CRHIAM

CENTRO DE RECURSOS HÍDRICOS PARA LA AGRICULTURA Y LA MINERÍA

CONICYT/FONDAP/15130015

2014-2018 REPORT

Water Research Center for Agriculture and Mining

With acknowledgements to professor Fernando Concha, María I. Carrillo, professor Pedro G. Toledo, Sujey Hormazábal, Gloria Gómez and Elizabeth Monsálvez for the editing work.

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DIRECTOR'S REPORT

In 2013 the Water Research Center for Agriculture and Mining (CRHIAM) was started by a handful of researchers concerned about water resources before the issue became a priority in Chile. CRHIAM was born with the mission of becoming an authority on water management, generating advanced scientific and technological knowledge to allow stable, harmonious agriculture and mining development and interacting with governmental institutions and local and international experts to influence the formulation of policies and the planning of more sustainable processes for the benefit of society. Some of the researchers came from the area of mineral processing with the idea, which for many was strange, to use seawater in mining processes and those in the agricultural sector, concerned about the poor use and management of water in a sector that uses the resource in the highest proportion, while other researchers were interested in the closure of water circuits in industrial processes and water treatment and still others were concerned about the legal aspects associated with the availability and use of water resources.

All these efforts upon which CRHIAM was founded were undoubtedly serious and relevant, but they proved to be ineffective because they were made in isolation. CONICYT, through its FONDAP program, believed in our project and supported it during an initial five-year stage. Today that the first stage ended, CRHIAM is a mature center with very high scientific productivity and committed to its work, with high rates of advanced human capital formation in water resources and new professionals and scientists flooding private companies, public institutions, universities and academies and broad, effective collaboration networks with Chilean and foreign institutions. The first individual efforts have gave way to an optimal integral use of the water resource and our center adopting the modern philosophy on Water Safety committed to the crucial and difficult task of carrying out a multidisciplinary and interdisciplinary work in water-related issues, a priority area.

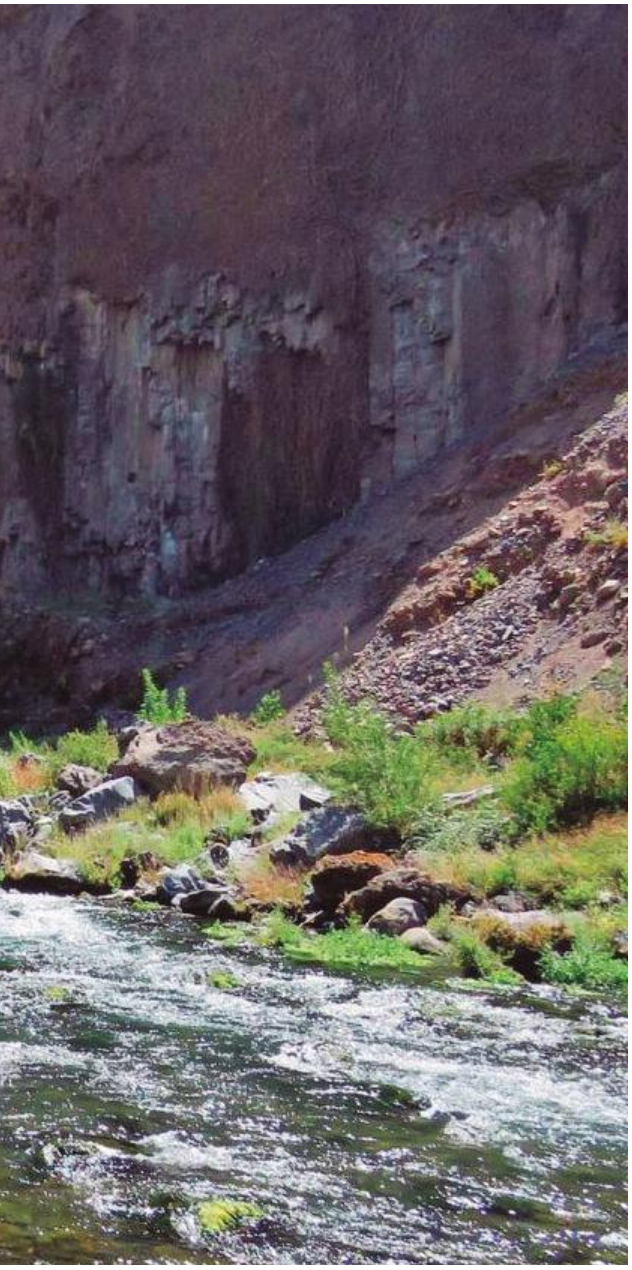
At this key moment in the existence of CRHIAM we are proud to inform that the 5 year project was extendend for another 5 year. We are grateful for the contributions of the CONICYT Council, the International Scientific Council, the Advisory Committee, the International and the peer reviewers, which have helped shape today's CRHIAM. We are grateful to the authorities of the University of Concepción for their unconditional support and, especially, to the human group of CRHIAM, whose work has been fundamental in achieving success in our mission.

Fernando Concha
Director

Eduardo Holzapfel
Deputy director

2014-2018 REPORT

WATER RESEARCH CENTER FOR AGRICULTURE AND MINING



CRHIAM
PROJECT

DESCRIPTION

Chile is currently in the midst of one of the worst droughts in history.

The impacts of this shortage cut across the country, affecting the population, ecosystems and industrial development.

Two of the most important activities in the national economy are agriculture and mining. Both face the challenge of seeking alternatives for sustainability even if there is less water available for their processes.

To make a scientific contribution to this effort, the Water Research Center for Agriculture and Mining (CRHIAM) was founded in 2014 within the framework of CONICYT's Fifth National Competition for Research Centers in Priority Areas (FONDAP).

This five years project is led by the University of Concepción, in association with the Universidad del Desarrollo and Universidad de La Frontera, in which a total of 8 schools from various disciplines participate.

In addition, CRHIAM has partnerships with 13 highly internationally prestigious foreign institutions.

The center has three main objectives:

- To promote research and develop technologies in water resources, optimize their management and consumption, find new resources of water and provide standards to regulate the interaction of different actors.

- To train researchers at the undergraduate and especially graduate and postdoctoral levels to address the lack of advanced human resources in the country.
- To create links with other national and international research institutions and the public or private sectors to benefit from common research and technology transfer.

All of this with a view to promoting the sustainable use of water resources and ensuring their availability over time.

The CRHIAM team is led by the administration and supported by administrative personnel.

Then there is the Academic Council, composed of 8 principal researchers who lead 4 research teams: **the Demand, Technology, Resources and Water and Society clusters**, made up of associate researchers, support staff, postdoctoral fellows and undergraduate and graduate students.

They work in five research lines:
(1) Efficient use of water in agriculture and mining
(2) Seawater as a new source for agriculture, mining and communities
(3) Technology for water treatment and environmental remediation
(4) Hydrology, water availability and climate change
(5) Water governance, ecosystem services and sustainability

The Scientific Committee, composed of academics from foreign universities, ensures that the research carried out is top-tier.

And to guarantee that the work is directly related to issues facing the country, CRHIAM has an Advisory Council, made up of members of institutions linked to water management in agriculture and mining.

Thanks to all this, during CRHIAM's first 5 years period of operations the center has published 247 scientific articles and 10 books. In addition, during the same period, the center has trained 633 students. CRHIAM members have taken part in various initiatives aimed at developing public policies on water resources. And more than 100 scientific outreach events have been held, among other achievements.

This is the basis for the projections for the center over the next five years, and the foundation for continuing to contribute to the search for solutions in two industries that are vital to Chile, both of which are facing a complex situation of water scarcity.

ORGANIZATIONAL CHART 2014 - 2018

CRHIAM TEAM

CRHIAM members during a team meeting in June 2018.

ACADEMIC COUNCIL

The Academic Council is responsible for the center's operation and research progress. It is composed of eight principal investigators and is chaired by CRHIAM's director and deputy director.

Dr. Fernando Concha

Dr. Eduardo Holzapfel

Dra. Gladys Vidal

Dr. Pedro Toledo

Dr. José Luis Arumí

Dr. Ricardo Barra

Dr. Roberto Urrutia

Dr. Diego Rivera

SCIENTIFIC COMMITTEE

The Scientific Committee is in charge of recommending general research guidelines, evaluating the advances of ongoing research at the center and suggesting new lines when necessary. The committee includes the director, deputy director and members from prestigious international universities.

Dr. Jan Hopmans - Dr. Mark Servos - Dr. Neil Mcintyre - Dr. Peter Scales - Dra. María Reyes Sierra-Álvarez

ADVISORY COUNCIL

The Advisory Council aligns the center with the country's public and private sectors and society in general to ensure that the center's activity benefits the country.

CRHIAM's Advisory Council during their second meeting in November 2017.

PARTICIPATING NATIONAL INSTITUTIONS

Three Chilean universities participate in CRHIAM: Universidad de Concepción (UdeC), Universidad de La Frontera (UFRO) and Universidad del Desarrollo (UDD).

INTERNATIONAL NETWORK

CRHIAM has partnerships with 13 highly internationally prestigious foreign institutions.

1. The University of Arizona 2. Water Resources Research Institute 3. Colorado School of Mines 4. The University Melbourne 5. The University of Queensland 6. Universiteit Gent 7. Leibniz Universität Hannover 8. Instituto de Diagnóstico Ambiental y Estudios del Agua (IDAEA) 9. University of Waterioo 10. York University 11. University of California-Davis 12. Universidad Politécnica de Madrid 13. Lund University.

1. University of Arizona (USA), (http://www.arizona.edu/)
2. New Mexico Water Resource Research Institute(USA), (https://nmwrri.nmsu.edu/)
3. Colorado School of Mines (USA), (https://www.mines.edu/)
4. University of Melbourne (Australia), (http://www.unimelb.edu.au/)
5. Sustainable Minerals Institute (SMI), University of Queensland (Australia), (http://www.smi.uq.edu.au/)
6. Ghent University (Belgium), (http://www.ugent.be/)
7. Leibnitz Universität Hannover (Germany), (https://www.uni-hannover.de/)
8. Institute of Environmental and Water Studies (IDAEA, Spain), (http://www.idaea.csic.es/)
9. University of Waterloo (Canada), (https://uwaterloo.ca/)
10. York University (Canada), (http://www.yorku.ca/)
11. University of California, Davis, (USA), (https://www.ucdavis.edu/)
12. Universidad Politécnica de Madrid (Spain), (http://www.upm.es/)
13. Lund University (Sweden), (http://www.lunduniversity.lu.se/)

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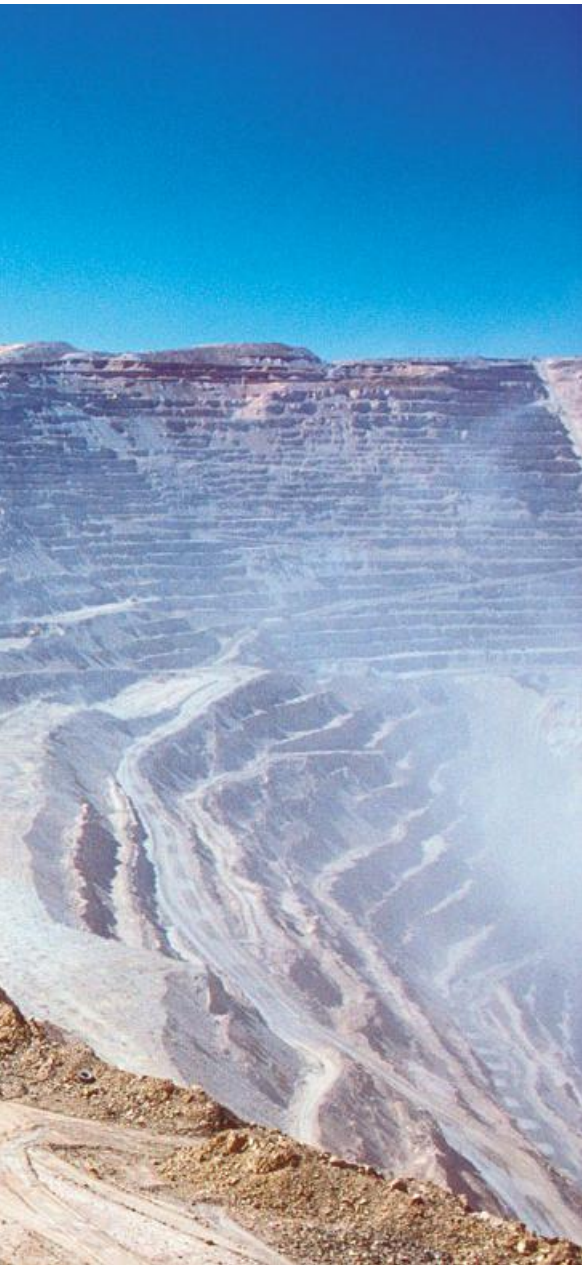
WATER RESEARCH CENTER FOR AGRICULTURE AND MINING



2014-2018 ACHIEVEMENTS SUMMARY

RESEARCH

The main philosophy of CRHIAM is to perform original, cutting-edge research into all aspects of water resources. In the first stage we have made great efforts to produce research that could change Chile, and the world in general, in terms of water resources, focusing on water security issues that affect societies and people on a broad scale. In this first stage, a substantial increase in the number of publications by CRHIAM researchers has been promoted, but more important, overall quality has been sought in terms of the impact factors and rankings of the selected journals. We have also promoted the documentation of definite knowledge in books and book chapters. An important precedent is that in the first stage some of the research has been done with the support of the public sector and, in other cases, with the support of the private industrial sector in the form of R+D+I projects. The latter is very important due to CRHIAM's needs in the second stage. For the dissemination of CRHIAM's research results, national and international congresses of the highest possible level were favored. A great effort has been made to focus on the selected research lines in order to achieve clear interdisciplinary work, an area in which there is still room for improvement, support our young researchers and postdocs and offer our students the possibility of residencies in quality centers and participation in congresses and work meetings abroad. The task was difficult considering that at the beginning of the project the total number of papers per year was 23, with a cumulative impact factor of 41, an average impact

factor per paper of only 1.8 and 43% of the total papers in journals ranked in the Q1 quartile. After four years of work (2015-2018), the total number of CRHIAM papers in 2018 were 62, with a cumulative impact factor of 201, and per year average impact factor per paper of 3.2 and more than 75% of the papers in journals ranked in the Q1 quartile, as figures 1a to 1d show. From these results and figures, the impact of FONDAP should be clear. As the first stage comes to an end it is also necessary to mention that the scientific productivity of CRHIAM is unequally distributed, and that in some cases it has been under FONDAP standards; this issue is clearly identified and will be corrected in the second stage through the selection of the best available CV. Student participation and contributions, measured through the indicators committed to, have been key in the fulfillment of CRHIAM's objectives in this first stage. Figure 1 reveals that along with the increase in the number of ISI publications by CRHIAM, student participation in publications, congresses and conferences has increased significantly (See publications list at the end of this report).

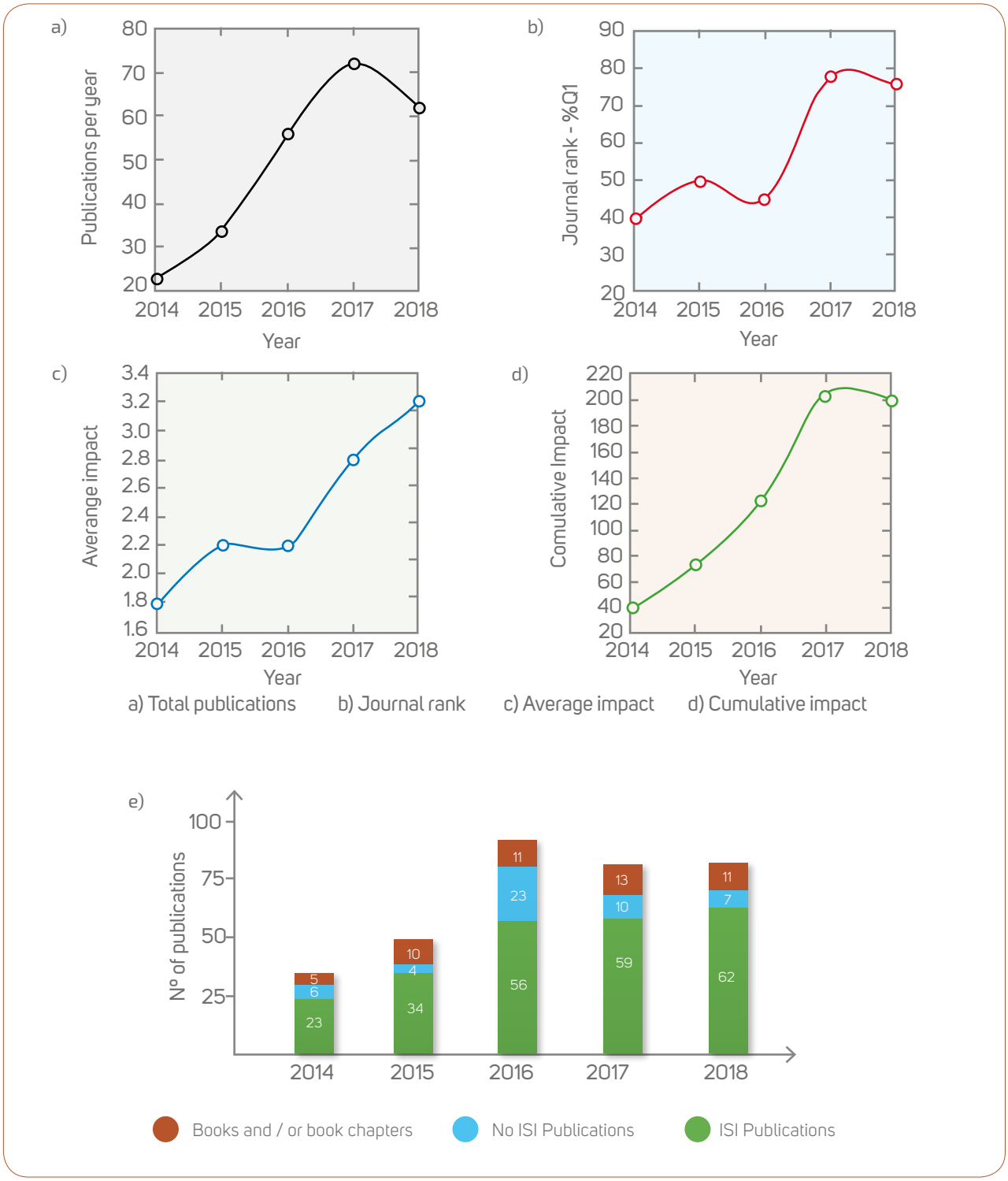


Fig. 1. Evolution of the productivity and participation of students and researchers.

Enhancing synergies in a collaborative environment has been one of CRHIAM's most difficult tasks, mainly due to the culture of working on individual research projects; researchers understand the benefits of multi/interdisciplinary work but feel that it delays individual research. Understanding that collaborative work is one of the reasons for the FONDAP program, the directors of CRHIAM and its council have been insistent on its necessity and its fruits have begun to be seen toward the end of the first stage. Based on this experience, a strategy will be developed to ensure close collaboration during the second stage. From the beginning, researchers from each research line have had to identify issues, problems and questions that they share with the other lines, and have committed to writing proposals to jointly address the identified challenges. This will enable the inclusion of new and even more challenging objectives in the second stage. Figures 2a and 2b, below, show the research collaboration networks of representative groups of CRHIAM. The nodes represent researchers, the links represent the connections among them and the thickness of the links the intensity of the connections; the greater the number of nodes and links the larger the collaboration network, and the thicker the links the more effective the network formed.

Figure 2a and Figure 2b show the collaborative research network of three groups led by CRHIAM researchers from the Universidad de Concepción at the end of 2013 and without FONDAP, left frame, and in 2016 and with FONDAP, right frame. Before FONDAP, the three groups published 26 papers in 2013, each working on their own. By 2016 the three groups, now with FONDAP, had slightly increased the number of papers to 29, but they took a fundamental step in the task entrusted to them by FONDAP, i.e., they formed a single group that now works in a collaborative network; the number of links between researchers increased from 95 to 280 and the thickness of some of them also increased, as can be seen in the figure. The results will be even more evident in the second stage of the project. Graphs 2c and 2d show the collaborative research network of two groups led by CRHIAM researchers, one of them at U. de Concepción and the other at U. de La Frontera at the end of 2013 and without FONDAP, left frame, and in 2016 and with FONDAP, right frame. Before FONDAP the groups produced 52 papers in 2013, each working on their own. By 2016 the two groups, now with FONDAP, had increased the number of papers to 65; now they constitute a single large group working in a collaborative environment, with the number of links between researchers having increased from 200 to 300. There are many such examples; the two shown are meant to exemplify the positive effect of FONDAP support.

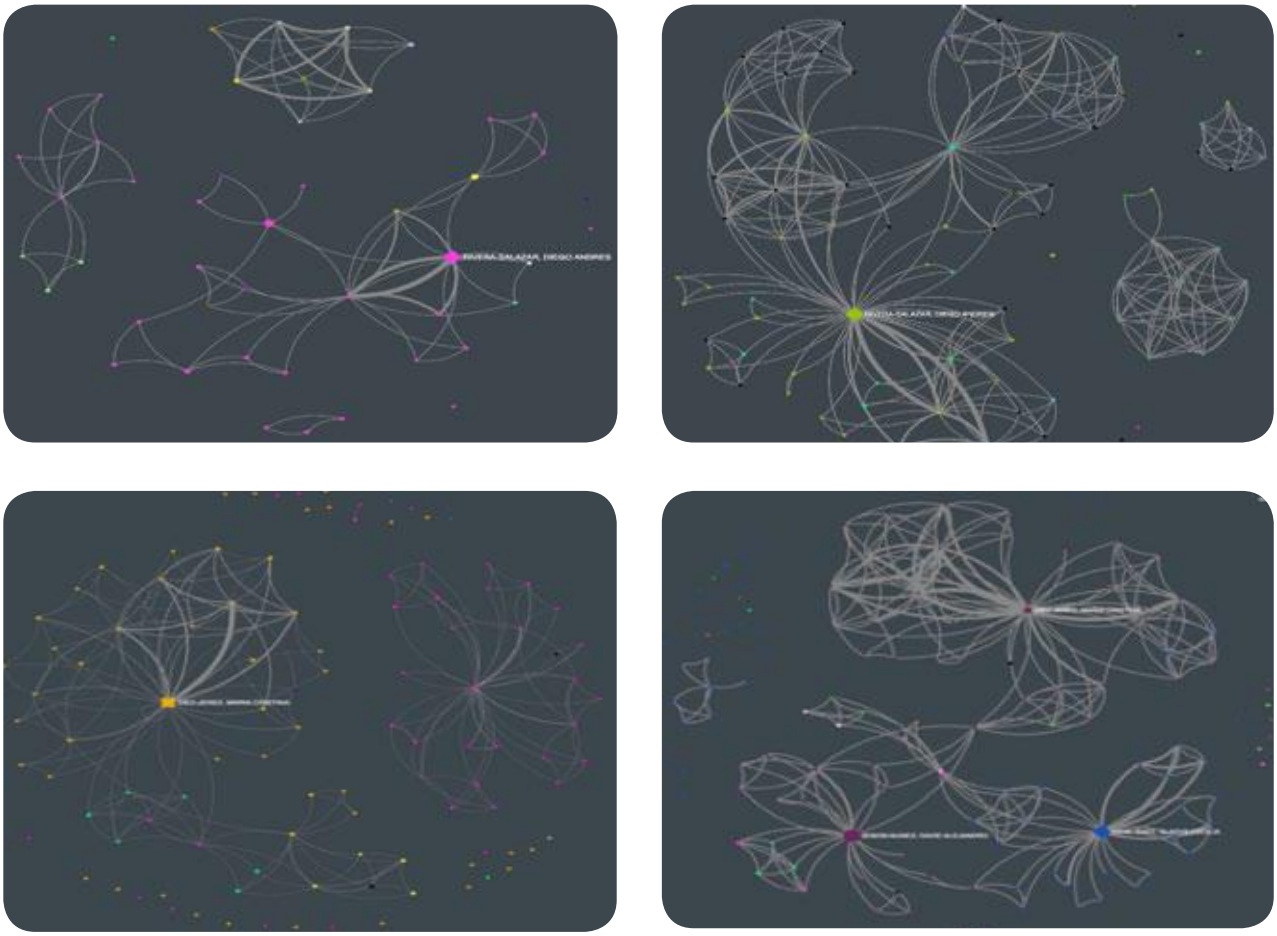


Fig. 2. Collaborative research network of three groups of CRHIAM researchers.

Two examples of the growth of collaborative research networks. Without FONDAP (left) with FONDAP (Right). Despite the uncertainties of the database managed by CONICYT, the data source for the graphics, the results show improvement in terms of scientific productivity and collaboration networks during the first stage. We are sure that this improvement has been possible not only thanks to FONDAP, but also due to the actions taken by the directors of CRHIAM and its academic council and the commitment of the researchers to carrying out such actions. At CRHIAM we have a great commitment to continue improving synergies in collaborative environments.

RESEARCHER TRAINING

The development of human resources is one of the main activities of CRHIAM. The importance of this activity is made explicit as the second objective of the project. From 2013 to 2018 the number of postdocs was almost constant at 6 to 15/year. The total number of postdoctoral fellows in the 2014-2018 period was 53; 26 postdoctoral fellowships were awarded by CRHIAM. The rest of the postdocs had the support of FONDECYT, CONICYT Anillo projects, the CI2MA Center and the Government of Brazil, among other sources. The number of doctoral students ranged from 24 to 45/year, the number of master's students from 14 to 26/year, and the number of undergraduate students from 54 to 82/year. Postdocs and grad students found positions in academia in most cases, while some went into industry, with some remaining connected to the center. In the case of undergraduate students, after obtaining their degrees they have had a variety of jobs. Some of them are in the public sector and others in industry, while some continue to support the center through participation in the various CRHIAM research groups, among other activities.

NETWORKING AND INTERNATIONAL RELATIONSHIPS

The relationships between CRHIAM and similar national and international institutions increased between 2014 and 2018. CRHIAM was visited 106 times by international researchers and 52 times CRHIAM researchers visited international centers. CRHIAM led the creation of a National Network of Water Research Centers under the umbrella of the National Council for Innovation for Development (CNID), a Chilean governmental agency. During the first stage, CRHIAM has actively participated in the Chilean water agenda. The main outcomes of the first stage of the project are effective connections with (I) universities and research centers abroad, (II) universities and research centers in Chile, (III) industry through joint research projects and technology transfer and (IV) various Chilean public officials, congressional representatives and senators, among others. This network, built during the first stage of the project, will be fundamental to achieving the lofty objectives planned for the second stage.

INDICATOR COMPLIANCE 2014-2018

INDICATOR	ACHIEVED VALUE 2014-2018
Number of ISI publications	247
Number of top – 10% – percent – impact ISI publications in the center's primary disciplines	206
Average publication impact	2.4
Number of postdoctoral fellows	53
Number of finished PhD dissertations	17
Number of finished master's theses	24
Number of finished undergraduate theses	74
Number of visiting researchers	106
International workshops or meetings in Chile organized by the center	146
Summer courses	9
Number of outreach books	10
Number of outreach articles	39
Number of outreach events (for example, seminars, workshops and exhibitions)	107
Number of participants in outreach events	4734
Number of technology transfer products (models, protocols, methods and processes, among other)	12
Patents	10
Attendance at congresses and international conferences	304

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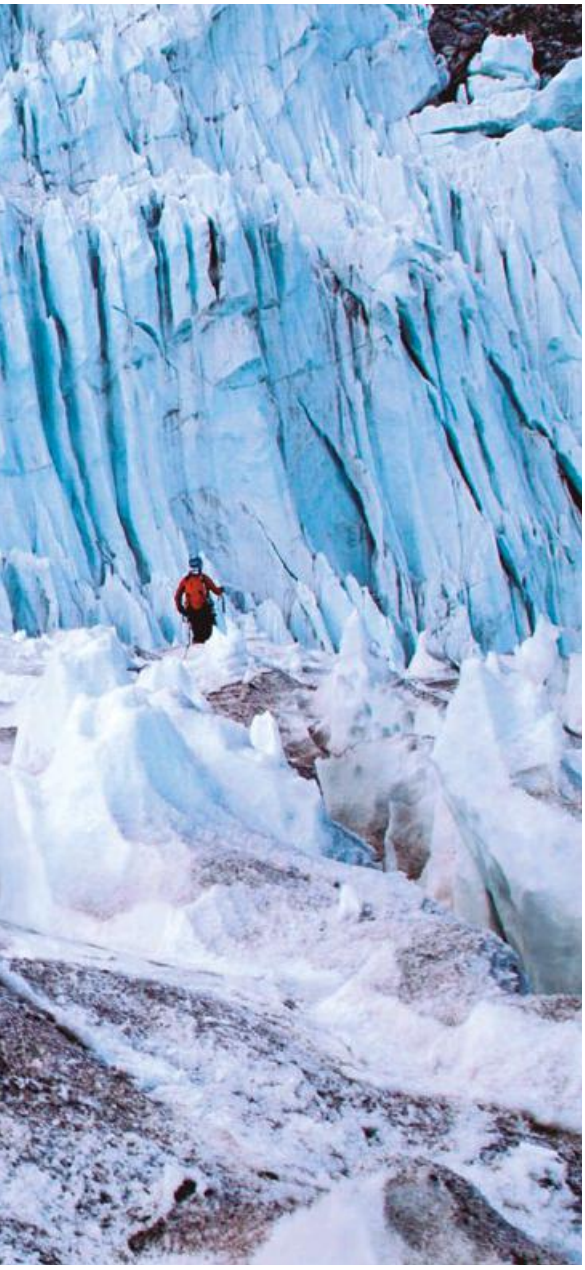

DETAILED RESULTS (2014 - 2018)

1. RESEARCH:

RL1 EFFICIENT USE OF WATER IN AGRICULTURE AND MINING

EFFICIENT USE OF WATER IN AGRICULTURE

The combination of increasing water demands and the periodic occurrence of droughts throughout Chile has brought tensions to mining operations and irrigated agricultural areas. This research line aims to identify key issues for the optimization of water use and reuse in irrigated agriculture, as innovations in technology and policy are needed to maintain the competitiveness of the agricultural sector.

Agricultural water management. Efficient water use in agriculture requires information regarding soils, plants, the climate and operational issues in the field. We addressed the effect of water amount, localization and frequency and field information to maximize yields and quality while minimizing energy use, percolation and leaching. For years we evaluated actual agricultural operations through modeling, field monitoring and remote sensing in vines, table grapes, apples, avocados, kiwi and hazelnuts.

Water use in orchards, blueberry plantations and vineyards; relationships among applied water, yield and quality. In vineyards the application of 20% to 40% of the potential irrigation water required by plants led to maximum yield values that doubled the historical mean while maintaining high quality wine. The treatment without irrigation showed a significant reduction in yield (Jara et al., 2017). Regarding avocados, four irrigation regimes (25 - 100% of reference evapotranspiration) were carried out. The size and yield increased significantly as applied water increased to the level equivalent to 75% ETo (Holzapfel et al., 2017). In blueberries and apples water localization and wetted area research was carried out. The highest blueberry yield occurred for four drip laterals per row with a daily frequency. For commercial production it is recommended that at least four drip laterals be used in sandy soils (Holzapfel, Jara, and Coronata, 2015). In apple orchards, research was done under two types of soils: loamy clay and stony loam. The results indicate that distribution and wetted area led to significant differences in production. The highest yield was obtained with one lateral per row in loamy clay soil and four laterals per row in stony loam soil (Lecaros, 2018). Thus, wetted area should be considered an important parameter in the design and management of micro-irrigation systems for fruit trees. Regarding kiwifruit, the main results were the decrease in water volume and its associated pumping costs of between 24 and 60% compared to the control treatment (Lagos et al., 2017).

Data science and information technologies in agriculture. Nowadays it is possible to estimate the water demand of different crops, providing spatial and temporally distributed information over a wide area, using information gathered from aircraft or satellite platforms (Gonzalo-Martín et al., 2017; Zambrano et al., 2017, 2016). During the last 4 years we developed new methodologies and technologies aimed at increasing water demand data (in terms of quality and quantity) to improve irrigation water management.

Decision support for water management. The main result was the development, validation and in-industry use of an integrated service for site-specific management of irrigation, which takes spatial-temporal variability into account in the estimation of water demand for crops and orchards. The research goal is to increase efficiency in the use of water resources and improve the competitiveness of the agricultural sector through the AQUASAT platform (www.aquasat.dluxe.io), which was evaluated in sugar beet fields and apple orchards by analyzing the performance of spatially variable application. One of the most important information requirements for estimating agricultural water demand is accurate and up-to-date information regarding canopy status and crop types. During the last 4 years we have developed different methodologies to characterize these variables at farm scale (Garcia-Pedrero et al., 2015; García-Pedrero et al, 2017; Lillo-Saavedra et al. 2016). In addition, as the irrigation area under center pivots has increased significantly in Chile, a dynamic decision support system (DDSS) was developed and tested to allow precise irrigation based on a sprinkler control system. In terms of research facilities, to manage more than one experiment at the same time, a Linear Variable Rate Irrigation System was set up.

Data methods for better irrigation system design. This research shows the need for better data management at field scale in order to define a homogenous area for design. Results show that current practice in Chile – SAG-USDA guidelines – for data management is inadequate for capturing spatial variability. The in situ method describes soils from a hydro-physical point of view, which allows spatial variability to be better captured (Valdivia-Cea et al., 2017). In addition, analysis methods based on neural networks were developed (Rivera, Sandoval, and Godoy, 2015) and analysis of soil water content time series was carried out (Rivera et al., 2014).

Management of water resources information. Funded by the Government of the O'Higgins Region, we integrated relevant information from different sources to provide stakeholders climate services (www.birh.cl). We estimate that this platform receives 2000 visits per month. We have produced modeling- and monitoring-based data (Rivera, Rivas, and Godoy, 2015; Montory et al., 2017; Espinosa and Rivera, 2016). We also developed GIS-based analyses of water availability and locations of reuse projects (Villamar et al., 2016; Aitken et al., 2016).

Water economics and climate change. Agriculture is one of the most vulnerable economic sectors to climate change and variations in water availability (Núñez et al., 2014). A key element for risk analysis is aggregating the information of the several risk constituents: natural hazards, system response and decision-making. We developed strong fundamental research on climatological, synoptic and forcing variables of the climate system (Garreaud, Falvey, and Montecinos, 2016; Massmann et al., 2017; Montecinos et al., 2017), as well as a platform for hydro-meteorological risk assessment (Candia et al., 2018) and resources optimization for maize and sugar beet in Chile (Kuschel et al., 2018). Using a hydro-economic model, we assessed the distributional impacts of and farmer vulnerability to climate change in time and space. We found relatively small impacts aggregated at basin scale, but large distributive impacts among both farming communities and agricultural activities (Fernández et al., 2016; Ponce et al., 2017; Vásquez Lavín et al., 2017).

The Chilean mining industry is currently facing challenges due to low copper prices, severe water scarcity, declining ore grades and high energy costs. In addition, the costs of water pumping and treatment are extremely high (Aitken et al., 2016). We collaborated on the definition of a theoretical framework for the hydro-economics of mining (Ossa-Moreno et al., 2018). The links among water demand, increasing electricity consumption and future copper prices need to be determined to generate new price-forecasting models for the mining industry.

EFFICIENT USE OF WATER IN MINING

The most important processes used to recover water in the mining industry are thickening, filtration and tailing dams. Given the great cost of using fresh water for mining processes, it is important to optimize the recovery and reuse of process water. After four and a half years of operations, the following primary results have been obtained:

Thickening of clay minerals. Clay minerals are a serious problem for all mining processes, especially thickening. Their chemical composition and extreme fines have prevented acceptable thickening. In this project, we successfully developed reactors for a new process for copper mining called ultra-flocculation, which solved the problem of the sedimentation of minerals with high clay content (Del Río et al., 2018; Betancourt et al., 2015; Betancourt, 2016, 2017).

Effect of concentration of suspensions on transport in pipelines in the mining industry. The sedimentation of particles is a problem in the hydraulic transport of suspensions in pipes, especially when the suspension is very concentrated and behaves like a non-Newtonian fluid. No adequate mathematical model describes the sedimentation of particles in these suspensions. In this work we developed an explicit equation to calculate the sedimentation velocity in a non-Newtonian fluid. Results were compared with experimental data presented. The validity range of the approach is for Reynolds numbers less than 1000 (Betancourt et al., 2015).

Modeling and control of sedimentation-consolidation in an industrial thickener. A one-dimensional model of sedimentation was developed for a continuous thickening unit. This model extends the known model for the dynamics of a suspension flocculated in a thickener-clarifier developed by Bürger et al. (2005). Stationary state operation matrices are used in the development of a control system, in particular, to maintain the level of sediment and the volumetric fraction of solids in the discharge in the desired values. A numerical scheme and numerical simulations are presented (Betancourt et al. 2015, Torfs et al., 2015, Bürger et al. 2017e-f).

Auditing of industrial thickeners with new online instrumentation. The phenomenological theory of sedimentation-consolidation evolved in the last part of the 20th century and is accepted today by researchers worldwide. This theory provides a reliable method of thickener design, simulation and control. However, a process model, whether simple or sophisticated, empirical or phenomenological, is useful only if it is possible to objectively determine its experimental parameters. Although it is important for a mineral processing plant to perform periodic laboratory tests to determine thickening parameters and adjust the operation

accordingly, laboratory tests do not always represent the behavior of the material in a thickener. We developed several new instruments and algorithms and software for the determination of thickening parameters and the inventory of solid material in an industrial thickener (SediRack Online and SMC), the dilution in the feedwell, floc size and size distribution (Sampler-Floc size). In this work the auditing of an industrial thickener in a major mineral processing plant in Chile was used to validate the newly developed online instrument (Concha et al. Patent N°51548 of 10-12-2015; Concha et al. 2017).

Effect of hot air on the blowing of copper concentrates. A new laboratory filtration instrument was designed and constructed to apply hot air in the blowing stage of filtration. The result was a decrease of the blowing time from 450s without air heating to 100s with heating to reach 10% humidity (Concha et al. Patent submitted S.P. 3425-2017.).

Other related results: The work during the first five years of CRHIAM led to several results that, while not directly applicable to the research line "Efficient use of water in agriculture and mining," may be applicable in other areas, such as the theory of conservation laws, which are fundamental in the theory of thickening, but also applicable in the theory of road traffic (Acosta et al. 2015), chromatography (Bürger et al. 2018) and spread of diseases (Bürger et al. (2018a)).

RL2 SEAWATER AS A NEW WATER SOURCE FOR AGRICULTURE, MINING AND COMMUNITIES

The projected increase in copper mining capacities requires significant additional quantities of process water. The mining industry currently consumes 14.7 m3/s of fresh water and will require 24.6 m3/s by 2025. There is not enough fresh water available in the northern regions of Chile to meet this demand. Thus, mining companies, the agricultural sector and communities are considering seawater as a new water source. The use of seawater is necessary, but its direct use can be harmful in some cases. The Chilean Congress is discussing a law that would force the use of seawater in all copper mining in Chile, without knowing its exact effect on the concentration process, particularly the role played by electrolytes at high concentrations. Pre-FONDAP, in the framework of an INNOVA project with the participation of five large mining companies, we developed a new process that avoids desalination and that with a simple pretreatment can efficiently process copper minerals by flotation with seawater.

Today a growing number of other mining projects use seawater as-is or desalinated. Seawater is not free; thus, in light of its extremely high cost, a closure of water circuits is still necessary. This closure leads to a major problem: an increase in salt content that makes an understanding of the effect of electrolytes in the various stages of the process even more critical. This knowledge and the experience of some of the group's researchers in the concentration of K and Li from brines were the basis for proposing a series of objectives and challenges regarding the use of seawater during the first stage of the FONDAP project. The effect of highly concentrated electrolytes was studied through experiments and molecular simulation. The objectives committed to were all met, as were those regarding publication, human resources formation and networking. Of course, the issue has not been exhausted and requires additional efforts so that the technology can be implemented more widely, releasing fresh water for agriculture and

society in general. Thus, scientific unknowns in the use of seawater should be solved, technologies adapted, and new technologies created. The following is a summary of the objectives achieved during the first five years.

New flotation technology with seawater. A new technology was developed to pre-treat seawater and other saline waters for use in industrial processes, preferably in mineral flotation plants. The procedure improves the chemical quality of seawater without significantly affecting its salinity by removing secondary ions, mainly magnesium, calcium, bicarbonate, carbonate and sulfate, among others, which, when forming precipitates at alkaline pH, are harmful to industrial processes, particularly metallurgical processes in mineral flotation plants (Concha et al., patent application).

Economic evaluation of producing process water from seawater for mining. An economic analysis of the use of seawater in mineral processing plants was carried out. The options evaluated were: (a) seawater desalinated by reverse osmosis (SWRO), (b) seawater pre-treated (partially desalinated) and (c) raw seawater (non-desalinated). The desalinated, pre-treated and raw seawater (US$/m3) resulted in costs of US$6.0, US$ 4.2 and US$4.0 per cubic meter 160 km from the coast and 4000 meters above sea level (Concha et al., 2017).

Molecular simulation of mineral-water interaction in seawater ions in the presence of large reagent molecules. Several research groups have reported on the utility of molecular modeling tools to allow an understanding of mineral–reagent interactions. In the first stage of the project we developed our own codes (Thorneywork et al., 2015; Rozas et al., 2015; Wagemann et al., 2016; Elder et al., 2016; Schmiedeberg et al., 2017; Achim et al., 2017) and used commercial programs to demonstrate that molecular modeling provides a sound method to quantify the crystal structure specificity of diverse organic molecules for different mineral systems; for example, we quantified the partially-hydrolyzed polyacrylamide (HPAM) specificity for quartz in saltwater (Quezada et al., submitted 2018), corindon in saltwater (Quezada et al. submitted 2018) and kaolinite in saltwater (Quezada et al., accepted for presentation at CHISA 2018), and we are currently quantifying the specificity of methyl isobutyl carbinol (MIBC) for the saltwater-air interface (accepted for presentation at COLL 2018) and the specificity of fatty acids for spodumene in saltwater (in progress). The first major challenge is the correct molecular modeling of organic macromolecules in saltwater. We made significant progress in the correct representation of HPAM. The conformation and transport of an HPAM chain in saline aqueous solutions were studied by means of molecular dynamics simulations. Partial charges in the polymer chain and crystals were derived through ab initio calculations (Quezada et al., 2018). The most outstanding result is the use of molecular modeling tools for molecular recognition of phenomena at the inorganic-organic interface in freshwater and saltwater in mineral processing, reducing the expensive trial and error process of selecting reagents.

Study of the nano-force-distance curves between two flat surfaces in water by molecular dynamics simulation. Molecular dynamics simulations allow determination of the force between a tip and a sample mediated by a fluid or a nano-scale capillary bridge at any separation distance in approach–retract cycles. However, without further consideration, the procedure leads to force–distance curves without control of tip-to-sample distance and tip oscillations. Here we show that the solution of a macroscopic model describing the dynamics of the tip–sample interaction can precisely guide the choice of optimum parameters, for instance, tip elastic constant and approach speed, for controlled simulations. The subject is of interest in determining the force between two particles (minerals) mediated by water (eventually saltwater) (Valenzuela et al., 2016, 2017).

Flotation of copper ores containing clays in seawater and the need for new flotation reagents. Seawater electrolytes are not the only great challenge that must be faced by mining plants; in addition, clays, which are especially abundant in older deposits, are an issue due to the depressing effect they impose on chalcopyrite. Flotation results seem to indicate that the depressing effect in seawater may be related to the formation of hydrolyzed species of calcium and magnesium. These species can induce hetero-coagulation between kaolinite

and chalcopyrite. The trends observed in the micro-flotation experiments are in good agreement with the results of the induction time measurements and slime coating tests (Uribe et al. 2017). For ores with clays in seawater, new reagents are needed to replace standard sodium metabisulfite. Work is in the advanced stages, with some very promising results (Hernández et al., 2017; Gutiérrez et al., in progress).

Flocculation and rheological behavior of particle suspensions and sediments with seawater ions. The silica-water interface is central to the processing of a large number of mineral systems and the flow properties of particulate suspensions. The sediment samples were subject to flocculation (Romero et al., 2018) and creep-recovery tests (Romero et al., 2018; Quezada et al., 2018). In another study we focused on the effect of salinity on the yielding properties and viscoelastic behavior of flocculated kaolinite sediments through stress growth and creep-recovery tests (Jeldres et al., 2017). We also used oscillatory rheological assays to determine the viscoelastic properties of flocculated kaolinite sediments over a range of sodium chloride concentrations (Jeldres et al., submitted 2018). We are currently using oscillatory rheological assays to determine the viscoelastic properties of flocculated silica-kaolinite mixtures in saltwater (Contreras, thesis in progress, 2018). The measured flow properties define the upper limit of processing of tailings suspensions in the mining industry and, ultimately, the recovery of water. In addition, we used macroscopic modeling in two cases of interest, with special attention to the physical meaning of the parameters depending on the chemical environment: (a) a population balance model to describe the time evolution of aggregate size distribution in turbulent shear flow during flocculation (Jeldres et al., 2015) and (b) a new empirical three-parameter visco-elastic model for describing the rheological behavior of linear and nonlinear materials (Goñi et al., 2015).

Scaling mechanisms and inhibitors. The formation of mineral calcium carbonate and gypsum scale is a recurrent, expensive problem that affects a large number of industrial processes using brines or seawater. The classical scale mechanisms were revised, as were the lifetimes of the bridges. These bridges are occasional and short-lived; however, they allow minute amounts of anti-scale to induce defects in the structure of the deposited crystals so that they can be easily carried away by the existing hydrodynamic forces (Flores et al., submitted 2018).

Other related results: The work during the first stage led to a series of results that, while possibly not directly applicable to the use of seawater, may be applicable in other areas. Examples are: detailed modeling and understanding of small-scale structures in ocean turbulence, fundamental to understanding the diffusion of material in the ocean (Cornejo et al. 2016; Herrera et al. 2018), large-scale parallel simulation of flow and transport in pore networks with pore size correlation (Quezada et al. 2004) and fabrication of bionanotubes, nanowires and nanocables for microcircuit connection to energy sources (Acuña et al., 2017; Bastías et al., 2017).

RL3 HYDROLOGY, WATER AVAILABILITY AND CLIMATE CHANGE

There is a broad consensus that climate change is producing a water availability crisis in terms of both quantity and quality that is affecting economic growth, social welfare and the structure and functioning of ecosystems in Chile. The aim of this research line was to improve our understanding of the current state (in terms of quality and quantity) of water resources in south-central Chile, specifically glaciers/snow, groundwater, rivers and lakes, and determine how climate change and human activities will affect their future availability.

MASS BALANCE AND HYDROLOGICAL CONTRIBUTION OF UNIVERSIDAD GLACIER

Understanding of glacier processes and their interactions with the climate is essential in order to assess the importance of glaciers within the regional hydrological cycle and diagnose their sensitivity to climate change. There have been various studies reporting changes in glacier length and area in Chile over the past two decades. Recent summaries in central Chile report a general decrease in glacier lengths and areas, although with large differences among glaciers, which highlights the importance of site-specific factors in controlling the response of glaciers to climate change. While observations regarding glacier geometry changes are both valuable and more abundant due to the relative ease of mapping glaciers from remote-sensing sources, they give an incomplete picture of the hydrological contribution and response of glaciers to climate variability, as the dynamic response of mountain glaciers to the climate can be slow and depend on their size and altitudinal distribution, among other factors.

The glacier mass balance is considered the best indicator of a glacier's "health status." It represents the direct link between a glacier and the atmosphere, as climate variations will result in direct changes to the glacier surface through variations in snow accumulation and snow and ice ablation rates. In contrast, the dynamic response of glaciers to climate variations (i.e., the advance or retreat of a glacier) occurs following a prolonged period of positive or negative mass balance, and thus implies a time lag in the geometric response of glaciers to climate change. Glacier mass-balance can be obtained from direct field measurements using the glaciological method or via indirect observations using the geodetic method, which derives mass balance from topographic changes over time, or the hydrological method, which infers mass-balance as a residual term of the water balance equation. In this context, Universidad Glacier was studied in order to determine its current mass balance and hydrological contribution in relation to current climate conditions, with emphasis on the effect of distributed albedo and distributed energy balance, glaciological and geodetic methods and ice movement (Kinnard et al., 2018). The glacier-wide mass balance was slightly negative in 2012/13 (Ba = -0.32 ± 0.40 m w.e.a-1), but much lower in 2013/14 (Ba = -2.53 ± 0.57 m w.e.a-1) due to increased summer ablation. The current drought conditions affecting the extratropical region of Chile (Garreault et al., 2017) could reduce mass balance not only through decreasing snow accumulation, but also through increased ablation resulting from earlier exposure of the ice surface in the ablation zone and a corresponding decrease in albedo.

UNDERSTANDING GROUNDWATER CONTRIBUTION TO MINIMUM FLOW IN MOUNTAIN WATERSHEDS

This research line is focused on the study of streamflow generation in minimum flow conditions, based on the hypothesis that groundwater storage and release processes play a major role in base flow generation in watersheds with small or non-existent glacial or snowmelt contributions.

We focused on the study of the water balance in the Laja and Diguillín watersheds, both located in the Biobio Region (37° S) in the foothills of the Andes Mountains. Different models have been used and compared in the area: SWAT (Kerch, 2015), WEAP (Kasargodu, 2016) and a water balance model developed by the research group (Muñoz et al., 2014). We concluded that WEAP presents

significant limitations in the estimation of agricultural water demands and that SWAT presents significant limitations in its applications in Andean watersheds with scarce soil data information. Therefore, we prefer the use of our own parsimonious models, which allow model experiments that improve our knowledge of the watershed to be generated (Muñoz et al., 2016).

To improve the modeling of minimum streamflow, we developed methodologies for the use of available streamflow records to characterize groundwater storage and release systems. We studied the recession flow of several Chilean rivers, finding that there is a relationship between the predominant geological characteristics and the behavior of the recession streamflow.

To reduce uncertainty in the study of hydrological processes it is necessary to have direct or indirect measurements of the variables that intervene in the water balance. We developed different probes of concepts with applications in monitoring technologies in different bodies of water of the Biobío Region. We used environmental tracers to study groundwater contribution to surface water bodies (both rivers and lakes) and were able to map groundwater entry from the bottom of a lagoon using radon measurements. We combined the use of drones and standard and thermal cameras to determine the dynamic of the streamflow in a section of the Diguillín River. The results were validated using streamflow gauging surveys and hydrochemical and environmental tracer (stable isotopes and Radon) analysis. We used environmental tracers and Bayesian modeling to estimate the contribution of groundwater and snowmelt to streamflow in the Diguillín River, finding that groundwater release is the main contributor during the summer.

INTERDECADAL TO LONG-TERM FLUCTUATIONS OF SPECIFIC COMPONENTS OF THE WATER BALANCE

During the last eight years (2010-2017), central-southern Chile has experienced the most persistent meteorological and hydrological drought in the last 120 years. The so-called mega-drought has affected an area from 32° to 39°S in Chile, encompassing regions with very different hydroclimate regimes. This unprecedented mega-drought is the result of the combined effect of anthropogenic external forcing in concomitance with the cold phase of the interdecadal Pacific Oscillation (IPO), which is one of the most important internal modes of the climate system. In fact, this interdecadal mode is one of the processes most responsible for the "climate hiatus." In general terms, the recurrence of persistent droughts during the 21st Century is expected, although it is not clear if the duration and/or intensity of these droughts will increase. According to some studies, the transition from the cold to warm IPO phase should occur in the coming years. Thus, in the following years wet seasons and the recovery of the water supply in the affected regions are expected. We propose that our capabilities be focused on the decadal prediction of rainfall and temperature along with the application of downscaling statistical techniques in order to provide plausible scenarios with the associated errors.

EFFECT OF CLIMATE CHANGE ON LAKE ECOSYSTEMS

Lakes hold a large majority of Earth's liquid freshwater, support enormous biodiversity and provide key provisioning and cultural ecosystem services to people around the world. Climate change is among the greatest threats to lakes, yet empirical knowledge of global lake responses remains fragmented. Lakes are excellent sensors of environmental change, including climate change. Lake sediments contain important records of past environmental conditions, in both the water body itself and the surrounding catchment, which can be used to reconstruct environmental change (Alvarez et al., 2015; Alvarez 2017; Lami et al., 2017). In this context, different natural (Fagel et al., 2017; Kempf et al., 2017; Contreras et al., 2018) and anthropogenic (Pozo et al., 2014; Alvarez et al., 2018) drivers were studied.

Another effect on lake ecosystems has been the increase in frequency and distribution of harmful algal blooms (HABs) worldwide due to eutrophication and climate change (increased temperature, alteration of rainfall

patterns and lake water residence time). We reported the first bloom of Ceratium furcoides – an invasive species in South America – in Chile (Almanza et al., 2016a). Cyanobacteria blooms (cyanoHABs) in some urban lakes were also described (Almanza et al., 2016b; Almanza et al., 2016c). Microcystis sp. blooms are the most common in freshwater bodies around the world and are of concern because they are a hepatotoxin producer. A toxin analysis showed a high concentration of total microcystin, above the limit recommended by the WHO for human health (Almanza et al., 2016d).

EFFECTS OF LAND-USE CHANGES ON AQUATIC ECOSYSTEMS

The land use of a watershed defines not only aspects of water availability and quality, but also their effect on the associated biota. In this regard, studies have been carried out on the effects of forest plantations on the water regime of forested wetlands and the litter decomposition process due to loss of local biodiversity (Correa-Araneda et al., 2014). Effects of water abstractions for irrigation on invertebrate communities were also analyzed (Guevara et al., 2016). Another study showed that replacement of native forest by tree plantations causes changes in the thermal regime of Andean streams (Pedreros et al., 2016), modifying the benthic macroinvertebrate community.

RL4 TECHNOLOGY FOR WATER TREATMENT AND ENVIRONMENTAL REMEDIATION

Further development of anaerobic digestion as tool for waste (water) treatment and reclamation and nitrogen removal. During the 80s and 90s there was significant development in anaerobic digestion, and today it is one of the most cost-effective technologies for waste transformation. It can be used as a base technology for energy and water reclamation and can be applied in a wide variety of economic activities; however, several aspects of this technology still require research in order to facilitate their implementation and optimize their performance. This cluster has made great efforts to advance the development of several aspects of this technology that are crucial to its successful application. Some of these aspects are pre-treatment alternatives (Neumann et al., 2016; Neumann et al., 2017), co-digestion of different biomass sources (Beltrán et al., 2016), nutrient supplementation (Pinto-Ibieta et al., 2016), nutrient dosing (Serrano et al., 2017), biogas upgrading (Meier et al., 2017; Krayzelova et al., 2015; Valdés et al., 2016) and methodology or process improvements (Reyes-Contreras and Vidal, 2015; Da Silva et al., 2017, Araneda et al., 2017; Capson-Tojo et al., 2017), among other topics. Anaerobic digestion does not promote nutrient conversion; thus, in general, it needs to be coupled to other processes that provide efficient conversion or removal of nutrients such as nitrogen and phosphorus.

Partial nitrification/denitrification or partial nitrification/anammox-based technologies are feasible and reliable options for removing nitrogen from industrial effluents that allow maximum use of organic matter to generate methane (Val del Rio et al., editors, 2017). In this regard, the post-treatment of pig slurry was successfully carried out by means of partial nitrification/denitrification processes (Belmonte et al., 2017) while the stability of partial nitrification/anammox processes was studied in the presence of high ammonia and nitrite concentrations (Campos et al., 2017). Nowadays one of the biggest

challenges in urban wastewater treatment is reducing the energy consumption of WWTPs. This can be achieved by applying partial nitrification/anammox processes in the mainstream. However, the partial nitrification process becomes unstable under mainstream environmental conditions (10-20 °C and 30-50 mg NH4+-N/L) and, ultimately, ammonia is fully oxidized into nitrate instead of nitrite (Morales et al., 2017). To avoid this drawback, an operational strategy based on nitrous acid accumulation was developed to maintain the stability of the partial nitrification process (Pedrouso et al., 2017). The treatment of urban wastewater by aerobic granular sludge (AGS) systems is a feasible option in terms of operating and capital costs to replace existing activated sludge systems. Despite the benefits of this technology, its implementation at industrial scale is still limited because most experimental aerobic granular sludge work and commercial technology are based on sequencing batch reactors. For this reason, a continuous flow system composed of two completely mixed tanks was developed and the operating conditions promoting aerobic granular biomass formation were defined (patent request CL 201800714).

In addition, nutrient removal using alternative technology – a constructed wetland coupled to an anaerobic system – has been studied for industrial wastewater (i.e., swine wastewater) with high nutrient levels at full scale (Plaza de los Reyes et al., 2014, 2015; Villamar et al., 2014). The use of a free-water surface constructed wetland for post-treatment of anaerobically treated swine wastewater effluent, operated at a nitrogen loading rate range of 2.0–30.2 kg nitrogen/ha·d, presents nitrogen removal efficiencies between 47.7–71.8%, with the NLR, quantity of dissolved oxygen available and seasonality being the main parameters associated with the behavior of the nitrogen in the system. The low concentration of dissolved oxygen available in the system (0.3–1.5 mg O_2/L) hinders nitrification processes within the system, representing 0.3–5.6% of the estimated nitrogen, which can be removed via nitrification/denitrification. The volatilization of NH3–N is the main route of nitrogen removal, with an average of 19.5%, with maximum volatilization values and a nitrogen loading rate higher than 5 kg nitrogen/ha·d (40.2%), enhanced by the increase in temperatures (18.5 ± 1.2 °C) associated with seasonality (spring), the high concentration of NH+4–N present in the system (600.0 mg NH+4 –N/L) and the increase in pH from 7.9 to 8.4.

Furthermore, four horizontal subsurface flow wetland units (4.5 m^2 each) designed for wastewater were used to evaluate the development and nutrient uptake of Phragmites australis and Schoenoplectus californicus. The nutrient content in tissues of Schoenoplectus californicus and Phragmites australis presented markedly seasonal trends, with the highest concentrations of nitrogen (7.52 for Schoenoplectus californicus and 11.39 g N m^{-2} for Phragmites australis) and phosphorus (0.23 for Phragmites australis and 0.83 g P m^{-2} for Schoenoplectus californicus) during the growing seasons (spring and summer). Therefore, Phragmites australis and Schoenoplectus californicus are capable of removing a maximum of 6% of the N and P loads applied to the HSSF (López et al., 2016).

Development of membrane separation processes for wastewater and sea water. Membrane processes have great potential as a tool for separation of pollutants in wastewater and sea water. This cluster has made significant efforts regarding the development and application of membranes to reclaim water from different waste sources. Work done on forward osmosis (FO), a novel membrane separation process based on natural osmosis, deserves special mention. Indeed, this cluster is one of the few Latin American groups working in this field. Research has been done on the application of FO to sewage treatment (Ortega-Bravo et al., 2016), as well as for mining wastewaters (Vital et al., 2018; Ambiado et al., 2017). International cooperation with researchers from the Netherlands and USA has been established in this field and is expected to play a large role in the coming years.

Nanofiltration (NF) and reverse osmosis (RO) have been evaluated for recovering metals and sulfate from acid mine drainage (AMD). The results showed high ion removal, which reached 92% for the NF99 membrane and 98% for the RO98pHt membrane. Sulfate removal reached 97% and 99% for NF99 and RO98pHt, respectively. In

the case of copper, aluminum, iron and manganese, the removal percentage surpassed 95% in both membranes. It is important to note that the permeate fluxes observed in nanofiltration were five times greater than those obtained by reverse osmosis, with only slightly lower divalent ion rejection rates, making it the most promising option for the treatment of AMD (Ambiado et al., 2017, Pino et al., 2017).

In relation to the study of NF as an alternative to reverse osmosis in seawater desalination, the results were patented in Chile under registration N° 52.855. The objective of this study was to design, implement and evaluate a seawater desalination pilot unit by using NF membranes in two stages. Studies at laboratory level show that the best performance was with a permeate flux of 39.7 (L/m^{2}h) and a total dissolved solids rejection of 93.6% at a transmembrane pressure of 37 bar with a seawater feed flow of 1625 L/h. In the second stage, a commercial NF90 membrane achieved a salt rejection of 99.9% and a permeate flux of 72.5 (L/m^2 h) at 16 bar and a feed flow of the permeate from the first stage of 1625 L/h. Thus, the employed pilot unit (1.5 m^3/h of desalinized water) exhibited similar behavior at 40 and 15 bar for the first and second stages, respectively. The final water composition was adjusted to a concentration of 395 mg/L of NaCl, equivalent to 200 mg/L of chlorides, conforming to the drinking water standard. Currently, this unit is used to supply water in a coastal village of Chile (Bórquez and Ferrer, 2016).

Alternative technologies as tool for wastewater treatment and reuse in rural areas. Horizontal subsurface flow (HSSF) constructed wetlands have been a widely used technology for the removal of organic matter and suspended solids from domestic wastewater. The performance of HSSF for sewage treatment was evaluated under different organic sewage loading rates, seasons and macrophytes at full scale (Sepulveda et al., 2017). The HSSF systems of the present study showed organic removal efficiencies of around 70% for organic matter, with no differences among seasons. Suspended solids removal efficiencies averaged 93%. Studies with ornamental plants (Iris pseudacorus, Eichornia crassipes, Tulbaghia violacea, and Cyperus papyrus) at lab scale were carried out. The species of ornamental plant exhibited an insignificant effect on organic matter. Conversely, Tulbaghia violacea and Cyperus papyrus had a significant influence on the NH_4^+-N and PO_4^{-3}-P effluent concentrations. Therefore, these two ornamental plant species have greater potential for treating sewage under different organic loading rates, even though Tulbaghia violacea is a plant that has not been used previously in constructed wetlands (Burgos et al., 2017). In addition, special importance was placed on the plant fiber and its uses (Vidal and Hormazabal, 2016), the constructed wetland design and operation (Vidal and Hormazabal, 2018) and the characteristics of the generated sewage (Vidal and Araya, 2014). Moreover, nutrient removal by a mesocosm-scale constructed wetland was evaluated considering different support media (natural zeolite) for ammonium removal during the treatment of sewage (Vera et al., 2014, Araya et al., 2016). The results showed that PO−34 − P removal efficiency was 70% in the zeolite medium, presenting significant differences with the results obtained with the gravel medium. In addition, the reuse of treated sewage from constructed wetlands in rural areas (Vera et al., 2016), as well as its political aspects and public attitudes toward it in the desert and rainy regions of Chile, was evaluated (Segura et al., 2018).

An efficient biotechnological tool to mitigate point source pollution by agricultural pesticides is the on-farm biopurification system (BPS), also known as biobeds. The BPS, widely used in Sweden and other countries in Europe, is based on the adsorption and degradation capacity of an organic biomixture prepared with top soil, straw and peat, with a plant cover. Several aspects of this technology still require research in order to facilitate its implementation and optimize its performance. In our cluster we demonstrated that the rhizosphere of a L. perenne, F. arundinacea and T. repens mixture significantly enhanced pesticide dissipation in the BPS, increasing oxalic and malic acid exudation, which induced lignin-degrading enzyme activities (Urrutia el al., 2015) even at different hydraulic loading rates (Diez et al., 2015) and after repeated applications (Diez et al., 2017a). In a large-scale BPS, we demonstrated that plant cover increased pesticide dissipation compared

to the system without plant cover, decreasing the half-life (t1/2) of pesticides at least twofold even after three reapplications. In addition, a high similarity (qPCR) between microbial groups (actinobacteria, bacteria and fungi) was observed, suggesting no influence ascribable to the successive pesticide applications (Diez et al., 2017b). Furthermore, Elgueta et al. (2017) showed small and transitory shifts over time in a fungal community detected in the BPS treating atrazine, chlorpyrifos, and iprodione in a single application. Plant-microbial interaction increases microbial activity at the root-soil interface, where physical, chemical, and/or biological parameters are being modified by action of the roots' exudates.

In relation to improving the efficiency of the BPS, we formulated a novel pelletized support to immobilize white-rot fungi (patent request 201301395, granted until 2033) to be used as an inoculum in the BPS. The half-life of atrazine in the inoculated BPS decreased from 14 to 6 days, with an increase in the fungal taxa assessed by DGGE and phenoloxidase activity (Elgueta et al., 2016a). Inoculation of fungi in the pelletized support may be a coadjutant in the increase of increase of fungal efficiency of enzymatic production (Elgueta et al., 2016b). On the other hand, bioaugmentation with specific pesticide-degrading bacteria in combination with rhizosphere-assisted biodegradation could be used as optimization strategies to improve the performance of the BPS (Campos et al., 2017a).

Specific microorganisms (individual and consortium) to degrade specific organophosphorus pesticides (OPs) have been evaluated (Briceño et al., 2016a, 2016b). Both the individual strains of diazinon-degrading Streptomyces spp. and the defined mixed culture may offer a promising contribution to the future development of biological treatment systems that simultaneously and efficiently remove a complex mixture of OPs (chlorpyrifos, diazinon, azinphos methyl and methidathion) from wastewaters or other matrices in the environment (Briceño et al., 2016b). In addition, we isolated and characterized bacteria from a pristine acidic soil environment capable of transforming iprodione and 3,5-dichloraniline (Campos et al., 2015) and elucidated the full metabolic pathway of the degradation of iprodione and its metabolites by the isolated bacteria (alone or in combination). This finding is the first report on the metabolic pathway of iprodione degradation by soil bacteria (Campos et al., 2017b).

RL5 WATER GOVERNANCE, ECOSYSTEM SERVICES AND SUSTAINABILITY

Various international diagnoses warn of the great number of social conflicts over water in Chile and have identified the improvement of water governance – with regard to how institutional and regulatory decisions should be made – as a national challenge. To this end, we seek to help make our society one that is capable of ensuring that water quality remains adequate for its varied uses (basic human needs, ecosystems and production) under a framework of social welfare while guaranteeing agricultural and mining production.

Perception of water value. We carried out a study based on the sociological investigation entitled "Perception and civil practices of the value of water as a natural and social good: human, agricultural and mining consumption in Chile in times of climate change," which was carried out in four regions of the country (Rojas, 2015). Water is largely seen as a vital element and a public good. In terms of priority uses, human consumption should be atop the hierarchy. There is a deep disagreement about the current regulation/deregulation of water resources in the Water Law of 1981. It is believed that water is a human, production and environmental right. High levels of conflict around water are perceived, with three major conflicts over water resources detected: i) watershed pollution by mining use, ii) construction of hydroelectric power plants and iii) water shortages in rural areas. The quality of drinking water is a recurring problem. There is dissatisfaction with the current institutional water framework; thus, a change in the framework is required. It is considered urgent and necessary to regulate and protect water. There would be a willingness to transfer water to regions with deficits. In addition, important changes in the rainfall regime, caused mainly by climate change due to anthropogenic interventions, are perceived. There is a broad awareness of the phenomenon of drought affecting major towns of the territory. Respondents consider themselves very concerned about all environmental problems related to climate change, while noting that they are not employing strategies for mitigation and adaptation to water scarcity.

Water and judicial problems in Chile. Water demand and climate variability increase competition and tension between water users – agriculture, industry, mining and hydropower – and local communities. We developed a new, innovative method to analyze and quantify water conflicts by geo-tagging decisions issued by Chilean courts (Costumero et al., 2017). The spatial pattern of the intensity of conflicts related to specific sections of the Water Code is explained in terms of the main geographical, climatic and production characteristics of Chile (Rivera et al., 2017).

We studied every single case regarding water rights decided during 2013 by a Chilean court. The idea is to provide the legal technical inputs necessary to understand the reasons for conflicts over water rights and be able to provide valuable empirical information to the legal community, as well as policymakers. To create the database, the researchers chose to use the open access case law database made available by the Ministry of Justice (www.poderjudicial.cl) through its institutional website as a source of information. This option allowed them to access a vast amount of court decisions from throughout country. Of the total number of cases that form the basis of 1st instance, 40% are related to improvements and 34% to adjustments and 14% discussed issues regarding entries in the Water Registry. This means that 88% of cases dealt with activities aimed at consolidating factual situations without a proper reflection in the registration system. The findings of this study were that conflicts reflect the lack of a robust water rights registration system, the issue of illegal water uses that need to be regularized and, finally, the lack of consistency between the given water rights versus the actual amount of water available to be distributed among the different water users.

Regarding the institutional framework, the same regulations for water management rules are applied throughout the highly diverse ecosystems of the country, impeding the resolution of conflicts that are strongly related to the local geographical context. This

leads to a collision of interests and visions around water resources – of a public and private, national and international nature, regarding extractive and non-extractive uses – of individuals, aboriginal communities and corporations, especially mining operations. One important result is the paradox of the Chilean water management system, which allows water to be extracted from protected areas. This case is an interesting policy issue as it shows how different agencies and regulations collide in the context of the conservation of protected areas (Rivera et al., 2016).

Gaps in Chilean water Law. Environmental issues and water quality are just marginally mentioned in current law. For instance, we reviewed, from legal and technical perspectives, how groundwater catchment protection areas are regulated in European and American law, especially when the water is used for human consumption. Second, we contrasted these regulations with Chilean standards in order to assess the recent regulation of groundwater in the Water Code, as well as in Supreme Decree 203 of 2013. We concluded that there are at least two important differences: a) although there is a protected area for groundwater collection, Chilean legislation does not impose restrictions on polluting activities that can be installed near the collection point, even in the case of drinking water, although there is a lower-ranking regulation that is not applied and does not allow contaminating activities to be monitored. The Chilean Water Code only prevents new groundwater wells from being opened. In addition, b) the protection area does not vary, regardless of differences in site characteristics and the speed at which a contaminant advances. This requires other serious deficiencies recently highlighted by the World Bank to be overcome, such as the lack of an integrated management system of surface and groundwater, authorities actually empowered to impose restrictions for the common good and participatory governance of water resources (Delgado et al., 2017).

Identification and quantification of ecosystem services. Ecosystem services (ES) are being identified on a basin scale. As a first step we are working on case studies in the Biobio Basin in south-central Chile. The idea was to select methodologies for assessment and validation of the important issues addressed by the Fondap cluster. The group has already identified the methodology proposed by the Millenium Ecosystems Assessment Program (UN) as suitable for our purposes. The analysis of certain ecosystem features such as the macroinvertebrate communities in which the functioning and degradation of organic matter occurs in rivers were also addressed this year in an attempt to understand the role and service of organic matter degradation in terms of ecosystem resilience. Finally, the threat of invasive species such as toxic algal blooms was studied as it relates to water contamination and water quality deterioration in central Chile. This emerging threat is related to both pollution issues and climate change considerations.

In a case study in the Biobio Basin, we identified sixteen ES associated with the characterizations of three categories: i) Supply services: provision of fresh water, renewable energy, food and genetic heritage; ii) Regulating services: climate, water regulation, morpho-sedimentary and natural disturbances and iii) Cultural services, which correspond to aesthetic landscape, cultural identity and sense of belonging, scientific knowledge and recreational activities, among others. We have compiled 217 key environmental indicators to analyze the status and trends of these categories.

Water as a common good. We studied how to consider the community alternatives of access, control and management of water as a common good, emanating from both non-indigenous and Mapuche communities and socio-territorial and hydro-social movements (Torres et al, 2017). Under the current regulatory system, water is considered a commodity rather than a common or public good, which has major implications both in the perception of water issues by the people, as indicated in the water perception survey, and practical matters for local communities. People without water are mainly concentrated in rural areas, but urban centers are also increasingly vulnerable to the water crisis. What do hydrological changes mean in social, political-ecological and legal terms? As Chile is an extreme case of water privatization and vulnerability to climate change, this research seeks to change the traditional paradigm of top-down research, moving toward a bottom-up model by collecting and systematizing multiple socio-cultural and interdisciplinary visions in which the guiding principle is water as a common good.

This research line has integrated scientists from different disciplines who worked to create a multidisciplinary group that has advanced on proposals to improve water governance, helping to ensure the welfare of the population and guaranteeing agricultural and mining production.

2. FORMATION OF HUMAN RESOURCES

Human resources training is one of the key activities for CRHIAM, with the second goal of the project making the importance of this activity explicit. Through the formation of advanced human capital, FONDAP funding has transformed the training of young researchers. Our partner universities (UDEC, UDD, UFRO) offered undergraduate and graduate programs in several disciplines related to water, but work in all of these programs was carried out independently, with only intermittent and mainly informal communication and collaboration. Moreover, collaboration was restricted to specific, time-limited projects. CRHIAM was able to bring them together in common research lines to address cross-cutting issues, benefitting not only research outputs, but also the formation of new advanced human resources.

The center has maintained constant activity in human resources training through postdoctoral, graduate and undergraduate programs. In addition, different activities related to water resources such as seminars, workshops and training courses have taken place. At the doctoral level researchers are part of five programs: (a) Environmental Sciences with a Concentration in Continental Aquatic Systems, (b) Engineering Sciences with a Concentration in Chemical Engineering, (c) Metallurgical Engineering, (d) Applied Sciences with a Concentration in Mathematical Engineering and (e) Agricultural Engineering with a Concentration in Water Resources in Agriculture. The first four programs are accredited by the National Accreditation Commission (CNA). The agricultural engineering doctoral program has introduced a new curriculum, incorporating the area of energy, and changed its name to "Doctorate in Water Resources and Energy in Agriculture." As a result, the program is again undergoing the accreditation process.
At the master's level, there are five scientific programs, all of which require the completion of a thesis and publication: (a) Agricultural Engineering with a Concentration in Agroindustry, Energy and Water Resources, (b) Engineering Sciences with a Concentration in Civil Engineering, (c) Engineering Science with a Concentration in Chemical Engineering, (d) Metallurgical Engineering and (e) Regional Sciences. All master's programs are accredited.

The undergraduate programs comprise the Bachelor of Mathematics, Law, Geophysics, Environmental Engineering, Civil Engineering, Agricultural Engineering, Mining Engineering, Metallurgical Engineering, Chemical Engineering and Sociology. Senior undergraduate students benefit from their participation in seminars and workshops and the development of integrated final projects.

Certification programs are important activities to transfer new knowledge to professional engineers whose work involves water resources-related issues. Through its associated units, CRHIAM has been developing new certification programs. In September 2014 the University of Concepción obtained a grant from CONICYT to offer a program entitled "Certification in Water Resources Management in the Agricultural-Food Industry," which started in 2015 with 42 students and ended in October 2016.

The total number postdoctoral fellows and graduate students active per year, depending on scholarship type – FONDAP-funded, CONICYT-funded and project-funded – shows stable figures for postdocs, but a significant increase in the number of graduate students. The ratio of FONDAP scholarships to other sources is skewed toward other sources as the budget for scholarships is fixed; however, the increase in scholarships from other funding sources shows the ability of the center's members to attract funding and students. Figure 3 shows the percentage of postdoctoral fellows, graduate and undergraduate students in CRHIAM during the first stage of the center.

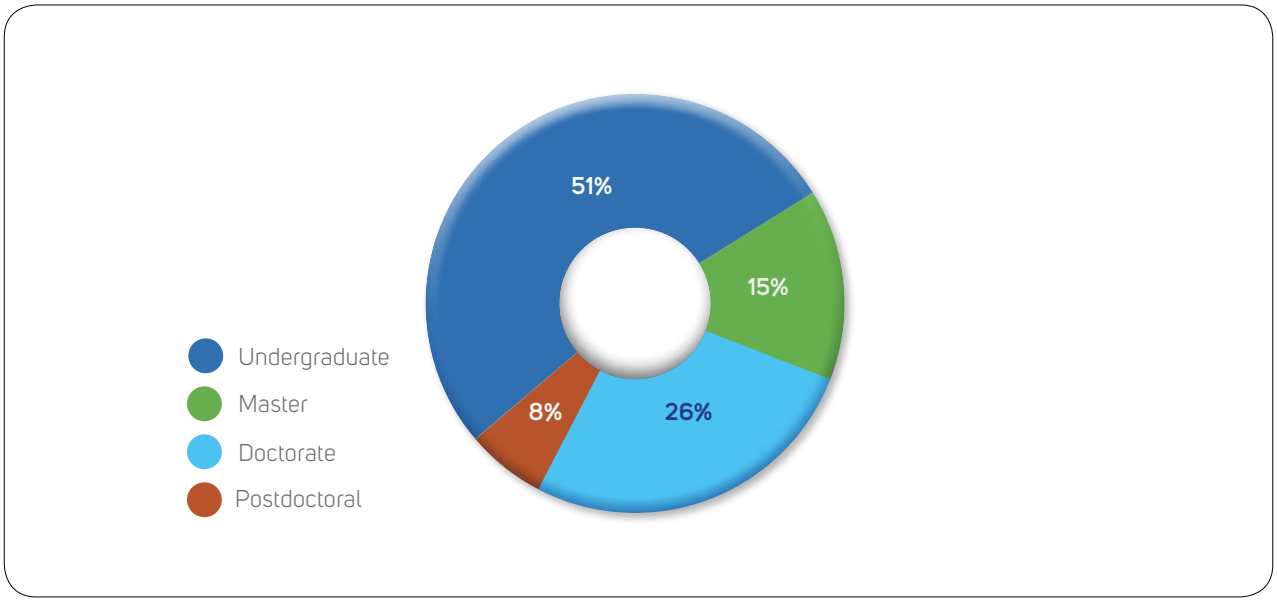

Fig. 3. Percentage of students in the first 5 years of CRHIAM (2014-2018), by academic grade in progress. Total number of students = 633.

SCHOLARSHIPS

FONDAP finances 20% of the enrolled students. In CRHIAM's 5 years of operation it has financed 12 postdoctoral fellows, 45 graduate scholarships and 130 undergraduate scholarships. Figure 4 shows the contributions of FONDAP and other funding sources to scholarships for postdoctoral researchers, graduate and undergraduate students.

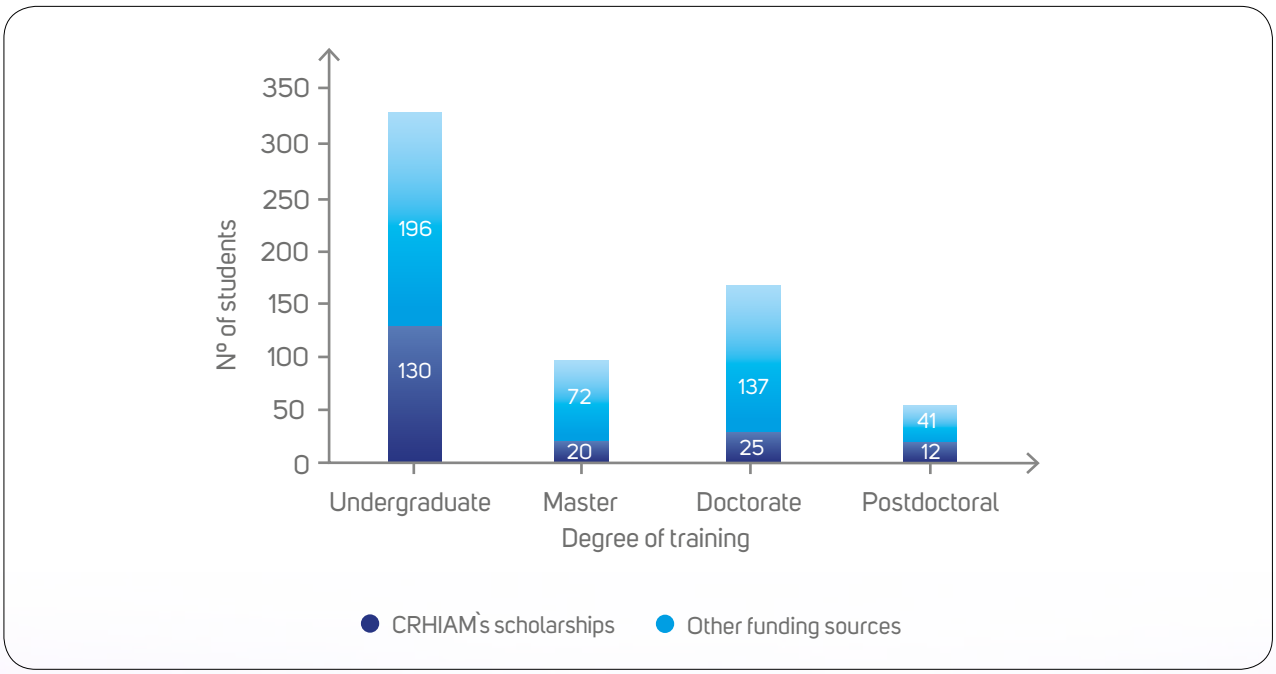

Fig. 4. Number of postdoctoral fellows, graduate and undergraduate scholarships.

3. NATIONAL AND INTERNATIONAL COLLABORATION

Over these recent years of the CRHIAM FONDAP center, international cooperation has been consolidated as a key element of the internationalization of the center's activities, as well as a pathway for creating new international research networks for the coming five years. Even before CRHIAM's creation, its researchers were part of various collaboration networks with Chilean universities and research centers, which were reinforced by the funding granted by FONDAP.

A diverse set of international activities has been developed during this time, including workshops, seminars and postgraduate courses, as well as both short- and long-term visits by incoming scientists and research stays abroad by our researchers and students. The growing recognition of the quality of CRHIAM's research has also led to an increased number of invitations to our researchers to be plenary and keynote speakers at a number of international meetings. The figure below shows the increasing participation of CRHIAM members in national and international conferences, congresses and workshops. CRHIAM is becoming attractive to international scientists as a leading institution in the field.

Another impact of international cooperation in our research activities is reflected in the large number of co-authored papers in international journals, which has grown over the last few years. Another benefit of this cooperation is the influence of our international partners in the training of doctoral students in the different research lines of the center.
There are some remarkable examples of the increasing role of internationalization in the interdisciplinary research conducted at the center, among which are the international students attracted by the center, increased participation in international events and the potential for establishing new research partners (See figure 5). The invitation by CINDA to present the experience of CRHIAM in Barcelona last year at the Research and Innovation in Water Research conference is an example of the impact of CRHIAM on an international level.

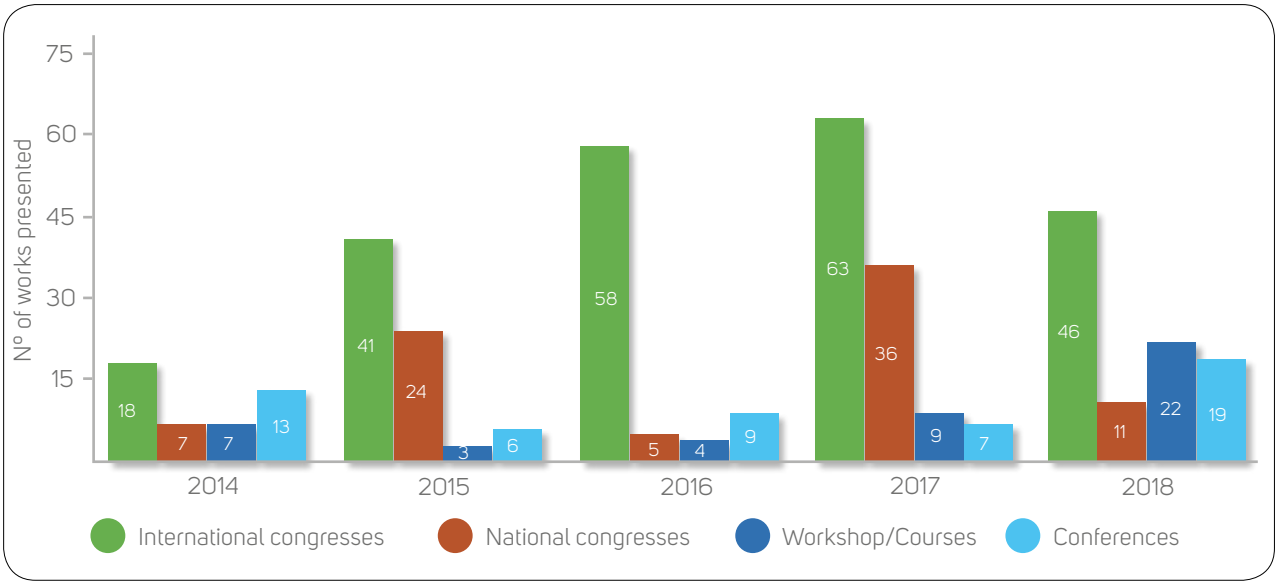

Fig. 5. Participation of members of the Center in congresses in the first 5 years of CRHIAM (2014-2018).

CRHIAM has a strong commitment to establishing reliable links among its researchers and industry stakeholders. Building this network is a long-term process and requires actions at different levels such as outreach and extension activities, i.e., enhancing the access of producers and industries to knowledge and technologies, and technology transfer, i.e., the co-creation of products or processes applicable to solving industry's problems. Within this long-term process, the first actions are related to outreach and extension in order to not only position the center as a potential partner, but also to identify technological needs.

Thus, the center has been working on internal and outreach activities such as newsletters, workshops and scientific meetings, as well as participation in international events. In terms of technology transfer, the center has been awarded patents and engaged in joint projects with industries. A summary of the center's international mobility is given in the following in the following Figure.

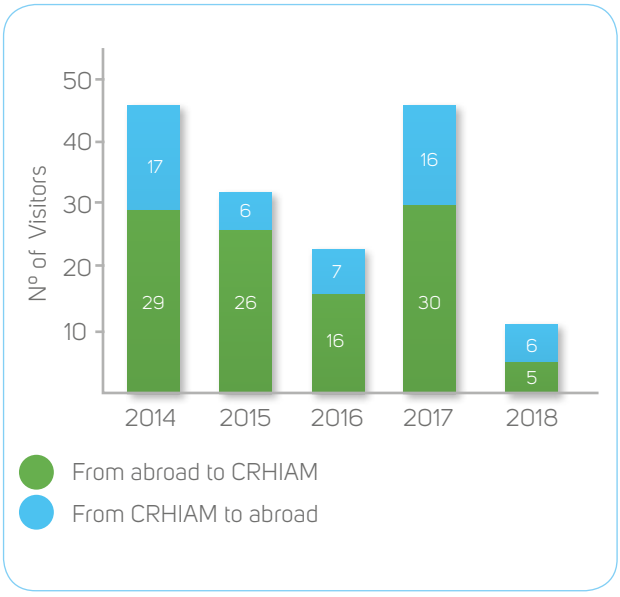

Fig. 6. Number of collaborative visits in the first 5 years of CRHIAM (2014-2018).

Research and training have been the main components of international cooperation during the first phase of the FONDAP center and the original list of international research institutions is increasing, demonstrating the interest of international partners in being associated with the center.

The training has been developed in conjunction with the center's PhD programs and a series of international courses and workshops was organized by CRHIAM scientists. One of the latest developments in this regard is the organization of these activities abroad, as is the case of the workshop held in Canada this year on water and indigenous communities.

Several policies implemented by the center have proven be effective and instrumental in stimulating overall productivity in terms of the number and quality of published papers in the scientific literature. The "trips for papers" approach clearly demonstrated its effectiveness at spurring both research stays abroad and an increasing number of scientific publications.

The impact of international collaboration and the relationships established so far by CRHIAM researchers allows us to predict that in the near future more relationships will be established as a result of the international impact of the center through its excellence in research.

The organization of international events such as the INNVOAGRI Meeting in 2016, the WONAPDE 2016 (Fifth Chilean Workshop on Numerical Analysis of Partial Differential Equations) meetings and the recently held South America Water from Space symposium organized in conjunction with the National Center for Spatial Studies of France, held in March 2018, opened new lines for collaboration with international institutions interested in the study of water resources in the Southern Cone. The outcomes of these meetings established CRHIAM as a leading research institution in the region and a serious international partner for developing water research in the near future.

The contribution of international collaboration to the internationalization of the PhD programs associated with CRHIAM has been another positive outcome for the center in recent years. The opportunity to develop PhD theses co-guided by international partners has positively affected the training of our students and the quality of the research carried out here, which has resulted in a high percentage of the published papers with international co-authors appearing in the highest-ranked journals in the center's fields of expertise. In addition, the increased number of foreign students from partner institutions who carry out their research at the center is an indication of the positive results of these activities.

In 2018 CRHIAM established an MOU with the SMIICE Chile Center to start working on two projects, the Dry Mining Project and the Limari Project, and in 2017 we signed an MOU with the UC Davis to establish a Life Science Innovation Center. Both are funded by the Chilean Government through the Corporación de Fomento de la Producción (CORFO). Our increasing collaboration with other FONDAP centers such as the Center for Climate Science and Resilience (CR2) through peer-to-peer collaboration, resulting in joint publications (Garreaud-Montecinos; Arumí-Farías) and projects (Rivera-Zambrano; Rivera-Farías), is also worth noting.

One of the lessons learned during this first phase of the center is that international visits are useful, but only if they are integrated with training and research efforts. The vast experience of our international partners should be better incorporated into our process of PhD program internationalization by considering co-teaching opportunities in the training of PhD students.

"Keeping-in-touch" activities after a valuable international contact has been made are needed to consolidate the center's relationships. In addition, building a legally recognized entity at the university level is envisaged such that agreements could be signed directly by the center and its international partners.

4. OUTREACH

Outreach activities are of paramount importance to support growth and increases in productivity, which is why CRHIAM has a strong commitment to establishing reliable links among its researchers and stakeholders in industry and society. CRHIAM needs to be recognized as an authority on water resources management for agriculture, mining and communities.

Building this reputation is a long-term process in which the first actions are related to outreach and extension in order to establish the center as a potential partner and identify technological needs. We believe that in order to make knowledge and technology available to industries and Chilean society, there must be a combination of actions – extension, technology and knowledge dissemination and technology transfer – that are carried out within an established network of information flow. It is also important to train our researchers and personnel as active communication agents in order to promote the positive positioning of CRHIAM among its target groups. Thus, the center is developing various products such as newsletters and internal activities such as conferences, workshops and scientific meetings. We also make an effort to take part in national and international events related to water resources in agriculture and mining.

It is also important for CRHIAM to spread knowledge and provide reliable information about the water resources scenario in the country to Chilean society. Therefore, our center has been using social media platforms to establish links with citizens at different levels. We have also aimed to share content in the print media with press releases, interviews and opinion columns, among other efforts.

We can highlight the participation of CRHIAM in the 2018 season of the scientific TV program "Investigadores del átomo al cosmos" on a national TV channel (Canal 24 Horas), for which we prepared three short documentaries on water use in agriculture, wastewater treatment and desalination. The director of the center will take part in a live television interview when these documentaries air this July.

We have also focused on the development of activities with local schools, organizing and taking part in several conferences on topics related to water. A school science fair in the village of Llico in 2016, where members of our team held workshops and conferences for more than 130 students ages 12 to 15, bears mentioning. This fair was a joint effort of both CRHIAM and INCAR, the Interdisciplinary Fondap Project Center for Aquaculture Research.

In order to spread our center's work in the academic world and promote the international interaction of our researchers and students, we organized the CRHIAM-INNOVAGRI international congress that took place in Concepción, Chile, in October 2016. It brought together more than 150 researchers, mainly from Brazil and Chile, but also from other parts of the world such as Australia, Canada, Germany and the USA, who shared their research results in the field of water management and new technologies for efficient use of water in agriculture, mining and communities. About 20 CRHIAM students participated actively in this congress through presentations and coordination work. We also organized the international Water in Industry 2017 conference and are organizing the Water in Industry 2018 conference in Santiago in May of this year.

Other actions taken to meet this objective were the Fifth Chilean Workshop on Numerical Analysis of Partial Differential Equations (WONAPDE 2016) and the "Judicialization of strategic causes: Theoretical framework, challenges, obstacles and opportunities compared" workshop of public law interest.

Knowledge and extension are related to various transfer activities established in the framework of technological and innovation projects. Among these, we established a knowledge transfer and dissemination model developed by the Water Center (CAA) with the support of the University of California, Davis. This project focuses on strengthening the capacities of leaders and users of different water user organizations of the O'Higgins Region through training activities in irrigation technologies, legal, financial, accounting and organizational aspects and ICT tools that ensure improved management and administration of water resources.

The second line of knowledge transfer and extension consists of transfer activities designed according to the requirements of stakeholders. The target audience has mainly been farmers and professionals from public and private institutions. Among the different types of activities carried out in this line, highlights are certification courses, short courses, workshops and talks.

We have made an effort to reflect the interdisciplinary nature of CRHIAM throughout our varied endeavors, from research to dissemination of our work. Thus, as a result of our outreach activities, in 2016 we created "Water Forums," a series of events aimed at providing a space to promote the exchange of ideas between the public and private sectors, academia and society to contribute to the analysis of the different scenarios that currently complicate decisions regarding water resources. The series debuted in November of that year. Targeted talks and meetings with relevant stakeholders, politicians and policymakers have also been part of our program to impact policymaking.

5. CONTRIBUTION TO PUBLIC POLICIES

CRHIAM has collaborated continuously in the discussion of public policies regarding water resources in Chile. Members of the center have participated in various activities, first working with the Presidential Delegate for Water Resources and later taking part in high-level government committees to develop administrative tools and regulations that would allow Chile to advance in integrated water resources management. These committees were led by the National Council of Innovation for Development (CNID).

As a result of this collaboration with CNID, we participated in the drafting of two documents: Report of the R+D+I Commission for the Sustainability of Water Resources and the Guidelines for a National Policy of Research Centers, which were delivered to the former President of Chile, Michelle Bachelet, in 2016 and 2017 (See figures 7 and 8).

http://www.cnid.cl/portfolio-items/informe-de-la-comision-de-idi-para-la-sostenibilidad-de-los-recursos-hidricos/?portfolioCats=203

Fig.7. Report delivered to President Michelle Bachelet on December 20, 2016, by the Innovation Council.

CRHIAM also participated in the Water and Environment Board, a multi-sectoral initiative led by ANDESS that emerged in 2011, bringing together economic, academic, non-governmental and citizen organizations in order to advance toward a comprehensive vision of water resources problems and their social, economic and environmental implications. The members of this committee have delivered several publications over the years, the following of which are the most noteworthy: Forward to Integrated Water Resources Management

Fig. 8. The act of delivery of the report in La Moneda.

(2015), The Manifesto of Agreements of the Water and Environment Board (2016) and the Water and Environment Roadmap (2017). All these documents were distributed among stakeholders from the public, academic and private sectors. The members of this committee delivered President Michelle Bachelet and ministers the Manifesto of Agreements of the Water and Environment Bureau, a document summarizing in 11 points the concerns on the lack of information for sustainable management and informed decision-making and the dispersion of authority among various agencies and institutions in the public sector. The figure shows the act of delivery of the document to President Michelle Bachelet.

CRHIAM, with the active participation of E. Holzapfel, D. Rivera and F. De la Hoz, led the formation of a network

Fig. 9. Water Research Network formed with the sponsorship of CNID.

of 25 public and private water centers in Chile under the umbrella of CNID in November 2016. The network seeks to provide a space for collaboration among research groups in water resources to generate data, information and knowledge, develop projects and scientific and technical publications and disseminate knowledge (See figure 9). In addition, it supports the formation of advanced human capital, generates public policies and analyzes new challenges facing the country.

This network was made up of the Center for Environmental Sciences of the University of Concepción (EULA); INIA Intihuasi; the Institute of Ecology and Biodiversity; the Center for Water Resources (CAA) of the University of Concepción; the Water Center for Agriculture of the University of Concepción (CRHIAM); INFOR; the Center for Studies of the Quaternary of Fire-Patagonia and Antarctica; CIDERH of Arturo Prat University; the Technological Research Center of Water in the Desert (CEITSAZA); the Center for Scientific and Technological Research for Mining (CICITEM); the School of Forestry Sciences of the University of Chile; the Technological Center of Environmental Hydrology of the University of Talca (CTHA); the Center for Climate Science and Resilience (CR2) of the University of Chile;

and the UC Center for Global Change and the Center for Advanced Studies in Arid Zones of Coquimbo (CEAZA).

Concerning water management in various Chilean basins, members of CRHIAM took part in the negotiations that produced a new operating agreement for Laja Lake in the Biobio Region of Chile, which for the first time includes environmental aspects and the use of water by the tourism industry. It is also important to mention that twelve of the thirteen groundwater user communities that currently exist in Chile, as well as the Víctor-Codpa River Board, recently created in the Arica and Parinacota Region, were developed by members of the Water Resources Department of the University of Concepción associated with the Water and Society cluster of CRHIAM.
Moreover, CRHIAM members are participating in "Water Scenarios 2030," led by Fundación Chile. This IDB-funded project aims to collectively construct different water scenarios for 2030-2050, which will contribute to water security and sustainability as part of the national discussion on water resources, the formulation of water policies in this area and the identification of the risks to and opportunities for various sectors, as well as the mobilization of the implementation of specific systemic solutions that are effective, coordinated and cost-efficient.

During the water week held in March (26-28), the book Water Analysis: The Water Gap and Water Risk in Chile, the first publication of Water Scenarios 2030, which offers a current study of water resources in Chile – in terms of the water gap (water supply versus demand) and water risk (water deficit, excess water, water quality) analysis – was launched.

2014-2018 REPORT

WATER RESEARCH CENTER FOR AGRICULTURE AND MINING

CRHIAM
TEAM

PRINCIPAL RESEARCHERS

Fernando Concha
Eduardo Holzapfel
Roberto Urrutia
Pedro Toledo
Ricardo Barra
José Luis Arumí
Gladys Vidal
Diego Rivera
Alex Schwarz

current staff 2018

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Mario Lillo	Jorge Rojas
Octavio Lagos	Sergio Acuña
Jorge Jara	Aldo Montecinos
Pablo Cornejo	José Luis Campos
Raimund Bürger	Amaya Álvez
Fernando Betancourt	Sergio Castro
Alex Schwarz	Alejandra Stehr
David Jeison	Christian Goñi
Alex Godoy	Gonzalo Montalva
Rodrigo Borquez	José Vargas
Maria Cristina Diez	Oscar Link
Verónica Delgado	Daniel Sbarbaro

Current staff 2018

ADMINISTRATIVE STAFF

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Carla Inzunza	Aurora Varela
Alejandra Fajardo	Héctor Guzmán
Hector Ramírez	Ronald Burgos
Leonora Hidalgo	Carla Castelli
Marianela Carreño	Elizabeth Sandoval
Matias Vejar	-

Current staff 2018

SUPPORT STAFF

María Ignacia Carrillo	Mario Sepúlveda
Constanza Bello	Waldo Lama
Marcelo Vergara	Constanza Hidd
Fernando Ochoa	Solange Jara
Carlos Cea	Carlos González
Roberto Rozas	Jerónimo Ferrer
Jorge Saavedra	Cintia Beltrán
Felipe de la Hoz	Ricardo Pradenas
Denisse Alvarez	Priscilla Ceballos
Gerson Valenzuela	Catalina Plaza de los Reyes
Patricio Leonelli	Silvana Pesante
María Fernanda Saavedra	René Iribarren
Viviana Gavilán	Fabiola Lara
Pablo Pedreros	Pamela Villalón
Catalina Monardes	Douglas Aitken
Sujey Hormazábal	Manuel Silva
María José Ortega	Javier Pérez
Pamela Sanhueza	Juan Carlos Ortega
Loreto Acevedo	Nicolás Yung
Francisco Flores	Cristian Romero
Alvaro Paredes	David Vidal
Javier Quispe	Jonathan Labrin
Joshua Parra	Ricardo Matta
Norma Pérez	Gabriela Morales
Niela Araneda	Nelson Valenzuela

Current staff 2018

POSTDOCTORAL FELLOWS

Name	Research Topic	Tutor's name	Associated Institution
2014			
Soledad Chamorro	Evaluación de la eliminación del potencial biológico presente en aguas residuales urbanas y efluentes de celulosa kraft a través de sistemas biológicos convencionales y no convencionales detectado con Saccharomyces cerevisiae recombinante y Daphnia magna	Gladys Vidal	Universidad de Concepción
Carolina Reyes	Evaluation of organic micropollutants, nutrients and organic matter removal contained on domestic wastewater treated by constructed wetlands	Gladys Vidal	Universidad de Concepción
Heidi Schalchli	Valorization of potato organic wastes: production of ligninolytic enzymes and antifungal compounds by white-rot fungi	María Cristina Diez	Universidad de La Frontera
Mauricio Schoebitz	Aplicación combinada de purines de cerdo y un consorcio bacteriano para mejorar las propiedades del suelo y la absorción de nutrientes en plantas de ballica inglesa	Gladys Vidal	Universidad de Concepción
Jorge Saavedra	Effect of electrolytes on physicochemical and rheological porperties of suspensiones, Molecular simulation of water	Pedro Toledo	Universidad de Concepción
Javiera Cárdenas	Indicadores biológicos de cambio climático	Roberto Urrutia	Universidad de Concepción
Jorge Alvez	Desenvolvimento de modelos de regressão de efeito mistos para tecnologias de manejo de água e solo para uma agricultura intensiva sustentável	Eduardo Holzapfel / Jorge Jara	Universidad de Concepción
Sudarshan Kumar	Numerical Analysis of Partial Differential Equations	Raimund Bürger	Universidad de Concepción
María del Carmen Martí	Numerical Analysis of Partial Differential Equations	Raimund Bürger	Universidad de Concepción
Yessica Rivas	Water availabilty and gender issues in coastal watersheds	Diego Rivera	Universidad de Concepción
2015			
Isaac Reyes	Osmotic pre-concentration as a strategy for efficient anaerobic treatment of sewage	David Jeison	Universidad de La Frontera

POSTDOCTORAL FELLOWS

Name	Research Topic	Tutor's name	Associated Institution
Alvaro Torres	Producción de bioplásticos a partir de cultivos microbianos mixtos	Rodrigo Navia	Universidad de La Frontera
Heidi Schalchli	Valorization of potato organic wastes: production of ligninolytic enzymes and antifungal compounds by white-rot fungi	María Cristina Diez	Universidad de La Frontera
Soledad Chamorro	Evaluación del riesgo ambiental de drenajes acido de mina a través de biondicadores de calidad de agua y uso de suelo	Gladys Vidal	Universidad de Concepción
Carolina Reyes	Evaluation of organic micropollutants, nutrients and organic matter removal contained on domestic wastewater treated by constructed wetlands	Gladys Vidal	Universidad de Concepción
Gerson Valenzuela	Surface force between two surfaces separated by few nanometers	Pedro Toledo	Universidad de Concepción
Javiera Cárdenas	Indicadores Biológicos de Cambio Climático	Roberto Urrutia	Universidad de Concepción
Cristina Villamar	Revalorización de residuos de la agricultura y minería	Diego Rivera	Universidad de Concepción
Douglas Aitken	Life Cycle Assessment of Water Consumption and Intensity of the copper mining industry in Chile	Alex Godoy	Universidad del Desarrollo
Yessica Rivas	Water available, water use, and water quality evaluation in rural Chilean watersheds, through community participation and field research	Diego Rivera	Universidad de Concepción
Sudarshan Kumar	Numerical Analysis of Parcial Differencial Equations	Raimund Bürger	Universidad de Concepción
Sudarshan Kumar	Numerical Analysis of Parcial Differencial Equations	Raimund Bürger	Universidad de Concepción
María del Carmen Martí	Numerical Analysis of Parcial Differencial Equations	Raimund Bürger	Universidad de Concepción
2016			
Alvaro Torres	PHA production from wastewater	David Jeison	Universidad de La Frontera
Juan Carlos Ortega	Forward osmosis for water recovery from mining wastewater	David Jeison	Universidad de La Frontera
Soledad Chamorro	Evaluación del riesgo ambiental de drenajes acido de mina a través de biondicadores de calidad de agua y uso de suelo	Gladys Vidal	Universidad de Concepción

POSTDOCTORAL FELLOWS

Name	Research Topic	Tutor's name	Associated Institution
Carolina Reyes	Evaluation of organic micropollutants, nutrients and organic matter removal contained on domestic wastewater treated by constructed wetlands	Gladys Vidal	Universidad de Concepción
Daniela López	Reúso de agua servida tratada mediante humedales construidos	Gladys Vidal	Universidad de Concepción
Heidi Schalchli	Valorización de residuos agroindustriales. Obtención de productos de valor agregado	María Cristina Diez	Universidad de La Frontera
Sudarshan Kumar	Numerical Analysis of Partial Differential Equations	Raimund Bürger	Universidad de Concepción
Maria del Carmen Martí	Numerical Analysis of Partial Differential Equations	Raimund Bürger	Universidad de Concepción
Cristina Villamar	Valorización de residuos agrícolas	Diego Rivera	Universidad de Concepción
Yessica Rivas	Water availability in Coastal watersheds	Diego Rivera	Universidad de Concepción
Douglas Aitken	Water use in mining	Alex Godoy	Universidad de Concepción
Robinson Torres	La Hidro-Modernidad de lo Común: Una Ecología Política de los Nuevos Movimientos Sociales por el Agua en Chile	Jorge Rojas/ Ricardo Barra/José Luis Arumí	Universidad de Concepción
Felipe Tucca	Monitoreo de compuestos orgánicos hidrofóbicos en agua mediante dispositivos de muestreo pasivo: una aproximación hacia el conocimiento de la calidad del agua en sistemas fluviales	Ricardo Barra	Universidad de Concepción
Viviana Almanza	Limnología	Roberto Urrutia	Universidad de Concepción
Gerson Valenzuela	Surface force between two surfaces separated by few nanometers	Pedro Toledo	Universidad de Concepción
2017			
Viviana Almanza	Cyanobacterial blooms in aquatic ecosystems	Roberto Urrutia	Universidad de Concepción
Mariela Yevenes	Reactive nitrogen sources and their cycling in river catchment areas subjected to a strong land use change and a water deficit drainage, the case of central-southern Chilean rivers	José Luis Arumí	Universidad de Concepción

POSTDOCTORAL FELLOWS

Name	Research Topic	Tutor's name	Associated Institution
Felipe Tucca	Dinámica de compuestosorgánicos peristentes (COPs) en lagos oligotróficos.	Ricardo Barra	Universidad de Concepción
Daniela López	Evaluation of methane and nitrous oxide emissions in hybrid subsurface wetlands for wastewater treatment in rural areas.	José Luis Campos	Universidad Adolfo Ibáñez
Daniel Valenzula	Treatment of wastewater by of the anammox process	José Luis Campos	Universidad Adolfo Ibáñez
Juan Carlos Ortega	Forward osmosis for water recovery from mining wastewater	David Jeison	Universidad de La Frontera
Daniela López	Water reuse served treated by constructed wetlands (until february 2017)	Gladys Vidal	Universidad de Concepción
Pablo Salgado	Disinfection of treated wastewater for reuse in agriculture via solar radiation and nanoparticles obtained from vegetable waste	Gladys Vidal	Universidad de Concepción
Sudarshan Kumar	Numerical Analysis of Partial Differential Equations: sedimentation problems, approximate Lax-Wendroff schemes, flow in porous media	Raimund Bürger	Universidad de Concepción
Maria Carmen Martí	Numerical Analysis of Partial Differential Equations: sedimentation problems, models of flotation	Raimund Bürger	Universidad de Concepción
David Zorío	Numerical Analysis of Partial Differential Equations: high-resolution methods, WENO schemes, approximate Taylor methods	Raimund Bürger	Universidad de Concepción
2018			
Alvaro Torres	PHA production from wastewater	David Jeison	Universidad de La Frontera
Pablo Salgado	Wastewater disinfection from a subsurface flow wetland by copper and iron nanoparticles in the presence of solar radiation and H2O2	Gladys Vidal	Universidad de Concepción
Daniela López	Evaluación de las emisiones de metano y óxido nitroso en humedales subsuperficiales híbridos para la depuración de aguas servidas en zonas rurales	José Luis Campos / Gladys Vidal	Universidad Adolfo Ibañez
Gonzalo Quezada	Flotación de minerales ricos en litio	Pedro Toledo	Universidad de Concepción

POSTDOCTORAL FELLOWS

Name	Research Topic	Tutor's name	Associated Institution
Pablo Pedreros	Cambio en altitud de las isotermas en ambientes fluviales alto-andinos, en base a proyecciones de cambio climático: Estudiando el efecto de compresión y/o expansión en la distribución de macroinvertebrados bentónicos	Alberto Araneda / Roberto Urrutia	Universidad de Concepción
Felipe Tucca	Presencia de insecticida organofosforados (OFs) y organoclorados (OCs) en aguas subterráneas del valle central de la región del Biobío.	Ricardo Barra	Universidad Andrés Bello

Information Updated Until November 2018

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
2014			
Leslie Meier	Biogas purification by microalgae	David Jeison	Universidad de La Frontera
Francisco Cabrera	Development of strategies for polyhidroxyalcanoate production in mixed microbial cultures by online control of oxygen and pH variations	David Jeison	Universidad de La Frontera
Juan Carlos Ortega	Osmosis directa: una alternativa para la concentración de aguas residuales urbanas	David Jeison	Universidad de La Frontera
Daniela López	Evaluación estacional de humedales construidos de flujo horizontal subsuperficial para la depuración de aguas servidas en zonas rurales: implicancias en la generación de metano	Gladys Vidal	Universidad de Concepción
Patricio Neumann	Evaluación del desempeño operacional y ambiental de la digestión anaerobia de lodos provenientes del tratamiento de aguas servidas incluyendo pre-tratamiento mediante ultrasonido e hidrólisis térmica	Gladys Vidal / Almudena Hospido	Universidad de Concepción
Alejandra Villamar	Effect of anaerobic treatment on the efficiency of removing nutrients and metals in pig manure in constructed wetlands	Gladys Vidal	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Cynthia Urrutia	Rhizosphere effect on the degradation of pesticides in biobeds.	María Cristina Diez	Universidad de La Frontera
Norma Pérez	Optimización del tratamiento de drenajes ácidos con arsénico en reactores anaerobios con difusión activa	Alex Schwarz	Universidad de Concepción
Gerson Valenzuela	Análisis del crecimiento anisotrópico de cristales de hielo mediante simulación computacional	Pedro Toledo / Roberto Rozas	Universidad de Concepción
Ricardo Jeldres	Estudio experimental de floculación de suspensiones minerales y modelación en base a balance poblacional	Pedro Toledo / Fernando Concha	Universidad de Concepción
Gonzalo Quezada	Dinámica molecular de interfases entre óxidos minerals y agua en presencia de electrolitos y polielectrolitos a alta concentración de sal y en un rango de pH	Pedro Toledo / Roberto Rozas	Universidad de Concepción
Lina Uribe	Efecto del agua de mar en la recuperación de minerales de cobre-molibdeno por procesos de flotación	Leopoldo Gutiérrez	Universidad de Concepción
Pablo Pedreros	Macroinvertebrados bentónicos en ríos de cabecera: potenciales implicancias del calentamiento global actual	Roberto Urrutia / Ricardo Figueroa	Universidad de Concepción
Denisse Alvarez	Reconocimiento de cambios en la temperatura durante los últimos 1.000 años en la Patagonia Norte, mediante la aplicación de isótopos estables y otros proxies	Roberto Urrutia	Universidad de Concepción
David Fonseca	Evapotranspiración desde imágenes de satélite	Mario Lillo	Universidad de Concepción
Francisco Zambrano	Agricultural drought in Chile: from the assessment toward prediction using satellite data	Mario Lillo	Universidad de Concepción
Angel Pedrero	Detección y análisis automático basado en objetos de anomalías de riego mediante el uso de imágenes multimodal	Consuelo Gonzalo / Mario Lillo	Universidad Politécnica de Madrid
Alejandro Pannunzio	Sustainable criteria for design and operation of drip irrigation in blueberries	Eduardo Holzapfel	Universidad de Buenos Aires
Hernán Aguilera	Estimación de la variabilidad espacial y temporal del estado hídrico del suelo en un huerto de uva de mesa (Vitis vinífera L. var. Thompson Seedless)	Octavio Lagos	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Carlos González	Desarrollo de un modelo de estimación de radiación neta, en condiciones de alta resolución espacial y temporal	Octavio Lagos	Universidad de Concepción
Elvis Gavilán	Modelamiento Matemático y Simulación Numérica de Modelos Espacio-Temporal de Enfermedades Transmitidas por Vectores	Raimund Bürger	Universidad de Concepción
Lihki Rubio	Una Contribución al Estudio de Métodos Numéricos Eficientes para Algunos Modelos Multi-Especies en una Dimensión	Raimund Bürger	Universidad de Concepción
Haydee Osorio	Síntesis del sistema hidrológico del río Chagres, República de Panamá	José Luis Arumí	Universidad de Concepción
Vanessa Novoa	Contabilidad de la huella hídrica de la cuenca del rio Cachapoal para la evaluación de la Sostenibilidad	José Luis Arumí	Universidad de Concepción
María Fernanda Saavedra	Evaluación de los efectos de efluentes de plantas tratamiento de aguas servidas (Planta Los Angeles y Planta Sta. Barbara), sobre Oncorhynchus mykiss mediante el uso de experimentos de laboratorio y terreno: utilización de biomarcadores, como herramientas de evaluación de respuestas bioquímicas, reproductivas y hematológicas	Ricardo Barra	Universidad de Concepción
Ana Araneda	Uso de lombriz de tierra como organismo indicador del impacto de agroquímicos en una cuenca agrícola	Ricardo Barra	Universidad de Concepción
Meyer Guevara	Efectos de la reducción del caudal por actividades agrícolas en ríos de la zona mediterránea de Chile	Ricardo Figueroa	Universidad de Concepción
María Elisa Díaz	Determinación de servicios ecosistémicos de la cuenca del Río Biobío	Ricardo Figueroa	Universidad de Concepción
Katherine Brintrup	Control hidrológico sobre la dinámica del nitrógeno biodisponible en un río intermitente de la cuenca del Itata, región del Biobío	Ricardo Figueroa	Universidad de Concepción
2015			
Francisco Cabrera	Development of strategies for polyhidroxyalcanoate production in mixed microbial cultures by online control of oxygen and pH variations	David Jeison	Universidad de La Frontera
Leslie Meier	Biogas purification by microalgae	David Jeison	Universidad de La Frontera
Edward Hermosilla	Biological pretreatment of wheat straw using combined wood-rotting fungi for improving the anaerobic digestion process	María Cristina Diez	Universidad de La Frontera

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Norma Pérez	Optimización del tratamiento de drenajes ácidos con arsénico en reactores anaerobios con difusion activa	Alex Schwarz	Universidad de Concepción
David Fonseca	Evapotranspiración desde imágenes de satélite	Mario Lillo	Universidad de Concepción
Francisco Zambrano	Agricultural drought in Chile: from the assessment toward prediction using satellite data	Mario Lillo	Universidad de Concepción
Angel García	Computación en avanzada para Ciencias de la Ingeniería	Consuelo Gonzalo / Mario Lillo	Universidad Politécnica de Madrid
Alejandro Pannunzio	Sustainable criteria for design and operation of drip irrigation in blueberries	Eduardo Holzapfel	Universidad de Buenos Aires
Karla Silva	Balance Hídrico en diferentes variedades de naranjos bajo condiciones de no riego	Eduardo Holzapfel	Universidad de Recocavo de Bahia
Jorge Espinosa	Vulnerabilidad hídrica en cuencas andinas: la cuenca del Río Ángel, Ecuador	Diego Rivera	Universidad de Concepción
Claudia Sangüesa	Patrones espaciales y temporales de intensidad de precipitación en Chile Central	Diego Rivera	Universidad de Concepción
Elvis Gavilán	Modelamiento Matemático y Simulación Numérica de Modelos Espacio-Temporal de Enfermedades Transmitidas por Vectores	Raimund Bürger / Gerardo Chowell-Puente	Universidad de Concepción
Lihki Rubio	Una Contribución al Estudio de Métodos Numéricos Eficientes para Algunos Modelos Multi-Especies en una Dimensión	Raimund Bürger / Pep Mulet	Universidad de Concepción
Camilo Mejías	Advanced Numerical Techniques for Convection-Diffusion-Reaction Problems Arising in Secondary Settling Tanks and Related Applications	Raimund Bürger / Stefan Diehl	Universidad de Concepción
Gonzalo Quezada	Dinámica molecular de interfases entre óxidos minerals y agua en presencia de electrolitos y polielectrolitos a alta concentración de sal y en un rango de pH	Pedro Toledo / Roberto Rozas	Universidad de Concepción
Eimmy Ramírez	Evaluación de la capacidad de diatomeas bentónicas como biorremediadores de aguas con elevadas concentraciones de arsénico	Roberto Urrutia	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Viviana Almanza	Evaluación de Riesgo Ambiental por Plaguicidas Organofosforados en Agua superficial y Aire en una Cuenca con Intensa Actividad Agrícola: cuenca del río Cachapoal (Chile Central)	Oscar Parra	Universidad de Concepción
Carlos Mendoza	Variabilidad Glacio-Hidrológica y Sensibilidad Climática del Glaciar Universidad (34°40´S, 70°20´W), Chile	Roberto Urrutia	Universidad de Concepción
Maria Jose Climent	Evaluación de Riesgo Ambiental por Plaguicidas Organofosforados en Agua superficial y Aire en una Cuenca con Intensa Actividad Agrícola: cuenca del río Cachapoal (Chile Central)	Roberto Urrutia	Universidad de Concepción
Lina Uribe	Efecto del agua de mar en la recuperación de minerales de cobre-molibdeno por procesos de flotación	Leopoldo Gutierrez	Universidad de Concepción
Javier Camaño	Estudio del comportamiento hidrológico de techos verdes y su aplicación para climas mediterráneos	José Luis Arumí	Universidad de Concepción
Julieth Galdamez	Indicadores de sustentabilidad sistémica (Thrivability) para la gestión de los recursos hídricos en las cuencas del Almanzora (España) e Itata (Chile)	José Luis Arumí	Universidad de Concepción
Vanessa Novoa	Contabilidad de la huella hídrica de la cuenca del rio Cachapoal para la evaluación de la Sostenibilidad	José Luis Arumí	Universidad de Concepción
Rafaela Retamal	Percepción de actores claves de la subcuenca del río Vergara a la interacción del cambio climático sobre los servicios ecosistémicos hídricos: hacia una gobernanza sustentable del agua en Chile	Oscar Parra / Jorge Rojas	Universidad de Concepción
Katherine Brintrup	Control hidrológico sobre la dinámica del nitrógeno biodisponible en un río intermitente de la cuenca del Itata, región del Biobío	Ricardo Figueroa	Universidad de Concepción
Andiranel Banegas	Importancia de los ríos intermitentes ante el cambio climático: análisis de su resiliencia en el Río Lonquén	Ricardo Figueroa	Universidad de Concepción
Ana Araneda	Uso de lombriz de tierra como organismo indicador del impacto de agroquímicos en una cuenca agrícola	Ricardo Barra	Universidad de Concepción
Daniela Pedraza	Presencia de contaminantes emergentes en el río Biobío y sus efectos sobre la biota acuática	Ricardo Barra	Universidad de Concepción
María Elisa Díaz	Determinación de servicios ecosistémicos de la cuenca del Río Biobío	Ricardo Figueroa	Universidad de Concepción
2016			
Leslie Meier	Biogas purification by microalgae	David Jeison	Universidad de La Frontera

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Carla Duarte	Precipitation of heavy metals on mining wastewater through microbial induced carbonate precipitation (MICP) process	David Jeison	Universidad de La Frontera
Francisco Cabrera	Development of strategies for polyhidroxyalcanoate production in mixed microbial cultures by online control of oxygen and pH variations	David Jeison	Universidad de La Frontera
Bárbara Vital	Treatment of acid mine drainage by forward osmosis: Rejection of selected metals	Jan Bartacek / David Jeison	University of Chemistry and Technology, Prague, Czech Republic
Daniela López	Evaluación estacional de humedales construidos de flujo horizontal subsuperficial para la depuración de aguas servidas en zonas rurales: implicancias en la generación de metano	Gladys Vidal	Universidad de Concepción
Patricio Neumann	Evaluación del desempeño operacional y ambiental de la digestión anaerobia de lodos provenientes del tratamiento de aguas servidas incluyendo pre-tratamiento mediante ultrasonido e hidrólisis térmica	Gladys Vidal / Almudena Hospido	Universidad de Concepción
Jorge Cornejo	Identificación y caracterización de híbridos de Populus spp. asociados a la tolerancia de cobre y cadmio como una aproximación biotecnológica y mecanismos de fitorremediación	Jaime Tapia / Gladys Vidal	Universidad de Talca
Thais González	Energy recovery from sewage treatment by integrating a microbial fuel cell into a constructed wetland	Gladys Vidal	Universidad de Concepción
María Venegas	Influence of advanced anaerobic digestion on the environmental quality of stabilized sludge	Gladys Vidal	Universidad de Concepción
María Gutiérrez	Modelación fenomenológica de espesamiento en pasta	Fernando Betancourt	Universidad de Concepción
Alonso Pereira	Estudio de sistemas de control para espesadores	Fernando Betancourt	Universidad de Concepción
Diana Celi	Basic studies for water balances in tailing dams	Fernando Betancourt / Christian Goñi	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Elvis Gavilán	Modelamiento Matemático y Simulación Numérica de Modelos Espacio-Temporal de Enfermedades Transmitidas por Vectores	Raimund Bürger / Gerardo Chowell-Puente	Universidad de Concepción
Lihki Rubio	Una Contribución al Estudio de Métodos Numéricos Eficientes para Algunos Modelos Multi-Especies en una Dimensión	Raimund Bürger	Universidad de Concepción
Camilo Mejías	Advanced Numerical Techniques for Convection-Diffusion-Reaction Problems Arising in Secondary Settling Tanks and Related Applications	Raimund Bürger	Universidad de Concepción
Víctor Osores	Sistema Shallow Water Multicapas para Sedimentación Polidispersa: Teoría, Análisis Numérico y Aplicaciones	Raimund Bürger / Enrique Fernández-Nieto	Universidad de Concepción
Alejandro Pannunzio	Sustainable criteria for design and operation of drip irrigation in blueberries	Eduardo Holzapfel	Universidad de Buenos Aires
Jorge Espinosa	Vulnerabilidad hídrica en cuencas andinas: la cuenca del Río Ángel, Ecuador	Diego Rivera	Universidad de Concepción
Claudia Sangüesa	Patrones espaciales y temporales de intensidad de precipitación en Chile Central	Diego Rivera	Universidad de Concepción
Francisco Zambrano	Agricultural drought in Chile: from the assessment toward prediction using satellite data	Mario Lillo	Universidad de Concepción
Ángel García	Computación en avanzada para Ciencias de la Ingeniería	Mario Lillo	Universidad Politécnica de Madrid
Daniel Inzunza	Métodos Implícitos-Explícitos para Problemas de Convección-Difusión-Reacción no Lineales y no Locales	Raimund Bürger	Universidad de Concepción
Javier Camaño	Estudio del comportamiento hidrológico de techos verdes y su aplicación para climas mediterráneos	José Luis Arumí	Universidad de Concepción
Julieth Galdamez	Indicadores de sustentabilidad sistémica (Thrivability) para la gestión de los recursos hídricos en las cuencas del Almanzora (España) e Itata (Chile)	José Luis Arumí	Universidad de Concepción
Vanessa Novoa	Contabilidad de la huella hídrica de la cuenca del rio Cachapoal para la evaluación de la Sostenibilidad	José Luis Arumí	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Benigno Banegas	Importancia ecológica de un río intermitente para la biota acuática, que sirva como un modelo para entender posibles escenarios de cambio climático	Ricardo Figueroa	Universidad de Concepción
Katherine Markovich	Water resource vulnerability to climate change in a permeable alpine system	Graham Fogg / Reed Maxwell / José Luis Arumí	University of California Davis
Andrés Ramírez	Flotación de minerales Cu-Mo en agua de mar usando dispersantes y acondicionamiento de burbujas	Leopoldo Gutiérrez	Universidad de Concepción
Enrique Wagemann	Atomistic study of flow enhancement in silicon and titanium dioxide nanopores induced by graphene coatings	Harvey Zambrano	Universidad de Concepción
Gonzalo Quezada	Dinámica molecular de interfases entre óxidos minerals y agua en presencia de electrolitos y polielectrolitos a alta concentración de sal y en un rango de pH	Pedro Toledo / Roberto Rozas	Universidad de Concepción
María José Climent	Evaluación de Riesgo Ambiental por Plaguicidas Organofosforados en Agua superficial y Aire en una Cuenca con Intensa Actividad Agrícola: cuenca del río Cachapoal (Chile Central)	Roberto Urrutia	Universidad de Concepción
Carlos Mendoza	Variabilidad Glacio-Hidrológica y Sensibilidad Climática del Glaciar Universidad (34°40´S, 70°20´W), Chile	Roberto Urrutia	Universidad de Concepción
Isis Montes	Reconstrucción de eventos de floraciones de cianobacterias durante los últimos 1000 años basado en Pigmentos Sedimentarios y ADN: Buscando evidencias de eventos climáticos y alteraciones Antrópicas	Roberto Urrutia	Universidad de Concepción
Lina Uribe	Efecto del agua de mar en la recuperación de minerales de cobre-molibdeno por procesos de flotación	Leopoldo Gutiérrez	Universidad de Concepción
Rodrigo Yepsen	Comportamiento de la enargita en la flotación utilizando agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
2017			
María José Climent	Evaluación de Riesgo Ambiental por Plaguicidas Organofosforados en Agua superficial y Aire en una Cuenca con Intensa Actividad Agrícola: cuenca del río Cachapoal (Chile Central)	Roberto Urrutia	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
José Troncoso	Historia climática, ambiental y cultural en cuencas de Chile-Centro Sur de los últimos 1000 años, inferidas a través de un enfoque multiproxy	Roberto Urrutia	Universidad de Concepción
Isis Montes	Reconstrucción de eventos de floraciones de cianobacterias durante los últimos 1000 años basado en Pigmentos Sedimentarios y ADN: Buscando evidencias de eventos climáticos y alteraciones Antrópicas	Roberto Urrutia	Universidad de Concepción
Arnaldo Collazo	Evaluación de los efectos del cambio climático en el régimen térmico y temperatura superficial de los lagos del Centro Sur de Chile	Roberto Urrutia	Universidad de Concepción
Gonzalo Quezada	Dinámica molecular de interfases entre óxidos minerales y agua en presencia de electrolitos y polielectrolitos a alta concentración de sal y en un rango de pH	Pedro Toledo / Roberto Rozas	Universidad de Concepción
Lina Uribe	Efecto del agua de mar en la recuperación de minerales de cobre-molibdeno por procesos de flotación	Leopoldo Gutiérrez	Universidad de Concepción
Andrés Ramírez	Flotación de minerales Cu-Mo en agua de mar usando dispersantes y acondicionamiento de burbujas	Leopoldo Gutiérrez	Universidad de Concepción
Rodrigo Yepsen	Comportamiento de la enargita en la flotación utilizando agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
Iongel Durán	Impactos de la disminución de almacenamiento de las aguas subterráneas en las cuencas Ligua y Petorca sobre las zonas agrícolas y los humedales costeros	José Luis Arumí	Universidad de Concepción
Loreto Arriagada	Efectos de los usos de suelos y geoquímica de cuencas del centro sur de Chile sobre las fuentes del Nitrógeno: Implicancias de los impactos sobre los humedales costeros	José Luis Arumí	Universidad de Concepción
Oscar Reichener	La incorporación de objetivos de protección ambiental de las aguas en los instrumentos de ordenamiento territorial en Chile. Programa de doctorado en Ciencias Ambientales	José Luis Arumí	Universidad de Concepción
Javier Camaño	Estudio del comportamiento hidrológico de techos verdes y su aplicación para climas mediterráneos	José Luis Arumí	Universidad de Concepción
Julieth Galdámez	Indicadores de sustentabilidad sistémica (Thrivability) para la gestión de los recursos hídricos en las cuencas del Almanzora (España) e Itata (Chile)	José Luis Arumí	Universidad de Concepción
Victor Parra	Uso de análisis de recesión para mejorar la modelación hidrológica	José Luis Arumí	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Andiranel Banegas	Importancia de los ríos intermitentes ante el cambio climático: análisis de su resiliencia en el Río Lonquén	Ricardo Figueroa	Universidad de Concepción
María Elisa Díaz	Determinación de servicios ecosistémicos de la cuenca del Río Biobío	Ricardo Figueroa	Universidad de Concepción
Katherine Brintrup	Control hidrológico sobre la dinámica del nitrógeno biodisponible en un río intermitente de la cuenca del Itata, región del Biobío	Ricardo Figueroa	Universidad de Concepción
Mauricio Quiroz	Respuestas biológicas en peces nativos por mezcla compleja de contaminantes químicos en el río Biobío, Chile Central. Aporte a los antecedentes biológicos necesarios en una norma secundaria de calidad ambiental	Ricardo Barra	Universidad de Concepción
Winfred Espejo	Biomagnificación de contaminantes persistentes y sus posibles efectos en la trama trófica de la península antártica	Ricardo Barra	Universidad de Concepción
Diana Cárdenas	Desarrollo de estrategias analíticas para el monitoreo de plaguicidas organoclorados, organofosforados y compuestos perfluorados en fuentes de aguas superficiales	Ricardo Barra	Universidad de Concepción
Enzo García	Multidisciplinary Environmental Approach to the Sustainable Management of Seawater Desalination Effluents	Ricardo Barra	Universidad de Concepción
Francisco Zambrano	Agricultural drought in Chile: from the assessment toward prediction using satellite data	Mario Lillo	Universidad de Concepción
Mathias Kuschel	Water use efficiency: Joint use of life cycle assessment and multiperiod optimization	Diego Rivera / Eduardo Holzapfel	Universidad de Concepción
Alejandro Pannunzio	Sustainable criteria for design and operation of drip irrigation in blueberries	Eduardo Holzapfel	Universidad de Buenos Aires
Camilo Souto	Multilayer Model to Determine Evapotranspiration in Orchards with Partial Wetting Area	Octavio Lagos	Universidad de Concepción
Hernán Aguilera	Estimación de la variabilidad espacial y temporal del estado hídrico del suelo en un huerto de uva de mesa (Vitis vinífera L. var. Thompson Seedless)	Octavio Lagos	Universidad de Concepción
Carlos González	Desarrollo de un modelo de estimación de radiación neta, en condiciones de alta resolución espacial y temporal	Octavio Lagos	Universidad de Concepción
Ilka Roose	Social Dynamics in Water Conflicts: Towards Social.Political Innovations in Urban Systems using the Example of Water Conflict in Petorca (Chile)	Alex Godoy	University of Duisburg-Essen

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Tania Sánchez	Valorization of saline wastewaters: a challenge for the obtainment of bioproducts	Anuska Mosquera-Corral / José Luis Campos	Universidad de Santiago de Compostela
Carla Duarte	Precipitation of heavy metals on mining wastewater through microbial induced carbonate precipitation (MICP) process	David Jeison	Universidad de La Frontera
Francisco Cabrera	Development of strategies for polyhidroxyalcanoate production in mixed microbial cultures by online control of oxygen and pH variations.	David Jeison	Universidad de La Frontera
Luis Pino	Modelación, simulación y validación experimental del tratamiento mediante membranas de nanofiltración de drenajes ácido mineros	Rodrigo Bórquez	Universidad de Concepción
Patricio Neumann	Evaluación del desempeño operacional y ambiental de la digestión anaerobia de lodos provenientes del tratamiento de aguas servidas incluyendo pre-tratamiento mediante ultrasonido e hidrólisis térmica	Gladys Vidal / Almudena Hospido	Universidad de Concepción
Jorge Cornejo	Identification and characterization of hybrids of Populus spp. associated with the tolerance of copper and cadmium as a biotechnological approach and phytoremediation mechanisms	Jaime Tapia / Gladys Vidal	Universidad de Talca
Thais González	Energy recovery from sewage treatment by integrating a microbial fuel cell into a constructed wetland	Gladys Vidal	Universidad de Concepción
María Venegas	Influence of advanced anaerobic digestion on the environmental quality of stabilized sludge	Gladys Vidal	Universidad de Concepción
Lihki Rubio	Una Contribución al Estudio de Métodos Numéricos Eficientes para Algunos Modelos Multi-Especies en una Dimensión	Raimund Bürger	Universidad de Concepción
Camilo Mejías	Advanced Numerical Techniques for Convection-Diffusion-Reaction Problems Arising in Secondary Settling Tanks and Related Applications	Raimund Bürger	Universidad de Concepción
Elvis Gavilán	Modelamiento Matemático y Simulación Numérica de Modelos Espacio-Temporal de Enfermedades Transmitidas por Vectores	Raimund Bürger	Universidad de Concepción
Víctor Osores	Sistema Shallow Water Multicapas para Sedimentación Polidispersa: Teoría, Análisis Numérico y Aplicaciones	Raimund Bürger	Universidad de Concepción
Daniel Inzunza	Métodos Implicitos-Explicitos para Problemas de Convección-Difusión-Reacción no Lineales y no Locales	Raimund Bürger	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Rafael Ordoñez	Modelling, analysis and numerical solution of conservation laws with discontinuous and non-local flux arising in water resources	Raimund Bürger	Universidad de Concepción
Alonso Pereira	Estudio de sistemas de control para espesadores	Fernando Betancourt	Universidad de Concepción
María Gutiérrez	Modelación fenomenológica de espesamiento en pasta	Fernando Betancourt	Universidad de Concepción
Diana Celi	Estudio de nuevas tecnologías en los procesos de recuperación de agua para relaves de cobre	Fernando Betancourt / Christian Goñi	Universidad de Concepción
2018			
Luis Pino	Modelación, simulación y validación experimental del tratamiento mediante membranas de nanofiltración de drenajes ácido mineros	Rodrigo Bórquez	Universidad de Concepción
Enrique Wagemann	Atomistic study of flow enhancement in silicon and titanium dioxide nanopores induced by graphene coatings	Harvey Zambrano	Universidad de Concepción
Luver Echeverry	Molecular dynamics simulation of spodumene-water interface in sltwater	Pedro Toledo	Universidad de Concepción
Katherine Markovich	Water resource vulnerability to climate change in a permeable alpine system	Graham Fogg / Reed Maxwell / José Luis Arumí	University of California Davis
Nancy Arriagada	Efectos de los usos de suelos y geoquímica de cuencas del centro sur de chile sobre las fuentes del nitrógeno y carbono: implicancias de los impactos sobre los humedales costeros	José Luis Arumi	Universidad de Concepción
Julieth Galdamez	Indicadores de sustentabilidad sistémica (Thrivability) para la gestión de los recursos hídricos en las cuencas del Almanzora (España) e Itata (Chile)	José Luis Arumi	Universidad de Concepción
Thais González	Energy recovery from sewage treatment by integrating a microbial fuel cell into a constructed wetland	Gladys Vidal	Universidad de Concepción
María Venegas	Influence of advanced anaerobic digestion on the environmental quality of stabilized sludge	Gladys Vidal	Universidad de Concepción
Andiranel Banegas	Importancia de los ríos intermitentes ante el cambio climático: análisis de su resiliencia en el Río Lonquén	Ricardo Figueroa	Universidad de Concepción

DOCTORATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Katherine Brintrup	Control hidrológico sobre la dinámica del nitrógeno biodisponible en un río intermitente de la cuenca del Itata, región del Biobío	Ricardo Figueroa	Universidad de Concepción
Patricio Neumann	Evaluación del desempeño operacional y ambiental de la digestión anaerobia de lodos provenientes del tratamiento de aguas servidas incluyendo pre-tratamiento mediante ultrasonido e hidrólisis térmica	Gladys Vidal / Almudena Hospido	Universidad de Concepción
Andrés Ramírez	Flotación de minerales Cu-Mo en agua de mar usando dispersantes y acondicionamiento de burbujas	Leopoldo Gutierrez	Universidad de Concepción
Rodrigo Yepsen	Comportamiento de la enargita en la flotación utilizando agua de mar	Leopoldo Gutierrez	Universidad de Concepción
Diana Celi	Estudio de nuevas tecnologías en los procesos de recuperación de agua para relaves de cobre	Fernando Betancourt	Universidad de Concepción
Alonso Pereira	Estudio de sistemas de control para espesadores	Fernando Betancourt	Universidad de Concepción
Elvis Gavilán	Solución Numérica de Modelos Epidemiológicos Espacio-Temporales.	Raimund Bürger	Universidad de Concepción
Camilo Mejías	A contribution to the numerical simulation of settling tanks and related applications.	Raimund Bürger	Universidad de Concepción
Victor Osores	Sistema Shallow Water Multicapas para Sedimentación Polidispersa: Teoría, Análisis Numérico y Aplicaciones.	Raimund Bürger	Universidad de Concepción
Daniel Inzunza	Métodos Implicitos-Explicitos pa-ra Problemas de Convección-Difusión-Reacción no Lineales y no Locales.	Raimund Bürger	Universidad de Concepción
Rafael Ordoñez	Modelling, analysis and numerical solution of conservation laws with discontinuous and non-local flux arising in water resources.	Raimund Bürger	Universidad de Concepción
Paul E. Méndez	Numerical methods for the simulation of viscous flow and transport in porous media.	Raimund Bürger	Universidad de Concepción
Catalina Vargas	Modificación Superficial de Membrana de Nanofiltración para incrementar su Productividad en la Desalinización de Agua de Mar.	Rodrigo Bórquez	Universidad de Concepción
Camilo Souto	Modelización de la transpiración de cultivo y evaporación de suelo para cultivos de cobertura parcial y suelos parcialmente humedecidos.	Octavio Lagos	Universidad de Concepción
Gonzalo Quezada	Dinámica molecular de interfases entre óxidos minerales y agua en presencia de electrolitos y polielectrolitos a alta concentración de sal y en un rango de pH	Pedro Toledo	Universidad de Concepción

Information Updated Until November 2018

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
2014			
Michael Araneda	Biofloculación en la sedimentación primaria como estrategia para aumentar la producción de biogás en plantas de tratamiento de aguas servidas	David Jeison	Universidad de La Frontera
María Elisa Neubauer	Organic matter from kraft mill process valorization: Mitigation of the global change	Gladys Vidal	Universidad de Concepción
Gustavo Chaparro	Sistema de Intercambio Difusivo Para el Tratamiento de Drenajes Ácidos Mineros con Elevadas Concentraciones de Cobre	Alex Schwarz	Universidad de Concepción
Gonzalo Valenzuela	Efecto de la variabilidad espacial en la vulnerabilidad sísmica de tranques de relave	Gonzalo Montalva	Universidad de Concepción
Álvaro Paredes	Depresante de pirita en agua de mar	Pedro Toledo / Sergio Acuña / Leopoldo Gutiérrez	Universidad de Concepción
Cristian Romero	Mecanismos de floculación	Pedro Toledo	Universidad de Concepción
Francisco Flores	Estación de prueba de anti-incrustantes para calcita y yeso	Pedro Toledo	Universidad de Concepción
Julio Mendoza	Water management at farm scale through a spatially distributed programming service	Eduardo Holzapfel	Universidad de Concepción
Walter Valdivia	Clasificación de suelos para diseño de sistemas de riego	Eduardo Holzapfel	Universidad de Concepción
Francisco Lecaros	Effect of water application in apple	Eduardo Holzapfel / Jorge Jara	Universidad de Concepción
Waldo Lama	Riego deficitario controlado en kiwi	Octavio Lagos	Universidad de Concepción
Edgard Faúndez	Ultrafloculación en reactores cilíndricos	Fernando Concha	Universidad de Concepción
Marco Salazar	Estudio experimental de equipos de ultrafloculación	Fernando Concha	Universidad de Concepción

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Carolina Morales	Determinación del comportamiento del flujo base y su relación con variables de estado hidrológicas en la cuenca del Río Diguillín, Región del Biobío	José Luis Arumí	Universidad de Concepción
María José Pérez	Análisis de Ciclo de Vida en la Industria de Vinos Premium en Chile	Alex Godoy	Universidad del Desarrollo
Tania Mundaca	Elaboración de un modelo de enfoque sistémico para analizar los conflictos socioambientales de las cuencas del Maule e Itata	Alex Godoy	Universidad del Desarrollo
Mariela Guajardo	Estudio de Factibilidad Técnico-Económica de una red de Monitoreo Ambiental, Autónoma y a bajo costo, aplicada en Sistema Hídricos de Chile	Camilo Rodríguez / Alex Godoy	Universidad del Desarrollo
Victoria López	Sistema de Gestión Integrada para el Club Hípico de Concepción	Ricardo Figueroa	Universidad de Concepción
Nicole Alavania	Propuesta de un Sistema de Gestión Integrada a considerar en una planta piloto de Producción de Huevos	Ricardo Figueroa	Universidad de Concepción
2015			
Michael Araneda	Bioflocculación en la sedimentación primaria como estrategia para aumentar la producción de biogás en plantas de tratamiento de aguas servidas	David Jeison	Universidad de La Frontera
Fernanda Pinto	Efecto de la concentración de metales traza (Fe, Co, Ni y Ba), sobre la velocidad de producción de metano en la digestión anaerobia de muestras de alperujo fresco y alperujo pretratado	David Jeison	Universidad de La Frontera
Camilo Segura	Dynamics of microalgae inhibition by ammonia	David Jeison	Universidad de La Frontera
Juan Carlos Ortega	Osmosis directa: una alternativa para la concentración de aguas residuales urbanas	David Jeison	Universidad de La Frontera

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Gustavo Chaparro	Sistema de Intercambio Difusivo Para el Tratamiento de Drenajes Ácidos Mineros con Elevadas Concentraciones de Cobre	Alex Schwarz	Universidad de Concepción
Jorge Roncagliolo	Evaluación del contenido de finos en la licuación de suelos chilenos	Gonzalo Montalva	Universidad de Concepción
Catalina Vargas	Tratamiento de aguas de drenaje ácido de minas empleando nanofiltración y osmosis directa	Rodrigo Bórquez / Alex Schwarz	Universidad de Concepción
Julio Mendoza	Water management at farm scale through a spatially distributed programming service	Eduardo Holzapfel	Universidad de Concepción
Francisco Lecaros	Effect of water application in apple	Eduardo Holzapfel / Jorge Jara	Universidad de Concepción
María Cristina Veloso	Efecto de la concentración, valencia de electrolitos y pH en el autoensamblaje del péptido difenilalanina	Sergio Acuña	Universidad del Biobío
Denisse Duhalde	Evaluación de la vulnerabilidad a la contaminación de un acuífero de roca volcánica, ubicado en la Cordillera de los Andes, en condición de escasez de datos. Caso de estudio, Valle del Renegado, Región del Biobío, Chile	José Luis Arumí	Universidad de Concepción
Camila Matta	Evaluación de la contribución de la recarga proveniente de zonas de media montaña al balance hídrico del sistema de aguas subterráneas de la cuenca del Punitaqui	José Luis Arumí	Universidad de Concepción
Daniel Páez	Caracterización de la relación escorrentía-almacenamiento subterráneo en cuencas del sistema hidrogeológico de Chiloé	José Luis Arumí	Universidad de Concepción
Katerina Wernekinck	Propuesta de manejo al problema de crecimiento de plantas acuáticas en canales de riego	José Luis Arumí / Roberto Urrutia	Universidad de Concepción
Luis Higueras	Análisis de los procesos hidrológicos en una Microcuenca del Secano Interior	José Luis Arumí	Universidad de Concepción

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Carla Cid	Pretratamiento de agua de Mar, alcance jurídico	Amaya Álvez	Universidad de Concepción
Kim Echeverría	La necesidad de una regulación especial sobre el proceso de desalinización en Chile	Verónica Delgado	Universidad de Concepción
2016			
Camilo Segura	Dynamics of microalgae inhibition by ammonia	David Jeison	Universidad de La Frontera
Michael Araneda	Biofloculación en la sedimentación primaria como estrategia para aumentar la producción de biogás en plantas de tratamiento de aguas servidas	David Jeison	Universidad de La Frontera
Fernanda Pinto	Efecto de la concentración de metales traza (Fe, Co, Ni y Ba), sobre la velocidad de producción de metano en la digestión anaerobia de muestras de alperujo fresco y alperujo pretratado	David Jeison	Universidad de La Frontera
Francisco Lecaros	Effect of water application in apple	Eduardo Holzapfel	Universidad de Concepción
Julio Mendoza	Water management at farm scale through a spatially distributed programming service	Mario Lillo	Universidad de Concepción
Karla Silva	Riego en Cítricos	Eduardo Holzapfel	Universidad de Recocavo de Bahia
Daniel Pérez	Simulación numérica de un hidrociclón utilizando dinámica de fluidos computacional	Pablo Cornejo	Universidad de Concepción
Viviana Gavilán	Optimization of reservoir management with the support of satellite images	Mario Lillo	Universidad de Concepción
Marco Del Rio	Estudio de la hidrodinámica en diseños preliminares de ultra floculadores mediante simulación numérica	Pablo Cornejo	Universidad de Concepción

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Daniel Páez	Caracterización de la relación escorrentía-almacenamiento subterráneo en cuencas del sistema hidrogeológico de Chiloé	José Luis Arumí	Universidad de Concepción
Katerina Wernekinck	Propuesta de manejo al problema de crecimiento de plantas acuáticas en canales de riego	José Luis Arumí / Roberto Urrutia	Universidad de Concepción
Prajna Kasargodu	Simulation of water availability and demand in the Laja-Diguillin river system with weap. Masters Thesis University of Leibniz Hannover, Germany.	Jorg Dietrich / José Luis Arumi	University of Leibniz Hannover
Vincent Vorgel	Field investigations about soil and sediment parameters and implications to improve an eco-hydrological model of the Itata catchment in Chile	Jorg Dietrich / José Luis Arumi	University of Leibniz Hannover
Kim Echeverría	La necesidad de una regulación especial sobre el proceso de desalinización en Chile	Verónica Delgado	Universidad de Concepción
Álvaro Paredes	Depresante de pirita en agua de mar	Pedro Toledo / Sergio Acuña / Leopoldo Gutiérrez	Universidad de Concepción
Cristian Romero	Mecanismos de floculación	Pedro Toledo	Universidad de Concepción
2017			
Francisco Flores	Estación de prueba de anti-incrustantes para calcita y yeso	Pedro Toledo / Jorge Saavedra	Universidad de Concepción
Álvaro Paredes	Depresante de pirita en agua de mar	Pedro Toledo / Sergio Acuña / Leopoldo Gutiérrez	Universidad de Concepción
Cristian Romero	Mecanismos de floculación	Pedro Toledo	Universidad de Concepción
Alejandro Álvarez	Floculación selectiva de molibdenita fina mediante el uso de óxido de polietileno	Leopoldo Gutiérrez	Universidad de Concepción

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
María Cristina Veloso	Efecto de la concentración, valencia de electrolitos y pH en el autoensamblaje del péptido difenilalanina	Sergio Acuña	Universidad del Biobío
Daniel Páez	Caracterización de la relación escorrentía-almacenamiento subterráneo en cuencas del sistema hidrogeológico de Chiloé	José Luis Arumí	Universidad de Concepción
Marcelo Díaz	Aplicación de Fotogrametría y Termografía como herramientas para la gestión de un tramo de río	José Luis Arumí	Universidad de Concepción
Alejandro Baquedano	Diagnóstico de las descargas de aguas provenientes de Enap refinería Biobío para el uso de tecnología no convencionales	Ricardo Figueroa	Universidad de Concepción
Sebastián Marín	Modelo de gestión para el Uso de tecnología no convencional: wetland artificial, para el tratamiento y mejoramiento de la descarga de aguas provenientes de ENAP refinería Biobío.	Ricardo Figueroa	Universidad de Concepción
Julia Benítez	Diagnóstico para el desarrollo e implementación de un centro de educación sustentable para Santa Juana.	Ricardo Figueroa	Universidad de Concepción
Elizabeth Mella	Modelo de gestión para la implementación de un centro de educación sustentable Santa Juana	Ricardo Figueroa	Universidad de Concepción
Carlos Oliva	Propuesta de sistema de gestión de emergencias y respuesta ante incidentes en CMPC Pulp Planta Laja	Ricardo Figueroa	Universidad de Concepción
Kim Echeverría	La necesidad de una regulación especial sobre el proceso de desalinización en Chile	Verónica Delgado	Universidad de Concepción
Viviana Gavilán	Optimization of reservoir management with the support of satellite images	Eduardo Holzapfel / Mario Lillo	Universidad de Concepción

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
María Soledad Aguirre	Estimation of the evapotranspiration and surface energy fluxes in sugar beet using SEB-PV model and satellite images	Octavio Lagos	Universidad de Concepción
Isabel Erpel	Crop Yield, Risks and Climate Change in Chile	Alex Godoy	Universidad del Desarrollo
Fernanda Sánchez	Water Gini Index Methodology	Alex Godoy	Universidad del Desarrollo
Andrés Pérez	Evaporación en cuerpos de agua	Octavio Lagos	Universidad de Concepción
Cristopher Da Silva	Influence of the concentration of micronutrients in the anaerobic digestion of sludge	Lorna Guerrero / Henrik Hansen / José Luis Campos	Universidad Técnica Federico Santa María
Héctor Zúñiga	Study of the delay in the response of the activity of a microbial population to changes in operating conditions	David Jeison / Andrés Donoso	Pontificia Universidad Católica de Valparaíso
Javier Andalaf	Evaluation of the fouling in the nanofiltration of mining acid drainage	Alex Schwarz / Rodrigo Bórquez	Universidad de Concepción
Marcela Levio	Packed bed reactor with organic biomixture to treat wastewater contaminated with pesticides	María Cristina Diez	Universidad de La Frontera
Pamela Donoso	Biochemical and molecular characterization of pesticides degrading bacteria	María Cristina Diez	Universidad de La Frontera
Edward Hermosilla	A combined biological pretreatment of wheat straw using native wood-rotting fungi for improving its biodegradability	María Cristina Diez	Universidad de La Frontera
Daniel Pérez	Simulación numérica de un hidrociclón utilizando dinámica de fluidos computacional	Pablo Cornejo	Universidad de Concepción
Marco Del Río	Estudio de la hidrodinámica en diseños preliminares de ultra floculadores mediante simulación numérica	Pablo Cornejo	Universidad de Concepción

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
2018			
Francisco Flores	Inhibición de incrustación de sales insolubles mediante agentes anti-incrustantes	Pedro Toledo	Universidad de Concepción
Alejandro Álvarez	Floculación selectiva de molibdenita fina mediante el uso de óxido de polietileno	Leopoldo Gutiérrez	Universidad de Concepción
Gonzalo Dinamarca	Efecto de dispersantes en la floculación/sedimentación de relaves	Leopoldo Gutiérrez	Universidad de Concepción
Karien García	Mejoramiento de la calidad del agua para la agricultura en la zona centro sur mediante técnicas costo-efectiva	Pedro Toledo / José Luis Arumí	Universidad de Concepción
Juan Daza	Influencia de la distribución granulométrica sobre el roping en hidrociclones	Pablo Cornejo	Universidad de Concepción
Alejandro Baquedano	Diagnóstico de las descargas de aguas provenientes de Enap refinería Biobío para el uso de tecnología no convencionales	Ricardo Figueroa	Universidad de Concepción
Sebastián Marín	Modelo de gestión para el Uso de tecnología no convencional: wetland artificial, para el tratamiento y mejoramiento de la descarga de aguas provenientes de Enap refinería Biobío	Ricardo Figueroa	Universidad de Concepción
Julia Benítez	Diagnóstico para el desarrollo e implementación de un centro de educación sustentable para Santa Juana, VIII Región	Ricardo Figueroa	Universidad de Concepción
Carlos Oliva	Propuesta de sistema de gestión de emergencias y respuesta ante incidentes en Cmpc Pulp Planta Laja	Ricardo Figueroa	Universidad de Concepción
Marco Del Río	Estudio de la Hidrodinámica en Diseños Preliminares de ultra flocuradores mediante simulación numérica.	Pablo Cornejo	Universidad de Concepción

MASTER STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Yasmin Hashemi	Impact of climate change on irrigation and hydropower. A nexus study in the Laja River basin, Chile, using the SWAT agro-hydrological simulation model.	José Luis Arumi	Universidad de Concepción
Meghna Vipul	Impact of Climate Change on Irrigation and Hydropower. A Nexus Study in the Laja River Basin, Chile, using the WEAP Water Resources Simulation Model	José Luis Arumi	Universidad de Concepción
Andrés Pérez	Evaluación de modelos para estimar evaporación en Cuerpos de agua	Octavio Lagos	Universidad de Concepción
María Cristina Veloso	Efecto de la concentración, valencia de electrolitos y pH en el autoensamblaje del péptido difenilalanina	Sergio Acuña	Universidad del Biobío

Information Updated Until November 2018

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
2014			
Gabriela Morales	Evaluation of the stability of an activated sludge system by physicochemical and biological indicators	Gladys Vidal	Universidad de Concepción
Silvana Pesante	Application of ozone in origin biosolids reduction in activated sludge plant for wastewater treatment	Gladys Vidal	Universidad de Concepción
Loreto Acevedo	Disinfection processes (chlorine and UV) for a decentralized wastewater treatment (constructed wetlands)	Carolina Baeza / Gladys Vidal	Universidad de Concepción
Paola Urquijo	Mejoramiento de sistema de tratamiento de efluentes de celulosa Kraft mediante la incorporación de una tecnología terciaria para la eliminación de materia orgánica recalcitrante	Gladys Vidal	Universidad de Concepción
Laura López	Eliminación de nitrógeno mediante humedales construidos de flujo vertical	Gladys Vidal	Universidad de Concepción
Camila Bustos	Tratamiento de drenaje ácido utilizando nanofiltración	Alex Schwarz	Universidad de Concepción
Karen Ambiado	Tratamiento de aguas salobres ácidas empleando osmosis inversa	Alex Schwarz / Rodrigo Bórquez	Universidad de Concepción
Dalton Anziani	Instalación experimental de una columna para la caracterización de la consolidación en relaves de cobre	Gonzalo Montalva	Universidad de Concepción
Gustavo Chaparro	Desarrollo de un biorreactor de sulfato con sistema de intercambio difusivo a escala banco	Alex Schwarz	Universidad de Concepción
Nicolás Yung	Efecto de sales en mojabilidad de sólidos	Pedro Toledo / Fernando Concha	Universidad de Concepción
Nathaly Yañez	Tensión superficial de espumantes en aguas salinas: Efecto de electrolitos	Pedro Toledo / Jorge Saavedra	Universidad de Concepción
Viviana Contreras	Efecto de sales constructoras y destructoras de estructuras del agua sobre la mojabilidad de superficies de sílice	Pedro Toledo / Jorge Saavedra	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Pedro Lledó	Evaluación de un sistema de barras interceldas en refinería de Codelco División Ventanas	Pedro Toledo	Universidad de Concepción
Sebastián Lara	Reología de un sistema particulado: Impacto del pH en presencia de floculante	Pedro Toledo	Universidad de Concepción
Natalia Campos	Lixiviación de cobre a partir de la ganga del composite de mineral PV-M103050 en función de la acidez	Pedro Toledo	Universidad de Concepción
Francisco Flores	Estudio de incrustación de sales en superficies sólidas: Diseño e implementación de sistema experimental	Pedro Toledo	Universidad de Concepción
Cristian Romero	Efecto de tipos de sales sobre el comportamiento reológico de suspensiones floculadas de sílice en función del pH	Pedro Toledo / Fernando Concha	Universidad de Concepción
Jerónimo Ferrer	Mecanismos de flujo y transporte de soluciones salinas en rocas porosas	Pedro Toledo	Universidad de Concepción
Javiera Torrijos	Efecto de sales de agua de mar sobre la mojabilidad de sólidos particulados	Pedro Toledo	Universidad de Concepción
Cristian Benaprés	Comparación de la flotabilidad de pirita en agua fresca y agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
Cristina Oblitas	Depresión de la flotabilidad de pirita a través del uso de polímeros	Leopoldo Gutiérrez	Universidad de Concepción
Mauricio Keller	Efecto de iones presentes en agua de mar en la flotabilidad de pirita	Leopoldo Gutiérrez	Universidad de Concepción
Jonathan Ortega	Estudio de la flotabilidad de pirita en agua de mar utilizando distintos tipos de colectores	Leopoldo Gutiérrez	Universidad de Concepción
Niela Araneda	Aplicación de los modelos de calidad de agua ELCOM-CAEDYM para la elaboración de un plan de restauración de la laguna Tres Pascualas, comuna de Concepción	Roberto Urrutia	Universidad de Concepción
Paulo Alarcón	Evaluación de los efectos de las plantaciones forestales sobre los caudales en microcuencas de la Cordillera de Nahuelbuta	Roberto Urrutia	Universidad de Concepción
Gonzalo Rebolledo	Determinación de nutrientes en microcuencas de la cordillera de Nahuelbuta con plantaciones forestales y bosque nativo	Roberto Urrutia	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Patricio Muñoz	Generación de un modelo distribuido para la modelación de la acumulación y derretimiento del manto nival en la cuenca alta del río Malleco	Alejandra Stehr	Universidad de Concepción
Natalia Sepúlveda	Low frequency variability of the 0°C isotherm (freezing, Ho) level in Chile	Aldo Montecinos	Universidad de Concepción
David Mellado	Desarrollo de un Gestor de Descargas Automática de Imágenes de Satélite	Mario Lillo	Universidad de Concepción
Sebastián Lucares	Diseño de una Base de Datos como Herramienta de Apoyo al Manejo Productivo Agrícola en el Predio Los Abedules	Mario Lillo / Octavio Lagos	Universidad de Concepción
Marcelo Soto	Diseño de una Base de Datos con Características Espaciales, para Apoyar el Manejo Agrícola en el Predio Santa Mónica	Mario Lillo / Octavio Lagos	Universidad de Concepción
Jonathan Labrin	Implementation and evaluation of a methodology for automatic co-registration of multimodal satellite images	Mario Lillo	Universidad de Concepción
Viviana Gavilán	Identificación semiautomática de pivotes centrales mediante imágenes satelitales	Octavio Lagos	Universidad de Concepción
Rodolfo Bascur	Modelamiento del riego de precisión en Pivotes Centrales	Octavio Lagos	Universidad de Concepción
Andrés Agurto	Riego de precisión en pivotes centrales	Octavio Lagos	Universidad de Concepción
Gastón Rodríguez	Estimación de evaporación en cuerpos de agua	Octavio Lagos	Universidad de Concepción
Camilo Souto	Fertirriego de Precisión	Octavio Lagos	Universidad de Concepción
Francisco Faúndez	Evapotranspiración en Arándanos	Octavio Lagos	Universidad de Concepción
Rodrigo Carvajal	Numerical Simulation of Sedimentation Processes Using Stochastic Differential Equations	Raimund Bürger / Carlos Mora	Universidad de Concepción
Camilo Mejías	Identification of the flux density function by measurement of settling curves and numerical simulation of continuous sedimentation	Raimund Bürger / Fernando Betancourt	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Víctor Osores	Mathematical Modelling and Numerical Simulation of a Multilayer Shallow Water System with Polydisperse Sedimentation in Two Horizontal Dinemnsions	Raimund Bürger	Universidad de Concepción
Julio Careaga	Modelamiento Matemático y Simulación Numérica de Sedimentadores con Área Variable en Planta de Tratamiento de Aguas Servidas	Raimund Bürger	Universidad de Concepción
Manuel Silva	Technical Evaluation of Ultra-flocculator reactors by using CFD	Fernando Betancourt / Fernando Concha	Universidad de Concepción
Fernando Matus	Experimental analysis of reactives used for thickening of copper tailings	Fernando Betancourt	Universidad de Concepción
Camila Matta	Balance hídrico de la Laguna Santa Elena	José Luis Arumí	Universidad de Concepción
Álvaro Conejeros	Estudio conceptual de las filtraciones del Lago Laja	José Luis Arumí	Universidad de Concepción
Alejandra Lavados	Evaluación de la interacción de aguas superficiales y subterráneas en el estero Renegado	José Luis Arumí	Universidad de Concepción
Eduardo Lados	Monitoreo hidrológico en cuencas costeras: relaciones precipitación escorrentía y estimación de recarga	Diego Rivera	Universidad de Concepción
María Paz Rojas	Tendencias en precipitación y Caudal de la cuenca del Itata.	Diego Rivera	Universidad de Concepción
Danissa Valdivia	Evaluación preliminar del grado de contaminación de un sitio con residuos de la actividad forestal	Ricardo Barra	Universidad de Concepción
Gabriel Abogasl	Regulación Borde Costero	Verónica Delgado	Universidad de Concepción
Jessica Cabezas	Regulación del Cálculo Caudal mínimo ecológico	Verónica Delgado	Universidad de Concepción
Leopoldo Carrasco	Regulación para un sistema integrado de cuencas hidrográficas	Verónica Delgado	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Alejandra Gálvez	Aspectos normativos de la consulta indígena en Chile	Verónica Delgado	Universidad de Concepción
María Ignacia Sandoval	Problems in the rules for granting water rights	Verónica Delgado	Universidad de Concepción
Fernando Cortez	Institutional groundwater	Verónica Delgado	Universidad de Concepción
Juan Pablo Asenjo	Bases para la regulación del mecanismo de Bancos de Compensación de biodiversidad	Verónica Delgado	Universidad de Concepción
Javier Peñaloza	Challenging the Chilean Water Model under the human rights threshold	Amaya Álvez	Universidad de Concepción
Yaritza Burgos	Comunidad de MIB asociados a vegetación nativa y exótica en ríos de cabecera en la zona Centro-Sur de Chile	Ricardo Figueroa	Universidad de Concepción
Andrés Altamirano	Comportamientos de Oxitetraciclina en purines producidos por el bovino en una lechería. Habilitación profesional Ingeniería Ambiental (en desarrollo).	Ricardo Figueroa	Universidad de Concepción
Rossana Fuentes	Ácaros de aguas continentales de la región del Biobío	Ricardo Figueroa	Universidad de Concepción
José Muñoz	Implementación de la Norma ISO 6878:2004 E, para la determinación de Fosforo Total en aguas residuales	Ricardo Figueroa	Universidad de Concepción
2015			
Benjamín Luza	Start up and operation of bioflocculation SBR	David Jeison	Universidad de La Frontera
Madeleine Aguilera	Factibilidad técnica de concentración de jugo de arándanos por osmosis directa	David Jeison	Universidad de La Frontera
Cristóbal González	Producción de PHA con cultivos microbianos mixtos	David Jeison	Universidad de La Frontera
Álvaro Torres	Anaerobic digestion as a tool for improving energetic yield of microalgae based biodiesel	David Jeison	Universidad de La Frontera

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Nicolás Millahueque	Efecto del caudal de agua contaminada con plaguicidas en la actividad biológica de un sistema de biopurificación	María Cristina Diez	Universidad de La Frontera
Bárbara Leiva	Efecto de la reaplicación de una mezcla de plaguicidas en un sistema de biopurificación a escala de campo	María Cristina Diez	Universidad de La Frontera
Paola Urquijo	Mejoramiento de sistema de tratamiento de efluentes de celulosa Kraft mediante la incorporación de una tecnología terciaria para la eliminación de materia orgánica recalcitrante	Gladys Vidal	Universidad de Concepción
Laura López	Eliminación de nitrógeno mediante humedales construidos de flujo vertical	Gladys Vidal	Universidad de Concepción
Laura Hernández	Evaluación de la toxicidad de efluentes de celulosa kraft expuestos a derrames de licor negro	Gladys Vidal	Universidad de Concepción
Mario Sepúlveda	Producción de metano en el tratamiento de aguas servidas por humedales de flujo horizontal subsuperficial utilizando Phragmites australis y Schoenoplectus californicus: composición de las comunidades microbianas	Gladys Vidal	Universidad de Concepción
Viviana Burgos	Evaluación de humedales construidos plantados con especies ornamentales en la eliminación de materia orgánica, nutrientes y contaminantes patógenos de aguas servidas de origen rural	Gladys Vidal	Universidad de Concepción
Guido Carrasco	Reuso de efluente de celulosa kraft en la producción aeropónica de lilium asiático como planta ornamental	Gladys Vidal	Universidad de Concepción
Ana María Leiva	Evaluación del proceso de Nitrificación de Aguas Servidas mediante Humedales Construidos de Flujo Vertical Subsuperficial	Gladys Vidal	Universidad de Concepción
Camila Bustos	Tratamiento de Drenaje Ácido utilizando Nanofiltración	Rodrigo Bórquez / Alex Schwarz	Universidad de Concepción
Karen Ambiado	Tratamiento de aguas salobres ácidas empleando osmosis inversa	Rodrigo Bórquez / Alex Schwarz	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Dalton Anziani	Instalación experimental de una columna para la caracterización de la consolidación en relaves de cobre	Gonzalo Montalva	Universidad de Concepción
Eduardo Labarca	Recuperación de cobre y agua a partir de drenajes ácidos de minas empleando nanofiltración y extracción por solventes	Rodrigo Bórquez / Alex Schwarz	Universidad de Concepción
Camilo Souto	Análisis de sistema de tasa variable de riego como herramienta para fertirrigación en pivotes centrales	Octavio Lagos	Universidad de Concepción
Viviana Gavilán	Identificación semiautomática de pivotes centrales mediante imágenes satelitales	Mario Lillo	Universidad de Concepción
Jonathan Labrin	Implementation and evaluation of a methodology for automatic co-registration of multimodal satellite images	Mario Lillo	Universidad de Concepción
Bárbara Flores	Relationship between the state of El Yali wetland and climate variability	Diego Rivera	Universidad de Concepción
Jonathan Venegas	Relationship between flow and water rights of river boards	Diego Rivera	Universidad de Concepción
Claudia Escalona	Modelo para diseño de riego por goteo	Eduardo Holzapfel / Diego Rivera	Universidad de Concepción
Grace Rivera	Study of the effect of the flocculants on the consolidation of copper tailings using Seditest equipment	Fernando Betancourt	Universidad de Concepción
Fernando Matus	Experimental analysis of reactives used for thickening of copper tailings	Fernando Betancourt	Universidad de Concepción
Joshua Parra	Tailings sedimentation study using Sedirack online equipment	Fernando Betancourt	Universidad de Concepción
Rodrigo Carvajal	Numerical Simulation of Sedimentation Processes Using Stochastic Differential Equations	Raimund Bürger / Carlos Mora	Universidad de Concepción
Camilo Mejías	Identification of the flux density function by measurement of settling curves and numerical simulation of continuous sedimentation	Raimund Bürger / Fernando Betancourt	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Víctor Osores	Mathematical Modelling and Numerical Simulation of a Multilayer Shallow Water System with Polydisperse Sedimentation in Two Horizontal Dinemnsions	Raimund Bürger	Universidad de Concepción
Julio Careaga	Modelamiento Matemático y Simulación Numérica de Sedimentadores con Área Variable en Planta de Tratamiento de Aguas Servidas	Raimund Bürger	Universidad de Concepción
Darío Sandoval	Aproximación al comportamiento reológico de un fluido polidisperso mediante dinámica de fluidos computacional	Pablo Cornejo / Christian Goñi	Universidad de Concepción
Oscar García	No-estacionalidades y efectos no-locales en modelación de turbulencia	Pablo Cornejo	Universidad de Concepción
Daniel Pérez	Simulación numérica de un hidrociclón empleando un modelo CFD-DPM	Pablo Cornejo / Cristian Rodríguez	Universidad de Concepción
Francisco Alarcón	Cinética de floculación de alúmina	Pedro Toledo	Universidad de Concepción
Nicolás Yung	Efecto de sales en mojabilidad de sólidos	Pedro Toledo	Universidad de Concepción
Viviana Contreras	Efecto de sales constructoras y destructoras de estructuras del agua sobre la mojabilidad de superficies de sílice	Pedro Toledo	Universidad de Concepción
Millaray San Martín	Viscoelastic behavior of clay suspensions	Pedro Toledo	Universidad de Concepción
Nicolás Rojas	Hidrología de Wadis	José Vargas	Universidad de Concepción
Francisco Ortiz	Estudio de la evolución temporal de las crecidas en cuencas de la VII, VIII y IX Región	José Vargas	Universidad de Concepción
Pablo Vidal	Análisis de la precipitación en el Norte Grande de Chile, para determinar posibles zonas propensas a Wadis	José Vargas	Universidad de Concepción
Yoshihiro Kawaguchi	Análisis comparativo de caudales máximos estimados a través de series históricas de caudales. Aplicación zona centro-sur de Chile	José Vargas	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Claudio Cortés	Efecto de arcillas en la flotabilidad de calcopirita en agua convencional y agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
Gustavo Gutiérrez	Evaluación del recubrimiento de burbujas por arcillas en el proceso de flotación de calcopirita en agua convencional y agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
Gastón Avilés	Estudio del efecto de las arcillas en la flotación de sub-productos de los minerales de cobre	Leopoldo Gutiérrez	Universidad de Concepción
Gonzalo Dinamarca	Determinación de espumante óptimo Cytec para 5 tipos de minerales de distintas características	Leopoldo Gutiérrez	Universidad de Concepción
Luis Monge	Evaluación de reactivos alternativos al NaSH en la flotación selectiva Cu-Mo	Leopoldo Gutiérrez	Universidad de Concepción
Carlos Muñoz	Desarrollo de un canal de ensayo para evaluar la interacción entre aguas superficiales y subterráneas	José Luis Arumí	Universidad de Concepción
Álvaro Conejeros	Estudio conceptual de las filtraciones del Lago Laja	José Luis Arumí	Universidad de Concepción
Nicolás Vidal	La extracción ilegal del recurso hídrico en Chile	Verónica Delgado	Universidad de Concepción
Cristina Benítez	Agua de mar cruda o sin tratamiento	Amaya Álvez	Universidad de Concepción
Antonia Alfaro	La desalación de agua de mar como alternativa para el consumo humano	Amaya Álvez	Universidad de Concepción
Andrea Catalán	Desafíos jurídicos del Plan Regional de Ordenamiento Territorial en Chile	Verónica Delgado	Universidad de Concepción
Julia Saavedra	Análisis biogeográfico comparativo Zona Norte y Mediterránea, mediante macroinvertebrados bentónicos	Ricardo Figueroa	Universidad de Concepción
Manuel Beltran	Estudio de comunidades zooplantonicas de lagos urbanos	Ricardo Figueroa	Universidad de Concepción
2016			
Sebastián Sepúlveda	Bioprecipitación de metales pesados en efluentes mineros usando precipitación de calcita inducida microbiológicamente (MICP)	David Jeison	Universidad de La Frontera

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Andrés Huirilef	Evaluación de condiciones hidrodinámicas en el proceso de recuperación de agua de relaves mineros por osmosis directa	Juan Carlos Ortega	Universidad Católica de Temuco
Ignacio Castillo	Evaluación técnico-económica de la escalabilidad de un proceso de ósmosis directa para la recuperación de aguas de relaves mineros	Juan Carlos Ortega	Universidad Católica de Temuco
Madeleine Aguilera	Factibilidad técnica de concentración de jugo de arándanos por osmosis directa	David Jeison	Universidad de La Frontera
Benjamín Luza	Start up and operation of bioflocculation SBR	David Jeison	Universidad de La Frontera
Ana María Leiva	Evaluación del proceso de Nitrificación de Aguas Servidas mediante Humedales Construidos de Flujo Vertical Subsuperficial	Gladys Vidal	Universidad de Concepción
Mario Sepúlveda	Producción de metano en el tratamiento de aguas servidas por humedales de flujo horizontal subsuperficial utilizando Phragmites australis y Schoenoplectus californicus: composición de las comunidades microbianas	Gladys Vidal	Universidad de Concepción
Ariel Rivas	Determinación del costo exergético del tratamiento de aguas servidas del humedal construido de Hualqui	Gladys Vidal	Universidad de Concepción
Gloria Gómez	Obtención de biogás a partir de materia orgánica contenida en efluentes de celulosa kraft mediante un consorcio metanogénico en un reactor UASB	Gladys Vidal	Universidad de Concepción
Pilar Rivera	Reutilización de las aguas residuales en el riego o en el propio proceso de fabricación del aceite de oliva	Gladys Vidal	Universidad Pablo de Olavide
Leonardo Peña	Transformation of organic matter through constructed wetlands coupled to microbial fuel cells	Gladys Vidal	Universidad de Concepción
Romina Nuñez	Evaluation of constructed wetlands under a polyculture regime and monoculture of ornamental plants for wastewater treatment	Gladys Vidal	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Carol Burgos	Identification and Evaluation of Toxicity (SIT) of acid mine drainage, through water quality bioindicators	Gladys Vidal	Universidad de Concepción
Adrián Albarrán	Evaluation of the potential reuse of wastewater in agriculture, treated by activated sludge and wetlands built under different disinfection processes	Gladys Vidal	Universidad de Concepción
Marcela Levio	Operación de un reactor de lecho empacado con biomezcla para la remoción de atrazina	María Cristina Diez	Universidad de La Frontera
Bárbara Ravena	Evaluación de biomezclas de un sistema de biopurificación para el tratamiento de plaguicidas	María Cristina Diez	Universidad de La Frontera
Daniela Segura	Comparative analysis of the perception of the adult population of the communities of Hualqui and San Pedro de Atacama regarding the reuse of treated wastewater	Gladys Vidal	Universidad de Concepción
Felipe Barriga	Influence of a sequential pre-treatment on methane production and microbiological activity during the anaerobic digestion of sanitary sludge	Gladys Vidal	Universidad de Concepción
Javier Cartes	Alternativas de gestión energética en la industria sanitaria y su impacto ambiental	Gladys Vidal	Universidad de Concepción
Javier Andalaft	Control del ensuciamiento durante la nanofiltración de drenaje ácido	Alex Schwarz / Rodrigo Bórquez	Universidad de Concepción
José Suárez	Biorreactor para tratamiento de DAM y recuperación de metales	Alex Schwarz / José Vargas	Universidad de Concepción
Mauricio Montalva	Electrodiálisis de Drenaje Ácido	Alex Schwarz / Rodrigo Bórquez	Universidad de Concepción
Alejandra Morales	Estimación de demanda de agua en áreas verdes urbanas.	Diego Rivera	Universidad de Concepción
Andrés Pérez	Evaporación en el Lago Laja	Octavio Lagos / Diego Rivera	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Camila Palma	Uso eficiente del agua en la agricultura	Christian Goñi	Universidad de Concepción
Grace Rivera	Study of the effect of the flocculants on the consolidation of copper tailings using Seditest equipment	Fernando Betancourt	Universidad de Concepción
Julián Ravanal	Estudio de floculantes para sedimentación de relaves con alto contenido de arcillas	Fernando Betancourt	Universidad de Concepción
Sebastián Carrasco	Estudio de sedimentación de relaves de minera Caserones utilizando equipo Sedirack Online.	Fernando Betancourt	Universidad de Concepción
Daniela Aguayo	Modelo para el pronóstico de caudales mediante Minería de Datos	Mario Lillo	Universidad de Concepción
Nicolás Muñoz	Effect of number of laterals in the production of apples under drip irrigation	Eduardo Holzapfel	Universidad de Concepción
Jonathan Labrin	Implementation and evaluation of a methodology for automatic co-registration of multimodal satellite images	Mario Lillo	Universidad de Concepción
Bárbara Flores	Relationship between the state of El Yali wetland and climate variability	Diego Rivera	Universidad de Concepción
Jonathan Venegas	Relationship between flow and water rights of river boards	Diego Rivera	Universidad de Concepción
Fernando Matus	Experimental analysis of reactives used for thickening of copper tailings	Fernando Betancourt	Universidad de Concepción
Joshua Parra	Tailings sedimentation study using Sedirack online equipment	Fernando Betancourt	Universidad de Concepción
Edgar Faúndez	Experiments of ultraflocculation using a cylindrical reactor	Fernando Concha	Universidad de Concepción
Marco Salazar	Experiments of ultraflocculation using a hydrocyclone-type reactor	Fernando Concha	Universidad de Concepción
Julio Careaga	Modelamiento Matemático y Simulación Numérica de Sedimentadores con Área Variable en Planta de Tratamiento de Aguas Servidas	Raimund Bürger	Universidad de Concepción
Mathias Kuschel	Análisis de Ciclo de Vida en producción agrícola	Diego Rivera	Universidad de Concepción
Álvaro Galindo	Aspectos Jurídicos relevantes de la NCH 409, sobre agua potable en Chile	Verónica Delgado	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Constanza Guajardo	Trade-off ecosistémicos: ¿Qué es lo que se pierde por generar hidroelectricidad?	Ricardo Figueroa	Universidad de Concepción
Cristián González	Recarga Artificial de acuíferos en derecho comprado	Verónica Delgado	Universidad de Concepción
Daniel Inzunza	La efectividad del sistema jurídico de aguas, en el Derecho Internacional de los Derechos Humanos, frente a situaciones de escasez hídrica	Amaya Álvez	Universidad de Concepción
Ignacio Codelia	Caracterización limnológica de la laguna Rayenantu, Santa Juana, Chile	Ricardo Figueroa	Universidad de Concepción
Joselinne Carrasco	¿Y si le saco la sal se acaba el problema? Desafíos jurídicos en torno al derecho humanos al agua y el proceso de desalinización	Amaya Álvez	Universidad de Concepción
Laura Carrillo	Planes de descontaminación asociado a norma de calidad secundaria río Bío - Bío	Verónica Delgado	Universidad de Concepción
María José Carrasco	Recarga artificial de acuífero en el derecho comprado Europeo	Verónica Delgado	Universidad de Concepción
Paula Hoffer	El reciclaje de las aguas en el marco constitucional del derecho a vivir en un medioambiente libre de contaminación	Amaya Álvez	Universidad de Concepción
Yaritza Burgos	Comunidad de MIB asociados a vegetación nativa y exótica en ríos de cabecera en la zona Centro-Sur de Chile	Ricardo Figueroa	Universidad de Concepción
Natalia Ramírez	Determinación de la existencia de Fármacos en aguas del Río Biobío, mediante monitoreos pasivos con la utilización de SDB (Styrene Divinyl Benzene)	Ricardo Barra	Universidad de Concepción
Gabriela Álvarez	Evaluación del Riesgo de Contaminación de Suelos y Aguas Subterráneas por plaguicidas en un viñedo	Ricardo Barra	Universidad de Concepción
Luis Higueras	Hidrología del Secano Interior	José Luis Arumí	Universidad de Concepción
Eric Osorio	Calibración de un muestreador pasivo de vinil etileno (eva) para el monitoreo de pesticidas hidrofóbicos en un medio acuático superficial	José Luis Arumí / Felipe Tucca	Universidad de Concepción
Patricio Silva	Impacto Social de la escasez hídrica en el secano interior de la región del Bío Bío	Jorge Rojas	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Francisco Alarcón	Cinética de floculación de alúmina	Pedro Toledo	Universidad de Concepción
Millaray San Martin	Viscoelastic behavior of clay suspensions	Pedro Toledo	Universidad de Concepción
Francisco Ortiz	Estudio de la evolución temporal de las crecidas en cuencas de la VII, VIII y IX Región	José Vargas	Universidad de Concepción
Nicolás Rojas	Hidrología de Wadis	José Vargas	Universidad de Concepción
Pablo Vidal	Análisis de la precipitación en el Norte Grande de Chile, para determinar posibles zonas propensas a Wadis	José Vargas	Universidad de Concepción
Yoshihiro Kawaguchi	Análisis comparativo de caudales máximos estimados a través de series históricas de caudales. Aplicación zona centro-sur de Chile	José Vargas	Universidad de Concepción
Erick Rebolledo	Dispersantes para mejorar flotabilidad de molibdenita en agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
2017			
Nicolás Ávila	Evaluación de los fundamentos científicos y metodológicos de elaboración de anteproyectos de norma Secundaria. Caso de estudio río Rapel	Roberto Urrutia	Universidad de Concepción
Cesar Vera	Evaluación histórica de las floraciones algales de Microcystis sp. en laguna Grande de San Pedro de la Paz a través, del uso del registro sedimentario	Roberto Urrutia	Universidad de Concepción
Jorge Balvoa	Evaluación de variables físicas y químicas que explican el desarrollo de floraciones algales de Microcystis en la Laguna Lo Galindo, a través de la modelación numérica	Roberto Urrutia	Universidad de Concepción
Ariel Navarro	Geología de los depósitos glaciares en la Reserva Nacional Río Cipreces	Roberto Urrutia	Universidad de Concepción
Daniel Contreras	Propiedades dinámicas de pulpas de arcilla	Pedro Toledo / Ricardo Jeldres	Universidad de Concepción
Joaquín Céspedes	Medición y modelamiento de la evaporación en tranques de relaves y el impacto de los poros de aguas salinas en la tasa de evaporación	Pedro Toledo / José Luis Arumí / Thomas Baumgartl	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Milton Garcés	Evaluación del efecto de dispersantes en la flotación de calcopirita en agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
Felipe Muñoz	Uso de 222Rn como trazador ambiental para determinar la existencia de aportes de agua subterránea en la Laguna Santa Elena	José Luis Arumí	Universidad de Concepción
Eric Osorio	Calibración de un muestreador pasivo de vinil etileno (eva) para el monitoreo de pesticidas hidrofóbicos en un medio acuático superficial	José Luis Arumí / Ricardo Barra	Universidad de Concepción
Constanza Guajardo	Trade-off ecosistémicos: ¿Qué es lo que se pierde por generar hidroelectricidad?	Ricardo Figueroa	Universidad de Concepción
Julia Saavedra	Análisis biogeográfico comparativo Zona Norte y Mediterránea, mediante macroinvertebrados bentónicos	Ricardo Figueroa	Universidad de Concepción
Ignacio Codelia	Caracterización limnológica de la laguna Rayenantu, Santa Juana, Chile	Ricardo Figueroa	Universidad de Concepción
David Ormazábal	Áreas verdes urbanas de Concepción metropolitano: Un aporte a los servicios ecosistémicos	Ricardo Figueroa	Universidad de Concepción
Alberto Jorquera	Respuesta de los macroinvertebrados a los lixiviados de especies vegetales ribereñas nativas y exóticas	Ricardo Figueroa	Universidad de Concepción
Gabriela Torres	Deriva de macroinvertebrados en un río intermitente durante un evento de lluvia	Ricardo Figueroa	Universidad de Concepción
Álvaro Galindo	Aspectos Jurídicos relevantes de la NCH 409, sobre agua potable en Chile	Verónica Delgado	Universidad de Concepción
Cristián González	Recarga Artificial de acuíferos en derecho comparado	Verónica Delgado	Universidad de Concepción
Laura Carrillo	Planes de descontaminación asociado a norma de calidad secundaria río Bío - Bío	Verónica Delgado	Universidad de Concepción
María José Carrasco	Recarga artificial de acuífero en el derecho comparado Europeo	Verónica Delgado	Universidad de Concepción
Gustavo Romero	Las aguas olvidadas de Chile: "Protección ambiental de las vertientes en Chile"	Verónica Delgado	Universidad de Concepción
Josefa Valdivia	El principio: "Quien conserva, cobra" y su aporte en materia de protección ambiental	Verónica Delgado	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Vanesa Lobos	Desafíos jurídicos en la protección ambiental de los humedales y lagunas que se nutren de aguas subterráneas	Verónica Delgado	Universidad de Concepción
Humberto Quiroz	Reservas de agua (dulce) para la humanidad: La verdadera naturaleza jurídica de los glaciares	Verónica Delgado	Universidad de Concepción
Antonio Muñoz	Normativa en materia de incendios	Verónica Delgado	Universidad de Concepción
Daniel Inzunza	La efectividad del sistema jurídico de aguas, en el Derecho Internacional de los Derechos Humanos, frente a situaciones de escasez hídrica	Amaya Álvez	Universidad de Concepción
Joselinne Carrasco	¿Y si le saco la sal se acaba el problema? Desafíos jurídicos en torno al derecho humanos al agua y el proceso de desalinización	Amaya Álvez	Universidad de Concepción
Paula Hoffer	El reciclaje de las aguas en el marco constitucional del derecho a vivir en un medioambiente libre de contaminación	Amaya Álvez	Universidad de Concepción
Rodrigo Castillo	Déficit democrático de las aguas. análisis jurídico de la participación en la gestión de las aguas en chile, y en particular en las juntas de vigilancia de los ríos	Amaya Álvez	Universidad de Concepción
Emmanuel Arredondo	Radiografía a la desalinización del agua: Análisis a la normativa aplicada y propuestas	Amaya Álvez	Universidad de Concepción
Victoria Ulloa	Derechos de aguas ancestrales: relaciones de género y raza en las estrategias de gestión de los pueblos originarios del norte de Chile. Un estudio especial de las comunidades de Putre, Socoroma y Chapiquiña	Amaya Álvez	Universidad de Concepción
Pablo Torres	La naturaleza: un sujeto de derechos	Amaya Álvez	Universidad de Concepción
Erick Anacona	Cambios climáticos y conflictos socio-ambientales en la comuna de Florida: Un análisis a la cotidianeidad de vivir sin agua	Robinson Torres	Universidad de Concepción
Antu Campos	Modernización y seguridad hídrica en espacios rurales: Impactos y transformaciones desde experiencias de turismo rural en el Archipiélago de Chiloé	Robinson Torres	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Mónica Paredes	Impactos socioculturales del desarrollo hidroeléctrico en comunidades Pehuenches de Alto Bio Bío: casos Quepuca, Ralco y Ralco Lepoy	Robinson Torres	Universidad de Concepción
Constanza Rodríguez	Diagnóstico de la Evaluación Ambiental del Medio Humano para pequeñas centrales hidroeléctricas en Chile	Robinson Torres	Universidad de Concepción
Nicolás Salas	Percepción social del riesgo ambiental en la comuna de Penco	Robinson Torres	Universidad de Concepción
Francisco Lecaros	Effect of wetting area in yield and fruit quality, in apples under drip irrigation	Eduardo Holzapfel	Universidad de Concepción
Nicolás Muñoz	Effect of number of laterals in the production of apples under drip irrigation	Eduardo Holzapfel	Universidad de Concepción
Celso Orellana	Automation of furrow irrigation systems	Eduardo Holzapfel / Christian Correa	Universidad de Concepción
Andrés Pérez	Evaporación en el Lago Laja	Octavio Lagos	Universidad de Concepción
Agustina Villegas	Usos consuntivos y no consuntivos del agua en áreas protegidas, y su efecto en los servicios ecosistémicos de provisión	Diego Rivera	Universidad de Concepción
María Inés Hernández	Catastro de los sistemas de agua potable rural de la provincia de Ñuble	Diego Rivera	Universidad de Concepción
Luis Ramírez	Modificación de software de modelación del movimiento del agua en tres dimensiones	Diego Rivera	Universidad de Concepción
Paulina Cisternas	Caracterización isotópica de fuentes de nitrato y su distribución en el territorio Itata	Diego Rivera	Universidad de Concepción
Juan Carlos Echeverría	Caracterización de los derechos de aprovechamiento de agua de la región del Maule y del Bio-Bio	Diego Rivera	Universidad de Concepción
Carolina Ordenes	Evaluación de un sistema de riego avance frontal con sistema VRI	Octavio Lagos	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Cristóbal Sepúlveda	Technical and economic evaluation of sprinkler for permanent systems	Eduardo Holzapfel	Universidad de Concepción
Claudia Ramírez / Yocelyn Ocampos / Fernanda Villarroel	Wastewater treatment through the sulfur cycle	José Luis Campos	Universidad Adolfo Ibáñez
Daniela Jaunez / Franco Ghio / Edwin Holvoet	Plan for the efficient use of water and management of hazardous waste -Marinetti Packaging	José Luis Campos	Universidad Adolfo Ibáñez
Constanza Cofré	Generation of aerobic granular biomass in continuous operation from activated sludge	José Luis Campos / Lorna Guerrero	Universidad Técnica Federico Santa María
Francesca Adriazola / Catalina Higgs / Gonzalo Neira / Pablo Raposo	Redesign of algae production plant – Tivar	José Luis Campos	Universidad Adolfo Ibáñez
Camila Cabrera	Bioprecipitation of calcite as a strategy to improve the mechanical properties of the soil	David Jeison / Lorena Jorquera	Pontificia Universidad Católica de Valparaíso
Javier Barraza	Technical-economic feasibility of a biological treatment system for milk whey from a lower dairy	David Jeison	Pontificia Universidad Católica de Valparaíso
Ignacio Díaz	Production of calcium bicarbonate from seawater using nanofiltration	Rodrigo Bórquez	Universidad de Concepción
Loreto Inzunza	Alternatives of pretreatments to brackish water nanofiltration	Rodrigo Bórquez	Universidad de Concepción
Eduardo Beltrán	Combined system of nanofiltration and solvent extraction applied to acid mine drainage	Rodrigo Bórquez	Universidad de Concepción
Fernanda Durán	Recovery of calcium from seawater using nanofiltration and incorporation in desalinated water	Rodrigo Bórquez	Universidad de Concepción
Ariel Espinoza	Theoretical-experimental study of optimal configurations of desalination units according to energy consumption	Rodrigo Bórquez	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Francisca Labarca	Reduction of nitrate, iron and chlorides in the water that supplies a rural drinking water system (APR)	Rodrigo Bórquez	Universidad de Concepción
Paula Fuentes	Influence of the operating conditions on the permeability during the nanofiltration of acid drainage	Alex Schawarz / Rodrigo Bórquez	Universidad de Concepción
Daniela Segura	Comparative analysis of the perception of the adult population of the communities of Hualqui and San Pedro de Atacama regarding the reuse of treated wastewater	Gladys Vidal	Universidad de Concepción
Carol Burgos	Identification and Evaluation of Toxicity (SIT) of acid mine drainage, through water quality bioindicators	Gladys Vidal	Universidad de Concepción
Romina Núñez	Evaluation of constructed wetlands under a polyculture regime and monoculture of ornamental plants for wastewater treatment	Gladys Vidal	Universidad de Concepción
Felipe Barriga	Influence of a sequential pre-treatment on methane production and microbiological activity during the anaerobic digestion of sanitary sludge	Gladys Vidal	Universidad de Concepción
Adrián Albarrán	Evaluation of the potential reuse of wastewater in agriculture, treated by activated sludge and wetlands built under different disinfection processes	Gladys Vidal	Universidad de Concepción
Camila Zapata	Characteristics of water reuse of the mining thickening process from carbon indicators	Gladys Vidal	Universidad de Concepción
Elizabeth Gutiérrez	Ibuprofen and triclosan removal by vertical subsurface flow constructed wetland under nitrification capacity	Gladys Vidal	Universidad de Concepción
Ariel Álvarez	Instalación, operación y evaluación de la eficiencia de un sistema de desinfección UV a escala piloto	Gladys Vidal	Universidad de Concepción
Leonardo Peña	Transformation of organic matter through constructed wetlands coupled to microbial fuel cells	Gladys Vidal	Universidad de Concepción
Diego Piedra	Estudio de roping en hidrociclones ante cambios en granulometría de entrada	Fernando Betancourt	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Luciana Macera	Evaluación técnica de reactores de ultra-floculación para espesamiento de pulpas de cuarzo	Fernando Betancourt	Universidad de Concepción
Patricio Encina	Estudio del control de floculante en espesamiento mediante mediciones de carbono orgánico residual en aguas de rebalse	Fernando Betancourt	Universidad de Concepción
Edgardo Faúndez	Modificación y pruebas preliminares de nuevo equipo Filtratest.	Fernando Betancourt	Universidad de Concepción
Juan Yáñez	Estudio de escurrimiento en bandeja de suspensiones con esferas de vidrio	Fernando Betancourt	Universidad de Concepción
Juan Daza	Influencia de la distribución granulométrica sobre el roping en hidrociclones	Pablo Cornejo	Universidad de Concepción
2018			
Cristian Chaparro / Cristian Gómez / Fernando Toledo	Análisis de factibilidad en la expansión de la línea de negocio de la empresa AWS	José Luis Campos	Universidad Adolfo Ibáñez
Mackarena Amunátegui/ Constanza Aguirre / Joao Campagnaro	Bio- Reactor, solución para costos de insumos (VIVEROS SUNNYRIDGE)	José Luis Campos	Universidad Adolfo Ibáñez
María Cabezas / Carlos Pereira / Thomas Spargo/ Joao Campagnaro	Mejora de Sostenibilidad Medioambiental de Mercado Libre	José Luis Campos	Universidad Adolfo Ibáñez
Claudia Díaz	Aplicación del proceso anammox a baja temperatura en aguas residuales urbanas para la eliminación de nitrógeno	Marisol Belmonte / José Luis Campos	Universidad Adolfo Ibáñez
Camila Panatt	Aplicación del proceso anammox a aguas residuales urbanas para la eliminación de nitrógeno	Marisol Belmonte / José Luis Campos	Universidad de Playa Ancha
Cristobal Díaz	Resultados preliminares de la eliminación de materia orgánica contenido en las aguas residuales urbanas mediante la reducción del sulfato utilizando agua de mar como fuente de azufre	Marisol Belmonte / José Luis Campos	Universidad de Playa Ancha

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Bratian Busolich	Evaluación de prefactibilidad de proyecto para la generación de un mercado de agua en el río Ñuble	José Luis Arumí	Universidad de Concepción
Gabriela Fernández	Lixiviación de nutrientes de biosólidos provenientes de digestión anaeróbica con y sin pretratamiento	Gladys Vidal	Universidad de Concepción
Juan Pablo Miranda	Evaluación de la obtención de energía eléctrica a partir de materia orgánica facialmente biodegradable mediante el sistema integrado humedal construido-celda microbiana	Gladys Vidal	Universidad de Concepción
Nicolás Román	Mapeo y Análisis de albedo Glaciar tapado con cámara time-lapse en la modelación del balance energético	Roberto Urrutia	Universidad de Concepción
Lucas Brito	Estudio de la controlabilidad de un hidrociclón mediante análisis de vibraciones	Fernando Betancourt	Universidad de Concepción
Esteban Tereucán	Evaluación a nivel de laboratorio del uso de silicato de sodio como dispersante en circuito de flotación Cu-Mo, y su posterior efecto en la floculación/ sedimentación	Leopoldo Gutiérrez	Universidad de Concepción
Paulina Gutiérrez	Evaluación a nivel de laboratorio del uso de hexametatosfato de sodio como dispersante en un circuito de flotación Cu-Mo, y sus posterior efecto en floculación	Leopoldo Gutiérrez	Universidad de Concepción
Antu Campos	Modernización y seguridad hídrica en espacios rurales: Impactos y transformaciones desde experiencias de turismo rural en el Archipiélago de Chiloé	Jorge Rojas	Universidad de Concepción
Bárbara Pulgar	El daño ambiental en la jurisprudencia Chilena (2000-2008)	Verónica Delgado	Universidad de Concepción
Giovanna García	Alternativas económicas del uso de agua de mar en minería	Fernando Concha	Universidad de Concepción
Yenifer González	Evaluación de la eficiencia de desinfección de un sistema UV para efluentes provenientes de un sistema de humedales construidos de flujo horizontal subsuperficial	Gladys Vidal	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Rodrigo Sepúlveda	Evaluación de la tolerancia de plantas macrófitas a efluentes salinos tratados por Humedales Construidos.	Gladys Vidal	Universidad de Concepción
Lorena Troncoso	El daño ambiental irreparable en la jurisprudencia chilena desafíos para su compensación	Verónica Delgado	Universidad de Concepción
Carlos Muñoz	Evaluación técnica de reactores de ultra floculación	Fernando Betancourt	Universidad de Concepción
Darko Arias	Optimización de la flotación molibdenita fina utilizando óxido de polietileno con mineral real	Leopoldo Gutiérrez	Universidad de Concepción
Rocío Figueroa	Estudios de reactivos de coagulantes utilizados en procesos de sedimentación para el espesamiento de pulpas de minerales silíceos	Fernando Betancourt	Universidad de Concepción
Alonso Grau	La protección de los humedales costeros como estrategia de la seguridad hídrica en un contexto de cambio climático	Verónica Delgado	Universidad de Concepción
Joaquín Roa	Evaluación de dispersantes a la flotación y espesamiento de minerales cobre-molibeno en presencia de arcillas, micas y esmectitas en agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
Joaquín Elgueta	Implementación del modelo hidrológico SWAT para la cuenca del Río Lonquén	José Luis Arumí	Universidad de Concepción
Fanny Araya	Propuesta de un Modelo de Gestión Integrada de Cuencas de Lagos para la rehabilitación y uso de contacto directo: laguna Rayenantú, Santa Juana	Ricardo Figueroa	Universidad de Concepción
Kalam Cai	Evaluación del aporte del río Bio Bio al crecimiento económico regional: Un enfoque desde los servicios ecosistémicos de abastecimiento.	Ricardo Figueroa	Universidad de Concepción
Pedro Díaz	Diseño y operación de un equipo para tratar relaves con gran contenido de finos mediante clasificación y ultrafloculación	Fernando Concha	Universidad de Concepción
Paulina Lobos	Evaluación del uso de un consorcio microalgal para la remoción de nutrientes: Aplicación en descargas puntuales al lago Lanalhue.	Roberto Urrutia	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Gaspar Guerrero	Automatización de un analizador de tamaño de partículas basado en un cyclosizer.	Fernando Concha	Universidad de Concepción
Cristian Ríos	Concentración de litio usando procesos basados en membranas	Rodrigo Bórquez	Universidad de Concepción
Sebastián Silva	Rediseño y operación de un filtro de laboratorio con calentamiento de aire y medición de humedad	Fernando Concha	Universidad de Concepción
Levi Campos	Estudios fundamentales del empaquetamiento de partículas (tranque de relave)	Fernando Concha	Universidad de Concepción
Erick Anacona	Cambios climáticos y conflictos socio-ambientales en la comuna de Florida: Un análisis a la cotidianeidad de vivir sin agua	Robinson Torres	Universidad de Concepción
Jean Paul Cáceres	Determinación de condiciones óptimas para la obtención de harina de zapallo y sus semillas	Sergio Acuña	Universidad de Concepción
Ignacio Jara	Uso de nano burbujas en la flotación de minerales arcillosos	Leopoldo Gutiérrez / Fernando Concha	Universidad de Concepción
Juan Lavín	Gestión Territorial en base al estado del recurso hídrico para territorios indígenas en la cuenca del río Pucón	Robinson Torres	Universidad de Concepción
Matías Olivera	Evaluación de la concentración de amonio en la producción de metano de un reactor anaerobio para el tratamiento de lodos sanitarios operado con lodos pre-tratados con ultrasonido	Gladys Vidal	Universidad de Concepción
Juan Yáñez	Estudio de escurrimiento en bandeja de suspensiones con esferas de vidrio	Fernando Betancourt	Universidad de Concepción
Patricio Encina	Estudio del control de floculante en espesamiento mediante mediciones de carbono orgánico residual en aguas de rebalse	Fernando Betancourt	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Luciana Macera	Evaluación técnica de reactores de ultra-floculación para espesamiento de pulpas de cuarzo	Fernando Betancourt	Universidad de Concepción
Camila Palma	Diseño y evaluación de estudio de escurrimiento en bandeja de suspensiones con esferas de vidrio y relave	Fernando Betancourt	Universidad de Concepción
Ignacia Pinol	Efectos del pre-chancado en operación de molienda SAG, Cía. Contractual Minera Candelaria	Fernando Betancourt	Universidad de Concepción
Danor Fuentealba	Desarrollo y puesta en marcha modelos geometalúrgicos de proceso División RadomiroTomic	Fernando Betancourt	Universidad de Concepción
María Azócar	Cambio de perfil de revestimientos del pre-chancado	Fernando Betancourt	Universidad de Concepción
Emilio Venegas	Balance de agua y ajuste con multiplicadores de Lagrange, Concentradora Laguna Seca, Minera Escondida	Fernando Betancourt	Universidad de Concepción
Edgardo Faúndez	Estudio del efecto de la temperatura de aire en las variables de filtración usando equipo Filtratest	Fernando Betancourt	Universidad de Concepción
Diego Piedra	Estudio de roping en hidrociclones ante cambios en granulometría de entrada	Fernando Betancourt	Universidad de Concepción
Gerardo Saavedra	Caracterización reológica de relaves producidos en planta de Pellets, Compañía Minera CAP	Fernando Betancourt	Universidad de Concepción
Rodrigo Pinto	Evaluar la operación de los ciclones de molienda, analizando la operación en búsqueda de la mejor eficiencia en clasificación	Fernando Betancourt	Universidad de Concepción
Daniel Contreras	Efecto de sal y tipo y dosis de floculante sobre el comportamiento reológico de sedimentos de cuarzo y mezclas de cuarzo con caolinita	Pedro Toledo / Ricardo Jeldres	Universidad de Concepción
Denny Keller	Operación y Evaluación de una Planta de Desalinización de Agua de Mar empleando Nanofiltración.	Rodrigo Bórquez	Universidad de Concepción
Eduardo Beltrán	Combined system of nanofiltration and solvent extraction applied to acid mine drainage	Rodrigo Bórquez / María Cristina Diez	Universidad de Concepción

UNDERGRADUATE STUDENTS

Name of student	Thesis Title	Tutor's name	University that gives the degree
Emmanuel Arredondo	Radiografía a la desalinización del agua: Análisis a la normativa aplicada y propuestas.	Amaya Alvez	Universidad de Concepción
Ricardo Barrientos	Ultrafiltración como pretratamiento en la desalinización de agua de mar.	Rodrigo Bórquez	Universidad de Concepción
Valentina Pezoa	Estudio a Escala Laboratorio de Membranas de Ultrafiltración para reducción de Contenido de Manganeso y Arsénico en Agua Potable.	Rodrigo Bórquez	Universidad de Concepción
Kamila Retamal	Abatimiento de Hierro en Drenaje Ácido en Minas empleando Nanofiltración.	Rodrigo Bórquez	Universidad de Concepción
Pablo Faúndez	Análisis y evaluación del proceso de Quemigacion en Pivotes Centrales	Octavio Lagos	Universidad de Concepción
Milton Garcés	Evaluación del efecto de dispersantes en la flotación de calcopirita en agua de mar	Leopoldo Gutiérrez	Universidad de Concepción
Fernanda Durán	Recovery of calcium from seawater using nanofiltration and incorporation in desalinated water	Rodrigo Bórquez	Universidad de Concepción
Juan Daza	Influencia de la distribución granulométrica sobre el roping en hidrociclones	Pablo Cornejo	Universidad de Concepción

Information Updated Until November 2018

2014-2018 REPORT

WATER RESEARCH CENTER FOR AGRICULTURE AND MINING

CRHIAM

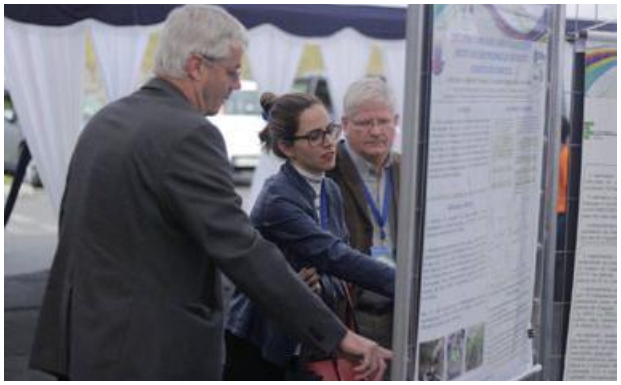
ACTIVITIES
SUMMARY

- Congresses, seminars, workshops and conferences
- Scientific meetings
- Internal activities
- Water forums
- Activities with public and private institutions and NGOs
- Human resources formation activities
- Field trips and technical visits
- Outreach iniciatives with school and society in general
- CRHIAM media

CONGRESSES, SEMINARS, WORKSHOPS AND CONFERENCES

Water Congress, Gecamin, 2018

Fondap Centers Meeting, 2014



CRHIAM-Inovagri International Meeting, 2016

Conference, Dr. Janusz Laskowski, 2014

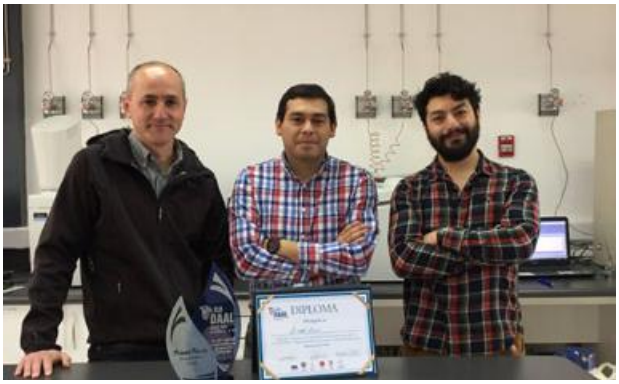
Perumin, Arequipa, Perú, 2017

Water Congress, Gecamin, 2017

Water Congress, Gecamin, 2018

Water Congress, Gecamin, 2018

Conference, Dr. Verónica Delgado, 2017



Best Oral Presentation Award at XII Taller y Simposio Latinoamericano en Digestión Anaerobia, 2016

International Conference "Decolonizing Law? Methods, Tactics & Strategies", University of Windsor, Canada, 2018

CRHIAM-Inovagri International Meeting, 2016

8th World WaterForum, Brazil, 201

Darcy Lecture, Concepción, Chile 2016

SCIENTIFIC MEETINGS

Water and Society Cluster, Scientific Meeting

Scientific Committee Meeting, 2018

Scientific Committee Meeting, 2018

Scientific Committee Meeting, 2018

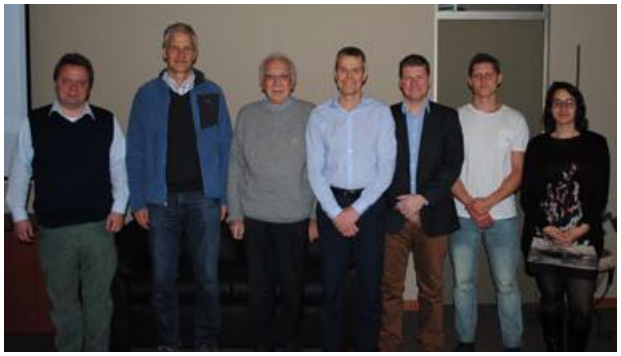
Water Research Centers Meeting, 2015

Water Research Centers Meeting, 2015

Scientific Committee Meeting, 2014

Demand Cluster, Scientific Meeting, 2015

Meeting with Dr. Alan Kolok (Univesity of Idaho), 2018



Scientific Meeting with researchers from Lund and Gehnt universities, 2014

Scientific Committee Meeting, 2018

INTERNAL ACTIVITIES

CRHIAM Team 2017

Internal workshop for CRHIAM researchers, 2015

Internal workshop for CRHIAM researchers, 2015

Internal workshop for CRHIAM researchers, 2015

CRHIAM Team Meeting, 2018

CRHIAM Team Meeting, 2018

CRHIAM Team Meeting, 2018

WATER FORUMS

First Water Forum, 2016

First Water Forum, 2016

First Water Forum, 2016

First Water Forum, 2016

Third Water Forum, 2017

Third Water Forum, 2017

Second Water Forum, 2017

Third Water Forum, 2017

ACTIVITIES WITH PUBLIC AND PRIVATE INSTITUTIONS AND NGOs

Advisory Council Meeting, 2014

Act of delivery of the report of the R+D+I Commission for the Sustainability of Water Resources, La Moneda, 2016

Act of delivery of the report of the R+D+I Commission for the Sustainability of Water Resources, La Moneda, 2016

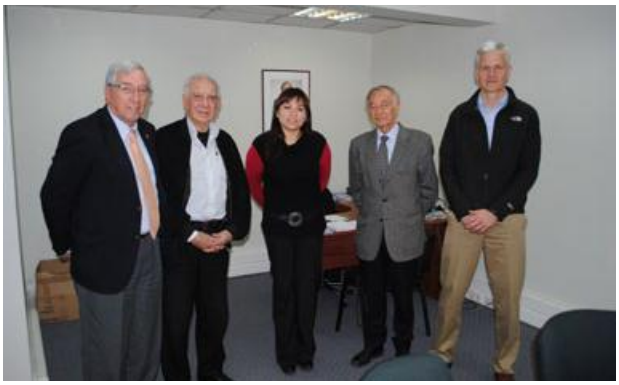
Meeting with Regional Council of the O`Higgins Region, 2014

Meeting with former first authority of the Biobio Region, 2016

Meeting with National Council of Innovation for Development (CNID), 2016

Meeting with Regional Council of the O`Higgins Region, 2014

Meeting with Codelco, 2014



Meeting with National Delegate for Water Resources, 2014

Meeting with CIREN, 2014

Meeting with CIREN, 2014

Meeting with Codelco, 2014

Advisory Council Meeting, 2016

Participation at the Agriculture Commission of the National Congress, 2018

Participation at High Level Panel of Experts on Food Security and Nutrition (HLPE) of the FAO, 2017

Water Resources and Environment board, Essbio, 2018

Fieldtrip to Lota, El Chiflón del Diablo mine, 2018

HUMAN RESOURCES FORMATION ACTIVITIES

Workshop about circular economy, 2017

Students support team, CRHIAM-Inovagri International Meeting, 2016

Graduate course with students from the University of York, 2015

"Three minutes thesis" contest at University of Concepción, 2015

Science Week at University of Concepción, 2016

Workshop about effective communication for CRHIAM students, 2016

Workshop about effective communication for CRHIAM students, 2016

Graduate course with students from the University of York, 2015

FIELD TRIPS AND TECHNICAL VISITS

Visit to campus of the University of Concepción in Chillán, 2015

Visit to campus of the University of Concepción in Chillán, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Scientific Committee fieldtrip, 2015

Visit to University of La Frontera, 2015

Visit to University of La Frontera, 2015

Visit to University of La Frontera, 2015

Visit to University of La Frontera, 2015

OUTREACH INICIATIVES WITH SCHOOL AND SOCIETY IN GENERAL

Participation at Science Week Explora Conicyt Biobío, 2018

Scientific Fair at local school in Llico, 2016

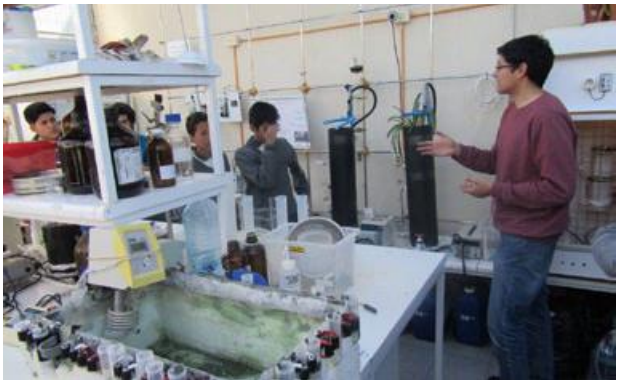
Scientific Fair at local school in Llico, 2016

Scientific Fair at local school in Llico, 2016

Scientific Fair at local school in Llico, 2016

Scientific Fair at local school in Llico, 2016

Local school visit to university campus, 2016



Local school visit to university campus, 2016

Opening ceremony of scientific interactive space for students “Biobiósfera”, 2018

Opening ceremony of interactive center for students “Biobiósfera”, Explora Conicyt Biobío, 2018

Participation at "Scientific Coffee" event, 2018

Participation at "Scientific Coffee" event, 2018

Participation at school radio program about scientific dissemination, 2015

Participation at school radio program about scientific dissemination, 2015

Science Week at University of Chile, 2018

Multi-Institutional Network, Explora Conicyt Biobío, 2018

Science Week at University of Chile, 2018

Science Week at University of Chile, 2018

Opening ceremony of interactive center for students "Biobiósfera", Explora Conicyt Biobío, 2018

CRHIAM MEDIA


EL MERCURIO

Bien EE.UU. para las manzanas chilenas

En Concepción crean centro de investigación en recursos hídricos

PORTAL WEB Campo

Las claves para determinar el éxito económico de una lechería

Promueven producción sustentable del aceite de oliva


El Sur | ciencia y tecnología

App agrícola ayuda a ahorrar hasta un 20% de agua y energía en predios

Mapa revela las rutas que amenazan la vida silvestre

Récord de costos por desastres naturales

Descubren fósiles inéditos en Sudamérica

CES: Un peluche inteligente ayudará a niños a dormir mejor

Faraday Future presentó su auto eléctrico en la feria tecnológica CES, como una "nueva especie" veloz

GESTIÓN DE RECURSOS HÍDRICOS Y SISTEMAS DE RIEGO

CENTRO DE RECURSOS HÍDRICOS PARA LA AGRICULTURA Y LA MINERÍA

En búsqueda de soluciones para la escasez hídrica

El nuevo centro de investigación de la Universidad de Concepción aborda diferentes aristas del problema de la disponibilidad de agua en dos de los sectores económicos más importantes para el país.

El equipo del Centro de Recursos Hídricos para la Agricultura y la Minería, junto a sus asesores extranjeros.

SOLUCIONES EFICIENTES

ASESORÍA INTERNACIONAL

CENTRO EXTENSIÓN PLURIANUAL

CONCEPCIÓN | economía y negocios | El Sur

CARNE 1.344 | PETRÓLEO WTI 66,82 | COBRE 2.819 | HARINA DE PESCADO 1.525 | CELULOSA MISK 1.229 | TRIGO BLANCO 14.300

DÓLAR K. BOMBA | MONEDAS | IPC | UF | UTM | BOLSA SANTIAGO

EJECUTIVOS DE EMPRESAS Y EXPERTOS OPINAN

Industrias ven elevarse costos de energía en torno al 10% en promedio

El nuevo esquema tarifario, aún en transición, significó que sean hoy los consumidores quienes pagan cargos adicionales como el cobro de transmisión zonal.

20% promedio sube esta cifra el costo de cargo de transmisión nacional

CONSUMIDORES ACTIVOS

Cambió la forma de planificación dice la CNE

CENTRO DE RECURSOS HÍDRICOS DE LA UDEC

Conicyt aprueba continuidad del Crhiam por 5 años más

Por un segundo período de cinco años, la UdeC podrá ejecutar proyectos de investigación en temas prioritarios para el país vinculados al uso sustentable del agua en agricultura y minería

P2 / SEGUNDO FORO DEL AGUA

P4 / ESTUDIANTE DE MAGÍSTER GANA BECA "PRENSA COBRE"

P5 / FORO CIENTÍFICO-ACADÉMICO CHILE FRANCIA

CRHIAM Noticias

Nº12 / 31 de marzo de 2017

CRHIAM celebra el Día Mundial del Agua con estudiantes de Penco

Más de doscientos estudiantes de segundo ciclo básico de la Escuela Los Conquistadores de Penco participaron de dos charlas didácticas por integrantes del Centro de Recursos Hídricos para la Agricultura y la Minería, CRHIAM, en el marco del Día Mundial del Agua.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14 seguidos
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Les gusta a consubarrios y 9 personas más
crhiam En el marco de las actividades de vinculación con el medio de #CRHIAM, el Dr. Felipe de la Hoz realizó un curso en el liceo técnico El Tambo
20 DE NOVIEMBRE · VER TRADUCCIÓN

Diario Concepción Lunes 27 de marzo de 2017 13

Sociales

II Foro del Agua

El coordinador nacional para la Reconstrucción por Incendios Forestales del Gobierno de Chile y subsecretario de Obras Públicas, Sergio Galilea, participó en el segundo Foro del Agua.

El profesional dictó la conferencia "Dimensiones e Impactos de Mega Incendios Forestales y Políticas de Reconstrucción" La actividad fue organizada por la Vrim y Chriam de la Universidad de Concepción.

SERGIO GALILEA y Jorge Rojas.

CARLOS SEPÚLVEDA y Javier Avila.

RENÉ CARVAJAL, César Saavedra y Araceli Ulloa.

FABIOLA MACHEIRA, Fernando Concha y Verónica Delgado.

RICARDO BARRA y José Luis Arumí.

VANESSA NOVOA y Ricardo Figueroa.

GÉNESIS ESPINOZA y Andrés Fernández.

OPINIÓN

Planificación y técnicas eficientes de riego

Por Dr. Eduardo Holzapfel,
profesor del Departamento de Recursos Hídricos y del Centro de Recursos Hídricos para la Agricultura y la Minería de la Universidad de Concepción.

TECNICAS Y TECNOLOGIAS

Fecha: 18-08-2017

SEQUÍA EN BIOBÍO

José Luis Arumí: "Estamos mejor que el año pasado, pero aún estamos bajo el promedio"

Expertos se reunieron en la sede de Inacap Los Ángeles y analizaron el tema de la escasez hídrica. Hablaron, derechamente de sequía, de embalses y napas subterráneas, pero sobre todo, reiteraron que aún falta agua.

Publicado Por ALEJANDRA SANCHEZ OCAMPO, LaTribuna

Escuchar Noticia

Clic para ampliar

En el marco de la Reforma al actual Código de Aguas, se reunieron diversos expositores en un seminario organizado por Inacap sede Los Ángeles, para tratar la situación del recurso hídrico en la provincia de Biobío.

En la ocasión, se trataron tres puntos relevantes, la Reforma al Código de Aguas, expuesto por el director regional de la DGA, César Saavedra; el Desafío País que Imponen los Recursos Hídricos, dictado por Roberto Pizarro de CTHA y, finalmente, el Decano de la facultad de ingeniería agrícola de la UdeC, sede Chillán, José Luis Arumí, realizó un diagnóstico de la situación hídrica en la provincia de Biobío.

ESCENARIO PROVINCIAL

En su intervención, José Luis Arumí, dio un mensaje más optimista a los asistentes, manifestando que pese a que en el tema de la situación hídrica falta mucha inversión e investigación, en los últimos años, hay mucho más conocimiento, interés, más gente trabajando y se hacen más actividades, como seminarios o talleres. "hay cosas en las que se han avanzado, quizás no a la velocidad que queremos, pero hay mayor conocimiento. No hay que ser tan pesimista, tampoco tenemos que ser conformistas, sino que hay que estar atentos a seguir trabajando, y a la medida que seamos más los que trabajamos en este tema, va a ser mejor".

EDICIÓN IMPRESA

Ediciones Anteriores

DIPLOMADO EN IMPLEMENTACIÓN Y AUDITORIA INTERNA DE SISTEMA INTEGRADOS DE GESTIÓN


Inicio
Sobre nosotros
Universidad del Desarrollo
Tweets 575
Siguiendo 386
Seguidores 486
Me gusta 120
Seguir
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¿Qué es el CRHIAM? Te invitamos a conocer más sobre este centro Fondap liderado por la Universidad de Concepción en asociación a las universidades de la Frontera y del Desarrollo.
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La Dra. María Cristina Díez, asumió como investigadora principal en el marco del proyecto de continuidad de CRHIAM.
Los detalles en la siguiente nota: crhiam.cl/?p=3133
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21,4 mil Tweets
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57,7 mil Tweets
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571 mil Tweets


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Periodista deportivo
nuevo hombre, cada vez más preocupado de su imagen. Francisca Buzeta, psicóloga y sexóloga, afirma a este medio que este
en el mundo de la estética corporal, que por años fue casi exclusivo de las mujeres".
Respecto a cómo este renovado
contratan asesores de imagen, están atentos a las nuevas colecciones de moda y buscan datos y nuevos productos en el mercado
mente estos nuevos hombres tienen que sentirse cómodos, activos y no preocuparse por los prejuicios".
El informe indica que la mayo-
opinión
Día Mundial del Agua
Ricardo Barra
Facultad de Cs. Ambientales, Centro EULA, U. de Concepción
Cada 22 de marzo se celebra el Día Mundial del Agua, como una forma de recordar y fomentar el cuidado por este recurso tan importante para la sobrevivencia humana. Este año 2018 la celebración se centra en explorar cómo la naturaleza puede ayudarnos a superar los desafíos que plantea el agua en el siglo XXI.
Nuestro país, que se caracteriza por una distribución de este recurso de forma muy desigual, está siendo impactado severamente y desde hace varios años por un fenómeno cada vez más persistente de escasez hídrica en la parte centro-sur. Justo donde se concentra la mayor parte de la población del país.
Las causas de este fenómeno las encontramos en ejemplos locales, como el masivo cambio de uso del suelo agrícola-forestal, o la creciente urbanización y la inevitable demanda de agua asociada a ella.
Sin embargo, también encontramos estas causas en procesos que ocurren a una escala global, como el cambio climático. Todos ellos consecuencia de la actividad humana, de ahí lo importante de ocuparnos de estos problemas y concentrarnos más en las causas que los efectos.
Así, todas las predicciones indican que si no tomamos acciones pronto, la condición de escasez que observamos hoy va a empeorar. Es decir, que estos fenómenos que se reflejan en una disminución de las precipitaciones y un aumento de las temperaturas, están teniendo profundos efectos adversos sobre la disponibilidad de agua, pero también sobre la calidad del recurso.
En este escenario, la investigación científica aplicada es fundamental para encontrar soluciones apropiadas, para adaptarnos y mitigar los efectos adversos de estos fenómenos en la economía y la sociedad.
Por ejemplo, en lo que tiene que ver con nuevas fuentes de agua para consumo humano y actividades productivas, (de mar, de niebla, cosechada de la lluvia, etc.), estas se transforman en opciones cuya viabilidad se debe evaluar, para determinar si pueden constituirse en una alternativa viable, que pueda brindar seguridad a la población, para que esta pueda seguir contando con acceso a este recurso vital.
En tal contexto, la Universidad de Concepción ha otorgado a este tema una elevada prioridad, desarrollando investigación sobre cambio climático, cuencas hidrográficas, contaminación acuática y calidad del agua además del continuo río-mar, desde hace más de 30 años. Por lo tanto, y conjugando cada una de las realidades recién expuestas, es que hoy se hace más importante que nunca que los actores relevantes del desarrollo de nuestro país sigan invirtiendo en este conocimiento, que nos otorgará mayores posibilidades de abordar el incierto futuro con mayores herramientas y alternativas sostenibles.

CRHIAM

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2014 - 2018

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