



(CR)² | Center for Climate
and Resilience Research
www.CR2.cl

10 años

10 YEARS REPORT

Center for Climate and Resilience Research CR2
2013 - 2022



PATROCINA



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AGENCIA NACIONAL DE
INVESTIGACIÓN Y DESARROLLO

FINANCIA



INDEX

3 EDITORIAL

6 ABOUT CR2

- 7 | CR2
- 8 | A Bit of History
- 10 | Research Team
- 11 | Scientific Productivity
- 13 | Scientific Equipment

15 RESEARCH

- 16 | Research Lines
- 22 | Cross-cutting Themes
- 24 | Reports to the Nations
- 27 | Interdisciplinary Nature

28 CONTRIBUTION

- 29 | Climate Services
- 32 | Science-policy Interface
- 34 | Projects
- 36 | Collaboration Networks
- 38 | Education

41 COMMUNICATIONS

- 42 | Media and Social Networks
- 43 | Outreach

44 THE CR2 TEAM

This report is dedicated to Macarena Valdés Salgado

CR2 is a center of excellence funded by ANID's FONDAP program (Project 1522A0001) in which nearly 60 researchers from the University of Chile, the University of Concepción, the Austral University of Chile, and other academic institutions participate.

Edition and design: CR2 Communications



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EDITORIAL

René Garreaud Salazar

Director CR2 | 2022 - 2023

In 2013, a dozen researchers gathered to present a proposal to the FONDAP Climate Change contest, the largest type of project offered by the scientific system. Our proposal had three major objectives: improve our comprehension of Chile's climate system, including its impacts and interactions with the socio- environmental environment, strengthen the emerging community of social and natural scientists, and contribute to defining adaptation and mitigation measures to increase resilience to imminent climate change. In 2018 we added the tasks of training the new generation of scientists and professionals to face these challenges and contribute to the goals of sustainable development and low carbon consumption in line with the Paris Agreement.

After a decade of work, it is an opportune time to review our achievements, synthesize out science and reflect on how the center has evolved. This is the objective of the report that we deliver today. We are pleased to note that internal and external evaluations indicate that CR2 has become a well- known center, promoting and leading nationally in climate science and resilience. These achievements are due to the dedicated and talented work of our research, management and student teams, who have produced high quality disciplinary studies along with employing new modes of interdisciplinary research inside and outside the center. Excellence and rigor are a transversal condition of our work, much of which is based on the drive line of research of the center. The interdisciplinary approach is required to face problems as complex as climate change, but it does not arise spontaneously. Thus, the center has devoted time and energy to fostering collaborative research, using transversal themes as catalysts for this effort. In this decade we have addressed the Megadrought and water security in Chile, the change of regime of forest fires, red tide and the air pollution, the manifestations of the Anthropocene and the integrated governance of air, earth, fire and water.



The generation of scientific knowledge on sensitive and urgent issues such as the impact, adaptation and mitigation of climate change must be made available to society quickly and openly. Since its inception the center has sought to fulfill this task, balancing the rigor and complexity of our work with the clarity necessary for a non-expert audience. Our communication team has achieved

this proper balance and employed very efficient means, from our well known "Reports to the Nations" to analyses, policy briefs and climate capsules. The center has also excelled in its support for many instances required by the powers of the State. This contribution to public policy is diverse and has a high point in the formation of Chile's Framework Law on Climate Change. Equally important and valuable has been the role of CR2 in training the new generation of professionals and researchers, through thesis, undergraduate and postgraduate courses and summer schools.

Despite progress, the challenges ahead are great and varied. At a time when the impacts of climate change are becoming more intense and the opportunity window to slow the green-

house effect is narrowing, CR2 is looking for ways to maintain and extend its human and technical group. Contrary to the idea that "science is solved" there are many aspects yet to be understood in order to correctly inform society about its adaptation and mitigation options. These challenges fuel our dream to continue learning and transferring to and from society in the broad arc of climate science and resilience.

Maisa Rojas Corradi

CR2 Director | 2019 - 2021

Climate Change is one of the issues that has been addressed continuously and coherently in Chile by governments of all political persuasions, since there is consensus that it is an urgent problem and, at the same time, offers opportunities for sustainable development. In this context, CR2 was created a decade ago as part of the FONDAP program of research centers in areas that the

State of Chile considers a major priority for the country, such as climate change, solar energy, disaster management, cities, indigenous peoples, among others.

CR2 has been characterized not only by the development of knowledge and the training of researchers, but also by contributing to public policy and generating close ties with political authorities, public and private institutions, and civil society. This is essential when we face a triple environmental crisis: climate change, loss of biodiversity and pollution. All these crises are interrelated and must be faced in a synergistic and systemic

manner to advance the construction of social and environmental resilience, always based on the best scientific knowledge available for decision making.

CR2 understood early that in order to contribute to resilience it had to be a resilient institution, which has translated into a continuous process of self-assessment and learning how interdisciplinary is called out.

On this tenth anniversary, I congratulate CR2 for establish itself as a reference in climate research, climate change and resilience, and I hope that its contribution to science and public policy continues to have a positive impact on our country.



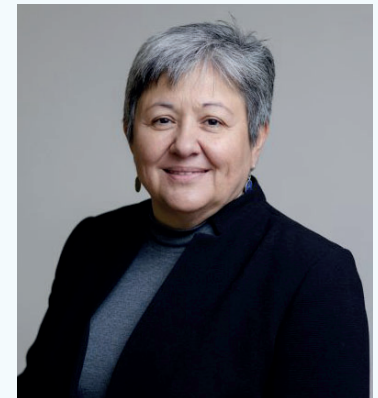
Laura Gallardo Klenner

CR2 Director | 2013 - 2018

A few days ago, I was giving a class on interdisciplinary and complexity for a group of Chilean and Swedish researchers. Suddenly I thought: “What audacity!” But, of course, CR2 has an interdisciplinary ethos and we have learned from each other over these ten years. Better yet, we have been relevant and influenced the national discussion.

At the end of 2011, the same year of the student revolt that demanded “free and quality education”, and whose leaders are today senior government officials, including the President of the Republic Gabriel Boric, suddenly surprising is, a call appeared to proposals for centers of excellence in priority areas including, for the first time, climate change. In the international scientific arena, there was talk of the need to have an integrated vision of the Earth System, including its physical, chemical, biological and social dimensions (Earth System Science). It was also recognized that it was necessary to establish bridges between science and decision making if the sustainable development goals were to be effectively achieved. We already knew (we sensed) that we were dealing with a complex system –and therefore we had to approach it interdisciplinary– and that we had to build bridges with decision making – transdiscipline–.

Seen ten years later, the conclusion is that, after a lot of conscientious work, we achieved it. But today’s challenges are even greater. The good thing is that those who have succeeded is have more tools to continue doing science conscientiously. Hopefully the authorities are also aware that we are addressing a priority areas and imperative financing.



ABOUT CR2

- CR2
- A bit of History
- Research Team
- Scientific Productivity
- Scientific Equipment
- Computational Resources
- Stations and Instruments



Cajón del Maipo 2013



Villa Alegre 2014



Roca Negra 2015



Malalcahuello 2016



Punta Arenas 2017



Chillán 2018



Puerto Varas 2019



Online 2020/2021



Reñaca 2022

CR2

The Center for Climate and Resilience Research CR2 is a **research center** that brings together researchers from the social and natural sciences with the purpose of generating knowledge about **climate science and resilience** from an interdisciplinary approach, and how climate change impacts to Chilean ecosystems and society.

At CR2, researchers from the **University of Chile** (sponsoring institution), the **University of Concepcion** and the **Austral University of Chile** (associated institutions), and other academic institutions throughout the country converge.

The CR2 teams of management, administration, scientific computing, interdisciplinary work, education, and communications operate in the **Geophysics Department** of the Faculty of Physical and Mathematical Sciences of the University of Chile.

In addition to supporting the training of new researchers, CR2 seeks to collaborate with the **public policy** and **disseminate** the knowledge generated in order to be a global reference on climate and resilience issues from Latin America.



A Bit of History

The first cycle of CR2, between 2013 and 2017, focused on understanding the climate system and its impacts on the country, strengthening the national scientific community, and contributing to climate change adaptation and mitigation measures.

2013



Official launch of the Center for Climate and Resilience Research CR2.

Tuesday, October 15, 2013

Film Library of the Palacio La Moneda Cultural Center

2014



CR2 legal bulletins are released.

Digital newsletters prepared by the Human Dimension team of our Environmental Law Center at the University of Chile.

2015



The first Report to the Nations CR2 is launched: *The 2010 - 2015 Megadrought: A Lesson for the Future*.

Friday, November 6, 2015

Enrique D'Etigny FCFM auditorium, University of Chile

The first CR2 document related to the Proposed Legal and Institutional Framework to Address the Climate Change in Chile is published.

2016



The Explora - Conicyt project "Julieta in the Land of Girls" is developed.

CR2 is part of the International Network of Climate Change Centers of Excellence and Think Tanks for Capacity Development.

It also participates in the drafting of the chapter "Vulnerability of the Country and its Adaptation to Climate Change" of the Third National Communication of Chile to the United Nations, all of this within the framework of COP22.

Economic and comparative legislation reports are published.

Documents related to the Proposed Legal and Institutional Framework to Address the Climate Change in Chile.

2017

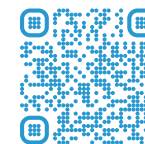


CR2 fifth anniversary is celebrated in a ceremony with the participation of the President of the Republic, Michelle Bachelet.

Tuesday, October 17, 2017

Enrique D'Etigny FCFM auditorium, University of Chile

Full video of the event



In its second cycle, CR2 adds the commitment to become a relevant national actor to achieve sustainable development and achieve the Chilean goal of reducing carbon emissions according to the Paris Agreement.

2018

CR2 begins its second life cycle



Official presentation of the CR2 climate platforms and services to support decision making.

Tuesday, September 4, 2018

Alessandri Auditorium, Law Faculty of the University of Chile.

2019



Launch of the Report to the Nations CR2: The Anthropocene in Chile: Evidence and Ways Forward.

Tuesday, March 19, 2019

Enrique D'Etigny FCFM Auditorium, University of Chile.

The Climate Change Law Observatory for Chile is created.

CR2 researcher participates as author of the report of the Intergovernmental Panel on Climate Change (IPCC).

Specifically, she collaborated in the writing of the "Special Report on the Ocean and Cryosphere in a Changing Climate".

2020



Launch of the CR2 Report to the Nations: Forests Fires in Chile: Causes, Impacts and Resilience.

Thursday, January 9, 2020

Espacio Mas Auditorium, University of Concepción.



Launch of the CR2 Report to the Nations: "The Air we Breathe: Past, Present and Future".

Monday, September 7, 2020
Online

The climate platform Atlas of Climate Risks for Chile ARClm is presented.

2021



Launch of the CR2 Report to the Nations: Climate Governance of the Elements.

Tuesday, August 24, 2021
Online

CR2 members participate as authors of the report "Climate change 2021: The physical science basis, by IPCC".

2022



The sixth CR2 Report to the Nations: "Red Tide and Global Change is launched".

Tuesday, November 17, 2022

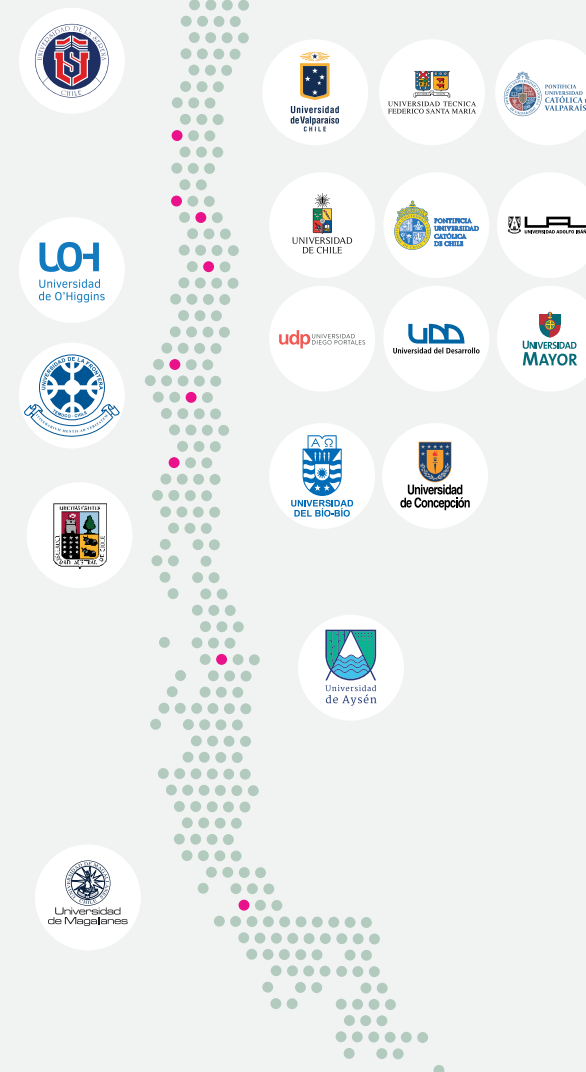
Cultural Office of Quellón

CR2 members participate as authors of the report "Climate change 2022: Impacts. Adaptation and Vulnerability by IPCC".

Research Team

Understanding that climate change generates differentiated impacts in each territory, CR2 has been characterized by bringing together a research team from different universities and regions of the country, as a way to have multiple views and perspectives, and thus be able to develop work that considers the different national realities.

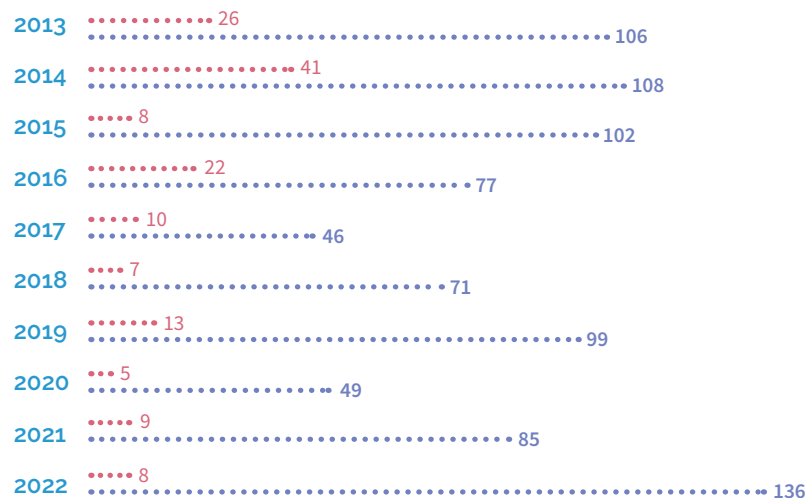
The research work of CR2 has not only been evidenced in the more than 800 scientific publications, but also in the training of students and future researchers, counting in these ten years of existence: **58 doctoral theses, 149 master's theses and 142 undergraduate theses.**



Scientific Productivity

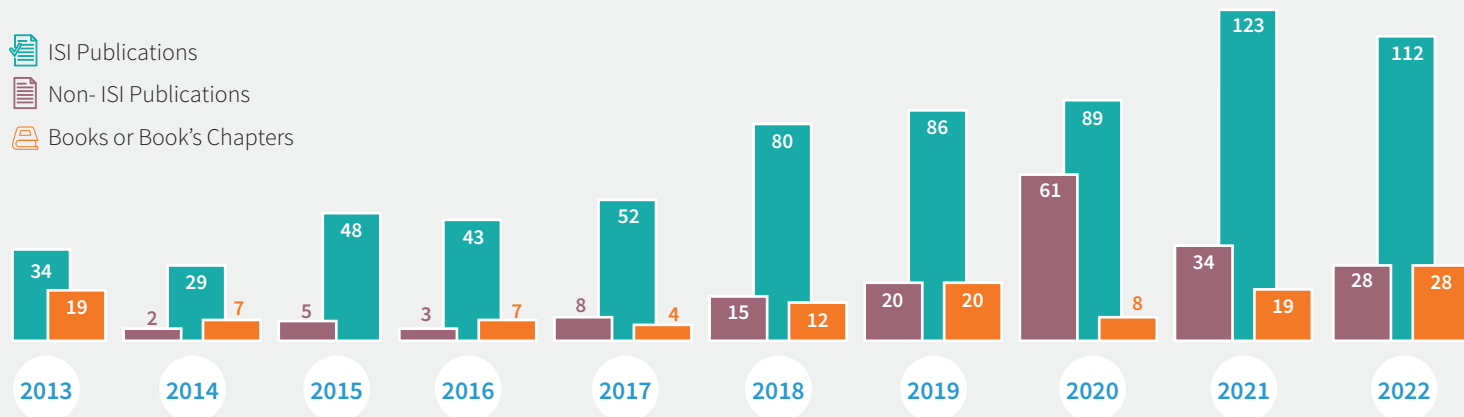
Conferences

• Organization • Participation



Publications

- ISI Publications
- Non- ISI Publications
- Books or Book's Chapters



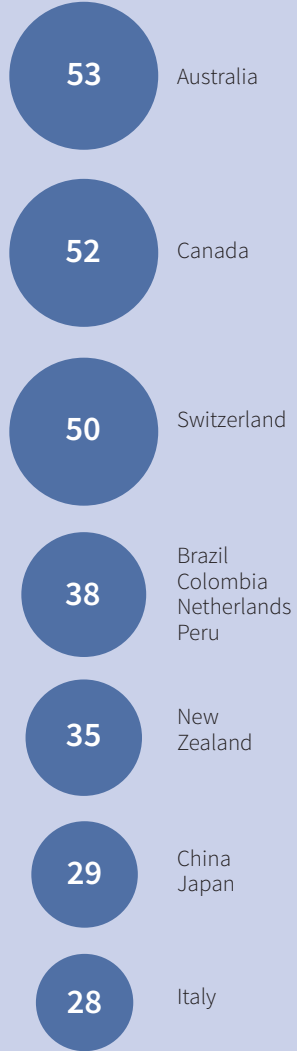
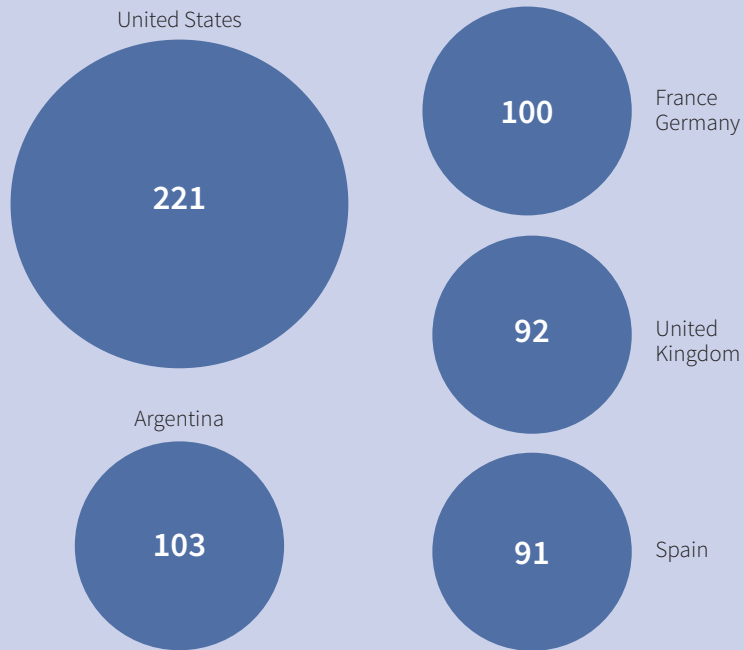
Totals 2013-2022

696
ISI Publications

176
Non-ISI Publications

124
Books or Book's Chapters

Publications in ISI magazines that have been developed in collaborative ways between international and CR2 researchers. The graph shows the number of collaborations by country between 2013 and 2022.



Scientific Equipment

Computational Resources

CR2 is committed to providing advanced computational infrastructure and cutting-edge resources to support research in atmospheric and climate sciences. These resources allow high quality studies to be carried out and contribute to the advancement of knowledge in this field.

It has a large data storage capacity and virtualization infrastructure that allows us to store different databases and platforms. Some of these are the historical database of fire scars in Chile, streamflow response to native forest restoration, climate change adaptation practices, transformation actions, in addition to climate reconstructions and data on different variables, such as: precipitation, temperature, ozone, flows, and particulate matter, among others.



Our storage capacity is supported by two environments. The first is an exclusive area for CR2 in the **Computer Center of the University of Chile**, where there is a combined storage capacity of 500 Terabytes.



The second is located in the **National Laboratory of High-Performance Computing (NLPHC)** of the Mathematical Modeling Center of the University of Chile. Here you have access to the Guacolda and Leftraru systems that offer 120 processing course per user and five terabytes available for temporary storage of results.



Stations and Instruments

CR2 has equipment that allows different variables to be recorded. These data of extremely importance for national and international research are available to the entire community.



SODAR

This equipment allows measuring wind (**magnitude and direction**), vertical speed and turbulence in a column of air up to 1000 meters high above the installation level.



📍 Quinta Normal Station



Proton transfer reaction system with time-of-flight mass spectrometry (PTR-TOF-MS)

Quantify in real time the volatile organic compounds present in the air.

📍 Department of Geophysics, Faculty of Physical Sciences of Mathematics, University of Chile

Meteorological stations and pluviometer station

Its objective is to study climate variability and water balance (rainfall-snow regime) in a mountain basin dominated by araucaria and lenga forests. A meteorological station and pluviometer station are located at 1,260 meters above sea level, another two meteorological stations are at 1,450 meters above sea level.

📍 Nasampulli Reserve, Melipeuco, La Araucanía Region



Solar photometer

Allows to study the interaction between solar radiation and aerosols.

📍 Department of Geophysics, Faculty of Physical Sciences and Mathematics, University of Chile



Cerro Tres Puntas

Station that provides, among other things, **temperature, pressure and precipitation** data from the mountain area of the metropolitan region, generating time series that are available in free form and real time.

📍 3,685 meters above the sea level, in the limits of Valle Nevado Ski Center, about 60 kms. from Santiago.



Atmospheric River Observatory

This station allows us to understand the **behavior of atmospheric rivers**. It has various state of the art instruments that operate autonomously and automatically.

📍 Faculty of Physical Sciences and Mathematics, University of Concepción.



POSAR System

The Observation Platform of the Ocean Atmosphere Coupled System is made up of instruments that allow **meteorological and oceanographic variables** to be recorded. The data obtained is available freely and in real time.

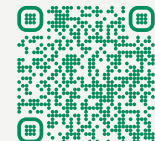
📍 5 nautical miles in front of the mouth of the Itata river, Biobío region, 30 kms. North of Talcahuano.

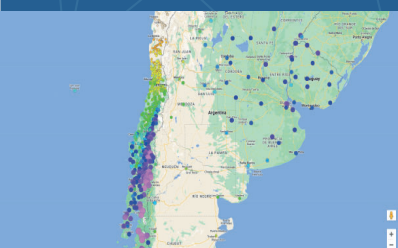
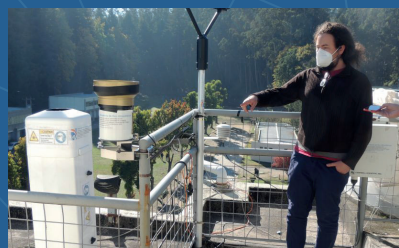
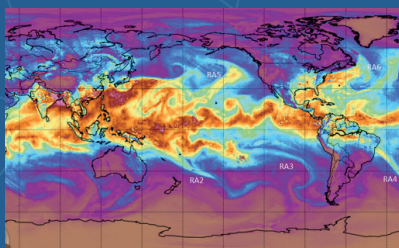


Flow Tower

36 meters tall tower instrumented for measuring the **flow of CO2 and water**; seeks to know if the alerce (*Fitzroya cupressoides*) forests acts as sinks or as a source of carbon in the different seasons of the year, along with knowing their productivity and comparing this attribute with other ecosystems globally.

📍 National Park Alerce Costero, La Unión, Los Ríos region, 820 meters above sea level



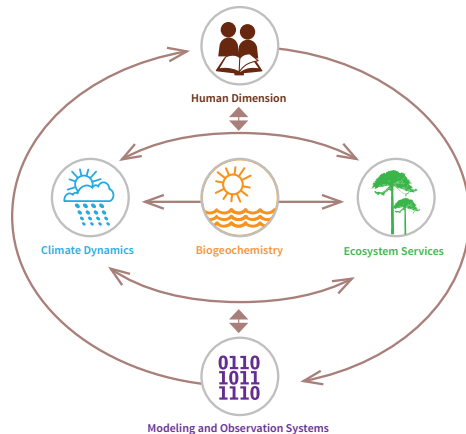


RESEARCH

- Research Lines
- 2013-2017
- 2018-2022
- Cross-cutting Themes
- Reports to the Nations
- Interdisciplinary Nature

Research Lines

2013-2017 Cycles



Biogeochemistry

This line of research was made up of and interdisciplinary group of specialists dedicated to the study of the movement and transformation through Earth system of elements such as water, carbon, greenhouse gases and nutrients, among others.

Climate Dynamics

The research of this line focused on the characterization and understanding of the variability over time of water resources, in addition to the underlying physical factors throughout the country and at multiple times scales.

Human Dimension

This line developed its research, mainly, from law, economics, sociology and social psychology. They analyzed public policies related to climate change in Chile and relations between different social sectors in decision making.

Modeling and Observation Systems

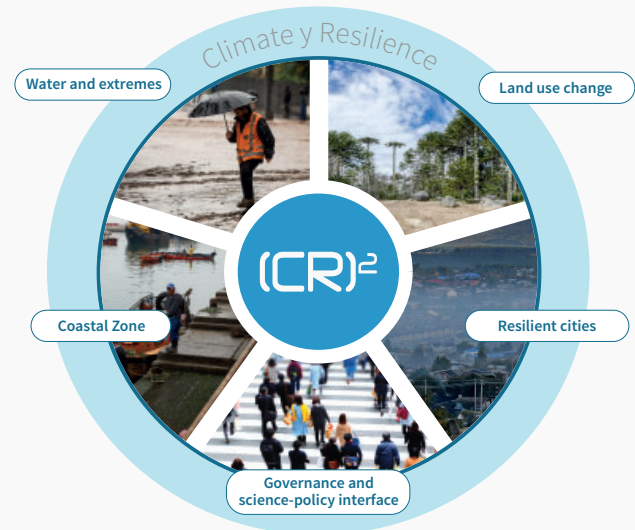
The research efforts of the modeling and observation systems line focused on studying climate variability and estimating the disturbance of human beings on the climate.

Ecosystem Services

This line focused its work on land use change, ecological restoration, forest fires and their relationship with ecosystem services, that is, the benefits that nature brings to society.

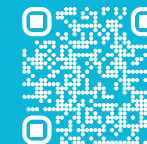
2018-2022 Cycle

The second cycle of the Center sought to go beyond the disciplinary approach developed through its first five years, and decided to focus on topics that would allow an interdisciplinary approach. Thus, the current research lines were created: water and extremes, coastal zones, land use change, governance and science-policy interface, and resilient cities.



Water and Extremes

This line of research seeks to study **extreme hydrometeorological** events and their impact on both natural and non-natural ecosystems, analyzing the role played by natural variability and anthropogenic climate change.



It has been determined that in terms of duration and intensity, the current megadrought in central Chile is **unprecedented in the last 1000 years**. This phenomenon is generating adverse effects on rivers, on the coastal zone productivity, on socio-ecosystems and biodiversity.



The projections made by this line show that precipitations, river flow, the mass of Andean glaciers and the snow cover of central Chile **will decrease between 25% and 40%** by the end of this century.



It has been detected that the atmospheric rivers that occur in the summer period, added to the heat waves and deglaciation, generate **negative impacts on the drinking water supply of Santiago** due to the landslides and the increase in sediments and turbidity in the water.



It has been determined that the current Water Code and its system for water use rights is **not compatible** with the natural processes that occur in the basins.



Using hundreds of thousands of tree rings, the history of drought and soil moisture across South America between 1400 and 2019 was reconstructed. With this information the **South American Drought Atlas** was developed, implementing an interactive platform that can be easily used by the center's different target audiences.

Principal Investigators

- René Garreaud
- Duncan Christie

Principal Co-investigator

- Camila Álvarez-Garretón

Associate Researchers

- Paulina Aldunce
- Ariel Muñoz
- Mauricio Zambrano

Full-time Researcher

- Juan Pablo Boisier

Postdoctoral Researcher

- Dipjyoti Mudiari

Adjoint Researchers

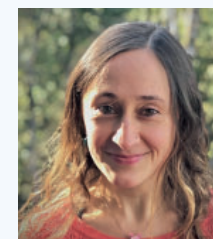
- Deniz Bozkurt
- Raúl Valenzuela
- Patricio Moreno



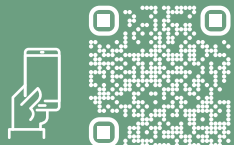
René Garreaud



Duncan Christie



Camila Álvarez-Garretón



Research Line 2018 -2022

Land Use Change

The objective of this line is to study the change in land use, its impacts on ecosystems and its relationship with climate change, basic for the **design of resilient landscapes**.

Principal Investigator

- Antonio Lara

Principal Co-investigator

- Mauricio Galleguillos

Associate Researcher

- Mauro González

Adjoint Researchers

- Susana Gómez-González
- Jorge Hoyos-Santillán
 - Javier Lopatin
- Alejandro Miranda
 - Rocío Urrutia
 - Felipe Vásquez
- Carlos Zamorano

Research Collaborators

- Armando Sepúlveda-Jauregui
- Camila Tejo



A drastic change in the fire regime was documented in South Central Chile in terms of the **occurrence of large fires, increase in the total area burned, and extension of the fire season**. This change is mainly due to the megadrought and the development of homogenous landscapes dominated by exotic forest plantations.



It was shown that the expansion of forest plantations, compared to the restoration of native forest in the basins, would lead to an **18%** reduction in flows if the ratio of plantations to native forest were 50%, and a **38%** reduction if the ratio were 90%.



The removal of eucalyptus plantations and their restoration to native forests leads to a **persistent increase in annual flow** (40 to >100% in most years), being the first study to address this issue.



A **database of fire scars in the landscape** was developed, mapping the historical burned area and the severity of the fire in Chile, which is available to any user.



A relevant finding is that Patagonian peatlands store **4,800 million tons of carbon**, one of the main reservoirs in Chile. This result was of great importance for the inclusion of peatlands in Chile's Nationally Determined Contribution in 2020.



Mauricio Galleguillos



Antonio Lara

Resilient Cities

This line of research seeks to understand how **Chilean cities evolve** in terms of pollution, extreme events, vulnerability, resilience, and governance, focusing on how the dynamics of these processes are perceived on a human scale and are aggravated by social inequality.



The **impacts of the COVID-19 pandemic** in urban areas were evaluated, both the effect of inequality in terms of emissions and impacts on the health of Chilean society and the impacts of mobility restrictions and polluting emissions at the global level.



Documentation was developed to achieve the **black carbon mitigation goal** in the context of Chile's Nationally Determined Contribution.



Territorial energy vulnerability has been evaluated to improve the transition process towards cleaner energy sources. This research work addresses everything from the firewood market in Southern Chile to the impact of social inequalities in the framework of national measures to mitigate pollution.



The interaction between **resilience** and multiple **urban risks** was evaluated and characterized in one of the main cities of the central zone.



A detailed **national inventory of residential, mining, energy, and industrial emissions** was developed, which also provides a historical inventory national mobile emission between 1990 and 2020.



Principal Investigator

- Eugenia Gayó

Principal Co-investigator

- Anahí Urquiza

Associate Researchers

- Nicolás Huneus
- Fabrice Lambert
- Pamela Smith

Full Time Researcher

- Rodrigo Seguel

Adjoint Researchers

- Estela Blanco
- Zöe Fleming
- Laura Gallardo
- Marcela Munizaga
- Axel Osses
- Mauricio Osses
- Pablo Sarricolea

Research Collaborator

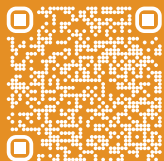
- Enrique Aliste



Eugenia Gayó



Anahí Urquiza



Research Line 2018 -2022

Governance and Science-policy Interface

Understanding that climate change is a phenomenon that affects the entire society, this line of research seeks to **understand and improve the science-policy interface** to favor decision making based on scientific evidence, aiming for low carbon development that is economically viable.

Principal Investigator

- Pilar Moraga

Principal Co-investigator

- Rodolfo Sapiains

Associate Researchers

- Gustavo Blanco
- Cecilia Ibarra
- Antoine Maillet
- Raúl O’Ryan

Adjoint Researchers

- Gabriela Azocar
- Marco Billi
- Roxana Bórquez
- Dominique Hervé

Research collaborator

- Rosario Carmona



This line of research led the project called “**The Legal and Institutional Framework to Address Climate Change in Chile**”, which allowed the preparation of various documents that sought to advance the need to have a climate law in the country.



Participated as technical support in the discussion of the **Climate Change Framework Bill** in the Senate Environment Commission, answering questions and proposing legislative solutions.



A **conceptual framework for climate governance** was developed with a perspective from the southern hemisphere.



To monitor the development of this new national legislation, the **Observatory of the Climate Change Framework Law** was created. In this context, members of the line participated in different related instances and prepared dissemination material, such as minutes of the sessions, policy briefs and talks.



A participatory project was led to identify the legal reforms necessary to achieve the **national net zero emissions goal**.



Progress has been made in the social perception of climate change in different subjects with the aim of understanding how the impacts generate **cognitive and relational changes** in the population, especially in terms of community participation.



Rodolfo Sapiains



Pilar Moraga

Coastal Zone

Considering that the main Chilean cities are located in the coastal zone, this line of research seeks to determine what the **impact of climate change will have** on these socio-natural territories.



Greenhouse gas exchange zones between the ocean and the atmosphere were identified along the South Pacific, achieving better resolution than global models. It was determined that the **coastal upwelling emits greenhouse gases** (nitrous oxide, methane and carbon dioxide) from the ocean into the atmosphere, in addition to causing a decrease in sea surface temperature and oxygen. This deoxygenation is accelerating in recent years on the coast of central Chile, which would lead to massive mortality of fish and changes in the food chain.



It was identified that the decrease in river water, as a result of the megadrought, **reduces the transport of nutrients to the sea and the biomass of phytoplankton**, impacting the ecological processes and productivity of the coastal zone.



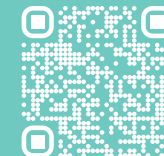
Future climate scenarios were generated for the Antarctic Peninsula Sea, and projected that the acceleration of climate change will generate changes in the **composition and functions** of polar microbial communities.



Extreme events affecting the coastal zone have been characterized, in particular, storm surges, tornadoes and water spouts, atmospheric and marine heat waves, atmospheric rivers, and harmful algal blooms. In addition, environmental factors that promote them have been identified, which potentially contribute to their prognosis and location of impacts. This knowledge has been generated and shared with government institutions in charge of its monitoring and management.



It has been evident in recent decades that the **absence of marine heat waves** favors the existence of algae in the southwest of Patagonia, so this region could be considered a possible climatic refuge for these species.



Principal Investigator

- Martín Jacques

Principal Co-investigator

- Laura Farías

Associate Researchers

- Catalina Aguirre
- Roberto Rondanelli

Adjoint Researchers

- María Estrella Alcamán
- Deniz Bozkurt
- Noelia Carrasco
- Beatriz Diez
- Ítalo Masotti
- Laura Ramajo

Postdoctoral Researcher

- Ana María Ugarte

Research Collaborator

- María del Pilar Aparicio



Martín Jacques



Laura Farías

Cross-cutting Themes

As a way to understand and address the impacts of climate change from an inter and transdisciplinary perspective, the CR2 has developed integrative themes led by researchers from the center, which aim to study complex and relevant phenomena that occur in the national territory.

The topics that have been investigated are:

First Cycle 2013-2017

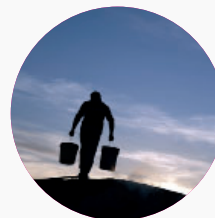
- Megadrought studies
- Regional manifestations of the Anthropocene: the case of Chile

Second Cycle 2018-2022

- Atmospheric pollution
- Harmful algal blooms
- Forest fires
- Water security

2013-2017 Cycle

Megadrought Studies



Lead Researcher
René Garreaud

Research related to the megadrought –the series of dry years in central Chile that began in 2010 and extends to today– was the first cross-cutting theme developed by CR2. Understanding the causes of this phenomenon and the socio-environmental impacts it generated throughout Central Chile involved an interdisciplinary approach that culminated in multiple scientific articles and also in the first Report to the Nations called The 2010-2015 Mega-drought: A Lesson for the Future.

Regional Manifestations of the Anthropocene: The Case of Chile

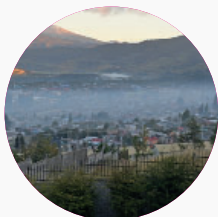


Lead Researcher
Laura Gallardo

We live in a time where the future of the Earth System is dominated by human activities. To see how this manifested itself in Chile, CR2 developed this cross-cutting theme as a way to identify paths towards great resilience, an analysis that ended in a series of articles published in a special edition of the journal *Elementa: Science of the Anthropocene* and whose results were synthesized in the second Report to the Nations of the center: The Anthropocene in Chile: Evidence and Ways Forward.

2018-2022 Cycle

Atmospheric Pollution



Lead Researcher
Nicolás Huneeus

This cross-cutting theme aims to characterize air quality in relation to PM_{2.5} in central and southern Chile from pre-Columbian times to the present, including socioeconomic and technological factors related to atmospheric pollution and its mitigation. To achieve this, we worked with multiple databases, simulations and collaborative work with researchers from different disciplines. This line developed the Report to the Nations The Air we Breathe: Past, Present and Future. PM_{2.5} air pollution in Central and Southern Chile.

Harmful Algal Blooms



Lead Researcher
Laura Farías

For more than 2 years, this interdisciplinary team carried out multiple studies to determine the natural and anthropogenic causes that favor the occurrence of harmful algal blooms, the associated socioecological impacts and risks, as well as the responses that different social actors and communities have developed to reduce vulnerability for these events. These allowed us to contribute scientific evidence to the knowledge of this phenomenon and contribute to the strengthening of public policies. The results were synthesized in the Report to the Nations “Red Tide” and Global Change.

Forest Fires



Lead Researcher
Mauro González

A research group of more than 30 people formed this line of work that sought to evaluate the main drivers of the change in the fire regime in Chile and its social, economic, ecosystemic, and institutional effects. The results culminated in various scientific articles and the Report to the Nations Forest Fires in Chile: Causes, Impacts and Resilience.

Water Security



Lead Researcher
Camila Álvarez-Garretón

This cross-cutting theme focuses on reconstructing and evaluating Chile’s water security in the last sixty years, from a national to local scale, considering the climatic and social factors that have determined its trajectory. Likewise, water security levels are projected during the 21st century in a context of climate change. At the end of 2023, the main milestones of this working group will be published in the Report to the Nations Water Security.

Reports to the Nations

The work developed by the cross-cutting themes has involved collaboration and synergy between the different lines of research, which has generated high impact results such as Reports to Nations. These documents provide updated information on issues of national interest related to climate change and include recommendations that serve as input for decision makers.

In the 10 years of CR2, six reports have been prepared, which have addressed the current megadrought, the era called the Anthropocene, forest fires and the changes that have occurred in recent years, air pollution due to fine particulate matter, a model proposal climate governance, and harmful algal blooms. A new report related to water security will be published at the end of 2023.

The first report made by CR2 was about the mega-drought; the president of the Republic, Michelle Bachelet, officially received the document in November 2015 from the principal investigators of the center.



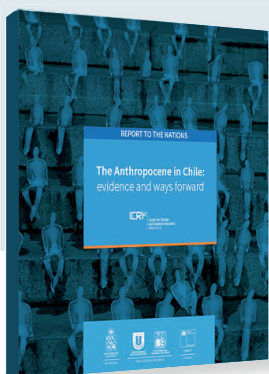
The 2010-2015 Mega-drought: A Lesson for the Future

The first CR2 Report to the Nations was the one that coined the concept of “mega-drought”. Some of their findings indicate that at least 25% of the current rainfall deficit can be attributed to climate change caused by human emissions of greenhouse gases. Among the recommendations, we can highlight the proposal to establish an interinstitutional organization that promotes the adaptive capacity of society, reform the Water Code, enshrine water as a human right and strengthen research into freshwater reservoirs.

Launch

 November 6, 2015

 Campus Beauchef, Santiago



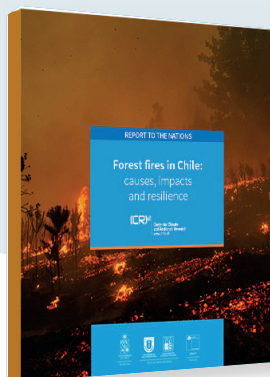
The Anthropocene in Chile: Evidence and Ways Forward

This cross-cutting report from the center sought to demonstrate how the era of the Earth dominated by human activities (Anthropocene) was expressed in Chile, spanning from pre-Hispanic period to the present. Some of the recommendations it provides are to take into account all the factors and be able to consider the interrelationships between the various physical and social subsystems, Advanced rapidly in the carbonization material and promote changes in the behavior of society in the face of this new epoch.

Launch

 March 19, 2019

 Campus Beauchef, Santiago



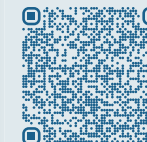
Forest Fires in Chile: Causes, Impacts and Resilience

This report provide evidence of how the fire regime in the country has changed, and what the impacts have been on the atmosphere, biodiversity and the neighborhood of society. Among the findings, the extension of the fire season, the greater severity, and especially the increase in the occurrence of megafires (> 10,000 ha) associated with extreme weather conditions (heat waves and drought) and a coverage strongly dominated by forest plantations stands out.

Launch

 January 9, 2020

 Concepción University



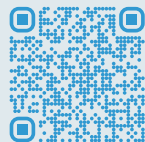
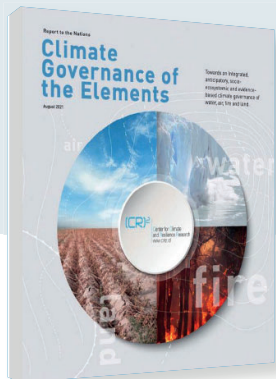
The Air we Breathe: Past, Pre- sent and Future. PM_{2.5} Air Po- llution in Central and Southern Chile

This report focused on pollution with fine particulate matter, addressing topics such as health, climate change, industry, energy transition, among others. Some of the recommendations provided postulate the improvement of monitoring, the implementation of a national system of inventory of missions of pollutants that affect air quality, the flexibility of the requirements to dictate prevention plans and increase the standard of the Technical Standard of homes, among others.

Launch

 September 7, 2020

 Online



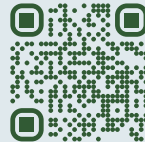
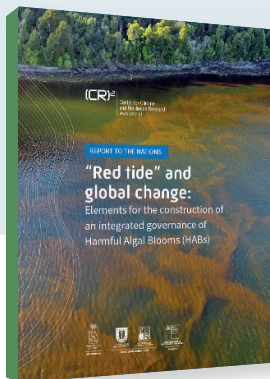
Climate Governance of the Elements: Towards an Integrated, Anticipatory, Socio-ecosystemic and Evidence-based Climate Governance of Water, Air, Fire, and Land in Chile

This report proposes a new way of addressing socio-environmental problems through a governance model that takes into account the interaction between the four elements of nature that makes up the climate system: water, air, fire, and earth. Likewise, the governance that currently govern Chile is examined to identify gaps and possible paths to advance towards the proposed model.

Launch

 August 24, 2021

 Online



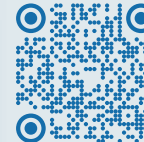
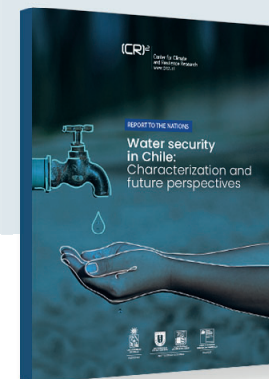
"Red Tide" and Global Change: Elements for the Construction of an Integrated Governance of Harmful Algal Blooms (HABs)

The latest CR2 report was framed in the study of harmful algal blooms in Chilean Patagonia from the risk framework of the Intergovernmental Panel on Climate Change (IPCC) and with a preventive, inter and transdisciplinary approach focusing on natural and anthropogenic causes. That favor its occurrence, the associated multidimensional risks and impacts and the responses that the different social sectors have developed.

Launch

 November 17, 2022

 Quellón, Chiloé Island



Water Security CR2 Report

By the end of 2023, the last Report to the Nations of the second cycle of CR2 is expected to be published, which will address Chile's water security. This document will refer to the historical and projected national water availability under climate change scenarios, as well as sectorial uses of water, current legislation and instruments focused on water management, among other related matters. One of its objectives is to provide scientific evidence and governance recommendations to advance towards water security.

Launch

 November 23, 2023

 Campus Beauchef, Santiago

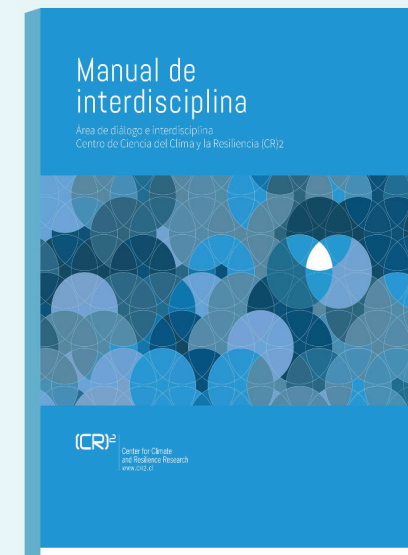
Interdisciplinary nature

As its name indicates, interdisciplinary nature has been transversal in CR2, manifesting itself in all facets of its work: from the methodologies used for collaborative work, research, decoration of dissemination products and internal and external reports, to the generation of cross-cutting themes and collaboration with various institutions of society, all of which has required dialogue and participation processes as well as the construction of robust analytical and methodological frameworks.

From the first life cycle of the center, it was considered that interdisciplinary was necessary to overcome the gap between the natural sciences and the social sciences, which has led to the implementation of important organizational transformations that are required to advance an interdisciplinary approach to research in variability, climate change and resilience.

Interdisciplinary Manual

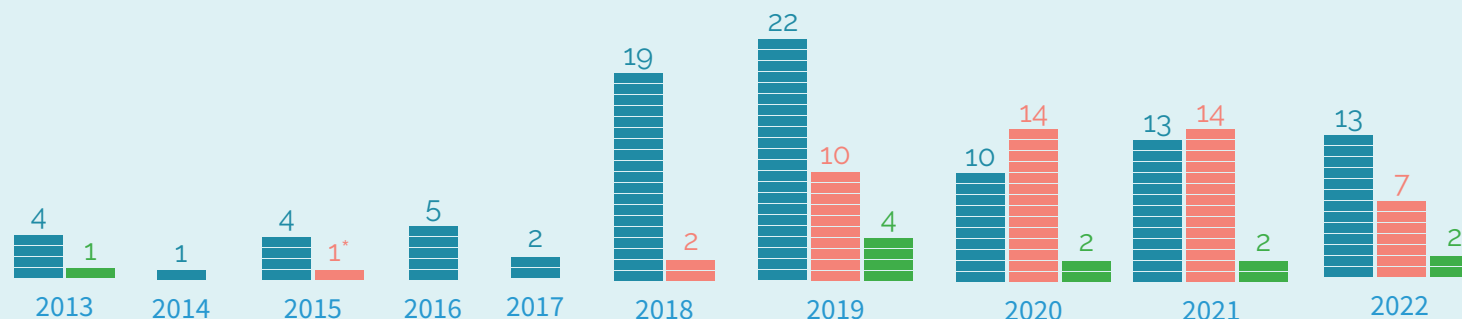
Since climate change is a complex problem, interdisciplinary methodologies appear to be the most effective to understand, analyze and address it. Considering the above, CR2 prepared its Interdisciplinary Manual, which has four objectives: 1. Make known the interdisciplinary experience of CR2 and the challenges it has represented; 2. present the principles that allow interdisciplinary work; 3. provide theoretical, methodological and monitoring tools of the interdisciplinary and 4. provide greater collaboration between the different disciplines that are part of CR2.



Interdisciplinary Publications

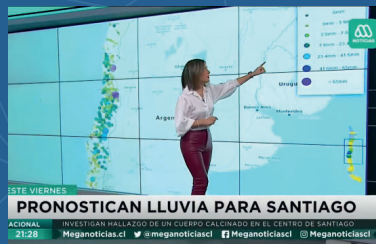
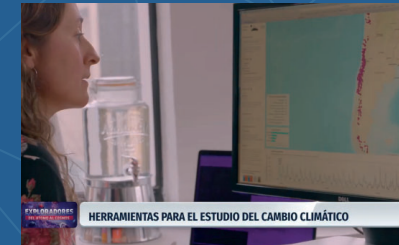
- ISI Articles
- Non-ISI Articles
- Books' Chapters

*Report to the Nation
"Megadrought 2010-2015:
A Lesson for the Future".



CONTRIBUTION

- Climate services
- Science-policy Interface
- Projects
- Collaborations networks
- Education



Climate Services

Always thinking about making observations and recorded data available to society and its different institutions, the CR2 has various climate services that allow viewing, for example, the historical and current rainfall that has occurred in the country, the temperature, the flows of its basins, among others. This data has been obtained from stations of different national and international entities.

Climate Explorer

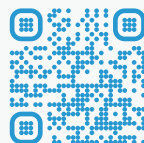
This climate service developed in 2016 allows to view temperature, precipitation and flow data from the year 1940 onwards for the entire country. It is designed to be used by all type of audiences. It has data from the Meteorological Directorate of Chile, the General Directorate of Water, the National Oceanic Administration of the United States and the Department of Geophysics of the Faculty of Physical Sciences and Mathematics of the University of Chile.



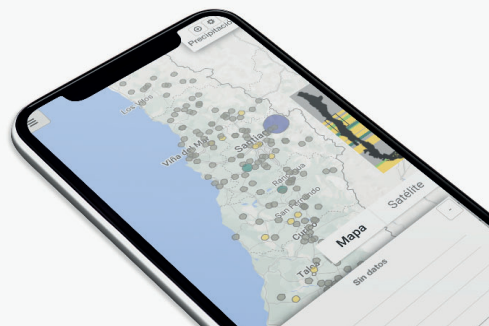
4.131 
Average monthly visits year 2022

Meteorological Visualizer (VisMet)

Launched in 2018, it allows to see the precipitation and temperature of the country in real time from that date. The records are obtained from more than 500 stations belonging to the General Directorate of Water, the Meteorological Directorate of Chile, Agromet, the Ministry of Agriculture and the Center for Advanced Studies in Arid Zones.

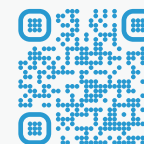


 **3.874**
Average monthly visits year 2022



CAMELS-CL

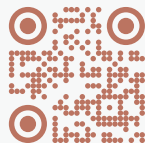
This platform allows to obtain data such as flow, runoff, precipitation or temperature from 516 pluviometers stations located throughout Chile. In addition, it has information on land cover or consumptive rights. Its objective is to contribute to decision making and develop adaptation strategies to climate change.



 **3.500**
Average monthly visits year 2022



Platforms with historical climate and environmental data



South American Drought Atlas (SADA)



Wayra: Historical ozone measurements in Rapanui and Tololo



Coastal Zone Platform: Integrated socioeconomic information for the coastal zone of Chile

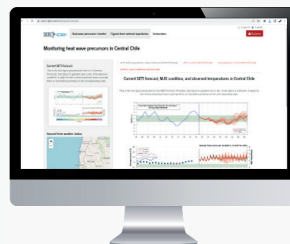
Real Time Monitoring and Observation Platforms



Snow Observatory in Los Andes of Argentina and Chile

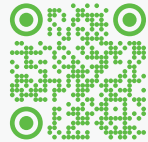
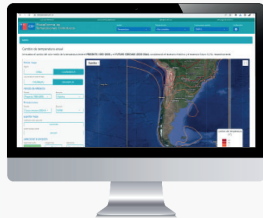


Cerro Tres Puntas Andean Refuge: Monitoring meteorology and air quality in mountains

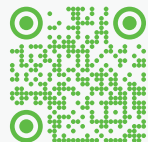


Heat waves Monitoring: Indices to predict heat waves in Chile

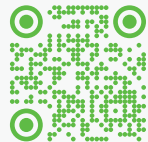
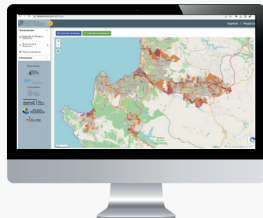
Climate Projection Platforms, Risks and Response Strategies



Climate Simulation Online Platform



Climate Risk Atlas (ARClím)

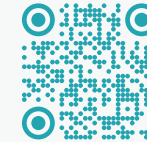
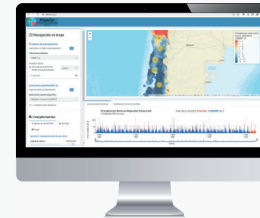


Climate Risk Maps for Viña del Mar and Valparaíso



Drought and Water Security in Chile Platform

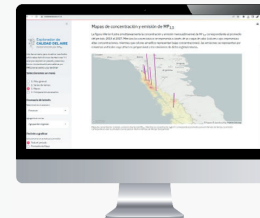
Benchmarking and Specialized Tools Platforms



Mawün: Precipitation Explorer



R-Explorer: Atmospheric analysis data



Explorador de calidad del aire: MP_{2,5} emissions and concentrations in Chile



ClimaWeb

Science-policy Interface

That research is at the service of the country is one of the objectives of CR2. With this in mind, the members of the center have worked together with communities, municipalities and other states entities so that climate change plays a relevant role in public policies.

Proposal for a Legal and Institutional Framework to Address Climate Change in Chile

CR2 y Adapt-Chile, supported by the 2015 Prosperity Fund of the British Embassy in Chile and sponsored by the Ministry of the Environment, carried out a pioneering diagnosis on the **need to have a climate change law in the country**. The work was participatory, involving experts from civil society, academia, municipalities, among other institutions.

Later, members of the center participated in **analyzing the Climate Change Framework Bill** in the Environment Commission of the Chamber of Deputies, whose implementation began on June 13th, 2022.



Proposals for the New Constitution

Considering the contents of the Report to the Nations Climate Governance of the Elements, the center **presented various initiatives** to the Constitutional Convention that was in operation between 2021 and 2022.

Although that proposed Constitution was rejected through plebiscite, the CR2 **continues to work on proposals** for the environment and climate change to be part of the new Constitution to be plebiscized in December of this year.



Collaborations and Advice

Ministry of the Environment: Development of future climate simulations project for Antarctic and insular Chile. The center contributed to updating Chile's National Determined Contribution to the Paris Agreement through the design of a black carbon goal including nature-based solutions as part of the country's strategies for adaptation to climate change. In addition, CR2, together with the UC Global Change Center, led the development of the Chilean Climate Risk Atlas (ARclim) which involved the work of 27 research groups from all over Chile.

Quintero Municipality: Air quality monitoring campaigns were carried out and efforts were made to strengthen alliances between citizens, science and public policies.

Magallanes Regional Government: Joint work was developed to develop the National Development Strategy and a governance model for Magallanes under the concept of "climate refuge".

Fisheries Development Institute: There was a collaboration to improve research, generation and dissemination of knowledge on coastal areas, harmful algal blooms and climate change.



Department of Agriculture: Members of CR2 were part of the report that brought together almost 80 specialists, which provides solid scientific evidence on the value of native forests.

Instances that had the Participation of Members of CR2

- Metropolitan Regional Government Climate Action Advisory Committee
- Future Commission of the Chamber of Deputies, where the Sixth Evaluation Report of the United Nations Intergovernmental Panel on Climate Change (IPCC) was presented
- Expanded Operational Committee of the Plans and Standards Department of the Air Quality and Climate Change Division of the Ministry of the Environment
- Senate Future Challenges Commission, where adaptation to climate change was presented
- Long-term Energy Planning Process defined in the General Law of Electrical Services
- Advisory Committee for the 2050 Energy Policy Update Process of the Ministry of Energy
- National Platform for Disaster Risk Reduction of the Ministry of the Interior and Public Security
- Regional Climate Change Committees of the Metropolitan, Valparaíso and Biobío Regions
- Native Forest Council of the Ministry of Agriculture and CONAF
- Climate Change Commission of the Council of Rectors of Valparaíso
- Cities and Climate Change Working Group of the National Urban Development Council
- Climate Action Advisory Committee of the Ministry of the Environment
- Preparation of the Fifth Assessment Report of the IPCC
- Preparation of the Sixth Assessment Report of the IPCC
- Chilean delegation for the approval of the Summary for Policy Makers of the Sixth IPCC Assessment Report
- United Nations High Level Energy Dialogue
- Scientific Advisory Committee of the Interamerican Institute for Global Change Research
- Promoter Group for the Maipo River Basin Council of the Metropolitan Regional Government
- Trend anticipation exercise "Chile Creates Future" of the National Council of Science, Technology, Knowledge and Innovation for Development
- Scientific Committee on Climate Change of the Ministry of Science, Technology, Knowledge and Innovation
- Strategic Committee for the Ministry of Energy's Green Nitrogen Action Plan
- Fair Socioecological Transition Advisory Committee for the Presidency of the Chamber of Deputies
- Directory of Mirador Interactive Museum

Projects

With the aim of contributing to the translation of the country and Latin America towards low carbon development, the Center for Climate and Resilience Research CR2 implements various initiatives in collaboration with other scientific institutions, as well as with public and private actors and international cooperation organizations rebuild a society more resilient to climate change.

Bridging the Water Adaptation and Governance Gap in Valparaíso (Aconcagua). Promoting Adaptation and Governance in the Face Climate Change in Basins.

Year of execution **2022-2027** Financing: **SSHRC N° 895-2022-1016, Fondecyt N° 32204447 y Fondap CR2**



Inter and transdisciplinary research initiative that seeks to develop participatory adaptation and governance strategies to address climate change and water security that allow building resilience with a basin approach.

Drought and Water Security Platform for Basin Planning: Historical Evolution and Future Trajectories Under Global Change.

Year of execution **2022** Financing: **National Research and Development Agency (ANID)**

Hydrographic basin management platform that offers data on droughts and climate, soil, use and availability of water, among others, to support decision making in the face of droughts in water scarcity in Chile.



Race to Resilience



Year of execution **2021-2022** Financing: **Rockefeller Philanthropy Advisors, Inc.**



In 2021, CR2 assumes the technical secretariat of this campaign of the United Nations Framework Convention on Climate Change that seeks to promote climate resilience worldwide.

Development and implementation of an institutional strengthening and capacity building program at the sub-national level in the context of the development of the climate strategy for resident and low emission development in 2050

Year of execution **2021** Financing: **Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH. Oficina de GIZ en Chile**

The project aims to strengthen the capacities of Regional Climate Change Committees (CORECC) in climate change management and reflect on the challenges of regional governments in public policy towards 2050.

Diploma on climate action and municipal management

Year of execution **2021** Financing: **United Nations Development Program (PNUD)**

This diploma was taught by CR2 researchers and taken by more than 80 municipal officials from all over the country, who acquired various tools to integrate climate change into municipal management.



Air Quality: Worldwide Analysis and Forecasting of Atmospheric Composition for Health (AQ WATCH)

Year of execution
2020-2022

Financing: [European Commission/Research Executive Agency \(REA\)](#)

CR2 is part of the international consortium of this project, which seeks to create innovative products and services to improve forecasts and attribution of air quality with the aim of improving public health and supporting the management of the energy sector in different regions of the world.

Black carbon mitigation in the update of Chile's Nationally Determined Contribution

Year of execution
2019 - 2020

Financing: [United Nations Environment Program](#)

CR2 supported the Climate Change Office of the Ministry of the Environment in the design, evaluation and justification of a quantified black carbon reduction goal that could be integrated and consistent with the national greenhouse gas production goal.



Climate Risk Atlas (ARClim)

Year of execution
2019 - 2020

Financing: [Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH, Federal Ministry of Economic Cooperation and Development \(BMZ\)](#)

Project that identifies the potential impacts of climate change on several critical productive sectors to facilitate the development of adaptation measures. The results are displayed on a free and open access web platform.

Prediction of air pollution in Latin America and the Caribbean (PAPILA)

Year of execution
2018 - 2022

Financing: [European Union/Project for development and innovation, Horizon 2020](#)

CR2 integrates the network of a European and Latin American institutions involved in this project, whose objective is to develop a homogeneous air quality forecast system for Latin American countries.

CO₂



Traditional climate simulations for the Antarctic continent

Year of execution
2018 - 2019

Financing: [Ministry of Environment](#)

The project generates climate projections for the Chilean Antarctic territory through mathematical models in order to support the development of public policies. The information is available on an open and interactive platform.

Regionals Climate Simulations

Year of execution
2017

Financing: [Ministry of Environment](#)

The project generated climate predictions for Chile through climate modeling at a regional scale. This information contributes to the estimation of the country's vulnerability and is available on an interactive platform to support the design of public policies.



Proposal for a legal and institutional framework to address climate change in Chile

Year of execution
2015 - 2016

Financing: [Prosperity Fund of the British Embassy in Chile](#)


CR2 and Adapt-Chile project that consisted of carrying out a diagnosis on the need and viability of having a climate change law in Chile and providing the minimum contents of said institutional framework.

Collaboration Networks


CR2 collaborates with public and private institutions in Chile and abroad to promote the development of the center's different research areas. Some of these collaborations have allowed us to contribute directly to the definition of public policies on climate change in Chile.


International

-  GFZ (German Research Centre for Geosciences)
- GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH)
- University of Greifswald


-  CIMA (Center for Sea and Atmospheric Research)
- IANIGLA (Argentine Institute of Snow Science, Glaciology and Environmental Sciences)
- INCIHUSA (Institute of Human, Social and Environmental Sciences)

-  University of Melbourne


-  IISEC (Socio-Economic Research Institute)

-  Grupo de Pesquisa innovacao, Sociedade e Eco-territorialidade (GRIST)
- University of Brasilia
- University of Sao Paulo


-  CIDSL (Center for International Sustainable Development Law)
- IISD (International Institute for Sustainable Development)
- Scotiabank Canada – NZRF, Net Zero Research Fund
- Université LAVAL
- University of Regina


-  Laboratory of Water Disaster Management and Hydroinformatics (Sun Yat-sen University, China)


-  National University of Colombia

-  Environmental Humanities Program, University of Costa Rica


-  CIN (Research Center), Espiritu Santo University, Guayaquil


-  Rey Juan Carlos University
- University of Barcelona
- University of Alicante, CEAM

-  Aix-Marseille University
- CNES (Centre National d'Études Spatiales)
- CNRS (Centre National de la Recherche Scientifique)
- LMD (Laboratoire de Météorologie Dynamique)
- LSCE (Laboratoire des Science du Climat et de l'Environnement)
- PHOTONS (PHOTométrie pour le Traitement Opérationnel de Normalisation Satellitaire)
- Indigenous People (University of Lyon)
- University of Pau and the Adour Region (UPPA)
- University of Toulon
- Lille-I University


-  IDLO (International Development Law Organization)

-  WASEDA University


-  INCCETT (International Network of Climate Change Centers of Excellence and Think Tanks for Capacity Building)

-  CIESAS (Center for Research and Advanced Studies in Social Anthropology)
- MCE2 (Molina Center for Energy and Environment)


-  University of Groningen
- Wageningen University & Research


-  SENAMHI (National Service of Meteorology and Hydrology of Peru)

-  MISU (Department of Meteorology, Stockholm University)
- Södertörn University, Sweden
- SRC (Stockholm Resilience Center)
- University KEH, Sweden

-  GEWEX-WCRP (Global Energy and Water Exchanges, World Climate Research Programme)
- PAGES (Past Global Changes)
- Transdisciplinary Lab, ETH Zürich

-  Met Office Hadley Center
- SOAS University of London (UK)
- University of East Anglia (UEA, UK)

-  ANII (National Research and Innovation Agency)
- IAI (Inter-American Institute for Global Change Research)
- Fluvial Ecology Hub
- ARAS (The South American Institute for Resilience and Sustainability Studies)

-  GEIA (Global Emissions Initiative)
- IGAC AWG (International Global Atmospheric Chemistry, Americas Working Group)
- NASA (National Aeronautics and Space Administration)
- NCAR (National Center For Atmospheric Research)
- Rockefeller Philanthropy Advisors
- SAAG (South American Affinity Group)
- University of Albany
- University of Colorado
- University of Wyoming
- The Air Force Research Laboratory



Latin American

- ESOCITE, Latin American Association of Social Studies of Science and Technology
- ROSE (Regional Observatory of Sustainable Energy, ECLAC)



Global

- 4S, Society for the Social Studies of Science
- Climate Litigation (C2LI)
- European Commission (Horizon 2020, European Union)
- ICCI (International Cryosphere Climate Initiative)
- iCACGP (international Commission for Atmospheric Chemistry and Global Pollution)
- IPAM (International Platform on Adaptation Metrics)
- IPCC (Intergovernmental Panel on Climate Change) AR6, AR7
- UNDP (United Nations Development Programme)
- UNEP (United Nations Environment Programme)
- Race to Resilience
- REA (Research Executive Agency), European Commission (Horizon 2020, European Union)



Chilean

- ACERA (Chilean Association for Renewable Energy and Storage)
- Agromet (National Agroclimatic Network, Ministry of Agriculture)
- ANID (National Research and Development Agency)
- Antofagasta Minerals
- BCN (Library of National Congress of Chile)
- Valparaíso Lifeboats (volunteer corps)
- CAPES (Center of Applied Ecology and Sustainability)
- CEAZA (Center for Advanced Research in Arid Zones)
- Center for Energy
- GAIA Antarctica Research Center, University of Magallanes
- Research Center in Technologies for Society, UDD
- IDEAL Fondap Center
- Association of Engineers in Renewable Natural Resources
- CORECC (Valparaíso, Biobío and Metropolitan regions)
- Department of Engineering Sciences (University of Los Lagos)
- Department of Civil Engineering (University of La Frontera)
- DGA (General Directorate of Water)
- Directemar (Directorate of Maritime Territory and Merchant Marine, Navy of Chile)
- DMC (Meteorological Directorate of Chile)
- DOP (Port Works Directorate)
- EBP-Chile (Ernst Basler + Partner)
- ECOTECNOS S.A.
- EGEA NGO (Alternative Energy Generation and Entrepreneurship)
- ENEAS (Energy, Water and Sustainability)
- Chile Foundation
- Chile Sustentable Foundation
- Data Observatory Foundation
- Legado Chile Foundation
- Chilean Association of Power Generators
- GLZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH) Chile
- Regional Government of Coquimbo
- IEB (Ecology and Biodiversity Institute)
- ISCI (Complex Engineering Systems Institute)
- Itrend (Institute for Disaster Resilience)
- Ministry of Energy
- Ministry of Environment
- El Bosque, Renca, Independencia, Recoleta, Tiltill and Viña del Mar Municipalities
- NEST: Nucleus of Systemic Transdisciplinary Studies
- NITES: Nucleus of Research in Interdisciplinary and Transdiscipline for Higher Education
- NLHPC (National Laboratory for High Performance Computing).
- NODO Austral Science
- AndesPeat Millennium Nucleus
- UPWELL Millennium Nucleus
- Climate Change Unit (Ministry of Environment)
- EfD (Environment for Development Network)
- Red-IEL (Latin American Energy Inclusion Network)
- RedLama
- RedPE (Energy Poverty Network)
- SECOS (Coastal Social-Ecological Millennium Institute)
- SENAPRED (National Service for Disaster Prevention and Response) formerly ONEMI
- SERNAPESCA (National Fisheries and Aquaculture Service)
- SERVIMET (Navy Meteorological Service)
- Chilean Society of Public Policy
- SUBPESCA (Undersecretary of Fisheries and Aquaculture)
- University of O'Higgins
- Valle Nevado

Education

Among the objectives of CR2 is the training of advanced human capital. To this end, different courses and workshops have been designed for undergraduate and graduate students, professionals, members of the academy, public service and the community.

These initiatives have an interdisciplinary academic body made up of professionals and researchers from the center and also from other institutions, and seek to provide updated information on topics that concern climate change.

Diploma on Climate Change and Low-Carbon Resilient Development



Since 2017, this diploma has sought to provide conceptual and methodological tools to understand and address, with a comprehensive vision, the problems related to climate change and sustainable development.



145 students between 2017 and 2023

Municipal Climate Risk Diagnosis Workshop (ARClim)



After the creation of the ARClim platform, a workshop was organized for municipal officials from the Communes of the Municipal Environmental Certification System. This was a joint initiative between the Ministry of the Environment, the European Union, CR2 and the International Festival of Social Innovation.



More than 200 participants public sector participants



UAbierta



The Open University (UAbierta) initiative consists on virtual courses suitable for all audiences. The “Climate Change” course is the result of a collaboration between CR2 and the Institute of Communication and Image of the University of Chile. This 2023 has developed its eight editions.

7 editions  **8.724 students in total**

Strengthening program for Regional Climate Change Committees (Corecc)

In 2021, within the framework of the elaboration of the Climate Strategy for Resilient and Low Emission Development by 2050, this initiative was developed with the objective of strengthening the technical capacities for climate change management aimed at the Regional Committees of Climate Change (CORECC). Participants in this event included people from public services, civil society organizations and universities from different regions of the country.



More than 700 participants



Summer School



This course is design for those who begin their scientific career, such as master's, doctoral and postdoc students, as well as, researchers and experienced professionals. Three editions of the Summer School have been held, each with topics related to climate change.

1^{ra} versión “Integrative Assessment of Climate Change: Water Scarcity”.

Year 2021. **23 students from Chile and abroad**

2^{da} versión “Cities and short-lived climate forcings: Complexity, challenges, and opportunities”.

Year 2022. **18 students from Chile and abroad**

3^{ra} versión “With feet in the sea: Towards the co-design of resilient coasts. Climate risks and responses along the coastal zones”.

Year 2023. **19 students from Chile and abroad**

General Training Course



With the aim of providing updated knowledge of climate change to the country's future professionals, two General Training Courses (CFG, by its Spanish acronym) have been developed for undergraduate students at the University of Chile, which address issues related to climate change and energy poverty.

CFG Climate change and sustainability.

Year 2020 **88 students**

Year 2021 **102 students**

Year 2022 **50 students**

CFG Energy poverty in Chile: approaches and perspectives.

Year 2020 **52 students**

Year 2021 **51 students**



Climate Change Education Conference CIECC



This conference is linked to the French initiative Office for Climate Education. Since its inception in 2019, it seeks to convene representatives of universities, teachers, public policy agents, decision makers and the private sector, to reflect on the need to have a focus on climate change in primary and secondary education.

It is organized by the University of Chile through the IBSE (Inquiry-Based Science Education) program, the Institute for Advanced Studies in Education, the Siemens International Foundation and the UNESCO Climate Education Office.

Diploma on Climate Action and Municipal Management



In 2021, and with financing from the United Nations Development Programme, this diploma course was carried out and taught by CR2 researchers to municipal officials from across the country, who acquired various tools to integrate climate change into municipal management.



77 municipalities participating



84 officials approved

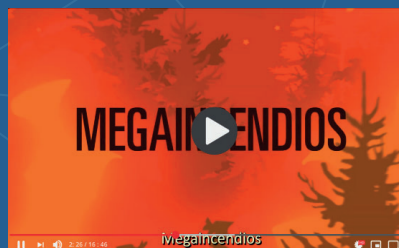
RedLama



The Latin American Educational Network for the Environment (Red-Lama) was born as an initiative of CR2 students and research assistants to deliver knowledge about climate change and environment to the community. It currently carries out its work at the University of O'Higgins, thanks to a collaboration agreement sign with the University of Chile, where it carries out activities in conjunction with the Water Museum.

Workshops for CR2 students

Along with the development of training activities for people outside the center, workshops focused on CR2 own students are also developed, where information is provided, for example, on science communication, use of climate services, interdisciplinary nature, among other topics.



COMMUNICATIONS

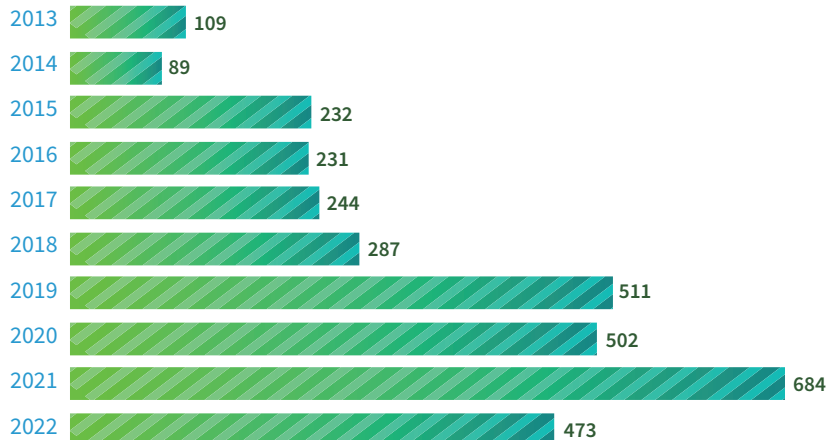
- Media and social networks
- Outreach

Media and social networks

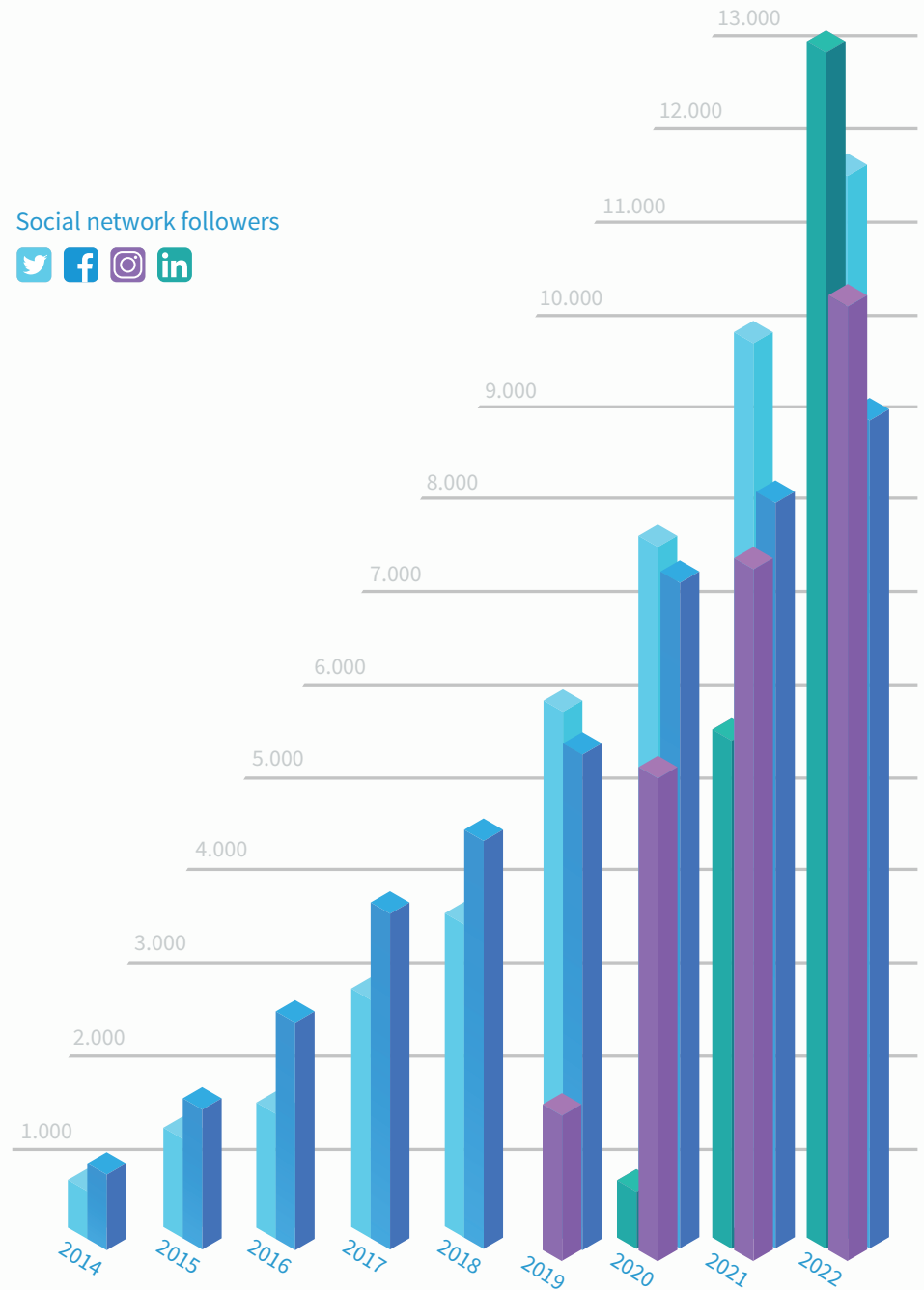
One of the pillars of CR2 is the dissemination of science to the entire community. For this purpose, different strategies have been developed that aim to: 1. presence in the media; 2. Active dissemination on social networks; 3. dissemination initiative on our website, such as analysis, policy briefs, podcast, reports, stories, among others, which have allowed us to count more than 1.5M visits to our page; and 4. conferences, open talks and participation in events and projects that have a large number of attendees.

With this, the work of the center has been visualized, concepts such as “mega-drought” and “atmospheric rivers” has been positioned, the work carried out in international bodies such as the Intergovernmental Panel on Climate Change (IPCC) has been known, and they have been evidenced at the national, regional, and international and community levels key problems related to climate sciences and socio-environmental resilience.

Media appearances



Social network followers



Outreach



Videos

Present the results of the CR² Reports to the Nations.



24.000
Most viewed video

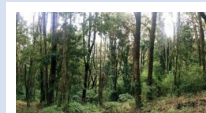


Policy briefs

Documents aimed at decision makers to support the development of adaptation and mitigation policies in Chile.

34
2019-2022

12.500
Most read policy brief



El impacto del bosque nativo y las plantaciones forestales en el suministro de agua en Chile

Records

Graphic support that synthesizes scientific publications led by CR² members.

42
2017-2022

5.200
Most viewed record



Julieta in the land of Girls

Explora project that aimed to awaken the scientific curiosity of girls from 7 to 11 years old. It was developed in conjunction with the Andean Geo-thermal Center of Excellence (CEGA) and the Institute of Ecology and Biodiversity (IEB).

700
Delivered kits



Analysis

Texts written by CR² specialists that address contingent topics related to climate change, climate science and socio-environmental resilience.

92
2014-2022

24.800
Most read analysis



El agua de los ríos no se pierde cuando llega al mar

Legal Bulletins

Documents that analyzed the state of national, international and multilateral climate governance.

15 2014-2015

Infographics

Graphic product that synthesizes the CR² research results.

7.000
Web Views

Constitutional bulletins

Documents developed in the context of the process of elaboration of the New Constitution of Chile.

8
2021-2022

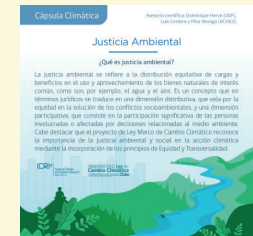
13.000
Total readings

Climate capsules

Product that briefly explains the concepts of climate science and socio-environmental resilience that appear in public policy.

17
2019-2022

16.000
Most viewed capsule



Rocadictos

Joint initiative of the Radio University of Chile, the Departments of Geology and Geophysics of the University of Chile and CR², whose objective is to disseminate Earth sciences.

40
chapters
2019-2022



Online talks

Presentations that present the results of the research carried out by CR² members.

100
2017-2022

1.100
Most viewed talk



CR2 features

They deal with contingent topics and include the participation of researchers from the center.

Tales

Short stories with touches of fantasy that are based on research findings carried out by CR² members.



CR² members chat about their investigations or events of national and international relevance.

THE CR₂ TEAM

2013 - 2023



CR2 Researchers

Principal

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Duncan Christie
Eugenia Gayó
Martín Jacques
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René Garreaud

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