CLIMAT AmSud

2024 call for proposal approved projects

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ANTHRACITE

The impact of anthropogenic black carbon deposition on the cryosphere of the south-central Andes

The cryosphere of the Andes has been shrinking over the last decades, which poses a threat to water resources sustainability and ecosystem survival. Climate change is the main driver of this evolution, but light-absorbing particles (LAPs) such as black carbon (BC) also contribute to increased melt once deposited onto snow. However, the impact of BC deposition on snow dynamics and glacier mass balance at the scale of the Andes has never been quantified. Recent atmospheric modeling studies have provided low-resolution maps of BC deposition fluxes over the Andes, but never included a dynamic snow model nor a glacier mass balance model to estimate the resulting radiative forcing of BC on the cryosphere.

Through a multidisciplinary approach, combining expertise from glaciologists and atmospheric scientists, the objective of this project is to examine the impact of anthropogenic BC deposition on snow cover dynamics and glaciers in the Andes of Chile and Argentina by setting up a holistic modeling chain simulating atmospheric pollution, aerosol transport and deposition on snow, down to the impact on snow dynamics.

First, the dominant sources contributing to BC deposition on the Andean snow cover will be assessed using the WRF-CHIMERE regional chemistry-transport model. Using sensitivity analyses, the simulations conducted will also provide insight on the relative role of atmospheric dynamics versus source intensity in modulating BC deposition. Finally, the impact of BC deposition on snow cover dynamics and glacier mass balance will be assessed using the snowpack model SURFEX/ISBA-CROCUS, forced by the WRF-CHIMERE simulations.

Future perspectives include expanding the study area to encompass Bolivia, enhancing glacier data collection, and investigating other LAPs such as natural BC from fires and mineral dust.
Through workshops, targeted summaries for decision-makers, and public outreach efforts, the project seeks to disseminate its findings widely, facilitating dialogue between researchers, policymakers, and the public to address the pressing challenges of water resource management and environmental sustainability in the Andean region.

Project coordinators

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CCM-BioRef

Boosting climate change mitigation and energy transition through sustainable organic acids production via anaerobic fermentation-based biorefineries.

Climate change constitutes a major global challenge due to the excessive reliance on fossil fuels for energy and chemical production. Despite the severe environmental impacts, the global economy continues to depend on these energy sources. To address this issue, international organizations such as the UN, EU, and OECD have implemented frameworks like the Sustainable Development Goals (SDGs) and the Paris Agreement to reduce environmental impact through the use of sustainable technologies. This research project promotes international cooperation to develop new
strategies to mitigate climate change and encourage energy transition through sustainable biomass conversion under the biorefinery concept. The project aims to create a collaborative network between research teams at Universidad de La Frontera (UFRO, Chile), Universidad Católica de Temuco (UCT, Chile), Universidad Nacional de Colombia - Sede Manizales (UNAL-Manizales, Colombia), and the Jean-Pierre Bourgin Institute - INRAE (IJPB-INRAE, France). The goal is to improve skills of each team regarding change mitigation and sustainable product production within the biorefinery concept. The project involves capitalizing on the team's proficiency in biomass
conversion, anaerobic fermentation, and sustainability evaluations within biorefineries.

Through this project, students and scientists will have the opportunity to exchange experiences, enhancing each institution's interdisciplinary expertise and capability to combat climate change. The participating institutions have specialized in several complementary technical, analytical, educational, and outreach capacities. The IJPBINRAE research unit has developed numerous projects focused on waste utilization and the production of valuable compounds from lignin, which is a platform to reduce environmental impact. UFRO and UCT, have significant experience and equipment for waste valorization and organic acid production within the biorefinery framework.

UNAL-Manizales has extensive experience in the design, analysis, and sustainability assessment of biorefineries using different feedstocks.

The project plans to hold an international seminar in Latin America involving political and civil society actors, integrating the expertise of all teams. The project will support the mobility of postgraduate students and junior researchers through bilateral exchanges among the institutions, with at least four annual trips per institution aimed at improving theoretical and technological knowledge and furthering their research efforts. As a result of this initiative, a collaborative framework for climate change mitigation will be developed with an emphasis on biorefineries. A roadmap for short-, medium-, and long-term collaborative activities will be designed to establish future project proposals related to climate change mitigation and encourage energy transition.

The project's execution will enhance research capabilities, stimulate interdisciplinary knowledge exchange, and engage stakeholders from the scientific community, policymakers, and civil society.

Project coordinators

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CLIMAGLOF
Impact of climate change on Andean Glacial Lake Outburst Floods

Glacial Lake Outburst Floods (GLOFs) are catastrophic events that result from the abrupt release of meltwater from moraine- or ice-dam lakes due to dam failure. They are among the most destructive natural hazards on Earth. GLOFs are particularly notorious in the southern (Patagonia) and tropical (Cordillera Blanca) Andes, where they frequently cause important damage to infrastructure and are responsible for the loss of livestock and human lives. The recent increase in the number and size of glacial lakes in the Andes due to climate change is well documented but the implications for GLOF hazards remain essentially unknown.

In this collaborative project, we will investigate the impact of climate change on GLOF frequency, magnitude and location in Patagonia (Chile and Argentina) and Cordillera Blanca (Peru). To do so, we will (a) study the triggering mechanisms, hydrology, geomorphology, and signature in downstream sediment archives, of selected historical GLOFs, (b) investigate changes in GLOF occurrence during the last decades and centuries based on historical chronicles and high-resolution sediment archives, and (c) improve GLOF hazard assessments for Andean populations. Our proposed program includes joint field campaigns in Patagonia and Cordillera Blanca, research stays abroad for laboratory analyses, particularly geared toward students, as well as activities to communicate our results to regional government agencies.

Our gender-balanced consortium of students and scientists from France, Chile, Argentina, and Peru is designed to address these questions collectively using an interdisciplinary approach. The participation of methodological experts and scientists with regional knowledge who will lead the field campaigns ensures a comprehensive understanding of the evolution of Andean GLOF hazards.

Project coordinators

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FIREWALL

Global assessment of Fire Response in Wildland Local Vegetation in a Changing World: An International Network.

Forest fires have become an increasingly common and devastating disturbance worldwide. These events may trigger significant consequences at a global scale, especially in mediterranean and temperate areas, and with climate change predictions, wildfires are expected to affect areas where they were not previously frequent. Although several factors influence the behavior and severity of forest fires, the scientific community has recognized that vegetation flammability plays a significant role in fire propagation, and hence the impacts of forest fires. Flammability refers to the biomass's ability to burn when exposed to high temperature and reduced humidity conditions, and the vegetation's behavior after burning (maximum temperature, flame phase, propagation, combustion time, among others).

As a result, studies on vegetation flammability have increased over the past couple of decades, particularly in northern hemisphere countries such as the United States, Canada, Spain, France, Portugal, etc. However, in the southern hemisphere (e.g., Chile, Argentina and Uruguay), although there is some information available on vegetation flammability, it is not a topic of great importance yet, neither for researchers nor for decision-makers, mainly due to lack of knowledge in the discipline. To date, there are few isolated research groups dedicated to this area, despite its importance for both society and ecosystems, but not very well connected in the region.

Given this issue and opportunity, this proposal aims at establishing a knowledge network in the field of vegetation flammability in the southern cone of South America, focused on sharing knowledge, methodologies, experiences, and results among peers in the same South American region. This will be accompanied by the support of well-known French researchers who can assist in knowledge dissemination for academics, professionals, decision-makers, and students.

Through this collaboration network, a permanent link is expected to be established between South American and European research centers related to vegetation flammability and fire risk management. Opportunities for student exchanges and training, collaboration in ongoing projects and research articles, and dissemination science activities are anticipated. This will result in a significant scientific impact and create awareness of the community's perception about the influence of vegetation flammability on the behavior and severity of forest fires.

This initiative will not only contribute to the development of a deeper and more detailed understanding of vegetation flammability in South America, but will also provide a concrete approach to identify species that could be strategically incorporated into landscape planning to improve the resilience capacity of these areas to forest fires. More importantly, we expect to inform policy-maker agencies and decision-takers from both the public an private sector, as well as providing educational opportunities for civil society.

Project coordinators

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ModFir
Modelling the atmospheric effect of wildfires in South America

According to the IPCC Special Report on Climate Change on Land, “Climate change is playing an increasing role in determining wildfire regimes alongside human activity (medium confidence), with future climate variability expected to enhance the risk and severity of wildfires in many biomes such as tropical rainforests (high confidence).”. The increase in the frequency and severity of forest fires throughout the Amazonian rainforest and its surroundings due to climate change has been documented in the recent past. It is bound to increase in the foreseeable future. In this context, severe wildfires have occurred in recent years in the rainforests of Colombia and Bolivia and the Orinoco savannas between Colombia and Venezuela. The coastal forests of Chile have also experienced significant episodes of wildfires in recent years. Argentina suffers from wildfires as well, in the north-central part of the country during the local winter, and in the Patagonia during summer. The increased occurrence of droughts and heatwaves under the influence of climate change and the effects of the El-Niño Southern Oscillation (ENSO) have been found to feed these events.

The first months of 2024 have seen record-breaking pollutant emissions not only in Chile and Argentina but also in the Amazonian basin and its surroundings, including Brazil and Colombia. A few months earlier, Bolivia was also undergoing severe wildfire episodes in the second half of 2023, as well as Venezuela record-breaking. Such events have consequences that range from ecosystem impacts to massive loss of human life (the latter being blatantly illustrated by the 2024 fire season in Chile). Wildfires also cause loss of human life more indirectly through the health effects of fine particulate pollution they generate.

In this context of increased wildfire occurrence and intensity in both the recent past and the foreseeable future, it is important to understand the regional fate and transport of pollutants. For this, the promotion of modeling activities of wildfire plumes in South America is relevant, including the evaluation of emissions, which could benefit the operational forecast of such events (permitting better mitigation measures to protect the health of the potentially exposed population). Simulating the exceptional fire season of late 2023-early 2024 in South America and evaluating its impact on air quality at the continental and regional scale may give us a hindsight of what could await people in this region in the near-future, as highlighted by the IPCC.

Project coordinators

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NASClimateLitigation
Climate Litigation: A Cross-Look Between the North and South

Currently, both citizens and governments stand as actors and respondents in climate litigation, seeking, depending on the case, compensation for damage, the cessation of activities contributing to global warming, or the implementation of state policies on adaptation and/or mitigation. It is true that the effects of climate change have empowered society against the state's responsibility to preserve constitutional rights to a stable climate and a healthy environment in the name of present and future generations (Boom et al., 2016), but also regarding corporate accountability. It is worth noting that literature identifies 90 companies as responsible for one hundred percent of global emissions (Heede, 2014). According to doctrine, this context would lead to an increase in litigation in this area, especially in countries lacking effective public policies for greenhouse gas mitigation and adaptation to climate change effects (Wilensky, 2014; Preston, 2011).

In such a context, the judicial path is considered an alternative to address climate change, to enforce, through judicial decisions, the obligations incurred at domestic and international legal levels (Alabi, 2012), and to promote mitigation and adaptation (Preston, 2011).

The current project proposes to develop a comparative analysis of the jurisprudential experience of the Courts of Brazil, Chile, and France, aiming to answer how climate change is or is not decisive in the interpretative change of the norms that serve as the basis for the resolution of judicial conflicts related to the causes or effects caused by this global phenomenon.The team proposes research concerning the judicial decisions issued by the national courts of these three countries (Brazil, Chile, France). The selection cases will consider the disputes within the framework of which the issue of climate change is discussed, and this element changes the understanding and interpretation of the facts and/or the law.

Project coordinators

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Per Turbera
Evolution of lateral carbon export in mid-mountain tropical and temperate peatlands under climate change

Although climate change impacts on water and carbon (inorganic and organic) transfers in mid-mountain peatlands and, with their watershed, they remain somehow understudied due to their small surface, despite their high C content, especially in temperate and tropical areas. This collaborative project aims to analyze these carbon dynamics in two monitoring systems (Jura Mountains, France; Campo Belo, Brazil), in order to evaluate the hydrometeorological, geochemical and physiographical factors that constraints discharge and C fluxes (in both inorganic and organic forms). On this basis, we expect to develop conceptual and analytical models to simulate water and C exports from these systems according to the above-mentioned factors. This would constitute the basis for further modeling and prediction of future fluxes under various climate change trajectories, provided by climate simulations, e.g. throughout the Climate Model Intercomparais on Panel (CMIP).

This project will help to achieve the following specific objectives: 1) quantify the multi-time scale (sub-hourly, daily, seasonal, and annual) dissolved and particulate C exports, and initiate (Brazilian peatland) or complete (French site), the carbon balance exported by the peat bogs, by considering both organic and inorganic carbon fluxes; 2) assess the watershed scale and ecosystem scale hydrometeorological and ecological factors (e.g., seasons, dynamics of the water table, extreme events, soil moisture, etc) influencing the variability of carbon export; 3) characterize the origin and proportions of carbon (superficial versus deep organic carbon/biogenic versus terrigenic inorganic carbon); 4) extrapolate estimated carbon exports for the future decades, based on historical data and regionalized climate projections (e.g., SSP245, SSP585) up to 2100, the trends in terms of carbon export and the contribution of the sources previously identified and propose a typology of C export dynamics in similar ecosystems worldwide, in the case that watershed scale parameters are found to be potential factors to explain C export dynamics, through remote sensing data. This project will allow the development of a multidisciplinary collaboration team, combining geochemists (UFF, UC, UFC, UNC) and specialists in hydrology and environmental remote sensing (UFPB, UFC). Throughout this scientific-technical collaboration, we aim to build and strengthen long-term observation sites that deal with Critical Zone processes, similar to the Long-Term Ecosystem Research (LTER) philosophy, that will serve as a support for pedagogical activities about water and carbon dynamics, for graduate and post-graduate students throughout international exchanges between the partners.

Project coordinators

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PIPDRY
Pedological Indicators for Paleoenvironmental Studies in South Americ Drylands

The aim is to reconstruct paleoenvironments in three of the drier areas of South America. We will test the hypothesis that: 1) inselbergs in the Brazilian semiarid are part of ancient forests connections and refuges for Amazon and Atlantic species; 2) El Niño events influence vegetation changes from the Eastern Mountain domain of the Amazon region to the desert lowlands of Peru; and 3) the climatic changes in the semiarid Chaco region affect plant species composition in northeastern Mesopotamia.

We will evaluate the effects of climate oscillations on paleoenvironmental changes in the Brazilian Semiarid region, the desert lowlands of Peru, and the semiarid region of the Argentine Chaco. We propose a multi-proxy environmental reconstruction analysis (radiocarbon, phytoliths, charcoal). Our results will elucidate the paleoenvironmental evolution, the trajectory of climate change, and the extent of human impact in the dry regions of South America.

Project coordinators

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