CLIMAT AmSud
2021 call for proposal approved projects

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ANDeDNA
The Andes : co-constructing an e-DNA observatory of biodiversity changes in response to climate change

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The impacts of climate change on biodiversity are already visible in the Andes, at least aboveground, and particularly in forest ecosystems. However, a large part of the biodiversity is represented by soil microorganisms, which are often overlooked and often understudied, but which have important implications for ecosystem functioning and response through their role in biogeochemical cycling, and interact intimately with aboveground diversity. The recent development of environmental DNA sequencing (eDNA) allows us to investigate the response of multiple organisms and functions from soil eDNA, including below and above ground diversity. While soil diversity response to climate change is not yet studied at the scale of the Andes, the few available studies indicate a strong response of microorganisms to elevational gradients in Argentina, Peru and Chile. Our project aims at bringing together experts in soil, soil biology, eDNA sequencing and climate, to initiate a large-scale observatory of biodiversity and functional changes in the Andes, and integrate the different responses thanks to the use of common methods. Moreover, our project will initiate a long-term study in the Andes, targeting ecosystems threatened by climate change such as arid and high-elevation ecosystems.

Project coordinators

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Using deep learning spatial-temporal graph models for seasonal forecasting of extreme temperature events

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Forecasting extreme seasonal temperature events is especially relevant to society and its ecosystem due to their potentially dangerous impacts. Despite the above, the study of this problem is still very incipient in South America, where most of the methods proposed in the literature correspond to process-based dynamic models and classical statistical methods. Increasing the accuracy of predicting the probability of occurrence of extreme temperatures at the seasonal scale would have huge impacts on our economical life (on our food production, on our energy consumption), on our health, etc.

Currently, innovative approaches are emerging in climate forecasting, using network science and machine learning methodologies. The complex interrelations between temporal and spatial variables in climate time-series justify the use of climate networks as an underlying automatic model explanation of the complex physical processes involved. The use of machine learning methods, and in particular deep learning architectures, is justified by their success in several forecasting problems. In this project, we will evaluate the precision of the most prominent deep-learning architectures for our forecasting problem, and in particular, those implementing spatio-temporal models based on graphs (climate networks). The most promising antecedents for the use of this methodology are several works based on climate networks and on the effect of “El Niño” on similar forecasting problems. We expect to propose improvements to these deep learning architectures to increase their precision in our particular problems. For example, changing the scale of nodes, changing the similarity of edges, proposing new architectures that include multiple networks, training the model with augmented data, etc. We will implement and compare the results with classical statistical methods, such as principal component regression technique and Wavelet transform-based methods, among others.

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METAZOOTRANSFER

Secondary production of metazooplankton from tropical to subtropical highly productive marine ecosystems: methodological development of indicators of global change impact

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Zooplankton production represents a reliable indicator for the functional response of marine ecosystems to regional and global climate changes, because captured matter by the zooplankton communities transformed into energy, is transferred and integrated to higher trophic levels, up to fish resources. In the context of climate change, there are few estimates of marine zooplankton production at the community level in Chile and Colombia, and studies are mainly focused on some specific abundant species (e.g. key small copepod species) and upwelling areas, limiting the comparisons with other systems. Therefore, it is necessary to develop more comprehensive tools, that include new methodologies, in order to improve the predictions accuracy of ecological and biophysical models (Figure 1). In recent years, great advances have been made to improve and facilitate production zooplankton estimates, however, these techniques and methodologies have not yet been widely implemented in Chile or Colombia. Understanding the structure and functioning of marine ecosystems is key to predict the oceanic responses to climatic tensors. Our approach will deliver essential data for modeling functional processes and simulate ecological interactions, providing quantitative information to decision makers in response to climate change. In order to estimate zooplankton production rates and characterize the metazooplankton community structure, it is proposed to use quantitative and qualitative biochemical and semi-automated imagery methodologies in three upwelling productive regions of Chile and Colombia, during two contrasting periods (winter/summer, dry/rainy, respectively). Index values of zooplankton structure and production compared for the different contrasted regions and seasons, will be used to estimate potential deviation linked to shifts of planktonic communities due to climate change (red slope on the graphical abstract) from the current reference status (blue slope) established by Metazootransfer.

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MICCONS
MItigating Climate Change with pOwer electroNics and Smart-technologies

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Over the latest years, the positive outcome derived from access to electricity, information technologies (ICTs) and an environment pollutants-free has demonstrated to efficiently promote the social and economic development of societies. Notwithstanding, transition to renewable energy, e-home, air conditioning, home automation, among other advances, are not necessarily aimed at households, especially those in a situation of vulnerability due to the costs involved. These households tend to focus their consumption on the cheapest supply available, which is usually fossil energy or firewood with high moisture content. Nevertheless, this implies also an opportunity presented to transform societal structures which would contribute to mitigate the climate change' effects and contribute to the energy transition, which may address the challenges to reduce costs in cleaner, more efficient technologies, so they will facilitate equitable access to quality energy, as well as to the reduction of emissions and the impacts of climate change.

This initiative proposes cooperation between Argentina, Chile, Colombia, France, and Paraguay for the development of new contributions in the area of power electronics for the conversion of renewable energies to mitigate variability and climate change. The aim is to encourage innovation and technological transfer by proposing new configurations of power converters with the use of local technology, and the proposal of new advanced control techniques that allow increasing energy efficiency. Moreover, the proposal will also target to offer them at a lower cost, in order to guarantee its accessibility to the entire community. Renewable sources such as solar photovoltaic, solar thermal, wind, among others, are considered as well as the use of local technology, adapted to the reality and geographical characteristics of each involved country.

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TUPIWAM
Territorial and Urban Planning for integrated watershed management. Experiences in France, Argentina and Chile

The current development model, based mainly on quantitative parameters of economic growth, does not consider negative externalities on the environment, as well as the economic and social equity among people, making it unsustainable.
The extreme meteorological phenomena (e.g., increase in heat waves, water shortage, melting of glaciers, rising of sea levels, more acidic and warmer oceans, heavy rains and floods, increased storms and hurricanes among others) that have taken place and that they will continue to be produced by Climate Change on our planet (product of the prevailing development model), seriously affect people´s lives in cities and countryside. Given these events, it is urgent to rethink territorial and urban planning to also consider those effects.

In Chile, some of the most serious environmental problems at present are the mega-drought affecting the central-southern part of the country (for more than 10 years) and urban sprawl over agricultural areas. In addition, the Province of Mendoza (Argentina) is experiencing a serious water shortage and the lack of control in urban-territorial planning has led to the invasion of the foothills. In the French context, there are several problems related to water, such as floods, drought, landslides, among others.

Before these realities, the aim is to identify the essential criteria that will allow territorial and urban planning based on integrated watershed management, from the experiences of France, Argentina and Chile.

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