Project: 1207 Project title: Decadal Variability of the Tropical Pacific – El Niño Events Principal researcher: Dimitry Sein Report period: 2024-01-01 to 2024-10-30

Over the course of the year, the following activities were carried out in the frame of this project:

## 1) Article publication:

The first activity carried out at the beginning of the year was related to the publication of a research article. Once it was submitted for review, feedback was received on the first version of the manuscript. The necessary modifications were made to the text, and figures requested to illustrate the study's findings and improve the clarity of the text were prepared. The responses to the reviewers, along with the revised version of the manuscript, were submitted.

We can summarize the findings of this study as follows:

- The 2-meter air temperature showed improvements over much of the South American continent with the use of the ROM coupled model.
- The sea level pressure in the South Pacific Anticyclone area was better represented in the coupled simulation.
- The location of the Intertropical Convergence Zone (ITCZ) improved during the austral winter.
- Precipitation over the Andes benefited less from the coupling, but a more realistic moisture transport reduced precipitation biases over extensive regions.
- The ROM regional coupled model also demonstrated good skills in reproducing the Humboldt upwelling system.

The ocean-atmosphere interaction is important for the circulation mechanisms that determine the climate over the South American region. The results obtained have been published in the journal *Atmospheric Research and* is available online from 27 April 2024.

Jorge Ordoñez, Jonathan Paredes, Rubén Vázquez, Alan Llacza, Gerardo Jacome, Gustavo De la Cruz, Jorge Llamocca, Delia Acuña, Dmitry V. Sein, Erick Álvarez, William Cabos, Benefits of the coupling in the downscaling the South American climate, Atmospheric Research, Volume 305,2024.

https://doi.org/10.1016/j.atmosres.2024.107447

## 2) Preparation of initial conditions for the WRF regional model.

Data have been prepared for the initial and contour conditions for the Weather Research and Forecasting (WRF) regional model, from 3 global models NorESM2-MM, CNRM-CM6-1 and ACCESS-ESM1-5.

These data have been prepared for the historical period from 1981 to 2014 and for the future period from 2015 to 2100 in the RCP5-8.5 emission scenario.

This process involves vertical interpolation to pressure coordinates and, if necessary, horizontal interpolation of sea surface temperature. Additionally, data is adjusted to a 6-hourly time step and converted to GRIB format [Fig 1].

## 3) Statistical correction of CMIP6 models for Peru.

The statistical correction of 5 CMIP6 models was carried out: ACCESS-CM2, HadGEM3-GC31-LL, EC-Earth3-CC, MPI-ESM1-2-HR y KACE-1-0-G., for the emission scenarios SSP5-8.5 y SSP2-4.5, for daily precipitation, maximum and minimum temperature.

Different bias correction techniques (Quantile Mapping, Quantile Delta Mapping, and Linear Scaling) were used to correct the biases in daily precipitation, maximum and minimum temperature data simulated by 36 global climate models (GCMs) from the Coupled Model Intercomparison Project (CMIP6). Observed data were obtained from 440 weather stations distributed throughout Peru. Historical simulation data were taken from the period (1970-2014), while future projections covered (2015-2100) under the SSP2-4.5 and SSP5-8.5 scenarios for each model. An

evaluation was conducted to identify the most appropriate models for the Peruvian territory, resulting in the selection of five models, as well as an assessment of the effectiveness of the aforementioned methods.



Fig. 1. Schematic representation of the data preparation process for a CMIP6 model, intended as input to the WRF regional model.



Fig 2. Monthly variations for the period 1981-2005 for a) accumulated precipitation, b) mean monthly maximum temperature, and c) mean monthly minimum temperature for the raw and corrected GCMs for the Southern Andes region of Peru