Project: **1207**
Project title: Decadal Variability of the Tropical Pacific - El Niño Events
Principal researcher: **Dmitry Sein**
Report period: **2022-01-01 to 2022-09-30**.

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

1) The first activity was focused on preparing the ERA5 reanalysis data to be used as boundary conditions for the REMO and ROM models. To do this, the python tools provided by the *"pyremo package" (*https://pyremo.readthedocs.io/en/stable/) for REMO2015 were installed manually on the Mistral server. Once installed, a script (see ANNEX 01) to access the ERA5 data, contained on the Mistral data catalogue of the DKRZ filesystem, based in the "*pyremo preproc*" was developed. Then, we prepared the global dataset, which contains all the input data. To perform the initial tests, we selected the "EUR-11" domain and a period of 2014. Nevertheless, after running the script, using the *"preproc.to_netcdf"* function to obtain the data in netcdf format, we realized that the extracted data (gfiles) did not contain all the necessary fields to run the simulations with REMO or ROM. Therefore, it was not possible to run simulations using the ERA5 data as a forcing. Finally, it is important to consider that, although the backup data was stored on the new DKRZ supercomputer, Training in the use of pyremo by GERICS will be requested in order to run ROM with ERA5.

2) The second activity involved the elaboration of the paper on the coupled and uncoupled modeling for the South America domain (link for a previous version is given in ANNEX 02). In this study we analyze the performance of coupled ROM and its stand–alone atmospheric component REMO in simulating the main large-scale systems that characterize the climate over South America (SA) and the eastern Pacific Ocean. Furthermore, we address two specific research goals: (i) to evaluate the performance of rainfall and temperature simulation over the region. (ii) to assess the oceanic simulation of the coupled model. *Coupled and uncoupled climate simulations were developed in the period 1980-2017. The evaluation was done comparing the results of REMO and ROM outputs with 3 databases: 1 ERA5 for height and surface variables. 2 TerraClimate and CHIRPS for precipitation. 3 IMARPE (Instituto del Mar del Perú) and SODA for depth temperature. The main results show that:*

- *In DJF and JJA season (figure 1), underestimations were observed in Amazonia when comparing REMO and ROM outputs with the observed databases. During DJF season they reached -240 mm/season and in JJA -640 mm/season. In the Andes, overestimation prevailed between +350 mm/season and +750 mm/season.*

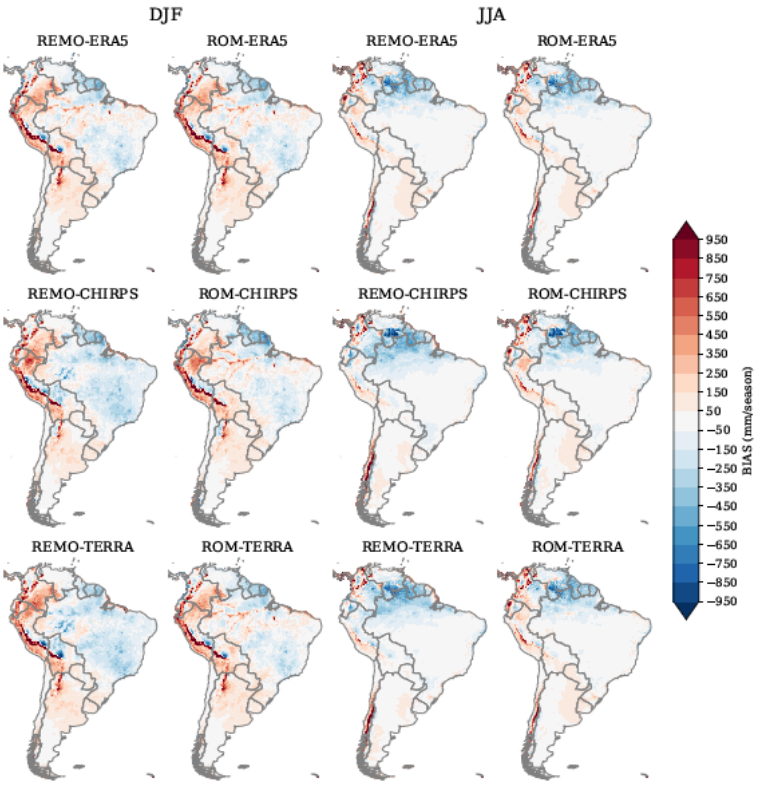

Figure 1. Spatial distribution of the average annual precipitation in 1982-2011 for DJF (austral summer) and JJA (austral winter), simulated with two simulations: the coupled ROM and uncoupled REMO simulations.

- *The deep temperature shows slightly similar conditions in July* (figure 2) *and January (figure 3). Near shore (grey area) ROM shows similar spatial distribution of upwelling at 12 °S and 20 °S. Further from the coast, the ROM output has a horizontal distribution pattern and slightly similar to SODA but different from IMARPE. In the first 50 meters at the equator and 4 °S, the ROM outputs in the month of July overestimate SODA by 2 °C and IMARPE by 1 °C, while at 12 °S and 20 °S presents result closer to both databases. Moreover, acceptable correlations of SST were identified in the region Niño 1+2. Such correlations were 0.77 during austral summer and 0.53 in austral winter and they evidence notable improvements in the coupled model.*

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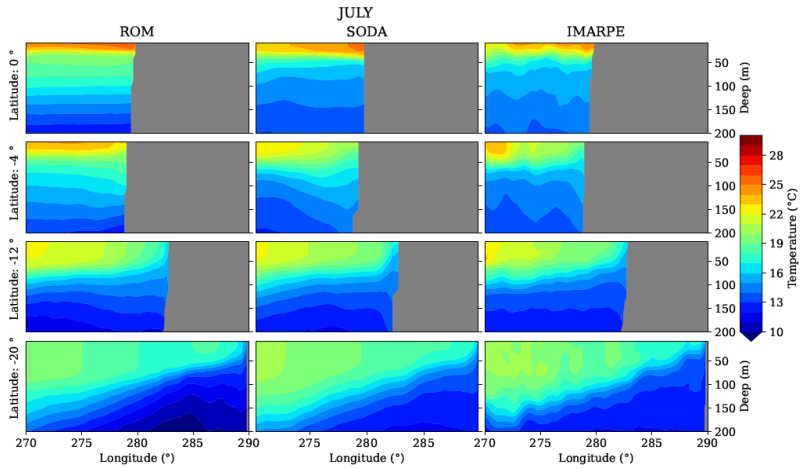

Figure 2. Longitudinal cuts at 4 latitudes of temperature from ROM, SODA and IMARPE data for July.

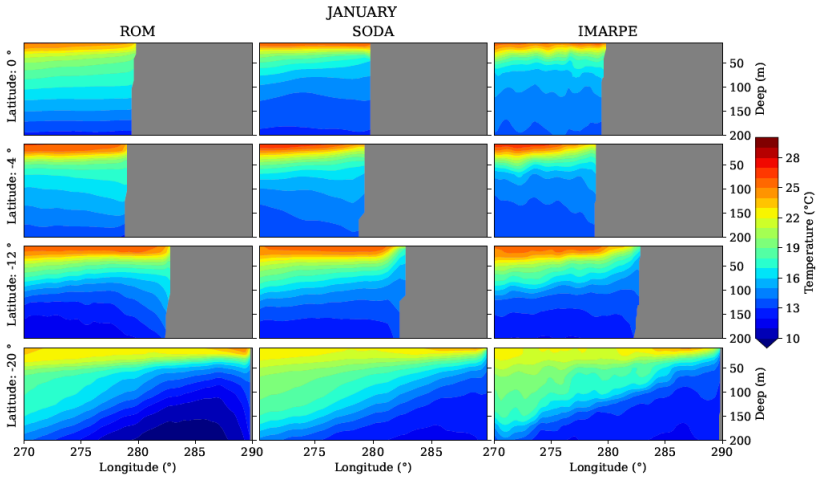

Figure 3. Longitudinal cuts at 4 latitudes of temperature from ROM, SODA and IMARPE data for January.

ANNEX 01

Script to access the mistral ERA5 data

```
import pyremo as pr
import dask
dask.config.set(**{'array.slicing.split_large_chunks': False})
r1=pr.preproc.ERA5(catalog_url='/pool/data/Catalogs/mistral-era5.json',
scratch=None)
xgfile=r1.gfile(["2014-01-01T06:00:00"], parallel=False, cf_meta=True,
clean_coords=True, add_fx=True)
gfile=xgfile.rename({'lev': 'lev_gm'})
domain_info = pr.domain_info('EUR-11')
surflib = pr.data.surflib('EUR-11', crop=False)
vc = pr.vc.tables['vc_27lev']
gfile=gfile.rename({'nhyi': 'lev_2'})
ads = pr.preproc.remap(gfile, domain_info, vc, surflib)
output = pr.preproc.to_netcdf(ads, path='/scratch/b/b381095/gxa')
```

ANNEX 02

Link to download previous version of paper

https://we.tl/t-y71005LgUM