Project: **1068**
Project title: **ViWA - Virtual Water Values**
Principal investigator: **Susanne Pfeifer**

Report period: **2020-01-01 to 2020-12-31**

Summary: The aim of the BMBF-project ViWA is to provide information from the local to the global scale in order to develop praxis-relevant solutions for the efficient and sustainable use of the global water resources. Within ViWA a multi-disciplinary monitoring and modelling framework is developed and applied. HZG-GERICS contributes to ViWA by providing high-resolution global-scale climate information using a multi-domain downscaling approach (WP 2.1) as well as by sophisticated analysis of natural climate variability effecting global water resources (WP 5.1).

The HZG/GERICS contribution to the ViWa project officially ended end of April 2020. Most of the ViWa partners however applied for and got granted a cost neutral extension of the project until the end of December 2020.

Results: In the year 2020 our focus was on the finalizing of the second work package WP 5.1 (analysis of natural climate variability) for the ViWA project, where natural climate variability was assessed with a focus on the El-Nino phenomenon. The ENSO (El-Nino Southern Oscillation) phenomenon is one of the strongest natural and inevitable climate fluctuations which regularly induces regionally varying impact on water cycles worldwide.

The last months of the project were dedicated to a brief look into the future. Before analyzing the REMO downscaled CORDEX-CORE RCP8.5 simulations for the 9 regions for future changes in the precipitation regime, the historical period of these simulations was analyzed and compared to the respective ERA INTERIM data. In this way it can be checked whether the model is capable of reproducing the monthly pressure fluctuations corresponding to the actual climate. Figure 1 shows exemplarily the Southern Oscillation Index calculated from the reanalyses (Fig. 1 left) as well as from the global model MPI-ESM-LR (Fig. 1 right) for the same period of 1979 to 2018. The distribution pattern in the time series of the SOI index from the model shows a similarly large air pressure fluctuation in its amplitudes in the simulated El-Nino/La-Nina phases as well as a similar periodicity in the El-Nino events.

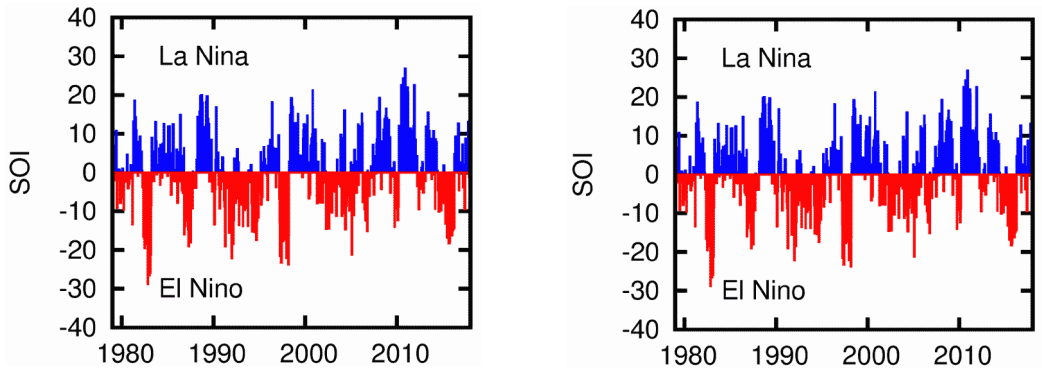
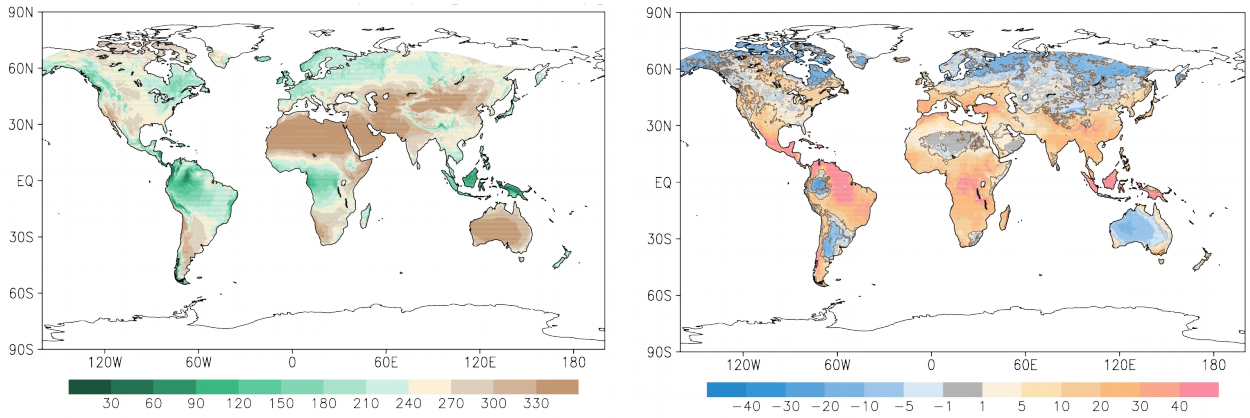


Fig 1: Southern Oscillation Index (SOI) (method taken from the Australian Bureau of Meteorology (BOM)) applied to the monthly based ground pressure of Darwin (Australia) and Tahiti (Central Pacific), with reduction to sea level for the periods 1979-2018 with the reanalysis ERA interim (left), MPI-ESM-LR (right: historical simulation)

In the future climate, effects of El Nino / La Nina could overlap and interact regionally with changes in the mean and extreme climate caused by climate change.
To have a first glimpse on this, projected changes in climate indices related to water availability / water scarcity have been mapped for the near (2021 to 2050) and far (2071 to 2100) future under RCP8.5 conditions.
Figure 2 shows exemplarily a composit visualization of the historical numbers and the projected changes of the number of dry days per year as from the REMO 0.22° downscaling of one MPI-ESM-LR historical and RCP8.5 scenario simulation.

REMO 1971 – 2000: historical

REMO 2021 – 2050: RCP8.5 – historical



num. of dry days [days/year]

Δ num. of dry days [days]

Fig 2: Number of dry days per year averaged over the period 1971-2000 (left) and its future changes for the period 2021-2050 (right figure) with respect to the reference period of 1971 to 2000. Results of the REMO downscaling to 0.22° resolution of the MPI-ESM-LR historical and RCP8.5 scenario simulation on the CORDEX-CORE domains.

Already for the relatively close future period of 2021 to 2050, significant changes of the number of dry days can be expected based on this simulation, with increasing dry days in large parts of Africa, Southern Europe and the Amazon region and decreasing values for Northern Europe, Siberia, Northern North America and central South America (brown-bordered regions have a 95% probability of being significant using the t-test). As the analysis is based on only one realization with one GCM/RCM model combination, the study gives just a first impression on possible regions where water availability might be affected both by climate change and high precipitation variability due to El-Nino (the so-called ENSO-sensitive regions were assessed in the last reporting period).