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SPCZ and air surface temperature in the south-central Pacific in CMIP5 simulations and a forced 50 km downscaling: changes in RCP4.5 and RCP8.5 vs historical period

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The South Pacific Convergence Zone (SPCZ) is a key feature in the South Pacific climate. Its orientation, intensity and variability directly impacts the population's water resource as well as risks of floods and provides an ideal place for perturbations to develop and grow into depressions or even tropical cyclones.

In this study, we focus on the changes in precipitation and surface air temperature, with CMIP5 models and a forced 50km downscaled simulation including a bias correction of SST. The reference period 1960-2005 has been chosen from the historical simulations of CMIP5 models in order to evaluate the change implied by two scenarios of the twenty-first century : RCP8.5 and RCP4.5. The three thirty year periods 2006-2037, 2038-2069, 2070-2100, are analyzed to highlight the transition, for the two austral seasons, summer and winter.

We confirm the double ITCZ bias in the CMIP5 simulations (Brown et al, 2012, Clim. Dyn.) which is slightly improved in the forced simulation while the amount of precipitations is increased. It turns out that a westward contraction of the simulated SPCZ occurs along the twenty-first century, more significant in the RCP8.5. Finally the SPCZ leaves the eastern Polynesian islands (the Gambiers archipelago) suggesting a drier climate during the austral summer by the end of the twenty-first century. This move is not obvious in the forced simulation and it makes sense regarding the global coupled model CNRM-CM5, which SSTs (after bias correction) are used to produce the forced simulation. Indeed, the departure of the SPCZ is not as pronounced as it is in the majority of models.

The surface air temperature increases in the whole south Pacific but the warming is more intense over the equatorial cold tongue and persistent all year long, it reaches more than 3°C by the end of the twenty-first century under the RCP8.5 scenario. The forced simulation exhibits a similar but smoother pattern and the anomalies are somewhat reduced.

People living on small tropical islands in the South Pacific are particularly vulnerable to climate change and assessing the change in precipitation and surface air temperature which are two variables that directly affects the population can therefore help decision makers planning climate change adaptation programs and policies.