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Water budget of tropical cyclones in GCMs and the role of horizontal resolution.

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Projections of tropical cyclone precipitation in future climate is rendered uncertain by the inability of current GCMs to simulate the right number and intensity of tropical cyclones in present climate. This study aims to assess the representation of the water budget of tropical cyclones in climate models and its sensitivity to model's horizontal resolution.

To do so, we use an ensemble of six GCMs (HadGEM3-GC31, EC-Earth3, MPI-ESM, CNRM-CM6-1, CMCC-CM2, ECMWF-IFS) as part of the EU-project PRIMAVERA, spanning the range of resolutions 200 to 20 km. Tropical cyclone have been tracked in each simulation with the same tracking algorithm. For each observation, the water budget has been computed in a radial cap of 5 degree.

Our results show that the impact of resolution depends on models. However, most models tend to show a redistribution of precipitation when resolution is increased, with precipitation occurring closer to the eye at higher resolution, but with no net change of the amount of precipitation within the cap. We show that this is the result of a large scale control of the moisture budget of TC, which is driven by moisture convergence at the edge of the cap and which low resolution models can capture. We do find a change of the contribution of tropical cyclones to global precipitation but it is primarily due to a change in the number of tropical cyclones rather than a change in the contribution of individual cyclones.

One interesting implication is that it is possible to use a low resolution model to investigate how the water budget of a single tropical cyclone will change in future climate. However, high resolution will be required to model the right number of tropical cyclones if one wants to determine the change in frequency of extreme rainfall associated with tropical cyclone.