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Mid-Pliocene climate an analogue for near future climate?

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The last development of sustainable warm climate occurred during the Mid-Pliocene
[3.3–3.0 Ma] period which is a world tectonically similar to our present day world. Despite some climatic modulations, this time period may be considered as a long (300 Ka) warm period with global annual temperature higher by 2or 3°C than pre-industrial. We choose the opportunity of the comparison exercises CMIP5 and PMIP3 (PLIOMIP) to compare Mid Pliocene equilibrium climate simulations obtained with IPSL, OAGCM with PLIOMIP boundary conditions and RCP4.5 future scenario using the same model.

Here we focus mainly on the tropical response atmospheric dynamics in terms of Hadley and Walker cells. As it is very often claimed that Mid-Pliocene is a good analogue for future climate, we investigate this issue through a comparison of both runs, and checking the robustness of our conclusions in comparison with other model results from PLIOMIP and CMIP5.

Our results show that there is a damping of the Hadley cell intensity in the northern tropics and an increase in both subtropics. Moreover, northern and southern Hadley cells expand pole ward. The response of Hadley cell in terms of intensity and shift is stronger for RCP4.5 scenario than mid-Pliocene, but in very good agreement with the fact the atmospheric CO_2 concentration is higher in future scenario than mid-Pliocene (543 versus 405ppm). Concerning the response of Walker cell, we show that despite very large similarities there are also some differences. i.e. the common features are for both scenarios: weakening of the ascending branch, leading to a suppression of the precipitation over the western tropical Pacific. Nevertheless the response of Walker cell is stronger in RCP4.5 scenario than mid-Pliocene but also depicts some major difference as an eastward shift of the rising branch of Walker cell in future scenario compared to the mid-Pliocene.

In this presentation, we shall explain the dynamics of the Hadley and Walker cells, and show that, despite minor discrepancy, mid-Pliocene is certainly an interesting analogue for future climate changes.