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Changes in the Mean Meridional Circulation associated with different condition in the global surface temperature

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This study focuses on the behavior of the Mean Meridional Circulation (MMC) and its relationship with the precipitation distribution under different conditions of mean surface temperatures at global scale. Modifications in the MMC and in particular in the Hadley and Ferrel Cells, have important implications for subtropical and mid-latitude societies because may lead to profound changes in regional climate. There are still many open questions on the strengthening/weakening and widening/narrowing of the Hadley Cells in occurrence of Global Warming scenarios. Therefore this work aims at highlighting the differences in the MMC according to changes in global surface temperature.

Analysis of the differences in the MMC between coldest and warmest years of the 20th - 21th Century is presented using an ensemble of 10 climate model runs of the ERA-20CM Experiment on monthly time scale with 1.5°x1.5° horizontal resolution.

The meridional mass stream function is computed to study variation in the MMC. It gives some useful information about strength, width and poleward extent of the Hadley and Ferrel Cells, in order to understand how the MMC responds to different conditions in the mean surface temperature field.

The relationship between the meridional mass stream function and the monthly total (convective and stratiform) precipitation zonal mean is also investigated in order to find out how the strengthening and weakening of the Hadley and Ferrel cells control the amount of the rainfall in the MMC.

During warm years the analysis shows that, in both hemispheres, the Hadley and Ferrel cells are stronger. The intensification of the ascending branch of the Hadley Circulation determines more precipitation in the Tropics. Conversely a stronger subsiding branch implies less precipitation over subtropical areas. Moreover, during warm years the strengthening of the Ferrel Circulation displaces precipitation poleward both in Northern and Southern Hemispheres.