Estimate of strength and extension of the Hadley Circulation: weak consistency among methods based on different variables.

Ascanio Luigi Scambiati (1), Roberta D'Agostino (2), Piero Lionello (1,3)

(1) University of Salento, Disteba, Climatology, Italy (ascanioluigi.scambiati@unisalento.it), (2) Max Planck Institute für Meteorologie , Hamburg Germany, (3) CMCC, Lecce, Italy

This study estimates of the Hadley Circulation (HC) strength and extension (the position of the poleward edges) using the zonal average of five different variables: stream-function, precipitation, vertical velocity, outgoing longwave radiation (OLR) and precipitation-evaporation unbalance (P-E). The 10 members of the AMIP-like experiment ERA-20CM, the deterministic reanalysis ERA-20C and ERA-Interim are considered. The analysis is restricted to the winter (boreal and austral) season when the corresponding HC have largest extension and strength. The adopted method and criterion depend on the adopted variable. The comparison shows that different procedures produce systematic differences in the position of the HC edges. In the Northern Hemisphere (NH) the Northern Edge (NE) moves progressively northward depending on method: vertical velocity describes the narrowest HC (with the poleward edges located at 24°N/S), while the P-E describes the largest HC (with the edges at 40°N/S), whereas the stream-function agree with the vertical velocity in the NH and with OLR in the Southern Hemisphere (SH). Correlation among edges and strength found with these five parameters varies between hemispheres and among data sets, but they are generally small. The unique features present in all datasets is the link between the stream-function with the NE and strength of HC found with precipitation. In conclusion this analysis shows that the description of the behaviour of the HC has a strong dependence on the method used for estimating its characteristics.