



Width of the Hadley Circulation and its trends: weak consistency among methods based on different variables

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

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

As key component of the climate system, the Hadley circulation is one of the most studied atmospheric feature and changes in its width with global warming may affect the environment and the population of large part of the Earth. Therefore, give a correct representation of its width is fundamentally important. Different methods have been used for estimating its extent, based on different diagnostic variables: stream-function (ψ), Total Precipitation (TP), Outgoing Longwave Radiation (OLR), Precipitation minus Evaporation (P-E), Mean Sea Level Pressure (MSLP) and vertical velocity (ω). This study shows that the level of consistency among such different methods in terms of location, interannual variability and trends of the HC poleward edges is not satisfactory. ERA-20C reanalysis is used to perform this analysis, and only the winter (boreal and austral) season is considered. The period covered by the dataset is the whole 20th century, from 1900-2010. The position of HC edges is estimated by considering two alternative approaches: 1) calculating the HC edge using the zonal mean distribution of the diagnostic variables 2) calculating the zonal mean of the HC edges computed from the diagnostic variables as function of longitude. Different methods produce substantially different zonal mean position of the edges, ranging from 20°N up to 40°N for the Northern Edge and from 40°S up to 15°S for the Southern Edge. TP and P-E describe the narrowest and the widest HC, respectively. Correlations among time series of the zonal mean position produced by different methods are in general weak and not statistically significant. Most methods do not show statistically significant trends during the 20th century when applied to ERA-20C, therefore, the characterisation of the behaviour of the HC width is found to be strongly dependent on the method used and caution should be paid by drawing general conclusions from individual studies based on a single method.