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Variability of energy transports in the atmosphere and implications for the Hadley circulation

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The observed energy balance is maintained by horizontal poleward energy transports within the atmosphere and the ocean. In the atmosphere, processes occur on very different scales in space and time to ensure a 'seamless' transfer of energy: in the tropics most of the energy is transported poleward by the Hadley circulation, whereas eddies dominate the transports in mid-to-high latitudes. However these synoptic systems are also believed to interact in a quite complex manner with the Hadley circulation.

This study aims to improve our understanding of the behavior of atmospheric circulations such as the Hadley cell, by providing a new estimate of energy transports and determining the relative role of large-scale and synoptic circulations in the global energy redistribution. Using 6-hourly outputs from state-of-the-art reanalyses (e.g. ERA-Interim and JRA55), we examine the spatial contrasts in the transport of sensible heat, latent heat, potential and kinetic energy fields, and diagnose how these may have been changing on seasonal to inter-annual timescales. These contributions are further partitioned into mean meridional circulations and (stationary and transient) eddy activities, to explore the complementary variations occurring between high latitude synoptic systems and mean tropical cells.

This diagnostic energetic framework is also applied to CMIP5 model simulations to provide new insights and compare the behavior of atmospheric circulations in the present climate and under a global warming scenario.