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CMIP6 models evaluation using multi-resolution analysis and satellite observations : study of the atmospheric water vapor

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Water vapor is one of the fundamental atmospheric components, and as such, is one Essential Climate Variable (ECV) monitored by the Global Climate Observing System. In this work, the global water vapor Climate Data Record (CDR) generated within the ESA Water Vapor climate change initiative project (WV_cci) is used as reference (daily, 0.1°, 2003-2014) to evaluate a sample of the Coupled Model Intercomparison Project phase 6 (CMIP6) as well as the fifth generation ECMWF reanalysis (ERA5), with a focus on temporal signal decomposition. This temporal decomposition is performed using multi-resolution analysis (MRA). MRA is a mathematical tool which consists of decomposing a signal into its subcomponents on different time scales. Using this tool, the representation of the total column water vapor over the tropics in the CMIP6 models and ERA5 can be assessed separately from daily to annual and decadal time scales, including monthly and seasonal time scales. This approach is powerful for the identification of the relevant time scales for which CMIP6 predictions are most reliable. Hence, at the global-tropical scale, the MRA decomposition of the water vapor signal shows a good correlation between CMIP6 and WV_cci on both seasonal (2 - 8 months) and annual (1 - 1.4 year) time scales. Using a linear regression, we attempt to reconstruct the WV_cci signal using the CMIP6 models and ERA5 as explanatory variables based on the correlation found between the products and WV_cci at each level of decomposition. Such reconstruction highlights the scales of variability that are closest to the observed one. The presentation will detail the MRA approach and the most prominent results, as well as an extension to other parameters linked to atmospheric water vapor distribution, namely cloud cover and types and sea surface temperature.