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Evaluation of the tropical water vapor of CMIP6 GCMs with ESA CCI+ “Water Vapor” climate data records: Insights from large-scale atmospheric circulation

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Water vapor is one of the fundamental elements in the atmosphere. Its distribution is strongly associated with large-scale atmospheric circulation. Here the new global water vapor climate data records (CDR) generated within the ESA Water Vapor CCI+ project (WV_cci) is used to perform a comprehensive evaluation of total column water vapor provided by 21 global climate models (CMIP6 framework). The ESA WV_cci CDRs cover the period 2002-2017 with a daily frequency and a regular 0.5° spatial resolution. The focus is on the tropical region (30°S - 30°N). The observational diagnostic relies on the decomposition of the tropical atmosphere into large-scale dynamical regimes using the 500 hPa atmospheric vertical velocity w_{500} (in hPa/day) as a proxy. The ESA WV_cci and the CMIP6 data are then sorted according to dynamical regimes (intervals of 10 hPa/day) allowing to study the evolution of the regimes in terms of frequency of occurrence and is linked to water vapor variation. While the basic picture of the tropical atmosphere is properly represented by the models (moister in ascending branches, drier in subsiding branches) there are noticeable differences in the patterns that will be discussed. The inter-annual variation of water vapor for both observation and the models will be analyzed, and the trend significance are assessed using Mann-Kendall test. This highlights the interest of water vapor climate data records for model evaluation.