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Interpreting the time variability of integrated water vapour retrievals using local meteorological data and teleconnection indices.

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Being the most important natural greenhouse gas and responsible for the largest known feedback mechanism for amplifying climate change, the role of water vapour is crucial in a warming climate. As a matter of fact, the amount and the time variability of atmospheric water vapour is globally governed by the temperature through the Clausius-Clapeyron equation which states that the water holding capacity increases at about 7% per degree Celsius increment in temperature. Of course, on local scales, water vapour also strongly influences atmospheric dynamics and the hydrologic cycle through latent heat transport and diabatic heating, and is, in particular, a source of clouds and precipitation.

Atmospheric water vapour is highly variable, both in space and in time. Therefore, measuring it remains a demanding and challenging task. As a consequence, in this study, three different datasets have been taken into account. At 118 globally distributed Global Positioning System (GPS) sites, Integrated Water Vapour (IWV) is retrieved from a homogeneous data reprocessing from 1995-2010. At those site locations, also UV/VIS IWV satellite retrievals by GOME, SCIAMACHY and GOME-2, and ERA-Interim reanalysis output is used to study the time variability of the IWV. The IWV seasonal behaviour and the long-term variability are fitted together by means of a stepwise multiple linear regression of the station's time series, with a selection of regionally dependent candidate explanatory variables. Overall, the variables that are most frequently used and explain the largest fractions of the IWV variability are the surface temperature and precipitation. Also the surface pressure and tropopause pressure (in particular for higher latitude sites) are important contributors to the IWV time variability. All these variables also seem to account for the sign of long-term trend in the IWV time series to a large extent, when considered as explanatory variable. Furthermore, the multiple linear regression linked the IWV variability at some particular regions to teleconnection patterns or climate/oceanic indices like the North Oscillation index for West USA, the El Niño Southern Oscillation (ENSO) for East Asia, the East Atlantic (associated with the North Atlantic Oscillation, NAO) index for Europe.