Geophysical Research Abstracts
Vol. 18, EGU2016-13006, 2016
EGU General Assembly 2016

Short-term variability of atmospheric water vapour isotopes reveals local and regional influences on water vapour in the tropics (Sulawesi, Indonesia)

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Measurements of stable water isotopes have proven to be a useful way to determine source areas and contributors to atmospheric water vapour and are valuable tools to retrieve more information about the climatology of a region. Such measurements in South East Asia are however sparse and until now the present work results in the only water vapor measurement campaign ever performed in the Indonesian Archipelago. Here we present the results and analysis of the water vapor isotopic composition (δD, δ^{18}O and *dexcess*) measurement campaign that was performed between March and June 2011 in the coastal city of Palu (0˚54' S, 119˚50' E, elev. 70 m a.s.l.), Central Sulawesi, Indonesia. Isotopic measurements were complemented with meteorological data retrieved from the weather station of the nearby Mutiara Airport. The isotopic composition of the surface layer water vapor (δD and δ^{18}O) shows little day-to-day variability but their mean values reflect mostly the seasonal fluctuation of the ITCZ, while the second order parameter *dexcess* is showing larger daily fluctuations instead of a clear seasonal signature. Water vapor concentration shows large daily fluctuations that are mainly attributed to the particular geographic location of the Palu bay and to the topography of the area that determine the wind distribution and intensity of a sea -land wind system. In order to disentangle the local from the regional influences on atmospheric water vapour and its isotopic composition, we used a set of ECMWF ERA-INTERIM climatology fields coupled with ARL-HYSPLIT backward trajectories to show the variation of the moisture source area across the Indonesian archipelago during the 4 months of measurements. Ocean surface water vapor isotopic composition resulting from the Craig and Gordon evaporative model calculated from reanalysis data and tropospheric values of ?D and water vapor concentration from the TES-AURA satellite mission are than used to understand if vertical mixing is involved during air parcel transport.

Reanalysis data coupled with backward trajectories show that there is a shift in the main regional direction of wind flow from March to June that is attributed to the latitudinal shift of the ITCZ. Even if the shift in the mean monthly isotopic composition could be attributed to a transition in the moisture source area, dexcess measurements fail to depict a distinct signature even when the two main wind direction components (sea breeze and land breeze) are analysed separately. Daily ensemble of isotopic and meteorological observations show a bi-modal distribution in hourly dexcess and wind fields values that lead to the hypothesis that due to the particular topography of the area the wind distribution acts as a buffer, suppressing distinct isotopic signatures from different sources of moisture and recirculating daily the local evaporative flux. The whole set of isotopic data align on a regression line very close to the GMWL, indicating that a predominant Rayleigh distillation process is involved and little vertical mixing takes place.