Validating an isotopic AGCM with new satellite measurements of water vapor isotopes

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ABSTRACT

We performed an intensive verification of an isotope-incorporated AGCM with vapor isotope observation data by two satellite sensors as a part of preparation for data assimilation of water isotopes. A Reanalysis-nudged run with IsoGSM, atmospheric column data with SCIAMACHY on Envisat, and mid-tropospheric (800 to 500 mb) data with TES on Aura were used. For both mean climatological δD of atmospheric column and mid-troposphere, the model reproduced their geographical variability quite well. There is, however, some degree of underestimation for the latitudinal gradient (higher δD in tropics and lower δD in mid latitudes) compared to the SCIAMACHY data, whereas there is over-amplification of the longitudinal variation (higher δD in South America-Atlantic-Africa and lower δD in Maritime Continent) comparing with the TES data. It was also found that the two satellite products have different relationships between water vapor amount and its isotopic composition. Particularly, atmospheric column mean δD, which is likely represented by lower tropospheric vapor, exhibits a closer relationship with a typical Rayleigh-type "rain-out" process with isotopic fractionation, whereas in the mid-troposphere it is more closely related with "mixing" process. This feature is not quite reproduced by the model, where the relationships between δD and the vapor are similar each other at atmospheric column and mid-troposphere. From comparison on a shorter time scale, it becomes clear that the data situation for future data assimilation is best for tropical and subtropical desert areas (i.e, Sahel, south Africa, middle east Asia, Gobi, Australia, and southwest US) for total column δD, whereas the available mid-tropospheric δD observation cover wider regions particularly over tropical to sub-tropical oceans.