

SOWER (Soundings of Ozone and Water in the Equatorial Region): Dehydration in the TTL estimated from the water vapor match

Yoichi Inai[†]; Fumio Hasebe; Masatomo Fujiwara; Masato Shiotani; Noriyuki Nishi; Shin-Ya Ogino; Holger Voemel; Takashi Shibata; Suginori Iwasaki

[†] Graduate School of Science, Tohoku University, Sendai, Japan, Japan

Leading author: wwwyoww@hotmail.com

A match method, applicable to quantify the dehydration in the tropical tropopause layer (TTL), has been developed using the network observations by cryogenic frostpoint hygrometer on board radiosonde in the tropical Pacific. The match pairs are sought from the Soundings of Ozone and Water in the Equatorial Region (SOWER) campaign network observations during every boreal winter from December 2004 to January 2009 with the use of isentropic trajectories. For those pairs identified, extensive screening procedures are performed to verify the representativeness of the air parcel and the validity of isentropic treatment, and to check possible water injection by deep convection, consistency between sonde data and analysis field and conservation of the included ozone amount. Among those pairs survived, we found some cases corresponding to the first direct evidence of the dehydration associated with horizontal advection in the TTL. The statistical features on the dehydration for the air parcels advected in the TTL are derived from the match pairs. It is indicated from match analysis that the ice nucleation must have started before the relative humidity with respect to ice (RHi) reaches the value of $191 \pm 84\%$ (1 sigma), this value is derived from the ratios of the first observed water vapor mixing ratios to the minimum saturation water vapor mixing ratios (SMRmin) during advections. The SMRmin is estimated from ECMWF analysis fields. Another statistical feature is also indicated that the air mass is dehydrated until the RHi reaches $82 \pm 30\%$ (1 sigma), this value is derived from the ratios of the second observed water vapor mixing ratio to SMRmin. The efficiency of dehydration is estimated as the relaxation time of the relative humidity for the supersaturated air parcel to approach saturation state. This is empirically estimated from the match pairs as the quantity that reproduce the second water vapor observation given the first observed water vapor amount and the sequence of saturation mixing ratio of the match air mass exposed to during the advection. The relaxation time is found to be ranging from about 2 to about 3 hours, which agree with those reported from previous studies.