

Water and relative humidity at the tropical tropopause

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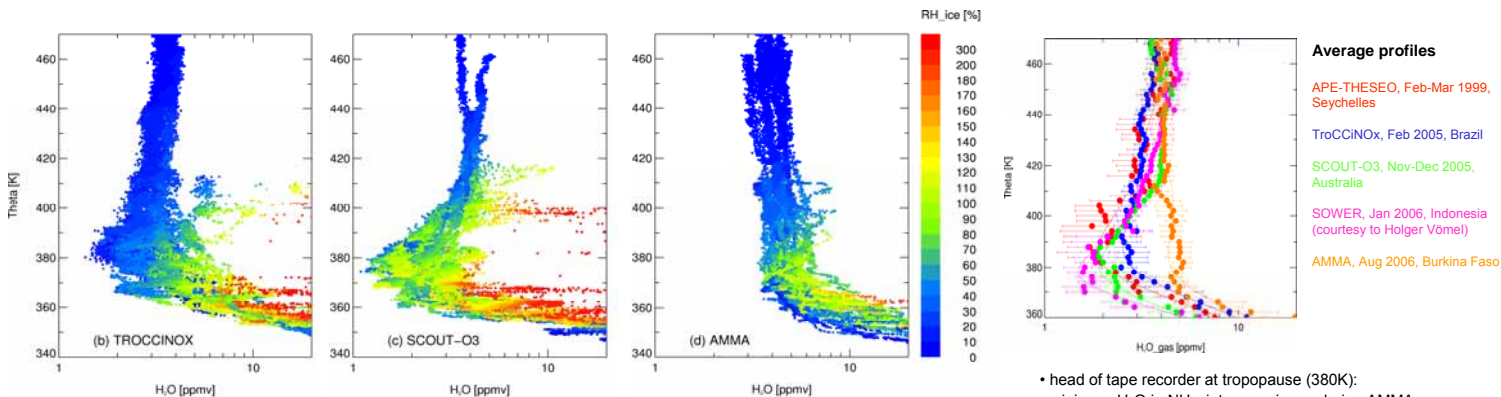
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Abstract

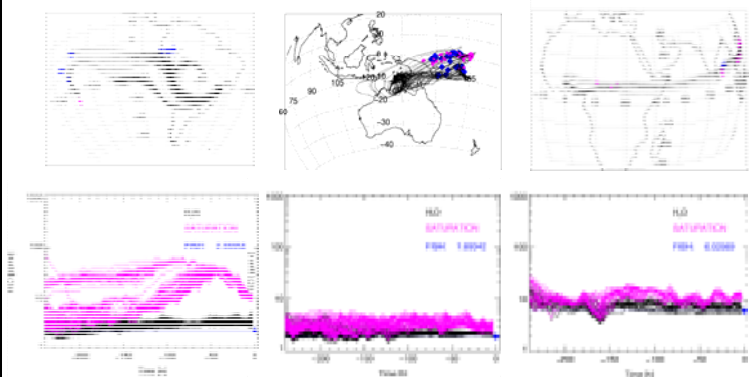
Total water was measured onboard the Geophysica high-altitude aircraft using the Jülich fluorescence hygrometer FISH at different tropical regions: Over the Indian Ocean during APE-THESEO in February-March 1999, over Southern Brazil during TroCCINOx in January-February 2005, in the Northern Australian region during SCOUT-O3 in November-December 2005, and over West Africa during AMMA in August 2006. Below 420 K, local phenomena control the water concentration and lead to a highly variable distribution and RH_i, for a single campaign as well as for the mean profiles of the individual experiments. The cold point temperatures and minimum H₂O abundances were lowest during SCOUT-O3 and APE-THESEO 1999 with minimum mixing ratios of 1.3 ppmv, consistent with the temperature history of backward trajectories. During TroCCINOx and SCOUT-O3, deep convection penetrating the tropopause was observed, injecting ice and humidity into the TTL and up to 420 K, and during AMMA, signatures of enhanced H₂O as an indicator of aged convection becomes apparent in a few profiles.



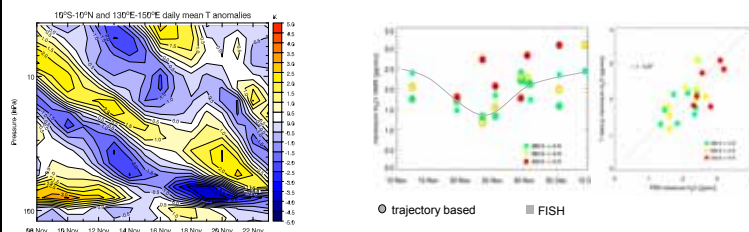
- lowest H₂O m.r. (1.3 ppmv) during SCOUT; 4-6 ppmv at cold point during AMMA
- highest RH_i and cloud occurrence during SCOUT (ongoing dehydration)
 cloud formation and high saturation at cold point not frequent during AMMA and TroCCINOx
- convective injections with RH_i > 100 % (ice) moisten subsaturated environment in the TTL and up to 420 K

- head of tape recorder at tropopause (380K):
 minimum H₂O in NH winter, maximum during AMMA
- hygropause at tropopause for NH winter campaigns
 hygropause at 19-20 km during AMMA
- H₂O at hygropause during AMMA higher than min H₂O of other campaigns (interannual variability, NH/SH difference)

Temperature history and H₂O



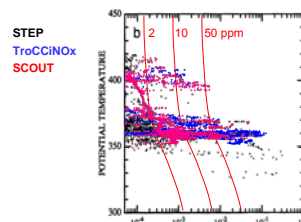
- minimum T along trajectories explains observed minimum H₂O for all three regions
- drying region may be remote (Pacific, Indian Ocean)



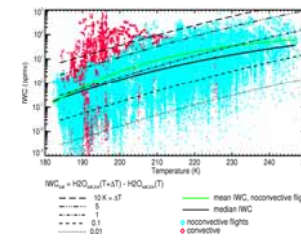
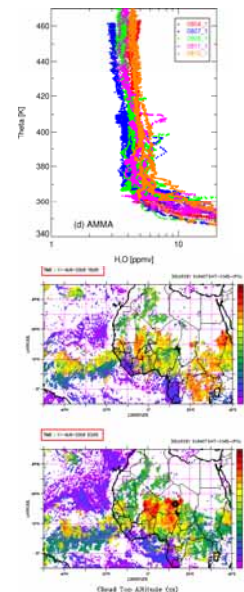
- SCOUT-O3: equatorial Kelvin wave with ΔT=10K at TP in WP region in Nov 2005
- measured H₂O at TP follows T perturbation

Convective impact on H₂O

the shooting and ...



... the smoking gun



- TroCCINOx/SCOUT-O3: active convection probed, high IWC
 AMMA: aged signatures of convection observed
- moistening of TTL and LS up to 420 K
- individual profiles only
 upscaling: impact for stratospheric H₂O entry < 2-10%