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High frequency chilled mirror hygrometer for atmospheric measurements with fixed wing UA

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In atmospheric sciences water vapour is an often neglected parameter aside temperature, wind speed and direction. Water vapour plays an important role in energy transfer in the atmosphere, e.g. in latent heat fluxes. While the large scale moisture fluxes can be captured by lidar and microwave radiometry, those remote sensing techniques provide a high coverage yet a low resolution. Satellite-based microwave radiometry can chart the whole atmosphere, the spacial resolution however is not suited for turbulence evaluations. Capacitive sensors show a maximum frequency of only about 1 Hz. The latter sensor types are small and light weight enough to be equipped in UAS (unmanned aircraft systems), yet the temporal resolution is still too low to measure turbulent fluxes.

Through recent advances in miniaturising electrical components and by using user friendly micro processors a miniature CMH (chilled mirror hygrometer) has been built and equipped to the MASC Mk3 UAS of the University of Tuebingen. The sensor consists of a TEC (thermoelectric cooler) covered by a gold mirror. The TEC is controlled by a PID (proportional–integral–derivative) controller. The sensor will be presented, its features and limitations. Spectra will show its capabilities to measure turbulent fluxes in the atmosphere.

Measurement averages are compared to slower state of the art industrial capacitive humidity sensors.

The results are from the first field measurements onboard the MASC Mk3 UAS. The goal of the new CMH is to be fast enough to measure atmospheric turbulent humidity and latent heat fluxes. A fast humidity sensor onboard of automated UAS has the potential to study humidity fluxes over different vegetation types and various altitudes.