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Atmospheric moisture supersaturatons in the near-surface atmosphere of Dome C, Antarctic Plateau

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Moisture supersaturations occur at the top of the troposphere where cirrus clouds form, but is comparatively unusual near the surface where the air is generally warmer and laden with liquid and/or ice condensation nuclei. One exception is the surface of the high antarctic plateau. This study presents one year of atmospheric moisture measurement at the surface of Dome C on the East Antarctic plateau. The measurements are obtained using commercial hygrometry sensors adapted to allow air sampling without affecting the moisture content even in case of supersaturation. Supersaturation is found to be very frequent. Common unadapted hygrometry sensors generally fail to report supersaturation, and most reports of atmospheric moisture on the antarctic plateau are thus likely biased low.

The measurements are compared with results from 2 models with cold microphysics parametrizations: the European Center for Medium-range Weather Forecasts through its operational analyses, and the Model Atmosphérique Régional. As in the observations, supersaturation is frequent in the models but the statistical distribution differs both between models and observations and between the 2 models, leaving much room for model improvement.

The representation of supersaturations is not critical for the estimations of surface sublimation since they are more frequent as temperature is lower i.e. as moisture quantities and water fluxes are small. However, ignoring near-surface supersaturation may be a more serious issue for the modeling of fog and when considering water isotopes, a tracer of phase change and temperature, largely used to reconstruct past climates and environments from ice cores. Because observations are easier in the surface atmosphere, longer and more continuous in situ observation series of atmospheric supersaturation can be obtained than higher in the atmosphere to test parameterizations of cold microphysics, such as those used in the formation of high altitude cirrus clouds in meteorological models.