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Finding proper quantities to describe key cloud parameters and their uncertainty from PATMOS-x long-term satellite observations

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Satellite observations provide outstanding possibilities to investigate the Essential Climate Variables (ECV) of cloud properties for decades. The massive amount of data makes it necessary to define parameters, which abstract the instantaneous measurements to values, which represent the cloud parameter over a certain time and space.
The most popular approach is to build average monthly values over all valid measurements in a 1x1 longitude/latitude degree grid, as carried out in the GEWEX cloud assessment project. These results provide initially a good global and regional knowledge of Earth's state of climate.

However, the exclusive use of averaged data inherits some problems, which are the potential source of misinterpretation. Some examples are the high sensitivity on the order of averaging (first spatially or first temporally), random and systematic data gaps, sampling differences or changing observation constellation over the years (e.g. orbital shift). For some of the variables the distribution of observed values are far from Gaussian, so that the mean value may provide non-physical or at least very unlike values. To provide an example: The height of cloud tops, which has mostly a bimodal distribution with many low and high-level clouds, shows often an average of a mid-level cloud, which may be not representative at all.

We will point up the options of modifying level-3 mean values to describe the distribution of long-term observations of an ECV. These quantities will be tested if this approach fulfills the GCOS climate monitoring principles, especially regarding stability and accuracy.

In this study we look at uncertainty sources from algorithm, sensor calibration, satellite drift, observation geometry as well as seasonal variability. Furthermore, the estimation of the level-3 uncertainty requires a-priori knowledge of diurnal cycle and the day-to-day variability of the ECV to take in account gaps in the observation during the course of a month. This may even have a greater impact than the uncertainty propagation from level-2 data to the climate value.

All approaches and results will be demonstrated on cloud products of the Pathfinder Atmospheres Extended (PATMOS-x) which makes use of NOAA's Advanced Very High Resolution Radiometer (AVHRR).