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Consistency of mixing height retrieved over a large spatial domain from different data sources

Gionata Biavati and Dietrich G. Feist
Max-Planck-Institute, Biogeochemie, Jena, Germany (gbiavati@bgc-jena.mpg.de)

The monitoring of GreenHouse Gases (GHG) fluxes over large domains is performed coupling measurements with transport models.
A key parameter, for successfully quantifying the fluxes is the altitude of the capping inversion, or the mixing height (MH).
This parameter is commonly estimated as a diagnostic variable within global models, or estimated using radiosonde data.
Both these methods have problems in representing the MH.
In particular the time evolution and the spatial representation are the weakest aspects.
Within the context of the Integrated Carbon Observation System (ICOS), a network of measurement stations is going to be created.
Together with a complete equipment of instruments for measuring GHG concentrations and meteorological quantities, it is planed to monitor the MH using ceilometers and lidars.

Ceilometers are a less expensive version of lidars, they are capable to estimate aerosolic load and within almost the first two kilometers the molecular density. The estimations are obtained looking for relevant time and space fluctuations of aerosol concentration.
This is equivalent to placing the MH over an strong variation of the measured signal.
So the most of the algorithms for locating MH are edge detection algorithms.

The evaluation of the MH, estimated with different algorithms applied to optical data, shows bad agreement with the estimate performed on radiosonde data.
However, a deeper study on the automated methods used on radiosonde data reveals that the commonly used algorithms, based on different implementations of Richardson Bulk Number method, are not reliable or suitable for evaluating results of other methods.

The use of optical instruments for estimating MH has several limitations: multiple edges are commonly detected and a selection criteria is required; depending on the stability of the boundary layer MH can be outside the detection limits of the instrument; clouds and other water condensations phenomena can prevent the estimation of MH.

Applications of such instruments is tested over a wide domain covering the German Weather Service network of ceilometers and the estimations are compared to different methods of estimating MH, in particular: geostatistical interpolation of MH estimated with radiosonde; distance weighted interpolations of MH estimated with radiosonde; direct comparison of co-located ceilometer and radiosonde.

The results reveal the need of developing a more appropriate approach for using both radiosonde and optical methods in an automated context.