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Multi annual cloud analysis from Meteosat data

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The satellites of the METEOSAT series have continuously measured the state of the atmosphere as well as that of land and sea surfaces for the whole earth disc over the past 30 years. With METEOSAT Second Generation (MSG) in operation and the third generation in planning another 30 years of consistent measurements can be expected.

This unique data set is ideal for climate analysis. One prominent aspect of climate changes is forcing of the water cycle. The analysis of cloud cover, structure and statistics on cloud types can give an indication for a change in atmospheric conditions.

The “classical” approach identifying clouds is based on their spectral signature on a pixel by pixel basis. As a supplement additional input such as spatial, context and neighbourhood can be used to gain further information.

Advanced image analysis algorithms enable the segmentation of satellite data on various scales. The segmentation process uses multi spectral and spatial information to generate homogeneous segments. The weighting of spectral and spatial homogeneity is adjusted to the current situation. Furthermore the approximate size of segments is pre-selected by a parameter. Depending on this scale parameter one segment can contain a small homogeneous area e.g. one cumulus cloud or for larger scales it can contain various different areas e.g. a field of coastal cumuli containing cloudy and non cloudy patches. The connection between the different scales is done by “region merging” thus every smaller segment belongs explicitly to one bigger segment.

Every segment has a spectral signature upon which a classification similar to the “classical” pixel by pixel analysis can be performed. In addition to pixels the segments have properties like size and form. The analysis of neighbourhood and the relationship between “children” and “parents” (i.e. the embedding of small segments in big ones) is used as a powerful tool for advanced classification. With this additional information

segments with a similar spectral signature are assigned to different classes. A cirrus cloud can now be distinguished being a condensation trail (slim and straight) or the edge of a thunder storm (sickle form and neighbourhood to cumulus).

The ability of the algorithm has been shown in NOAA/AVHRR case studies and was successfully used with MSG data. The use of this technique enables the statistical analysis of cloud types over large areas and long time series. Changes in the cloud cover and cloud type can be detected.

To use satellite data in climate modelling some variables, especially cloud cover, derived from METEOSAT and modelled in the climate version of the Local Model (CLM) from the DWD have been compared. First results show a good agreement for frontal systems, but some significant differences on convective situations.