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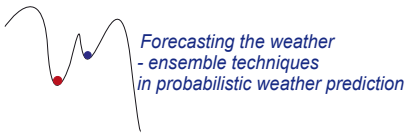

Four-dimensional identification and tracking of cyclones and upper-tropospheric jet-streams

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We have implemented a novel segmentation algorithm for the identification and tracking of specific four-dimensional structures in large atmospheric data sets. The segmentation algorithm also allows for a precise localization of the occurring merging and splitting events. As a first application, this algorithm has been used with ECMWF reanalysis data to perform a two-year climatology of upper-tropospheric jet-streams and their merging and splitting events. Jet-streams have been defined as regions with a horizontal wind speed exceeding 40 m/s. The efficiently implemented algorithm was able to handle the large amount of atmospheric data in less than five hours on a standard Linux computer. The results show a clear signal of more short-lived jet-streams in the North Atlantic compared to the North Pacific region.

The segmentation algorithm is very flexible and could be adapted also for the identification of cyclones in four-dimensional data sets. Several different criteria were tested and evaluated in order to obtain an accurate identification of coherent three-dimensional vortices corresponding to extratropical low-pressure systems. One of the most promising approaches appears to identify coherent three-dimensional structures with a strong negative geopotential height anomaly. This extension to three dimensions, compared to standard two-dimensional cyclone identification techniques, provides novel insights into the development of cyclones. For example, in case of classical top-down cyclogenesis events, the formation and structure of a cyclone can be identified first in the upper troposphere, hours or days before the cyclonic structure reaches into the lower troposphere.

The presentation will introduce the basic ideas of the segmentation algorithm and show new results on the segmentation of jet-streams and cyclones.