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Application of Analogue Ensemble in Horizontal Visibility Forecasting

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Most of the operational thresholds of aviation and air traffic controlling are related to horizontal visibility or cloud ceiling. It is clear that the importance of accurate visibility forecasts in aviation meteorology is essential. Due to the complex physical background of forecasting visibility, numerical weather prediction models are not the most effective tools in this field, even they apply post-processing methods. Nowadays, best results in ultra-short term prediction of visibility are mainly from the field of analogue or artificial neural network forecasting. Our fuzzy logic-based analogue forecasting method also provides convincing verification results, but in its deterministic visibility prediction there is not any information about the uncertainty of this forecast. However, this kind of information could be an efficient tool to reduce or make avoidable weather related risk in aviation. This gave us the idea to compose analogue ensemble forecast besides the deterministic one.

In traditional ensemble forecasts the perturbed initial field can cause significantly different ensemble members which run within the possible limits designated by the governing physical processes. In our analogue forecasting the applied method finds the most similar weather situations to the actual one in the historical database and the deterministic forecast is based on these situations. The differences between the most similar situations and the actual one are small enough, so they can be regarded as “perturbations”. Then we can apply the whole analogue forecasting algorithm once again on the selected situations in order to create analogue ensemble members. Obviously, those parts of the historical database which are involved as similar situations are skipped during the repeated application of the algorithm to avoid finding themselves. In the presented case studies we show different applications of analogue ensemble members. On the one hand we can use these forecasts as the traditional ensemble members to provide probabilistic prediction of visibility. On the other hand we can check their reliability because their predictions are valid for past time, so they can be easily verified. It means that in this case we can have probabilistic information about the behavior of analogue forecasting in such situations. The first preliminary results are convincing, but comprehensive verification need to be carried out to prove applicability of the presented method.

We have to note, the mentioned analogue forecasting method cannot give us fairly accurate prediction in case of dynamical changes, because of its basic concept. If such kind of change occurs during the forecast period, the visibility prediction can be supported by other forecasting methods such as numerical and/or hybrid ones.