Verification of fog and low cloud simulations using an object oriented method

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1. Introduction

The forecasting of the onset, development and dissipation of fog remains today as one of the biggest challenges in the field of weather forecasting. We want to know if the use of meso-microphysical models scales in weather forecasting with sophisticated microphysics may improve the representation of fog and low clouds. Besides, the verification of clouds is a complex issue. Traditional point verification has many limitations due to scarce observations, different meaning of cloud cover from ground observer and model calculation, and limitations of traditional scores (RMSE, bias, MAE).

The aim of this study is to explore the use of an object-based verification method and satellite observations to verify the model performance. We will use the SAL algorithm to see how well is the model able to represent the spatial structure of low clouds. SAL method has been designed for precipitation verification and we want to know if it can be applied for cloud verification. Model clouds will be compared with satellite observations using SAF estimates of cloud type.

It seems important to focus the study in a relatively small area to have homogeneous meteorological conditions and for the SAL method to work well. The Spanish Northern Plateau is a fairly homogeneous terrain where radiation fog usually appears during winter. We select two months of data to outline the SAL methodology applied to cloud cover using the quasi-operational HARMONIE/AROME model running at AEMET and satellite observations.

2. SAL method

The SAL method (Wernli et al., 2008) is a feature-oriented approach which describes a model forecast skill when verified against gridded observations. Using this method it is possible to estimate the goodness of a model forecast attending not only the quantity of the magnitude but the spatial distribution of the field: SAL stands for Structure, Amplitude and Location, the three parameters providing the information of the field in a domain:

- Structure, S: compares the shape and the size of the objects.
- Amplitude, A: compares quantitatively the objects, in this case, cloud fraction.
- Location, L: compares the location of the objects in a relative and absolute way

SAL results at different forecast ranges

SAL results at different verification times

3. Data

MODEL

- HARMONIE v36h1.4
- AROME configuration
- Horizontal resolution 2.5 km, 65 vertical levels
- 6-hr cycle for surface fields, upper air fields are taken from the ECMWF H+6 forecasts
- ECHAM5 scheme for shallow convection
- GEM4L scheme for diffusion of hydrometeors

OBSERVATIONS

- MSG v2012.2 images
- Satellite Application Facility product of cloud type
- Native satellite files converted to grib files, filtered low clouds
- Horizontal resolution ~ 3 km

DATA

- North Spanish plateau: ~320x120 points ~ 800x300 km
- Jan 2012 and Jan 2013
- Model runs at 00,06,12,18 UTC
- Low and Very low cloud cover every hour up to H+24

4. Conclusions and future work

Cloud field is complex to verify. In this work the proposal is to compare satellite products and model output to validate results for fog and low clouds from a more objective and quantitative point of view.

- Structure-Amplitude-Location (SAL) gives information that can be used to assess model performance from a different perspective, complementing the classical verifications.

- The SAL method applied to two months of data shows that HARMONIE overestimate the fog/low-cloud events at any forecast range. However, it is interesting the underestimation of the model at 12 UTC during the daylight fog and low clouds are dissipated more than expected compared to observations.

- This study opens the possibility to extend it to verify other variables as the liquid water content or the brightness.