EUMETSAT METEOROLOGICAL SATELLITE CONFERENCE 2018
17-21 September 2018, Tallinn, Estonia

Simulated MSG SEVIRI imagery from the HARMONIE-AROME high-resolution numerical weather prediction model: applications in AEMET

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BACKGROUND AND MOTIVATION

Satellite imagery simulated from Numerical Weather Prediction (NWP) model fields, using fast Radiative Transfer (RT) models, has become considerably more realistic during the last decade, as a result of advances in both NWP and RT modelling.

Current NWP high-resolution models are typically non-hydrostatic convection permitting and their nominal horizontal resolution is in the same range as that of current geostationary satellite imagery.

The range of applications of Simulated Satellite Imagery (SSI) is therefore becoming wider, from well-established applications such as a proxy for new platform-sensor or in operational weather forecasting, to emerging applications such as the evaluation of NWP forecasts.

HASSI = HARMONIE-AROME SIMULATED SATELLITE IMAGERY

The simulated images from HARMONIE-AROME shown in this poster have been generated with HASSI, an application in development in the NWP group of AEMET as part of its contribution to the HIRLAM group. In all the HARMONIE-AROME simulations used here to generate SSI:

- The boundary conditions are taken from the ECMWF global model.
- The horizontal resolution is 2.5 km.
- The number of vertical levels is 65.

HASSI uses the RT model RTTOV v12 from the EUMETSAT NWP SAF.

HARMONIE-AROME is a non-hydrostatic convection permitting mesoscale model, and its nominal horizontal resolution is by default 2.5 km, very close to that of MSG SEVIRI imagery (3 km at the sub-satellite point).

SSI from HARMONIE-AROME model and from the global ECMWF model are complementary: HARMONIE-AROME SSI provides more detail in its limited domain, in the short-range (Fig. 1).

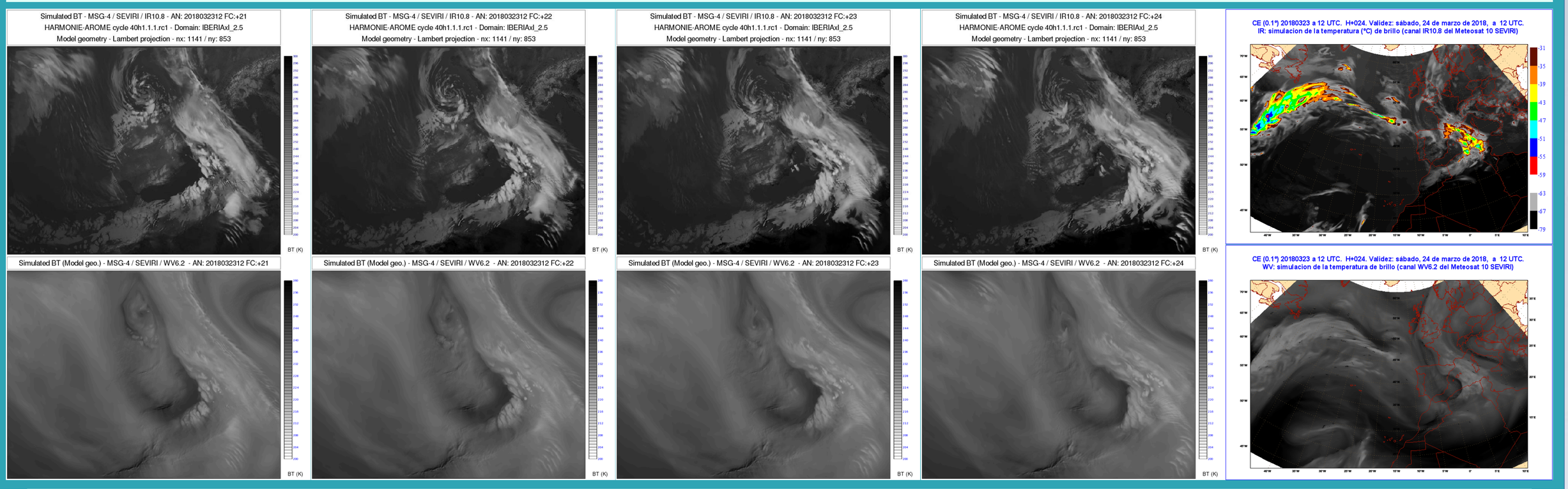

Figure 1. The first four columns show a sequence of hourly SSI from HARMONIE-AROME during cyclone Hugo (HH+21 to HH+24, from AN=20180323 at 12 UTC). The rightmost column shows SSI from the ECMWF model (HH+24 from same AN time). Top row: all IR10.8, bottom row: all WV6.2.

Applications in operational weather forecasting

SSI are a well-established tool in operational weather forecasting. They can be used to summarize an NWP forecast, in an intuitive way, as shown in Fig. 1.
In addition, WV6.2 images represent a snapshot of the dynamics of the middle and upper troposphere (Fig. 2).

SSI can also help to assess the quality of an NWP analysis (or a very short range forecast), as when the NWP forecasts reach the forecasting room, the observed images - against which the SSI can be compared - are already available.

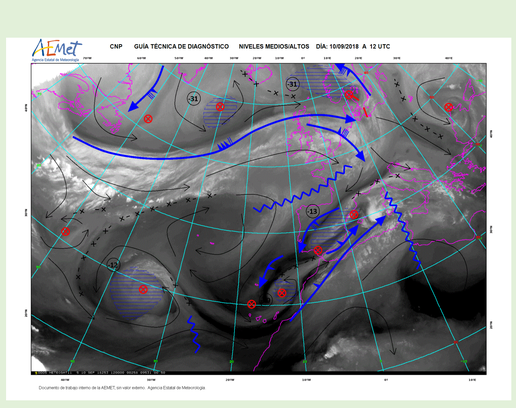

Figure 2. Sketch emphasizing the main features of the upper and middle trophospheric flow, using an observed Meteosat-11 WV6.2 image as one of the key fields. Source: Centro Nacional de Prediccion, AEMET.

Applications in NWP model development and validation

SSI can help in case studies, to compare different versions of a model (see Fig. 3) or different components of the same model and version, e.g. different parameterizations.

The current degree of realism of SSI allows to be optimistic about objective comparison (e.g. object-based methods) between simulated and observed imagery. For objective comparison, simulated and observed images need to share the same geometry, though. Figure 4 shows a pair of SSI re-mapped to satellite geometry.

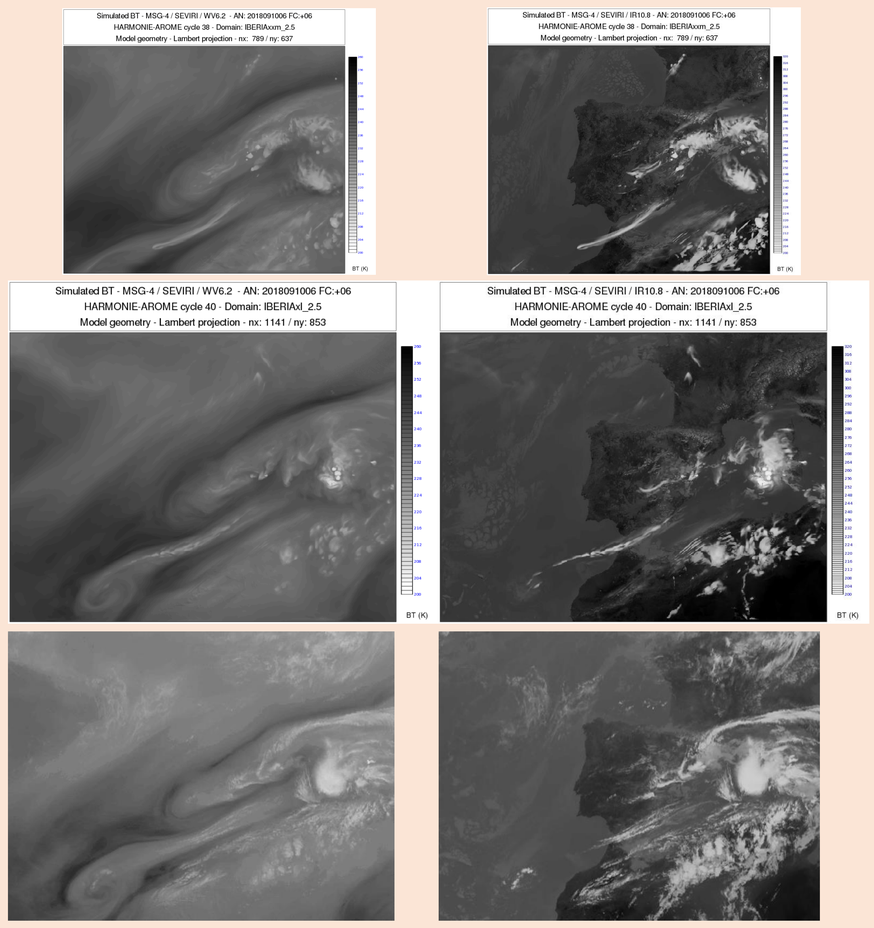

Figure 3. IR10.8 (right) and WV6.2 (left) images from an experiment using cycle 38 of HARMONIE-AROME (top), cycle 40 (middle), and observed Meteosat-11 (bottom), all for time 20180910 at 12 UTC.

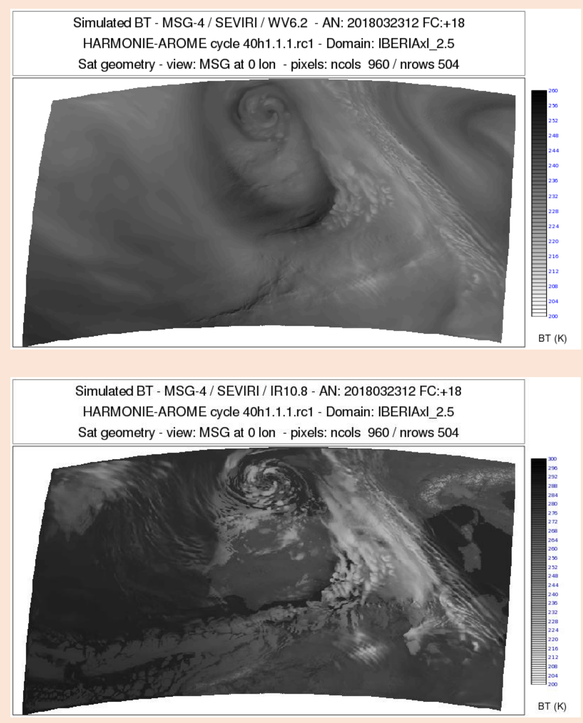

Figure 4. WV6.2 (top) and IR10.8 (bottom) SSI from the same sequence as in Fig. 1, re-mapped to the satellite geometry (MSG at 0 lon).

References

- Bengtsson, L. et al. (2017). The HARMONIE-AROME Model Configuration in the ALADIN-HIRLAM NWP System. Mon. Wea. Rev., vol 145, pp 1919-1935.
- Hocking, J. et al. (2018). RTTOV v12 Users Guide. Available from www.nwpsaf.eu.

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