A Note on the Direct Comparison of Synthetic Satellite Images from COSMO Model with MSG Products

Avgoustoglou Euripides

Hellenic National Meteorological Service

1 Introduction

The meteorological satellite observations provide a substantial and extensive source of data for comparison with numerical weather prediction models (Refs. Reichert et al. 2004, Reichert et al. 2005, Reichert et al. 2006). We examine the synthetic satellite images produced by the COSMO model, version 4.11 (COSMO_4.11) in reference to Meteosat 9 (MSG) data. These data are available on real time at HNMS and are manipulated through SYNESAT software for operational use. In particular, the infrared of 3.9 μm and 10.8 μm as well as the water-vapor channels of 6.2 μm and 7.3 μm were considered. Furthermore, the model low, medium, high and total cloud covers are directly compared with the corresponding MSG products produced by the Meteorological Products Extraction Facility Algorithms (MPEF).

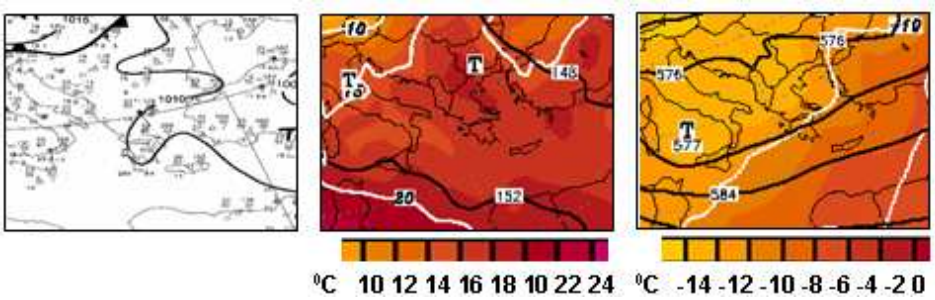

Figure 1: Surface (left), 850 Hpa (medium) and 500 Hpa (right) analysis on August 31 2011 at 00 UTC ©Deutscher Wetterdienst.

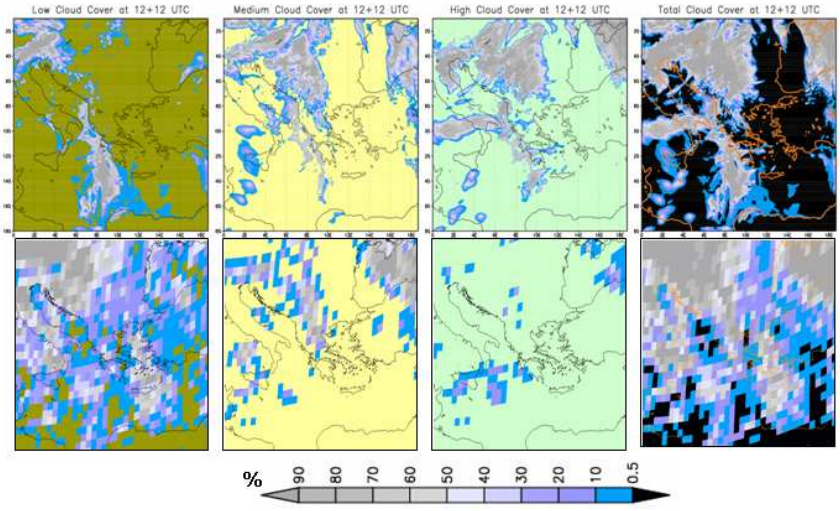

Figure 2: Cloud cover on August 31 2011 at 00 UTC from COSMO model (upper row) in reference to the corresponding satellite (MPEF) figures (lower row ©EUMETSAT). The first, second, third and fourth columns refer to low, medium, high and total cloud cover respectively.

2 Case Study

A 36-hour period was considered, starting from 12 UTC of August 30 2011. The boundary conditions came from three-hour, forty-level analysis intervals based on GME and with horizontal grid of 0.5^0 ($\sim$ 50 Km). The horizontal grid size of COSMO model run was 0.0625^0 ($\sim$ 7 Km) and the integration time step was 30 secs. The run was based on the default sub-grid statistical cloud scheme based on relative humidity. The domain under consideration is the wider Balkan Area with Greece at its center.

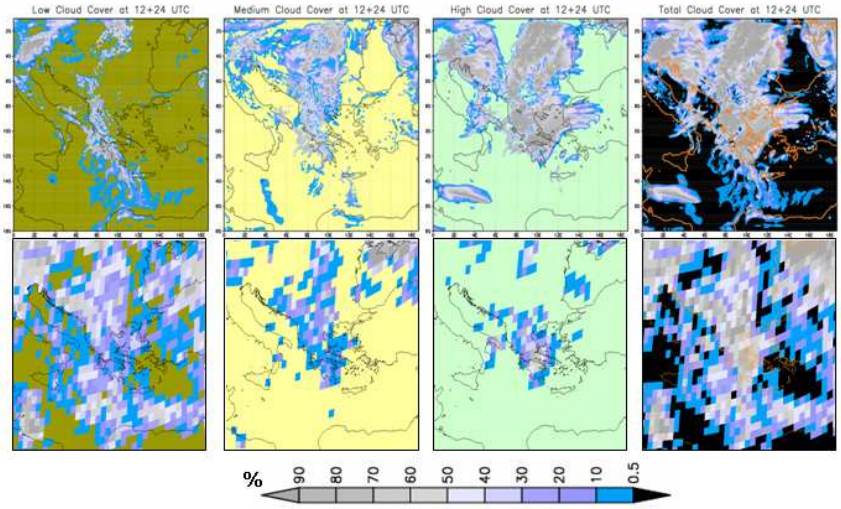

Figure 3: Cloud cover on August 31 2011 at 12 UTC from COSMO model (upper row) in reference to the corresponding satellite (MPEF) figures (lower row ©EUMETSAT). The first, second, third and fourth columns refer to low, medium, high and total cloud cover respectively.

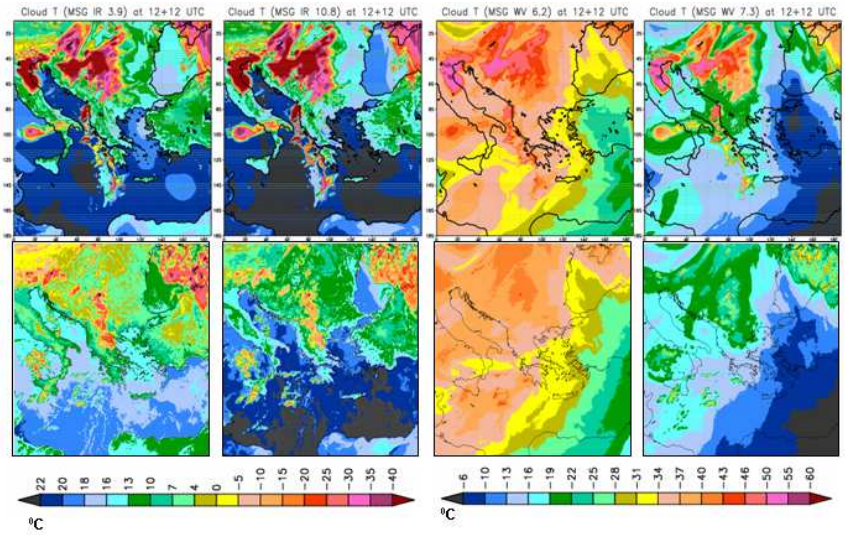

Figure 4: Cloudy brightness temperatures for artificial satellite images on August 31 2011 at 00 UTC from COSMO model (upper row) in reference to the corresponding MSG satellite figures (lower row) ©EUMETSAT. The first, second, third and fourth columns refer to 3.9 μm, 10.8 μm, 6.2 μm and 7.3 μm channels respectively.

From the synoptics standpoint (Fig. 1), the 500 Hpa geopotential analysis chart shows a relatively weak west south-west wind field over the region. This feature, combined with the almost homogeneous mean sea level pressure field of 1010 hPa associated with an extended weak barometric low over the east led to an extensive cloud cover over the whole domain.

Regarding low cloud cover (Fig. 2 and Fig. 3), it is underestimated by the the model with respect to cloud analysis, especially over marine areas. The situation is reversed for high cloud cover which is overestimated by the model, mainly over land. The very good agreement for middle cloud cover between the model and cloud analysis "hides" these differences to a degree , mainly for high clouds, leading to good agreement for the total cloud cover. However, over the areas where the low clouds preponderate the model performance looks quite modest. The above situation is highlighted in the comparison of cloudy brightness temperatures between MSG and synthetic satellite images created by COSMO model (Fig. 4 and Fig. 5). In the infrared channels, the MSG images show lower cloudy brightness temperatures than the corresponding synthetic satellite images over the marine areas and higher cloudy brightness temperatures over most of the land areas. It is worth observing however that this trend regarding the mainland of Greece is not followed in Fig. 4.

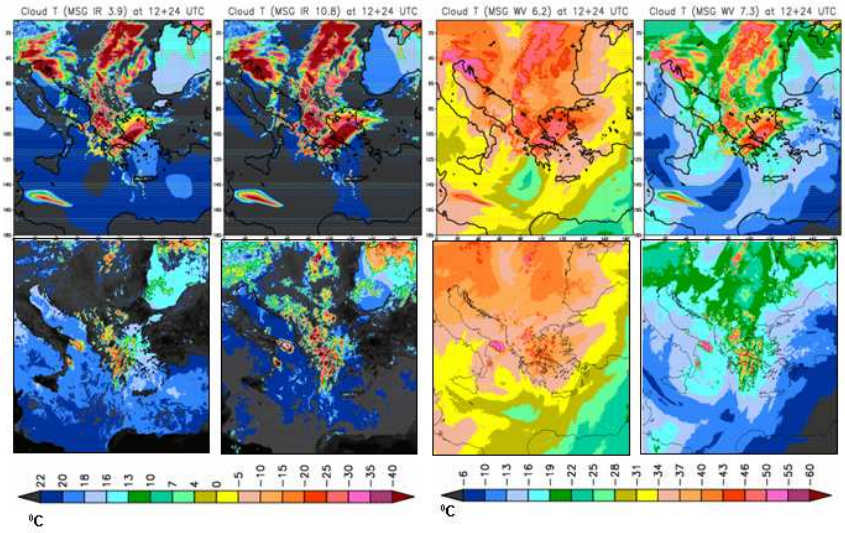

Figure 5: Artificial satellite images on August 31 2011 at 12 UTC from COSMO model (upper row) in reference to the corresponding MSG satellite figures (lower row) ©EUMETSAT. The first, second, third and fourth columns refer to 3.9 μm, 10.8 μm, 6.2 μm and 7.3 μm channels respectively.

3 Summary and Outlook

The possibility for direct comparison of cloud cover and synthetic satellite images of COSMO model with the corresponding remote sensing products is a valuable feature towards both the validation of the model but also for research purposes. In particular, the evaluation of different cloud schemes through the availability of these products (Refs. Avgoustoglou2011) is currently under progress.

References

[1] Reichert, B. K., C. Träger, and J. Asmus, 2004: Automatic Monitoring of NWP Fields Using Synthetic Satellite Images. EUMETSAT Meteorol. *Sat. Conf.*, EUMETSAT, Darmstadt, Germany, **371-376**.

[2] Reichert, B. K., C. Träger-Chatterjee, and J. Asmus, 2005: Using synthetic satellite images for automatic monitoring of NWP fields: operational applications. *EUMETSAT Meteorol. Sat. Conf.*, EUMETSAT, Darmstadt, Germany, **67-74**.

[3] Reichert, B. K., C. Träger-Chatterjee, and J. Asmus, 2006: How can synthetic satellite images from NWP models help in operational forecasting? *EUMETSAT Meteorol. Sat. Conf.*, EUMETSAT, Darmstadt, Germany, **72**.

[4] Avgoustoglou E., 2011: Investigation Of Different Parametrizations Of The Mixed Liquid-ice Sub-grid Statistical Cloud Scheme Over Greece. Presentation available at *www.cosmo-model.org/content/consortium/generalMeetings/general2011/wg3a.htm*.