Ministry of Forestry and Water Affairs
Turkish State Meteorological Service

Analysis of Dust Event over Eastern Mediterranean on 1 February 2015

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On January 31 a severe dust storm broke out in Northern Africa. The dust plume moved rapidly north-eastwards, affecting Greece and Turkey. Ferry traffic and flights were interrupted.

Turkey is strongly affected by Middle East and African dust source areas. Dust sources to the eastern Mediterranean vary throughout the year with the northcentral Sahara dominating in the spring, the northeast Sahara in the summer, and the Middle East in the autumn (Alpert et al., 1990; Dayan, 1986; Israelevich et al., 2002, 2003; Kubilay et al., 2000; Pey et al., 2012). An interesting and important event for this dust event affecting Greece and Western Turkey is to seen in the winter.

Satellite and Ground Based Observations

The intense signature of the dust transport on Feb 1, 2015 appeared in concentration of particulate matters (PM10) at the ground. The daily average values of PM10 were very high up to 800 µg/m^3 on Feb 1, 2015 (Figure 1).

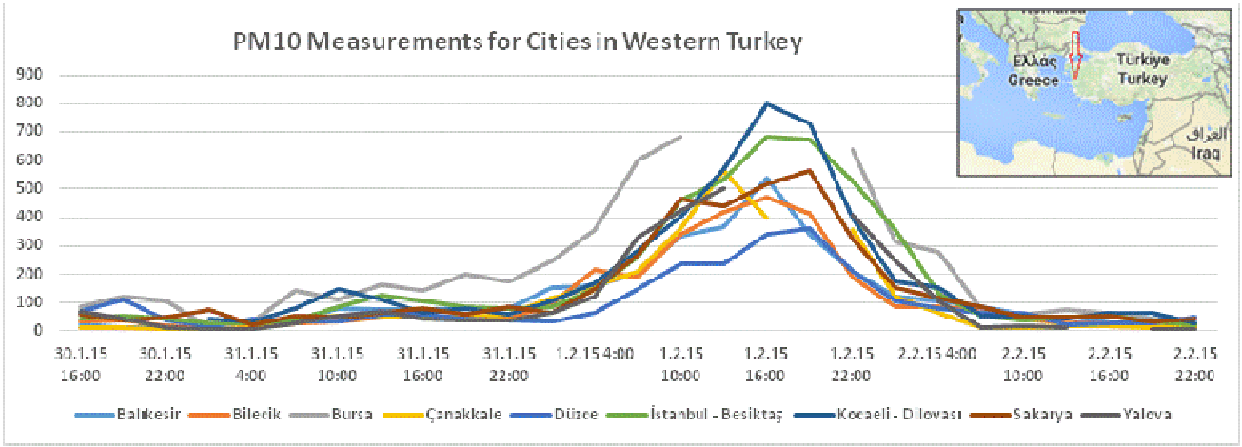

Figure 1. Measured PM10 values for several cities.

The maximum PM10 concentrations were 800 µg/m^3 in Kocaeli, 685 µg/m^3 in Istanbul, and 565 µg/m^3 in Sakarya those are considerably quite higher than WHO and EU air quality daily PM10 standard of 50 µg/m^3. Same trend was also observed on satellite images. MODIS real-time images for 31 Jan – 2 Feb 2015 are shown in Figure 2. Dust transport through southern Greece and western Turkey is visible on Feb. 1, 2015.

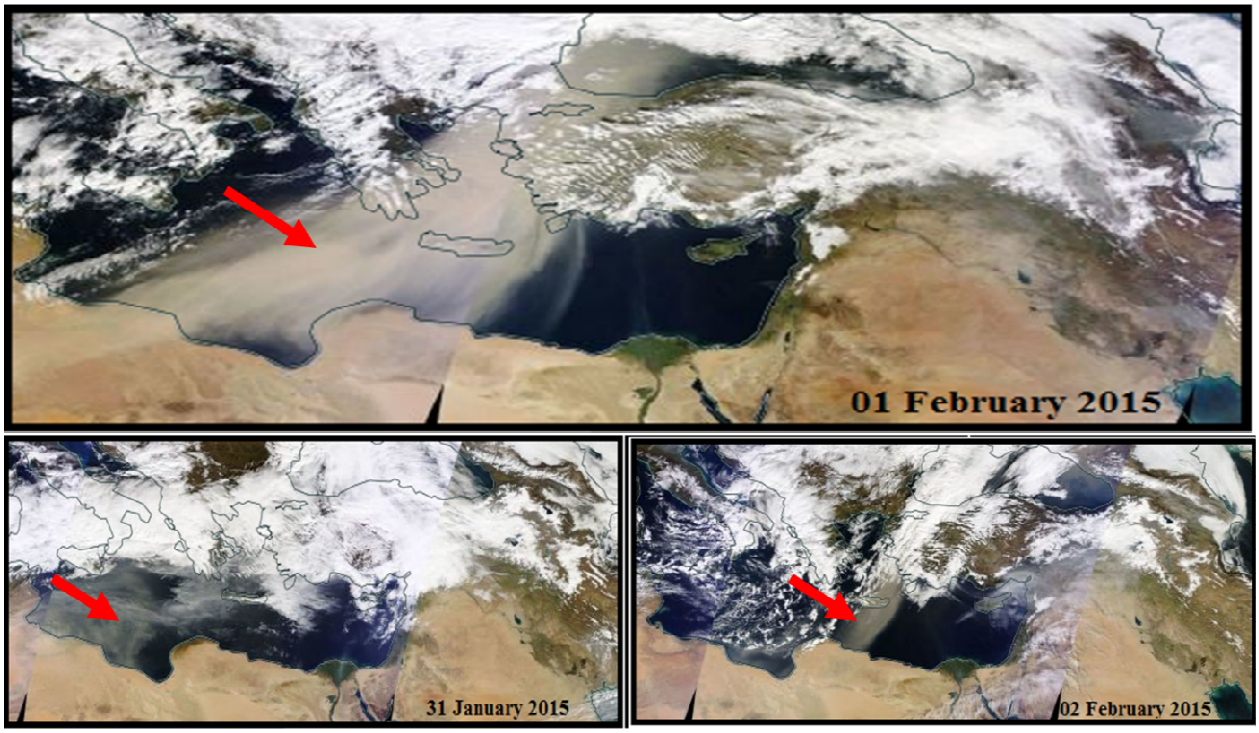

Figure 2. MODIS real-time images for 31 January – 2 February 2015

Meteorological conditions, which shows difference over Mediterranean and surrounding continents makes enable air masses transport through different regions. Mediterranean region is known as area of frequent cyclonic movements throughout the year. Meteorological pattern, which enable dust transport was related with a lower pressure area over northern Italy in this phenomenon. This lower pressure area moving through north-western Turkey formed suitable conditions to transport dust from Northern Africa to Mediterranean (Figure 3).

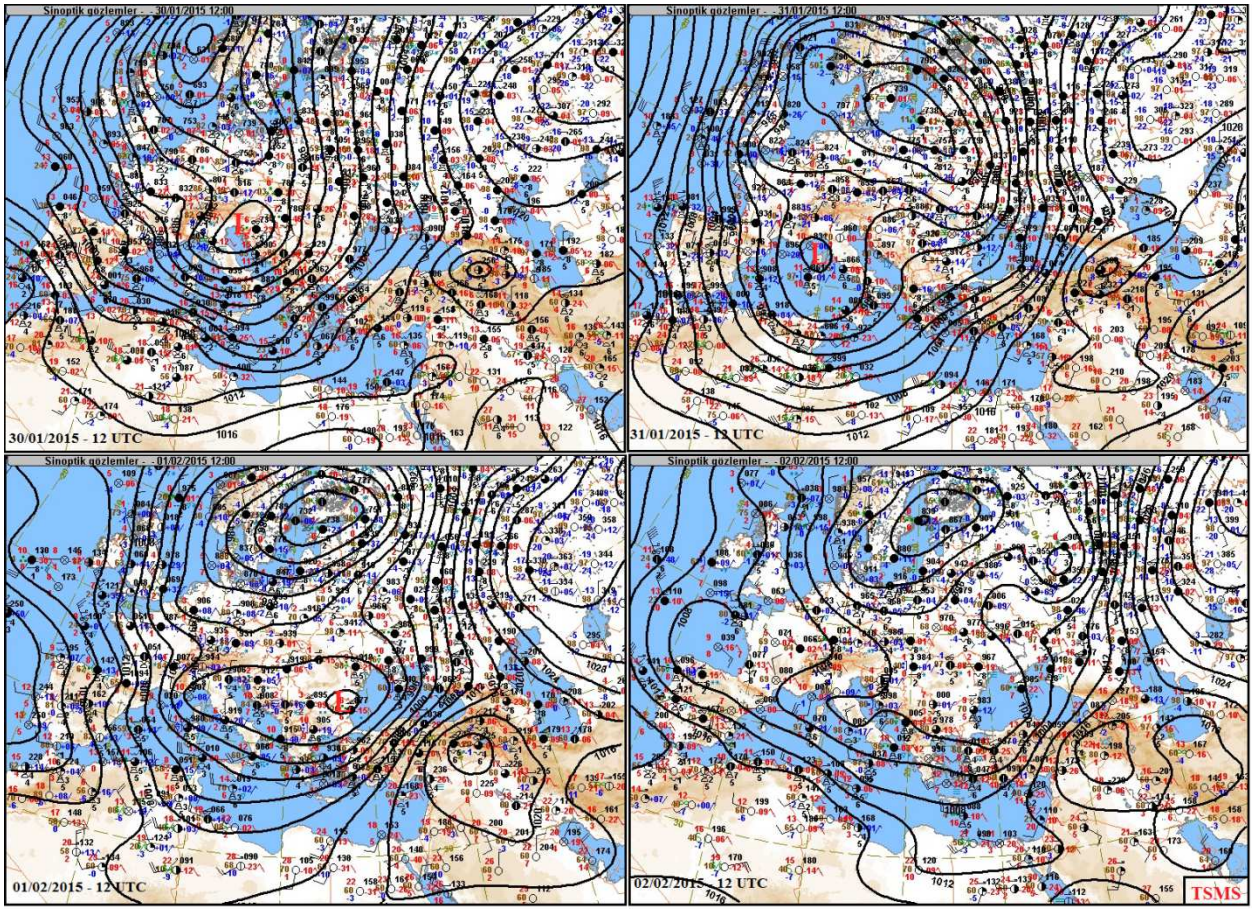

Figure 3. Synoptic charts for 30 January – 2 February 2015 12 UTC.

In order to investigate about the origin of aerosol particles 48 h back trajectories were simulated using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model developed at the Air Resources Laboratory, National Oceanic and Atmospheric Administration. The altitudes selected were chosen to indicate; 1) the near-surface level (10 m above ground) to give representative origins of air masses near the surface, 2) the 500 m level, which can serve as a representative altitude for the mixing height, in which the majority of the aerosol particles is present, and 3) the 1500 km level for the presence of dust layers to be captured. The time chosen for the air-mass arrivals is 12 UTC in order to give a more representative pattern for the air masses affecting the study area.

Air masses arriving over north-western Turkey on 1 Feb 2015, HYSPLIT model in the backward mode is shown in Figure 4. All air masses arriving at heights of 10 and 500m over Bursa are coming from Egypt, whereas those that arrived at 1500m originated from western Mediterranean (Figure 4).

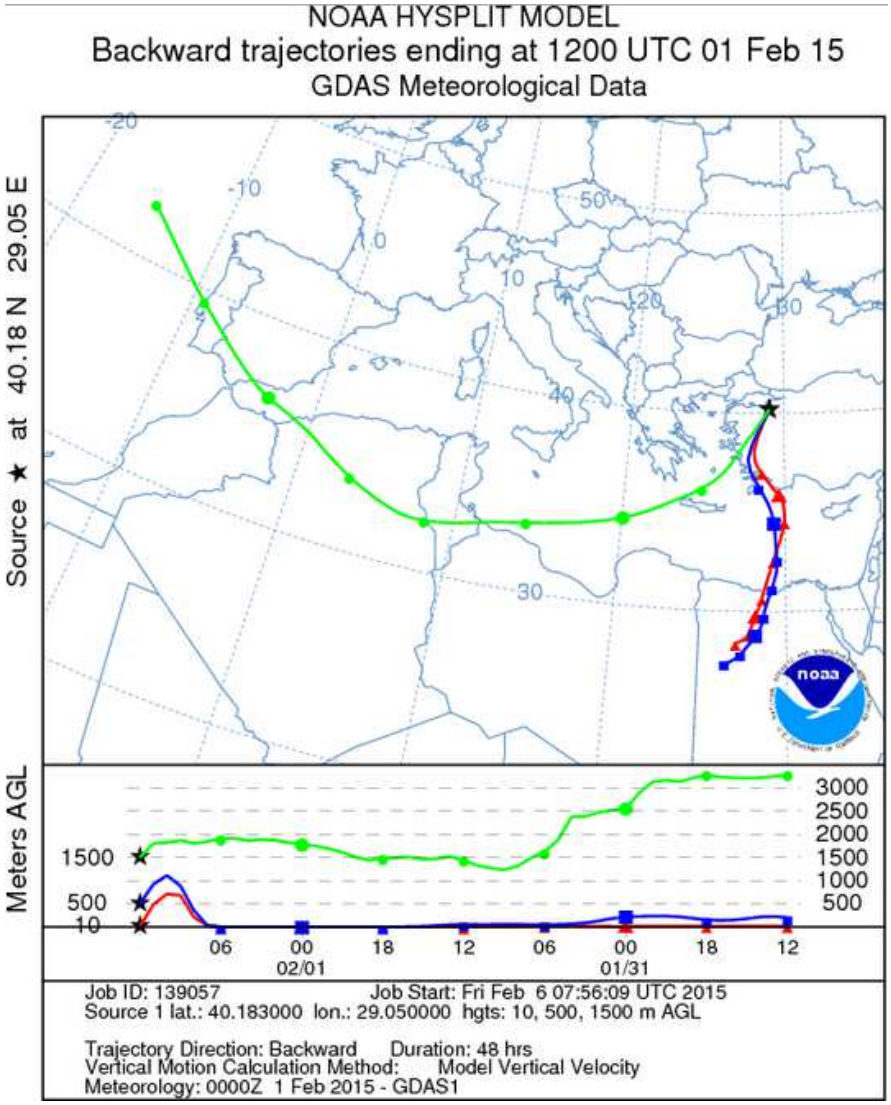

Figure 4. 48 hours backward trajectory analysis of HYSPLIT model centered in Bursa on 1 Feb 2015 12UTC. (Red, blue and green lines show air mass trajectory of 10 m, 500 m and 1500 m levels respectively).

Remotely sensing aerosols via satellite images gives general picture and can provide information about the spatial aerosol distribution. Figure 5 shows the daily MODIS AOD product for the period between 31 Jan - 2 Feb 2015. AOD values are very high (AOD > 0.9) related with the dust transport over northern Libya through Greece and Turkey on 1 Feb 2015. Next day of the event, high AOD values are seen only over southwest of Turkey.

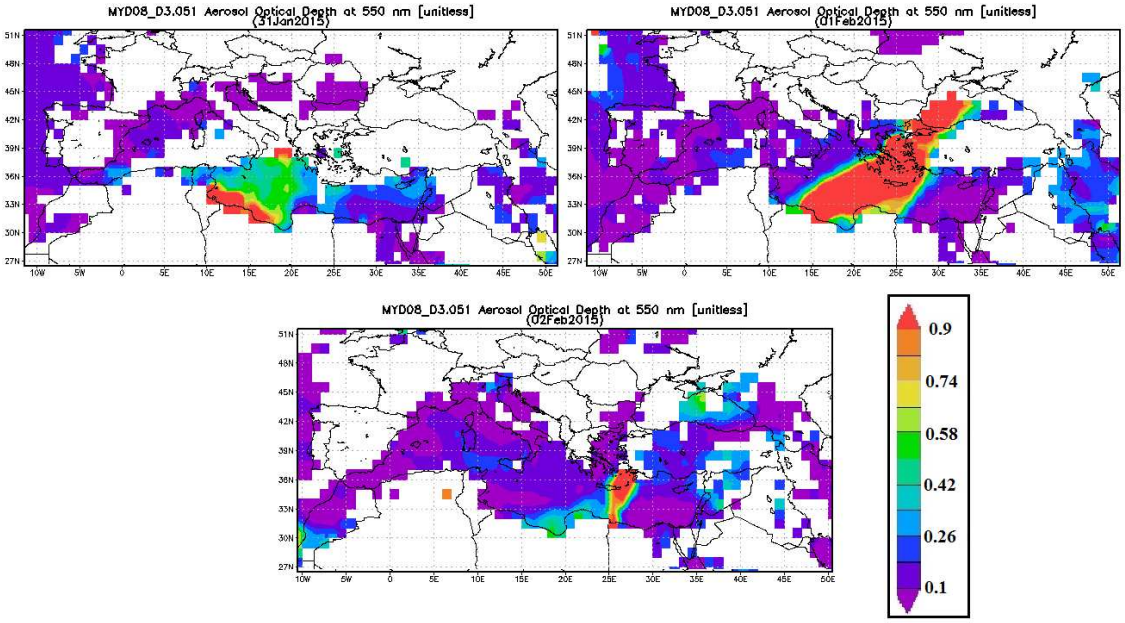

Figure 5. MODIS-AOD products for 31 Jan - 2 Feb 2015.

3.3. Dust Forecast Model Products

Daily mean dust surface concentrations of MGM/BSC-DREAM8b model are shown in Figure 6. Model forecasts on 1 Feb 2015, 12UTC shows the effects of intense dust.

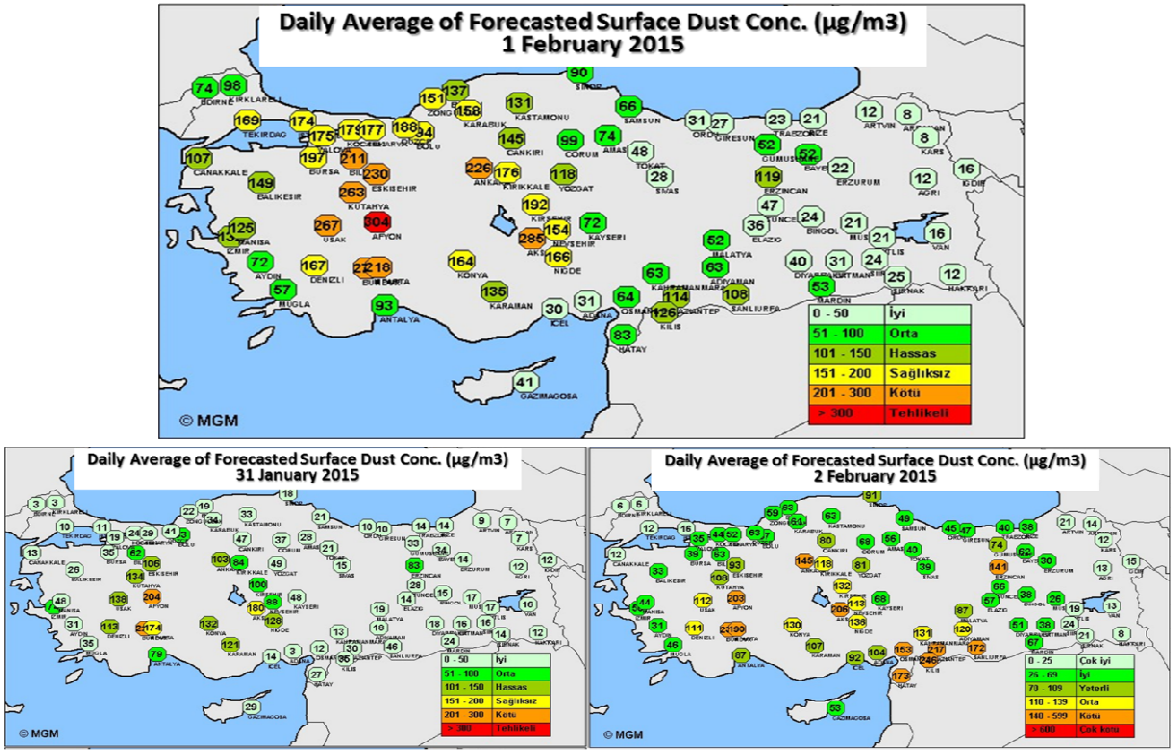

Figure 6. Daily mean dust surface concentrations of MGM/BSC-DREAM8b model.

On the other hand, modelled dust surface concentration on 1 Jan 2015 in Gebze, located in north-western Turkey, are shown to see the dust distribution at atmospheric column in Figure 7. It is forecasted that transported dust were concentrated at 2 km level with the intensity of 400 µg/m^3.

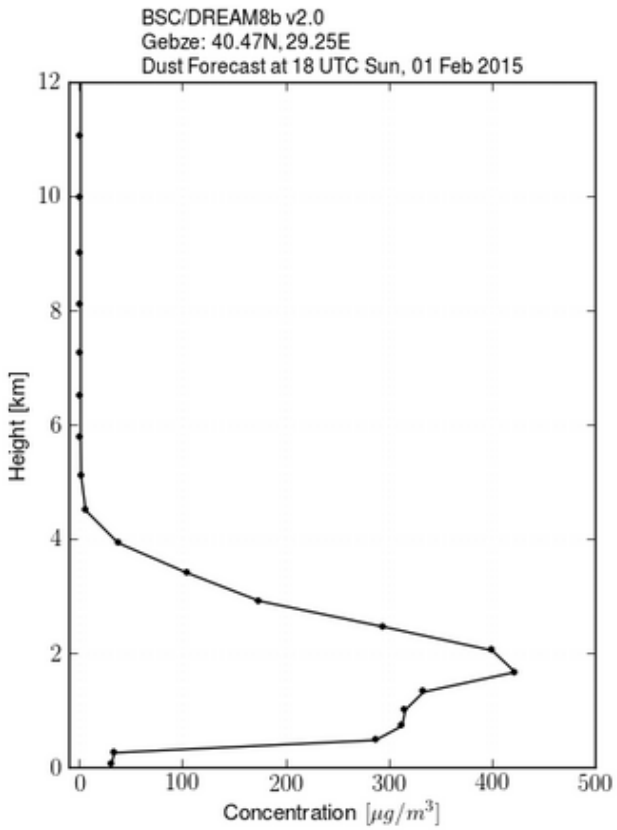

Figure 7. Dust Concentration Profile of Gebze Province on Feb, 1 2015 18 UTC

(Image from the BSC-DREAM8b (Dust REgional Atmospheric Model) model, operated by the Barcelona Supercomputing Center (http://www.bsc.es/projects/earthscience/BSC-DREAM/)).

On the other hand, MSG/RGB satellite images, MGM/BSC-DREAM8b and NMMB/BSC-DREAM8b model forecasts are shown Figure 8.

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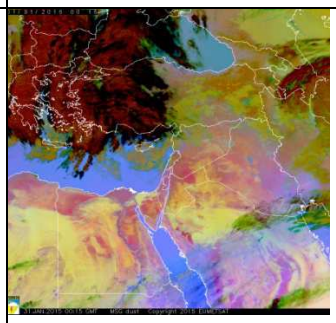
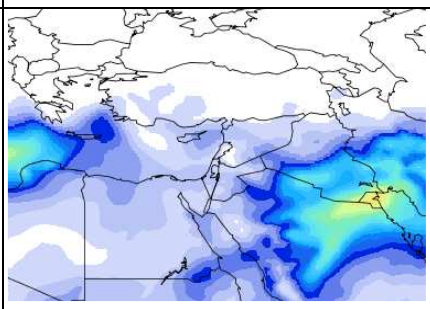
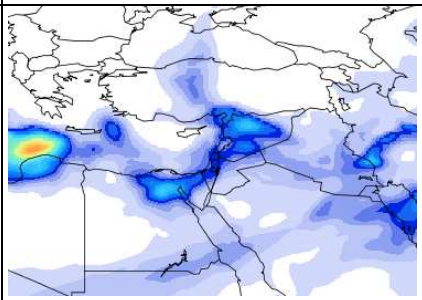
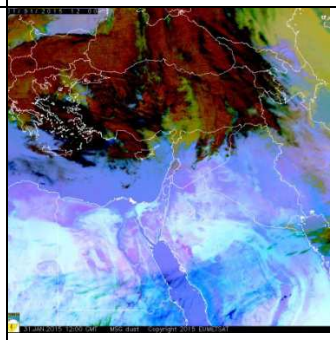
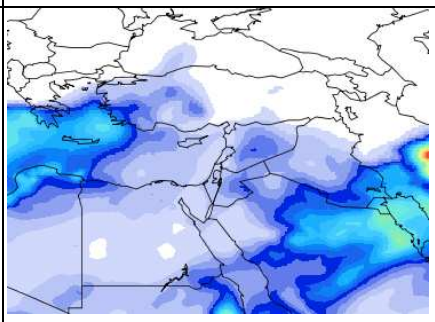
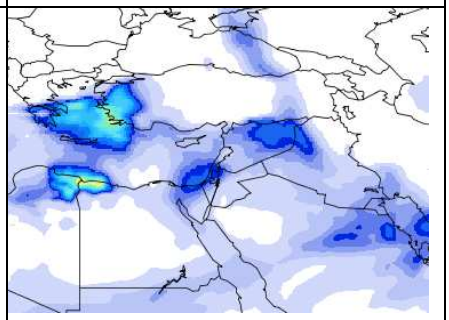
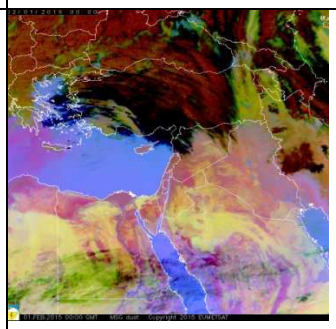
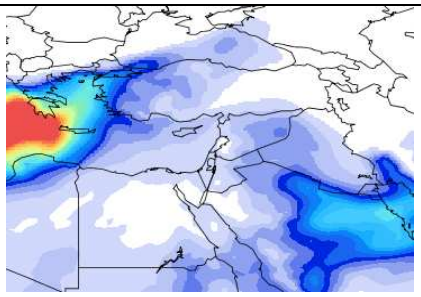
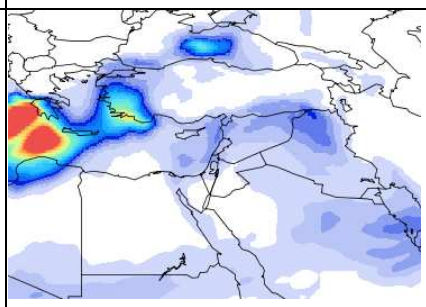
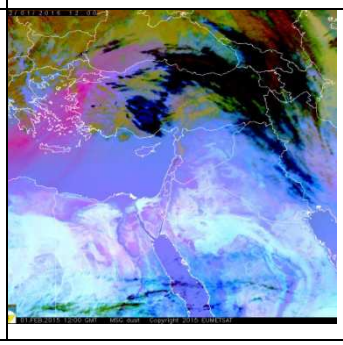
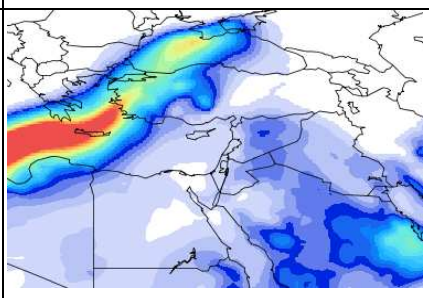
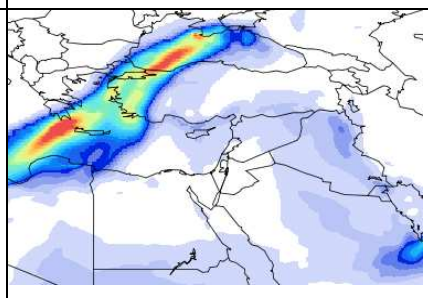
	MSG/RGB	MGM/BSC-DREAM8B (Dust Optical Depth)	NMMB/BSC-DREAM8b (Dust Optical Depth)
31/01/2015 00UTC			
31/01/2015 12UTC			
01/02/2015 00UTC			
01/02/2015 12UTC			

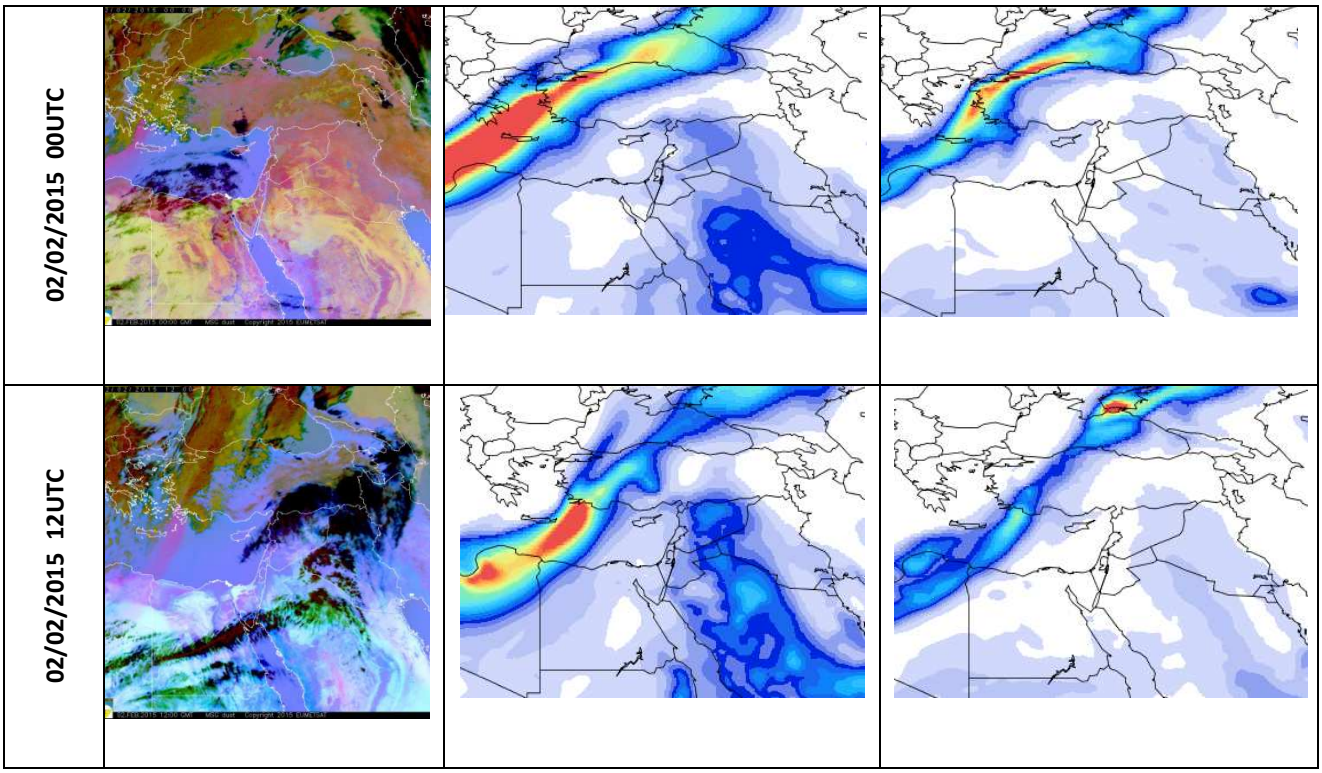


Figure 8. MSG/RGB Satellite Images and Modelled Dust Optical Depth Products of MGM/BSC-DREAM8b and NMMB/BSC-DREAM8b.