MONITORING AND FORECASTING DUST STORMS

A GMES contribution to health hazard warning and cooperation with Africa

The challenge

Dust storms are of great importance to GMES because of their impact on air quality and human health. Indeed, they represent an important natural source of particulate matter, which is now considered one of the most harmful air pollutants. It may cause respiratory diseases or infections and, in some regions, can trigger serious epidemics, e.g. meningitis in the Sahel. In addition, dust plays an important role in different aspects of weather and climate, including the earth's radiative budget, the hydrological cycle and atmospheric chemistry. The impact of dust storms on the economy is also significant, affecting air traffic and road transportation, the semiconductor industry, and solar power plants. Finally, dust interacts with diverse continental and maritime ecosystems.

Benefits to citizens

Europe is close to the Sahara, which is the largest source of mineral dust in the world. Each year, Europe is hit by dust intrusions from Africa that cause the concentrations of particulate matter to exceed the thresholds established by the EU. A better knowledge of dust spatial distribution will improve the design and management of air quality policies. Also, robust real-time dust prediction will significantly improve meteorological forecasts and early warning of hazardous weather. This information is critical to air traffic management.

Dust intrusion over the Iberian Peninsula seen by the MODIS instrument on board the Terra satellite, on 6 April 2011

The space-based solution

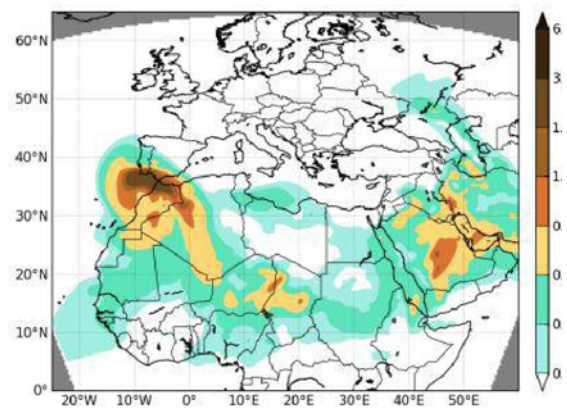
Nowadays, beyond the standard meteorological stations, the capacity to observe the atmosphere in Northern Africa, near to the major dust sources, is very limited. For this reason, dust monitoring from space becomes an essential component of any resilient

'ESA's Sentinel satellites will play a key role in the integrated European dust monitoring and prediction system.' **Emilio Cuevas, AEMET**

observational system. Atmospheric dust prediction models, born in the early 1990s, are still in an early stage, consequently dust predictions present large uncertainties.

Satellite products such as aerosol optical depth, computed from the MODIS sensor on board the Terra and Aqua satellites, are already being continuously incorporated into numerical models, thereby correcting and improving operational predictions.

Satellite observations are also used to verify and validate model-based predictions for remote areas, such as deserts or oceans, where no ground-based observations are available. On the other hand, real-time observations, like those provided by the Meteosat Second Generation, enable reliable dust 'nowcasting', i.e. the prediction of dust storms within the next few hours. This information which is critical to air traffic management, would not be possible based only in numerical models.



Aerosol optical depth forecast by BSC-DREAM8b for 6 April 2011. A Saharan dust plume is observed over the Iberian Peninsula. Dust was observed in Scandinavia on 10 April.

Outlook for the future

Synergies between the deployment of new space-borne instruments, such as those on board the ESA Sentinel satellites, and the launch of a new generation of numerical models will significantly improve the accuracy of dust prediction.

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