

NEWSLETTER CGE/DFIS

**CENTRO DE GEOFÍSICA DE ÉVORA
DEPARTAMENTO DE FÍSICA DA UNIVERSIDADE DE ÉVORA
ÉVORA, PORTUGAL**

O Centro de Geofísica de Évora, criado há cerca de 12 anos no âmbito do Programa Ciência e com cerca de 50 membros, desenvolve a sua actividade científica no domínio das Ciências da Terra e da Atmosfera, tendo adquirido elevada competência nos seguintes domínios de investigação: Sismologia, Geofísica Aplicada, Geodinâmica e Tectónica, Física da Atmosfera e Detecção Remota, Dinâmica do Clima, Cenários e Impactos das Alterações Climáticas, Transporte de Fluidos em meios porosos em estruturas vivas e inertes.

Viu recentemente reconhecida a qualidade da sua actividade científica pela Entidade Responsável pelo financiamento da Investigação em Portugal, a Fundação para a Ciência e a Tecnologia, que, na avaliação do último triénio de actividade, lhe atribuiu a classificação de “Excelente”.

O Centro de Geofísica de Évora e o Departamento de Física da Universidade de Évora há muito que pensavam iniciar a publicação regular, de uma Newsletter que desse a conhecer a sua actividade de investigação aos meios científicos nacional e internacional e ao público mais jovem que pretende iniciar-se no mundo da ciência.

A oportunidade surgiu, com a ocorrência de um episódio atmosférico, que foi notícia em todos os canais de televisão no passado dia 24: Portugal era invadido por uma camada espessa de aerossóis, castanha-acinzentada, que desfigurava o Sol e toldava a luminosidade natural do céu. Em simultâneo, o ar quente e abafado invadia Portugal fazendo lembrar o velho ditado popular: “de Espanha nem bom vento nem bom casamento”.

Afinal que fenómeno era esse, que tanto impressionou os media e que alguns devem ter de imediato associado ao falado Aquecimento Global ou às Alterações Climáticas?

A resposta, baseada nas observações feitas nos Observatórios de Física da Atmosfera do Centro de Geofísica de Évora, em Évora e no Cabo da Roca, Portugal são o mote para esta edição “**número zero**” da futura Newsletter do Centro de Geofísica de Évora e do Departamento de Física da Universidade de Évora.

Big Desert Dust Event over Portugal and Spain

Frank Wagner, Ana Maria Silva, João Corte-Real, Sergio Pereira and Nuno Belo

frankwagner@uevora.pt

Around the weekend of July 23-25, an unusual large amount of dust particles coming from Africa passed over Portugal. The clear sky changed the colour from the normal blue to a brownish colour, and the solar disk was not clearly visible; it was rather a diffuse bright region on the sky (Fig. 1). The whole dust episode lasted about 1 week with the maximum aerosol particle load on July 24-25.



Fig. 1: Desert dust over Évora. Photo taken during the evening of 24th of July.

Satellite Image

Analysis showed that the dust particles were coming from the Saharan desert over the Canary and Madeira Islands and were arriving in Portugal and Spain. This can be clearly seen on the July 26 satellite image of the visible spectral channel (Fig. 2) of the MODIS (Moderate Resolution Imaging Spectroradiometer) sensor onboard of the Aqua Satellite. The Iberian Peninsula and Northern Africa can be seen near the centre and at the bottom of the image respectively. The desert dust can be identified in the image by the bright yellow colour over the blue ocean. The white colour in the north of the image indicates clouds over France and England. It is not possible to see the dust over the continent because the reflection of the solar radiation at the Earth's surface and by the particles leads to similar coloured pixels in the image.

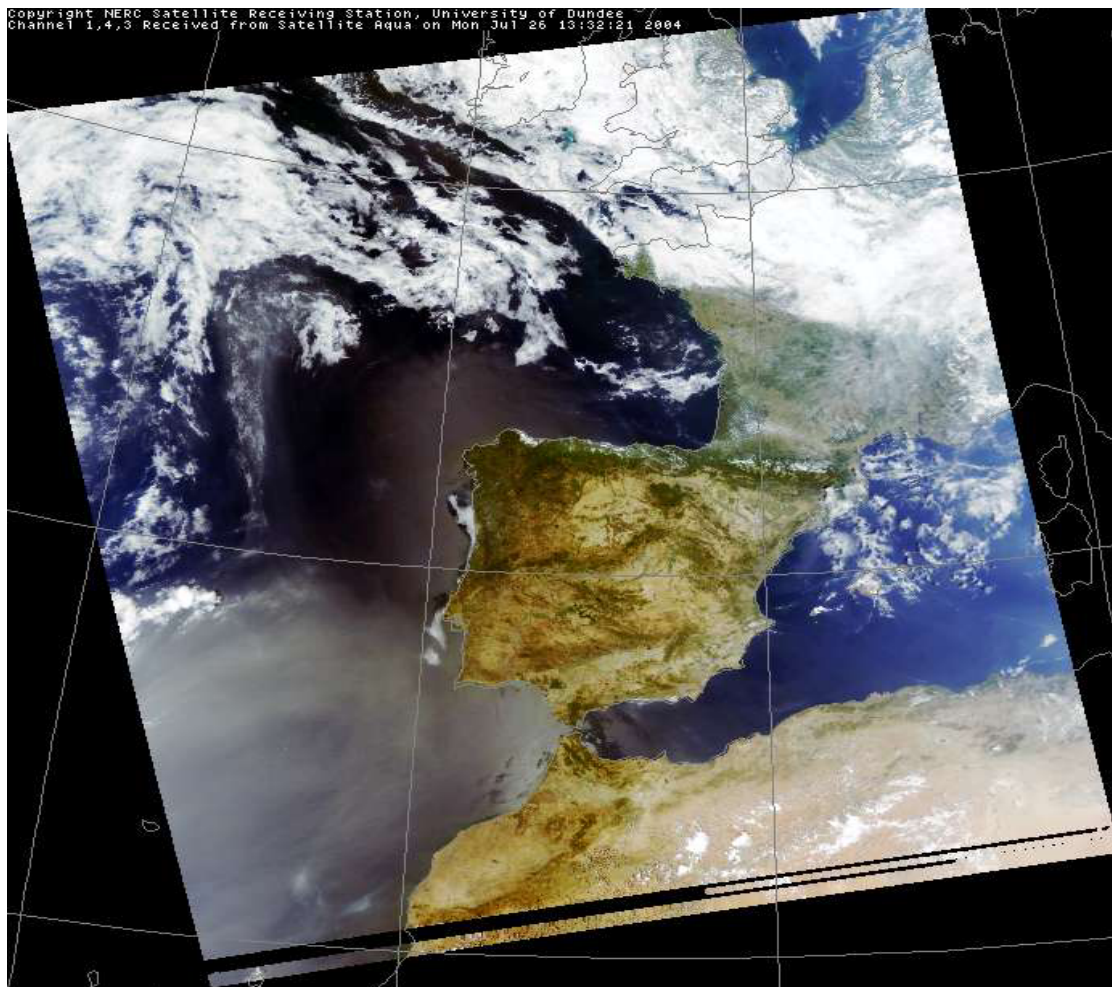


Fig. 2: MODIS image from 26th of July 2004 taken at 13:32 UTC in the visible spectral region. It is a composite of the red, green and blue channels of the MODIS sensor. Image courtesy of the NERC Satellite Receiving Station University of Dundee (<http://www.sat.dundee.ac.uk>).

Trajectory Analysis

The long-range transport of Saharan particles seen in the satellite image can be verified with back-trajectory analysis. Fig. 3 shows 5-day-back-trajectories reaching Évora at 12 UTC on all days during the event. In the 850 hPa and 700 hPa pressure levels, corresponding approximately to 1500 m and 3000 m height, the air masses were originated over the regions of South Morocco or Senegal or West Africa in general. The Saharan dust needs about 2 to 2.5 days to cross from the African Coast to the Iberian Peninsula. It can be seen that between the 22nd (orange curve) and the 23rd of July (red curve) there is a change in the origin of the trajectories from the North Atlantic Ocean to Africa and the Saharan desert. Furthermore there is a constant shift with time in the origin of the air parcels from the interior to West Africa with subsequent motion towards the coast and furthermore out of the African continent in connexion with the development of the general meteorological situation. Finally, on the 27th, the dust event over Portugal and Spain comes to an end.

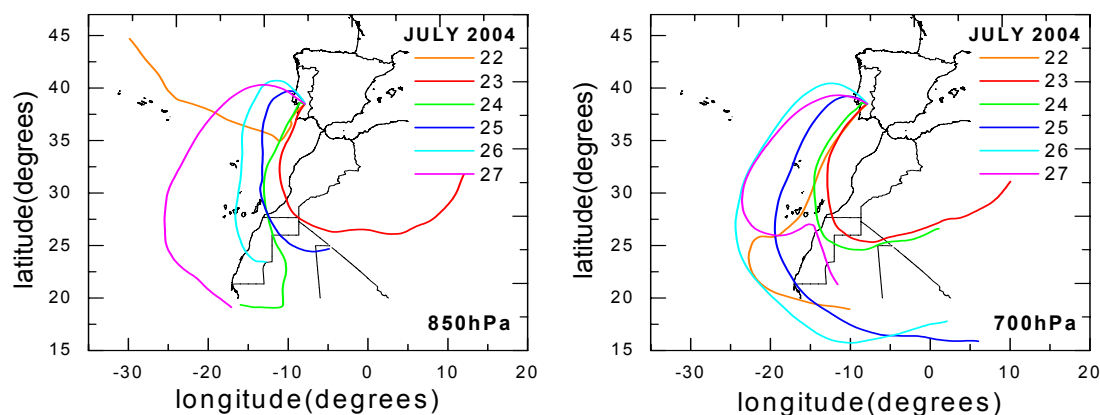


Fig. 3: 5-days back- trajectories ending over Évora at two pressure levels: 850 hPa (left) and 700 hPa (right).

Weather Observations

The dust event occurred when the atmospheric circulation over the Iberian Peninsula and North Africa transported hot and dry air masses from Spain to Portugal at the lower tropospheric levels, and carried desert dust aloft from the Saharan desert to the Atlantic at Southern Morocco and Senegal latitudes, and then northwards to Spain and Portugal. In general, the temperatures were about 10 degrees higher during daytime and about 5 degrees higher during night-time than the corresponding summer climatological means (Fig. 4). Of course, these anomalous temperatures increase also the risk of forest fires. Effectively, this year the big fires in Algarve (Serra de Monchique, Serra do Caldeirão) and Serra da Arrábida started on 25th of July and became out of control in the following days.

The presence of desert dust at higher atmospheric levels helped in keeping high temperatures at the surface during night-time because the aerosol layer reflects back to the Earth the long-wave thermal radiation emitted by the surface.

Optical Measurements

The optical instruments of the CGE, automated sunphotometers linked to the AEROSOL ROBOTIC NETWORK (AERONET) from NASA – <http://aeronet.gsfc.nasa.gov> - were measuring the optical properties of this desert dust event; the columnar aerosol load over Évora and Cabo da Roca could be determined. It is expressed in terms of the aerosol optical thickness (aot). At Évora (Fig. 5) values up to 1.2 at the wavelengths of 440 nm could be observed. They are about 10 times larger than “normal” and a factor of 20 above those under very clean conditions conditions. Such clean

conditions with aot-values of about 0.06 can be observed at Évora in about 5 to 10 days during the year. At Cabo da Roca the aerosol optical thickness is even higher than in Évora which is a consequence of the inhomogeneity of the desert dust plume.

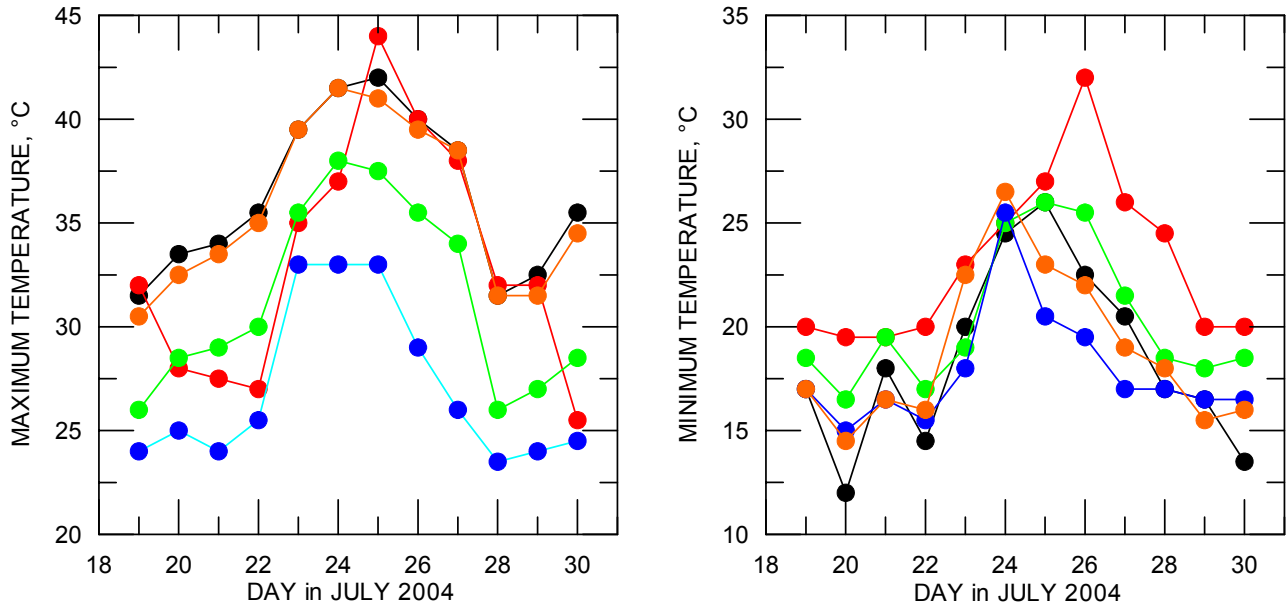


Fig. 4: Maximum temperatures during daytime (left) and minimum temperatures during night-time (right) for several cities in Portugal: Évora (black), Faro (red), Lisboa (green), Sines (blue) and Beja (orange).

Note: in the figs. Should be °C and not deg

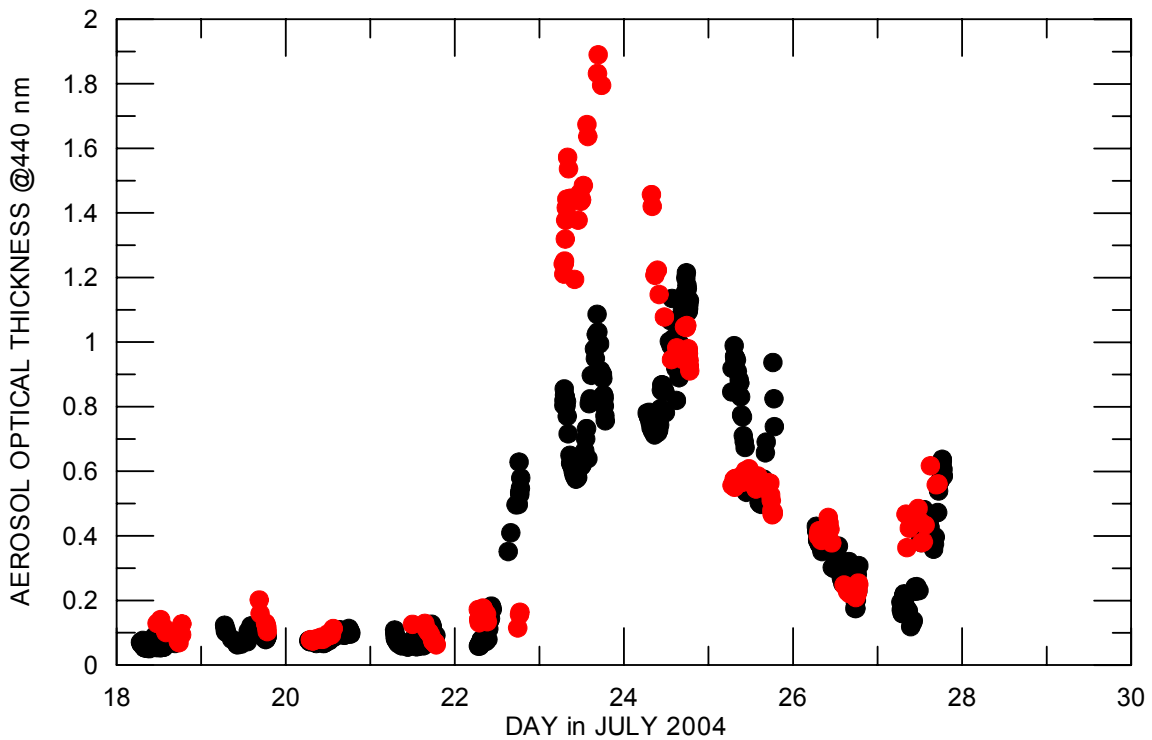


Fig. 5: Aerosol optical thickness in Évora (black) and Cabo da Roca (red) during the desert dust event in July 2004 at a wavelength of 440 nm.

Acknowledgement

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Literature

Draxler, R.R. and Rolph, G.D. (2003): HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY website (<http://www.arl.noaa.gov/ready/open/hysplit4.html>). NOAA Air Resources Laboratory, Silver Spring, MD.