(Spring to) Summer atmospheric circulation intra-seasonal variability related to Saharan aerosols transport in the Mediterranean

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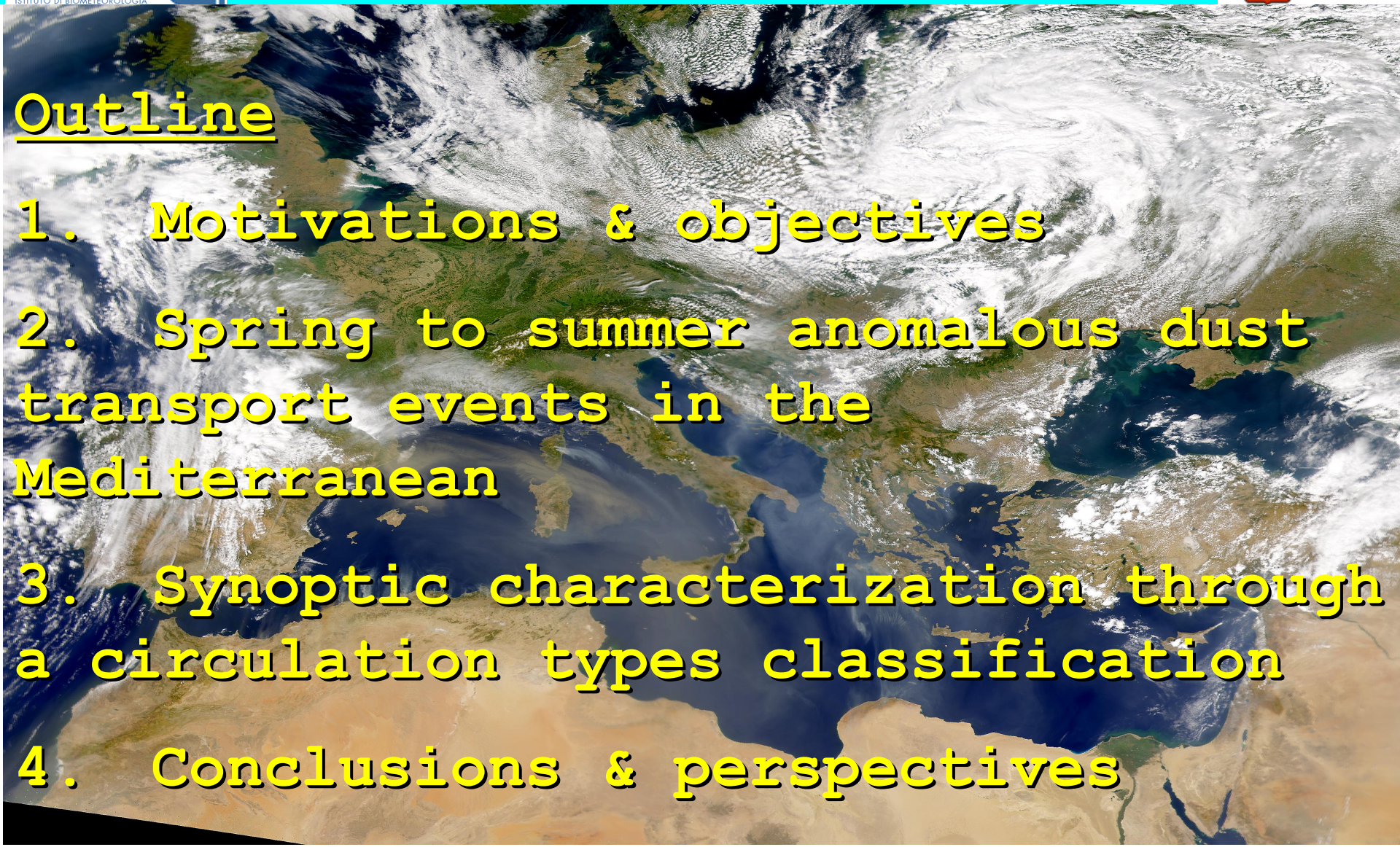
CL6 – Synoptic Climatology
12-16 September 2011
Berlin, Germany

Forecasting the weather
- ensemble techniques
in probabilistic weather prediction



Outline

1. Motivations & objectives
2. Spring to summer anomalous dust transport events in the Mediterranean
3. Synoptic characterization through a circulation types classification
4. Conclusions & perspectives

25/08/2005 (SeaWIFS Image)

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Saharan aerosol intrusion into the Mediterranean:
specific atmospheric conditions,
> extraction from the surface, lifting above the PBL, advection northwards.

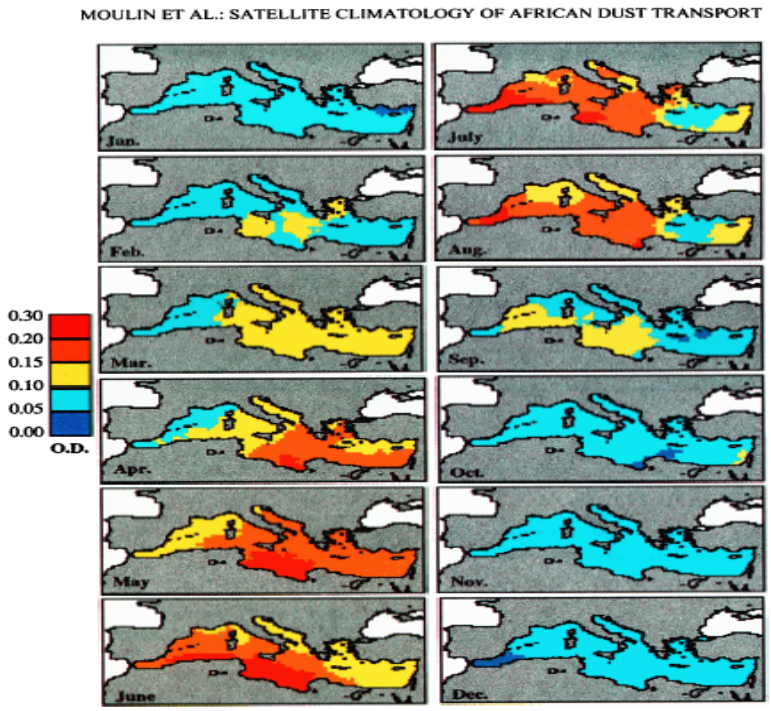

Plate 1. Monthly 11-year average of dust optical depths (O.D.). Data from available Meteosat images between 1984 and 1994 (see Table 1).

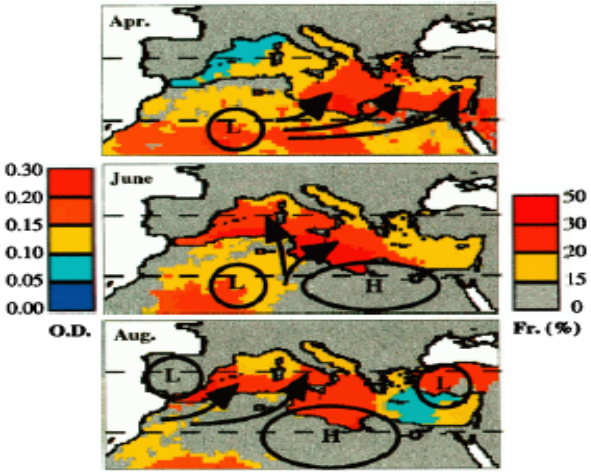

Plate 2. How the main meteorological synoptic situations generate a recurrent dust transport during spring and summer. Locations of the major lows (L) and highs (H) are shown. The cyclogenesis is adapted from *Alpert et al.* [1990]. It shows the Sharav cyclones in April; the coupling between Saharan low and Libyan high in June; and the effect of the Balearic cyclogenesis in August. The frequency (Fr.) of dust mobilization over North Africa during these months has been estimated from IDDI computed from Meteosat infrared images between 1984 and 1994, using the method of *Legrand et al.* [1994]. Finally, our monthly dust optical depths (O.D.) over the sea surface are shown as in Plate 1. The lower and upper horizontal dashed lines correspond to latitudes of 30° and 40°N, respectively.

Moulin et al, 1998 JGR

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Objectives:

> identification of spring to summer (Mar-Sep 2000-2007) anomalous dust transport events in the Med, at a sub-basin scale;

> synoptic characterization of the anomalous events through circulation types classification over the Med.

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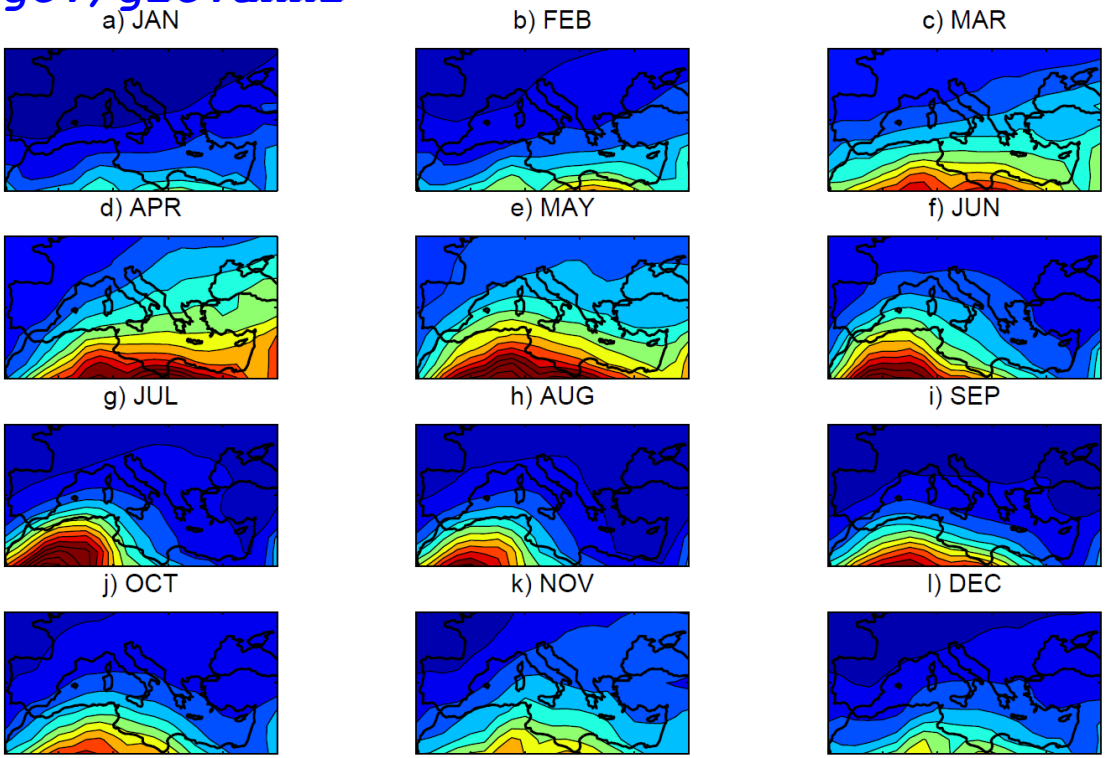
2 Mar-Sep anomalous dust events in the Med

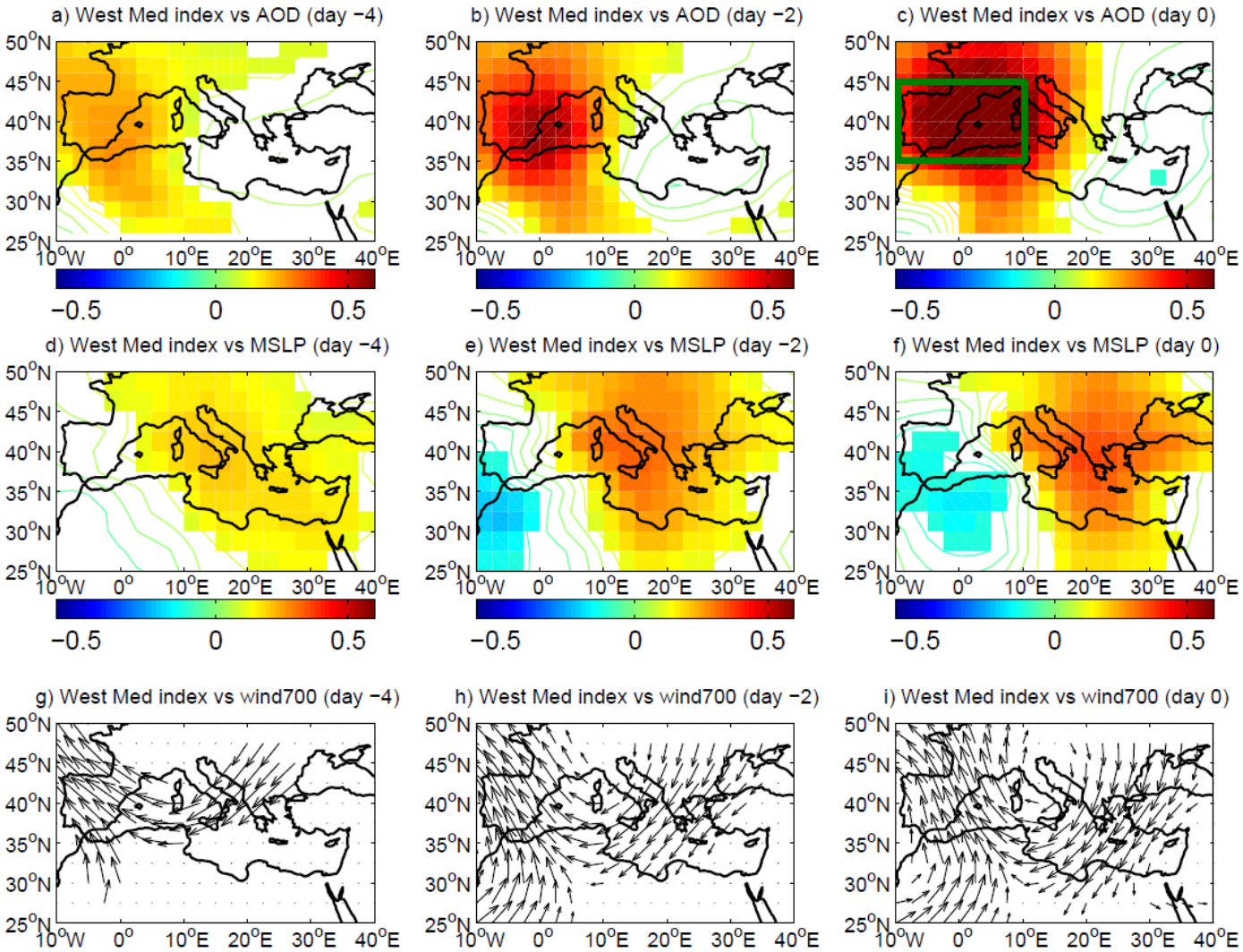
Aerosol data:
NASA Goddard Chemistry Aerosol Radiation and Transport (GOCART) model,
Dust Aerosol Column Optical Depth (AOD) (550 nm),
2°*2.5° lat-lon resolution.
http://disc.sci.gsfc.nasa.gov/giovanni



Atmospheric variables
NCEP-DOE Reanalysis 2,
MSLP, HGT700, wind700,
2.5° lat-lon resolution.
http://www.esrl.noaa.gov/psd/

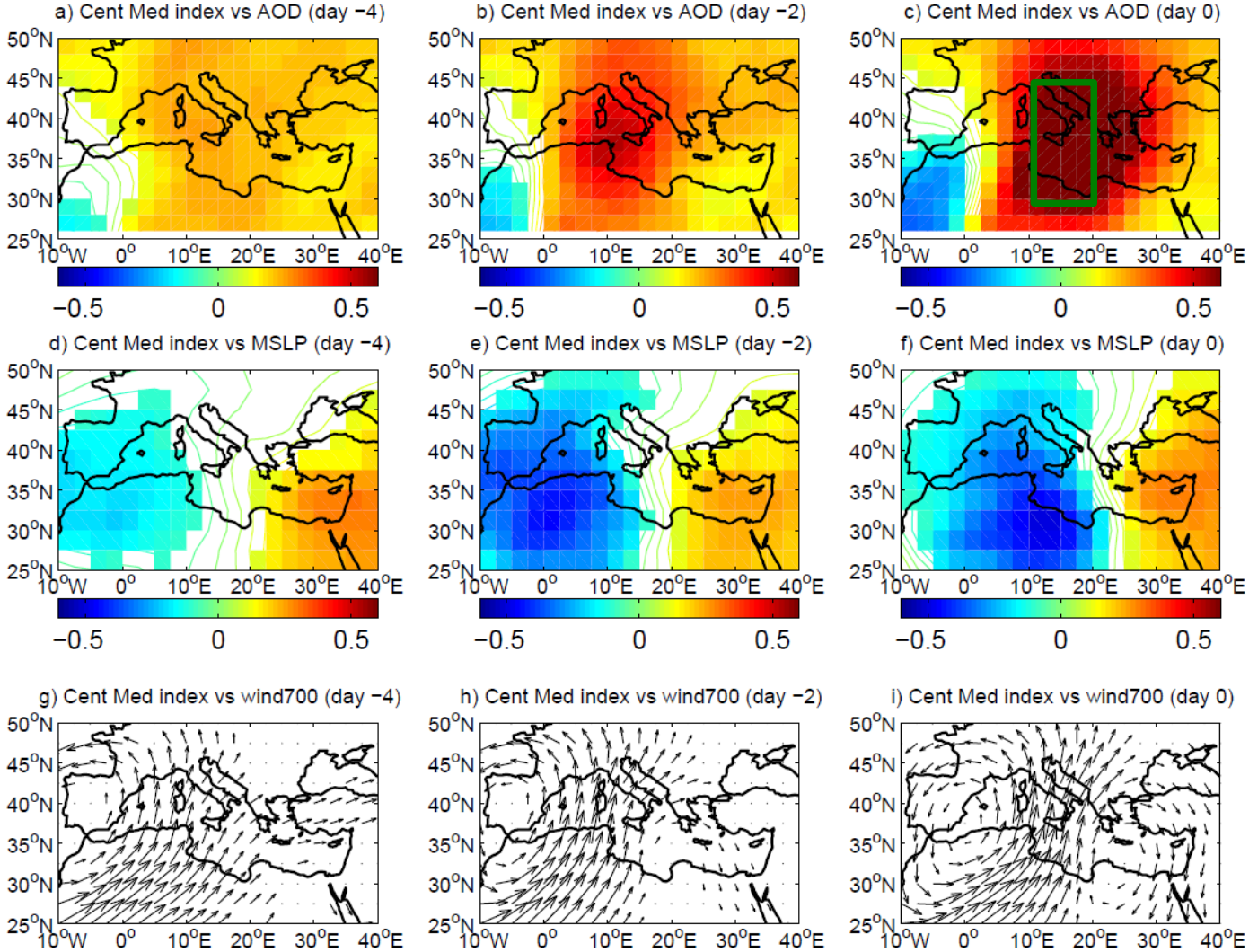
2 Mar-Sep anomalous dust events in the Med

West Med (10W-10E, 35N-45N) AOD index
Correlation (95% significant)



2 Mar-Sep anomalous dust events in the Med

Cent Med (10E-20E, 30N-45N) AOD index
Correlation (95% significant)



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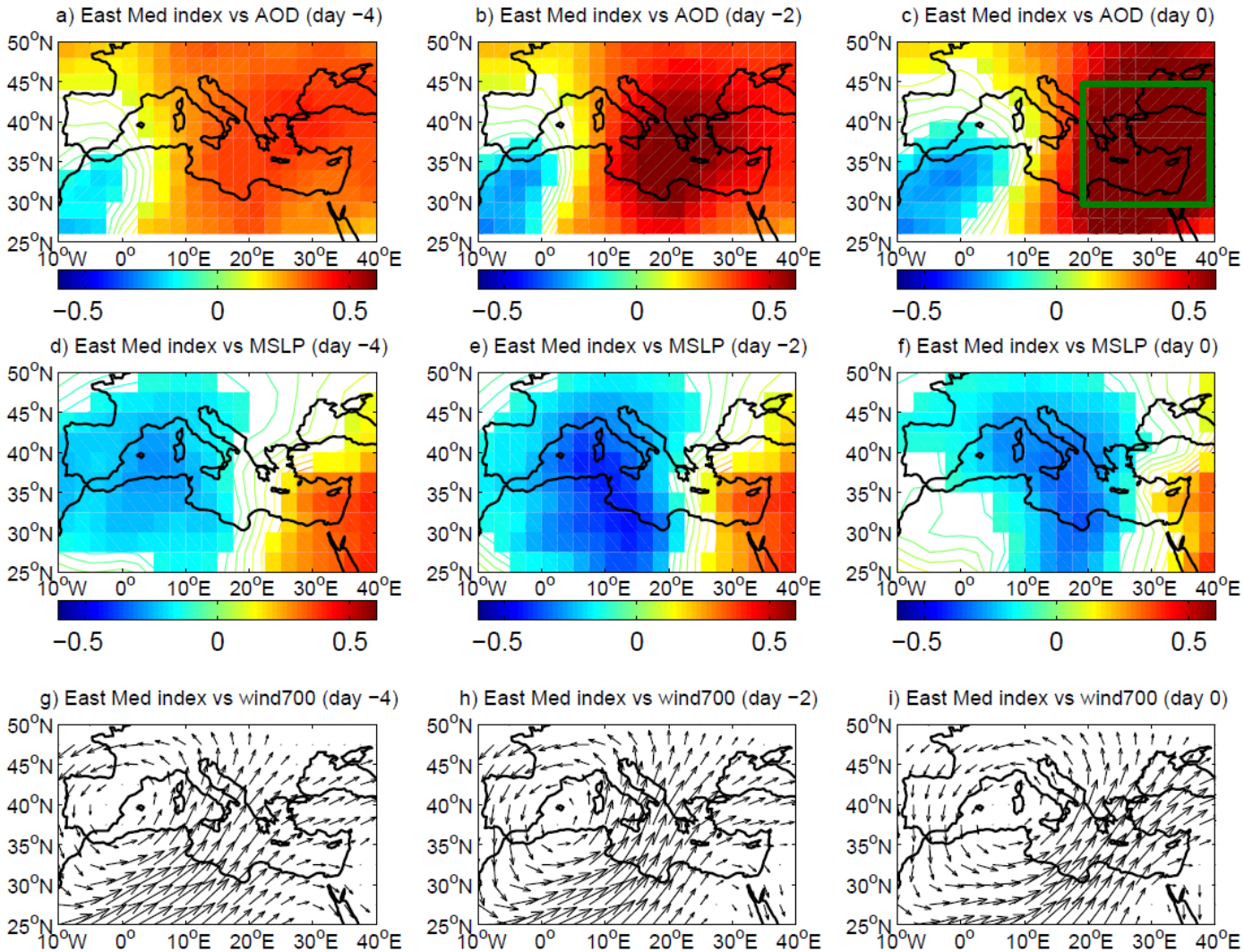
East Med (20E-40E, 35N-45N) AOD index
Correlation (95% significant)



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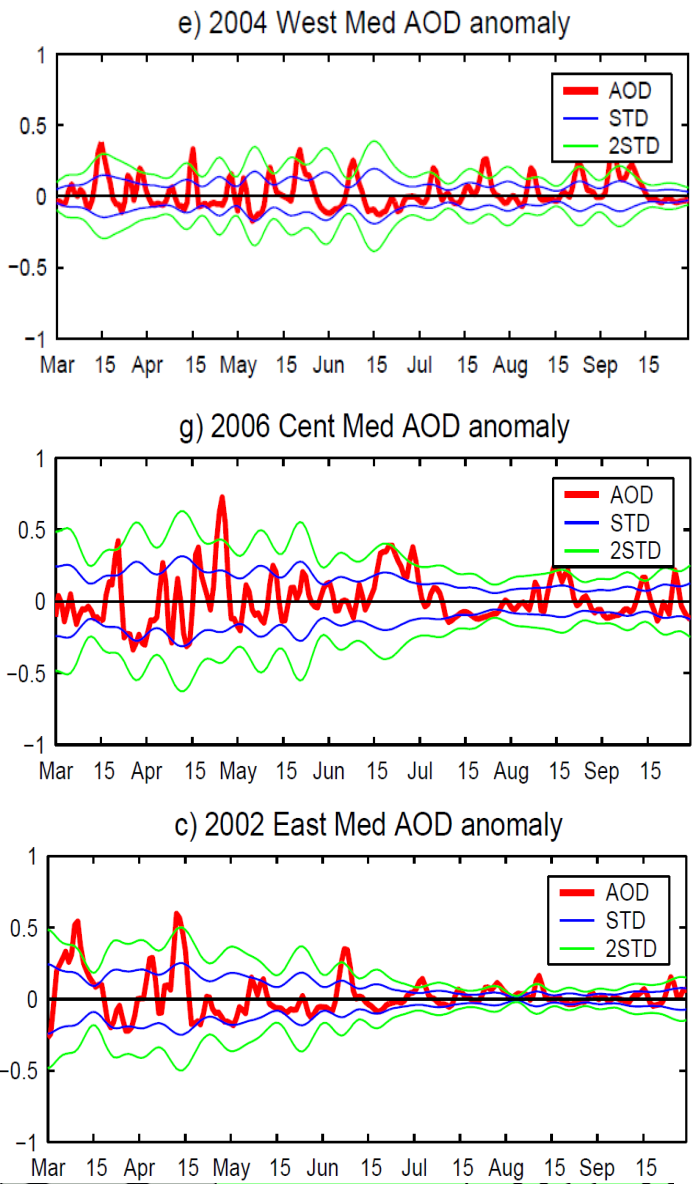
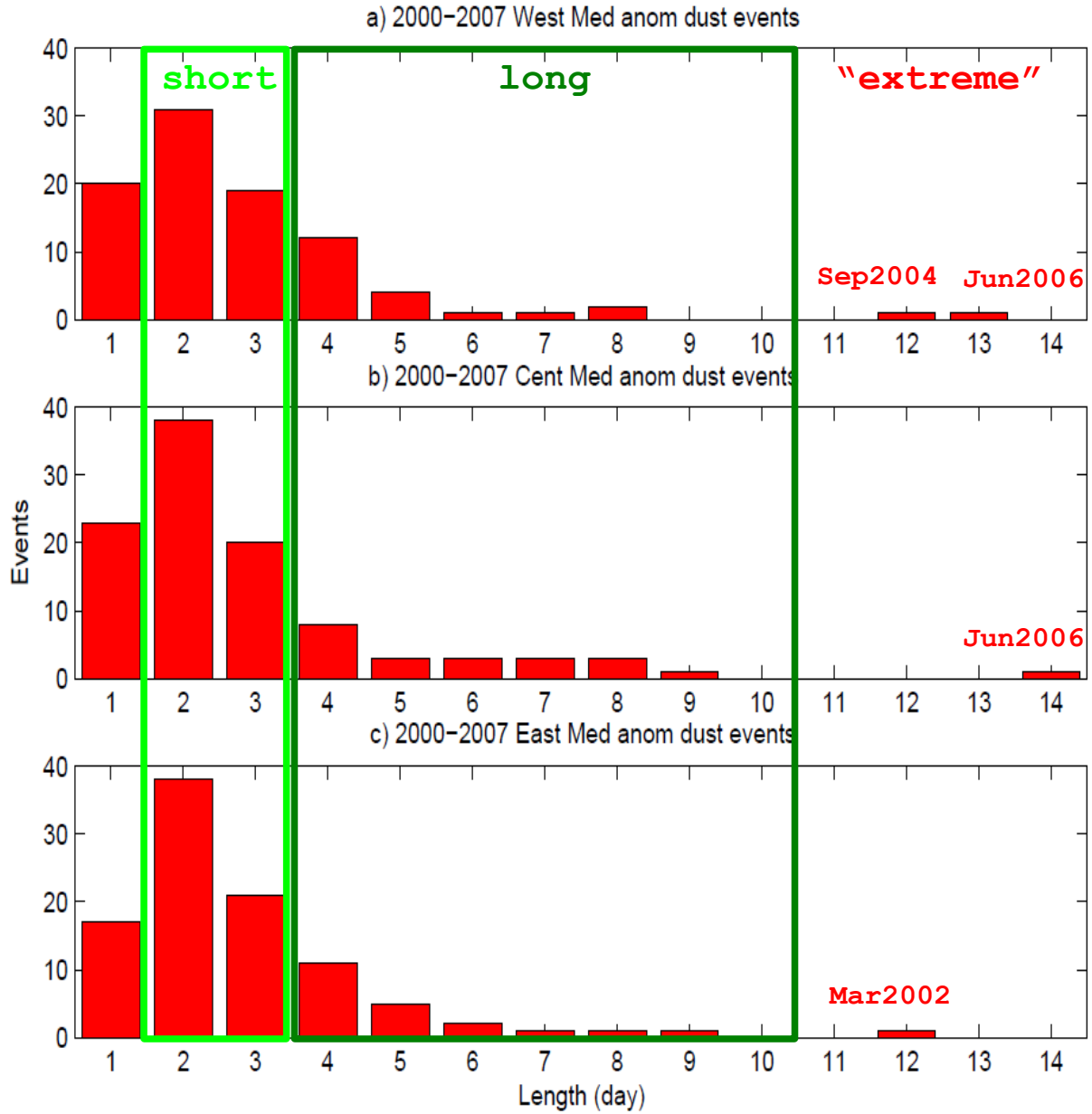
2 Mar-Sep anomalous dust events in the Med

AOD index anomaly -> anomalous dust events definition





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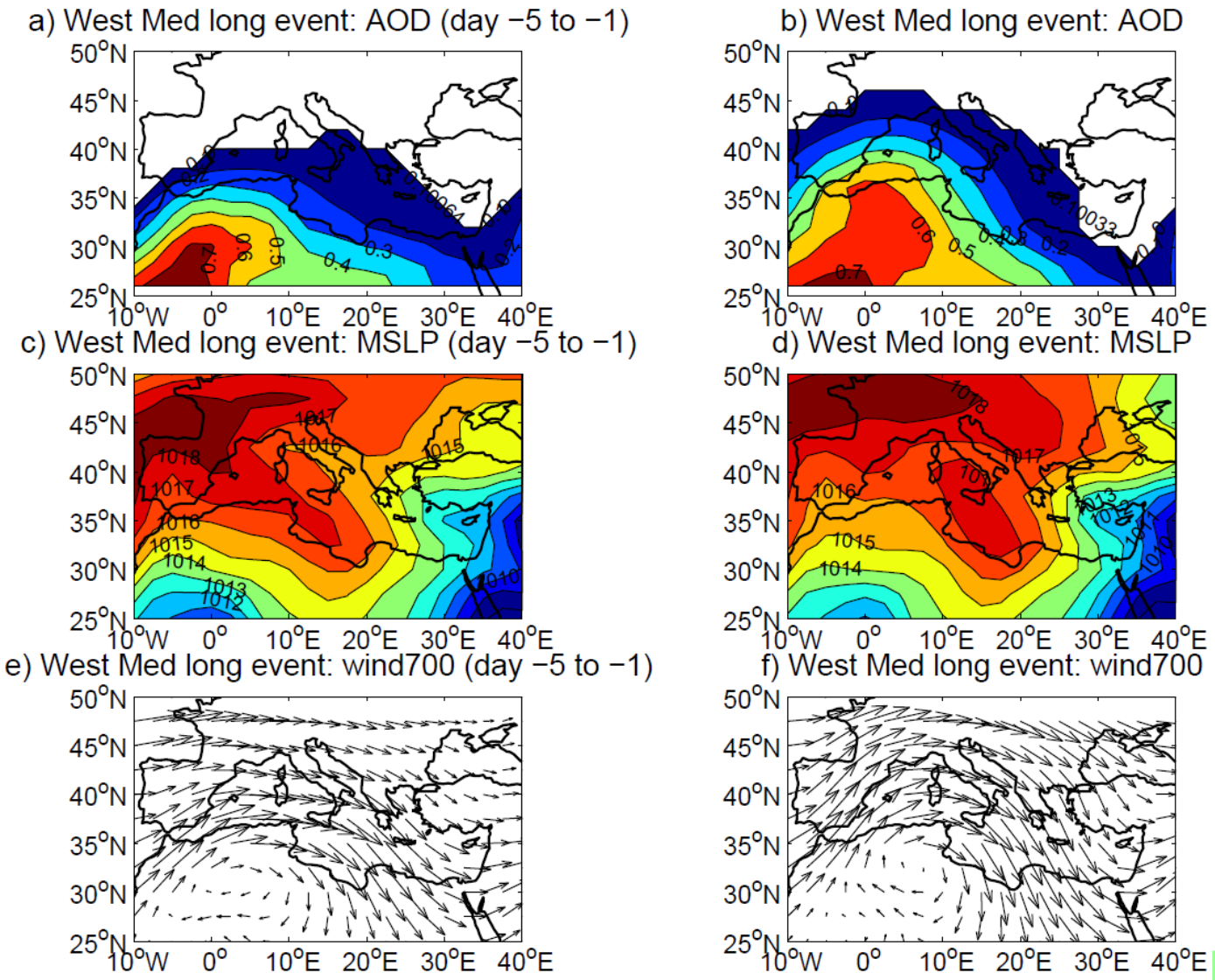
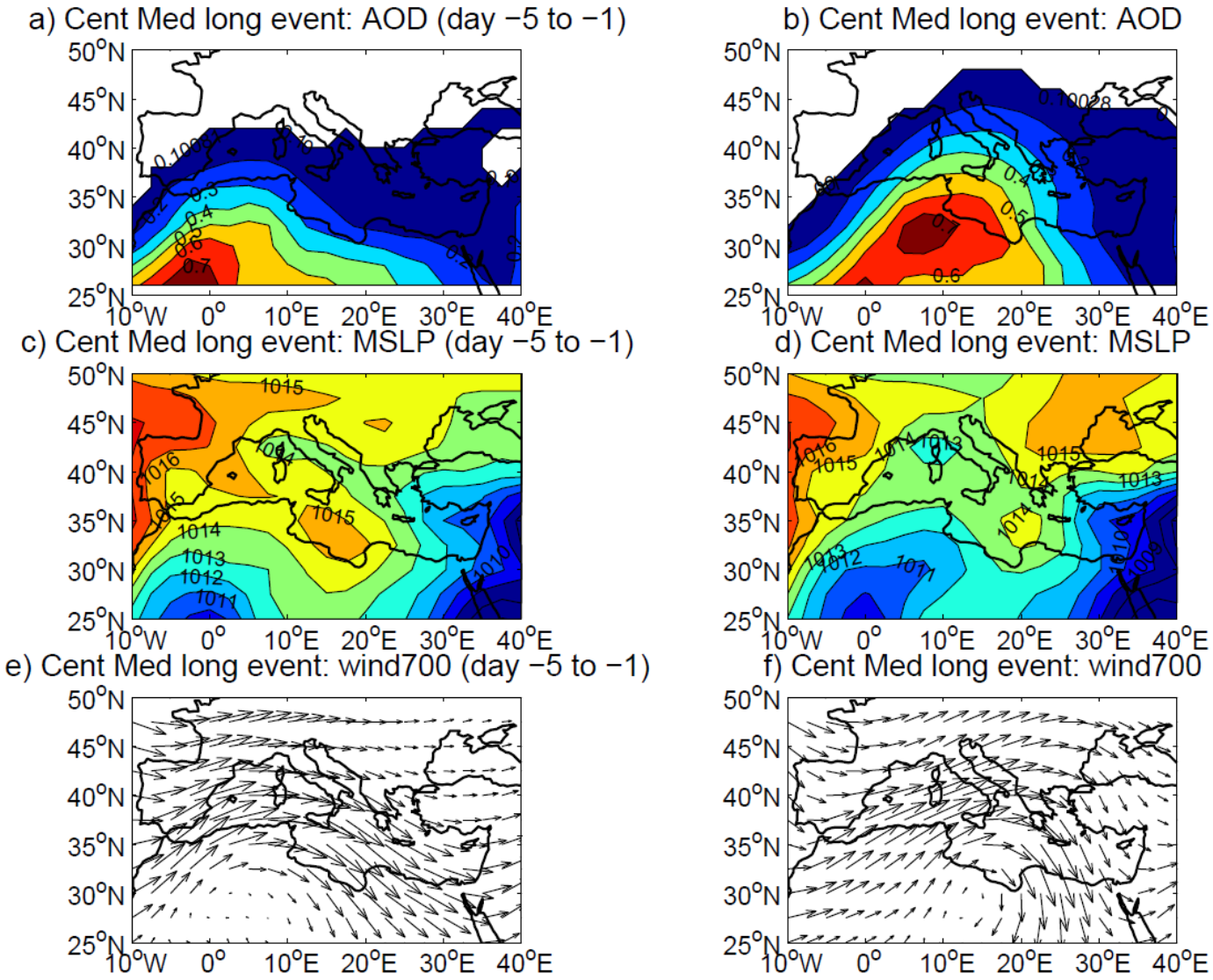
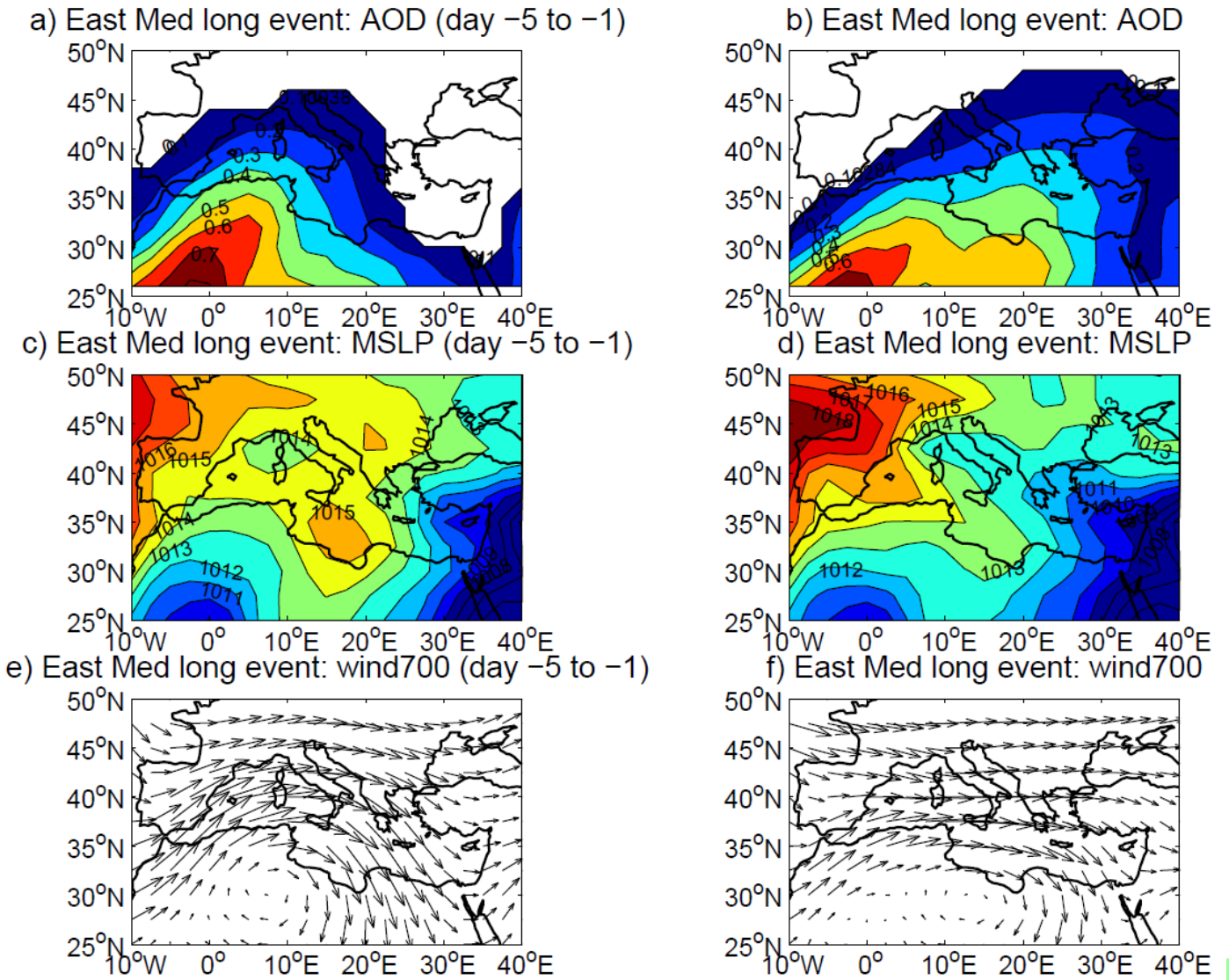
West Med long dust events
(mean conditions, before and during the event)



Cent Med long dust events
(mean conditions, before and during the event)



East Med long dust events
(mean conditions, before and during the event)

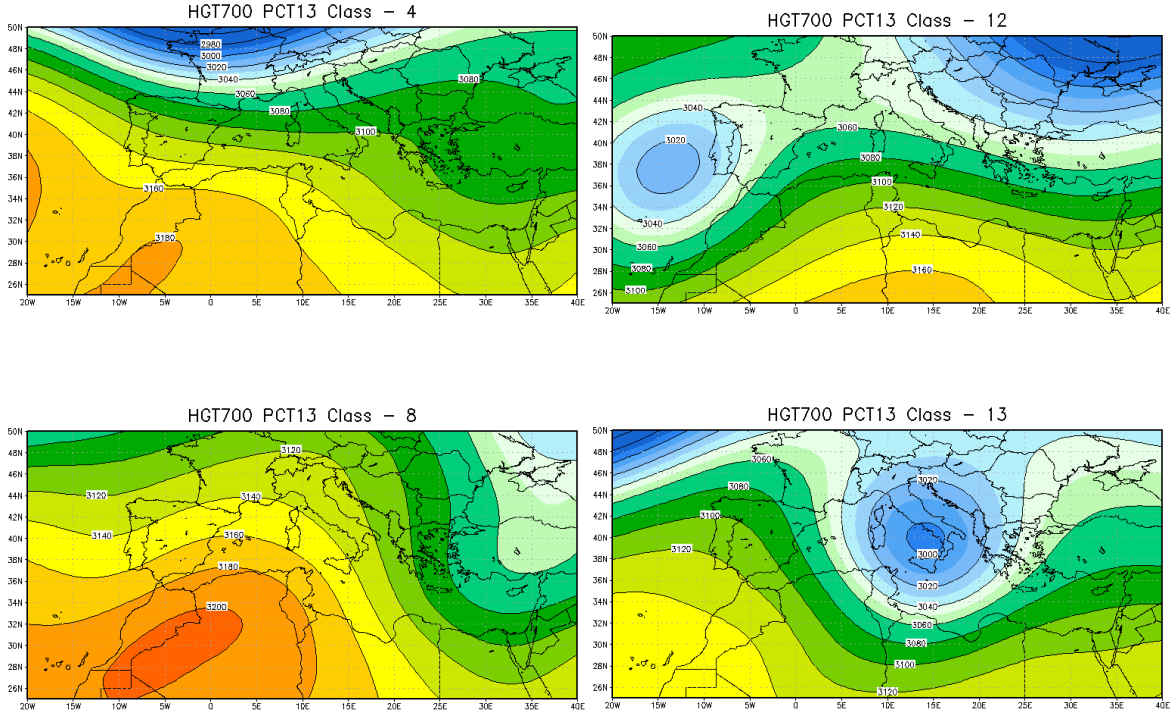


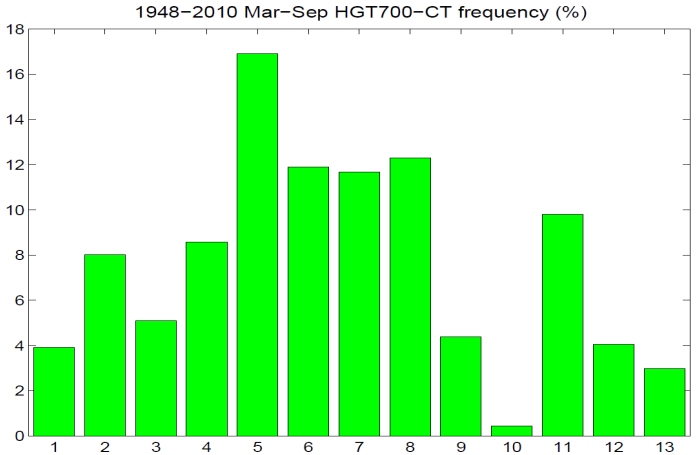
Harmonisation and applications of weather type Classifications for European Regions

http://cost733.met.no/

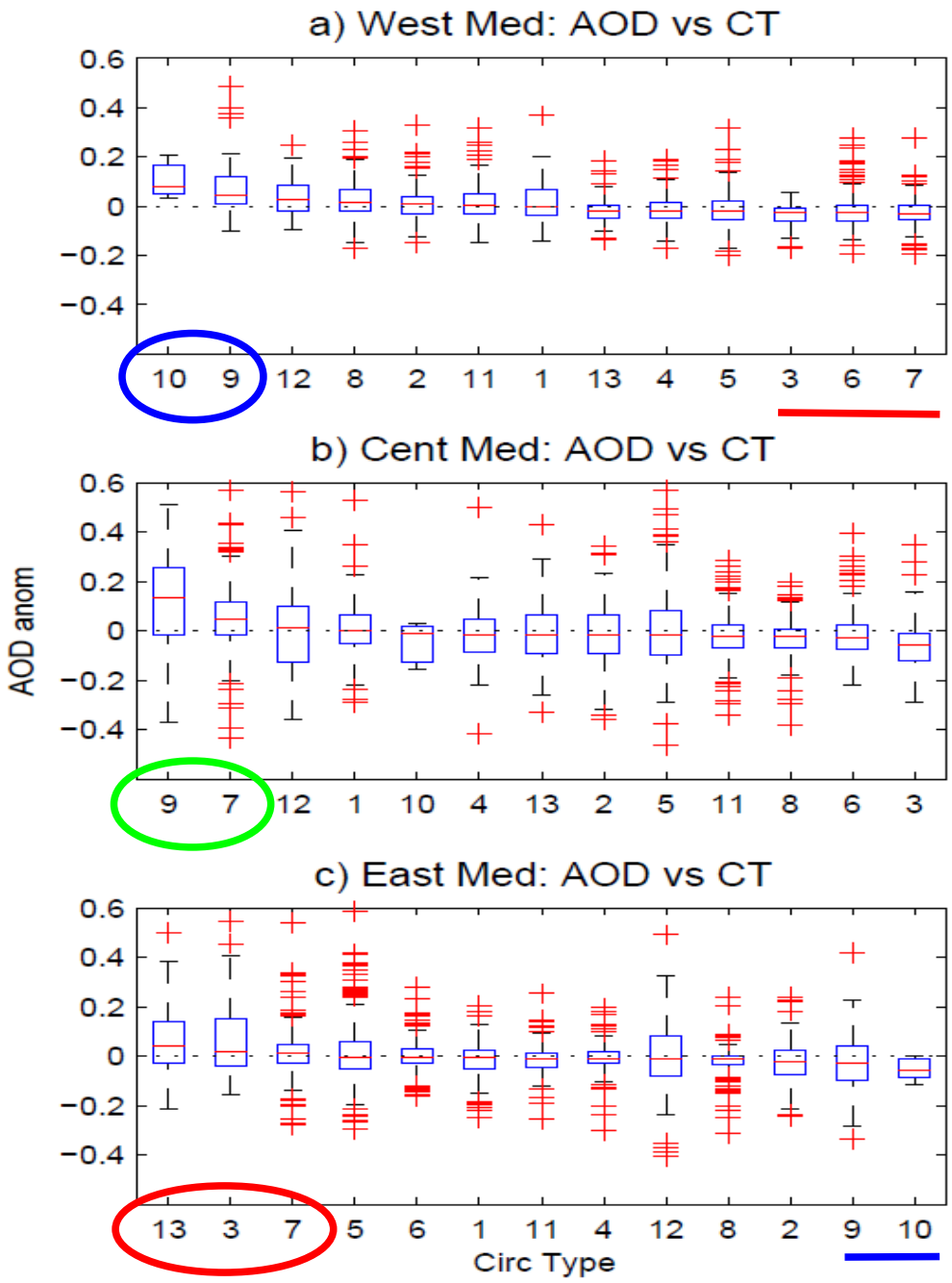
Cost733class software package for classification methods: among the 32 different methods implemented in the software, the **PCT** (t-mode principal component analysis, with an oblique rotation) is applied to **NCEP R2 700hPa HGT**;

13 classes are imposed for the period 01.01.1948–31.12.2010.

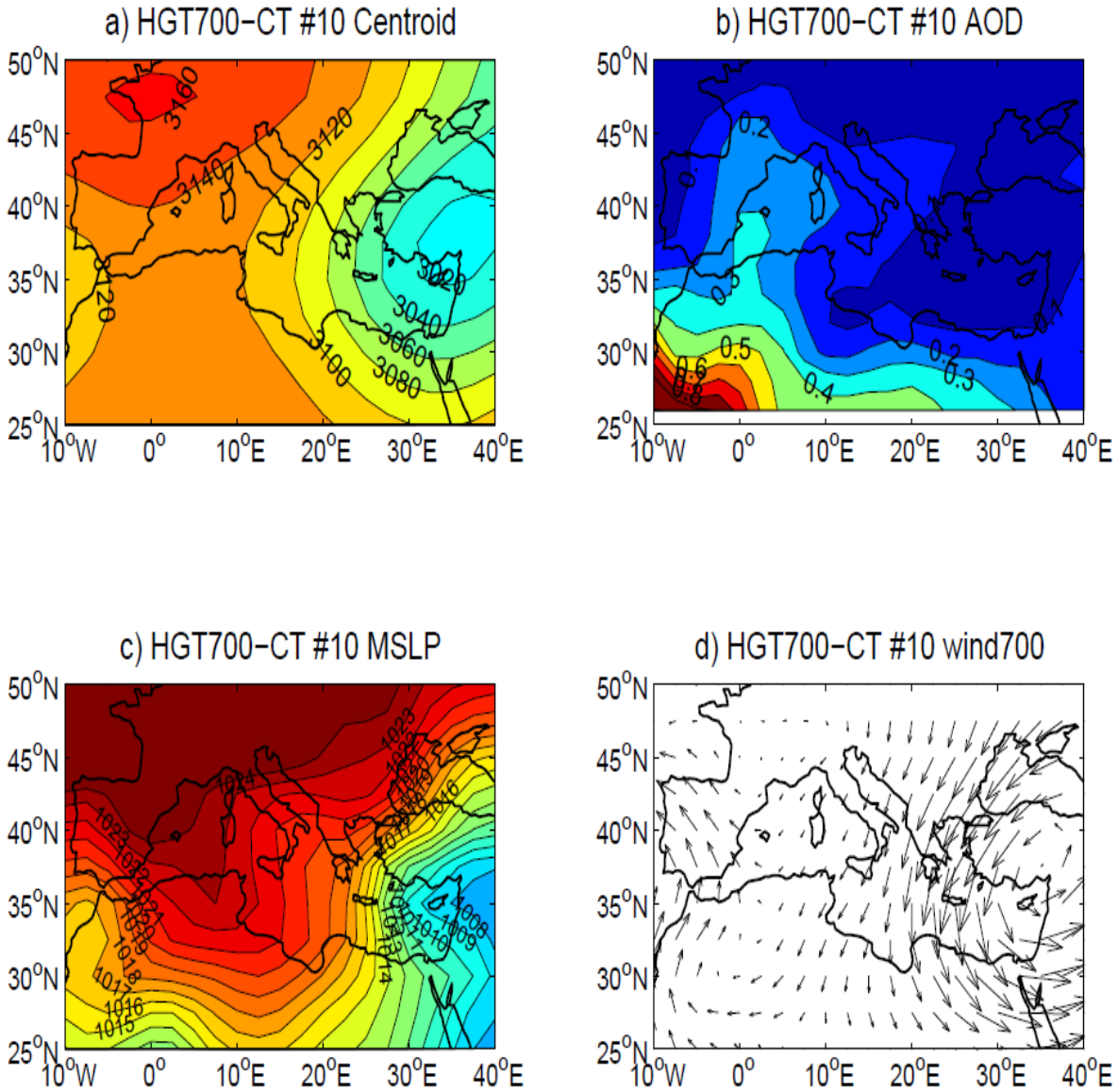




AOD anomalies distribution vs Circulation Types



CT#10
West Med transport



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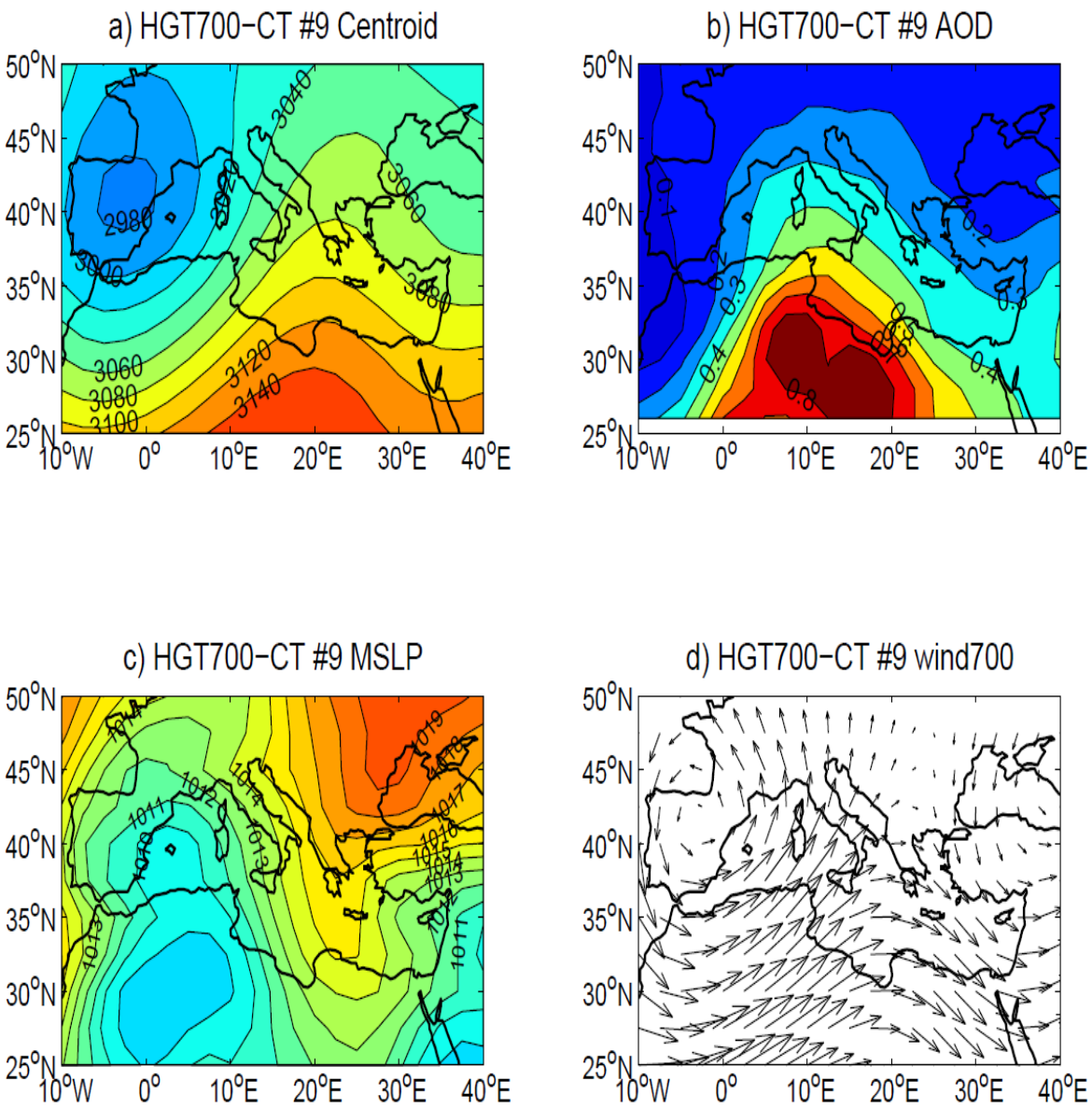
CT#9 West/Cent Med transport



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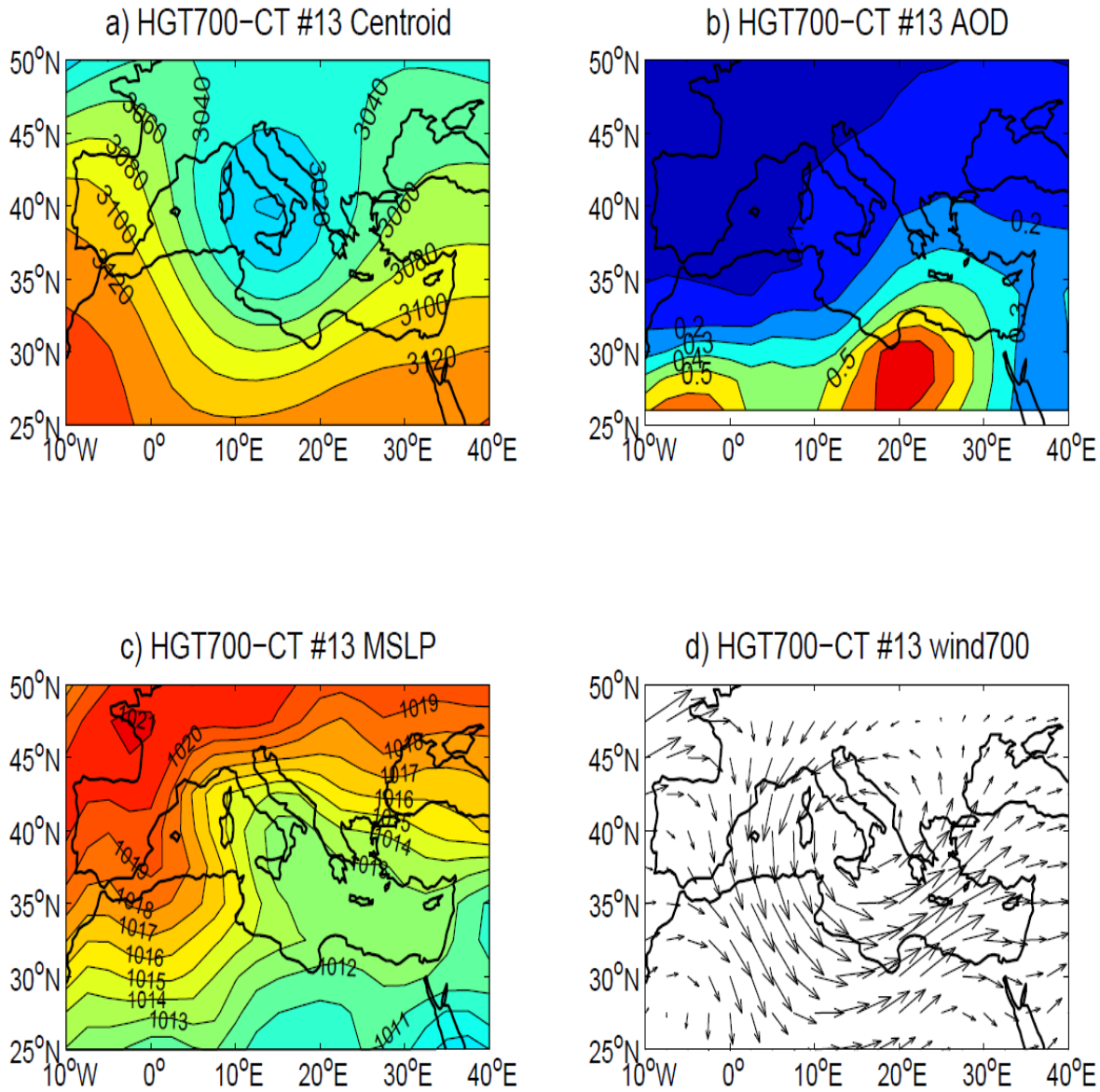
CT#13
East Med transport



> GOCART data are effective in describing the Saharan dust transport in the Med;

> the Med dust events are associated to cyclonic systems crossing North Africa;

> the events occurence at a sub-basin scale is related to the persistence of high pressure in the central Med:

long persistence > west Med event,
short persistence > cent/east Med event;

> a CT characterization of the dust transport anomalies at a sub-basin scale is possible.

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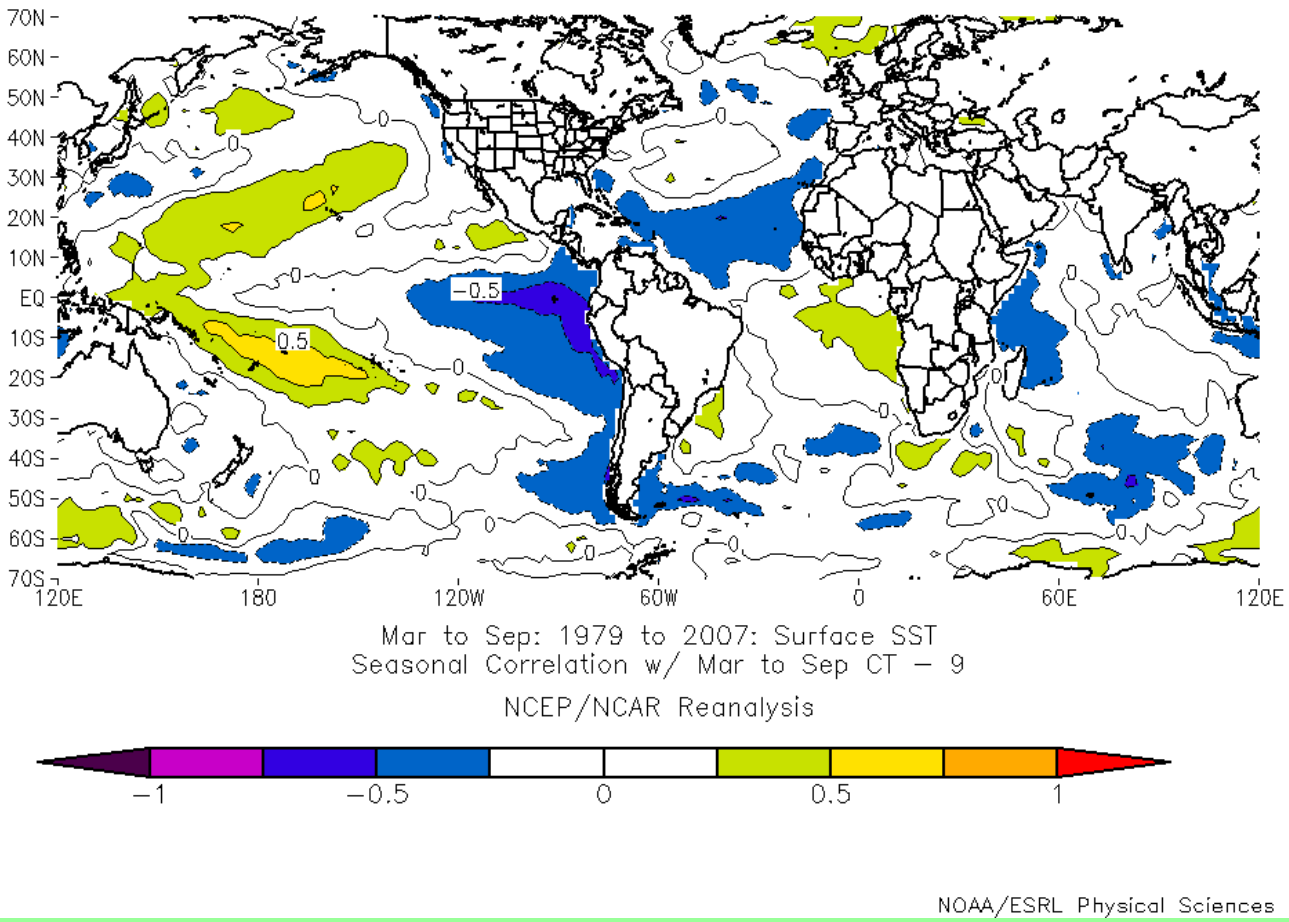
Statistical forecast of CT occurrence using global indices (correlation, CT9 freq vs SST)



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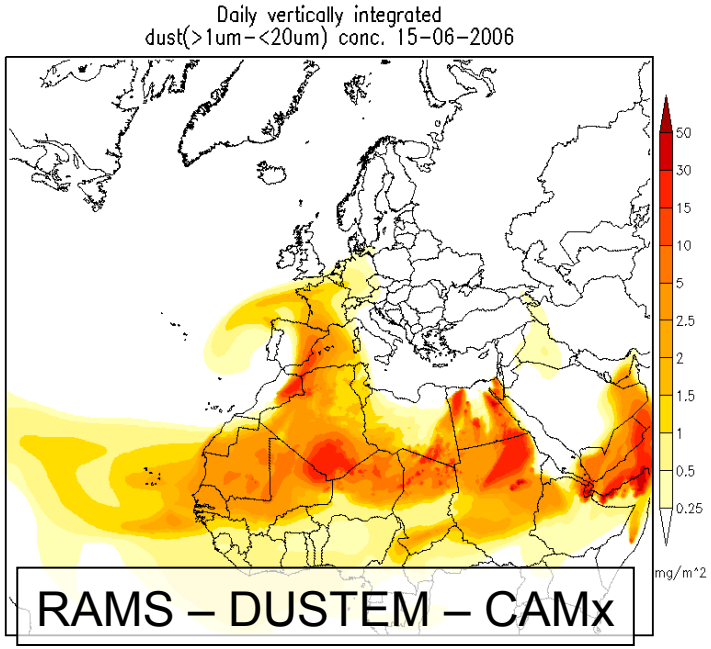
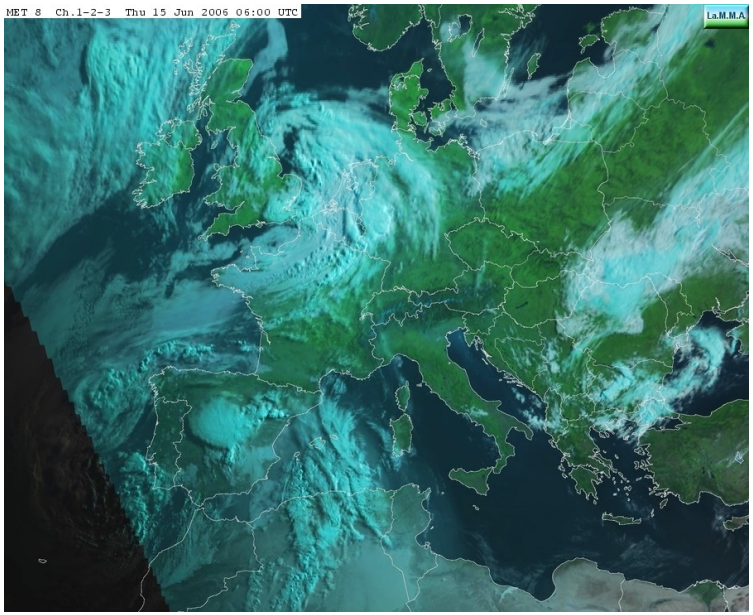
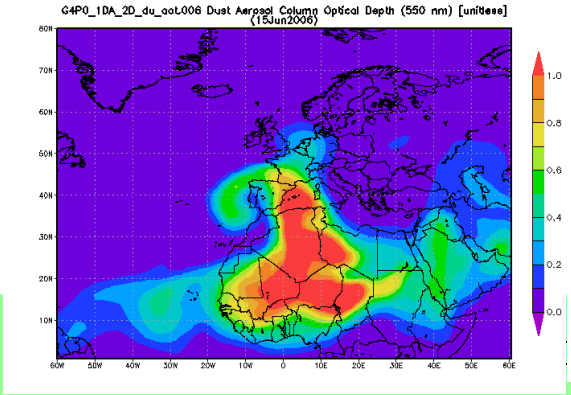
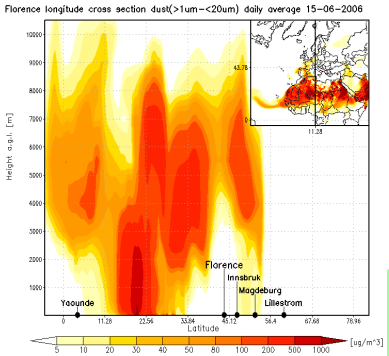
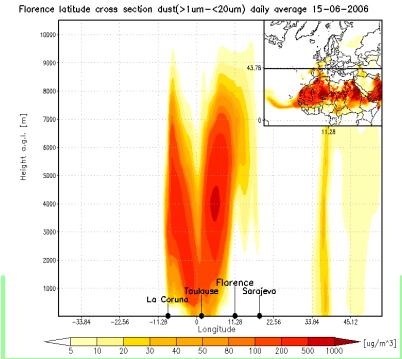
Numerical simulations of dust events through a 3-module regional modelling system, RAMS + DUSTEM + CAMX (June 2006 dust event).











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