International Workshop on "Meteorology, sand and dust storm, combating desertification and erosion"

Sand and Dust Storm (SDS) Forecast and Virtual SDS Center

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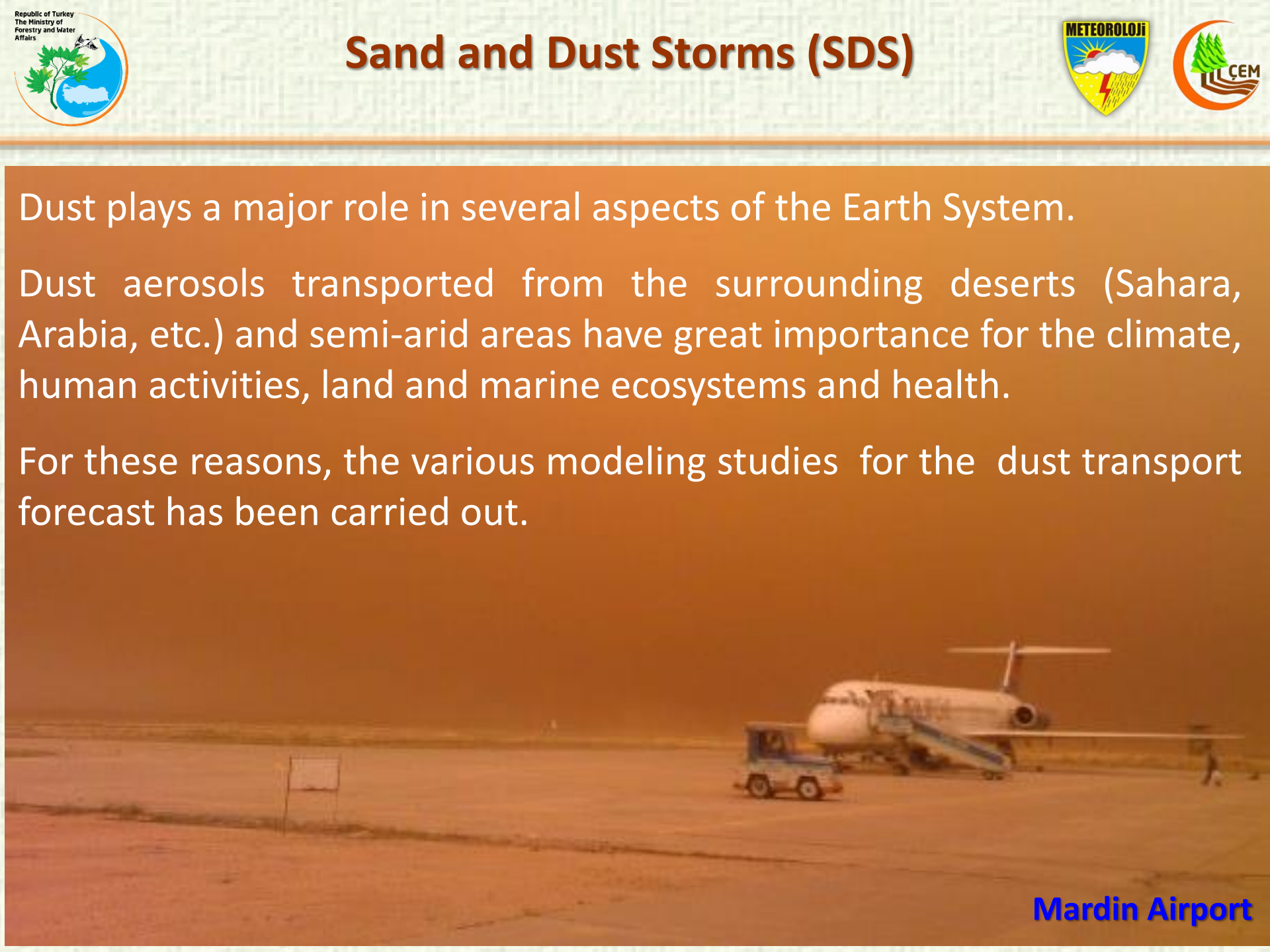
Sand and Dust Storms (SDS)

Dust plays a major role in several aspects of the Earth System.

Dust aerosols transported from the surrounding deserts (Sahara, Arabia, etc.) and semi-arid areas have great importance for the climate, human activities, land and marine ecosystems and health.

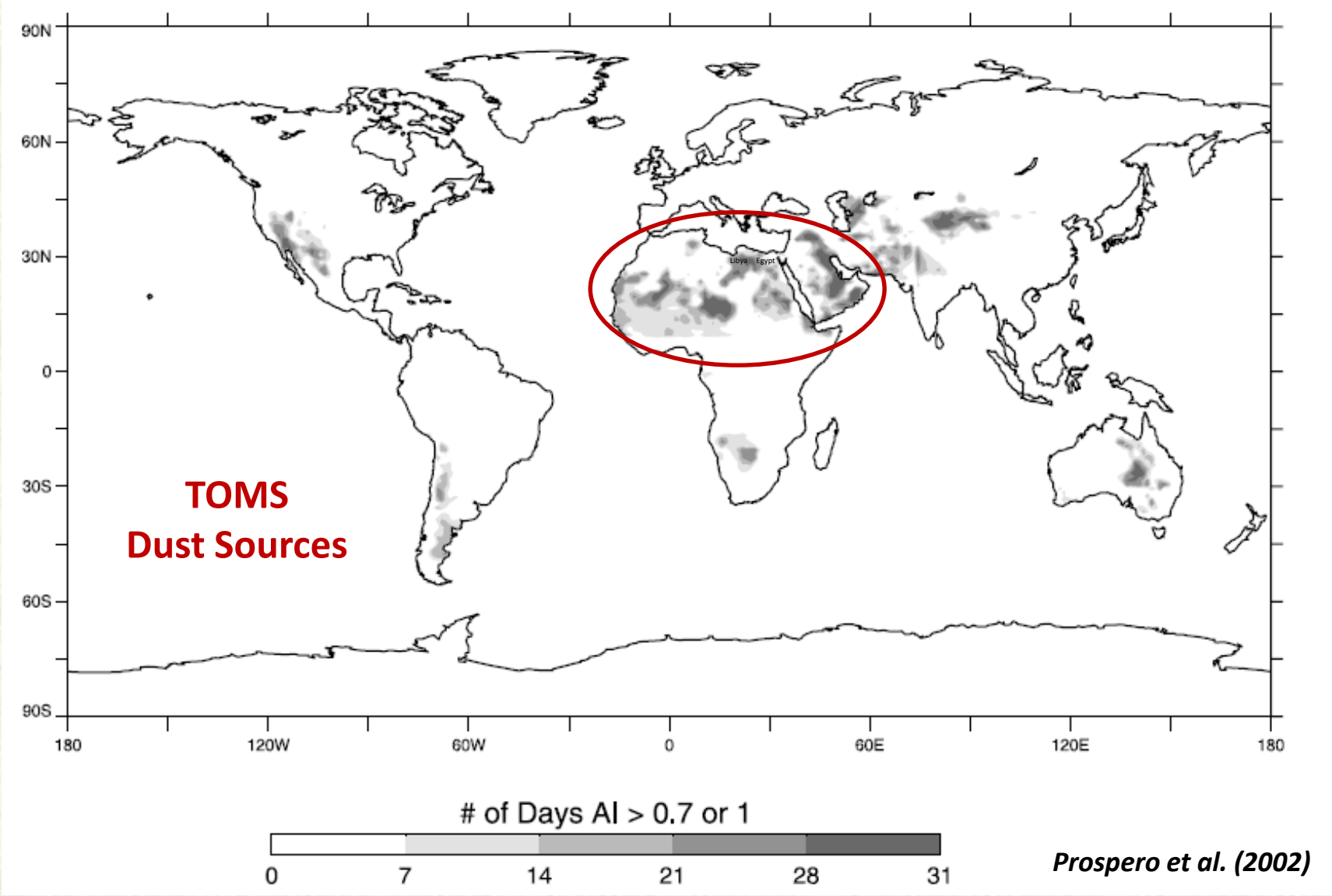
For these reasons, the various modeling studies for the dust transport forecast has been carried out.



Mardin Airport

Main Dust Source Areas

Global Distribution of Dust

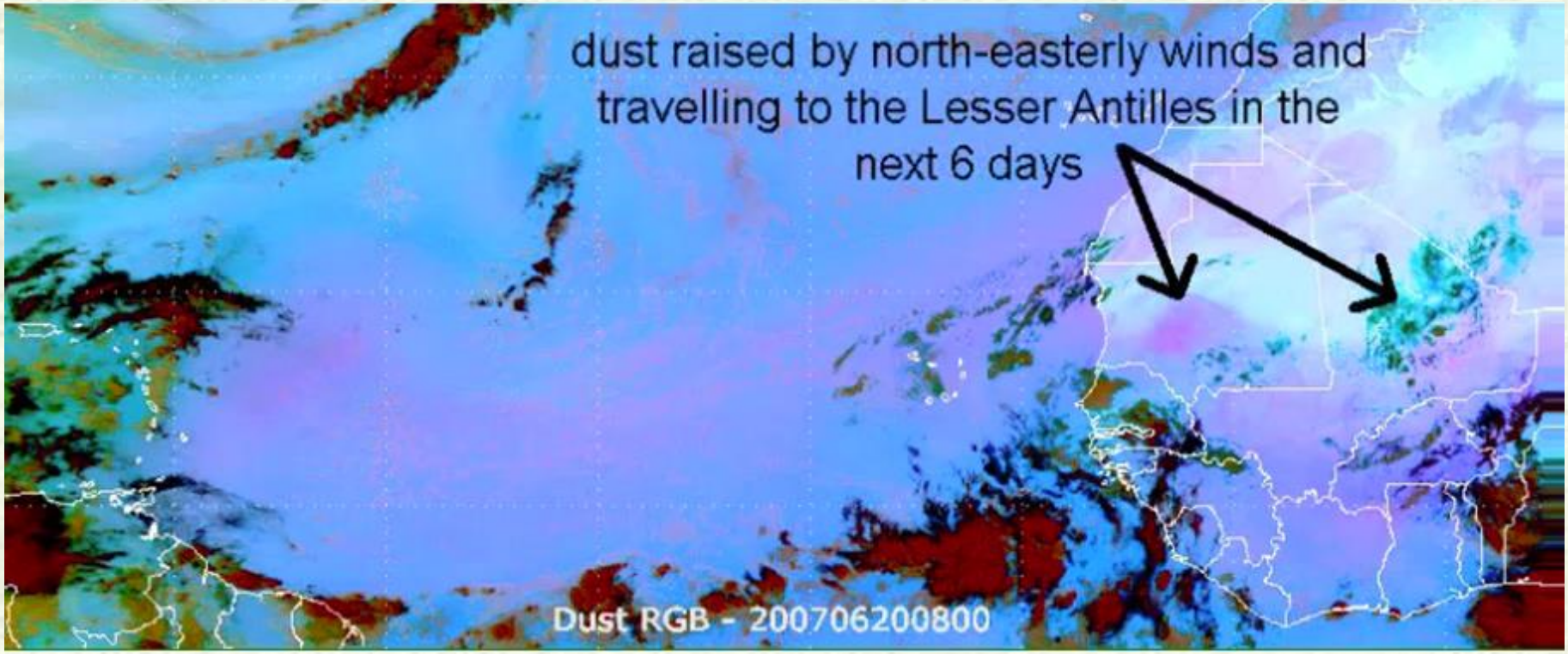


Prospero et al. (2002)

The Lifetime of Dust Particles

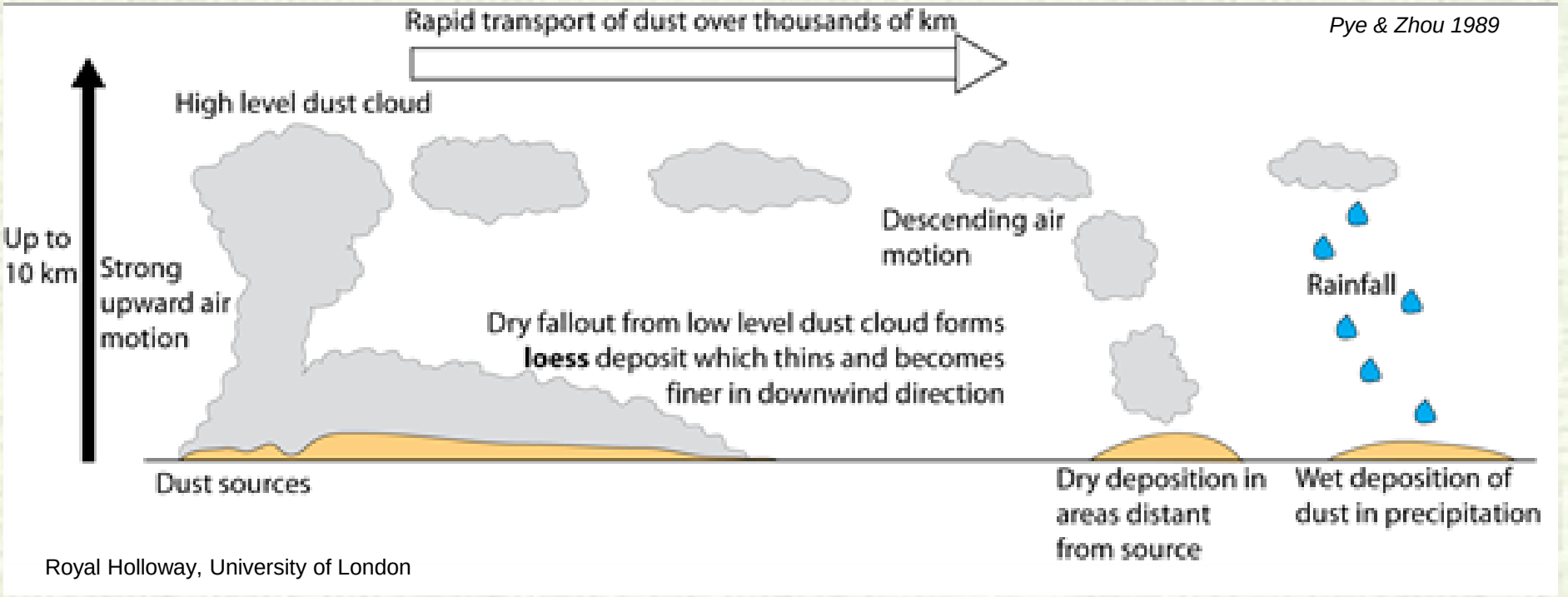
The Lifetime of Dust Particles in the Atmosphere(Tegen and Lacis, 1996)

Particle Size (µm)	0.2	0.3	0.4	0.8	1.5	2.5	5.0	8.0
Atmosph. lifetime (hour)	231	229	225	219	179	126	67	28



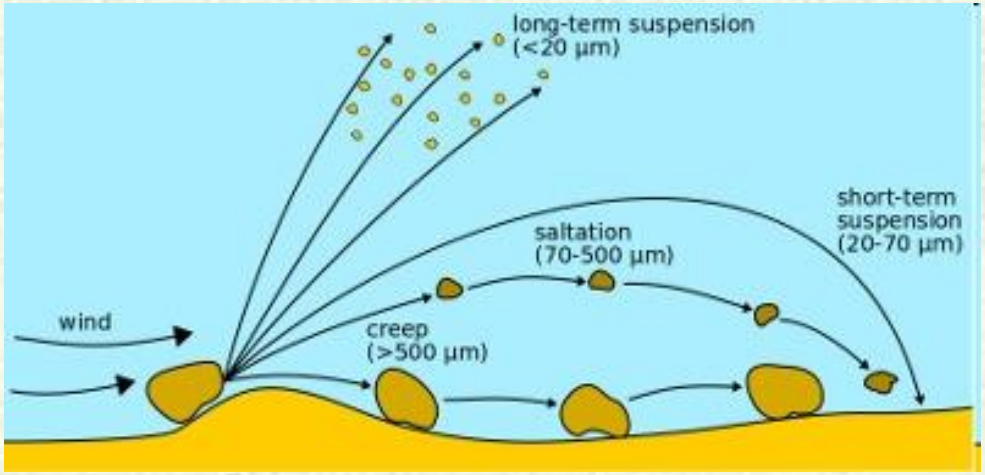
Dust Transport Mechanism

- Mineral dust aerosols controlled by dominant winds in the atmosphere transport as vertically with vertical movements.
- At the end, they deposite as dry and wet over earth surface.



Dust Transport Mechanism

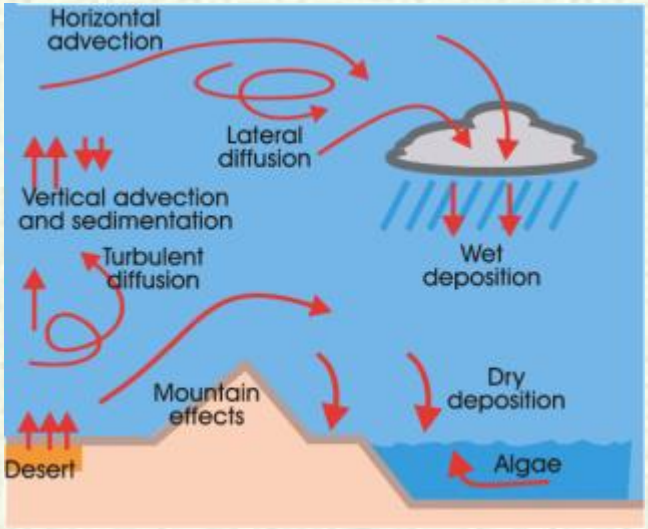
Emission



- Soil Texture/Wetness
- Vegetation
- Wind
- Surface Turbulance

Dust Emission is Heterogeneous and Small Spatial Phenomenon

Dust Cycle

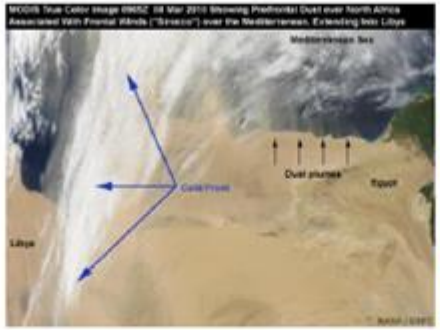


- Emission
- Mixing
- Long-range transport
- Wet and dry deposition

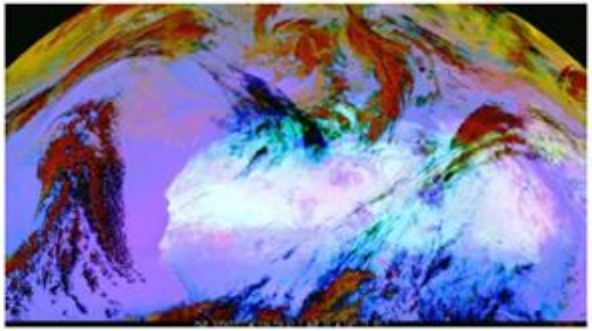
Dust Transport is Global Phenomenon

Type of Dust Storms

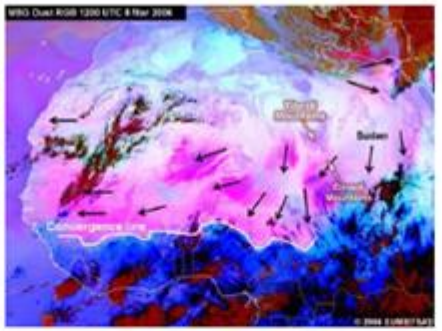
Synoptic dust storms (large scale weather systems) **Well captured by models.**



Pre-frontal winds

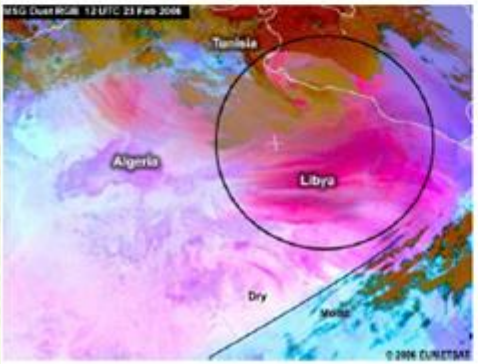


Post-frontal winds

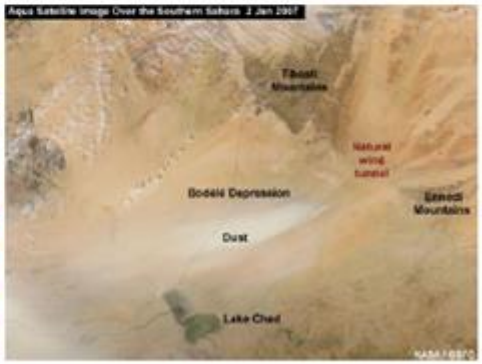


Large-scale trade winds

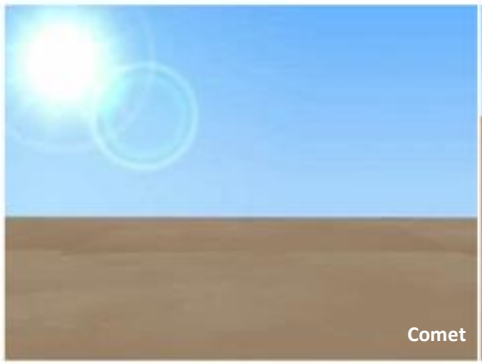
Mesoscale dust storms **Poorly captured by models.**



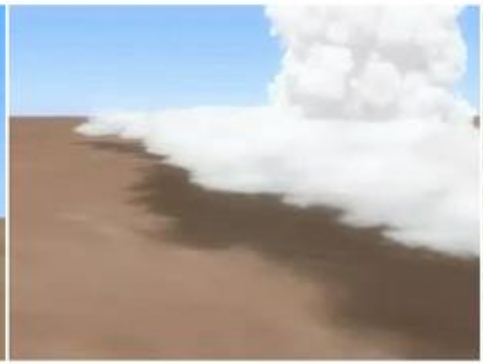
Downslope winds



Gap flow



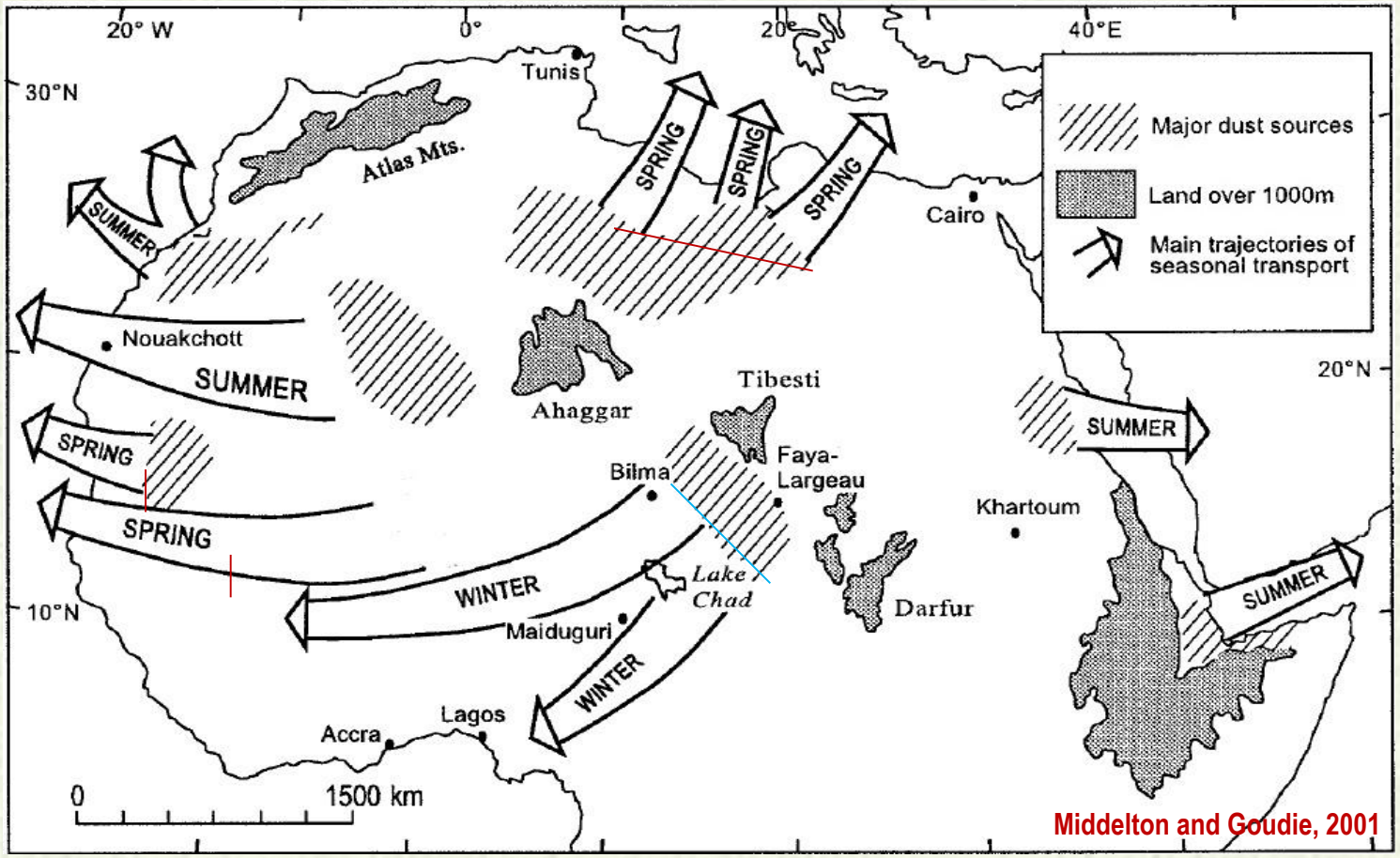
Convection



Haboobs

Basart, S. (2014)

Sources and Main trajectories of African Dust



- Most dust transport events over Mediterranean are western and southwestern component.
- Dust transport pathway is through Mediterranean and North Athlantic on **spring season**, while Arabian and again North Athlantic on **summer season**.
- The pathway is through Gulf of Guinea on **winter season**.

SDS Forecast at TSMS by BSC-DREAM8b Model

SDS Forecast by BSC-DREAM8b Model

The BSC-DREAM8b dust transport model has been established at TSMS in cooperation with Spanish Met. Service (AEMET & BSC) under the EU TAIEX Small Grants Program.

The operational forecasts by BSC-DREAM8b have been started in June 2010. Estimates are publishing at the website of TSMS.

SDS Forecast by BSC-DREAM8b Model

The main general features of the original DREAM model (Nickovic et al. 2001) are:

- Dust production scheme (Shao et al. 1993) with introduced viscous sub-layer (Janjic, 1994).
- Soil wetness effects on dust production (Fécan et al. 1999).
- Dry deposition (Giorgi, 1986) and below cloud scavenging.
- Horizontal and vertical advection, turbulent and lateral diffusion (Janjic, 1994) represented as for other scalars in the Eta/NCEP model.

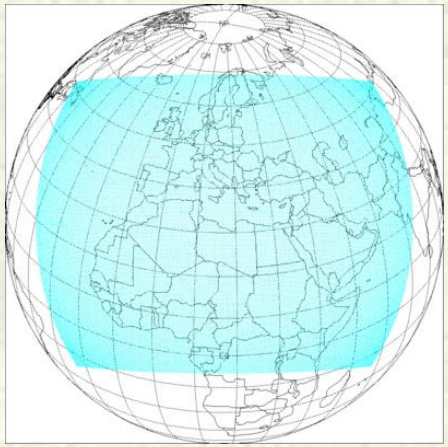
The developments included in the BSC-DREAM8b v1.0 model (Pérez et al. 2006a, Pérez et al. 2006b) are:

- Eight size transport bins between 0.1 and 10 µm range are considered following Tegen and Lacis (1996). Within each transport bin, dust is assumed to have time-invariant, sub-bin log-normal distribution employing the transport mode with mass median diameter of 2.524 um and geometric standard deviation 2.0.
- Dust-radiation interactions are taken account. Dust affects the radiative fluxes at the surface and the top of the atmosphere and the temperature profiles at every model time step when the radiation module is processed (Pérez et al. 2006b).
- Grid points acting as desert dust sources are specified using arid and semiarid categories of the global USGS 1-km vegetation data set and the FAO 4-km global soil texture data set.

https://www.bsc.es/earth-sciences/

SDS Forecast by BSC-DREAM8b Model

	MGM/BSC-DREAM8b
Particle Size	0.15, 0.25, 0.45, 0.78, 1.3, 2.2, 3.8 and 7.1 µm
Forecast Area	Europe, Africa and Turkey
Forecast Products	Dust Surface Concentration Dust Load Dry and Wet Deposition
Forecast Period	72 hours by 3h steps
Initial and Boundary Conditions	ECMWF IFS (Integrated Forecast System) Global Model



BSC-DREAM8b Forecast Domains

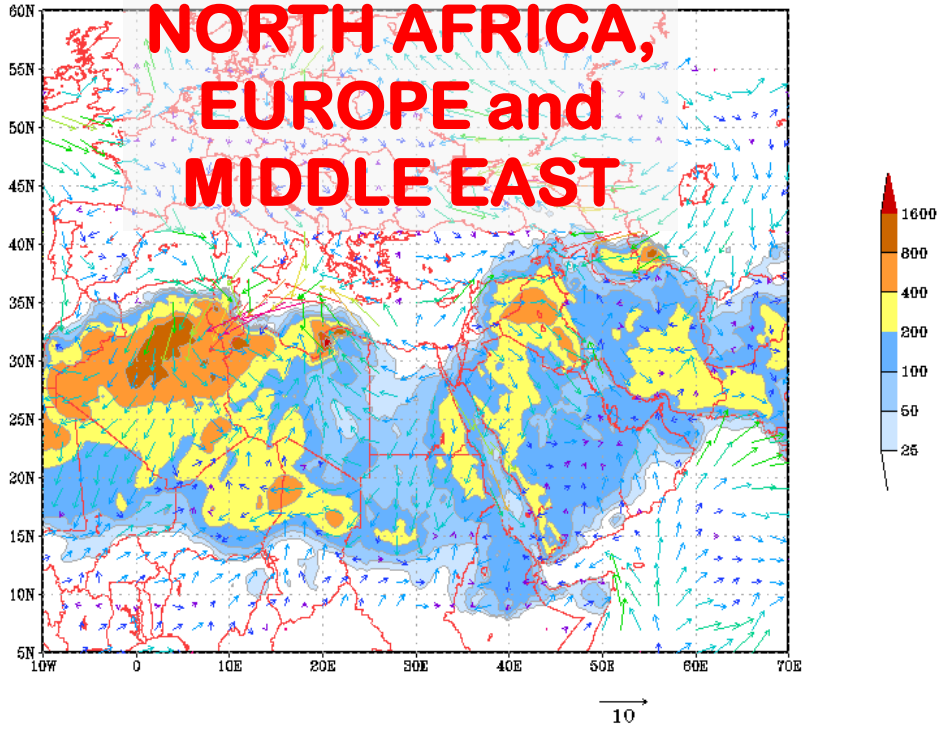
Surface concentration (µg/m³) Dust Flux (g/m²) Dry & Wet Deposition (mg/m²)

Toz Tahmini

Gösterim Şekli	Harita | Hareketli Görüntü
Bölge	Avrupa | Türkiye | Ortadoğu
Harita Türü	Yüzey Toz Konsantrasyonu | Toz Yükleme | Kuru Çökelme | Yaş Çökelme
Yüksek Seviye	1700 m. Toz Konsantrasyonu | 3000 m. Toz Konsantrasyonu | 5800 m. Toz Konsantrasyonu
Saat	00 | 03 | 06 | 09 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72

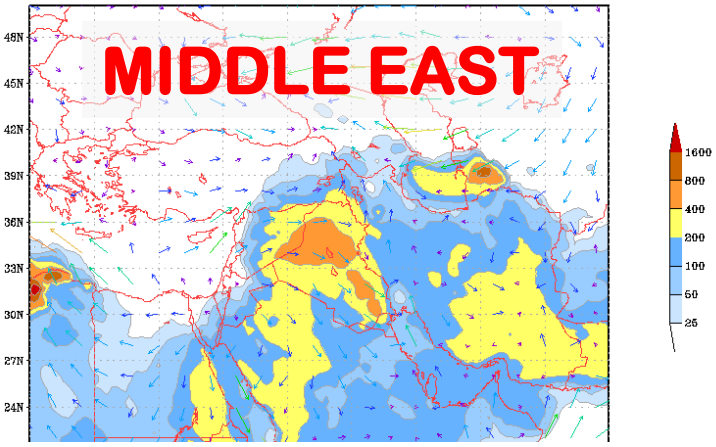
MGM/BSC-DREAM8b Yuzey Toz Konsantrasyonu (ug/m**3) ve 10m Ruzgar

12h forecast for 00z 03 JUN 14



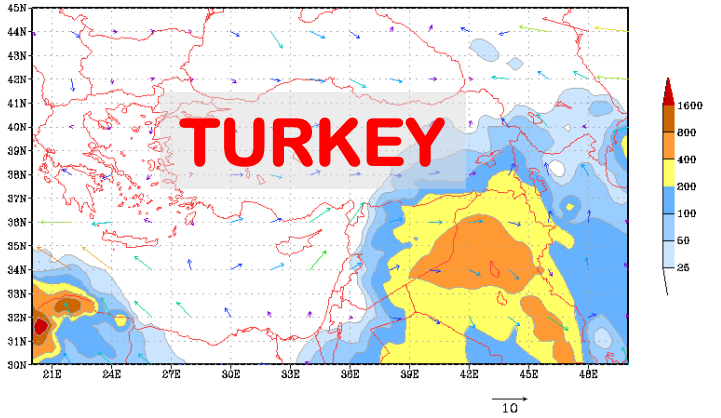
MGM/BSC-DREAM8b Yuzey Toz Konsantrasyonu (ug/m**3) ve 10m Ruzgar

12h forecast for 00z 03 JUN 14



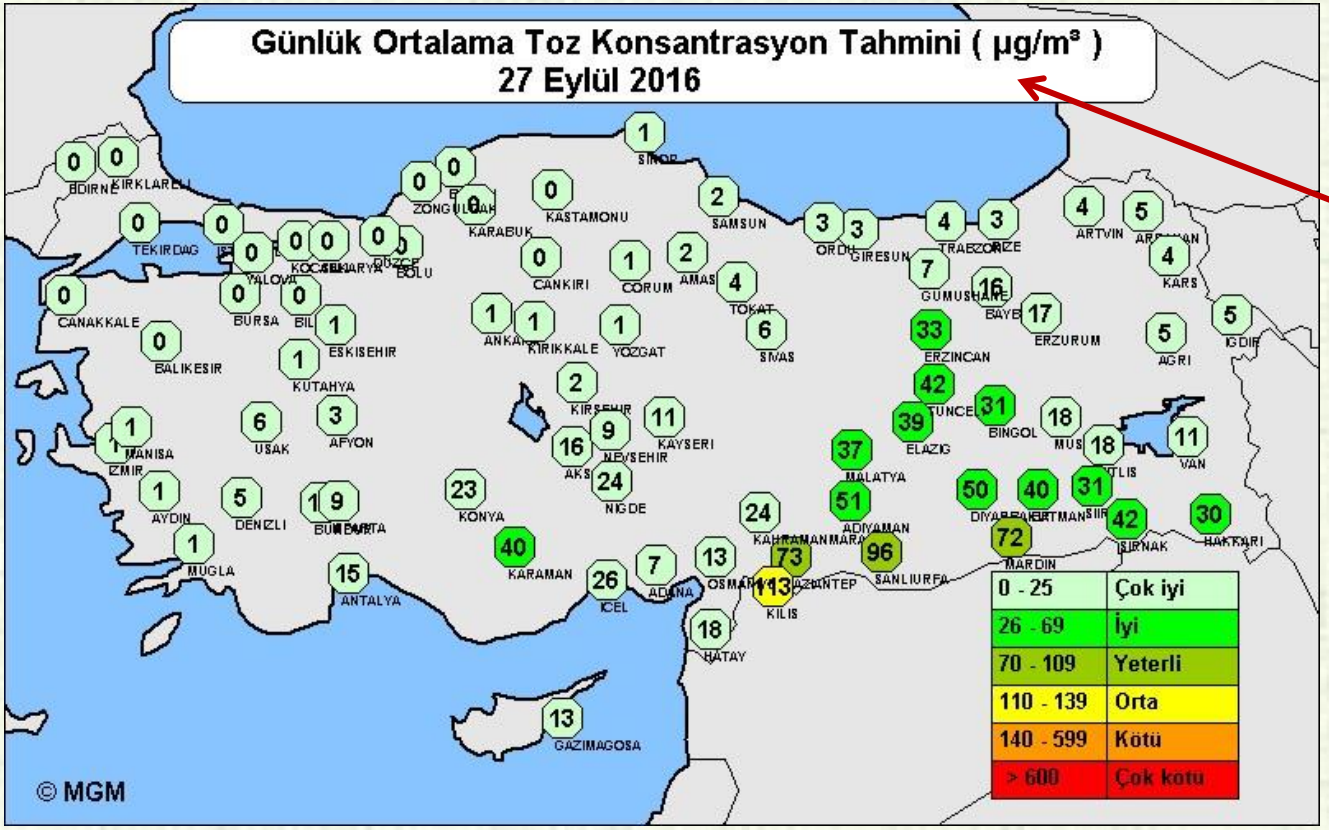
MGM/BSC-DREAM8b Yuzey Toz Konsantrasyonu (ug/m**3) ve 10m Ruzgar

12h forecast for 00z 03 JUN 14



SDS Warning System (Map)

SDS Warning System has been operating for the people living in urban centers. The system is in operational use providing 48 hours forecasts. The results are available on the internet.



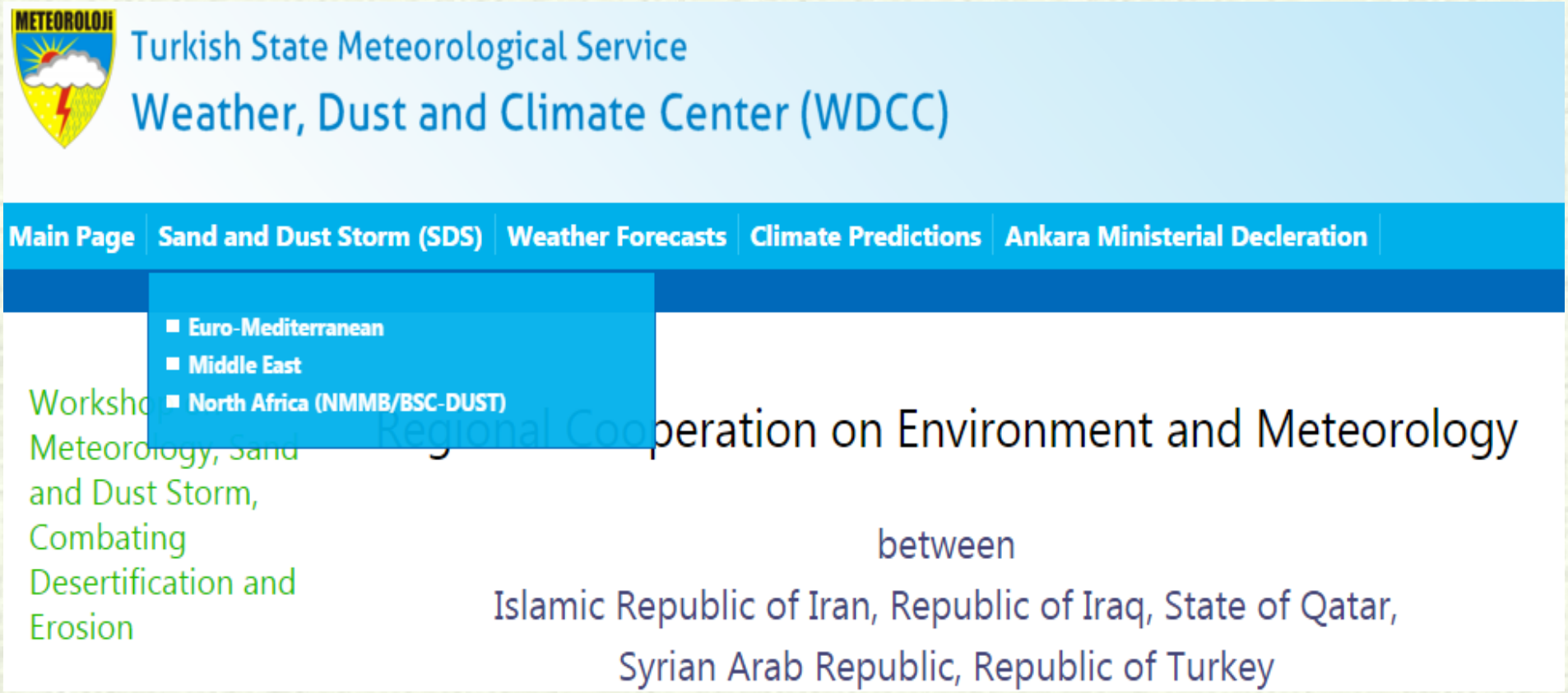
Daily Mean Dust Concentration Forecast (µg/m3) 27 September 2016

SDS Warning System (Map)

İller	26 Eylül 2016, Pazartesi										27 Eylül 2016, Salı									
	Ort.	Mak.	00	03	06	09	12	15	18	21	Ort.	Mak.	00	03	06	09	12	15	18	21
Adana	3	**6**	0	0	0	2	5	6	4	3	7	**11**	3	4	5	7	10	11	10	7
Adiyaman	47	**98**	9	9	10	22	54	97	98	79	51	**62**	62	48	51	56	60	58	41	32
Afyon	21	**46**	21	6	8	15	36	46	26	5	3	**9**	0	0	1	2	6	9	5	2
Agri	3	**9**	0	0	1	4	9	5	2	3	5	**7**	4	4	4	7	7	6	3	2
Aksaray	81	**183**	46	40	80	183	124	84	55	32	16	**36**	16	9	8	12	27	36	16	6
Amasya	8	**14**	2	7	14	9	11	11	7	6	2	**6**	6	5	3	1	0	0	0	0
Ankara	13	**34**	34	25	15	12	8	9	4	1	1	**4**	1	0	0	1	4	4	1	0
Antalya	21	**37**	37	32	13	8	12	22	23	20	15	**32**	13	14	32	15	12	13	10	8
Ardahan	1	**4**	1	1	0	0	1	1	2	4	5	**9**	5	6	7	9	6	3	1	0
Artvin	3	**10**	0	1	0	0	1	5	8	10	4	**7**	7	4	3	5	5	3	2	1
Aydin	0	**1**	0	0	0	0	0	1	1	1	1	**1**	1	0	0	0	0	1	1	1
Balikesir	0	**1**	1	1	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0
Bartin	1	**2**	1	2	1	1	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0
Batman	9	**31**	1	1	1	2	3	9	22	31	40	**55**	40	42	34	40	55	49	37	21
Bayburt	27	**49**	10	6	7	22	38	49	46	39	16	**32**	32	24	12	20	18	12	7	4
Bilecik	1	**3**	3	2	1	1	1	0	0	0	0	**0**	0	0	0	0	0	0	0	0
Bingol	9	**30**	0	1	1	1	3	10	22	30	31	**38**	35	36	33	36	38	33	22	11
Bitlis	3	**11**	0	0	0	2	3	3	6	11	18	**31**	15	14	11	13	30	31	22	12
Bolu	4	**14**	14	9	3	1	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0
Burdur	29	**69**	13	6	7	11	40	69	60	24	10	**17**	9	4	8	7	17	16	11	6
Bursa	0	**1**	1	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0
Canakkale	0	**0**	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0
Cankiri	8	**25**	12	25	15	8	4	2	1	0	0	**0**	0	0	0	0	0	0	0	0
Corum	10	**17**	8	15	17	10	11	8	5	4	1	**4**	4	3	1	0	0	0	0	0
Denizli	11	**32**	5	3	5	5	25	32	10	4	5	**9**	4	3	4	3	7	9	7	5
Diyarbakir	20	**69**	3	3	3	3	5	22	50	69	50	**74**	74	67	54	52	53	42	35	22

Virtual SDS Center (WDCC) at TSMS

Virtual SDS Center

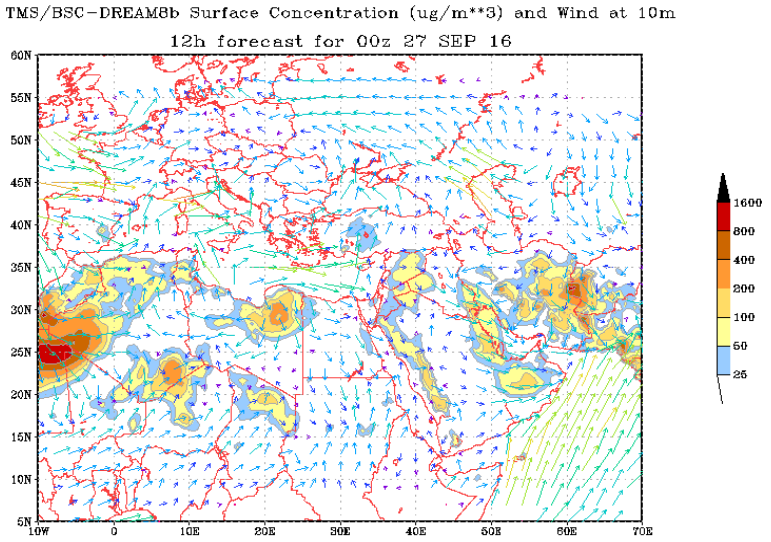


http://www.wdcc.mgm.gov.tr/

Virtual SDS Center

Sand and Dust Storm (SDS) Forecast **Mediterranean**

Type	Map | Animation
Region	Euro-Mediterrenean | Middle East | North Africa(NMMB/BSC-DUST) | MSG-Dust-Image
Parameter	Concentration | Dust Load | Dry Deposition | Wet Deposition
Hour (GMT)	00 | 03 | 06 | 09 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72

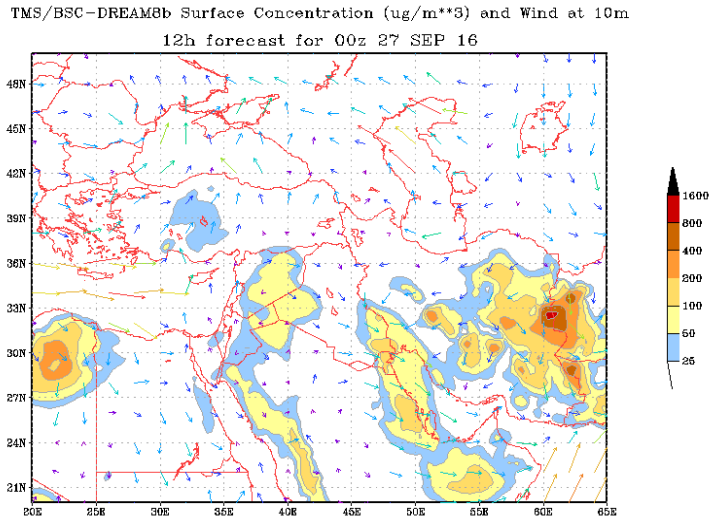


SDS Forecasts for the Mediterranean, Middle East

- Concentration
- Dust Load
- Dry Deposition
- Wet Deposition

Sand and Dust Storm (SDS) Forecast **Middle East**

Type	Map | Animation
Region	Euro-Mediterrenean | Middle East | North Africa(NMMB/BSC-DUST) | MSG-Dust-Image
Parameter	Concentration | Dust Load | Dry Deposition | Wet Deposition
Hour (GMT)	00 | 03 | 06 | 09 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72



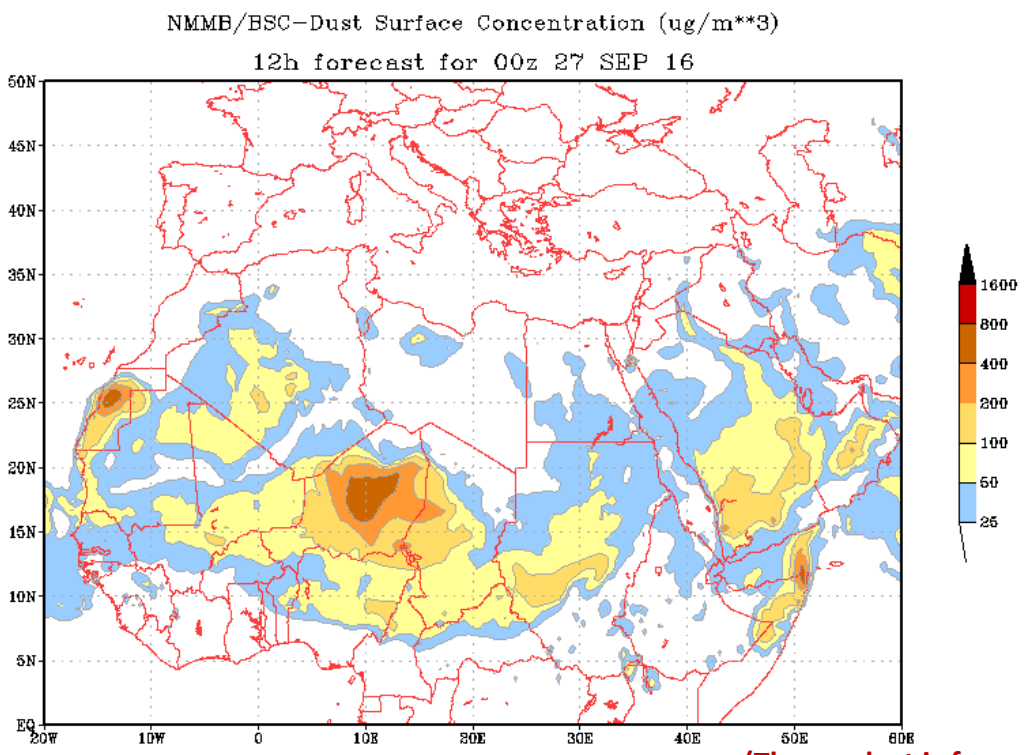
Virtual SDS Center

SDS Forecasts for North Africa

Sand and Dust Storm (SDS) Forecast — **North Africa**

Type	Map | Animation
Region	Euro-Mediterrenean | Middle East | North Africa(NMMB/BSC-DUST) | MSG-Dust-Image
Parameter	Concentration
Hour (GMT)	00 | 03 | 06 | 09 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72

NMMB/BSC-Dust



(The product is from sds-was)

Virtual SDS Center

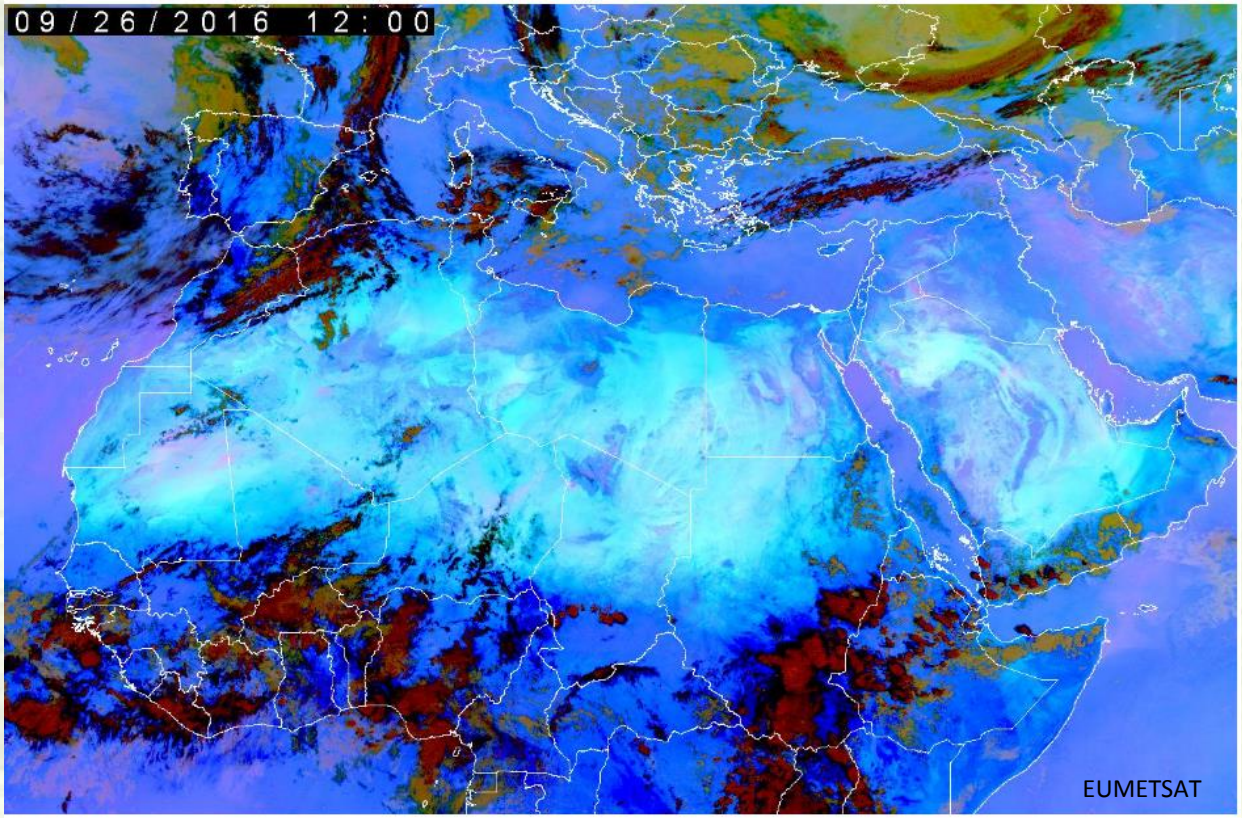
MSG/RGB-Dust Images

Sand and Dust Storm (SDS) Forecast

Type Image

Region Euro-Mediterrenean | Middle East | North Africa(NMMB/BSC-DUST) | MSG-Dust-Image

Hour (GMT) 00 | 03 | 06 | 09 | 12 | 15 | 18 | 21 → **(Last 24 hours)**



WMO SDS-WAS

World Meteorological Organization

Sand and Dust Storm Warning, Advisory and Assessment System

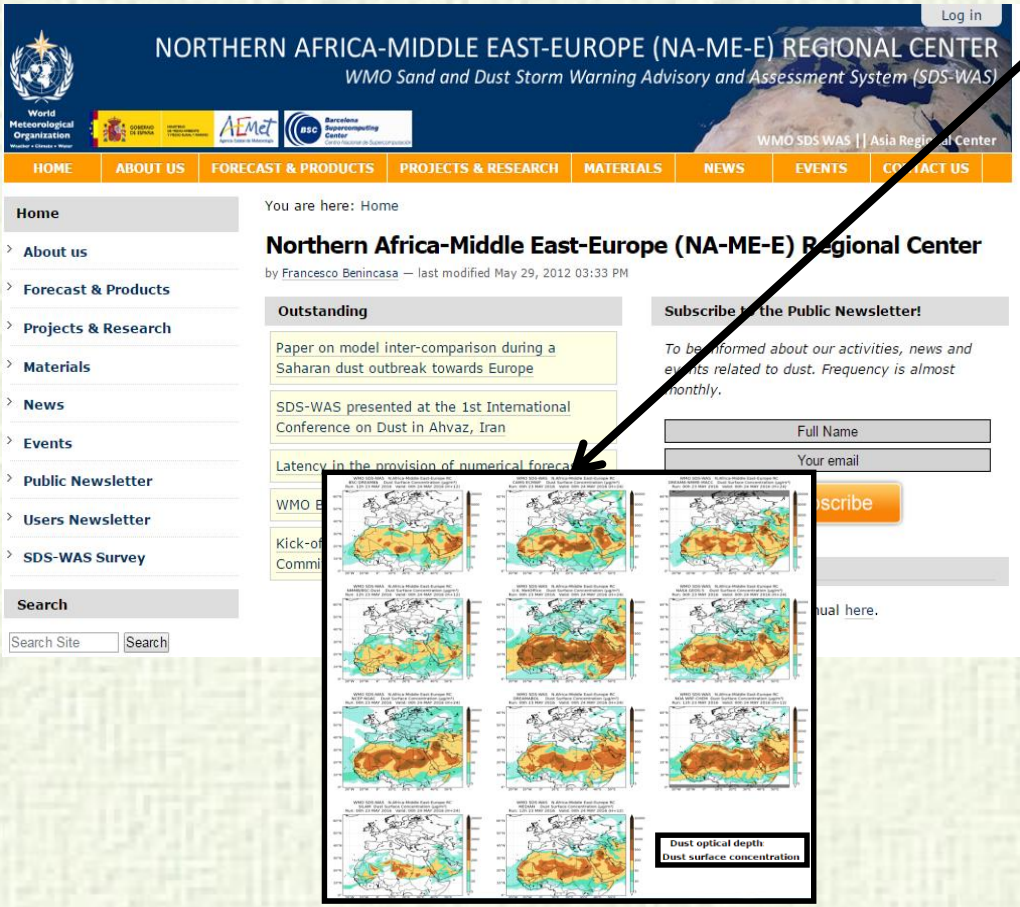
SDS-WAS

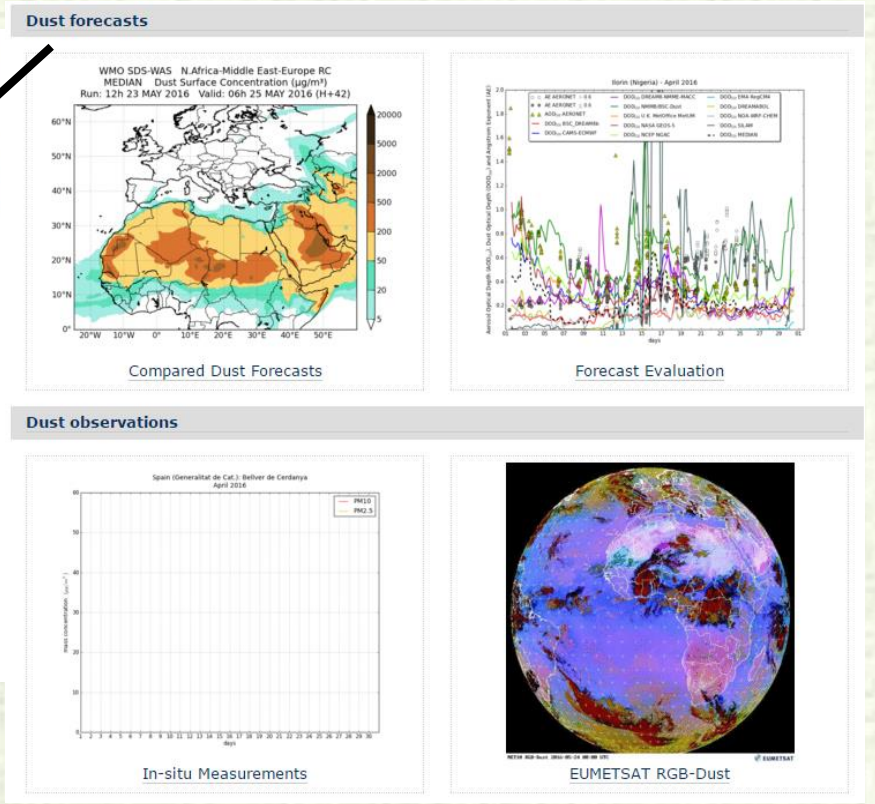
Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) had been formed in WMO-AREP (Atmospheric Research and Environment Program). The establishment of the SDS-WAS project is a response to interest of more than 40 WMO members to improve capabilities for more reliable sand and dust storm forecasts.

WMO has 2 different SDS Center located at Spain and China. The responsibility area of Spain covers Europe, North Africa and Middle East. China is responsible from Asia Region.

Northern Africa-Middle East-Europe (NA-ME-E) Regional Center

WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)





http://sds-was.aemet.es/

SDS Training Activities

Workshop on "Meteorology, Sand and Dust Storm (SDS), Combating Desertification and Erosion"

22-26 Feb. 2011, Istanbul

21-25 Nov. 2011, Antalya

26-28 Nov. 2012, Ankara

28-31 Oct. 2013, Istanbul

International Workshop on "Meteorology, sand and dust storm, combating desertification and erosion"

THANK YOU FOR YOUR ATTENTION…

Kahraman OĞUZ

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Meteorological Engineer

Turkish State Meteorological Service