A 15-year climatology of Desert dust episodes in the broader Mediterranean Basin

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Previous Studies

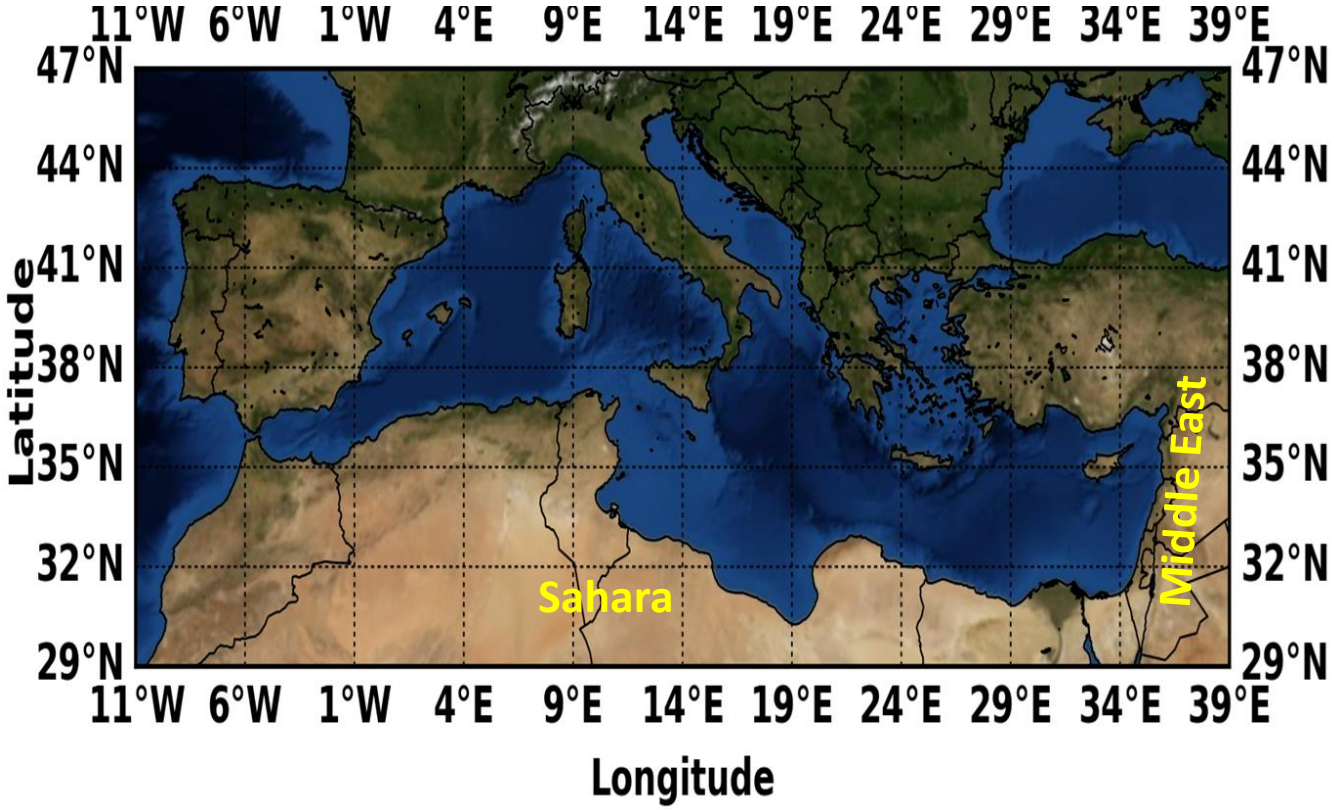
- Dust Aerosol Episodes have also been investigated in previous studies

- However, most of these studies are focused on a ***specific dust episode*** (Kaskaoutis et al., 2019; Solomos et al., 2018; Dulac et al., 1992) or on a ***specific region*** (Achilleos et al., 2019; Meloni et al., 2007; Dayan et al., 1991; Toledano et al., 2007) or have ***limited temporal coverage*** (Schepanski et al., 2016).

- **Gkikas et al. (2013)** used a satellite algorithm based on aerosol optical properties in order to determine intense desert dust episodes regime in the Mediterranean Basin over the period 2000-2007. Satellite data provides a full 1°x1° pixel spatial coverage.

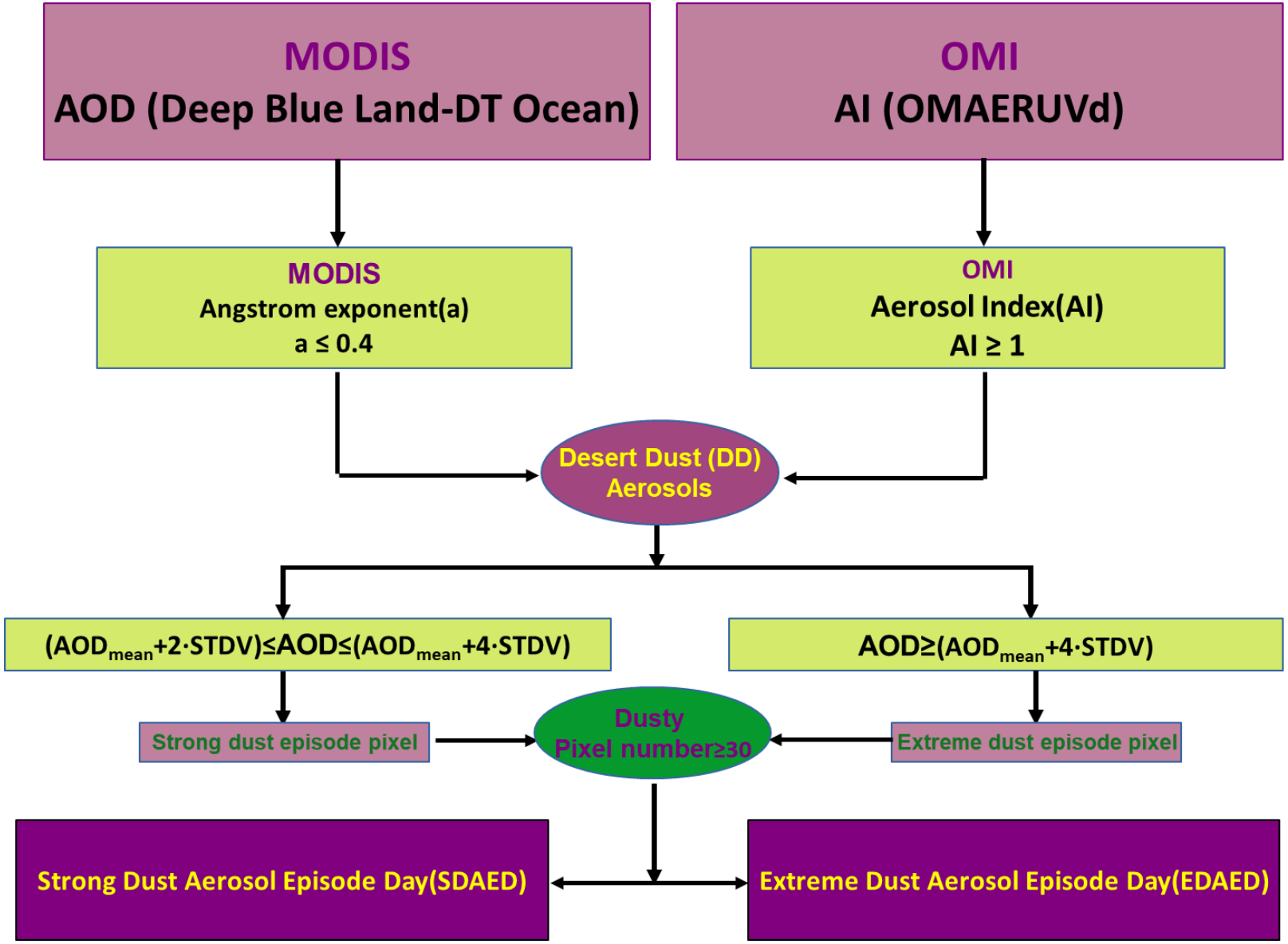
- Here, a modified version of this algorithm is used over an the extended period from 2005 to 2019.

In the present study



A satellite algorithm, based on aerosol optical properties, is used for the DAEDs determination in the broader Mediterranean Basin (MB)

The algorithm



Applied on a specific day and pixel level basis!

Data

MODIS (Moderate Resolution Imaging Spectroradiometer)	OMI (Ozone Monitoring Instrument)
Satellite: Aqua **Collection**: Collection 6.1 **Processing Level:** Level-3 **Temporal Resolution:** Daily **Spatial Resolution:** 1°x1° **Spatial Coverage:** **11W, 39E, 47N, 29S** ***(Mediterranean Basin, MB)***	**Satellite:** Aura **Collection:** OMAERUV **Processing Level:** Level-3 **Temporal Resolution:** Daily **Spatial Resolution:** 1°x1° **Spatial Coverage:** **11W, 39E, 47N, 29S** ***(Mediterranean Basin, MB)***
Used Data: Spectral Aerosol Optical Depth (AOD), 7 wavelengths, above ocean and 3 above land	Used Data: Aerosol Index (AI)

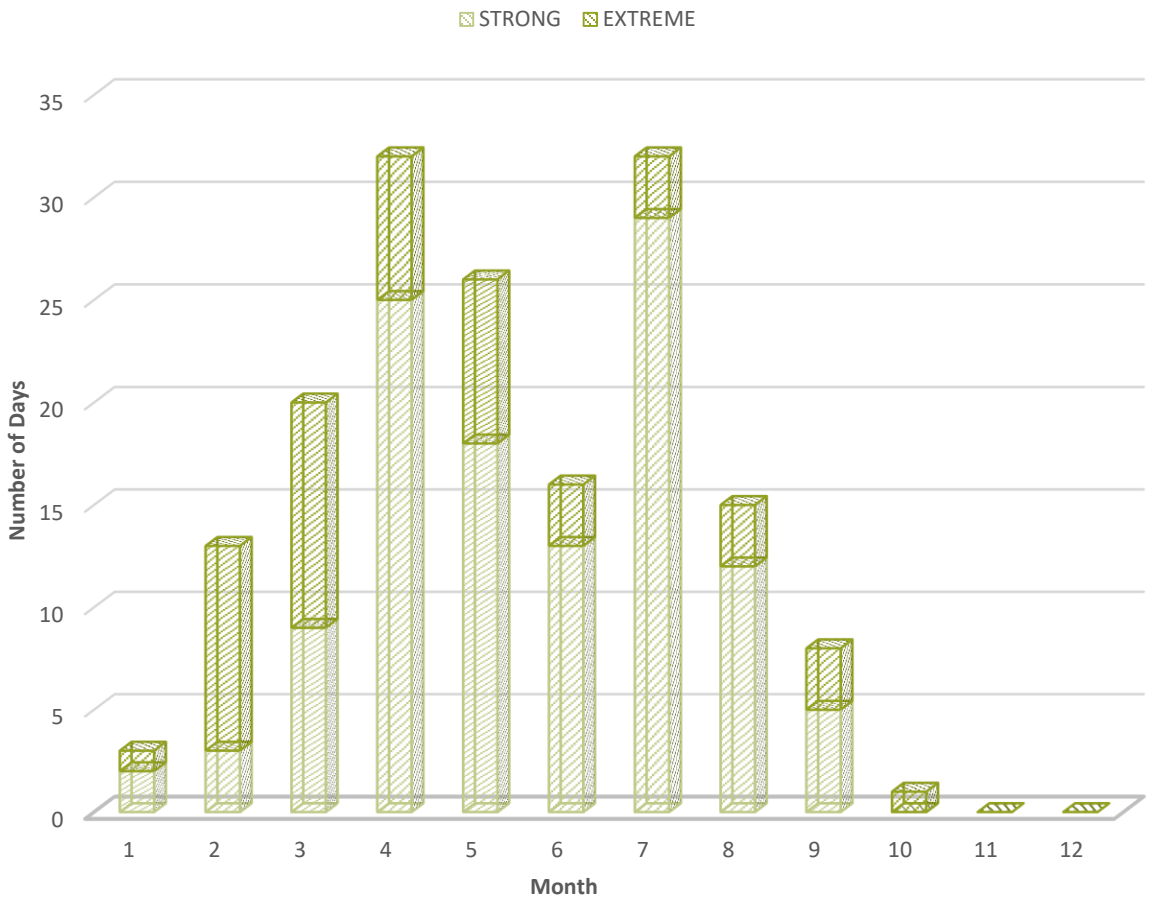
Results

Dust Aerosol Episode Days (DAEDs) | Seasonality

STRONG+EXTREME-EPISODES	*WINTER*	*SPRING*	*SUMMER*	*AUTUMN*
DAEDs	16	78	63	9
%	10	**47**	**38**	5

STRONG-EPISODES	*WINTER*	*SPRING*	*SUMMER*	*AUTUMN*
DAEDs	5	52	54	5
%	4	**45**	**47**	4

EXTREME-EPISODES	WINTER	SPRING	SUMMER	AUTUMN
DAEDs	11	26	9	4
%	22	52	18	8



- **Most DAEDs are observed in spring and summer**
- **This seasonality is valid for strong DAEDs, but not for extreme ones**
- **Most extreme DAEDs take place in spring and winter**

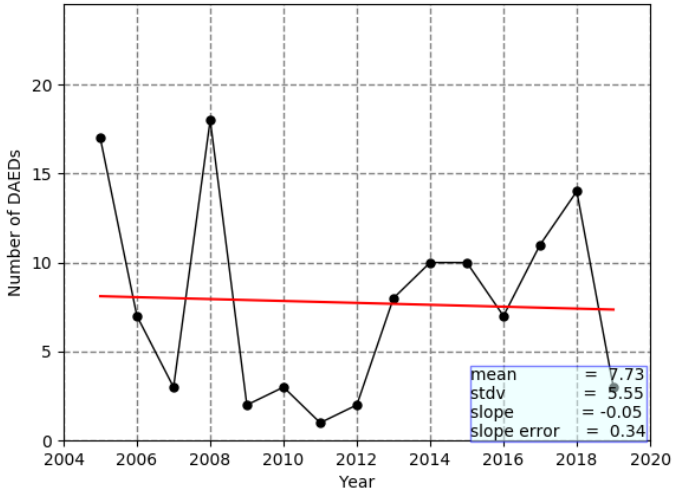
Results

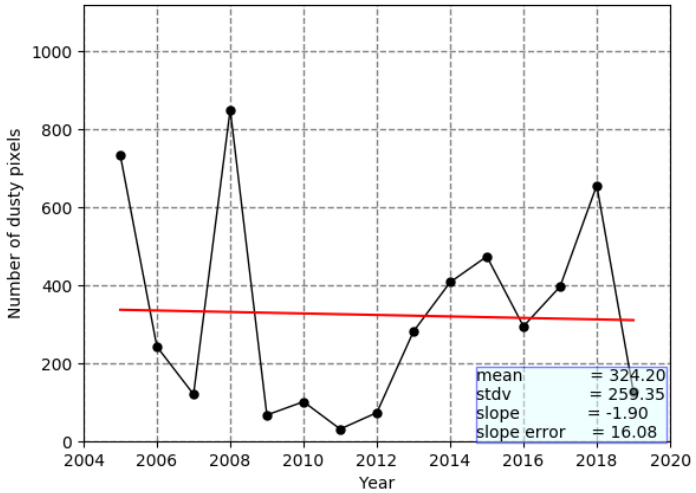
Dust Aerosol Episode Days (DAEDs) | Inter-annual variability and trends

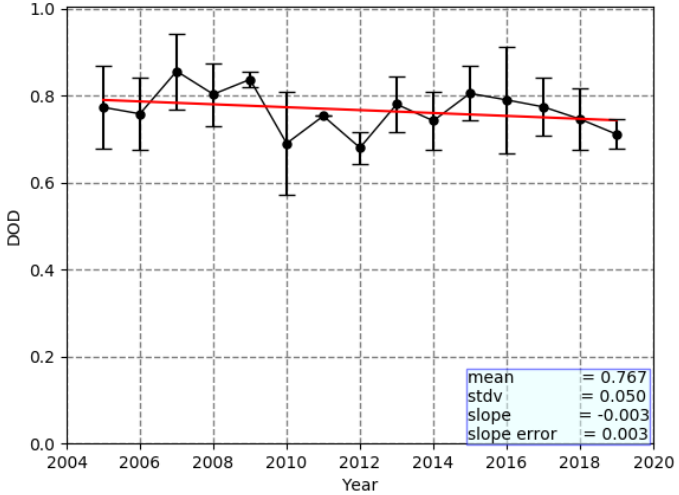
Frequency of DAEDs

Spatial Coverage of DAEDs
(accumulated number of dusty pixels of every year's DAEDs)

Intensity of DAEDs



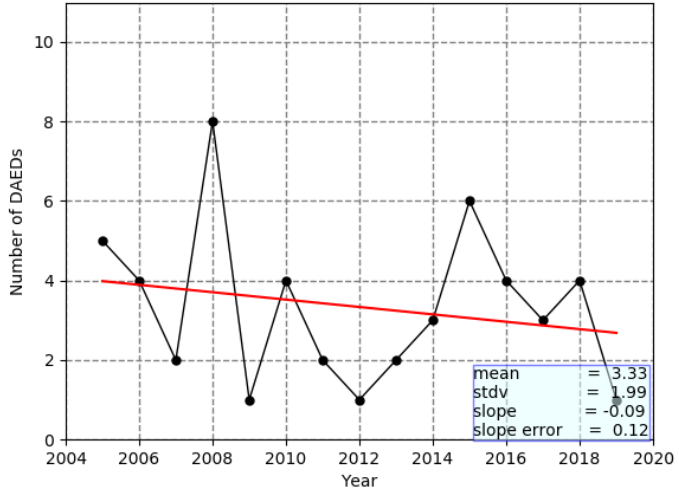


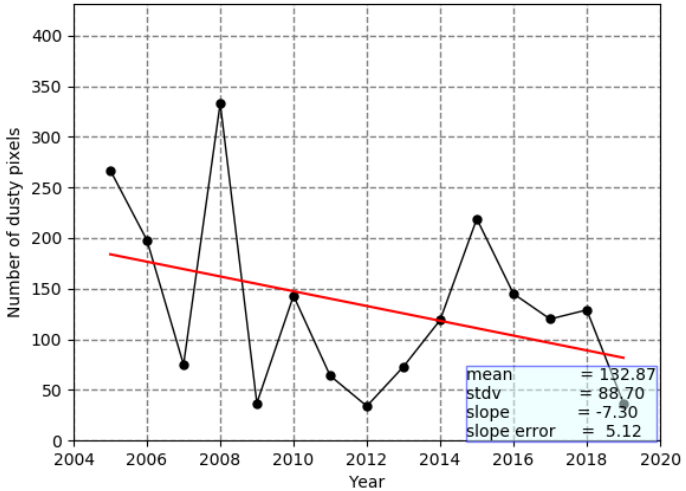


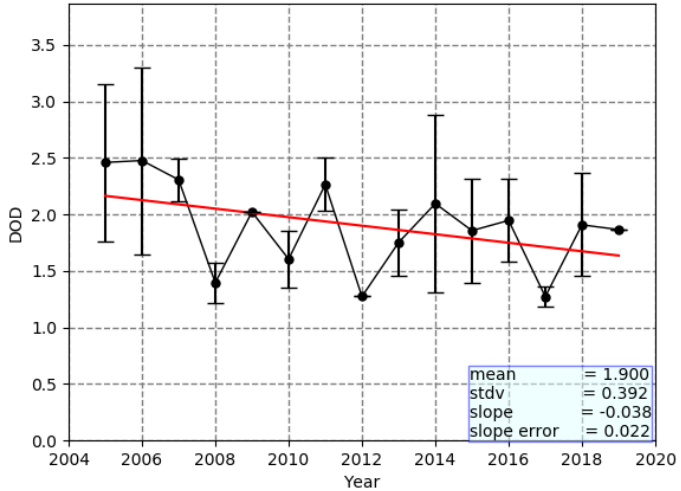
Strong

DAEDs' number, intensity and spatial extent show slightly decreasing trends …

Most of these trends are not statistically significant!







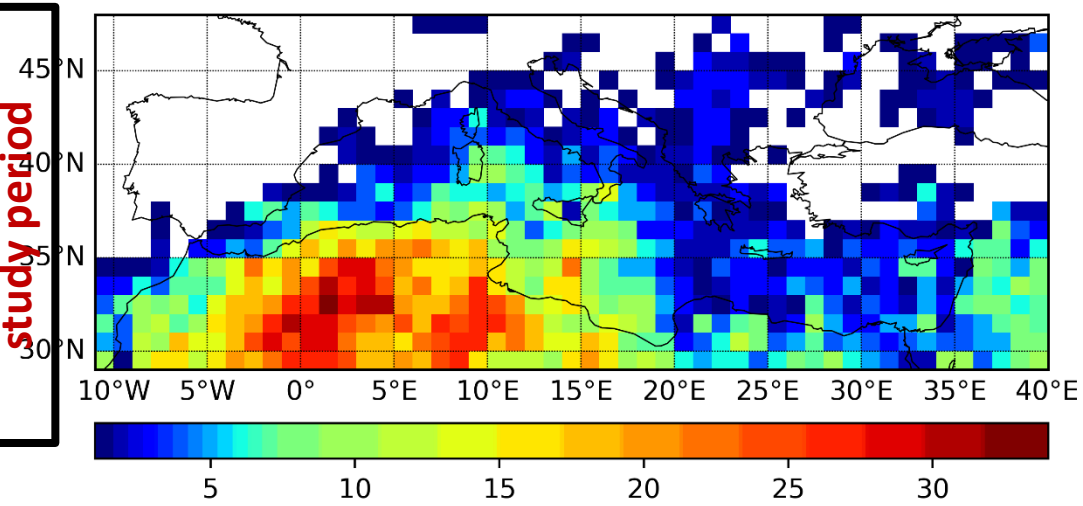
Extreme

Results

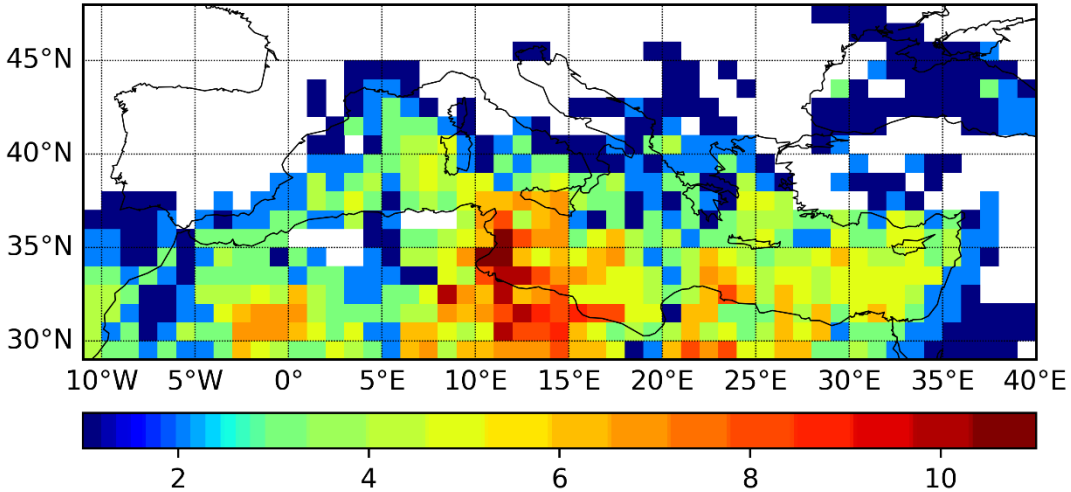
Climatological (2005-2019) mean annual geographical distributions of dust episodes

Total number of dust episodes of DAEDs during the study period

Strong

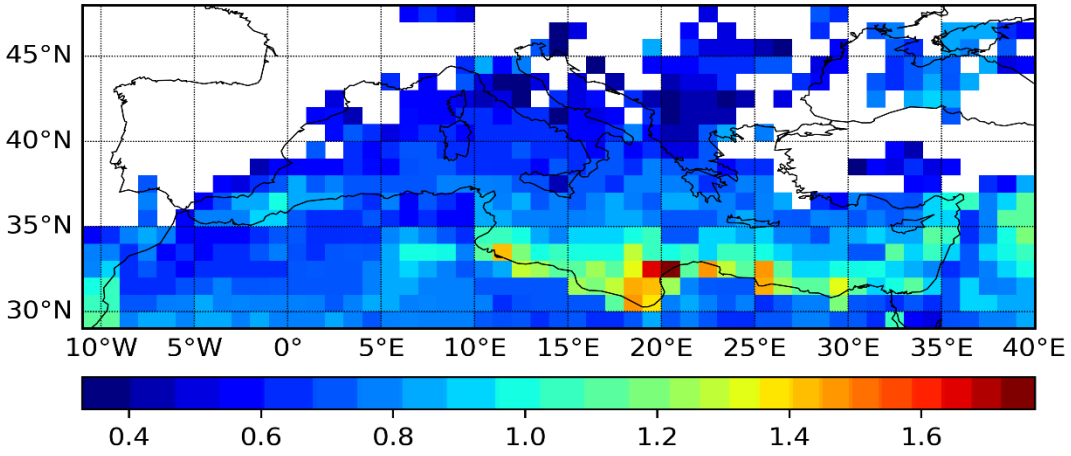


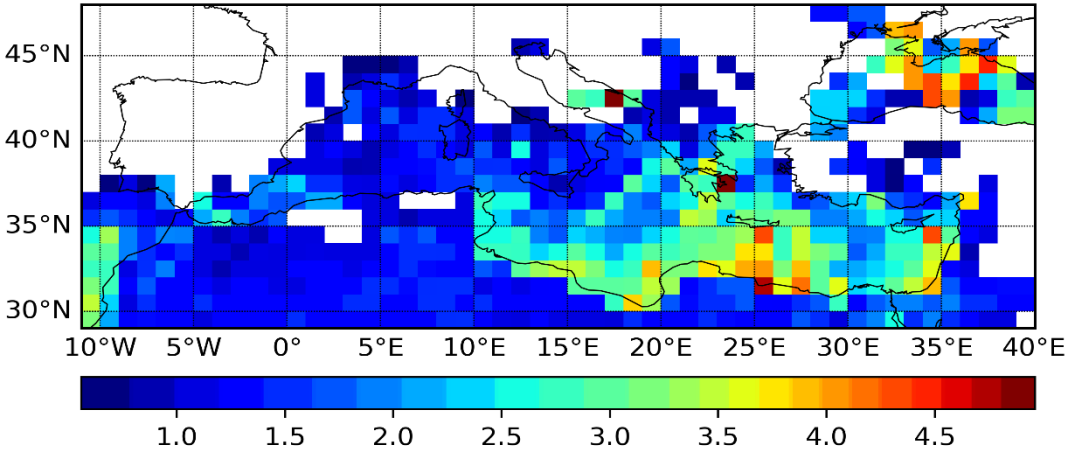
Extreme



Episodes of strong DAEDs are more frequent over the western Mediterranean Basin, while the extreme ones over the central and eastern parts of the basin! The most intense episodes are observed along the coasts of Libya and Egypt

DOD





Conclusions

- According to the satellite-based algorithm results, **166 dust aerosol episode days (DAEDs)** took place in the Mediterranean Basin during the last 15 years (2005-2019)
- From these, **116** are characterized as **strong DAEDs** and **50** as **extreme ones**
- Most ***strong*** DAEDs took place in spring (47%) and summer (38%)
- Most ***extreme*** DAEDs took place in spring (52%) and winter (22%)
- The number of both strong and extreme DAEDs and the number of associated pixels as well as the associated aerosol (dust) loads (DOD) have slightly declined during the last 15 years (not statistically significant change)

Perspectives

- Use of ***vertical profile data*** (e.g. CALIOP, MERRA2) for aerosol optical properties, but also from meteorological parameters (such as temperature)

- Investigation of ***meteorological conditions*** (i.e. pressure and cloud regime, temperature, stability indices) before, during and after DAEDs, using both satellite (MODIS, CALIOP) and reanalysis (MERRA2) data

- Insert of the current study results as input in ***Radiative Transfer Model (RTM)*** to estimate the radiative effect of DAEDs