



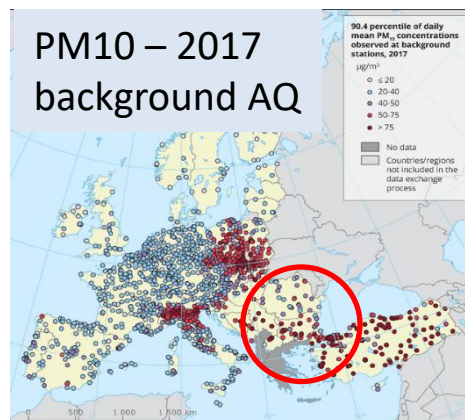
Effects of Saharan Dust Intrusions on Precipitation Chemistry In Bulgaria

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Motivation - 1

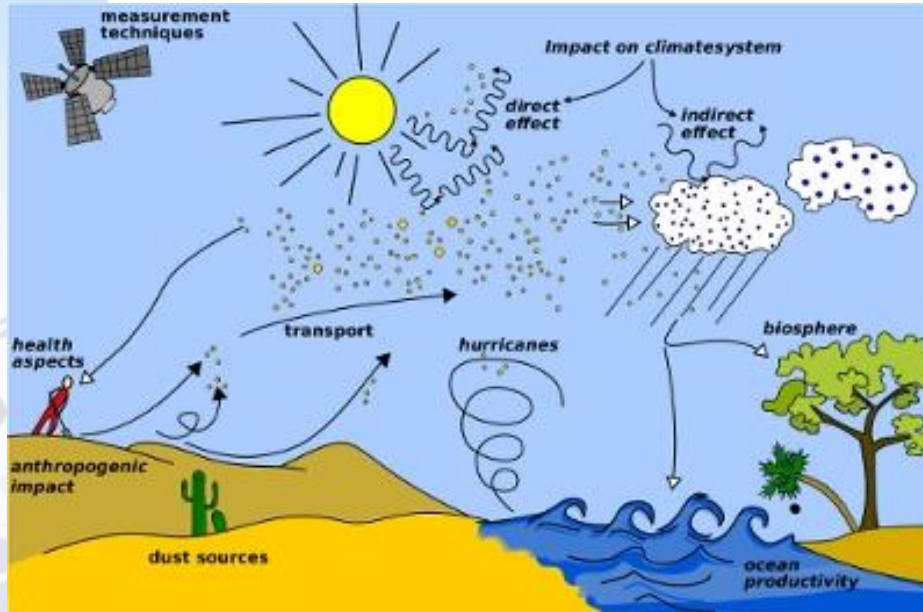
1. **Dust storm** – unique form of **natural hazard** with impact on
 - Human health (respiratory & cardiovascular systems, meningitis)
 - Air quality
 - Aviation
 - Energy and Industry
 - Agriculture
 - Ocean fertilization&algal bloom
 - Weather and Climate



Motivation - 2



Unique form of natural hazard: Saharan Dust travels $10^2 - 10^3$ km from the source region



Dust particles undergo extensive changes during their transport

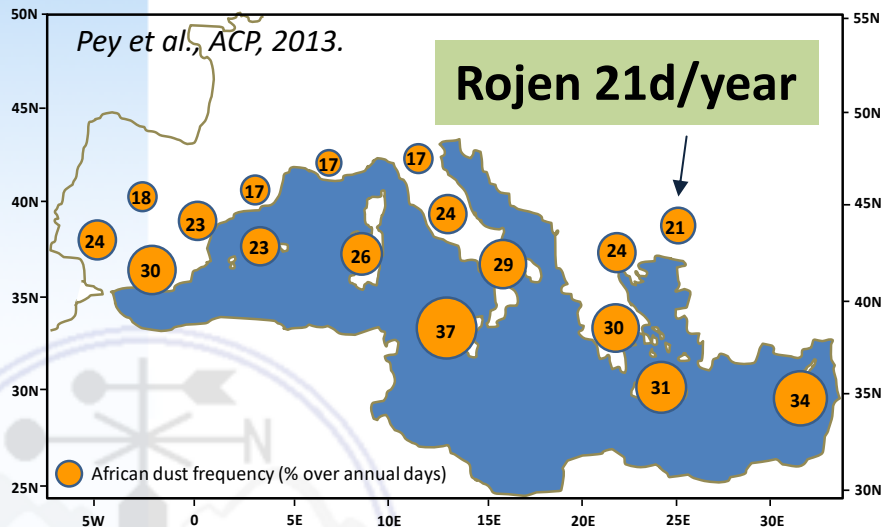
Rain (Wet depositions) – one of the mechanisms for removal of dust particles

1890 Source WMO
<https://community.wmo.int/sds-hurricanes>



Saharan Dust outbreaks in BG

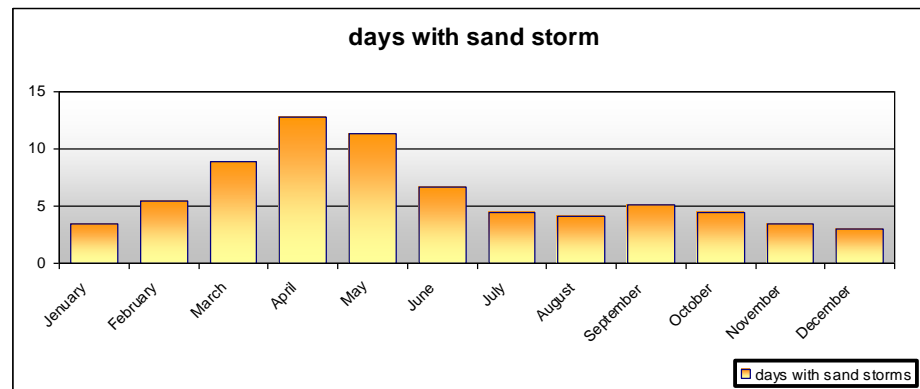
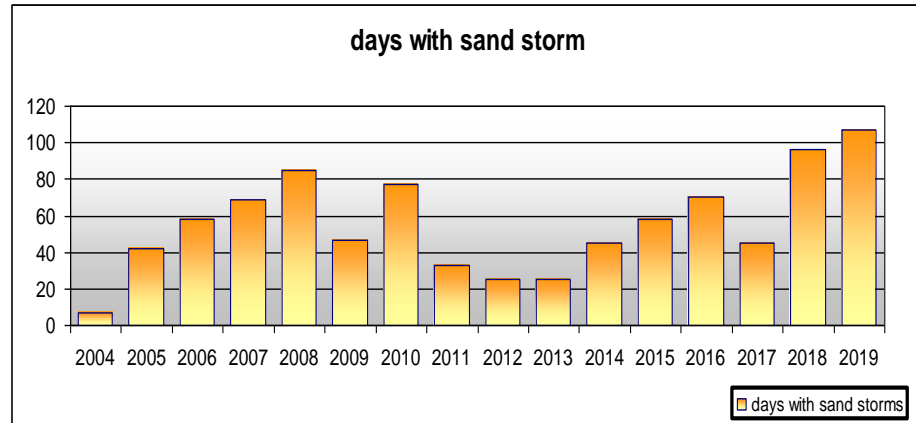
1. African Dust frequency (%) (2001-2011) at Background AQ stations



**27 % of the days in 2019
With max in Spring**

2. Days with sand storms in BG based on satellite data (2004-2019)

Maria Dimitrova, SRTI-BAS, 2020





Goals & Methodology

Analyse the influence of Saharan Dust on the chemical composition of rain samples collected in Bulgaria in the period 2017-2018

How to achieve the goal :

synergetic use of various observations & models

- rain samples & chem. analysis
- satellite data for AOD
- modelling results (Dust and AQ) over Europe & NA



Precipitation samples - 3 sites



Sofia - urban
Cherni Vruh
2286 m a.s.l



Ahtopol –
rural



Sampling: daily, campaigns 2017-2018

Chem.analysis: pH, conductivity-EC, main ions Cl^- , SO_4^{2-} , NO_3^- , NH_4^+ and elements Na, K, Mg, Ca, Fe, Si, Zn, Cu



Identification of Saharan Dust outbreaks

Operational Models:

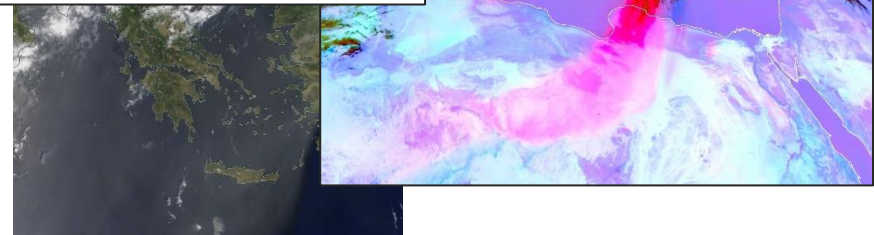
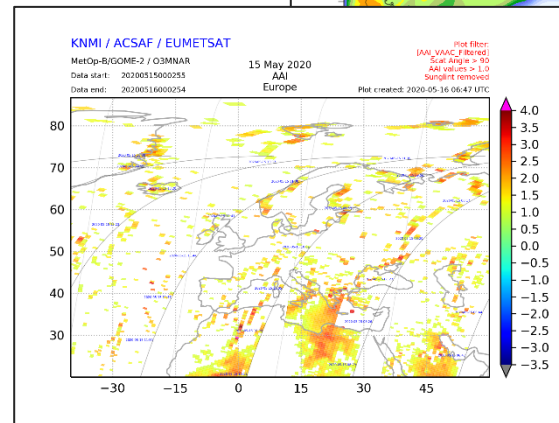
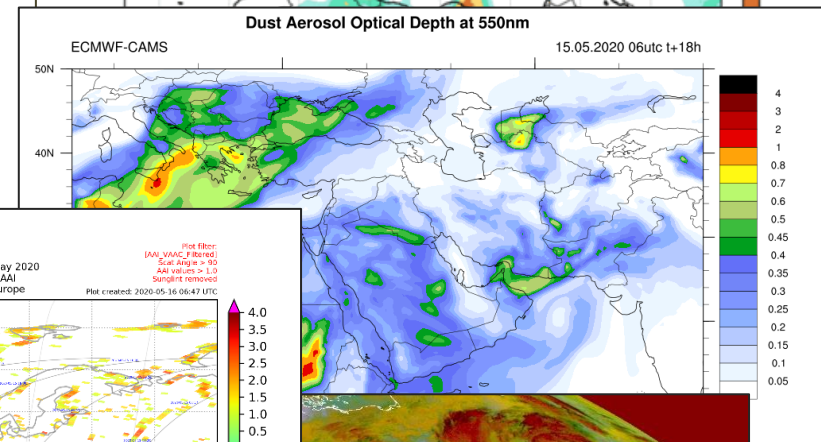
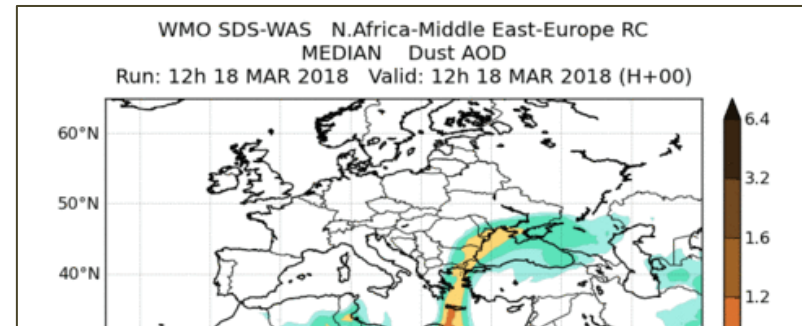
- WMO – SDS-WAS NAMEEU (ENS)
- Copernicus: CAMS-ENS
- Copernicus: CAMS-ECMWF
- BSC- DREAM
- USA NRL

Back-trajectory model

- HYSPLIT

Satellite data

- ❖ MODIS Terra&Aqua, and EUMETSAT



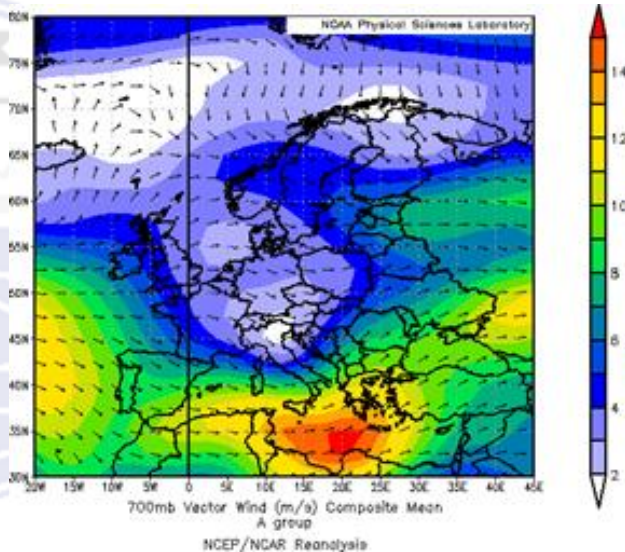
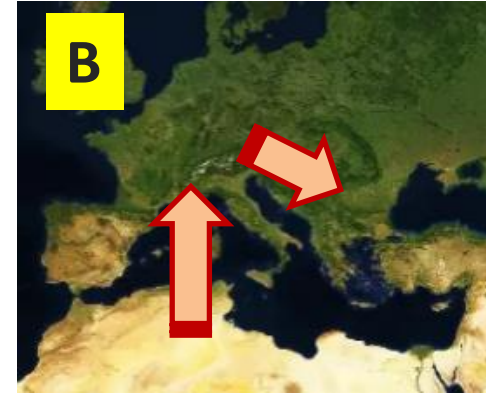
26 daily samples were selected



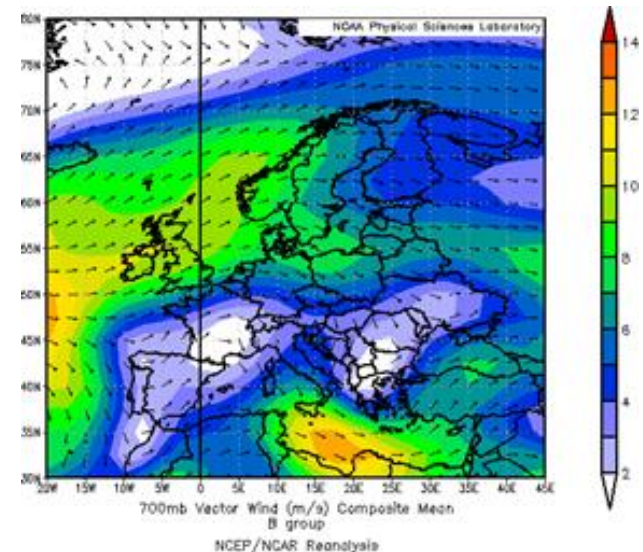
A, B groups of samples

Direct influence (N.16)

Indirect Influence (N.10)



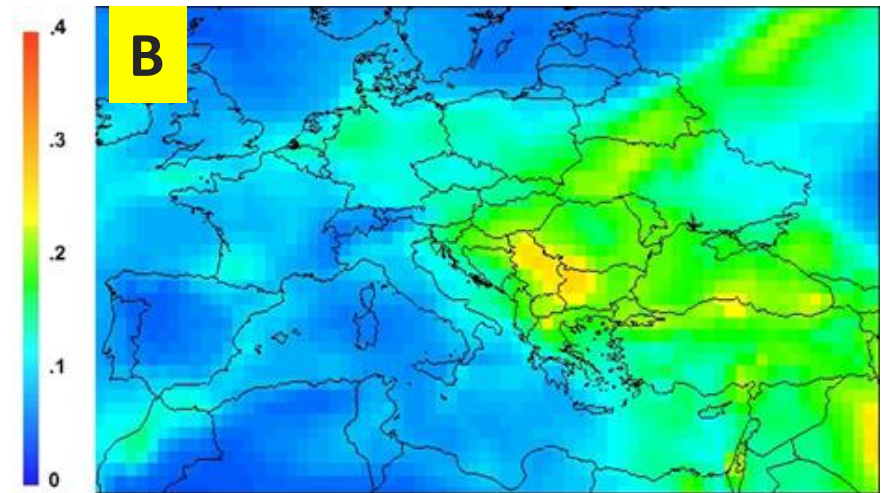
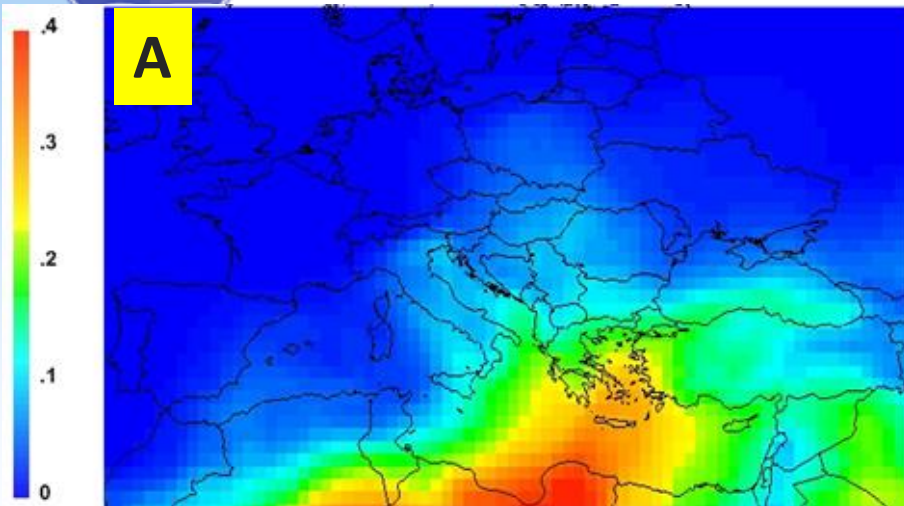
**NCEP/
NCAR
re-
analys
is**



Composite maps of 700 mb WIND (m/s)



AOD – composite maps

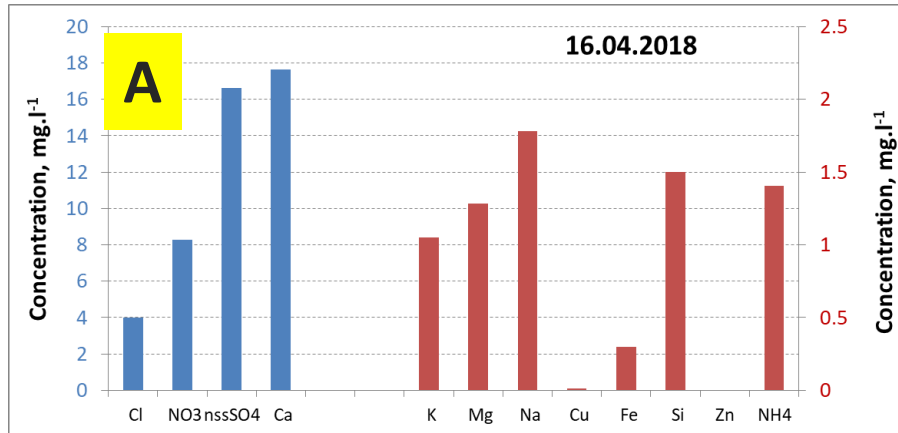


CAMS-ECMWF – model
Composite maps for AOD for the
days in groups A, B

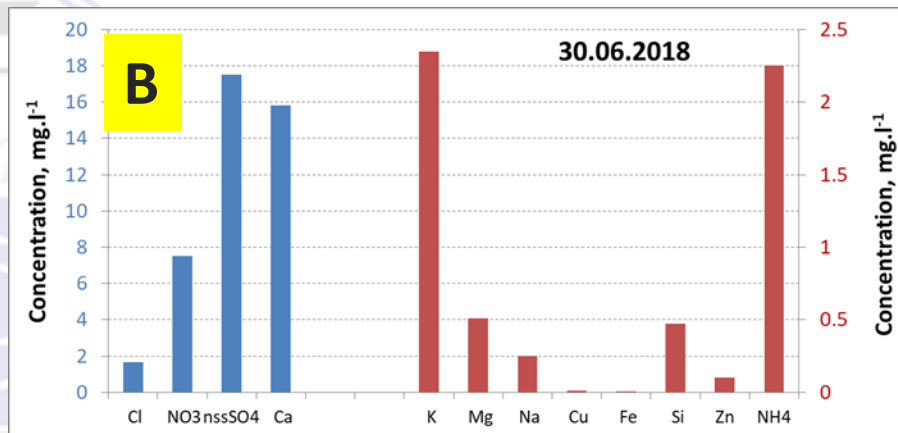




Chemical composition – example A,B



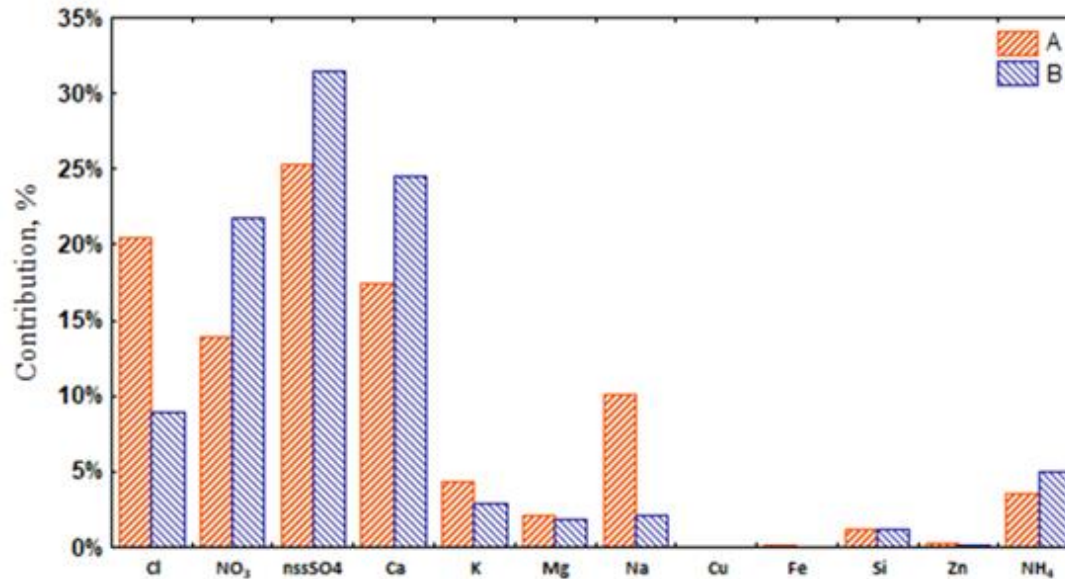
Cl, K, Mg, Na, Ca, Si:
higher in A samples
(direct influence)





Chemical composition – avg A,B

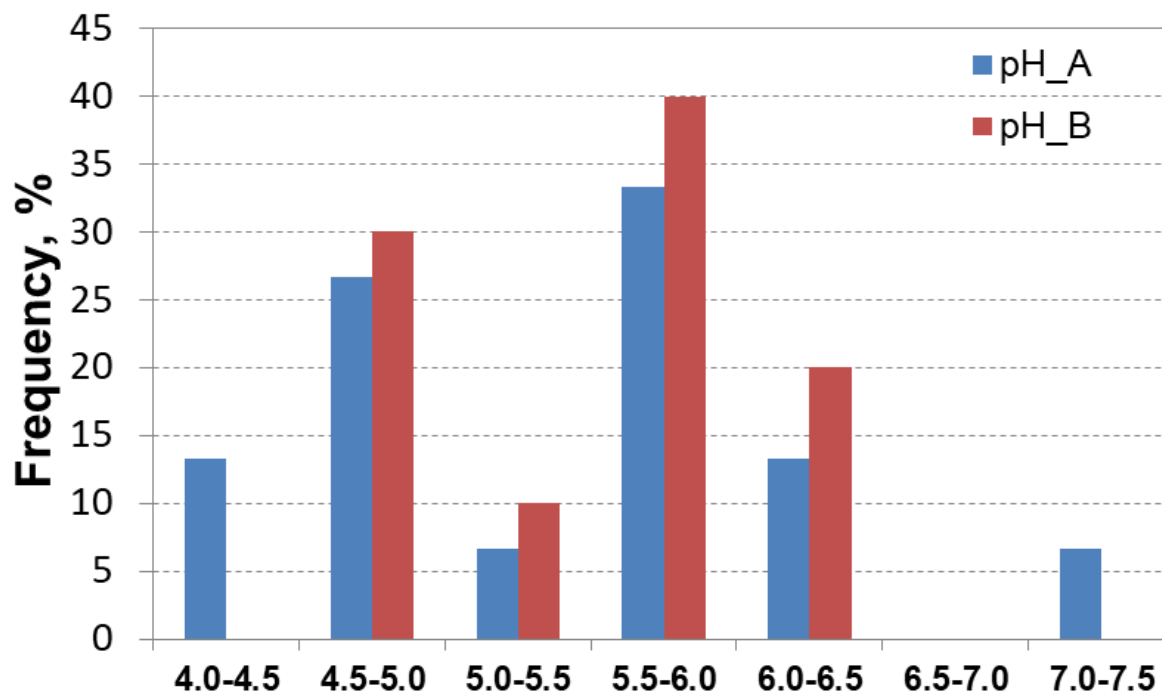
Contribution of different elements to total ionic concentrations (TIC)



NO₃⁻,
Non sea salt SO₄²⁻
Ca⁺
higher in B samples
(indirect influence)

- The total ionic concentration in both A and B samples consist mainly of nssSO₄²⁻, NO₃⁻ NH₄⁺ (A - 44% and B - 58%).
- For A the air masses passing over the Mediterranean Sea are enriched with sea salt aerosol (↑Cl, Na)
- The higher contribution of sulphates, nitrates and ammonium ions in B samples can be explained by the enrichment of air masses with substances of anthropogenic origin

pH -??



The pH values ranged from 4.1 to 7.4.

A:

40% - acidity range (pH < 5.0),
6.7% - slightly acidic range (5.0 – 5.5)
6.7% - alkaline range (> 7.0)
33% - neutral range

B:

30% - acidity range (4.5-5.0),
10% - slightly acidic range,
20% - slightly alkaline range.
40% - neutral range



Key messages – Eli pomisli

- **pH .. Values in the alkaline range ??**
- **prevailing:** nssSO_4^{2-} , NO_3^- , NH_4^+
- The precipitation associated with dust intrusions is characterized by higher concentrations of terrigenous elements (Ca, Si, K)
- In both types of intrusions the correlation between nssSO_4^{2-} and Ca is relatively high, indicating similar source of origin.
- **the chemical composition depends on the type of Saharan intrusions (direct, or indirect). For indirect - ????**
- The concentrations of Si and Ca were significantly higher (up to 1.5 and 25 mg.l^{-1}) for A samples.
- In B samples higher concentrations of sulphates, nitrates and ammonium ions suggest enrichment of air masses with anthropogenic pollutants.
- **More data /cases are needed for firm conclusions**



Acknowledgments

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БЛАГОДАРЯ за ВНИМАНИЕТО!

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