Desert Division
Research Institute Forests and Ranglands Iran

NaDiMa Dialogue #3

Sand and Dust Storms (SDS) in Iran
Challenges and Manangment

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Webinar:
NaDiMa Dialogue #3, Droughts, Sand & Dust Storms: Challenges and Management, September 23, 2020

Philipps Universität Marburg

Outline

Introduction

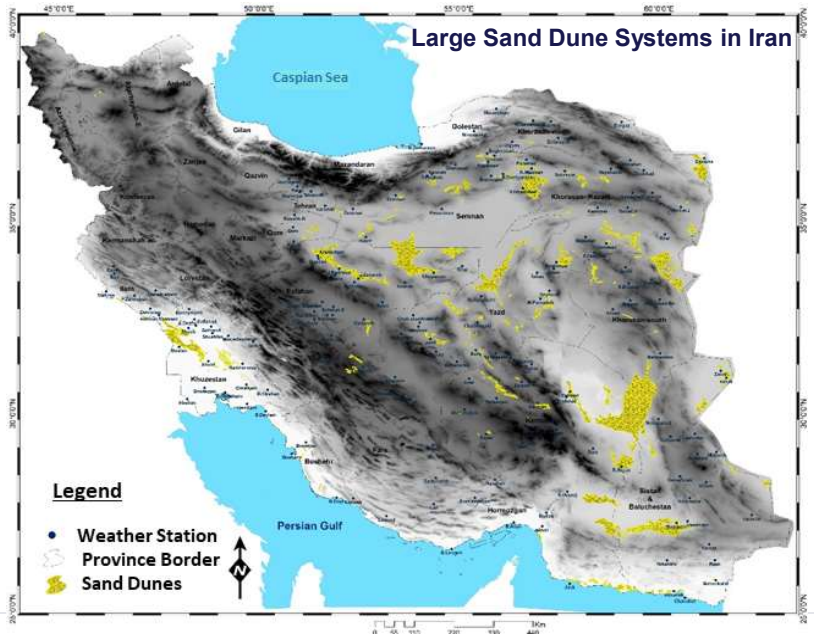
Iran specifications

- **Topography**
  - Caspian Sea
  - Alborz Mountains
  - Iranian Deserts
  - Zagros Mountains
  - Persian Gulf, Oman Sea
- **Deserts**
  - 55% of Iran desert area (Khosroshahi 2006)
  - Dasht-e-Kavir Desert (77,600 km^2)
  - Lut Desert (51,800 km^2)
- **Climate**
  - Annual average rainfall: 228mm
  - Average temperature: 17 °C (WDA 2017)

Source: https://en.wikipedia.org/wiki/Dasht-e_Kavir#/

Wind erosion in Iran

- **Desertification**
  - 89% under desertification (Darvish 2003)
- **Wind erosion**
  - 35 million hectares (FAO 1994)
- **Sand dunes**
  - Dewan & Famouri (1964), Bhimaya (1971), Ehlers (1980), Mahmoodi (1992), 4.8 million hectares (RIFR 2012)
- **Cost of damages**
  - 193 million Euros, annually (Rajaei 2014)



Source: Research Institute Forests and Ranglands Iran (2012)

Problem Statement

- **Wind erosion:**
  Produces soil loss
  Reduces soil productivity
  Decreases agricultural production
  Deteriorates soil quality

- **Dust storms:**
  Reduce visibility
  Affect human health
  Pollute the air
  Affect jets

- **Shifting sand dunes:**
  Fill in canals and road ditches
  Cover the railroads and roads
  Cause house damages


Abbasi, Zabol (2013)


Mehrnews, Zabol (2016)


Asrehhamoon, Sistan (2016)


Mehrnews, Ilam (2018)


Abbasi, Bam (2015)


Asrehhamoon, Zahak (2016)


ISNA, Ahwaz (2016)

Problem Statement


Goli , Sistan 2016


Goli , Sistan 2016

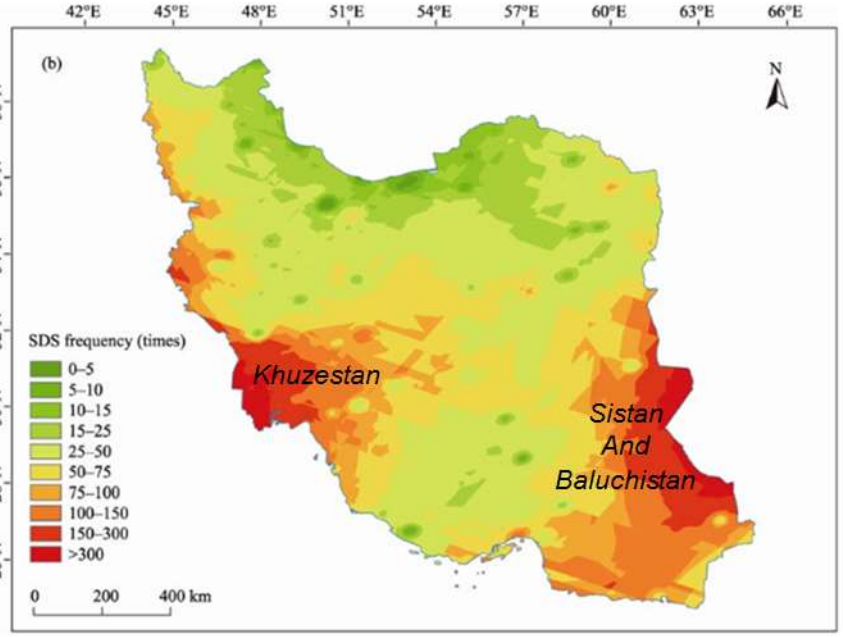

Abbasi , Sistan 2013


Abbasi , Sistan 2013


Abbasi , Sistan 2013

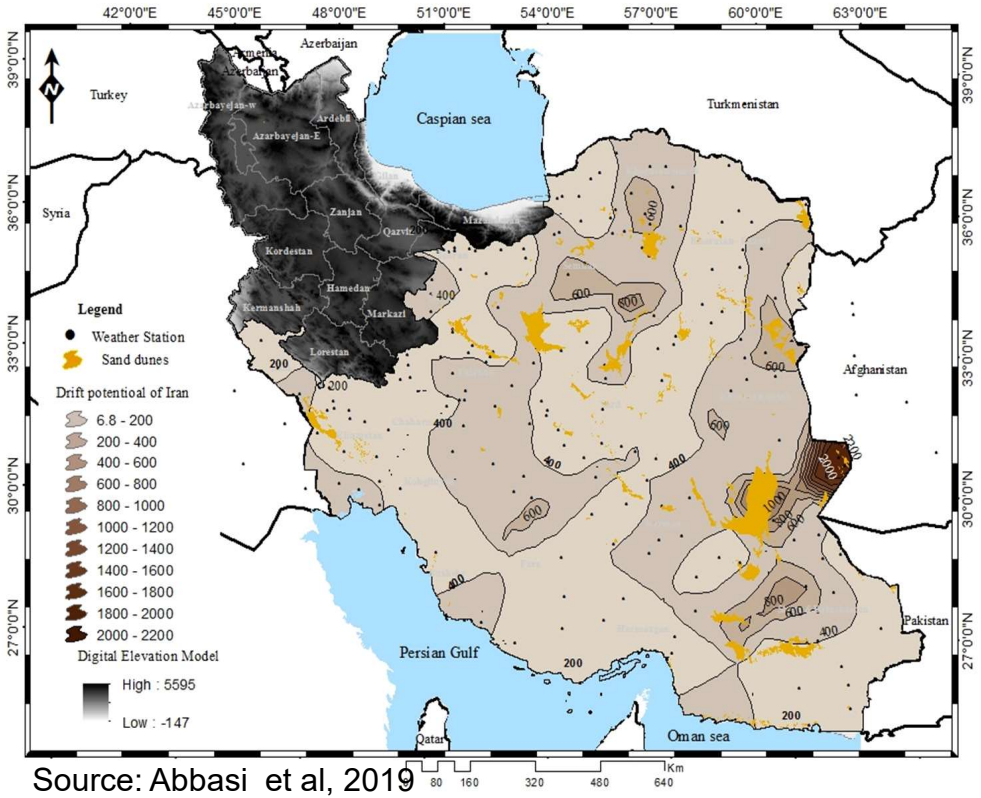

Abbasi , Sistan 2013

Sand and Dust Storms frequency 2000-2013



Source: CAO et al, 2015

Spatial wind energy variation in Iran deserts 2000-2013



Source: Abbasi et al, 2019

The classification of wind energy environments based on drift potential and directional variability

DP (vector units)	Wind energy environment	RDP/DP	Directional variability	Directional category (probability distribution)
<200	Low	<0.3	High	Complex or obtuse bimodal
200-400	Intermediate	0.3-0.8	Intermediate	Obtuse or acute bimodal
>400	High	>0.8	Low	Acute unimodal

Source: Fryberger and Dean (1979), p.148.

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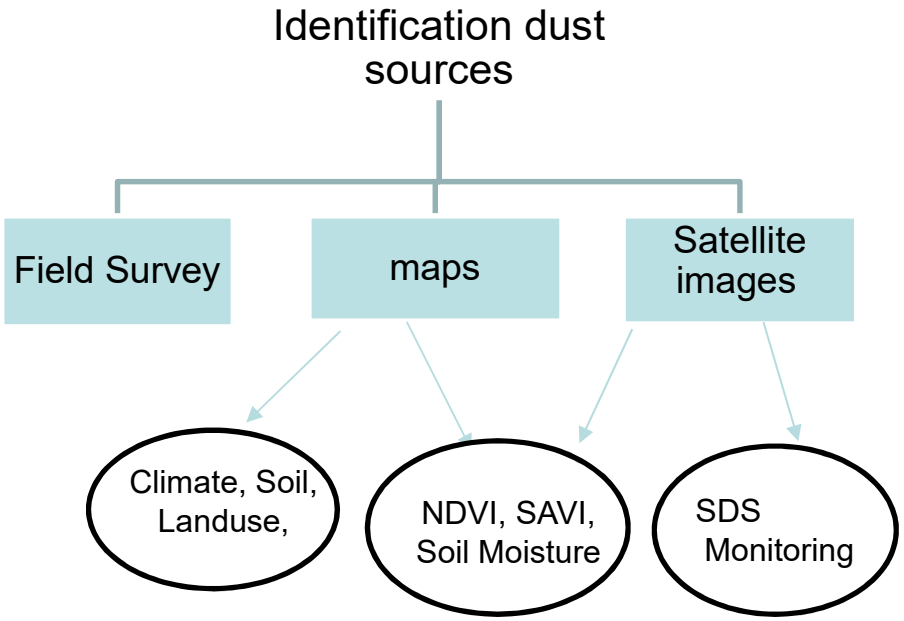
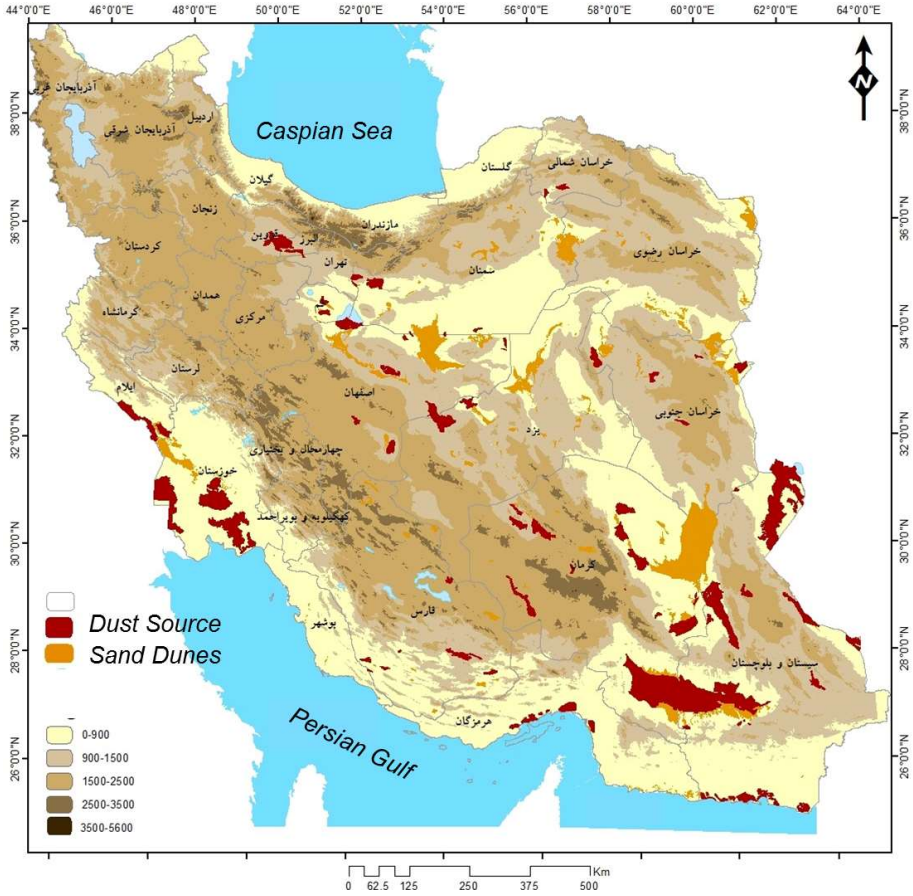
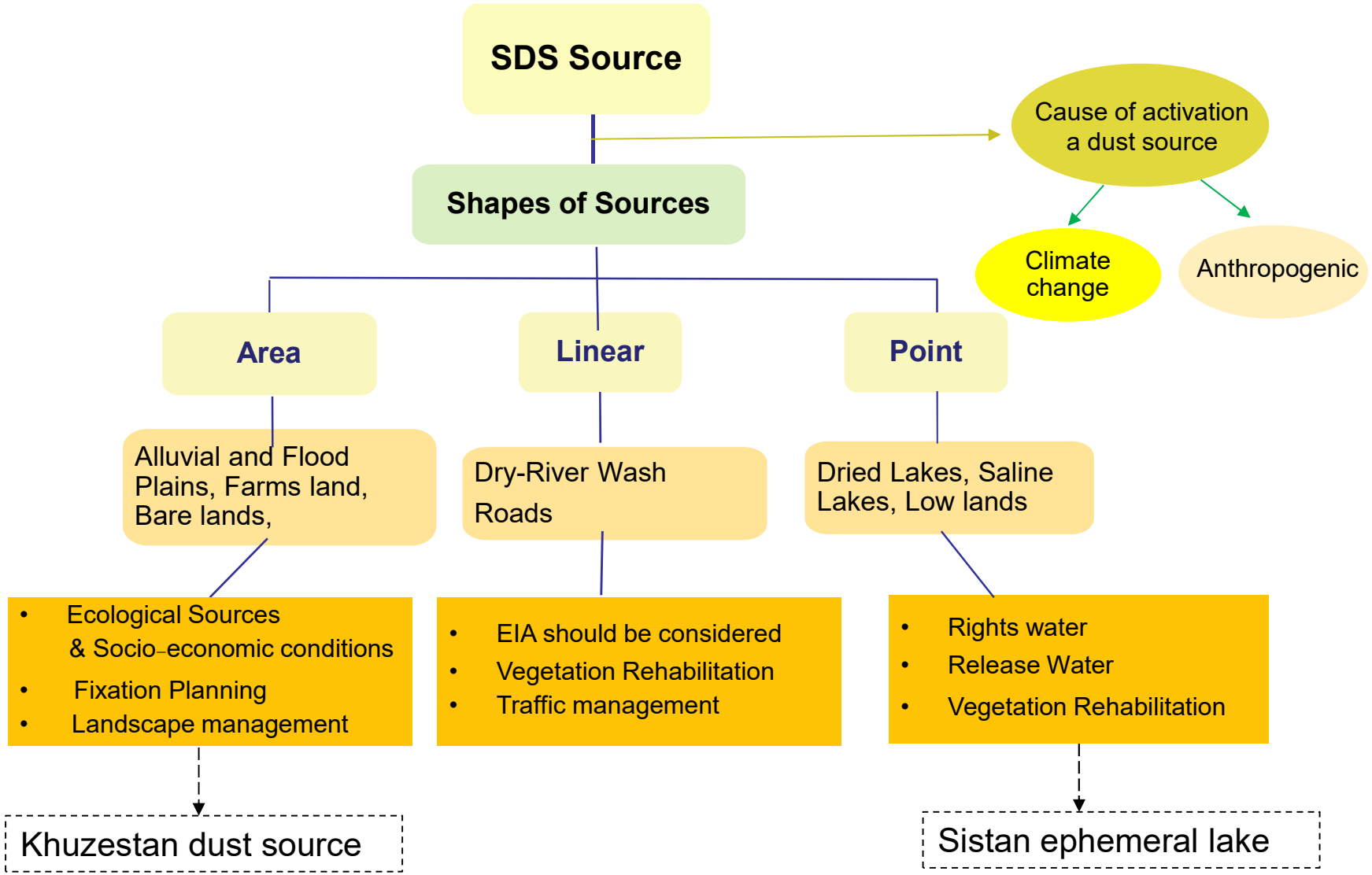
Identification of SDS Sources (scale 1: 25000 – 1:50000)

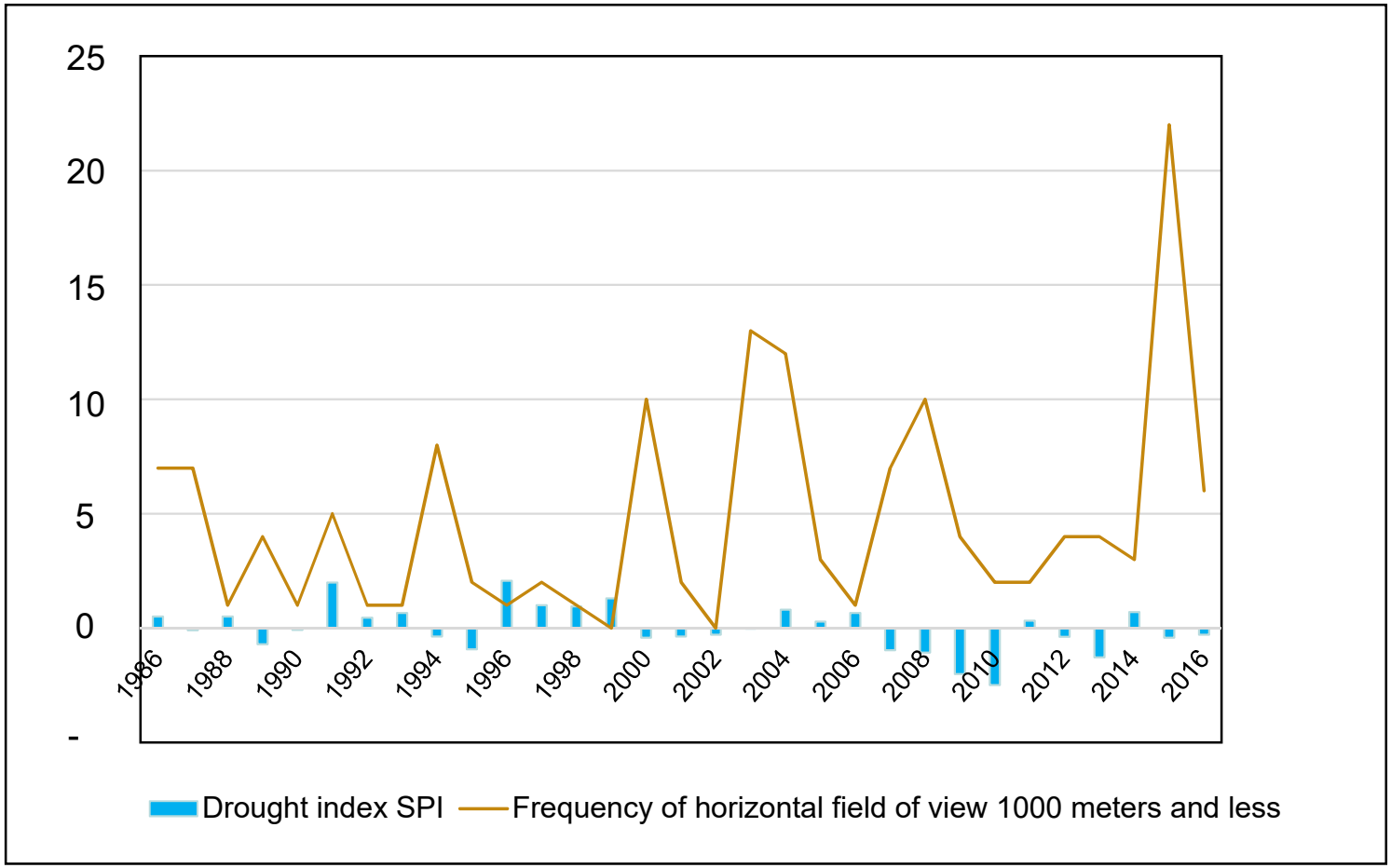




National Plan of Sand and Dust Sources control in Iran



Drought (SPI index) and Dusty Days in Khuzestan Plain

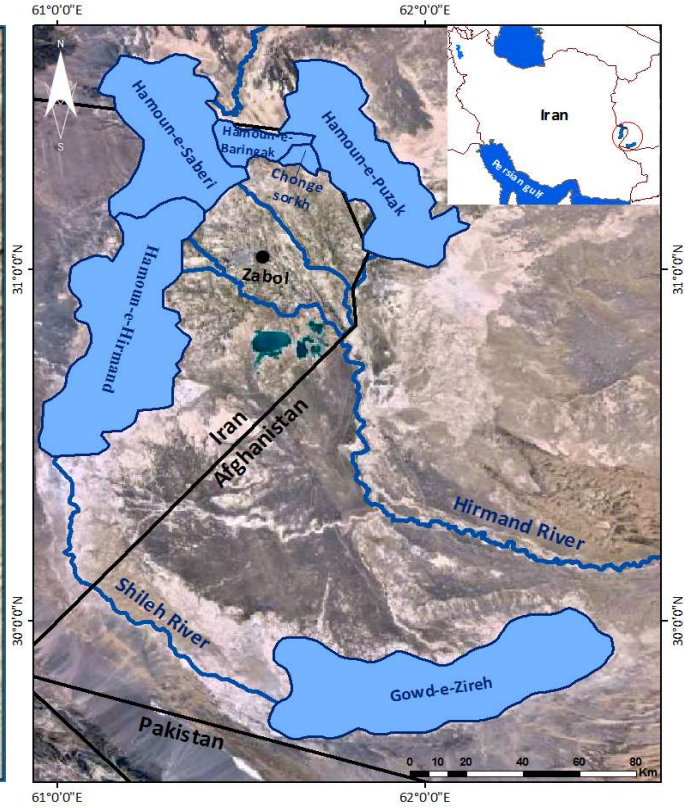


Source: Dargahian et al, 2018

SPI: It quantifies observed precipitation as a standardized departure from a selected probability distribution function that models the raw precipitation data.
When it is negative, drought has occurred

Hirmand Basin and Complex Hamoun Lakes in Sistan

Source: Wikipedia

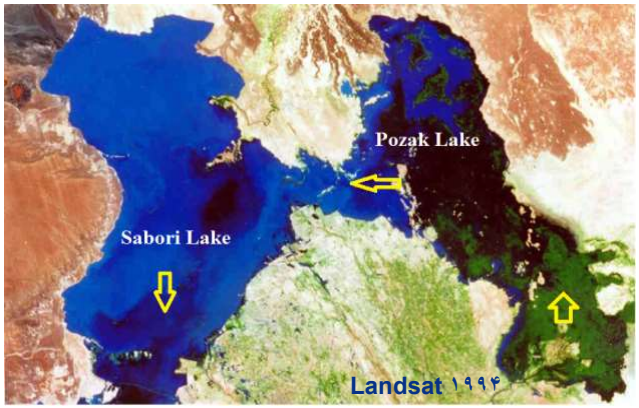


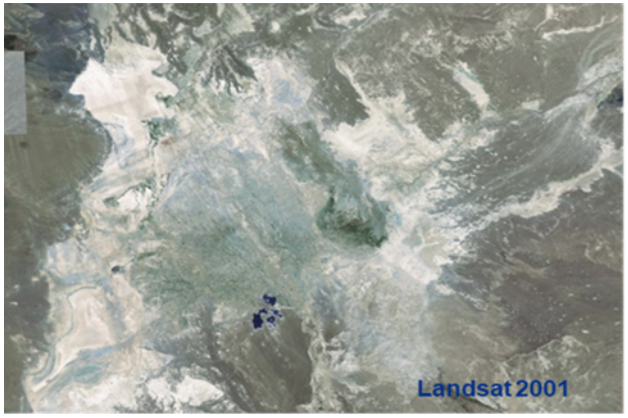
Source: Abbasi et al. (2018) in ZfG.

Area, average depth and location of the six Sistan Lakes (UNEP 2006)

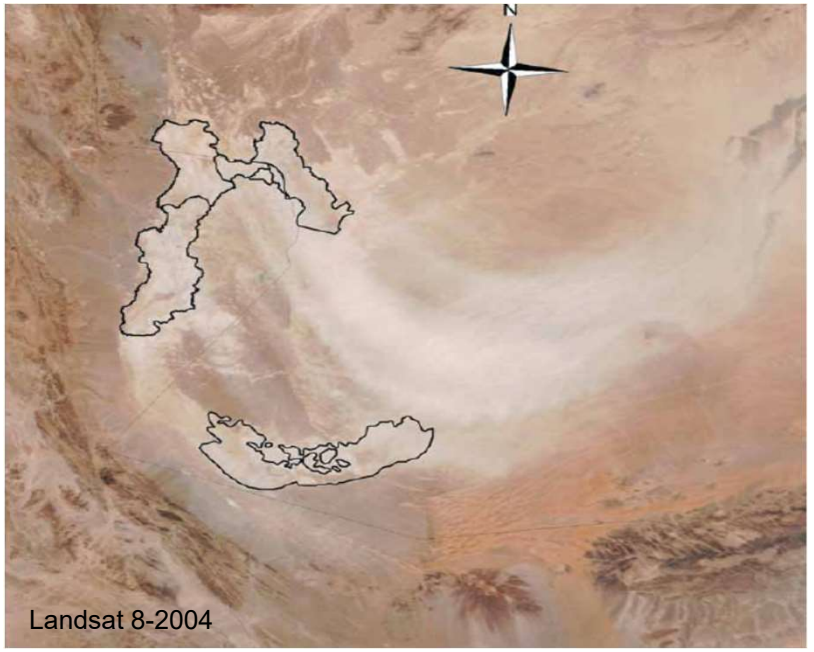
Sistan Hamouns Lakes	Average depth (m)	Area (km²)	Area in Iran (%)	Area in Afghanistan (%)
Baringak	1	221.6	100	-
Chonge Sorkh	1	59.8	100	-
Hamoun-e Hirmand	2	2388.8	100	-
Hamoun-e Puzzak	2-3	1514.4	5.2	94.8
Hamoun-e Sabari	3	1161.5	41	59
Gowd-e Zareh	10	2417.5	-	100

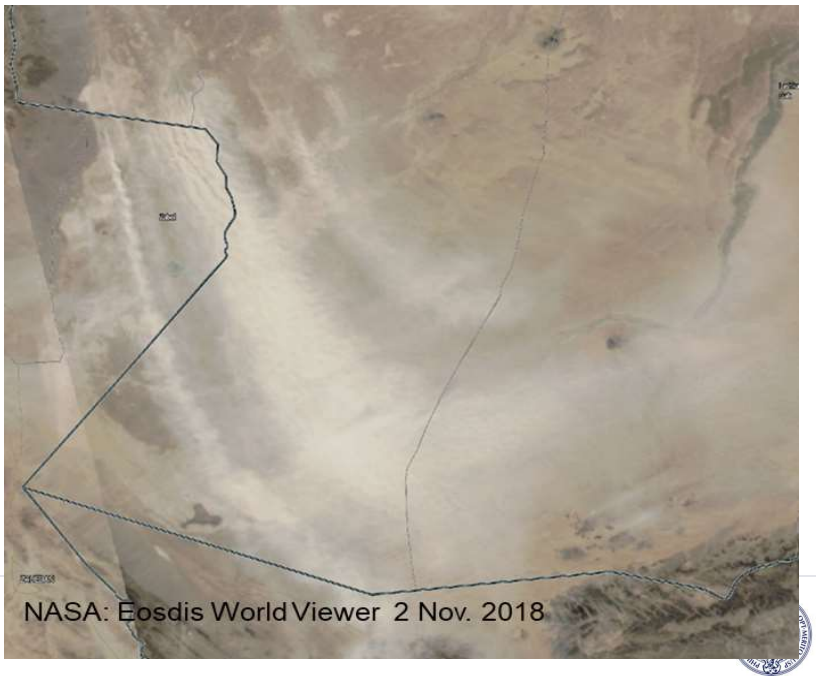
Sistan Lakes Under Wet and Dry Conditions

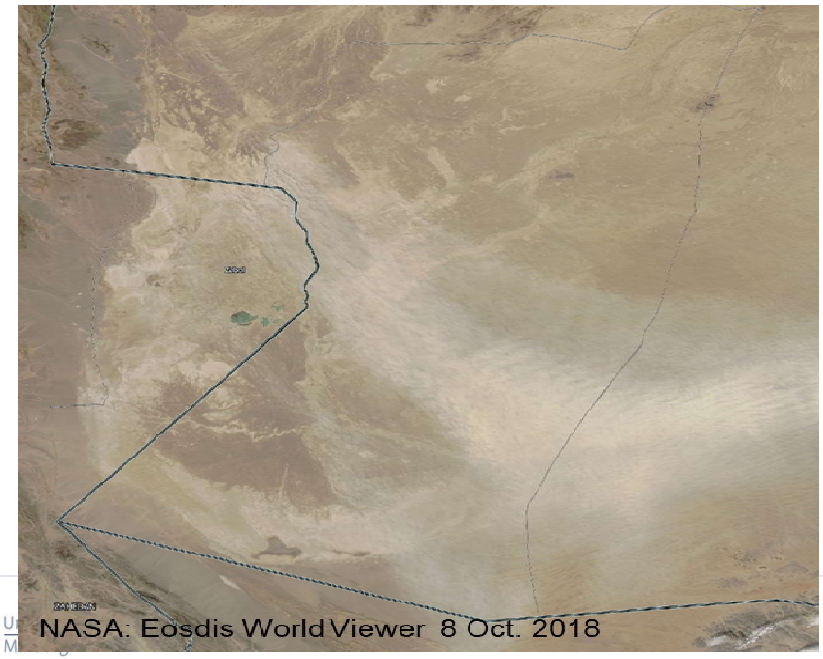




SDS Sources in Sistan



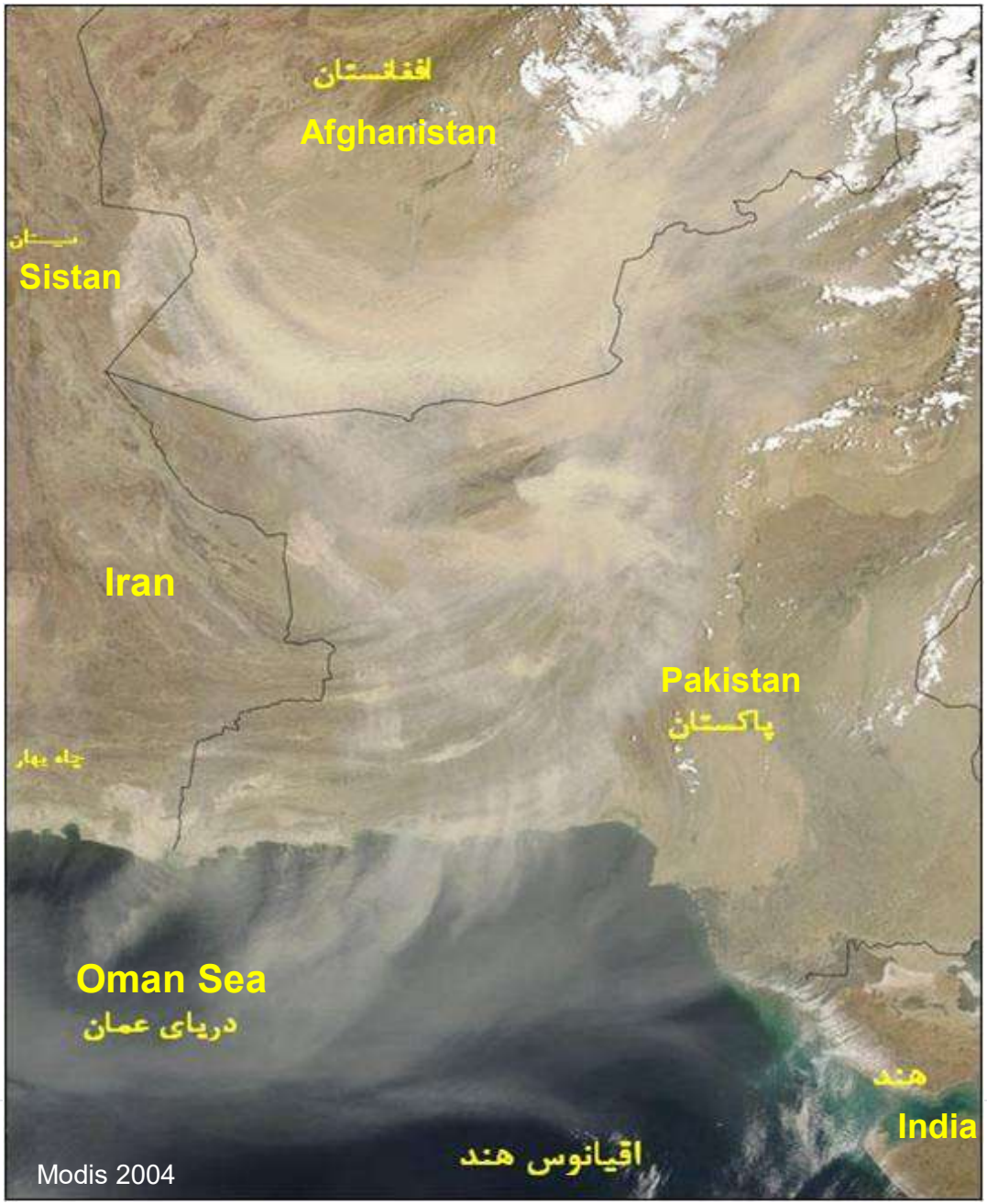




Sistan Lakes Under Dry Conditions

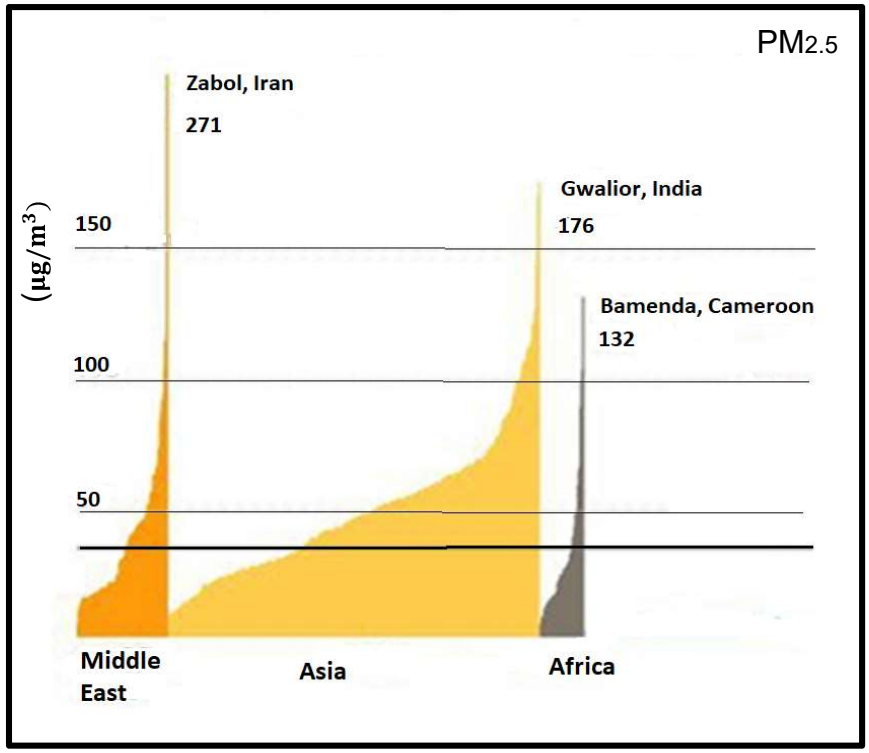
Abbasi 2016

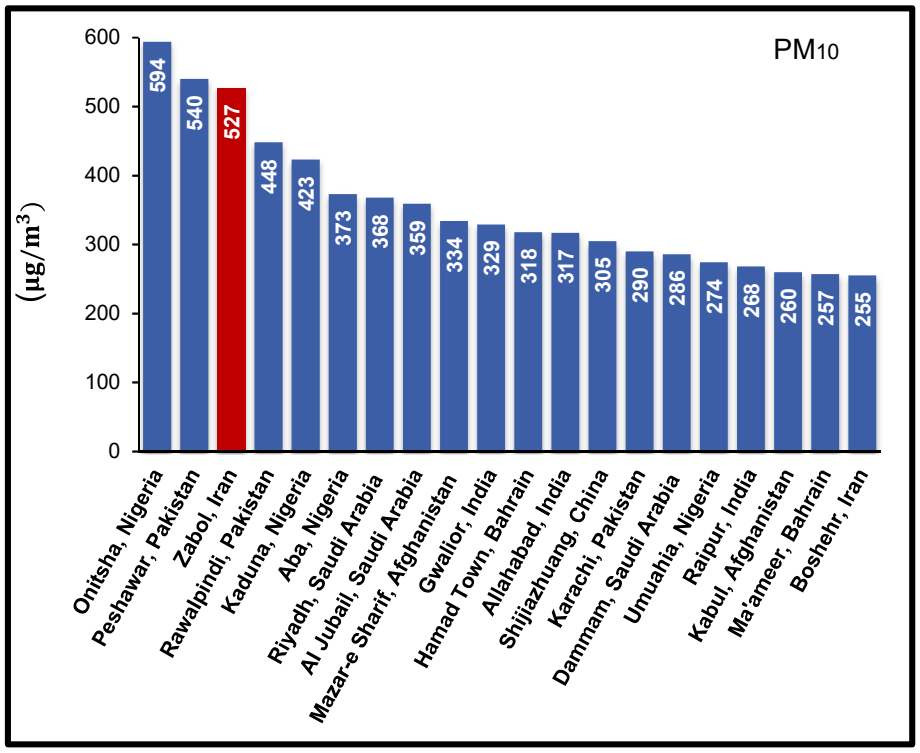
Sand and Dust Storms (SDS) in Sistan



Problem Statement

- The annual average of days with dust events, 174 days in Zabol and 84 days in Ahwaz (2000-2016)
- Zabol as the most polluted city in the world

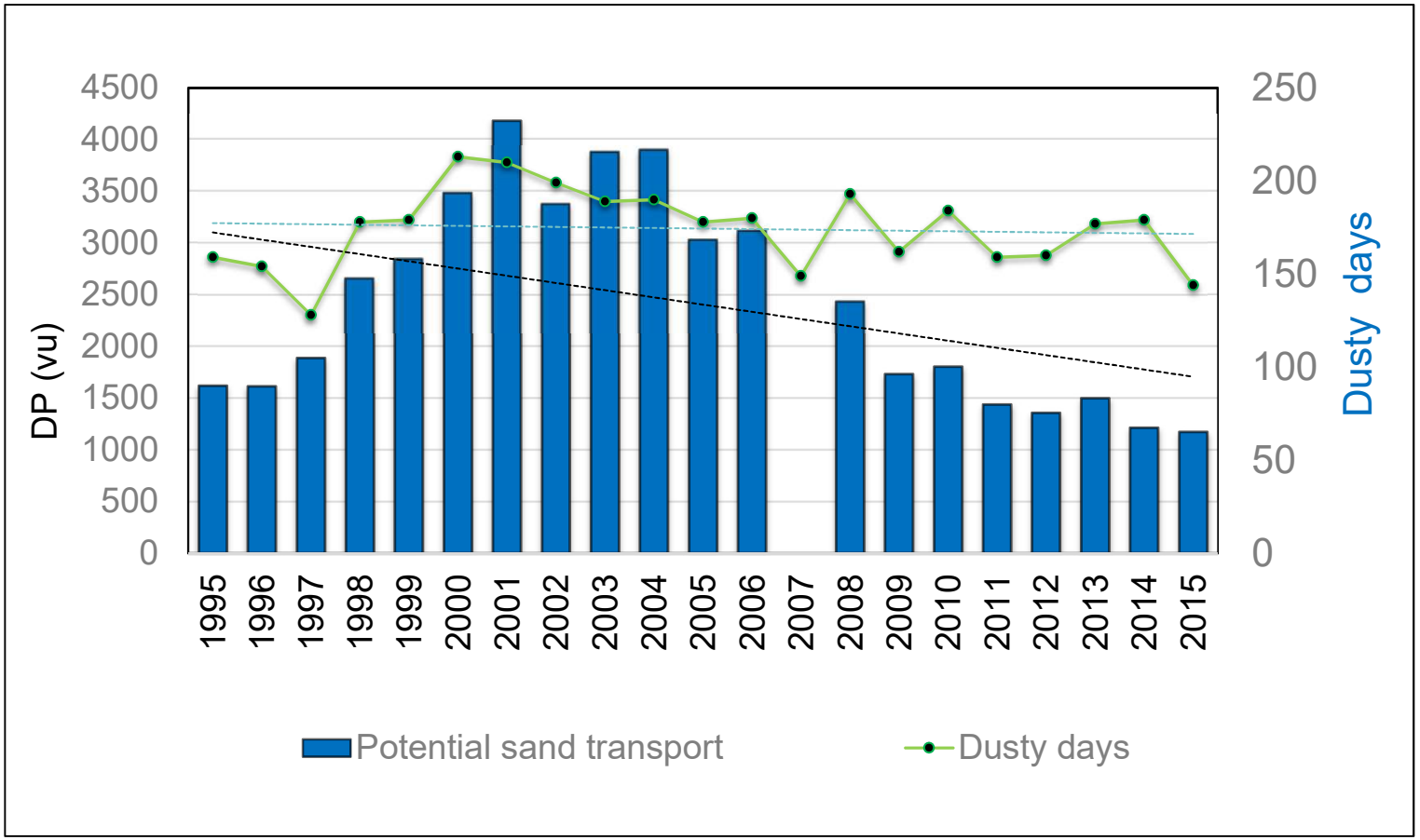




Source: WHO (2016)

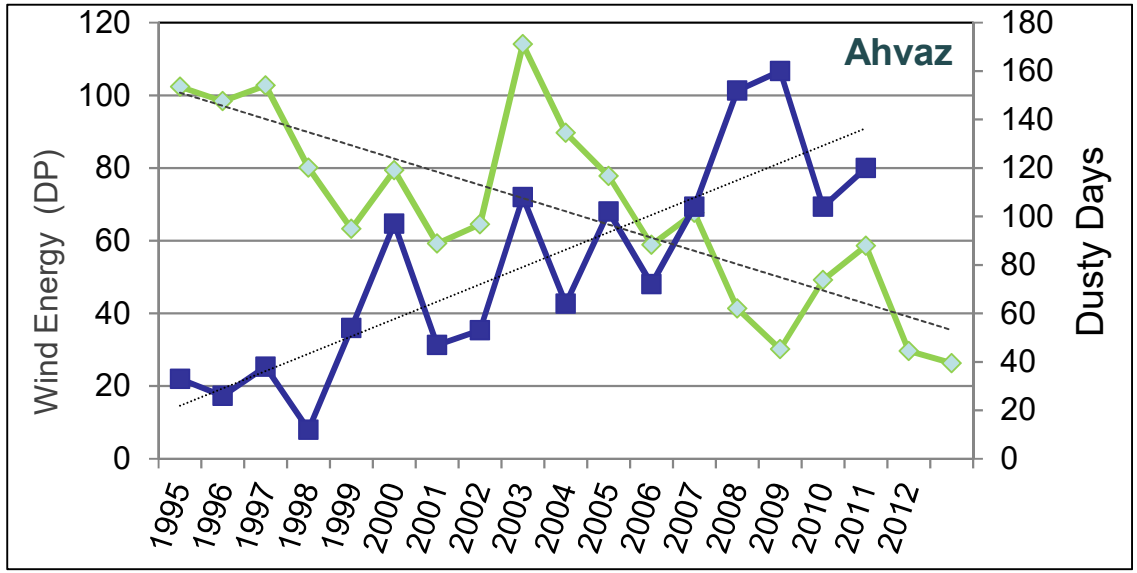
PM10: Particle matter less than 10 micrometers
PM2.5: Particle matter less than 2.5 micrometers

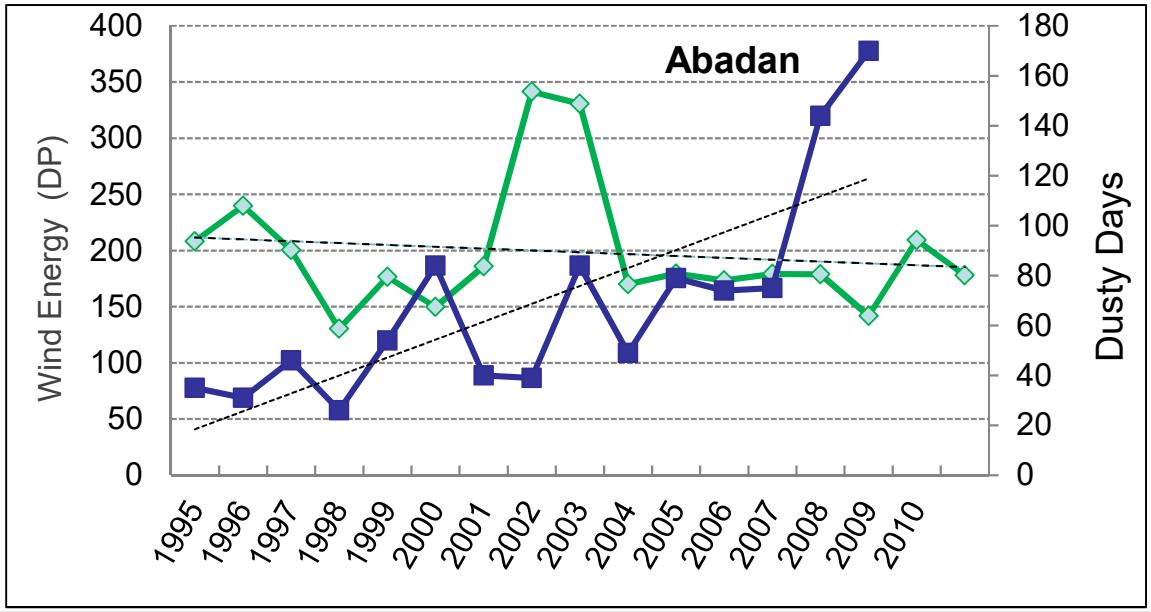
Effective Winds and Days with Dust Storms in Zabol



DP: represents yearly total wind power and describes the potential maximum amount of sand transport for each wind direction.

Effective Wind and Days with Dust Storms in Ahvaz and Abadan (Khuzestan)

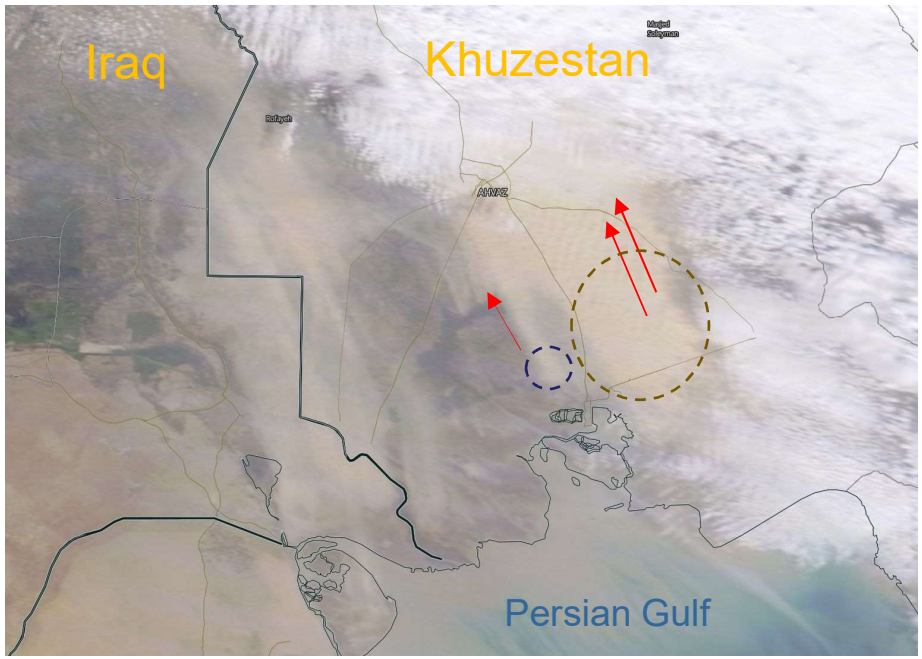




Wind Energy

Numbers of days with Dust

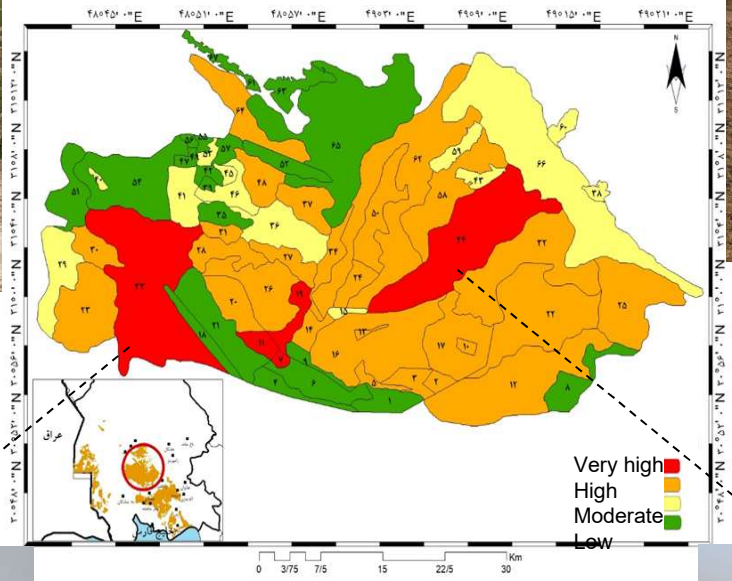
Forms of Sand and Dust Sources



Khuzestan Dust Sources (Abbasi 2018)

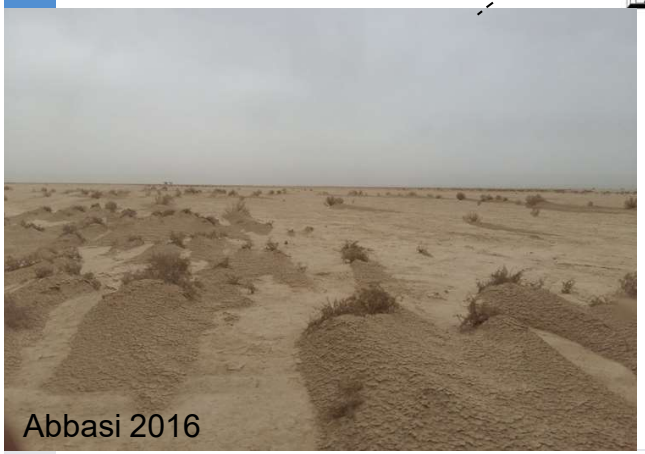
Khuzestan SDS Source
Southwest of Ahvaz

Landscape management



Land sensitivity to wind erosion

Landscape management



Conclusions

1. Sand and Dust storms (SDS) are common phenomena in arid and semi-arid areas.
2. WMO SDS is as result of surface winds raising large quantities of dust into the air and reducing visibility at eye level (1/8 m) to less than 1000m.
3. Unclear trends in SDS occurrence
4. DSS have negative and positive environmental impacts.
5. The activity of a dust source depends on the fraction of surface winds (upper wind erosion thresholds) and local land surface properties.
6. Key physical factors influencing wind erosion are climate factors, sediment or soil surface characteristics, vegetation and landforms.
7. SDS sources can be classified into point, linear, and area sources.
8. Each of them needs different methods and strategies to reduce dust.

Danke -
Thank you for your attention!
سپاسگزارم

Abbasi, Hamoun-e-Baringak (2013)