Climate Change Signals and Impacts: 
From region to sub region 

Impacts of 
Sand & Dust Storms  
(On Agriculture) 

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Immediate Objectives of Initiative:

(5) Identification and analysis of projected extreme events in the Arab Region

Examples of severe weather conditions: *flooding, drought, tropical storms, heat wave, cold spells, sand & dust storms, ..etc.*
IPCC Projected:
Increase frequency of Occurrence & intensity of Sever Weather Conditions
Noah’s ark .. And the floodgates of heavens opened. And rain fell on the earth forty days and fort nights....
Joseph, the son of Jacob...

7 years of plenty followed by 7 years of famine
Climate & Climate Change:
Perpetual interaction of Earth’s System Components

Thermal Regime;
Hydrological Regime;
Atmospheric chemistry;

Temperature
Currents
Chemistry ....

Surface characteristics;
Biological Processes. .etc.
Looks familiar??
Frequency... Regional examples

Rising Dust (Days) distribution over Middle & southern Iraq (1971-2000) days/month

BAHRAIN CIVIL AVIATION AFFAIRS
METEOROLOGICAL DIRECTORATE

NUMBER OF DAYS WITH DUST HAZE (3000 M OR LESS)

Decadal Mean number of days with S&D in Amman

Amman

Storms Kuwait (1962-2010)

Riyadh
Known Sources in the Region... another geopolitical issue !!!!

Tigris & Euphrates basin, Sistan & Baluchistan Basin, East of Alhejaz Mountains, Southwest Alhajar Mountains, Sahara Desert.
Weather conditions
(Temp., wind, rain, evpn., solar...)

+ 

Soil Biophysical Characteristics
(type, texture, moisture, vegetation cover, etc...).
Identification Card

~100 μm or less
6000 μg/m³
Up 10 km high
Life time: 4-7 days
Intercontinental transport
How much dust there is?

Global Flux of dust: 3 Billion tons/yr
Impacts: Human Health  (Respiratory, asthma, infections, meningitis in Africa, valley fever in the America’s);
In 542 BC, Cambyses II, son of Syros the Great, sent 50,000 strong soldiers to Siwa Oasis to destroy the oracle at the Temple of Amun after the priests there refused to legitimize his claim to Egypt.... They all vanished in a sand storm.....
Other Impacts

Industrial activities (outdoors works, oil production, Precision Manufacture Industry, etc.);

Weather and Climate Processes: Radiation

Agriculture
Impact of Sand & dust storms on Agriculture

1. Immediate Impact on ag. Systems:
   i. Plant & Crop’s yield;
   ii. Operators, systems & infrastructure;
   iii. Livestock (diseases, productivity,.. )
   iv. Marine life (+ ve impact)

2. Wind erosion (removal of top soil)
Dust storms can be useful fertilizers dedicated for SDS haters….

Amazon rain forest: receives from Sahara/Sahel dust 2.5 and 0.2 kg ha\(^{-1}\)y\(^{-1}\) of K and P & 1-4 kg of phosphate ha\(^{-1}\) y\(^{-1}\);

Saharan dust is the most important parent material for clay-rich soils on Caribbean islands;

Dust from China is major component of alkali ice crystals which neutralize acid rain in Japan.
SDS Impact Plankton
Planktons: Who Care ?

Major source of food production "grass" of aquatic habitats..... Base in food chain;

Consume aquatic bacteria;

Generate 50% of world’s Oxygen, Sink of CO2; Oceans’ Invisible Forest;

Major Climate controllers (past-present).

Iron fertilization of the oceans (Return of Ice Age:16 tankers of Fe particles.. $b 20, John Martine 1991)
1. Blasting of leaves

$$6\text{CO}_2 + 12\text{H}_2\text{O} \xrightarrow{\text{light}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$$

Carbon + Water $\rightarrow$ Sugar + Oxygen + Water

**PHOTOSYNTHESIS**

- **WATER + LIGHT = CHEMICAL ENERGY**
  1. Chloroplasts trap light energy
  2. Water enters leaf
  3. Carbon dioxide enters leaf through stomata
  4. Sugar leaves leaf

**CHEMICAL ENERGY + CARBON DIOXIDE = SUGAR**
Timing Scenarios

1. Emerging plants
   - Total loss

2. Early growing season
   - Minor damage

3. Flowering
   - Loss of flowers

4. Maturity & harvesting
   - Major damage
2. Impacts on irrigation systems: Regional examples

Yemen

Morocco

Iraq
2. Wind erosion of Soil

Erosion $\propto V^3$

Removal of topsoil
Loss of vital nutrients (Potassium & Phosphorous)
Decrease in crop productivity:

Measures to mitigate SDS ??

1. Reduce wind: wind breakers
2. Protect surface:
### Wind breakers: the higher, the more efficient

<table>
<thead>
<tr>
<th>Distance from windbreak</th>
<th>5H</th>
<th>10H</th>
<th>15H</th>
<th>20H</th>
<th>25H</th>
<th>30H</th>
</tr>
</thead>
<tbody>
<tr>
<td>% reduction in wind speed</td>
<td>78%</td>
<td>66%</td>
<td>35%</td>
<td>14%</td>
<td>10%</td>
<td>4%</td>
</tr>
</tbody>
</table>

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Regional Examples-ACSAD

Egypt

Saudi Arabia, Ihsaa
Regional Examples
Wind breakers

Tunis

Morocco

Sudan
Saudi Arabia: wind breakers

Riyadh

Mecca
Regional examples

Sudan

Morocco
Regional examples: Local Material

Egypt
Indigenous Technology
Jordan
Aden Tanks, Yemen
Thank you

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