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Asian and Pacific Centre for the Development of Disaster Information Management

Sand and Dust Storms Risk Assessment in Asia and the Pacific

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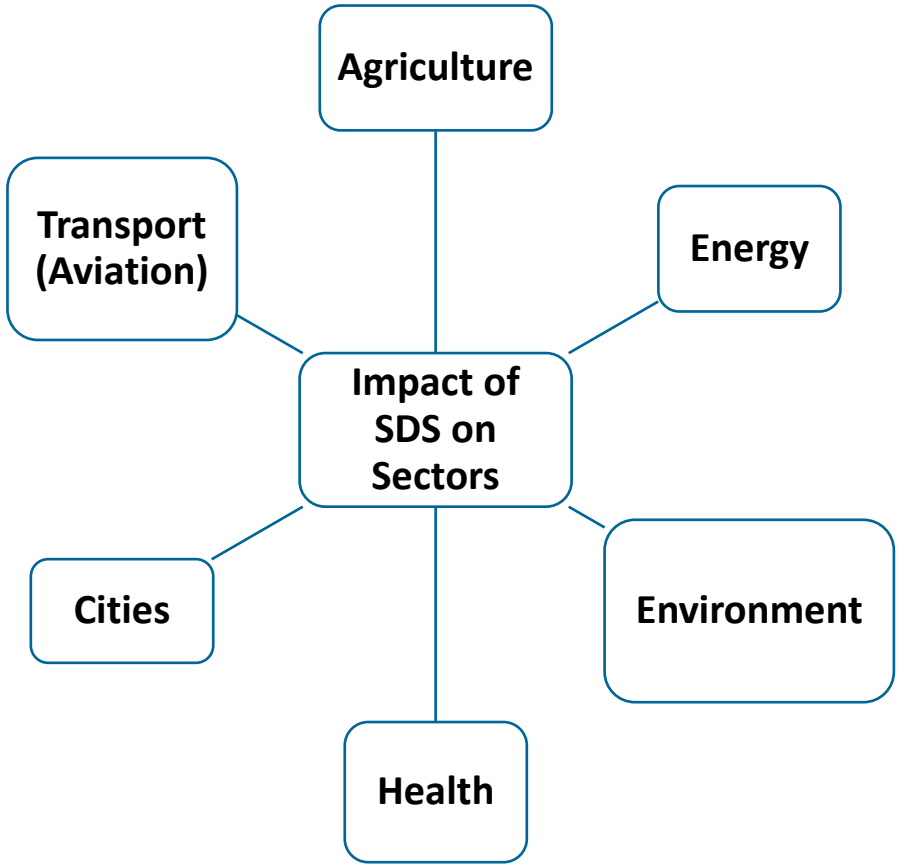
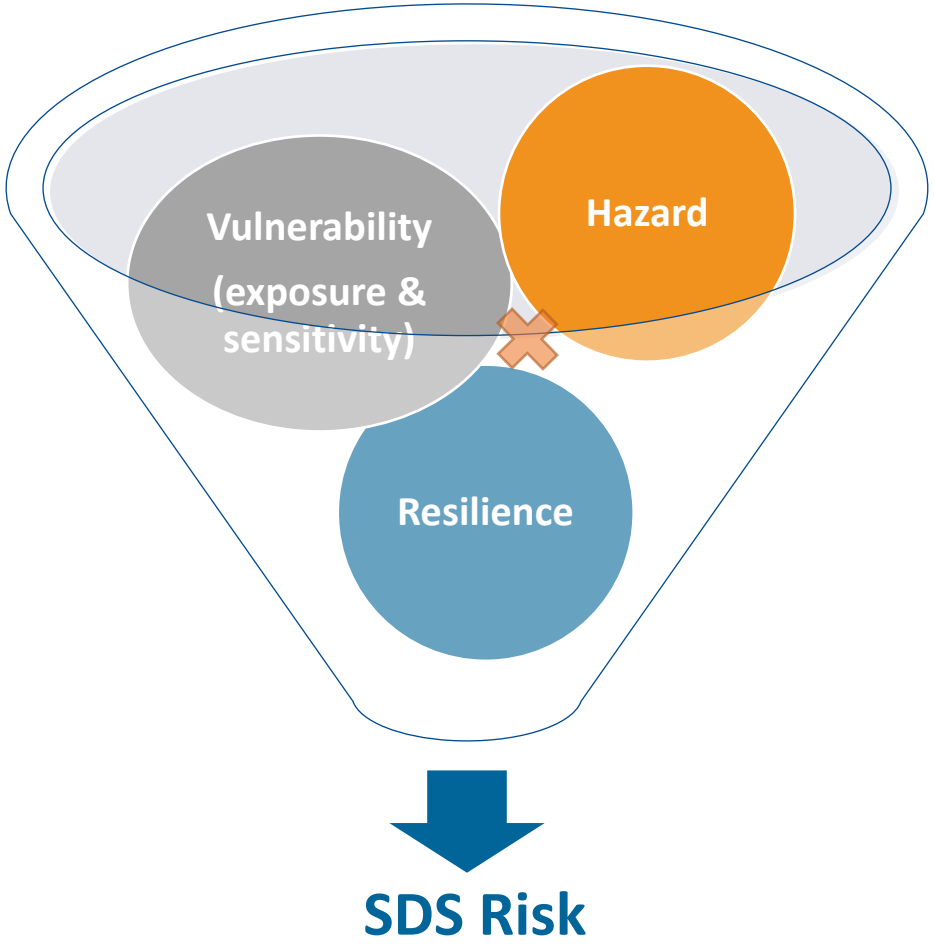
Sand and Dust Storms Risk Assessment in Asia and Pacific

Methodology

Sectors Covered in the Risk Assessment



Concept of Risk in the Assessment



Data Sources

Hazard

- MERRA-2
- Resolution of 0.625°×0.5°
- From 1980-2019

Sectors

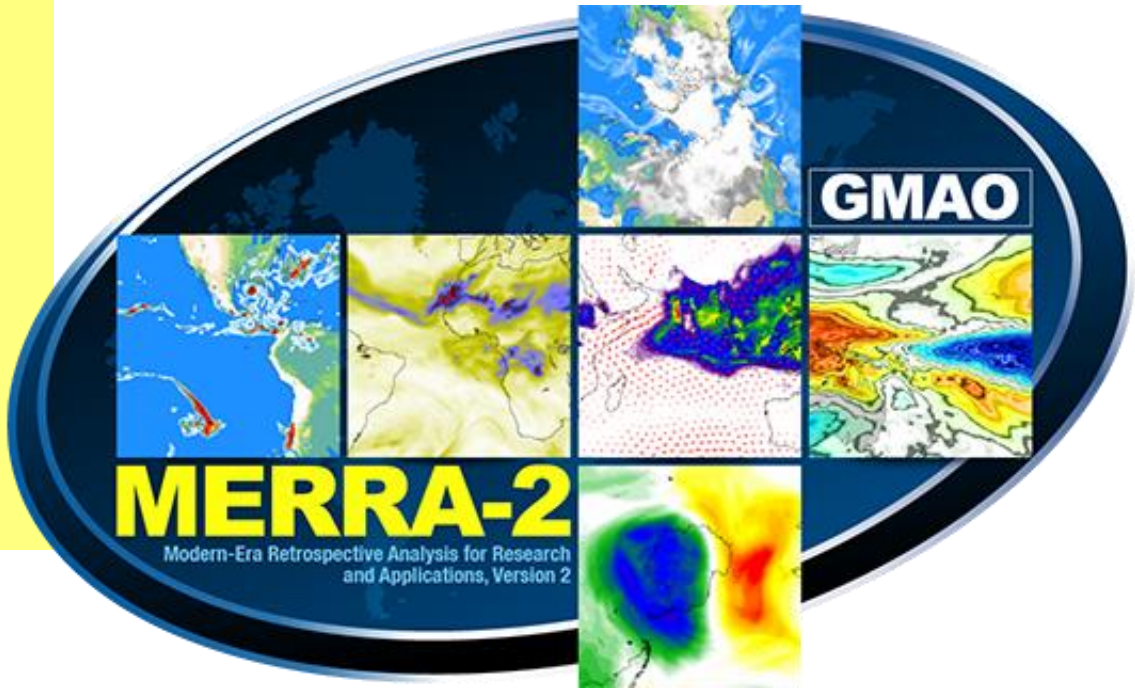
(exposure, sensitivity, resilience)

- **Agriculture** and **Environment**: Landcover map (GLCNMO-V3, MODIS-2013), Resolution of 15 arcseconds
- **Energy**, Solar powerplant database (location, capacity, etc), ESCAP, DustClim
- **Transport, Aviation:** OPS group, OpenFlights, DustClim
- **Health**, WHO, SEDAC, UNDP, WB.
- **Cities**, UNDESA, 2020

■ Simulations for SDS hazard : Surface dust concentration

MERRA-2 (NASA)

Period : 1980 - present
Spatial Resolution
0.5° lat x 0.625° lon
Time Resolution : Hourly
Utilized variables :
Dust Surface Concentration
Dust Sedimentation

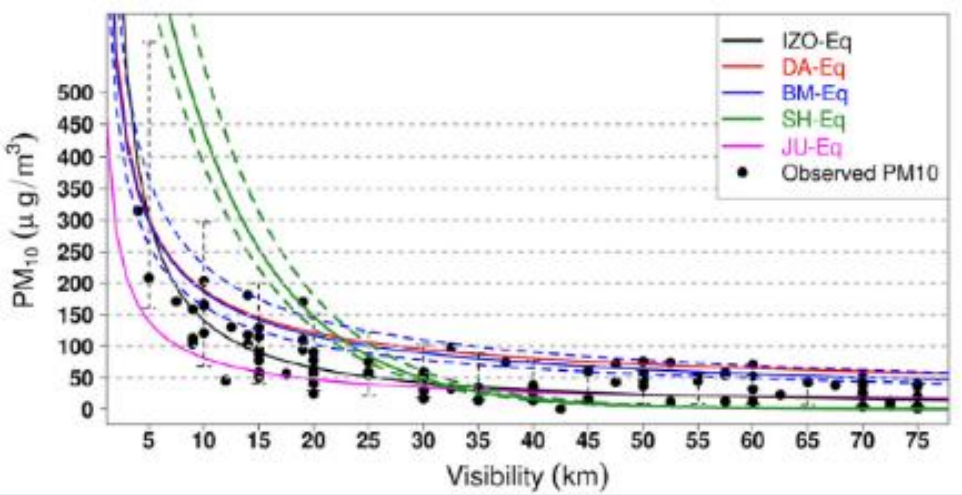


MERRA-2 (NASA)

■ Simulations for SDS hazard : Surface dust concentration

Visibility

By dust surface concentration



Empirical equations for visibility (Camino et al. 2015)

Empirical curves compared in North Africa.
JU-Eq (Jugder et al. 2014) was utilized.
Input : Dust Surface Mass Concentration

Engine erosion

By dust mixing ratio and air density (3D)

The flight levels at standard pressure levels (Dustclim)

hPa	Flight Level	Critical flight stages
1000	**FL000 (ground)**	take off, landing, taxying
975	**FL010**	min. alt. for light aircraft
850	**FL050**	initial climb/min WAFS/WAFC
750	**FL080**	
700	**FL100**	decent
600	**FL140**	climb
500	**FL180**	
400	**FL240**	climb/initial decent
350	**FL270**	
300	**FL300**	
250	**FL340**	
175	**FL410**	cruise
150	**FL450**	
100	**FL530**	max WAFS/WAFC

Average atmospheric dust concentration (PM10) in each flight levels was calculated.

■ Simulations for SDS hazard : Surface dust concentration

Health

By dust sedimentation (PM10)

WHO AQG Global Update (2005)

Pollutant	Averaging time	AQG value
Particulate matter - $PM_{2.5}$	1 year	10 µg/m³
	24 hour (99th percentile)	25 µg/m³
Particulate matter - PM_{10}	1 year	20 µg/m³
	24 hour (99th percentile)	50 µg/m³

Total days when PM10 concentrations were higher than 50 µg/m³ were counted.

(the WHO's acceptable 24-hour mean atmospheric concentration)

Energy

By dust sedimentation

Dust on solar panel (Akash 2016)

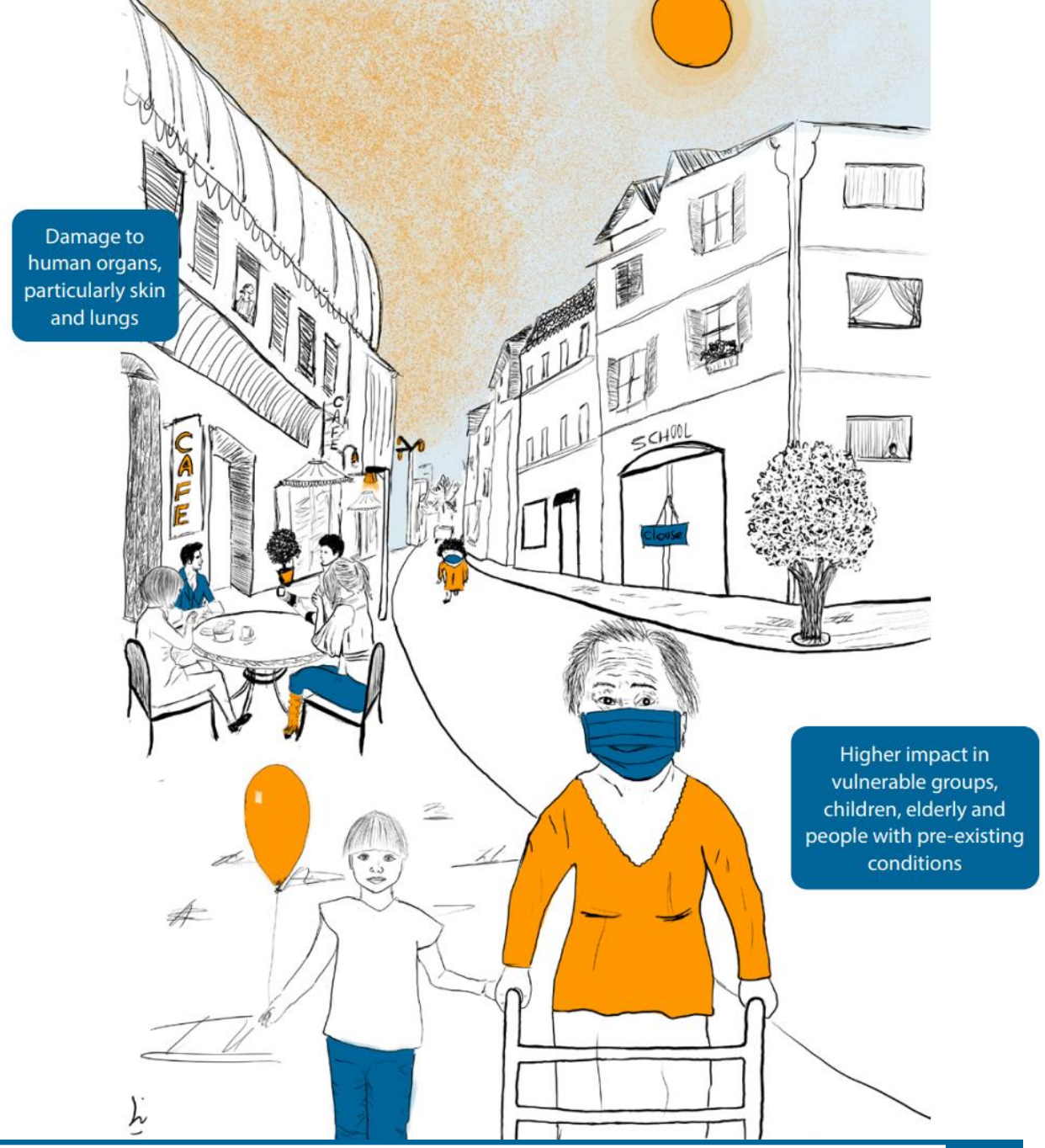
The current assessment focused in particular on reduction in energy production caused by dust deposition.

It was calculated monthly.

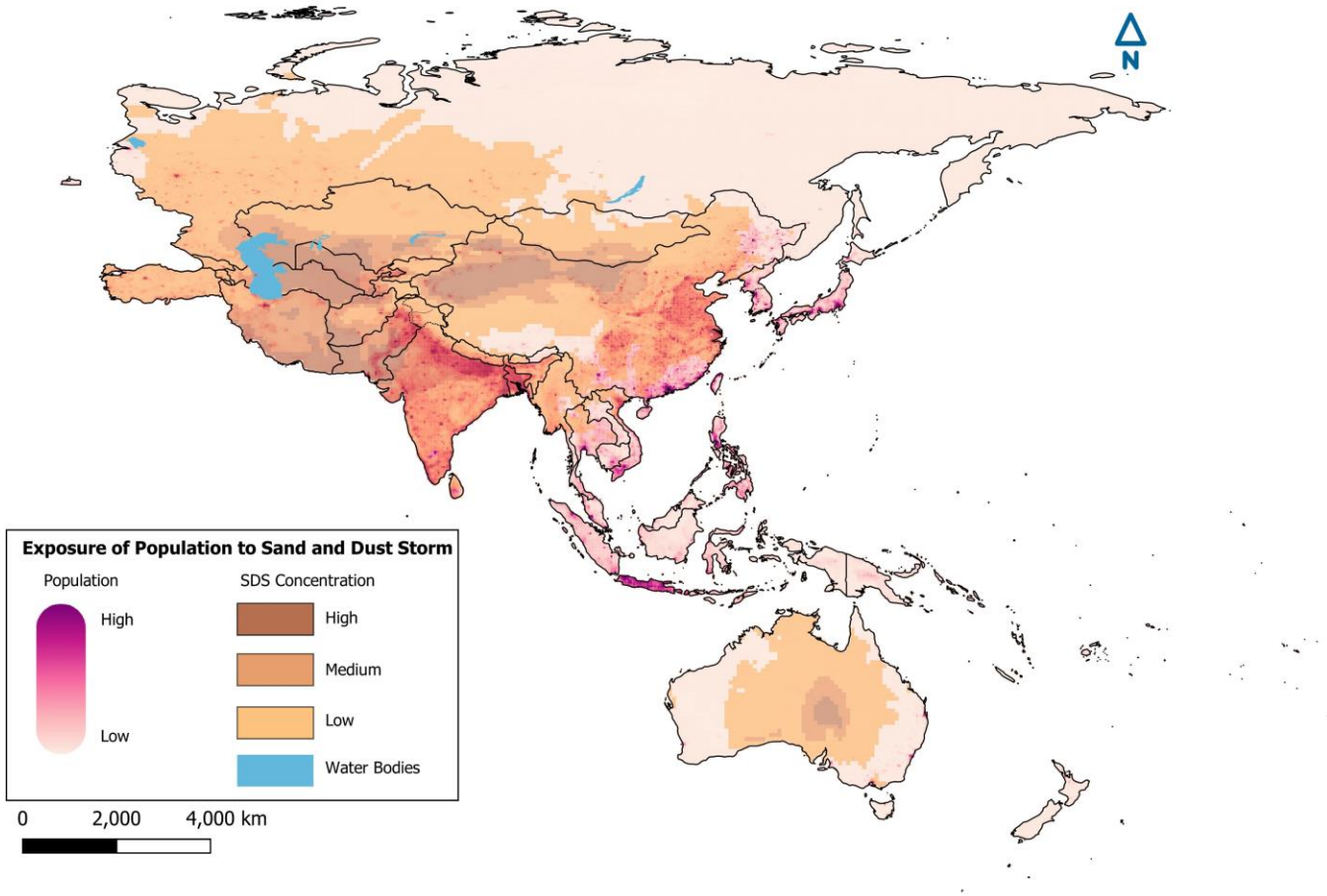
Sand and Dust Storms Impact on Sustainable Development

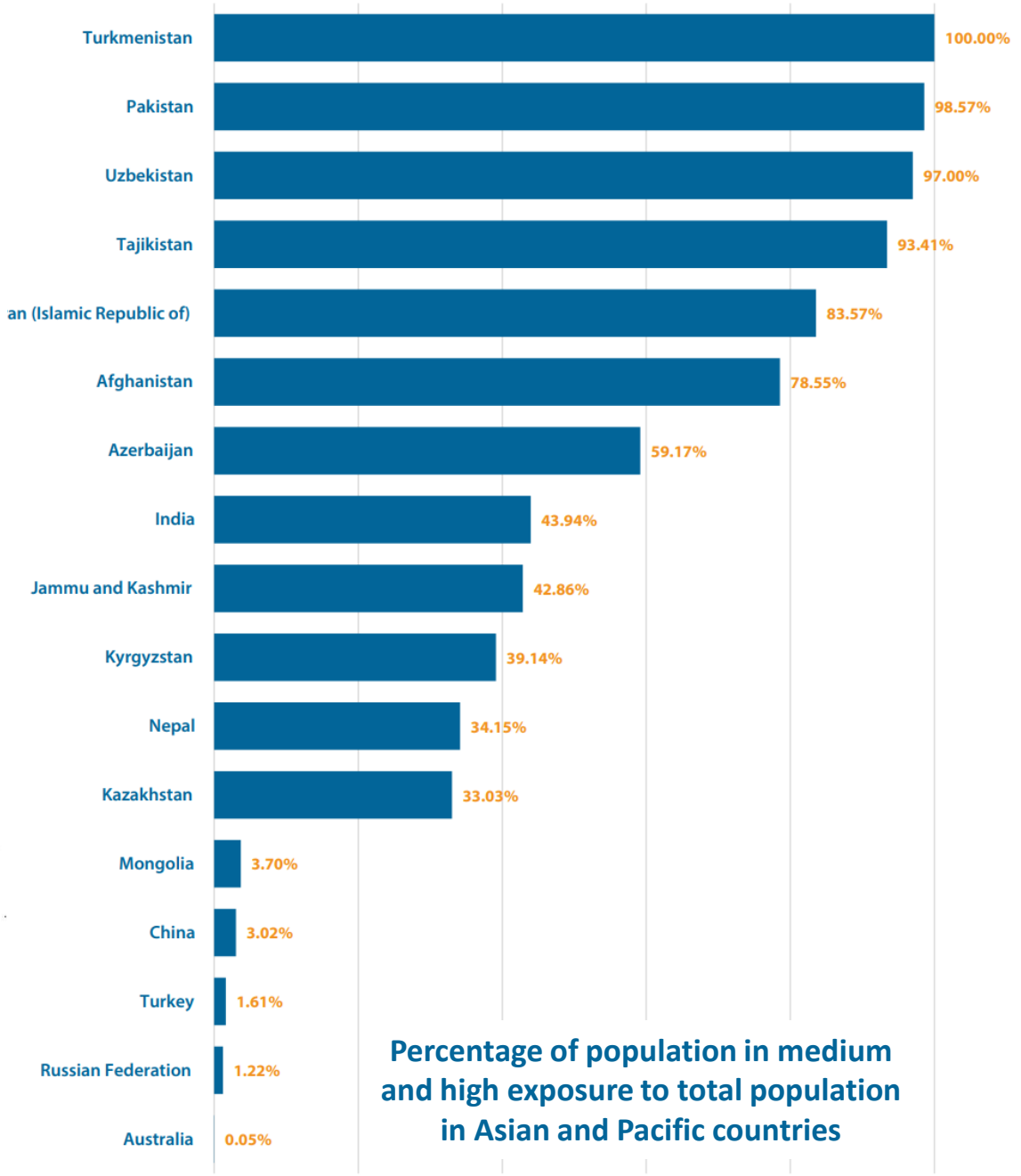
Finding 1: Human Health

More than **80 per cent** of the entire populations of the Islamic Republic of Iran, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan are exposed to medium or high levels of poor air quality.



Population at Risk





Percentage of population in medium and high exposure to total population in Asian and Pacific countries

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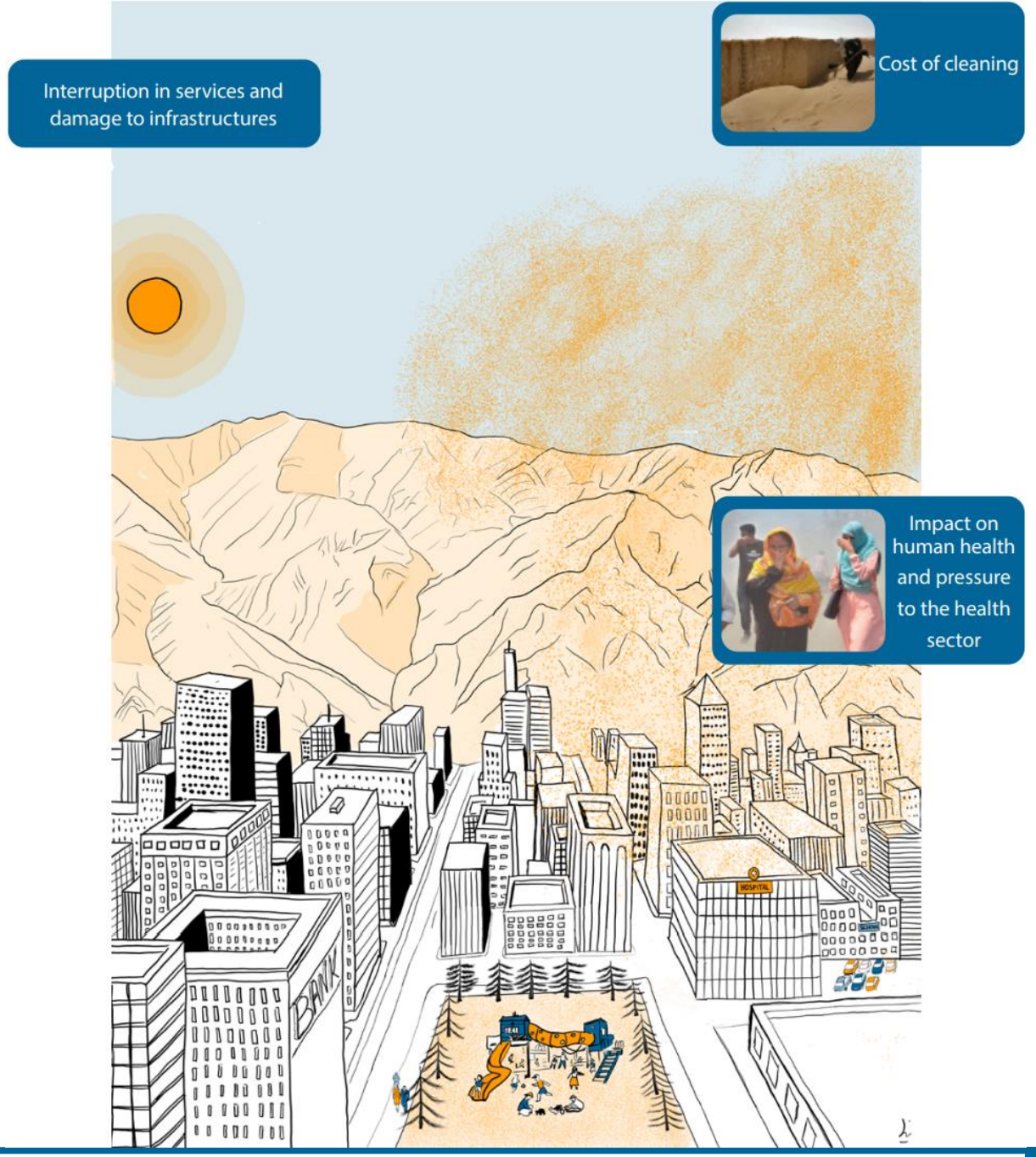
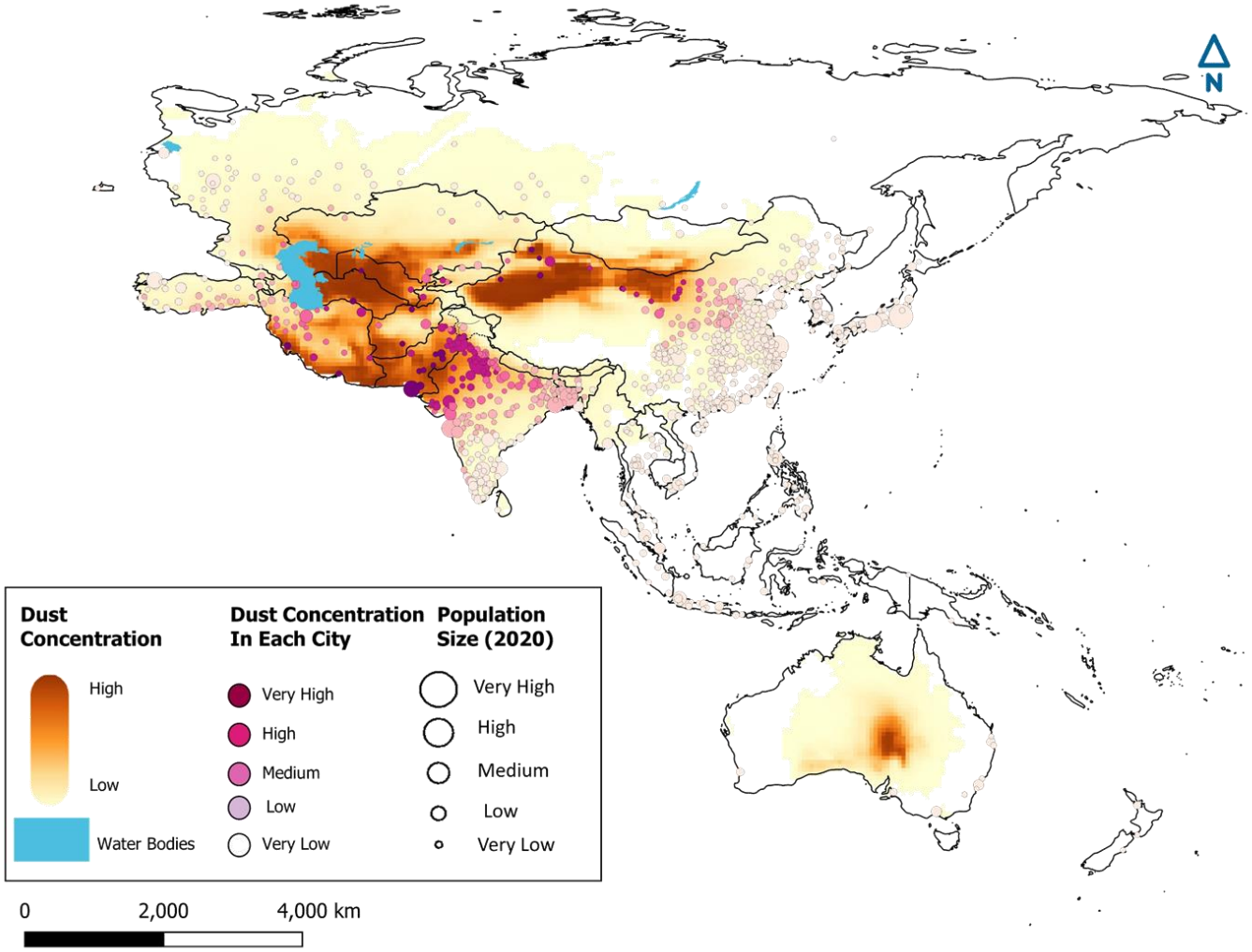
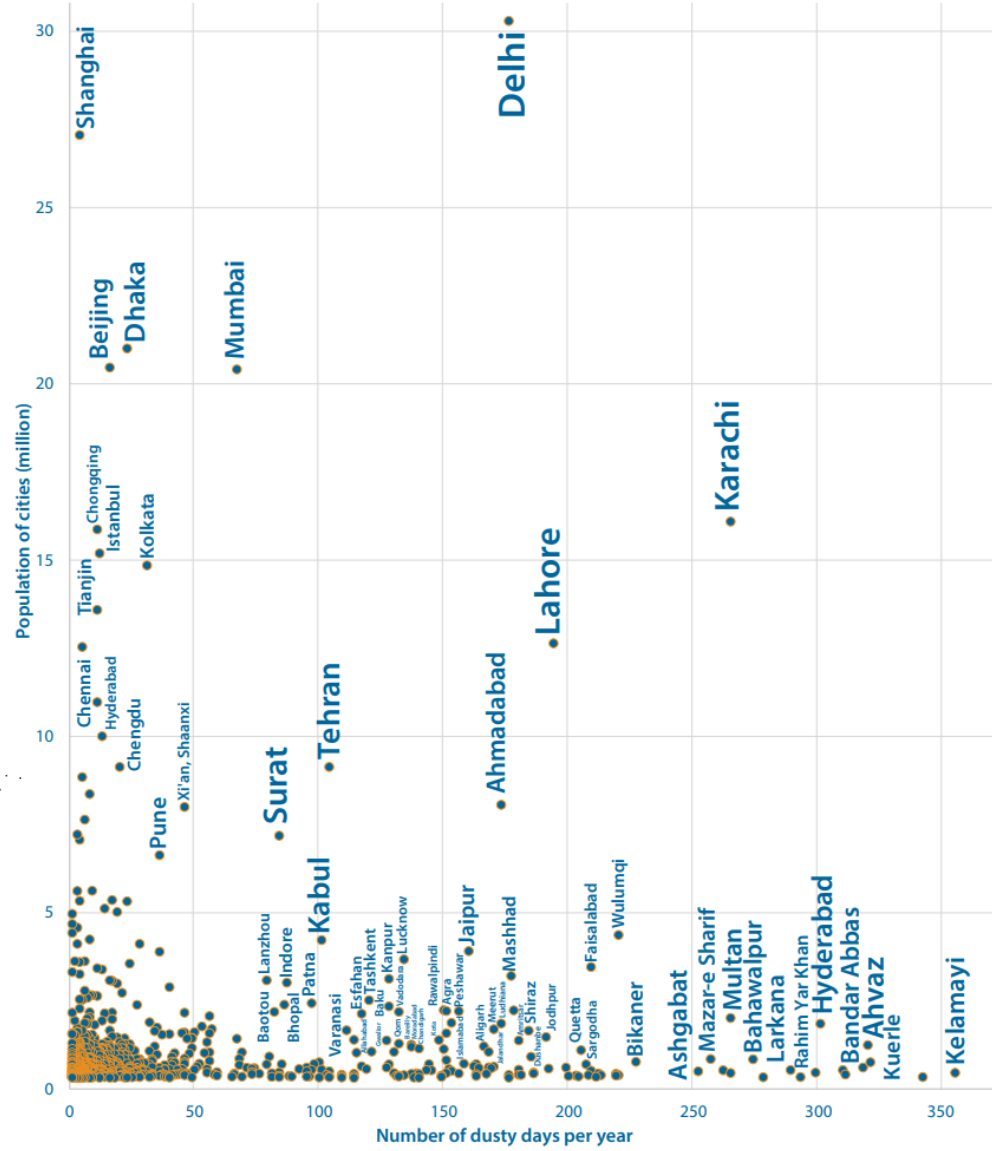
Finding 2: Urban

Cities in southwestern Asia have the highest exposure to sand and dust storms, where nearly **60 million** people experienced **more than 170 dusty days** in 2019.



Dust Exposure in Urban Area





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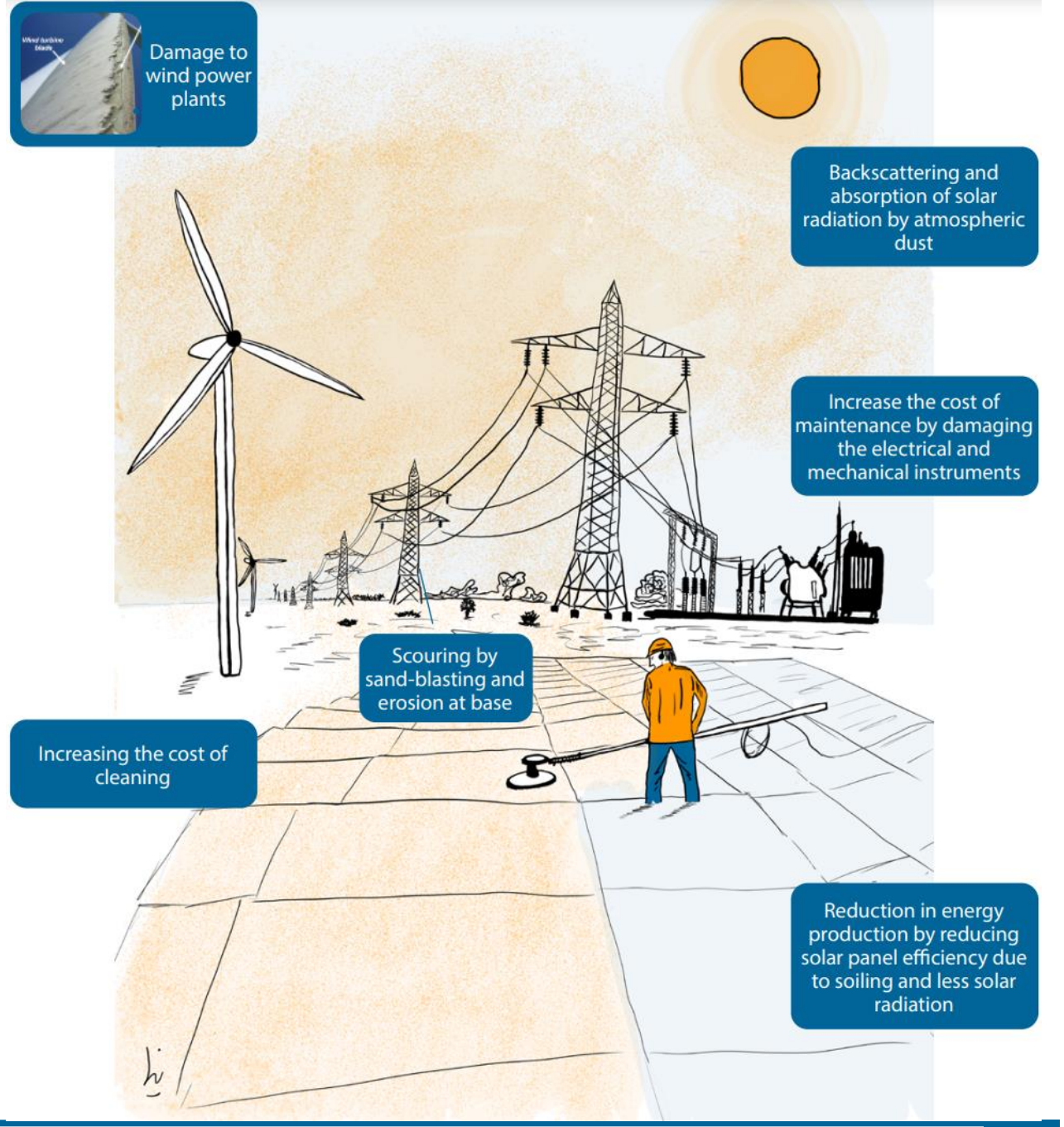
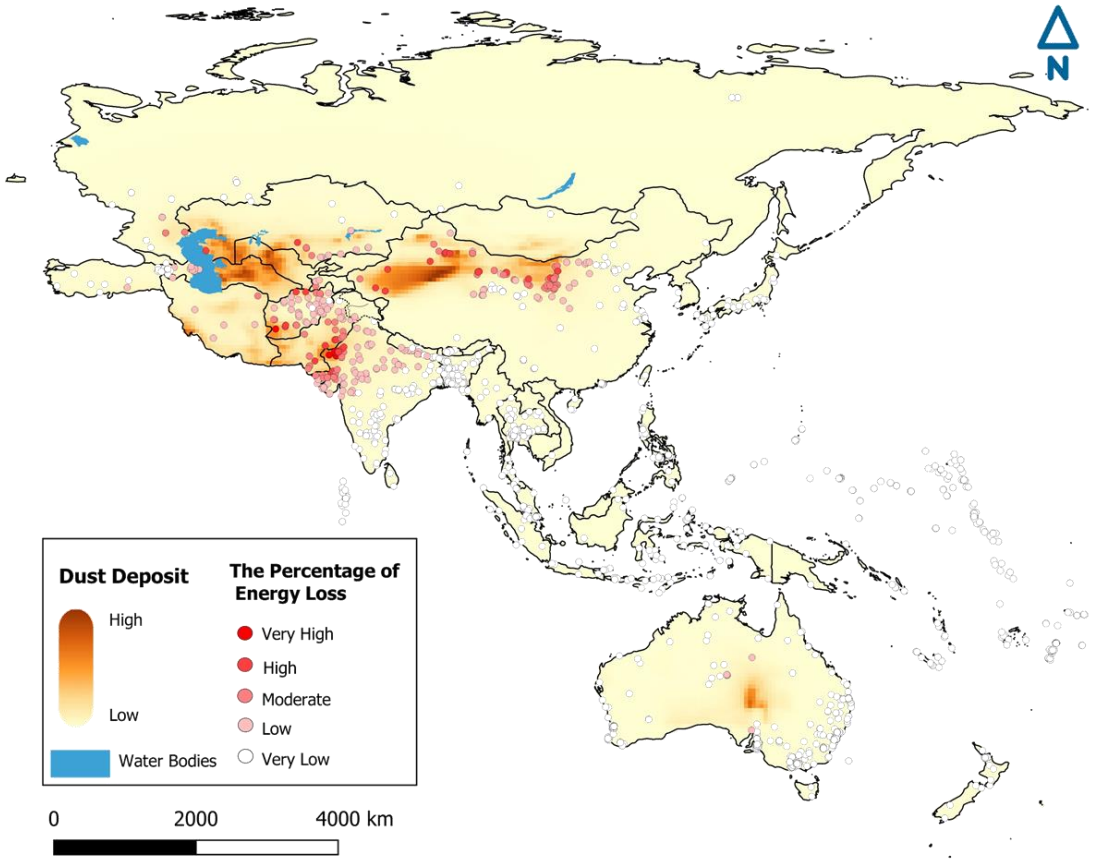
Finding 3: Energy

Sand and dust storms have a considerable impact on the generation of electricity by solar power plants which, measured in economic terms, is greater than USD107m a year in India, and exceeds USD46m and USD37m a year in China and Pakistan.

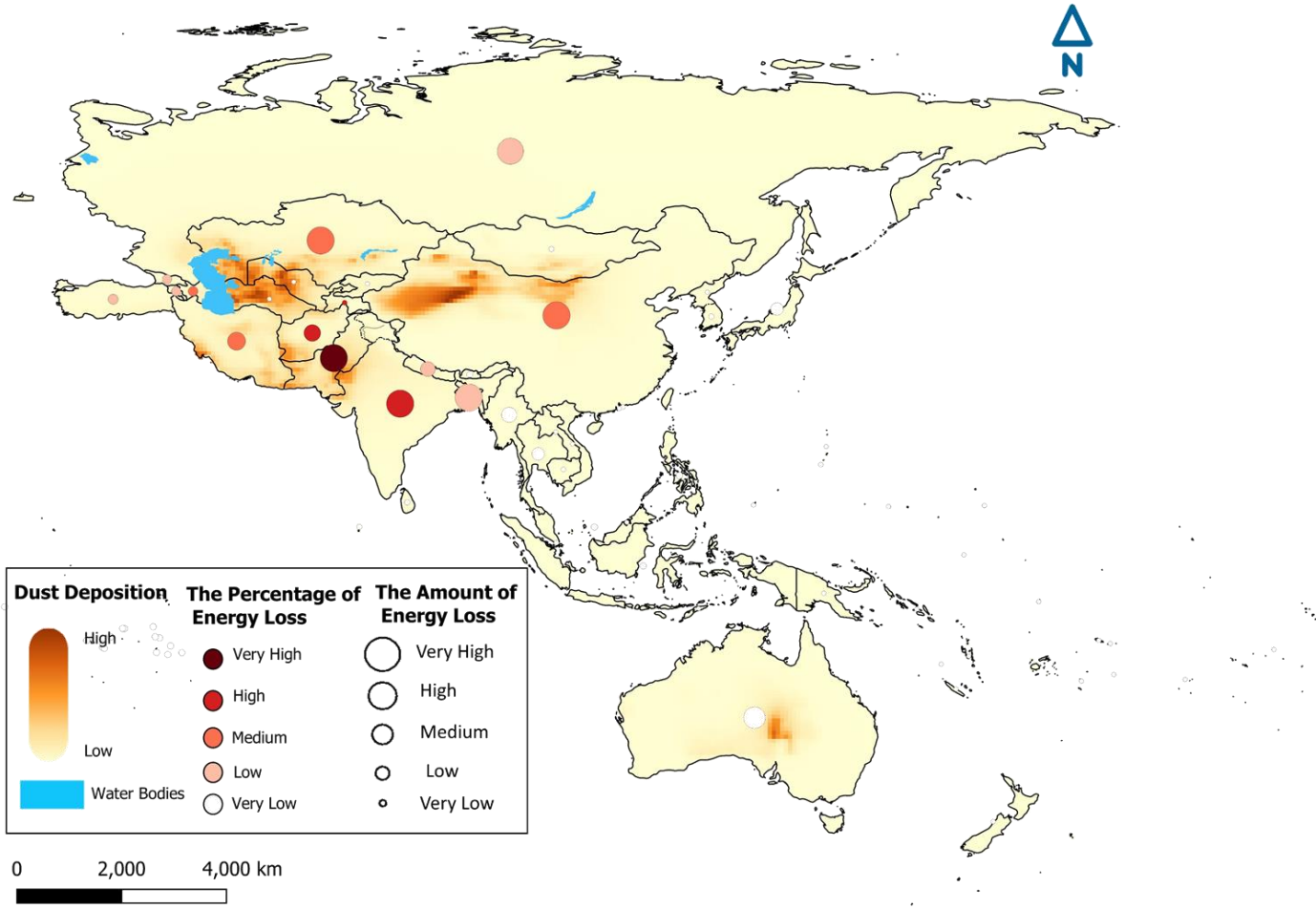


Exposure and Impact of SDS on Energy Sector (Solar)

Exposure of solar powerplants (circles on map) to dust (average deposited) and percentage of average energy loss due to dust deposition



Amount of energy loss and percentage of energy loss in energy production of solar powerplants in Asia-Pacific countries



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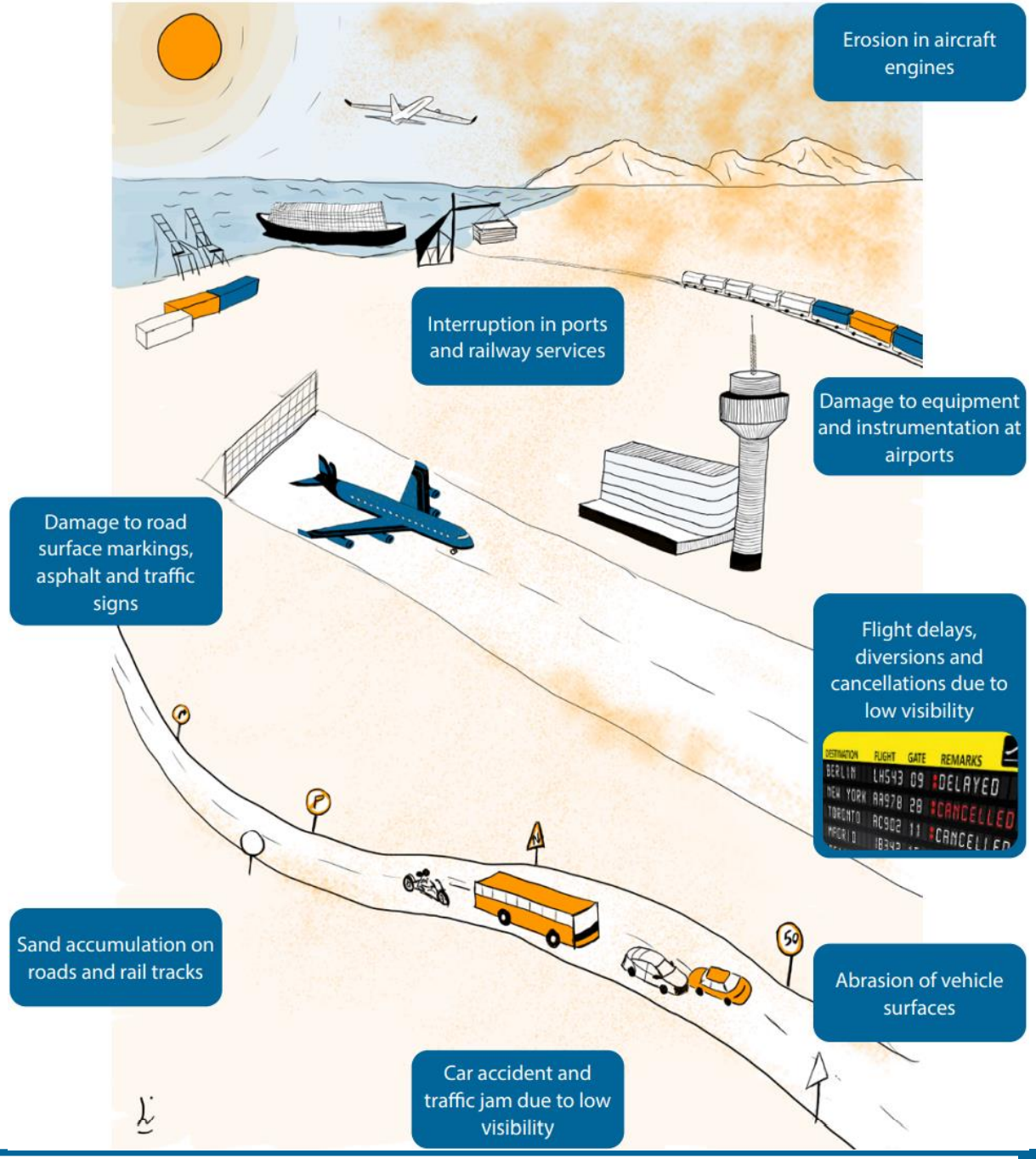
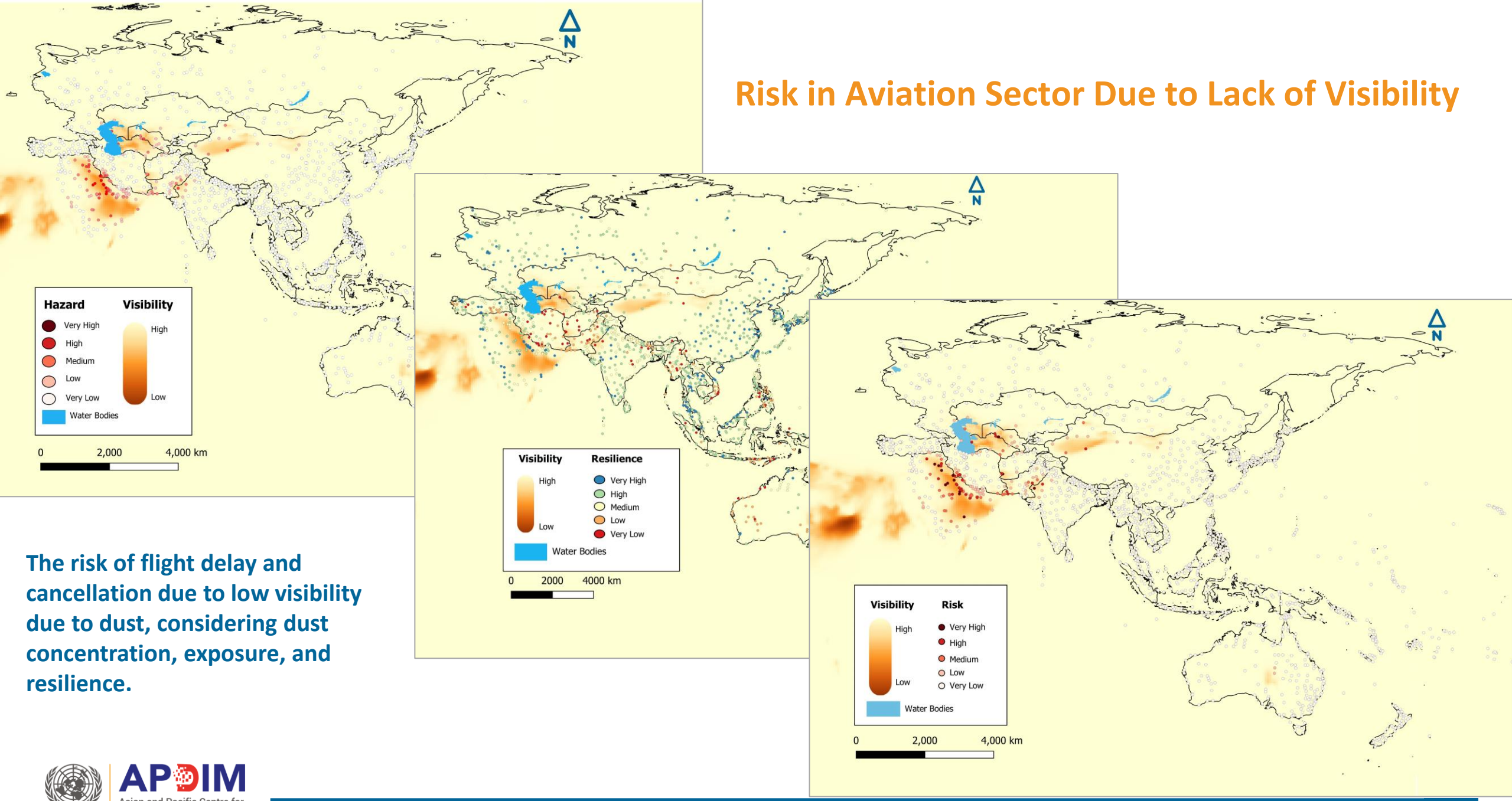
Finding 4: Transport

Risk of flight delay and cancellation due to low visibility is greatest at airports in Central Asia, southern parts of the Islamic Republic of Iran, the border area between Pakistan and India, and northern parts of China.

Exposure of aircraft engines to dust particles is a considerable risk on flightpaths traversing southwestern and central parts of Asia and flights to and from airports on the Arabian Peninsula, Pakistan, India and China are most affected.

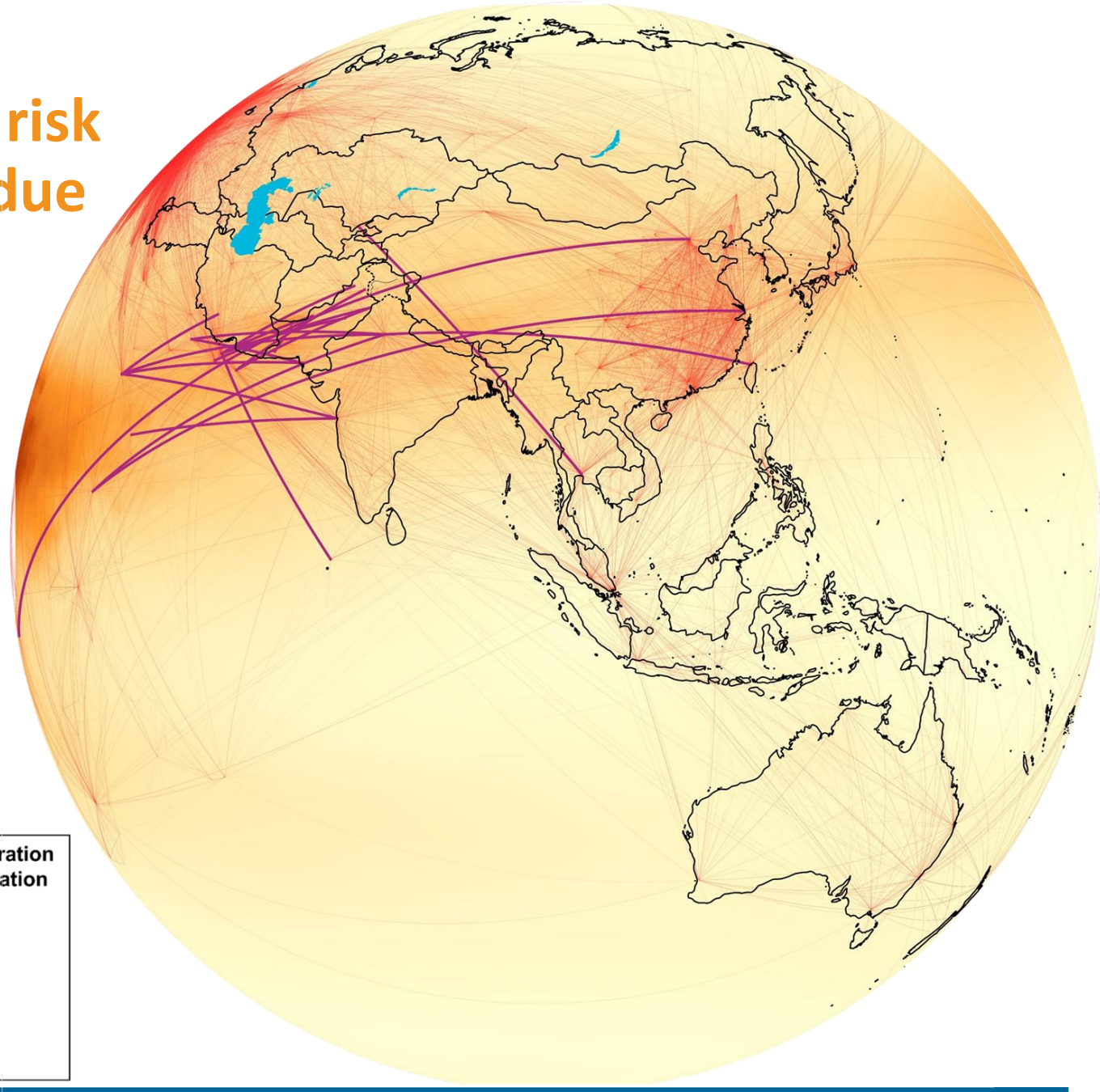


Risk in Aviation Sector Due to Lack of Visibility



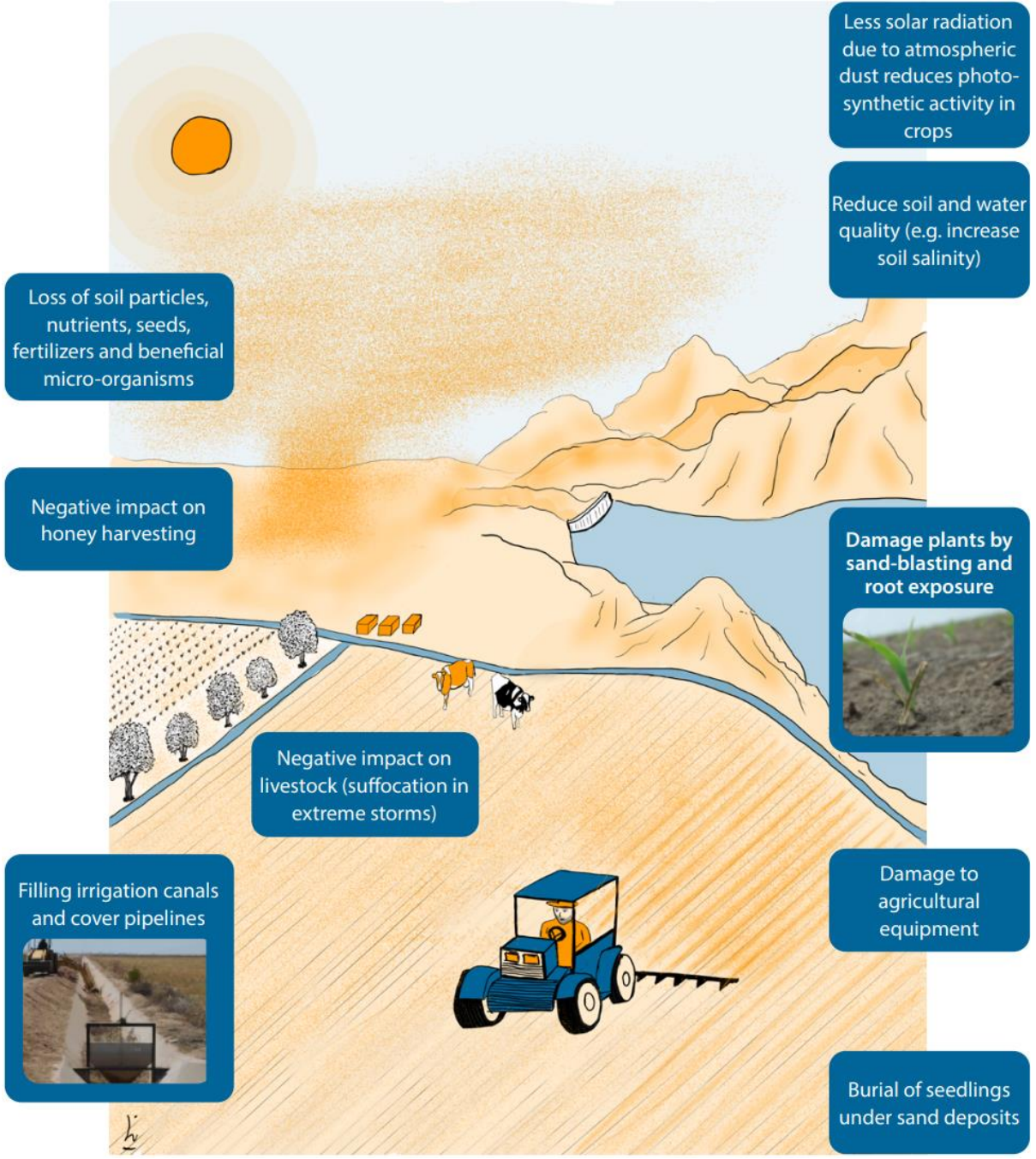
The risk of flight delay and cancellation due to low visibility due to dust, considering dust concentration, exposure, and resilience.

The flight paths with the high risk of erosion in aircraft engines due to dust concentration in the cruise elevation

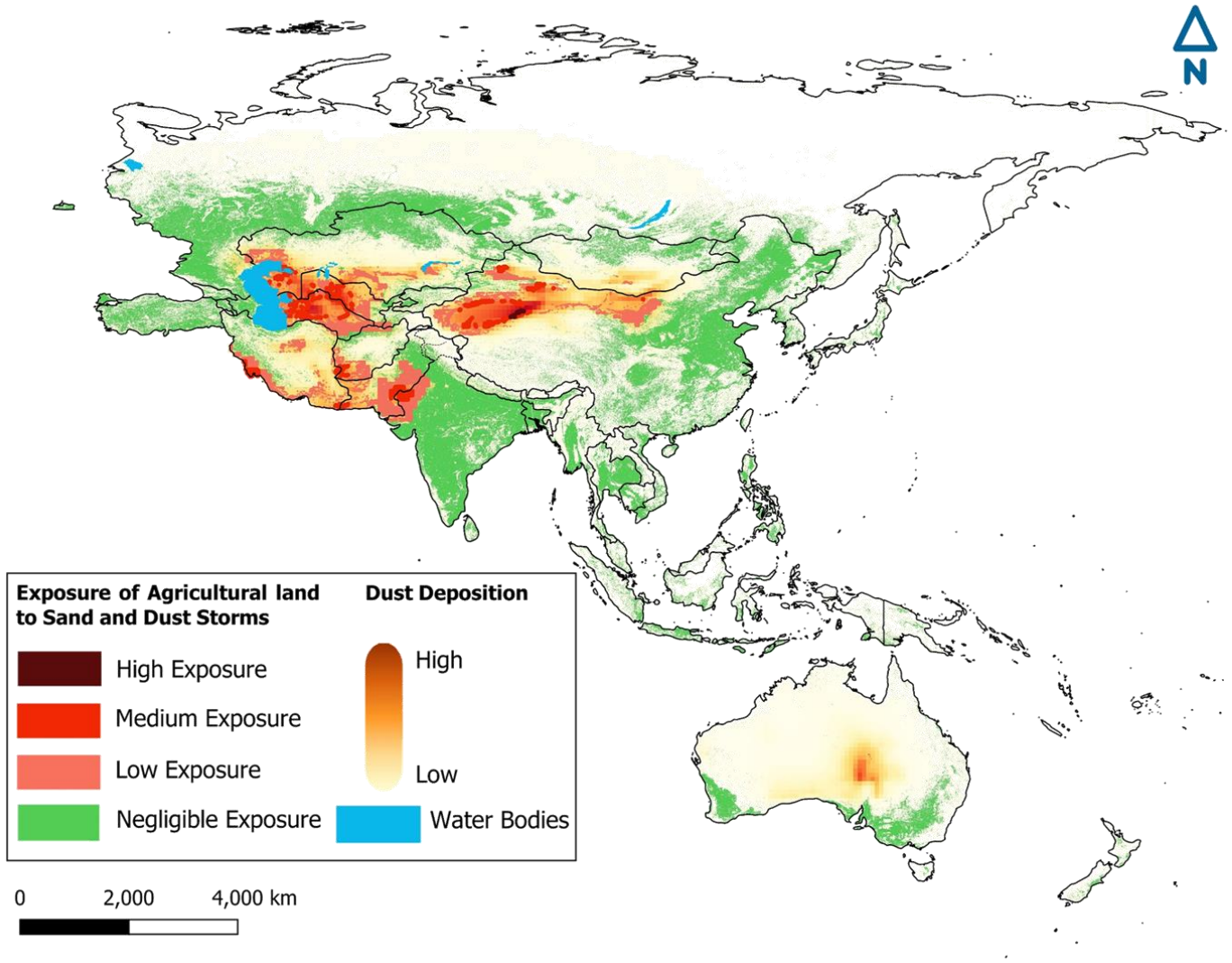


Finding 5: Agriculture

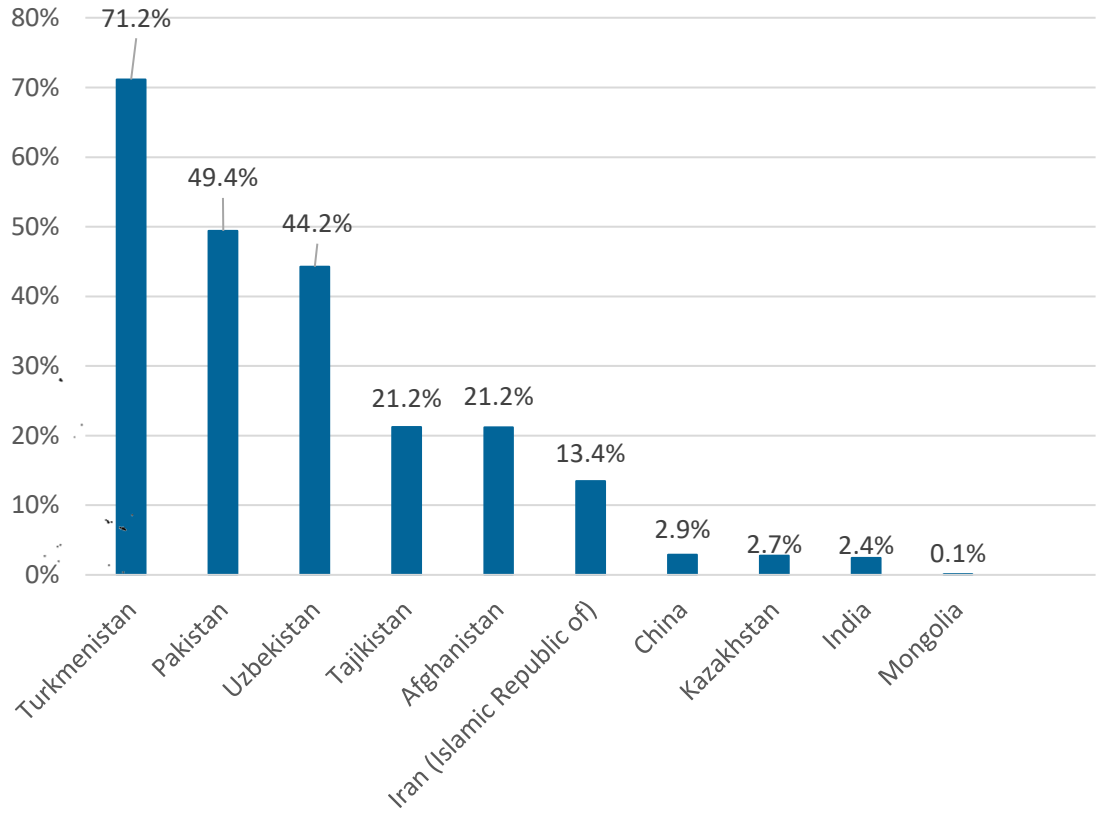
Large areas of farmland are affected by dust deposition in Turkmenistan (71% of the cropland area), Pakistan (49%) and Uzbekistan (44%).



The exposure of agricultural land to average dust deposition (2019)



Percentage of Agricultural land exposed to sand and dust storms



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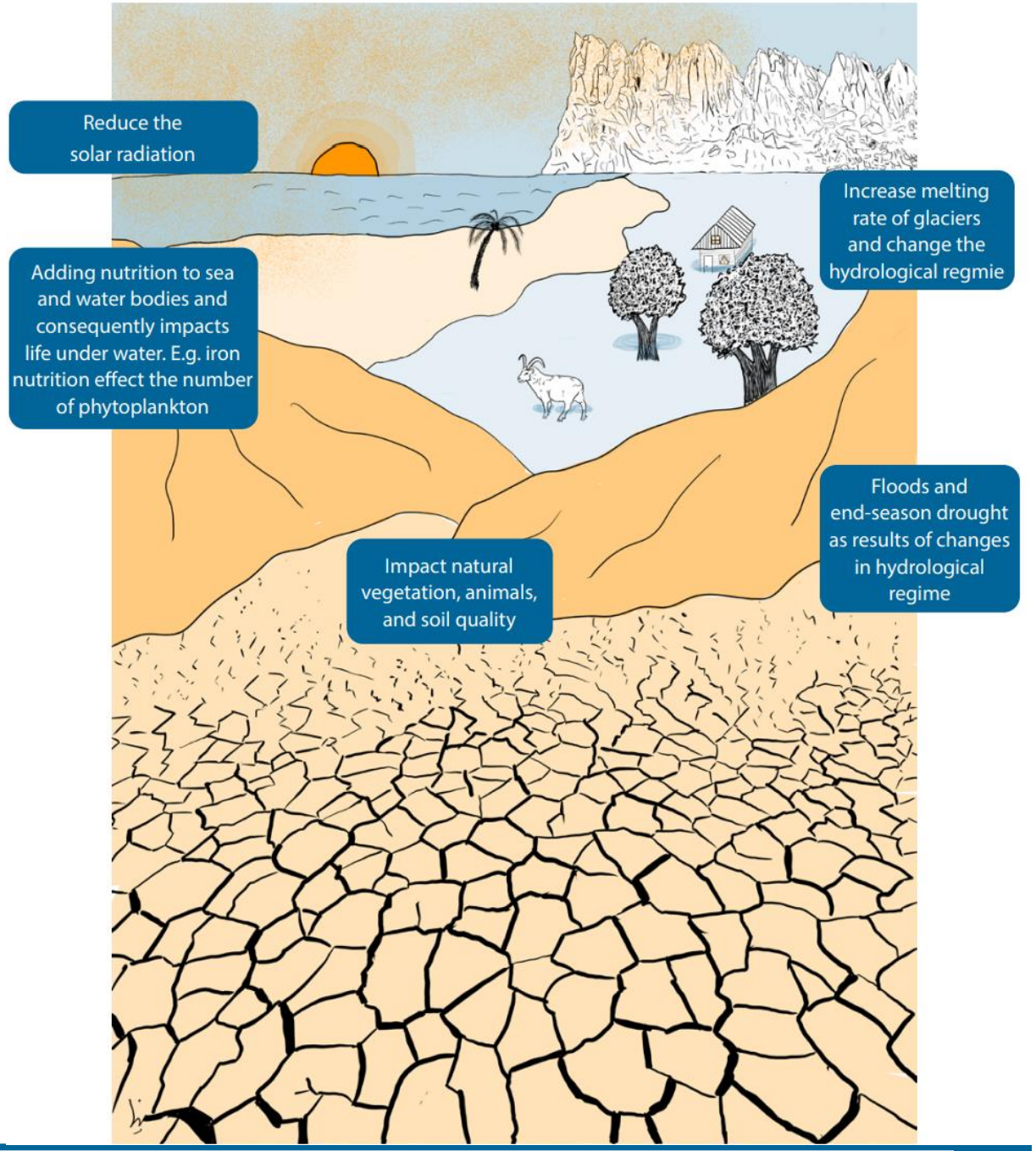
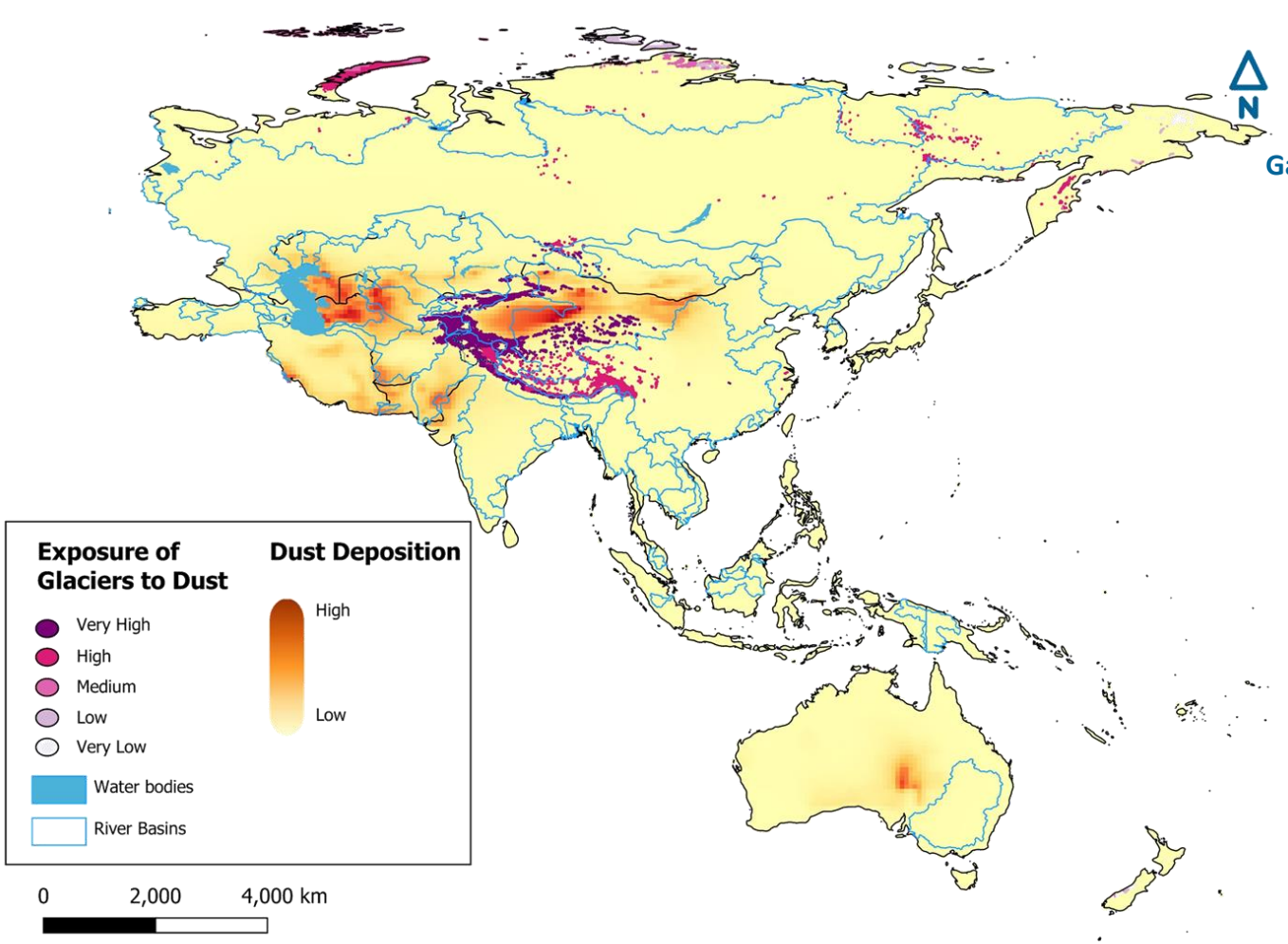
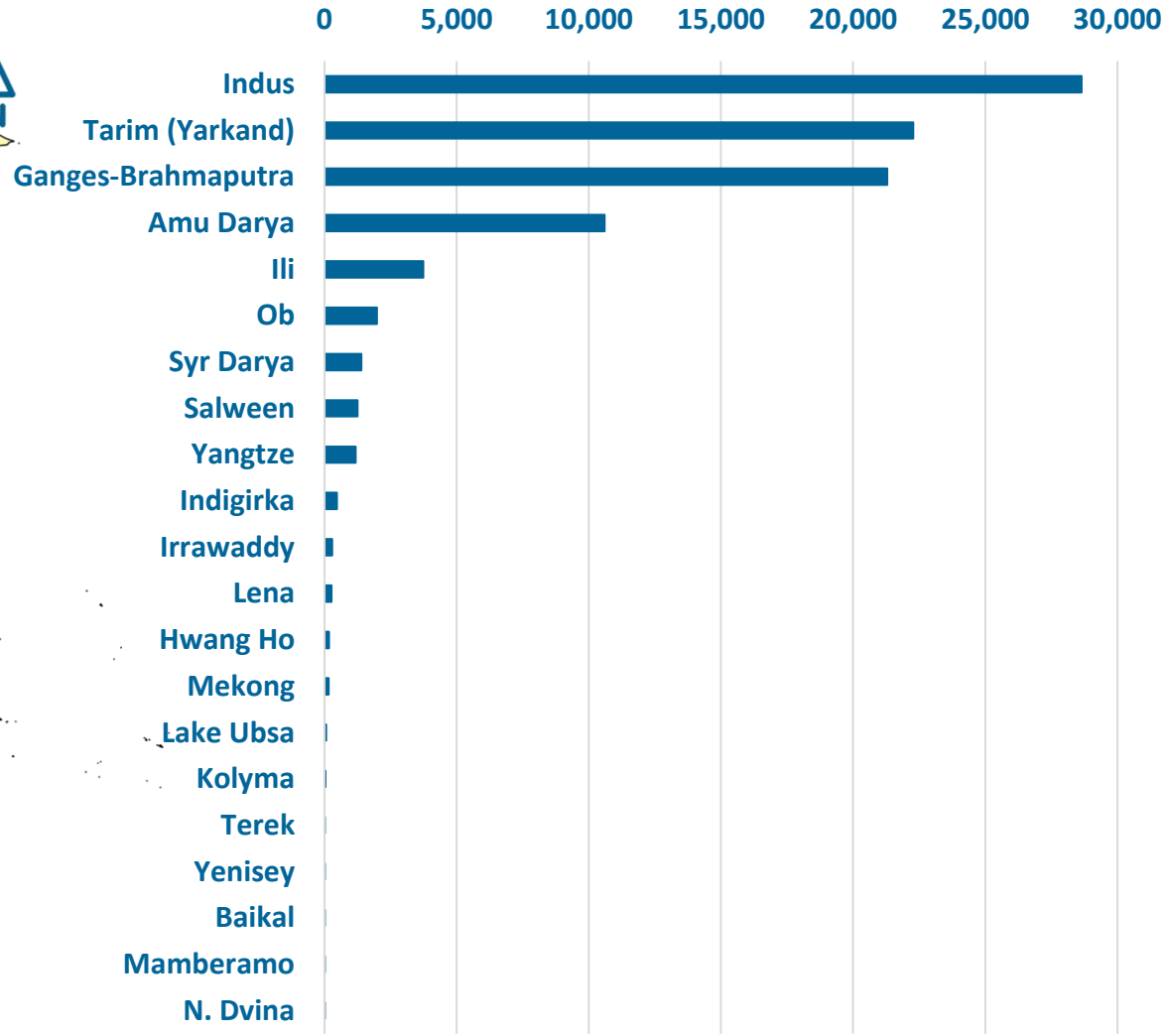
Finding 6: Environment

High dust deposition occurs in the Himalaya-Hindu Kush mountain range and the Tibetan Plateau, the so-called Third Pole which provides fresh water to more than 1.3 billion people in Asia.



The exposure of glaciers to average dust deposition (2019)





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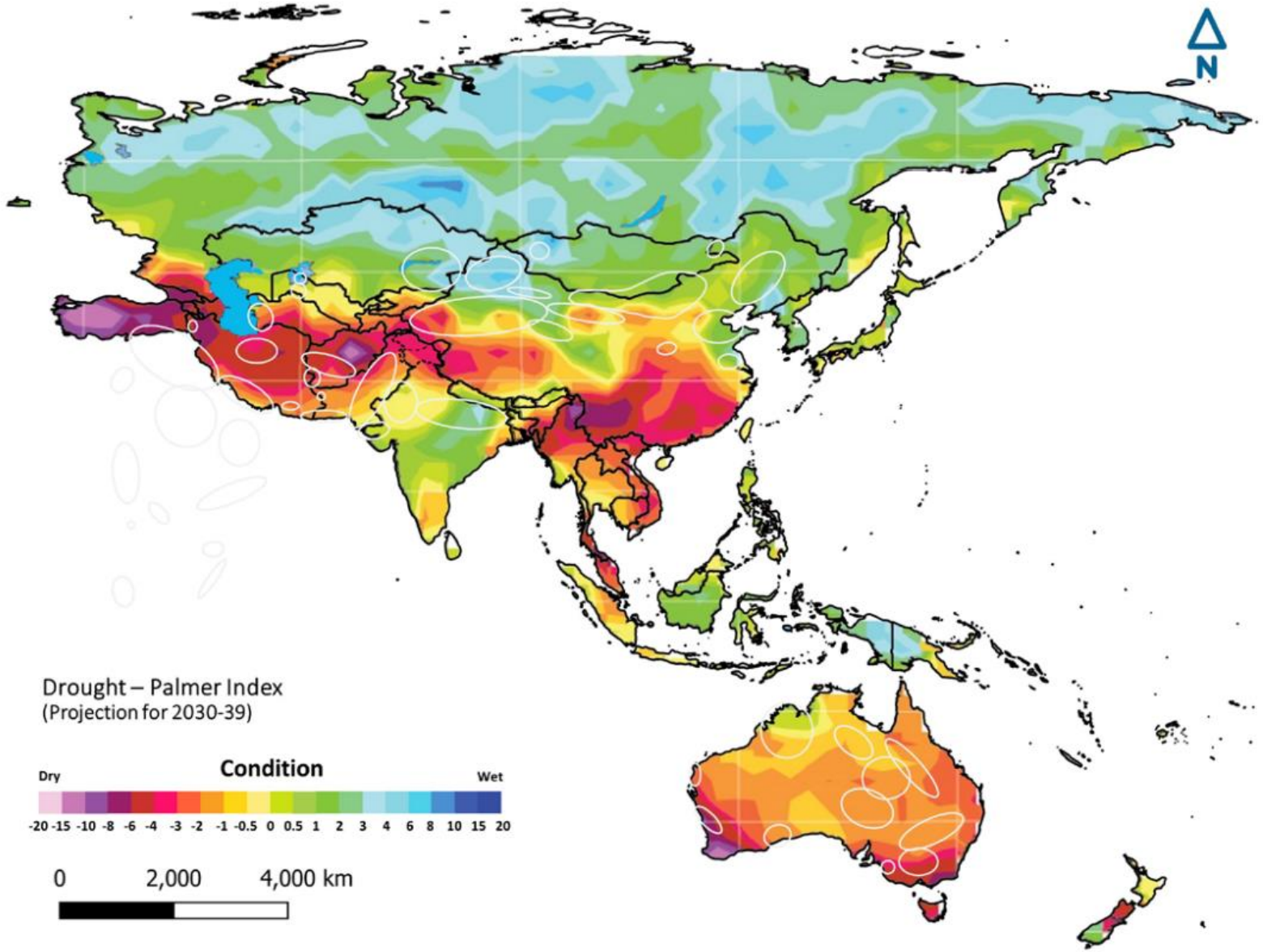
Finding 7:
Long-term Impact

Risk of impacts of SDS is projected to **increase in the 2030s** due to more extreme drought conditions in parts Western Australia, south-eastern Turkey, Iran and Afghanistan



Looking Ahead:
Suggested Next Steps for Coordinated Regional Action on Sand and Dust Storms

- A **deeper understanding** of the socio-economic impacts of sand and dust storms

- A **coordinated monitoring and early warning** system, with an **impact-based** focus, to timely forecast sand and dust storms and enable targeted measures to minimize exposure and reduce risks

- **Coordinated actions** in most at-risk and exposed geographical areas with a view to **mitigating the risks**

Partners in the SDS Risk Assessment

- ESCAP Divisions (Statistic, IDD, Transport, Energy)
- World Meteorological Organization (WMO)
- United Nations Convention to Combat Desertification (UNCCD)
- Food and Agriculture Organization of the United Nations (FAO)
- World Health Organization office in Iran (WHO)
- Tohoku University
- Barcelona Supercomputing Center (BSC)
- United Nations Environment Management Group
- Finnish Meteorological Institute
- Japan Meteorological Agency (JMA)
- Environment Department of Environment of the Islamic Republic of Iran (DOE)
- European Institute on Economics
- Spanish Council of Scientific Research in Barcelona
- Risk Nexus Initiative

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Thank You