APDIM – sand and dust storm assessment Australia

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Source:Australian Newspaper 28 Jan 2006

Acknowledgments

- DustWatch project and its community volunteers
- Climate and Atmospheric Science Branch
- NASA - CSIRO

Dust storm in Mildura, Victoria, Australia, photo taken by Robert Klarich on 7 May 2019. Photo Submitted to APDIM Call for Photography 2021: Living with Sand and Dust Storms

Outline

- Welcome to Southern Oceania - Australia and New Zealand
- Trans boundary issues
- Mitigating impact

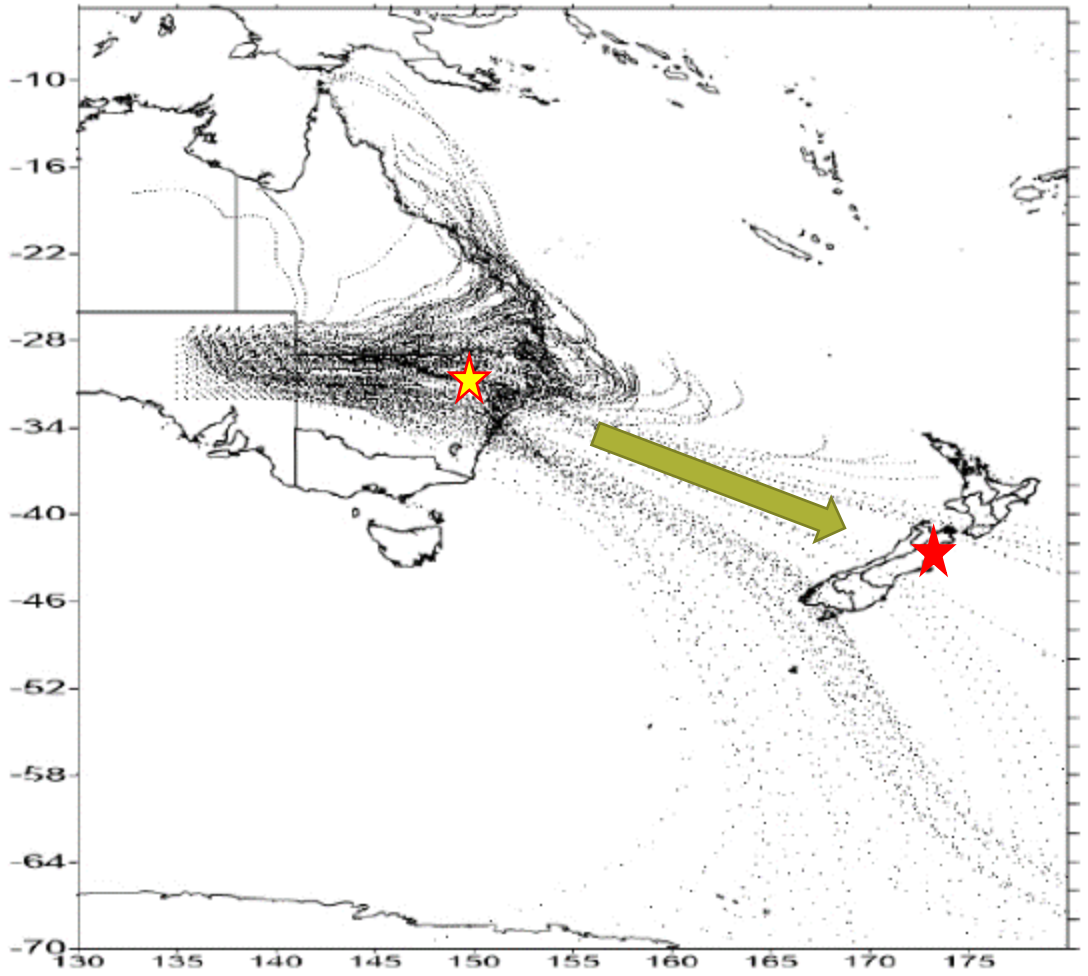
Trans boundary issues

- Australia is the largest dust source in the southern hemisphere. Australian dust emissions 106 Tg y^{-1} (Tanaka and Chiba 2006).
  - No incoming dust
  - Dust exporter – New Zealand and Antarctica

Dust Pathways

- Australia to New Zealand 2200km

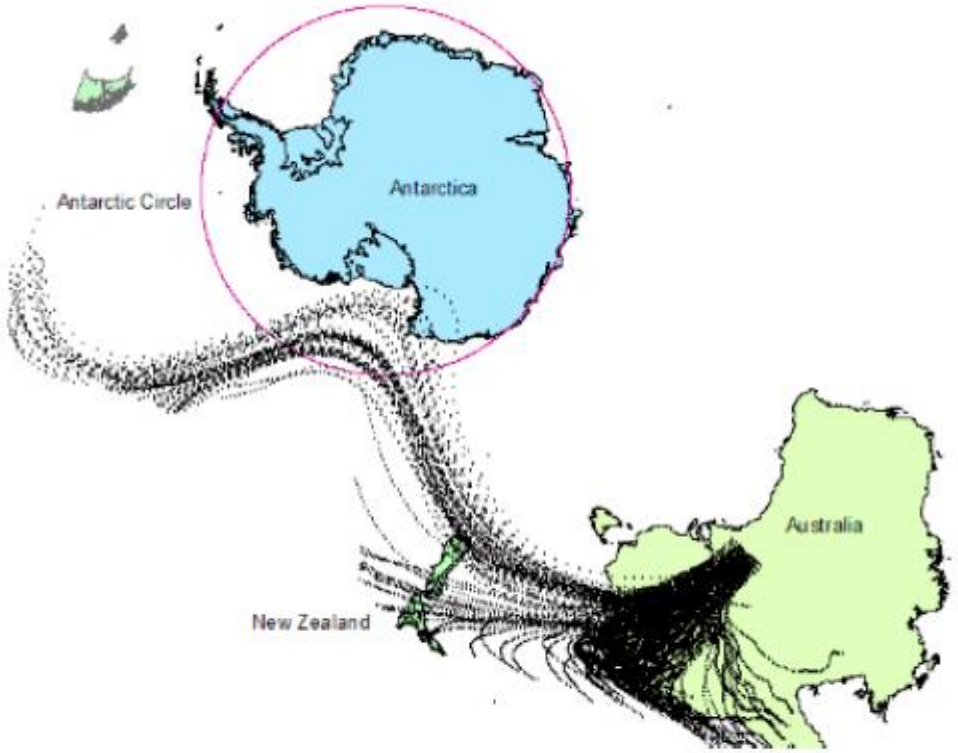
- Australia
  - ☆ Tamworth maximum PM10 of **607 ug/m^3** at 13 February 2019 06:00 UTC
- New Zealand
  - ★ maximum PM10 of **127 ug/m^3** at 14 February 2019 08:00 UTC



HYSPLIT forward trajectory ensemble analysis for 96 h at 10 m height from a source area in Central Australia on 11 February 2019 4 UTC. Source: Nguyen, etal. 2020

Dust Pathways

- Antarctica



NOAA HYSPLIT model matrix forward trajectory analysis from dust source areas in Central Australia with particle release times on 11 February 2019 4:00. Source: Nguyen, etal. 2020

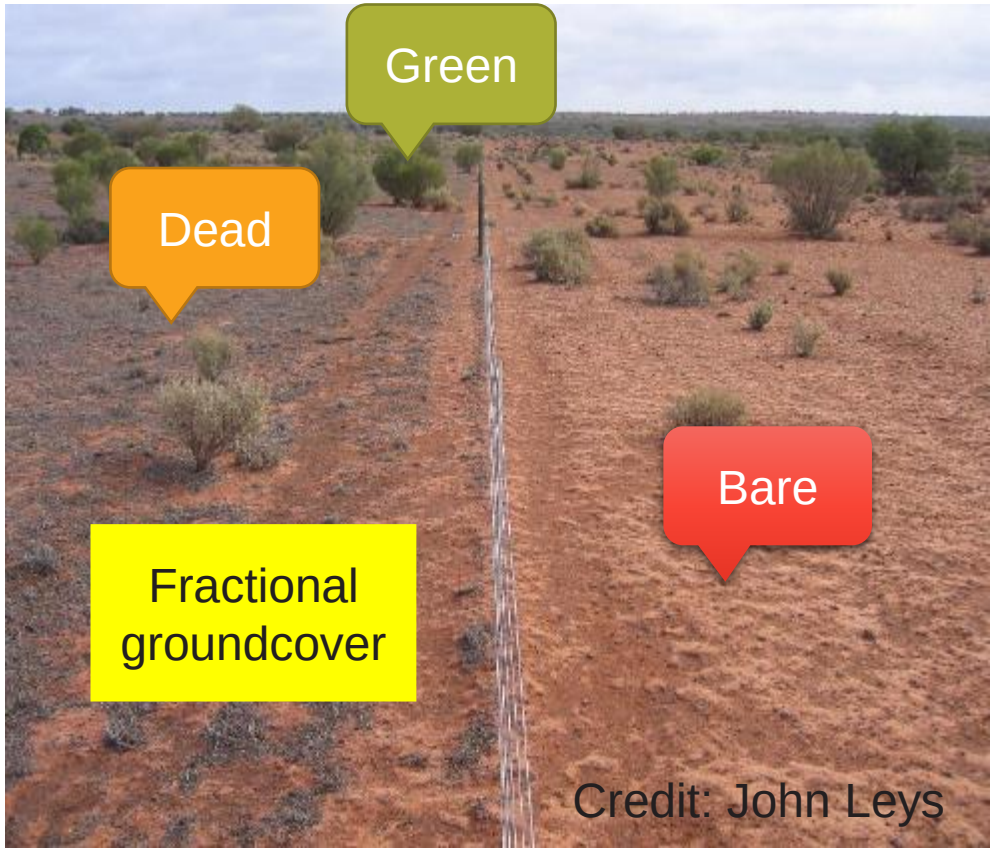
Mitigating impact

- On-site impacts
  - Soil erosion
  - Burying of infrastructure
  - Damage to native vegetation
- Off-site impacts
  - Air quality
  - Dust deposition

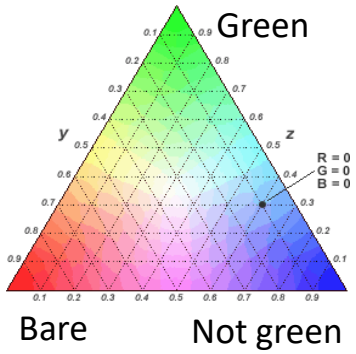
Measuring ground cover for Australia

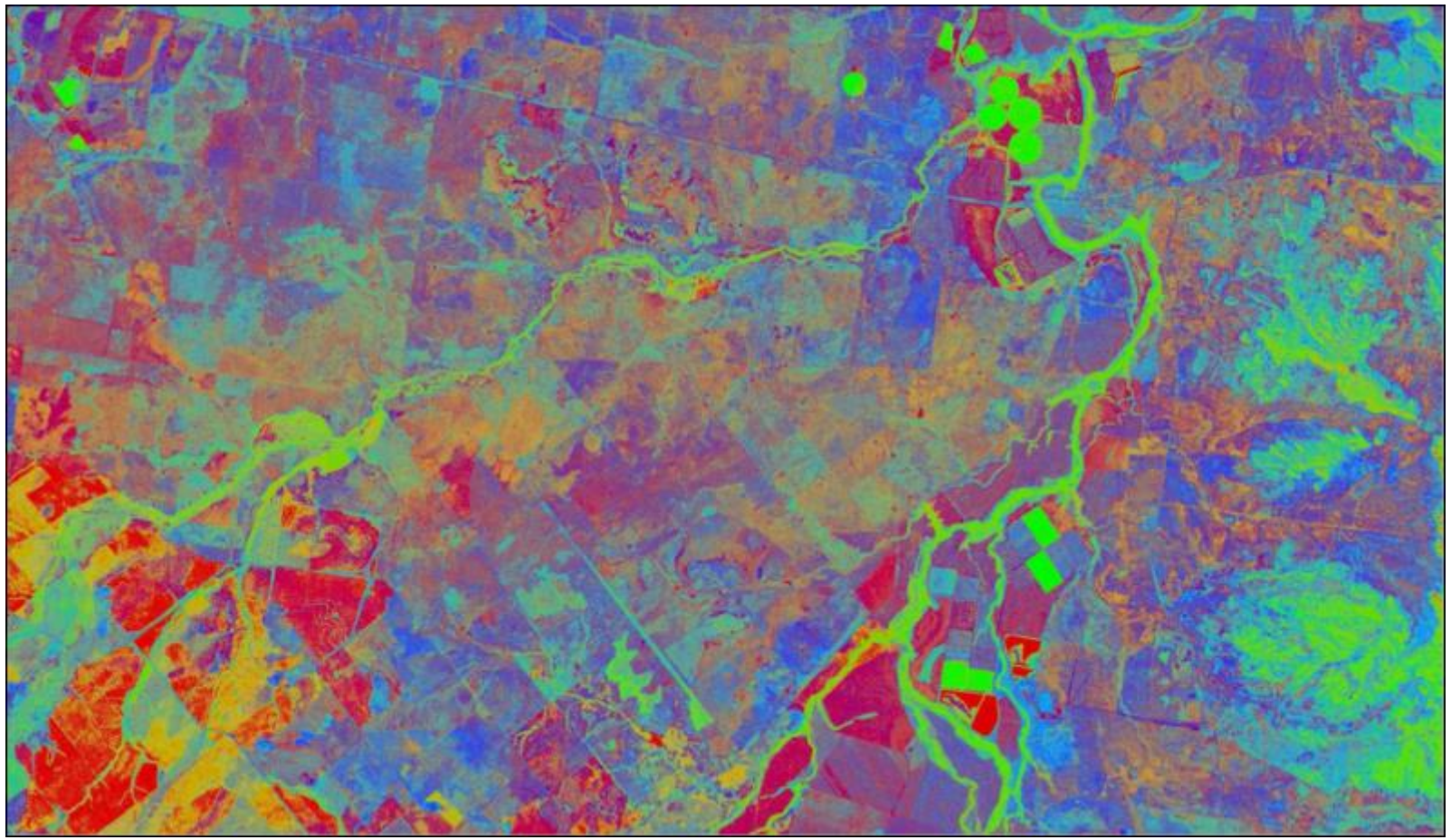
- Satellite – MODIS at 500m resolution, Landsat at 30 m and Sentinel 2 at 10m
- Full validated by Joint Remote Sensing group and Guerschman (CSIRO)

Source https://www.quora.com/Why-are-there-no-pictures-from-space-of-satellites-or-real-photos-of-the-Earth-that-are-not-simulated

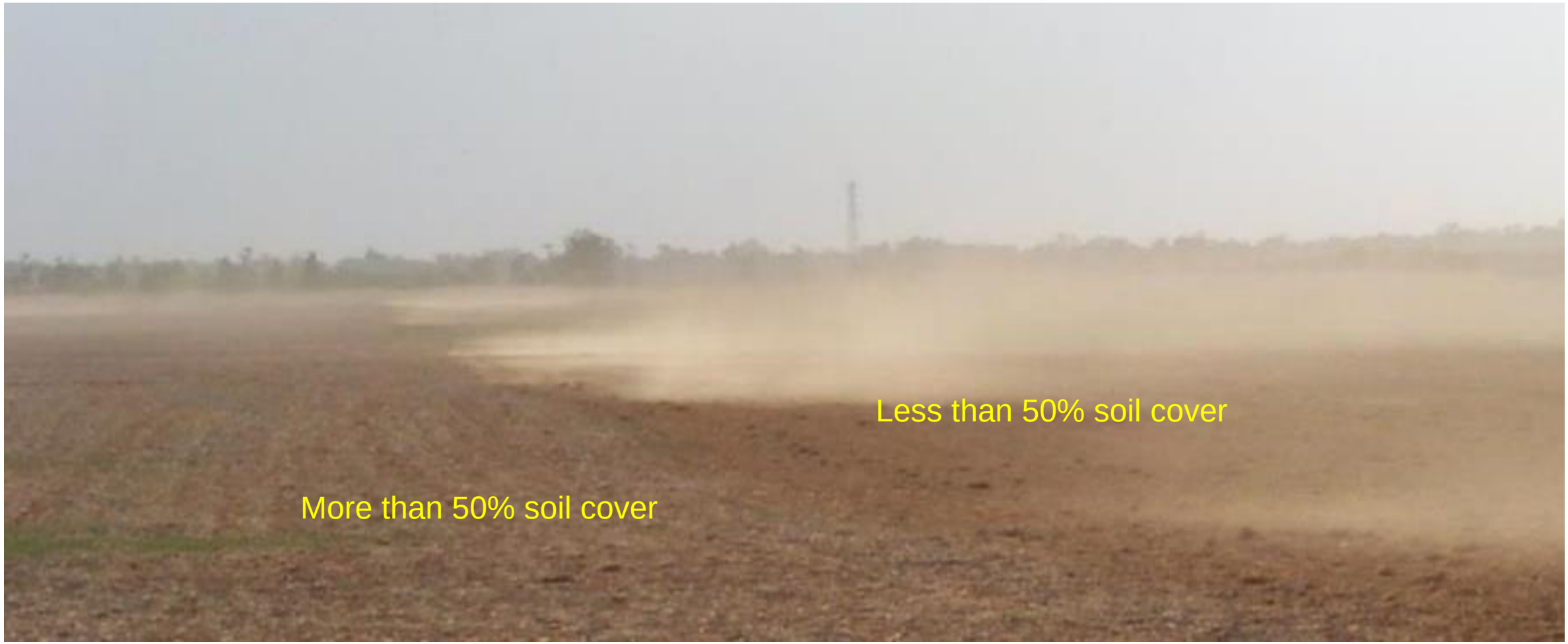


Cover type; green, dead or bare ground for each month



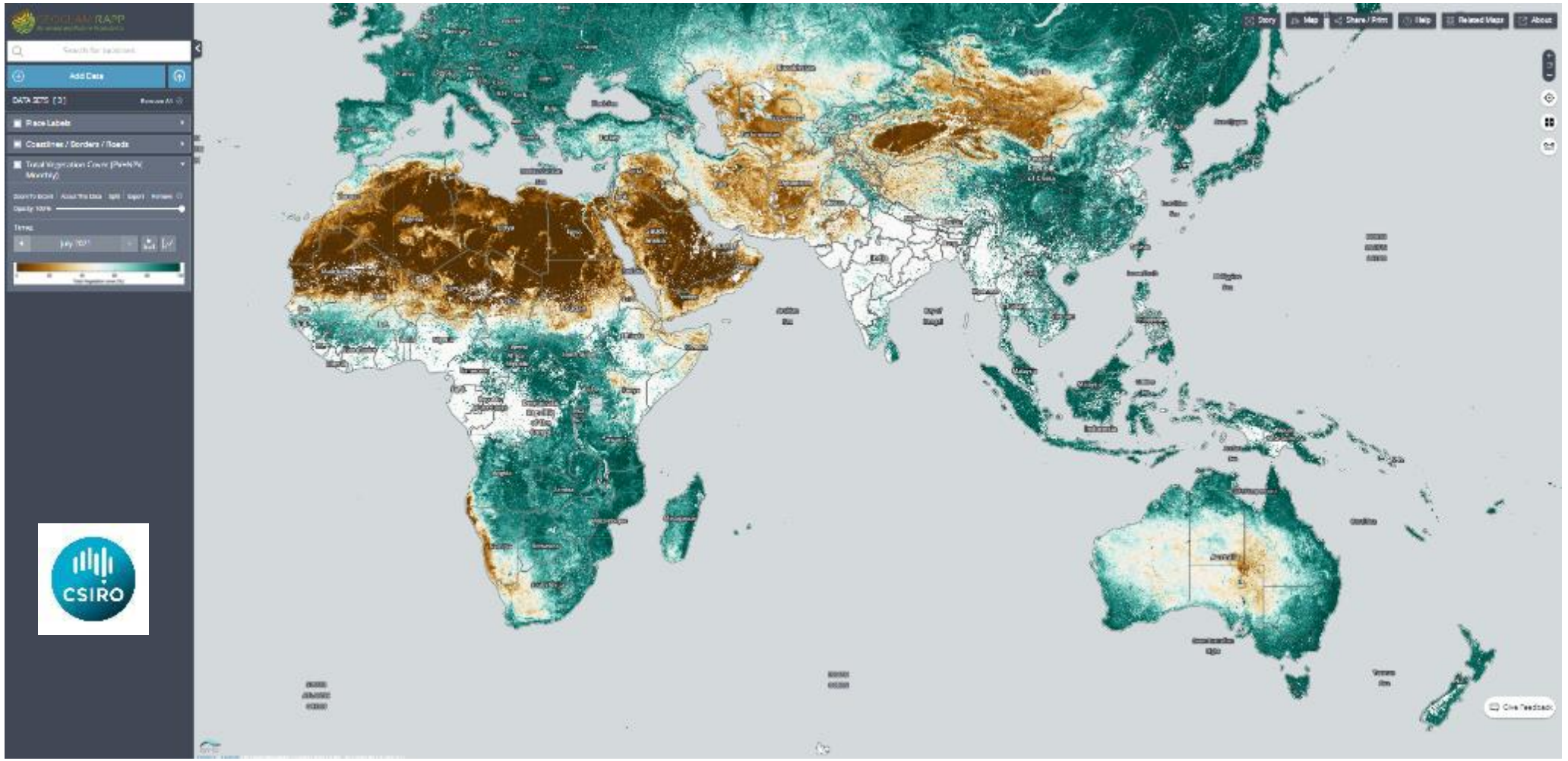


How much cover do we need



Credit: John Leys

Global vegetation cover – RaPP Map http://map.geo-rapp.org/



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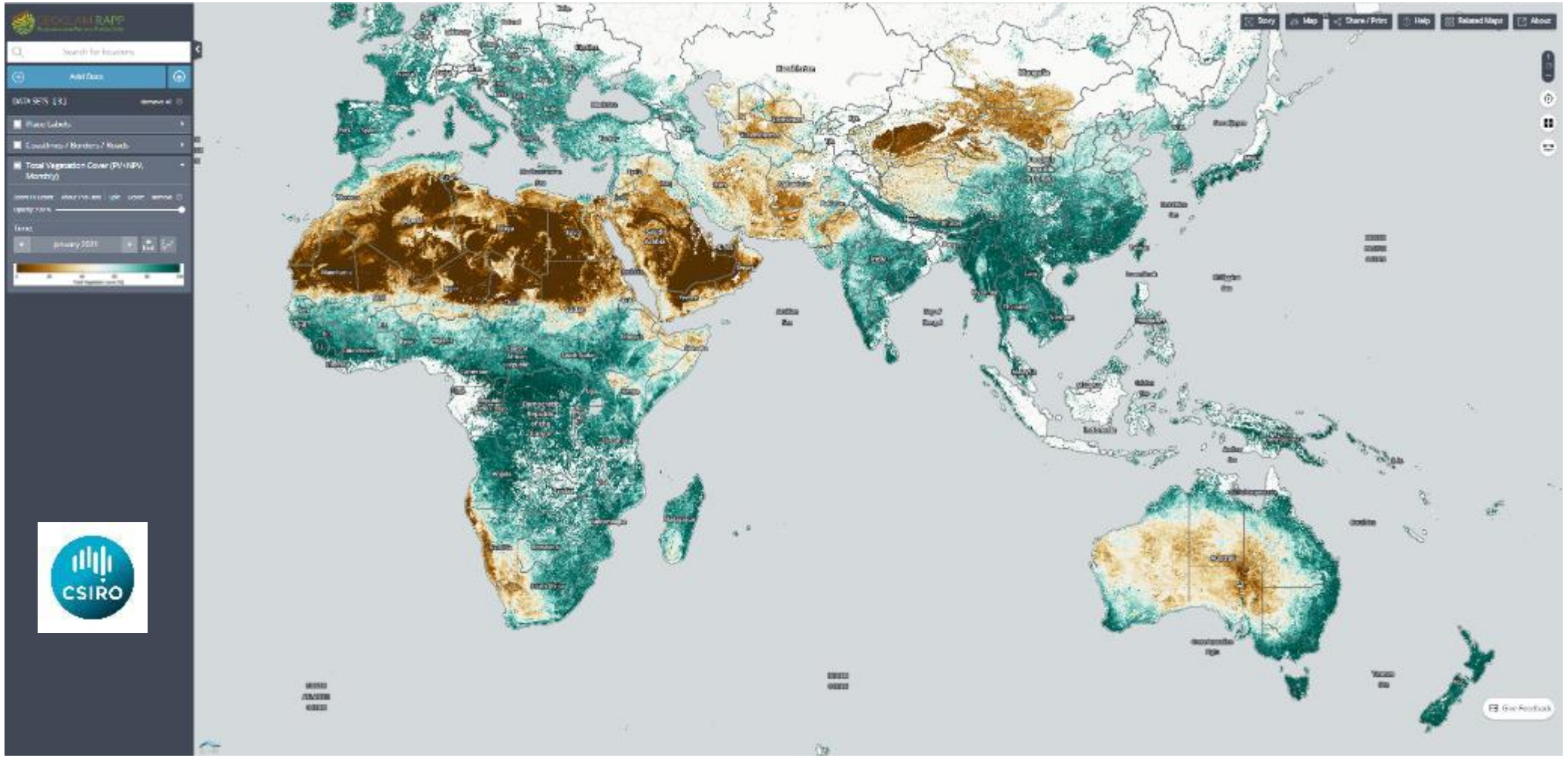
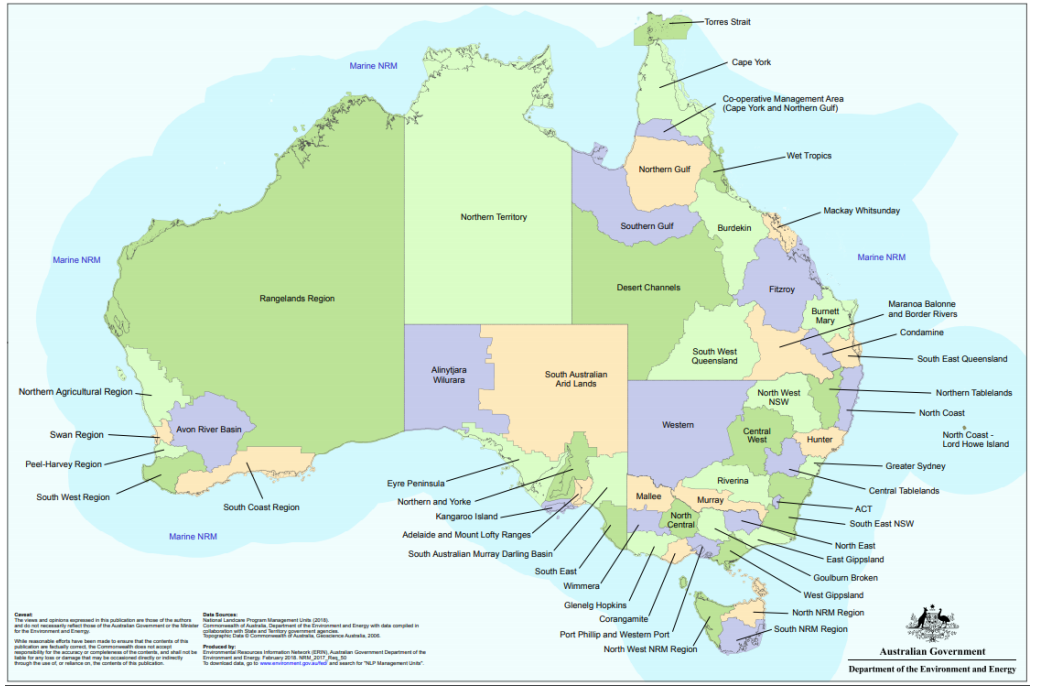


The onsite issue, wind erosion reduces productivity

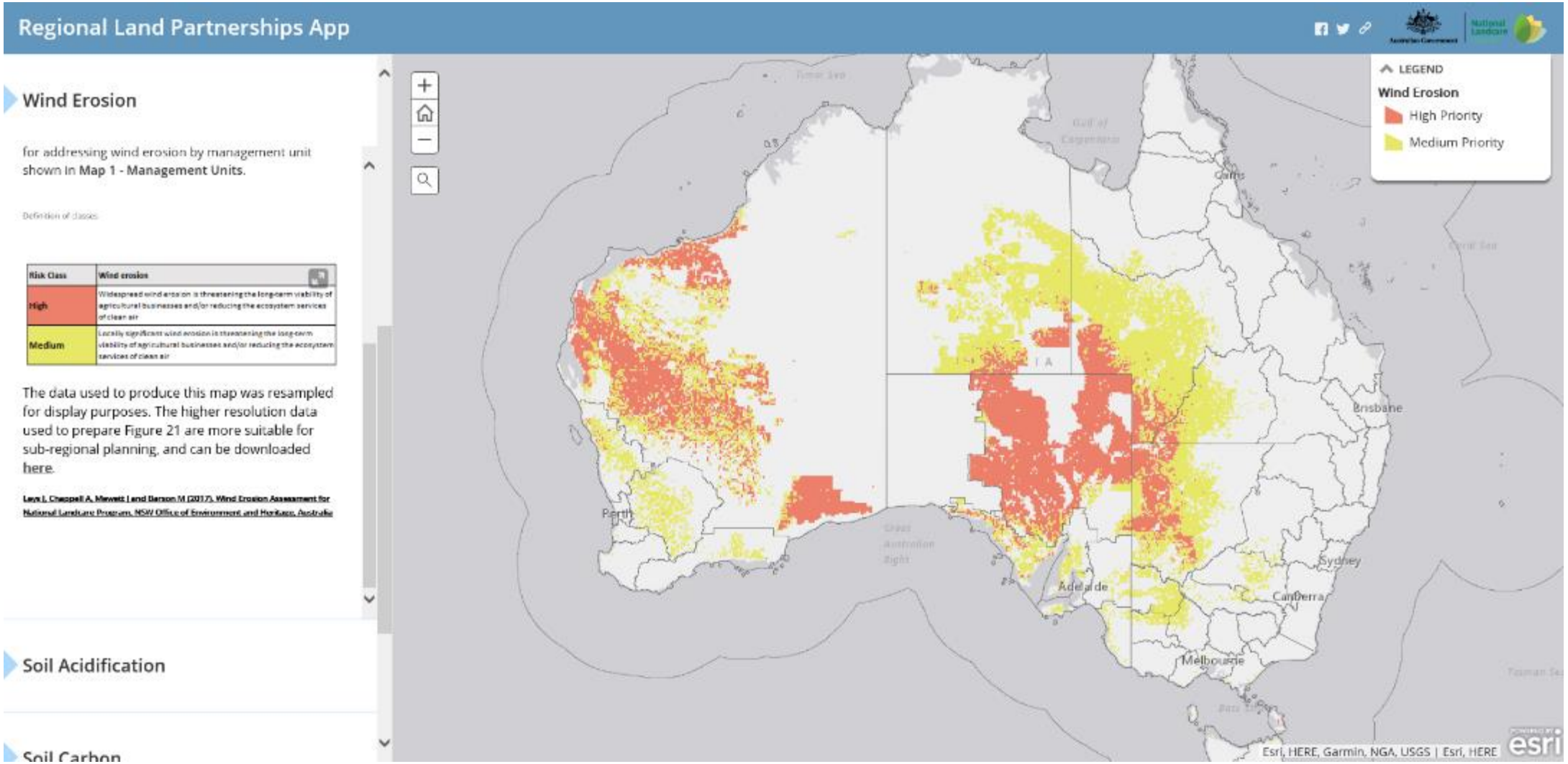
Photo credits: John Leys

Onsite

- Mitigation though education programs
  - National Landcare program
  - From June 2018 to June 2023 the Australian Government is investing in partnerships with “governments, industry, **communities** and individuals to **protect and conserve** Australia’s **water, soil, plants, animals and ecosystems**, as well as support the productive and sustainable use of these valuable resources”

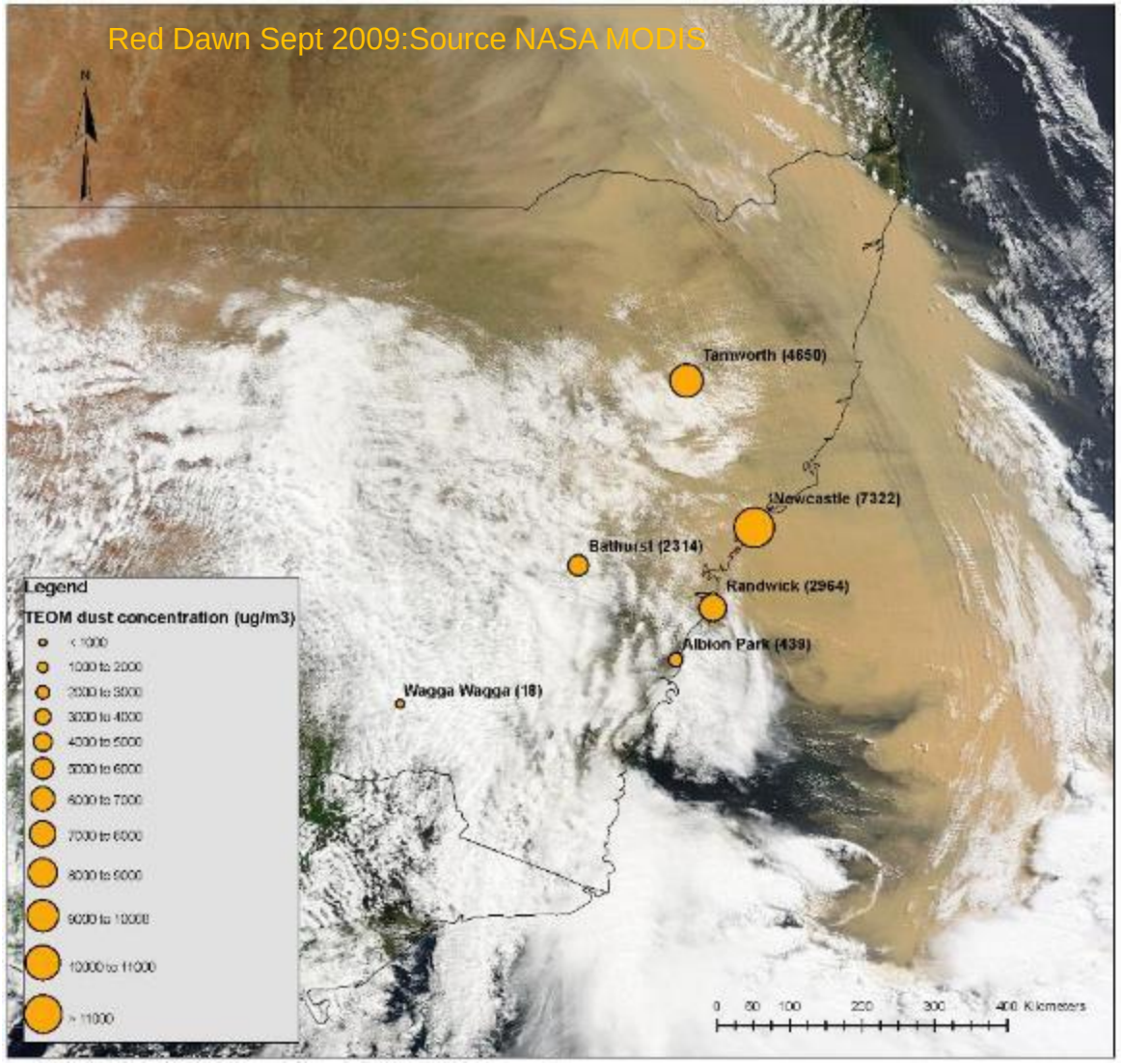


Offsite impacts – mitigated at on-site

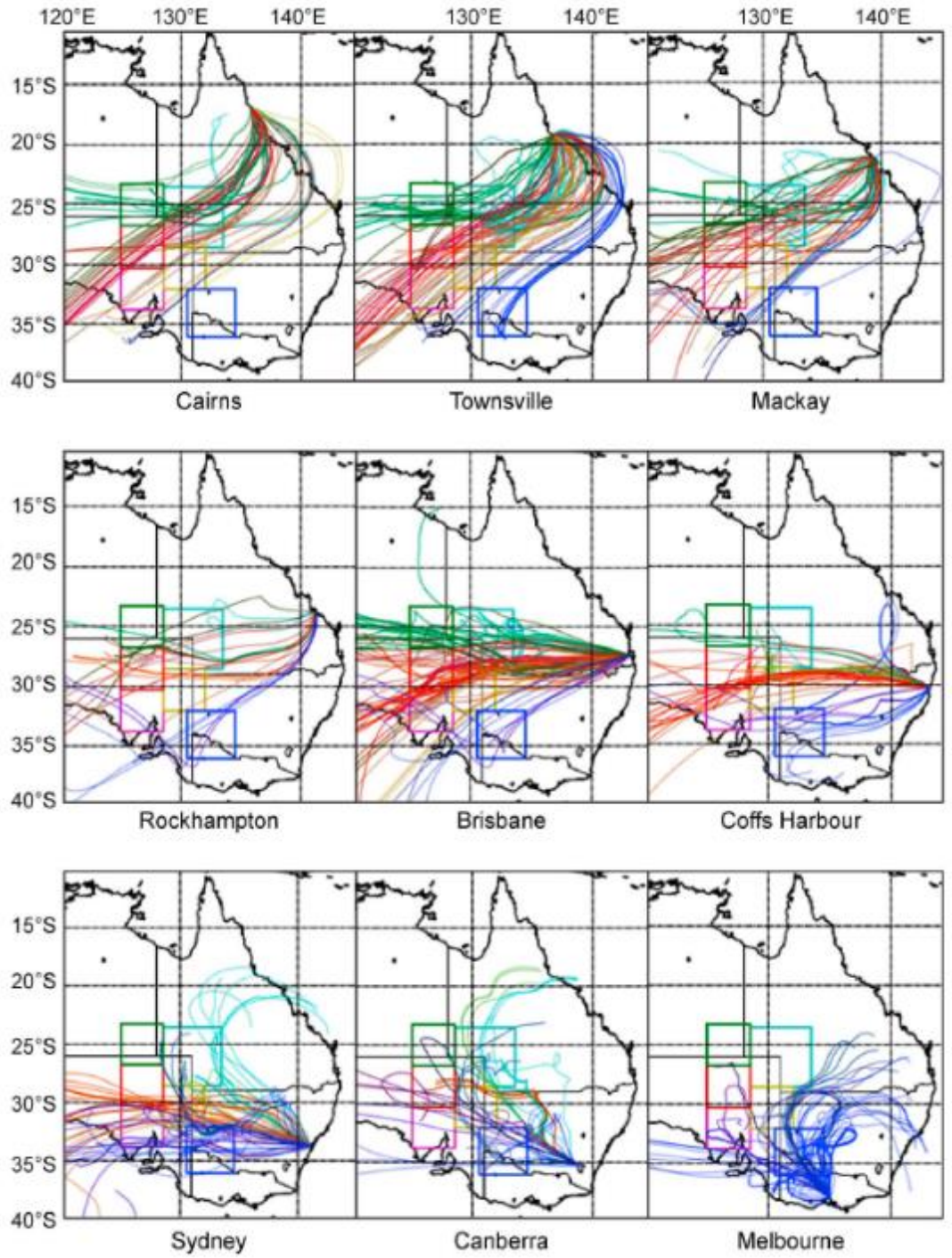


Source: https://erin.maps.arcgis.com/apps/MapSeries/index.html?appid=c2606f315ee74d899c4f7ae478c29ccc

Dust travels long distances



(from Leys et al. 2011)



(from O'Loingsigh et al. 2017)

The offsite issue – dust storms reduce air quality

Red Dawn" dust storm September 2009

- 2.54 Tg y^{-1} (Leys et al 2011).
- $299M for New South Wales economy (Tozer and Leys 2013)

February 2019

- 161 respiratory and 7 cardiovascular disease hospitalisations (Aragnou et al 2021)

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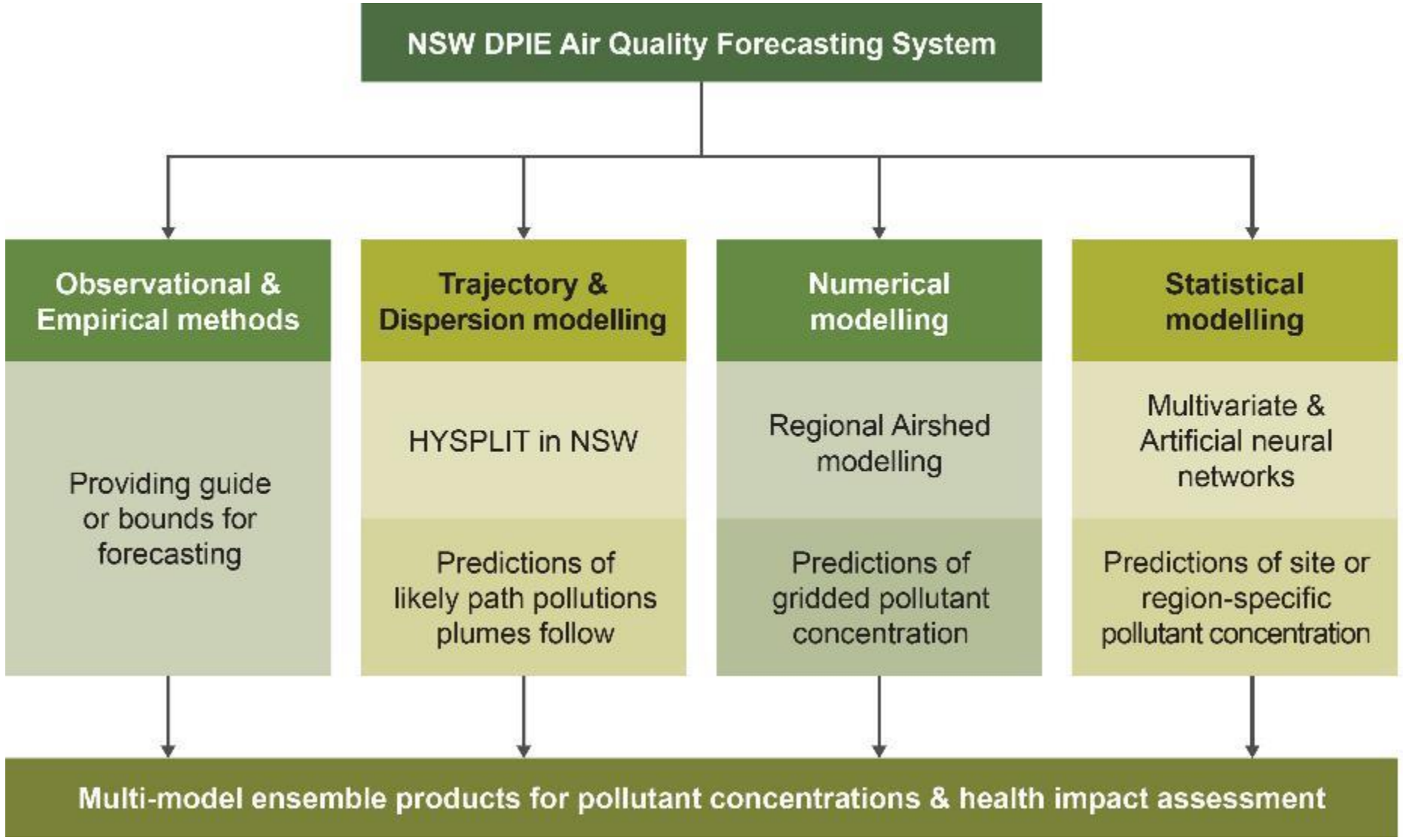
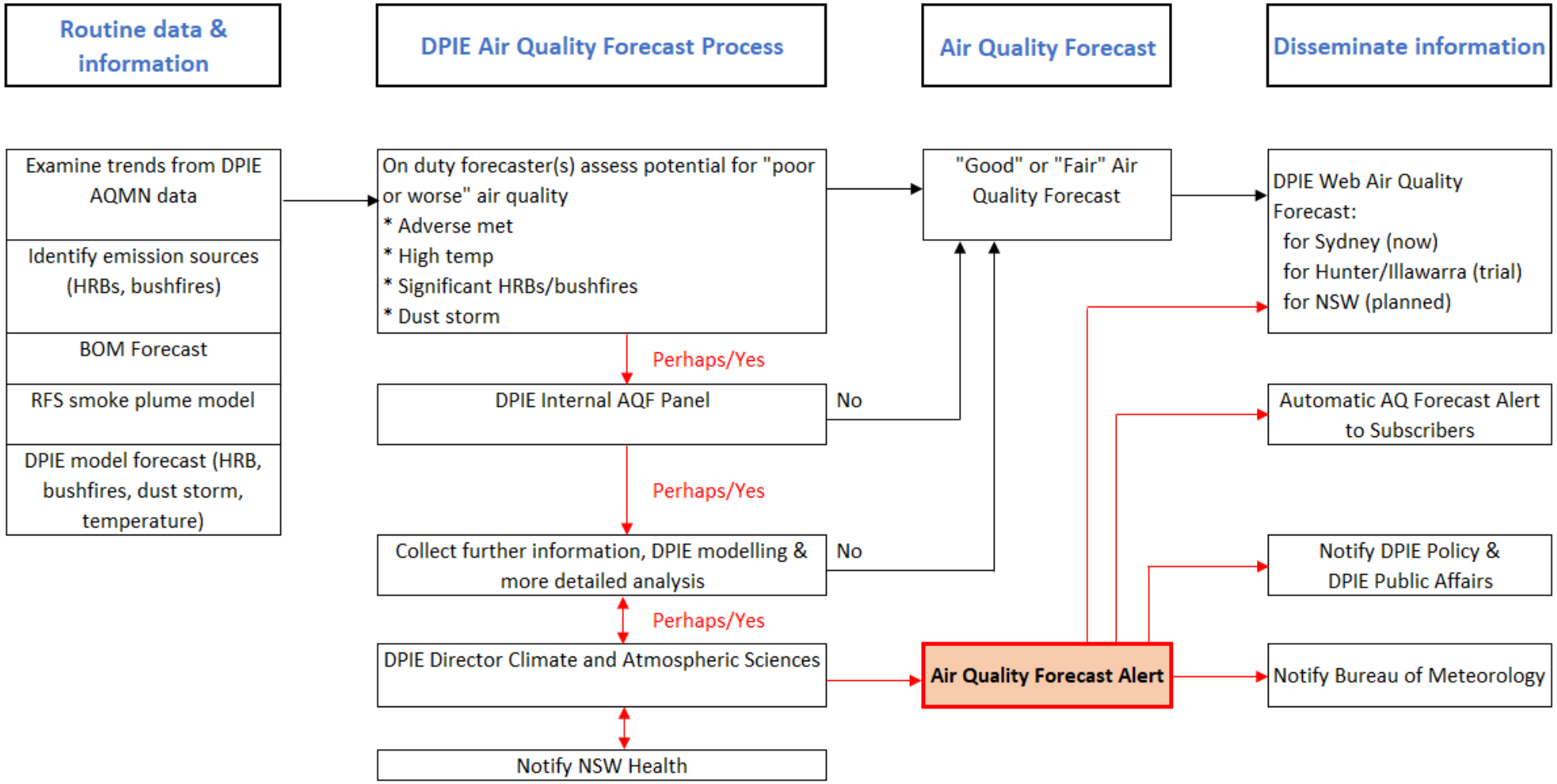
NSW DPIE Air Quality Forecasting Framework

NSW GOVERNMENT | Planning, Industry & Environment



Dust forecasting – Australian east coast



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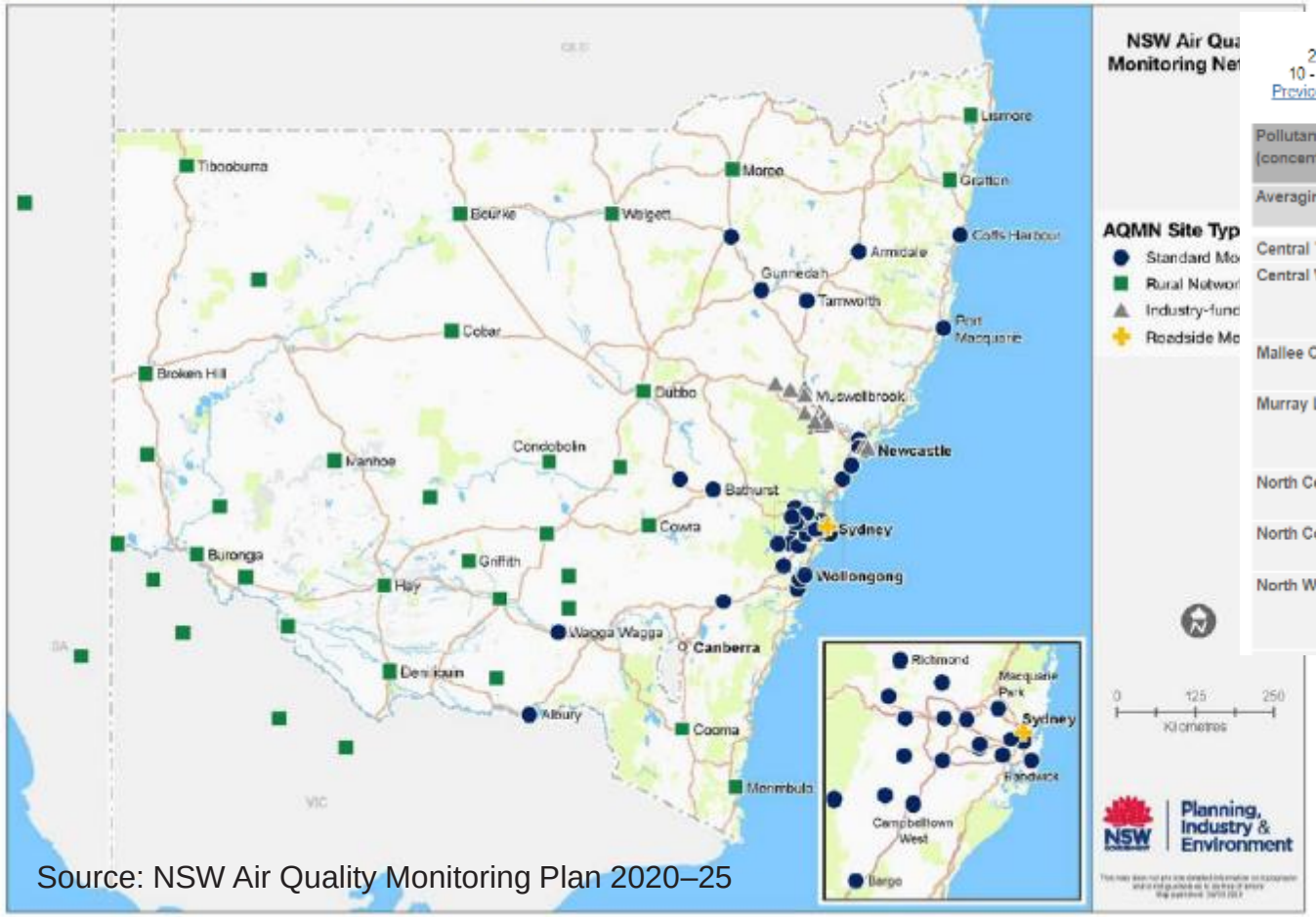
Operational Dust Forecast in NSW

NSW GOVERNMENT | Planning, Industry & Environment

1. Monitor regional dust activities by TSP/PM_{10}/$PM_{2.5}$ observations from NSW rural air quality network

Maps of NSW monitoring stations



Source: NSW Air Quality Monitoring Plan 2020–25

Online data

Tuesday
27 July 2021
10 - 11 pm (AEST)
Previous | Next | Select

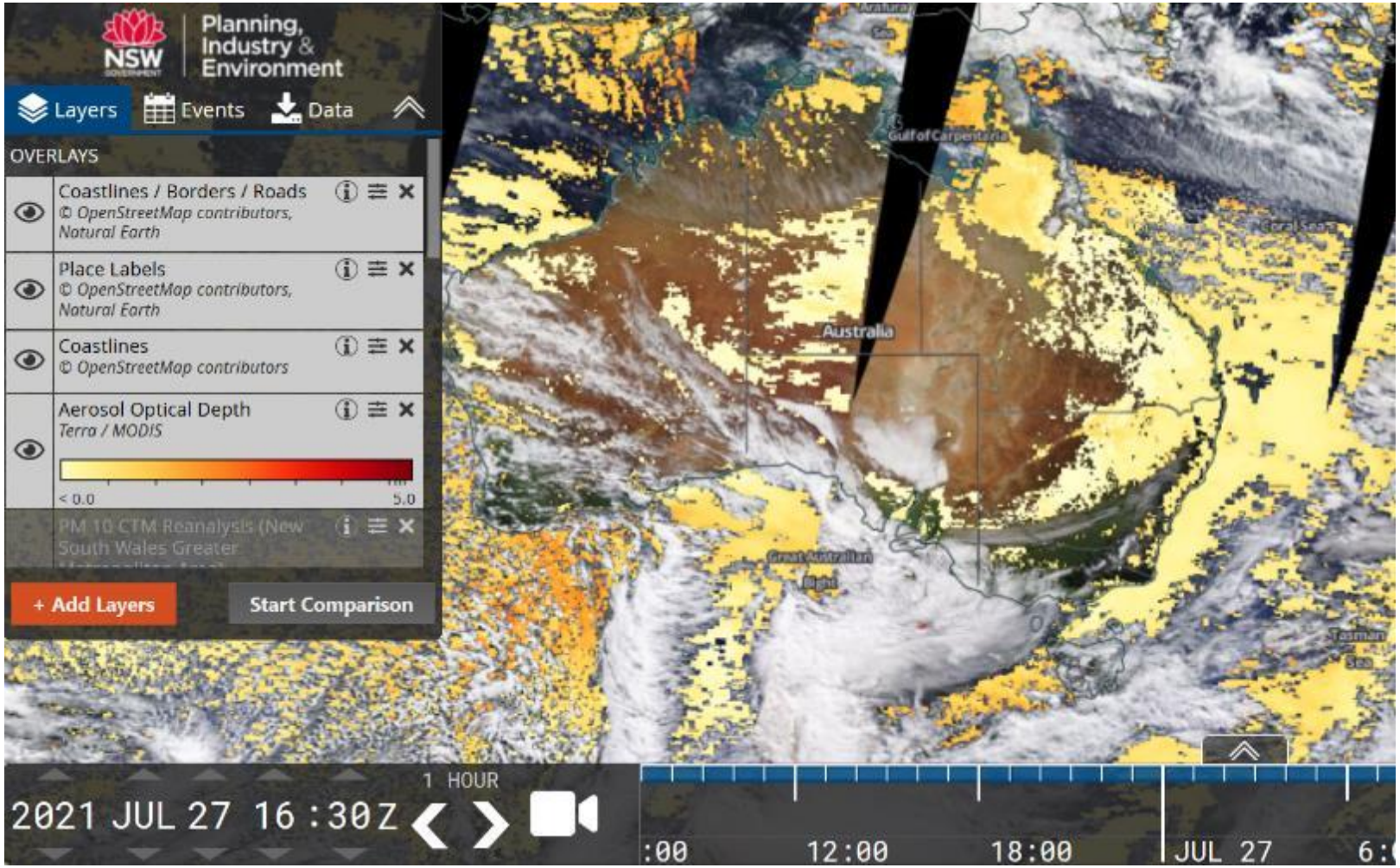
27 July 2021
11pm

Pollutants (concentration unit: µg/m³)		Particles PM2.5	Particles PM10	Total Suspended Particles
Averaging Periods		1-hour average	1-hour average	1-hour average
Central Tablelands LLS	Cowra	1	4	5
Central West LLS	Condobolin	2	7	9
	Dubbo	0	0	0
	Parkes	1	6	8
Mallee CMA	Walpeup	3	31	34
	Werrimull	22	424	500
Murray LLS	Deniliquin	1	5	6
	Kyalite	1	3	8
	Rand	2	7	9
North Central CMA	Loddon Plains			
	Wycheproof	1	7	9
North Coast LLS	Grafton	3	5	6
	Lismore	1	8	10
North West LLS	Gunnedah	66	69	69
	Moree	1	3	3
	Walgett	1	5	5

Operational Dust Forecast in NSW

2. Dust observations from real-time satellite imagery

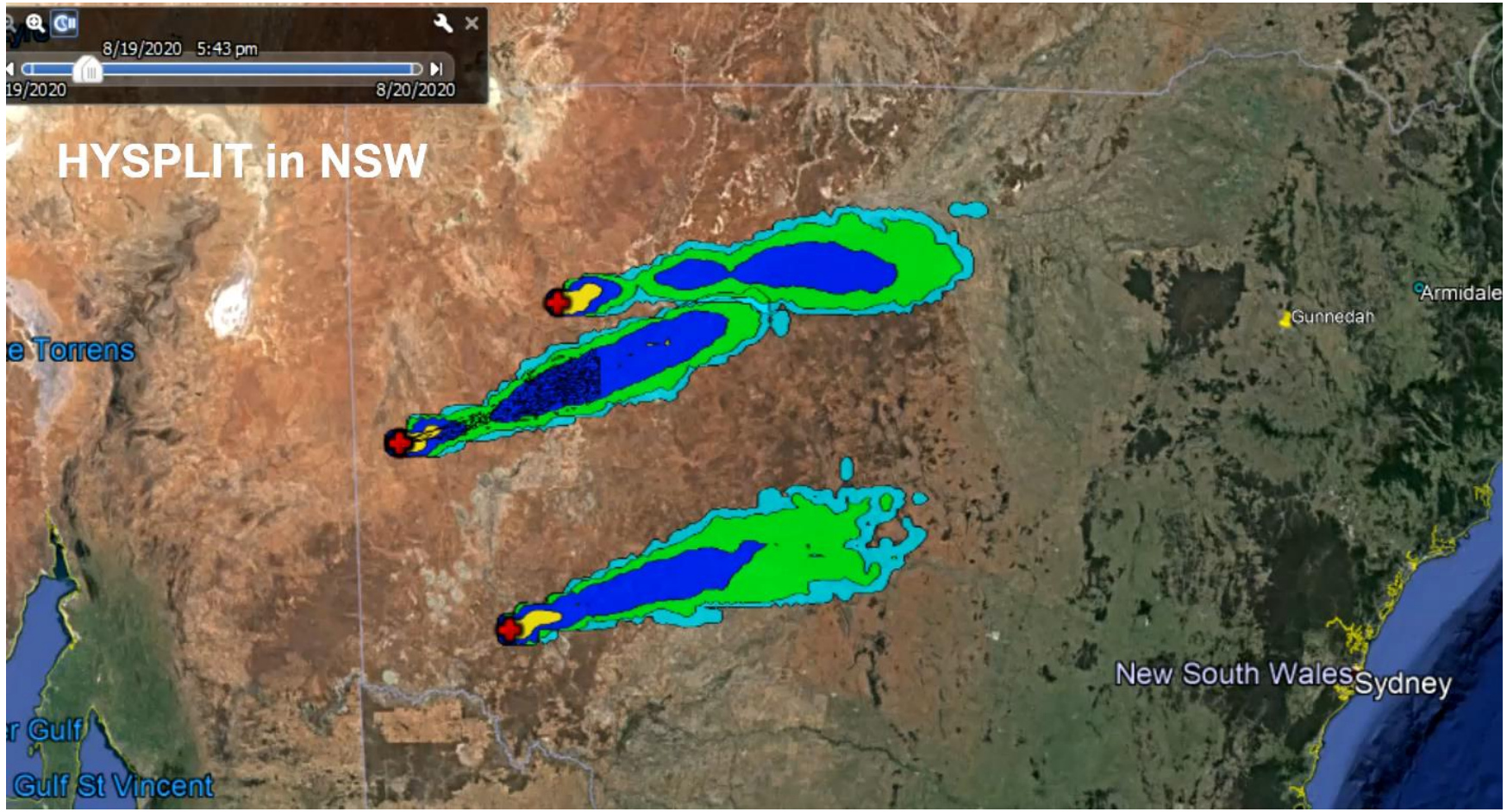
NSW DPIE Worldview visualisation platform (AOD + Corrected Reflectance Terra/MODIS)



Operational Dust Forecast in NSW

3. Dust trajectory and dispersion modelling

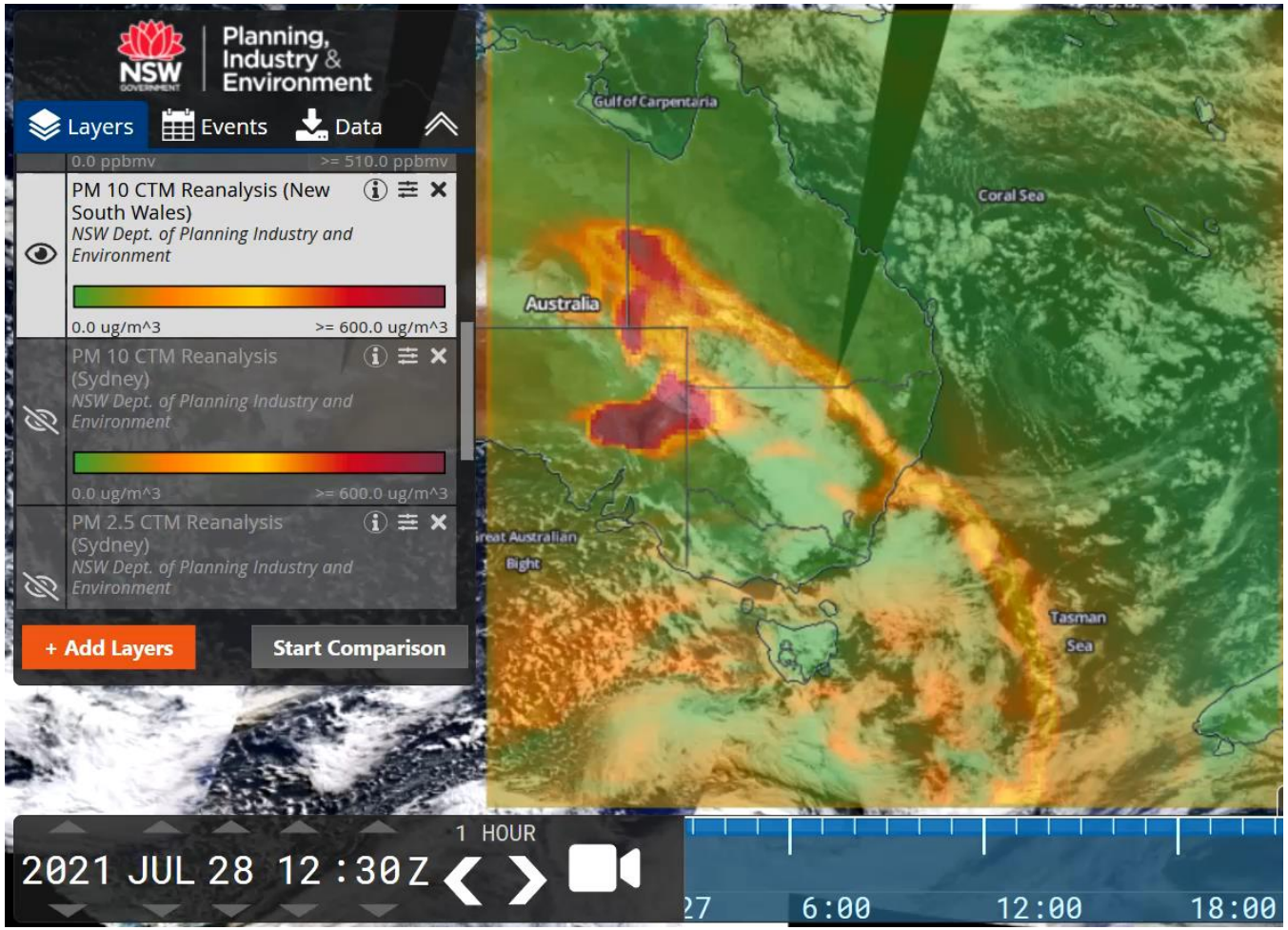
Example of the **HYSPLIT in NSW** forecast for a regional dust storm event (19 August 2020)



Operational Dust Forecast in NSW

4. Numerical modelling (in-line dust emission model + regional airshed model)

NSW DPIE Worldview visualisation platform – PM10 prediction (27-28 July 2021)



Conclusions

- Australia is the southern hemispheres largest emitter of dust.
- It does not receive dust from other continents
- The dust travels to New Zealand and Antarctica
- Due to the threat to the environment and people, Australia has several mitigation plans – e.g. National Landcare.
- Australia's largest population centre, Sydney, has a dust storm warning system that utilises multiple lines of evidence to warn the population of reduced air quality caused by dust

Questions

Mildura 1966. Source: Don Turvey, Sunraysia Daily