Modelling of the spatial and temporal patterns of dust storms emitted from the Aralkum (the former Aral Sea) in Central Asia

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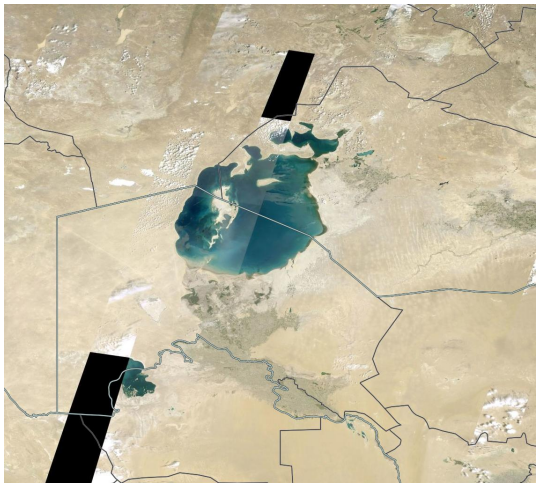
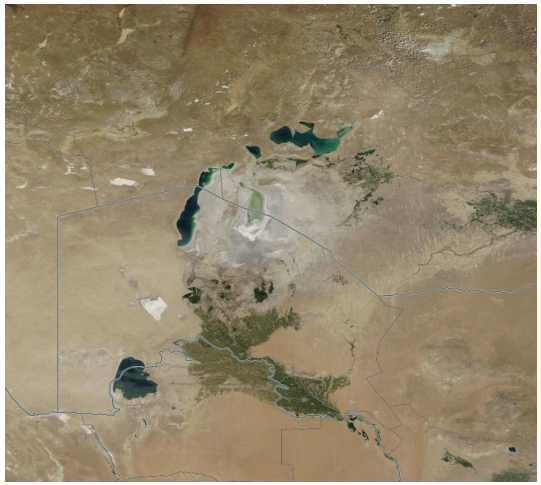
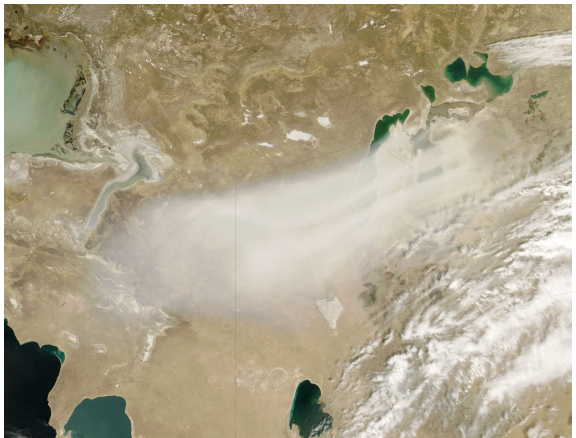
Landsat, June 1986





Terra MODIS, 28th July 2015



Aqua MODIS, 29th April 2008

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Surface water coverage change in Central Asia

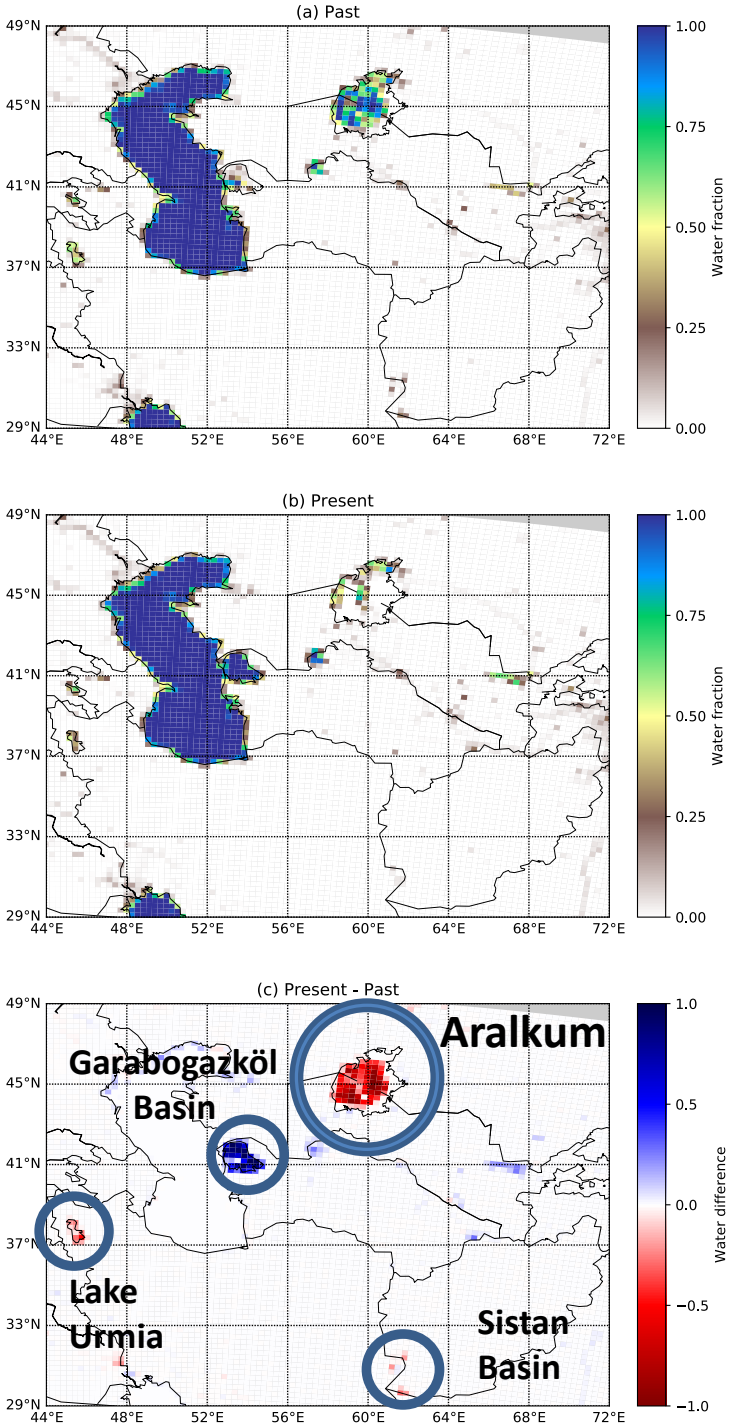
~60,000 km^2 (87%) of the Aral Sea's surface area was lost between 1960 and 2009 [*Micklin, 2010*]

The Aral Desert (Aralkum) is now a known dust source [e.g. *Xi et al., 2014, JGR*]

Global Surface Water product, derived from Landsat data [*Pekel et al., 2016*]
Past – 1980-1990s
Present – 2000-2010s
~28,000 km^2 of land has been added to the Aralkum.

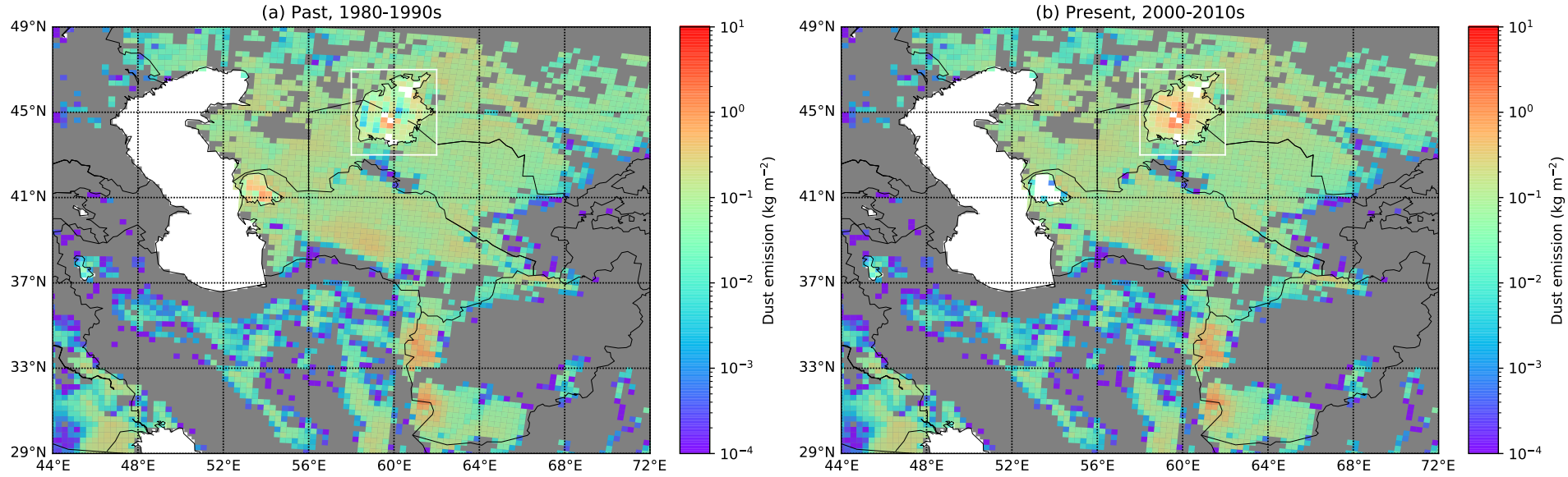
Using the regional aerosol model COSMO-MUSCAT, two dust transport scenarios are simulated for the Dustbelt (DUBLT), for the 'Past' and 'Present'.

Paper currently under review at JGR.



‘DUBLT’ simulated emissions March 2015 – March 2016

Key point #1:
The expanded lakebed of the Aralkum has contributed an estimated extra ~7% to Central Asian dust emissions over the past 30 years.

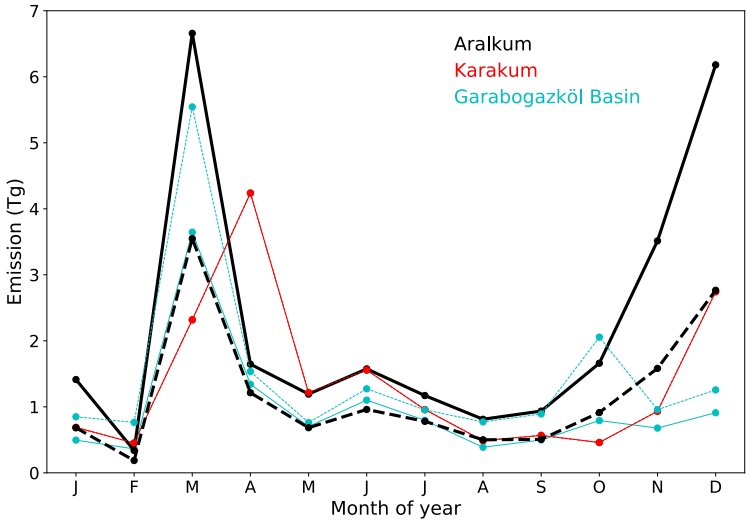


Regional emissions
(Past → Present)

Aralkum: 14.3 → 27.1 Tg

Karakum (old desert): 16.6 Tg

Garabogazköl Basin: 17.61 → 11.71 Tg



Total emissions (Tg)

Past : 180.3

Present : 187.3

Solid lines: Present
Dashed lines: Past

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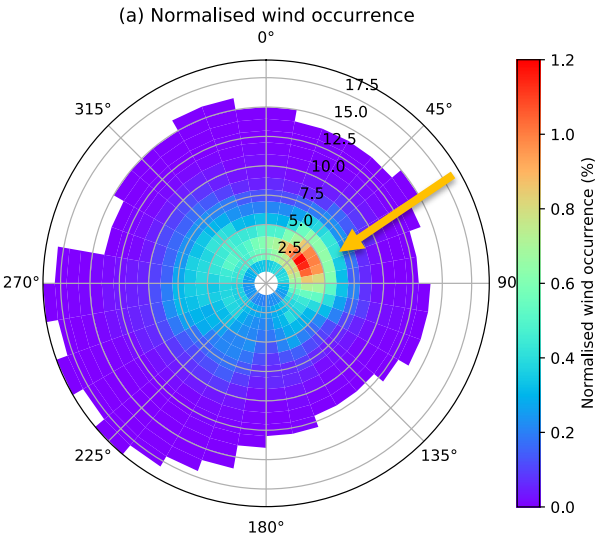
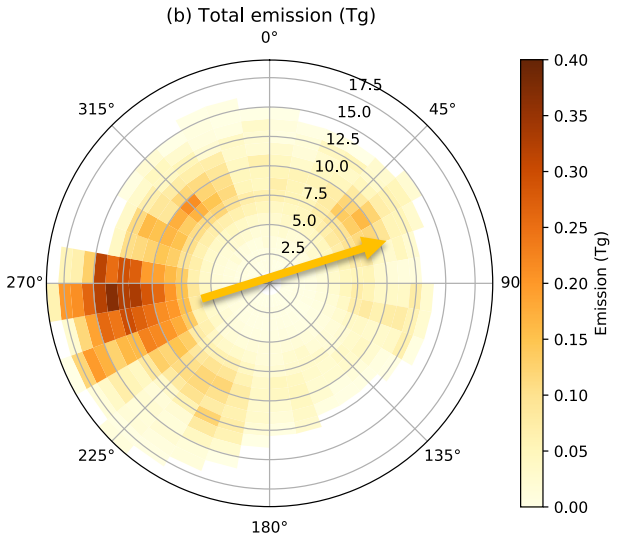
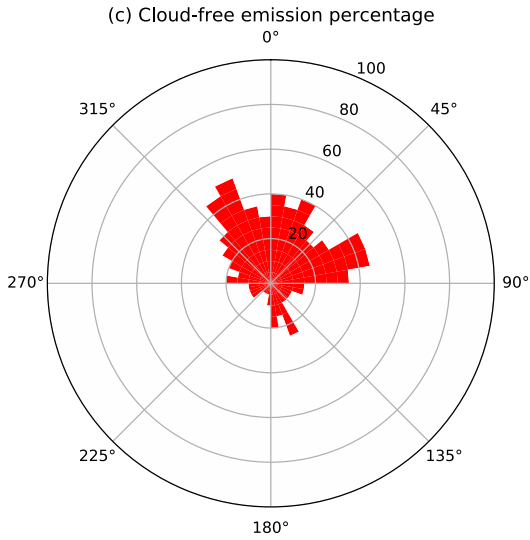
Aralkum dust emission directions
March 2015 – March 2016

Key point #2:
Over two thirds of the Aralkum's dust events may not be observable by satellites.







All-sky total = 27.1 Tg
Clear-sky total = 4.5 Tg

68% of the total emissions occur when the cloud cover > 95%.

17% occur when the cloud cover < 5%.

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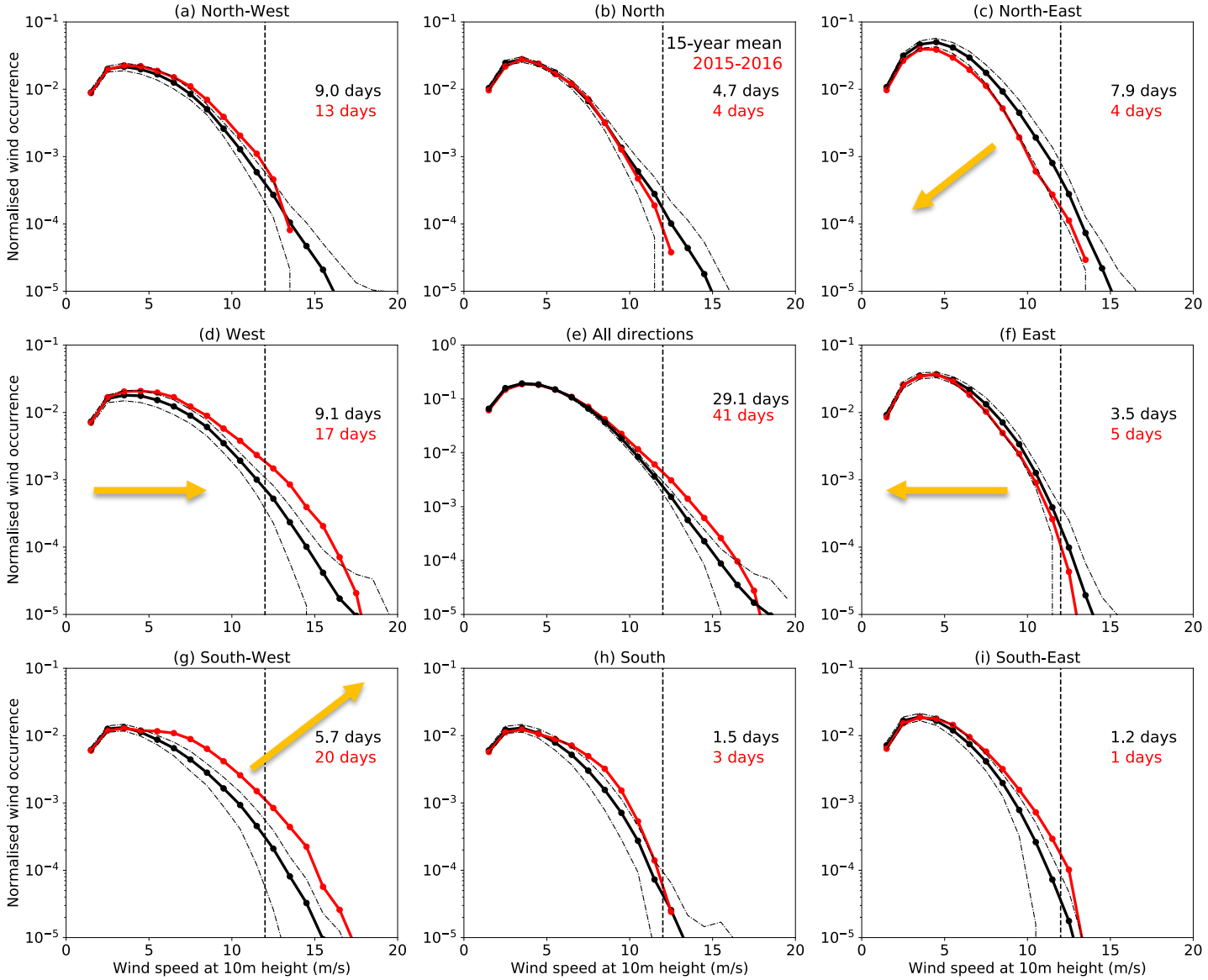
ERA5 directional wind distributions over the Aralkum, 2006-2020

The number of days refers to the number of days per year on which the wind speeds exceed 12 m s^{-1} somewhere in the Aralkum.

Standard deviation lines bracket the mean.



Key point #3:

There is a high degree of interannual variability in the directions of dust-producing high wind speed events over the Aralkum.

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Case studies of Aralkum dust events

Left: COSMO-MUSCAT dust optical depths

Right: Aqua MODIS true-colour images

Daily emission rankings within the year

3) 18th December 2015: 1.24 Tg

⋮

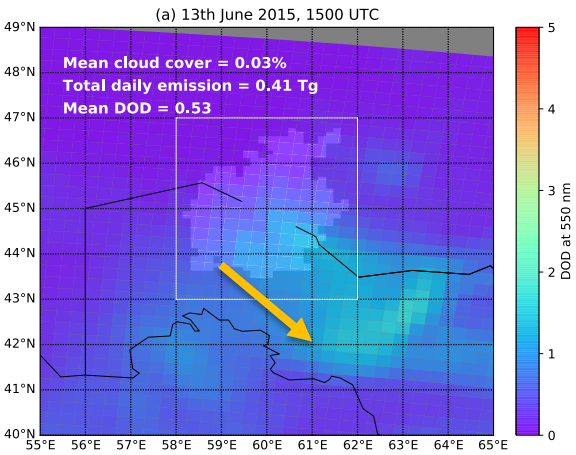
6) 17th March 2016: 0.86 Tg

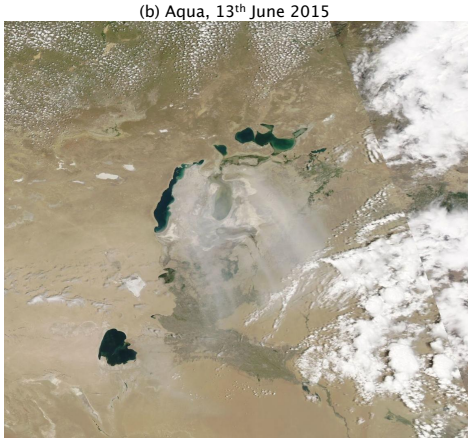
⋮

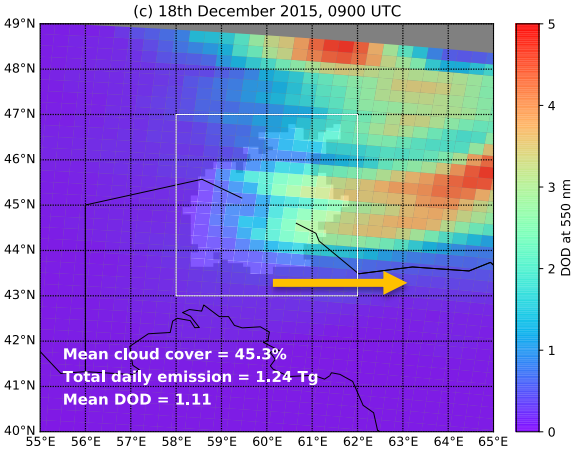
12) 13th June 2015: 0.41 Tg

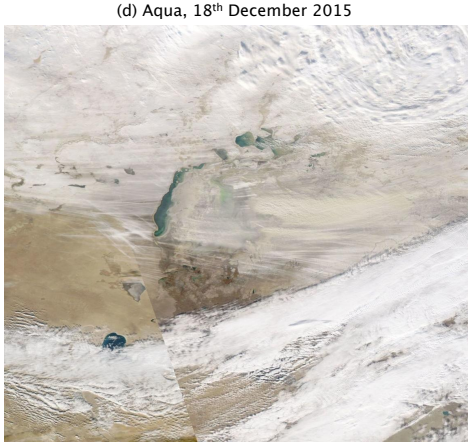
Outlook:

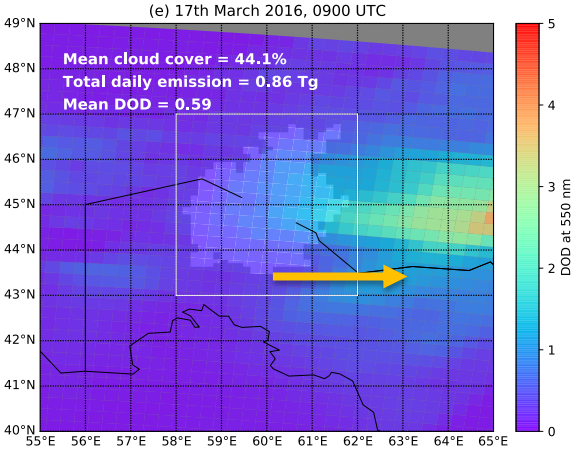
Investigations of the Aralkum's dust radiative effects are ongoing.

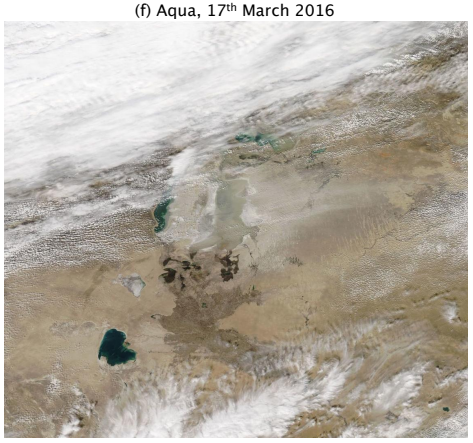












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