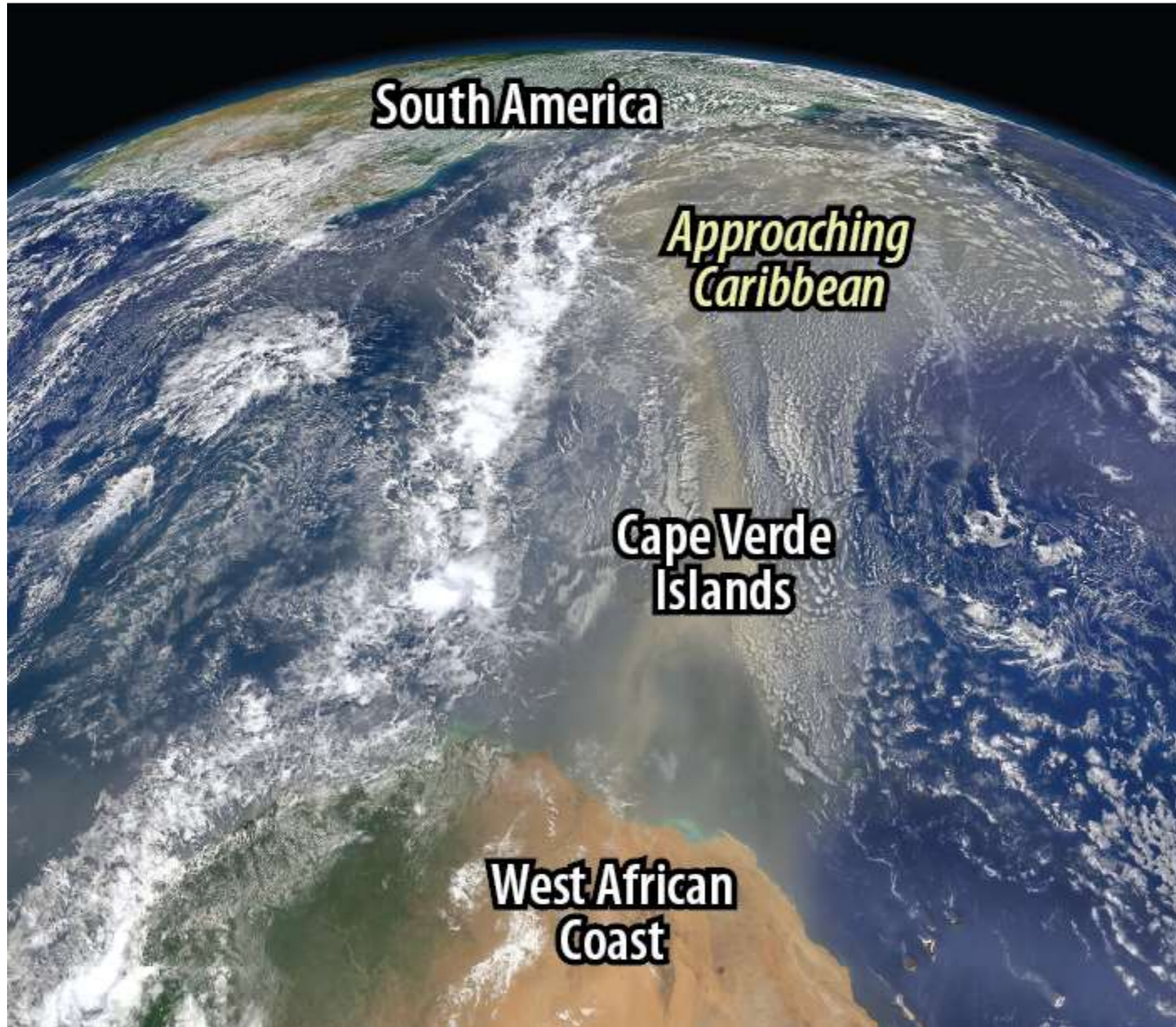


Forecasting Saharan Dust Transport with the NASA GEOS Earth System Model

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with contributions from:
Anton Darmenov, Arlindo da Silva, Ed Nowottnick, John Yorks, Brent Holben, NASA GSFC
Peng Xian and Jeffrey Reid, NRL-Monterey
ICAP contributing model teams

Motivation

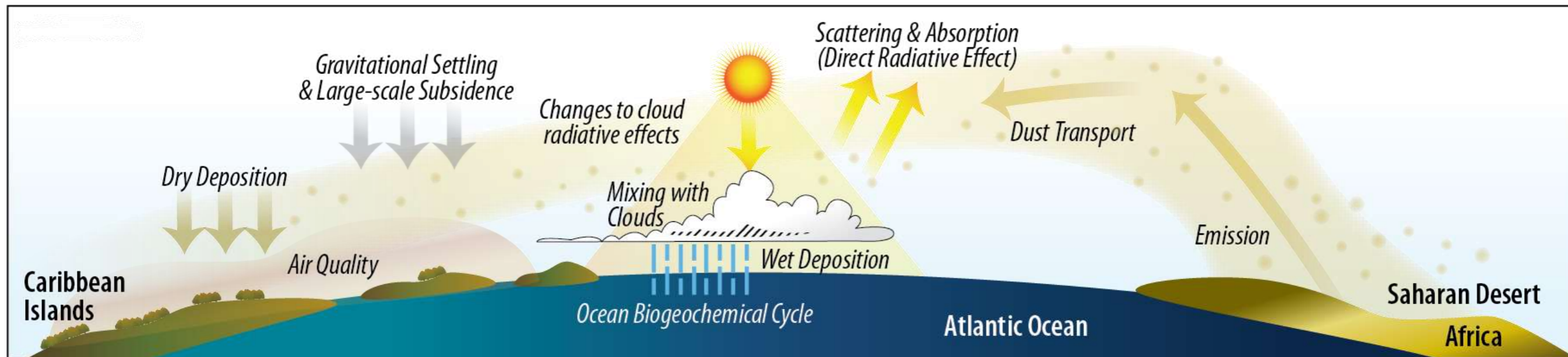


Mineral dust particles are Earth's most abundant aerosol suspended in the atmosphere

Saharan dust swept over the North Atlantic is the most visible aerosol feature from space

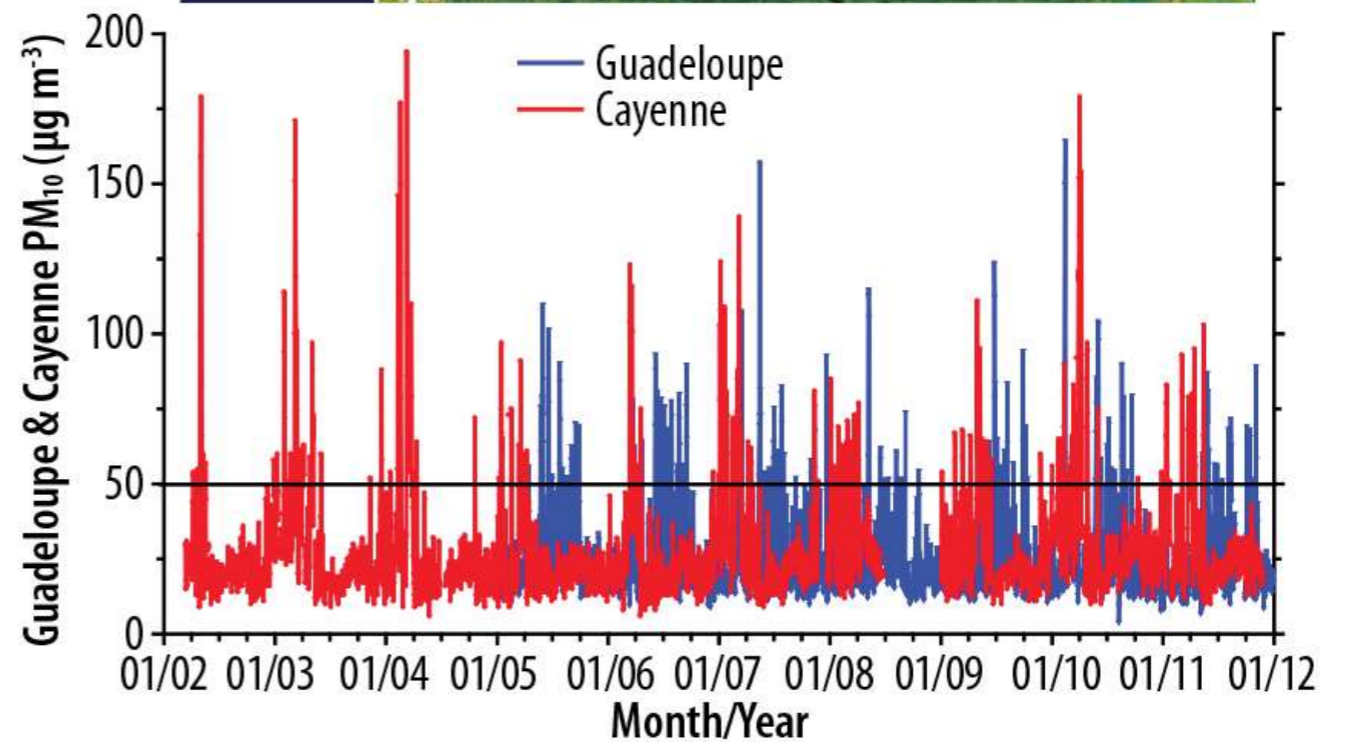
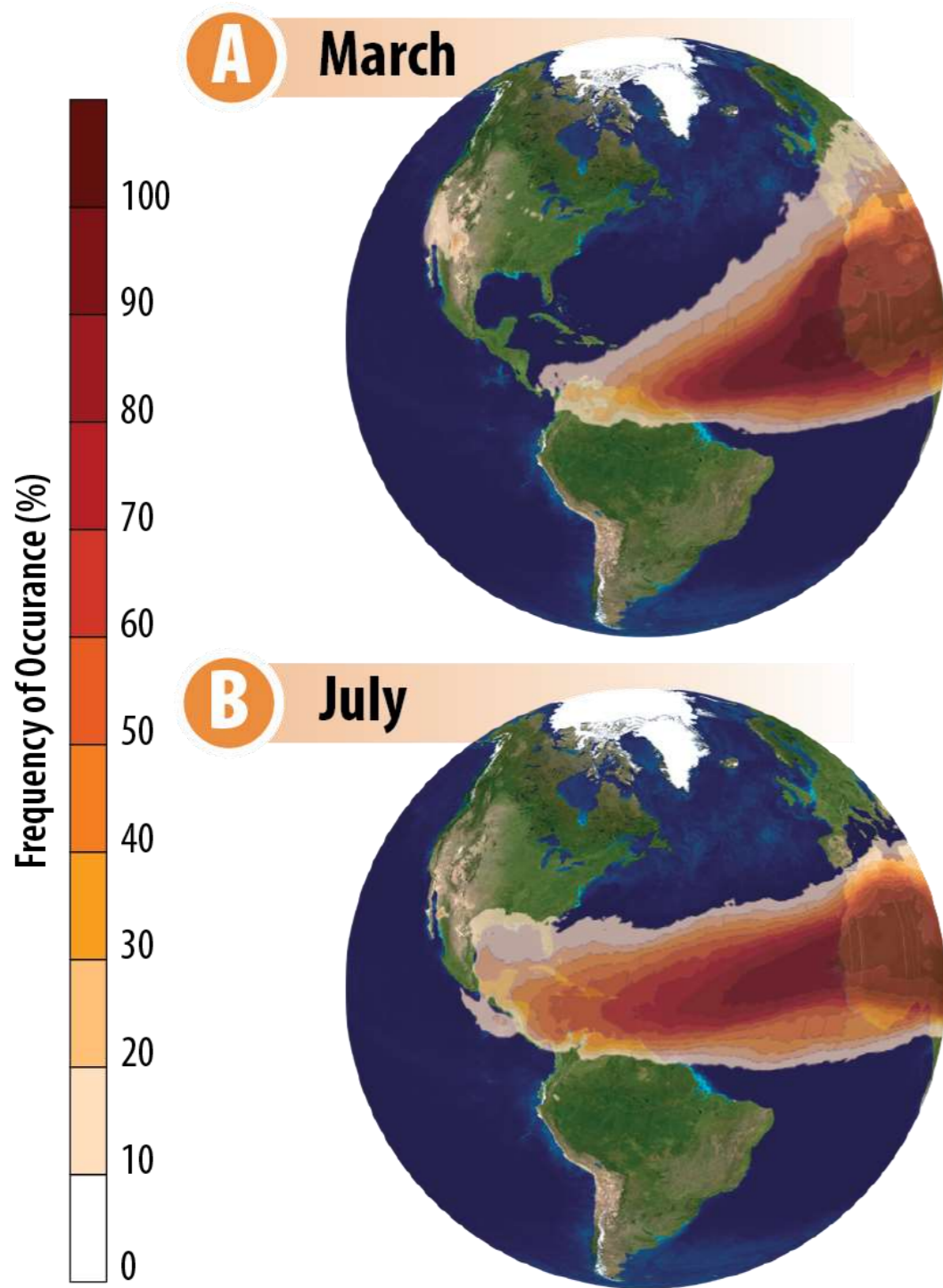
Each year enough dust is carried from the Sahara to the Caribbean to fill the Empire State Building 15 times

Earth System Interactions with Dust

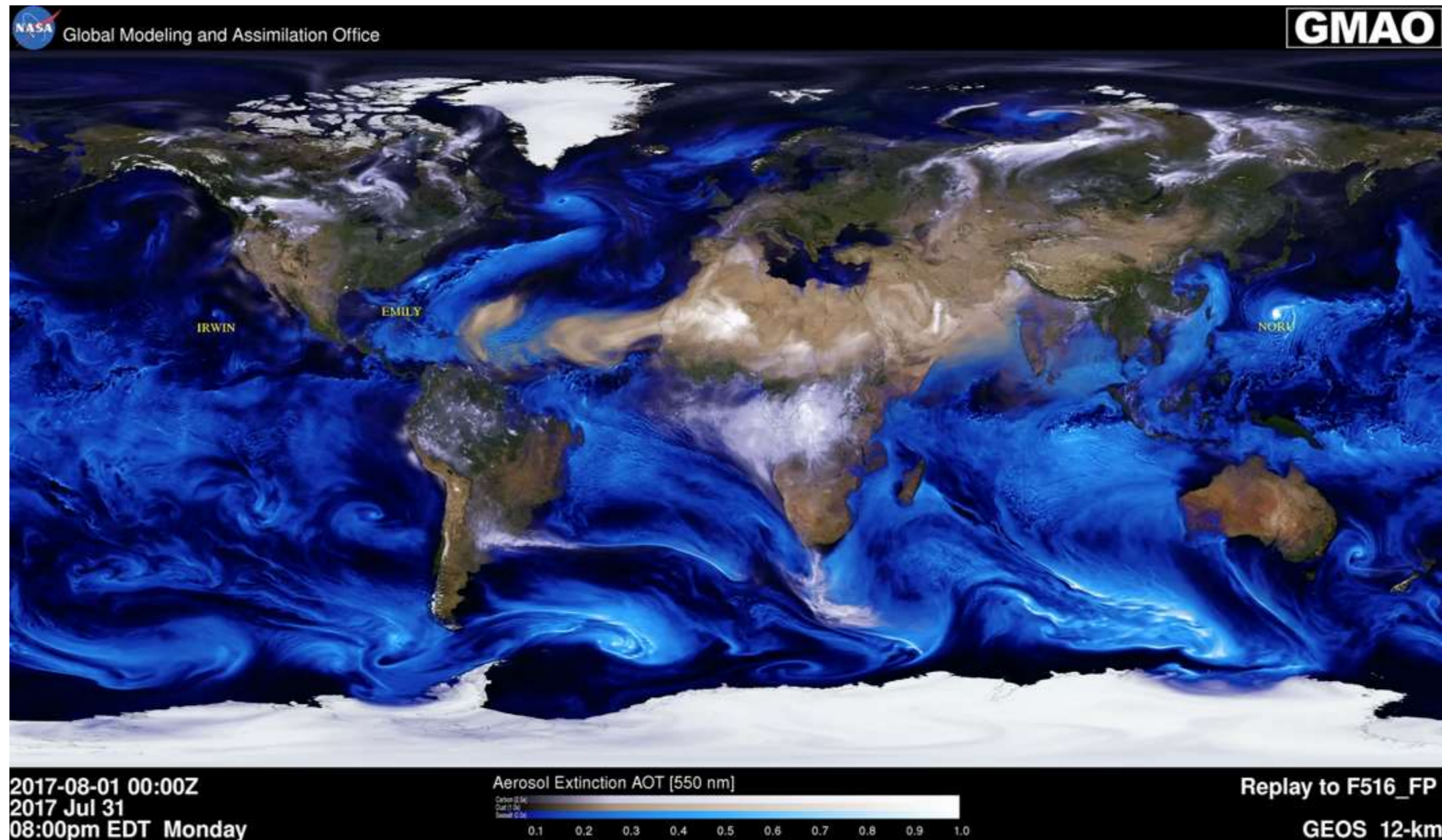


During its week-long, thousands-of-kilometers journey across the Atlantic dust particle interact with a number of processes in the atmosphere and Earth system

Dust Transport over the Atlantic

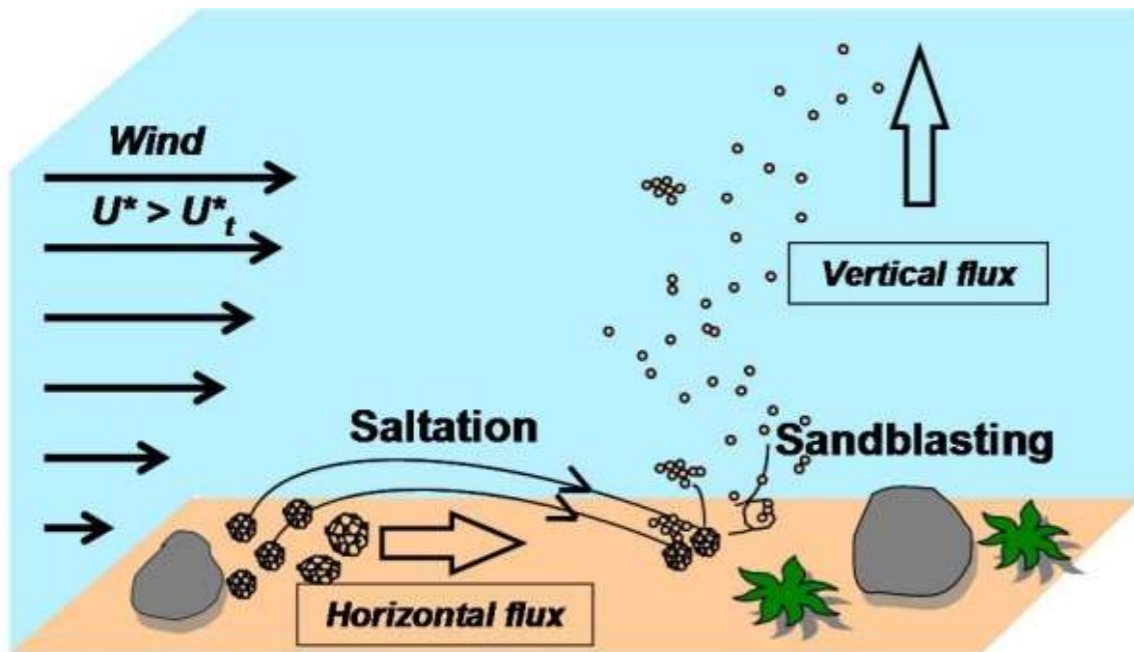


Global Aerosol Simulation



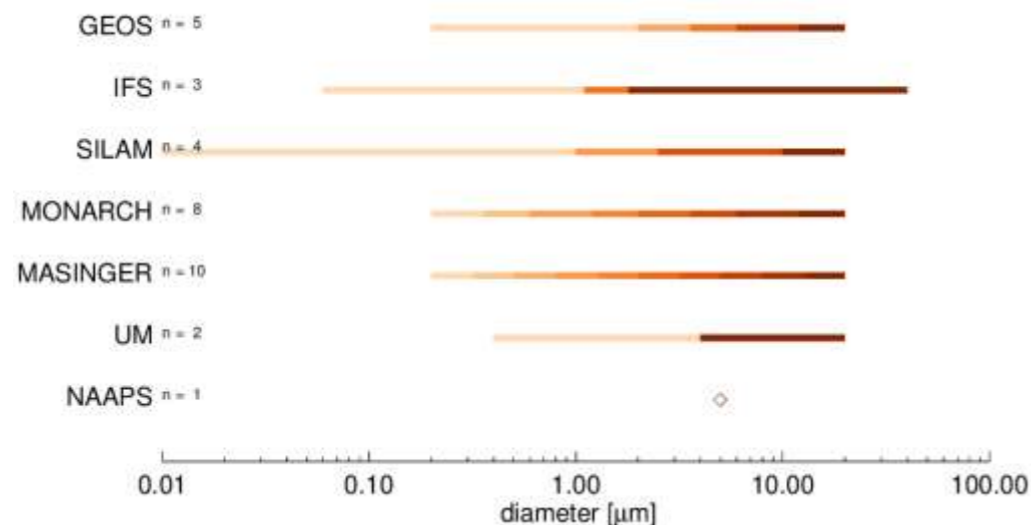
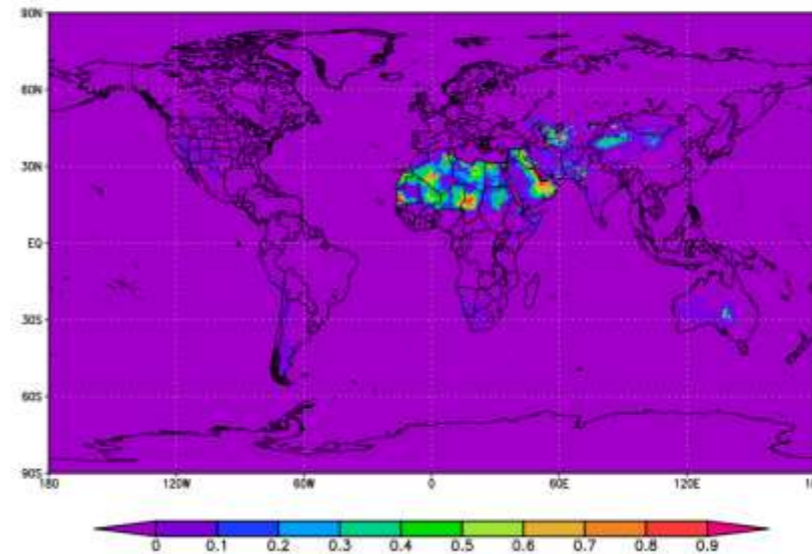
- Near-real time system runs 4x forecasts a day with prognostic aerosols and aerosol data assimilation
- Model description and output availability: <https://gmao.gsfc.nasa.gov>

Dust Lifecycle



<http://www.lisa.u-pec.fr/en/instruments/37-outils-de-simulation-numerique/161-modeling-of-dust-emissions>

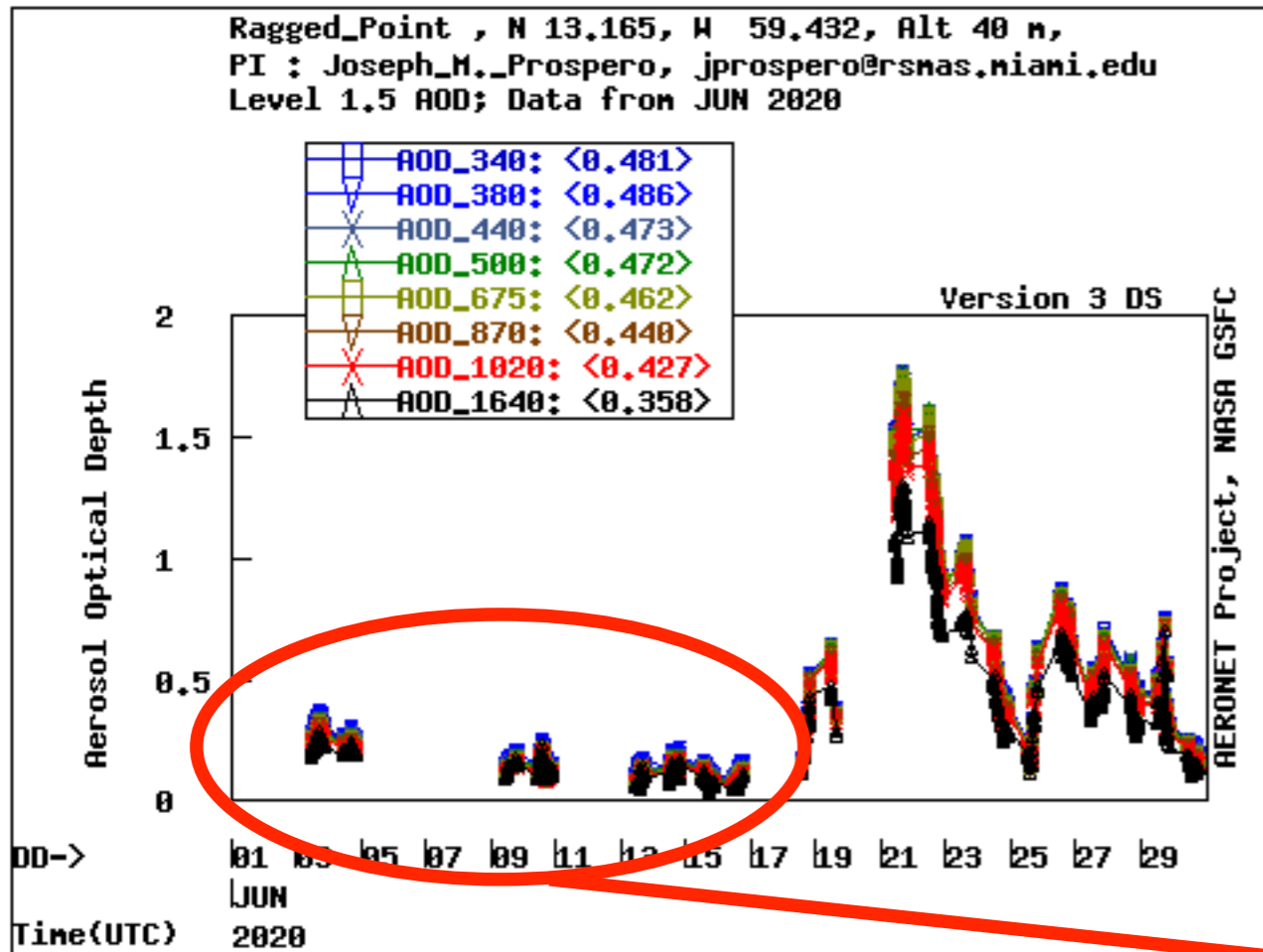
Parameterize detailed soil and surface processes into simple function of surface winds and local efficiency to calculate dust emissions



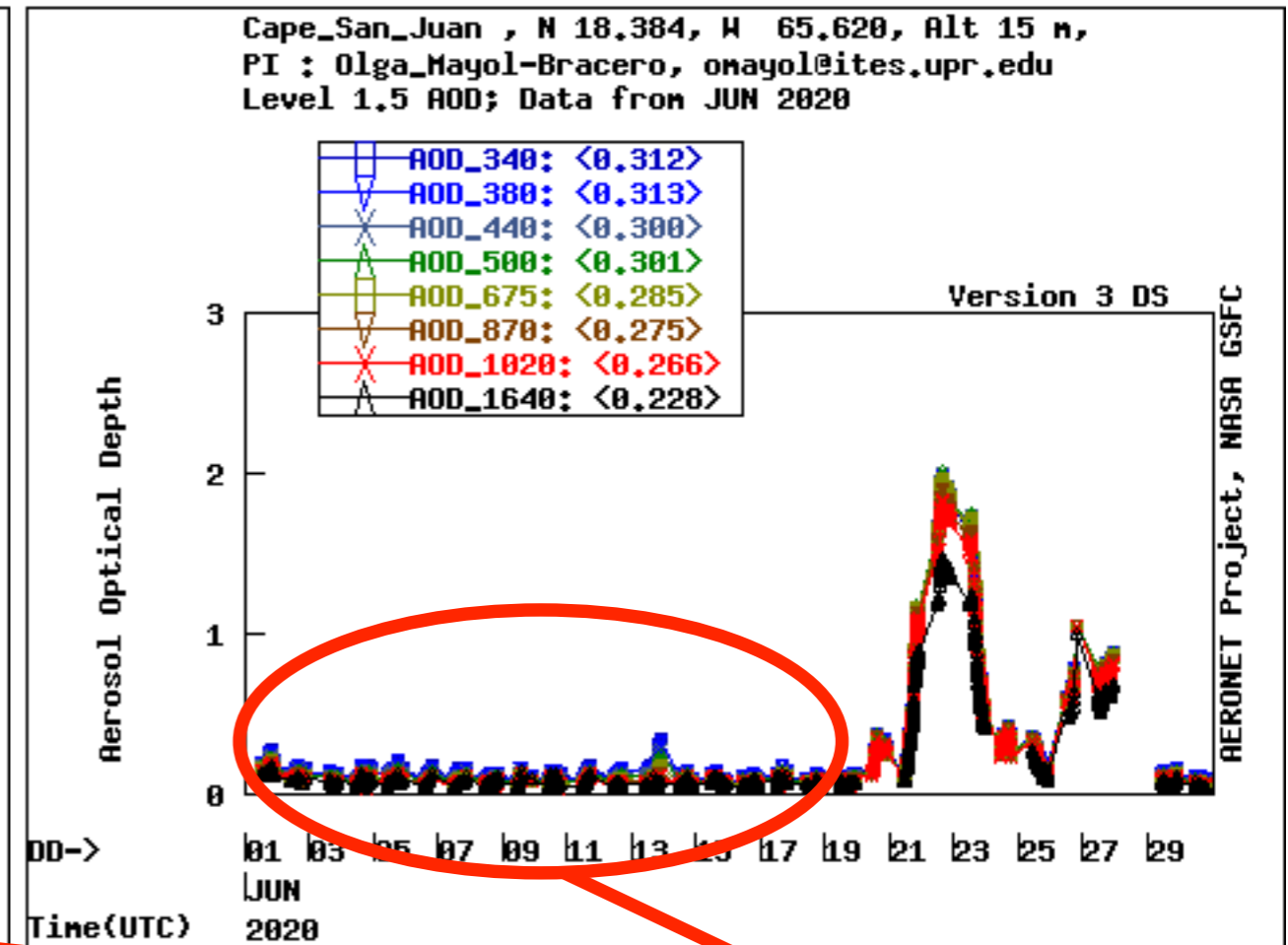
Discretize the dust particle size distribution into some number of "bins" to describe size dependent loss processes and optical properties

Case Study: June 2020 Dust Event

Barbados



Puerto Rico

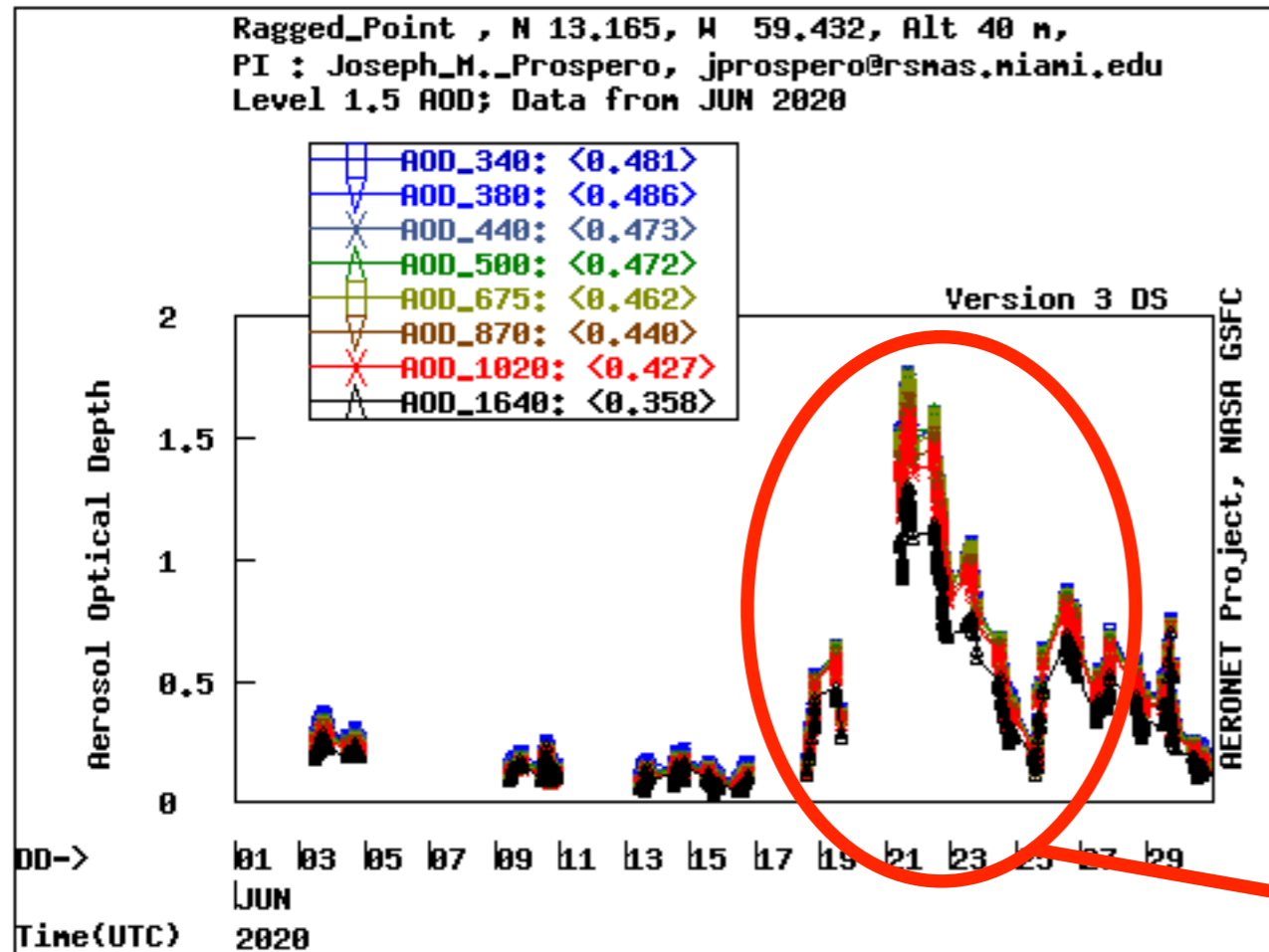


Early June is a period of low dust in the Caribbean...nice for air quality, but if you want to measure dust (CALIMA-PH)...?

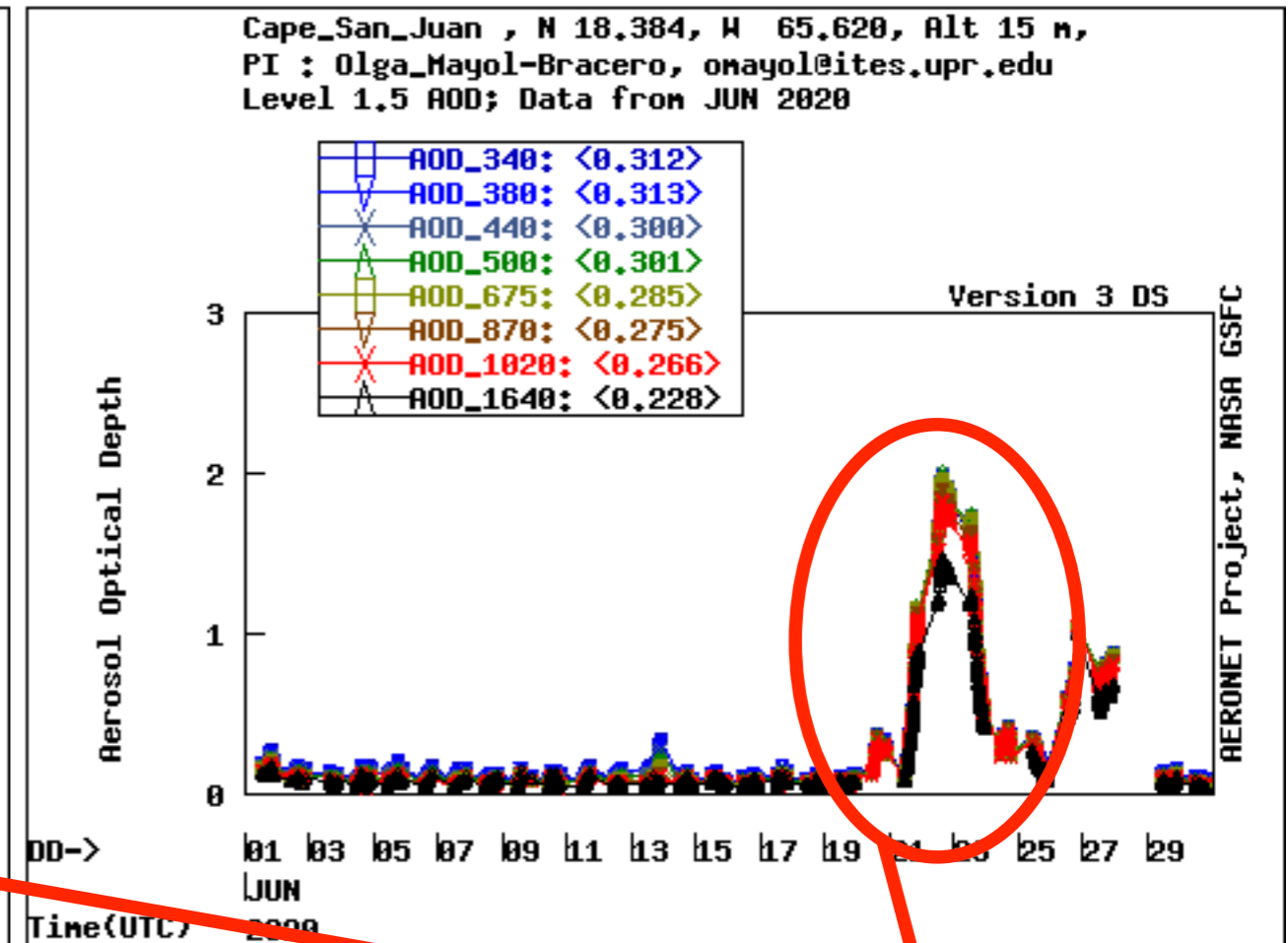


Case Study: June 2020 Dust Event

Barbados



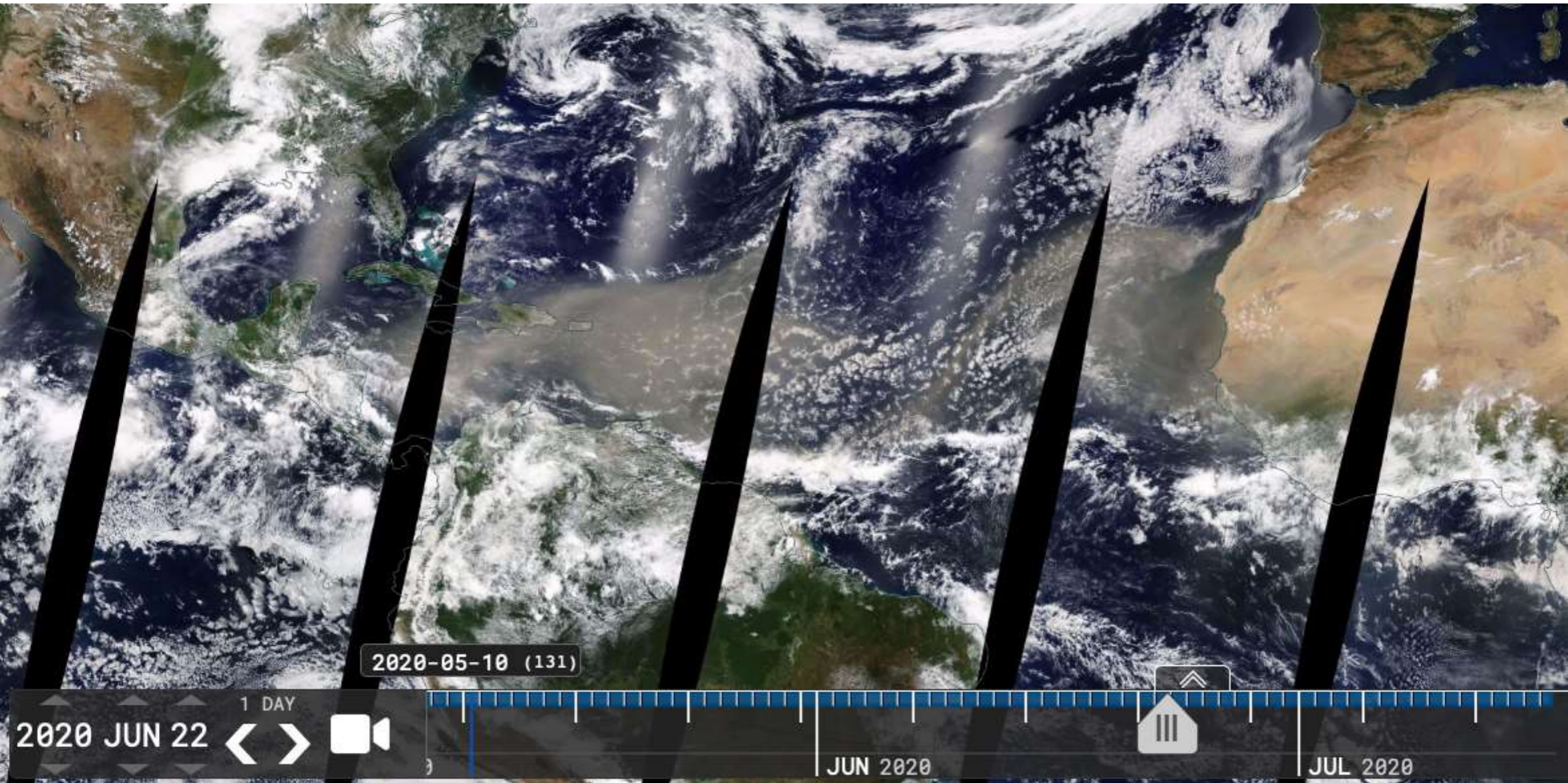
Puerto Rico



Not so boring now!

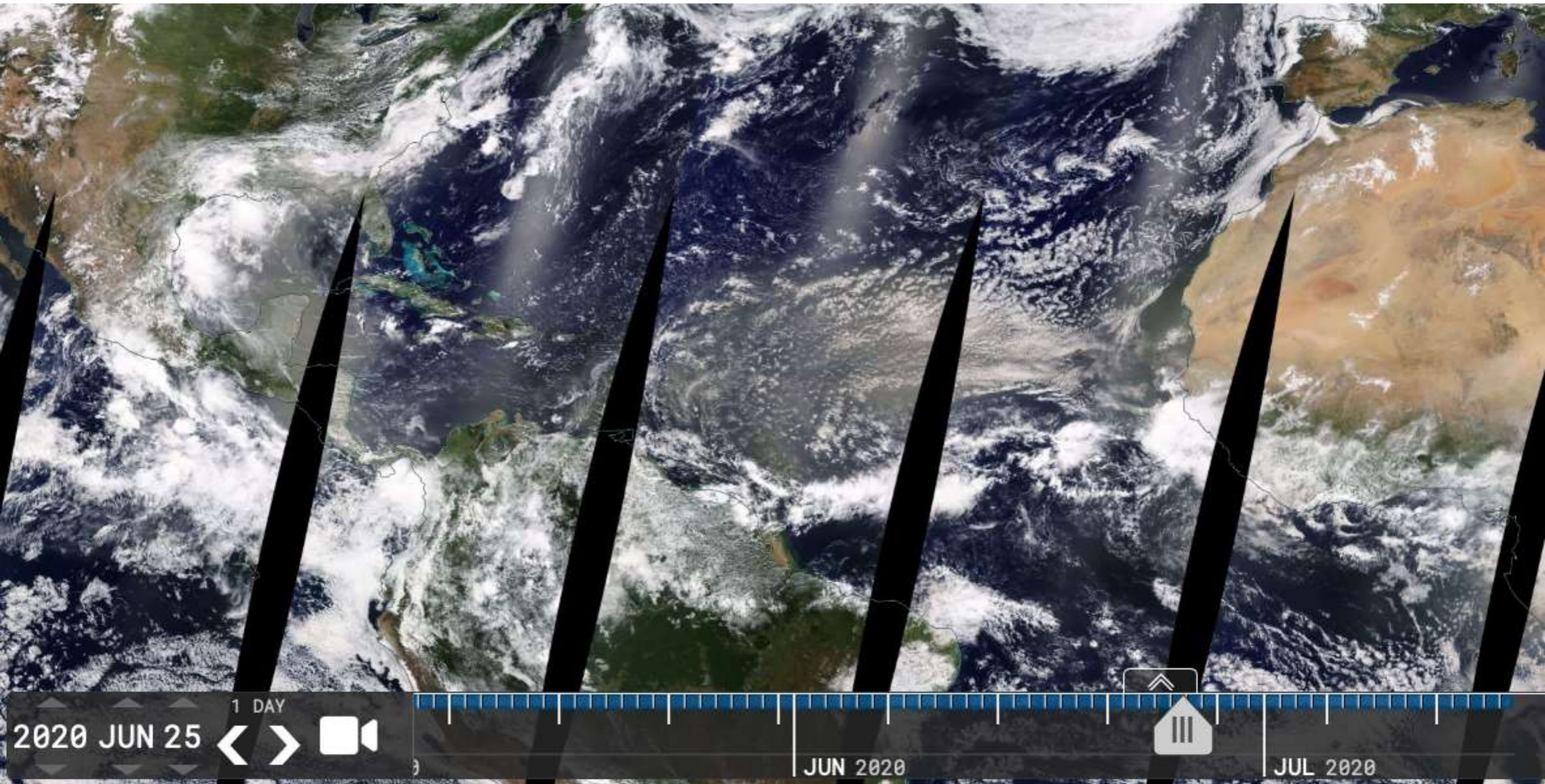


Case Study: June 2020 Dust Event



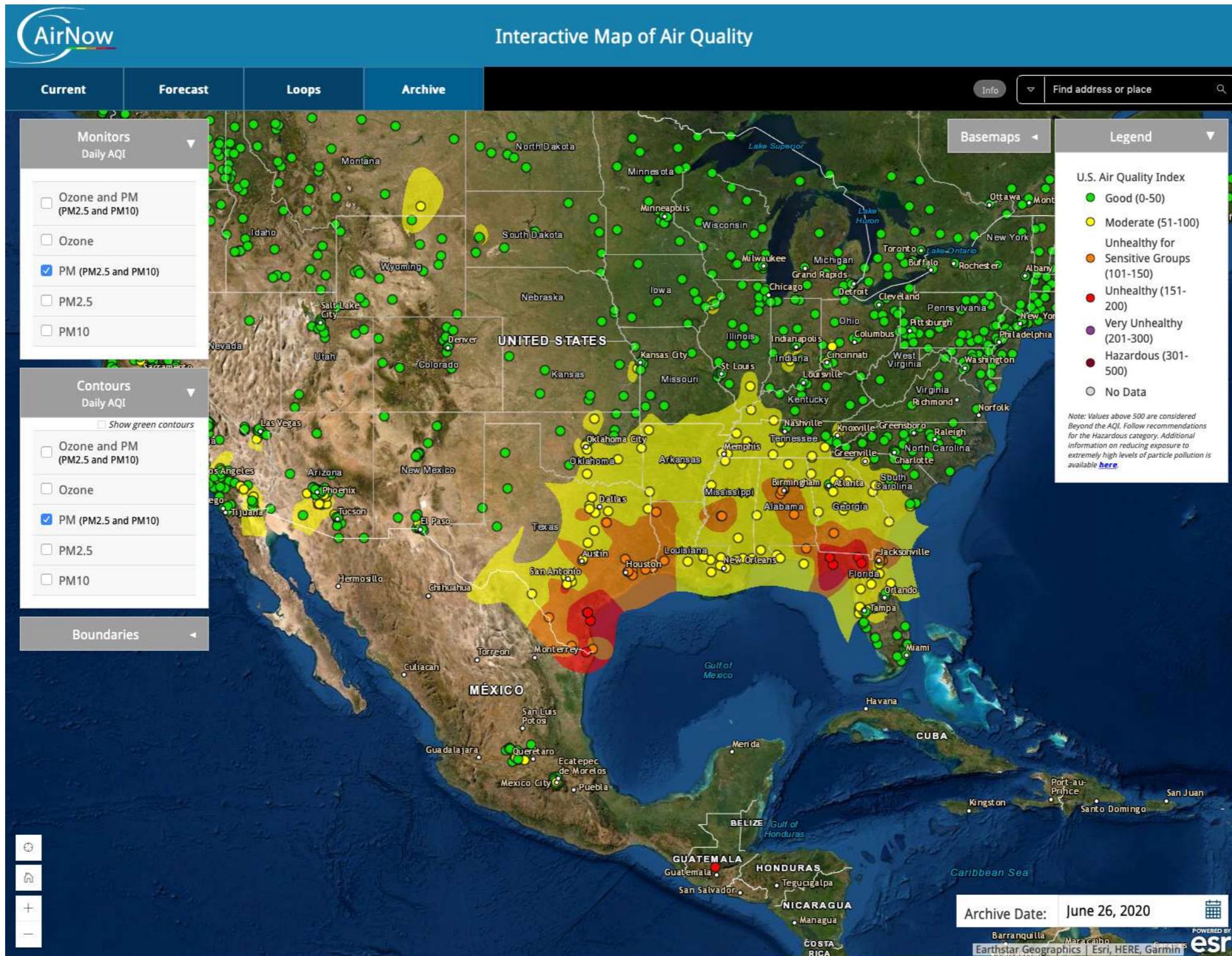
Terra/MODIS True Color Imagery, <https://worldview.earthdata.nasa.gov>

Case Study: June 2020 Dust Event



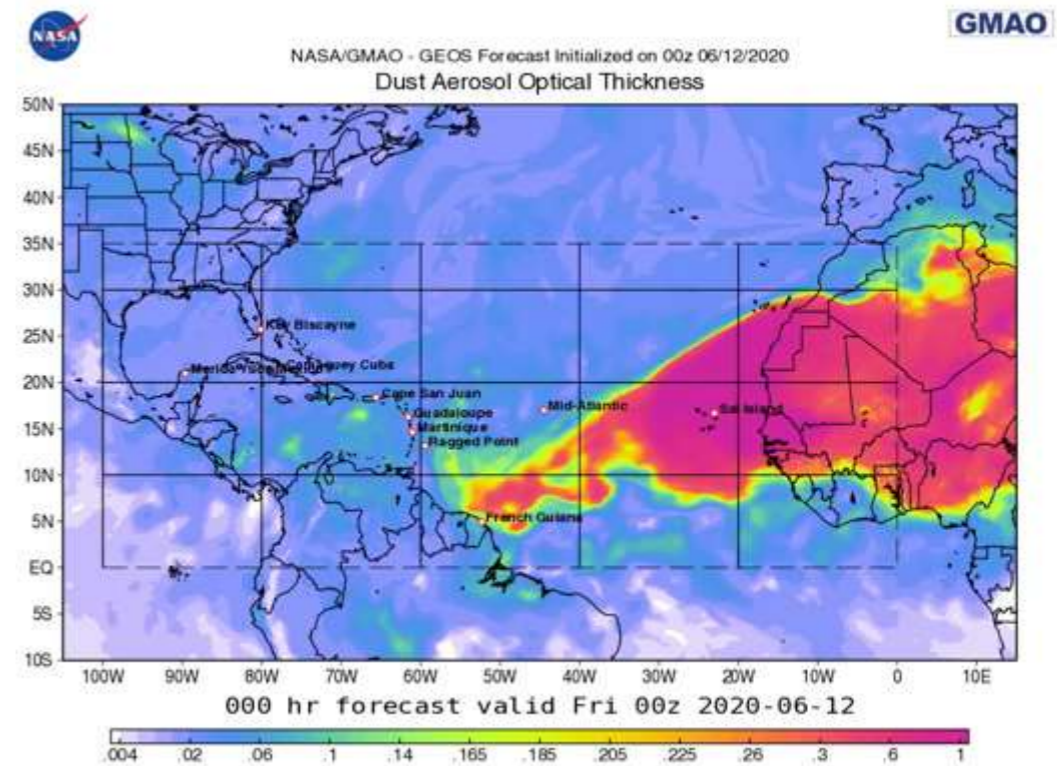
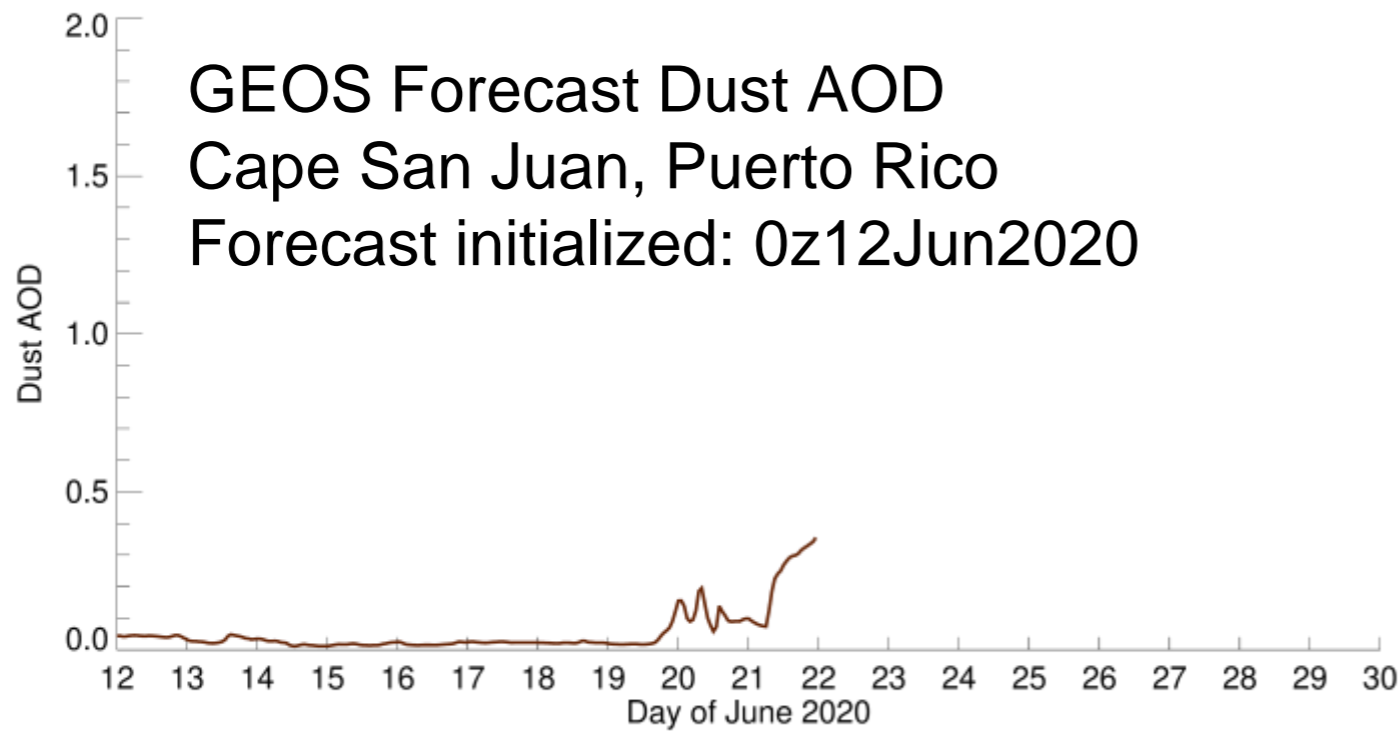
Terra/MODIS True Color Imagery, <https://worldview.earthdata.nasa.gov>

Case Study: June 2020 Dust Event

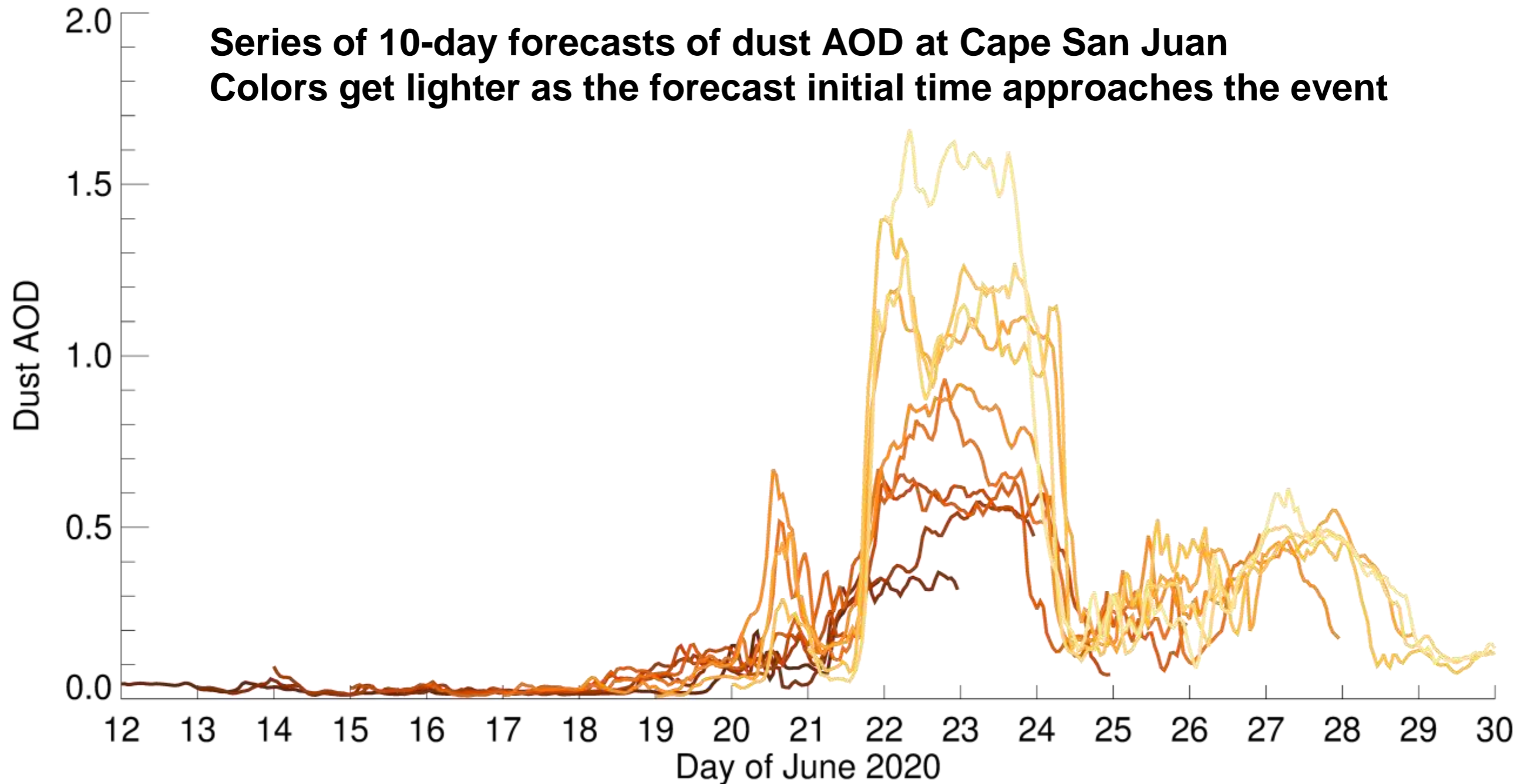


AirNow, <https://gispub.epa.gov/airnow/>

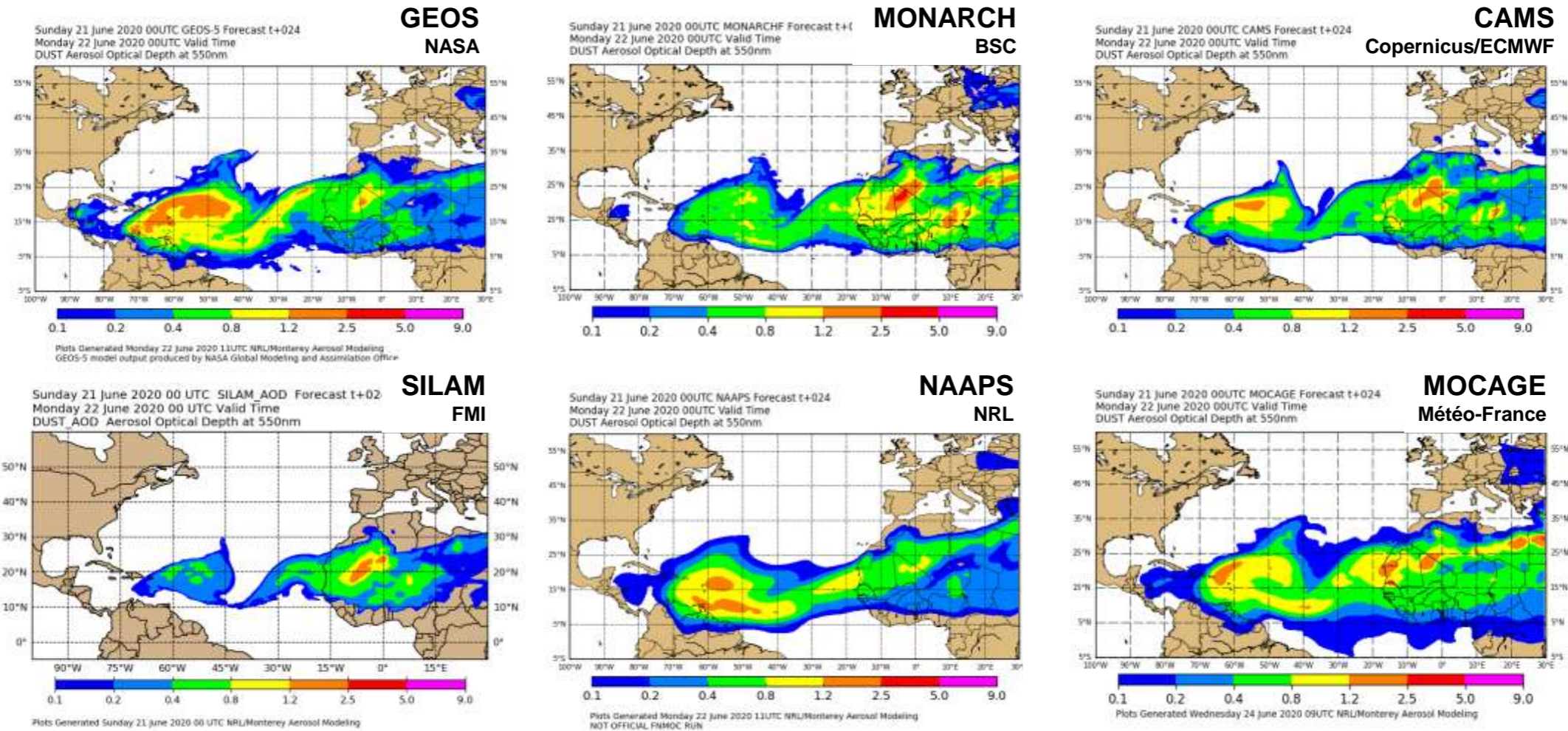
Case Study: June 2020 Dust Event



Case Study: June 2020 Dust Event



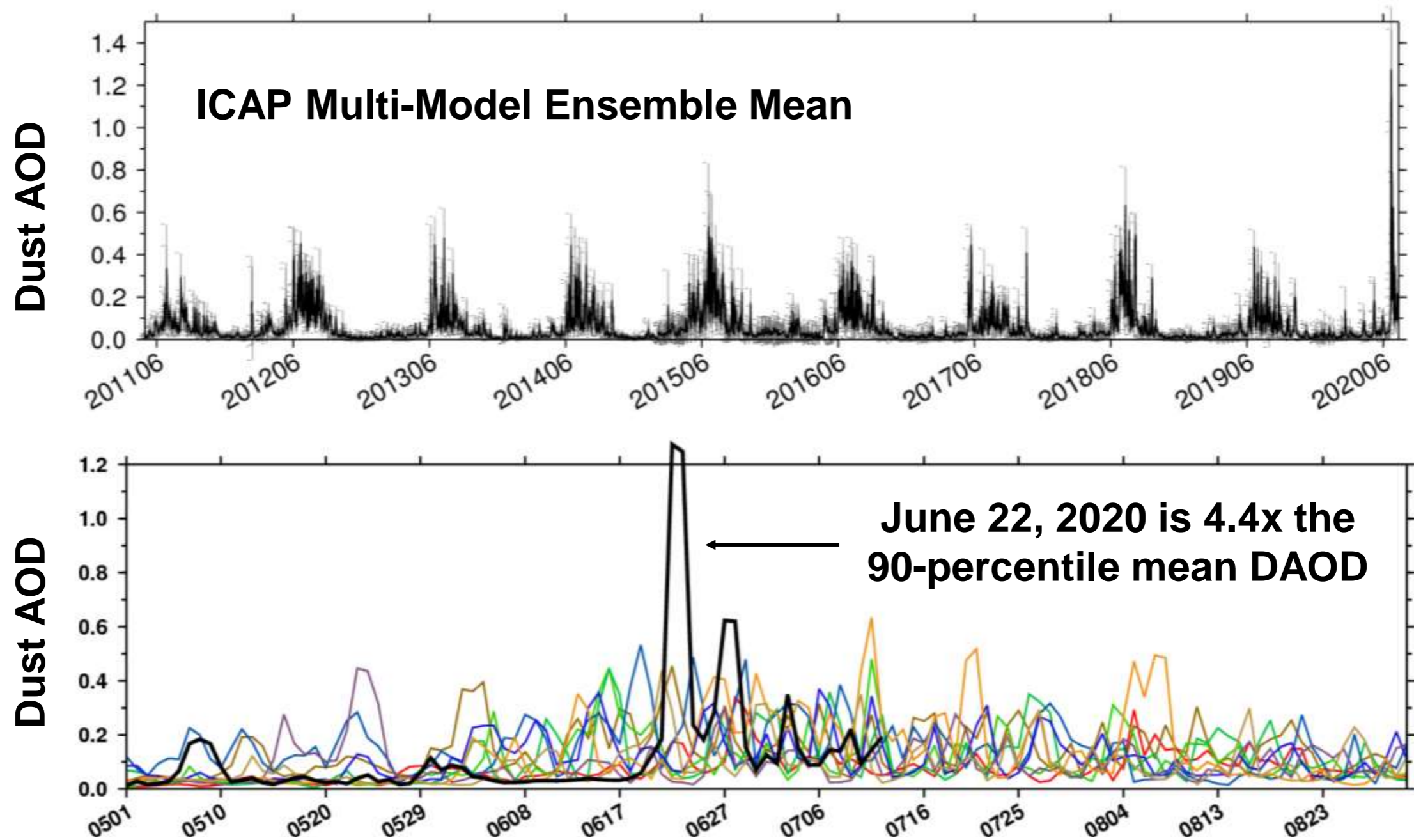
ICAP: International Cooperative for Aerosol Prediction



<https://www.nrlmry.navy.mil/aerosol/icap.1135.php>

- ICAP is a grassroots consortium of model developers, data providers, and NWP center representatives
- ICAP was founded in 2010 to promote collaboration and best practices for NWP centers producing global aerosol forecasts
- There are presently 9 operational/near-real time centers that contribute to the ICAP multi-model ensemble (MME): NASA GSFC, NRL, ECMWF, JMA, Météo-France, UKMO, FMI, BSC, NCEP

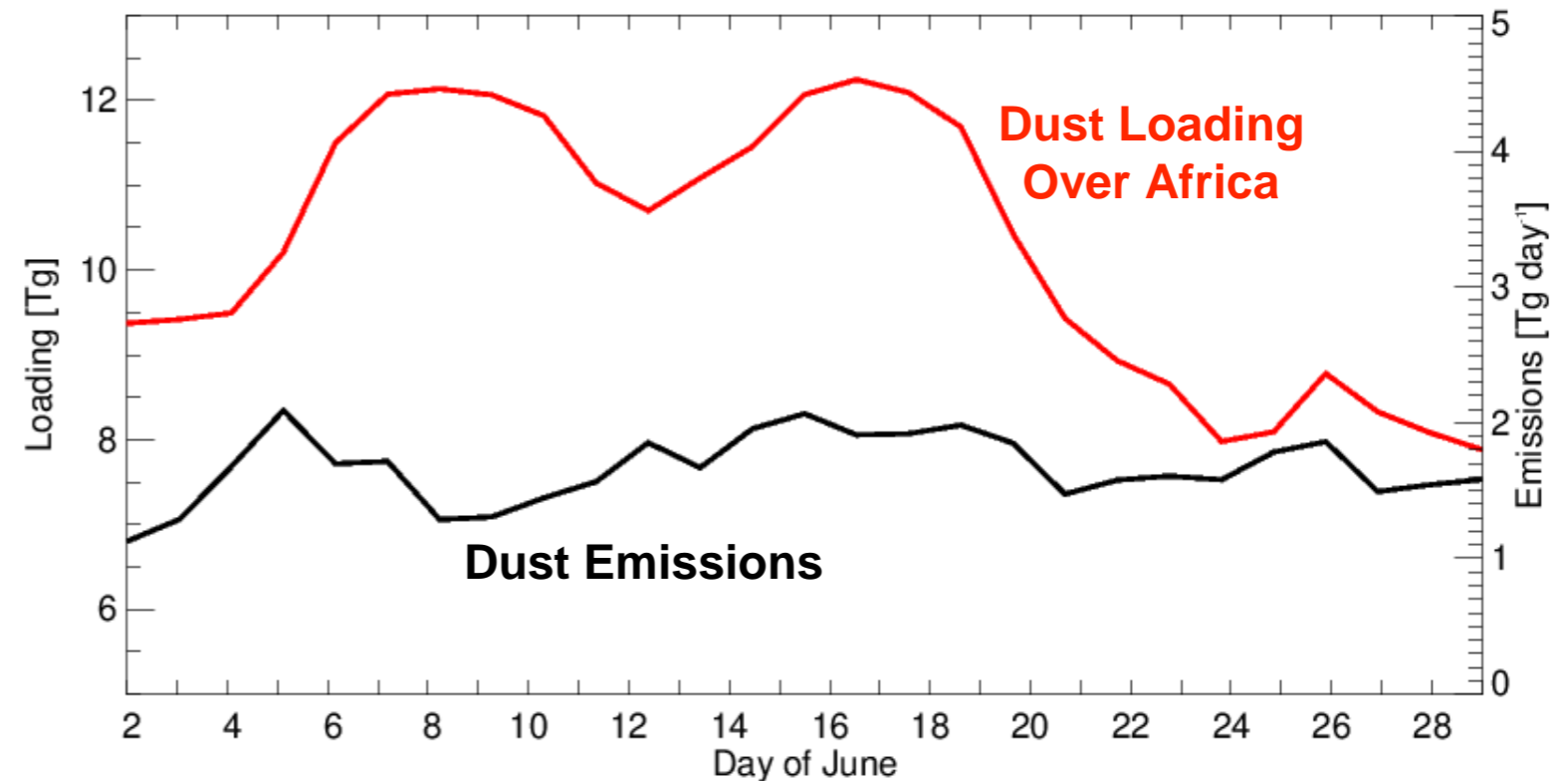
ICAP: International Cooperative for Aerosol Prediction



Courtesy P. Xian, NRL

Summary

Hypothesis: An anomalous and persistent weather system off the west coast of North Africa trapped dust as it accumulated in the atmosphere; the breakdown in that system exported suddenly a large amount of dust



- What was the role of dust radiative heating in stabilizing the atmosphere, reducing convective activity, and prolonging the dust lifetime?
- What is the relationship between the meteorological situation and the vertical distribution of dust, and how did that play into the dust lifetime?
- Why did the ICAP models differ so much in their predictions of this event?
- Ultimately, what are the drivers of this extraordinary event, and what can we say about the likelihood for similar future events?