Revealing Urban Pollution Patterns from a Bird's Eye View

Laura M. Judd, PhD
Research Physical Scientist
NASA Langley Research Center

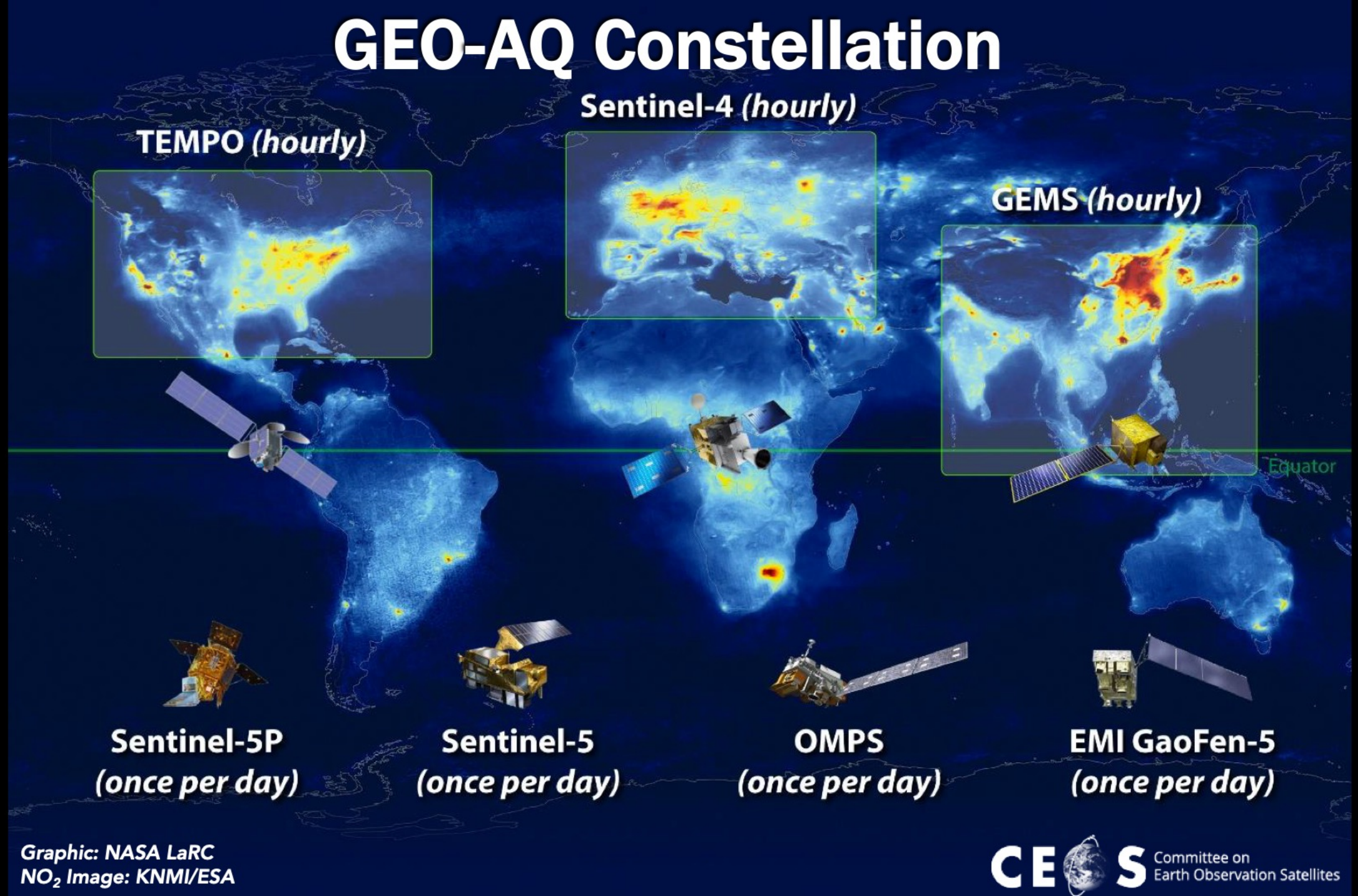
National Aeronautics and Space Administration

NASA

U.S. CENTER
GLASGOW 2021

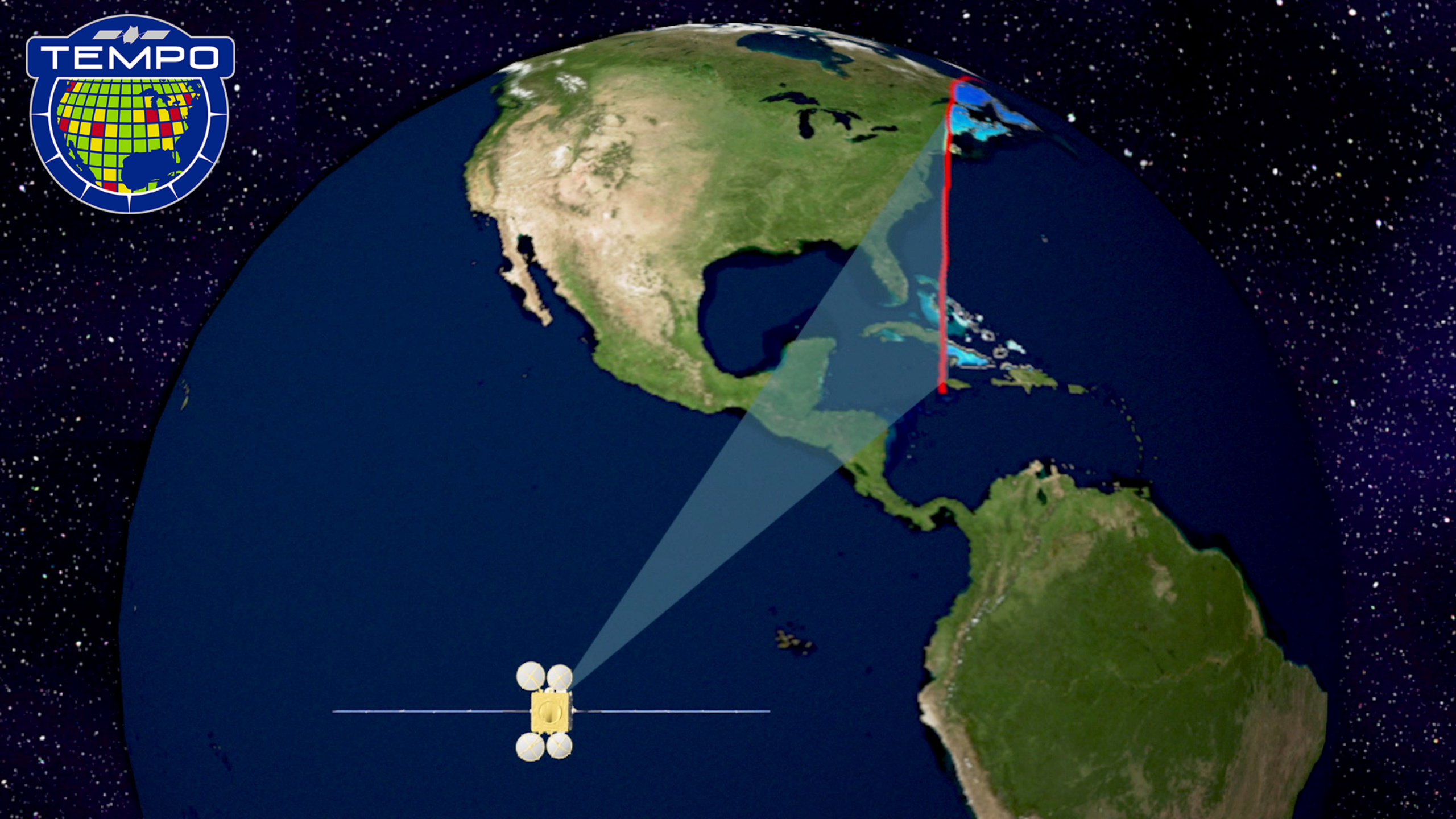


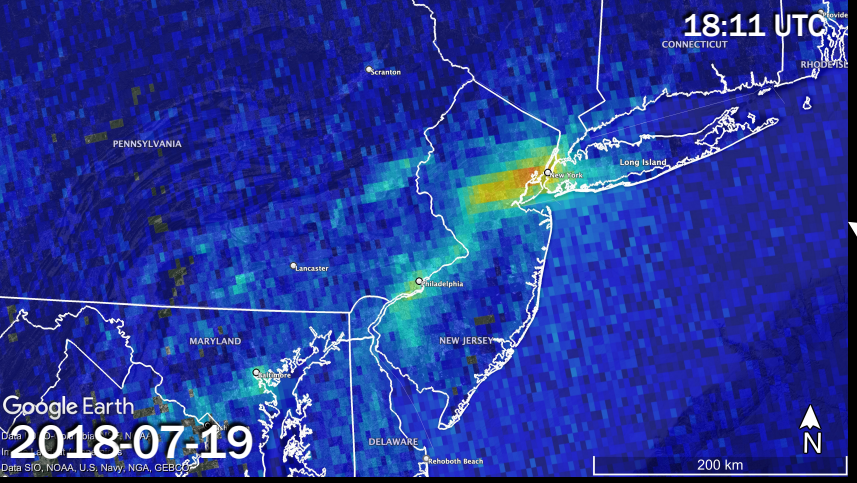
GEO-AQ Constellation



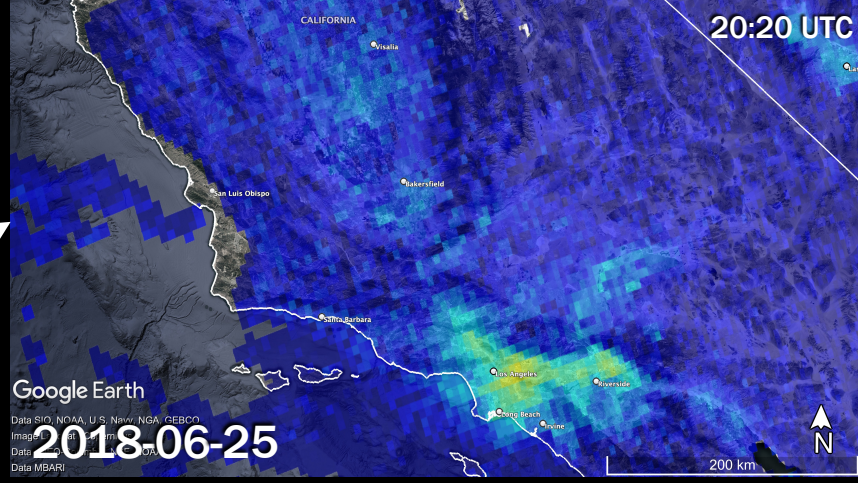
Graphic: NASA LaRC
NO_2 Image: KNMI/ESA

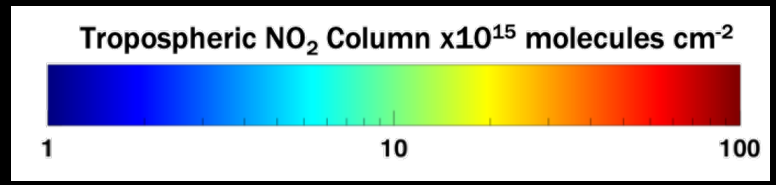
CEOS Committee on Earth Observation Satellites

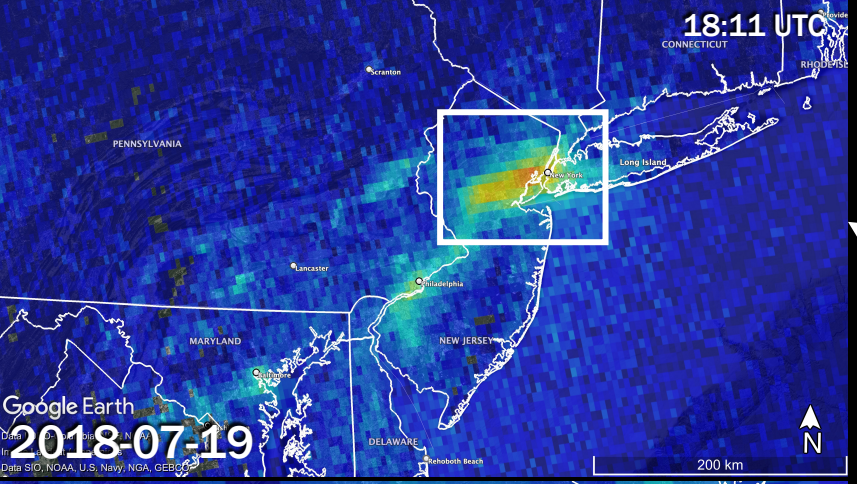

TEMPO

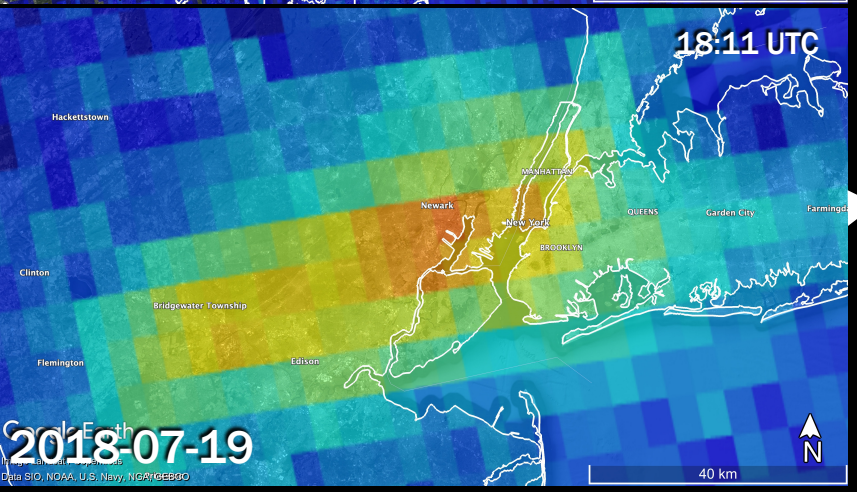


Sentinel 5-P TROPOMI





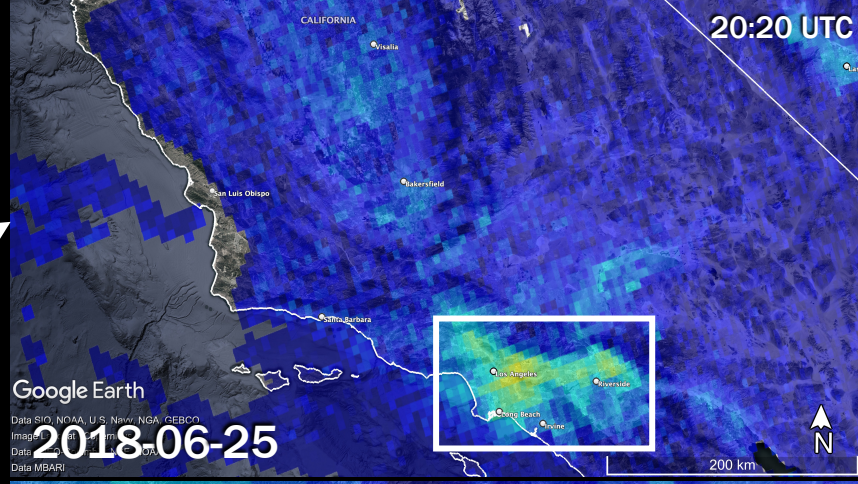


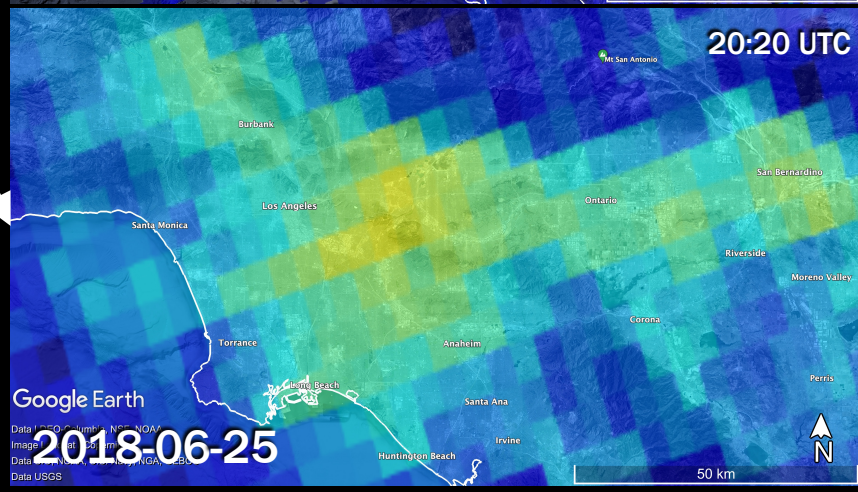


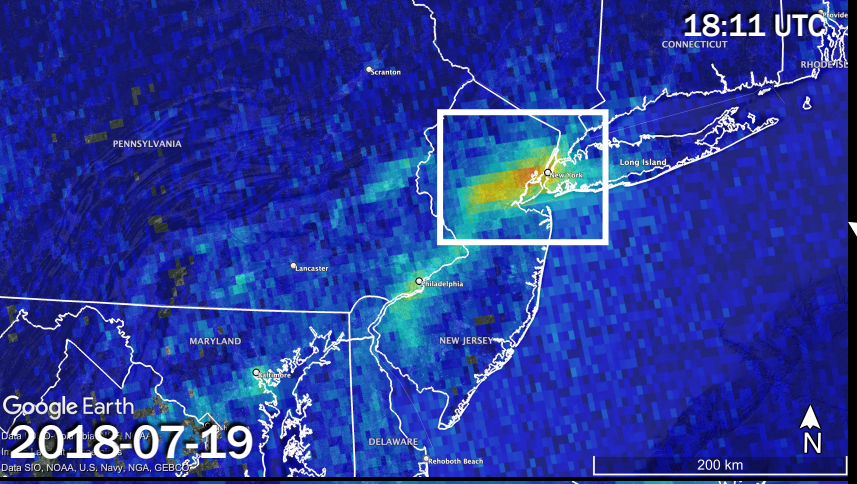
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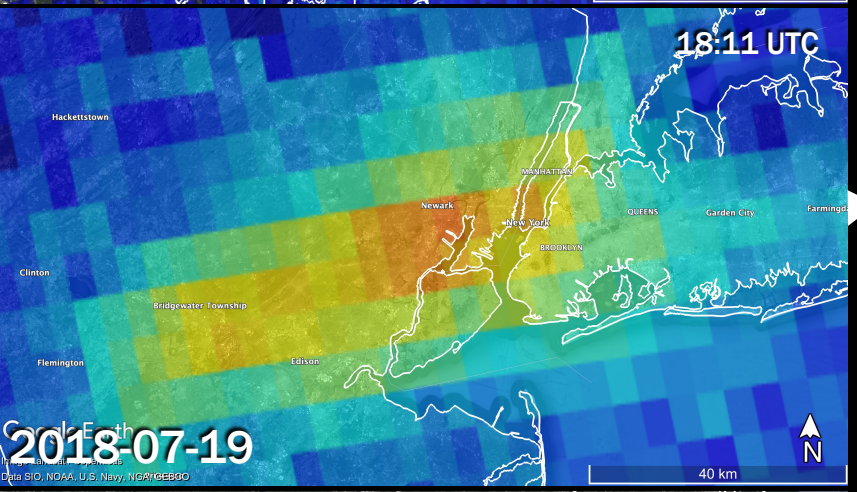
Tropospheric NO_2 Column x10^{15} molecules cm^{-2}

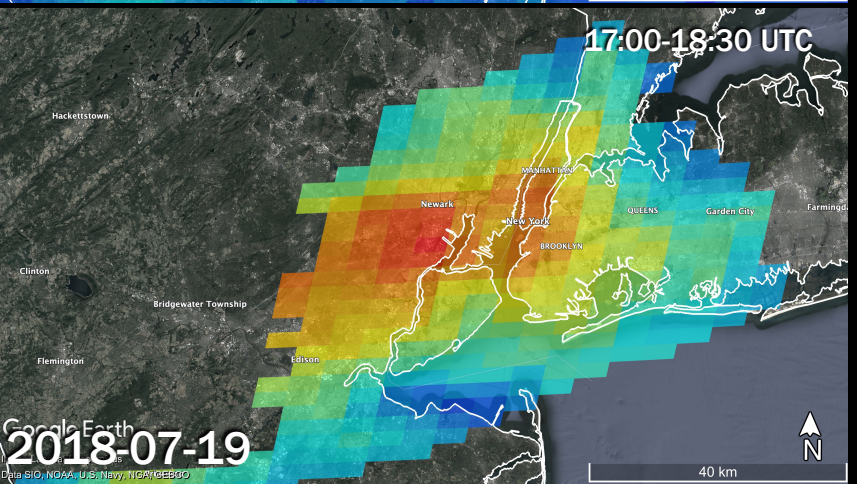
1 10 100









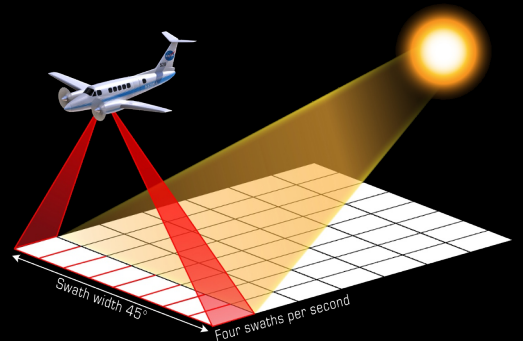


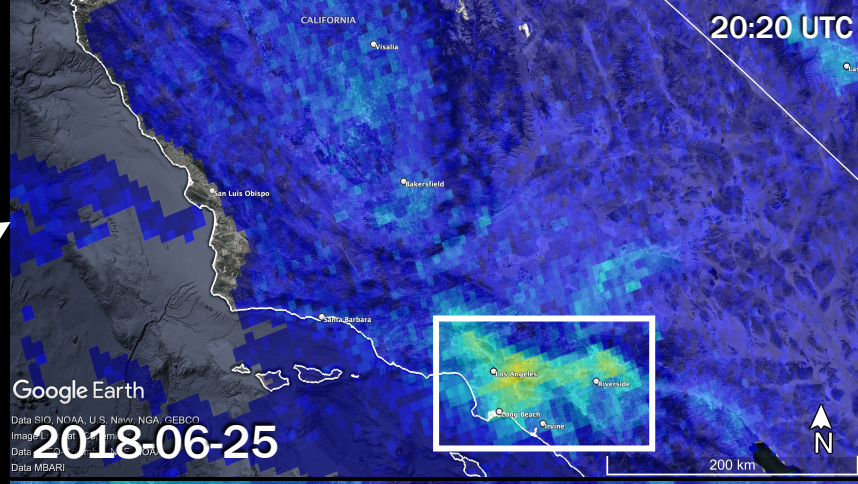
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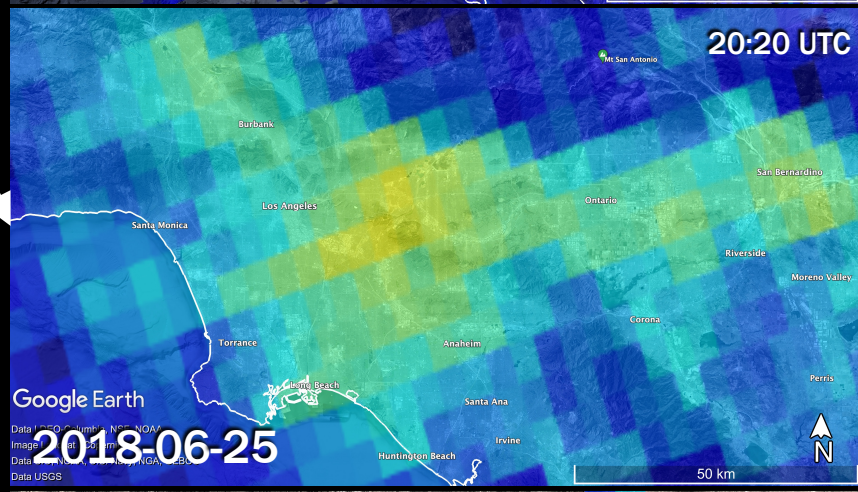
Tropospheric NO_2 Column x10^{15} molecules cm^{-2}

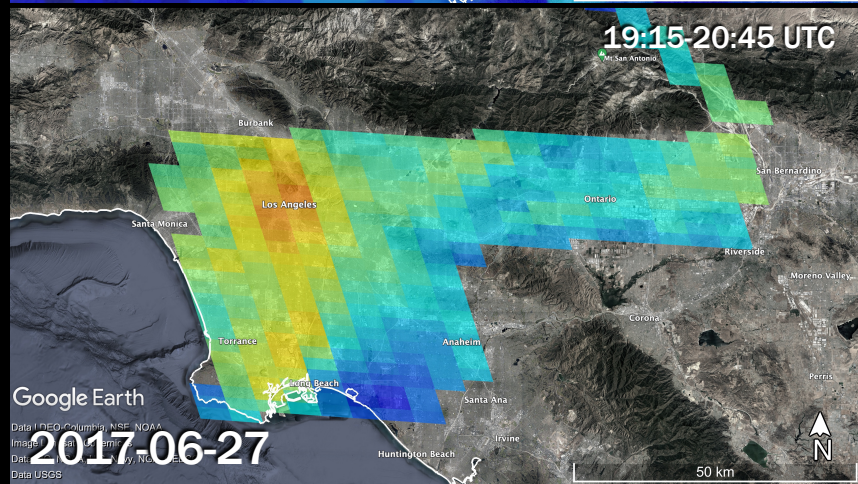
1 — 10 — 100

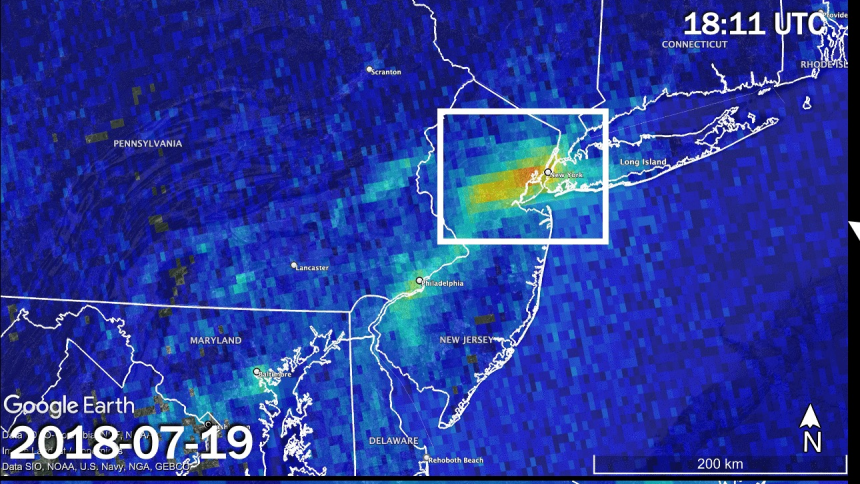
Airborne Spectrometer @ TEMPO Scale

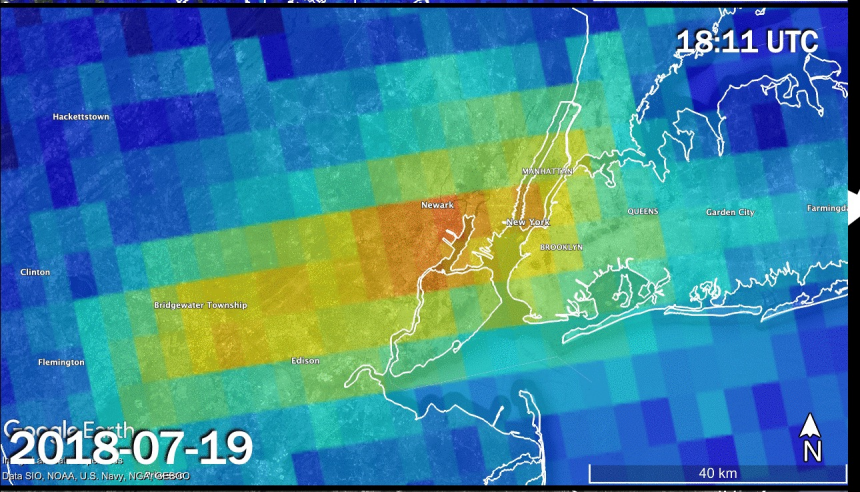


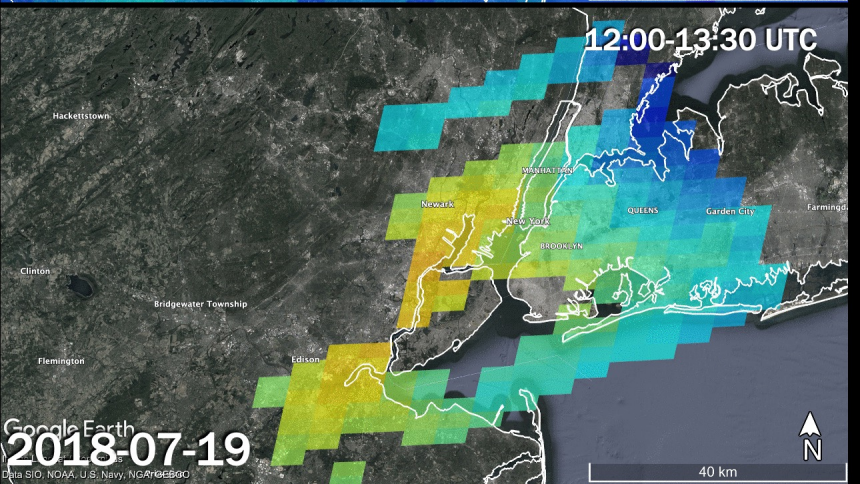










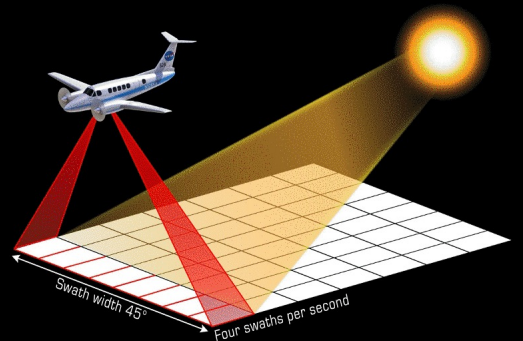


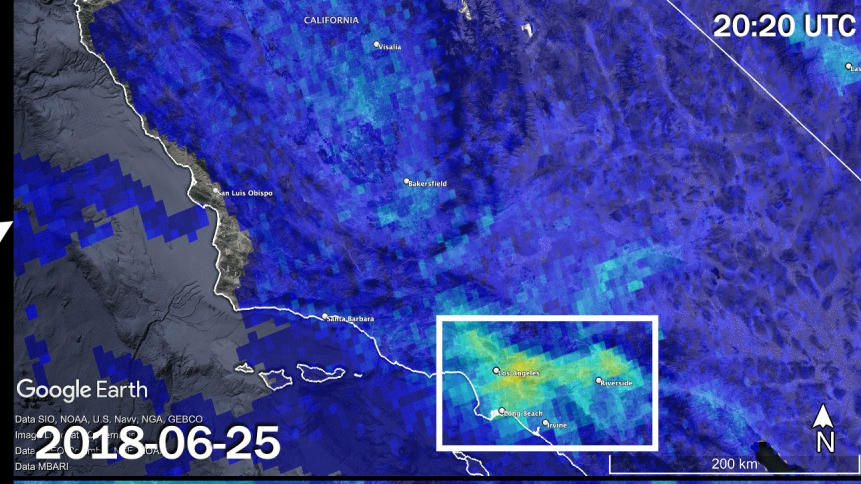
Sentinel 5-P TROPOMI

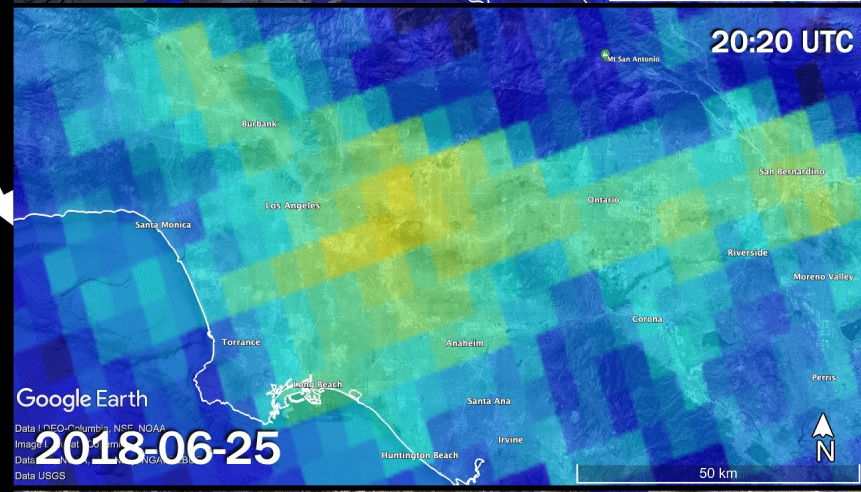
Tropospheric NO_2 Column x10^{15} molecules cm^{-2}

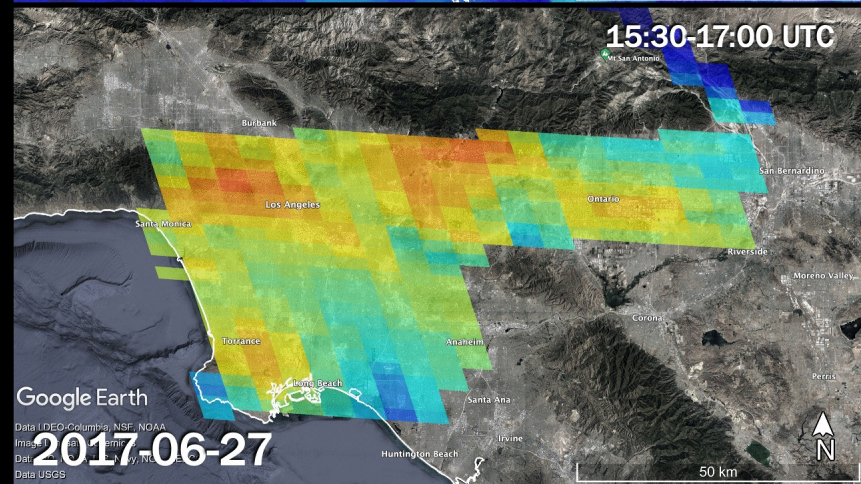
1 — 10 — 100

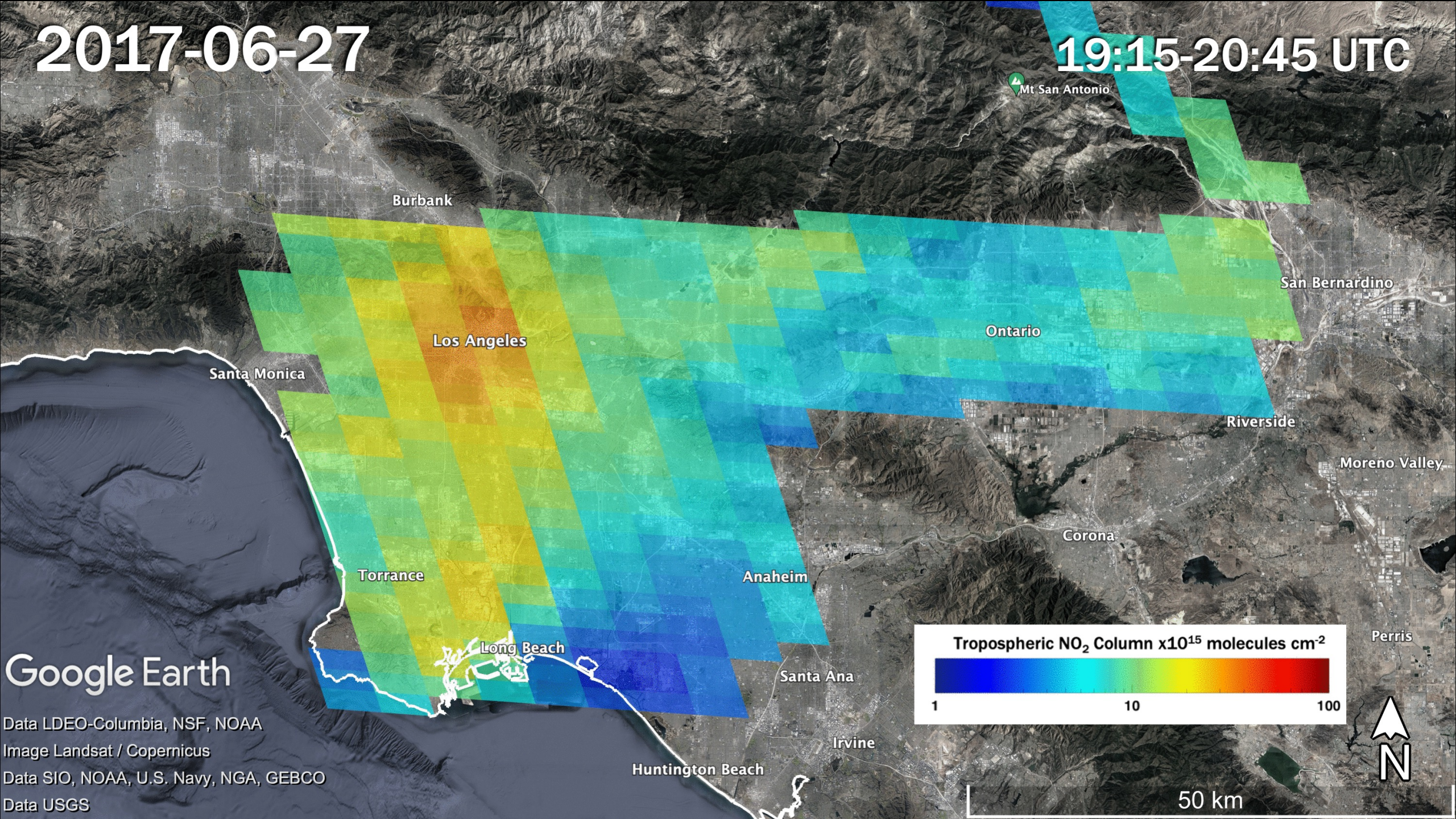
Airborne Spectrometer @ TEMPO Scale

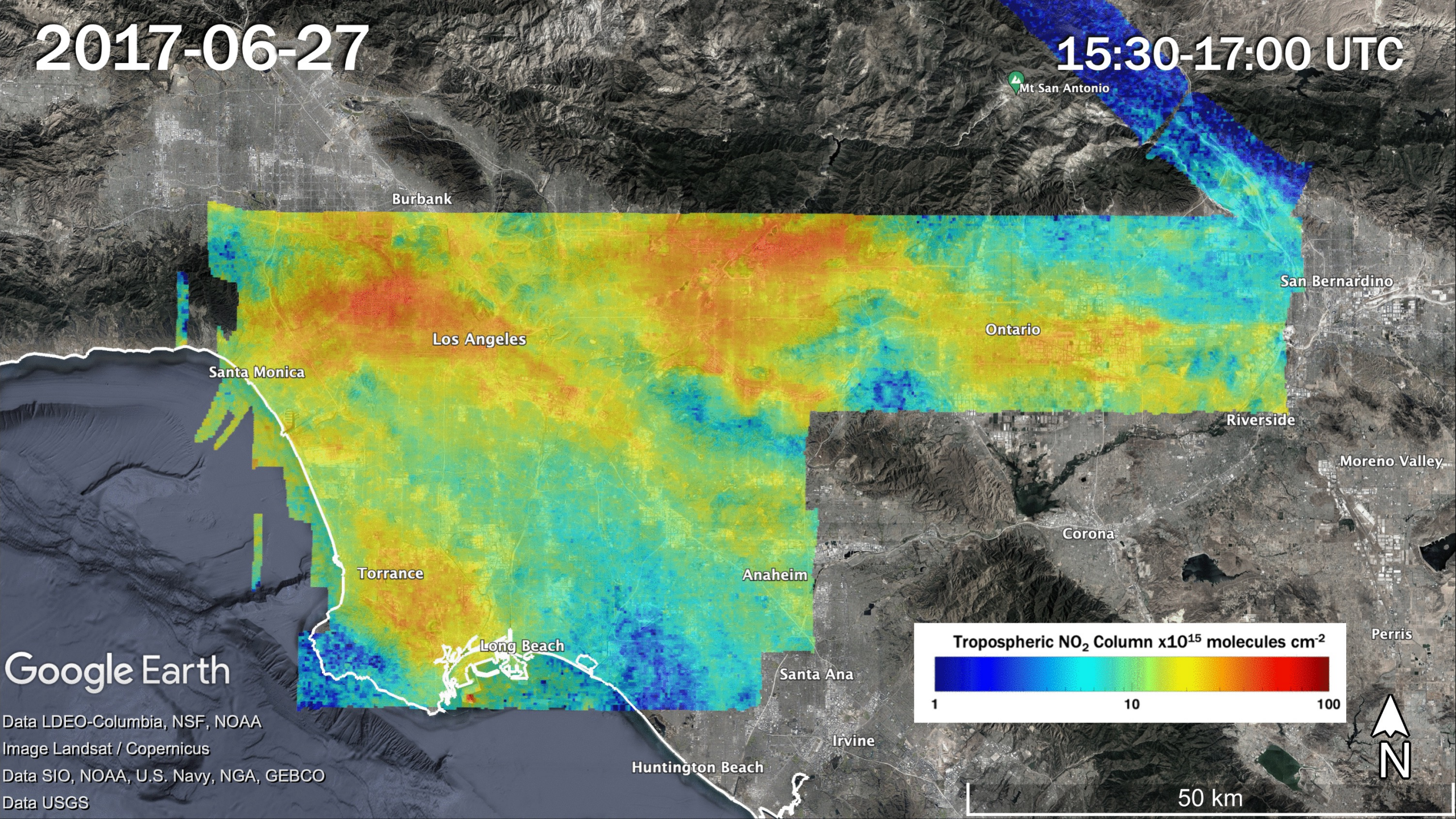


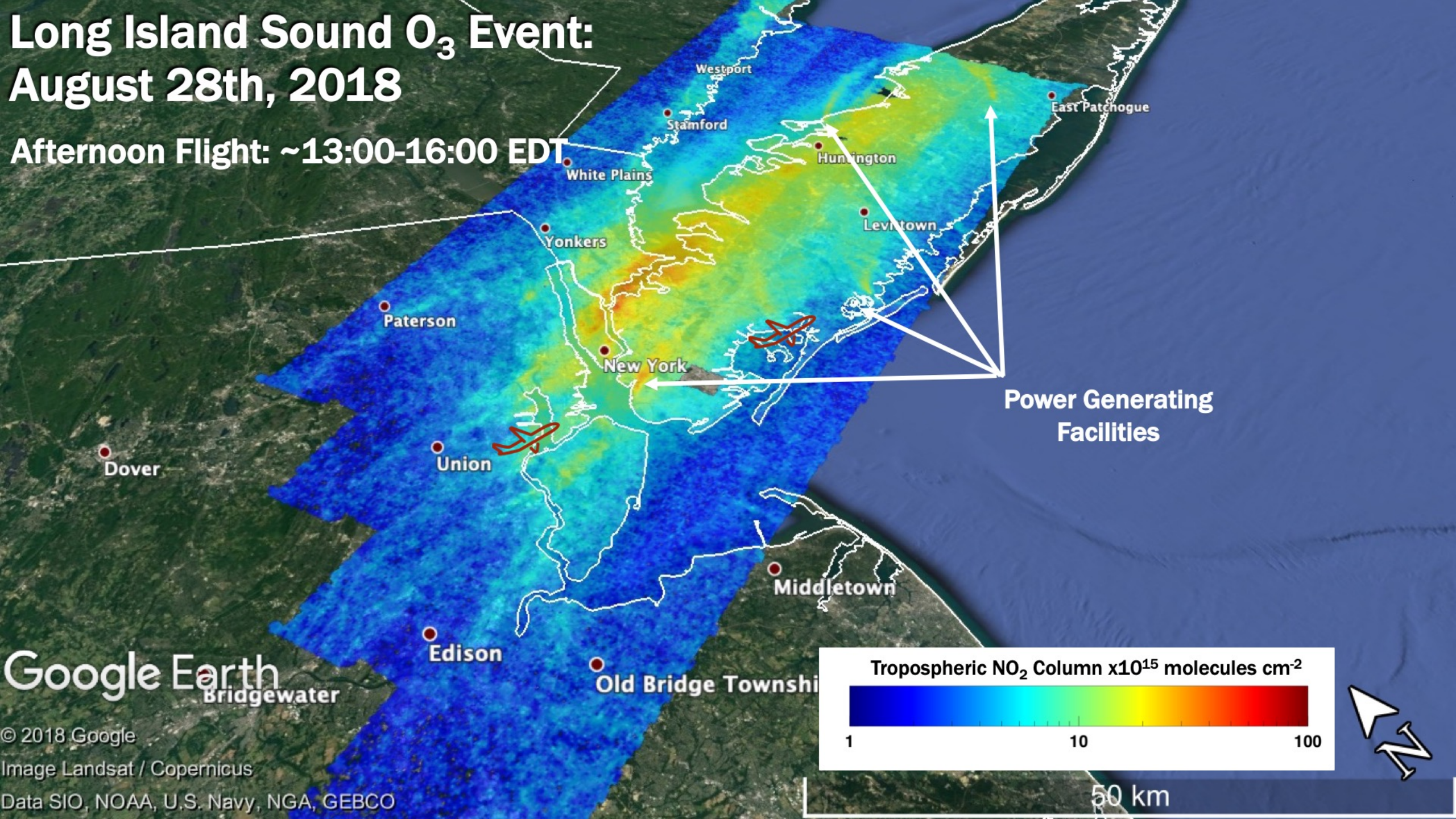


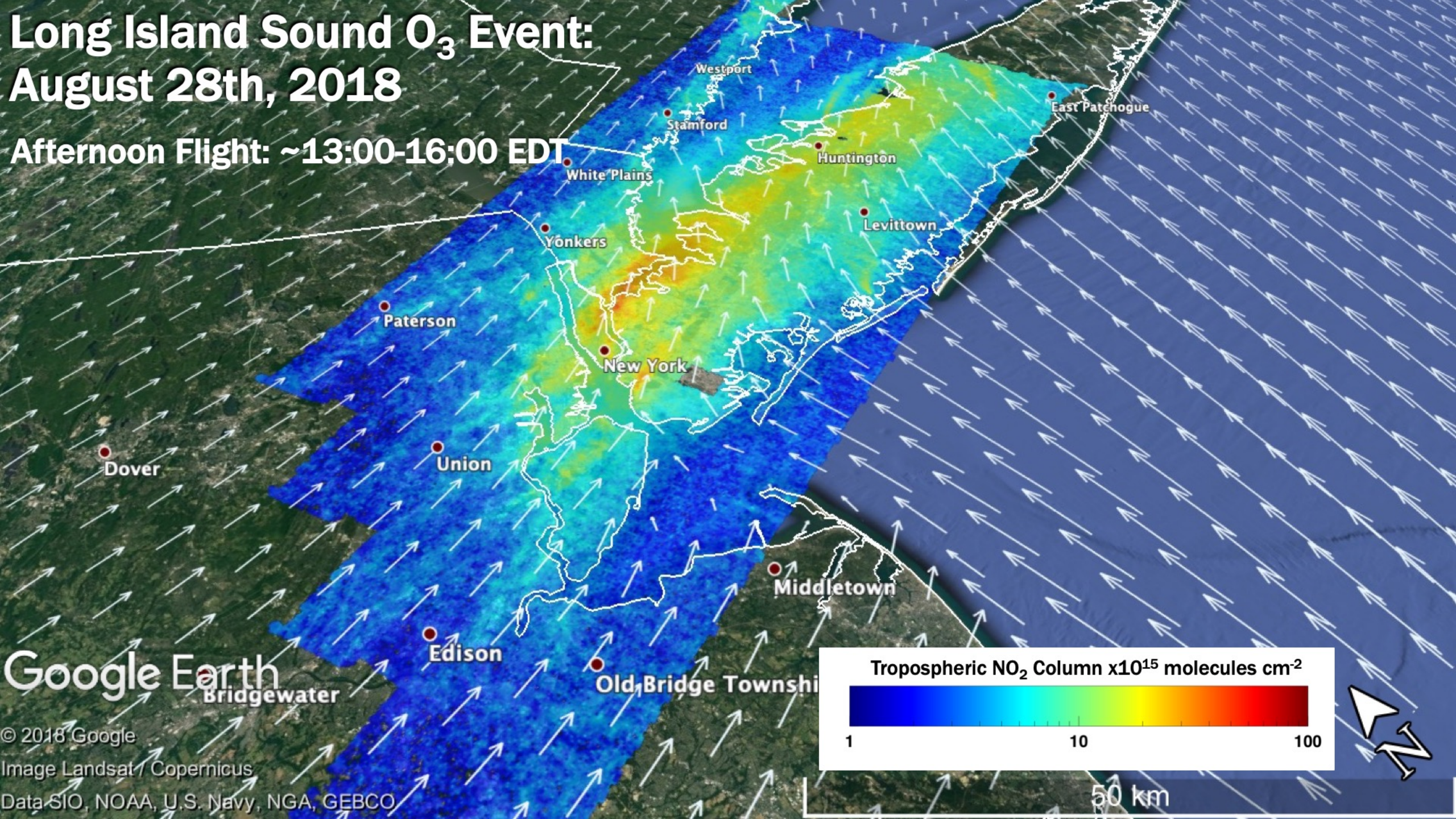





2017-06-27
19:15-20:45 UTC
Mt San Antonio
Burbank
Los Angeles
Ontario
San Bernardino
Santa Monica
Riverside
Moreno Valley
Corona
Torrance
Anaheim
Long Beach
Santa Ana
Perris
Irvine
Huntington Beach
Tropospheric NO2 Column x10^15 molecules cm^-2
1
10
100
N
50 km
Google Earth
Data LDEO-Columbia, NSF, NOAA
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data USGS

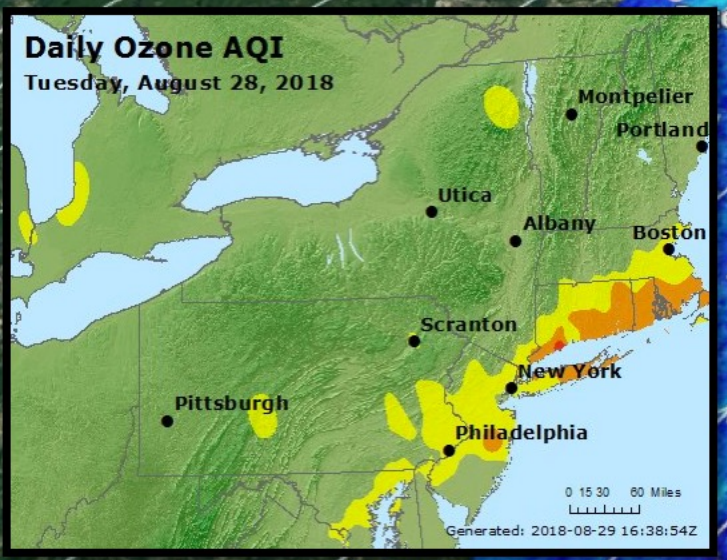

2017-06-27
15:30-17:00 UTC
Mt San Antonio
Burbank
Los Angeles
Santa Monica
Ontario
San Bernardino
Riverside
Moreno Valley
Corona
Torrance
Anaheim
Long Beach
Santa Ana
Irvine
Huntington Beach
Perris
Tropospheric NO2 Column x10^15 molecules cm^-2
1
10
100
N
50 km
Google Earth
Data LDEO-Columbia, NSF, NOAA
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Data USGS

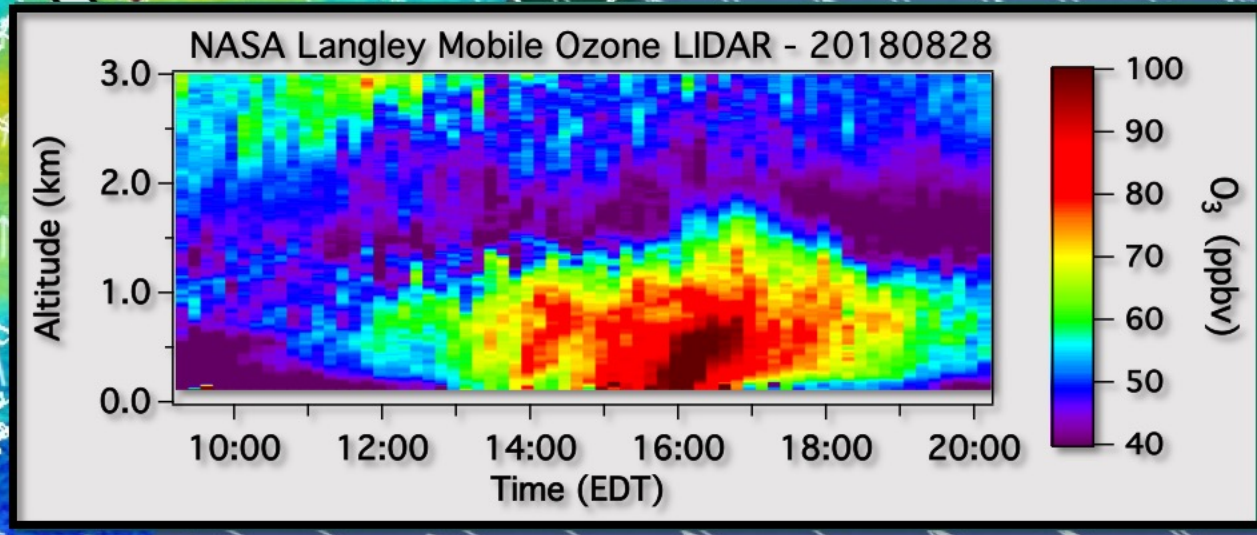

Long Island Sound O_3 Event:
August 28th, 2018
Afternoon Flight: ~13:00-16:00 EDT
Westport
Stamford
White Plains
Yonkers
Paterson
New York
Union
Dover
Edison
Bridgewater
Old Bridge Townshi
Middletown
Huntington
East Patchogue
Power Generating Facilities
Tropospheric NO_2 Column x10^{15} molecules cm^{-2}
1
10
100
N
50 km
Google Earth
© 2018 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO


Long Island Sound O_3 Event:
August 28th, 2018
Afternoon Flight: ~13:00-16:00 EDT
Westport
Stamford
White Plains
Yonkers
Paterson
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Huntington
East Patchogue
Levittown
Dover
Union
Middletown
Edison
Old Bridge Township
Bridgewater
Google Earth
© 2018 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Tropospheric NO_2 Column x10^{15} molecules cm^{-2}
1
10
100
N
50 km

Long Island Sound O_3 Event: August 28th, 2018

Afternoon Flight: ~13:00-16:00 EDT





Tropospheric NO_2 Column x10^{15} molecules cm^{-2}

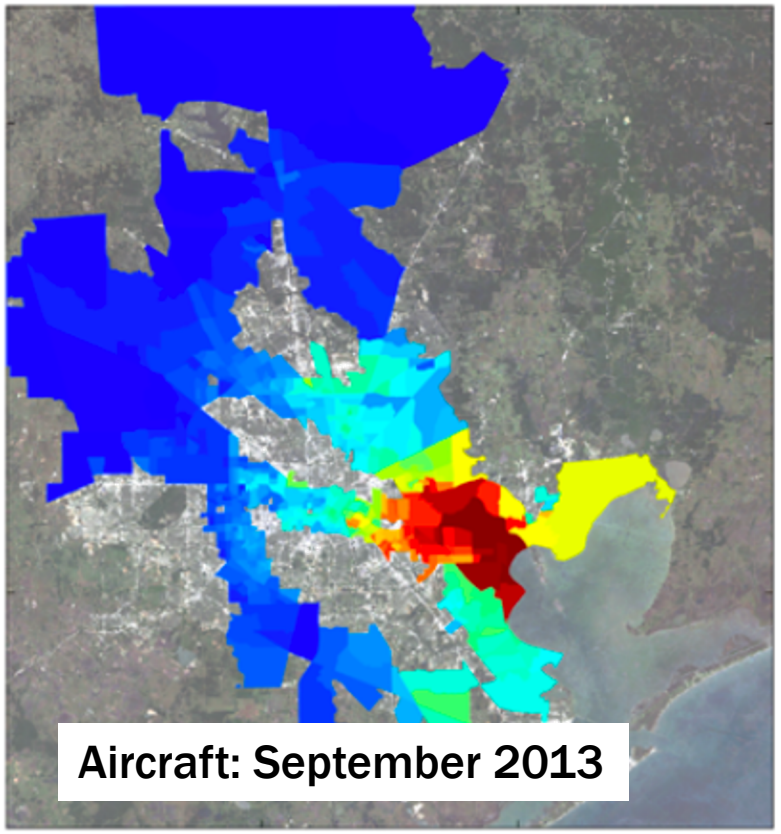
1 10 100

Google Earth

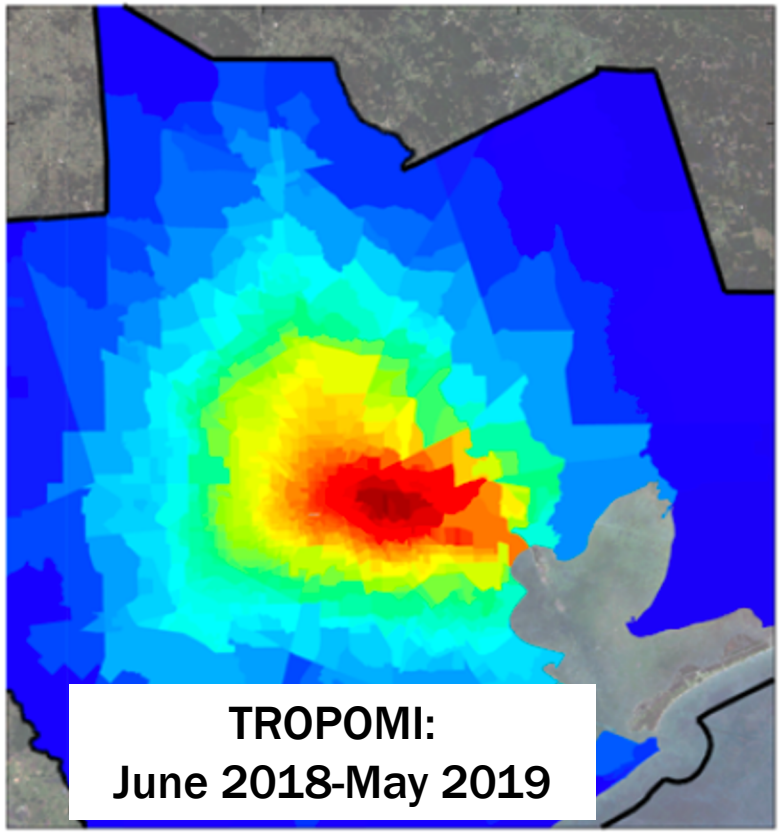
© 2018 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

50 km

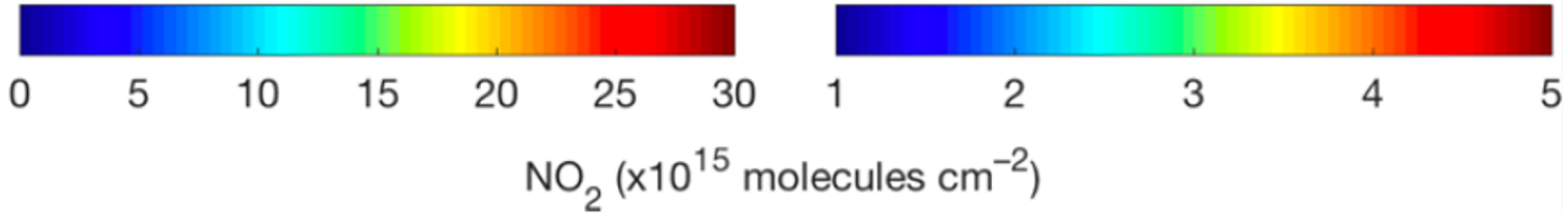
Houston, Texas

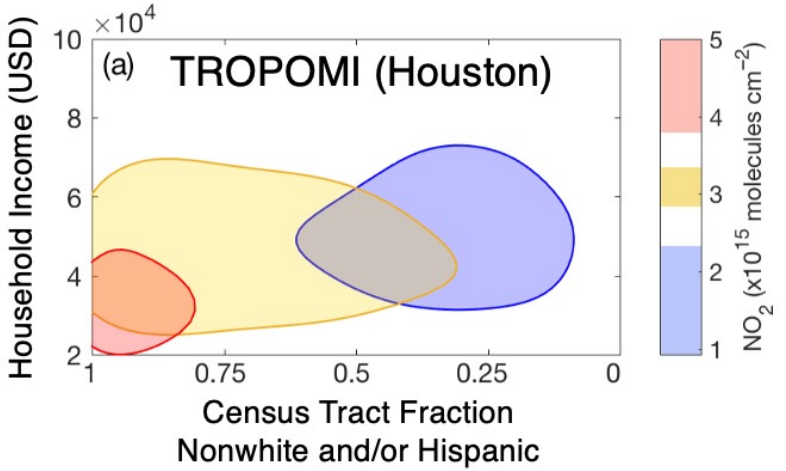


Aircraft: September 2013



TROPOMI:
June 2018-May 2019

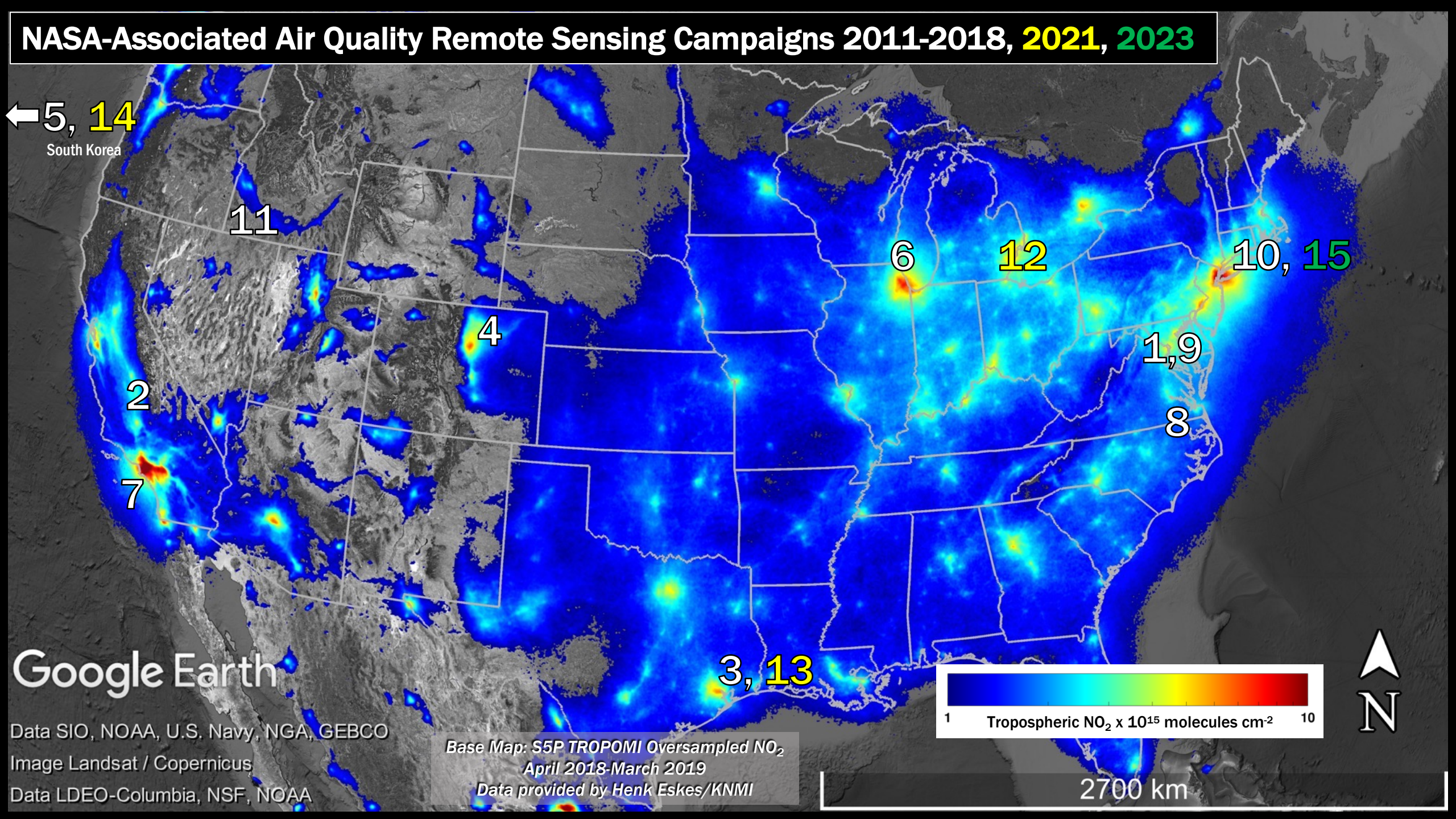


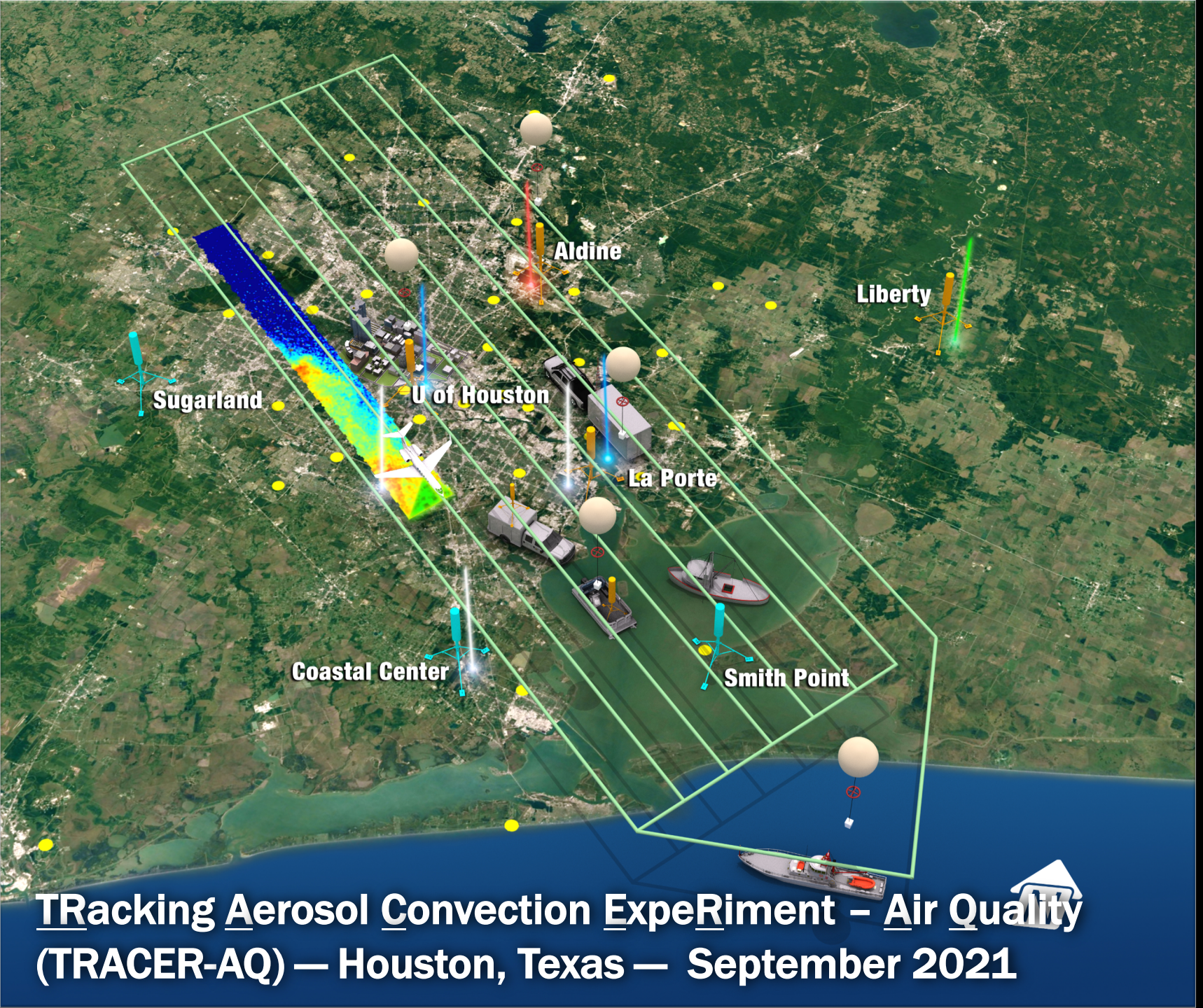


NO_2 was 37% higher for non-whites and Hispanics living in low-income tracts compared to whites living in high-income tracts in September 2013.

Results with TROPOMI show that a 65% reduction in diesel NO_x emissions will reduce NO_2 inequality by 50% in Houston.

Demetillo et al. (2020):
https://dx.doi.org/10.1021/acs.est.0c01864
Demetillo et al. (2021):
https://doi.org/10.1029/2021GL094333


NASA-Associated Air Quality Remote Sensing Campaigns 2011-2018, 2021, 2023
5, 14
South Korea
11
4
2
7
6
12
10, 15
1,9
8
3, 13
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Data LDEO-Columbia, NSF, NOAA
Base Map: S5P TROPOMI Oversampled NO2
April 2018-March 2019
Data provided by Henk Eskes/KNMI
1
Tropospheric NO2 x 10^15 molecules cm^-2
10
N
2700 km



TRacking Aerosol Convection ExpeRiment – Air Quality (TRACER-AQ) — Houston, Texas — September 2021





Ozone Photochemistry and Meteorology

Modeling and Satellite Evaluation

Intersection of Air Quality and Socioeconomics Factors

Thanks for your attention!

National Aeronautics and Space Administration

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NASA Langley Research Center
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