PRESS CONFERENCE: Impacts of covid-19 on people and the environment, as seen from space

Monday, 7 December
1:00 pm US Eastern Time

AGU FALL MEETING

SHAPING THE FUTURE OF SCIENCE

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PANELISTS

- **Ned Bair,** University of California Santa Barbara/Earth Research Institute
- **Timothy Newman,** US Geological Survey
- **Nima Pahlevan,** NASA Goddard Space Flight Center

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INFORMATION FOR REPORTERS

- Slides from this presentation are available in the Fall Meeting Media Center: https://www.agu.org/Fall-Meeting/Pages/Attend/Media-Center

- A recording of this event will be posted to AGU's YouTube channel: https://www.youtube.com/c/AGUvideos
  - Playlist "Fall Meeting 2020 Press Conferences"

- An informal, 30-minute discussion room via Zoom will follow this event:
  - Link will be posted in this event's chat box
  - Meeting ID: 962 1469 2326
  - Passcode: agupress

- Questions: Email news@agu.org

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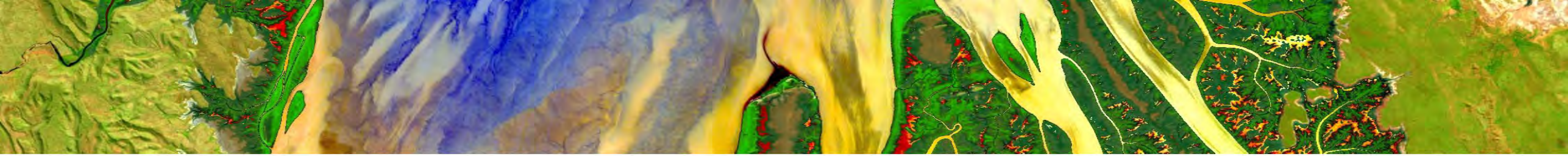


Assessing COVID-19 environmental impacts through remote sensing

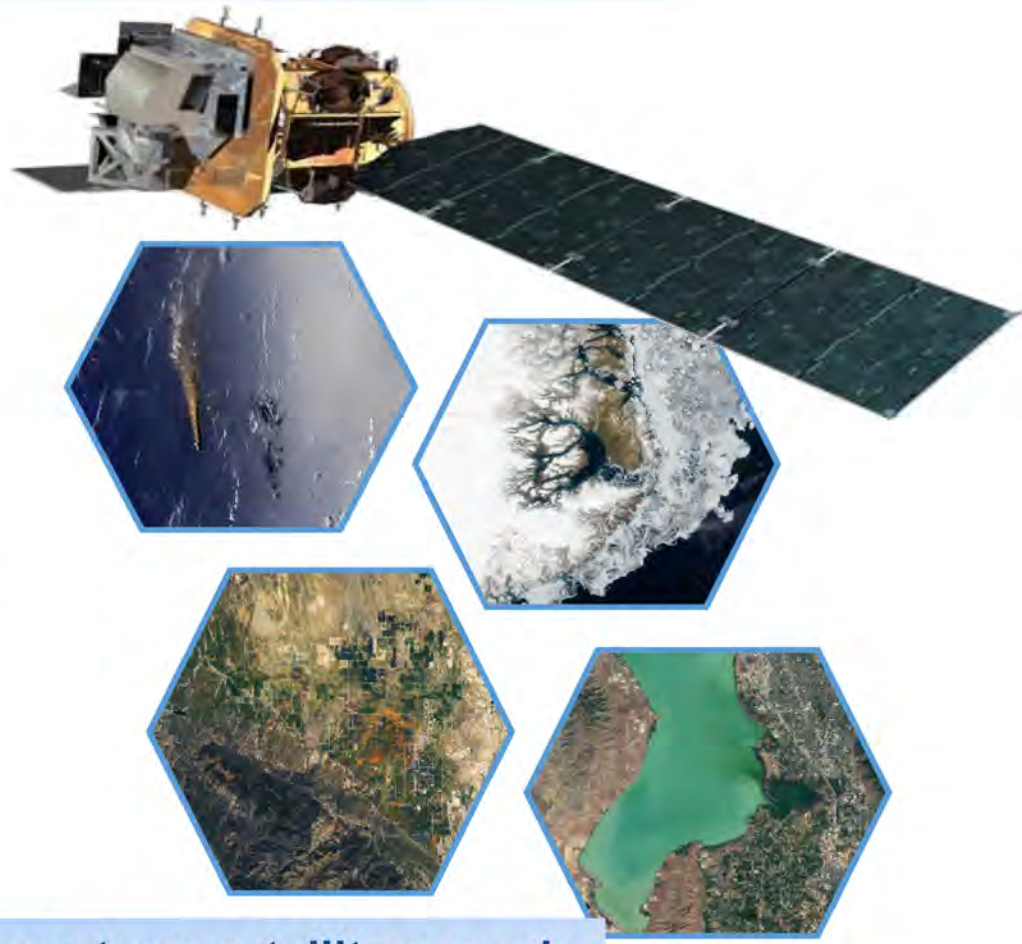
Timothy Newman

National Land Imaging Program Coordinator
U.S. Geological Survey
Department of the Interior

USGS

Landsat and the challenge of detecting COVID-19 impacts

- Landsat is the world's longest-lived series of land imaging satellites, providing a 48+ year archive of natural and human-induced changes to the global landscape
  - Multispectral; 15 / 30 / 100-meter spatial resolution, 8-day revisit rate
- Multiple confounding factors can make it challenging to observe and identify direct COVID-19 impacts, in part since visible impacts to land surfaces may take a long time to manifest
- Long-term well-calibrated satellite data records such as Landsat are crucial to provide a baseline to evaluate COVID-19 environmental impacts, both directly and indirectly



Detecting COVID-19 impacts from space requires consistent long-term satellite records

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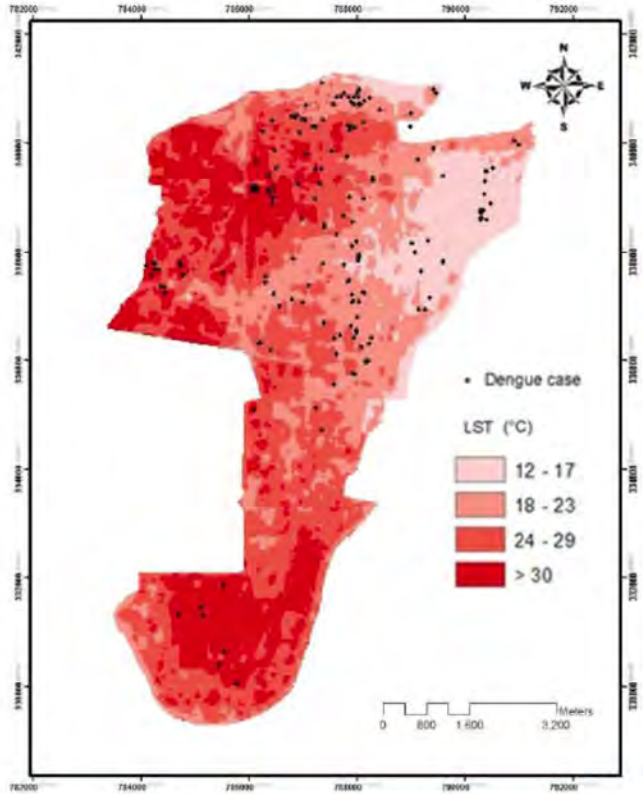
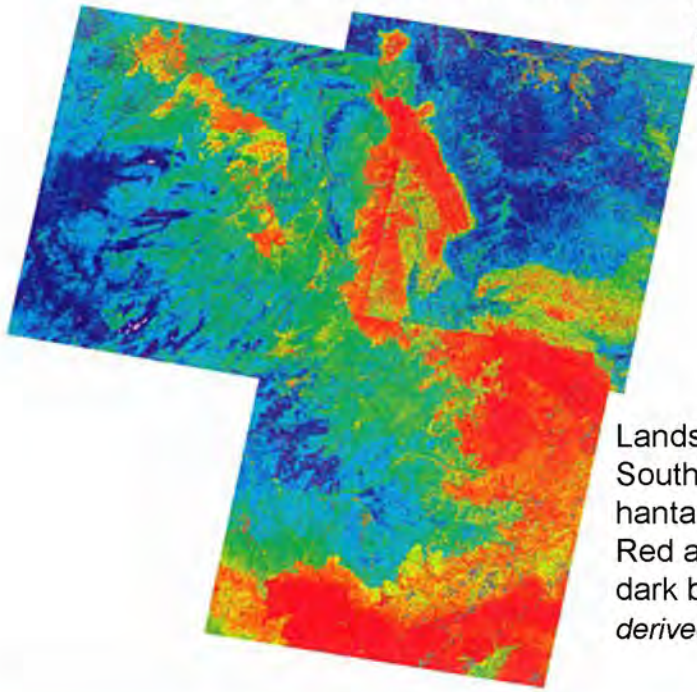
Landsat used historically to observe disease outbreaks

- **Dengue Fever**: Dengue fever is a major mosquito-borne viral disease. Cases occur worldwide, though mostly in the tropics as the virus is sensitive to temperature.



Dengue cases mapped onto Landsat surface temperature (LST) in Subang Jaya city, Malaysia. *(Latif et al. 2016)*

- **Hantavirus**: The 1991-92 El Niño brought unusually high precipitation to the Four Corners (U.S.) region in 1992. This led to an increase in vegetation and a hypothesized increase in the rodent population in 1993.



Predicted risk for hantavirus pulmonary syndrome (HPS) in 1993

Landsat 5 satellite imagery in the American Southwest shows the predicted risk for hantavirus pulmonary syndrome in 1993. Red and yellow indicate high-risk areas, and dark blue indicates low-risk areas. (*Image derived from Glass et al.*)

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Satellite imagery provides an efficient survey of large area environmental indicators of disease

Complex dynamics involving COVID-19 effects on the land

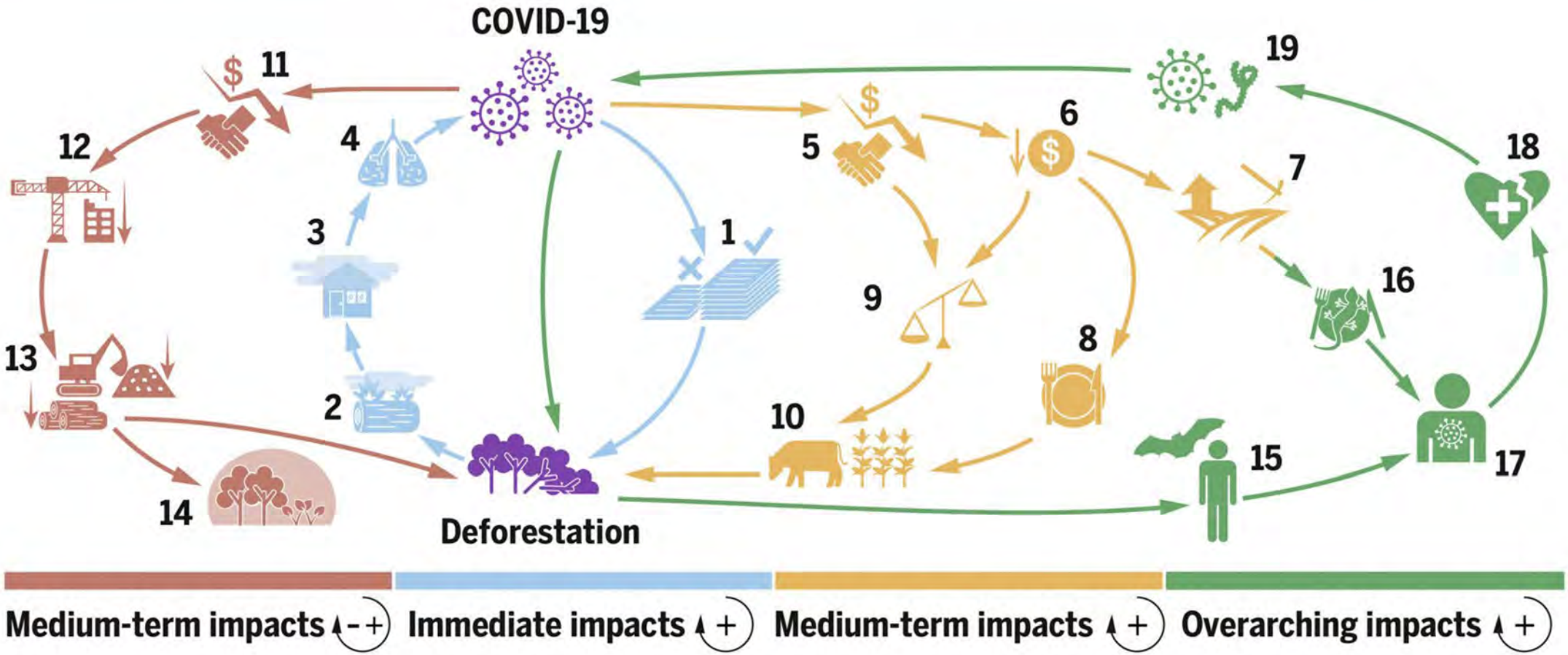
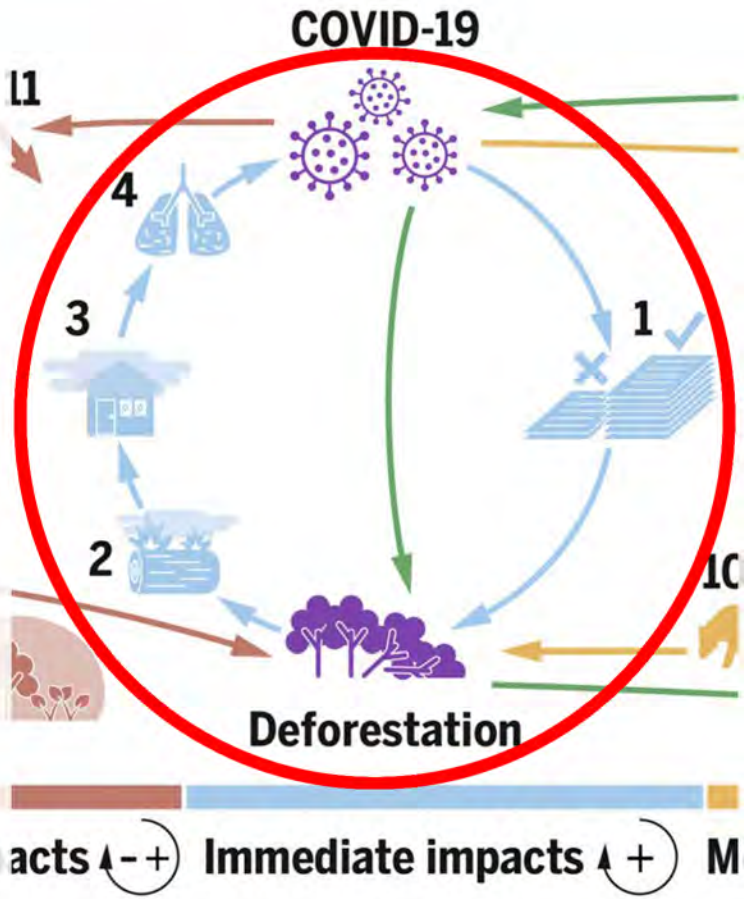


Figure from Brancalion, P.H., et al. Emerging threats linking tropical deforestation and the COVID-19 pandemic. Perspect Ecol Conserv. (2020). https://doi.org/10.1016/j.pecon.2020.09.006

Complex dynamics involving COVID-19 effects on the land



1 Relaxed legal enforcement

2 Biomass burning

3 Air pollution

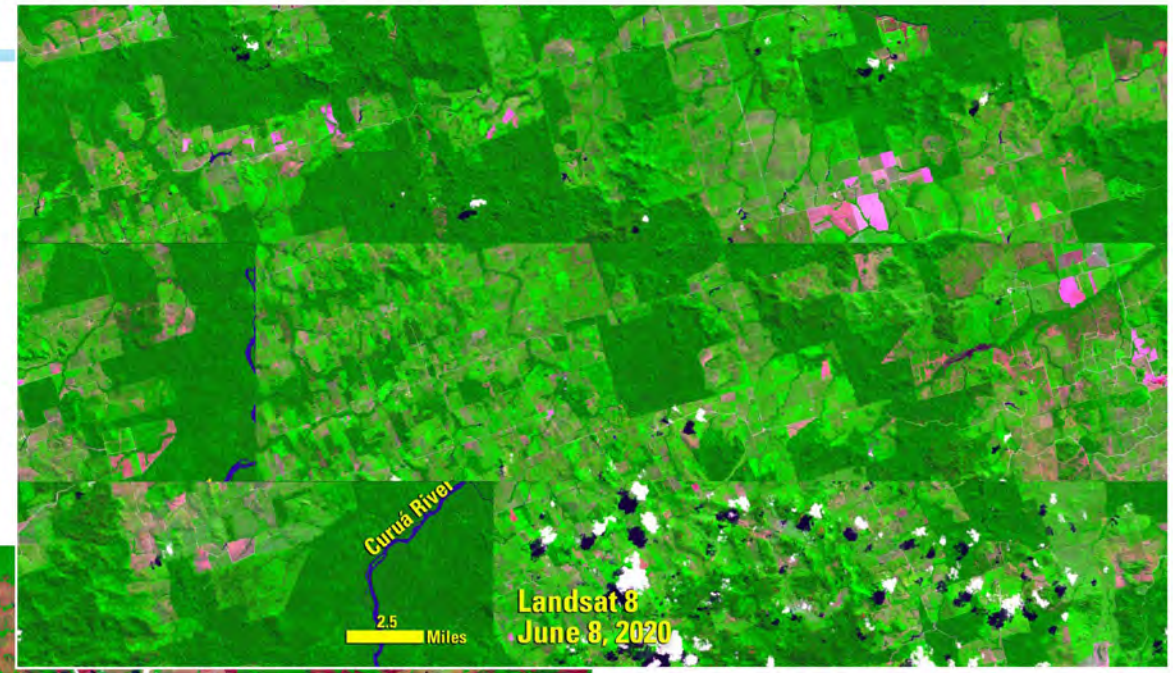
4 Respiratory problems

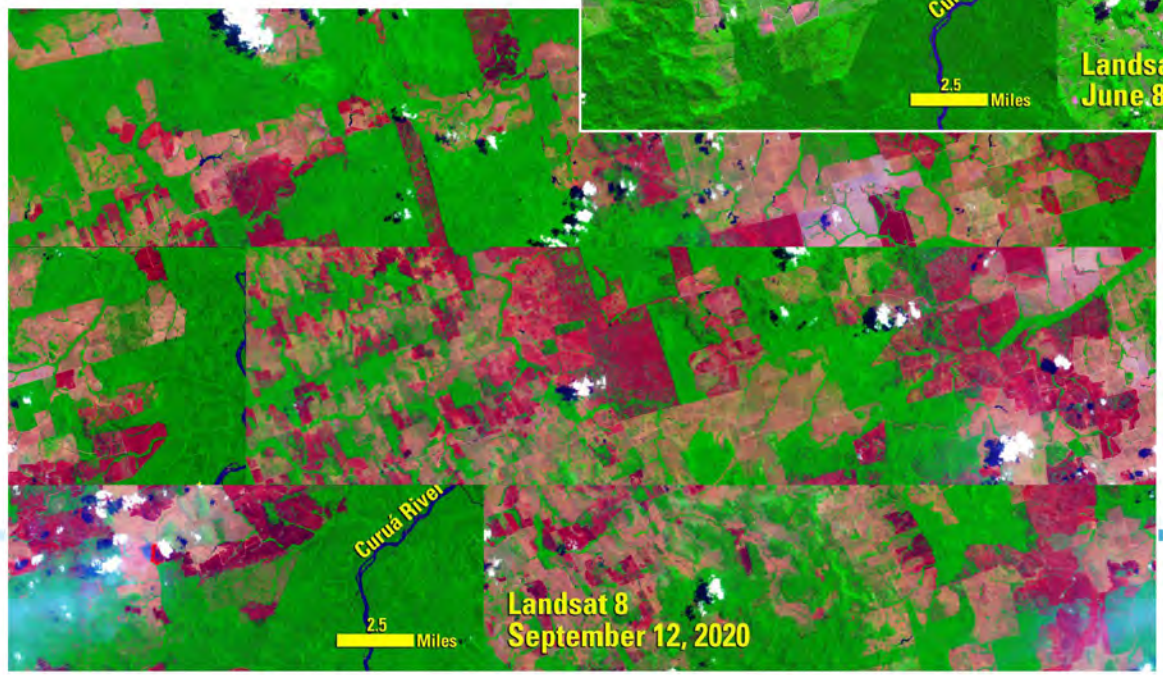
- Agriculture, forests, economy and public health are linked in complex positive and negative feedback loops
- **Well-calibrated satellite records can be used to evaluate short- and long-term COVID-19 impacts**

Figure from Brancalion, P.H., et al. Emerging threats linking tropical deforestation and the COVID-19 pandemic. Perspect Ecol Conserv. (2020). https://doi.org/10.1016/j.pecon.2020.09.006

COVID-19 may be accelerating deforestation in Brazil

- Brazil's Real-time Deforestation Detection System (DETER) uses moderate-resolution satellite images to quickly identify potential deforestation.
- More than 8700 km^2 of primary forest cover has disappeared since August 2019, compared with 6800 km^2 in the previous 12 months



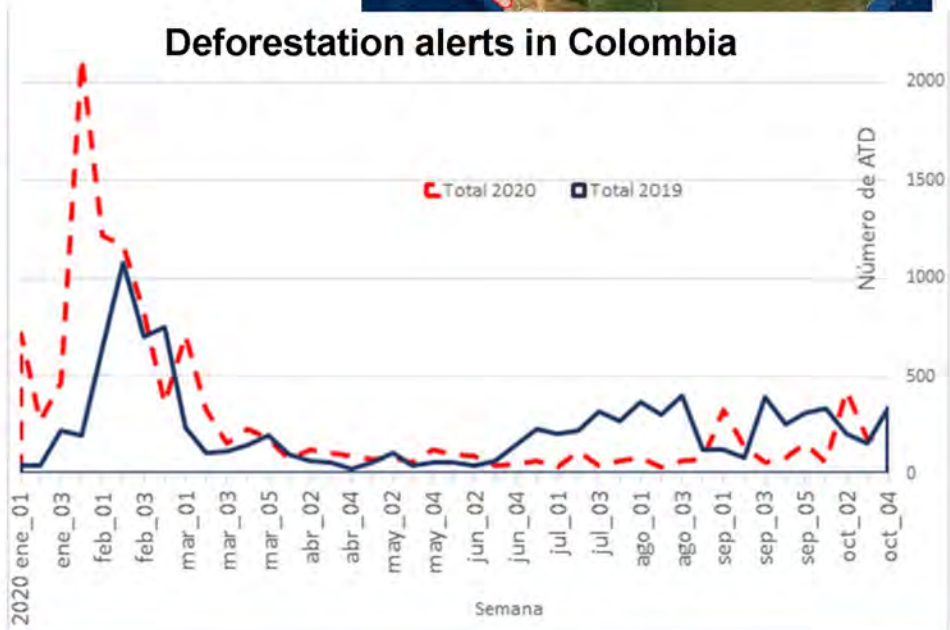


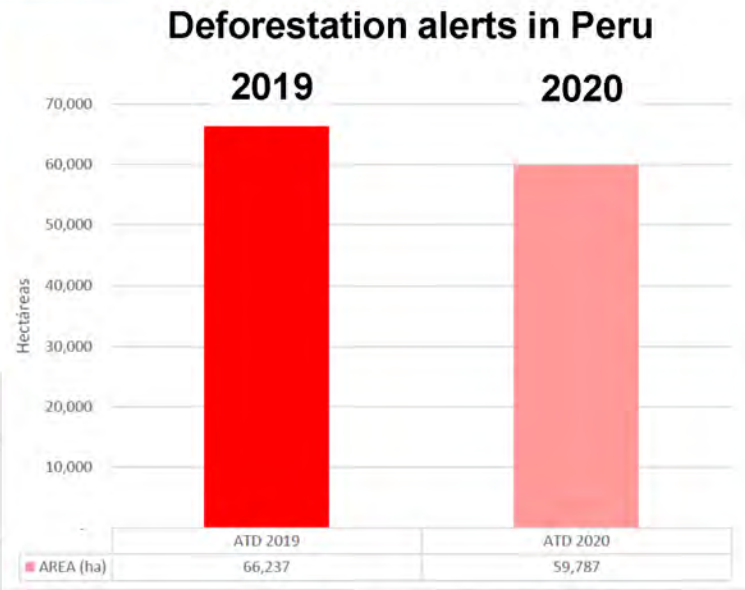
Landsat imagery showing an area of the Brazilian Amazon rainforest in June and Sept 2020

COVID-19 may be decelerating deforestation elsewhere in Amazonia

- For other countries in Amazonia, deforestation has shifted location, but overall number of alerts is slightly lower than this time last year
- *In situ* monitoring has given way to remote sensing alerts
  - Deforestation alerts measured using **Landsat, Sentinel-1, and Sentinel-2**

Continuous Landsat data record can be used to track year-to-year and week-to-week changes on the land





Fuente: Programa Nacional de Conservación de Bosques (PNCBMCC)

Above: total number of deforestation alerts in Peru during COVID, versus same time period in 2019.

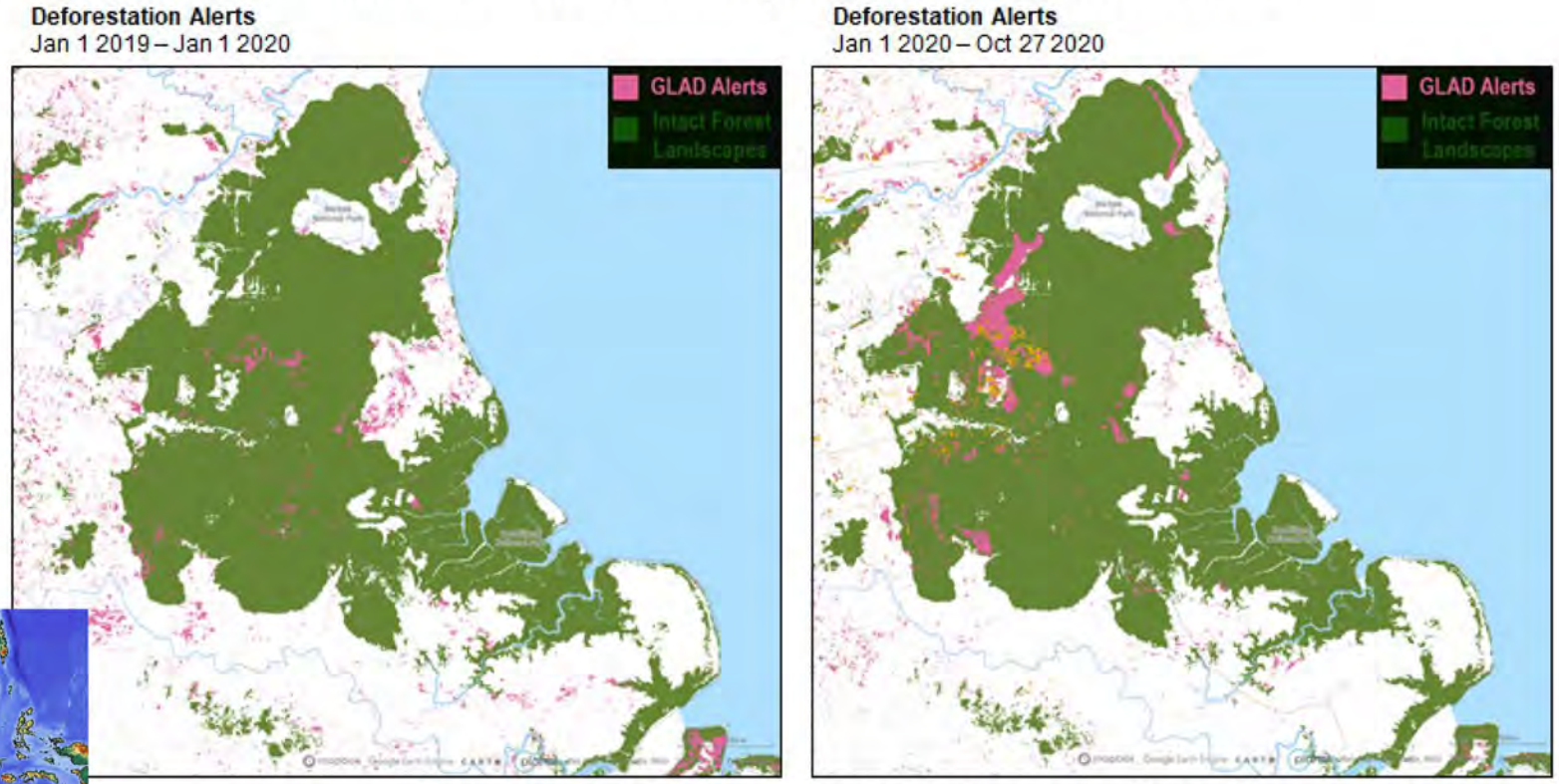
Left: number of weekly deforestation alerts Jan-Oct for Colombia, comparing 2019 & 2020.

Figures are courtesy of the Peruvian and Colombian Ministries of the Environment

COVID-19 may be accelerating deforestation in the Tropics

- Deforestation alerts occur in the tropics worldwide
  - Global Forest Watch alerts using **Landsat** imagery show varied levels of activity across the tropics
- The long-term dataset of **Landsat** provides a unique resource in measuring both growth and loss of these forests

Increased deforestation events (shown in pink) were detected in Indonesia



Maps from **Global Forest Watch GLAD alerts** on the island of Sumatra, Indonesia

An alert is defined as any Landsat pixel that experiences a canopy loss in excess of 50% cover

Global survey Landsat mission allows tracking of deforestation and reforestation worldwide

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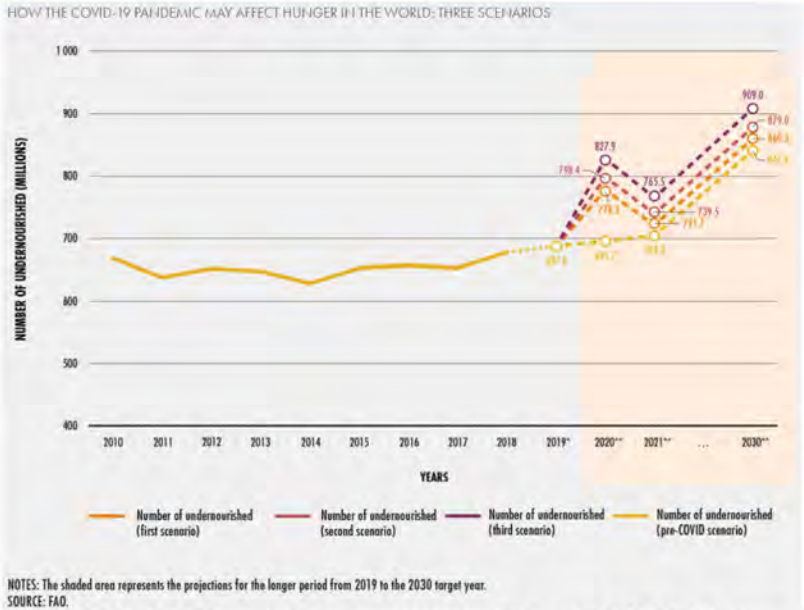
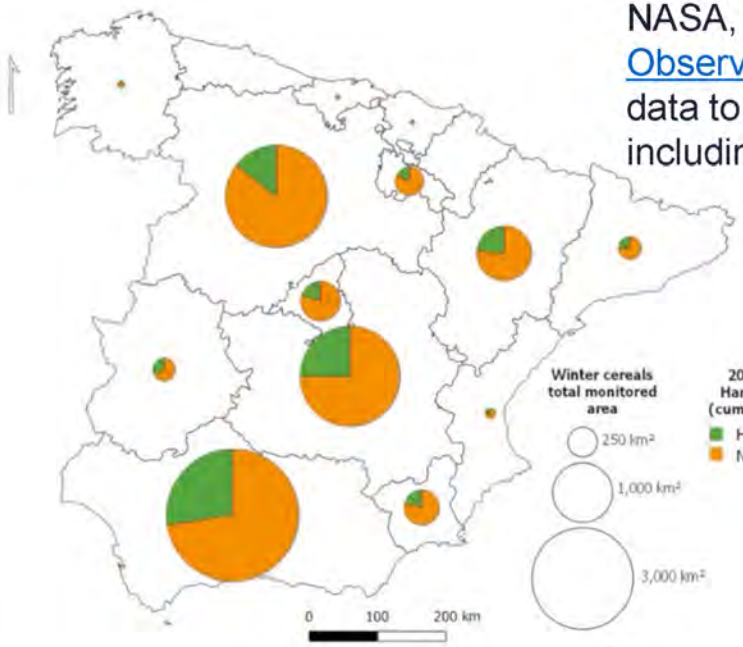
COVID-19 may be contributing to Global agricultural issues



UN World Food Programme: The COVID-19 pandemic could push over 130 million additional people into chronic hunger by the end of 2020.

Winter cereals harvesting status in Spain (6/7/2020)



NASA, ESA and JAXA created the [COVID-19 Earth Observation Dashboard], a platform that combines satellite data to monitor the impacts of COVID-19 worldwide—including agricultural production.

2020 harvesting season started in mid-June, later than the average crop calendar for winter cereals in Spain

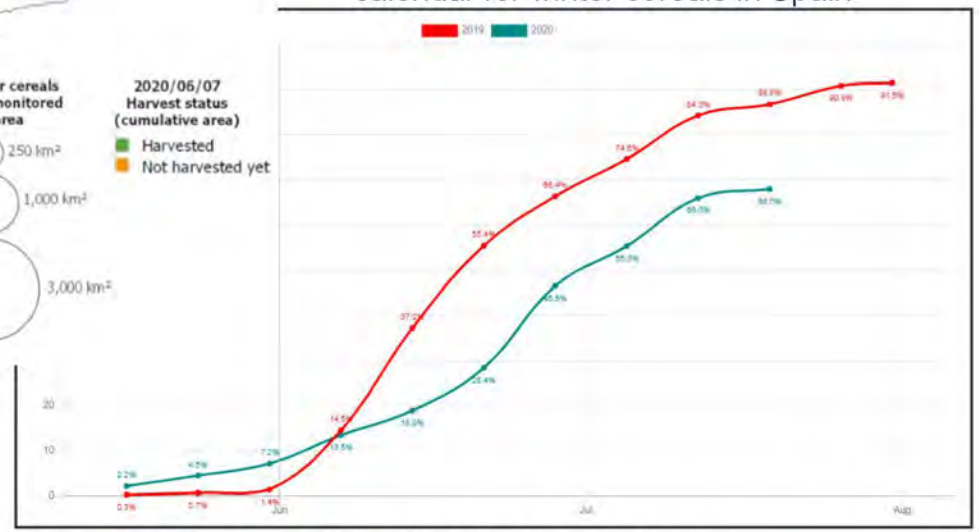


Figure credits: Sen4Stat project, Université catholique de Louvain, Belgium

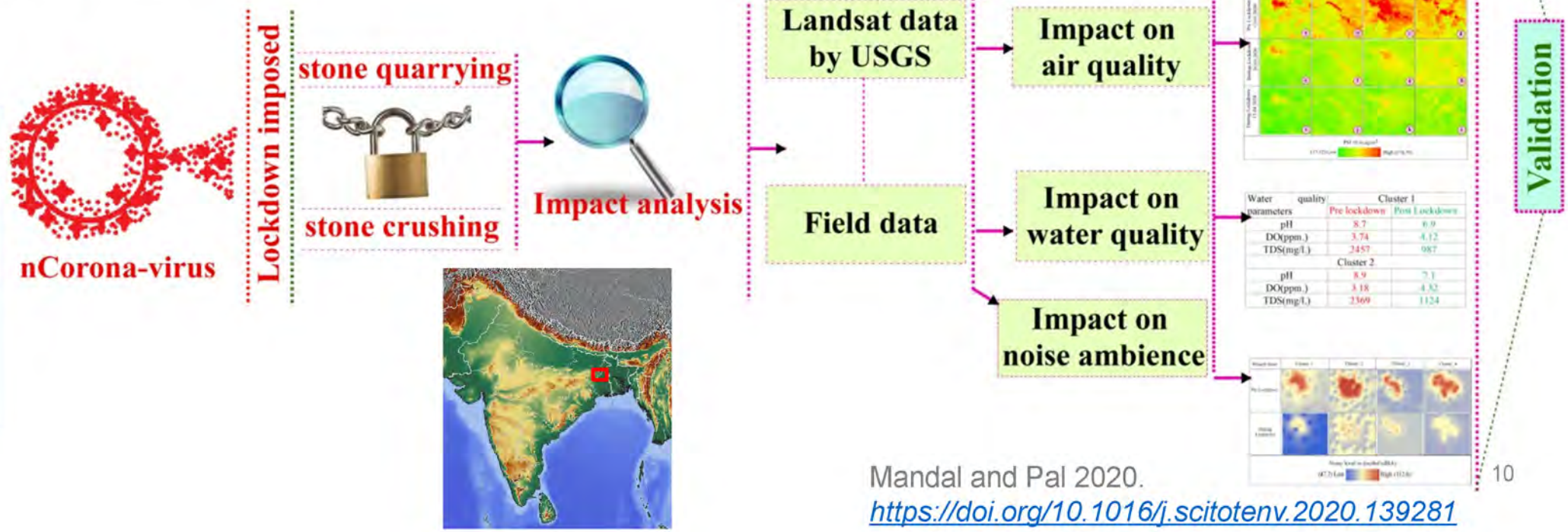
Global freely-available moderate-resolution imagery provides continuous global agricultural monitoring from space

COVID-19 may be reducing environmental pollution

- Industrial activities such as stone quarrying & crushing cause environmental pollution and can harm human health
- **Landsat** data were used to evaluate environmental impacts in the Dwarka river basin in India
- COVID lockdown reduced Particulate Matter (PM_{10}) by 3-4 times, land surface temperature by 3-5ºC, improved water quality, and reduced noise levels (*in situ*)

Moderate spatial resolution thermal infrared data from Landsat can observe heat flux from space

Rich spectral information from Landsat provides multi-dimensional view of COVID-19 environmental impacts

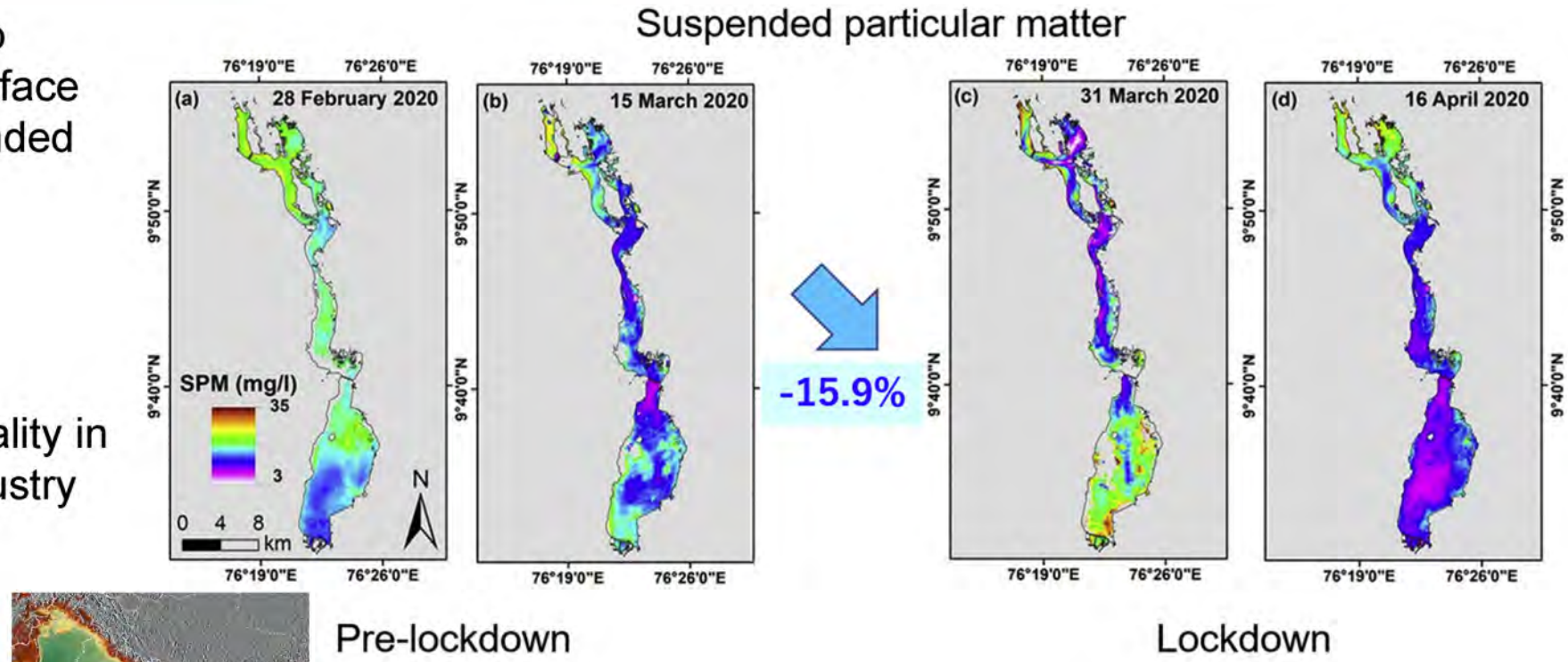


Mandal and Pal 2020.
https://doi.org/10.1016/j.scitotenv.2020.139281

COVID-19 may be improving surface water quality

- **Landsat 8** imagery was used to quantify the improvement in surface water quality in terms of suspended particulate matter (SPM) in Vembanad Lake, the longest freshwater lake in India
- COVID-19 lockdowns have measurably improved water quality in lakes adjacent to cities and industry

Moderate spatial resolution and high-quality Landsat enables local scale monitoring



Yunus et al. 2020. https://doi.org/10.1016/j.scitotenv.2020.139012

Landsat and other Earth observations support environmental and public health

Image from Planet blog

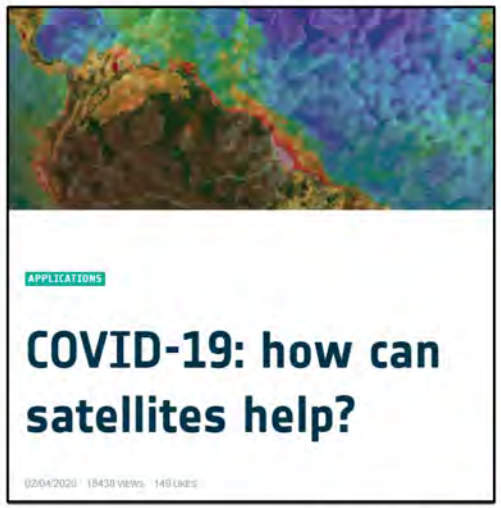


Image from ESA blog

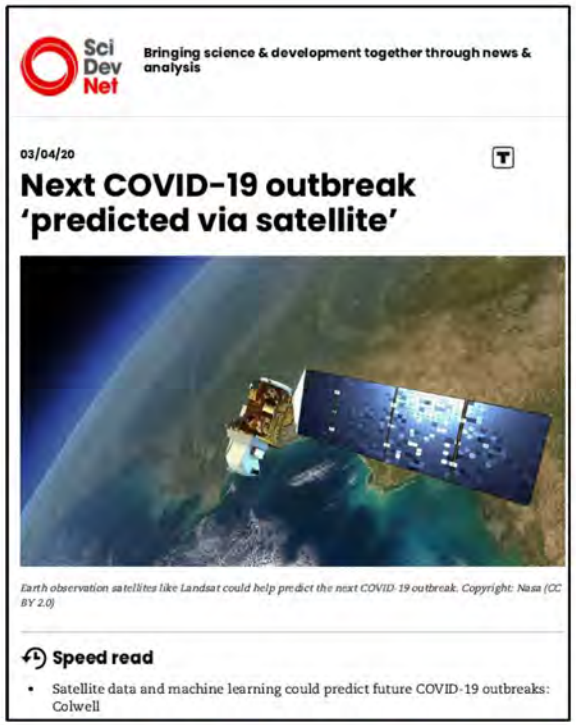


Image from NASA blog

- Improved understanding of previous disease outbreaks' environmental impacts
- Ability to monitor multiple current environmental trends during the current pandemic
- Further multidisciplinary research needed to clearly attribute environmental changes to COVID-19

Global, long-term, science-quality land and surface water observations will help us to better understand COVID-19 impacts

USGS

Impacts of COVID-19 Lockdown on Surface Water Quality

Nima Pahlevan[a,b], Ajit Subramaniam[c], Naomi Schulberg[d], Armin Mehrabian[a,b]

[a] NASA Goddard Space Flight Center

[b] Science Systems and Applications Inc. (SSAI)

[c] Columbia University

[d] Cornell University

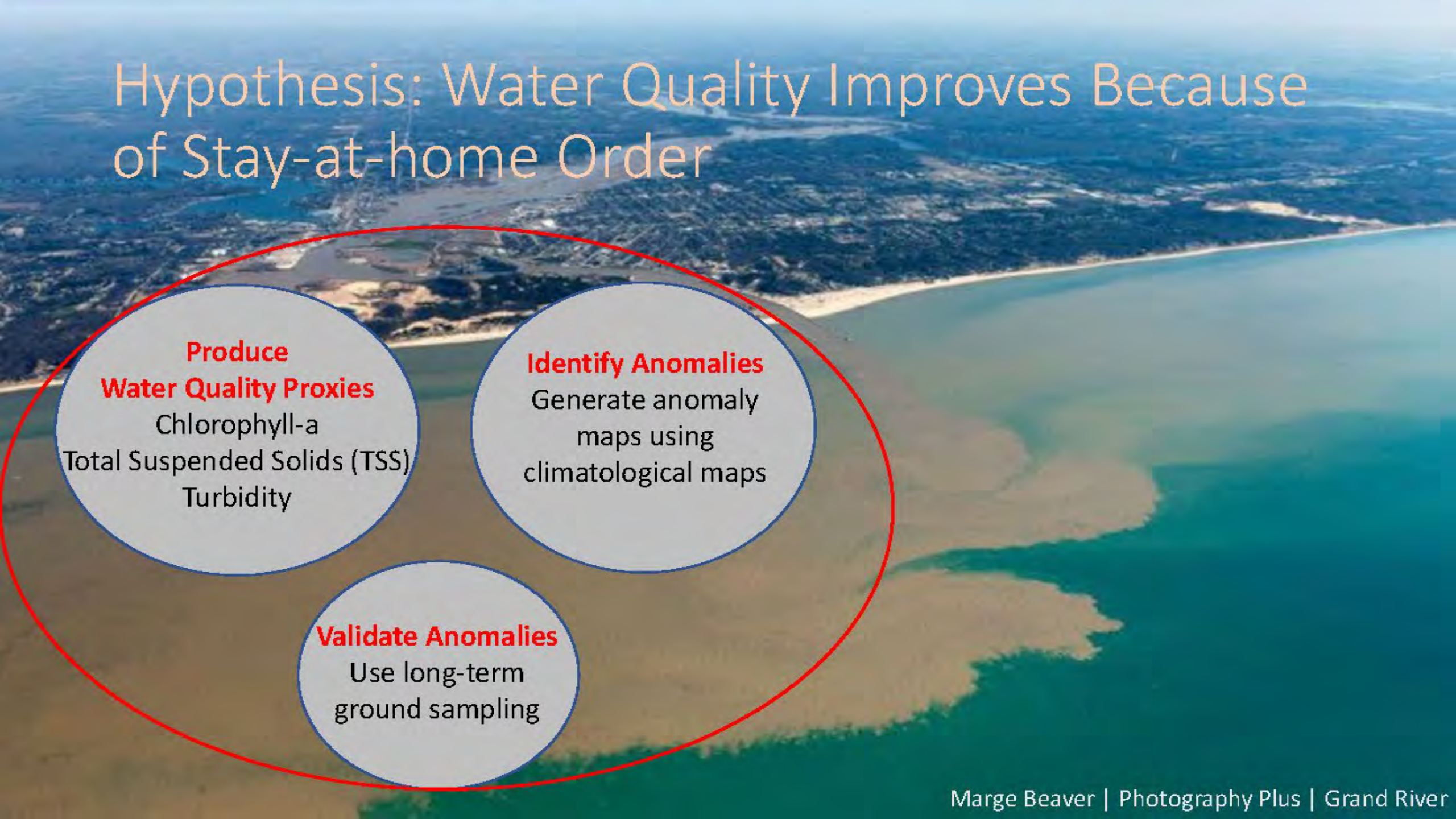
AGU 2020 – COVID-19 Panel Discussion

Dense Microcystis bloom - West Sister Island (Lake Erie) Landsat-8/OLI - 09/27/2014

Hypothesis: Water Quality Improves Because of Stay-at-home Order

Marge Beaver | Photography Plus | Grand River

Hypothesis: Water Quality Improves Because of Stay-at-home Order



Marge Beaver | Photography Plus | Grand River

Hypothesis: Water Quality Improves Because of Stay-at-home Order

Produce Water Quality Proxies
Chlorophyll-a
Total Suspended Solids (TSS)
Turbidity

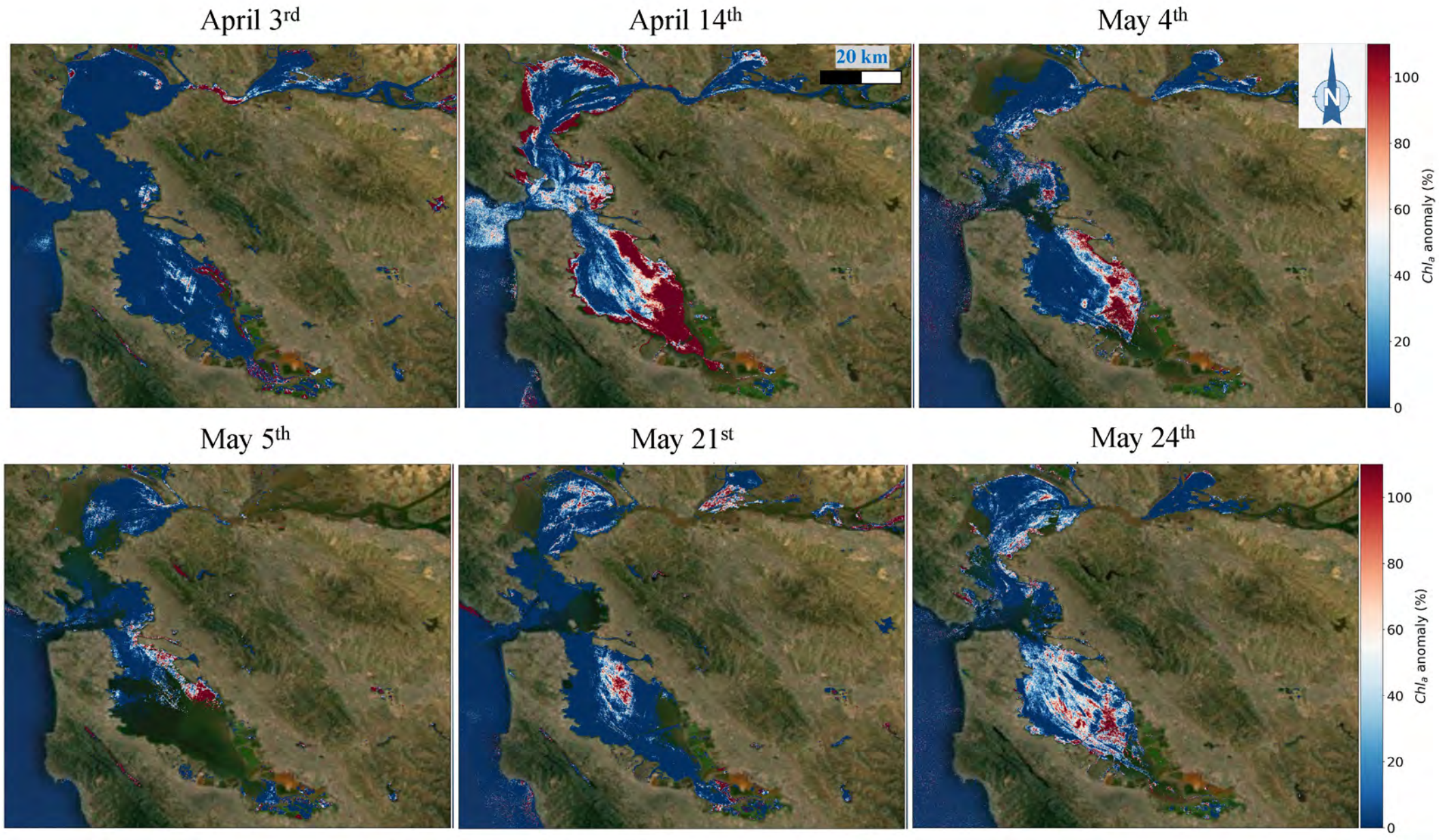
Identify Anomalies
Generate anomaly maps using climatological maps

Validate Anomalies
Use long-term ground sampling

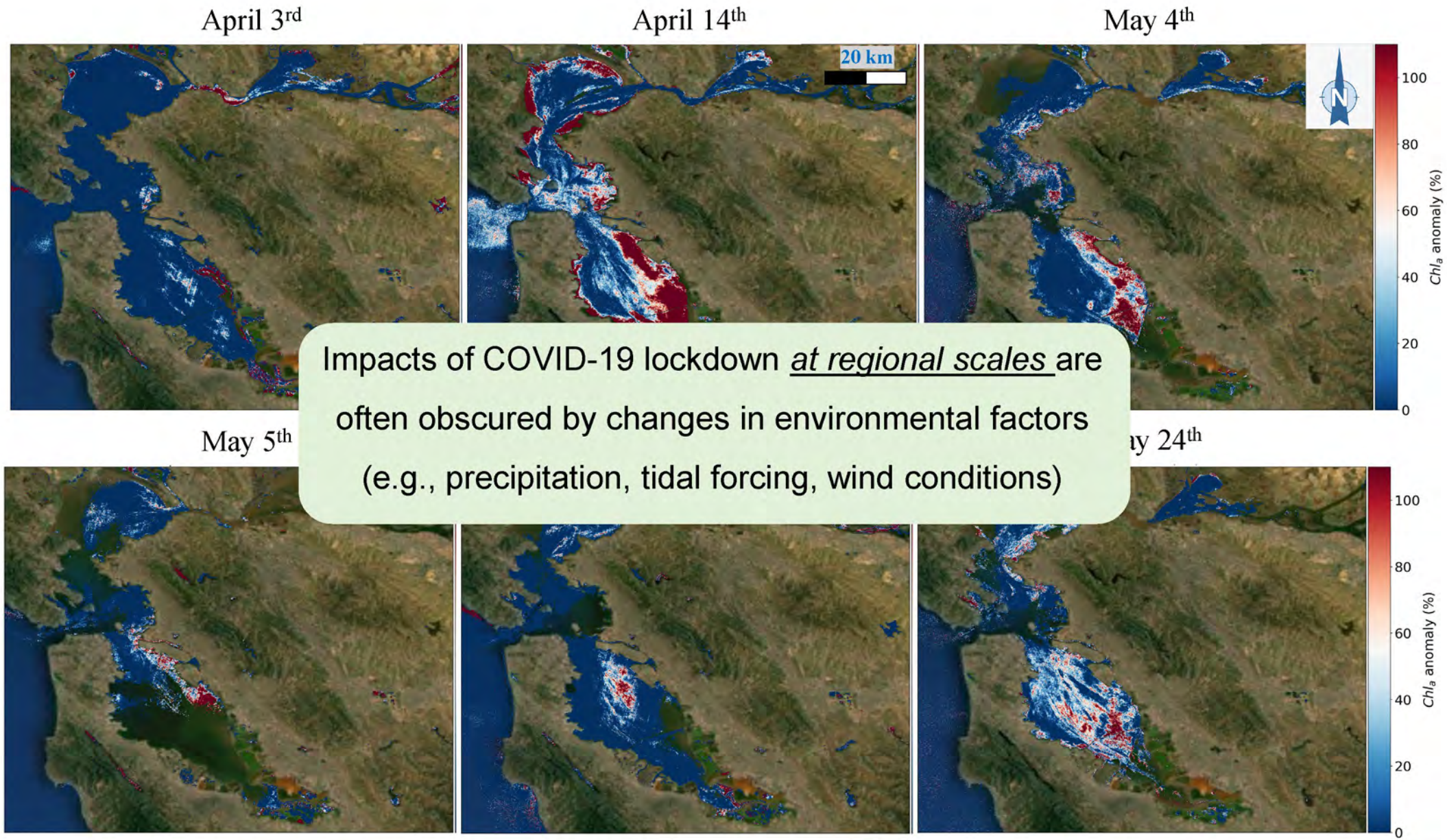
Experiments
San Francisco Bay
Venice lagoon
New York City
Chesapeake Bay

Satellite Datasets
Landsat-8
&
Sentinel-2

San Francisco Bay: Anomaly Maps (2020)



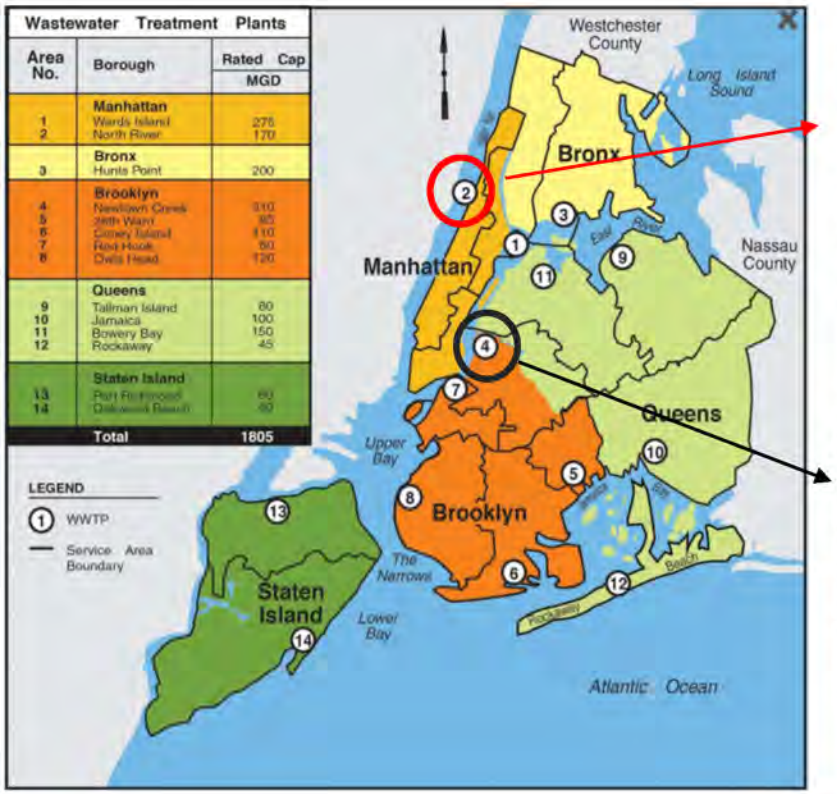
San Francisco Bay: Anomaly Maps (2020)

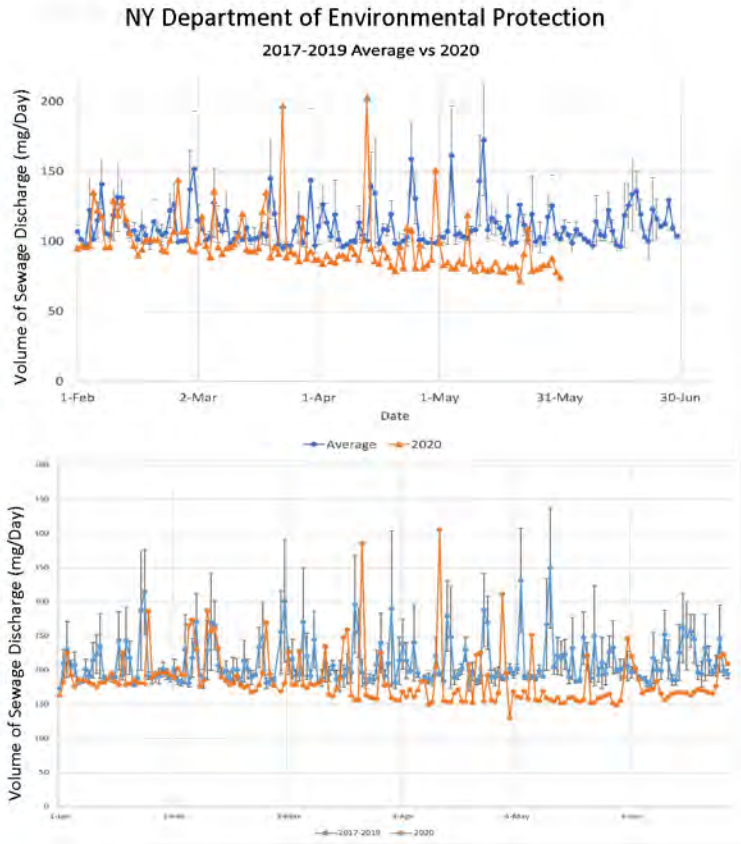


Impacts of COVID-19 lockdown *at regional scales* are often obscured by changes in environmental factors (e.g., precipitation, tidal forcing, wind conditions)

New York City

- A Region where subtle COVID-19 impacts can be isolated from environmental/physical forcing
- Manhattan has ~ *2.1 million commuters* that stayed home. Consequently, sewage discharge originated from businesses is expected to be significantly reduced





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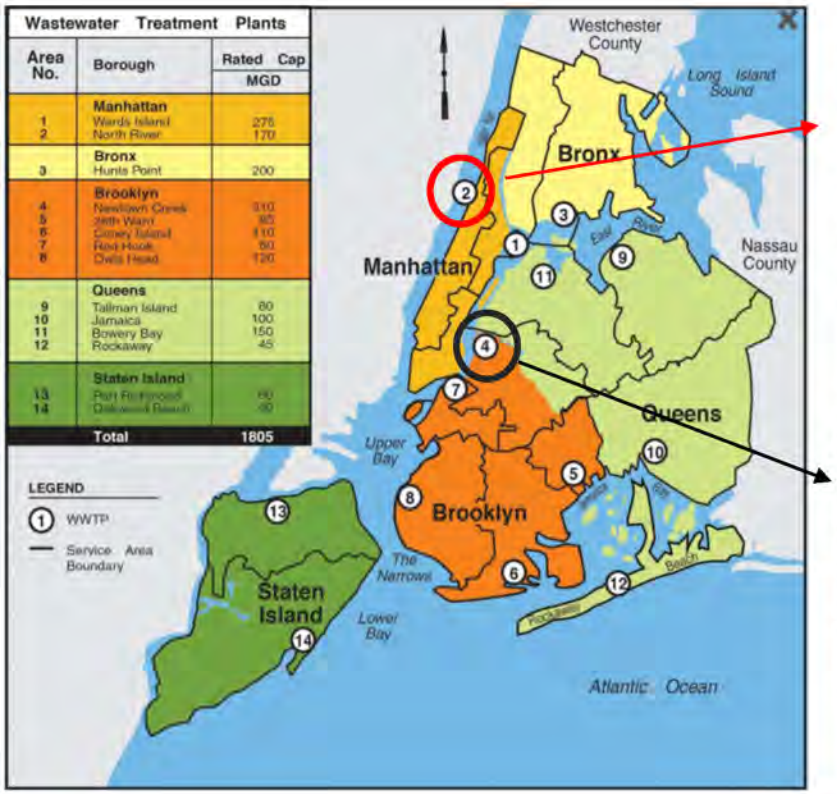
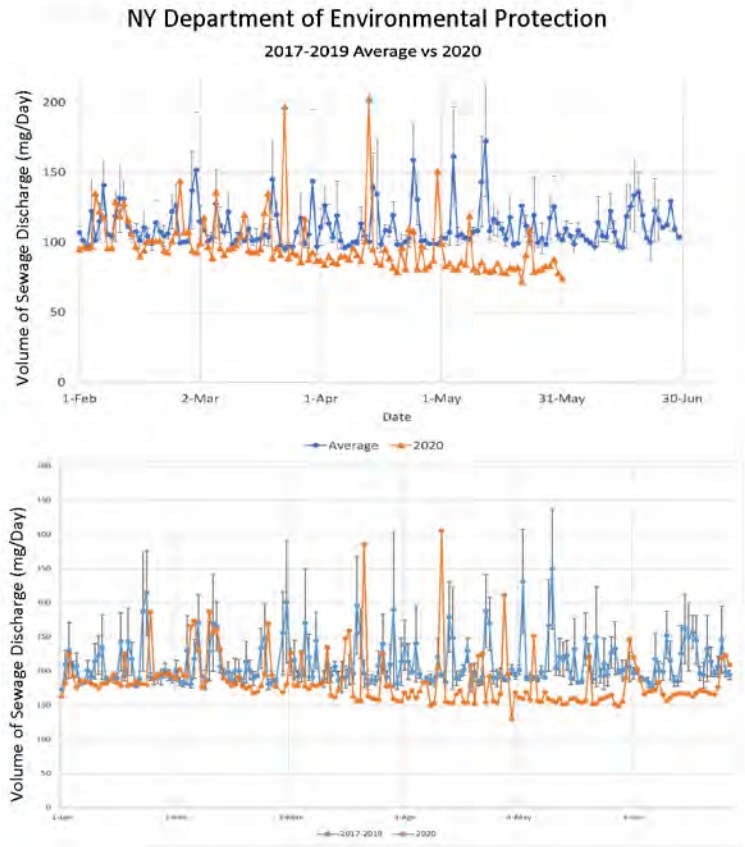
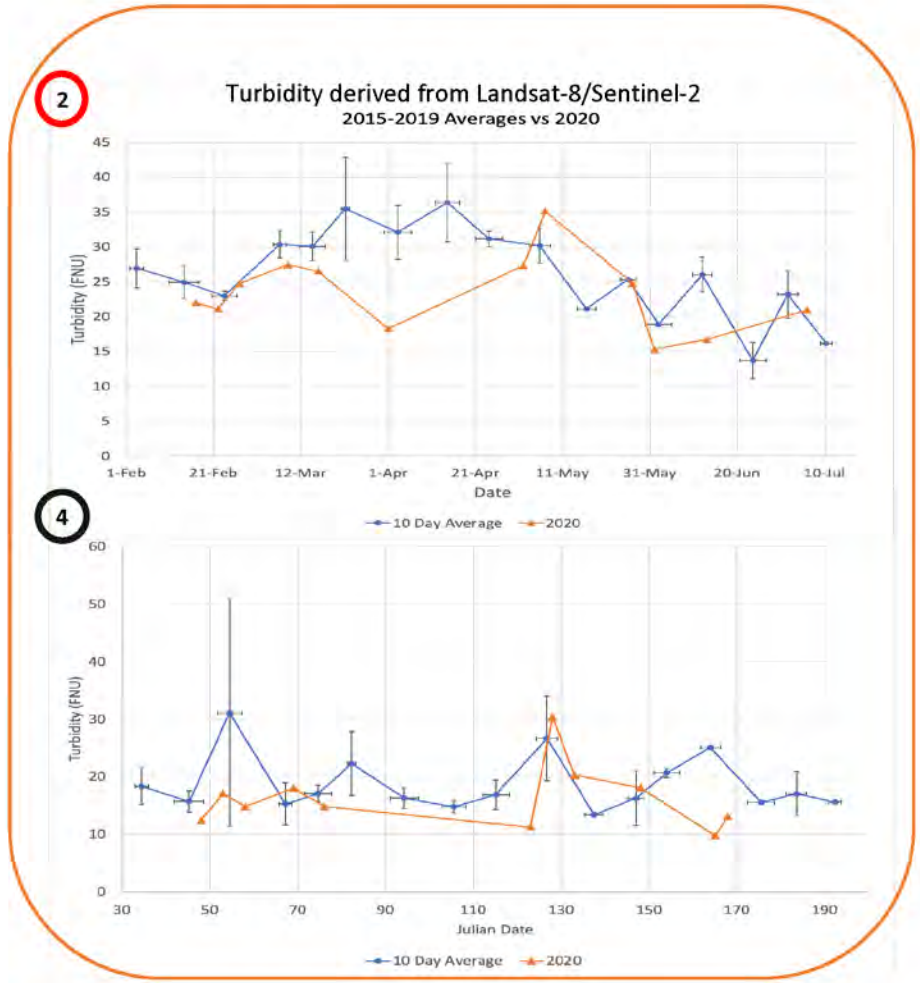
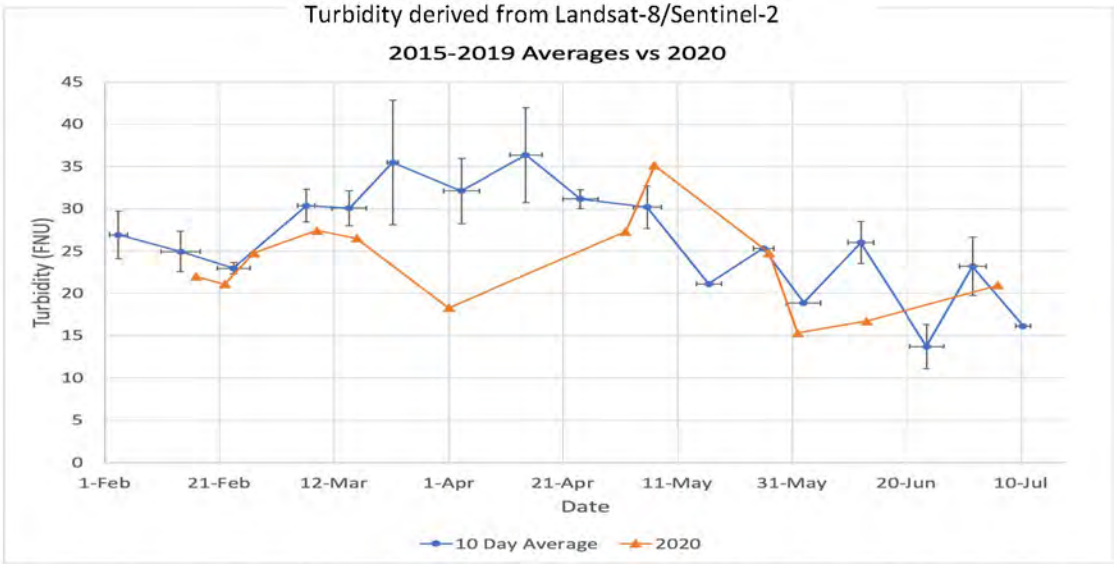




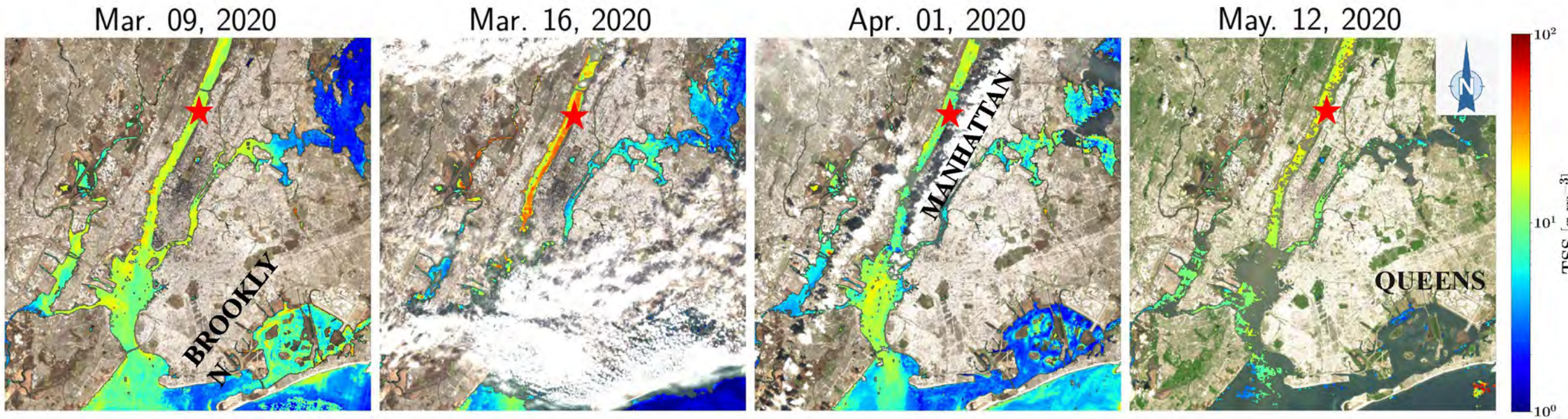


Takeaways…

- *Major changes in living patterns are anticipated to be discernible from space in nearshore areas.*
- *Statistically significant changes have been identified in western Manhattan (Hudson River).*
- *Further localized assessments in the San Francisco Bay and New York regions are under development.*



See Naomi Schulberg's poster - *ED004-0023: Did the COVID-19 Lockdown Impact New York Harbor's Water Quality?*



COVID-19 impacts on snow albedo in the Indus River Basin

2020/12/7 13:00 EST

Edward Bair[a], Timbo Stillinger[a], Karl Rittger[b], McKenzie Skiles[c]

[a]University of California, Santa Barbara;
[b]University of Colorado, Boulder;
[c]University of Utah

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EDWARD (NED) BAIR

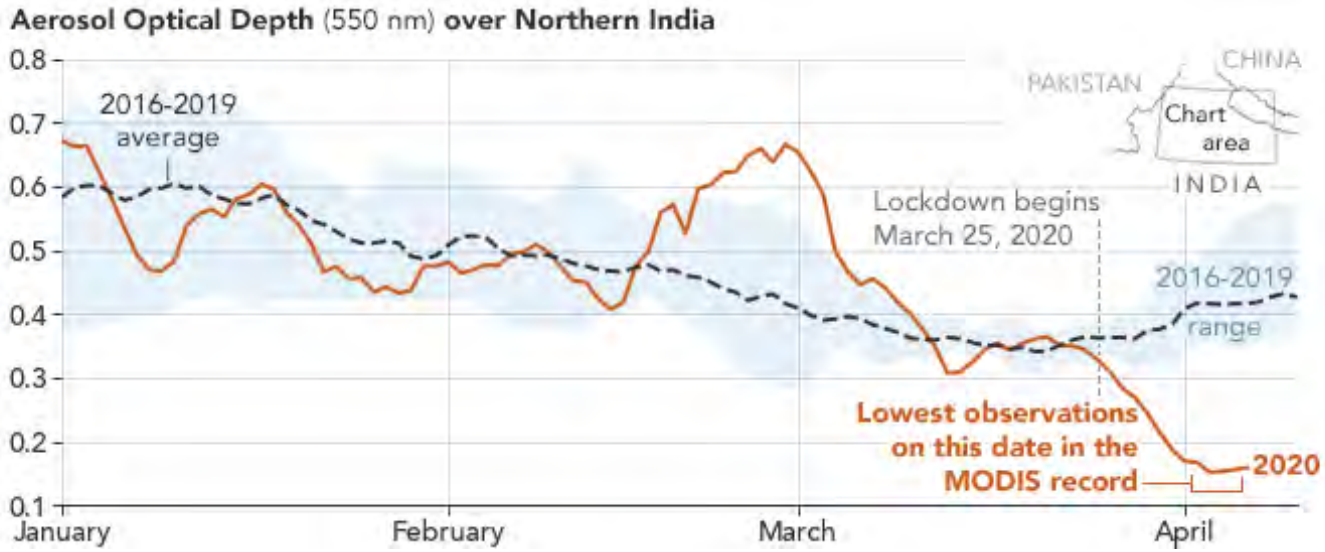
SNOW.UCSB.EDU

Associate Researcher, Earth Research Institute, University of California, Santa Barbara

UC SANTA BARBARA

Dirty snow in Solang Valley, India March 2019

BACKGROUND



Patel, K. (2020), NASA Earth Observatory

- April 2020: Tweets on how the Himalaya were visible from Delhi for the first time in 30 years
- Hypothesis: The cleaner atmosphere must have an effect on the snow, specifically its albedo (latin for whiteness)

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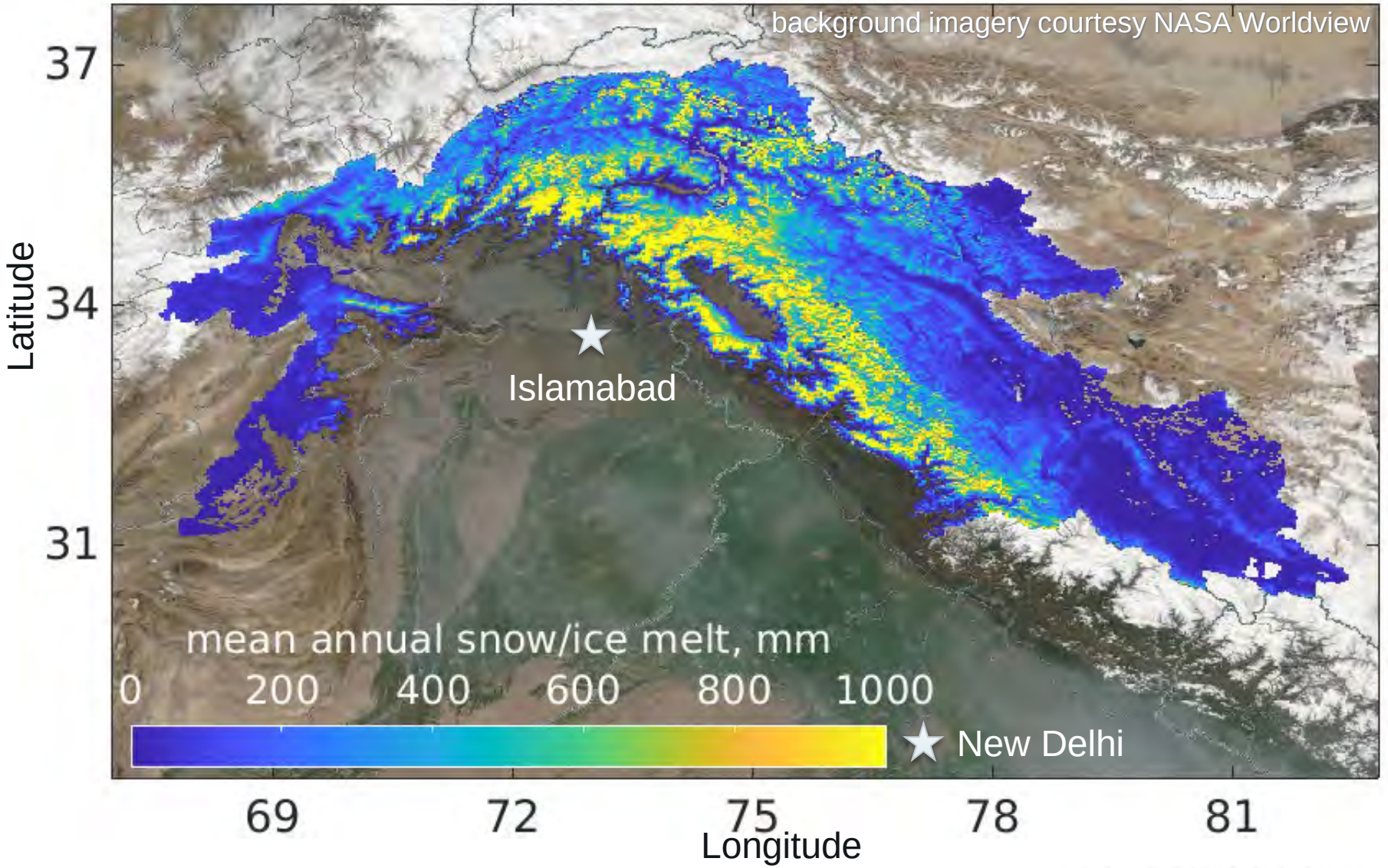
TAKE HOME

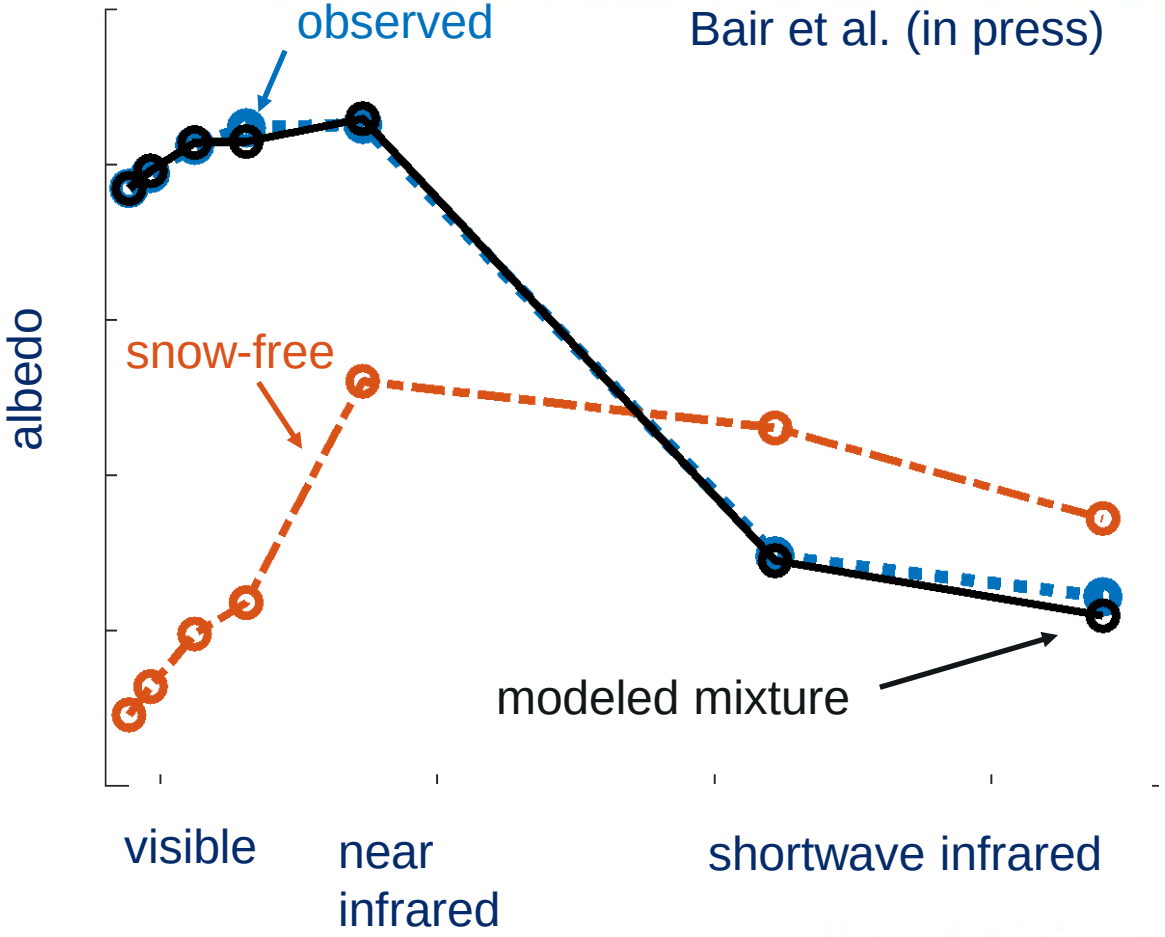
- Indus River Basin: 95 km³ of meltwater from snow and ice
- Supplies water > 300 million people (Khan et al., 2019)
- Snow/ice was cleaner during lockdowns, by 36 parts per million
- Changed the timing of melt for 0.73 to 0.93 km³ water (e.g. Lake Tahoe)

from the ParBal model (Bair et al., 2016; Rittger et al. 2016)



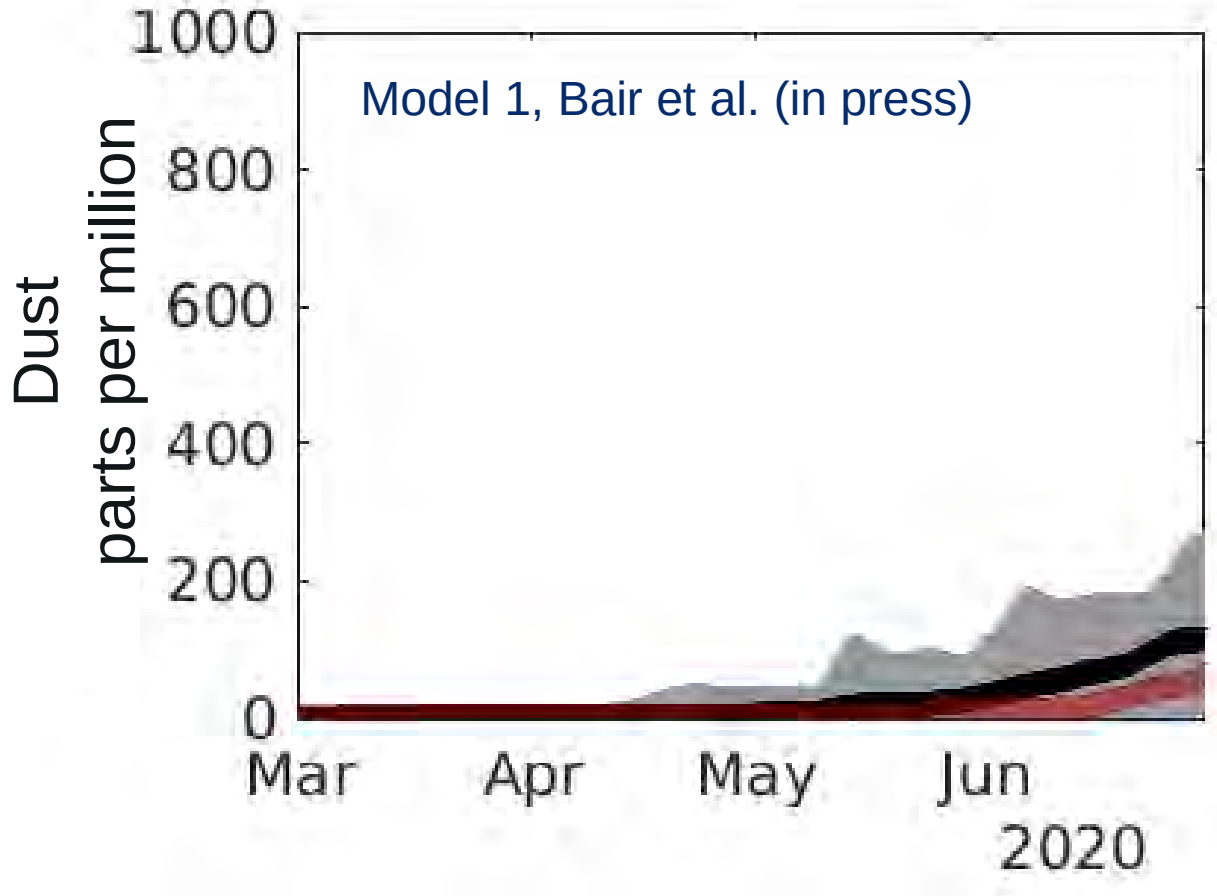
METHODS

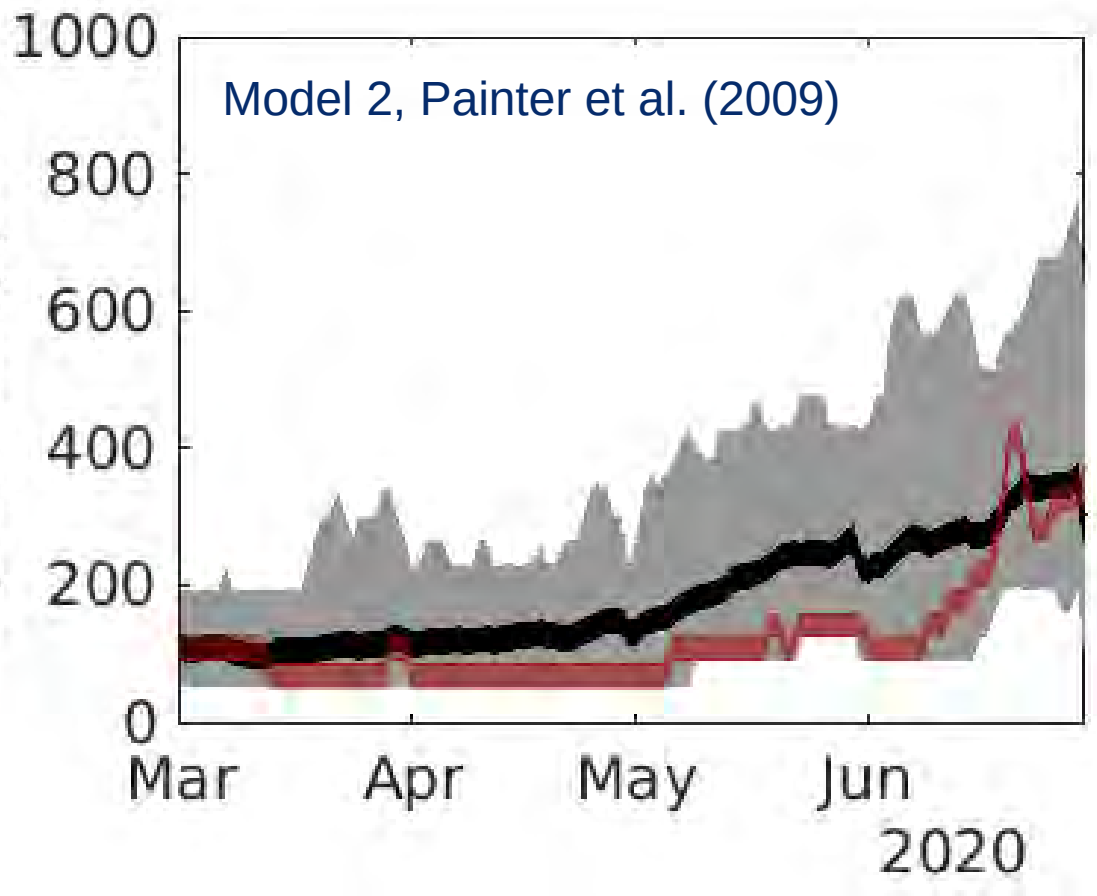
- Snow cover over the Indus River Basin was examined over the past 20 years
- Two models used data from the Moderate Resolution Imaging Spectrometer (MODIS)
- Both models assume mixtures where observed is composed of: a specific type of snow and a snow-free component



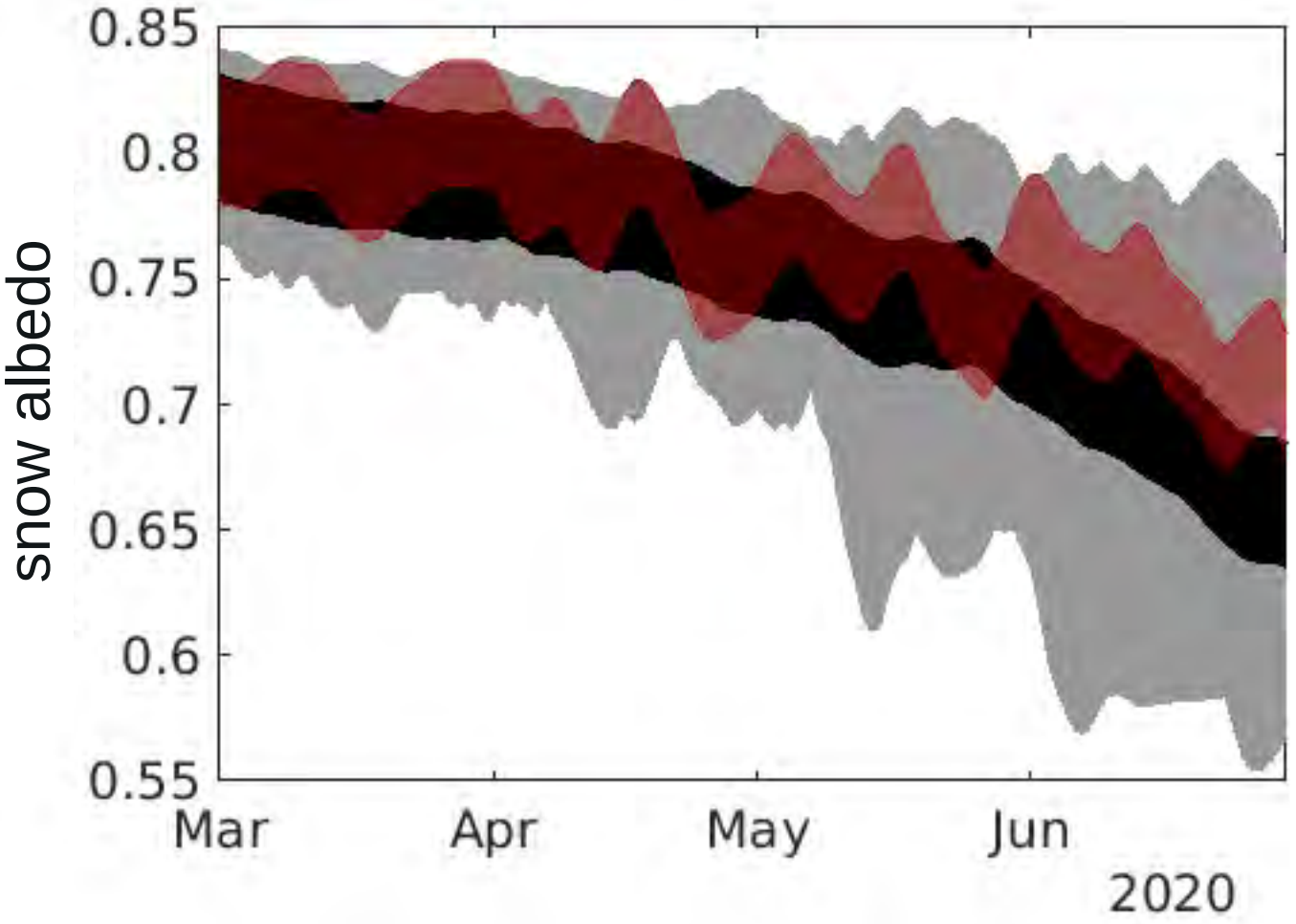
RESULTS

- Both models show 2020 dust levels (red) significantly below the mean (black) and near the lowest levels recorded over the 20 year record (gray)
- For the red and black lines, line width represents uncertainty





RESULTS



- However, snow albedo also depends on grain size.
- Neither model showed significantly different grain sizes in 2020 from other years
- Uncertainty in albedo (5%) is too high to say definitively that the snow in 2020 was brighter than in previous years, but there is evidence for this

Funding from:
University of California award LFR-18-548316; NASA awards 80NSSC18K1489 and 80NSSC18K0427, and NOAA award NA18OAR4590380.

THANK YOU

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snow.ucsb.edu

Works cited:

Bair, EH, Stillinger, T, Dozier J (in press), Snow Property Inversion from Remote Sensing (SPIReS): A Generalized Multispectral Unmixing Approach with Examples from MODIS and Landsat 8 OLI, IEEE TGRS

Bair, E.H., Rittger, K., Davis, R.E., Painter, T.H. and Dozier, J. (2016) Validating reconstruction of snow water equivalent in California's Sierra Nevada using measurements from the NASA Airborne Snow Observatory. Water Resources Research, 52: 8437-8460.

Khan, S.I. and Adams, T.E. (2019), Introduction of Indus River Basin: Water Security and Sustainability. In: S.I. Khan and T.E. Adams (Editors), Indus River Basin. Elsevier, pp. 3-16.

Painter, T.H., Rittger, K., McKenzie, C., Slaughter, P., Davis, R.E. and Dozier, J. (2009), Retrieval of subpixel snow-covered area, grain size, and albedo from MODIS. Remote Sensing of Environment, 113: 868-879.

Patel, K., Stevens, J., Gupta, P., Hiren, J., Levy, R. and Kahn, R. (2020). Image of the day for April 21, 2020: Airborne Particle Levels Plummet in Northern India. NASA Earth Observatory, EOS Project Science Office, NASA Goddard Space Flight Center.

Rittger, K., Bair, E.H., Kahl, A. and Dozier, J.(2016). Spatial estimates of snow water equivalent from reconstruction. Advances in Water Resources, 94: 345-363.

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QUESTIONS

Please write your questions in the Q&A box and AGU will ask it on your behalf.

Reminder: A 30-minute, informal discussion will commence in Zoom after this event ends.

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