

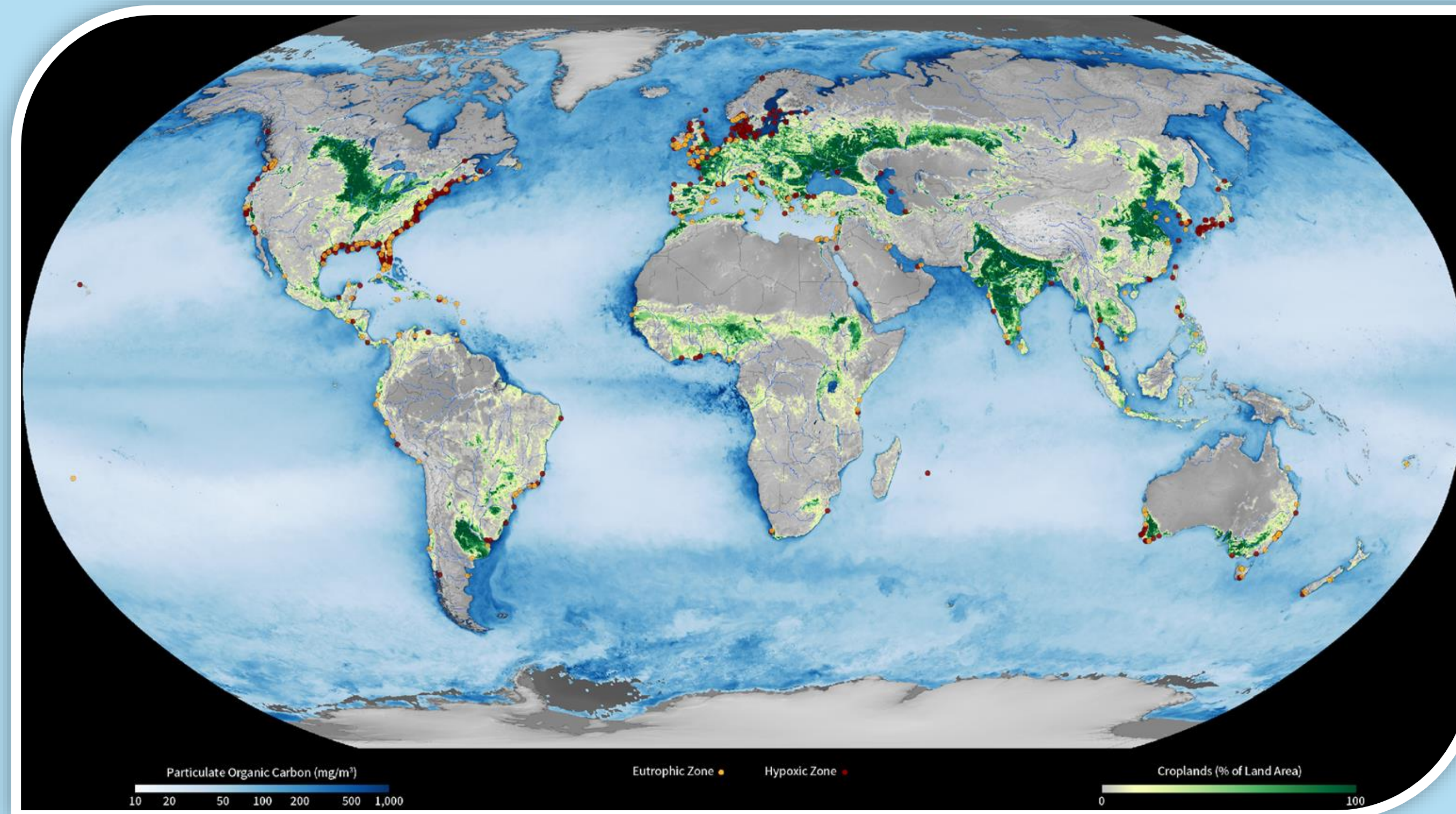
The Application of Remote Sensing and Machine Learning to Improve Early Warning Systems for Harmful Algal Events in the Highland Lake Chains, TX

Shuyu Y Chang^{1,2,4} (shuyu.chang@psu.edu), Kaitlynn Hietpas^{1,2}, Mark Radwin^{1,2}, Emma Waugh^{1,2}, Addison Pletcher^{1,2}, Ryan Hammock^{1,2} (Ryan.hammock@nasa.gov), Erin Urquhart^{1,3}, Kimberly Van Meter⁴
¹NASA DEVELOP National Program, ²Science Systems and Applications, Inc., ³NASA Goddard Space Flight Center, ⁴Pennsylvania State University Main Campus, Geography

@shuyo5

RESEARCH OBJECTIVES

- Use earth observation data to improve algal bloom monitoring systems
- Create user-friendly tools to monitor near real-time remotely sensed algae and environmental indicators and to help our partners determine when and where harmful algal events are likely to occur.
- Detect historical hotspots to help inform future field sampling efforts.

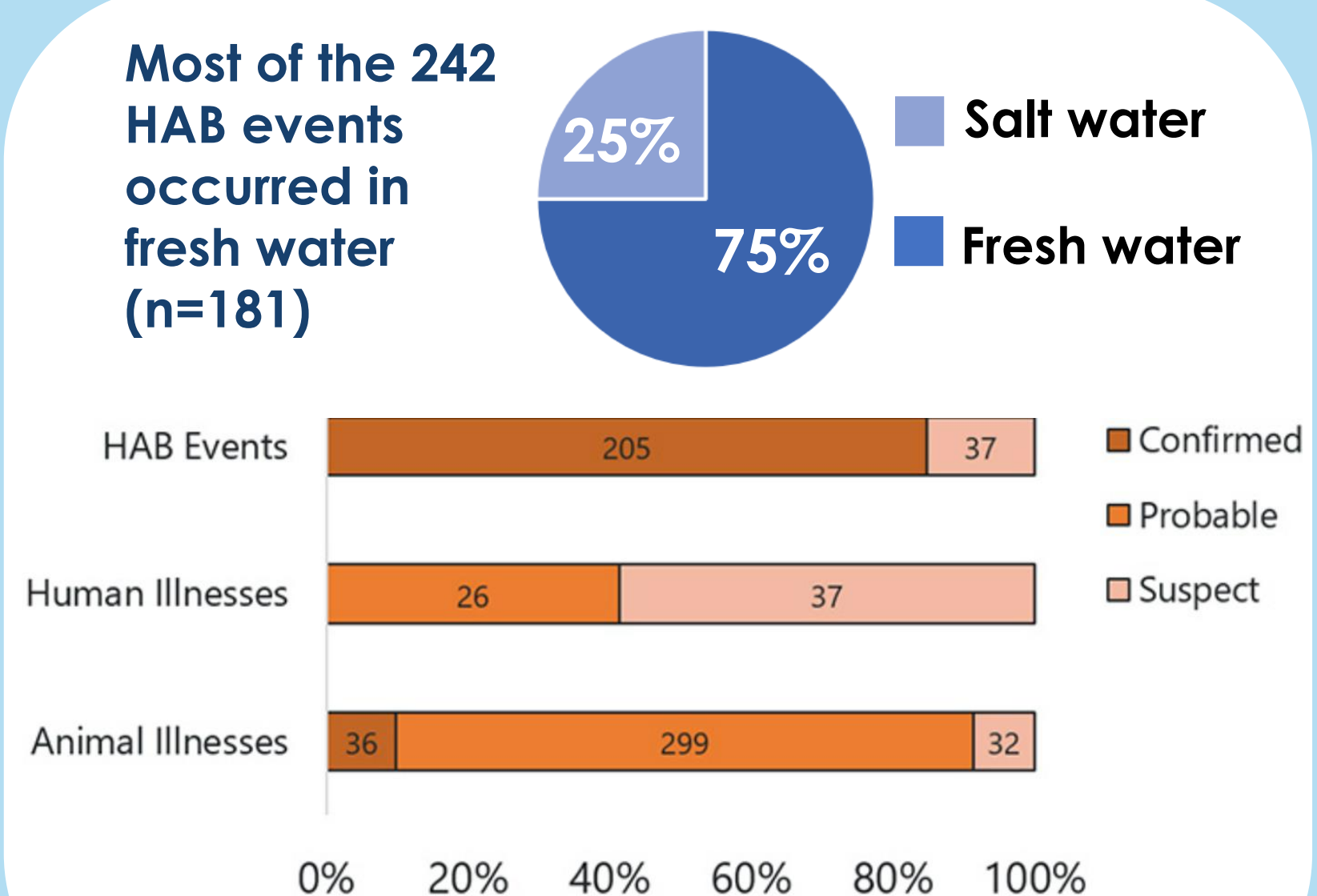


Anthropogenic Eutrophic and Hypoxic Zones: Yellow circles on this map show the location of observed eutrophic zones. Red dots show where hypoxic zones have been observed. Fertilizer-laden runoff triggers explosive planktonic algae growth in coastal areas
svs.gsfc.nasa.gov

BACKGROUND

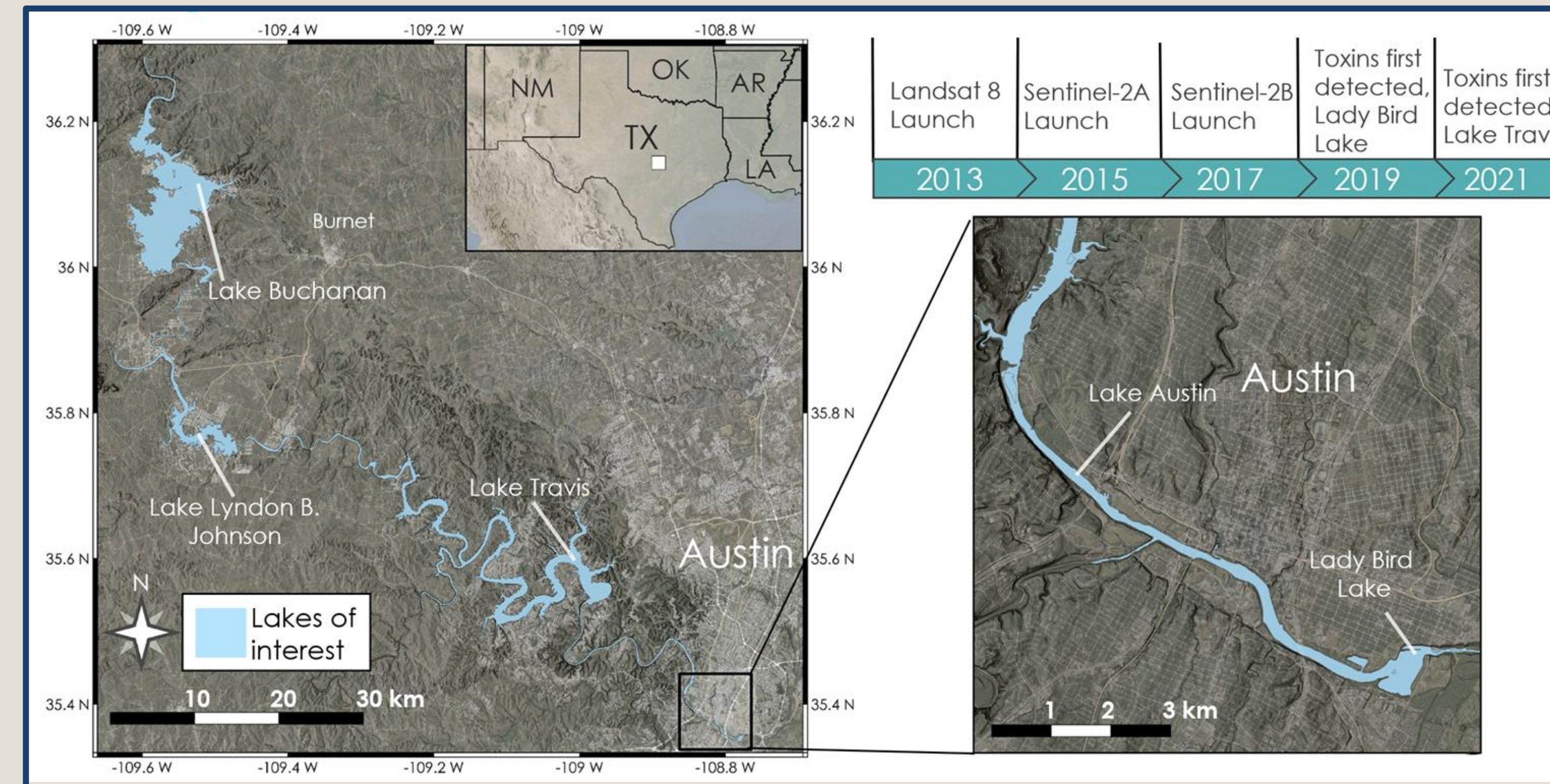
The increasing frequency and extent of the development of algal blooms in the many thousands of human-constructed water reservoirs is of particular concern not only from the perspective of aquatic habitat but also due to the frequent use of these reservoirs as both drinking water sources and recreational spaces. Beginning in 2019, harmful algal events have caused canine deaths in both Lady Bird Lake and Lake Travis located near Austin, Texas. These two reservoirs are part of the larger Highland Lakes chain, managed by the City of Austin Department of Watershed Protection (COA DWP) and the Lower Colorado River Authority (LCRA), which fulfill municipal, commercial, and agricultural water demands. The LCRA and the COA DWP have been collecting in situ water samples and routinely monitoring lake conditions for decades. But limitations such as cost and lab delays result in insufficient monitoring coverage from field sampling alone. Given the recent increase in favorable environmental conditions for algal events in Central Texas, our NASA DEVELOP team partnered with the LCRA and COA DWP to improve their monitoring and detection of algal events, through the application of NASA Earth observations and machine learning.

One Health Harmful Algal Bloom System (OHHABS), US, 2019



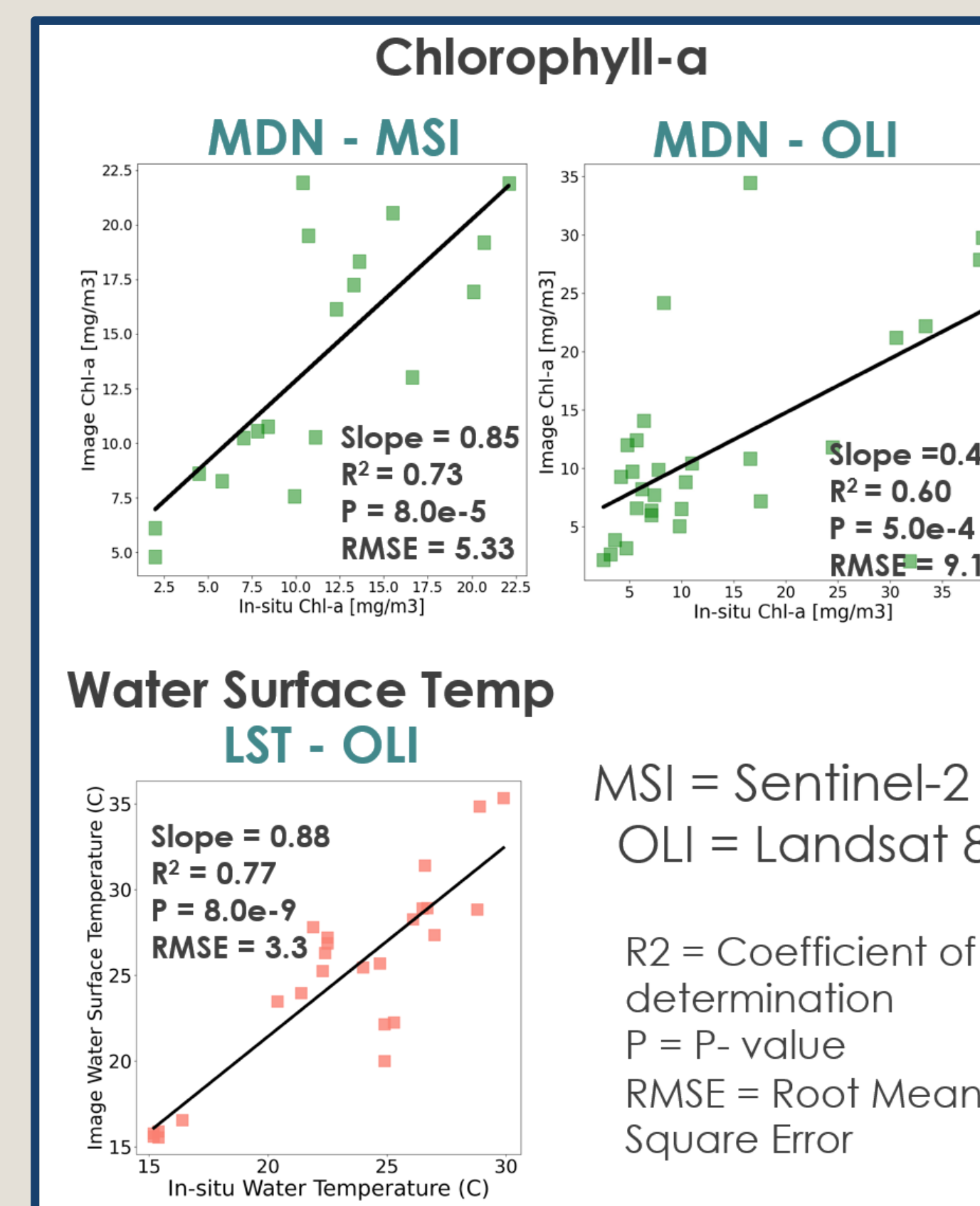
Algae in the Highland Lakes
 Source: LCRA and COA DWP

STUDY AREA



Spatial extent of the study area including all seven reservoirs in the Highland Lakes chain in Central TX, with an inset on the city of Austin and its surrounding reservoirs

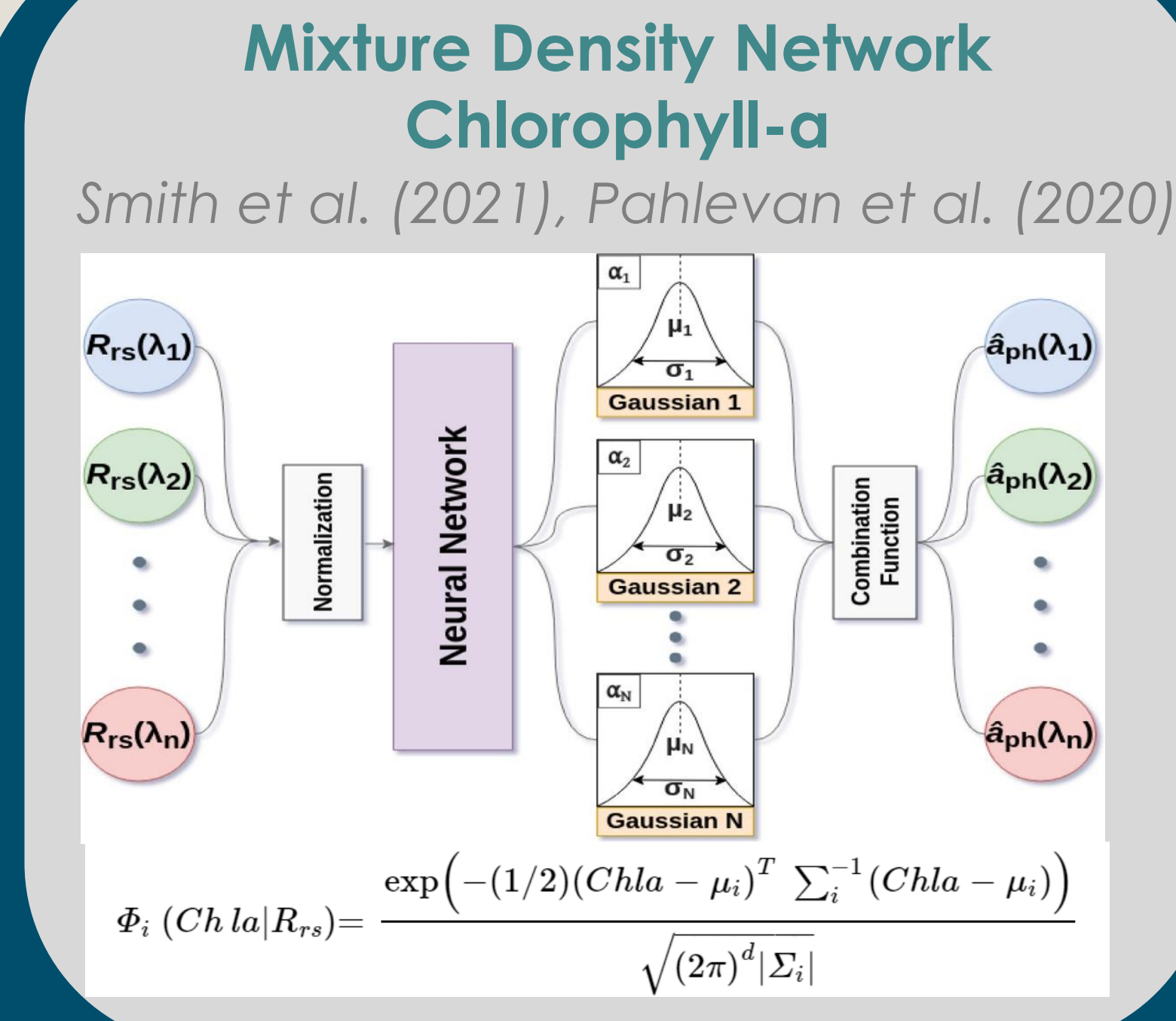
VALIDATIONS



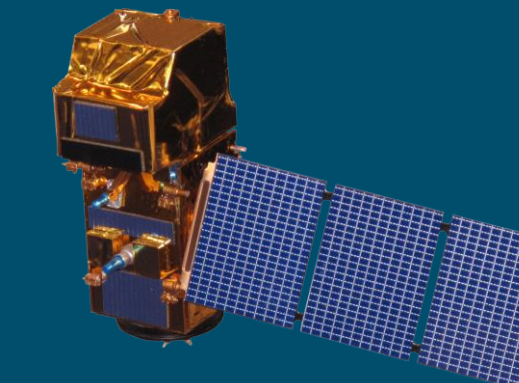
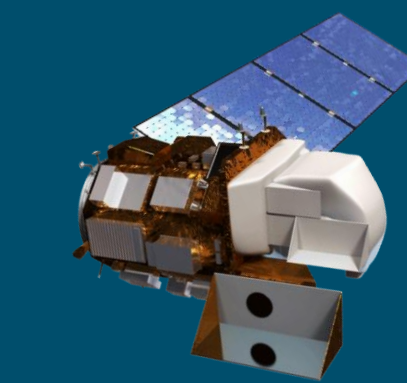
Recommended Human Health Recreational Ambient Water Quality Criteria for Microcystins (May 2019)

Risk level	Cyanobacteria (cells/count)	Chlorophyll-a (ug/L)	Microcystin (ug/L)
Low	≤ 20,000	≤ 10	< 10
Moderate	> 20,000 – 100,000	> 10 – 50	2 – 4 to 20
High	> 100,000	> 50	> 20

METHODS



Landsat 8 OLI
 16-day revisit



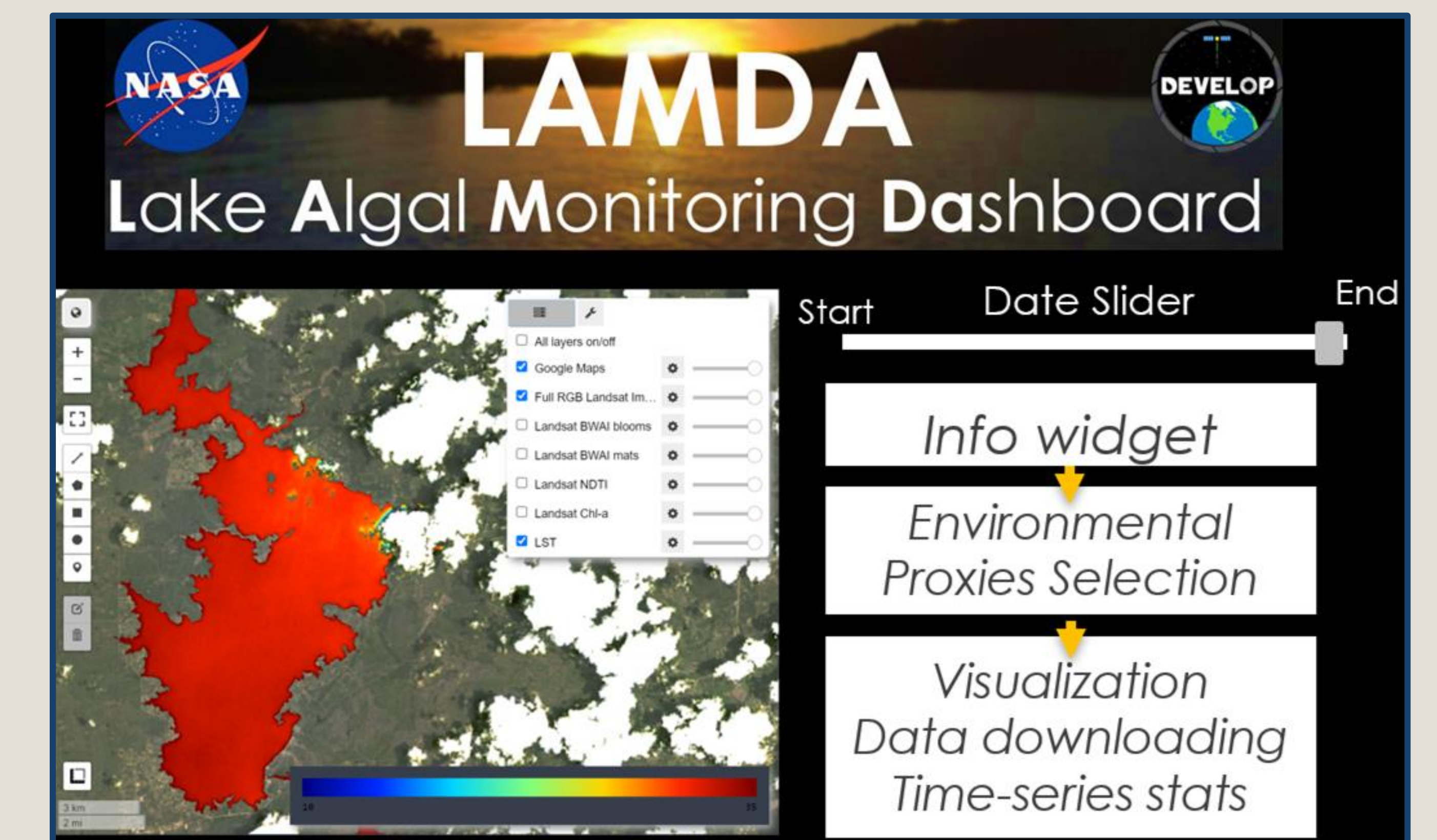
Sentinel-2 MSI (ESA)
 5-day revisit (A + B)

Broad Wavelength Algae Index (BWAi)
 Zhao et al., 2020

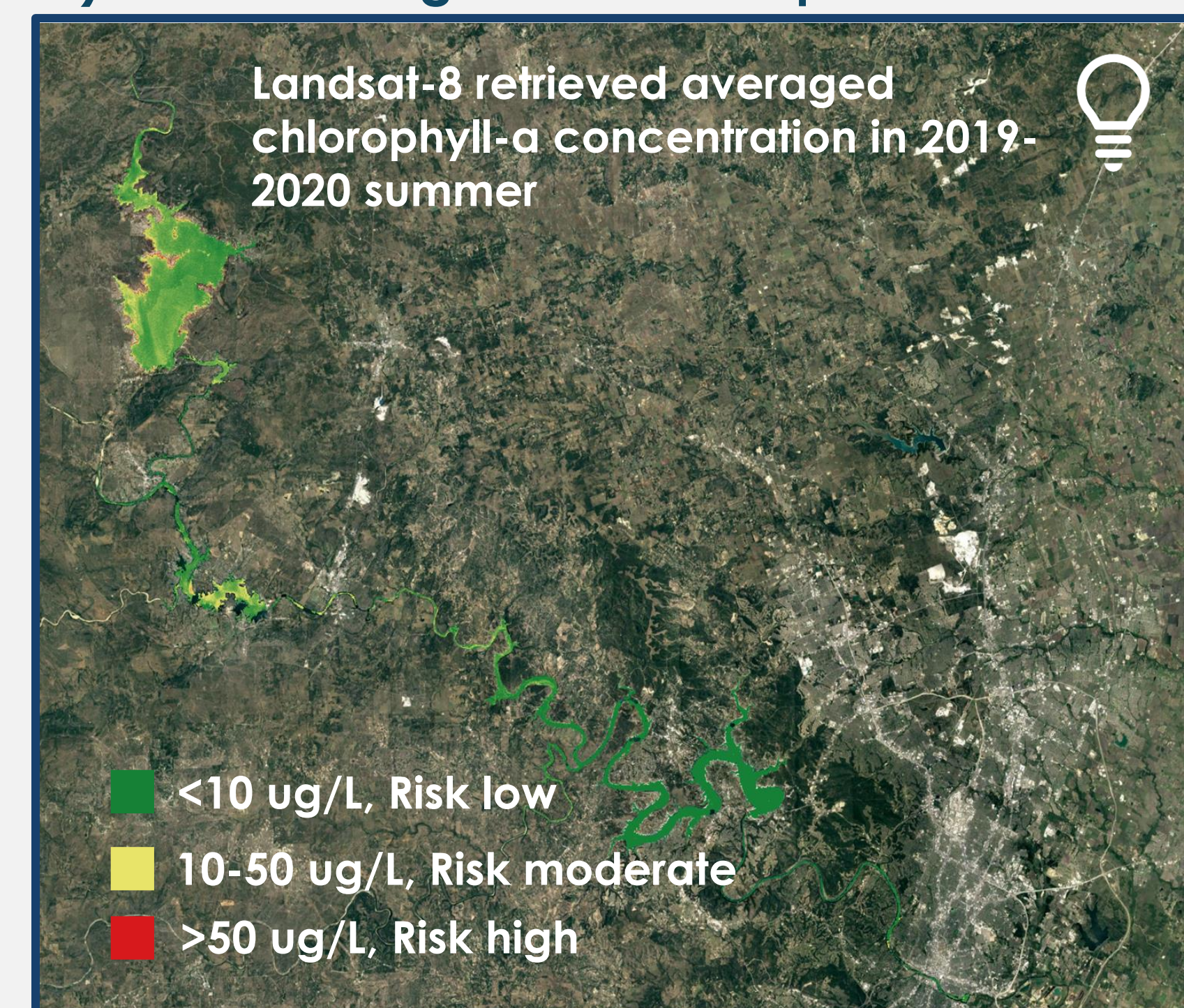
Water Surface Temperature
 Sekertekin & Bonafoni, 2020

Normalized Difference Turbidity Index (NDTI)
 Lacaux et al., 2007

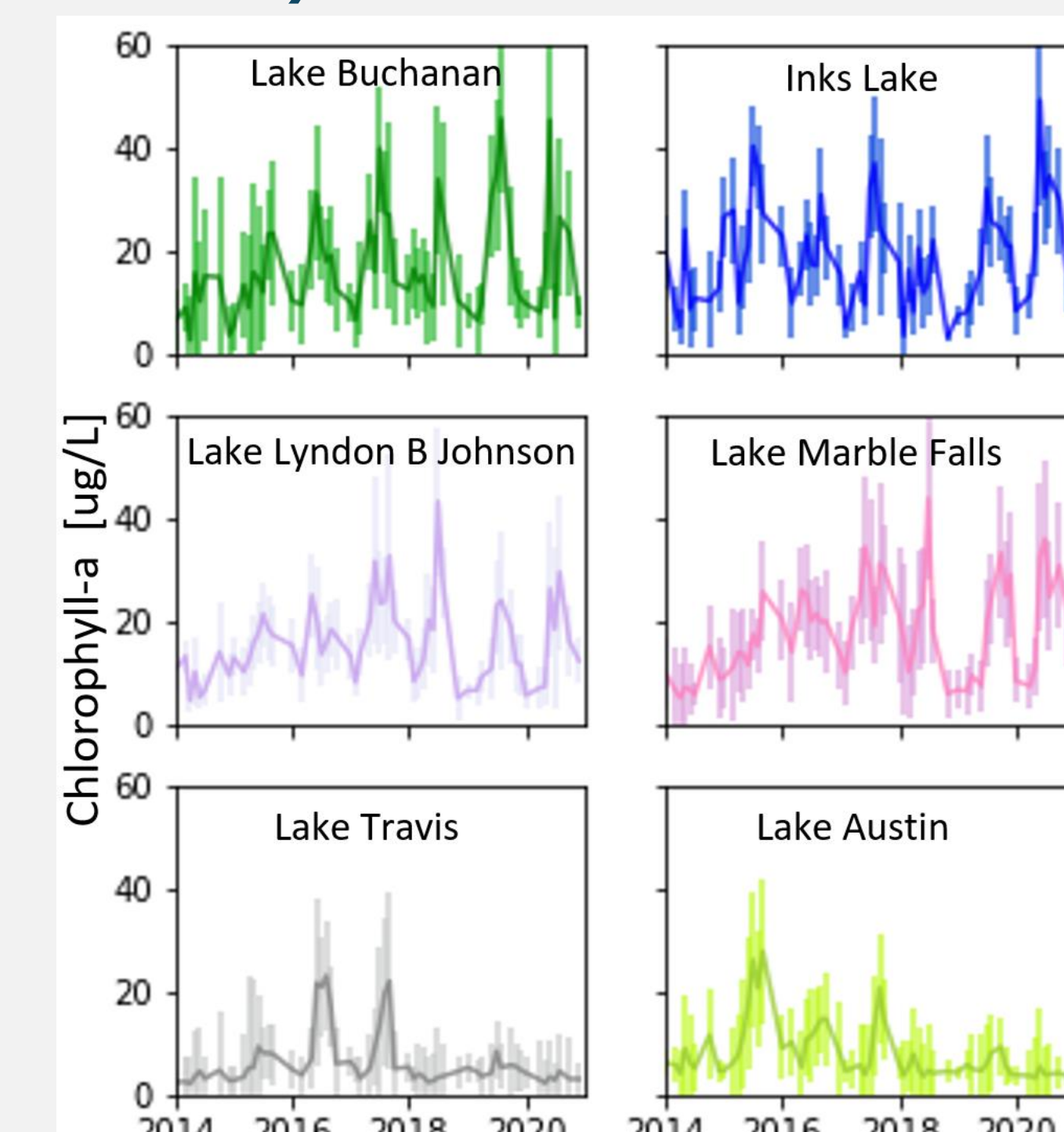
TOOL/GUI DEVELOPMENT



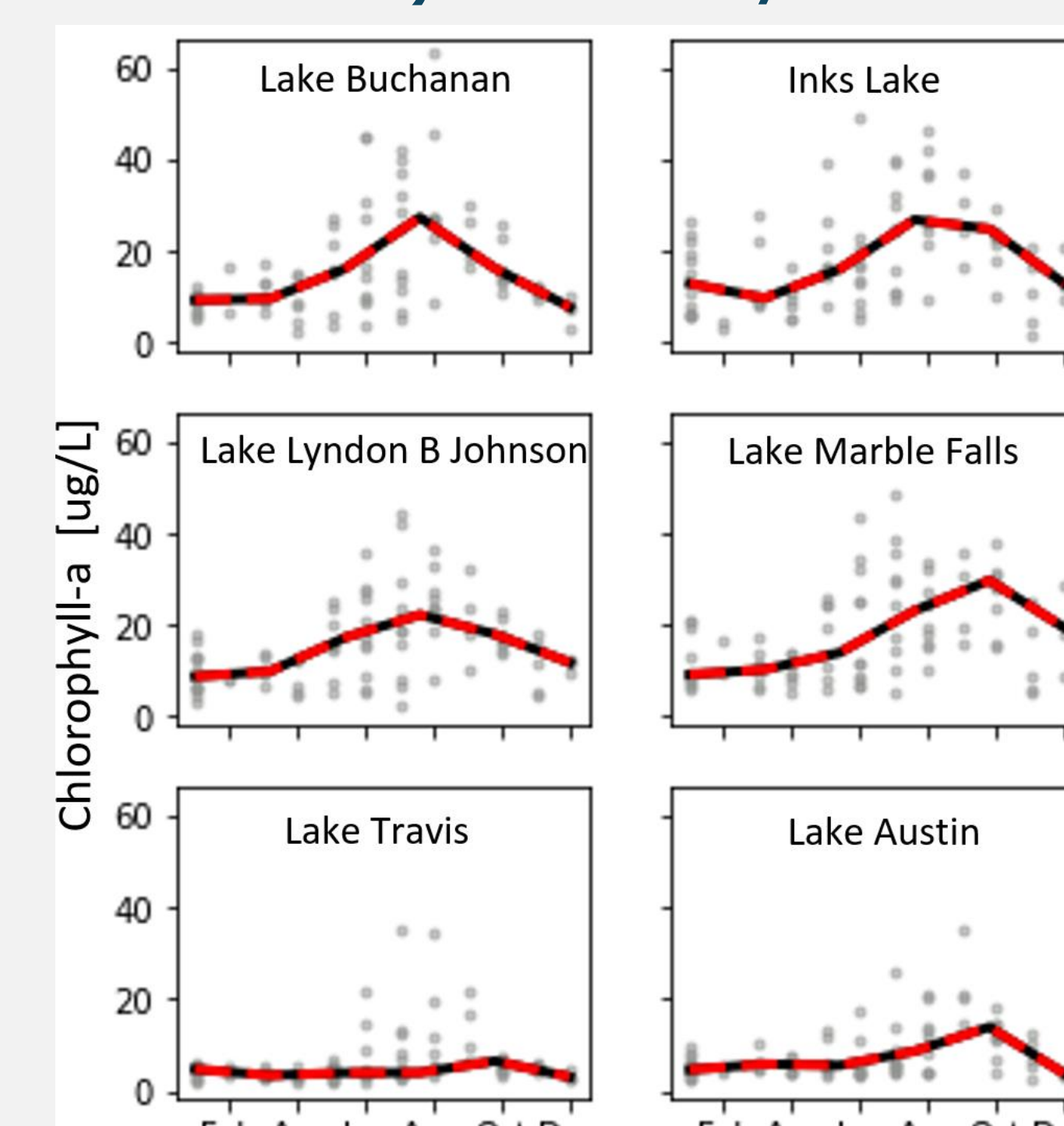
a). Historical algal bloom hotspots detections



b). Interannual variabilities



c). Seasonality



The resulting products enable near real-time monitoring of environmental proxies relevant to algal event presence in the Highland Lakes chain, and will ultimately support water management, decision making, and risk communication.

ACKNOWLEDGEMENTS

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- The City of Austin Department of Watershed Protection
 - The Lower Colorado River Authority
 - NASA DEVELOP Lead & Fellow
 - Ryan Hammock, NASA DEVELOP, AZ

