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# SPECTRAL MIXTURE ANALYSIS FOR SURVEILLANCE OF HARMFUL ALGAL BLOOMS (SMASH): A NEW TOOL FOR INFERRING BLOOM TAXONOMY FROM REMOTELY SENSED DATA

Dr. Carl J. Legleiter – cjl@usgs.gov

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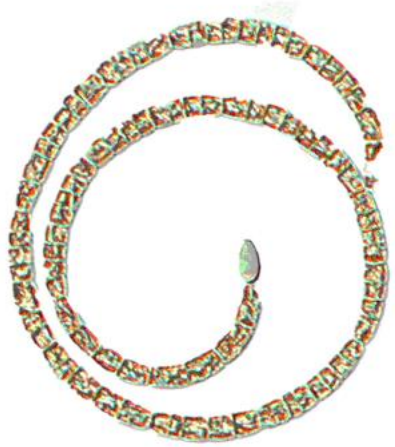

# PROJECT SUMMARY

**Spectral Mixture Analysis for Surveillance of Harmful Algal Blooms (SMASH):** A framework for integrating hyperspectral images acquired in the lab and from space to not only detect the presence of an algal bloom but also identify which taxa are present and their fractional abundances

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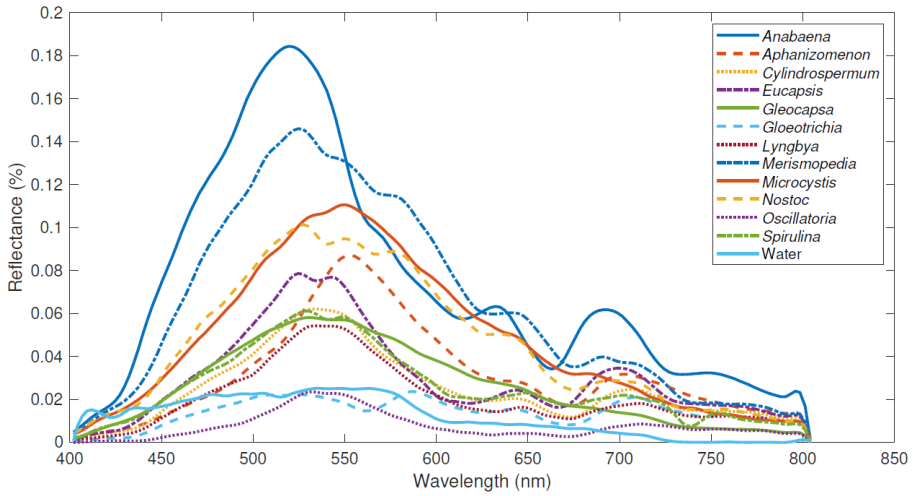


Lab-based spectral library of cyanobacterial endmembers

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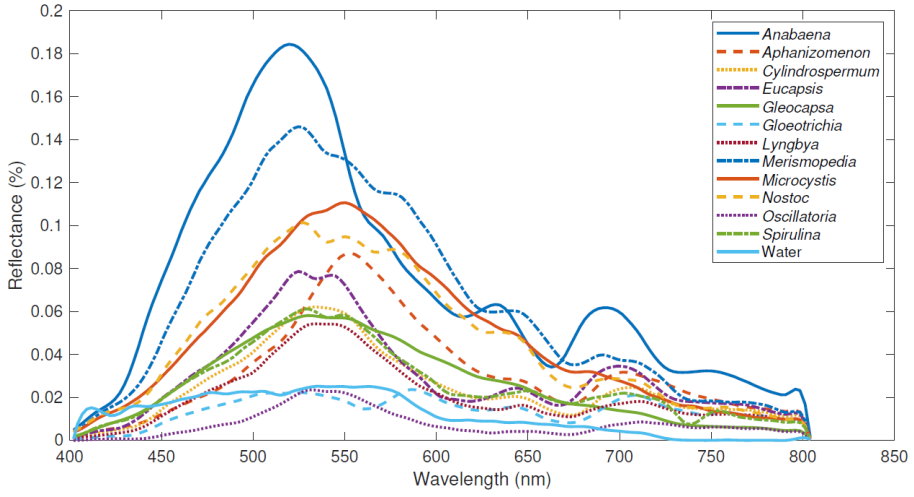


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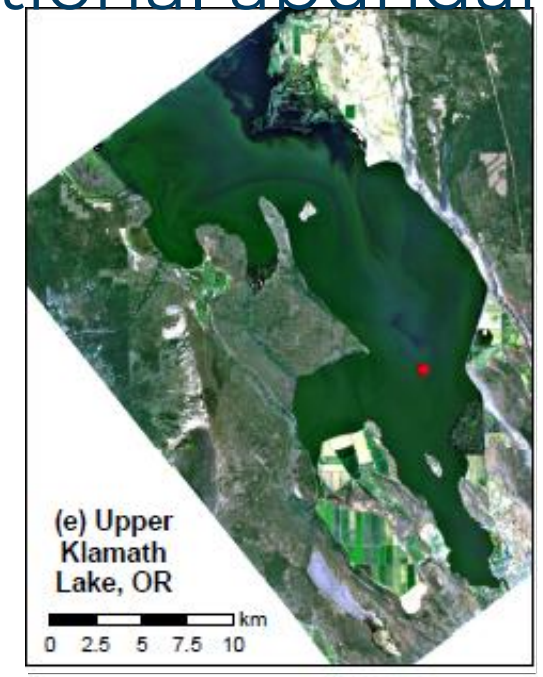


Hyperspectral satellite image

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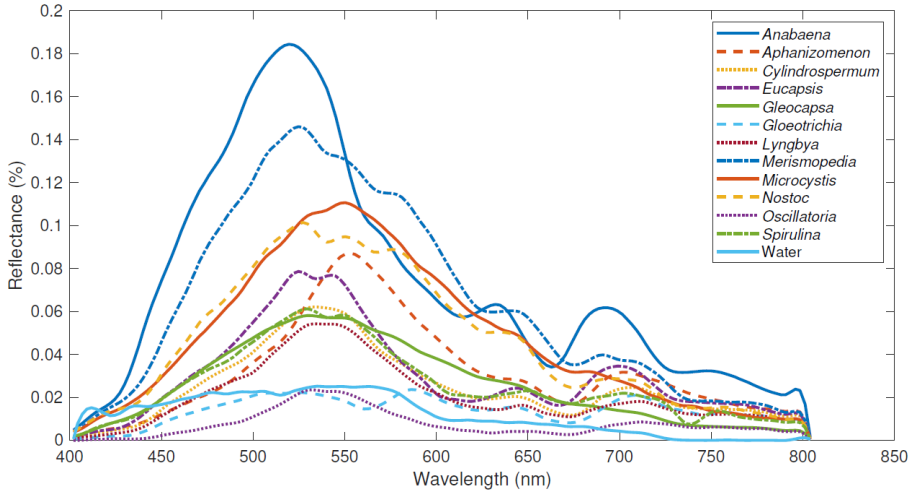


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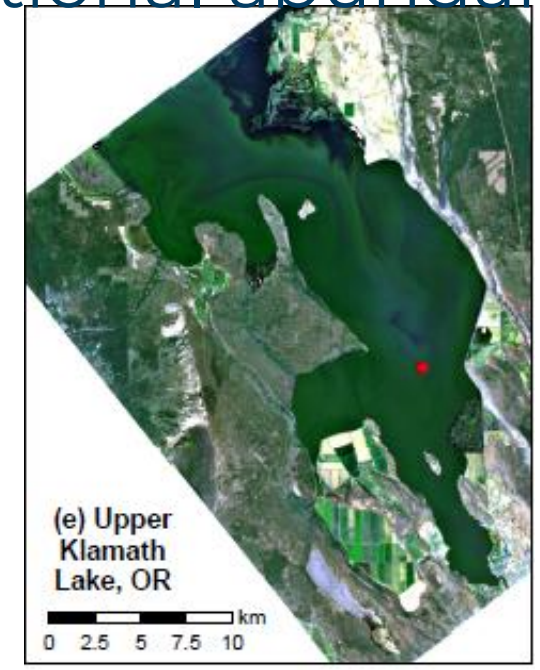


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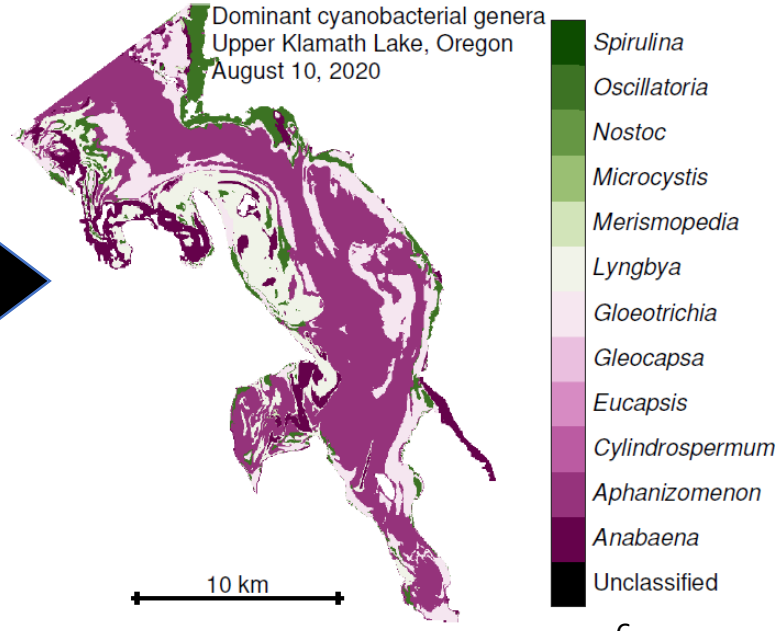
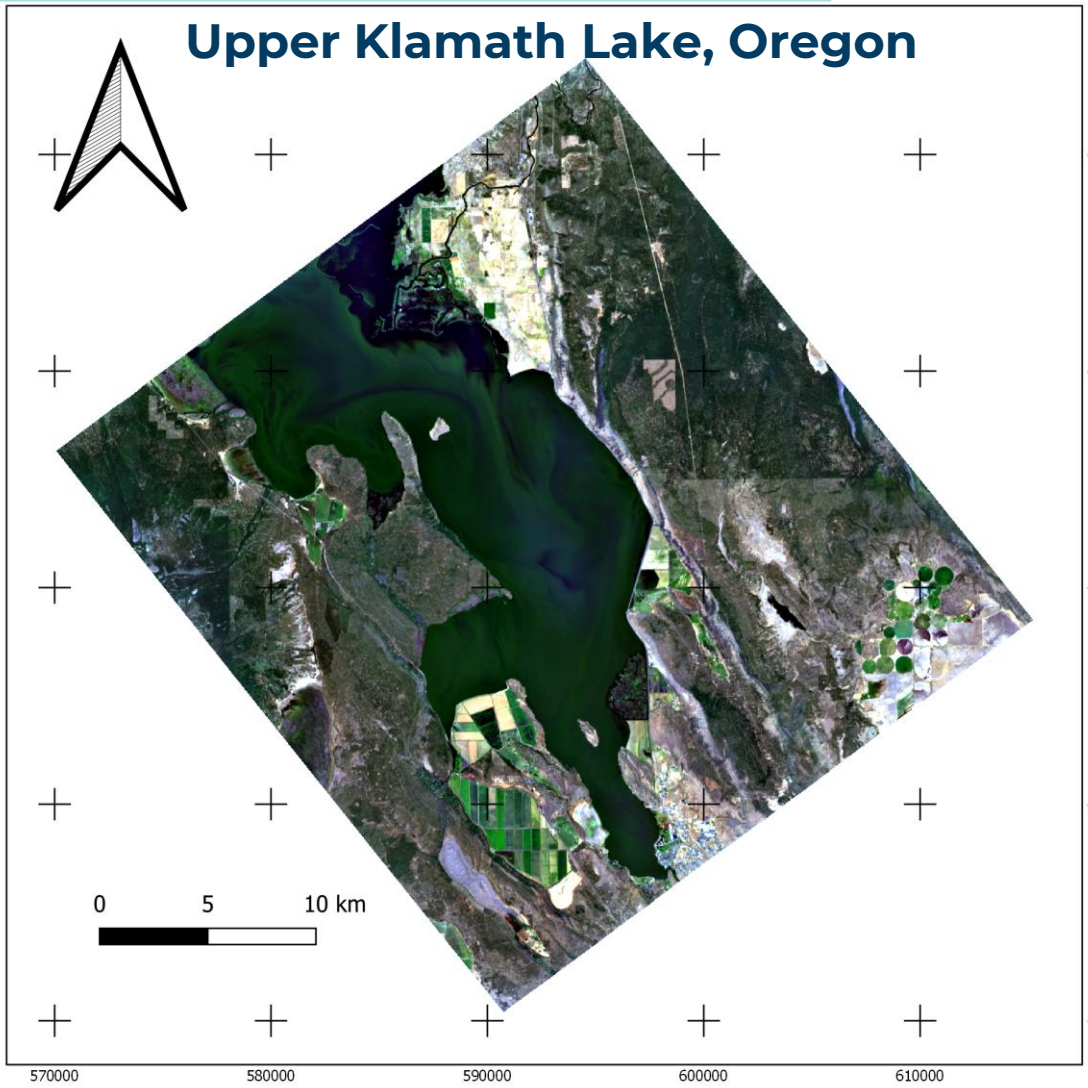



Map of cyanobacteria genera

# MAJOR TAKEAWAYS

**SMASH application:**

- Hyperspectral image

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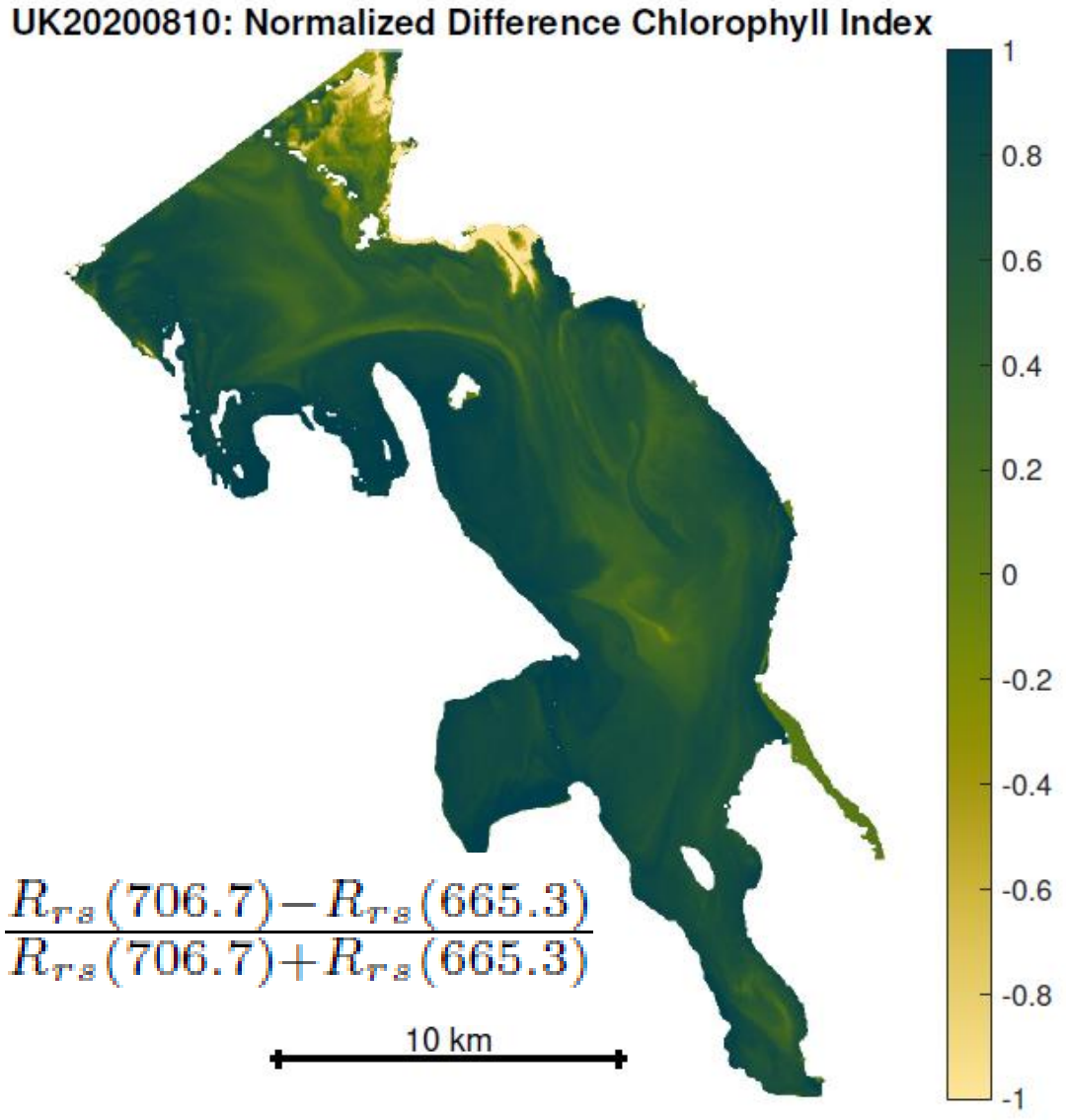

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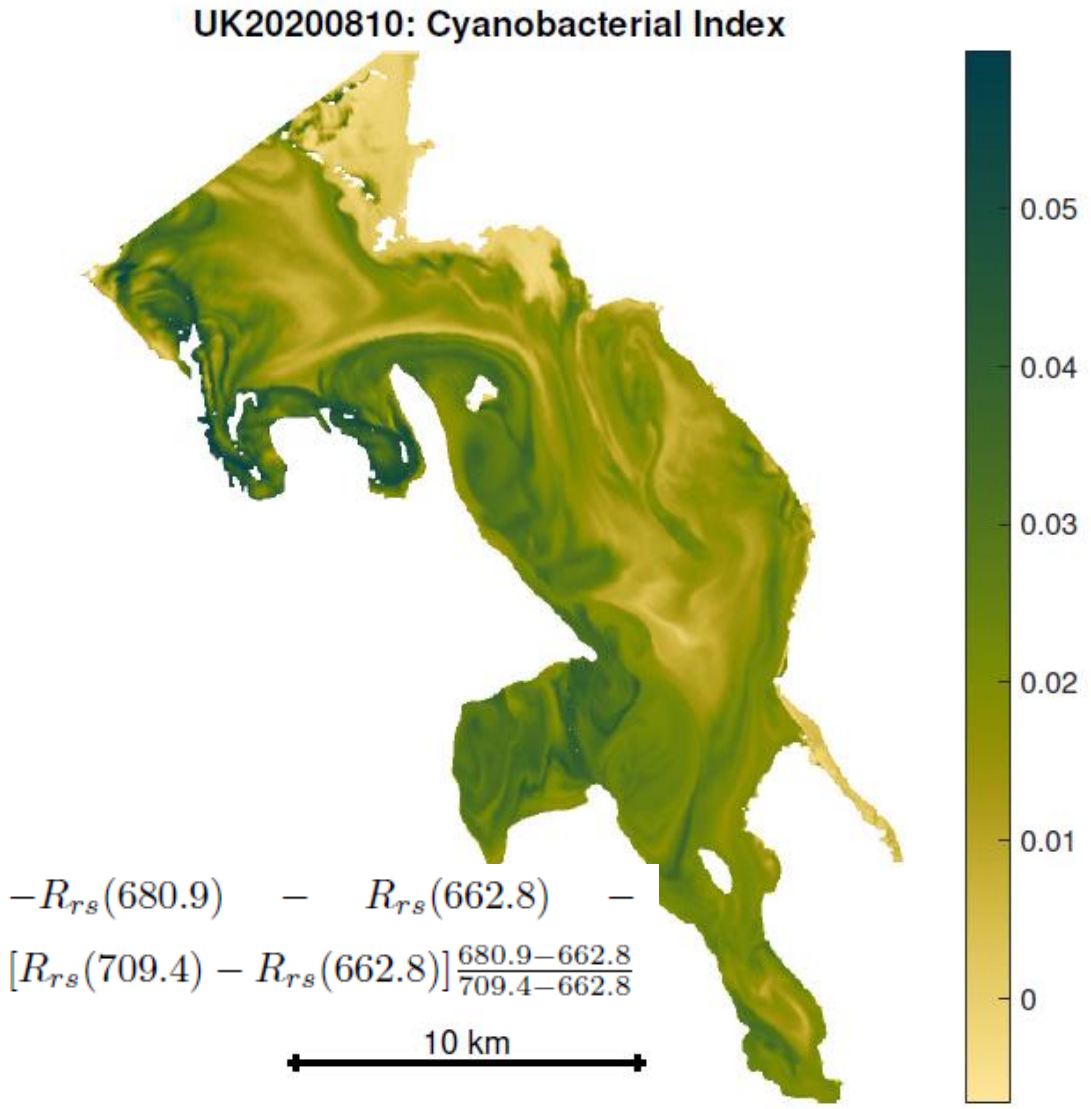

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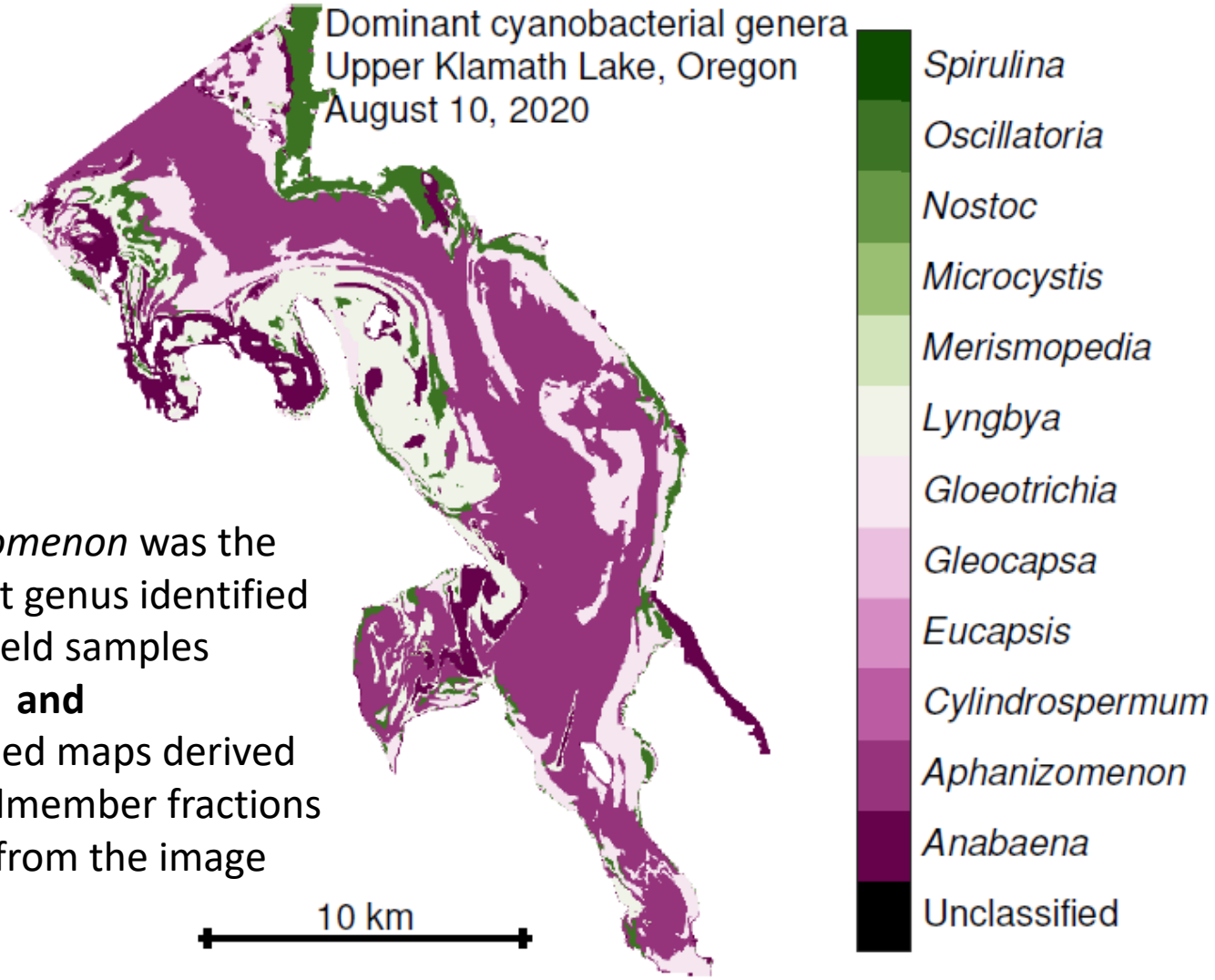
**SMASH application:**

- Hyperspectral image
- First mask water, …
- …, then check for chlorophyll, …
- … get a bit more specific with a cyano-bacterial index, and …
- … then use SMASH to identify which particular genera are present and where




*Aphanizomenon* was the dominant genus identified in algal field samples

**and**

in classified maps derived from endmember fractions inferred from the image

# ADDITIONAL RELEVANT INFO

**What about other taxa?**

- Multiple endmember spectral mixture analysis (MESMA) provides estimated fractional abundances for each endmember in each pixel

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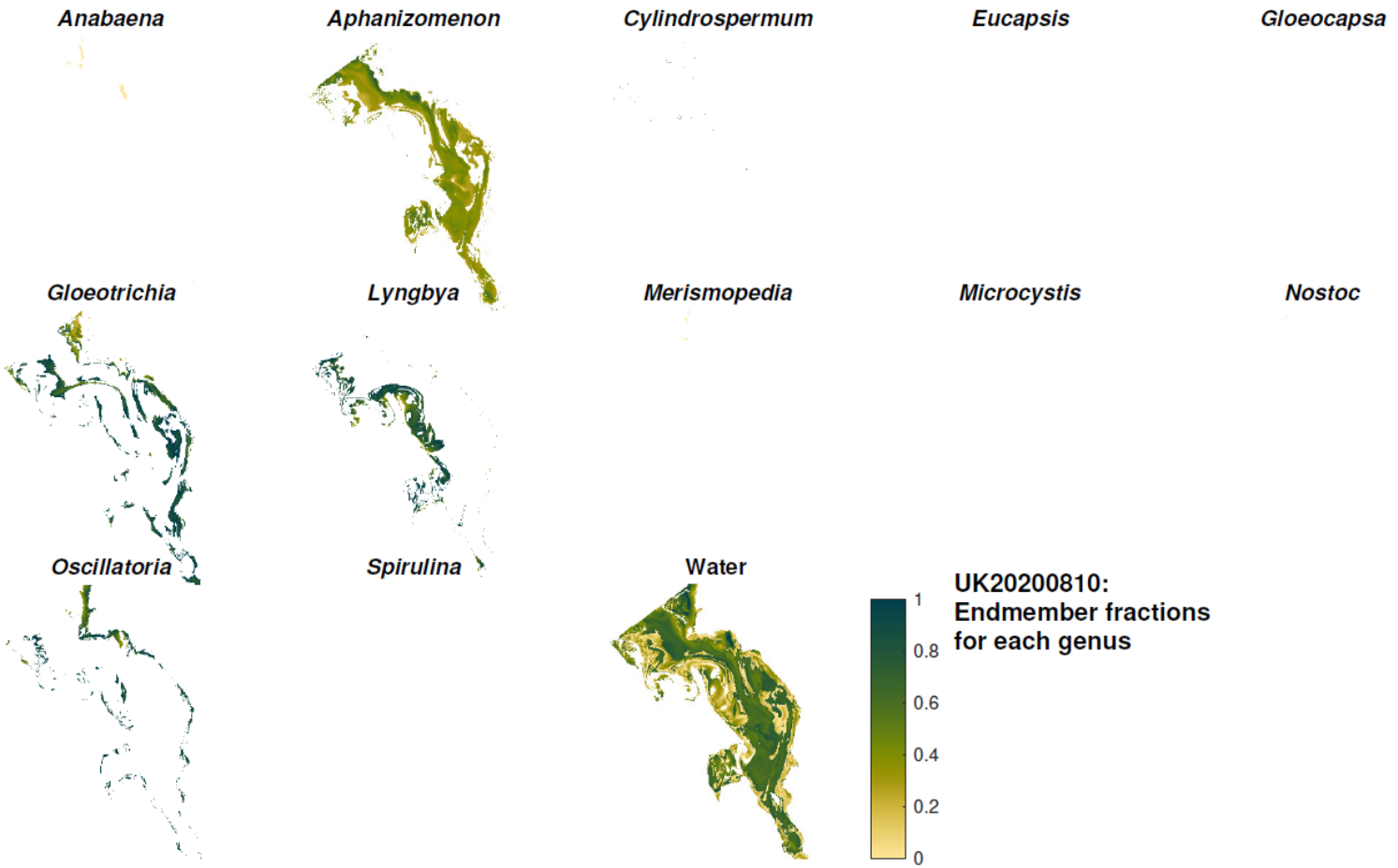
- Four genera account for most of the non-negligible fractions: *Aphanizomenon*, *Gloeotrichia*, *Lyngbya*, and *Oscillatoria*



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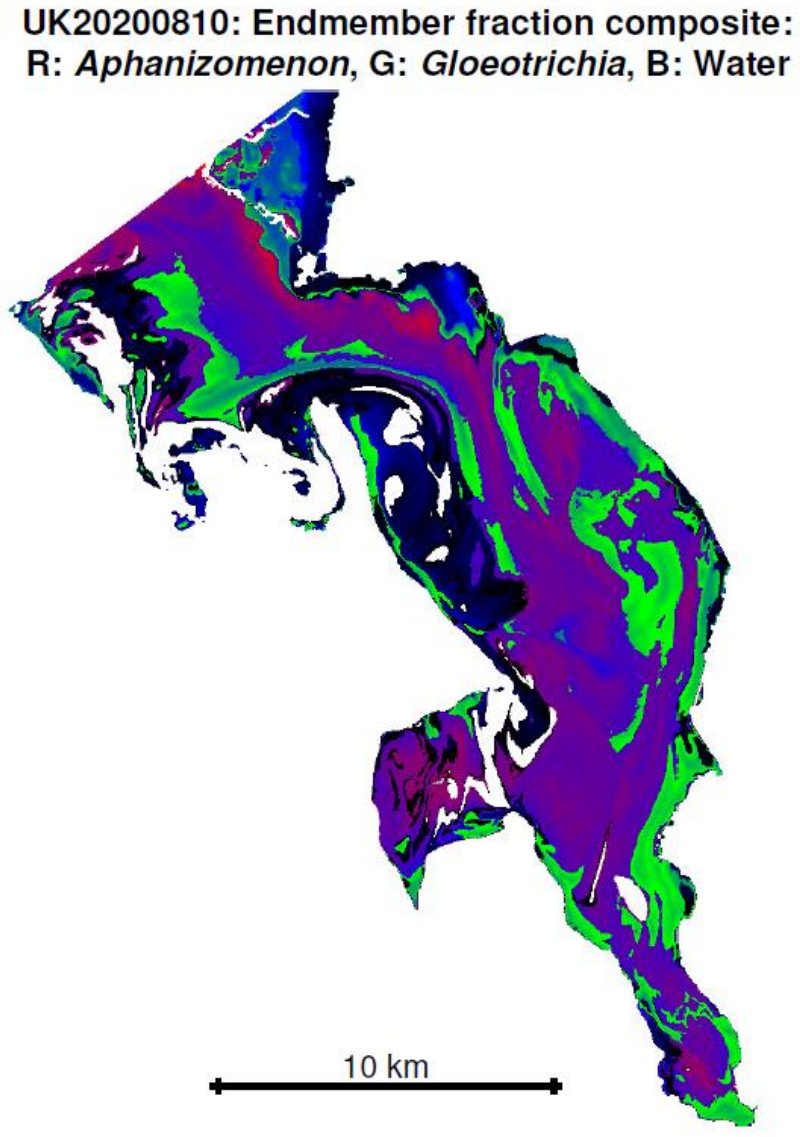
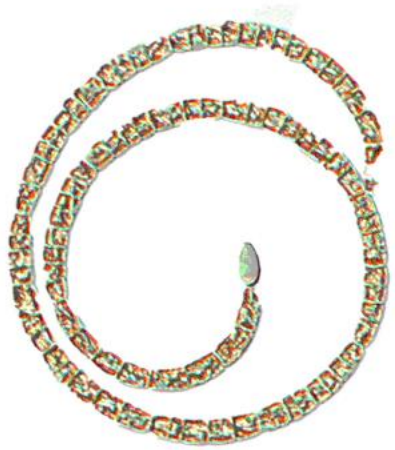
- Four genera account for most of the non-negligible fractions: *Aphanizomenon*, *Gloeotrichia*, *Lyngbya*, and *Oscillatoria*
- Fraction images can be combined into a color composite for visualization



# RESEARCH PRIORITIES

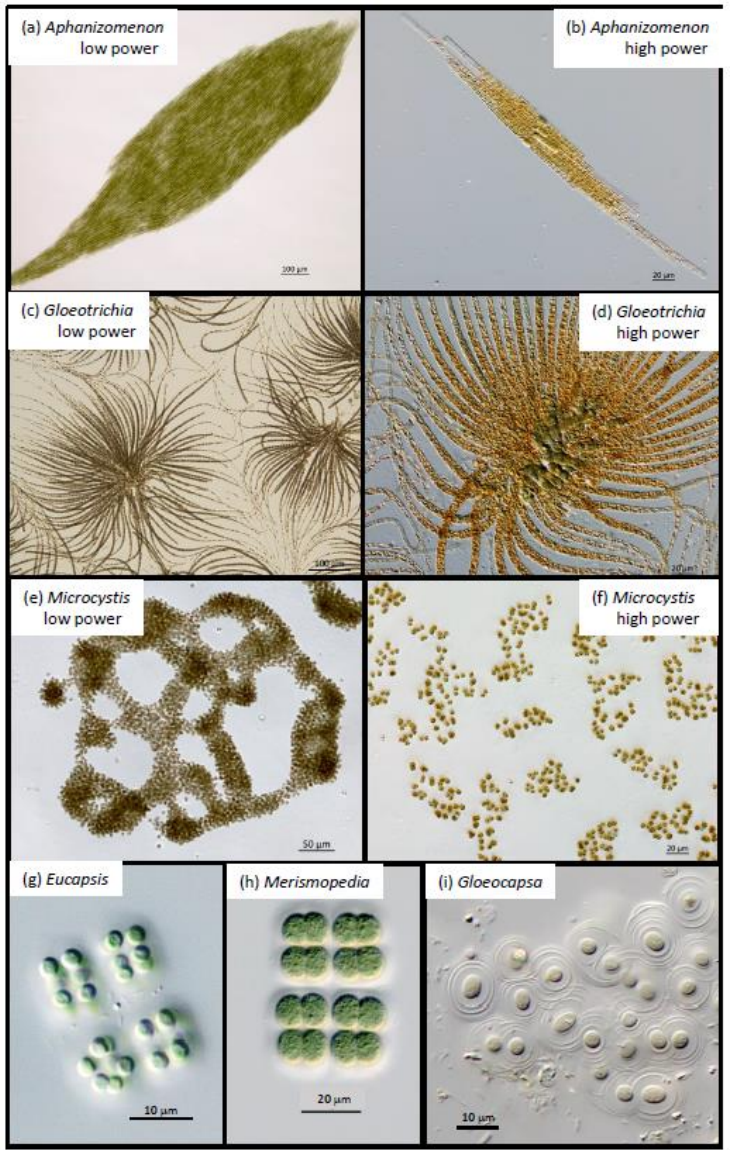
- Enhance blue-green algae monitoring, including time series (longitudinal) as another data point
- Improve blue-green algae field identification
- Determine if and what role environmental conditions have on cyanotoxin levels
- Understand sensor limitations



# NEW DATA GAPS

**Augment spectral library**

First input to SMASH is a spectral library of algal endmembers, so further work is needed to grow the current library by collecting additional field samples to analyze under microscope




Example microscope images for 6 of the 12 genera included in the spectral library, under low or high power as indicated. Planktonic filamentous cyanobacteria include *Aphanizomenon* (a and b) and *Gloeotrichia* (c and d). *Microcystis* (e and f) is a planktonic coccoid cyanobacteria. (g) *Eucapsis*, (h) *Merismopedia*, and (i) *Gloeocapsa* are coccoid cyanobacteria occurring in planktonic or benthic forms.

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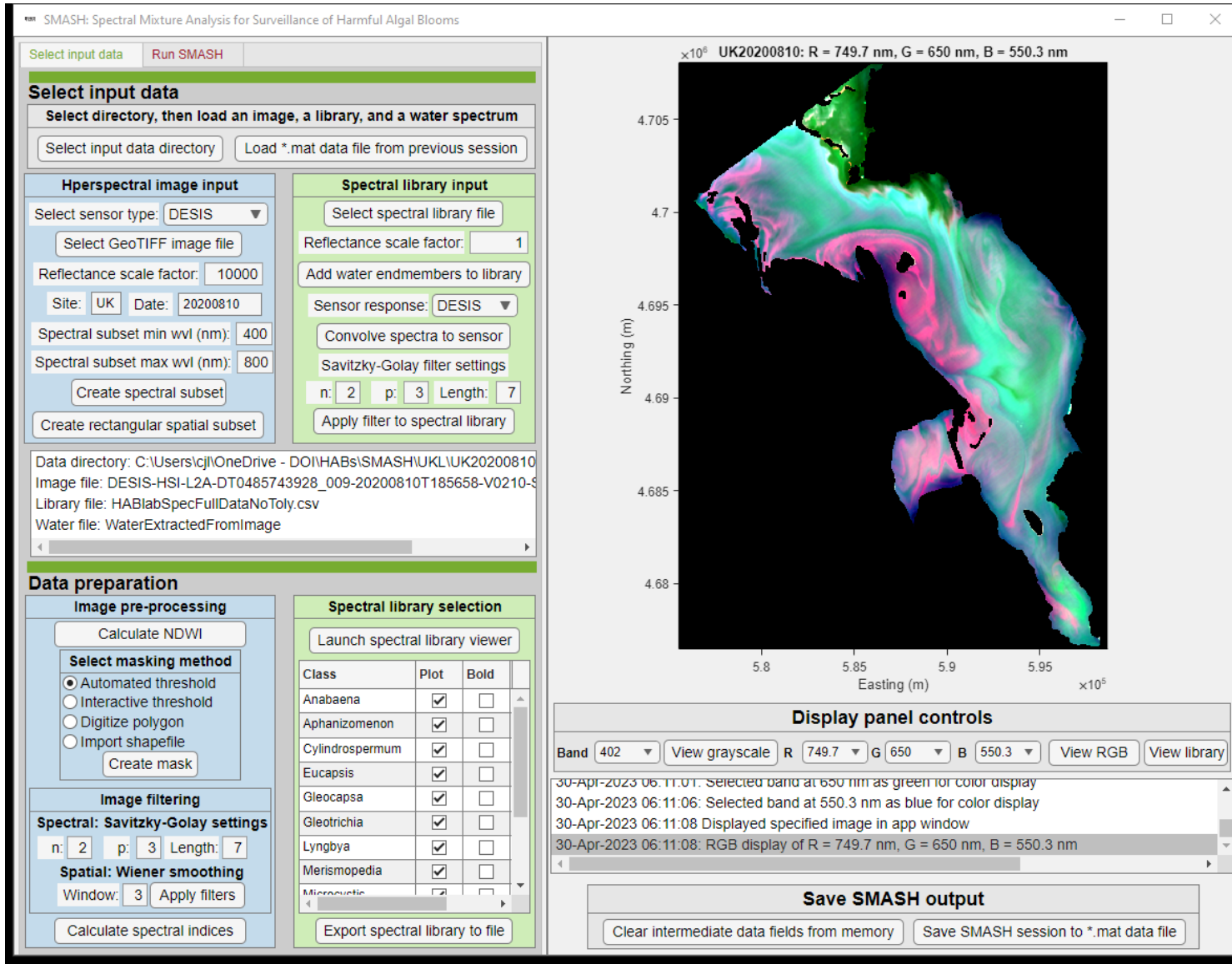
**Develop end-user software**

Ongoing effort to provide a flexible tool to facilitate the application of SMASH



# ACKNOWLEDGEMENTS

**Co-authors on paper introducing the SMASH framework:**

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- Terry Slonecker, USGS National Civil Application Center
- Jennifer Graham, USGS New York Water Science Center
- Victoria Stengel, USGS Oklahoma-Texas Water Science Center
- Nancy Simon, USGS Laboratory & Analytical Sciences Division
- Barry Rosen, Florida Gulf Coast University

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