

US EPA ARCHIVE DOCUMENT



The use of on-lake remote sensing to measure water quality in New England lakes

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Rationale

- States are responsible for monitoring water quality of lakes
- Traditional sampling provides good information vertically, but not horizontally
- Remote sensing could provide data on many lakes simultaneously and/or repeated measurements over time in a cost-effective manner
- Little information exists on spectral characteristics of New England lakes

Steps

1. Collect lake spectral measurements from lakes paired with relevant limnological data
 - Chlorophyll, microcystins, CDOM, ect.
2. Characterize the spectral patterns found in New England lakes
3. Develop algorithms to measure Chl, CDOM and MC's in New England lakes
4. Apply algorithms to satellite imagery to validate the techniques

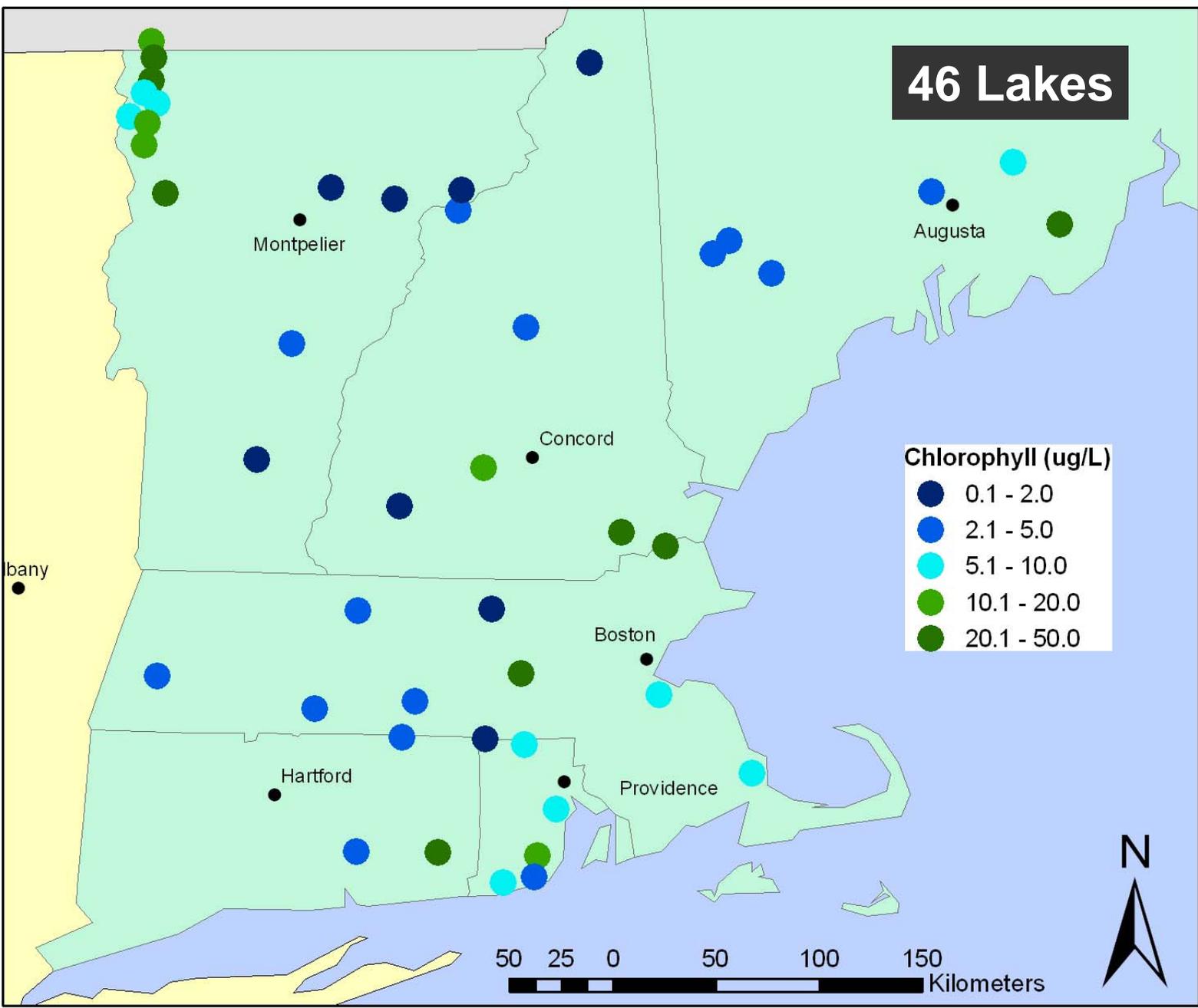
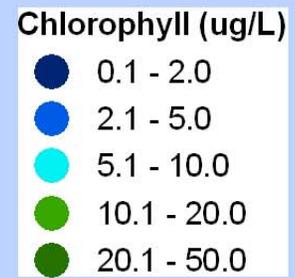
- Study Lakes: New England
- Spectral methods
- Spectral results
- Remote sensing algorithms
- Next steps...



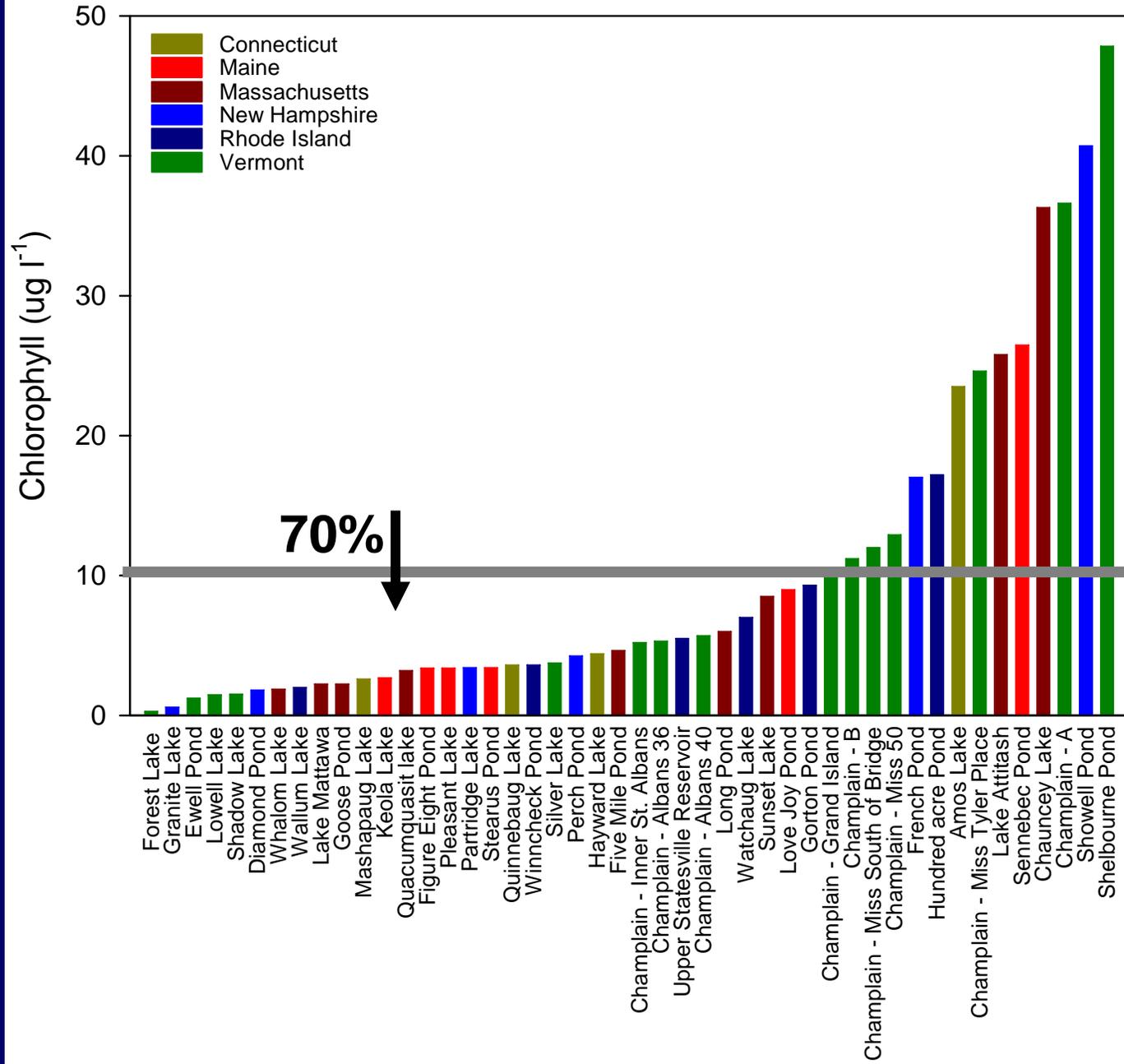
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46 Lakes



Chlorophyll in study lakes



- Study Lakes: New England
- **Spectral methods**
- Spectral results
- Remote sensing algorithms
- Implications for use



400-750 nm
3 nm bands

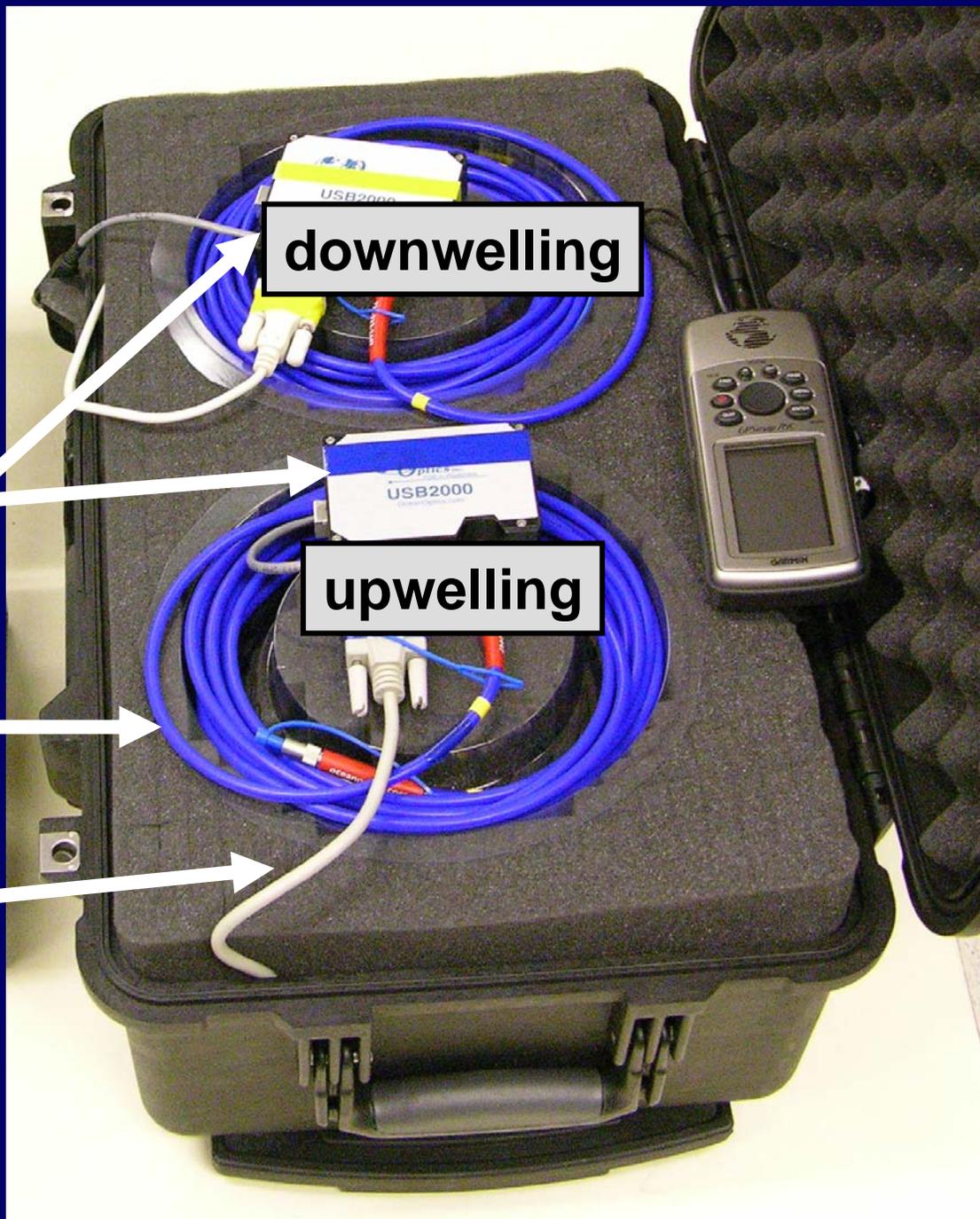
downwelling

USB 2000 radiometers
(measure light, output data)

upwelling

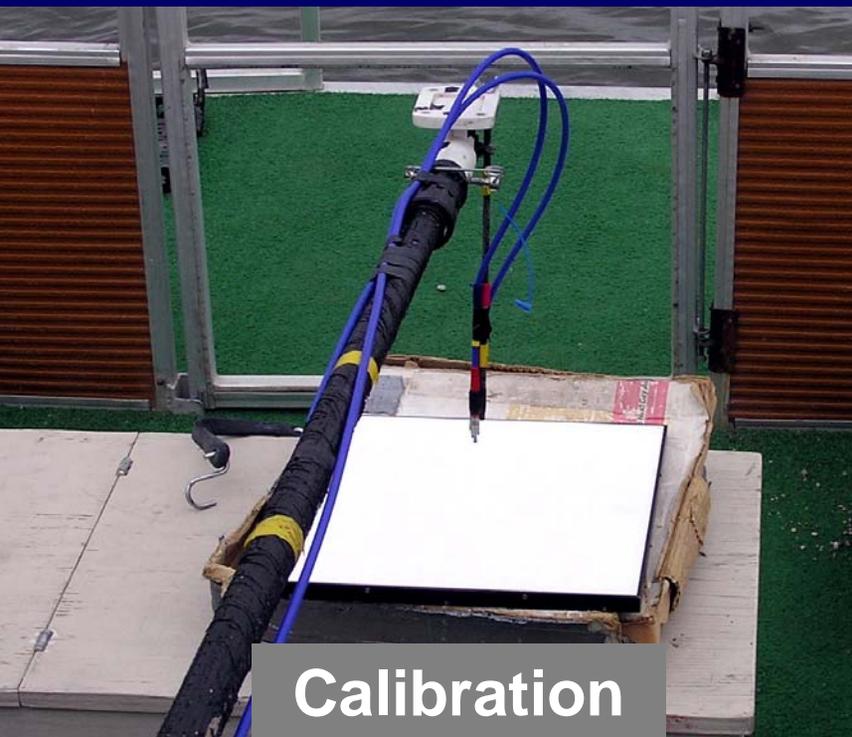
fiber optic cable
(transmit light)

serial cable
(transmit data)





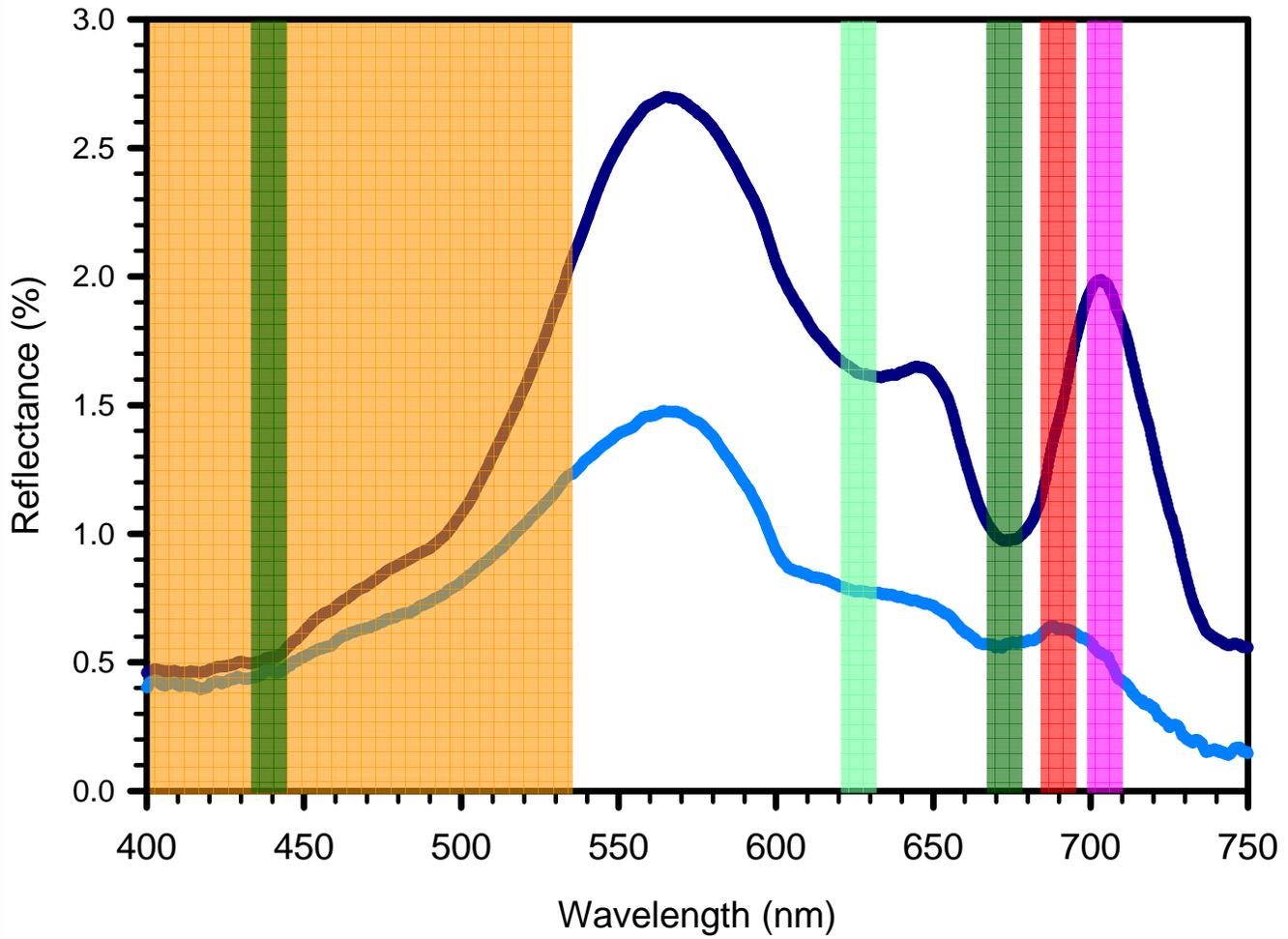
Upwelling



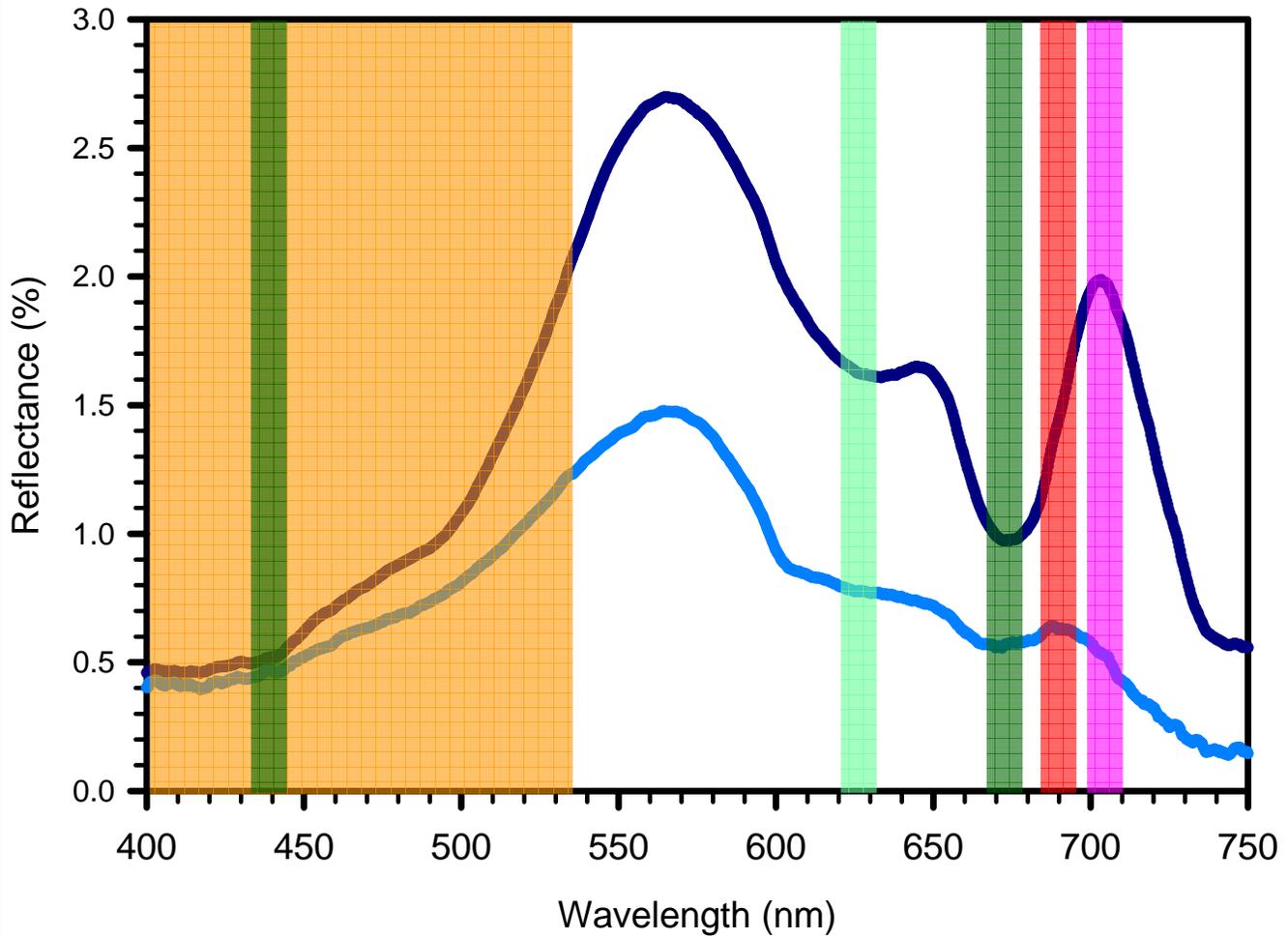
Calibration



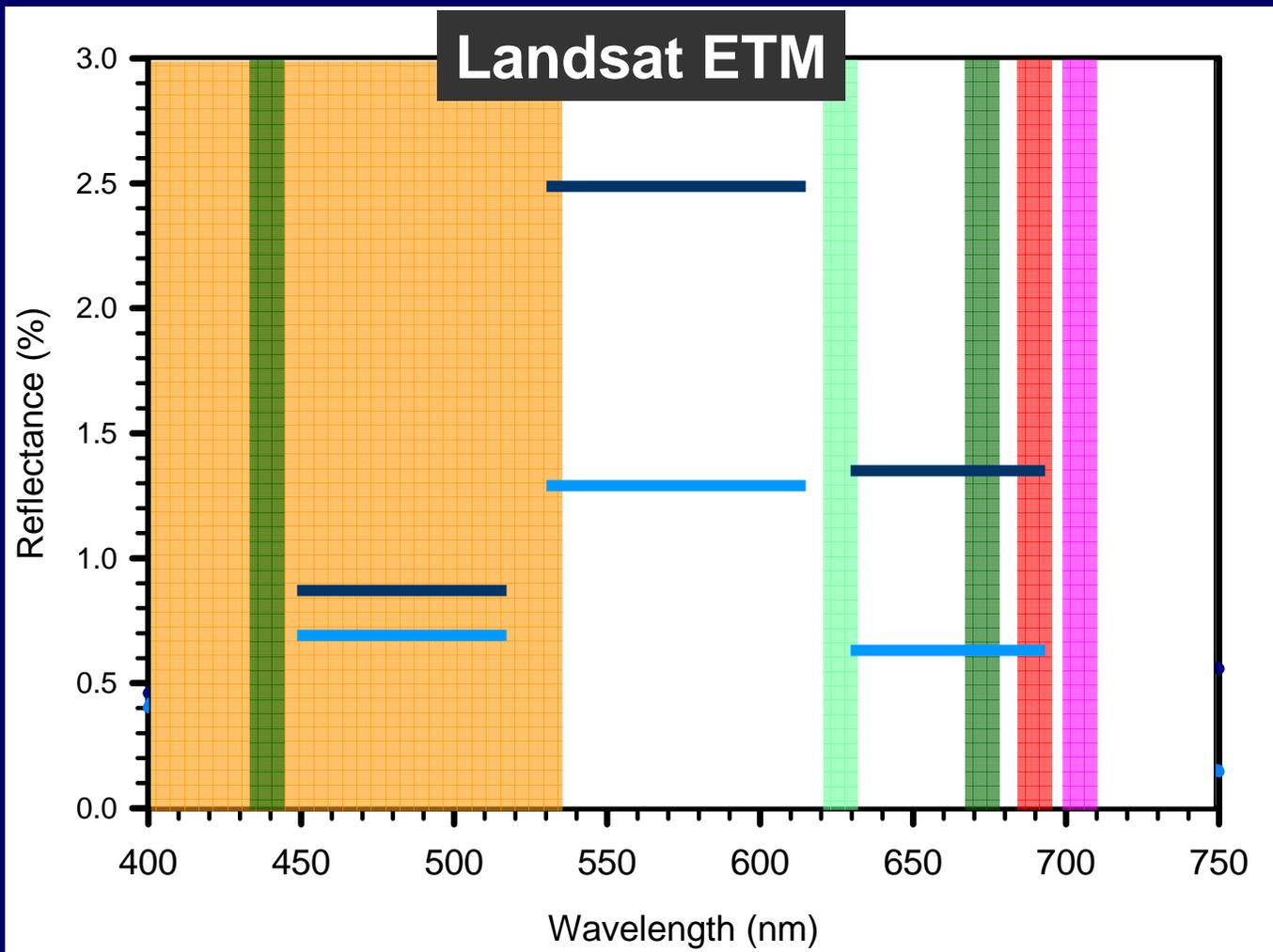
Downwelling

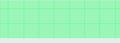
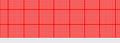
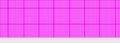
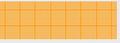


- Absorption by algae (chlorophyll)
- Absorption by cyanobacteria (phycocyanin)
- Fluorescence peak (seen in low chlorophyll lakes)
- Scattering peak (seen in high chlorophyll lakes)
- Absorption by CDOM

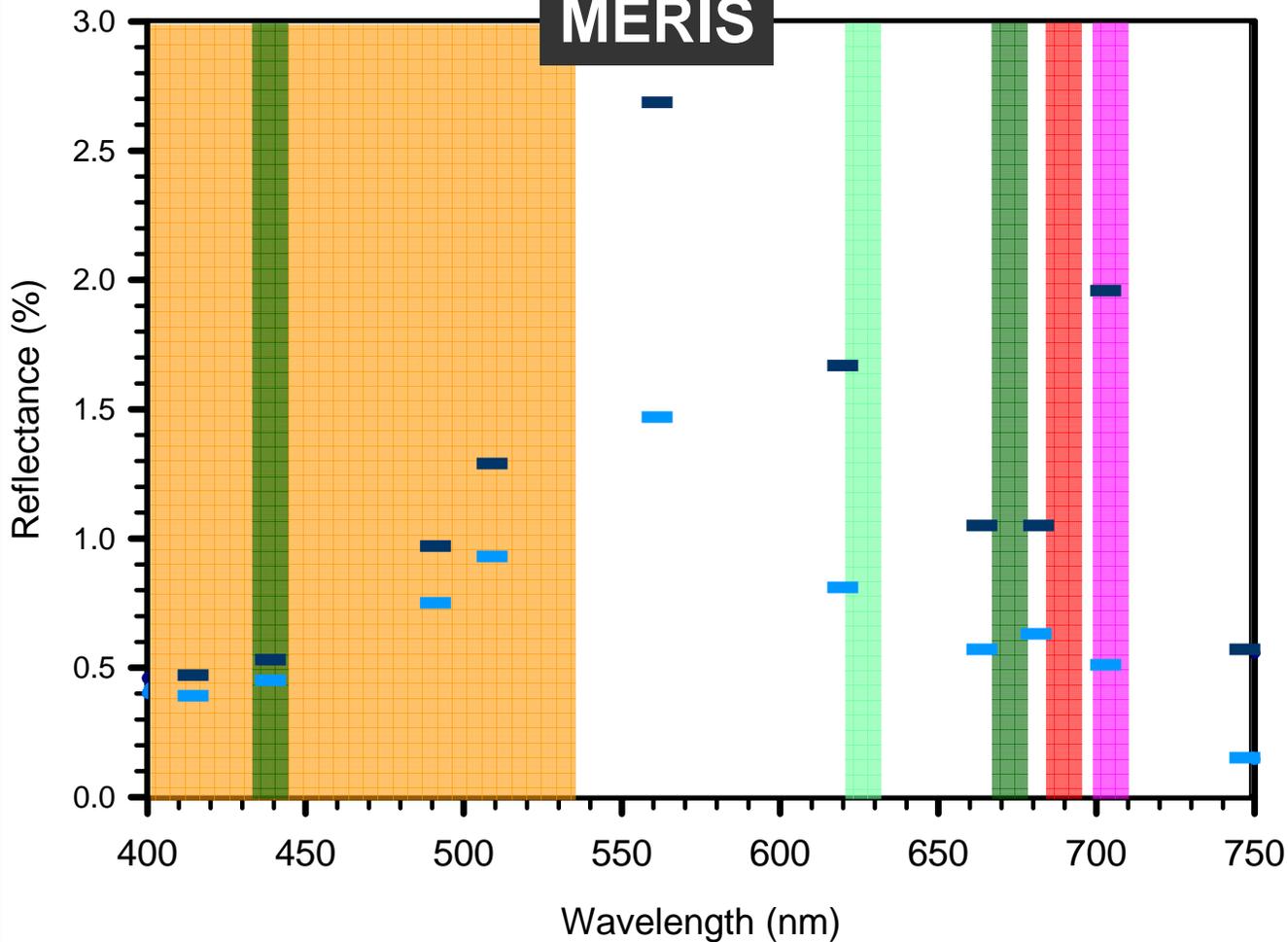


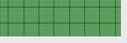
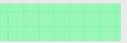
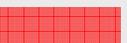
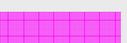
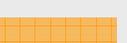
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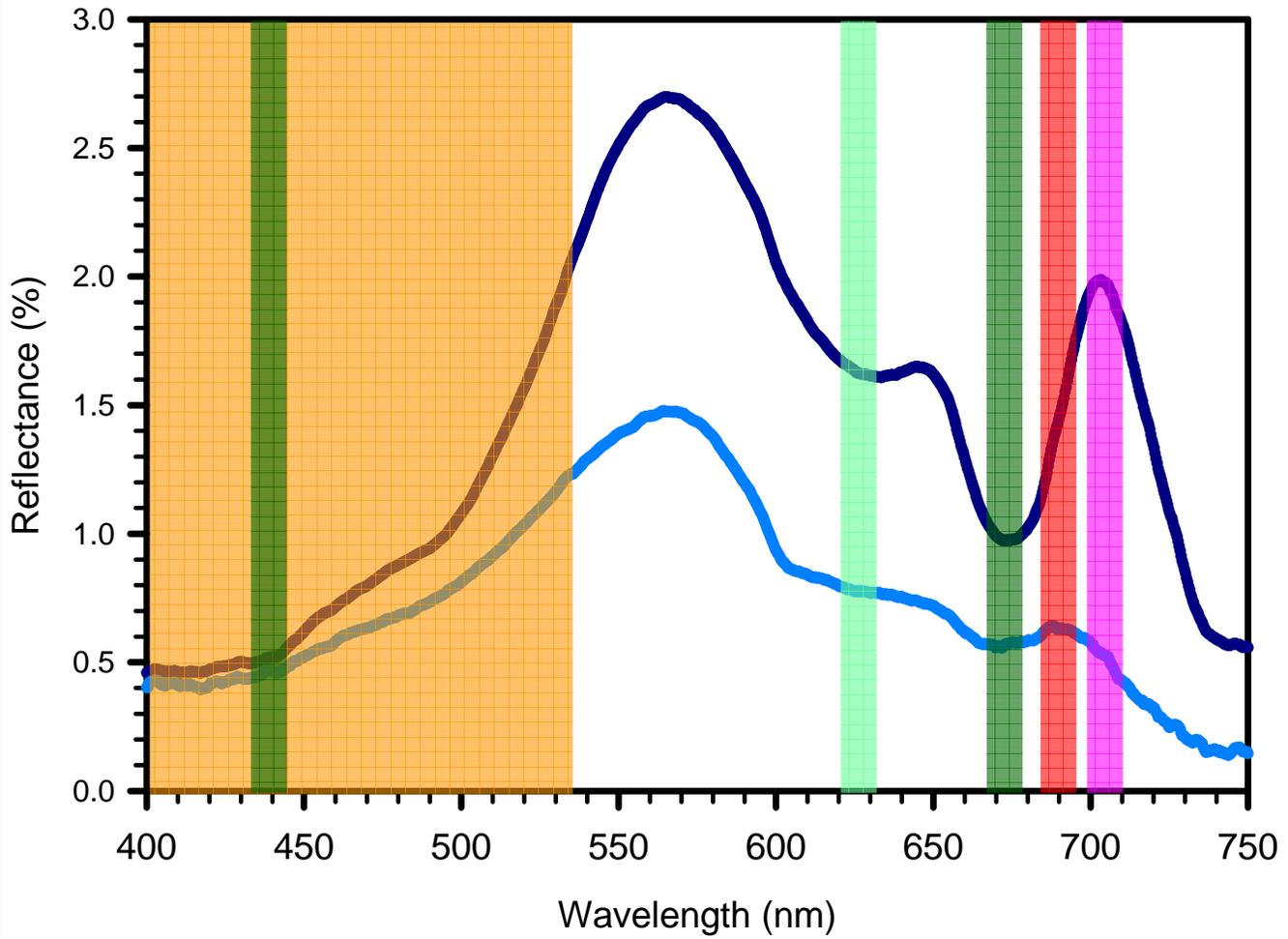


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MERIS



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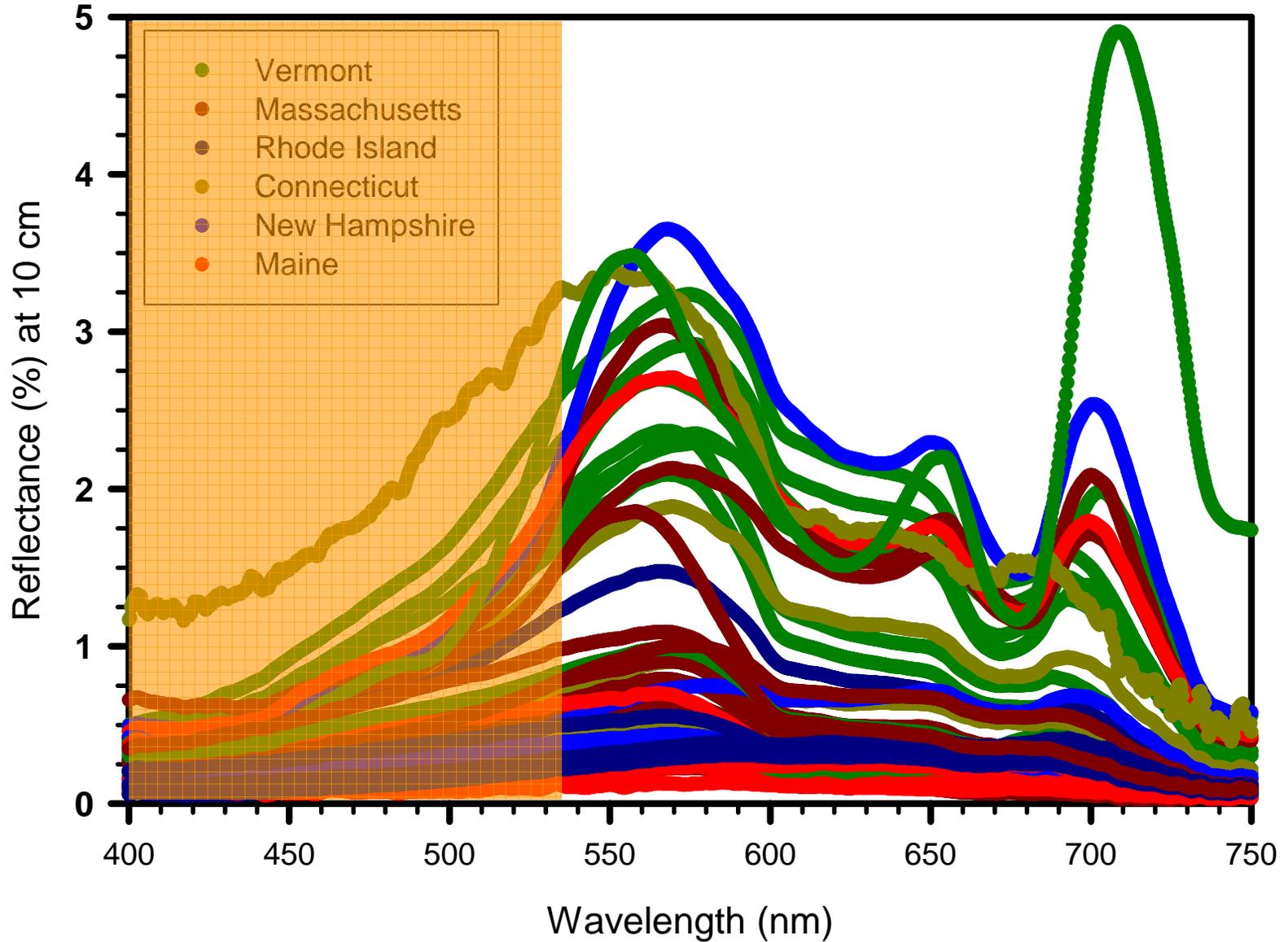


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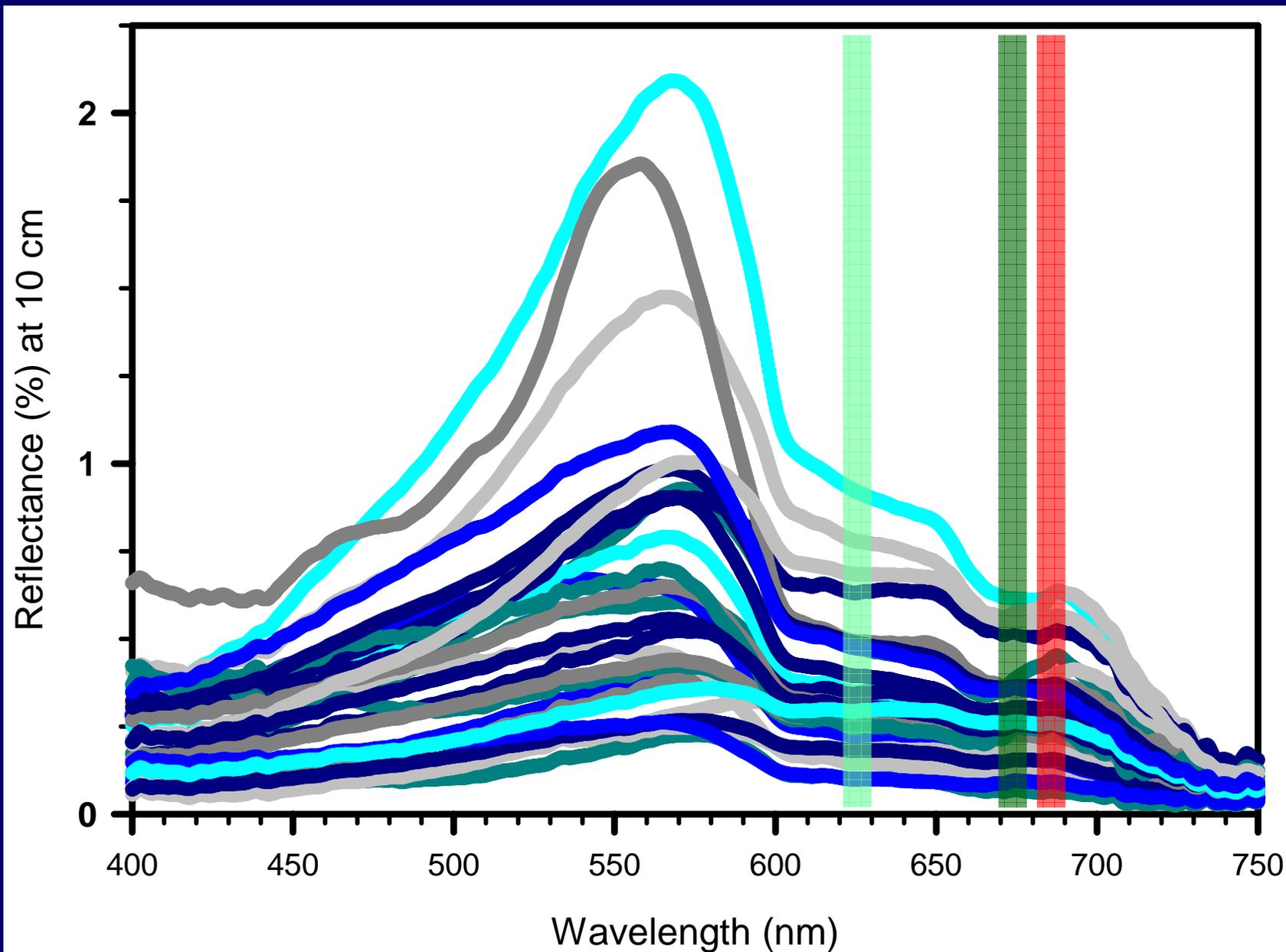
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- **Spectral results**
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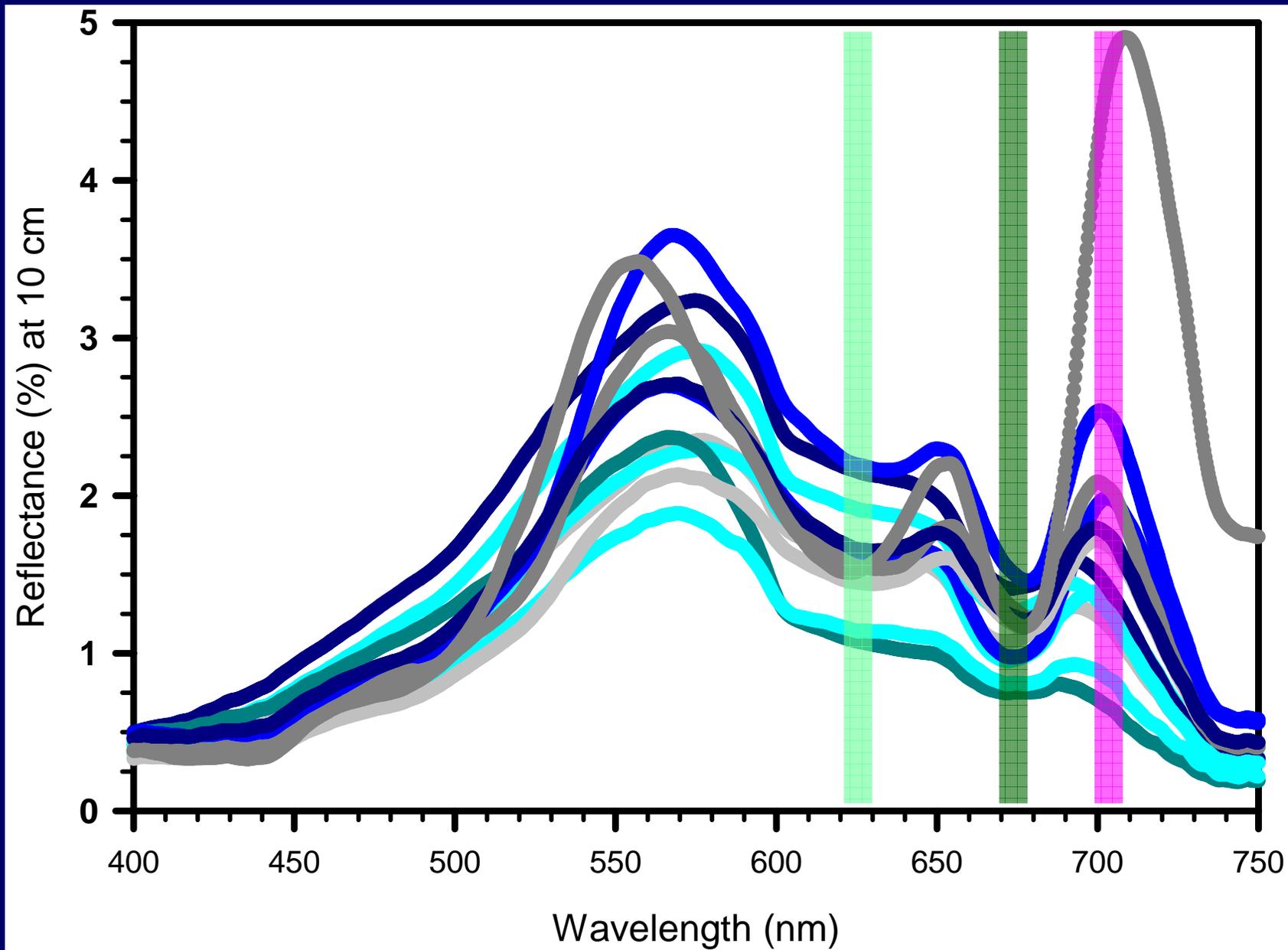
All Spectra (n=46)



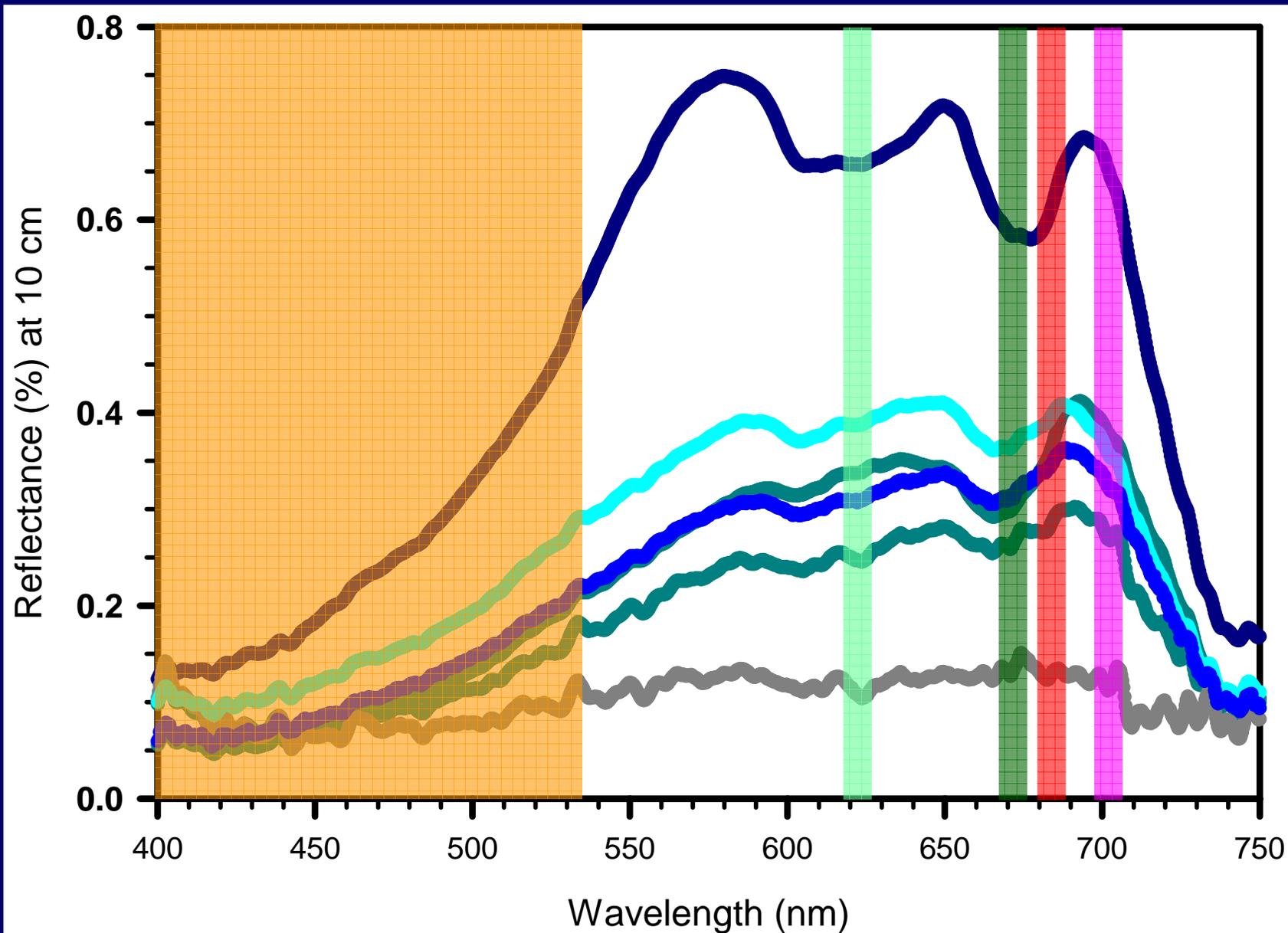
Fluorescence dominated (n=28)

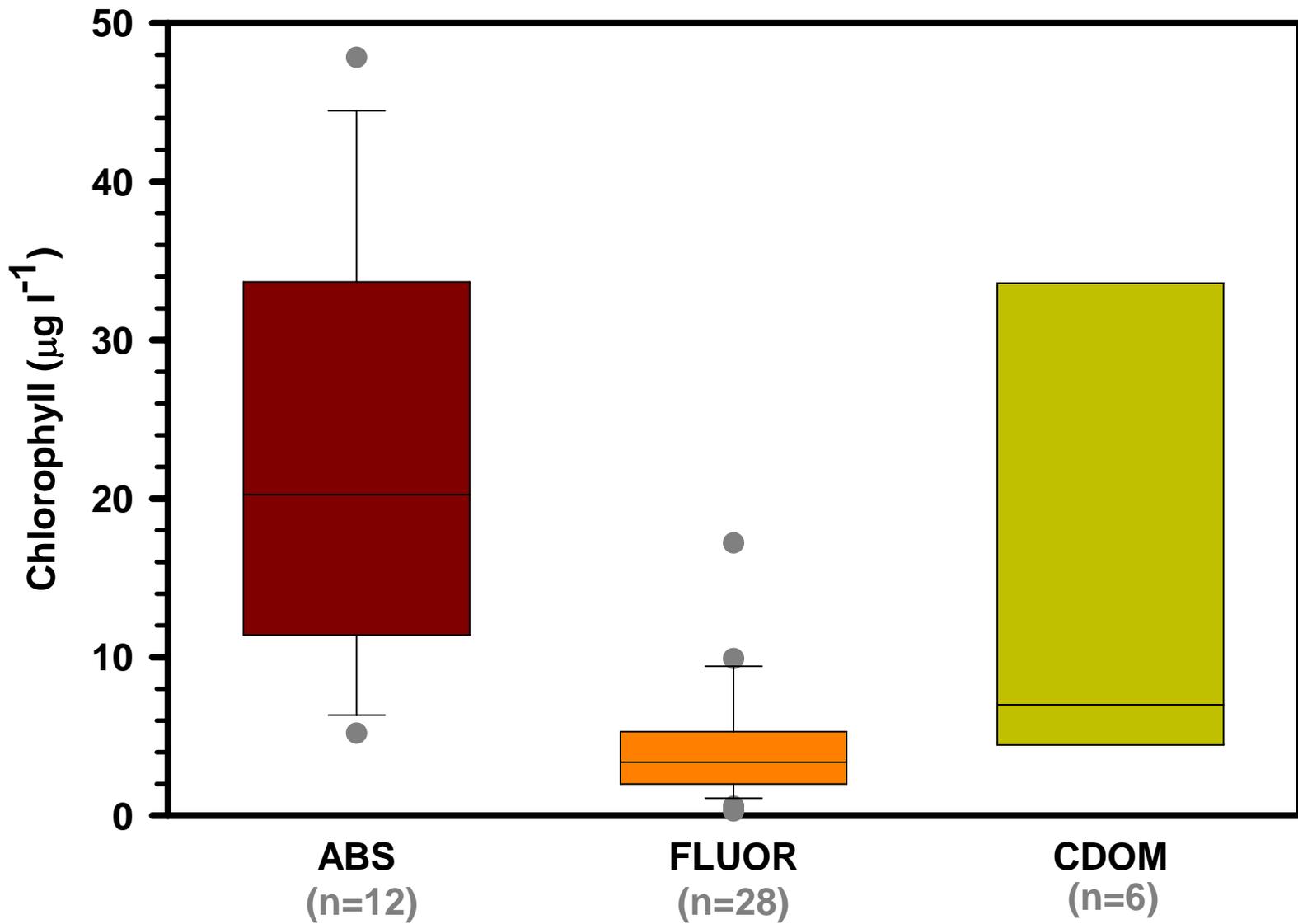


Absorption dominated (n=12)

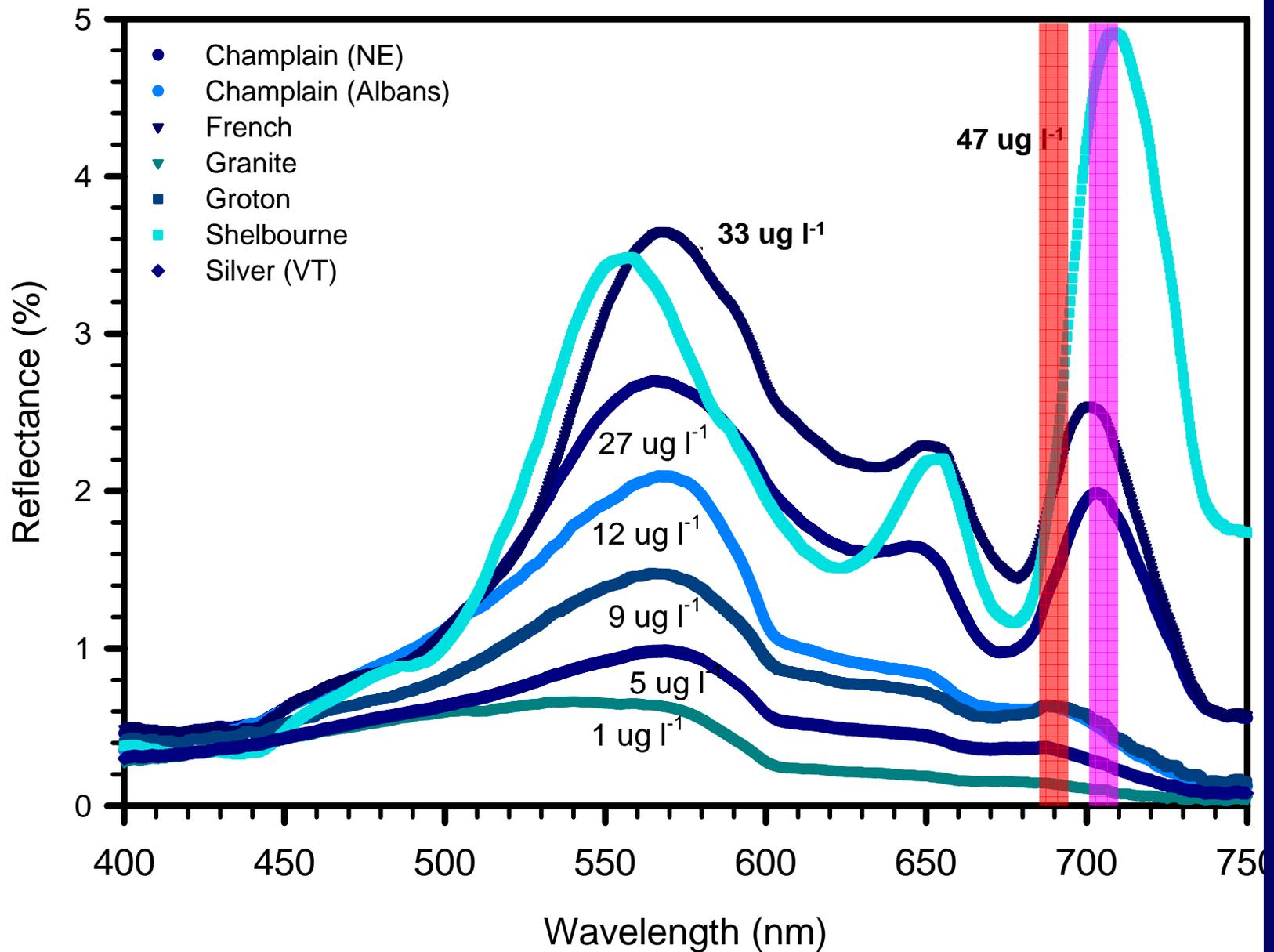


CDOM dominated (n=6)





Spectral response to chlorophyll



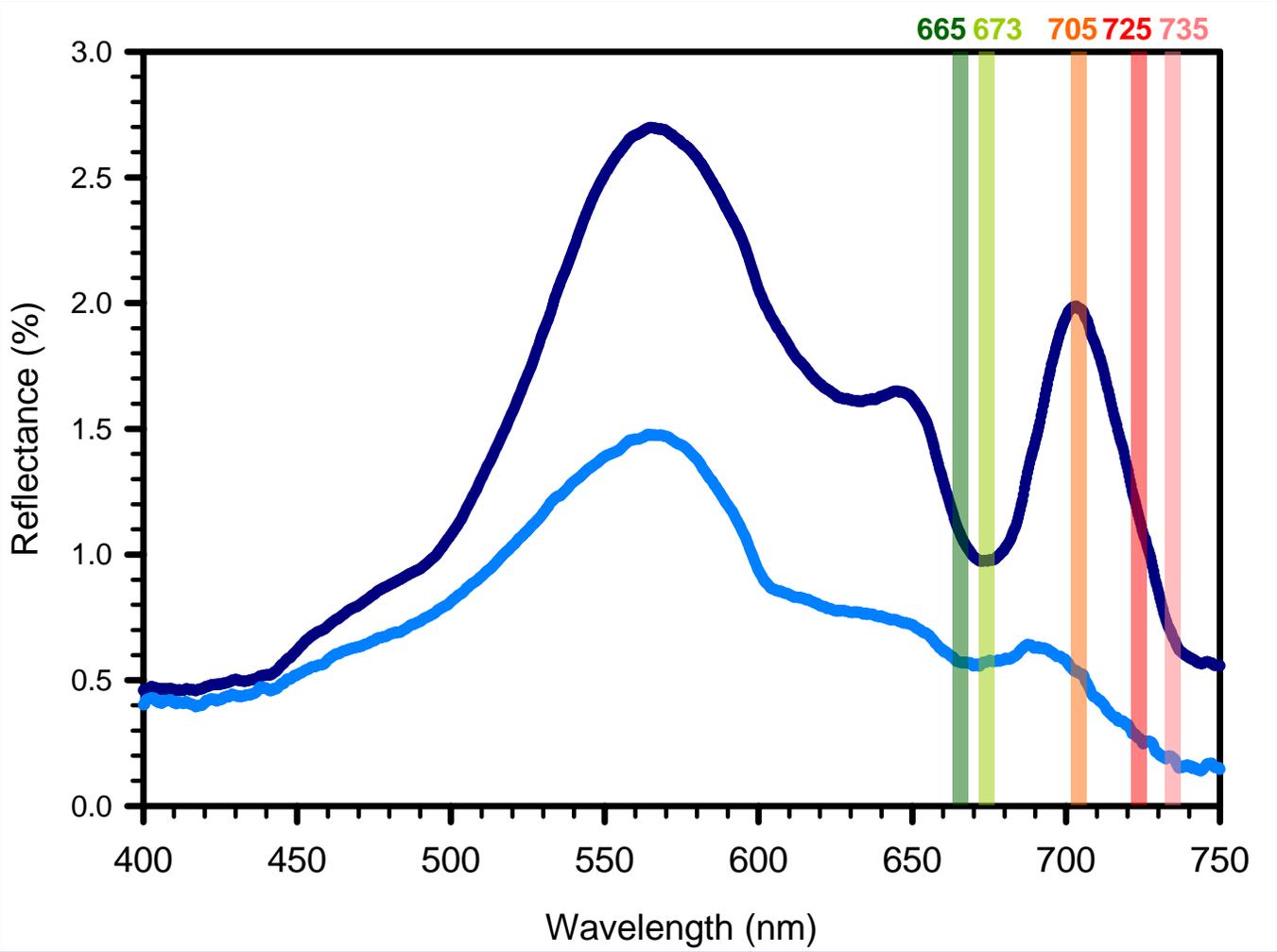
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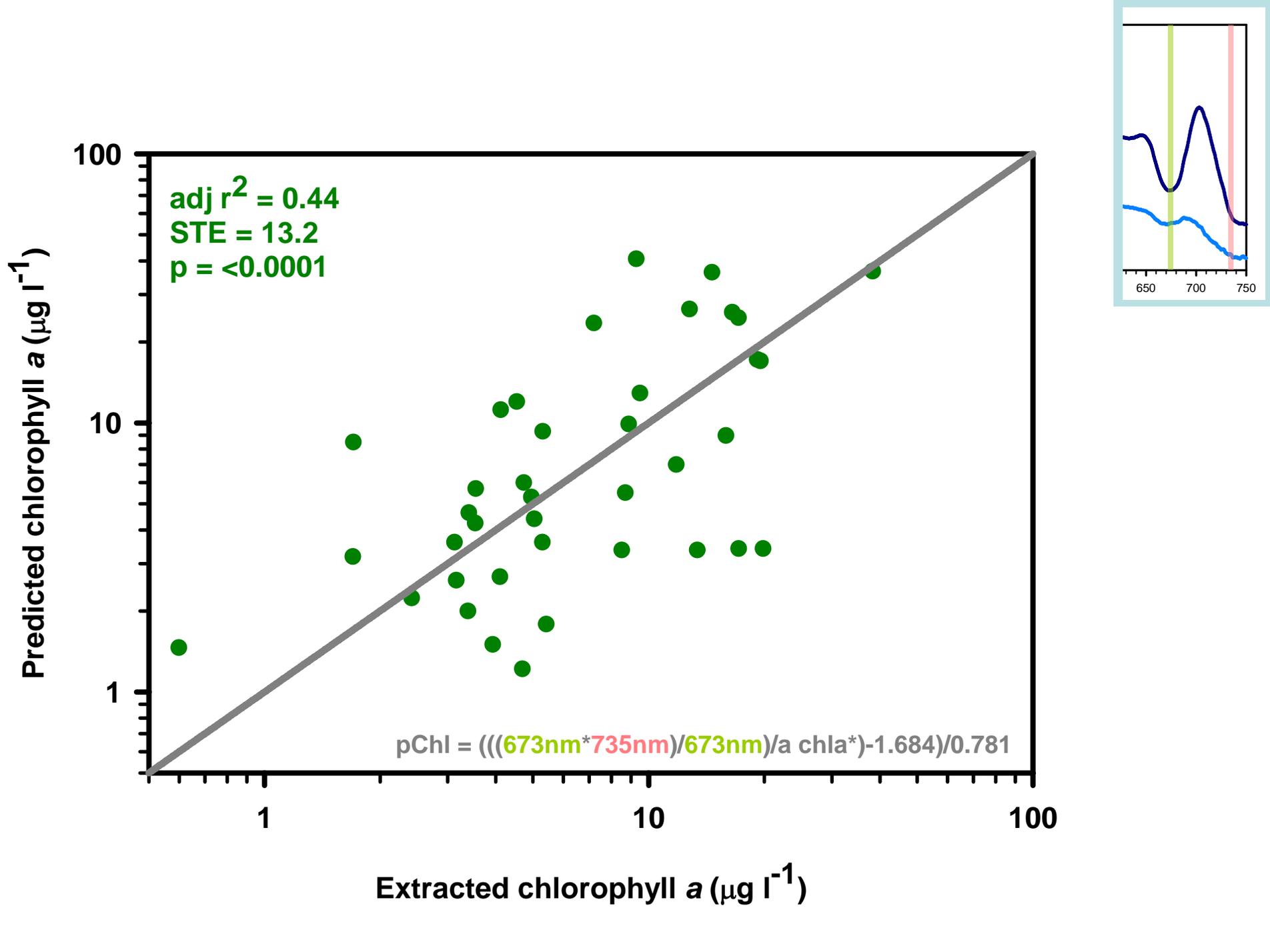


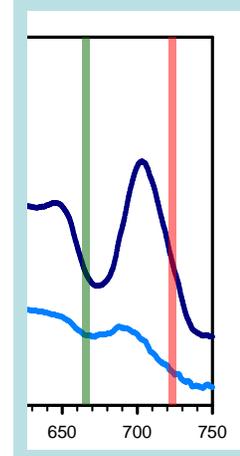
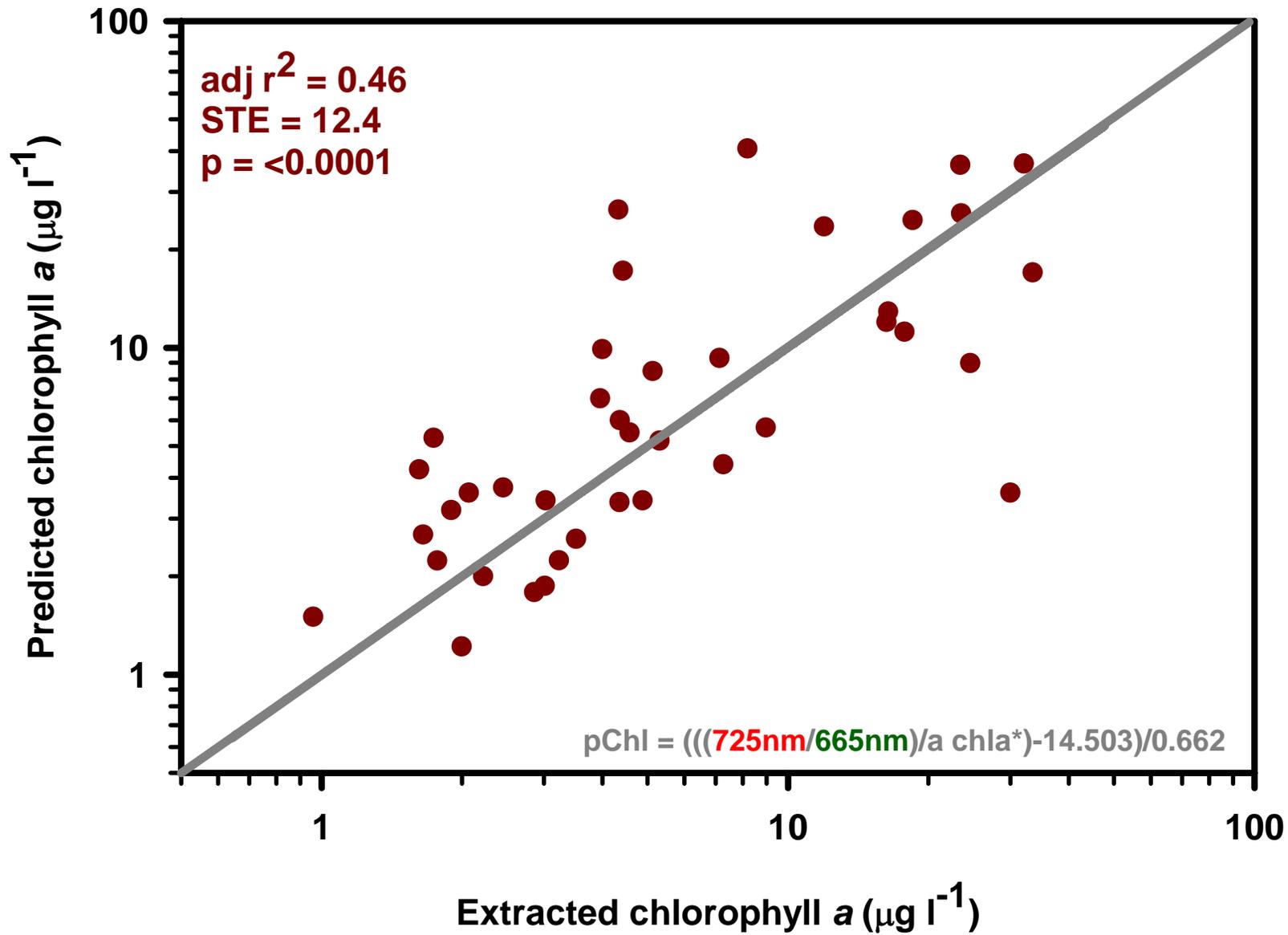
Algorithms...

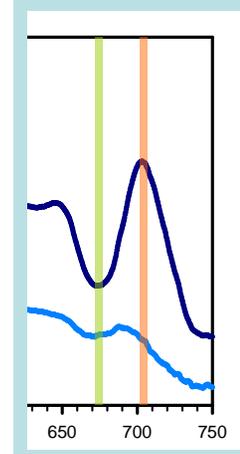
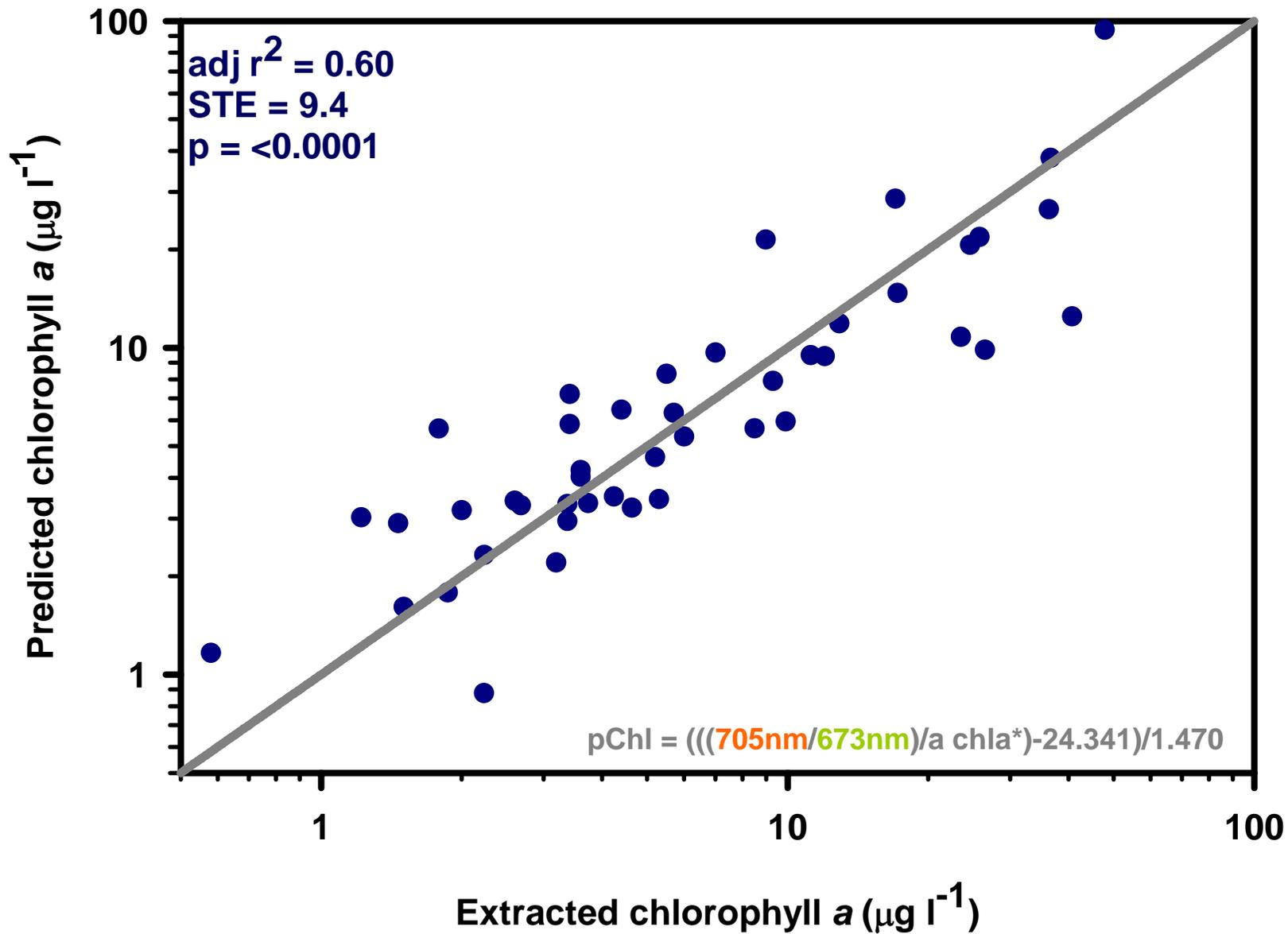
- Chlorophyll
 - Possibilities
 - MODIS, Dall'Olmo & Gitelson 2005, Gons 1999, Gitelson *et. al* 2007
 - Problems
 - None developed for similar lakes

Dall'Olmo & Gitelson 2005,









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Next Steps

- Combine 46 spectra with previous (40) and new (20) spectra to produce final dataset (>80 lakes)
- Continue work on New England algorithms
 - Chlorophyll, Cyanobacteria, CDOM...
- Use satellite/aerial platforms to test viability of remote sensing of New England Lakes
 - NASA MODIS, ESA MERIS, EPA AISA
 - Volunteer monitoring programs (NH LLMP)
 - State agency data lake data

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New England States

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ME Department of Environmental Protection
MA Department of Environmental Protection
NH Department of Environmental Services
URI Cooperative Extension
VT Department of Environmental Conservation

