Reduce methane estimation uncertainty in earth system models by including eco-hydrological patch types sub-grid representation coupled with HLS-derived within-wetland patch distribution

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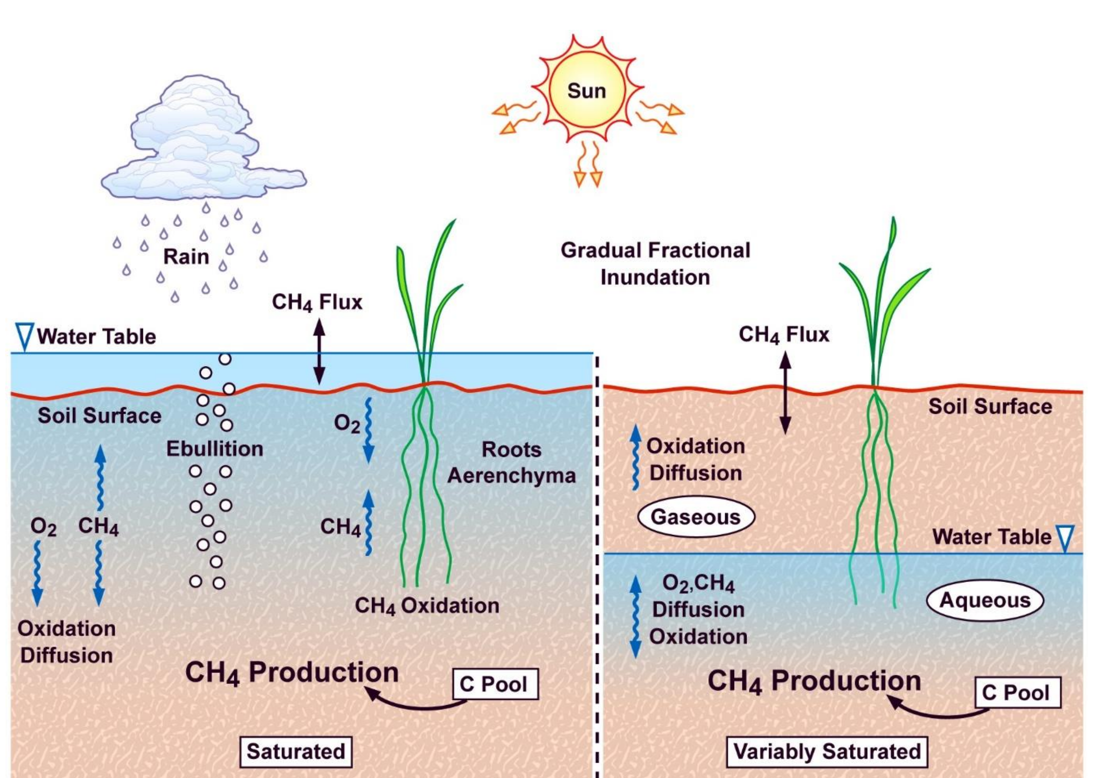
Abstract

- Small-scale spatial and temporal heterogeneity strongly affect CH_4 fluxes within wetlands.
- Here we introduce sub-grid modeling of coastal wetland CH_4 fluxes in the **E3SM Land Mode**l (ELM v1) in an attempt for **reducing model's uncertainty** in methane and carbon site-level budgets estimations.
- We are using seasonal time-series of **HLS-derived NDVI**, which provide distinct seasonal temporal "fingerprints" used to classify HLS pixels to specific patch types and **infer the corresponding plant cover distribution within the wetland**.
- Our findings show a **higher precision when simulating multiple patches compared to single patch representations**, thus, emphasizing the role of wetland sub-grid representation coupled with HLS-derived within-wetland patch distribution in reducing models uncertainty.

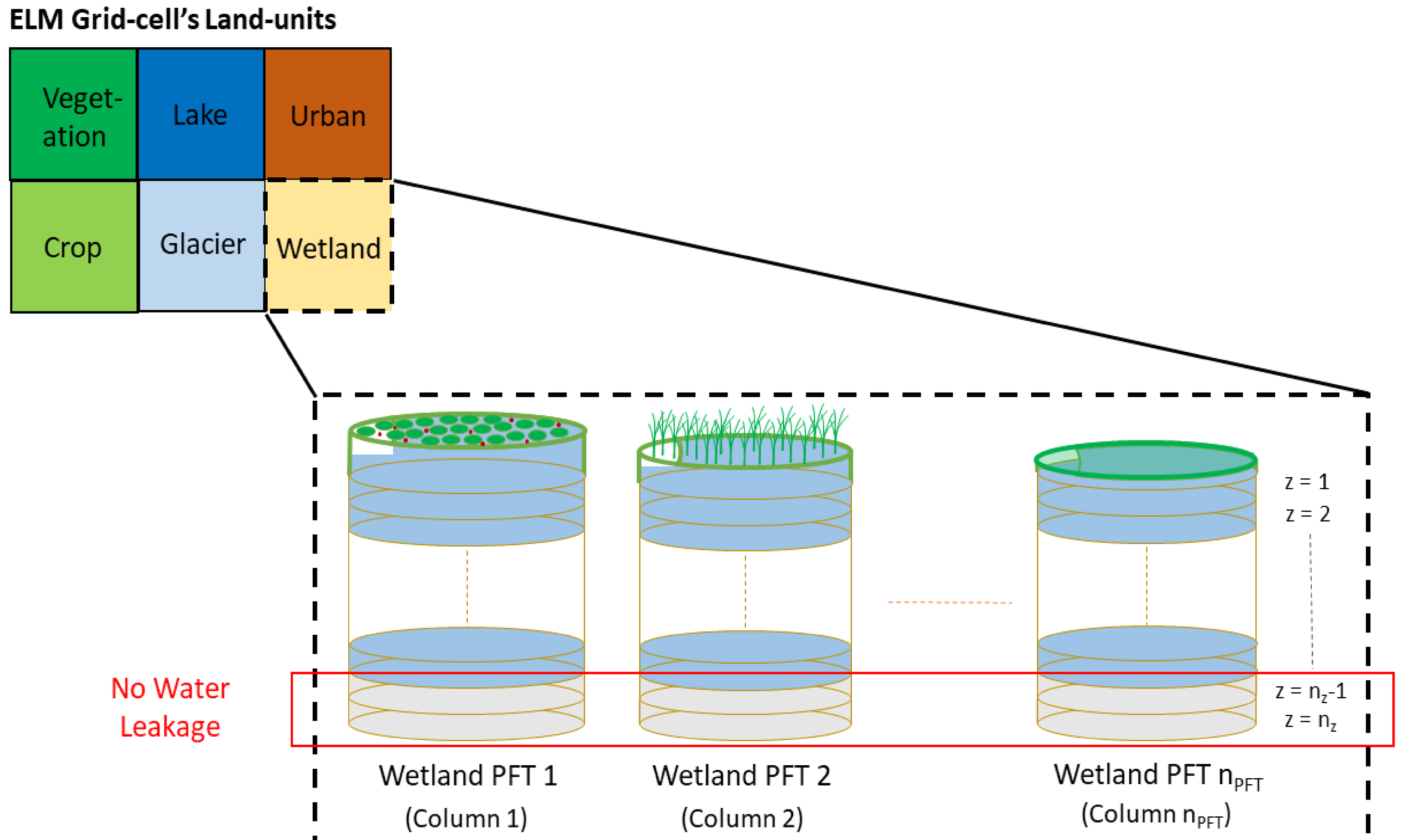
CH4 Processes in ELM v1 – Riley et al. (2011)



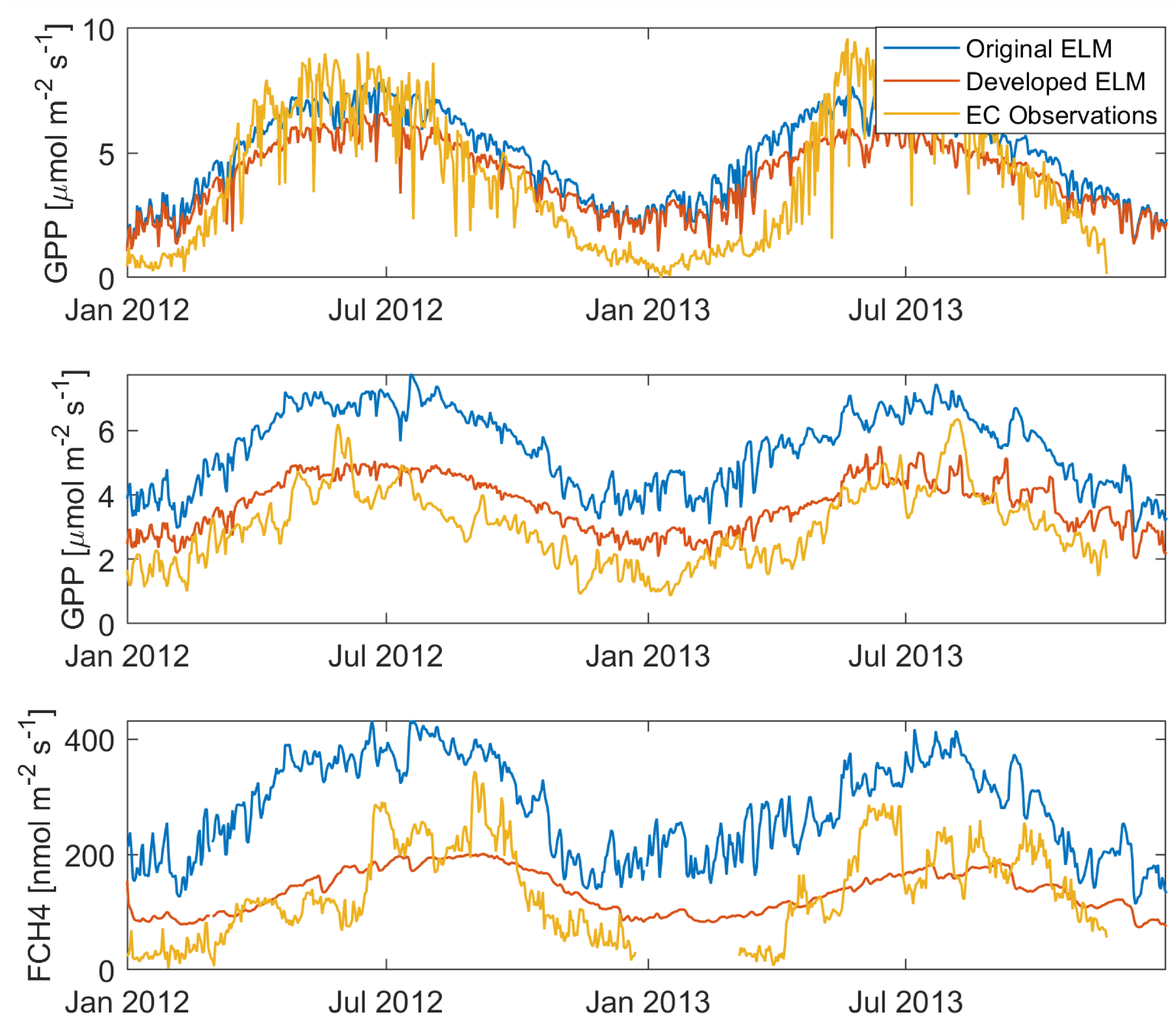
Modelled Processes:
- Production
- Oxidation
- Diffusion
- Ebullition
- Aerenchyma

Output:
- Methane Soil Concentration Profiles
- Methane Fluxes from 3 pathways
- Carbon Fluxes

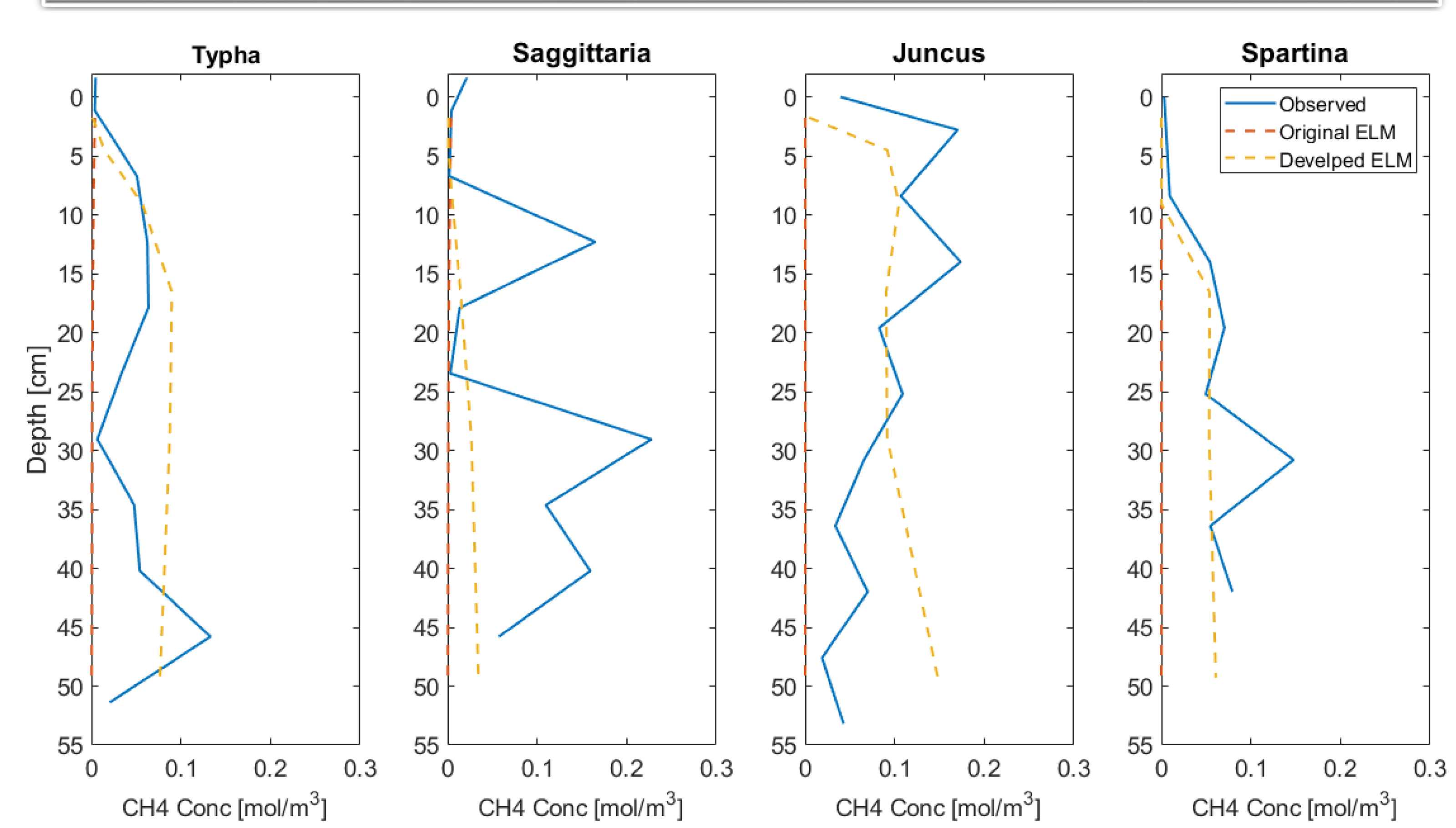
Developed Wetland Land-unit



US-LA2 Simulations



Model Validation – Methane Soil Concentration



Acknowledgements

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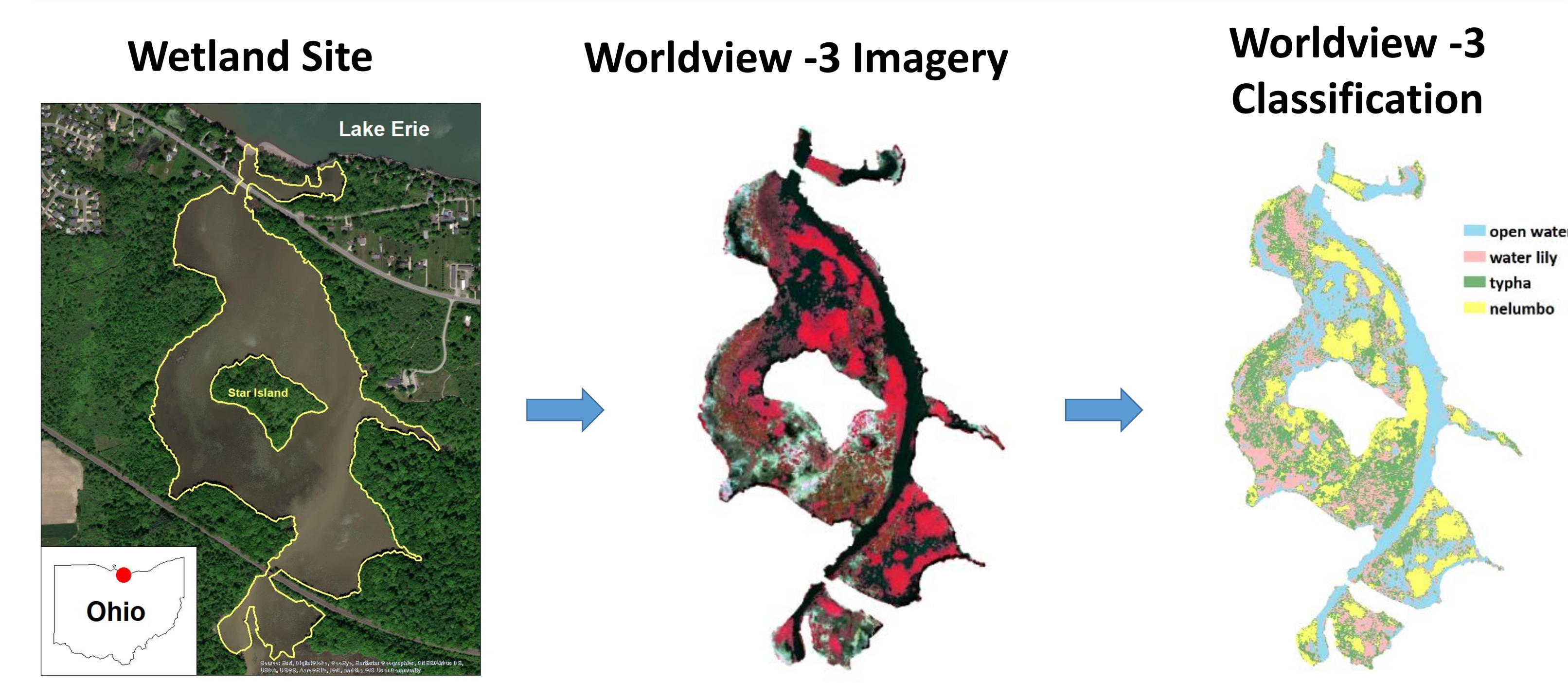
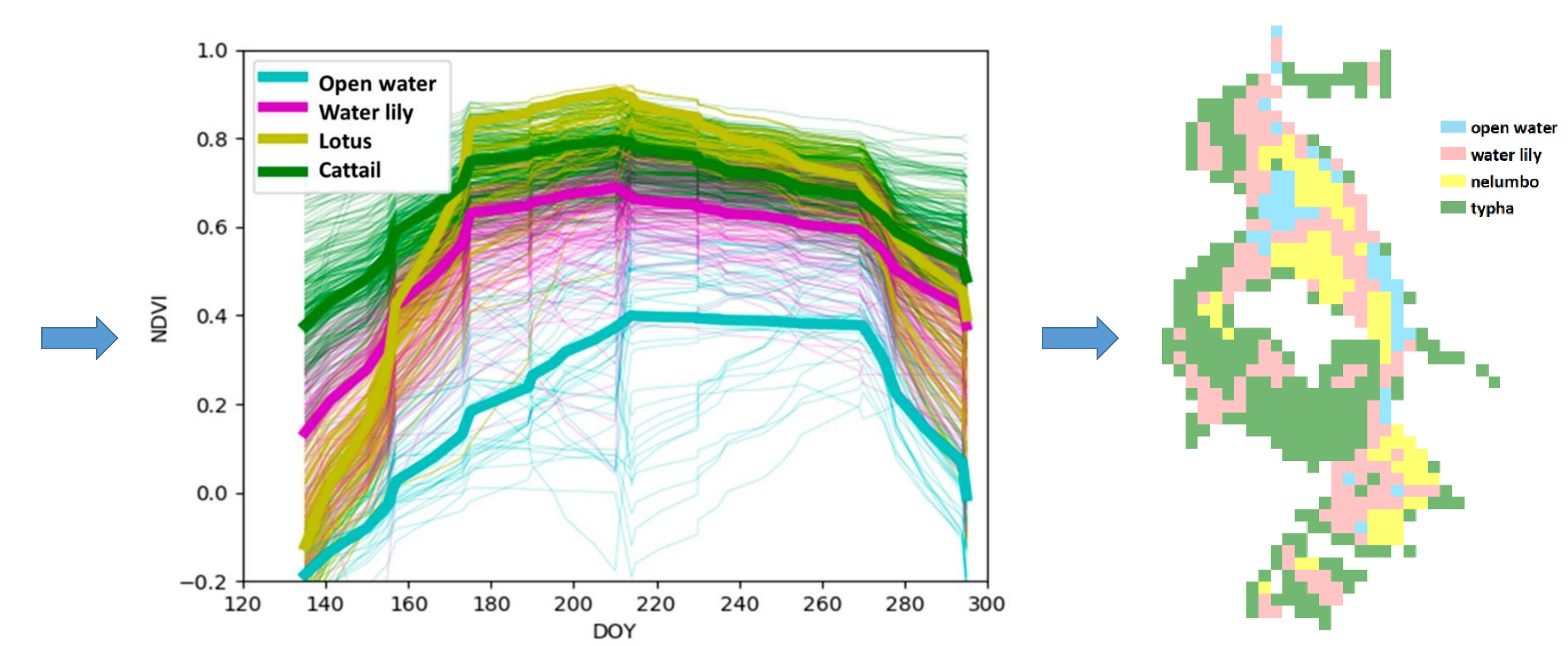
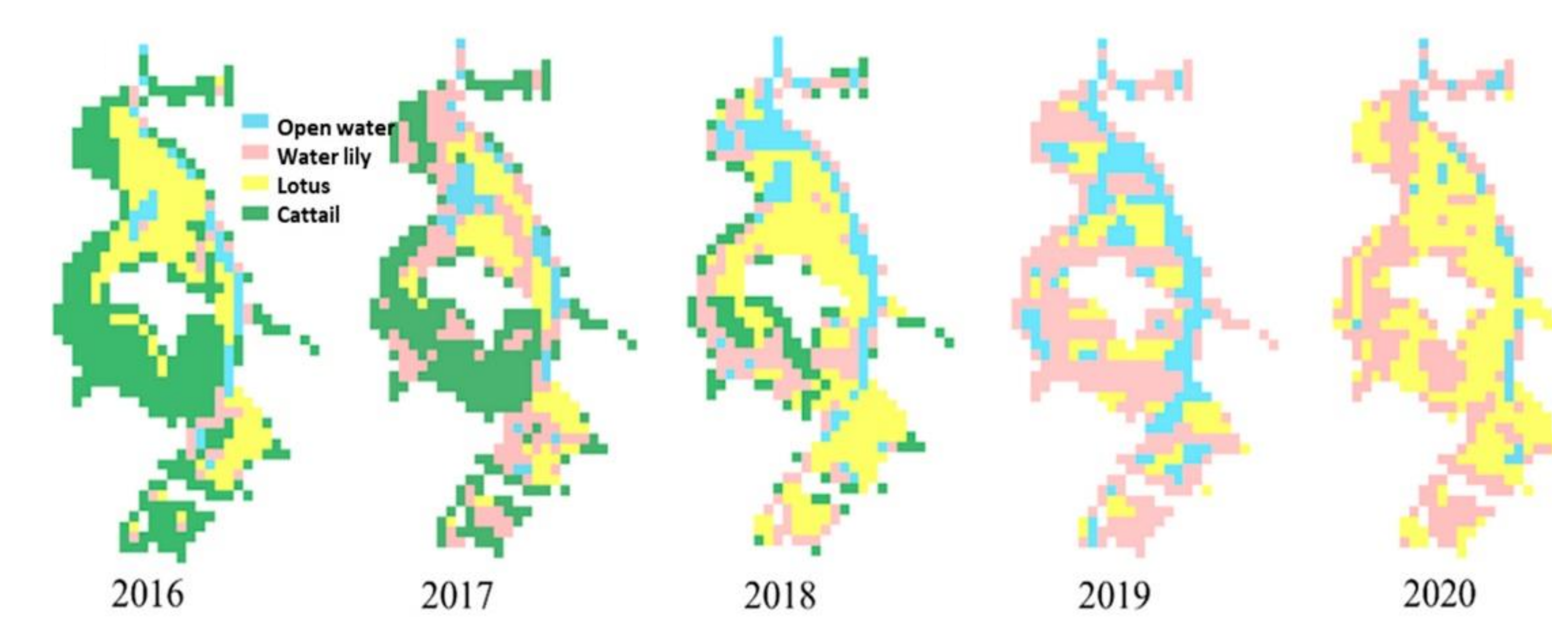
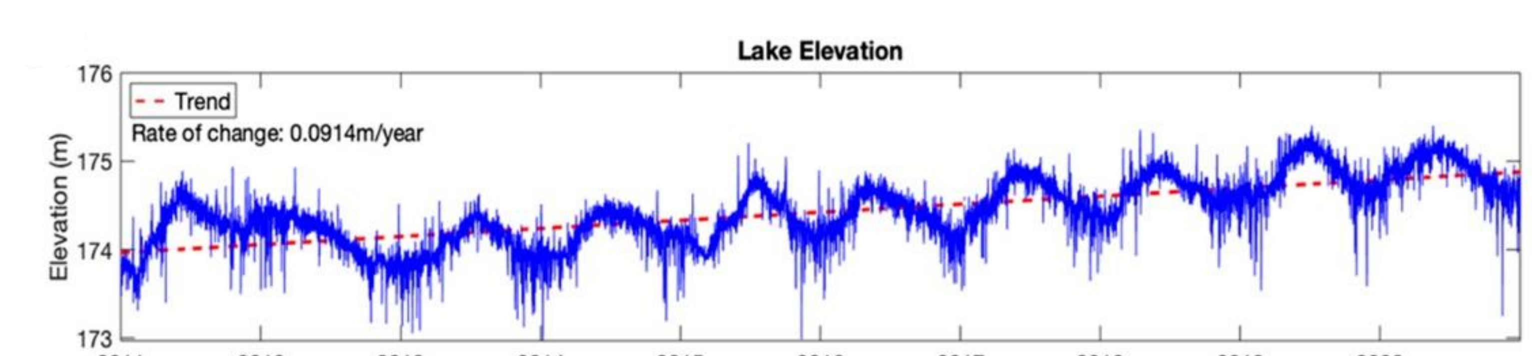
HLS Classification at US-OWC – Ju and Bohrer (2022)





US-OWC Patch Distribution – Ju and Bohrer (2022)





The rapid water elevation increase in Lake Erie drives a rapid shift in the patch type composition of the wetland. **The consistent availability of HLS images from 2016 up to present allow the characterization and quantification of these changes using the HLS-derived NDVI time-series classification.**