

Academia and the UFS: Lessons from the Transition of the Great Lakes Operational Forecast System (GLOFS)

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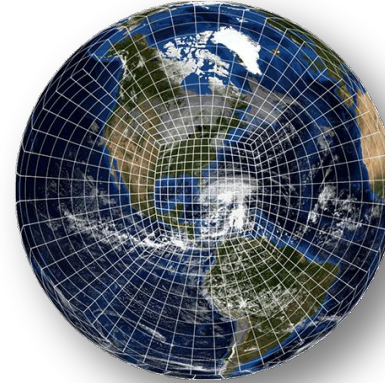
Hydrologic Science & Engineering
Civil & Environmental Engineering
Department of Geophysics

Colorado School of Mines

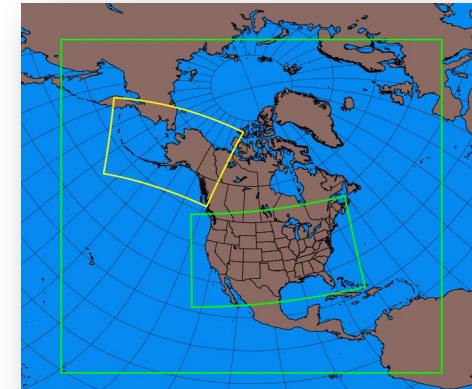


Why GLOFS? | UFS Coastal Applications

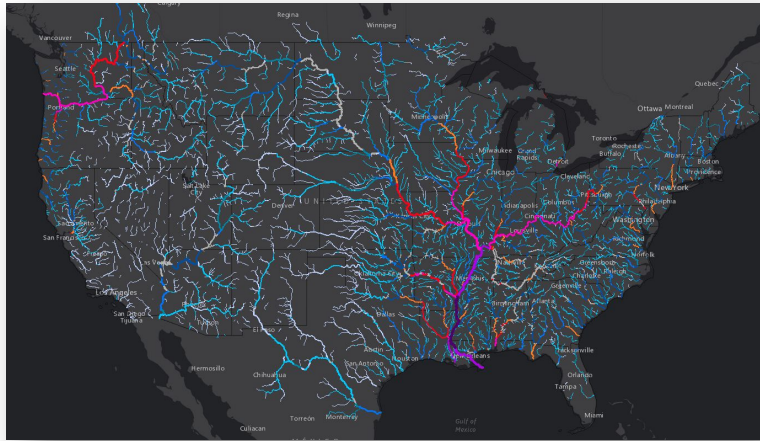
Global Weather



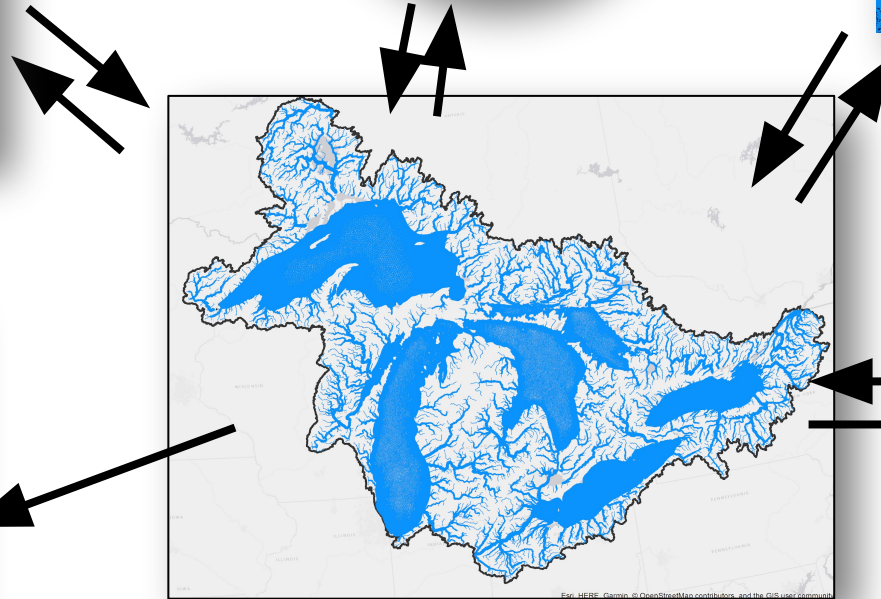
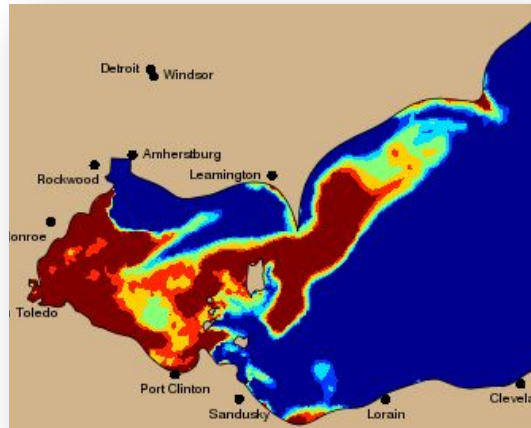
Regional Weather



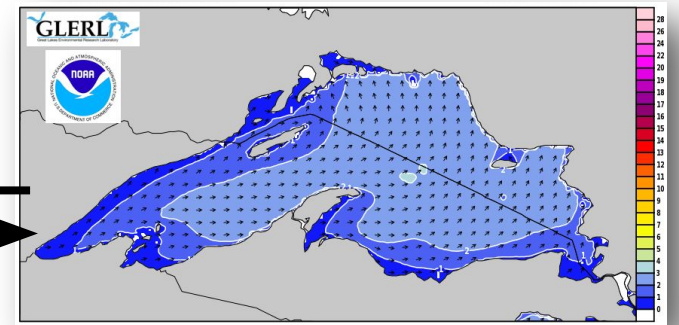
Streamflow / Groundwater



Water Quality / Ecology

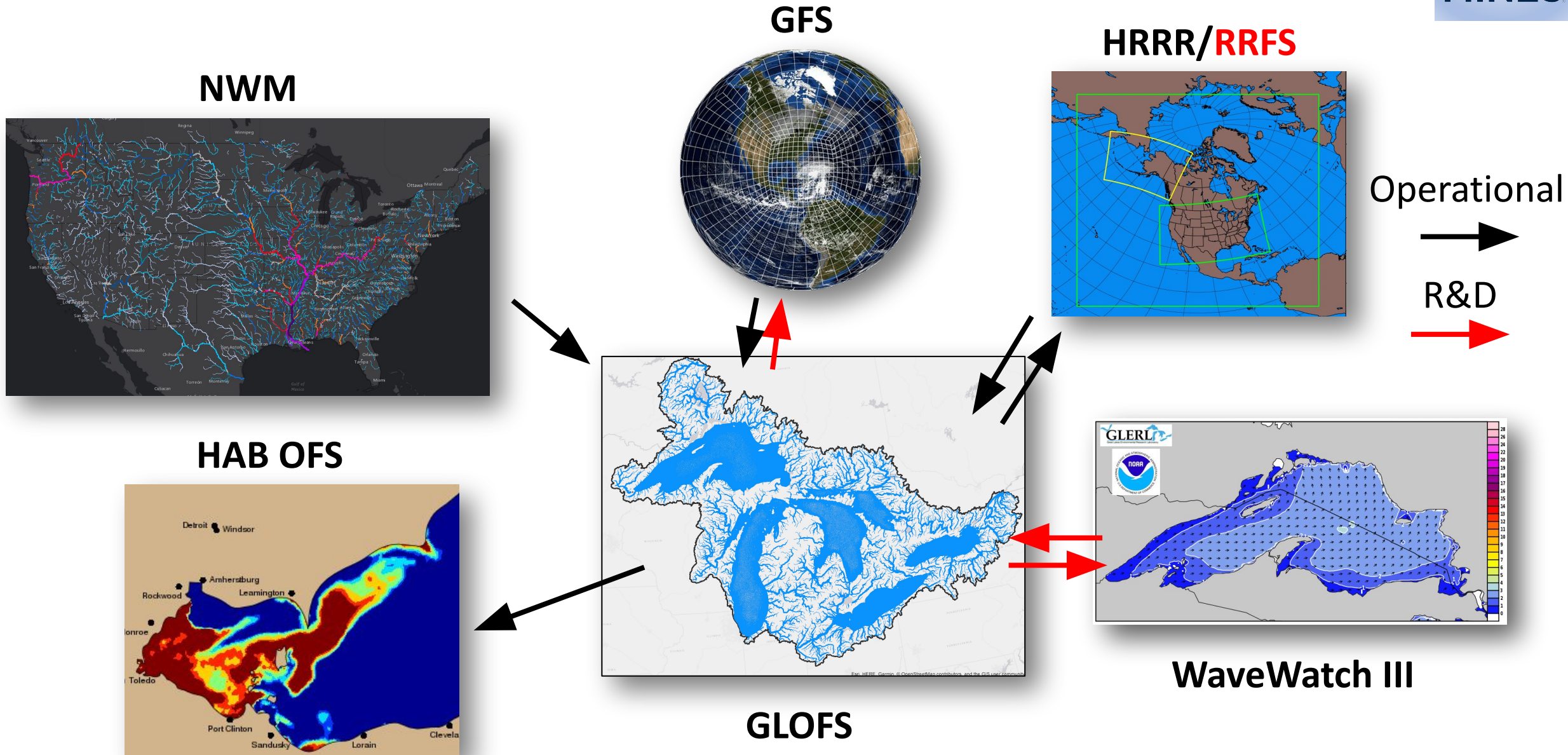


Coastal/lake Hydrodynamic-Ice



Waves

Why GLOFS? | UFS Coastal Applications



GLOFS | Mission

Navigation Support



Spill Response



Extreme Storms

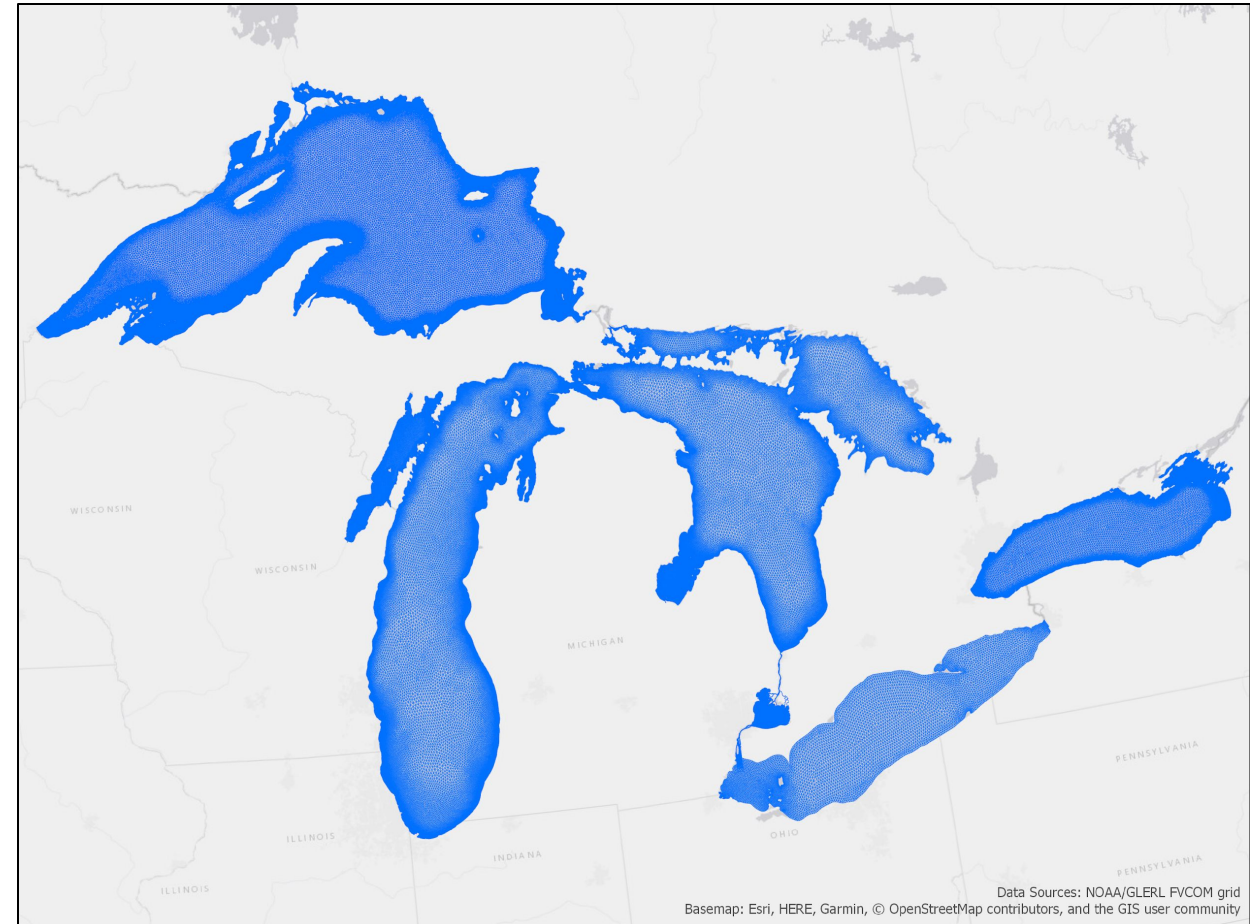


Photograph: Lindsay DeDario/Reuters

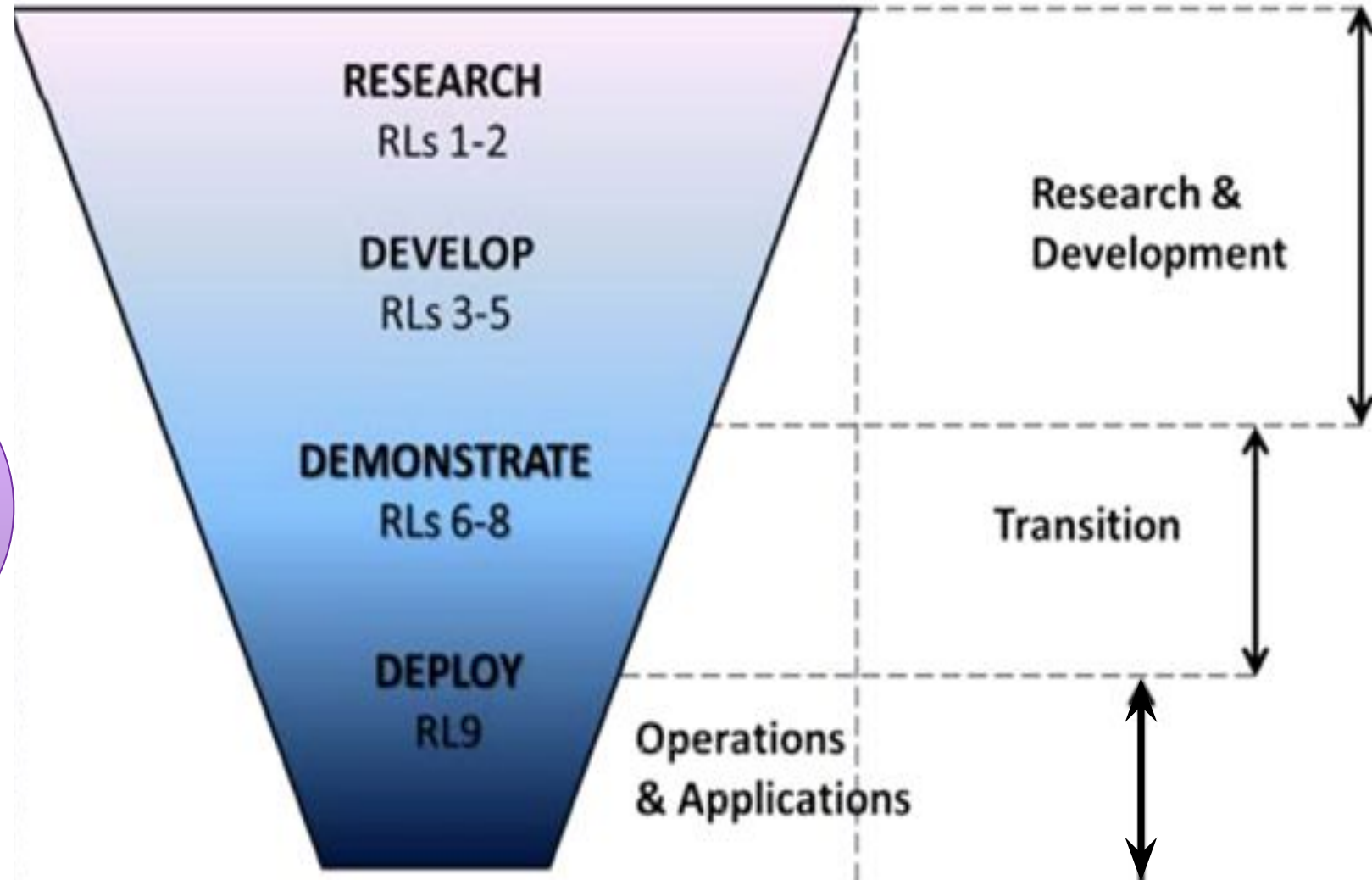
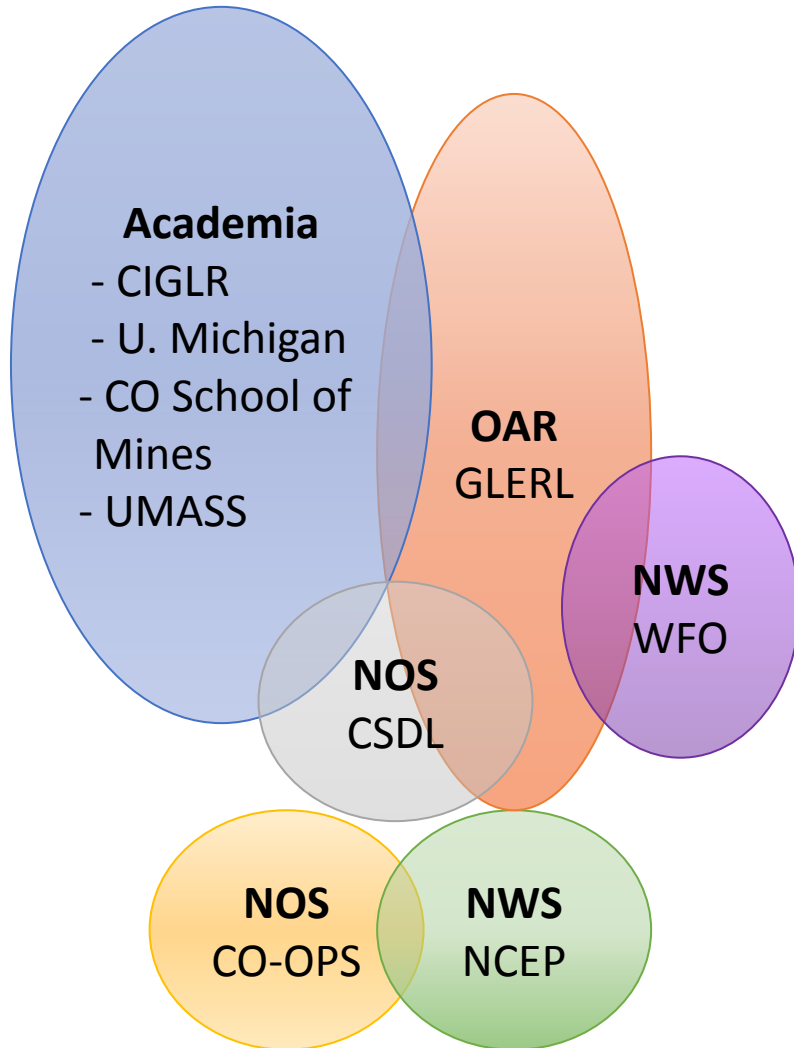
GLOFS Lessons | History

- 5 Individual OFS systems (1 per lake)
- Short-range forecast guidance
 - Water level
 - Currents
 - Water Temperature
- v1 2004-2006 GLERL -> NOS **(POM)**
- v2 2012-2022 **FVCOM** upgrade

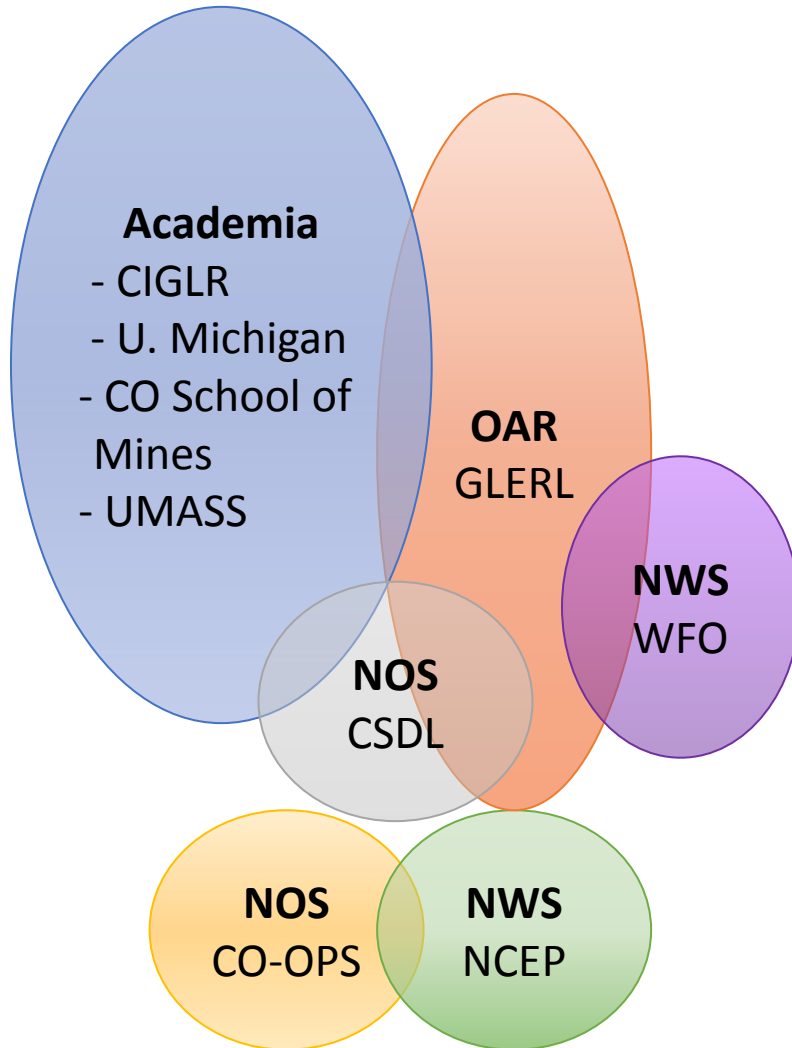
Great Lakes Operational Forecast System (GLOFS)



GLOFS Lessons | Relationships



GLOFS Lessons | Relationships



- Core relationships between academic partners and operators is key
 - Under pre-UFS model, transition likely not possible if not for existing relationships
- R2O team is often 1-person deep at many levels
 - Tenuous at Research end of spectrum

GLOFS Lessons | Timeline



1990 R&D GLERL and Ohio State University

OSU PhDs

2004-2006 v1 GLOFS (Princeton Ocean Model)

2007 FVCOM application to Freshwater (Great Lakes)

NRC Postdoc

2012 v2 GLOFS (FVCOM upgrade)

- 2016 LEOFS (Lake Erie)
- 2019 LMHOFS (Mich-Huron)
- 2022 LSOFS/LOOFS (Superior-Ontario)
- 2022 GLOFS-Ice (FVCOM-CICE)

UMASS
code
update

CIGLR Sci/Postdocs

Great Lakes Operational Forecast System (GLOFS)



Anderson et al., 2018, *JMSE*, doi:10.3390/jmse6040123

GLOFS Lessons | Timeline

2007 FVCOM application to Freshwater (Great Lakes)

NRC Postdoc

Compare with *Weather Forcing* timeline

Pre-2014 GLOFS-specific
interpolated meteorology

2012 v2 GLOFS (FVCOM upgrade)

- 2016 LEOFS (Lake Erie)
- 2019 LMHOFS (Mich-Huron)
- 2022 LSOFS/LOOFS (Superior-Ontario)
- 2022 GLOFS-Ice (FVCOM-CICE)

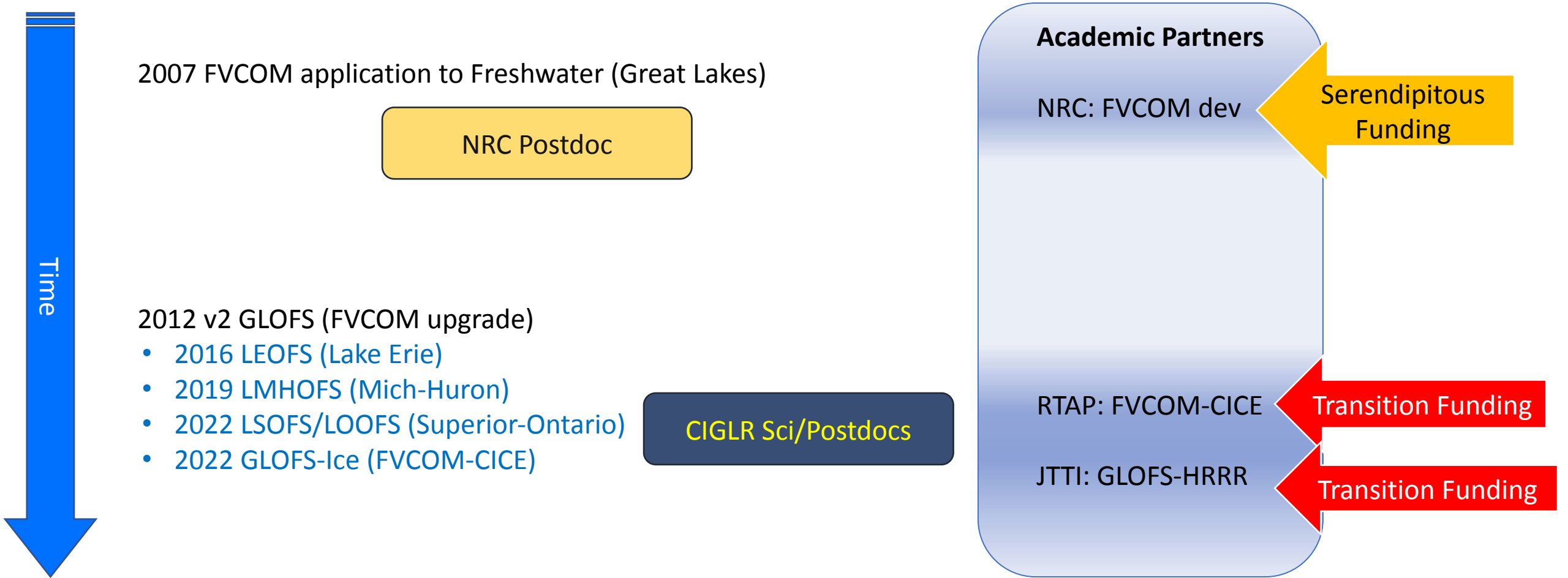
CIGLR Sci/Postdocs

2014 HRRR v1
2016 HRRR v2
2018 HRRR v3
2020 HRRR v4

**Each change in weather forcing can impact hydrodynamic performance*

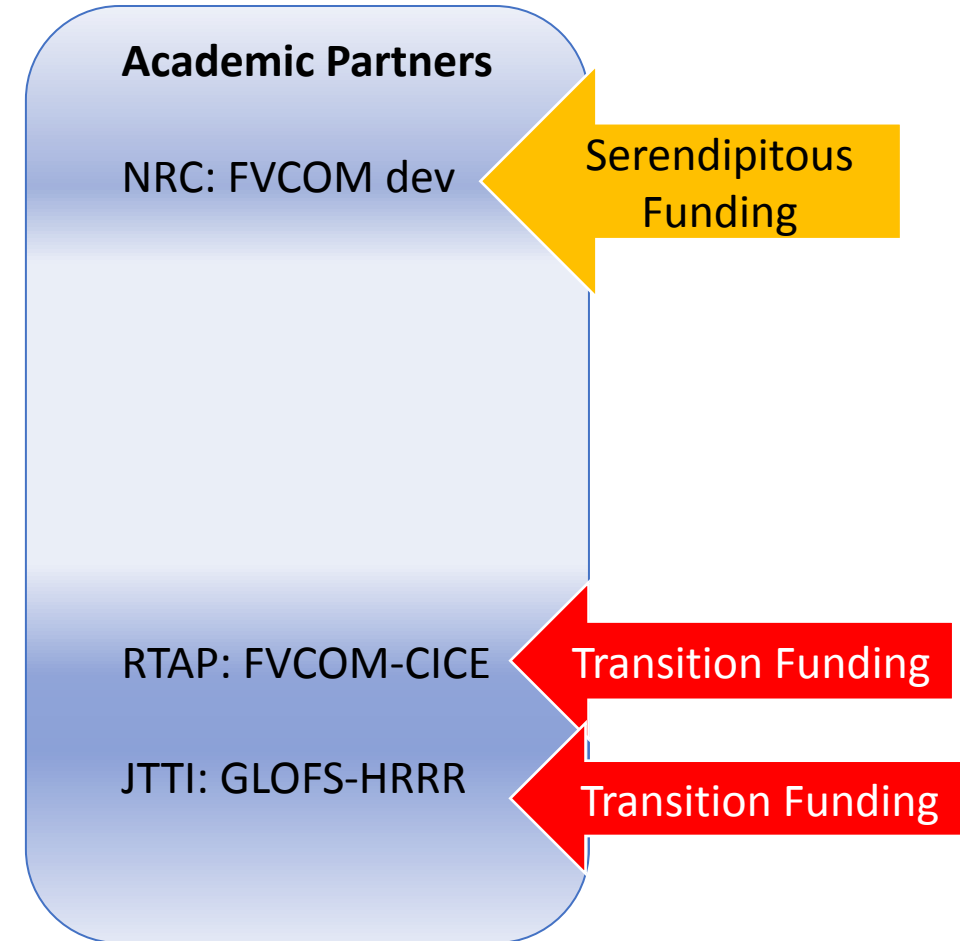
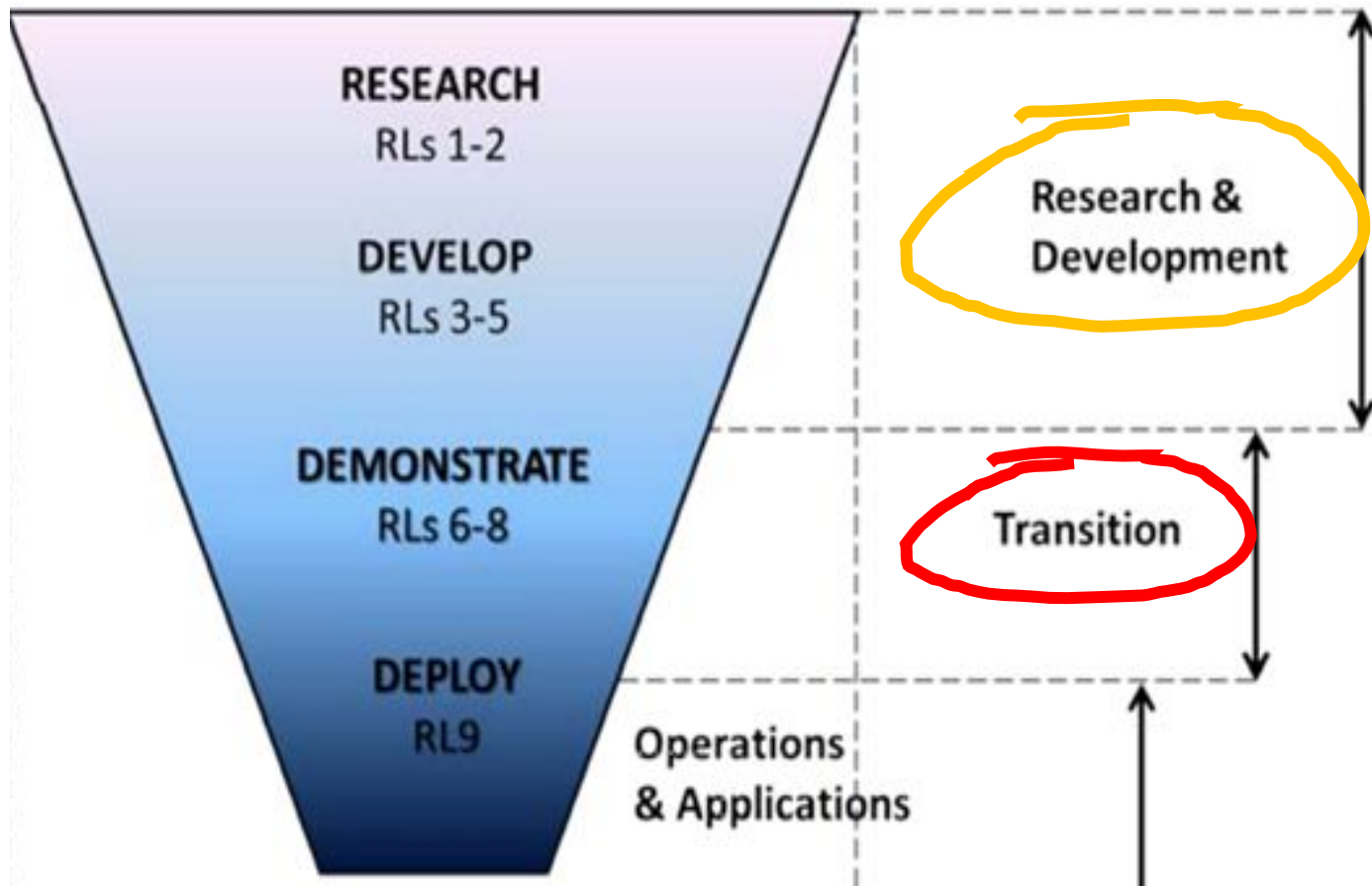
Time

GLOFS Lessons | Funding



*not including model developer (e.g., FVCOM) support

GLOFS Lessons | Funding

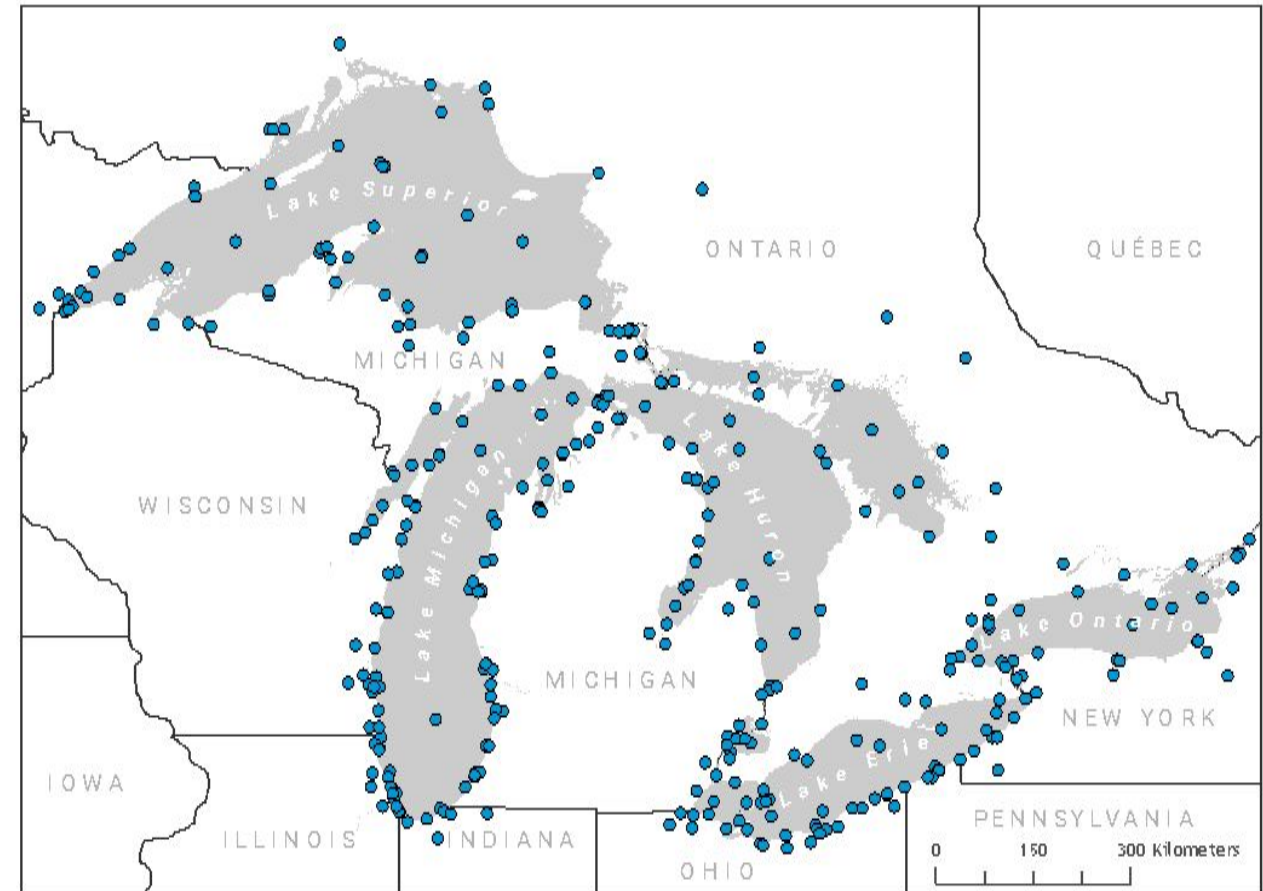


*not including model developer (e.g., FVCOM) support

GLOFS Lessons | Baseline support

- Occasional funding support for FTEs, but...
- Transition success relies on existing
 - Observations (thank you NDBC, GLOS, GLERL!)
 - Academic computing
 - GLERL computing (10 years of pseudo-operations and counting)
 - Additional/serendipitous funding
 - Stakeholder participation
 - Collaborators going above and beyond

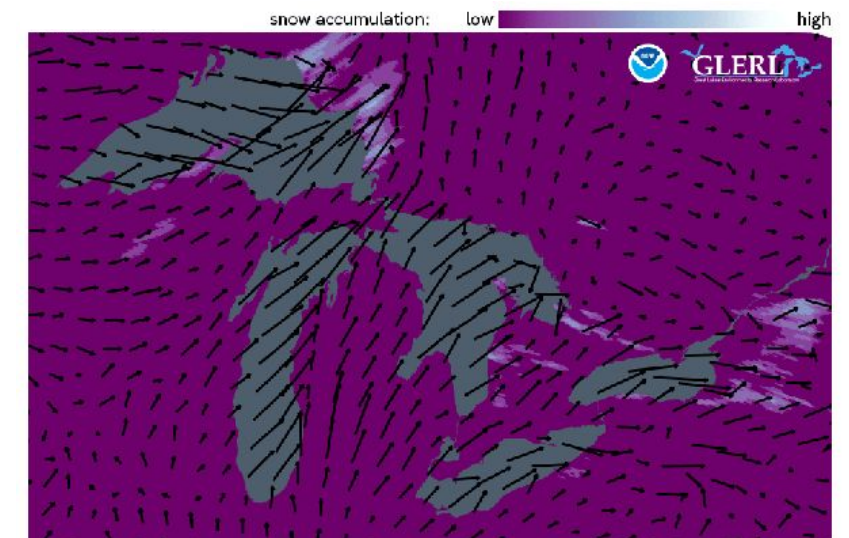
Existing Coastal observations



GLOFS Lessons | Bonus Outcomes

- Pre-UFS integration of coastal(lake) and short-range weather forecasts
- Foundation: existing relationships
 - OAR/GLERL
 - OAR/GSL
 - CIGLR / University of Michigan
 - NOS
 - NWS/NCEP, NWS/WFO-Detroit
- Funding:
 - JTTI Transition support

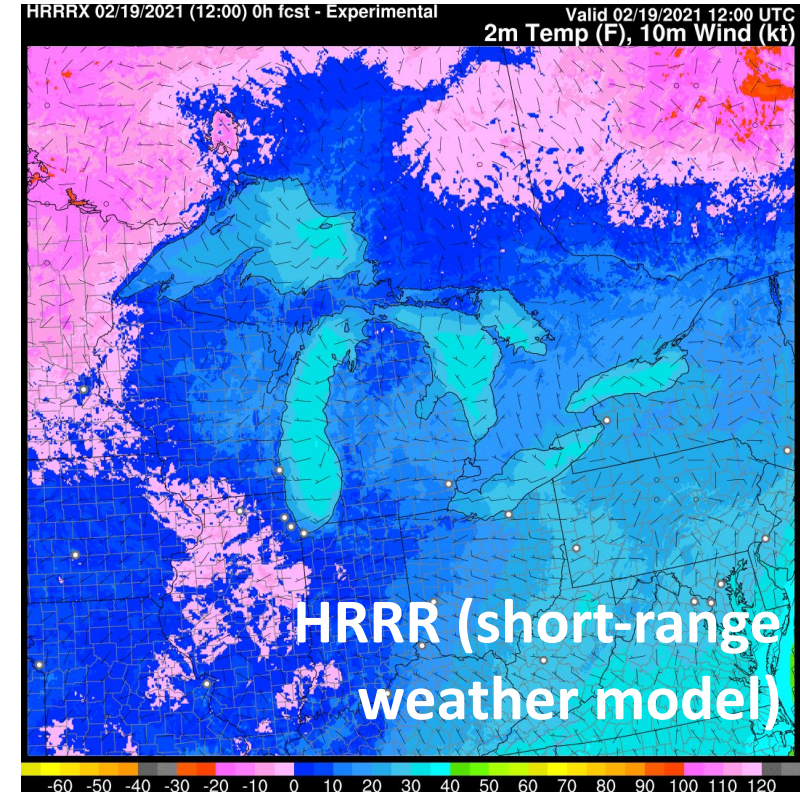
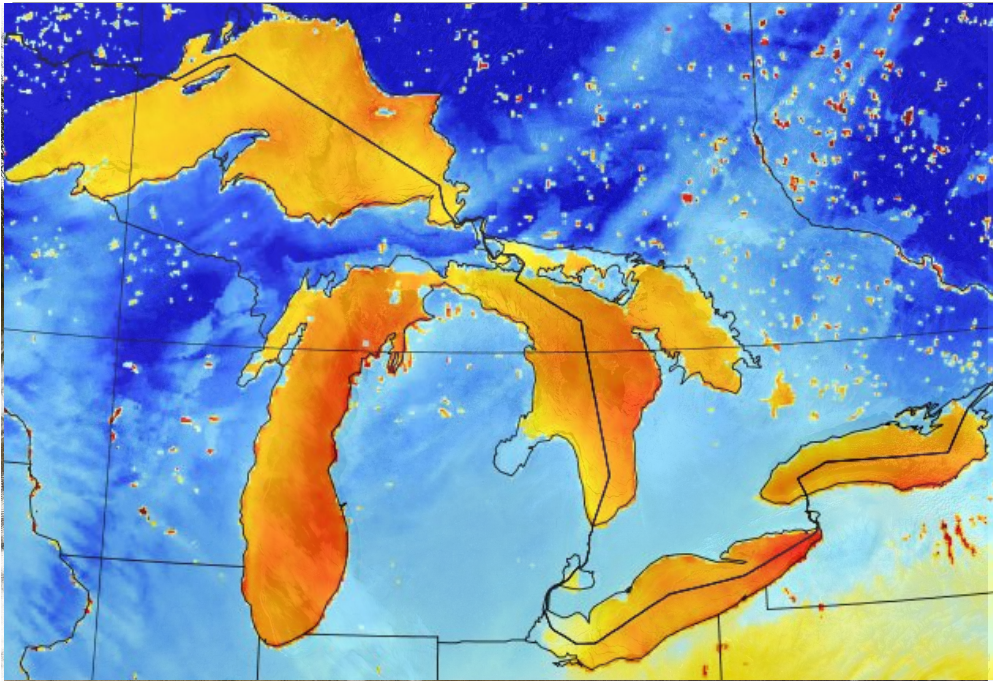
Photograph: Lindsay DeDario/Reuters



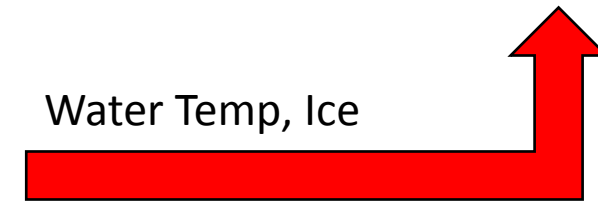
GLOFS Lessons | GLOFS-HRRR Coupling

Asynchronous Coupling

Wind, Air Temp, Pressure,
etc



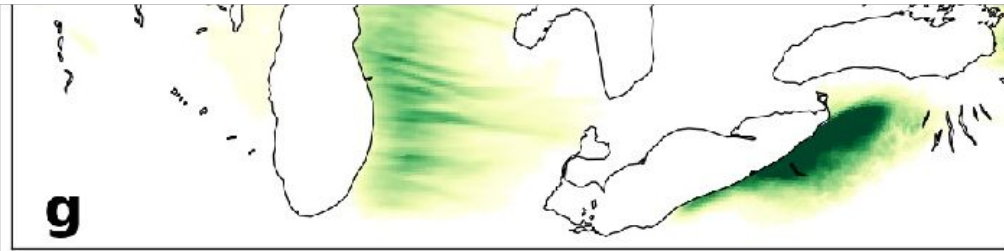
Water Temp, Ice



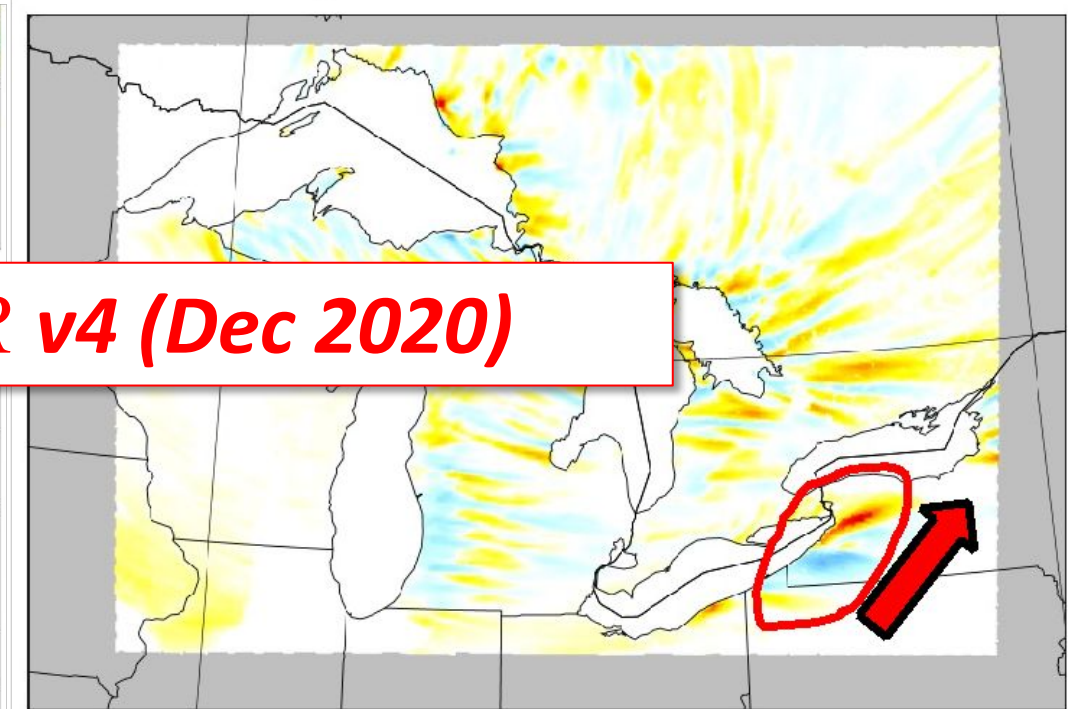
Water Temp, Ice Temp, Ice Fraction

GLOFS Lessons | GLOFS-HRRR Coupling

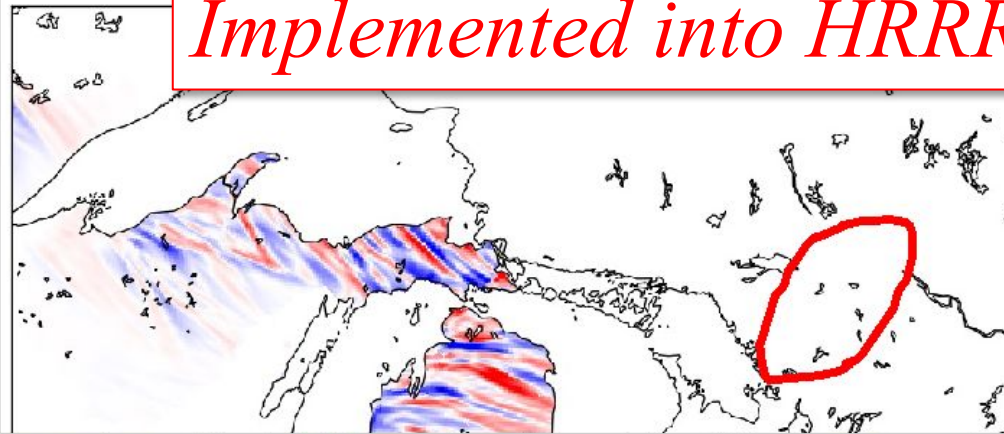
Snow Accumulation



Dynamic - Control



Implemented into HRRR v4 (Dec 2020)



Water Equiv Snow Depth (kg/m²)

-20.0 -12.0 -4.0 4.0 12.0 20.0

Summary

- GLOFS transition to operations has spanned pre-UFS to UFS era
- Success depends on
 - Relationships between NOAA and Academia ← *Fortunate to have*
 - Funding across R2O spectrum ← *Consistent limitation*
 - Timelines that empower project partners ← *Consistent limitation*
 - Existing infrastructure ← *Fortunate to have*
 - *Belief* in NOAA mission, the *will* to see implementation ← *Fortunate to have*

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