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CLIMATE AND SPACE SCIENCES AND ENGINEERING UNIVERSITY OF MICHIGAN

Using a Coupled FV3GFS-FVCOM Modeling System to Improve Lake-Effect Snowfall Forecasts

David Wright*[1,2], Eric Anderson[2], Philip Chu[2], Ayumi Fujisaki-Manome[1,3], Christiane Jablonowski[1], Brent Lofgren[2], Greg Mann[4]
[1]University of Michigan CLASP [2]GLERL [3]CIGLR [4]National Weather Service Detroit, MI

GLERL Great Lakes Environmental Research Laboratory

- Using FVCOM lake surface conditions in FV3SAR improves placement and intensity of lake-effect snowfall
- FV3GFS can reproduce lake-effect snow bands using a C768s5 grid to create a 3km horizontal resolution, but errors are introduced from smaller lakes that are now resolved within the higher resolution tile

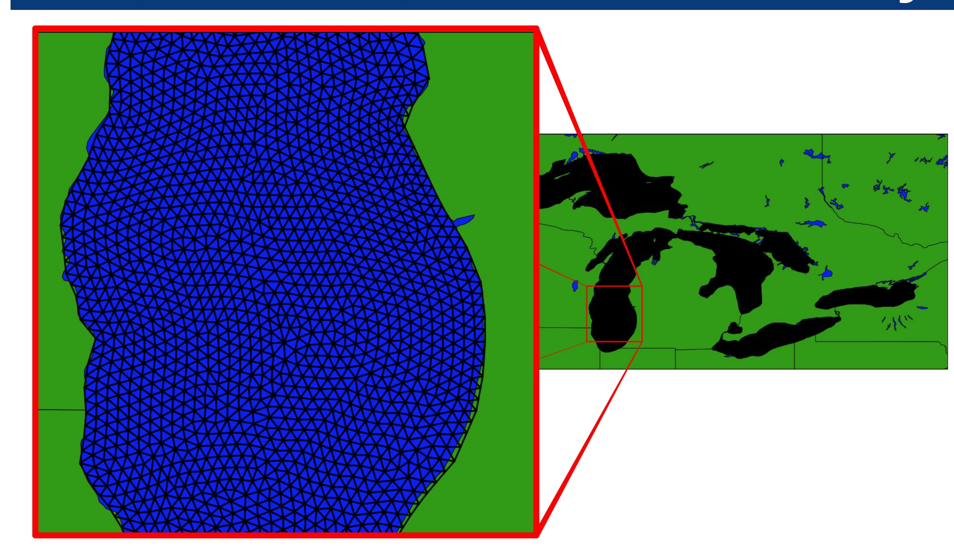
Introduction

•Modeling of lake-effect snowfall (LES) has been shown to be sensitive to lake surface characteristics (Wright et al. 2013)

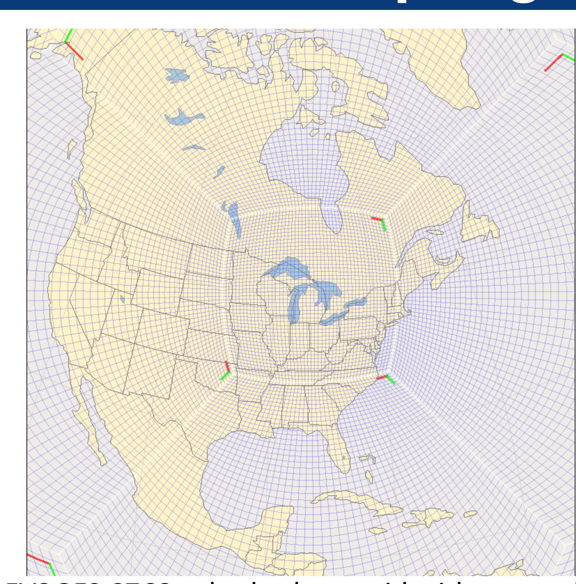
•Operational weather prediction models typically run with a static lake surface temperature, which can introduce errors during times of rapidly changing lake surface properties

•In this poster the initial framework for coupling FV3GFS and FV3SAR to FVCOM is presented to improve LES forecasts

FV3, FVCOM, and Iterative Asynchronous Coupling



Example of FVCOM's grid used for the Great Lakes Region.

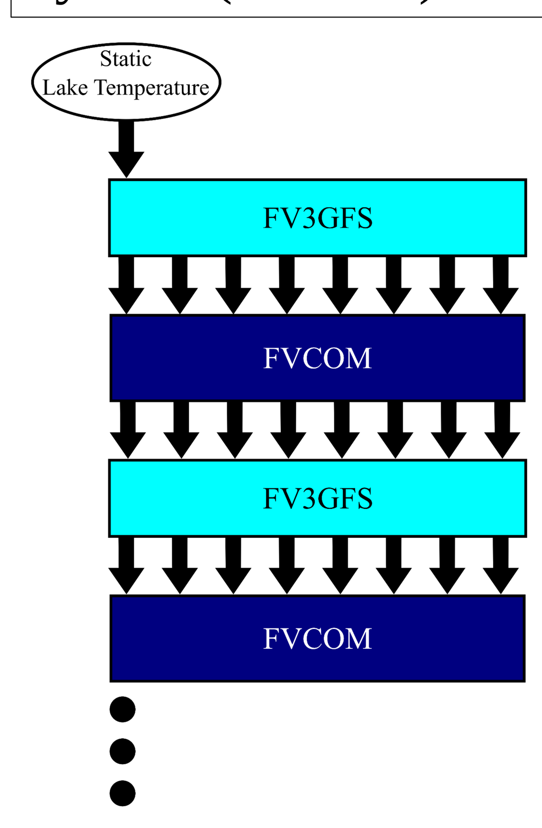


FV3GFS C768 cubed sphere grid with a stretch factor of 5 over the Great Lakes.

•FV3 Stand-Alone Regional (**FV3SAR**) is a limited area model that uses FV3 as the dynamical core with GFS physics. Results shown use a 3km grid spacing to better simulate LES structure.

•**FV3GFS**, presented here, is using a C768 cubed sphere grid with a stretch factor of 5 (C768s5) to produce ~3km grid spacing

•**FVCOM** is a hydrodynamic model using an unstructured grid that is the basis of the 3rd generation Great Lakes Coastal Forecast System (GLCFS)



•FVCOM data is used here as a static lake surface to initialize FV3SAR

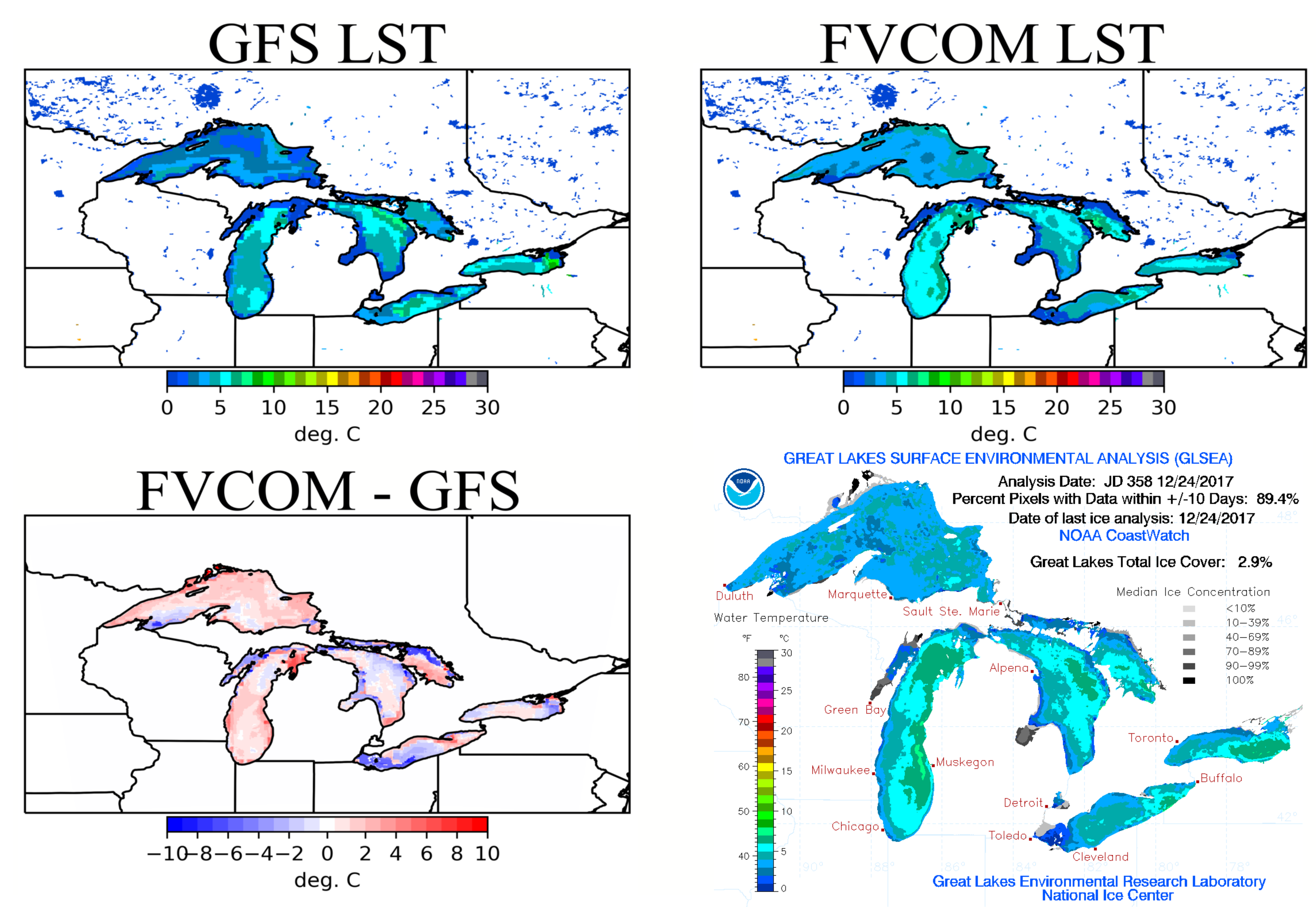
•In iterative asynchronous coupling, output from FV3GFS/SAR is used as boundary conditions for FVCOM

•Output from FVCOM is used to rerun FV3GFS/SAR for the same forecast with a temporally changing lake surface

•This has been used to couple WRF and FVCOM (Fujisaki-Manome et al. 2020)

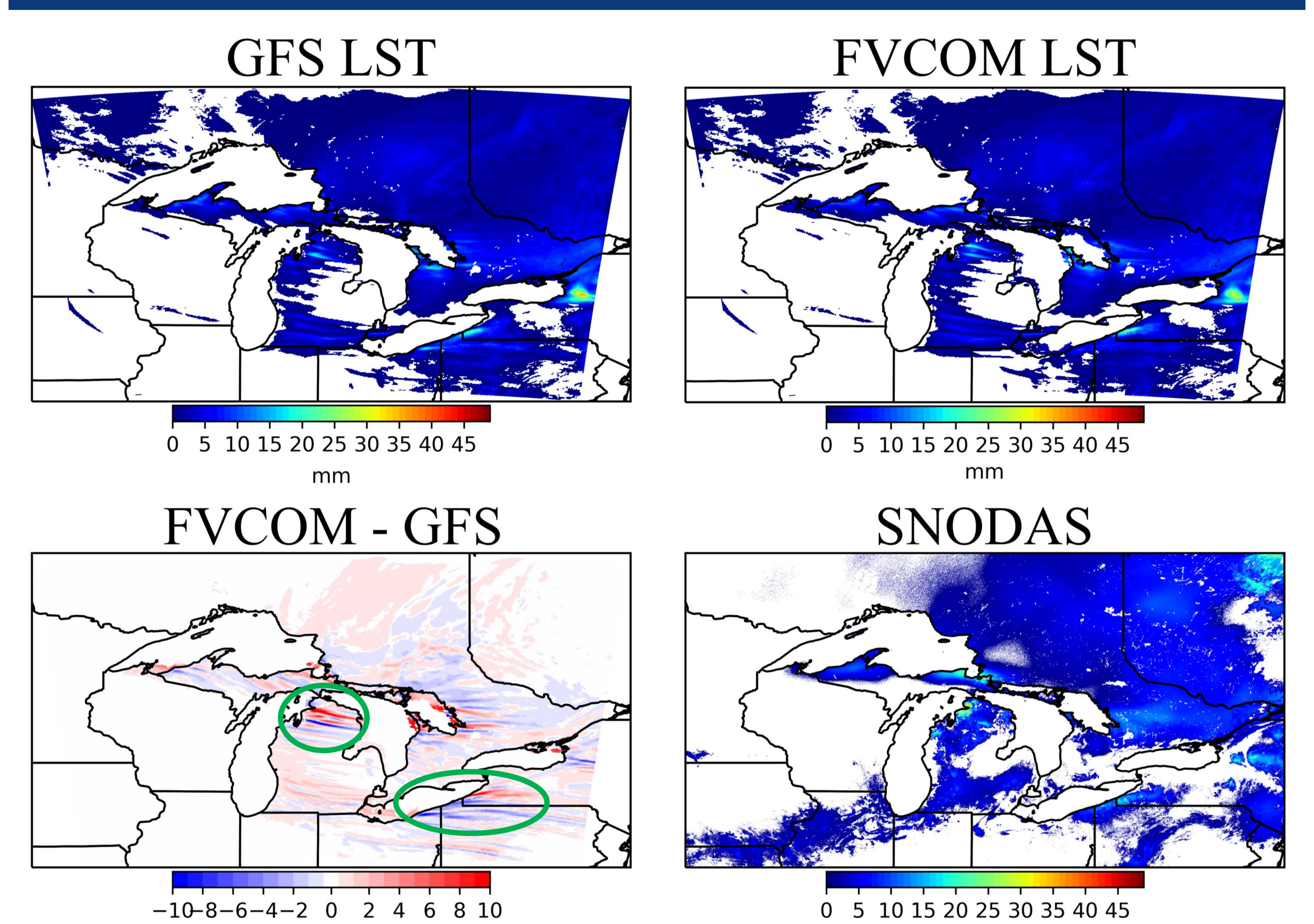
*Contact: David Wright, dmwright@umich.edu

FV3SAR Lake Surface Conditions for 12/24/17 12UTC



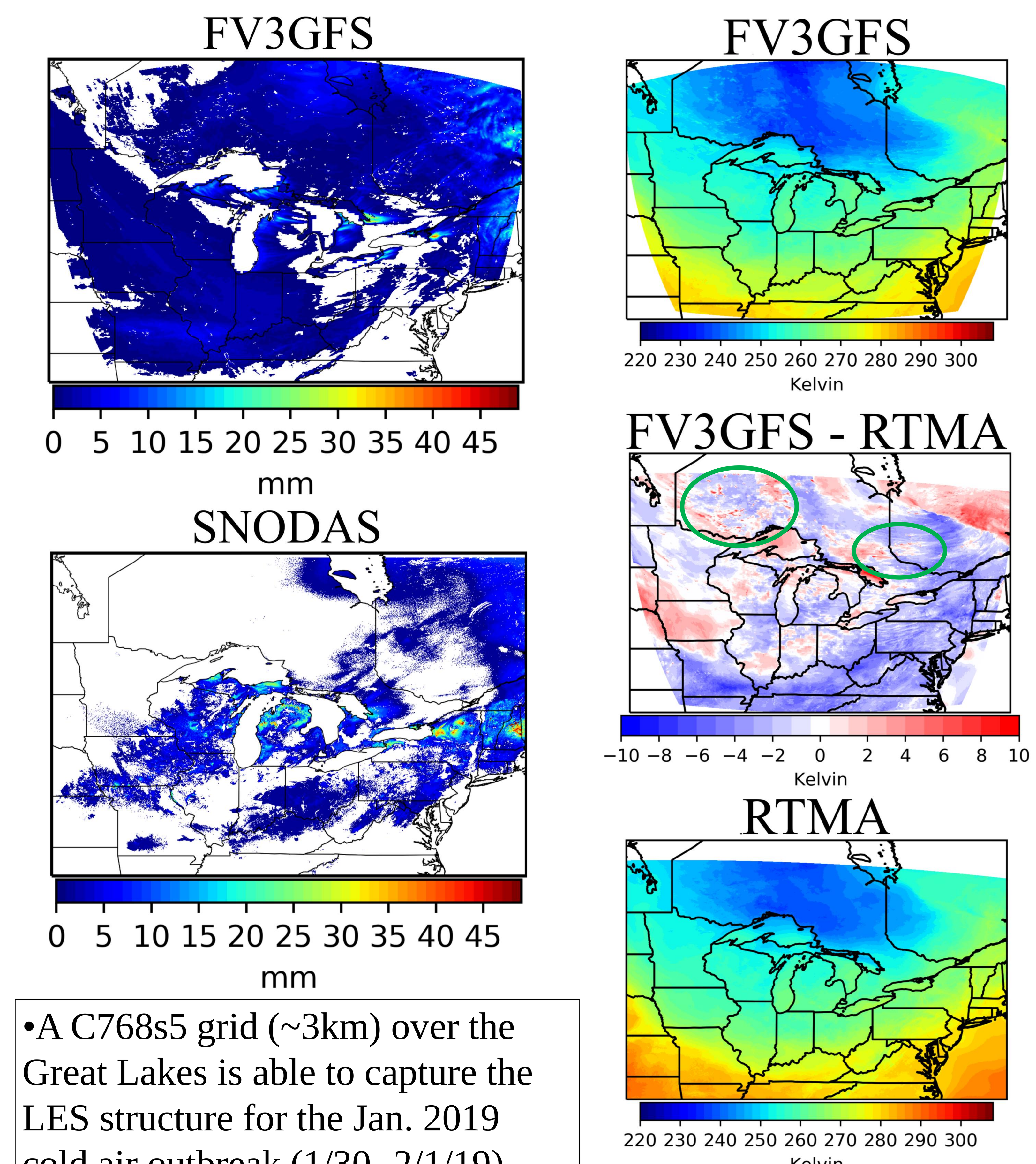
•Using FVCOM lake surface temperature (LST) results in warmer, closer to observed LST over most of the lakes in FV3SAR compared to using the GFS initial conditions

FV3SAR SWE 12/25 06UTC – 12/26/17 06UTC



•FVCOM LST creates heavier snowfall over northern Michigan and improves band placement downwind of Lake Erie

FV3GFS C768s5 SWE and 2m Temperature



•A C768s5 grid (~3km) over the Great Lakes is able to capture the LES structure for the Jan. 2019 cold air outbreak (1/30 -2/1/19)

•This grid setup resolves smaller lakes which are not present in the initial conditions, creating unfrozen lakes in Canada and pockets of warm air visible in 2m temperatures (see green circles)

Future Work

•Explore options to allow for temporally changing LST in FV3GFS/SAR, either through coupling or boundary conditions

•Work to improve initialization of smaller inland lakes when using the C768s5 grid in FV3GFS

Acknowledgements & References

Funding for this project was provided by the University of Michigan Cooperative Institute for Research (CIGLR), through the National Oceanic and Atmospheric Administration (NOAA) Agreement NA17OAR4320152. Simulations were performed on UCAR's Cheyenne HPC and NOAA's Jet HPC. Special thanks to Jacob Carley, Jeff Beck, and Gerard Ketefian for assistance with FV3SAR and Ligia Bernardet and Laurie Carson from GMTB for their assistance with FV3GFS.

Fujisaki-Manome, Ayumi, G. E. Mann, E. J. Anderson, P. Chu, L. E. Fitzpatrick, S. G. Benjamin, 2020: Improvements to Lake-Effect Snow Forecasts by a Loose Air-Ice-Lake Coupling Approach. *In prep.*

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