



MCMC modelling with JAGS and applications in the Great Lakes

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MCMC

Markov chain Monte Carlo:

- Applied in genetics, ecology, biostatistics, economics
- Accessible software packages: BUGS, Stan, JAGS
- Problems that are analytically intractable or better expressed in Bayesian probability framework
- ‘Inference’ of variables; uncertainty propagated, quantified, reduced

JAGS

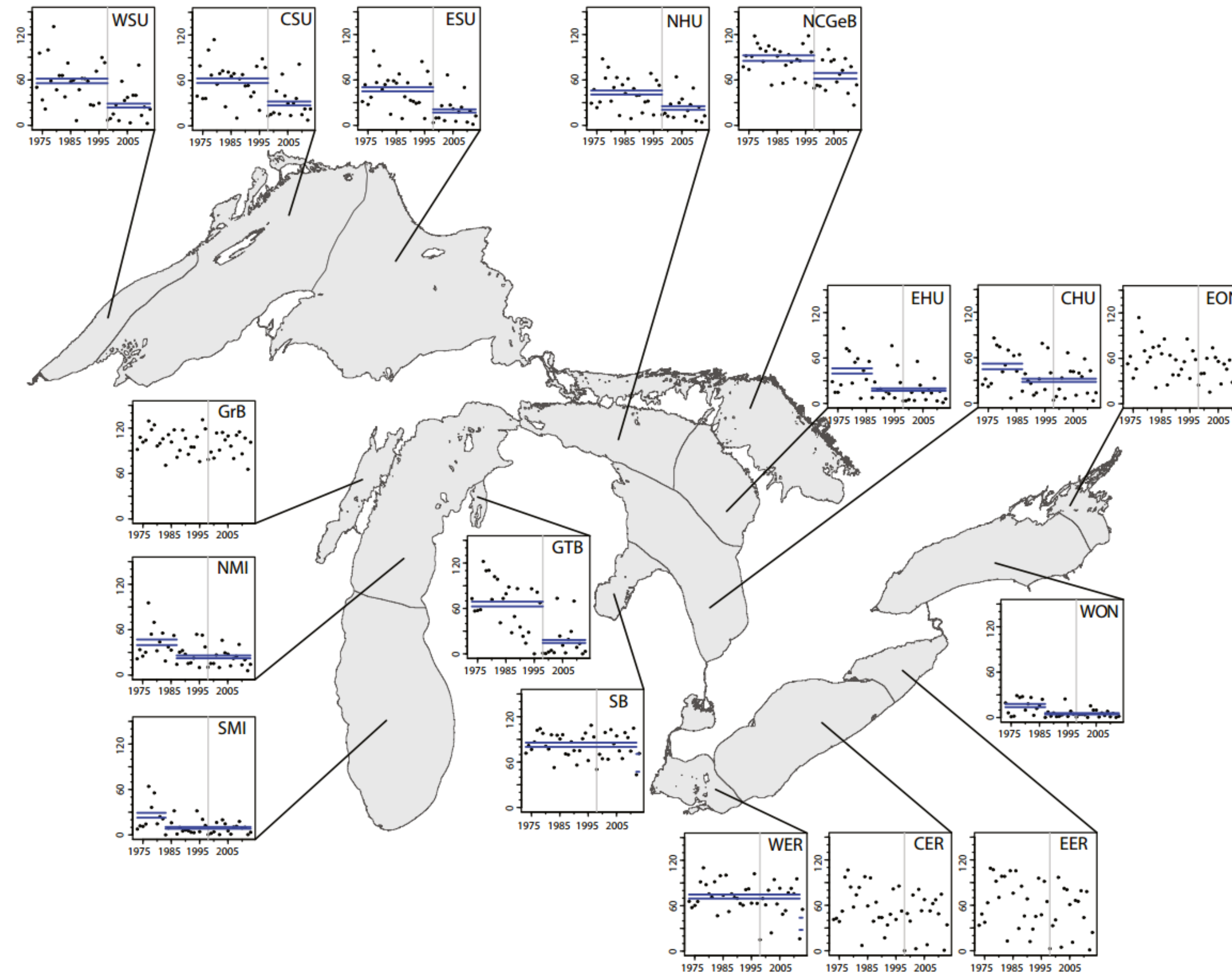
Just Another Gibbs Sampler: a MCMC analysis package

- Models specified in BUGS language (Bayesian inference Using Gibbs Sampling)
- R package `rjags` to run
- mcmc-jags.sourceforge.net/

Want to try it out?

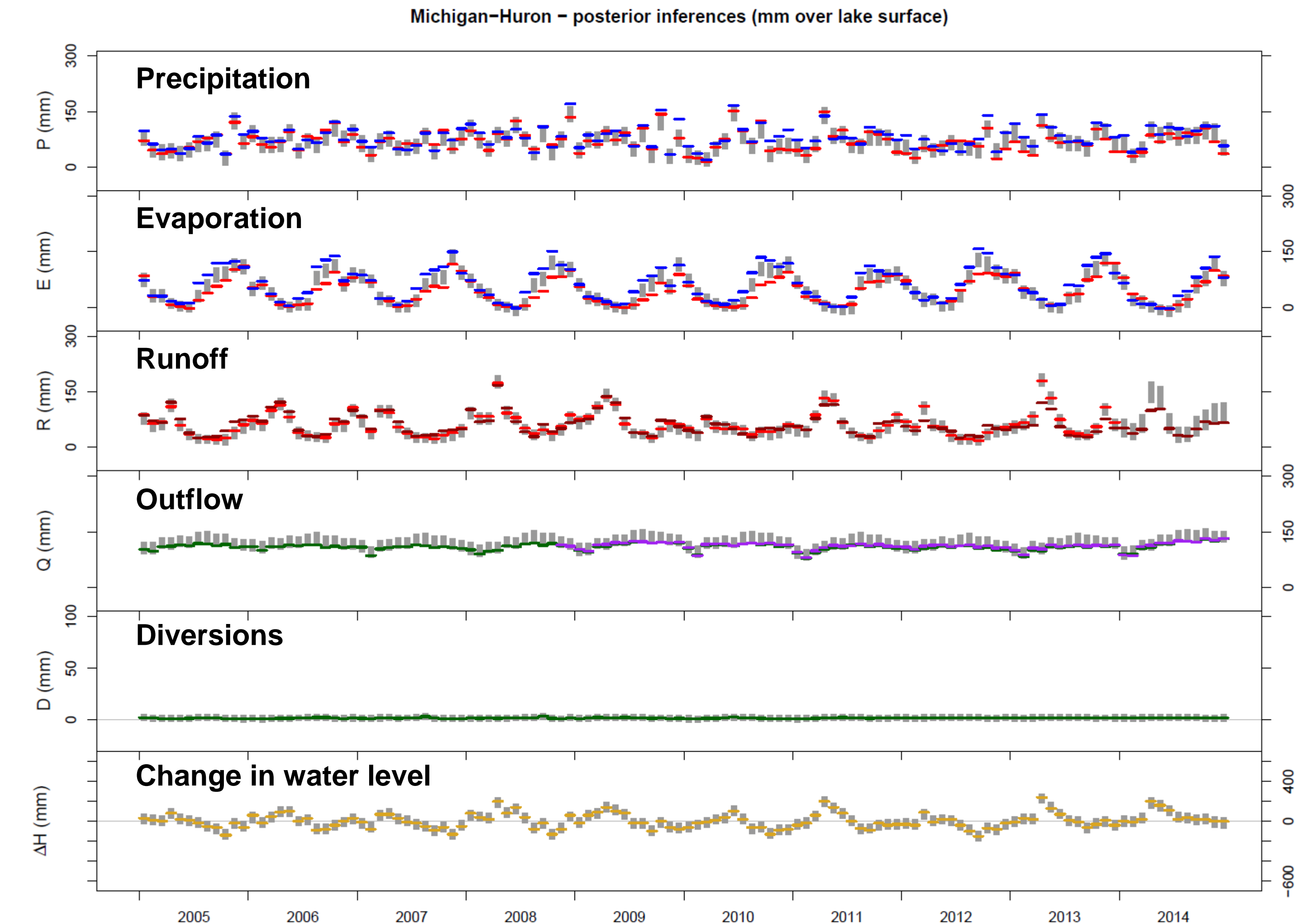
Ask for a hand-out

We thank the following people and organizations for support and/or funding for the featured work: Great Lakes Environmental Assessment and Mapping Project, Fred A. and Barbara M. Erb Family Foundation, Great Lakes Fishery Trust, Michigan Department of Natural Resources, University of Wisconsin Water Resources Institute, Great Lakes Aquatic Habitat Framework, United States Army Corps of Engineers – Detroit District, Environment and Climate Change Canada, International Joint Commission and their International Watersheds Initiative (special thanks to Wendy Leger and Mike Shantz), Jason Breck, Craig Stow, David Holtschlag, Brent Lofgren, Yves Atchade, Kerby Shedden, Edward Ionides, Vincent Fortin, Bryan Tolson, Jacob Bruxer, Frank Seglenieks, Tim Hunter, Lauren Fry, Cathy Darnell, and Nicole Rice.



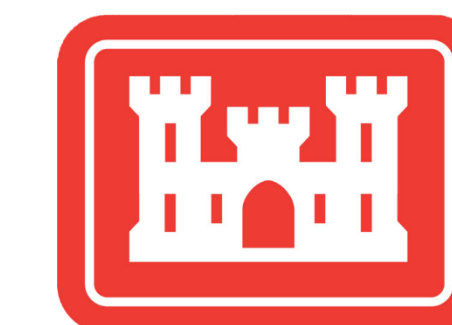
- Great Lakes ice duration (days) across 17 sub-regions, 1973-2013
- Tested regression, change-point, equal-means
- Change-point best described ice duration
- *Pictured:* results of change point models. Black dots indicate observed mean ice duration, vertical gray line indicates year 1998, blue lines indicate upper and lower bounds of the 95% credible interval for inferred ice duration

Mason, L.A., C.M. Riseng, A.D. GRONEWOLD, E.S. RUTHERFORD, J. WANG, A.H. CLITES, S.D.P. Smith, and P.B. McIntyre. Fine-scale spatial variation in ice cover and surface temperature trends across the surface of the Laurentian Great Lakes. *Climatic Change* 138(1):71-83 (2016). <https://www.glerl.noaa.gov/pubs/fulltext/2016/20160018.pdf>



- Water balance for Lakes Superior and Michigan-Huron
- Multiple component estimates – no combination closes
- Incorporated estimates, historical data
- Aided explaining record 2013-2014 Michigan-Huron water-level rise
- *Pictured:* Lake Michigan-Huron’s water balance component estimates (segments) and inferred/simulated 95% credible intervals (gray bars)

GRONEWOLD, A.D., J. Bruxer, D. Durnford, A.H. CLITES, J.P. SMITH, F. Seglenieks, S.S. Qian, T.S. HUNTER, and V. Fortin. Hydrological drivers of record-setting water level rise on Earth's largest lake system. *Water Resources Research* 52 (2016). <https://www.glerl.noaa.gov/pubs/fulltext/2016/20160014.pdf>



Environment and Climate Change Canada

