



Status report on the Great Lakes Runoff Inter-comparison Project for Lake Erie (GRIP-E)

Juliane Mai, Bryan A. Tolson, Hongren Shen, Étienne Gaborit, Nicolas Gasset, Vincent Fortin, Maria Abrahamowicz, Dorothy Durnford, Young Lan Shin, Lauren M. Fry, Tim Hunter, Andrew D. Gronewold, Lacey Mason, Kevin Sampson, Alan F. Hamlet, Shervan Gharari, Saman Razavi, Amin Haghnegahdar, Daniel Princz, and Alain Pietroniro



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Global Institute for
Water Security
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Environment and
Climate Change Canada
Environnement et
Changement climatique Canada



US Army Corps
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Aim of Study

- Develop strategies to handle **cross-border issues** of available data and develop unifying approaches
- Test **relative performance** of different models
- Identify respective **strengths of models**, i.e., learning which models perform best under certain conditions
- Generating **multi-model ensembles** to quantify uncertainty of model outputs
- Impact of **modeling decisions** on model performance high-quality models



Current Participating Models & Partners



Complexity

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LBRM model (lumped)

Lauren Fry (USACE)

Tim Hunter (NOAA-GLERL)

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GEM-Hydro (land-surface)

Étienne Gaborit (ECCC-MSC)

Maria Abrahamowicz (ECCC-MSC)

Dorothy Durnford (ECCC-MSC)

Young Lan Shin (ECCC-MSC)

WRF-Hydro (land-surface)

Drew Gronewold (NOAA-GLERL)

Lauren Read (NCAR)

Katelyn Fitzgerald (NCAR)



Phases of Inter-Comparison Project

Phase I – harmonize climate forcings only



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- until Sep 1, 2018: model setup
 - ↪ report on setup data used
 - ↪ report on discretization used
- until Oct 1, 2018: model calibration
- until Nov 1, 2018: model validation



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Phase II – harmonized climate and all other inputs



Phases of Inter-Comparison Project

Phase I – harmonize climate forcings only

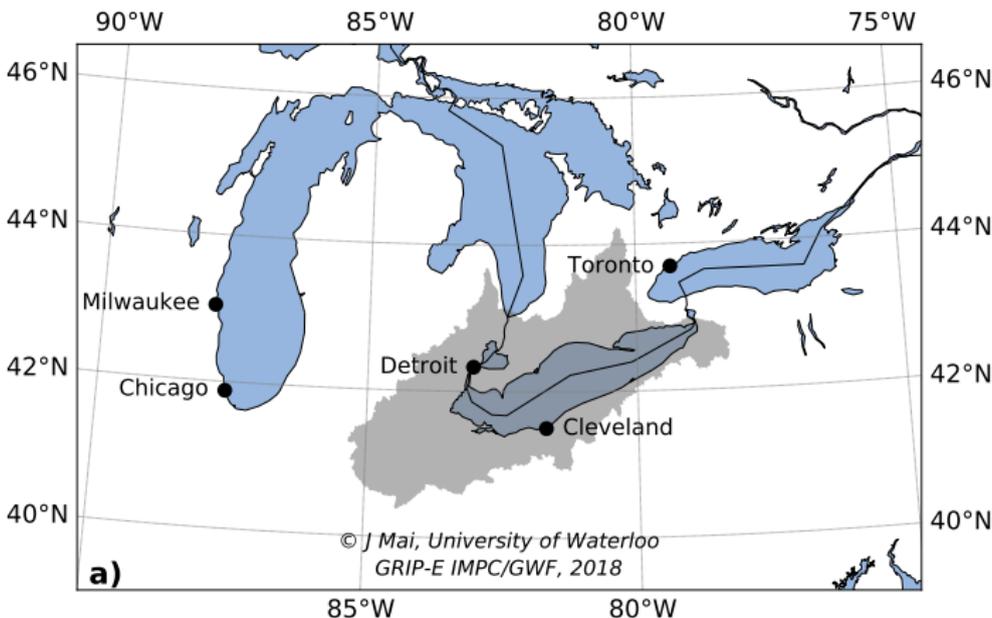
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 - ↪ report on setup data used
 - ↪ report on discretization used
- until Oct 1, 2018: model calibration
- until Nov 1, 2018: model validation

Phase II – harmonized climate and all other inputs

- start Sep 1, 2018: input data harmonization
- start Nov 1, 2018: model setup
- start Jan 1, 2019: model calibration
- start Mar 1, 2019: model validation



Modeling domain



Data source:

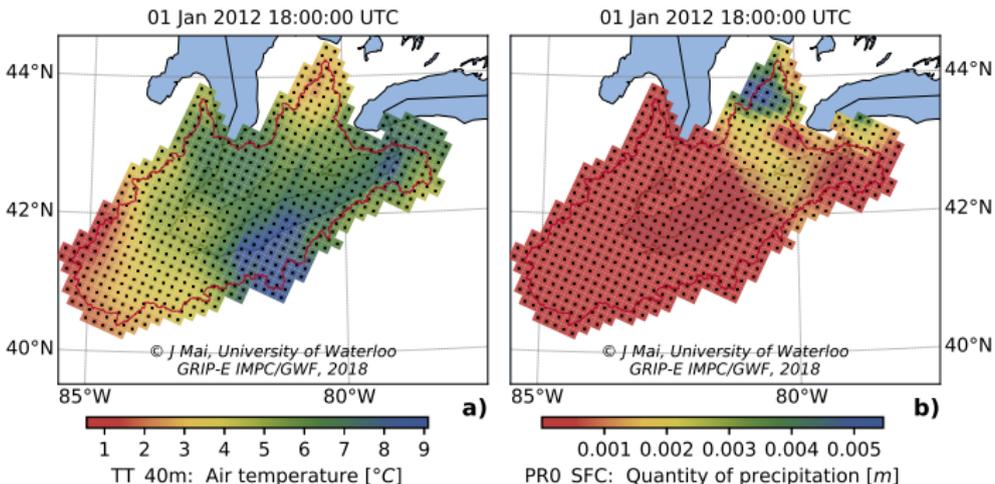
Great Lakes Aquatic Habitat Framework database

land area: 76 352 km²
water bodies: 27 314 km²
total area: 103 666 km²



Meteorologic forcings

Regional Deterministic Reforecast System (RDRS)



Data source:

Gasset, N., V. Fortin, M. Carrera, M. Dimitrijevic, É. Gaborit, G. Roy, and N. Gagnon (in prep.), Toward a 35 Years North American Precipitation and Land Surface Reanalysis, *Journal of Hydrometeorology*.



Meteorologic forcings

Regional Deterministic Reforecast System (RDRS)

| | | |
|---------------------------------------|---------------------|-----|
| Precipitation Rate | [m] | SFC |
| Inc. Shortwave Radiation | [W/m ²] | SFC |
| Inc. Longwave Radiation | [W/m ²] | SFC |
| Atmospheric Pressure | [mb] | SFC |
| Air Temperature | [°C] | 40m |
| Specific Humidity | [kg/kg] | 40m |
| Wind Components (along grid) | [kts] | 40m |
| Corr. Wind Components (along W-E/S-N) | [kts] | 40m |
| Wind Speed | [kts] | 40m |
| Wind Direction | [degree] | 40m |

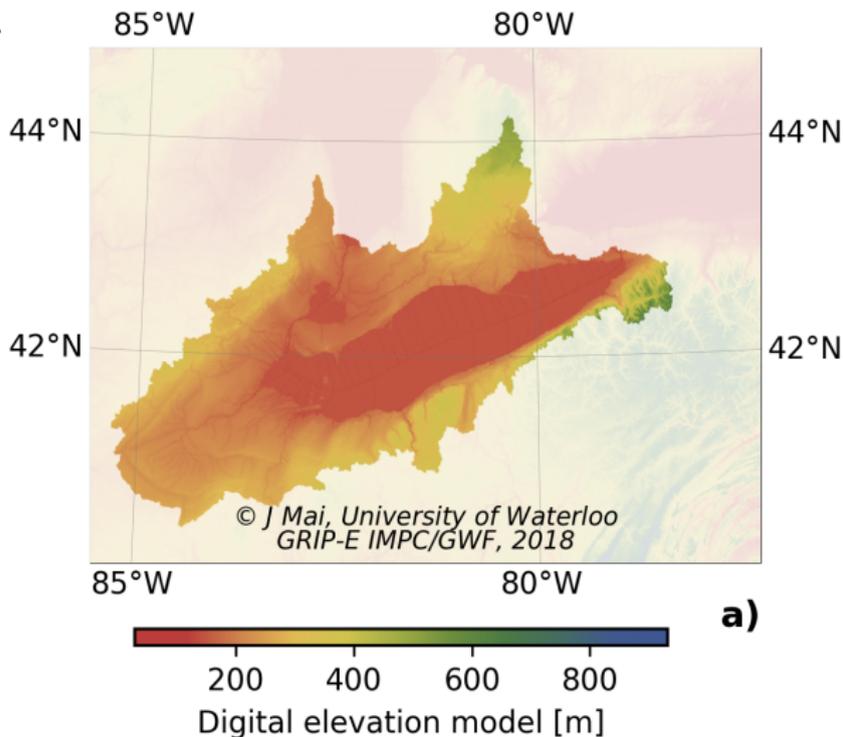
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Candidate Dataset

– Digital Elevation Model –



Data source:

HydroSheds by USGS based on conditioned, global SRTM DEM at 3" (90m) res.

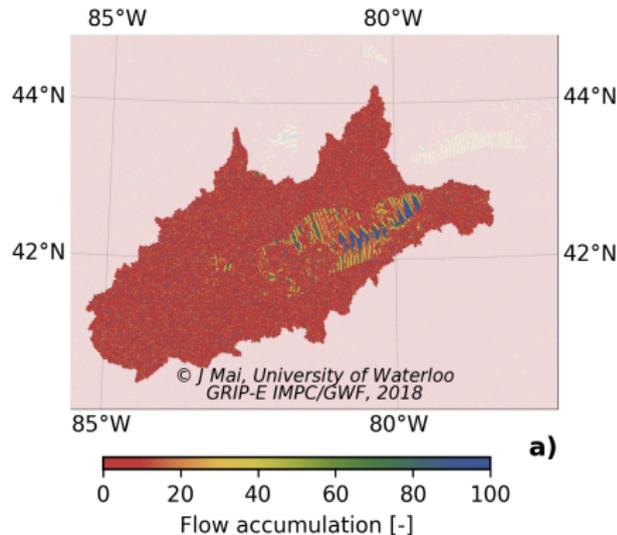
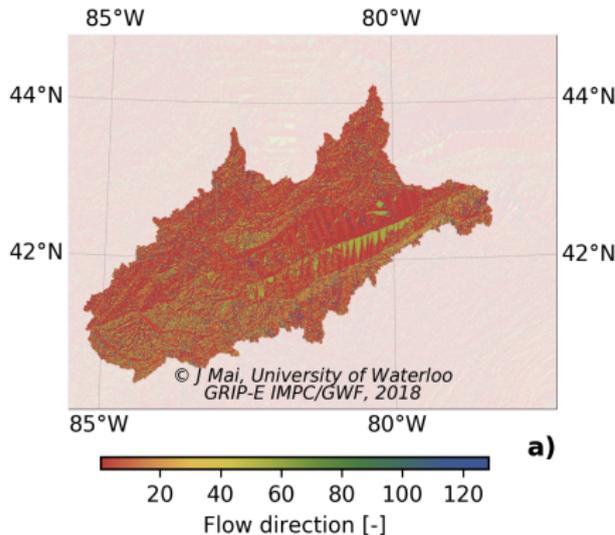
Alternative(s):

ASTER Global DEM from NASA, 1" (30 m)



Candidate Dataset

– Flow Direction and Accumulation –



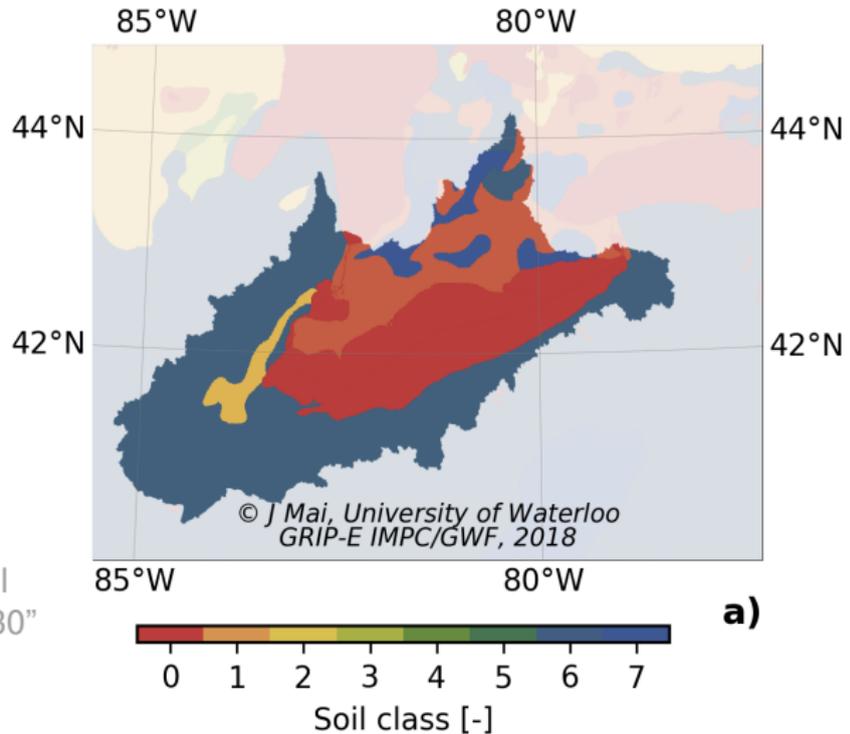
Data source:

generated from DEM at 3" (90m) resolution



Candidate Dataset

– Soil data –



Data source:

FAO Harmonized World Soil Database (HWSD) v1.2 at 30" (1km) resolution

Alternative(s):

Soil Landscapes of Canada (SLC), 1:1 000 000



Candidate Dataset

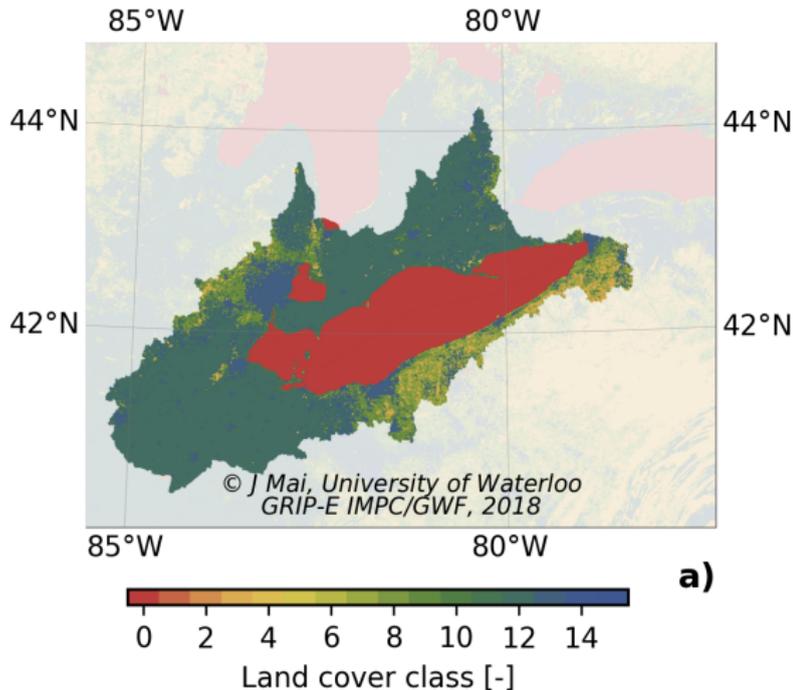
– Land-cover data –

Data source:

Global 500m MODIS MCD12Q1
product from NASA incl. 6
classif. schemes (↪ UMD)

Alternative(s):

- ESA GlobCover 2009, 300 m
- 2010 Landsat dataset for North America, 30m
- Land use & cover from the Great Lakes Aquatic Habitat Framework (GLAHF)
- UMD Global Land Cover Classification from Global Land Cover Facility, 1 km





Framework

Static data:

Candidate or
other dataset

Meteo. data:

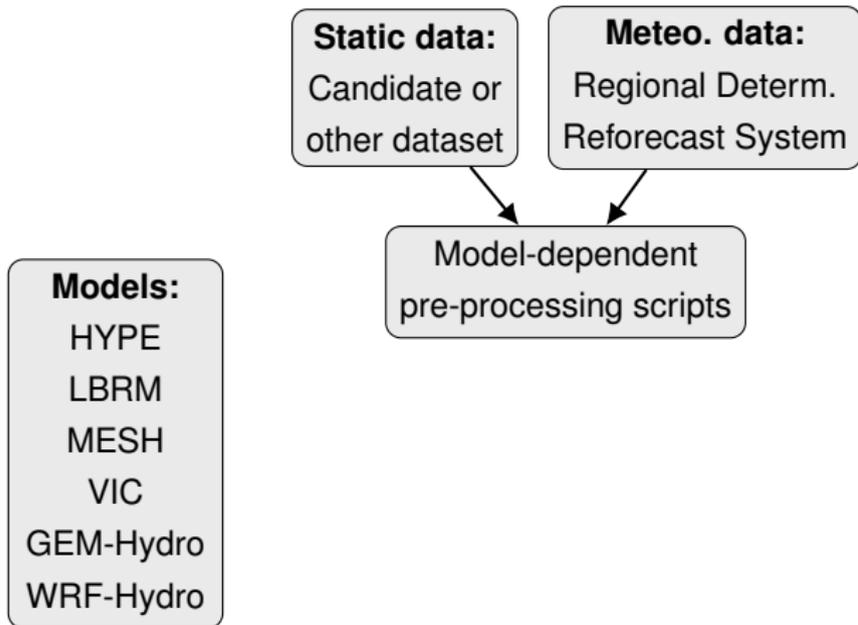
Regional Determ.
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Models:

HYPE
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MESH
VIC
GEM-Hydro
WRF-Hydro

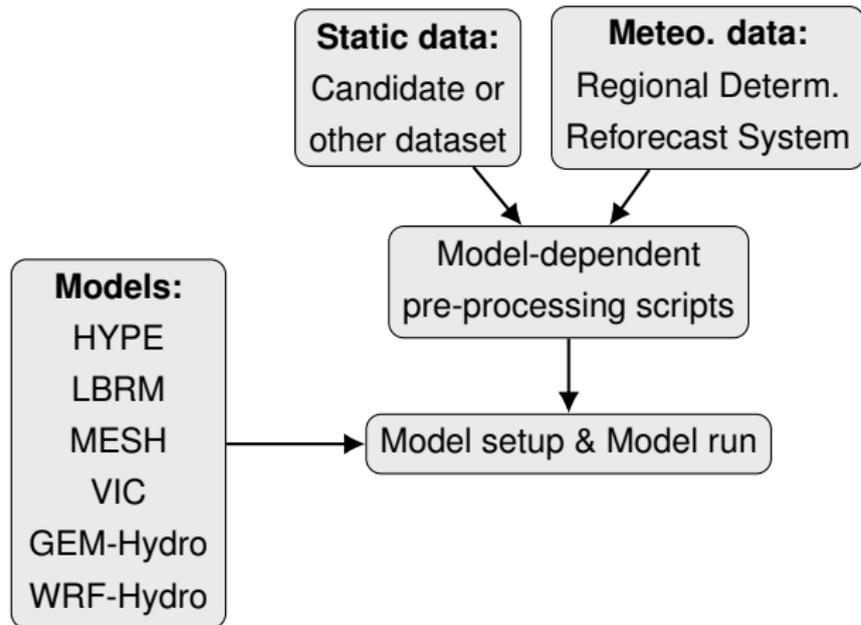


Framework



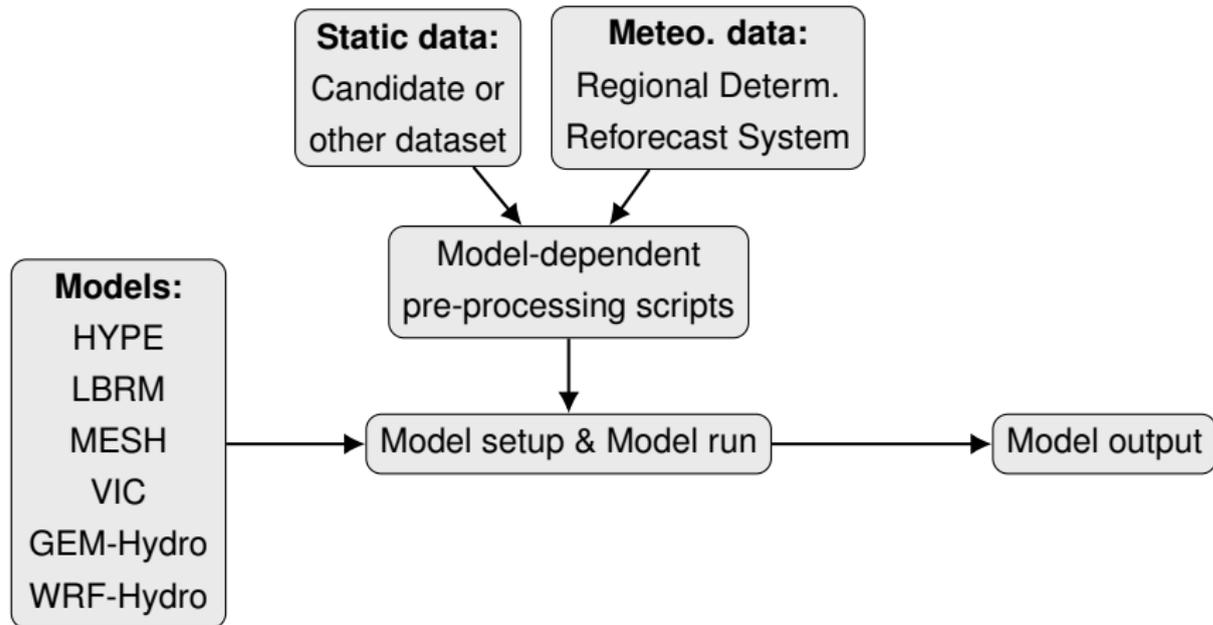


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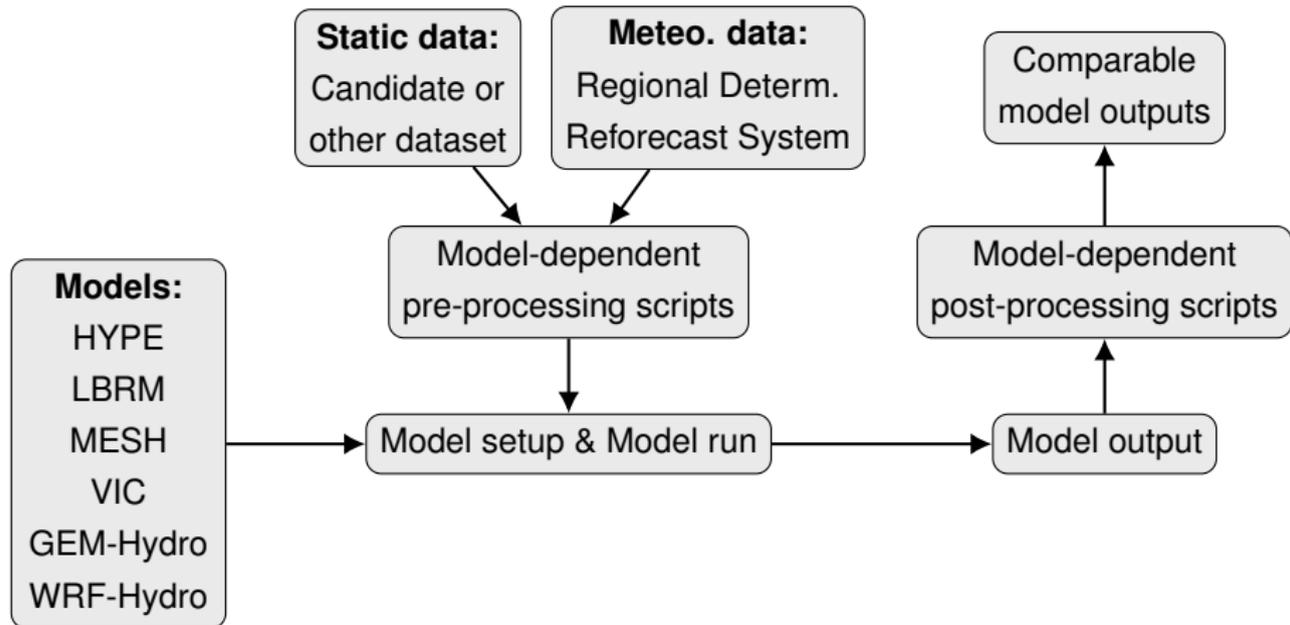


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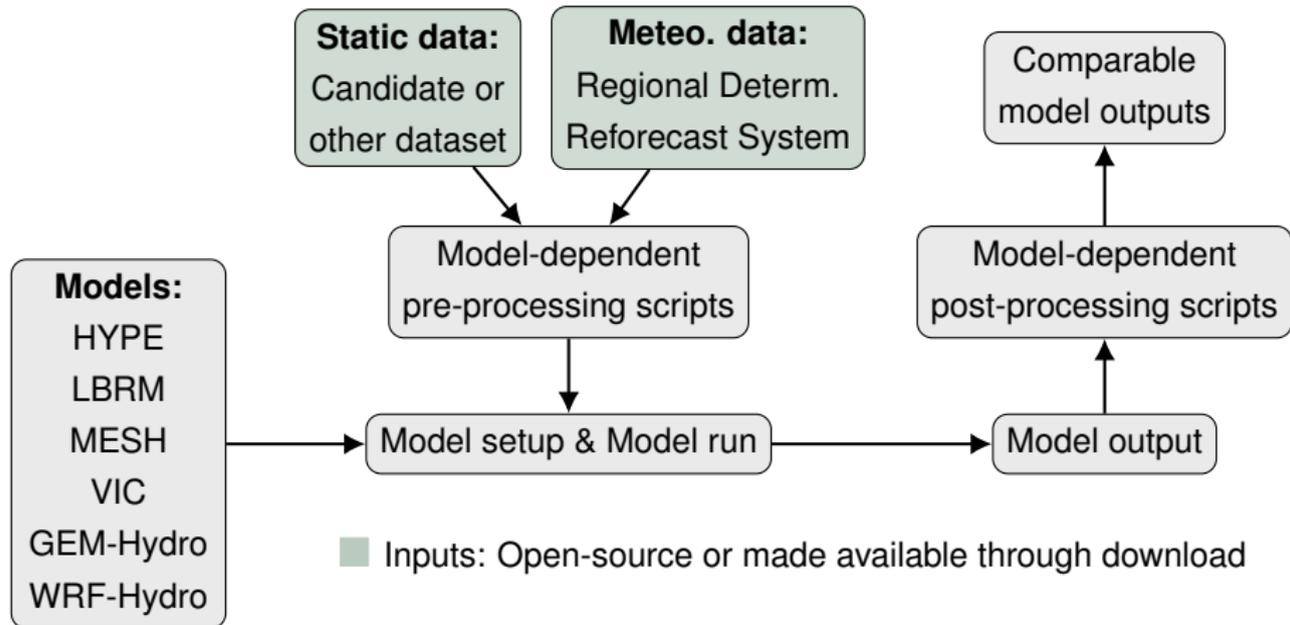


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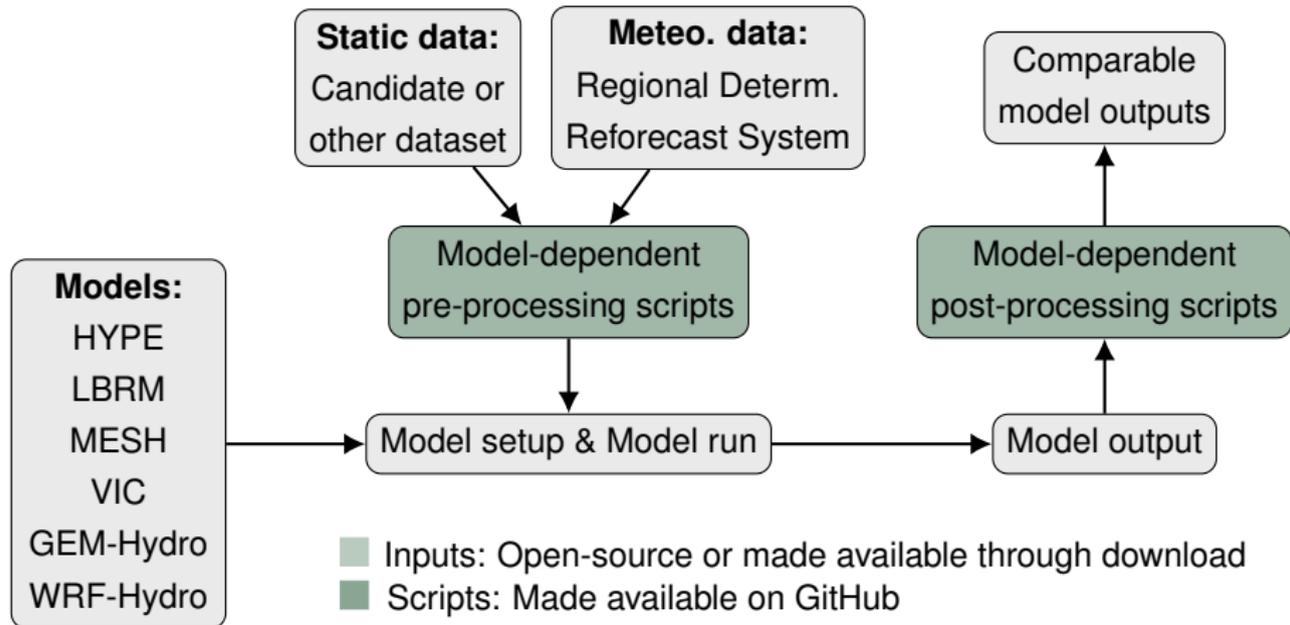


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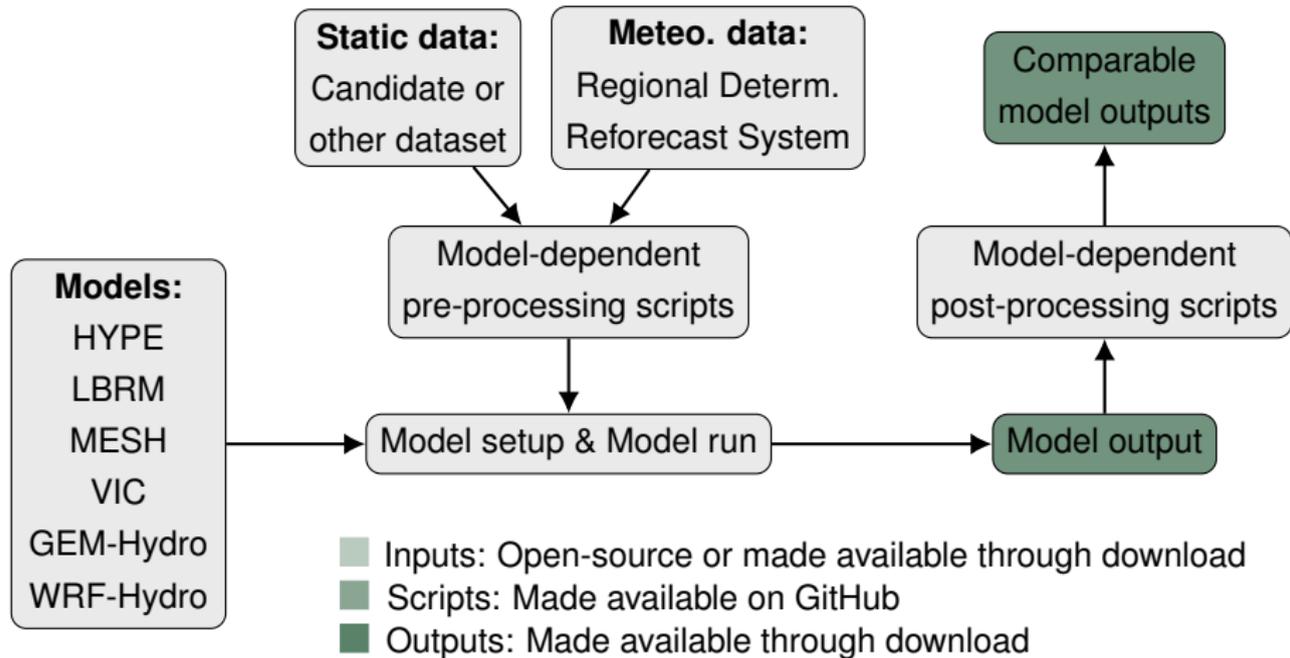


Framework





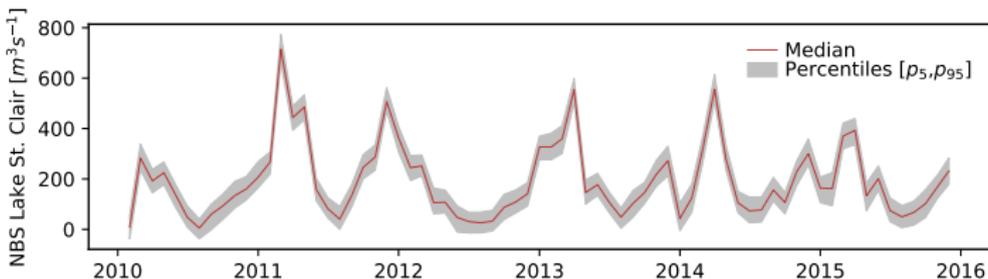
Framework





Comparable Model Outputs

- Modeled discharge at selected gauging stations
 - Requires routing
 - Lumped models need to have sub-basins setup such that they match those stations
- Net basin supply for Lake Erie and Lake St. Clair
 - Probability distributions of monthly net basin supply known from Joseph Smith & Drew Gronewold (2017)





Routing

- Offline routing in some models, e.g., VIC and GEM-Hydro
- Opens up possibility of **unified routing scheme** across models
- RAVEN routing is independent of model
- Routing for VIC and GEM-Hydro already performed with RAVEN

Supported by GWF HQP:

Ming Han (PhD student, U of Waterloo)

Shervan Gharari (Core Modeling Team, U of Saskatchewan)

Julie Mai (Core Modeling Team, U of Waterloo)

Poster #59

Ming Han

Tue pm



Support

- Provision of raw data for model building
- Interpolation of climate data to user-discretized model domain
- Automatic calibration support and limited deployment via OSTRICH
- Support for normalized approach of routing
- Deployment of model validation runs

Supported by GWF HQP:

Hongren Shen (PhD student, U of Waterloo)

Julie Mai (Core Modeling Team, U of Waterloo)

Poster

Hongren Shen

@ CGU



Project Management Tool



- private repository
- documentation in a Wiki
- discussions
- ticket system
- scripts and their version control
- sharing smaller datasets



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Interested in participating with your model?

↪ contact: juliane.mai@uwaterloo.ca



Integrated Modelling
Program for Canada

Global Water Futures



GLOBAL WATER FUTURES

SOLUTIONS TO WATER THREATS IN AN ERA OF GLOBAL CHANGE



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