Ensemble Lake Modelling with *LakeEnsemblR*

brought to you by AEMON-J

Tadhg Moore[1], Jorrit Mesman[2,3], Johannes Feldbauer[4] & Robert Ladwig[5]

[1]Virginia Tech, [2]Univ. of Geneva, [3]Uppsala Univ., [4]TU Dresden, [5]UW-Madison

https://github.com/aemon-j/LakeEnsemblR

supported by grants from NSF, EU, Saxonian State Parliament

Who's who?

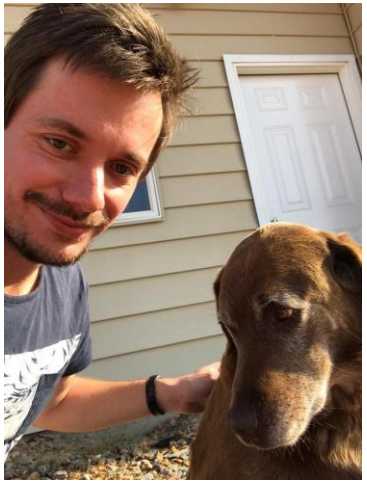
#LakeEnsemblR

Tadhg
fearless leader

Jorrit
package mastermind

Hannes
coding genius

Robert
living compiler



Welcome!

- If you want to run the simulations during the workshop, you will need to install the following software on your computer. If you just want to watch, ask questions, and drive from the back seat, that's fine, too!
- **Questions?** Ask in the Zoom chat, raise your hand in Zoom, or join our Slack channel

Two paths to the workshop examples:

(1) Clone or download files from: https://github.com/gsagleon/G21.5_GSA_workshop/tree/master/LakeEnsemblR
   (a) you'll need R (>= 3.5) and certain packages (instructions are online in the README)

(2) Get the container: https://hub.docker.com/r/hydrobert/lakeensemblr-rocker (requires docker)
   (a) this includes Rocker, all packages, all scripts and all data:

```
docker run --rm -d  -p 8000:8000 -e ROOT=TRUE -e PASSWORD=password hydrobert/lakeensemblr-rocker:latest
```

open any web browser and type 'localhost:8000' (user: rstudio, password: password)

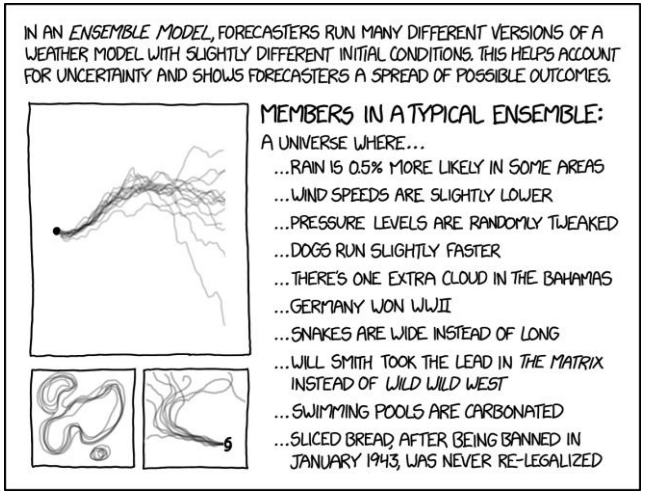
Time schedule today

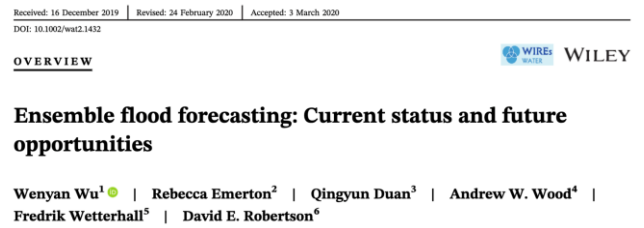
9:30-9:50	Introduction to LakeEnsemblR	• Why use ensembles? • What is LakeEnsemblR?
9:55-11:10	Using LakeEnsemblR	• Standardisation of input data • Functions • Visualising output & calibration • Apply it to YOUR lake! (or on OUR examples)
11:15-11:30	Future plans LakeEnsemblR	• Adding more models • Creating a static WQ model • Potential applications

The current state in lake modeling

- lots of different 1D hydrodynamic lake models

- (some) require compilation and additional instructions before running
- people chose the model that lab/supervisor is using
- ensemble modeling is state-of-the-art → quantifies uncertainty & identifies shortcomings

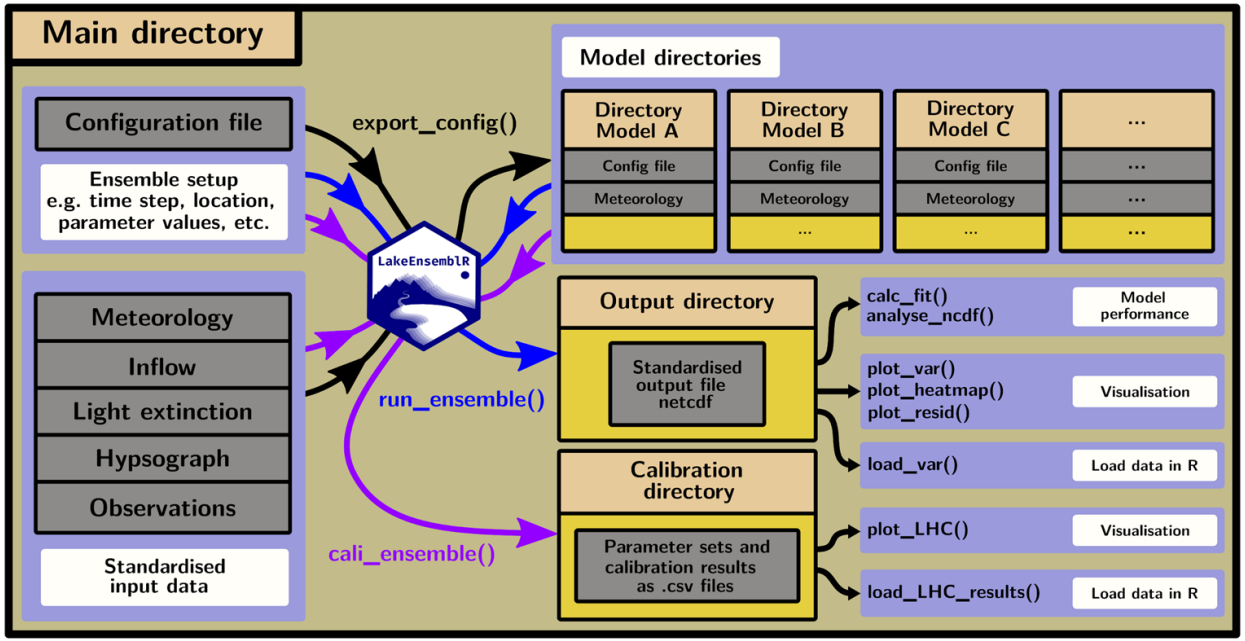




comic from xkcd.com; Wu et al. 2019

LakeEnsemblR

- open-source and open access R package (GNU 2.0 license)
- models: R-packages that contain executables for macOS, Windows & Linux
- standardized workflow



Moore, Mesman, Ladwig & Feldbauer et al. 2020, under review

LakeEnsemblR

- Models:

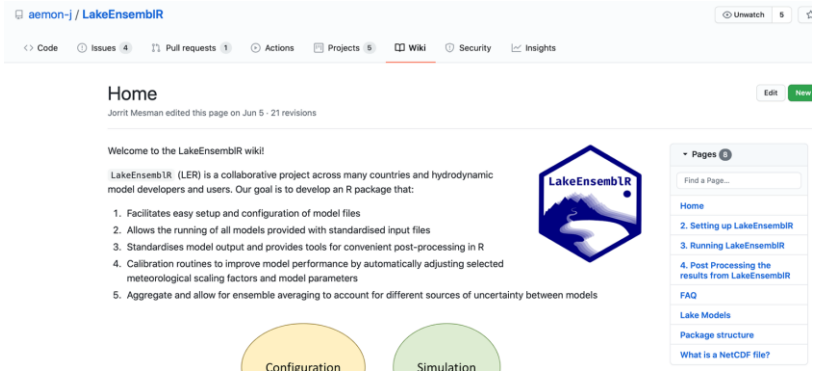
FLake	GLM	GOTM	SIMSTRAT	MyLake
Two-layer representation	1D energy balance approach	1D k-ε turbulence model	1D k-ε turbulence model	1D heat equation
Numerical weather predictions	Ecosystem modeling	Lake turbulence studies	Lake turbulence studies	Ecosystem modeling

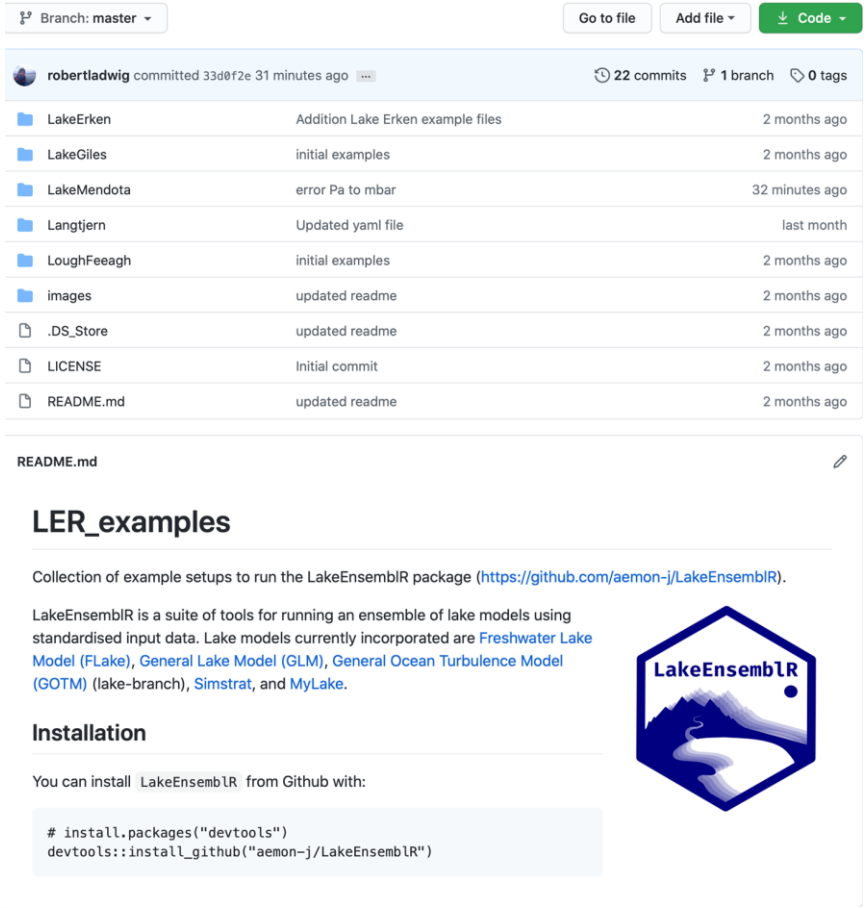
- Calibration:
  - Latin Hypercube Sampling
  - Markov-Chain Monte Carlo
  - Different algorithms for constrained optimization using the FME package

FME: Soetaert & Petzoldt 2010

LakeEnsemblR: support

- walk-through: vignette in R and wiki https://github.com/aemon-j/LakeEnsemblR/wiki
- example configuration files: https://github.com/aemon-j/LER_examples





Github: https://github.com/aemon-j/LakeEnsemblR

Funding

- J.F. was funded by the European Social Fund and co-financed by tax funds based on the budget approved by the members of the Saxon State Parliament.
- T.N.M. was funded by: the WATExR project which is part of ERA4CS, an ERA-NET initiated by JPI Climate, and funded by MINECO (ES), FORMAS (SE), BMBF (DE), EPA (IE), RCN (NO), and IFD (DK), with co-funding by the European Union (Grant number: 690462) and also by NSF grants DEB-1926050 and DBI-1933016.
- J.P.M. was funded by the European Union's Horizon 2020 Research and Innovation Programme under the Marie Skłodowska-Curie grant agreement no. 722518 (MANTEL ITN).
- R.L. was funded through a National Science Foundation ABI development grant (#DBI 1759865).

Diese Maßnahme wird mitfinanziert durch Steuermittel auf Grundlage des von den Abgeordneten des Sächsischen Landtags beschlossenen Haushaltes.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 722518.

Time for the workshop

- **Workshop materials:**
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  - Get the docker here: https://hub.docker.com/r/hydrobert/lakeensemblr-rocker (requires docker)
    - this includes Rocker, all packages, all scripts and all data, just do

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- **Four files (pdf, html, Rmd, R)**
  - You only need one of them; pick what you prefer

Try it out!

LakeEnsemblR: planned features for 2021

- **additional models** (implementation already in progress):
  - air2water
  - ALBM

- **LakeEnsemblR water quality**

  → working group meeting at this GLEON conference!

  - one-way coupling of WQ model to LER output
  - quantify effect of hydrodynamic differences on aquatic ecosystem response

air2water: S. Piccolroaz and M. Toffolon; ALBM: Z. Tan

LakeEnsemblR team: F. Olsson, R. Pilla, T. Shatwell, J. Venkiteswaran, A. Delany, H. Dugan, K. Rose & J. Read

```
require(devtools)
devtools::install_github("GLEON/rLakeAnalyzer")
devtools::install_github("USGS-R/glmtools", ref = "ggplot_overhaul")
devtools::install_github("GLEON/GLM3r", ref = "GLMv.3.1.0a3")
devtools::install_github("aemon-j/FLakeR", ref = "inflow")
devtools::install_github("aemon-j/GOTMr")
devtools::install_github("aemon-j/gotmtools")
devtools::install_github("aemon-j/SimstratR")
devtools::install_github("aemon-j/MyLakeR")

devtools::install_github("aemon-j/LakeEnsemblR")
```

Questions, issues, problems & feedback?

Join the official AEMON-J slack

Thanks for joining!