




# Ensemble Lake Modelling with *LakeEnsemblR*

brought to you by AEMON-J

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

supported by grants from NSF, EU, Saxonian State Parliament

# Who's who?

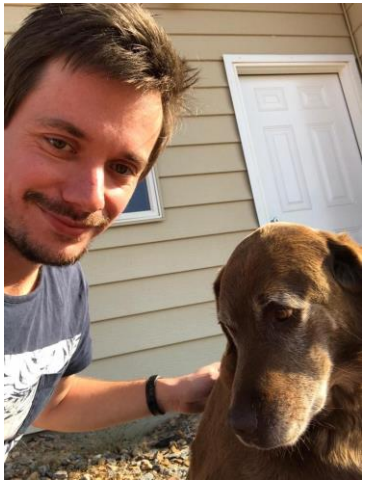
#LakeEnsemblR


Robert

Tadhg

Jorrit

Hannes



# 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

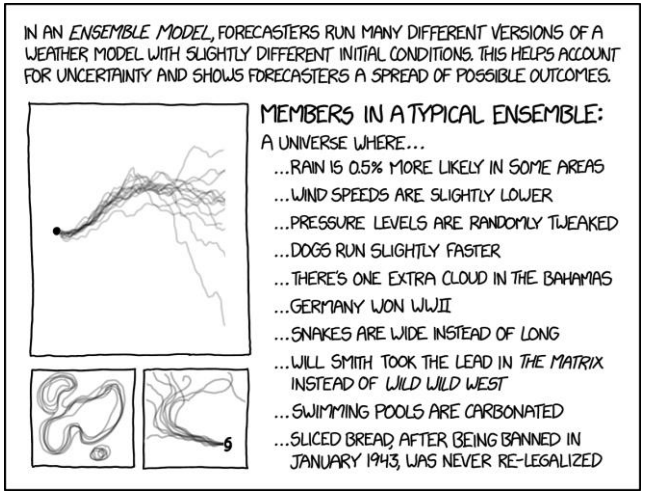
| | | |
|---|---|---|
| 9:00-9:15 | **Introduction to LakeEnsemblR** | • Why use ensembles?<br>• What is LakeEnsemblR? |
| 9:15-9:50 | **Using LakeEnsemblR** | • Standardisation of input data<br>• Functions<br>• Visualising output & calibration<br>• Apply it to YOUR lake! (or on OUR examples) |
| 9:50-10:00 | **LakeEnsemblR Q&A** | • Questions<br>• LakeEnsemblR & FLARE |

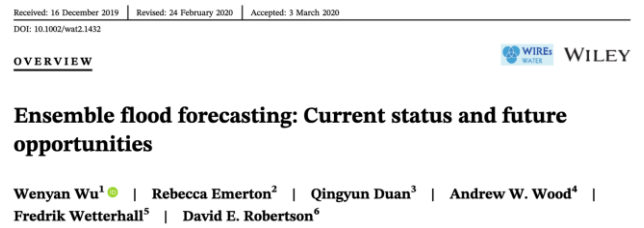
# The current state in lake modeling

- 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

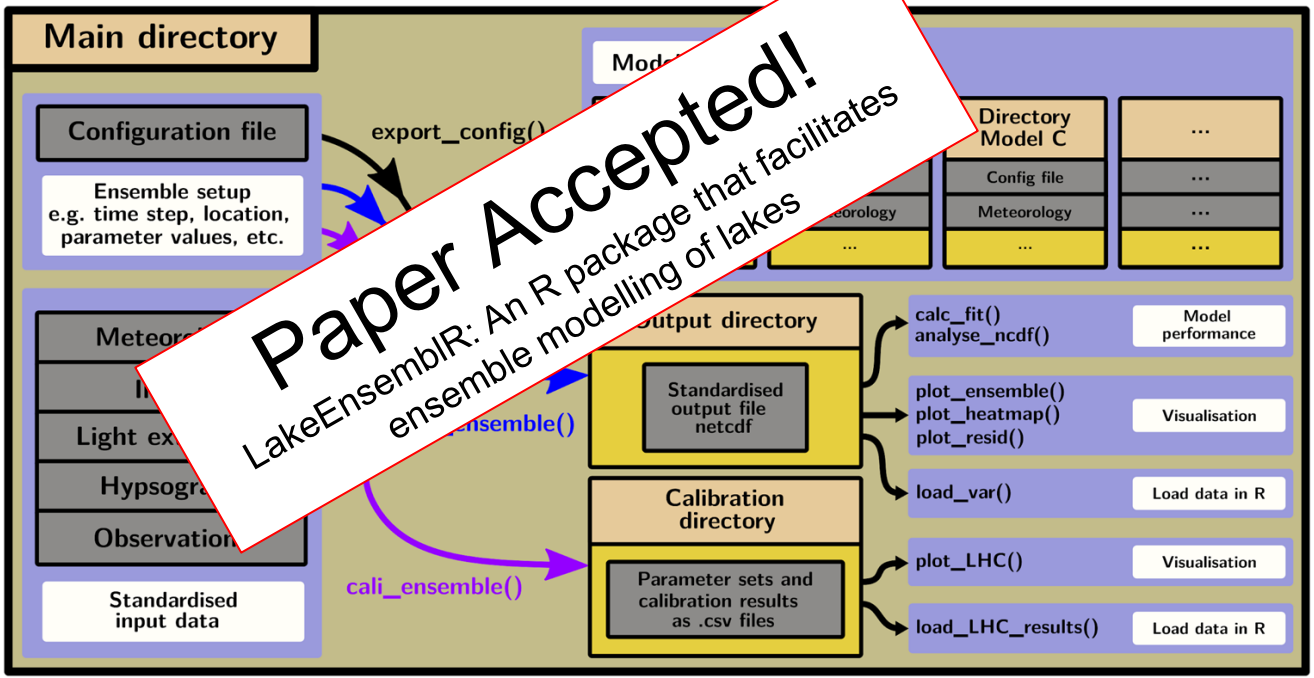



comic from xkcd.com; Wu et al. 2019

# 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:

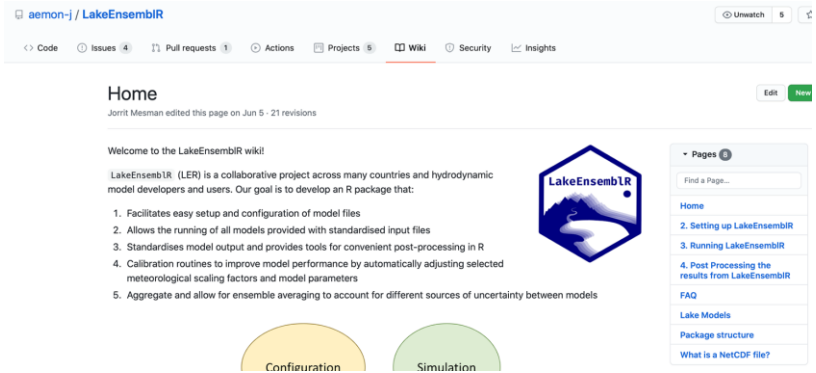
| FLake | GLM | GOTM | SIMSTRAT | MyLake |
|---|---|---|---|---|
| Two-layer representation | 1D energy balance approach | 1D k-ε turbulence model | 1D k-ε turbulence model | 1D heat equation |
| Numerical weather predictions | Ecosystem modeling | Lake turbulence studies | Lake turbulence studies |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

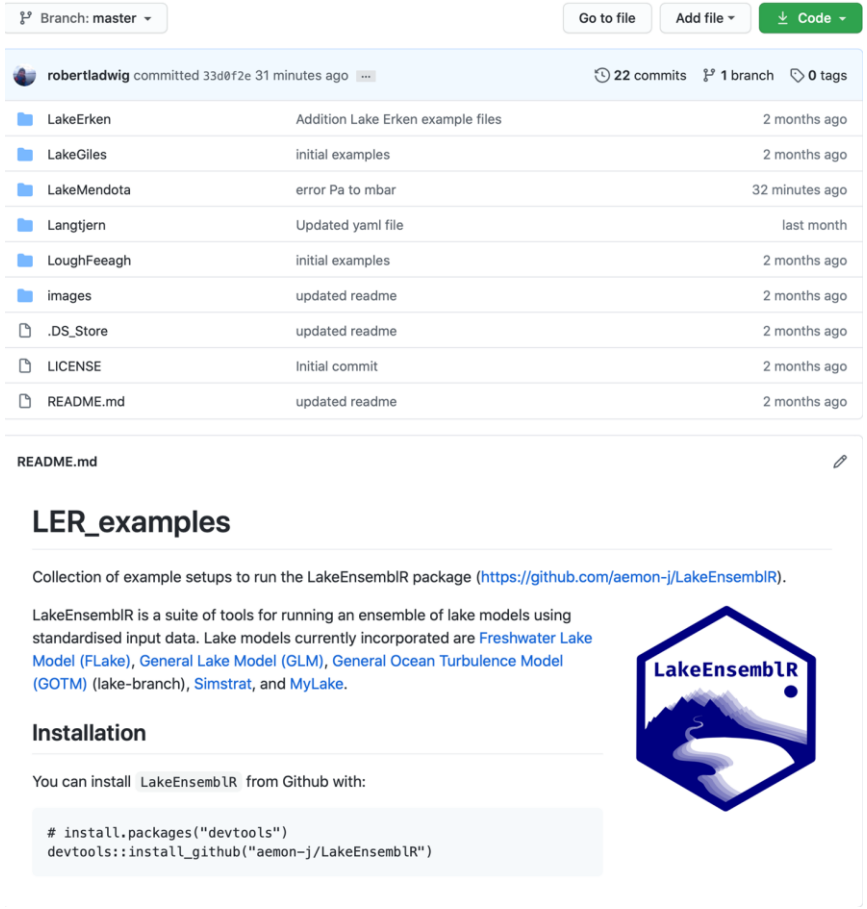
- Calibration:
  - Latin Hypercube Sampling
  - Markov-Chain Monte Carlo
  - Different algorithms for constrained optimization using the FME package

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).

Europäische Union

Europa fördert Sachsen.
ESF
Europäischer Sozialfonds

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

MANTEL ITN

*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:
  - Clone or download files from: https://github.com/tadhg-moore/LER_workshop
    - you'll need R (>= 3.5) and certain packages (instructions are online in the README)
  - 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

    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)

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

# Try it out!

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

```
remotes::install_github("GLEON/rLakeAnalyzer")
remotes::install_github("USGS-R/glmtools", ref = "ggplot_overhaul")
remotes::install_github("aemon-j/gotmtools", ref = "yaml")
remotes::install_github("FLARE-forecast/GLM3r")
remotes::install_github("aemon-j/GOTMr")
remotes::install_github("aemon-j/SimstratR")
remotes::install_github("aemon-j/FLakeR", ref = "inflow")
remotes::install_github("aemon-j/MyLakeR")
remotes::install_github("tadhg-moore/LakeEnsemblR", ref = "flare")

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


## Questions, issues, problems & feedback?

## Join the official AEMON-J slack

## Thanks for joining!