



Ensemble Lake Modelling with *LakeEnsemblR*

brought to you by AEMON-J

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Who's who?

 **#LakeEnsemblR**

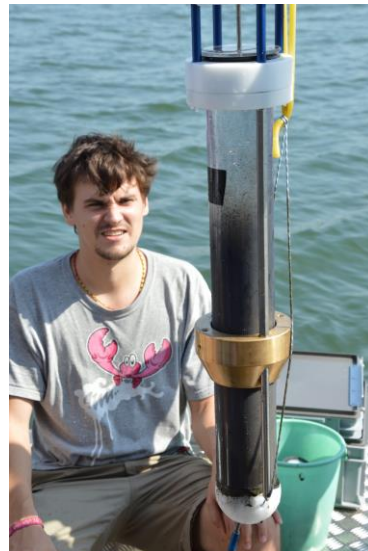
Jorrit
package mastermind



Robert
living compiler



Hannes
coding genius



Tadhg
fearless leader

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/gsgaleon/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

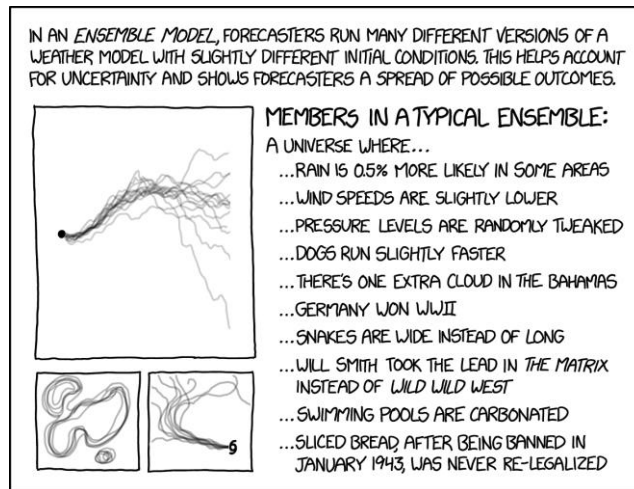
9:30-9:50	Introduction to LakeEnsemblR	<ul style="list-style-type: none">• Why use ensembles?• What is LakeEnsemblR?
9:55-11:10	Using LakeEnsemblR	<ul style="list-style-type: none">• Standardisation of input data• Functions• Visualising output & calibration• Apply it to YOUR lake! (or on OUR examples)
11:15-11:30	Future plans LakeEnsemblR	<ul style="list-style-type: none">• 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



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OVERVIEW

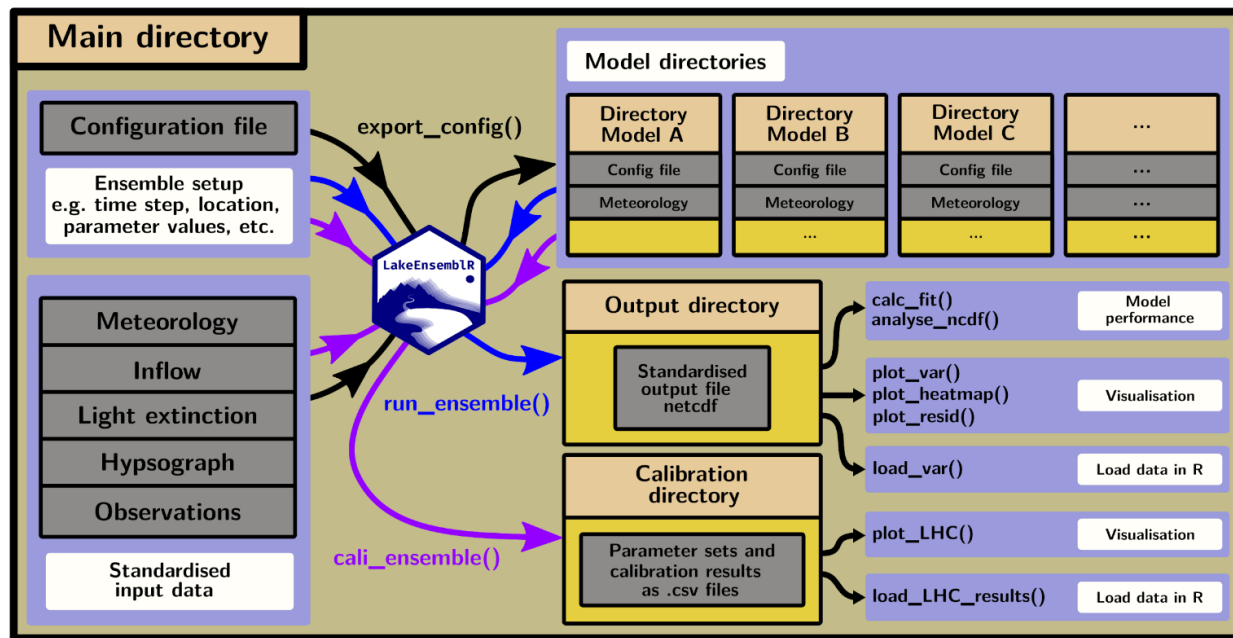


Ensemble flood forecasting: Current status and future opportunities

Wenyan Wu¹ | Rebecca Emerton² | Qingyun Duan³ | Andrew W. Wood⁴ |
Fredrik Wetterhall⁵ | David E. Robertson⁶

LakeEnsemblR

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



LakeEnsemblR

- Models:



Two-layer
representation

Numerical
weather
predictions



1D energy
balance
approach

Ecosystem
modeling



1D k- ϵ
turbulence
model

Lake
turbulence
studies

SIMSTRAT

1D k- ϵ
turbulence
model

Lake
turbulence
studies

MyLake

1D heat
equation

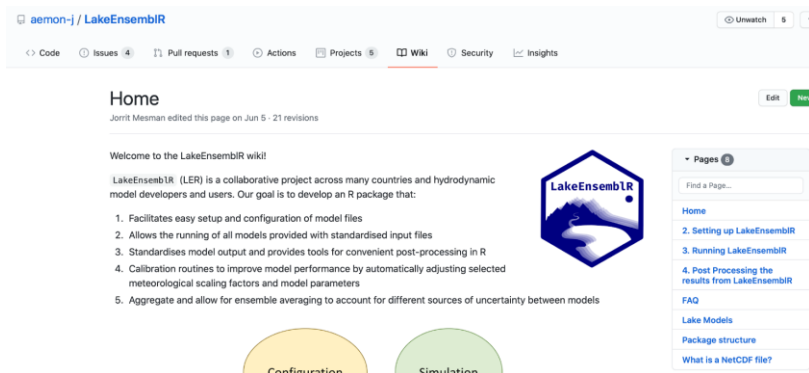
Ecosystem
modeling

- Calibration:

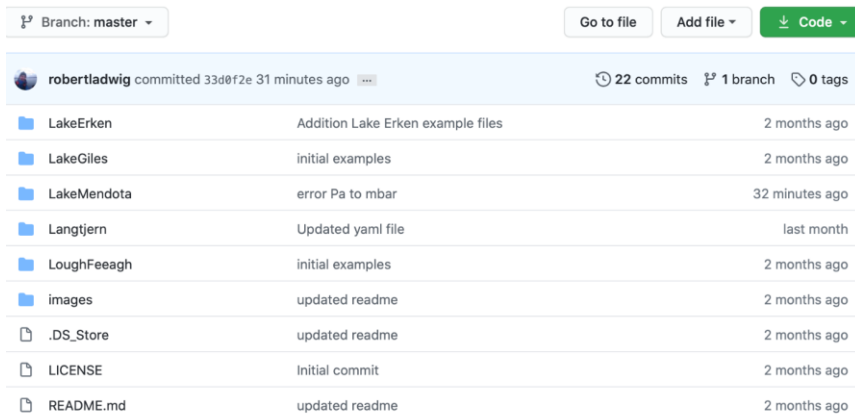
- Latin Hypercube Sampling
- Markov-Chain Monte Carlo
- Different algorithms for constrained optimization using the FME package

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



The screenshot shows the GitHub repository page for 'aemon-j / LakeEnsemblR'. The 'Wiki' tab is selected, displaying a 'Home' page. The page includes a welcome message, a description of the project as a collaborative effort for lake model developers, and a list of five key features: 1. Facilitates easy setup and configuration of model files, 2. Allows the running of all models provided with standardised input files, 3. Standardises model output and provides tools for convenient post-processing in R, 4. Calibration routines to improve model performance by automatically adjusting selected meteorological scaling factors and model parameters, and 5. Aggregate and allow for ensemble averaging to account for different sources of uncertainty between models. A 'LakeEnsemblR' logo is visible on the right, and a sidebar lists various pages like 'Home', 'Setting up LakeEnsemblR', 'Running LakeEnsemblR', etc.



Branch: master			Go to file	Add file	Code
robertladwig committed 33d0f2e 31 minutes ago 22 commits 1 branch 0 tags					
LakeErken	Addition Lake Erken example files	2 months ago			
LakeGiles	initial examples	2 months ago			
LakeMendota	error Pa to mbar	32 minutes ago			
Langtjern	Updated yaml file	last month			
LoughFeeagh	initial examples	2 months ago			
images	updated readme	2 months ago			
.DS_Store	updated readme	2 months ago			
LICENSE	Initial commit	2 months ago			
README.md	updated readme	2 months ago			

README.md

LER_examples

Collection of example setups to run the LakeEnsemblR package (<https://github.com/aemon-j/LakeEnsemblR>).

LakeEnsemblR is a suite of tools for running an ensemble of lake models using standardised input data. Lake models currently incorporated are [Freshwater Lake Model \(FLake\)](#), [General Lake Model \(GLM\)](#), [General Ocean Turbulence Model \(GOTM\)](#) (lake-branch), [Simstrat](#), and [MyLake](#).



Installation

You can install LakeEnsemblR from Github with:

```
# install.packages("devtools")
devtools::install_github("aemon-j/LakeEnsemblR")
```


Time for the workshop



- **Workshop materials:**

- Clone or download files from:
https://github.com/gsagleon/G21.5_GSA_workshop/tree/master/LakeEnsemblR
 - 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: 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



```
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!

