Developing the enCore Community Land Model (eCLM): Adapting Community Land Model version 5 (CLM5) to fit into modular Earth system simulation platforms

Paul Rigor[1], Stefan Poll[1,2], Johannes Keller[2], Ana Gonzalez-Nicolas Alvarez[1], Marco van Hulten[3], Daniel Caviedes-Voullieme[1,2], Klaus Goergen[2], Harrie-Jan Hendricks-Franssen[2], Stefan Kollet[2]

[1] Simulation and Data Lab Terrestrial Systems, Forschungszentrum Jülich, Germany
[2] Institute of Bio- and Geosciences-Agrosphere (IBG-3), Forschungszentrum Jülich, Germany
[3] High Performance Computing and Analytics Lab, University of Bonn, Germany

Contact: Paul Rigor p.rigor@fz-juelich.de

Problem Statement

TerrSysMP—a regional Earth system simulator developed at the Jülich Research Centre—uses a pre-2010 land surface model which is already outdated for doing geoscientific simulations. This needs to be updated to keep up with the latest advances in land surface modelling.

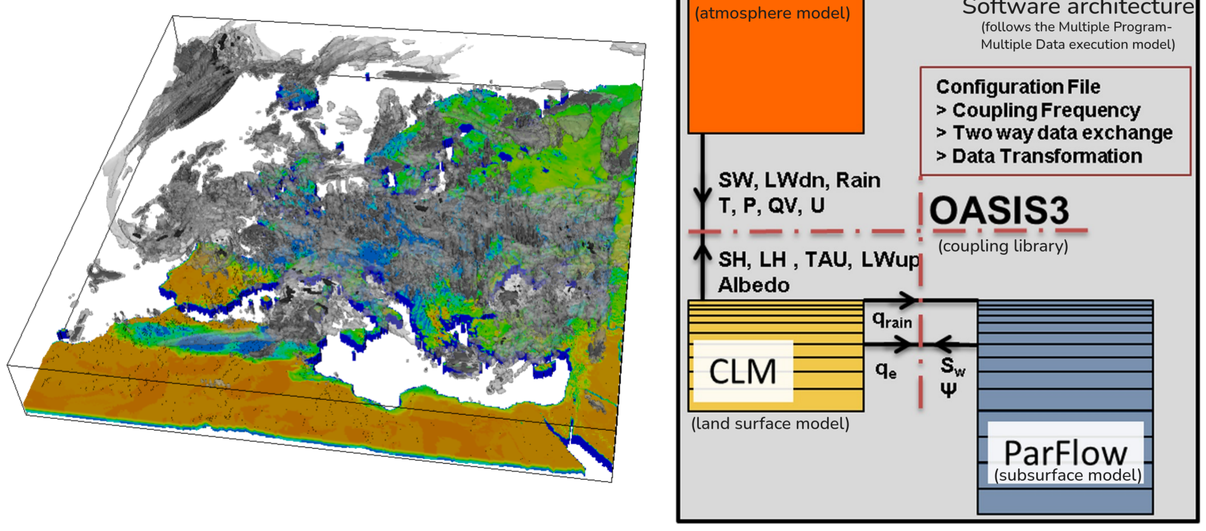


Fig. 1. TerrSysMP consists of a subsurface, a land surface, and an atmosphere model working together to simulate the terrestrial Earth system. (*Image source*: https://terrsysmp.org)

What is a land surface model?

A *land surface model* simulates the biogeophysical, biogeochemical, and hydrological processes on Earth's surface. eCLM is a land surface model that our team from Jülich have developed. We didn't start from scratch; rather we took an existing open-source land surface model called CLM5 and modified it to suit our needs.

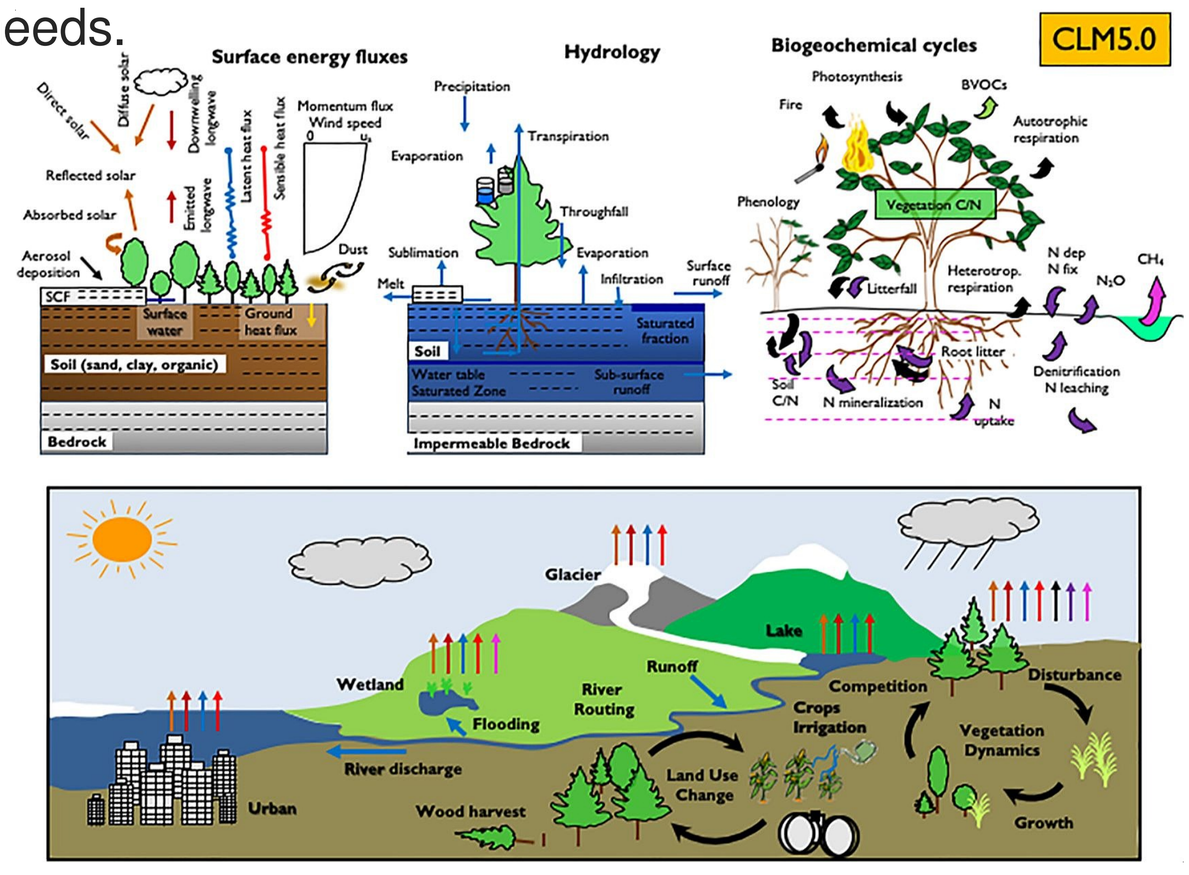
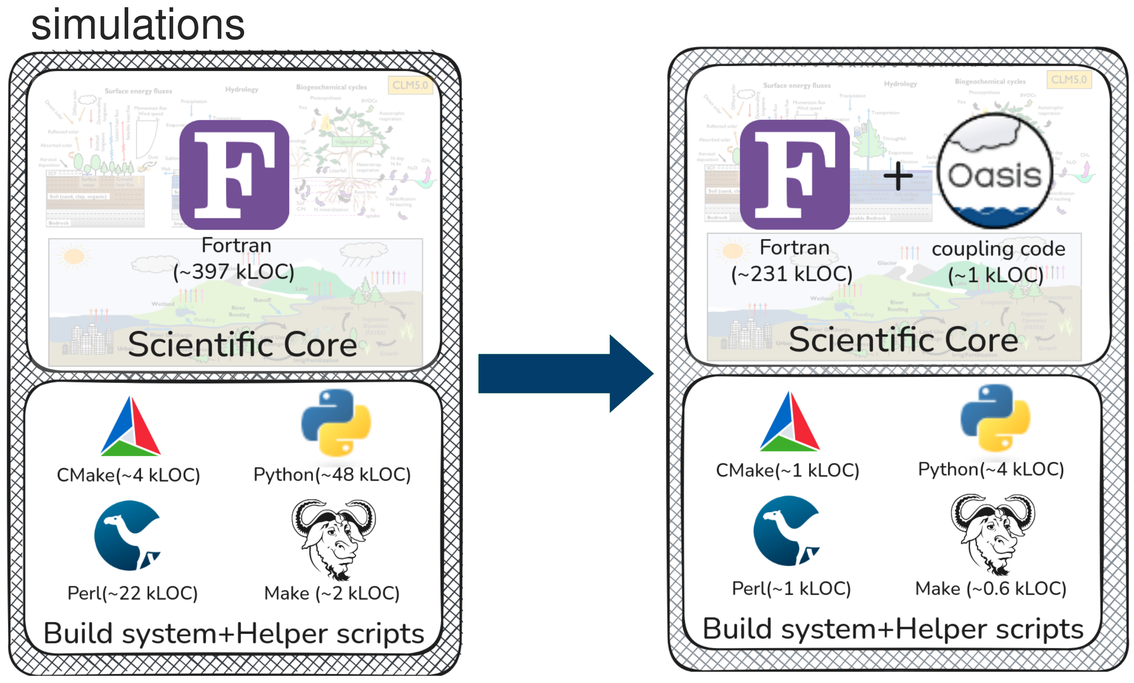


Fig. 2. eCLM is based on the open-source land surface model CLM5, which was developed by the awesome folks at the National Center for Atmospheric Research, USA.
(*Image source*: https://doi.org/10.1029/2018MS001583)

How eCLM was developed

eCLM is the result of extracting the core scientific functionality of CLM5 plus added features to make it work within TerrSysMP. In particular, we:

- Changed CLM5's Python-based build system to CMake
- Added coupling codes that enable eCLM to exchange information with the atmosphere and subsurface components of TerrSysMP
- Removed extra CLM5 features not necessary for our simulations



CLM5 (~670 kLOC) **eCLM** (~293 kLOC)

eCLM fits well into our existing workflows and is more manageable for our research group (we only have a handful of research software engineers).

eCLM source codes can be found here:
https://github.com/HPSCTerrSys/eCLM

Current Status

- eCLM has been integrated in the next-generation TerrSysMP, *a.k.a* TSMP2. Related paper to be submitted this month in *Geoscientific Model Development*.
- Software paper to be submitted in the *Journal of Open Source Software* before end of this year.
- eCLM is already used in multiple ongoing research projects within the Collaborative Research Centre DETECT (CRC:DETECT).

Acknowledgments

Jülich RSE
https://go.fzj.de/jurse

CRC:DETECT
https://sfb1502.de

HPSC TerrSys
https://www.hpsc-terrsys.de

Geoverbund ABC/J
shaping geosciences

JÜLICH
Forschungszentrum