Interactive Earth-System Models for Digital-Twins

Data Science Symposium No. 7

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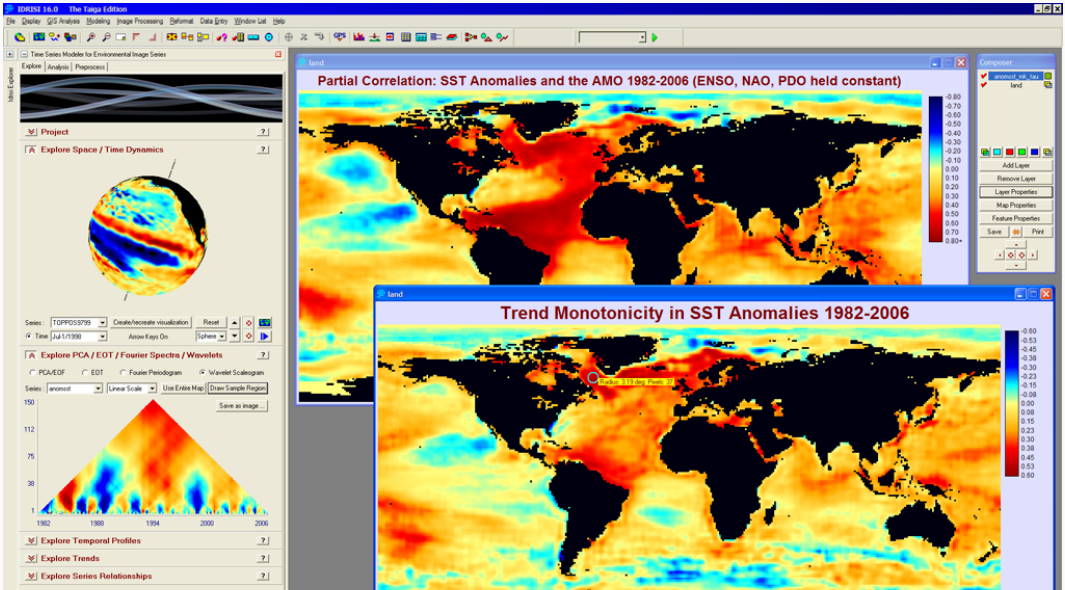
28th June 2022

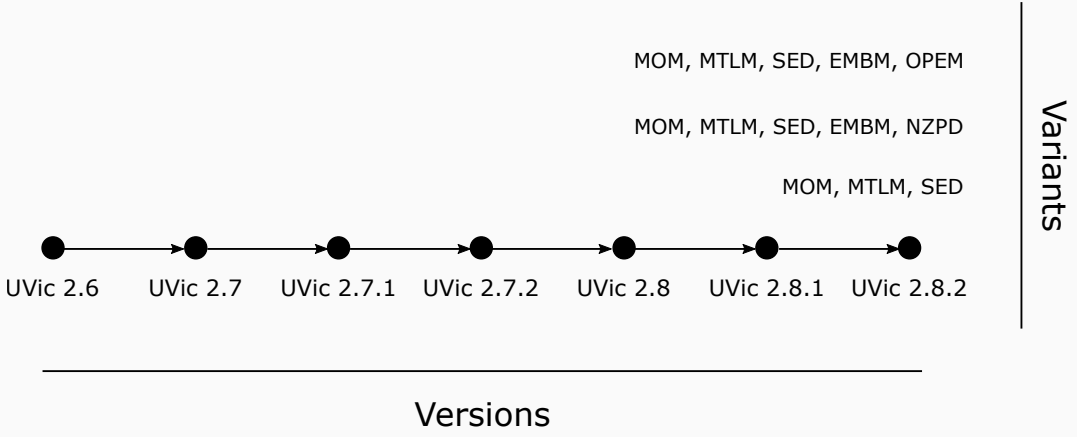
KIEL MARINE SCIENCE
CONNECTED RESEARCH

OceanDSL

Interactive Modular Earth-System Models



Model Versions and Variants



Current State on Models

Development

- Long-living software
- Roots often in small projects of on individual
- Many developers over time
- Developers have different styles

Structure

- Batch and time sharing system inspired setup
- Mixed concerns
- No or partial defined interfaces
- No designed architectures

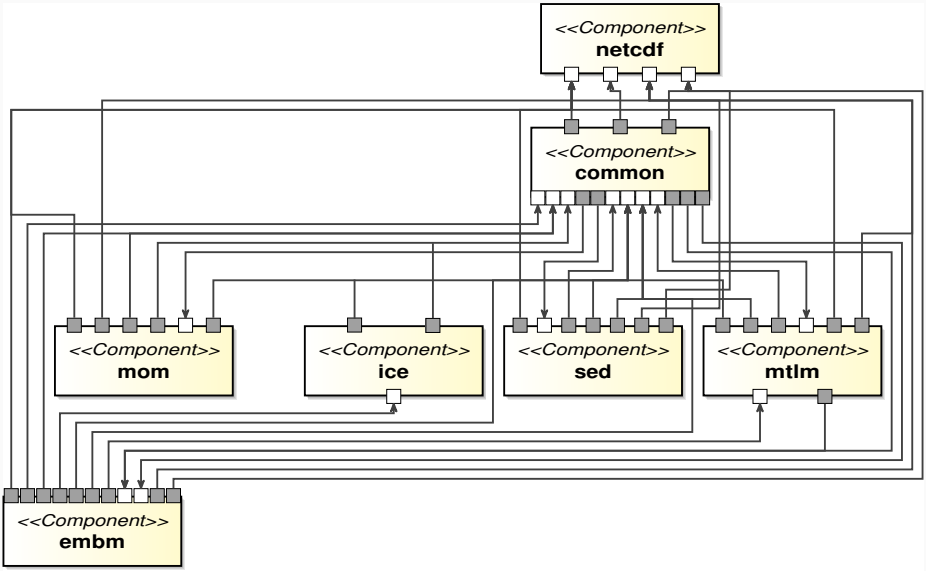
Limits the ability to

- combine models
- restart, and roll back model steps

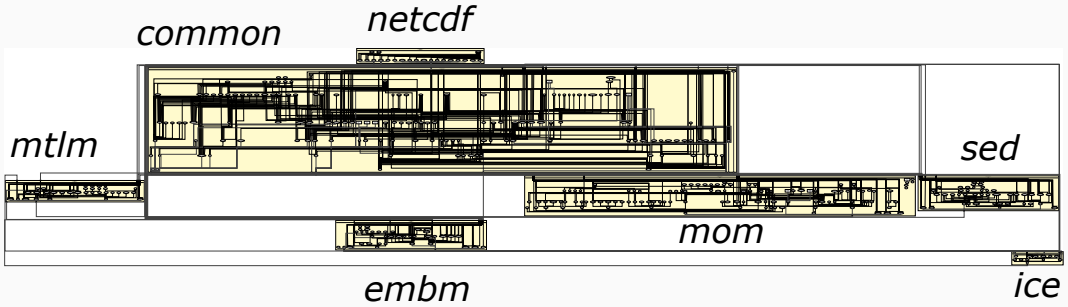
Solution

- Recover model structure
- Improve program comprehension
- Restructure to separate concerns
- Introduce standard interfaces
- Refactor into services

UVic Architecture



Architecture with Subroutines and Common Blocks



Restructure to separate concerns

Optimize Coupling

- Input
  - Control flow
  - Data flow
  - Developer information
- Approaches
  - Genetic algorithms (NSGA2, NSGA3, SPEA2)
  - Neural Network
  - Using SAT solvers

Interactive Architecture Modification

- Select architecture candidate
- Generate refactoring plans (plan modification)
- Discuss and select a plan

Conclusions

Summary

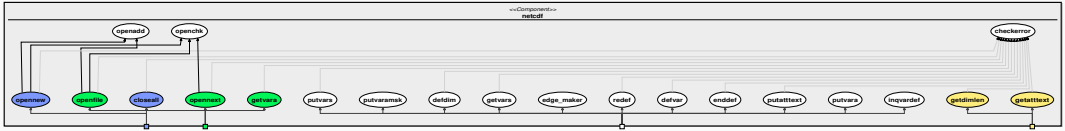
- Architecture recovery using mainly control-flow
- `https://oceandsl.uni-kiel.de/understanding-model-architecture/`

Outlook

- Improve recovery (extend data flow)
- Create refactoring tools
- Provide interactive tools for developers
- Convert model into services

Want to see your model's architecture? Contact us reiner.jung@email.uni-kiel.de

NETCDF Component



IFace7 *IFace5* *IFace8* *IFace6*

NETCDF Provided Interfaces

Name	Subroutines	Components
IFace5	getvara, openfile, opennext	mom,sed,common,mtlm,embm
IFace6	getdimlen, getatttext	common,sed,embm
IFace7	closeall, opennew]	common
IFace8	getvars, defvar, edge_maker, redef, defdim, putvara, enddef, inqvardef, putvars, putvaramsk, putatttext	mom,mtlm,sed,embm