

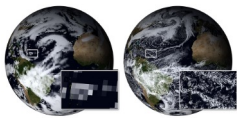
Making km-scale modeling easier

Florian Ziemer, Vera Schemann, and the WarmWorld Easier team



The Easier Workflow — From Simulation to Understanding

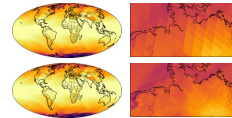
Motivation & Context



CMIP6 MPI-ESM HR and ICON 2.5 km simulations

- Model resolution and data volumes have exploded, workflows must adapt.
- Models are reaching similar resolutions as large-scale observations.
- Online data access eases international collaboration.

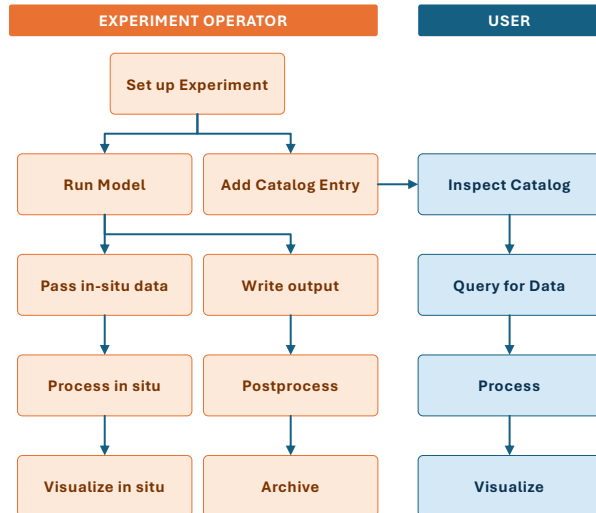
Hierarchical HEALPix output with Hiopy



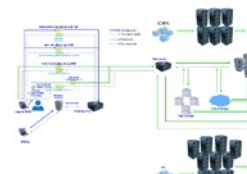
World map and cut-out at HEALPix zoom levels 7 (200k cells) and 11 (50M cells)

- Analysis ready output written during the simulation
- Zoom hierarchy for efficient access
- See Dreier and Tibrewal, P11-41

The Easier Workflow



Online Zarr stores to access data



Data flows

- Different storage backends united behind one common standard
- Native Zarr can be served from object stores
- Kerchunk-indexable data served via cloudify
- ZFDB exposes FDB5 data as Zarr
- See Wachsmann et al., P11-41, Modali et al., P11-31

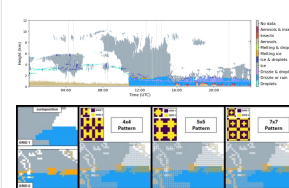
Catalogs to find data



Catalog web interface with demo datasets

- One place to find datasets hosted at different centers
- Database backend
- See Hinz et al., P11-23, Modali et al., P11-31

Data visualization for model-data comparison



Semantic colors, Different overlay patterns for model-data comparison.

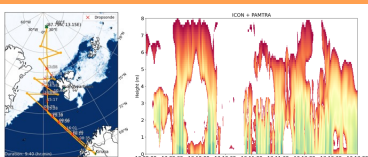
- Pattern based approach for comparing large categorical gridded data.
- Patterns help quickly identify differences, and point to the category causing them.
- Next: visualization for comparing large numerical gridded data
- See Pandey et al., 2026 (EnvirVis)

Structured model-setup with mkexp



- Abstraction between model configuration and machine parameters.
- One place for all configuration parameters.

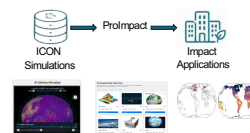
In-situ processing for model-data comparison



Application of the instrument simulator (PAMTRA) along a flight track in a regional ICON simulation

- Possibility to access, process and output ICON variables for a subsection of the 3D field (e.g. satellite or airborne flight tracks or specific cross sections)
- See Dreier and Ziemer, P11-20, Panton et al., P01-34, Schemann (Tue talks)

Beyond EASIER: ProlImpact brings data to decision



- In-situ derivation of decision-relevant statistics
- In-situ feature extraction and compressed output via hiopy
- Tool hub for easier overview
- See Chirulin et al., P11-17, Navarrete et al., P11-32

Reference

[1] Górski et al., 2005, *HEALPix: A framework for high-resolution discretization and fast analysis of data distributed on the sphere*, doi: 10.1086/427976.