ICCARUS
Offenbach/Main
Feb. 26-28, 2018

ProWaS Klima-Projektionsdienst

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Developing ICON-CLAM for climate simulations

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ICON-LAM already runs operationally as a NWP model at DWD. To provide climate simulations with ICON-LAM the model requires specific adaptations. These include the adjustment of a number of atmospheric processes that are not resolved in NWP mode.
Furthermore, climate projections require a coupled ocean component, not yet implemented in ICON-LAM, to be able to represent the long-term fluxes and exchange processes between the atmosphere, ocean and sea-ice. The quality of the regional ocean model is based on its ability to represent high resolution regional processes such as tides in coastal areas.
The new version is named ICON-CLAM indicating the climate adaptation of the model.

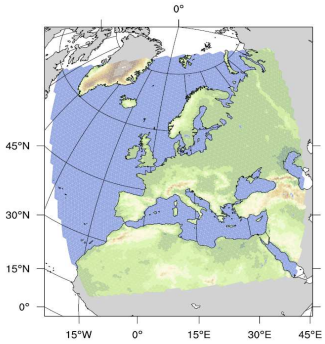


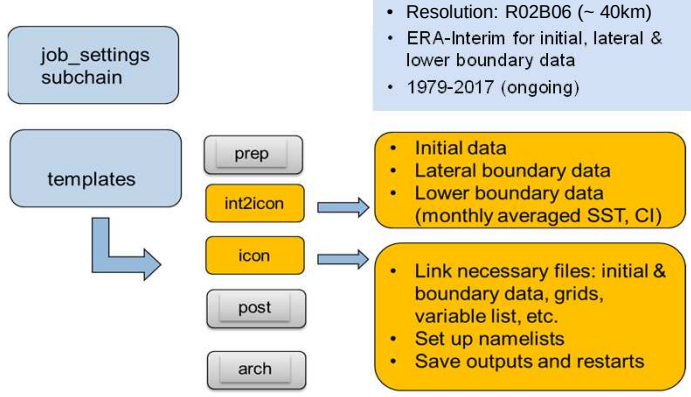
Figure: European domain for ICON-CLAM

I. ICON-CLAM: atmosphere setup

Limited Area Version ICON-LAM (developed by DWD and MPI)
- Based on ICON-NWP physics
- Tested for short time (several days)
- Forced with DWD or ICON global data (GRIB format input)
- Lots of features must be still tested for the climate application

ICON-CLAM is a regional climate model based on the ICON-LAM physics

Job setup



ICON-CLAM first experiment:
- Domain: EU-CORDEX
- Resolution: R02B06 (~ 40km)
- ERA-Interim for initial, lateral & lower boundary data
- 1979-2017 (ongoing)

Figure: Subchain routine for ICON-CLAM (based on the COSMO-CLM subchain)

First results

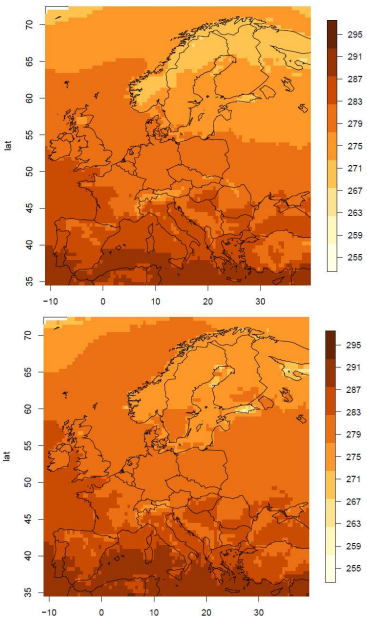


Figure: Temperature average from 1979-1982 in 2m (upper panel) and at the surface (lower panel)

Background

Within the pilot-project ProWaS (Projection service for Waterways and Shipping) German Federal agencies build tools to assess long-term influence of climate change on river and coastal waterways. ICON-CLAM is currently setup for future service.

Current ICON-CLAM version

- Can run with boundary data from reanalysis data in NetCDF format
- Runs stably for a longer period of time (years)
- Infrastructure established (runscripts, namelists, restarts, etc.)

Next steps with ICON-CLAM

- Investigate the soil layers, model top, ice, etc.
- Establish a standard format for all input data that iconremap can read

Coupling ICON-CLAM with ocean

Processes in the ocean are generally slower compared to the atmosphere and thus have a longer memory. Therefore, accurate ocean modeling is specifically important for long-term simulations, since changes in the ocean have strong influence on air-sea exchange (and thus on the atmospheric model).

Within ProWaS we examine existing ocean models. Important aspects to model the coastal and riverine regions of Germany are compared. These include:

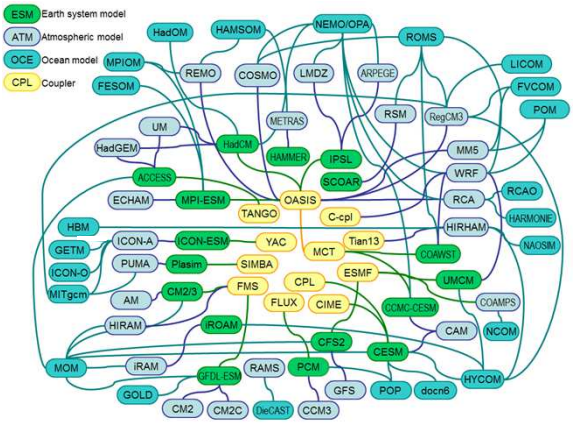
Technical aspects:
- Implementation into ICON-CLAM
- Adaptation to the model grid
- State-of-the-art program

Scientific aspects:
- Representation of small scale processes (like tides, coastal currents, flooding…)
- Representation of salinity

Usability:
- Model support and community
- Experience and longevity

II. ICON-CLAM: ocean aspects

Family tree of coupled ocean-atmosphere models with properties



Model	institute	resol.	tides	drying	turbulence	grid
DieCAST	U. Torino	7 km	X		MY82 / PP81	carthes.
FESOM	AWI	10 km (g)	X		LMD94	triang.
FVCOM	UMassD	10 km	X	X	GOTM	triang.
GETM	IOW	13 km	X	X	GOTM	curvilin.
HadOM3	HadleyCt	1.25° (g.)			LMD94	carthes.
HAMSOM	UHH	2 km	X	--	MY82	carthes.
HBM	DMI/BSH	2 km	X	X	k-ε	spherical
HYCOM	NRL	20 km			MY82	curvilin.
ICON-O	MPI-M	10 km (g)	X	--	modif. PP81	triang.
LICOM2	LASG	50 km			Canuto	carthes.
MITgcm	MIT	9 km	X		LMD94	curvilin.
MOM	GFDL	50 km	X	--	GOTM/LMD	carthes.
MPI-OM	MPI-M	5 km		--	PP81	curvilin.
NEMO	commun.	3 km	X	v4	k-ε / LMD94	carthes.
NCOM	NRL	2 km			MY82	curvilin.
POM	Princeton	2 km	X	--	MY82	curvilin.
POP	NCAR	0.6° (g.)	X	--	LMD94	curvilin.
RCO	SMHI	11 km			k-ε	carthes.
ROMS	commun.	1 km	X	X	LMD94	curvilin.

Figure: Out of 23 ocean models found in the literature that have been coupled to atmosphere models16 have been applied to regional models. For each ocean model its finest resolution in coupled model setups is given (g denotes global); PP81 is Pacanowski & Philander, 1981; MY82 stands for Mellor & Yamada 1982 ; LMD94 denotes Large, McWilliams & Doney, 1994 (also called KPP); Canuto et al., 2001 and 2010 – (list of tides, drying and resolution may not be completive).

ProWaS includes the German Federal Agencies
Deutscher Wetterdienst (DWD)
Bundesamt für Seeschifffahrt u. Hydrographie (BSH)
Bundesanstalt für Gewässerkunde (BfG) and
Bundesanstalt für Wasserbau (BAW)
led by the German Ministry of Transport and Digital Infrastructure (BMVI).

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