COSMO-CLM User's Seminar

How a two-way online coupled model system impacts regional climate simulations

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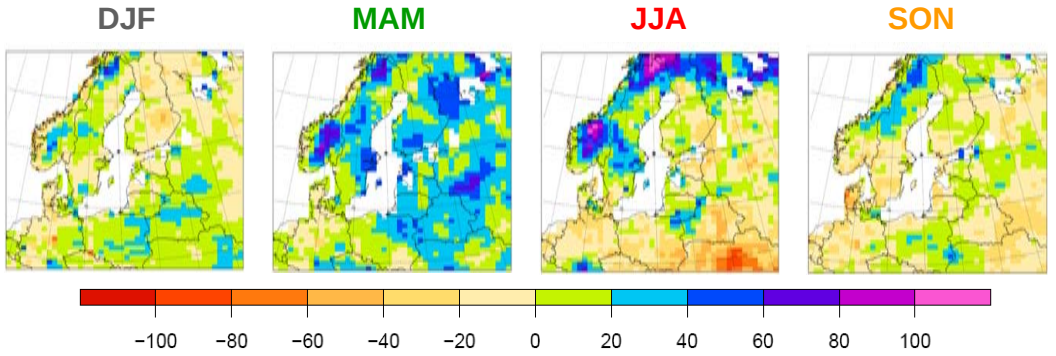
Difference of monthly precipitation [%], 1998 - 2002



CCLM - WATCH data (Daily time series of ECMWF reanalysis data where the monthly means are corrected with GPCC precipitation data and a gauge undercatch correction according to Weedon et al. (2011)

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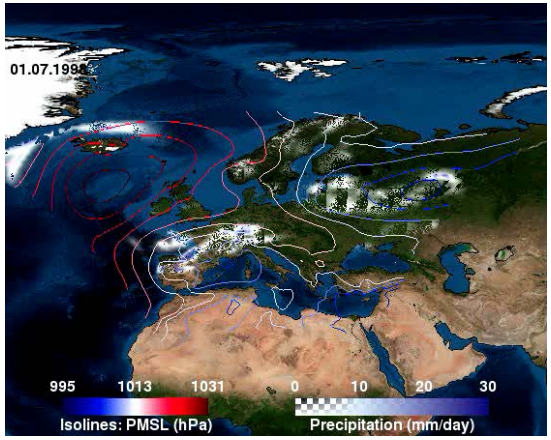
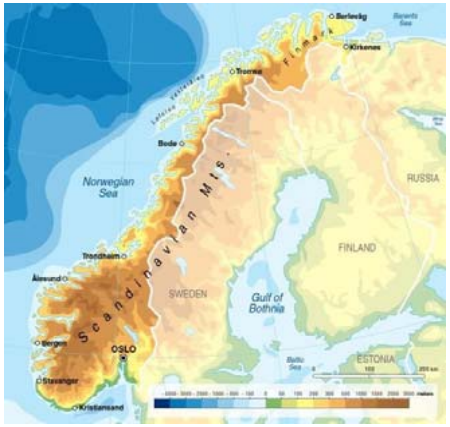
Daily Precipitation (shaded, grey), PMSL (contours) Jul. 1998

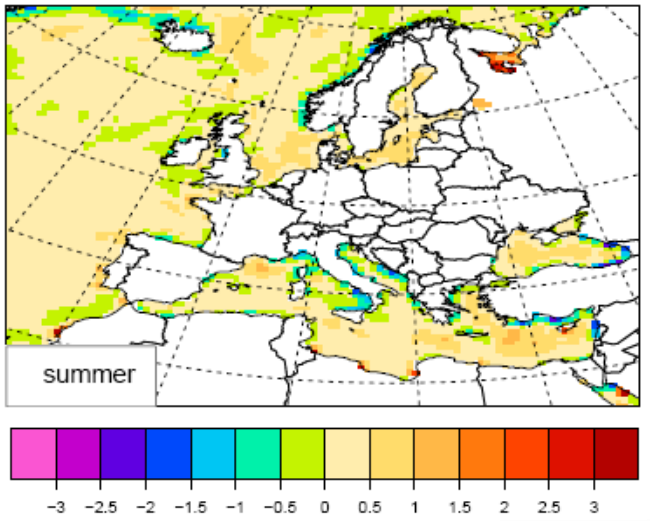




➢ Summer: Precipitation over Europe is strongly associated with the low over Central Europe and NAO.

➢ Combining with topography effects, precipitation is often overestimated along Norway coastlines and Sweden in CCLM.

Monthly Skin temperature, ERA-interim – OISST, 1998-2002



Warm bias over the Baltic & North Seas & North Atlantic Ocean of ERA-interim SST compared to AVHRR (Advanced very high resolution radiometer) **NOAA OISST** ¼ x ¼° data

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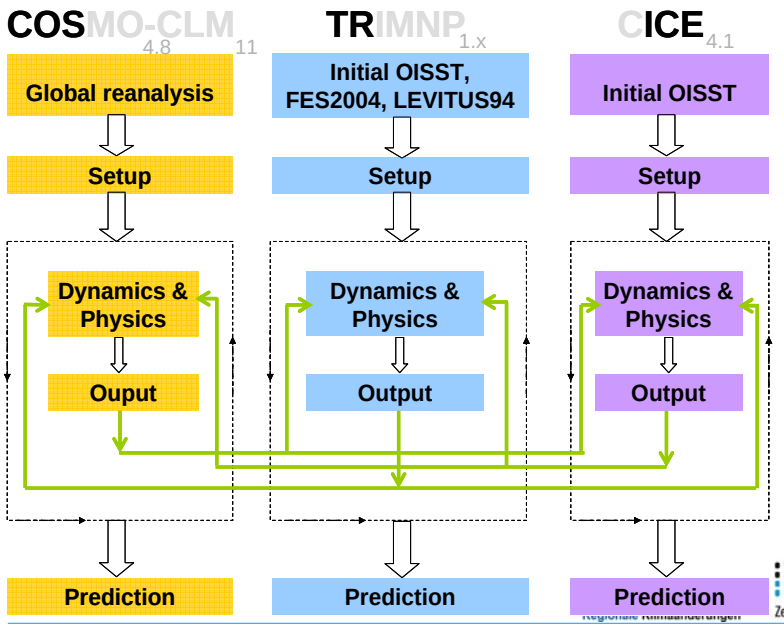
Outline

Aims

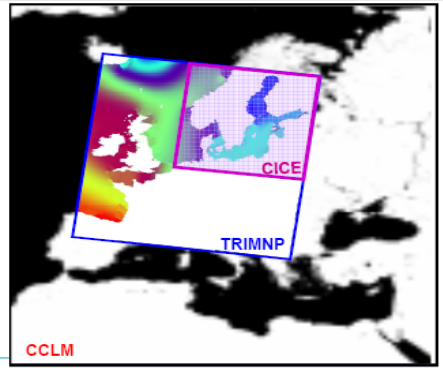
- → To reproduce atmosphere-ocean-sea ice interactions and feedbacks
- → To analyse impacts of the coupled system on climate simulations
- → To improve regional climate simulations over Baltic Sea and North Sea regions
- → To provide a potential member to ensembles for climate projections

1. **The coupled system COSTRICE**
2. **Experiments**
3. **Results**
4. **Conclusions**
5. **On-goings**



The coupler OASIS3 exchanges data 1-/3-hourly amongst component models via green arrows.

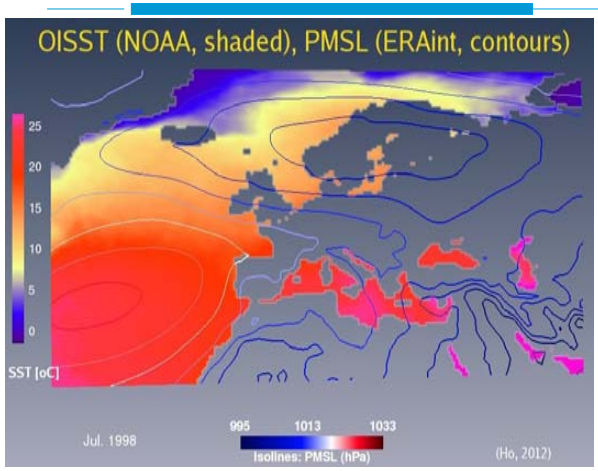
	CCLM	TRIMNP	CICE
Horizontal resolution	50km	12.8km	12.8km
Vertical resolution	32 layers	50 layers	5 ice-categories
Domain (grid points)	101 x 111	200 x 230	120 x 120
Initial & Lateral boundary conditions	6-hourly ERA-interim	NOAA OISST, Levitus94, FES2004	NOAA OISST

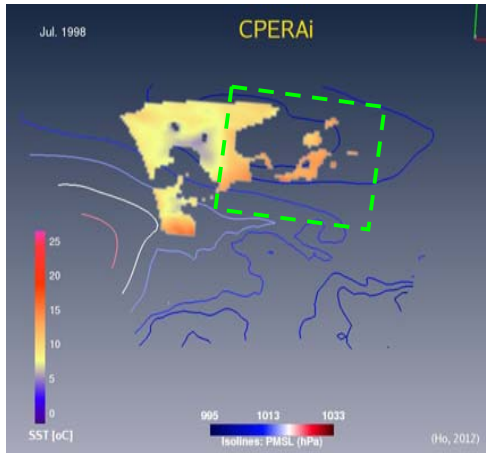


EXPS	Strategy	Time	Skin temperature
STERAi	Stand-alone	1997- 2002	ERA-interim, 6-hourly updated
CPERAi	Coupled	1997 – 2002 (Jan.1997 is a coupling "spin-up" time)	is the combination of SST of TRIMNP & sea ice skin temperature of CICE, 3-hourly exchanged

H. T. M. Ho, B. Rockel, H. Kapitza, B. Geyer, and E. Meyer (2012): COSTRICE – three model online coupling using OASIS: problems and solutions. Geoscience Model Development Discussion. Vol. 5, pp. 3261-3310.

SST &
Mean sea level pressure

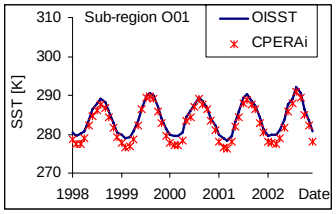


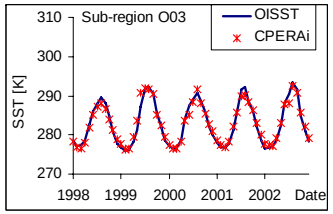


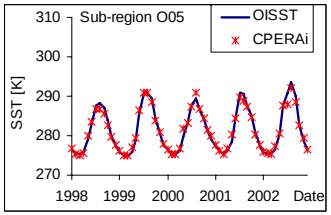
➢ Monthly mean SST (shaded) and mean sea level pressure PMSL (contours) for Jul. 1998 are reproduced well by COSTRICE.

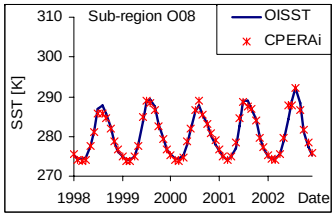
➢ Cold bias of SST is larger over North Atlantic due to no interactions & feedback.

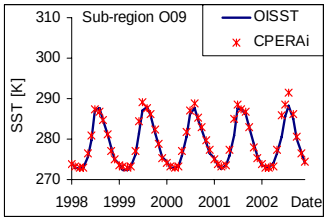
Monthly area averaged SST (K) for 1998-2002

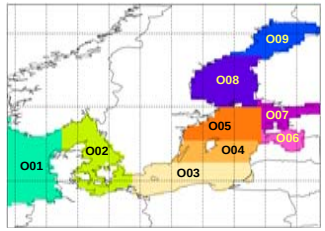








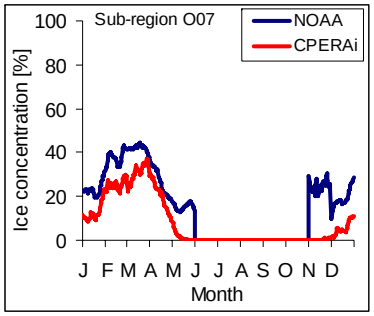


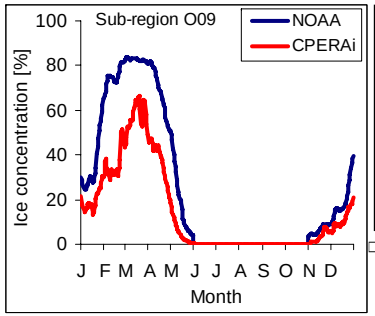


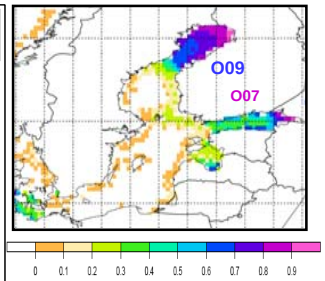
Results over Baltic Sea are better than over North Sea

Sea ice

Anually variation of area averaged ice concentration [%], 1998 - 2002







Although sea ice area is mostly underestimated compared to NOAA AVHRR data, variation & distribution of sea ice concentration are well captured by COSTRICE.

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Precipitation

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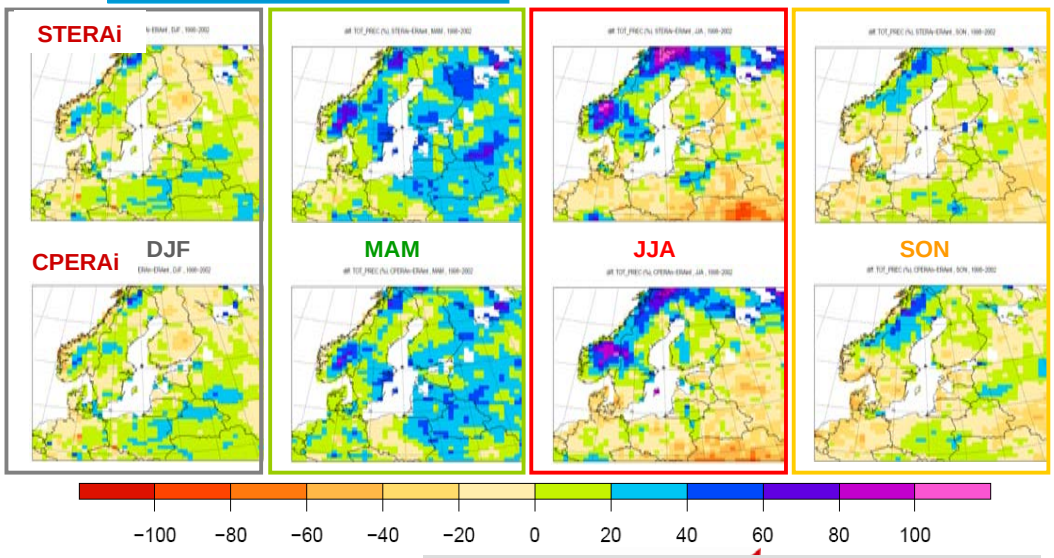
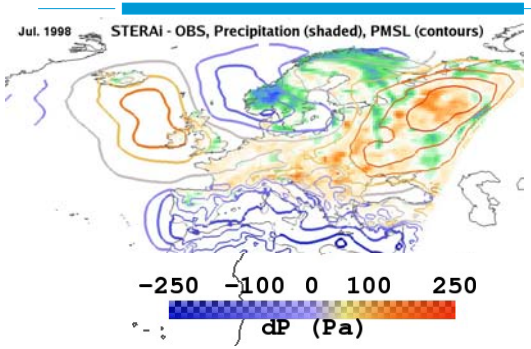
Difference of monthly precipitation [%], 1998 - 2002

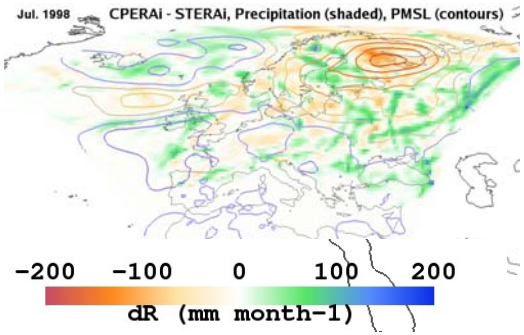


EXPs - WATCH data → COSTRICE mostly reduces biases of the control run

CTR – OBS



CPL – CTR



OBS:
- Precipitation: WATCH data
- PMSL: ERA-interim

➢ STERAi: summer rainfall is overestimated over Baltic catchment (Norway, Sweden), underestimated over Southern & Eastern Europe.

Reason ? NAO is more intensified ?

➢ CPERAi: reduces rainfall biases due to changes of circulation.

- COSTRICE1.0 has capability to reproduce SST and sea-ice over the Baltic Sea and the North Sea.
- Include a sea ice model within the coupled system to improve the simulation of skin temperature over the ocean in winter.
- Simulation of SST over North Sea is affected by Atlantic that needs longer spin-up time.
- SST simulation of COSTRICE over Baltic and North Sea also influences the simulated climate over adjacent areas via circulation.
- Air-ocean-sea ice interactions and feedbacks were reproduced in the coupled system, which lead to some improvements in the simulated climate. However, a more robust conclusion will be made after the assessment of a long term simulation.

1. **Spin-up TRIMNP**: 30 yrs (1958 – 1988), initialize & update LBC ocean temperature, salinity, currents in deep layers using the ECMWF operational Ocean Re-Analysis System 4 data (ORAS4, 1 x 1^{o}, monthly, available data: 1959-2011).
2. **COSTRICE2.0**: Upgraded TRIMNP2.5, the latest version of CCLM (5.0???), using the coupler OASIS3-MCT.
3. **Coupled**: long-term run for 23 yrs (1989 – 2011), higher resolutions (0.11 x 0.11 deg. CCLM, 3 km TRIMNP & CICE).
4. **Outlook:** A hydrological discharge model is recommended to be coupled into the system COSTRICE in the future.

Thanks for your attention !