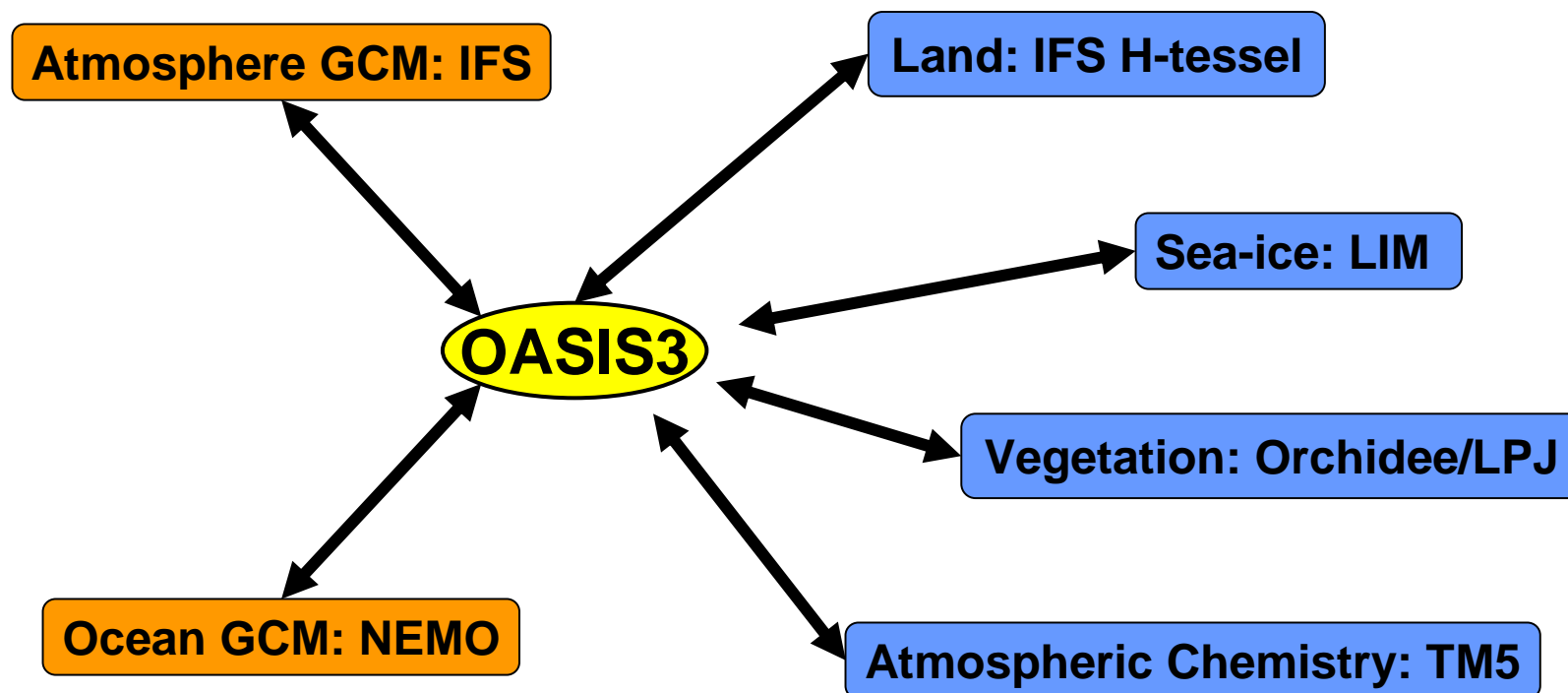# NEMO + LIM + IFS + OASIS = EC-Earth

Andreas Sterl, KNMI

- European Earth System Model based on ECMWF Models (Seasonal Forecast System)

- Consortium of several European Institutes (23 at the moment), led by KNMI

- Open to any ECMWF member state institutes

- EU-FP7 projects:
  - THOR
  - COMBINE
  - IS-ENES

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# EC-Earth

## Basic configuration:
- IFS T159L62 (cycle 31r1)
- NEMO2.0
- ORCA1 (1 degree)
- LIM2

## Development (SMHI):
- NEMO3.0
- LIM3

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# Current State

- coupled system running

- extra parameterizations + modules
  - gravity wave drag )       from
  - (dry) mass conserving advection )   IFS cycle 33
  - H-TESSEL
  - indirect aerosol effect (in progress)
  - snow albedo

- preparing for AR5 runs

- upgrade NEMO3/LIM3 in preparation

- coupling to chemistry in preparation

- according to Reichler & Kim (2008) performance index better than average AR4 model (≈ 0.93)

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# Coupling - OASIS

- oce -> atm: SST, IST, albedo, ice thickness, ...
- atm -> oce: fluxes (heat, water, momentum)
- complication: IFS has 'tiles'
- => fluxes must be conserved per tile type: $\Sigma_i A_i f_i^t F_i^t$
    - $A_i$: surface area of grid cell i
    - $f_i^t$: fraction of this grid cell covered by tile type t
    - $F_i^t$: flux in this cell per file type t
- transfer $f_i^t F_i^t$ and $f_i^t$ separately
- divide to get flux: $F_i^{t*} = (f_i^t F_i^t)^* / f_i^{t*}$
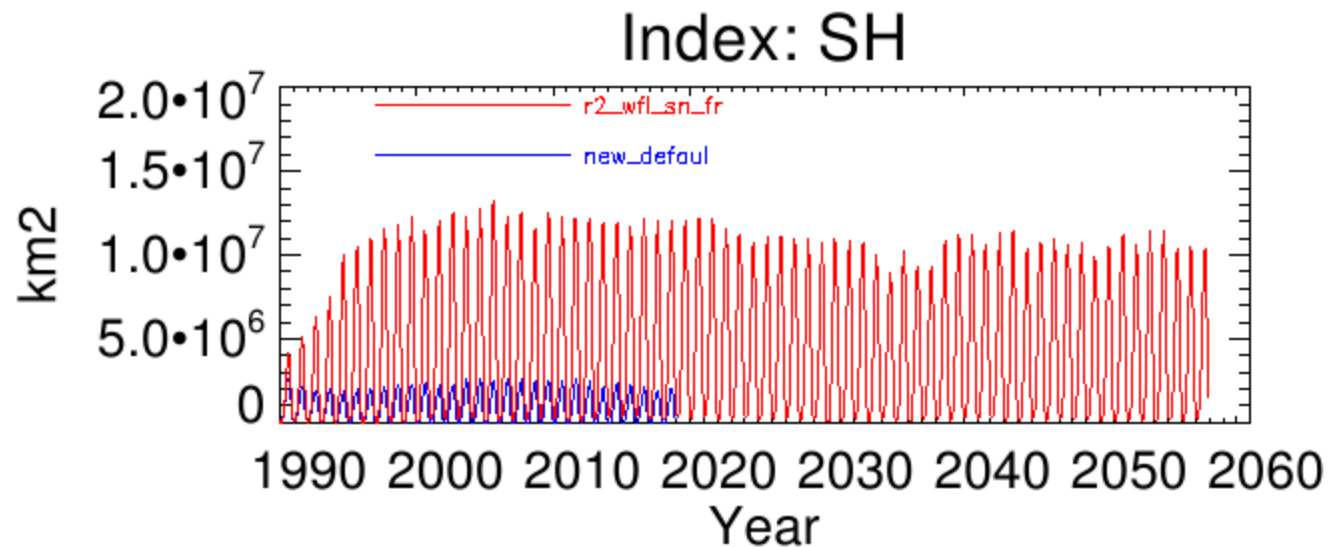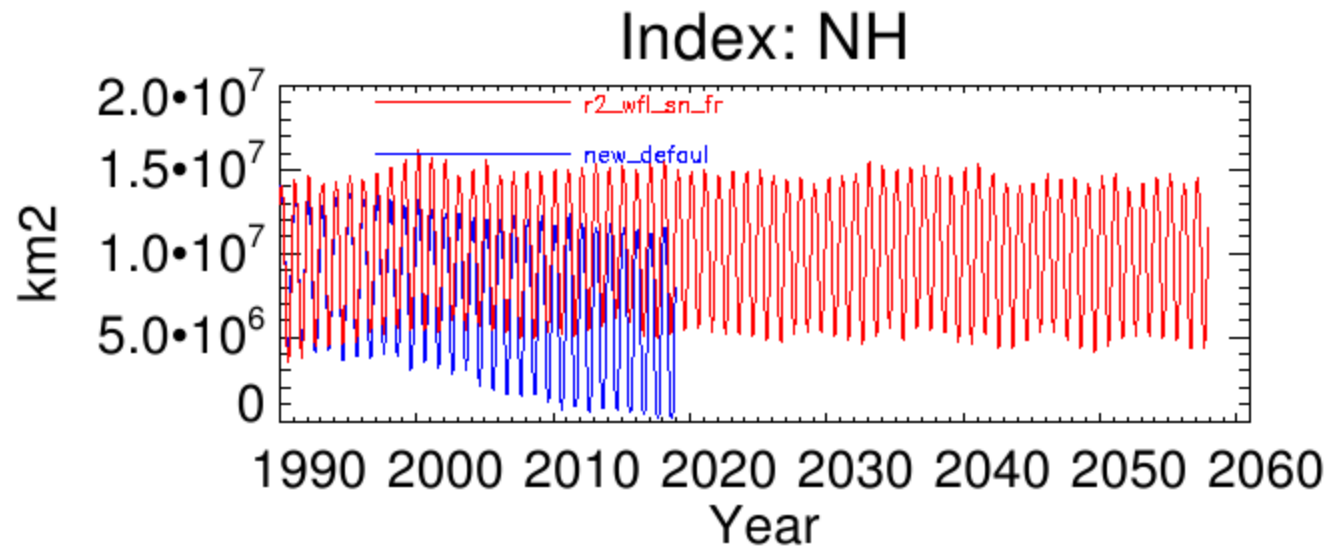- 1$^{st}$ order conservative regridding

# Coupling (II)

- The land-sea masks in IFS and NEMO are not identical.
  - No conservation of fluxes
- In the polar regions the NEMO grid has a much higher resolution than IFS
  - Local T much different from $T_{ave}$ used to calculate flux
  - Linear correction over sea-ice
  - Not flux conserving (additional global correction)
- implementation of 1st order conservative mapping not conservative, requiring a global correction:
  - unphysical transport
  - effect on global-mean Temp after 8 years
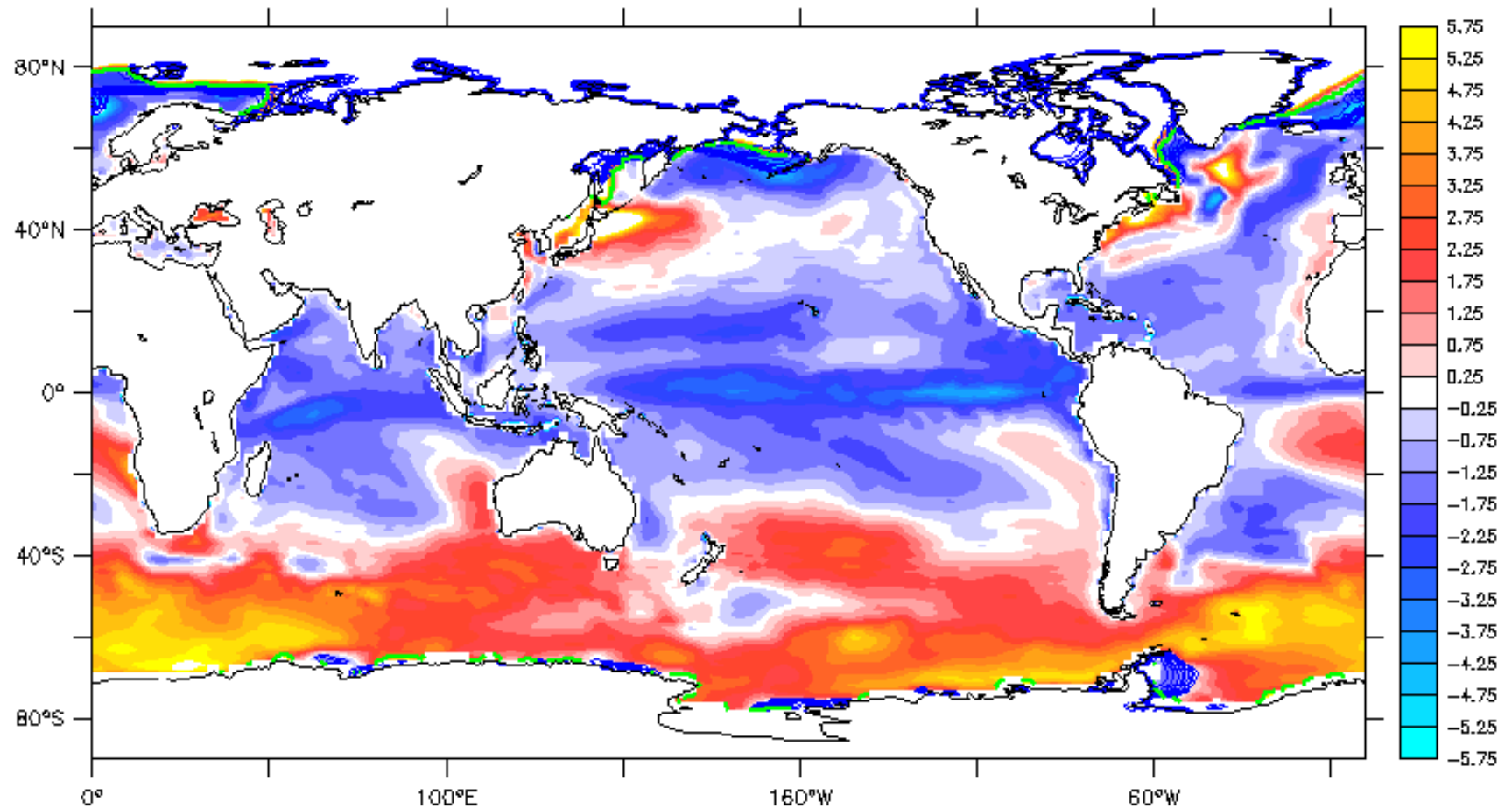
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# SSH – freshwater leakage



Sea Surface Height (m)

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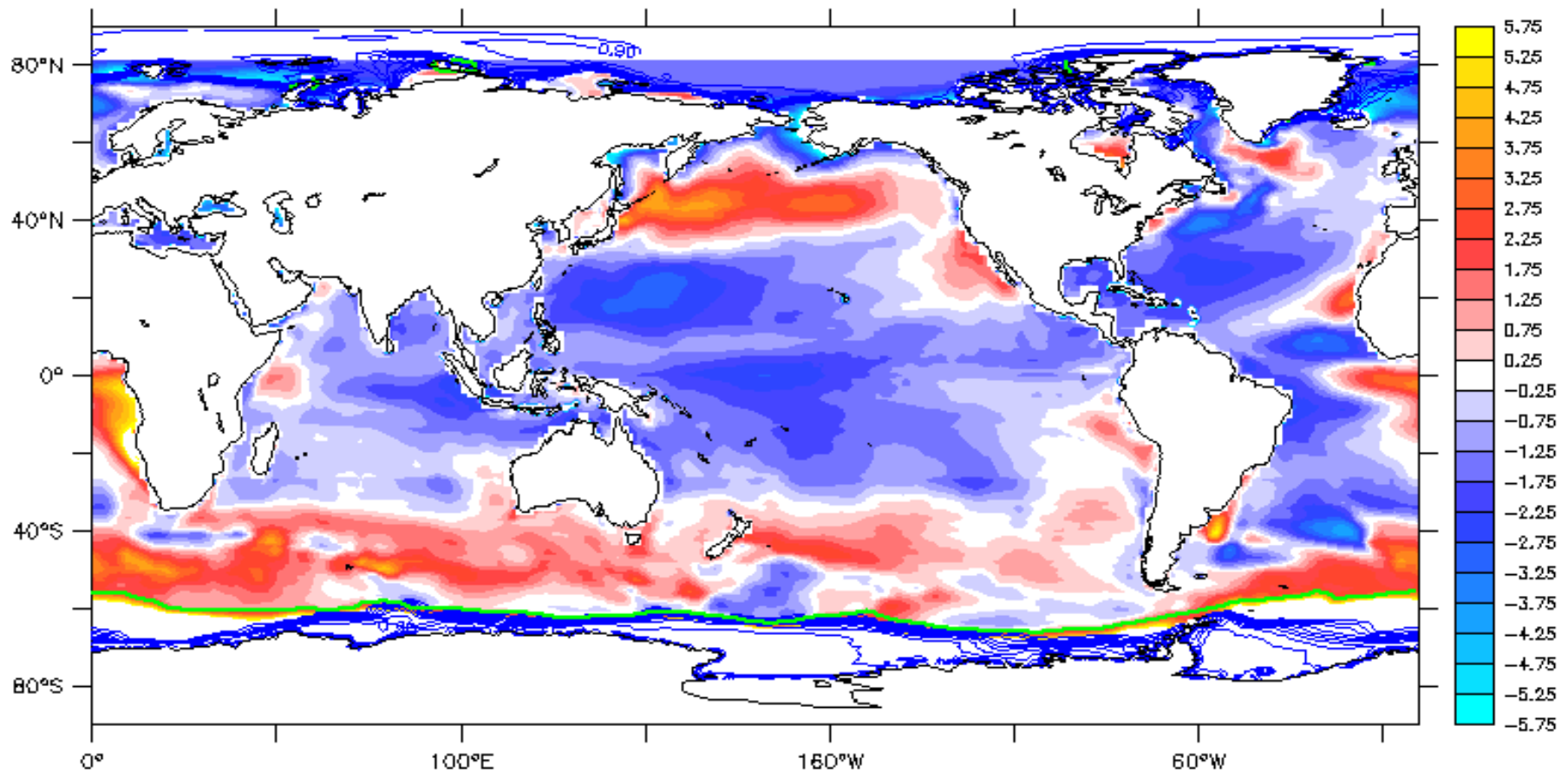
# Sea Ice Coverage

# SST bias - Jan



this kind of SST bias in the ACC region is also seen in other coupled models using NEMO

# SST bias - July



this kind of SST bias in the ACC region is also seen in other coupled models using NEMO

# **Conclusions**

- EC-Earth new ESM, based on IFS, NEMO and LIM
- open to partners from other ECMWF member states
- not completely closed
- results look reasonable (better than average AR4 model)
- large SST bias in ACC
- start AR5 runs soon

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