

Projects and Experience at IFM-GEOMAR and MPI-M

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Outline

- **Overview of our Projects**
- **Experience worth sharing**
- **Future plans**
- **Recommendations/Requests**

Projects

- **MPI-M climate model**
 - IPCC climate simulations
 - Seasonal - to - Decadal hindcasts
 - And many more
- **Kiel Climate Model (ECHAM5/NEMO)**
 - T31 climate simulation
- **OASIS3/4 as interpolator**

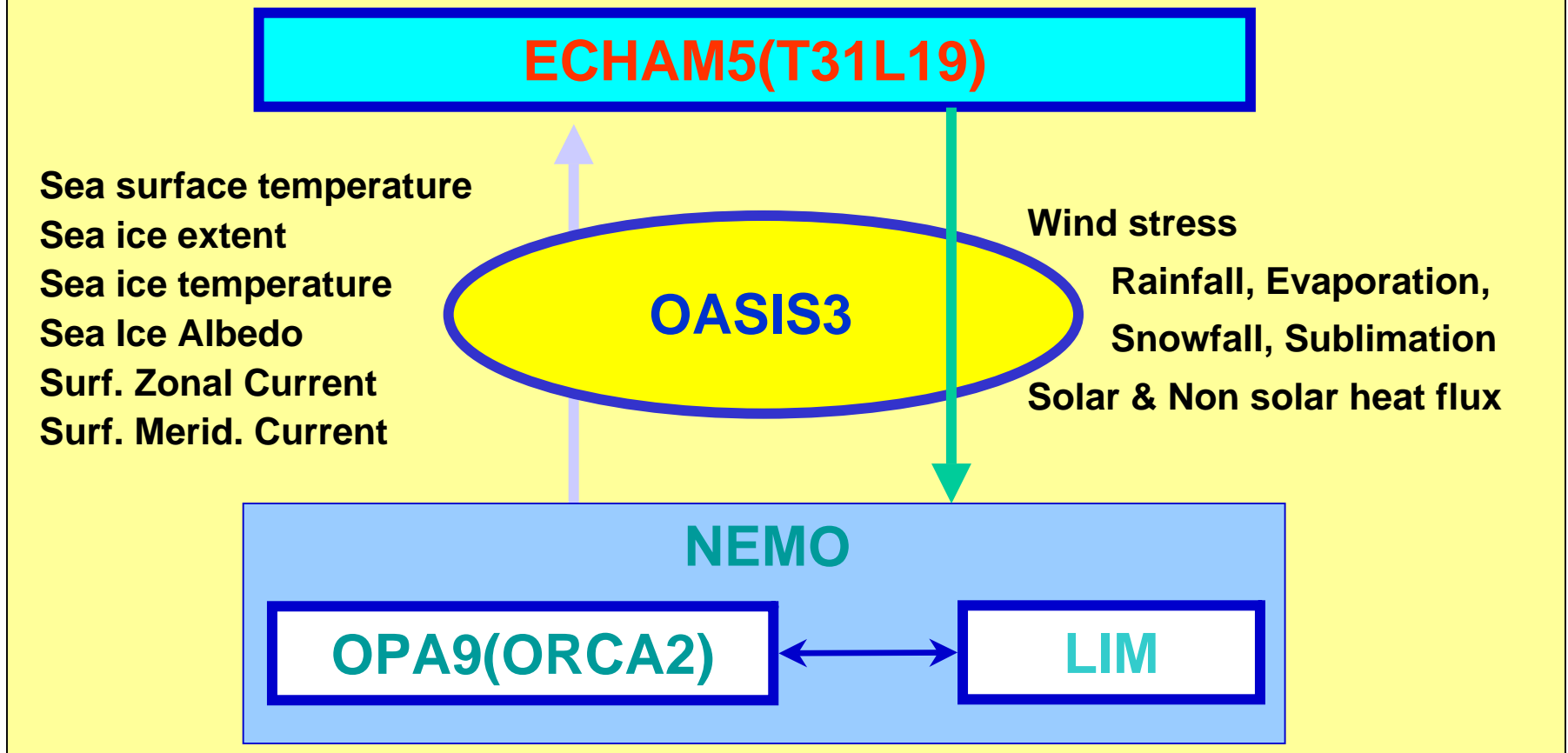
Extent of PRISM usage

What we use:

- OASIS3 coupler
- Compile and Run environments
- Stand alone interpolator

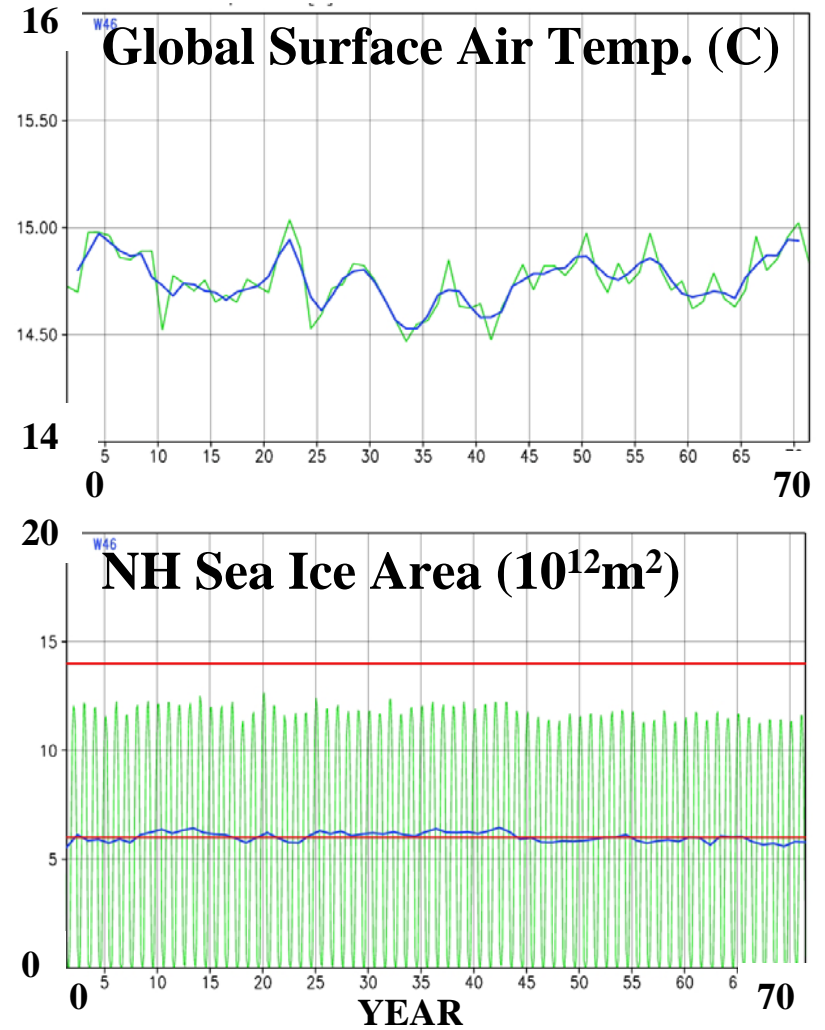
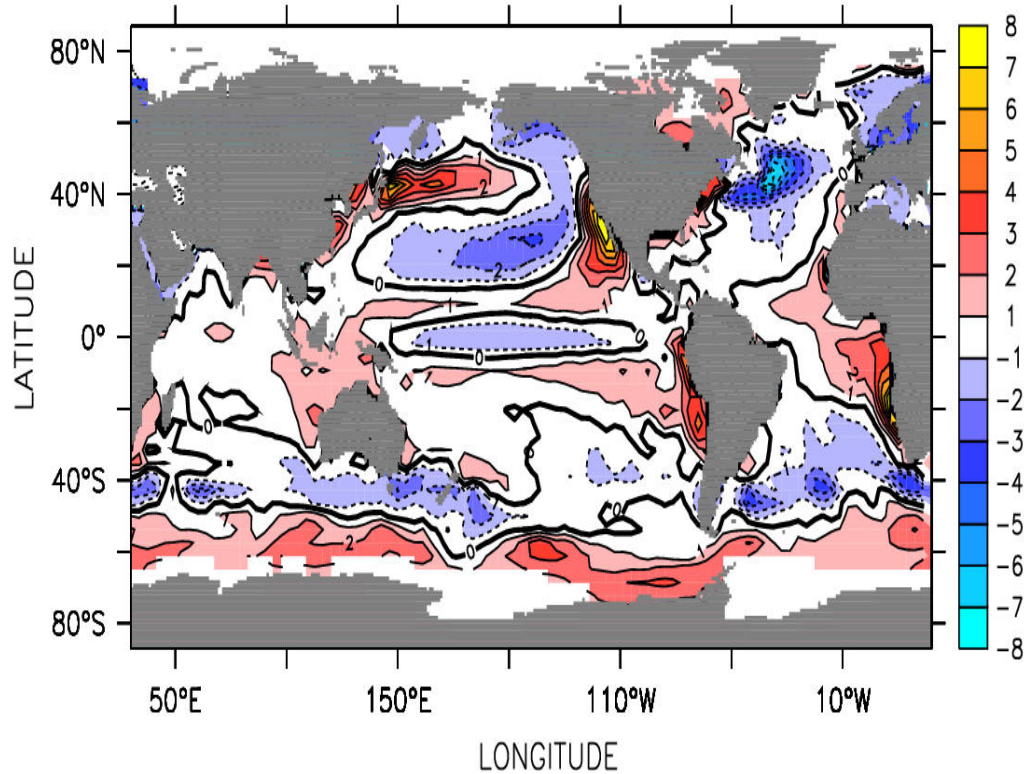
Building a new climate model

KCM - Kiel Climate Model



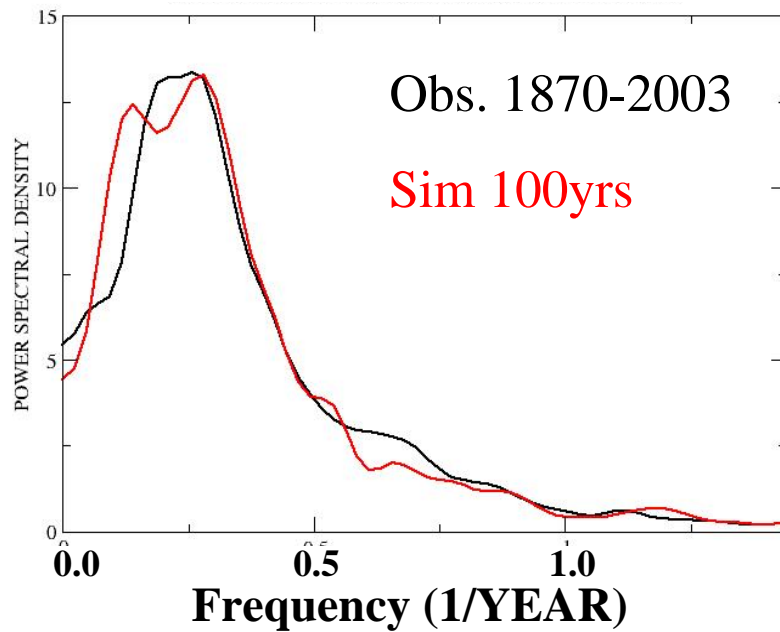
KCM – Mean Climate

Mean SST Bias relative to Reynolds OI

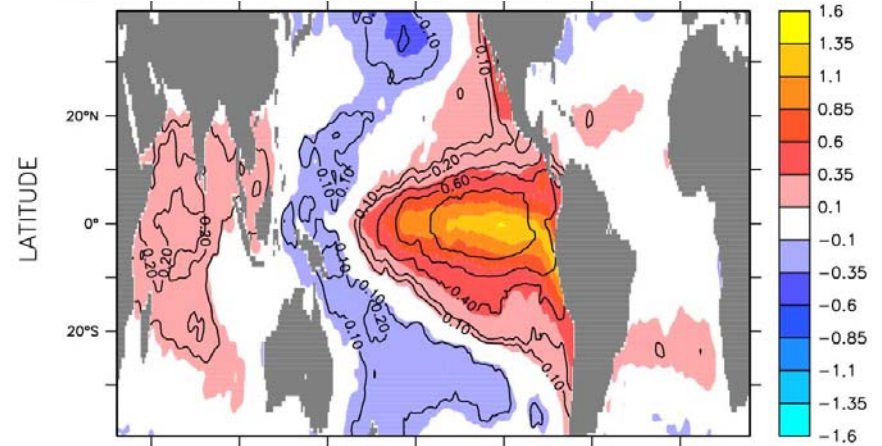


KCM – ENSO variability

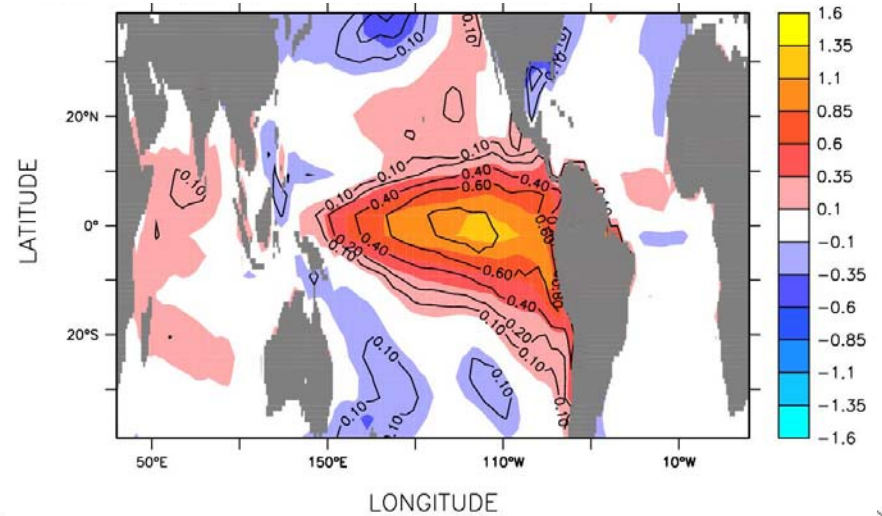
Nino3 SST Spectrum



Obs. SST Regression Pattern



Model SST Regression Pattern



Building a new climate model – Easy or Not?

- Technical Vs Physical Interfaces
- Technical
 - grid (corner) definitions
 - vector rotation
 - root or parallel exchange
- Physical (physical exchange fields)
 - Design and then implement it into the separate components

Building a new climate model – Physical Interface

- The physical interface problem means it is not trivial to couple models, e.g., the sea ice problem

How could this be improved

- Technical report series on Coupling
- Separating Technical and Physical aspects in the component models
- Models providing adaptable physical interfaces
- Sharing technical interfaces (e.g., Rene's NEMO interface)

MPI IPCC simulations— Performance Issues

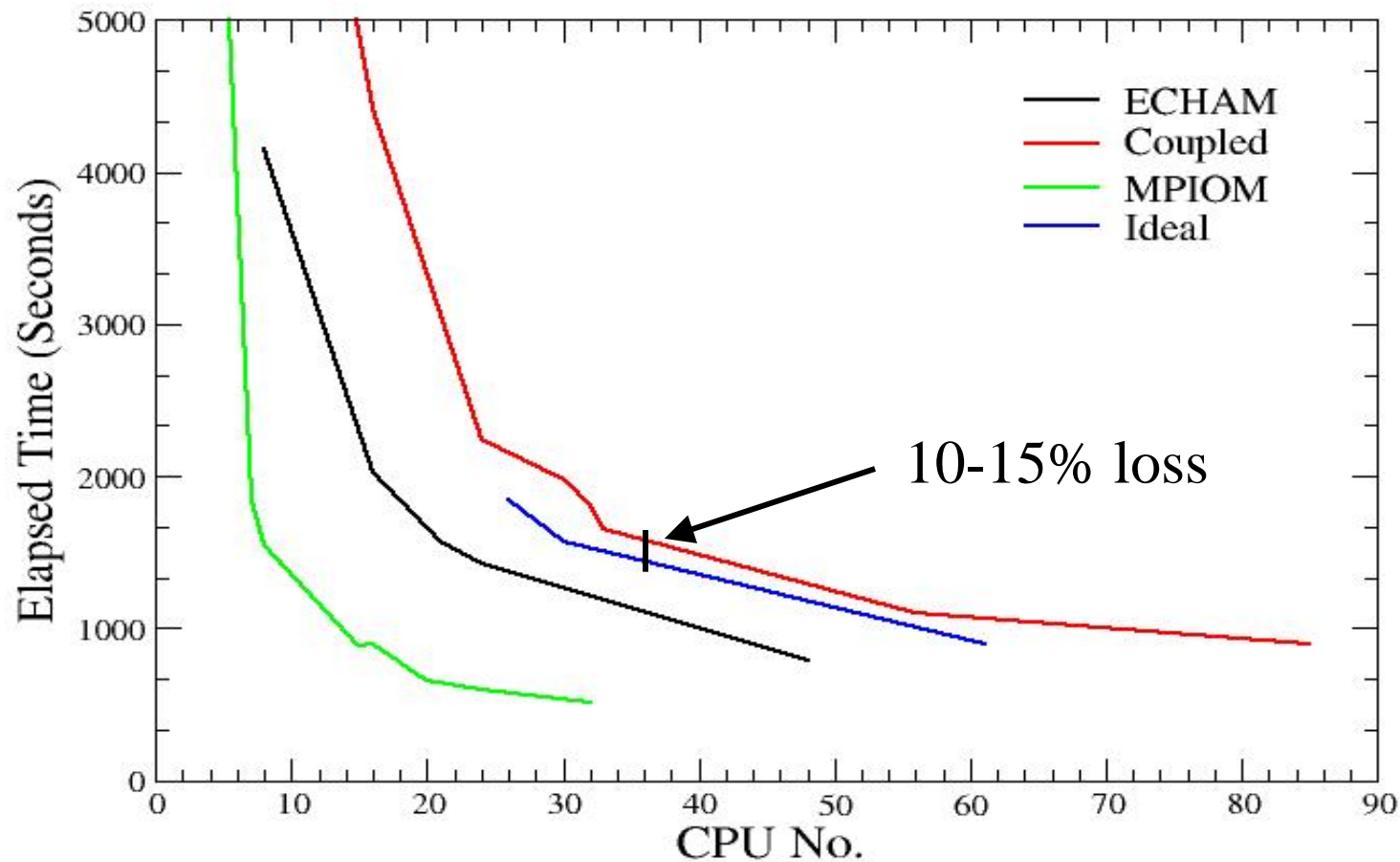
- Consisted of Extensive set of simulation
- Cost - 6 SX-6 nodes for 1 year

Better Performance can be Achieved

- Optimizing individual components
- Load balancing between components
- Minimizing time needed for coupling

Load Balancing a Coupled Model

Elapsed Times for 1 month simulation vs CPU No.



Coupler CPU time

- OASIS3 uses approx. 15% of the CPU time
 - Cost for IPCC scenarios alone 320,000 Euro

(Note added after the Community meeting: 15% is the total CPU overhead of the coupled system; it may include some CPU spent while waiting for data, due to load unbalance; it does not mean that the OASIS3 interpolation process uses 15% of the total CPU needed for the coupled system.)
- More efficient Coupler is required especially for high resolution scenarios
- Timing information should also be provided by coupler

ENSEMBLES work – Porting Issues

MPI-AO from NEC to IBM

- MPI2 code to MPI1 code
- New coupling interface for MPI-OM
- Porting OASIS3 (Luis Kornblueh)

None of these were trivial!

Platform independence of PRISM environment

- When it works it is great!!
- When it doesn't then it can be time consuming to identify problems
- Porting of environment is time consuming
 - Better separation between OS/Compiler/Site required

Oasis3 Vs Oasis4

PROS of OASIS3

- All required interpolation schemes available
- Well tested
- Evaluated
- In current use

CONS of OASIS3

- Poor performance in parallel applications
 - Implementation of exchange via a root process

Oasis3 Vs Oasis4

CONS of OASIS3

- Poor Search Algorithms
 - neighbourhood search done in pre-processing step
 - not efficient for larger fields,
 - **ONE** transformer process for interpolation

OASIS4

- Parallel features implemented, including coupling and search algorithms
- Not well tested and still lacking some essential features (e.g., conservative remapping)

Oasis3 Vs Oasis4 – Interpolation

Global: 2deg. (16200pts) -> 0.5 deg. (259200pts)

- **68 min OASIS3 : 5 min OASIS4**

(Note added after the Community Meeting: those numbers are not exactly the time needed to perform the interpolation; they also include reading and writing of 365 data sets to files before and after the interpolation.)

Reason: Different neighbourhood search algorithm.

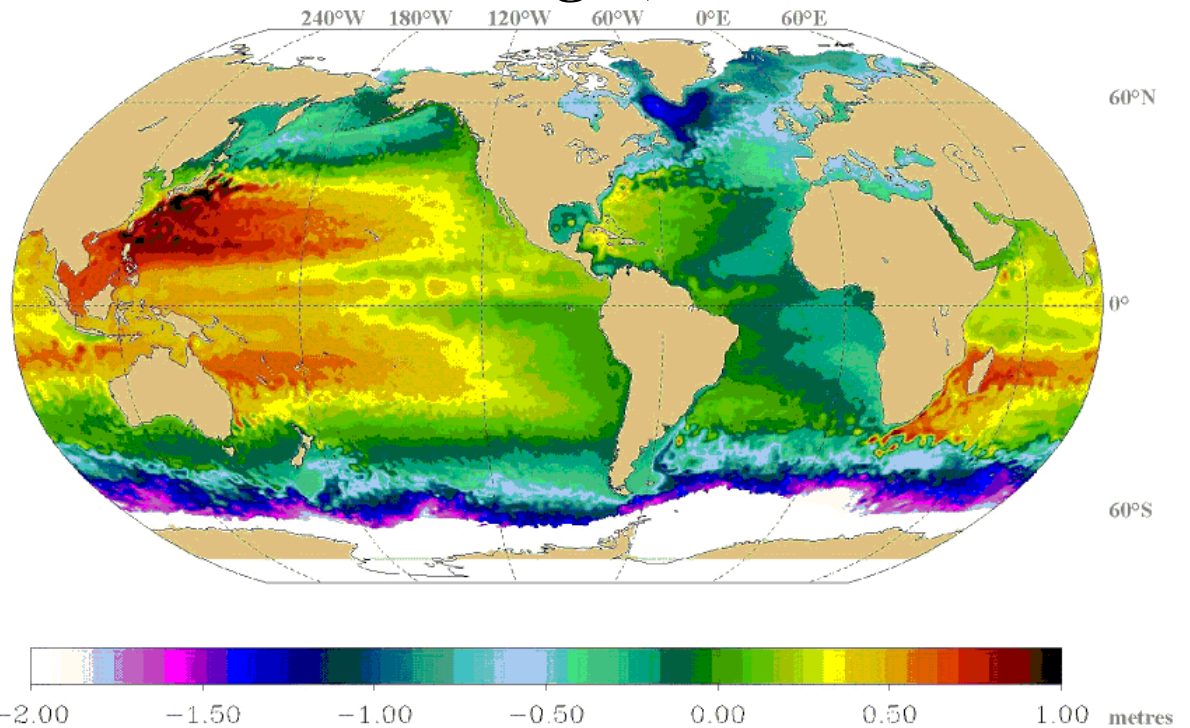
OASIS4 uses a multi-grid algorithm (Parallel)

- **$O(N^2)$ OASIS3 : $O(N)$ OASIS4**
 - Etopo5/120 ->ORCA05 vs. ORCA2 : **11.3/13.4**
(ORCA05/ORCA2 : 13)

Parallelisation allows interp. of high res. grids

Future Plans at IFM-GEOMAR

Sea Surface Height, ORCA025



Higher resolution

- T31L19 -> T106L31

- ORCA2 -> ORCA05

Coupled simulations with regionally enhanced oceanic res.

Summary/Recommendations

We are happy to have and use something like PRISM and OASIS

It would be good to have more:

- Support on Porting
- Community Support on Coupling Activities
- Simplification/Streamlining of run and compile environments
- Load balancing issues (for OASIS4)