ENES and PRISM
A European approach to Earth System modelling

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and the PRISM team across Europe

Outline:

- ENES, distributed network for earth system modelling
- The PRISM project
- Future
Europe and climate research

• Societal/political needs in Europe high (IPCC, mitigation,...)

• Recognized excellence in climate research:
  - variety of institutes at national level
  - key scientific diversity (models, approaches,...)

• Upcoming challenge:
  - integration of earth system modelling efforts
  - modularity (scientific & technical)

• Increasing international collaborations (US, Japan)
How to optimize Earth System modelling in Europe?

- Need for infrastructures up to the challenge:
  - software (PRISM)
  - hardware

- The « One-big-centre-does-it-all » not suitable:
  - expertise lies within historic centres
  - flexibility is key to research

- Efficiency and costs require sharing infrastructures
ENES: European Network for Earth System modelling

- «Think tank » to organize, plan and seek funding for efficient distributed Earth System modelling in Europe
- Follows a EuroClivar recommendation
- Open to any institute/industry (MoU)
- Coordinated by Guy Brasseur (MPI, Hamburg)
- 60 members so far (http://enes.org)
PRISM: Program for Integrated Earth System Modelling

- Funded by the European Commission FP5 (4.8 M€)
- 22 partners: leading climate research institutes and industrial partners

Coordinators: Guy Brasseur (MPI, Hamburg)
and Gerbrand Komen (KNMI, Amsterdam)
PRISM Director: Reinhard Budich (MPI)
Chair System specifications: Eric Guilyardi (CGAM/Univ. Reading)
Software structure of an Earth System Model

Running environment

Coupling infrastructure

Scientific code

Supporting software

Share

Keep diversity
Towards standard ESM support library(ies)

Today

Earth System model (Science + support)

Fortran Compiler

Hardware

Tomorrow

Earth System model (Science)

Standard support library

Fortran Compiler

Hardware

Modeler

Vendor
PRISM Goals

• Provide software infrastructure to
  – easily assemble earth system model components
  – launch/monitor complex/ensembles earth system models
  – access, analyze and share results across the community

• Share development and maintenance of HPC issues

• Help scientists spend more time on science!

• Define and/or promote community standards to
  – increase scientific and technical modularity
  – ensure HPC performance on a variety of platforms
**The science:**
- General principles
- Standard physical interfaces

**The technical developments:**
- System architecture
- Coupler and I/O
- Software management
- Vizualisation and diagnostics

**The users:**
- GUI interface
- Configuration editor
- Diagnostics outputs

**The participating models:**
- Atmosphere
- Atmos. Chemistry
- Ocean
- Ocean biogeochemistry
- Sea-ice
- Land surface
- ...
PRISM standards

Scientific:  Global parameters
            Physical interfaces

Technical:  Coupler and I/O
            Data format and grids
            Architecture and user interface
            Archiving and postprocessing
            Coding and quality

Collaboration with other groups (ESMF, ESG/NOMADS, ES, CF...)

Let’s not re-invent the wheel!
A recommendation for standard physical interfaces

**Atmosphere model**

1. Rainfall + int. energy
2. Snowfall + int. energy
3. Solar zenith angle
4. Fraction of diffuse solar radiation
5. Downward infrared radiation
6. Sensitivity of atmos temp. & humidity to surf. fluxes

**Surface layer turbulence**

1. Surface pressure
2. Air temperature, humidity and wind
3. Wind module
4. Height of these 4 variables

**Ocean surface module**

1. Non solar heat flux
2. Solar radiation
3. Fresh water flux
4. Salt flux
5. Wind stress
6. Mass of snow and ice

**Sea ice model**

1-2 Temp./Salinity at sea-ice base
3- Surf. radiative temp.
4- Surf. ocean current
5- Surface ocean current
6- Absorbed solar radiation

**Wave model**

1. Surf. Temp
2. Surf. Roughness
3. Displacement height
4. Surface velocity

**Land surface model**

1. Continental runoff + internal Energy

**Ocean model**

Note on subgrid fraction dependance:

<>*- Sea Ice categories (incl. open ocean)
<>*- Sea Ice or Land Surf. categories

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Iceberg parameters

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1* - Sensible heat flux
2* - Surf. emissivity
3* - Albedo, direct
4* - Albedo, diffuse
5* - Surf. radiative temp.
6* - Evaporation + int. energy [+ Q_{lat}]
7* - Wind stress
8* - Subgrid fractions

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Technical standards: PRISM coupler & I/O = OASIS*

10 years of expertise
Wide international use

driver
communicator
interpolator/transformer

*Sophie Valcke (CERFACS)
Technical standards:

- Standard compiling and execution environment (GNU)
- PRISM central server
- Adapt ECMWF’s PrepIFS GUI and SMS scheduler

Architecture** and GUI**

*Stefanie Legutke (MPI)
**Nils Wedi/Claes Larsson (ECMWF)
Technical standards: Archiving and data processing

* Mick Carter (Met Office)
PRISM Status

- PRISM System V.0 ready (June 2003)
  = prototype architecture and OASIS V3.0

- Demonstrations with System V.0 underway

- PRISM System V.1:
  - Prototype (PMIOD, GUI) : November 2003
  - Full monty: November 2004
    = OASIS V4.0, GUI+SMS (web),
    + set of coupled configurations
On going PRISM / ESMF collaboration

Earth System Model

Running environment

Coupling infrastructure

User code

Supporting software
Conclusion

- PRISM = Earth System Modelling tool box, based on international standards

- Will help share development and maintenance costs
- Will ensure HPC performance on main platforms
- Will help maintain a key scientific diversity
Upcoming agenda

- PRISM: community involvement and «buy in»
- Sustained PRISM support and maintenance
- Wider international collaborations (ESMF, ES, China,..)
- Extension of PRISM system (CAPRI):
  - interfaces to data assimilation, integrated assessment
  - European-wide data archiving and retrieval system