

# Experiences and projects with PRISM at ECMWF

**Kristian Mogensen (seasonal forecasting)**

**&**

**Johannes Flemming (GEMS)**

# Content of talk

- **Coupling of ocean models with IFS**
  - Operational seasonal and monthly forecasts with HOPE/IFS coupled using OASIS2
  - Moving towards a new system based on NEMO/IFS coupled using OASIS4
- **GEMS: Coupling of chemical transport models with IFS**
  - Work in progress
  - 3D-coupling
- **Use of OASIS4: goals and issues**
- **Use of prepIFS GUI**
- **Conclusions**

## Coupling of ocean models to IFS:

- **Coupling of the HOPE ocean model to IFS with OASIS2**
- **Operational seasonal forecasts:**
  - Once per month, 40 members with 184 days forecast length
  - Coupling frequency: daily
- **Operational monthly forecasts:**
  - Once per week, 41 members with 32 days forecast length
  - Coupling frequency: hourly.
  - Significant overhead in coupling
- **Also used for research:**
  - Research experiments are launched with prepIFS
- **All experiments are monitored with xcdp**

## Coupling of ocean models to IFS: current status 2

- **HOPE is shared memory (OpenMP) parallel only**
- **IFS is MPI and OpenMP parallel but only OpenMP parallel in coupled mode**
- **IFS/HOPE will form the basis for our next operational seasonal forecasting system (system 3) but is not going to be further developed**
- **Coupling of the OPA 8.2 ocean model to IFS with OASIS2**
  - Used for research experiments only
- **Common features for IFS/HOPE and IFS/OPA:**
  - All coupling is 2D only
  - Coupling is done via signal files and files
  - Shared memory (OpenMP) parallel set-up only

# The future of coupled ocean/atmosphere modelling at ECMWF: long term plans

- **The following strategy decisions have been made:**
  - The HOPE model will be replaced by the OPA model version 9.0 (NEMO)
  - The current OASIS2 coupler will be upgraded
    - OASIS4 is the preferred solution
    - OASIS3 is a fallback solution
  - The assimilation system will be replaced by a variational data assimilation system based in OPA developed at CERFACS
  - Installation of the components is ongoing
- **Long term development for system 4 and above**
- **It is possible that the coupled system will also be used for medium range weather forecasting in the future**
  - Efficiency is very important

## The future of coupled ocean/atmosphere modelling at ECMWF: short term plans

- **For the MERSEA project we might need a new setup with OPA 8.2**
  - Another version of OASIS might be used here (shorter time-frame)
  - Will (among other things) investigate high resolution coupled IFS (T511L60/T799L91) with OPA (ORCA025) for medium range forecasting
- **Primary a research project but experiences from MERSEA will be useful for future operational systems**

# GEMS

Global and regional Earth system Monitoring using Satellite and in-situ data

- **Assimilation of satellite data on atmospheric composition in IFS**
  - Data assimilation
  - Modelling (transport, sinks and sources)
- **Global Greenhouse gases (GHG)**
- **Global Aerosol (AER)**
- **Global Reactive Gases (GRG)**
- **Regional air quality (RAQ)**
- **Production System (PRO)**
- **Validation**
- **GEMS runs till 2009**
  - Operational production (forecast&analysis) is planned for 2007-2008
  - Semi-operational in summer 2006

# GEMS at ECMWF

- Production of Forecasts and Re-analysis of satellite chemistry data by IFS 4d-VAR
- Include species in IFS transport scheme
- Tendencies (chemistry, emission, deposition) have to be modelled

- **Integrated system**

- Approach in GHG and AER
- Include subroutines describing the processes
- Consistent with IFS structure
- Increases the complexity of an already complex system

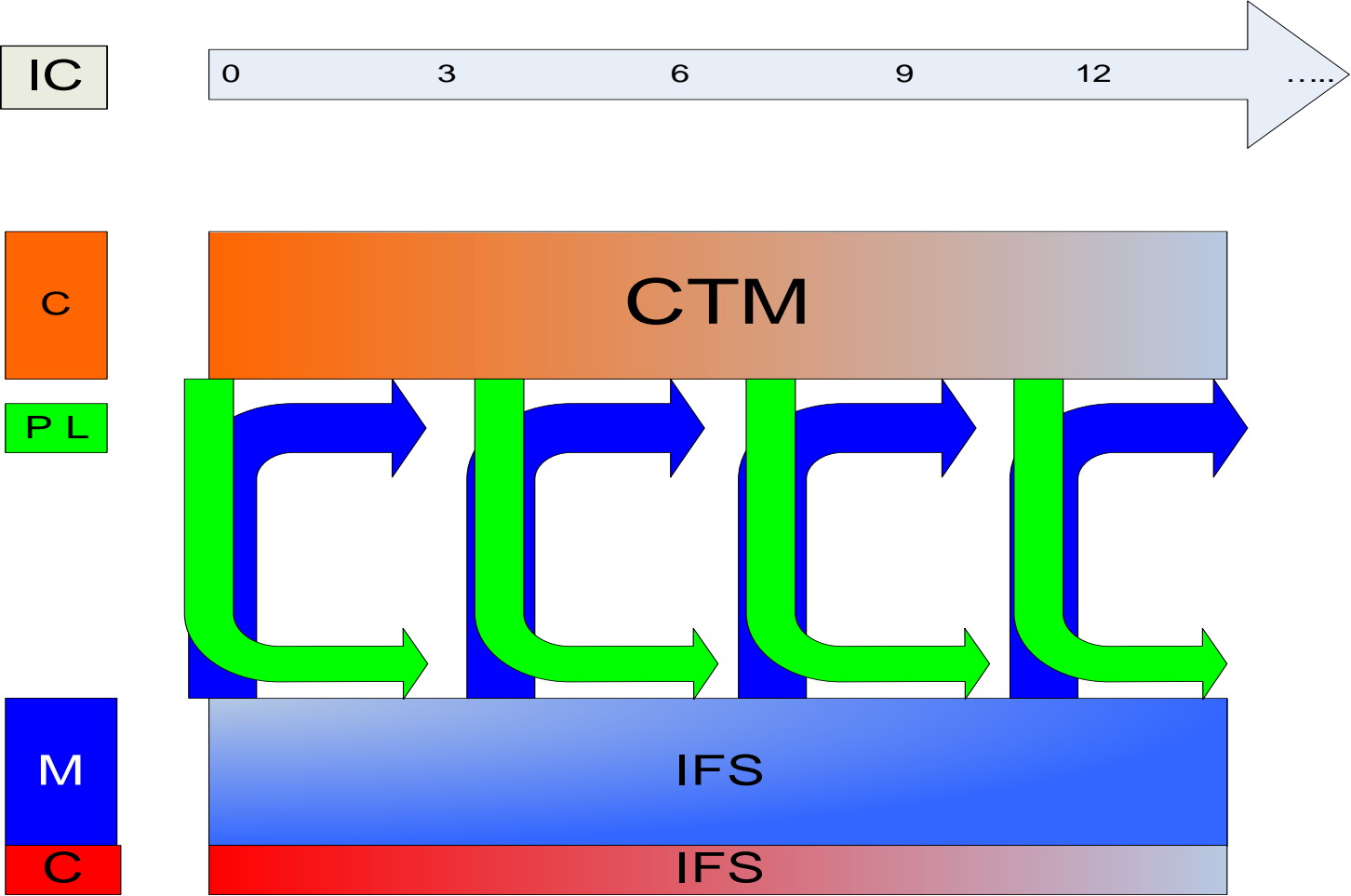
- **Coupled system**

- Approach in GRG
- Couple CTM by well defined interfaces
- Less limitations due to memory constrained
- More flexibility and independence
- Consistency problems

# GEMS GRG-modelling

- **Chemical mechanism with > 50 species can hardly be incorporated in IFS**
- **Couple IFS with CTM (MOZART, TM, MOCAGE)**
- **Include only O<sub>3</sub>, CO, NO<sub>2</sub>, SO<sub>2</sub> and HCHO in IFS (assimilation and transport)**
- **2-way data exchange**
  - **Production and loss rates (tendencies) due to chemistry, emission and deposition from CTM to IFS**
  - **Meteorological data from IFS to CTM**
  - **Assimilated chemistry fields from IFS to CTM**
- **Fields are 3D on sigma-hybrid coordinates**

# Coupling in Forecast mode



# Use of OASIS4: goals and issues

- **The OASIS4 interface in IFS should be the same both for seasonal/monthly forecasting and for GEMS**
  - So far most work has been for GEMS
- **Several different CTM's are going to be coupled to IFS with OASIS4**
  - prepOASIS is going to be useful for setting up the coupling
- **Only one ocean model (NEMO/OPA9) is going to be coupled to IFS**
  - We are still going to experiment with e.g. :
    - Frequency of coupling
    - Resolution of both ocean and atmosphere models
- **In the long term it is very important to have a highly parallel efficient way of coupling.**

# Scheduling issues in coupled models

- **The fundamental compute resource concepts for the IBM loadleveler is:**
  1. Number of nodes
  2. Total number of tasks
  3. Number of threads per task
- **In a OASIS4 coupled system you have in general:**
  1. OASIS4 running with a number of tasks and a number of threads per task (only 1 at present, but ...)
  2. A number of component models each with a specific number of task and threads per task
- **If the optimum number of threads in each component model is different a non trivial loadleveler setup has to be used.**
- **Computer vendors should think about coupled models**
- **Not just an IBM issue**

## prepIFS/xcdp in everyday use

- **The prepIFS tool is used to setup and launch research experiments**
- **The xcdp tool is used for monitoring of both research and operational suites**
- **Lots of experiments with IFS are launched everyday by both ECMWF internal users and external users**
- **It is extremely easy for a user to monitor and control both his/hers and other users experiments**

## Conclusions and outlook:

- **ECMWF have a long experience in coupled ocean/atmosphere modelling**
  - But our current setup are getting old and is not really suitable for future requirements
- **GEMS sets new challenges for ECMWF**
- **We are planning to make extensive use of OASIS4 both for IFS/NEMO and IFS/CTM coupling**
- **OASIS4 is for us the most important part of PRISM**
- **The preplIFS/xcdp tools have proven to be extremely useful to control and monitor experiments**