METEO FRANCE
Toujours un temps d'avance

The IFS / MOCAGE coupling

Implementation issues and status of the development

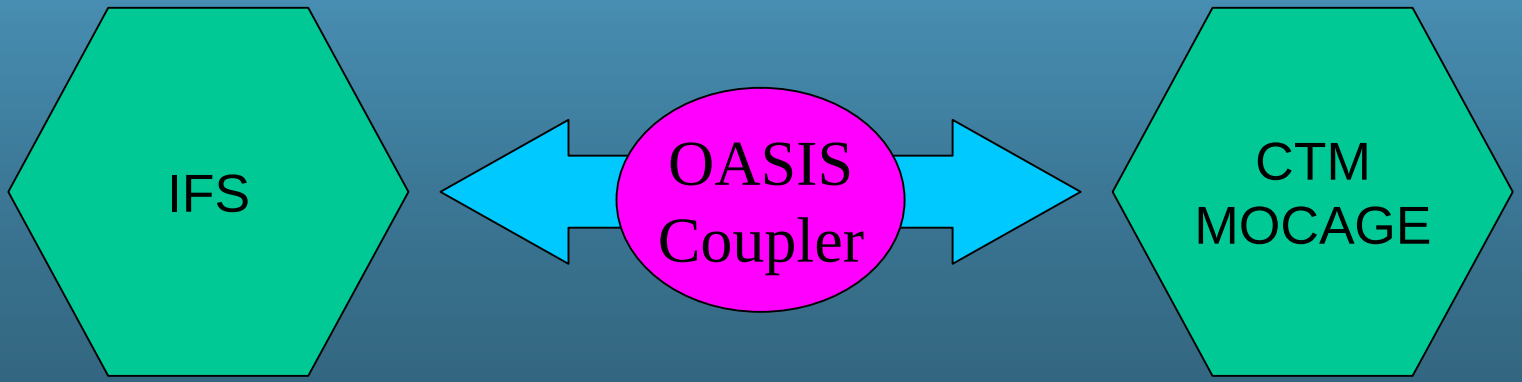
Philippe Moinat / Vincent-Henri Peuch

METEO FRANCE
Toujours un temps d'avance

Choice of the coupling software

- **METEO-FR contributed to the selection of the OASIS4 software to support the coupling of the IFS with the CTMs.**

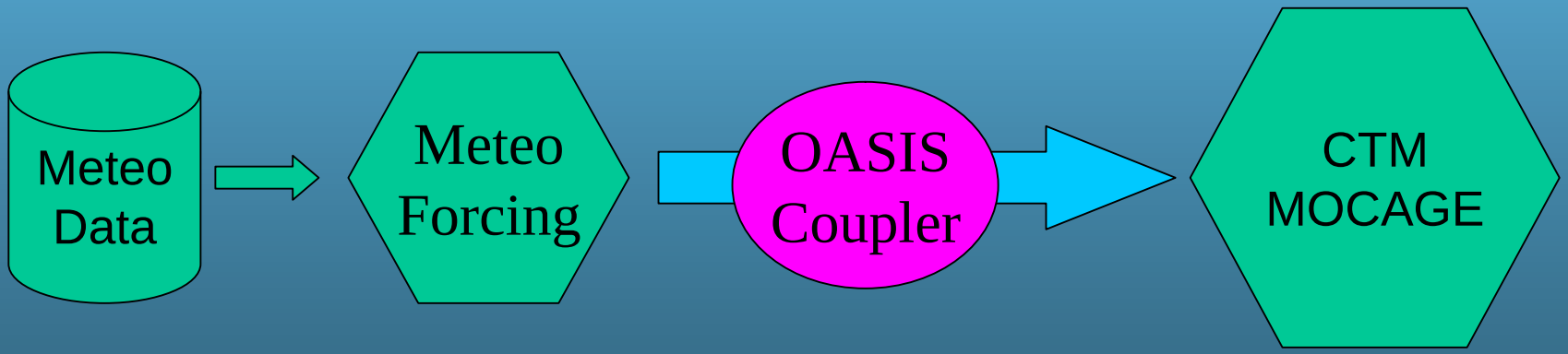
  (October meeting in Reading)



METEO FRANCE
Toujours un temps d'avance

Status of the interface development

- **MOCAGE/IFS interface via OASIS4 is under development.**
  - Interface definition in the fortran code
  - Xml description and configuration (smioc and scc)
- **Implementation on ECMWF HPCD**



  - Done for the serial version. Implementation for the parallel version in progress.

METEO FRANCE
Toujours un temps d'avance

Status of the interface development

- **IFS → CTM Meteo forcing**
  - 3D fields: T (*K*), U (*m/s*), V (*m/s*), W (*Pa/s*), Q (*kg/kg*), Psurf (*Pa*)
  - Vertical coordinate parameters P = ALF+BLF ×Psurf
  - Frequency 6h (adjustable)
- **CTM → IFS Chemical tendencies**
  - To be implemented. Tendency = ([final] – [initial])/Δt
- **IFS → CTM Assimilated Concentrations + Nudging**
  - To be done

METEO FRANCE
Toujours un temps d'avance

Implementation issues

METEO-FR has contributed to the discussion on the first approach to be tested to couple the IFS with the CTMs and advocated JF's first option:

IFS with complete CTM "physics":

<<All "physics" tendencies (diffusion, convection, emission, chemical conversion, deposition) come from CTM. IFS would only advect the tracers. Only one overall CTM tendency field would be necessary, which is in itself consistent.>>

METEO FRANCE
Toujours un temps d'avance

Proposed implementation: summary

- IFS → CTM, every hour, 3D (T,u,v,w,q,P)
- CTM → IFS, every hour, one "**total tendencies**" 3D field per chemical compound considered
- IFS advects its chemical compounds and applies the total tendencies ; assimilation for the different species is done monovariate (from the point of view of chemistry)
- IFS → CTM, 3D concentration fields (analyses or forecasts), sent to the CTM at a lower frequency or applied with a nudging scheme.

METEO FRANCE
Toujours un temps d'avance

Proposed implementation

The CTMs provide one "total tendencies" 3D field per chemical compound considered to the IFS (production and loss rates not exchanged as long as not required for the assimilation).

- All CTM physics included: comprehensive external parameterisation of chemistry
- Simplest approach. First go.
- **Monovariate assimilation** of the chemical variables in the IFS (Multivariate assimilation difficult due to insufficient vertical resolution of the obs.)

METEO FRANCE
Toujours un temps d'avance

Proposed implementation

IFS → CTM, every hour, 3D (T,u,v,w,q,P)

- The possible dislocation problem is minimized with a small coupling time step
- Better to have frequent update of a small number of fields than less frequent update of numerous variables (convective mass-fluxes, 3D rainfall, cloud distribution,... desirable to ensure a full consistency in IFS and the CTMs:).

CTM = comprehensive external parameterisation of chemistry !

METEO FRANCE
Toujours un temps d'avance

Proposed implementation

IFS → CTM, 3D concentration fields sent to the CTM at a lower frequency or applied with a nudging scheme.

- Low frequency "synchronisation" of IFS and CTM concentrations (~ 1 / day depending on typical separation time of IFS and CTM solutions)

- **Or** ~1 hour coupling + nudging

$[C]=[C(CTM)]\times(1-f(t))+ [C(IFS)] \times f(t)$, (f(t) relaxation time ~ 6 or 12 hours. To be tested)

Objective: avoid continuous spin-up of the CTM

METEO FRANCE
Toujours un temps d'avance

GRG WP1 Overview of activities

Task 1.2: Evaluation of chemical formation and loss rates for ozone, NOx, SO2, CO, HCHO, O3 and CH4 from the three CTMs

METEO-FR has contributed to the selection of the OASIS4 software to manage the coupling between the IFS and the CTMs. The use of this coupling software will provide high flexibility and will allow to perform extensive comparisons of the use of the IFS model with the products of one or the other CTMs.

METEO-FR has also contributed to the discussion of the coupling method which aims at making initial choices concerning the fields to be exchanged between the IFS and the CTMs, the frequency of exchange and the way to combine the received fields with the model variables without creating an unbalance of the models. At least for a first go, we advocate the first option proposed by Johannes Flemming, i.e. the CTMs provide one total tendencies of the chemical tracers to the IFS with no distinction between loss and production. In this approach, the CTM is recognised as a comprehensive external parametrisation of the chemistry

In brief, we propose the following implementation for a first go at the coupling between CTM and IFS :

-IFS provides every hour 3D (T,u,v,w,q,P) to the CTM (via OASIS)

-CTM provides every hour one "total tendencies" 3D field to the IFS per tracer considered (via OASIS)

-IFS advects its chemical compounds and applies the total tendencies ; assimilation for the different species is done monovariate (from the point of view of chemistry)

-3D fields in IFS (analyses or forecasts) are sent to the CTM at a lower temporal frequency or with a nudging scheme, so that the differences in these 3D distributions between CTM and IFS stay in a reasonable range.

Task 1.3: Addition of chemical formation and loss rates to the ECMWF assimilation system

The IFS/ MOCAGE interface via OASIS4 is under development. Instead of reading the meteo fields from files, the serial version of MOCAGE can now run at ECMWF with forcing fields provided by a coupled program. The implementation of the same interface but for the parallel version is in progress. The MOCAGE to IFS tracers tendencies sending is still to be implemented as well as the reception of the updated concentrations in MOCAGE.