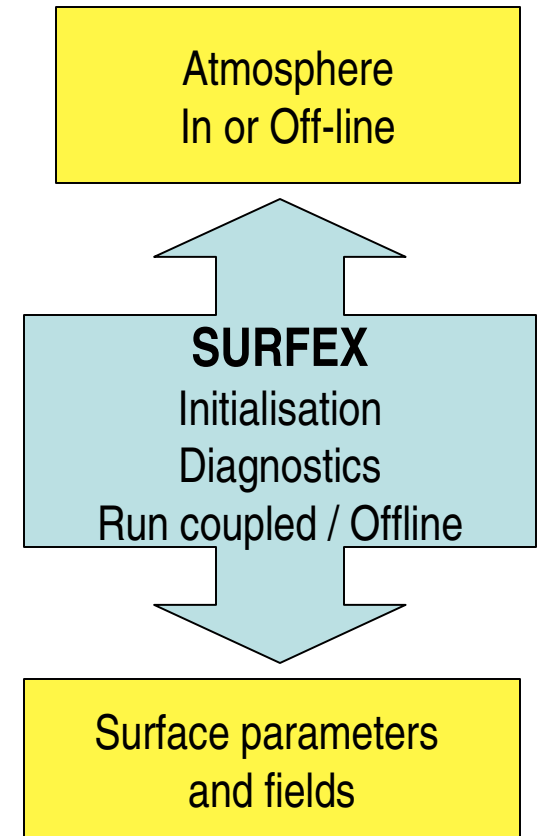


# SURFEX : recent scientific developments and plans

Eric Martin, Patrick Le Moigne, Sophie Belamari, Andrey Bogatchev, François Bouyssel, Aurore Brut, Jean-Christophe Calvet, Sylvie Donier, Véronique Ducrocq, Stéphanie Faroux, Hervé Giordani, Gwenaëlle Hello, Luksa Kraljevic, Pierre Lacarrère, Cindy Lebeaupin Joachim Munoz Sabater, Joël Noilhan, A. Pirani, Jean-Louis Roujean, Claire Sarrat, Yann Seity...

# Summary

- The SURFEX presentations :
  - Scientific aspects (this presentation)
  - Coupling SURFEX and ALADIN (Luksa Krlajevic)
  - Technical aspects (Gwenaelle Hello)
  
- Plan :
  - The SURFEX parametrisations (short)
  - New parametrisations and research work on advanced parametrisations
    - Sea fluxes
    - A-gs (CO2 fluxes and interactive LAI)
  - ECOCLIMAP
  - Assimilation / analysis (few words)
  - Plans for the future



# The Physical schemes



## Sea and ocean :

prescribed SST, Charnock formula,  
Mondon and Redelperger formulation

*Multi campaign fluxes formulations*

(thanks to CNRM/MEMO and MICADO teams)



## Lakes :

prescribed temperature, Charnock formula



## Vegetation and soil : ISBA

(Interface Soil Biosphere Atmosphere)



## Town : TEB (Town Energy Balance)

Canyon approach,

detailed radiation scheme (trapping – shadow effect)

heat storage in buildings

# ISBA physical options

ISBA	Soil	Force restore, 2 layers , temp, water, ice Force restore, 3 layers , temp, water, ice Diffusion, N layers , temp, water, ice
	Vegetation	Noilhan and Planton 89 (~Jarvis) A-gs (photosynthesis and CO2 exchanges) A-gs and interactive vegetation
	Hydrology	no subgrid process subgrid runoff subgrid drainage
	Snow	1 layer, varying albedo, varying density (Douville 95) 3 layers, albedo, density, liquid water in snow pack (Boone and Etchevers 2000) <i>operational ARPEGE/ALADIN scheme</i> <i>(thanks to Andrey !)</i>

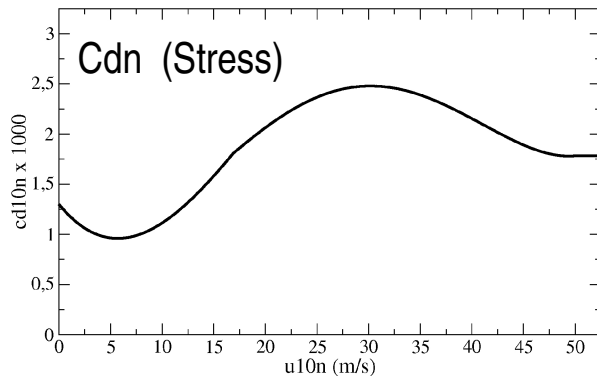




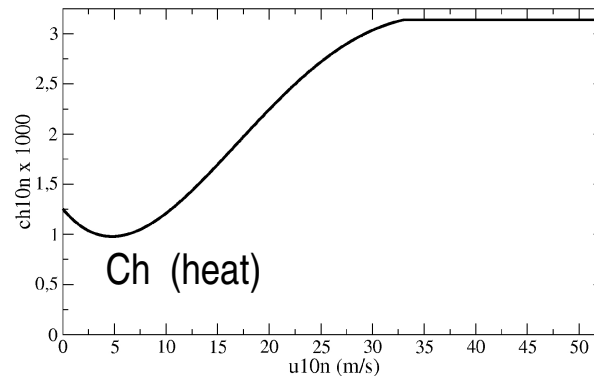
# Parametrisation of sea fluxes

- Provided by the MEMO team at CNRM
- Based on the TOGA-COARE code (Fairall et al., 1996).
- Calibrated using 5 recent experiments under various conditions POMME, FETCH, SEMAPHORE, CATCH, EQUALANT99
- Iterative determination of exchange coefficients (including also gustiness, precipitation correction)

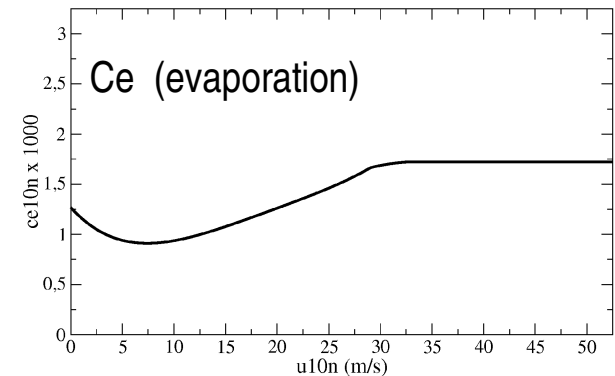
cd10n multi-campaigns calibration



ch10n multi-campaigns calibration



ce10n multi-campaigns calibration

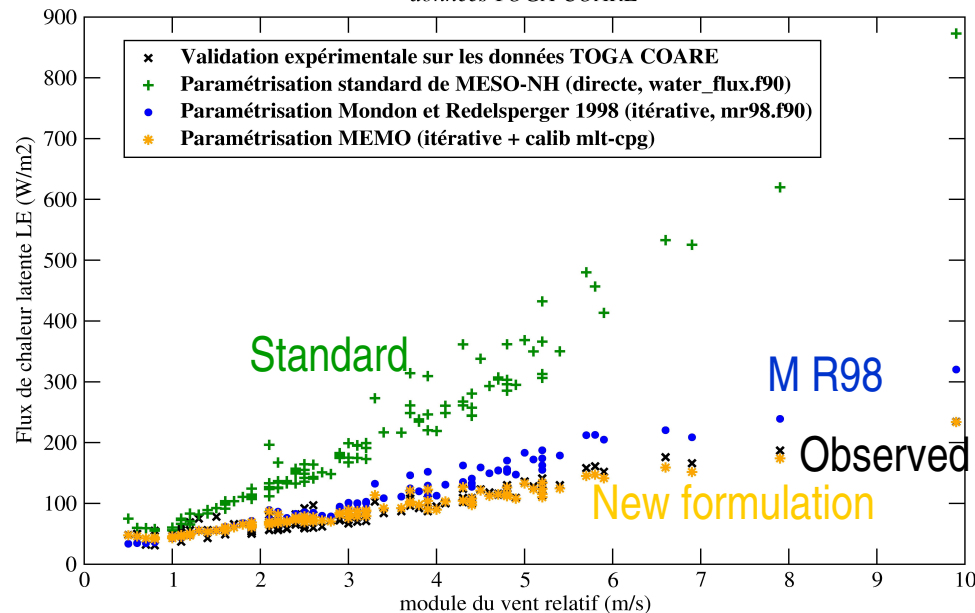


Exchange coefficients as a function of wind speed

# Impact of the new parametrisation

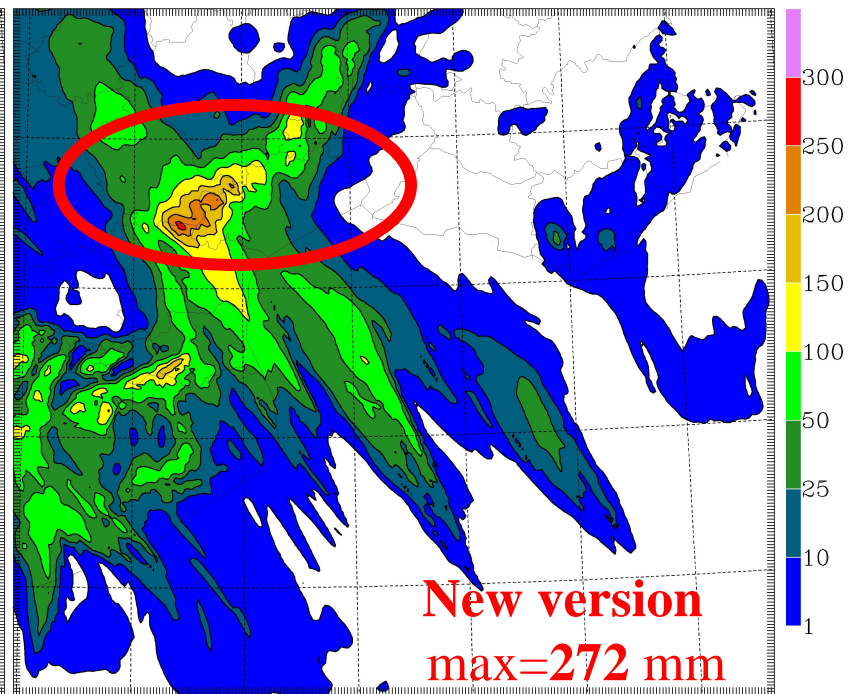
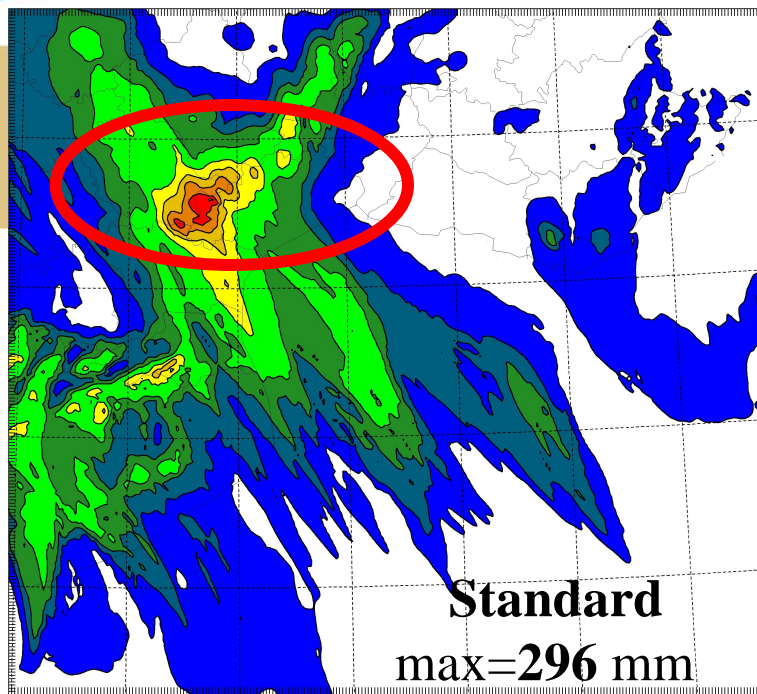
## Latent heat flux

Flux de chaleur latente au dessus de la mer  
données TOGA COARE

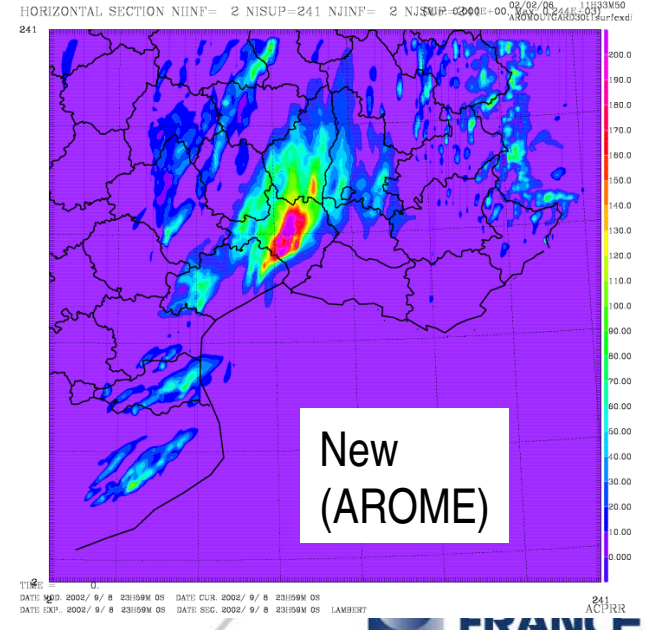
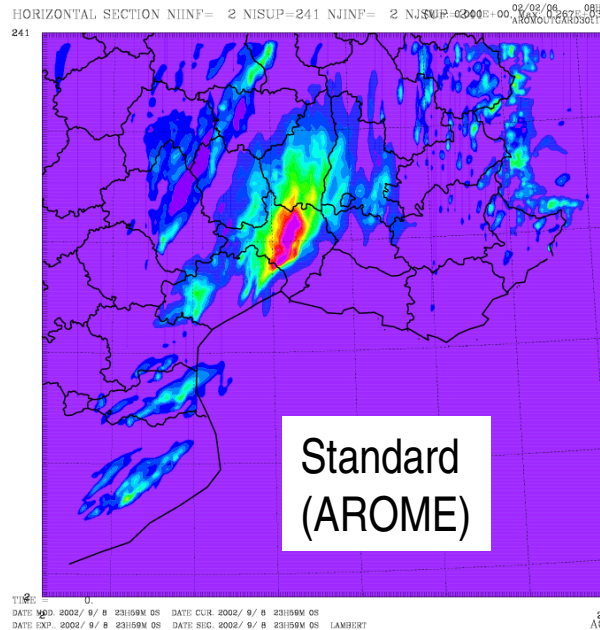


Latent heat flux :  
comparison with TOGA-COARE

- Improvement of the standard parametrisation
- Tests on some recent extreme events Meso-NH and AROME
  - Aude (1999)
  - Gard (2002)
  - Gard (2005)

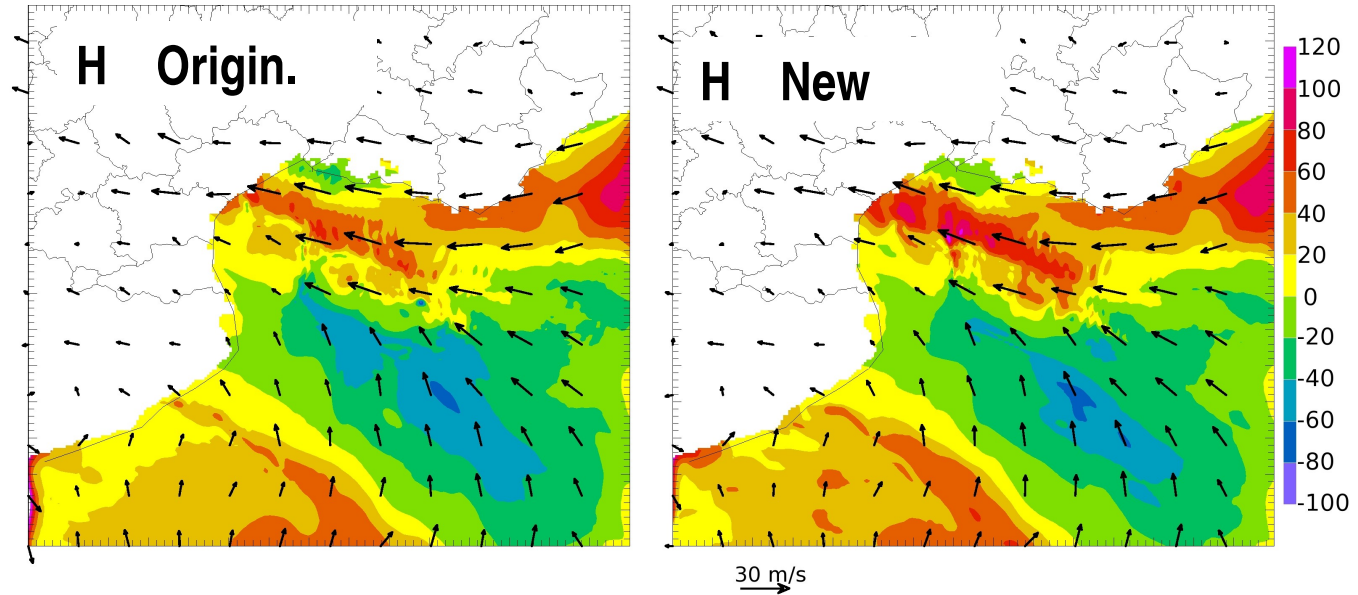


- Aude 1999 (Meso-NH) Large changes
- Gard 2005 (AROME and Meso-NH) small changes

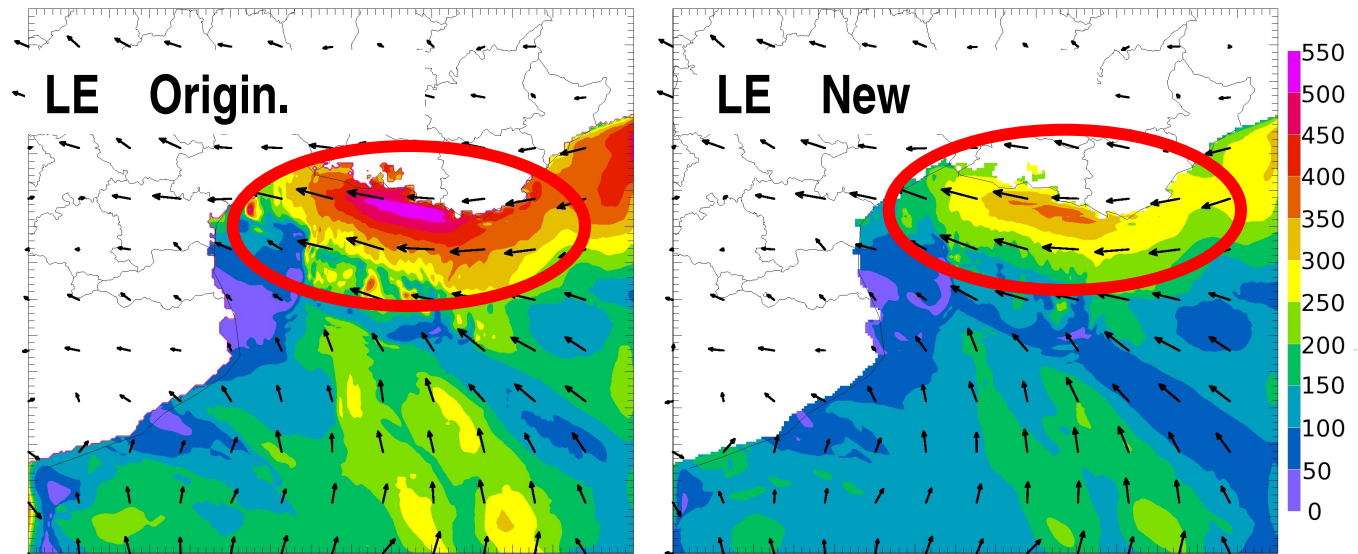


# Aude 1999 : Sensible and latent heat fluxes

- Sensible  
(few changes)



- Latent  
(high impact)

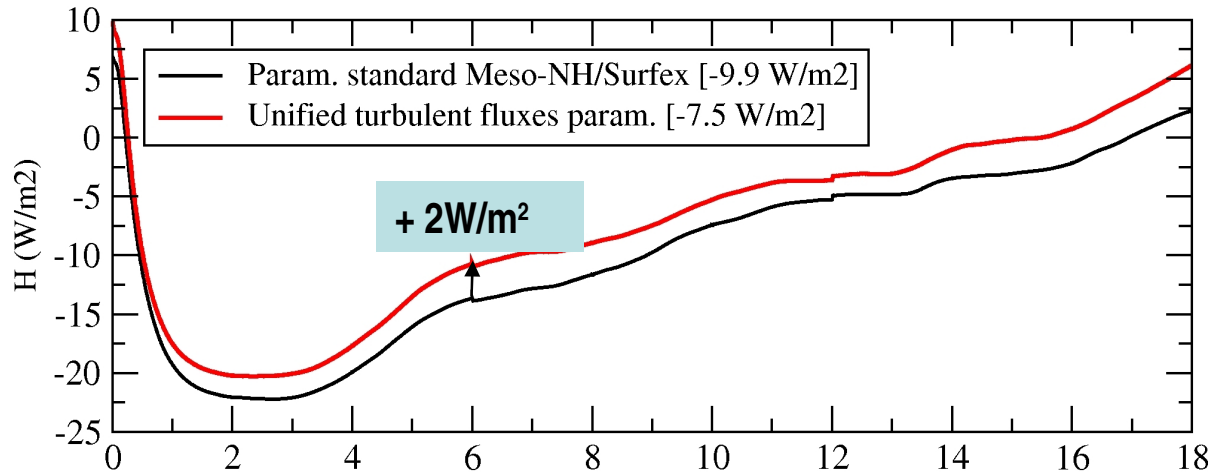




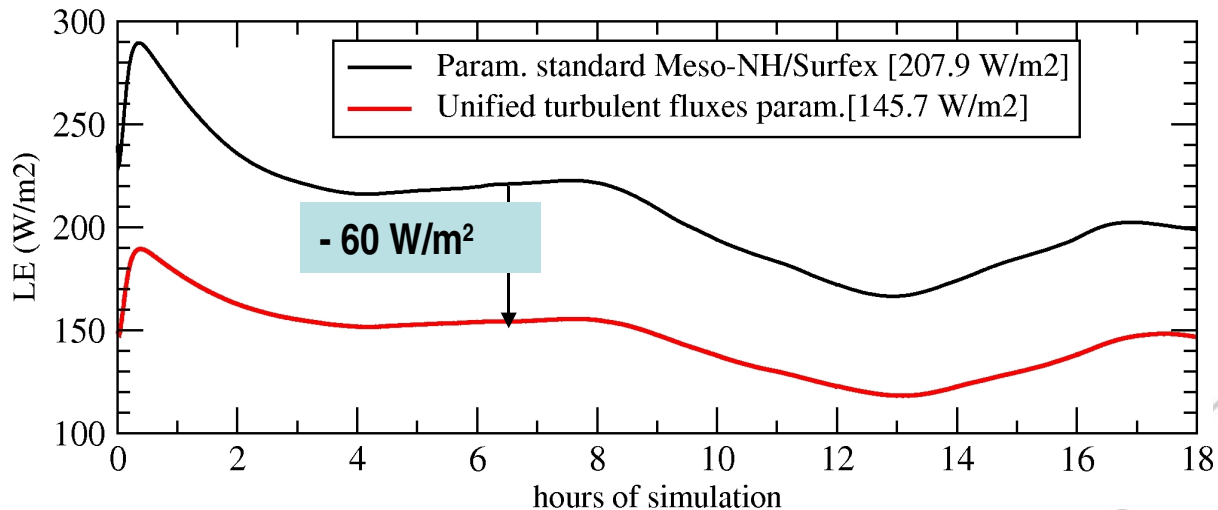
# Aude 1999 : global impact on surface fluxes

## AUDE CASE

### Sensible heat flux over sea surface



### Latent heat flux over sea surface

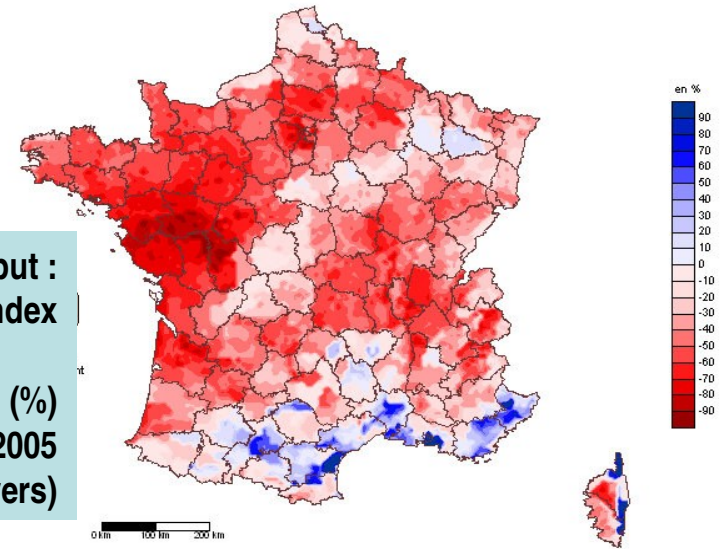


# Research on Carbon fluxes, LAI, Biomass and soil wetness

- An already operational chain for soil wetness monitoring and hydrological applications (Safran-Isba-Modcou)

SIM output :  
Soil wetness index

Deviation from mean (%)  
1 October 2005  
ISBA standard (3 layers)

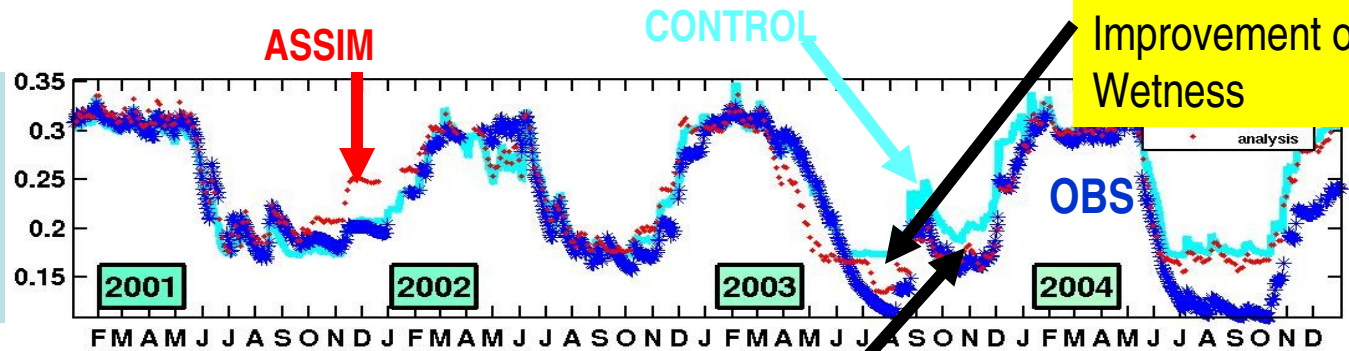


- **Objectives :**  
Test the A-gs and interactive LAI options of SURFEX in order to improve surface fluxes for monitoring and hydrological applications. Propose a model for the simulation of **regional carbon fluxes**.
- Assimilation of LAI and soil wetness at local scale
- 2xD offline runs, compare LAI simulated and observed
- Regional campaign : run coupled with the atmosphere

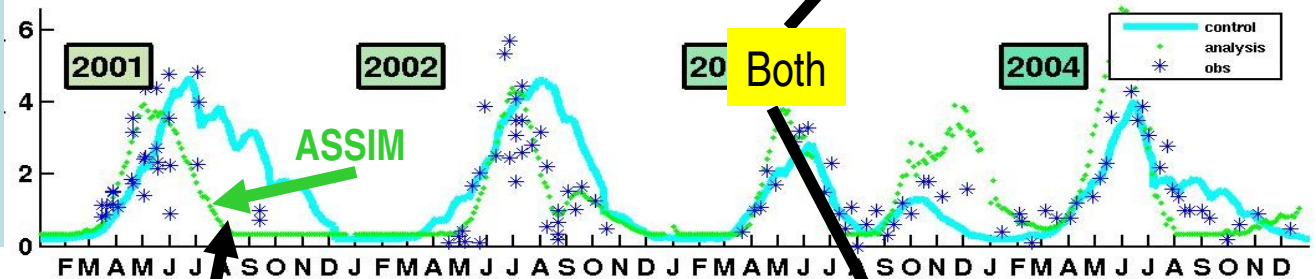
# Local results, SMOSREX site

- Test of various assimilation techniques, coupling Biomass and soil wetness.

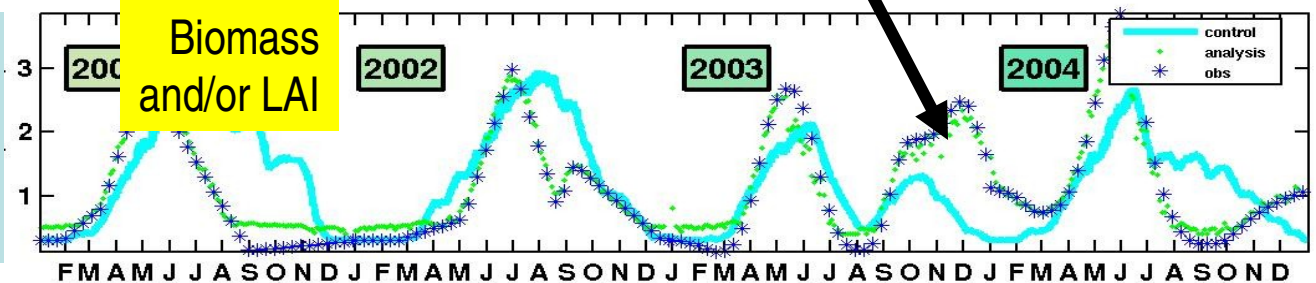
SOIL WETNESS  
(WG2 m<sup>3</sup>/m<sup>3</sup>)



BIOMASS  
(t/ha)



LAI

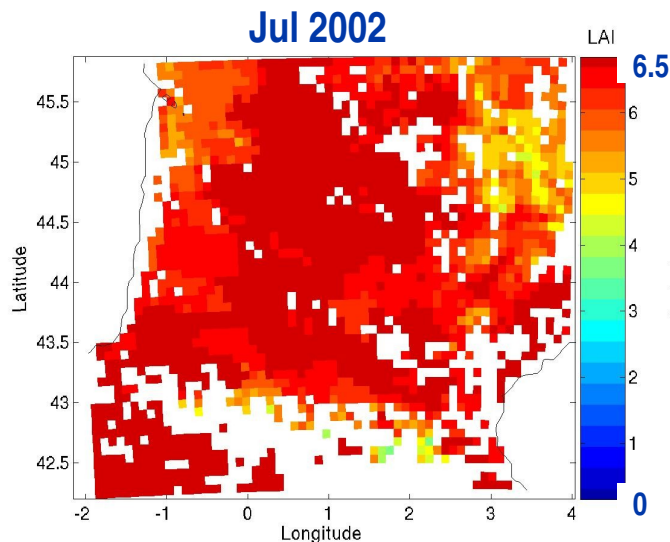




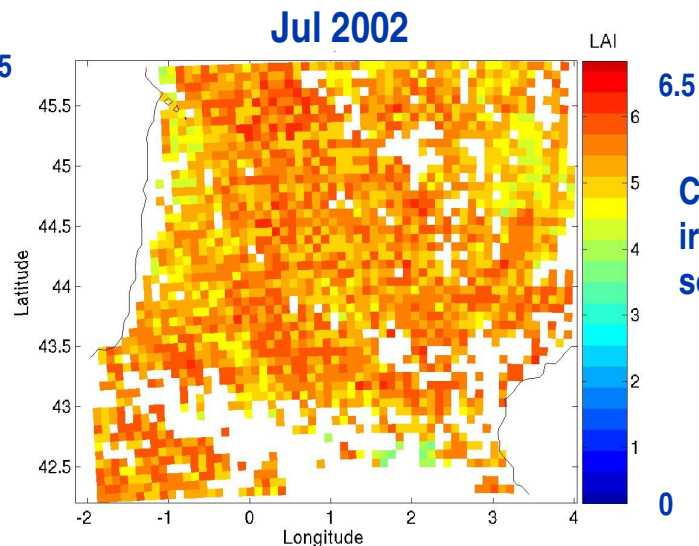
# Regional results (Force mode only)

- Needed :
  - inclusion of realistic sowing date
  - Irrigation parametrisation

C4 without  
irrigation and  
sowing



C4 with  
irrigation and  
sowing



Impact of irrigation and sowing :  
high impact on LAI

# Comparison of LAI with satellite data (may 2001)

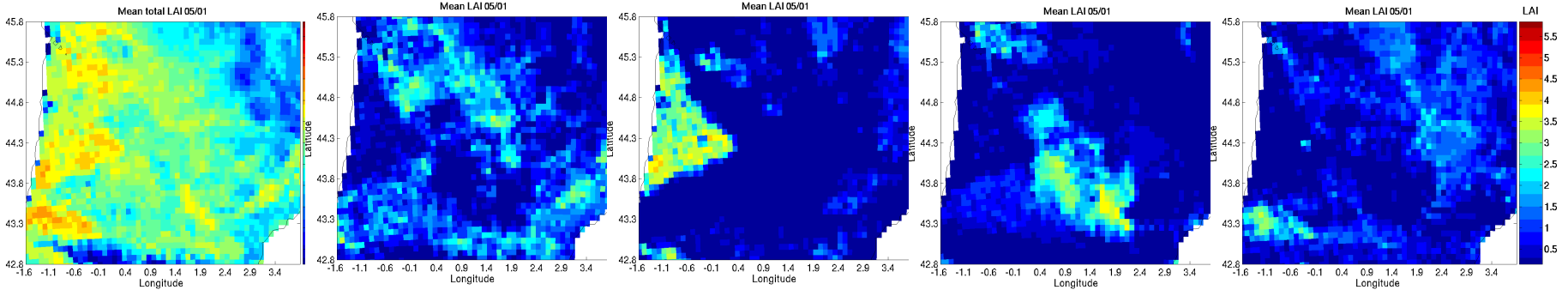
**TOTAL**

**Deciduous**

**Coniferous**

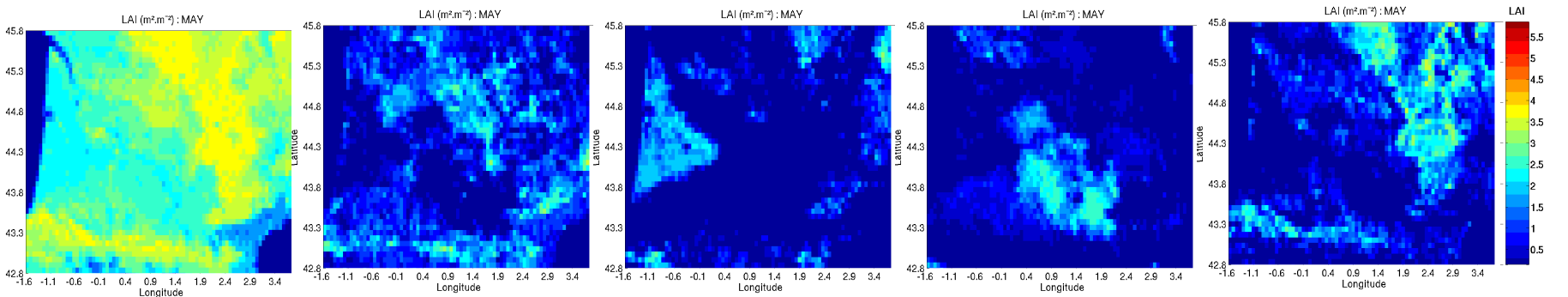
**C3 crops**

**Grassland**



**SURFEX - ISBA-A-gs**

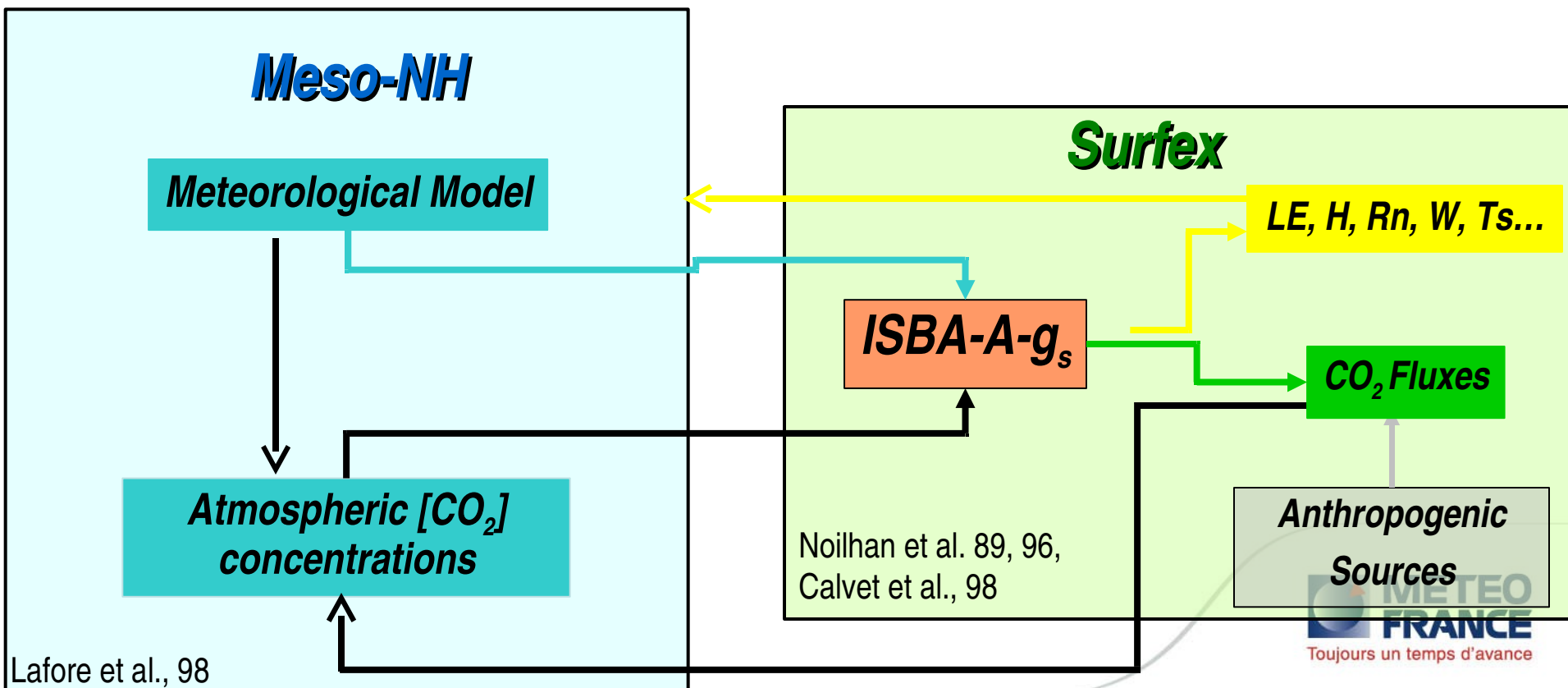
**MODIS satellite- CNRM method (J.-L. Roujean)**



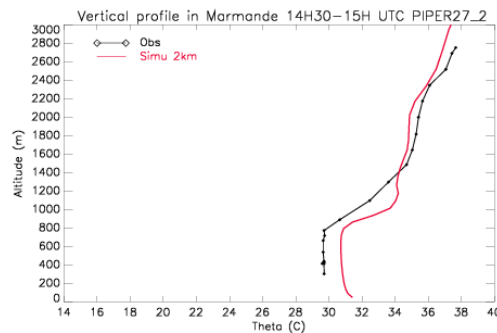
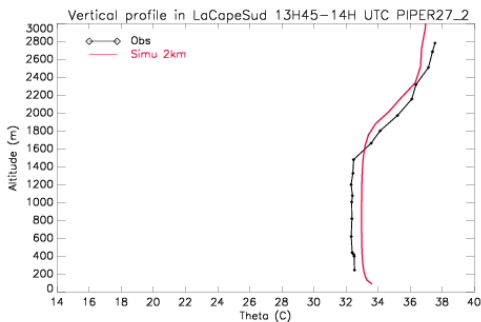
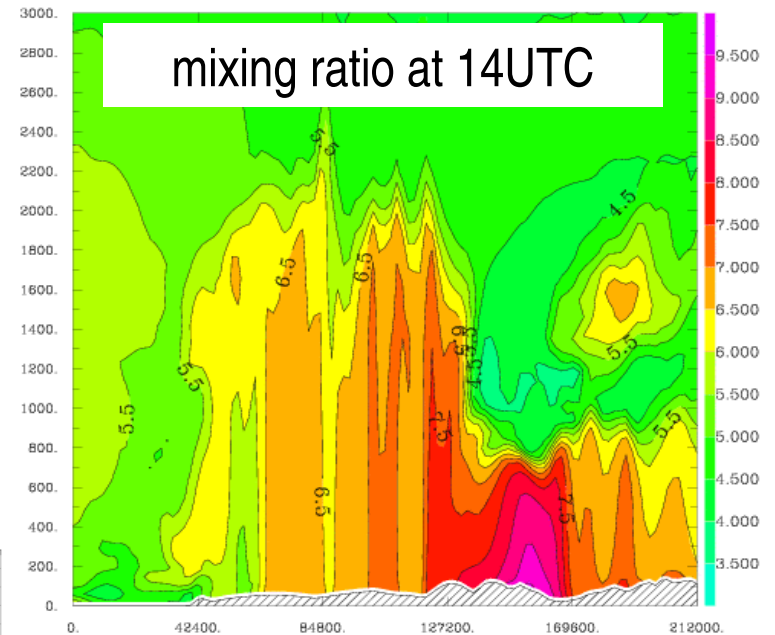
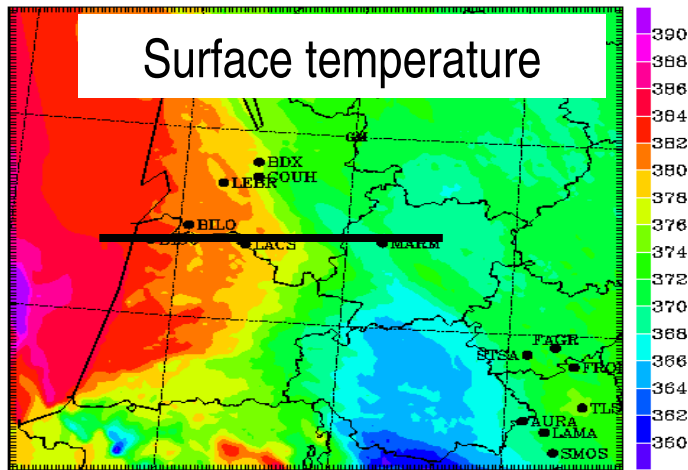
> Recalibration of ISBA-A-gs for coniferous and Grassland needed

# CarboEurope : Atmospheric CO<sub>2</sub> modelling using the Meso-NH model

- **CarboEurope** : physical basis for monitoring of Carbon fluxes
- Online coupling with the surface scheme ISBA-A-gs :
- Validation of CO<sub>2</sub> and other surface fluxes and the boundary layer



# CarboEurope : May – 27 2005 Boundary layer heterogeneity



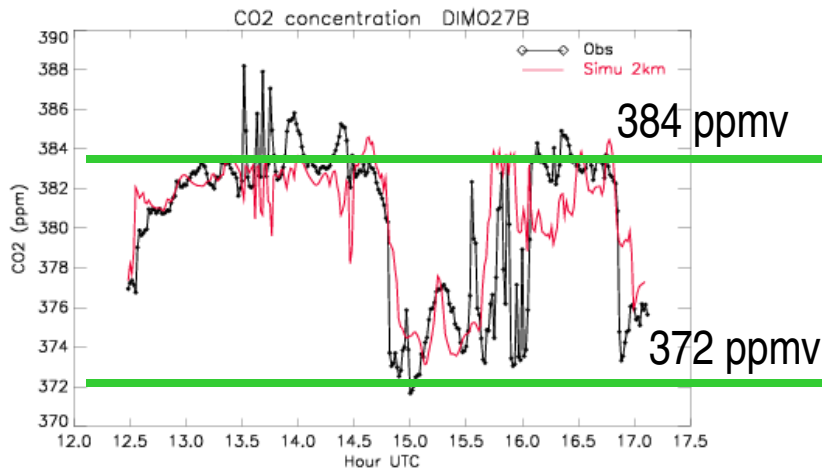
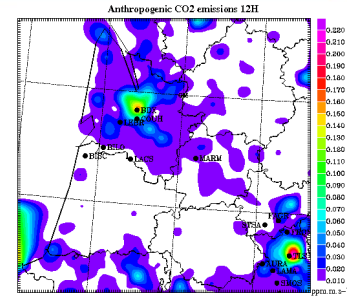
←→ OCEAN    
 ←→ FOREST AREA    
 ←→ AGRICUL. AREA

**METEO  
FRANCE**

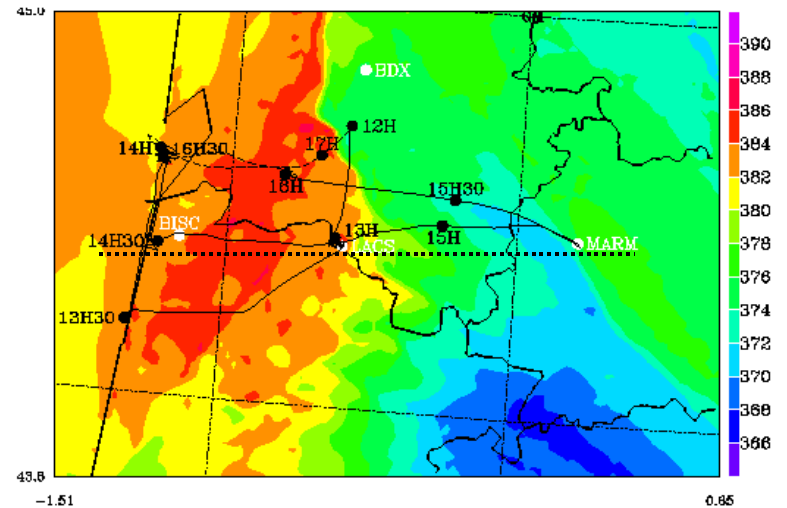
toujours un temps d'avance

# CarboEurope : CO2 concentration in the boundary layer

- The CO2 concentration in the boundary layer depends on
  - The « meteorological » boundary layer (including advection)
  - The respiration and assimilation of plants
  - Anthropogenic sources



DIMONA 27B TRAJECTORY : MAY-27 12-17UTC  
on simulated CO2 concentrations (ppm) at 14H

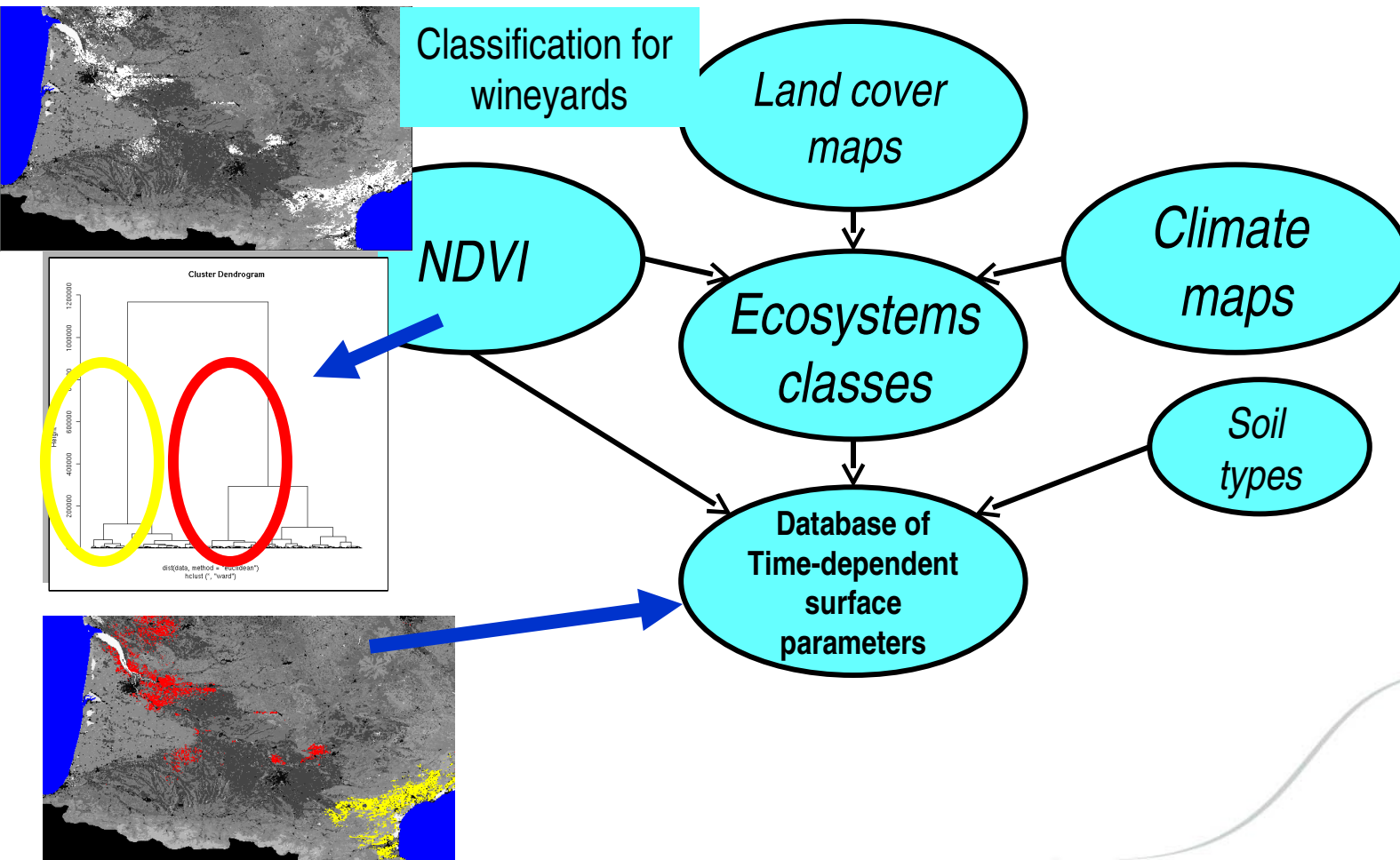


CO2 concentration along the plane trajectory

CO2 concentration at 14H

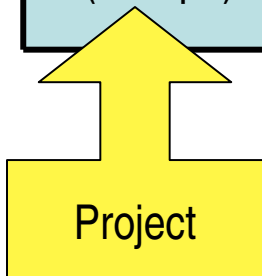
# ECOCLIMAP principles

- ECOCLIMAP is a database of ecosystems and time-dependent surface parameters for SVAT models



# ECOCLIMAP : history

Version	Land cover maps	NDVI sources	Time step	Grid Resolution
V1	UMD (1km)	NOAA/AVHRR	Monthly	1 km
V2	GCL2000 Corine 2000	SPOT/VGT	10 days	1km (global) 250 m (Europe)
V3 (Europe)	Corine2000 Next Corine?	SPOT/VGT 1999-2004	10 days	100 m (Europe)



V3 :

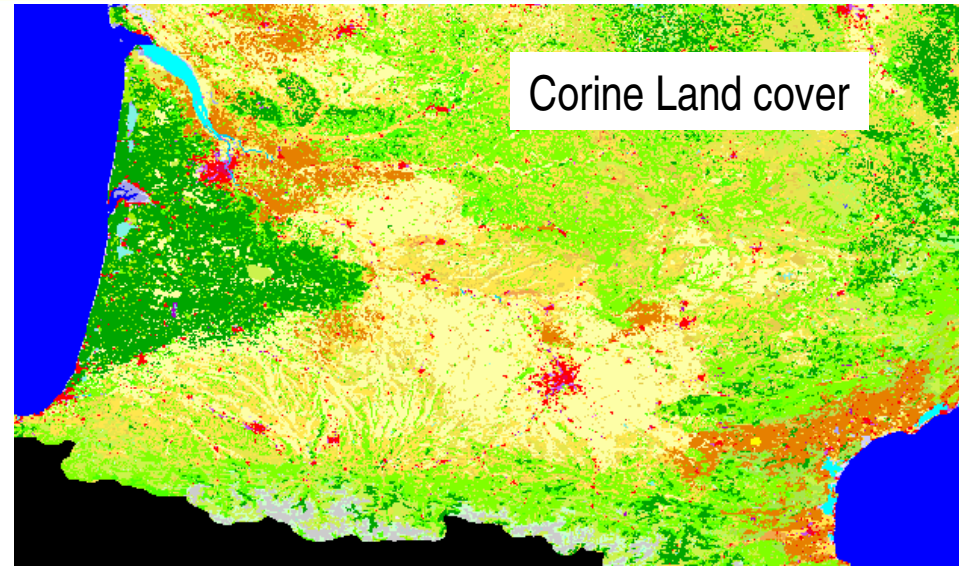
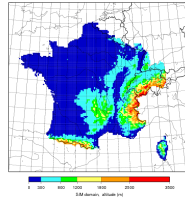
Improved cluster classifications

Import experience from **CarboEurope** project for S-W France (e. g. crops)



# Future plans for ECOCLIMAP

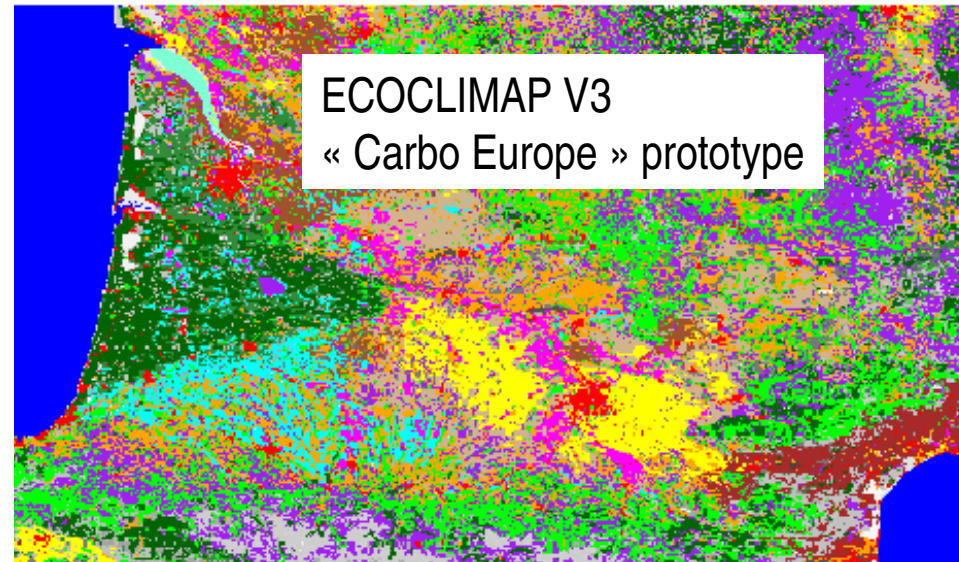
1. Build a « extended France » database
2. Test in offline (Safran-Isba-Modcou) and in NWP context
3. Build the European database
4. Other continents  
(Plan still open : alternate : go directly to Europe)



Work by Stéphanie Faroux

***For Europe : help from teams specialized in surface parameters needed or national databases to ensure the best quality for surface parameters***

***Stephanie.Faroux@meteo.fr***



# Assimilation /analyses

- **A still very open question !**
- **Some plans at Météo-France :**
- **Soil moisture analysis**
  - Transfer the existing ARPEGE soil moisture analysis to SURFEX/CANARI
  - relaxation to ARPEGE SWI
  - Test the introduction of a relaxation term to Offline simulations (SIM for France)

$$W = f( T_{2m} + H U_{2m} ) + g( S W I_{SIM} ) + h( S W I_{ARPEGE} )$$

- **Sea surface temperature**
  - Transfer the existing ARPEGE analysis
    - Ships+Buoys / SSMI (sea ice) / SST from NCEP(0.5x0.5)
  - Improve the analysis
    - New NCEP data (0.125x0.125)
    - Data from SAF-Ocean (AVHRR 2-3 km)
- **Snow ?** (previous works on ALADIN-F and ALADIN-BG)

# Conclusions

- **Recent improvements**

- Sea fluxes
- Operational ARPEGE/ALADIN snow to ensure compatibility of present surface parametrisation and SURFEX

- **ECOCLIMAP**

- V3 : fine mesh surface database
- Plans still in discussion, help needed to ensure good quality over Europe !

- **Assimilation /analysis**

- Short term plans are beeing built by now
- Long term plans via A-gs (LAI-CO2), research in Offline mode now

- **SURFEX plans**

- On-going research on A-gs ( >> Offline and assimilation)
- Oceanic mixing layer (MEMO-MICADO)
- Hydrology : redistribution of soil wetness within a catchment, improvement of ISBA drainage
- TEB improvement (air profile within the canyon) – Rafiq Hamdi (BE)
- Introduction of snow drift processes (with LGGE, Hubert Gallée)

➔ *Last 3 points to be discussed in the common HIRLAM-ALADIN surface plan*