Recent advances in SURFEX governance, scientific and technical aspects
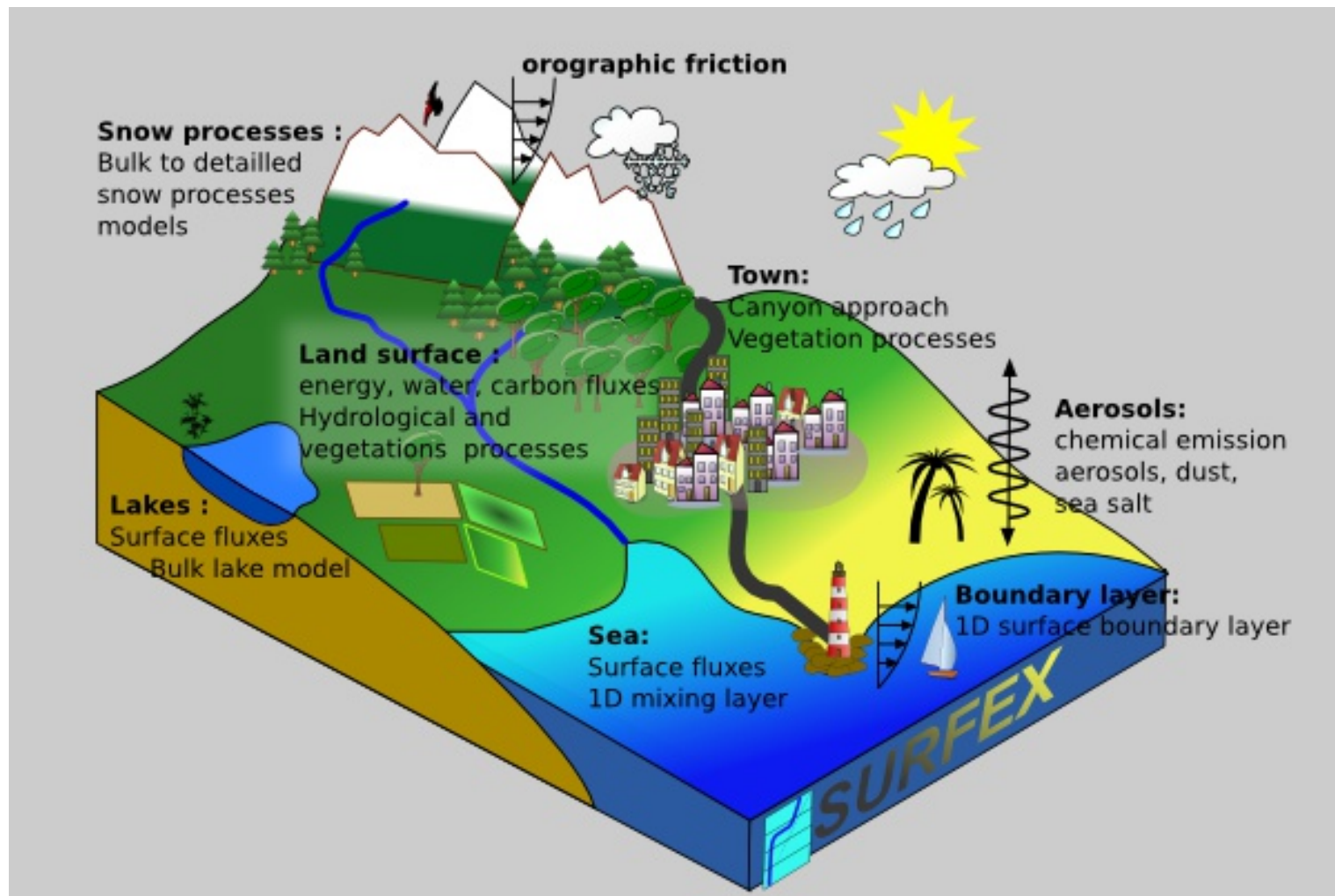
Eric Martin, Stéphanie Faroux, Patrick Le Moigne

CNRM/GAME
Mesoscale group

Outline

- Presentation of SURFEX the SURFEX team and the SURFEX steering committee

- Activities of the SURFEX SC : scientific, technical assimilation issues

- Short term and long term scientific improvements, focussed on ISBA

SURFEX overview

A short history of SURFEX (cycles)

2000 ~   Idea of SURFEX at CNRM

2005 : V1   MesoNH + AROME

2007 : V2

2008 : V3, V4   surfex4.8 : MesoNH masdev 4.8,   CY35t2

2009 : V5,   surfex5.8 :   CY36t1

2010 : V6   surfex6.0 + GMAP optimisations(V6+) : CY37t1

2011 : V7   surfex7.1 : MesoNH masdev4.9,

2012 :   surfex7.2 :   CY38t1

SURFEX team and Steering committee

The SURFEX team at MF : Hosted by the « coupled surface-atmosphere-hydrology team » of the Mesoscale group (GMME/MOSAYC)

- Stéphanie Faroux, Patrick Le Moigne, Eric Martin
- Coordination activities within CNRM, phasing, user support, some development activities
- One more people for user support at the end of 2012

The SURFEX SC was approved in june 2011. It agrees:

- the priorities for the <u>scientific evolution of the code</u>,
- the priorities for the <u>technical evolution of the code</u>, especially in view of adaptation to (massively) parallel machines, and inclusion into the atmospheric models
- the list of <u>new submodels and modifications to the existing submodels</u>, provided by SURFEX users, that will enter in the SURFEX code repository and become part of the mainstream code; similarly, the list of physiography datasets allowed.
- an outline of the <u>major maintenance steps</u> that will take place within about the upcoming year

SURFEX SC : members and recent activities

Members of the SURFEX SC :

- **Surfex team :** Eric Martin* (chair), Stéphanie Faroux, Patrick Le Moigne,
- **ALADIN :** Rafiq Hamdi*, Piet Termonia
- **HIRLAM :** Ekaterina Kourzeneva*, Patrick Samuelson
- **MesoNH :** Jean-Pierre Chaboureau*
- **GMGEC :** Bertrand Decharme*
- **GMAP :** Jean-François Mahfouf*
- **GMME :** Aaron Boone*

Activities :
- First meeting : 6 oct 2011
- Web conference : 1st March 2012
- Organisation of an assimilation Workshop (Jean-François Mahfouf) : 5/6 March 2012

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Main actions identified by the SURFEX SC

- **Enhancement of communication and collaborative tools :** web site mailing lists, code repository

- **Improvement of the coordination with atmospheric cycles**

- **Scientific issues :**
  - Harmonisation of the scientific developments within the SURFEX community for 2012 (physics of the model)
  - Coordination of assimilation development ->workshop 5/6 mars hosted by GMAP (J.-F. Mahfouf)

- **Technical issues**
  - Make SURFEX efficient in all the configurations of the SURFEX community

Enhancement of communication and collaborative tools and coordination

Mailing list :

- A user list : surfex@meteo.fr
  (contact S. Faroux to be included in the mailing list)

- Contact the sufex team : surfex-support@meteo.fr
  (Stéphanie Faroux, Patrick Le Moigne, Eric Martin)

- Web site for the surfex community : http://www.cnrm.meteo.fr/surfex-lab/
  (filtered on IP address, contact surfex-support@meteo.fr for access)
  Documentations, export version, physiography

- Svn Code repository (since v7.1)

- SURFEX practical course (annual, in october, 3 days)

- Improvement of the coordination between Surface and atmospheric cycles
  - Need to alert the SSC for development that need changes in both atmospheric and surface cycles (solution = preparation of a SURFEX cycle in phase with an atmospheric cycle, but need be prepared in advance).

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Short summary of scientific development (model)

- **ISBA :** Multiple energy budget (MEB), multi layer soil, vegetation processes, snow model CROCUS
- **TEB :** building energy model (BEM), vegetated roofsImprove the coordination between Surface and atmospheric cycles
- **SEA** : sea-ice model, coupling with an oceanic model using the OASIS software
- **Chemical emissions** : revised anthropic emissions and NO2 emission parameterisation

- Testing of advanced options in different configurations (all teams)

➔ A sea-ice model is missing
  - Implementation of the simple HIRLAM model (HIRLAM)
  - Implementation of Gelato thermodynamics (CNRM/Climate group, 2nd half of 2012)

Surface assimilation issues

See : http://www.cnrm.meteo.fr/aladin/spip.php?article239

- Presentations :
    - 2D OI optimal interpolation based on CANARI
    - 1D soil/vegetation/lake/discharge/snow assimilation based on OI, EKF, SEKF, STAEKF, EnKF

- Agreement to include the various development into SURFEX versions -> **SODA : Surfex offline data assimilation**
    - To start on v7.2 : merging of OI_MAIN and EKF_MAIN (possibly for CY39t1)
    - Then progressive inclusion of other assimilation types

- SODA : must run fully coupled with CANARI (I/O, parallelisation,…) and in offline mode for non NWP users

- Test improvement in physics with impact on assimilation : multilayer soil (ISBA-DF), multiple energy balance (ISBA-MEB)

- Need increased efficiency (PGD, PREP, OFFLINE)

Technical points

Critical points for an efficient use of SURFEX in the various configurations of the SURFEX community

- Coupling with MUSC
- Removing of global variables (Open-MP maintenance, OOPS)
  - Cooperation between CERFACS and CNRM (GMME/GMAP). mid 2012-mid 2013
- Reduction of the file size and optimisation of I/O (v7.2) (to be tested)
  - Choice of the variables to be written
  - No more writing of physiography (PGD) fields in outputs
  - FA file option, including possibility of compaction (xundef) (v7.2)
  - Improved I/O in MSE
- Parallel :
  - OFFLINE : MPI driver to be written (Surfex team+ computer team, Met.no, 2012).
  - PGD/PREP : coupling with FULLPOS (? which strategy, tbd), offline version (after OFFLINE parallelisation)

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# Summary of new features in recent cycles

- V5 : 36t1 (2010) : ECOCLIMAP2, ISBA subgrid hydrology, Orographic drag, Z0 over sea, gust parameterisation, linearisation of L and Cp (ALADIN)

- V6(+) : 37t1 (2011) : Implicit wind in Canopy, TEB : inclusion of vegetation (garden), ISBA (soil carbon), snow model CROCUS, Improvement of ECOCLIMAP (lakes),
  Open-MP (in cy37t1, not in V6), optimisation for vectorial computers

- V7.2 : 38t1 (2012) : Coupling with lake databases,
  reading of namelists at the beginning, interface module automatically generated, inclusion of Dr Hook, Open-MP in the official cycle, improvement of Netcdf outputs, use of GRIB-API library reduce the file size and use of full FA (no more writing of PGD fields in outputs, compaction possibility, technical points (I/O), modifications OI_main/MSE
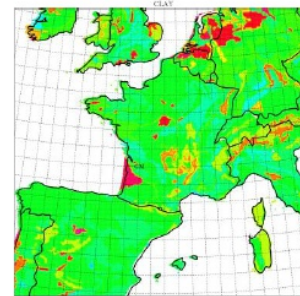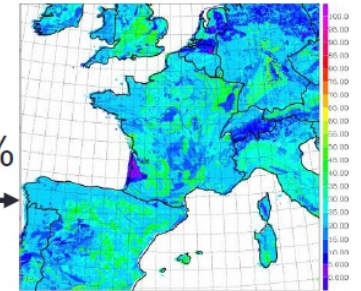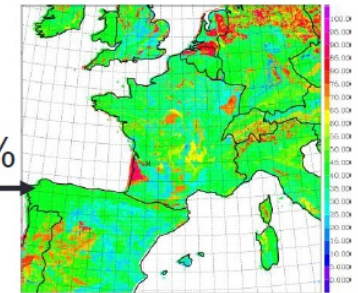
Improvement of physiography
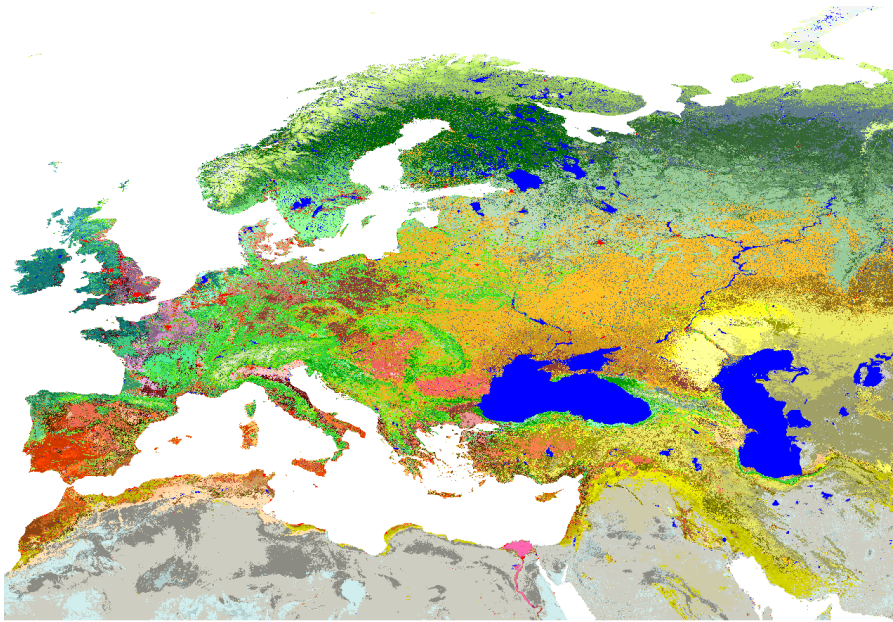
OPER (10km database)   New (1km database)
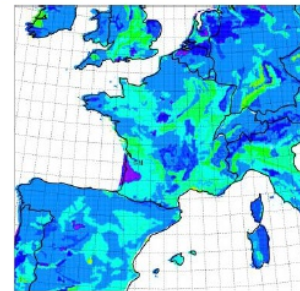
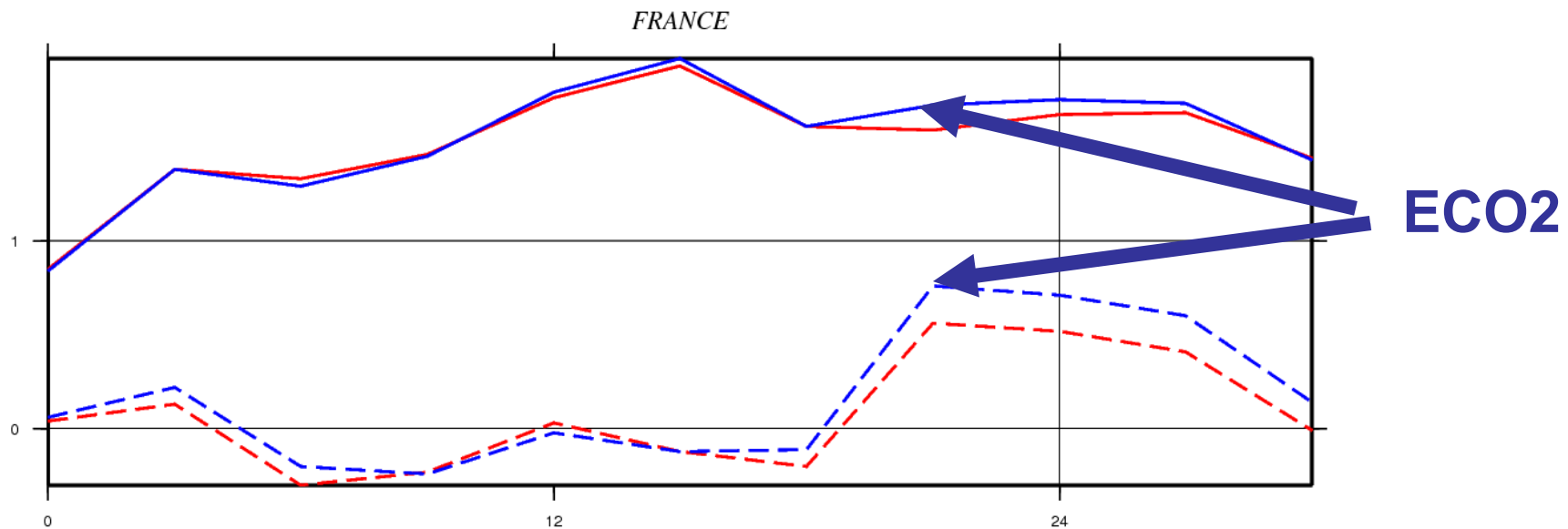Clay %

Sand %

Source : S. Faroux, Y. Seity

ECOCLIMAP 2   HWSD

HWSD : neutral impact on scores in AROME/France

ECOCLIMAP2 : in test in AROME/France

Testing of ECOCLIMAP2

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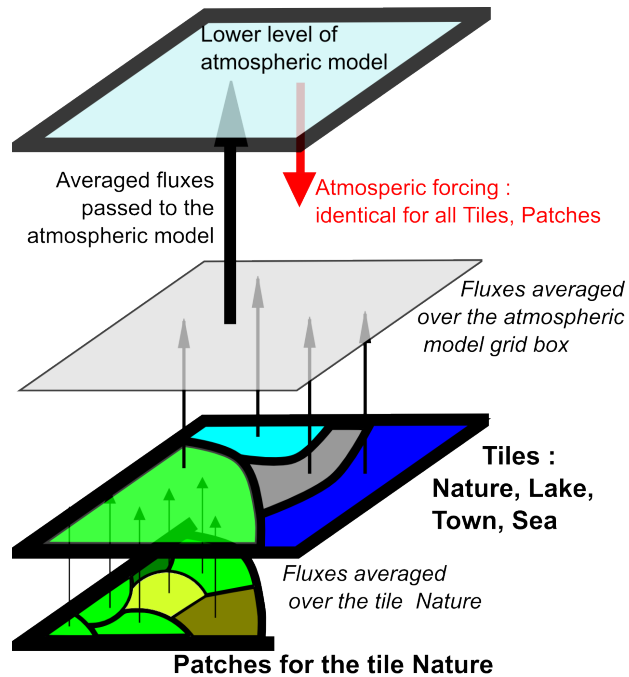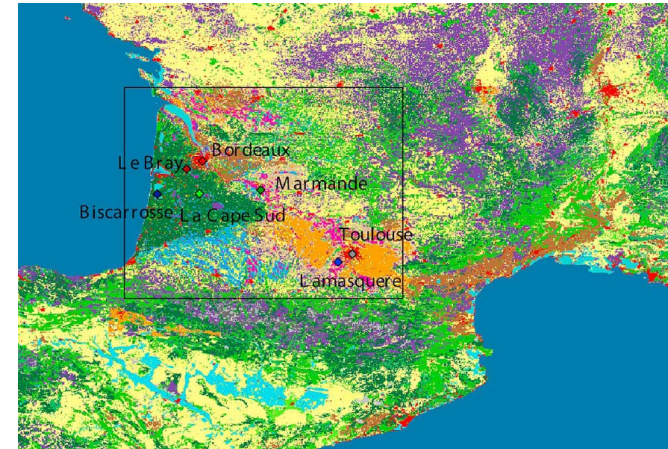
ECO2

**Score on 2m Temp. in August 2011 (bias and rms),
source Yan Seity, Sylvie Donier**

- ECO2 increases the warm bias of CANOPY which appear at the
  sunset
- Investigations on the parametrisation of stable boundary layer in
  CANOPY

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Future testing : patches

Lower level of atmospheric model

Averaged fluxes passed to the atmospheric model

Atmosperic forcing : identical for all Tiles, Patches

Fluxes averaged over the atmospheric model grid box

Tiles : Nature, Lake, Town, Sea

Fluxes averaged over the tile Nature

Patches for the tile Nature

SURFEX tiling and coupling with an atmospheric model

- T2m, Hu2m scores improvement at >=8 km with a 12 patches version

  CERES campaign, Noilhan et al.

- Higher resolution ?
  How many tiles ?

The next challenge : toward improved physics for nature (ISBA)

Physiography :
Use of improved data for texture (HWSD from FAO)
ECOCLIMAP-2

Model configuration :

Reference detailed version :

Multiple energy balance

Advanced evapotranspiration parameterisation

Multilayer snow model

Multilayer soil for temperature and hydrology

(Cf ISBA-MEB presentation)

Intensive testing (offline/coupled field campaigns)

Definition of the best configuration for each configuration

NWP depending on grid mesh

Climat runs

Offline runs monitoring

Conclusion

- The number of SURFEX users and applications is rapidly gowing
- In the recent years, SURFEX improved a lot in both technical and scientific aspects
- The SURFEX SC has been very active during the last 6 months. It helped a lot in organising and giving priorities.

- Main priorities :
  - Implementation of SURFEX in all models configurations (ALADIN)
  - Improvement of SURFEX efficiency
  - Integration of the assimilation developments in the official cycle of SURFEX
  - Design the future of the surface component of our models