Ongoing developments on surface aspects in ALADIN/LACE

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with contributions from

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B. Szintai (OMSZ), C. Soci (MF)

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Outline

- Current status on land surface modelling and assimilation
- Recent developments on modelling aspects
- Recent developments on data assimilation
- Future plans

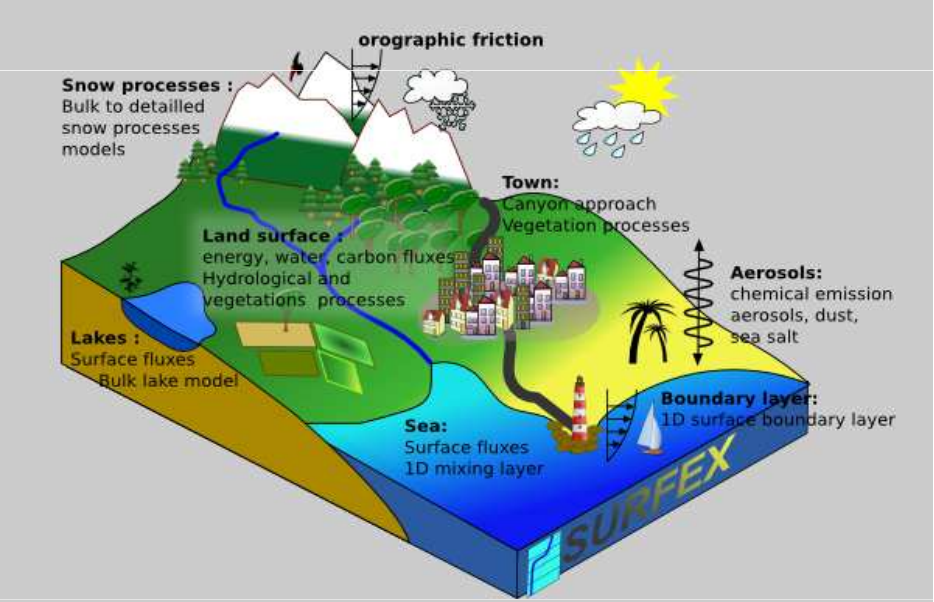
Presentations from the last working day of the **SRNWP ET on surface aspects** (Helsinki, 21 September 2012) available at :

- http://www.cnrm.meteo.fr/aladin/spip.php?article246

Externalized surface module : SURFEX

- Includes various physical modules : natural land surfaces, urbanized areas, lakes and oceans
- Can be coupled to various atmospheric models (ARPEGE, ALADIN, ALARO, AROME, Meso-NH) and also run offline
- Includes detailled **physiographic databases** for orography, surface covers, soil textures
- Includes **surface data assimilation** modules

http://www.cnrm.meteo.fr/surfex/



Geoscientific Model Development
GMDD-Special Issue on SURFEX

http://www.geosci-model-dev-discuss.net/special_issue13.html

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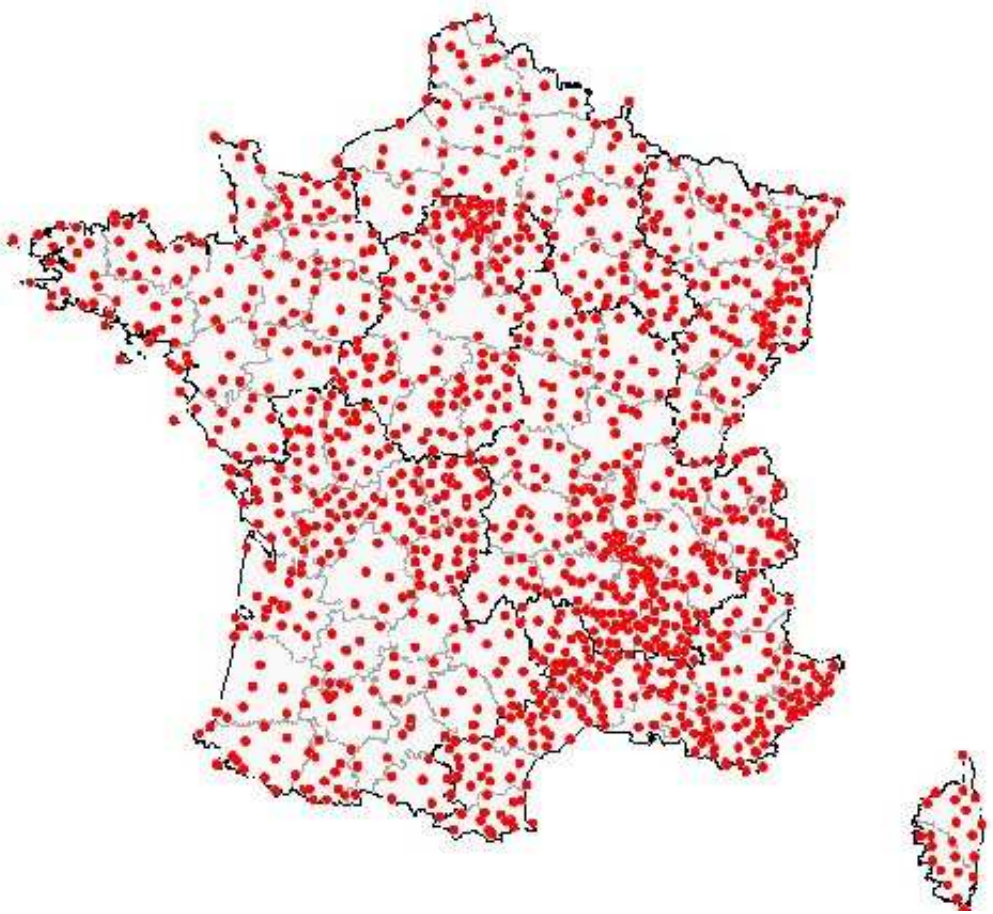
Modelling aspects

- **« Old » surface schemes in ALADIN models** : 2-layer soil scheme ISBA, bulk surface boundary layer scheme (Geleyn, 1988), Webb et al. (1991) soil texture database (1°) and Champeaux et al. (1998) land cover data base (2 km).
- **SURFEX features used in ALADIN models** : 3-layer soil scheme ISBA, multi-layer surface boundary scheme CANOPY (Masson and Seity, 2009), urban scheme TEB (Masson, 2000), ECOCLIMAP database (1km) and FAO soil texture data base (10 km) (operational configuration at Météo-France)
- Ongoing developments in the ALADIN consortium to include SURFEX in NWP models (working weeks) :
  - Scientific evaluation in 2011
  - Technical issues in 2012

Improved physiography

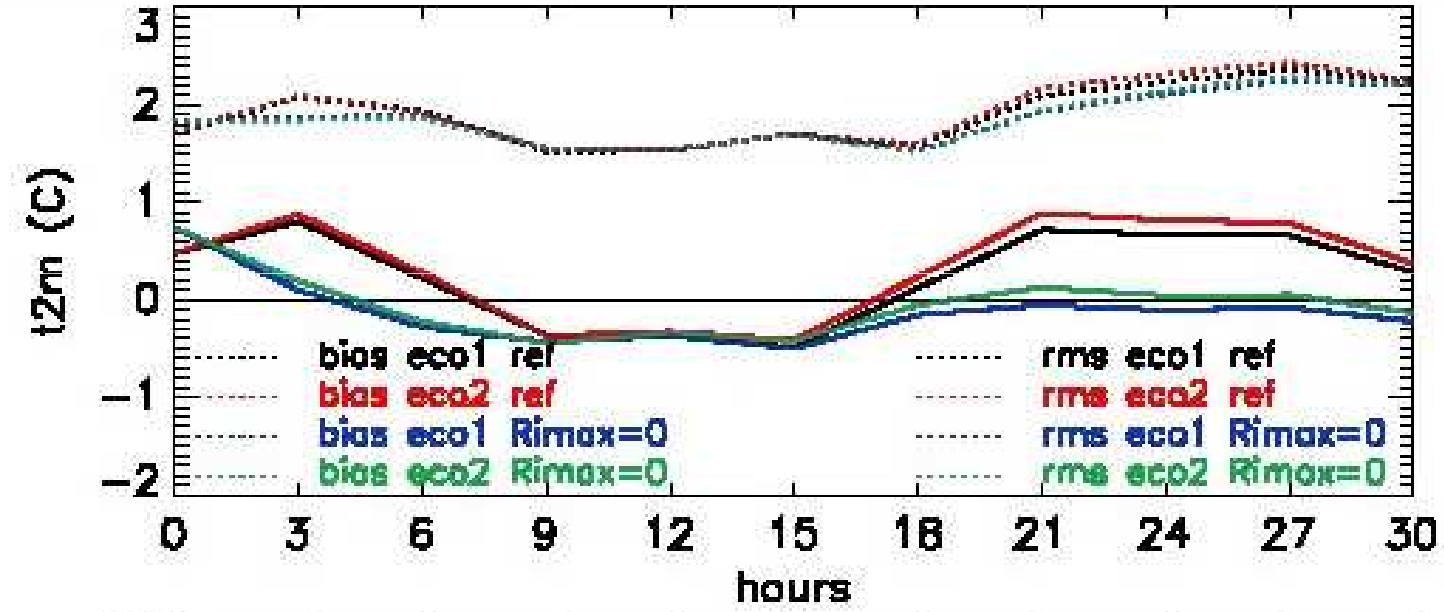
- AROME model (2.5 km -> 1.3 km in 2014) :
- Soil texture data base at higher spatial resolution : From FAO at 10 km to HWSD at 1 km – operational since 09/2012 (neutral impact on forecast scores)
- Improved cover classification : From ECOCLIMAP (Masson et al., 2003) to ECOCLIMAP-2 (Faroux et al., 2012) :
  - **ECOCLIMAP** : **215** ecosystems at 1 km resolution from land cover (e.g. Corine over Europe) and climate maps, and AVHRR NDVI (year **1993**)
  - **ECOCLIMAP-2** : **273** ecosystems at 1 km resolution from land cover (e.g. GLC2000) and climate maps, SPOT/VEGETATION NDVI (years **1999-2005**) (over Europe only)

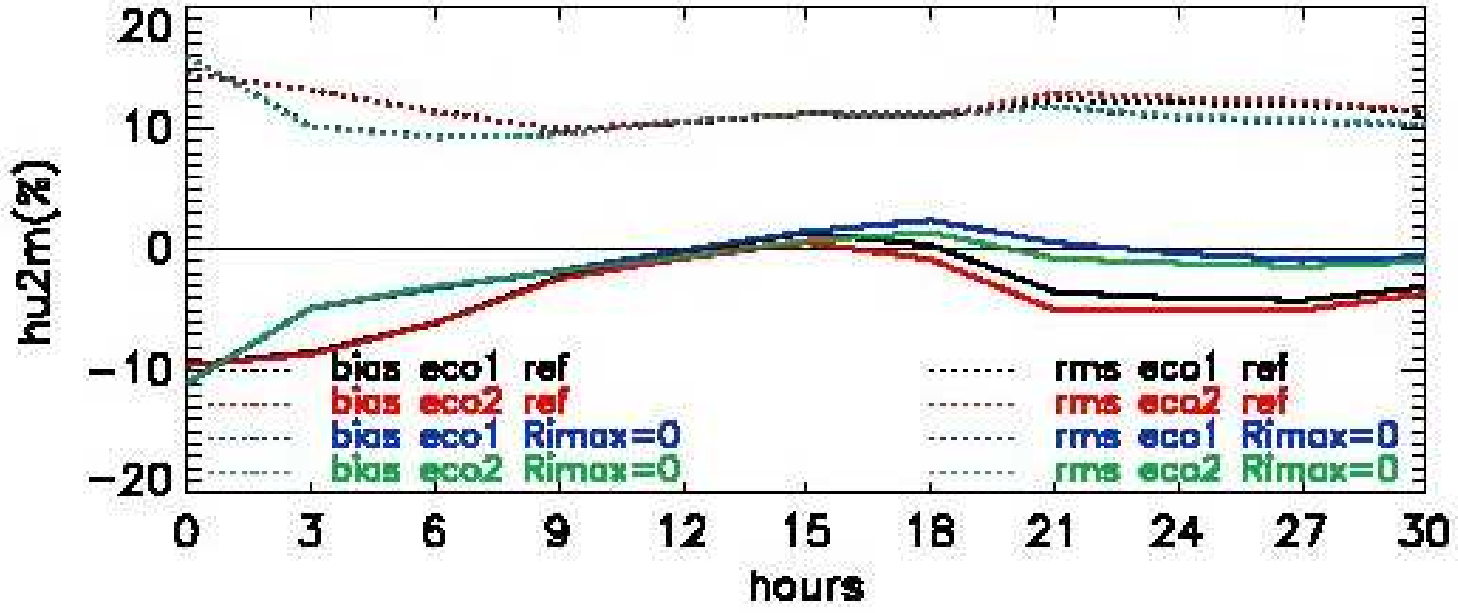
Use of ECOCLIMAP 2 in AROME



- 30h forecast runs
- Selection of 1 day per month in 2007
- Reference run
- Test run with Ri_max=0 in CANOPY scheme
- Validation: T2m, HU2m, V10m RMS and bias over 1200 SYNOP/RADOME stations over France

T2m and RH2m errors over 12 days



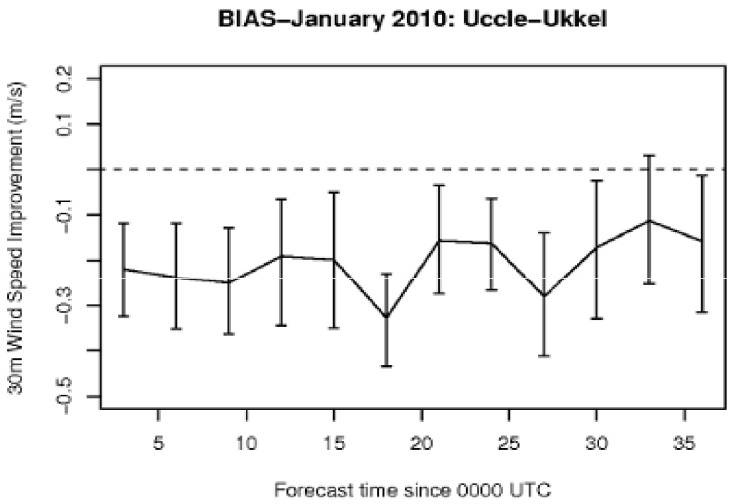


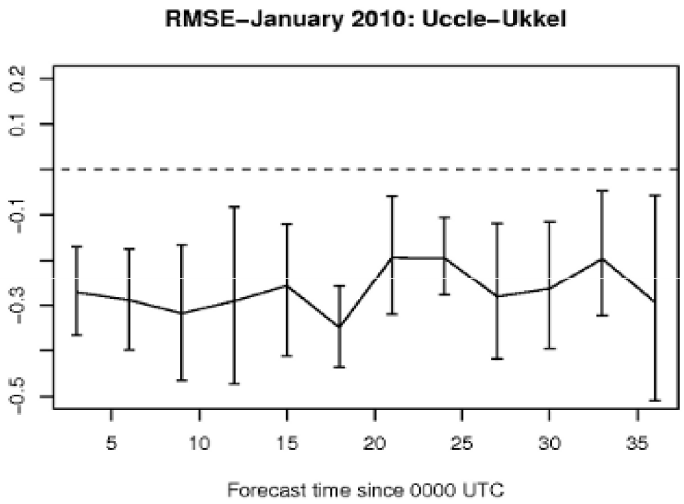
Y. Seity, MF

Impact of TEB on V30m ALARO forecasts

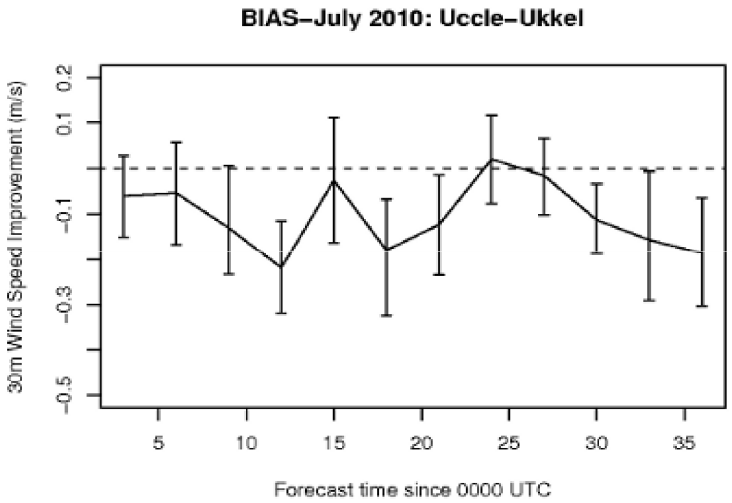
TEB – No TEB

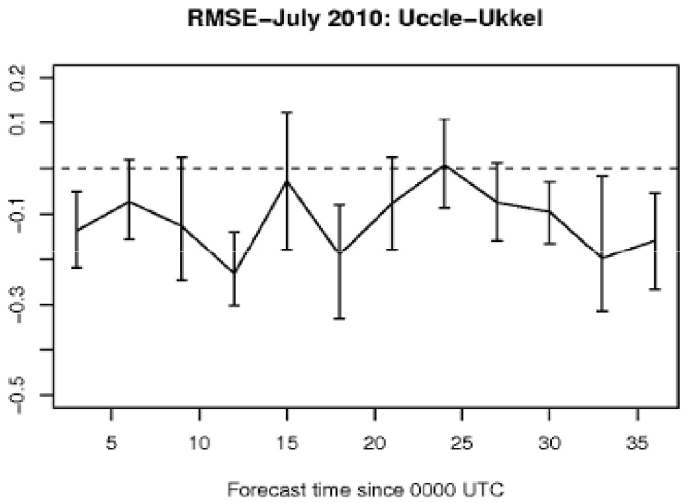
January 2010





July 2010





R. Hamdi, RMI

Location : Uccle/Ukkel (near Brussels)

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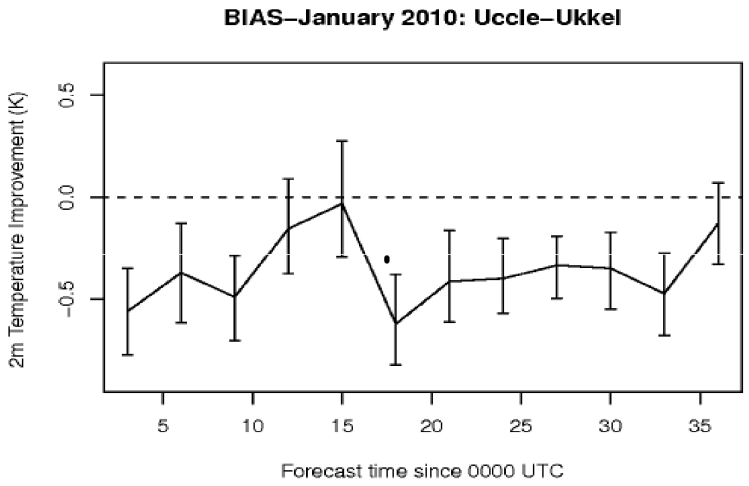
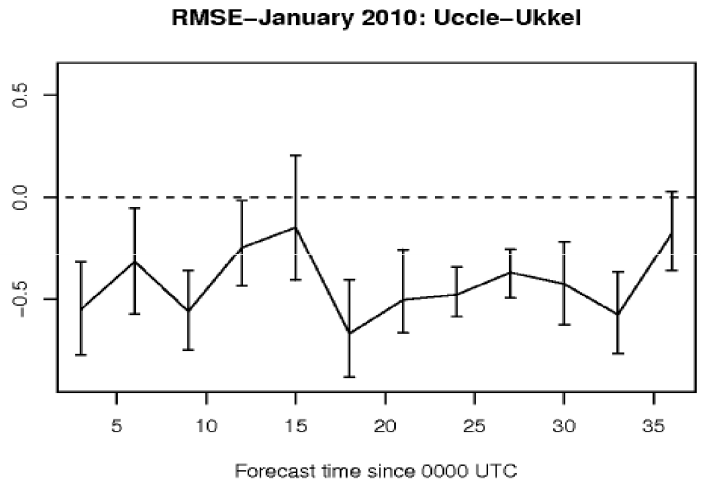
Impact of TEB on T2m ALARO forecasts

TEB – No TEB

January 2010





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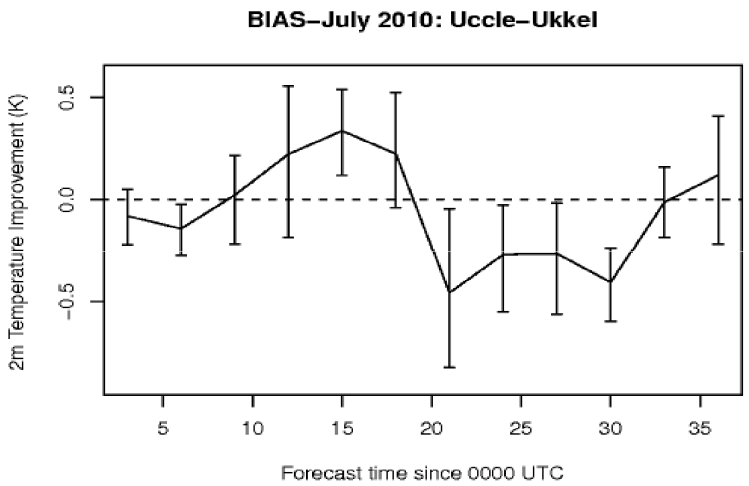

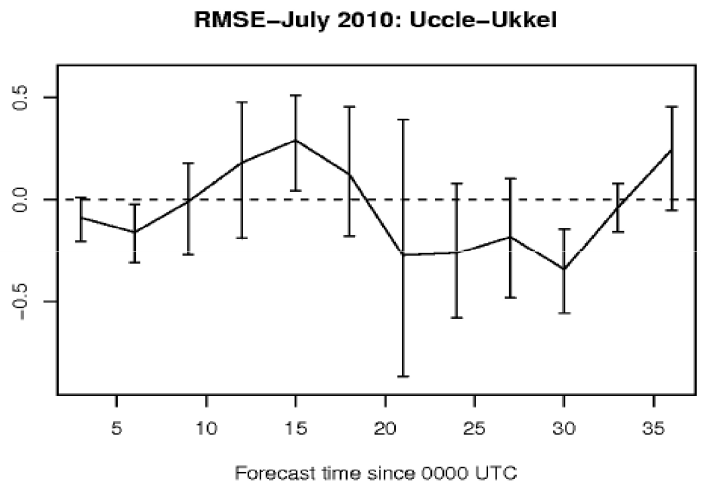

R. Hamdi, RMI

Location : Uccle/Ukkel (near Brussels)

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Surface data assimilation aspects

- Current operational status :
  - Surface analysis based on 2D OI CANARI (T2m, RH2m, SST)
  - Soil analysis based on 1D OI scheme (Giard and Bazile, 2000)
- Ongoing developments :
  - Improved 2D OI analysis (structure functions, extension to precipitation) : to replace MESAN/SPAN (HIRLAM) and SAFRAN (Météo-France) (FP7 EURO4M project)
  - Soil analysis scheme : Extended Kalman Filter (Mahfouf et al., 2009) developed in SURFEX

EURO4M : Mesoscale european re-analysis

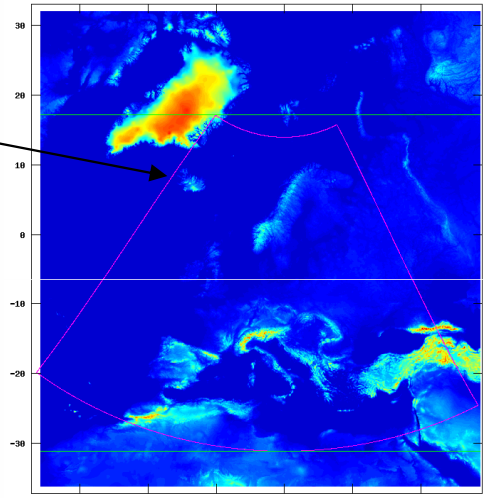
3D-Var Re-analysis at 22km over Europe (SHMI)

Downscaling

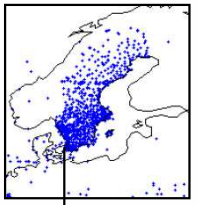
5.5 km over Europe

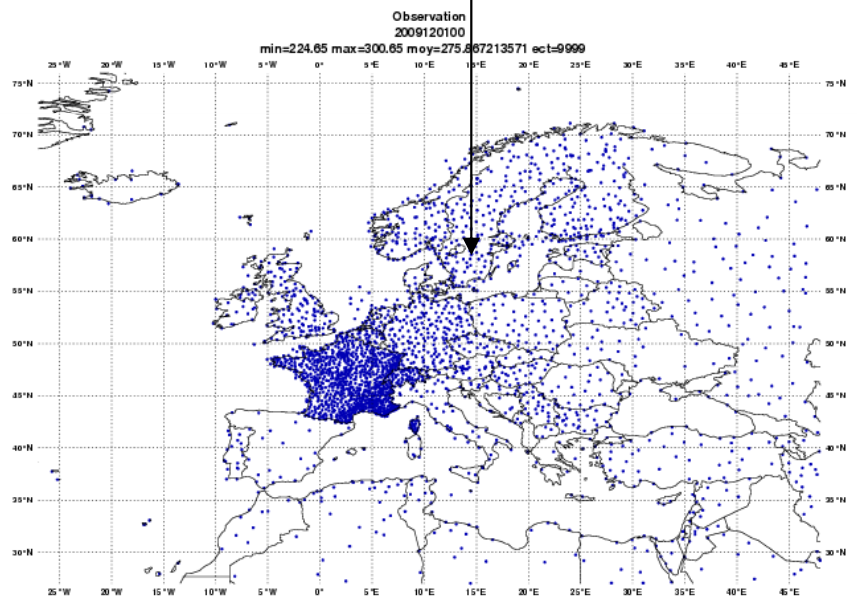
New and more observations

2D analysis at 5.5Km (MESCAN)



Thanks to T. Landelius (SMHI)

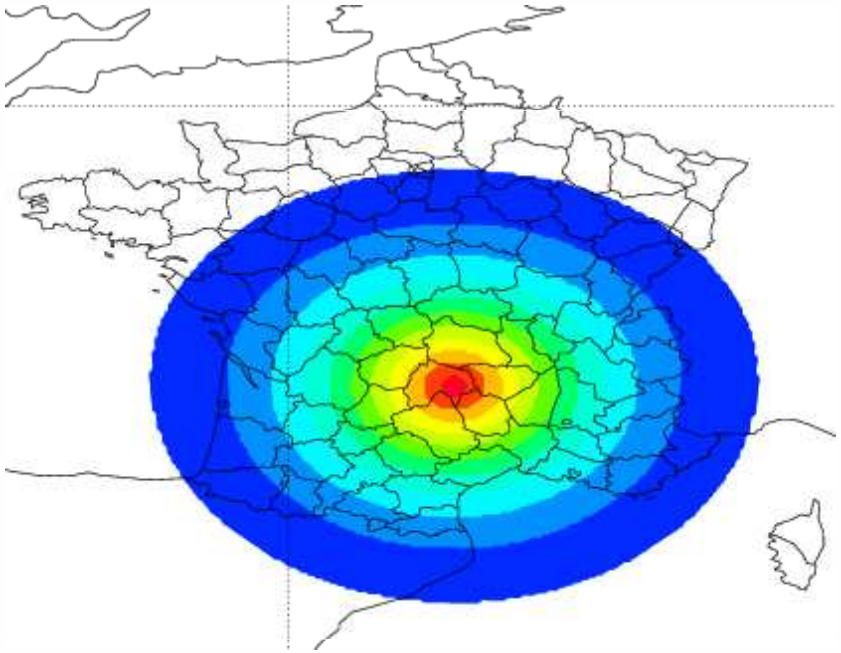




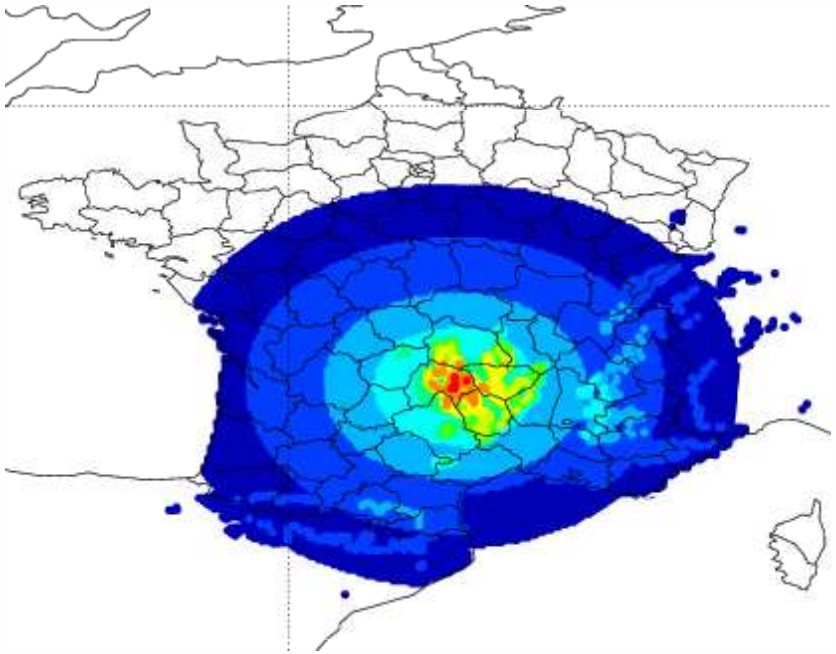
By adding details with topography and observations should improve the quality …
~4000 obs (1200 over France)

T2m analysis increment for SO experiment

CANARI



MESCAN

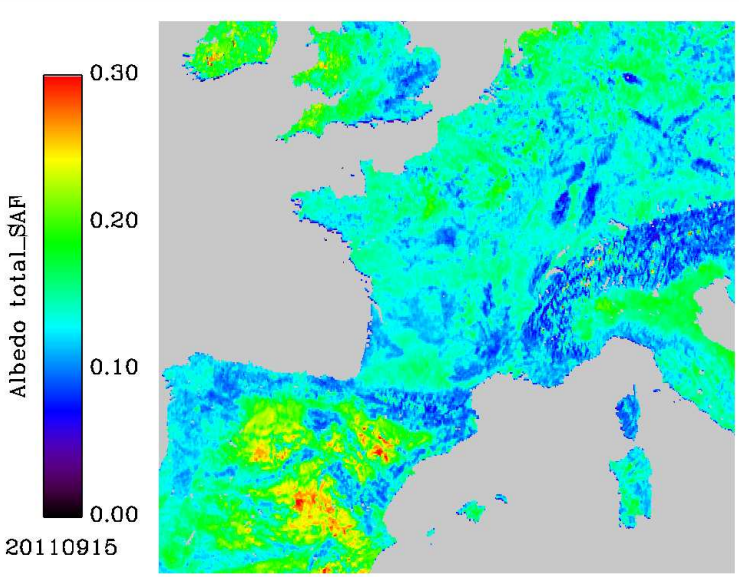


Correlation functions used in MESAN account for orography and land sea-mask. Small impact in average

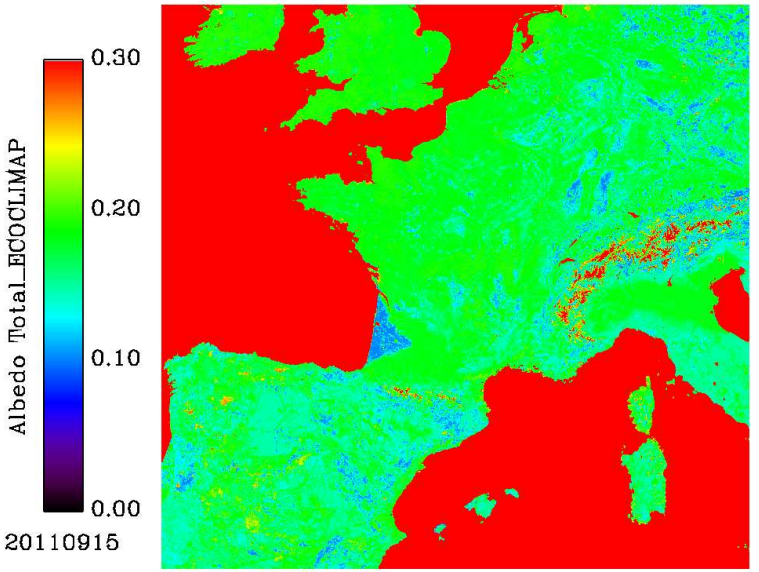
On the use of satellite derived albedo

- Daily albedos available in real-time over the MSG disk (5 km resolution) from EUMETSAT LSA-SAF since 2006 (three spectral bands – white sky and black sky components)
- Use of a simple Kalman filter to analyse separately vegetation and bare soil albedos (use of ECOCLIMAP as « backup » values)
- Preliminary studies undertaken by J. Cedilnik (Slovenia) with ALADIN : slight reduction of T2m cold bias
- Publication in JAMC : J. Cedilnik, D. Carrer, J.-F. Mahfouf, J.-L. Roujean (2012) : **Impact assessment of daily satellite derived surface albedo in a limited area NWP model** doi: http://dx.doi.org/10.1175/JAMC-D-11-0163.1

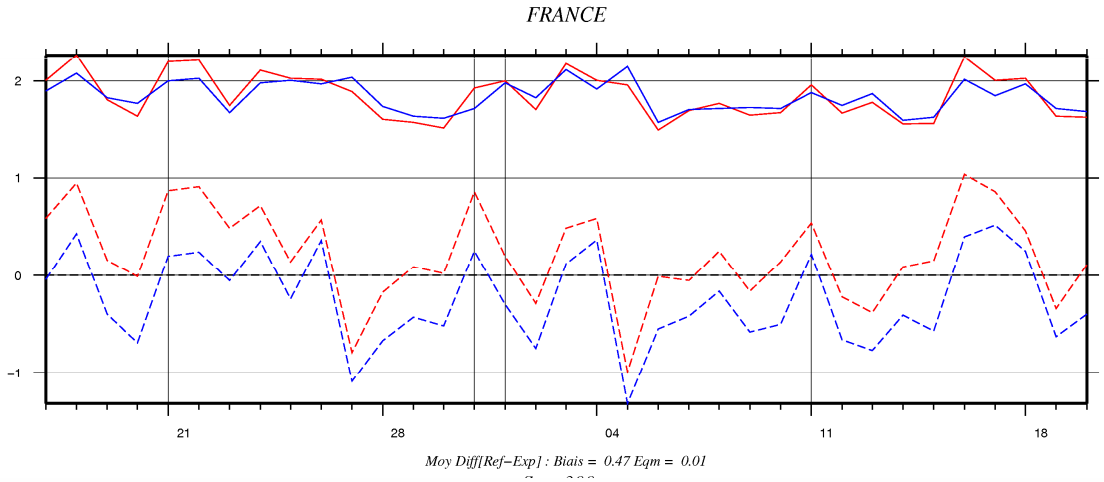
Impact of satellite albedo in AROME



LSA-SAF ALBEDO



ECOCLIMAP ALBEDO



T2m over France
FC+12H scores
16/08 -> 20/09/2011

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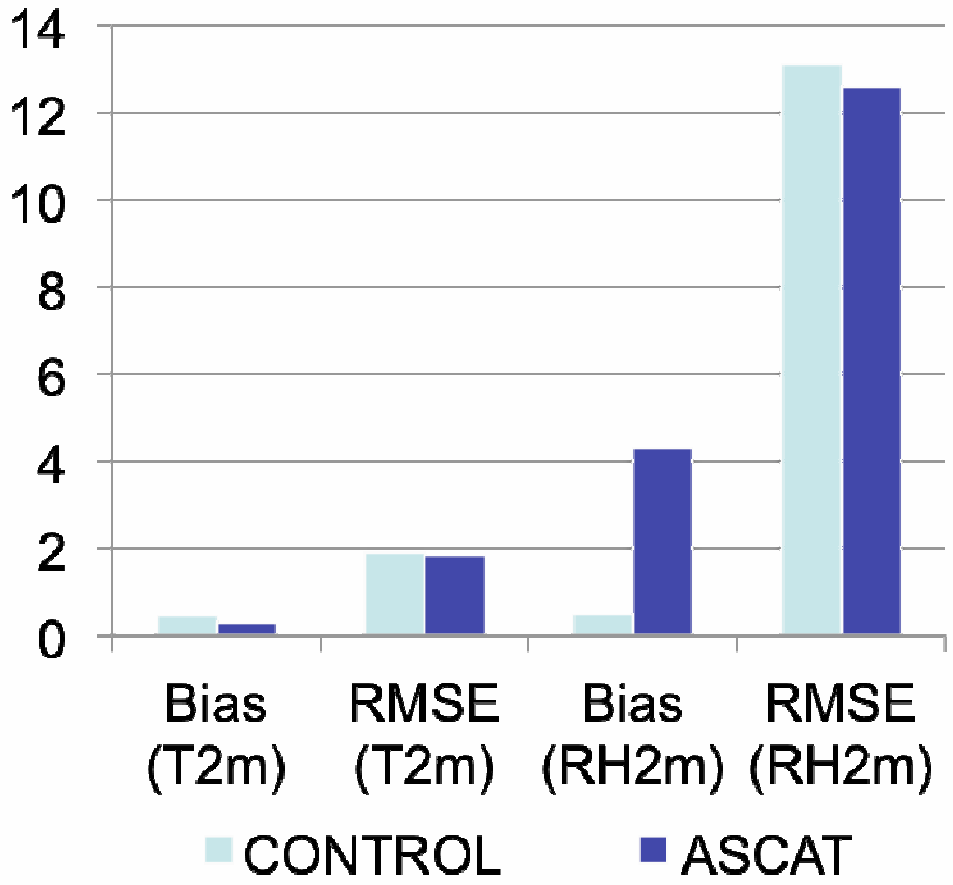
Assimilation of ASCAT soil moisture in ALADIN

- Method : Simplified EKF within SURFEX
- Observations : satellite derived superficial soil moisture from ASCAT
- Bias correction : local CDF matching
- Model : ALADIN-AUSTRIA (9.5 km and 60 levels)
- Domain : Central Europe
- Period : July 2009



48-h forecasts (00 UTC) against 36 Austrian weather stations

S. Schneider, ZAMG

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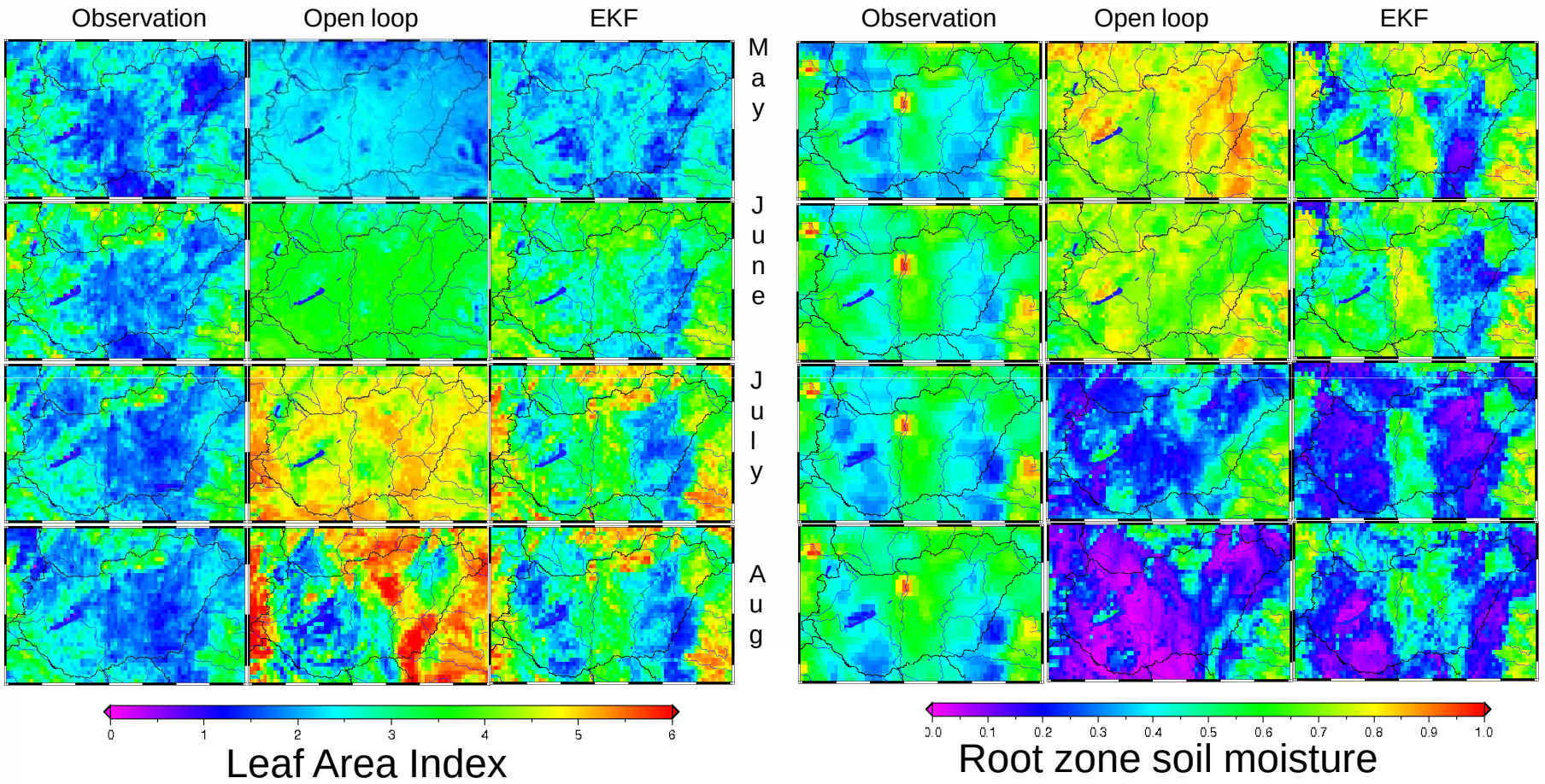
Simulation and assimilation of vegetation and natural carbon fluxes over Hungary

- Land Carbon Core Information Service of Geoland2: a Land Data Assimilation System is installed at the Hungarian Meteorological Service
- Modelling carbon and water fluxes with ISBA-A-gs (photosynthesis model available in SURFEX)
- Assimilation of satellite derived LAI and soil moisture (BioPar products of the Geoland2 project)
- Validation with FLUXNET measurements (1D) and satellite data (2D)
- Comparison of two Kalman Filter assimilation methods (EKF and SEKF)
- Project ends this year → near real time products of LAI, SWI and carbon fluxes will be available for Hungary

B. Szintai, OMSZ

Simulation and assimilation of vegetation and natural carbon fluxes over Hungary

- Impact of assimilation in 2D for 2010
- Serious overestimation of LAI and soil moisture by open loop simulation is corrected by the Kalman Filter



Conclusions

- SURFEX is becoming increasingly used in the ALADIN consortium
- Allows to consider new surface schemes (e.g. urban model) TEB and more up-to-date physiographic databases (ECOCLIMAP-2, HWSD)
- Surface data assimilation : improvements to the 2D OI analysis (EURO4M), moving from OI to EKF soil analysis schemes (new observations can be considered : LAI and satellite soil moisture)
- Ongoing activities :
  - Improving the efficiency of SURFEX (e.g. parallel OFFLINE version)
  - *New surface schemes : ISBA « diffusion version », Multi-Energy Balance (MEB*), FLake**
  - *SWE and precipitation analyses in OI CANARI**
  - *Assimilation of satellite products in EKF (coupled with atmospheric analyses)**

(*) Joint developments with HIRLAM (HARMONIE)