CONSORTIUM FOR SMALL SCALE MODELING

COSMO

PIEMONTE

Arpa

Agenzia Regionale per la Protezione Ambientale

Soil moisture perturbations for COSMO in the COTEKINO PP

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COSMO/CLM/ART User Seminar – Wroclaw – 7-10 September2015

Aim of the task

Increase the variability among members of a high resolution convection permitting COSMO ensemble model taking into account lower boundary uncertainties … SOIL MOISTURE

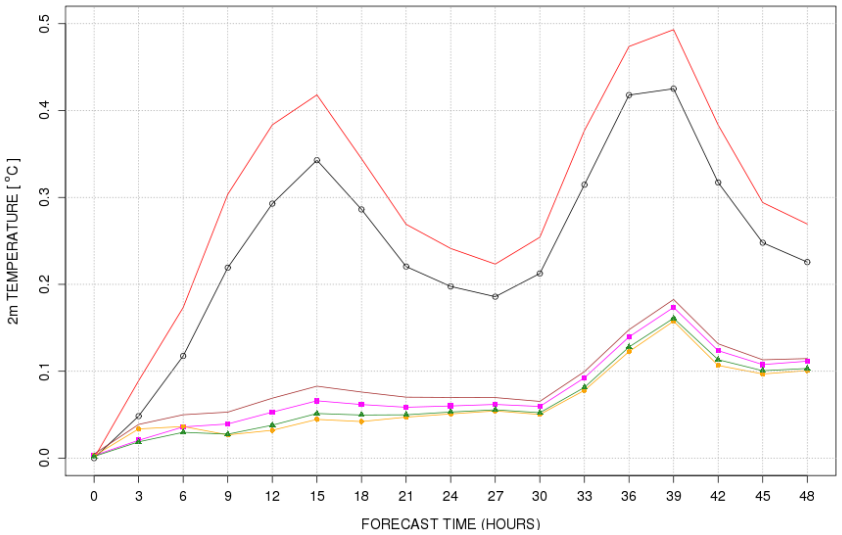
Steps of the research

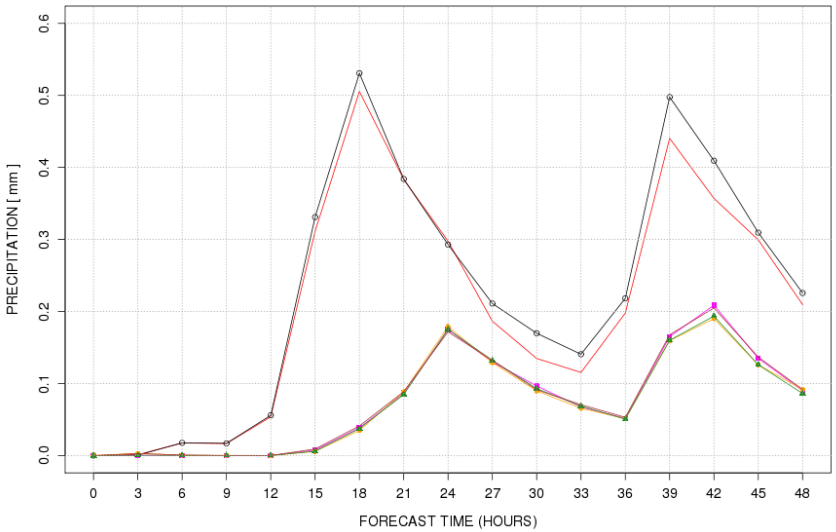
- Literature review search for methods and parameterizations
- COSMO model sensitivity tests on the soil moisture initial conditions (soil temperature also taken into account); COSMO newsletter n. 14
- Selection of best performing soil moisture perturbation technique and tests with case studies COSMO newsletter n.15
- Special Project SPITSOIL at ECMWF
- Suites development at ECMWF supercomputer and tests on case studies (COSMO USER SEMINAR 2015**)**
- Other case studies
- Conclusions

Main findings

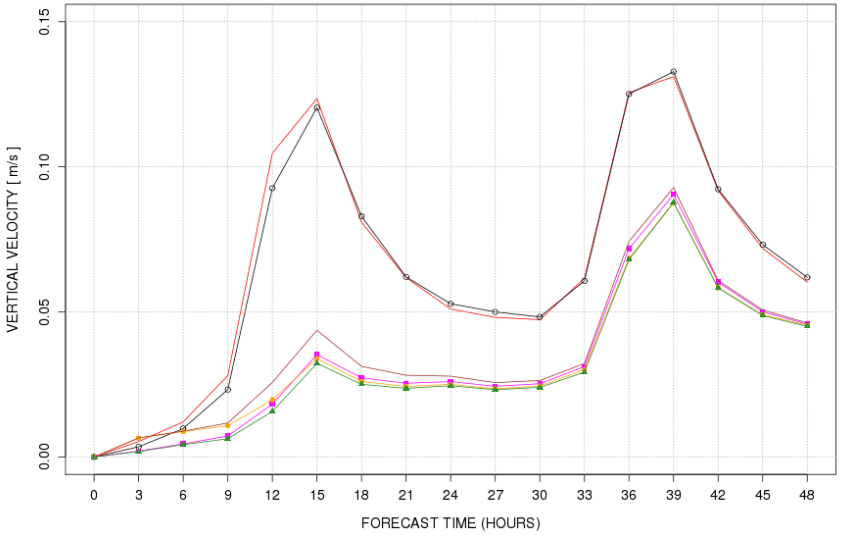
1. Lower boundary uncertainties (mostly SM) have a great impact on the spread generated among ensemble members both on surface variables and upper level prognostic variables (difference between IFS and COSMO-EU soil moisture IC).

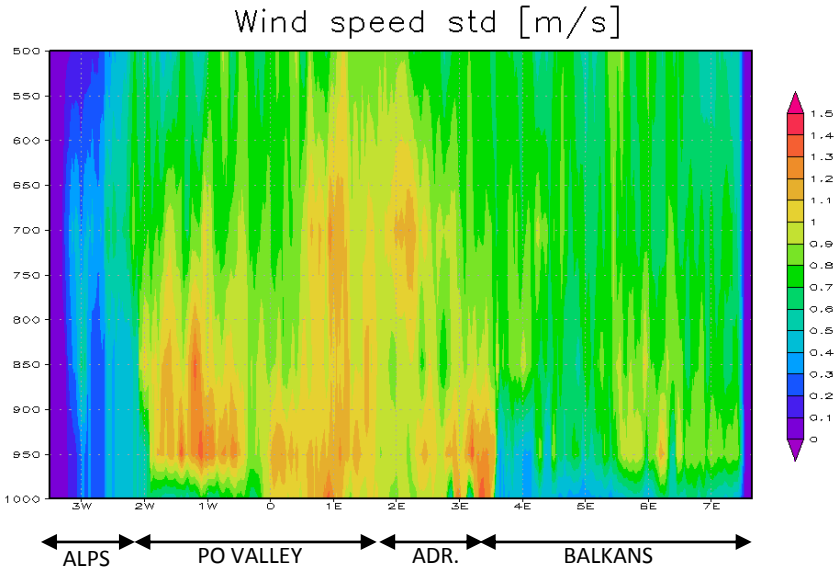
case study: 29/06/2011





sensitivity test
F_{max} = 0.08, L(0.5) = 125 km
F_{max} = 20%, L(0.5) = 125 km LAI
F_{max} = 20%, L(0.5) = 125 km z0
F_{max} = 20%, L(0.5) = 125 km PLCOV
F_{max} = 15%, L(0.5) = 125 km LAI+Z0+PLCOV





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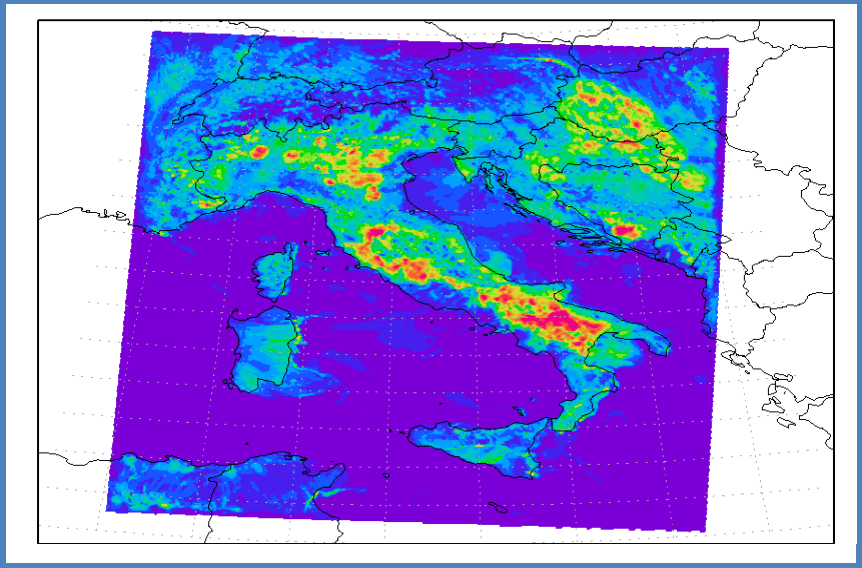
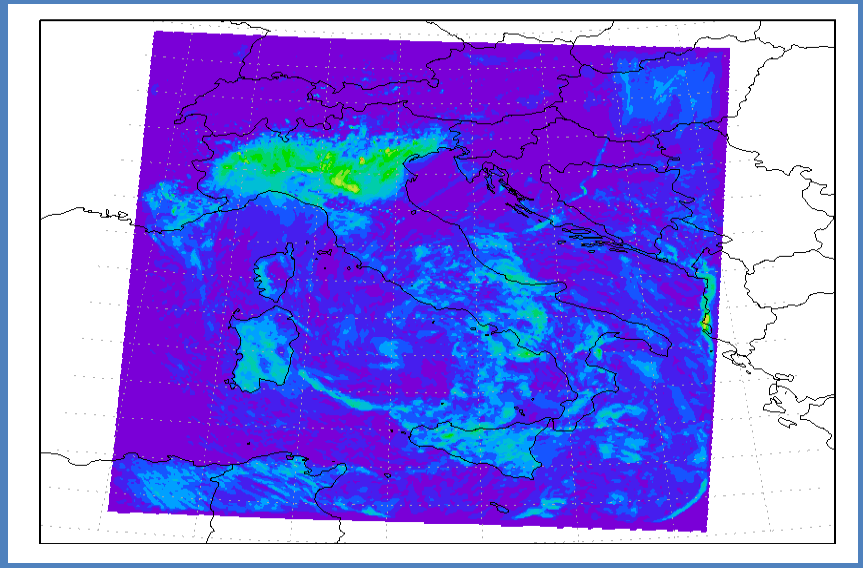
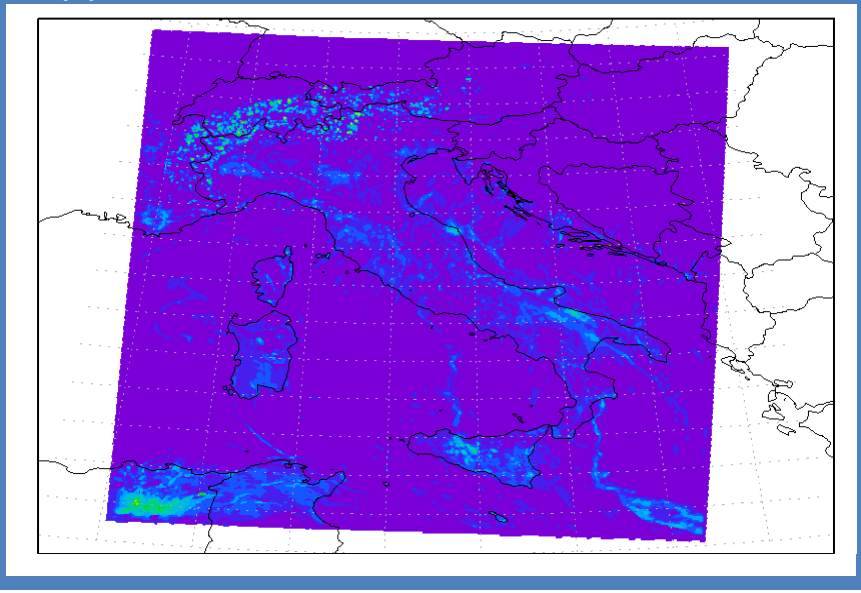
(1) 29-06-2011 00UTC - STRONG SYNOPTIC FORCING

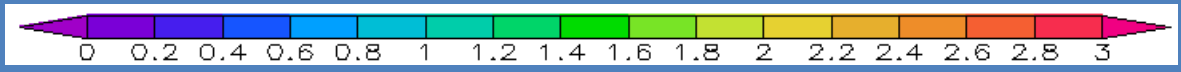


(2) 10-11-2013 00UTC - FOEHN OVER THE PO VALLEY



(3) 25-01-2013 12UTC – STABLE CONDITIONS





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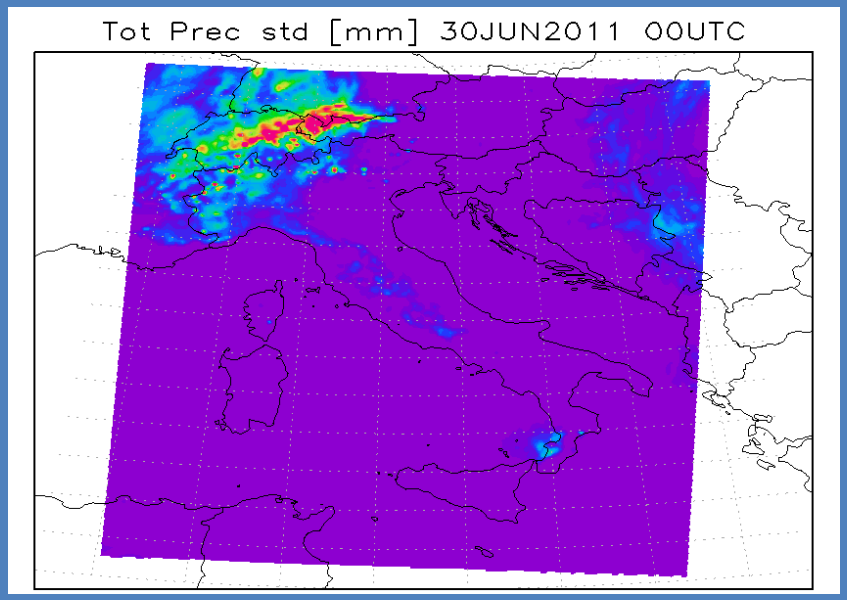
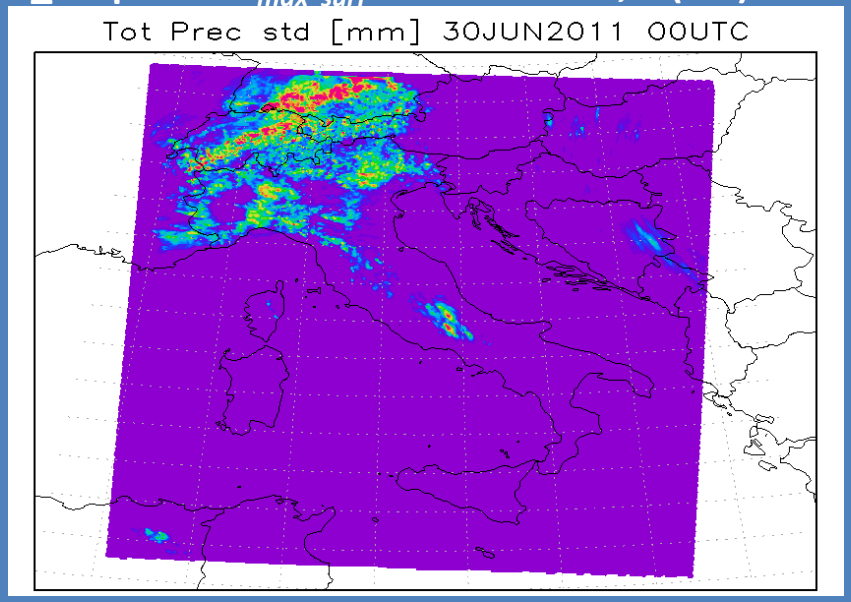
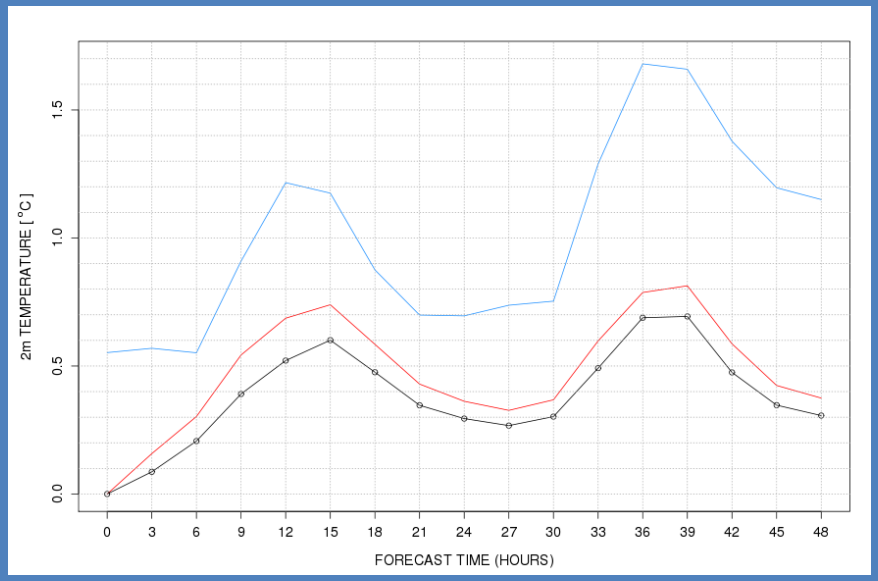
3. Spread comparable with the one coming from an ensemble system with perturbed atmospheric initial and boundary conditions (COSMO-LEPS).

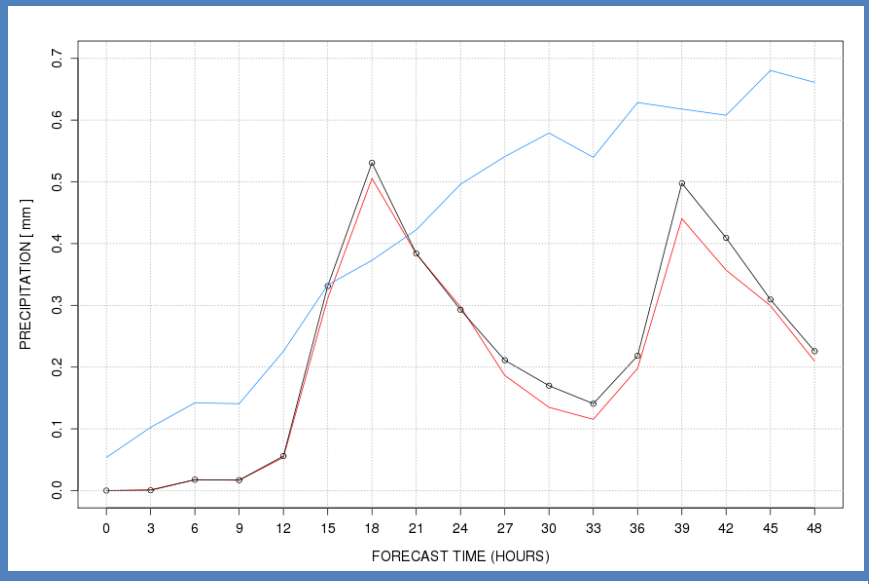
COSMO LEPS– run 28062011 12 UTC



W_SO pert. – $F_{max\ surf}$ = 0.08 $m^3\ m^{-3}$, L(0.5) = 125 km







COSMO LEPS run: 28062011 12UTC — sensitivity test — F_{max} = 0.08, L(0.5) = 125 km

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3. Spread comparable with the one coming from an ensemble system with perturbed atmospheric initial and boundary conditions (COSMO-LEPS).

4. Spread increases if the lower boundary uncertainties are coupled with those on the upper levels: complete perturbed ensemble system (soil IC and atmosphere IC / BC perturbed)

Last results

Different test suites have been developed at ECMWF:

SUITE EPS

Classic ensemble system: Atmospheric IC and BC from 10 random ECWMF EPS members, soil IC from ECMWF or COSMO-EU soil moisture analysis

SUITE SOIL

10 members made by perturbing soil moisture IC (from ECMWF or COSMO-EU soil moisture analysis) using Stochastic Pattern Generator (SPG)

SUITE EPS-SOIL (ECMWF)

"Completely" perturbed: SUITE EPS + SUITE SOIL – Soil moisture analysis from **ECMWF**

Last results

Additional test suites:

SUITE EPS-SOIL (COSMO-EU)

"Completely" perturbed: SUITE EPS + SUITE SOIL – Soil moisture analysis from COSMO-EU

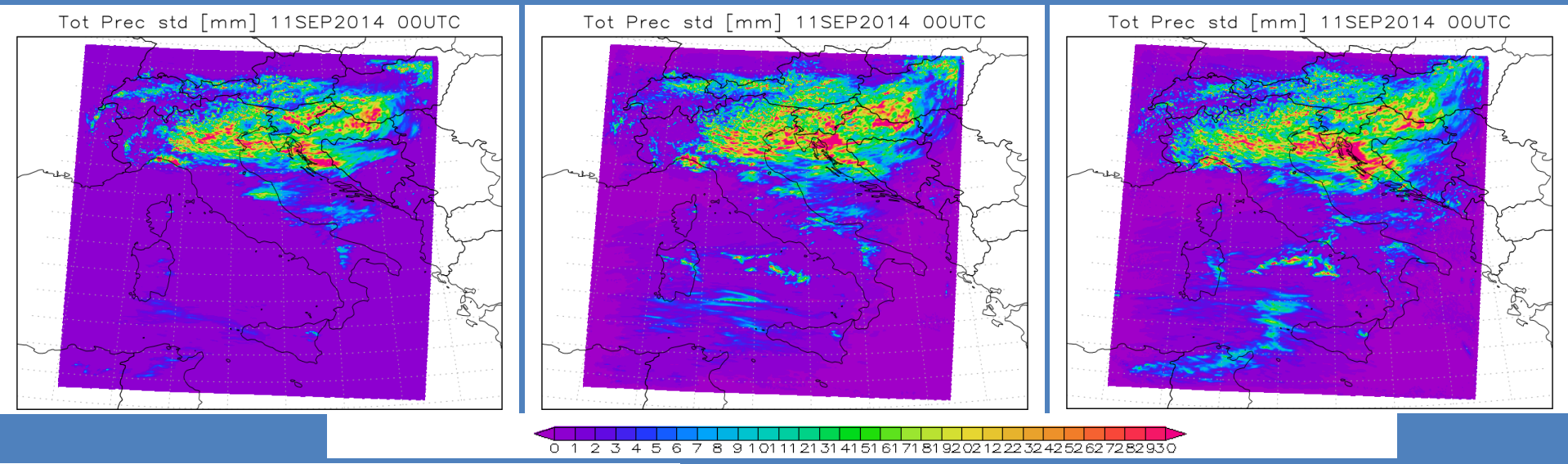
SUITE EPS-PHYSICS

SUITE-EPS + physics perturbation

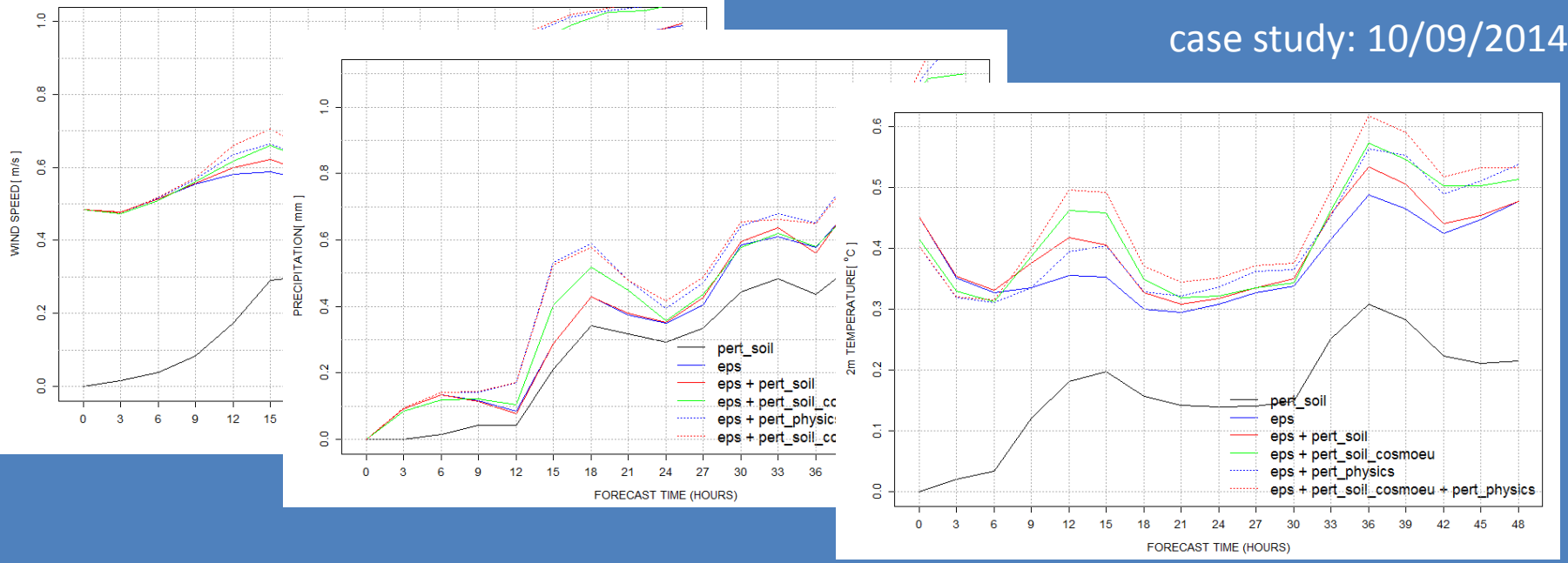
SUITE EPS-SOIL-PHYSICS (COSMO-EU)

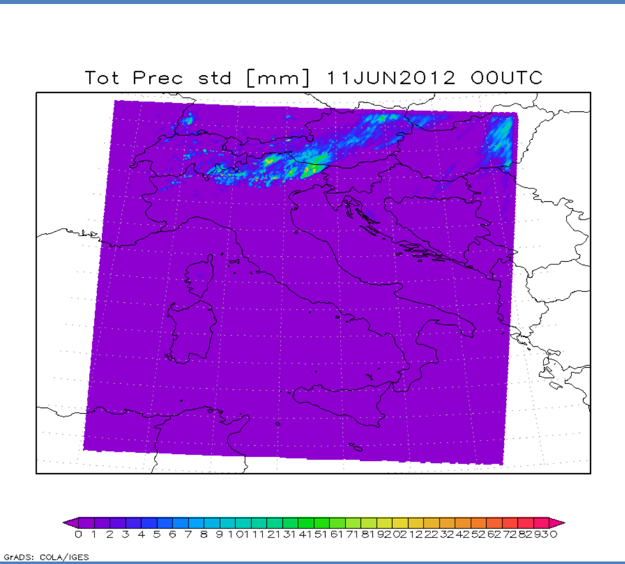
"Completely" perturbed: SUITE EPS-SOIL (COSMO-EU) + physics perturbation

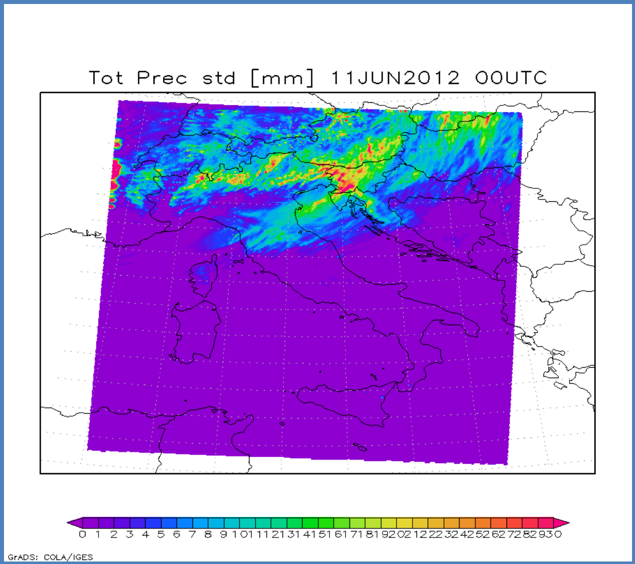
SPITSOIL – ECMWF special project

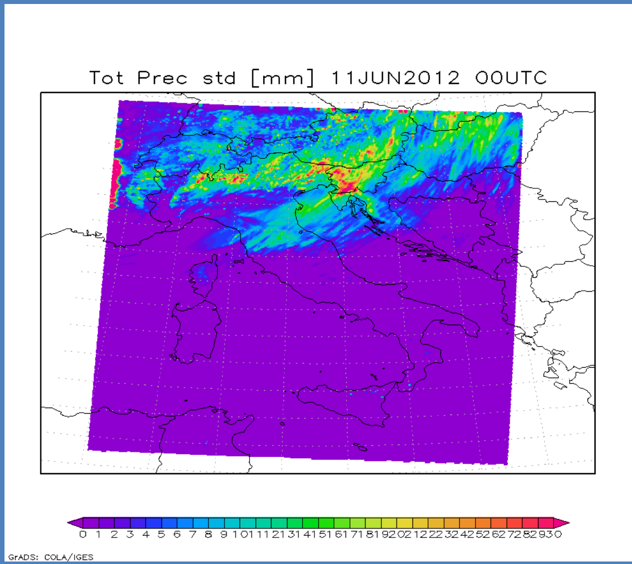


case study: 10/09/2014

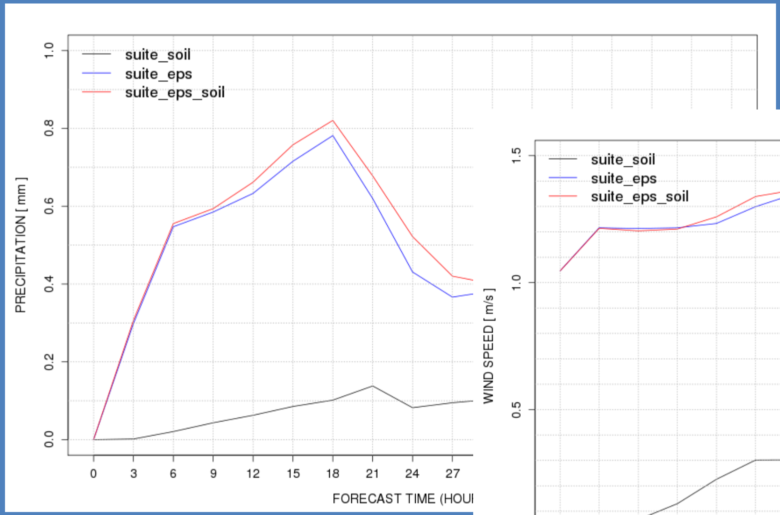


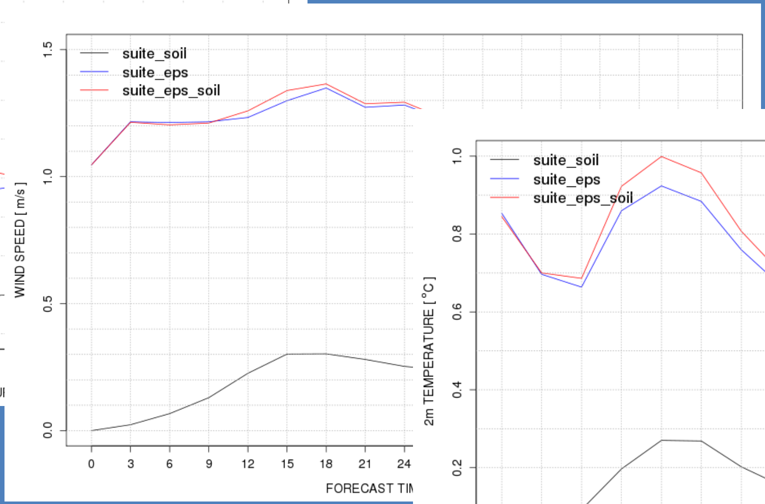


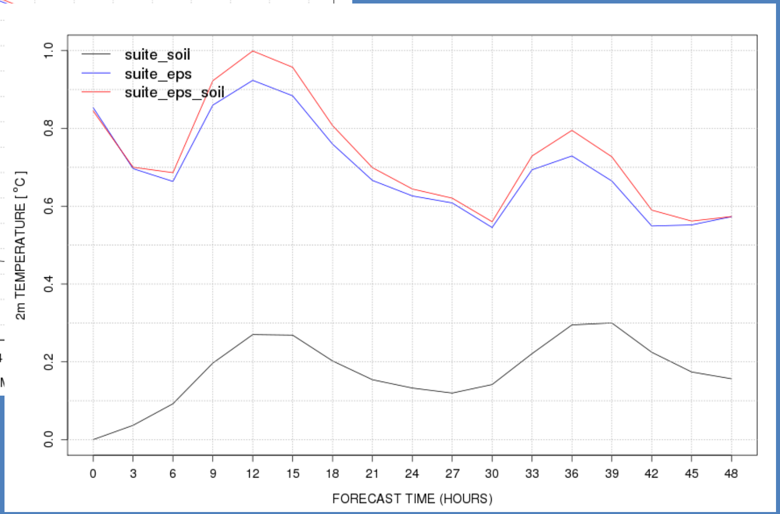




case study: 11/06/2012







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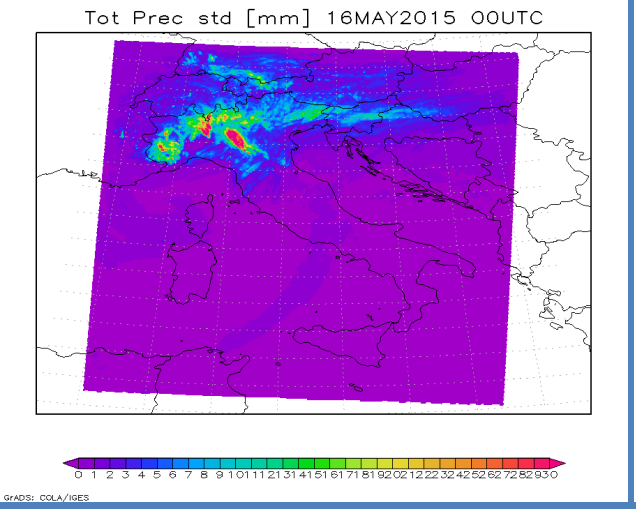

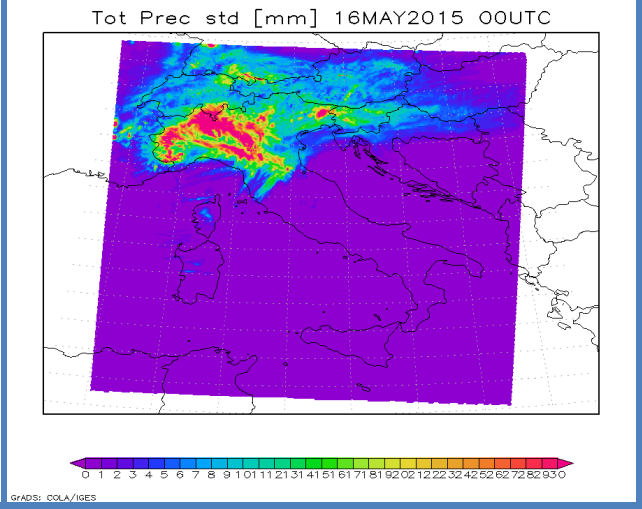

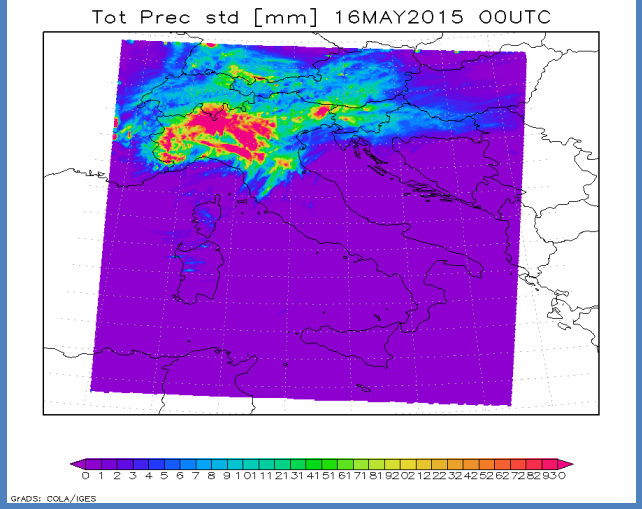

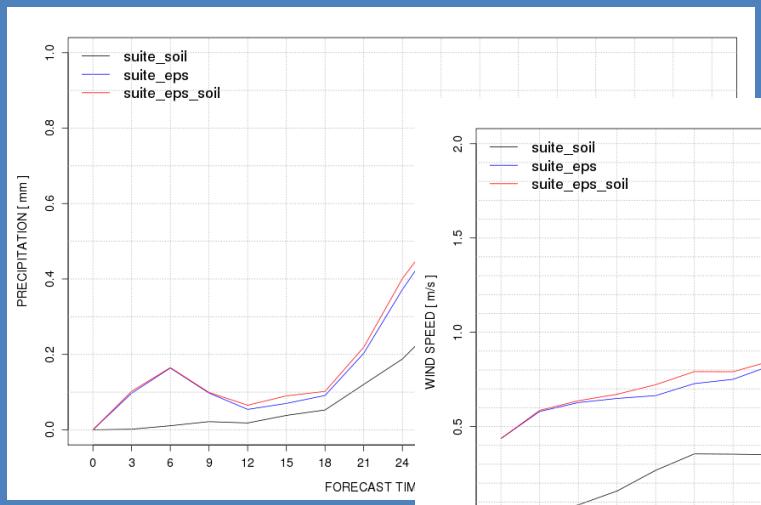

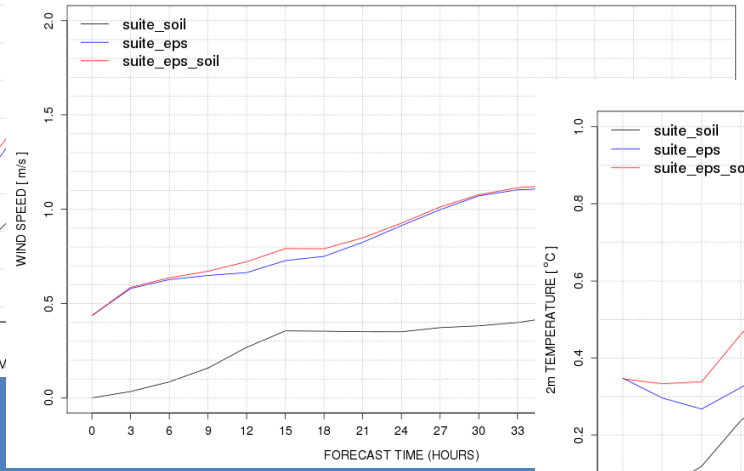

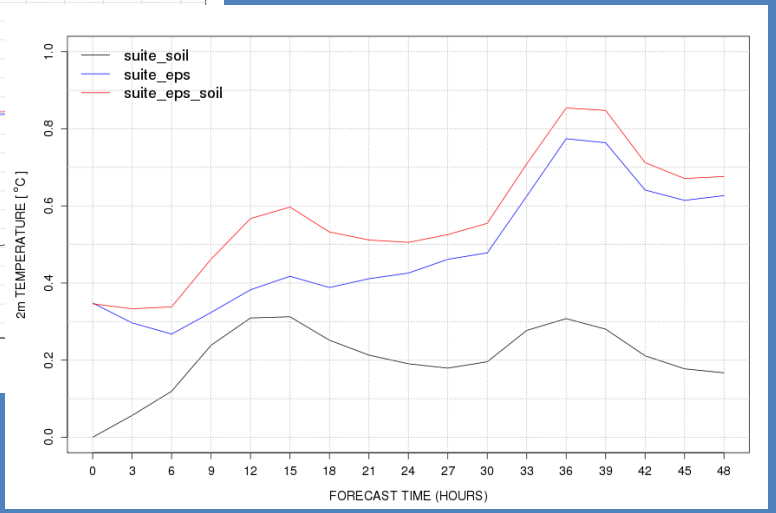

case study: 15/05/2015

Conclusions

- Uncertainties of the lower boundary influence the performances of a high resolution ensemble system based on COSMO I2.
- Among the surface variables Soil Moisture give the biggest contribution generating and increasing spread of the near surface prognostic variables as well as upper in the troposphere.
- It is worth to work on a high resolution ensemble system with soil IC and atmosphere IC/BC perturbed: it positively increases the spread (in spring and summer convective conditions).
- Spread is larger when COSMO-EU soil moisture analysis is used as surface field to perturb with SPG technique (IFS being more wet).
- Verification gives interesting results, even if more data would benefit the statistics

Future developments

Verification and ensemble technique

1. More simulations enabling a verification (possibly with VERSUS)
2. Set up a COSMO-IT-EPS implementing results from KENDA (new Priority Project)

Acknowledgments

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Thank you for your attention!