



# Combining Stochastic Perturbation of Physical Tendencies and parameter perturbation in the COSMO-IT-EPS convection-permitting ensemble

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# Outline

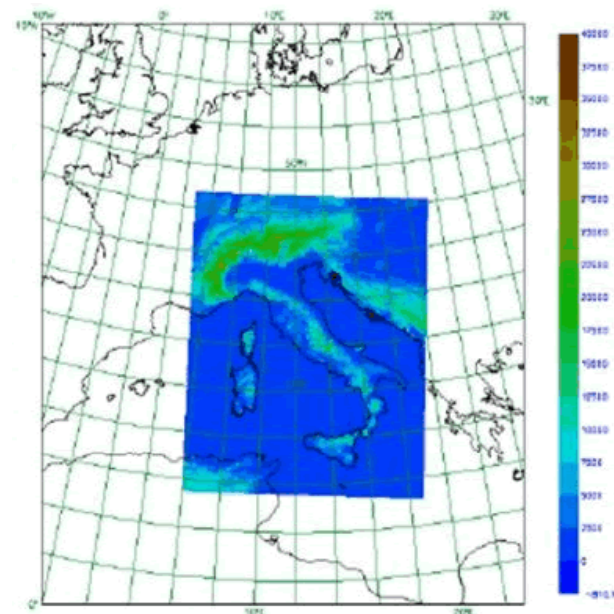
- Aim of this talk
- The COSMO-IT-EPS ensemble
- Evaluation of the model perturbations:
  - Spread/skill
  - Verification of precipitation
  - Behaviour on cases
- Conclusions

# Aim of this work

- Study the effect of combining different methods for the perturbation of the COSMO model in a CP ensemble
  - SPPT
  - Perturbed parameters
  - their combination
- Assess the different role of the two methods
- Spread/skill relation
- Impact on the precipitation forecast
- Behaviour of the spread for selected cases
- Spectra of perturbations

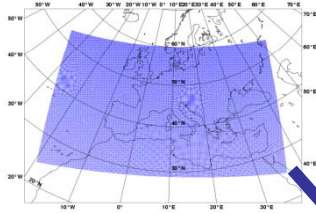
# COSMO-IT-EPS

- COSMO 2.8 km, 50 levels (nr. points 447 x 532)
- 10 members
- ICs and BCs from the first 10 members of COSMO-ME-EPS (10 km, LETKF for ICs, COMET)
- model perturbations:
  - Exp1: no model perturbation
  - Exp2: SPPT
  - Exp3: SPPT + Parameter Perturbation
- 1 month period: October 2015
- 1 run per day (00 UTC), +48 h



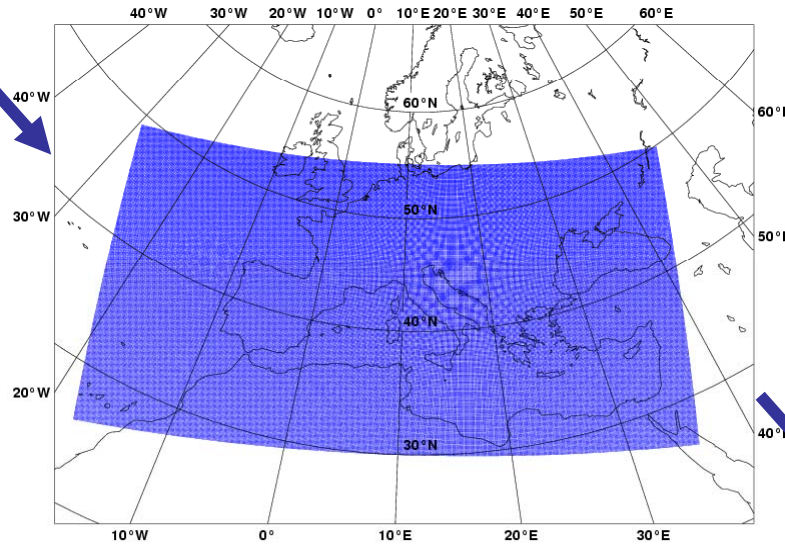
# COSMO-IT-EPS on COSMO-ME-EPS

**EnKF DA**



**10 km**  
**45 v.l.**

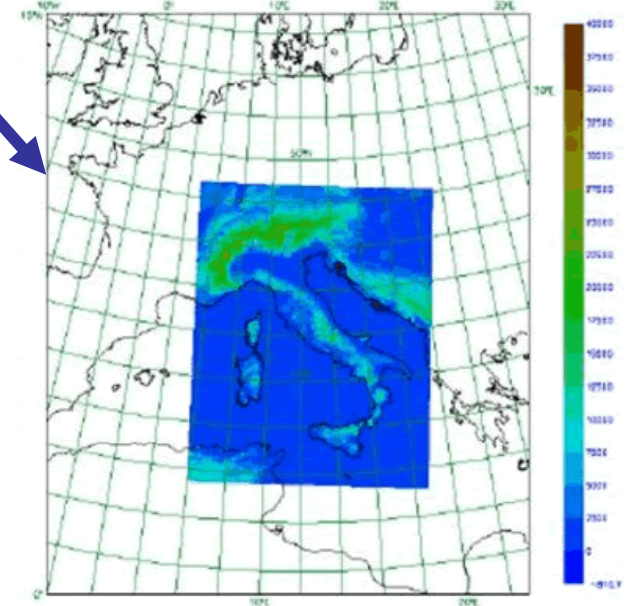
**COSMO-ME-EPS (COMET)**



**10 km**  
**40 v.l.** parameterized convection

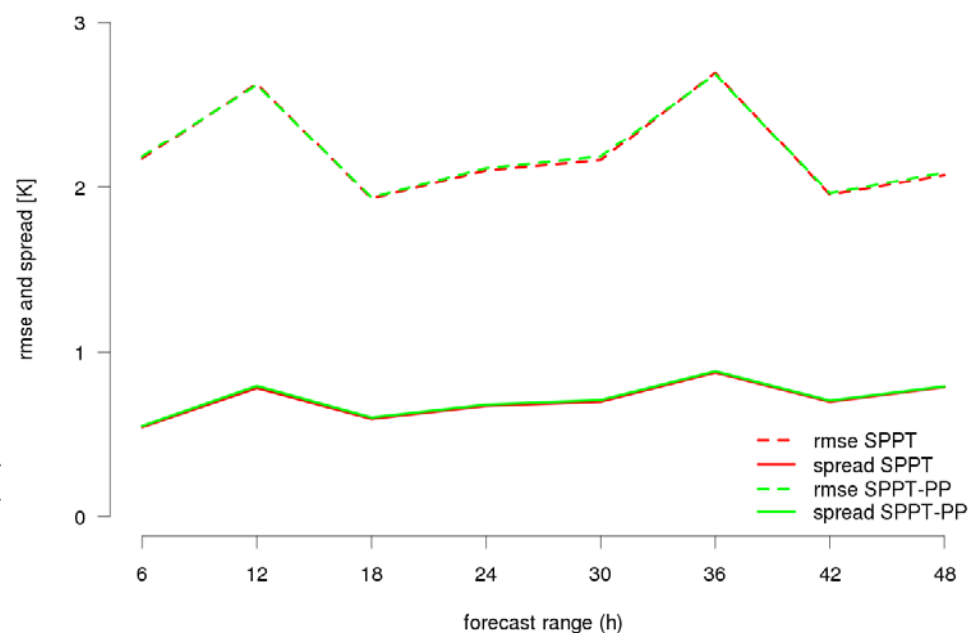
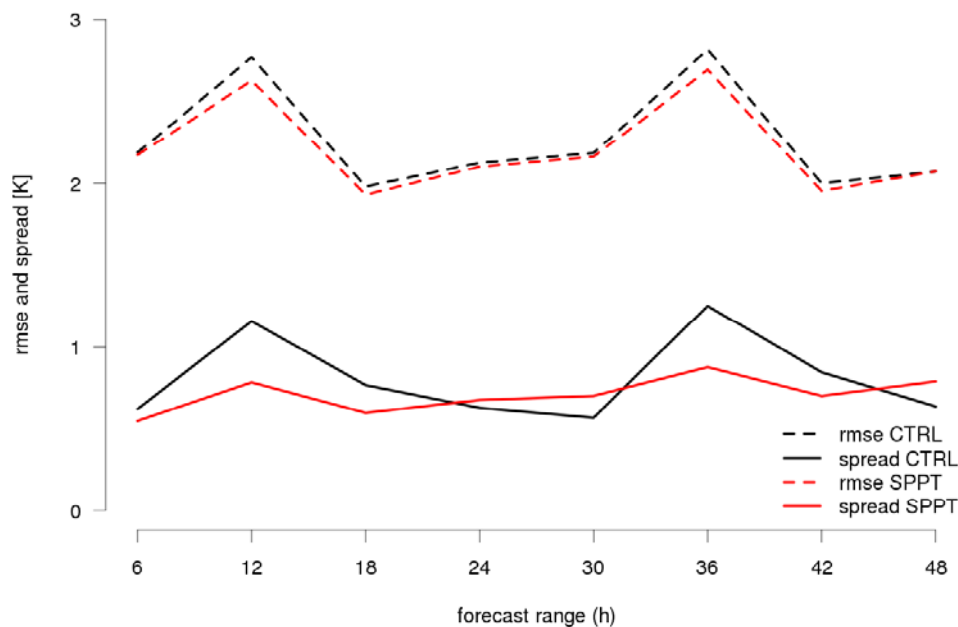
**COSMO-IT-EPS (Arape)**

**2.8 km** explicit convection  
**50 v.l.**



# spread/skill relation

## 2m temperature – October 2015



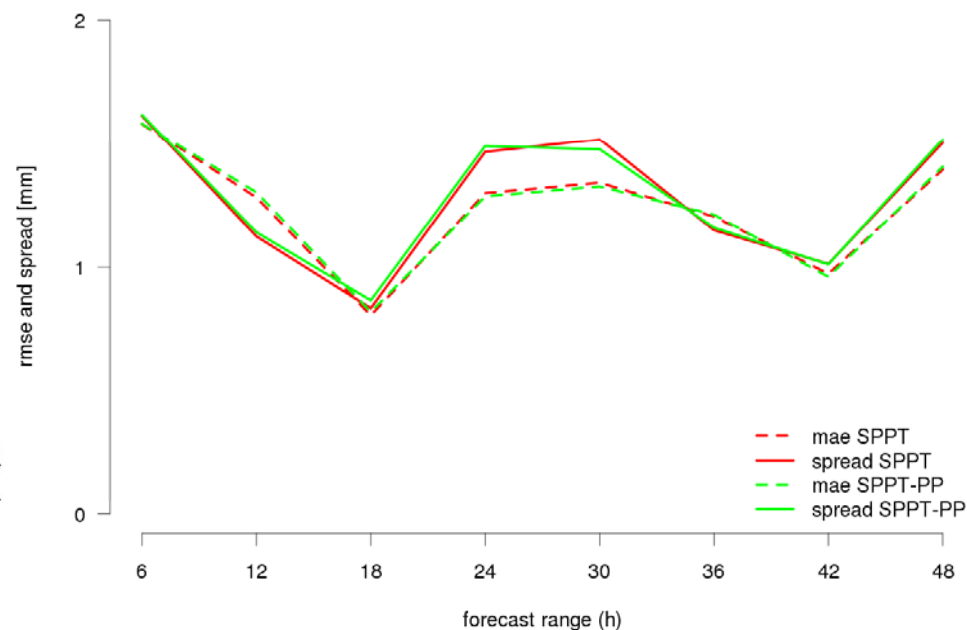
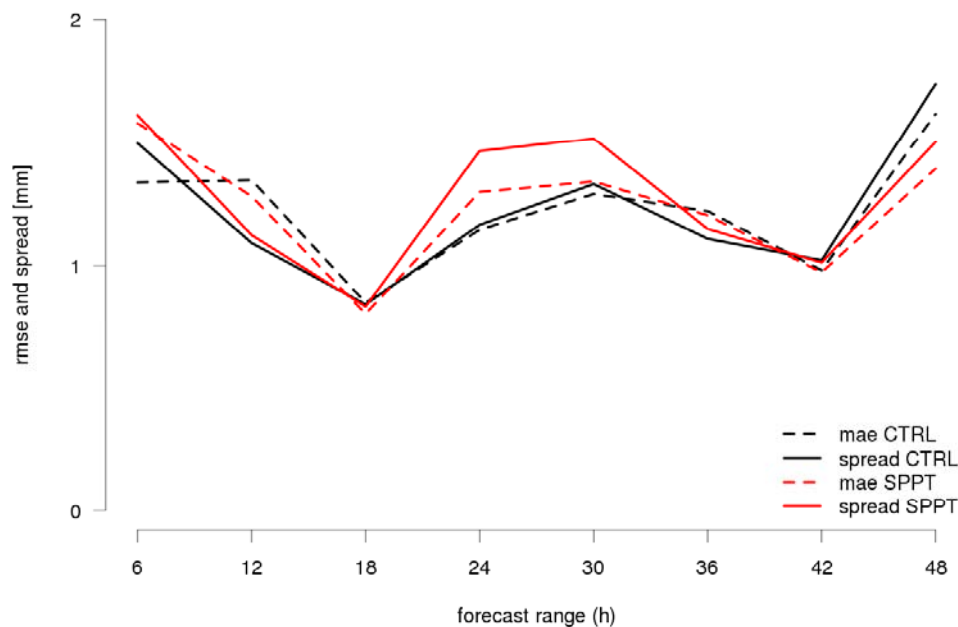
spread  
 error

root mean square error is computed against observations at ground stations over Northern Italy

spread = standard deviation of the ensemble members around the mean

# spread/skill relation

## 6h precipitation – October 2015



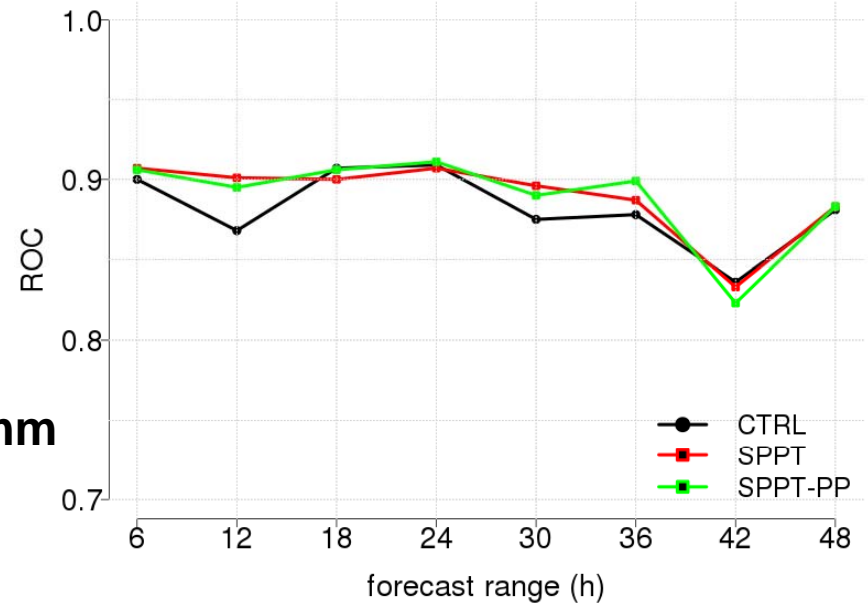
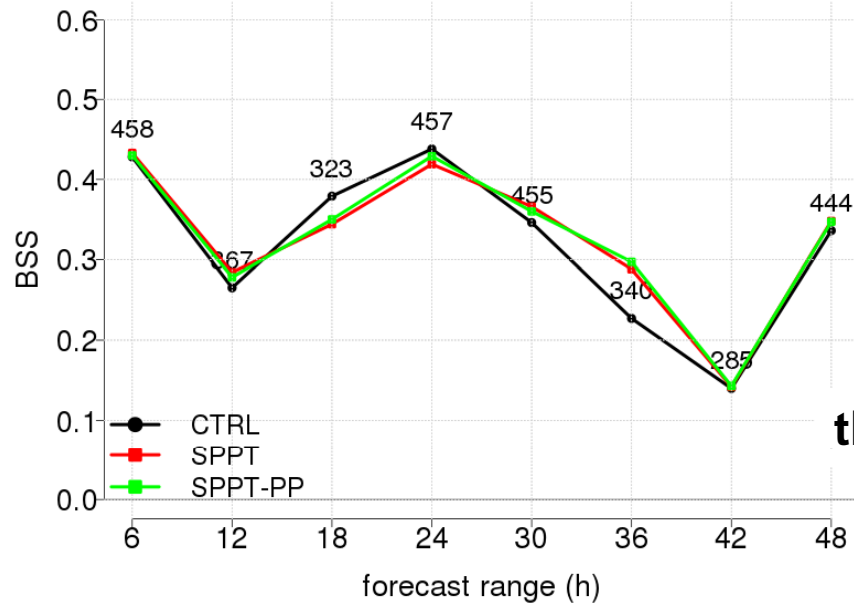
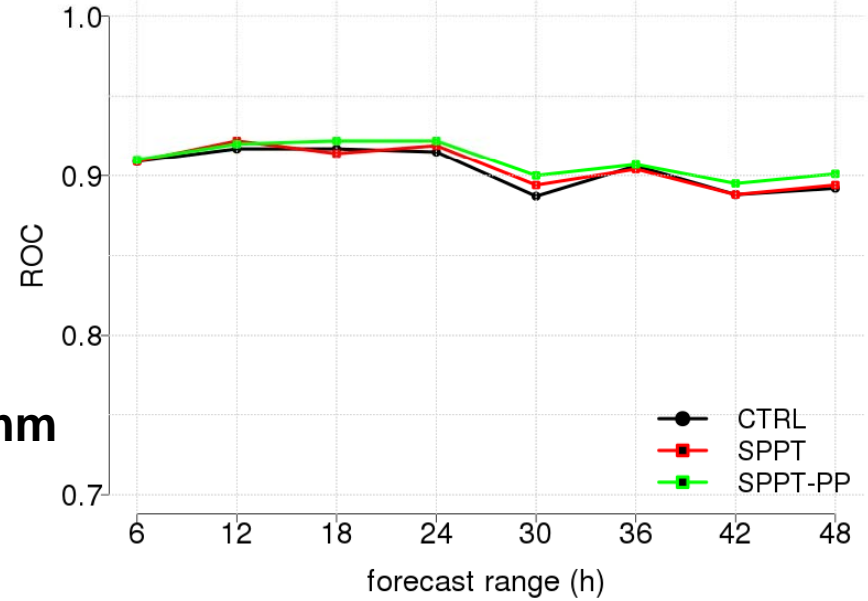
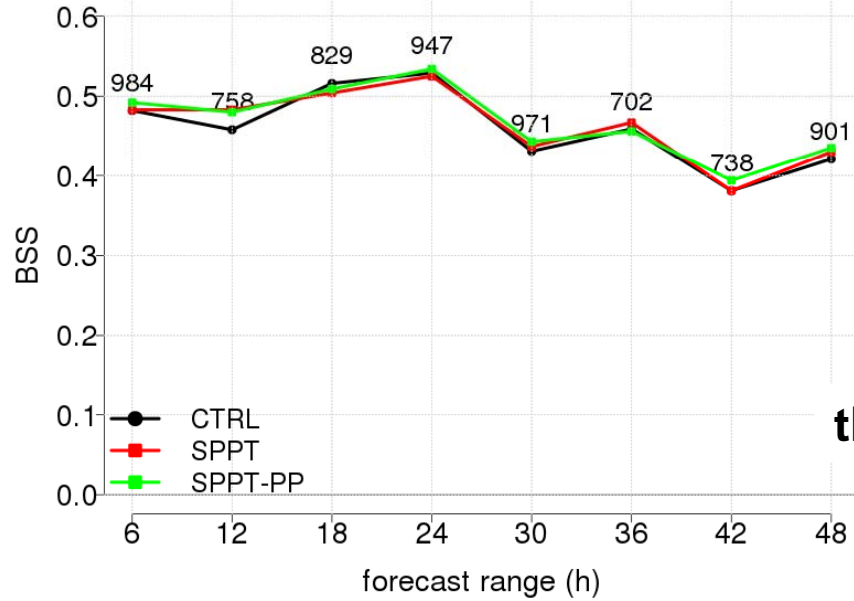
— spread  
--- error

mean absolute error is computed against observations at ground stations over Northern Italy

spread = mean absolute distance of the ensemble members from the mean

# verification of 6h precipitation

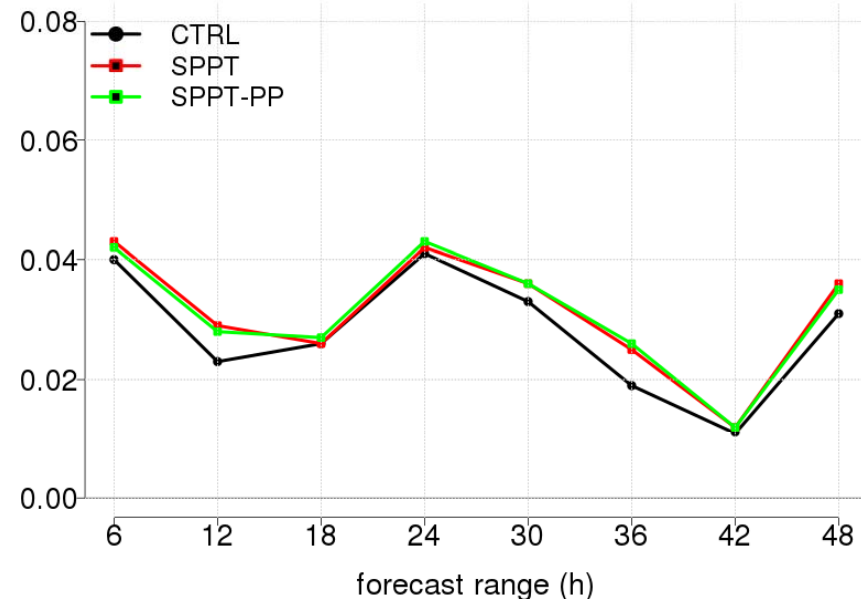
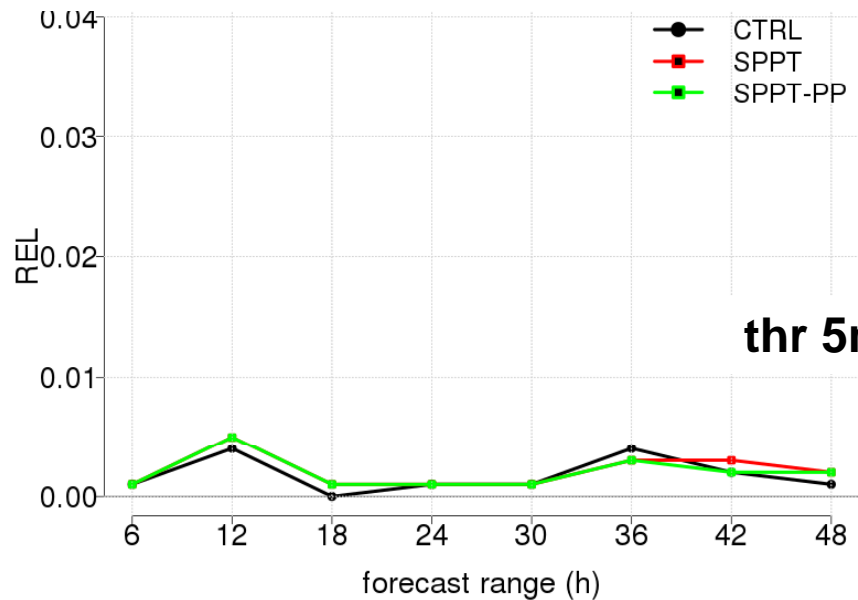
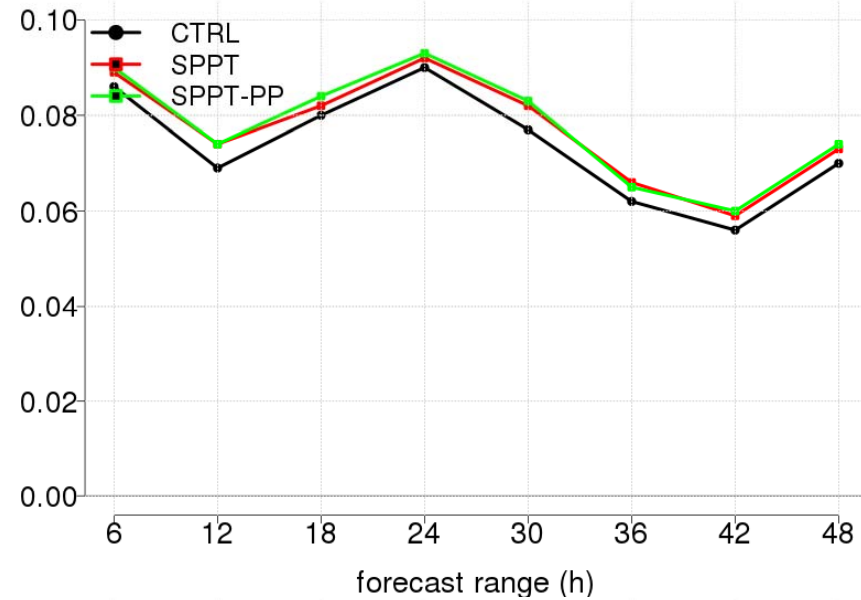
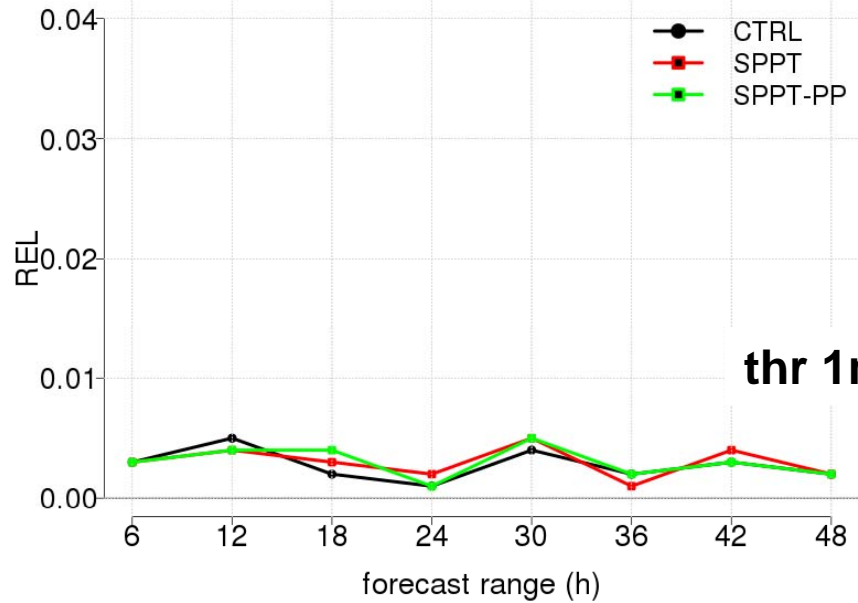
average value over boxes of 0.2 x 0.2 deg – Italy – October 2015





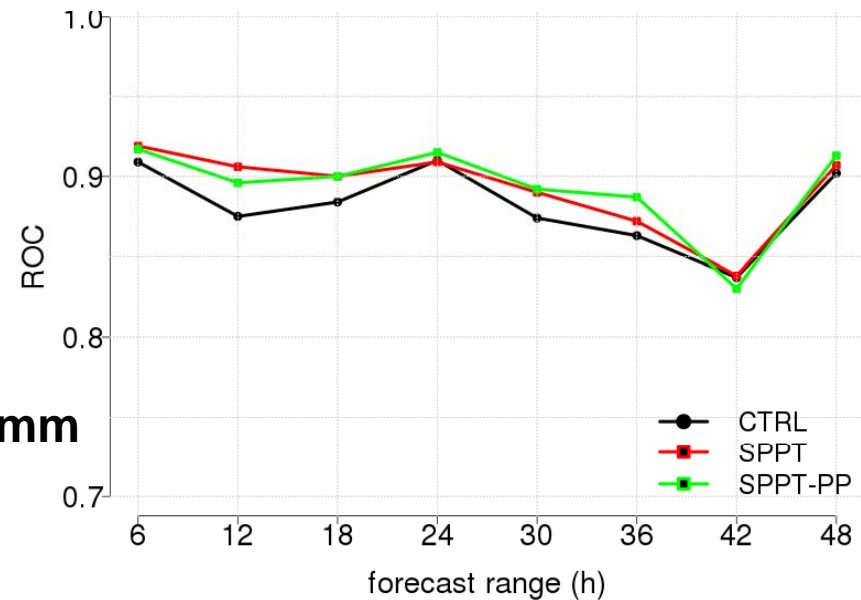
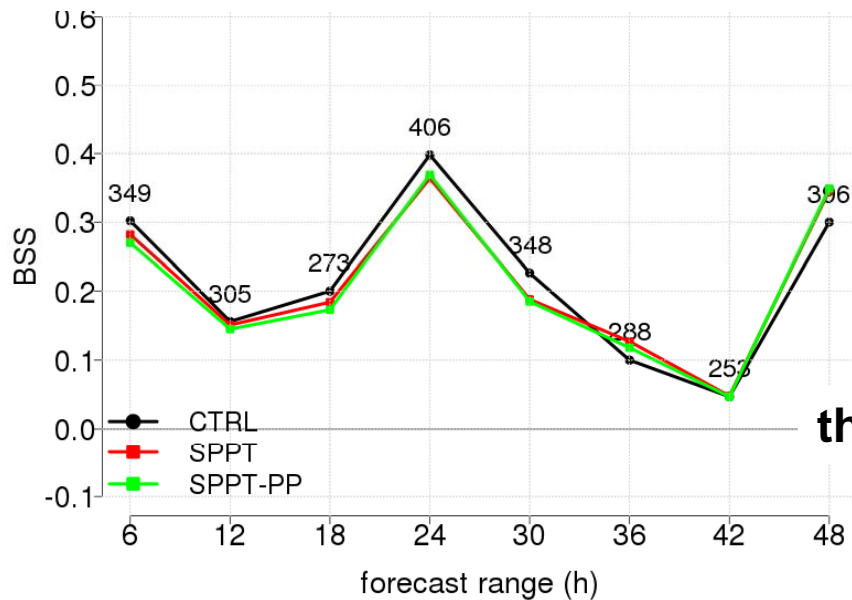
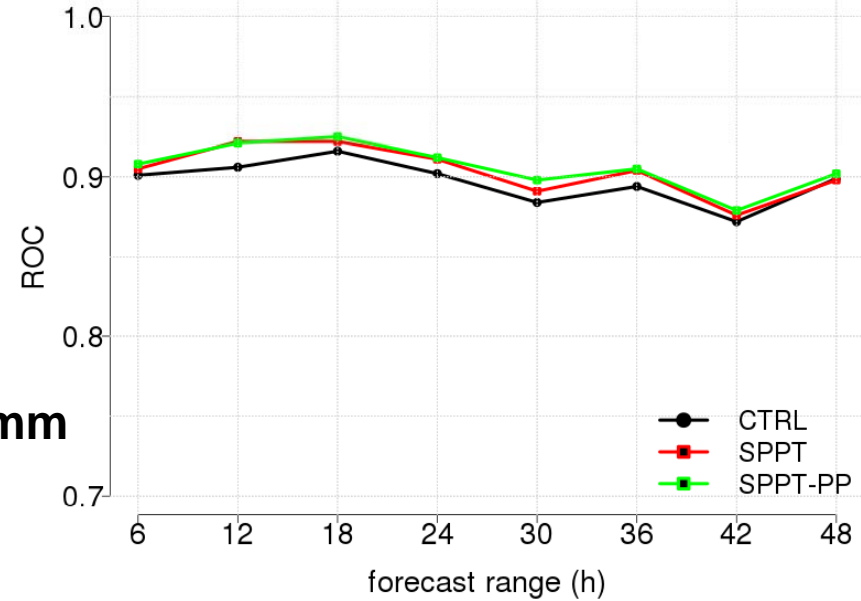
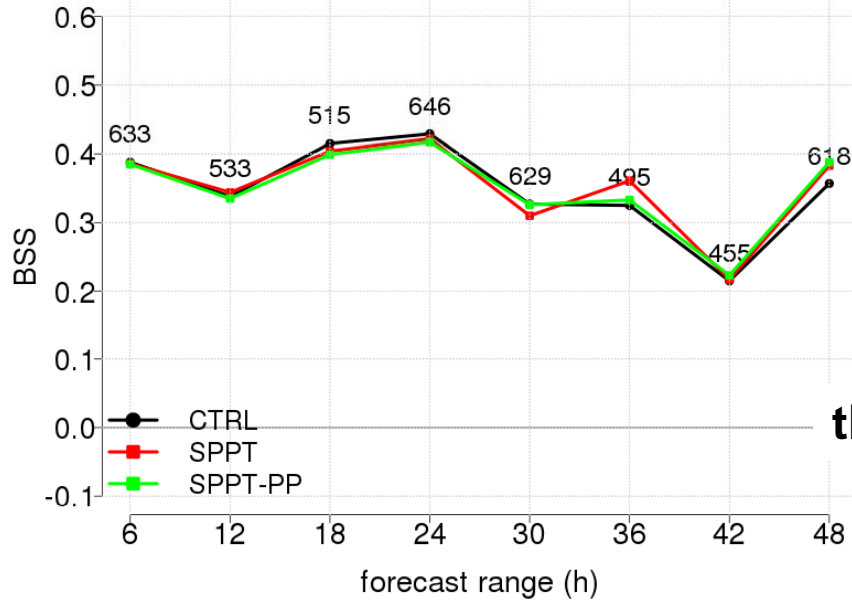
# verification of 6h precipitation

average value over boxes of 0.2 x 0.2 deg – Italy – October 2015



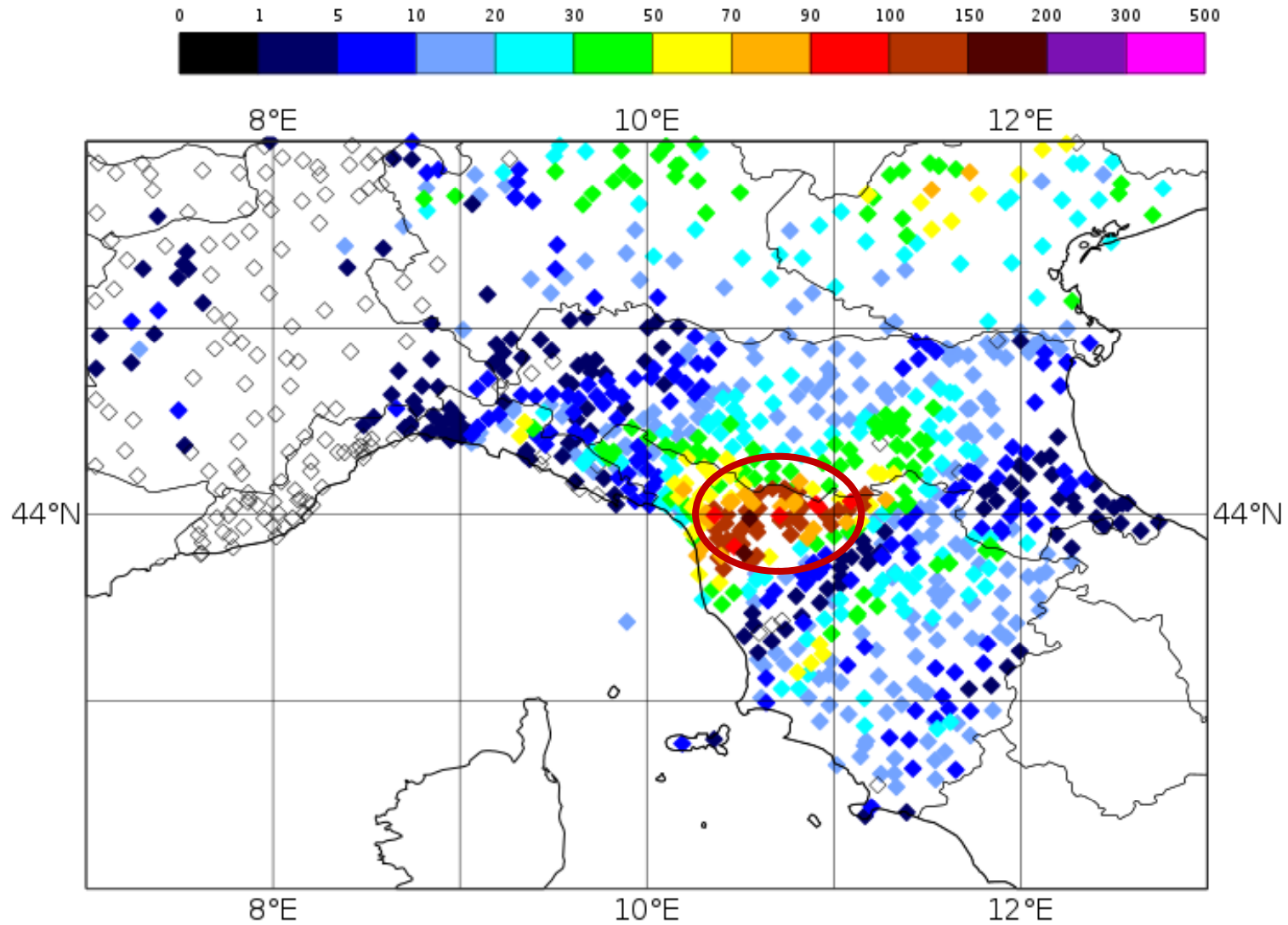
# verification of 6h precipitation

maximum value over boxes of 0.2 x 0.2 deg – Italy – October 2015

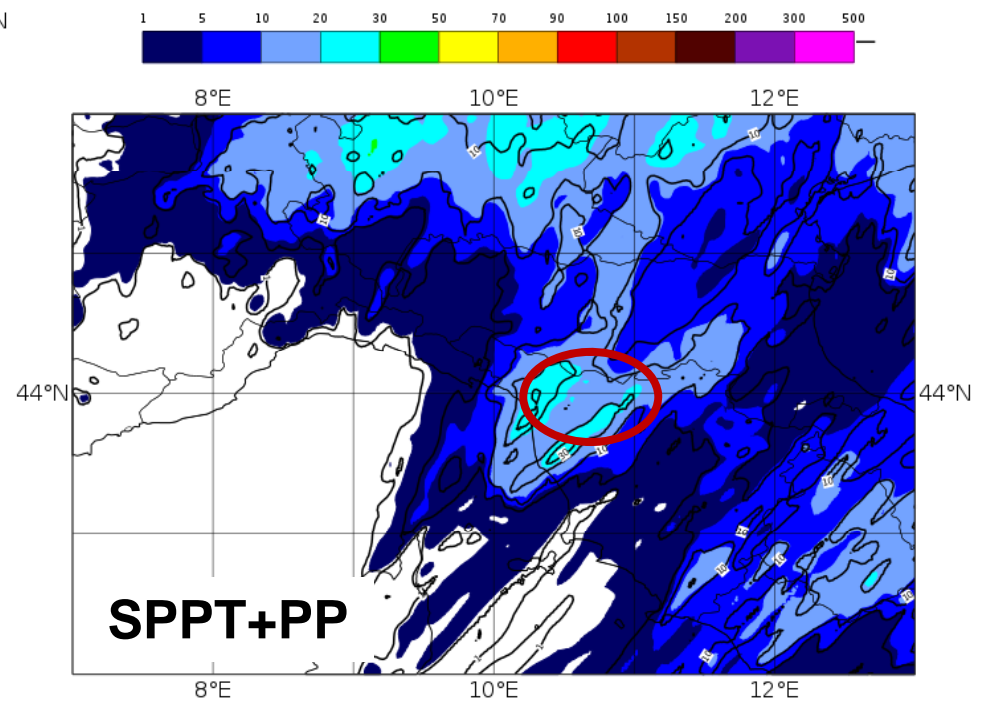
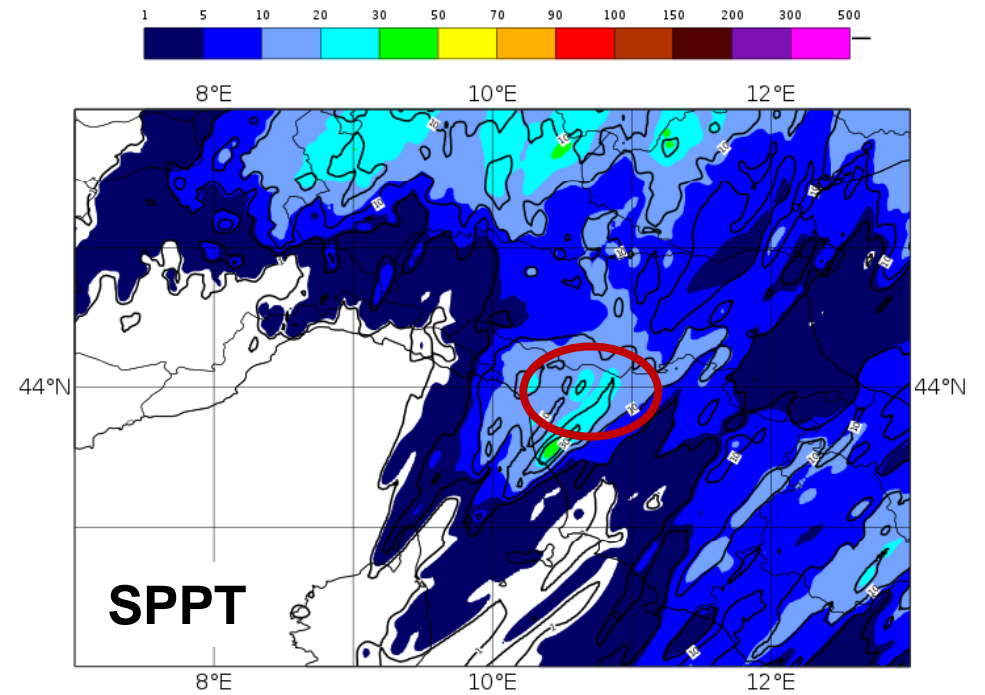
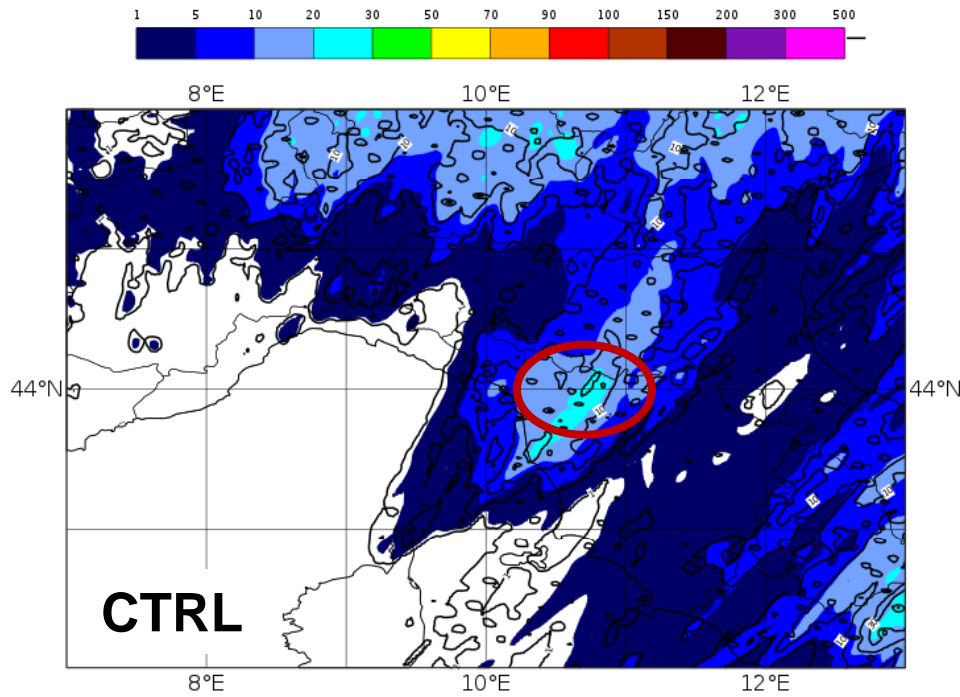


# 14/10/2015

## 24 h precipitation – raingauges

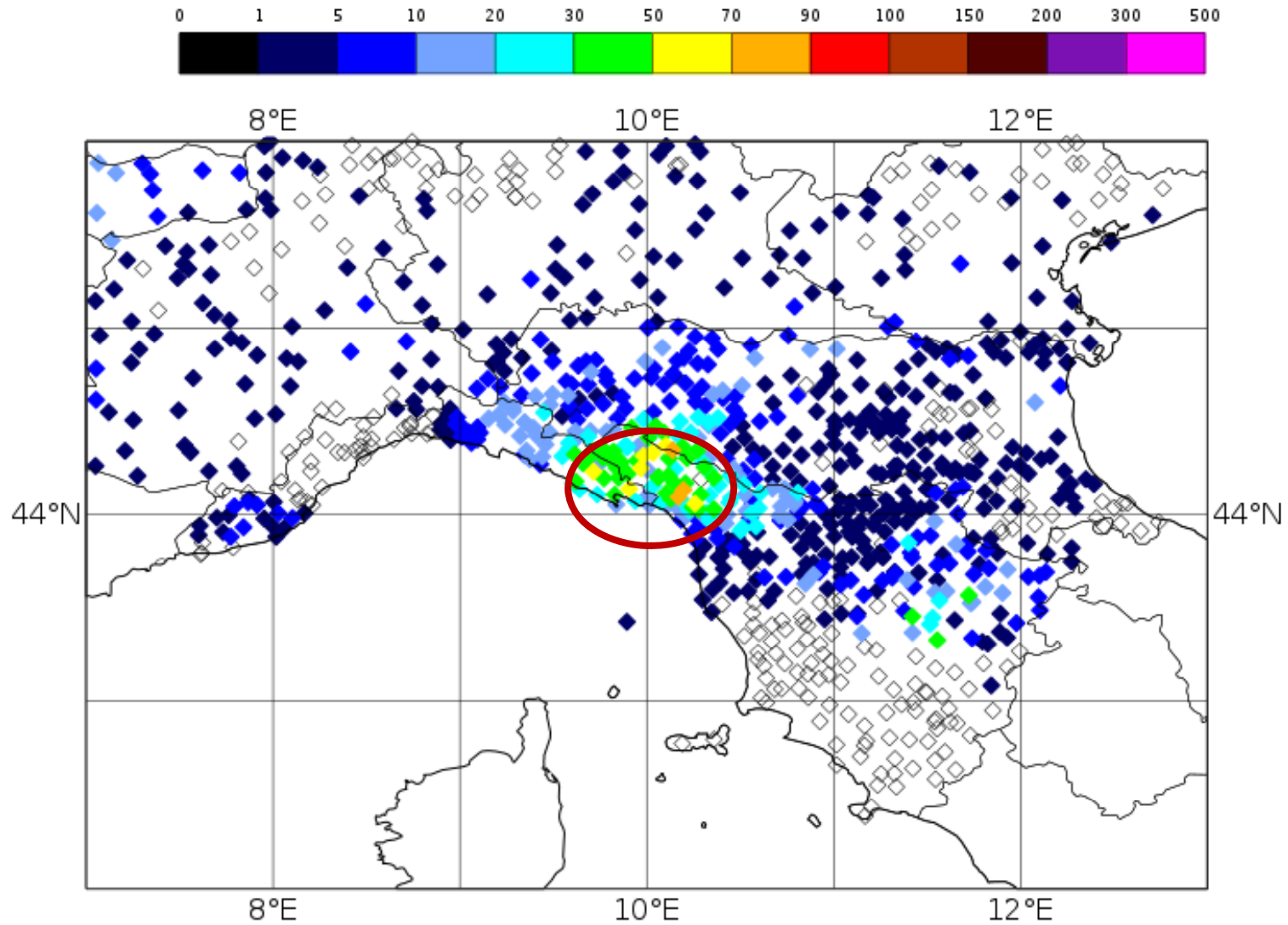


ens mean + spread  
18-24 h forecast

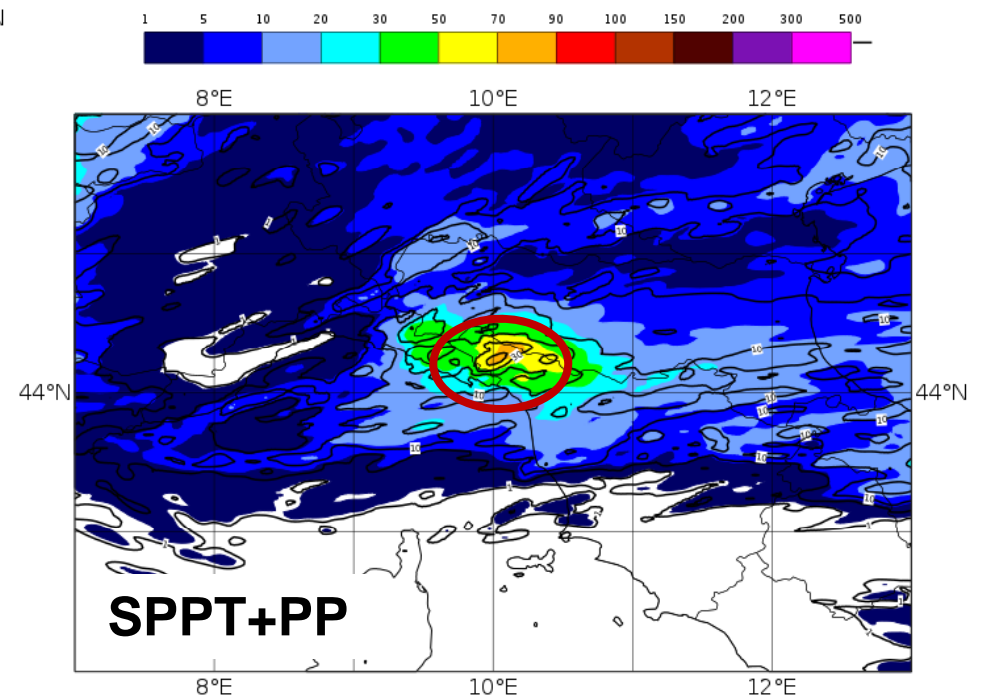
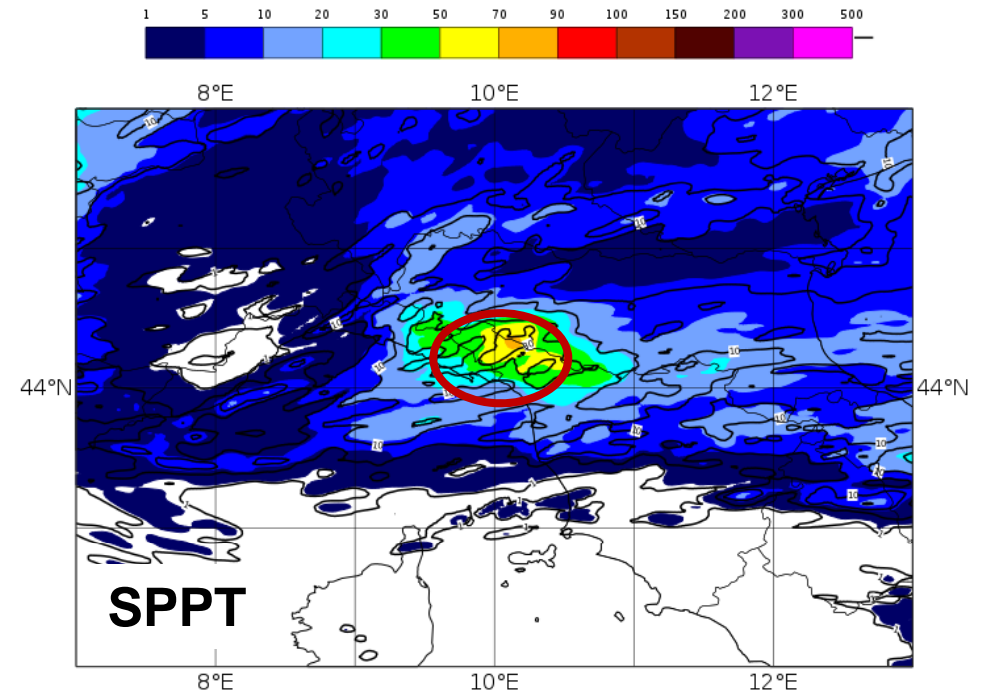
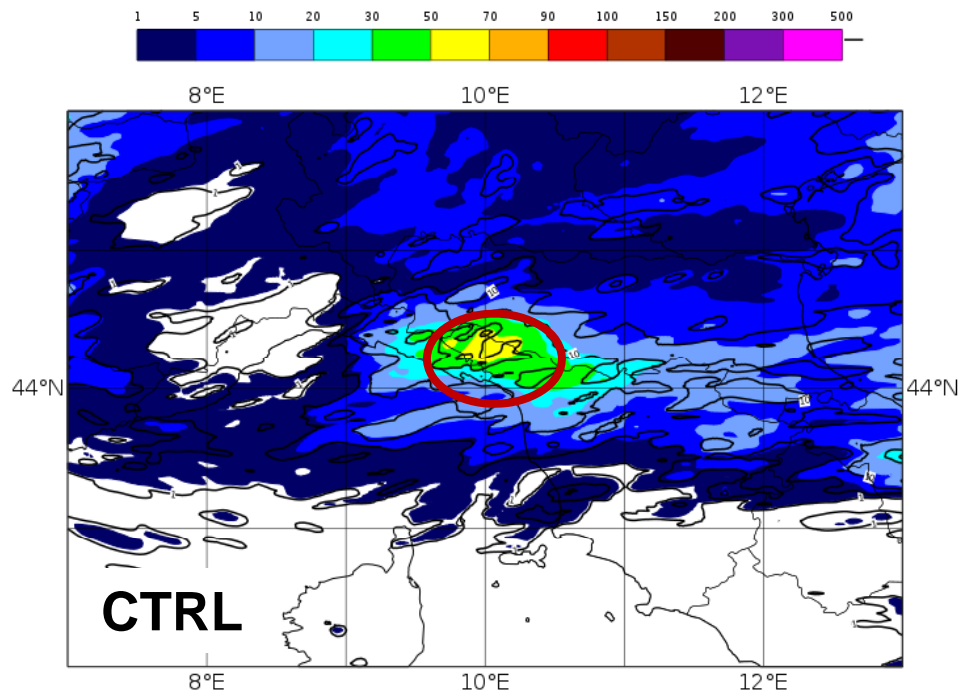


6/10/2015

24 h precipitation – raingauges



# ens mean + spread 00-24 h forecast



# Conclusions

- In terms of 2m temperature over Northern Italy, SPPT does not determine an increase of the spread but the error is slightly reduced
- Adding parameter perturbation have no significant impact on the spread/skill relation computed over the entire month over Northern Italy
- The skill of the precipitation forecast is slightly affected, with a better discrimination ability by the model-perturbed ensembles
- On the 14<sup>th</sup> Oct case the ensemble in which Perturbed Parameter are added to SPPT improves the localisation of the precipitation

**Thank you for your attention!**