New schemes to perturb near-surface variables in MOGREPS

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Ensemble Lagging

- MOGREPS plans to move to 6-hr cycling this autumn:

Global: 00/06/12/18Z (x12 mem)

Regional: 03/09/15/21Z (x12)

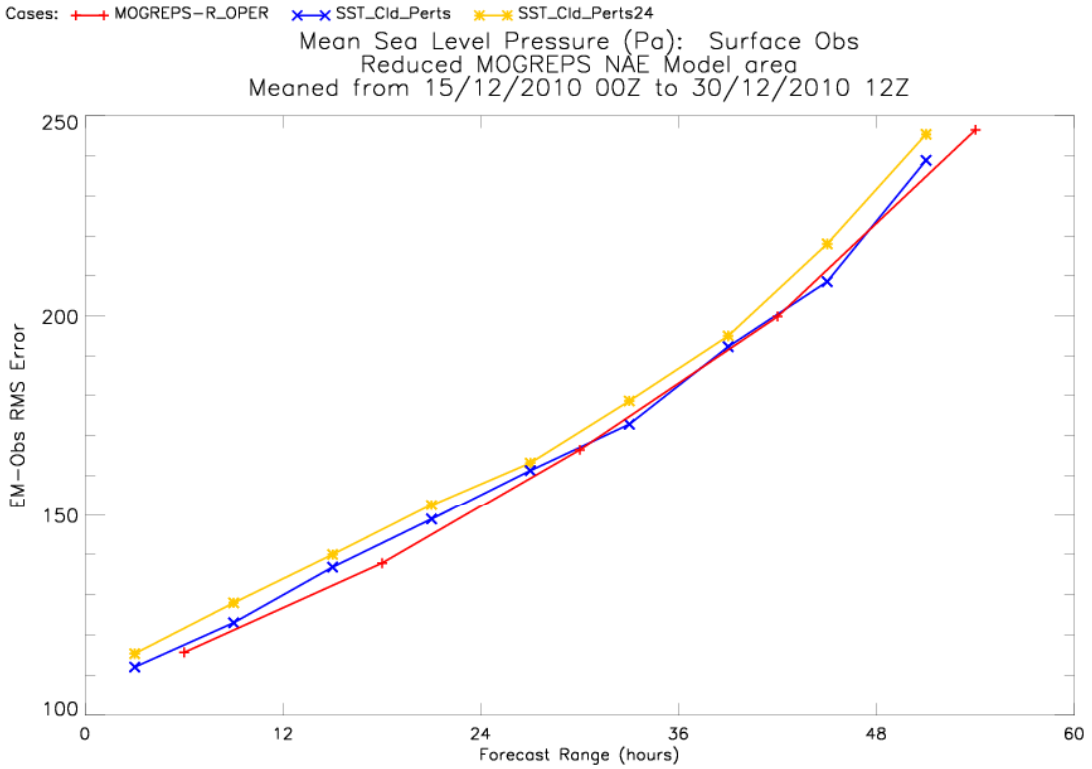
- Full ensemble of 24 members constructed by lagging latest two cycles

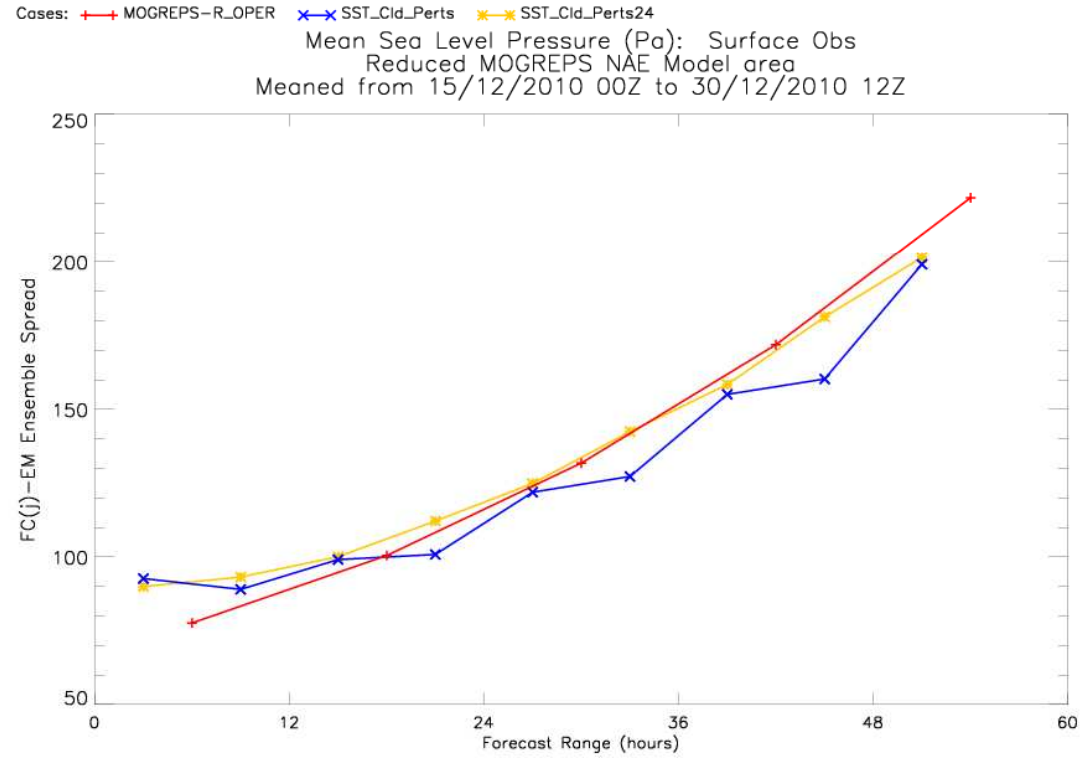
✔ Increases overall spread

✔ Reduces jumpiness in spread between forecast cycles

✖ Increases the RMSE of the Ensemble Mean

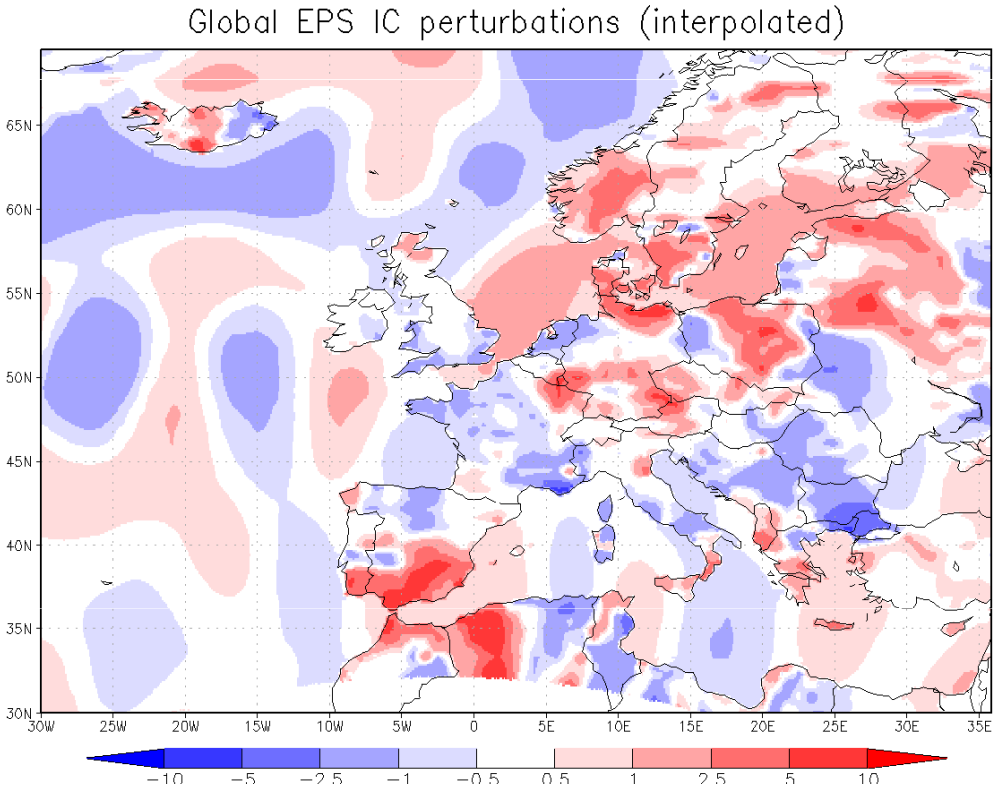
✖ Complicates control suite and post-processing





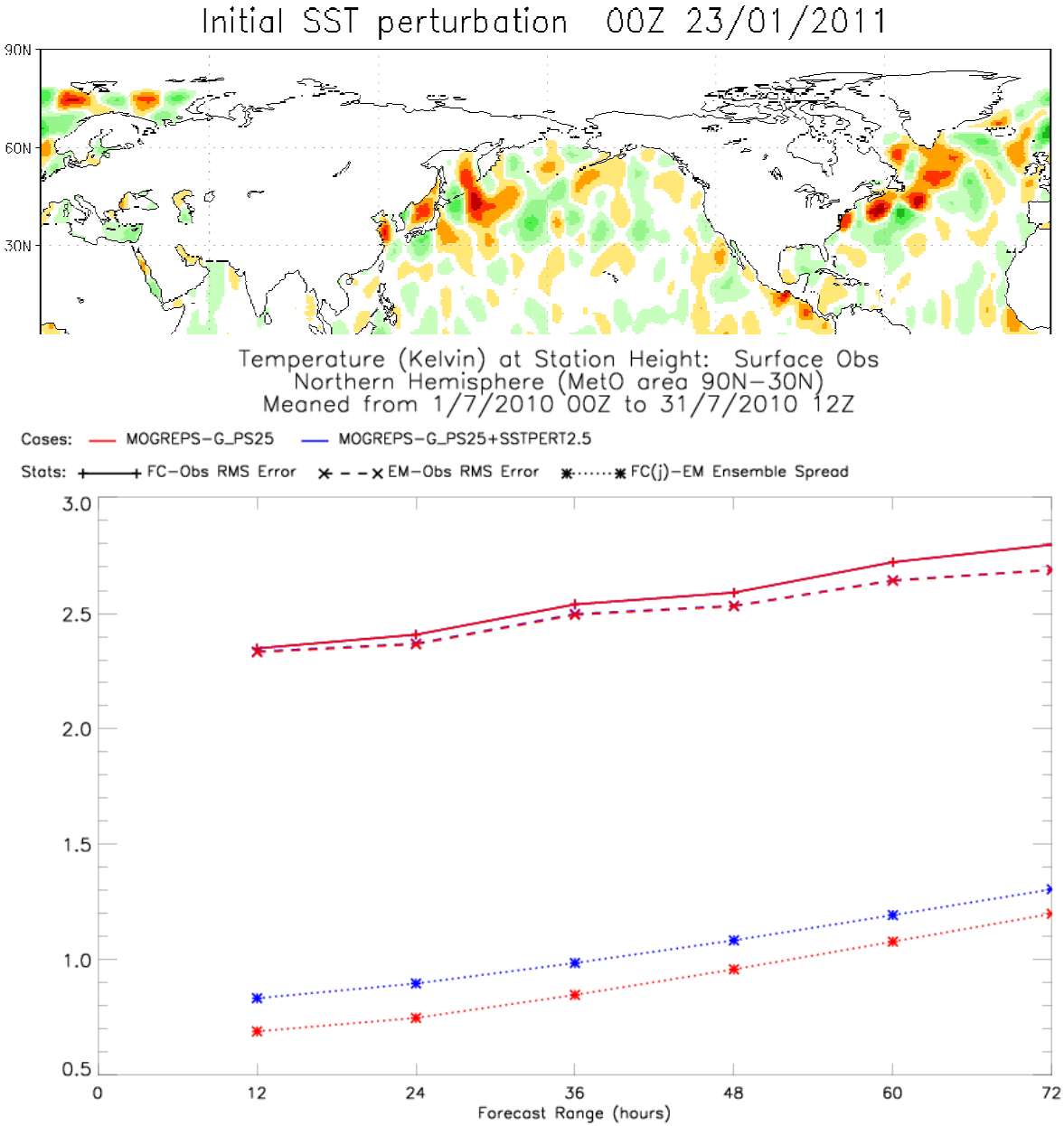
Initial perturbations in regional system

- Global T+3hr ensemble member forecasts are interpolated to the regional domain
- The difference between the perturbed members and the control at regional scale are stored in a perturbation file
- These are added at the start of the regional forecast which is initialised from a regional 4dvar analysis
- *Example of surface temperature perturbation*

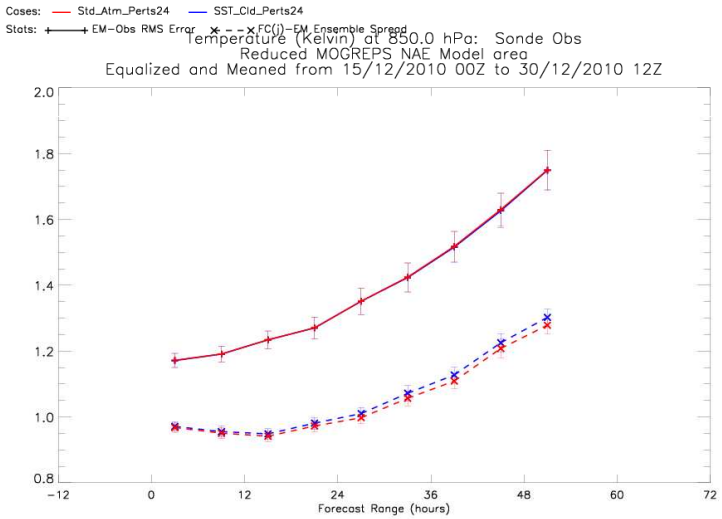


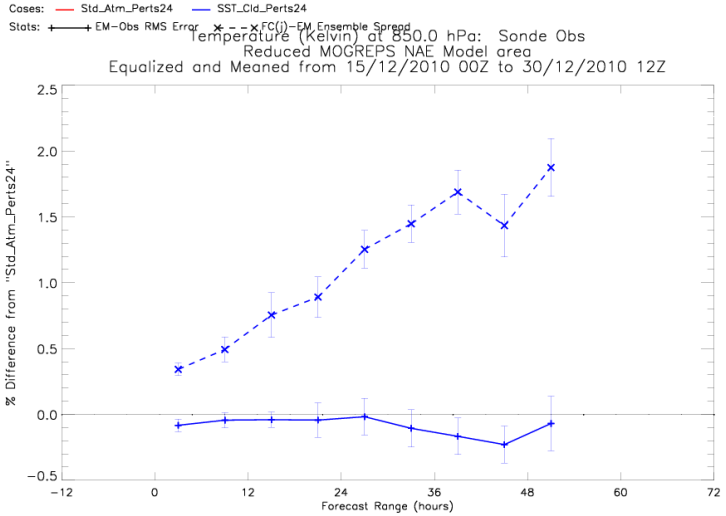
SST Perturbations

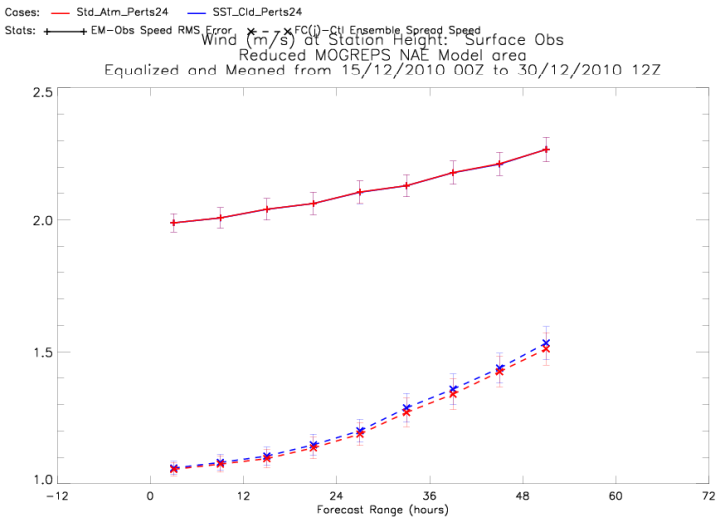
- SST perturbations generated with a prescribed power-law in the global ensemble
- Perturbation added to SST field (which remains constant during the forecast)
- Global perturbations interpolated to regional model
- Generally produce a substantial impact on ensemble spread

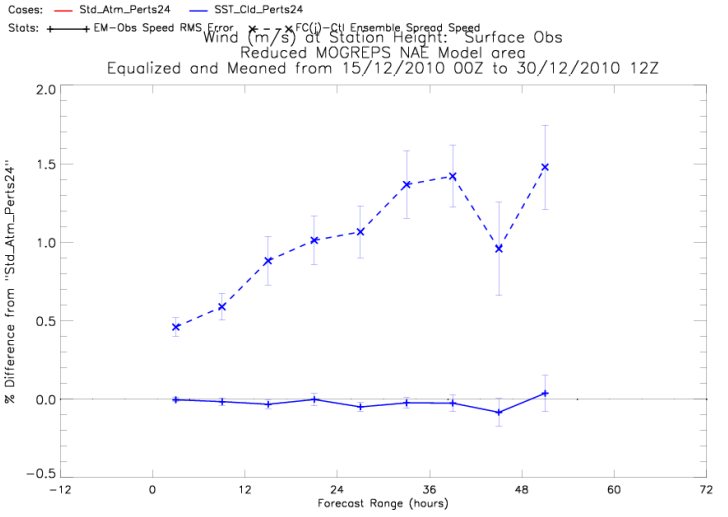


Impact of SSTs (1)

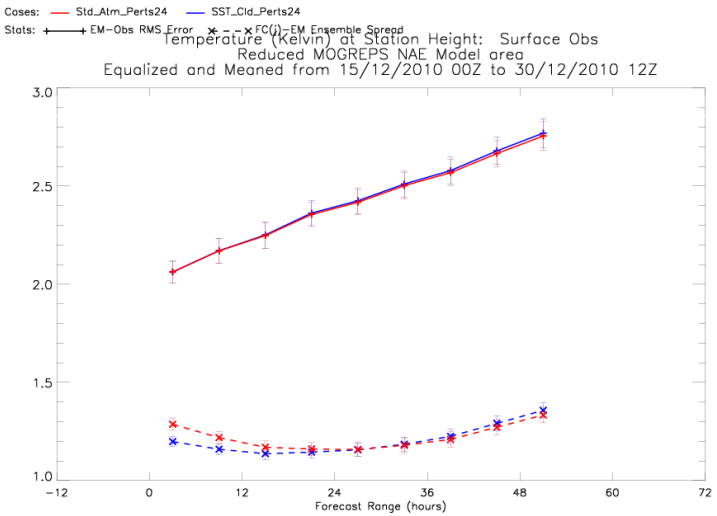


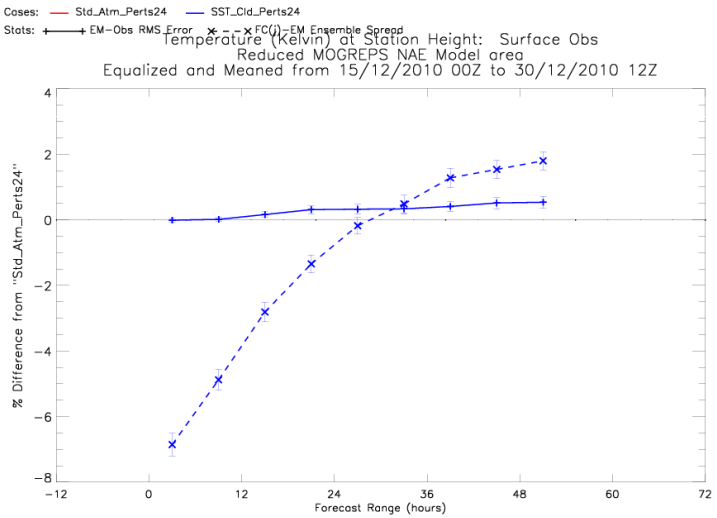


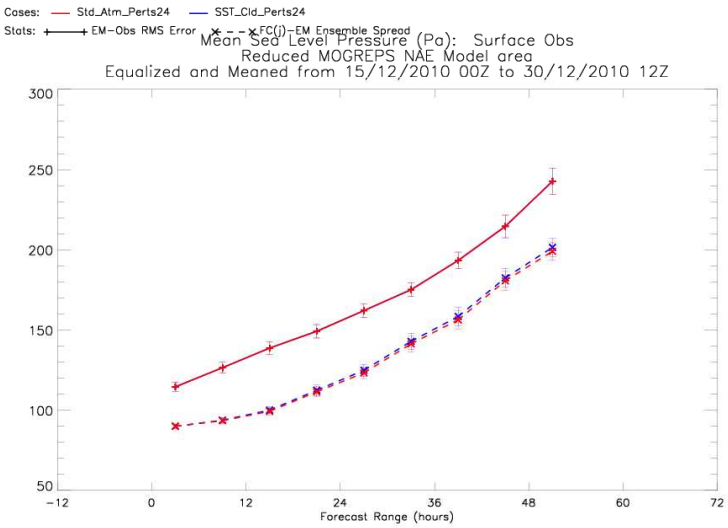


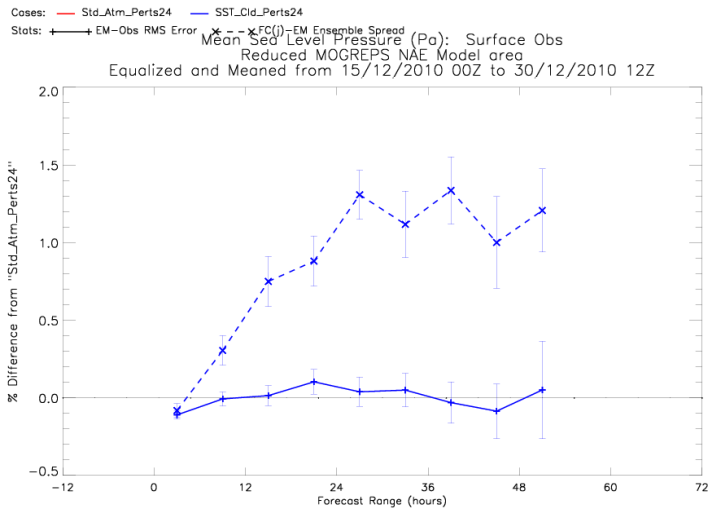


Impacts of SSTs (2)

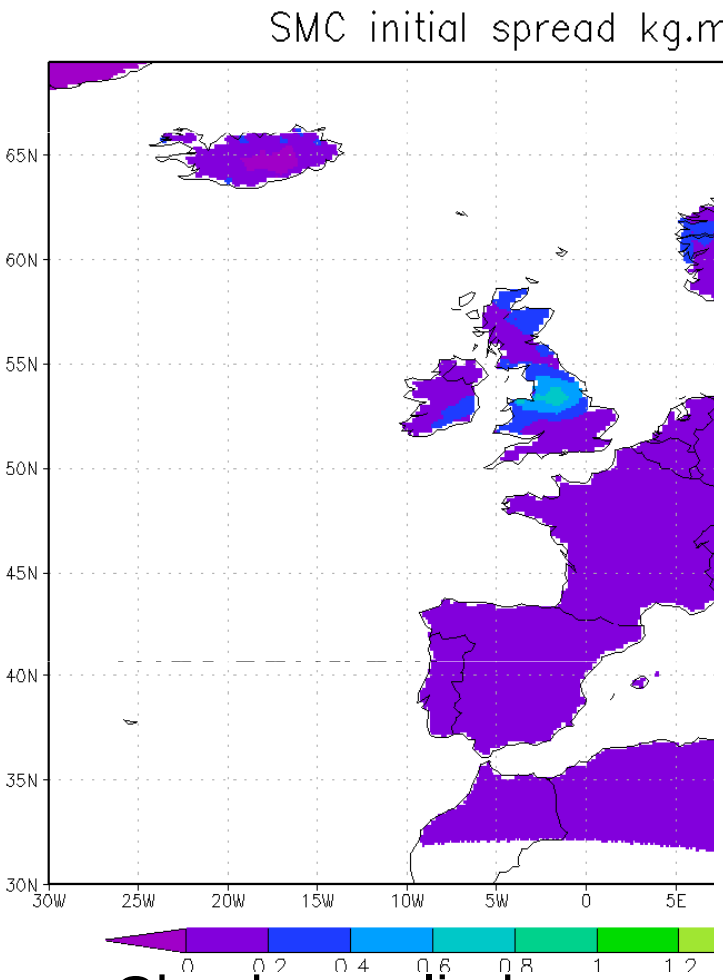


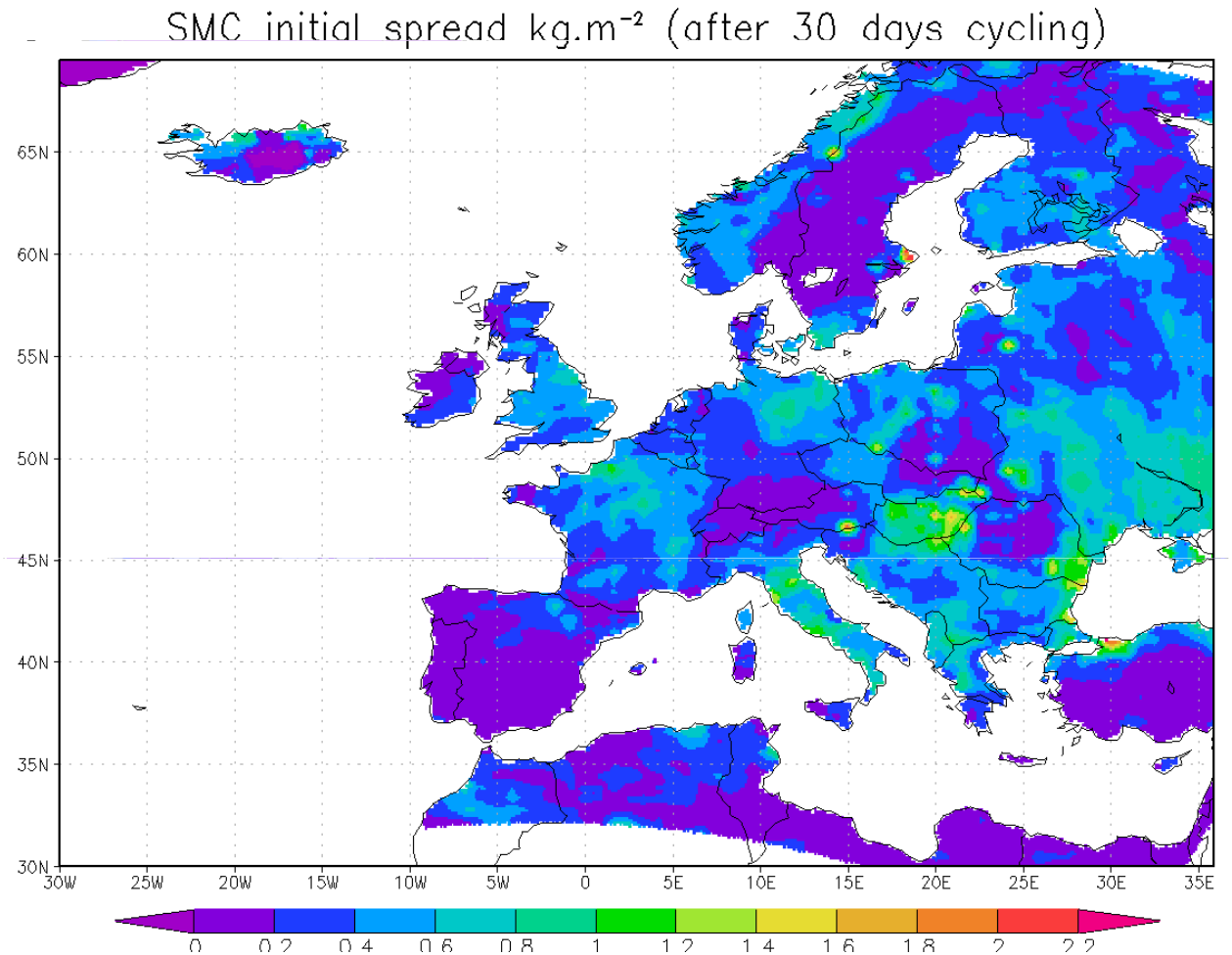






SMC Perturbations

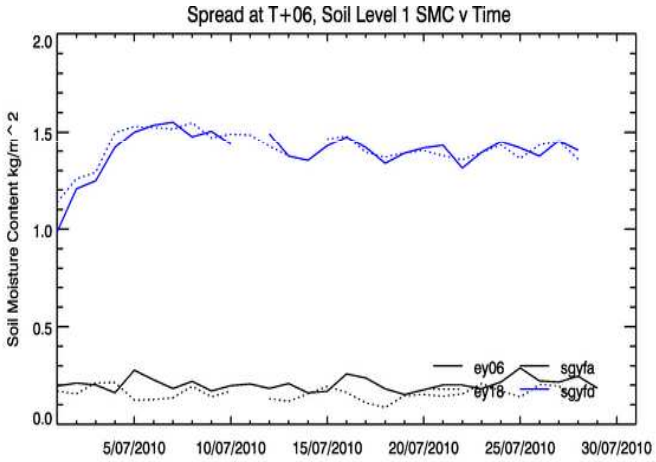


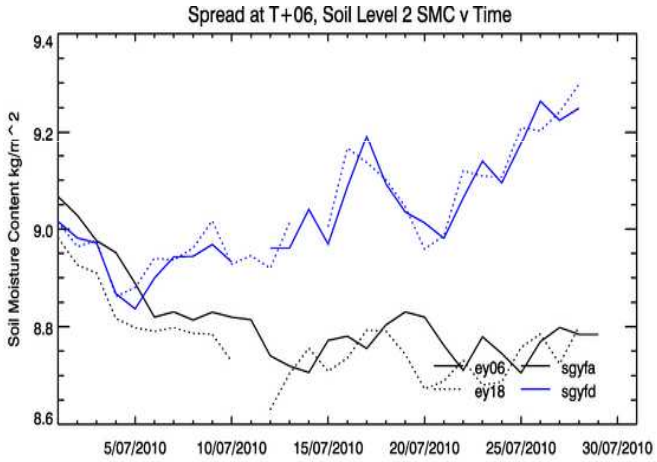


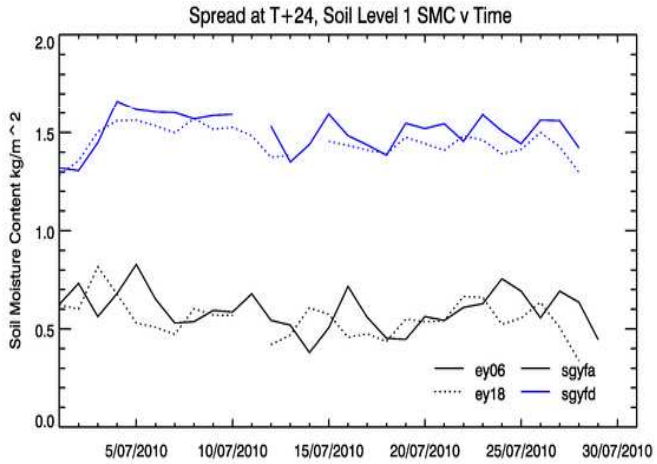
- Checks applied.

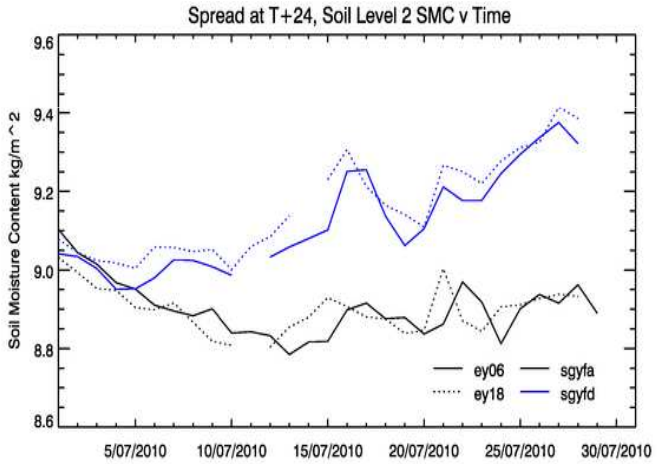
Impact of soil-moisture (1)

- Large increase in SMC from 0.2mm to 1.5mm at short-lead times (6hr)
- Increase in spread still large at 24-hours lead time
- Increased spread of SMC extends to soil level 2 after about 5 days

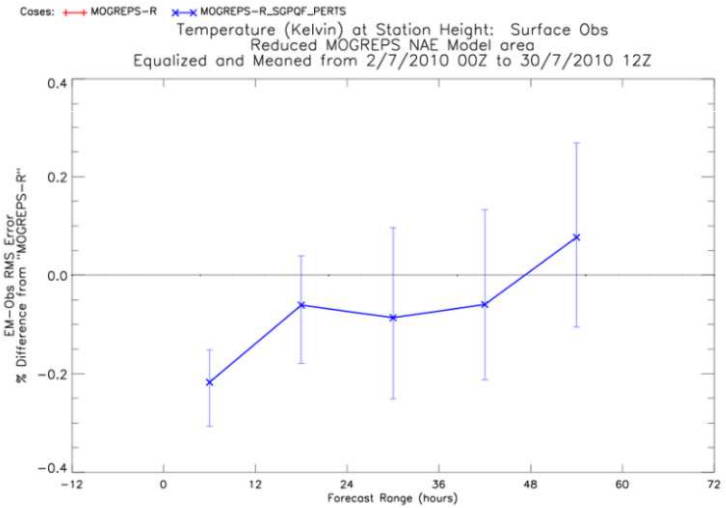


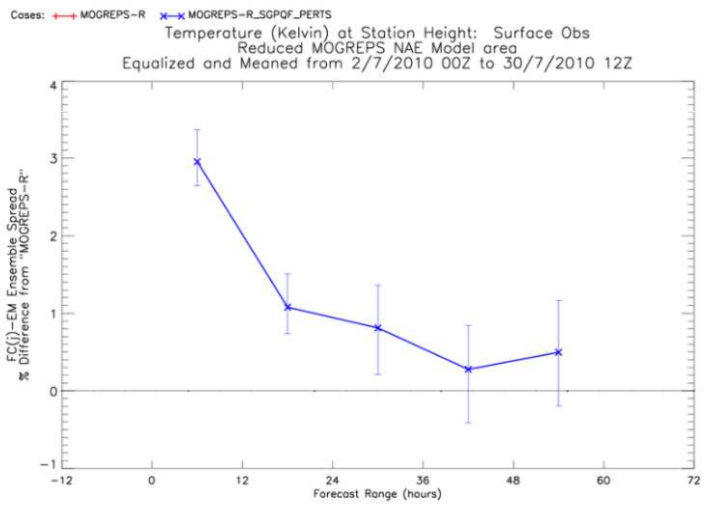


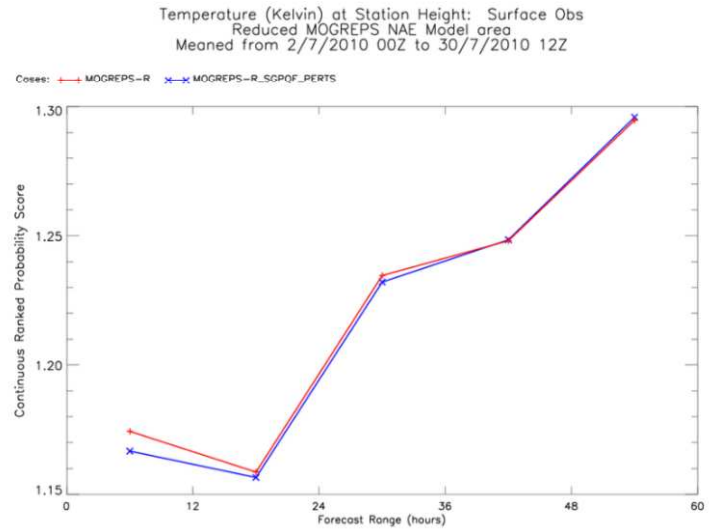


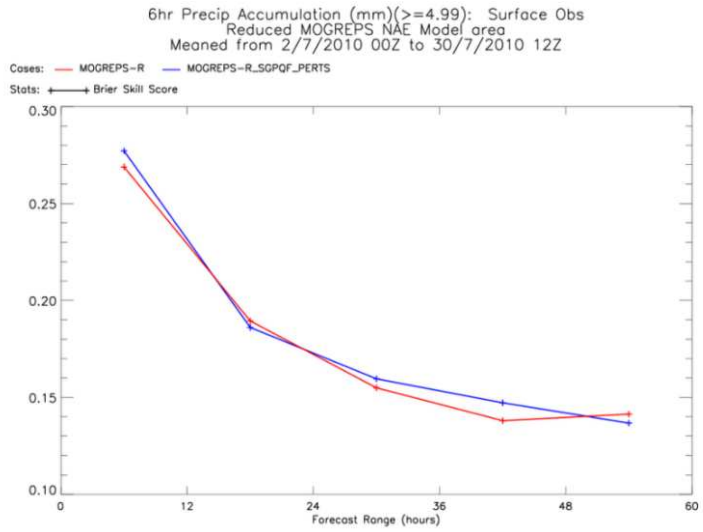


Impact of soil-moisture (2)









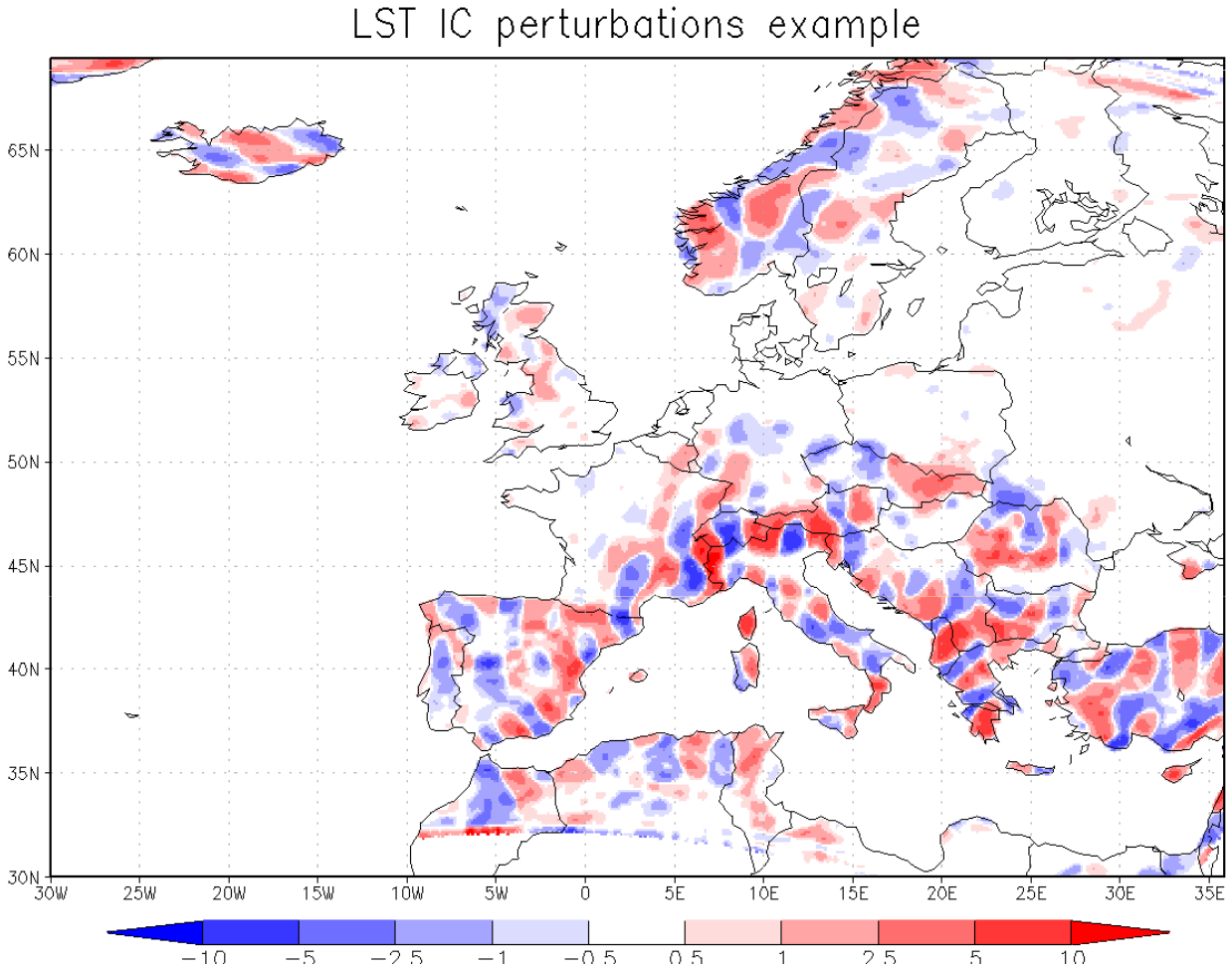
--- LST Initial Perturbations ---

Using random pattern modulated by orographic standard deviation

Generate LST perturbations using:

- random pattern (Gaussian ~100km decorrelation lengthscale);
- modulated by orography standard deviation;
- hilly terrain has larger perturbations

ADD to interpolated perturbations

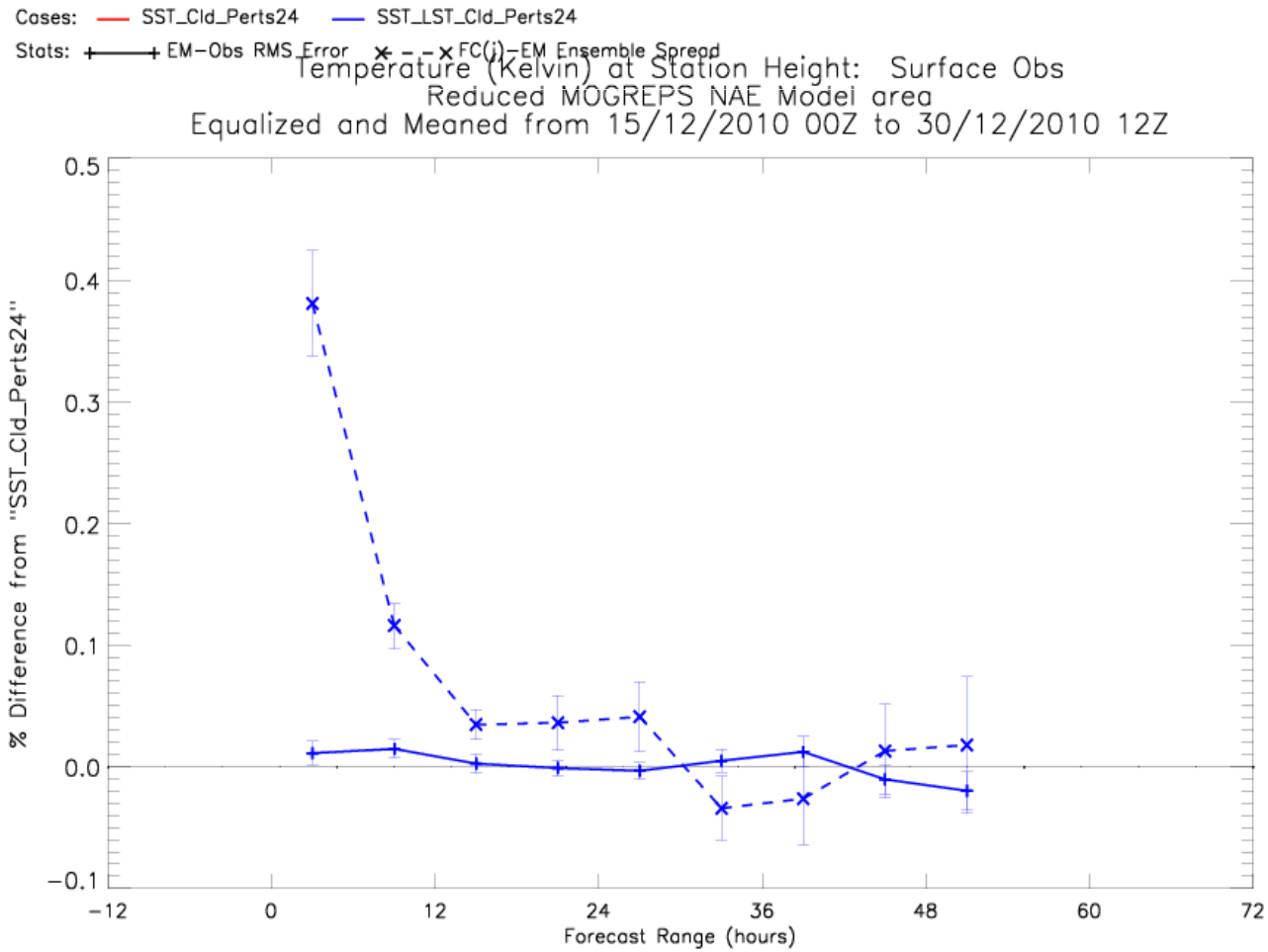


--- LST Initial Perturbations ---

Using random pattern modulated by orographic standard deviation

Results for period:
15-30 Dec 2010

- only marginal impact on verification scores;
- Early increase in surface temperature spread eliminated quickly

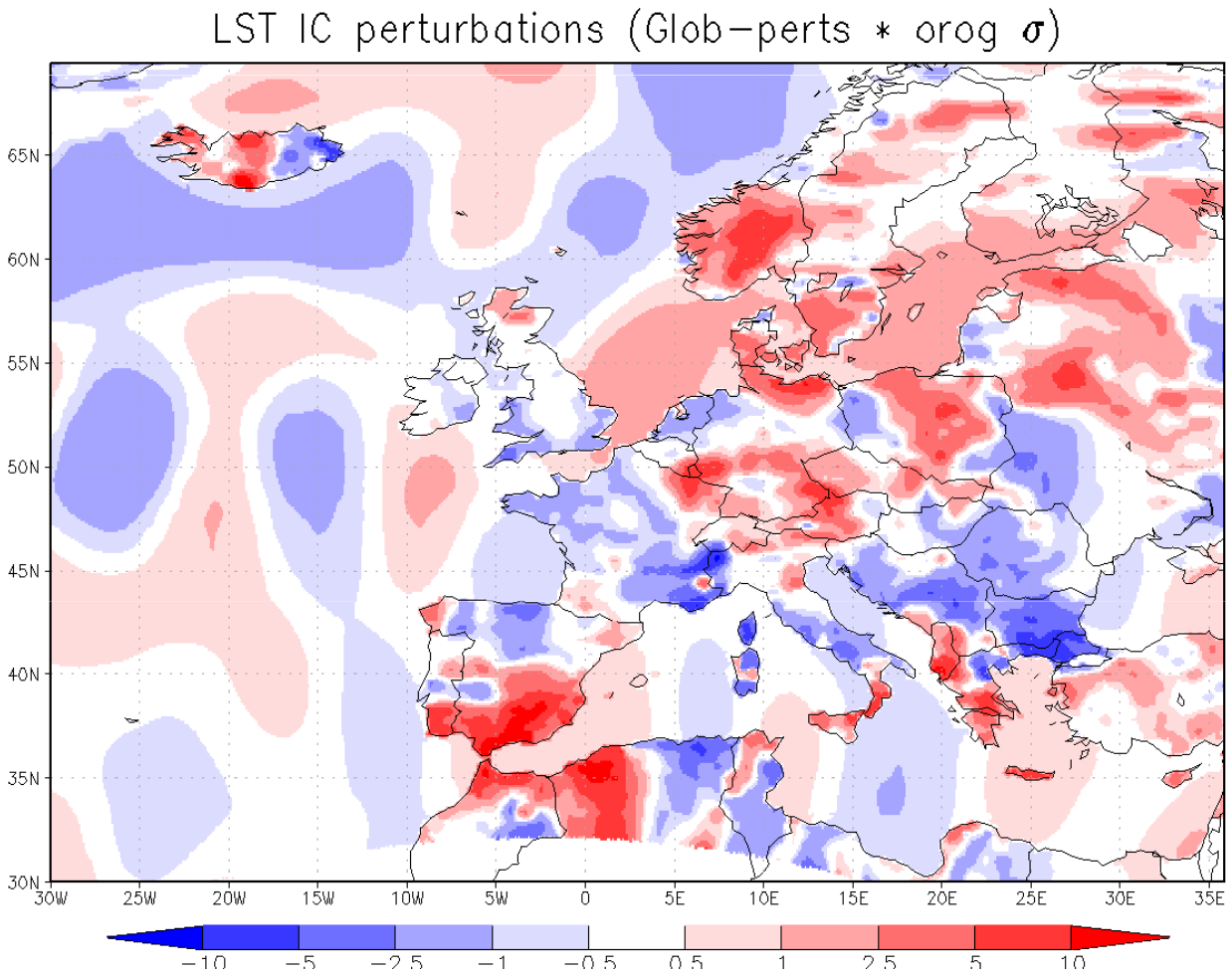


--- LST2 Initial Perturbations ---

Inflating interpolated perturbations using orographic standard deviation

Method 2 for LST perturbations:

- start with interpolated perturbations as before;
- Inflate perturbations using orography standard deviation ~ (0.5^{o}C/100m);
- hilly terrain has higher inflation values

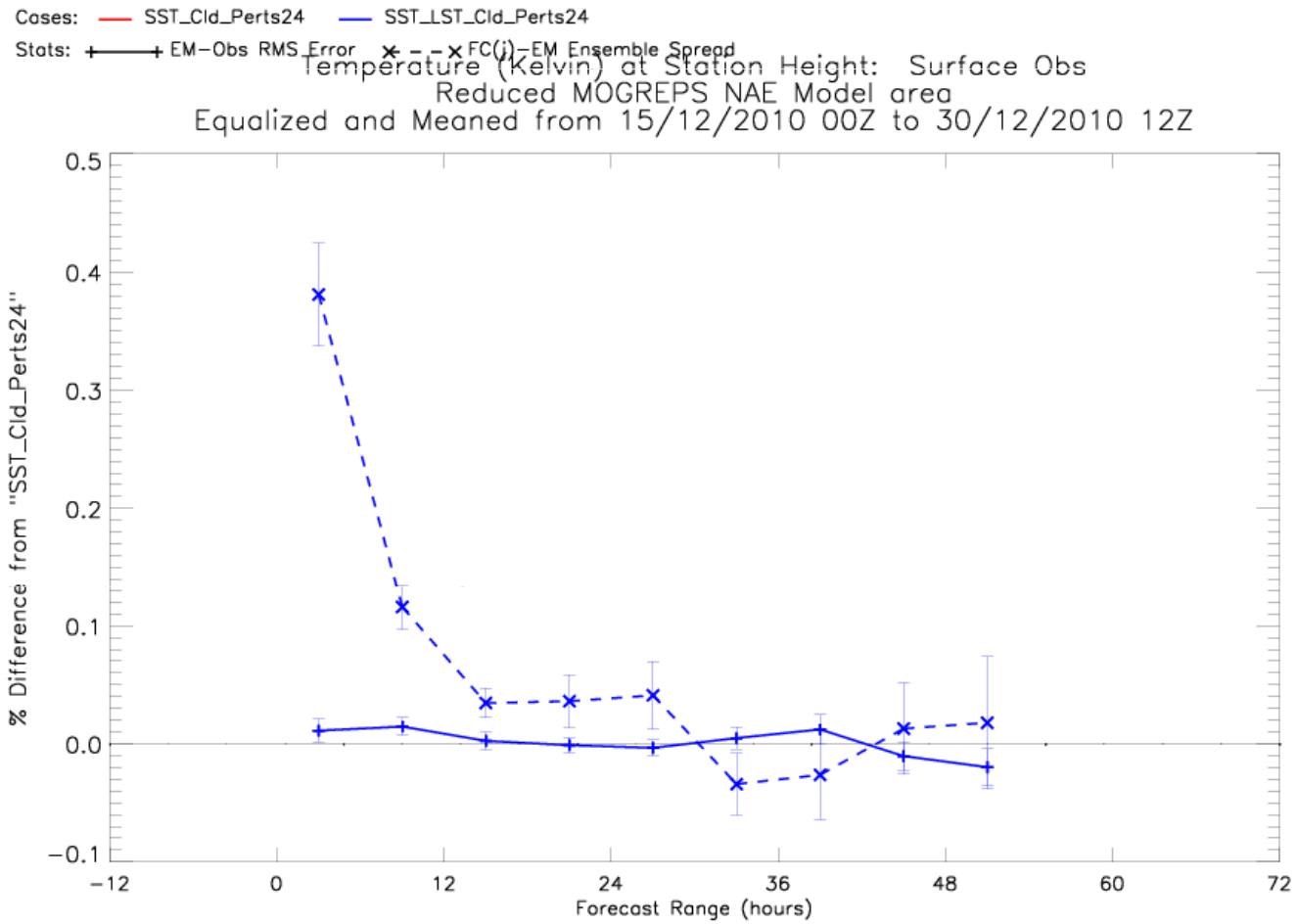


--- LST2 Initial Perturbations ---

Inflating interpolated perturbations using orographic standard deviation

Results for period:
15-30 Dec 2010

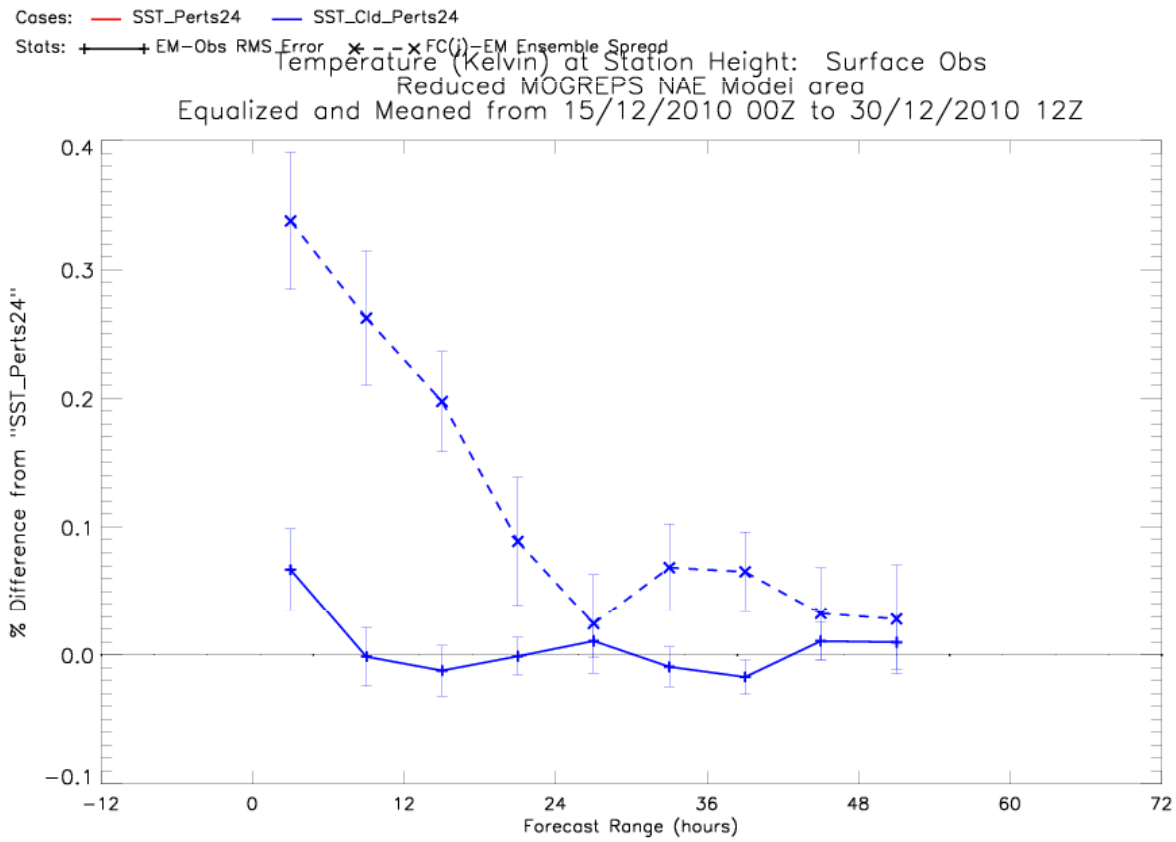
- larger impact on spread increase (factor of 10);
- Spread increase does still decay with lead-time, but has a smoother change
- Results suggest sensitivity to global ensemble perturbations



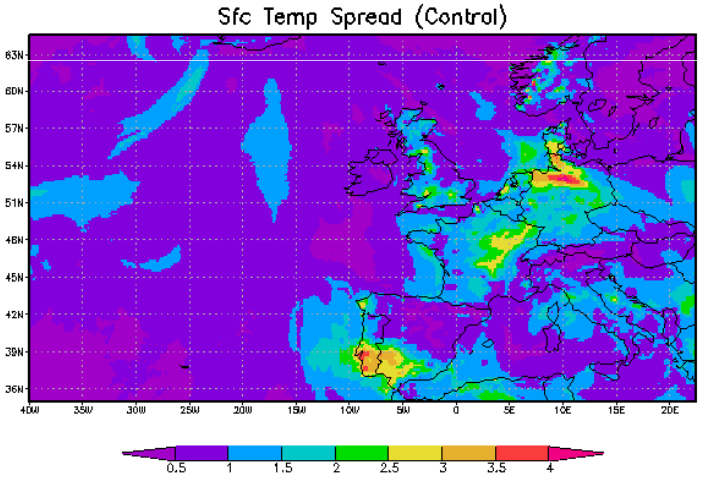
Impact of Cloud-perturbations

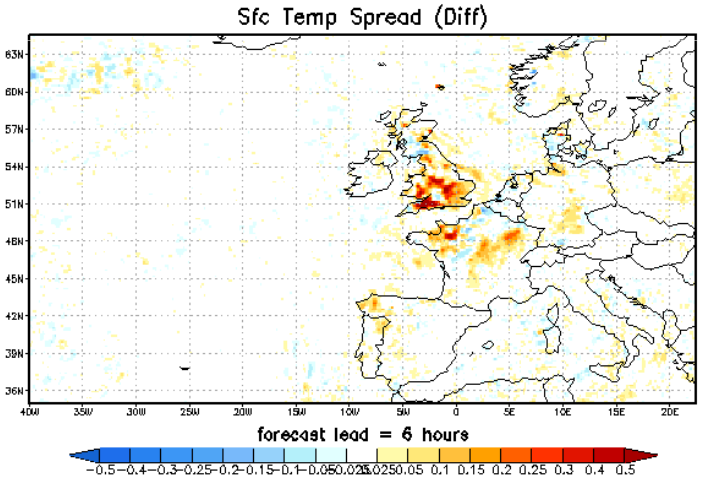
Perturbations from global suite passed to regional system (like SSTs)

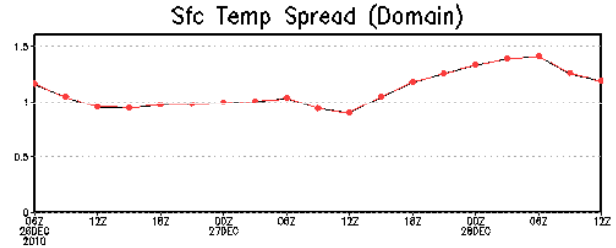
- Marginal (0.3%) increase in spread of surface temperature
- Increased spread decays after 24 hours
- No significant impact on other parameters
- No impact on RMSE of ensemble mean

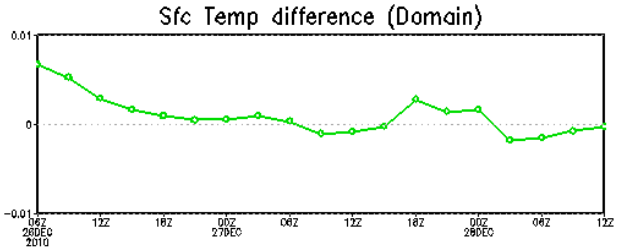


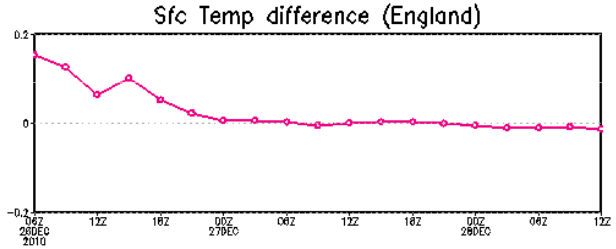
Cloud Perturbation Case Study::
03Z 26 Dec 2010 (surfc temp)

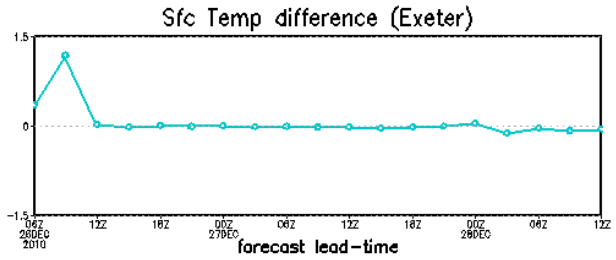




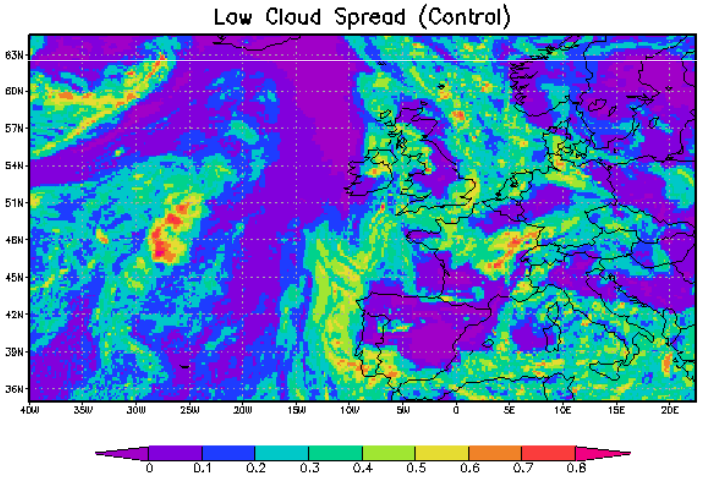


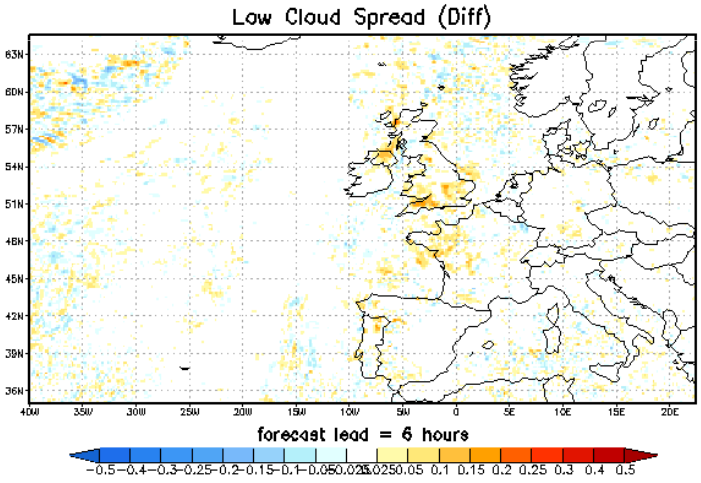


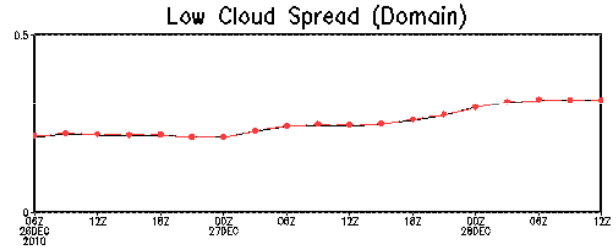


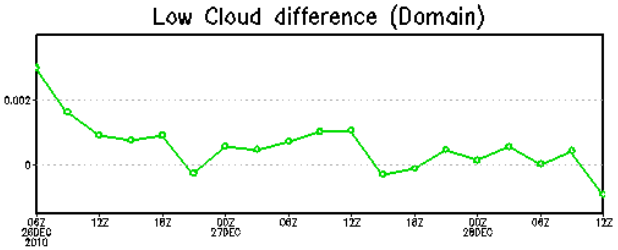


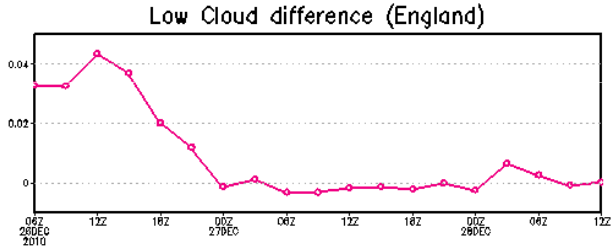
Cloud Perturbation Case Study::
03Z 26 Dec 2010 (low cloud)

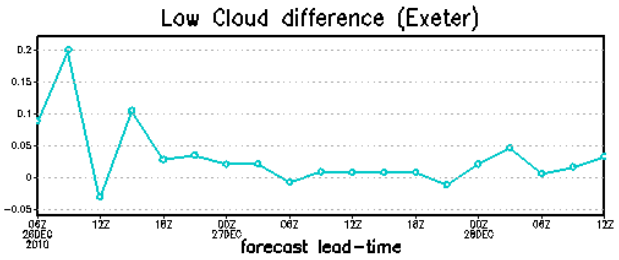




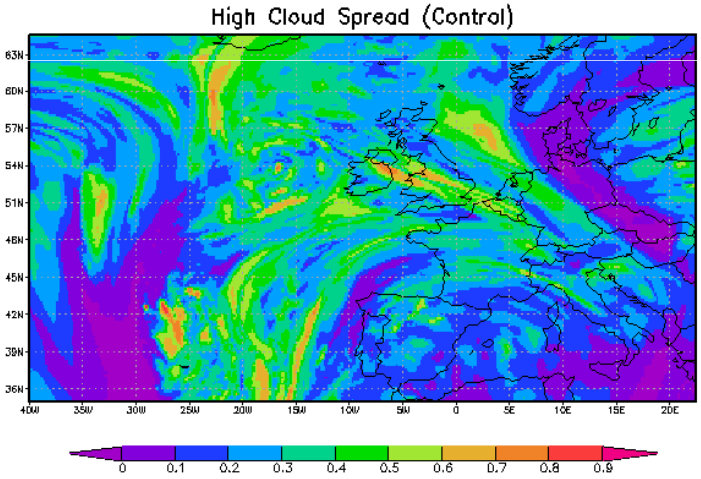


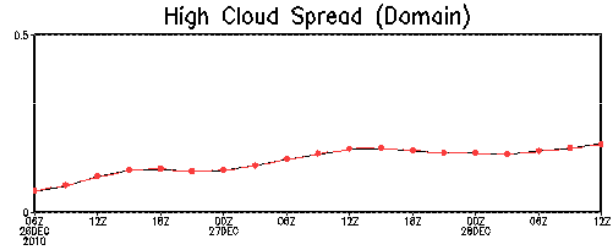


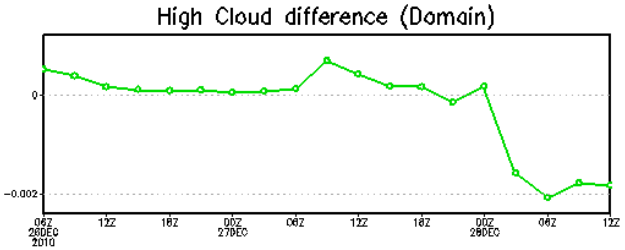


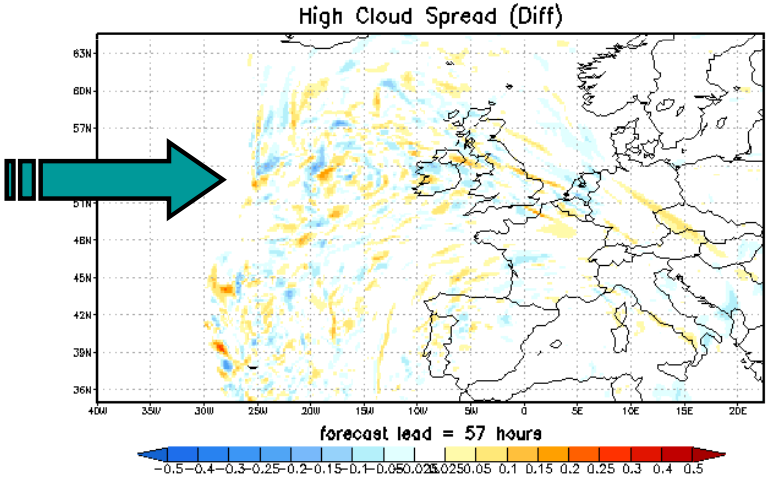


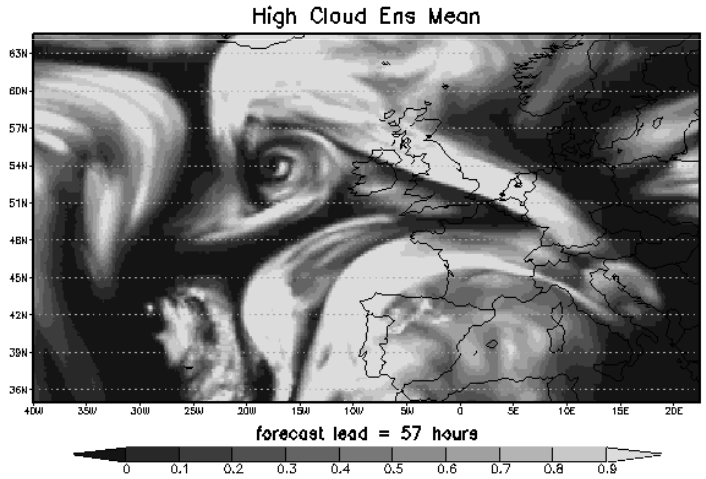
Cloud Perturbation Case Study::
03Z 26 Dec 2010 (high cloud)



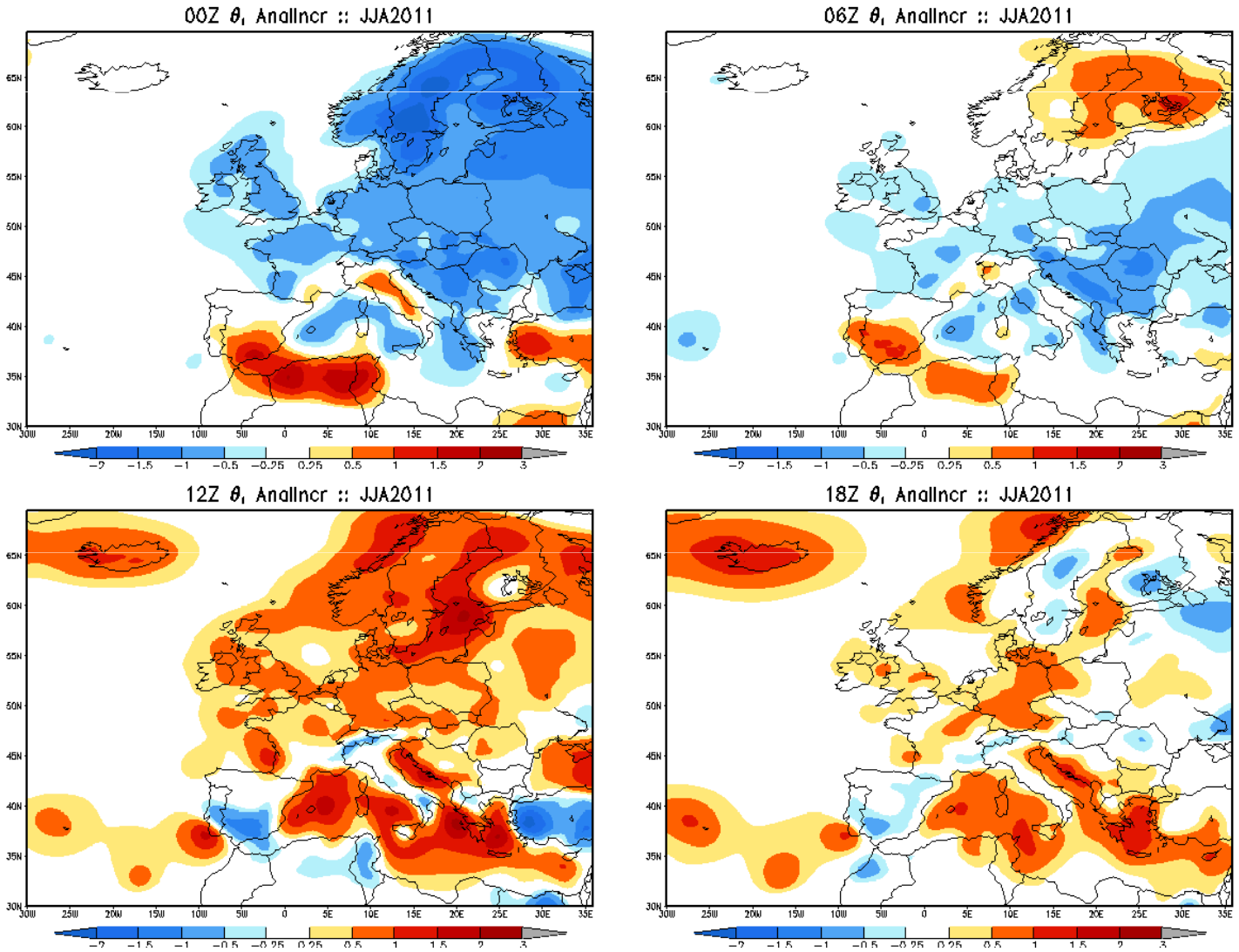








JJA average 4d-Var analysis increments to θ_1



Summary and Discussion

- Regional ensemble system appears to be highly sensitive to changes in the global system
- Regional fields need to correspond to LBCs (limit on stochastic physics in LAMs?)
- SSTs provide useful increase in spread
- LSTs, SMC and Cloud perturbations show modest increase in spread
- SMC does show benefit to reduce RMSE of EM
- Cloud condensate perturbations can have important local impacts

END – THANK YOU!!