

MSG cloud mask initialisation in the Rapid Update Cycle of Hirlam

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Changing initial clouds:

Use:

- cloud mask nowcasting SAF
- MSG cloud top temperatures
- Synoptic cloud base heights

Relation between cloud amount and specific humidity:

$$q_m = q_s \cdot ((1 - C) \cdot \sqrt{N} + C)$$

$$q_m = \min(q_m, C \cdot q_s)$$

$$C = rh_{\max} - (rh_{\max} - rh_{\min}) \cdot \sin\left(\pi \frac{p}{p_s}\right)$$

N: 3-D cloud cover

Preserve buoyancy when changing humidity (keep virtual T constant)

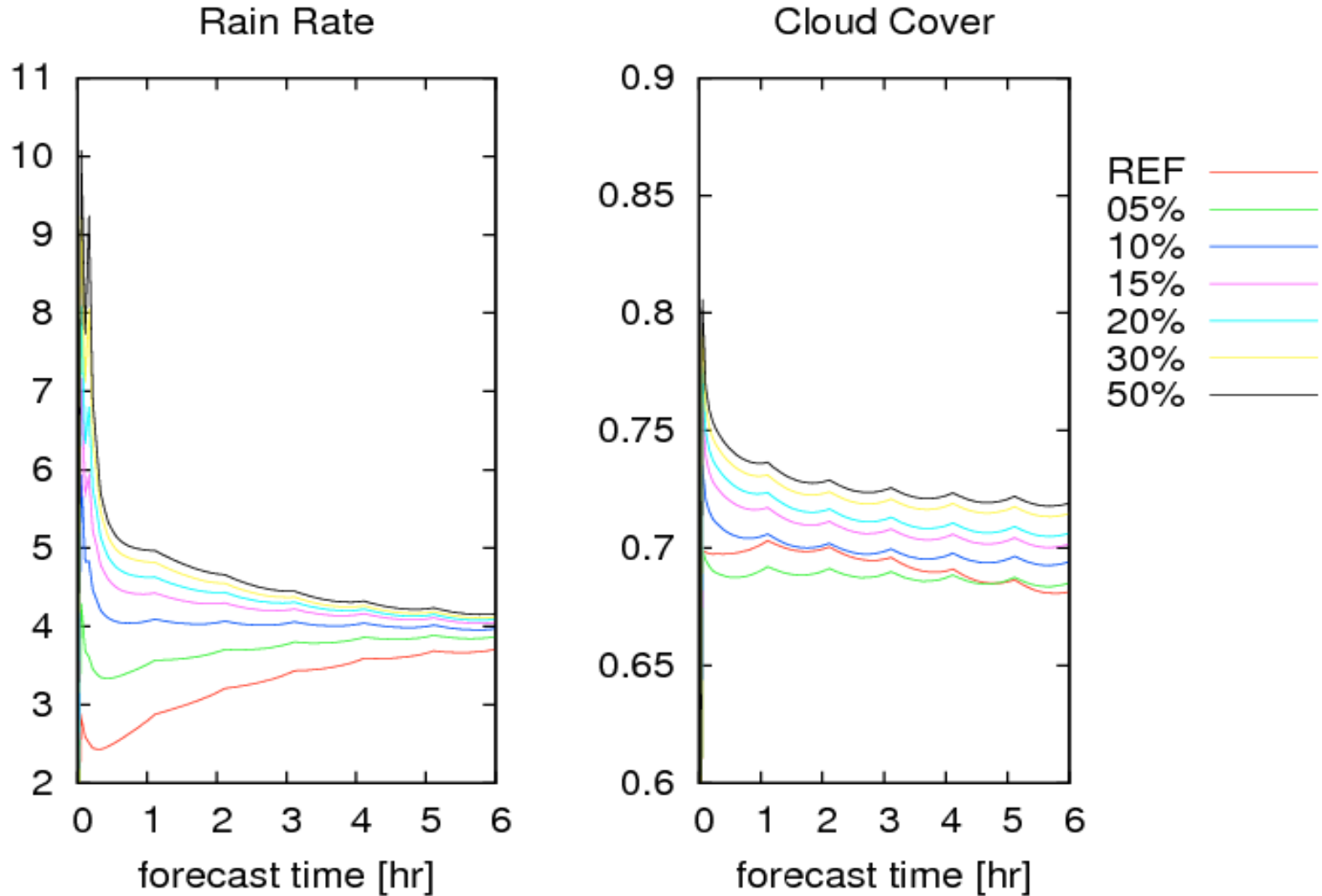
especially important in Harmonie!

$$T_v = T(1 + 0.61q_m - q_l)$$

Correction: $T = T_v / (1 + 0.61q_m - q_l)$

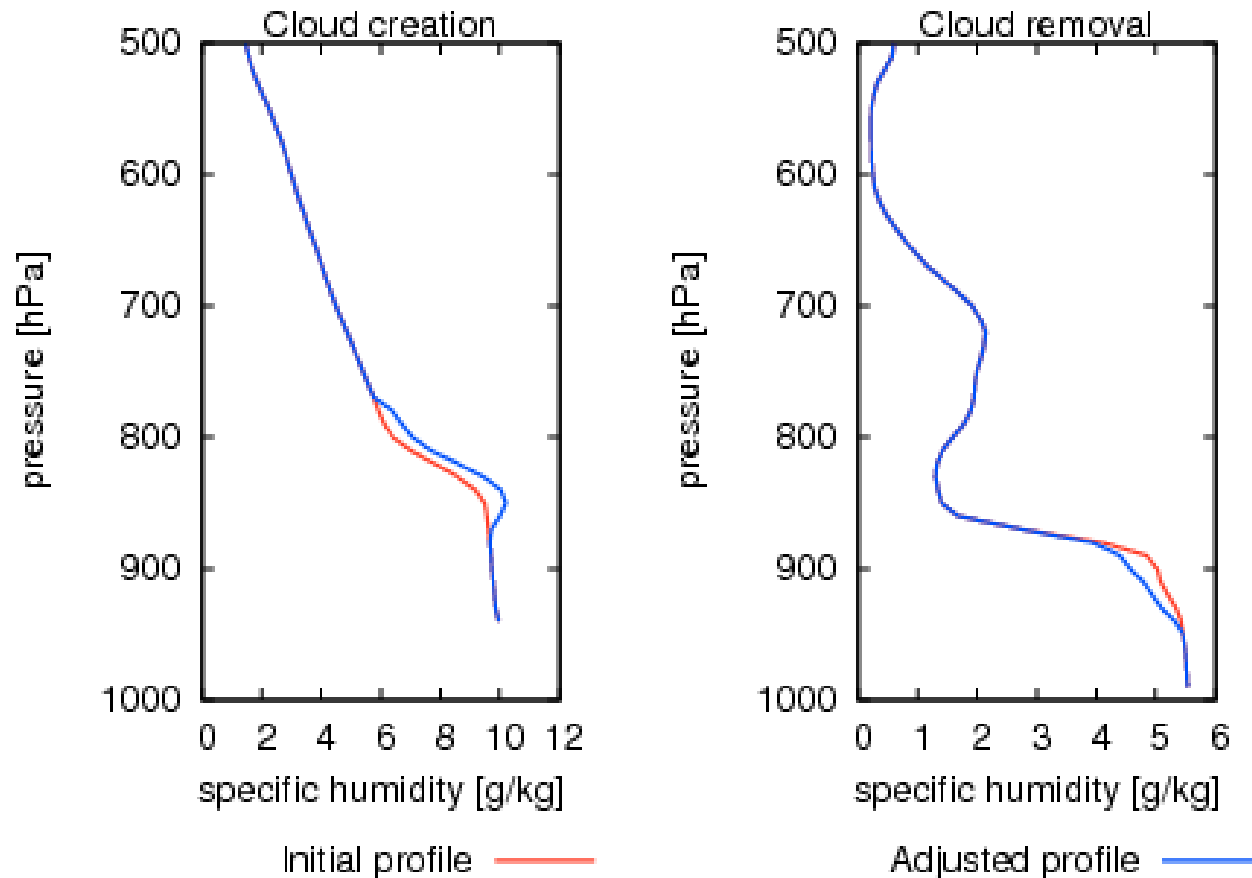
Spin up / spin down rainfall / cloud cover

Limit initial humidity changes to 10% (optimisation of precipitation forecasts)



results based on ~ 140 runs

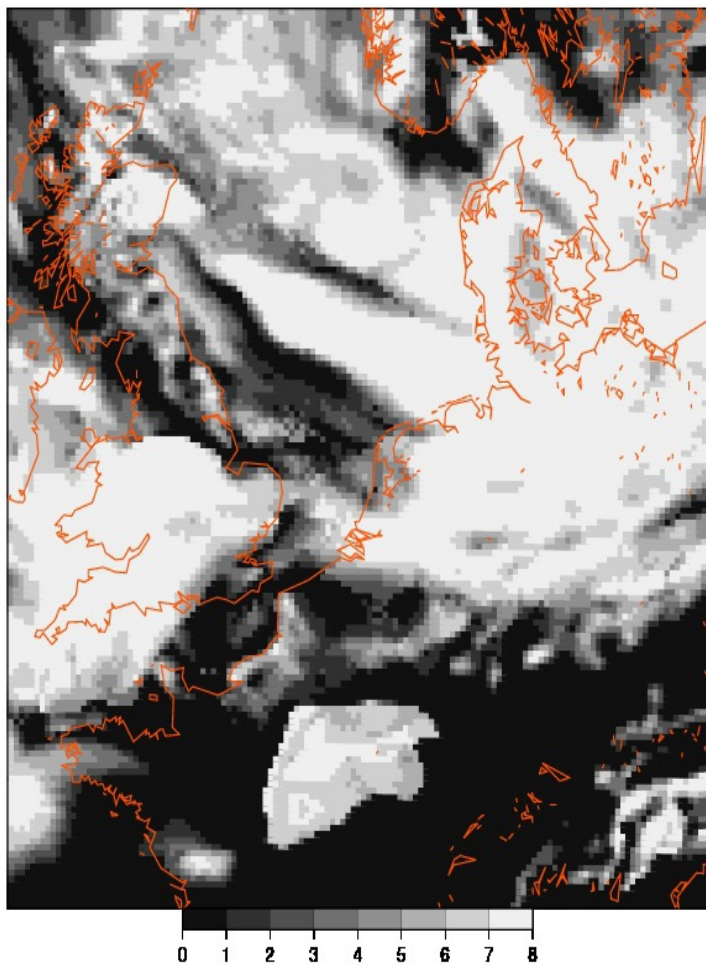
Example: cloud creation and cloud removal



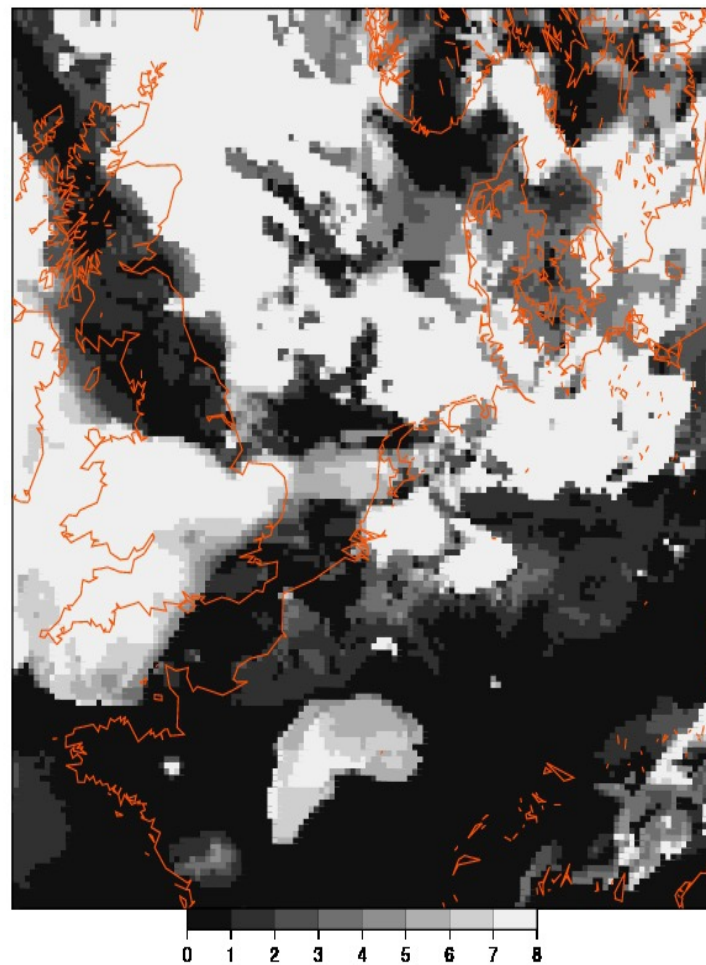
Hirlam Rapid Update Cycle

- Semi-operational (*version 7.3*), 11 km
- 3d VAR
- Observations: Mode S, AMDAR, synop, GPS
- Analysis every hour
- Forecast length: 6 h
- Period: 5 May – 23 December 2011
- Control run and 'MSG' run (Kain-Fritsch)

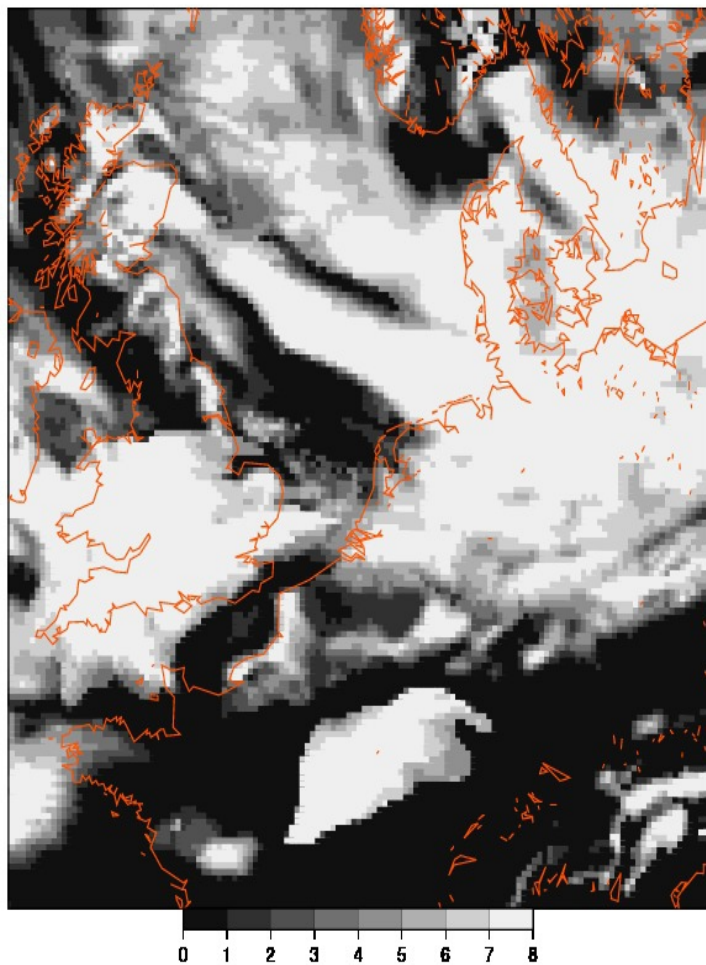
REF cloud cover 20110915_12+000



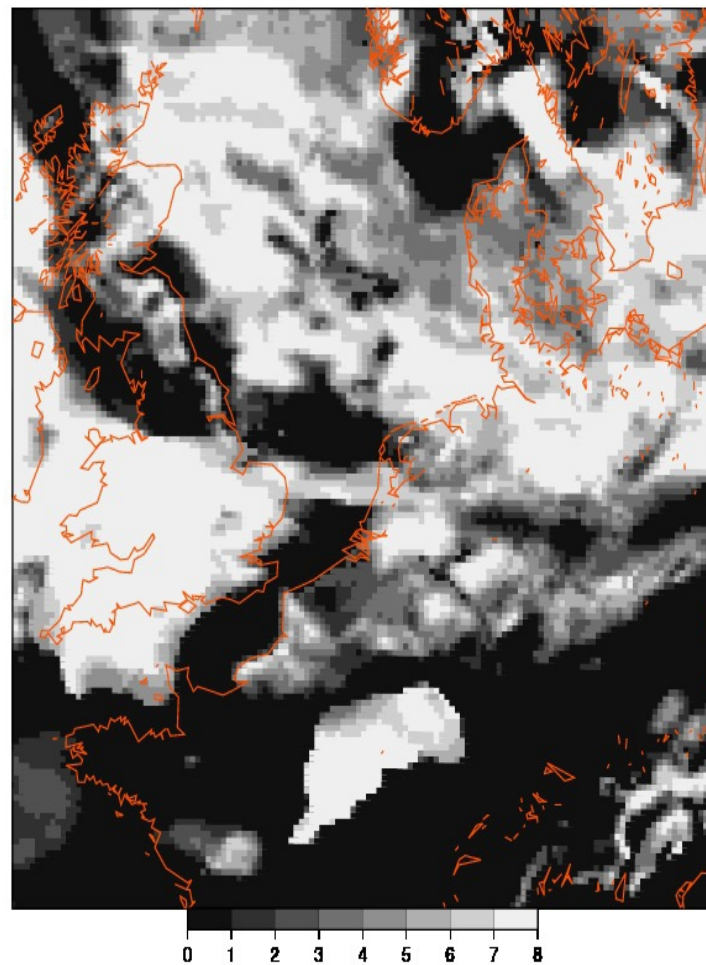
MSG cloud cover 20110915_12+000



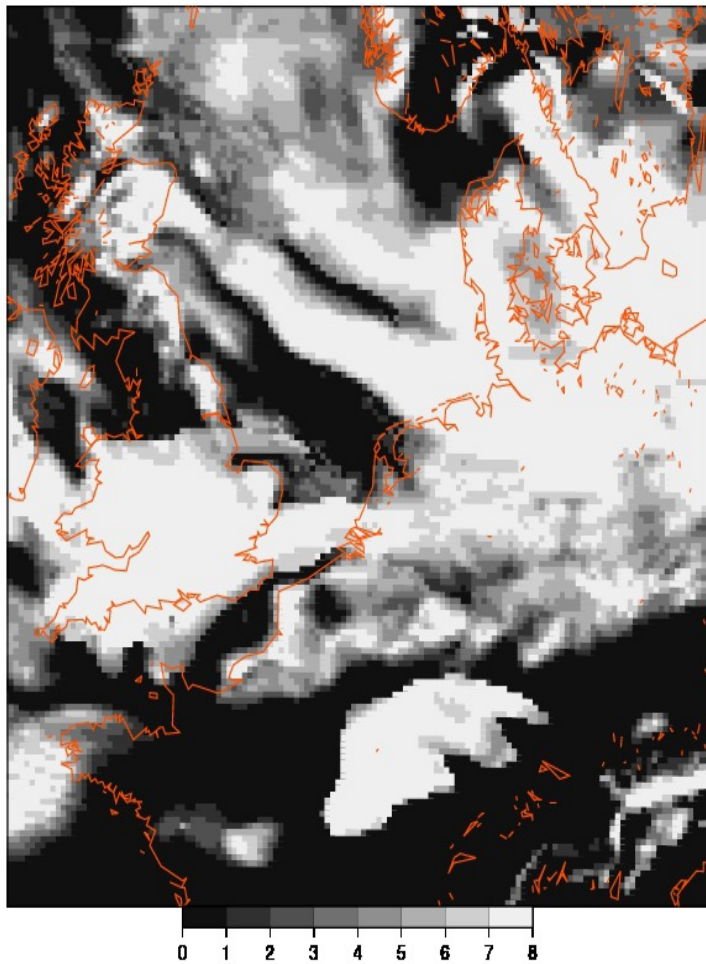
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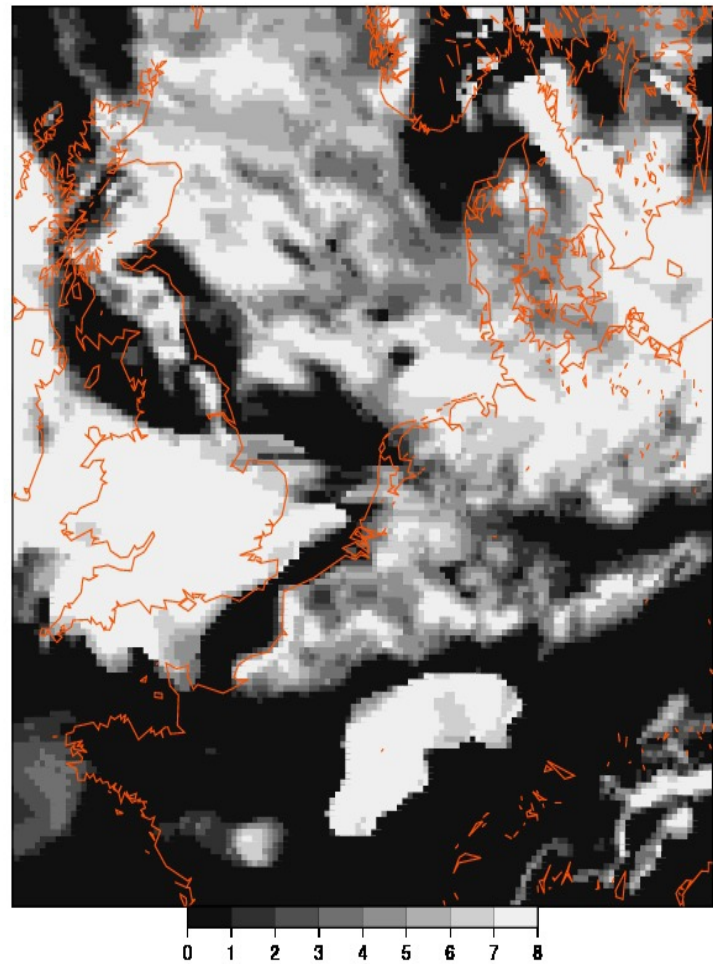
MSG cloud cover 20110915_12+001



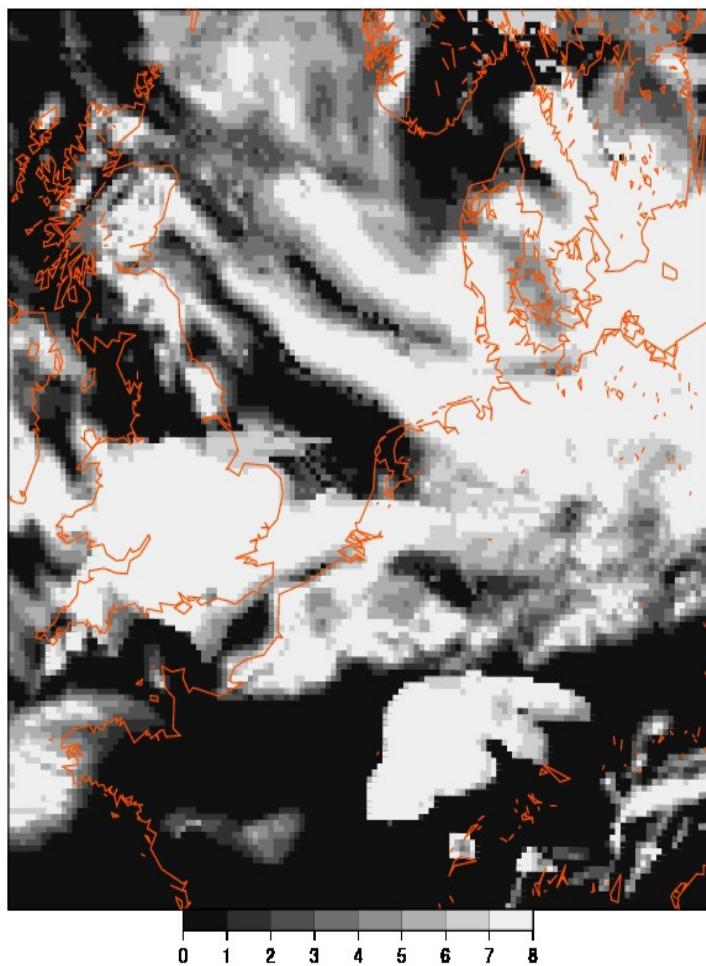
REF cloud cover 20110915_12+002



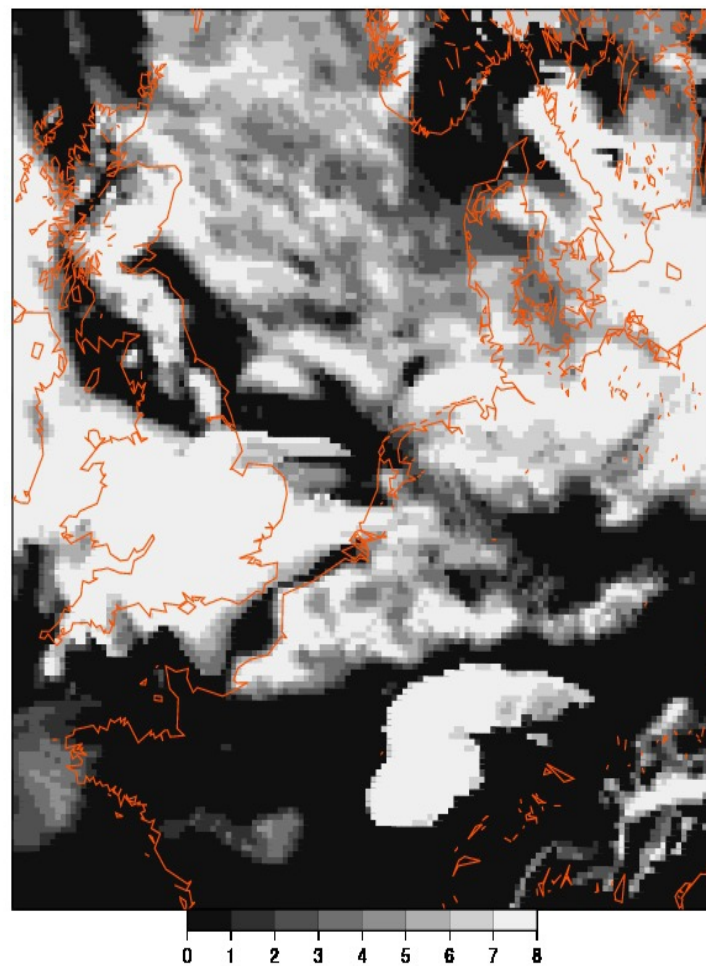
MSG cloud cover 20110915_12+002



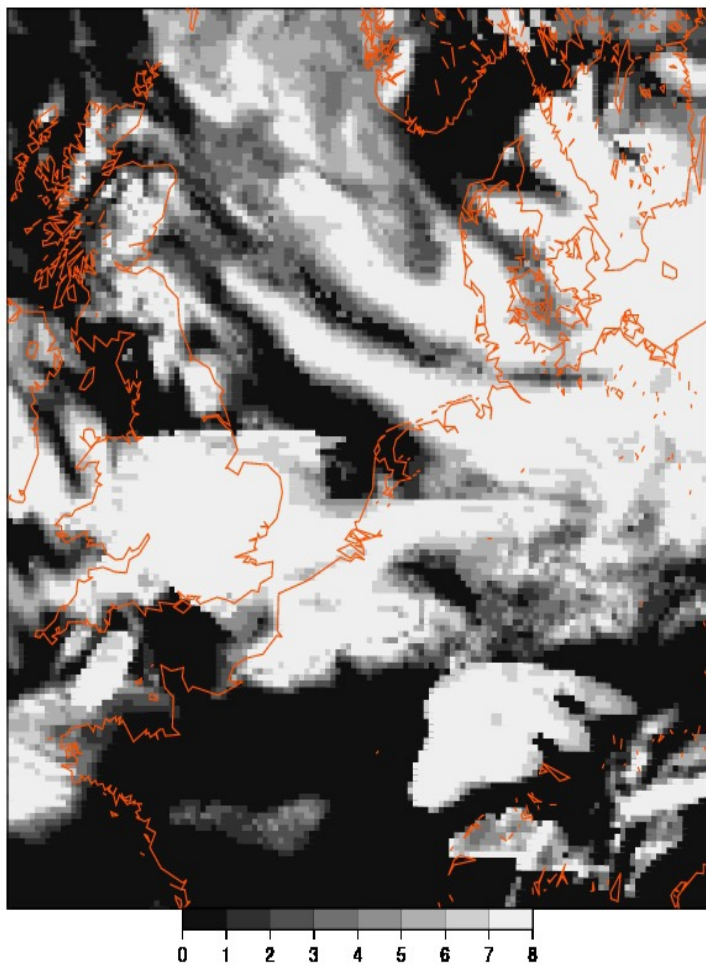
REF cloud cover 20110915_12+003



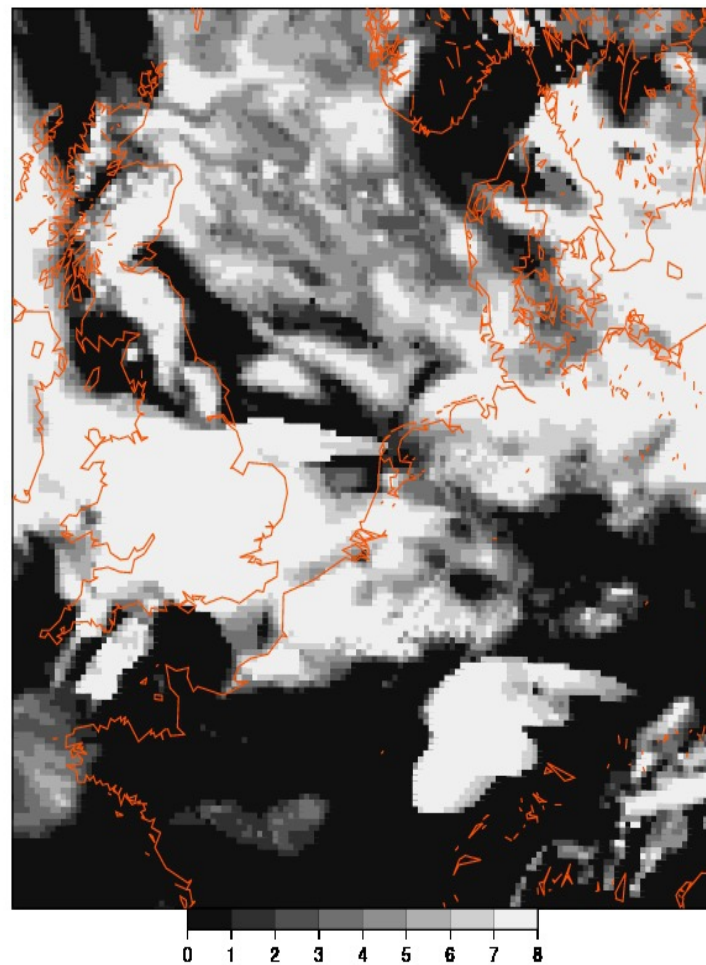
MSG cloud cover 20110915_12+003



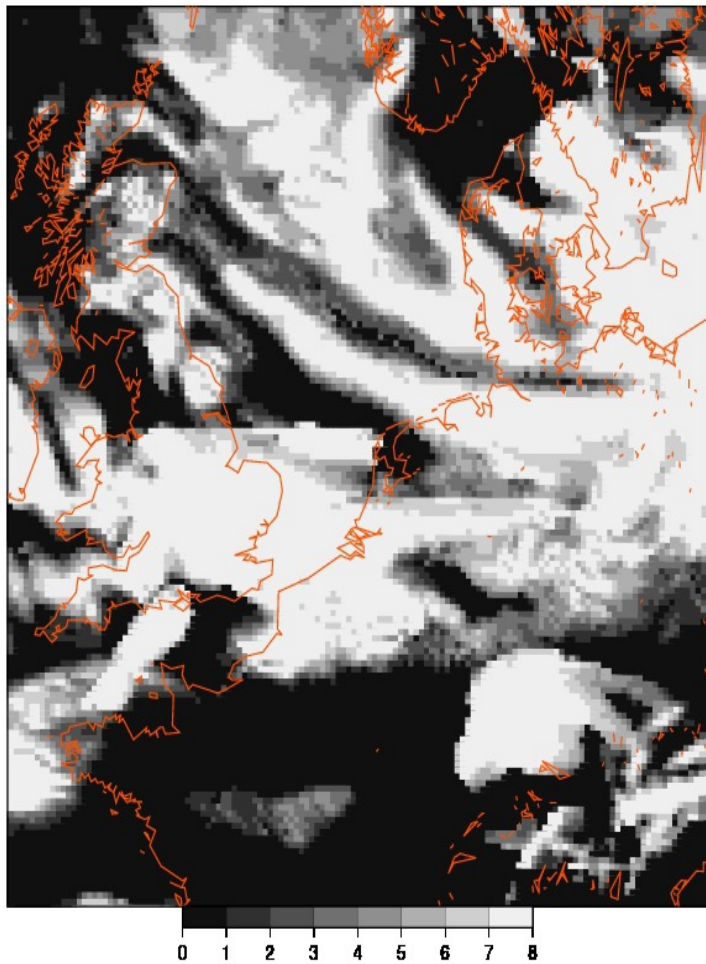
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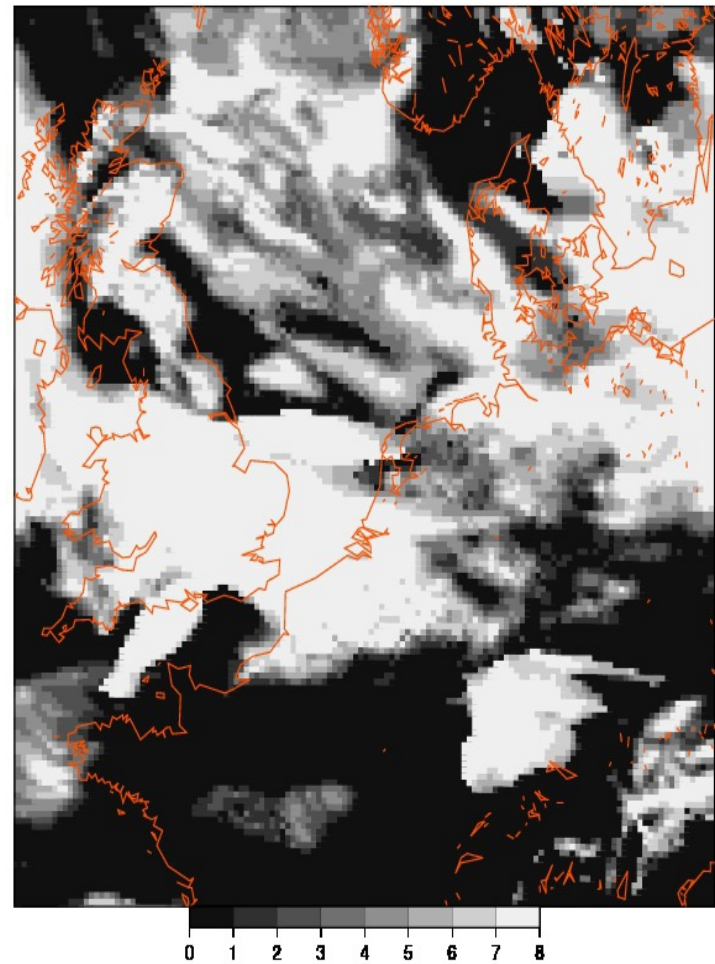
MSG cloud cover 20110915_12+004



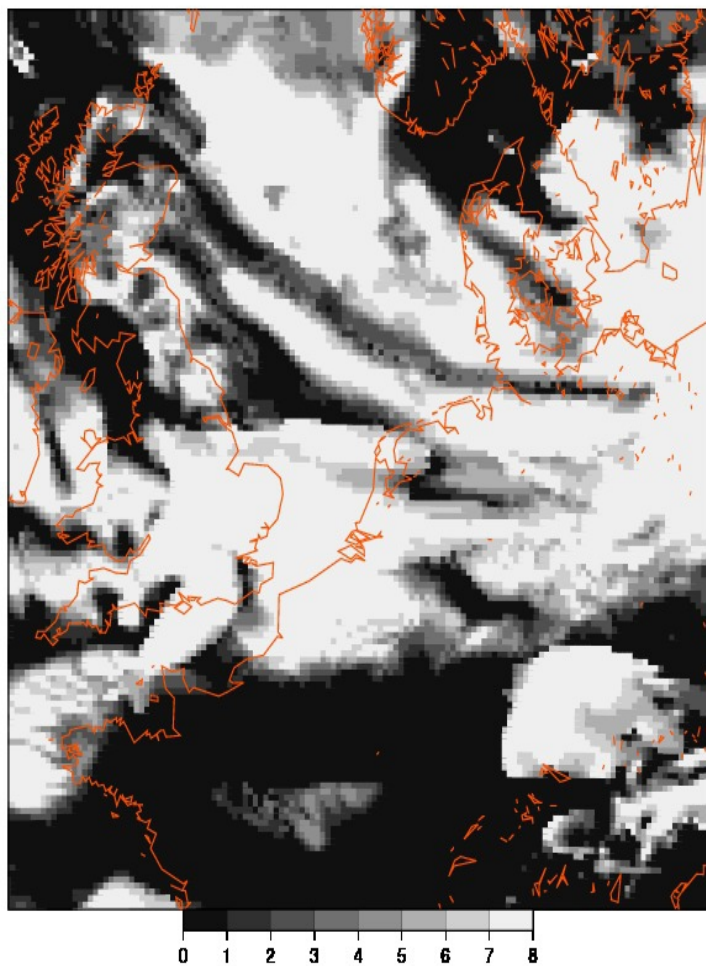
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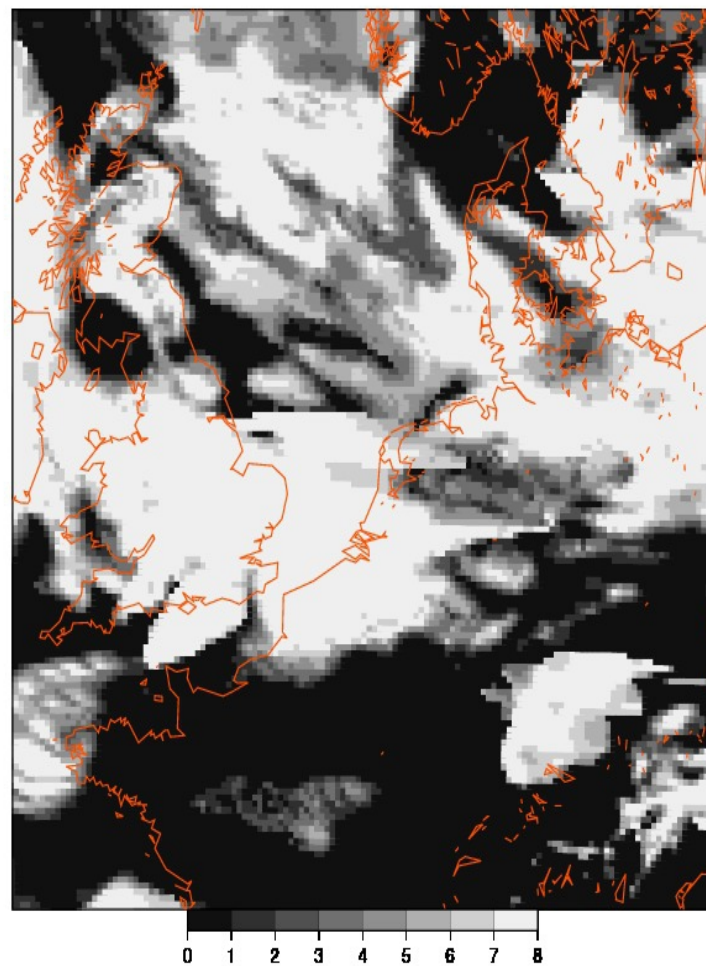
MSG cloud cover 20110915_12+005



REF cloud cover 20110915_12+006



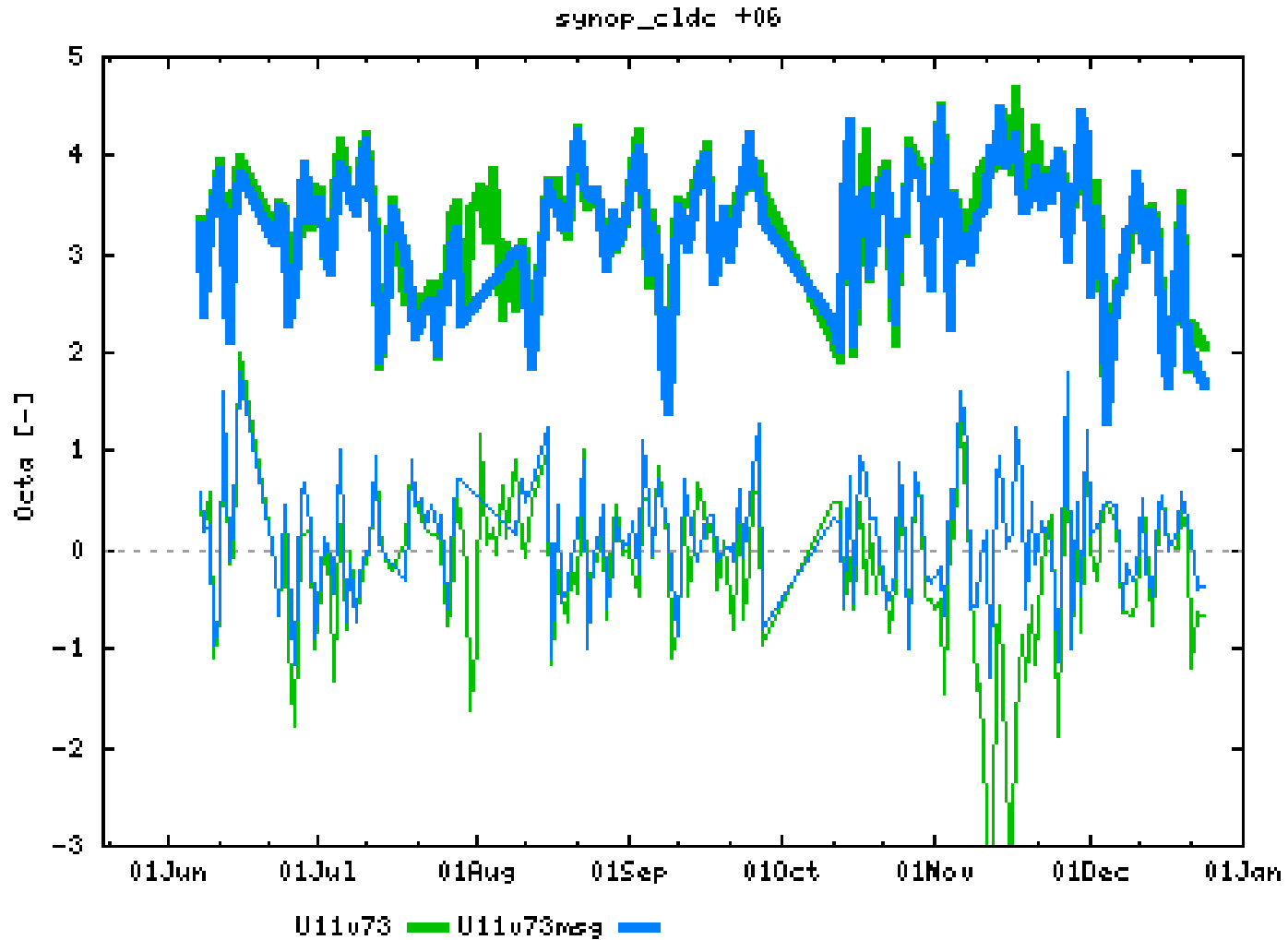
MSG cloud cover 20110915_12+006



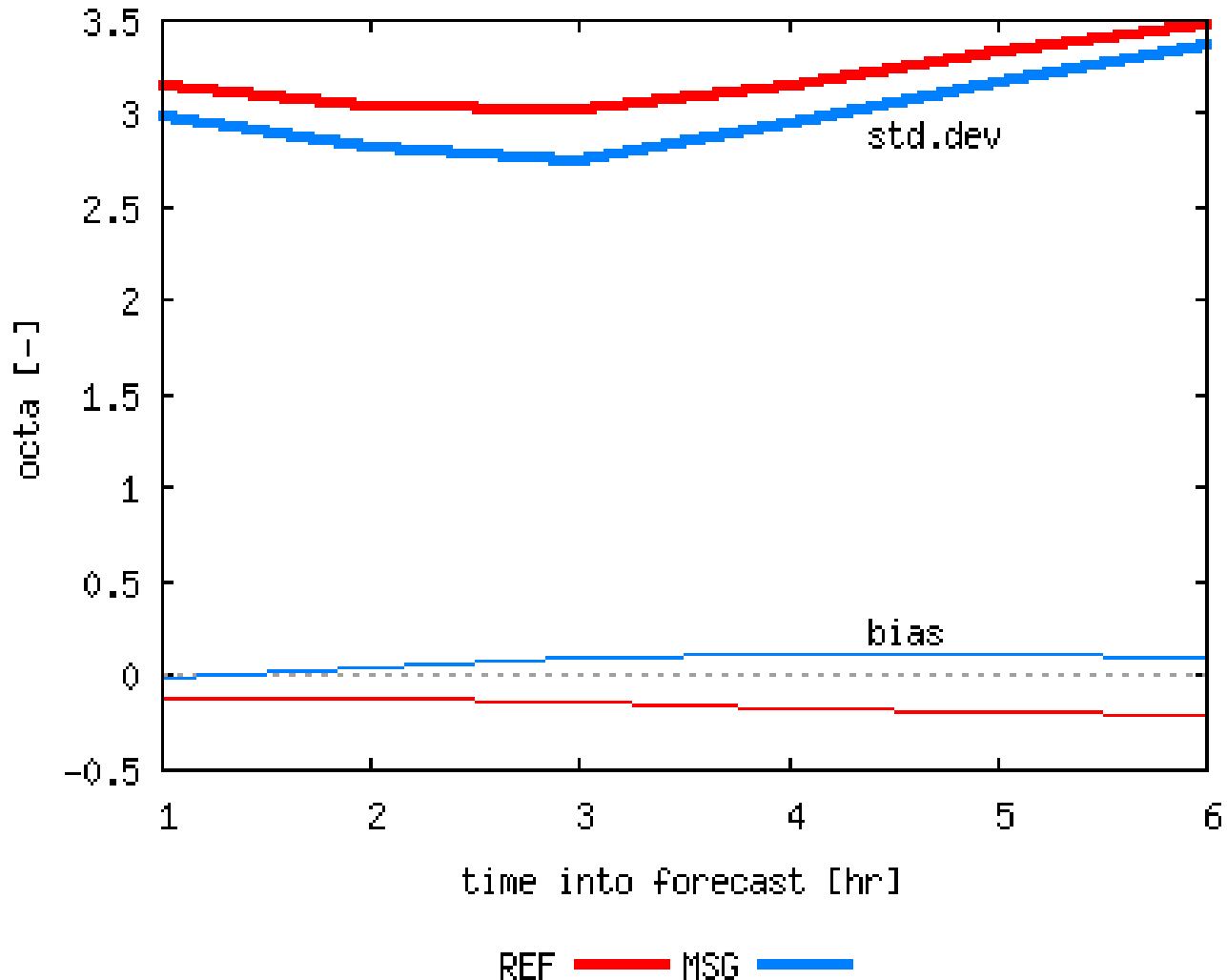
Observations used for verification:

- AMDAR: upper air temperatures
- Synop: cloud amounts
- Synop: pressure
- Synop: 2-m temperature

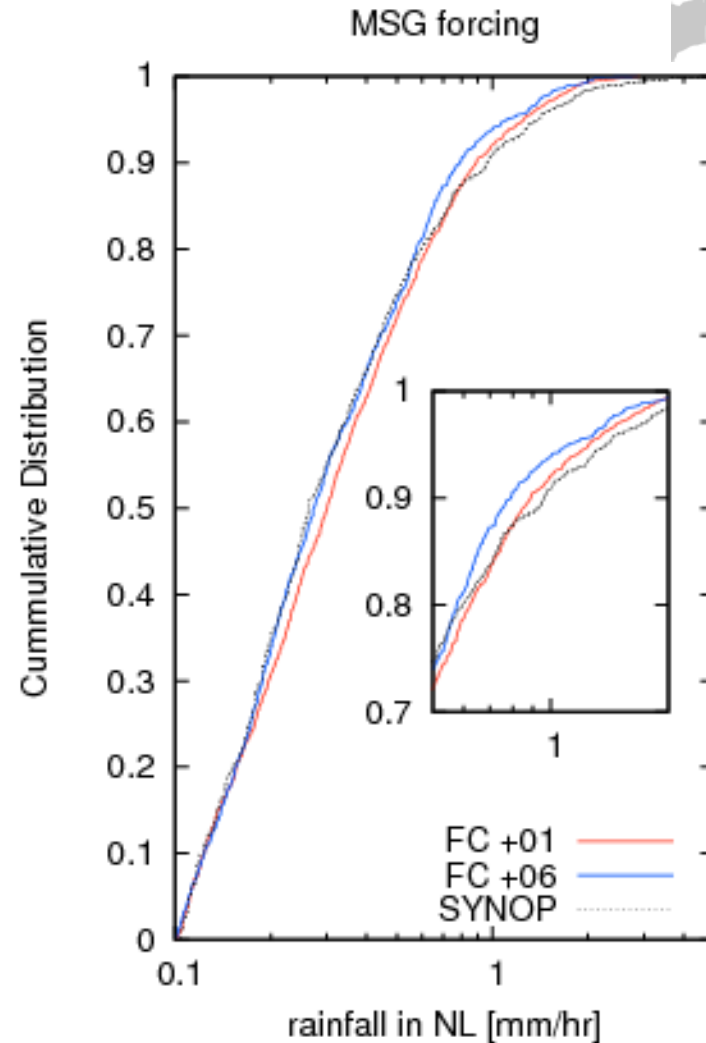
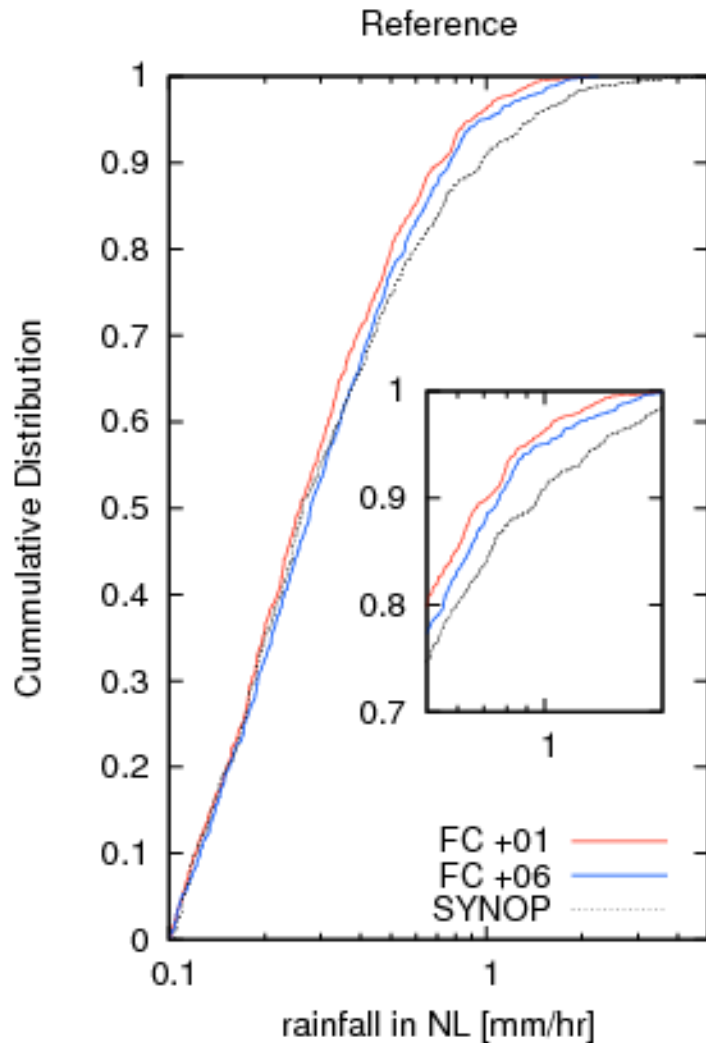
Verification of forecast cloud amounts:



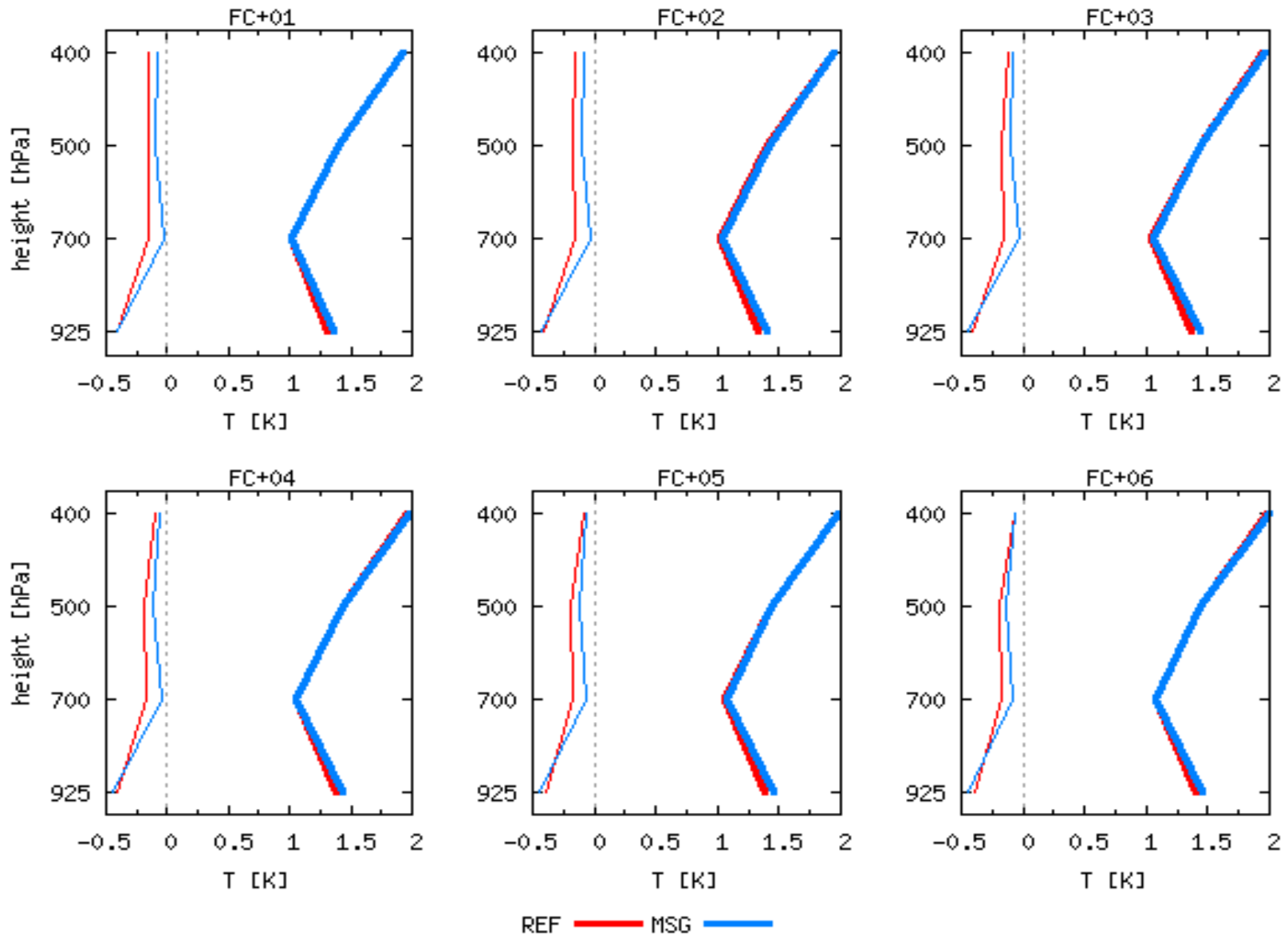
Standard deviation / bias cloudiness averaged over whole period



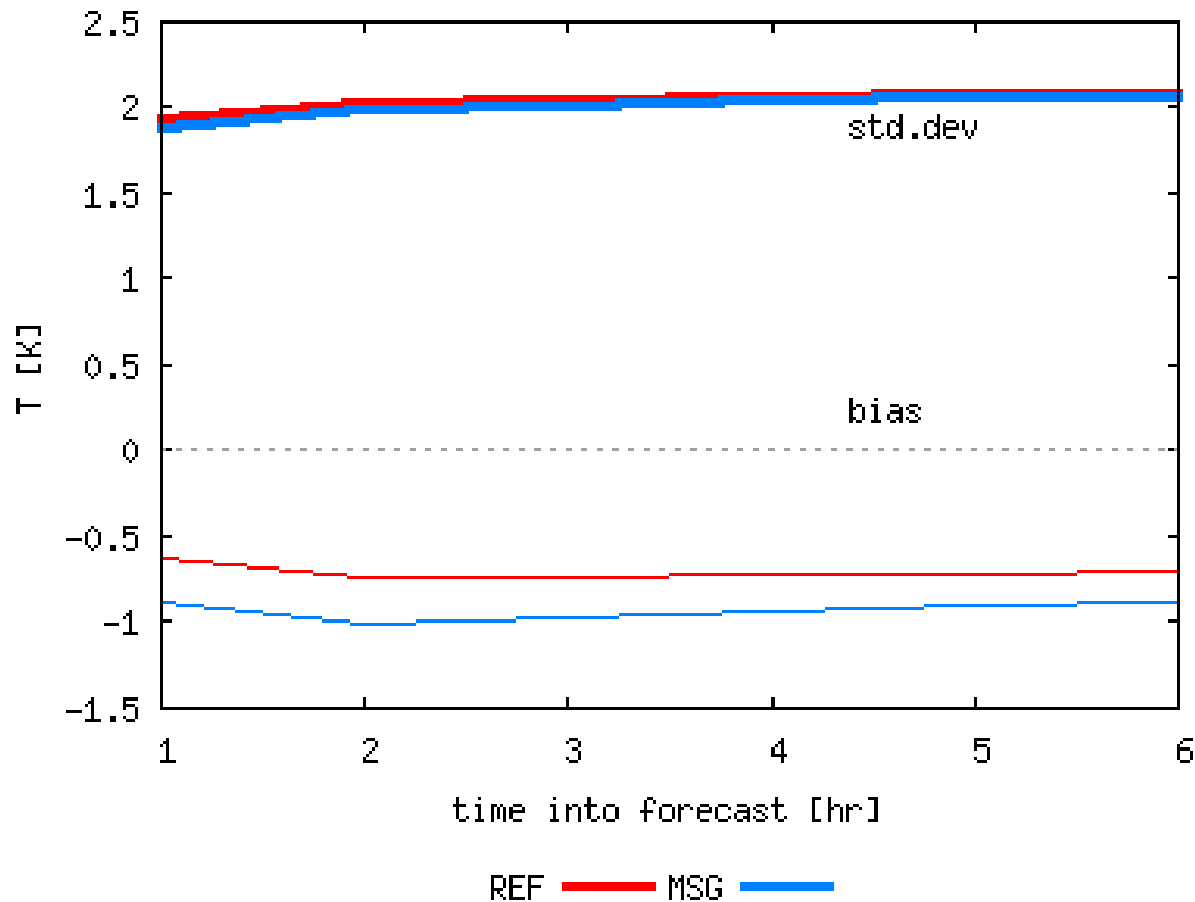
Verification of precipitation forecasts



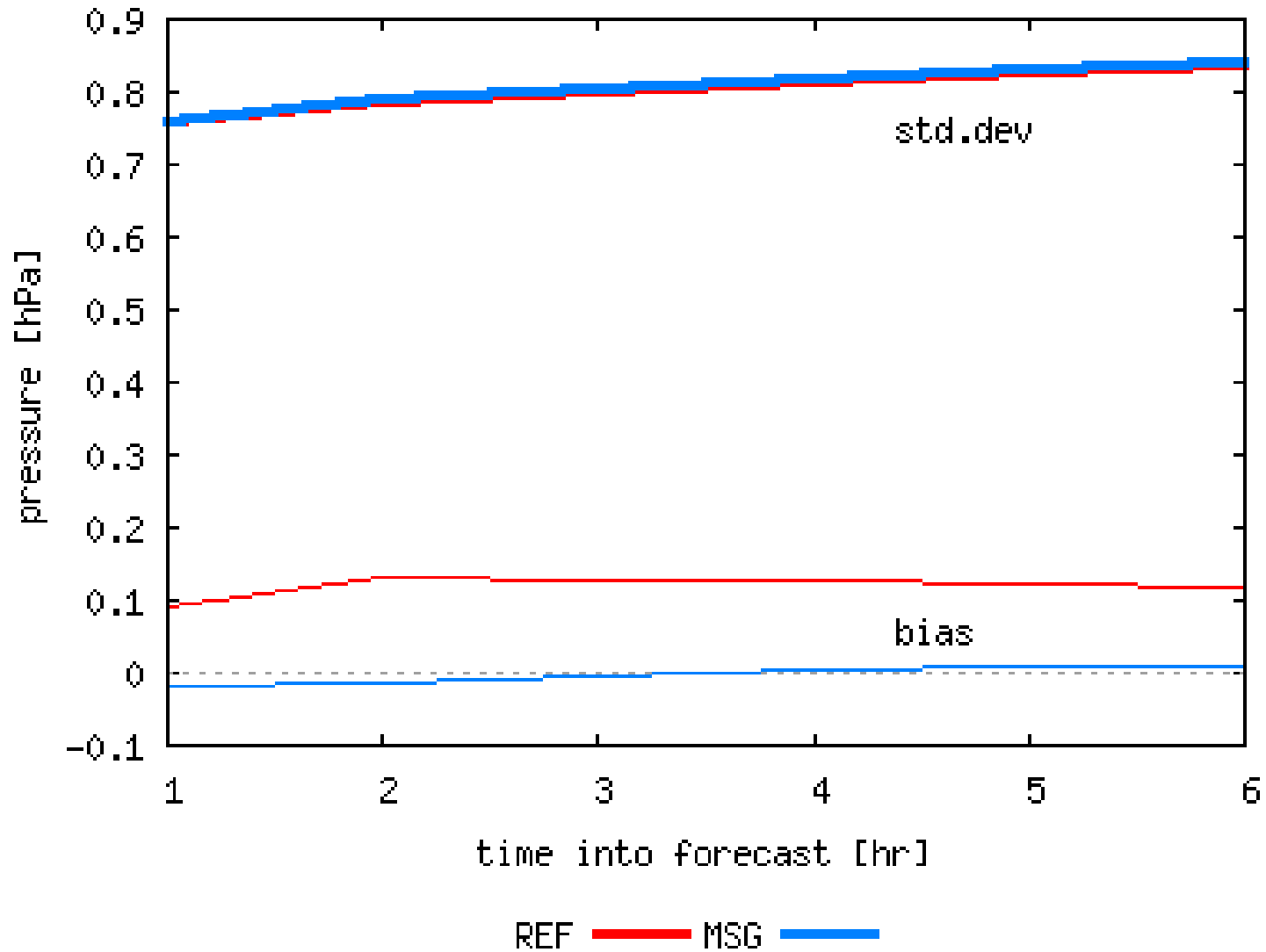
Verification of upper air temperatures:



- Verification of 2-m temperatures:
- Standard deviation: slightly better
- Bias: worse! (*radiation module?*)



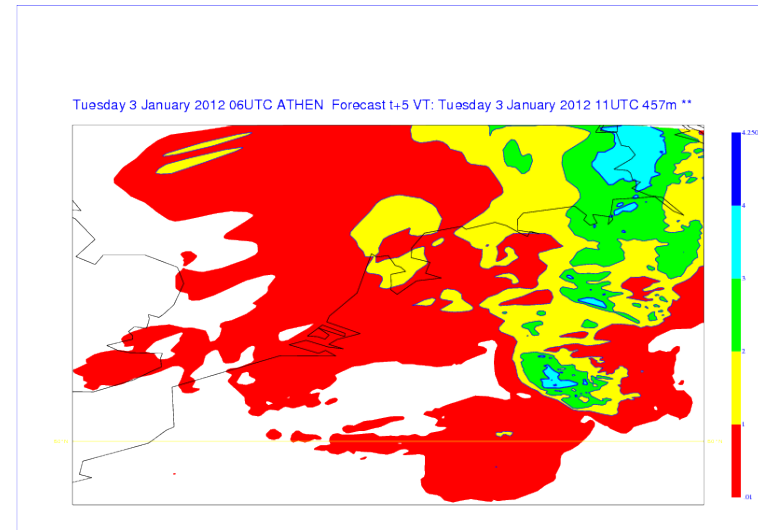
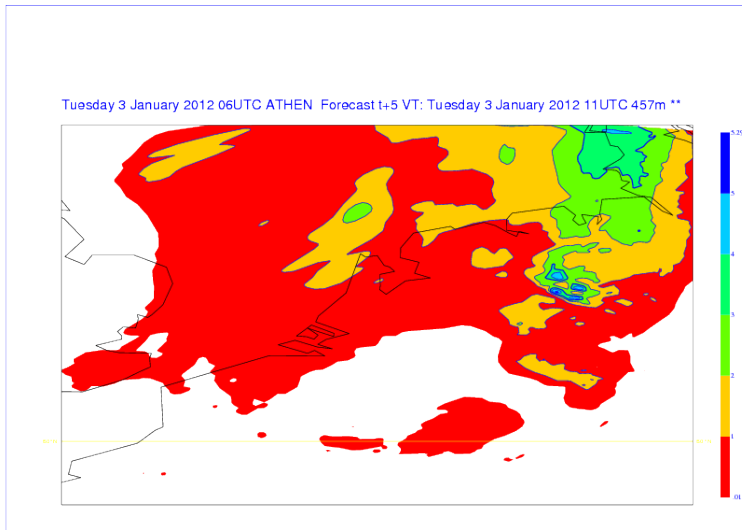
Verification of forecast surface pressure:



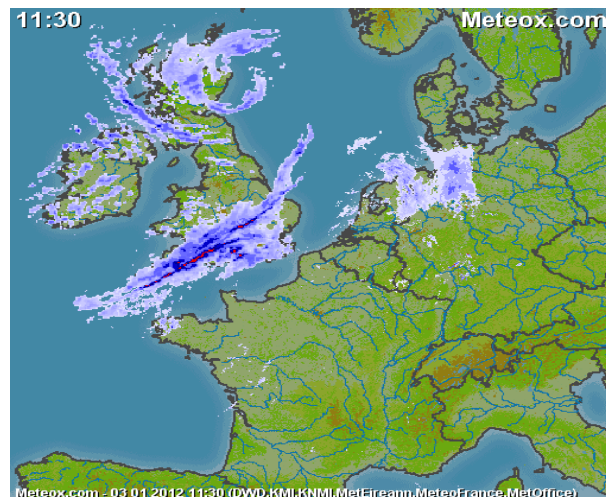
Outlook:

- Introduce clouds in first guess
- Improve cloud base initialisation over ocean
- Cloud initialisation in Harmonie

Example of rainfall change due to different initial clouds in Harmonie (3 January 2012):



REF: 6+5 – (6+4)



MSG: 6+5 – (6+4)

Summary

- **Initialisation procedure:**
 - * change *spec. humidity* after analysis (MSG, synoptic cloud base)
- **Verification results:**
 - * better *cloud cover, precipitation, upper air temperatures, surface pressure* for forecasts (+6 / +24 hours)
 - * worse *2-m temperatures*
- **Conclusions:**
 - * (variational) data assimilation not necessary for humidity

Verification of forecast cloud cover without limit in humidity change:

