

# Evaluating HARMONIE cloud cover using MSG clouds mask

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acknowledgements:

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# Outline

## Introduction

- Using MSG cloud mask for verification
- different versions of HARMONIE and cloud schemes.  
Investigated periods

## Results

- Harmonie versions
- cloud schemes

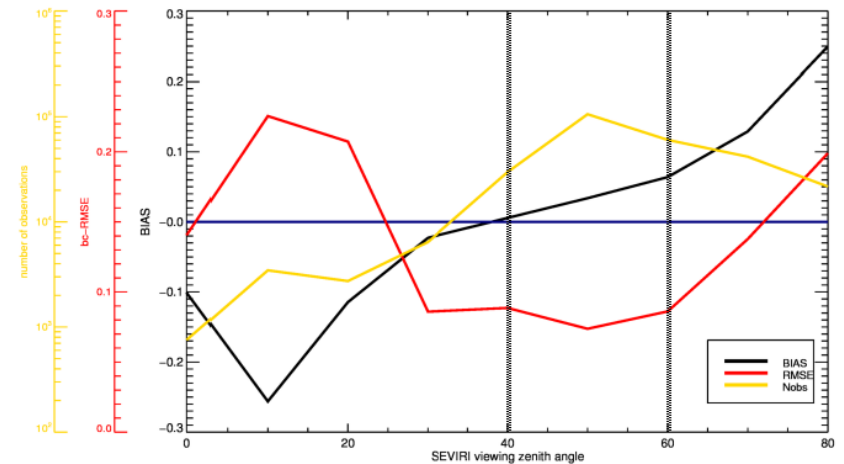
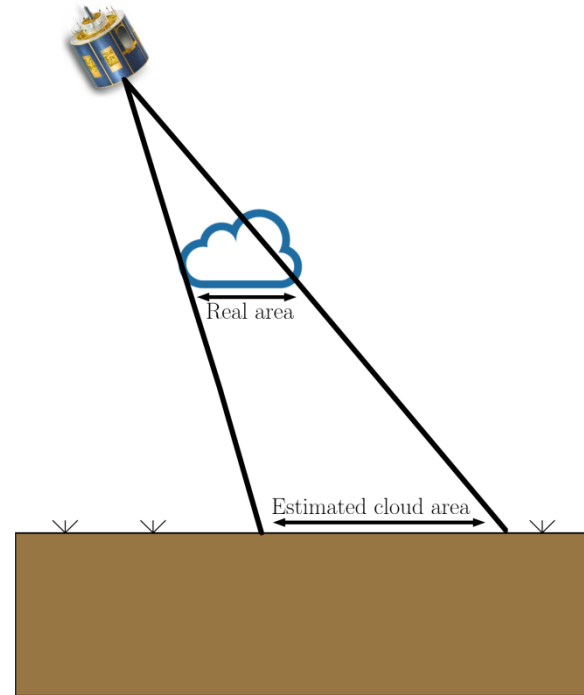
## Conclusions

**Future plans (CRIME)** (postponed to discussion session)

# Using MSG cloud mask

- Satellite data
- 4 x 7 km resolution
- $N = 0.0$  or  $1.0$
- Measurement angle
- Uncertainties:
  - Area, location
  - Day/night
  - Cirrus clouds above sea

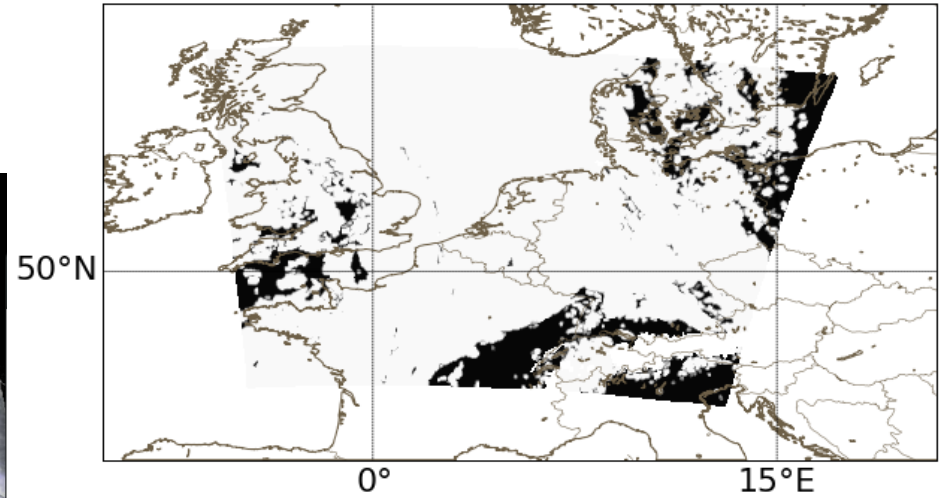
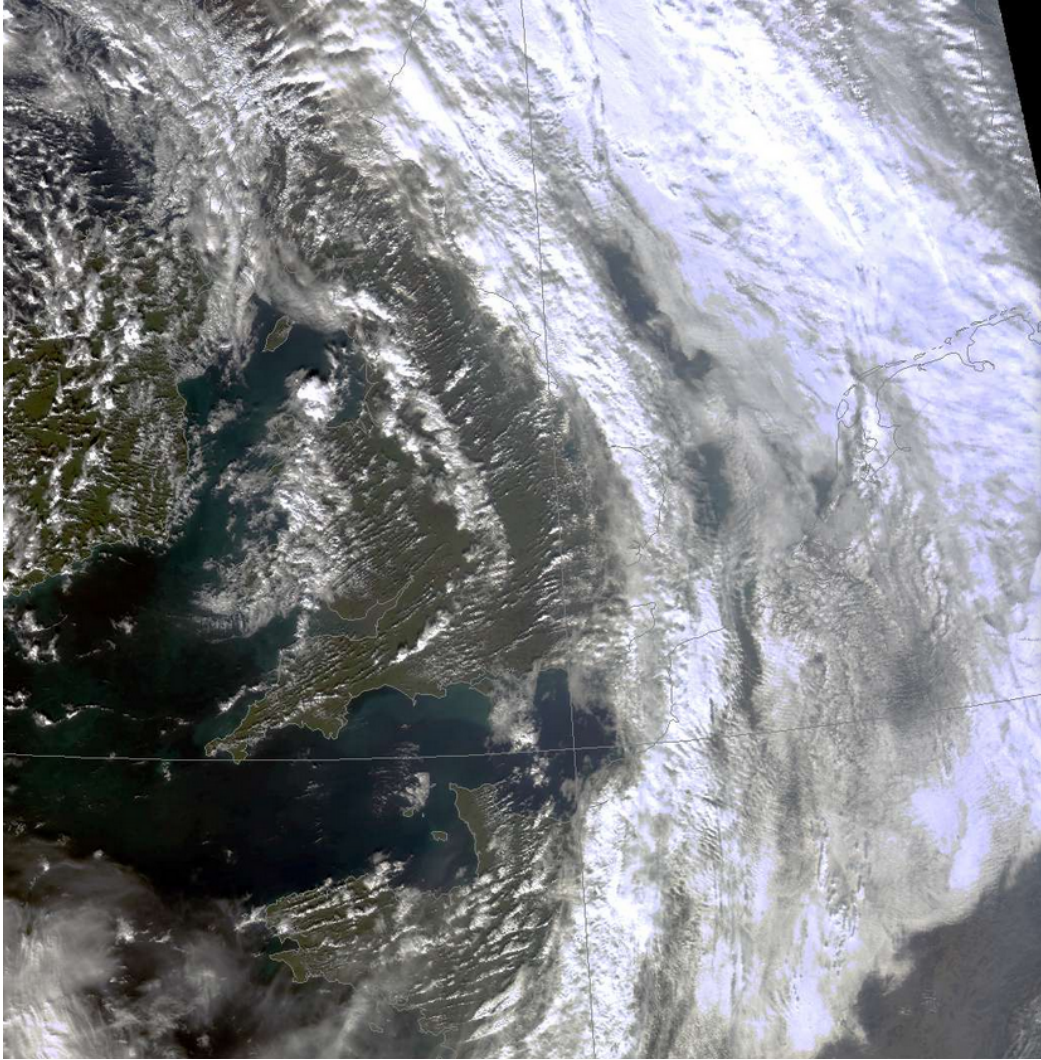
Generally overestimation (4%)



# Comparison with MODIS 3 March 2012, 13 utc

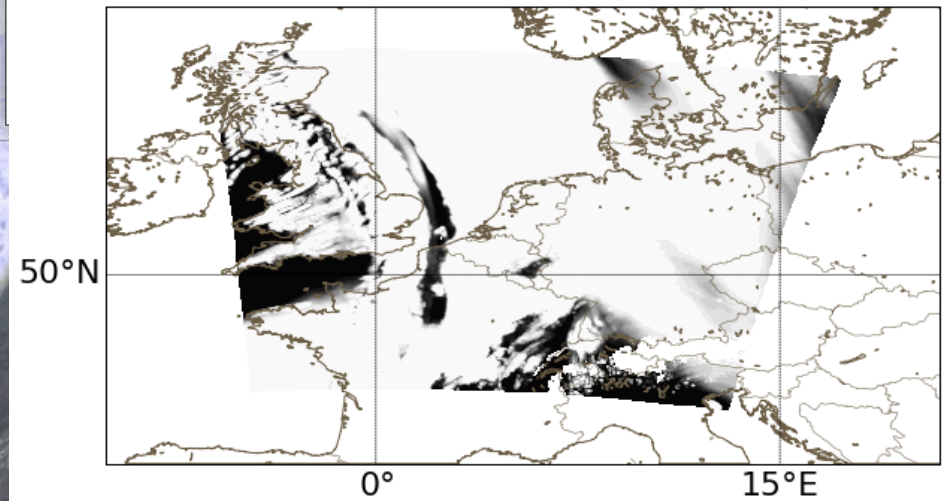
MSG

Modis



0.00 0.15 0.30 0.45 0.60 0.75 0.90  
Cloud cover

HARATU update



0.00 0.15 0.30 0.45 0.60 0.75 0.90  
Cloud cover

## **Model runs:** (+12 to +36h forecasts)

- Hindcast runs: Start every day from ERA interim, but surface initialized from previous run.
- Climate mode: Run freely after initialization
- DA mode: as operational (only for March 2012 and HARATU update)

## **Periods:**

- March 2012: Slippery road conditions
- May 2008: Unusual sunny and warm weather
- August 2006: Extraordinary cloud cover and precipitation
- Year 2012 (only hindcast with HARATU)

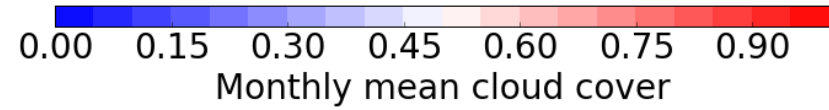
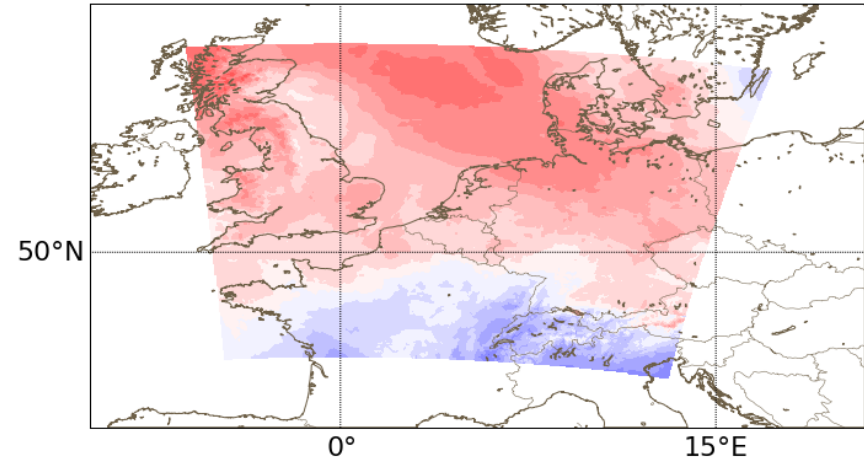
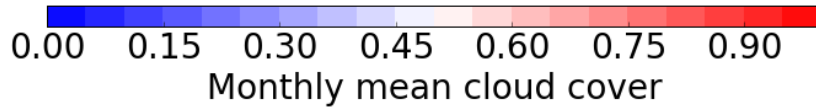
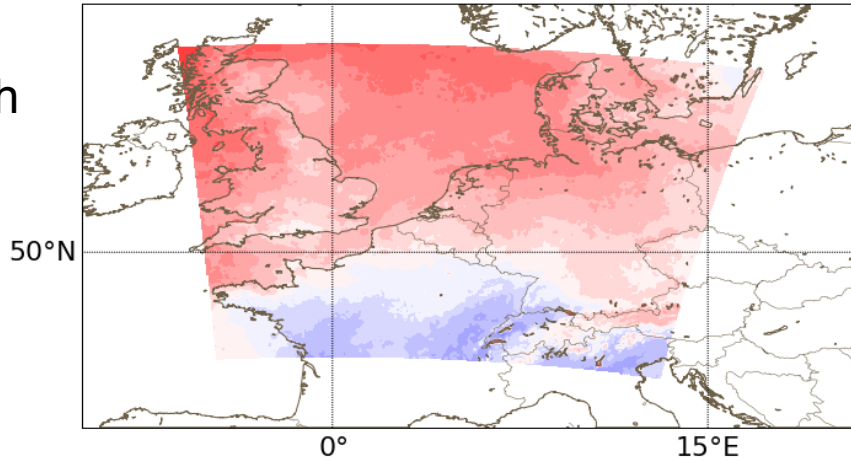
## **Versions** (all with inhomogeneity=1)

- HARMONIE cy38: Reference HARMONIE cy38
- HARMONIE SM: OCND2=FALSE
- HARATU: as cy38 but with HARATU turbulence
- HARATU update: HARATU update (+ all radiation updates)

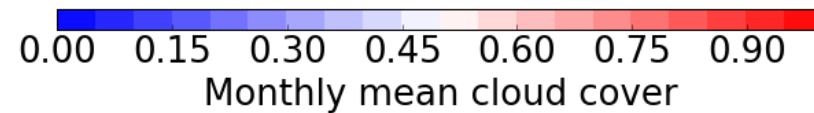
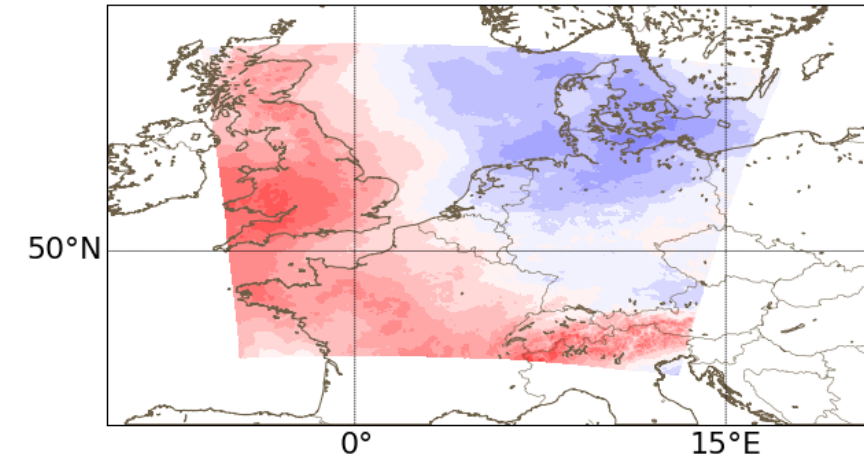
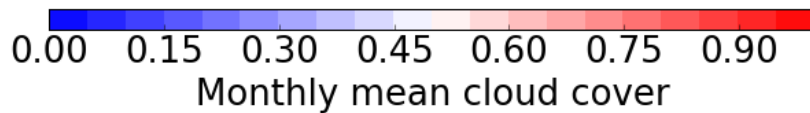
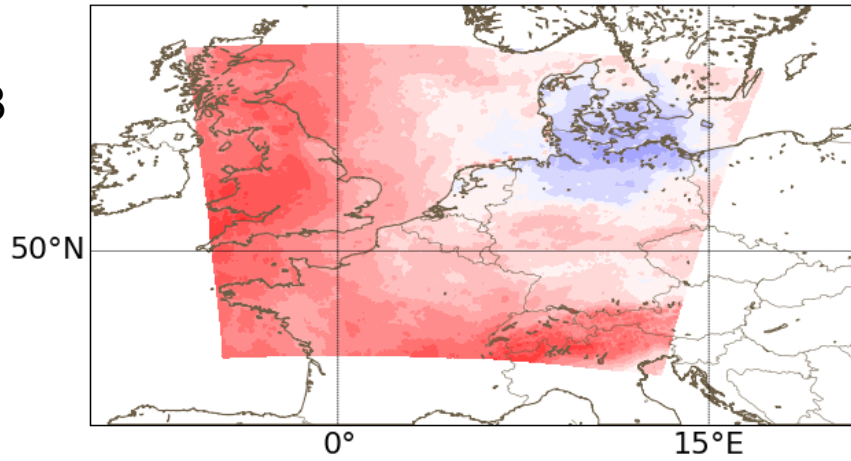
# MSG

# HARATU update

March  
2012

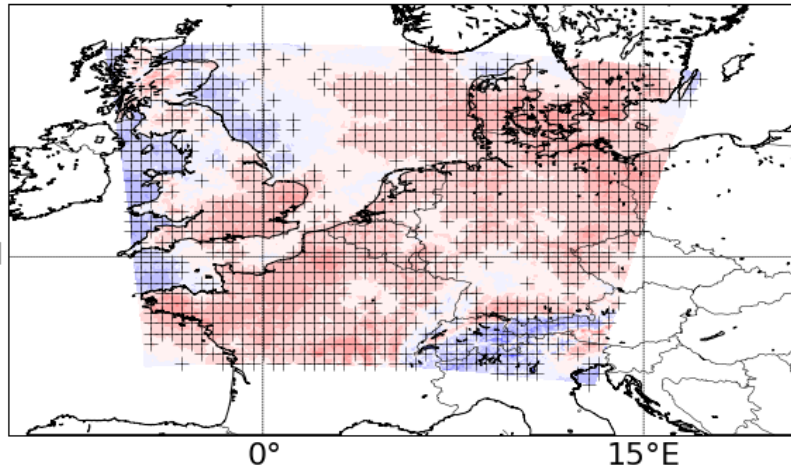


May  
2008



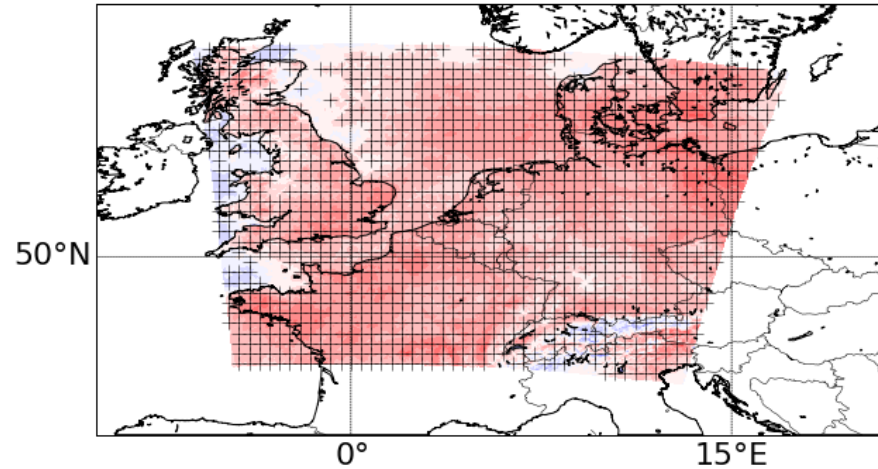
# March 2012: Mean cloud cover difference model - MSG

cy38



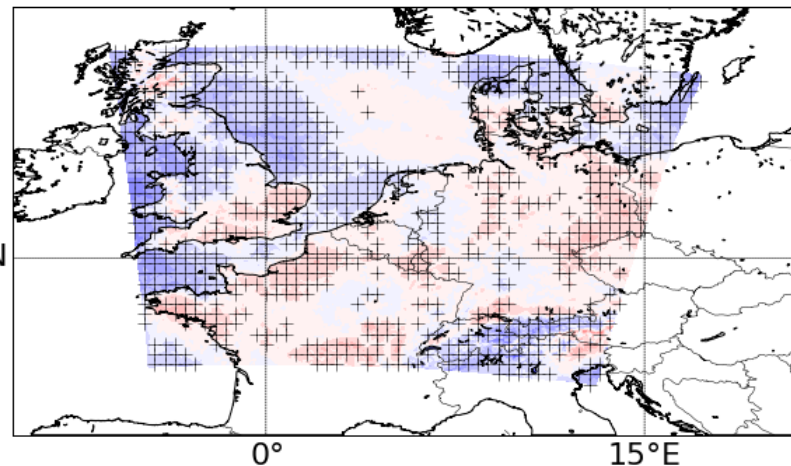
-0.36 -0.24 -0.12 0.00 0.12 0.24 0.36  
Mean cloud cover difference

No OCND2



-0.36 -0.24 -0.12 0.00 0.12 0.24 0.36  
Mean cloud cover difference

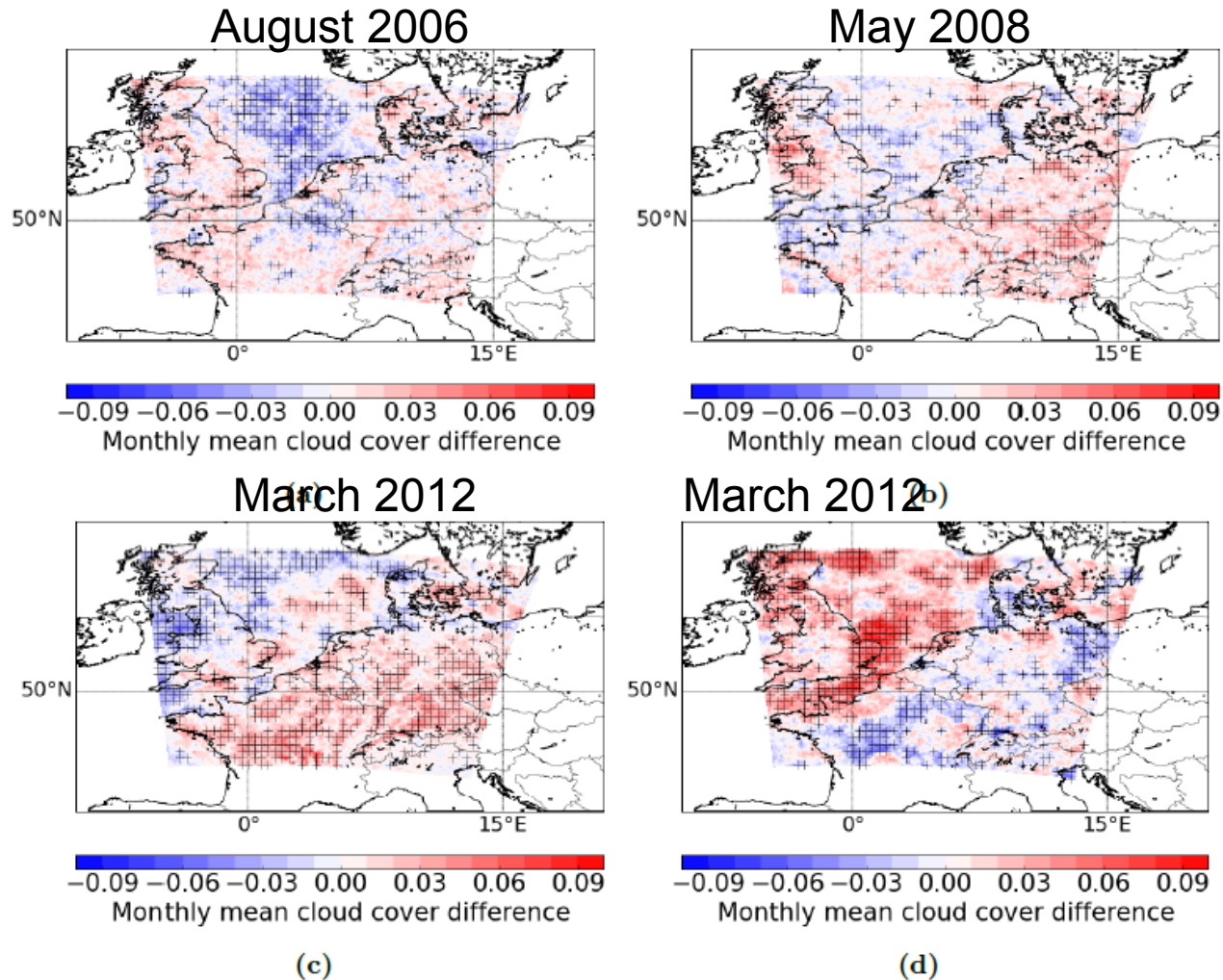
HARATU update



-0.36 -0.24 -0.12 0.00 0.12 0.24 0.36  
Mean cloud cover difference

However, not all months are the same

Red= improvement with Haratu update in comparison with cy38 for August 2006(a) May2008(b) and March 2012(c). The difference of the absolute mean bias is shown. Panel (d) shows improvement for March2012 against Haratu update in DA mode)

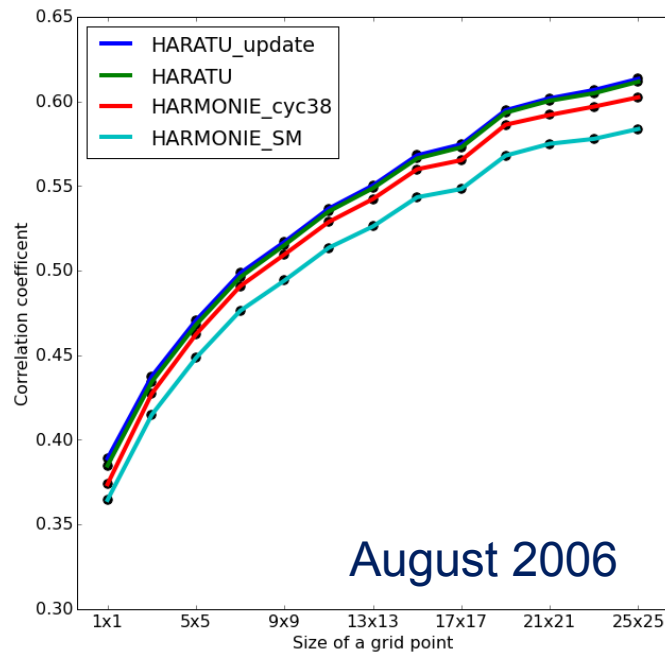
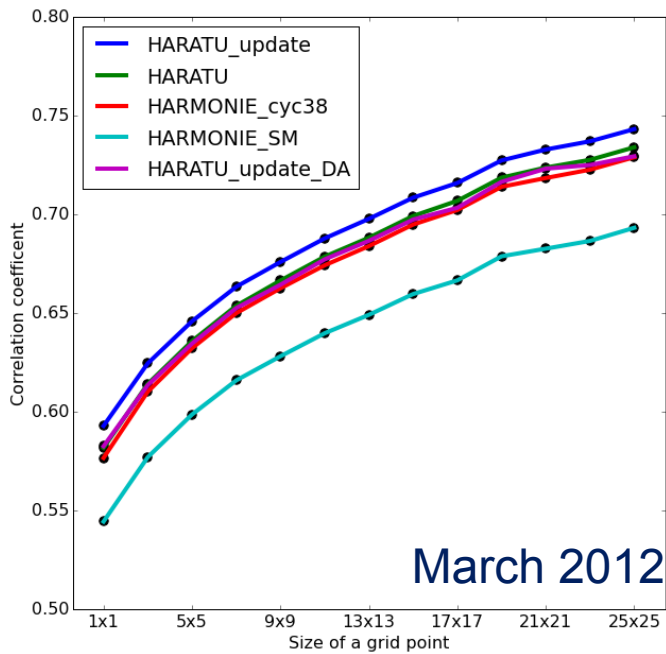


**Figure 5.6:** The difference between the absolute mean bias of HARMONIE cyc38 and MSG, and HARATU update and MSG for (a) August 2006, (b) May 2008 and (c) March 2012. Figure (d) shows the difference between the absolute mean bias of HARMONIE update DA and MSG, and HARATU update and MSG for March 2012. A plus resembles a significant change as determined by bootstrapping. Red shows that HARATU update performs better than HARMONIE cyc38 for (a), (b) and (c), and better than HARATU update DA for (d).

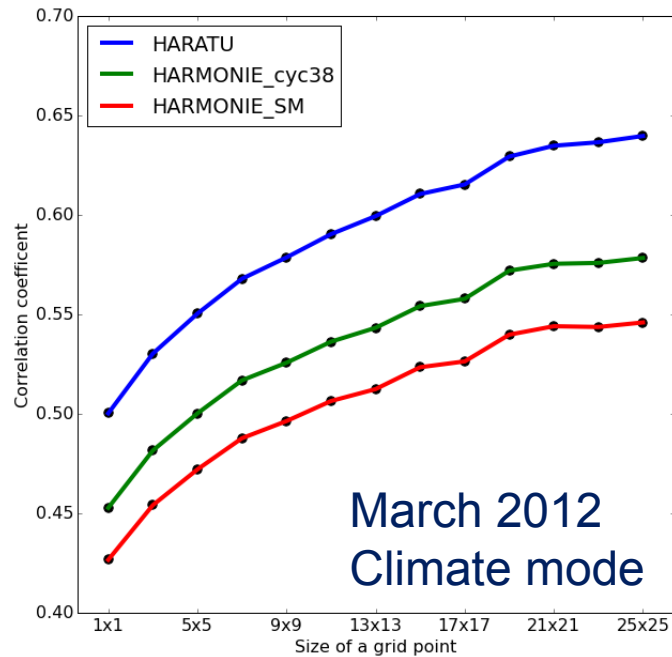
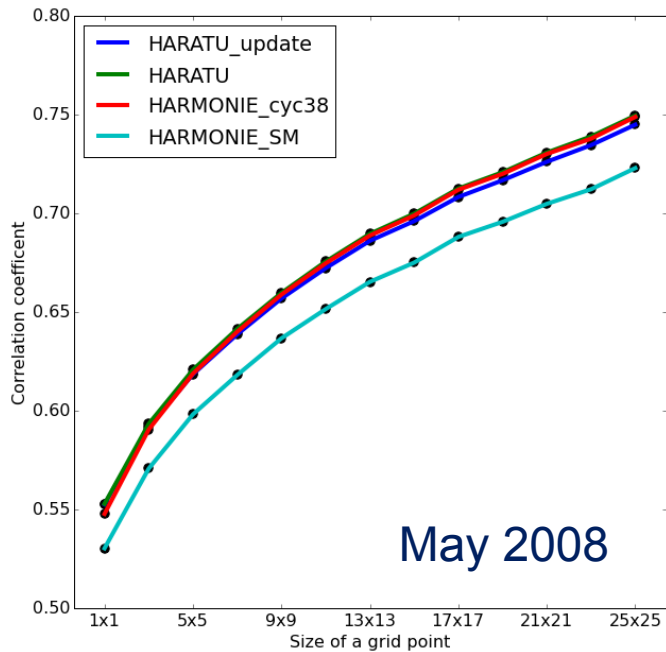
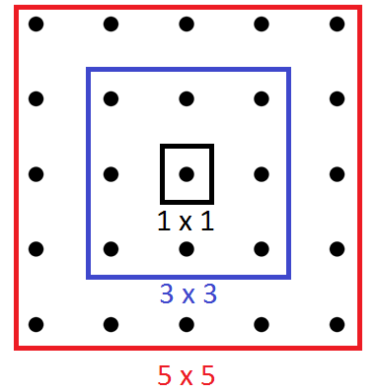


# Doubts about absolute value MSG clouds

## More suitable measure: correlation coefficients (?)

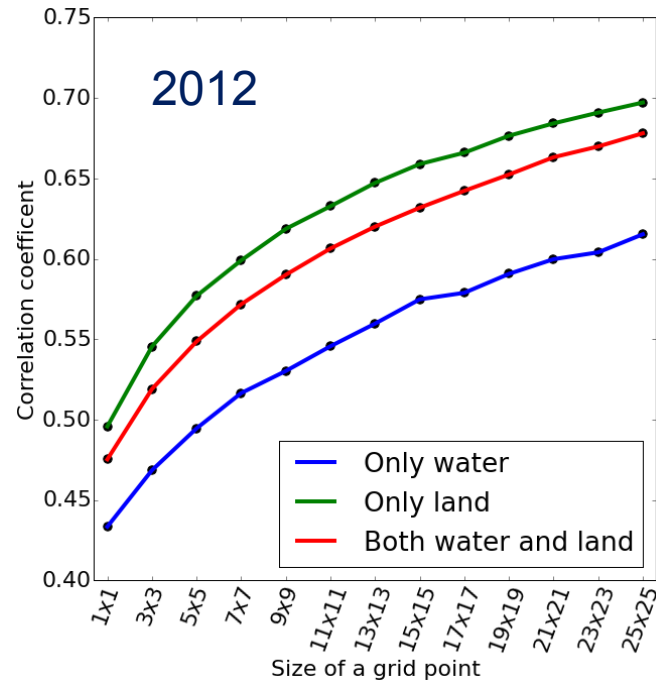
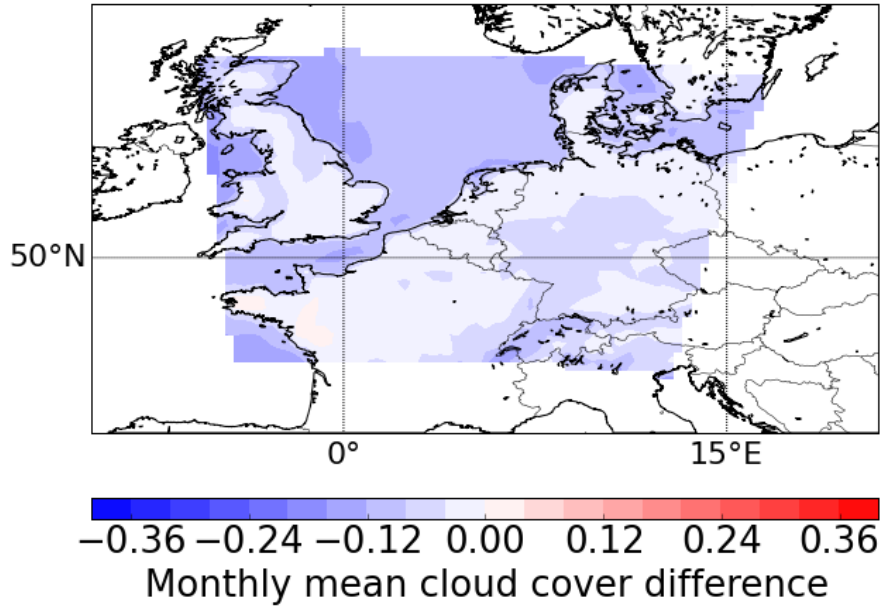


coarse graining



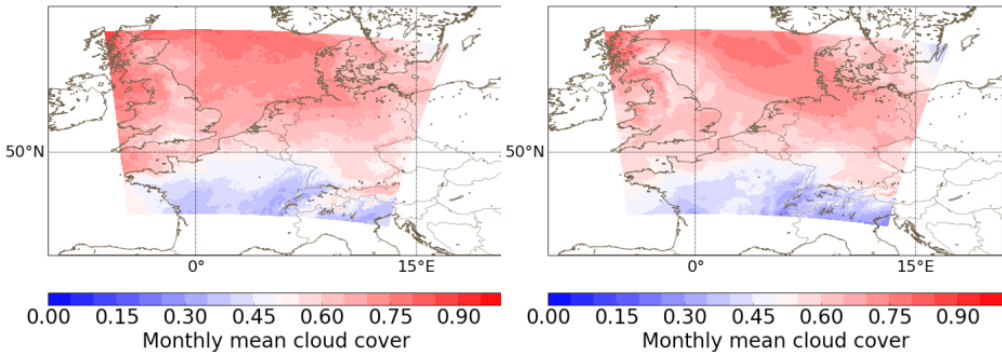
# Land ↔ sea issues

2012: cloud cover HARATU- MSG

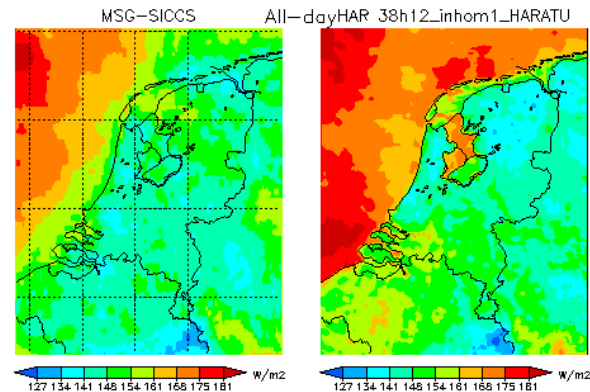


No (clear) seasonal dependence

difference in cloud cover  
land ↔ sea clearer in MSG!

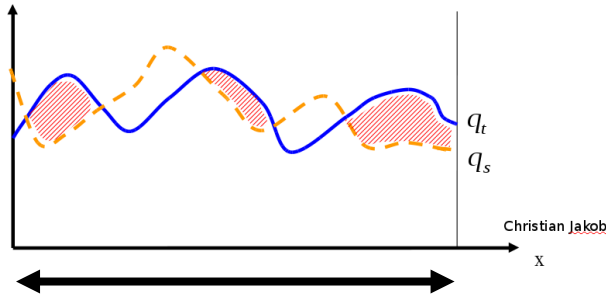


however, in radiation Harmonie shows much larger contrasts than MSG!?

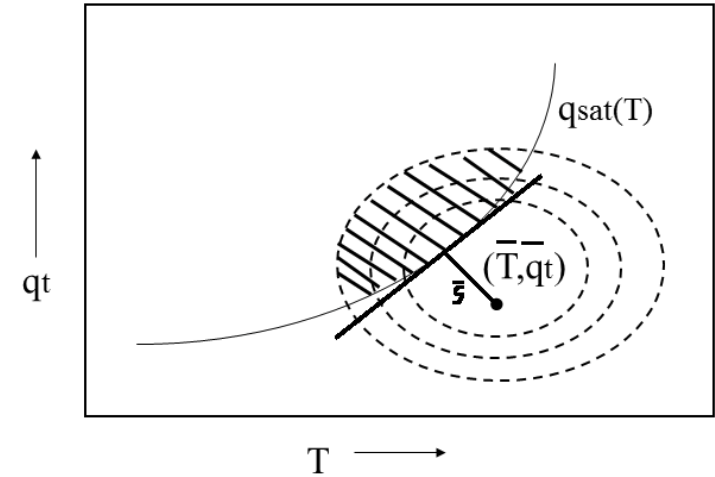


# Cloud schemes

## Basics Statistical cloud scheme



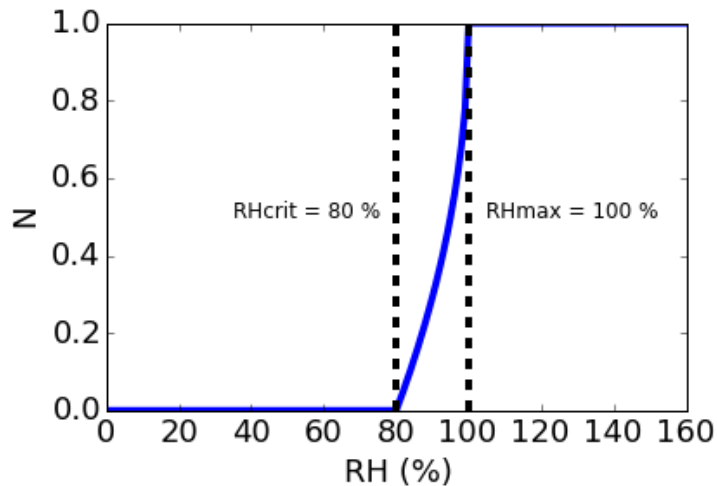
Model grid box



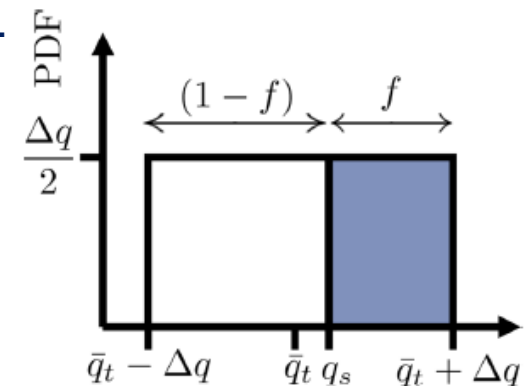
In Harmonie (option STAT): 
$$\sigma_s = \sqrt{(2\sigma_{conv,turb})^2 + \sigma_{extravar}^2}$$

Experiments with: reference, no variance (except ice part), only extra variance

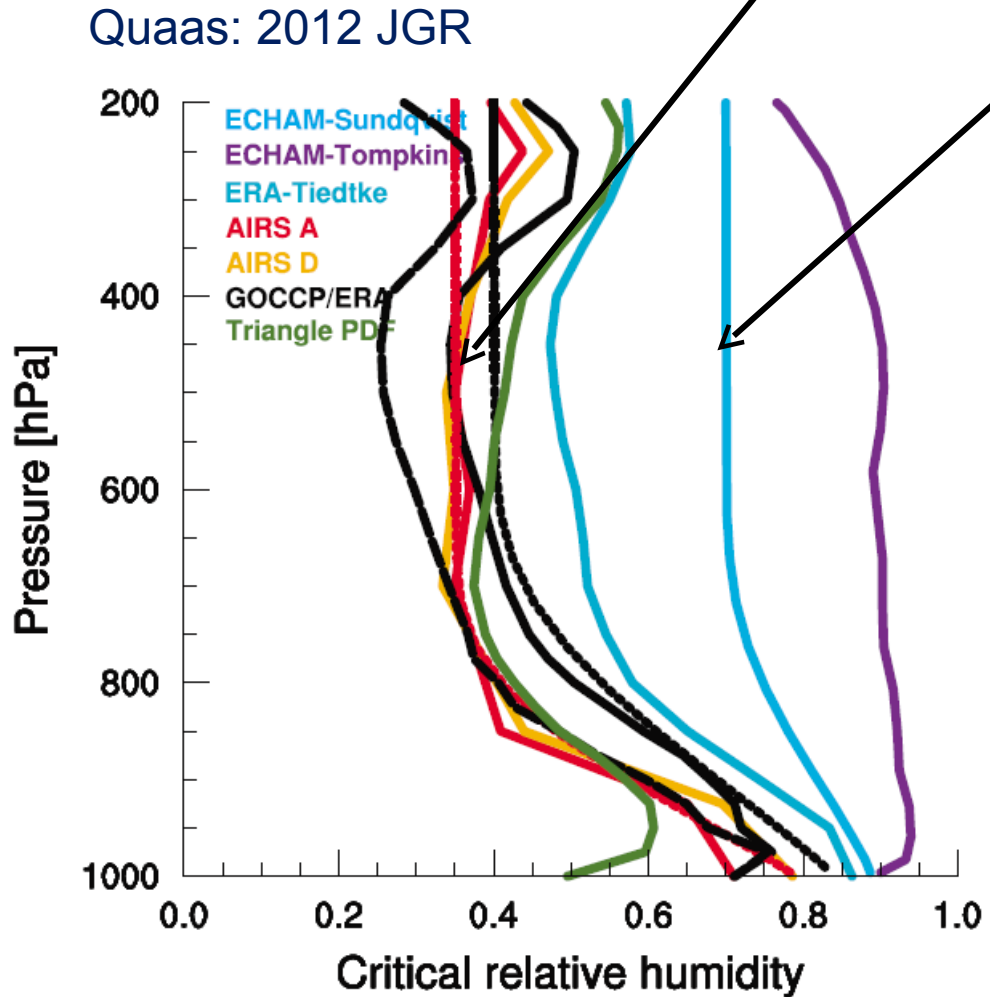
## Relative humidity cloud scheme



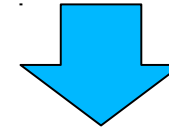
RH scheme can be interpreted as statistical cloud scheme with  $RH_{crit}$  related to variance.



# What happens if we run Harmonie with RH scheme? (with RHcrit from observations or Sundqvist)



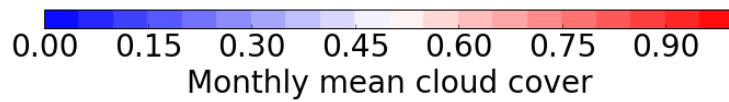
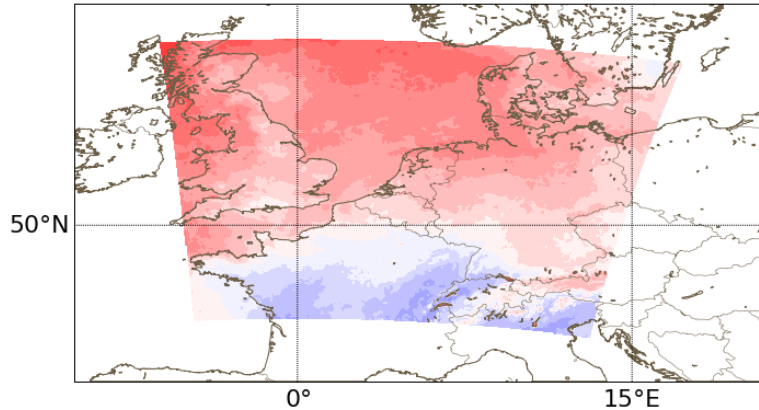
$RH_{crit}$  decreases with height



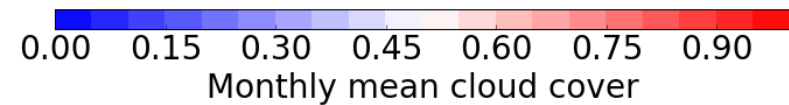
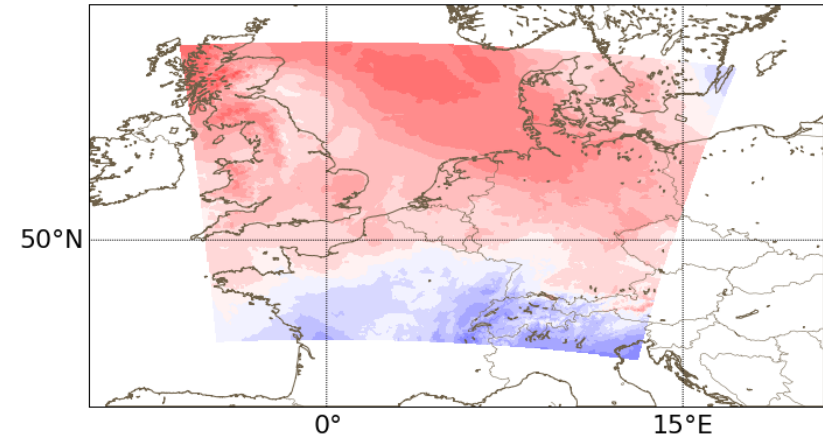
the relative variance increases with height  
counter intuitive?!?!

# Mean cloud cover March 2012

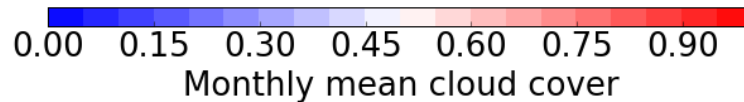
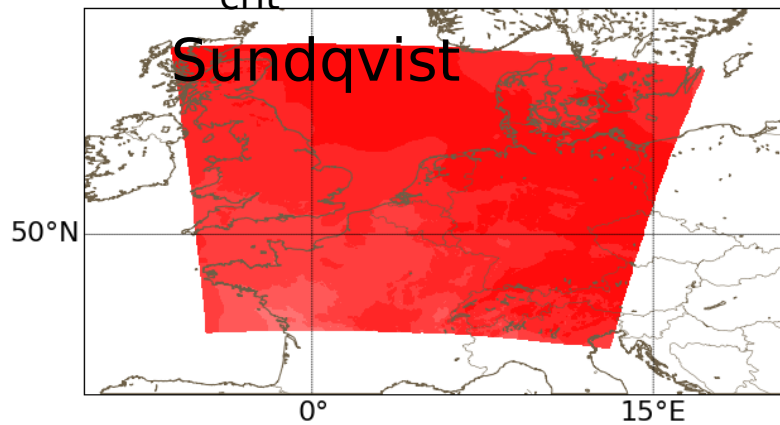
## MSG



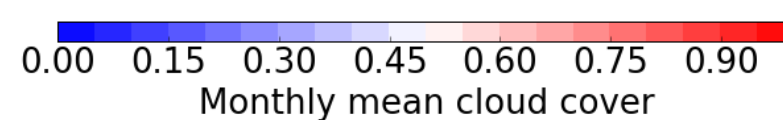
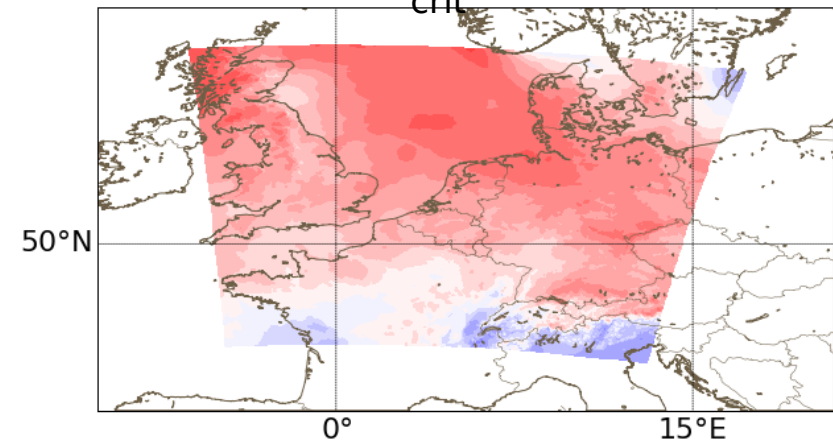
## HARATUUP stat



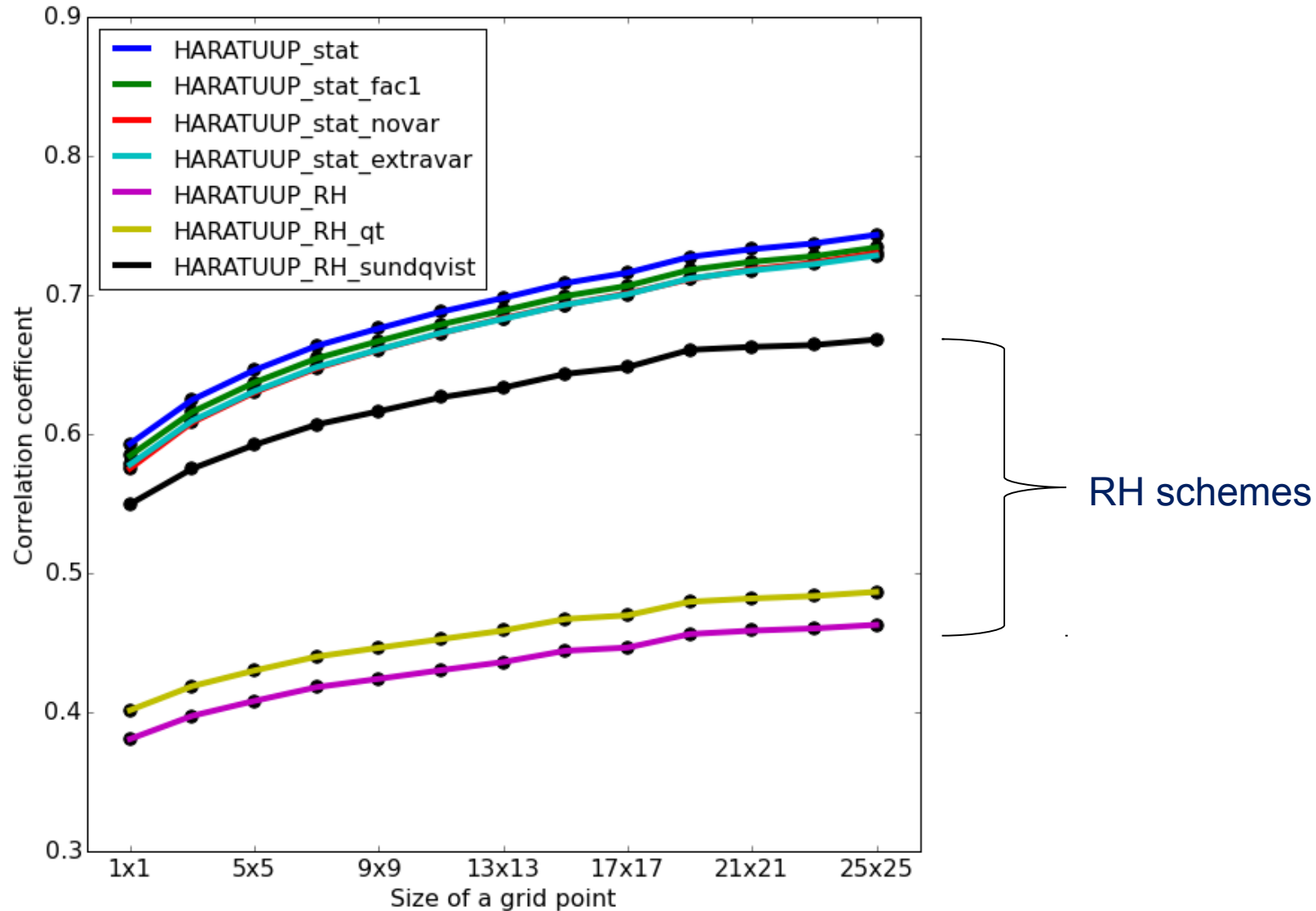
## RH<sub>crit</sub> observed



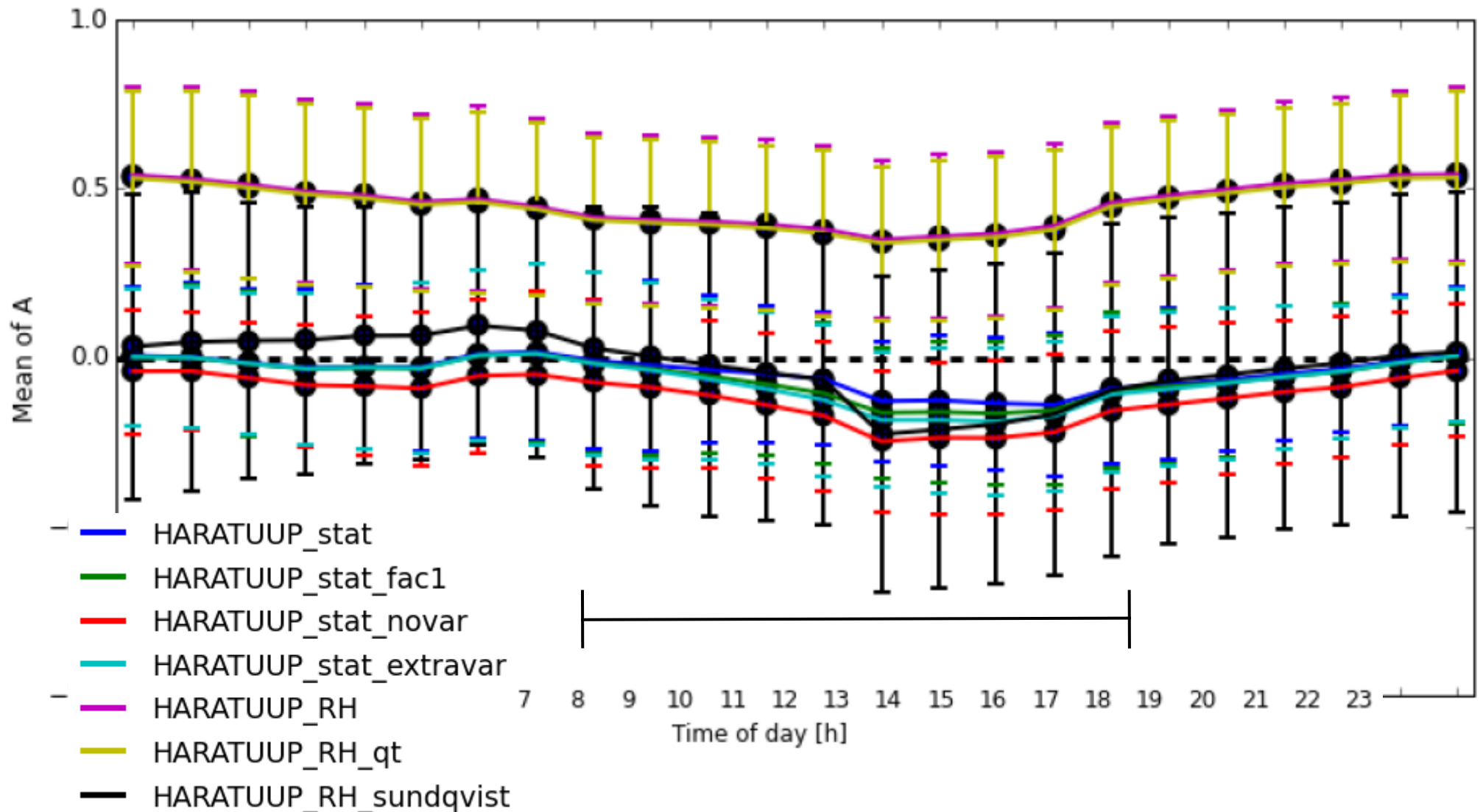
## RH<sub>crit</sub>



# Correlation coefficients March 2012 cloud scheme versions



# March 2012 Mean diurnal cycle of A (SAL verification)



# Conclusions

- Uncertainties in mean MSG cloud amount (how large is the overestimation?). Differences land  $\leftrightarrow$  sea? Night  $\leftrightarrow$  day? Maybe the use of a cloud simulator helps (CRIME)
- Climate mode suggests: Physics  $\Rightarrow$  overcast.
- DA run performs less then hindcast run...(?)
- generally improvement with OCND2 and on top of that HARATU(update).
- Indication that statistical cloud scheme improves on a RH scheme (as expected). More investigation needed (CRIME)
- Use of SAL verification problematic. Use FSS? (CRIME)
- Important to know the influence of individual components on output parameters. For example, OCND2 results in considerably less clouds. See also “Harmonie verification and evaluation” Hirlam scientific report (Wim de Rooy, Hylke de Vries et al., 2017)



An aerial photograph of a tropical atoll, showing a series of white sand beaches and turquoise lagoons surrounded by deep blue ocean water. The scene is filled with numerous small, white, fluffy clouds scattered across the sky.

**Merci,  
Questions?**