

# Synergies Active-Passive Microwave ASCAT Results

SMOS Progress Meeting  
April 1<sup>st</sup> 2008

Klaus Scipal

# SMOS and ASCAT

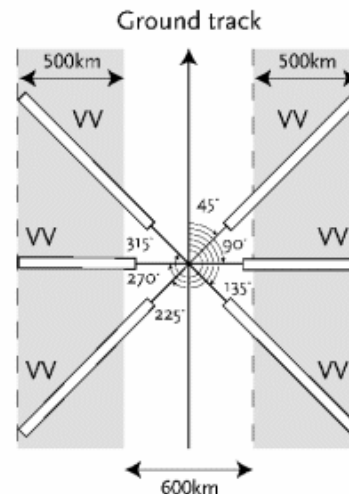
## SMOS (late 2008 – 2011)

- **Passive** Microwave
- **L-band**, 1.41 GHz, 21.3 cm
- V and H polarisation
- Multi-angular: 30 – 55°
- Eq. crossing 6:00 am/pm
- Resolution: 40 km
- Daily global coverage ?



## MetOp ASCAT (Oct. 2006 – 2020)

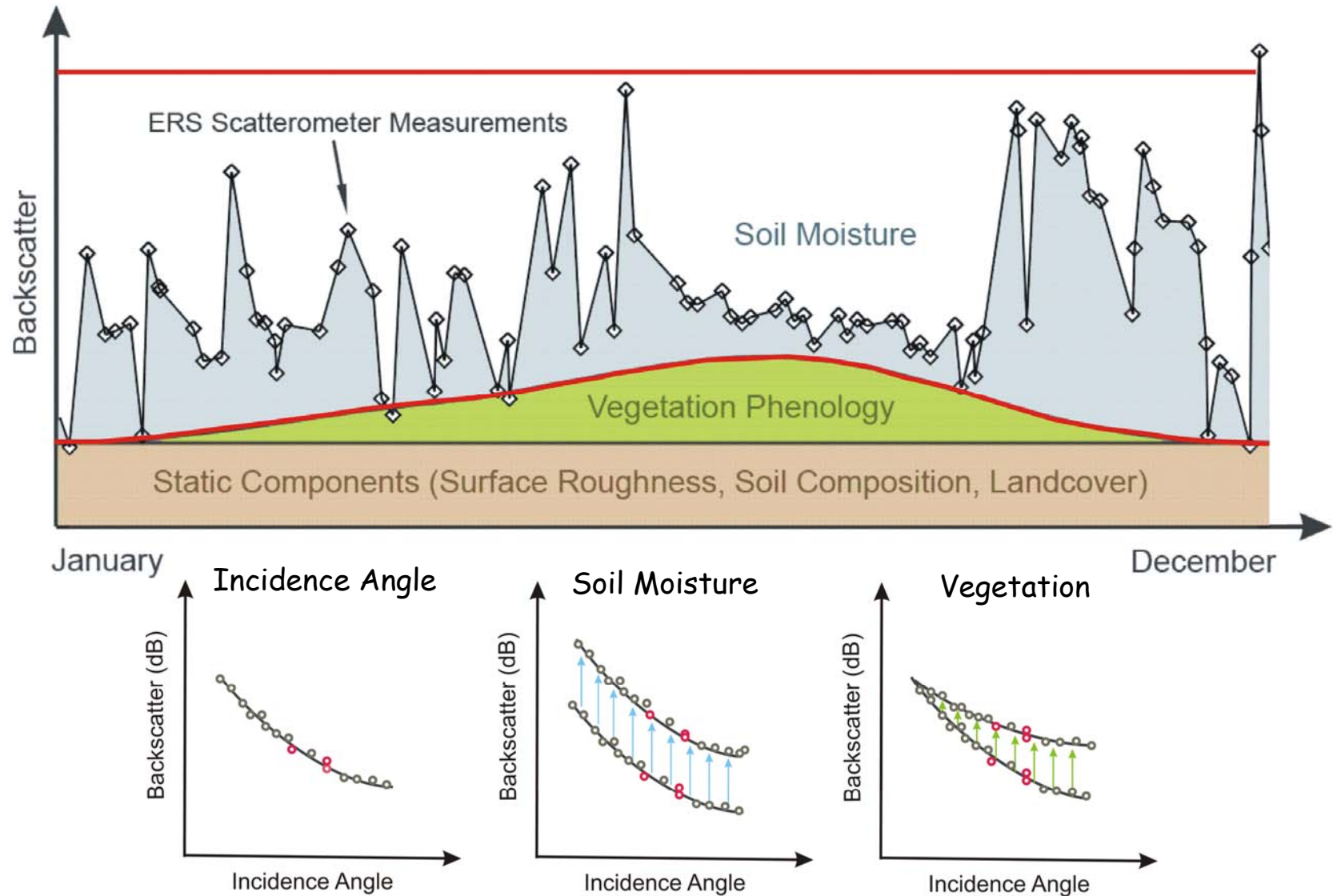
- **Active** Microwave
- **C-band**, 5.3 GHz, 5.67 cm
- VV Polarisation
- Multi-angular 25 – 62°
- Eq. crossing 9:30 am/pm
- Resolution: 25 / 50 km
- Daily global coverage > 80%



# The H-SAF Project

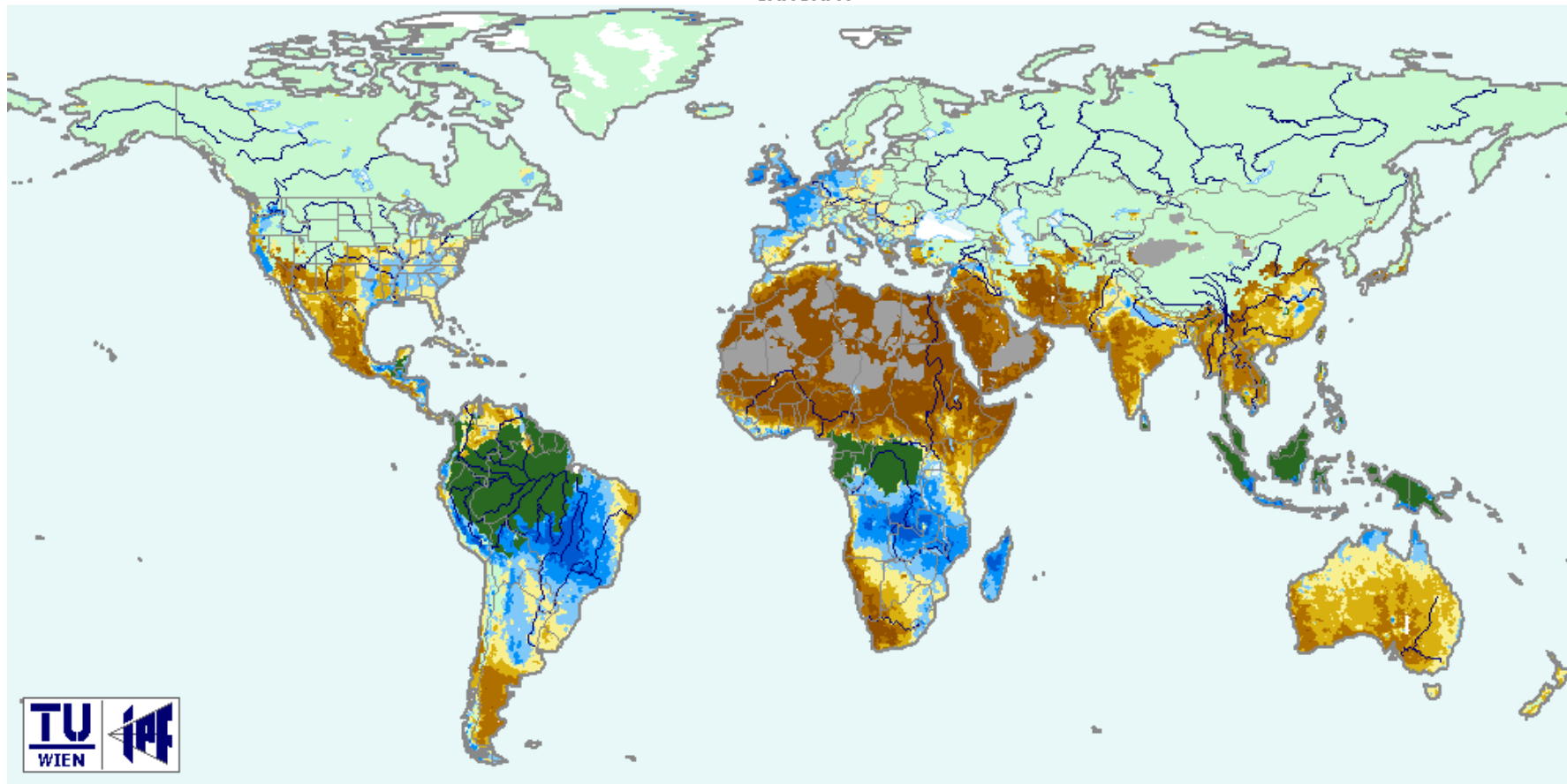
1. Satellite Application Facility on Support to Operational Hydrology and Water Management
  - Soil Moisture Cluster
  - Precipitation Cluster
  - Snow Cluster
2. Project financed by EUMETSAT
  - Development Phase Oct. 2005 – 2010
3. ECMWF part of the Soil Moisture Cluster
  - Evaluate scatterometer derived soil moisture
  - Monitoring of METOP ASCAT soil moisture within IFS (Summer 2008)
  - Prepare assimilation based on Extended Kalman Filter (Autumn 2008)
    - Demoversion based on ERS (January 2008)
    - Prototypeversion based on ASCAT (Summer 2008)
    - Operational implementation (?)




# Soil Moisture Retrieval - Concept

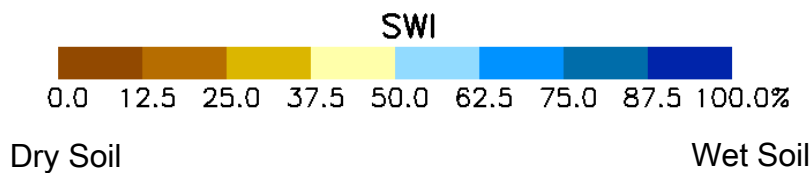


# Global Soil Moisture Dynamics

JANUARY

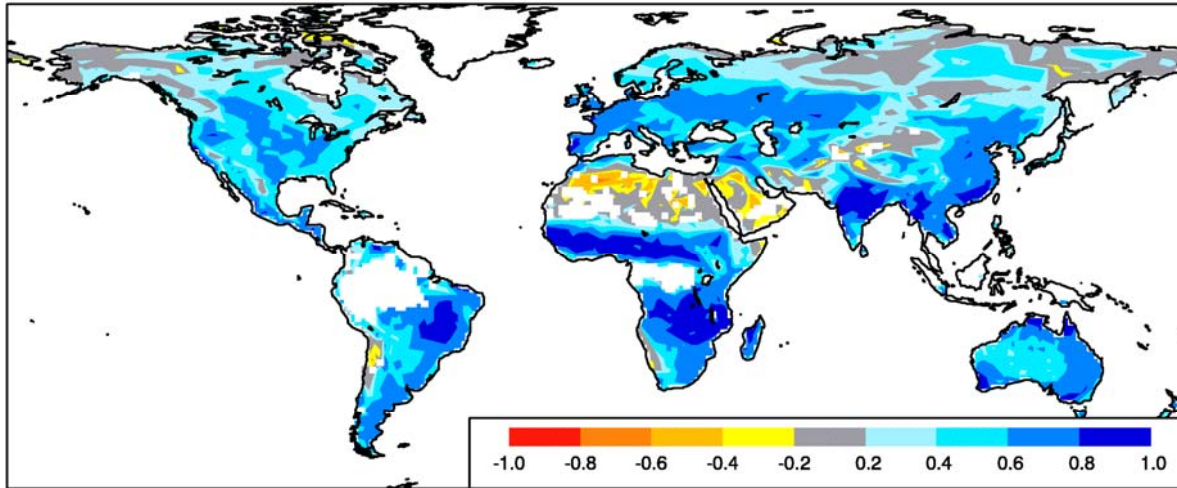


-  Closed Forest Cover
-  Azimuthal Effects
-  Frozen Soil/Snow Cover

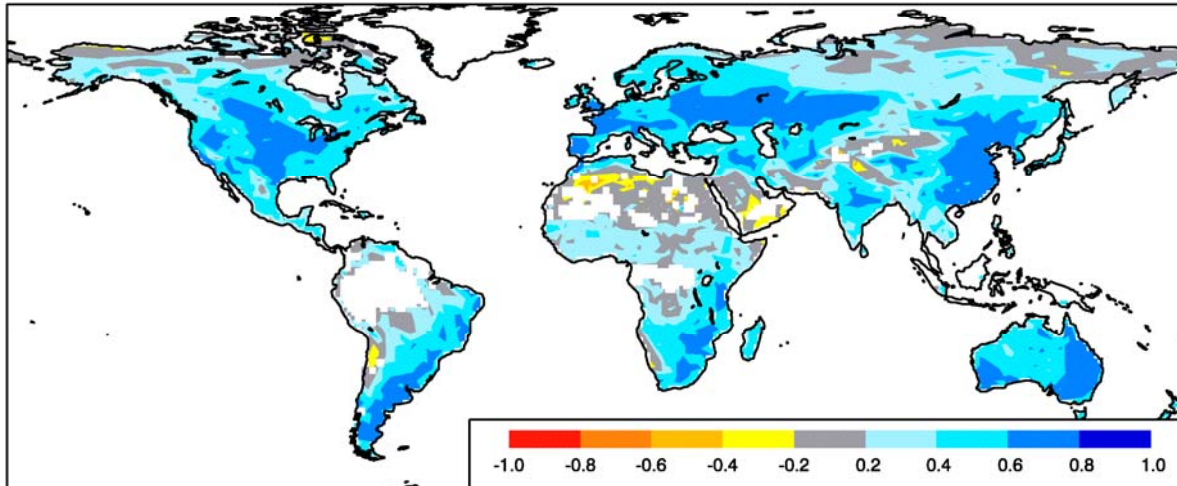


# Correlation Model vs. ERS Scat

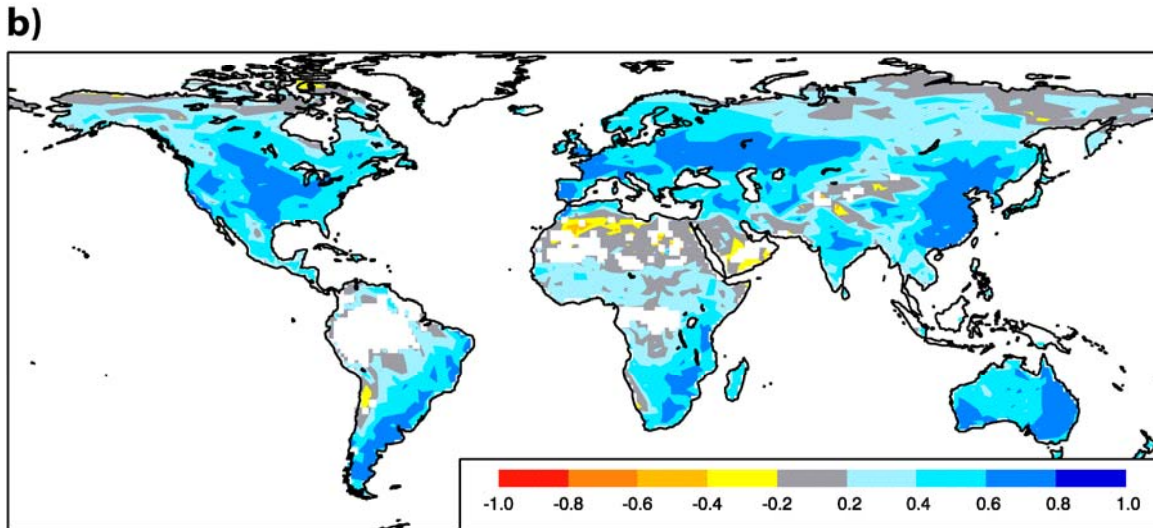
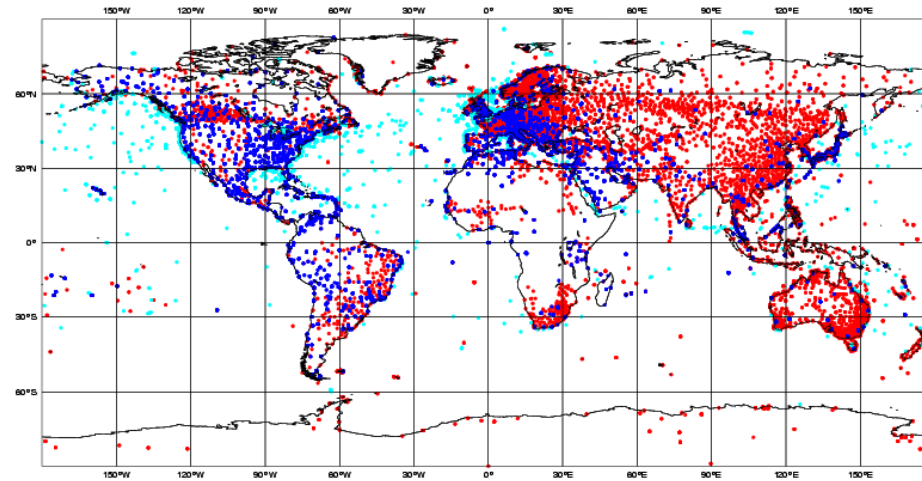
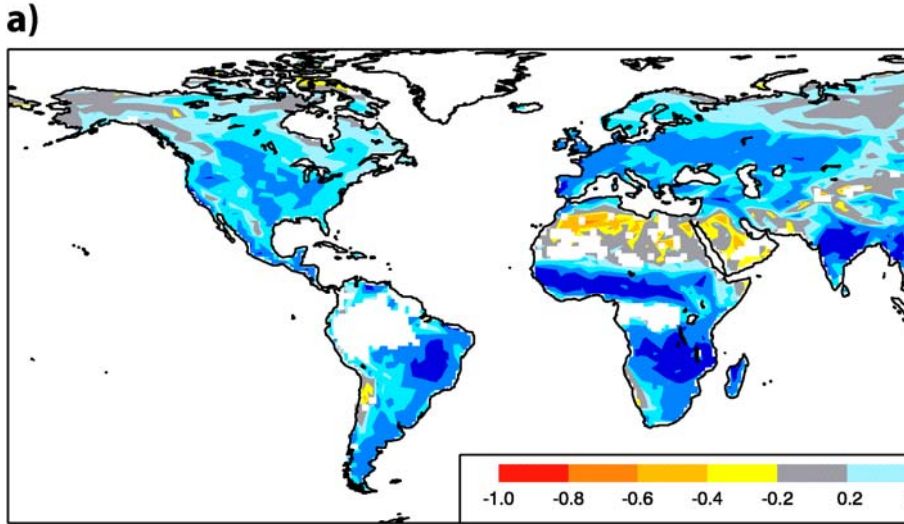
a)



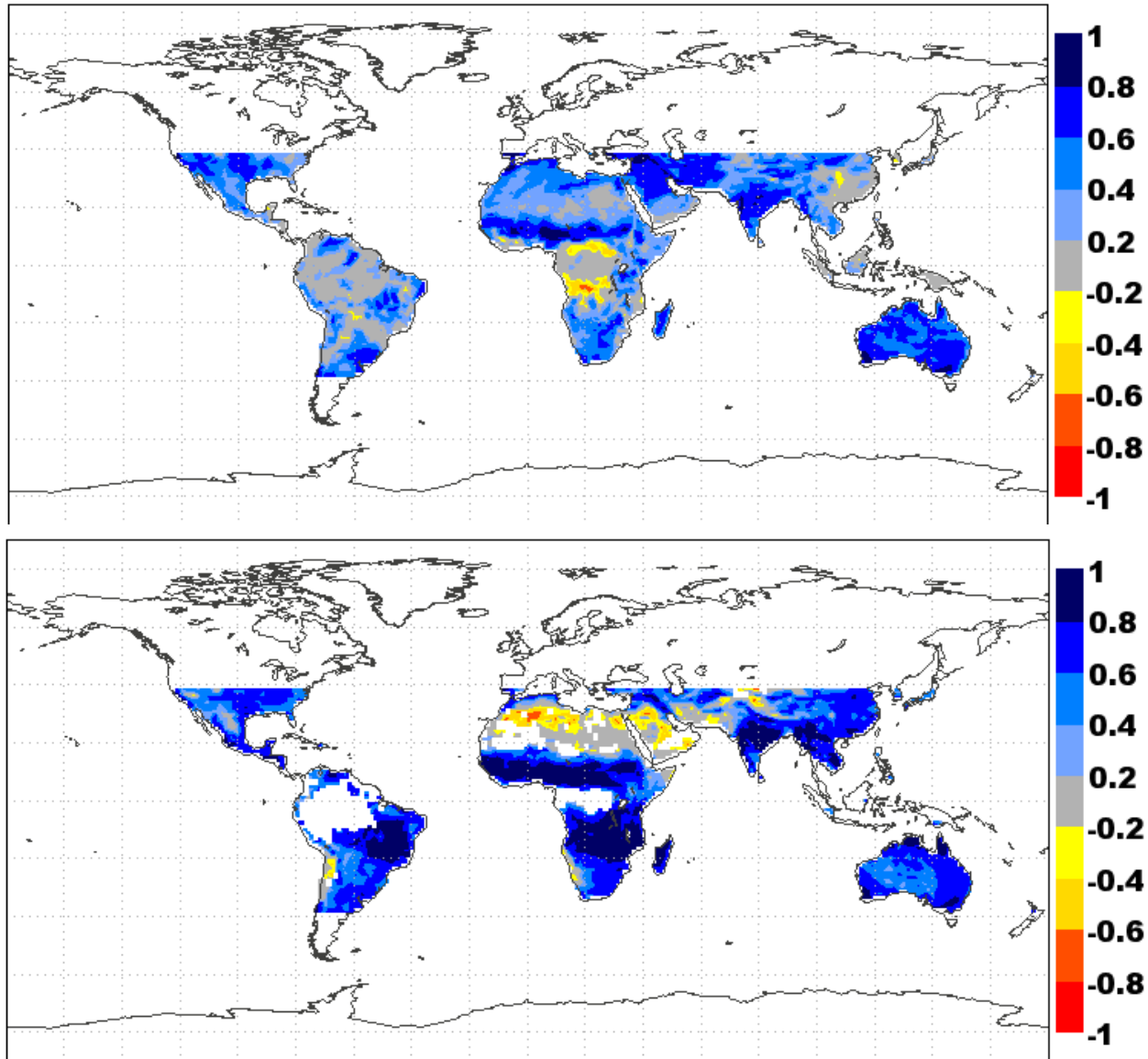
b)



# Correlation Model vs. Scat



# Synergies active passive soil moisture



Compare

1. TMI vs Model
2. Scat vs Model

Conclusions

1. TMI better under bare soil conditions
2. Scat better under Vegetation

TMI - Ku-band (13.8 Ghz) !!!

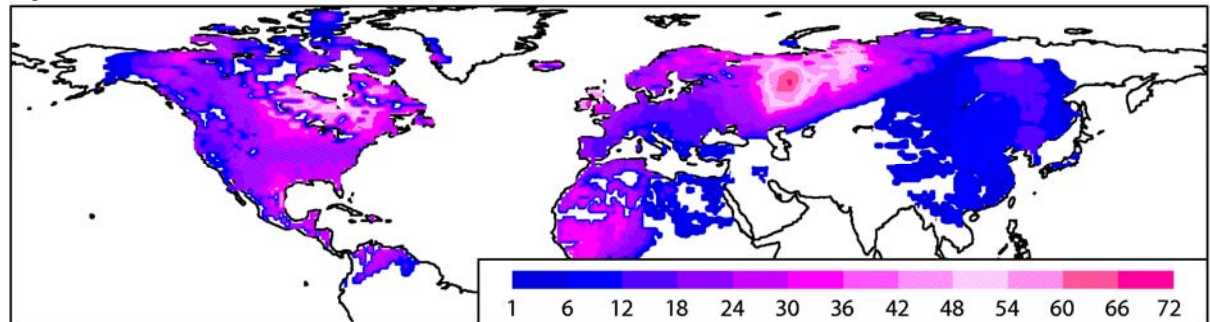
# Assimilation Experiment

## 1. 3 Experiments using different soil moisture initialisation:

- Baseline: soil moisture is not constrained (open loop)
- Baseline & Optimum interpolation of 2m T and rH (operational config.)
- Baseline & Nudging of scatterometer soil moisture obs. (ERS)

## 2. Experiment Setup

- T159 Res. / 91 levels
- Period: 2005 MJJ



## 3. Nudging Experiment

- ERS Scat soil moisture – daily averages
- FG - OBS for 1200 UTC
- $\frac{1}{4}$  of FG - OBS is added at 1200, 1800, 0000, 0600

# Observation Operator

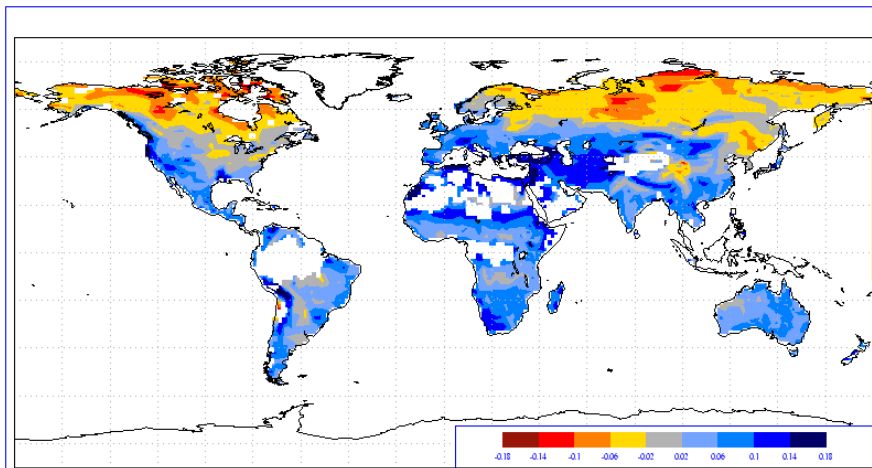
1. Set up functional relationship between model soil moisture and observations

$$W[\text{vol}\%] = W[\%] * \text{TWC}[\text{vol}\%]$$

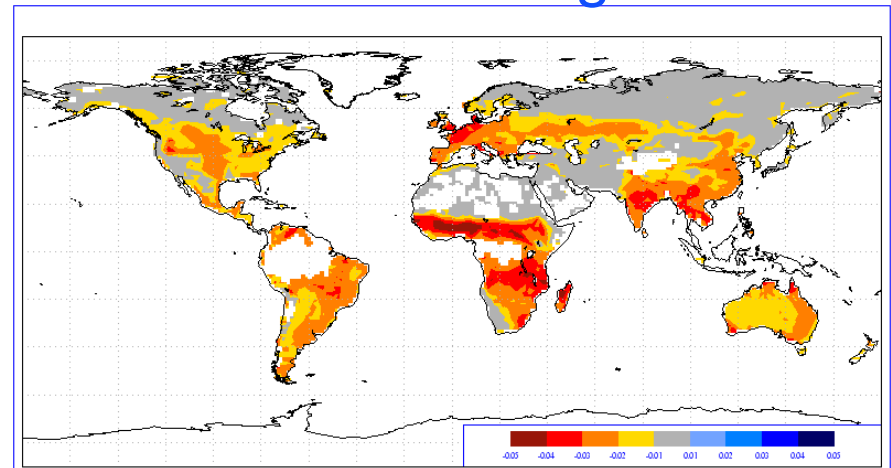
2. **But** differences due to

- Model: uniform soil type, constant vegetation, etc.
- Satellite: biased reference values, etc.

## Diff in Mean

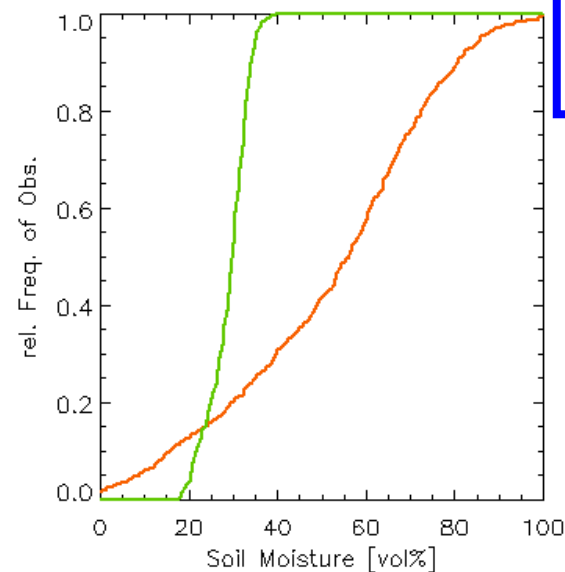
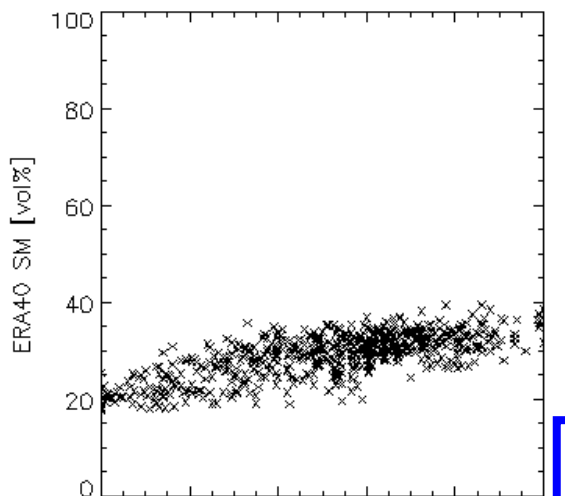


## Diff in Range



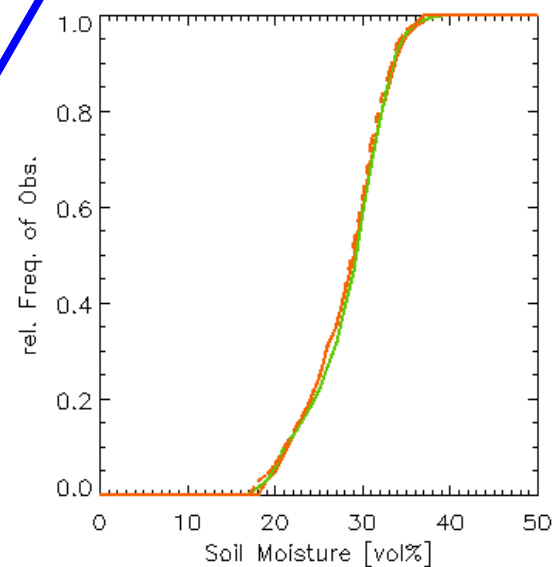
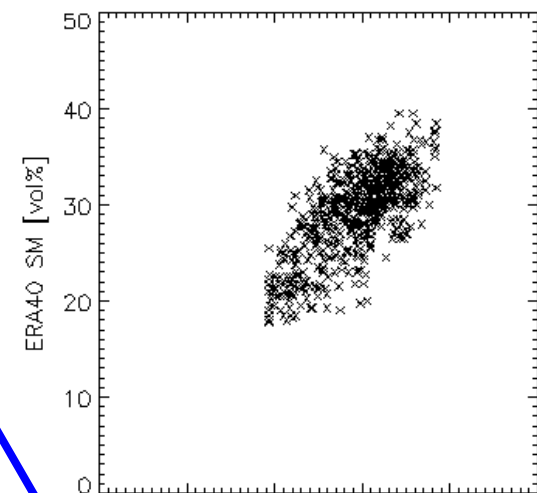
# Bias correction / CDF matching

GANZHOU lon= 114.95 lat= 25.85

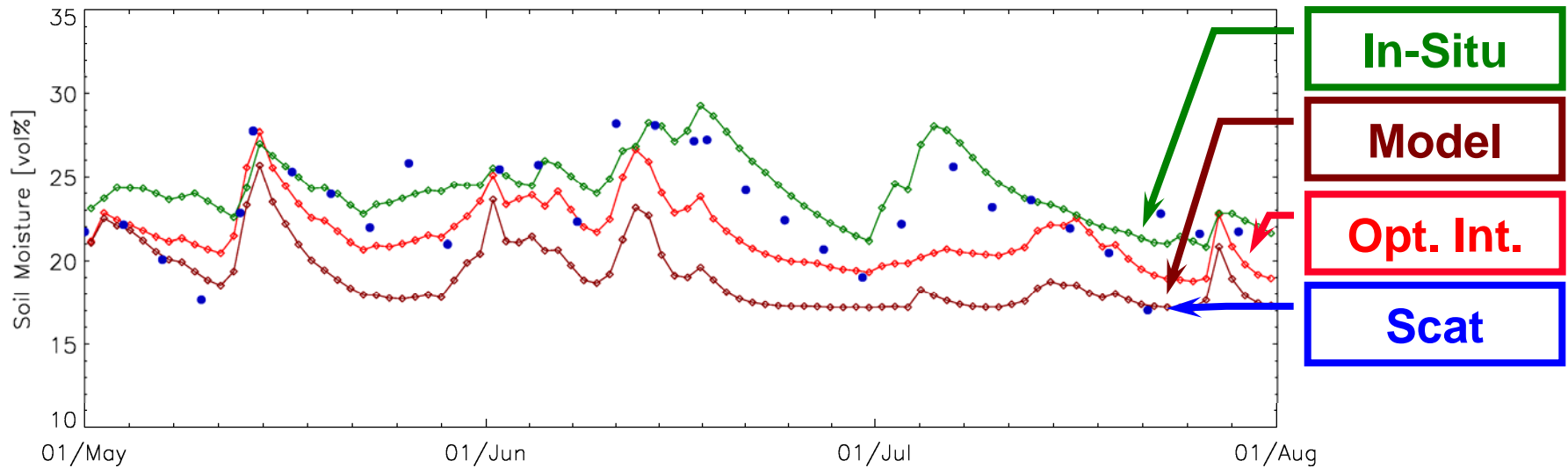


$$\theta_S' = \bar{\theta}_M + \frac{VAR(\theta_M)}{VAR(\theta_S)} \cdot (\theta_S - \bar{\theta}_S)$$

GANZHOU lon= 114.95 lat= 25.85



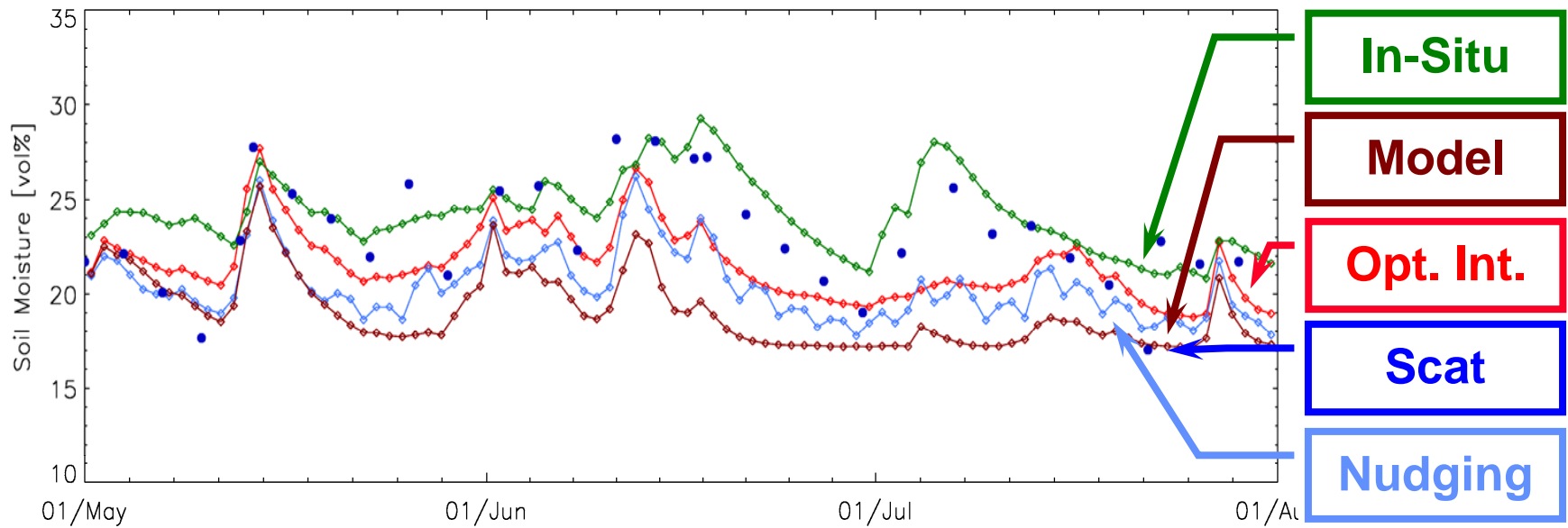
# Model vs. Scatterometer



## SCAT soil moisture

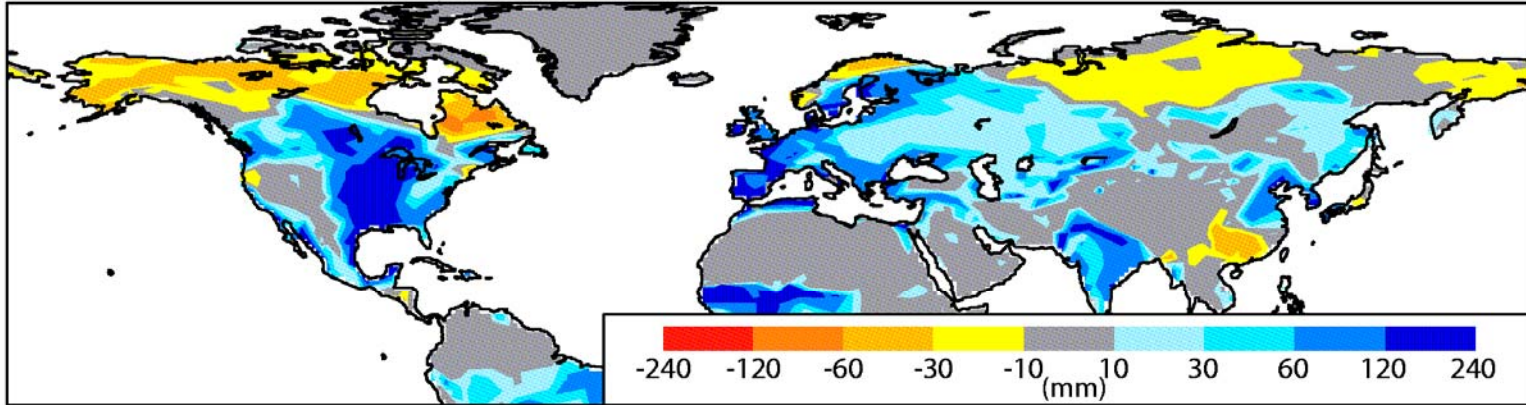
- Surface soil moisture (2-5 cm) derived using change detection
- Observation Operator: simplified CDF matching

# Results of Nudging Experiment

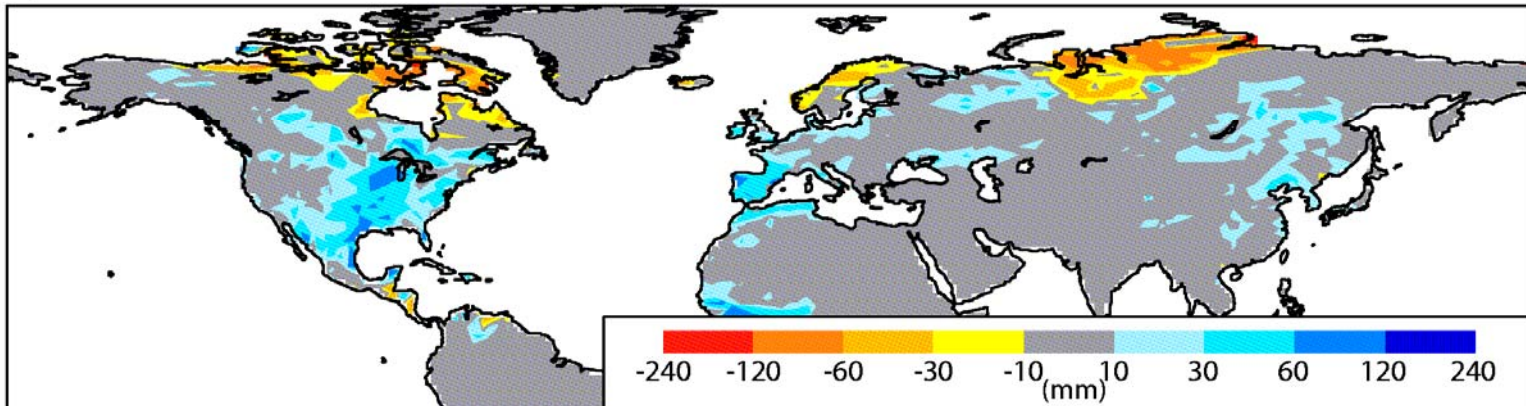


	Correlation	Bias	StDev	RMSE
Opt. Int	0.66	-2.6	1.5	3.0
Nudging	0.59	-3.8	1.7	4.2
Model	0.39	-5.1	2.1	5.5
SCAT	0.82	-1.9	1.4	2.3

# Soil Moisture Increments (accumulated)

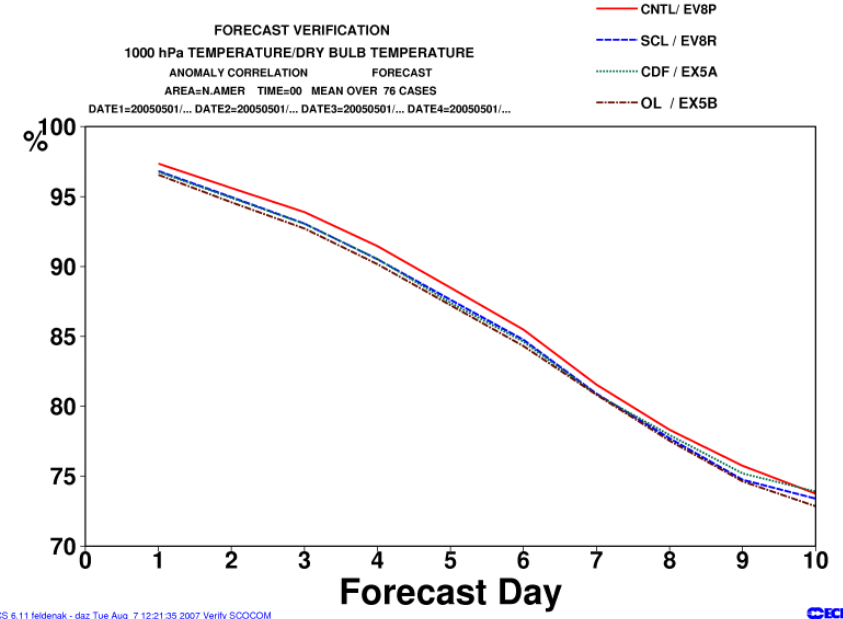
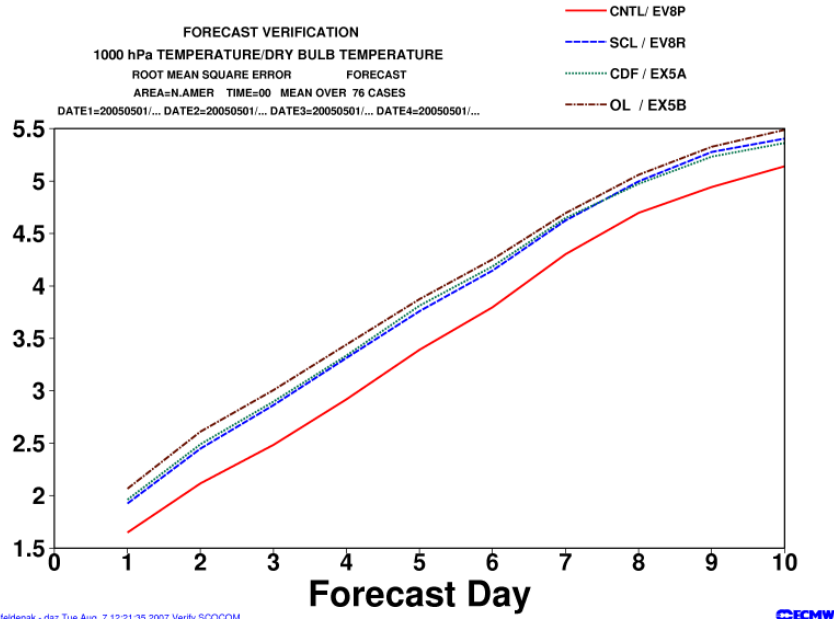
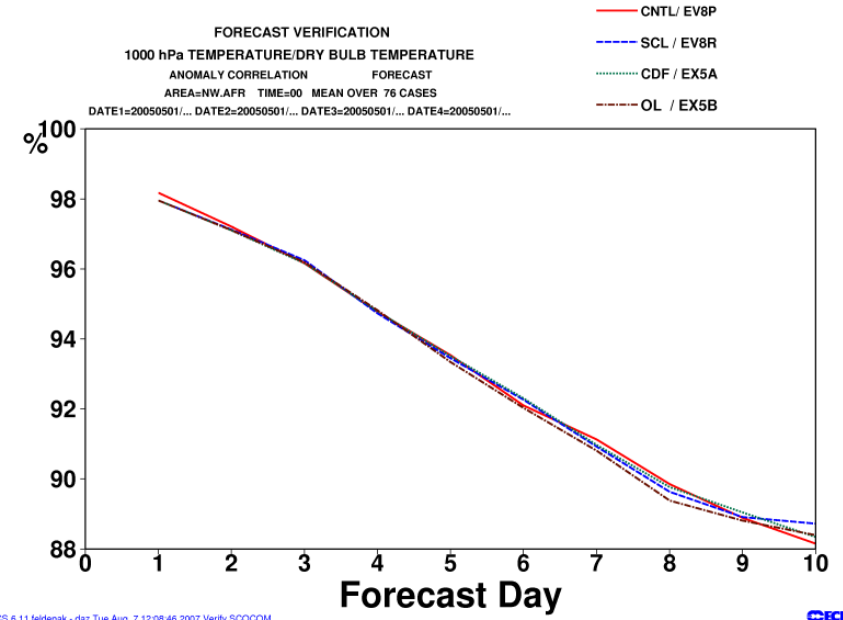
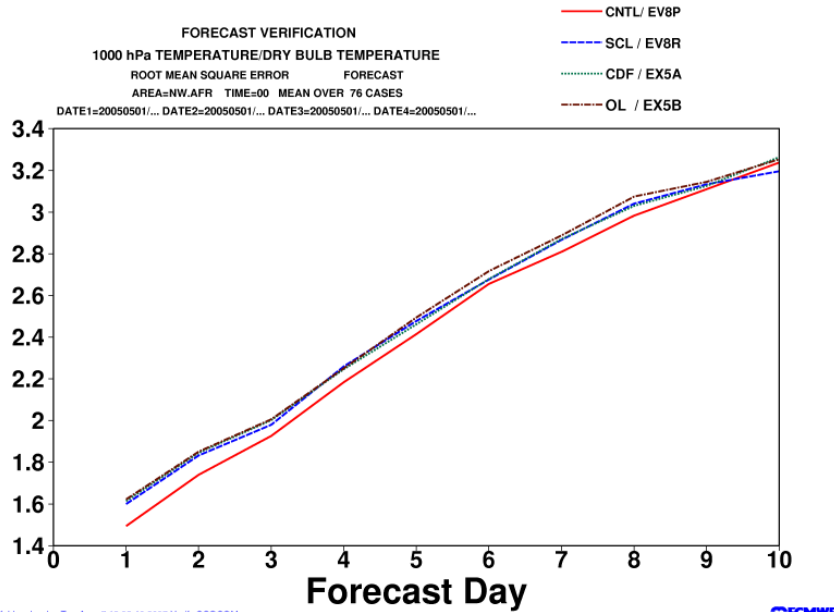


Opt.Int.



Nudge

# Impact on Forecast Scores



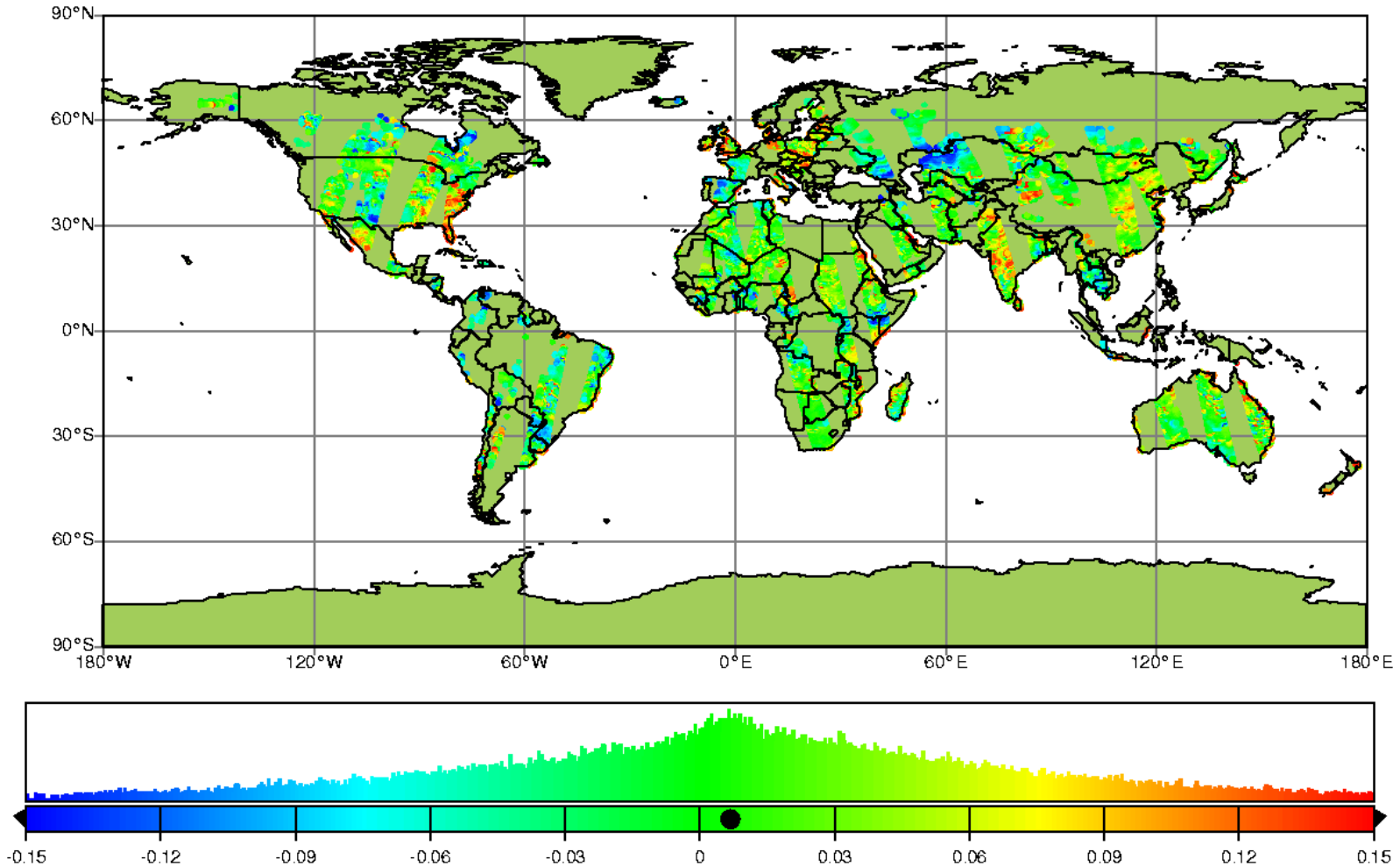
# Synergies HSaf SMOS

## 1. Joint Monitoring

- 3 independent datasets (Model, SMOS, ASCAT)
- Allow to reveal model problems more easily

# ASCAT Monitoring

ODB: 2007050212/an/ECMA.scatt  
SQL: /home/rd/daz/ODB\_SQLs/sm.sql (fg\_depar@body : 48332 observations)



# Synergies HSaf SMOS

## 1. Joint Monitoring

- 3 independent datasets (Model, SMOS, ASCAT)
- Allow to reveal model problems more easily

## 2. Development of Kalman Filter

- Allows to combine 2m Temp. & Humidity & SMOS & ASCAT
- Core is implemented in IFS
- Currently fine tuning

## 3. Validation

- Methods
- Data