



Assimilation of ASCAT soil wetness

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Conversion of ASCAT Soil Wetness to Soil Moisture

- We assume a Linear Transformation of the Soil Wetness:

$$\theta_{ASCAT}(t) = a + b \times m_s(t)$$

- OR a Linear Transformation of the Soil Wetness Anomaly

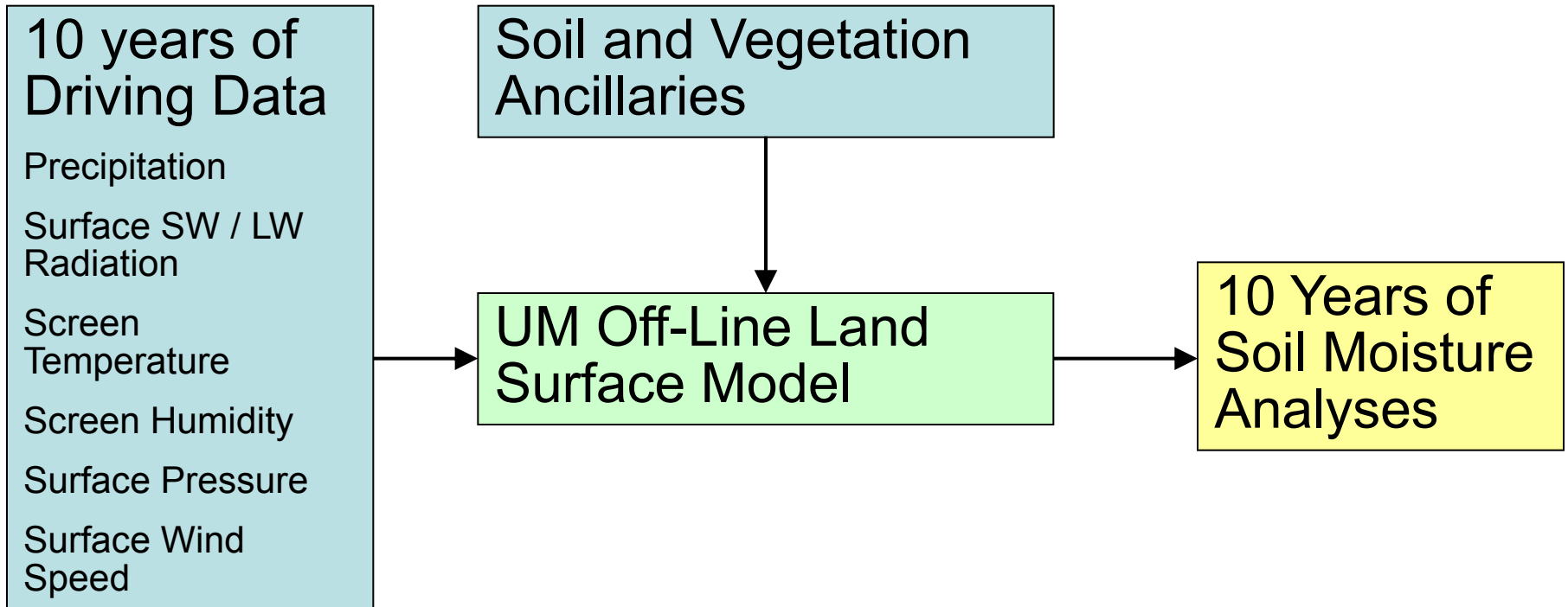
$$\theta_{ASCAT}(t) = \overline{\theta_{UM}}(t) + b \times \{m_s(t) - \overline{m_s}(t)\}$$

- parameters a and b vary spatially but not in time. They depend on the properties of the soil and vegetation.
 - a is the minimum value of soil moisture
 - b is the (maximum minus minimum) value of soil moisture
- We have implemented 5 different methods to determine the a and b parameters. One used operationally is
 - $b = \theta_s - v\theta_w$, where v is vegetation fraction



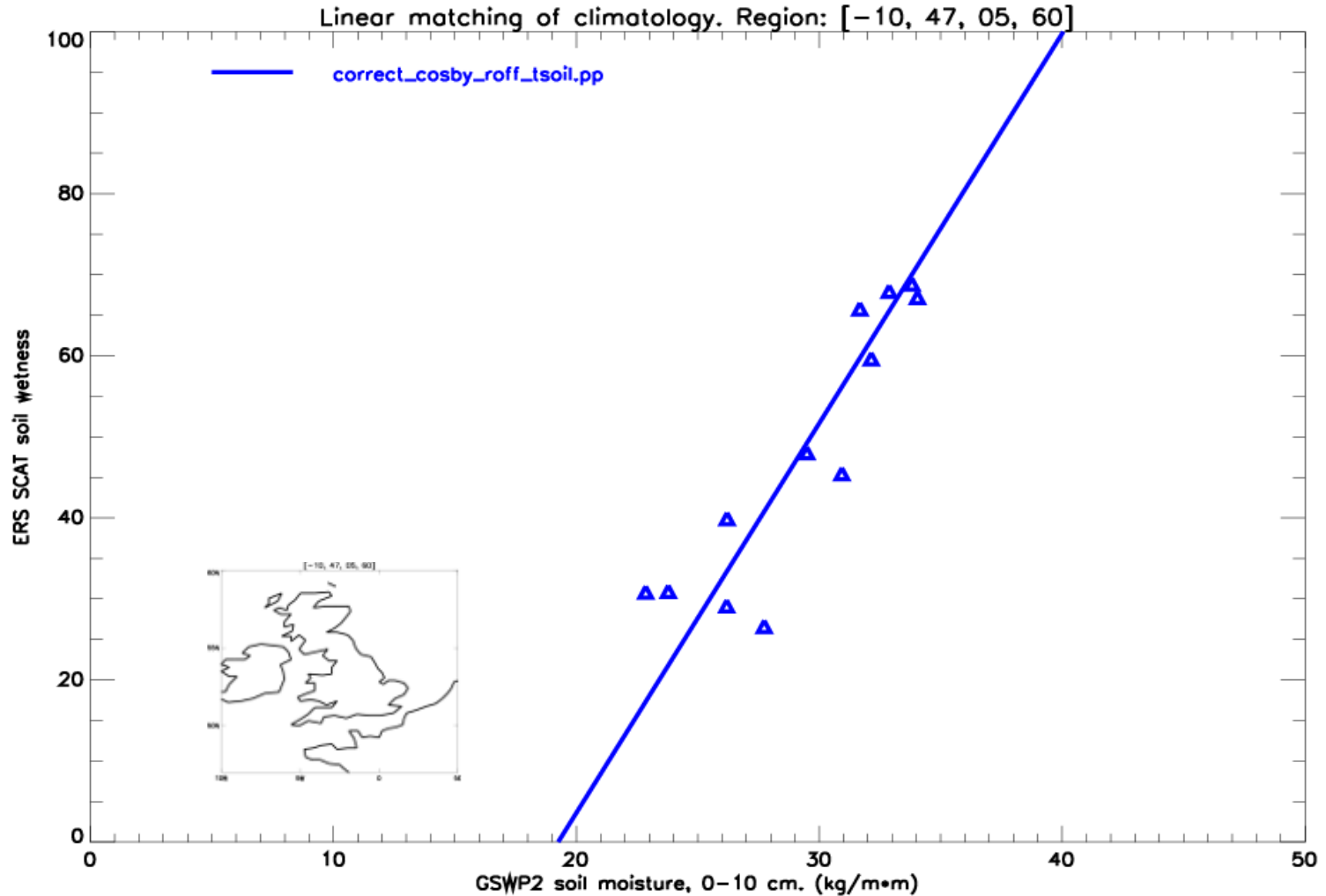
UM soil moisture climatology $\theta_{UM} \overline{(t)}$

- Drive the UM land surface model (JULES) with 10 years of observation based data from the Global Soil Wetness Project 2 (GSWP2)



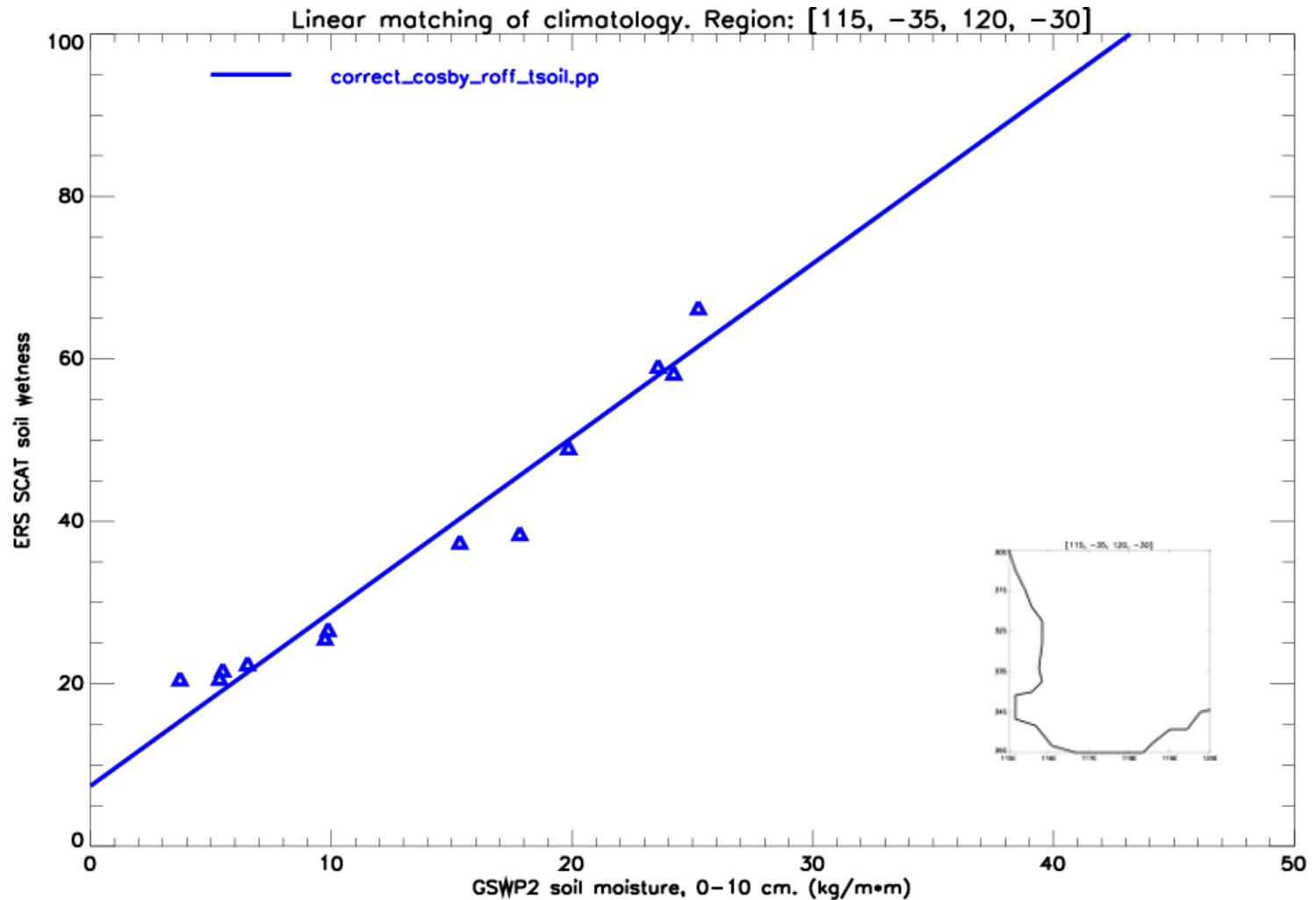


ERS SCAT Soil Wetness vs UM/GSWP2 Soil Moisture monthly means for the UK





Comparison for S.W. Australia





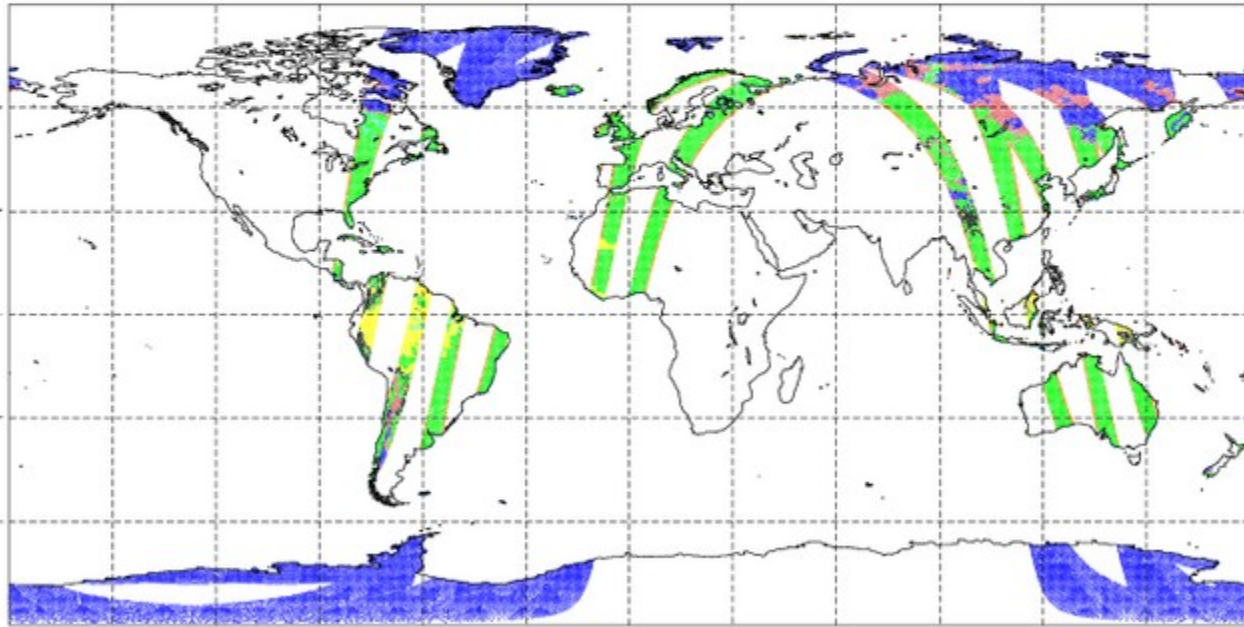
Quality Control

- ASCAT data is rejected from regions with:
 - Snow
 - Frost
 - Wetlands
 - Mountains
 - Dense Vegetation (e.g. Amazon)
 - Sand Dunes
- ASCAT data is rejected from the edges of the swaths. Cross-track cells: 1-4, 40-43, 77-82.
- A background check is also applied (Lorenz and Hammon, 1988).
 - Rejects observations with large o-b

Quality Control

Data Coverage: ASCATHRsmc Soil Wetness Level 1 (30/9/2010, 12 UTC, qu12)
Total number of observations assimilated (110952)

NOT FLAGGED: Passed (110952)
FLAGGED: Undefined (0) **Snow (112054)** **Frost (21739)** **WetLandWater (3661)**
TopoComplex (12270) **SMCerror (21480)** **SeaAsLand (10968)** **LandAsSea (2536)**
CrossTrackCell (20315) **BGcheck (14)** **MissingData (0)**





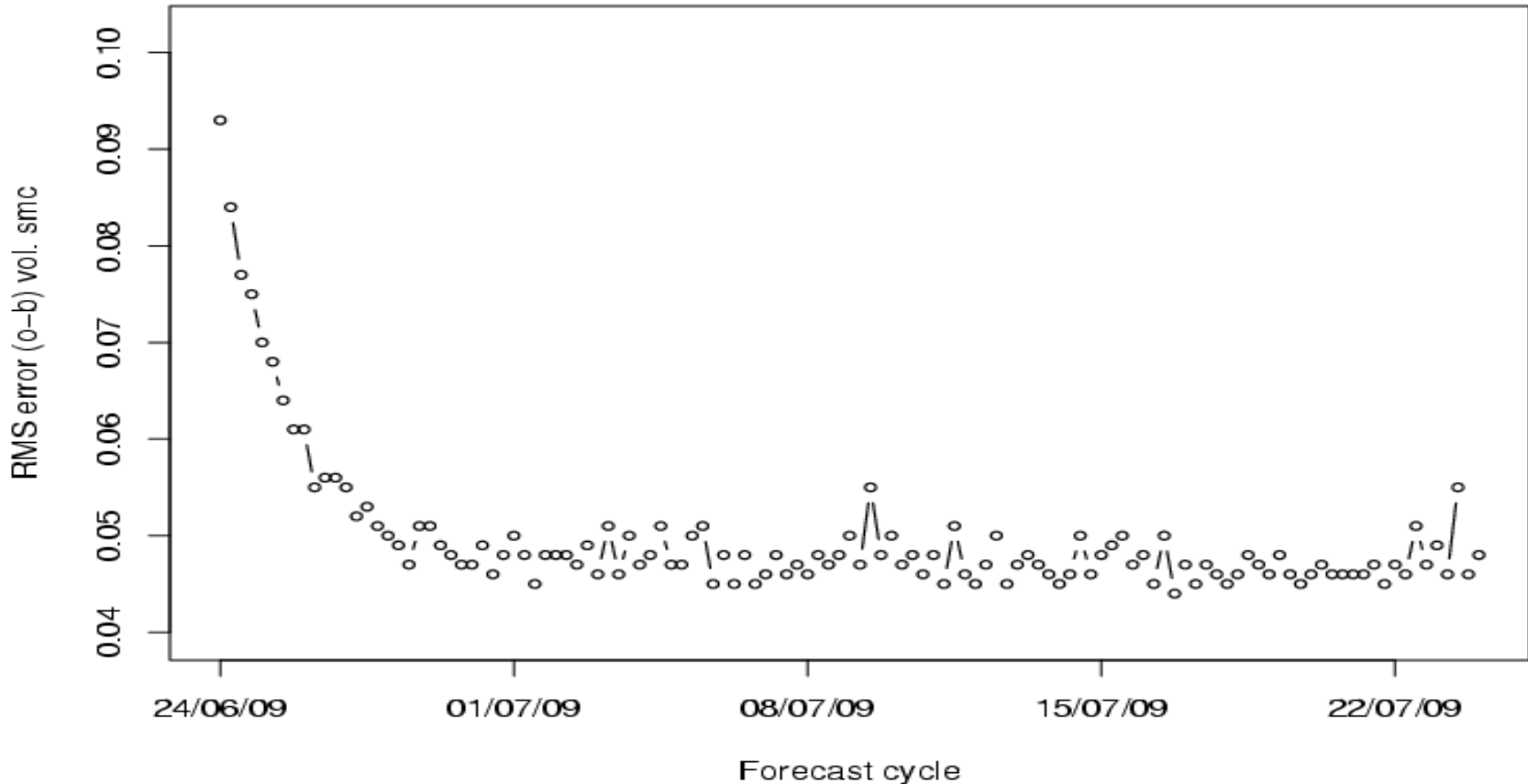
Assimilation

- A simple nudging scheme is used to assimilate the ASCAT derived soil moisture.
 - Only the UM soil level 1 is nudged
- Observations of Screen Temperature and Humidity are also used to nudge the UM soil moisture in all UM soil levels.
 - The ASCAT nudging is applied second.

RMS (o-b) stats

- The UM is able to retain the information from the data assimilation and the UM soil moisture converges towards the values derived from ASCAT.

RMS error (o-b) ASCAT

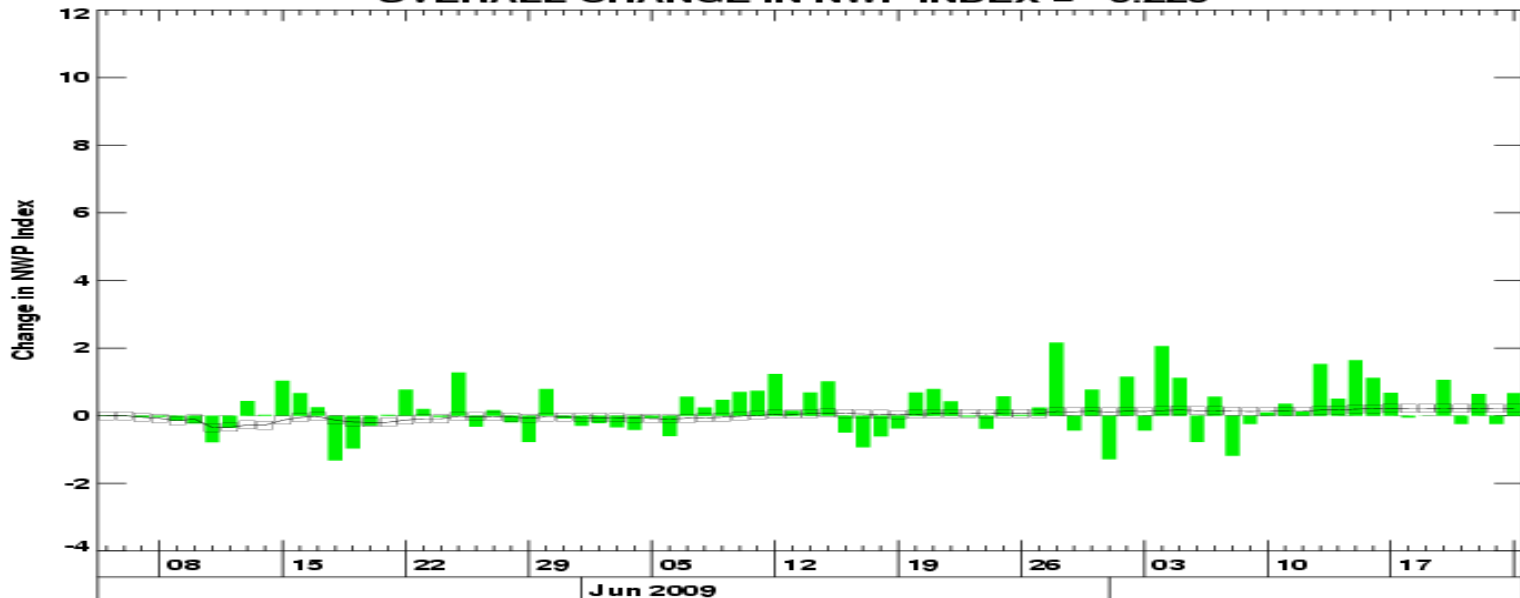




Impact on the Global NWP Index

- Trial from May-July 2009
 - vs obs +0.22 vs anal +0.06
 - RMS errors in NH PMSL are reduced, at T+120 by 0.8%.

**N320L50 4D-VAR TRIAL SPRING 2009:TEST: SGBMF VS CONTROL: SGBME (SPRING2009)
VERIFICATION VS OBSERVATIONS - DAILY NWP INDEX AND RUNNING MEAN
OVERALL CHANGE IN NWP INDEX = 0.220**





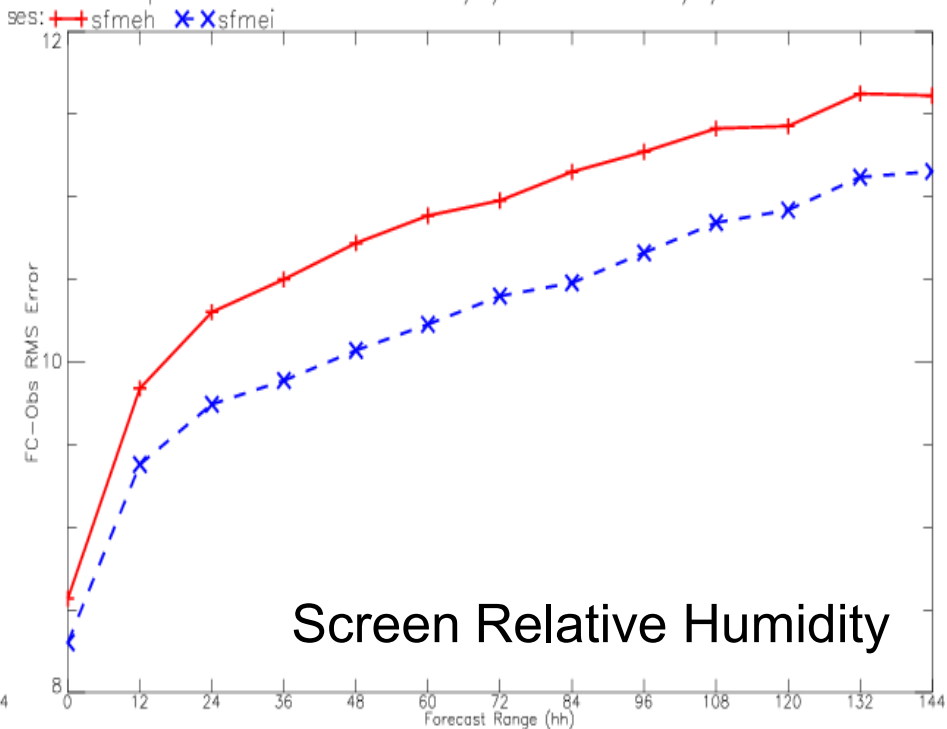
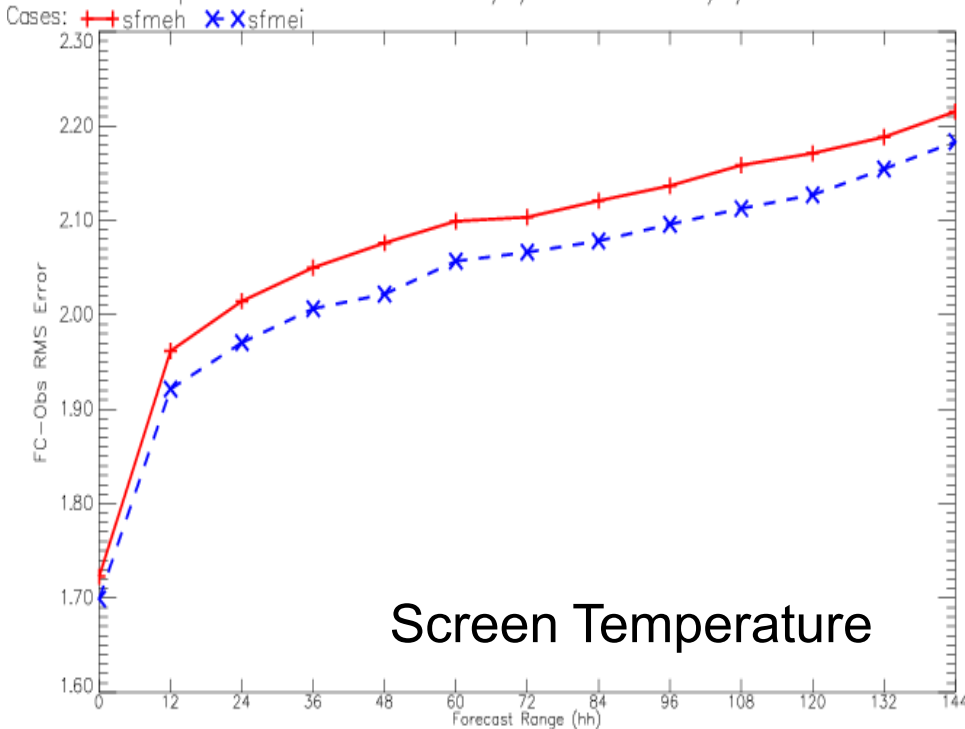
Tropics: RMS errors in screen T and RH (1 month)

Control

Test with ASCAT soil wetness assimilation

Temperature (Kelvin) at Station Height: Surface Obs
Tropics (CBS area 20N-20S) (land points only)
Equalized and Meaned from 24/6/2009 00Z to 24/7/2009 12Z

Relative humidity (%) at Station Height: Surface Obs
Tropics (CBS area 20N-20S) (land points only)
Equalized and Meaned from 24/6/2009 00Z to 24/7/2009 12Z





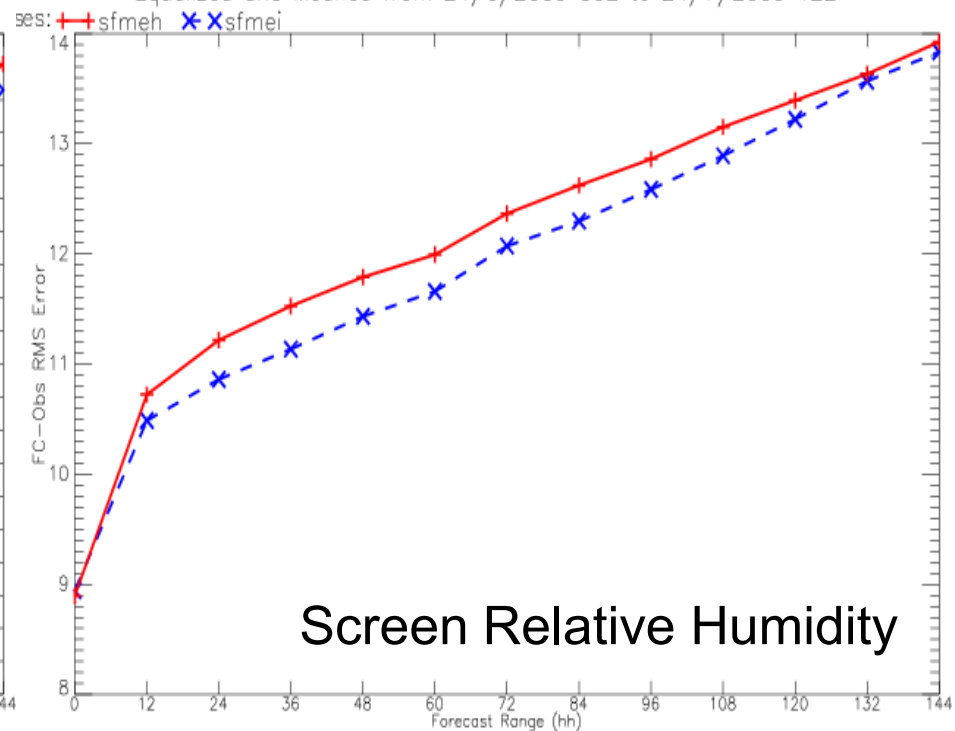
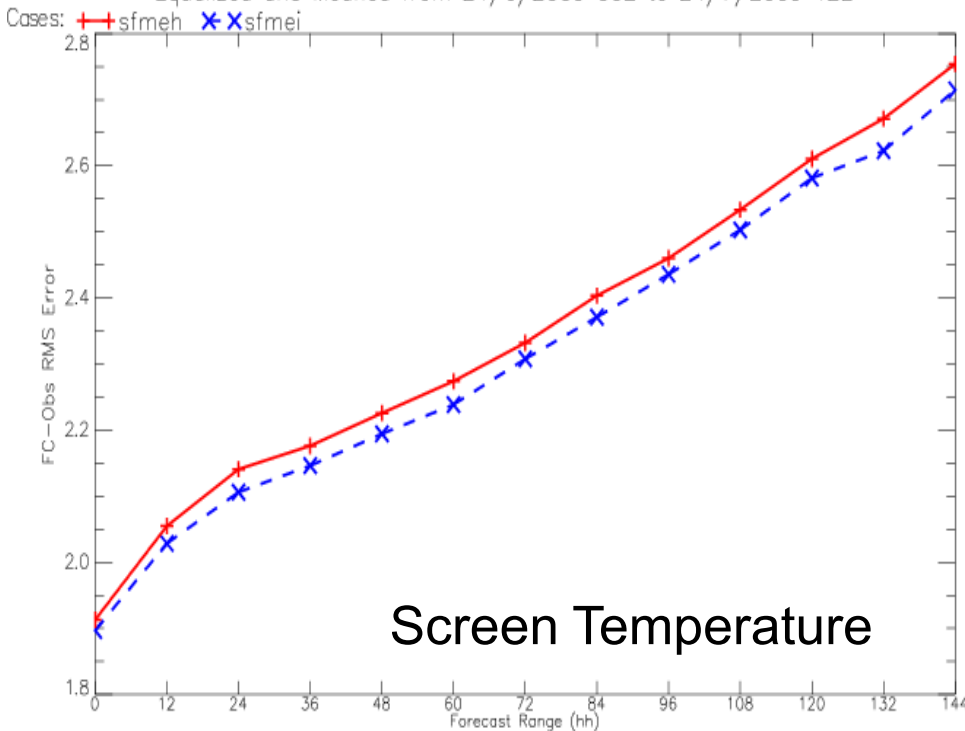
Australia: RMS errors in screen T and RH (1 month)

Control

Test with ASCAT soil wetness assimilation

Temperature (Kelvin) at Station Height: Surface Obs
Australia / NZ (CBS area 10S-55S, 90E-180E) (land points only)
Equalized and Meaned from 24/6/2009 00Z to 24/7/2009 12Z

Relative humidity (%) at Station Height: Surface Obs
Australia / NZ (CBS area 10S-55S, 90E-180E) (land points only)
Equalized and Meaned from 24/6/2009 00Z to 24/7/2009 12Z





Conclusions

Met Office

- We have implemented a simple and cheap method to assimilate measurements of ASCAT soil wetness (operational since 14th July 2010).
- Our pre-operational trials indicates that ASCAT soil wetness assimilation improves forecasts of screen temperature and humidity for the tropics. Impact in other regions is slightly positive or neutral.
- Tests of new EUMETSAT ASCAT pre-processing in progress
- We are planning the development of a Kalman Filter based land DA scheme that can propagate surface information into the deeper soil levels.