Department of Meteorology, University of Reading

Improved assimilation of trace gas retrievals from satellite

Andrea Kaiser-Weiss and Stefano Migliorini

A new vertical observation operator $\mathcal{H}(\mathbf{x})$ for incremental 4D-Var assimilation is presented, together with its tangent linear TL= $\mathcal{H}(\mathbf{x}_b)$ + H $\boldsymbol{\delta}\mathbf{x}$ and its adjoint.

We discuss the information content preservation and suggest this method to be applied for optimal assimilation of trace gas retrievals from satellite.

CO2 fluxes estimated with satellite, aircraft, and surface observations using an ensemble-based 4D data assimilation system

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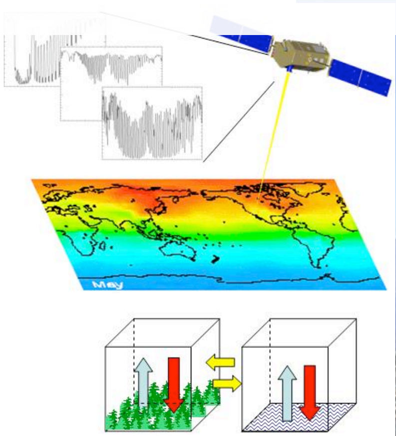
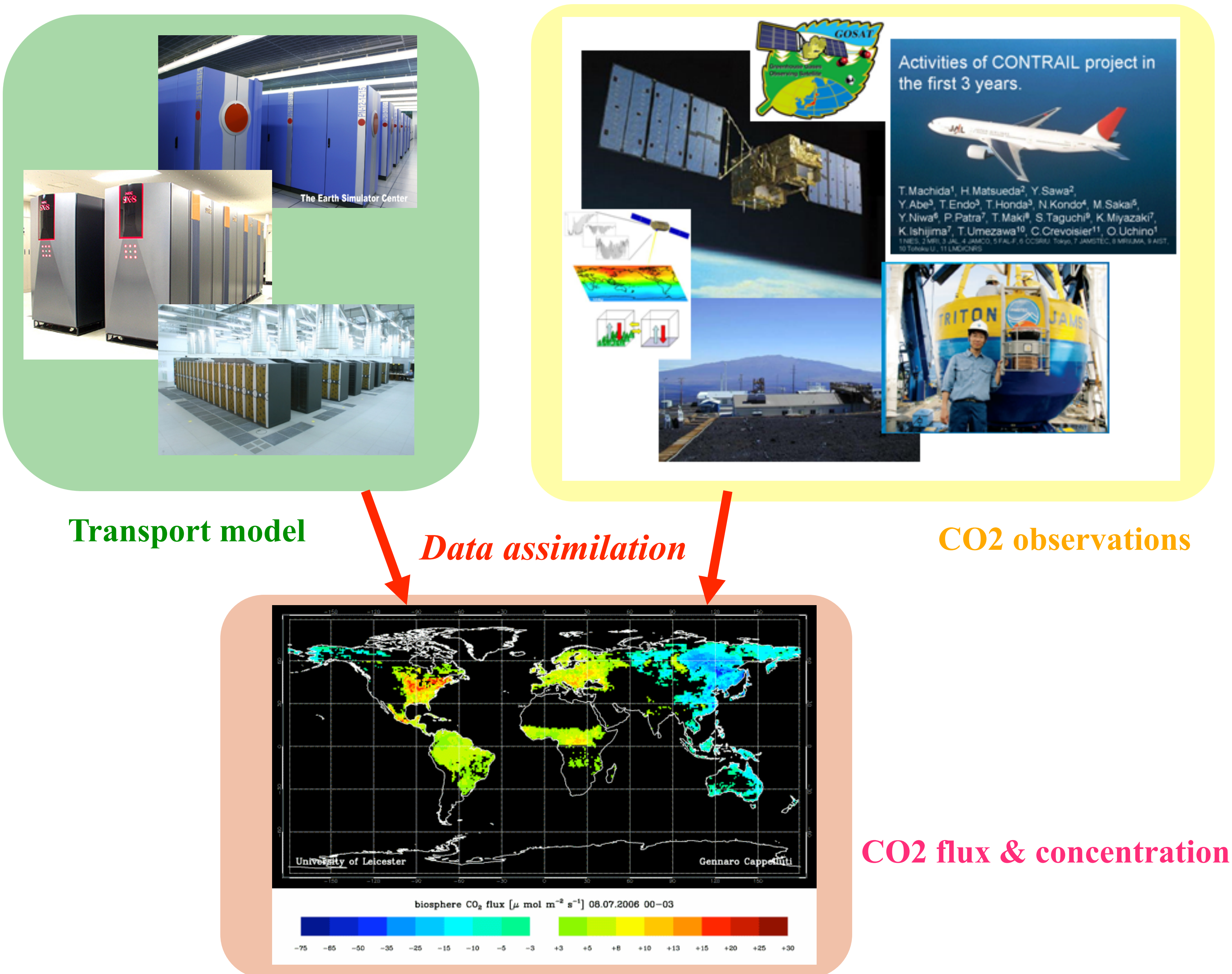
To be submitted

This study discusses a way to make efficient use of various observations to improve surface CO2 flux estimations using EnKF approach, and demonstrates the relative importance of satellite, aircraft, and surface observations on the flux estimation.

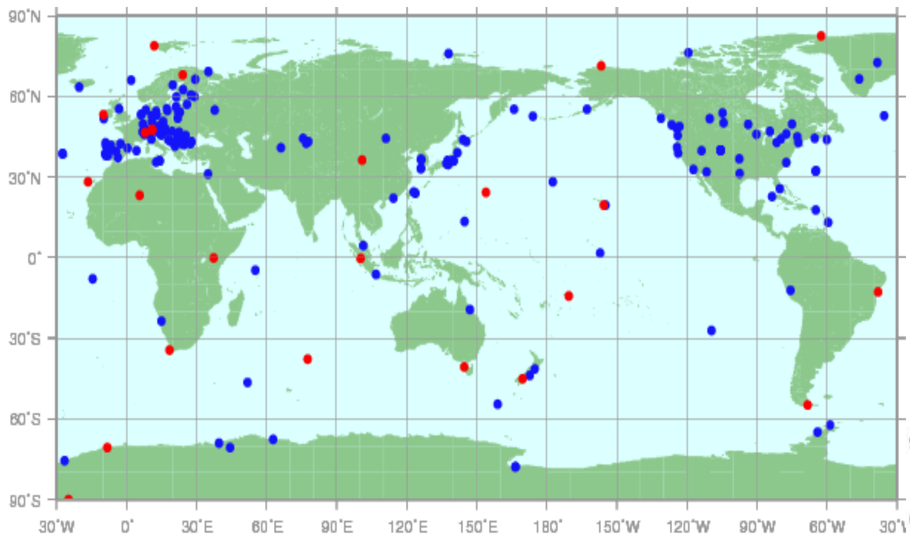


Various type data sets are available for CO2 !!!



The Earth Simulator Center
GOSAT
Activities of CONTRAIL project in the first 3 years.
T.Machida, H.Matsueda, Y.Sawa, Y.Abe, T.Endo, T.Honda, N.Kondo, M.Sakai, Y.Niwa, P.Patra, T.Maki, S.Taguchi, K.Miyazaki, K.Ishijima, T.Umezawa, C.Crevoisier, O.Uchino
TRITON
Transport model
Data assimilation
CO2 observations
University of Leicester
Gennaro Cappelluti
biosphere CO_2 flux [μ mol m^{-2} s^{-1}] 08.07.2006 00−03
−75 −65 −50 −35 −25 −15 −10 −5 −3 +3 +5 +8 +10 +13 +15 +20 +25 +30
CO2 flux & concentration

Observation system simulation experiments (OSSEs)



Continuous and flask surface observations

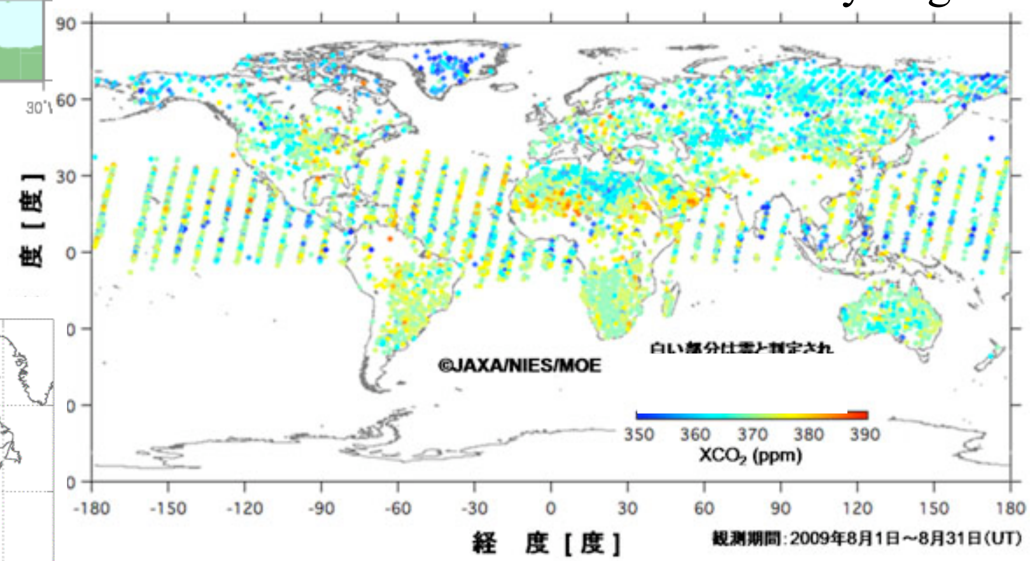
Density: low

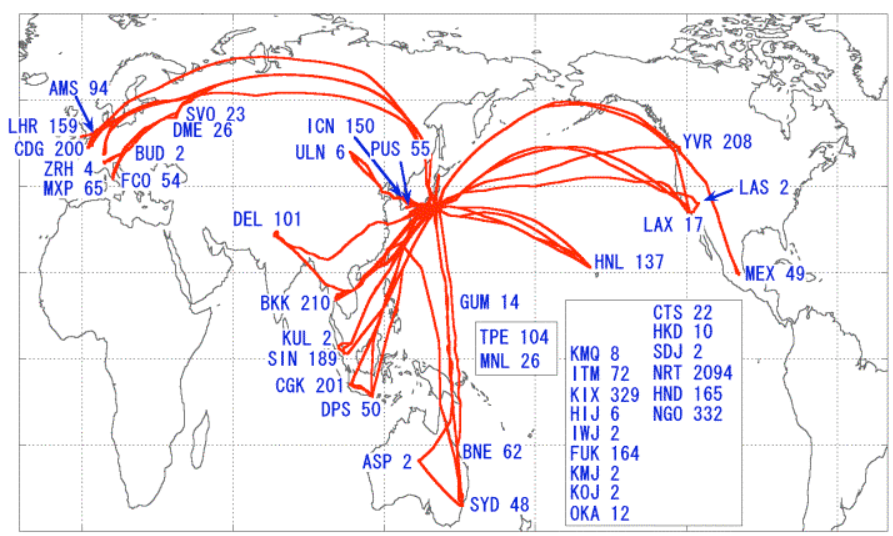
Error: small

GOSAT observations

Density: high

Error: relatively large





CONTRAIL aircraft observations

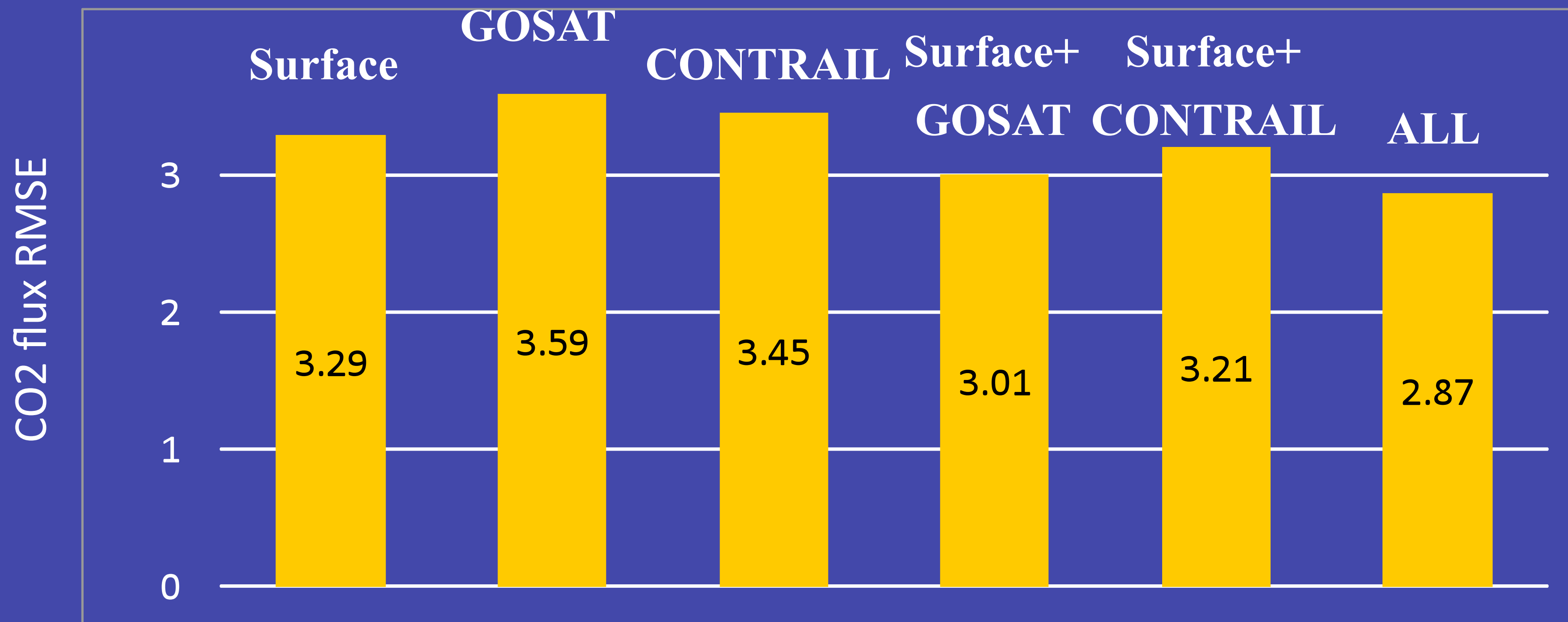
Density: high (+vertical profile)

Error: small

Relative importance of different platform data

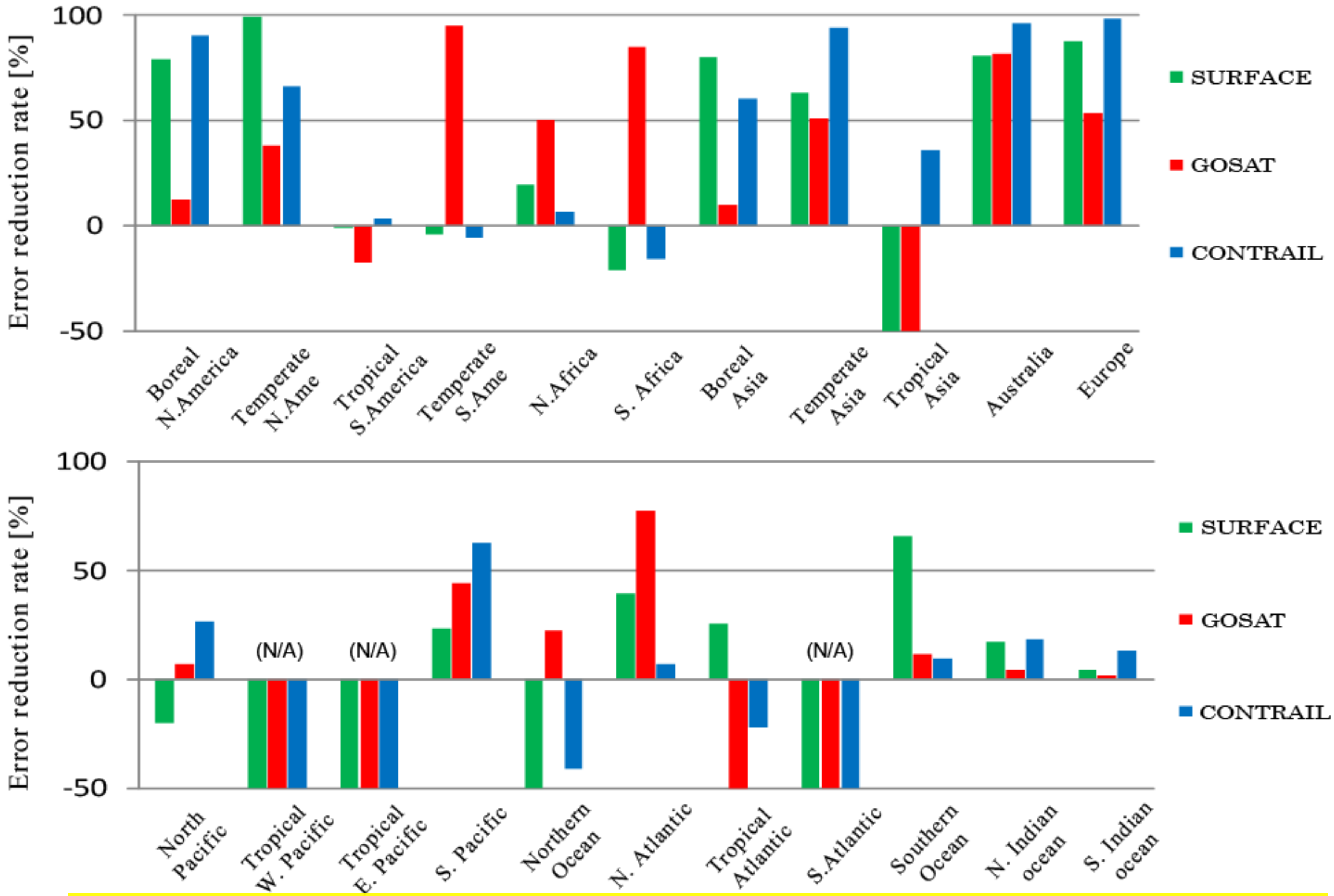
Best performance data assimilation system

- State augmentation method for parameter (i.e., surface flux estimations)
- Localization: h=1200 km, logP=0.75 hPa
- Conditional covariance inflation
- Weight-interpolated column data assimilation
- 4D data assimilation with 3-day window



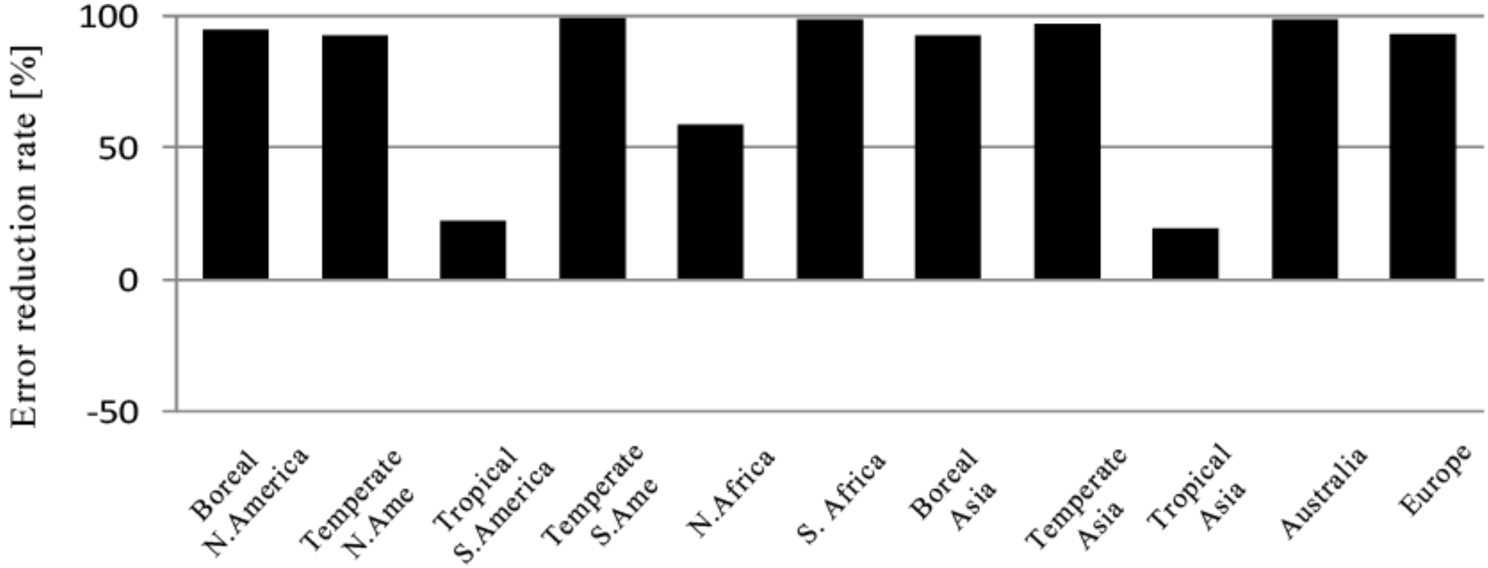
Initial RMSE = 5.4, Global mean absolute flux = 6.2

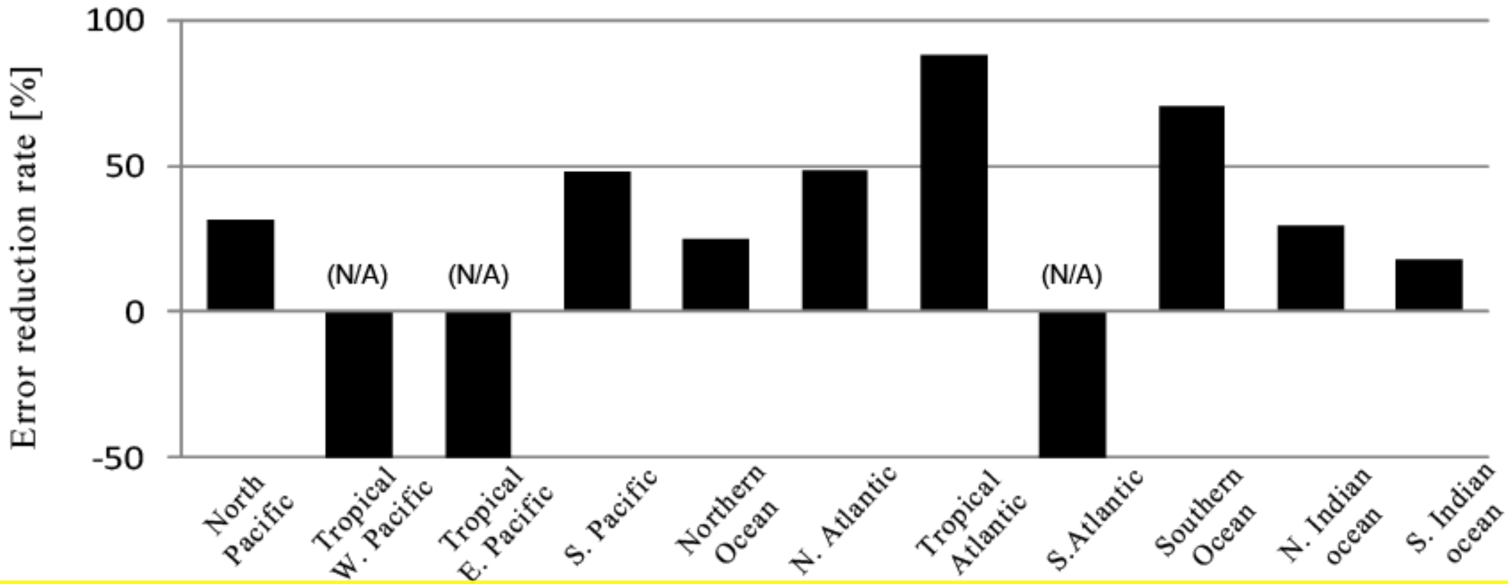
Surface flux error reduction rate [%]



GOSAT XCO2 and CONTRAIL vertical profile data provide strong additional constrains on the surface flux estimation.

Surface flux error reduction rate [%]





By combining all the data sets, the estimated surface flux in the data assimilation system becomes very similar to the true flux at many regions

Conclusions

The potential impacts of various data obtained from surface, satellite, and aircraft measurements on the estimation of surface CO2 fluxes have been investigated using an 4D EnKF data assimilation system.

•Conventional surface network data contributes to largest error reductions.

•GOSAT gives large flux error reduction over south-America and Africa.

•The impacts of CONTRAIL data are large over Europe, Australia, tropical-temperate Asia, and North America, where many vertical profiles data exist.

• By combining information obtained from all the data sets, the data assimilation system significantly improves the flux estimation globally.

•The data assimilation system for all types of data simultaneously is expected to improve our knowledge of carbon cycle.

Validation of Mesospheric analyses

David Long

Improvements to humidity assimilation at the Met Office

Bruce Ingleby

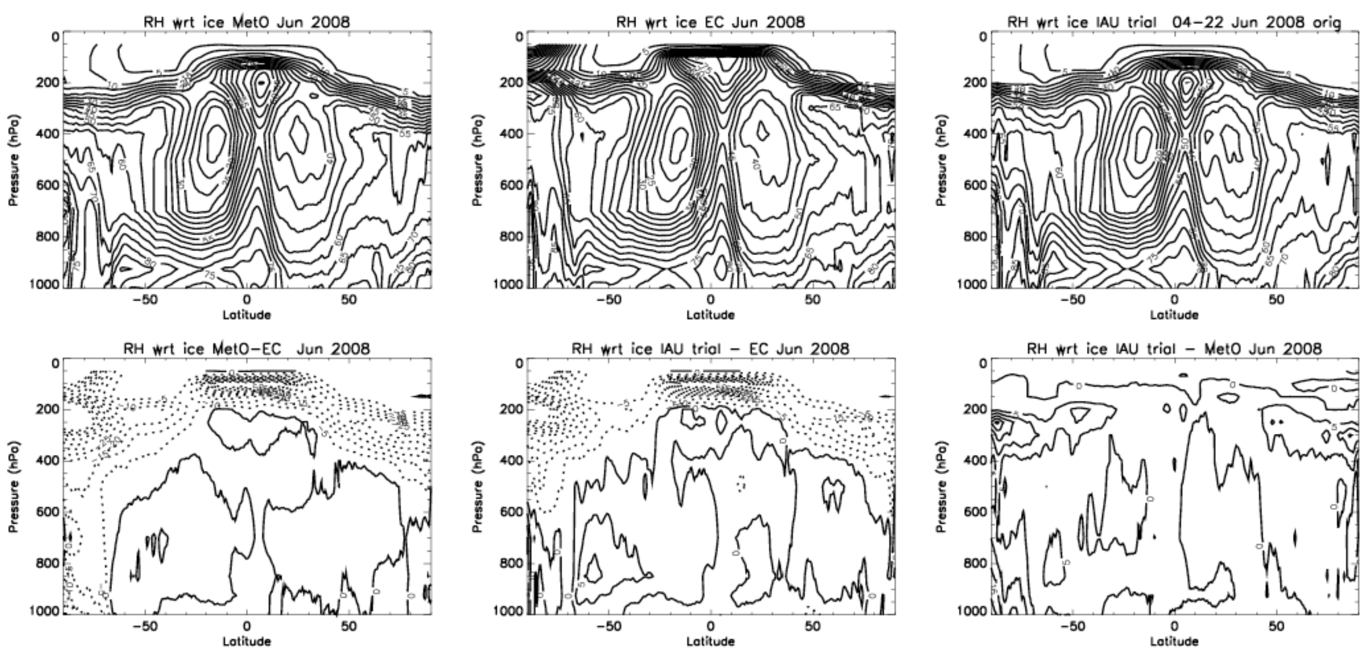
David Jackson, Andrew Lorenc, Keith Ngan, Rick Rawlins, Richard Renshaw

SPARC Workshop, Exeter, June 21-23, 2010

Stratospheric “fix”

- Reset values to 1 < q < 3 ppm and RH < 10% in ‘stratosphere’
- 2.5 PVU is too low down (below transition layer) in extratropics
- Change criterion to 5 PVU

MetO ECMWF 5 PVU trial



Dry bias in MetO cf EC

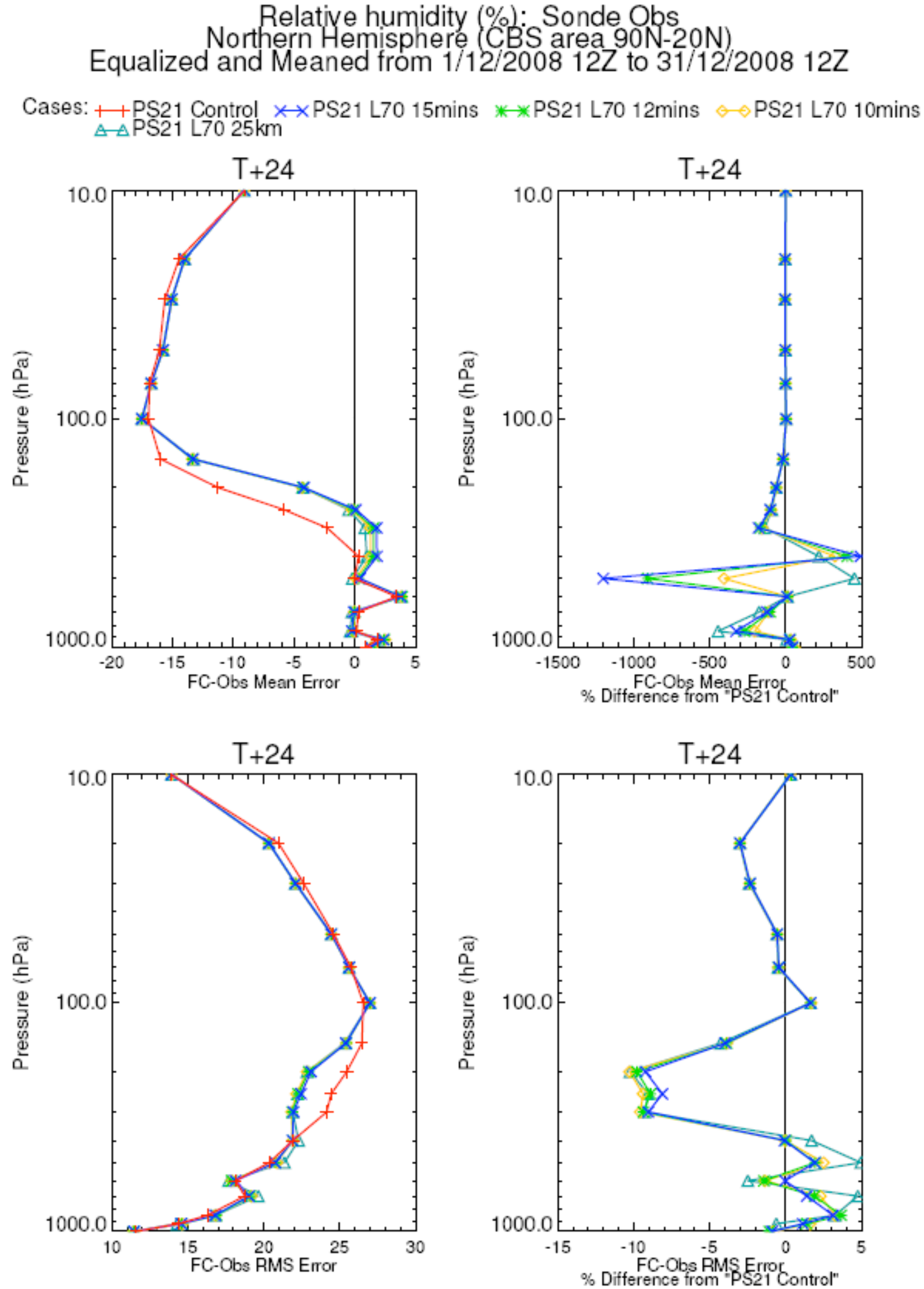
5PVU reduces extratropical bias by up to 20%

IASI O-B bias reduced too

Met Office

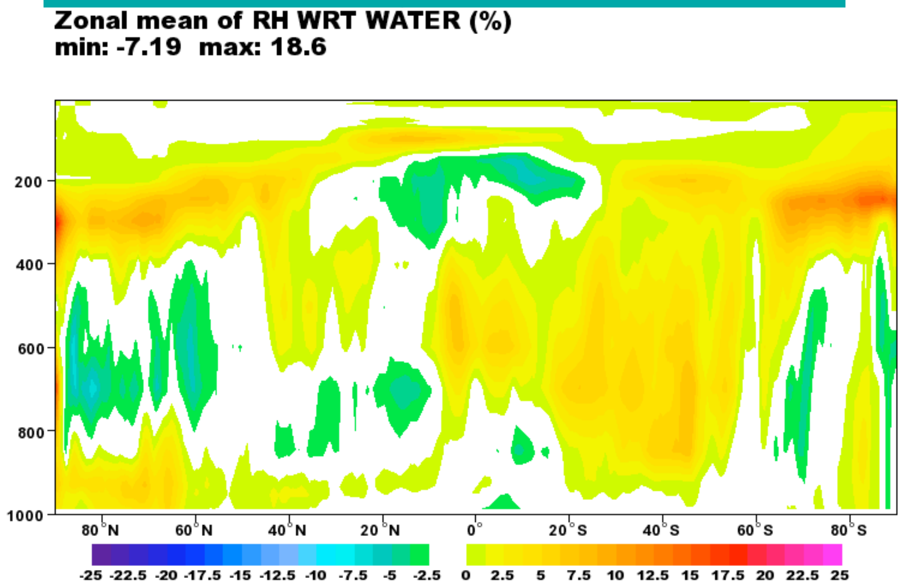
Sonde RH

- Previously cut-off at -40C
- Now used to -60C (RS80) or -80°C (RS90/92)
- Operational Nov 2009 + changed ‘stratospheric’ reset and 70 levels
- Reduced upper level dry bias
- Looking at bias correction – sondes dry in daytime

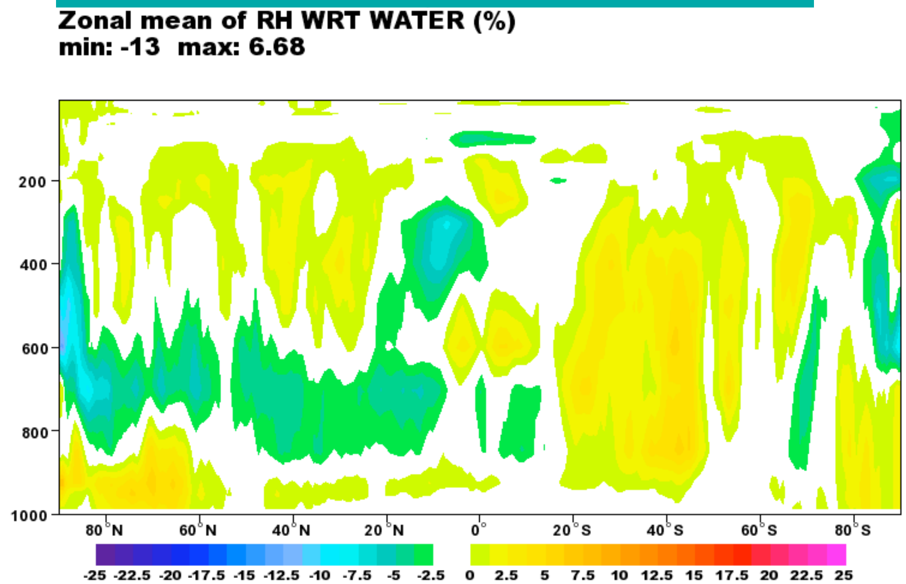


Impact of Revised Humidity Analysis on [RH] drift (fc –an) in day 5 NWP forecasts

(L50) Control : old humidity analysis



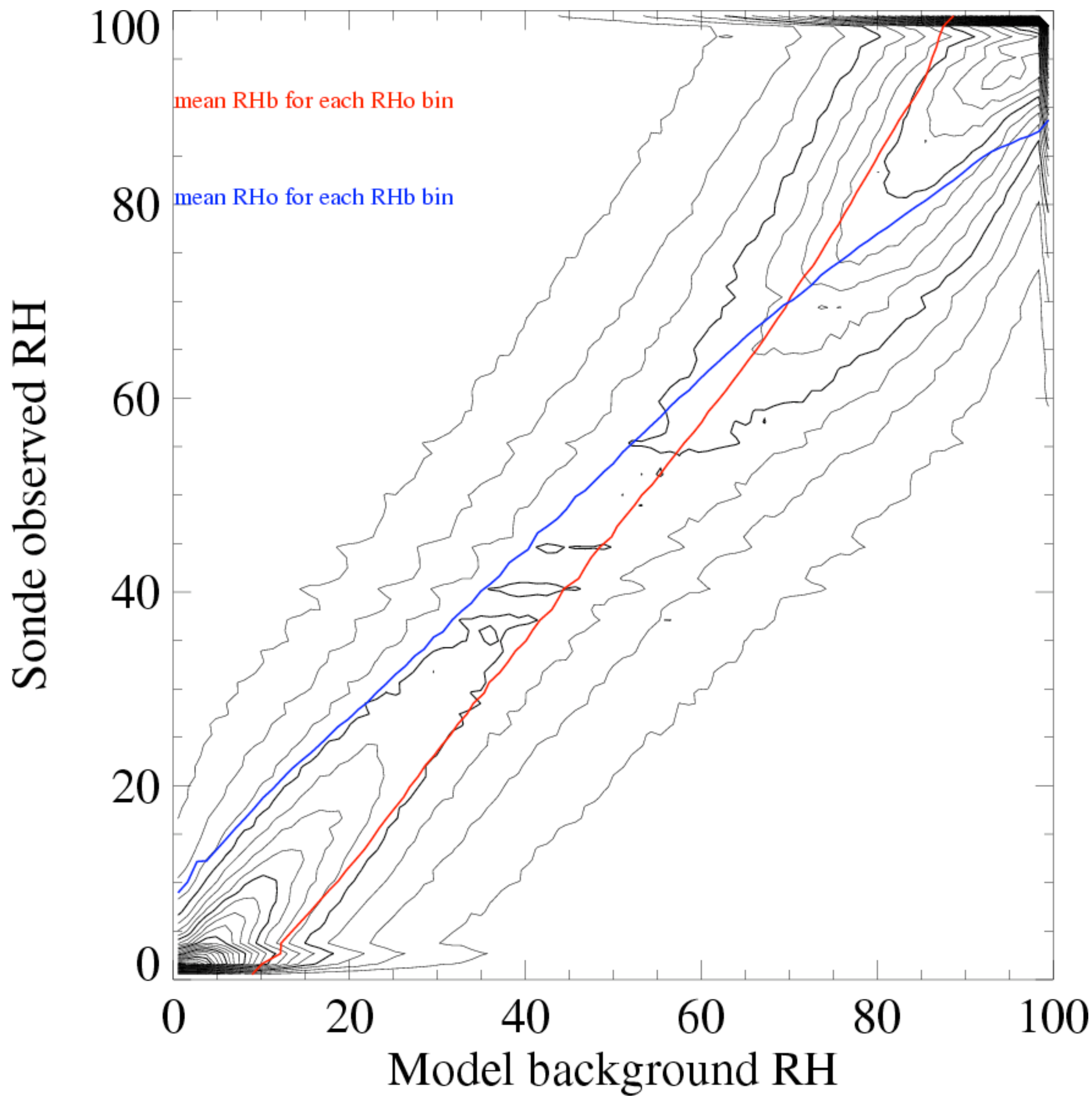
(L70) + Revised humidity analysis



Better agreement between (moister) model forecasts & analyses and less drift in upper tropospheric relative humidity arising from the revised humidity assimilation

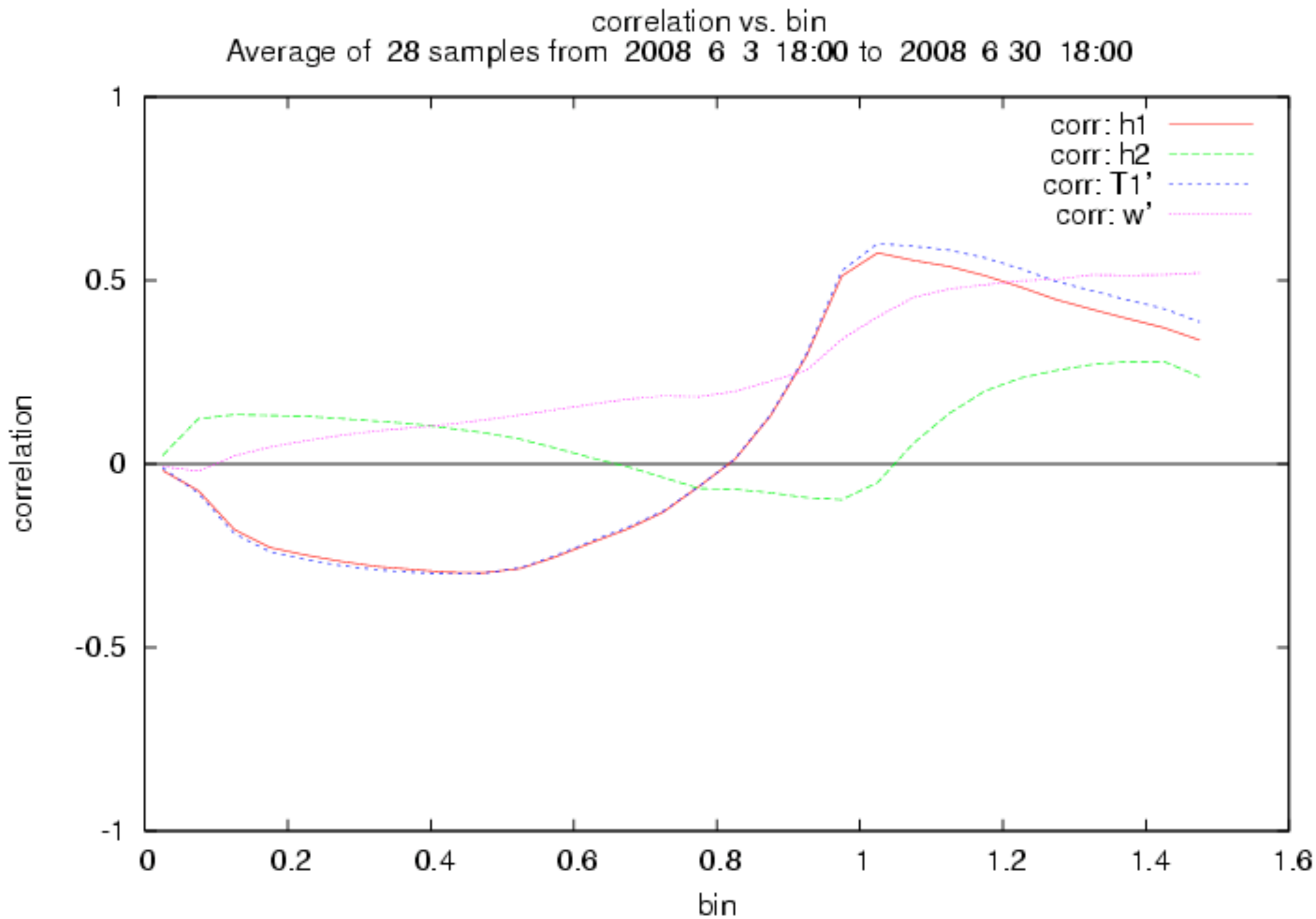
New moisture control variable

- Based on work by Holm – some differences
- Limits on RH: O-B pdf depends on B (nonlinear transform)
- Want symmetry between B and A distributions
- Results soon!



Correlation of ΔRH with ΔT as a function of background RH

- Red line
- <80% RH r~-0.2
- Saturation r~+0.5



Met Office

The Radio Occultation Processing Package (ROPP)

Huw Lewis

SPARC Workshop, Exeter, June 21-23, 2010

Met Office

Impact of the representation of the stratosphere on tropospheric weather forecasts

Sana Mahmood

SPARC Workshop, Exeter, June 21-23, 2010