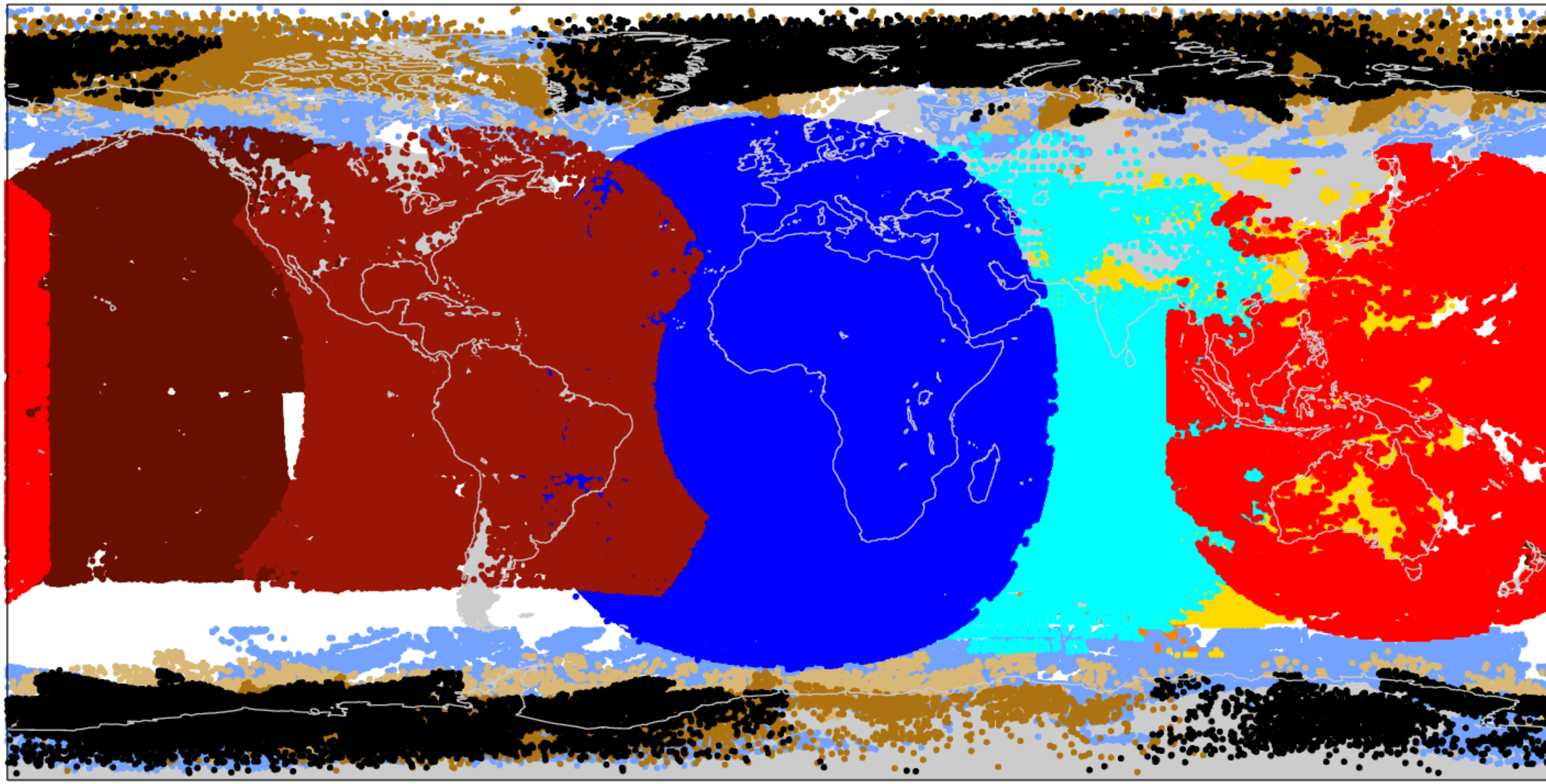
An overview of the status of the operational assimilation of AMVs at ECMWF

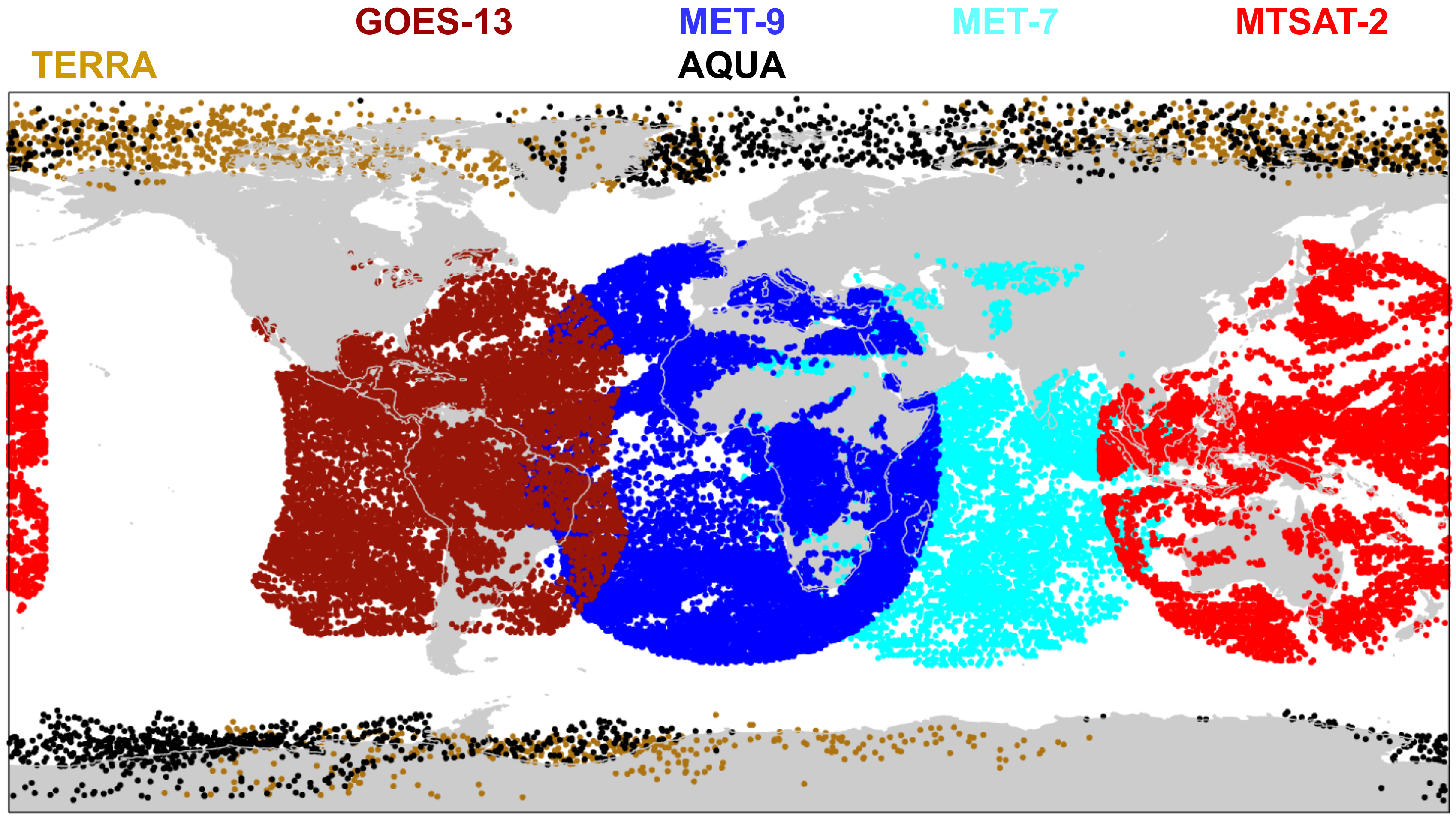
Niels Bormann, Kirsti Salonen, Carole Peubey,
Tony McNally, Cristina Lupu

12-h sample coverage: monitored AMVs

GOES-15
GOES-13
MET-9
MET-7
MTSAT-2
FY-2D
FY-2E
TERRA
AVHRR
AQUA
METOP-A



12-h sample coverage: used AMVs

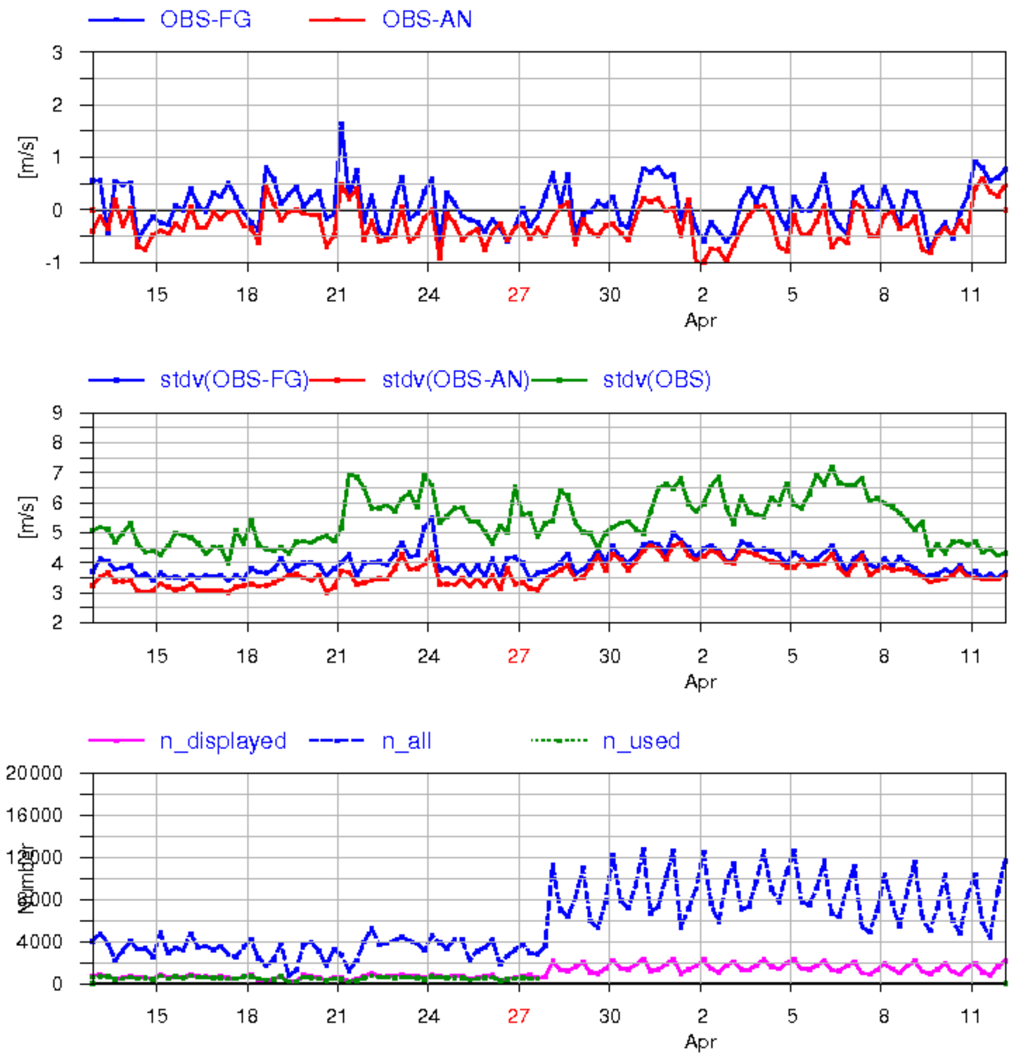


GOES-15 AMVs under evaluation since December 2011.

Outline

1. Hourly MTSAT AMVs
2. Contribution to OSE intercomparison
3. Wind information from geostationary radiances in 4DVAR

Hourly MTSAT-2 AMVs



- **JMA provides hourly AMVs since 28 March 2011.**
- **Previously: 3 hourly for NH, 6 hourly for SH**

IR channel

0-400 hPa height

QI > 80

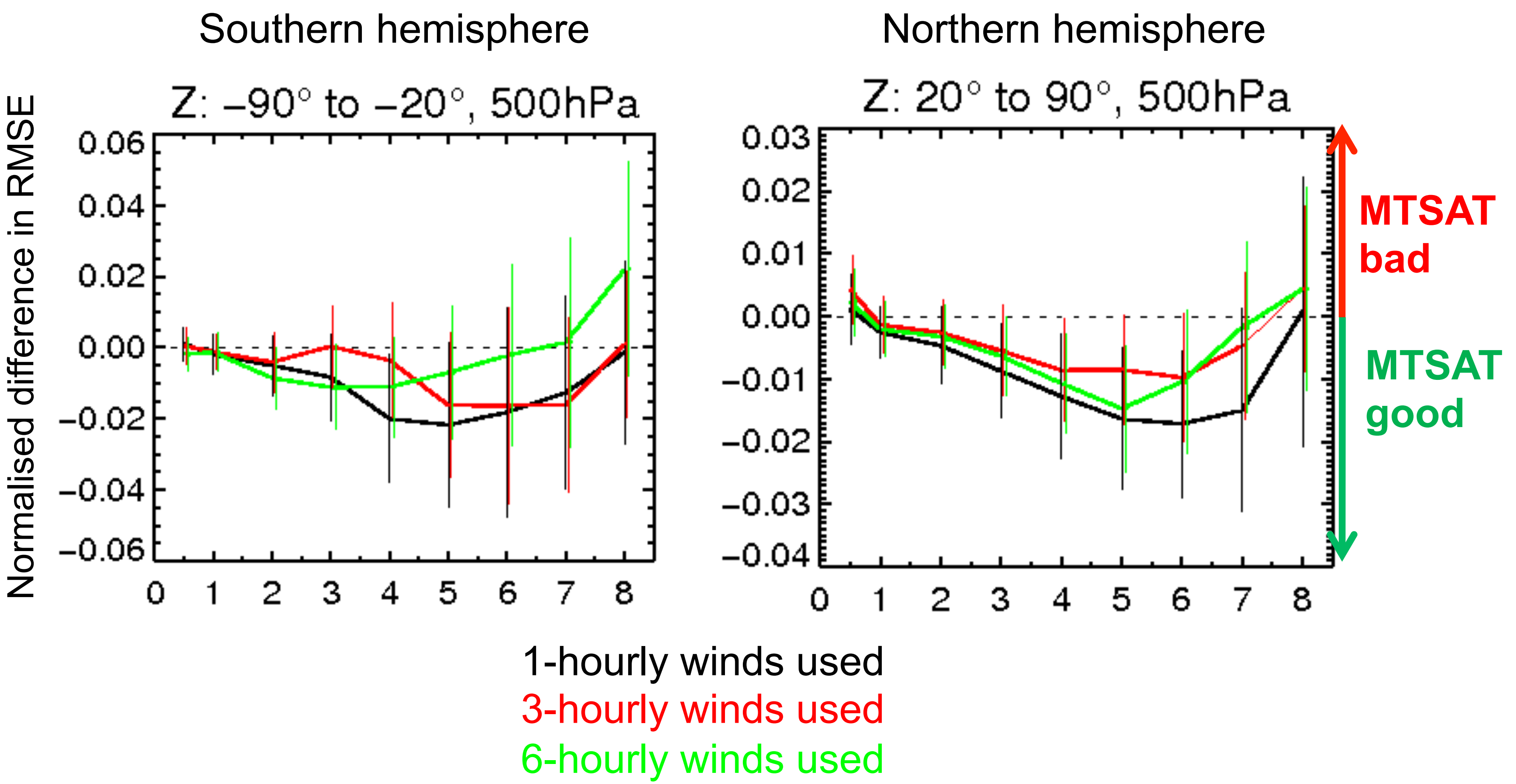
Tropics

(Kirsti Salonen)

ECMWF

Forecast impact

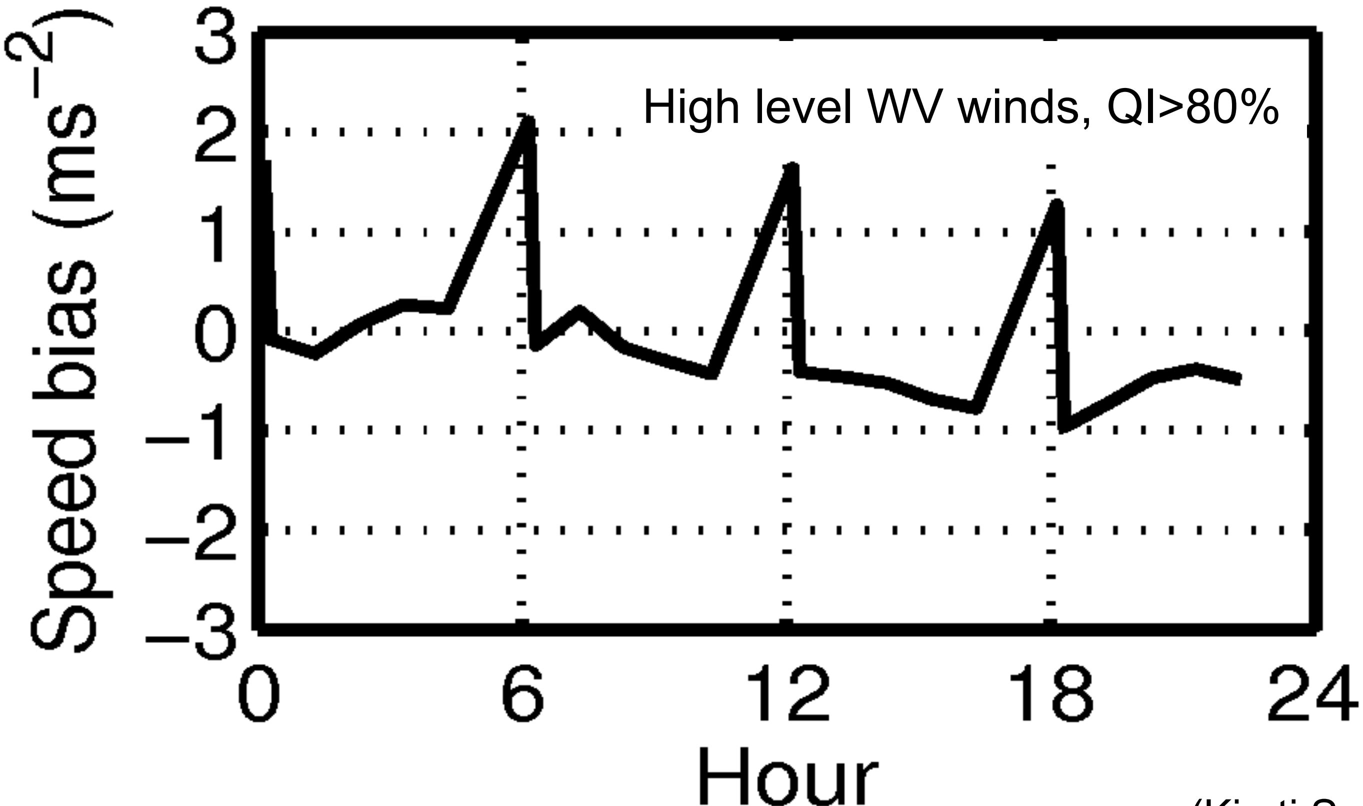
Relative to an experiment without MTSAT AMVs, 4 April – 3 June 2011



→ 1-hourly winds used in operations since 23 August 2011.

Statistics per time-slots

- Regular spikes per time-of-day over the Southern Hemisphere.
- Most likely linked to varying scan-intervals.



(Kirsti Salonen)

ECMWF

Outline

1. Hourly MTSAT AMVs
2. Contribution to OSE intercomparison
3. Wind information from geostationary radiances in 4DVAR

ECMWF

OSE intercomparison

Contribution to OSE intercomparison exercise:

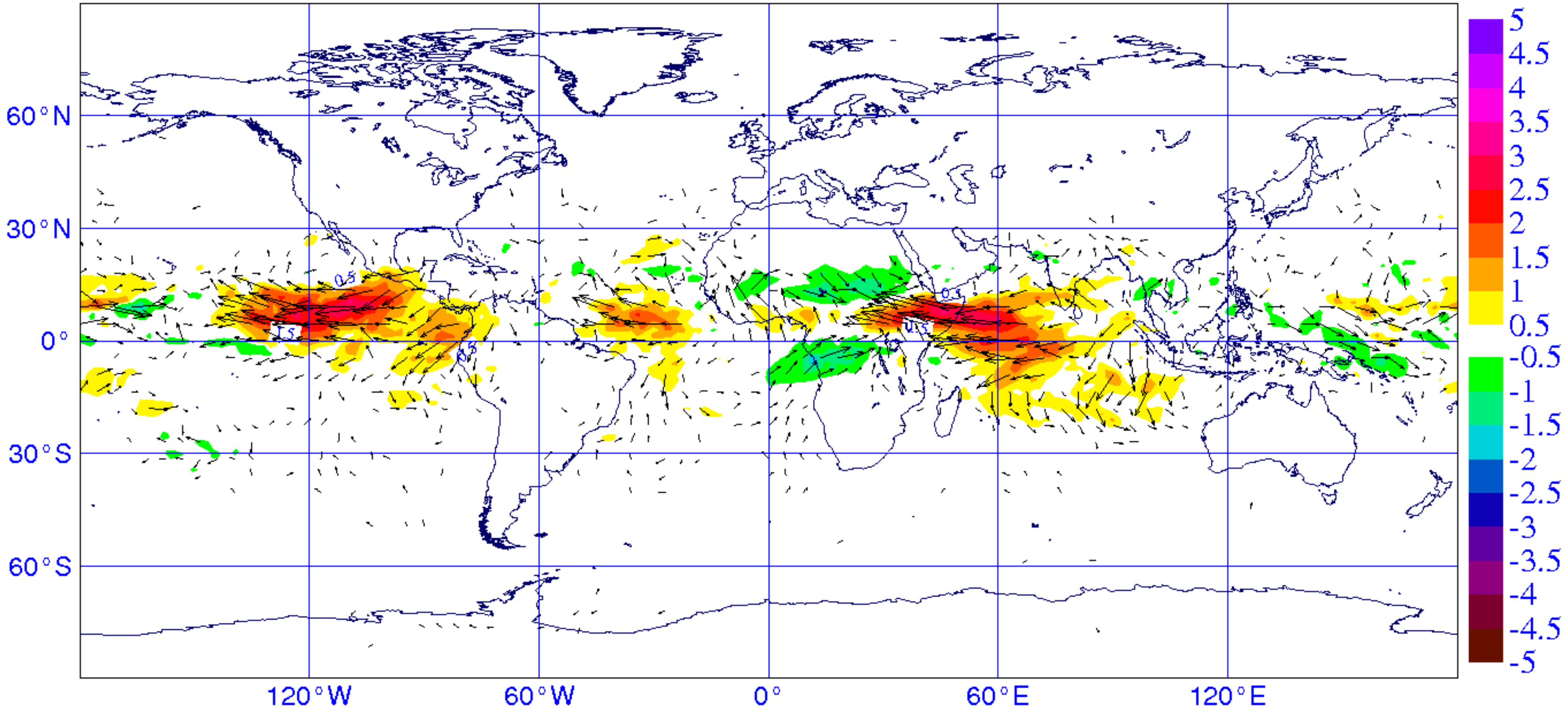
- Resolution: T799 (~25 km)
- Period 1: 15 August – 30 September 2010
  - Control
  - AMVs out
  - Scatterometer out
- Period 2: 1 December – 15 January 2011
  - Control
  - AMVs out
  - MODIS out

Control: includes conventional data + AMVs + Scat + 5 AMSU-As, 3 MHSs, 3 HIRSs; IASI, AIRS; CSRs from Met-7 & -9, GOES-11 & -13; SSMIS, AMSR-E, TMI; GPSRO from COSMIC, METOP-A, TERRA-SAR-X, …

Impact on mean wind analysis

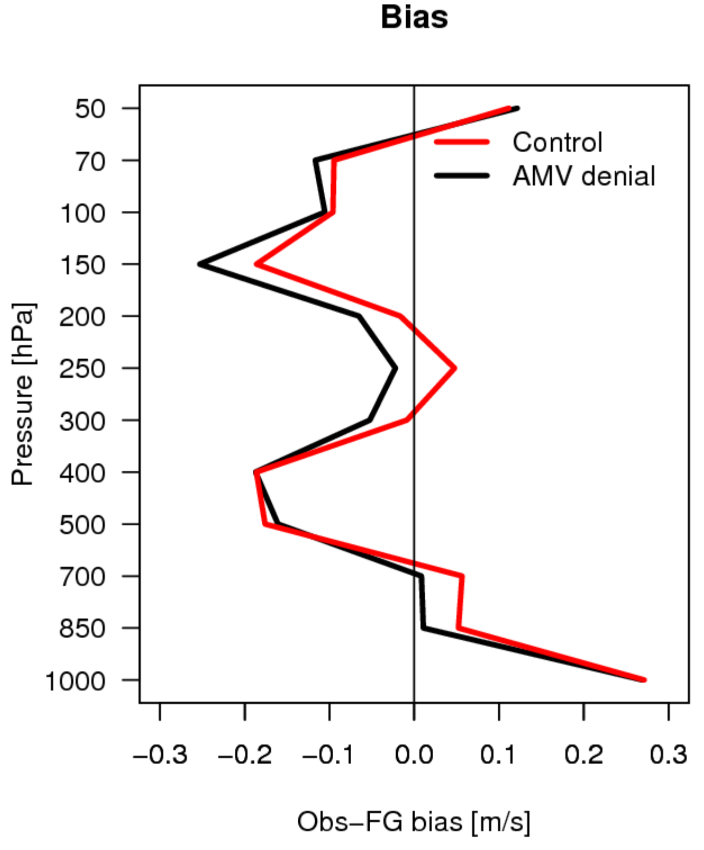
AMVs out – Control,

Period 1: 15 Aug – 30 Sept 2010, 200 hPa



Impact on departure statistics vs radiosondes

e.g., period 1: **AMVs out** vs **Control**
FG-departure statistics for u-component from radiosondes over the Tropics.

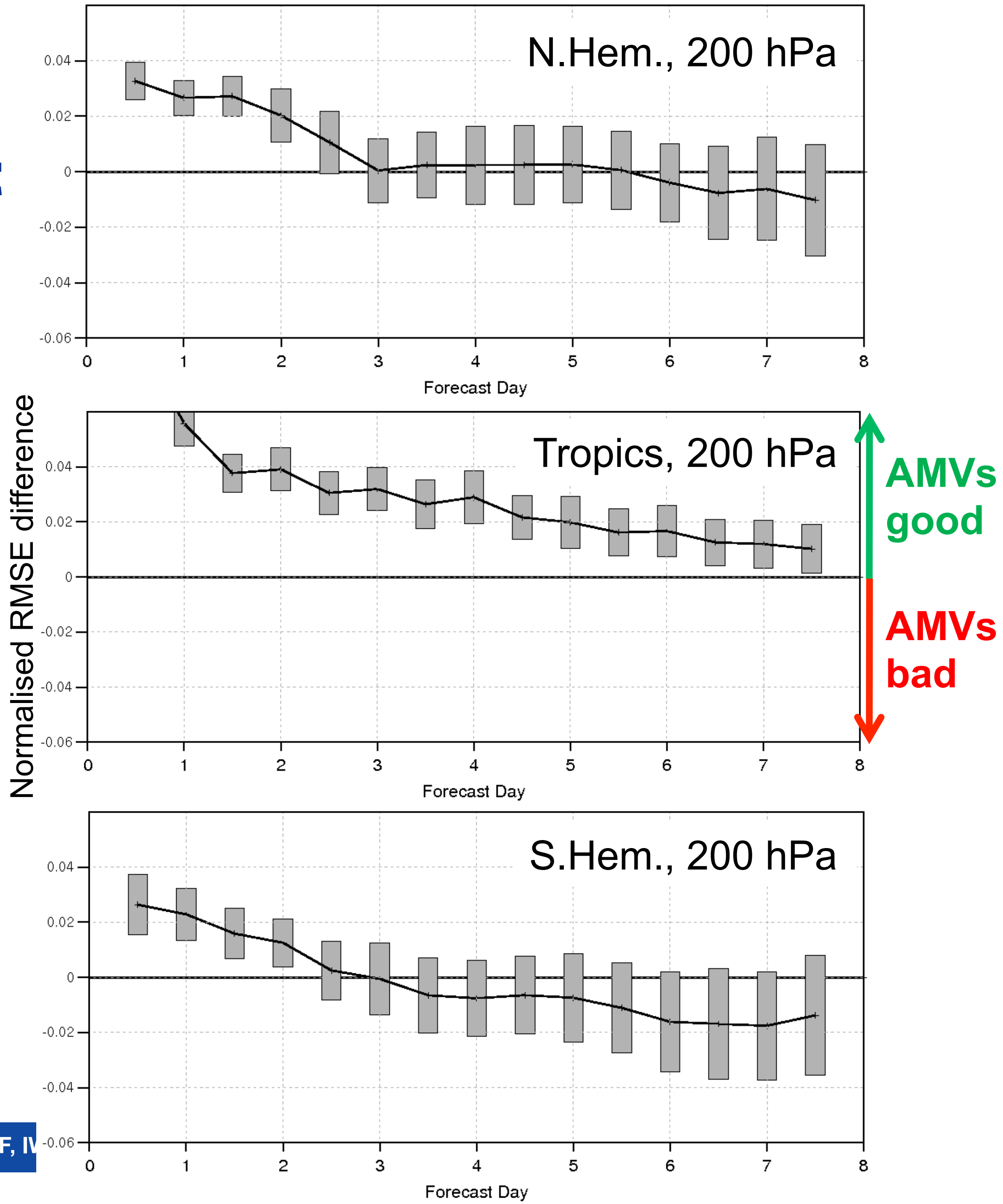


ECMWF

Positive forecast impact at high levels

Normalised RMSE difference for wind at 200 hPa, verified against own analysis, with 95 % confidence intervals.

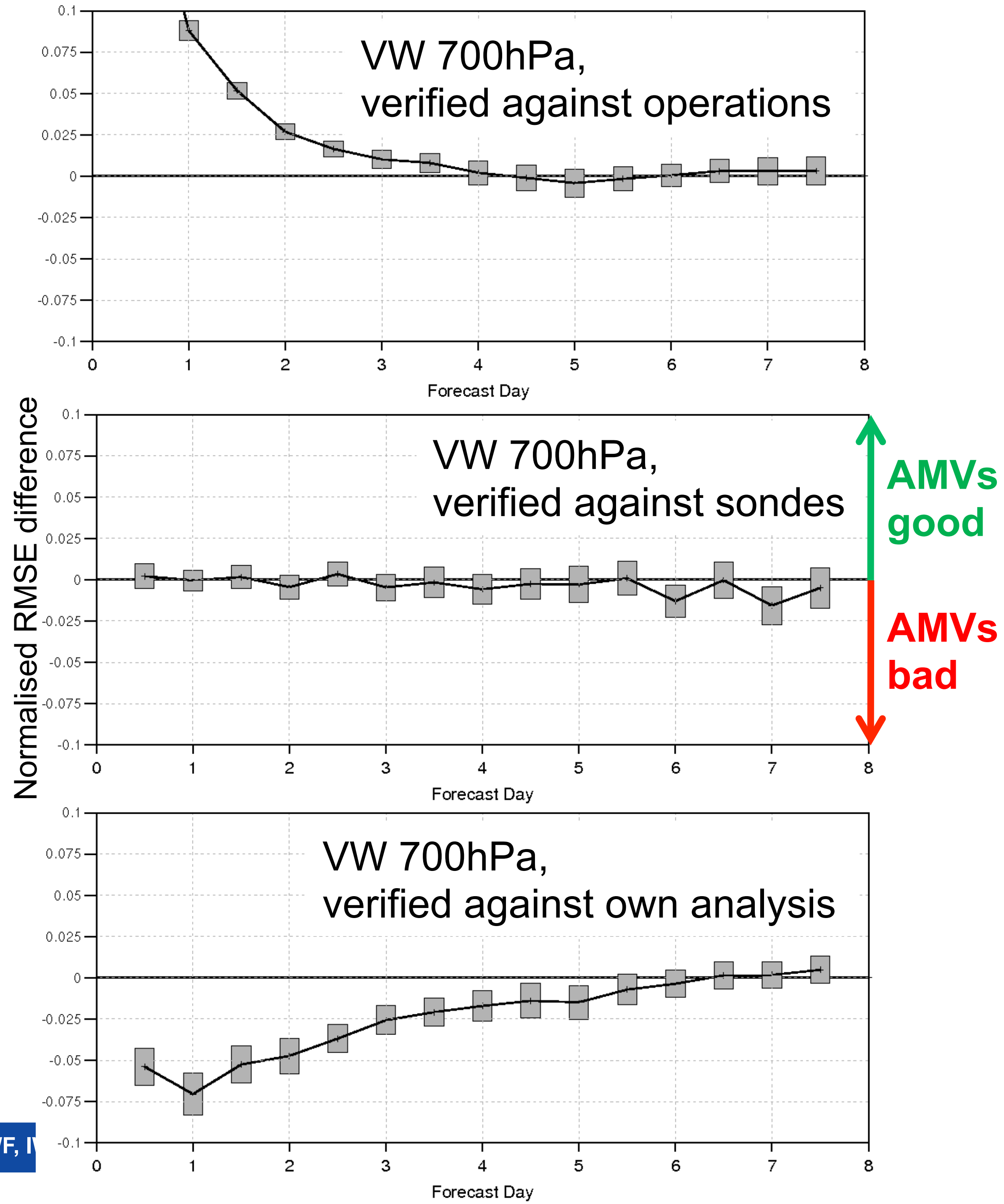
(Period 1 and period 2 combined, 77 cases)



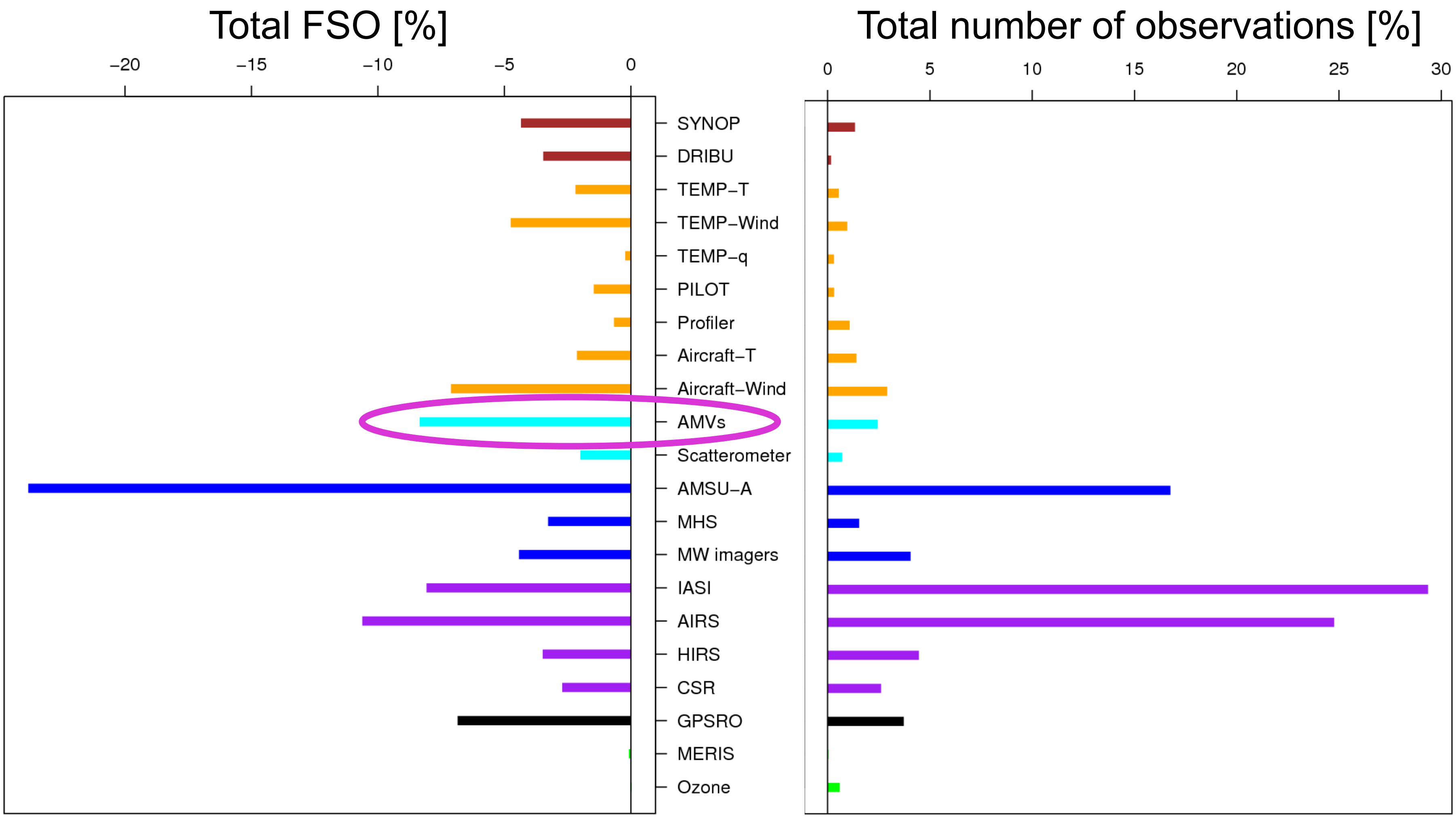
Problems verifying lower tropospheric tropical wind scores

For tropical lower troposphere, sign of forecast impact depends on verification method.

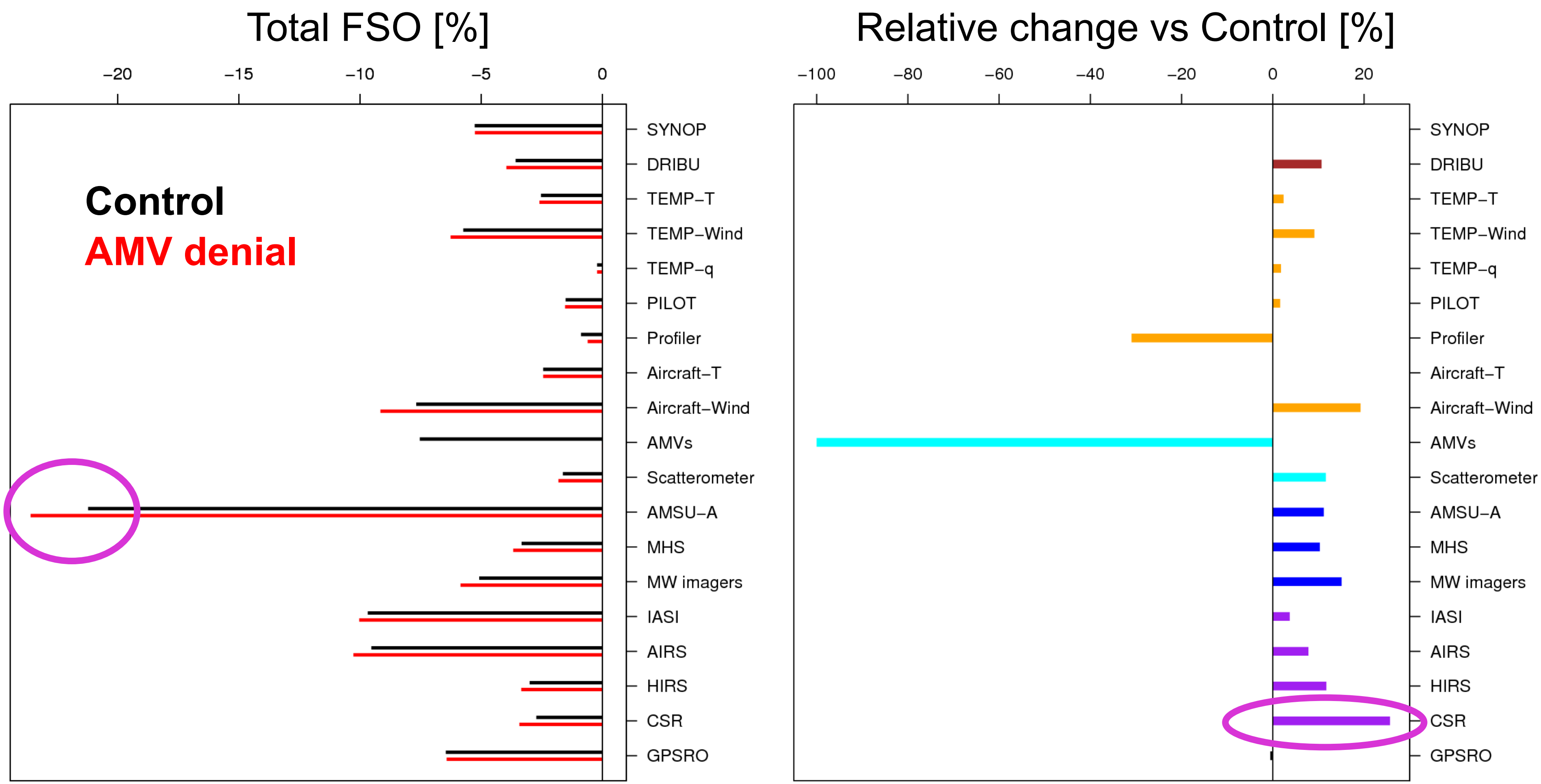
(Period 1 and period 2 combined, 77 cases)



Forecast sensitivity diagnostics: Entire observing system, period 1



Change in FSO by observing system, period 2



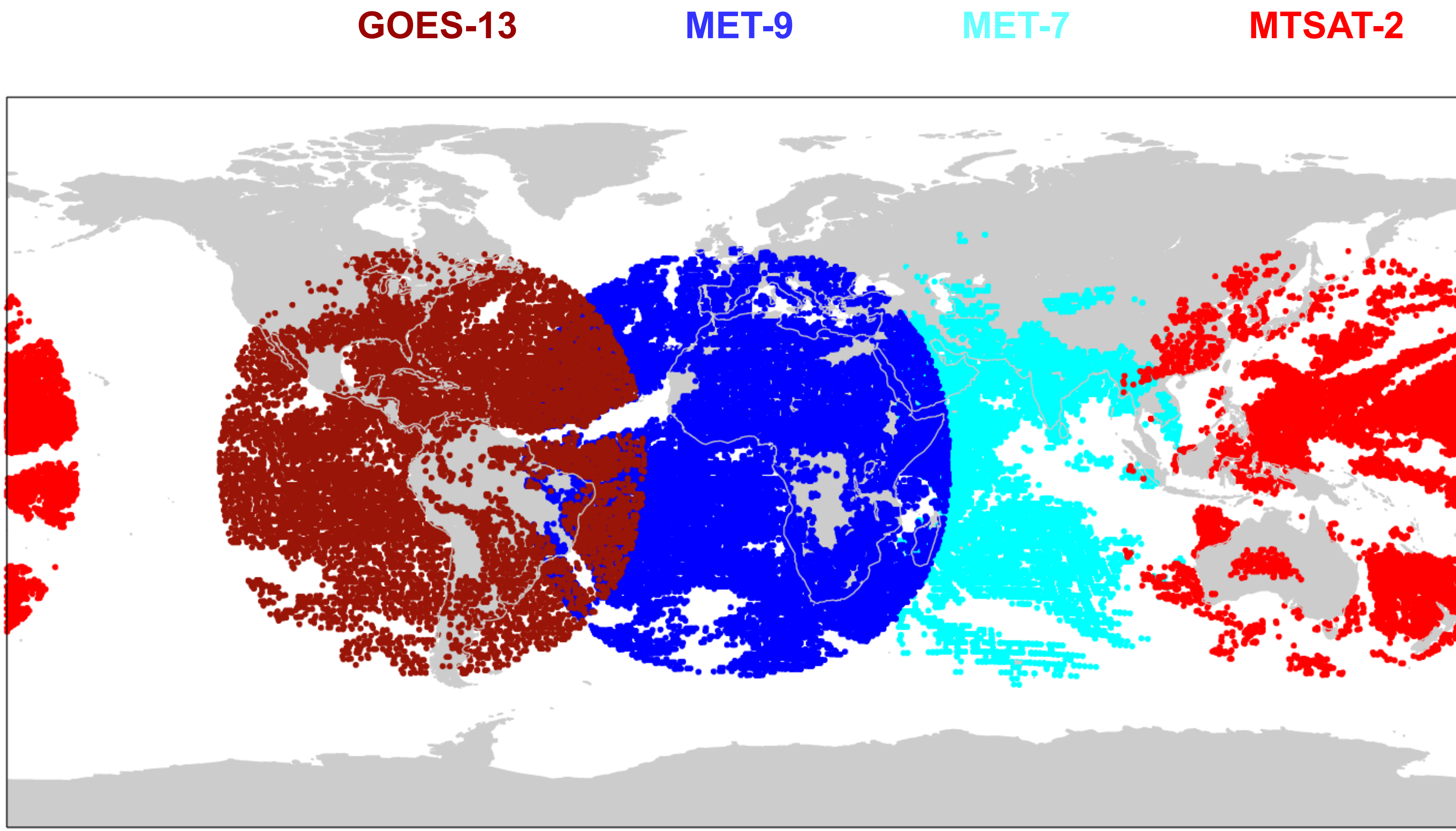
CSR = Segment-averaged Clear Sky Radiances from geostationary satellites

Outline

1. Hourly MTSAT AMVs
2. Contribution to OSE intercomparison
3. Wind information from geostationary radiances in 4DVAR

ECMWF

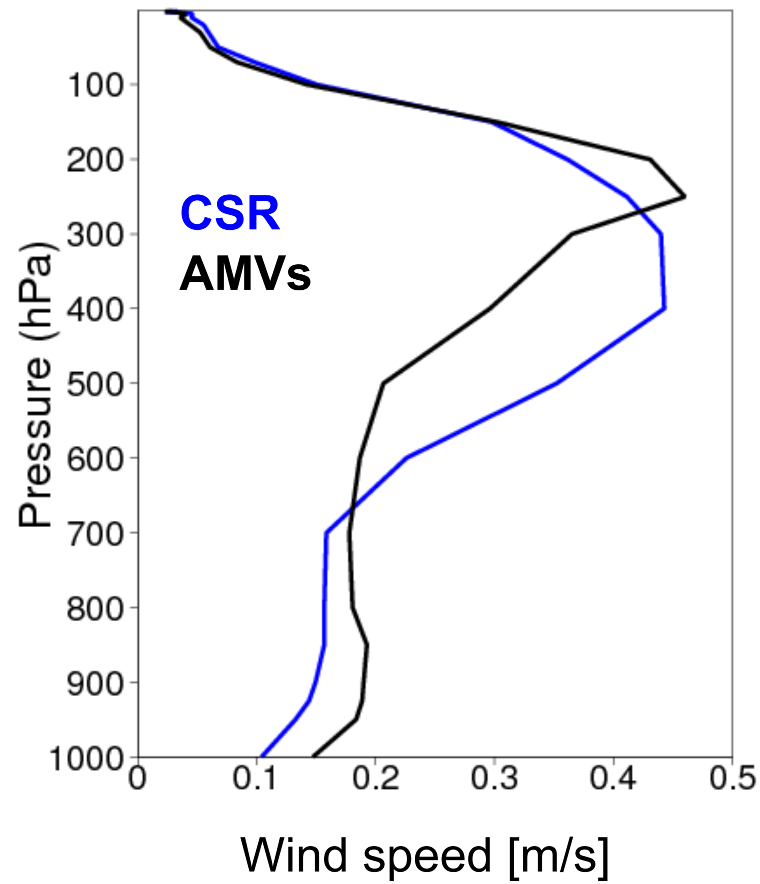
12-h sample coverage: used WV CSRs



GOES-15 CSR under evaluation since December 2011.

Wind adjustment with CSRs from MET-9

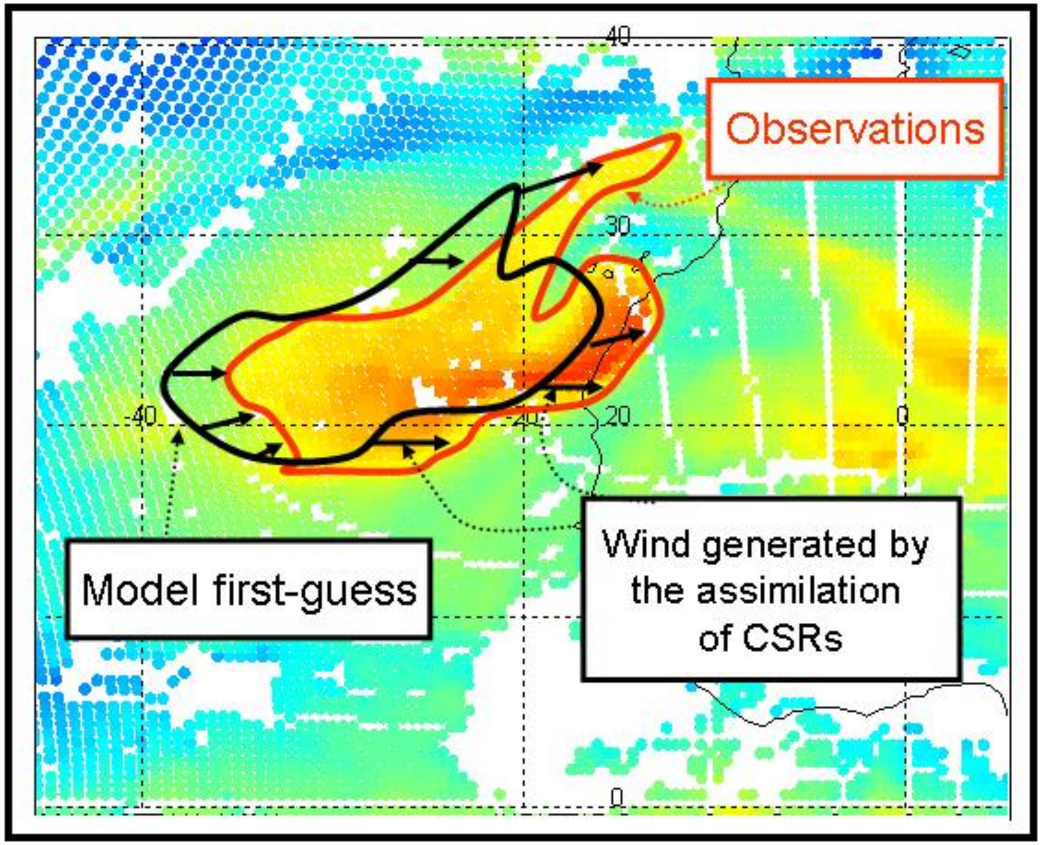
Profile of wind impact inside Met-9 disc (ie. profiles of RMS($AN_{Exp} - AN_{Baseline}$)): **CSRs** and (cloudy) **AMVs** added to a baseline system with conventional observations only.



(Cristina Lupu)

ECMWF

Wind information from radiances in 4DVAR

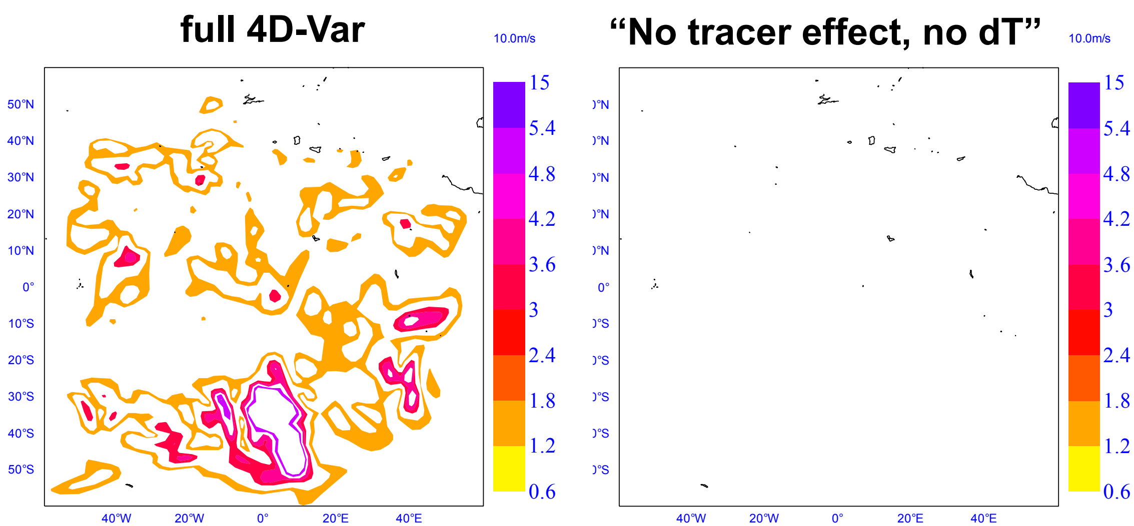


Humidity tracing from geostationary Clear Sky Radiances (CSRs)

→ Peubey and McNally, QJRMS, 2009

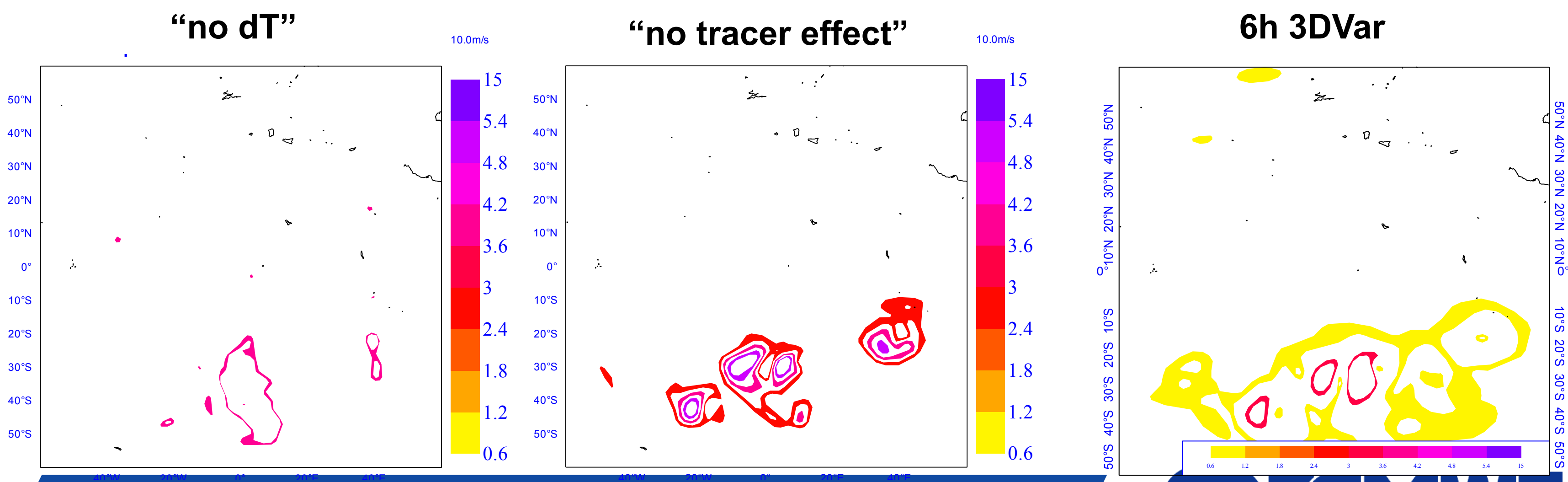
Dissecting the impact of CSRs on wind analyses in 4DVAR

First CSR-generated wind increment – 300 hPa



See Peubey and McNally, QJRMS, 2009 for more.

Assimilation of geo radiances is currently being extended to overcast scenes.



ECMWF

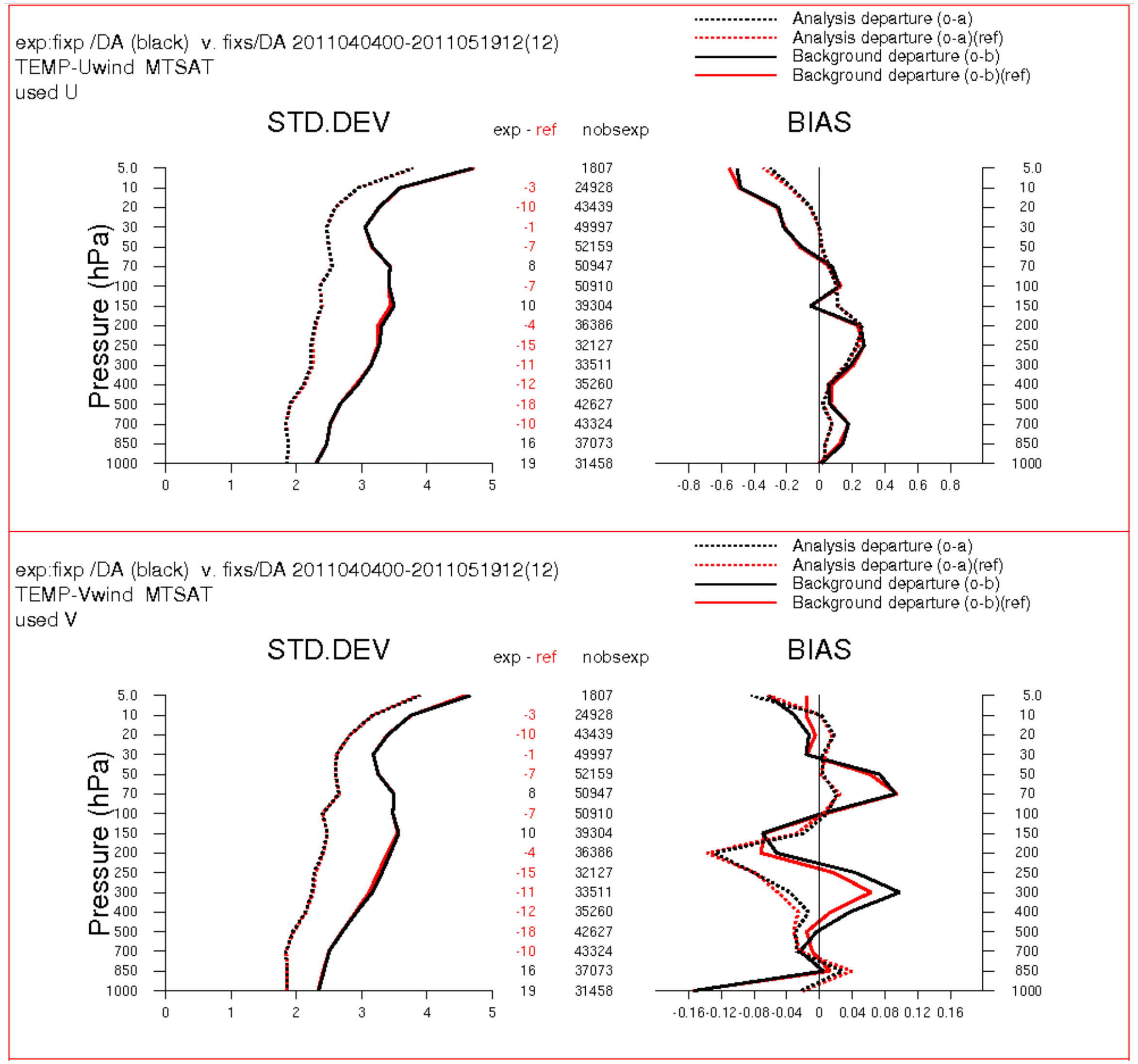
Summary

- Assimilation experiments show positive forecast impact from assimilation of hourly MTSAT AMVs.
- AMV OSE confirms earlier results:
  - Large impact on mean wind analyses.
  - Largest positive forecast impact at high levels in the tropics.
  - Problems with verifying forecast impact at low levels in the tropics.
- AMVs and CSRs have a complementary impact on wind analyses.
  - Humidity tracing effect primary mechanism for impact on wind from CSRs.

ECMWF

Observation fit statistics

- All experiments show improvements in observation fit statistics.
- Largest improvements when 1-hourly winds are used.

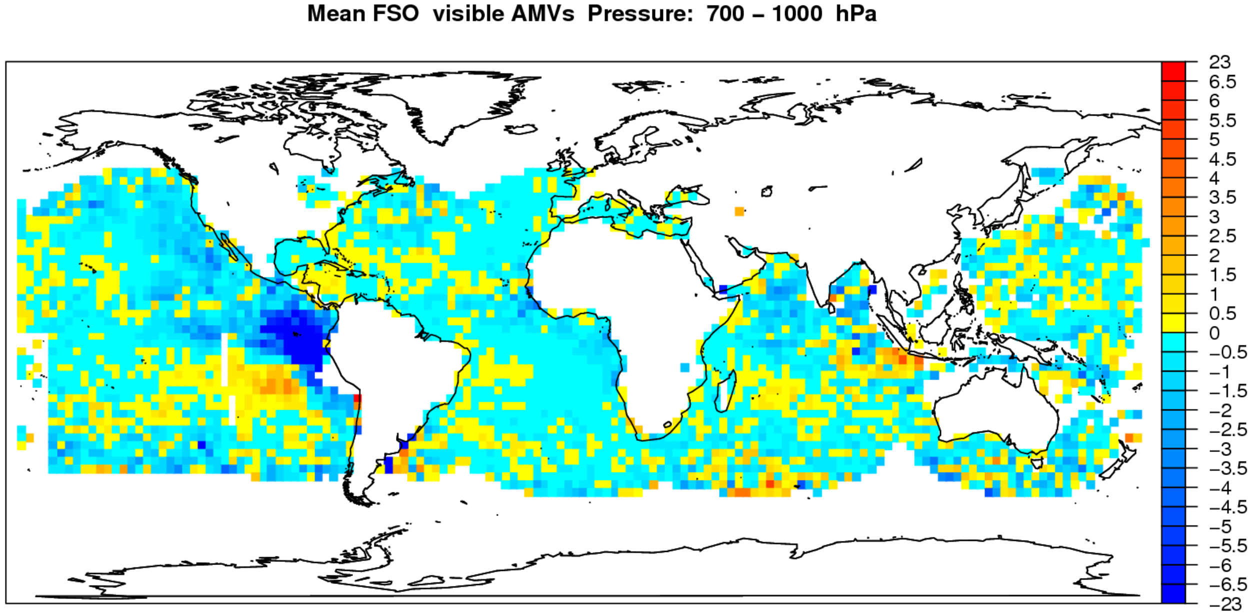


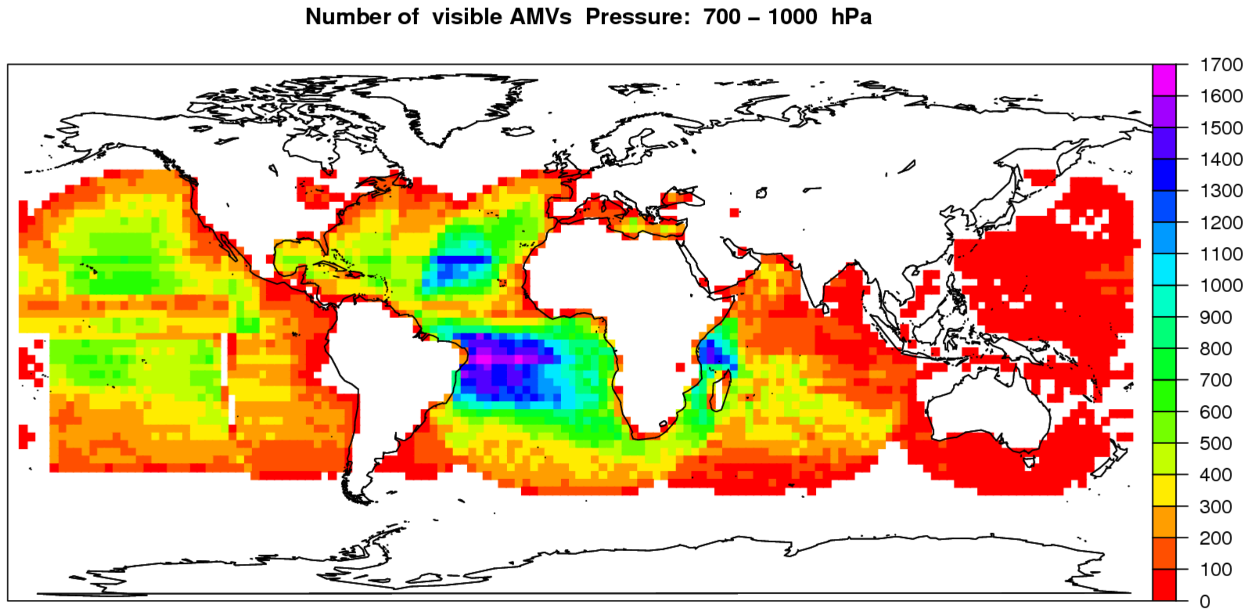
No MTSAT-2 AMVs

1-hourly MTSAT-2 AMVs

Mean FSO per AMV

Low level VIS winds, Period 1 (15 Aug – 29 Sept 2010)





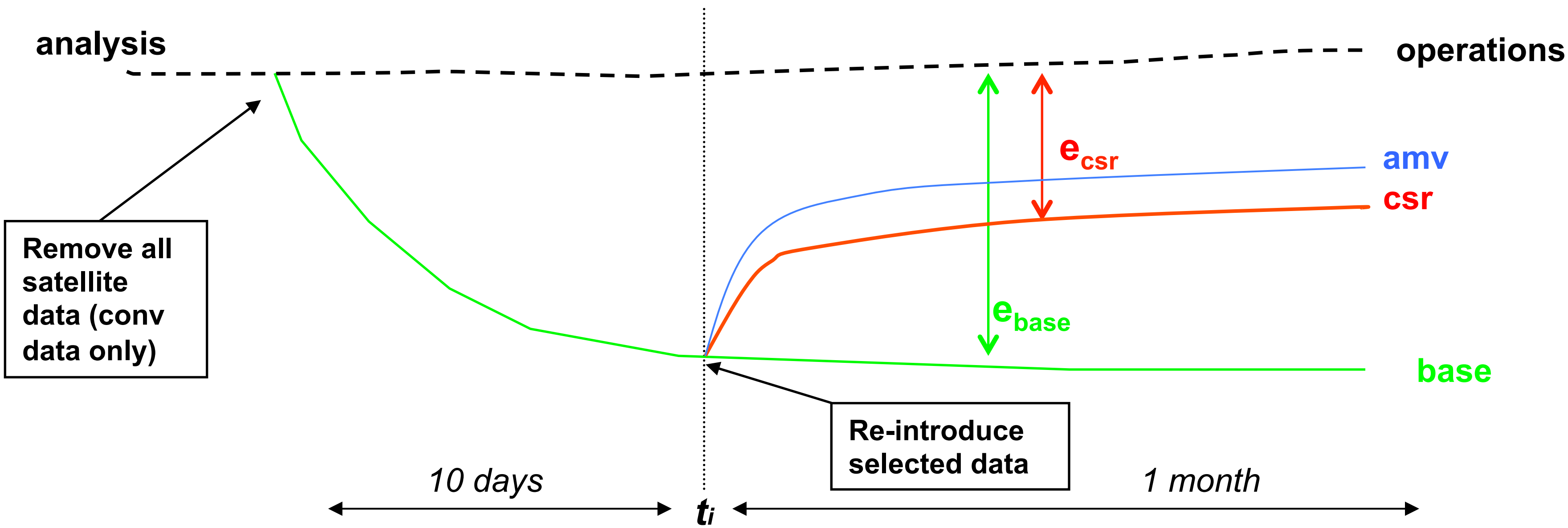
ECMWF

Impact of CSRs and AMVs on wind analyses: Experimental framework

Experiments with Met-9 AMVs and CSRs added to "baseline system":

CSRs= 2 WV channels, peaking 300 and 500 hPa

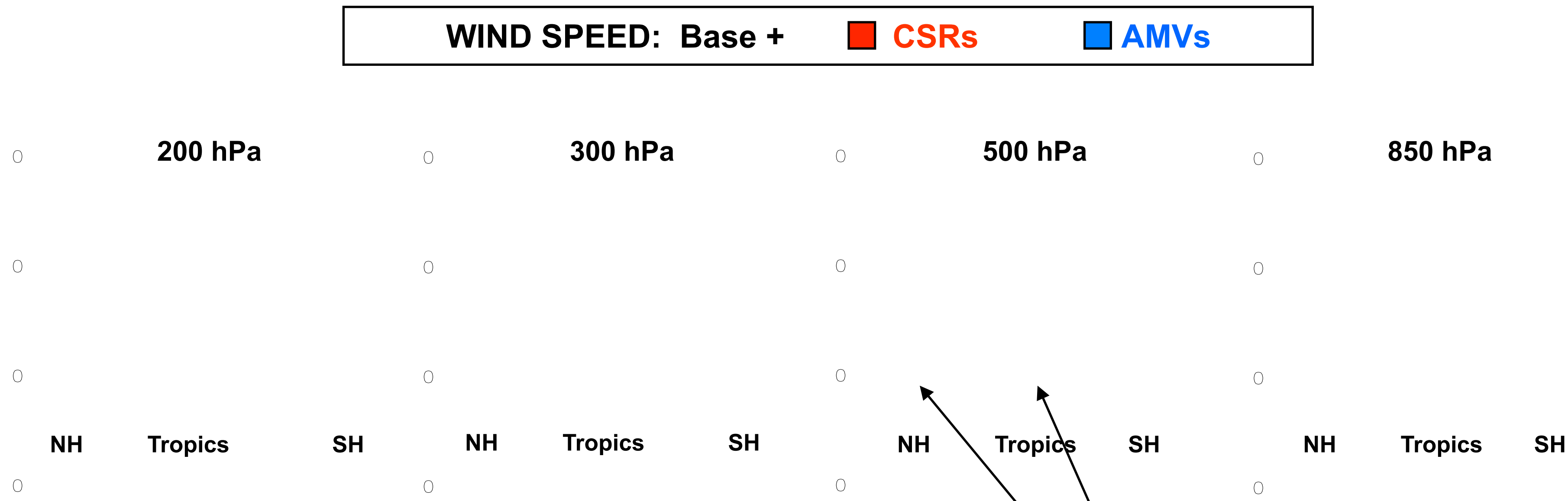
AMVs= AMV data assimilated as in operations (IR, cloudy WV and visible)



Analysis score: $\frac{\overline{(e_{base}-e_{csr})}}{e_{base}}$ **> 0 ➔ positive impact**

ECMWF

Impact of CSRs and AMVs on wind analyses

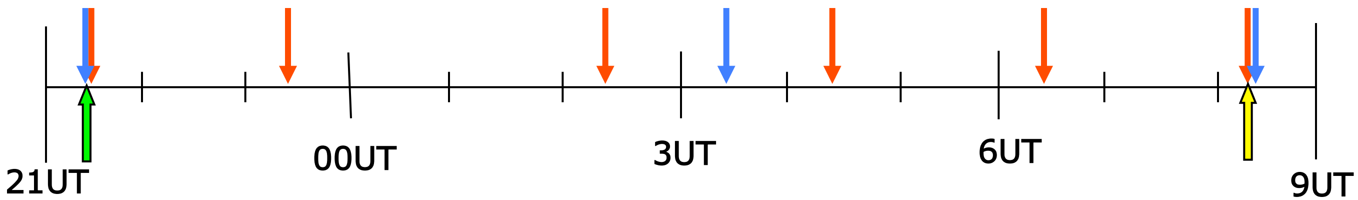


Few AMVs assimilated at 500 hPa

⇒ **AMV impact larger at 200 hPa and 850 hPa;**

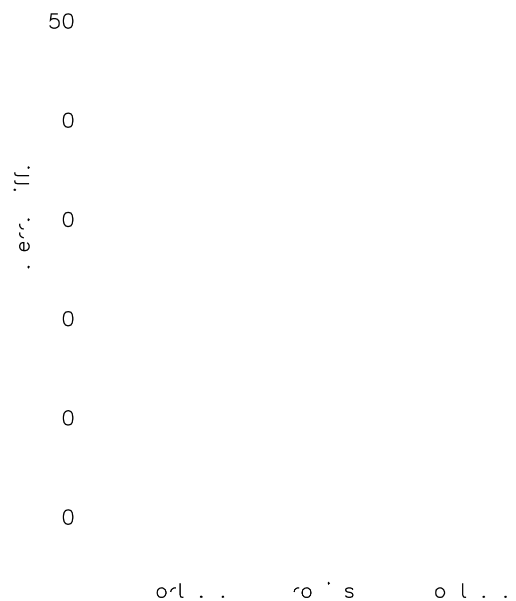
⇒ **CSR impact larger at 300 and 500 hPa**

Importance of observation frequency for CSRs

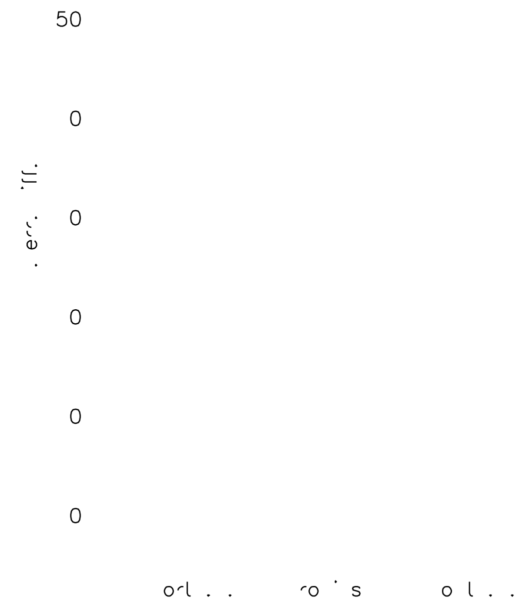


Base + CSRS
12 im./window
6 im./window
3 im./window
single im. at 1st slot of window
single im. at last slot of window

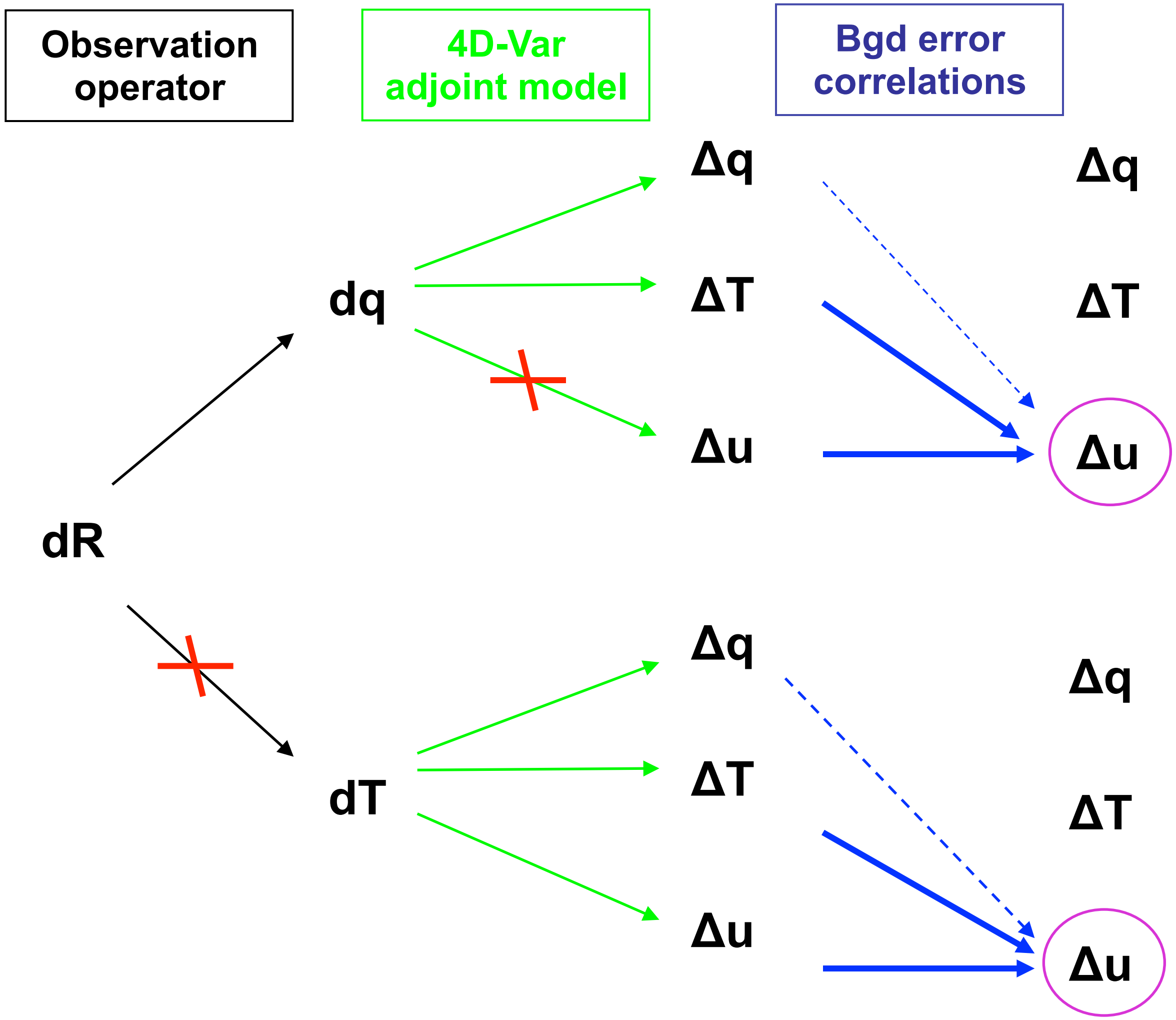
wind speed - 300 hPa



wind speed - 500 hPa



Dissecting the impact of CSRs on wind analyses



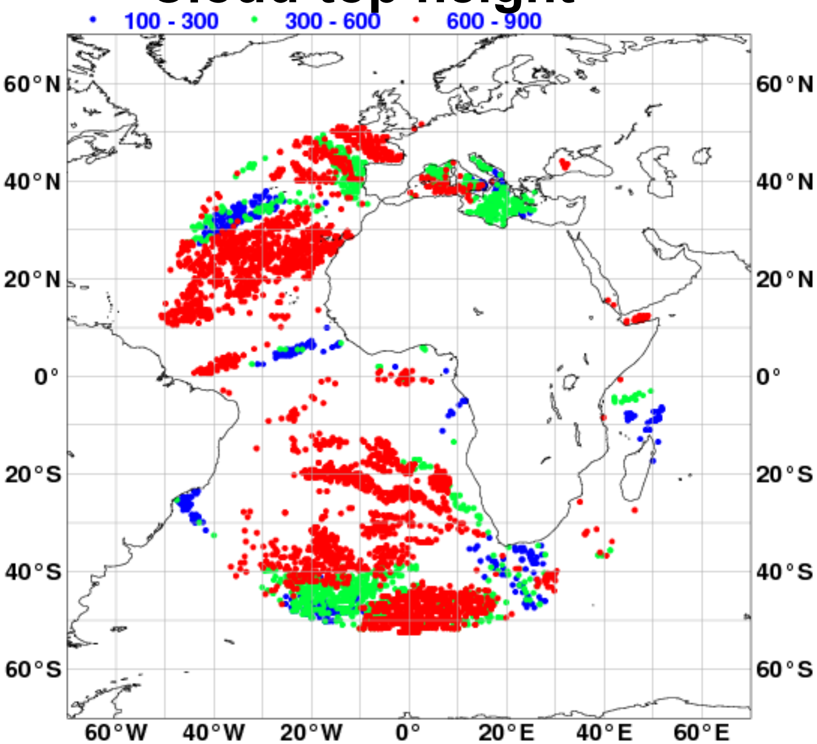
Peubey and McNally, QJRMS, 2009

Experiments:

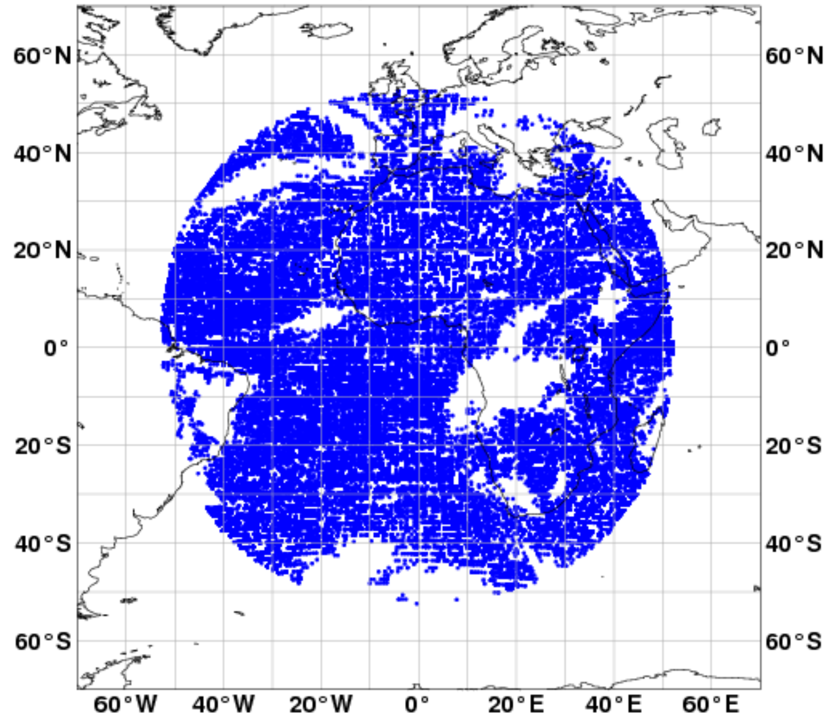
- full "4D-Var"
- "no dT"
- "no tracer effect"
- "no tracer effect, no dT"

Overcast radiances

Cloud-top height



CSR WV 6.2µm



Assimilation of geostationary radiances is currently being extended to totally overcast scenes (“sink variable approach”).

ECMWF