

# Assessment of AMVs from Himawari-8 and VIIRS

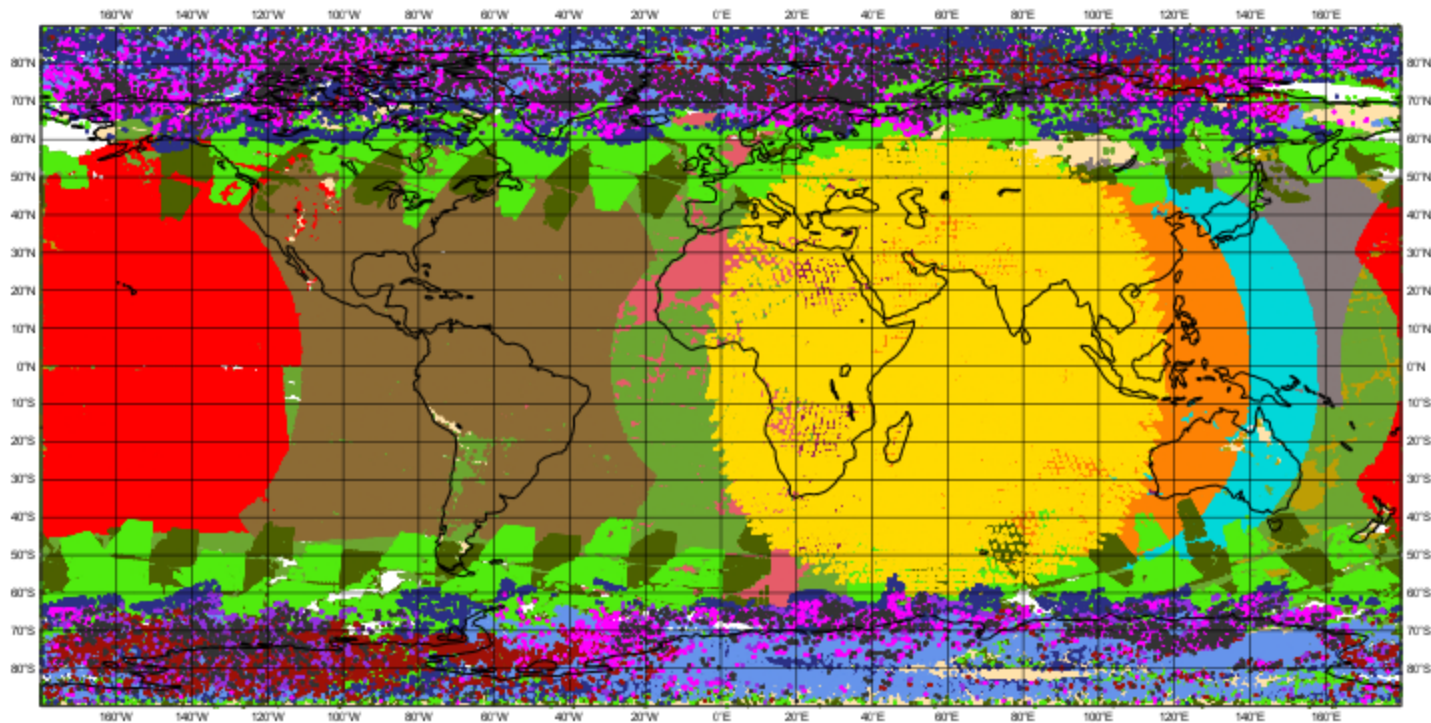
Katie Lean, Kirsti Salonen and Niels Bormann

13<sup>th</sup> International Winds Workshop, California, USA

[katie.lean@ecmwf.int](mailto:katie.lean@ecmwf.int)

# All AMVs at ECMWF

- Metop A ■ Metop B ■ Dual Metop A/B ■ GOES-13 ■ GOES-15
- Met-7 ■ Met-10 ■ AQUA ■ NOAA-15 ■ NOAA-18 ■ NOAA-19
- FY-2E ■ FY-2G ■ INSAT-3D ■ Himawari-8 ■ COMS-1 ■ SNPP ■ TERRA

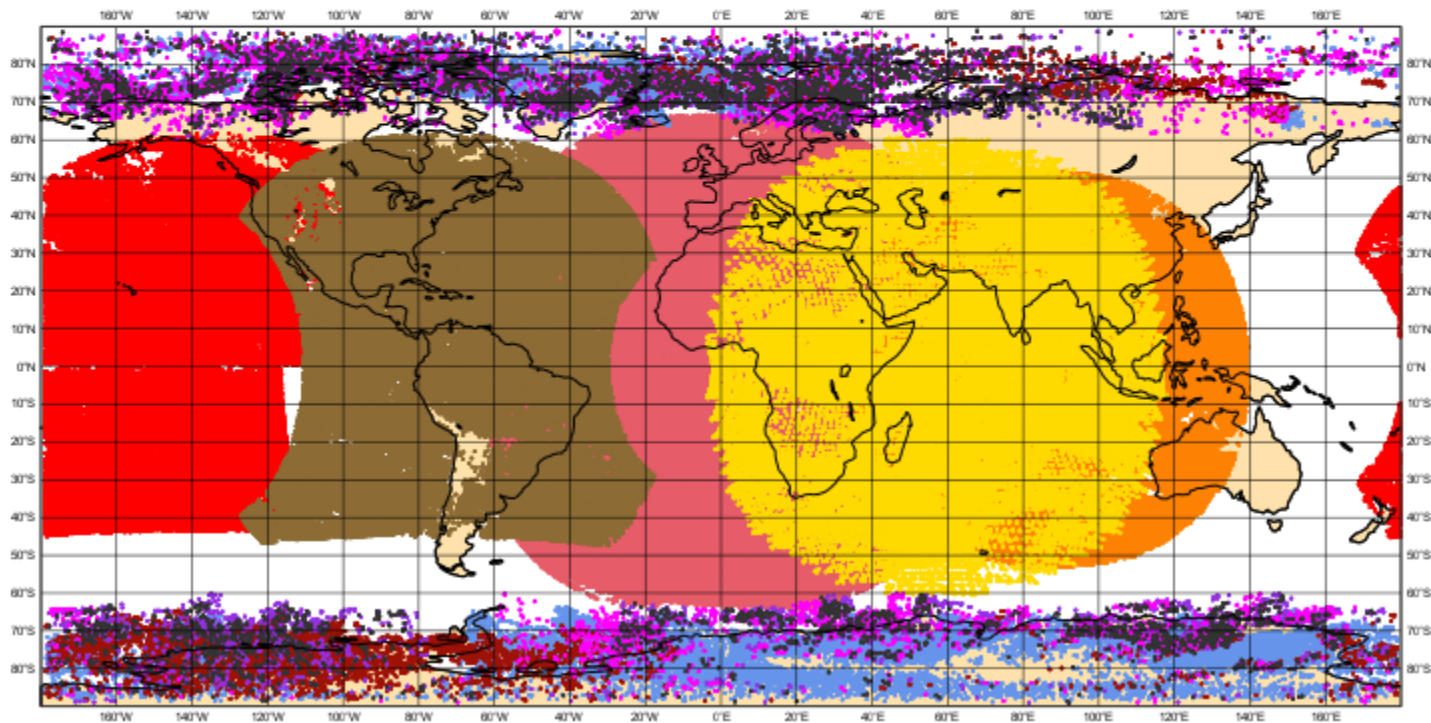


12Z 4<sup>th</sup> June 2016

# All AMVs at ECMWF

Without AMVs added in  
the past 2 years...

- Met-7
- FY-2E
- GOES-13
- GOES-15
- AQUA
- NOAA-15
- NOAA-18
- NOAA-19
- TERRA



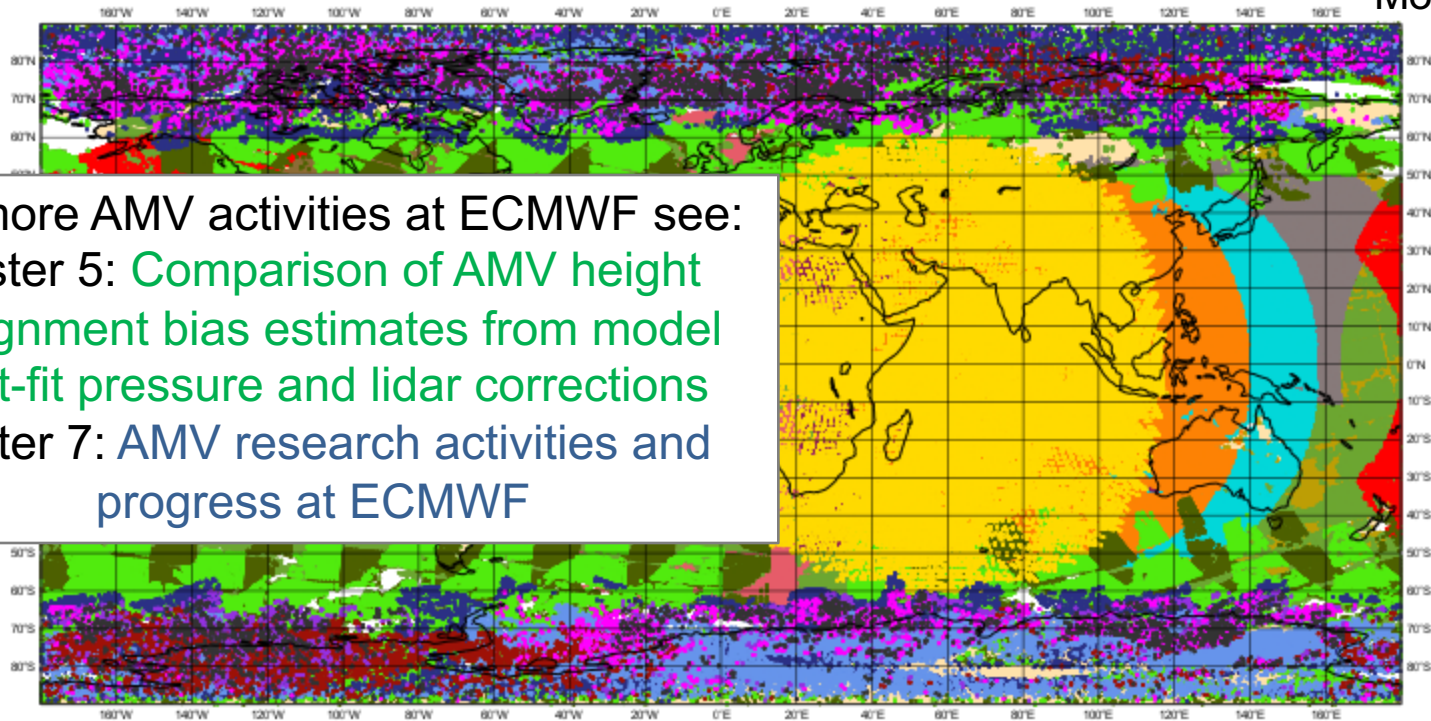
12Z 4<sup>th</sup> June 2016

# All AMVs at ECMWF

In operational use 4<sup>th</sup> Feb (see poster)

- Metop A
- Metop B
- Dual Metop A/B
- GOES-13
- GOES-15
- Met-7
- Met-10
- AQUA
- NOAA-15
- NOAA-18
- NOAA-19
- FY-2E
- FY-2G
- INSAT-3D
- Himawari-8
- COMS-1
- SNPP
- TERRA

Monitored only



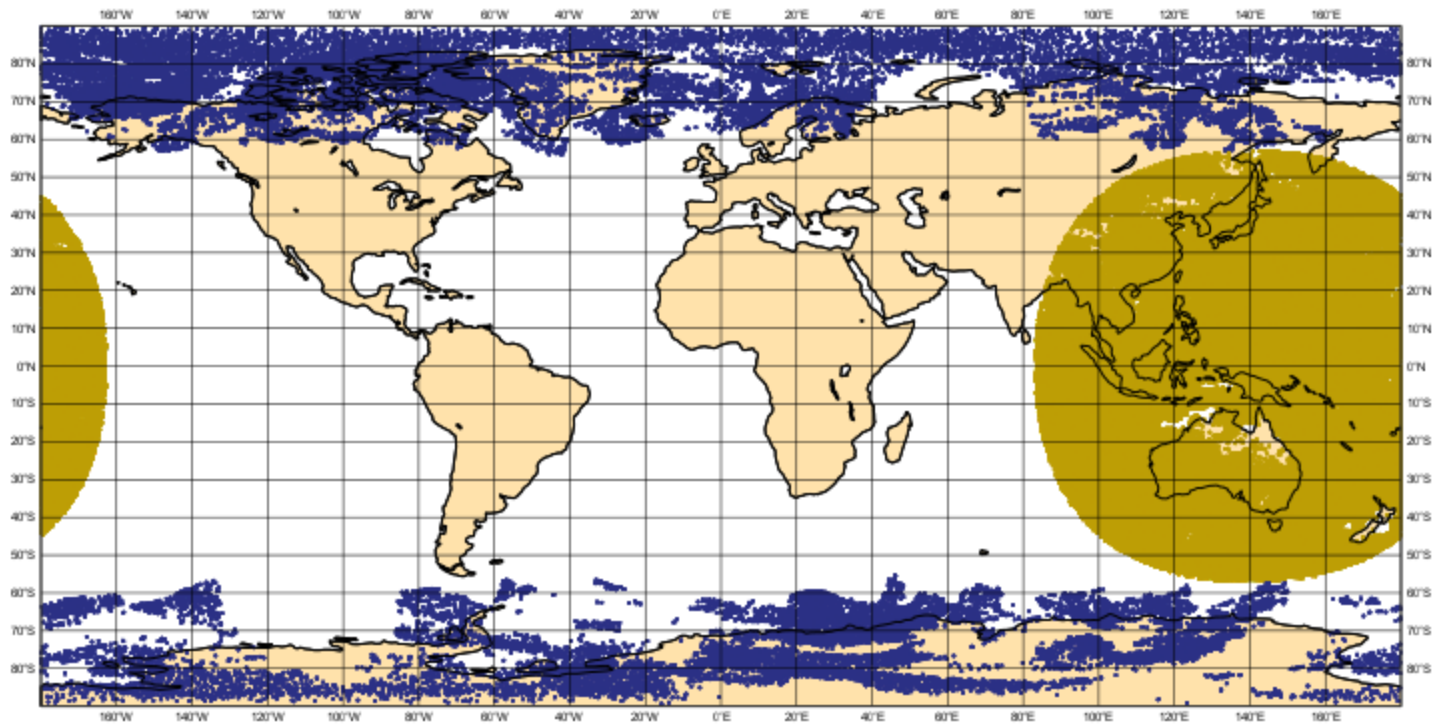
For more AMV activities at ECMWF see:  
Poster 5: Comparison of AMV height assignment bias estimates from model best-fit pressure and lidar corrections  
Poster 7: AMV research activities and progress at ECMWF

12Z 4<sup>th</sup> June 2016

# New AMVs at ECMWF

■ Himawari-8

■ SNPP



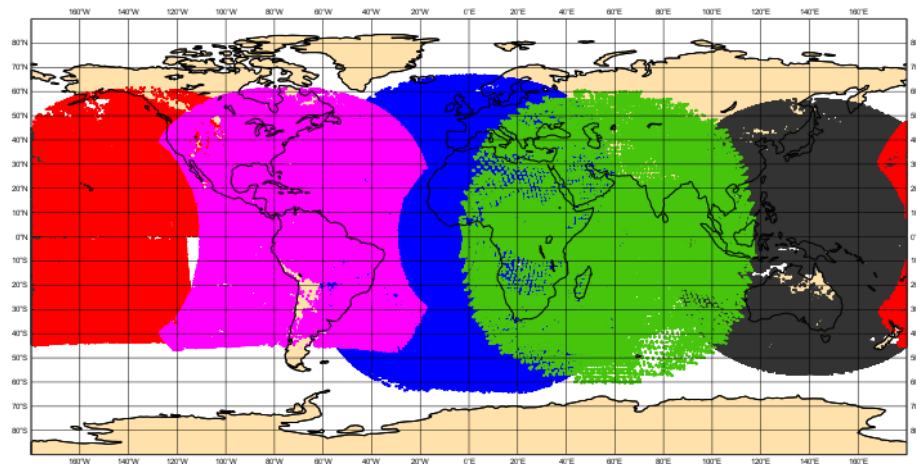
12Z 4<sup>th</sup> June 2016

# Himawari-8 AMVs

# Replacing MTSAT-2 with Himawari-8

- Replacement for MTSAT-2
- Himawari-8 launched Oct 2014
- New imager: **A**dvanced **H**imawari **I**mager (AHI)

■ Himawari-8 ■ Met-7 ■ Met-10  
■ GOES-13 ■ GOES-15



Geo AMV  
coverage

## Replacing MTSAT-2 with Himawari-8

- Replacement for MTSAT-2
- Himawari-8 launched Oct 2014
- New imager: **A**dvanced **H**imawari **I**mager (AHI)

<b>Feature</b>	<b>Himawari-8/AHI</b>	<b>MTSAT-2/IMAGER</b>
Location	140E	145E



## Replacing MTSAT-2 with Himawari-8

- Replacement for MTSAT-2
- Himawari-8 launched Oct 2014
- New imager: **A**dvanced **H**imawari **I**mager (AHI)

<b>Feature</b>	<b>Himawari-8/AHI</b>	<b>MTSAT-2/IMAGER</b>
Location	140E	145E
Spatial resolution	2km for IR, 0.5-1km for Vis	4km for IR, 1km for Vis

# Replacing MTSAT-2 with Himawari-8

- Replacement for MTSAT-2
- Himawari-8 launched Oct 2014
- New imager: **A**dvanced **H**imawari **I**mager (AHI)

Feature	Himawari-8/AHI	MTSAT-2/IMAGER
Location	140E	145E
Spatial resolution	2km for IR, 0.5-1km for Vis	4km for IR, 1km for Vis
Total channels	16	5
Channels for AMVs	3 x WV 1 x IR 1 x Vis	1 x WV 1 x IR 1 x Vis

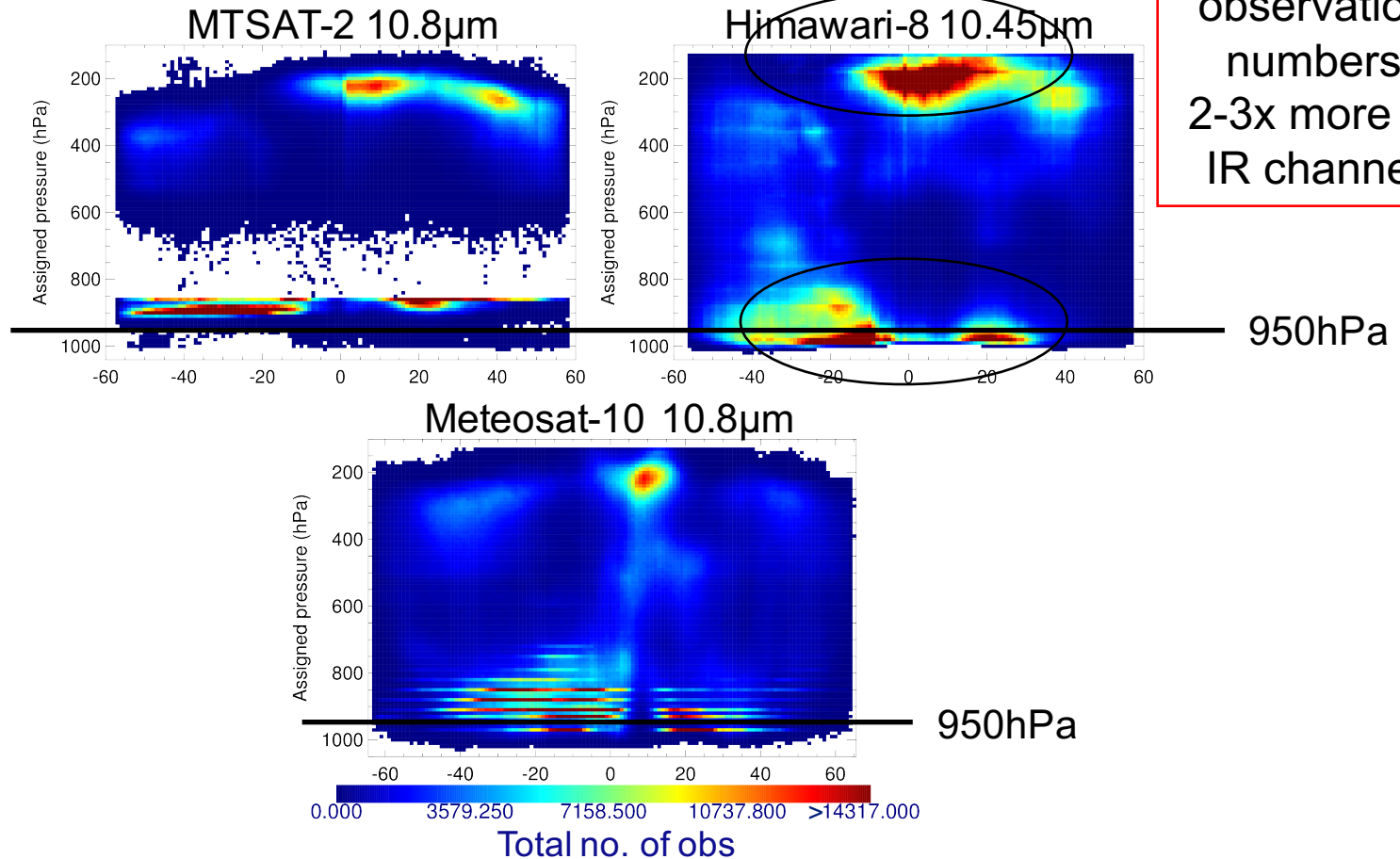
New tracking and height assignment methods

# Assessing Himawari-8

- Initial comparison of statistics with MTSAT-2/Meteosat-10
- Determine potential configurations for assimilation
- Run assimilation experiments to test:
  - Impact on forecast
  - Impact on the fit of other observation sources to model background
- Second iteration after initial operational implementation

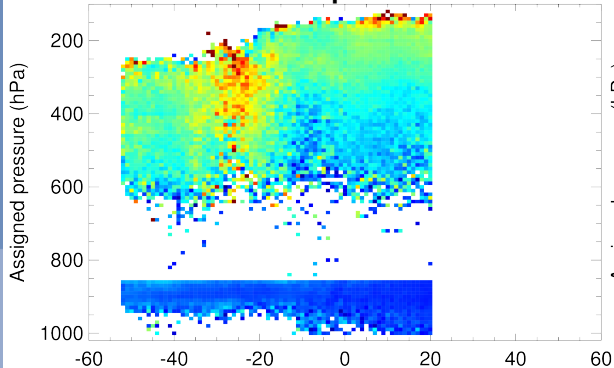
# Zonal statistics: Distribution of observations

19<sup>th</sup> June – 31<sup>st</sup> Aug

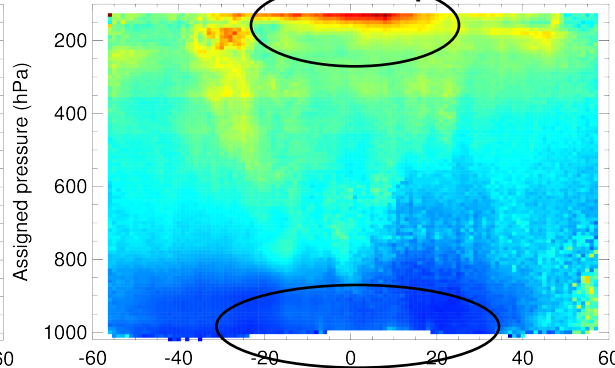


# Zonal statistics: RMSVD

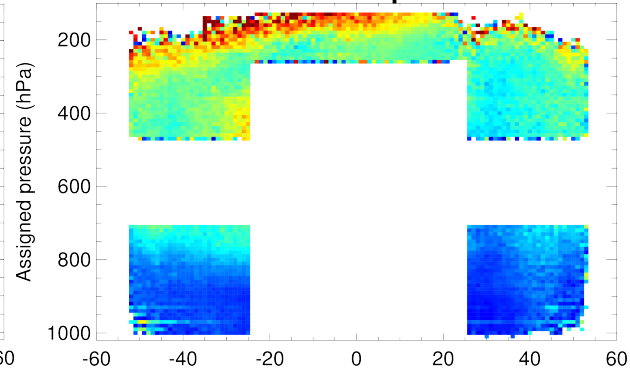
MTSAT-2 10.8 $\mu$ m active data



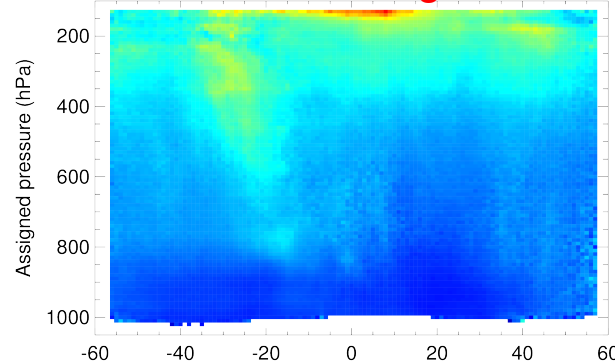
Himawari-8 10.45 $\mu$ m all data



Meteosat-10 10.8 $\mu$ m active data



Himawari-8 after 1<sup>st</sup> guess check



- Himawari-8 statistics look much improved
- Speed bias appears improved

- Seasonal large biases removed
- Similar height errors calculated

## Initial implementation

- Initial comparison showed **very promising results**
- **Many AMVs added** to system
- Attempts to use more channels/coverage produced **some positive, some negative** impacts
- Stricter thresholds **reduced** some negative impacts
- Initially using conservative set up similar to MTSAT-2

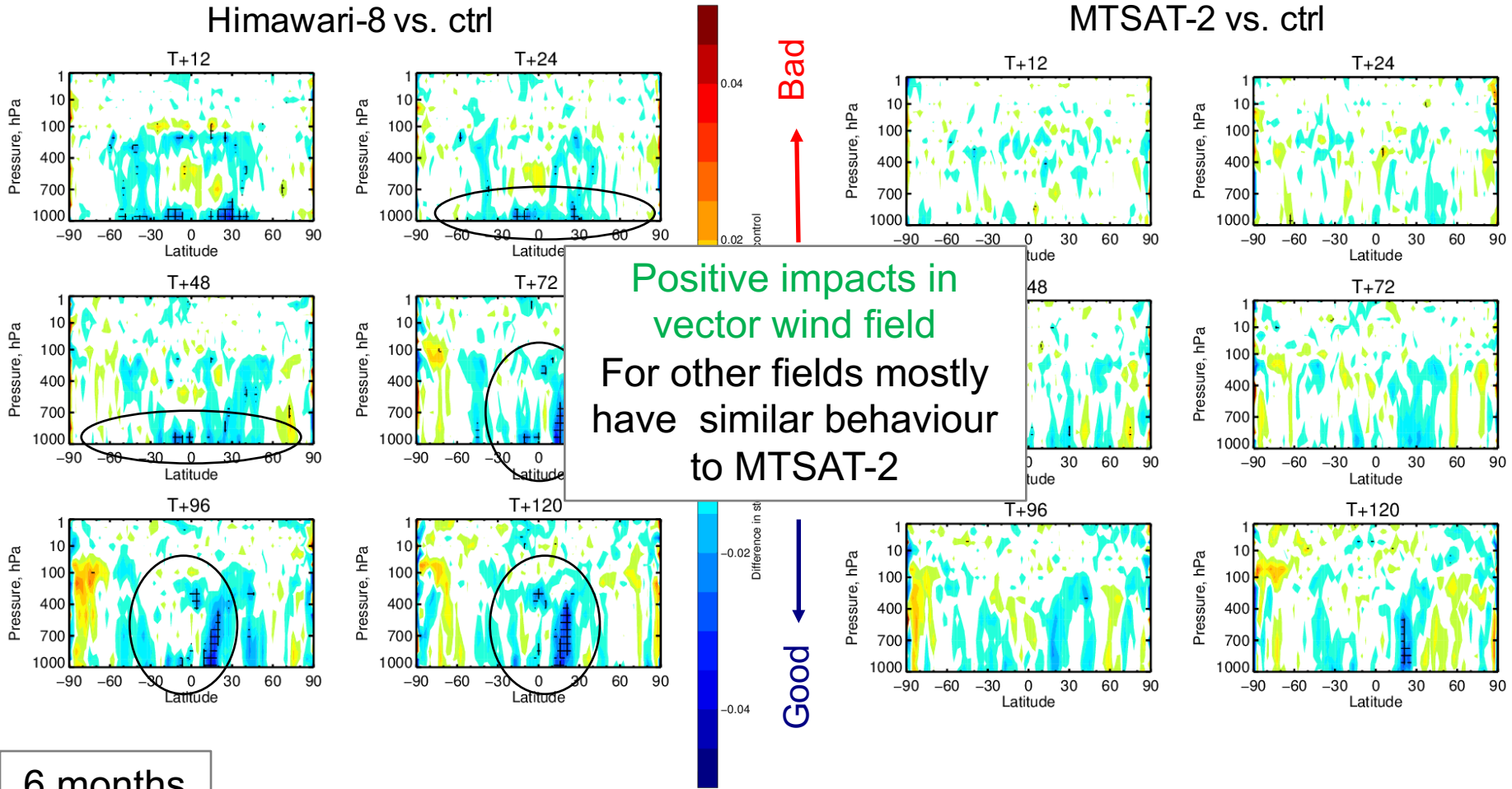
WV 6.95 $\mu$ m 150 < P < 400hPa

IR > 150hPa (screened in tropics > 300hPa)

Vis > 700hPa

# Impact on forecasts: change in error in vector wind

Control = no  
MTSAT-2



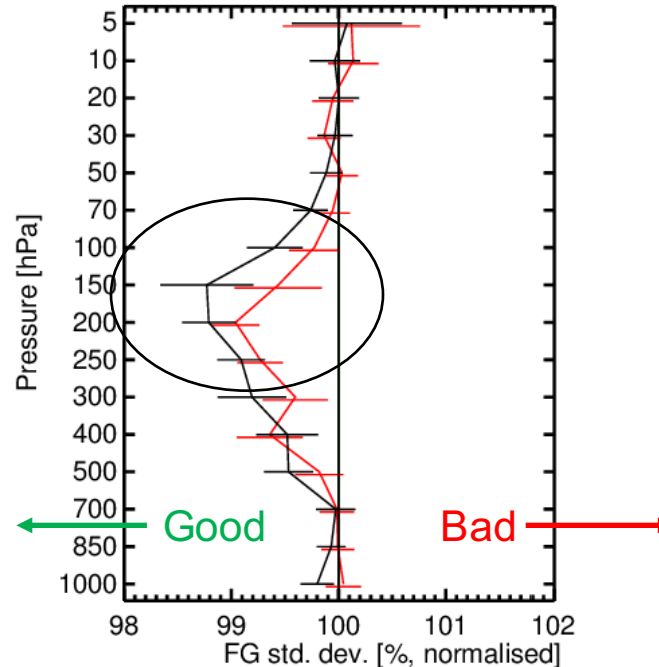
6 months  
(summer  
+ winter)

# Fits of other observations to model background

AIREP AMprofiler EUprofiler JPprofiler  
PILOT TEMP – U and V wind (tropics)

Both have +ve impact for ATMS humidity channels.

Impact similar for MTSAT-2 and Himawari-8 for other instruments.



Using ~150-200% more AMVs at most pressure levels

**AMVs became operational 15<sup>th</sup> March 2016**

6 months (summer + winter)

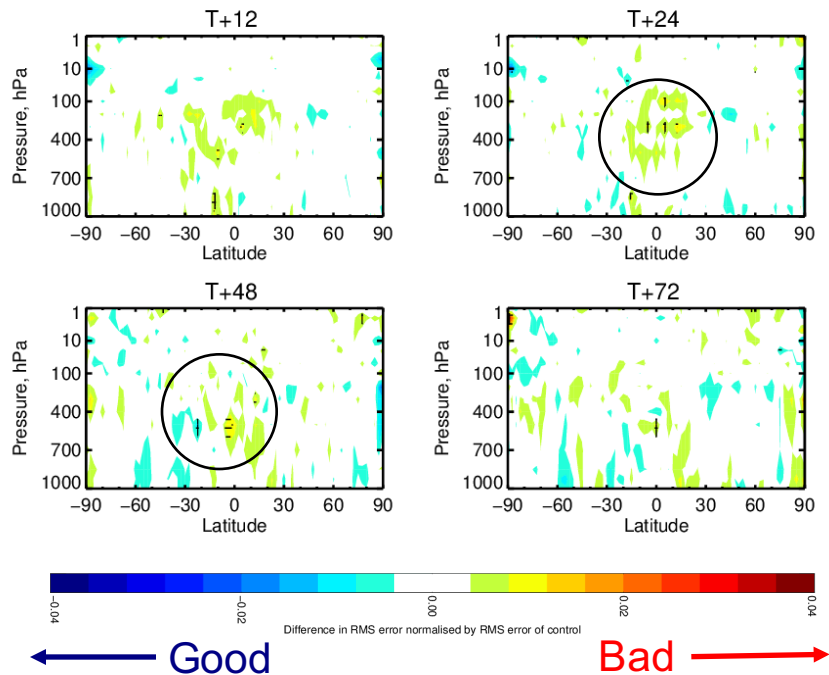
— Himawari-8  
— MTSAT-2



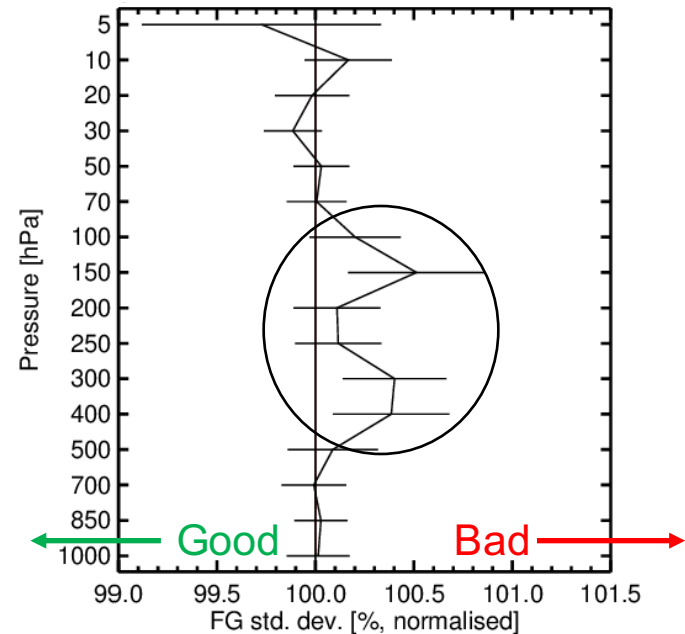
# Second iteration – additional WV AMVs

- Add AMVs from 6.25 $\mu$ m and 7.35 $\mu$ m

## Forecast impact on vector wind



## AIREP AMprofiler EUprofiler JPprofiler PILOT TEMP – U and V wind (tropics)



- Number of AMVs increases ~7-15% between 150-400hPa
- Is there some conflict between the channels?

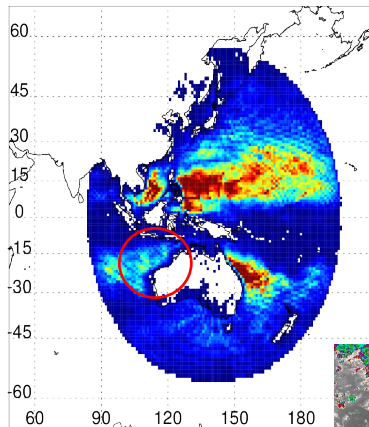
Control =  
current  
Himawari-8  
use

6 months  
(summer + winter)

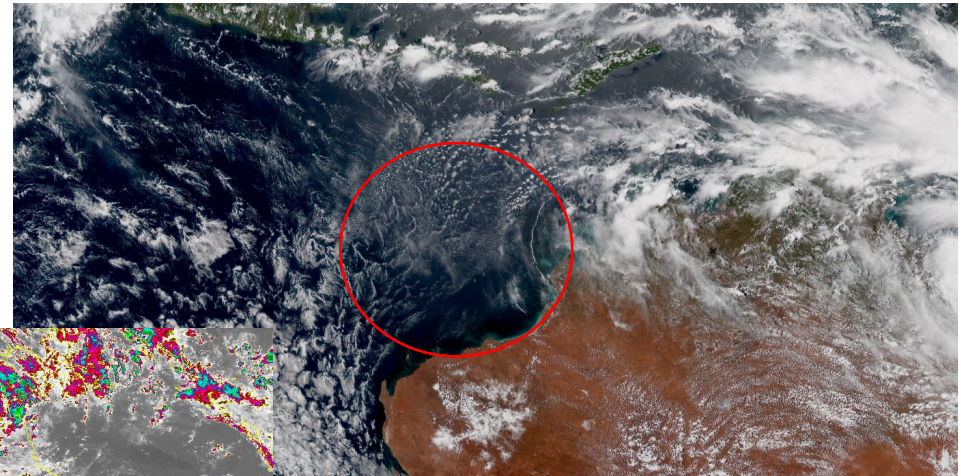
# Second iteration – removing near surface winds?

- Many winds  $P > 950\text{hPa}$  unlike other satellites
- Found mostly in regions of broken, small, low cloud

True colour image



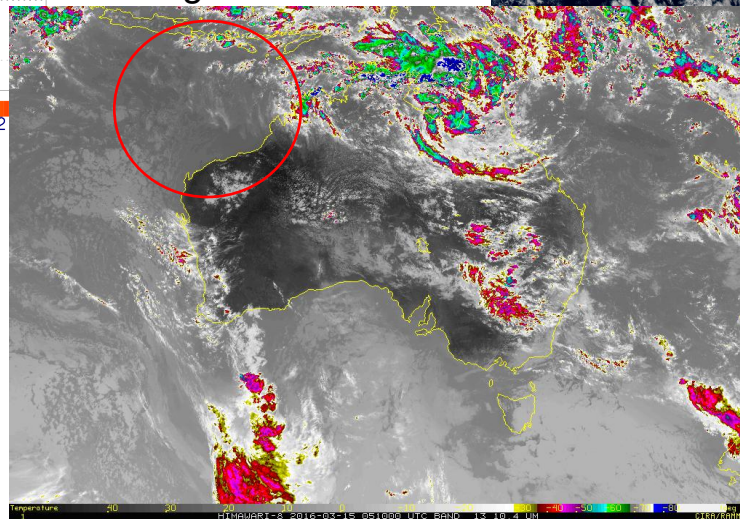
Case study  
15<sup>th</sup> March  
2016



0.000 175.727 351.455 527.182

No. of obs  $P > 950\text{hPa}$   
~3 weeks (IR channel)

Images from NOAA  
Regional and Mesoscale  
Meteorology Branch  
(courtesy of JMA)  
<http://rammb.cira.colostate.edu/ramsd/online/himawari-8.asp>



- Difficulty separating cloud and surface radiance
- ➔ Cloud top estimated  
~ half way between  
surface and cloud top

No obvious adverse impact in O-B statistics and forecast impacts very positive.  
Model fit to scatterometer winds improved

# Future use of Himawari-8

- Good impact from current configuration
- Extra water vapour AMVs have **slightly negative** impact
- Near surface winds not causing damage...
- ...instead impact appears **mostly positive**
- **Continue with same use as present**

# VIIRS AMVs

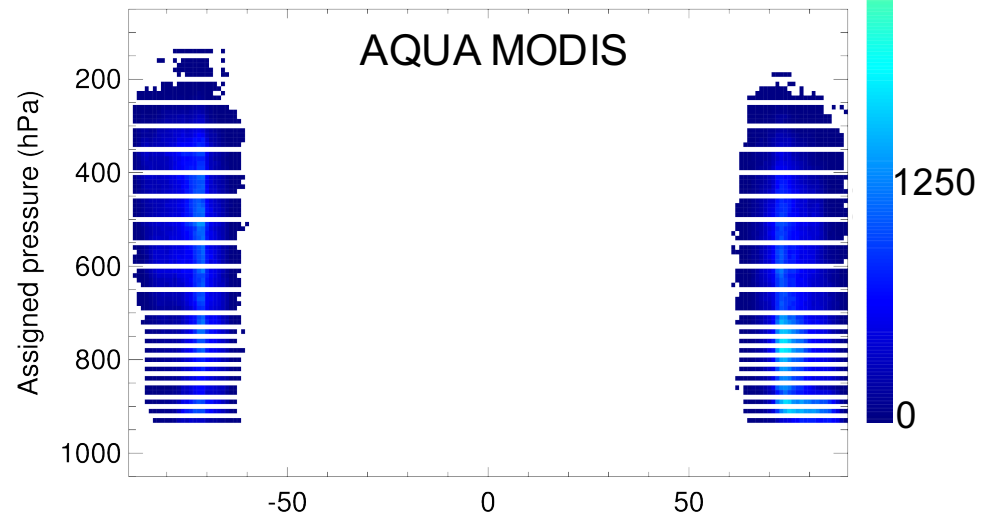
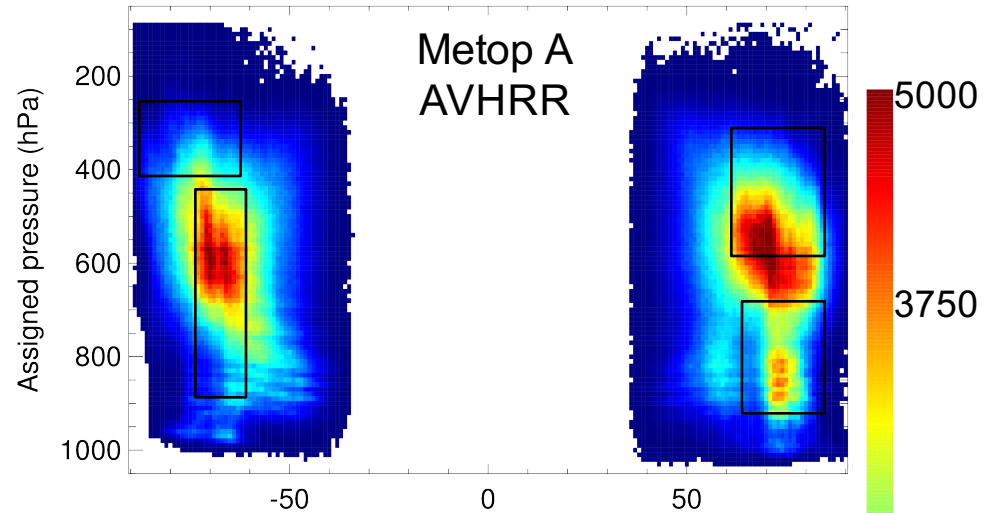
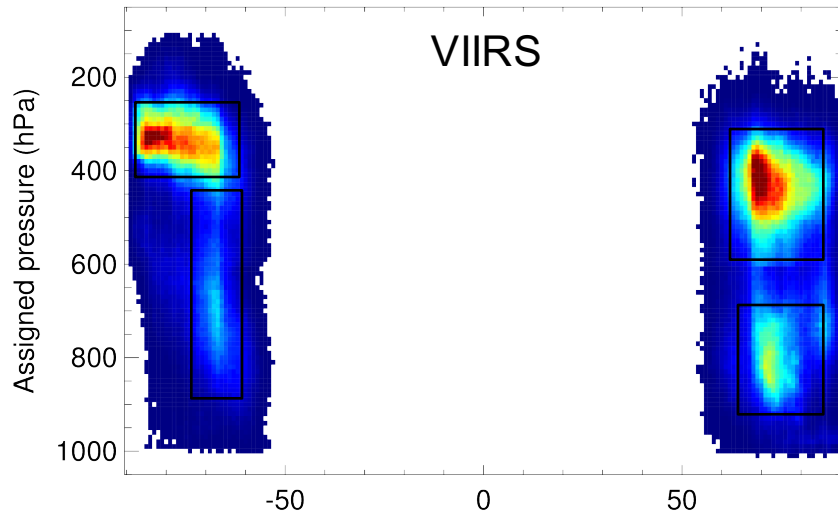
# Background

- Launched in October 2011 on Suomi-NPP satellite
- AMVs operationally produced since May 2014
- AMVs derived from infrared channel
- Routinely available at ECMWF from 26<sup>th</sup> Feb 2015
- Instrument design details:
  - Wider swath (3000km) than MODIS (2320km) and AVHRR (2600km)
  - Higher resolution (0.56km<sup>2</sup> compared to 1km<sup>2</sup>)
  - Constrained pixel growth
- Uses GOES-R AMV algorithm with triplet of images

AMV distribution → first guess departure statistics →  
assimilation experiments → final decision

# Number of AMVs

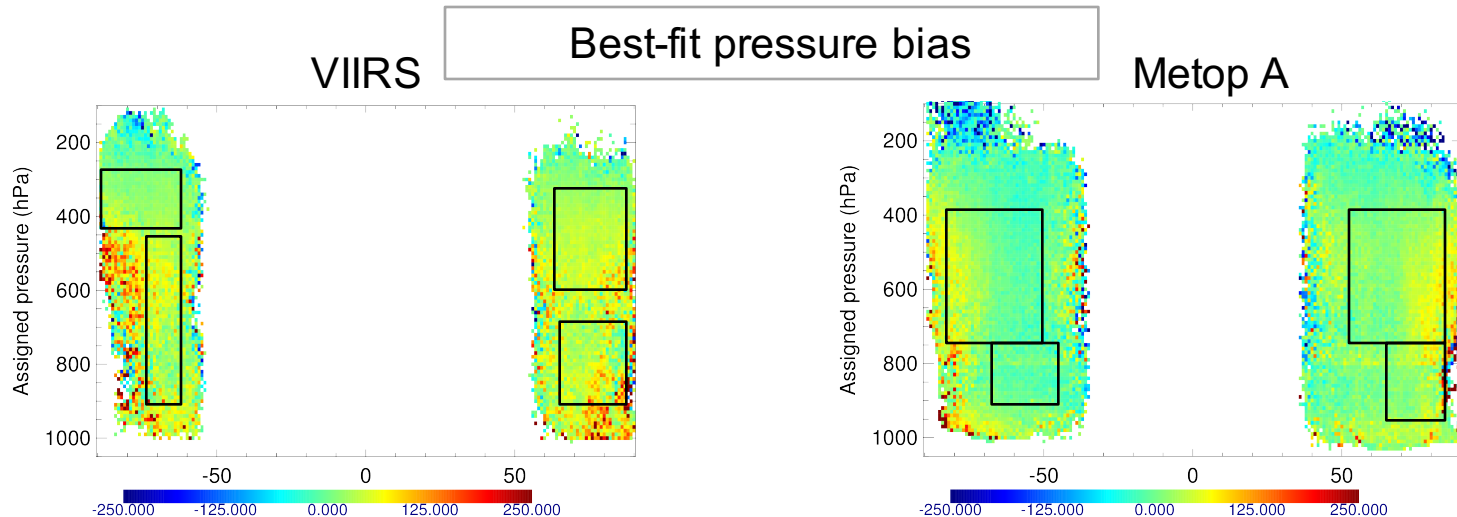
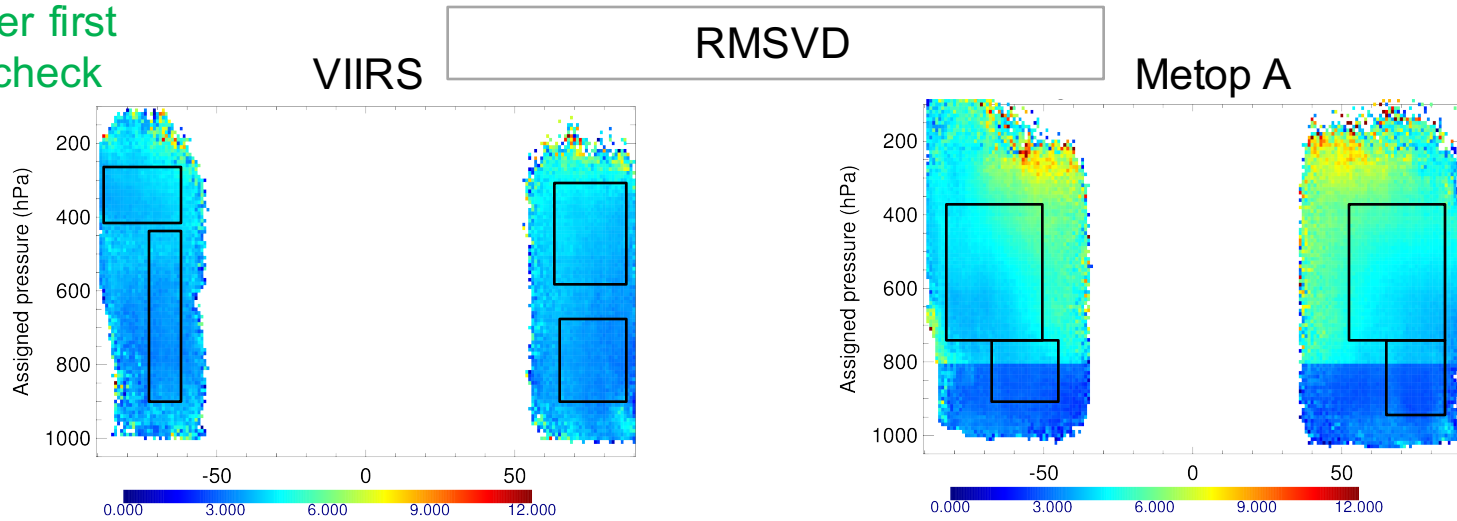
1<sup>st</sup> Oct – 30<sup>th</sup> Nov 2015  
All data



# Data quality

1<sup>st</sup> Oct – 30<sup>th</sup> Nov

Data after first  
guess check

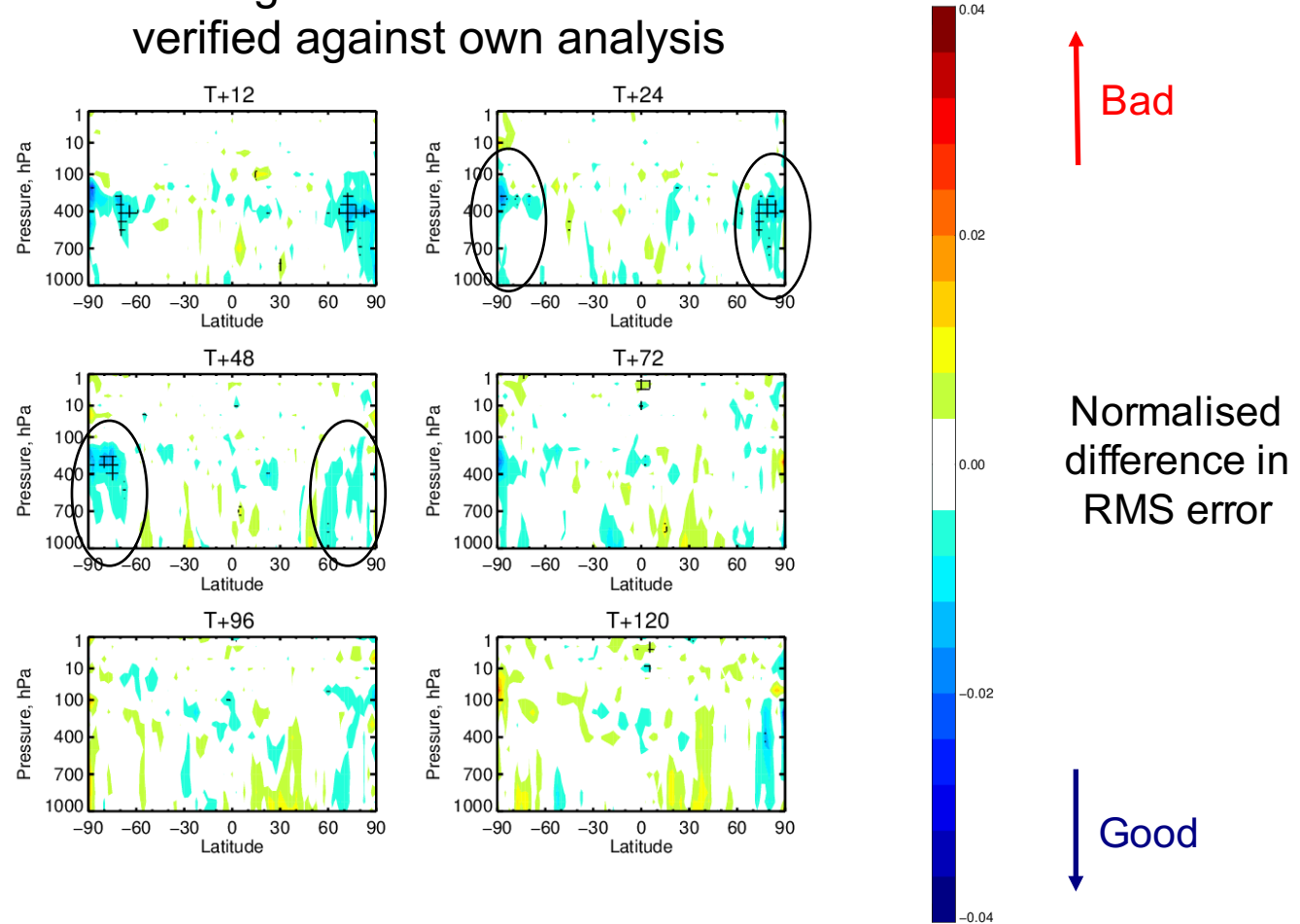


# Assimilation experiments: forecast impacts

Using standard blacklisting for polar orbiting satellite

7 months (summer + winter)

Change in vector wind error verified against own analysis

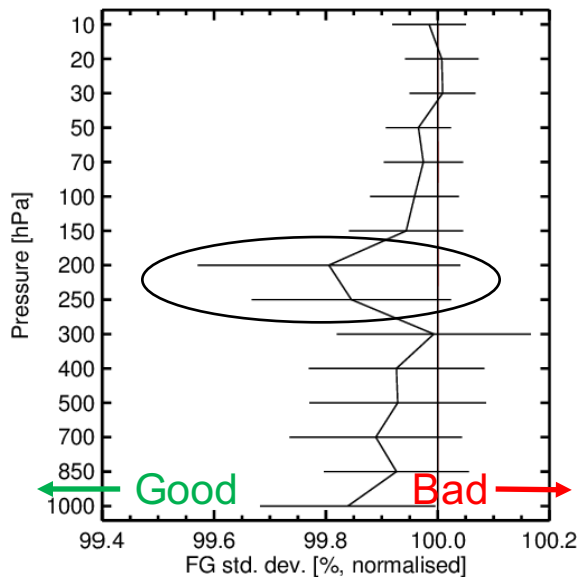




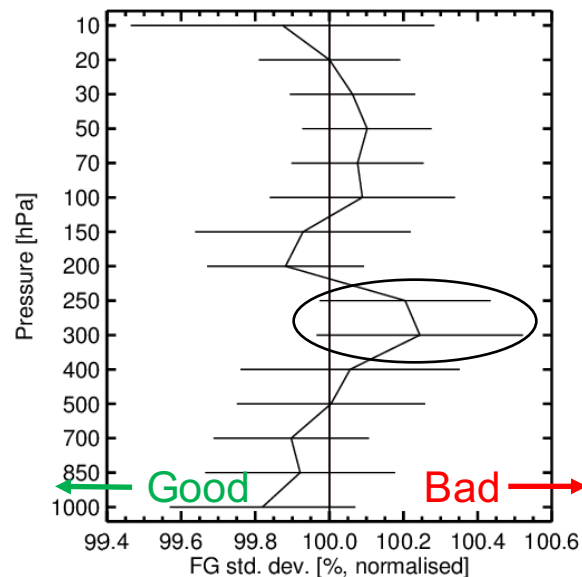
# Assimilation experiments: wind observations fit

AIREP AM profiler EU profiler JP profiler  
PILOT TEMP – U and V wind

Northern Hemisphere (>20N)



Southern Hemisphere (>20S)



Small disagreement...

7 months  
(summer  
+ winter)

# Summary

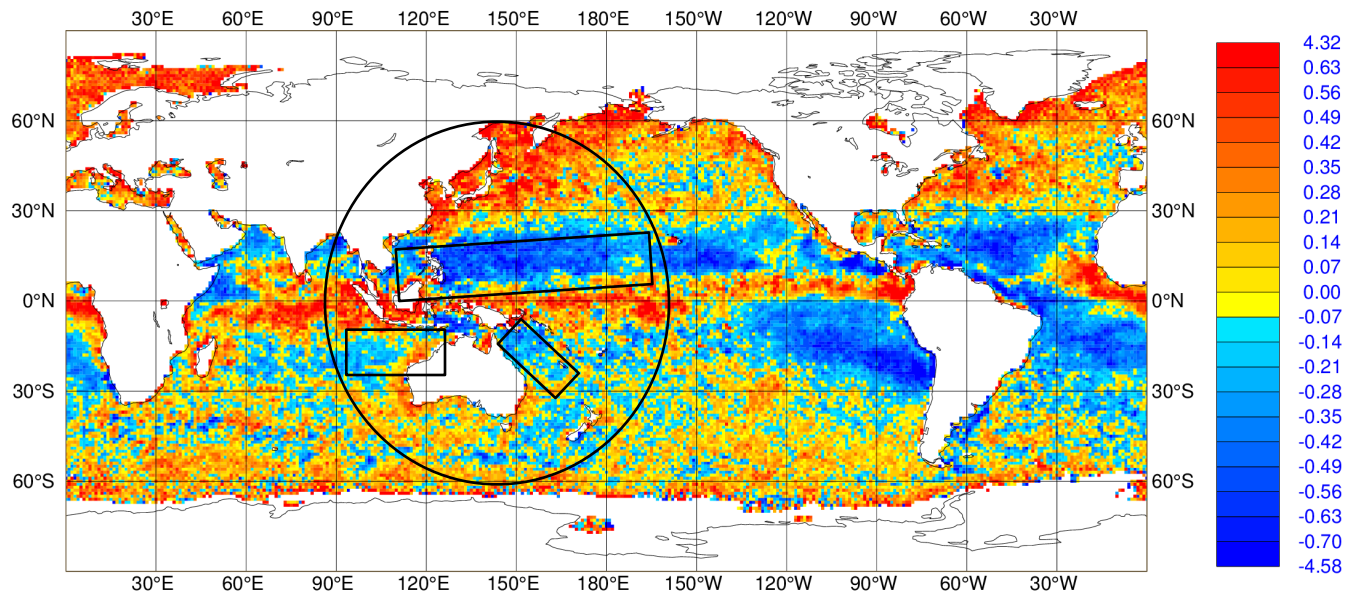
- First guess departures looked encouraging compared to Metop
- Forecast impacts mostly neutral but **slightly positive in polar regions at short range**
- Mixed impacts on observation fits (North/South divide)...
- ...But overall changes are small
- Plan to implement operationally this summer

Thank you for listening!

# Near surface winds – fit of scatterometer winds

No obvious adverse **impact in O-B statistics** and **forecast impacts very positive**.  
Look to independent wind observations...

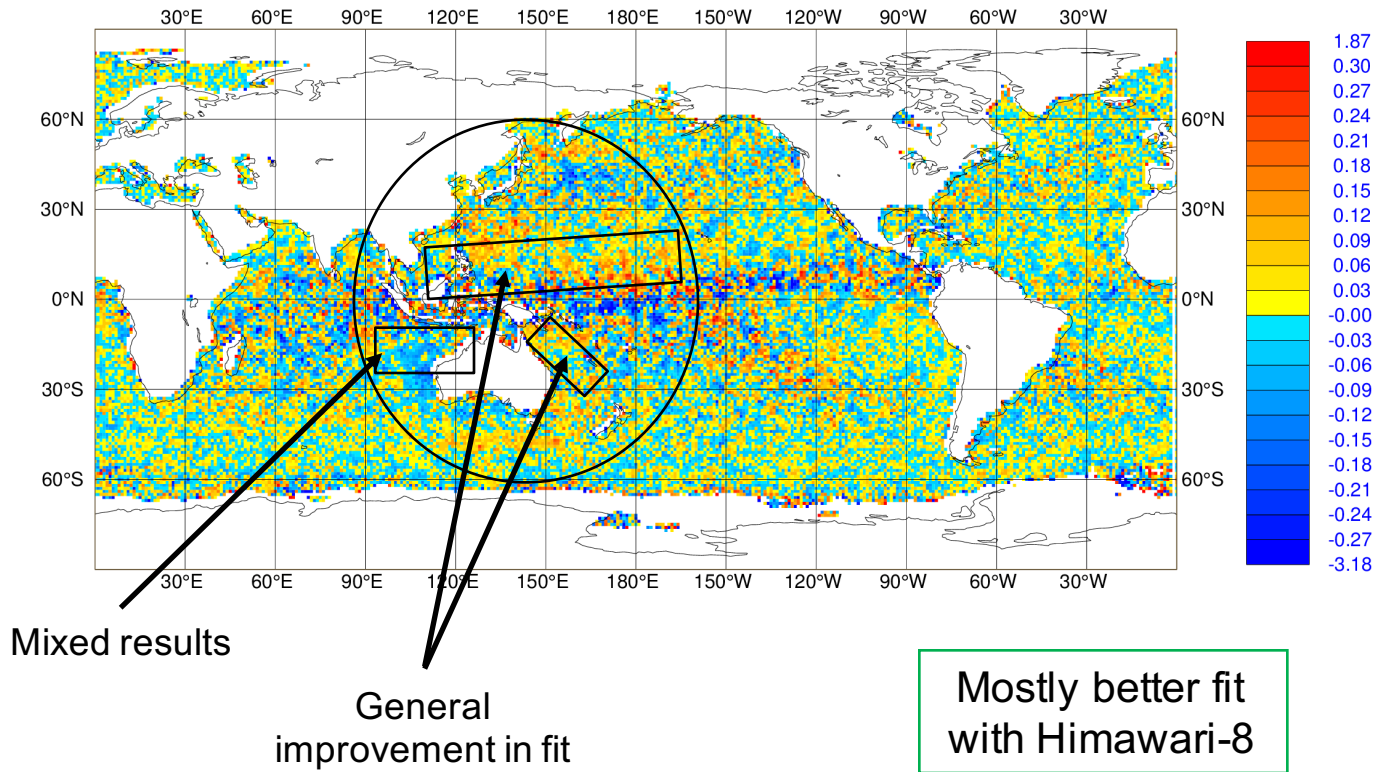
Bias (O-B) in 10m wind speed:  
Himawari-8 as operationally used



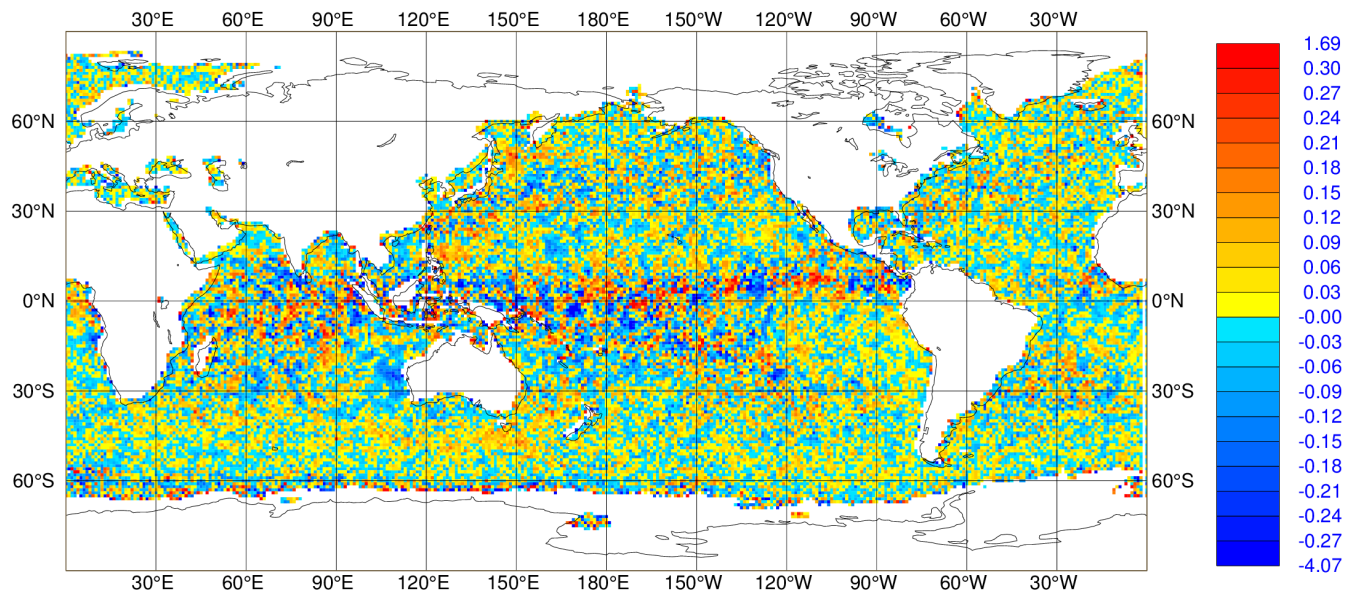
- Bias mostly negative areas of interest
  - Negative both with and without Himawari-8
- ➔ Him-8 **smaller bias** if difference  $(\text{Him-8} - \text{ctrl}) > 0$

# Near surface winds – fit of scatterometer winds

Difference in speed bias (O-B) at 10m:  
(Himawari-8 operational – no geostationary)

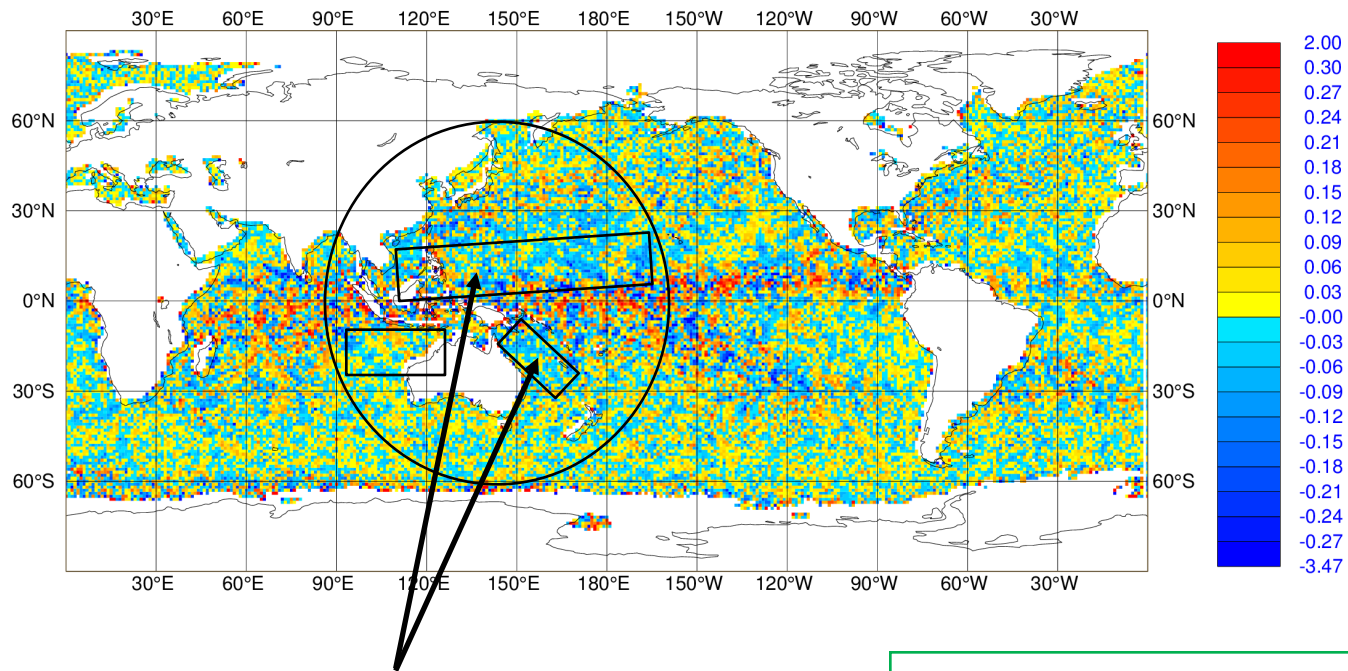


Difference in speed bias (O-B) at 10m:  
(Himawari-8 no near surf – no geostationary)



# Near surface winds – fit of scatterometer winds

Difference in speed bias (O-B) at 10m:  
(Himawari-8 with no near surface – Himawari-8 operational)

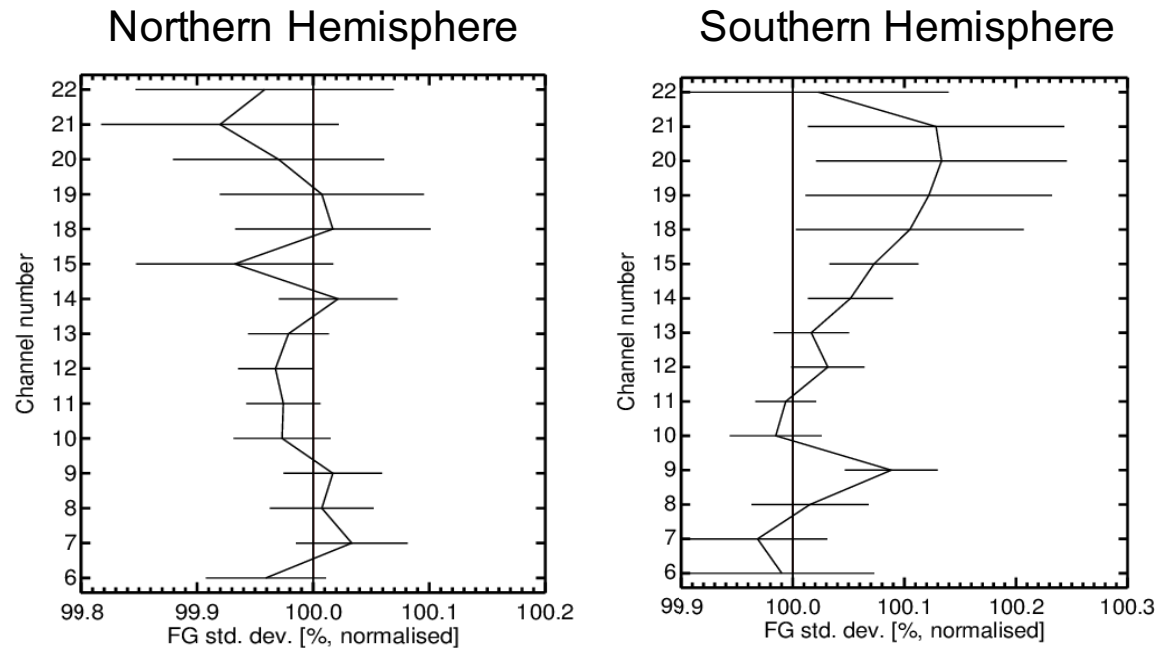


Fit worse when  
near surface  
removed

Fit to scatterometer  
improved more with low  
level winds present

# VIIRS assimilation experiments: humidity observation fit

ATMS



A little more disagreement...