AMV activities at ECMWF

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Key activities

- The Indian Ocean Data Coverage (IODC)
  - Meteosat-8 replaced Meteosat-7 on 2nd March as primary provider of Indian Ocean area (AMVs and Clear Sky/All Sky Radiances)
  - Study into potential other Indian Ocean options

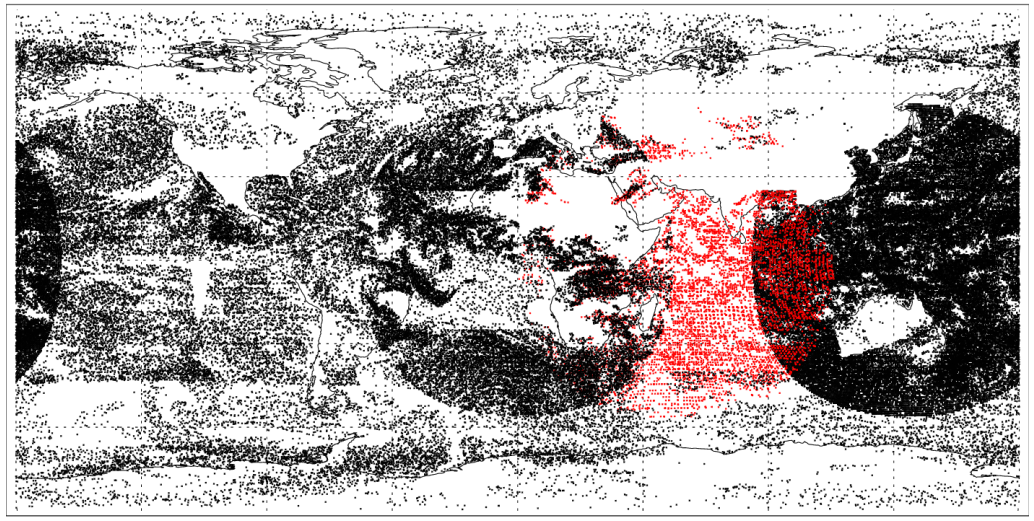
- Analysis of the new height assignment for Meteosat-10 (Optimal Cloud Analysis and new clear sky method)

- Assessment of GOES-13/-15 test data processed with new GOES-R algorithm

New provider of IODC

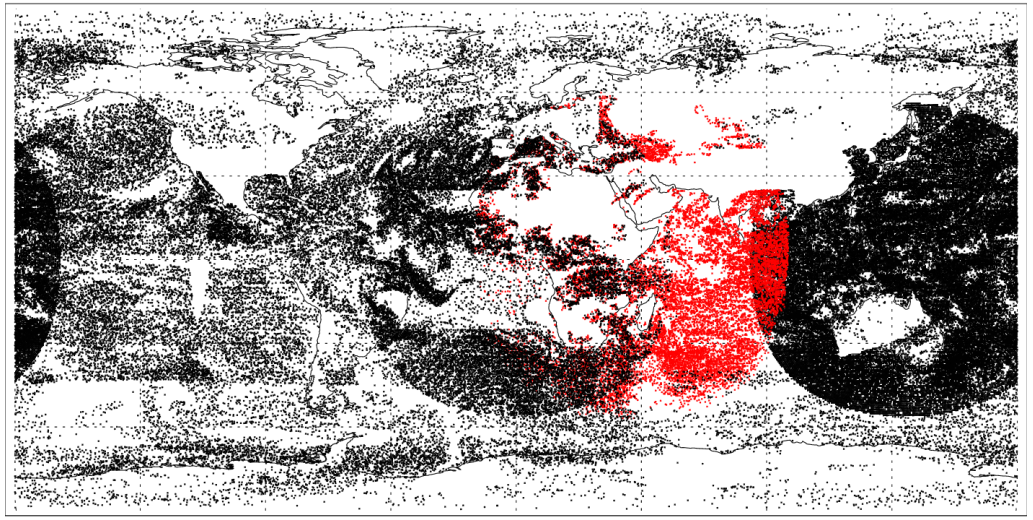
Met-7

All active AMVs 00z 25th October 2016: Met-7



Met-8

All active AMVs 00z 25th October 2016: Met-8



Improved first guess departures

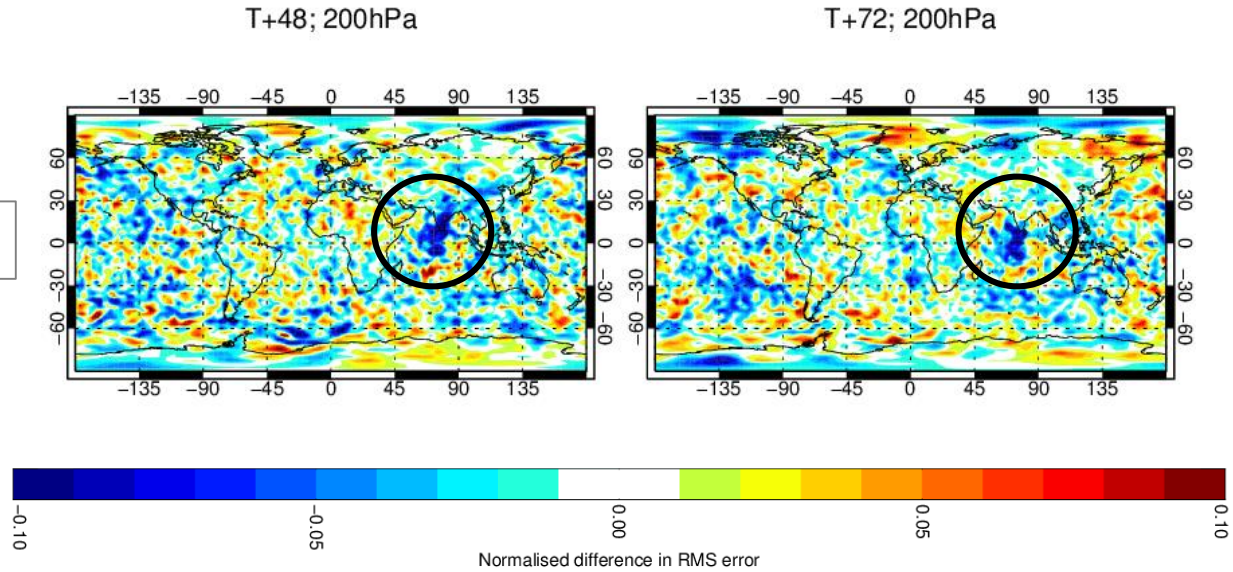
- Smaller RMSVD
- Large negative speed biases reduced in extra-tropics
- Similar data quality to Met-10

- Configuration proposed for assimilation similar to Met-10
  - → Same quality control choices with extra screening for Assigned pressure < 150hPa
  - → IR, Visible, 2 WV (6.25µm and 7.35µm)
- Control for experiments: No IODC AMVs (i.e. remove Met-7)

Continued benefit from IODC

Change in error in vector wind: 200hPa

Met-8



Met-7

- Positive impacts at high levels

21st Oct 2016 – 22nd Feb 2017

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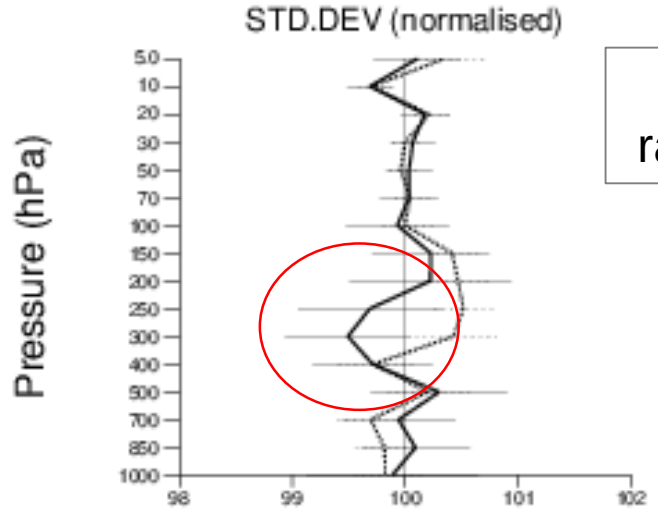
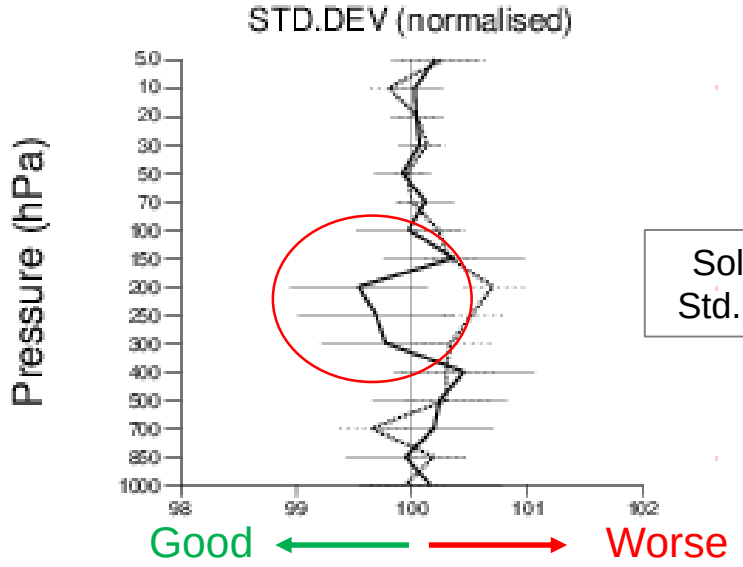
Continued benefit from IODC

Met-8



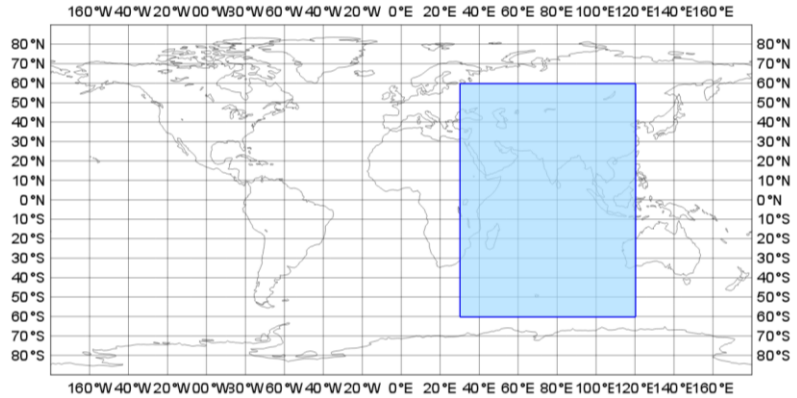
U wind radiosondes

Met-7



Solid line = Std. dev O-B

- Positive impacts at high levels
- Small changes in fit of independent obs but mostly neutral



1st Dec 2016 – 28th Feb 2017

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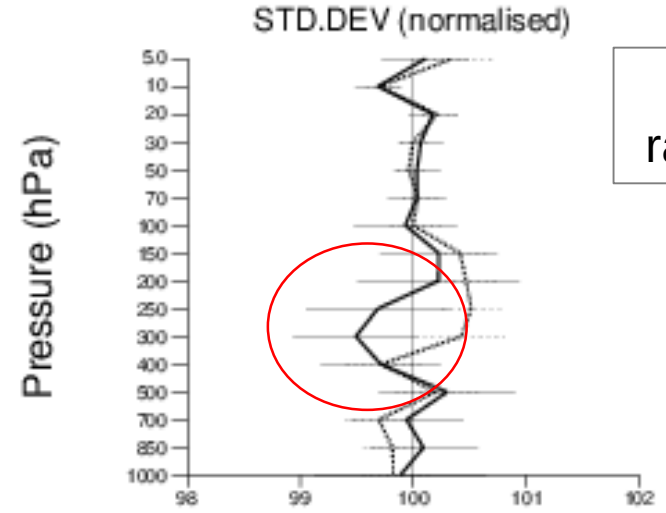
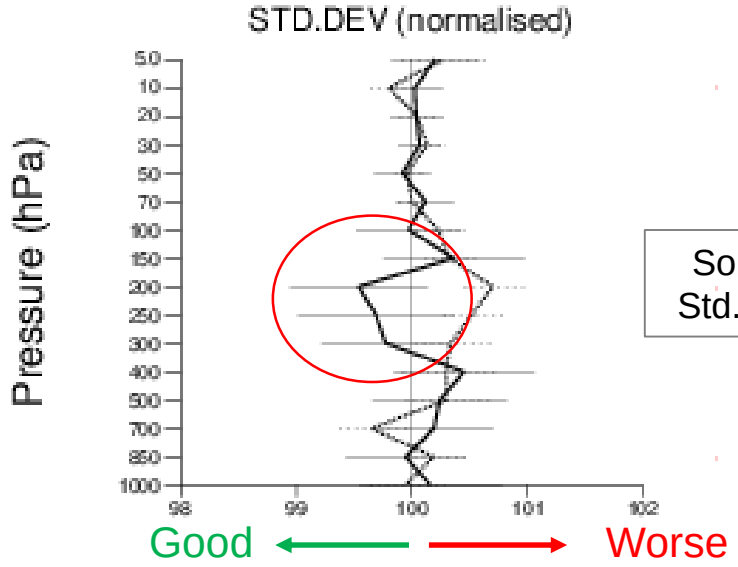
Continued benefit from IODC

Met-8



U wind radiosondes

Met-7



Solid line = Std. dev O-B

- Positive impacts at high levels
- Small changes in fit of independent obs but mostly neutral
- Area of apparent degradation at 850hPa for first half of experiment
- Identified as challenging area for model

Overall Met-8 improvement over Met-7
→ Switch in operations on 2nd March 2017

1st Dec 2016 – 28th Feb 2017

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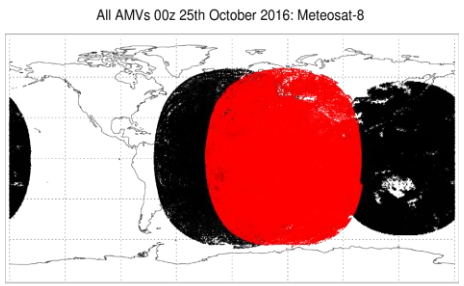
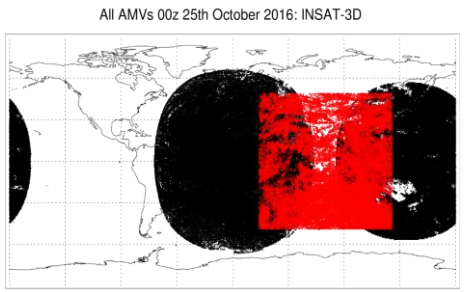
Other options for the Indian Ocean

IODC options

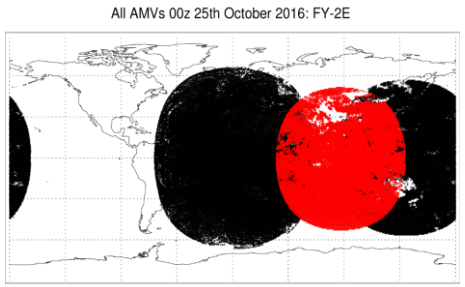
Met-8



INSAT-3D



FY-2E



(FY-2G also available but poorer Indian Ocean spatial coverage and very similar to FY-2E)

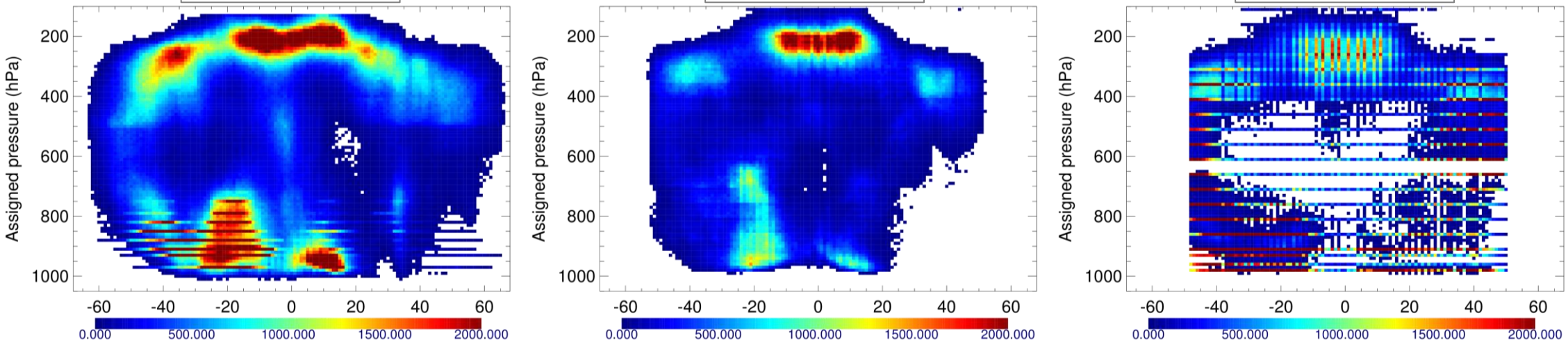
- Differences in:
  - channels available
  - spatial/temporal resolution
  - derivation algorithms
- Initial data quality assessment shows different characteristics
- Also account for impact of All Sky Radiances

Variation in first guess departures

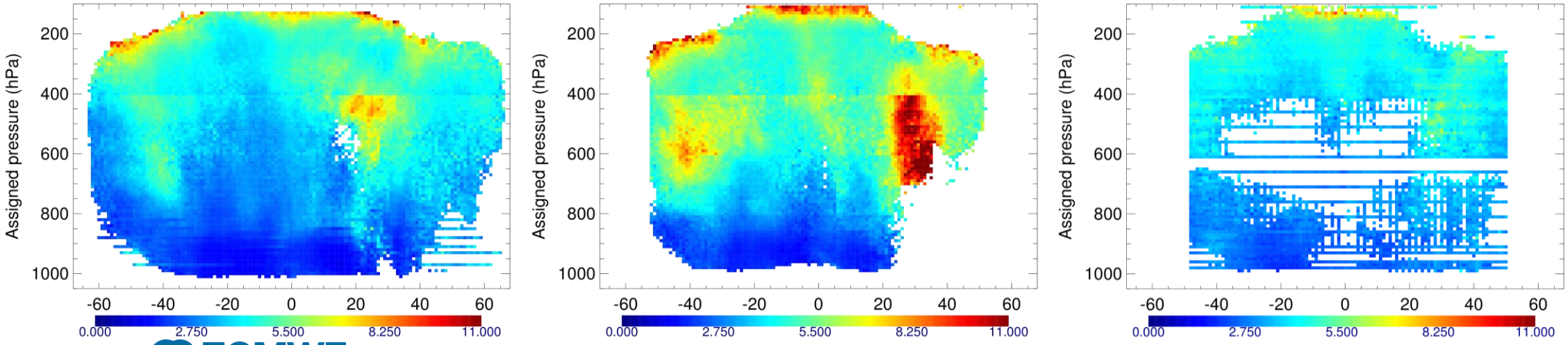
1st Dec 2016 – 15th Jan 2017
QI screen, first guess check and n > 20

Met-8 | FY-2E | INSAT-3D

No. of AMVs



RMSVD

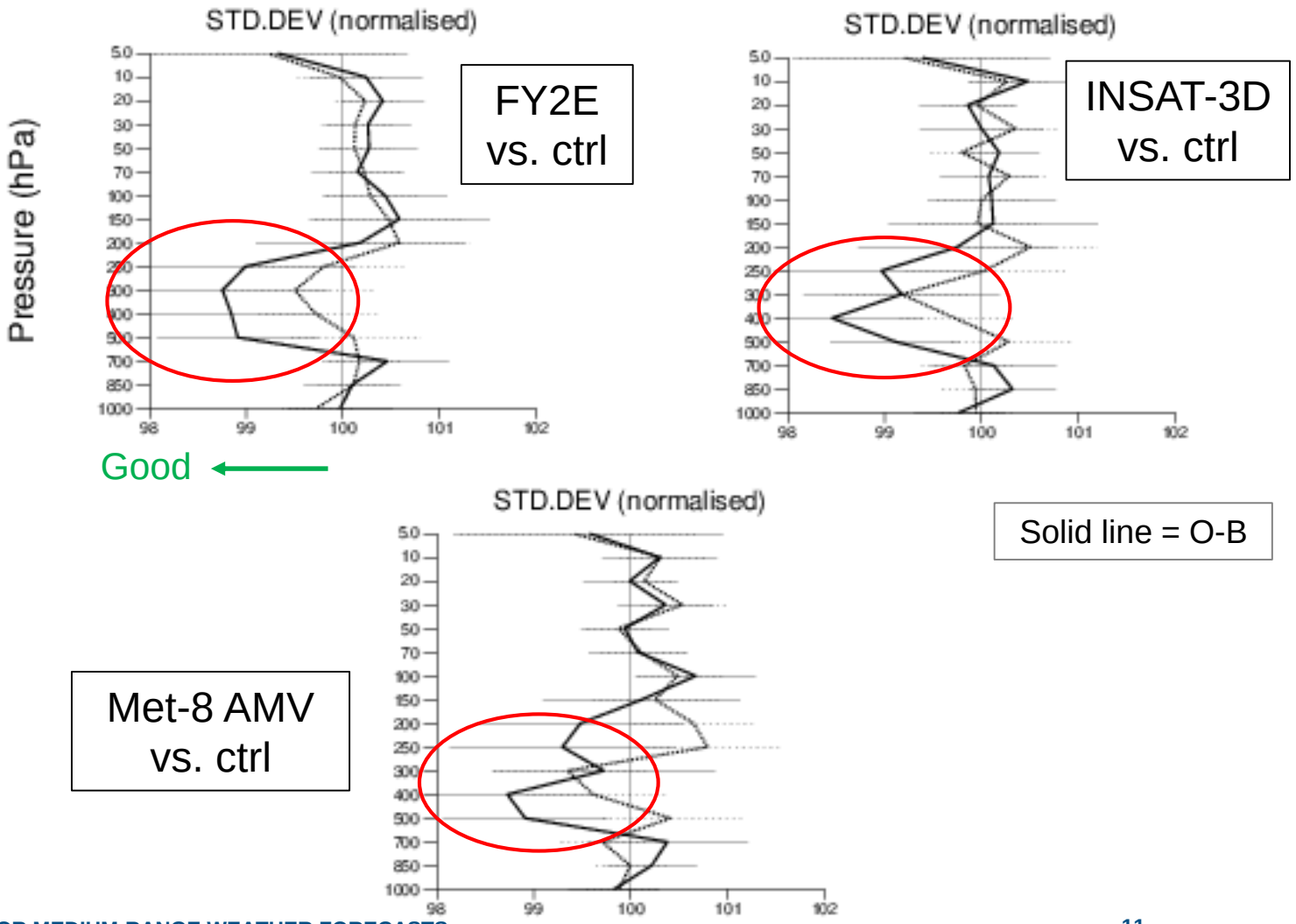


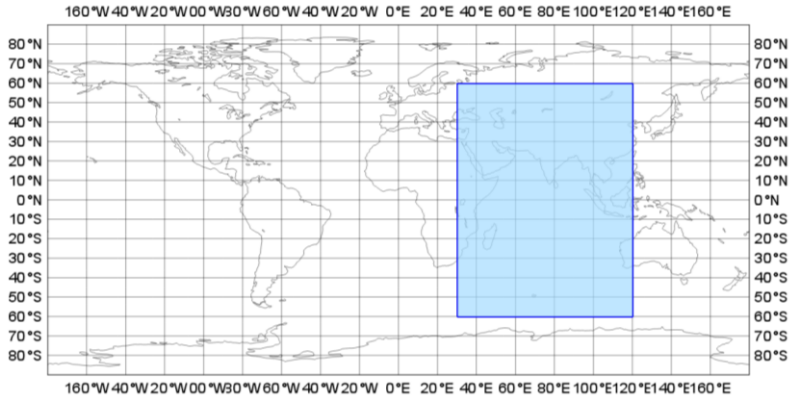
Similar impacts in assimilation

1st Dec – 28th Feb

- Small but positive changes against own analysis
- Small positive/neutral changes in fit of independent obs

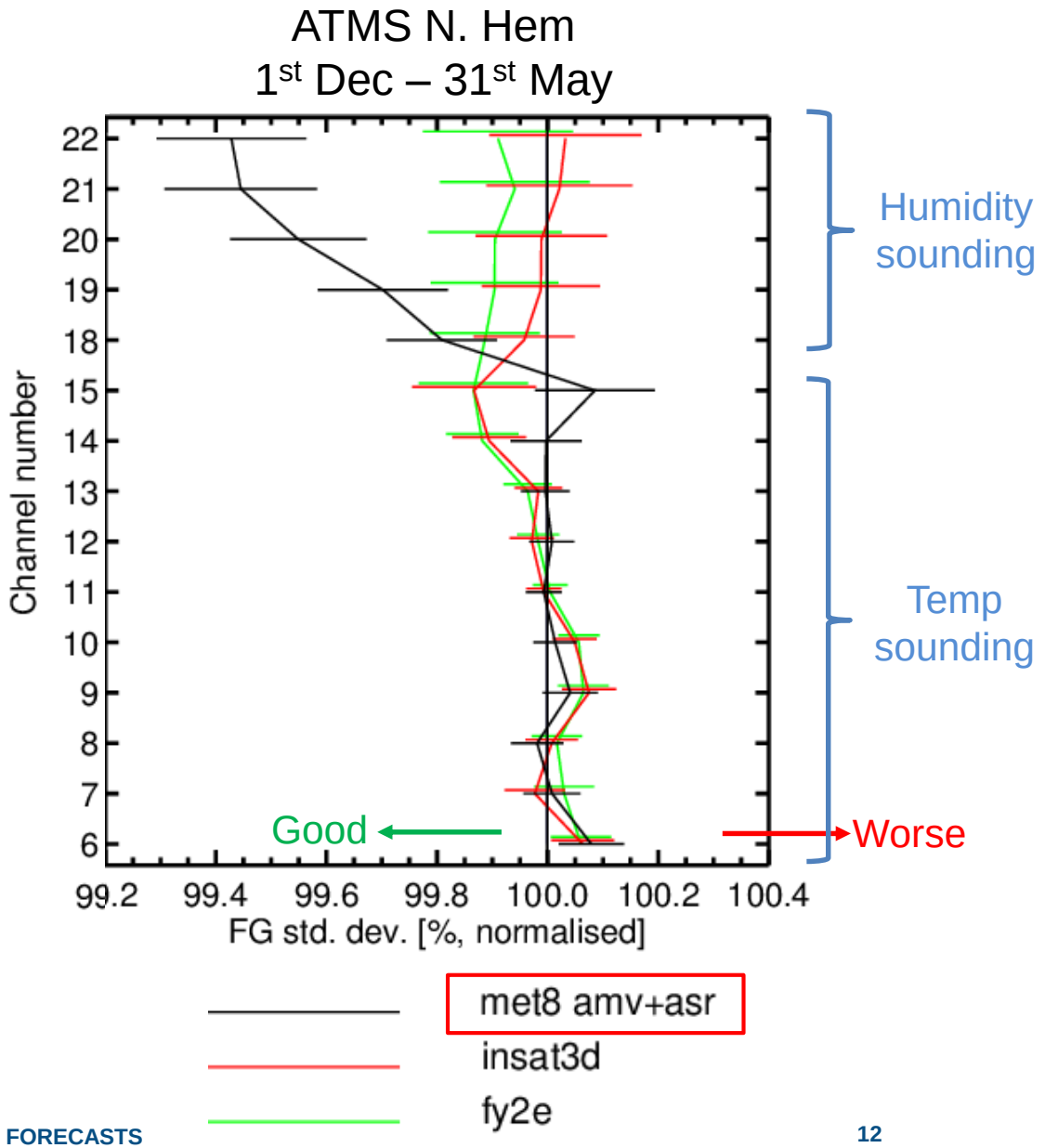
PILOT V wind





Similar impacts in assimilation

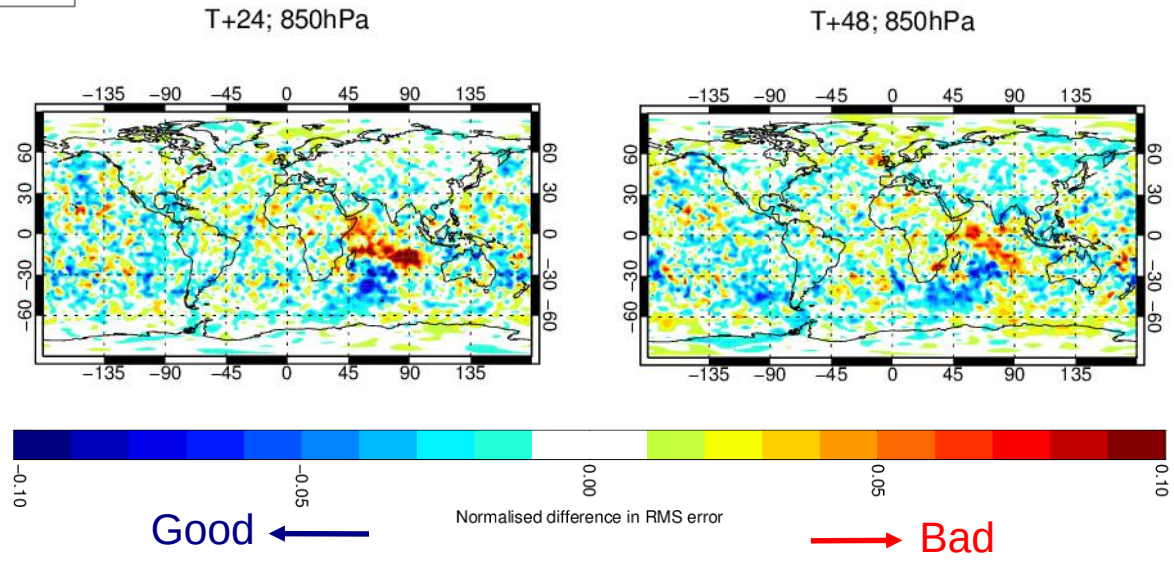
- Small but positive changes against own analysis
- Small positive/neutral changes in fit of independent obs
- Use of ASR gives additional positive impacts in humidity

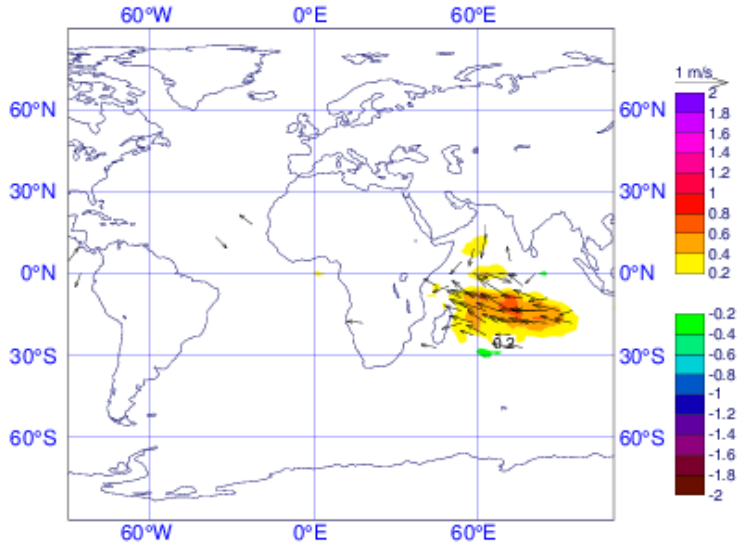


Challenges at 850hPa: Model bias

1st Dec – 30th Jun

Change in error in VW: 850hPa
Met-8 vs. ctrl



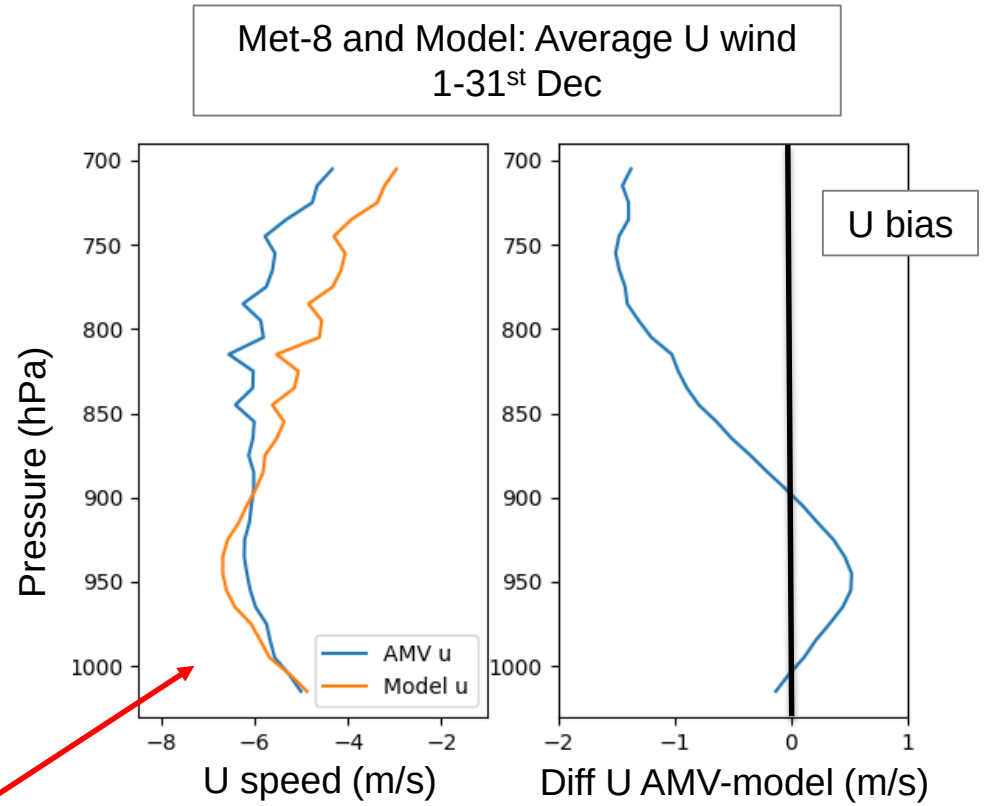


- Degradation feature (much larger for Met-8)
- AMVs increase westward flow of analysis
- Model bias identified for 1st part of expt

Changes to mean wind analysis at 850hPa
Met-8 – control
21st Oct – 18th Dec

Challenges at 850hPa: not enough wind shear?

- Met-8 and FY-2E show little wind shear
- Nearby radiosondes support variation seen in model
- Height assignment problems?
- Reassess with Aeolus



Summary

- Meteosat-8 improvement from Meteosat-7
- IODC AMVs continue to provide benefit
- Without Met-8, INSAT-3D/FY-2E could recover some impact from AMVs
- Met-8 ASR add clear benefit unavailable from INSAT-3D/FY-2E
- Difficult area identified at 850hPa

New height assignment for Meteosat-10: Optimal Cloud Analysis (OCA)

A new height assignment algorithm

Met-10 AMVs provided with:

1. Current Cloud Analysis (CLA) product
   - Exact method applied is situation dependent
2. Alternative Optimal Cloud Analysis (OCA) product
   - Uses optimal estimation method to extract cloud top height
   - Processes 2 layer cloud situations

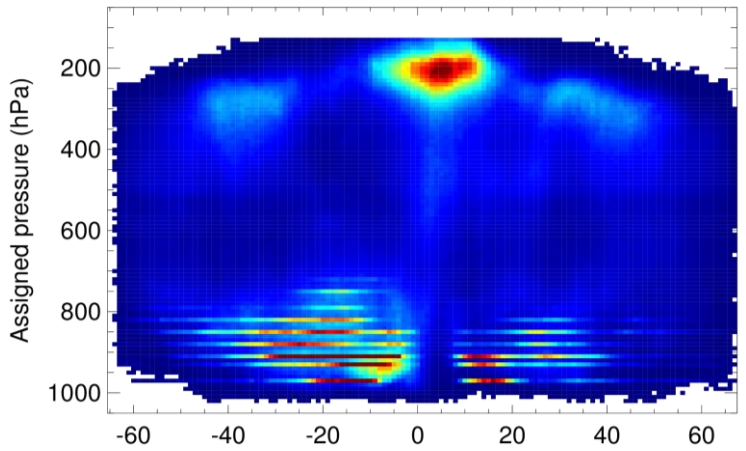
Change to the height distribution

Infrared 10.8µm

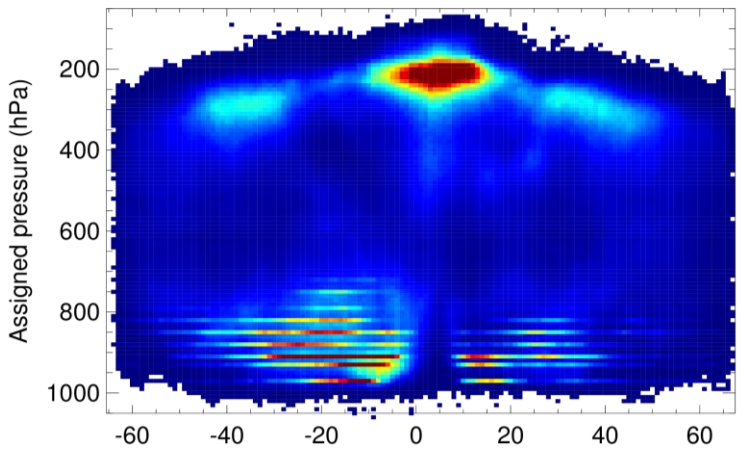
27th Apr – 26th May 2016, all AMVs

Total no. of AMVs

Current

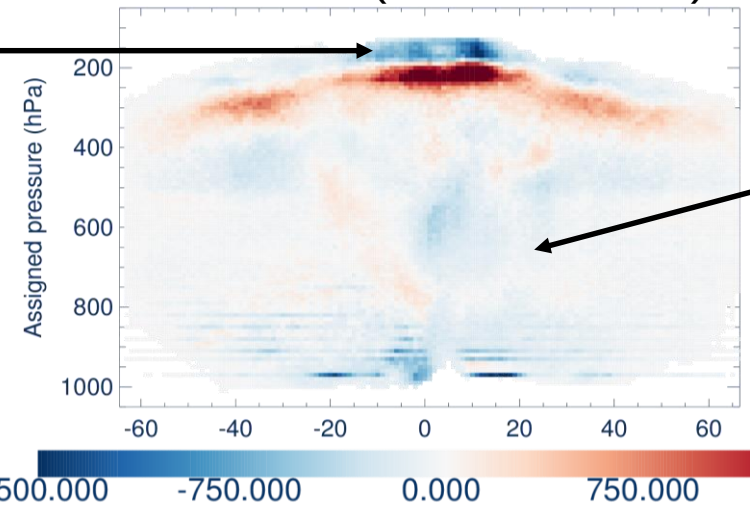


OCA



Difference (OCA – current)

Fewer very high AMVs



Reduction in lower winds due to selecting top layer in multi-layer situations?

High OCA AMVs concentrated into thinner pressure band

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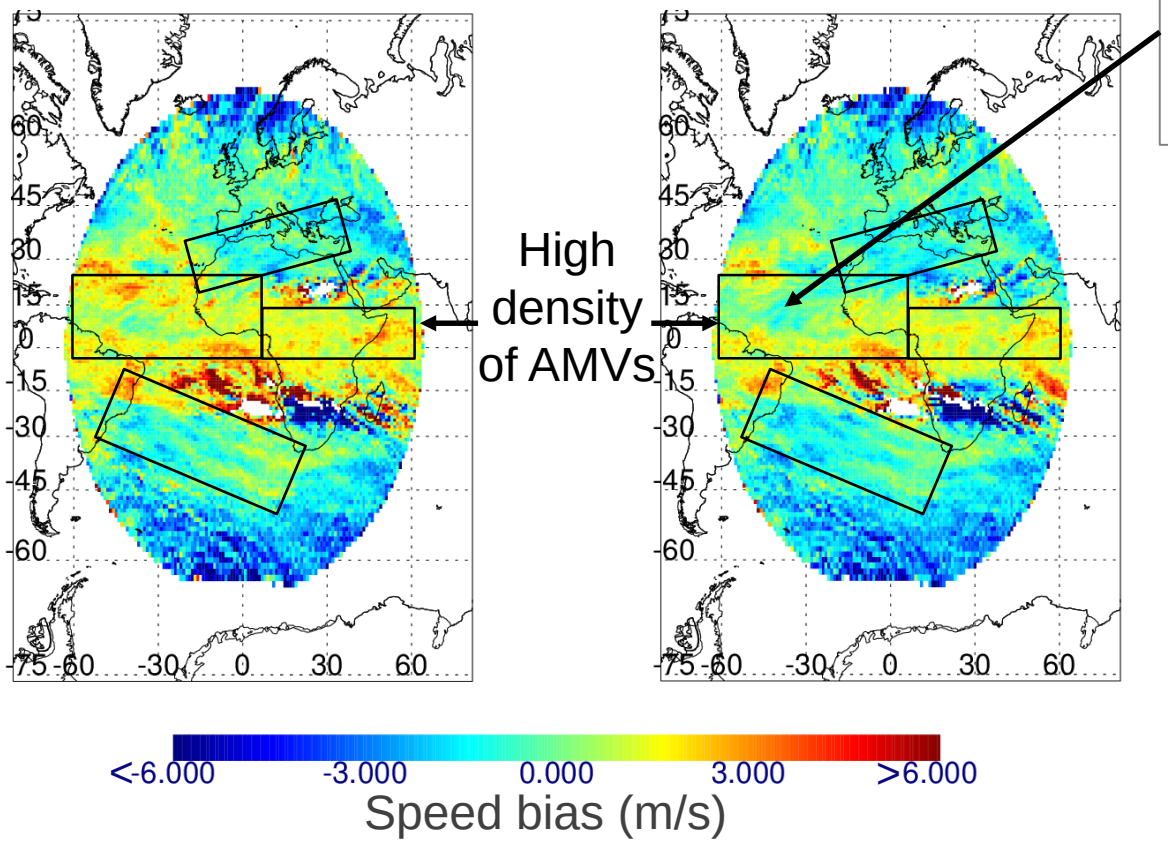
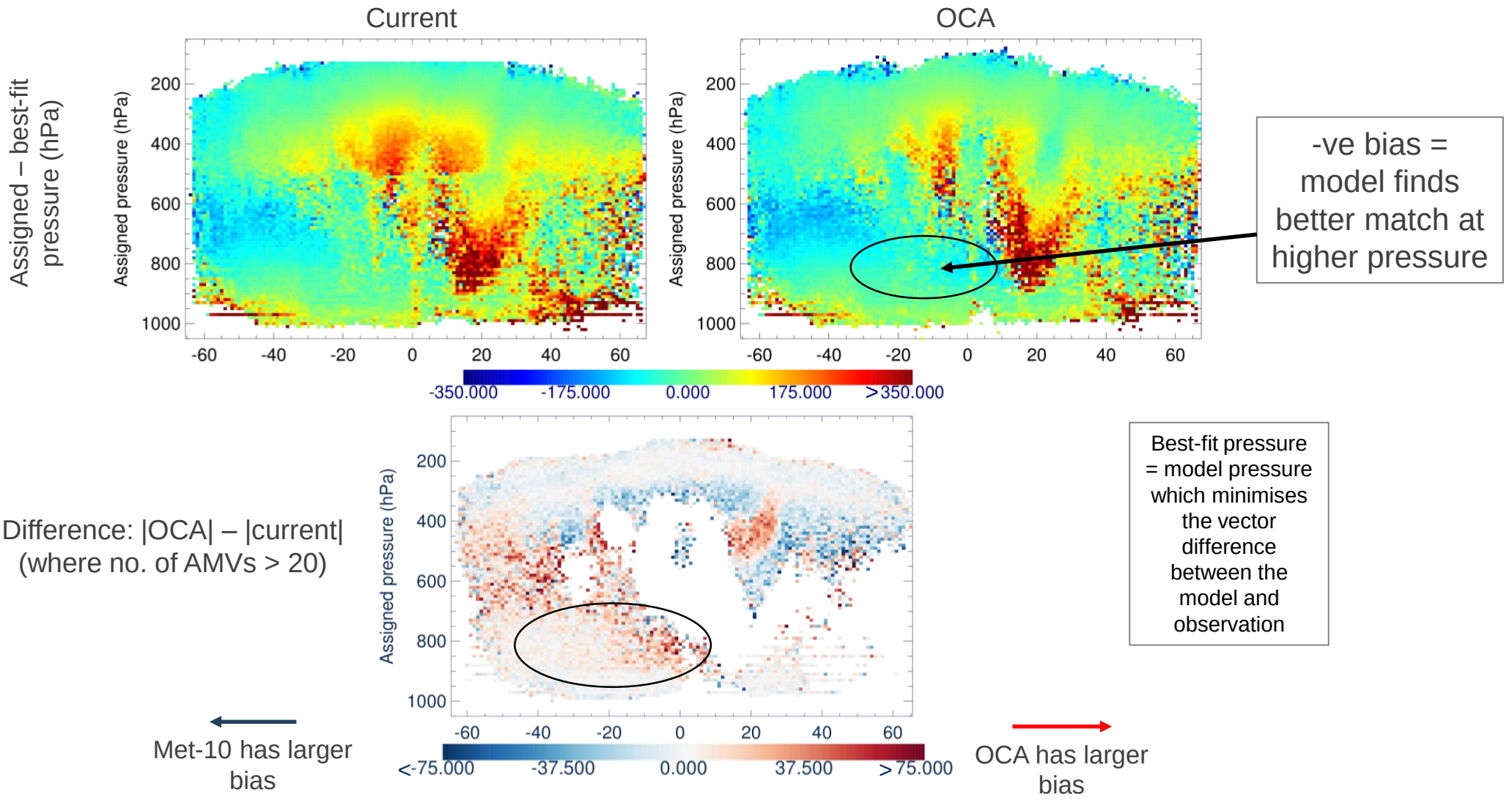
Data quality: reducing positive speed bias

27th Apr – 26th May 2016



Water vapour
7.3µm
QI>85
P < 400hPa

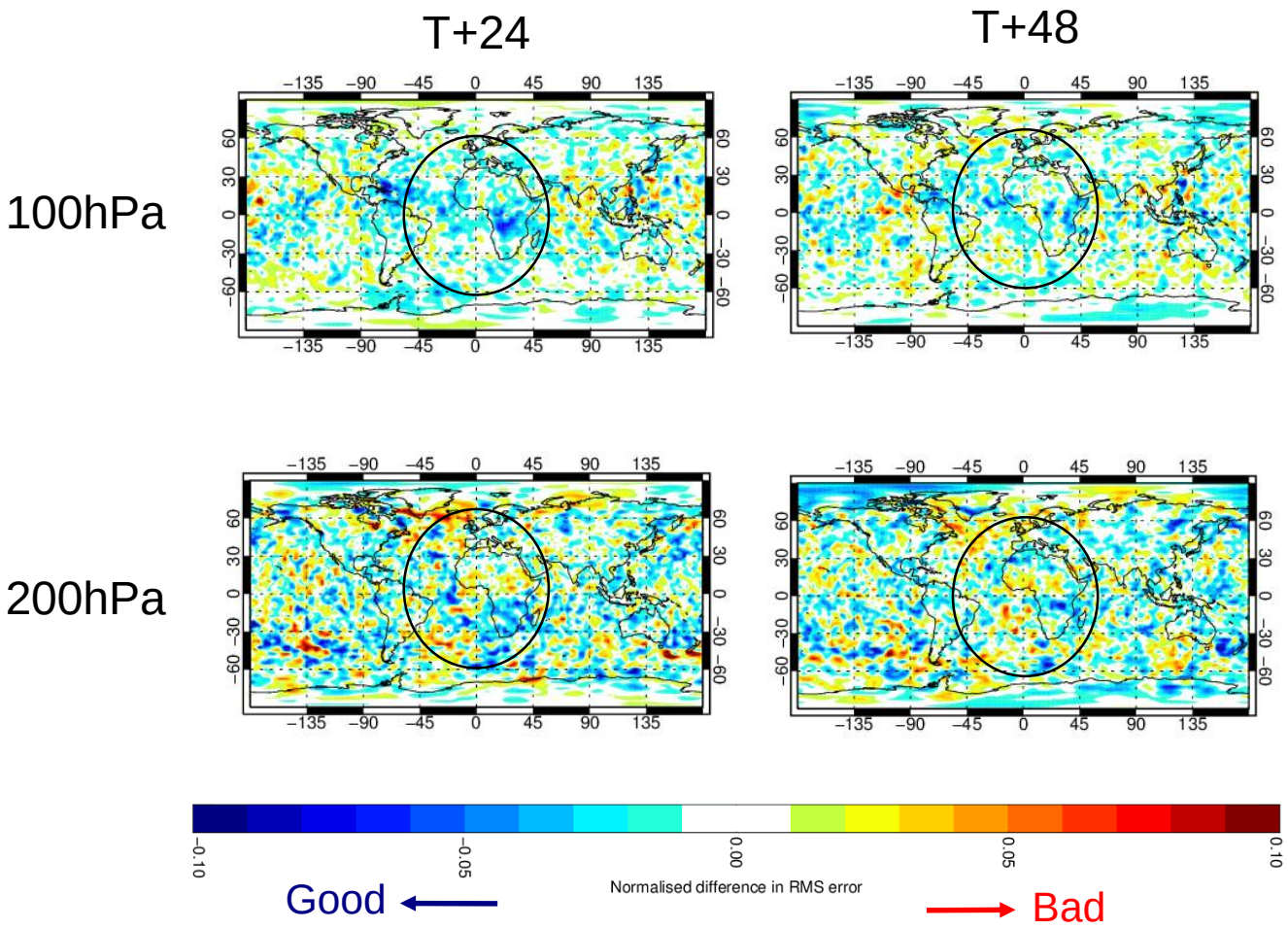
Data quality: best-fit pressure bias



Assimilation experiments

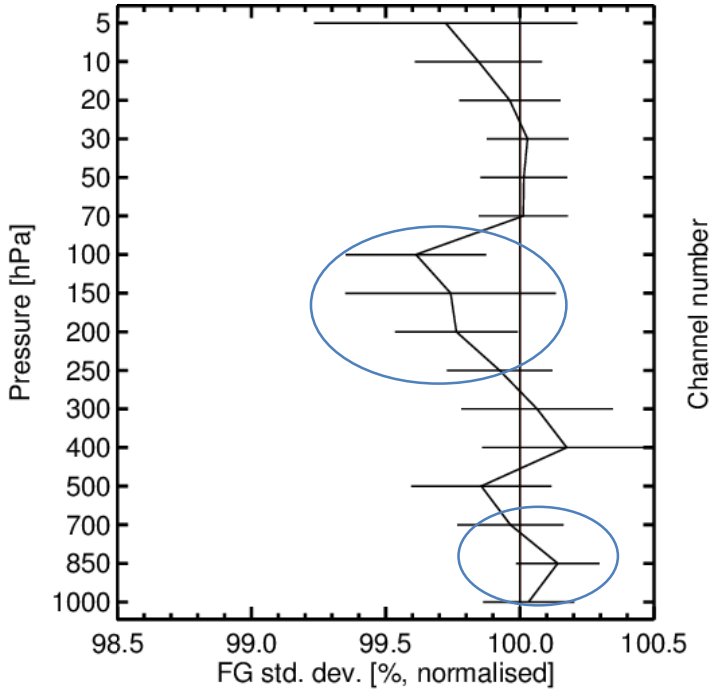
- Expt: Use OCA height assignment, leave Met-10 quality control choices unchanged
- Control: Met-10 with operational height assignment
- 1st May – 31st Oct 2016

Change vector wind error: higher levels improvements

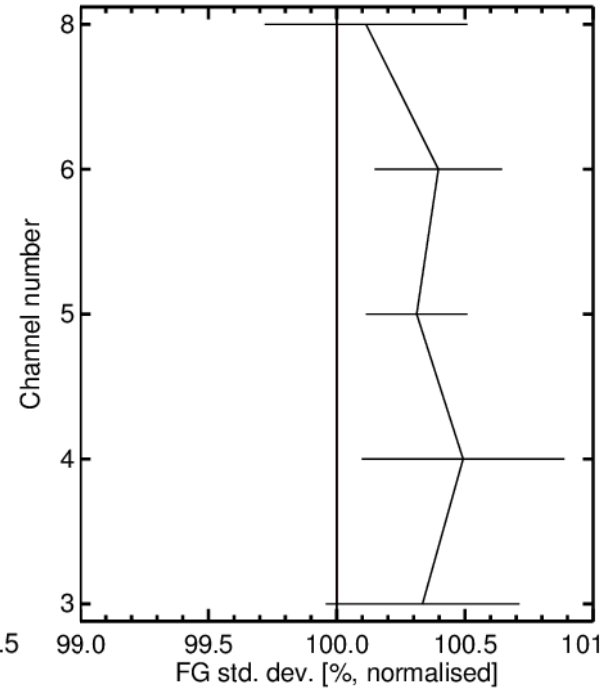


Fit of independent observations

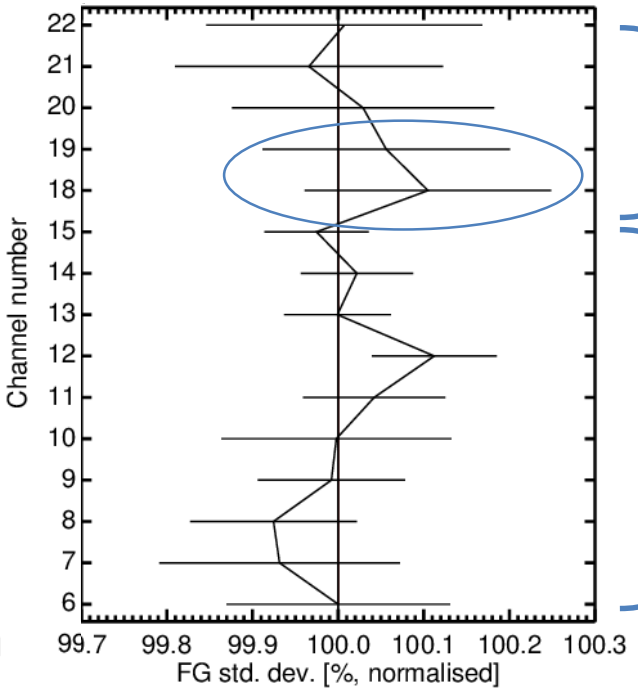
Conventional wind obs:
U and V wind
Tropics



GMI All sky radiances
Tropics



ATMS radiances
Tropics



Humidity sounding

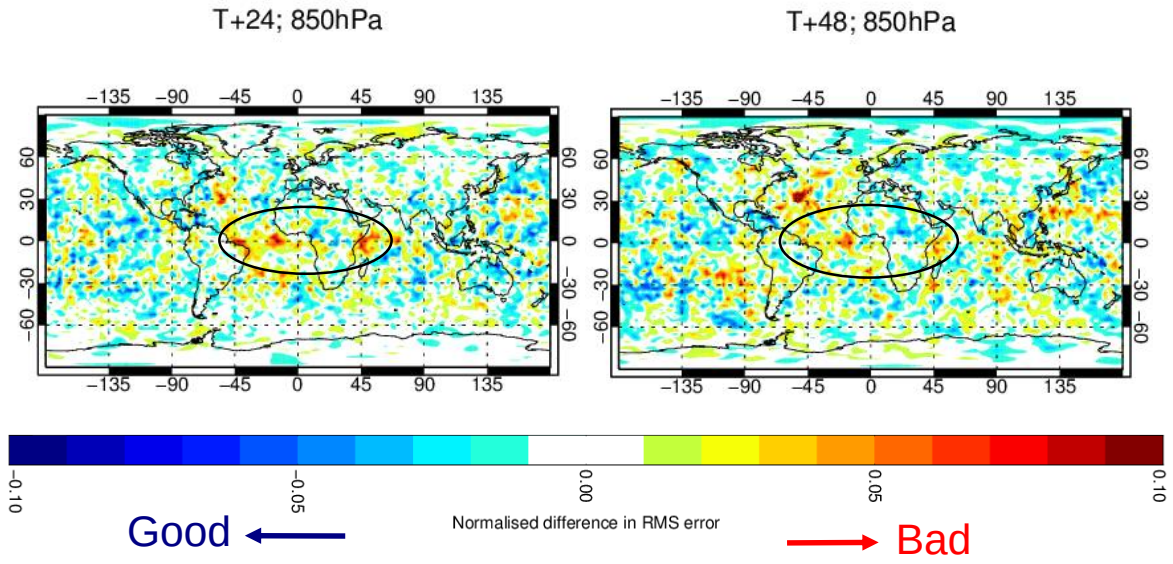
Temp sounding

Good ← → Bad

Imager dedicated to tropical region

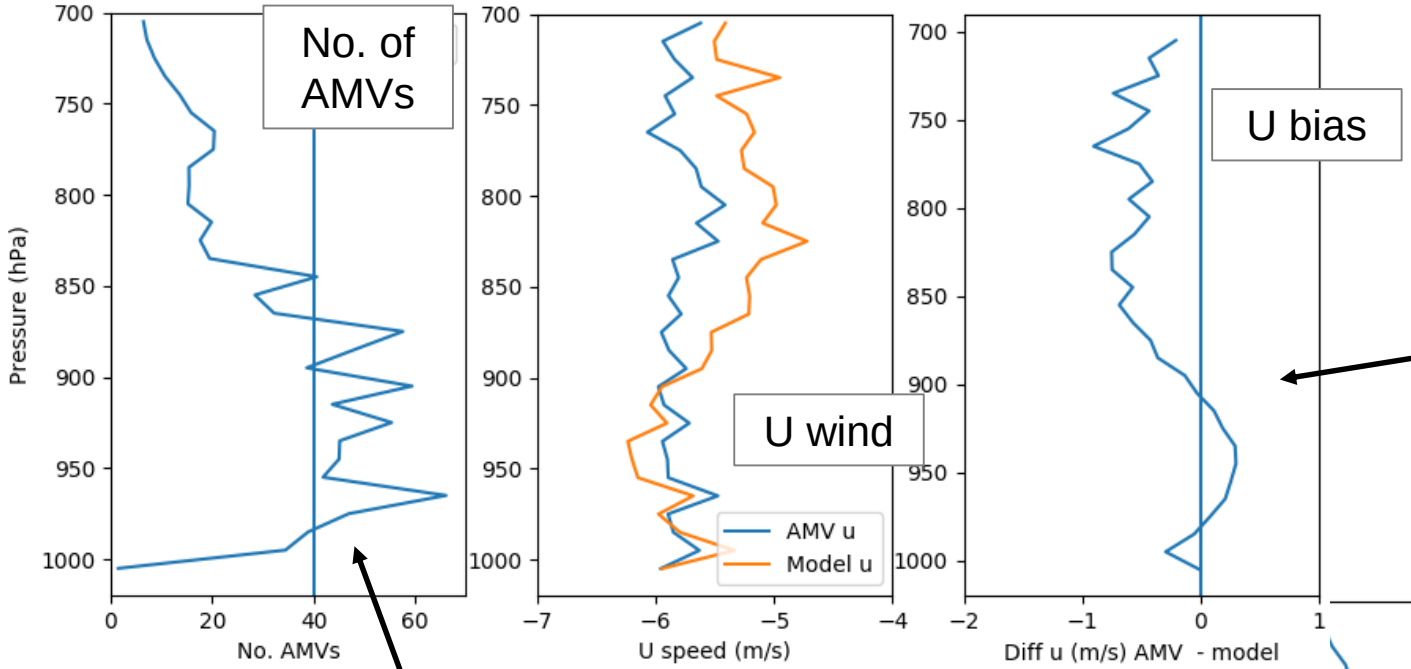
Another challenge at 850hPa!

Change in vector wind error: 850hPa



- Inversion regions are a difficult area
- Small changes to wind analysis by using OCA in Aug-Oct
- No indication of model bias as for Met-8

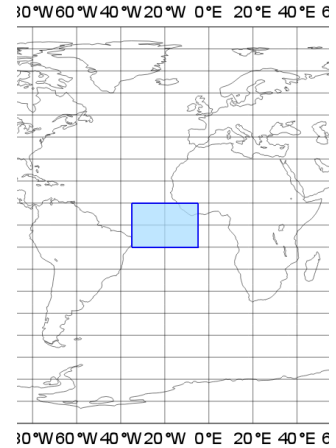
Similarity in U profile to Met-8

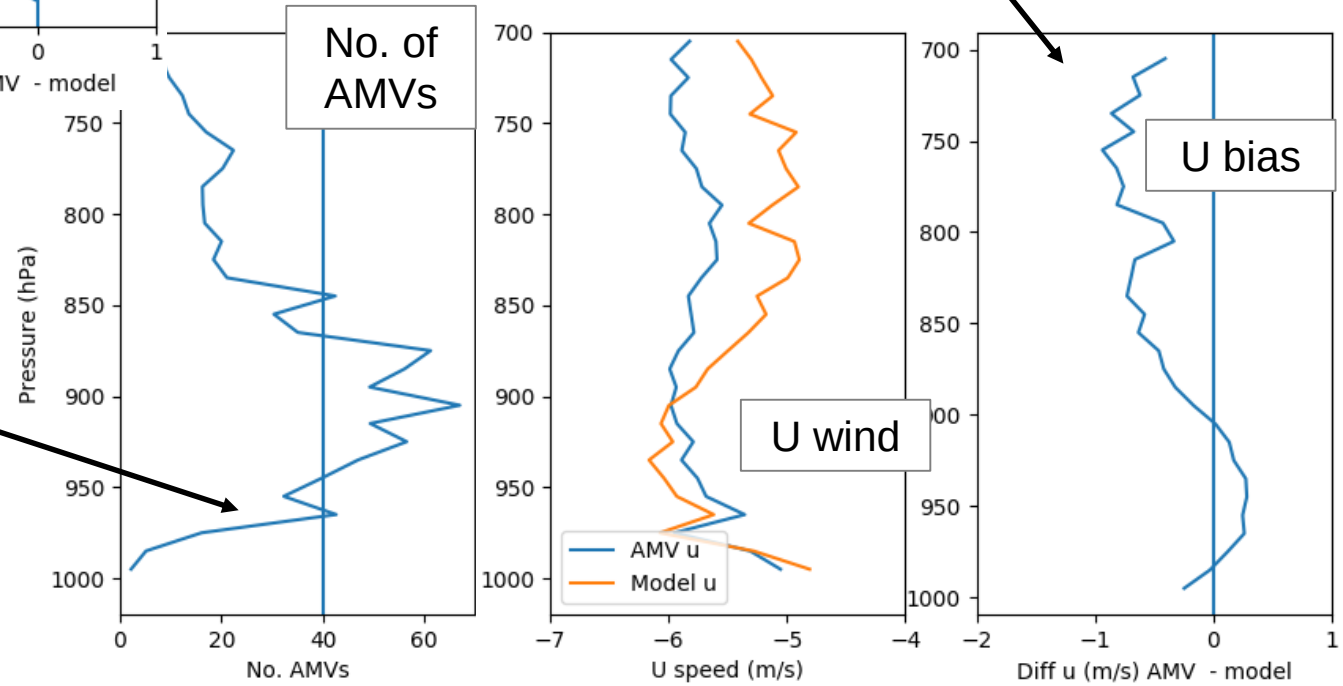


Orig Met-10

Very similar shape to Met-8 earlier but smaller

OCA Met-10

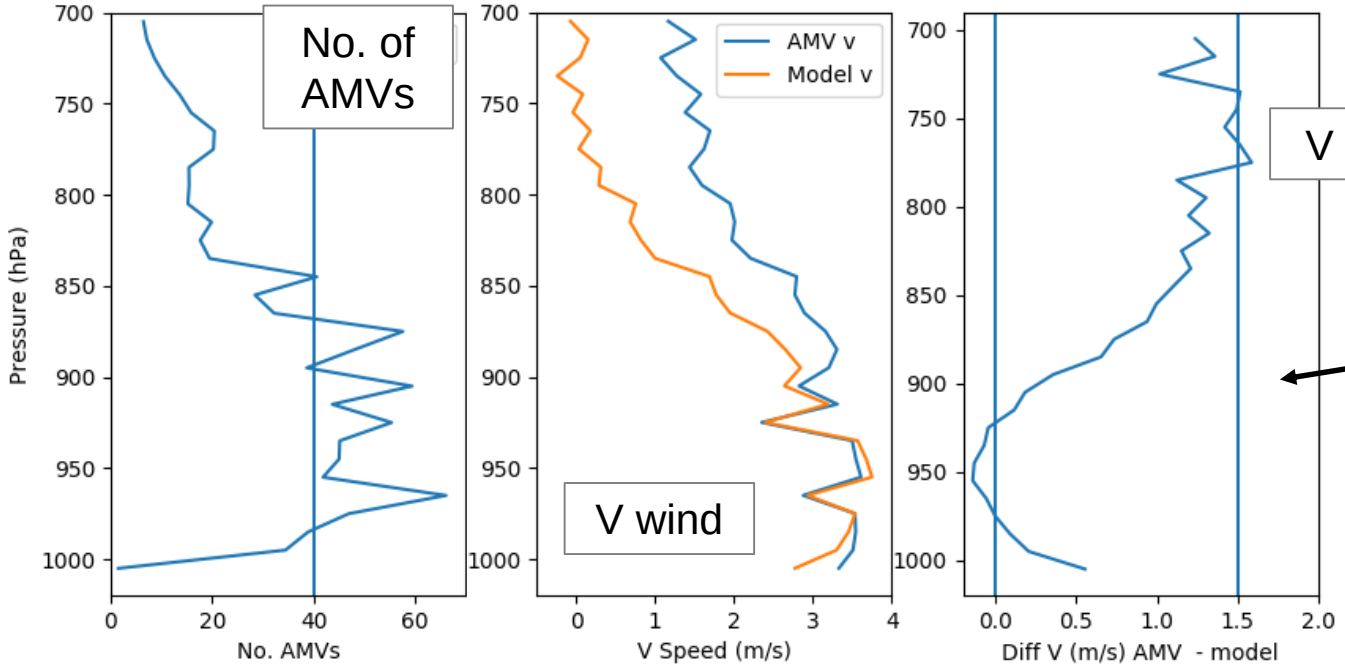




Reduction at very low levels

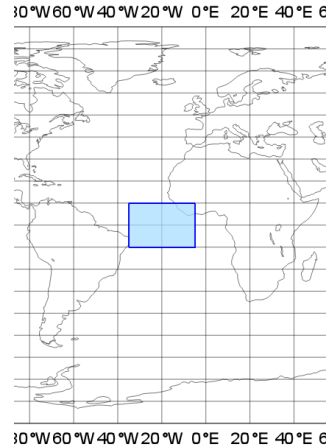
Active AMVs, 27th Apr – 5th June 2016

But larger bias in V

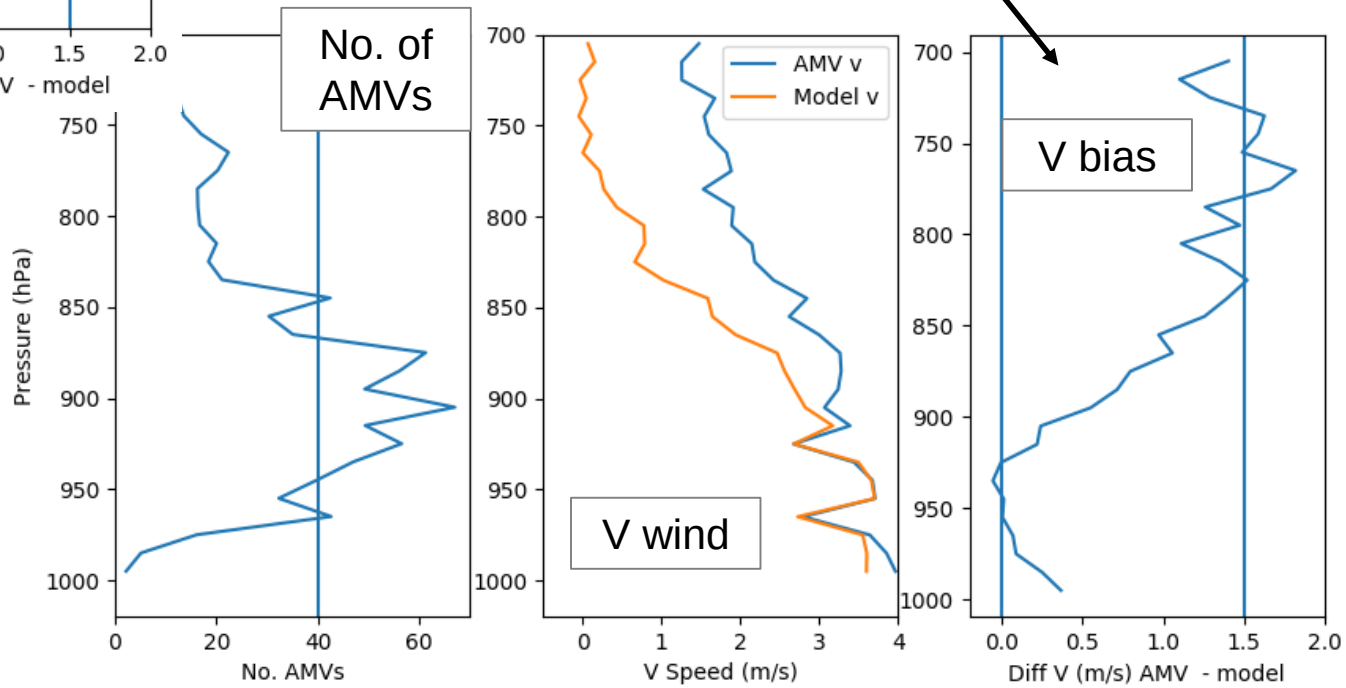


Orig Met-10

Larger v bias (Met-8 v bias small)



OCA Met-10



Are there winds being placed too high?

Active AMVs, 27th Apr – 5th June 2016

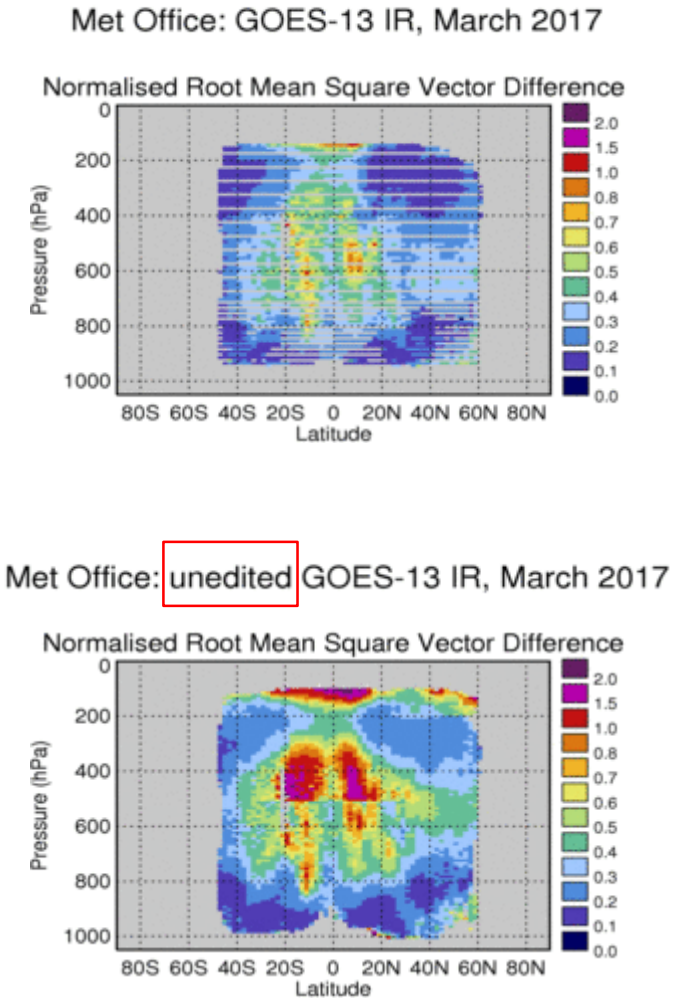
Summary of OCA results

- Different distribution of AMVs
- Promising features especially at high levels
- Positive changes on conventional wind obs
- Mixed results on humidity sensitive obs
- Inversion regions once again challenging!
- Could AMVs be assigned too high?

GOES-13/-15 with the GOES-R algorithm

A big change in processing

- Current operational scheme
  - “Traditional” methods e.g. CO_2 slicing
  - Auto-editor: greater NWP dependence and artificial speed up
- GOES-R:
  - Nested tracking
  - Heights from optimal estimation technique
- Comparison: new vs. auto-edited winds



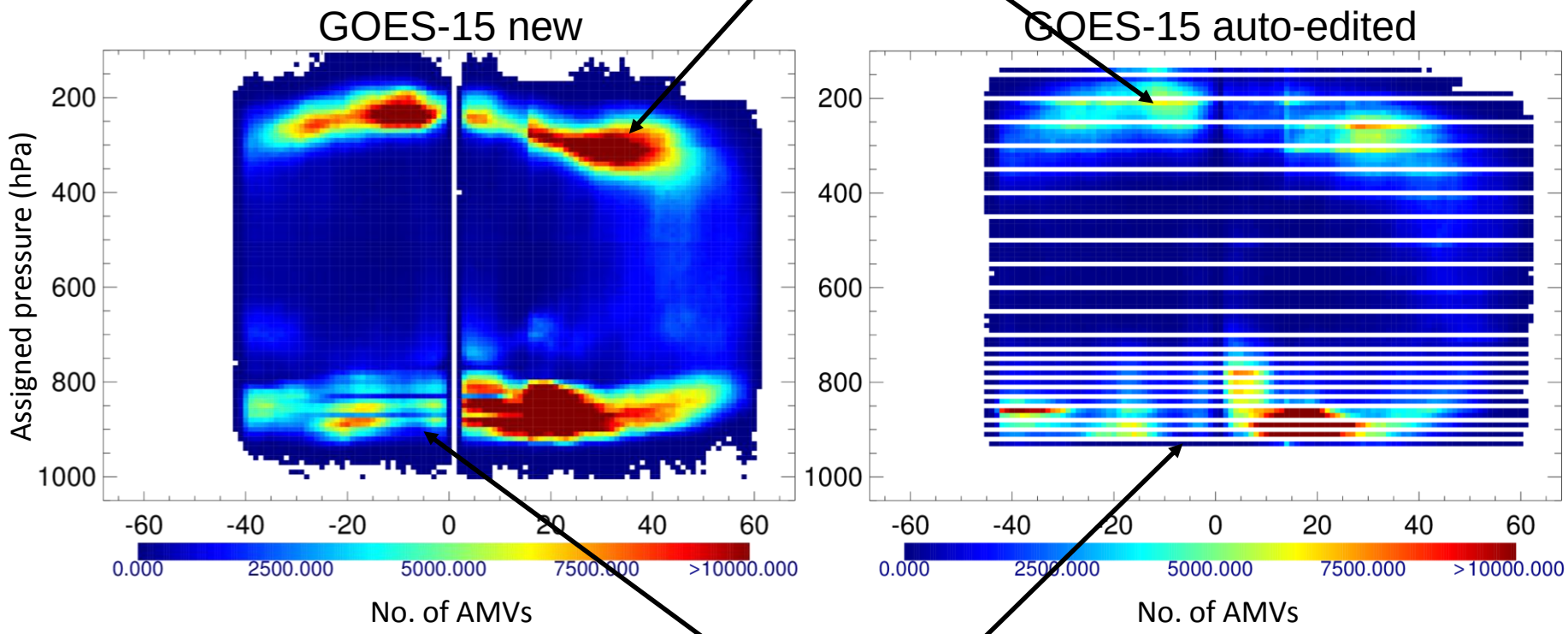
Better statistics at expense of NWP independence

Plots taken from NWP SAF monitoring website: https://nwpsaf.eu/site/monitoring/winds-quality-evaluation/amv/amv-monthly-monitoring/

More AMVs and in some different places

IR, 1st Mar – 15th Apr 17, all data

High levels shifted ~50hPa lower in new



Most channels doubled in number

Relatively more in tropics

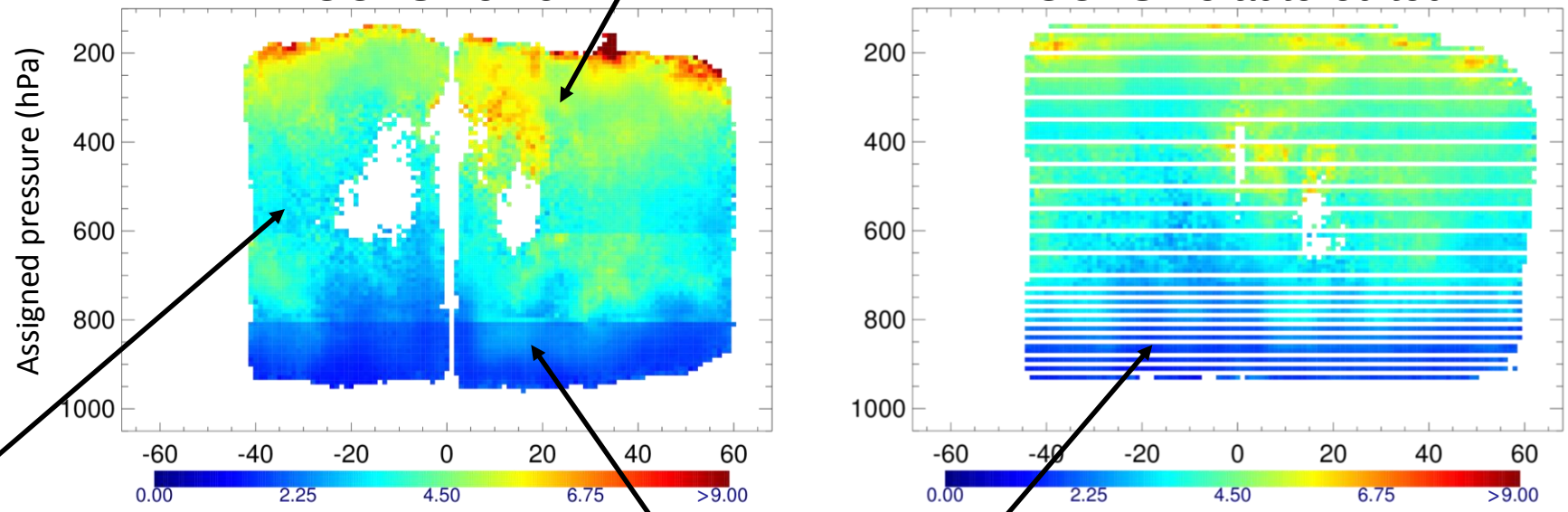
RMSVD changes

IR, 1st Mar – 15th Apr, QI screen + 1st guess check n > 20

~1m/s larger for high levels

GOES-15 new

GOES-15 auto-edited



RMSVD (m/s)

Improved at mid-levels

Comparable at low levels

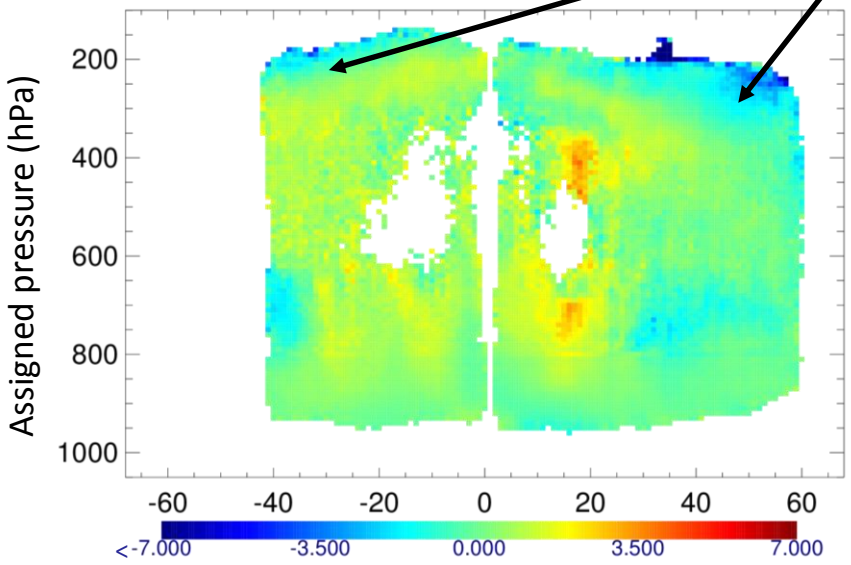
Mixed speed bias changes

Speed bias more negative where artificial speed up removed (now similar to values on NWP SAF site)

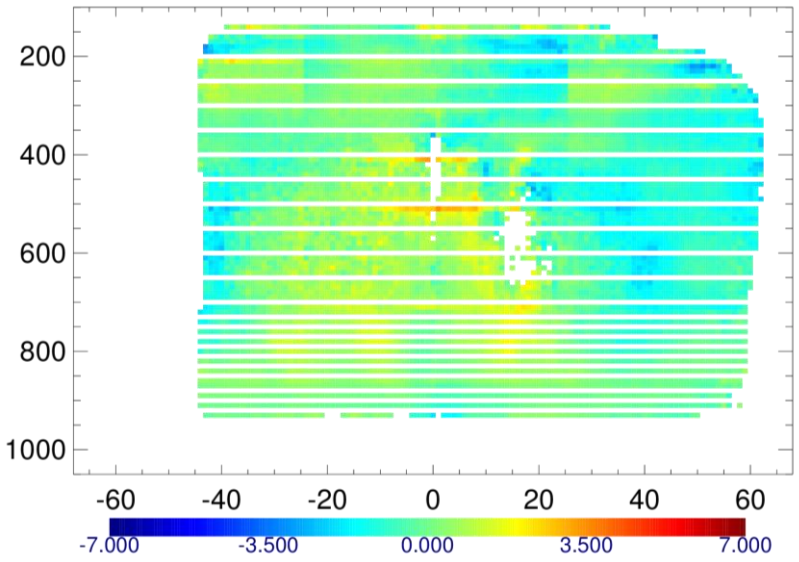
IR, 1st Mar – 15th Apr, QI screen + 1st guess check n > 20

Speed bias (m/s)

GOES-15 new



GOES-15 auto-edited



Generally less negative or changed to positive (Linked to shifts in pressure?)

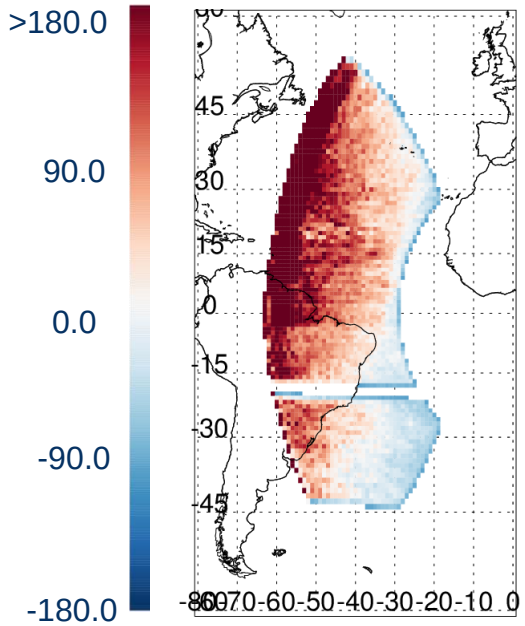
Overlap regions: GOES-13 vs. Met-10

IR, 1st Mar – 15th Apr, QI screen + 1st guess check n > 5

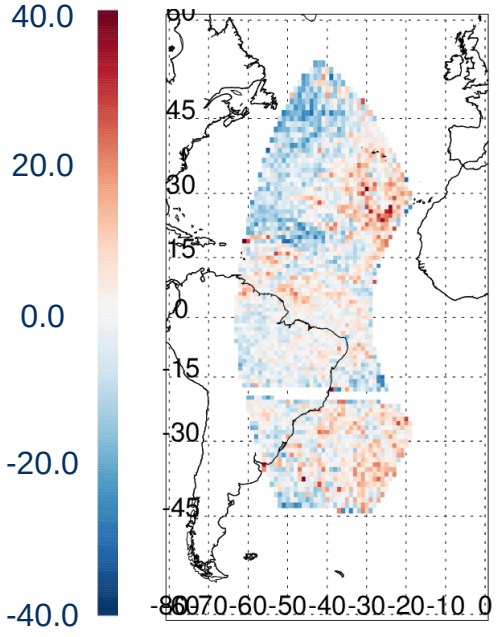
Met-10 lower

GOES-13 lower

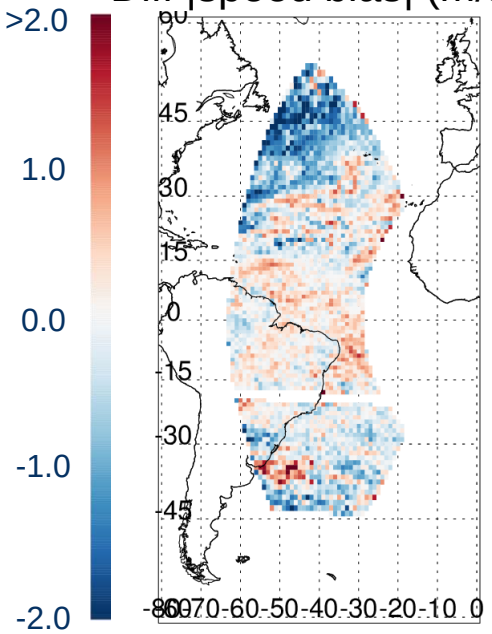
% Diff no. of AMVs



% Diff RMSVD



Diff |speed bias| (m/s)



No systematic differences → similar quality

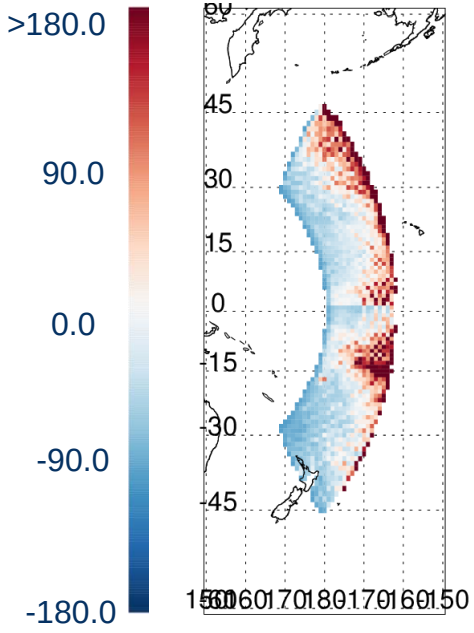
Overlap regions: GOES-15 vs. Himawari-8

IR, 1st Mar – 15th Apr, QI screen + 1st guess check n > 5

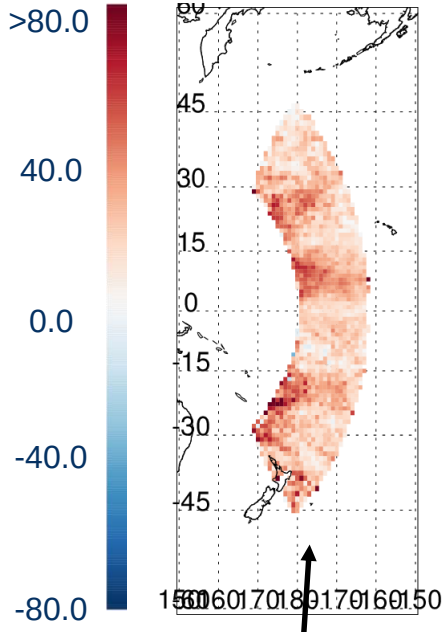
Him-8 lower

GOES-15 lower

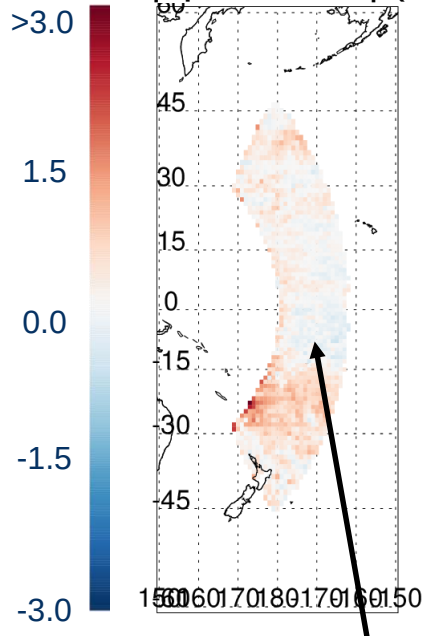
% Diff no. of AMVs



% Diff RMSVD



Diff |speed bias| (m/s)



Generally Himawari-8 has lower RMSVD…

…but GOES-15 has lower speed biases in some areas

GOES-13/-15 summary

- RMSVD higher with new algorithm but no auto-editor
- Mixture in speed bias change but mostly less negative
- Similar quality to Met-10
- Himawari-8 AMVs better (but higher resolution and more channels for height assignment)
- Changes in distribution, number and spatial patterns of statistics

  → Need assimilation experiments to determine forecast impacts
- Promising for GOES-R with added benefit from new imager

Thank you for listening!