

# GOES-16 AMV data evaluation and algorithm assessment

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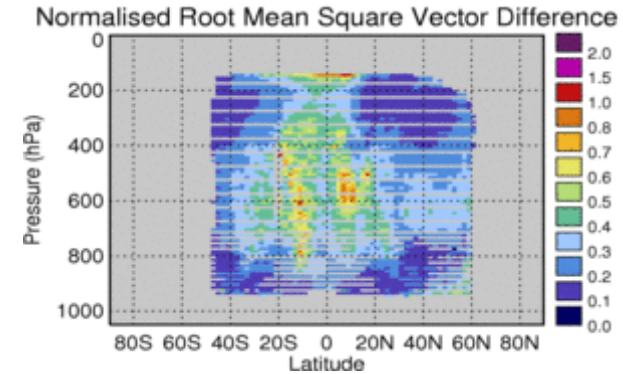
## Outline

- Introduction
- Changes in number and data quality using first guess departures
- Assimilation experiments
  - Initial challenges in the tropics
  - Promising outlook
- Next steps and summary

# Significant change in processing

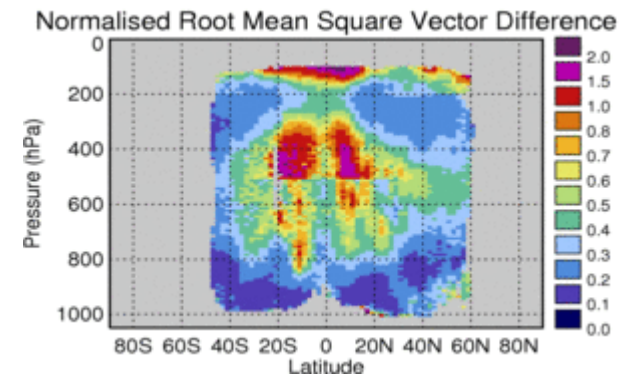
- Previous operational scheme
  - “Traditional” methods e.g. CO<sub>2</sub> slicing
  - Auto-editor: greater NWP dependence and artificial speed up
- GOES-16:
  - Nested tracking
  - Heights from optimal estimation technique
- GOES-16 vs. auto-edited GOES-13/-15 winds
  - Full disk winds only
  - Vis
  - IR
  - Cloudy WV (6.2µm only)
- Initially reprocessed GOES-13/-15 vs. auto-edited winds

Met Office: GOES-13 IR, March 2017



Better statistics  
at expense of  
NWP  
independence

Met Office: unedited GOES-13 IR, March 2017



Plots taken from NWP SAF monitoring website:

<https://nwpsaf.eu/site/monitoring/winds-quality-evaluation/amv/amv-monthly-monitoring/>

# GOES-16 data timeline

GOES-16 launched

10<sup>th</sup> Nov: News that BUFR are available

16<sup>th</sup> Nov: FTP set up at ECMWF for GOES-16

30<sup>th</sup> Nov: satellite drift starts

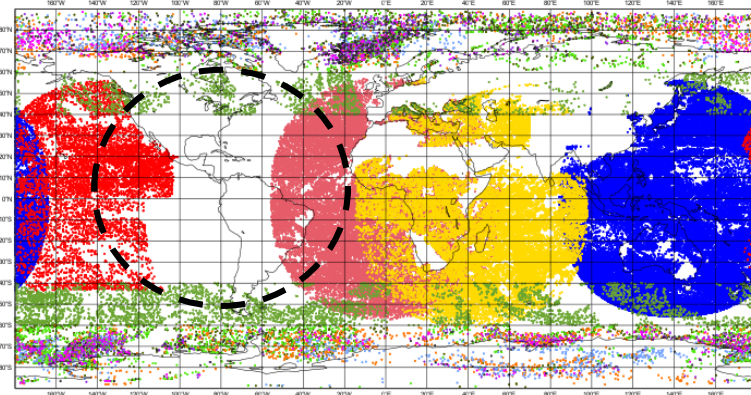
Sample GOES-16 available

GOES-13 retired in operations 2<sup>nd</sup> Jan



Regular acquisition of GOES-13/-15 reprocessed (corrected)

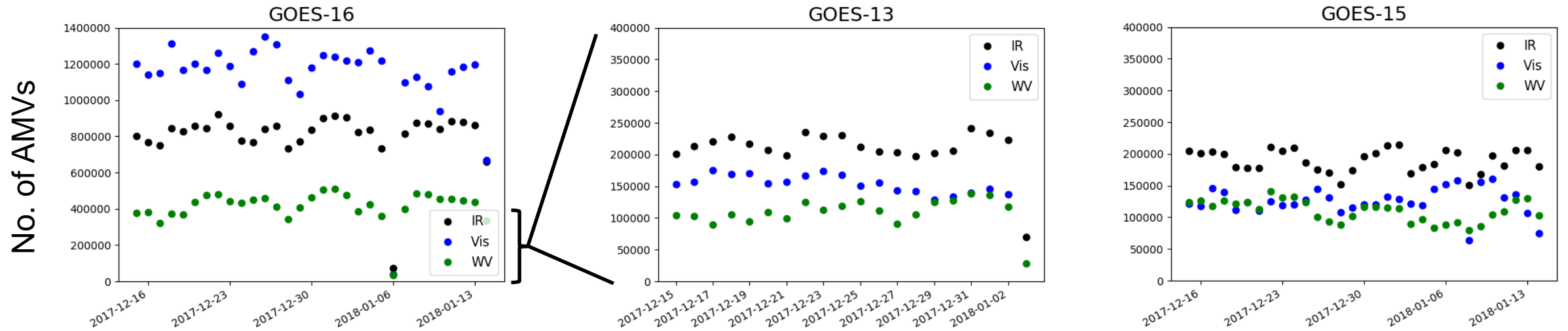
Active AMVs 12Z 25<sup>th</sup> Feb 2018



Regular acquisition of GOES-16 at final location 15<sup>th</sup> Dec

GOES-16 monitored 18<sup>th</sup> Apr

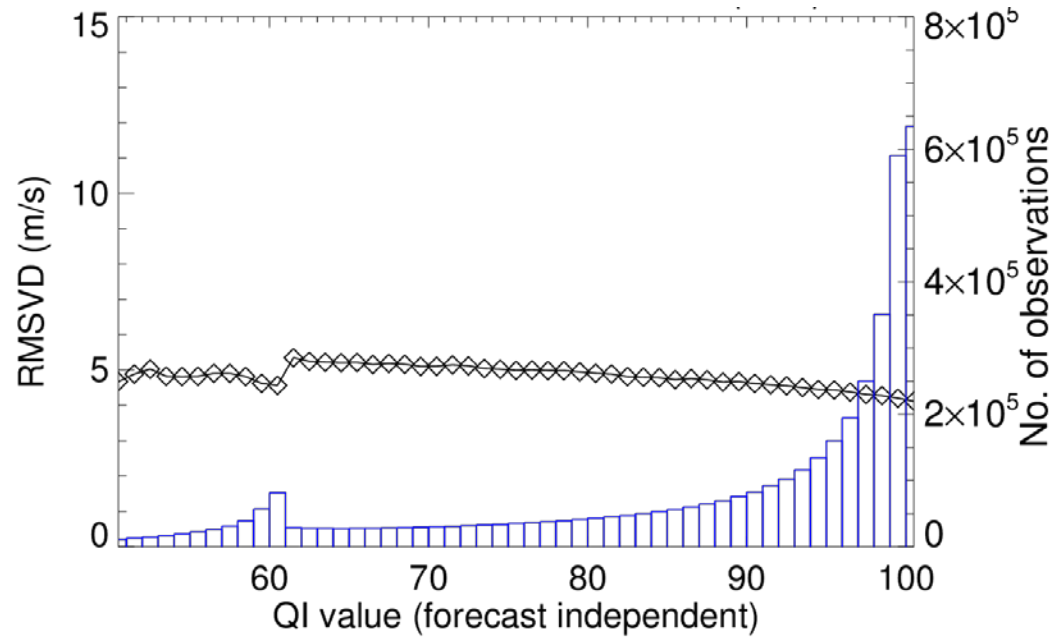
# Large increase in AMVs



- Algorithm alone ~doubles number (seen from reprocessed GOES-13/-15 data)
- Combined with higher resolution on GOES-16 ~doubles number again
- Visible channel increases even more
- Local winds ~same number as full disk

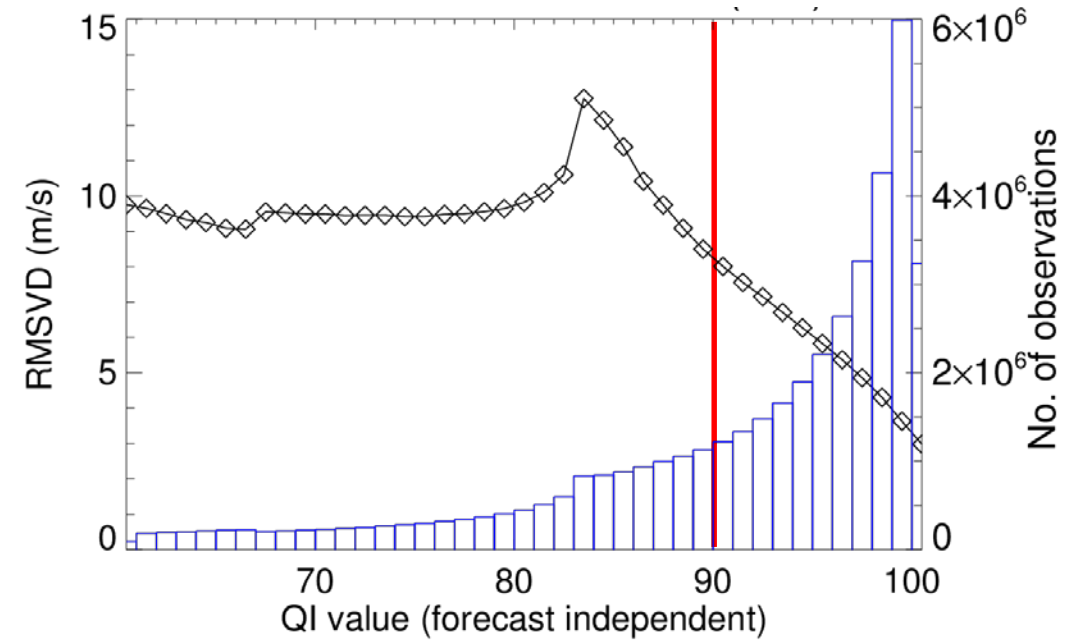
# Stronger dependence on forecast independent QI

## GOES-13 IR



Little dependence on QI meant  
no screening used

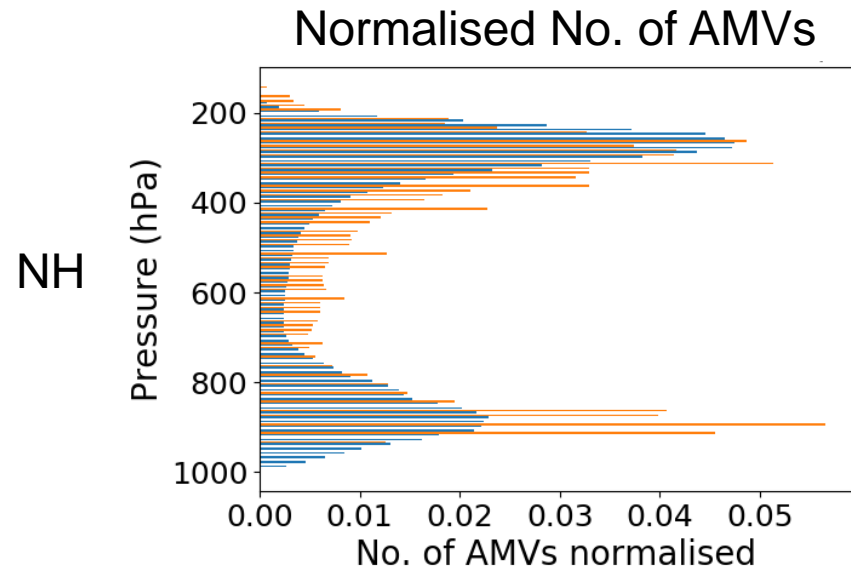
## GOES-16 IR



Stronger dependence –  
threshold of 90 suggested as  
compromise no. of AMVs vs.  
better quality

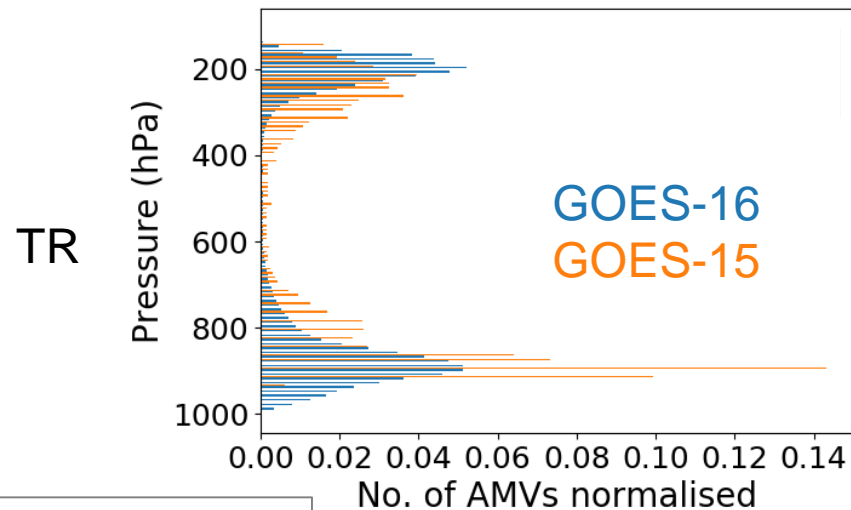
All data  
15<sup>th</sup> Dec –  
8<sup>th</sup> Jan

# Changes in vertical distribution and characteristics



Fewer mid level  
AMVs

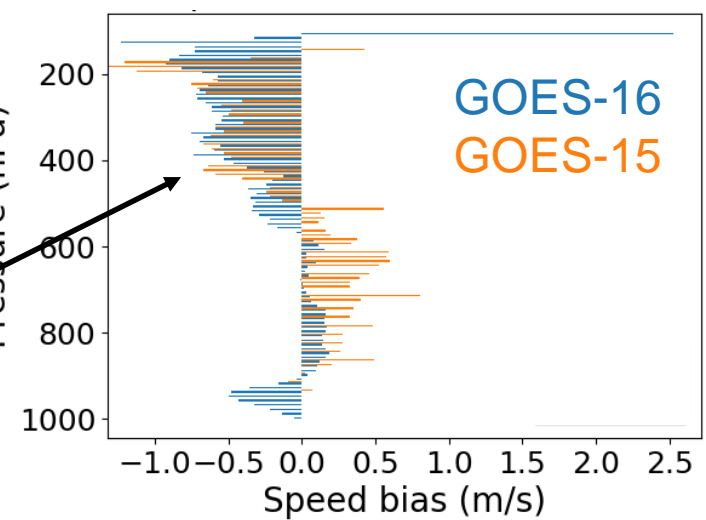
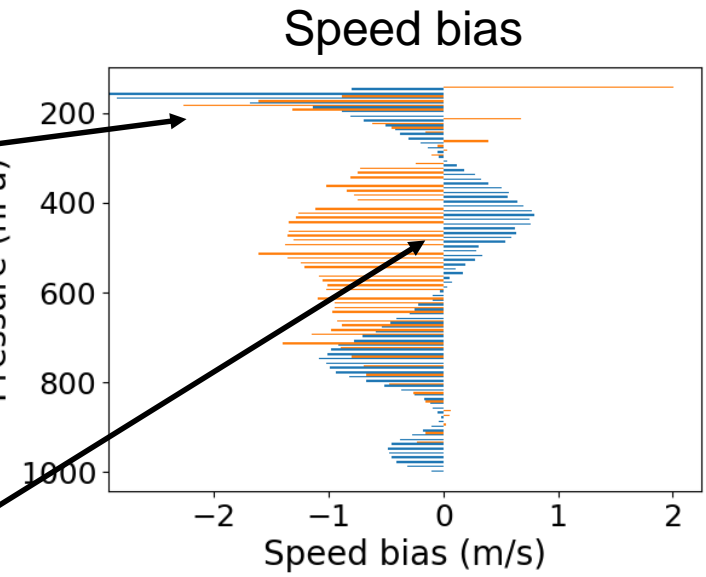
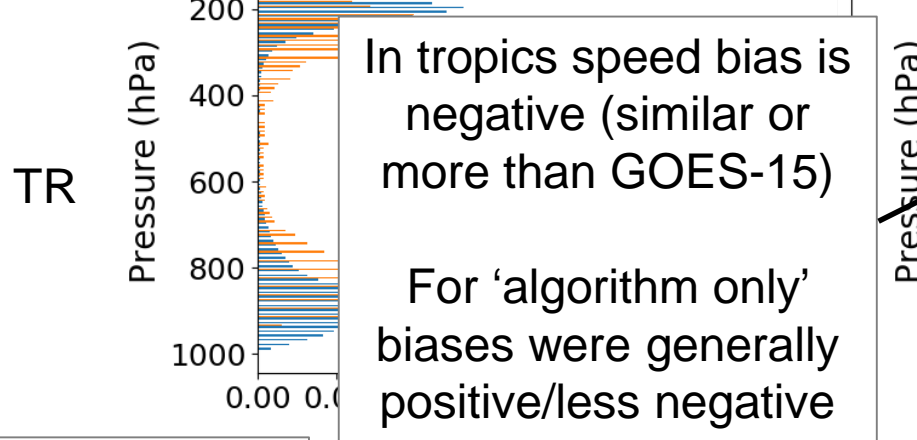
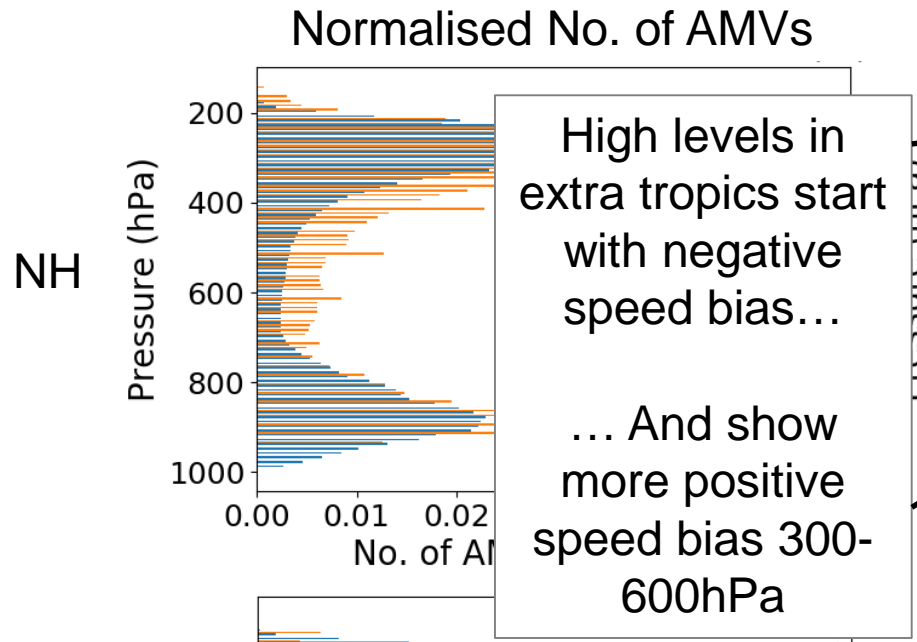
Concentrated into  
narrower bands  
high/low levels



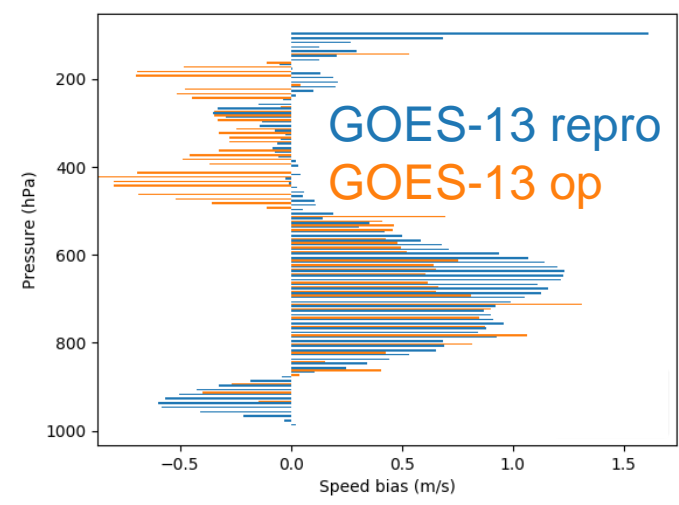
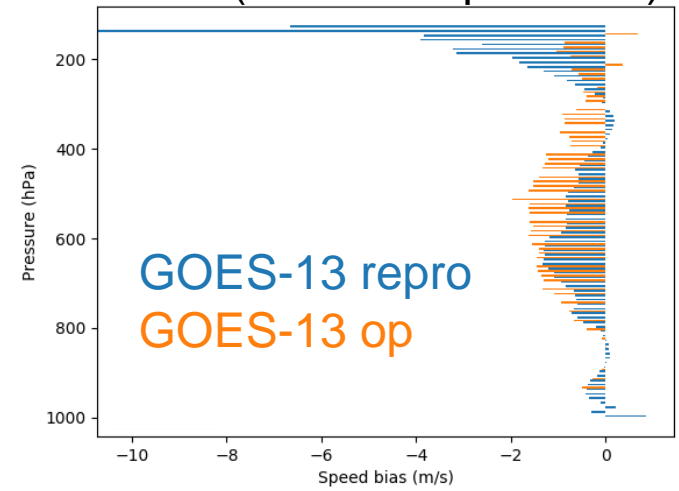
Changes also seen  
for 'algorithm only'

15<sup>th</sup> Dec – 14<sup>th</sup> Jan  
QI + first guess  
screening

# Changes in vertical distribution and characteristics



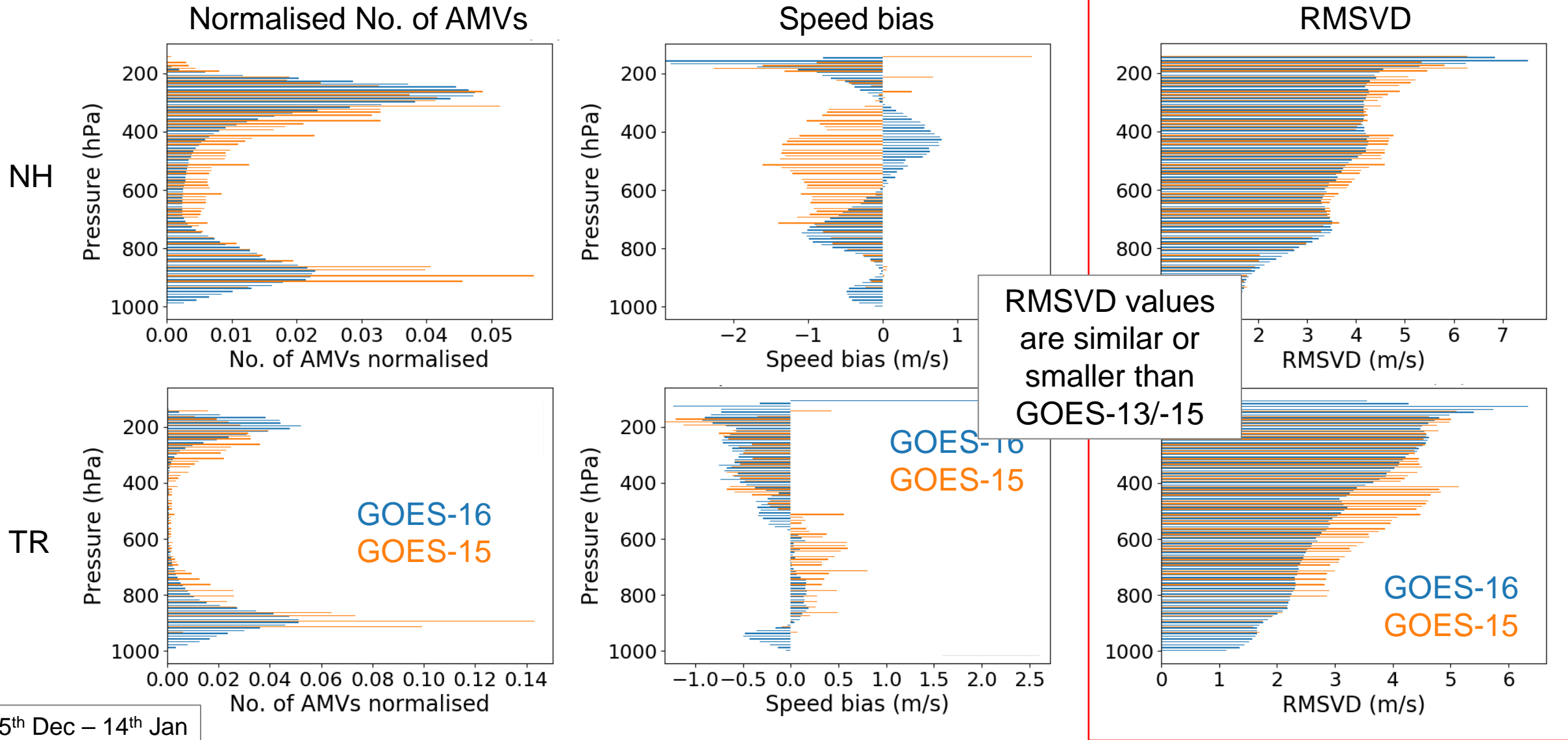
GOES-13 reprocessed vs. auto-edited (March – April 2017)



15<sup>th</sup> Dec – 14<sup>th</sup> Jan  
QI + first guess  
screening



# Changes in vertical distribution and characteristics



15<sup>th</sup> Dec – 14<sup>th</sup> Jan  
 IR, QI + first guess  
 screening

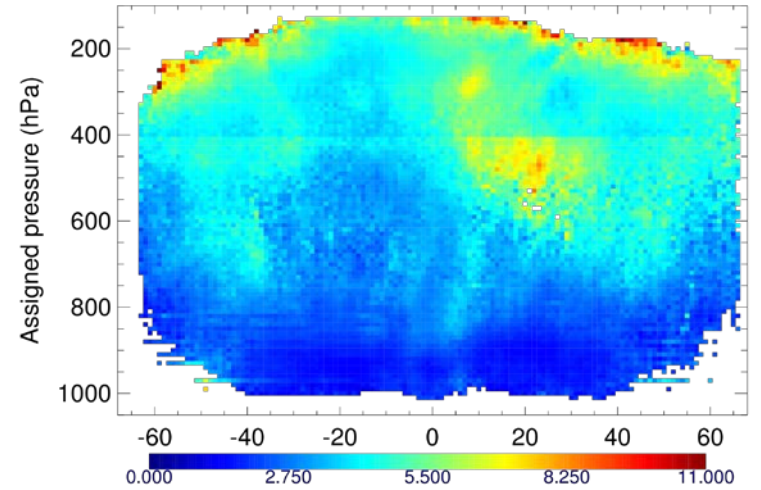
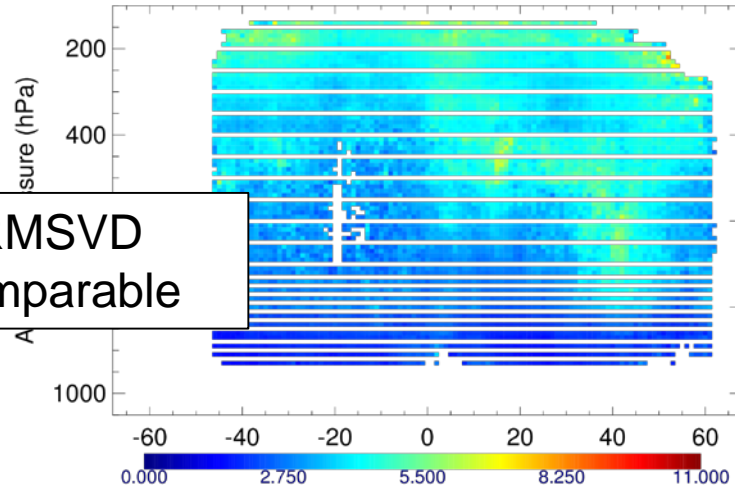
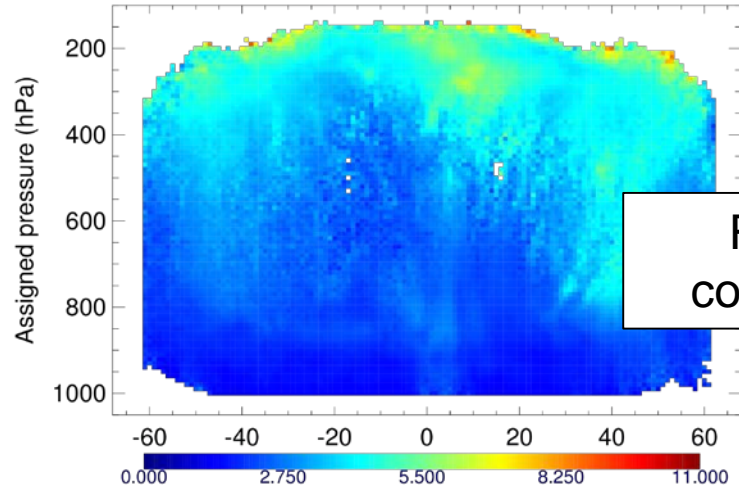
# Data quality comparable but change in patterns

GOES-16

GOES-13

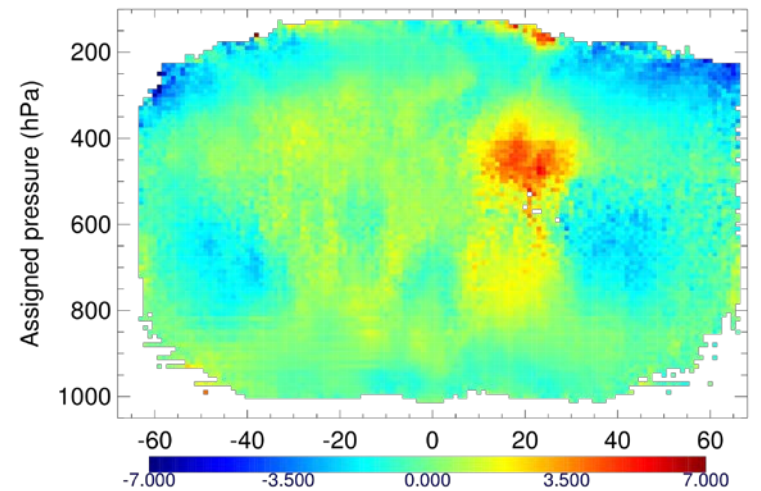
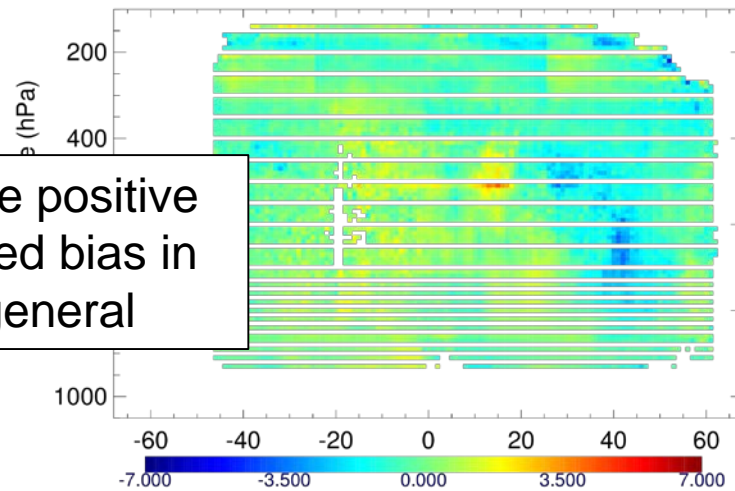
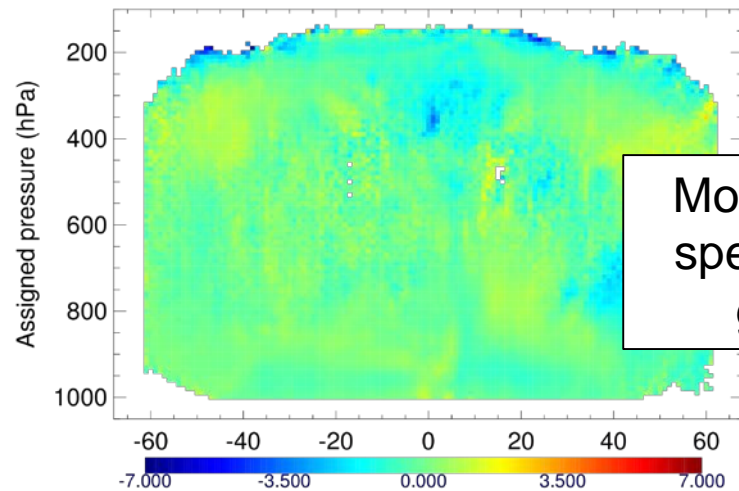
Met-10

RMSVD



RMSVD  
comparable

Speed bias



More positive  
speed bias in  
general

(1 month)

(2.5 weeks)

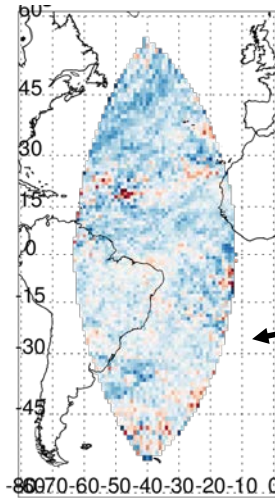
(1 month)

IR after QI and first  
guess screening

# Comparison with adjacent satellites

GOES-16 – Met-10

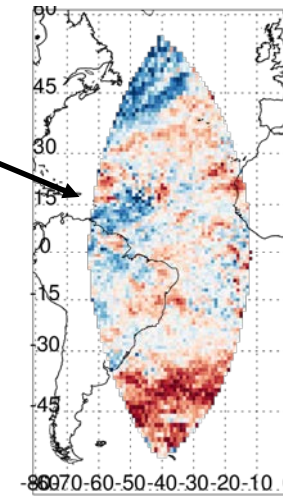
% Diff RMSVD



Similar pattern in reprocessed GOES-13

But RMSVD lower in GOES-16 case

Diff |speed bias|



High level water vapour winds

After QI and first guess screening

GOES-16 – GOES-15

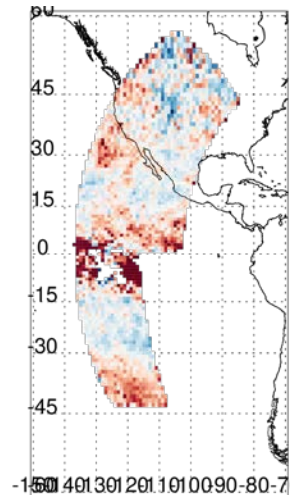


GOES-16 lower RMSVD

GOES-16 higher RMSVD

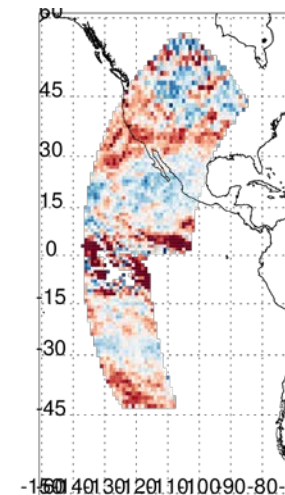
GOES-16 bias closer to 0

GOES-16 bias further from 0



Mixed changes but GOES-16 has no auto-editor

Larger differences in tropics



# Assimilation experiments: initial channel selections

Control: full observing system except AMVs in GOES-E position

Common criteria – reject GOES-16 AMVs if:

- $P < 150\text{hPa}$
- QI (forecast independent)  $< 90$
- Visible only:  $P < 700\text{hPa}$
- Low level winds over land
- WV removed in extra-tropics  $P > 300\text{hPa}$

Initial experiments tried a bolder use of data...

...but encountered issues at high levels

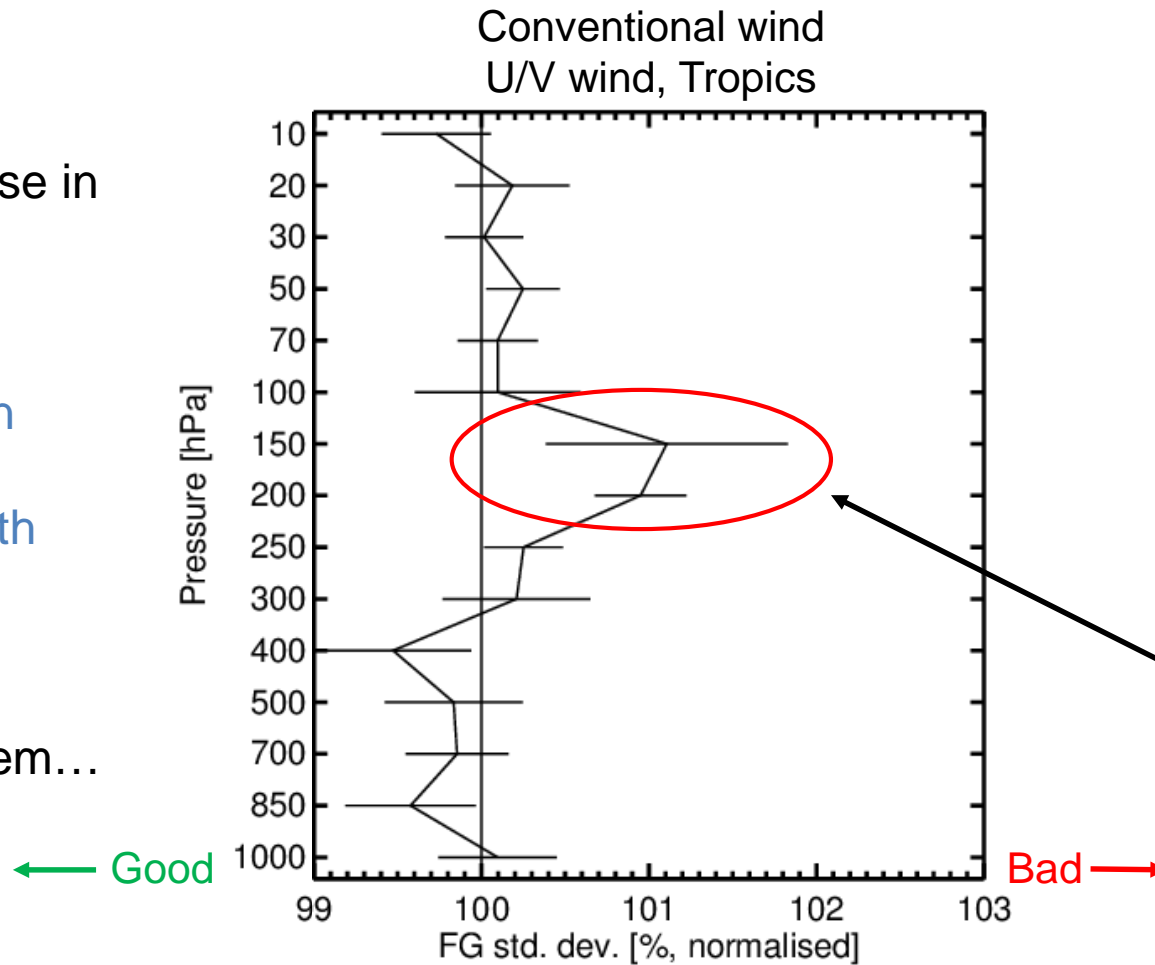
# Problems at high levels?

In verification vs. own analysis see large increase in analysis increments at 200hPa

Improvement/degradation signals in 200hPa short range forecast treated with caution

But more reliable observations show problem...

Using IR/WV at all pressures in tropics vs. control



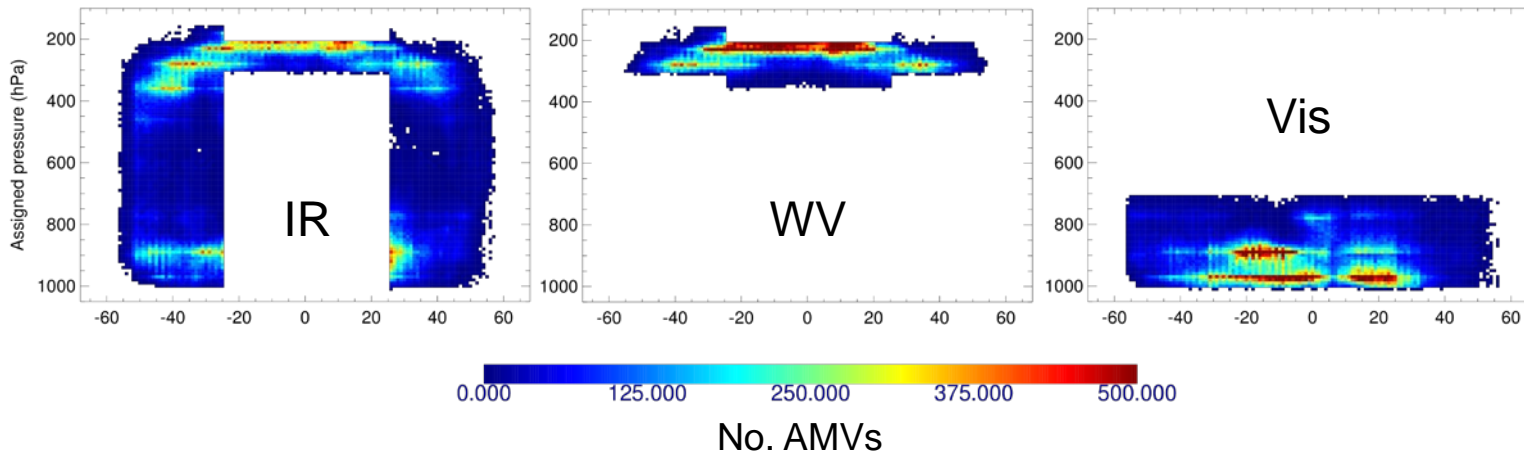
High level degradation in fit of conventional wind to model background

# Assimilation experiments: more conservative screening

- Tropics traditionally difficult area
- For Meteosat/Himawari, screening IR/WV at mid/low levels in tropics necessary
- GOES-16 negative impacts at lower pressures (150-200hPa)
- Most successful restricted tropics above 200hPa

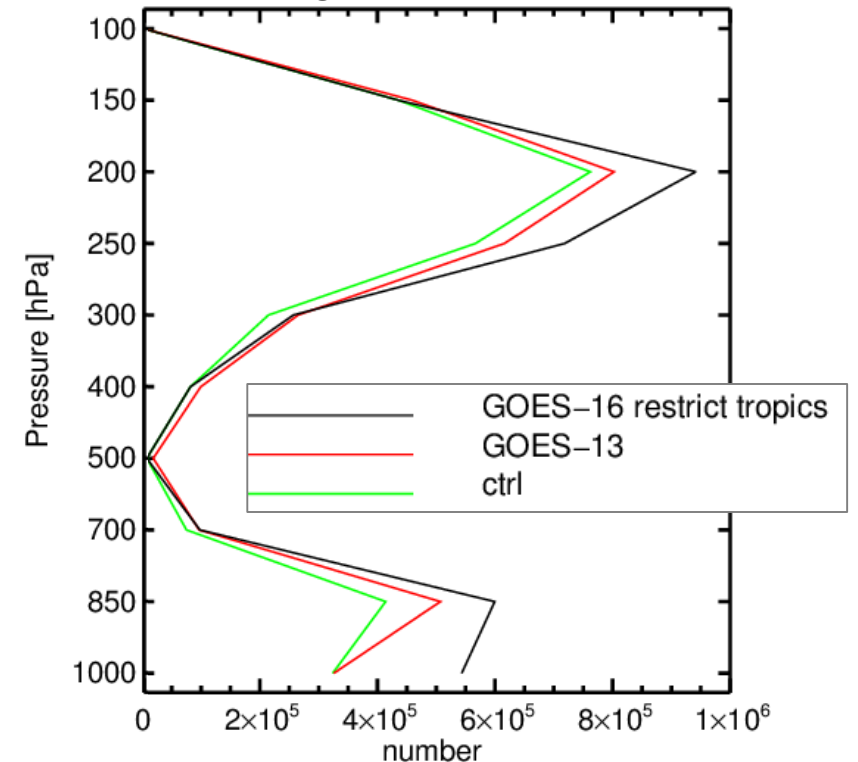
20<sup>th</sup> Dec 17  
– 2<sup>nd</sup> Jan 18

No. active GOES-16 AMVs 20-30<sup>th</sup> Dec



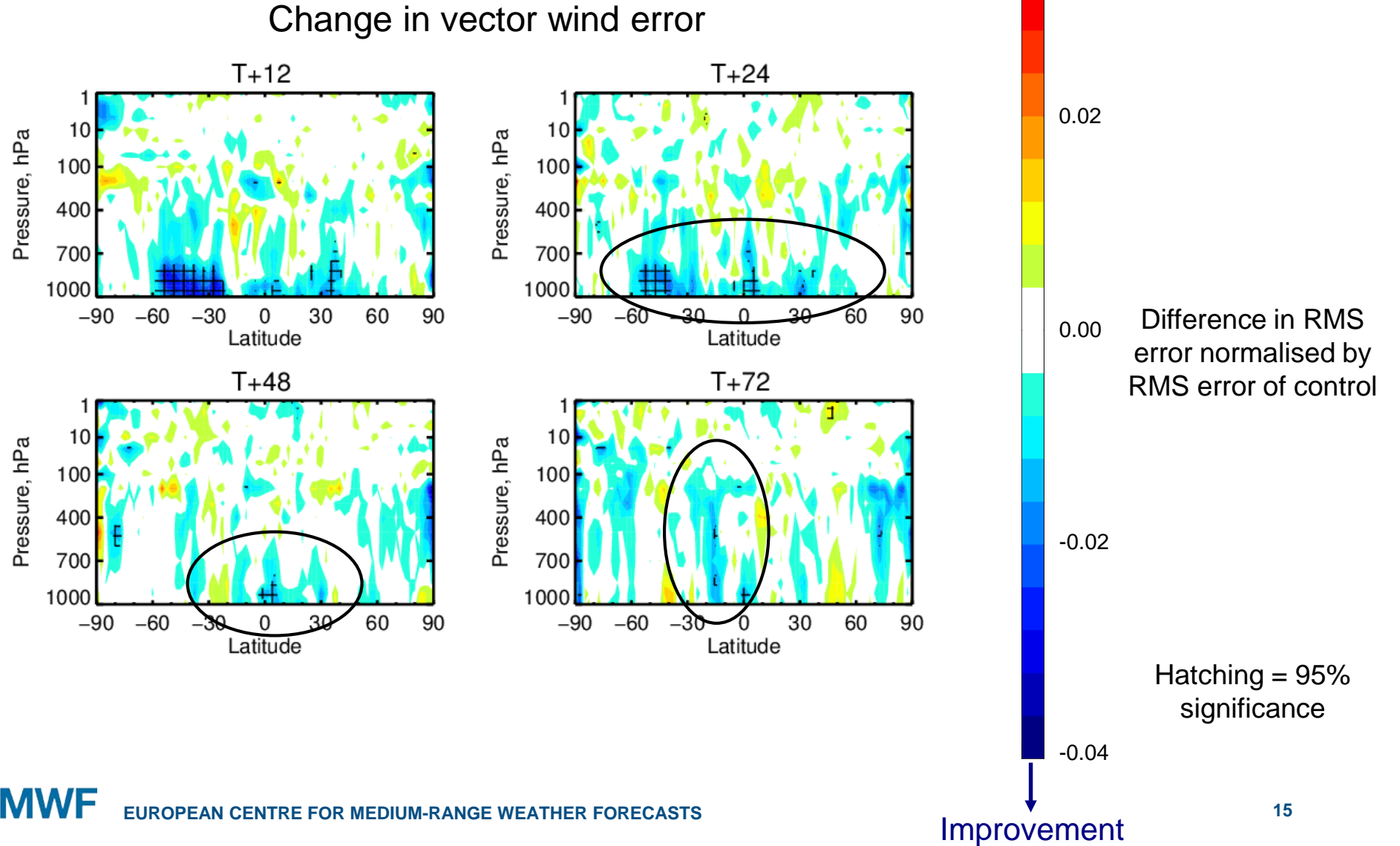
Despite stricter use, still more AMVs in use than GOES-13 except mid levels/above 150hPa

No. active global AMVs in tropics



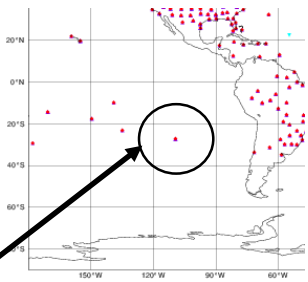
# Positive impacts in SH and low levels

GOES-16  
restricted use in  
tropics vs. control  
(no GOES-E  
AMVs)



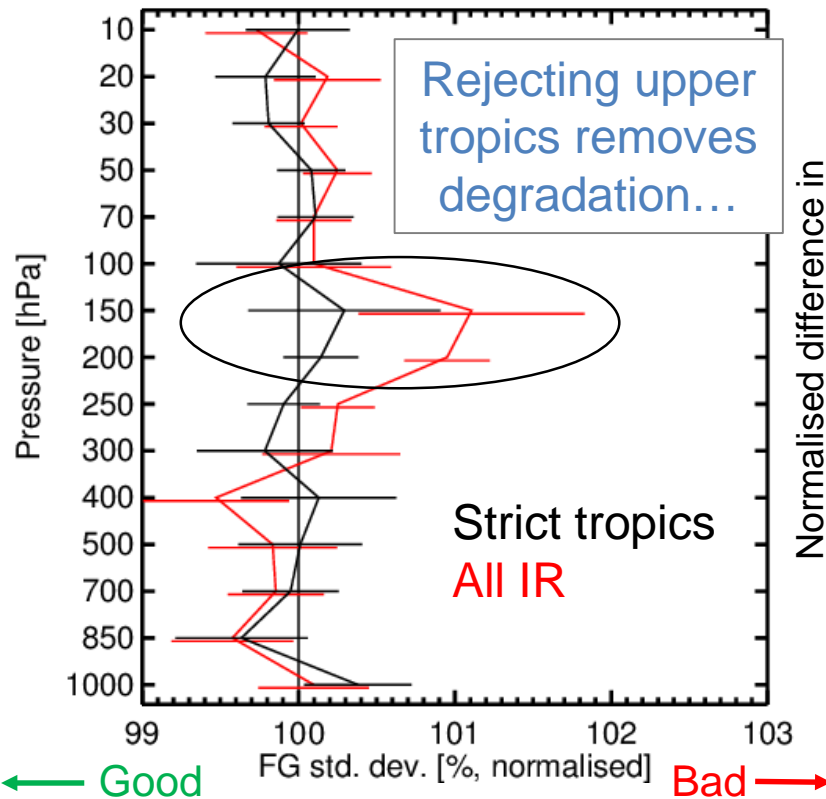
20<sup>th</sup> Dec 2017  
– 10<sup>th</sup> Mar  
2018

# High levels close to neutral

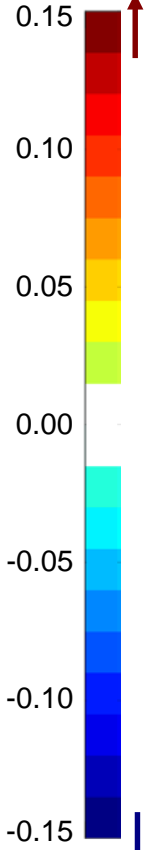


Only 1 radiosonde (Easter Island) available in area: suggests no issue

Conventional wind  
U/V wind, Tropics

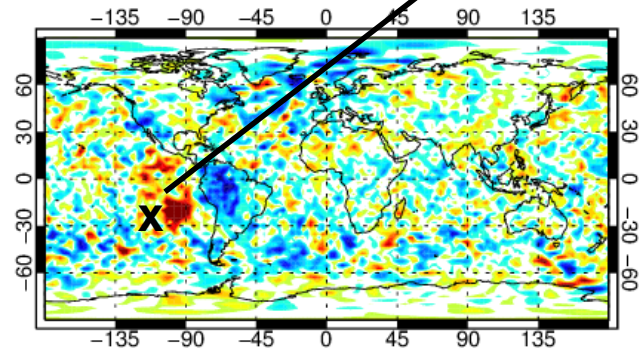


Degradation

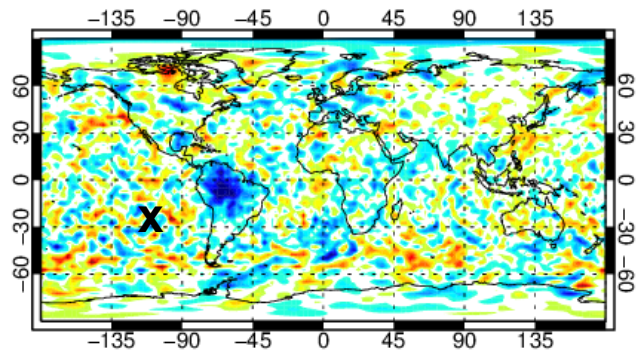


Change in vector  
wind error

T+24, 200hPa



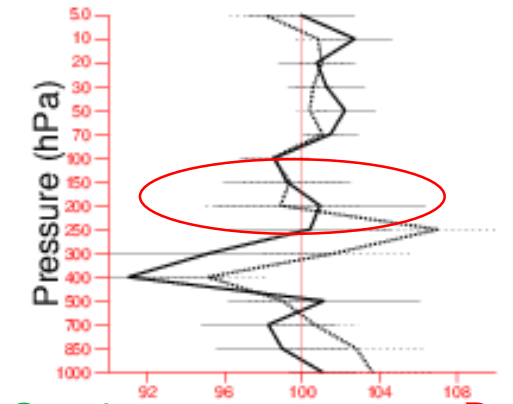
T+48, 200hPa



...And reduces area affected verified against own analysis

U component

STD.DEV (normalised)

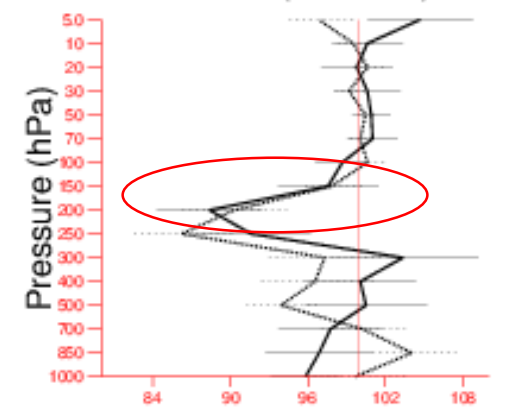


← Good

Bad →

V component

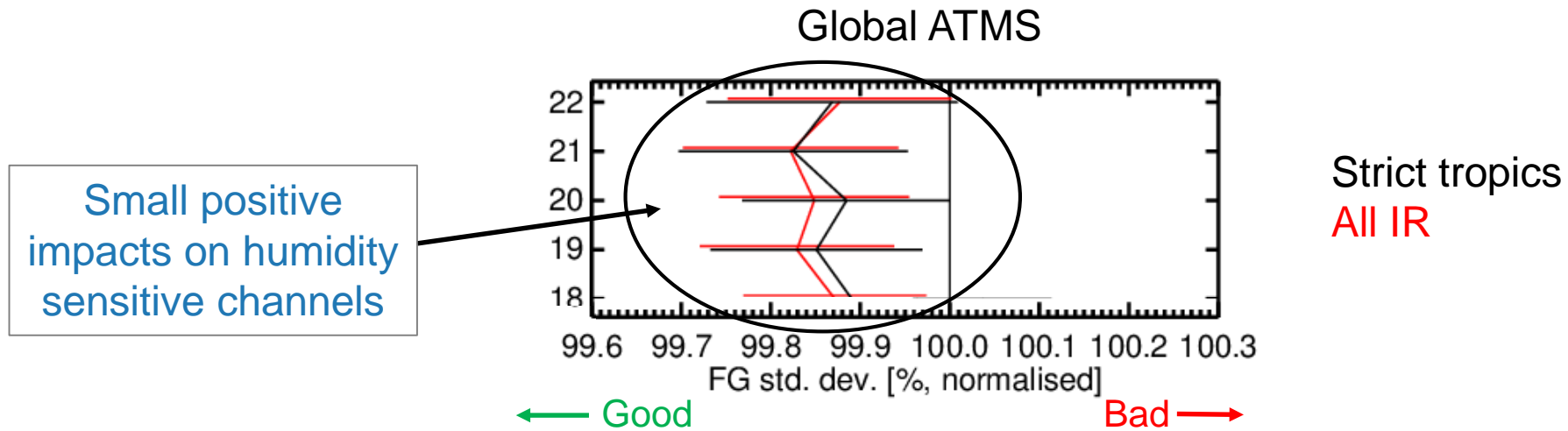
STD.DEV (normalised)



20<sup>th</sup> Dec 2017  
– 10<sup>th</sup> Mar  
2018



# Small neutral/positive impacts on humidity



Microwave/infrared sounders show generally neutral or small positive impacts on humidity sensitive channels

20<sup>th</sup> Dec 2017  
– 10<sup>th</sup> Mar  
2018

# Activation and reassessment

- Conservative screening helps remove degradation areas...
- ...while retaining positive impacts
- From 18<sup>th</sup> April data monitored
  - <https://www.ecmwf.int/en/forecasts/charts/obstat/?facets=Data%20type,Atmospheric%20Motion%20Vectors>
- Data ready to be activated

And then...

- Change to height assignment algorithm anticipated: re-evaluate after changes applied (data in parallel/ahead of time helpful)
- Other ongoing experiments to consider
  - Inflated observation errors
  - 3 hourly thinning

# Summary

- More winds and concentrated into upper/lower levels
- Changes in speed bias
- Mixed results in Met-10/GOES-15 overlap regions
- Assimilation experiments show promising areas...
- ...But suggest stricter screening for tropics necessary
- Activation planned soon
- Further assessment esp. after algorithm change required

Thank you for listening!