Recent work using Satellite winds at the Deutscher Wetterdienst (DWD)

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- Introduction
- Recent changes in satellite wind usage
- New products (IASI AMVs, Dual Sentinal-3 AMVs)
- Operational use of Aeolus HLOS wind data
- Use of scatterometer data
- Summary

The *deterministic* NWP-System of DWD

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Global-Modell ICON

grid size: 13 km
vertical levels: 90
Grid area: 173 km^2

Hybrid DA

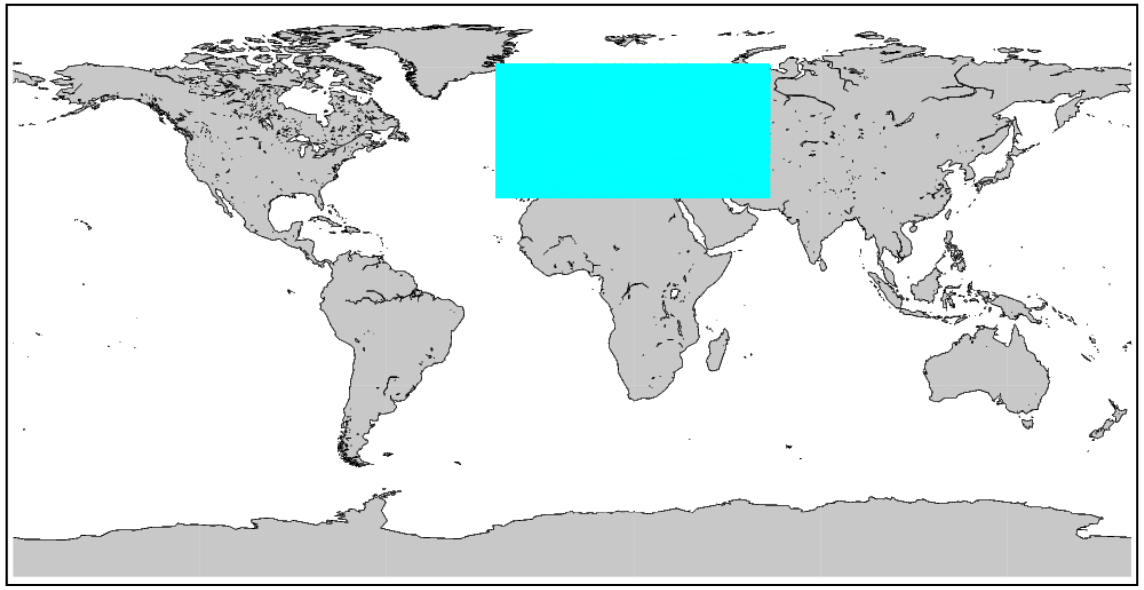
- **13km V**arEnKF
- Flow dependent B:
  $B_{VarEnKF} = \alpha B_{LETKF} + (\alpha\text{-}1)B_{3DVAR}$
- Incremental analysis update
- SST, SMA and snow ana

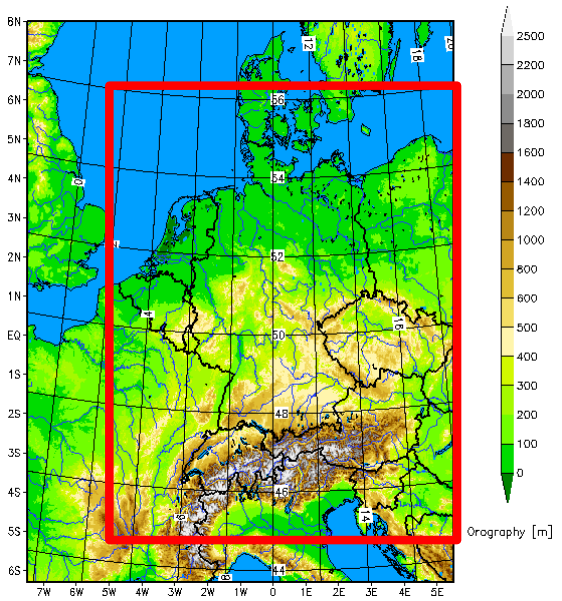
ICON-EU Nest over Europe

grid size: 6.5 km
Vertical levels: 60
forecasts:
Grid area: 43 km^2

COSMO-DE (convection resolving)

grid size: 2.8 km
vertical levels: 50
forecasts: 3-hourly
Girid area: 8 km^2
Det LETKF replaced nudging





The *probabilistic* NWP-System of DWD

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ICON-EPS; M40

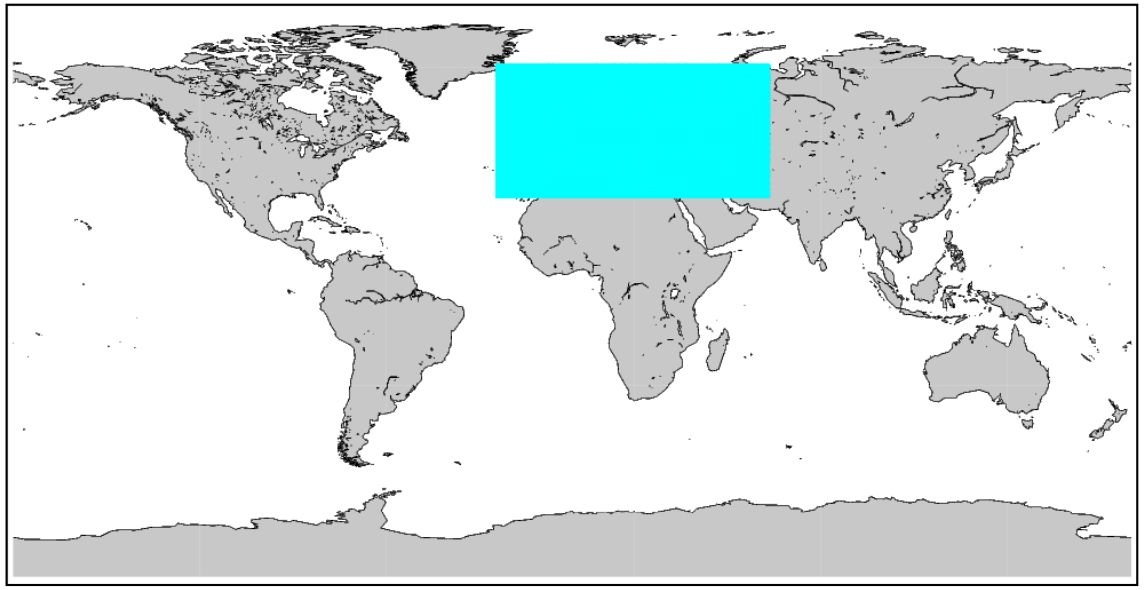
grid size: 40 km
vertical levels: 90
grid area: 1638 km^2

Ensemble DA

- 40 member 40km LETKF.
- Horizontal localization radius 300km.
- Relaxation to prior perturbations (0.75).
- Adaptive inflation (0.9 - 1.5).
- SST perturbations Soil moisture perturbations (experimental)

ICON-EU Nest over Europe

grid size: 20 km
vertical levels: 60
forecasts:
grid area: 407 km^2

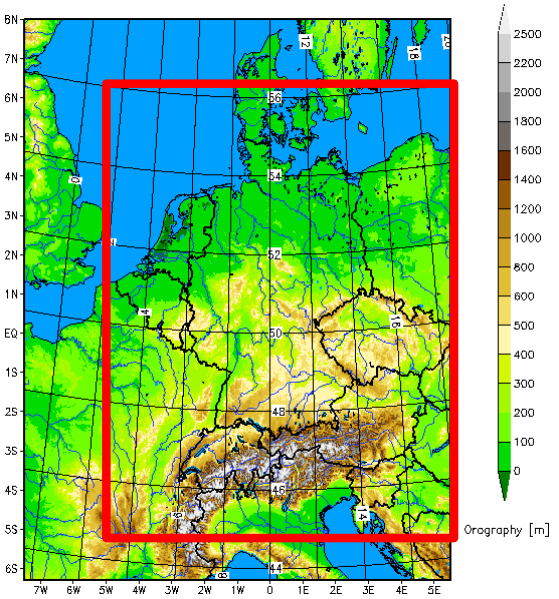


COSMO-DE-EPS; M20

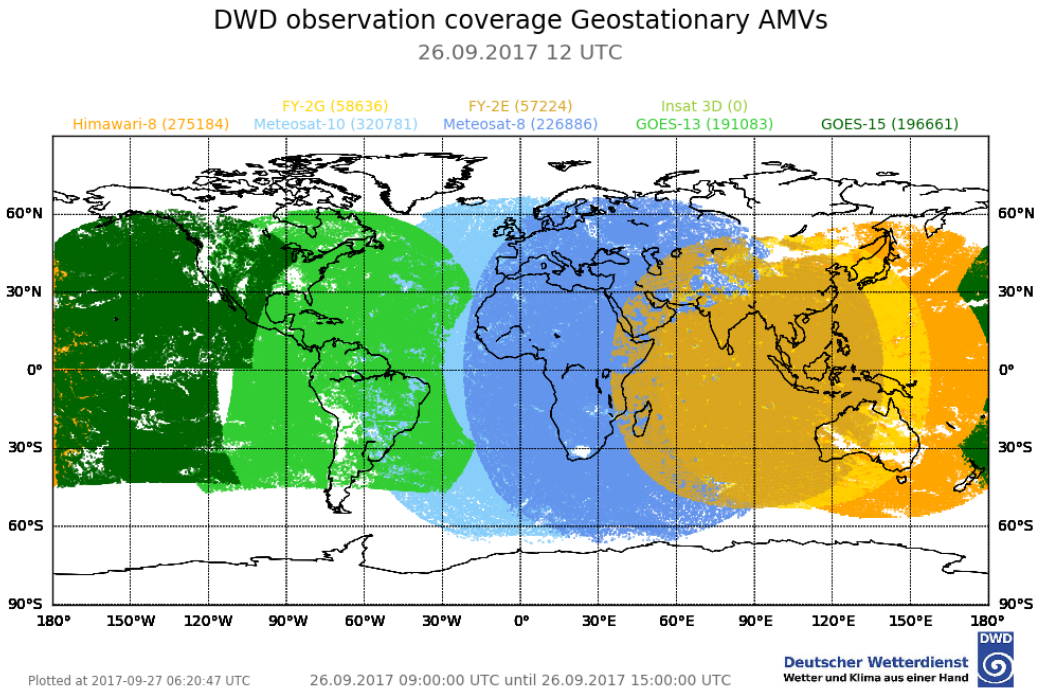
grid size: 2.8 km
vertical levels: 50
Forecasts: 3-hourly
grid area: 8 km^2

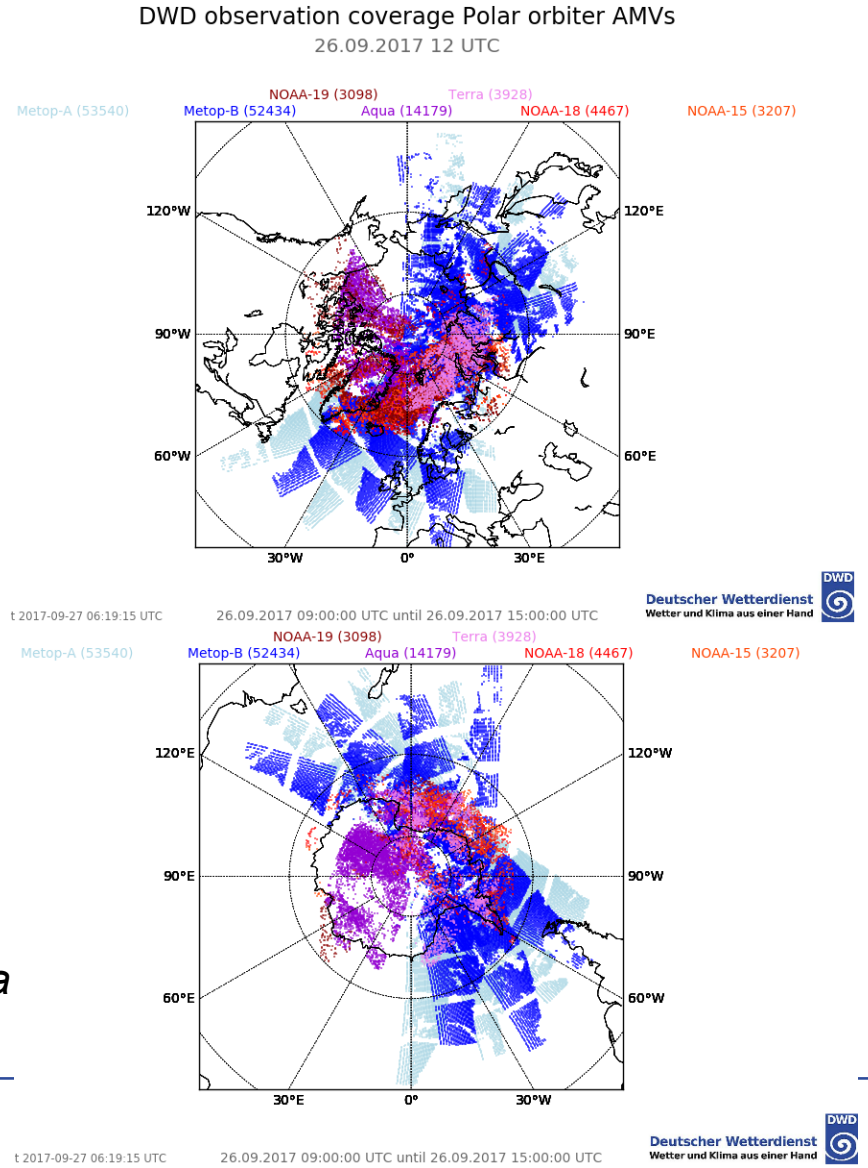
Ensemble DA

40 member 2.8 km LETKF
SST pertubations
Soil moisture pertubations



Data coverage AMVs



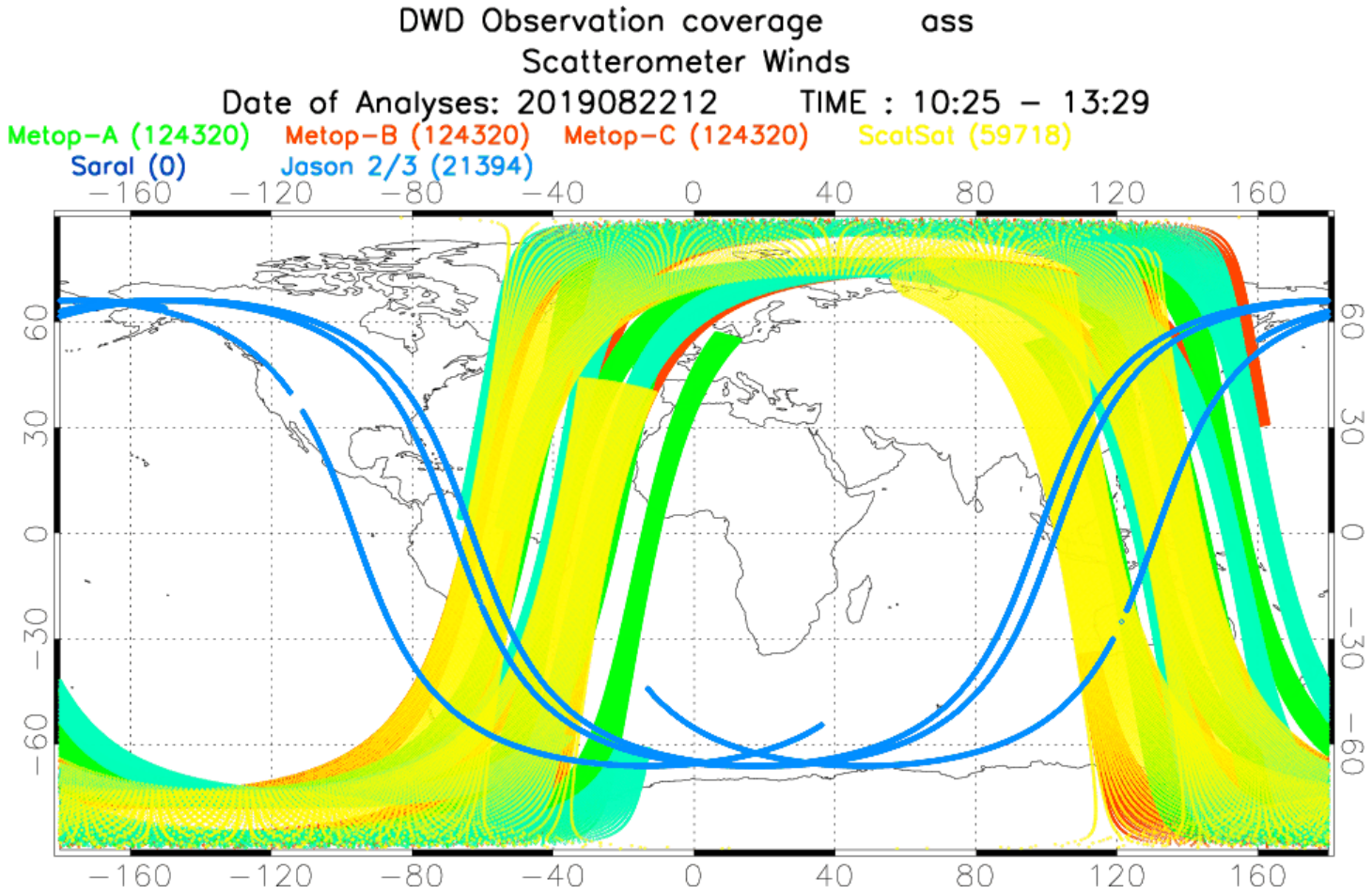


Operational

Geo: *GOES 16/17 Metop 8/11 Himarawi-8*

Polar: *AVHRR from Metop 3/4/5 single and dual, the NOAA series , MODIS from Terra and Aqua VIIRS from NOAA 19, NPP*

Data coverage scatterometer/altimeter

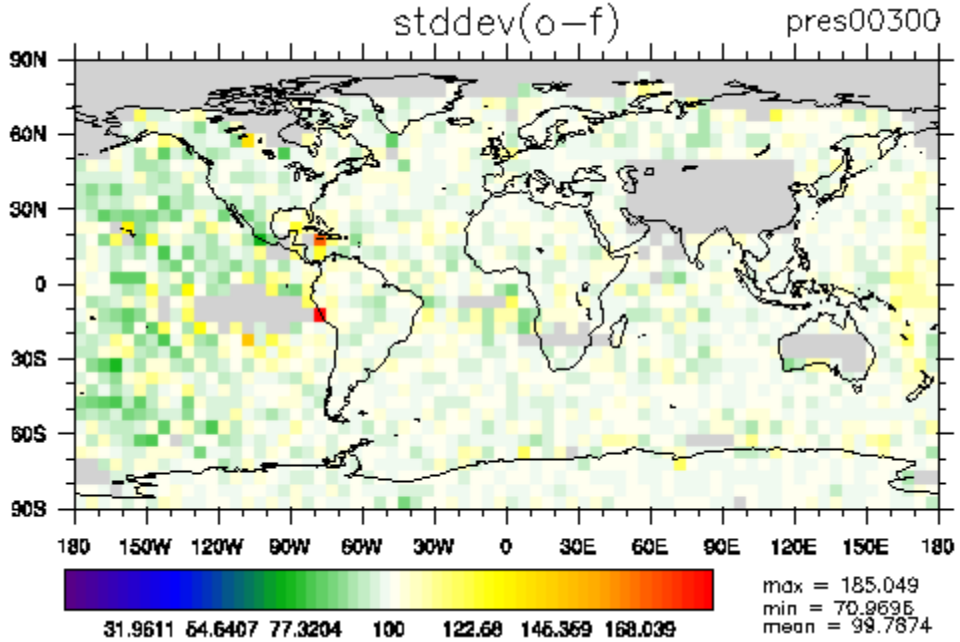


Operational scatterometer: ASCAT-METOP A/B/C and ScatSat, Monitoring HY-2A/B
Operational altimeter: Jason 2/3 and SARAL Monitor: Sentinal A/B

Changes in operationel usage of satellite winds since the last meeting

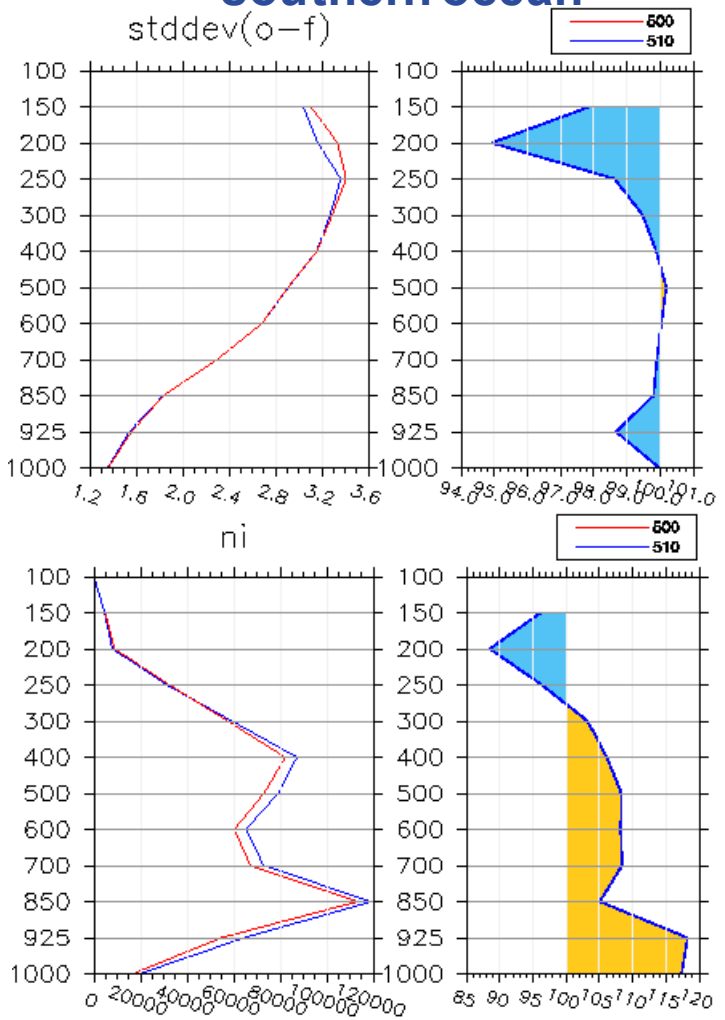
- Operational use of Dual Metop AMV winds
- Use of GOES 16 and GOES 17 AMVs with new Bufr template
- Use of the new AMV Bufr template for Eumetsat AMV
- Operational use of Aeolus HLOS wind oservations
- Operational use of ScatSat ocean winds
- Monitoring of IASI wind retrivals and dual Sentinal-3 test data sets
- Experimental use of HY-2A/B scatterometer winds

Replace GOES 15 by GOES 17 AMVs Assimilation Experiment



Small positive impact replacing GOES 15 by GOES 17. Largest in upper troposphere

southern ocean



Dual Sentinal-3 AMV product Aug.-Sep. 2020

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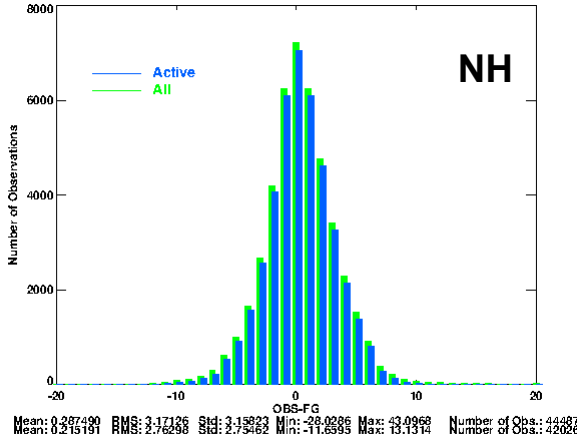
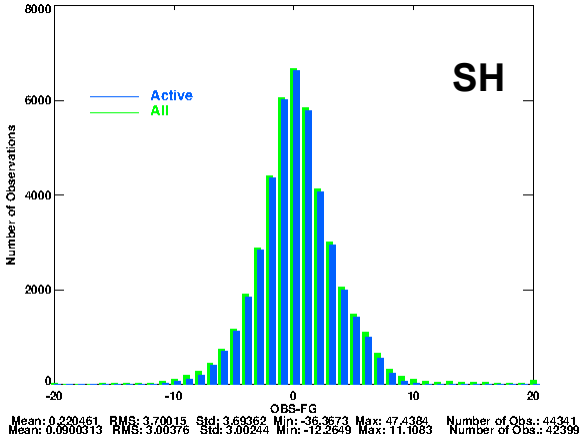
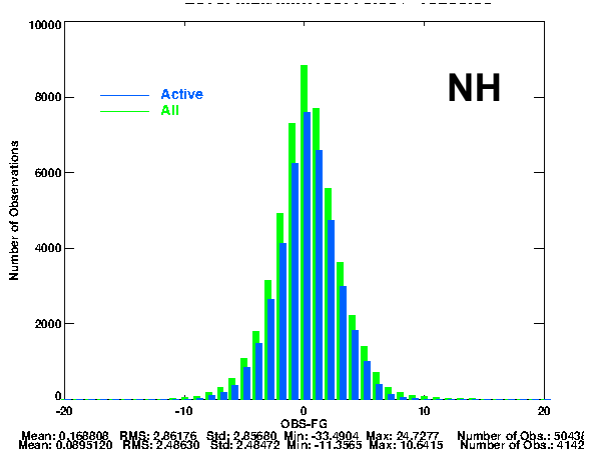
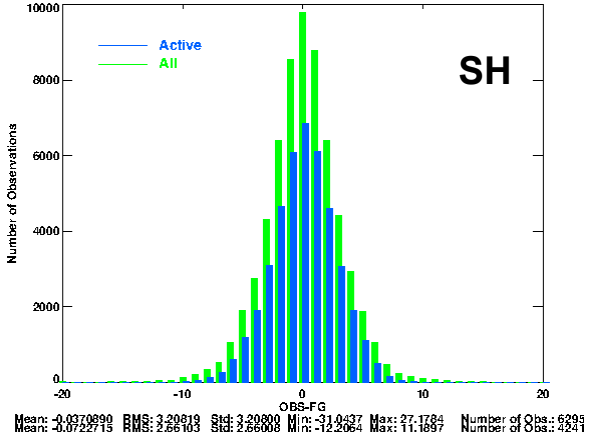
Sentinal-3





Dual Metop





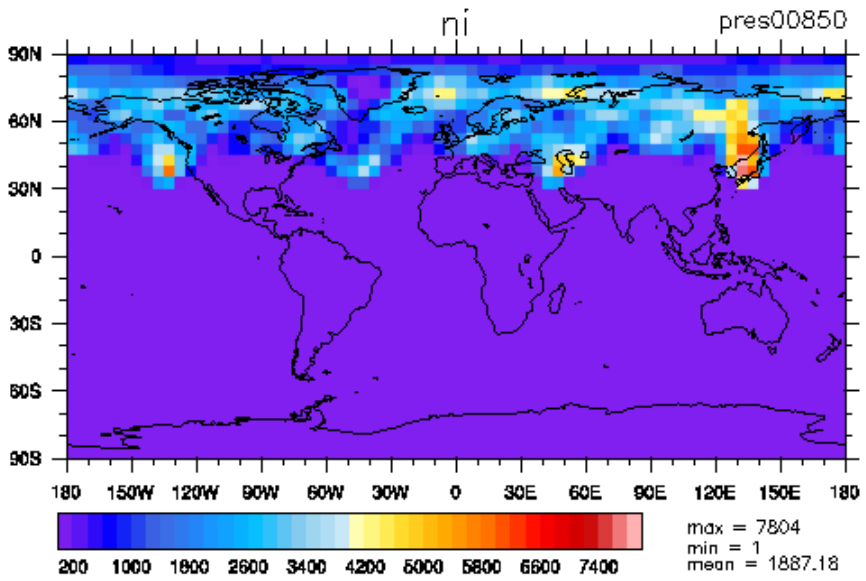
IASI wind retrievals

Introduction

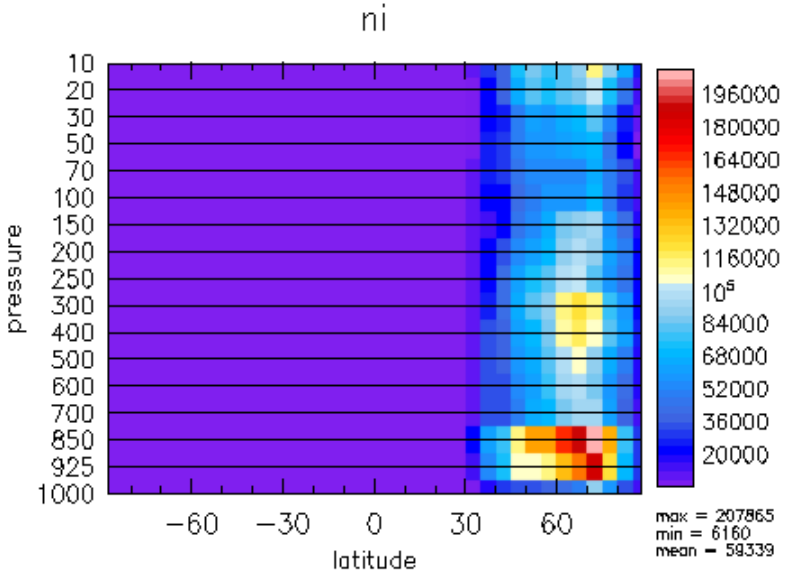
- IASI Wind retrieval data provided by Eumetsat
- One month of data in yml – Format
- Data not in Bufr Format problematic
- Development of python script to convert yml format into „Pseudo pilot bufr“
- „Pseudo pilot bufr“ format used in global data assimialtion system to produce Obs minus FG statistics
- One week of data investigated so far
- As a first approach observation error as for „pilots“ used (not appropriate for IASI wind retrievals)

IASI wind retrieval statistics
Observation distribution

Horizontal



Vertical



- **Number of observations highest in lower troposphere**
- **Secondary maximum in jet level niveau**
- **Large number of observations at southern edge of the regional distribution**
- **Local minimum over Greenland**

IASI wind retrieval statistics
Obs minus FG frequency distributions

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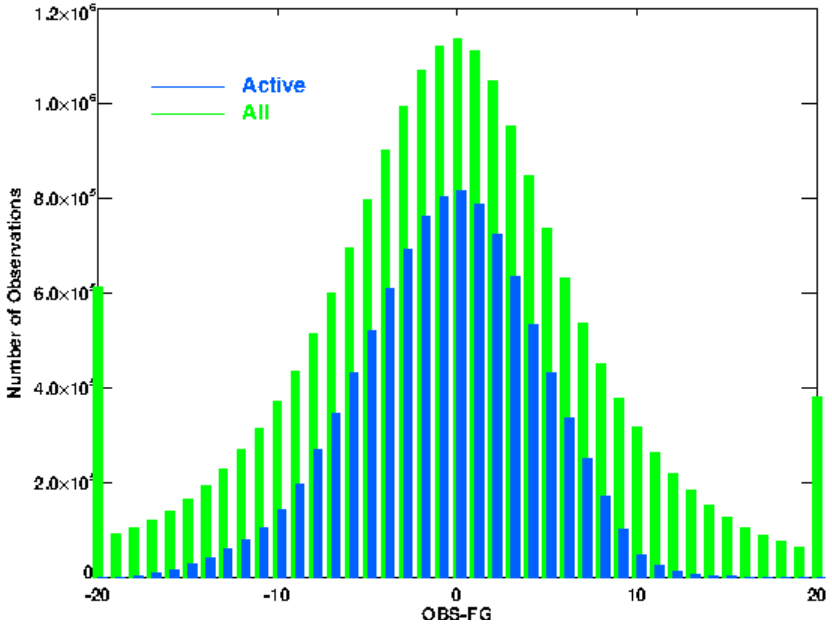
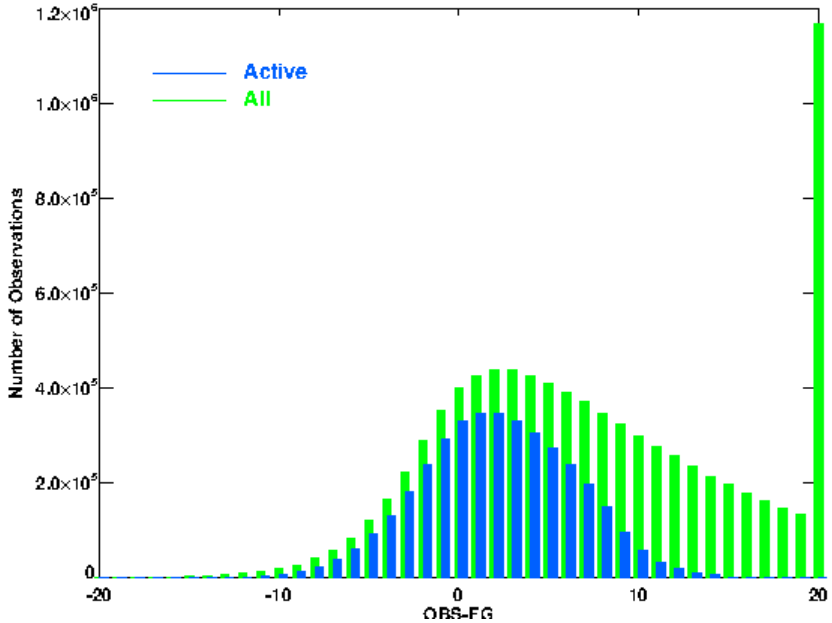
2017062500 - 2017063021

Troposphere



Stratosphere

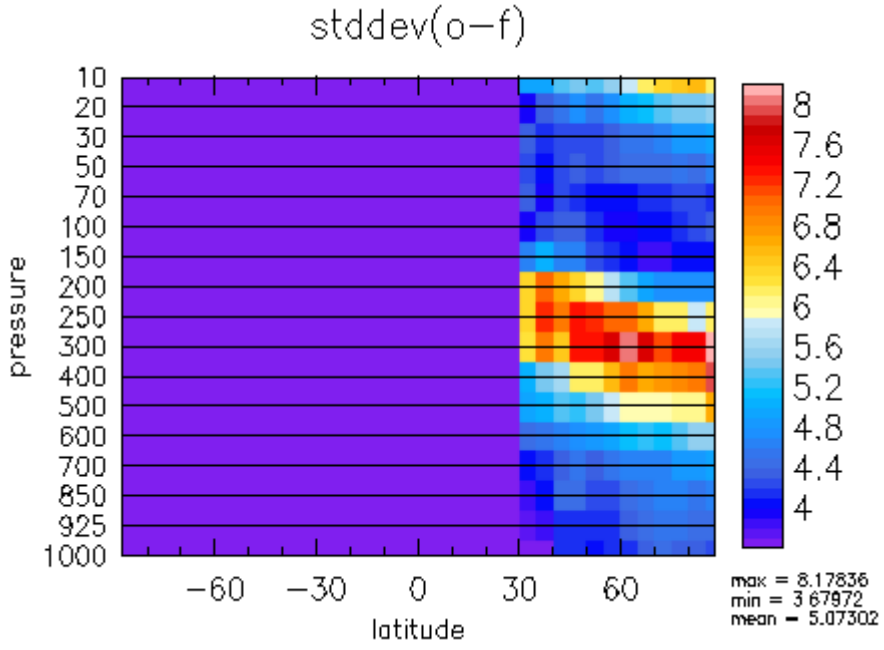


- Active means after the first guess check
- Frequency distribution in troposphere looks reasonable (gaussian)
- Skewed distribution in statosphere with large biases (non-gaussian)
- Many outliers in both distributions (over 100 m/sec)
- Large number of profiles => correlated errors

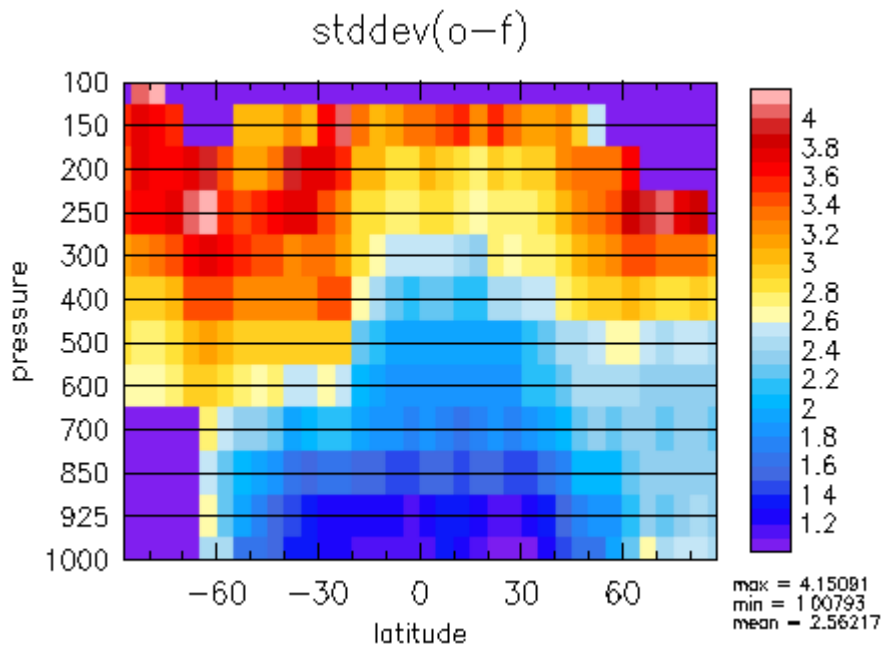
Obs minus FG statistics standard deviation

Statistics after FG check

IASI Wind Retrieval



AMV wind retrieval



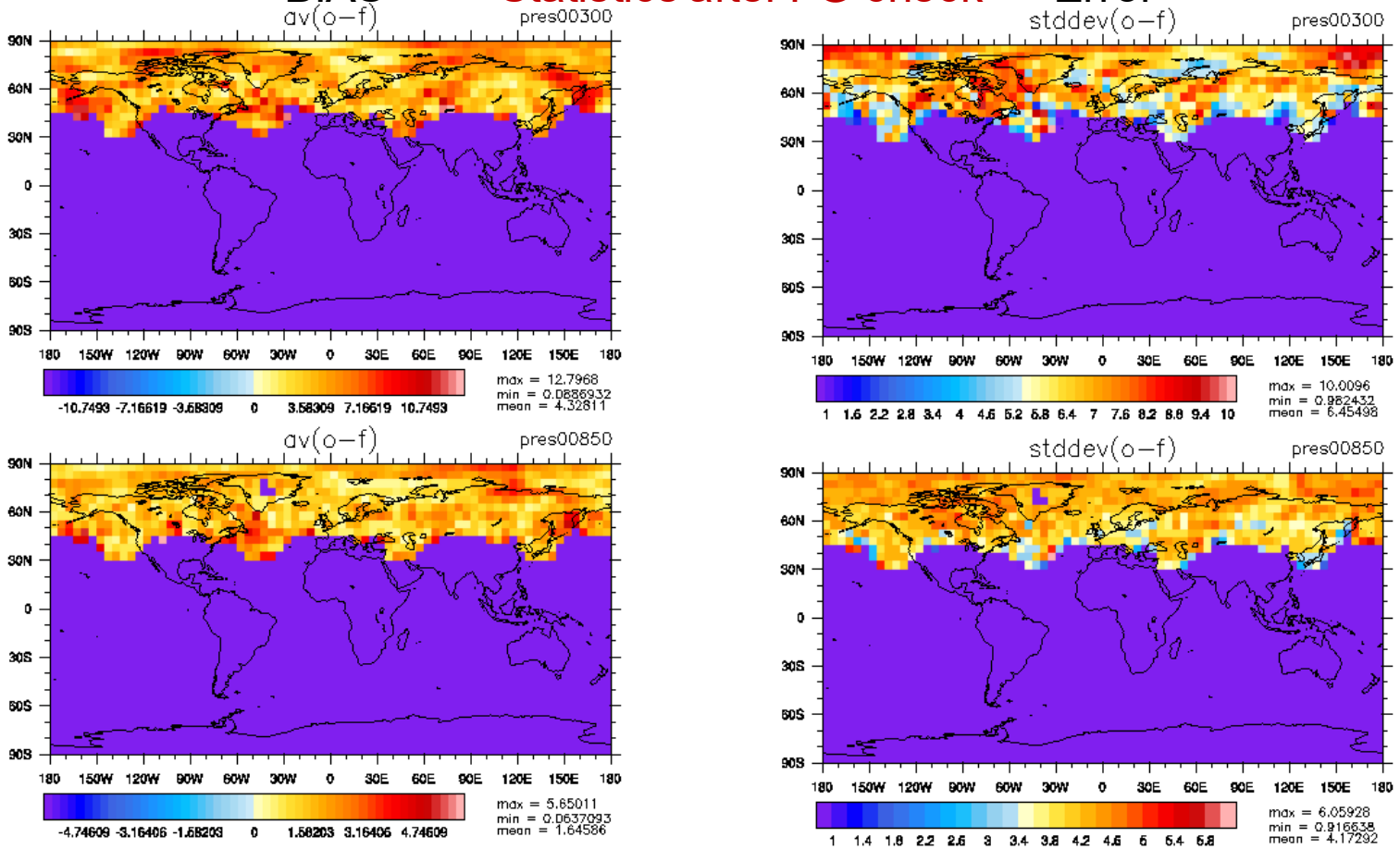
- Both, IASI and AMV wind retrieval show largest stddev in jet level niveau
- Stddev of IASI wind retrieval is up to twice as large as AMV wind retrieval

Obs minus FG statistics standard deviation

BIAS

Statistics after FG check

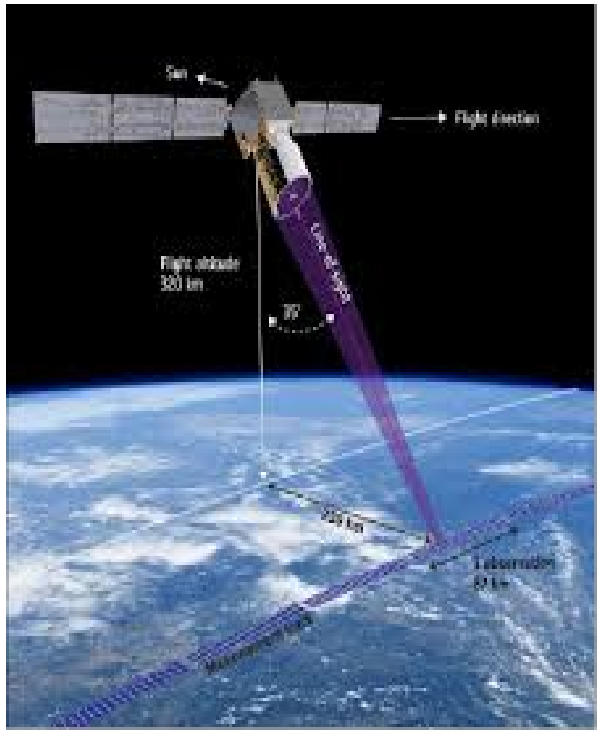
Error



- Biases and errors large in upper troposhere
- Large upper tropospheric biases over east siberia, Alaska, canadian Arctic, southern Atlantic
- Large errors over north-east Canada and eastern polar regions

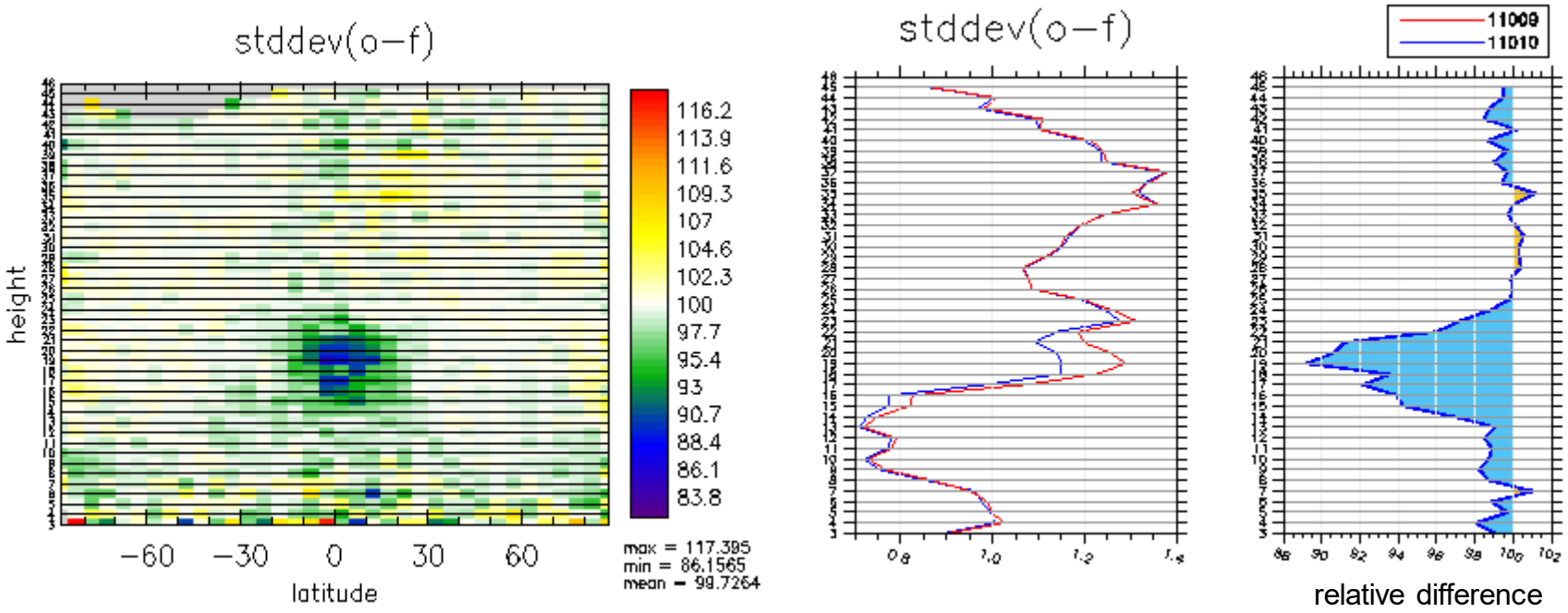
Aeolus Wind Lidar work

- *Aeolus launched in August 2018*
- *Observation variable: HLOS*
- *Level 2B Cal/Val dataset provided by ECMWF*
- *Data are provided in Bufr Format*
- *First laser operated till beginning of June 2019*
- *Second laser data available in July 2019*
- *German activities bundled in Project EVAA*
  (Experimental Validation and Assimilaton of Aeolus data)
- *Several impact experiments conducted with data from first and second laser*
- *All the activities resulted in the:*



➢ ***Operational use of Aeolus wind observations since 19th May 2020***

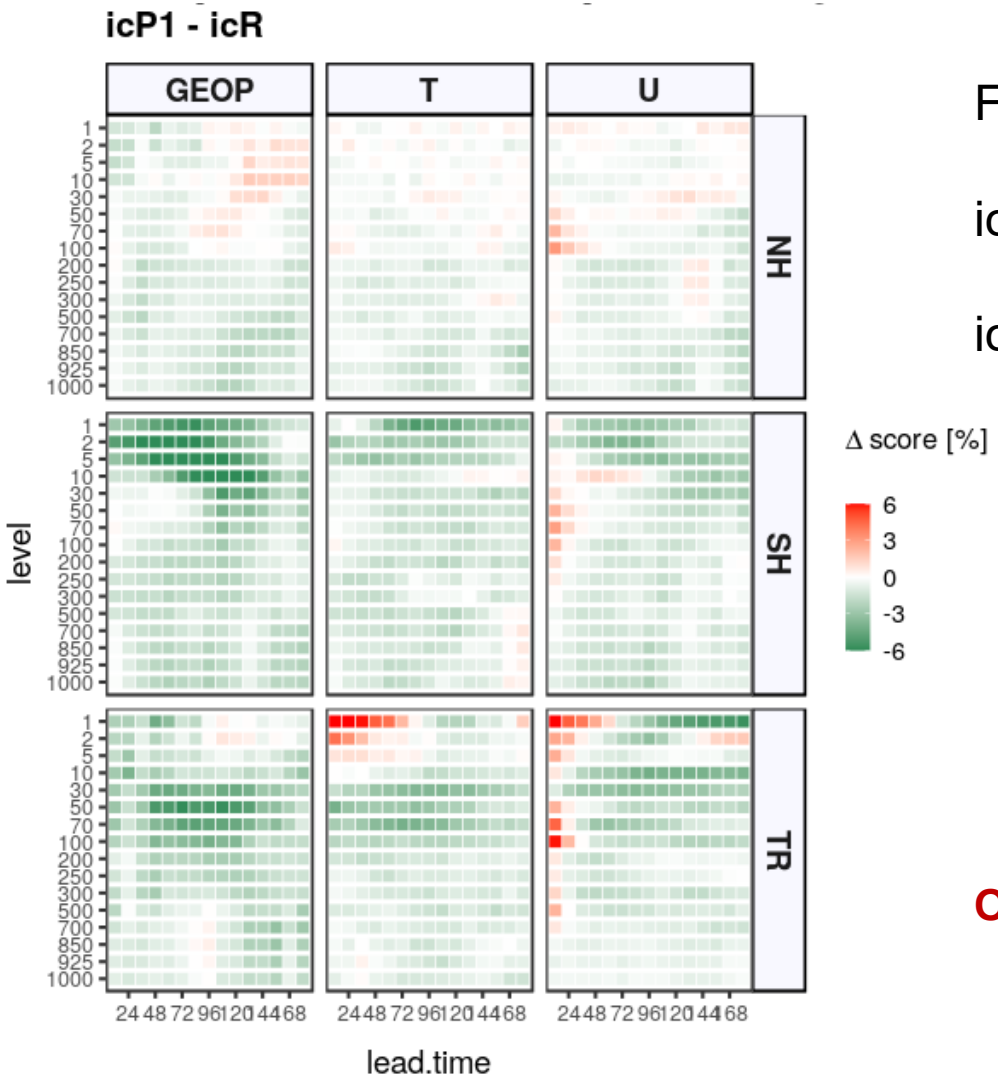
Radio Occultation



Green/blue: Improvement of using Radio Occultation data by using Aeolus data

Improvement in the tropical upper troposphere/lower stratosphere over 10 %

Score Card
Verification against own analyses
20200426 - 20200520



Final test before operational use

icP1: Experiment with operational setup including Aeolus data

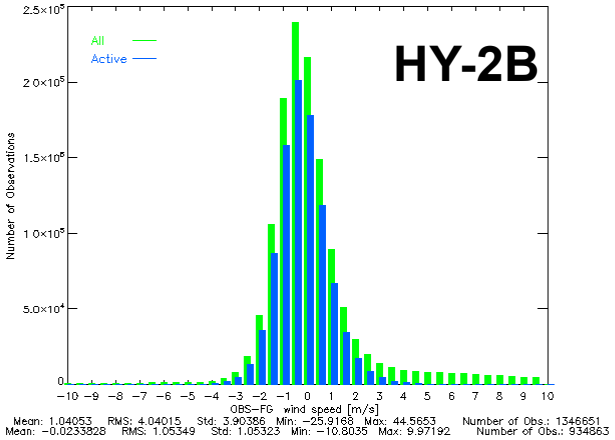
icR: Operational setting without Aeolus data

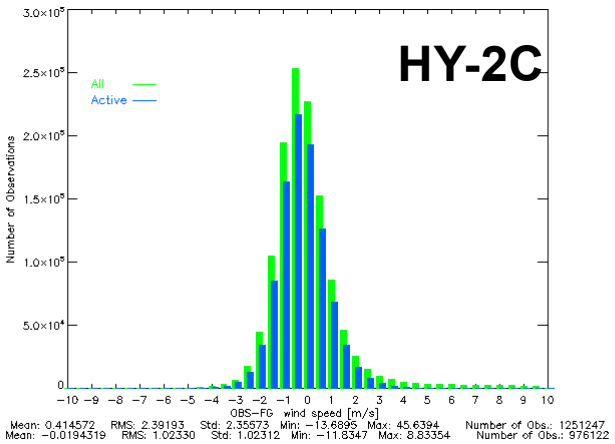
Green: positive impact of icP1
red: negative impact of icP0

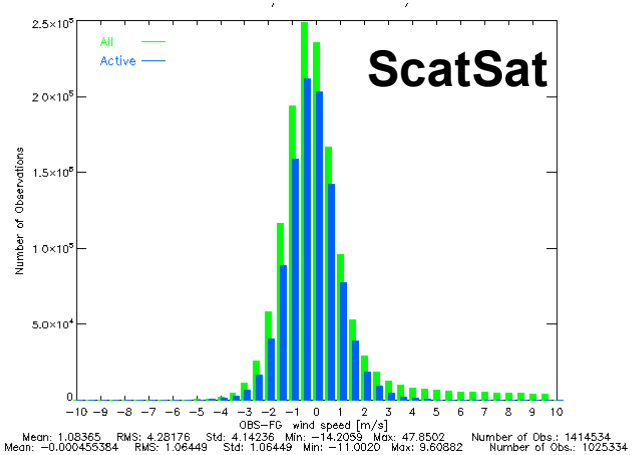
Clear positive impact using Aeolus HLOS wind data

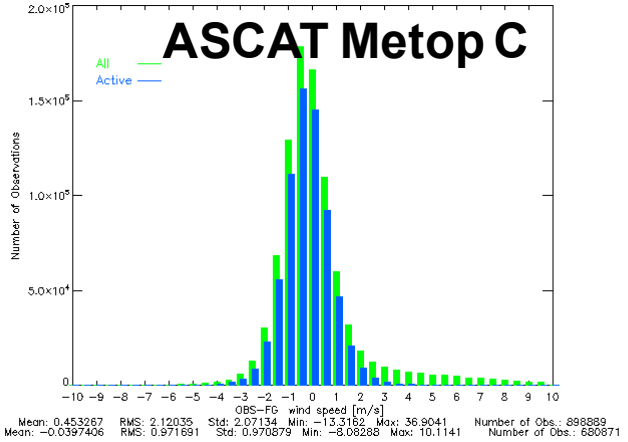
Operational use since 19th May 2020

HY-2 B/C scatterometer monitoring
Obs – FG comparison









Summary

- Satellite winds are an important contribution to the global observing system
- High impact in data assimilation and forecasting system of DWD
- Integration of new satellite wind products are ongoing work
- Open for collaboration with EUMETSAT to test new poducts
  - Test of IASI AMV test data
  - Monitoring of dual Sentinal-3 AMV product
- Integration of Aeolus wind lidar observation successful
  - ➢ Large impact in the upper troposphere lower stratosphere in the tropics and on both hemisphere
  - ➢ Operational use since May 2020
- Monitoring and use of new scatterometer data like HY-2B/C

Thank you for listening