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

Alexander Cress

Deutscher Wetterdienst, Frankfurter Strasse 135, 63067 Offenbach am Main, Germany

alexander.cress@dwd.de

➢ Introduction

➢ Recent changes in satellite wind usage

➢ New projects (HR AMVs / NWPSAF – DWD cooperation)

➢ Use of scatterometer data

➢ Aeolus plans

➢ Summary

The *deterministic* NWP-System of DWD

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Global-Modell ICON

grid size: 13 km

vertical levels: 90

Grid area: 173 km^2

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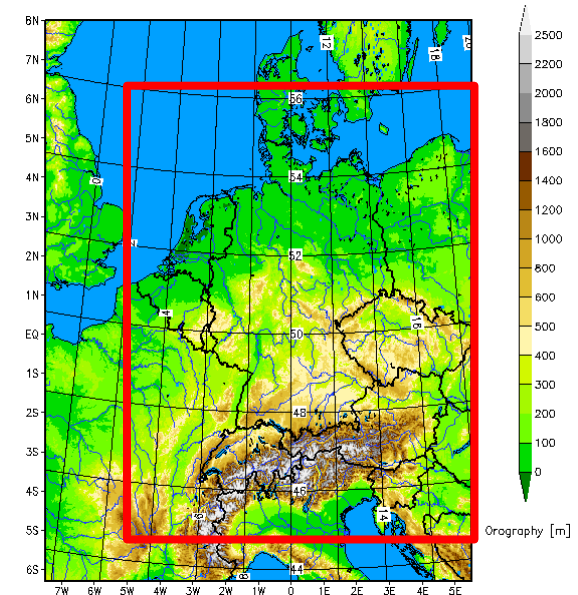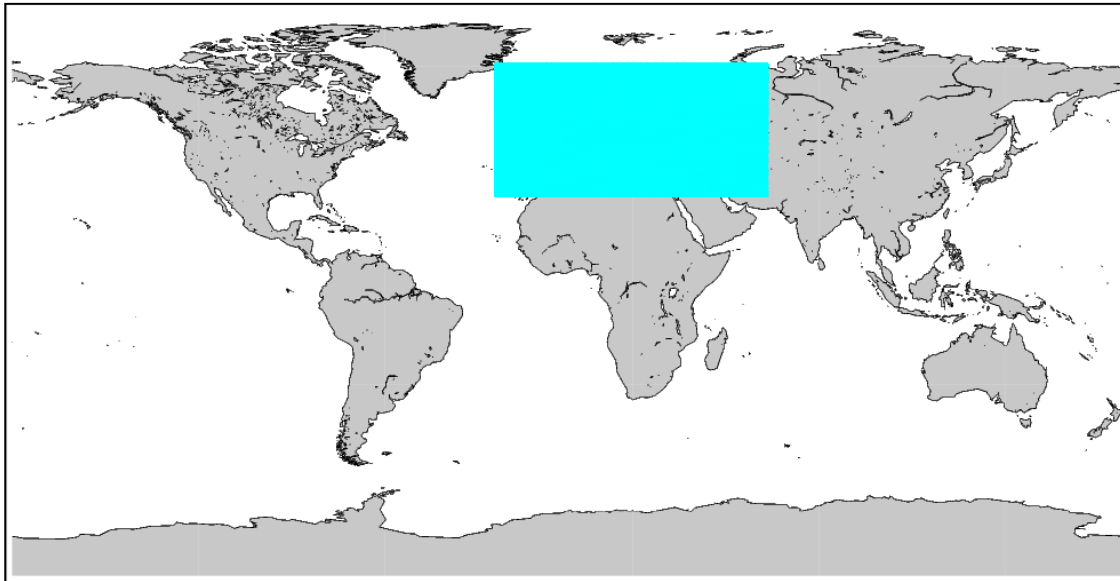
- **13km V**arEnKF
- Flow dependent B:
  $B_{VarEnKF} = \alpha B_{LETKF} + (\alpha-1)B_{3DVAR}$
- Incremental analysis update
- SST, SMA and snow ana

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

Orography [m]

The *probabilistic* NWP-System of DWD

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
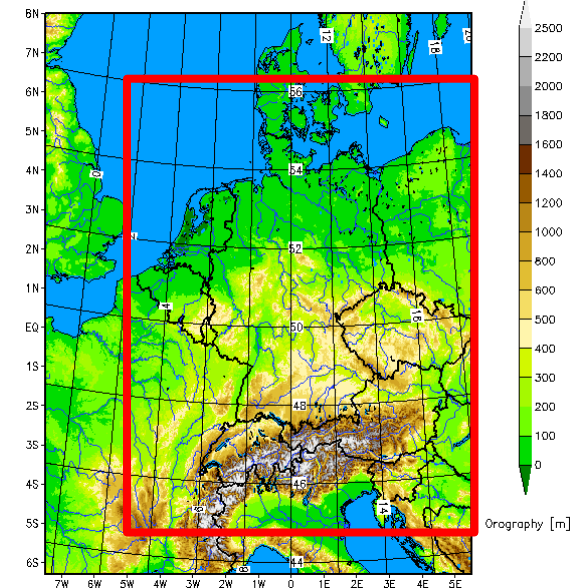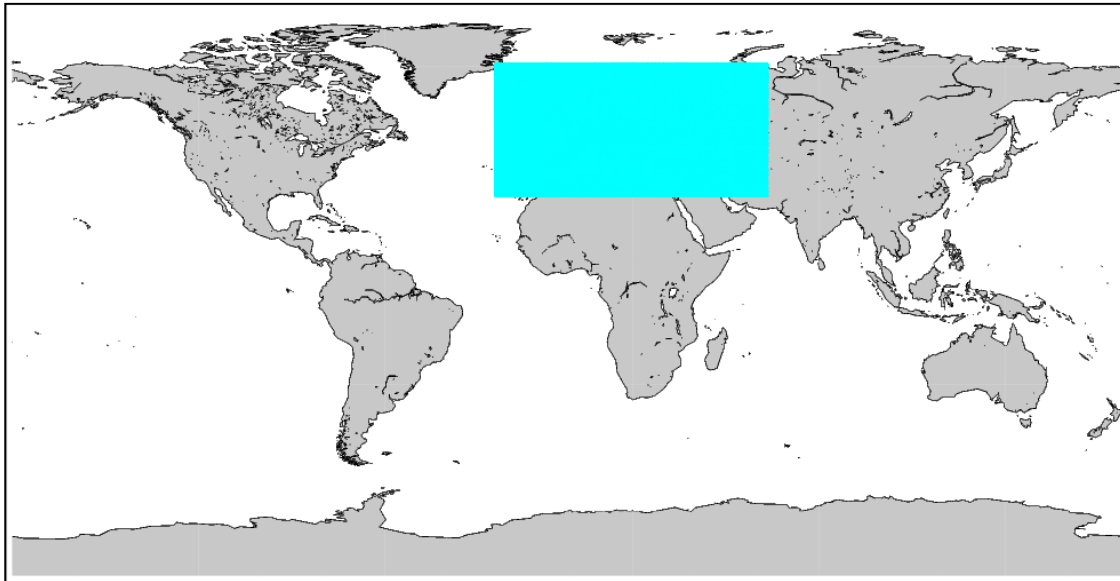
COSMO-DE-EPS; M20

grid size: 2.8 km

vertical levels: 50

Forecasts: 3-hourly

grid area: 8 km^2

Ensemble DA

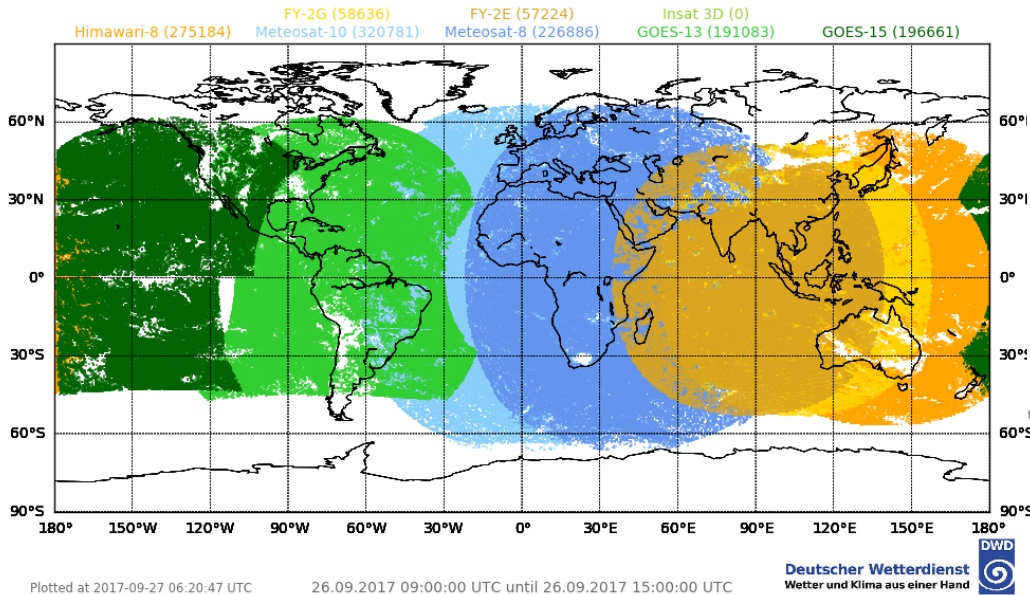40 member 2.8 km LETKF

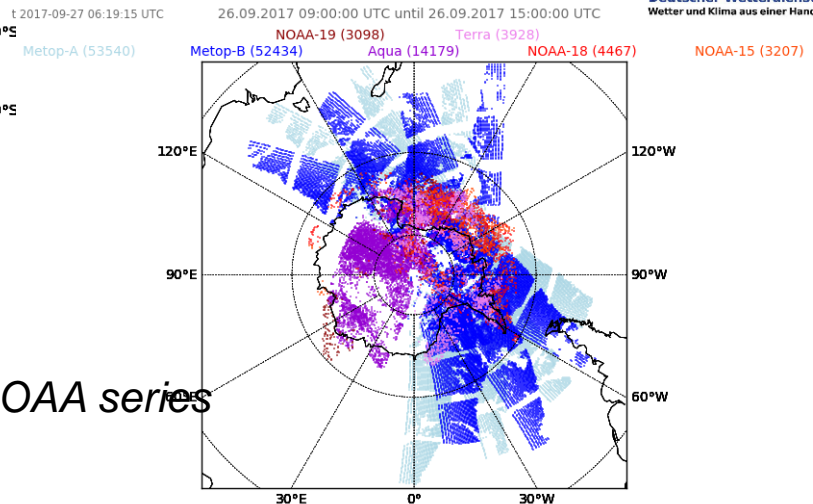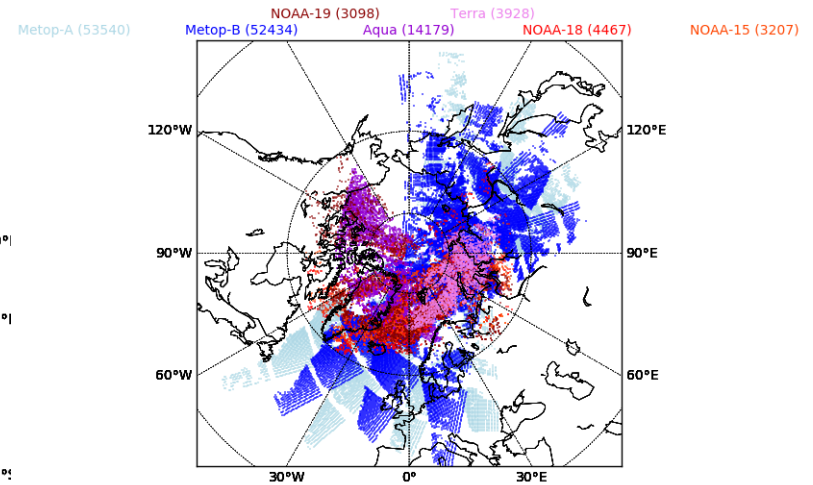SST pertubations

Soil moisture pertubations

Data coverage

DWD observation coverage Geostationary AMVs
26.09.2017 12 UTC

FY-2G (58636)   FY-2E (57224)   Insat 3D (0)
Himawari-8 (275184) Meteosat-10 (320781) Meteosat-8 (226886) GOES-13 (191083) GOES-15 (196661)

Plotted at 2017-09-27 06:20:47 UTC   26.09.2017 09:00:00 UTC until 26.09.2017 15:00:00 UTC

DWD observation coverage Polar orbiter AMVs
26.09.2017 12 UTC

Metop-A (53540)   NOAA-19 (3098)   Terra (3928)
Metop-B (52434)   Aqua (14179)   NOAA-18 (4467)   NOAA-15 (3207)

t 2017-09-27 06:19:15 UTC   26.09.2017 09:00:00 UTC until 26.09.2017 15:00:00 UTC

Metop-A (53540)   NOAA-19 (3098)   Terra (3928)
Metop-B (52434)   Aqua (14179)   NOAA-18 (4467)   NOAA-15 (3207)

t 2017-09-27 06:19:15 UTC   26.09.2017 09:00:00 UTC until 26.09.2017 15:00:00 UTC

Operationel

Geo: *GOES 15/16 Metop 8/11 Himarawi-8*

Polar: *AVHRR from Metop 3 / 4 single and dual the NOAA series*
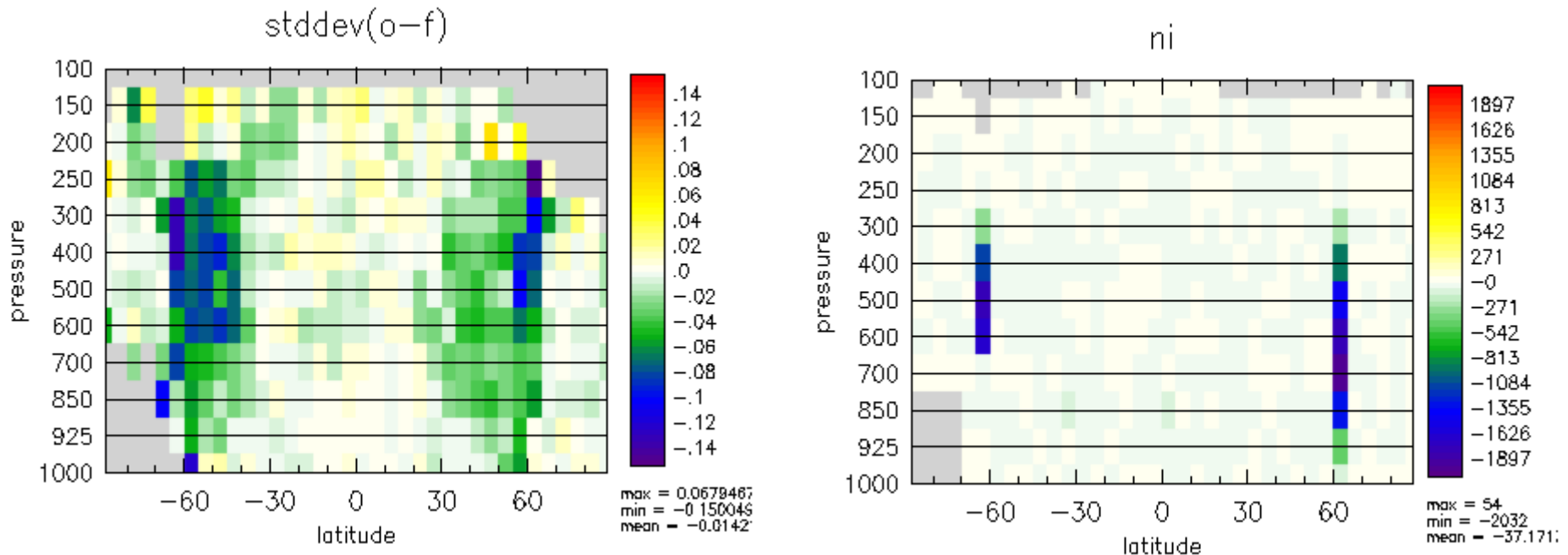*MODIS from Terra and Aqua*

Changes in operationel usage of satellite winds since the last meeting

- **Use of Dual Metop AMV winds**

- **Replacing Meteosat 10 by Meteosat 11 winds**

- **Filling the gap over eastern America by GOES 16 winds**

- **ScatSat ocean winds in parallel routine**

Crtl plus dual Metop – Crtl
all AMVs except dual Metop data

- **Positive impact using the other AMVs on both hemispheres**
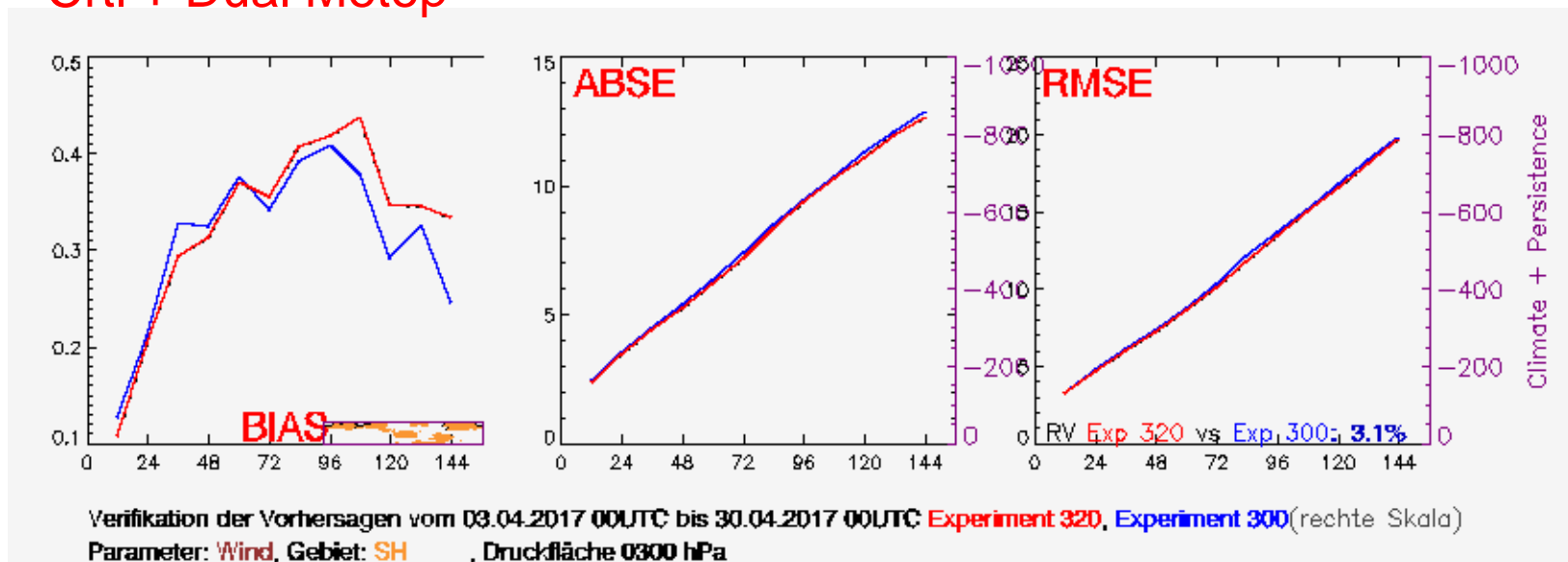- **Slightly more AMV data active**

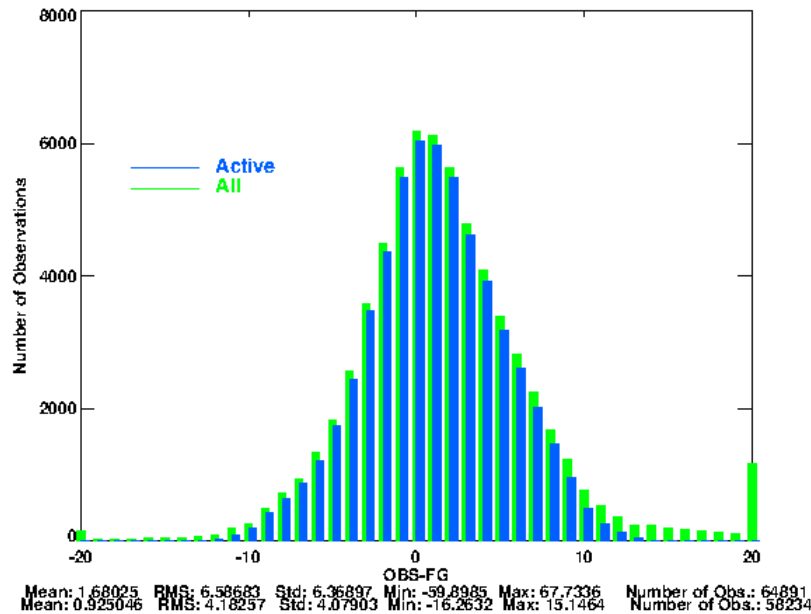# Wind 300 hPa

Crtl
Crtl + Dual Metop

- **Positive impact using Dual Metop on both hemispheres**
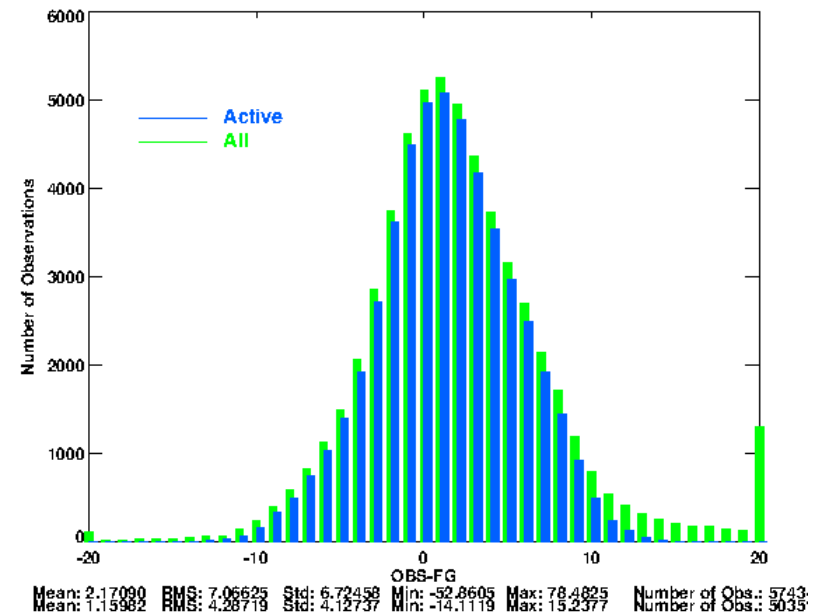- **Larger on the Southern Hemisphere in higher troposphere**

Obs –FG statistics
Comparison Meteosat 10 / Meteosat 11

AMV   Satellite: METEOSAT 10 / WV cloudy wind speed [m]
Date : 2018020700 - 2018022821
North: 90.00 SOUTH: -90.00 WEST: -180.00 EAST: 180.00
Level Max/Min: 46300.00 / 12300.00

Mean: 1.68025 RMS: 6.58683 Std: 6.36897 Min: -59.8985 Max: 67.7336 Number of Obs.: 64891
Mean: 0.925046 RMS: 4.18257 Std: 4.07903 Min: -16.2632 Max: 15.1464 Number of Obs.: 58234

AMV   Satellite: METEOSAT 11 / WV cloudy wind speed [m]
Date : 2018020700 - 2018022821
North: 90.00 SOUTH: -90.00 WEST: -180.00 EAST: 180.00
Level Max/Min: 46410.00 / 12300.00

Mean: 2.17090 RMS: 7.06625 Std: 6.72458 Min: -52.8605 Max: 78.4825 Number of Obs.: 5743
Mean: 1.15982 RMS: 4.28719 Std: 4.12737 Min: -14.1119 Max: 15.2377 Number of Obs.: 5035

	Meteosat 10 global		Meteosat 11 global	
Bias	1.69	0.93	2.17	1.16
	3,76	0.86	4.15	1.00
Std	6.37	4.08	6.72	4.13
	9.03	3.86	9.15	3.83

AMV   Satellite: GOES 16 / WV cloudy wind speed [m]   Ex
Date : 2018012100 - 2018021921
North: 90.00 SOUTH: -90.00 WEST: -180.00 EAST: 180.00
Level Max/Min: 35000.00 / 10210.00
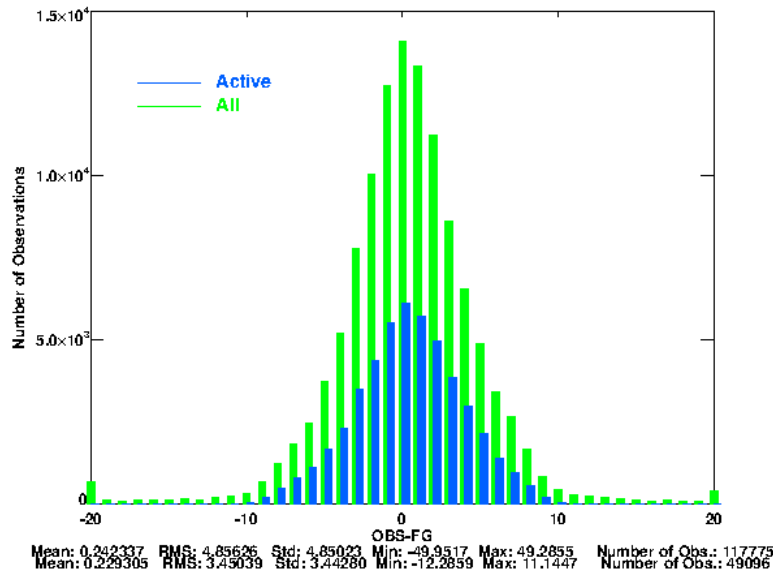
AMV   Satellite: GOES 15 / WV cloudy wind speed [m]   Ex
Date : 2018012100 - 2018021921
North: 90.00 SOUTH: -90.00 WEST: -180.00 EAST: 180.00
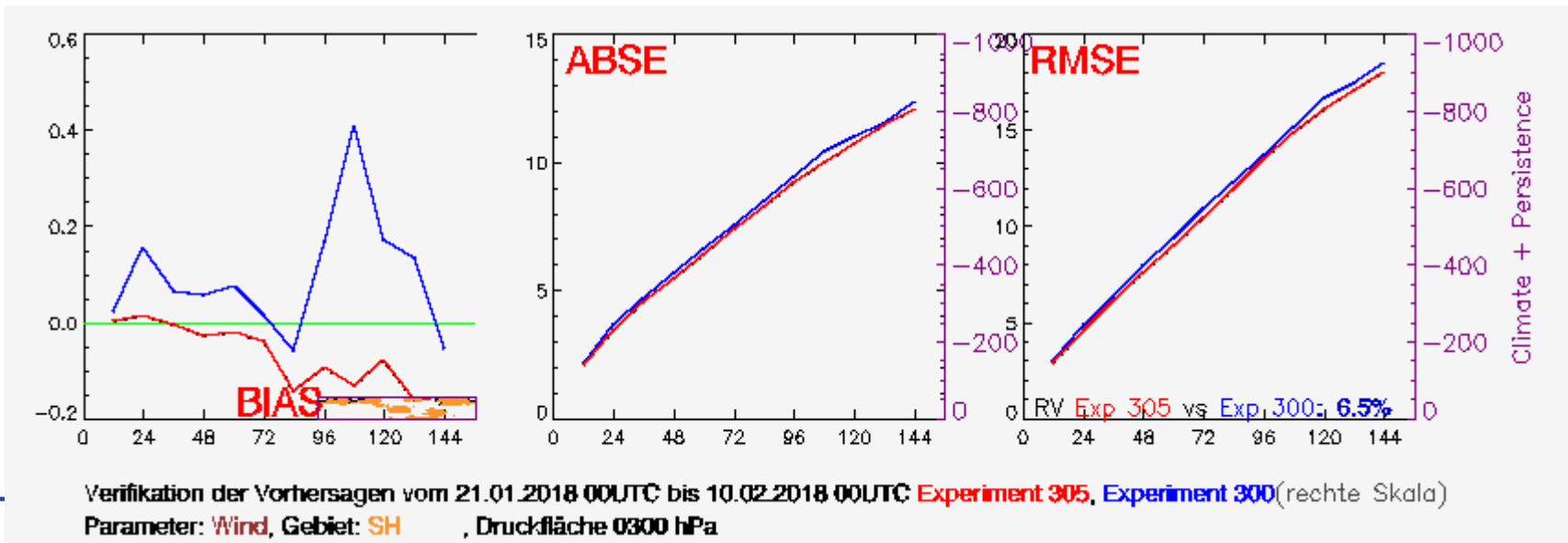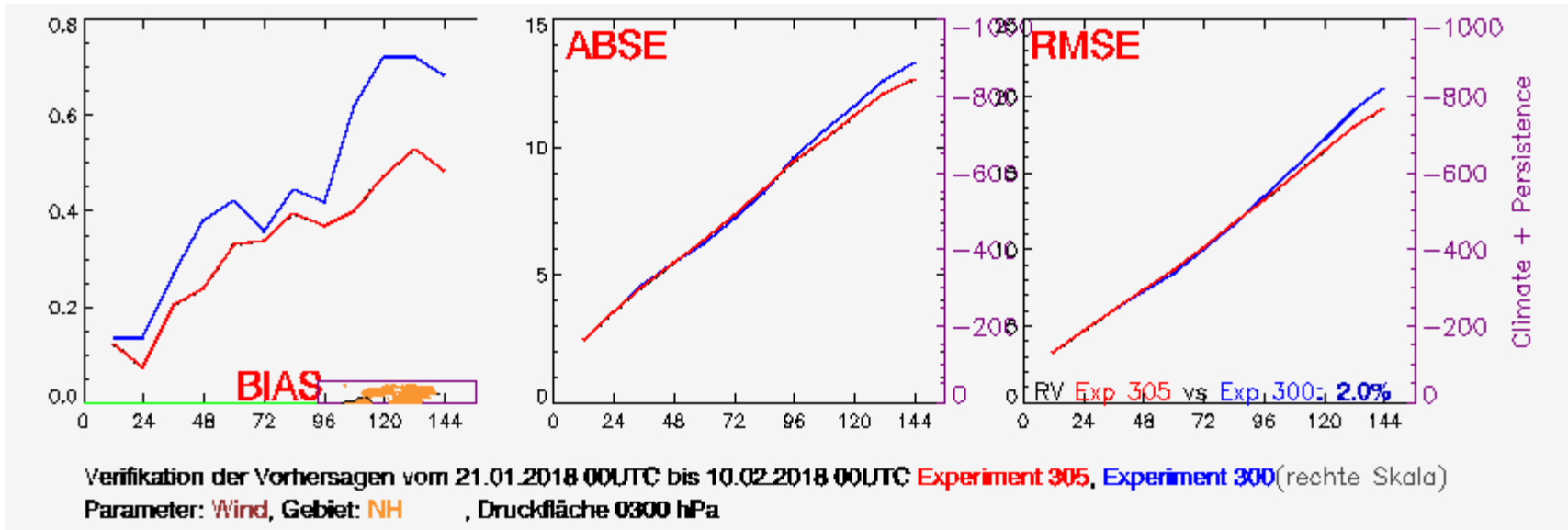Level Max/Min: 38700.00 / 13700.00
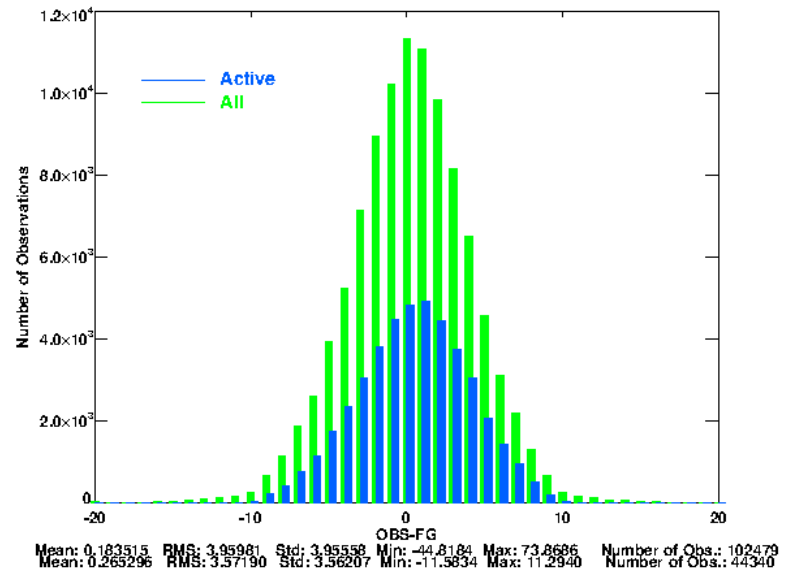
	GOES 16 global		GOES 15 global	
Bias	0.24	0.23	0.19	0.26
Std	4.85	3.44	3.96	3.56

Crtl (ohne GOES 16 und Meteosat11)
Exp: Mit Goes16 und Meteosat 11 AMVs

DWD

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Verifikation der Vorhersagen vom 21.01.2018 00UTC bis 10.02.2018 00UTC Experiment 305, Experiment 300 (rechte Skala)
Parameter: Wind, Gebiet: NH   , Druckfläche 0300 hPa

Verifikation der Vorhersagen vom 21.01.2018 00UTC bis 10.02.2018 00UTC Experiment 305, Experiment 300 (rechte Skala)
Parameter: Wind, Gebiet: SH   , Druckfläche 0300 hPa

Use of high resolution AMV winds derived by NWC SAF

- Run the NWC SAF software to derive high resolution AMV Winds in house

- Software: NWC SAF Software v2013. The new version (v2016) runs in test modus

- The available patches are incoparated (Katja Hungersdörfer)

- Area: EUROPA B (defined in house)

- Output: AMVs in EUMETSAT Bufr format

- # Wind guess use flag
   WIND_GUESS   0   ; no use of model winds

- DWD regional model system (COSMO/KENDA) is able to use HR AMVs similar to global system

- First monitoring experiment started

Use of high resolution AMV winds derived by NWC SAF

- *HR AMV monitoring started in Jan 2018*

- *First results lock promising*

- *A lot of wind obs. in competition with AMVs in Kenda area (radisonde, aircraft, MODE-S, radial winds)*

$\Rightarrow$ *Not easy to show impact*

- *Long experiments needed => expensive*

- *Evaluation software has to be adapted*
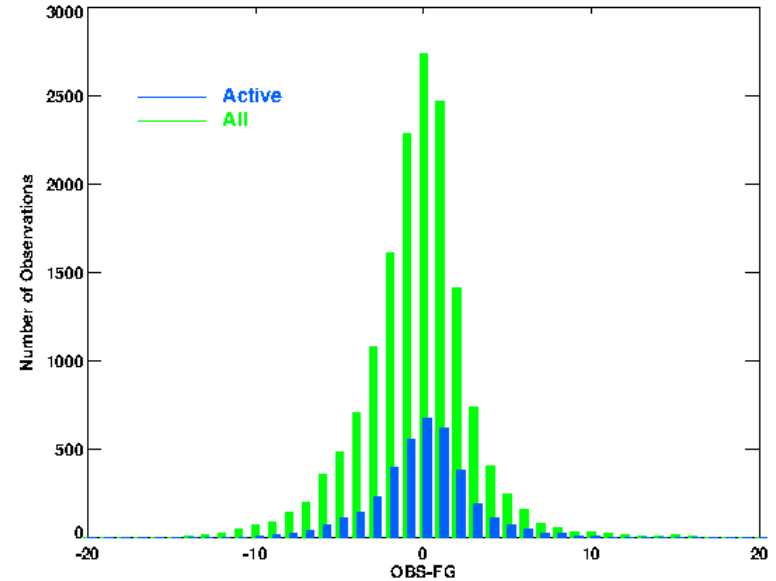
AMV   Satellite: METEOSAT 10 / Visible wind speed [m]   Ex
Date : 2018012012 - 2018012323
North: 90.00 SOUTH: -90.00 WEST: -180.00 EAST: 180.00
Level Max/Min: 95000.00 / 20000.00

	IR	VIS	WV
BIAS	-2.00 -0.63	-0.47 -0.16	-1.21 -0.08
RMS	4.96 3.45	3.28 2.98	5.01 3.94
STD	4.54 3.39	3.25 2.97	4.98 3.93

NWP SAF – DWD cooperation
AMV monitoring

Deutscher Wetterdienst
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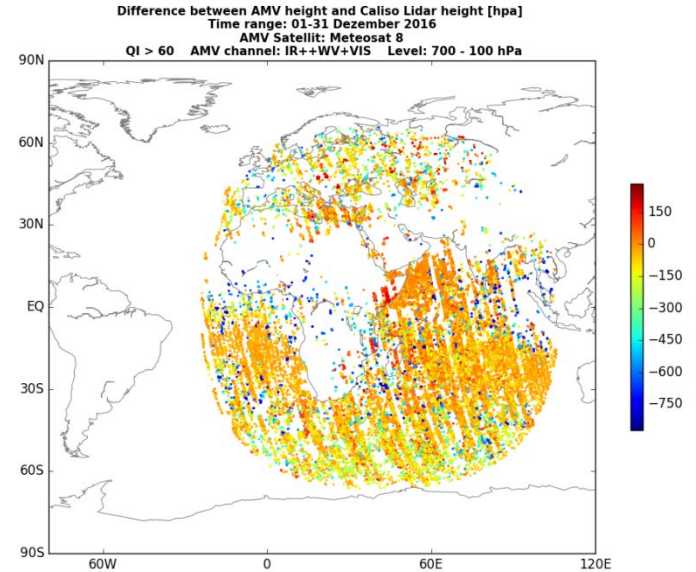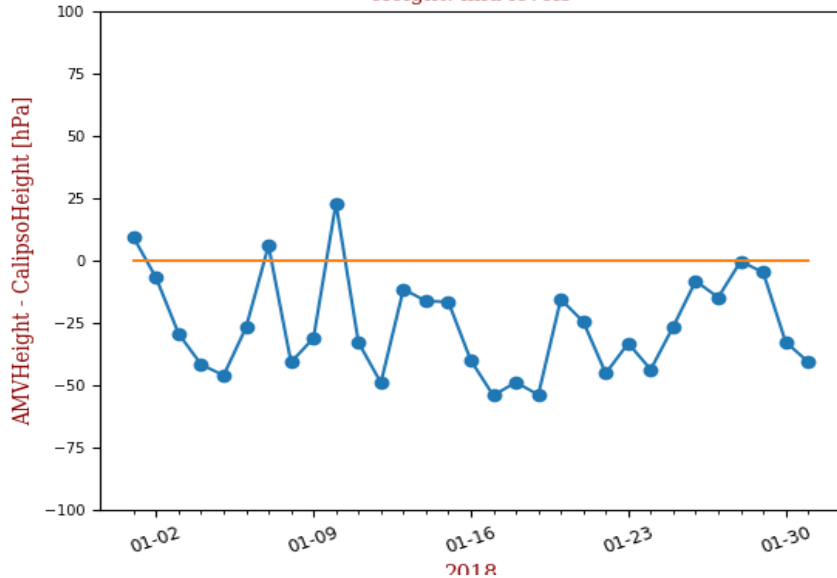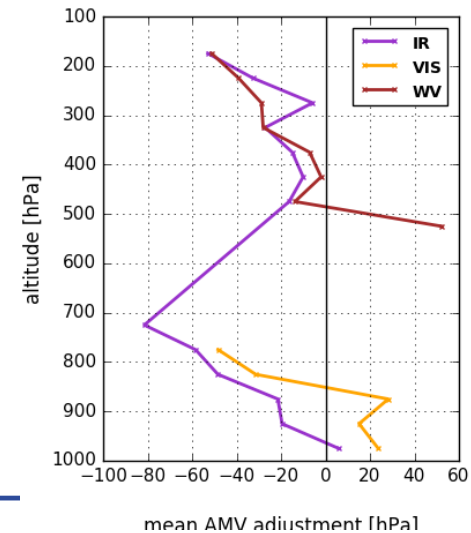Meteosat10 / water vapor cloudy
Northern Hemisphere
Height: mid levels


Difference between AMV height and Caliso Lidar height [hpa]
Time range: 01-31 Dezember 2016
AMV Satellit: Meteosat 8
QI > 60   AMV channel: IR++WV+VIS   Level: 700 - 100 hPa
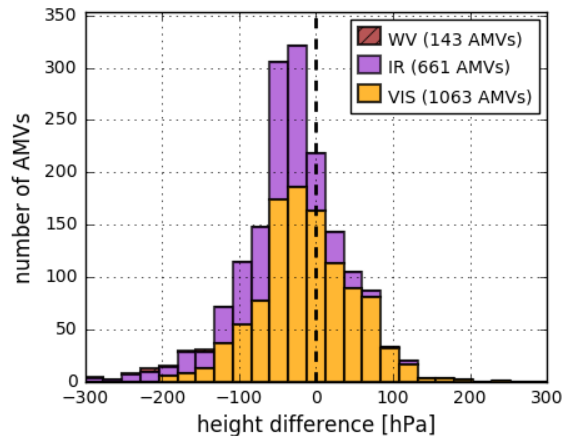
Meteosat10
evaluation period 161201_161229

Use of scatterometer data

**Operationel use of ASCAT onboard Metop 3/4
Pre-operationel use of ScatSat
Operational use of Altimeter data (Janson 2/3, SARAL)
Wind speed bias correction of Scatterometer/Altimeter data**

Relative difference of obs – fg rms between exp. with and
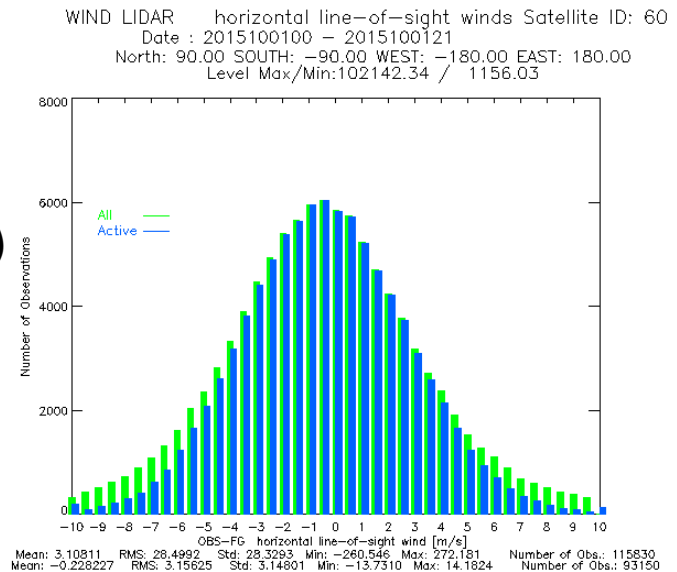without ScatSAT data for ASCAT observations
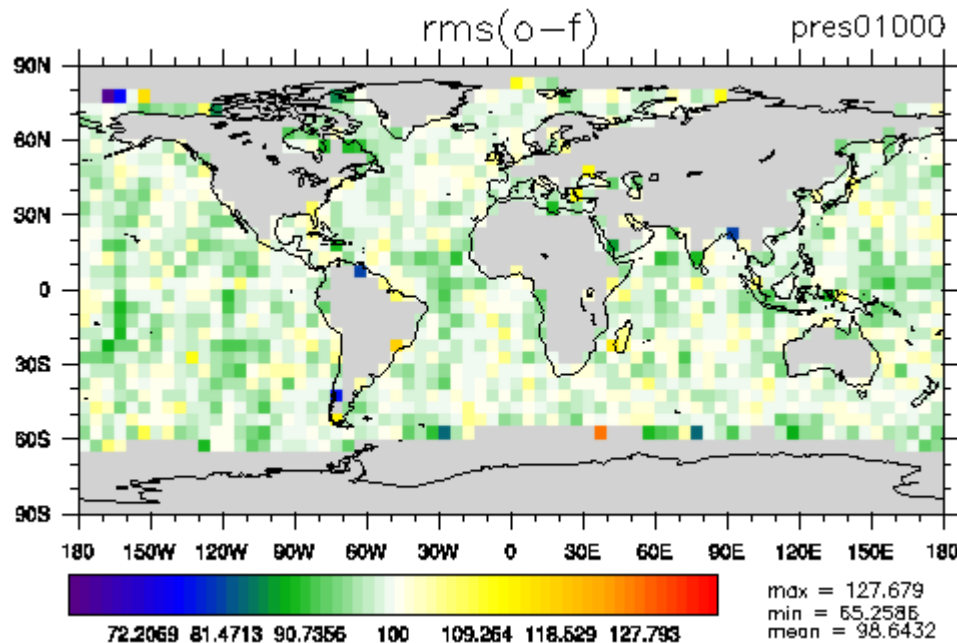
mean: 98.64 %

Aeolus Wind Lidar work

- *Aeolus will be launched in 2018*

- *Observation will be HLOS*

- *Level 2B Cal/Val rehearsal dataset provided by ECMWF*

- *The data has been regenerated (in March 2018) with the most recent processing chain: E2S v4.01, L1B v7.01 and L2B v3.00.*

- *Data are provided in Bufr Format*

- *Bufr reading is finished*

- *Observation operator implemented*

- *One day data assimilation with test data conducted*

- *Looking forward on the real data*

WIND LIDAR   horizontal line-of-sight winds Satellite ID: 60
Date : 2015100100 – 2015100121
North: 90.00 SOUTH: –90.00 WEST: –180.00 EAST: 180.00
Level Max/Min:102142.34 / 1156.03

OBS–FG horizontal line-of-sight wind [m/s]

Mean: 3.10811 RMS: 28.4992 Std: 28.3293 Min: –260.546 Max: 272.181   Number of Obs.: 115830
Mean: –0.228227 RMS: 3.15625 Std: 3.14801 Min: –13.7310 Max: 14.1824   Number of Obs.: 93150

Summary

- Dual Metop data show postive impact for differnt seasons
  - ➤ *AMVs operational since summer 2017*

- Quality of Meteosat 11 AMVs comparable to Meteosat 10
  - ➤ *operational since March 2018*

- Qulaity of GOES 16 AMVs slightly better than GEOS 13, show potive impact

  - ➤ *operational since April 2018*

- HR AMVs production - derived from NowCasting SAF software – successfully implemented and first monitoring experiments started

- NWPSAF-DWD cooperation started => monitoring of Lidar-AMV heights

- ScatSat winds in data assimilation system tested => operational this summer

- Aeolus Wind Lidar test data in DA integrated

Thank you for your attention!

Questions?