Slovak Mode-S data assimilation into AROME/SHMU

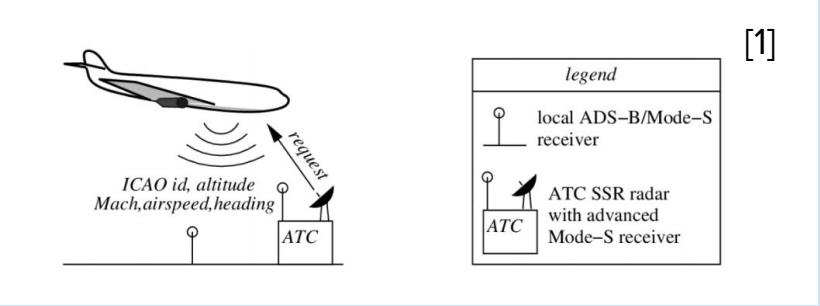
Data Assimilation Working Days 2019
Katarína Čatlošová (SHMU)

Outline

- Mode-S data sample
- Statistical approach
- Whitelist
- Case study
- Future plans
- Questions

What is Mode-S (selective) data?

- aeronautical navigation
- data
  - id, position
  - velocity, magnetic heading, Mach, ...
  - temperature, wind speed and wind direction
- communication: radar - aircraft



[1]

[1] EUMETNET (2015): EUMETNET Aircraft Derived Data Feasibility Study Expert Team. GIE EUMETNET, c/o L'Institut Royal Météorologique de Belgique [Retrieved 1 May 2019 from http://mode-s.knmi.nl/documents/EUMETNET_ADD_Report_FINAL_v1.0_03102015.pdf]

Mode-S data sample

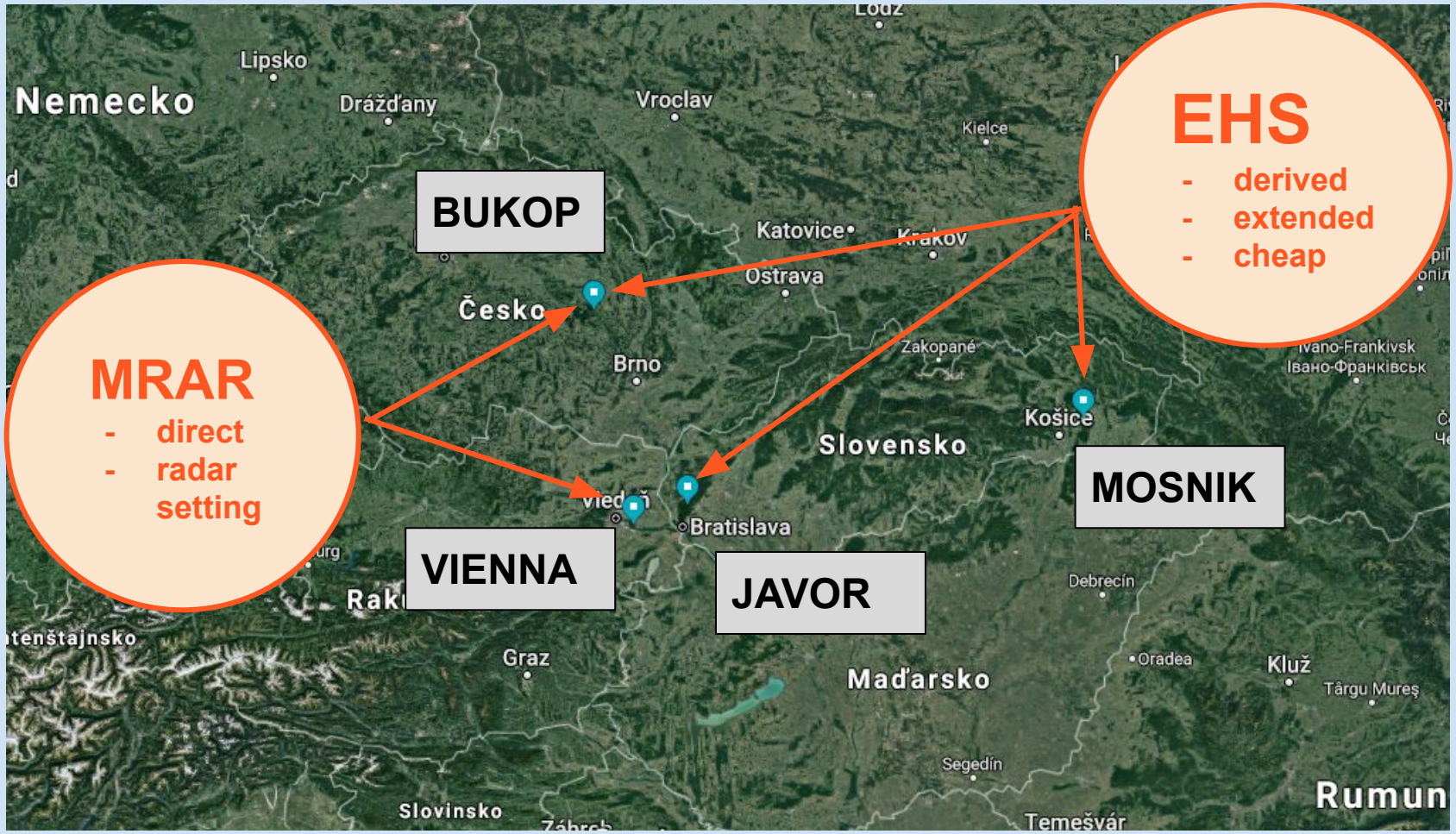
EHS
- derived
- extended
- cheap

MRAR
- direct
- radar setting

Enhanced Surveillance

Meteorological routine air report

Mode-S data sample



Mode-S data sample

Jan - Feb 2018

Total amounts of raw measurements from the studied period.			
Radar	Data type	Number of data	Number of aircrafts
Malý Javorník (JAVOR)	EHS	9 898 618	8 428
Mošník (MOSNIK)	EHS	4 752 200	7 110
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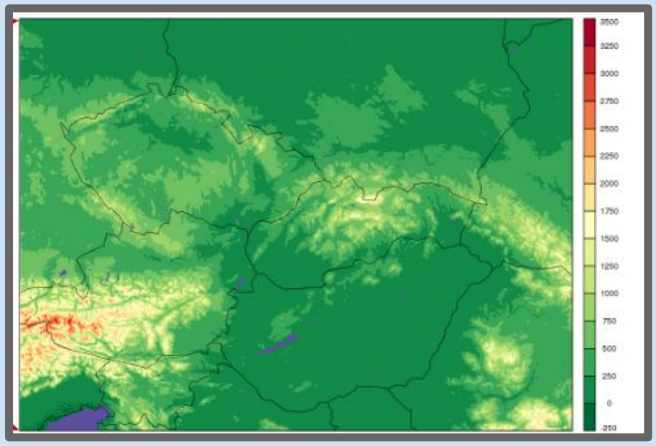
Buchtuv kopec (BUKOP)	MRAR	1 837 475	530
Vienna (VIENNA)	MRAR	95 758	401
	AMDAR	215 577	1 807

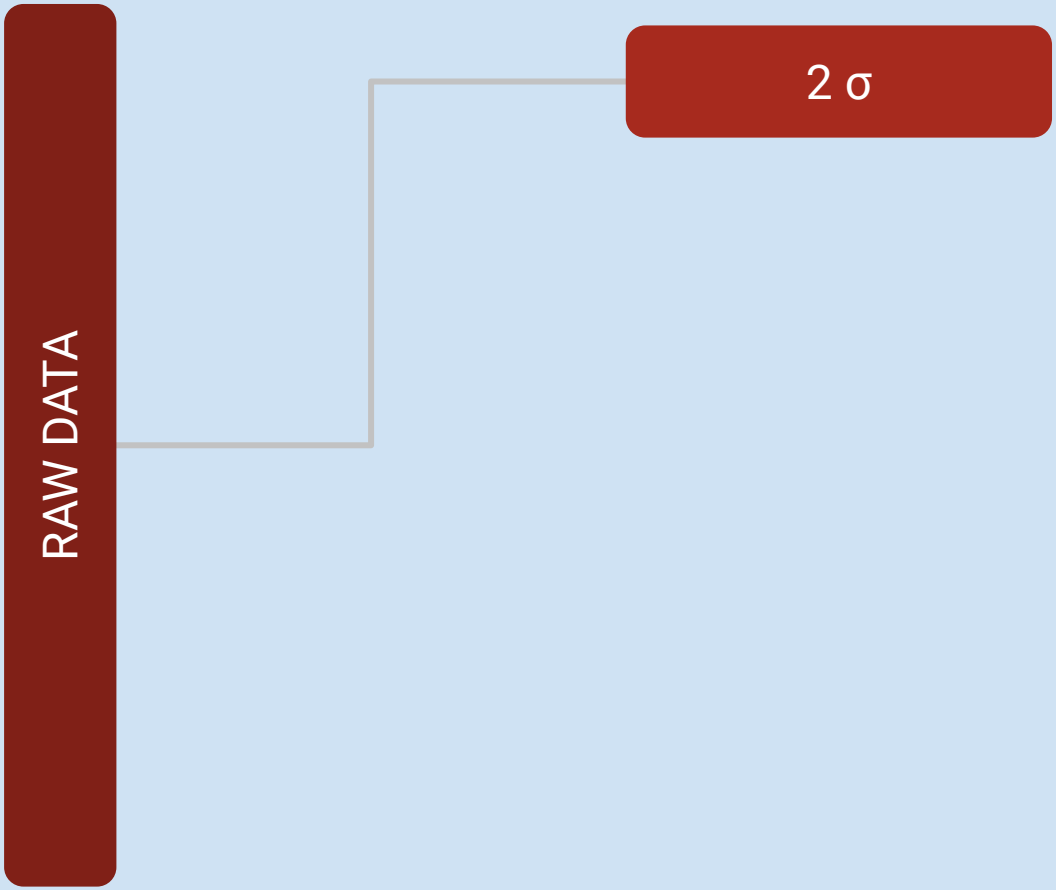
Statistical approach



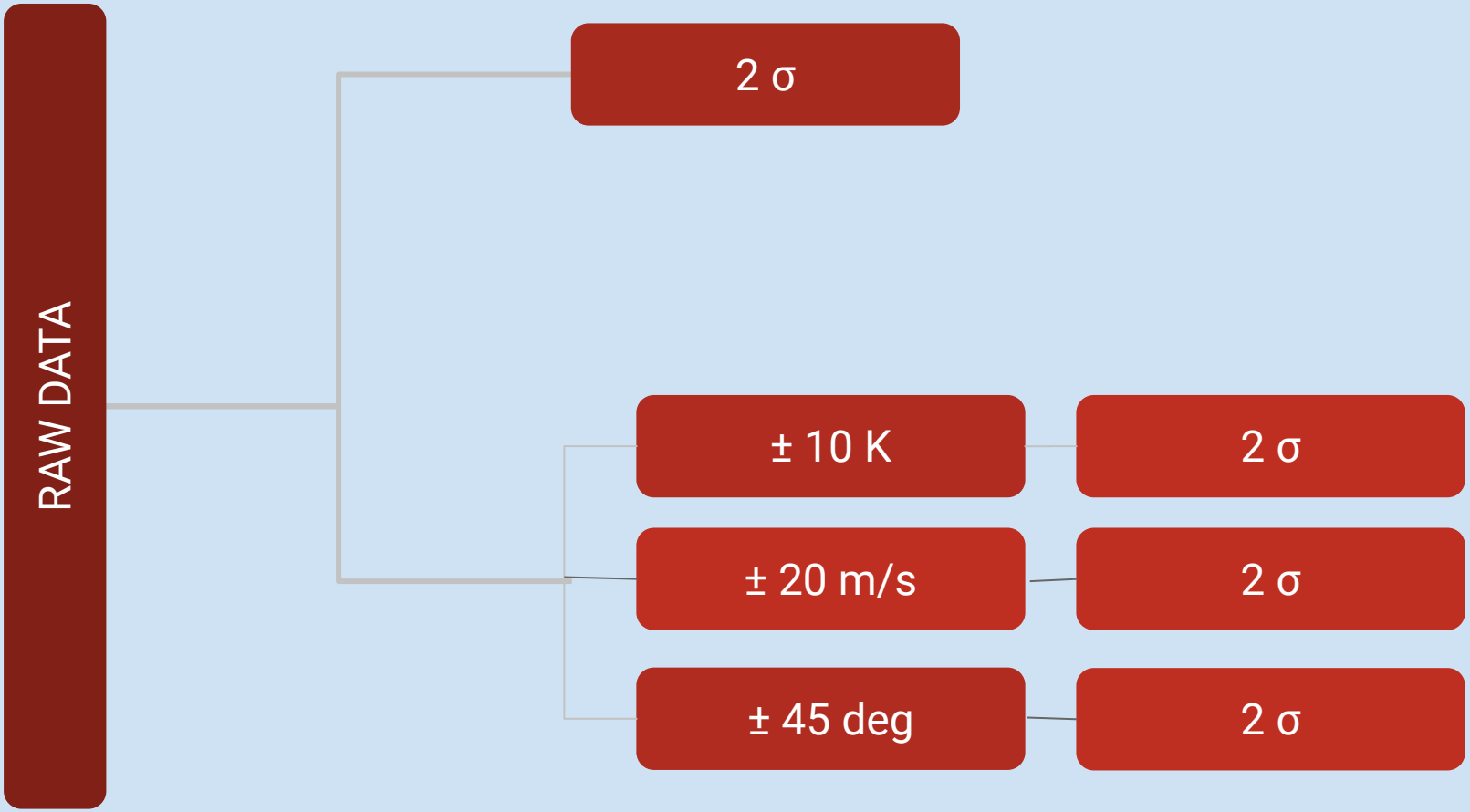
- OMG (observation minus first guess departures)

Parameters of AROME/SHMU NWP model	
status	experimental
code version	CY40T1bf07_export
coupling model	ALADIN/SHMU
horizontal resolution	2.0 km
vertical levels	73
time step	144 s

Statistical approach



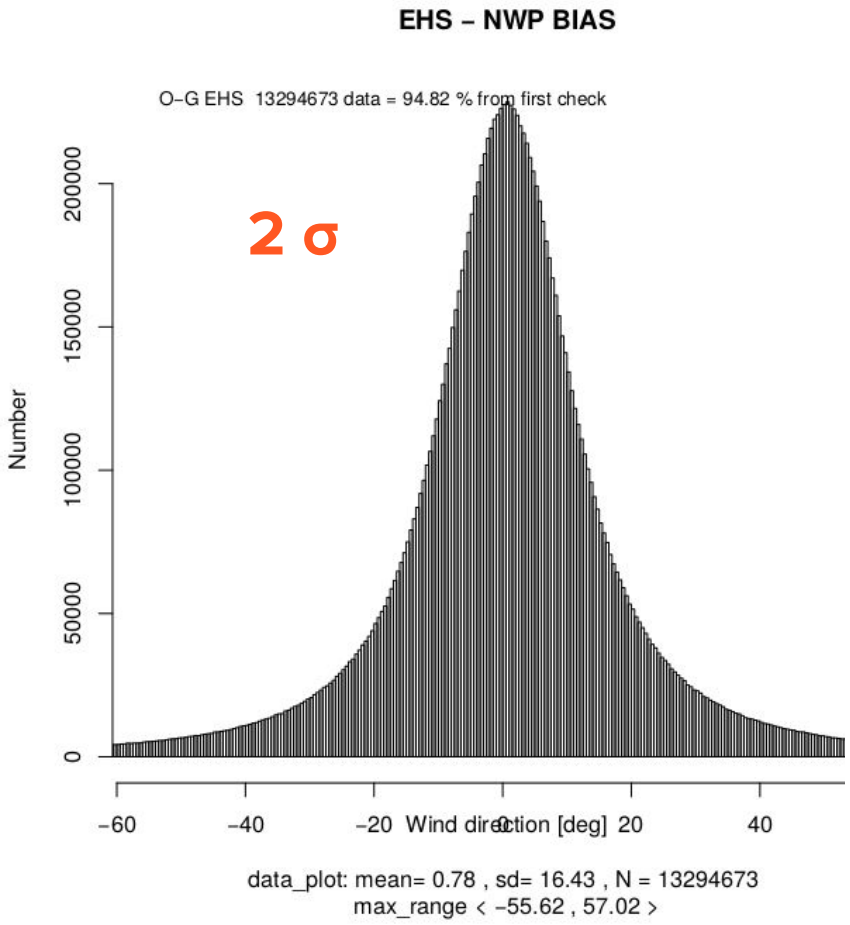
Statistical approach

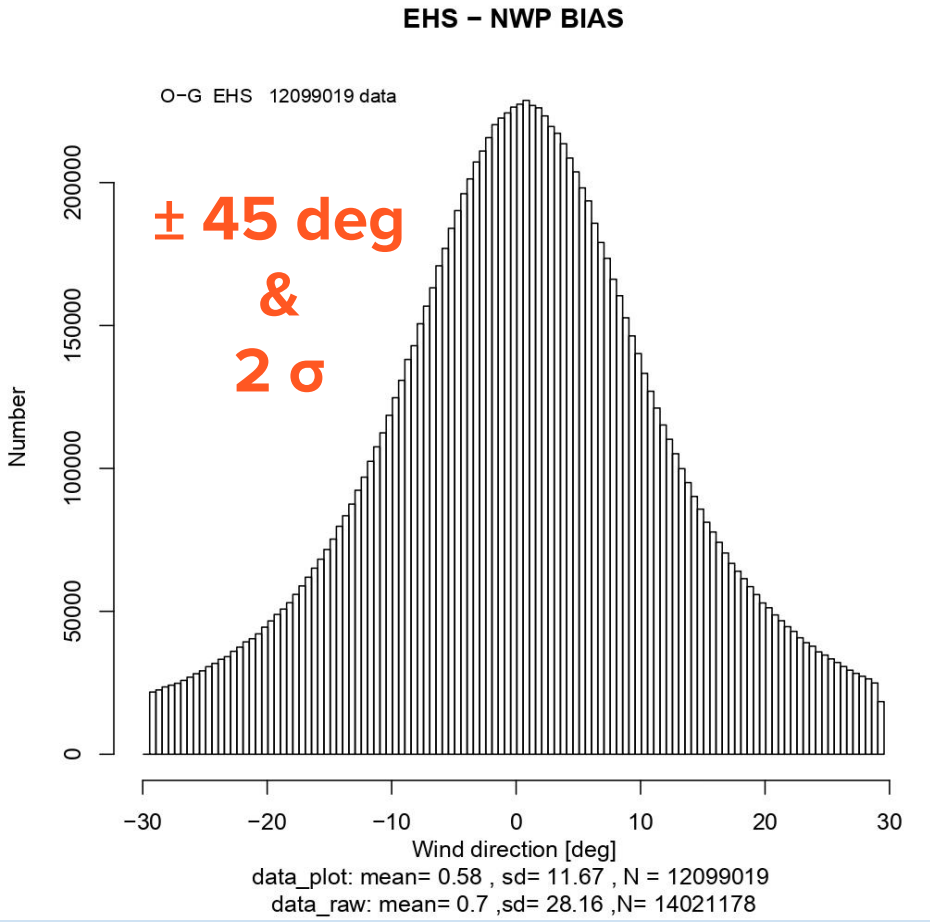


Statistical approach

WIND DIRECTION STATISTICS				
Data type	Number of data	Number of data [%]	Mean value [deg]	Standard deviation [deg]
2 σ of raw data				
AMDAR	200 239	94,81	-1,15	15,79
EHS	**13 294 673**	**94,82**	**0,78**	**16,43**
MRAR	1 723 774	94,93	-0,59	14,37
truncation ± 45 deg & 2 σ				
AMDAR	182 064	86.2	-0,8	10.98
EHS	**12 099 019**	**86.29**	**0.58**	**11.67**
MRAR	1 581 639	87.1	-0,48	10.13

Statistical approach (EHS wind direction)





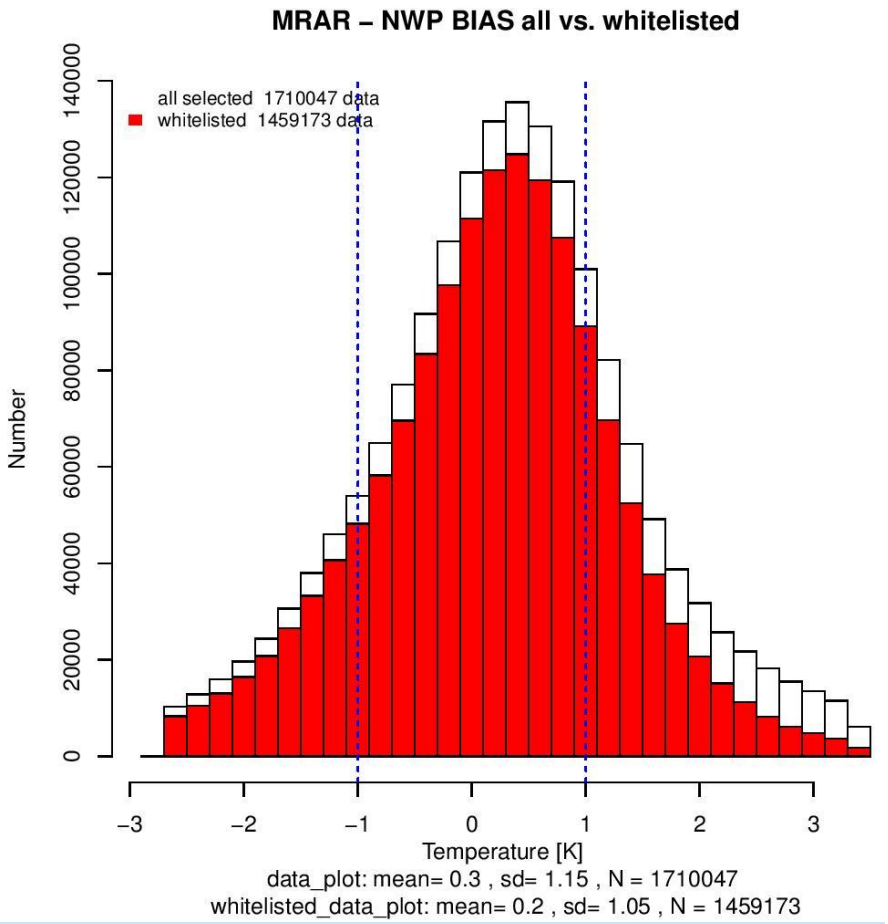
Whitelist

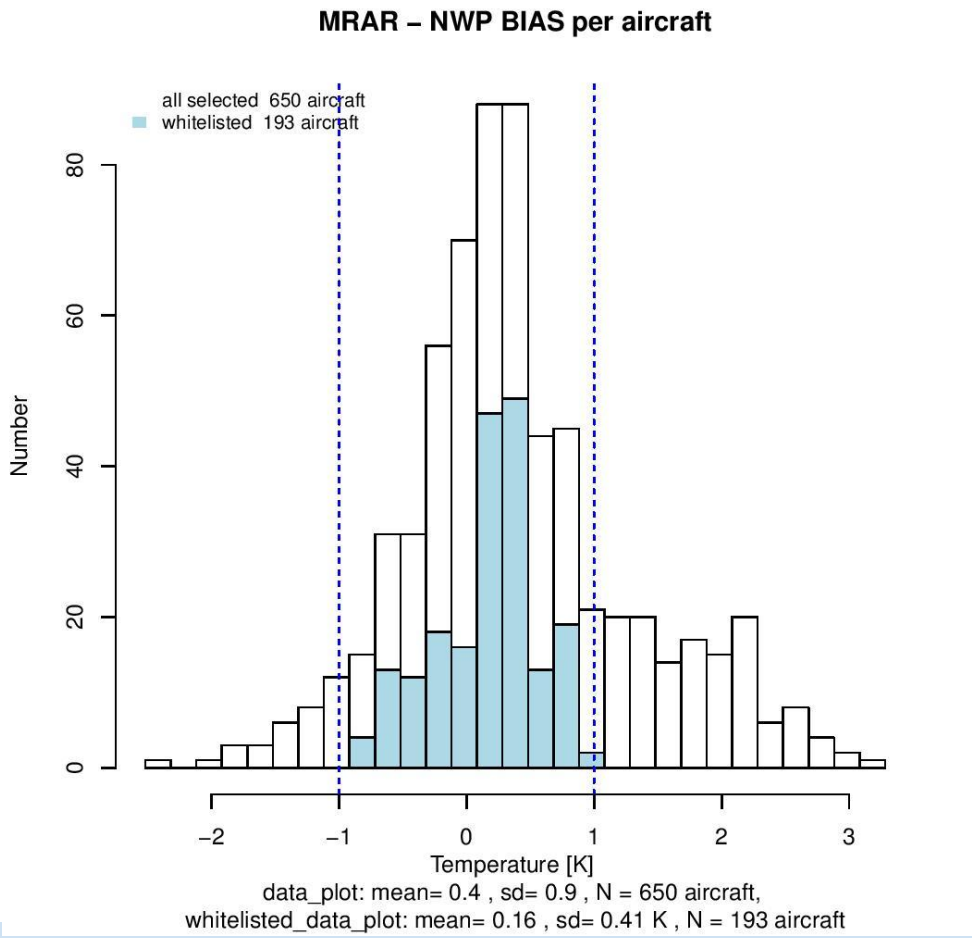
- selection by ICAO address

Whitelisting criteria [2]			
	Number of obs	Mean value	Standard deviation
Temperature	1 000	1 K	2 K
Wind speed	1 000	1 m/s	5 m/s
Wind direction	1 000	10 deg	100 deg

[2]Trojáková, A. - Benáček, P. - Brožková, R. - Bučánek, A. (2015): Assimilation of Mode-S observations in ALADIN/CHMI. [Retrieved 1 May 2019 from http://www.rclace.eu/?page=11]

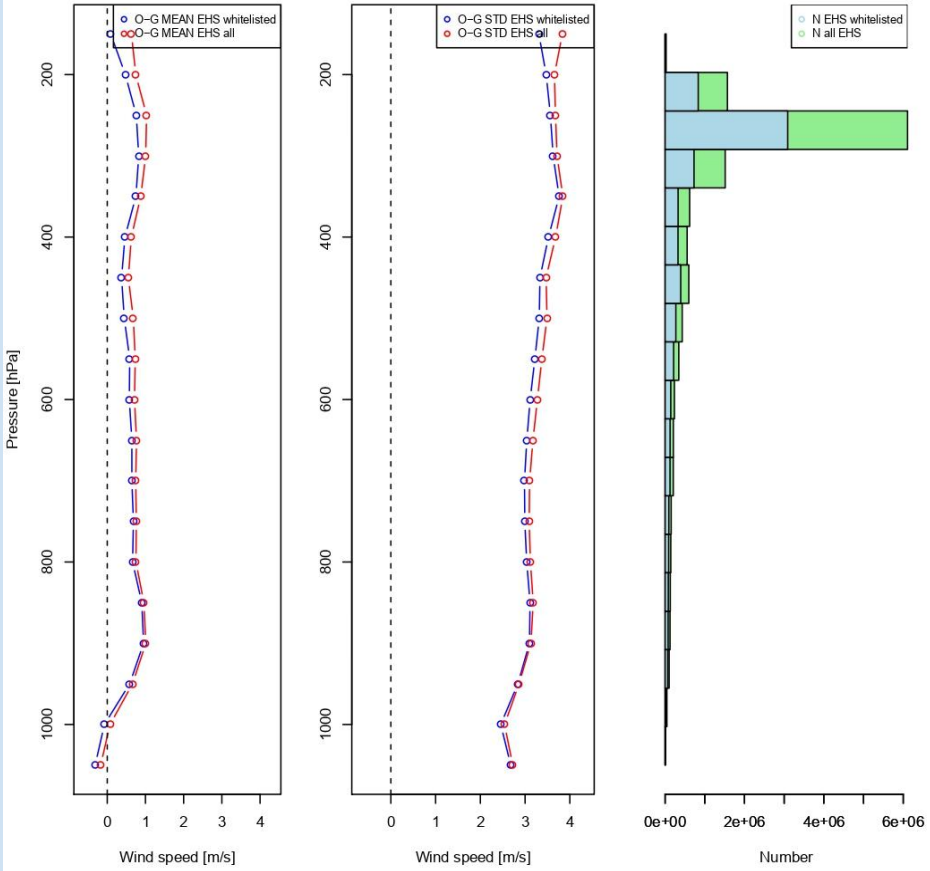
Whitelist - MRAR (temperature)



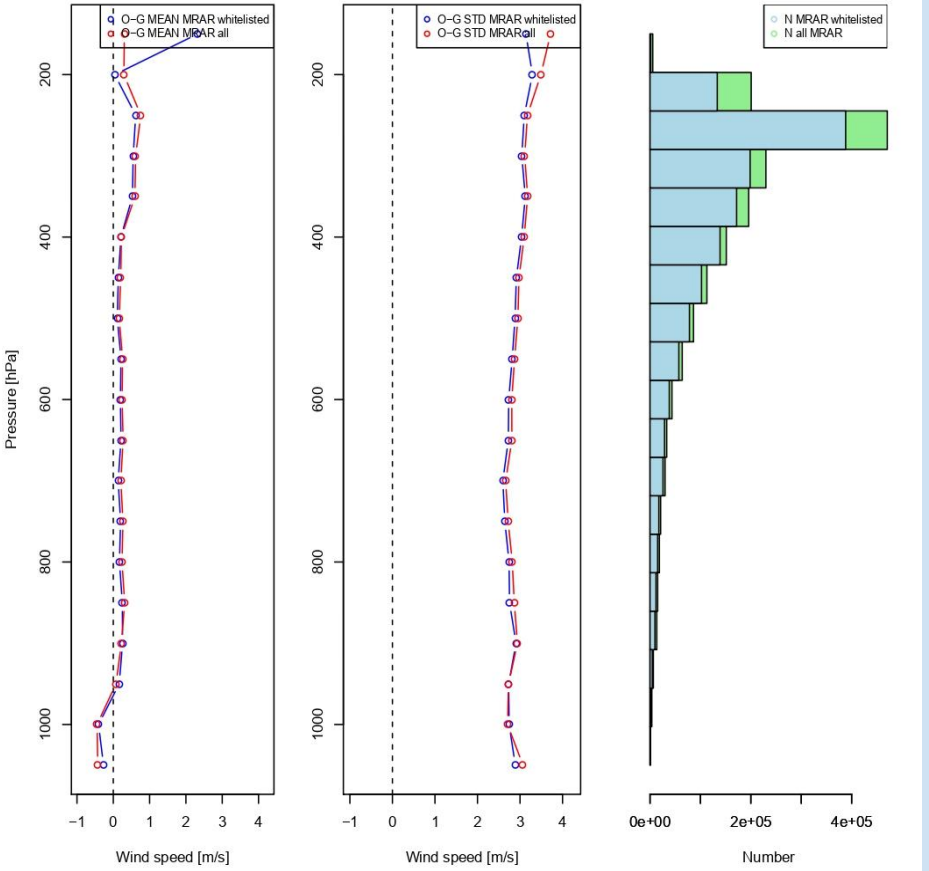


Whitelist - vertical profile (wind speed)

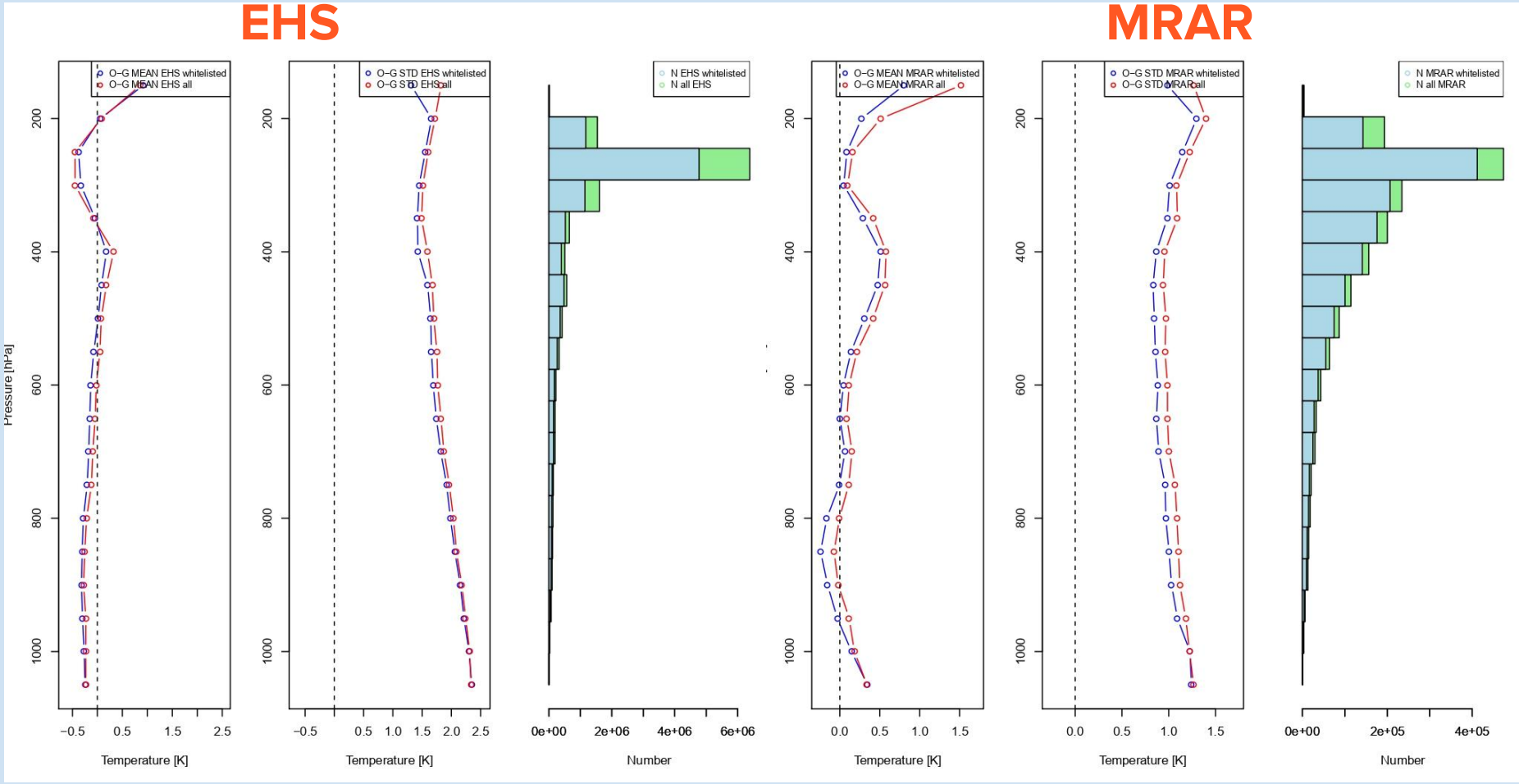
EHS



MRAR



Whitelist - vertical profile (temperature)

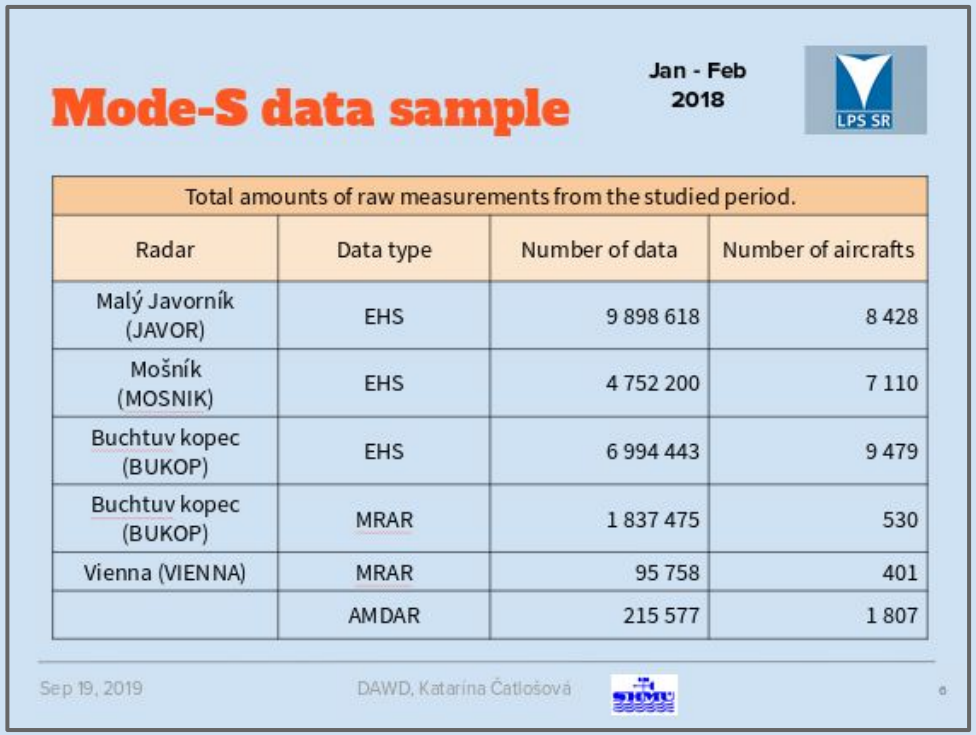


Whitelist - AMDAR ?

- selection by ICAO address

Whitelist - AMDAR ?

- selection by ICAO address



Mode-S data sample

Jan - Feb 2018

LPS SR

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Sep 19, 2019 DAWD, Katarína Čatlošová SHMÚ

Whitelist - AMDAR

- selection by ICAO address

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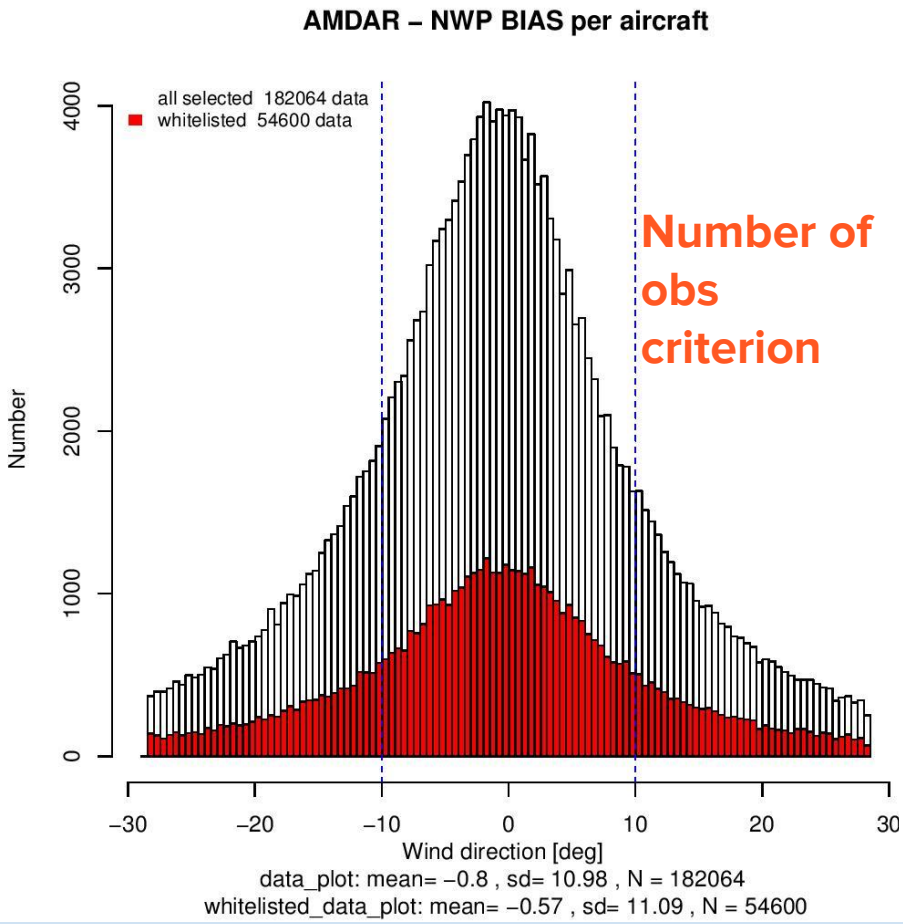
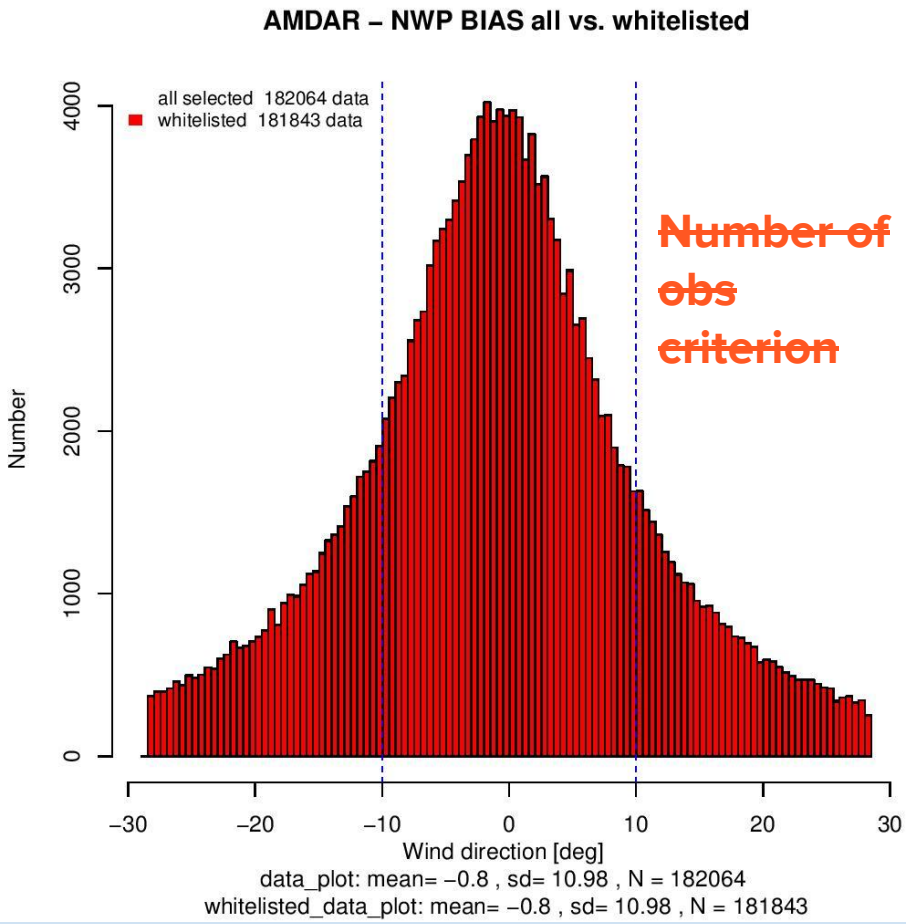
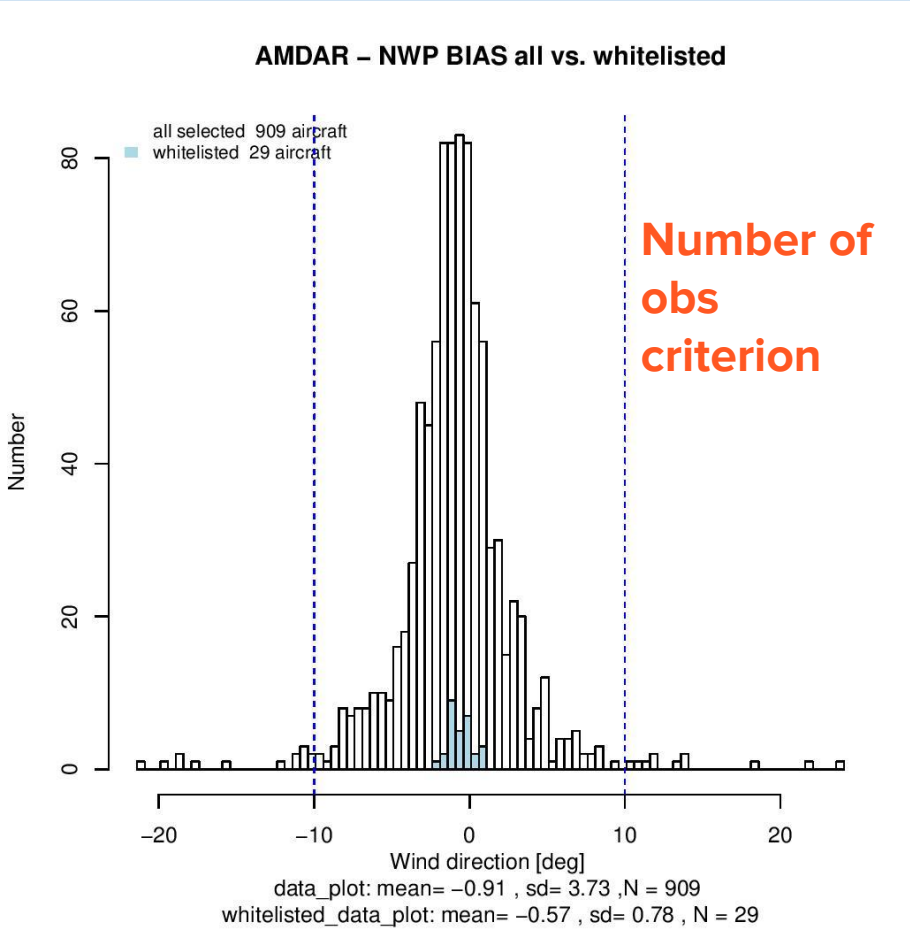
Whitelist - AMDAR (wind direction)

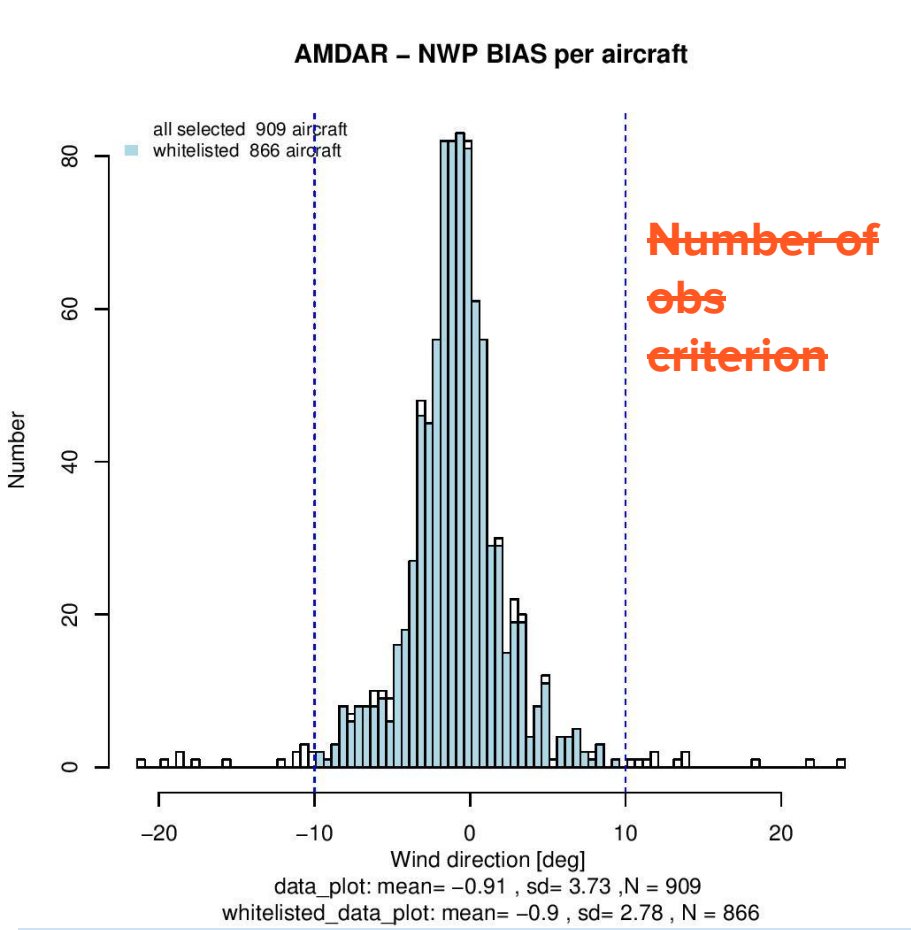




Whitelist - AMDAR per aircraft (wind direction)



Number of obs criterion



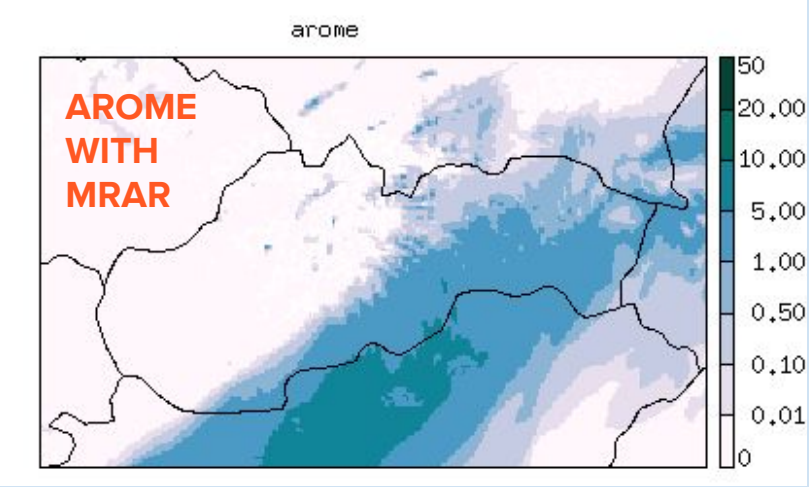
~~Number of obs criterion~~

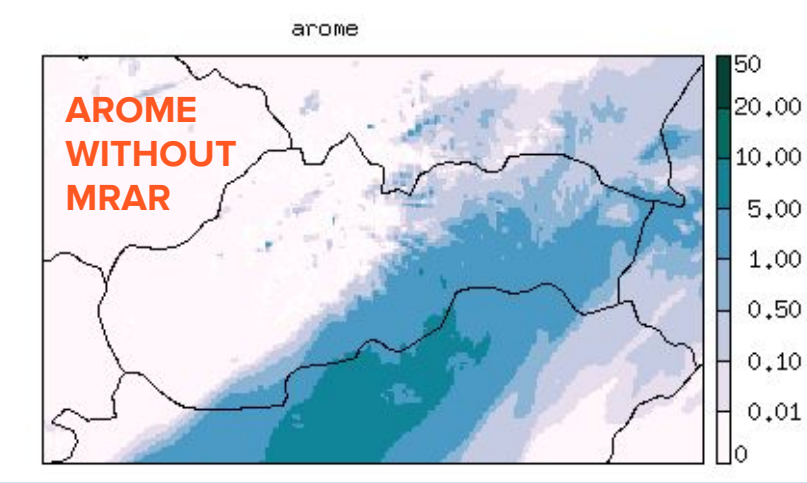
Case study - Feb 02, 2018 at 15 UTC

- cold front over eastern Slovakia

3-h accumulated surface precipitation 2018-02-01_12+30

Case study - Feb 02, 2018 at 15 UTC





3-h accumulated surface precipitation 2018-02-01_12+30

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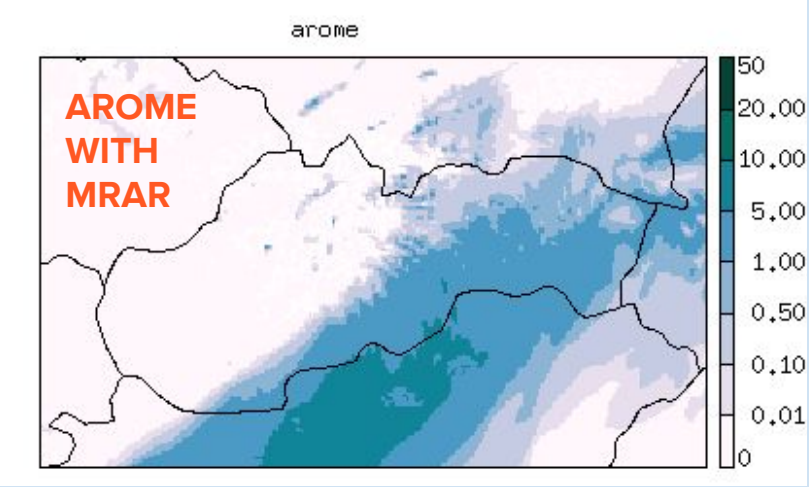

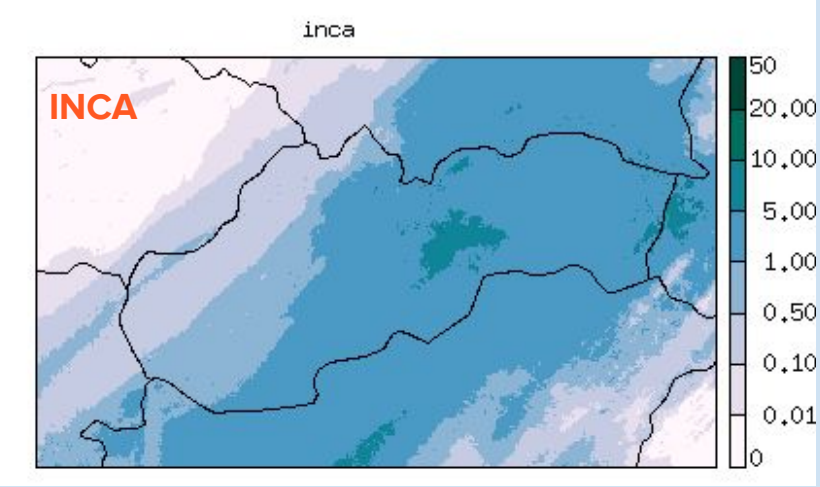

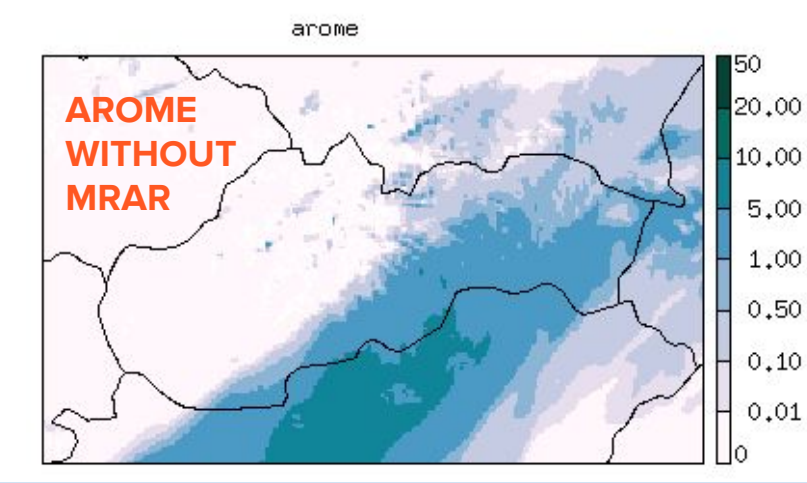

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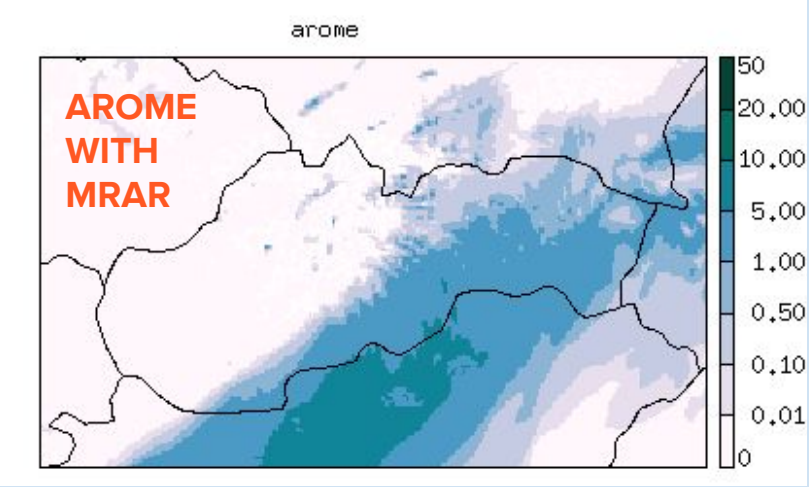
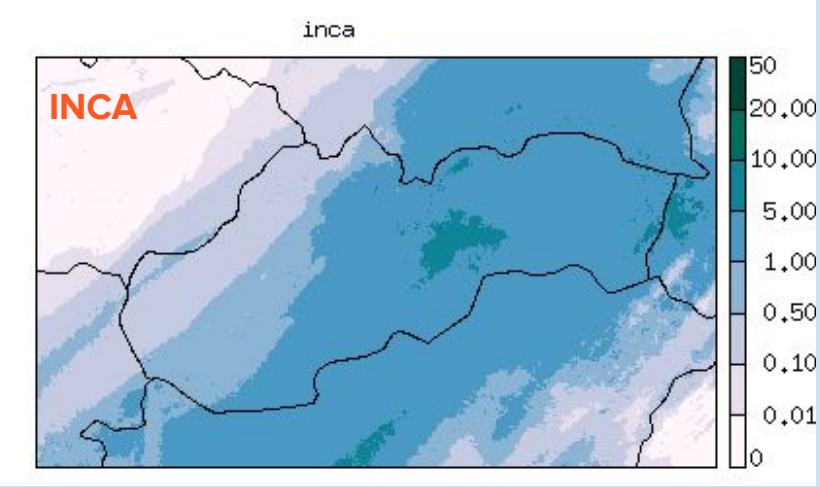
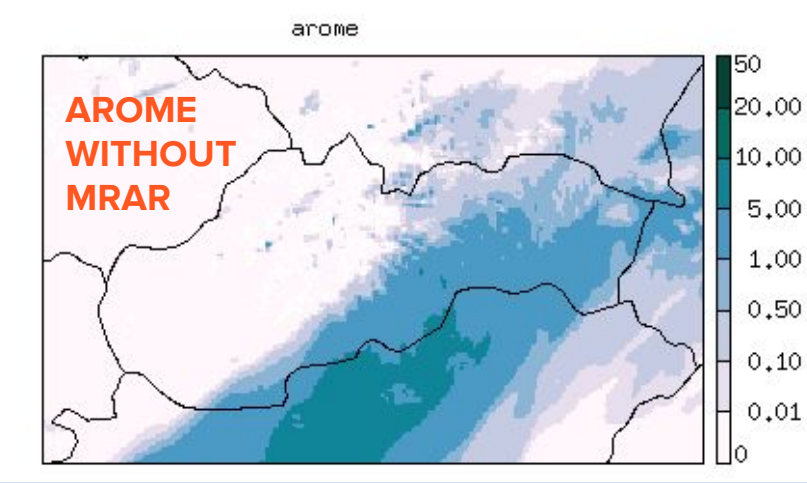
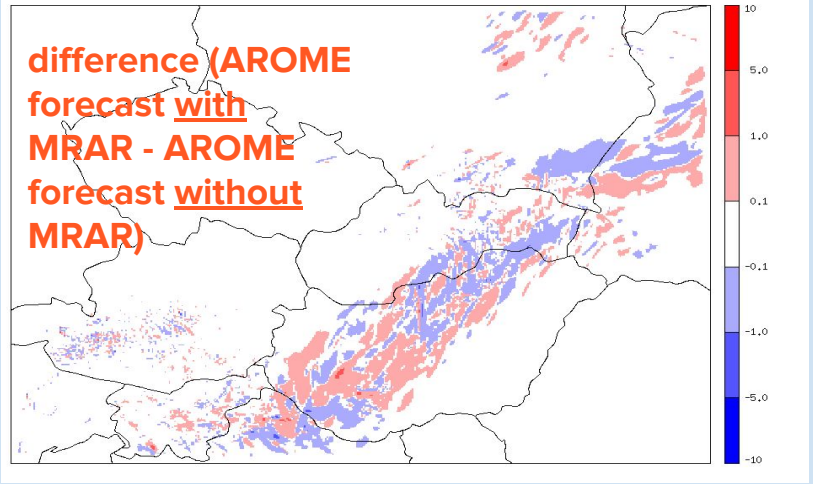


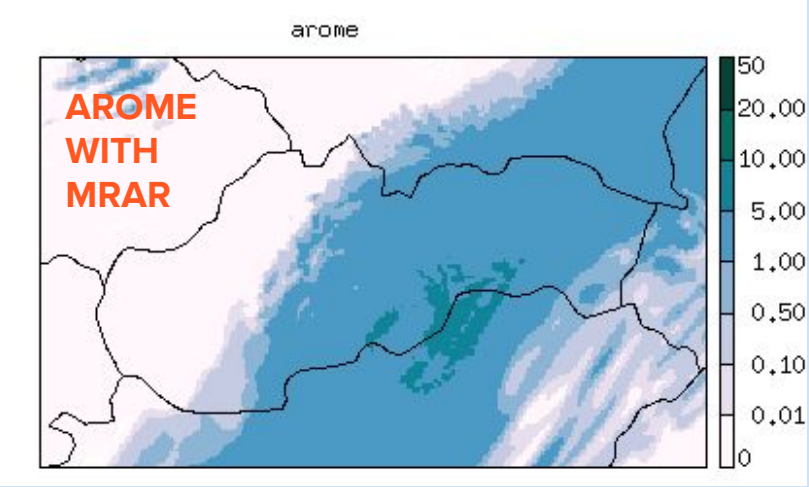


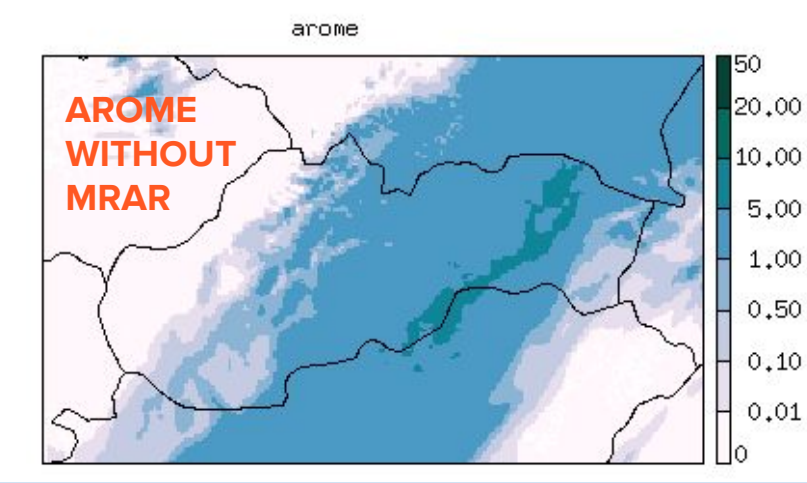




3-h accumulated surface precipitation 2018-02-02_12+06

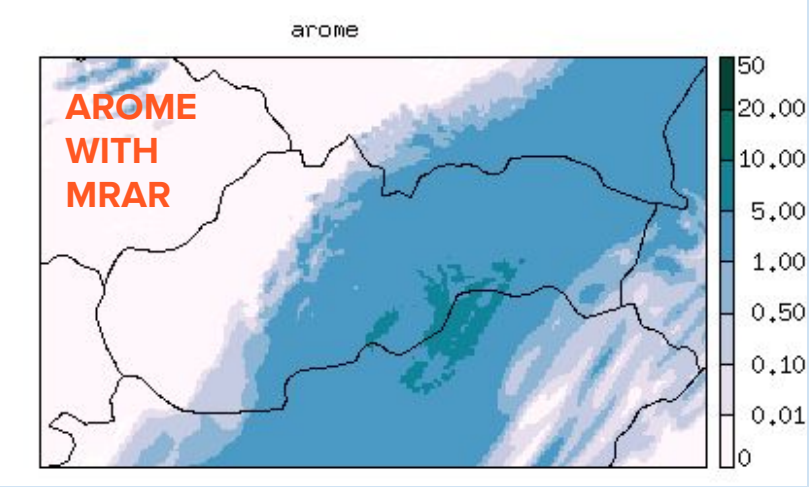
Case study - Feb 02, 2018 at 15 UTC

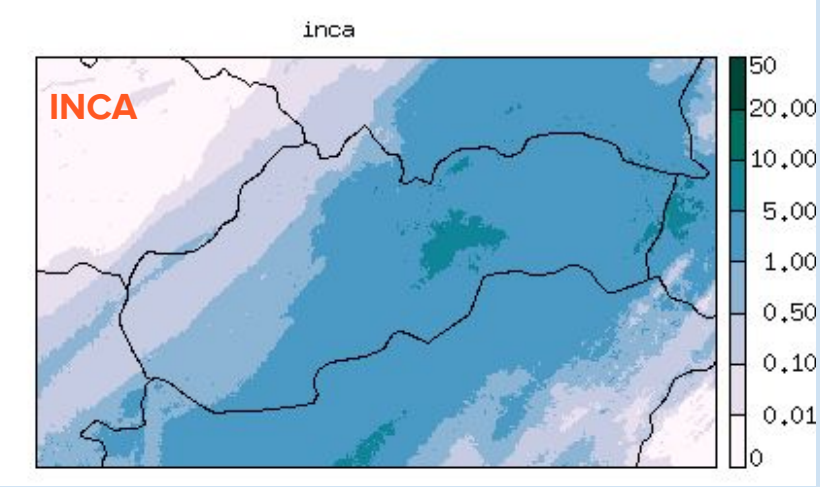


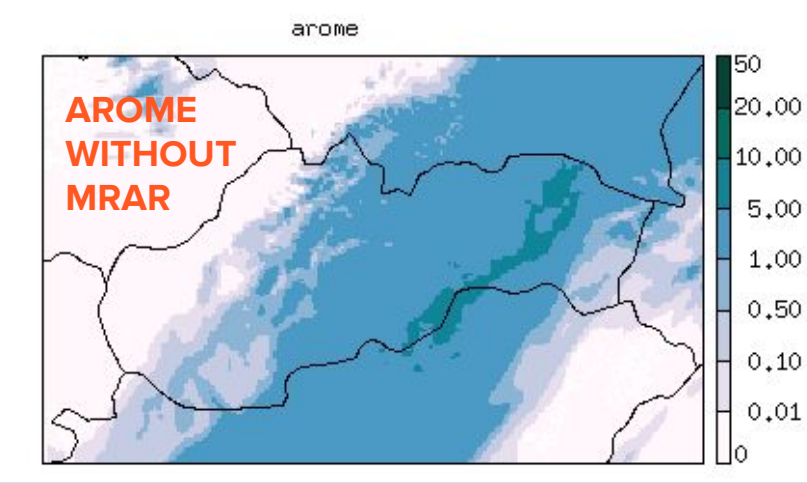


3-h accumulated surface precipitation 2018-02-02_12+06

Case study - Feb 02, 2018 at 15 UTC







3-h accumulated surface precipitation 2018-02-02_12+06

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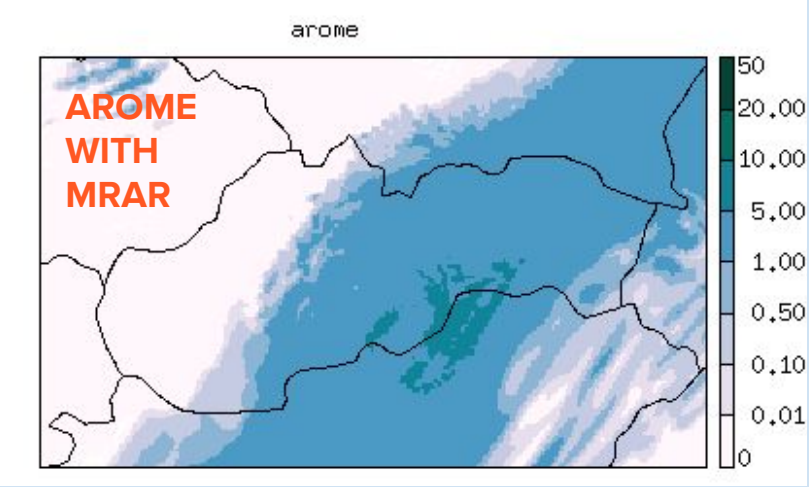
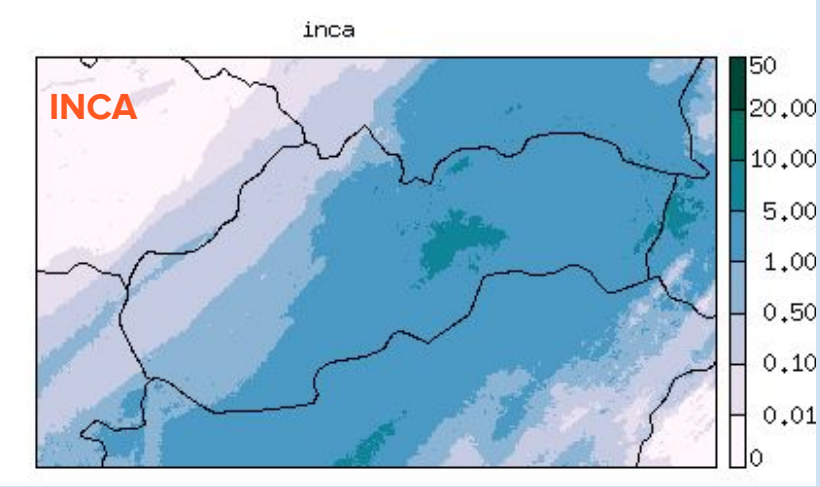
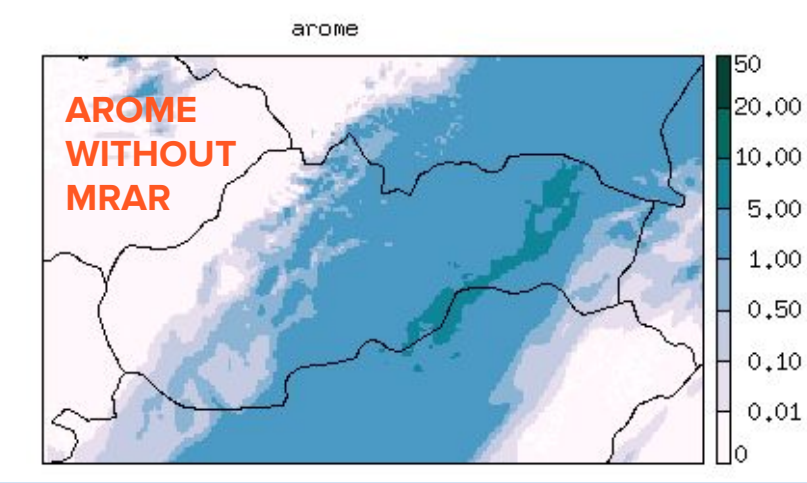
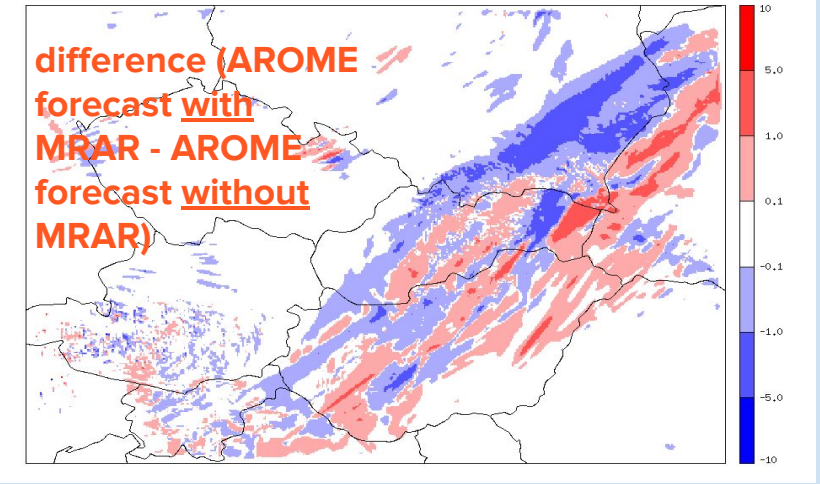


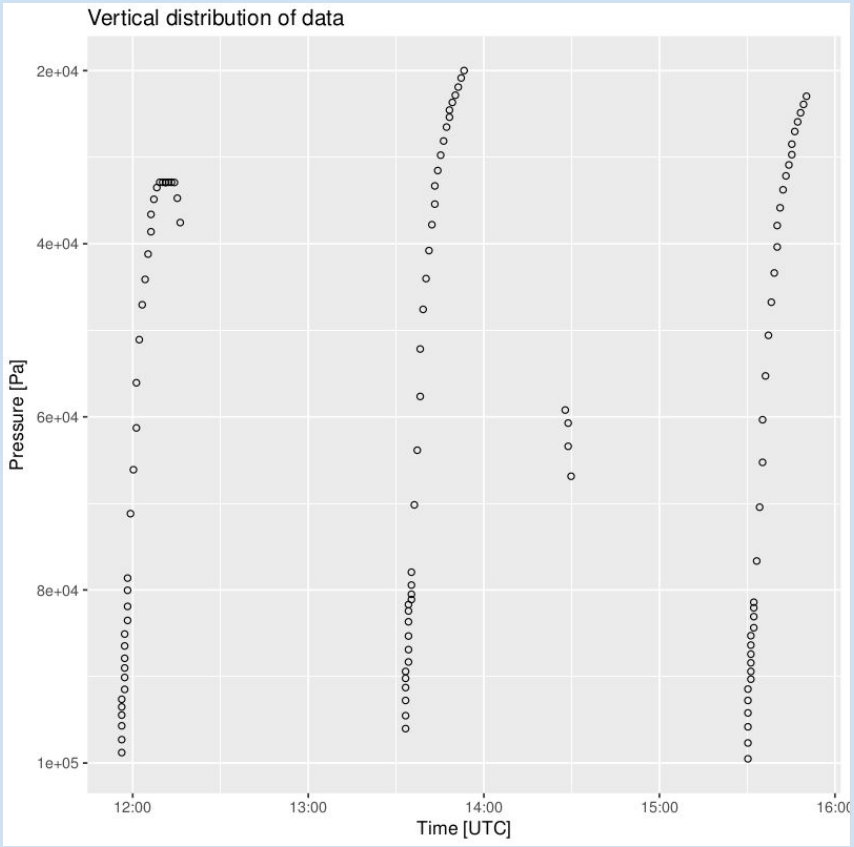


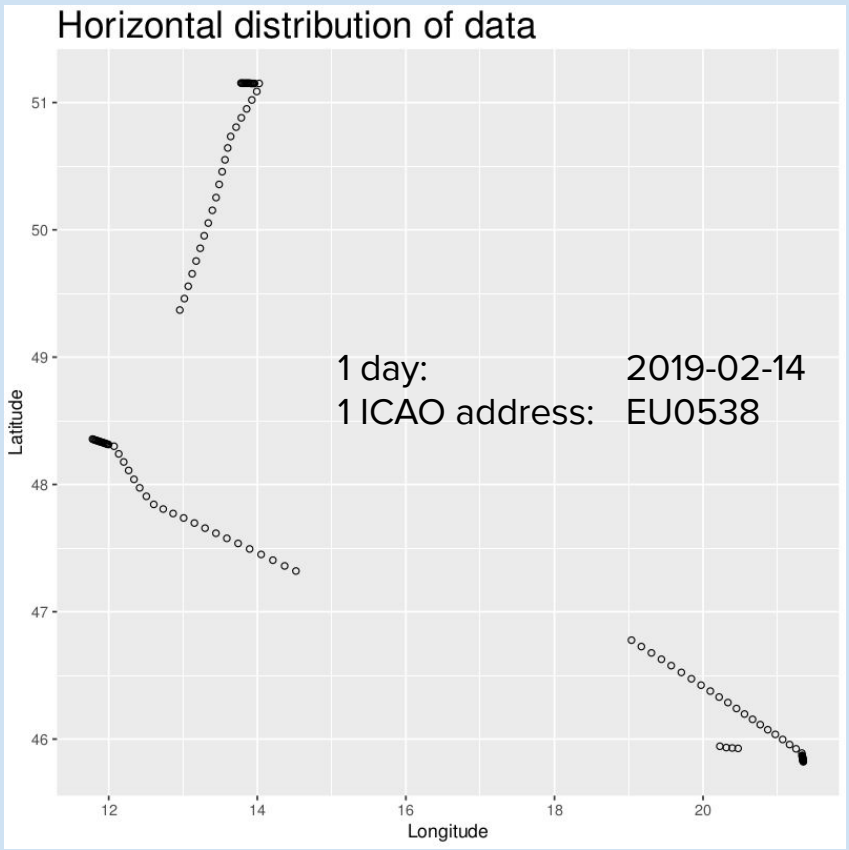




Future plans

- cruise level - taking off/landing measurements





Future plans

- **cruise level - taking off/landing measurements**
- EHS case study
- whitelist case study

Future plans

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- EHS case study
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- MRAR - EHS from the same radars

Future plans

- **cruise level - taking off/landing measurements**
- EHS case study
- whitelist case study
- MRAR - EHS from the same radars

- data acquisition

Questions

Questions

- AMDAR averaging - big diffvert, no difftime

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0,0,0.149787063872 62,0.149787063872 62,262.2,**2018-01-06**
08:24:15,**0**,**-5557.594503613**

2,"EU0538",2,**50.7717**,**13.6317**,**58556.517719646**,0,20180106,"082415",1,0,0,0,1,0,
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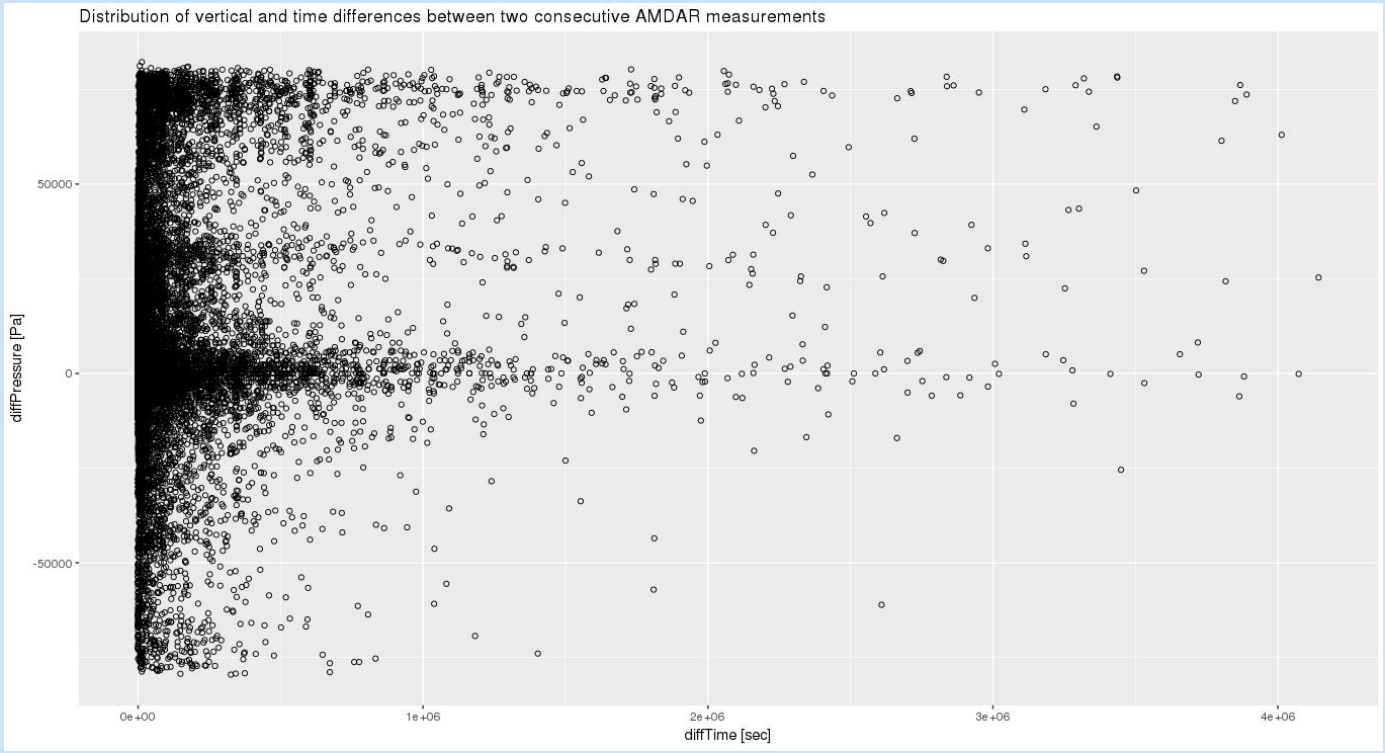
08:24:15,60,-4701.649320692

Questions

- AMDAR averaging - big diffvert, no difftime



less frequent for EHS

Questions

- AMDAR averaging - big diffvert, no difftime
- wind direction = NA (2700x)

obstype, statid, varno, lat, lon, vertco_reference_1, date, time, **fg_depar**, **obsvalue**, ffm, **ddm**, ffmodm, ddmodm, ffm - ffmodm, ddm - ddmodm

4372636, 2, 43EBEF, 3, 48.63902, 12.86524, 47053.903920491, 20180209, 153114, **-0.027373744536805**, **0**, 0, **NA**, 0.428651157382875, 356.338589113575, -0.428651157382875, NA

4372637, 2, 43EBEF, 4, 48.63902, 12.86524, 47053.903920491, 20180209, 153114, **0.42777621817454**, **0**, 0, **NA**, 0.428651157382875, 356.338589113575, -0.428651157382875, NA

Thank you
for your attention