

Data assimilation of Mode-S EHS observations

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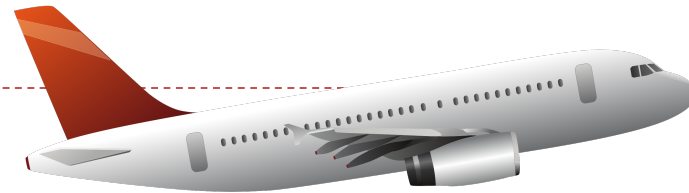


Outline

- ▶ Introduction
- ▶ Quality
- ▶ Thinning
- ▶ Impact on forecast
- ▶ Conclusions

Introduction

- ▶ Mode-S EHS are high-density aircraft observations provided by KNMI
- ▶ Wind almost directly observed, temperature calculated from using the speed of sound equation
- ▶ Reprocessing and calibration at KNMI
- ▶ Used by HIRLAM with encouraging results
- ▶ Available at OPLACE



Quality

- ▶ **Estimated from OMG values**

- With respect to short-range operational ALADIN/CZ forecast
- Estimated over 10 months
- Departures normally distributed with a few outliers

- ▶ **Estimated by status in assimilation**

- Statistics over active observations after screening

Quality – whitelisting approach

- ▶ Standard deviation and bias computed over complete OMG data set separately for each aircraft
- ▶ Several thresholds for gross error, error std. and bias used and $N > 10.000$ required

var.	gross	mean	sd	N_{data}	$N_{aircraft}$
T	15	0.3	1	53,763,057	3181
T	15	0.5	1.5	70,661,437	4618
T	15	1	2	71,787,439	4728
wsp	50	0.3	2	26,691	16
wsp	50	0.5	3	68,986,593	4038
wsp	50	1	5	72,267,829	4746
v	360	3	20	68,459,623	4494
v	360	5	20	68,480,174	4506
v	360	5	30	72,313,569	4761

Applied thresholds and number of selected aircraft

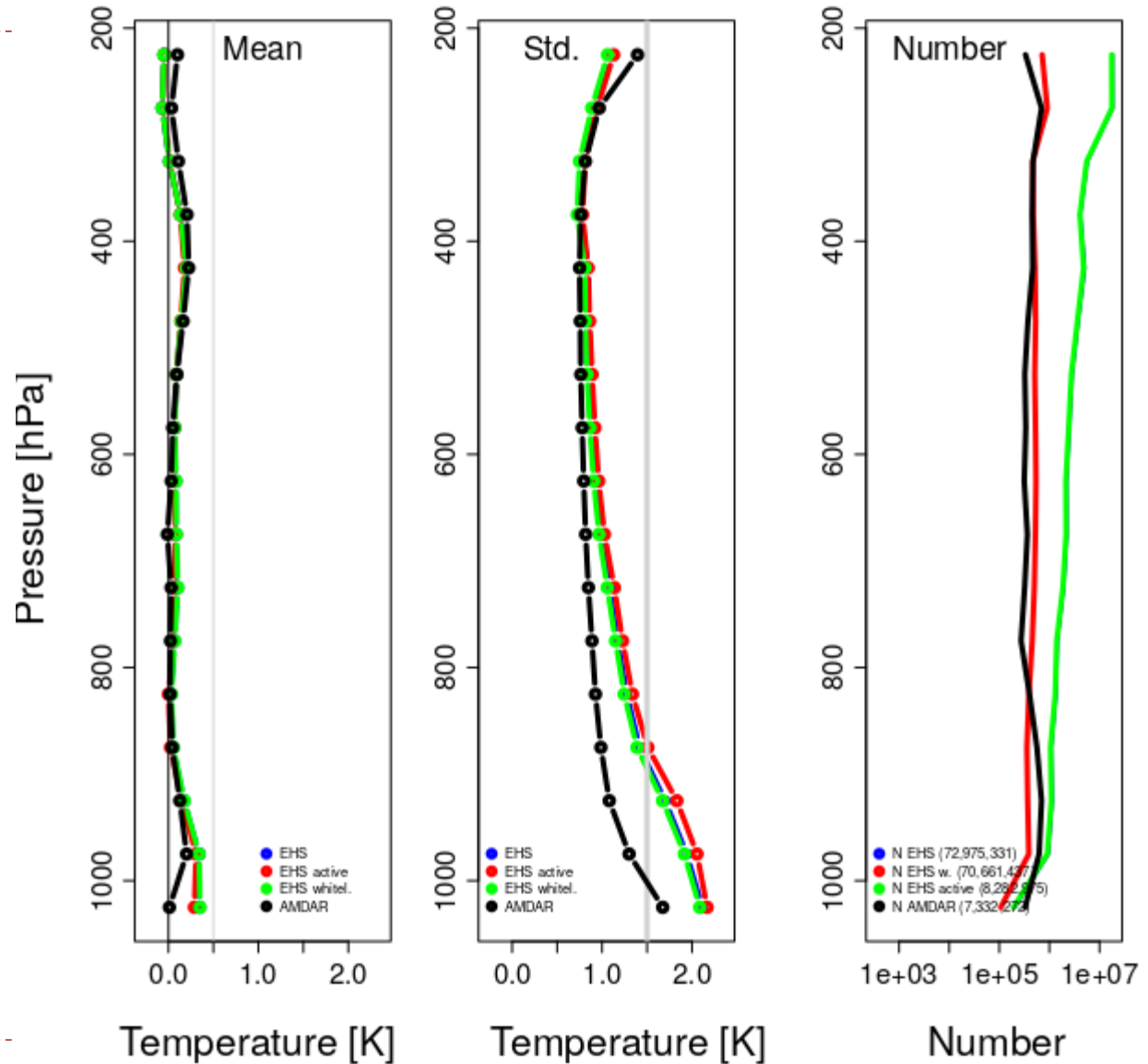
Quality

▶ Profiles of OMG:

- AMDAR
- EHS
- EHS, whitelisted
- EHS, active in screening

Profile of T aircraft OMG departures

Aircraft number EHS all:7012 whitelisted:4618 active:6880 AMDAR:1094 SI_MRAR:208
Size of EHS dataset reduced to 10%

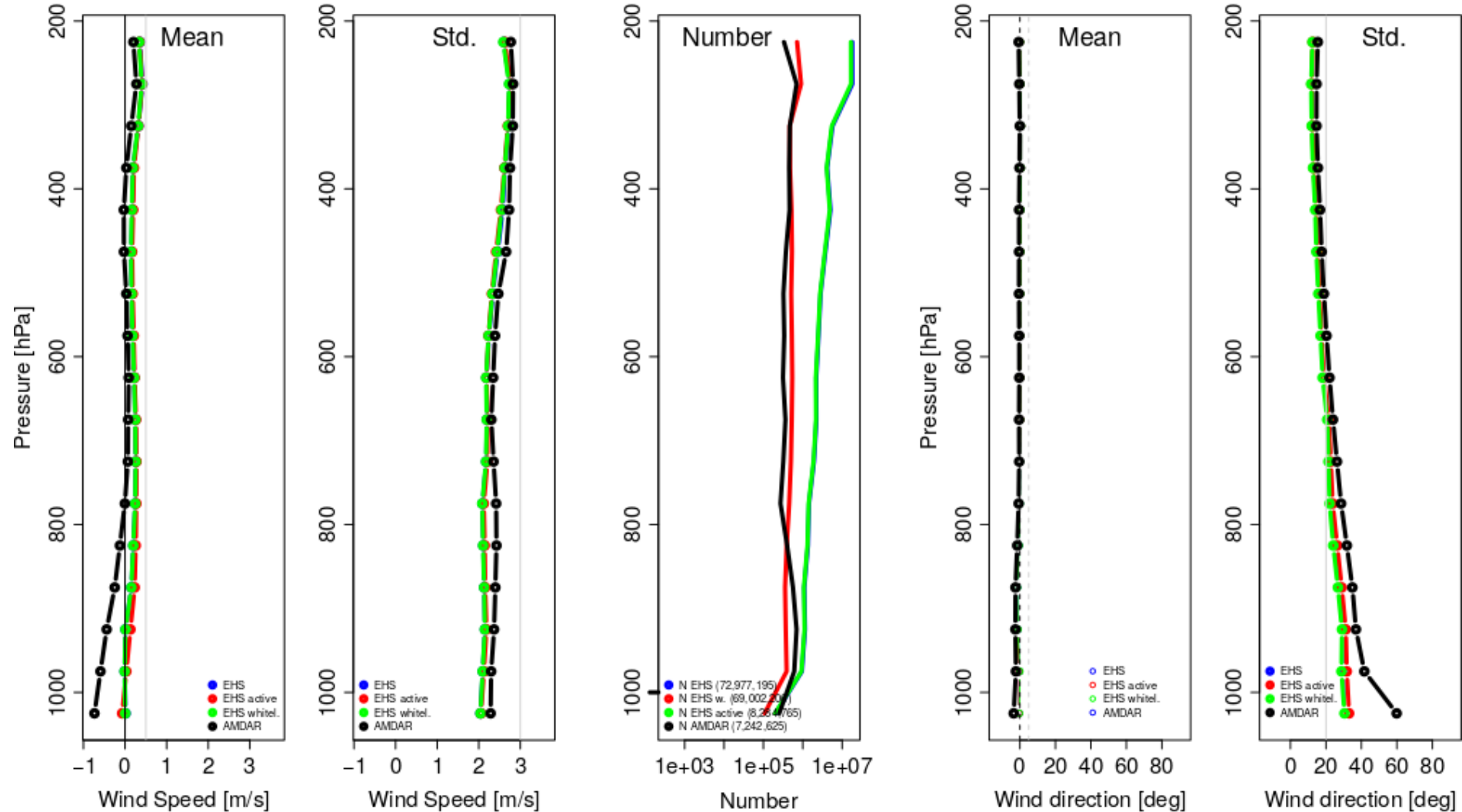


Quality

Profile of aircraft OMG departures

Aircraft number EHS all:7017 whitelisted:4039 active:6906 AMDAR:1094

Size of EHS dataset reduced to 10%



Thinning

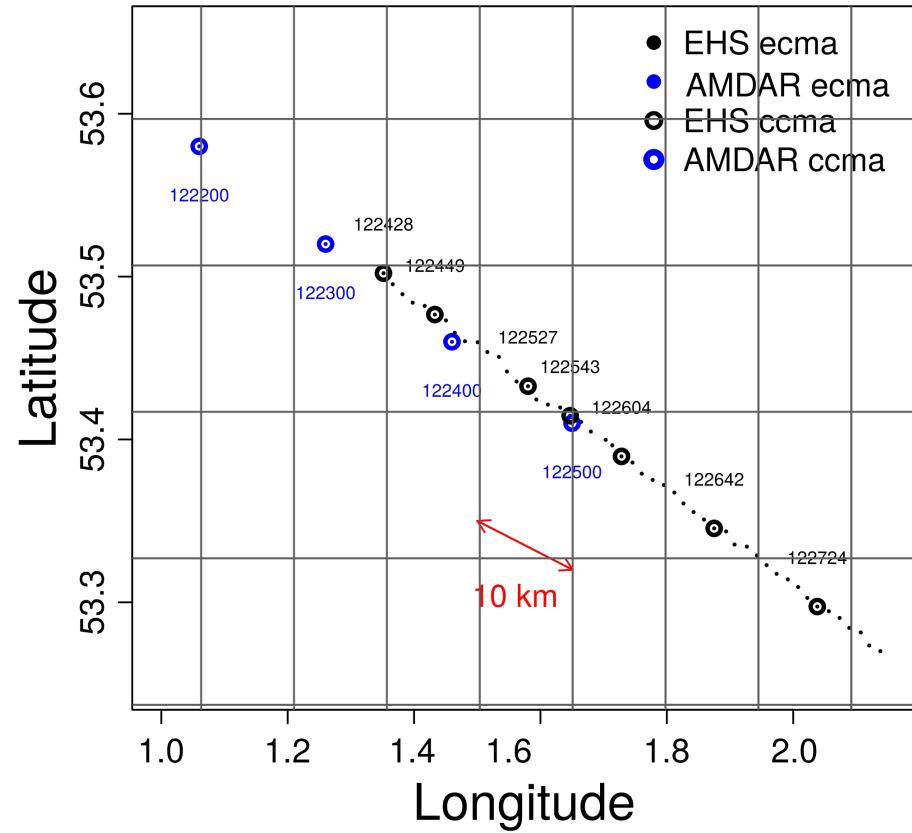
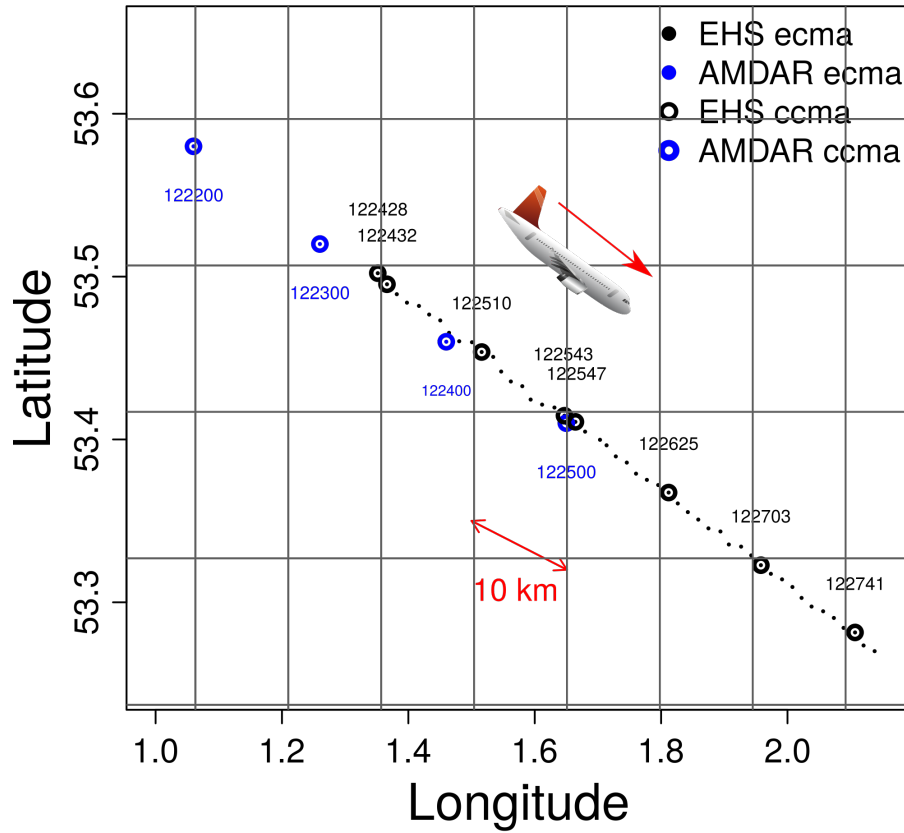
- ▶ Typical distance between Mode-S observations ~ 1 km
- ▶ ALADIN BlendVar uses 25 km thinning for AMDAR (tunning based on Desroziers diagnostics and using decreased obs. error std.). What to use for Mode-S EHS?
- ▶ A non-cycled assimilation experiment with 5 km thinning distance used to estimate optimal thinning distance.
- ▶ ObsTool (developed in CZ) - estimate the distance at which temperature observation error correlation falls below 0.2 (Liu and Rabier), found value between 50 and 100 km.

Performance of data selection (thiair.F90)

Original

**Mode-S EHS and AMDAR data selection in screening
single aircraft (AMDAR EU6638, Mode-S M75d1c6)**

Modified

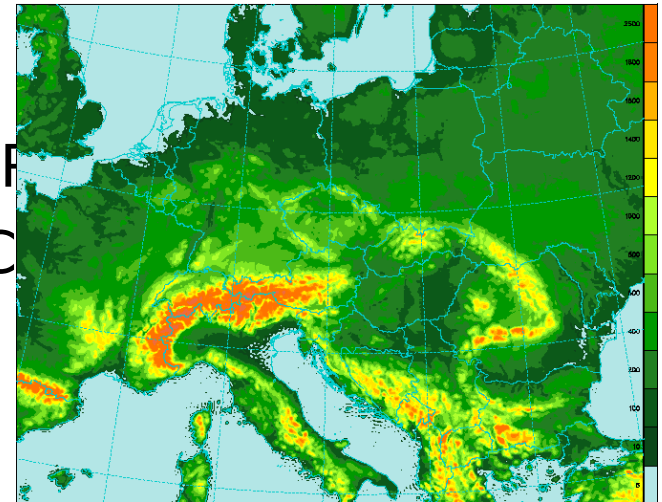


Thinning distance (RFIND_AIREP) is 10 km.



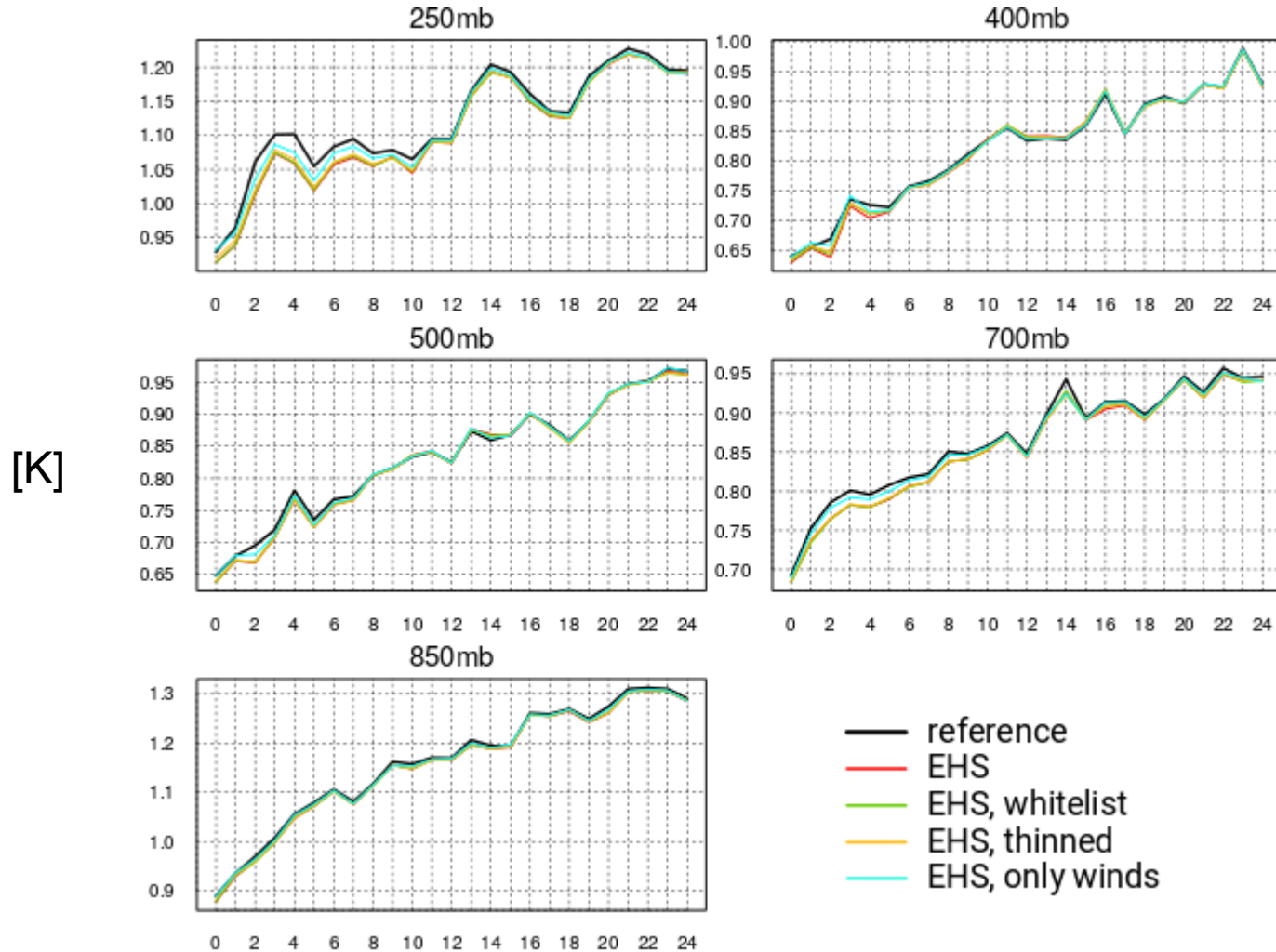
Impact on forecast in BlendVar/CZ

- ▶ Period: 10 Jan 2017 – 10 Feb 2017, 54 h forecasts
 - 6-hourly cycling (BlendVar)
 - domain (dx 4.7km, 87L)
 - SYNOP, TEMP, AMDAR, AMV, SEVIR
 - 54h forecasts from 00 and 12 UTC
- ▶ Experiments:
 - ▶ Reference
 - ▶ Full Mode-S EHS data set
 - ▶ Whitelisted Mode-S EHS data
 - ▶ Reduced thinning (50 km) and modified data selection
 - ▶ Only Mode-S wind assimilated

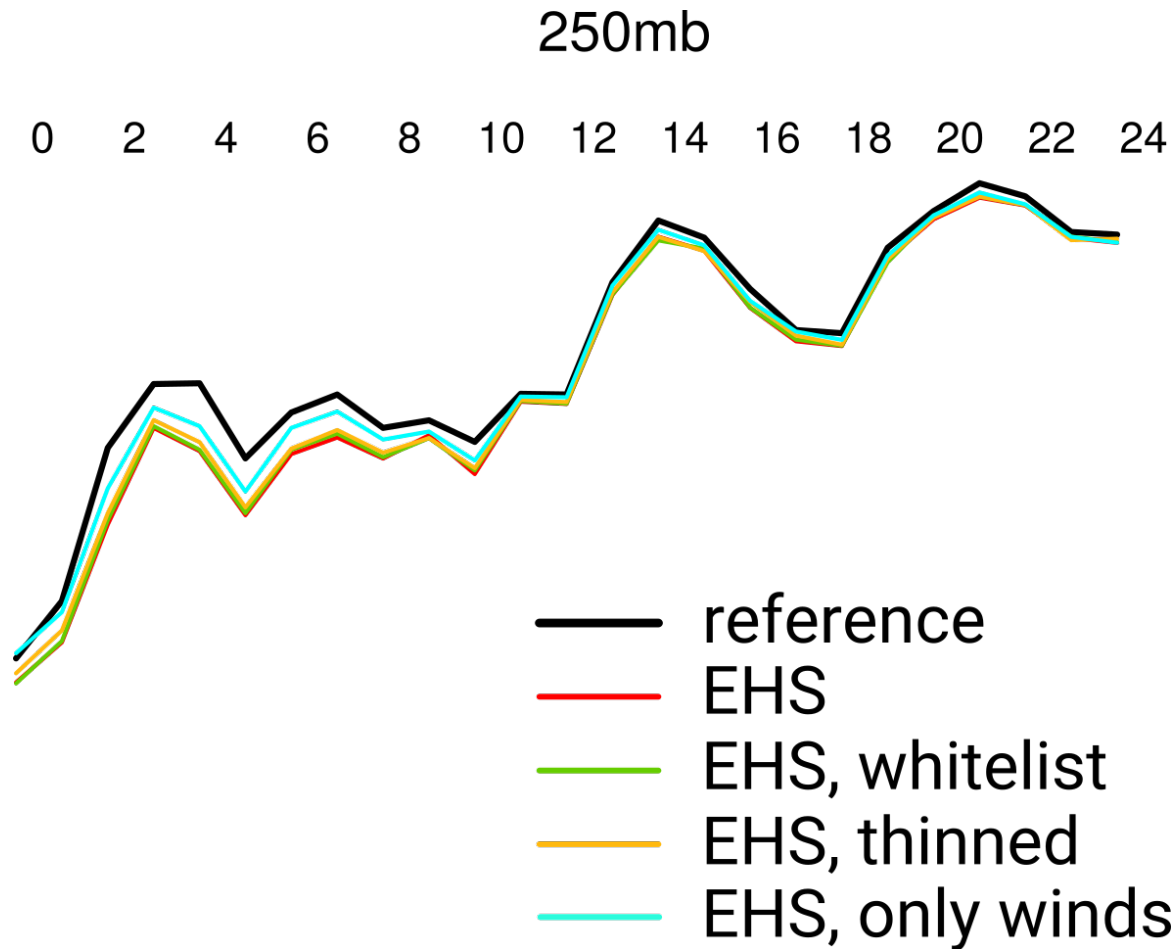


▶ Veral verficiation: comparison against AMDAR

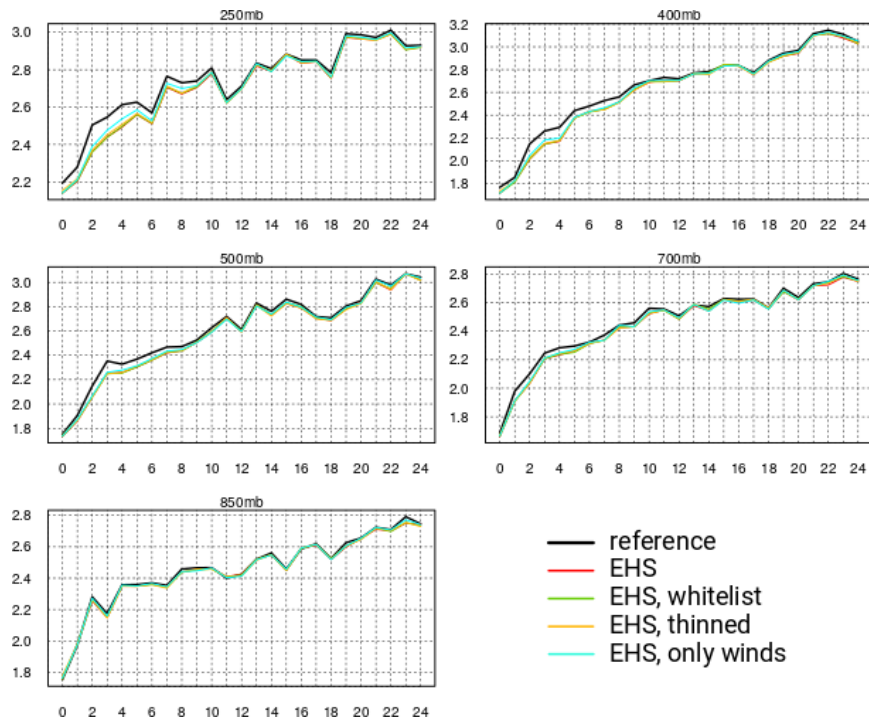
Impact on forecast - temperature



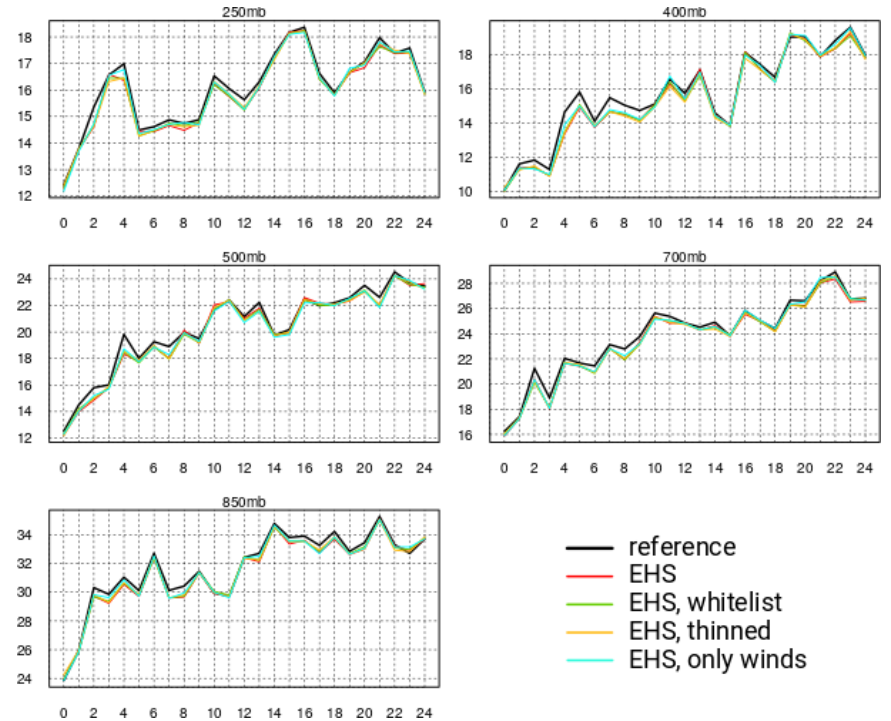
Impact on forecast – temperature



Impact on forecast – wind



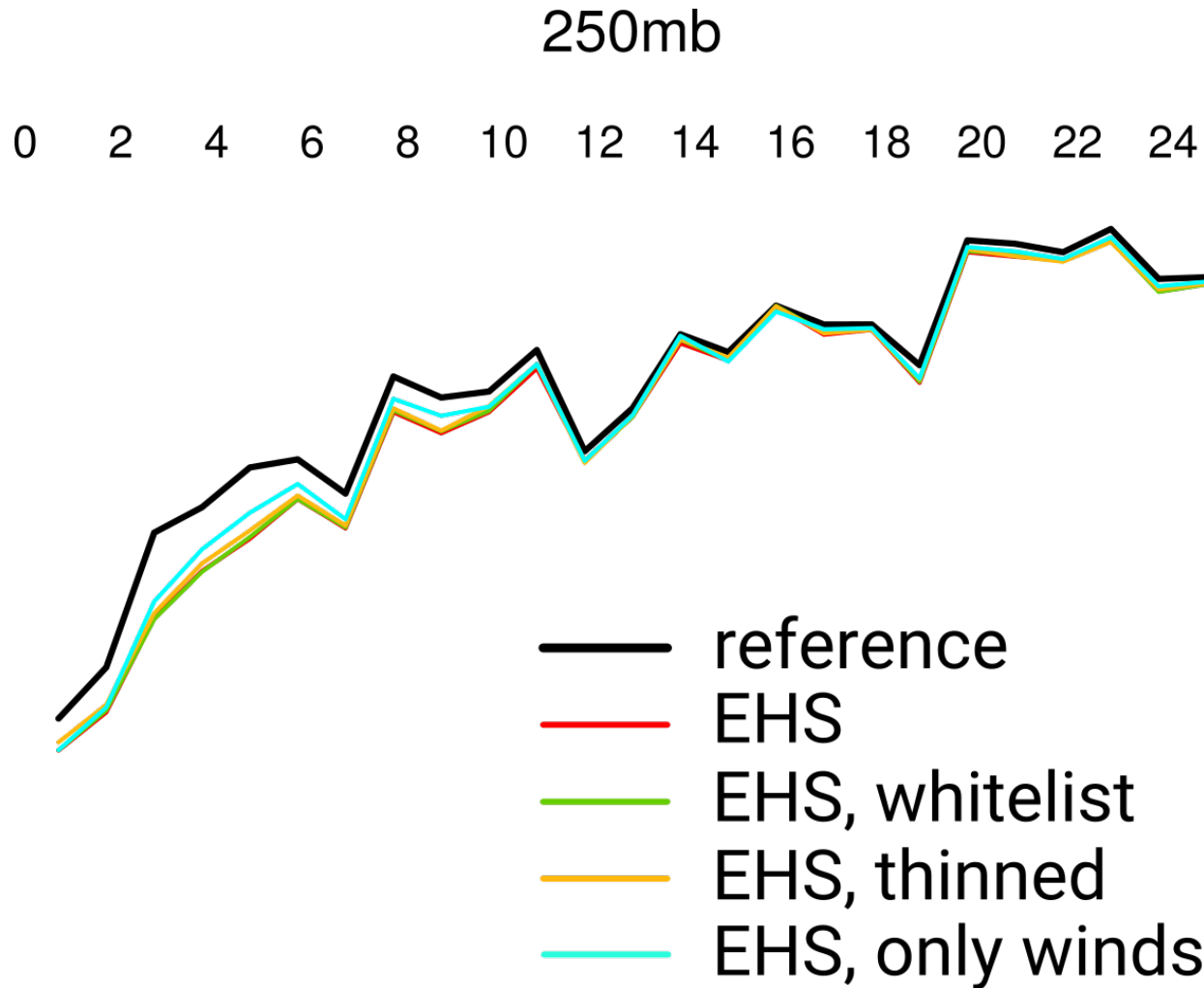
[m/s]



[deg]



Impact on forecast – wind



Conclusions

- ▶ Mode-S EHS is of good quality and useful for DA without further processing
 - ▶ Simple whitelisting not needed/effective
 - ▶ OMG departures show very good bias and std. for wind
 - ▶ High level forecast (T, wind) significantly improved up to 10 hours, to a small extent over 1 day, wrt. AMDAR
 - ▶ Temperature improves forecast, despite lower quality
 - ▶ Thinning and data selection issues
 - ▶ Impact on forecast almost negligible (25 vs. 50 km thinning)
 - ▶ Data selection by RFIN boxes provides smaller effective thinning distances, some solution proposed
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- ▶ 15 ▶ per-flight selection not any more satisfactory due to