Regional Cooperation for
Limited Area Modeling in Central Europe

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Mode-S data assimilation at CHMI

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DHMZ SHMU OMSZ ZAMG ROMANIA ANM

Outline

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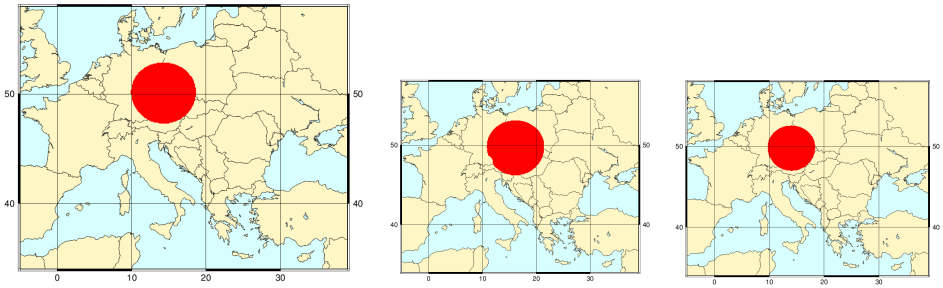
- Motivation
- Mode-S data
- Data quality assessment
- Conclusion and outlook

Motivation

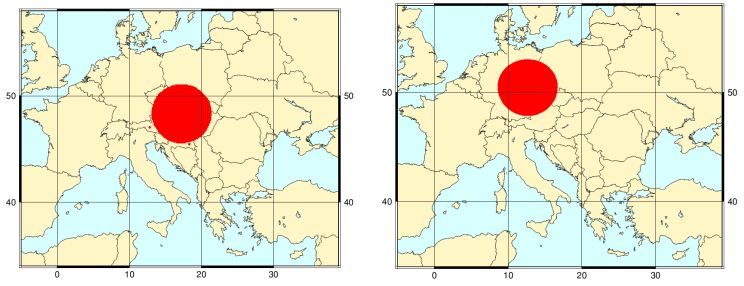
- following encouraging results of de Haan (2011), Strajnar (2012, 2015) we explored availability of Mode-S data in Czech Republic
- Mode-S (both EHS and MRAR) are collected by Air Navigation Services of Czech Republic (ANS-CZ)
- Mode-S data were kindly provided to CHMI for evaluation with aim to improve quality of weather forecasts used for air transport
- special national project "SmartMet" was proposed to provide flight crew with actual and precise weather information in a way which brings high added value without significant investments into the avionics equipment or ground infrastructure
- to gain knowledge of Mode-S MRAR data pre-processing the stay of Benedikt Strajnar was organized at CHMI

Mode-S data

- Mode-S MRAR and EHS
  - Praha (CZ)
  - Pisek (CZ)
  - Buchtuv kopec (CZ)

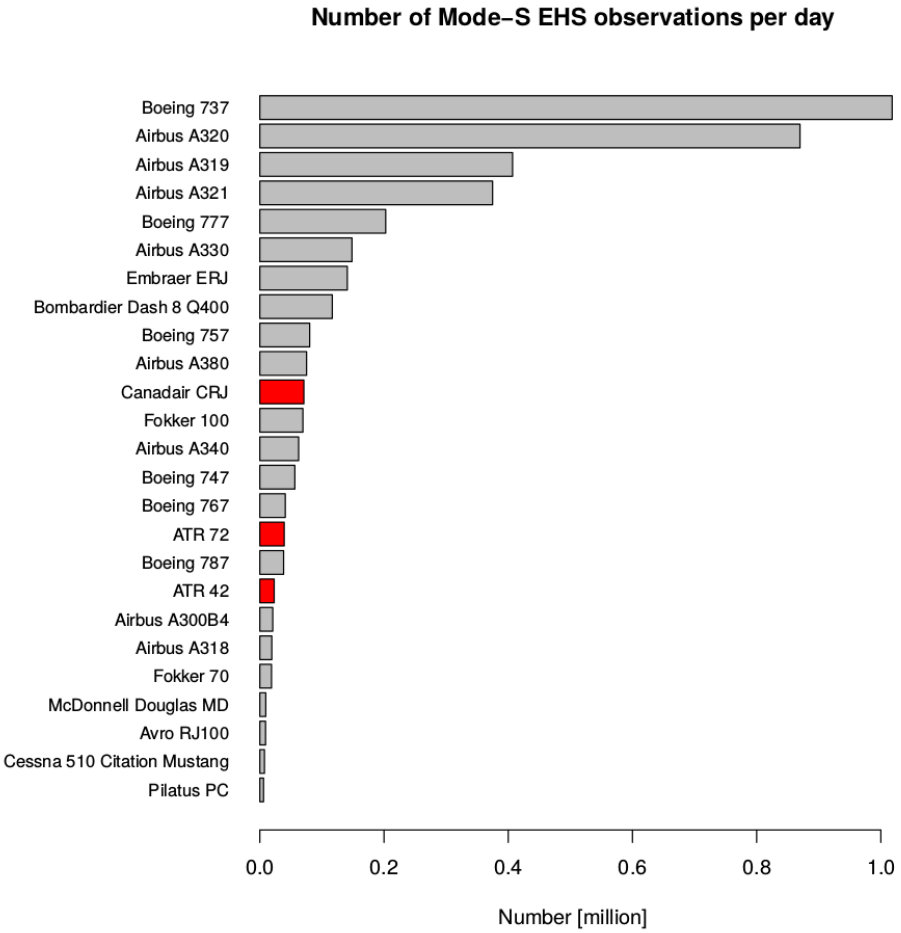


- Mode-S EHS only
  - Bratislava (SK)
  - Auersberg (DE)



- brief data summary:
  - 3.5 milion Mode-S EHS data per day
  - approx 4% Mode-S MRAR data per day
  - almost 9000 aircraft types (97% identified)

Mode-S data


Number of Mode−S EHS observations per day
Boeing 737
Airbus A320
Airbus A319
Airbus A321
Boeing 777
Airbus A330
Embraer ERJ
Bombardier Dash 8 Q400
Boeing 757
Airbus A380
Canadair CRJ
Fokker 100
Airbus A340
Boeing 747
Boeing 767
ATR 72
Boeing 787
ATR 42
Airbus A300B4
Airbus A318
Fokker 70
McDonnell Douglas MD
Avro RJ100
Cessna 510 Citation Mustang
Pilatus PC
0.0
0.2
0.4
0.6
0.8
1.0
Number [million]

Mode-s quality assessment

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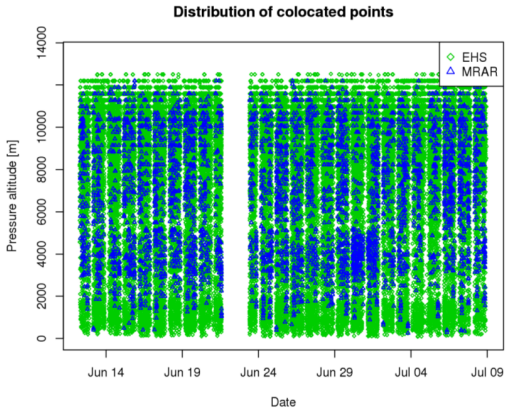
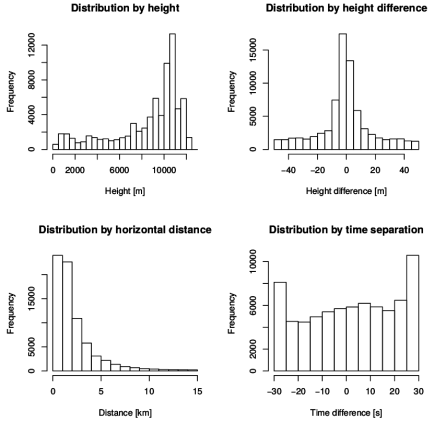
- Colocation of AMDAR and Mode-S
  - validation against other meteorological observations
  - colocated pairs within 30s time mismatch
    50m height difference
    10km horizontal separation
  - 73200 EHS-AMDAR pairs and around 4850 MRAR-AMDAR found in data sample of 12 June - 9 July 2015





Mode-S and AMDAR colocation

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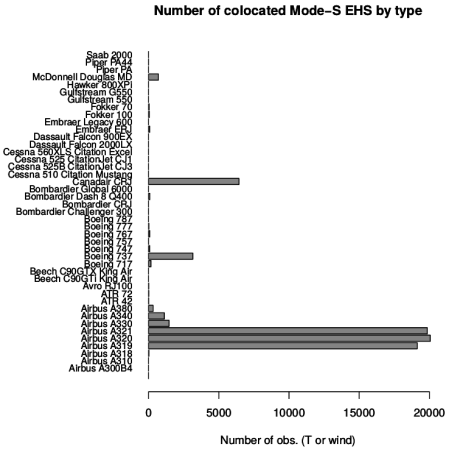

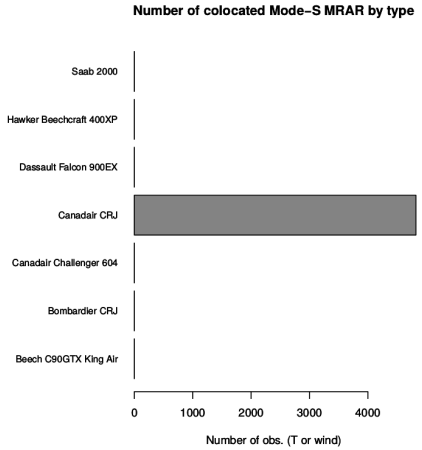

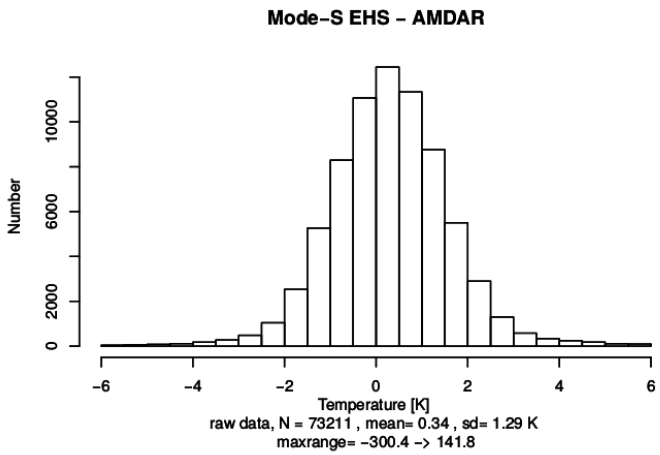

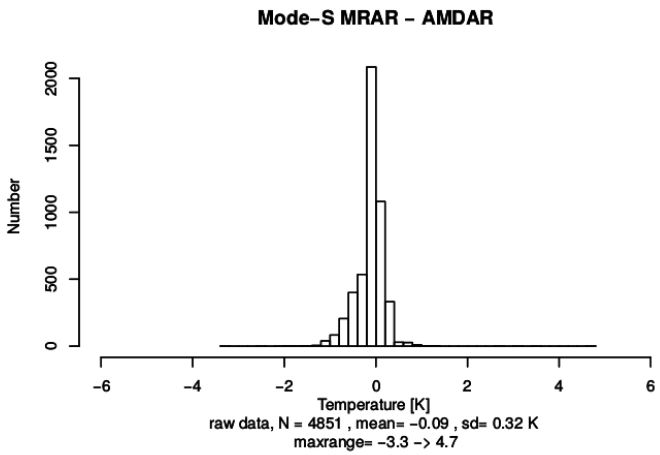

Mode-S and AMDAR colocation

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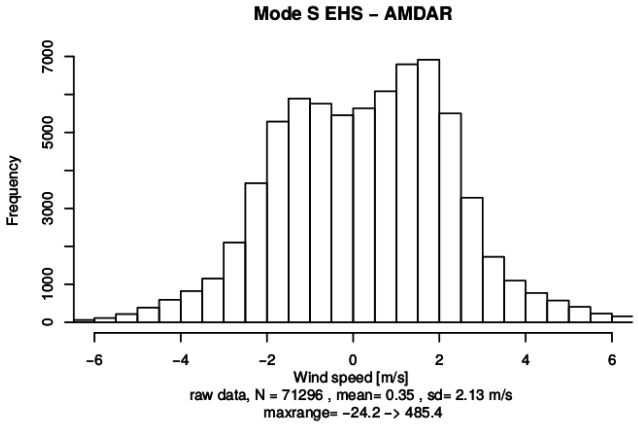

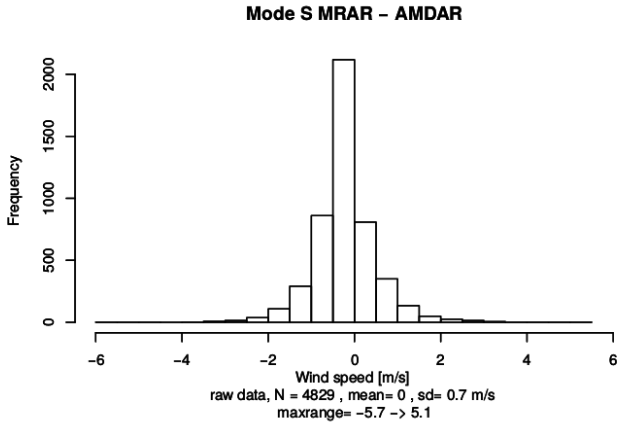

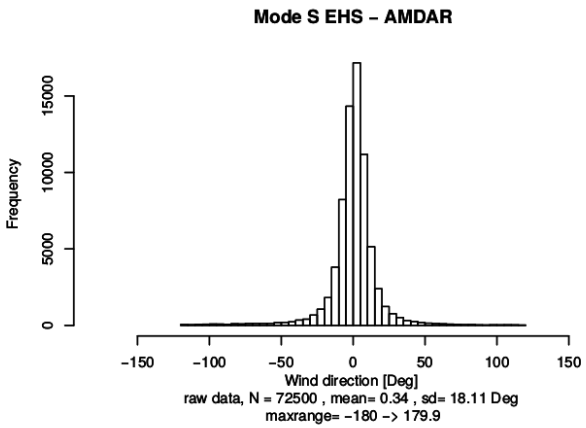

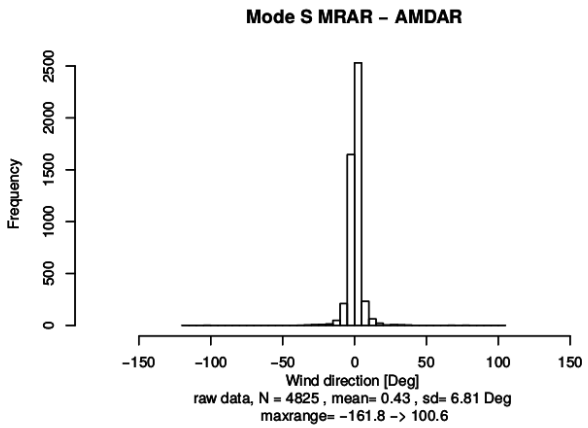

Mode-S and AMDAR colocation

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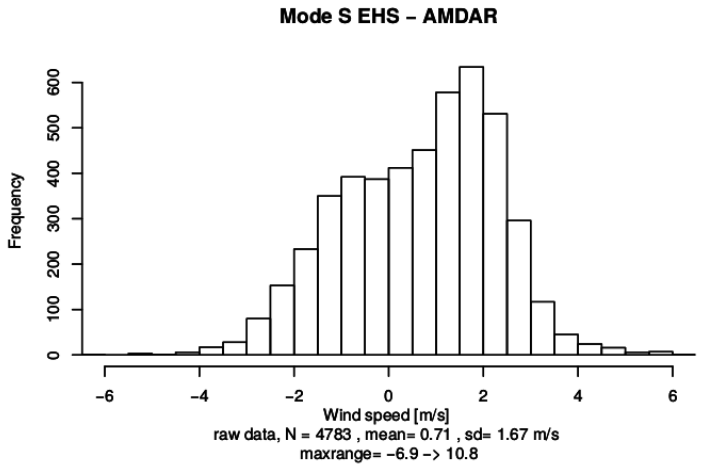
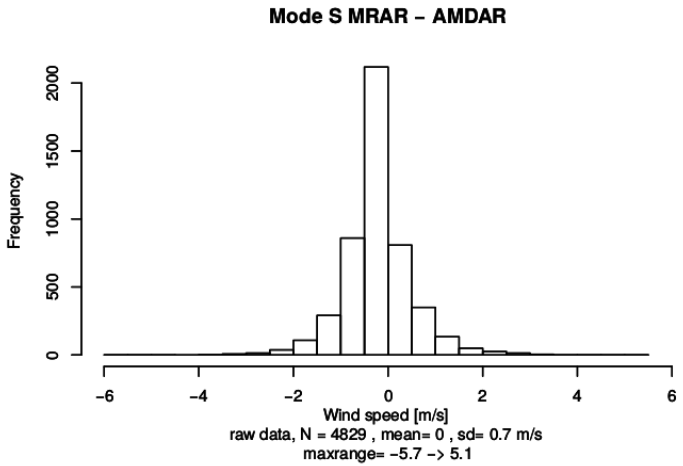
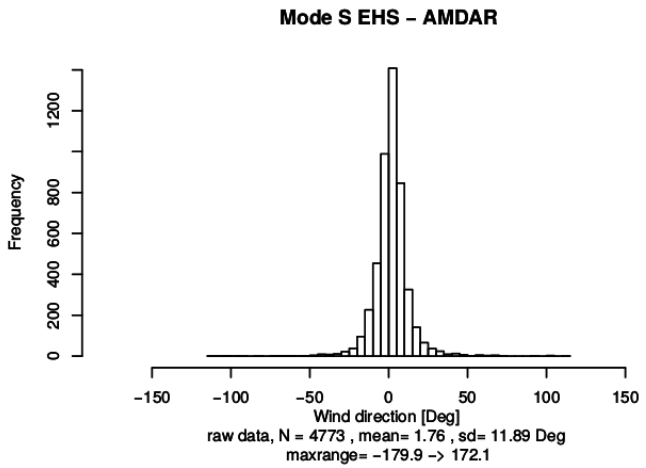
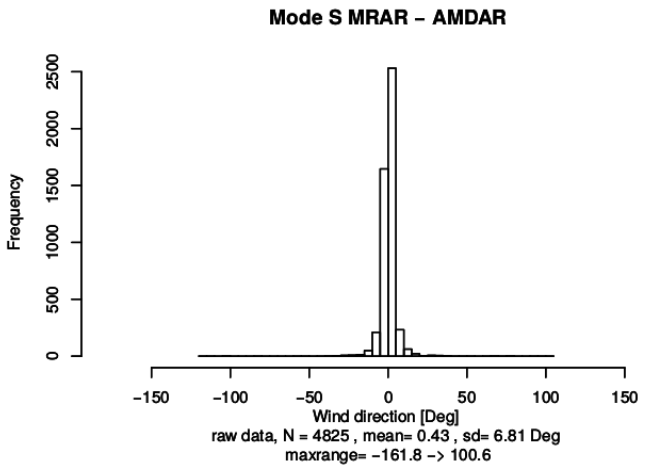
- only subset of both EHS and MRAR data









Validation against NWP model

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- comparison against AMDAR is limited to AMDAR-equipped aircrafts
- for evaluation of all Mode-S data NWP model can be used
  - ALADIN/CE forecasts of lengths 6-11 hours was used
  - screening (e002) configuration used to get model counterparts
  - only analysis for Mode-S MRAR data was performed

var	number of obs	mean	std
temperature	3000	$<$1K	$<$2K
wind speed	3000	$<$1m/s	$<$5m/s
wind direction	3000	$<$10	$<$100

Tab: Thresholds used to generate MRAR white list of aircraft

- final white list includes 127 aircrafts for temperatures and 116 for wind

Conclusions and outlook

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- preliminary evaluation of Mode-S data over Czech airspace was done
- data quality was evaluated with respect to AMDAR and NWP
- Mode-S MRAR observations are of good quality and ready for data assimilation just after the basic data selection based on statistics of differences with respect to ALADIN model
- Mode-S EHS observations needs further improvements
- ... for more details see http://www.rclace.eu/

  Benedikt Strajnar, 2015: Analysis and preprocessing of Czech Mode-S observations

- impact study of Mode-S MRAR data assimilation is still ongoing

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Thank You for Your attention !