Royal Netherlands
Meteorological Institute
Ministry of Infrastructure
and Water Management

Status and Plans of the European Meteorological Aircraft Derived Data Centre (EMADDC)

EWGLAM 2021

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Status and plans

- **Status**
  - EMADDC website http://emaddc.com
    - info for (new) data users /supplier
  - EMADDC v2.2
    - geographical expansion
    - output quality control
    - improvement in quality
    - ftp data exchange
- **Plans**
  - EMADDC v3.0
    - realisation of NewPENS connection to collect ATS data in real time
    - near real time processing instead of batch processing every 15 min
    - realisation of data portal (web services)

About EMADDC

The European Meteorological Aircraft Derived Data Center

www.emaddc.com

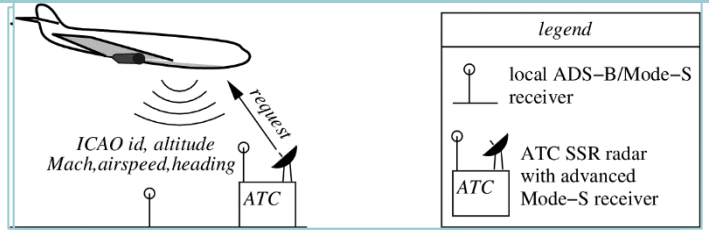
New air traffic control surveillance technologies present opportunities to obtain or **derive** observations for:

- Wind direction
- Wind speed
- Temperature

EMADDC objective: to obtain as many high quality meteorological upper air observations for Europe at large for as little cost as possible

by installing an operational service for collecting, processing and disseminating

Mode-S EHS derived, quality controlled meteorological data.

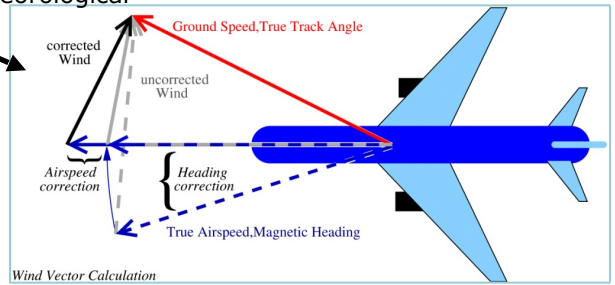


Active interrogation by ATC

Aircraft data that are broadcasted

BDS Register	Basic DAP Set (if track Angle Rate is available)	Alternative DAP Set (if Track Angle Rate is not available)
BDS 4,0	Selected Altitude	Selected Altitude
BDS 5,0	Roll Angle	Roll Angle
	Track Angle Rate	
	True Track Angle	True Track Angle
	Ground Speed	Ground Speed
		True Airspeed (provided if Track Angle Rate is not available)
BDS 6,0	Magnetic Heading	Magnetic Heading
	Indicated Airspeed (IAS) / Mach no. (Note: IAS and Mach no. are considered as 1 DAP (even if technically they are 2 separate ARINC labels). If the aircraft can provide both, it must do so).	Indicated Airspeed (IAS) / Mach no. (Note: IAS and Mach no. are considered as 1 DAP (even if technically they are 2 separate ARINC labels). If the aircraft can provide both, it must do so).
	Vertical Rate (Barometric rate of climb/descend or baro inertial)	Vertical Rate (Barometric rate of climb/descend or baro inertial)

Quality control process to improve the quality of derived meteorological observations



Impact of quality control on amount and quality of data

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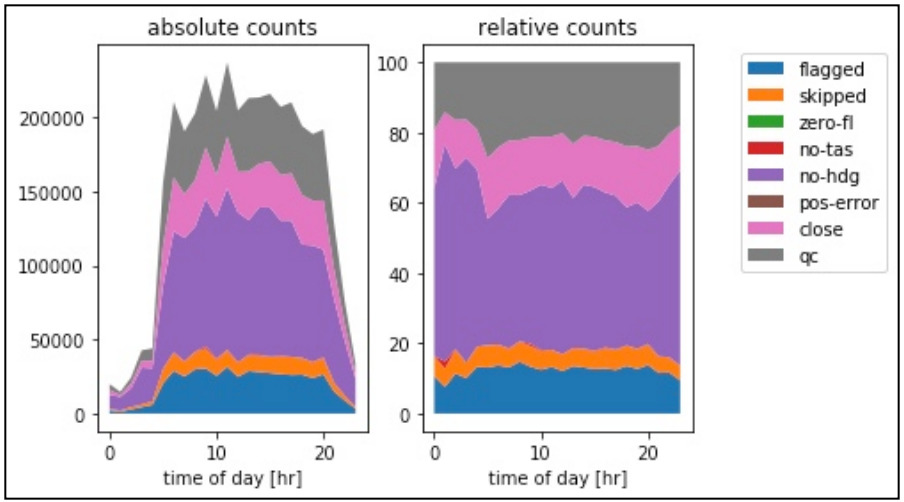
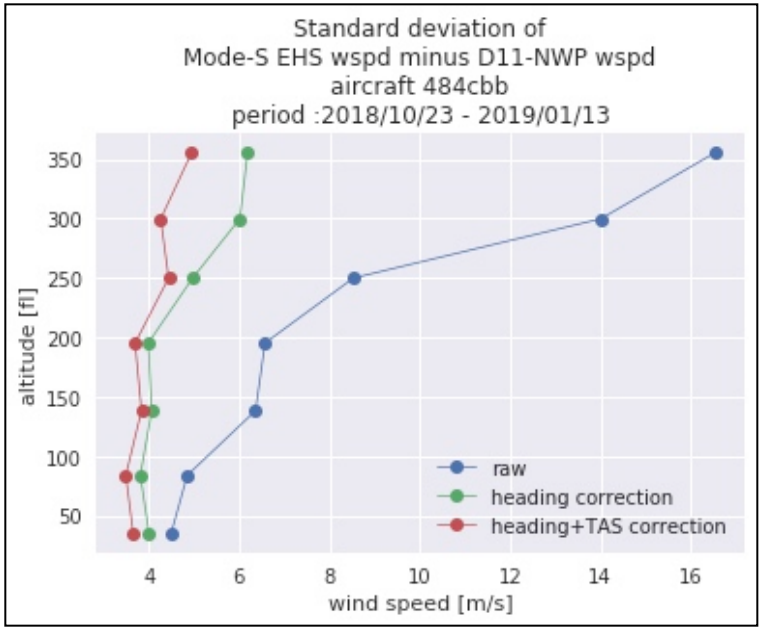
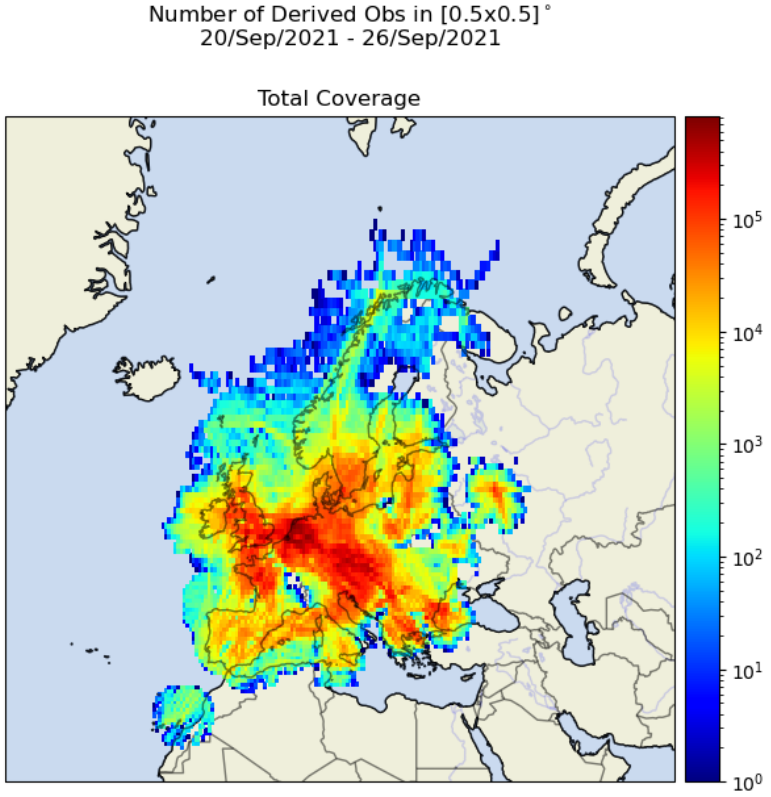


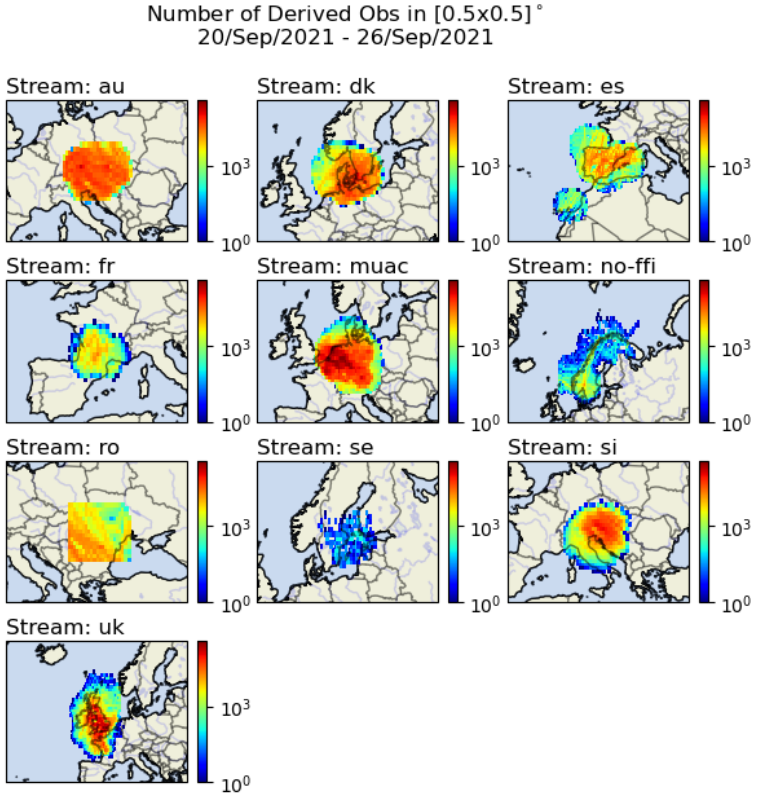
Impact of the different steps in input quality control process: flagged (e.g. roll angle, extreme angles, difference between true airspeed and ground-speed), skipped (double observations), no heading correction available, close (unreliable time/position) resulting in (input) quality controlled derived observations (qc).



Impact of input quality control on standard deviation of wind speed of an individual aircraft in comparison with NWP (extreme example)

Overview of current data streams





Monitoring versus ECMWF

	20 Sep 00:00 - 26 Sep 23:59										
	wind speed				wind direction			temperature			
	obs in	obs out	bias	s.d	obs out	bias	s.d	obs in	obs out	bias	s.d
level											
all	342,585,656	315,556,119	0.25	2.46	304,711,435	-0.01	11.22	210,118,196	173,197,573	-0.01	0.94
fl-50	11,690	9,777	0.47	1.22	4,795	0.83	14.63	3,341	312	1.96	1.70
fl050	19,374,495	14,600,620	0.19	1.87	12,171,993	-0.63	15.47	11,748,031	5,671,265	0.13	1.13
fl150	29,802,307	26,713,633	0.19	1.81	25,172,941	-0.22	11.55	23,469,123	15,933,222	0.11	0.84
fl250	43,264,485	39,306,986	0.25	2.16	38,190,993	0.53	11.37	33,784,276	25,670,945	0.04	0.74
fl350	223,513,097	210,306,718	0.27	2.60	205,285,800	0.02	10.86	126,932,180	113,316,426	-0.06	0.96
fl450	26,619,582	24,618,385	0.17	2.56	23,884,913	-0.59	11.11	14,181,245	12,605,403	0.09	1.07

7 days
70 Million obs/day

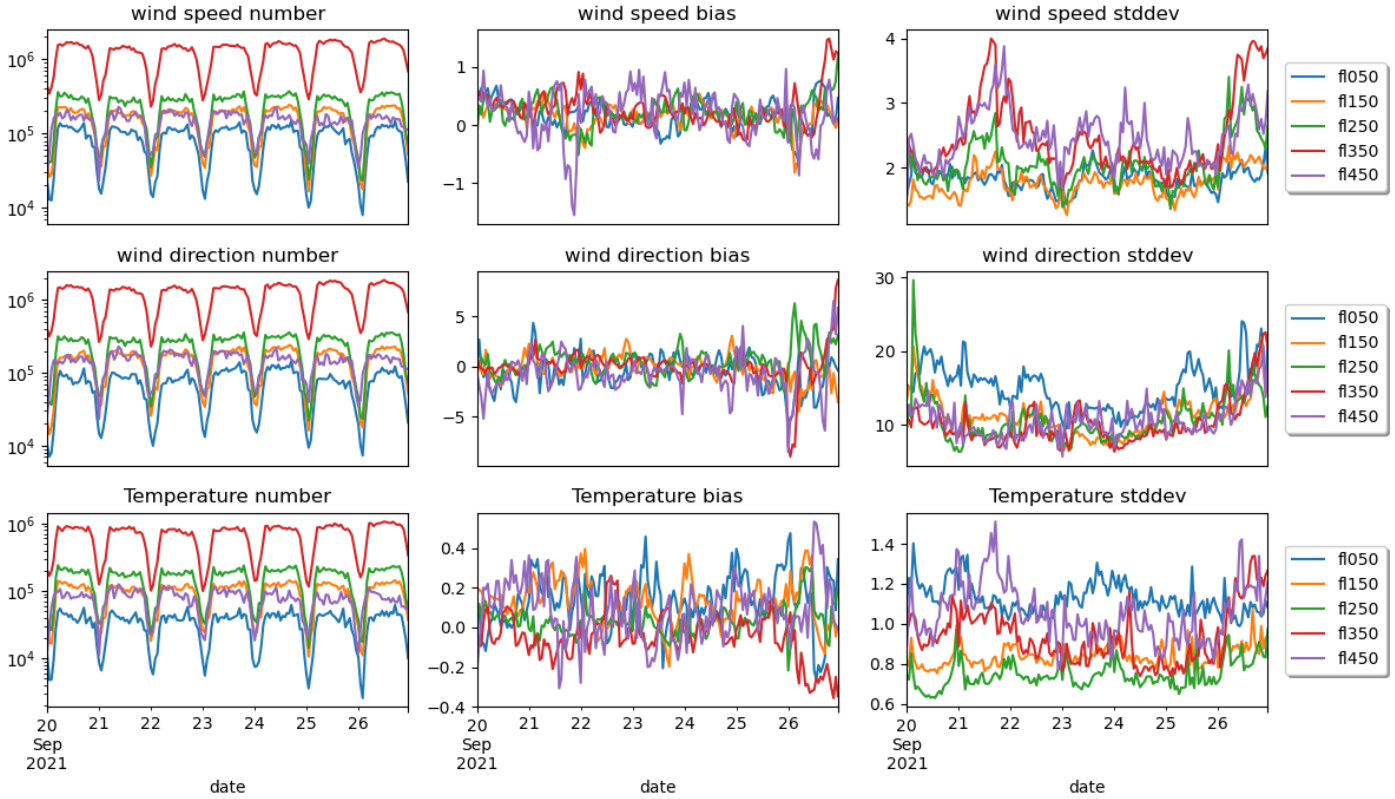
Statistics show good quality.
Quality depends on the height

number of wind = 2 x number of temperature

Monitoring per source

20 Sep 00:00 - 26 Sep 23:59											
	wind speed				wind direction			temperature			
	obs in	obs out	bias	s.d	obs out	bias	s.d	obs in	obs out	bias	s.d
source											
as-met	160,231,335	147,011,512	0.29	2.48	142,365,847	-0.04	11.20	96,322,662	82,356,765	-0.01	0.96
au	21,465,195	19,998,956	0.26	2.51	19,349,619	-0.20	11.07	14,003,820	11,798,023	-0.07	0.92
dk	18,872,670	17,430,159	0.13	2.27	17,169,234	-0.26	7.76	11,867,247	9,820,212	-0.08	0.90
es	13,086,486	11,748,170	0.41	3.12	11,516,758	-0.15	13.84	3,265,641	2,165,632	0.04	1.08
fr	1,024,646	913,883	0.41	4.53	892,243	-1.15	19.60	419,860	292,460	0.10	1.21
muac	70,197,613	63,202,634	0.13	2.46	60,495,672	0.18	11.26	44,949,713	34,738,323	-0.00	0.93
no-ffi	1,457,394	1,346,703	0.46	2.56	1,323,698	-0.48	9.07	816,765	482,836	-0.05	0.95
ro	4,765,053	4,657,329	0.23	2.24	4,594,496	-0.40	8.50	2,113,219	1,376,215	0.16	0.99
se	2,050,489	1,971,786	0.55	2.49	1,941,404	-0.25	8.12	1,362,062	1,183,636	0.08	0.99
si	12,263,260	11,887,437	0.39	2.57	11,551,128	-0.50	12.76	7,465,738	6,739,323	-0.08	0.99
uk	37,171,515	35,387,550	0.22	2.05	33,511,336	0.33	11.51	27,531,469	22,244,148	0.04	0.85

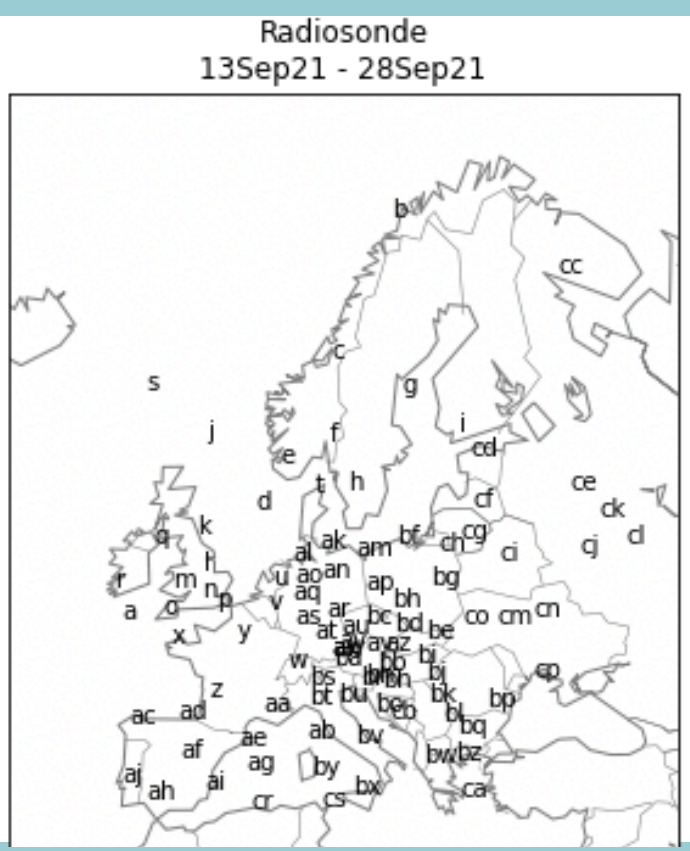
Monitoring over time

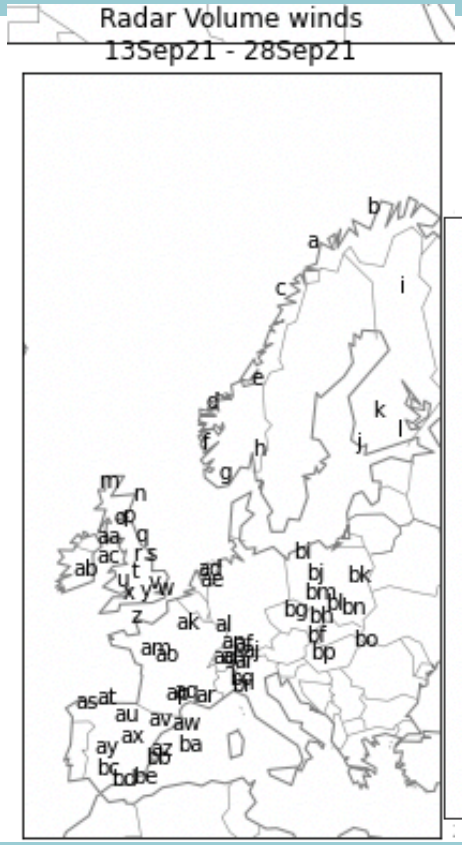


Statistics show dependance on time.

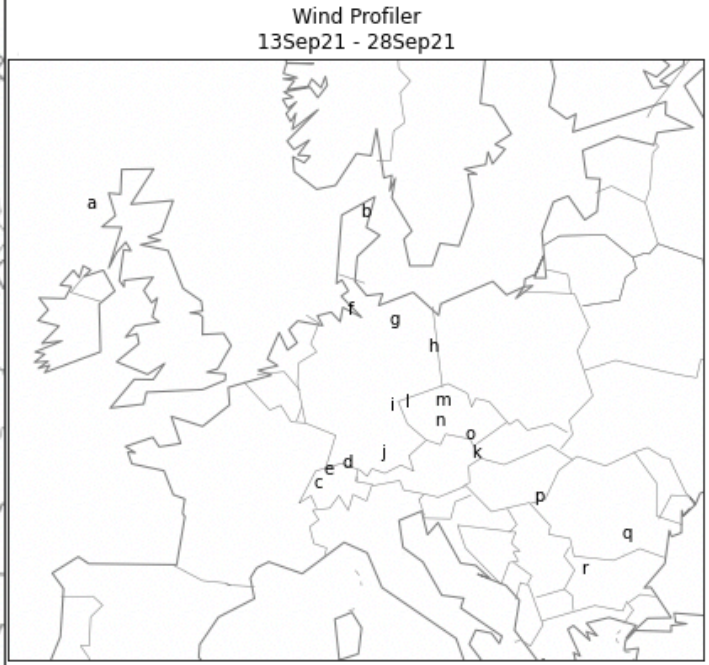
- error characteristics depend on:
  - flight direction?
  - wind?
  - both?

Validation





and AMDAR



Validation of temperature

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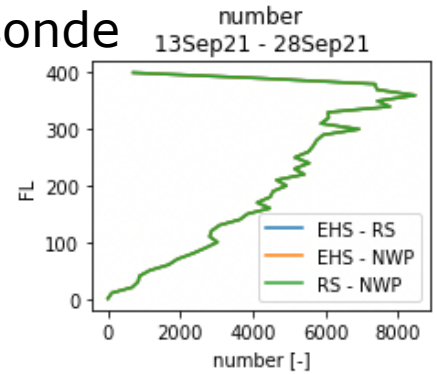
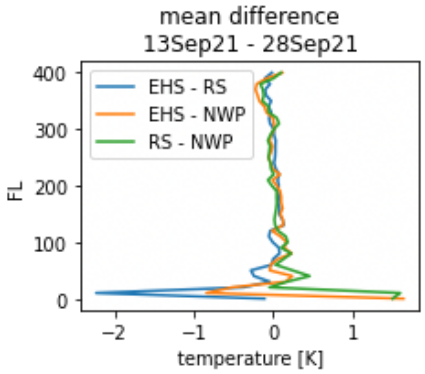
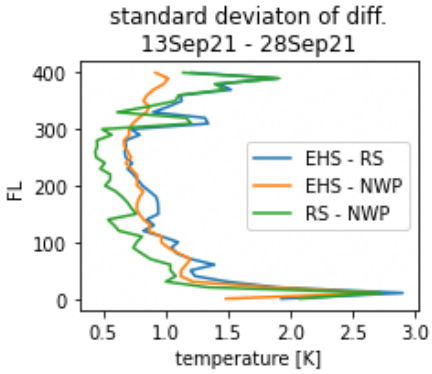
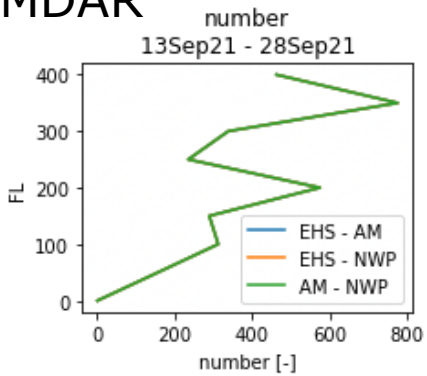
Radiosonde

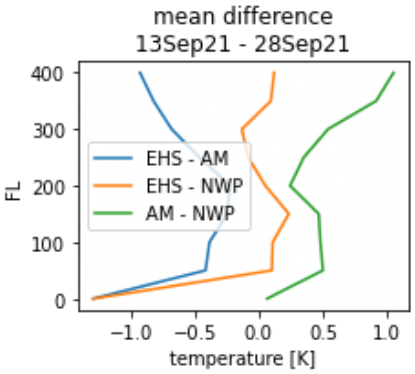


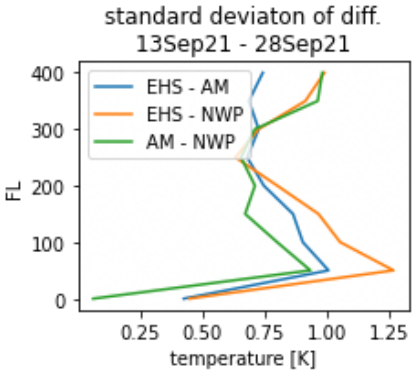




AMDAR







Mode-S EHS

- noisy below fl050
- above fl050 no bias

Validation of wind speed

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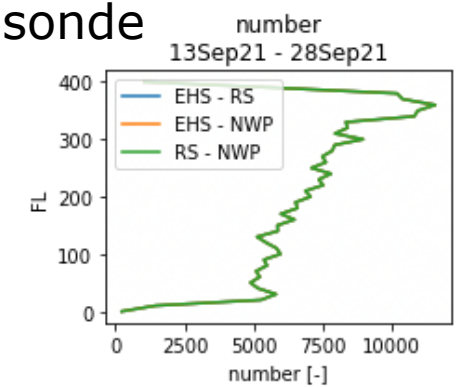
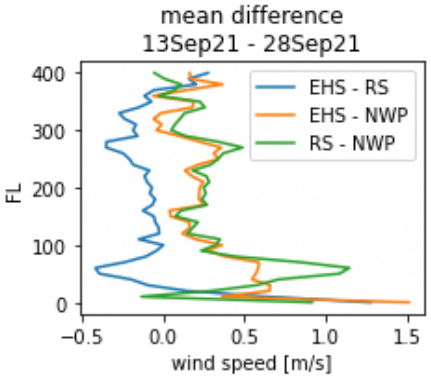
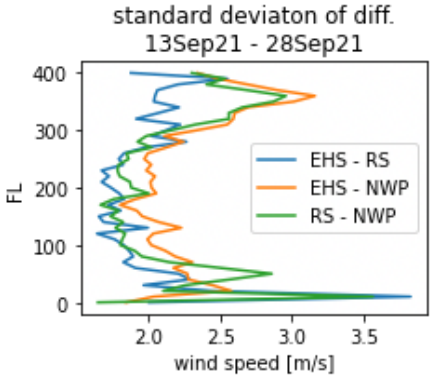
Radiosonde

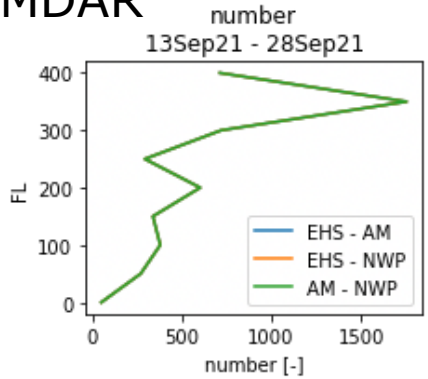


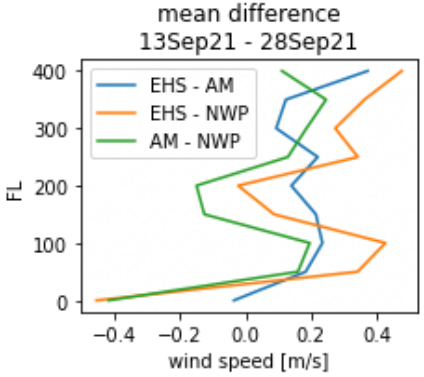


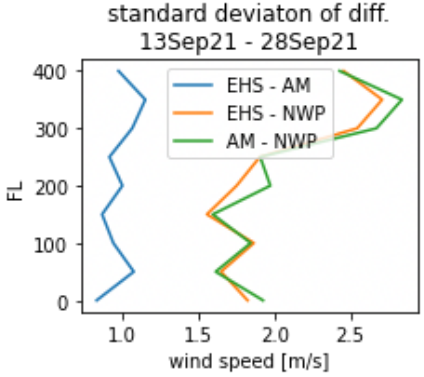


Mode-S EHS - RS
- no bias

AMDAR







Mode-S EHS - AMDAR
- small std.dev
- comparable

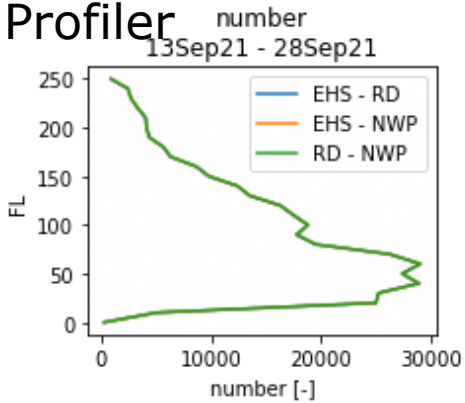
Validation of wind speed

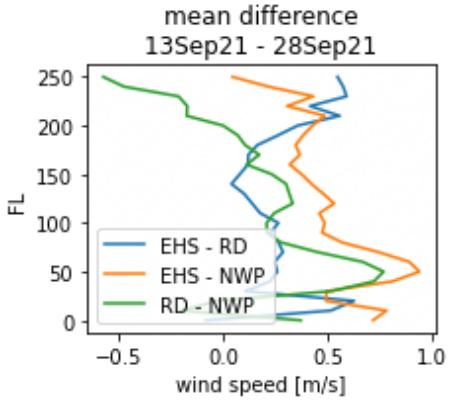
EUMETNET EUROPEAN METEOROLOGICAL SERVICES NETWORK

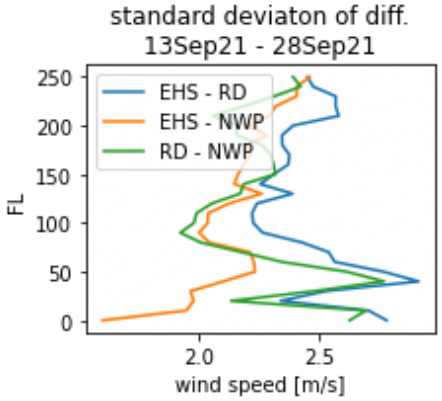
EMADDC www.emaddc.com

Royal Netherlands Meteorological Institute Ministry of Infrastructure and Water Management

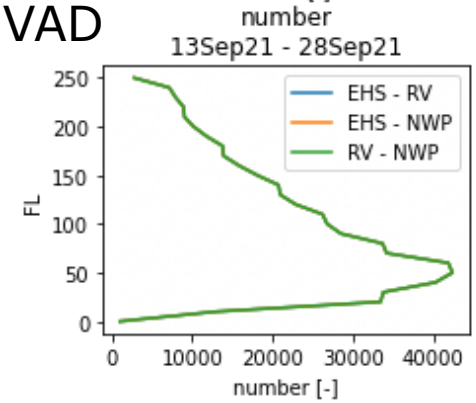
Profiler

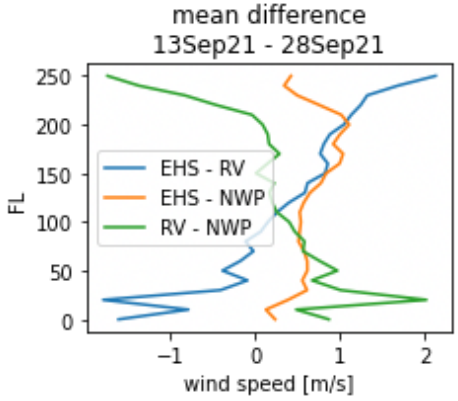


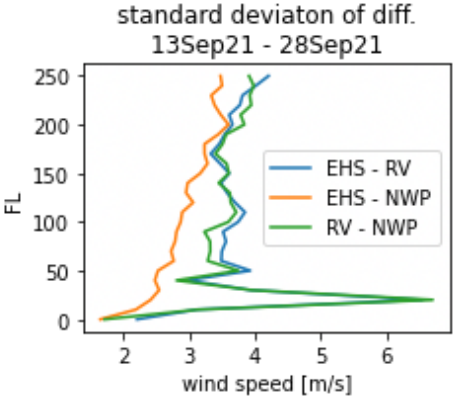




VAD







Data suppliers and data users

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Mode-S EHS data providers

Code	Supplier	Type
as-met	Air Support	adsb
au	Austro Control	mode_s
dk	local ANSP through DMI	mode_s
es	local ANSP through AEMET	mode_s
fr	Meteo France	adsb
muac	Maastricht Upper Area Control Centre	mode_s
no-ffi	local ANSP through MetNo	adsb
ro	ROMATSA	mode_s
se	SMHI	adsb
si	ARSO - Slovenian Environment Agency	adsb
uk	UK Met Office	adsb

Mode-S EHS derived observations users via FTP-service (research and/or operational use)

- ECMWF
- KMI, Belgium
- DMI, Denmark
- DWD, Germany
- Lace Consortium, Czech Republic
- CNMCA, Italy
- Meteo France, France
- University Warsaw, Poland
- NLR, Amsterdam
- SMHI, Sweden
- ZAMG, Austria
- MeteoSwiss, Swiss
- Met Eireann, Ireland

Status today

- EMADDC website http://emaddc.com
  - info for (new) data users /suppliers
  - please register to receive messages on updates, outages, etc
- EMADDC v2.2
  - geographical expansion
  - output quality control
  - improvement in quality
    - Temperature
      - no bias
    - wind
      - more observations
  - ftp data exchange:
    - operational (ftpservice.knmi.nl) 24/7
    - development/test (ftppro.knmi.nl)

Plans

- EMADDC v3.0
  - realisation of NewPENS connection to collect ATS data in real time
  - near real time processing instead of batch processing every 15 min
    - updating/replacing output file when new data has arrived?
      - ftppro.knmi.nl
      - info through website
  - realisation of data portal (web services)
- research on the error characteristics

EMADDC
www.emaddc.com

EMADDC knowledge partners, funding or data provided by:

EUROCONTROL

Luchtverkeersleiding Nederland
Air Traffic Control the Netherlands

Met Office

DFS Deutsche Flugsicherung

GOMSPACE

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

knowledge & development centre
Mainport Schiphol

EUMETNET
European Meteorological Services Network

esa

AIR SUPPORT

KLM Royal Dutch Airlines
SKYTEAM

BOEING

SESAR DEPLOYMENT MANAGER
LET'S DELIVER TOGETHER

The initial research on Mode-S EHS (2007)
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Mainport Schiphol (KDC) http://www.kdc-mainport.nl

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Connecting Europe Facility

Thank you for your attention.

To join or participate in the EMADDC programme please go to http://emaddc.com