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Canada

Global Aircraft Based Observation (ABO) Data Monitoring

Current & Future Meteorological Observations from Aircraft and their Use
ECMWF Reading UK, 12-13 February 2020

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- Quality Control Processing at CMC
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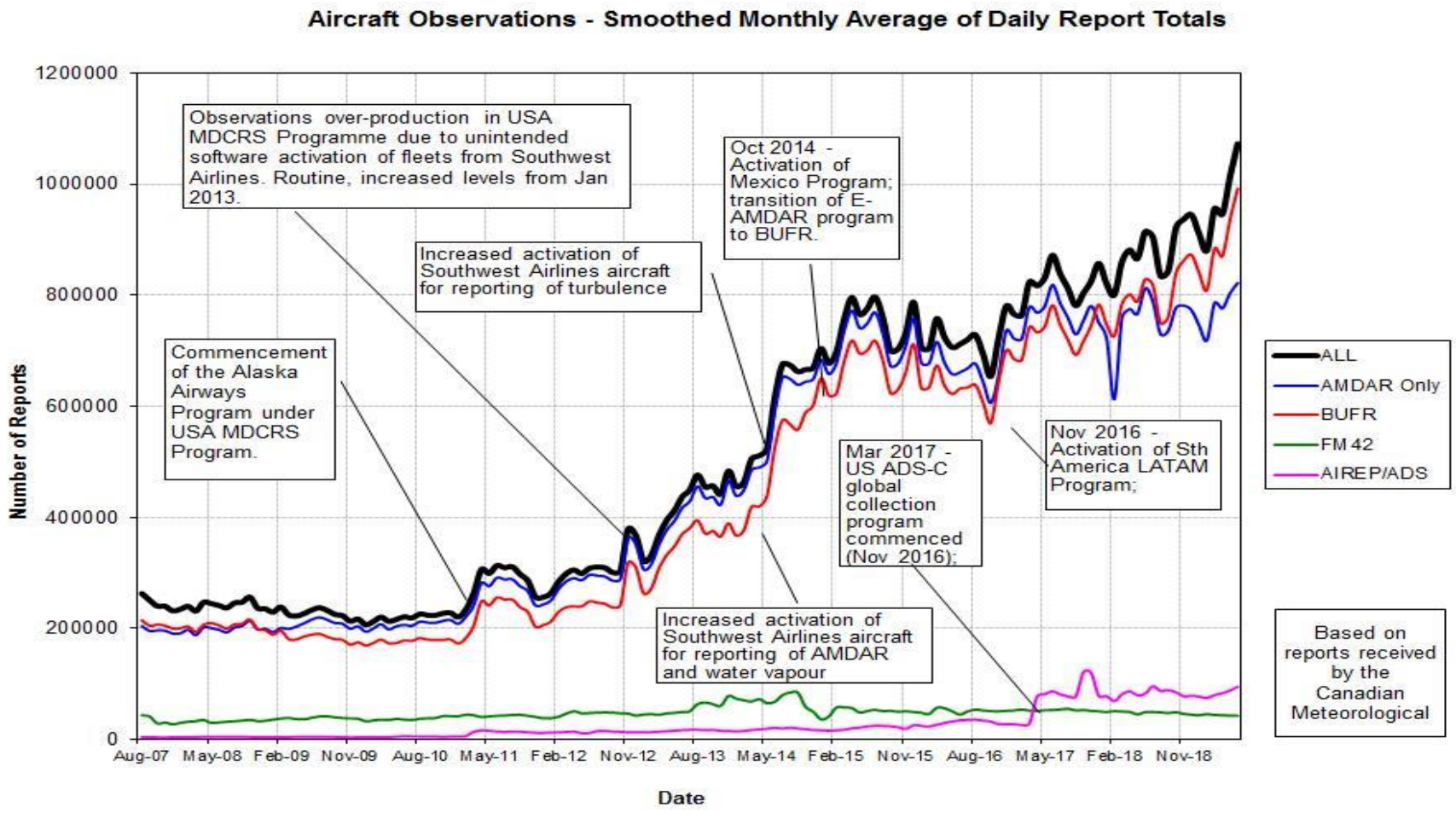
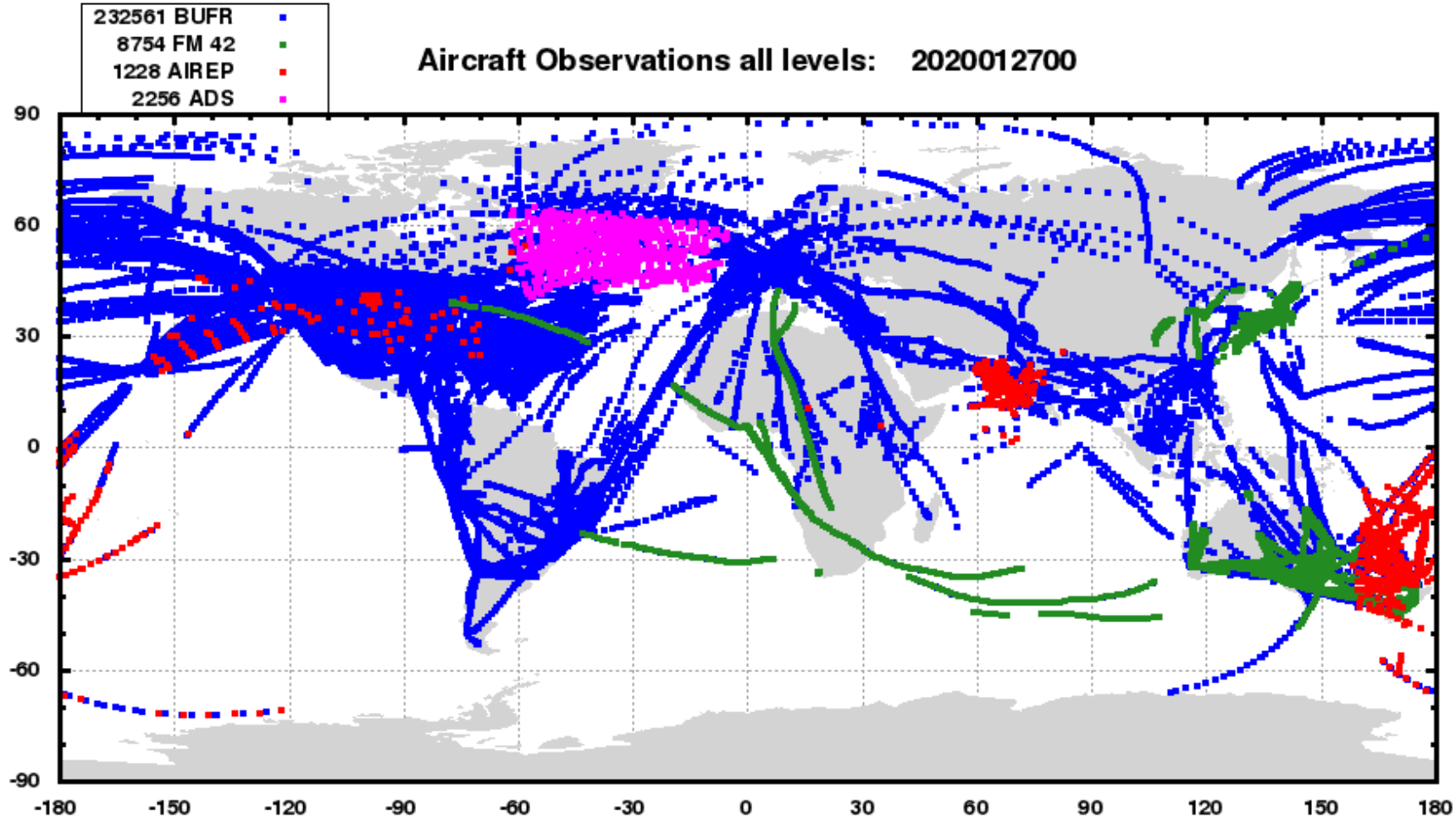
Mean daily ABO over recent years



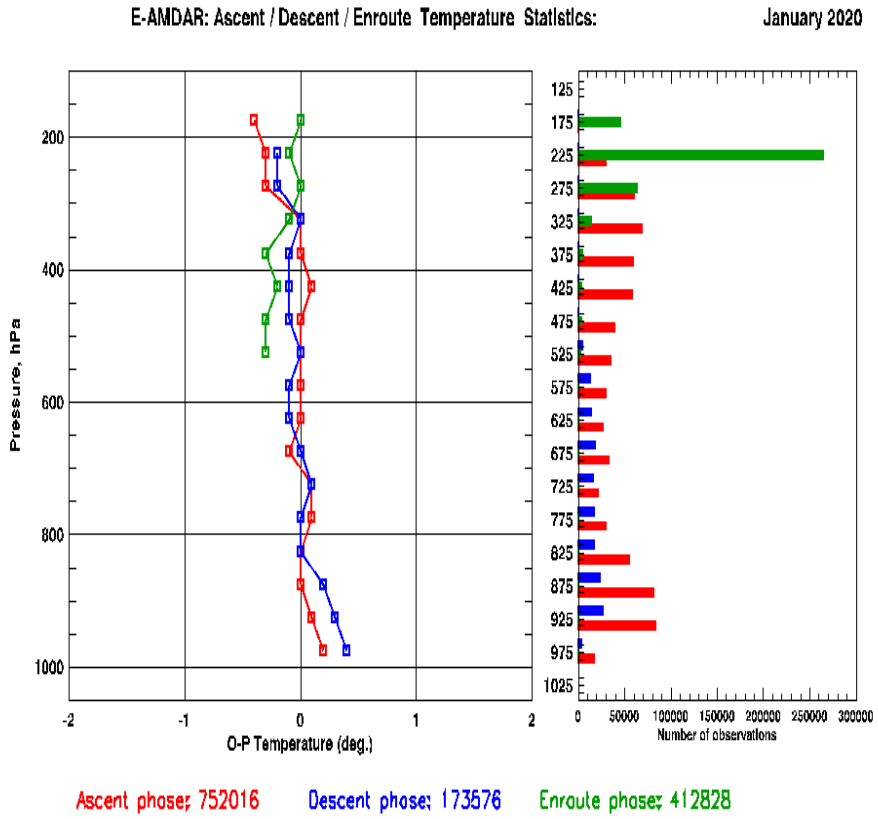
Reception of global ABO

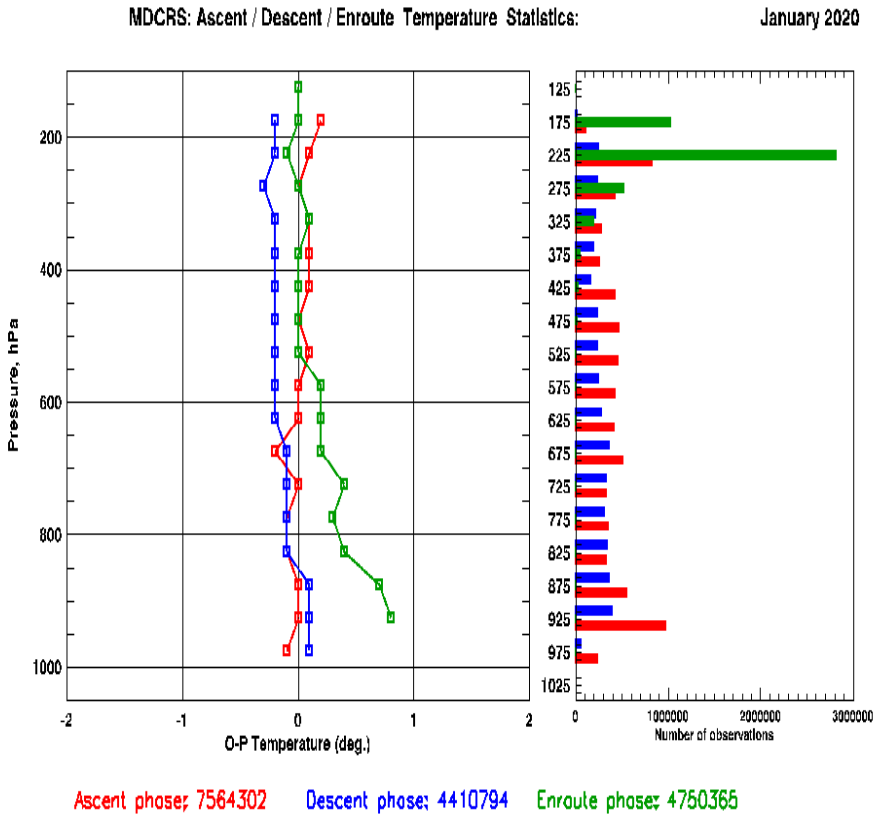


ABO Quality Monitoring

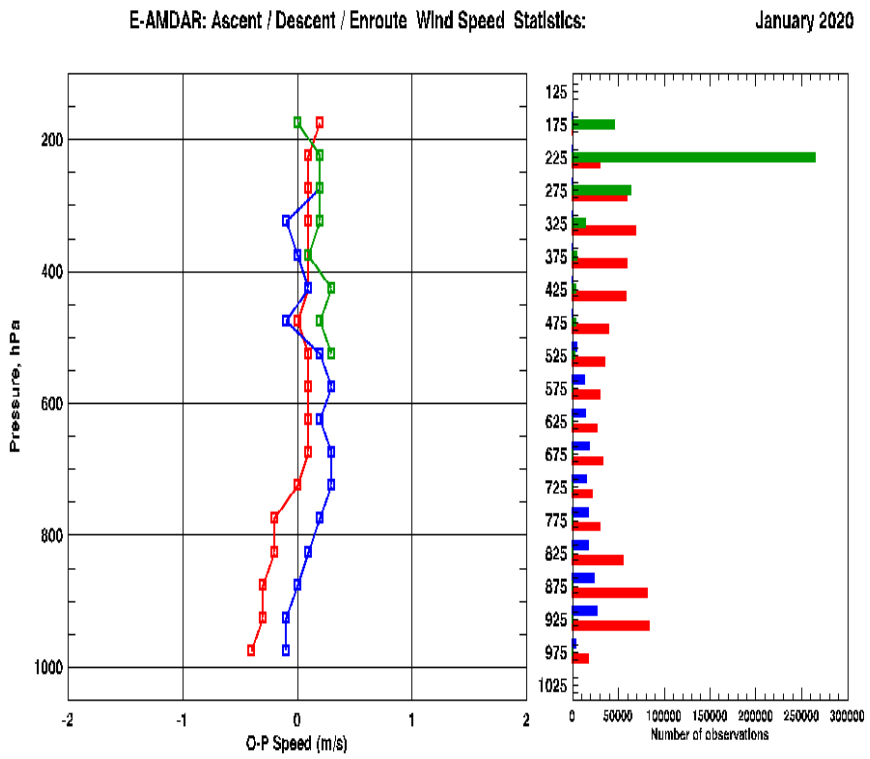
- Monitoring is mostly based on observed minus first guess values (innovations), as well as data rejection statistics, extracted from the operational data assimilation system
- Monitoring is performed for individual platform, station, as well as by various programs
- Time evolution of innovations, as well as their statistical distribution are extremely powerful and useful tools
- Display of information on Web sites useful due to large quantity of information available
- Change in behaviour, comparison with other observations, co-locations, etc
- List of suspect stations generated regularly, using specified criteria
- ABO monitoring plays an important role in maintaining the health of the observations, both in generating reject lists of aircraft providing bad observations and in providing feedback to the airlines

Example - Vertical profiles of O-B mean temperature by phase of flight (ascent/descent/cruise)

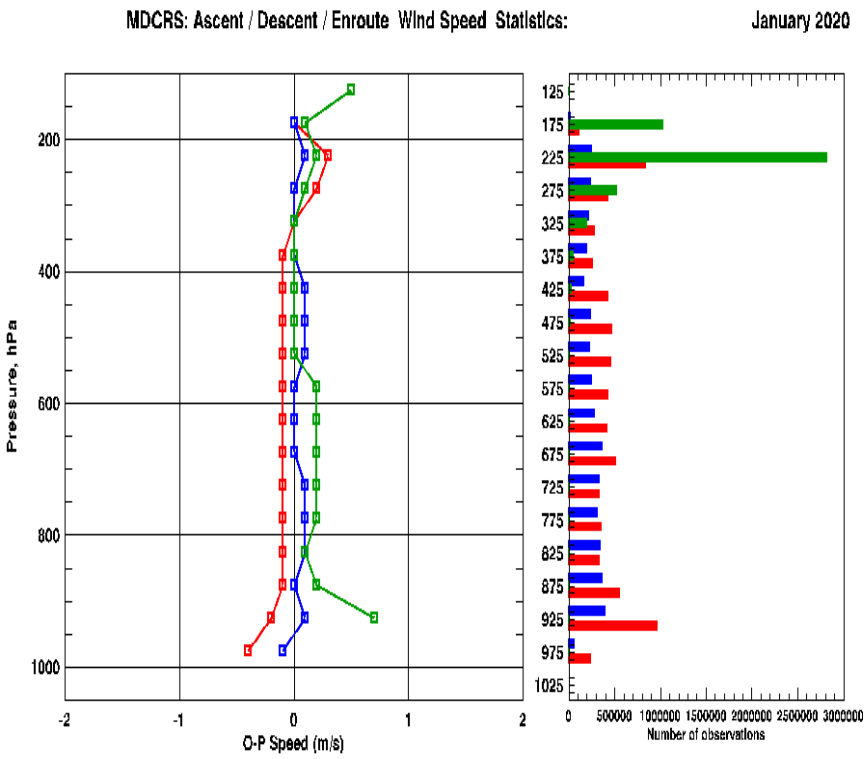




Example - Vertical profiles of O-B mean speed by phase of flight (ascent/descent/cruise)



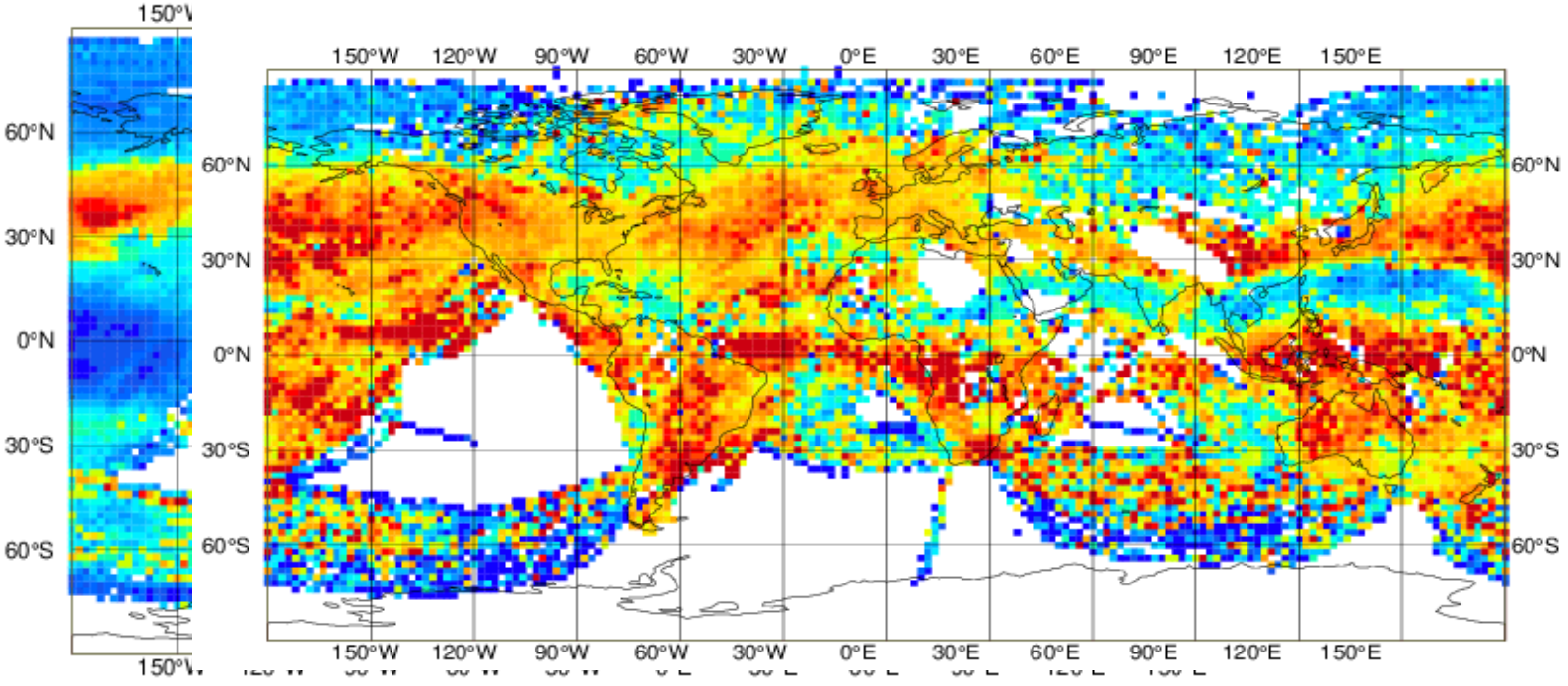
Ascent phase: 749597 Descent phase: 173336 Enroute phase: 412857



Ascent phase: 7549471 Descent phase: 4399943 Enroute phase: 4744949

Example - Wind Speed: Time-averaged geographical (O-B) mean (source ECMWF)

WINDSPEED FROM AMDAR
OBSERVED VALUE [M/S] (USED)
WINDSPEED FROM AMDAR
STDV OF FIRST GUESS DEPARTURE [M/S] (USED)
DATA PERIOD = 2019-12-11 21 - 2020-01-11 09
EXP = 0001, LEVEL = 0.00 - 400.00 HPA
Min: 0.000 Max: 7.242 Mean: 2.659
GRID: 2.00x 2.00



Quality Control Processing at CMC

- The observations are regrouped by aircraft in chronological order and repetitions are eliminated
- The speed and direction of displacement is computed from the latitude, longitude and time of observations
- ABO are rejected if the speed exceed prescribed threshold
- Some ABO may need to be (temporarily) blacklisted when quality issues are persistent. ABO monitoring must be done by aircraft ID's to be effective. The blacklist is updated monthly at CMC
- Suspect ABO statistics are updated monthly at CMC

Statistics by AMDAR program

- Monthly reports of ABO counts
  - sent to the WMO email-list
  - available on CMC external web site for one year
    *Note: before 2018 the ABO counts included the transmission errors (garbled, incomplete or duplicated)
- ABO quality monitoring for individual aircraft/program
- Vertical profile of O-B values by phase of flight for individual program
- Percentage change from previous year of the average number of aircraft reports for individual program

http//collaboration.cmc.ec.gc.ca/cmc/data_monitoring

(username: monitoring; password: CMC)

Statistics by AMDAR program

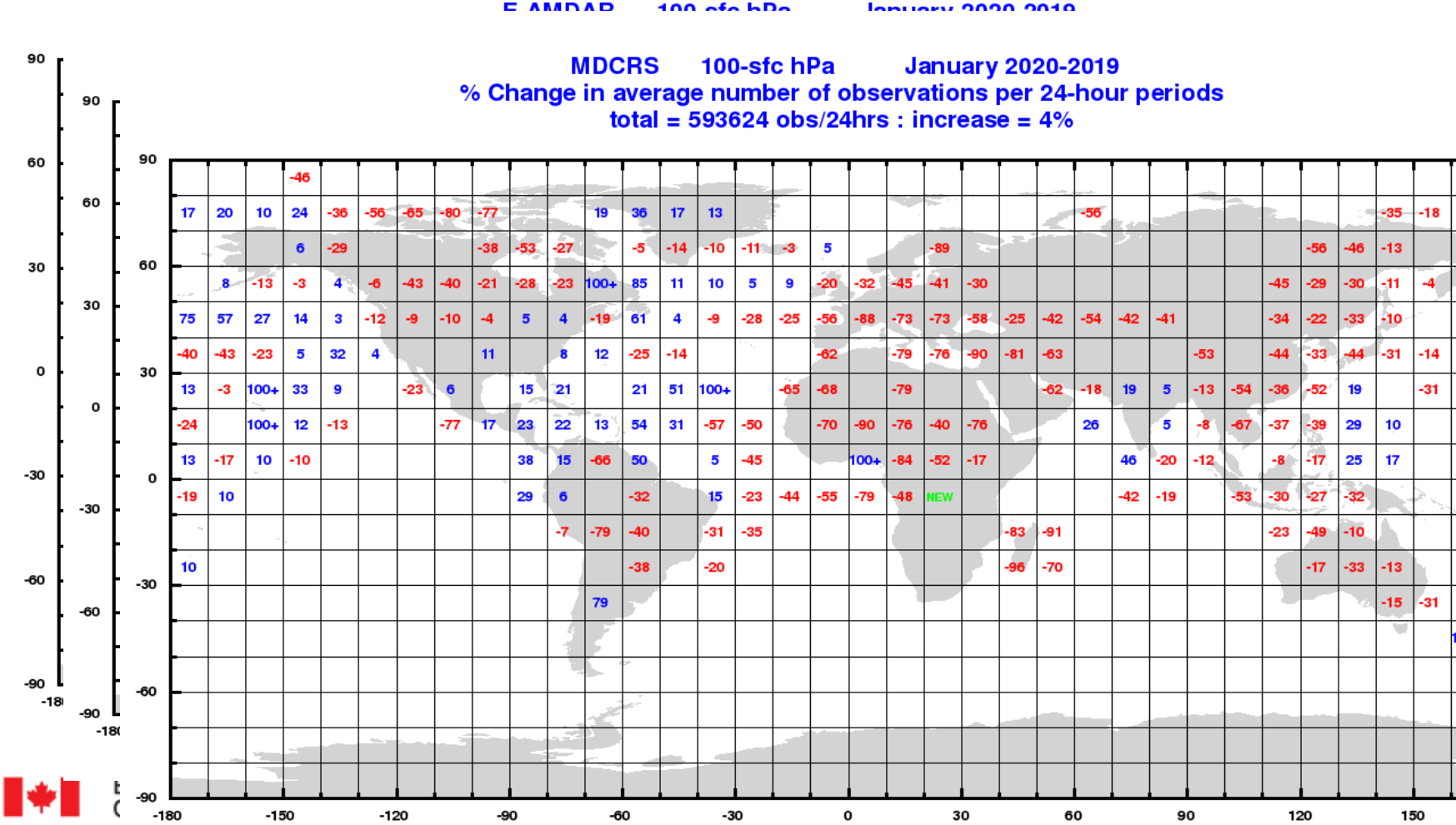
Comparison of number of reports at ECMWF/CMC/UK MetOffice for 7 Nov 2019

	ECMWF	CMC	MetOffice	FORMAT
Other	24639	20069	-	BUFR
USA	656987	661057	622789	BUFR
CANADA	4621	4883	4615	BUFR
MEXICO	5308	6307	6307	BUFR
LATAM	41526	43508	43507	BUFR
ARGENTINA	1281	1281	1046	BUFR
EUROPE	47447	48312	47699	BUFR
SOUTH AFRICA	7163	5683	5692	FM42
CHINA	6868	6867	6868	FM42
HONG-KONG	-	9773	6426	BUFR
KOREA	1917	1859	1757	BUFR
JAPAN	12429	11403	28801	BUFR (duplicated)
JAPAN	-	12429	-	FM42
AUSTRALIA	13448	13468	20258	BUFR (duplicated)
AUSTRALIA	9340	7318	-	FM42
NEW-ZEALAND	3155	3162	3162	BUFR (duplicated)
NEW-ZELAND	-	3162	3162	FM42

Statistics by AMDAR program

- Sources of differences between the number of reports from ECMWF, CMC and UK MetOffice
  - treatment of duplicates or near-duplicates
  - possible different cutoff times of received observations
- Japan, Australia and New-Zealand are sending data in two formats (BUFR and FM42)
- Papua New Guinea and Caribbean AMDAR: termination of program in August 2019
- Further investigation is needed to clarify these differences
- A more stringent quality control at the source should be considered to remove duplicated/invalid reports

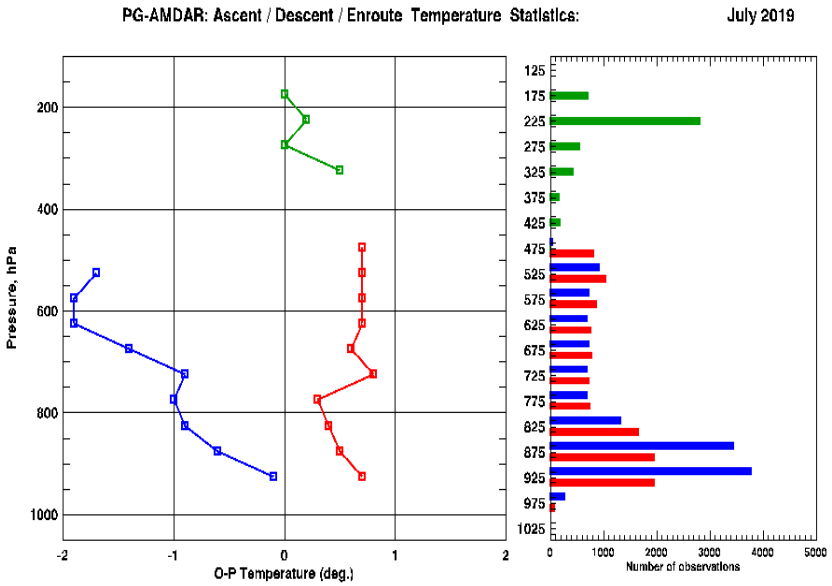
Example - % change of average number of aircraft reports 2020-2019



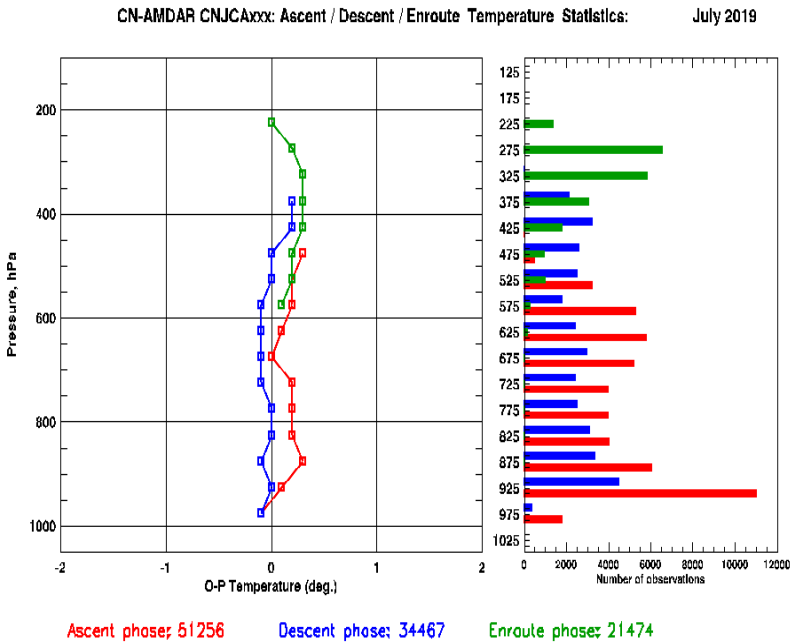
Example - Temperature ABO quality

July 2019

Canadian Aircraft data are good quality.



Ascent phase: 11570 Descent phase: 13552 Enroute phase: 4973



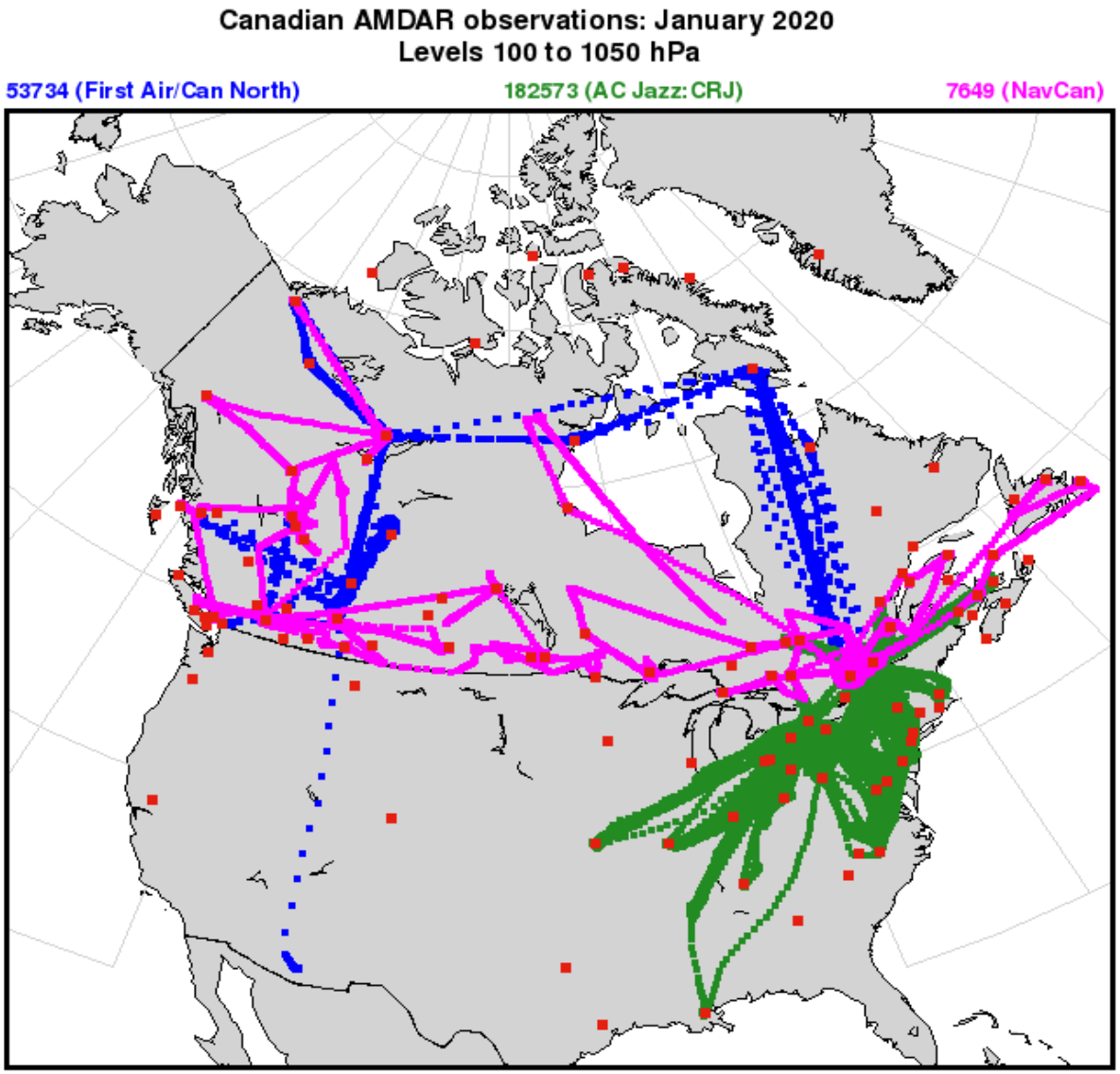
Ascent phase: 51256 Descent phase: 34467 Enroute phase: 21474

For Papua NG Aircraft, significant difference in bias between ascent / descent data.

Status of Canadian AMDAR Program Development

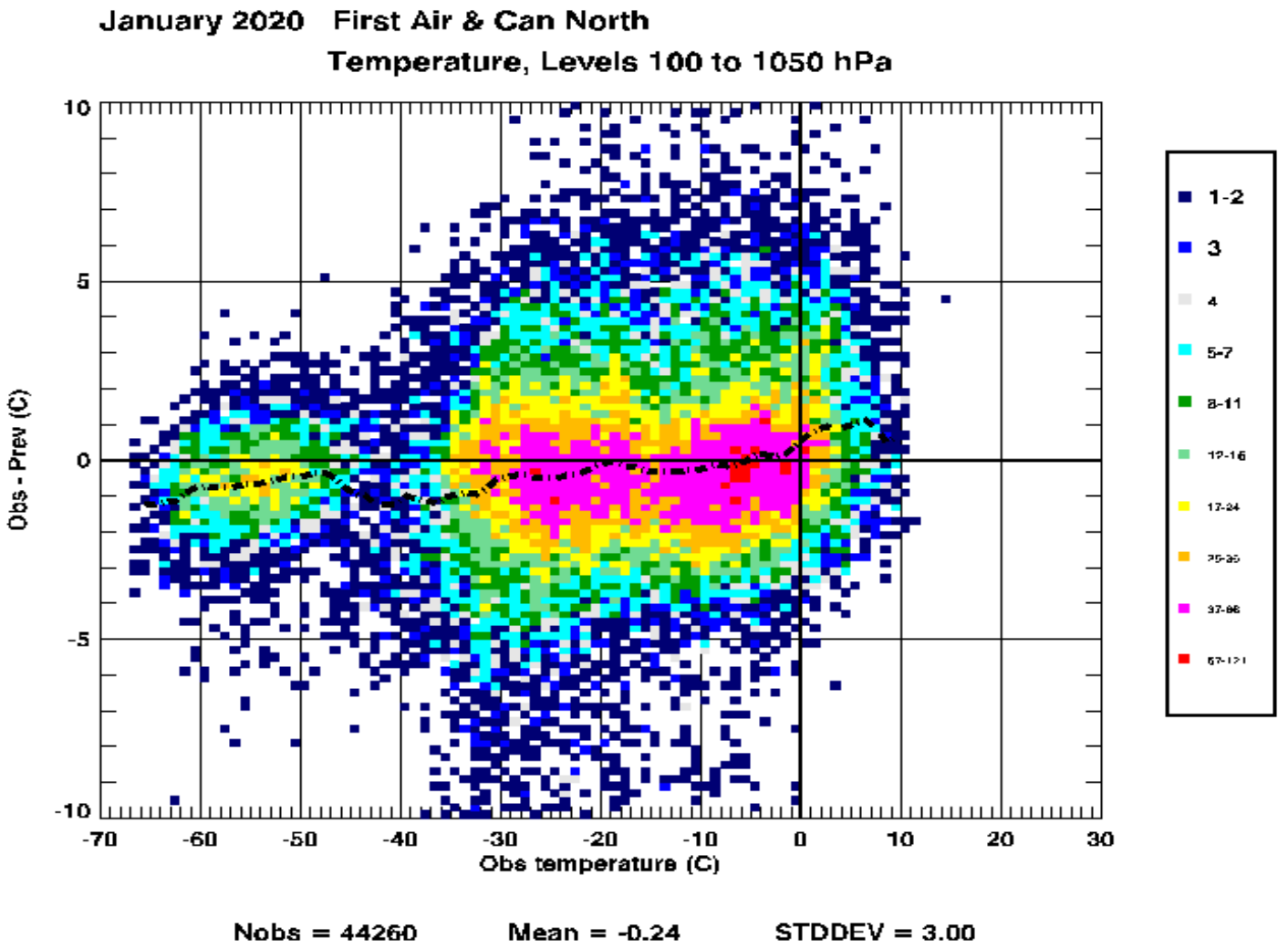
- Air-Canada Jazz contributing about 5200 daily AMDAR reports from a fleet of 17 CRJ aircraft
- Nav Canada operates 2 AMDAR CRJ aircraft contributing about 200 daily reports. These aircraft undergo unscheduled Flight Inspection at Canadian airports (approximately 2 annual visits per airport)
- CMC is currently evaluating ABO from 11 Boeing 737 aircraft from First Air and Canadian North fleets

Example of Canadian AMDAR - Coverage



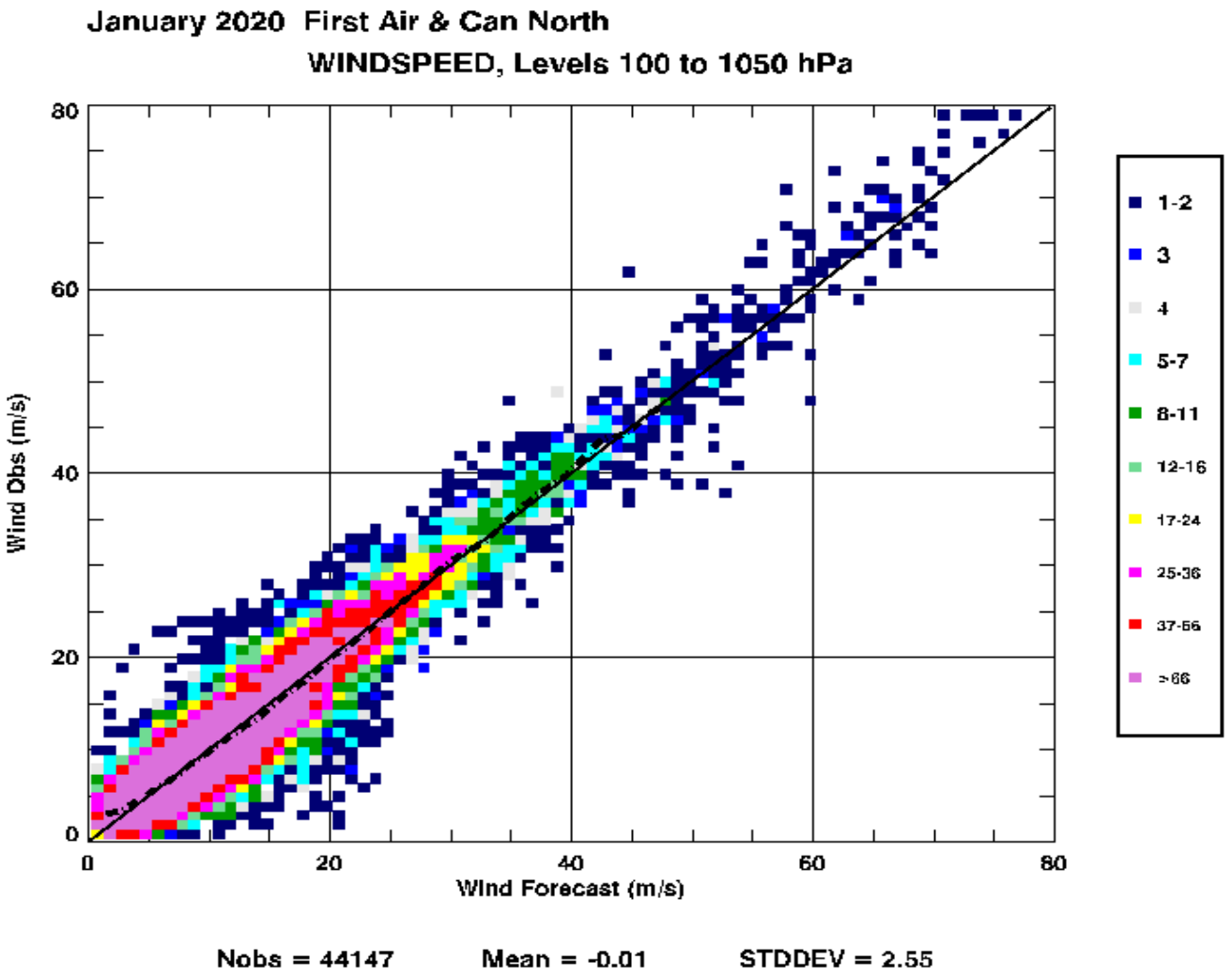
Analysis results from the 11 B-737 aircraft operated by First Air and Canadian North fleets

Density plot of innovations of temperature, January 2020. Note that the value of stddev is large compared to the CRJ aircraft



Analysis results from the 11 B-737 aircraft operated by First Air and Canadian North fleets

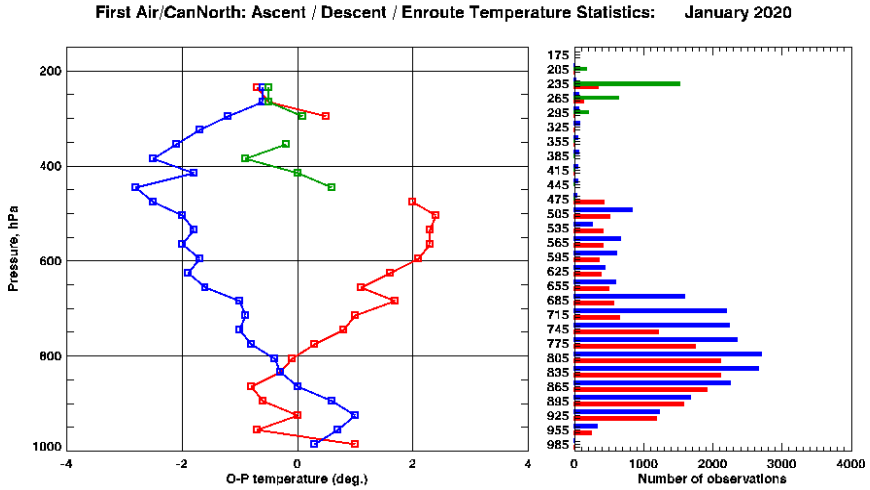
Scatter plot for wind, all data for month of January 2020
Note that the quality of wind data is good as the CRJ aircraft

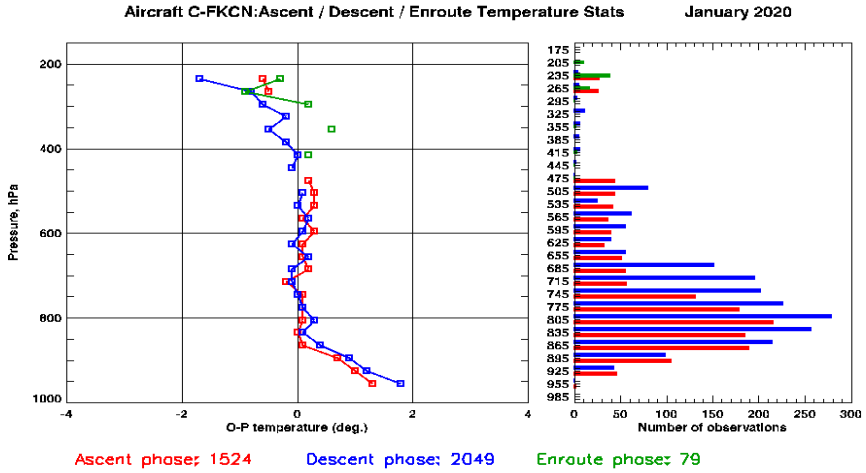


MC

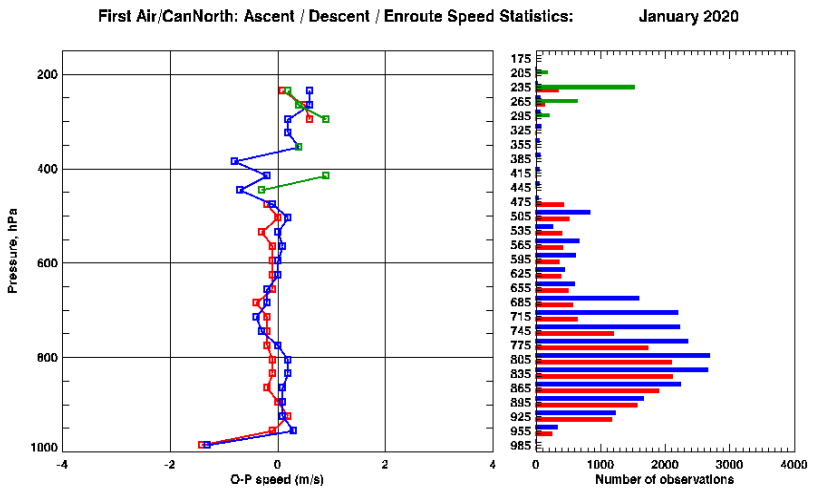
Ascent/Descent Wind/Temperature Statistics

Temperature





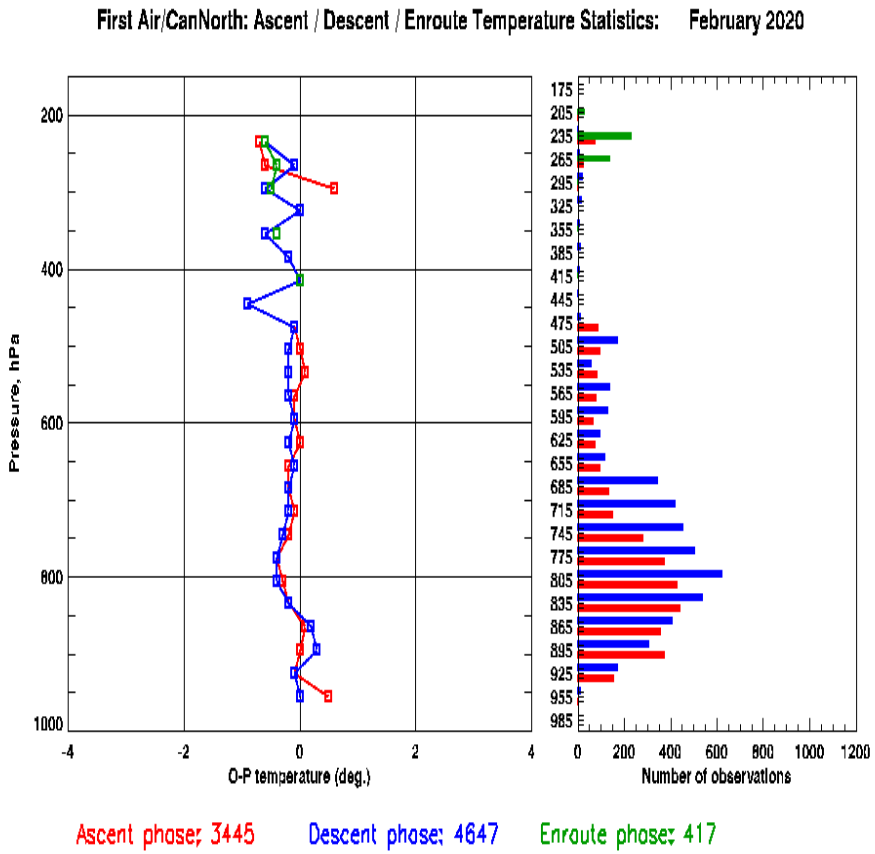
WIND



Preliminary evaluation of temperature ABO of 10 out of 11 B-737 aircraft shows a significant difference in bias between ascent / descent data. Note that just one aircraft shows good results. Quality of wind data by phase of flight is good as the CRJ aircraft

Canada

Ascent/Descent Temperature Statistics (9 days in February 2020)



The issue with temperature differences between ascent and descent measurements was corrected at the end of January for 8 B737 aircraft. The airlines discovered the discrepancy by comparing the configuration of the aircraft reporting correctly to the problematic ones. There are 2 aircraft that have not been corrected yet. 9-day statistics show a good quality of ascent/descent temperature data provided by 9 B737 aircraft.

Summary and Future Plan

- Temperature and wind observations from 19 aircraft (Air Canada Jazz/Nav Canada) are being distributed on the GTS
- The 11 First Air/Canadian North B737 aircraft show good quality of wind data. The quality of temperature data was improved after communication with the airlines.
- A longer evaluation period is needed for the quality assessment of the First Air/Canadian North AMDAR data
- Observing System Experiments (OSEs) will be conducted to evaluate the impact of Canadian AMDAR ABO on forecasts

Thank you!

Acknowledgments

I would like to thank my colleagues (S.Laroche, J.St-James, P. Koclas) and colleagues from ECMWF (B.Ingleby, S.Stringer) for their valuable suggestions and guidance in this presentation