

WORLD METEOROLOGICAL ORGANIZATION

**Joint Meeting of
CBS Expert Team on Surface-based
Remotely-Sensed Observations
(First Session)
and
CIMO Expert Team on Remote Sensing
Upper-air Technology and Techniques
(Second Session)**

Geneva, Switzerland, 23-27 November 2009

CBS-CIMO Remote Sensing/
Doc. 3.1

(17.XI.2009)

ITEM: 3.1

Original: ENGLISH ONLY

**ASSESS THE CURRENT AND POTENTIAL CAPABILITIES OF WIND PROFILERS FOR THEIR
USE IN THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM**

Develop guidance and standards on wind profiler siting, data exchange and operation

(Submitted by Hakaru MIZUNO and Kenji AKAEDA)

Summary and Purpose of Document

The document presents a summary of the operational use of wind profilers in Japan that shall be used as a basis to develop guidance material related to wind profilers siting, data exchange and operation.

ACTION PROPOSED

The meeting is invited to review the material provided in this document. The meeting will further be invited to identify whether it is suitable as guidance to Members or whether additional activities need to be carried out to provide appropriate guidance on wind-profiler siting, data exchange and operation to Members.

Operational Use of Wind Profiler in the Japan Meteorological Agency

Hakaru Mizuno
(Kenji Akaeda)



Japan Meteorological Agency

WMO

Joint Meeting of the CBS Expert Team on Surface Based Remote Sensing (First Session)

and

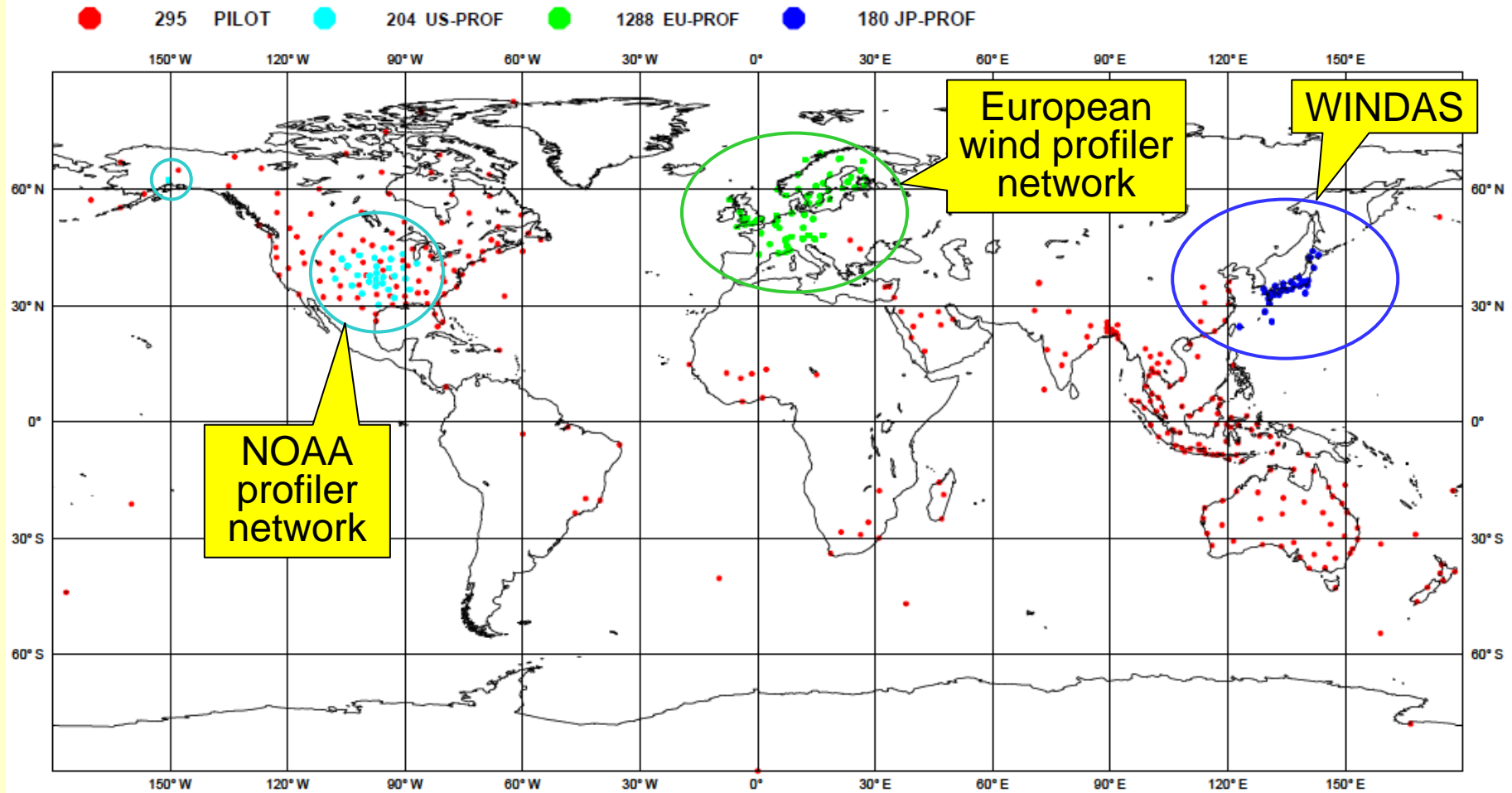
CIMO Expert Team on Remote Sensing Upper-air Technology and Techniques (Second Session)

23-27 November 2009, Geneva (Switzerland)



ECMWF Data Coverage (All obs DA) - PILOT/PROFILER

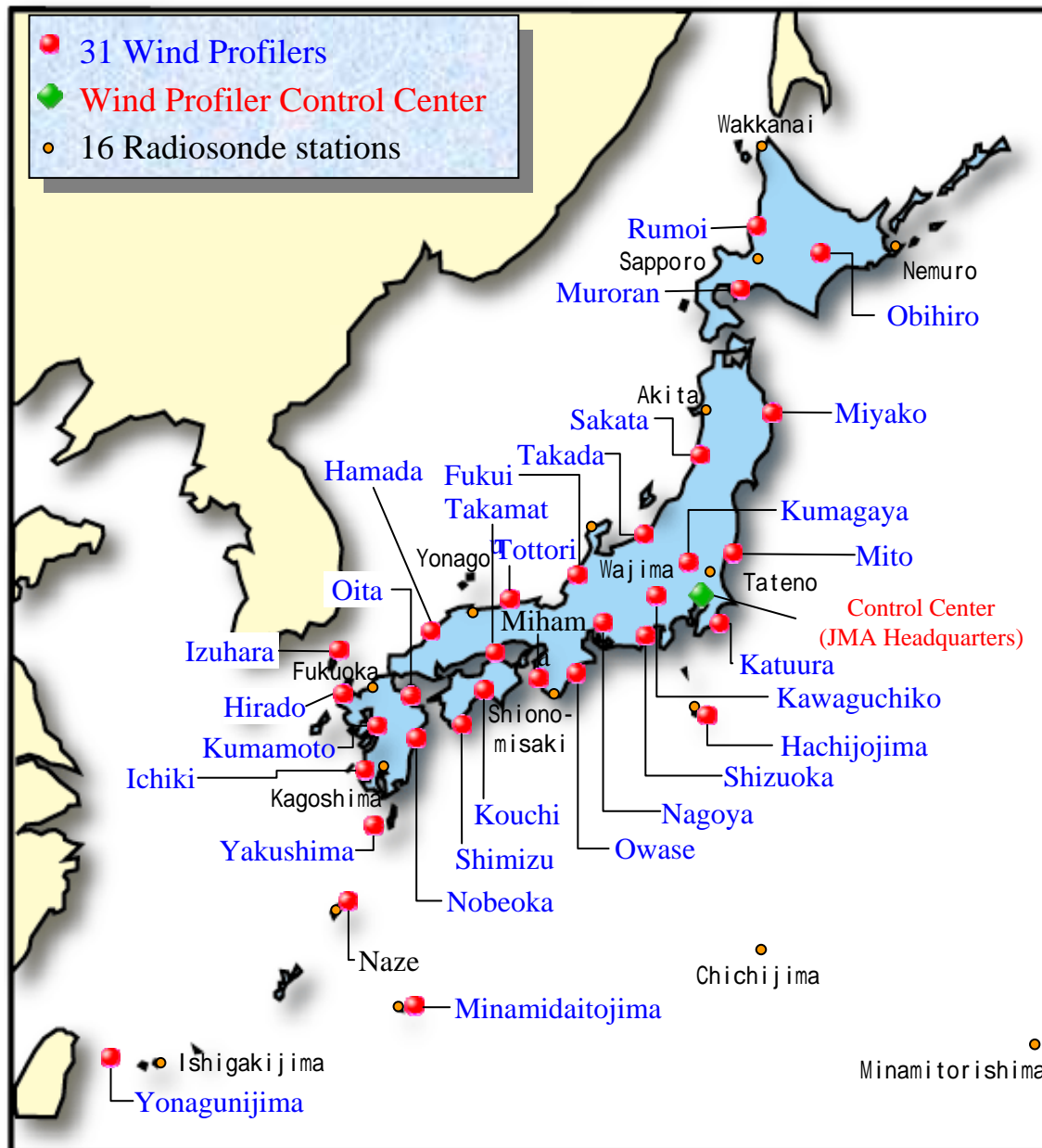
00 UTC 14/NOV/2009 (Total number of obs = 1967)



http://www.ecmwf.int/products/forecasts/d/charts/monitoring/coverage/dcover!Pilot-Profiler!00!pop!od!mixed!w_coverage!latest/



JMA Upper-air Observation Network



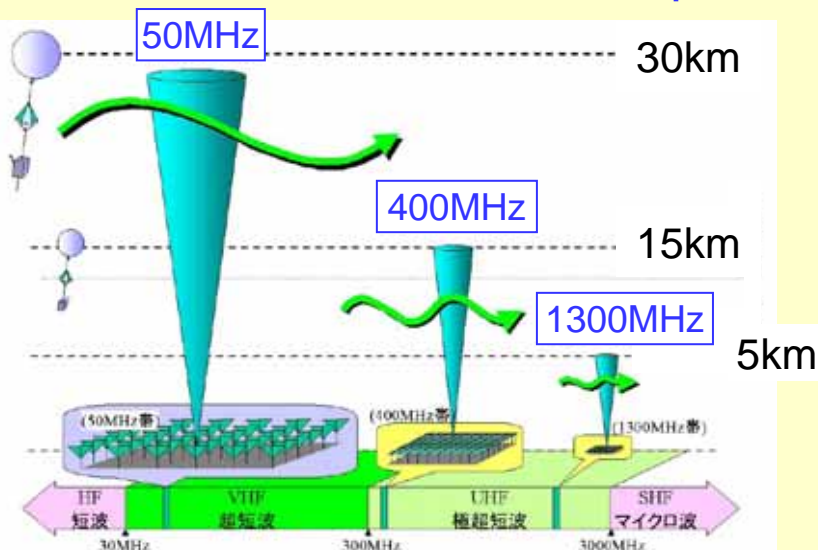
- JMA upper-air observation network consists of 31 wind profilers and 16 rawinsonde stations.
- Upper-wind observations are made at the interval of about 120km.

Wind Profiler in JMA



Brief History

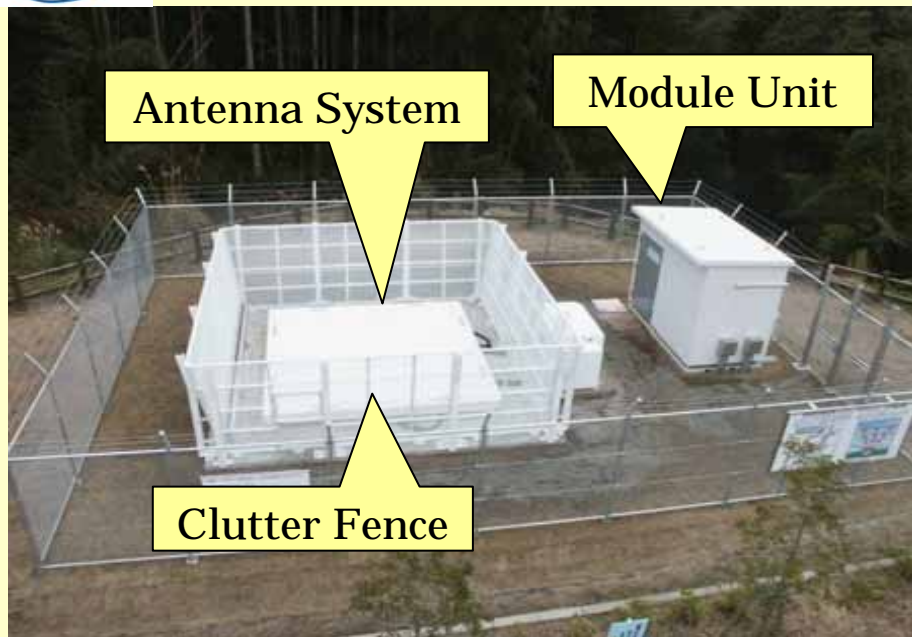
- 1988 Installation of the 400MHz wind profiler at MRI
 - Basic Study on Profiler and Evaluation of profiler data
 - Test for Operation
 - Observing System Experiment using the Meso-scale model
- 2001 Start of WINDAS* with 25 1.3GHz wind profilers
Assimilation of profiler data in Meso-scale model
- 2003 Addition of 6 wind profilers to WINDAS



*WINDAS: Wind profiler Network and Data acquisition System



Appearance of Profiler



Antenna System

Module Unit

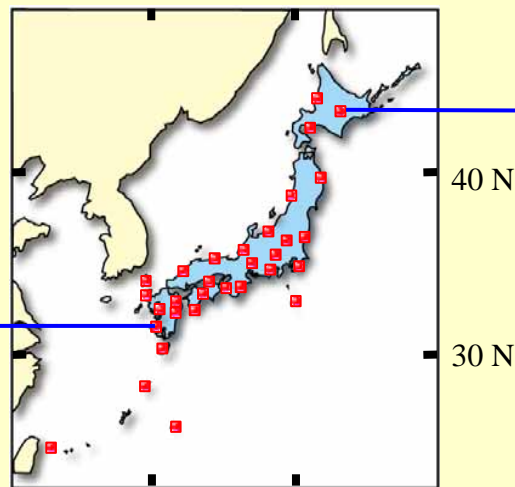
Clutter Fence

Standard type
(47848 Ichiki, Kagoshima)



Radome

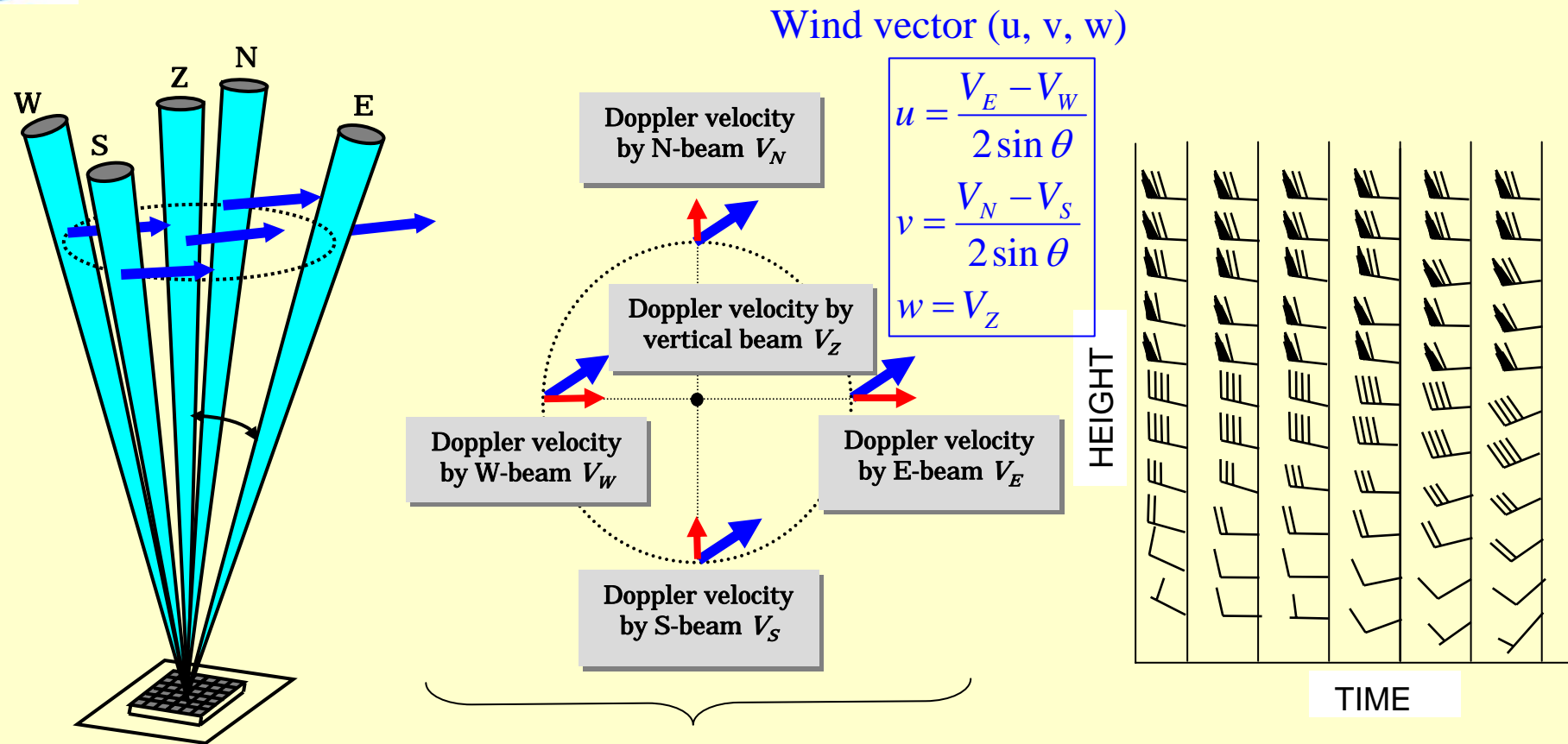
Radome type
(47147 Obihiro, Hokkaido)



130 E 140 E
Wind Profiler in JMA



Wind Measurement using Wind Profiler



Beams are emitted toward five directions.

Wind direction and wind speed are calculated from five Doppler velocities.

Vertical profiles of wind direction and wind speed from near the surface to nearly 5 km levels are obtained.

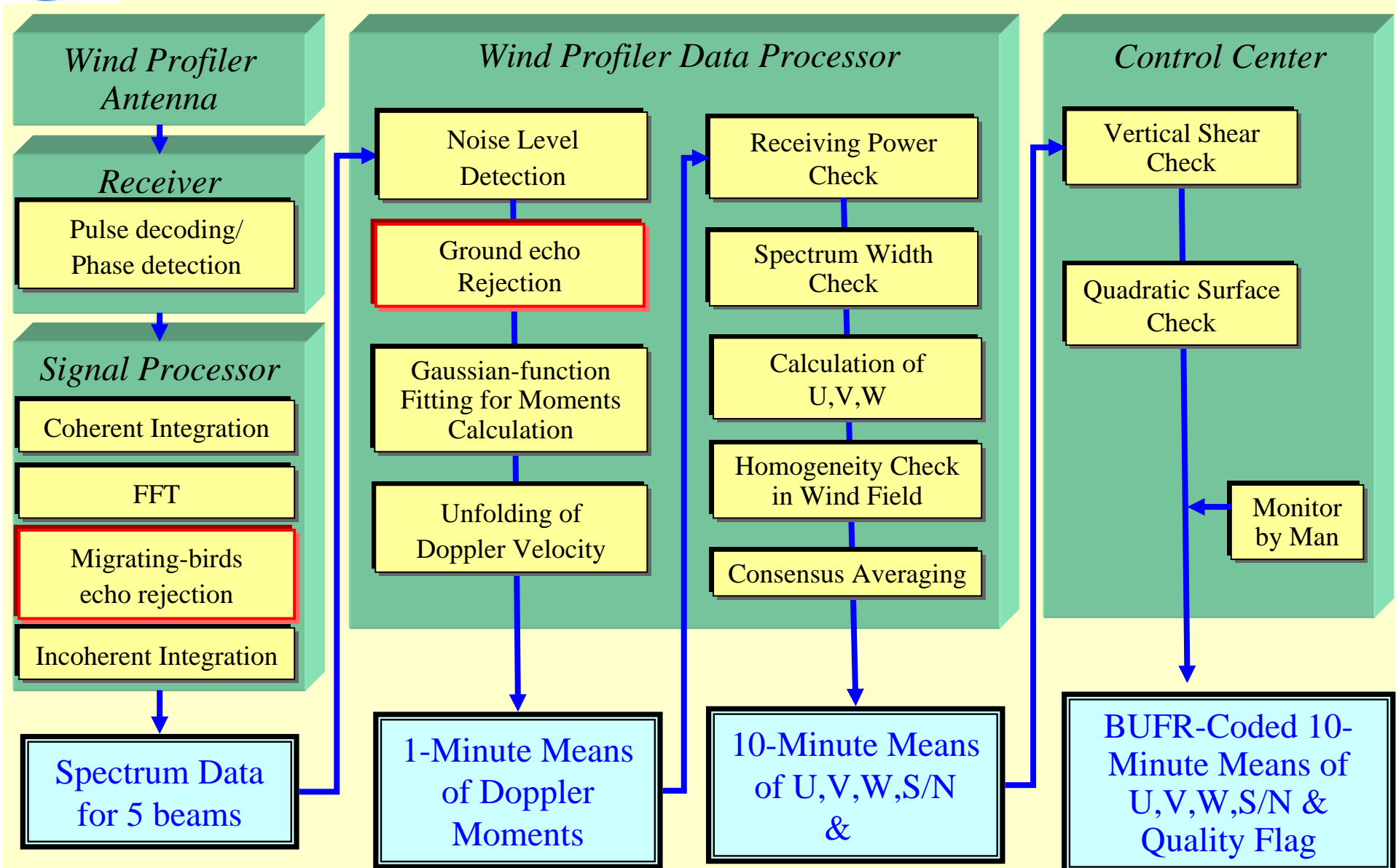


Characteristics of WINDAS

Frequency	1357.5MHz
Antenna	Active phased array, 4m x 4m
Peak Power	1.8kW
Beam width	4 degree
Beam configuration	Vertical and 4 directions of elevation angle 75 ~ 80 ° .
Beam Scanning Time	5 directions per minute
Pulse Length	0.67, 1.33, 2.00*, 4.00 × 10 ⁻⁶ sec
Vertical resolution	100, 200, 300*, 600 m
Observation Interval	10 minutes
Height Range	400m to 9.1km* (*: operational mode)
Basic Data	Doppler moments every minutes
Distributed data	wind(u,v,w), S/N ratio, data quality flag every 10minutes

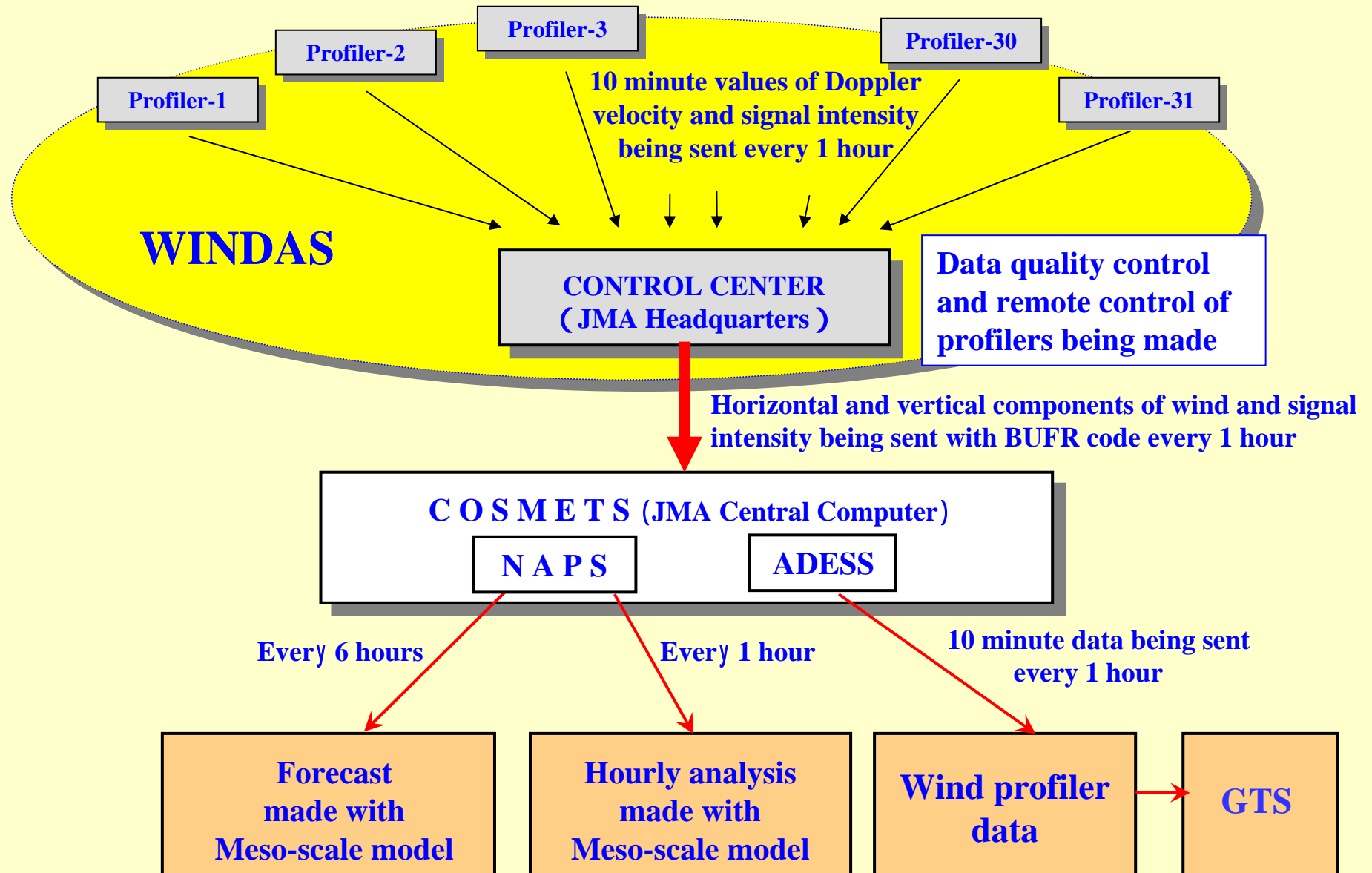


Signal Processing and Data Processing





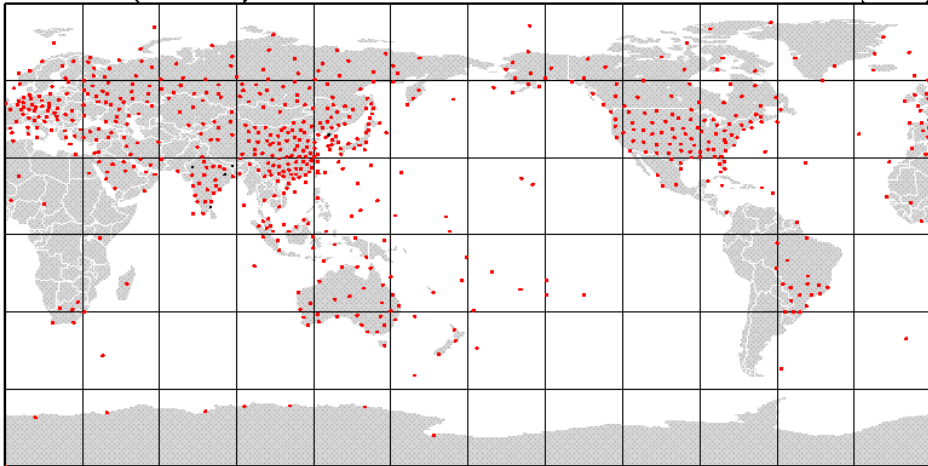
Data from WINDAS





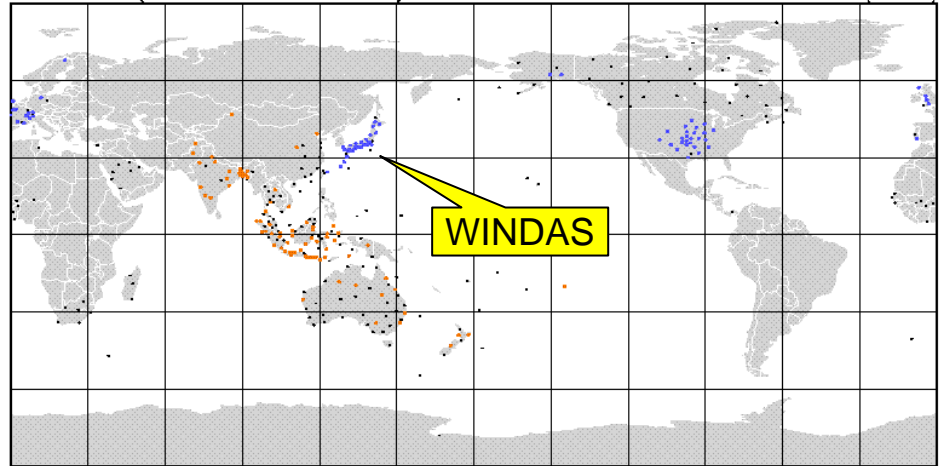
Data Coverage –TEMP and PILOT/WPROF

UPPER(TEMP) 2009/11/03 00:00(UTC)



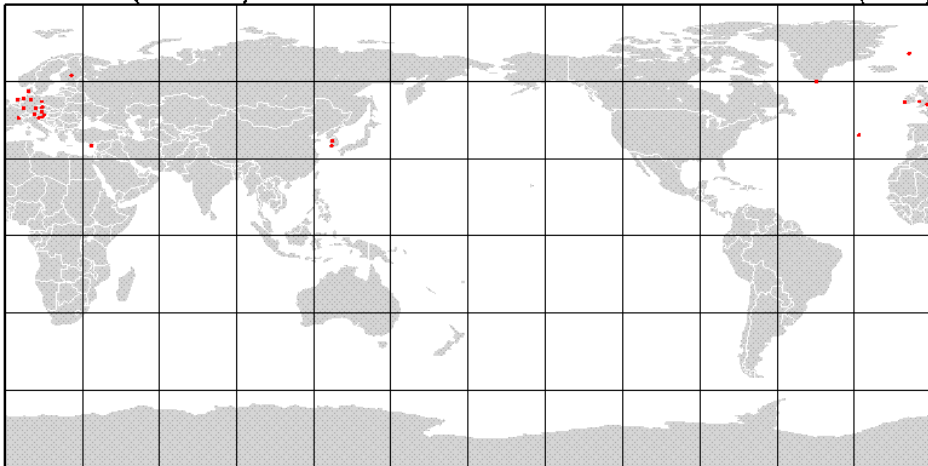
TEMP[●]: 642
NOUSE[●]: 6
ALL: 648

UPPER(PILOT/WPROF) 2009/11/03 00:00(UTC)



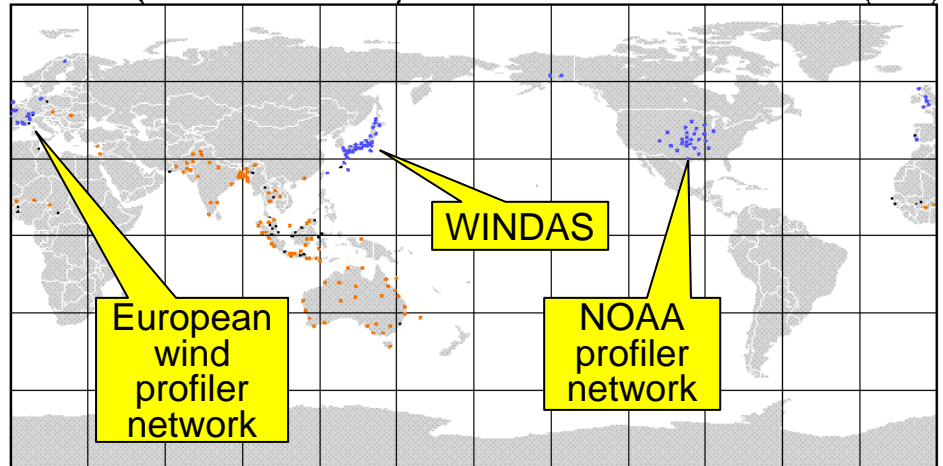
PILOT[●]: 81
NOUSE[●]: 251
ALL: 332
WPROF[●]: 74
NOUSE[●]: 1608
ALL: 1682

UPPER(TEMP) 2009/11/03 06:00(UTC)



TEMP[●]: 24
NOUSE[●]: 0
ALL: 24

UPPER(PILOT/WPROF) 2009/11/03 06:00(UTC)

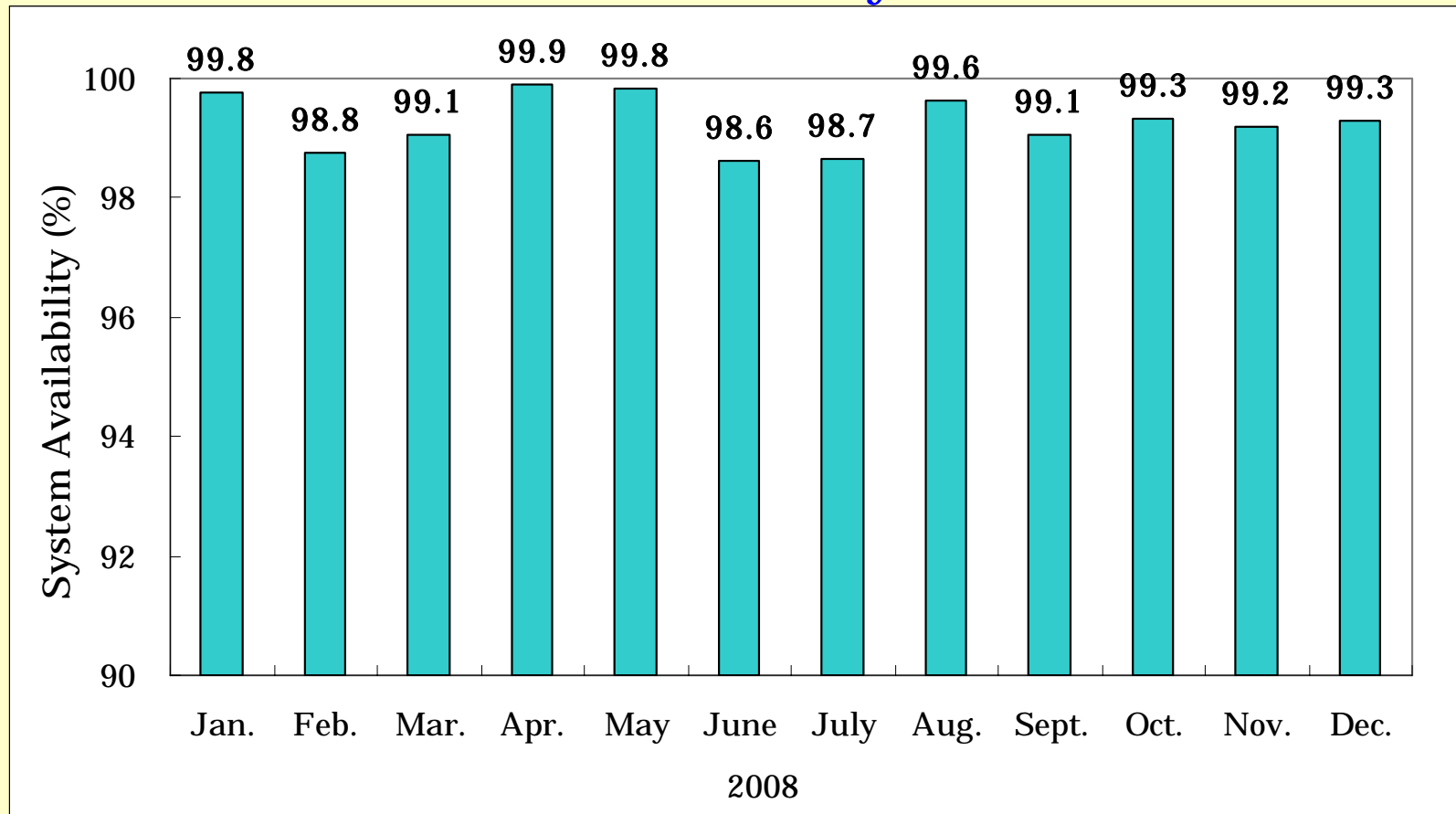


PILOT[●]: 97
NOUSE[●]: 110
ALL: 207
WPROF[●]: 79
NOUSE[●]: 1563
ALL: 1642



Data Availability in Real Time

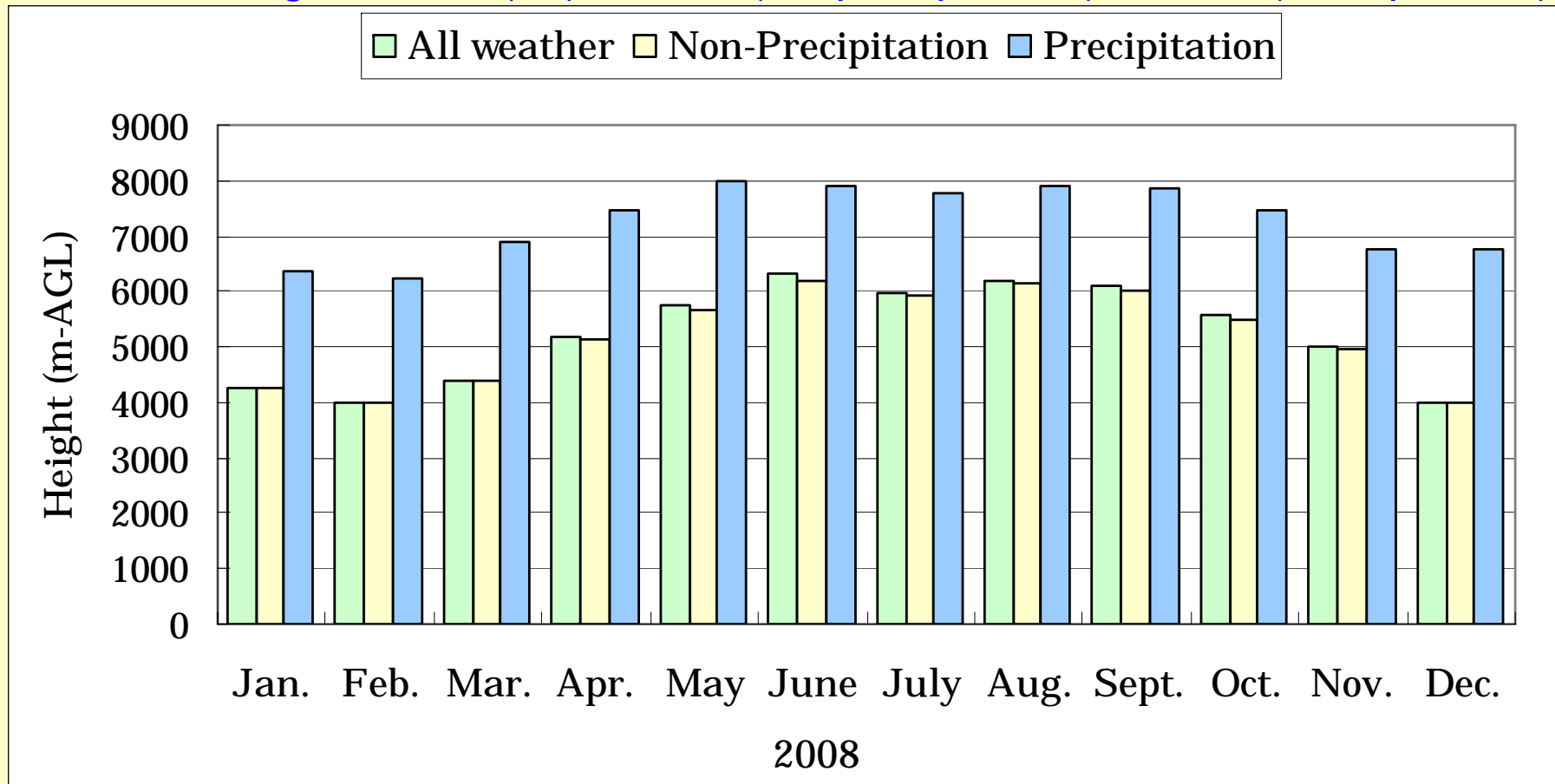
Annual data availability: 99.3%





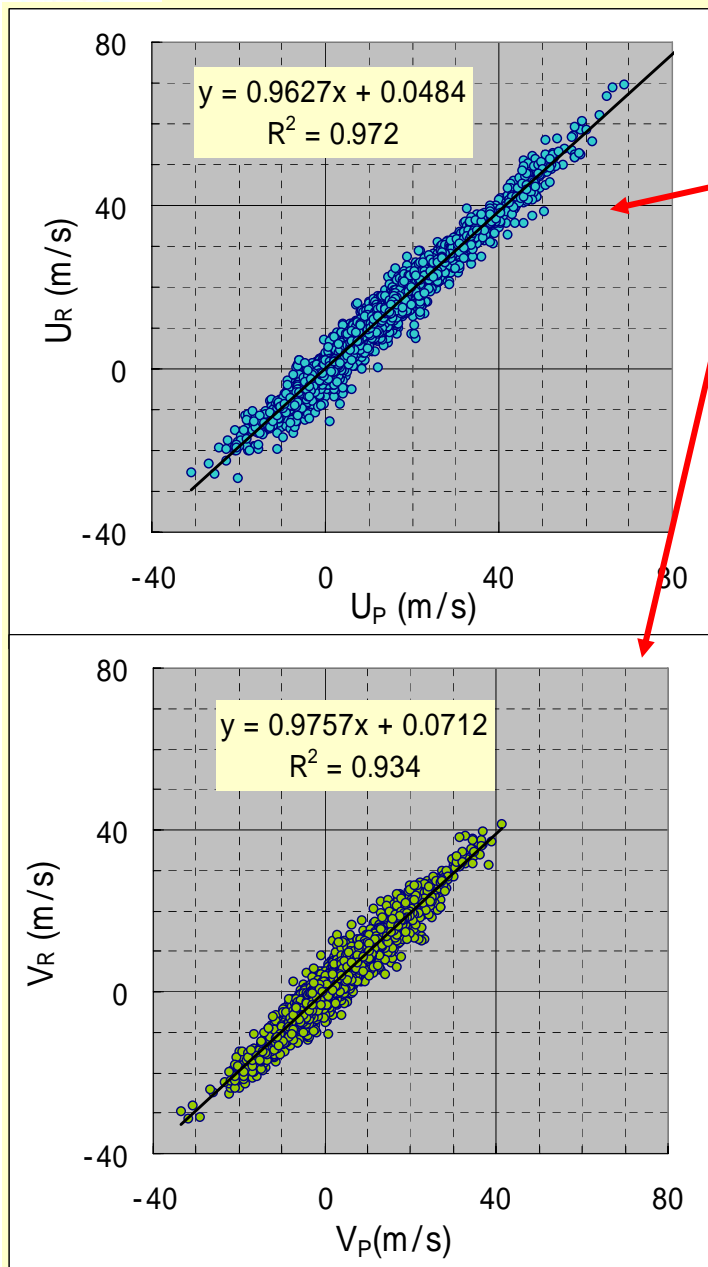
Observation Height Coverage of WINDAS

Annual average: 5225m(All), 5181m(No precipitation), 7281m(Precipitation)

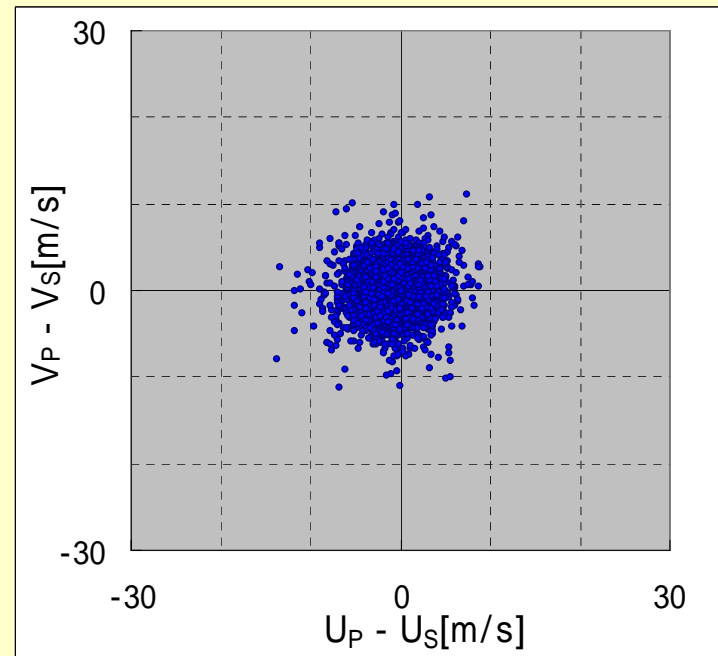




Comparison of Rawinsonde and Wind Profiler Measurements



Correlation of u- and v- component measurements for the wind profiler and the rawinsonde, both located at Hachijyojima in 2008.



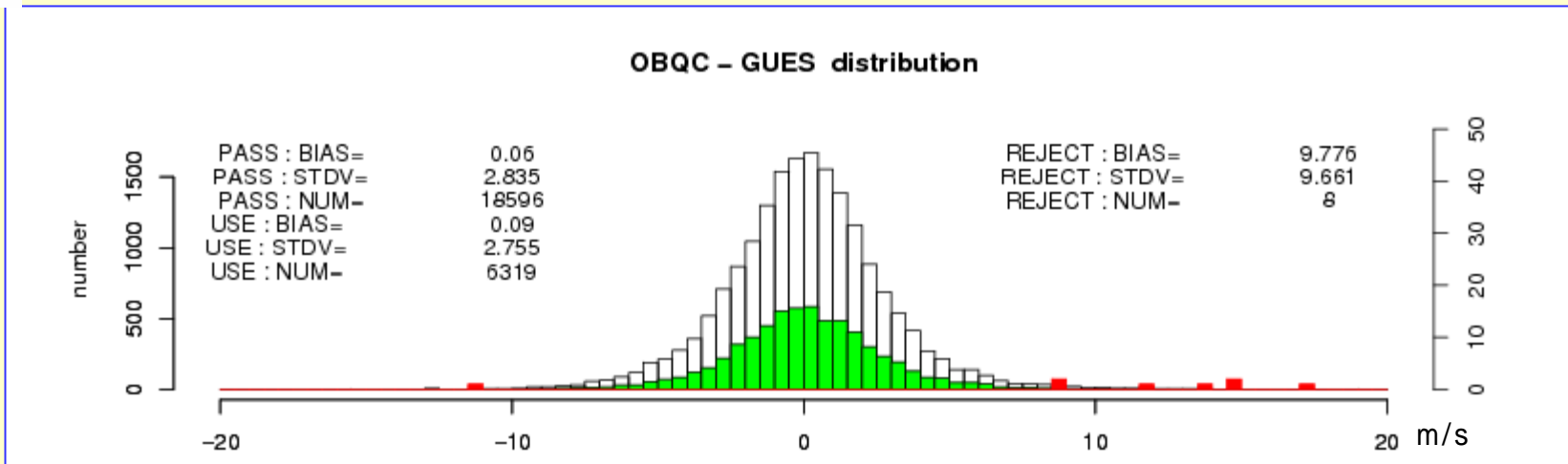
u-component:
avg. -0.36m/s
std. 2.13m/s

v-component:
avg. -0.02m/s
std. 2.06m/s

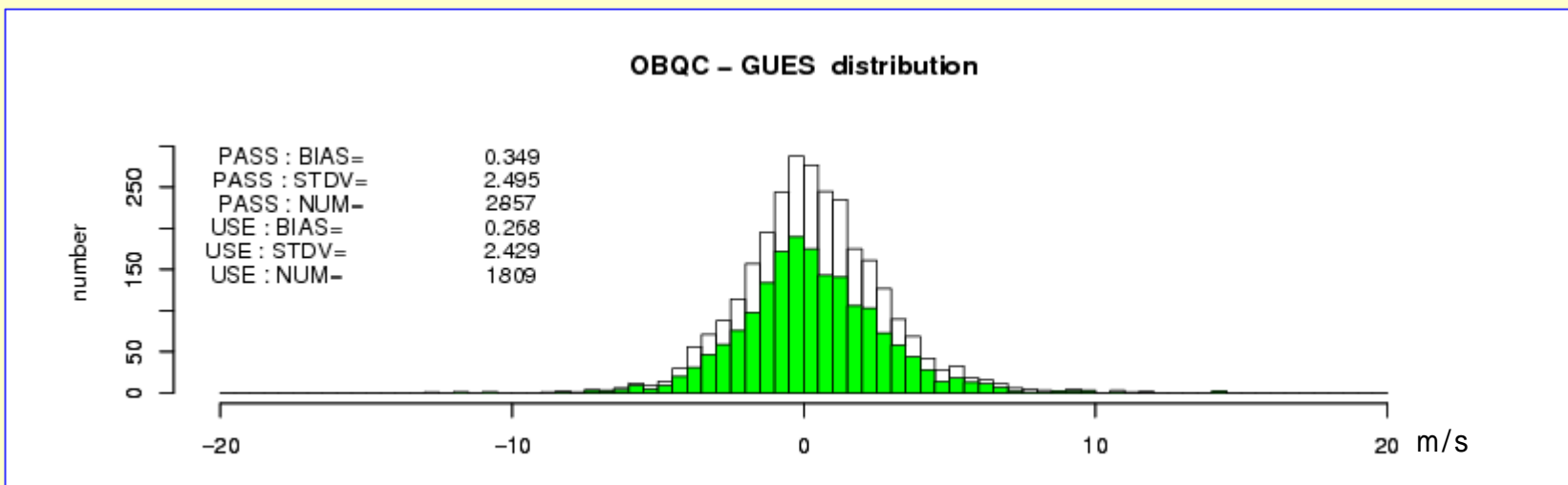
Differences between wind profiler and rawinsonde wind component measurements (N=7514).



Comparison with Wind Data of the Numerical Model



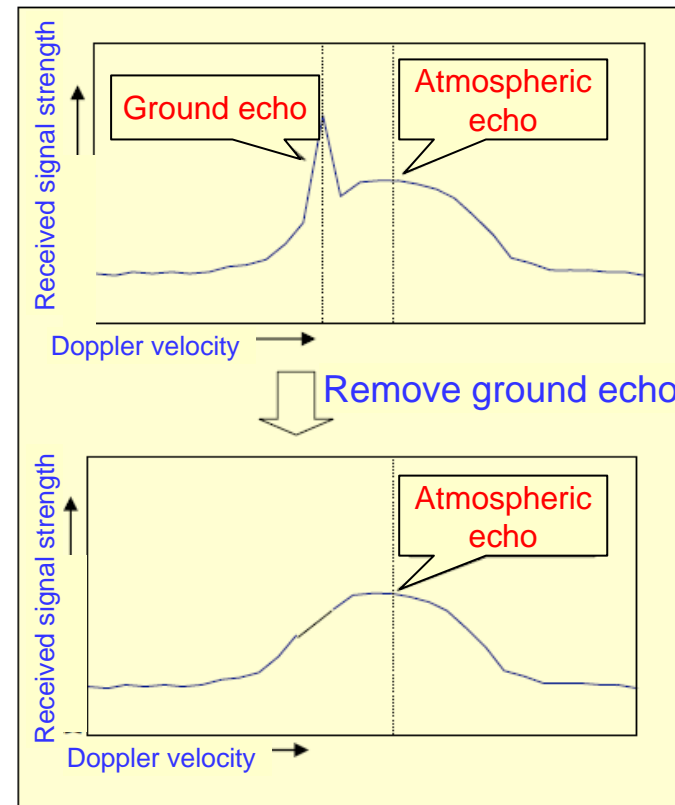
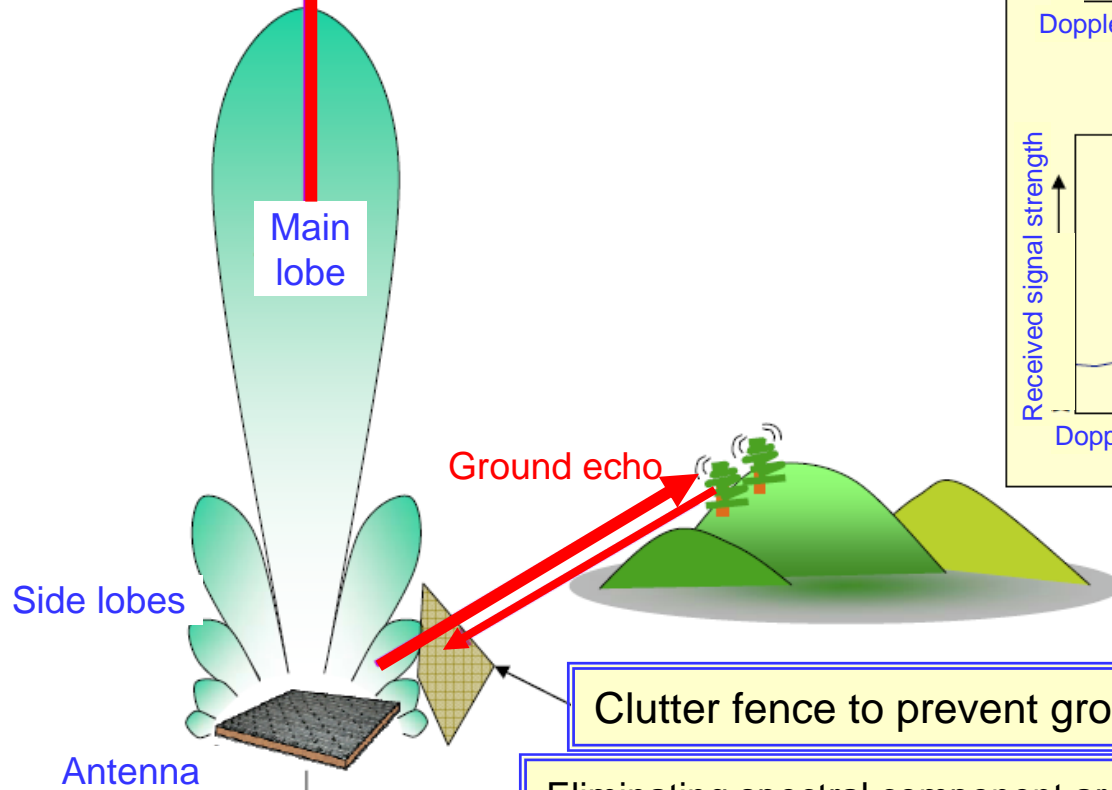
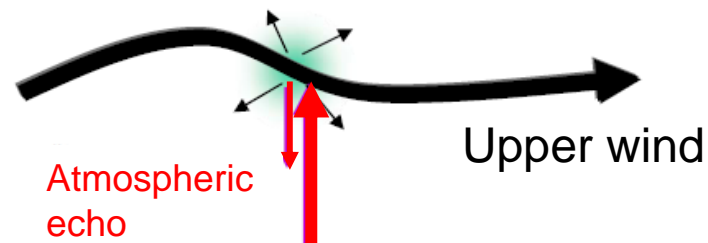
u for Wind Profilers, 1 ~ 10 October 2009, 900 ~ 800hPa



u for Rawinsonde, 1 ~ 10 October 2009, 900 ~ 800hPa

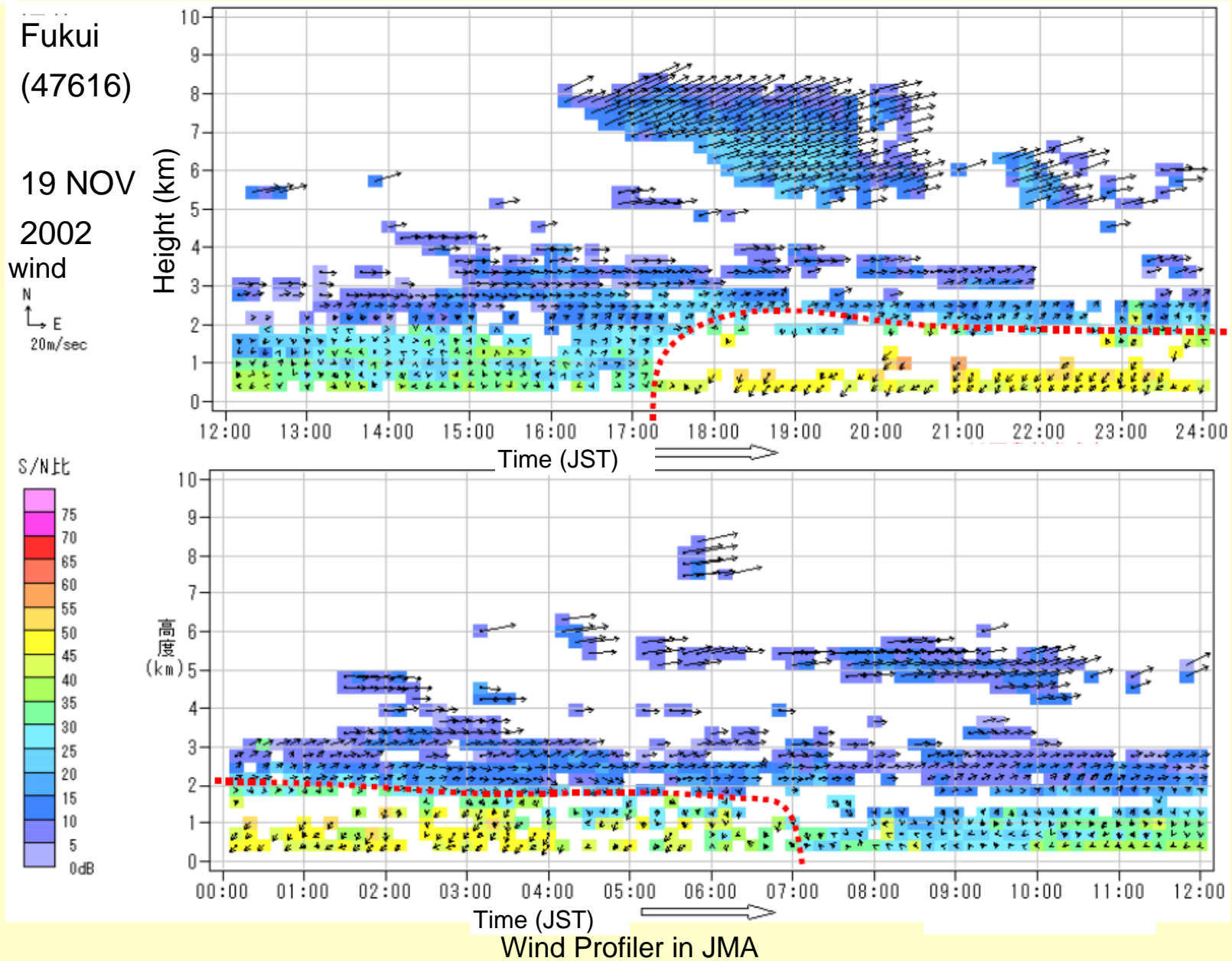


Example of ground echo rejection



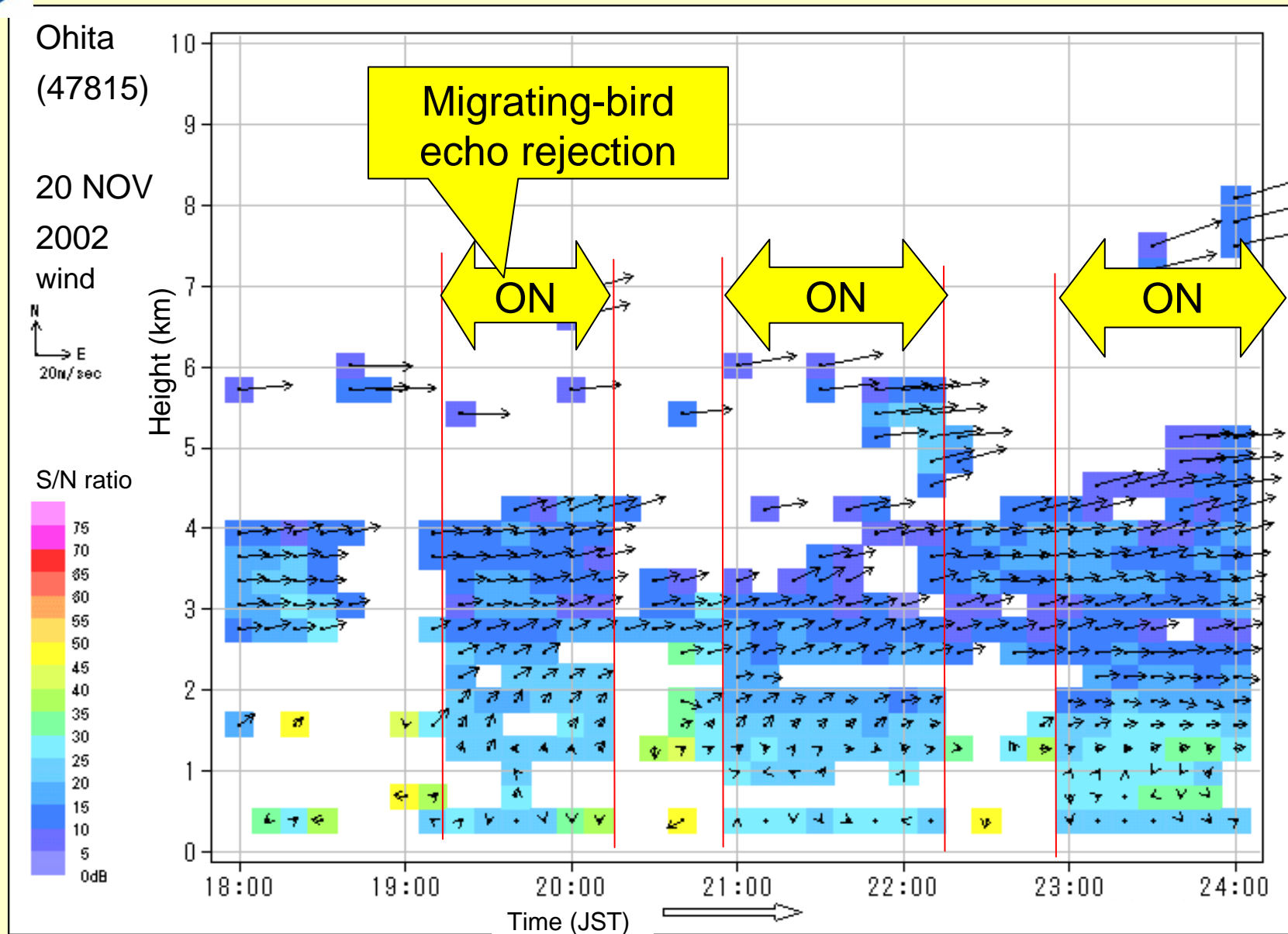


Example of migrating-birds echo



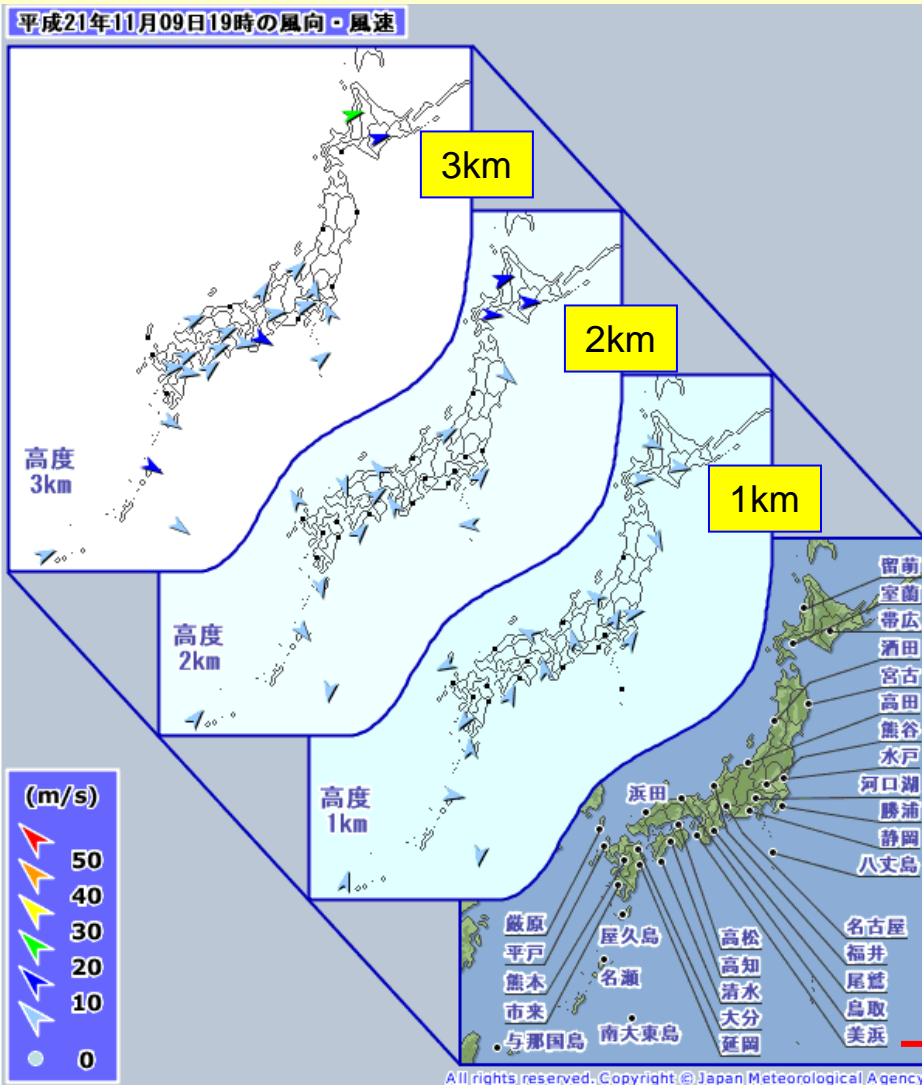


Example of migrating-birds echo rejection



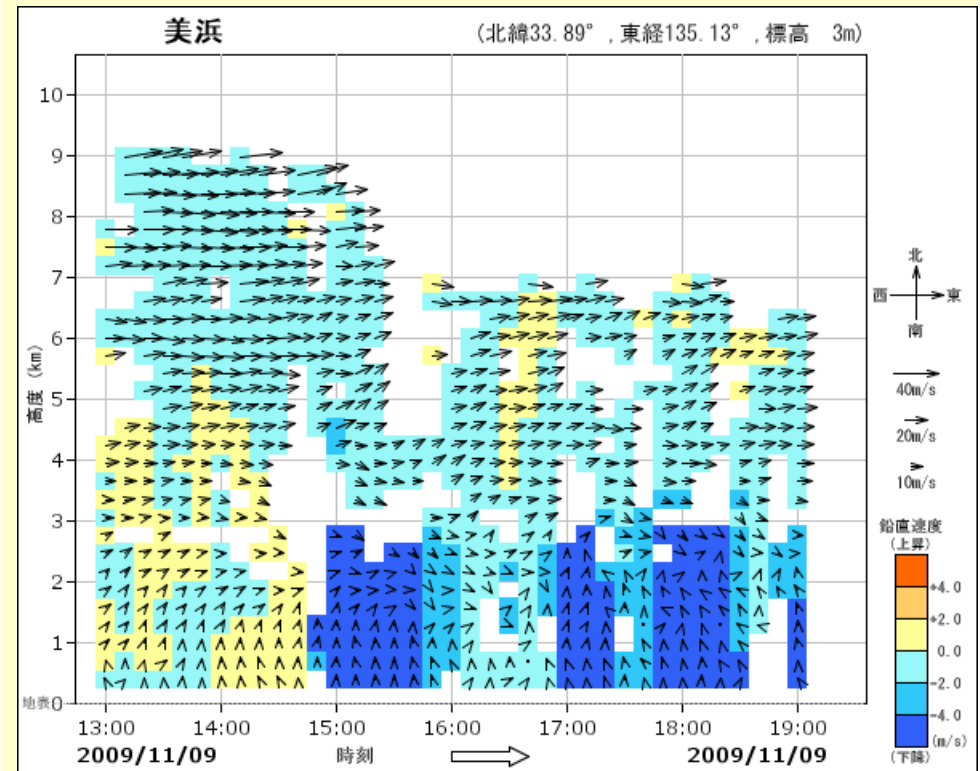


Profiler Wind Data Display for Public Use



1900JST 9 NOV 2009

Mihama, 1300JST-1900JST 9 NOV 2009



Horizontal () and vertical()winds

<http://www.jma.go.jp/jp/windpro/>



Application to the Hourly Analysis System

analysis scheme	3D-Var
assimilated observation	wind profiler, Doppler radar (radial velocity), ACARS (wind, temperature), hourly satellite wind, AMeDAS (wind, temperature)
first guess	the latest forecast from MSM* (forecast time = 2-4 hours)
analysis variables	horizontal wind (u and v components), temperature
domain	the MSM* domain, grid spacing 5km, vertical levels up to about 22 km
analysis time	on the hour every hour (calculation starts at 20 minutes past the hour)
product distribution	around 30 minutes past the hour

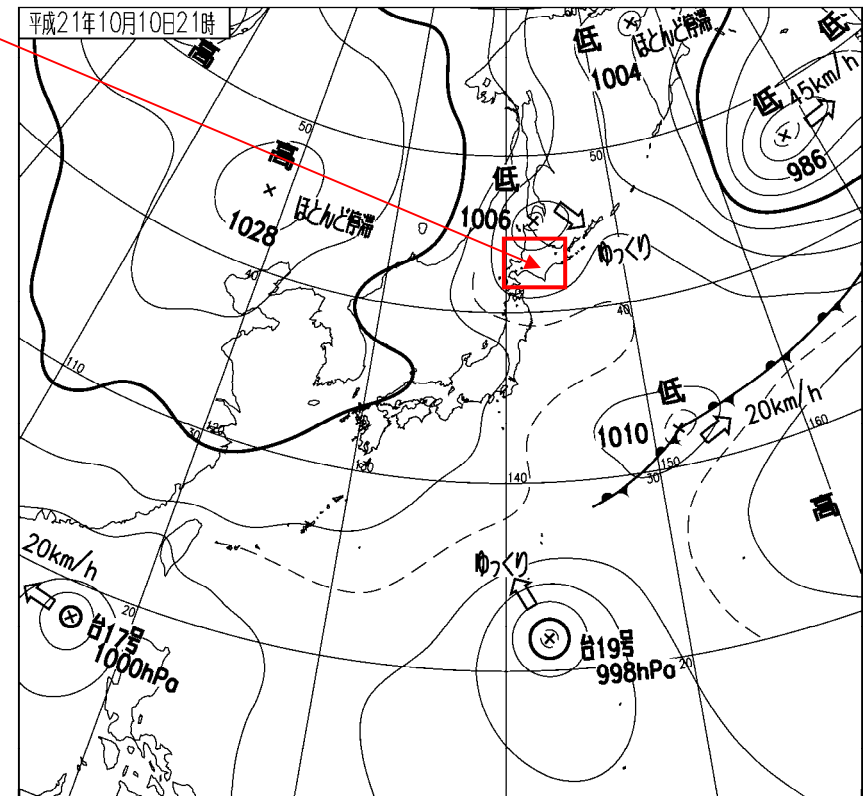
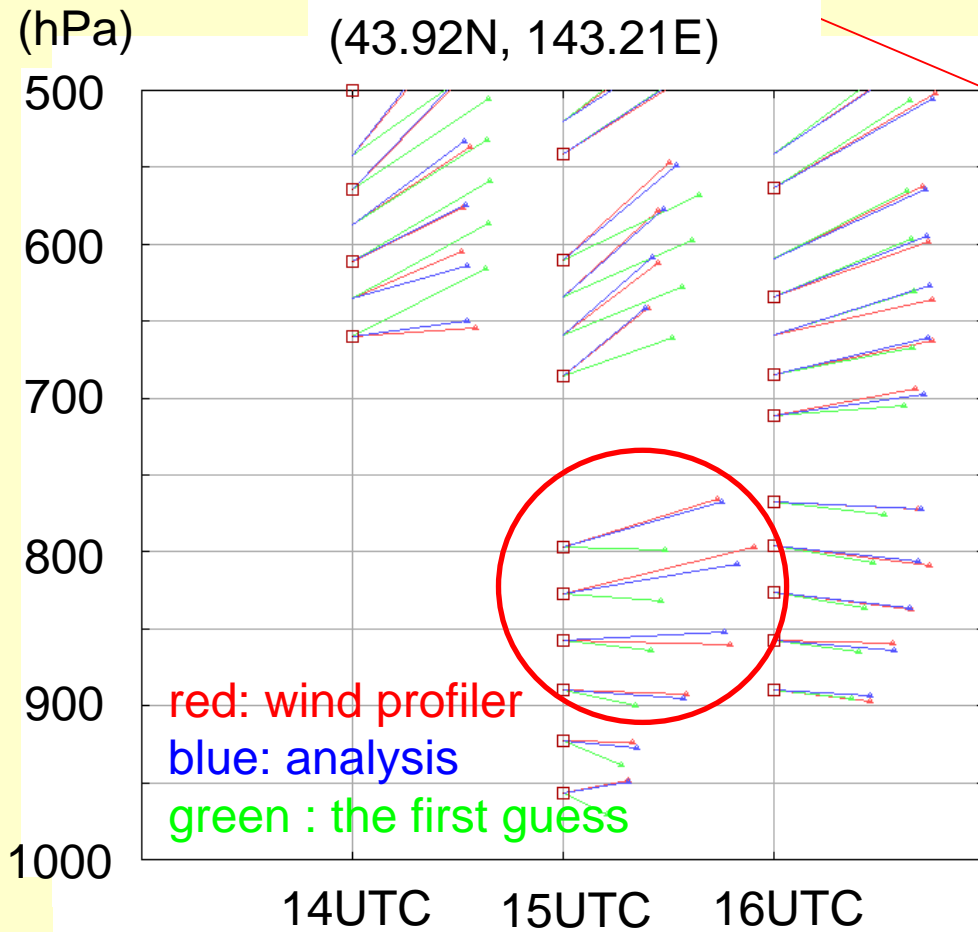
*MSM: Meso-scale model



Impact of the Wind Profiler Data in the Hourly Analysis

Obihiro Wind Profiler
(43.92N, 143.21E)

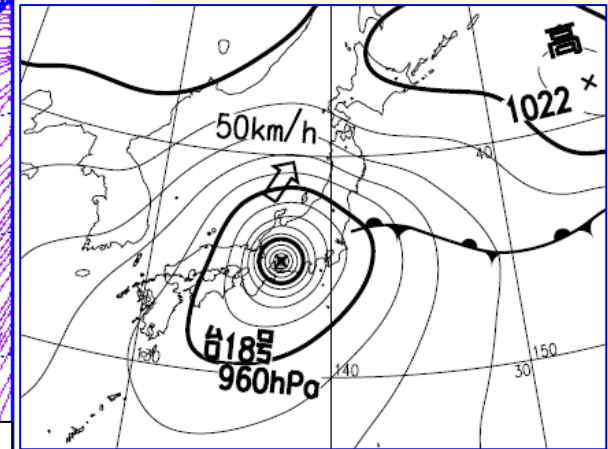
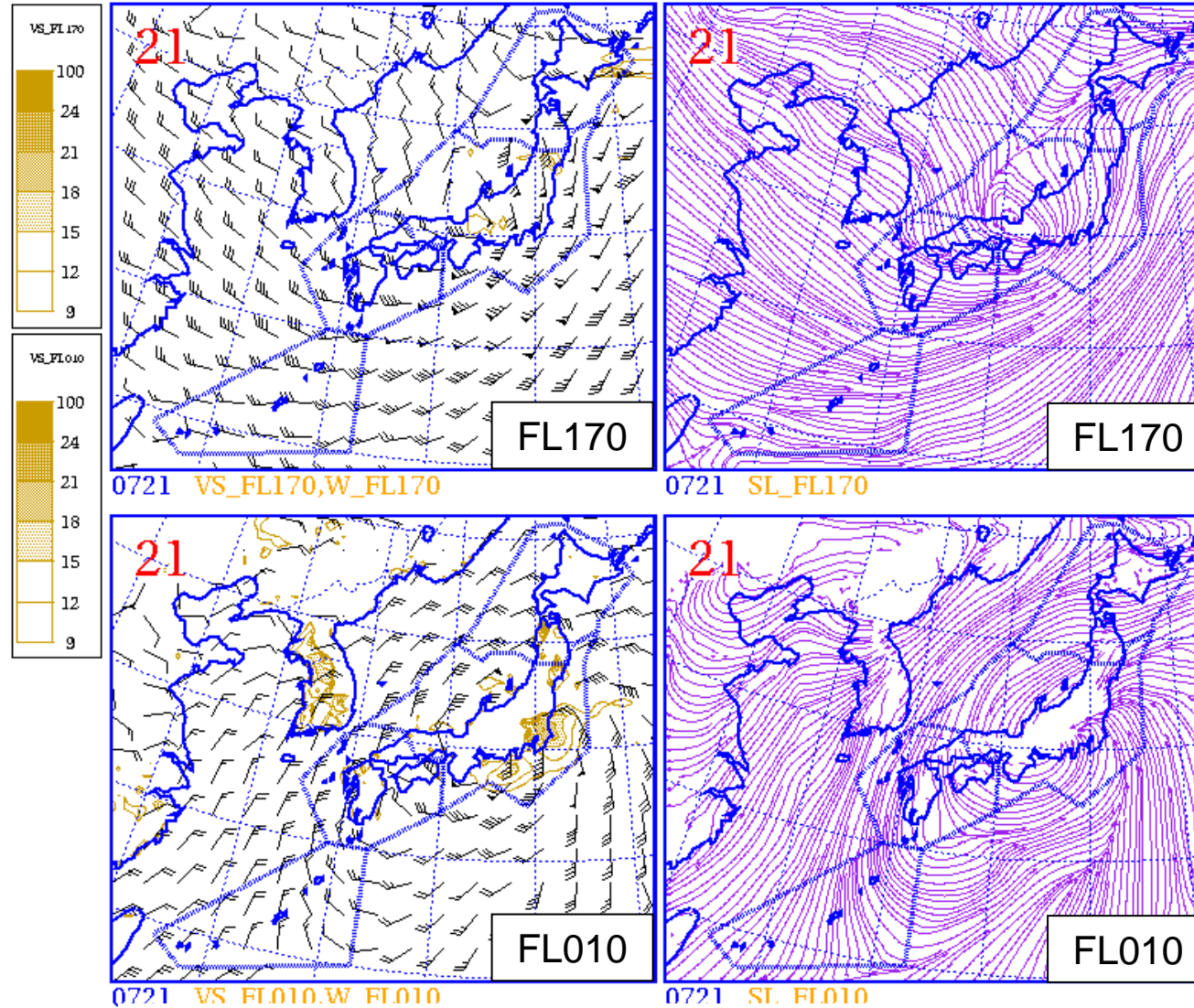
10 Oct. 2009 12UTC





Example of the Hourly Analysis

072100OCT2009



06JST 8 OCT 2009

Typhoon 0918

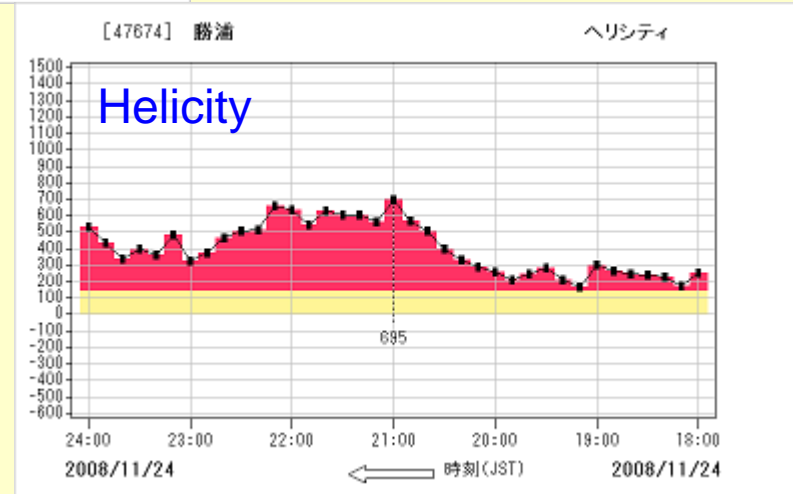
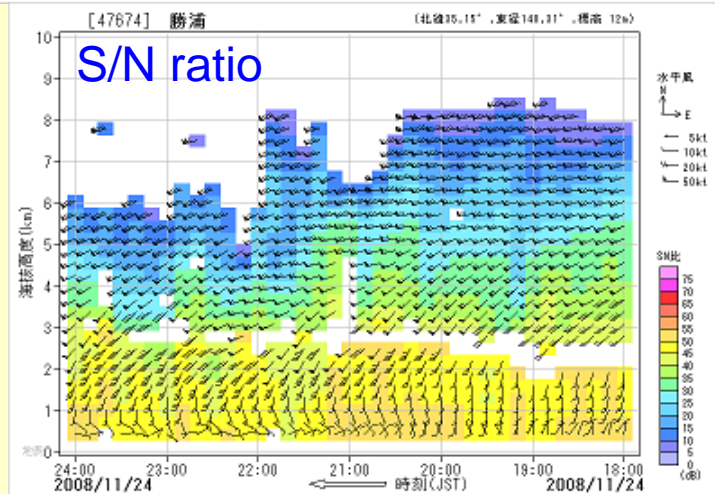
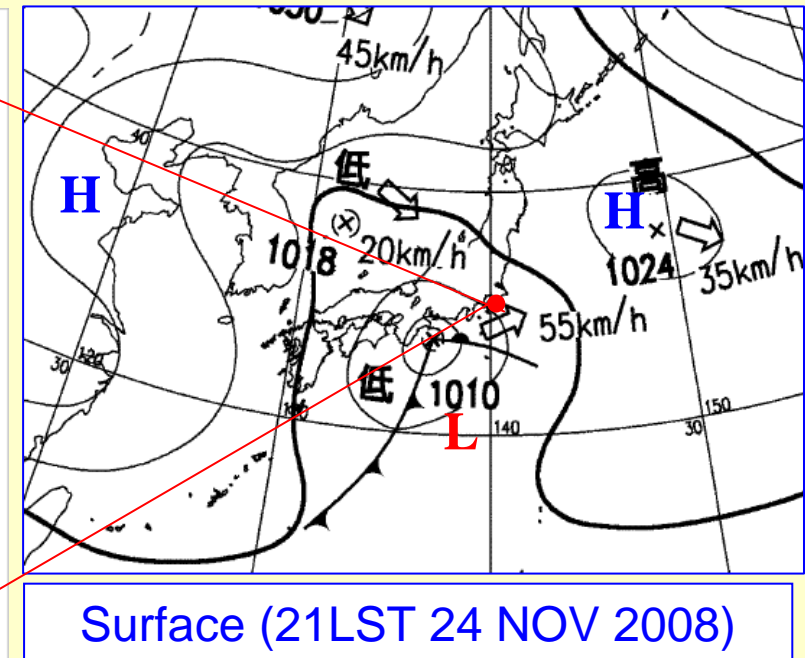
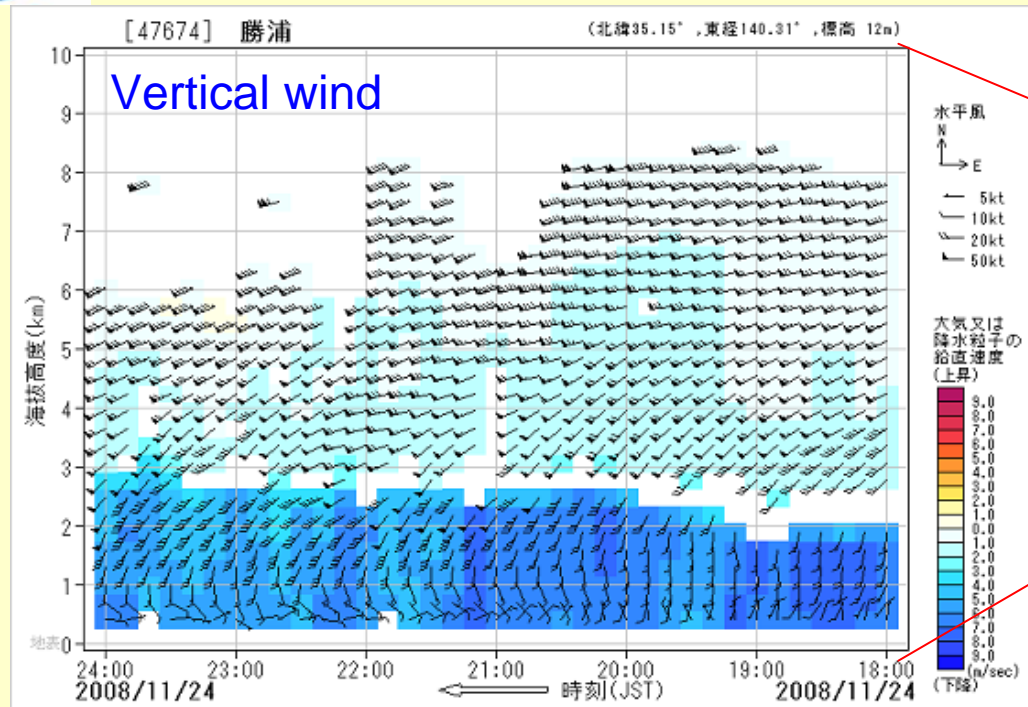
Winds and vertical wind shear

Stream lines

Wind Profiler in JMA



Application to the Weather Analysis





Comparison of Upper-Air Wind Observations

	WINDAS	Radiosonde	Doppler radar
Weather condition	All-weather	All-weather	Rainy (snowy) weather
Accuracy (m/s)	<2	<2	<2
Maximum height (km)	3 ~ 9 (depends on weather conditions)	30 ~ 35	15 (depends on weather conditions)
Vertical resolution (km)	0.3	0.3	1 ~ 2
Horizontal spacing (km)	120	190	1
Time between observations (h)	0.17	6 or 12	0.17
Delay in delivery to user (h)	0.3 ~ 1.3	1 ~ 2	0.3 ~ 0.5



Summary

- The “WINDAS”, 1.3GHz-band operational wind profilers of the JMA, is characterized with
 - horizontal spacing of 120 km on the average over the main islands of Japan,
 - height coverage of about 5 km,
 - high-accuracy, and high-availability data.
- The wind data from the WINDAS has contributed to improve accuracy of the NWP and to analyze atmospheric conditions.



Current Issues and Future Plan

- Data collection and distribution every 10 minutes to provide real-time wind data for aviation applications and to enhance data availability
- Estimation of humidity profiles with the WINDAS to improve accuracy of NWP models for heavy rainfall events
- Planning of the next generation WINDAS to improve height coverage and to resolve sharing issues concerning frequency bands used by wind profiler systems.



We would like to thank various persons and organizations for extending us much cooperation to build WINDAS.