

WIND PROFILER NETWORK OF JAPAN METEOROLOGICAL AGENCY

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14-17 March, 2005
Geneva, Switzerland

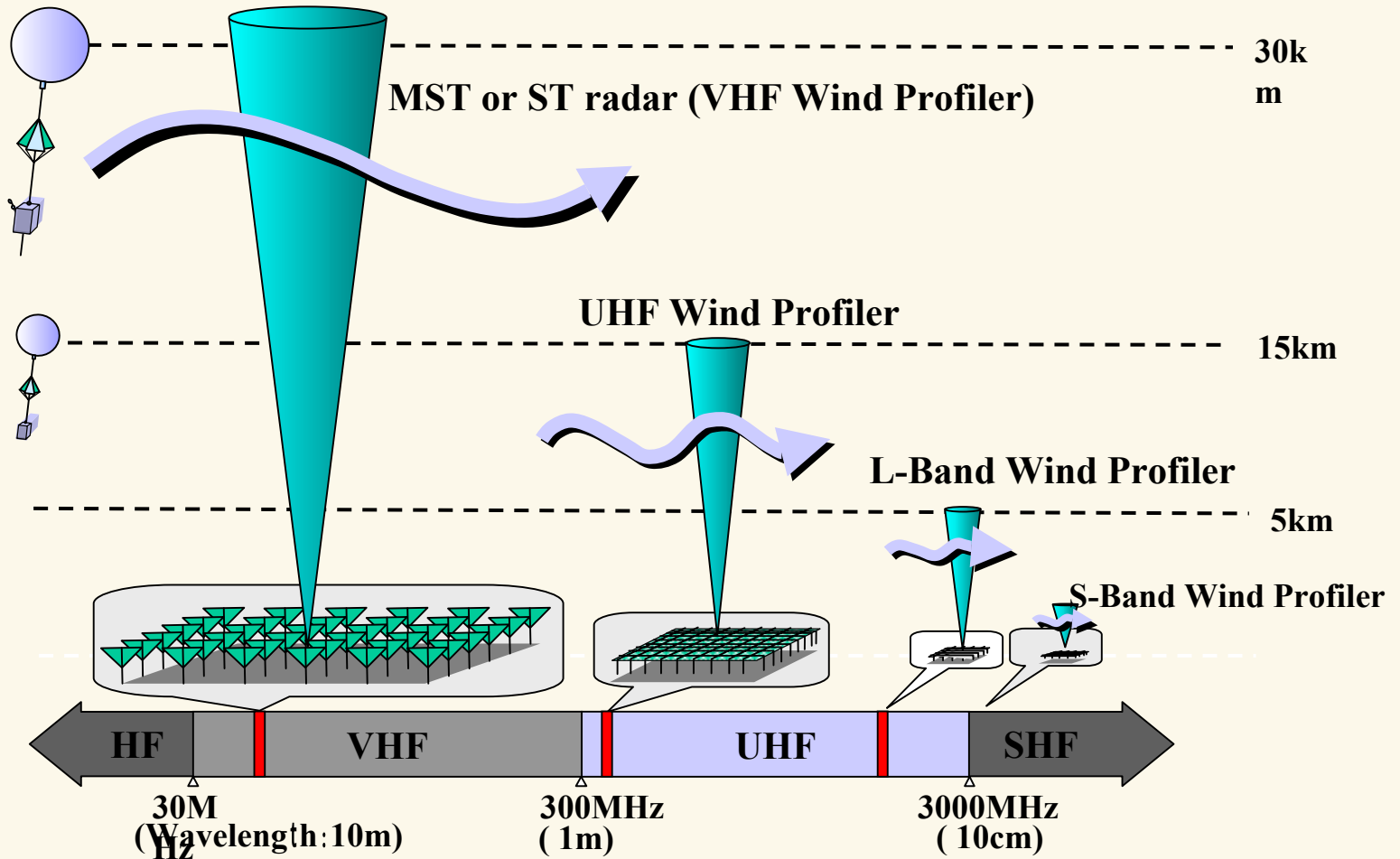
Radio Frequencies Allocated to Wind Profilers

The World Radiocommunication Conference 1997 (WRC-97) decided the allocation of Radio Frequencies to Wind Profilers for Resolution COM5-5 with Footnotes S5.162A and S5.291A as follows :

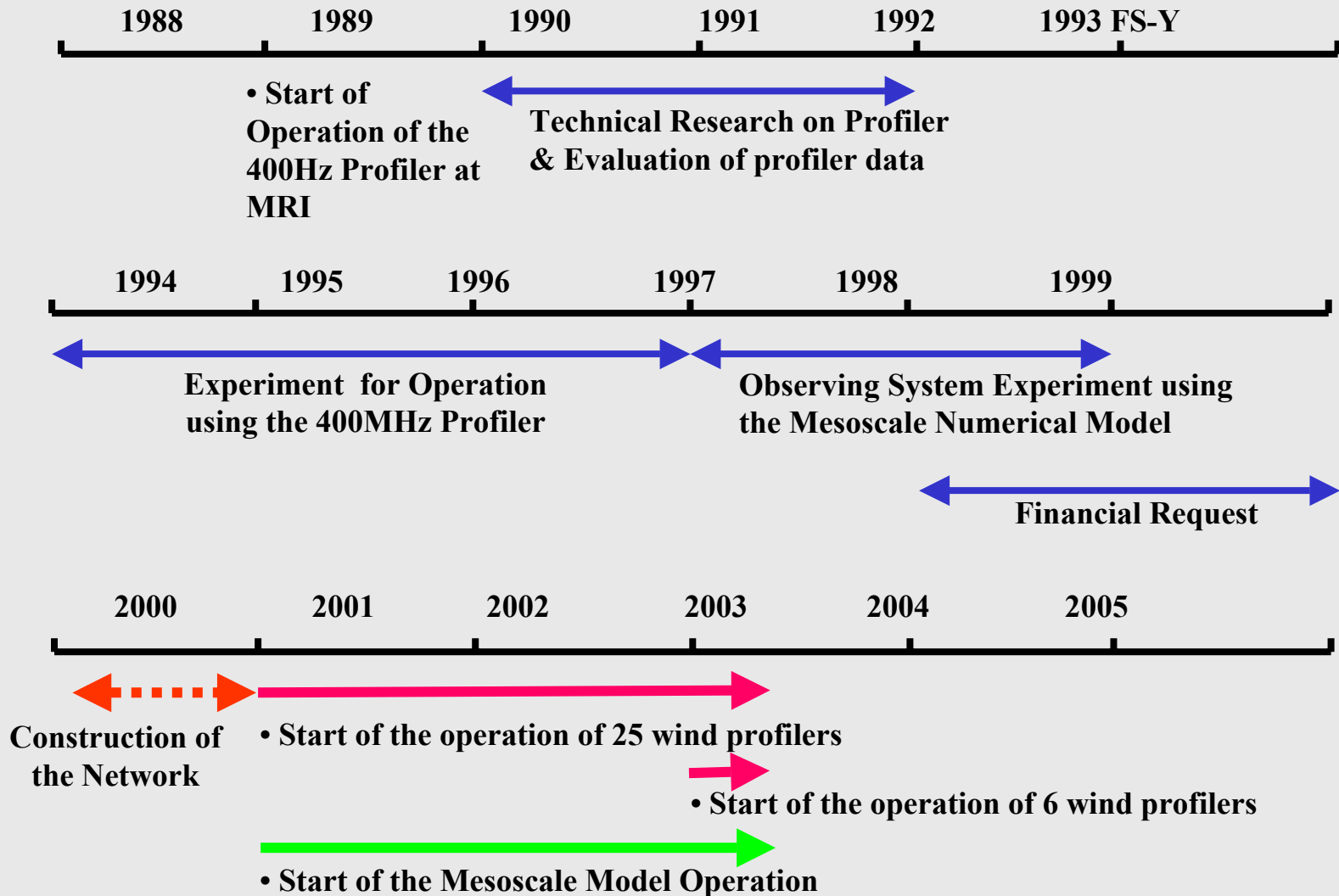
- | | |
|------------------------|---|
| 46-68 MHz | (Mesosphere) Stratosphere Troposphere Radar,
VHF Wind Profiler |
| • 440-450 MHz | VHF Wind Profiler |
| • 470-494 MHz | VHF Wind Profiler |
| • 904-928 MHz | UHF Wind Profiler (in Region II only) |
| • 1270-1295 MHz | UHF Wind Profiler |
| • 1300-1375 MHz | UHF Wind Profiler |
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Types of Wind Profilers

- Performances of wind profiler highly depend on radio frequency being used.

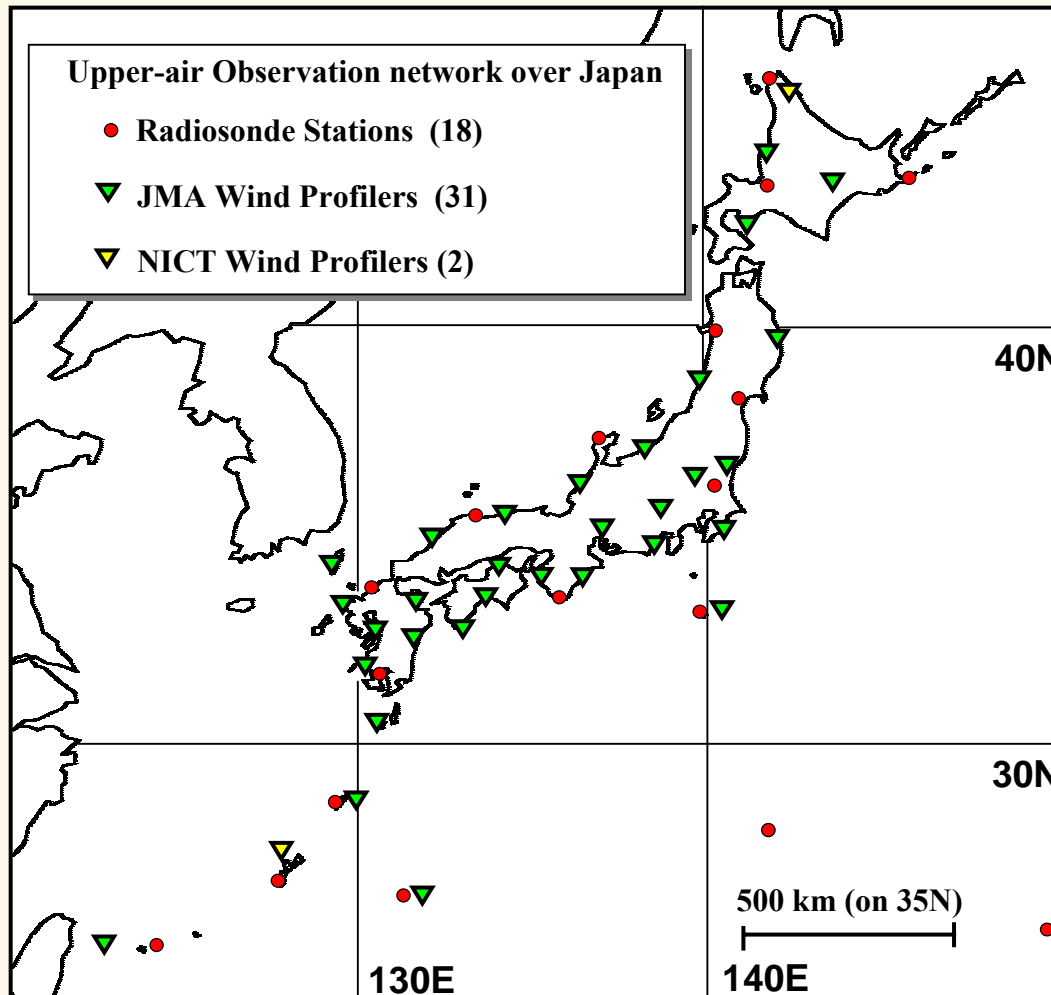


JMA Profiler Network Project



Wind Profiler Network and Data Acquisition System (WINDAS)

- Japan Meteorological Agency (JMA) started the operation of a wind profiler network in April 2001 after making several experiments for operation.



• NICT: National Institute of Information & Communication Technology

Wind Profilers in WINDAS

Standard Type (21)



Radome Type (9)



Doubled Clutter Fence Type (1)



**Control Center
(JMA Headquarters in Tokyo)**



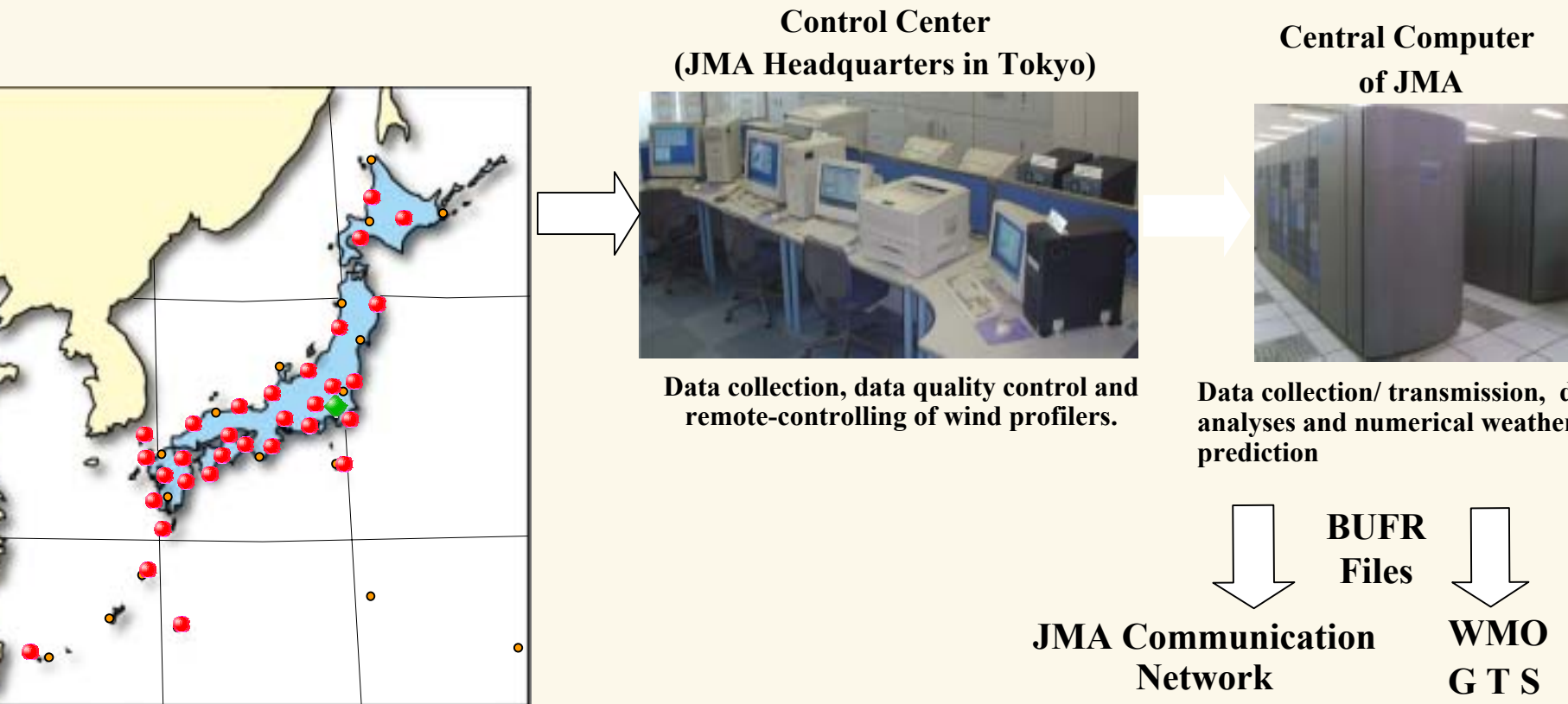
Characteristics of Wind Profilers in WINDAS

Characteristics of WINDAS

• Antenna gain	33 dBi
• Frequency	1357.5 MHz
• Peak Power	1.8 kW (Average Power 428 W Max.)
• Beam width	4 °
• Vertical resolution	100, 200, 300, 600 m
• Pulse Repetition Freq.	5, 10, 15, 20 kHz
• Beam positions	5
• Sidelobe level	-40dB or -60dB at elevation angles from 0 to 10 °
• Pulse compression	8 bits
• primary data	Spectral moments every 1 minute
• Distributed data	u,v,w components of wind, S/N ratio, & Data Quality Flag every 10 minutes

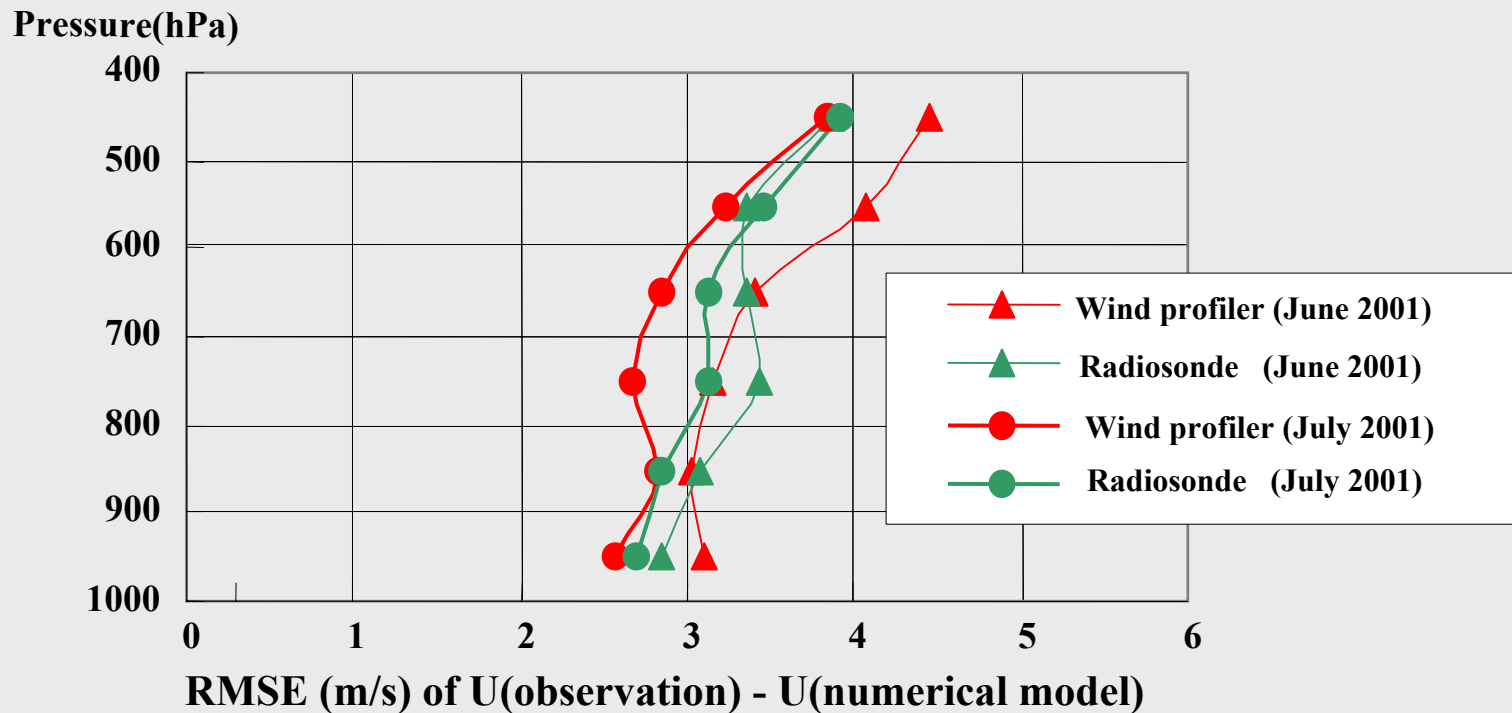
Data Flows in WINDAS

- The Control Center collects the wind profiler data every hour, makes data quality control, and sends the data to the JMA central computer.
- The wind profiler data are used for initial values of the numerical weather prediction (NWP) models, particularly in the Mesoscale Model with 4D-variational data assimilation system.



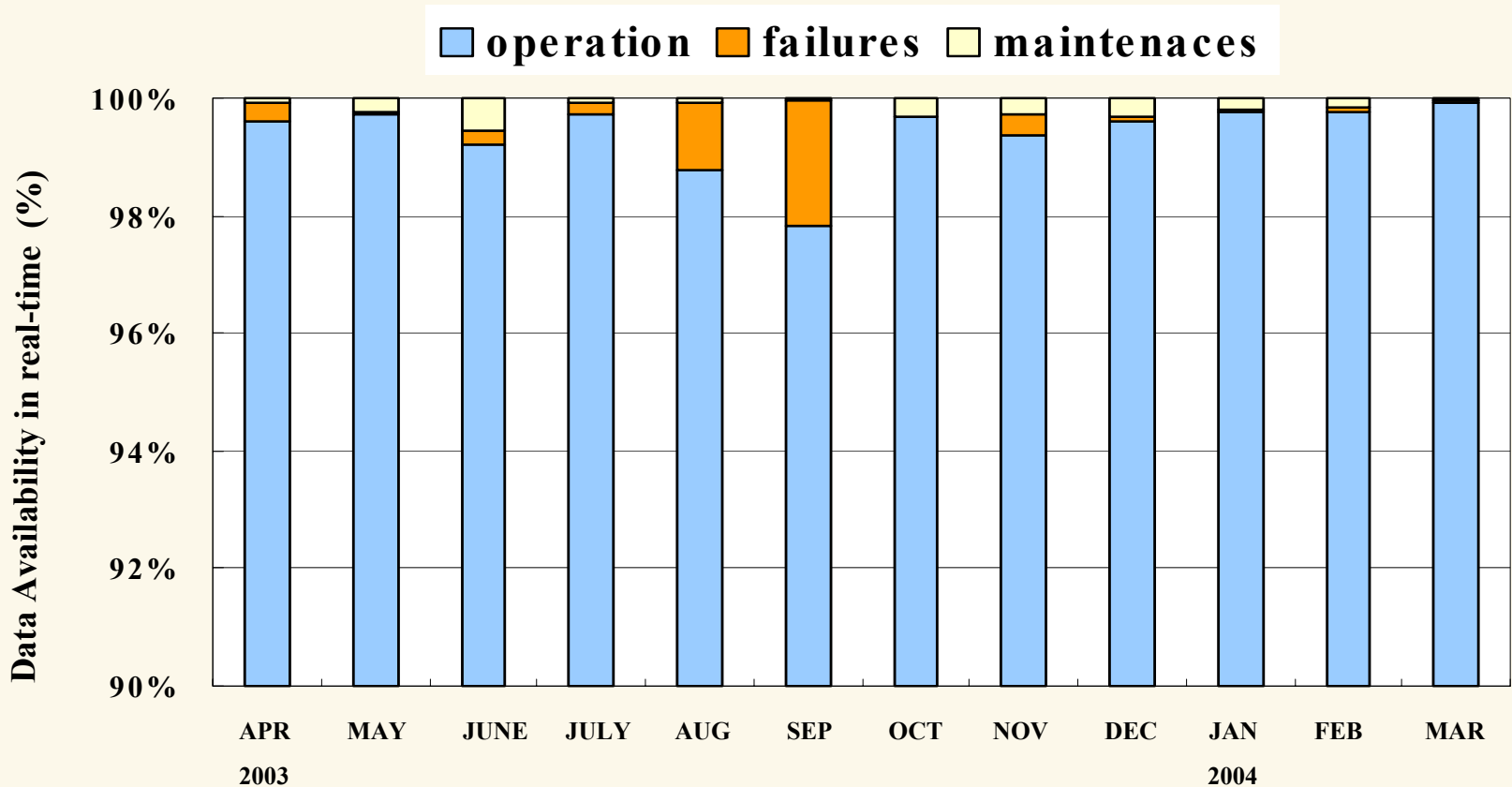
Evaluation of Accuracy of Wind Profiler Data

- Accuracy of the wind profiler data is evaluated by comparison with results of numerical weather prediction.
- It was demonstrated that wind data of WINDAS have high accuracy being comparable to that of radiosonde winds.



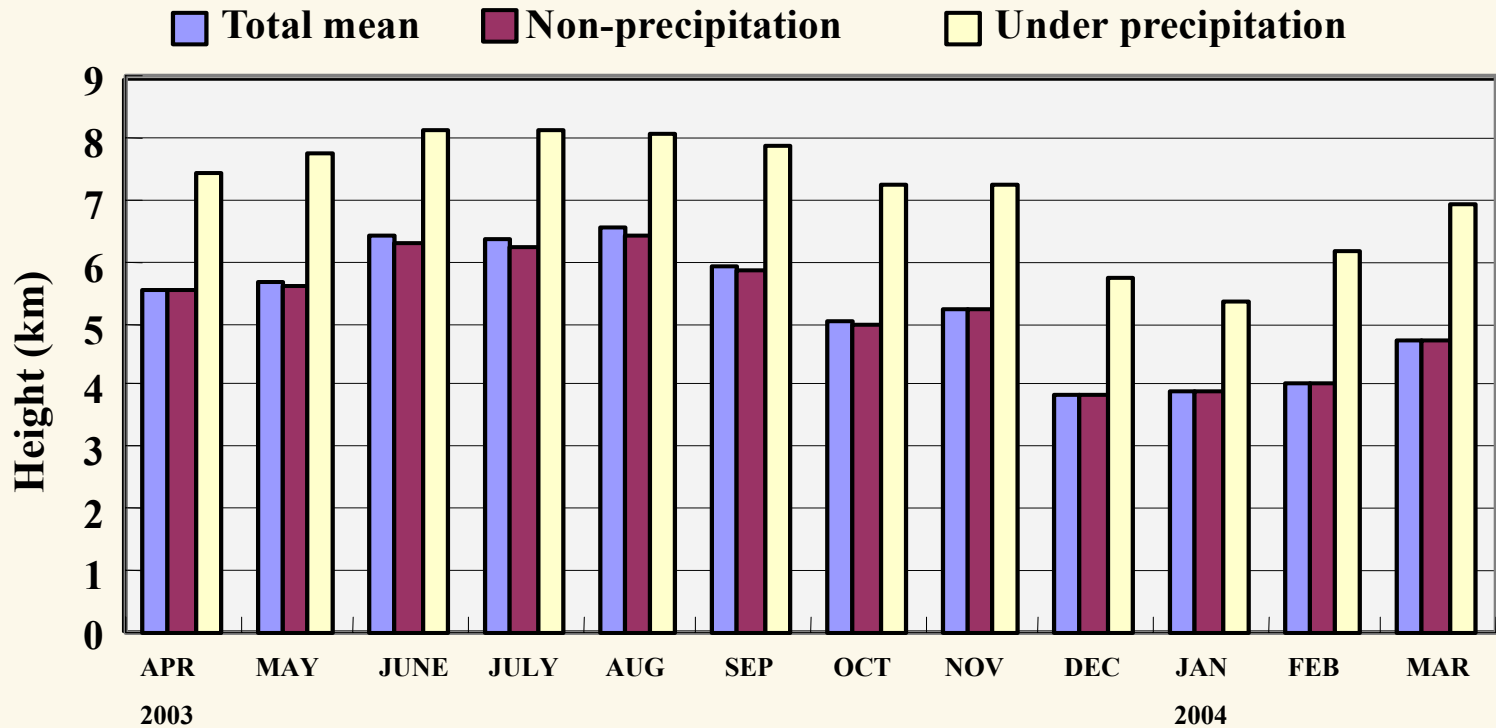
Data Availability in WINDAS

- 98% of data availability in real time has been obtained in the operation of WINDAS.



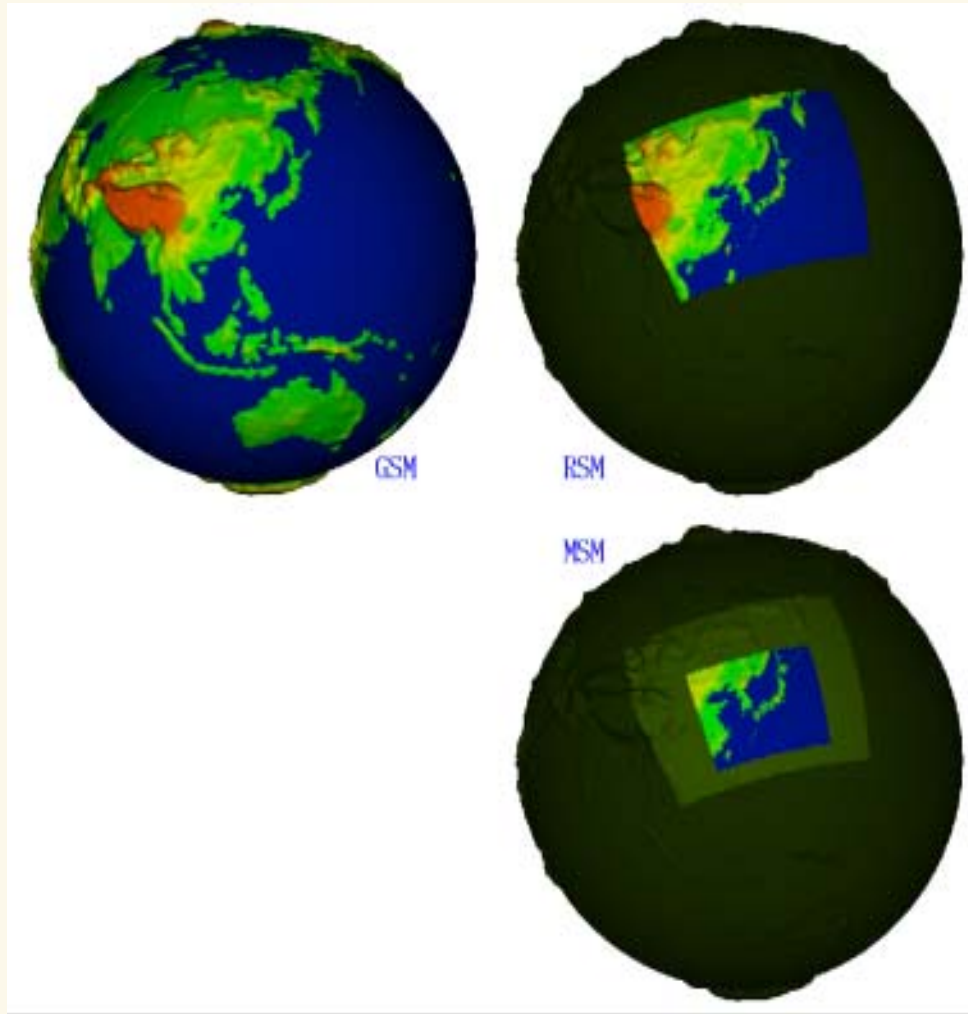
Seasonal change of height coverage

- Height coverage of wind profiler mainly depends on the amount of water vapor in the lower atmosphere and shows prominent seasonal variation.



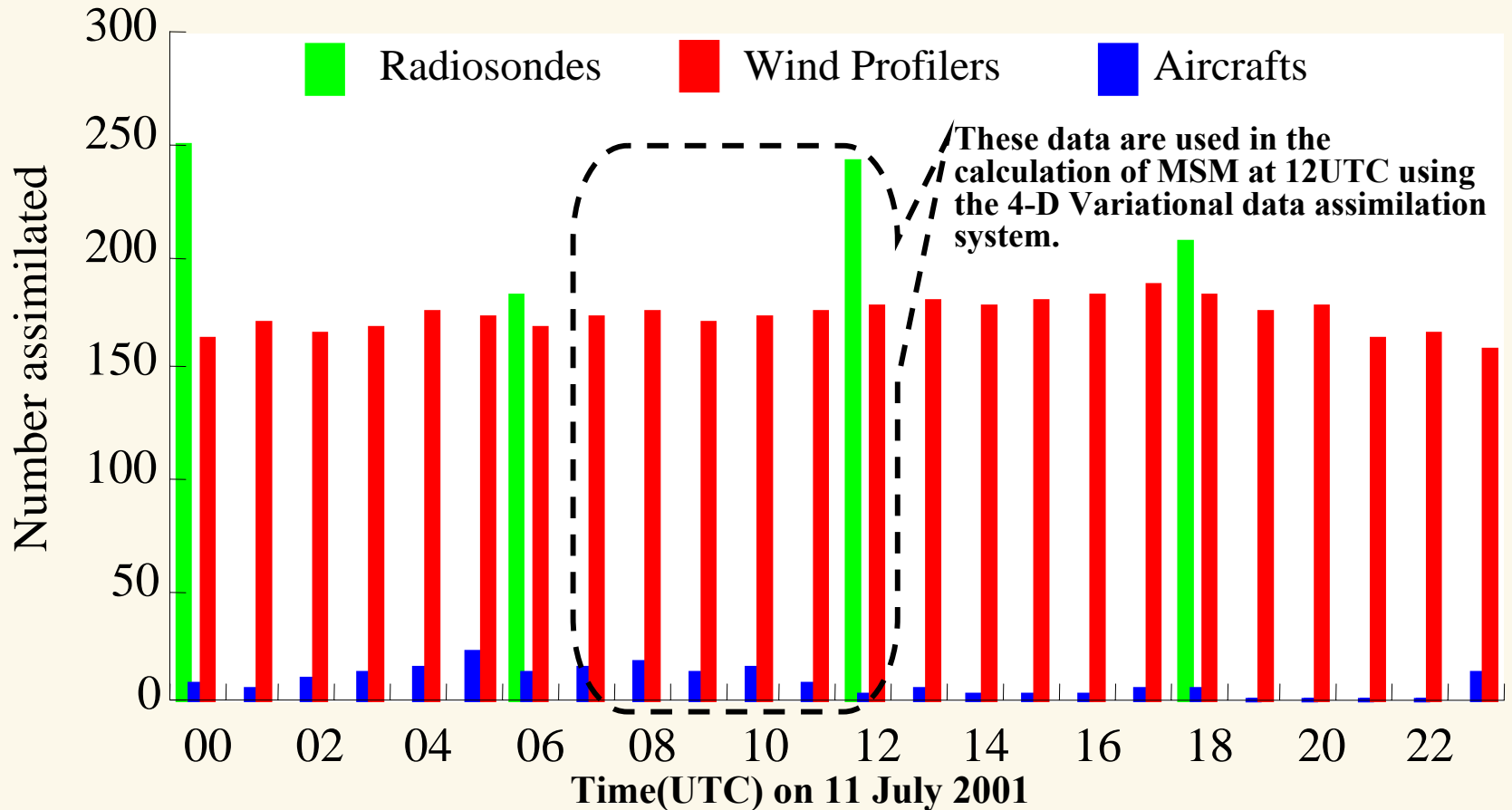
Contribution to Numerical Weather Prediction

- Wind data obtained from WINDAS are being assimilated in the numerical weather prediction models of Japan Met Agency as well as wind profiler data of U.S. and Europe.



Impacts of Numerical Weather Prediction

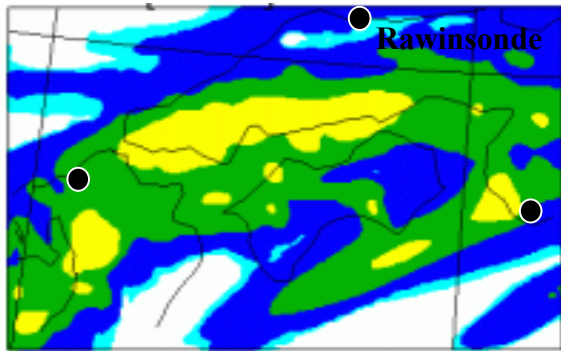
- The number of the wind data assimilated in the Numerical Weather Prediction Models of JMA are extensively increased due to the start of operation of WINDAS.
- MSM(Mesoscale Model) have assimilated profiler data every hour using the 4-dimensional variational data assimilation scheme.



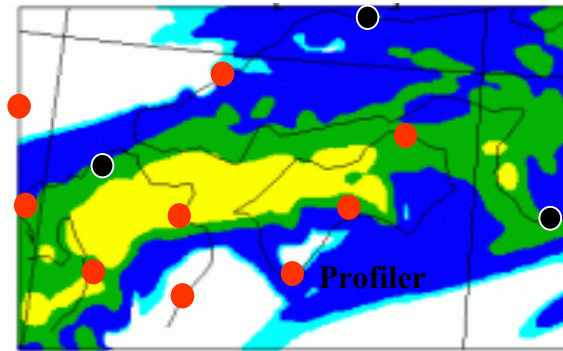
Impact of Profiler Data to the Mesoscale Model (1)

- Forecast of a severe rainstorm is well improved by including wind profiler data in the Mesoscale Model using the 4D-Variational data assimilation system.

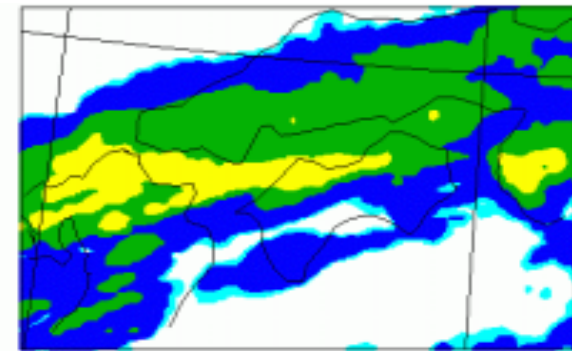
(a) 3hr Forecast of MSM without Profiler Data



(b) 3hr Forecast of MSM with Profiler Data

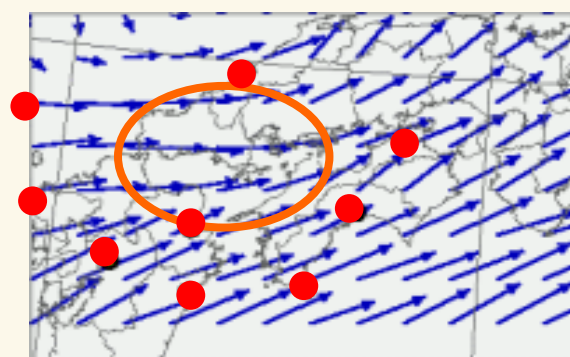
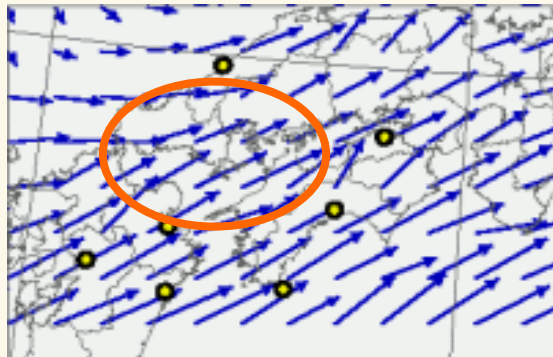


(c) Composite map of radars and rain gauges



0.5 1.0 5.0 10. 20. 30.
Total Rain Amount for 3 hours (mm)

100km



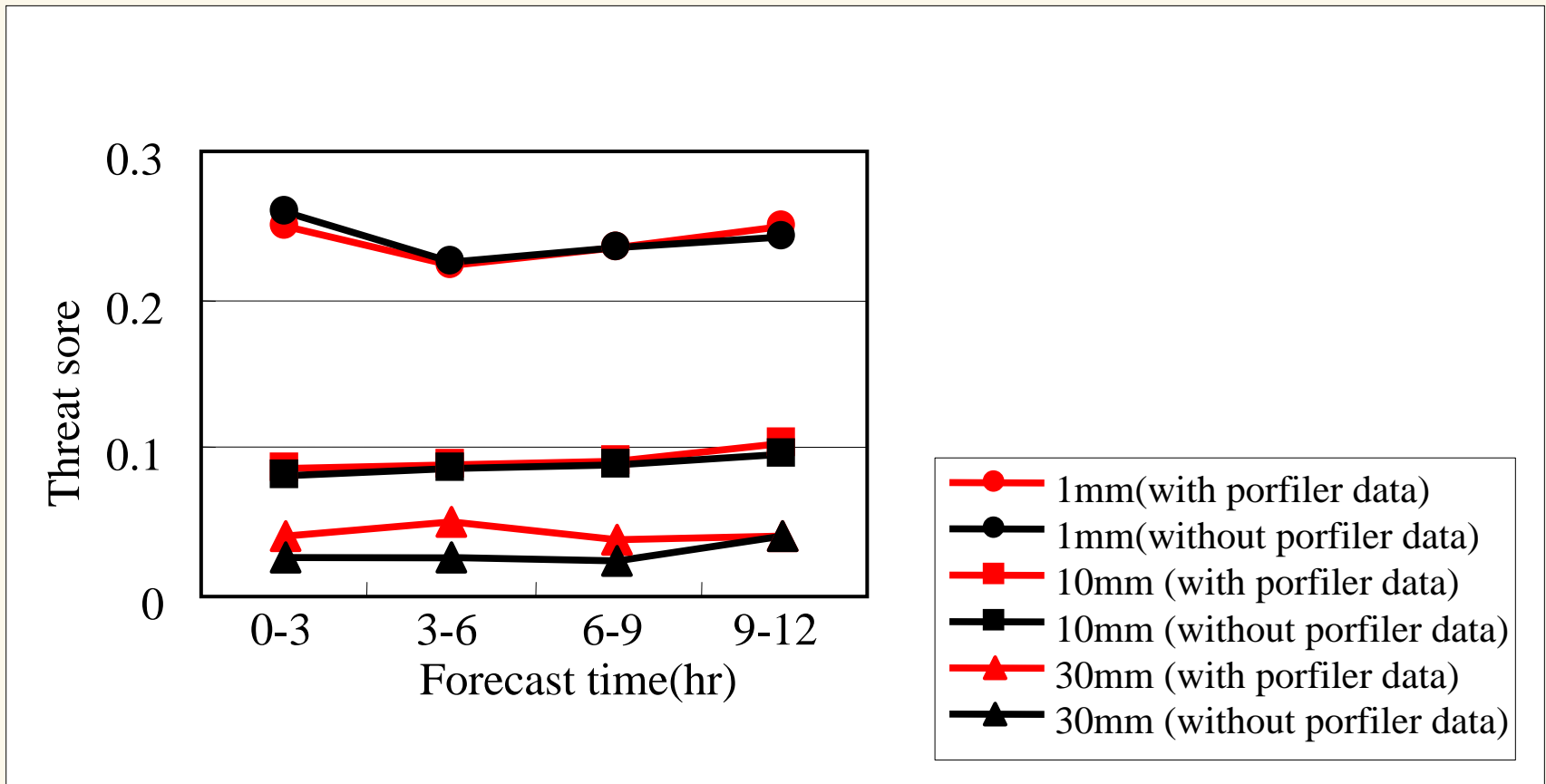
Forecast Winds at
850hPa

without Profiler

with Profiler

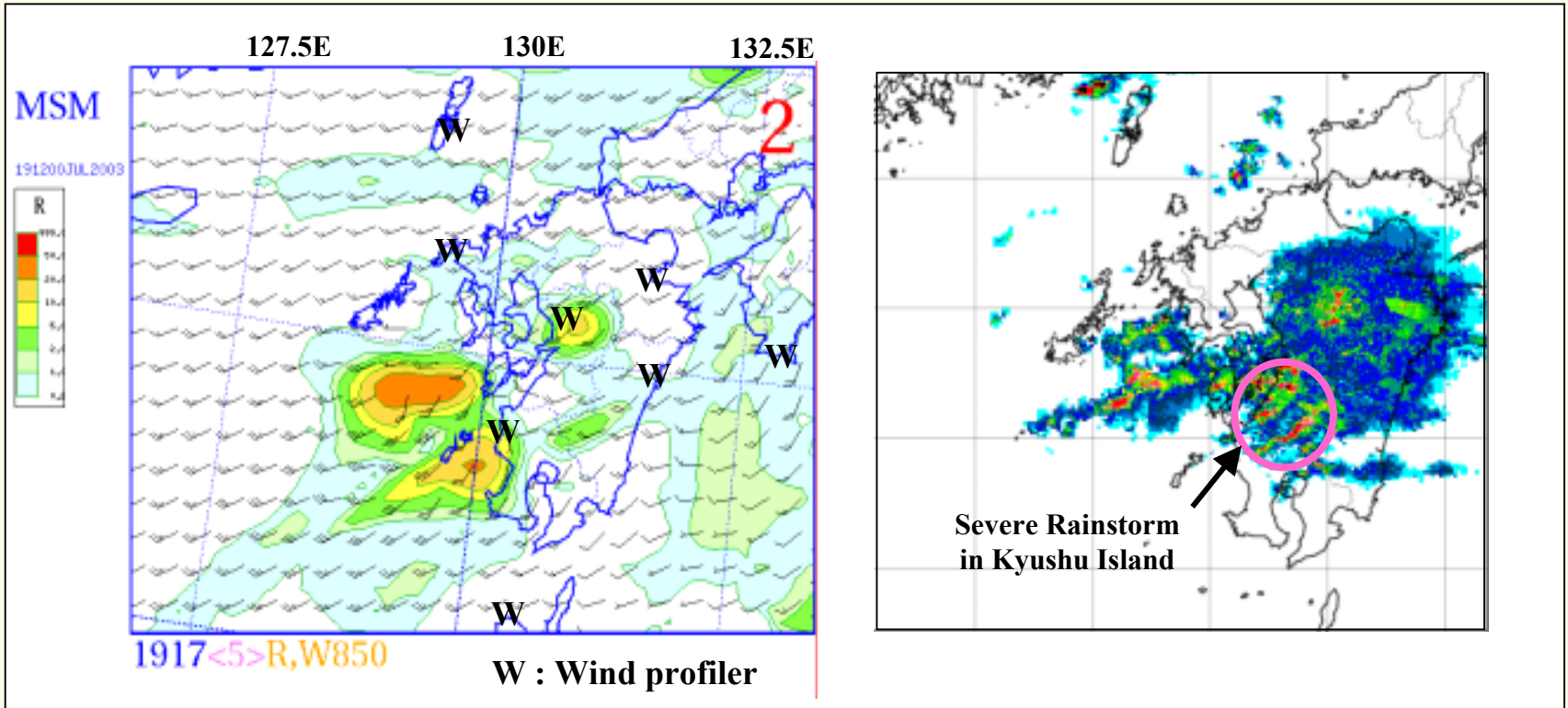
Impact of Profiler Data to the Mesoscale Model (2)

• Threat scores of numerical forecasts from the Mesoscale model are estimated in case of rainfalls during 27 June to 24 July 2001. Forecasts of a severe rainstorm are improved by using wind profiler data in the model with the 4D-Variational data assimilation system.



Impact of Profiler Data to the Mesoscale Model (3)

- The Mesoscale Model, however, does not always make accurate forecasts for severe rainfalls even using wind profiler data.

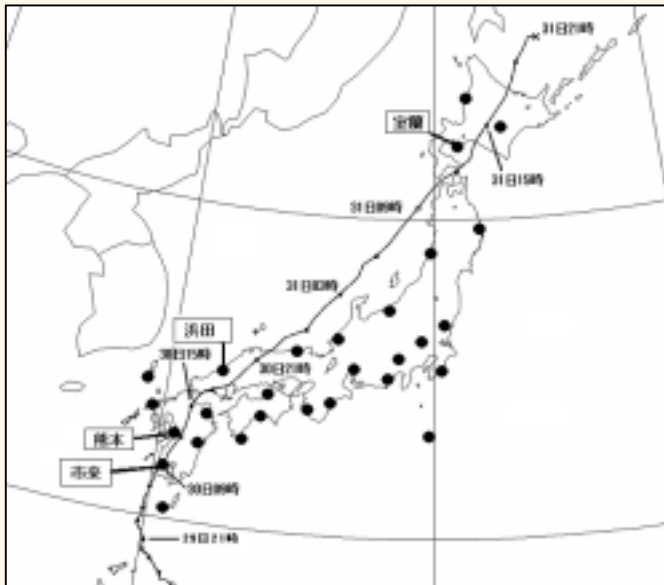


(a) 5-hour forecast of 1-hour rainfall amount and winds at 850hPa by MSM at 02LST 20 July 2003.

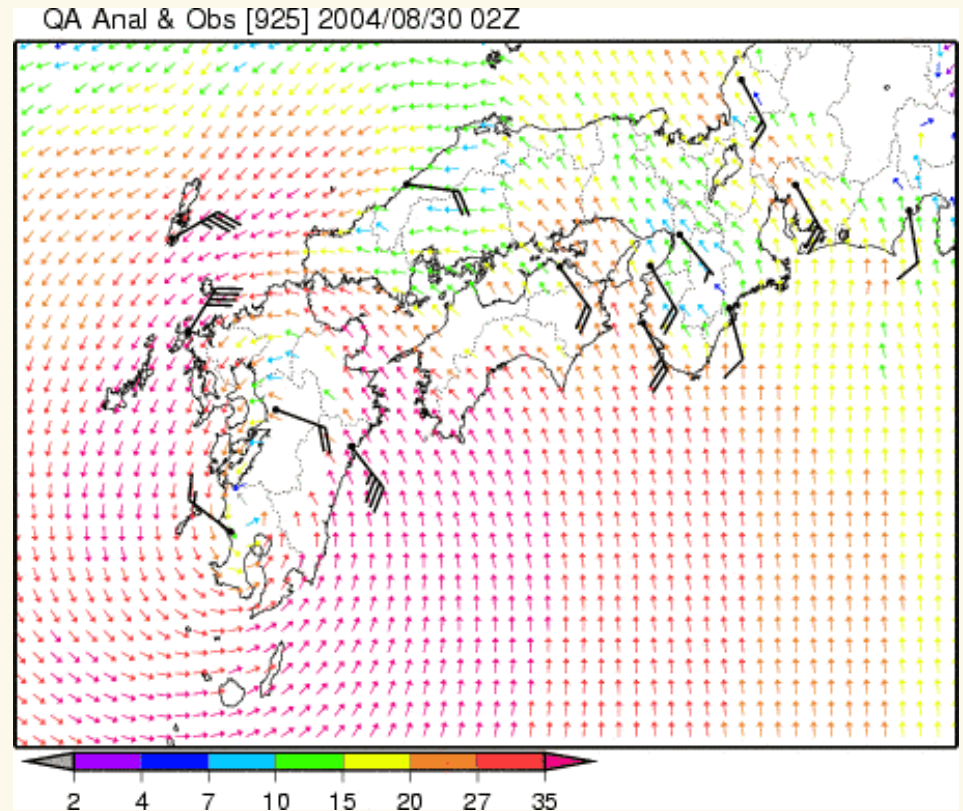
(b) Radar composite map as 'ground truth' of rainfall amount at the same time of (a).

Wind analysis using MSM, Wind Profilers, Doppler radars and ACARS

- Winds obtained from the Mesoscale Model are adjusted with data from wind profilers, Doppler radars and ACARS.
- Winds analyzed on 10km-grids are provided every hour for weather forecasts and aviation weather services.

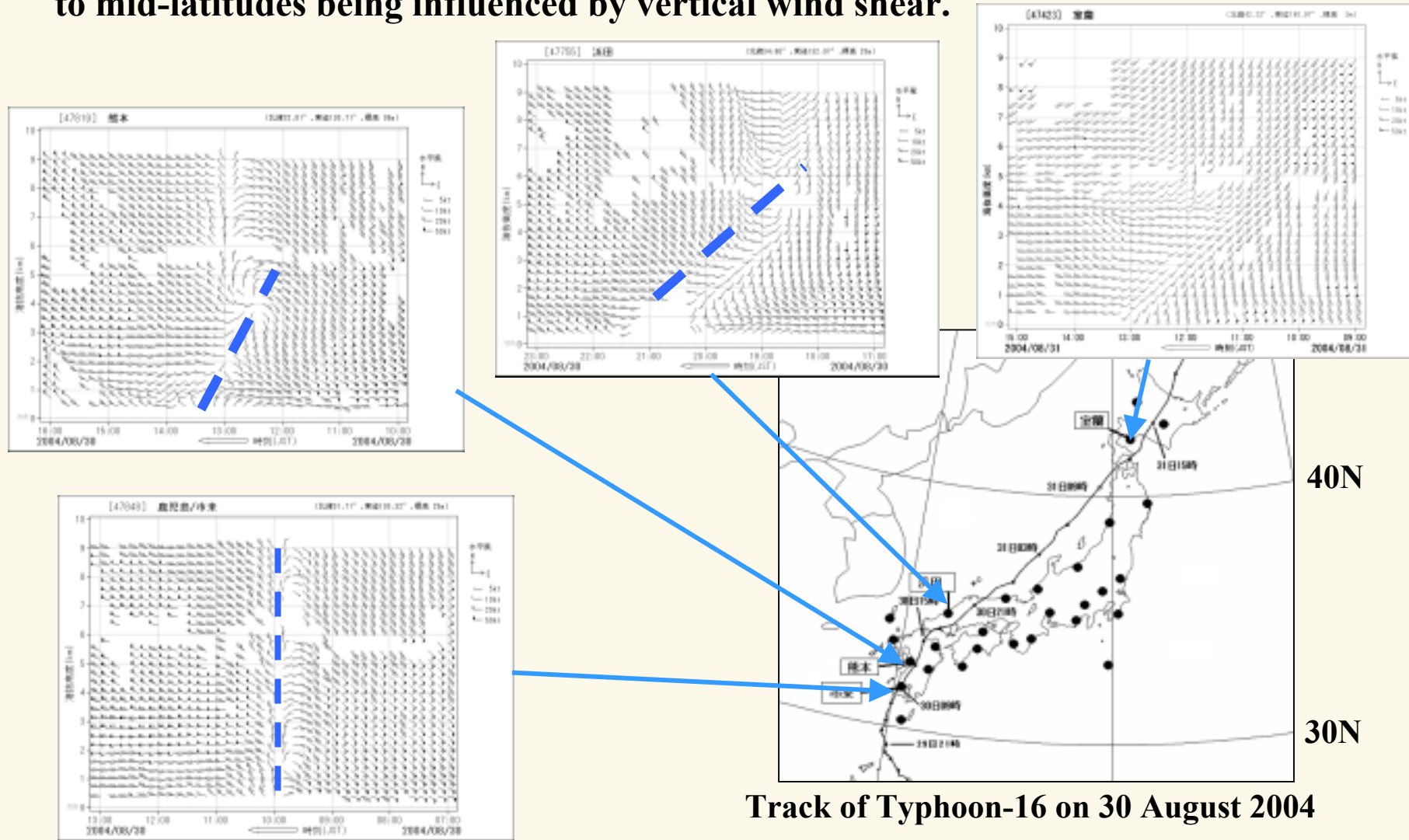


Track of Typhoon-16 on 30 August 2004



Transition of a typhoon to an extratropical cyclone as seen by wind profilers

- The axis of the vortex core of the typhoon gradually tilted as shifting from subtropics to mid-latitudes being influenced by vertical wind shear.

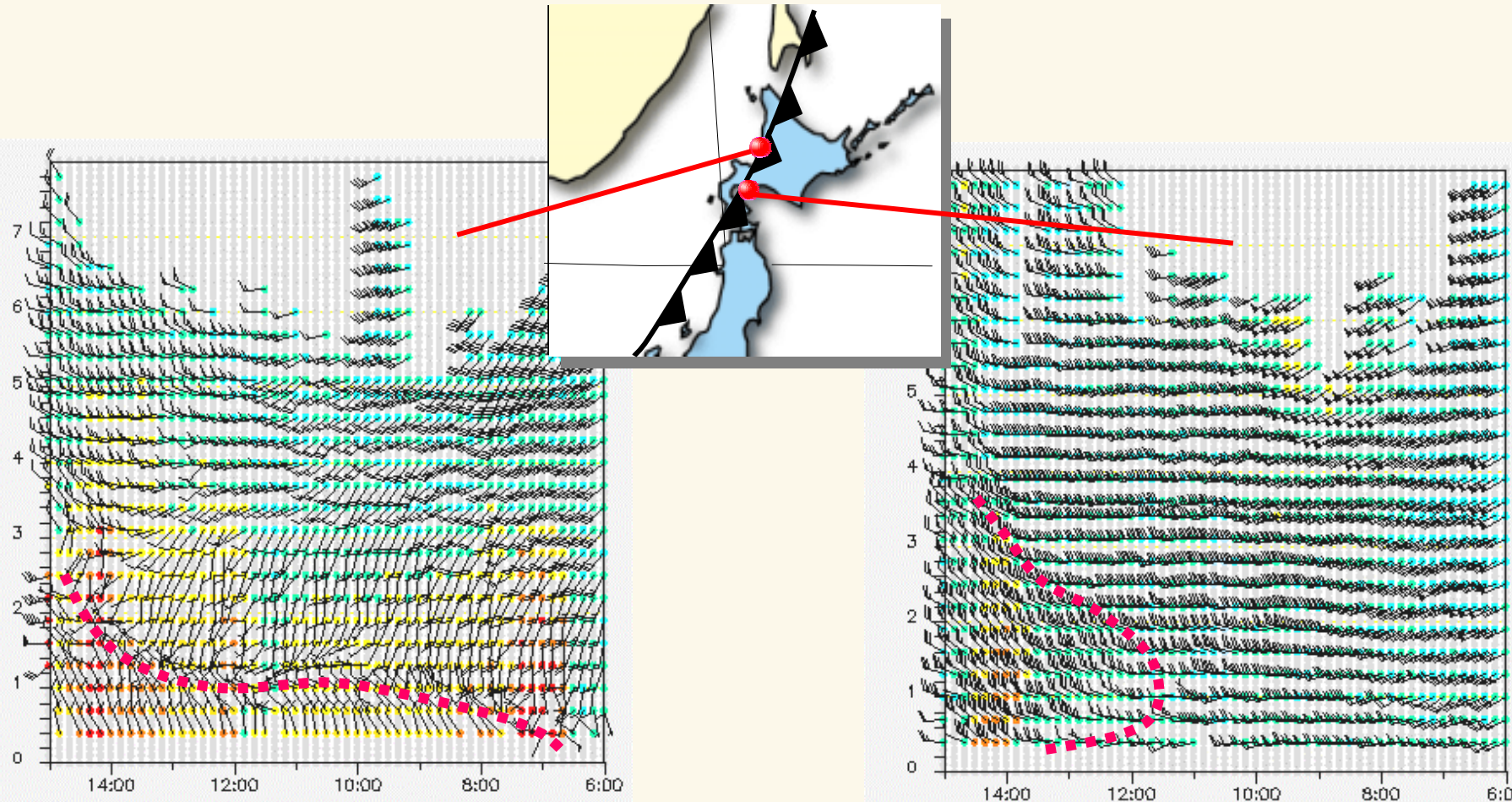


Track of Typhoon-16 on 30 August 2004

Modification of the Surface of a Cold Front by Topography

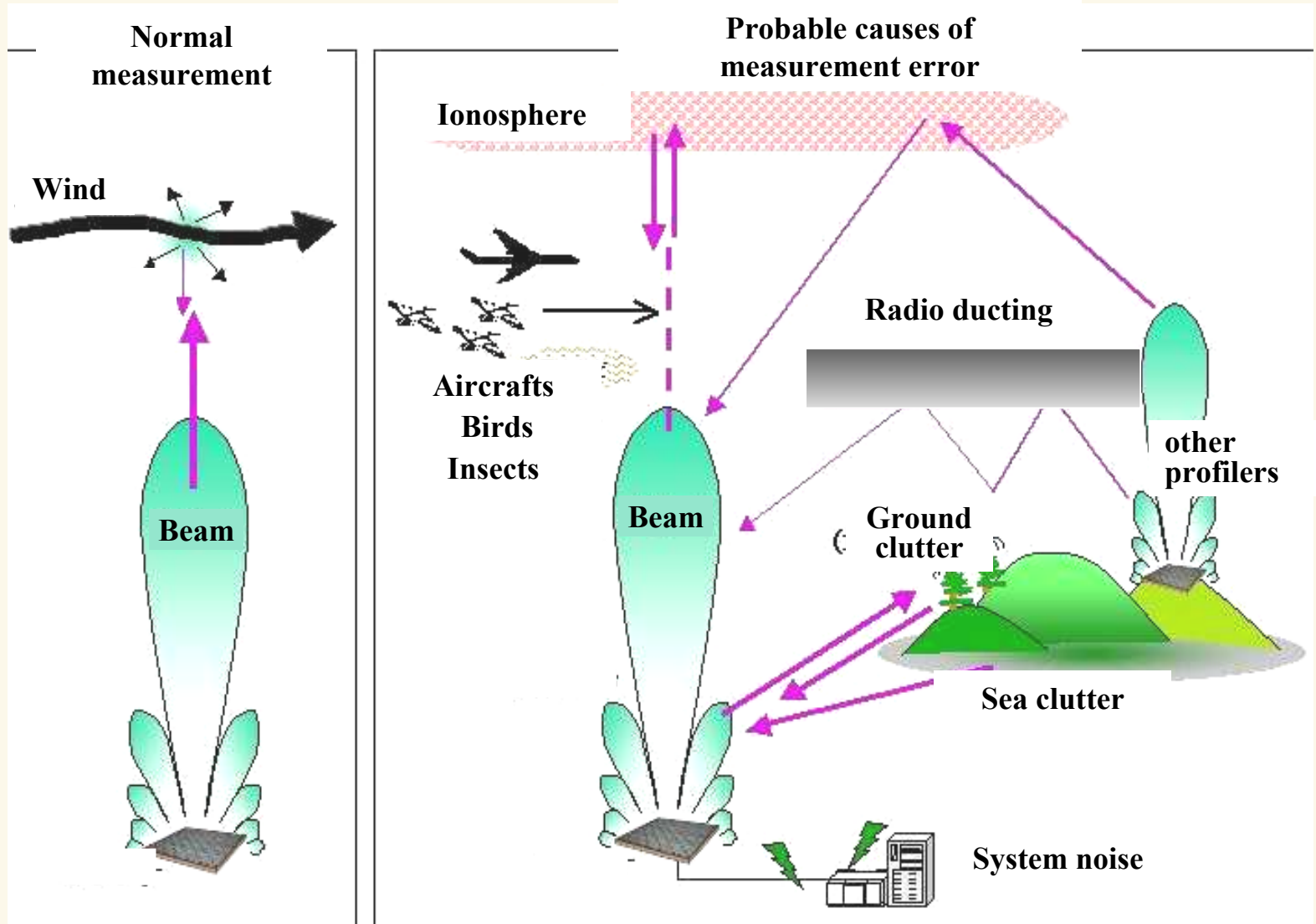
A surface of a cold front at lower levels was blocked by mountains and modified.

The modification was clearly illustrated by the data of two wind profilers located on both sides of the mountains.



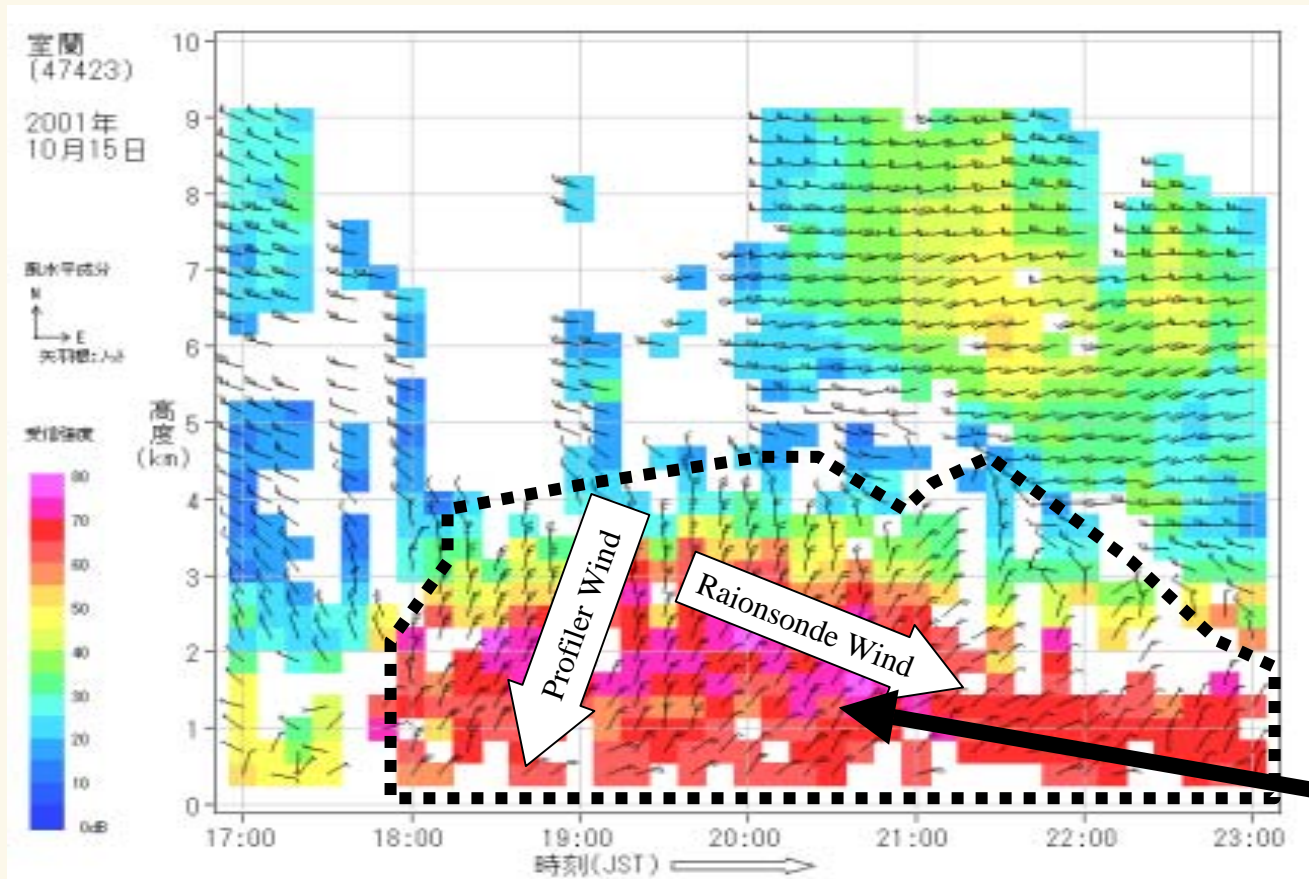
Error sources of wind Measurements

- There are many probable causes affecting wind measurements.



Contamination from Migrating Birds

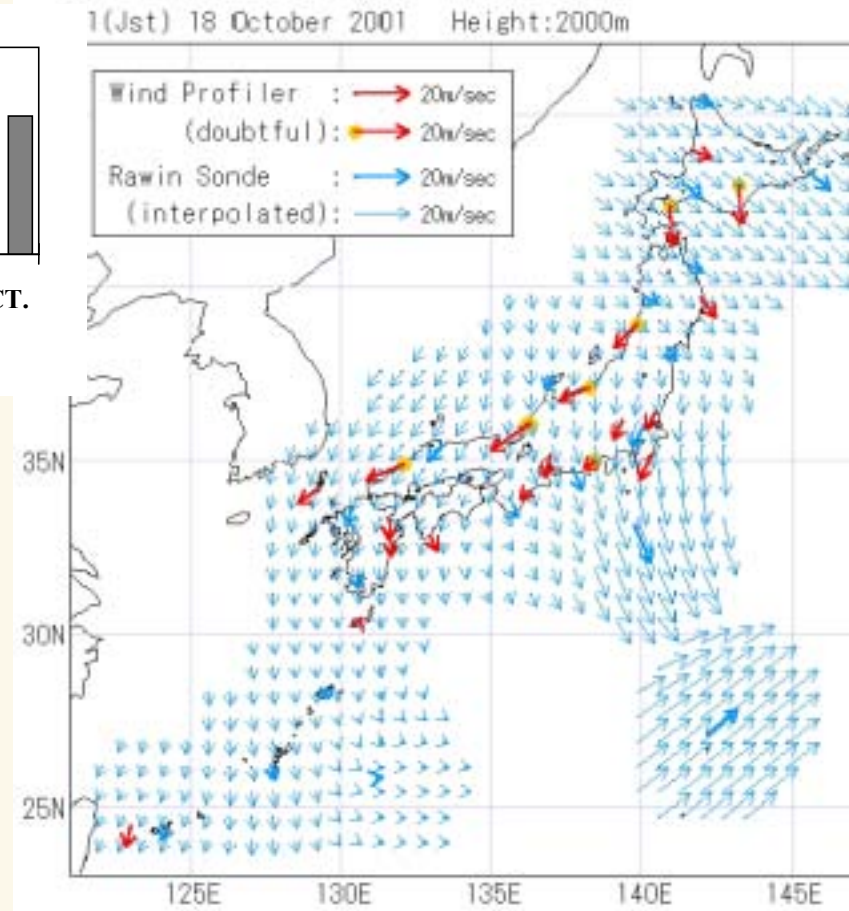
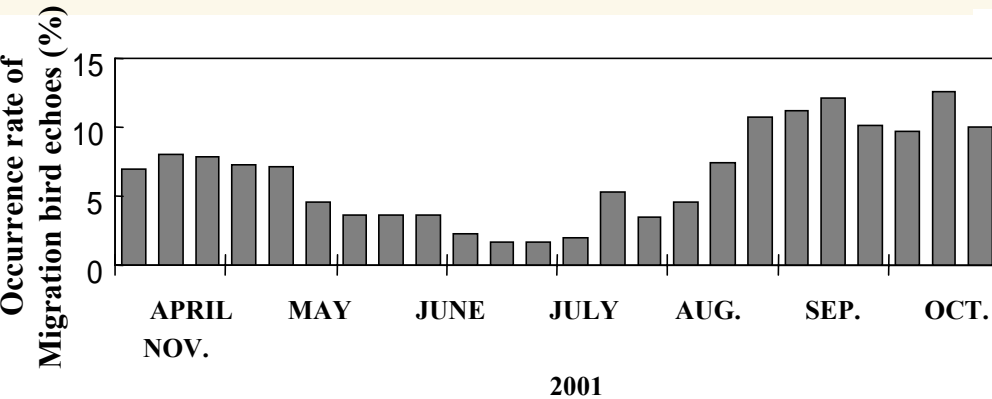
- Migrating birds have made most significant error in the wind measurements.



Intense migrating-bird echoes observed on 15 October 2001 at Muroran profiler.

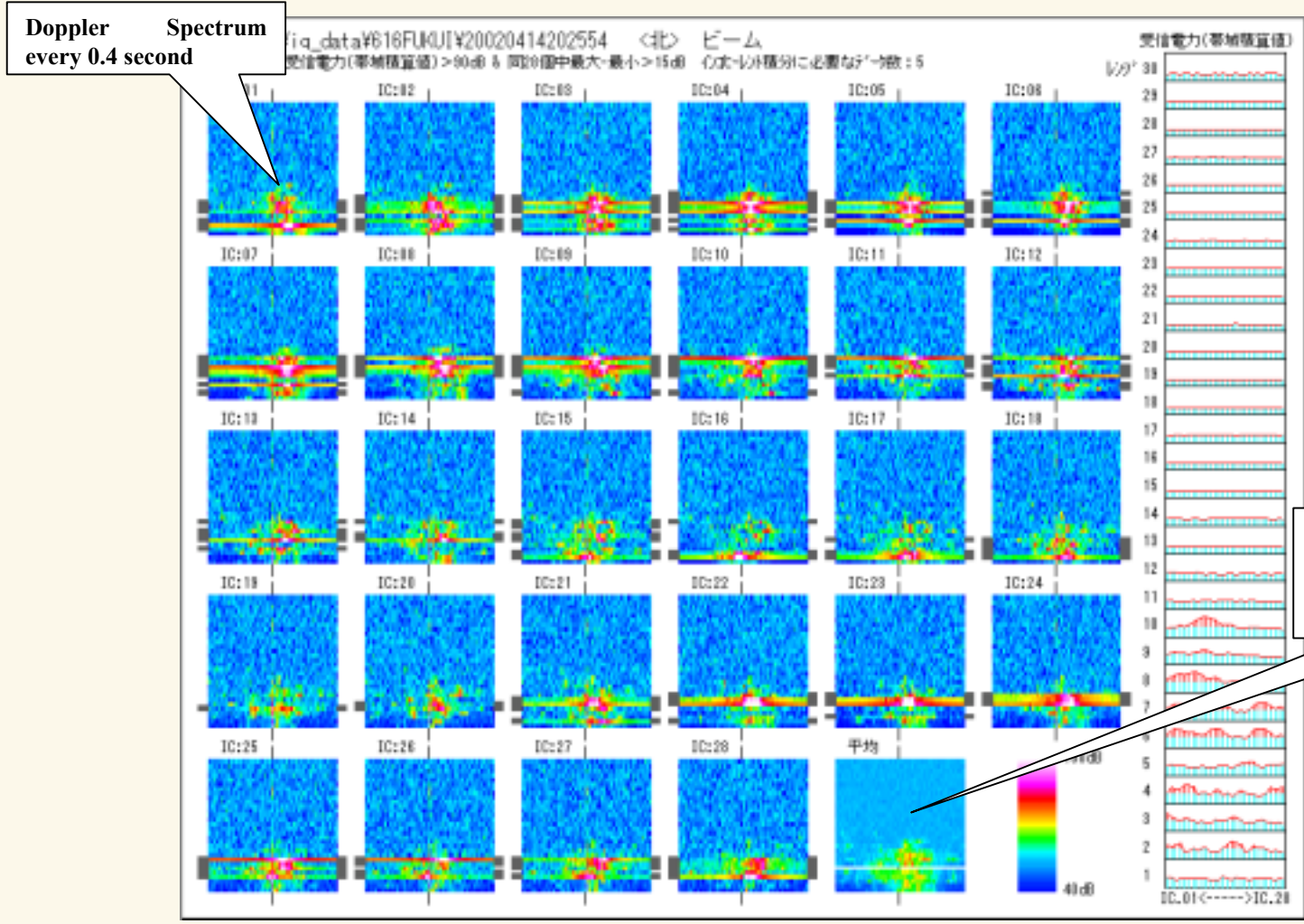
Contamination from Migrating Birds

- Migrating-bird echoes occur mostly at night of spring and autumn under fair weather conditions. In October 2001, 12% of the total amount of the profiler data were contaminated.



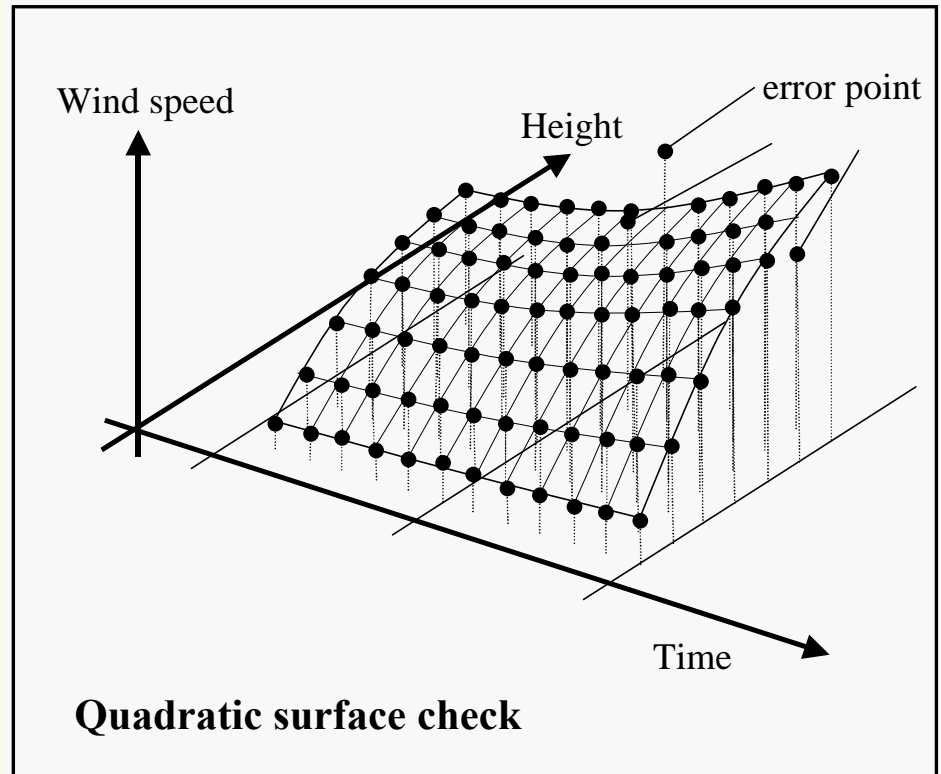
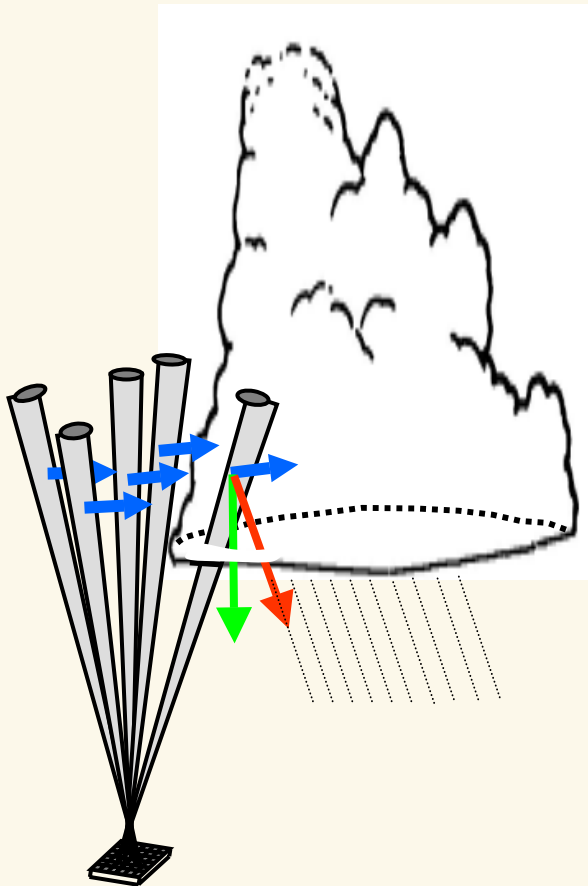
Contamination from Migrating Birds

- Data contaminated by migrating birds have been removed by monitoring time-variation of signal power between coherent integration and incoherent integration.



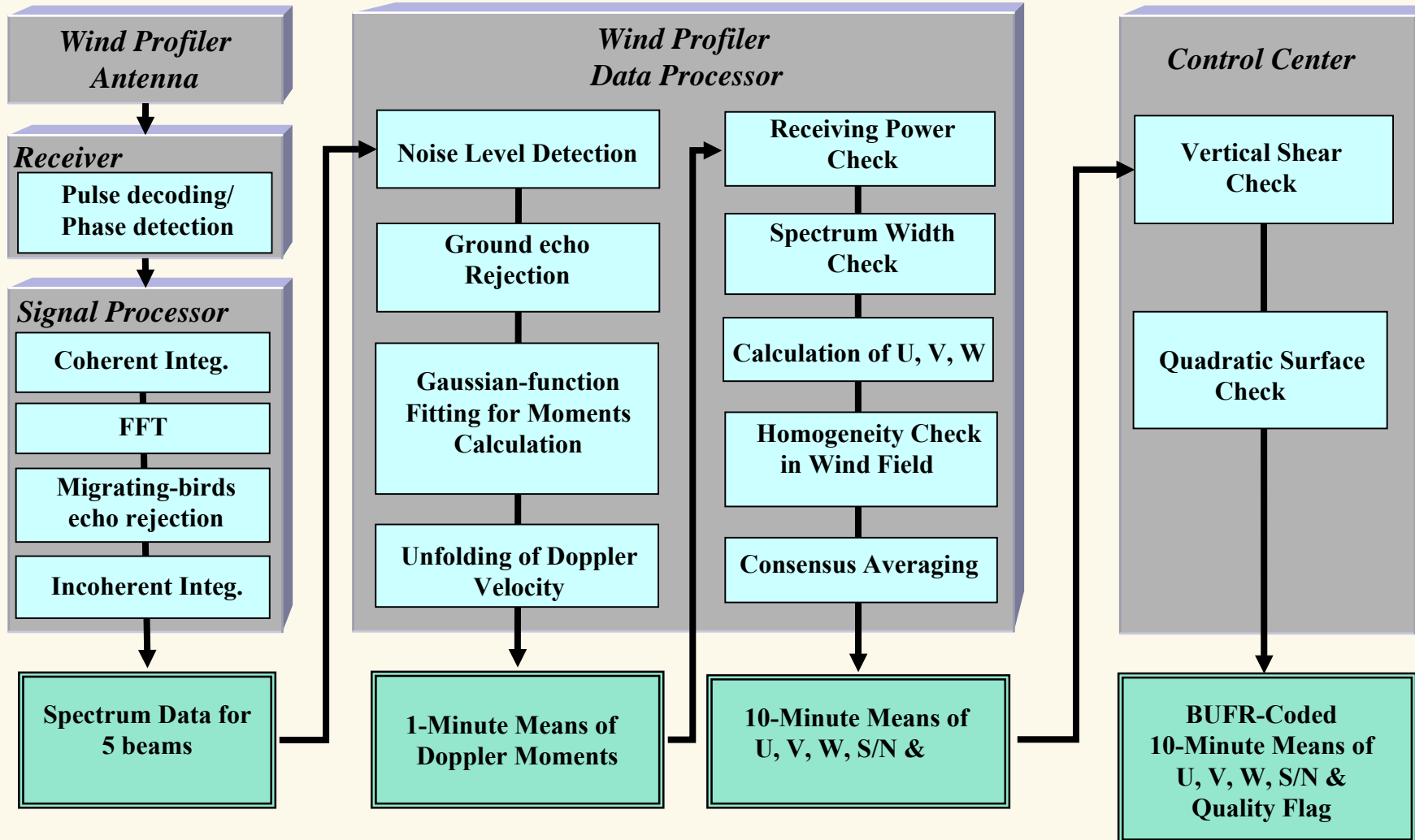
Quality Control of wind profiler data

- Data of wind profilers used in real-time at operational weather services have to be kept in high quality. Various types of quality control are adopted at the each stage of signal processing and data processing in WINDAS.



Data Quality Control

- Quality controls of signal and data are made at each stages of signal processing and data processing.



Summary

- **31 wind profilers are being operated as a meso- β scale upper-wind observation network ‘WINDAS’ in Japan.**
- **The WINDAS data have successfully been utilized in the 4-D variational data assimilation scheme built in the weather forecast models of JMA since 2002.**
- **It has been demonstrated that WINDAS improves the accuracy of the numerical forecast for severe rainstorms.**

Wind Profiler Networks of which data are distributed on GTS

ECMWF Data Coverage (All obs) - PILOT/PROFILER
09/MAR/2005; 06 UTC
Total number of obs = 852

