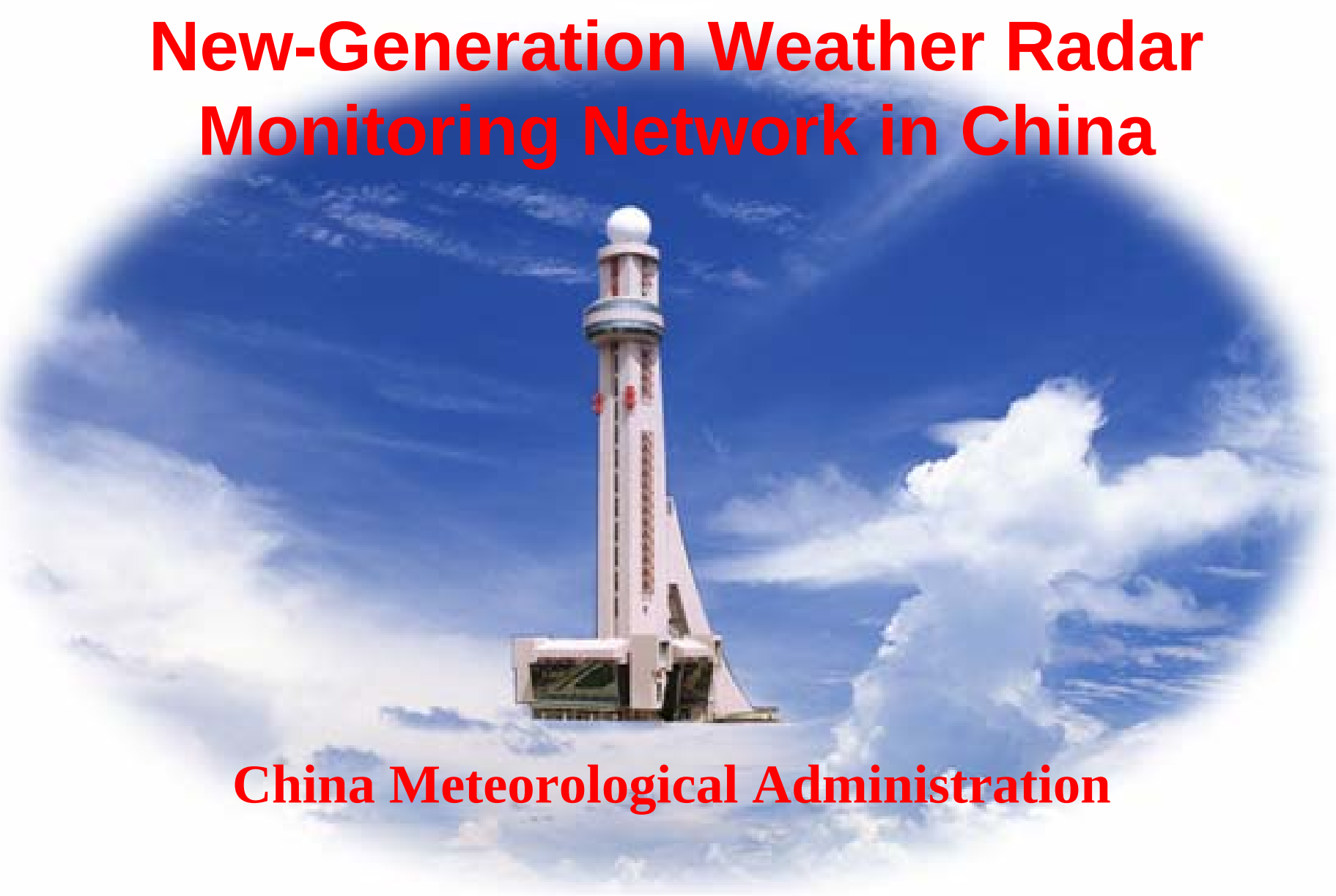
New-Generation Weather Radar Monitoring Network in China



China Meteorological Administration

CINRAD IN CHINA

China is affected by weather-related disasters. The China Meteorological Administration (CMA) is currently deploying a network of 158 C-band and S-band radars for the purpose of early detection of heavy rain, hail, floods, and typhoons.

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CINRAD IN CHINA

Heavy rain in Hebei
June 15, 2004

Hail in Shandong
June 03, 2003

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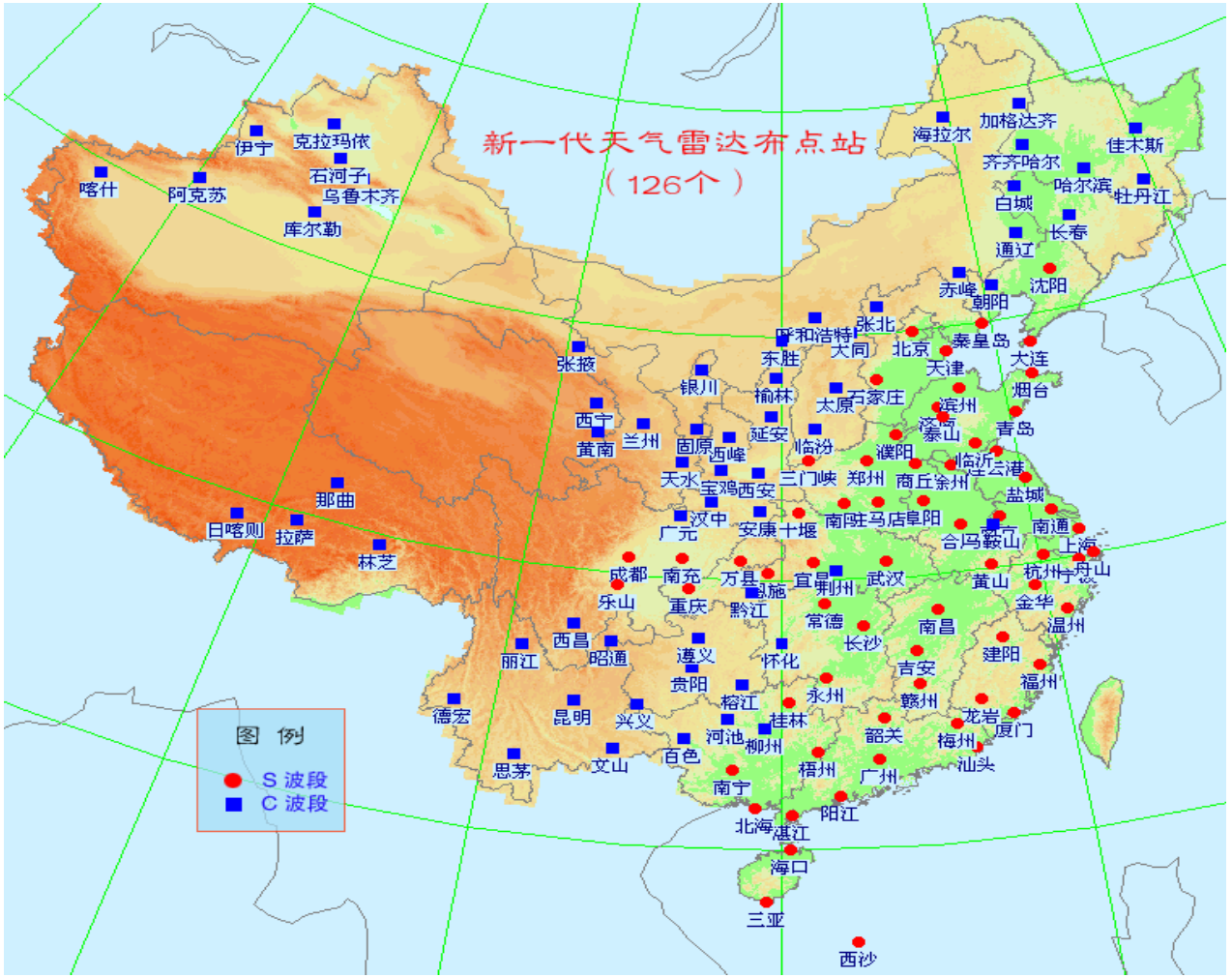
CINRAD General Project

- 158 CINRADs of which 87 are S-band and 71 are C-band .
- The red dots are S-band, blue squares C- band .



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CINRAD General Project

- **Currently 115 CINRADs are operational.**
- **Constantly running at same default VCPs 24 hours a day, 7 days a week.**
- **When necessary, some radars can be operated individually to rapidly obtain vertical cross section of storm.**

How Many Radar Types?

There are 8 types (7 in China, 1 in Korea).

3 Types of S-Band

- **CINRAD/SA --------- S-band (WSR-98D)**
- **CINRAD/SB --------- S-band**
- **CINRAD/SC --------- S-band**

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How Many Radar Types?

5 Types of C-Band

- **CINRAD/CA ------ C-band (for Korea)**
- **CINRAD/CB ------ C-band**
- **CINRAD/CC ------ C-band**
- **CINRAD/CD ------ C-band**
- **CINRAD/CCJ ------ C-band (mobile Doppler radar)**

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Principles for Radar Distribution

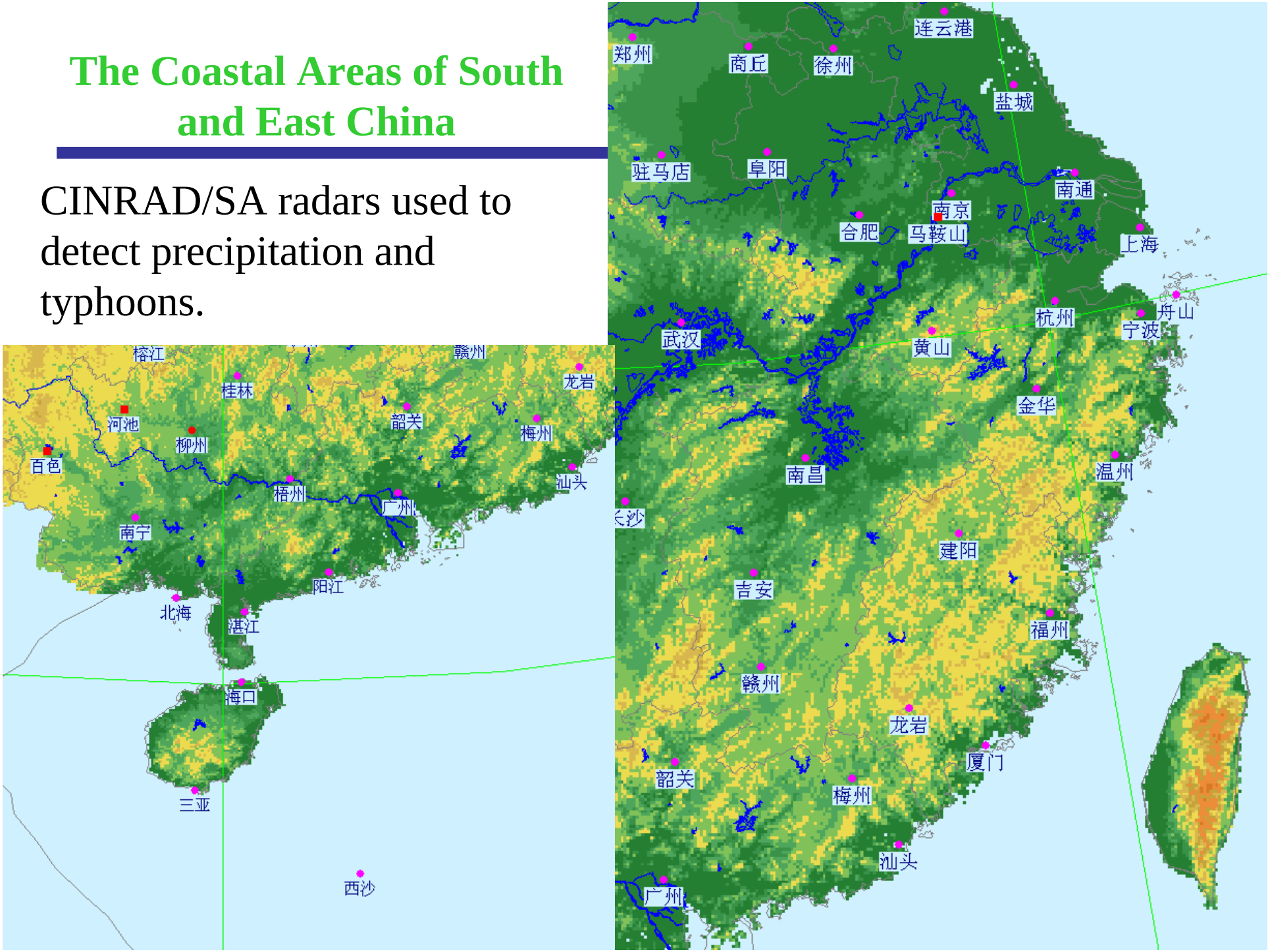
In accordance with the weather patterns, climate, and the need to detect severe weather, the Network has been designed with the following principles:

- S-Band will be deployed in coastal areas where typhoons and rainstorms often occur and in the Yangtze river reach which is vulnerable to rainstorms brought by Meiyu front.
- C-Band will be deployed in the western region and inland, where there is less rainfall but more frequent hail and severe convection.

Constantly scan to monitor Typhoon and extensive Rainfall, 47% time running VCP21

The Coastal Areas of South and East China

CINRAD/SA radars used to detect precipitation and typhoons.



Will run RHI as needed. (Mostly in western China.)

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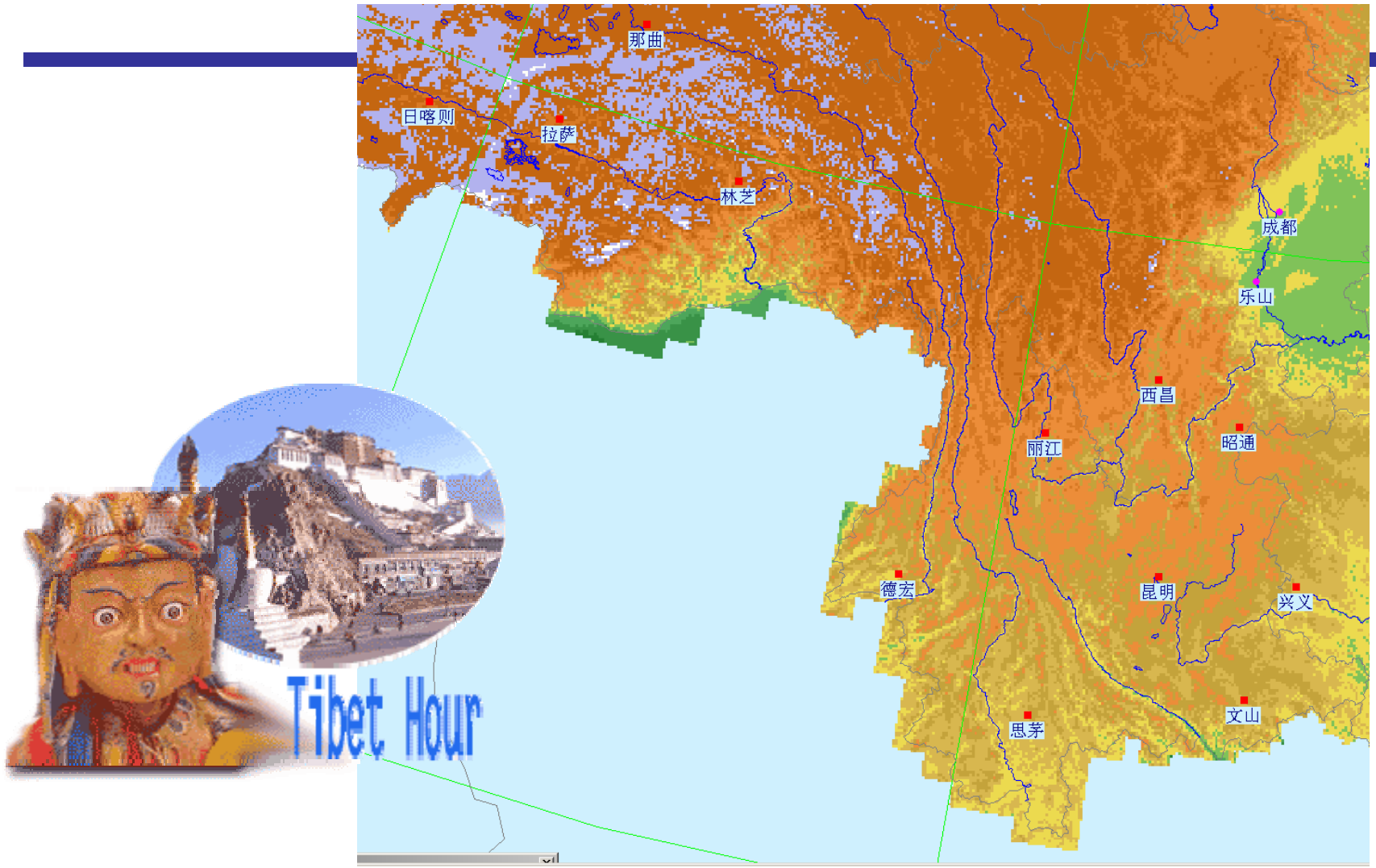
10 C-Bands in Yunnan and Tibet



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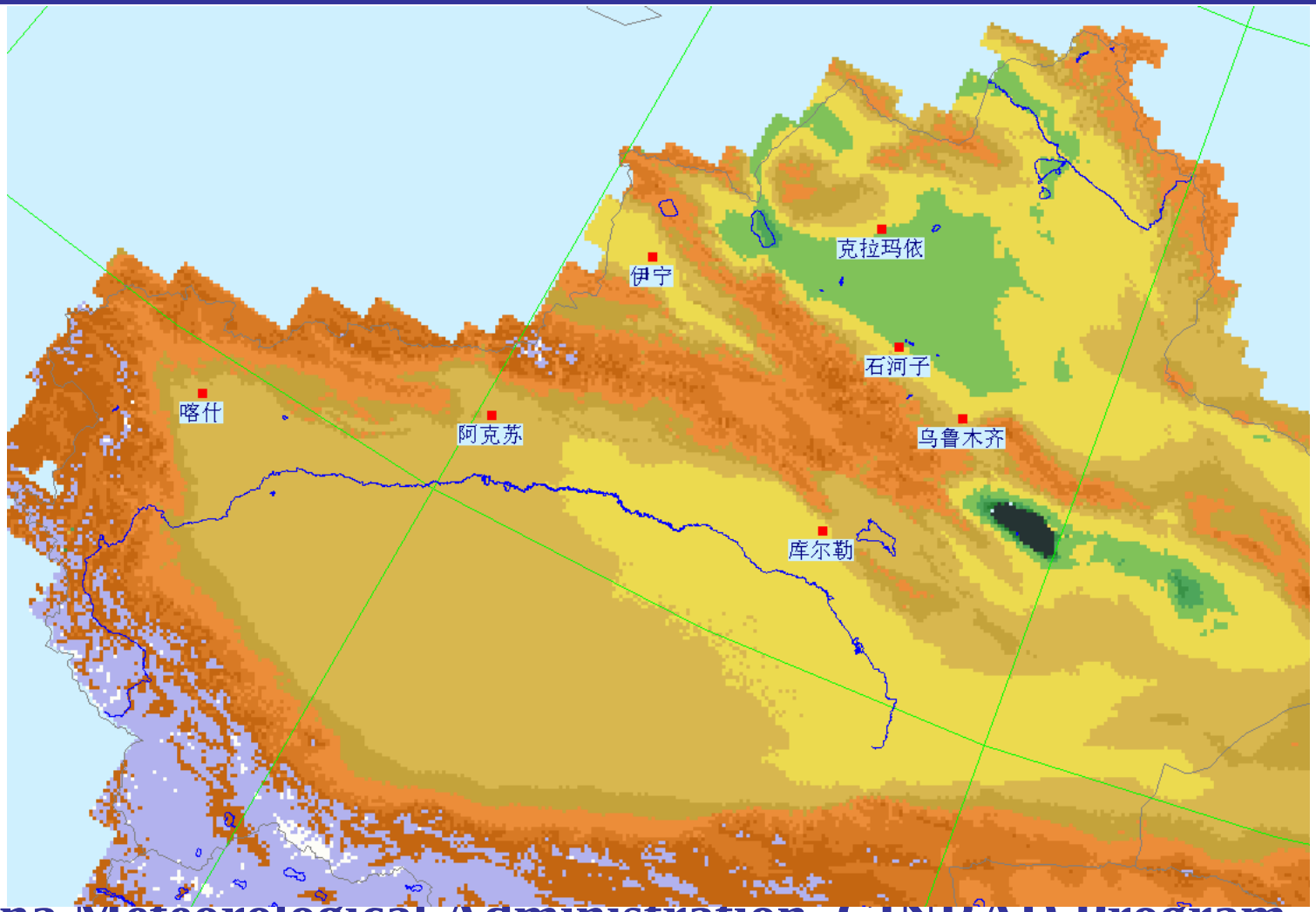
7 C-bands in Xinjiang



Radars Are Sited on Top of Buildings to Reduce Blockage

Around Cities

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Mountain Radars Use Negative Tilt Angles to Increase Low-Level Coverage

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High Density Deployment Along the Yangtze River to Detect Extensive Rainfall.

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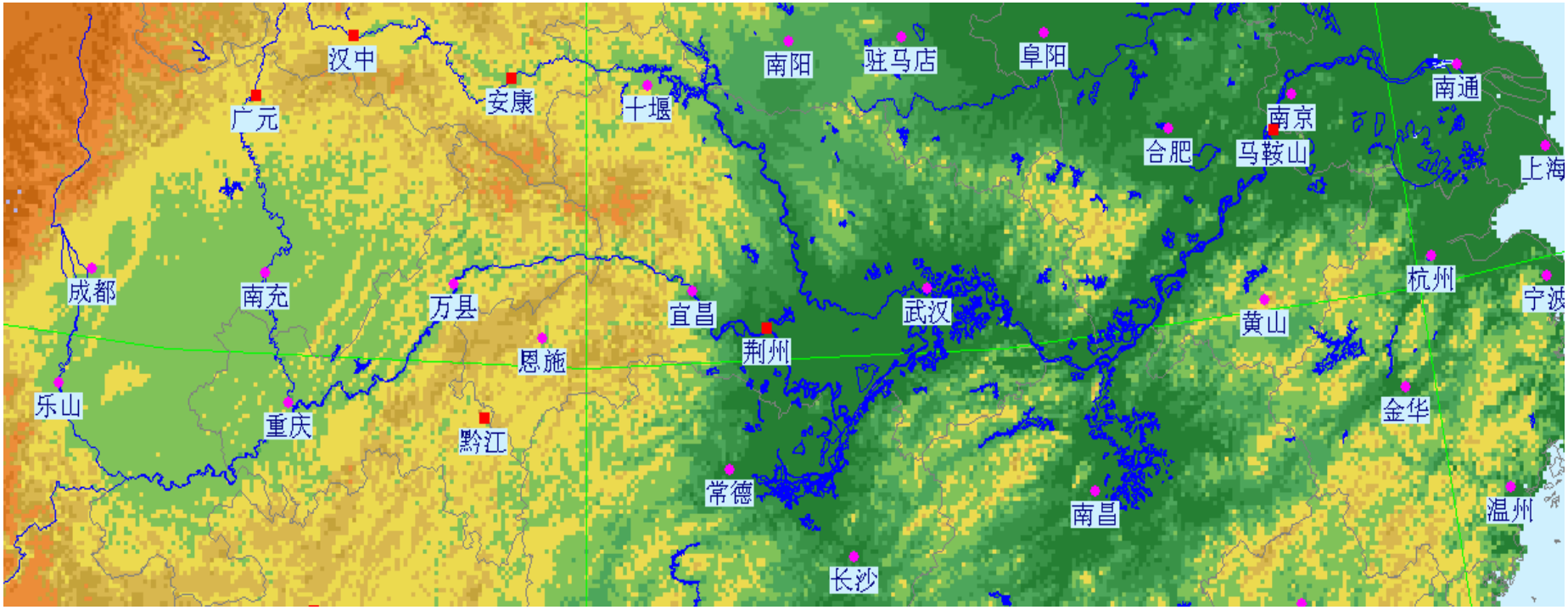
CINRAD Distribution Along the Yangtze River Basin



19 radars along Yangtze River Basin.

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Northeastern Region

Identify winter snow and local diversity weathers

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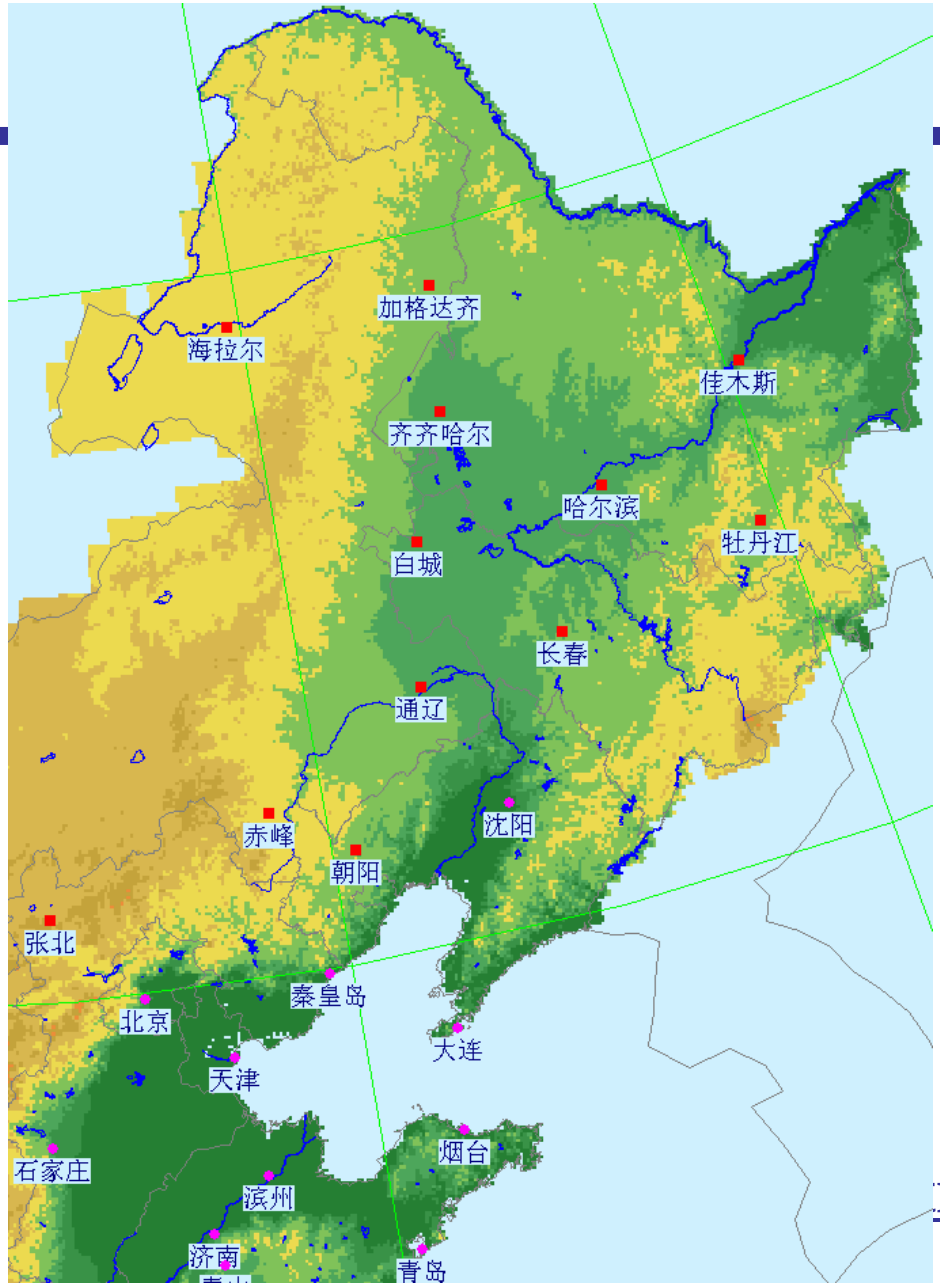
The CINRAD Distribution Along Songhuajiang River



CINRAD/CC and CINRAD/CD radars are set up in Northeast and Northwest China as well as Yunnan-Guizhou Plateau and Qinghai-Tibetan Plateau, these regions are characterized by short rainy season, mostly mountain climate, and local diversity in weather patterns.

11 C band CINRAD radars in the region

Dual-Doppler Observation and Science Experiment

Mobile radar

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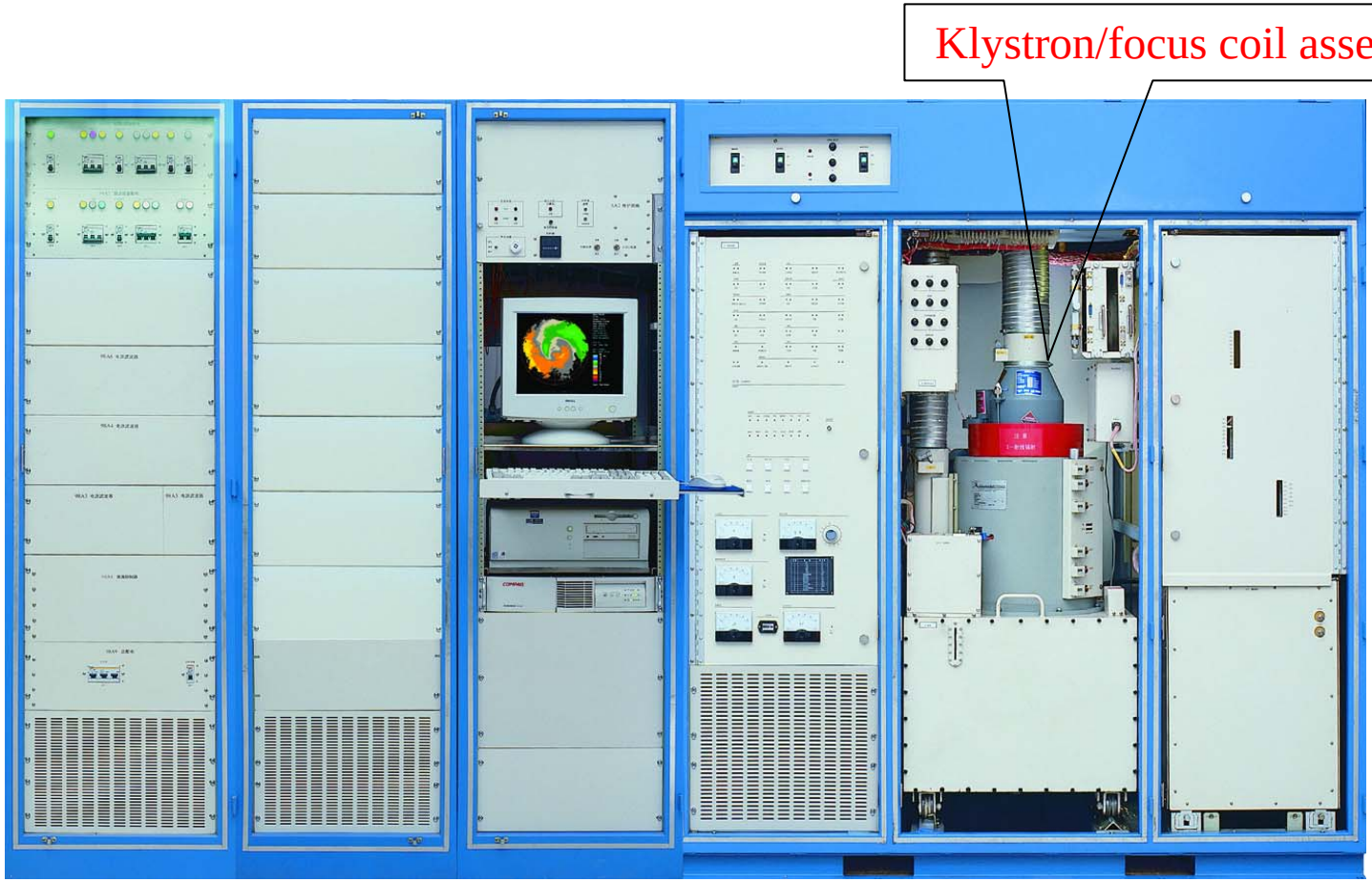
The Transmitter and Receiver



Receiver Components Transmitter Components

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CINRAD/CC

Since May 2001, CINRAD/CC radars have been working to detect important weather phenomena such as Meiyu front heavy rain, hail and squall-line etc.

The antenna diameter is 6.5 meters .

CINRAD/CC can run RHI and negative scan when need.

Transmitter: peak power >250 kw

Receiver : Dynamic range >85 dB

Working Freq : 5300 to 5500 MHz

The CINRAD/CCJ Radar in Scientific Experiment

Mobile radar at work in Qinghai Province

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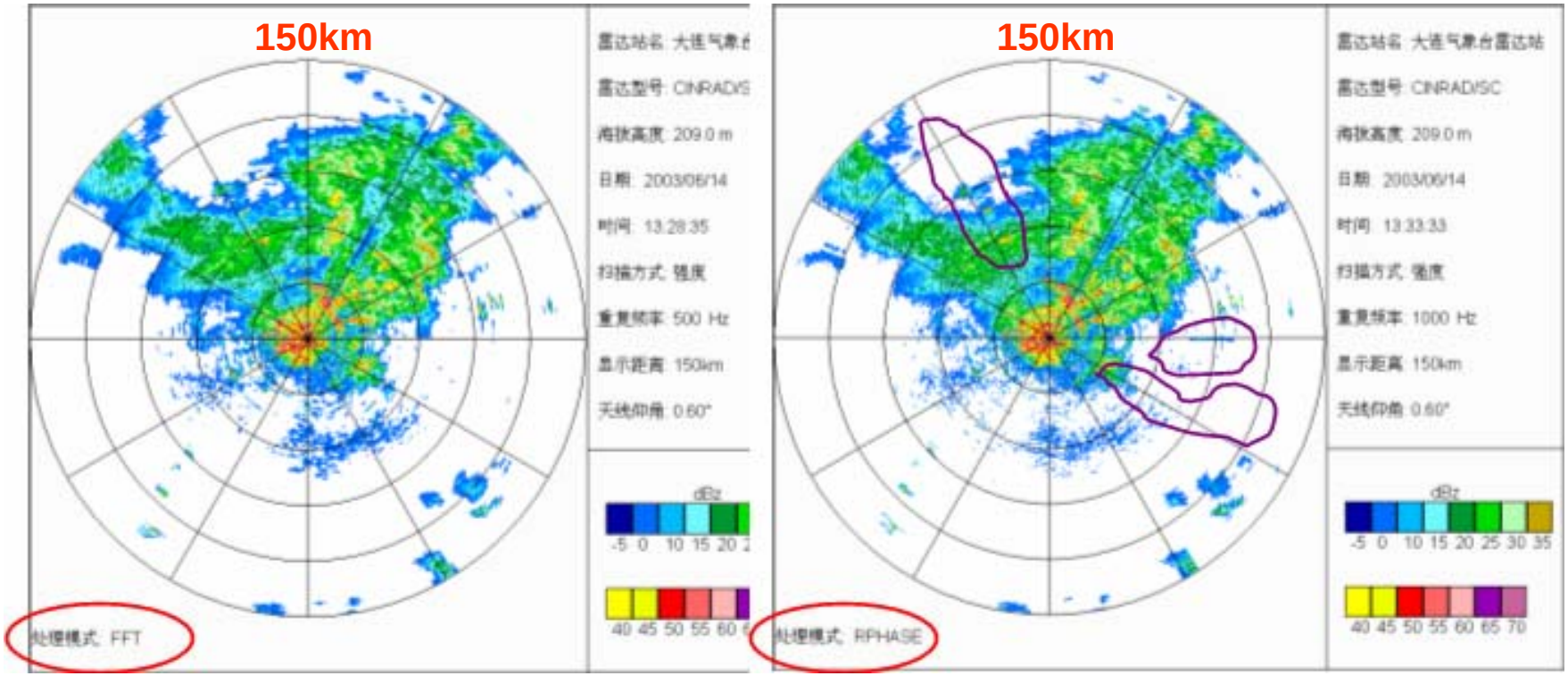
Data Quality Controlling

- **Phase Coding, Range-folding. Four prototype sites have been set up to deal with various weather phenomena.**
- **Dual-PRF. V-dealiasing has been successfully implemented in all radars.**
- **Dual-Polarization Is Under Development. Several prototype sites have been built.**

Phase Coding Effect



PRF=500/FFT **PRF=1000/Phased-coding**

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Mitigation of V with Dual-PRF

V+
Test recorder

Test point	1	2	3	4	5	6	7	8	9	10
Fd	0	140.0	250.0	320.0	406.0	560.0	640.0	710.0	790.0	860.0
PRF 1000 Hz	0	7.32	13.01	16.67	23.99	-22.77	-18.71	-15.05	-10.98	-7.32
Dual-PRF 1000 / 667	0	7.30	12.97	16.62	23.51	28.78	32.84	36.49	40.95	44.60
Error	0	0.02	0.04	0.05	0.048	0.57	0.57	0.58	0.19	0.2

Max Error 0.57m/s

V-
Test recorder

Test point	1	2	3	4	5	6	7	8	9	10
	0	8.8	29.4	69.4	179.4	319.4	479.4	559.4	729.4	879.4
PRF 1000 Hz	0	-0.41	-1.42	-3.66	-9.35	-16.67	-25.01	22.98	14.03	6.30
Dual-PRF 1000/ 667	0	-0.81	-1.62	-3.65	-9.32	-16.62	-25.14	-29.19	-38.11	-45.81
Error	0	0.40	0.20	0.01	0.03	0.05	0.13	0.13	0.02	0.01

Max Error 0.4m/s

Dalian real test recorders

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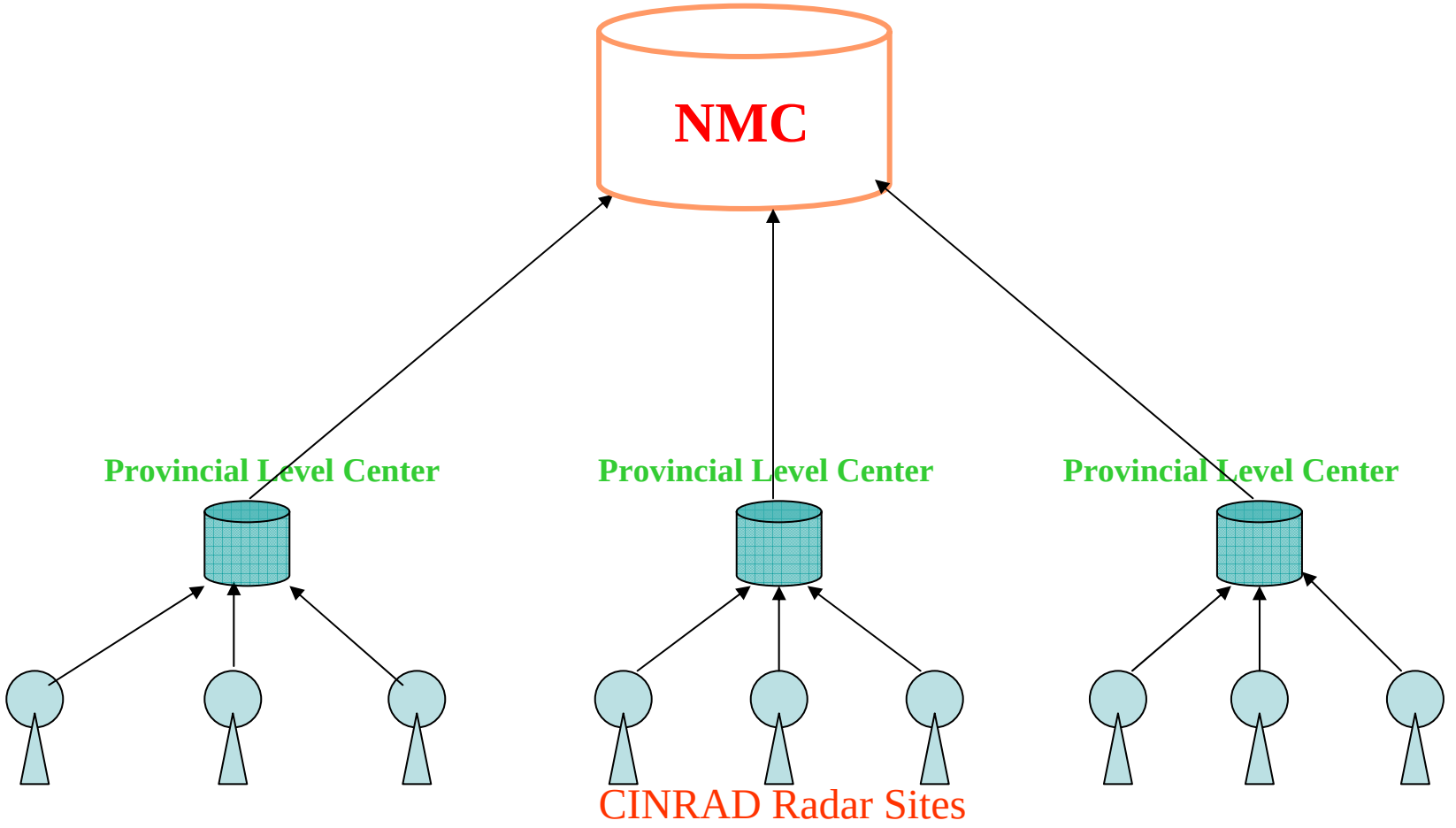
Data Central Collection Schemes

Radar sites disseminate real-time data to provincial sub-centers respectively, then to the National Meteorological Center (NMC) via a broadband backbone network.

Phase 1: Only radar products be transmitted since the trans-province broadband backbone network has not finished yet.

Phase 2: Base data disseminated to the NMC, when the construction of broadband networks linking radar sites with sub-centers and the trans-province broadband backbone network completed.

CINRAD Radar Data Transmission Scheme



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The CINRAD Radars in Operation

The first radar in Hefei, China in 1999

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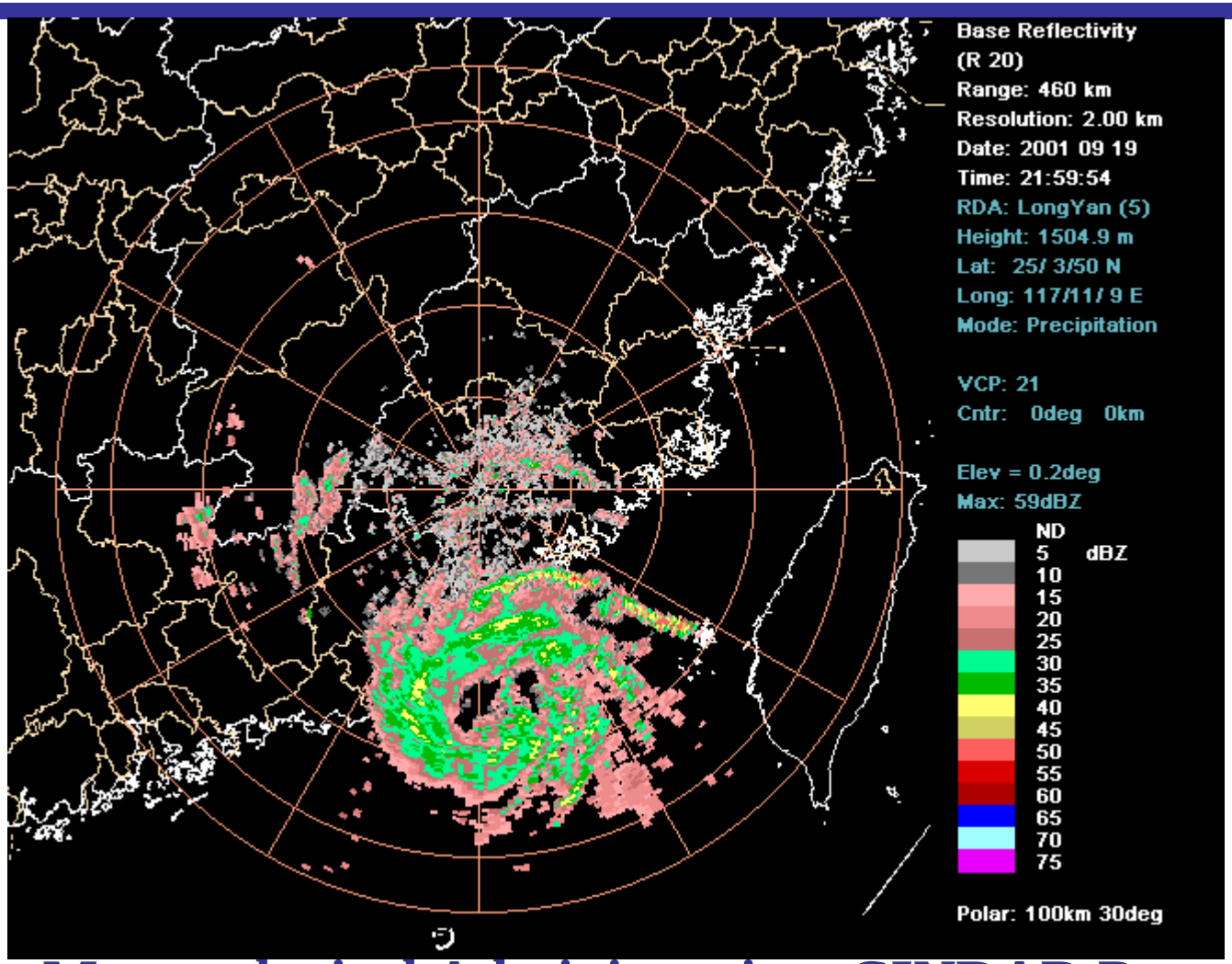
Longyan Typhoon Radar Echo



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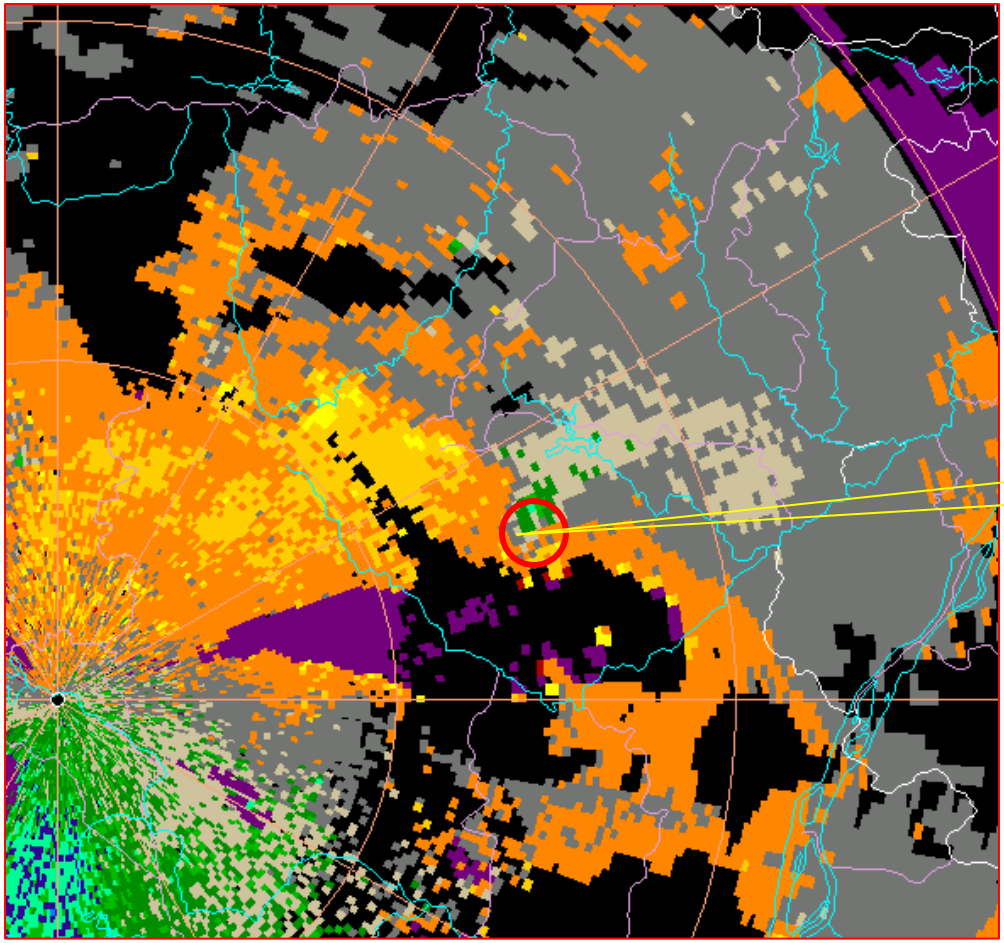
Mesocyclone

This mesocyclone produced 170 mm of precipitation in two hours.



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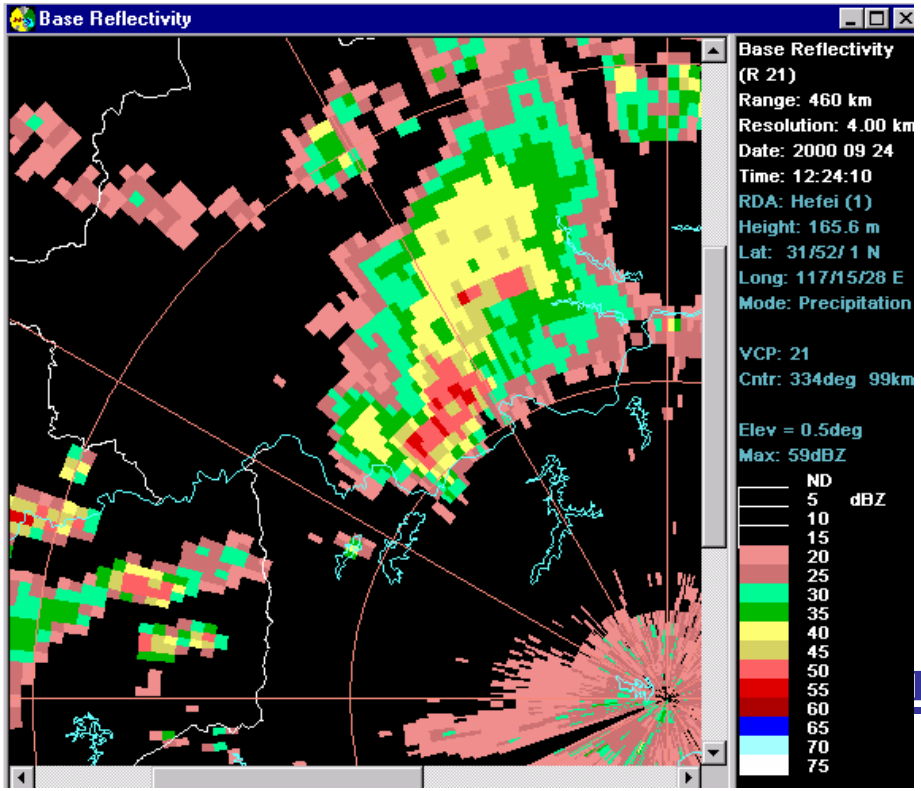
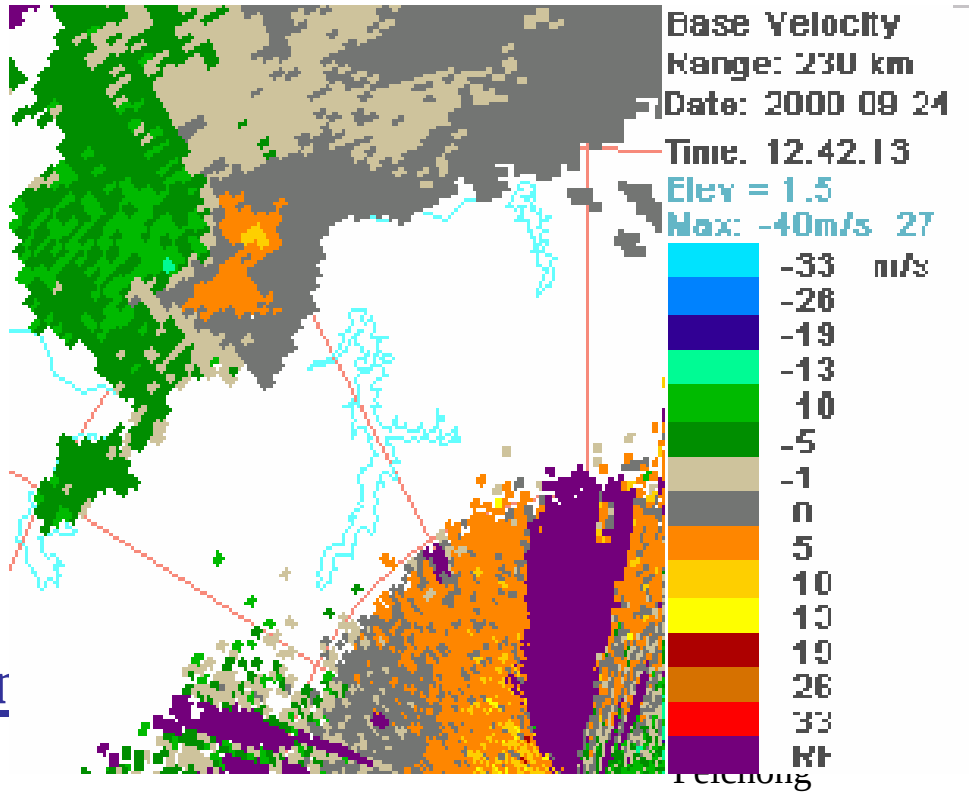
Mesocyclone

A Mesocyclone Associated with Hail

Reflectivity

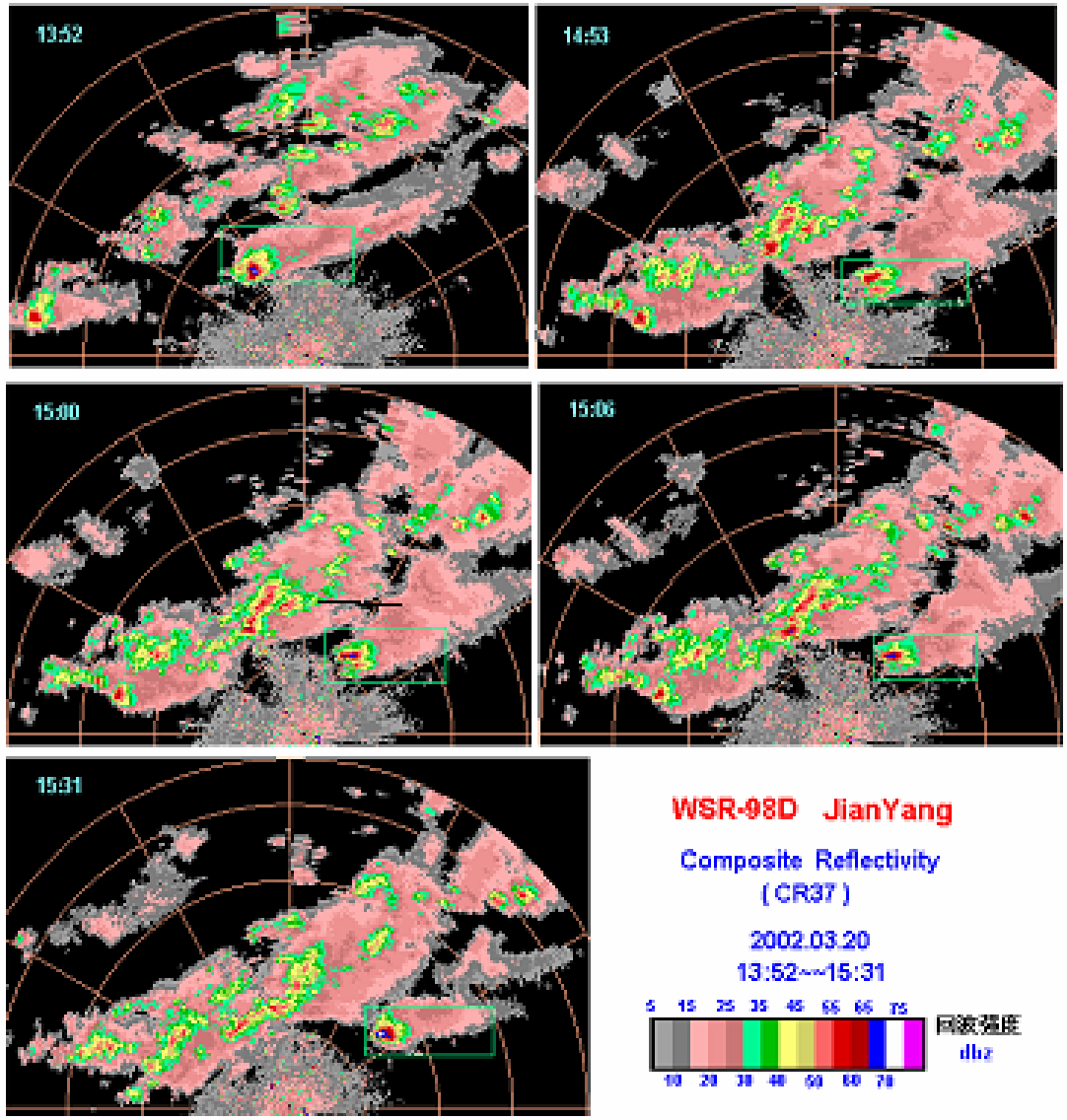


Radial Velocity



2002.03.20

Hail Echo



China Metec gram

On-going

- Continue to deploy the rest of the radars in 1-2 years
- Centralized collection of base data and products.
- Improvement of phase coding
- Further development of dual-polarization
- Continued improvement of data quality
- O&M system support

Summary

- **CINRAD construction is on-going.**
- **87 S-band and 61 C-band will be deployed in China, 56 radars are already operational.**
- **CINRAD baseline configuration.**
- **New technology has been used in CINRAD.**
- **Typhoons, hail, rain storms have been effectively detected.**