Cryospheric observations at CMA stations

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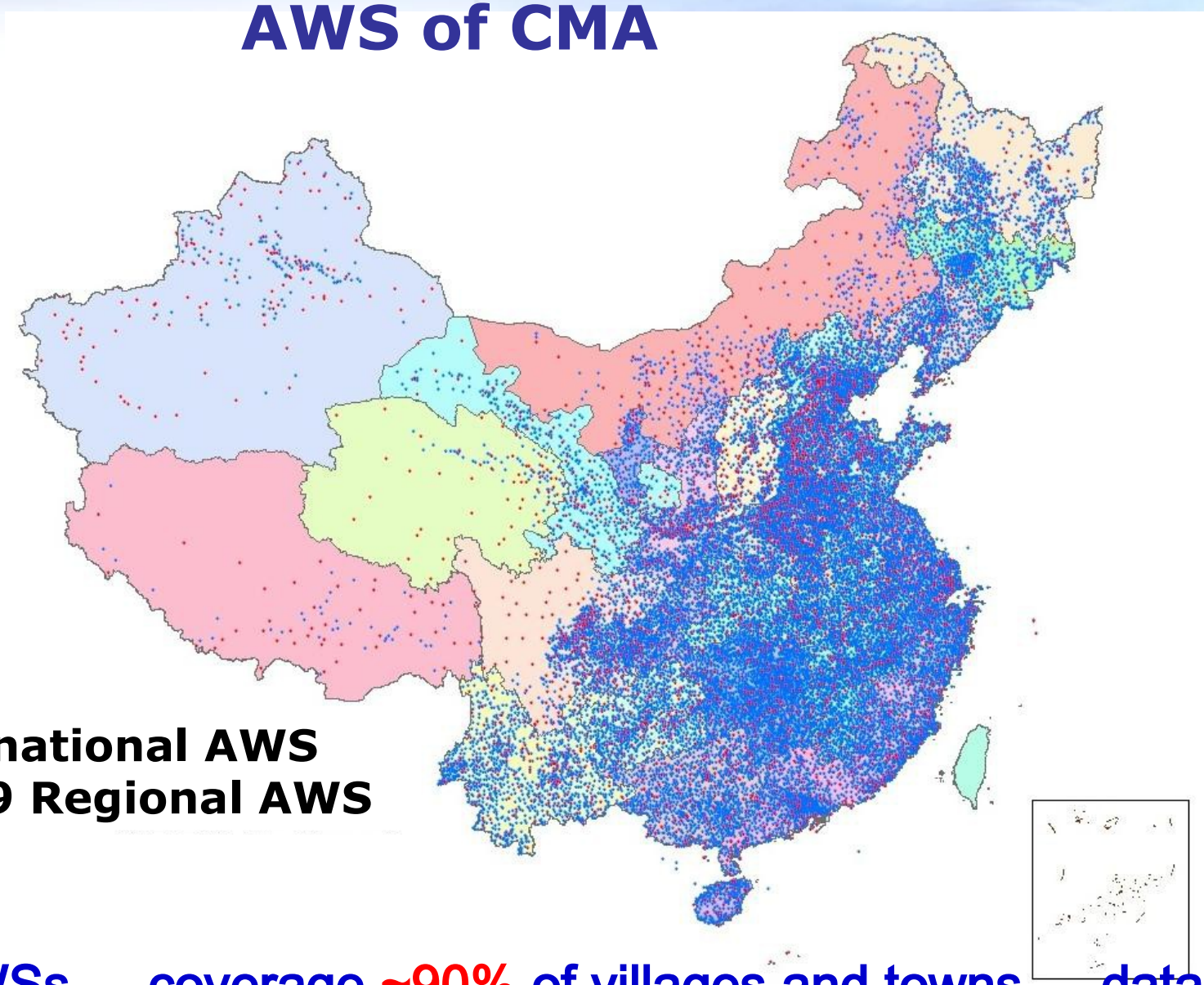
National observing stations (2423, updated)

- National climate reference station : 212
- National weather observation Station : 2211

Most of the stations have data series more than 50 years

AWS of CMA



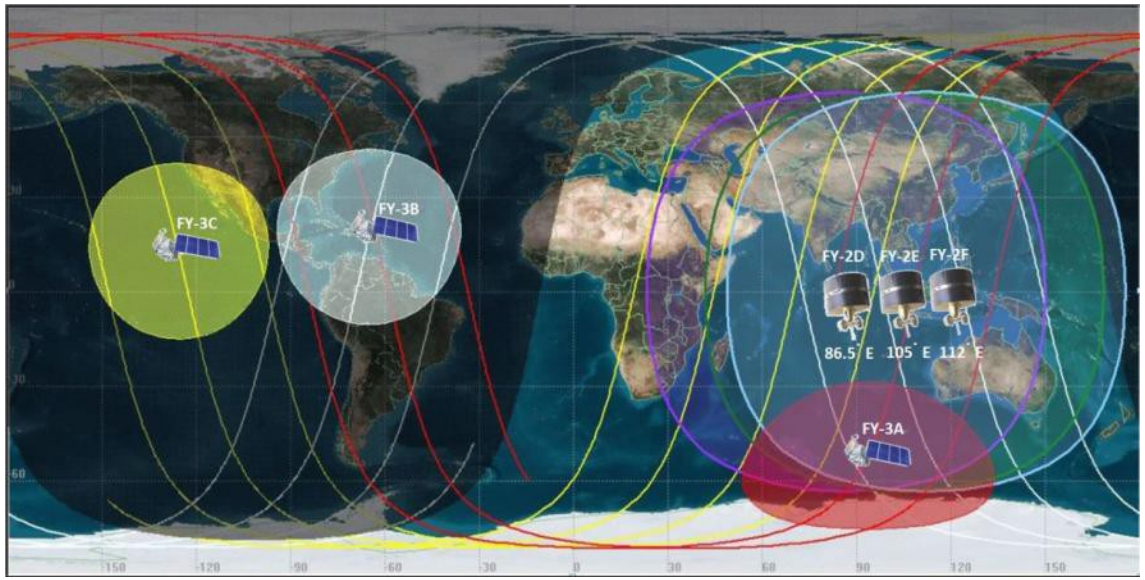
red: 2423 national AWS
blue:49409 Regional AWS

- 52132 AWSs , coverage ~90% of villages and towns , data availability 95.2%

FY Serial Meteorological Satellites

- Successfully launched 12 FY serial meteorological satellites
- Currently 6 in orbit
  - Polar: FY-3A/B/C
  - Geostationary: FY-2 D/E/F

At 11:07 on September 23, 2013 , the third FY-3 meteorological satellite was successfully launched



Currently six FY satellites in orbit

Polar-orbiting meteorological satellites

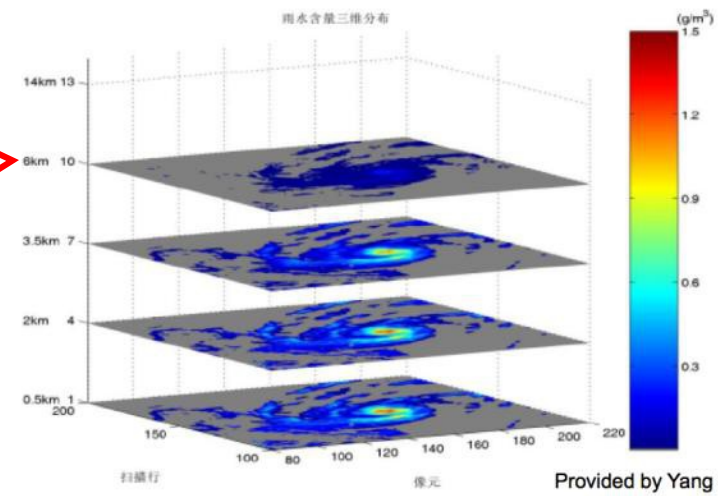
- From FY-1 to FY-3, representing the upgrade of polar-orbiting meteorological satellites
- Temporal resolution for global observation has shortened from 12 hours to 6 hours
- Morning- and afternoon-orbit satellite constellation
- Full spectrum of UV, visible , infrared and microwave measurements

FY-1

FY-3

FY-3 satellite Microwave Imager precipitation

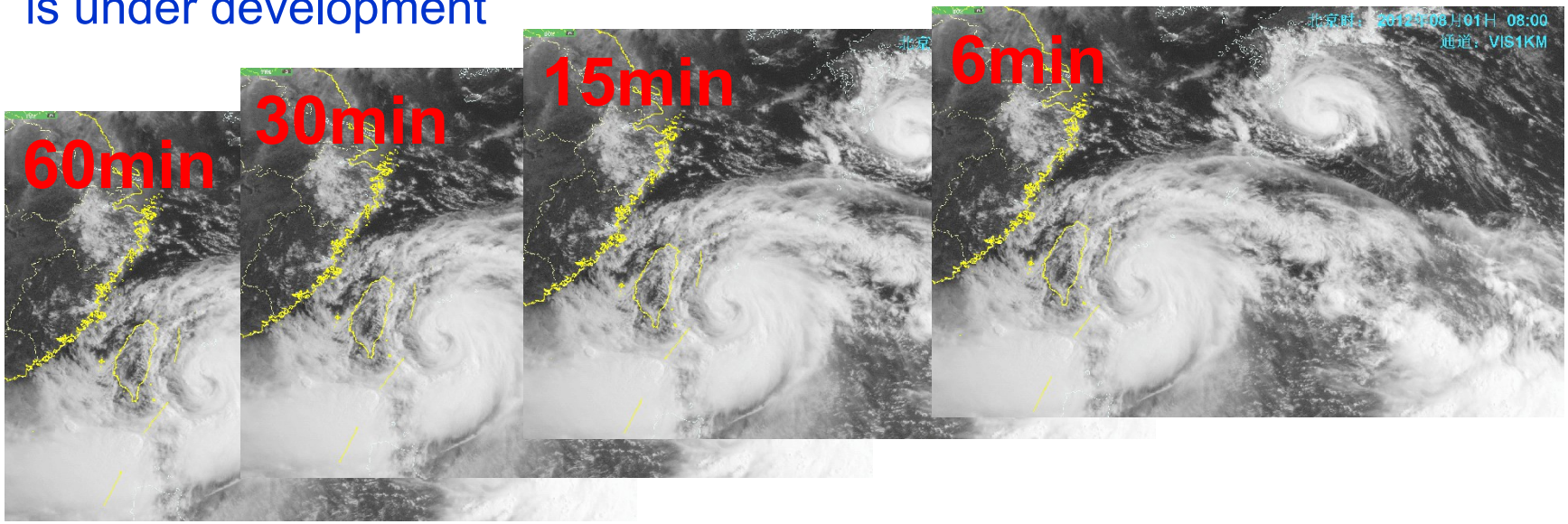
Precipitation 3D Structure of Typhoon Saoda by MWRI 89GHz Channel Data



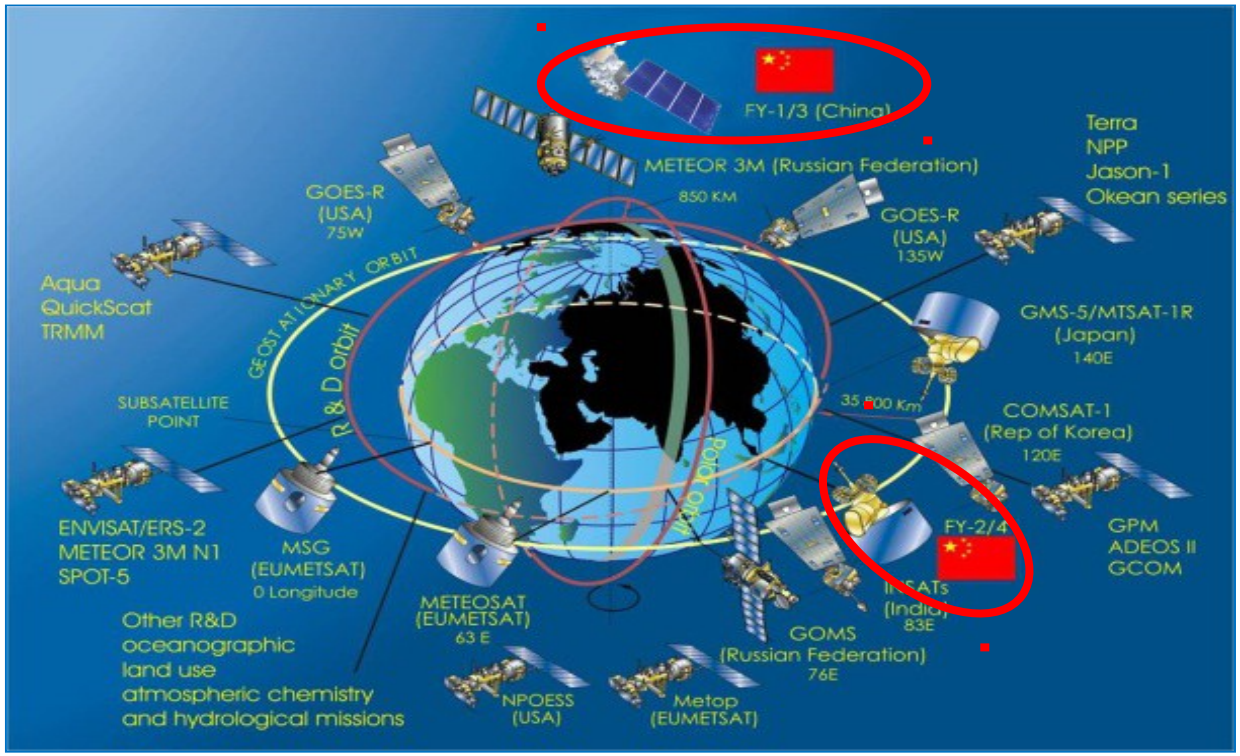
Provided by Yang Hu

Geostationary meteorological satellites

- Vertically observe atmospheric temperature-humidity profiles
- Regional observations reduced to 6 minutes
- Operational cloud-tracked wind proudct
- Next-generation geostationary meteorological satellite, FY-4, is under development



Data sharing: Number of users of FY satellites exceeds 2500
in more than 70 countries and regions



National observing stations

Observing content		frequency		
methods	parameters	national climate reference station （212）	national weather observation stations （2211）	
automatic	T、P、H、WS、WD、R、Ground T	Every minutes		
manual	cloud、visibility、weather phenomenon、precipitation	5（08、11、14、17、20BJT）	5（08、11、14、17、20BJT）	3（08、14、20BJT）
	Wire icing、snow depth/pressure、frozen soil	1（08 BJT）	1（08 BJT）	1（08 BJT）
	sunshine	1（after sunset）	1（after sunset）	1（after sunset）

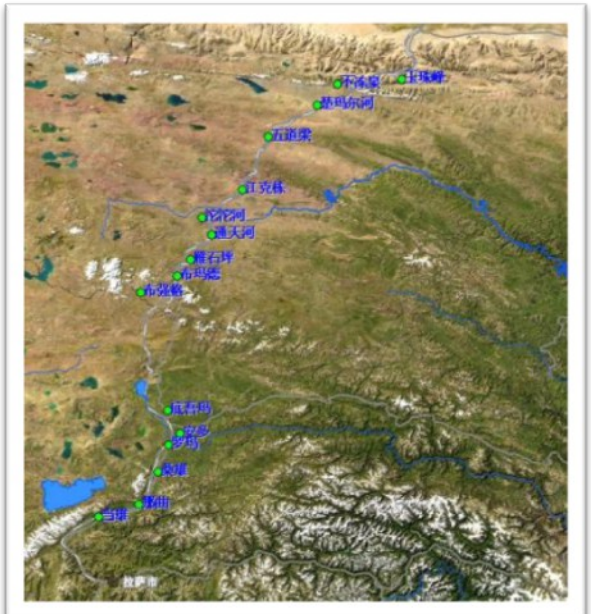



observation precision of national stations

parameters	range	resolution	maximum permissible errors
temperature	-50℃～50℃	0.1℃	±0.2℃
RH	5%～100%RH	1%	±3%（≤80%）
			±5%（＞80%）
Air pressure	500hPa～1100hPa	0.1hPa	±0.3hPa
WD	0～360°	3°	±5°
WS	0～60m/s	0.1m/s	±（0.5+0.03V） m/s
Precipitation	0～4mm/min (Tipping rain gauge)	0.1mm	±0.4mm，≤10mm/h；±4%， >10mm/h
	0～400mm (solid precipitation)		
Surface temperature	-50℃～80℃	0.1℃	-50～50℃： ±0.2℃
			50～80℃： ±0.5℃
Soil temperature	-40℃～60℃	0.1℃	±0.3℃

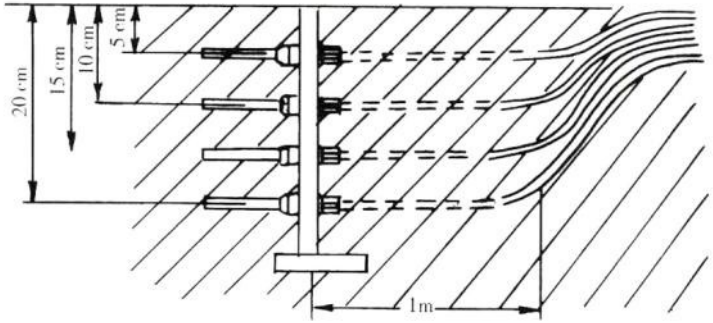
Frozen soil observing stations along Qinghai-Tibetan Railway （16）

parameter	range	resolution	accuracy	sensors arrangement
Air temperature	-50℃ ～ 60℃	0.1℃	±0.2℃	1.5m above ground surface
Soil temperature	-50℃ ～ 60℃	0.1℃	±0.2℃	10 、 20 、 40 、 60 、 80 、 100 、 120 、 160 、 180 、 320 cm depth
soil moisture	0 ～ 100 %	0.1 %	±3 %	10 、 40 、 80 、 120 、 180 cm depth



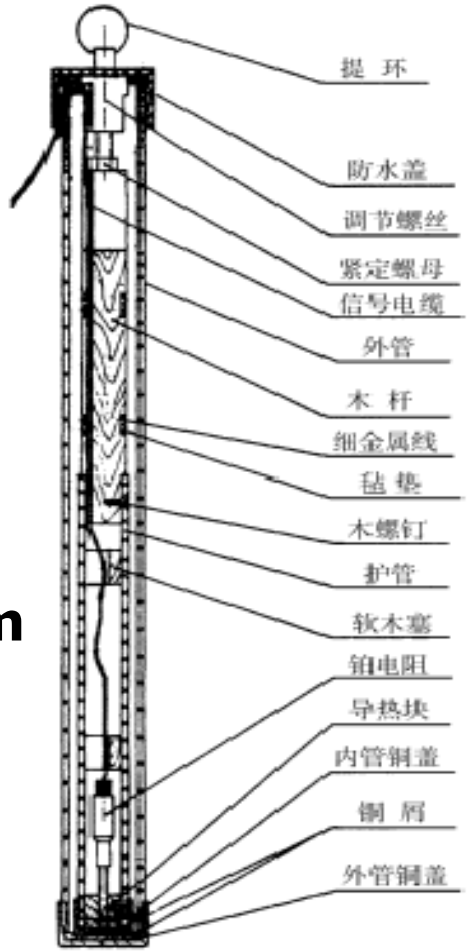
Instruments（soil temperature）

Platinum resistor Temperature sensor(PRT)



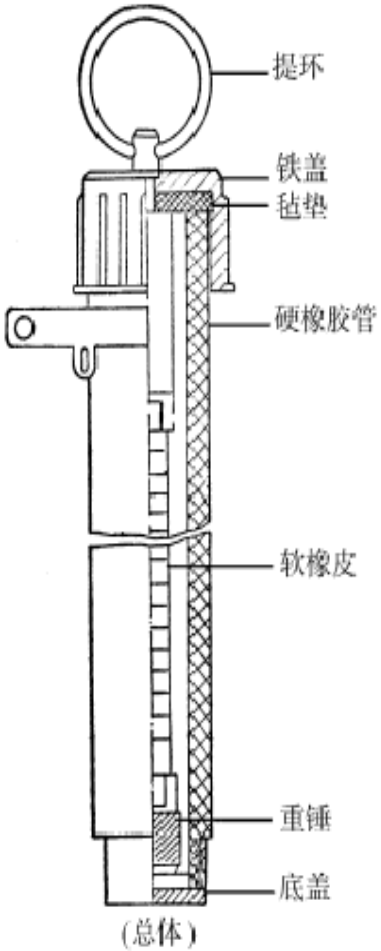
Fleet soil temperature: 5cm、10cm、15cm、20cm

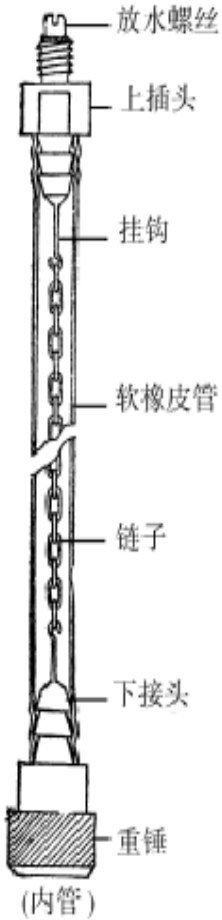
Deep-seated soil temperature: 40cm、80cm、160cm、320cm

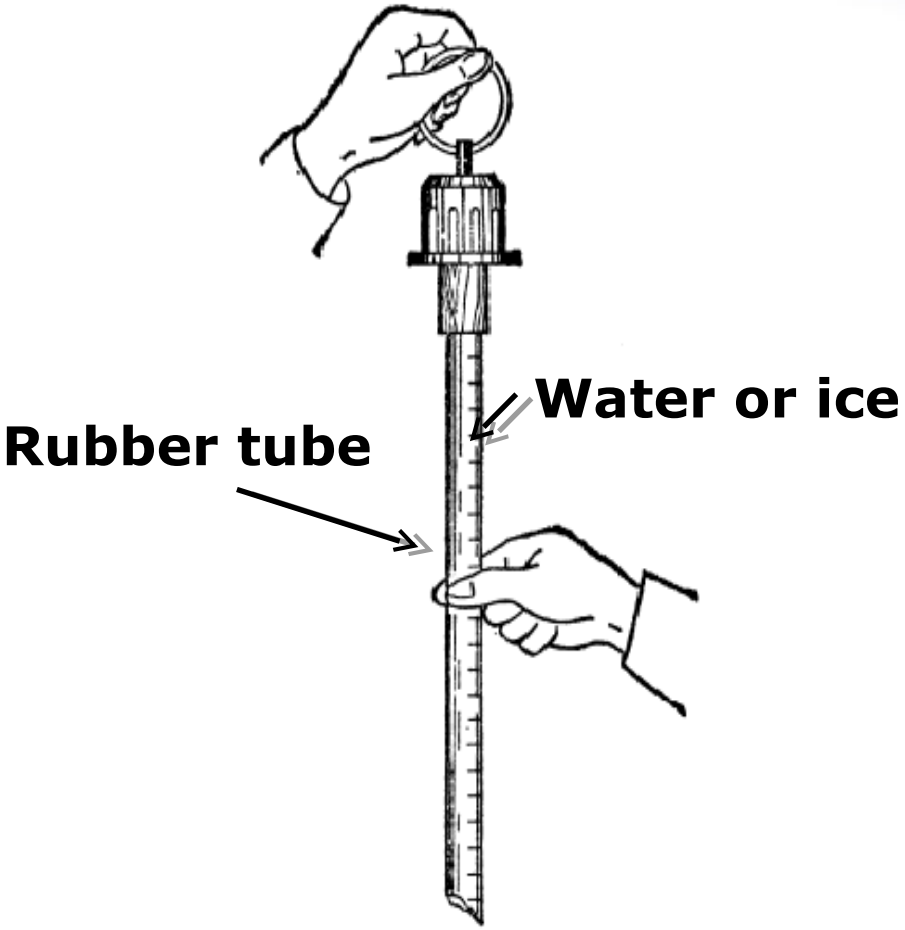


The method were used more than 60 years in the stations.

Instruments (frozen soil depth)







The method were used more than 60 years in the stations.

Instruments (solid precipitation)

- Auto instrument for Solid precipitation (482 stations)
- More than 2000 sites before 2017

Manual observation at most stations

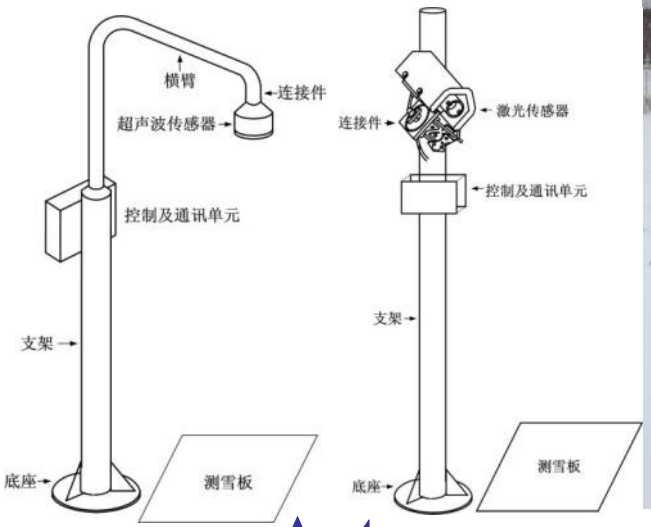
Range	resolution	accuracy
0 ～ 400mm	0.1mm	±0.4mm， ≤ 10mm/h； ±4%， >10mm/h

Instruments(snow depth)

- **60 ultrasonic/laser snow depth gauge**
- **More than 2000 sites before 2017**

	Range	resolution	accuracy
manual	0-2 m	1mm	±10mm
auto	0-2.5m	1mm	±5mm

Manual measurement

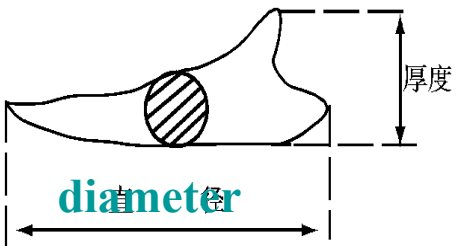


Auto measurement

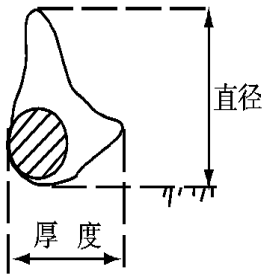
Wire icing

Diameter of icing (mm)

Thickness of icing(mm)

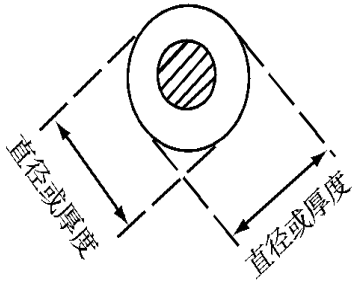


diameter

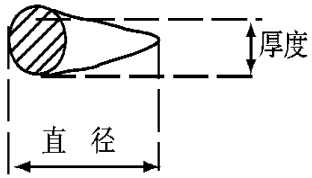


diameter

thickness



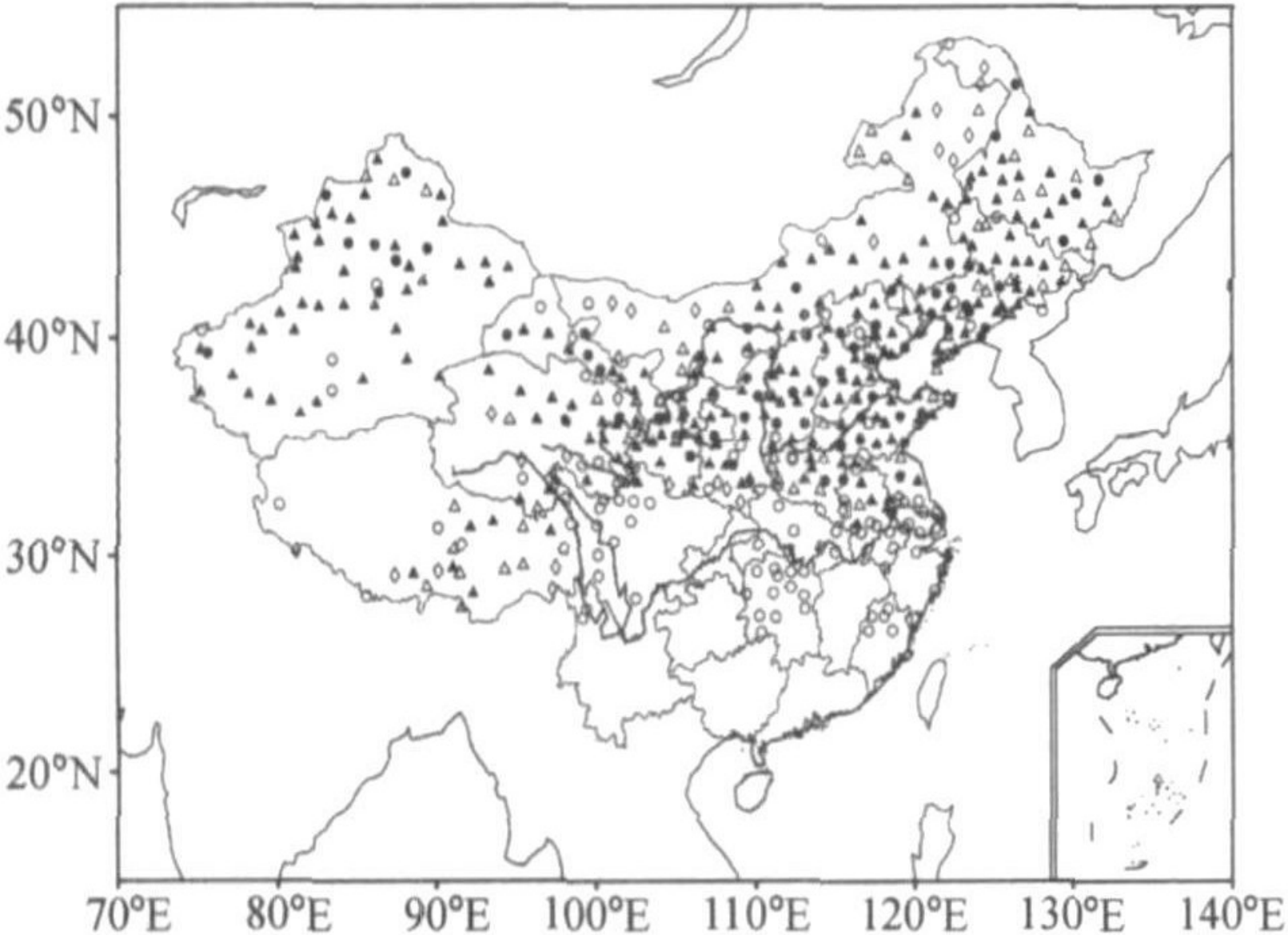
Diameter/thickness



thickness

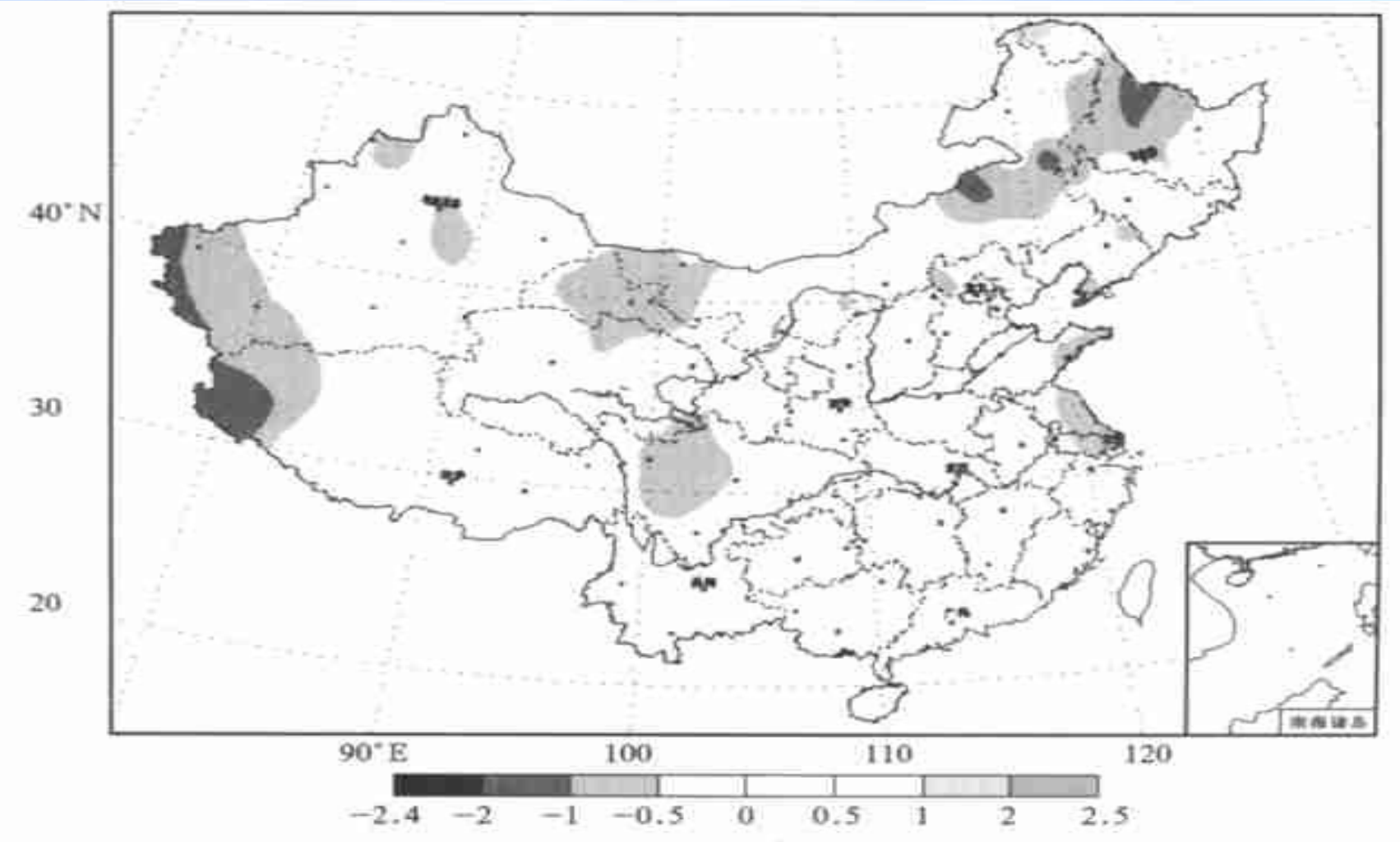
diameter

Brief introduction of Research on CMA cryosphere-related measurements



The stations distribution of frozen soil in China(476 stations). The stations have observation records more than or equal to 50 years (●) , 45 years (▲) , 40 years (Δ) , 25 years (◇) and less than 25 years (○)

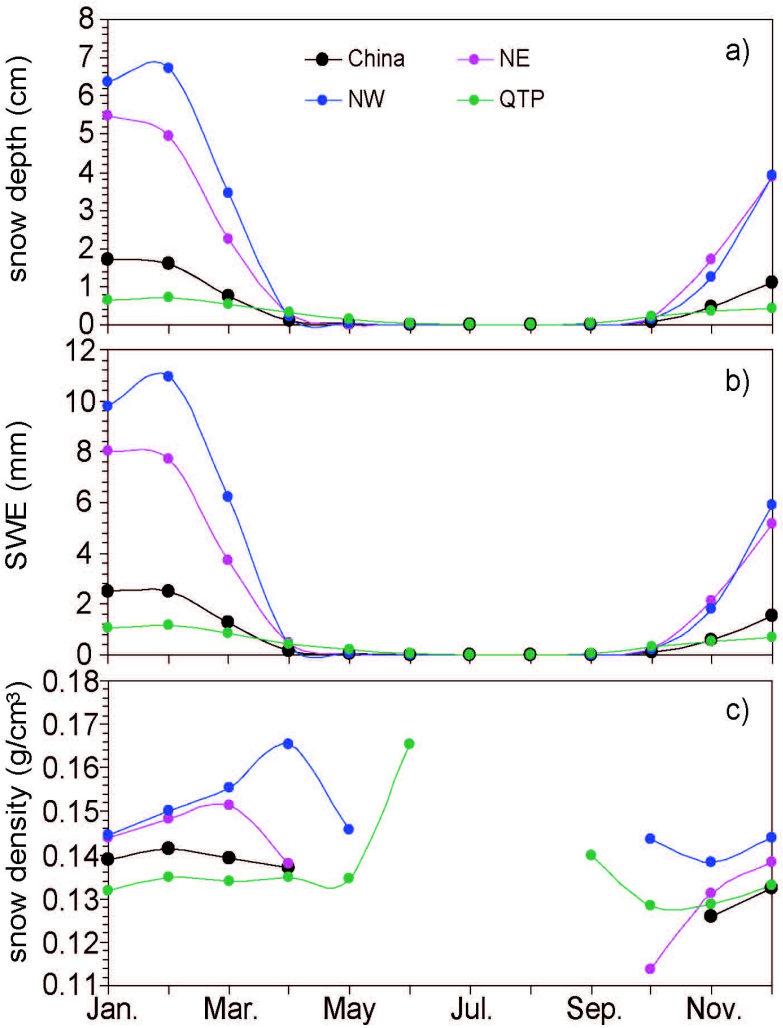
Chen and Li, 2008



the annual maximum frozen soil depth in China began to decrease since the 1980s, and decreased more distinctly during the 1990s.

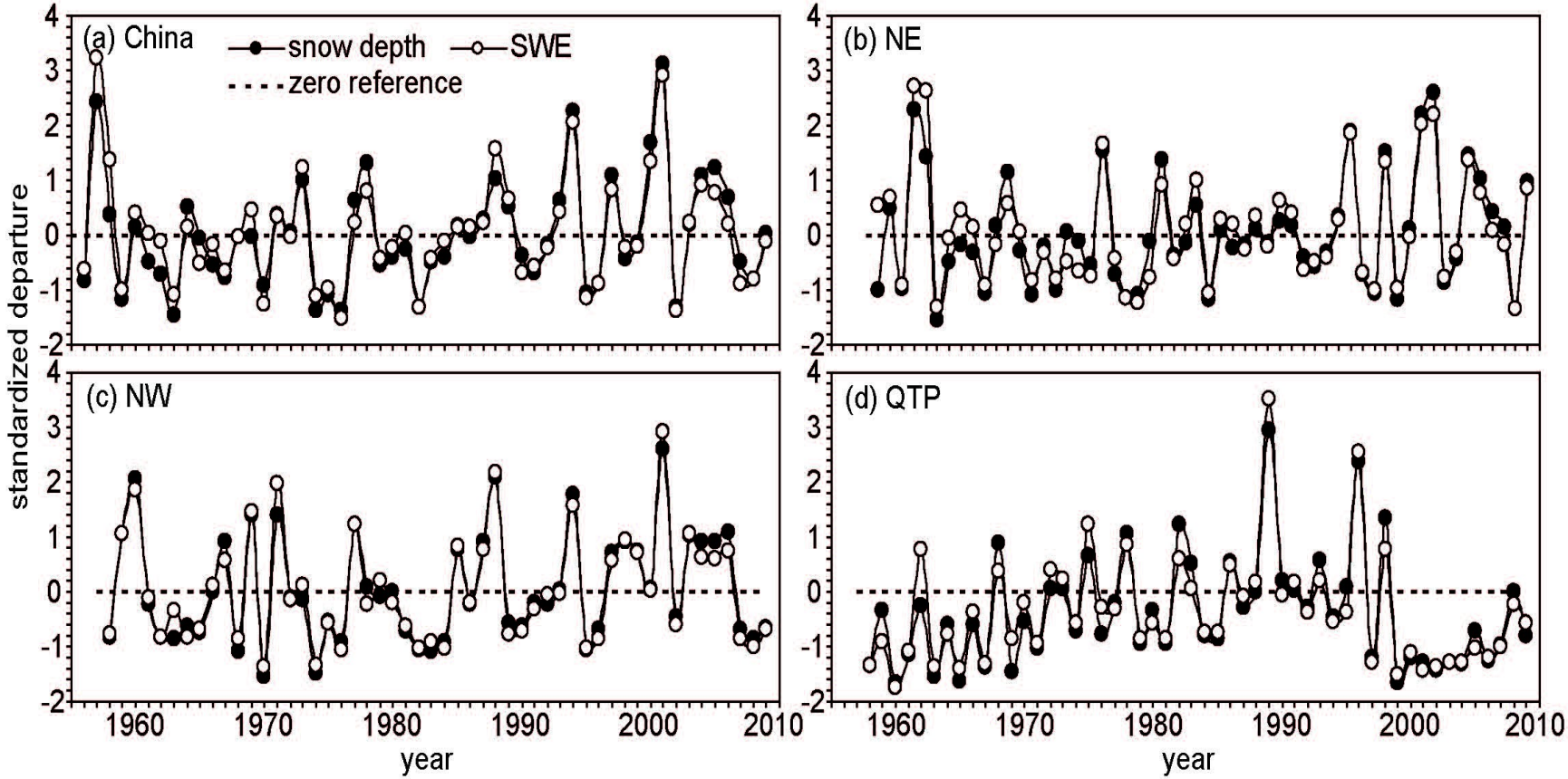
Liu and Li, 2003

Observed Changes of Snow Cover



- **Snow cover duration in China mainly began in October and ended with the next April. It was the longest in the QTP, from October to the next May.**
- **In October and November when snow began accumulating, snow depth and SWE in NE were the greatest, but after that period, they were greatest in NW until the fully melting of snow cover.**
- **Regionally, mean snow depth, SWE, and snow density were all the smallest in the QTP, and were greater in NW.**
- **The annual mean snow depth, snow density, and SWE for China as a whole were 0.49 cm, 0.14 g/cm³, and 0.7 mm, respectively.**

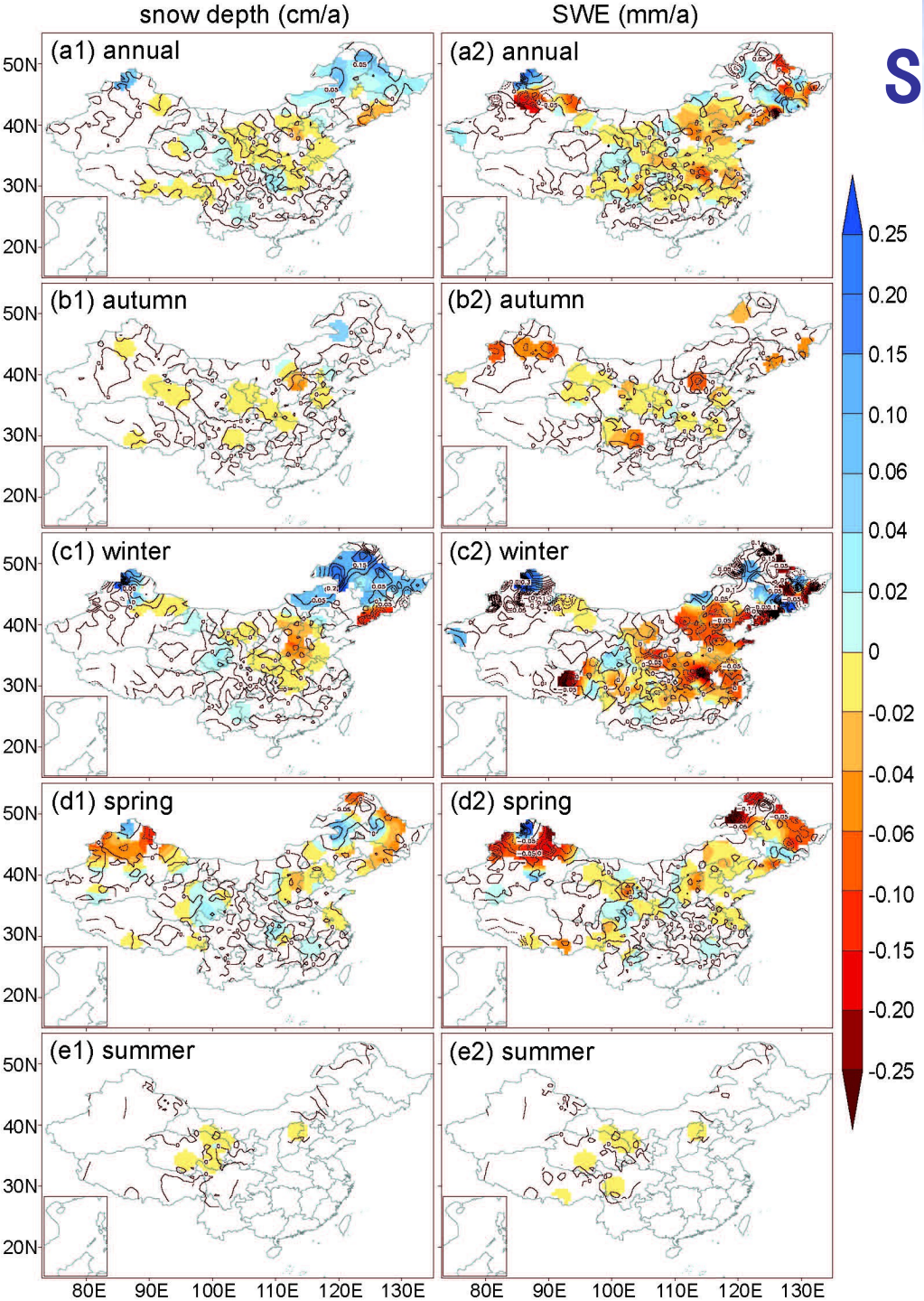
(Ma and Qin, 2012)



- **The variation of snow depth was consistent with that of SWE in all regions.**
- **For China as a whole, the amplitude of variation increased gradually in the second half of the 20th century, and began decreasing in the first 10 years of the 21st century.**
- **Annual mean snow depth changes in China as a whole can be explained by 76%, 46%, and 20% of respective changes in NE, NW, and the QTP together. For SWE, the proportions were 71%, 50%, and 21%, respectively, which indicated that snow cover changes in China were closest to changes in NE.**

(Ma and Qin, 2012)

Snow cover trends



- **In annual scale, the significant positive trends for snow depth are located mainly in eastern Inner-Mongolia, northern Northeast China, northwestern Xinjiang, and northeastern QTP, and the significant negative trends are distributed mainly in southeastern Northeast China, most of North China, and southern QTP.**

- **For SWE, the position of significant trends was similar to that of snow depth, but the range was not very consistent. The range with positive trends was not as wide as that of snow depth, but the range with negative trends was wider.**

- **In winter, the distribution pattern of trends was similar to their respective annual situation, but the trends were more significant. In spring, the negative trends dominated in China, distributing mainly in most of NE and NW, southern QTP, and parts of North China.**

(Ma and Qin, 2012)

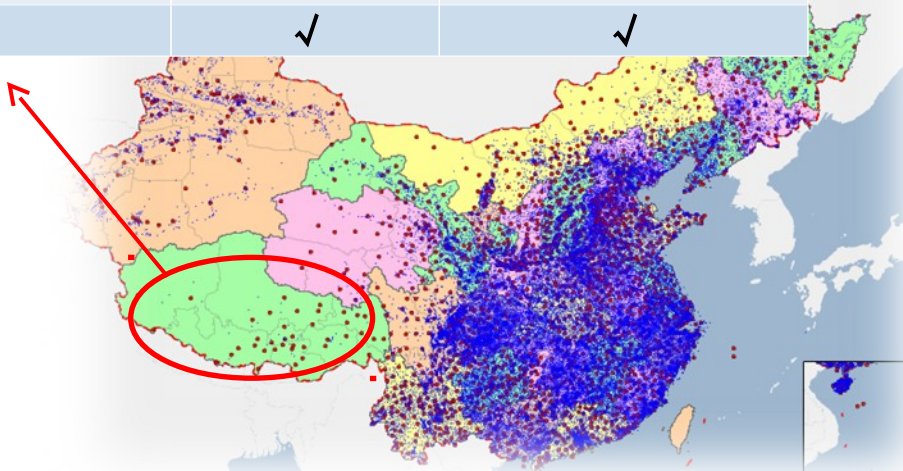
In 2014, CMA expect to promote the development of GCW through the following two ways:

- **As a data node of GTS, National Meteorological Information Centre, CMA is willing to undertake the data collection and transmission for Asia Cryospheric data**
- **data sharing in the area of Tibet to support GCW establishing a global CryoNet earlier**

The potential stations of CMA in Tibet for data sharing through GCW

	Sites	Surface Met.	Soil Temperature	Snow Depth	Frozen Soil Depth
1	SHIQUANHE	√	√	√	√
2	BAINGOIN	√	√	√	√
3	NAGQU	√	√	√	√
4	XAINZA	√	(building)	√	√
5	XIGAZE	√	√	√	√
6	LHASA	√	√	√	√
7	LHUNZE	√	√	√	√
8	TINGRI	√	√	√	(None)
9	PAGRI	√	√	√	(None)
10	SOG XIAN	√	√	√	√
11	DENGQEN	√	√	√	√
12	QAMDO	√	√	√	√
13	NYINGCHI	√	√	√	√

- national surface meteorological stations
- permanent stations with people
- >99.99% data acquisition



Thank you for your attention.