Space Based Global Observing System Requirements for Satellite Sounders

Dr. Jian Liu
Space Programme
World Meteorological Organization

WMO
OMM

The 15th international TOVS study Conference Maratea Italy, 4-10 October, 2006

Outline

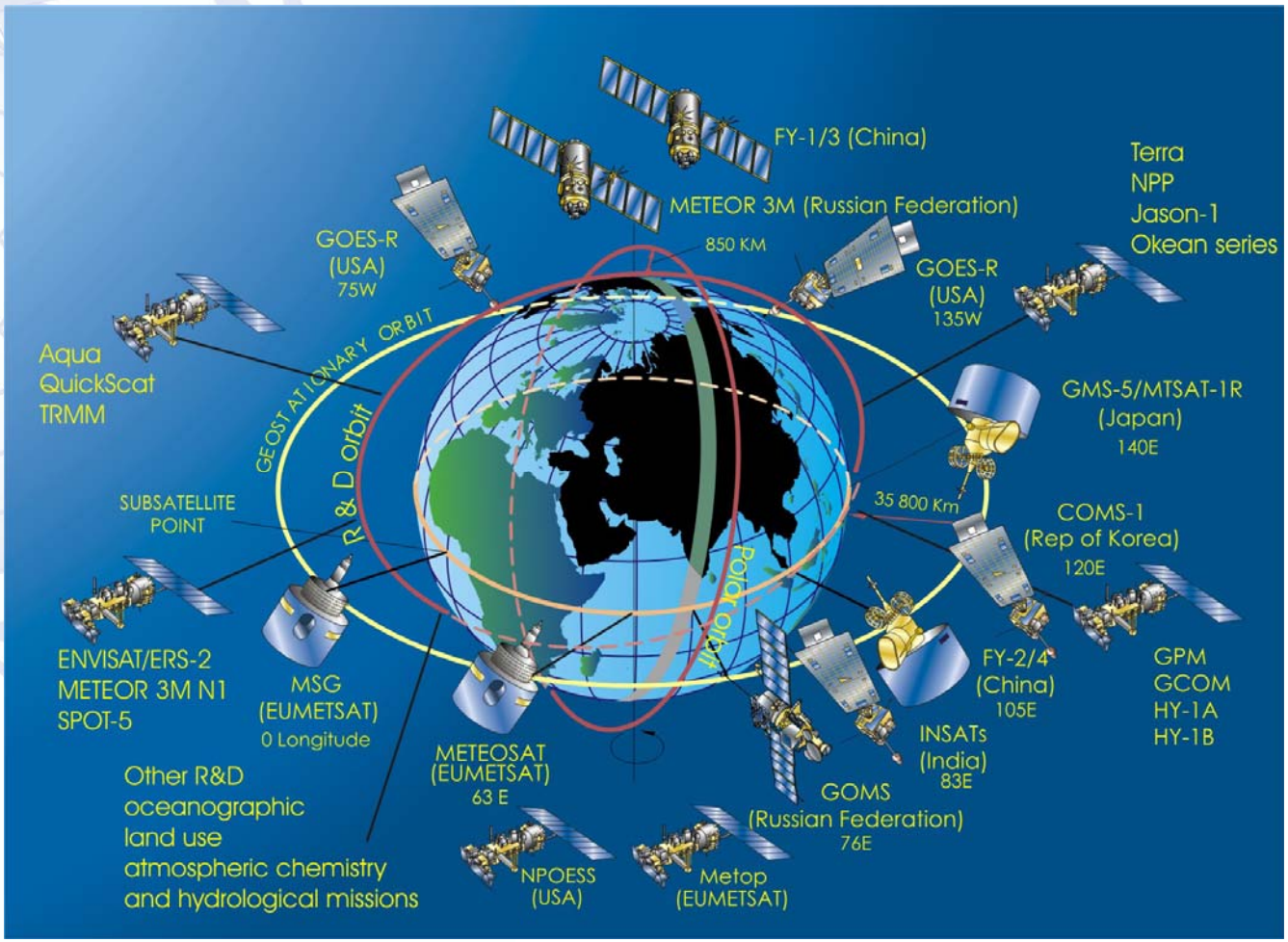
1. satellite sounders' capabilities
2. "User" requirements
3. Global access to training

Outline

1. satellite sounders' capabilities
2. "User" requirements
3. Global access to training

Satellite Sounders' Capabilities

WMO space-based sub-system of the WWW's Global Observing System (2006)



Unparalleled international cooperation has been achieved in satellite activities

Space-based sub-system of GOS (2005)

Operational meteorological geostationary satellite system

- **EUMETSAT** _ Meteosat
- **United States of America** _ GOES
- **Japan** _ GMS-5/MTSAT
- **People's Republic of China** _ FY-2/ FY-4
- **Russian Federation** _ GOMS-N1
- **Indian** _ INSAT and Kalpana (formerly MetSat)
- **Korean** _ COMS (being developed)

Operational meteorological sun synchronous satellite system

- **People's Republic of China** _ FY-1 and FY-3
- **United States of America** _ NOAA series, NPOESS, DMSP
- **European**_ Metop
- **Russian Federation** _ METEOR series

Research &Development satellite system

- **CNES**
- **ESA**
- **JAXA**
- **NASA**
- **ROSKOSMOS**
- …

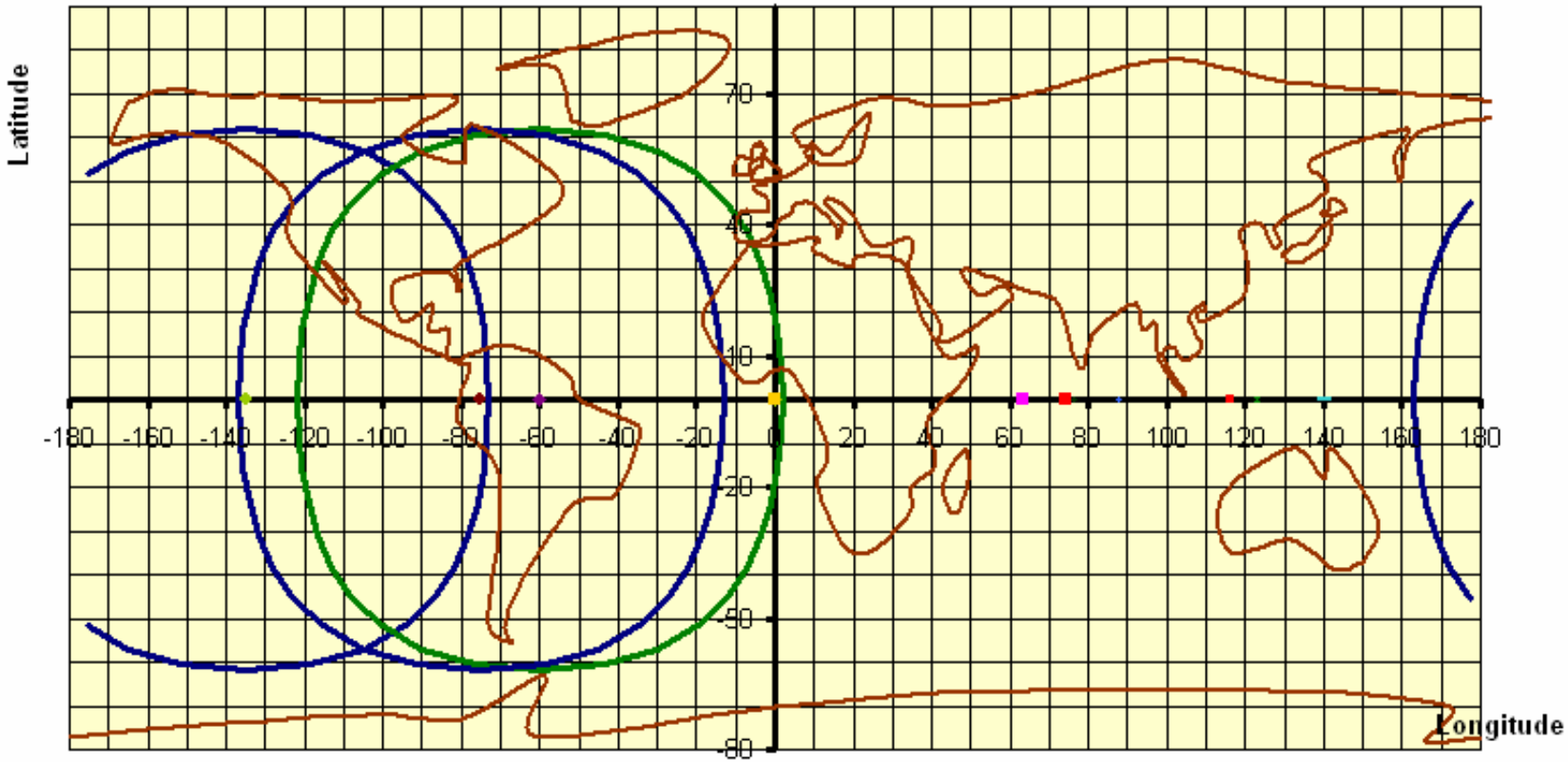
Sounders on operational satellites

(September, 2005)

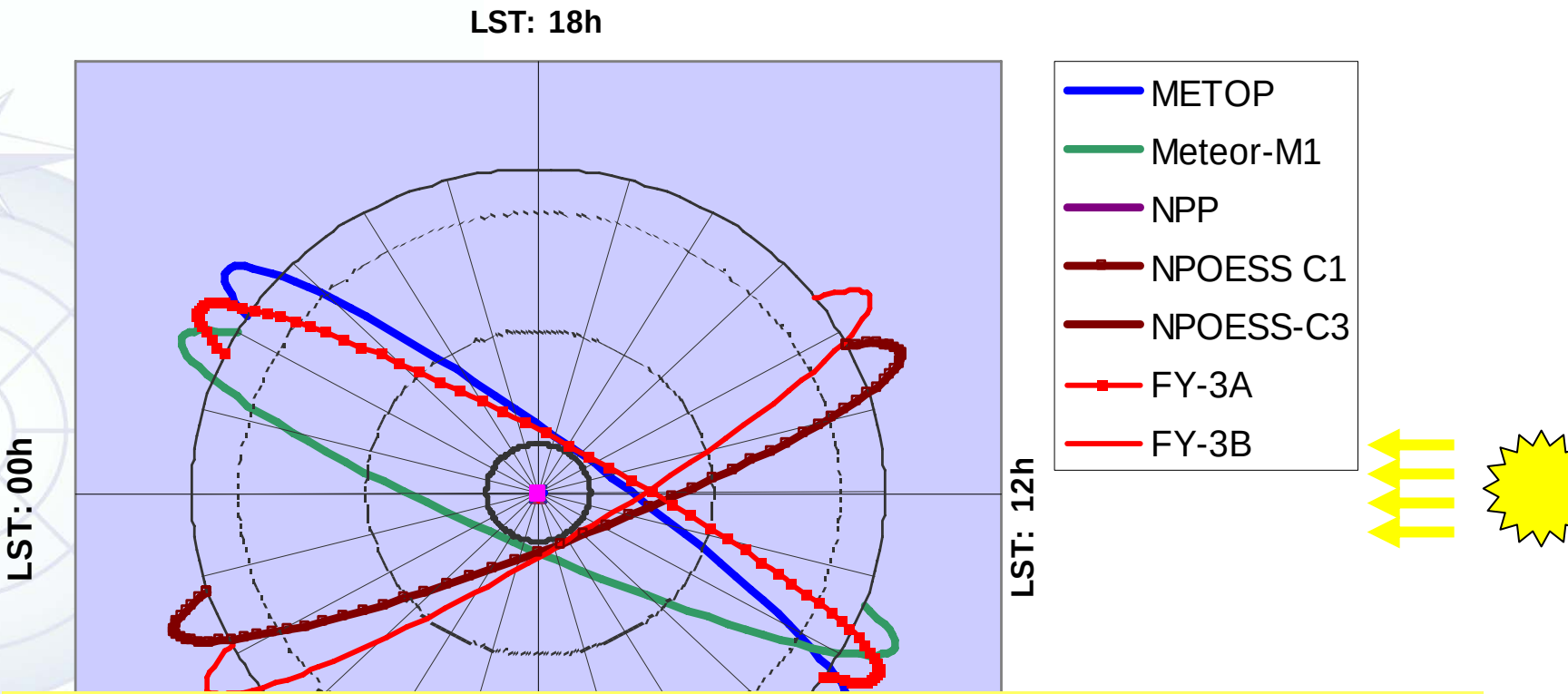
GEOSTATIONARY	Meteosat	GOES	MTSAT	Elektro-L	FY-2	INSAT-3D	Kalpana	COMS
Sounder		SOUNDER				SOUNDER		
Advanced sounder	MTG Sounder	HES						

SUNSYNCHRONOUS	NOAA	DMSP	NPOESS	Metop	Meteor-3M / Meteor-M	FY-3
IR sounder	HIRS 3/4			HIRS/4		IRAS
IR advanced sounder			CrIS	IASI	IRFS-2	
MW imager/sounder		SSMIS	CMIS		MTVZA	
MW sounder (temperature)	AMSU-A	SSM/T		AMSU-A		MWTS
MW sounder (humidity)	AMSU-B, MHS	SSM/T2		MHS		MWHS
MW advanced sounder			ATMS	~ATMS		
Radio-occultation sounder			GPSOS	GRAS	Radiomet	

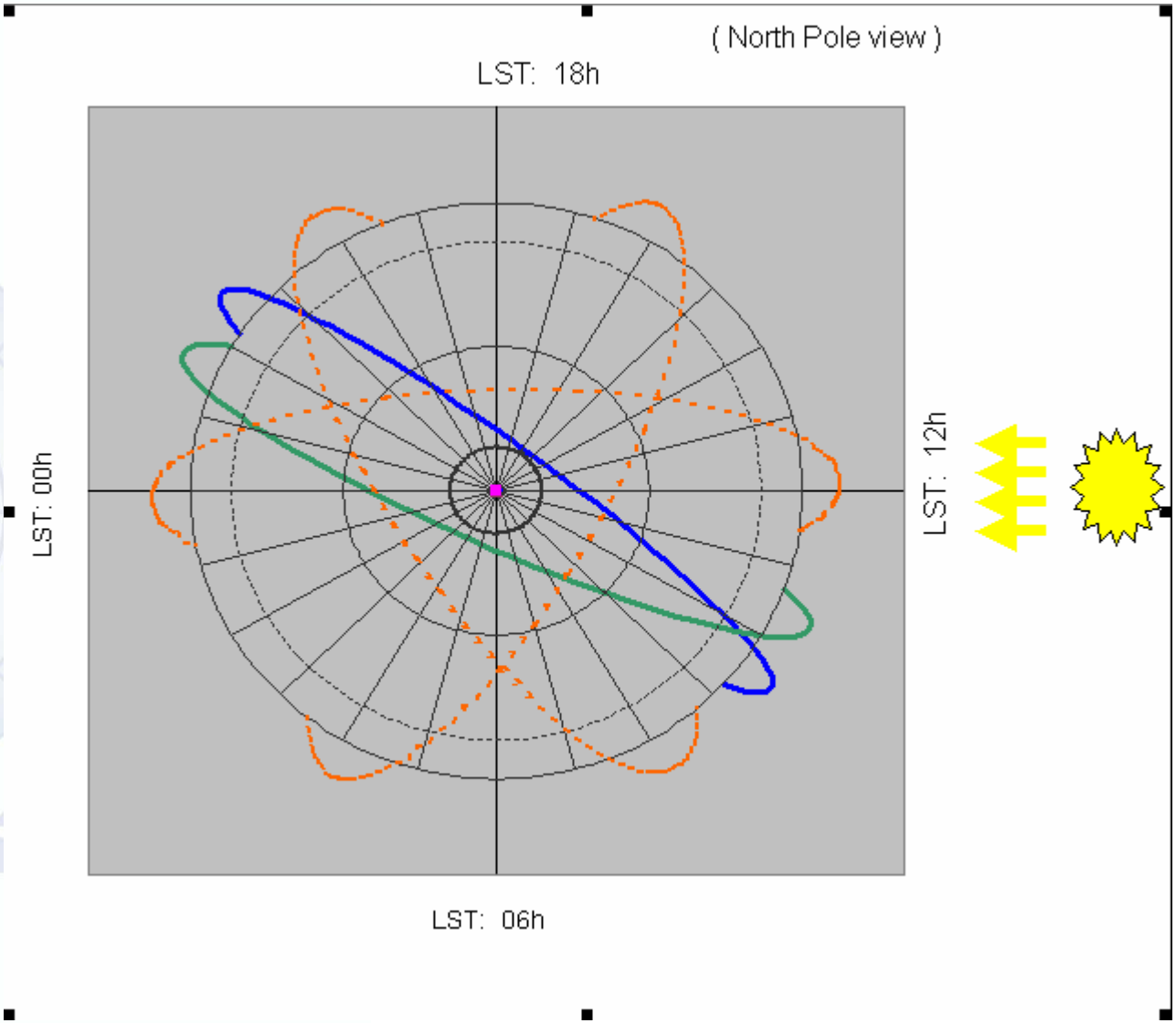
Coverage of current Geostationary satellite with Sounder (as of Oct 2006)

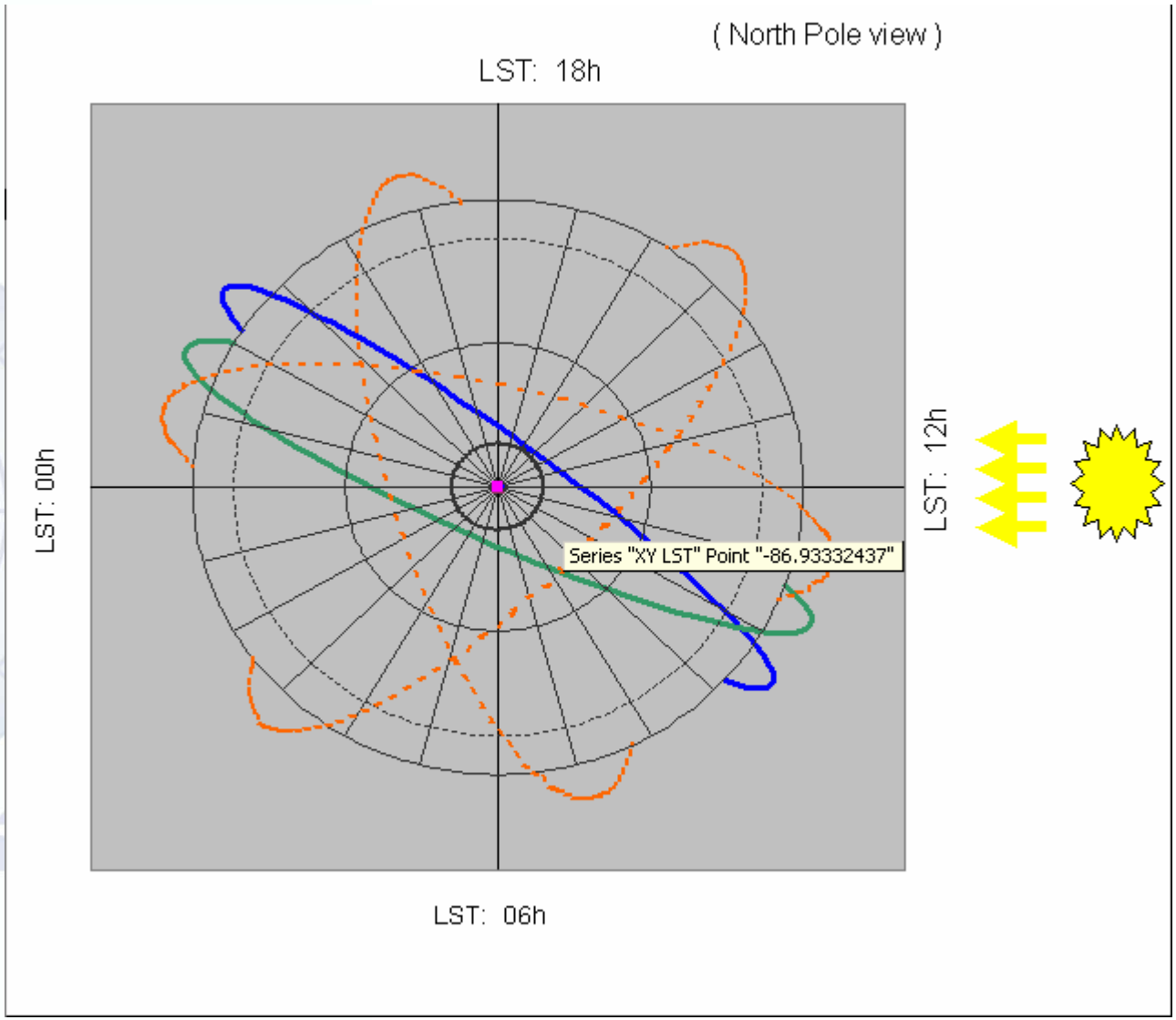


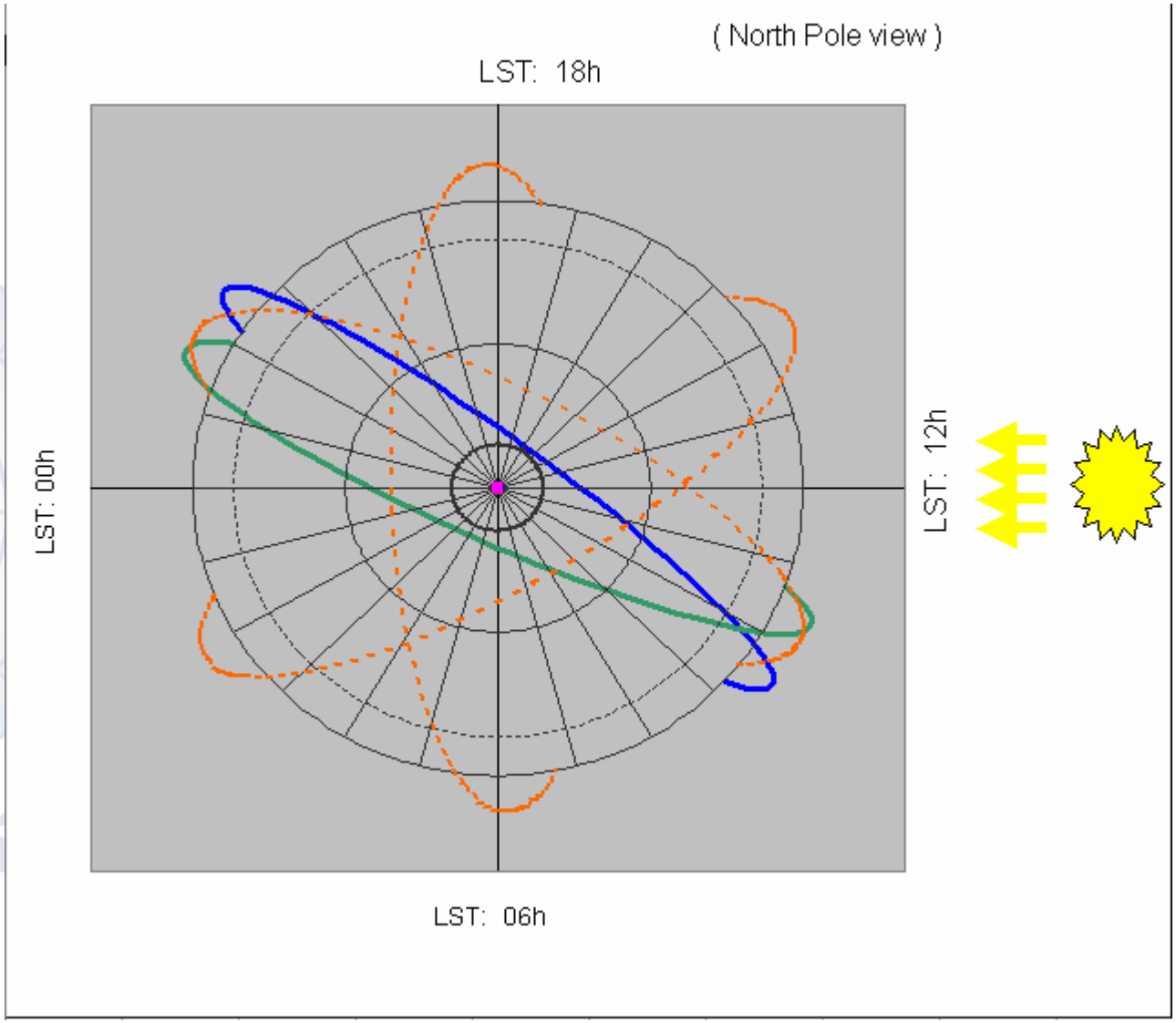
Microwave and IR sounders in 2010-2015

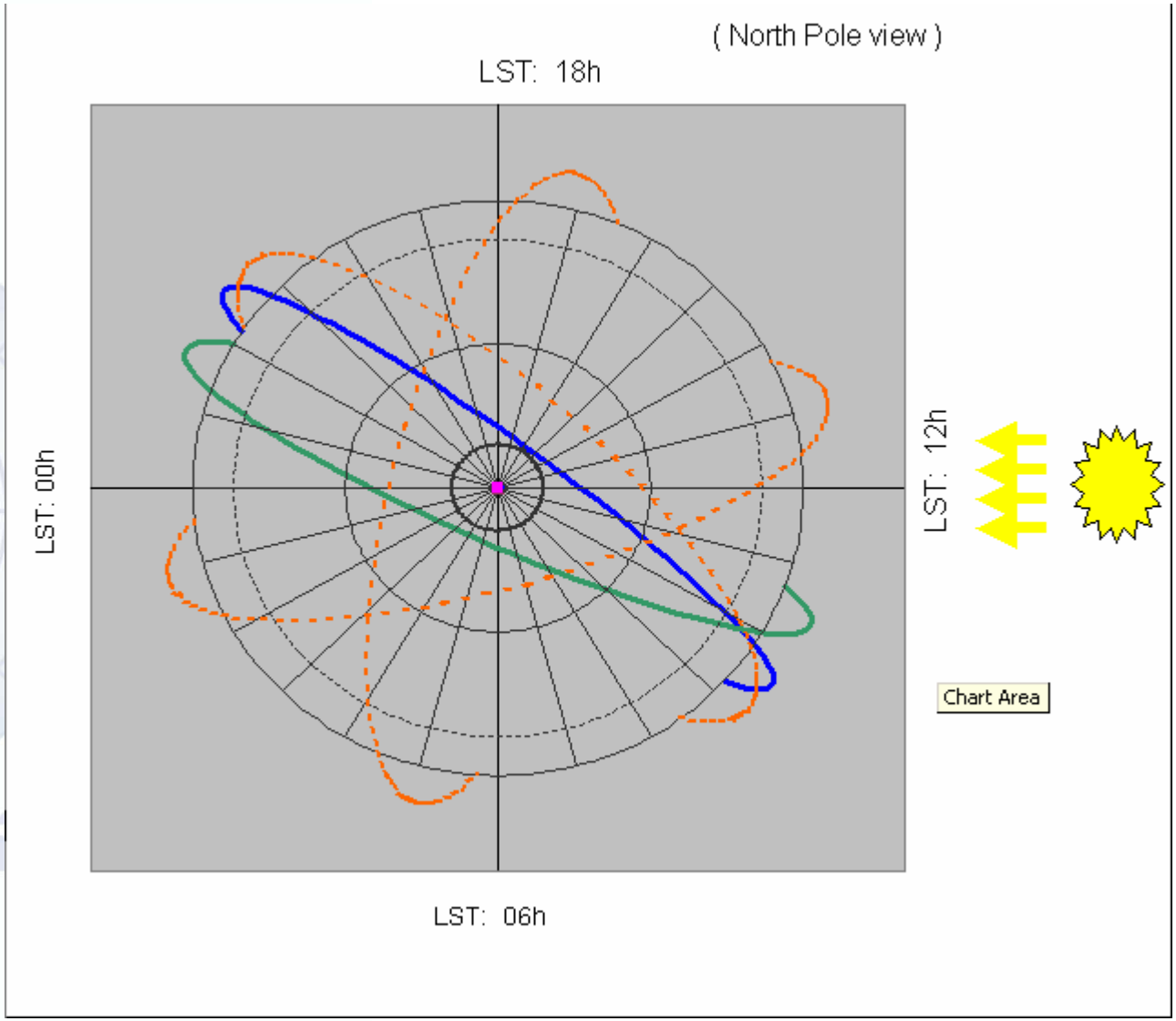


For the next two decades, between 4 and 5 IR and MW sounders, all grouped around 2 orbital planes (mid-morning and early afternoon) instead of 4 equally spaced in time.


(North Pole view)
LST: 18h
LST: 00h
LST: 12h
LST: 06h


(North Pole view)
LST: 18h
LST: 00h
LST: 12h
LST: 06h
Series "XY LST" Point "-86.93332437"


(North Pole view)
LST: 18h
LST: 00h
LST: 12h
LST: 06h


(North Pole view)
LST: 18h
LST: 00h
LST: 12h
LST: 06h
Chart Area

The Implementation Plan (IP) for the Evolution of the GOS

- S3.GEO Sounders - All meteorological geostationary satellites should be equipped with hyper-spectral infrared sensors for frequent temperature/humidity sounding as well as tracer wind profiling with adequately high resolution (horizontal, vertical and time).
- S5.LEO data timeliness - More timely data are needed to improve utilization, especially in NWP. Improved communication and processing systems should be explored to meet the timeliness requirements in some applications areas (e.g. Regional and Global NWP).
- S12.RO-Sounders - The opportunities for a constellation of radio occultation sounders should be explored and operational implementation planned. International sharing of ground support network systems (necessary for accurate positioning in real time) should be achieved to minimize development and running costs.

Outline

1. satellite sounders' capabilities
2. "User" requirements
3. Global access to training

“User” requirements

Commission for Basic Systems (CBS)

- ET-ODRRGOS & ET- EGOS
- Rolling Requirements Review (RRR)
- Critical Review

__ NWP & climate research

“User” requirements

- *3D wind field*

  > Advanced geostationary imager-sounders (e.g. GIFTS)
  > cloud-free areas
  > horizontal resolution 40km
  > vertical resolution 2km.

- *3D temperature and humidity field*

  > Polar satellites ⇒ global coverage

  > new microwave measurements (AMSU) ⇒ substantial improvements

  > Geostationary infrared soundings (GOES) ⇒ expand coverage

  > Vertical resolution substantially improved in cloud-free areas ⇐ EOS-Aqua, METOP and NPOESS.

“User” requirements

- *Clouds*
  - Infrared imagers and sounders ⇒ cloud cover, cloud-top height, good horizontal and temporal resolution and good/acceptable accuracy.
  - Microwave imagers and sounders ⇒ cloud liquid water of good horizontal resolution and acceptable temporal resolution, with an accuracy that is probably acceptable (though validation is difficult).

- *Additional observations for model validation*

  - Advanced infrared sounders (e.g. AIRS, IASI, CrIS)

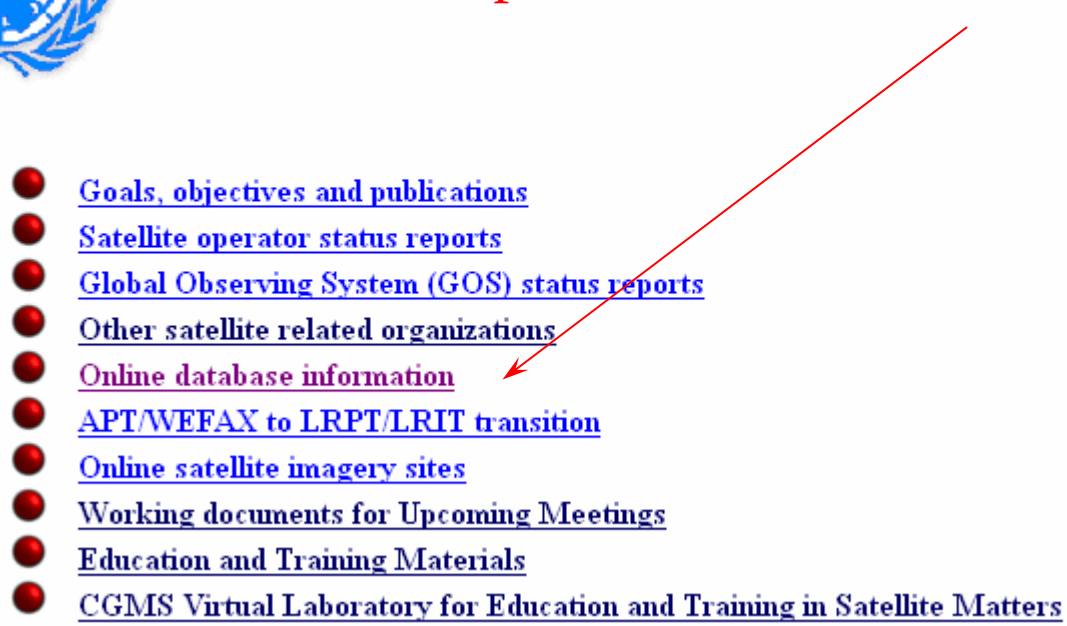
  ⇒ complete or near-complete spectral coverage & high spectral resolution (infrared)

  ⇒ surface emissivity with good horizontal resolution and accuracy.

“User” requirements

WMO/ CEOS Database

http://www.wmo.int/web/sat/satsun.html



Outline

1. satellite sounders' capabilities
2. "User" requirements
3. Global access to training

Virtual Laboratory for Education and Training in Satellite Meteorology

- **Collaboration between satellite operators & training centres**
  - along WMO strategy for Education &Training in Satellite Meteorology
  - adopted by CGMS (2001)
- **Coordinated by VL Management Group**
  - reporting to WMO and CGMS
- **Three-year VL goal of staging a Global VL High-Profile Training Event (HPTE).**

- **Maintains a Virtual Resources Library**
  - accessible on line via Home Page of each VL partner
  - Includes training materials, lectures, S/W tools
- **Runs training events (on-line or face-to-face)**
  - Distribution of E-Notebooks had strong positive impact

WMO OMM

Centres of Excellence

Satellite operator	Centre of Excellence	Primary language	WMO Region
EUMETSAT	Niamey (Niger) Nairobi (Kenya)	French English	RA I RA I
EUMETSAT and IMD	Oman	Arabic	RA II
NOAA/NESDIS	CIMH (Barbados) UCR (Costa Rica)	English Spanish	RA IV RA III & IV
CMA	Nanjing (China)	Chinese & English	RA II & V
JMA	BMTC (Australia)	English	RA V
CONAE and NOAA/NESDIS	Buenos Aires (Argentina)	Spanish	RA III
CPTEC *and NOAA/NESDIS*	*Brazil*	*Portuguese*	RA I & RA III
+ ESA & NASA			

Anticipated Outcomes For The HPTE

- VL capacity building
- Improvements in Education and Training options
- Provide practical experience in planning, implementing and delivering online training events for WMO Members as well as other groups such as GEOSS, JCOMM and CEOS.
- Improved utilisation of satellite data and products

High Profile Training Event (HPTE)

- 16-27 October 2006 : simultaneous training period involving all WMO Regions
- All CoE involved in classroom training and/or interactive on-line lectures
- 4 key on-line lectures provided globally (scheduled twice to account for time differences, and translated)
- Inter-regional on-line discussion on a “live” situation with image/product interpretation
- A project Plan endorsed at ET-SUP and CGMS

➢ Demonstration of VL efficiency and relevance at global scale
➢ Fostering cooperation at global and regional level (focus groups)
➢ Training opportunity for **all** WMO Regions

Thanks for your attention