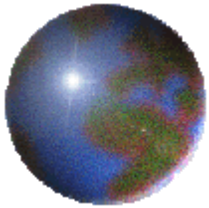


Japan's activity for the global precipitation measurement



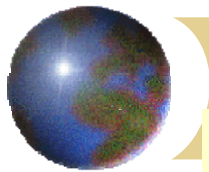
Kenji Nakamura

Hydrospheric Atmospheric Research Center,
Nagoya University, Japan

3 March 2005

The first IGWCO Workshop
University of Tokyo





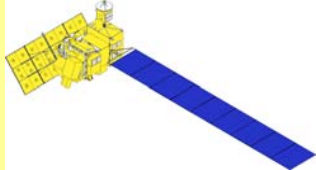
EO Satellite Road Map

2002~2006

2007~2011

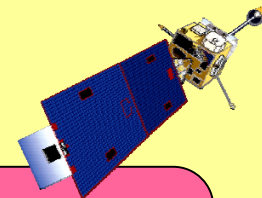
2012~2017

Measuring land & sea surface



ALOS

Optical triplet mode, High resolution
sensor;
Global mapping) : 2.5m
5m
PALSAR (L-band Synthetic Aperture Radar;
Land information, Disaster monitoring) :
10m
AVNIR-2 (Visible & Near Infrared Radiometer:
Disaster monitoring etc.) :
10m



ALOS F/O

Geostationary high res optical sensor:
10m
High resolution optical sensor: 0.5m
Multiple polarization*
Multiple wavelength SAR: 10m

Global monitoring of the Earth's environment

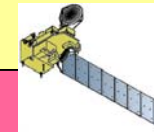


ADEOS-II

ILAS-II: Infrared spectrometer
GLI : Visible & Infrared Imager
AMSR : Microwave Radiometer

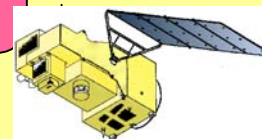
GOSAT

GHG and Cloud sensor



GCOM

SGLI :
Visible Land Infrared Imager
AMSR F/O :
Microwave radiometer

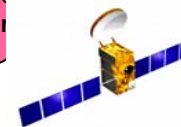
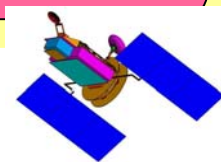


GPM

DPR: Dual Frequency
Precipitation Radar

EarthCARE

CPR: Cloud Profile Radar
FTS: Fourier Transform
Spectrometer etc.




TRMM

Precipitation Radar : 5Km,
Rain rate: 0.7mm/h
TMI Microwave Radiometer:
(NASA)

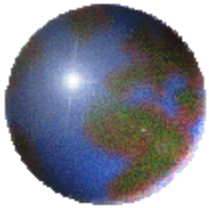


Green House Gas Monitoring
Global Climate Change Monitoring

Global Water Cycle Observation



Japan Aerospace Exploration Agency's activity for
IGWCO global precipitation mapping



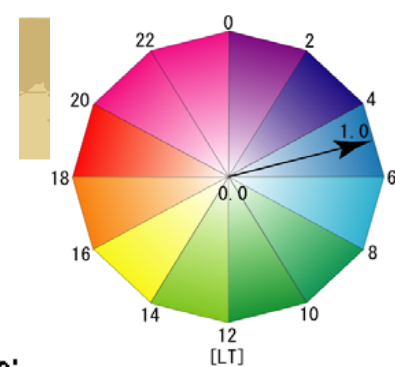
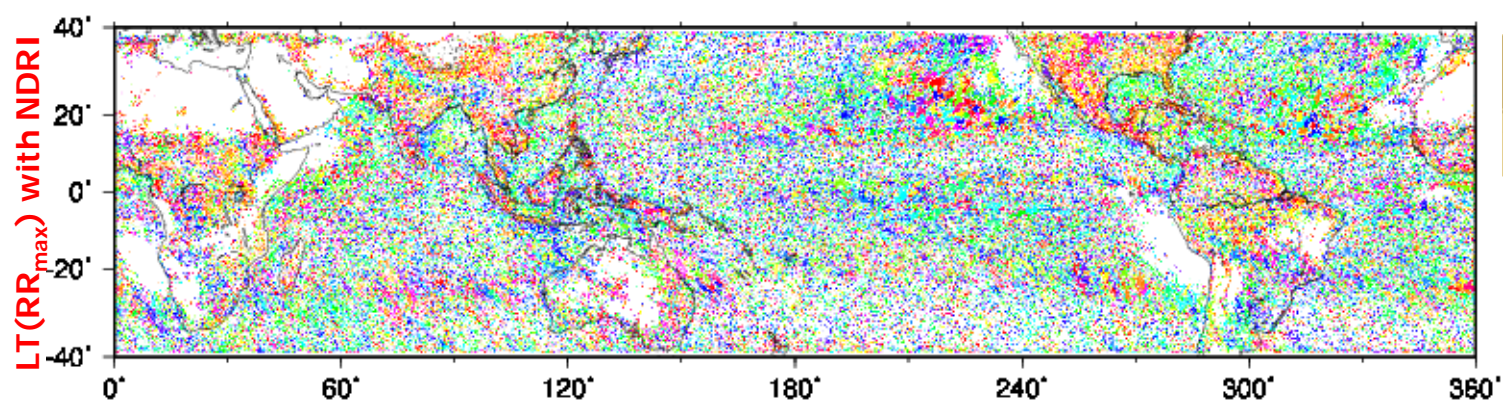
Continual operation of TRMM

PR maintenance, PR algorithm development,
PR data process, and TRMM data distribution

AMSR-E operation

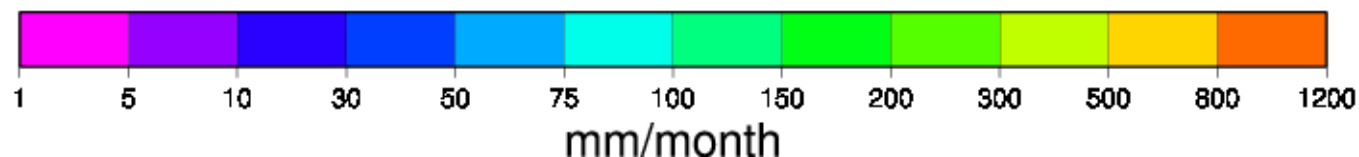
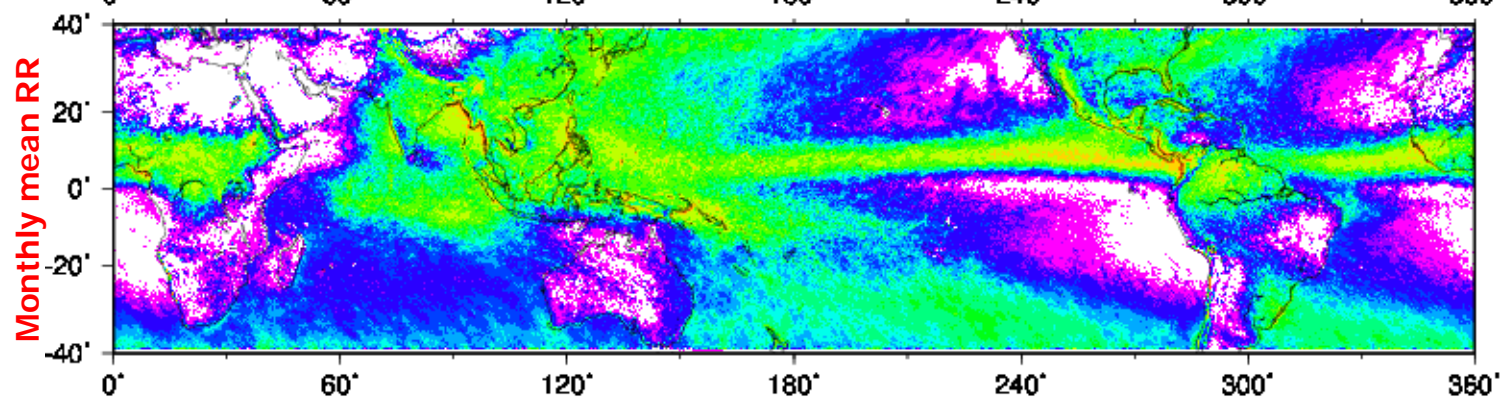
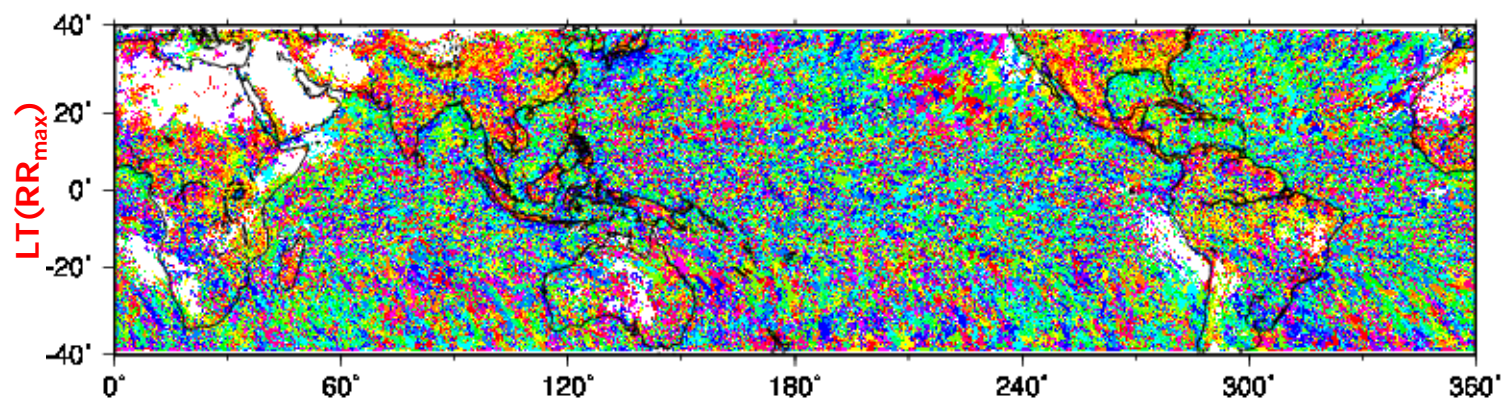
Global Precipitation Measurement (GPM)

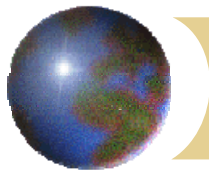
Core satellite with the dual-wavelength radar
with strong collaboration with National Information
and Communication Technology (NICT)



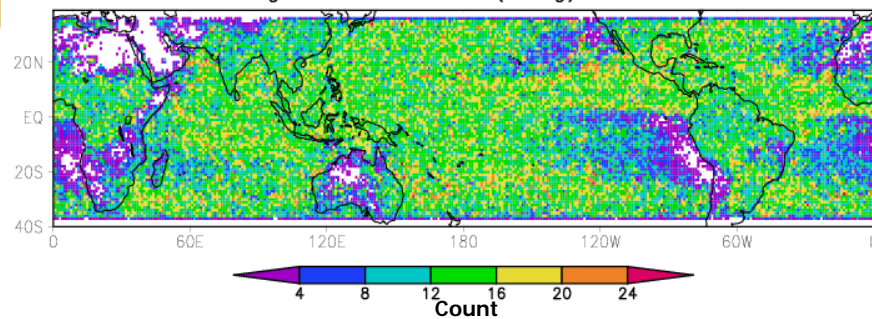
$$NDRI = \frac{RR_{\max} - RR_{\min}}{RR_{\max} + RR_{\min}}$$

TMI, all angle bins,
'98-'02 JJA

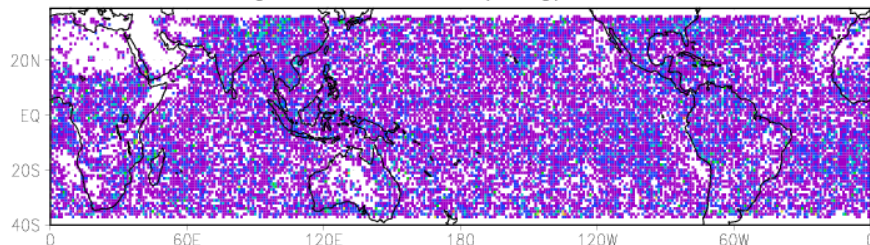




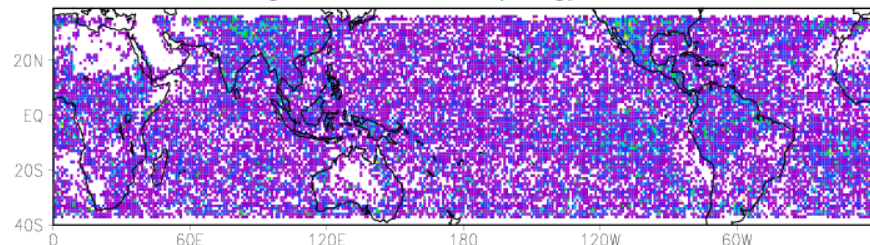
Histogram of LT diff. (1deg) TMI-PR=0



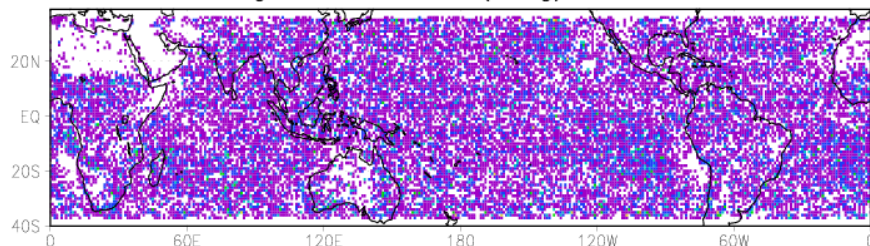
Histogram of LT diff. (1deg) TMI-PR=-3



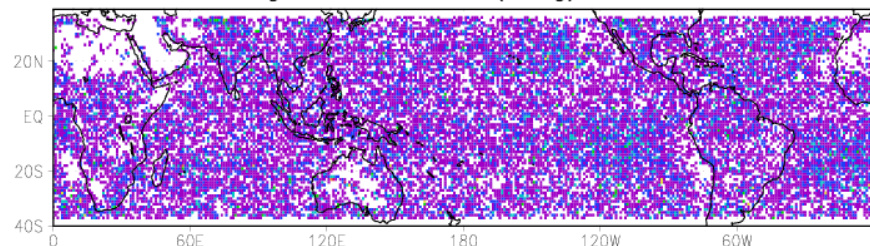
Histogram of LT diff. (1deg) TMI-PR=3



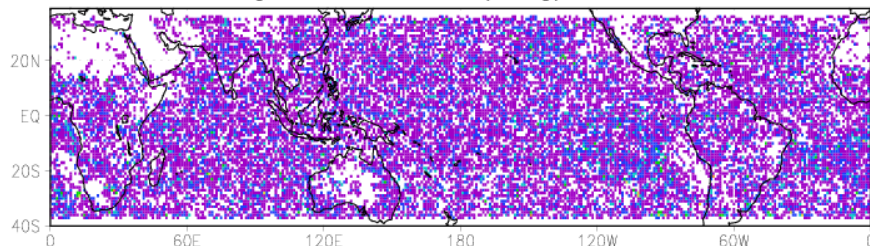
Histogram of LT diff. (1deg) TMI-PR=-6



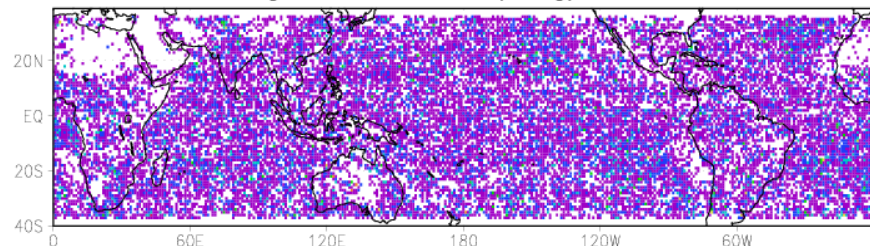
Histogram of LT diff. (1deg) TMI-PR=6

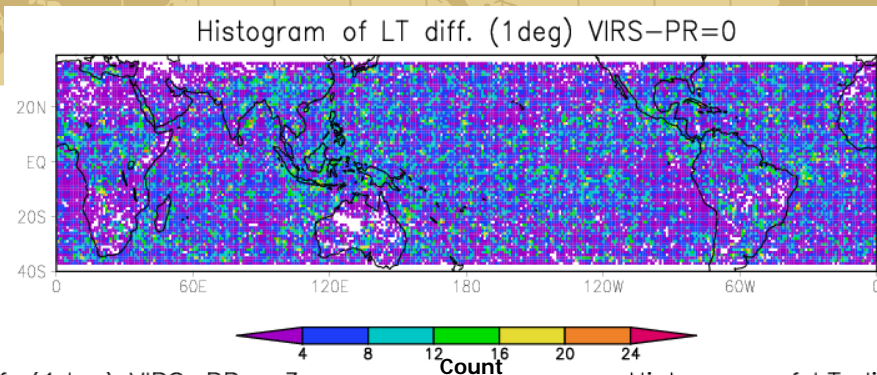
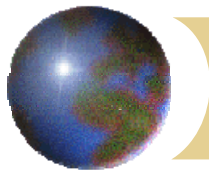


Histogram of LT diff. (1deg) TMI-PR=-9

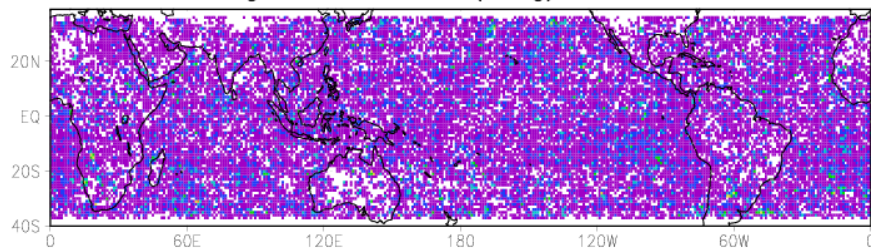


Histogram of LT diff. (1deg) TMI-PR=9

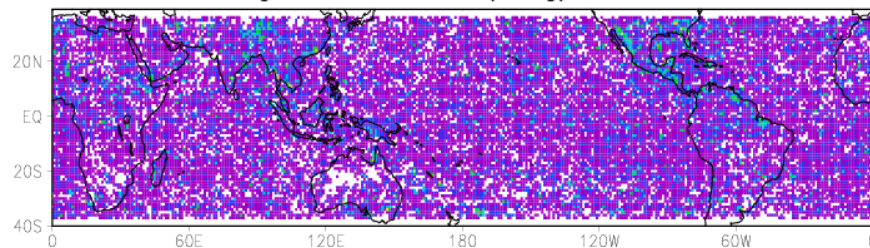




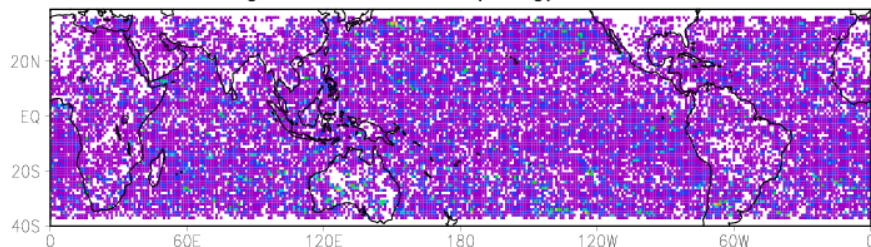
Histogram of LT diff. (1deg) VIRS-PR=-3



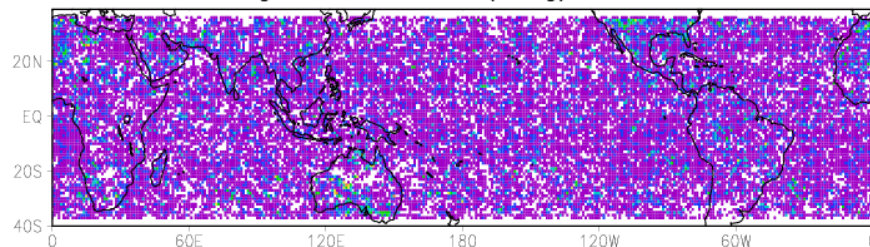
Histogram of LT diff. (1deg) VIRS-PR=3



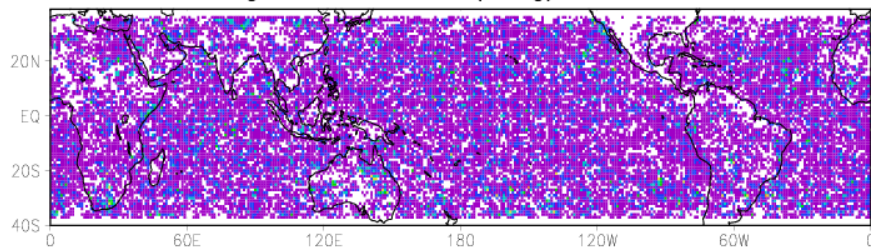
Histogram of LT diff. (1deg) VIRS-PR=-6



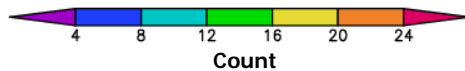
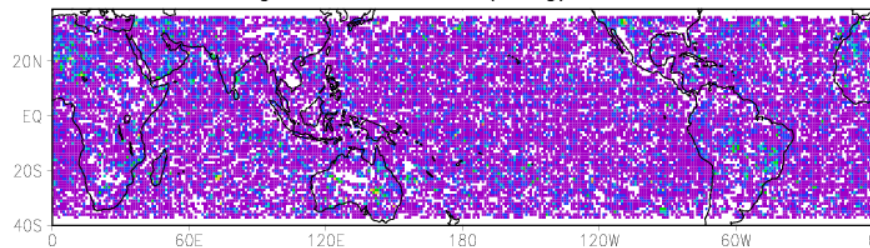
Histogram of LT diff. (1deg) VIRS-PR=6

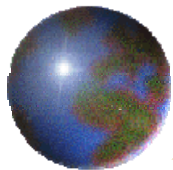


Histogram of LT diff. (1deg) VIRS-PR=-9

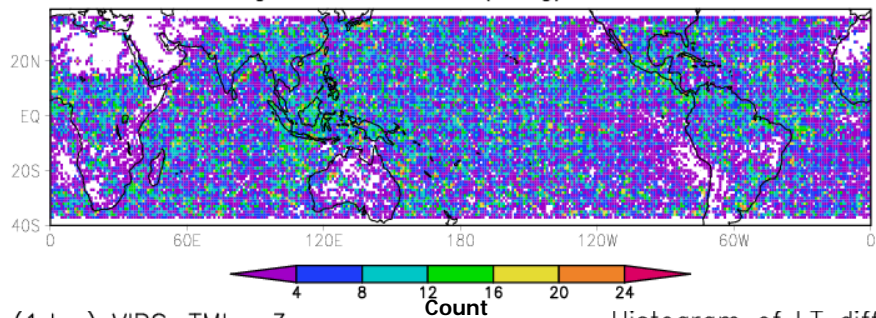


Histogram of LT diff. (1deg) VIRS-PR=9

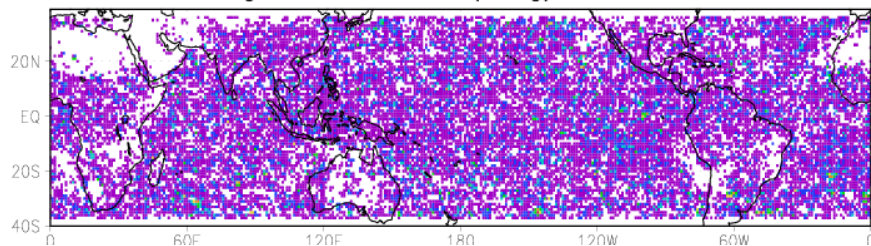




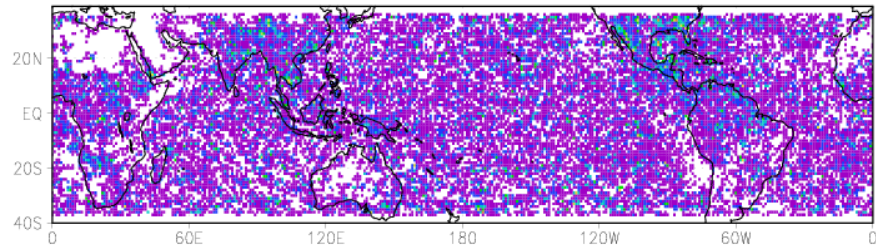
Histogram of LT diff. (1deg) VIRS-TMI=0



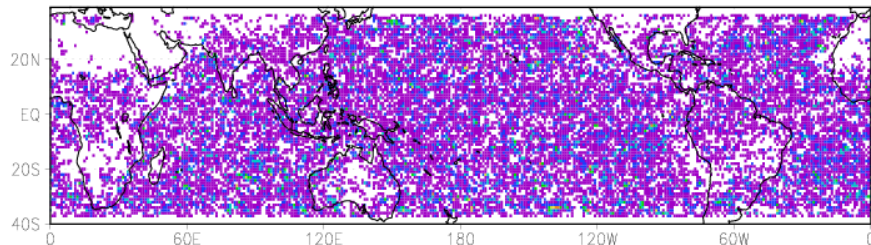
Histogram of LT diff. (1deg) VIRS-TMI=-3



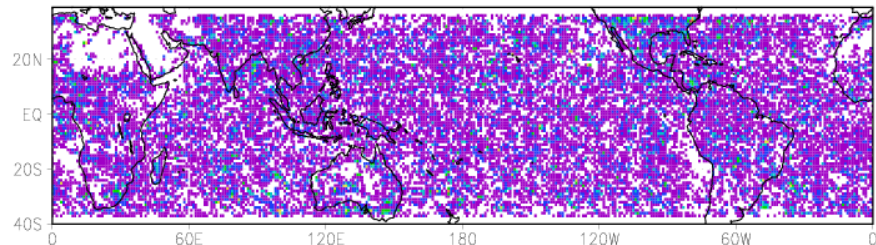
Histogram of LT diff. (1deg) VIRS-TMI=3



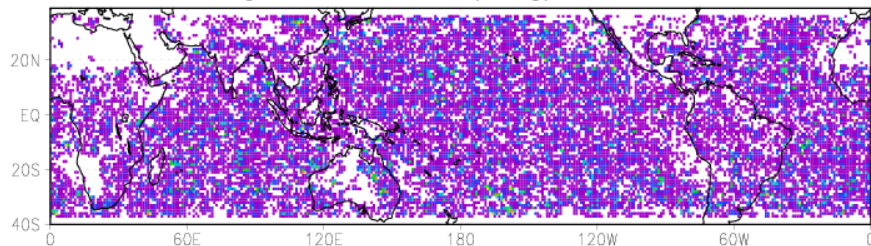
Histogram of LT diff. (1deg) VIRS-TMI=-6



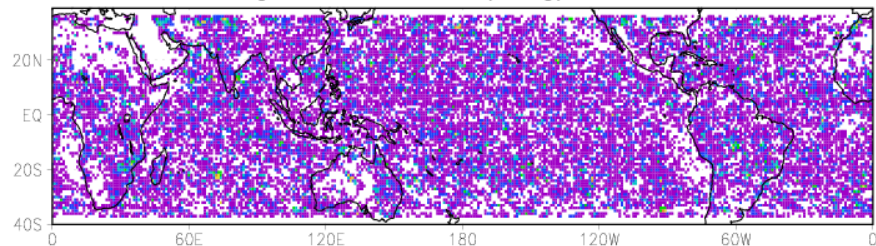
Histogram of LT diff. (1deg) VIRS-TMI=6

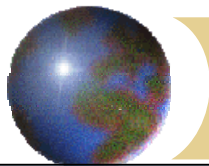


Histogram of LT diff. (1deg) VIRS-TMI=-9



Histogram of LT diff. (1deg) VIRS-TMI=9

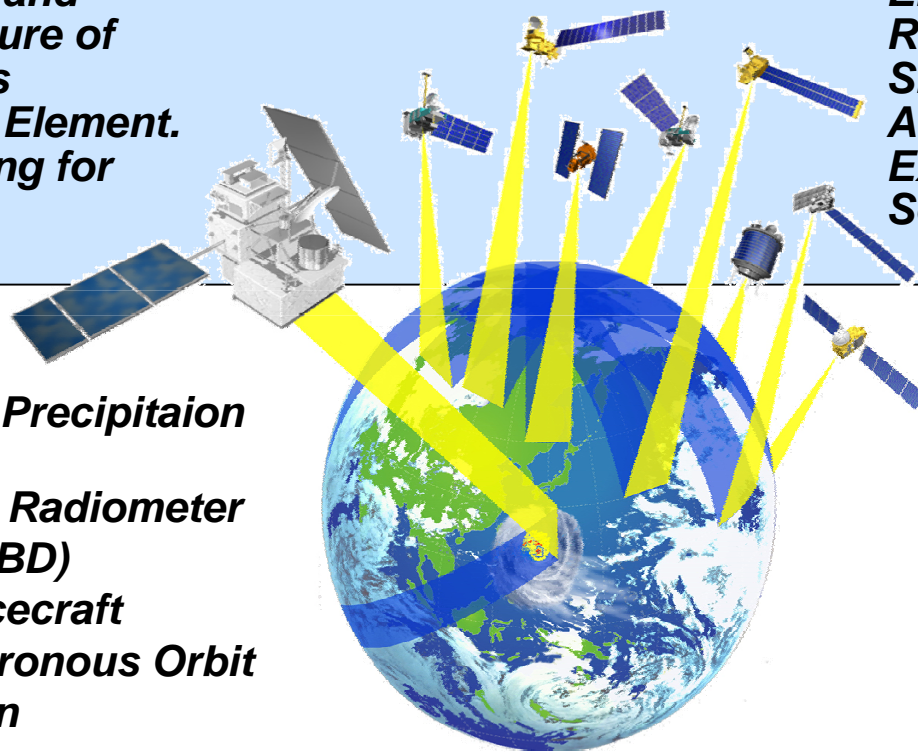




GPM Reference Concept

OBJECTIVE: Understand the Horizontal and Vertical Structure of Rainfall and Its Microphysical Element. Provide Training for Constellation Radiometers.

OBJECTIVE: Provide Enough Sampling to Reduce Uncertainty in Short-term Rainfall Accumulations. Extend Scientific and Societal Applications.



Core Satellite

- Dual-frequency Precipitation Radar
- Multi-frequency Radiometer
- H2-A Launch (TBD)
- TRMM-like Spacecraft
- Non-Sun Synchronous Orbit
- ~65° Inclination
- ~400 km Altitude
- ~5 km Horizontal Resolution
- 250 m / 500m Vertical Resolution

Precipitation Validation Sites

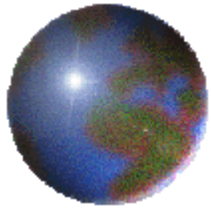
- Global Ground Based Rain Measurement

Constellation Satellites

- Small Satellites with Microwave Radiometers
- Aggregate Revisit Time, 3 Hour goal
- Sun-Synchronous Polar Orbits
- ~600 km Altitude

Global Precipitation Processing Center

- Capable of Producing Global Precipitation Data Products as Defined by GPM Partners



Expected Japan's contribution to GPM

Launch

DPR development

GV

Science and applications

Algorithm development and GV

Focused to DPR

Dual-wavelength algorithm

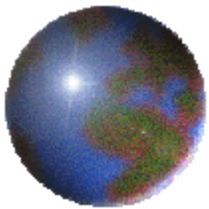
Better accuracy than TRMM PR

Solid precipitation

GV supersites: NICT Okinawa and Wakkanai



GV



Simple end-to-end comparison is never enough.

Satellite algorithms: very limited measurements

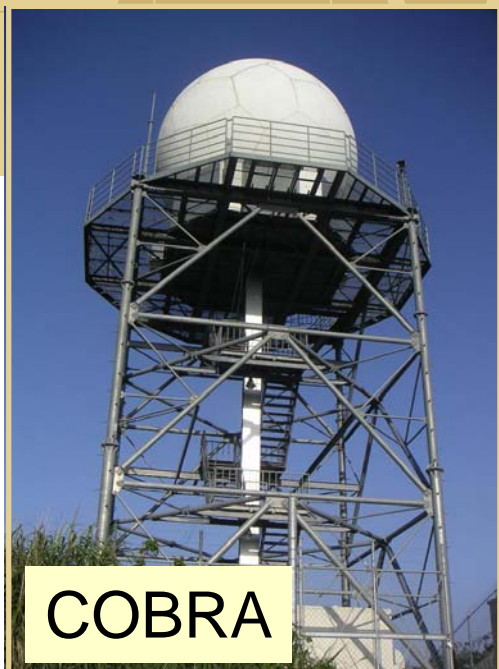
GV: much more data

→ Much more precise forward RTE calculation

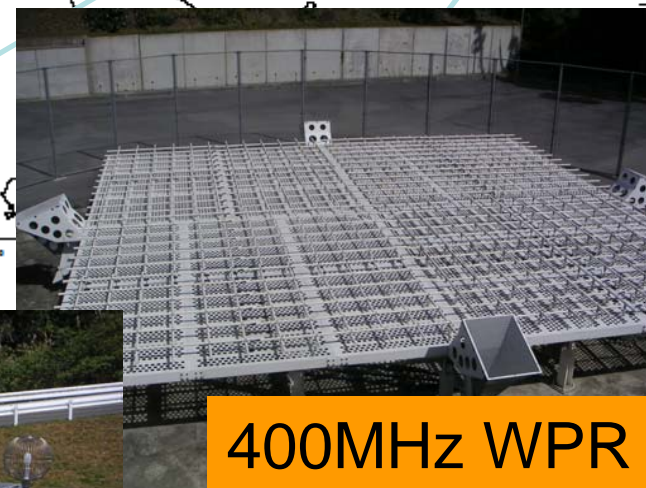
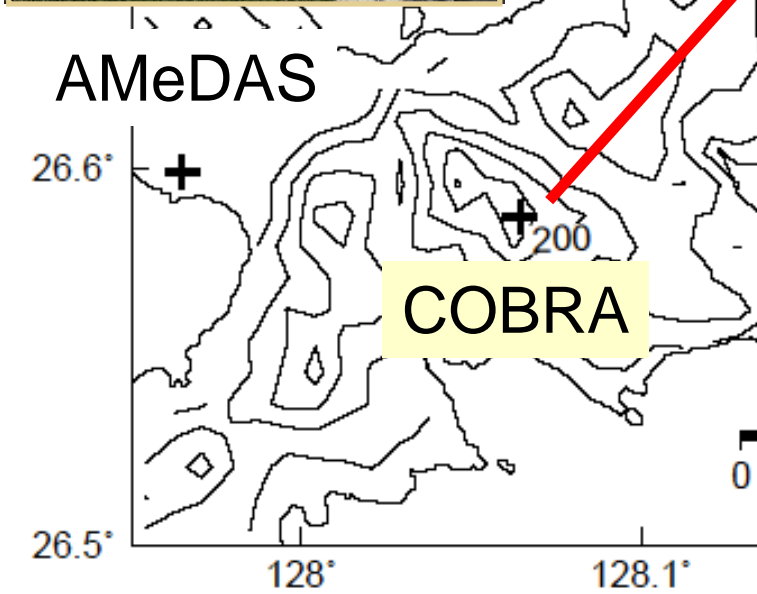
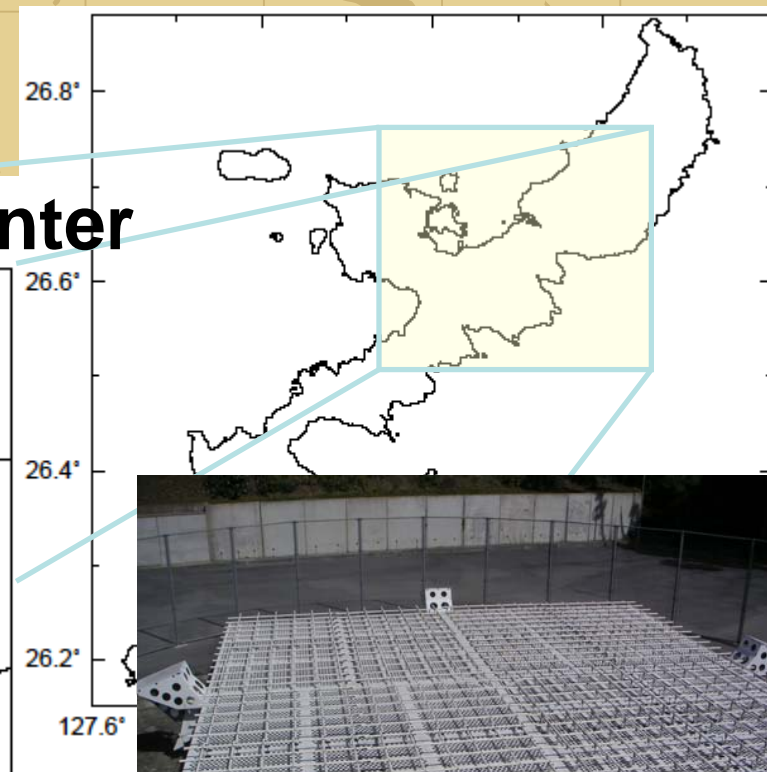
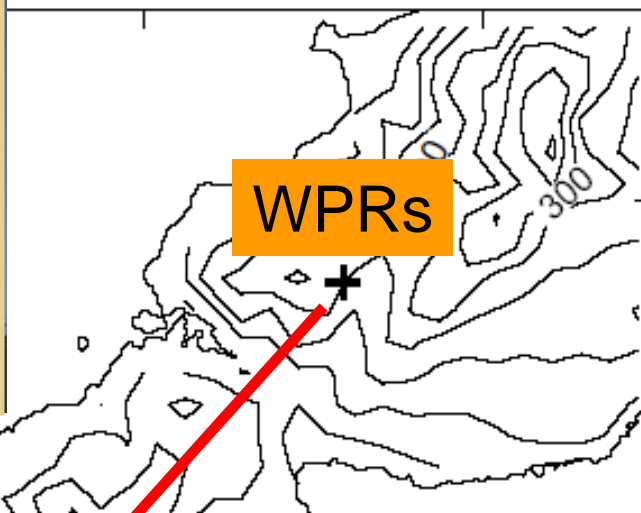
→ Zm, Tb's comparisons

Reduce uncertainty.

Improve GV technique.



NICT Okinawa Center

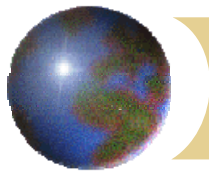




Global Satellite Mapping of Precipitation (GSMap): A Japanese project for global precipitation mapping

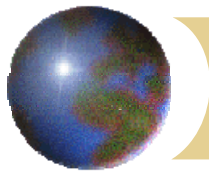
Led by Prof. K. Okamoto, Osaka Prefecture
University

A project of the Core Research for Evolutional
Science and Technology (CREST)
Supported by the Japan Science and Technology
Agency (JST)



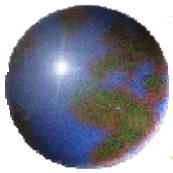
Background

- For climate research, precipitation observation is essential. Since precipitation has high temporal and spatial variations, high spatiotemporal resolution data are required.
- For hydrology and water resources management, high spatiotemporal resolution data are required.
- GPM could partly solve the requirement.



Objective

- **Generation of global precipitation map using mainly spaceborne microwave radiometers**
 - ▣ Daily, 0.1 x 0.1 degree
 - ▣ TRMM, DMSP × 3, Aqua, ADEOS-II
 - ▣ TRMM PR, VI/IR from geostationary satellites
- **Consistent algorithm for microwave radiometer and precipitation radar. — Space-based.**
 - ▣ Common precipitation model
- **Applicable for future global precipitation mapping using space data**
 - ▣ GPM



Group structure

