

# **Journey from Disciplines of Earth Science to Earth System Science**

Japanese Space Program for Mission to Planet Earth  
Since 1985

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**Japan**

# Japanese EO Program

1970s-1980s: Priority was given to Engineering  
to catch up US and USSR space technologies

Middle of 1980s: New Space initiatives was initiated.

- Space Station

- Mission to Planet Earth

1985: NASDA Jointed international cooperation  
through CEOS and EO-ICWG

1990:ADEOS and TRMM program started with International  
Cooperation with NASA/USA and CNES/France

1996: Launch of ADEOS

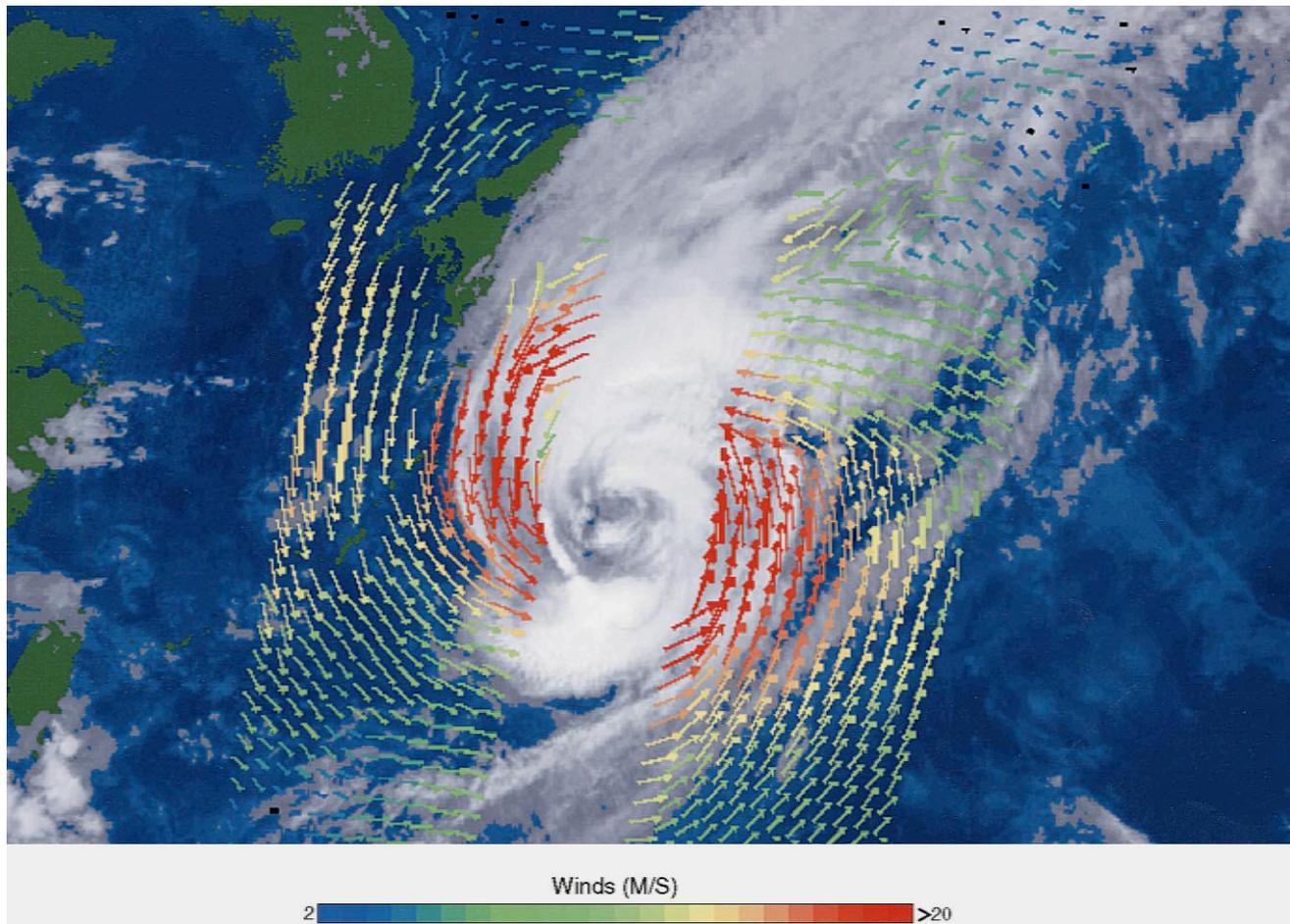
1997: 10-Months-Termination of ADEOS

Launch of TRMM

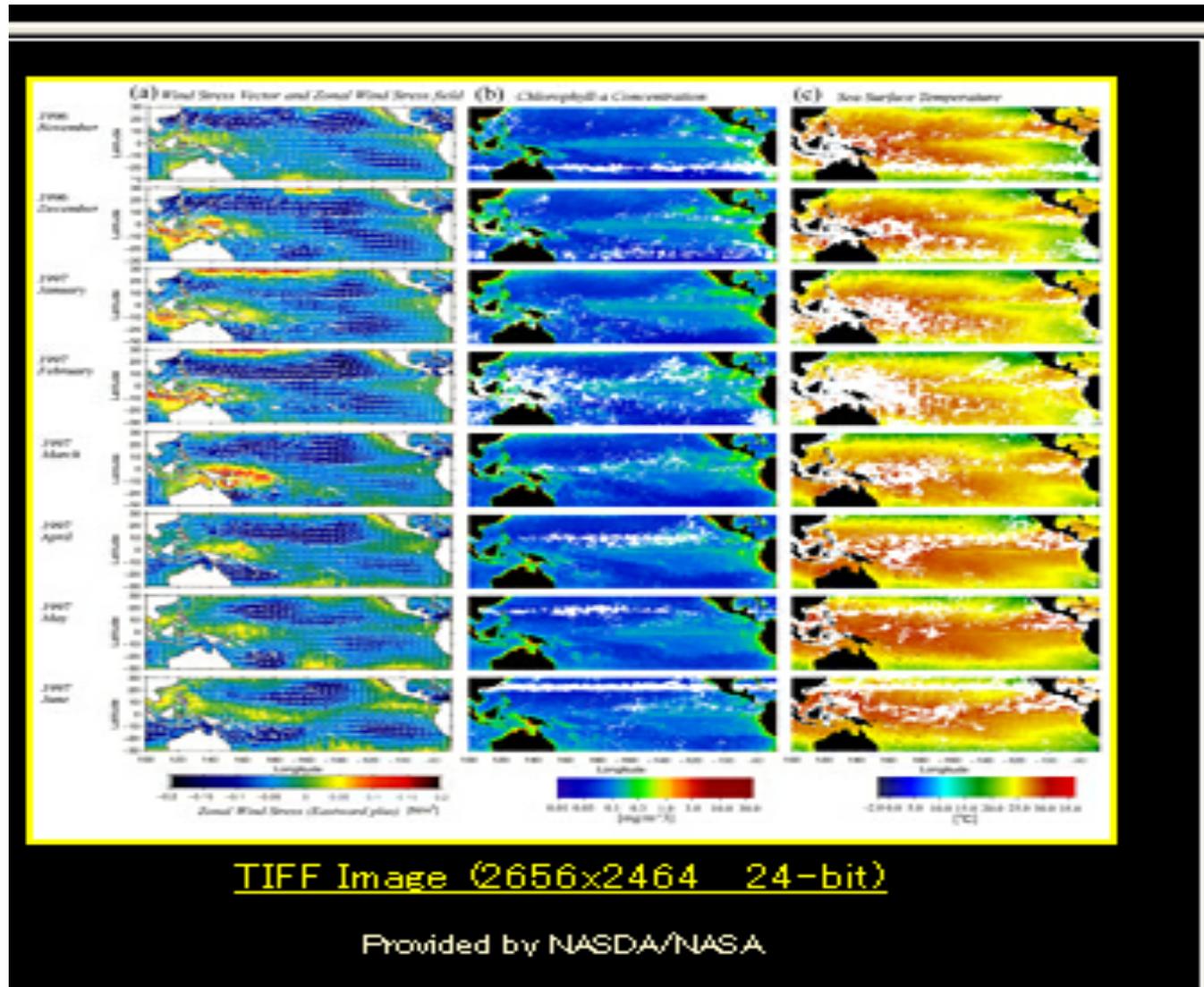
# Typhoon/ADEOS

## Sea Winds

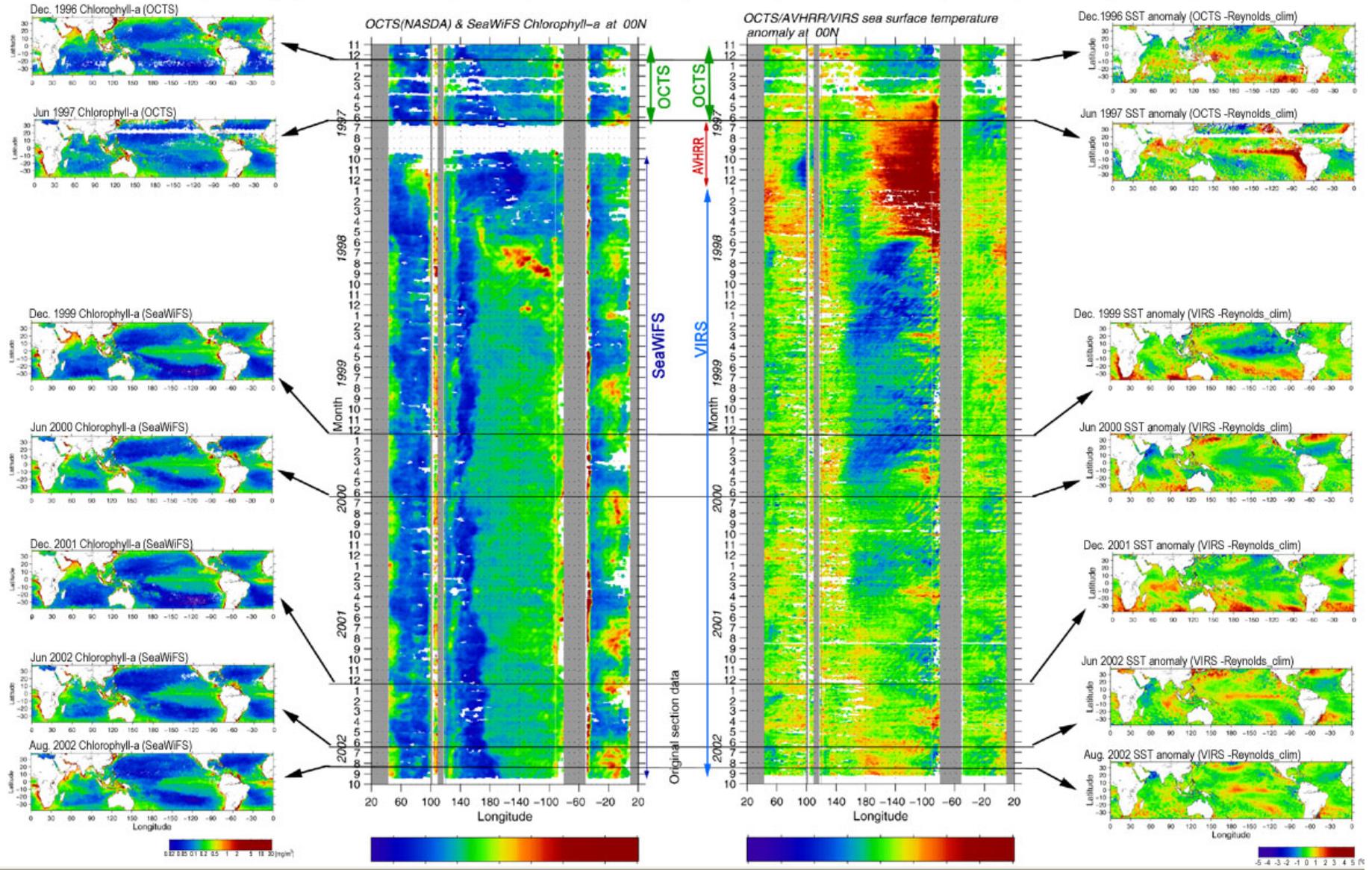
NSCAT/ADEOS (Sep. 21, '96)

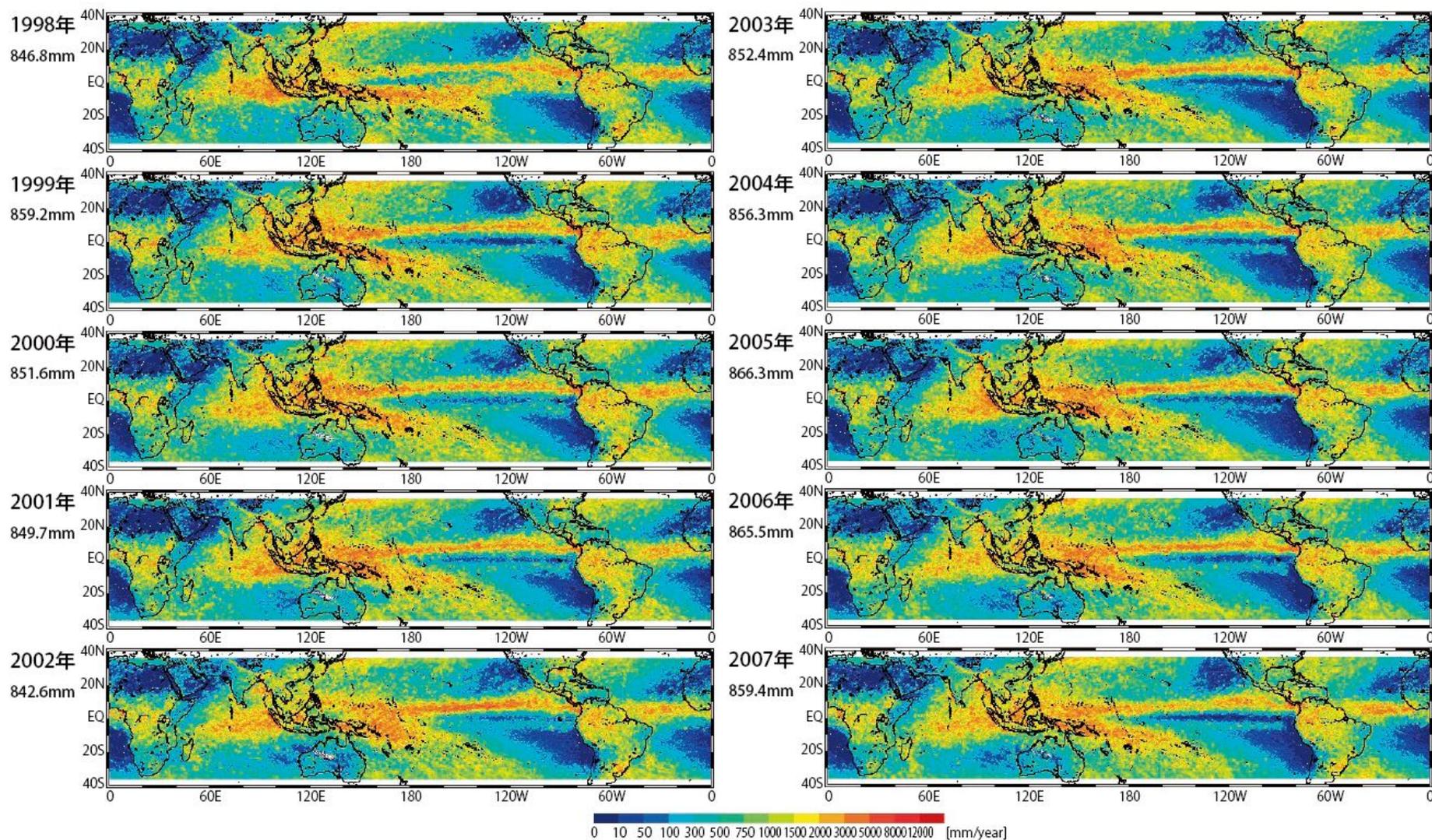


# El-Nino/ADEOS



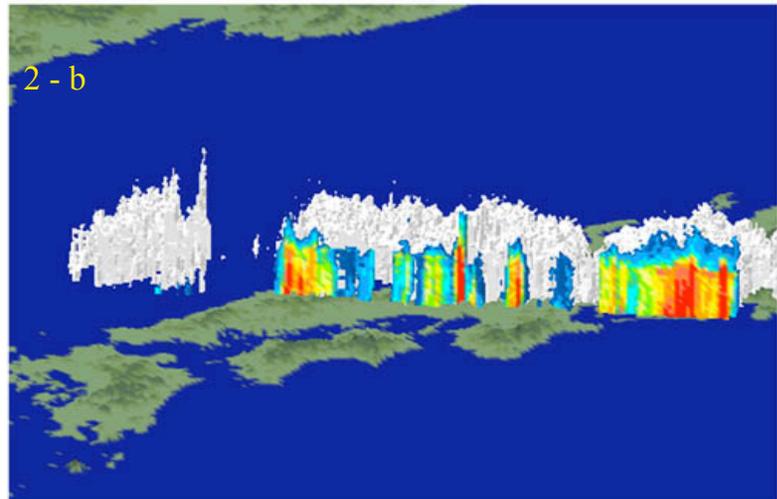
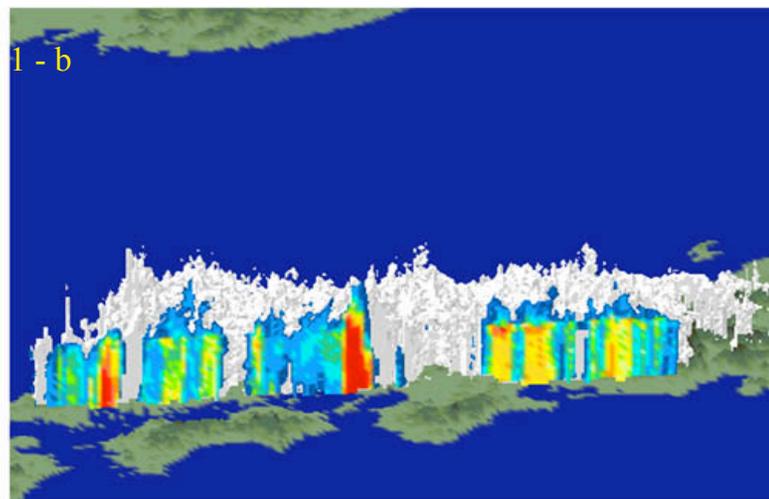
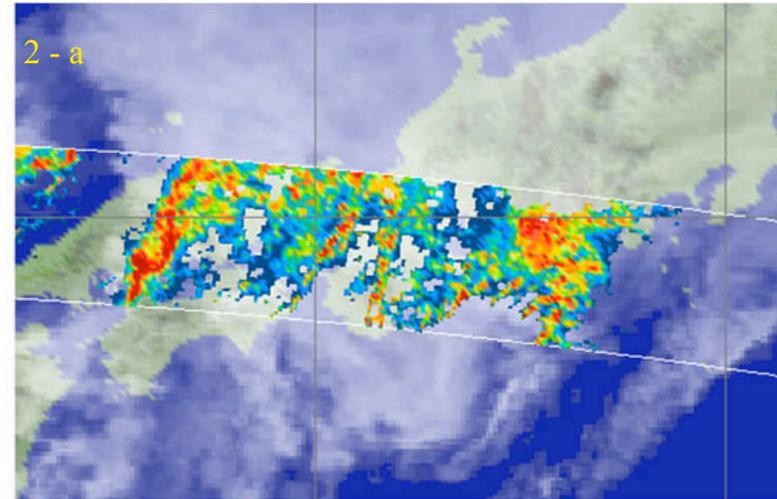
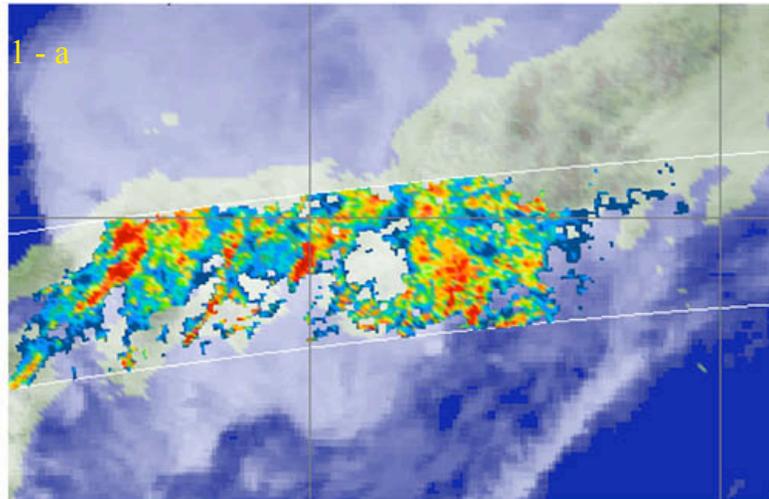
Time series of chlorophyll-a and sea-surface temperature anomaly on the equator observed by OCTS, SeaWiFS, AVHRR, and VIRS





1998年～2007年の各年の年積算量分布。各年の下の数値は、軌道高度変更の影響を反映した、全球平均の年積算降水量を示す。

# Rain/PR/TRMM



# Japanese EO Program

*June 22, 2009*

2002: Launch of AMSR/Aqua

2003: Launch of ADEOS-II

2004: Another 10-Months-Termination of ADEOS-II

2006: Launch of ALOS

2007: 10 Years Anniversary of TRMM

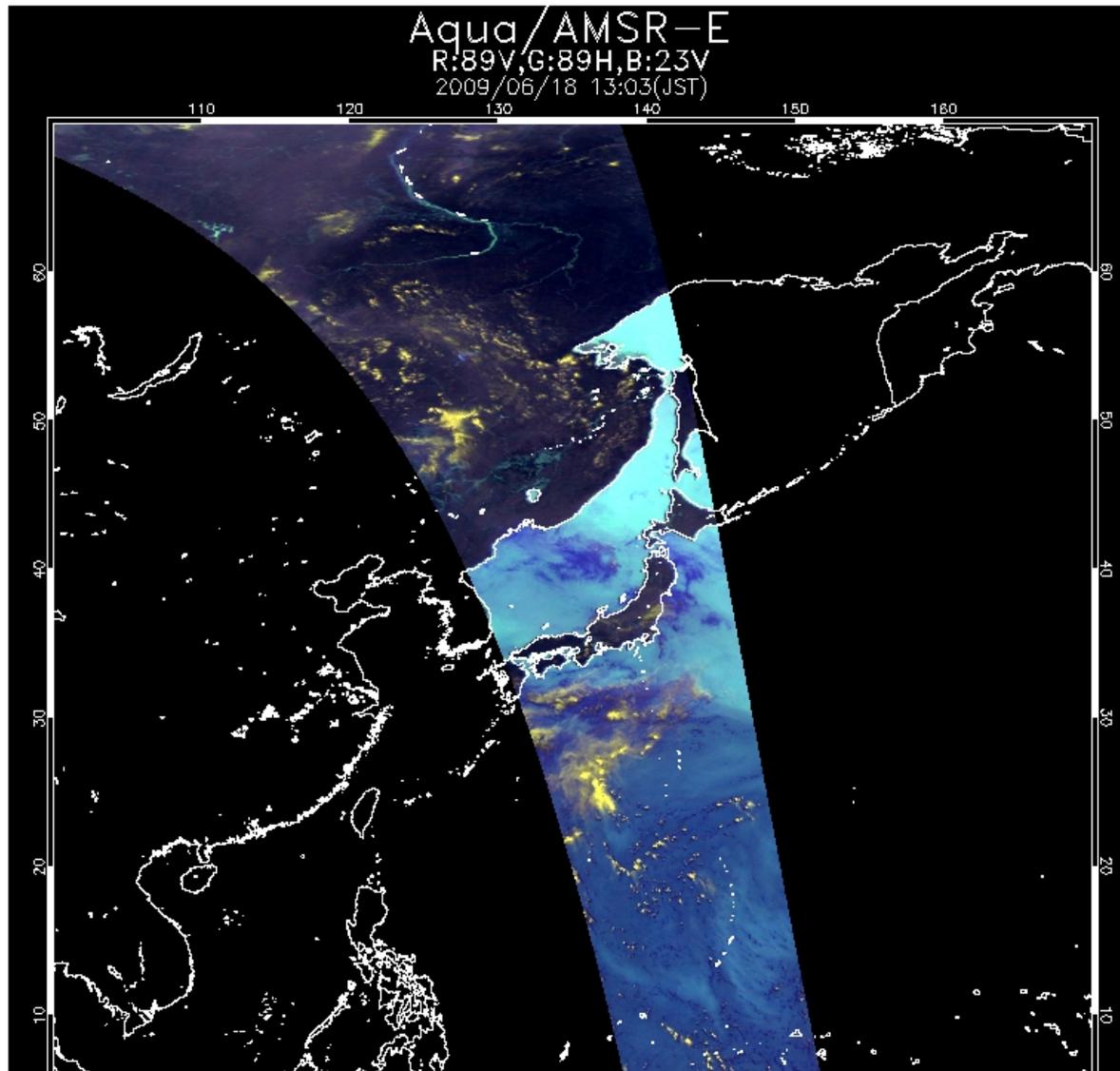
2009: Launch of GOSAT

Today: TRMM, AMSR/Aqua, ALOS and GOSAT  
are working

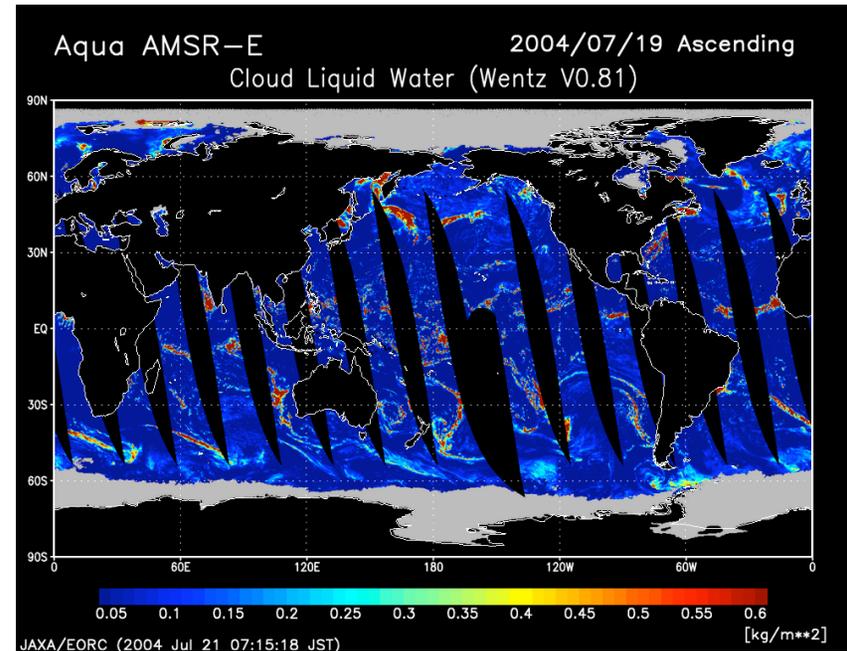
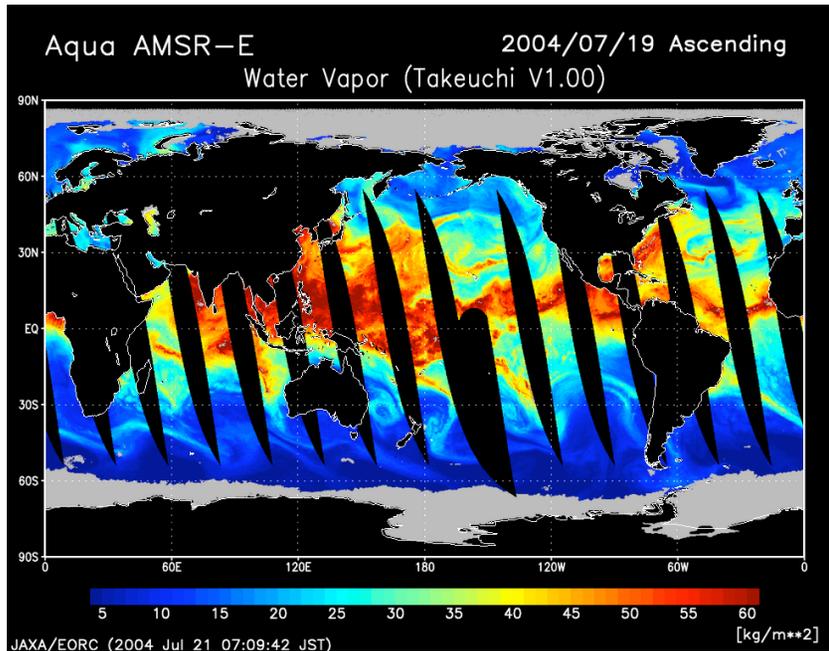
Future: EarthCARE, GPM, GOSAT

# AMSR-E/Aqua

*June 22, 2009*



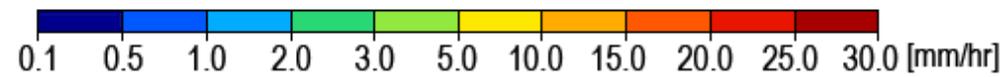
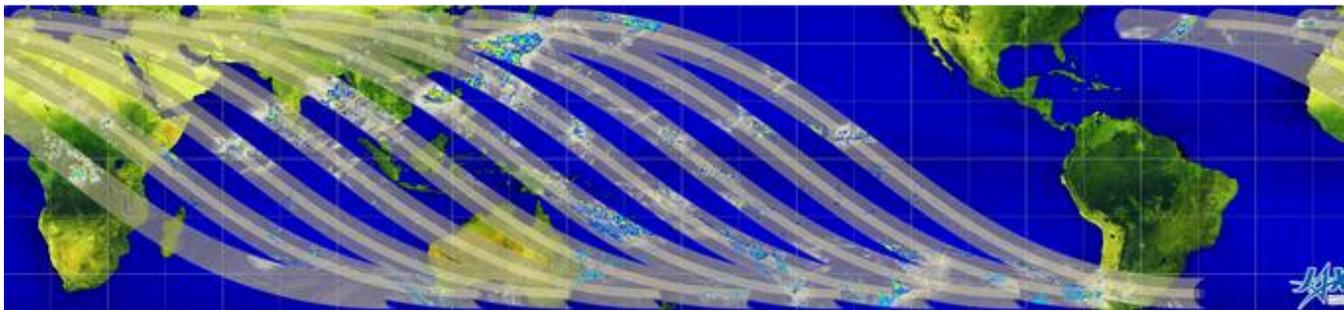
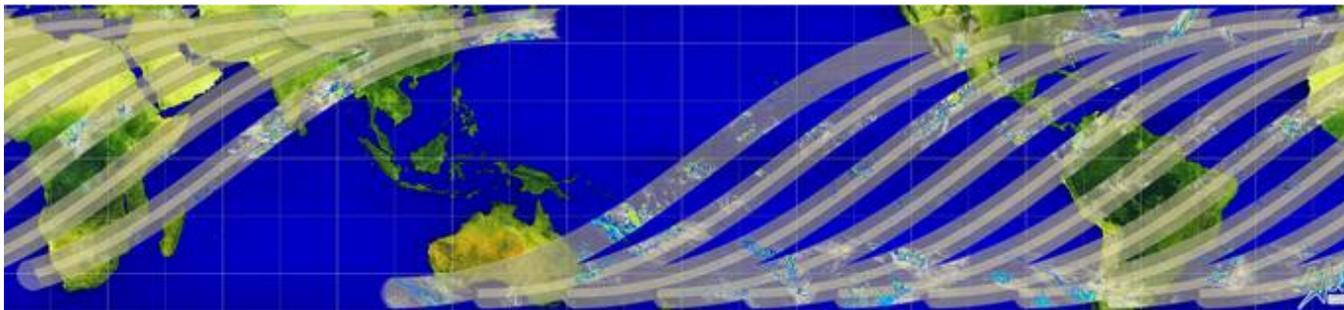
# AMER-E/Aqua



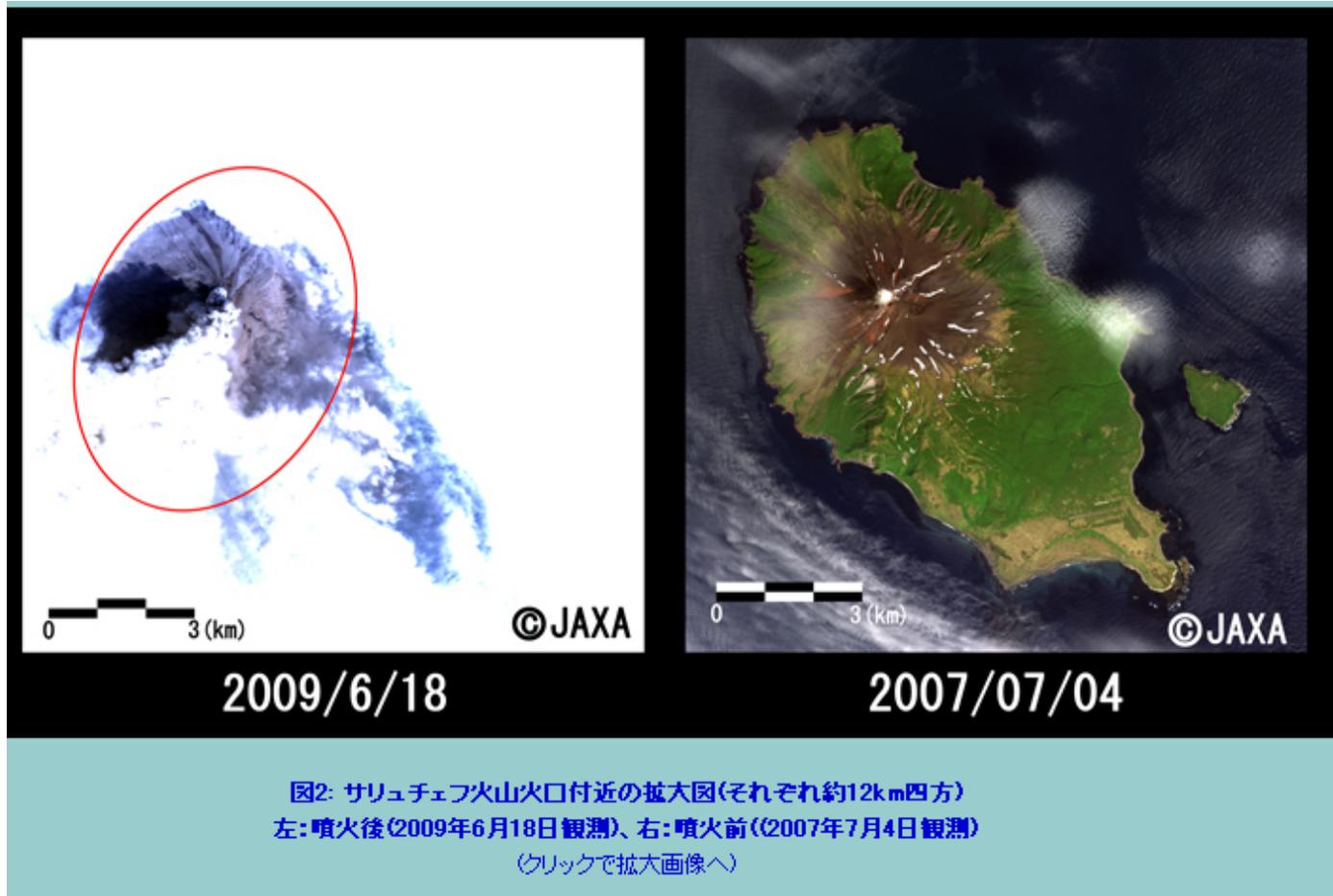
# PR/TRMM

日時(世界標準時) (Daily/Hourly)      センサ・観測時刻      物理量  
2009 ▾ - 6 ▾ - 18 ▾ Daily ▾      PR&TMI&VIRS ▾      PR(雨)&TMI(雨)&VIRS(雲) ▾      決定

PR(雨)&TMI(雨)&VIRS(雲) [2009-06-18]



# ALOS



# Lessons and Issues

Avoid vulnerability of launch and other failures.

NSCAT, OCO, LANDSAT(ALOS)

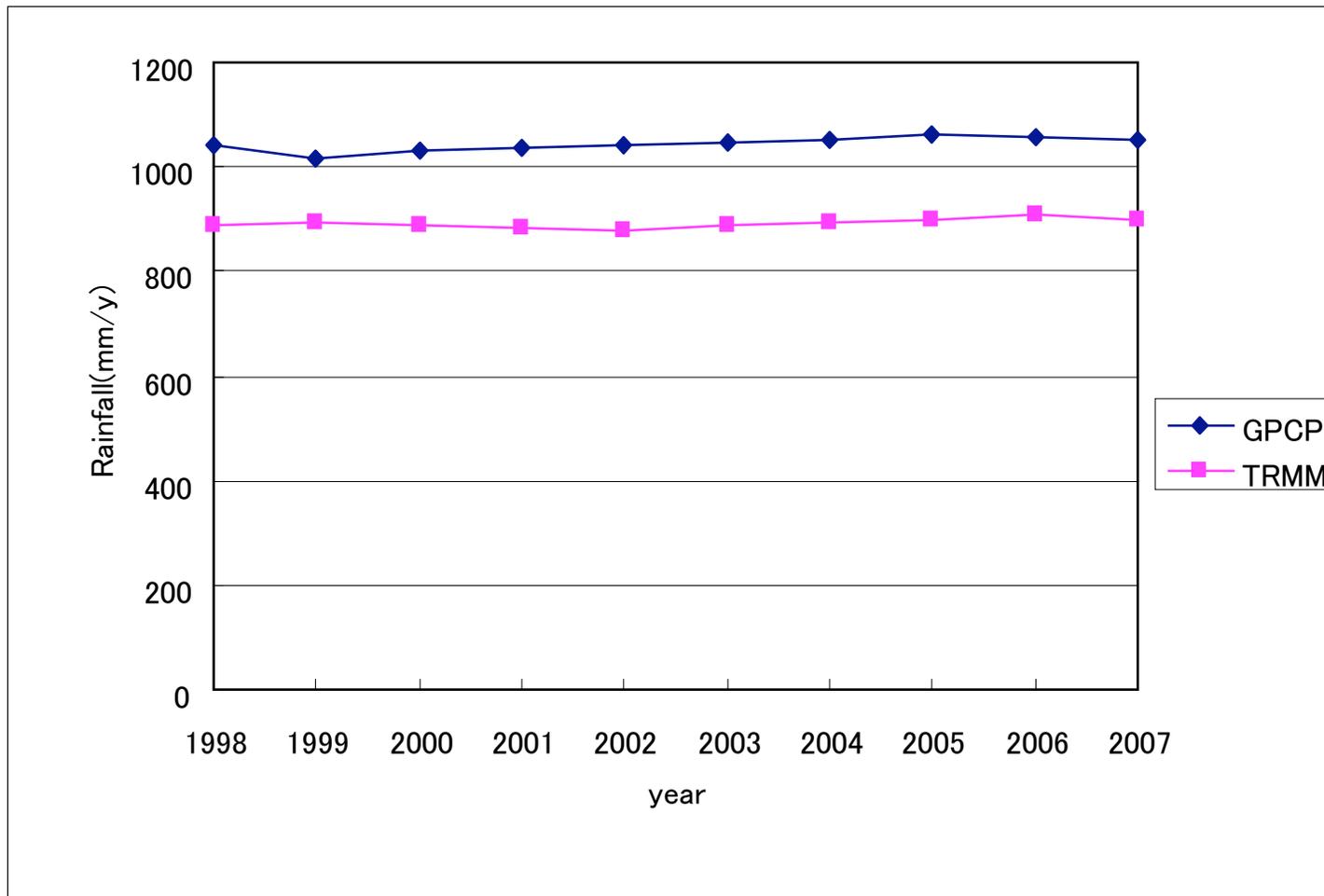
Can we replace ground-based observation by satellites?

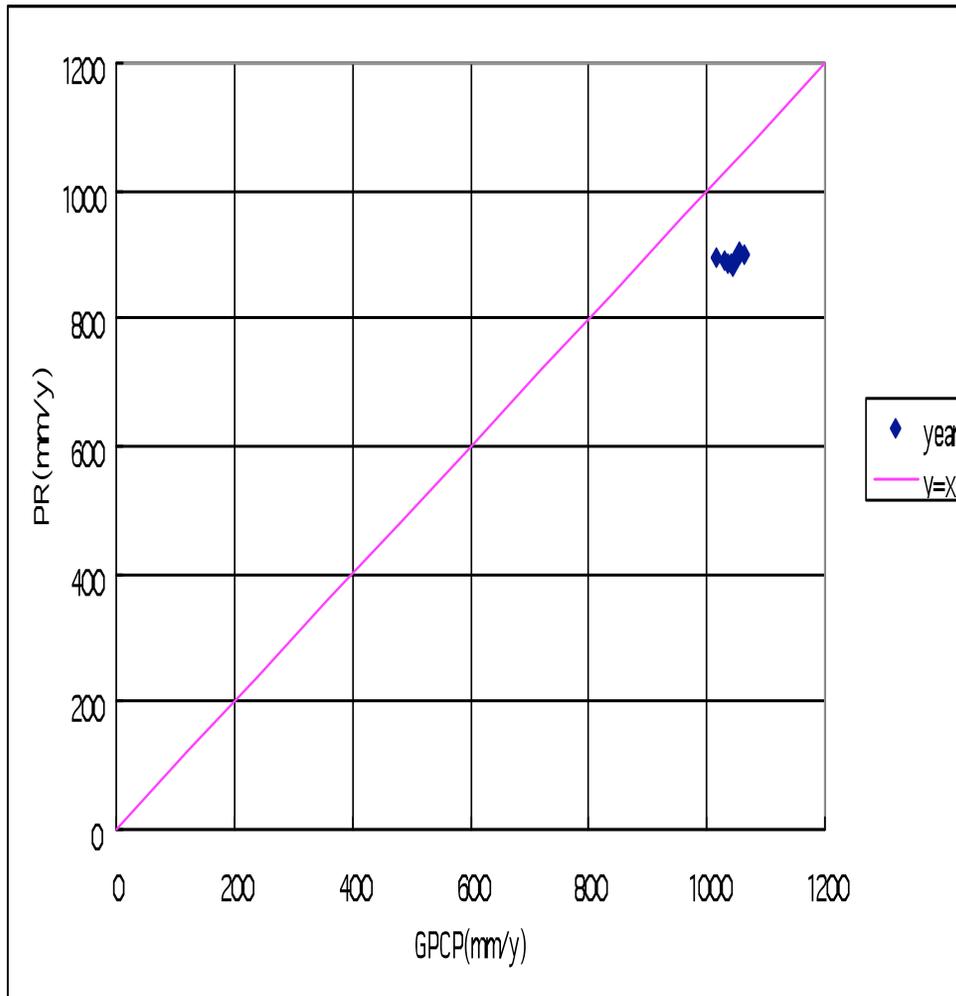
Statistical Data VS Instantaneous Data

Retrieval algorithm for high spectral resolution data

Fourier Type Spectrometer (FTR)

## Good Agreement of Annual Rainfall in the Tropics





$$\mu_X = 1043.7650(\text{mm} / \text{y})$$

$$\mu_Y = 892.1642(\text{mm} / \text{y})$$

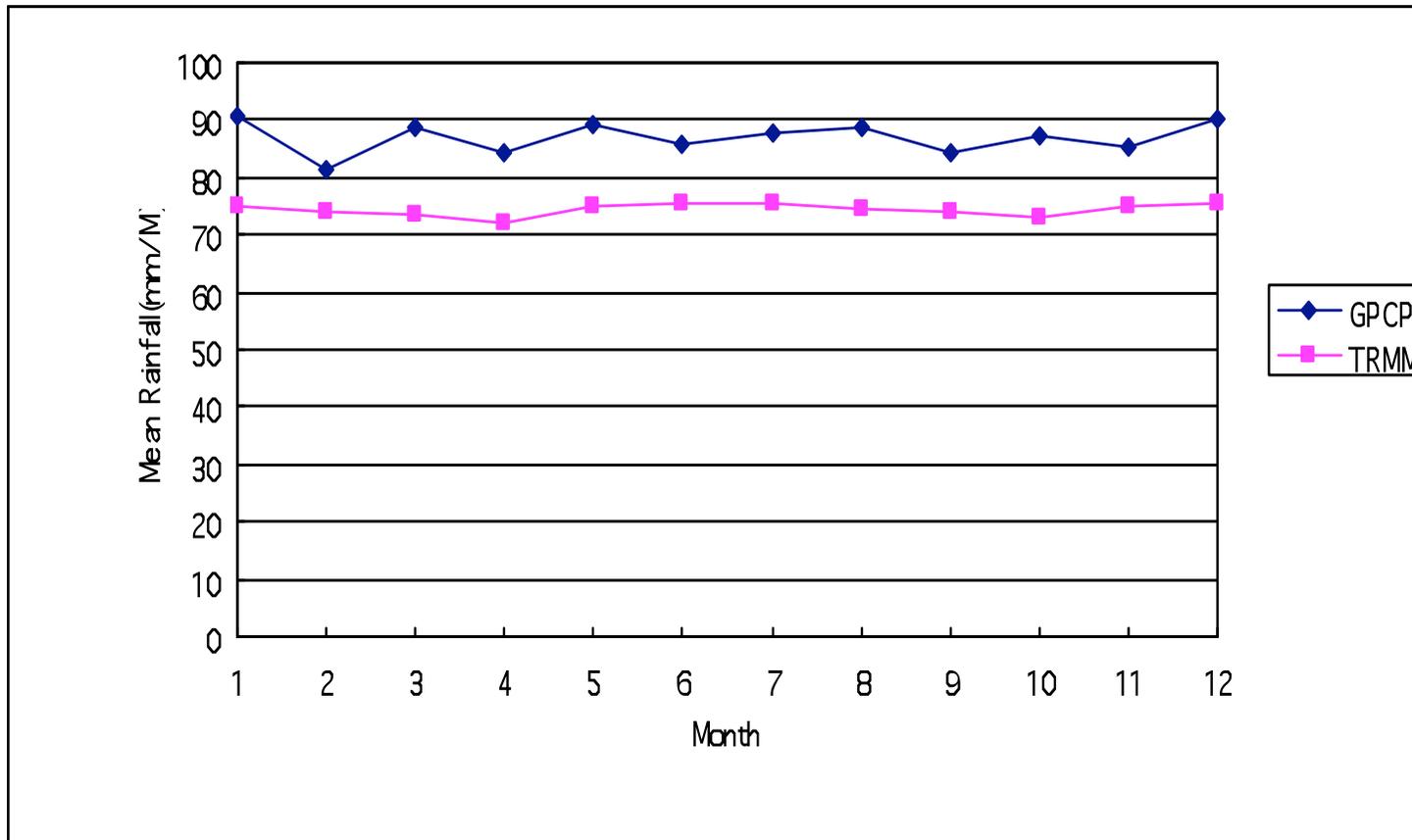
$$\sigma_X = 13.8344(\text{mm} / \text{y})$$

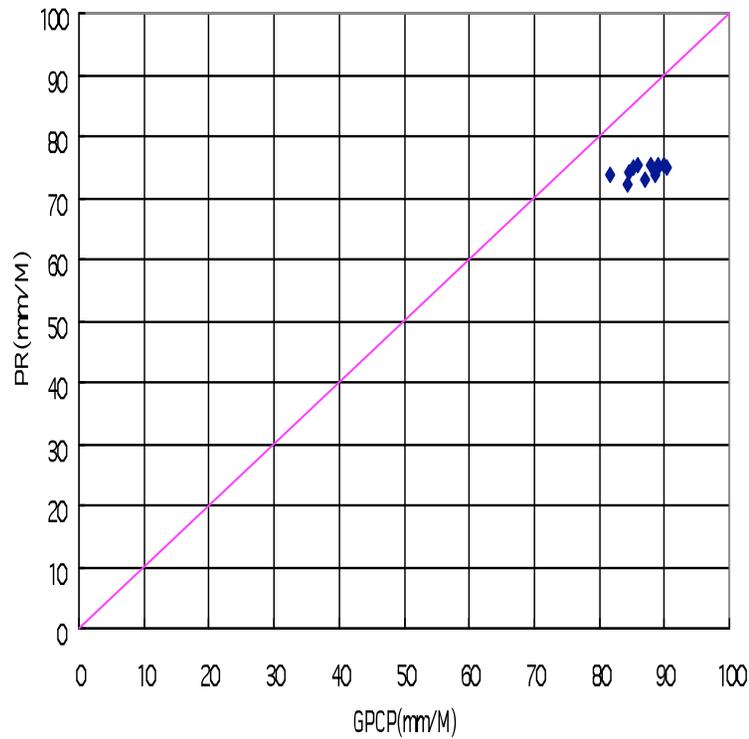
$$\sigma_Y = 47.4616(\text{mm} / \text{y})$$

$$\rho = 0.0684$$

$$SE = 159.1759(\text{mm} / \text{y})$$

## Good Agreement of Monthly Rainfall in the Tropics





$$\mu_X = 86.9804(mm / y)$$

$$\mu_Y = 74.3470(mm / y)$$

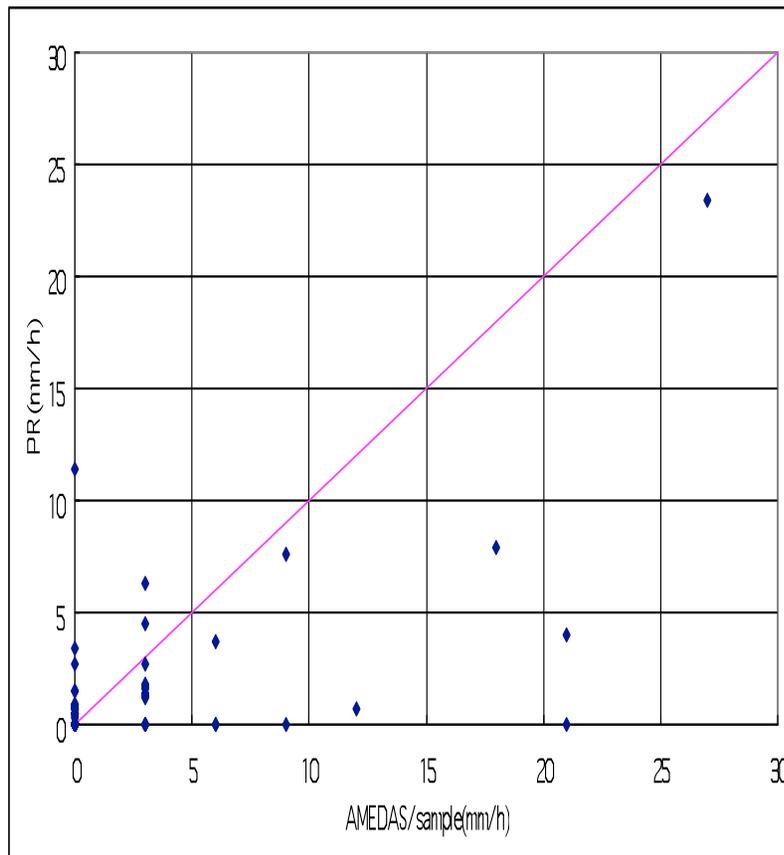
$$\sigma_X = 2.6640(mm / y)$$

$$\sigma_Y = 1.0208(mm / y)$$

$$\rho = 0.4579$$

$$SE = 12.8550(mm / y)$$

## Poor Agreement of Instantaneous Rainfall At Ube in 2007



$$\mu_X = 0.2458(\text{mm} / \text{h})$$

$$\mu_Y = 0.1386(\text{mm} / \text{h})$$

$$\sigma_X = 1.8240(\text{mm} / \text{h})$$

$$\sigma_Y = 1.1364(\text{mm} / \text{h})$$

$$\rho = 0.6611$$

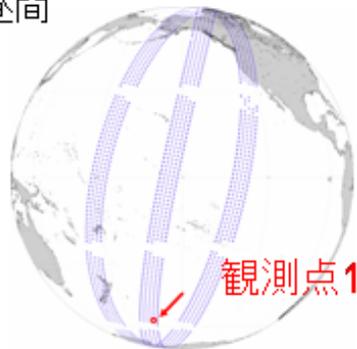
$$SE = 1.3745(\text{mm} / \text{h})$$

# GOSAT(赤外域)

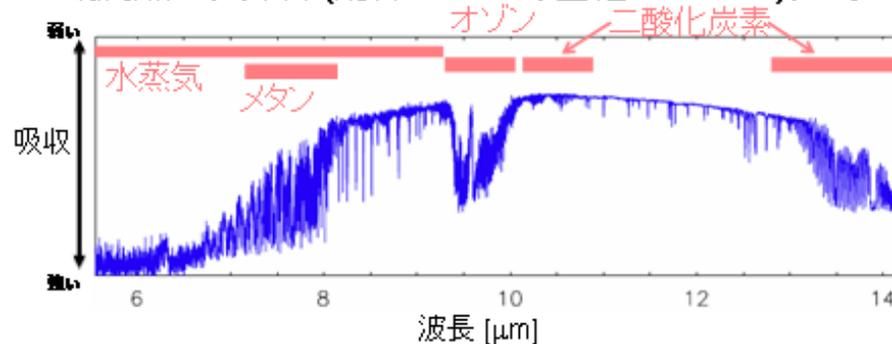


「いぶき」搭載 温室効果ガス観測センサ(TANSO-FTS)のデータから求めた波長ごとの光の強さ(スペクトル)  
 ~ 2009年3月12日に昼夜の熱赤外(バンド4)データの取得に成功 ~

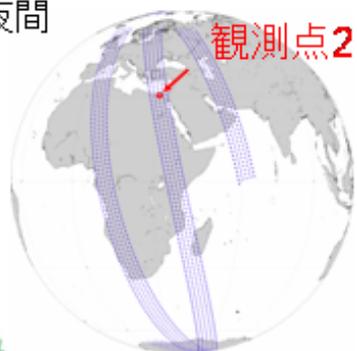
昼間



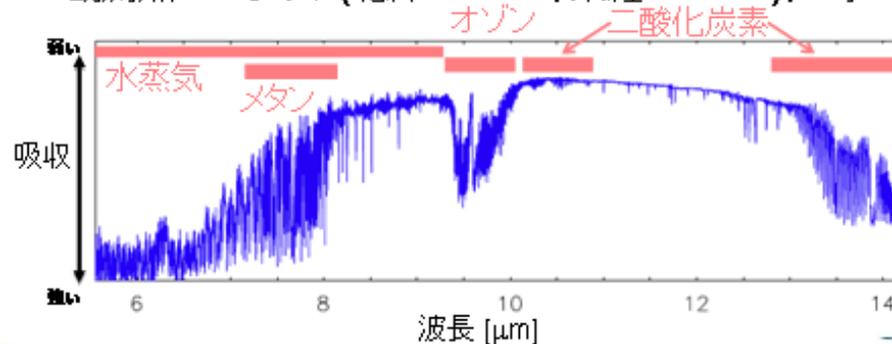
観測点1: 太平洋(南緯57.45°, 西経168.47°); 8時23分(JST)



夜間



観測点2: エジプト(北緯29.97°, 東経30.94°); 7時26分(JST)



波長 [μm]

※赤い帯の範囲は各気体の吸収帯を示す。





「いぶき」搭載 温室効果ガス観測センサ (TANSO-FTS) の観測データとシミュレーションデータの比較

観測点1: 太平洋(南緯57.45°, 西経168.47°); 8時23分(JST)

— 観測  
— シミュレーション

