



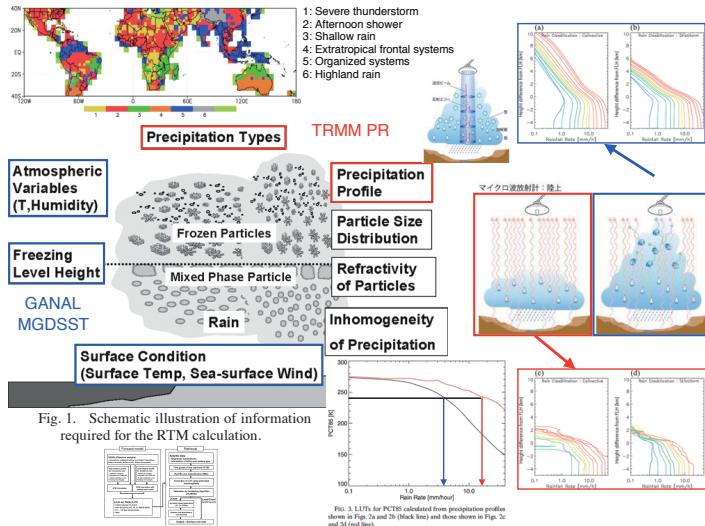
## Abstract

A long-term accumulated observation data is expected to diagnose the climate study statistically. Although rain gauge data has been mainly utilized for rainfall climatology, satellite rainfall products combining data obtained by microwave radiometers (MWRs) in low Earth orbit and by infrared radiometers (IRs) such as the Global Precipitation Climatology Project (GPCP) are available since late 1970s. However, spatiotemporal resolution is rough (2.5° in latitude-longitude grid and 1 monthly) and the quality is not fully enough. Owing to sparse satellite MWR observations, rainfall is mainly estimated from IR. The great success of the Tropical Rainfall Measuring Mission (TRMM) accelerated development of the rain retrieval algorithm for MWR. High spatiotemporal resolution satellite rainfall products (0.1°–0.25° in latitude-longitude grid and 0.5–3 hourly) have been available after the Tropical Rainfall Measuring Mission (TRMM) launch since 1998. The development of the rain retrieval algorithm combined MWRs and IR is enabling us to provide rainfall climatology using satellite rainfall data before the TRMM launch (~1998, pre-TRMM era). In this study, a prototype of GSMaP rainfall data in pre-TRMM era is constructed.

Surface rainfall in 1987–1999 is estimated by the latest version of GSMaP MWR algorithms using the Special Sensor Microwave Imager (SSM/I) onboard Defense Meteorological Satellite Program (DMSP) satellites F8, F10, F11, F12, F13, and F15. The Japanese-55-year Reanalysis data is used for atmospheric variables instead of the Global Analysis (GANAL). The 27 years of prototype GSMaP data may stand up to rainfall climate study.

In this presentation, a time series and horizontal distributions of monthly-accumulated GSMaP rainfall will be compared with other satellite rainfall products. In pre-TRMM era, the geostationary meteorological satellite data is more important to estimate rainfall precisely because the MWRs observation is scarce.

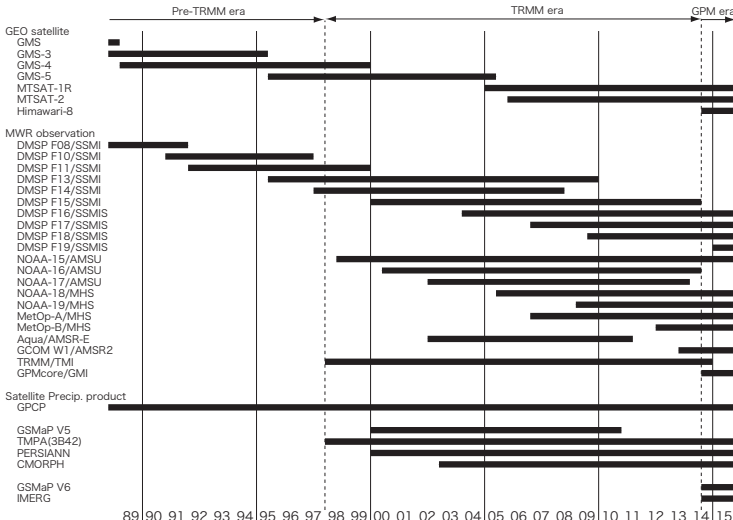
## GSMaP MWR Algorithm



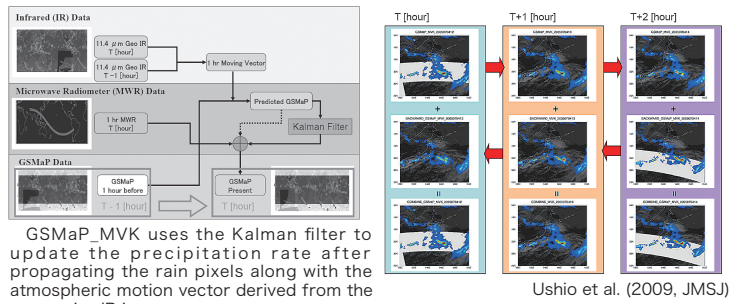
The GSMaP MWR algorithm consists of two parts. The former part is a forward calculation that calculates LUTs for the relationship between rainfall rate and Tbs using a RTM (Liu, 1998). The RTM inputs atmospheric field variables provided by the GANAL and precipitation-related variables such as vertical profile model of precipitation accumulated by TRMM PR data. Precipitation profiles are classified into six land-based types called precipitation type database (Takayabu, 2008). The convective and stratiform precipitation profiles from PR data, being relative to the freezing-level height to exclude the effect of atmospheric temperature variations (Kubota et al. 2007), are averaged trimonthly for each precipitation type in 5° × 5° boxes. The latter part is the retrieval part that rain rate is estimated using LUTs and measured Tbs with the rain/no-rain classification method developed by Seto et al. (2005) over land and that of Kubota et al. (2007) over coasts. The LUTs are selected by the dominant precipitation types, and the convective and stratiform ones are mixed giving a weight from the statistical frequency distribution from PR data.

Data	Period
Satellite data	Jul. 1987-Dec. 1999
- DMSP F08, 10, 11, 13-15 /SSM/I	
Reanalysis data	-> estimate rainfall by GSMaP MWR algorithm (GSMaP_SSI)
- JRA55 (instead of GANAL)	
Satellite precip.data	
- GPCP v2.2 monthly precip.	
* satellite-gauge combined (GPCP_PSG)	
* SSM/I composite (GPCP_PSC)	

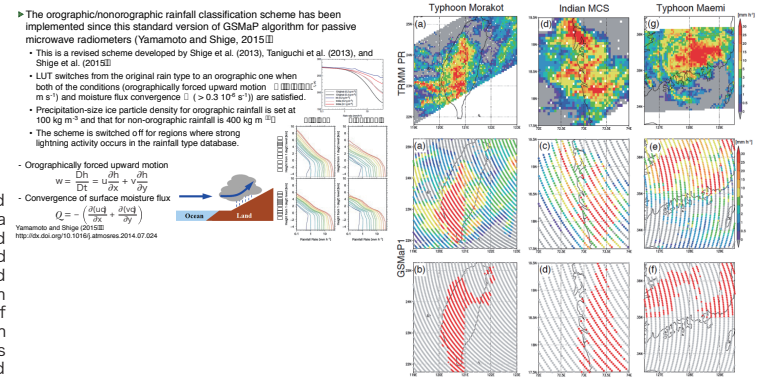
## Historical timeline of MWR satellite observation



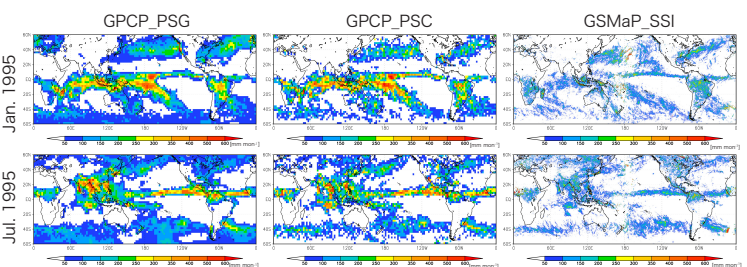
## GSMaP MVK algorithm



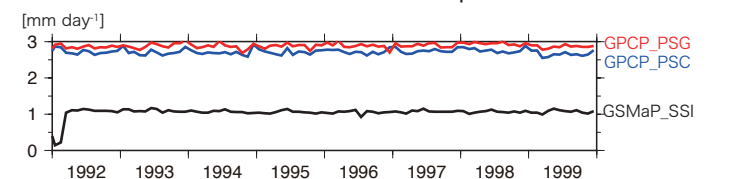
## Orographic/nonorographic rainfall classification scheme



## Horizontal distribution of rain amount



## Time series of rainfall amount in pre-TRMM era



## Summary and Future plan

- ▶ A prototype of GSMaP rainfall data from SSM/I in pre-TRMM era is constructed.
- ▶ Horizontal distributions in rainfall amount for GSMaP is similar to that for GPCP, however, underestimation remains.
- ▶ Sparse MWR observations in pre-TRMM era, bug, etc...
- ▶ MVK and rain estimation using VIS/IR algorithm become more important for complement of MWR.
- √ Data collection and development of geometric correction for GMS-2, -3, and 4.
- √ Implementation of MVK algorithm using GMS data.