Land Surface Emissivity for Passive Microwave Rainfall Retrieval over the Korean Peninsula

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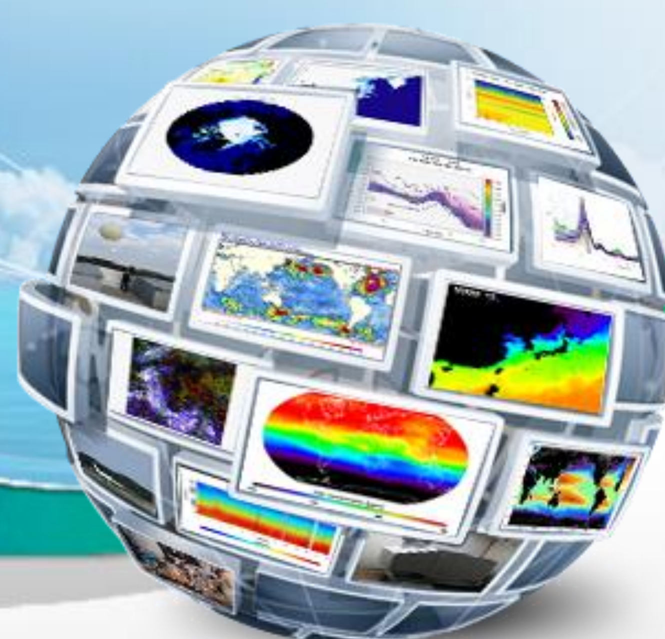

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Previous Study for Retrieval Land Surface Emissivity

TABLE I
SUMMARY OF EMISSIVITY INTERCOMPARISON PARTICIPANT GROUPS AND DATA SET ATTRIBUTES

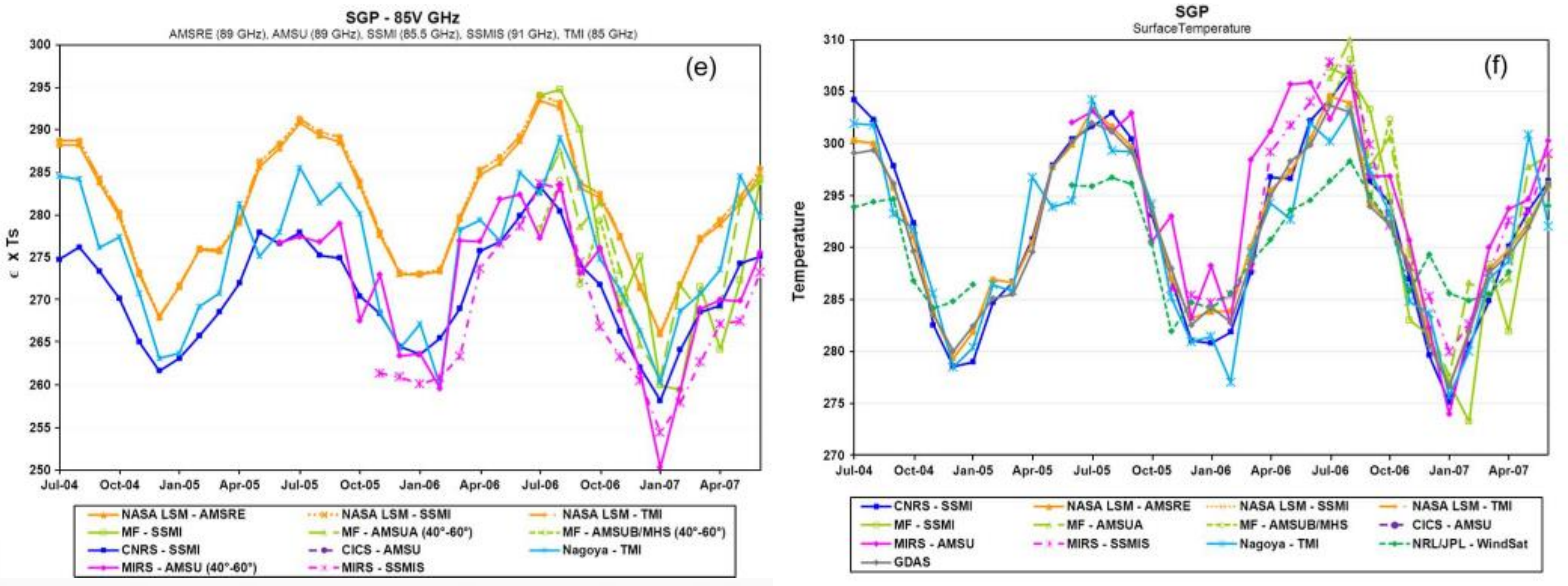
Algorithm Group	Sensor	Targets	Dates	Channels
NASA- GSFC	AMSR-E	All	07/04 - 06/07	All
	SSMI	All	07/04 - 06/07	All
	TMI	SGP, HMT-SE	07/04 - 06/07	All
CNRS	SSMI	All	07/04 – 06/07	All
Meteo-France	AMSU-A	All	07/06 - 06/07	23.8; 31.4; 50.3; 89 GHz
	SSMI	All	07/06 - 06/07	All
NOAA-CICS	AMSU-B/MHS	C3VP	12/05 - 02/07	All
Nagoya University	TMI	SGP, HMT-SE	07/04 - 06/07	All
NOAA-MIRS	AMSR-E	All	08/05 - 06/07	All
	AMSU-A, AMSU-B/MHS	All	08/05 - 06/07	All – AMSU (A & B)
	SSMIS	All	08/05 - 06/07	All
NRL/JPL	WindSat	All	07/04 - 06/07	All

TABLE II
DISTINCTION BETWEEN THE THREE MAIN APPROACHES TO MICROWAVE SURFACE EMISSIVITY ESTIMATION USED IN THIS INTERCOMPARISON STUDY

Type	Principle	Input Parameters	Advantages	Disadvantages
Land Surface Model	Dense media radiative transfer theory	Surface parameters (soil type, snow properties, etc)	Naturally couples to land surface models	Dependent upon realism of specified surface parameters
Direct observational	Observationally based	Satellite observations, land and atmosphere properties	No surface parameters needed other than temperature	Only works for partially-opaque atmospheric conditions, dependent upon land surface temperature and atmospheric profile and atmospheric model assumptions
Physical Retrieval	Parameterized radiative transfer	Satellite observations	Physical consistency amongst retrieved surface parameters	Parameterizations may not work well above X-band

[Ferraro et al. 2013, IEEE]

Previous Study for Retrieval Land Surface Emissivity



SGP: 1-degree box centered of the Southern Great Plane site (36.6° N, 97.5°W)

[Ferraro et al. 2013, IEEE]

Methodology

❖ Atmospheric contribution

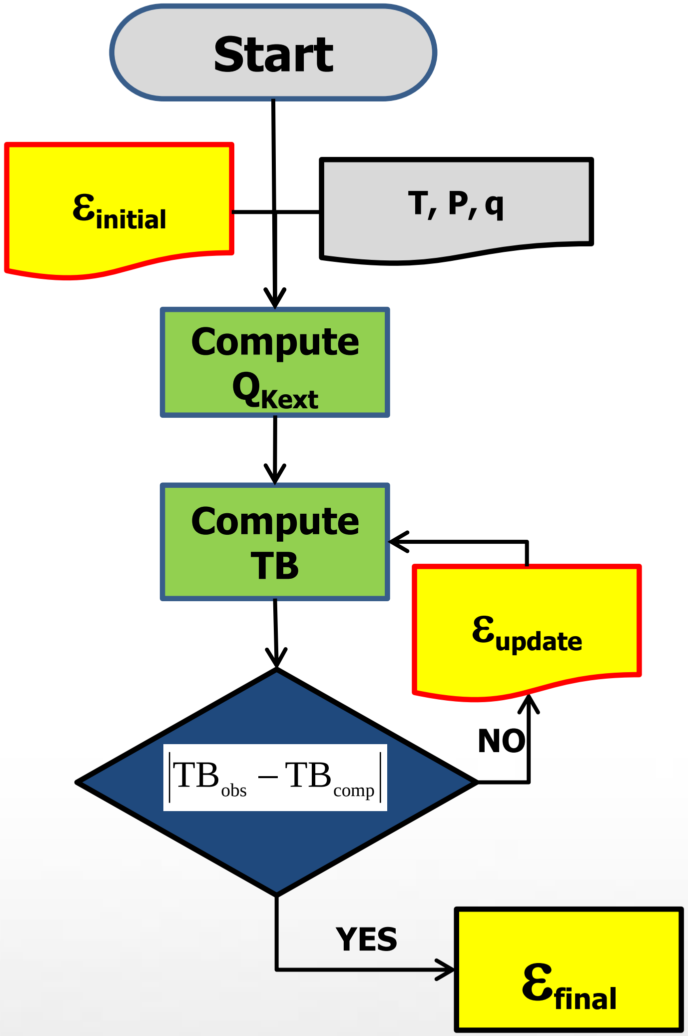
- Upwelling and downwelling atmospheric emission
- RTM: Plane parallel Eddington approximation

❖ Satellite observation

- Conically scanning PMW radiometer observation

❖ Retrieval

- Physical constraint for the emissivity



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Dataset

❖ TRMM TMI observation data

- Brightness temperatures for 9 channels (10 ~ 85 GHz)
- Period: 2011.01.01 ~ 2012.12.31

❖ Korea Local Analysis and Prediction System (KLAPS) reanalysis data

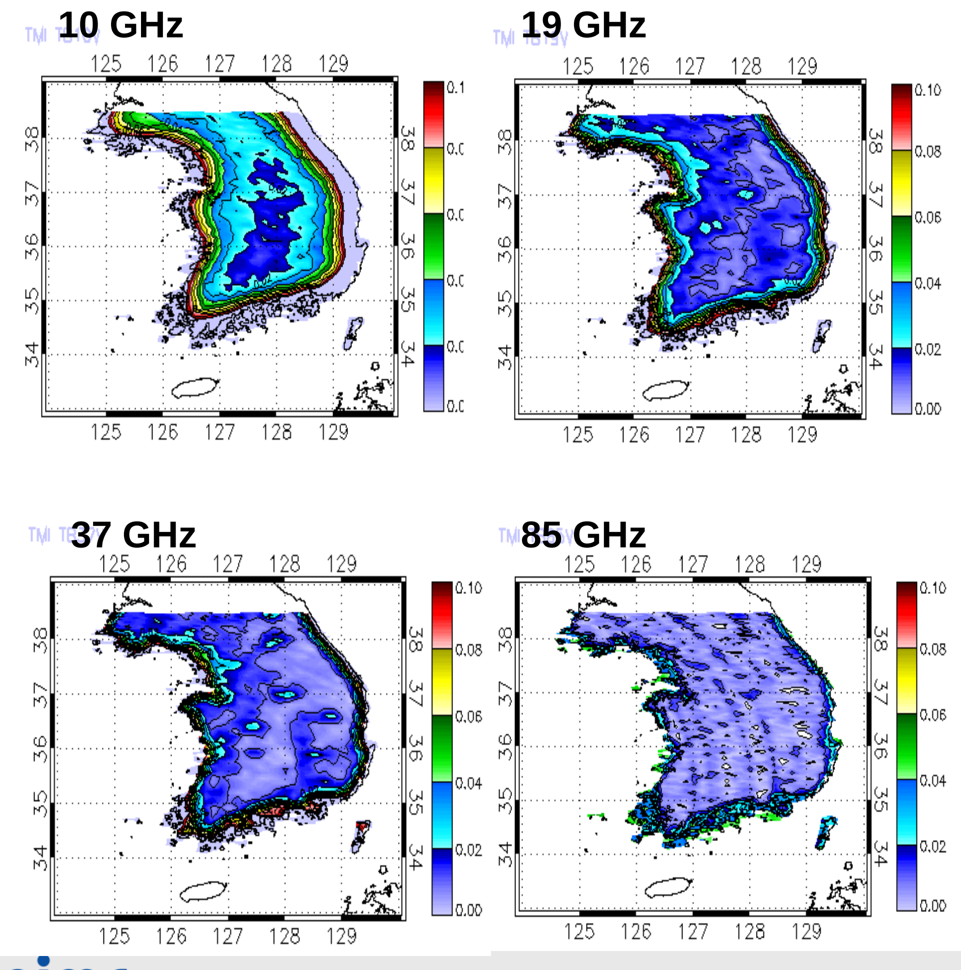
- Resolution: 5 km x 5 km
- Vertical profiles of temperature and humidity, surface temperature

❖ COMS cloud data

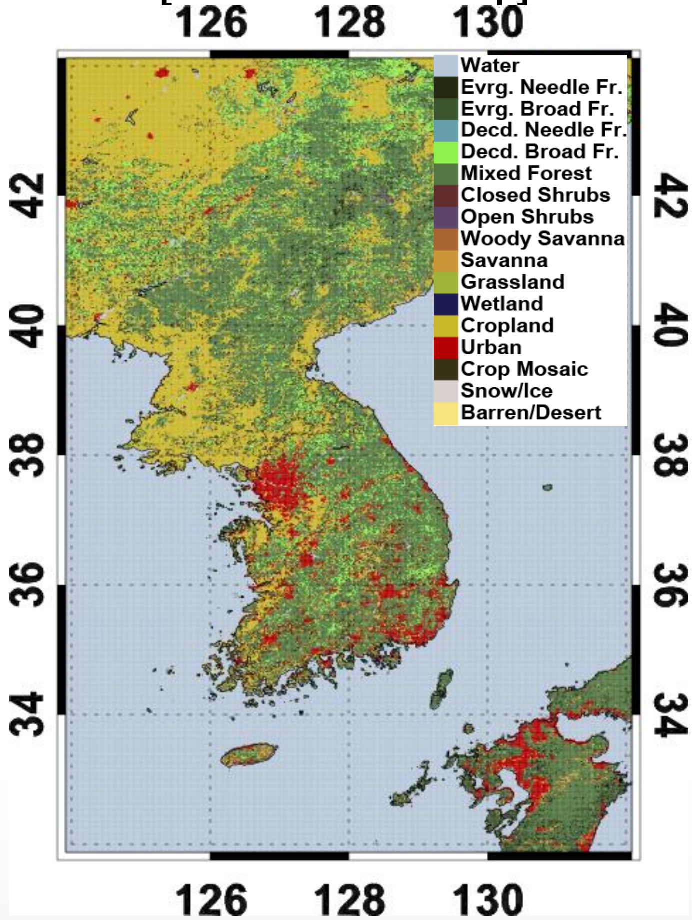
- Resolution: 4 km x 4km
- Level 2 cloud detection (0: clear, 1: cloud)

Polarization Difference

Polarization Difference
(Ev – Eh)



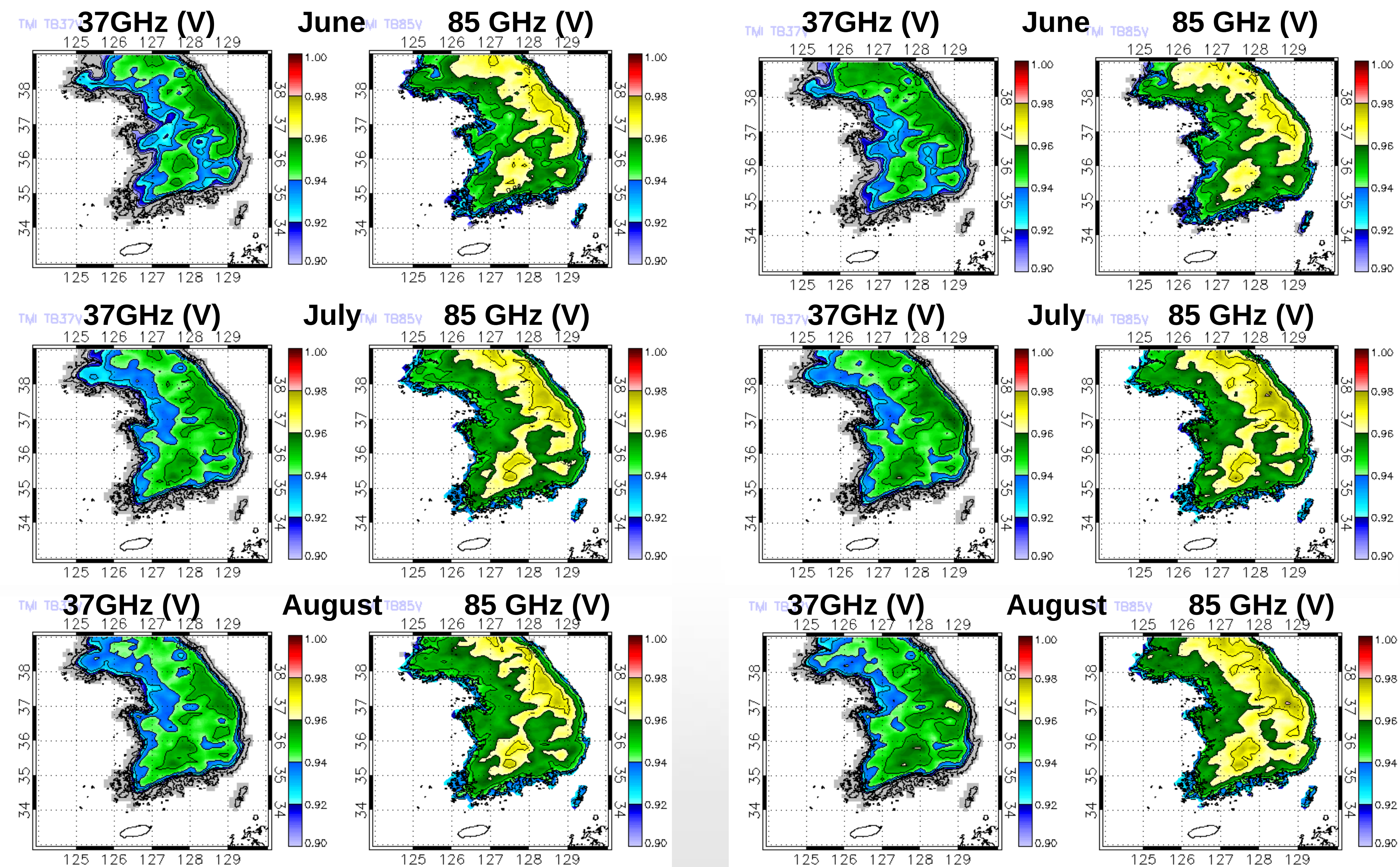
[IGBP Land Ecomap]



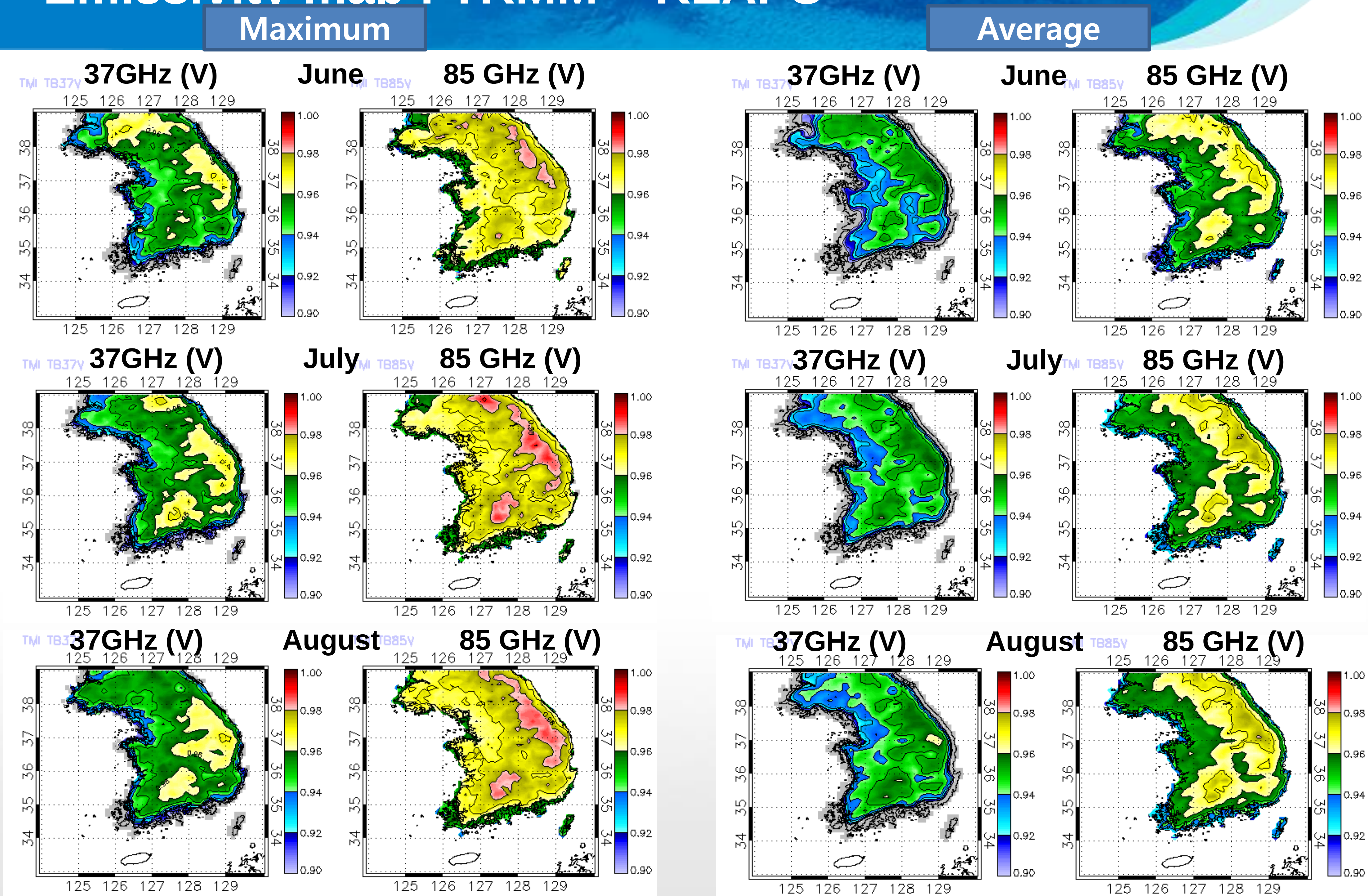
Surface	19 GHz	85 GHz
Woody	< 0.10	< 0.08
Desert	> 0.10	> 0.08

Emissivity map : TRMM + KLAPS

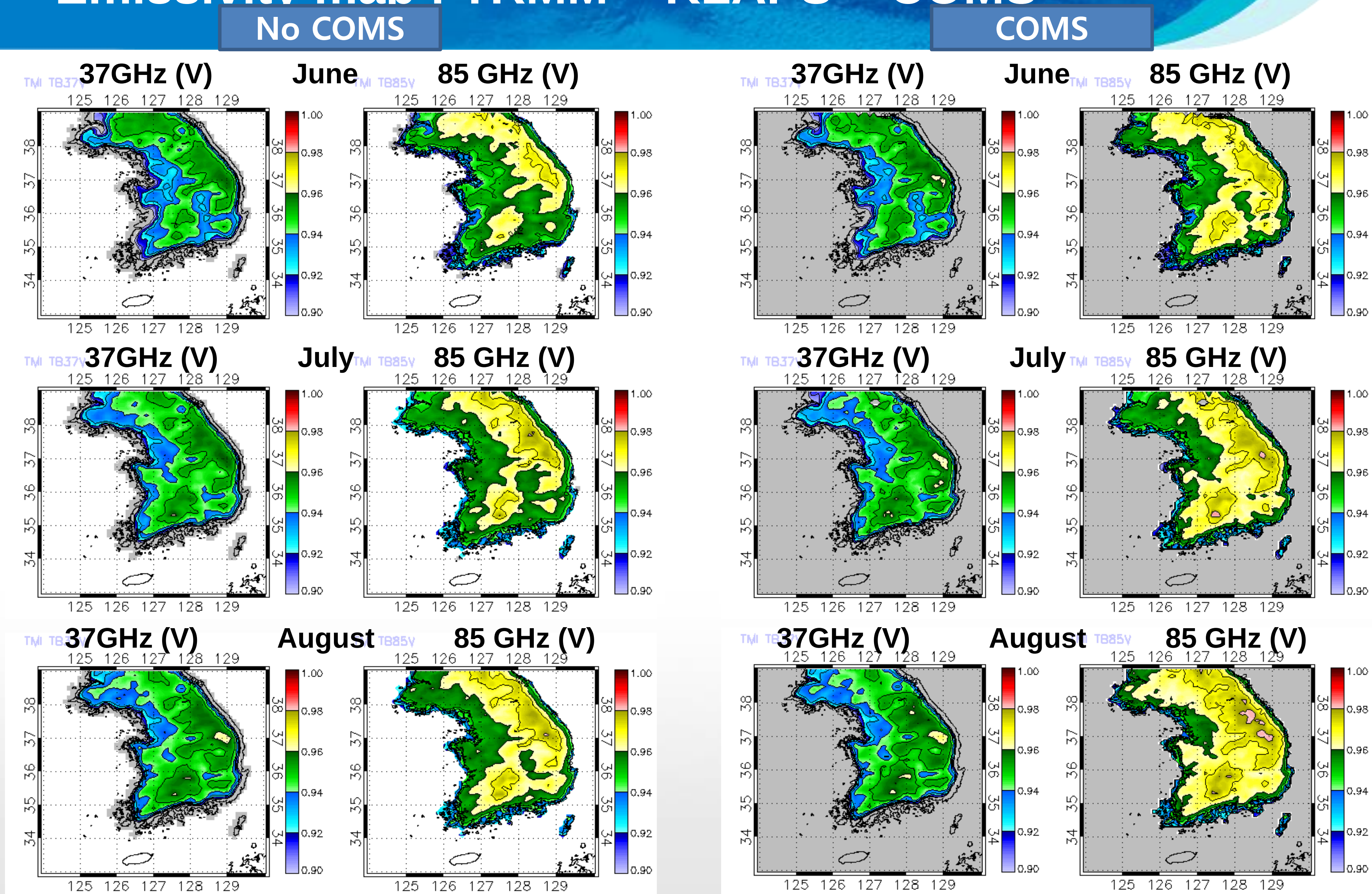
2011 2012



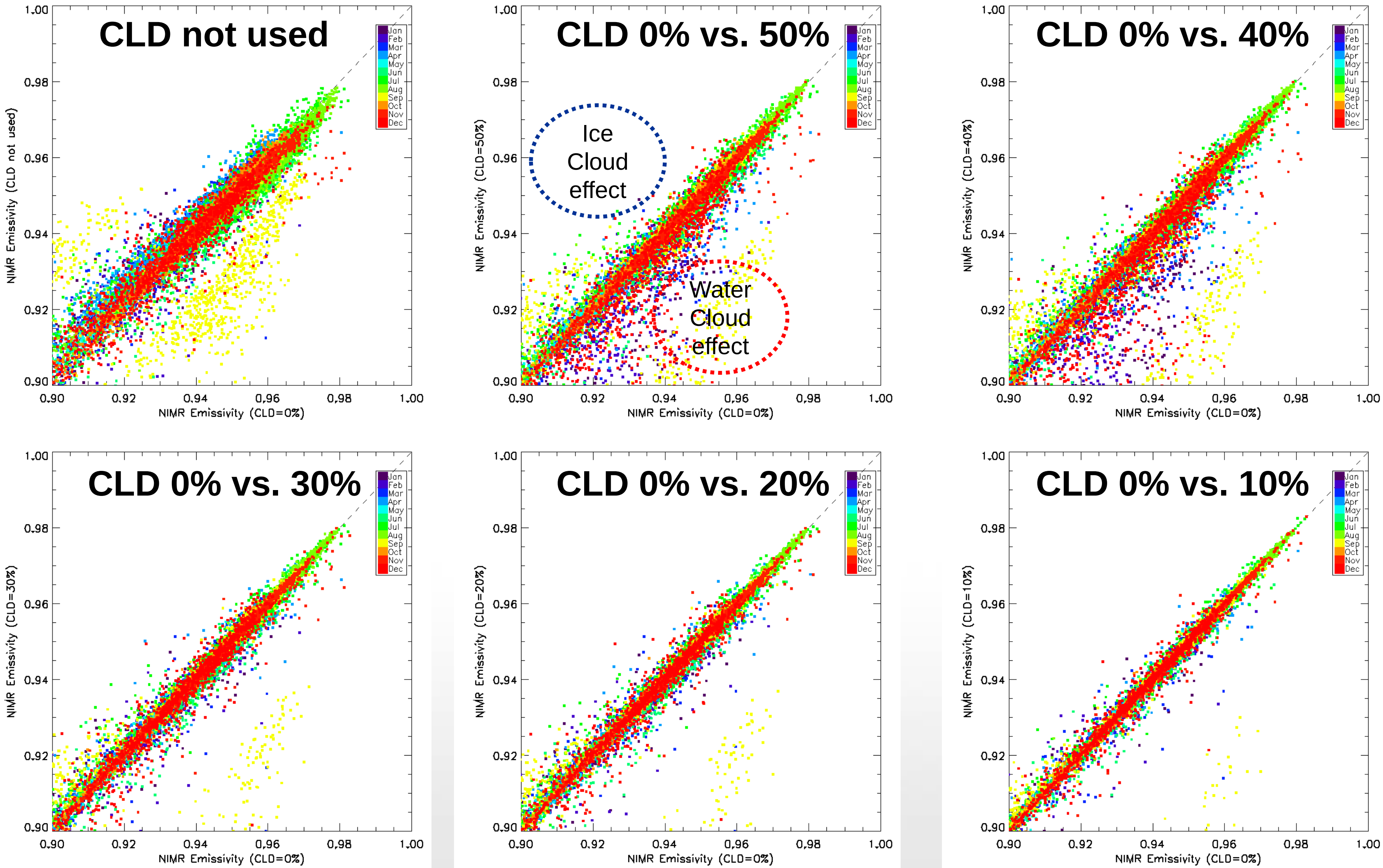
Emissivity map : TRMM + KLAPS



Emissivity map : TRMM + KLAPS + COMS

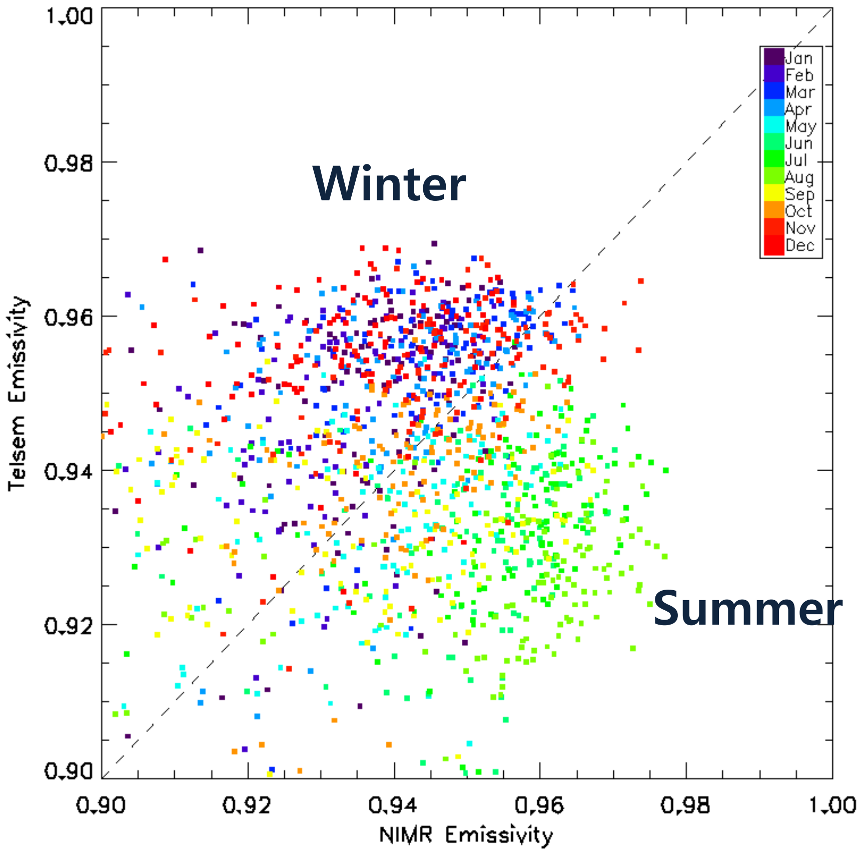


Emissivity Sensitivity for Cloud Amounts

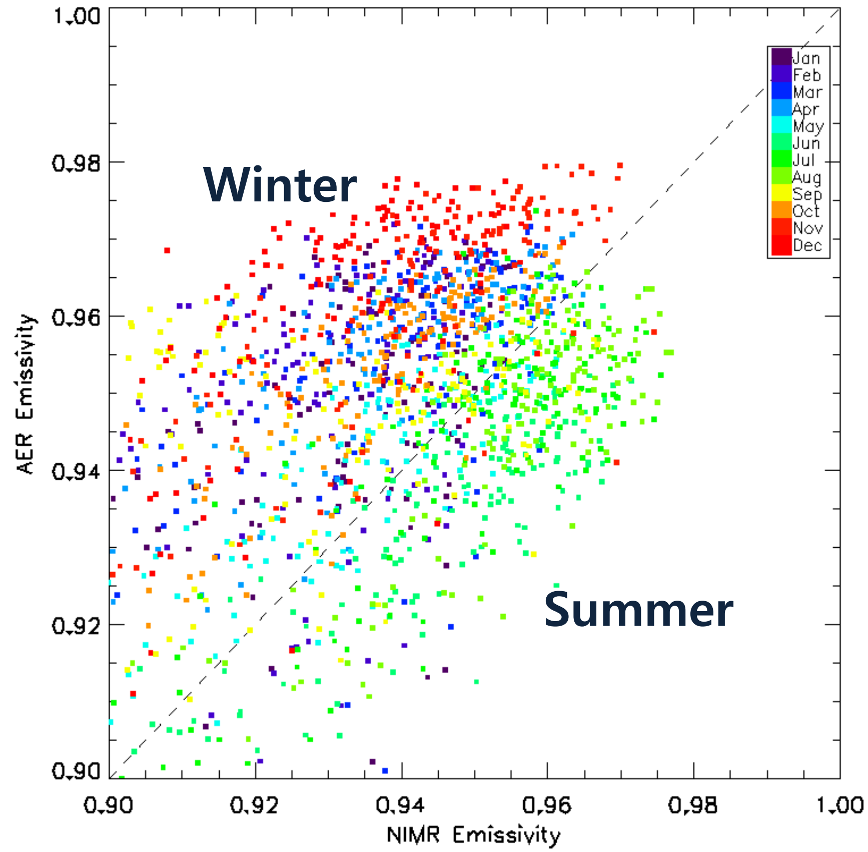


Comparison with other products

NIMR vs.TELSEM



NIMR vs. AER



TELSEM: A Tool to Estimate Land Surface Emissivities at Microwave frequencies (EUMETSAT)
AER: Microwave Surface Emissivity Database (Atmospheric and Environmental Research)

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TB Difference btw Clear and Rain

Clear sky with no cloud

→ IR has an advantage for cloud detection than MW.

→ To find clear pixel, COMS* cloud detection data were used to remove contaminated pixel.

→ It is possible to make error for low and thin cloud.

Rain sky with radar

→ Radar can detect rain drop widely.

→ Operational radar system over Korea was used to detect rain pixel.

→ It is possible to make error for mountainous region.

Spatial and temporal average

→ 0.1° x 0.1° gridding

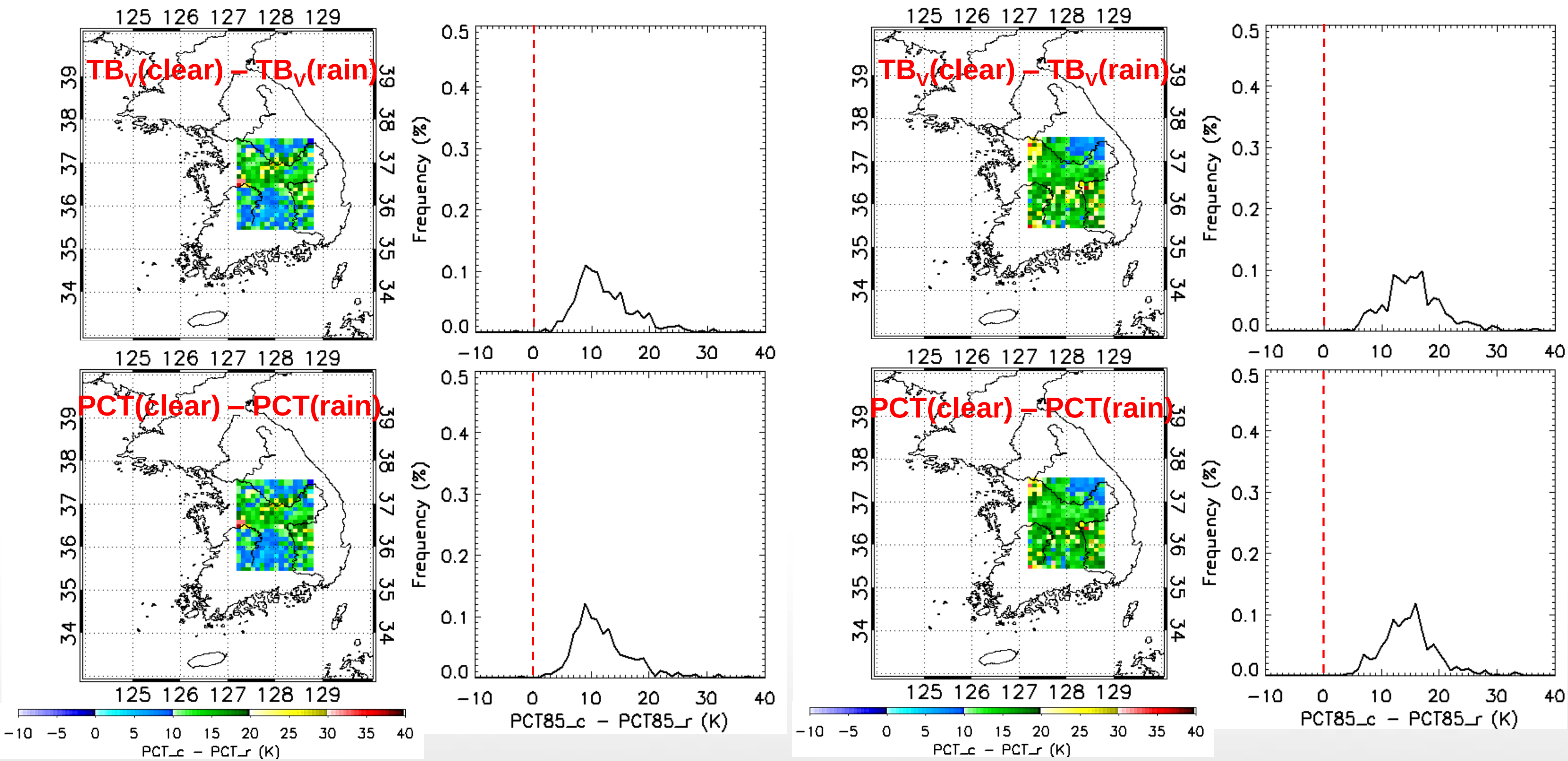
→ Monthly average for given grid.

→ To avoid ocean effect, only inland area (127.25E ~ 128.75E, 35.5N ~ 37.5N) is selected.

COMS: Communication, Ocean and Meteorological Satellite

TB Difference btw Clear and Rain

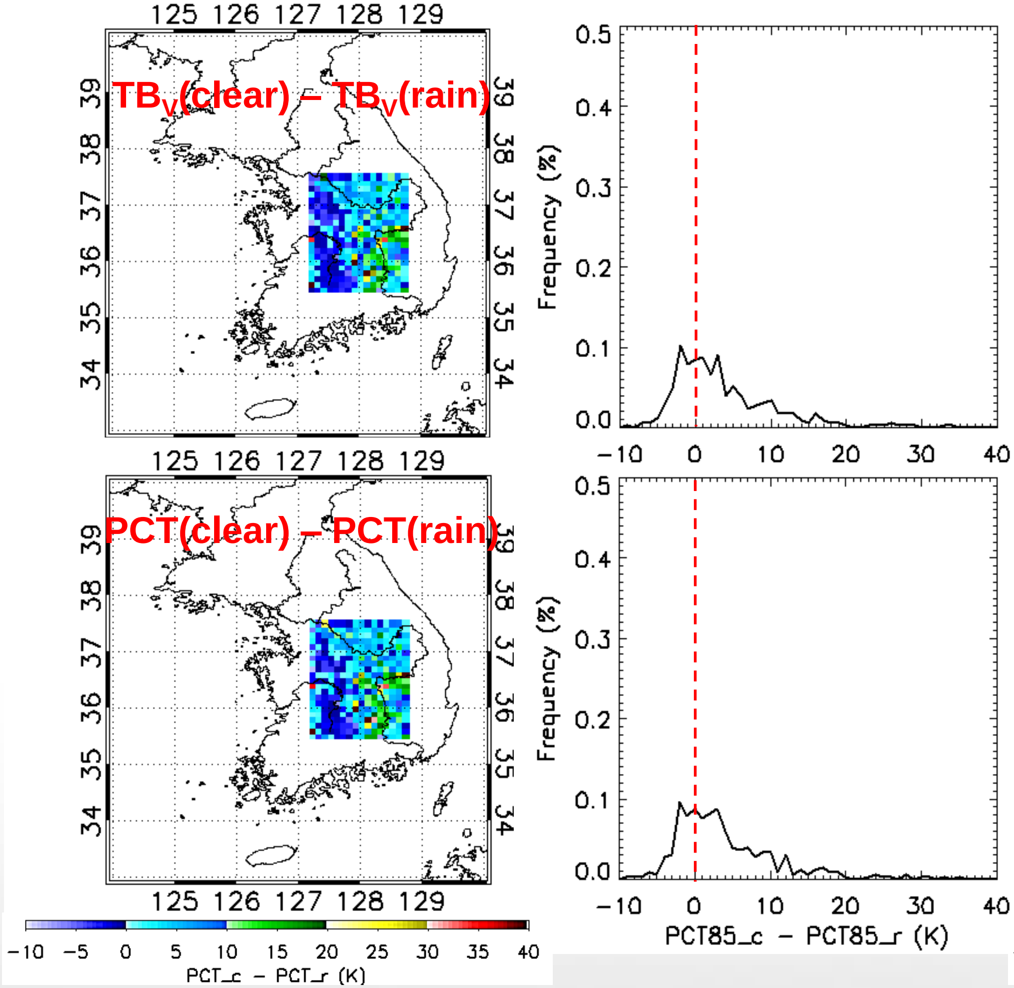
[July 2012] **[85 GHz]** **[August 2012]**

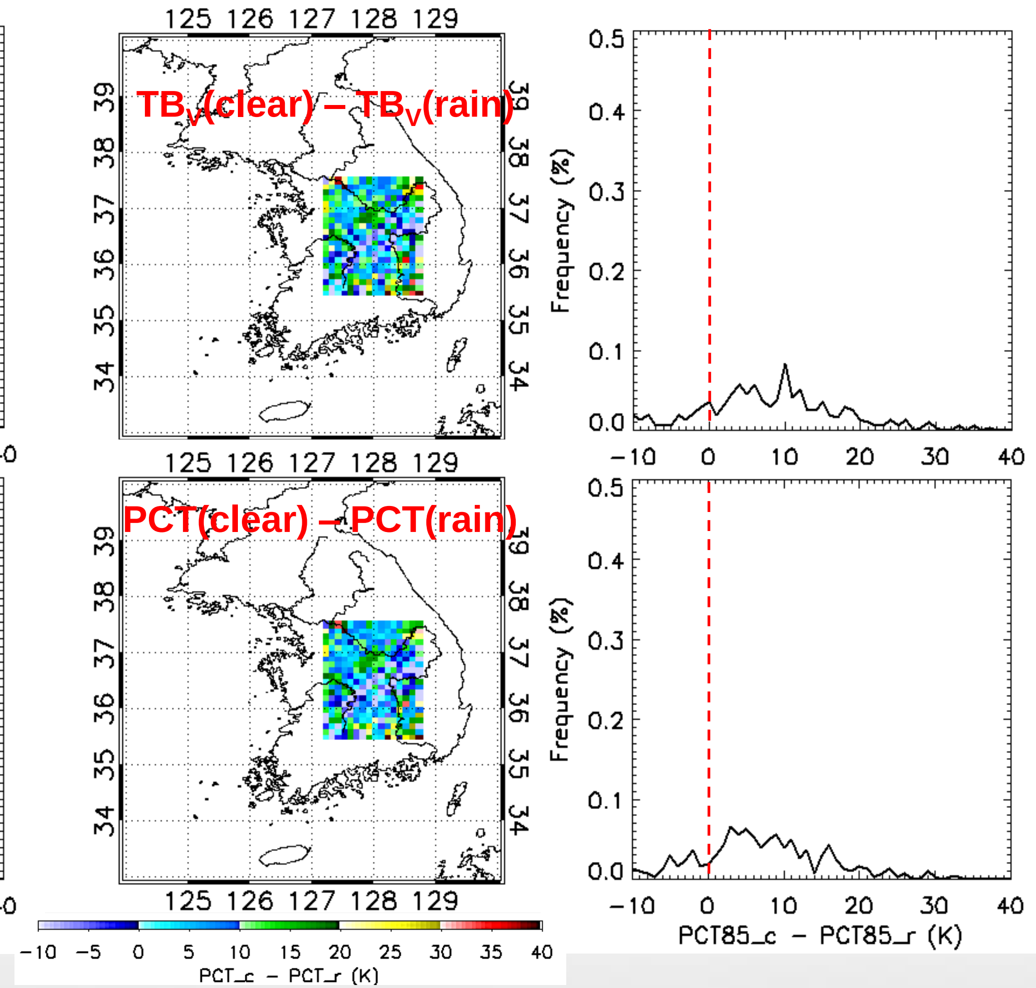


All rain cases represent clear TB are greater than rain TB

TB Difference btw Clear and Rain

[May 2012] **[85 GHz]** **[September 2012]**





Much rain cases show clear TB are less than rain TB

Thank You