Evaluation of GCOM-C1 Surface Radiation Budget Products Associated with Cloud and Aerosol Properties

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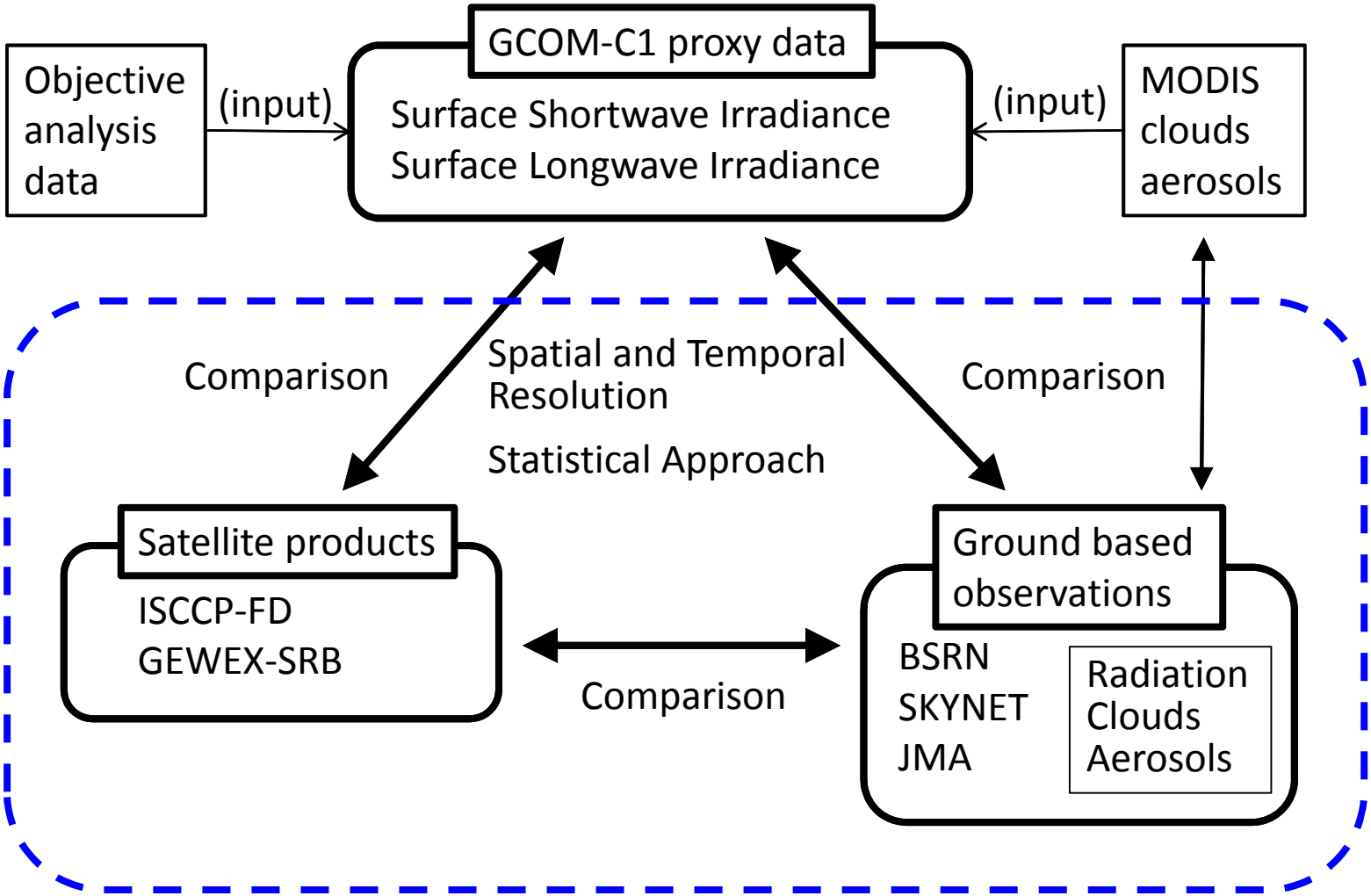
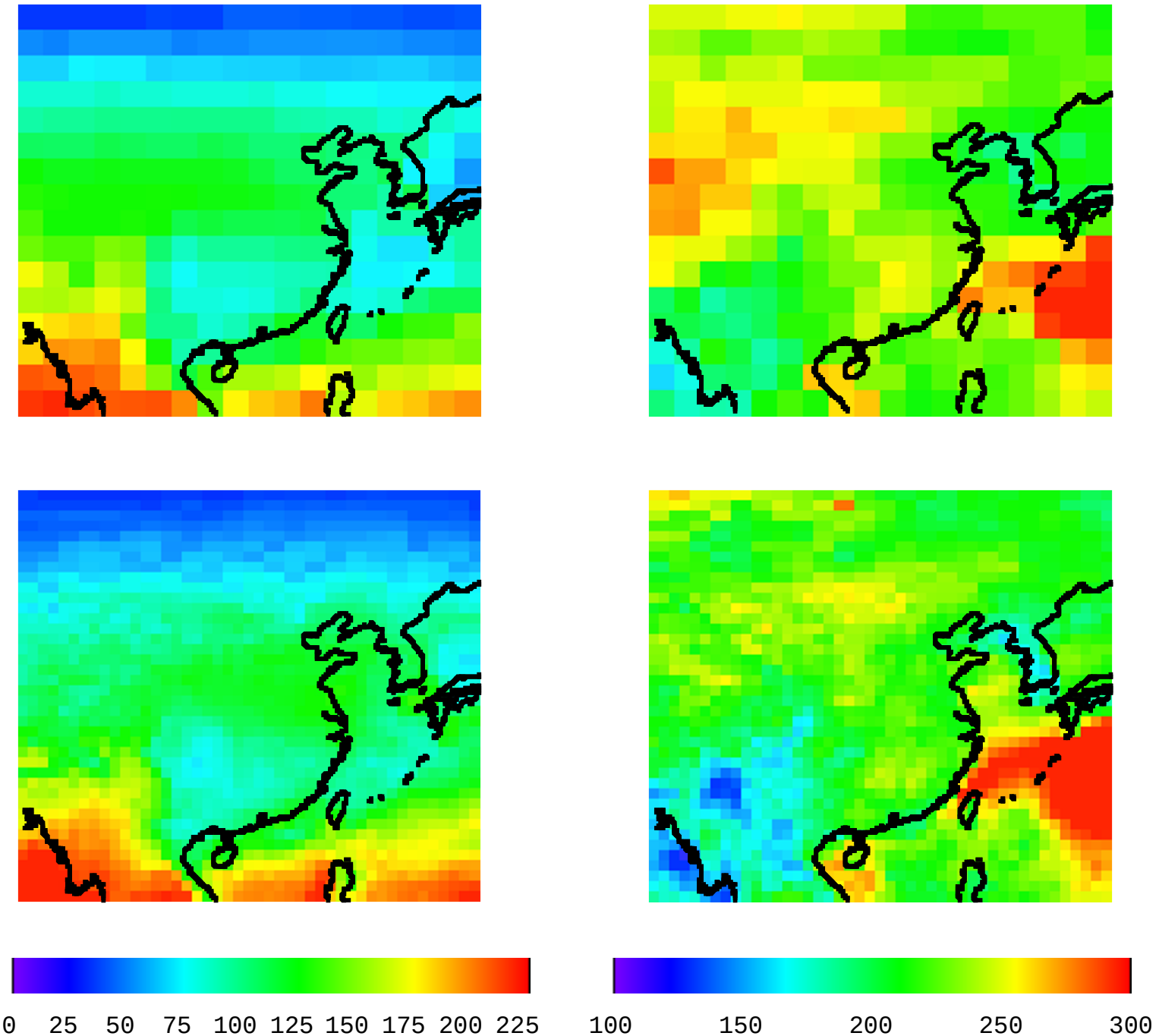

Objective analysis data
(input)
GCOM-C1 proxy data
Surface Shortwave Irradiance
Surface Longwave Irradiance
(input)
MODIS clouds aerosols
Comparison
Spatial and Temporal Resolution
Statistical Approach
Comparison
Satellite products
ISCCP-FD
GEWEX-SRB
Comparison
Ground based observations
BSRN
SKYNET
JMA
Radiation
Clouds
Aerosols

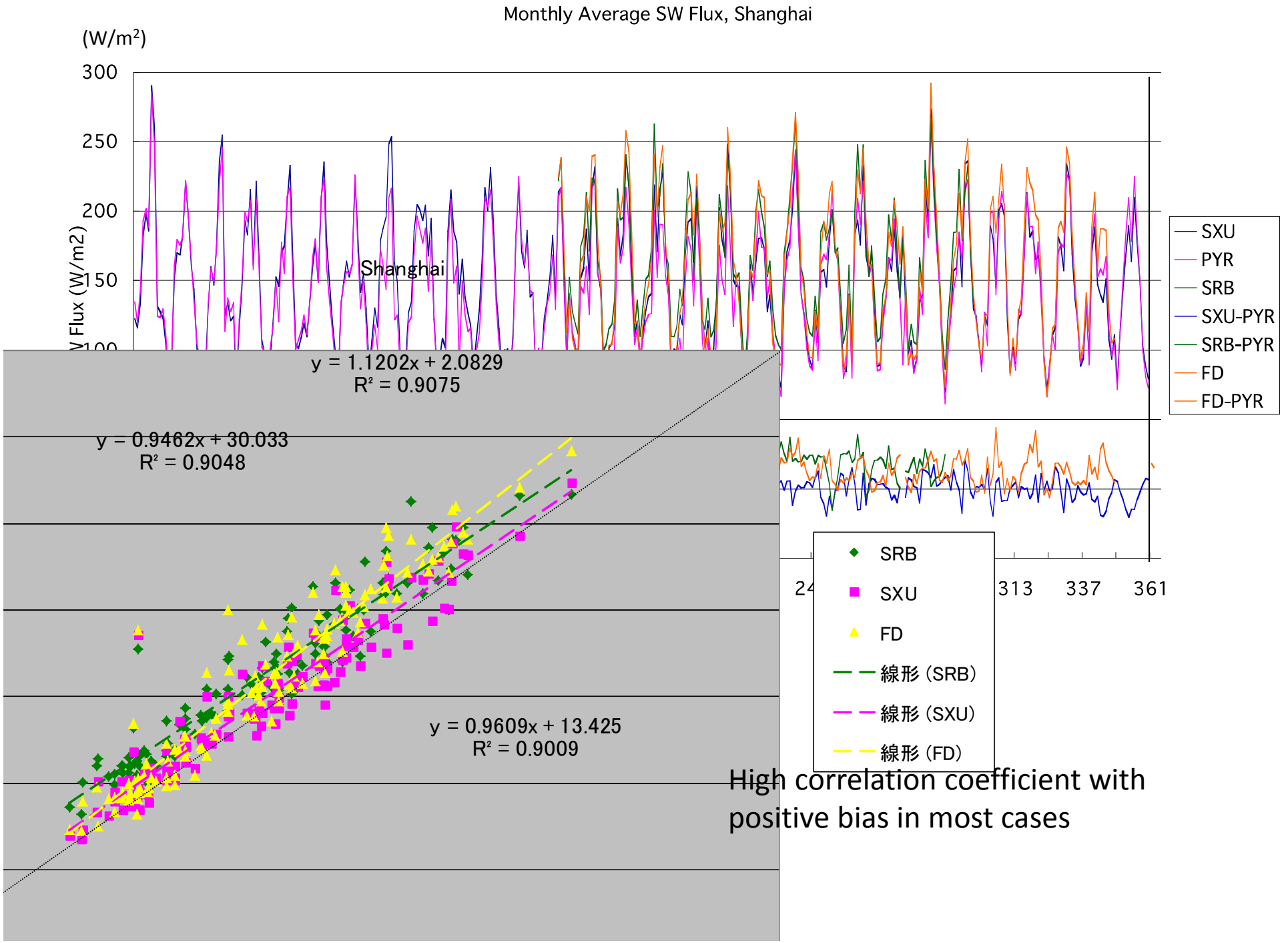
95, Jan

95, Jul

ISCCP
FD
2.5deg.

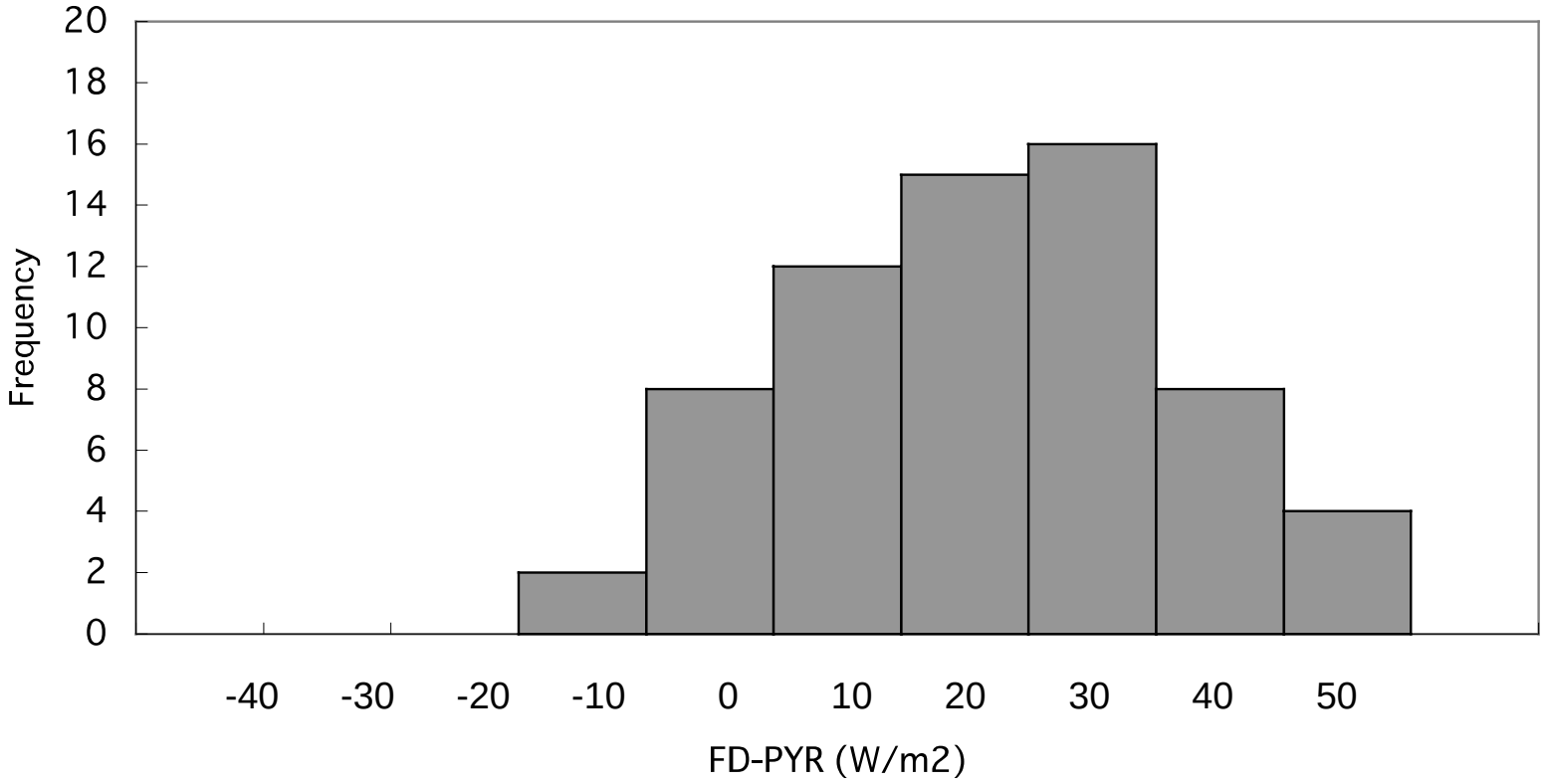
Langley
SRB
1deg.



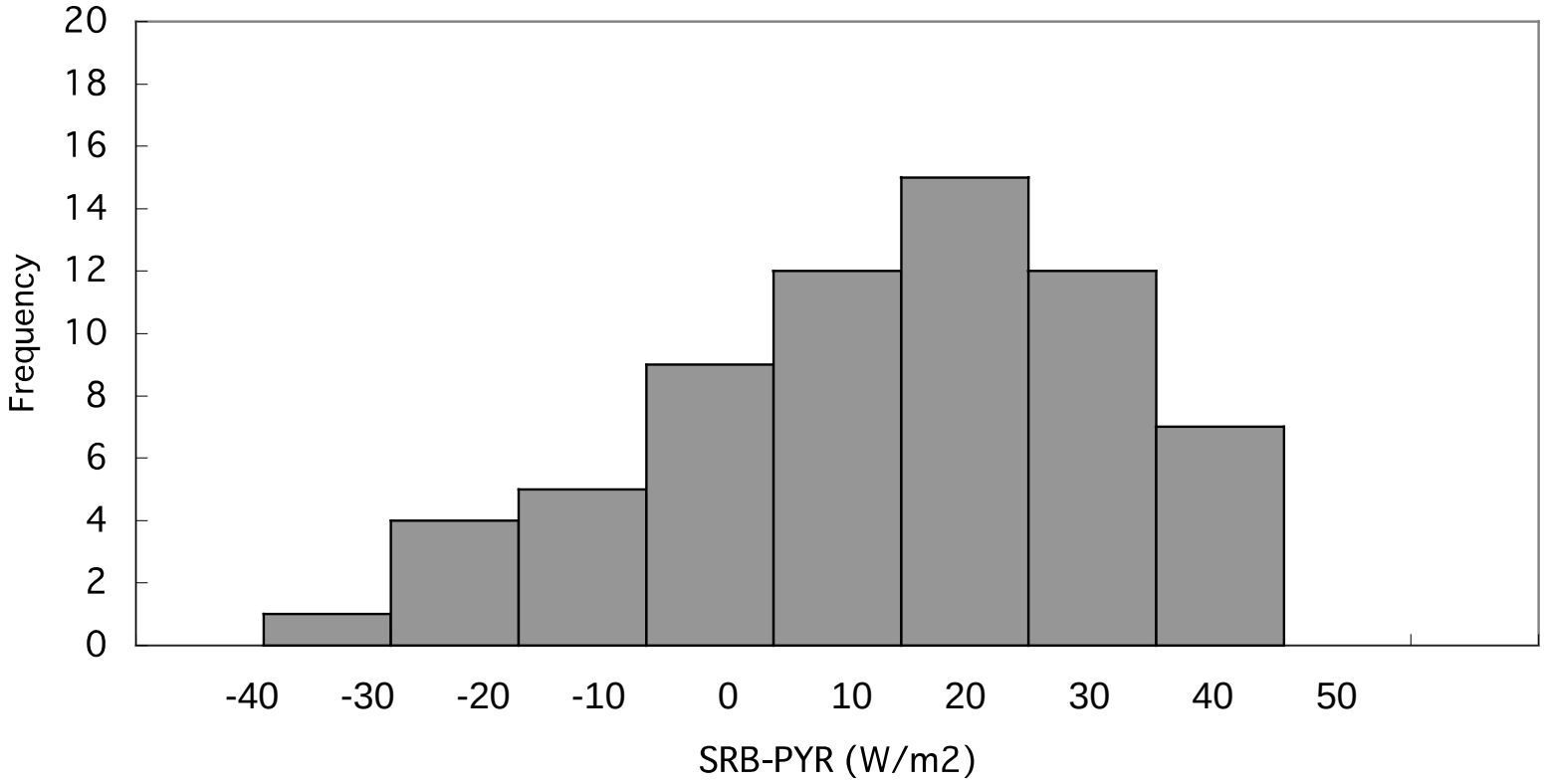


High correlation coefficient with positive bias in most cases

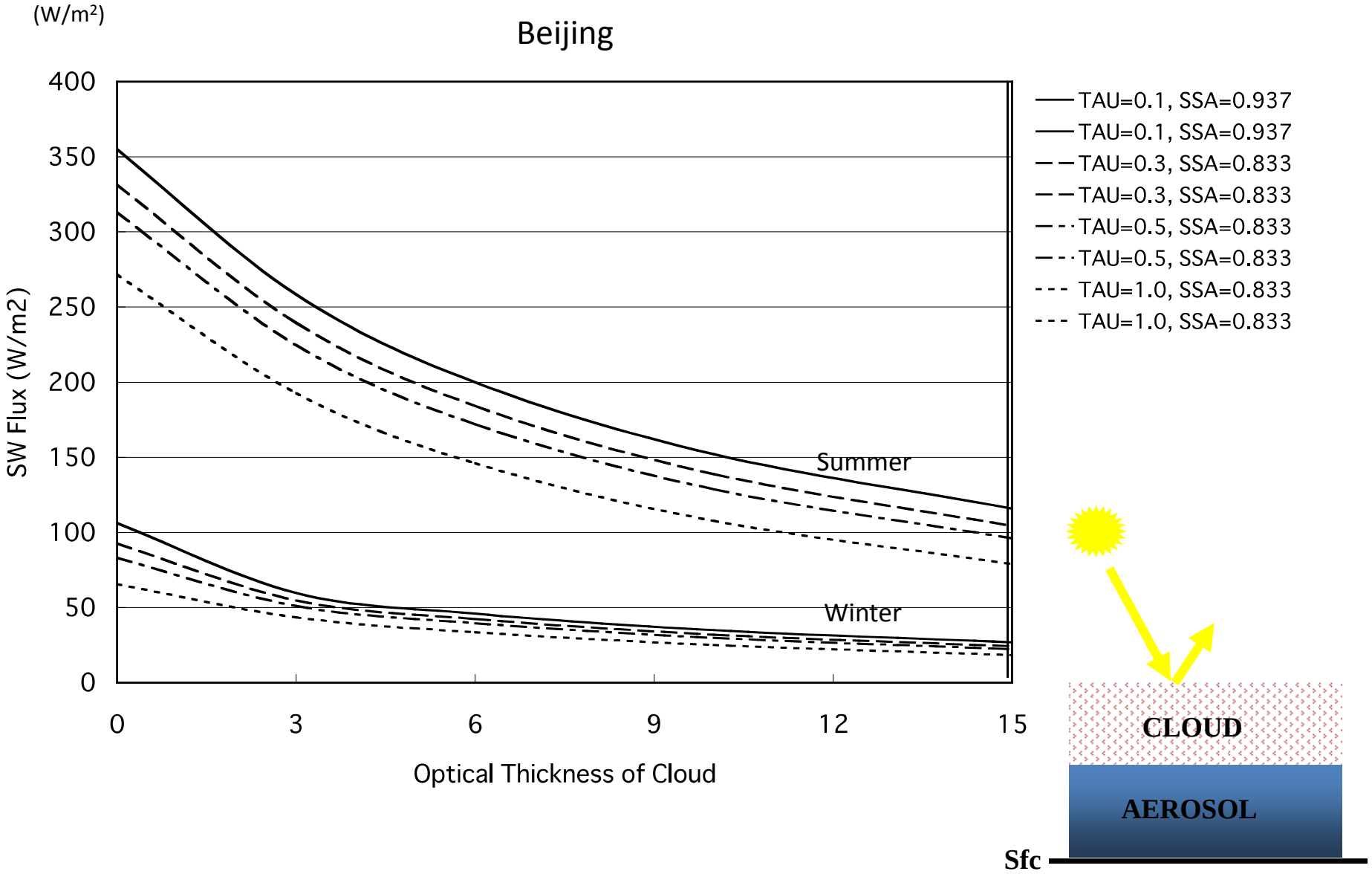
ISCCP−FD - Pyranometer data



GEWEX-SRB - Pyranometer data

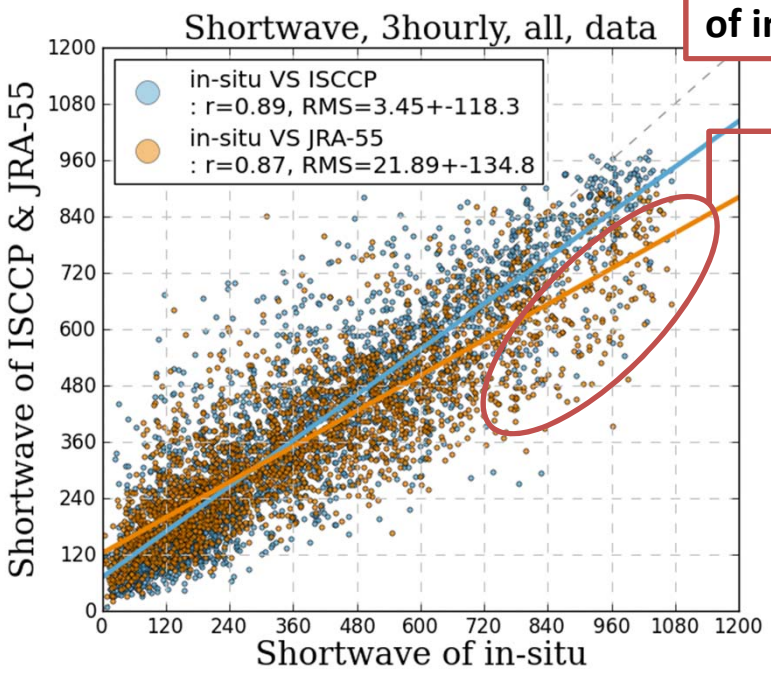


Effect of aerosols in the sub-cloud layer



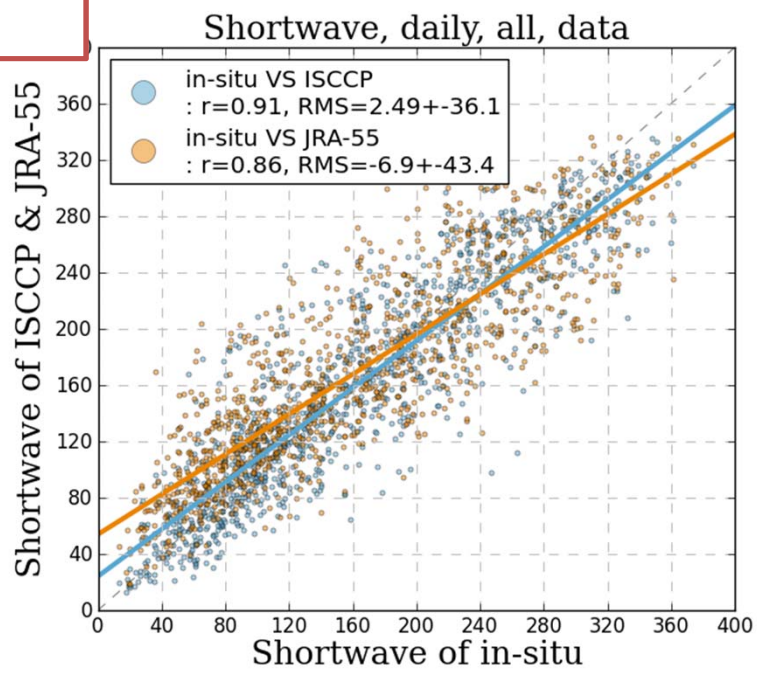
Comparison between in-situ, JRA-55, and ISCCP SW radiation (0^o<SZA<80^o) at buoys

3 hourly average

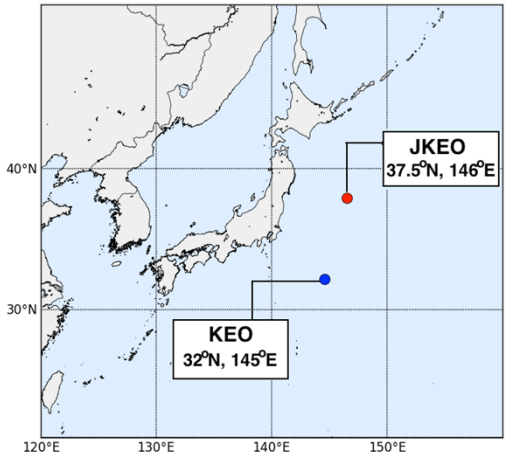


Overestimation of in-situ

Daily average

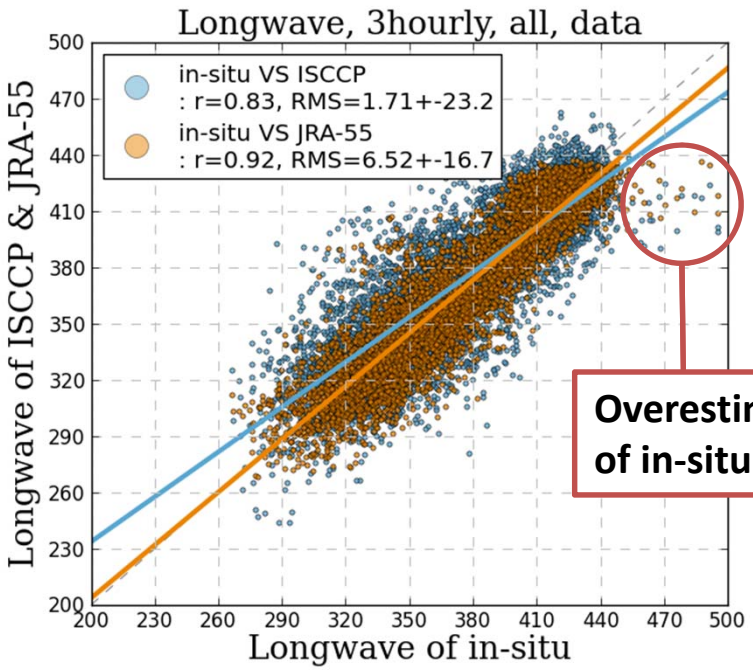


Data type	Term	Name	Period	Location	Temporal Res.	Spatial Res.
Buoy	3 years	KEO	11月, 2004年-10月, 2005年 01月, 2008年-12月, 2008年	145°E, 32°N	2min	-
		JKEO (Phase2-3)	01月, 2009年-12月, 2009年	146°E, 37-38°N	10min	-
Satellite	-	ISCCP (FD)	1983-2009年	Global	3hr	2.5°
Reanalysis	-	JRA-55 (fcst_phy2m125)	1958-2013年	Global	3hr	1.25°

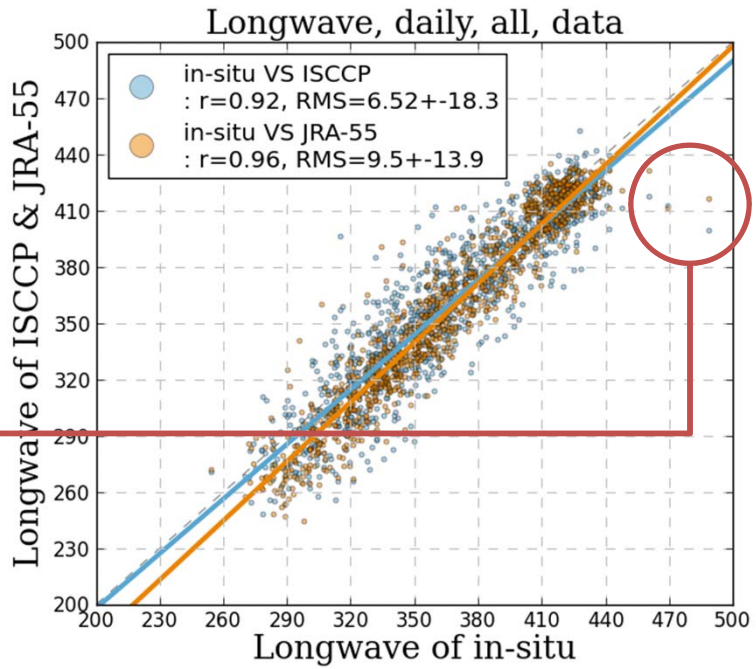


Comparison between in-situ, JRA-55, and ISCCP LW radiation at buoys

3 hourly average



Daily average



Overestimation of in-situ

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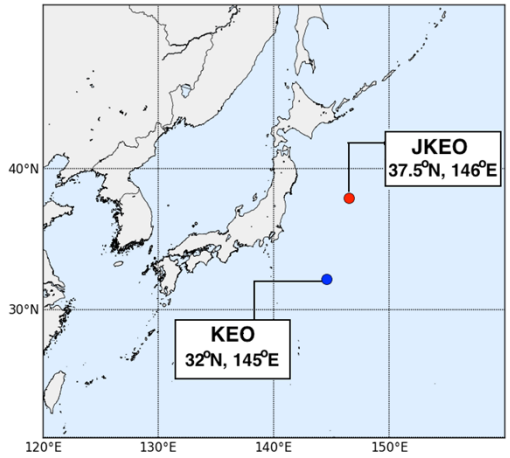
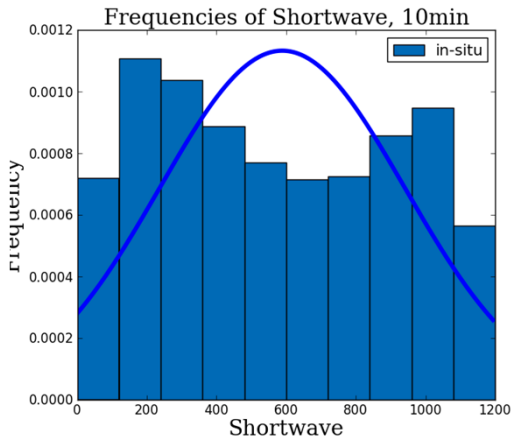
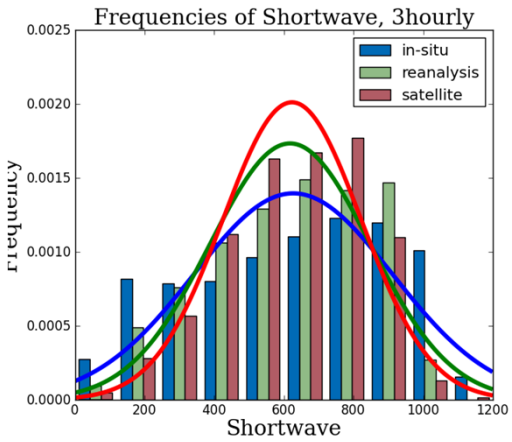
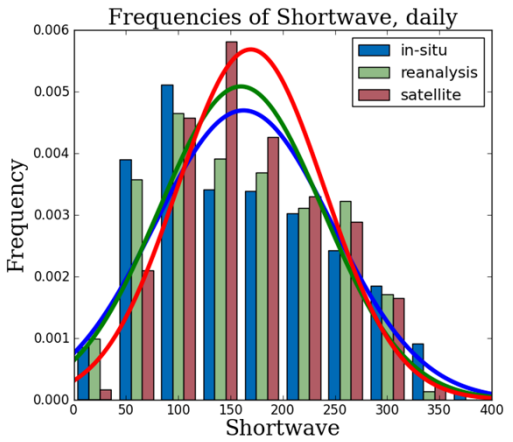
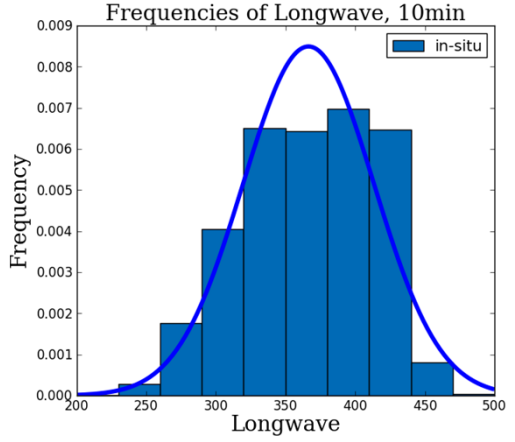
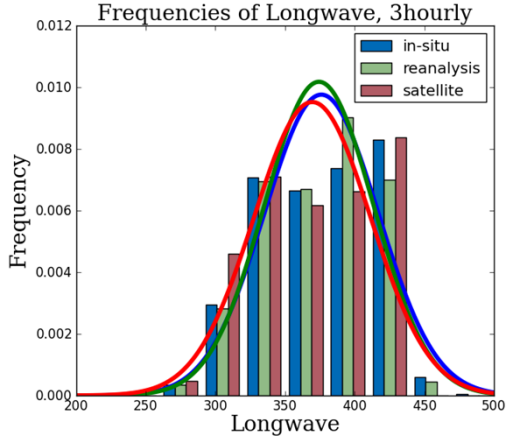
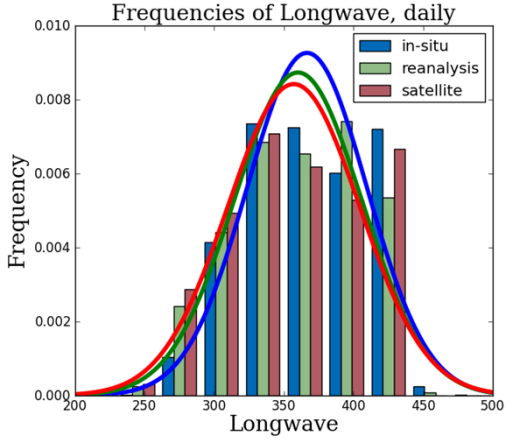


Histograms of in-situ, JRA-55, ISCCP

	10 min	3 hourly	Daily
Short wave			
Long wave			

Statistical Approach

(Hayasaka and Iwabuchi, 2000)

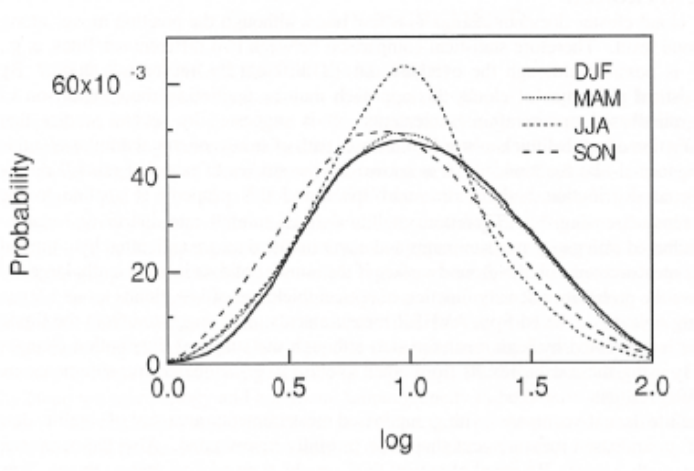


Figure 4. Probability density function of cloud optical thickness around Japan for 6 years retrieved from NOAA/AVHRR satellite measurements. DJF, MAM, JJA, and SON indicate winter, spring, summer, and autumn, respectively.

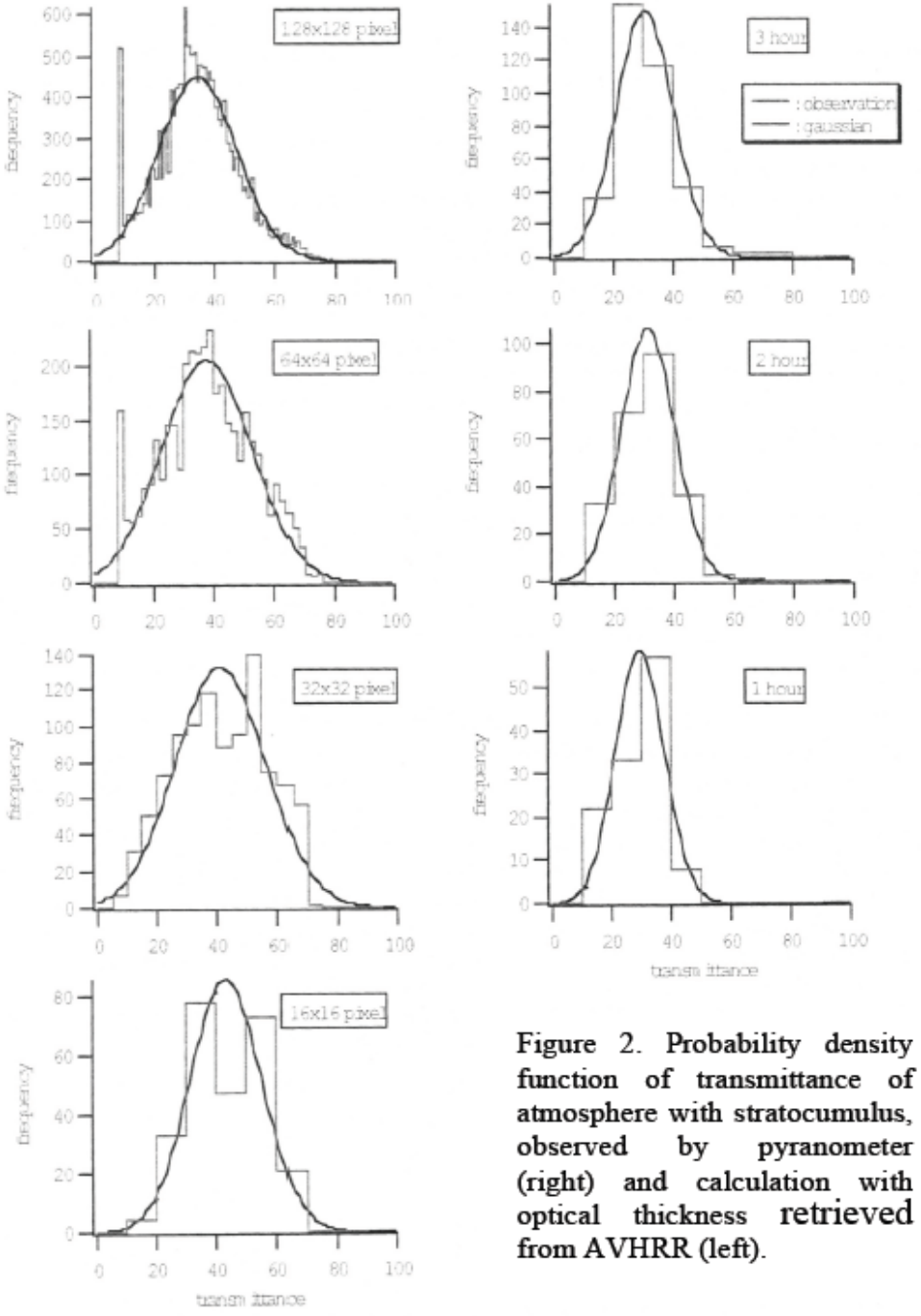
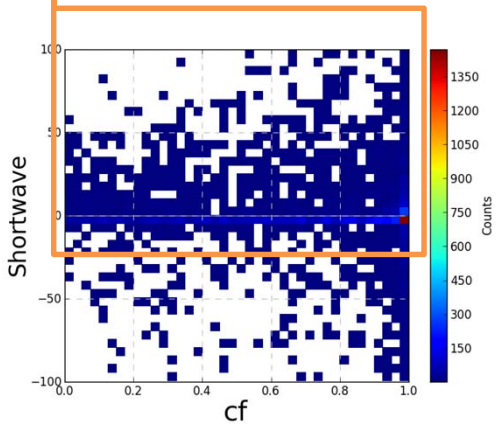
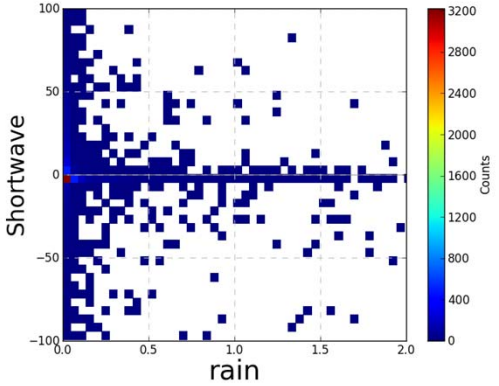
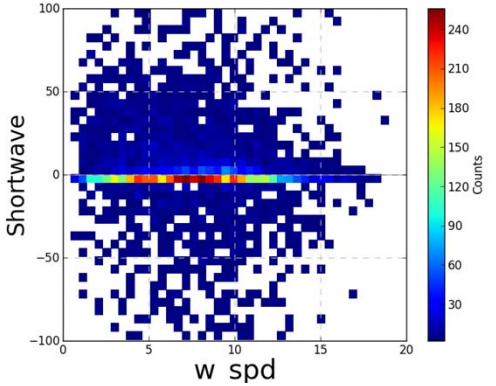


Figure 2. Probability density function of transmittance of atmosphere with stratocumulus, observed by pyranometer (right) and calculation with optical thickness retrieved from AVHRR (left).

Effects of cloud fraction, rain rate, and wind speed for shortwave (0^o<SZA<80^o)

- $\Delta F = F(\text{in-situ}) - F(\text{ISCCP})$

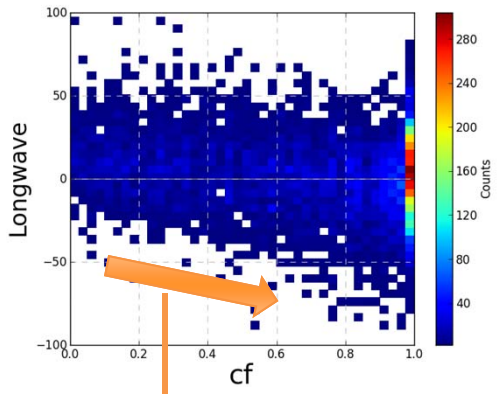
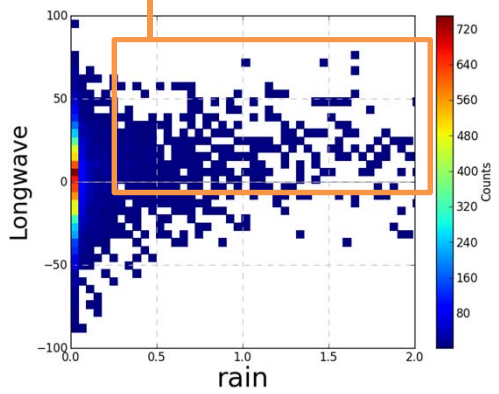
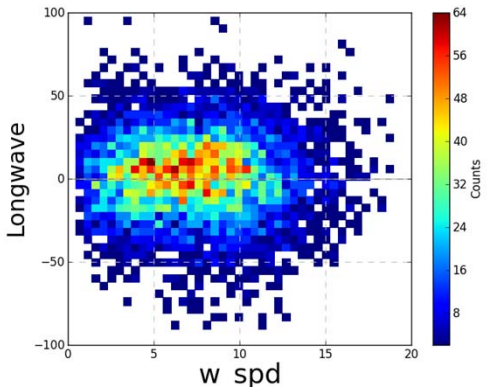
Overestimation of in-situ observation

	VS. Cloud Fraction [0-1]	VS. Rain Rate [mm/hr]	VS. Wind Speed [m/s]
ΔShort wave			

Effects of cloud fraction, rain rate, and wind speed for longwave

- $\Delta F = F(\text{in-situ}) - F(\text{ISCCP})$

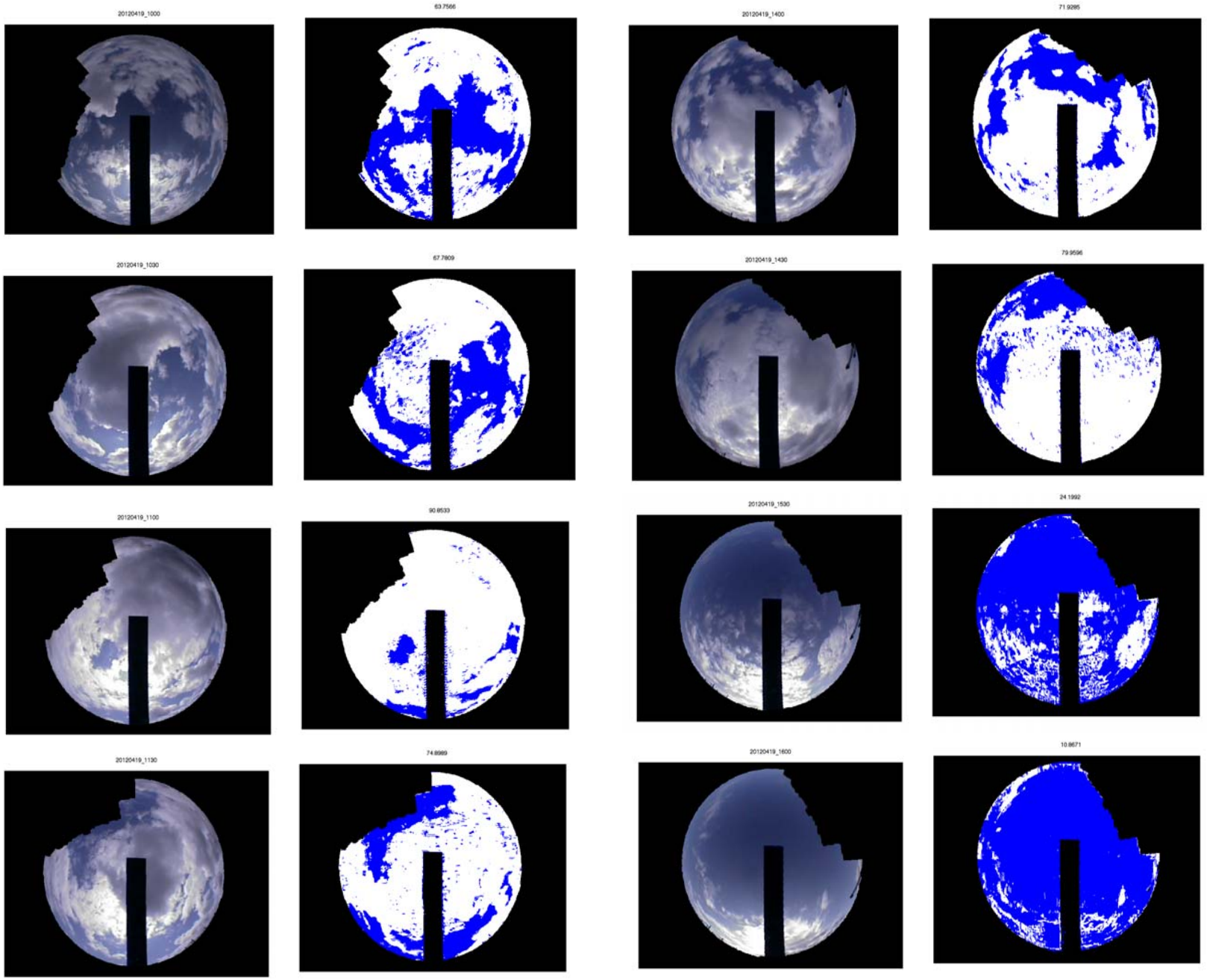
Overestimation of in-situ observation in rainy weather

	VS. Cloud Fraction [0-1]	VS. Rain Rate [mm/hr]	VS. Wind Speed [m/s]
ΔLong wave			

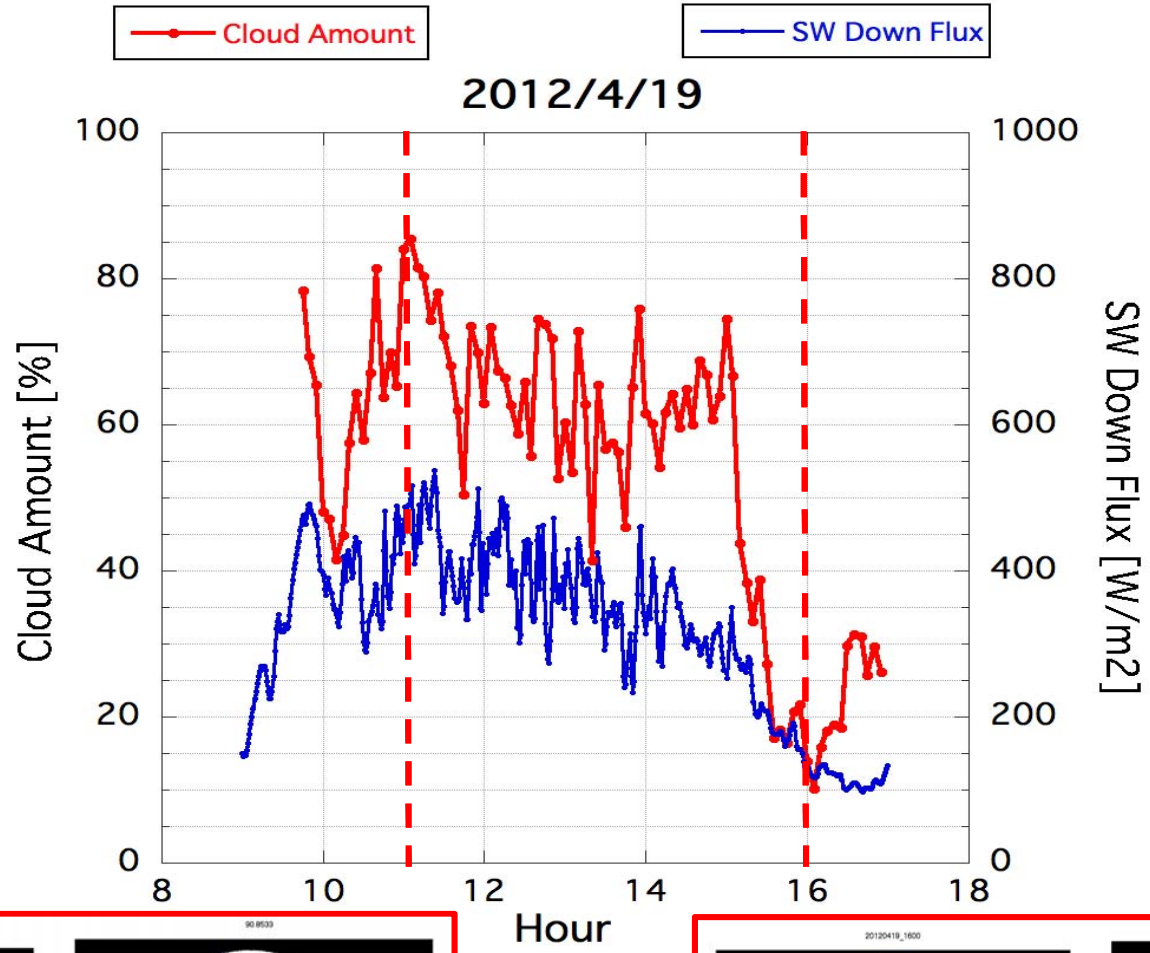
Negative correlation between cloud fraction and ΔLongwave

Evaluation of Cloud Cover by Using Sky-Camera

4/19/2012 Sndai



Comparison between Cloud Cover and SW Radiation



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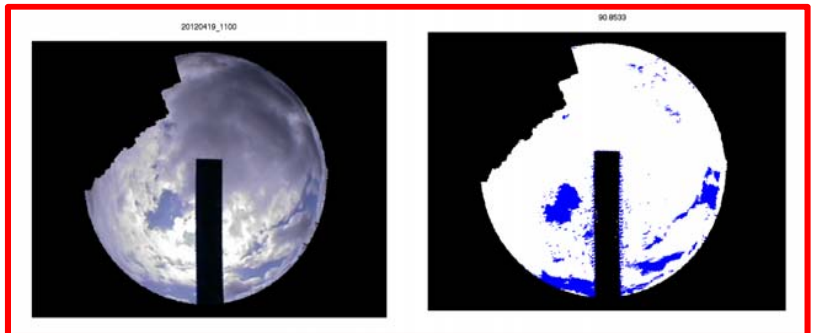

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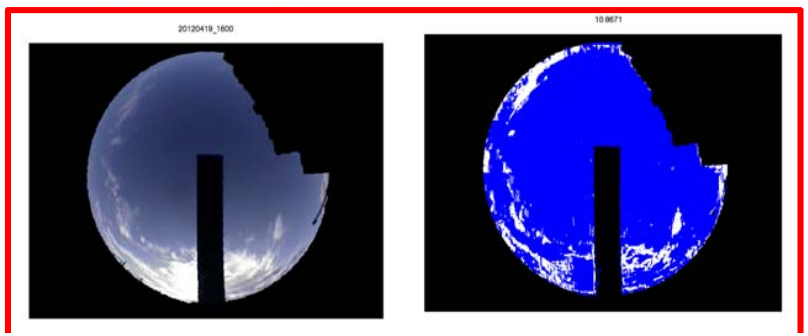


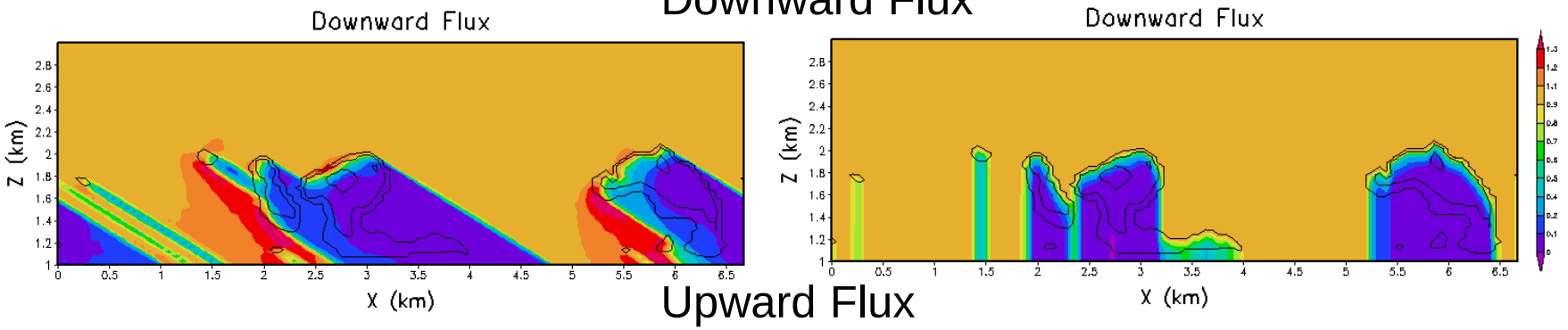
Summary

- Comparison of monthly SW radiation between pyranometer measurements at the ground surface and satellite-derived products in China.
  - Large biases in the urban area due to absorbing aerosols.
  - Aerosol is an important factor for the validation of satellite-derived radiation data.
- Comparison of SW and LW radiations between buoy measurements and satellite-derived data in the Pacific Ocean off the coast of Japan.
  - Biases due to cloud and rain.
- Introduction of statistical approach to the analysis of the validation of satellite-derived radiation data, and importance of the cloud inhomogeneity effect.
- Evaluation of cloud cover by using sky-camera and comparison between the cloud cover and SW radiation.
  - Aerosol is a key factor to evaluate cloud cover.

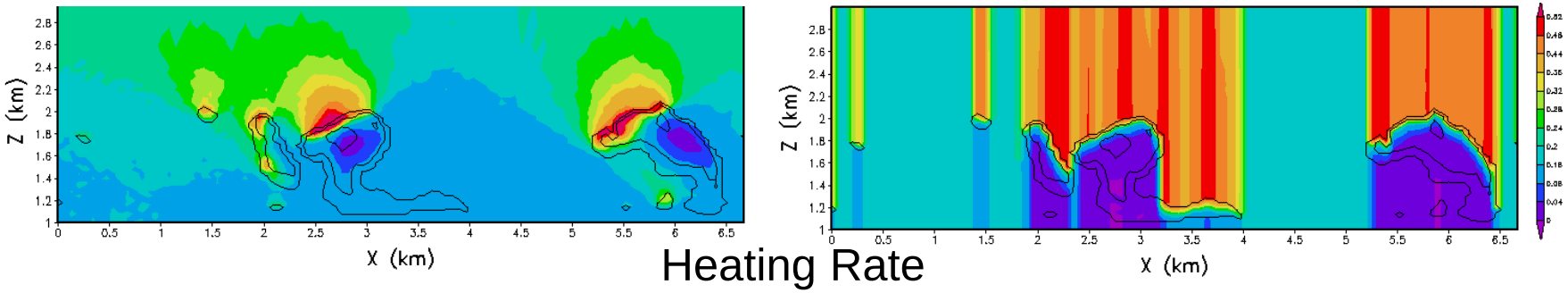
3D

1D

Downward Flux



Upward Flux



Heating Rate