

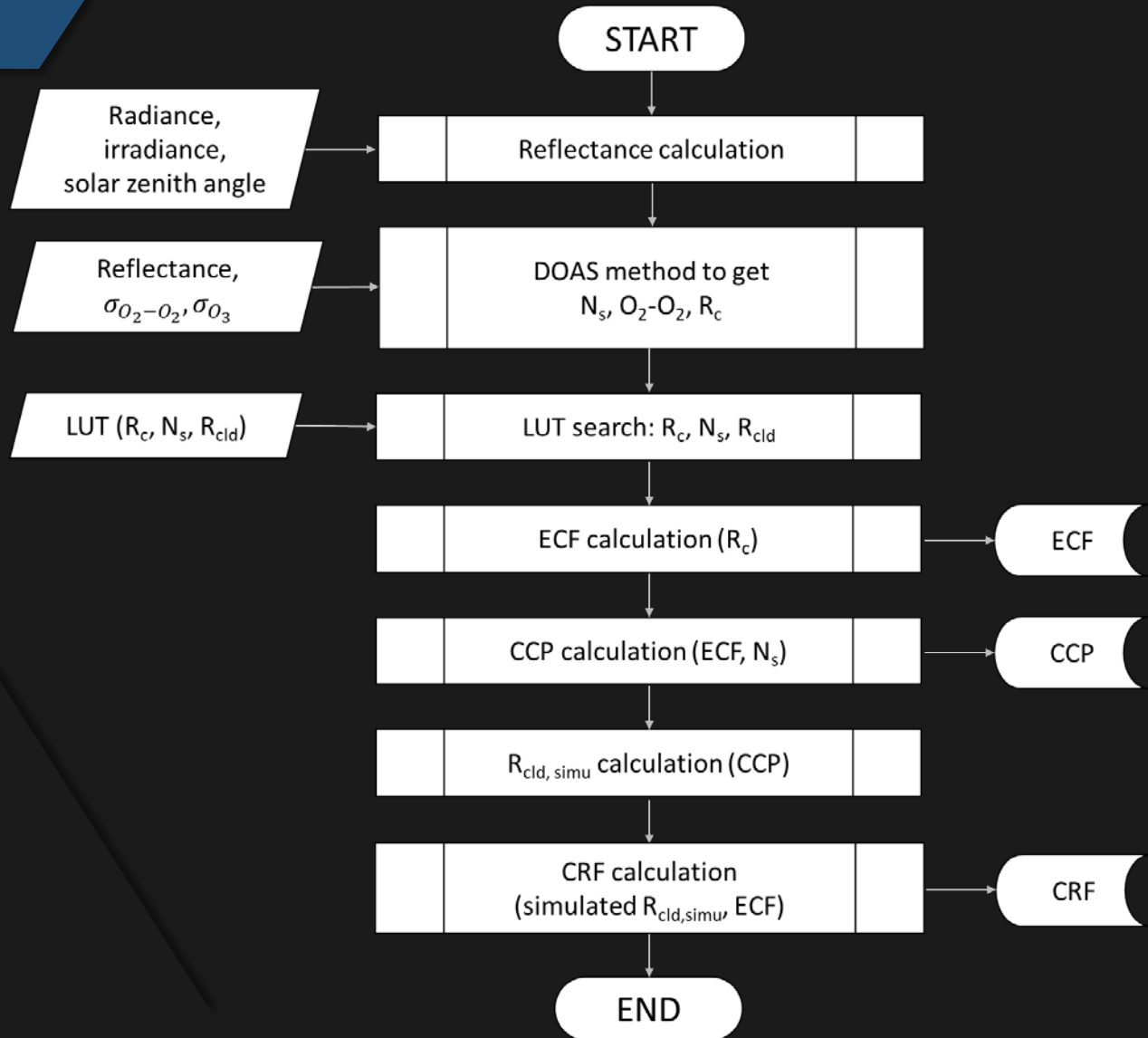
Status of GEMS Cloud Algorithm

Ewha Womans University

Yong-Sang Choi, Min-Jae Kwon and Gyuyeon Kim



GEMS Cloud Algorithm

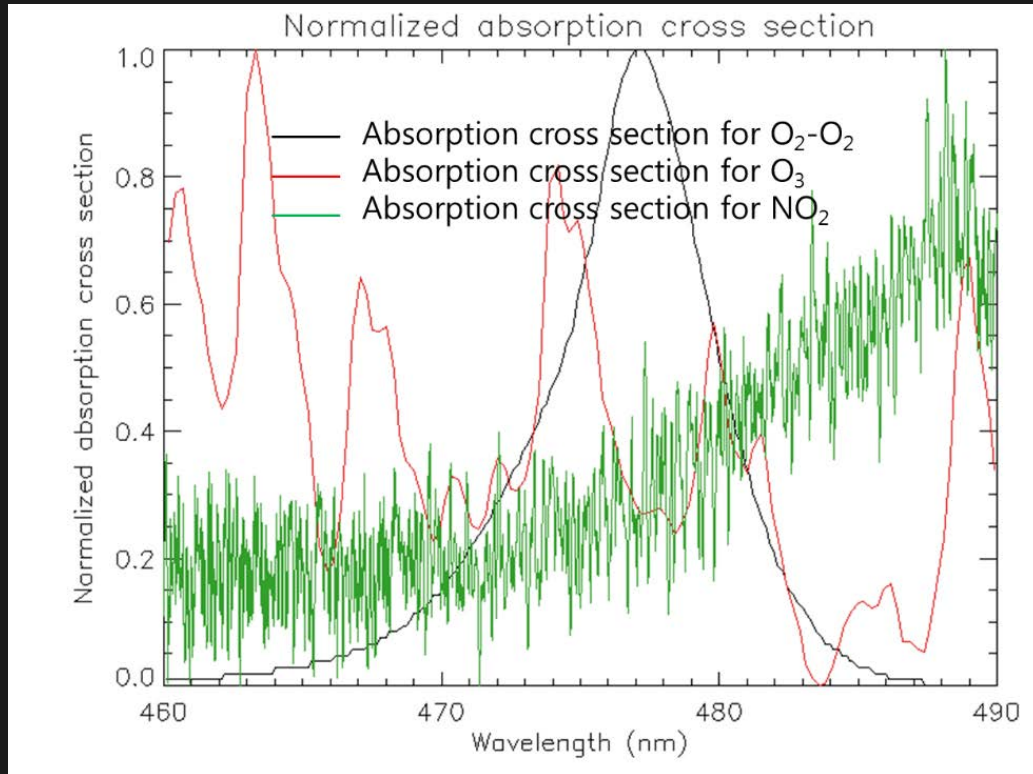




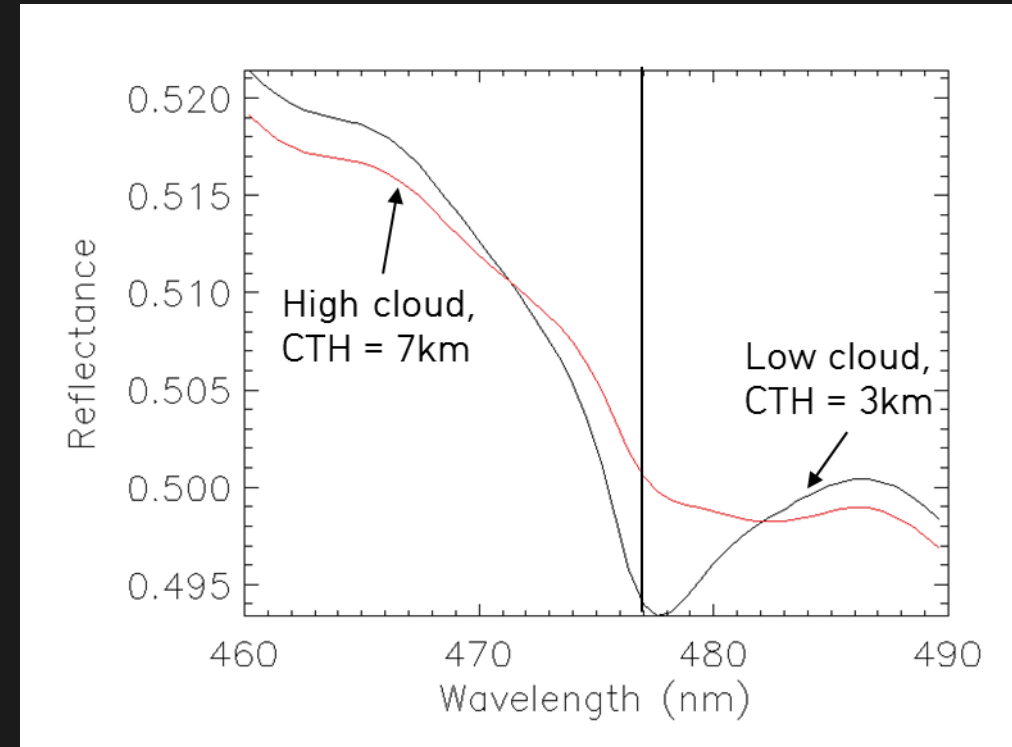
Theoretical Background

(O₂-O₂ absorption band)

Absorption is caused by collision between two O₂ molecules.



The feature of the absorption is stable.



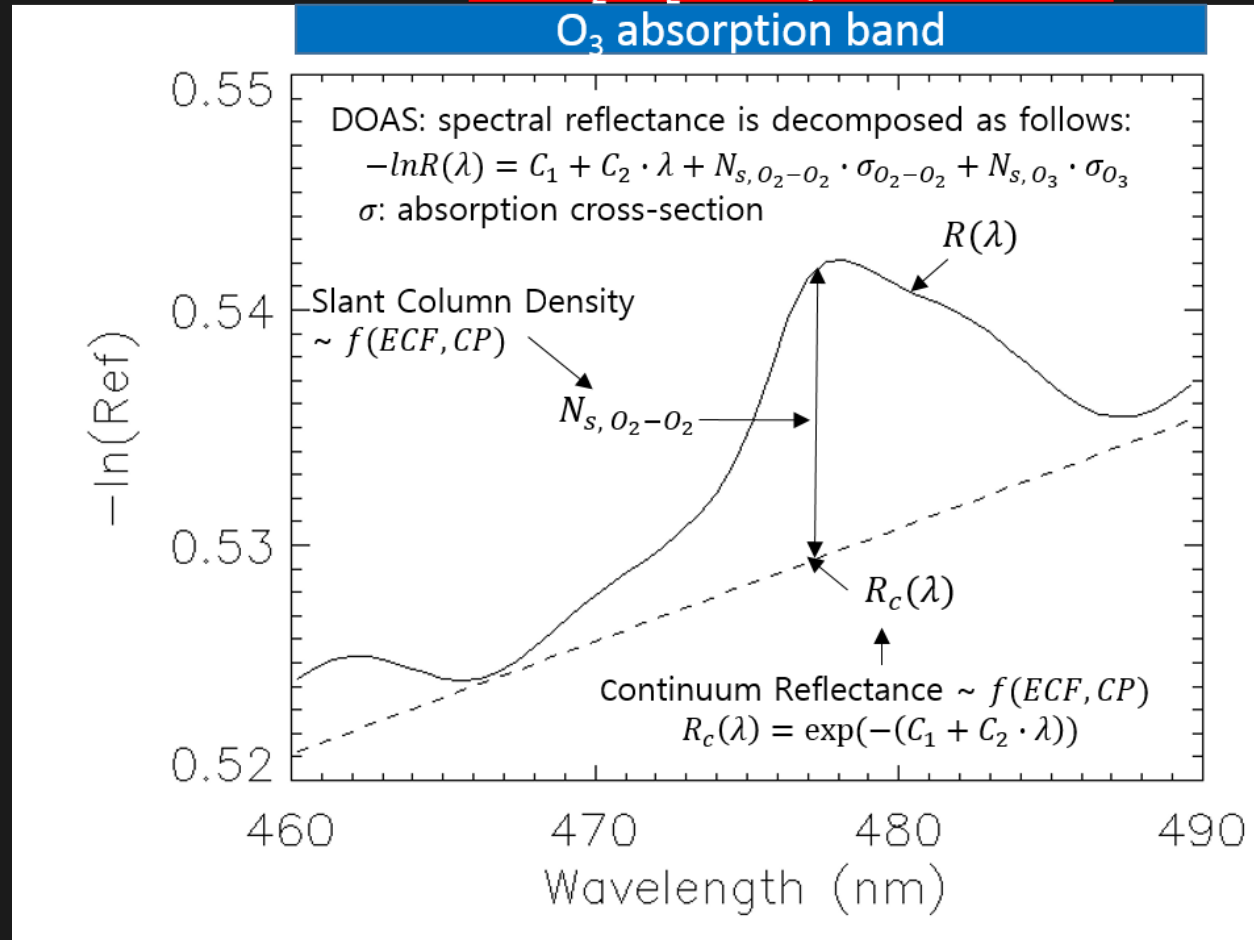
The O₂-O₂ absorption band is sensitive to cloud pressure in GEMS region.



Theoretical Background (DOAS method)

O₂-O₂ absorption band

O₃ absorption band



$$-\ln R_\lambda = C_1 + C_2 * \lambda + N_{s, O_2-O_2} * \sigma_{O_2-O_2} + N_{s, O_3} * \sigma_{O_3}$$



Theoretical Background

(Temperature correction factor)

- Cloud algorithm considering **temperature profile**

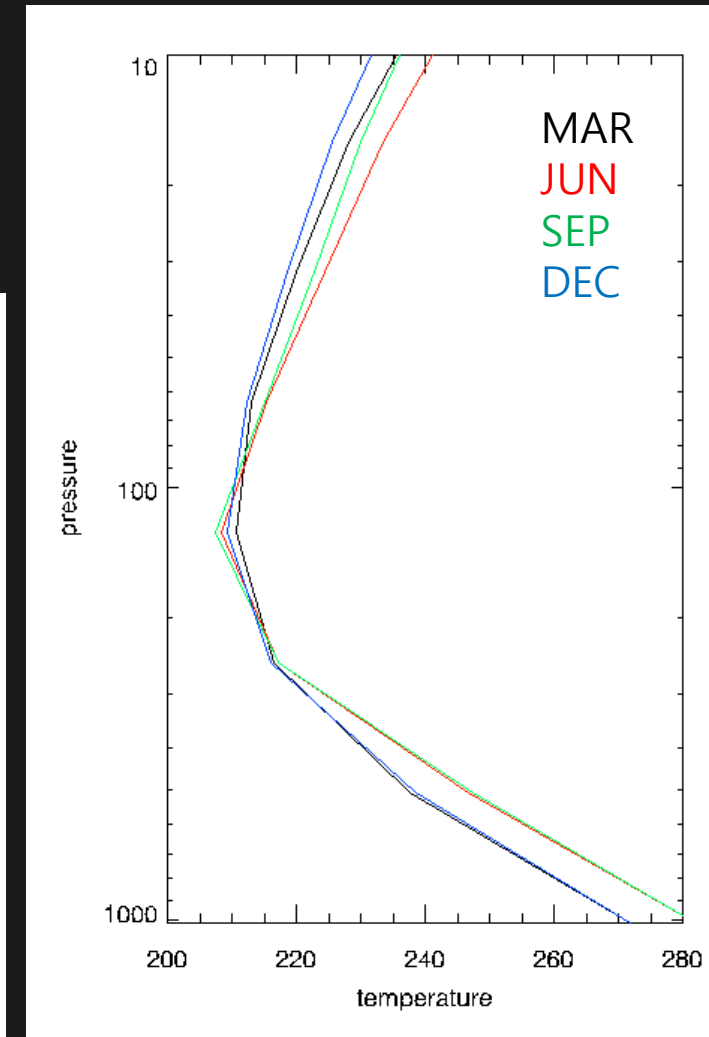
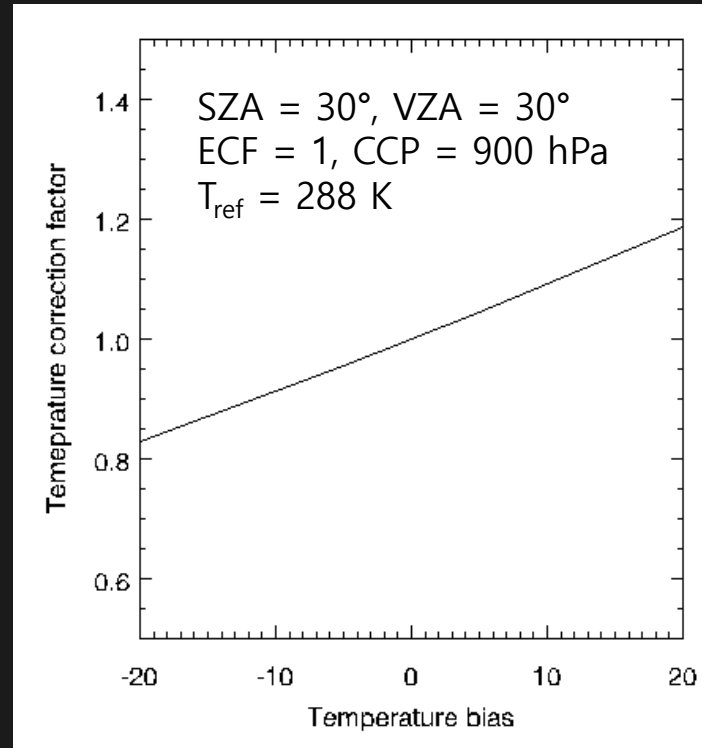
$$\gamma = \frac{N_s^{ref}}{N_s^{meas}} = \frac{\int_{p_{cld}}^{p_{TOA}} m(p, \lambda) \frac{p}{T_{ref}(p)} dp}{\int_{p_{cld}}^{p_{TOA}} m(p, \lambda) \frac{p}{T(p)} dp}$$

Pepjin et al., 2016

γ : **Temperature correction factor**

N_s : **Slant column density**

$m(p, \lambda)$: **O₂-O₂ air mass factor**





GEMS Cloud Products (Validation)

Validation with OMI

MAR

	Slope	Y-intercept	Correlation	Mean Bias
Goal	0.9-1.1	-	0.9	< 0.05
ECF	0.98	0.02	1.00	0.01

JUN

	Slope	Y-intercept	Correlation	Mean Bias
ECF	0.96	0.00	1.00	-0.01

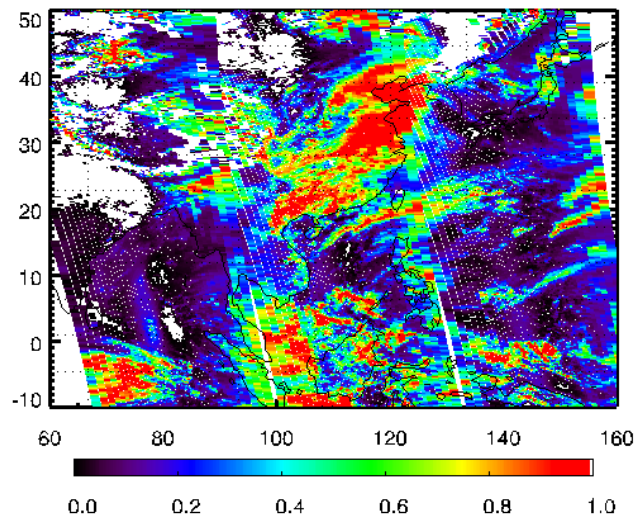
SEP

	Slope	Y-intercept	Correlation	Mean Bias
ECF	0.97	0.01	1.00	0.00

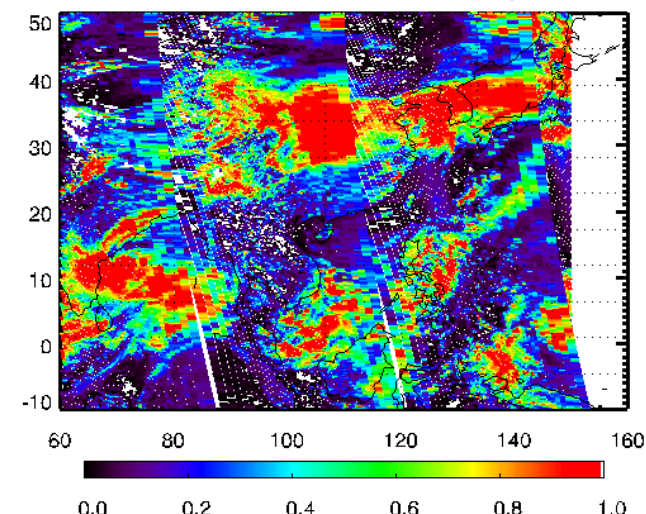
DEC

	Slope	Y-intercept	Correlation	Mean Bias
ECF	0.99	0.02	1.00	0.01

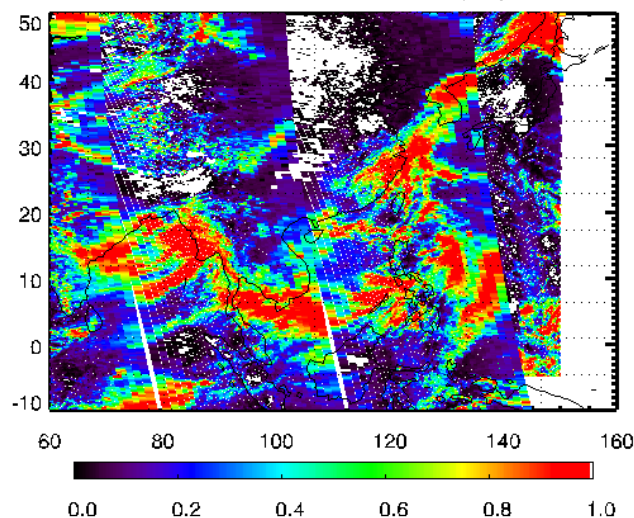
Effective cloud fraction 2007/03/23



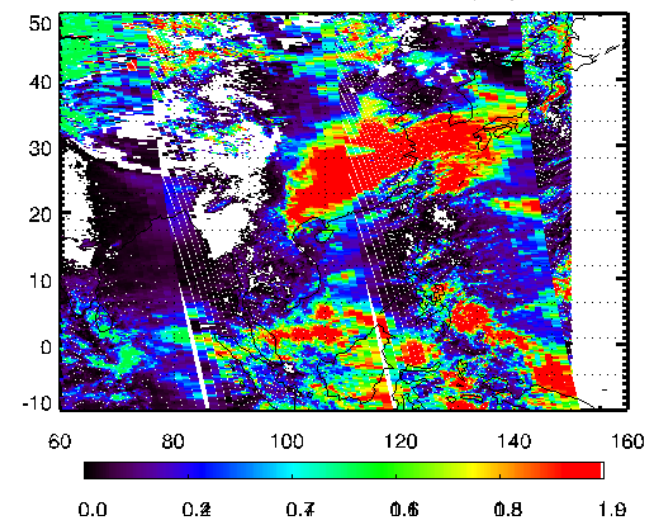
Effective cloud fraction 2007/06/21



Effective cloud fraction 2007/09/21



Effective cloud fraction 2007/12/21





GEMS Cloud Products (Validation)

Validation with OMI

MAR

	Slope	Y-intercept	Correlation	Mean Bias
GOAL	0.9–1.1	-	0.8	< 100
CCP	0.74	125.92	0.76	-50.45
CCP (ECF>0.2)	0.94	0.53	0.97	-34.56

JUN

	Slope	Y-intercept	Correlation	Mean Bias
CCP	0.76	86.32	0.79	-54.74
CCP (ECF>0.2)	0.97	-22.49	0.97	-38.56

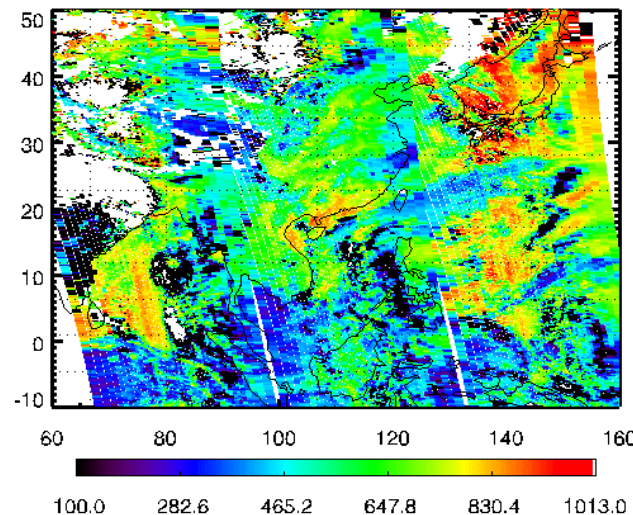
SEP

	Slope	Y-intercept	Correlation	Mean Bias
CCP	0.72	118.15	0.77	-58.50
CCP (ECF>0.2)	0.92	7.75	0.96	-34.39

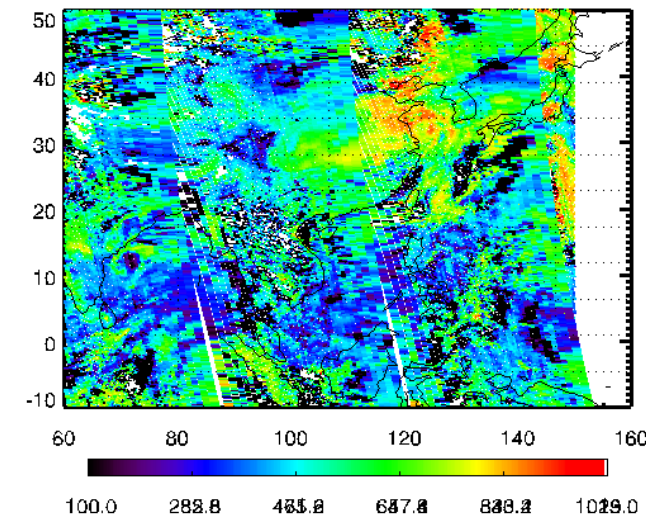
DEC

	Slope	Y-intercept	Correlation	Mean Bias
CCP	0.77	106.79	0.80	-53.90
CCP (ECF>0.2)	0.96	-9.18	0.97	-33.50

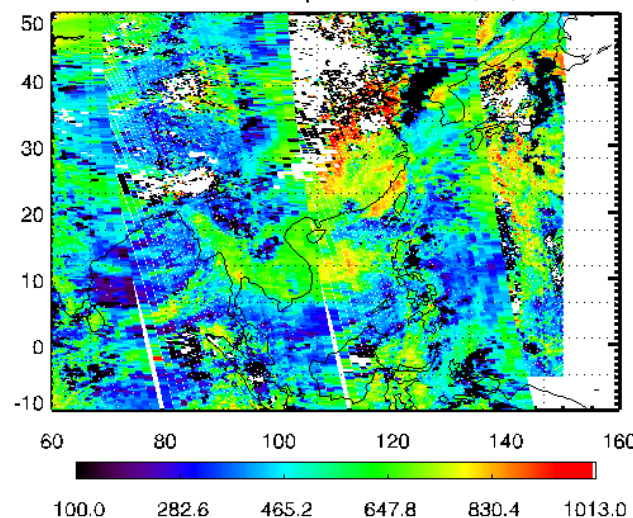
Cloud centroid pressure 2007/03/23



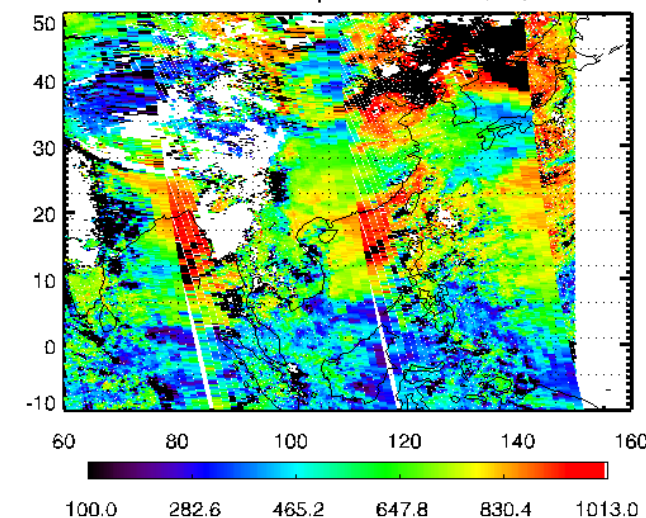
Cloud centroid pressure 2007/06/21



Cloud centroid pressure 2007/09/21



Cloud centroid pressure 2007/12/21



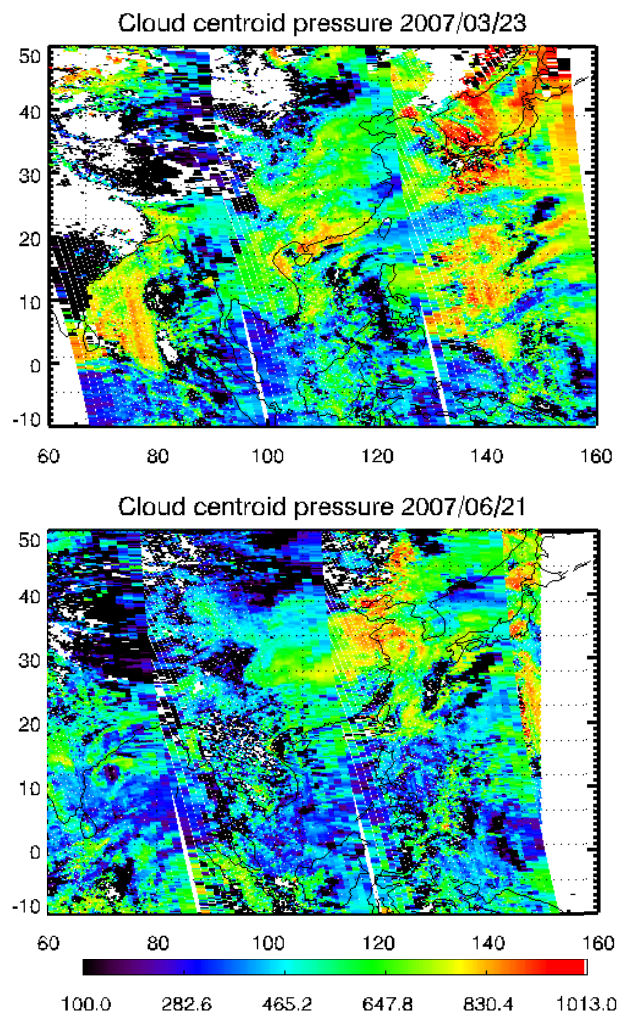


Sensitivity Tests to Input Data (Surface pressure)

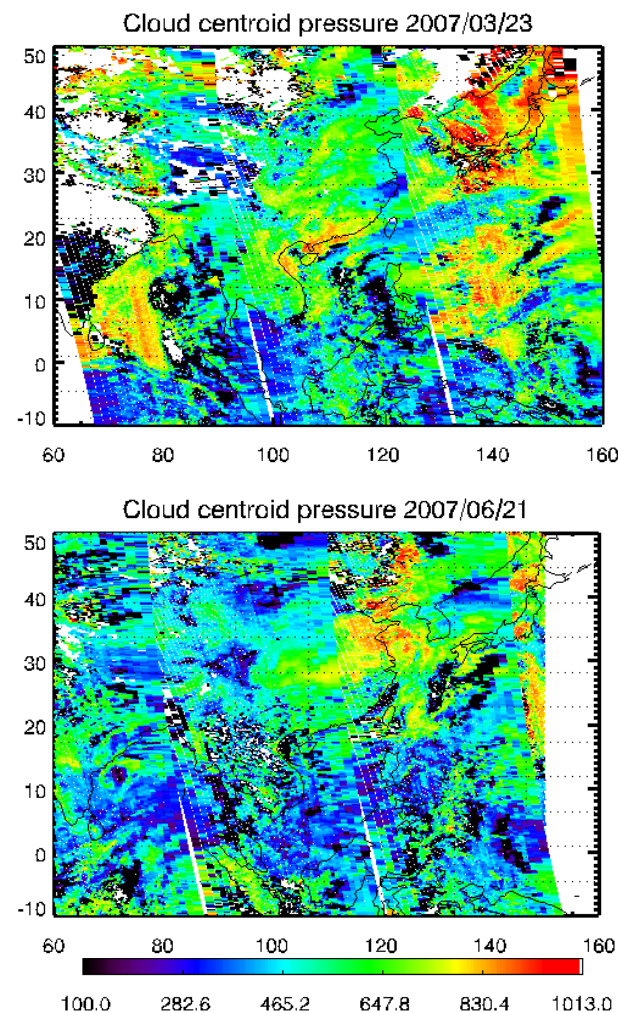
MAR

JUN

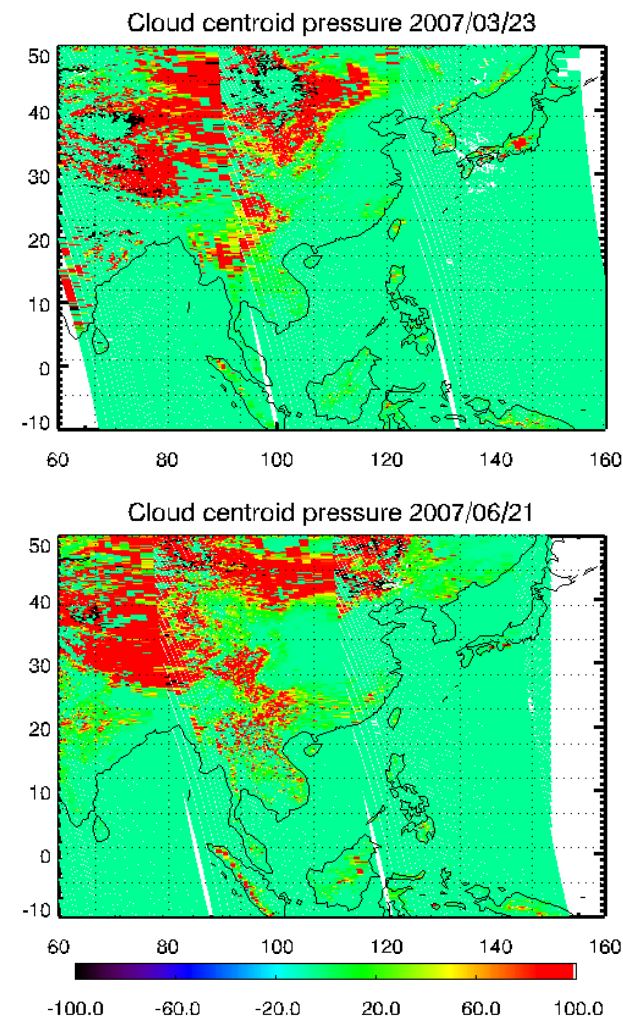
Fixed ($P_{\text{sfc}} = 1013 \text{ hPa}$)



Regional Surface Pressure



Difference



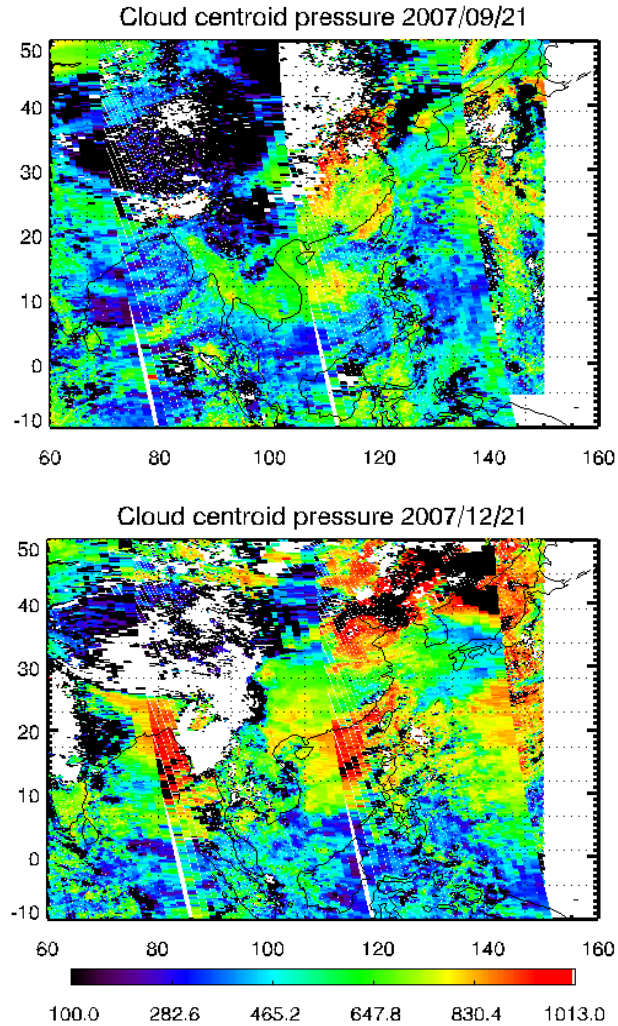


Sensitivity Tests to Input Data (Surface pressure)

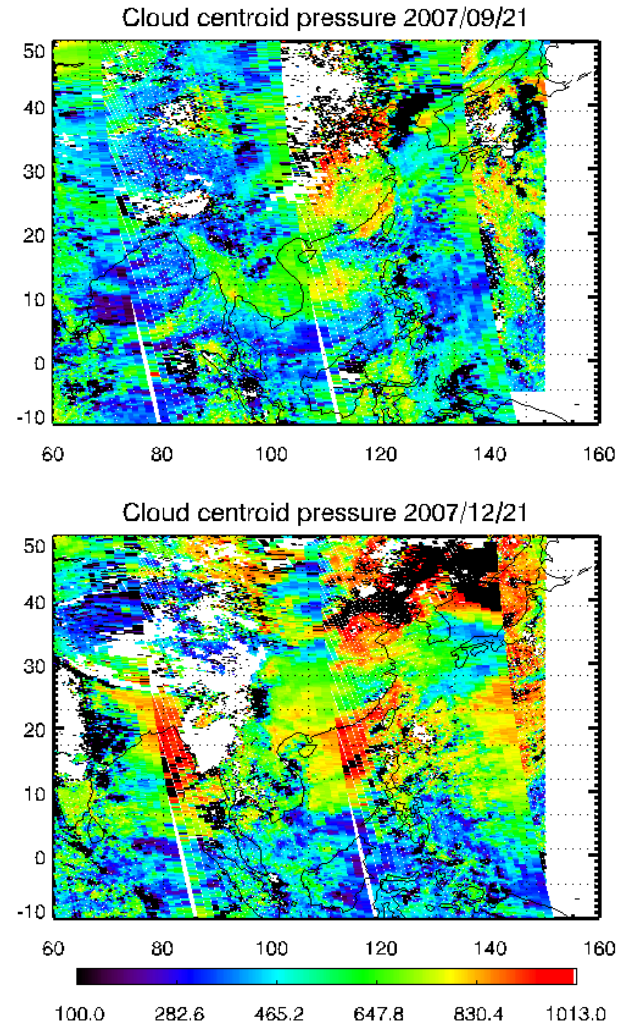
SEP

DEC

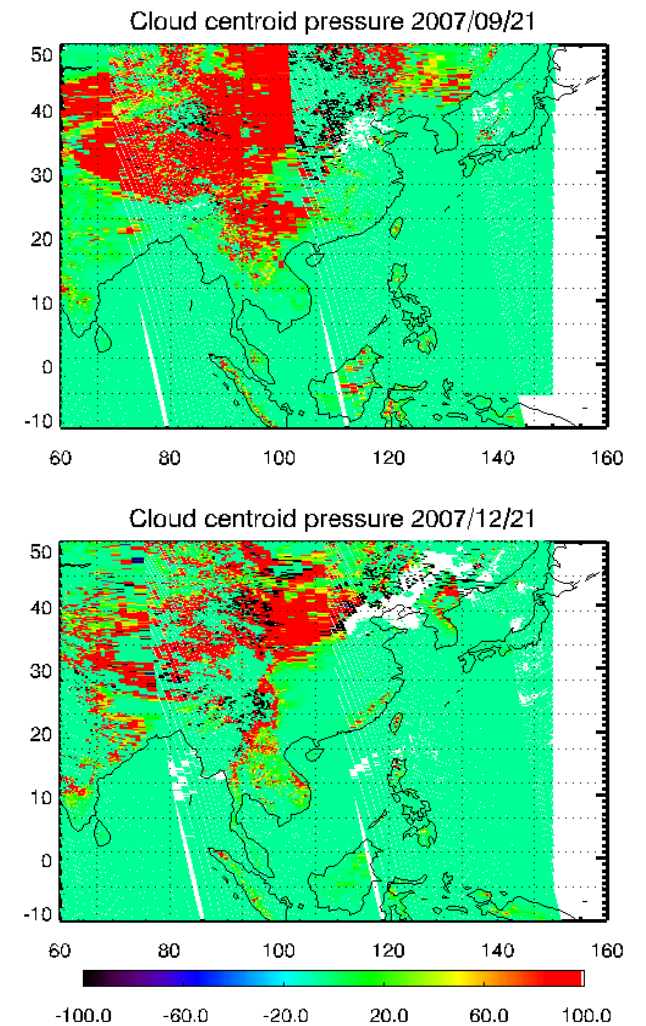
Fixed ($P_{sfc} = 1013$ hPa)



Regional Surface Pressure



Difference



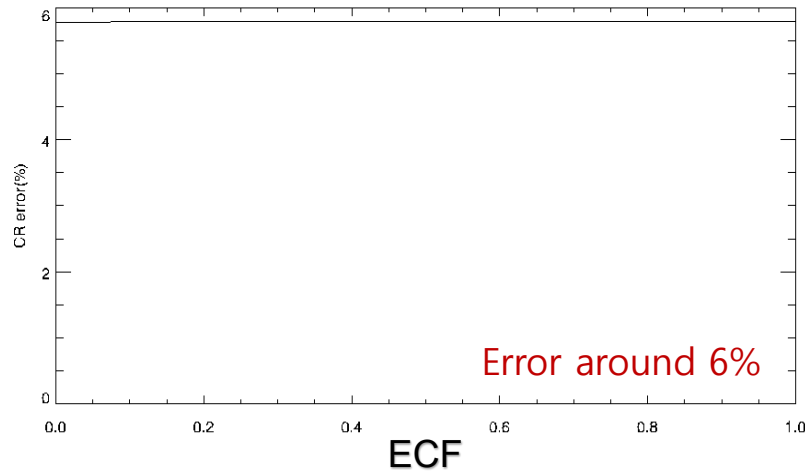


Sensitivity Tests to Input Data

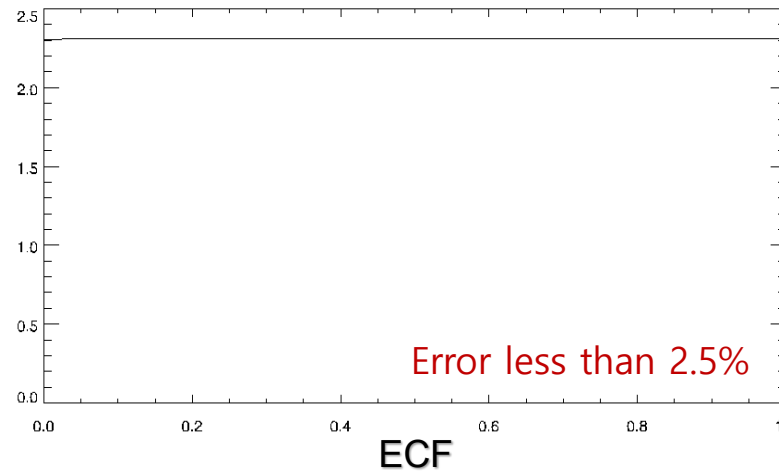
(Reflectance error analysis)

Linearly increasing error (10% error of total reflectance)

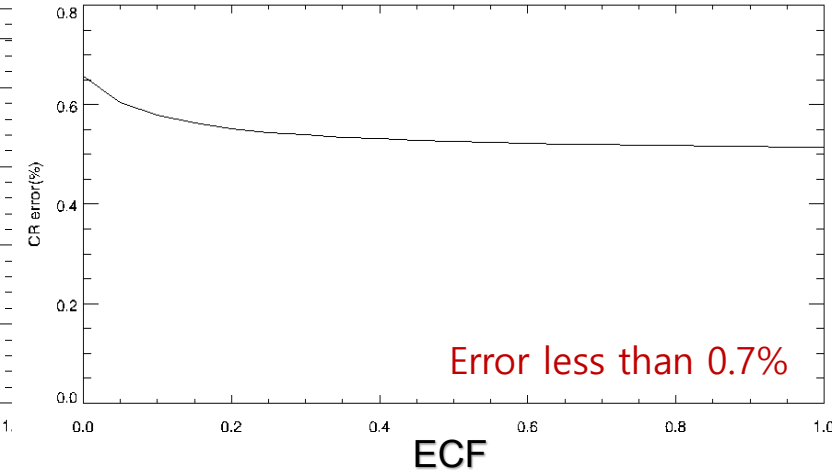
CR error(%)



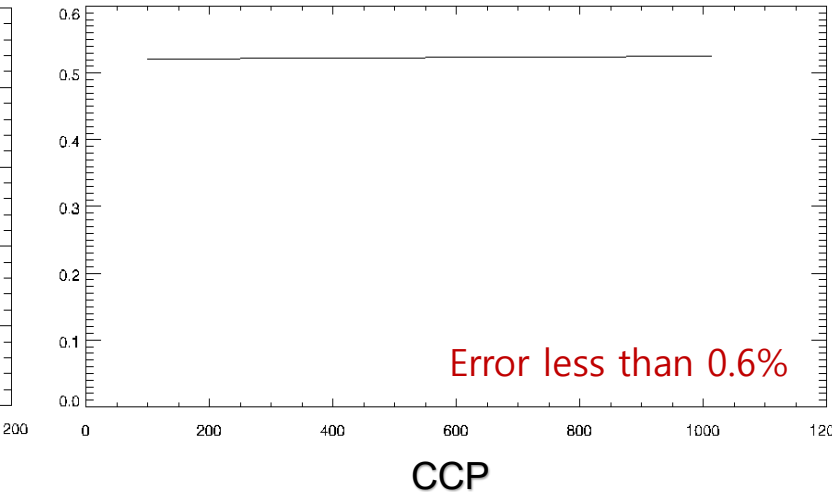
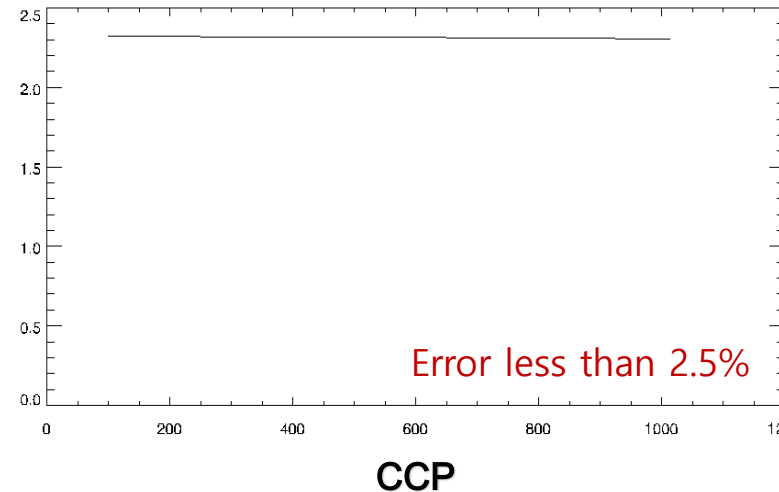
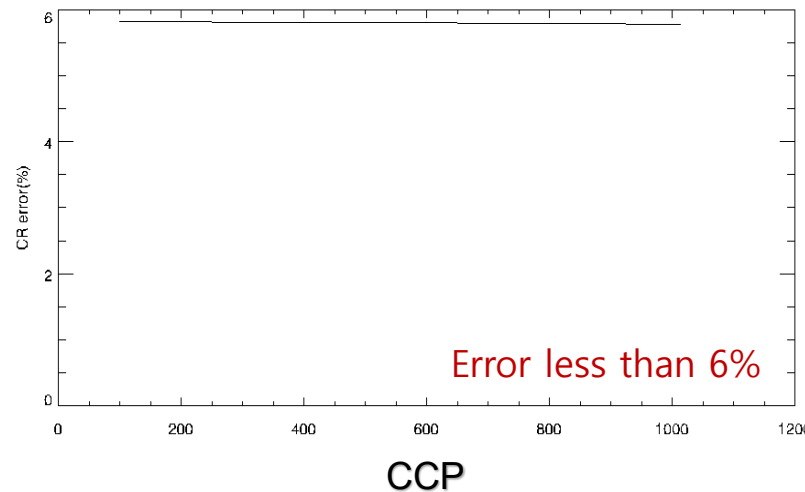
Linearly decreasing error (4% error of total reflectance)



Valley error (477 nm) (4% error of total reflectance)



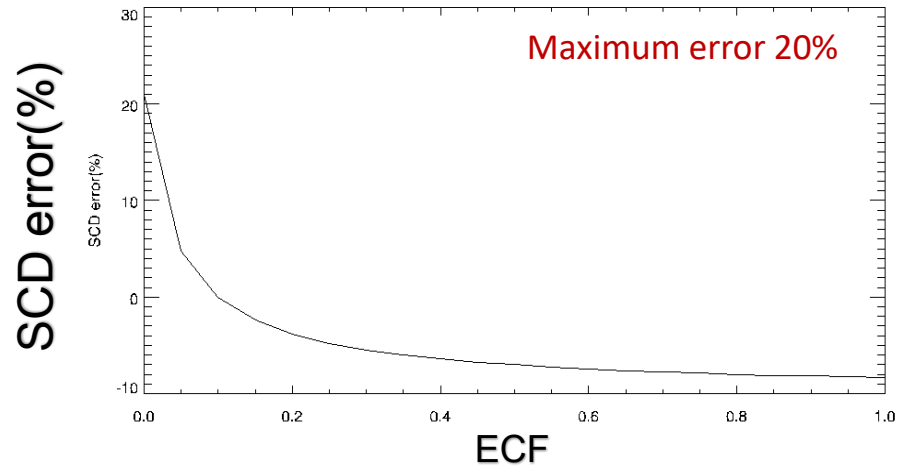
CR error(%)



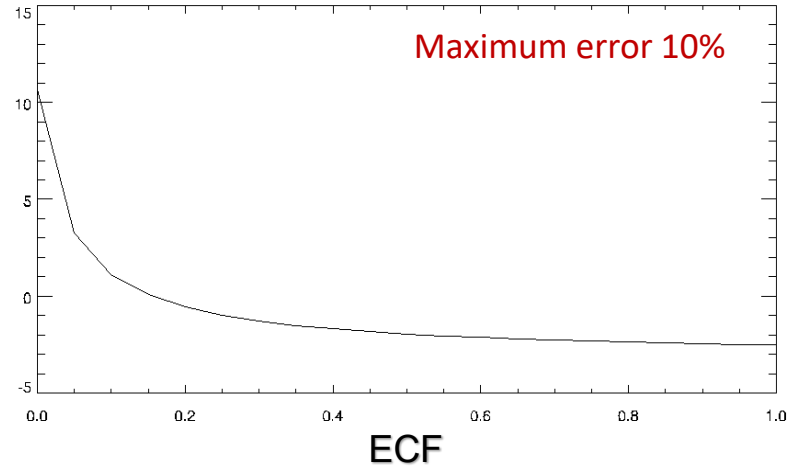


Sensitivity Tests to Input Data (Reflectance error analysis)

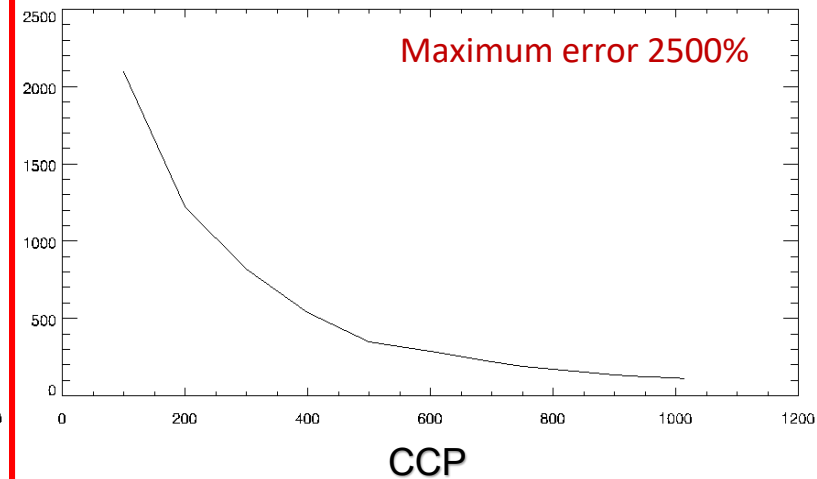
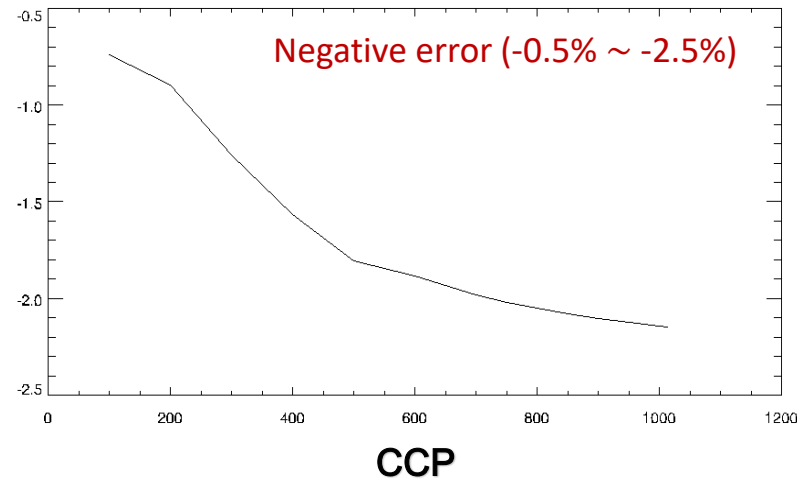
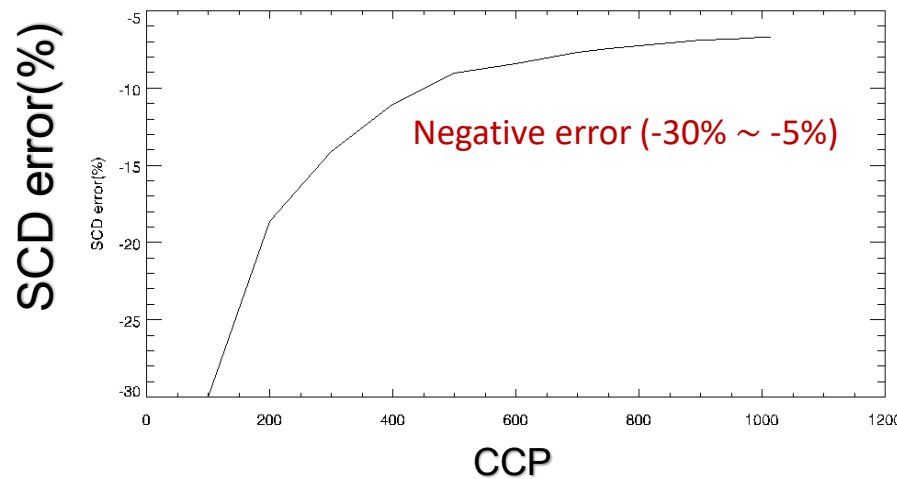
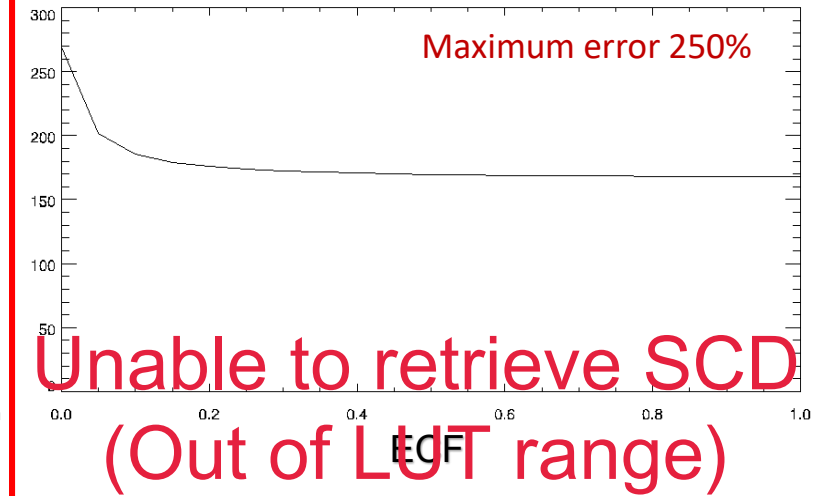
Linearly increasing error (10% error of total reflectance)



Linearly decreasing error (4% error of total reflectance)



Valley error (477 nm) (4% error of total reflectance)





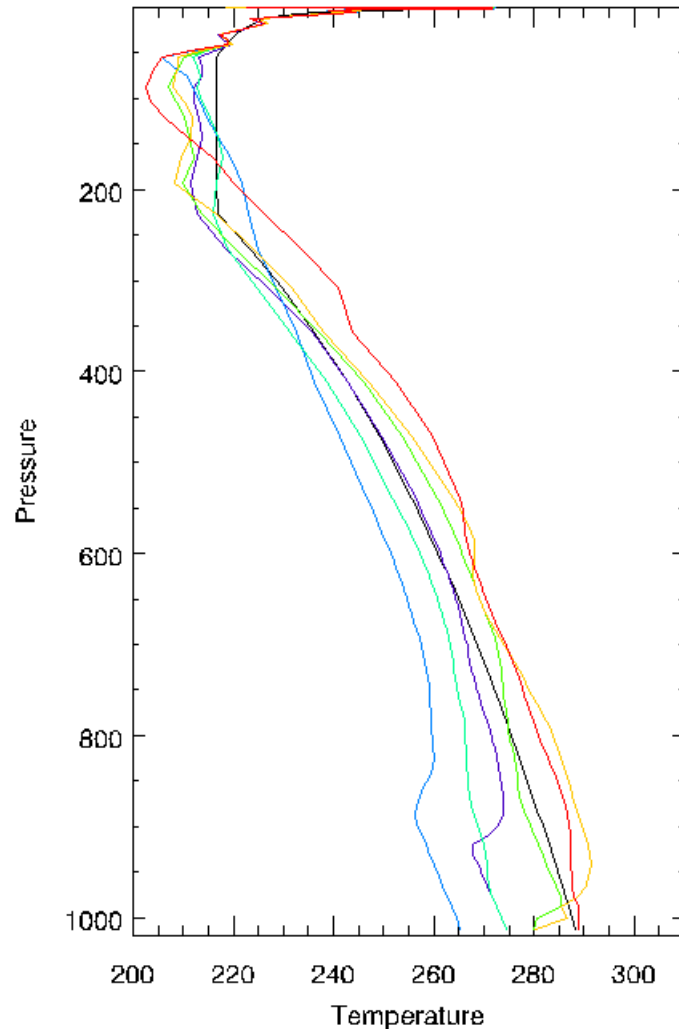
Contingency Plan

- ❖ In operation, if SCD is beyond the valid range of LUT, the retrieval proceeds as follows.
 - ECF is retrieved using continuum reflectance
 - ECP is assumed as 500 hPa or certain climatological value
 - At nighttime,
 - Radiance is reproduced after polarization correction
 - Final product of cloud is retrieved using corrected radiance data.



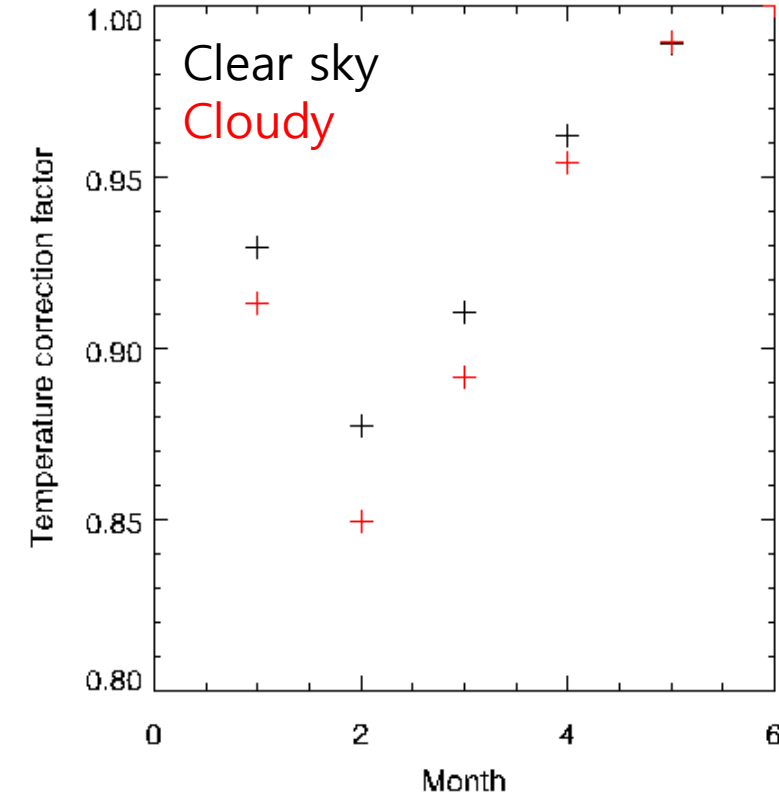
Sensitivity Tests to Input Data (Temperature profile)

Seasonal Temperature Profile



- ❖ LUT test in consideration of seasonal temperature profile
 - Based on the **monthly temperature** profile used in proxy data, theoretical **temperature correction factor** is calculated.
 - For winter cases, temperature correction factor 0.9 is applied.

Seasonal Temperature Correction Factor

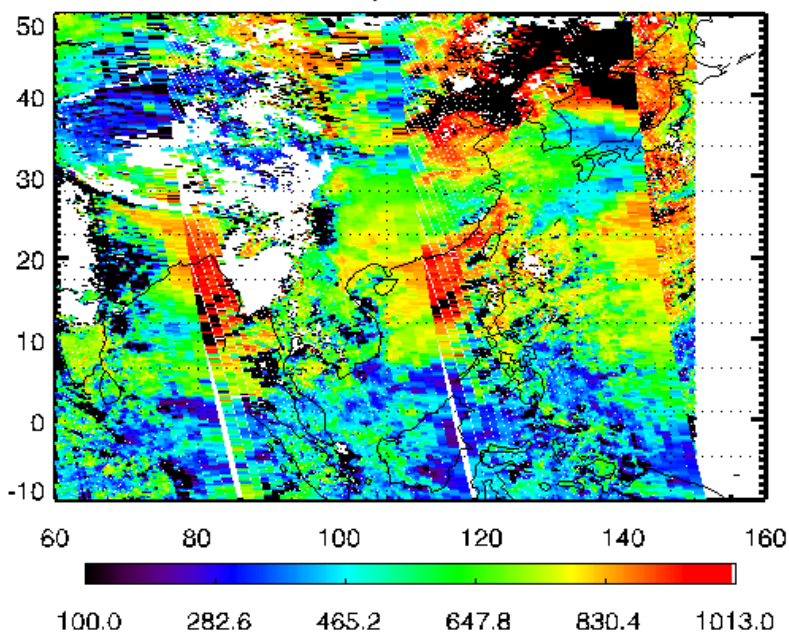




Sensitivity Tests to Input Data (Temperature profile)

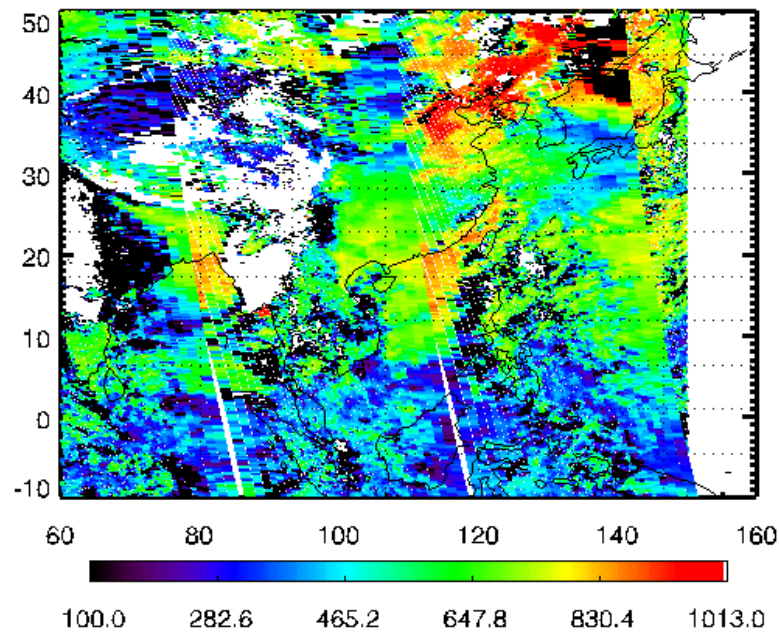
Before Correction

Cloud centroid pressure 2007/12/21



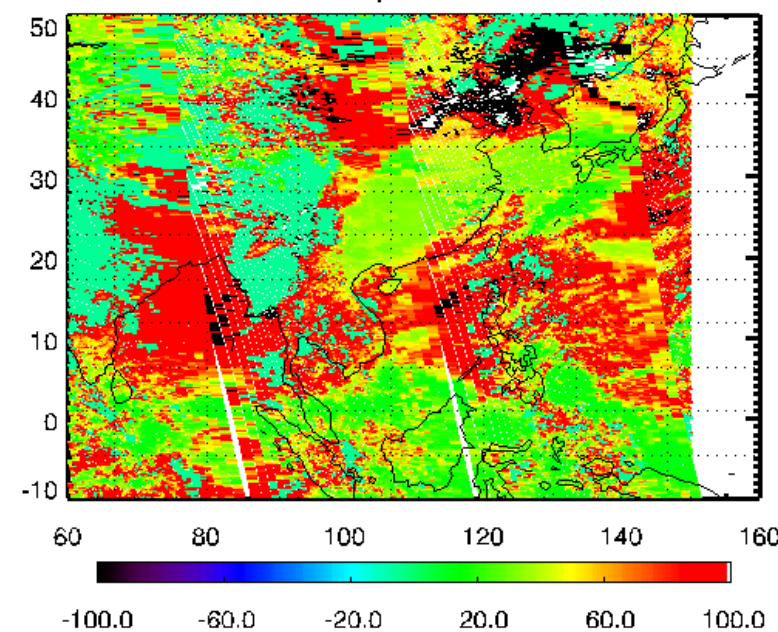
After Correction

Cloud centroid pressure 2007/12/21



Difference (before – after)

Cloud centroid pressure 2007/12/21



The background is an abstract composition of three main colors: a dark blue at the top and bottom, and a large black central area. The boundaries between these colors are defined by sharp, diagonal lines, creating a sense of movement and depth. A white triangular shape is visible in the top right corner, and another white shape is in the bottom left corner, both appearing to be part of the overall geometric design.

Thank You