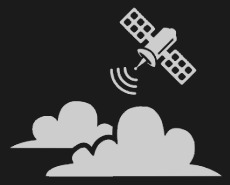
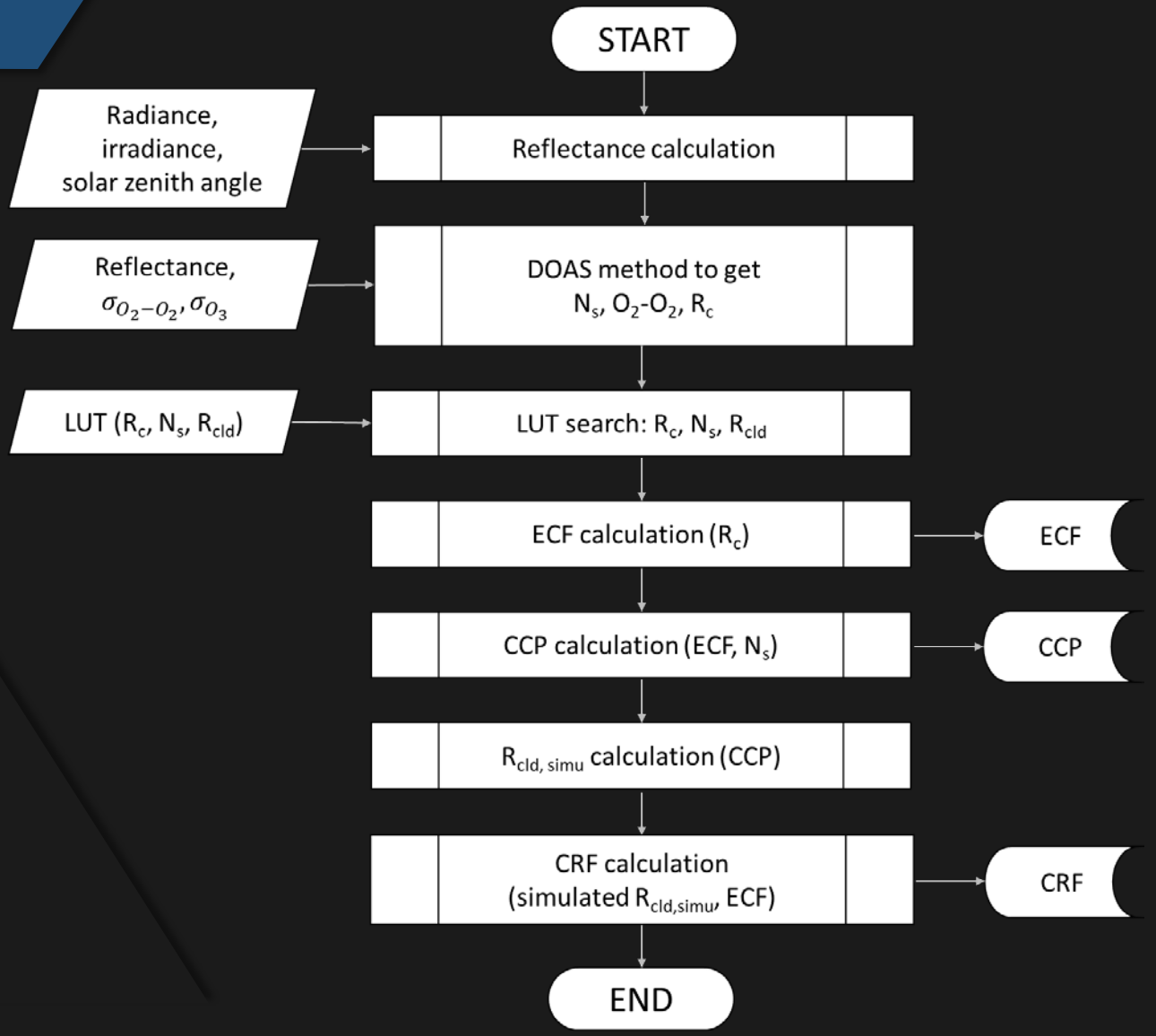
Status of GEMS Cloud Algorithm

Ewha Womans University

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

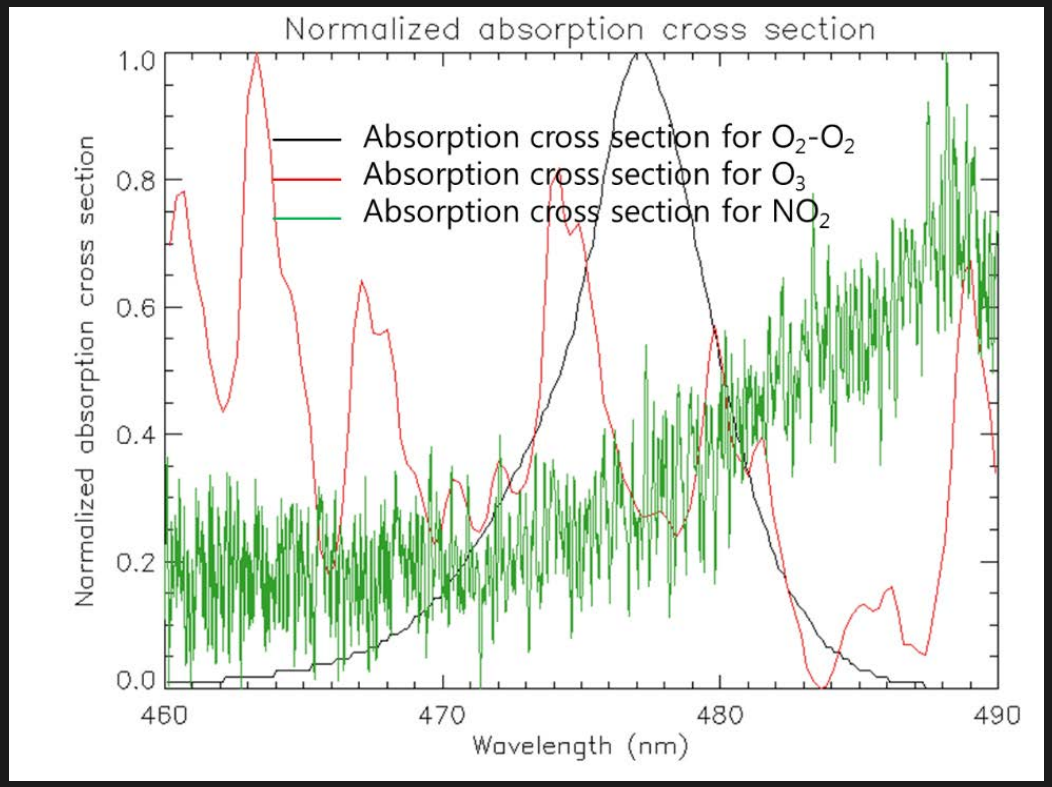
GEMS Cloud Algorithm



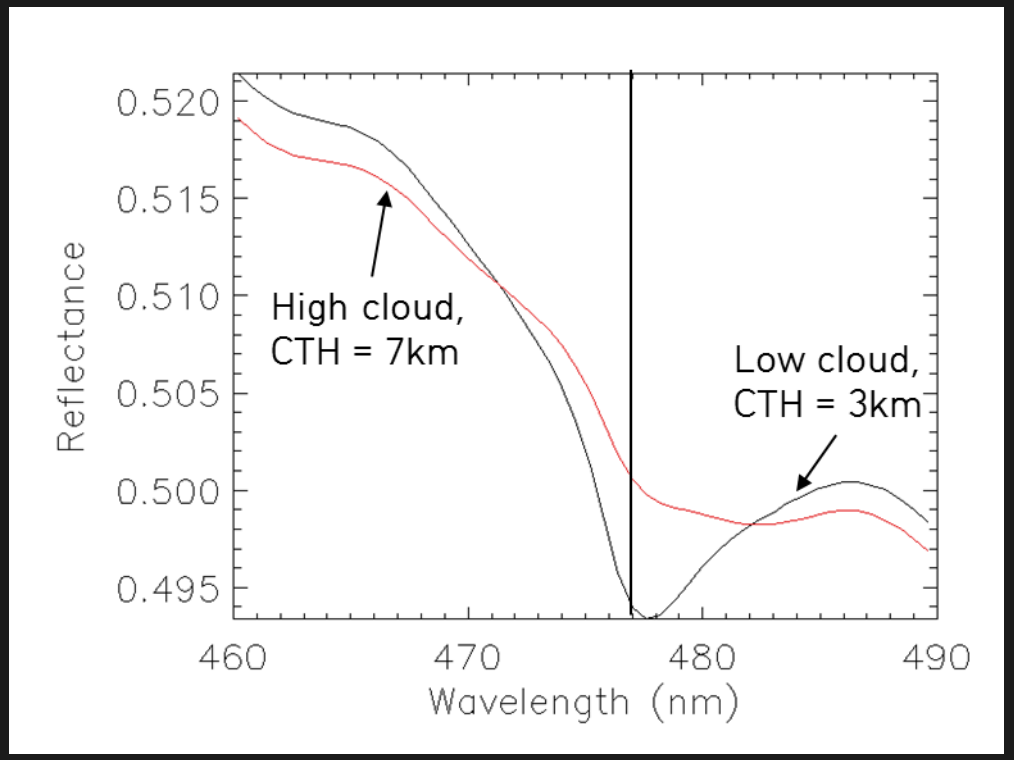


Theoretical Background
(O_2-O_2 absorption band)

Absorption is caused by collision between two O_2 molecules.

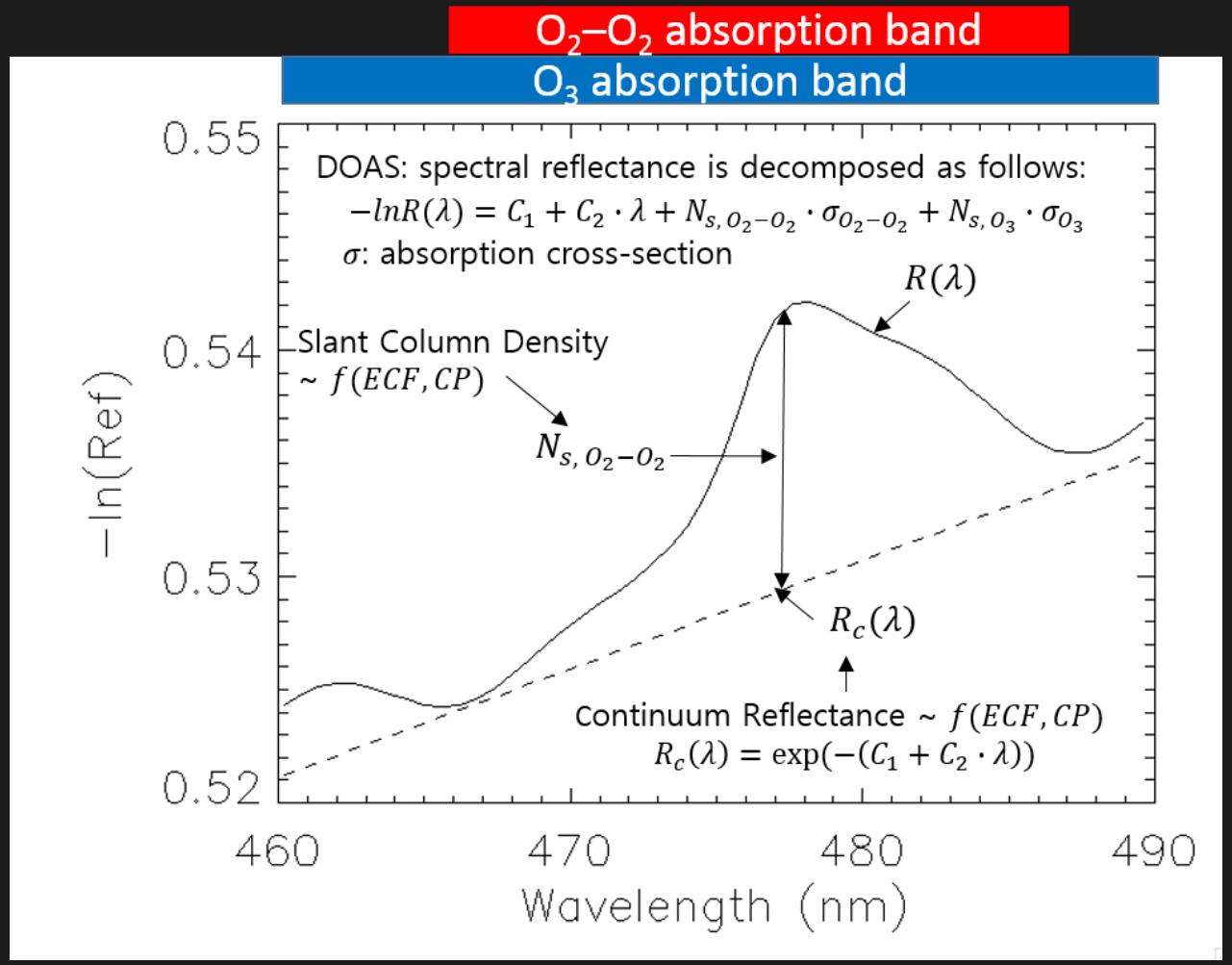


The feature of the absorption is stable.



The O_2-O_2 absorption band is sensitive to cloud pressure in GEMS region.

Theoretical Background
(DOAS method)



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

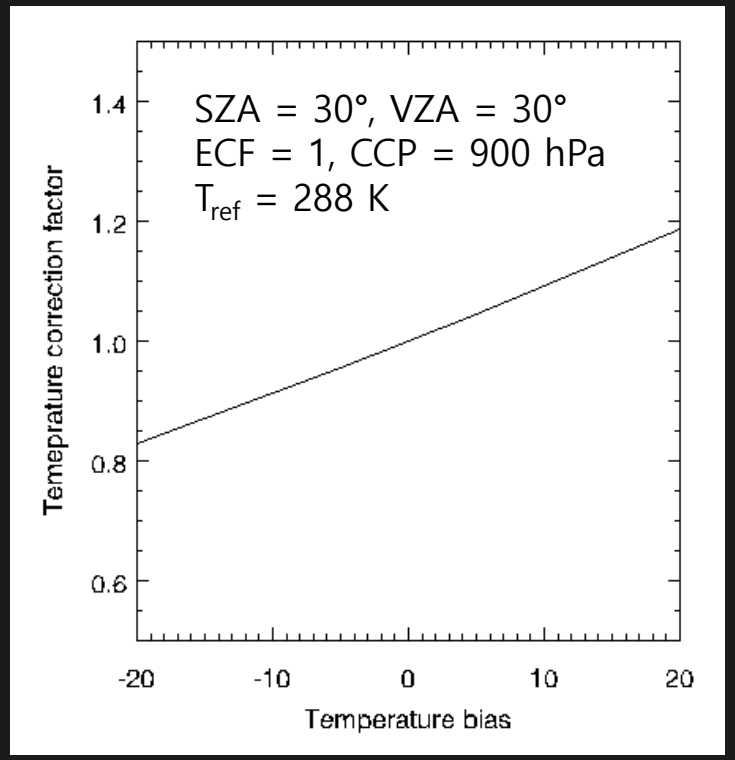
Theoretical Background
(Temperature correction factor)

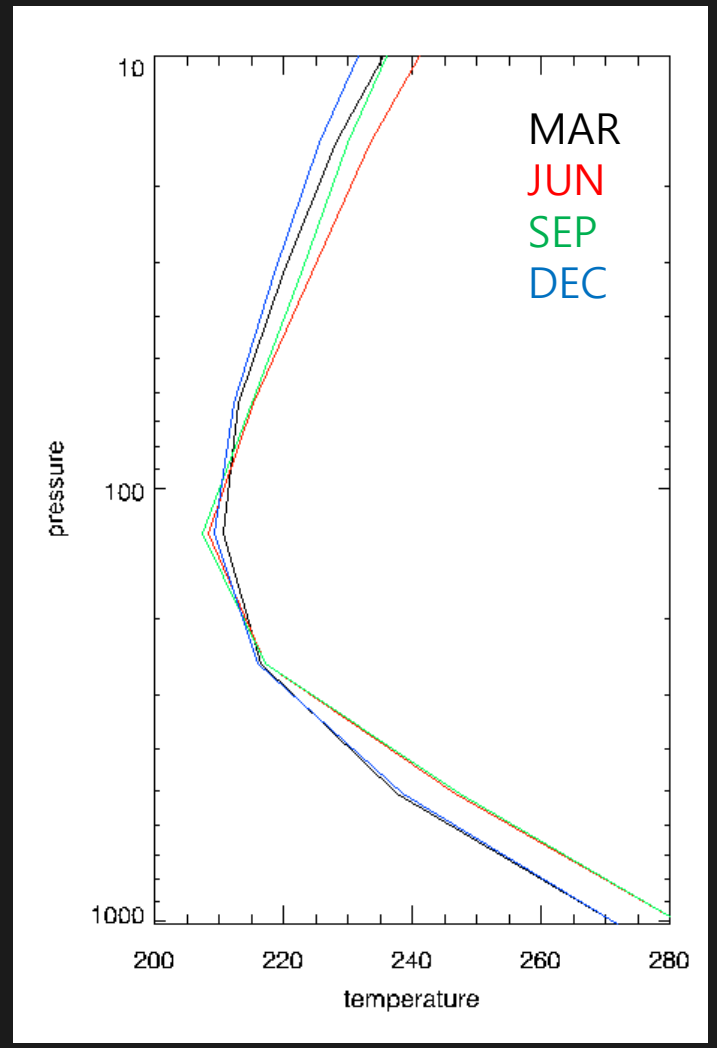
- Cloud algorithm considering temperature profile

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

Pepjin et al., 2016

γ: **Temperature correction factor**
N_s: **Slant column density**
$m(p,\lambda)$: **O_2-O_2 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

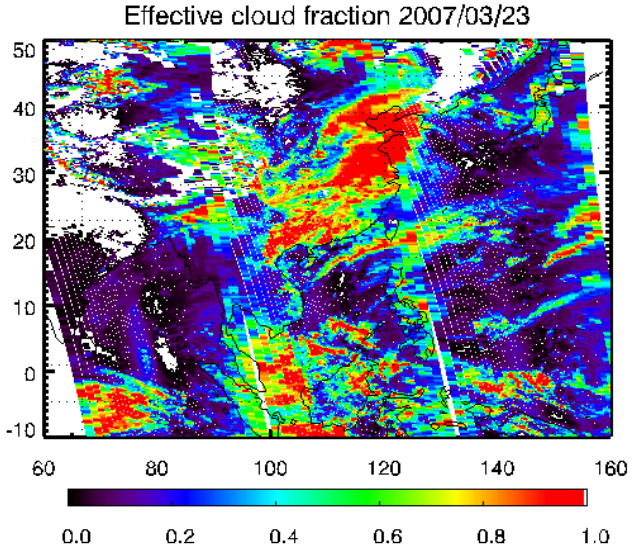
	Slope	Y-intercept	Correlation	Mean Bias
ECF	0.96	0.00	1.00	-0.01

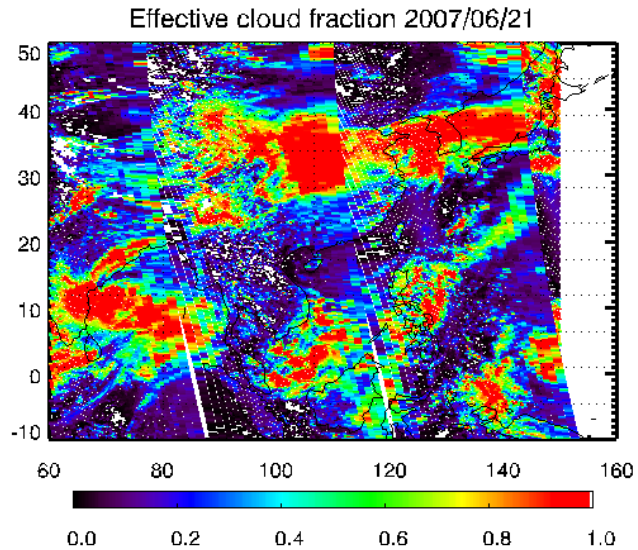
SEP

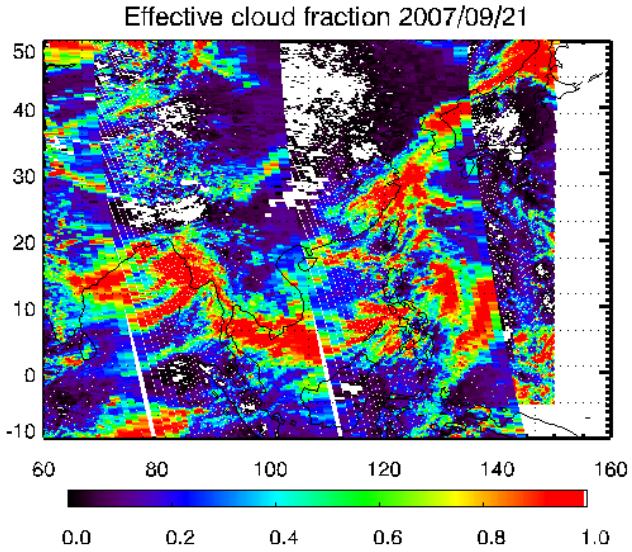
	Slope	Y-intercept	Correlation	Mean Bias
ECF	0.97	0.01	1.00	0.00

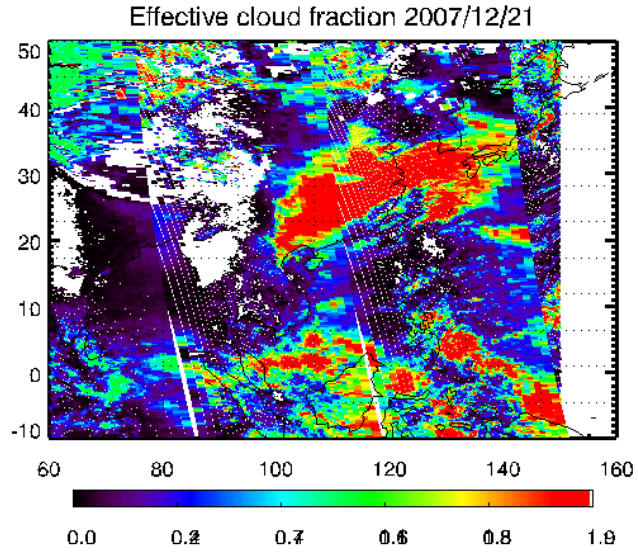
DEC

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









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

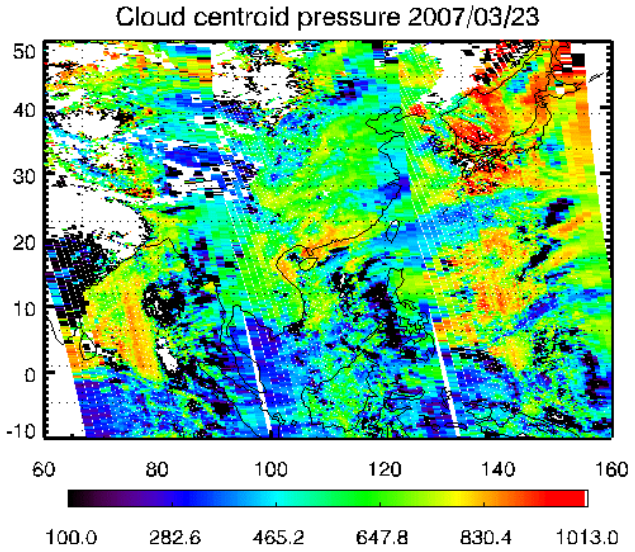
	Slope	Y-intercept	Correlation	Mean Bias
CCP	0.76	86.32	0.79	-54.74
CCP (ECF>0.2)	0.97	-22.49	0.97	-38.56

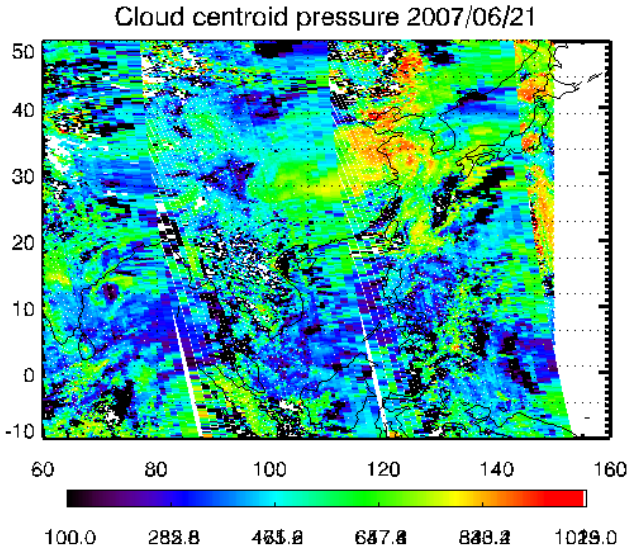
SEP

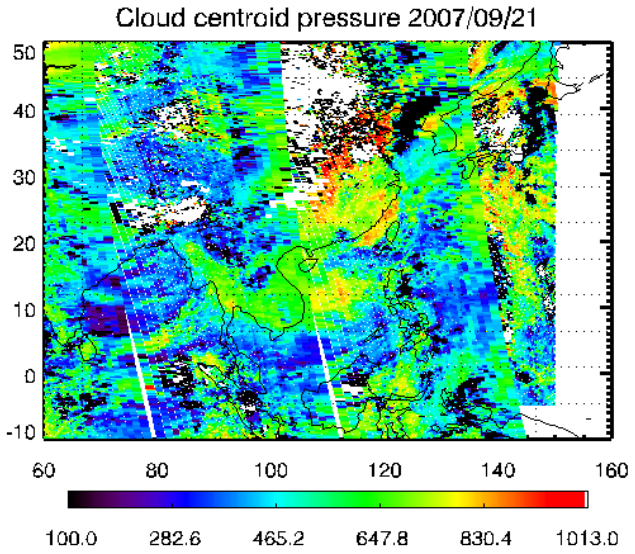
	Slope	Y-intercept	Correlation	Mean Bias
CCP	0.72	118.15	0.77	-58.50
CCP (ECF>0.2)	0.92	7.75	0.96	-34.39

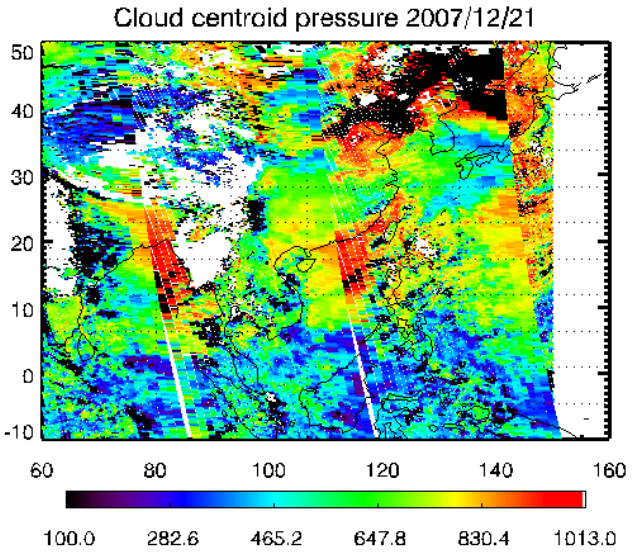
DEC

	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

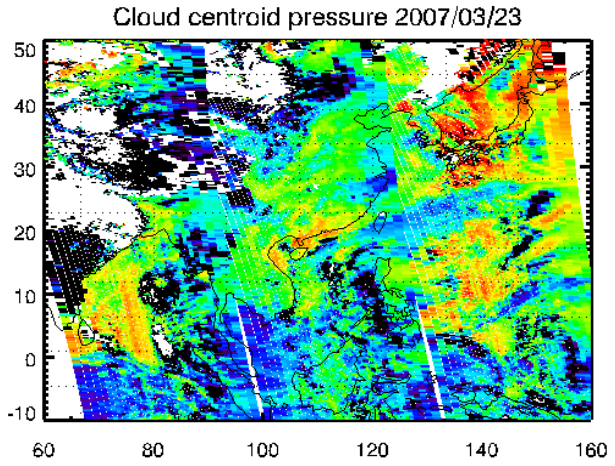
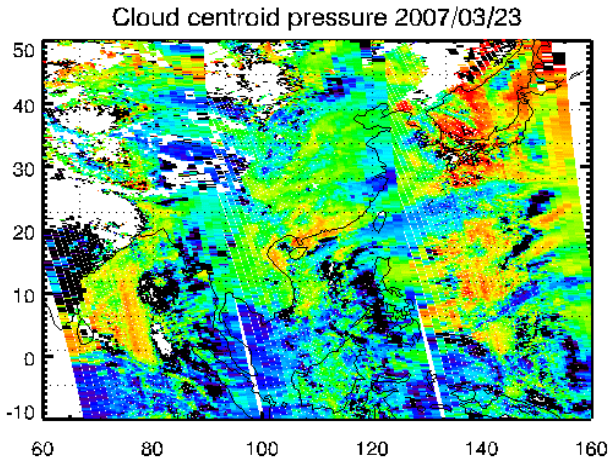
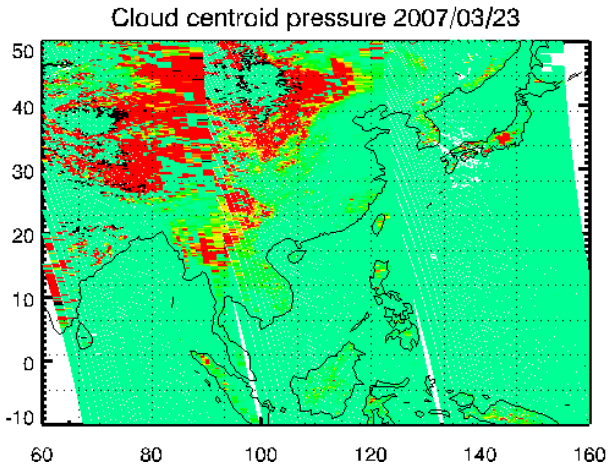
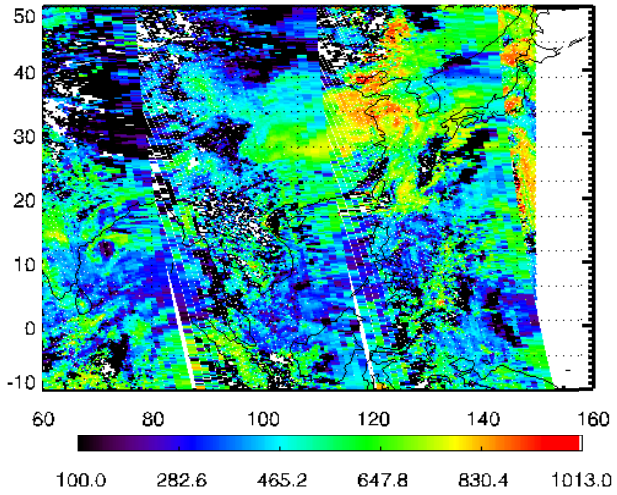
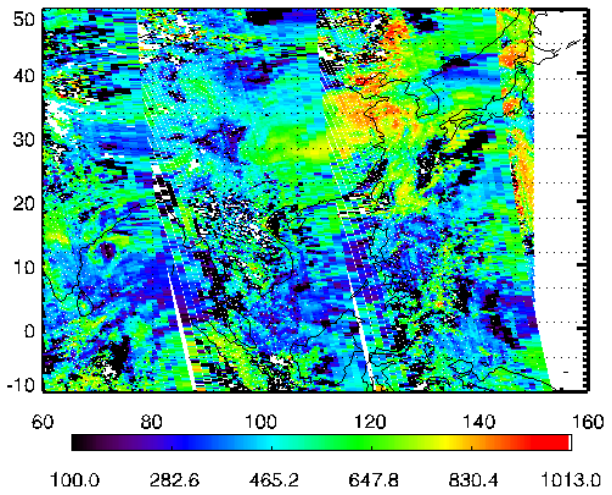
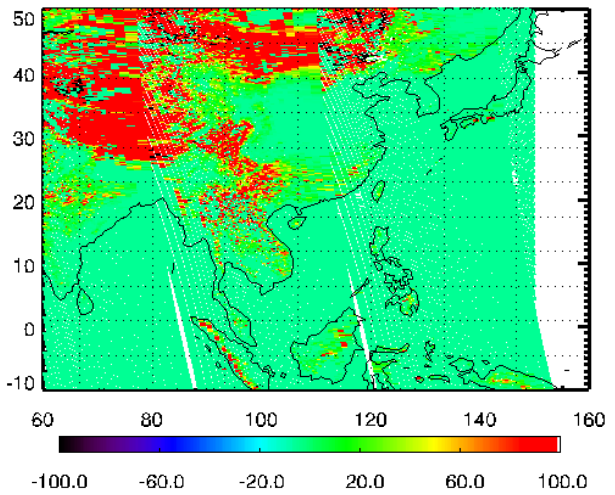




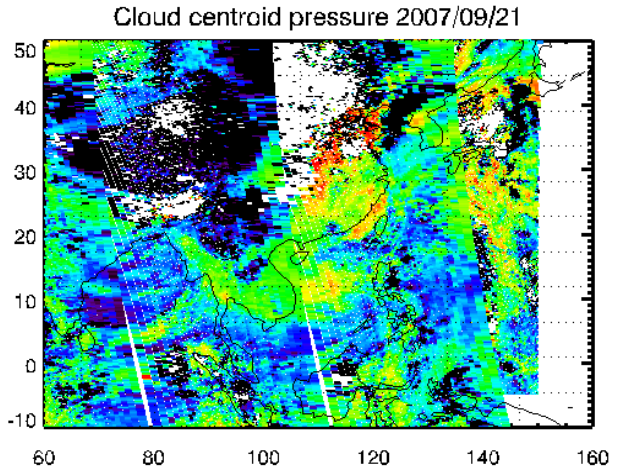
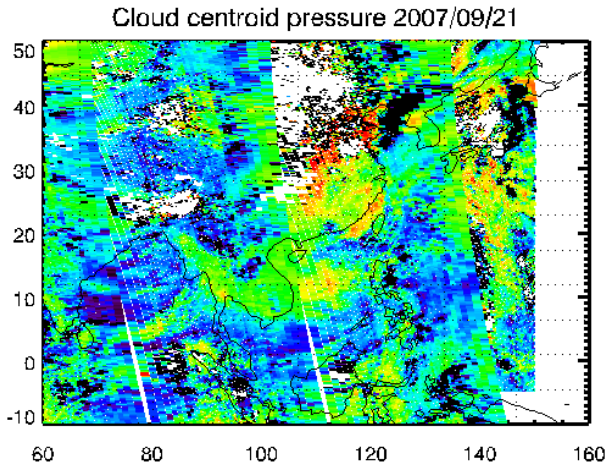
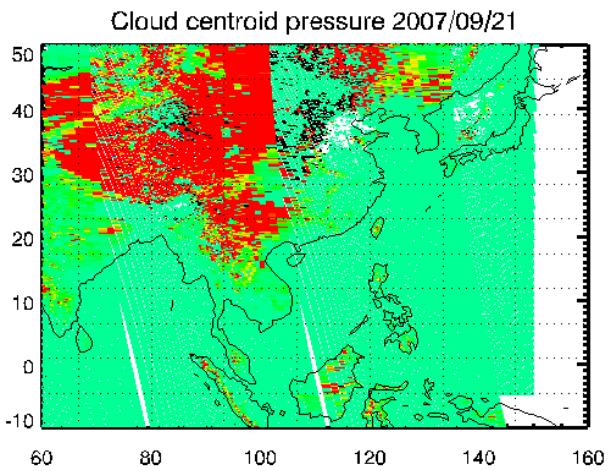
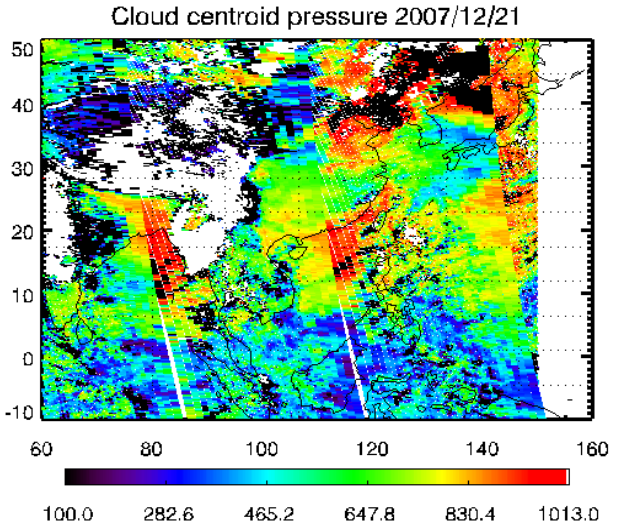
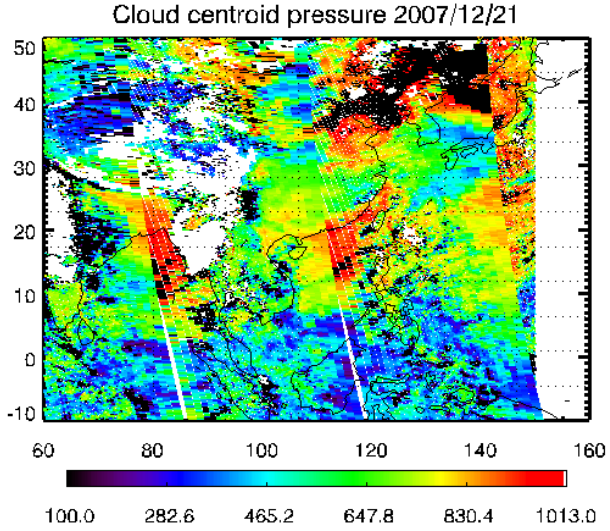
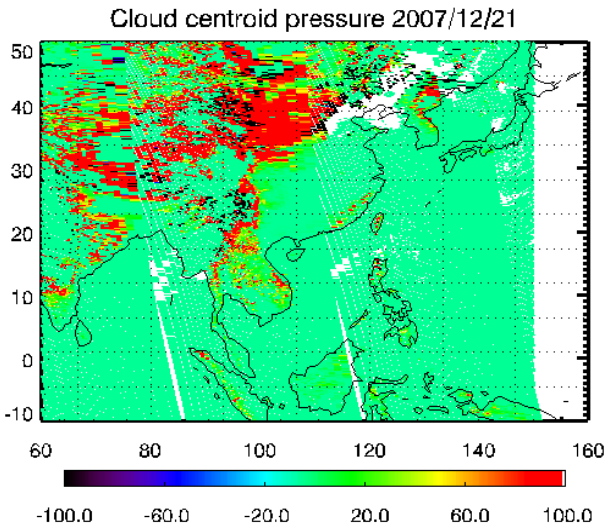




Sensitivity Tests to Input Data
(Surface pressure)

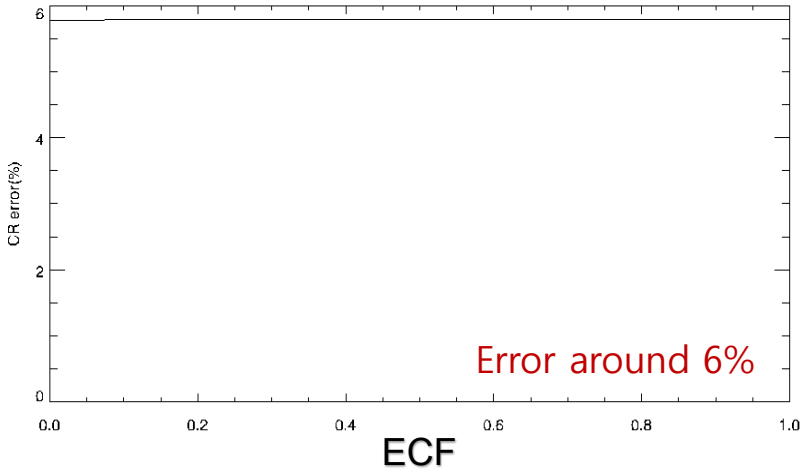
	Fixed (P_{sfc} = 1013 hPa)	Regional Surface Pressure	Difference
MAR			
JUN			

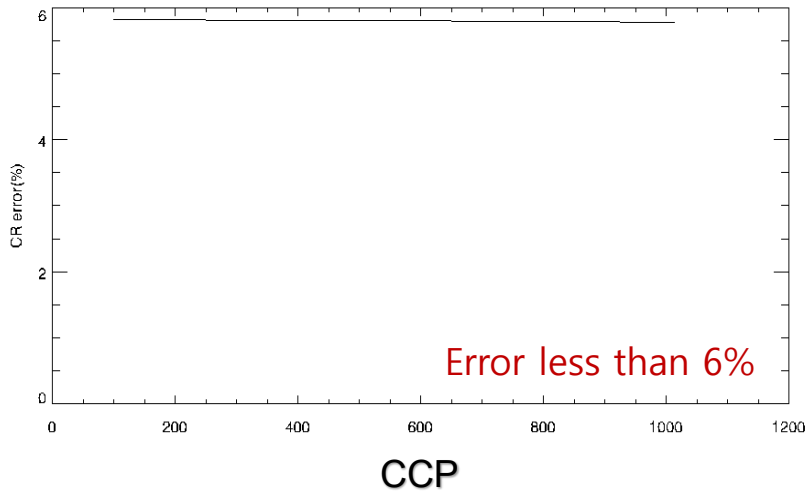
Sensitivity Tests to Input Data
(Surface pressure)

	Fixed (P_{sfc} = 1013 hPa)	Regional Surface Pressure	Difference
SEP			
DEC			

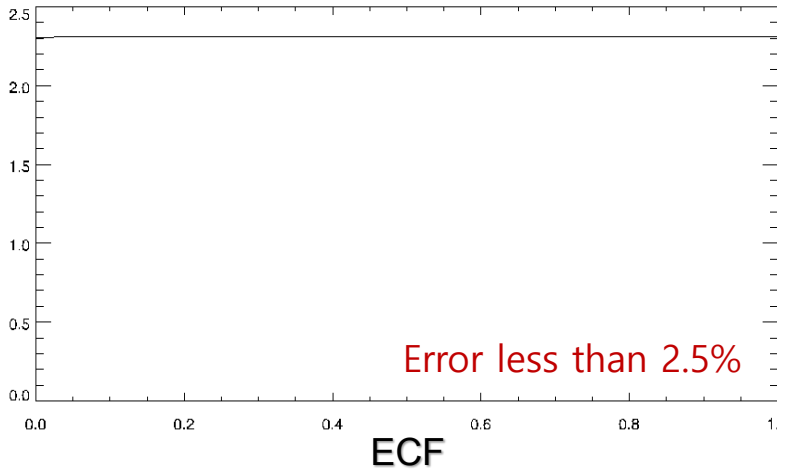
Sensitivity Tests to Input Data
(Reflectance error analysis)

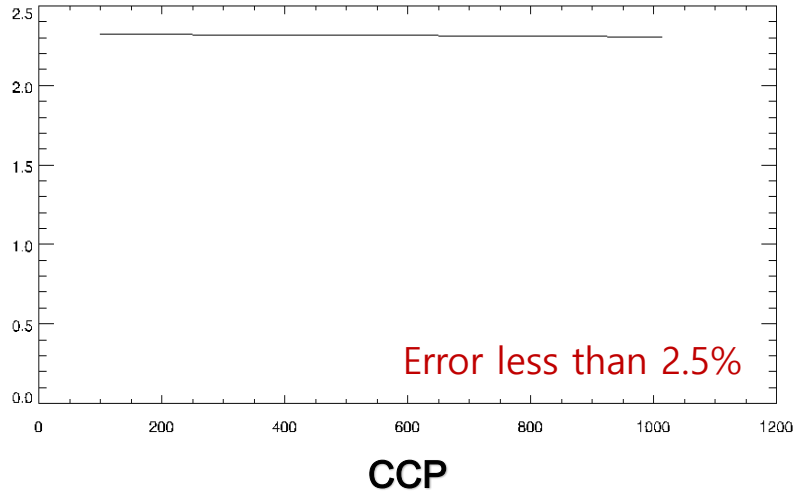
Linearly increasing error
(10% error of total reflectance)



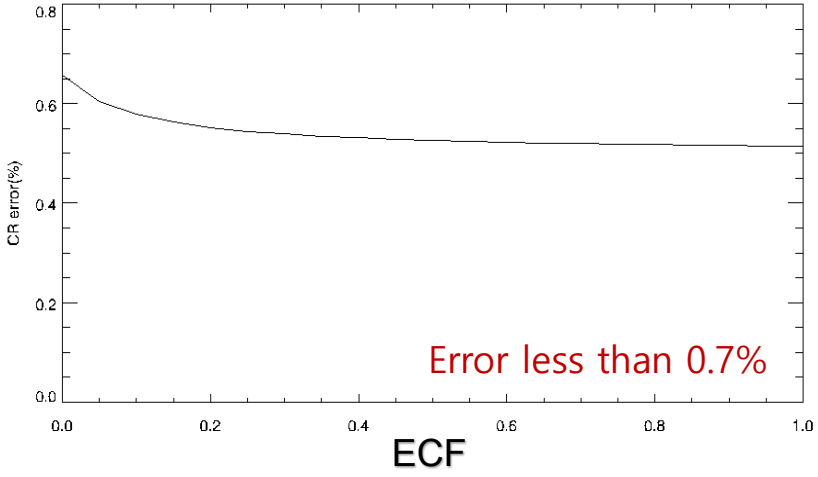


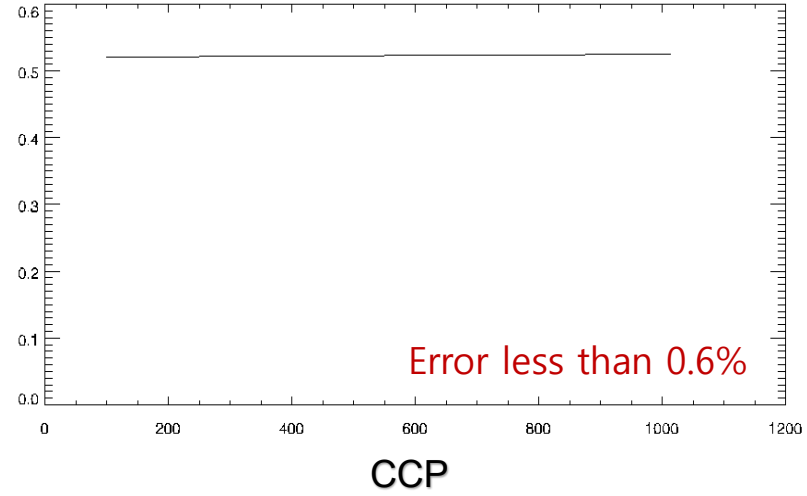
Linearly decreasing error
(4% error of total reflectance)





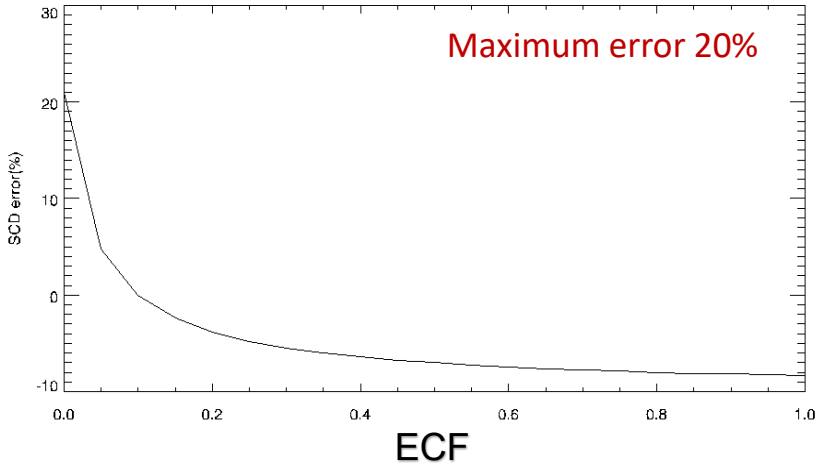
Valley error (477 nm)
(4% error of total reflectance)

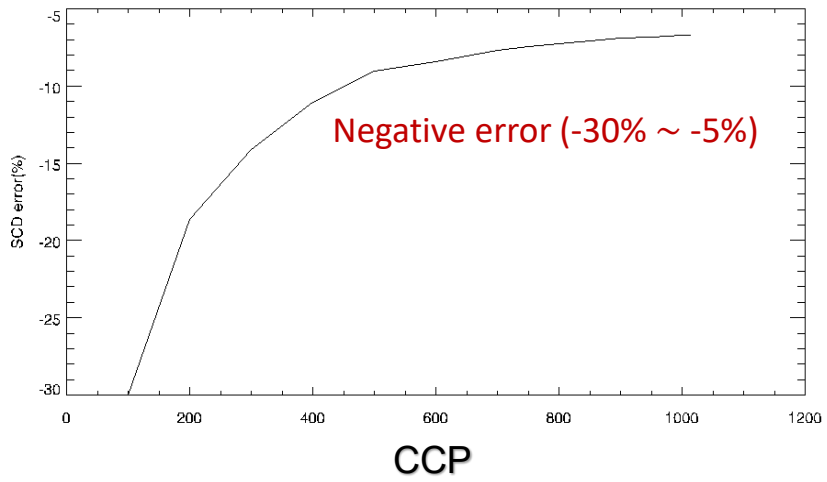




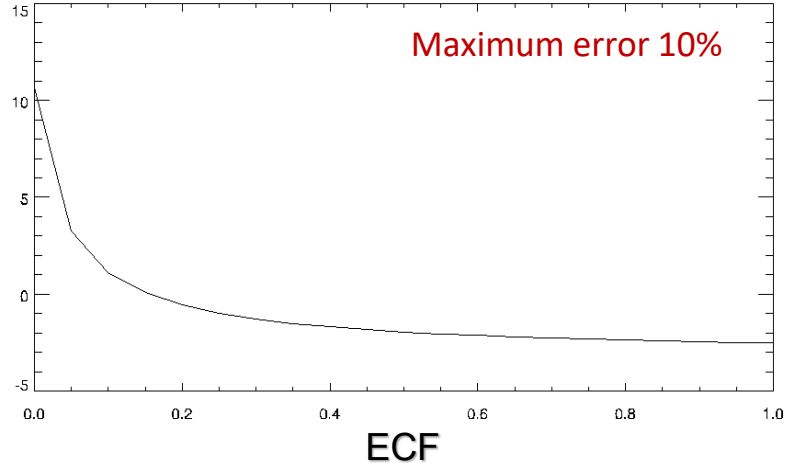
Sensitivity Tests to Input Data
(Reflectance error analysis)

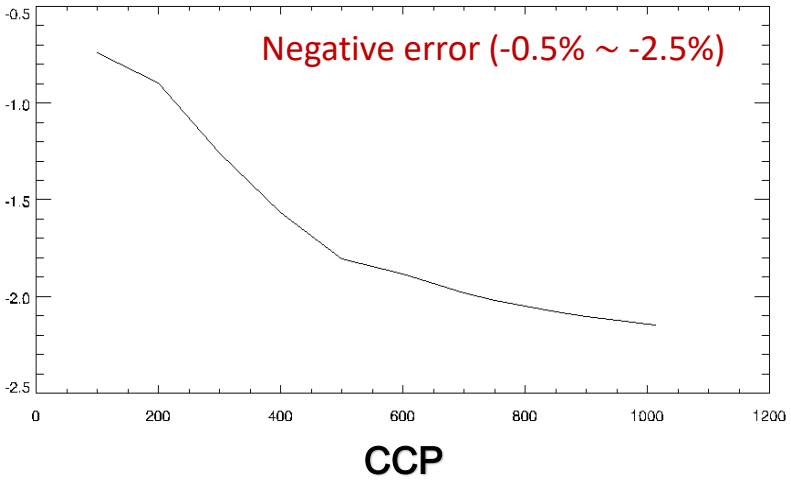
Linearly increasing error
(10% error of total reflectance)



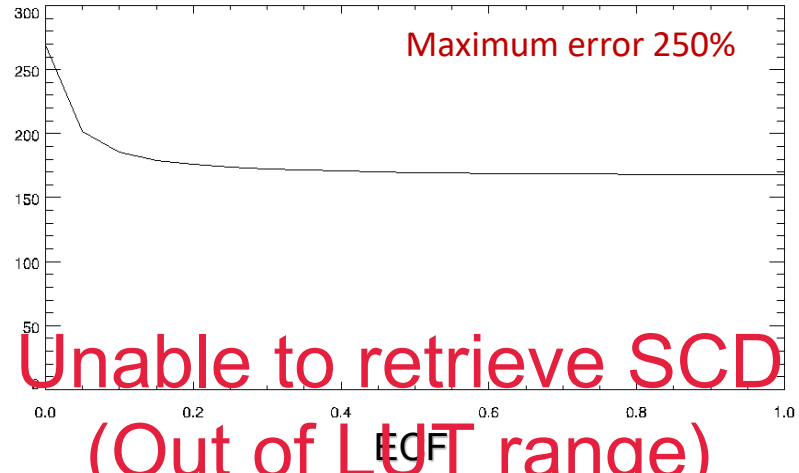


Linearly decreasing error
(4% error of total reflectance)

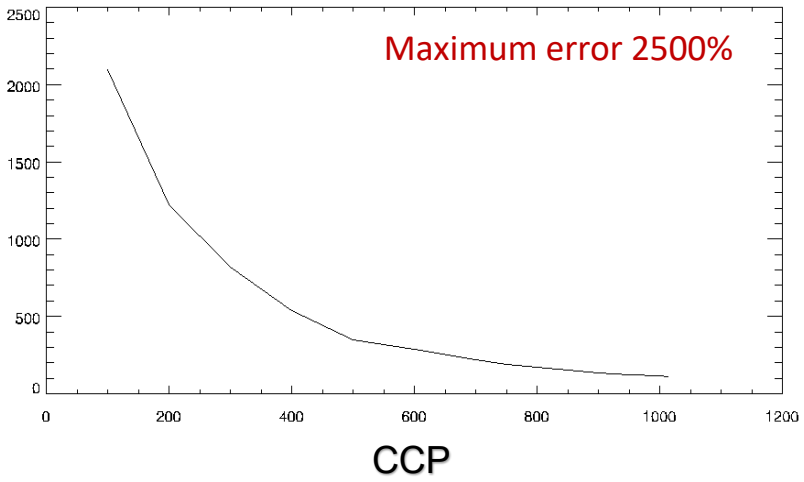




Valley error (477 nm)
(4% error of total reflectance)



Unable to retrieve SCD
(Out of LUT range)

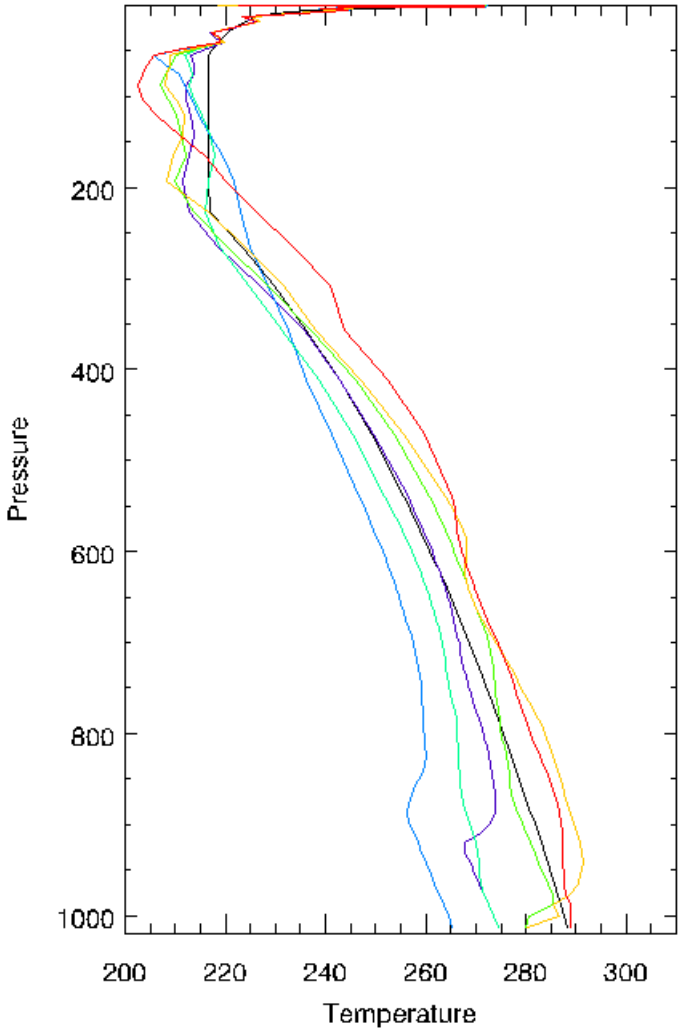


Contingency Plan

- 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.

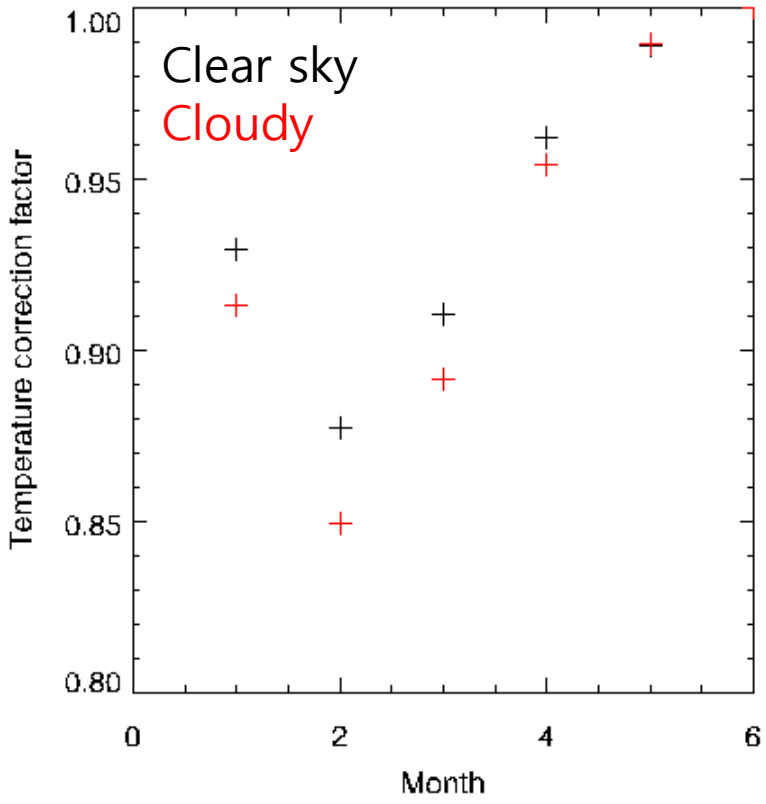
Sensitivity Tests to Input Data
(Temperature profile)

Seasonal Temperature Profile



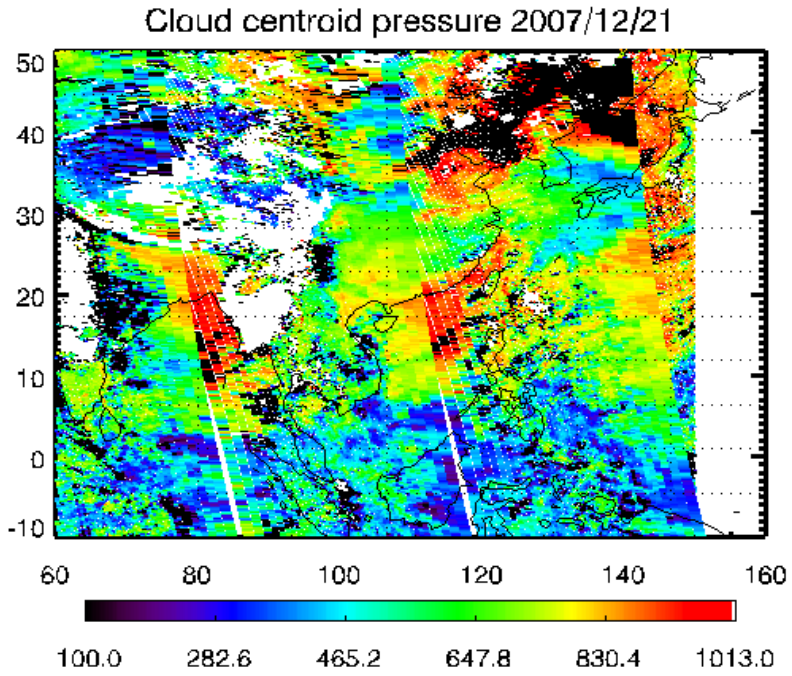
- LUT test in consideration of seasonal temperature profile
  - Based on the **monthly temperature** profile used in proxy data, theoretical **temperature correction factor** is calculated.
  - For winter cases, temperature correction factor 0.9 is applied.

Seasonal Temperature Correction Factor

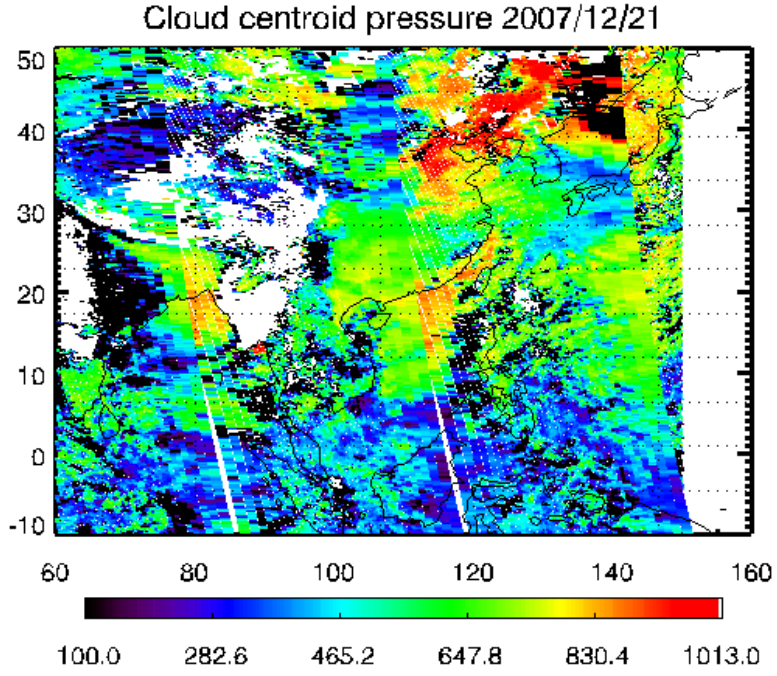


Sensitivity Tests to Input Data
(Temperature profile)

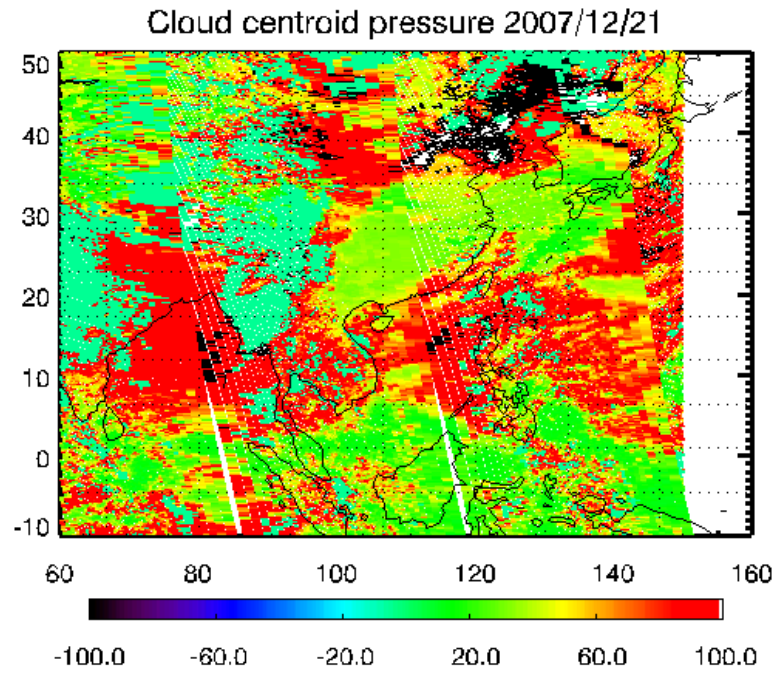
Before Correction



After Correction



Difference (before – after)



Thank You