Study of using multi-GEO satellites

- Application of Parallax Correction -

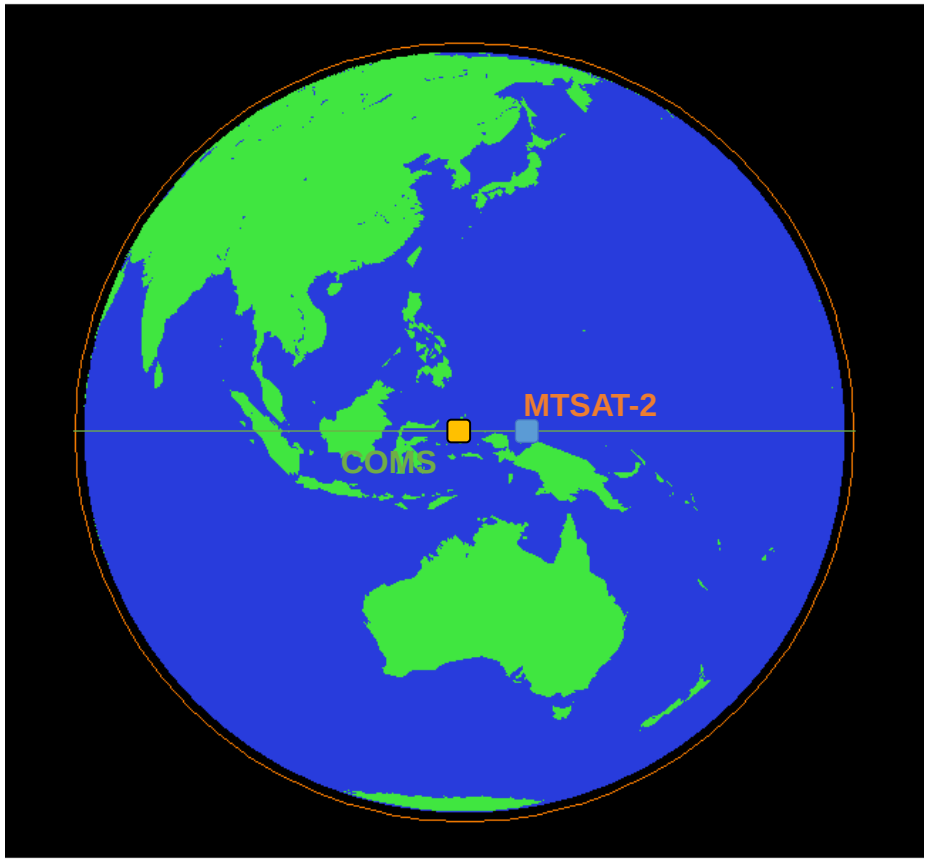
2017. 10. 21

KMA

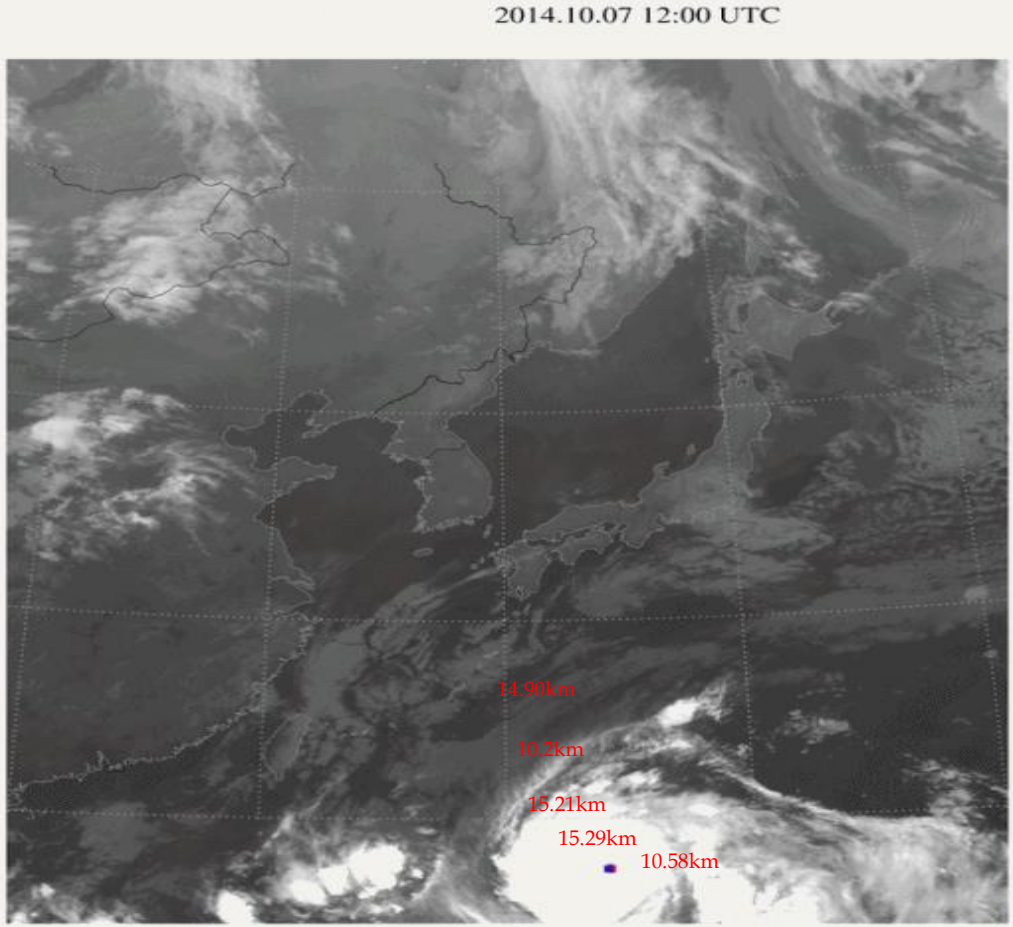
Using multi-GEO satellites (4th meeting)

Location

- **COMS** : 128.2° E
- **MTSAT-2** : 145° E



Example of using multi-GEO satellites



2014 19th Typhoon VONGFONG

- **2014.10.07 – 10.12**
- **COMS (128.2E) 00 minute**
- **MTSAT-2 (145E) 33 minute**

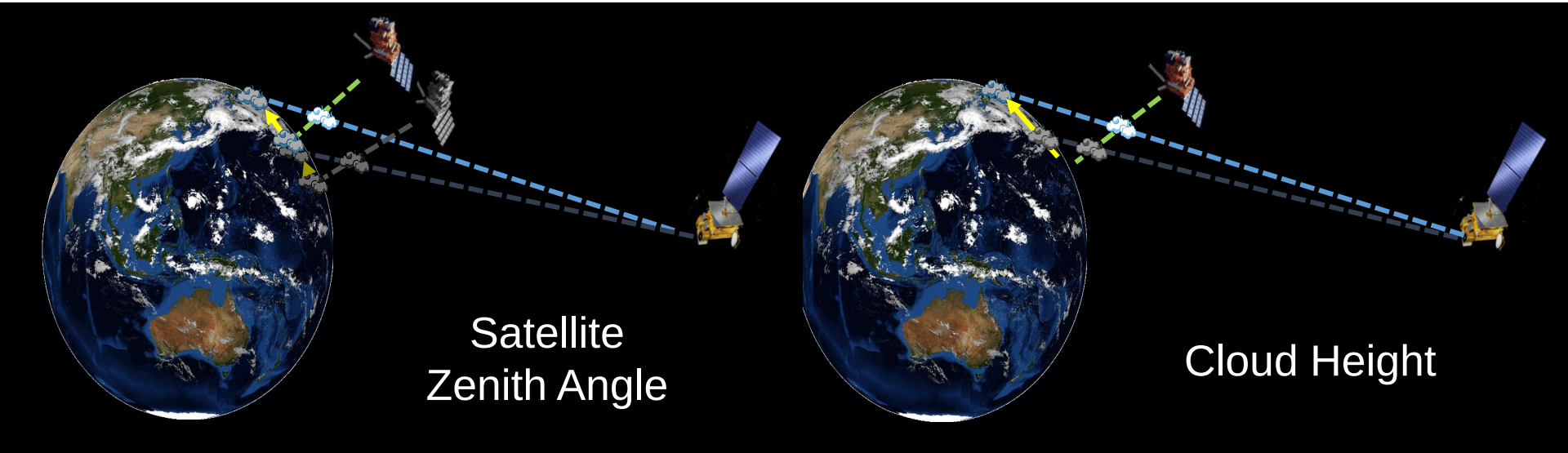
✓ **Red : Eye by COMS**

✓ **Blue : Eye by MTSAT-2**

- Difference the center of typhoon based on parallax of COMS and MTSAT-2

Introduction of Parallax Correction

- Parallax is an apparent displacement of cloud location with regard to the Earth's surface in satellite imagery which results from a non-zero viewing angle of the satellite.

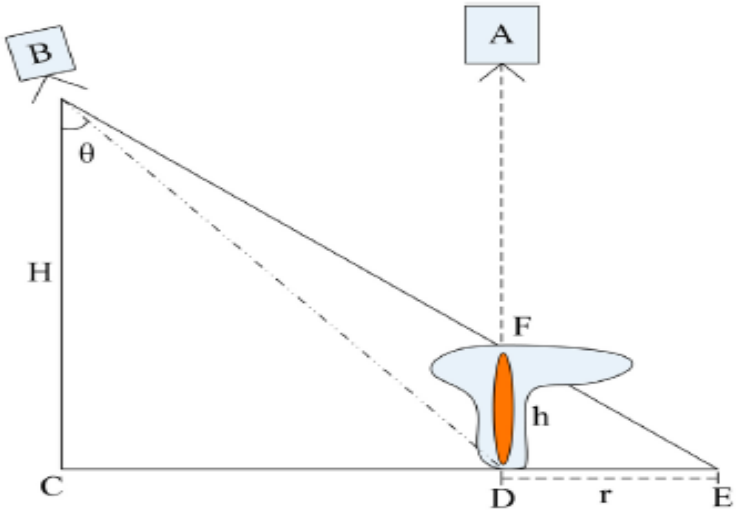


Introduction of Parallax Correction

Increasing both the cloud top height and satellite zenith angle

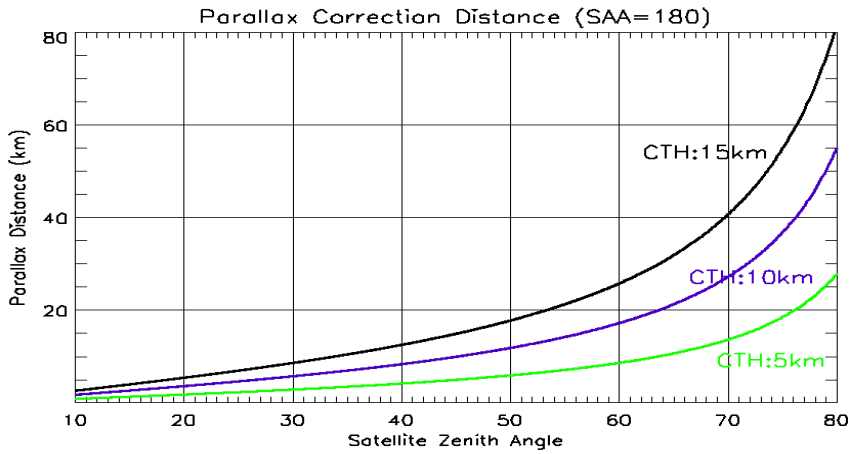
→ increasing cloud navigation errors

Satellite Zenith Angle ↑ = Cloud Navigation Error ↑



Wang et al., 2011

Cloud Height ↑ = Cloud Navigation Error ↑

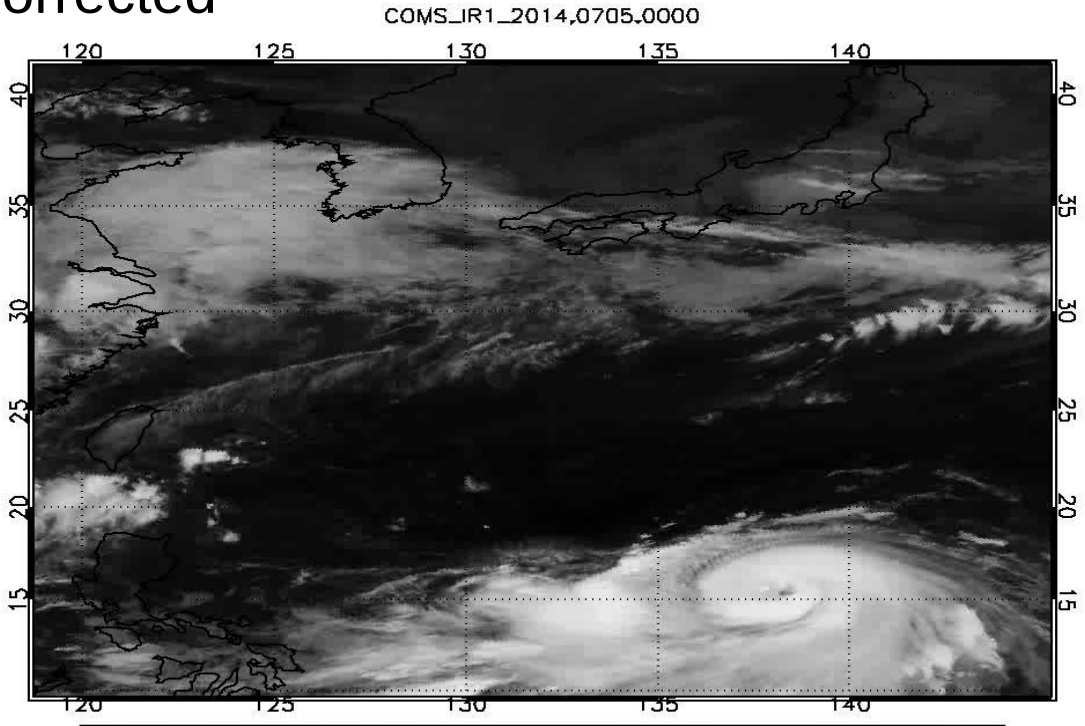


Lee. 2011

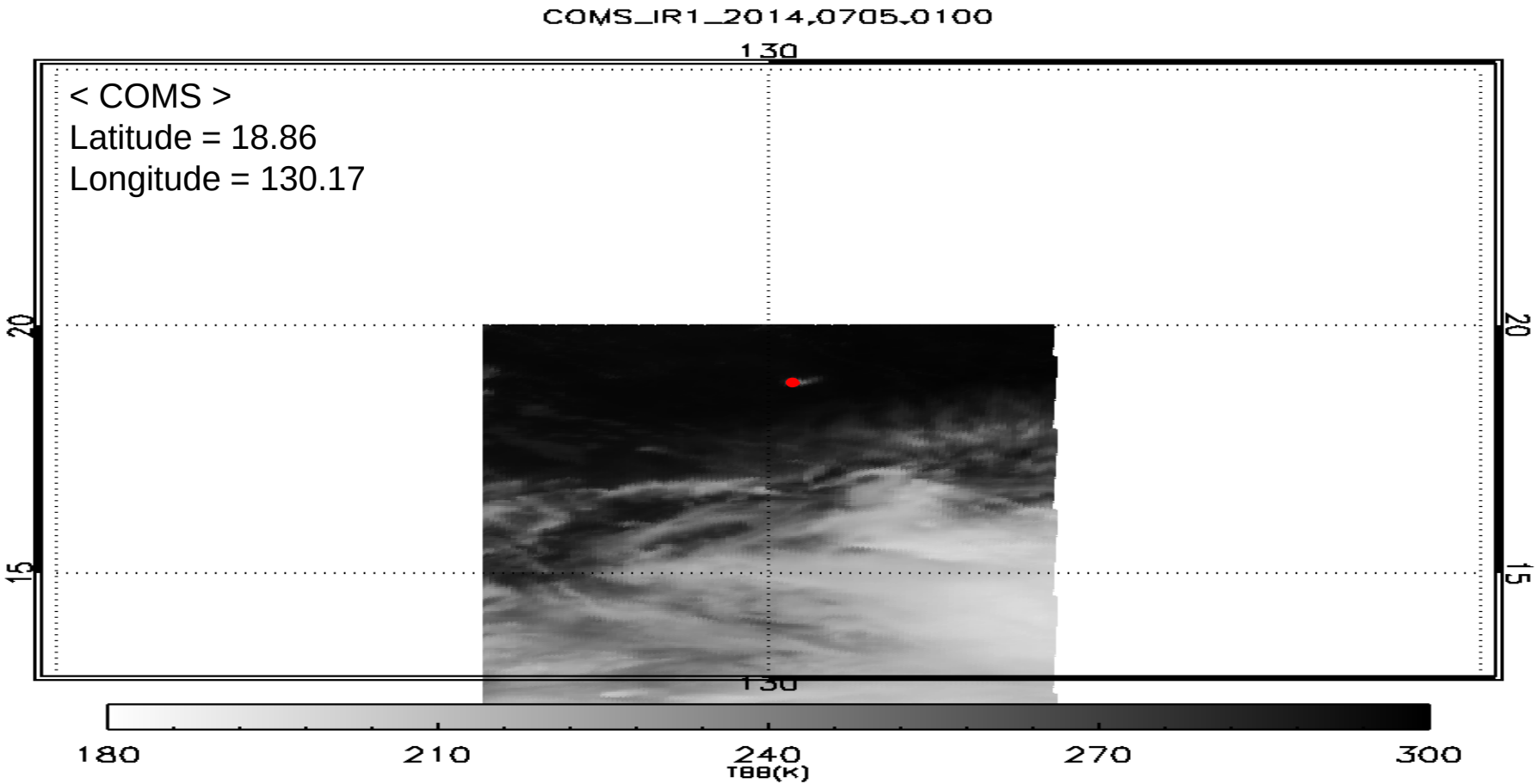
Using multi-GEO Satellite Image

- **Rapid scan satellite images** needed for utilization of rapidly developing thunderstorm, and typhoon analysis
- Different cloud position due to different satellite nadir position and parallax need to be corrected

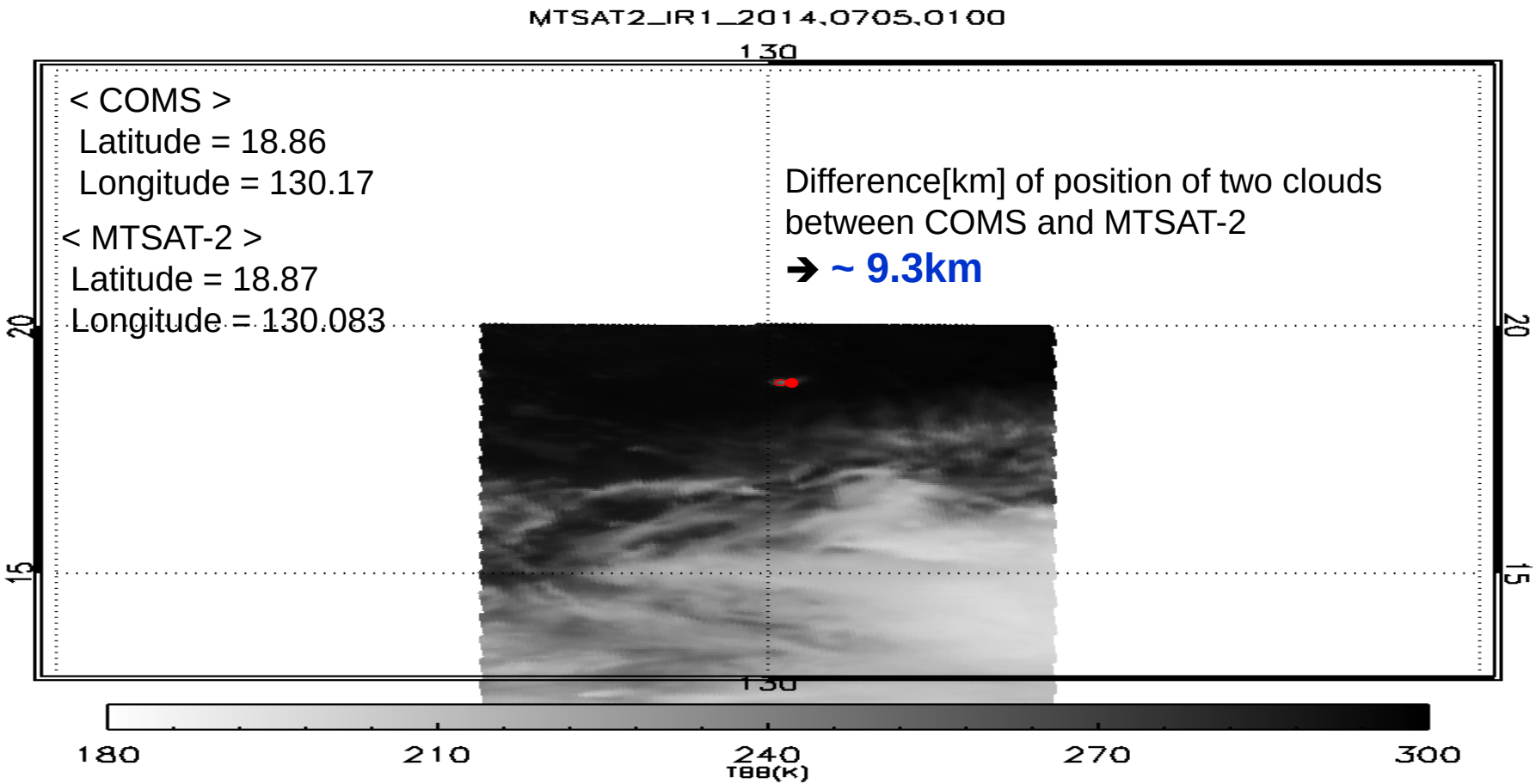
Typhoon Name : NEOGURI
Date : 2014.07. 05~08
COMS Image : Every 15, 30, 45 Min.
MTSAT-2 Image : Every Hour



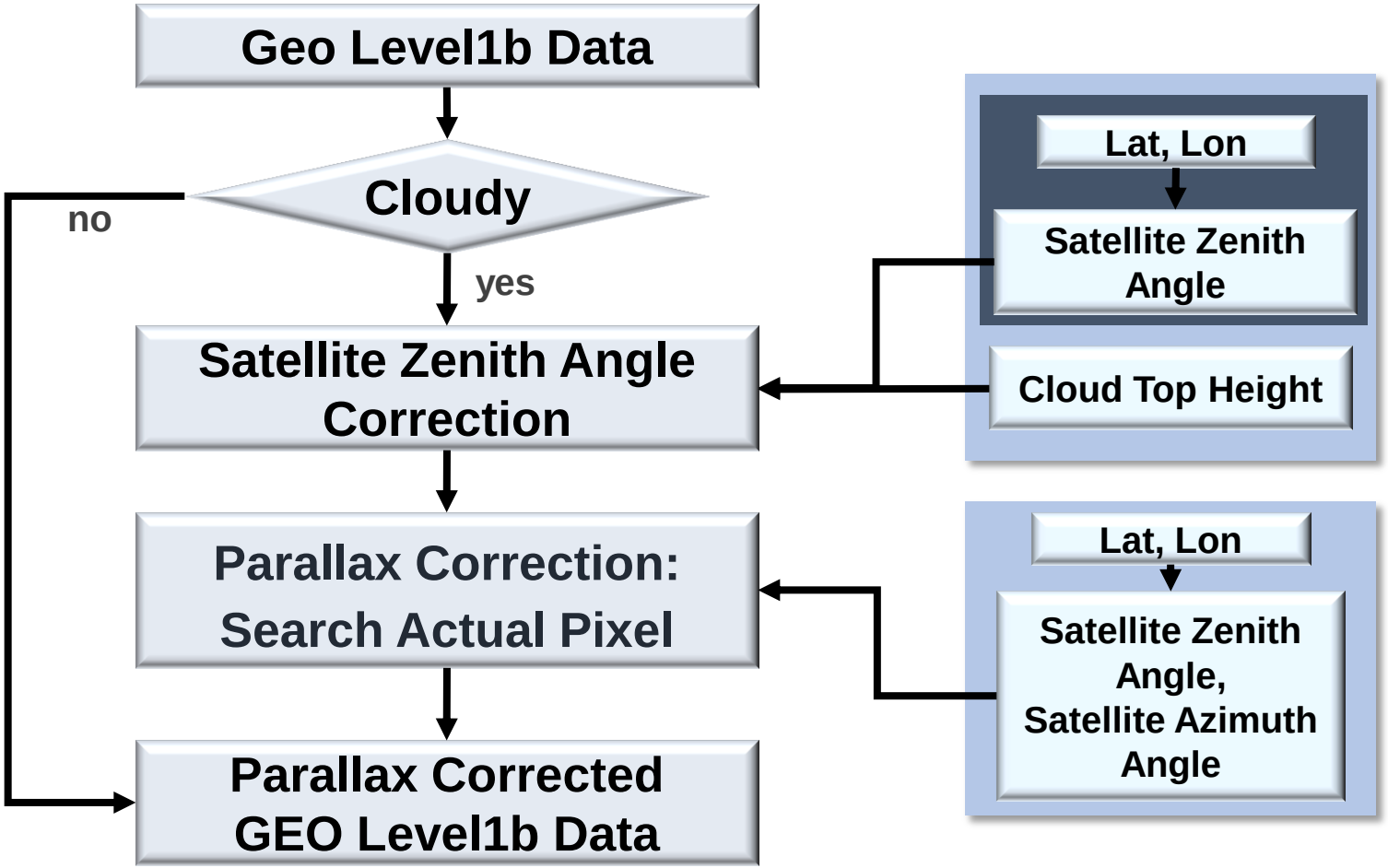
Using multi-GEO Satellite Image



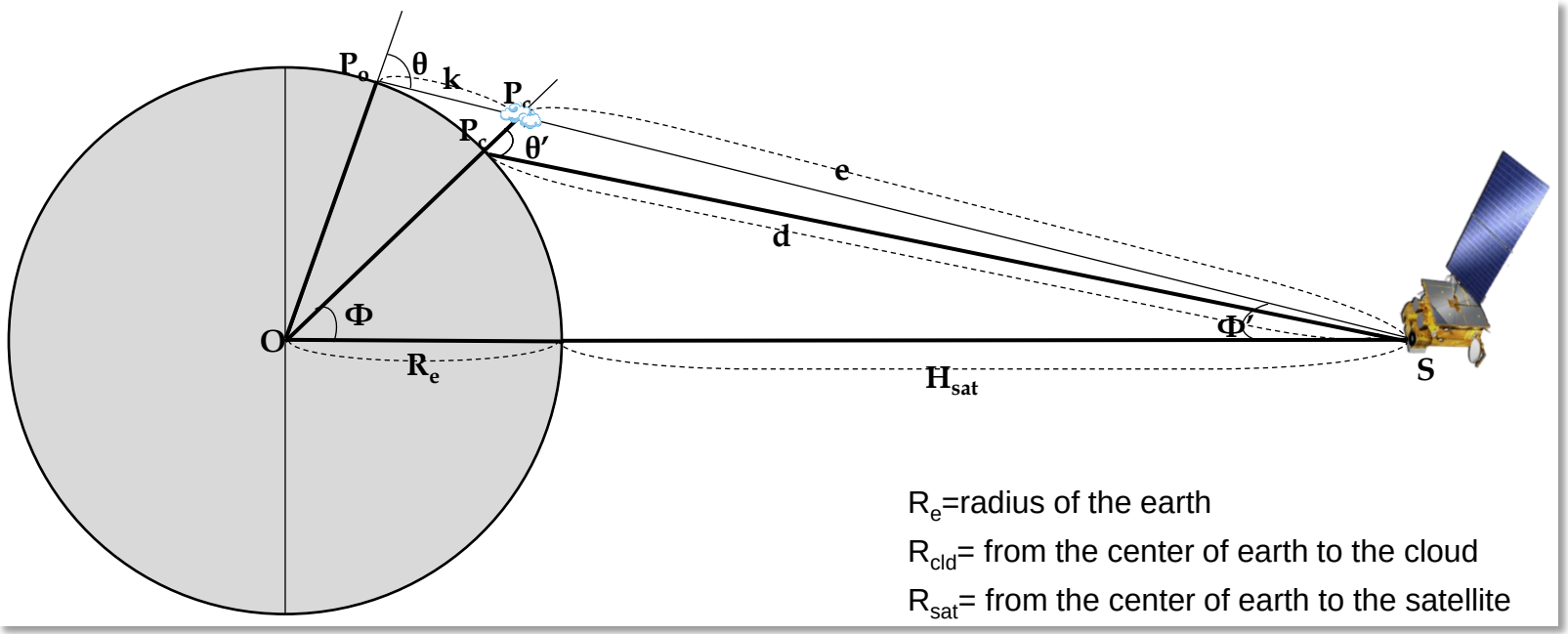
Using multi-GEO Satellite Image



Parallax Correction Flow Chart



Calculation of Parallax Correction



R_e=radius of the earth

R_{cld}= from the center of earth to the cloud

R_{sat}= from the center of earth to the satellite

$$\phi = \arcsin(R_e \sin(\pi - \theta / R_{cld}) - \arcsin(\pi - \theta) / R_{sat})$$

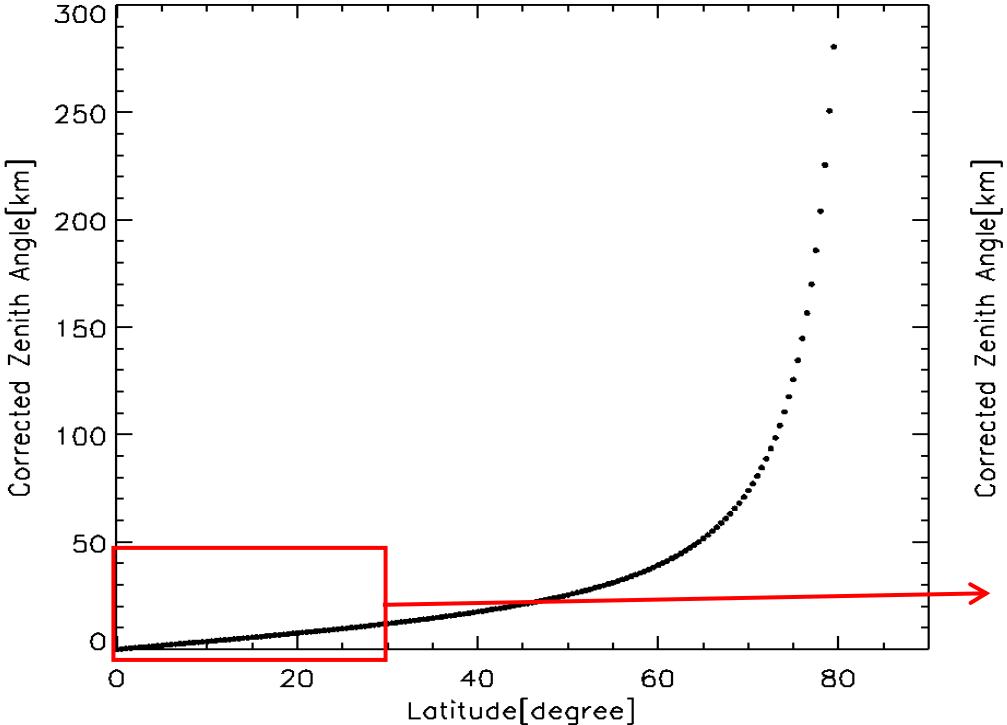
$$R_e = ab / \cos l \sqrt{a^2 + b^2 \tan^2 l}$$

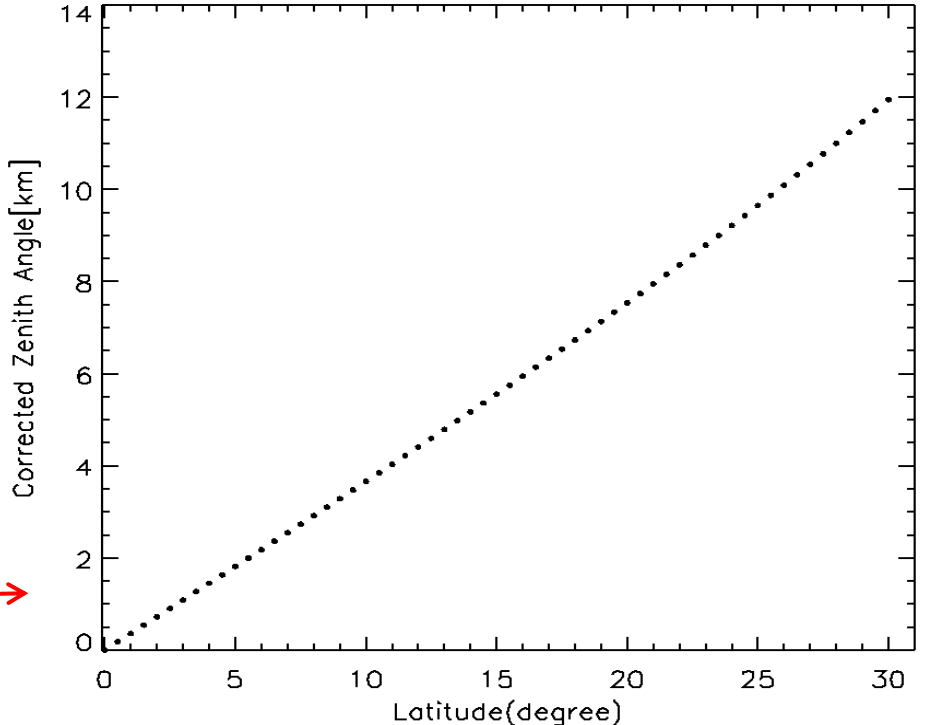
$$d = \sqrt{R^2_{sat} + R^2_e - (2 R_{sat} R_e \cos \phi}$$

$$\theta' = \pi - \arcsin(R_{sat} \sin \phi / d)$$

Corrected Satellite Zenith Angle

- Fixed Longitude = 128.2°E
- Latitude = 0 to 79.5° / 0.5° interval

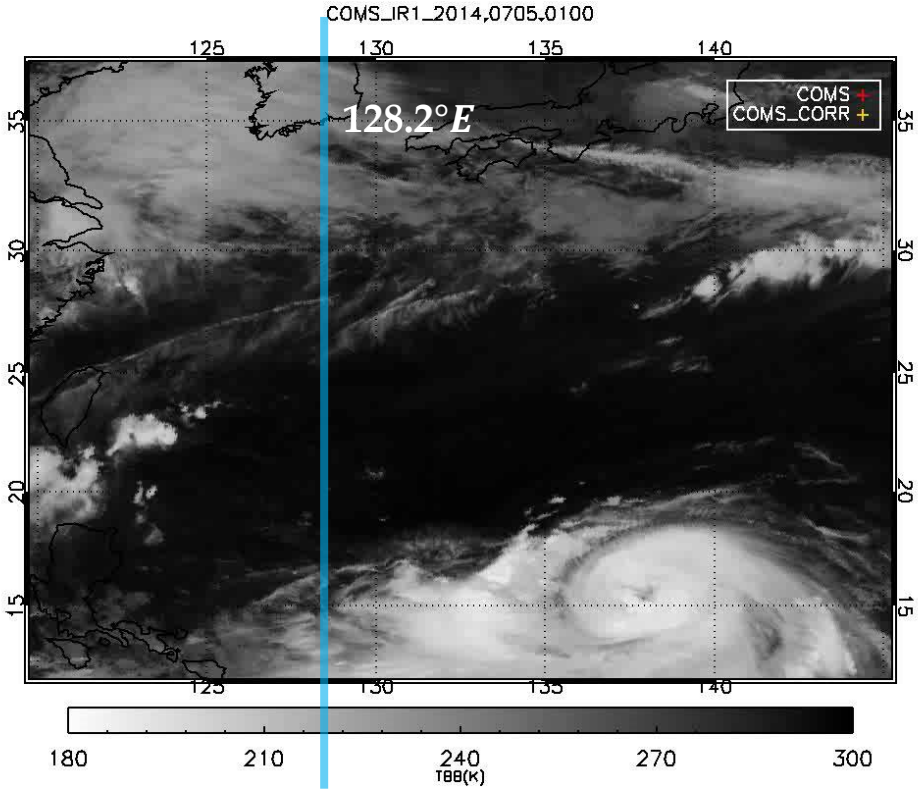


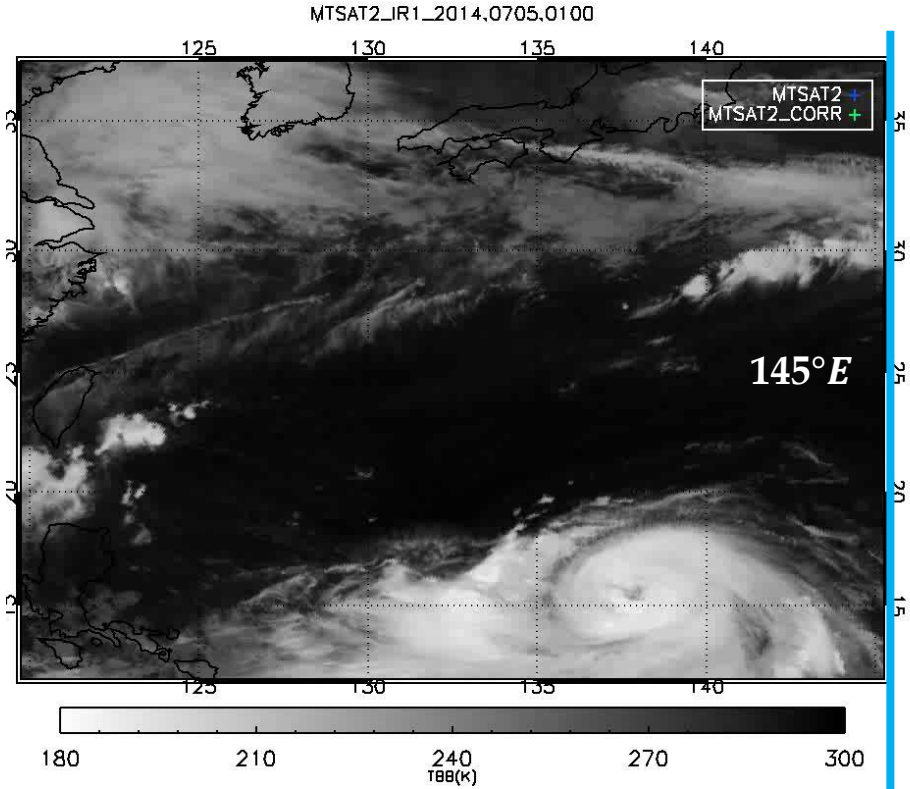


Application of Parallax Correction

Distance[km] of eye positions applying parallax correction

✓ Depend on satellite viewing angle from nadir position of GEO





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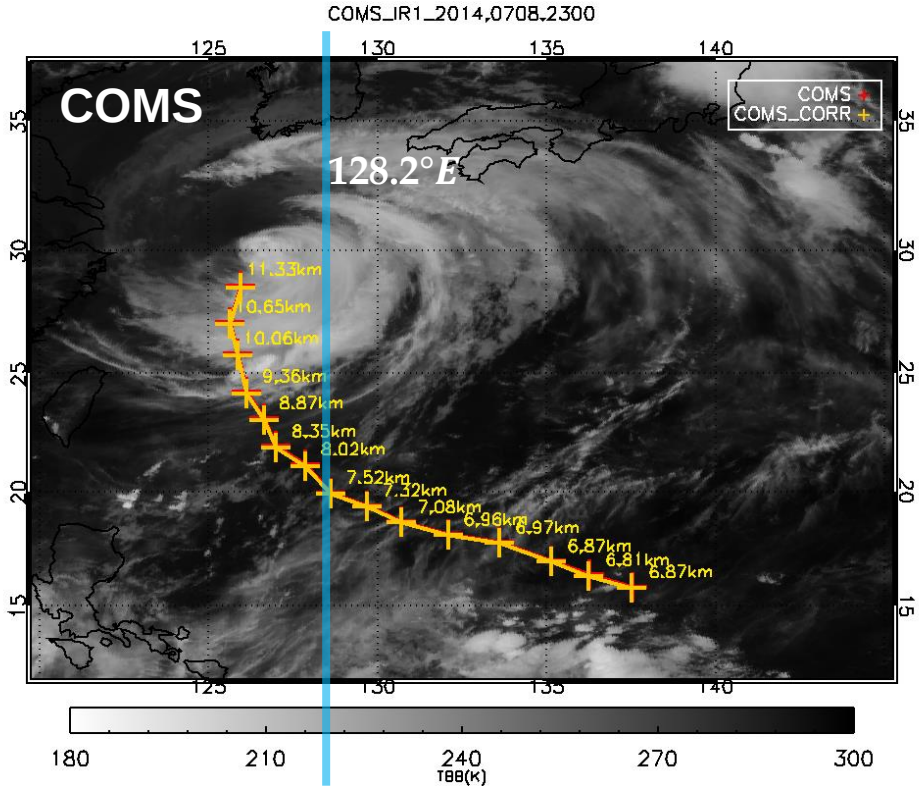
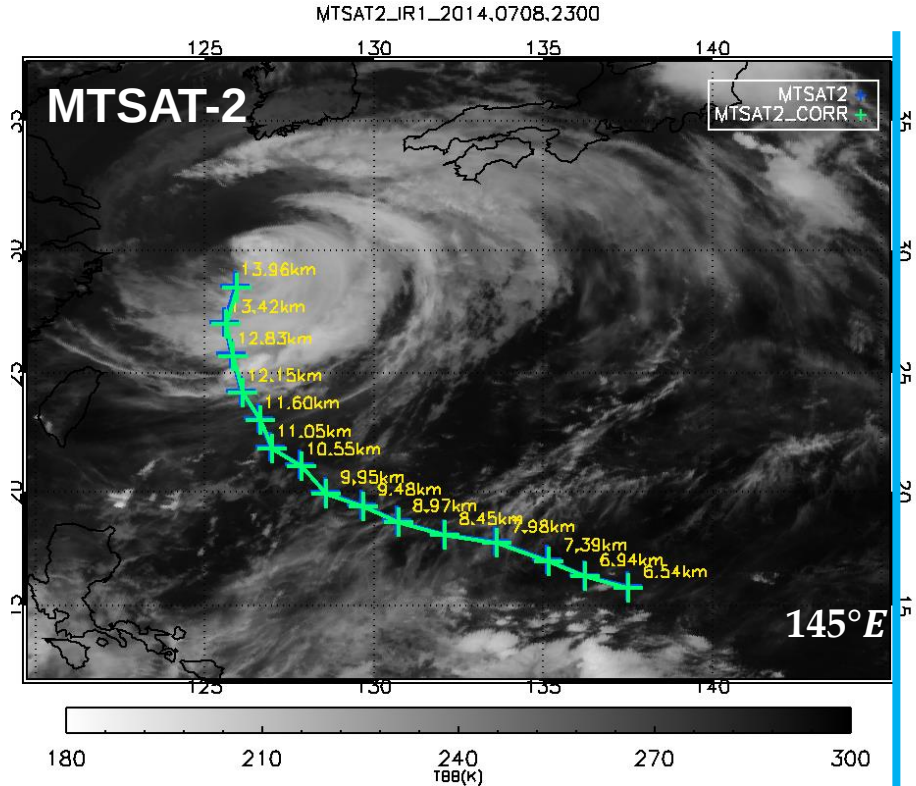
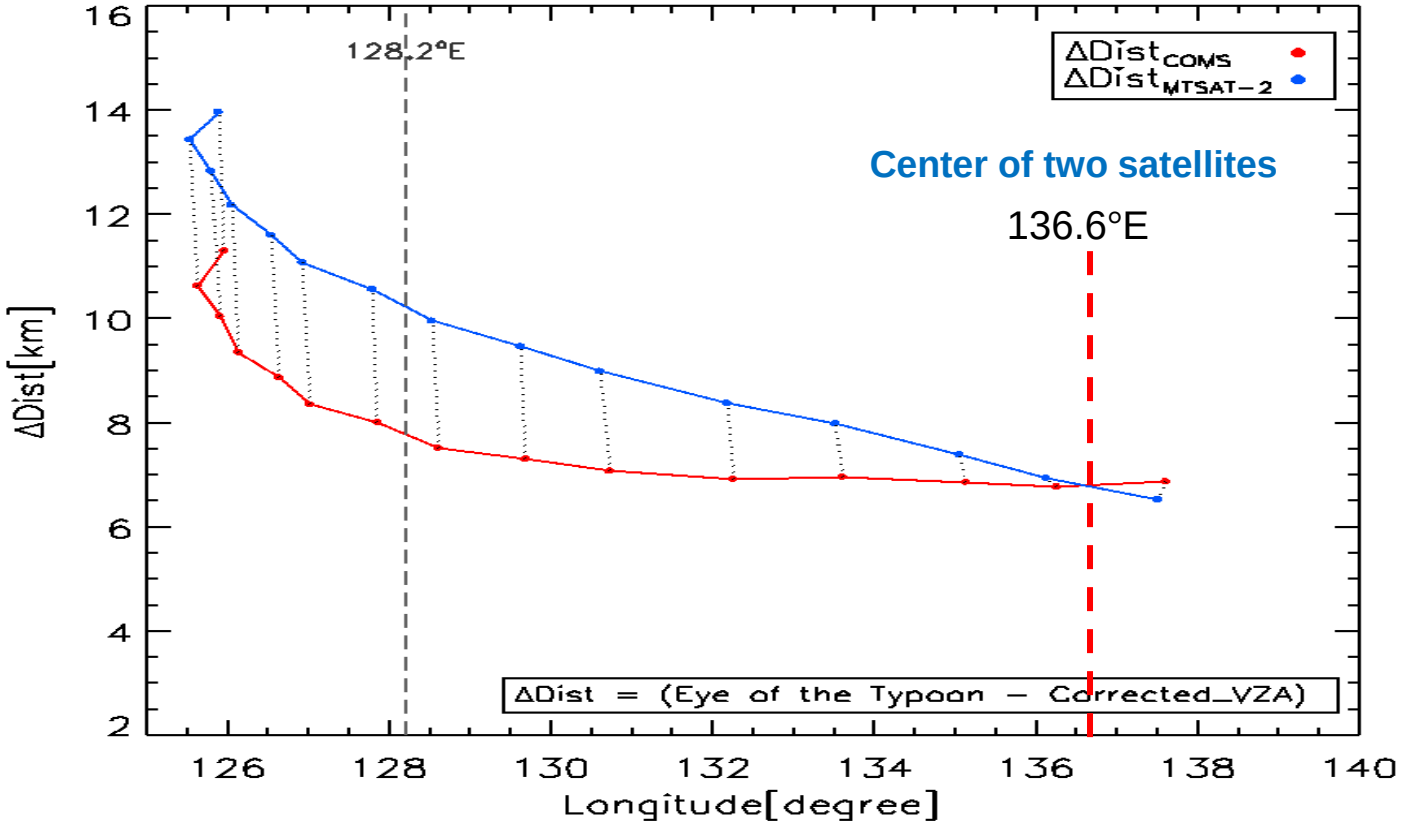




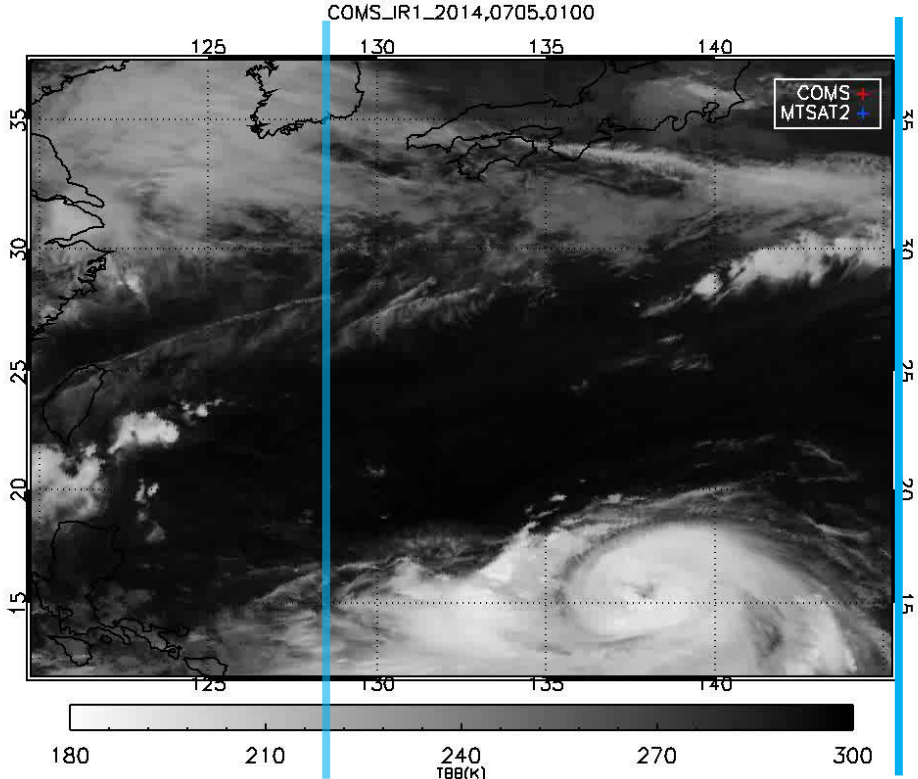
Difference[km] of eye positions (COMS vs MT-2)

The summary results of parallax correction

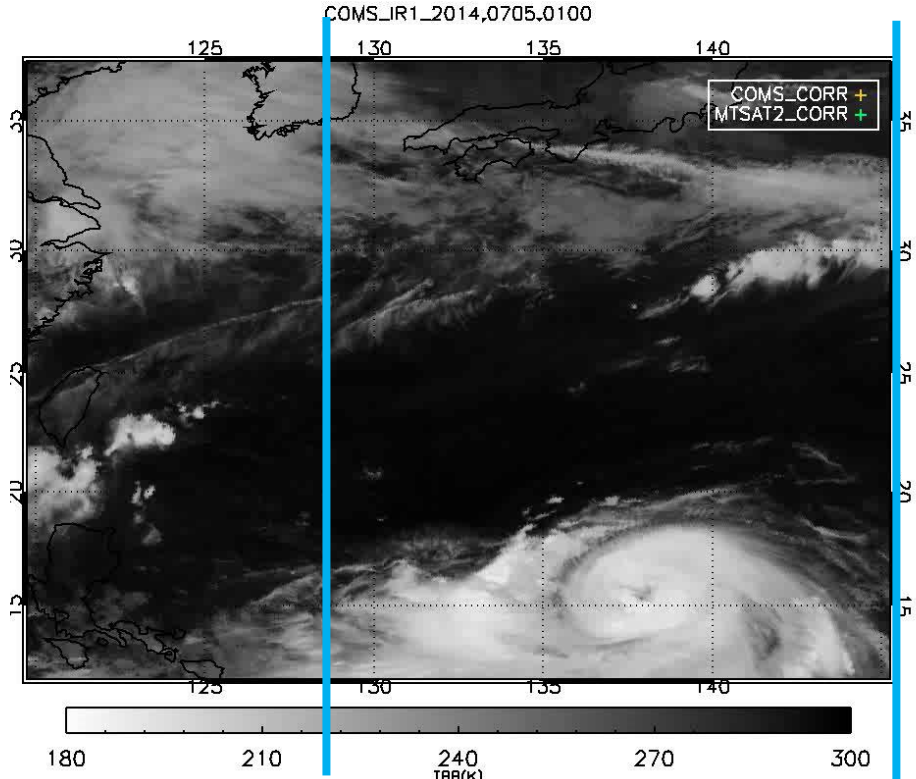


Difference[km] of eye positions (COMS vs MT-2)

Distance[km] of eye positions
before parallax correction

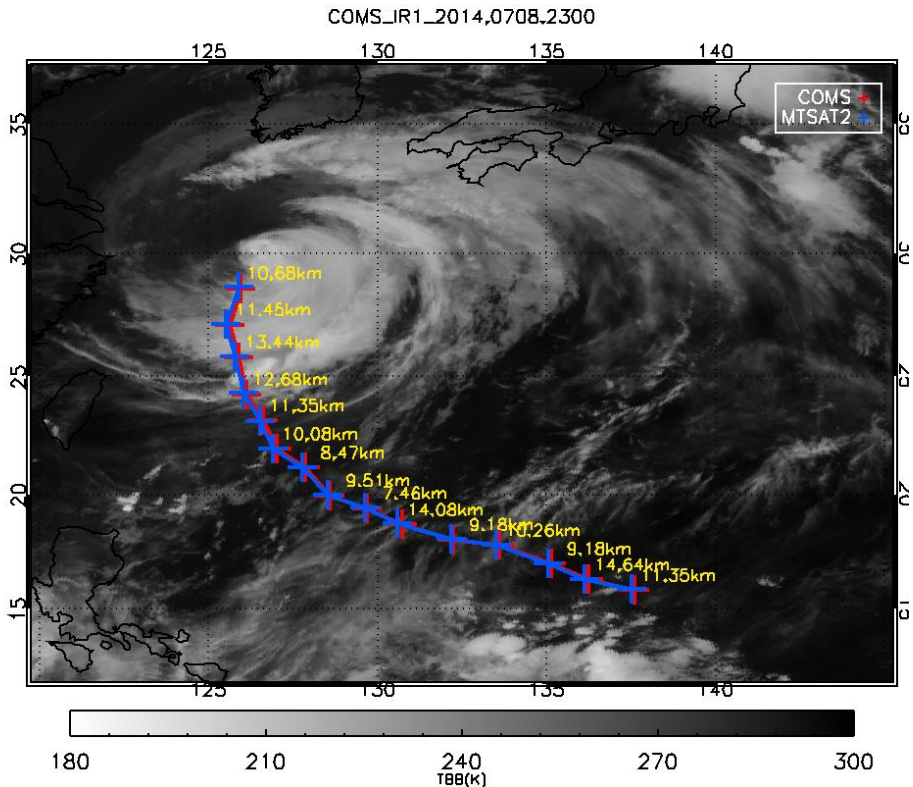


Distance[km] of eye positions
after parallax correction

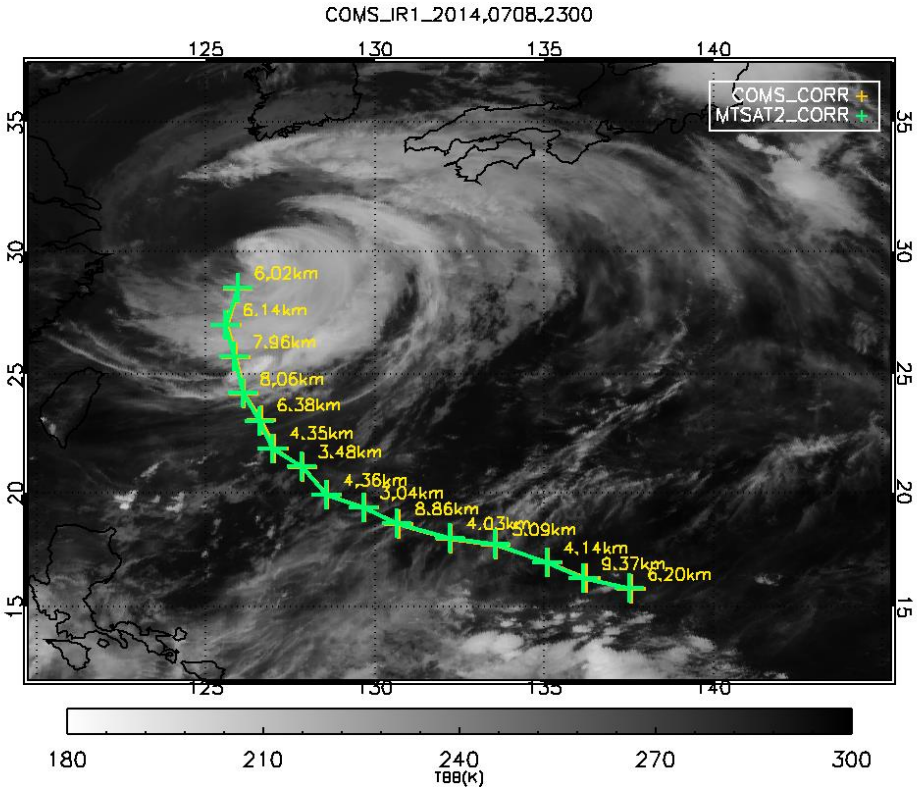


Difference[km] of eye positions (COMS vs MT-2)

Distance[km] of eye positions **before** parallax correction

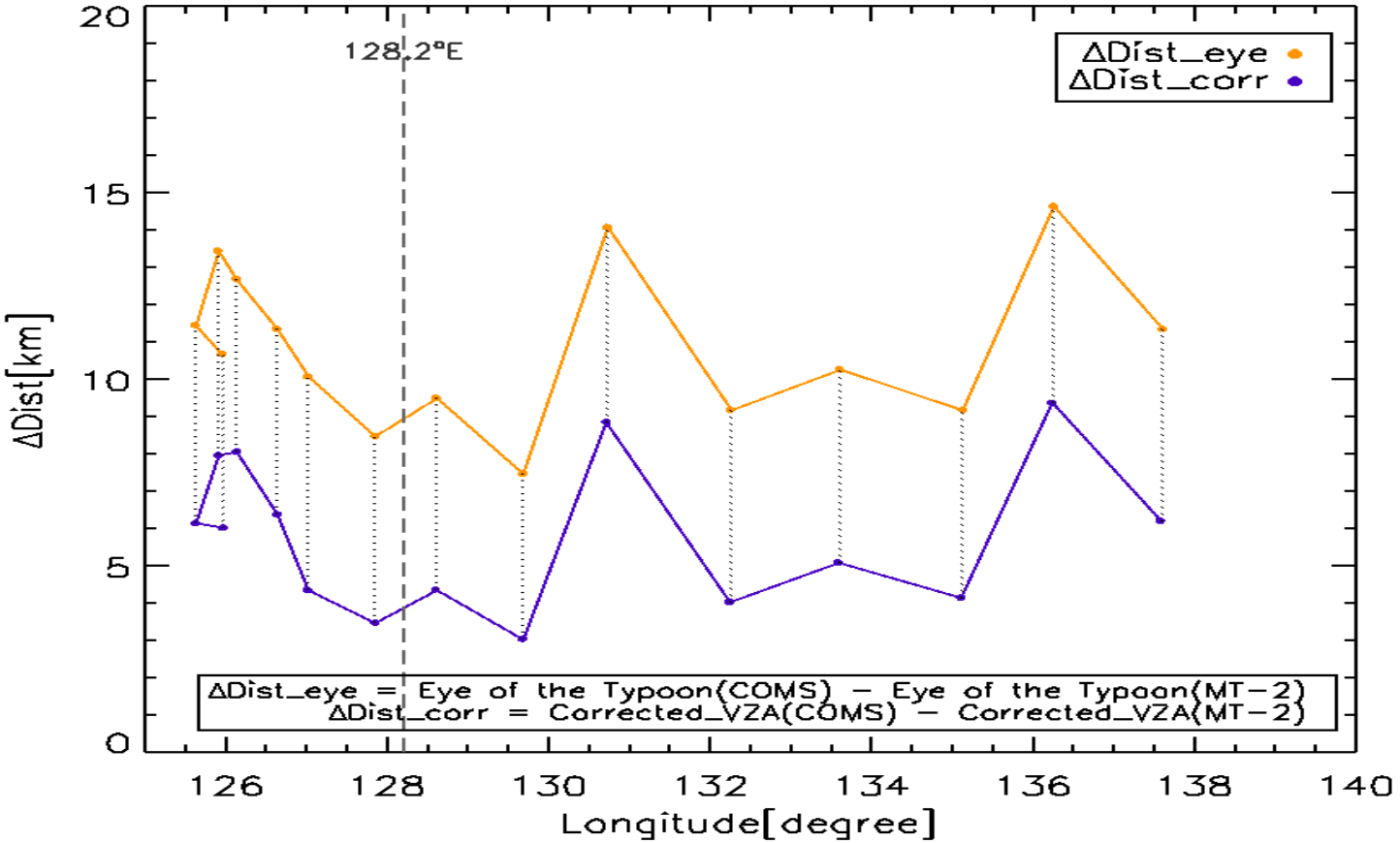


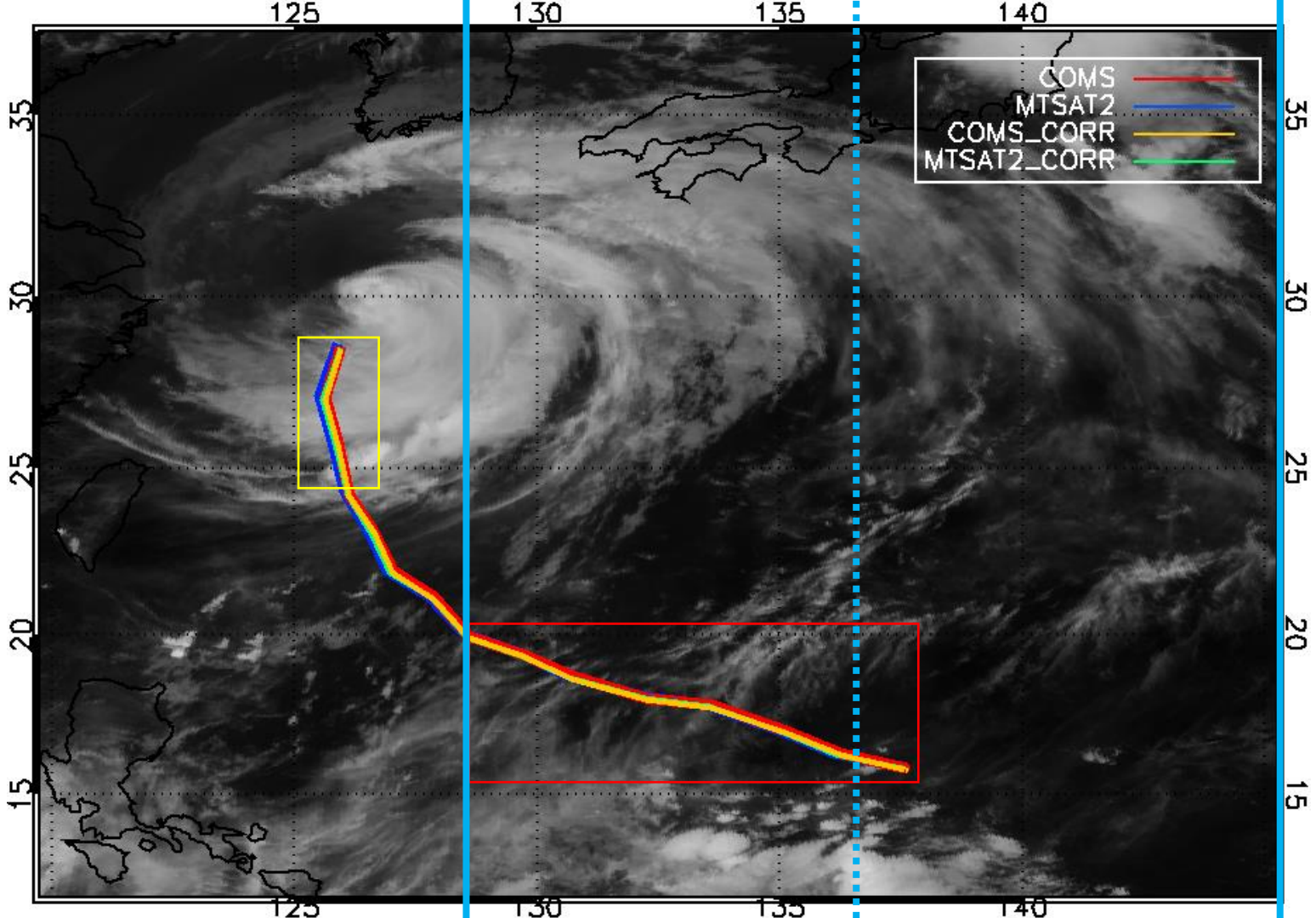
Distance[km] of eye positions **after** parallax correction



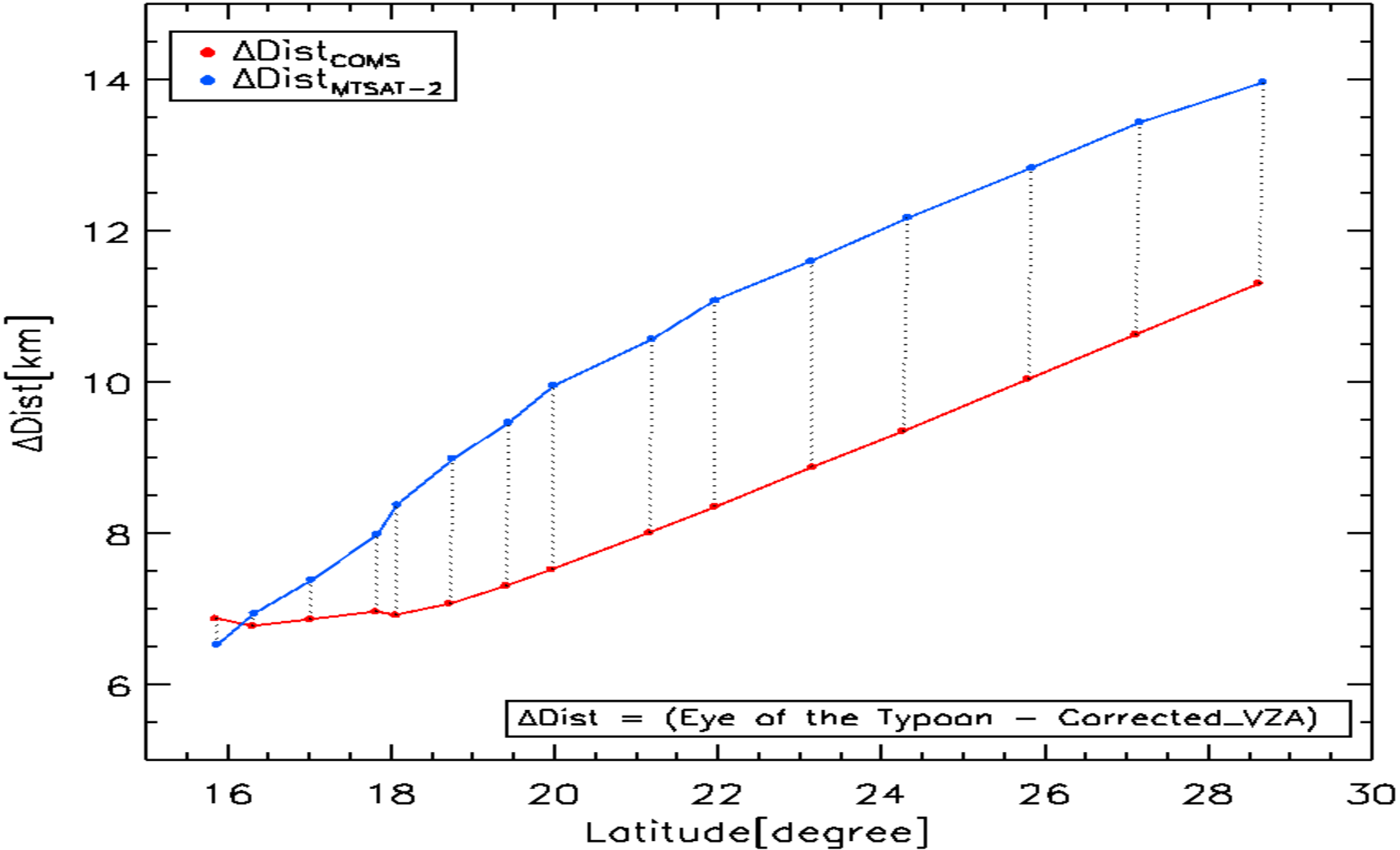
The effect of Parallax Correction

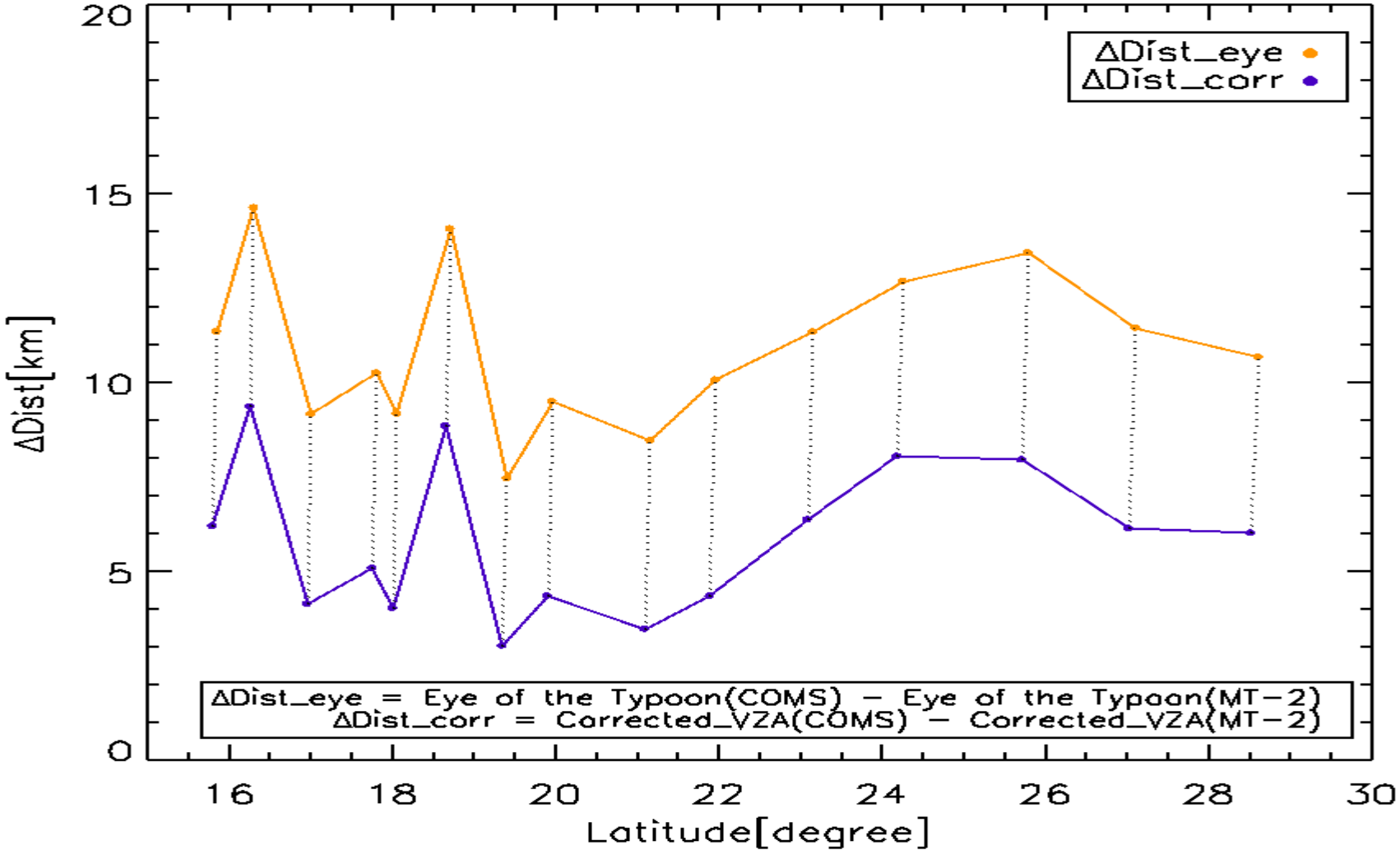
Distance[km] of eye positions after parallax correction




125
130
135
140
35
30
25
20
15
COMS
MTSAT2
COMS_CORR
MTSAT2_CORR

Thank You


ΔDist_COMS
ΔDist_MTSAT-2
ΔDist[km]
14
12
10
8
6
16
18
20
22
24
26
28
30
Latitude[degree]
ΔDist = (Eye of the Typoon − Corrected_VZA)


ΔDist_eye
ΔDist_corr
ΔDist_eye = Eye of the Typoon(COMS) − Eye of the Typoon(MT-2)
ΔDist_corr = Corrected_VZA(COMS) − Corrected_VZA(MT-2)
ΔDist[km]
Latitude[degree]
0
5
10
15
20
16
18
20
22
24
26
28
30