Inter-comparison of satellite-derived cloud parameters between COMS and MODIS & CALIOP

Haklim Choi, Eunha Sohn, Eun-Jeong Cha, Sangjin Lyu
National Meteorological Satellite Center of Korea Meteorological Administration
haklim84@korea.kr

KMA NMSC

Introduction

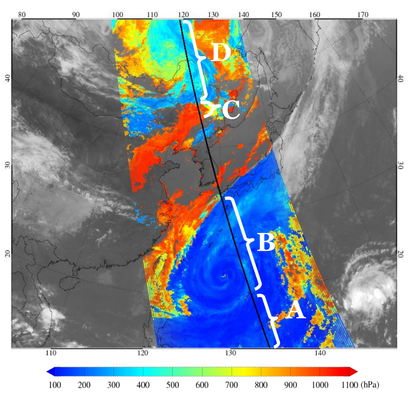
- Satellite-derived cloud parameters are necessary factors for severe weather monitoring and weather forecast. Moreover, inter-comparison among various satellite sensors is significantly important for understanding weak and strong points of various cloud parameter retrieval algorithms as well as improving the algorithms.
- COMS(Communication, Ocean and Meteorological Satellite) has started normal operation since April 2011, and cloud parameters such as Cloud Optical Thickness(COT), Cloud Phase(CP) and Cloud Type(CT) are has been generated operationally and utilized to the analysis of nowcasting and forecasting.
- We compared the various COMS cloud parameters with those derived from MODIS(Aqua) and CALIOP(CALIPSO) in the A-train constellation, and will improve the algorithms based on this study.

Data and Methodology

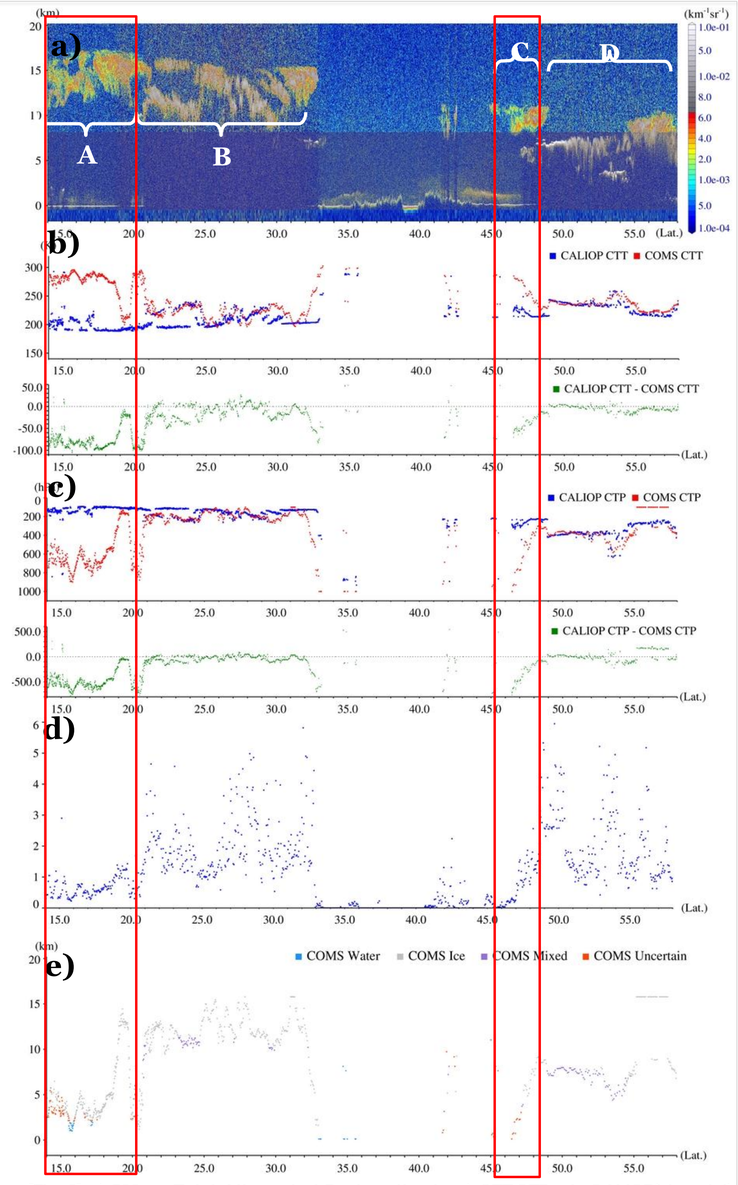
- Data
  - COMS : Level 2 products(CTT,CTP,CP)
  - CALIOP(CALIPSO): Level 1 (532nm Total Attenuated Backscatter)
    Level 2 1, 5 km layer products(CTT,CTP,CP)
  - MODIS(AQUA) : Level 2 (MYD06 CTP,CP)
- Period
  - October, 2013
- Collocation dataset

	MODIS	CALIOP
CTT, CTP, CP	Based on COMS observed time, -8 ~ +30 minute, MODIS 5 x 5 pixels mean data	Based on CALIOP pixels, nearest COMS pixel within 2km

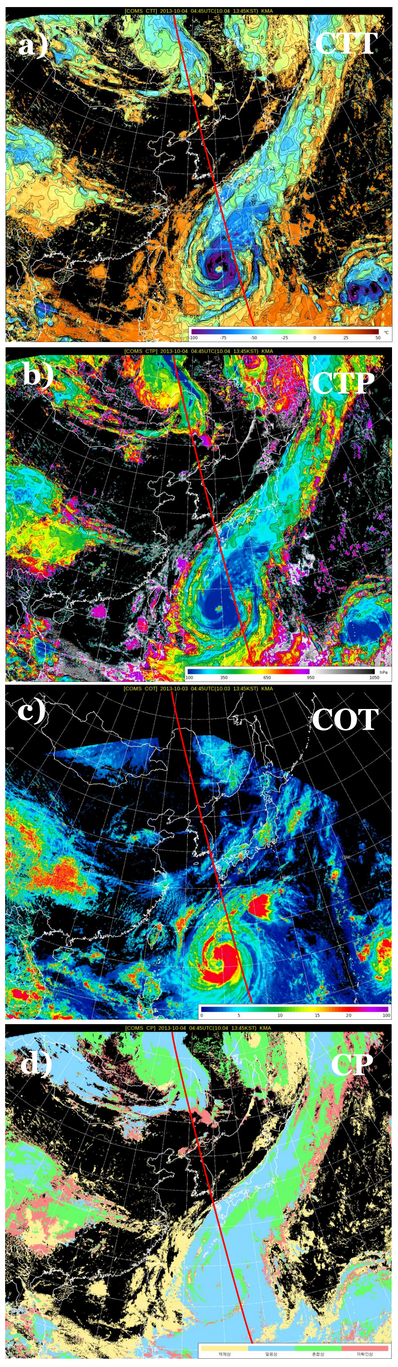
Scene Analysis (COMS vs. CALIOP)



[Fig. 1] Overlapped Image with COMS IR(background) and the Cloud top pressure of MODIS(Aqua) . Black line is the track line of CALIOP(CALIPSO) during 0435 ~ 0450 UTC, 4, Oct, 2013, the case of typhoon Fitow.



[Fig. 3] a) 532nm Total Attenuated Backscatter. b~c) CTT,CTP of CALIOP(blue dot), COMS(red dot), bias(green dot), d) CALIOP cloud optical thickness, e) COMS cloud phase corresponding to CALIOP track line from Fig 2.



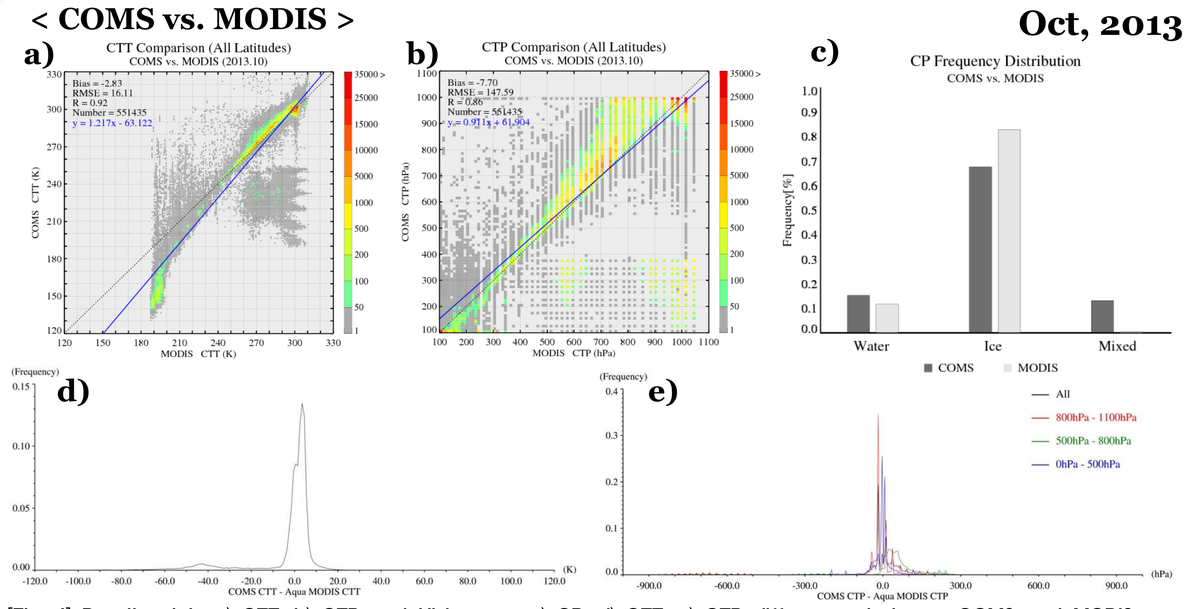
[Fig. 2] COMS cloud parameters a) CTT, b) CTP, c) COT, d) CP at 0445 UTC, 4, Oct, 2013.

- A : High level clouds and thin clouds (typhoon)
  - The CTT and CTP between CALIOP and COMS shows big differences(0~100K, 0~700 hPa) where the COT of CALIOP is less than 1. These are shown in red boxes of A and C of Figure 3 .
  - COMS CP tends to be classified as ice particle despite of low level cloud and high temperature(CTT > 0℃).
- B : High level and opaque clouds(typhoon)
  - Cloud parameters of COMS as shown in Figure 3, correspond to those of CALIOP.
  - COT(>5), CP(ice), CT(high level thin clouds)
    ※ CALIOP COT range (0 ~ 6), COMS COT range (0 ~ 100)
- C : High level and thin clouds
  - Similar pattern as in A.
- D : Mid level and opaque clouds
  - Similar pattern as in B, but CTP is estimated as lower value of the over the 55° N.

Monthy Analysis (COMS vs. CALIOP & MODIS)

< COMS vs. MODIS >

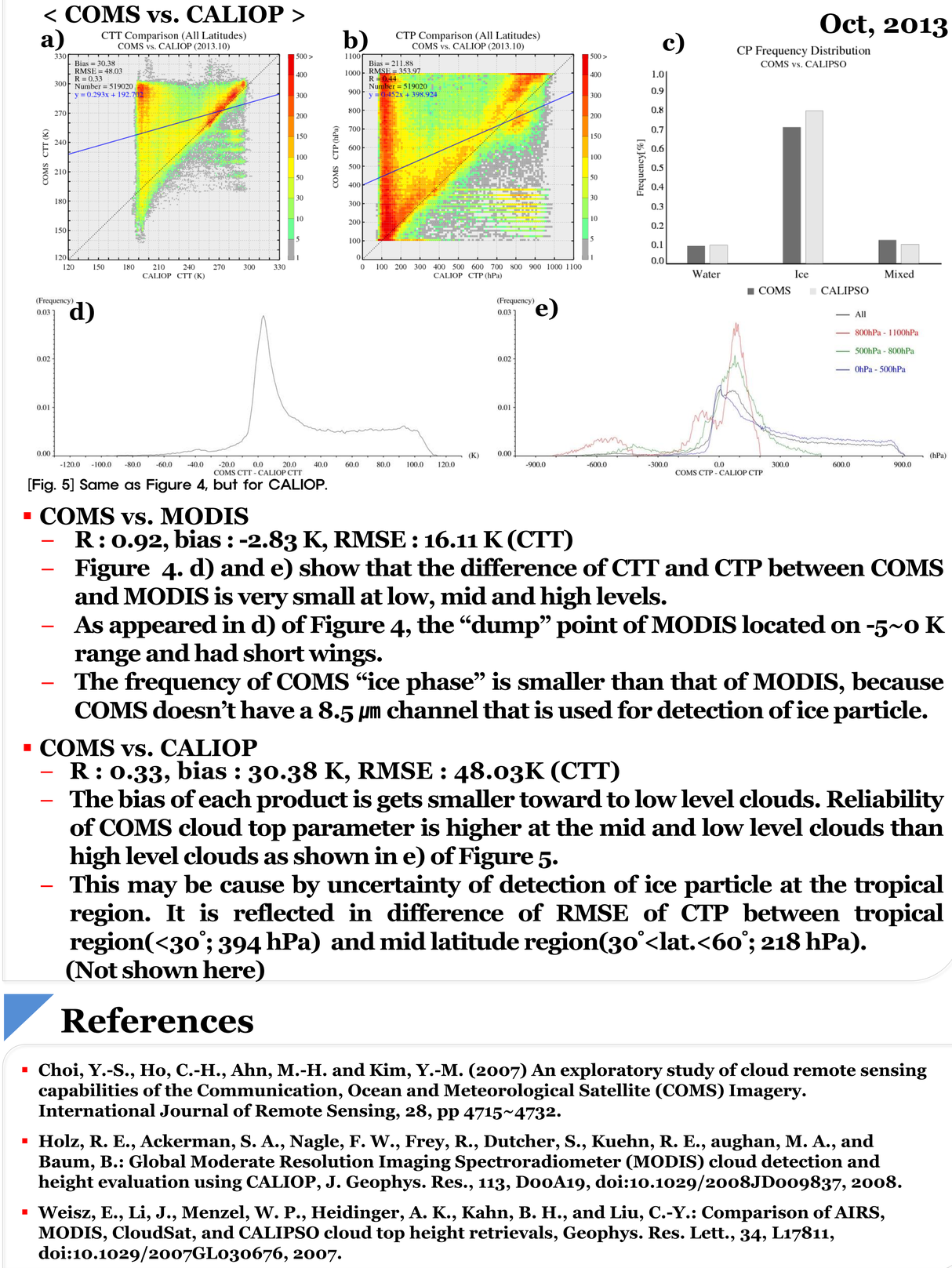
Oct, 2013



[Fig. 4] Density plots a) CTT, b) CTP and Histograms c) CP, d) CTT, e) CTP differences between COMS and MODIS are presented above for a month(Oct,2013) of COMS observations. The distributions are separated by high(〈 500 hPa), mid(500~800 hPa) and low(800~1100 hPa) levels.

< COMS vs. CALIOP >

Oct, 2013



[Fig. 5] Same as Figure 4, but for CALIOP.

- COMS vs. MODIS
  - R : 0.92, bias : -2.83 K, RMSE : 16.11 K (CTT)
  - Figure 4. d) and e) show that the difference of CTT and CTP between COMS and MODIS is very small at low, mid and high levels.
  - As appeared in d) of Figure 4, the "dump" point of MODIS located on -5~0 K range and had short wings.
  - The frequency of COMS "ice phase" is smaller than that of MODIS, because COMS doesn't have a 8.5 ㎛ channel that is used for detection of ice particle.
- COMS vs. CALIOP
  - R : 0.33, bias : 30.38 K, RMSE : 48.03K (CTT)
  - The bias of each product is gets smaller toward to low level clouds. Reliability of COMS cloud top parameter is higher at the mid and low level clouds than high level clouds as shown in e) of Figure 5.
  - This may be cause by uncertainty of detection of ice particle at the tropical region. It is reflected in difference of RMSE of CTP between tropical region(<30°; 394 hPa) and mid latitude region(30°<lat.<60°; 218 hPa). (Not shown here)

Summary and Future Works

- We compared COMS cloud parameters with those of CALIOP and MODIS by scene and monthly analysis.
- Cloud parameters(COT,CT,CP) of COMS are similar to those of CALIOP and MODIS. However, CTT and CTP are different from CALIOP.
- Appearing difference may occur in the area of thin cirrus. COMS cloud top parameters doesn't link to other parameters when retrieved the thin cirrus.
- COMS cloud top parameters are more correct in the opaque or low level clouds than thin clouds similar as in the case of MODIS.
- Future Works
  - Compare with diverse instruments(in-situ, CPR, VIIRS)
  - More detailed Analysis(according to single/multi layer , optical depth)
  - Improving the algorithm for detection of thin cirrus.

References

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