# KMA Implementation Plan for Satellite Climate products

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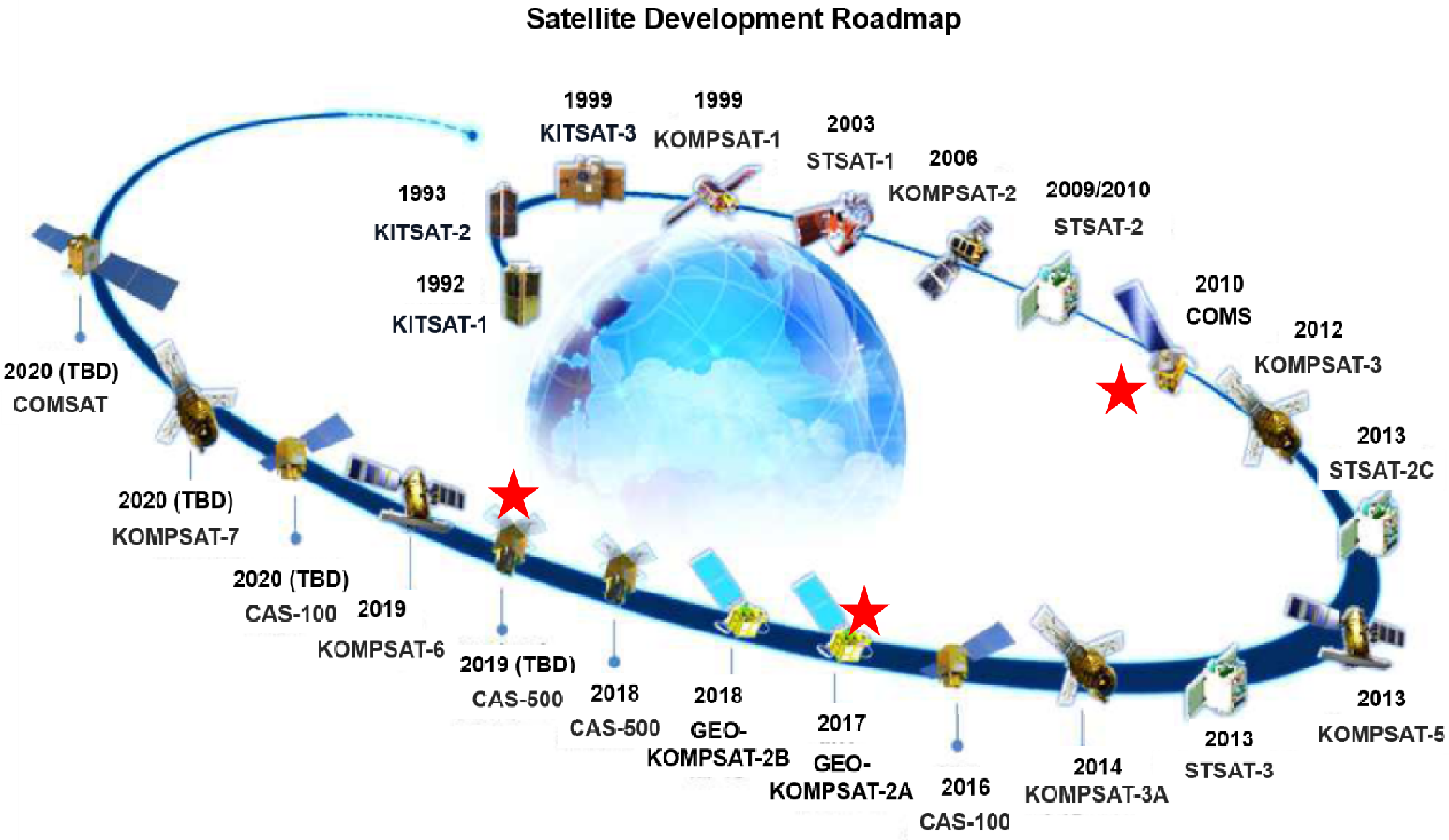
# Outline

# Korean Satellite Development Roadmap



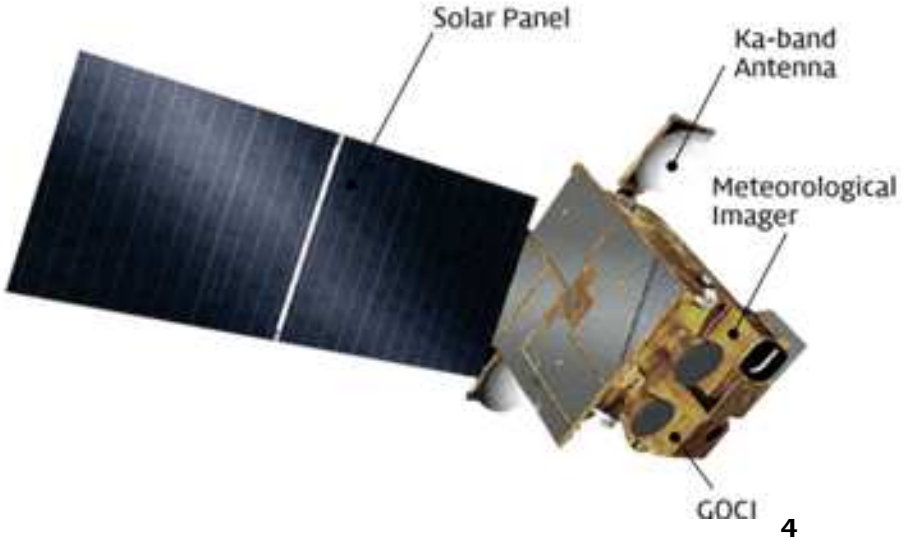
# Current GEO Satellite(COMS)

## CURRENT GEO SATELLITES

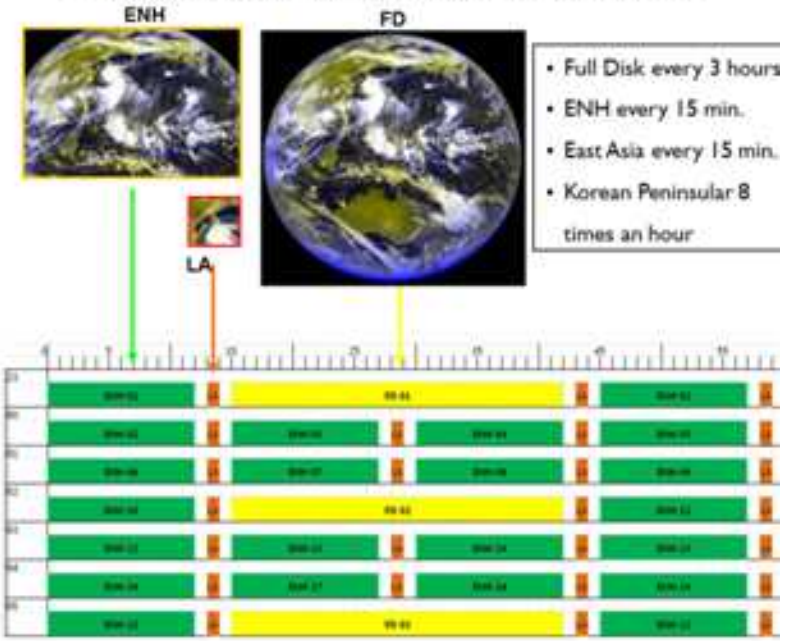
- COMS (Communication, Ocean, and Meteorological Satellite)
  - Launch : 26/06/2010
  - Orbit : 128.2°E
  - Payloads :
    - MI(5-channel VIS/IR Meteorological Imager)
    - GOCI(Geostationary Ocean Color Imager)
  - Lifetime estimated : 2011 - 2018
  - Operator : KMA, KIOST

The channels of COMS/MI

| channel | Wave length(㎛) |
|---|---|
| Visible | 0.67 |
| Shortwave IR(IR4) | 3.7 |
| Water Vapor(IR3) | 6.7 |
| IR1 | 10.8 |
| IR2 | 12.0 |



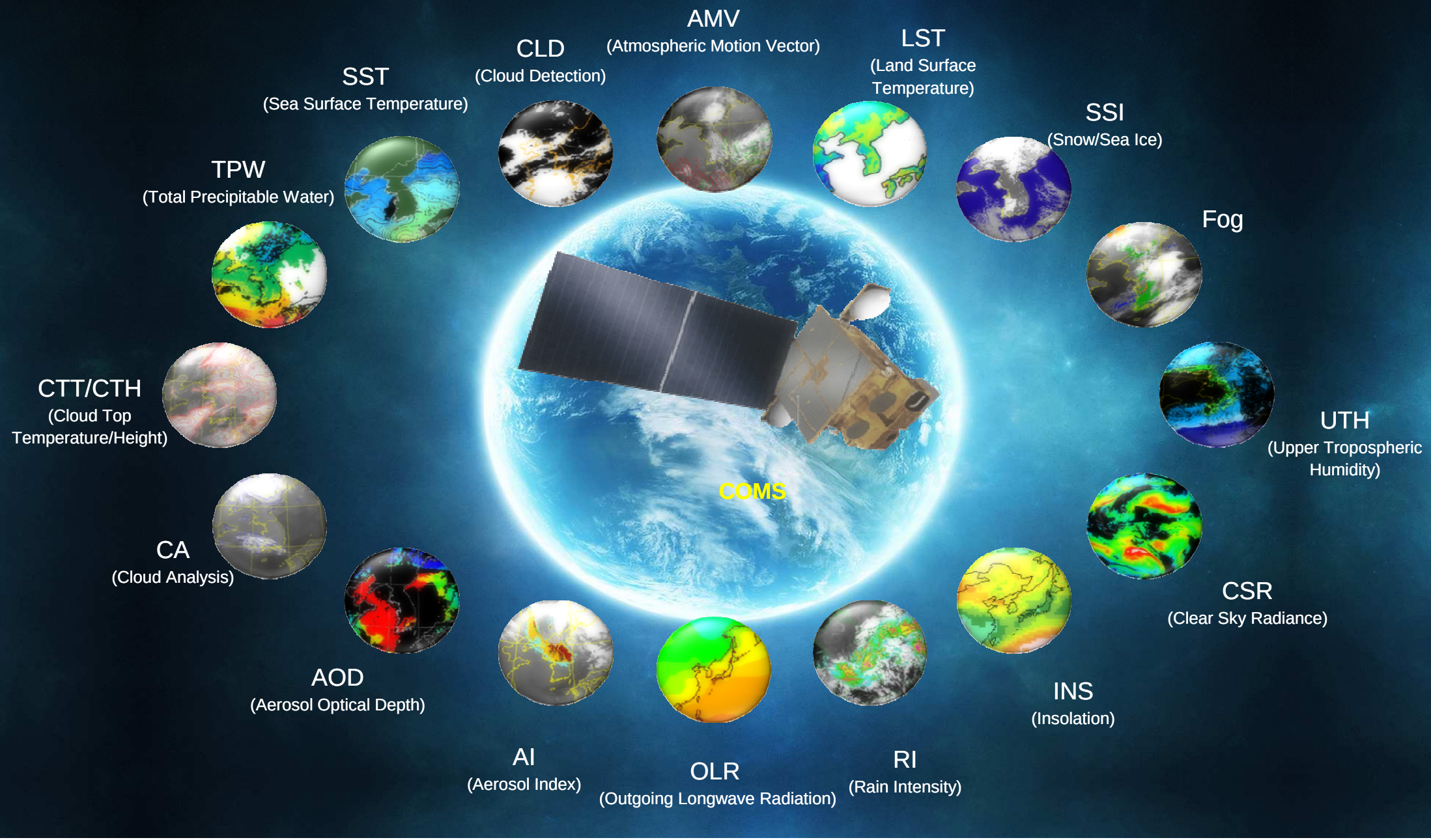

COMS MI Observation Schedule



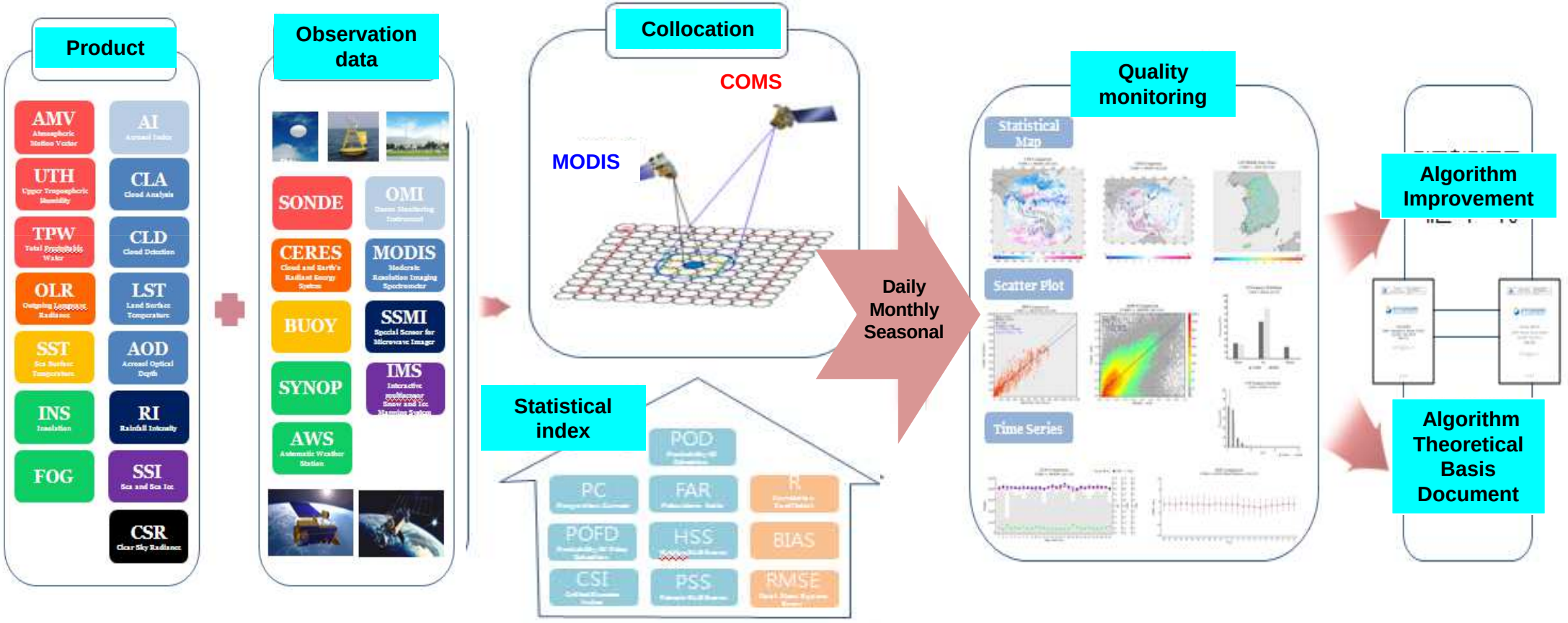
# COMS Products

NMSC

16 Baseline Products : Development (2003-2010) and operation (2011~)



# 1.2 Product Validation & Quality Monitoring -

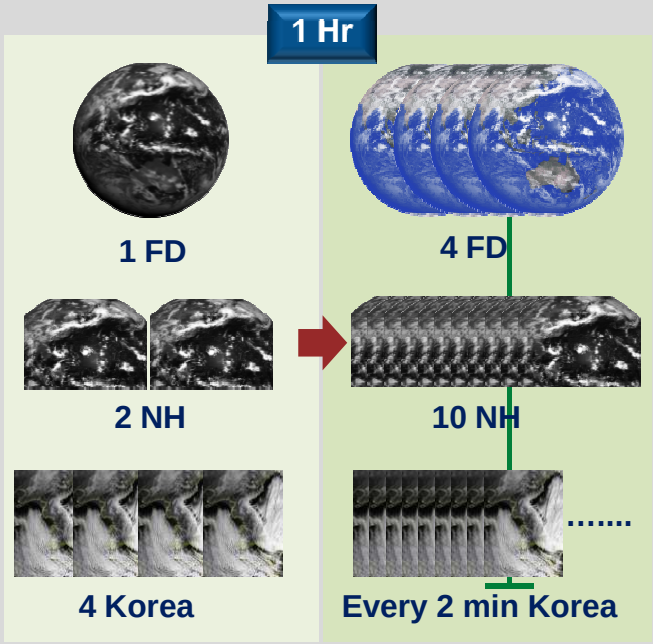


# COMS MI vs. GEO-KOMPSAT-2A (AMI)

## 4 times spatial resolution

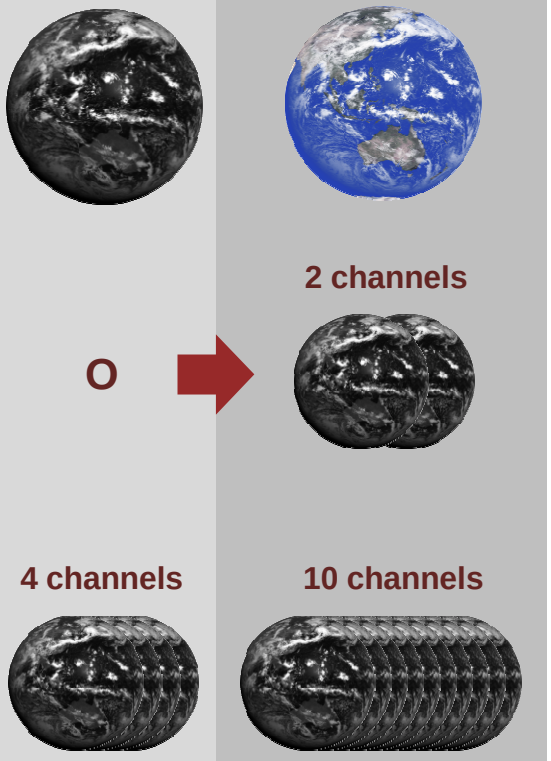
| COMS | Geo-KOMPSAT-2A |
|---|---|
| VI 1km | VI 0.5~1km |
| IR 4km | IR 2km |

## 4 times tempral resolution



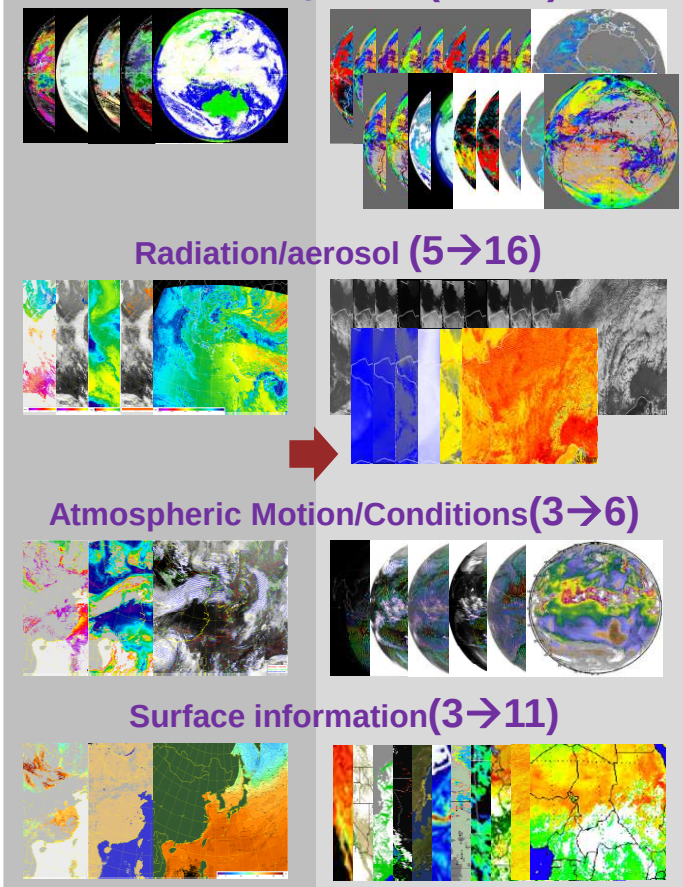

## 3 times number of channels

| | COMS | Geo-KOMPSAT-2A |
|---|---|---|
| VI | 1 channel (achromatic) | 4 channels (color) |
| SWIR | O | 2 channels |
| IR | 4 channels | 10 channels |
| | 5 channels | 16 channels |



## 3.5 times number of products

| COMS | Geo-KOMPSAT-2A |
|---|---|
| Cloud/Precipitation (5→19) | |
| Radiation/aerosol (5→16) | |
| Atmospheric Motion/Conditions(3→6) | |
| Surface information(3→11) | |
| 16 products | 52 products |



# 2. Implementation Plan of KMA

## PESK

- Sea Surface Temperatrue
- Outgoing Longwave Radiation
- Insolation

- Algorithms: In operation
- Similar algorithms with other GEO satellites
- Similar input data with other GEO satellites

**To participate immediately for SCOPE-CM**

## SESK

- Albedo
- Precipitation
- Cloud fraction

- Algorithm:
  - Developed (Albedo)
  - Improvement needed (Precipitation, Cloud fraction, Snow)
- Different algorithms and inputs with other GEO satellites

**To participate prospectively for SCOPE-CM after GK-2a launch**

# PESK Implementation Plan, KMA

| Primary ECVs for SCOPE-CM of KMA(PESK) | | |
|---|---|---|
| **Parameters** | Sea Surface Temperature<br>Outgoing Longwave Radiation<br>Insolation | |
| **Step-1 ( ~2017) Action Items** | Step 1-1<br>(3 years) | • **GSICS→FCDRs→TCDRs continuous generating**<br>• **Evaluation of effect of GSICS correction**<br>• QC./QA, algorithm improvement |
| | Step 1-2<br>(3 years) | • Inter-satellite comparison of products<br>• **EUMETSAT-KMA operating collaboration**<br>• Preparation for GeoKompsat-2a / Future Korean LEO satellite |
| **Step-2 (2018~ ) Action Items** | • **Obtaining consistency and continuity between COMS and GeoKompsat-2a TCDRs**<br>• **Continuous improvement of TCDRs**<br>• Continuous collaboration with SCOPE-CM working group | |

| **Parameters** | **SST** | **OLR** | **INS** |
|---|---|---|---|
| **Accuracy (objective)** | 0.5 –0.8 ℃ | 10 W/m$^2$ | 70-100 W/m$^2$ |
| **Spatial Resolution** | 1-5 km$^2$ | 15 km$^2$ | 15 km$^2$ |
| **Temporal Resolution** | 2 daily | daily | daily |

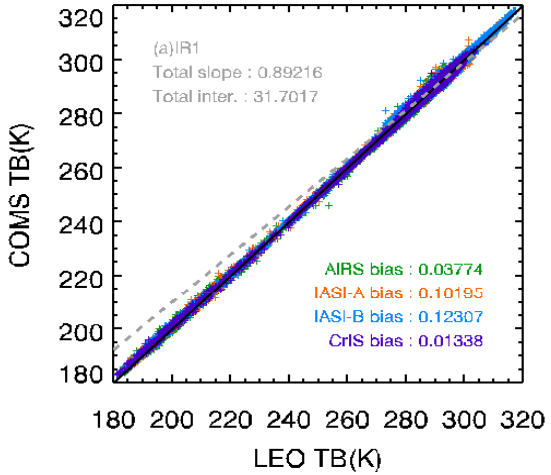
# SESK Implementation Plan, KMA

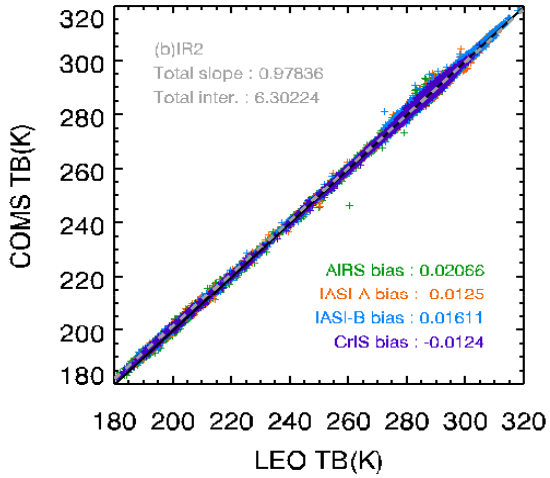
## Secondary ECVs for SCOPE-CM of KMA(SESK)

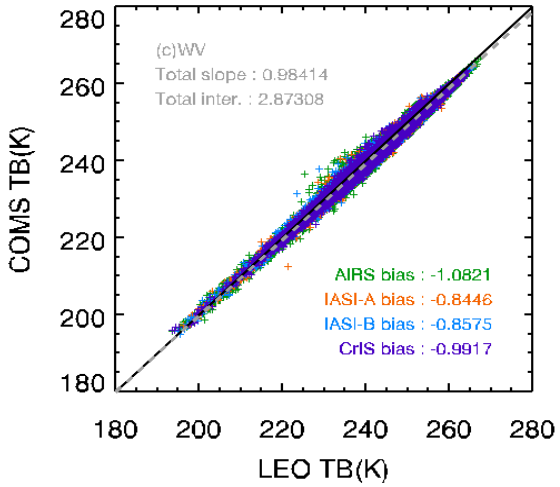
| | | | |
|---|---|---|---|
| **Parameters** | Albedo<br>Precipitation<br>Cloud Fraction | | |
| **Step-1 ( ~2017) Action Items** | • Preparation for GeoKompsat-2a / Future Korean LEO satellite<br>• **Algorithm development** | | |
| **Step-2 (2018~ ) Action Items** | • GSICS→FCDRs continuous generating<br>• FCDRs→TCDRs generating<br>• Evaluation of effect of GSICS correction<br>• QC./QA, algorithm improvement<br>• Inter-satellite comparison of products<br>• Obtaining consistency and continuity between COMS and GeoKompsat-2a TCDRs<br>• Continuous collaboration with SCOPE-CM working group | | |
| **Parameters** | **Albedo** | **Precipitation** | **Cloud fraction** |
| **Accuracy (objective)** | Albedo>0.15 : 10~20%<br>Albedo<0.15 : 0.015~0.15 | 40-80%<br>(> 10mm/h) | 10~20% |
| **Spatial Resolution** | 15 $km^2$ | 8 $km^2$ | 4 $km^2$ |
| **Temporal Resolution** | daily | daily | daily |

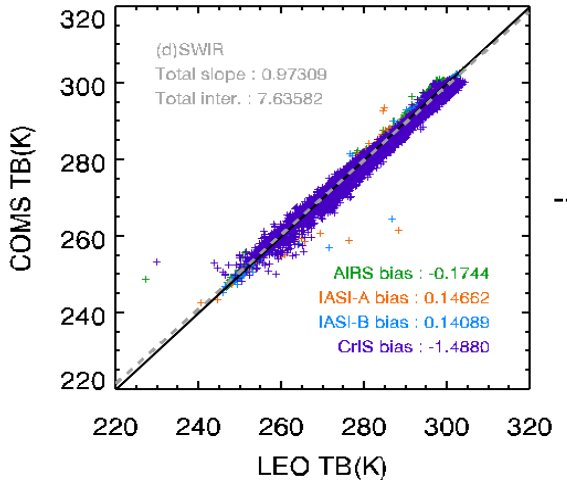
# 3. GSICS Processing Results (IR channels)

- AIRS, IASI-A : April/2011-Dec/2016
  - IASI-B : Aug/2013-Dec/2016
    - CrIS : Jan/2014-Dec/2016



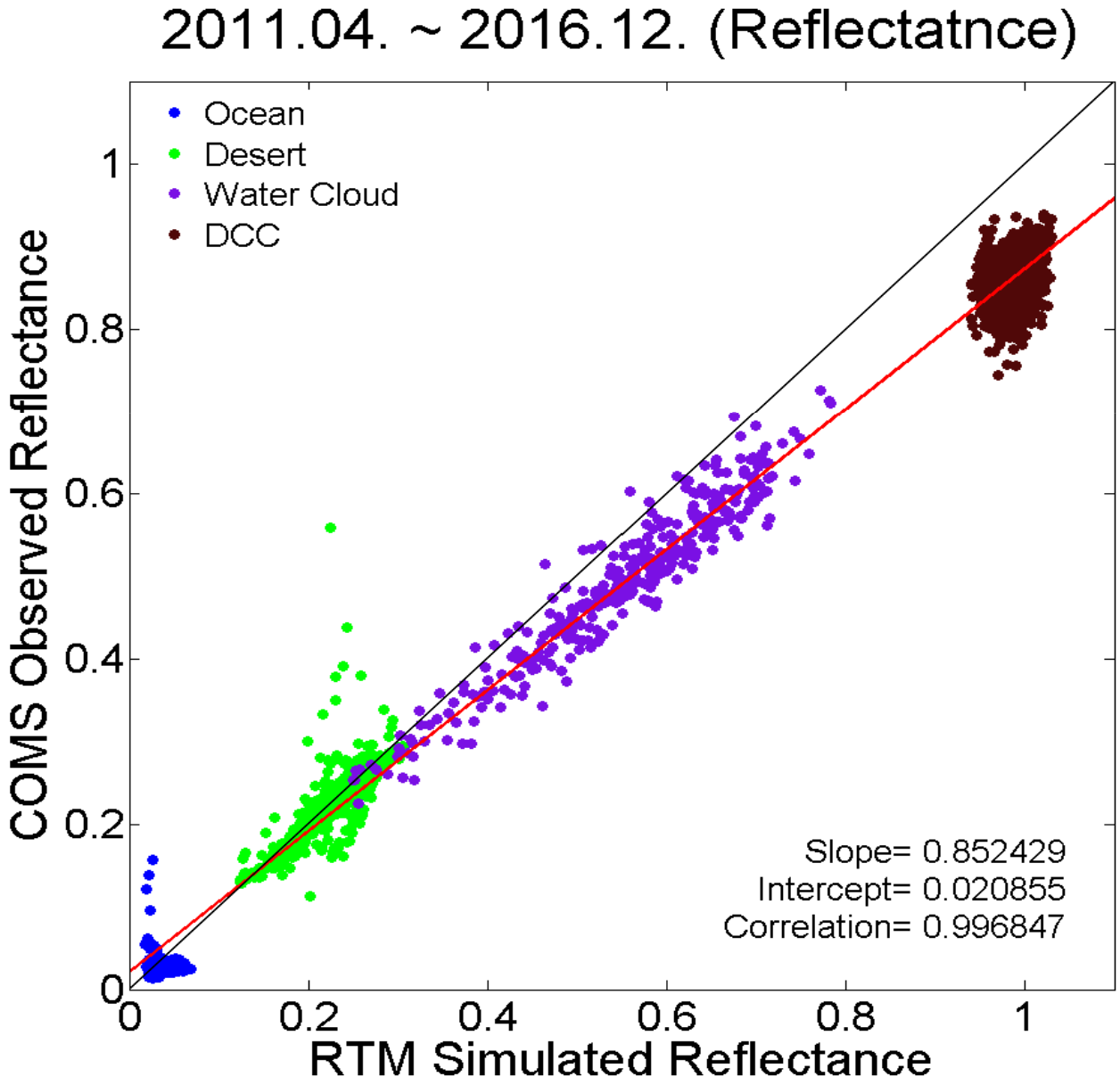



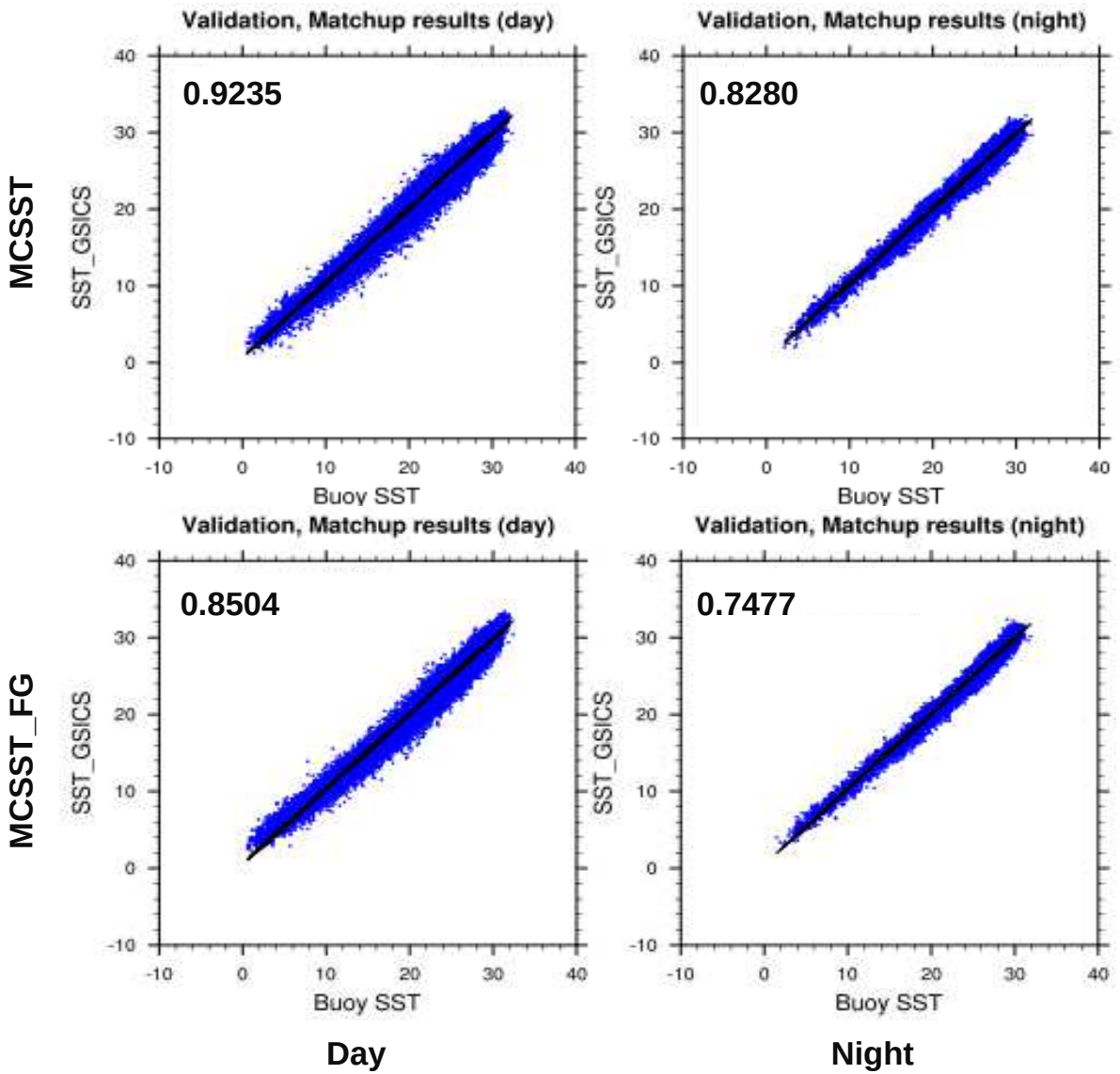

| | | IASI-A | IASI-B | AIRS | CrIS |
|---|---|---|---|---|---|
| IR1 | Number | 184711 | 156083 | 698417 | 349070 |
| | Bias | **0.1020** | **0.1231** | **0.0377** | **0.0134** |
| | RMSE | 0.3474 | 0.3459 | 0.4276 | 0.3996 |
| | Slope | 0.9953 | 0.9945 | 1.0134 | 1.0009 |
| | Intercept | 1.4723 | 1.7407 | -3.9022 | -0.2376 |
| IR2 | Number | 202627 | 173165 | 756648 | 381557 |
| | Bias | **-0.0126** | **0.0161** | **0.0207** | **-0.0125** |
| | RMSE | 0.3315 | 0.3337 | 0.3315 | 0.2867 |
| | Slope | 0.9930 | 0.9917 | 0.9879 | 0.9928 |
| | Intercept | 2.0254 | 2.4284 | 3.5324 | 2.0965 |
| IR3 (WV) | Number | 237595 | 201121 | 915472 | 499093 |
| | Bias | **-0.8446** | **-0.8576** | **-1.0822** | **-0.9917** |
| | RMSE | 0.4230 | 0.4206 | 0.4699 | 0.4384 |
| | Slope | 0.9826 | 0.9842 | 0.9840 | 0.9856 |
| | Intercept | 3.4033 | 3.0112 | 2.8210 | 2.5183 |
| IR4 (SWIR) | Number | 58182 | 49753 | 136962 | 52474 |
| | Bias | **0.1466** | **0.1409** | **-0.1745** | **-1.4880** |
| | RMSE | 0.2482 | 0.2230 | 0.4704 | 0.8874 |
| | Slope | 0.9947 | 0.9913 | 0.9859 | 0.9443 |
| | Intercept | 1.7125 | 2.6958 | 3.9601 | 15.0280 |

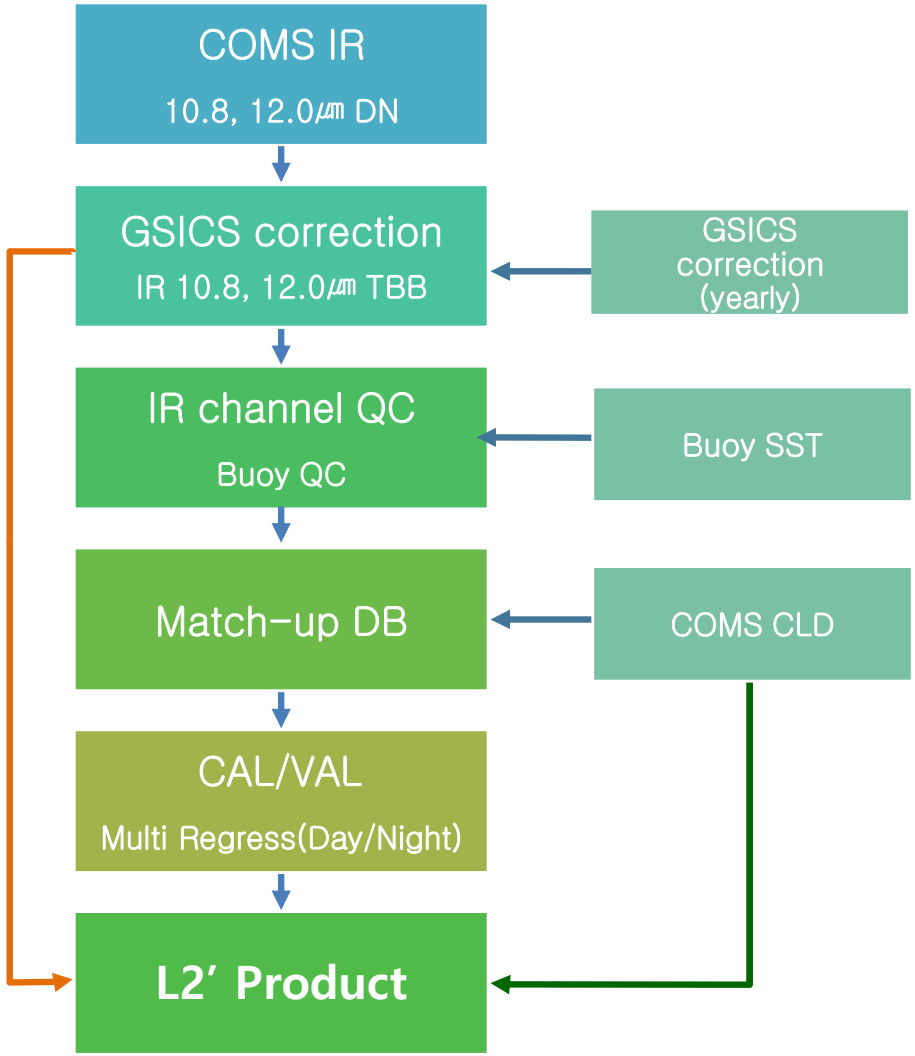
# 3. GSICS Processing Results (VIS channels)



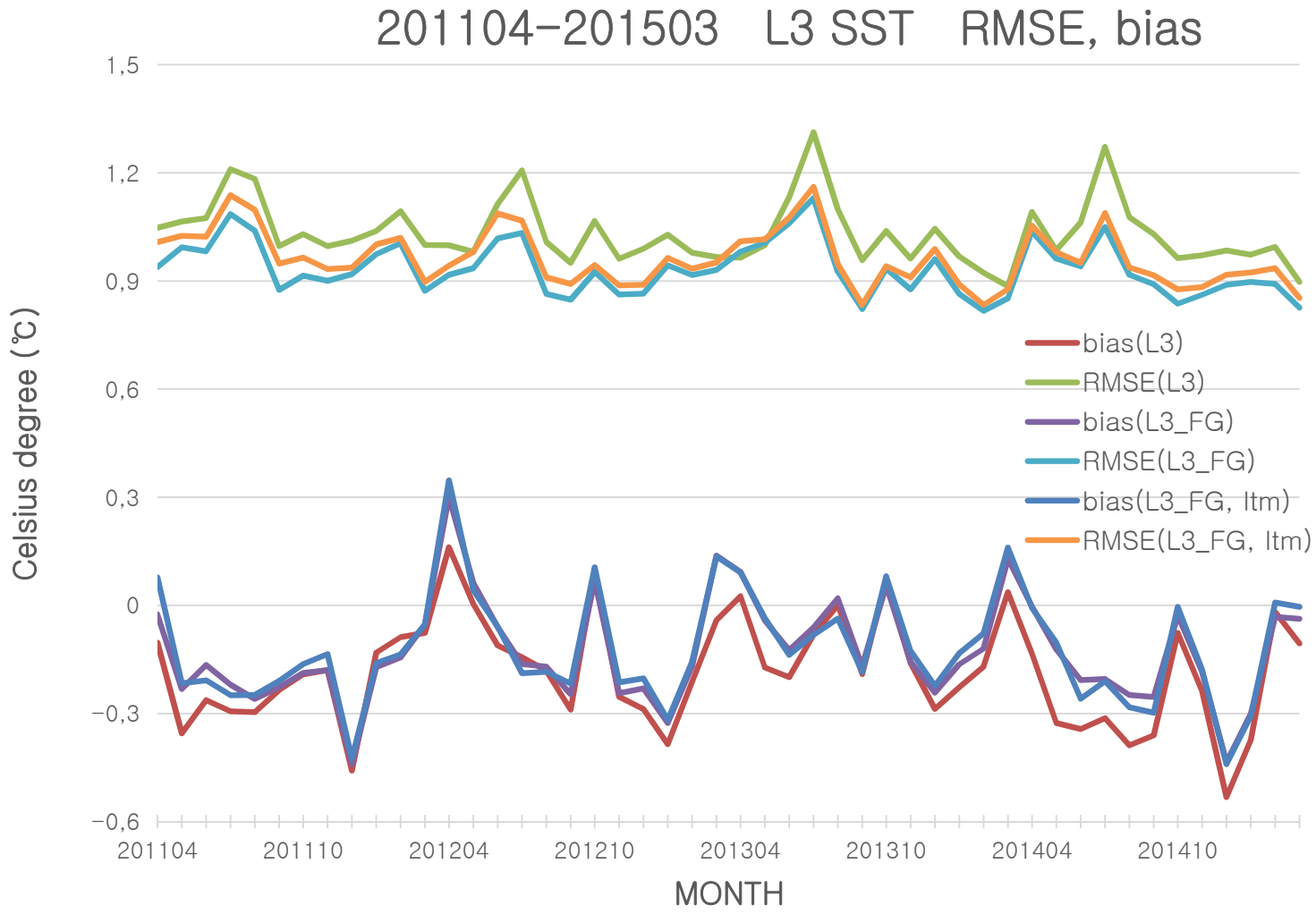
# Improvement of SST after GSICS Correction

**Data: Apr. 2011~Mar. 2015**



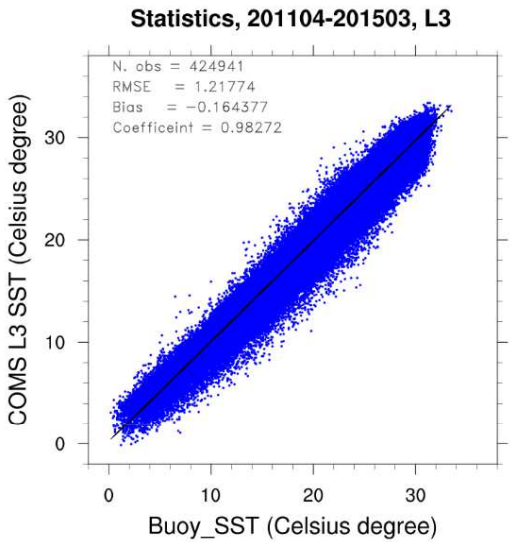



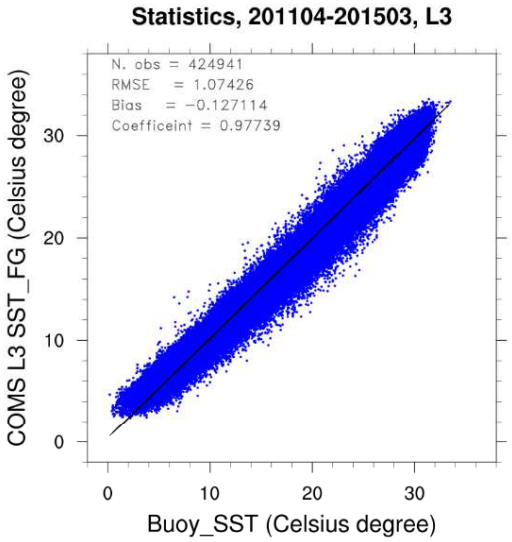
# Level 3 SST

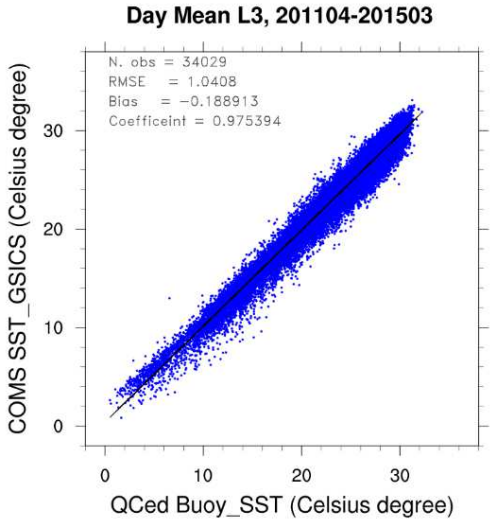

201104-201503 L3 SST RMSE, bias
1,5
1,2
0,9
0,6
0,3
0
-0,3
-0,6
Celsius degree (℃)
bias(L3)
RMSE(L3)
bias(L3_FG)
RMSE(L3_FG)
bias(L3_FG, Itm)
RMSE(L3_FG, Itm)
201104
201110
201204
201210
201304
201310
201404
201410
MONTH

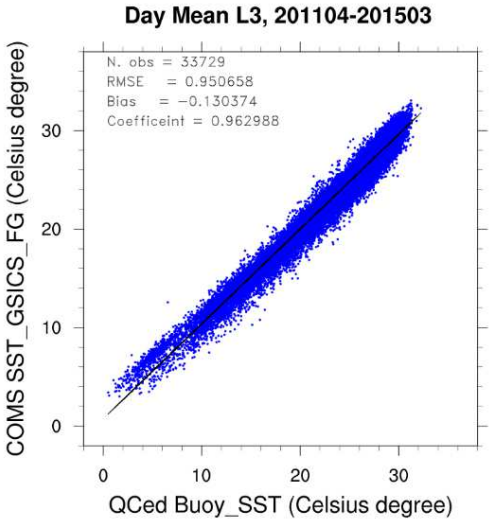
# Level 3 SST

| | RMSE (℃) |
|---|---|
| MCSST (L3) | 1.21774 |
| MCSST_FG (L3) | 1.07426 |
| MCSST(Day mean) | 1.0408 |
| MCSST_FG(Day mean) | 0.950658 |

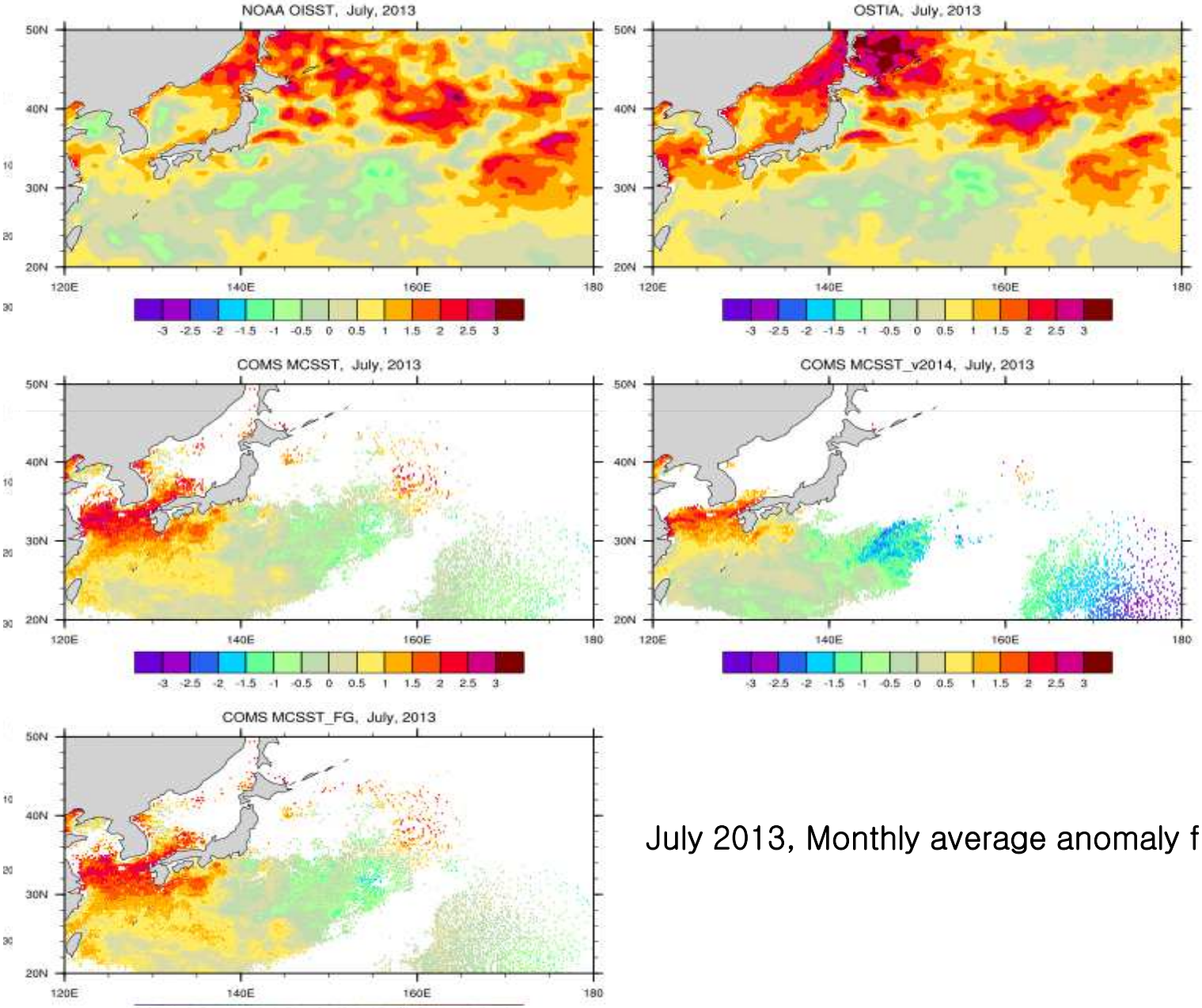


# SST Level 2', Level 3 validation




July 2013, Monthly average anomaly field

# 4. Summary

1. ECVs accuracy was improved after GCIS correction
2. Resulted positive effect of GSICS-based FCDRs toward TCDRs
3. These positive effect of GSICS should be continuously monitored.
4. Try to build CDR processing system for those ECVs

# Thank you

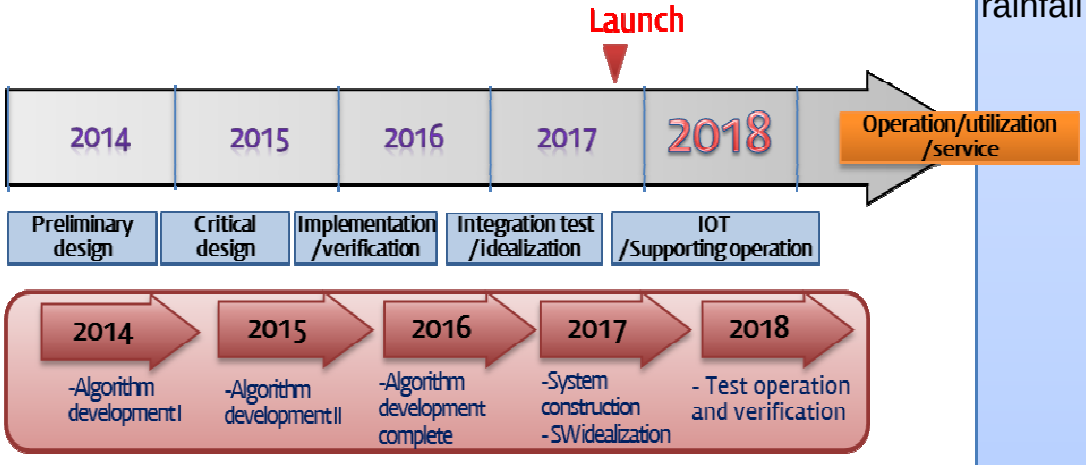
# GEO-KOMPSAT-2A payload

## 16 channels

| FPM | Band name | AMI(Geo-KOMPSAT-2A) | | ABI(GOES-R) | | AHI(Himawari-8/9) | | MI (COMS) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Center Wavelength (μm) | Resolution (km) | Center Wavelength (μm) | Resolution (km) | Center Wavelength (μm) | Resolution (km) | Center Wavelength (μm) | Resolution (km) |
| VNIR | VIS0.4 | 0.47 | 1 | 0.47 | 1 | 0.46 | 1 | | |
| | VIS0.5 | 0.51 | 1 | | | 0.51 | 1 | | |
| | VIS0.6 | 0.64 | 0.5 | 0.64 | 0.5 | 0.64 | 0.5 | 0.675 | 2 |
| | VIS0.8 | 0.856 | 1 | 0.865 | 1 | 0.86 | 1 | | |
| | NIR1.3 | 1.378 | 2 | 1.378 | 2 | | | | |
| | NIR1.6 | 1.61 | 2 | 1.61 | 1 | 1.6 | 2 | | |
| | NIR2.2 | | | 2.25 | 2 | 2.3 | 2 | | |
| MWIR | IR3.8 | 3.9 | 2 | 3.9 | 2 | 3.9 | 2 | 3.75 | 4 |
| | IR6.3 | 6.185 | 2 | 6.185 | 2 | 6.2 | 2 | | |
| | IR6.9 | 6.95 | 2 | 6.95 | 2 | 7.0 | 2 | 6.75 | 4 |
| | IR7.3 | 7.34 | 2 | 7.34 | 2 | 7.3 | 2 | | |
| | IR8.7 | 8.5 | 2 | 8.5 | 2 | 8.6 | 2 | | |
| LWIR | IR9.6 | 9.61 | 2 | 9.61 | 2 | 9.6 | 2 | | |
| | IR10.5 | 10.35 | 2 | 10.35 | 2 | 10.4 | 2 | 10.8 | 4 |
| | IR11.2 | 11.2 | 2 | 11.2 | 2 | 11.2 | 2 | | |
| | IR12.3 | 12.3 | 2 | 12.3 | 2 | 12.3 | 2 | 12.0 | 4 |
| | IR13.3 | 13.3 | 2 | 13.3 | 2 | 13.3 | 2 | | |

# Development & utilization of GK-2A data

## Schedule of meteorological data processing system




| | No. | Products | | No. | Products |
|---|---|---|---|---|---|
| cloud/ rainfall | 1 | Cloud detection | radiation/ Aerosol | 27 | Visibility |
| | 2 | Cloud Top Temperature | | 28 | O3 total |
| | 3 | Cloud Top Pressure | | 29 | Radiances |
| | 4 | Cloud Top Height | | 30 | Upward Shortwave Radiation(TOA) |
| | 5 | Cloud type | | 31 | Downward Shortwave Radiation(Surface) |
| | 6 | Cloud phase | | 32 | Absorbed Shortwave Radiation(Surface) |
| | 7 | Cloud Amount | | 33 | Downward Longwave Radiation(Surface) |
| | 8 | Cloud Optical Depth | | 34 | Upward Longwave Radiation(Surface) |
| | 9 | Cloud Particle Size Distribution | | 35 | Upward Longwave Radiation(TOA) |
| | 10 | Cloud Liquid Water | ATM motion/ condition | 36 | Atmospheric Motion Vector |
| | 11 | Cloud Ice Water Path | | 37 | Vertical Temp. Profile |
| | 12 | Cloud Layers/Heights | | 38 | Vertical Moisture Profile |
| | 13 | Fog | | 39 | Derived Stability Indices |
| | 14 | In-flight icing | | | Total Precipitable Water |
| | | | | 40 | Atmospheric Motion Vector |
| | 15 | Convection initiation | | 41 | Tropopause folding turbulent flow |
| | 16 | overshooting top/enhanced thermal couplet detection | surface | 42 | Sea Surface Temperature |
| | 17 | Rainfall Intensity | | 43 | Land Surface Temperature |
| | 18 | probability of rainfall | | 44 | Fire/Hot Spot Characteristic |
| | 19 | rainfall potential | | 45 | Vegetation Index |
| radiation/ aerosol | 20 | Aerosol detection | | 46 | Vegetation Fraction: Green |
| | 21 | Asian dust detection | | 47 | Surface Emissivity |
| | 22 | Volcanic Ash: Detection and Height | | 48 | Surface Albedo |
| | 23 | SO2 Detection | | 49 | Snow Cover |
| | 24 | Aerosol Optical Depth | | 50 | Snow Depth |
| | 25 | Asian dust Optical Depth | | 51 | Ice Cover |
| | 26 | Aerosol Particle Size | | 52 | Current |