Evaluation of cloud products for Himawari-8/-9

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Contents

- Outline of Himawari-8/-9
  - Schedule
  - Imager
- Cloud products algorithm
- Cloud products evaluation
  - For some periods
  - For a golden day
- Summary

Himawari-8/-9 Schedule

In Japan, Fiscal Year (FY) runs from 1 April to 31 March.

- Himawari-8 will be launched in or after (northern) summer.

- Himawari-8 data and products will be provided from (northern) summer 2015.

Himawari-8/-9 Imager (AHI)

Band	Himawari-8/-9		MTSAT-1R/-2		MSG
1	0.46 μm	1km			
2	0.51 μm	1km			
3	0.64 μm	0.5km	0.68 μm	1km	0.6 μm
4	0.86 μm	1km			0.8 μm
5	1.6 μm	2km			1.6 μm
6	2.3 μm	2km			
7	3.9 μm	2km	3.7 μm	4km	3.9 μm
8	6.2 μm	2km	6.8 μm	4km	6.2 μm
9	7.0 μm	2km			
10	7.3 μm	2km			7.3 μm
11	8.6 μm	2km			8.7 μm
12	9.6 μm	2km			9.7 μm
13	10.4 μm	2km	10.8 μm	4km	10.8 μm
14	11.2 μm	2km			
15	12.3 μm	2km	12.0 μm	4km	12.0 μm
16	13.3 μm	2km			13.4 μm
Launch	2014/2016		-		-

- Number of bands:
  5 -> 16
- Spatial resolution:
  4km -> 2km /
  1km -> 1km or 0.5km
- Temporal resolution (Full disk):
  60min -> 10 min

JMA Cloud products - outline -

- Elements: Cloud mask, cloud type/phase, cloud top height
- Area and resolution: Full disk, pixel basis
- Based on NWC SAF algorithm
  - Partly introduced NOAA/NESDIS algorithm
    - Idea of LRC
    - Threshold tuning
  - Comparison data
    - RTTOV simulation results with JMA numerical prediction data
    - Threshold table of ice and water clouds: from RSTAR simulation
    - Analysis data: ozone, aerosol from JMA analysis
    - Snow reflectance: Aoki et.al. 1999

Algorithm and output

- Algorithm
  - Cloud mask, cloud type/phase: threshold method
    - Thresholds: targeted best accuracy (cloud mask), best skill score (cloud type/phase)
  - Cloud top height: interpolation, intercept method, radiance ratioing method
- Output
  - Cloud mask: cloudy, clear, snow or ice, dust or volcanic ash, undefined
  - Cloud type: opaque (very high, high, medium, low, very low), semi-transparent (thick, medium, thin), fractional, undefined
  - Cloud phase: water, ice, undefined
  - Cloud top: temperature, height, pressure, effective cloudiness
  - Reliabilities of the above data

Present status
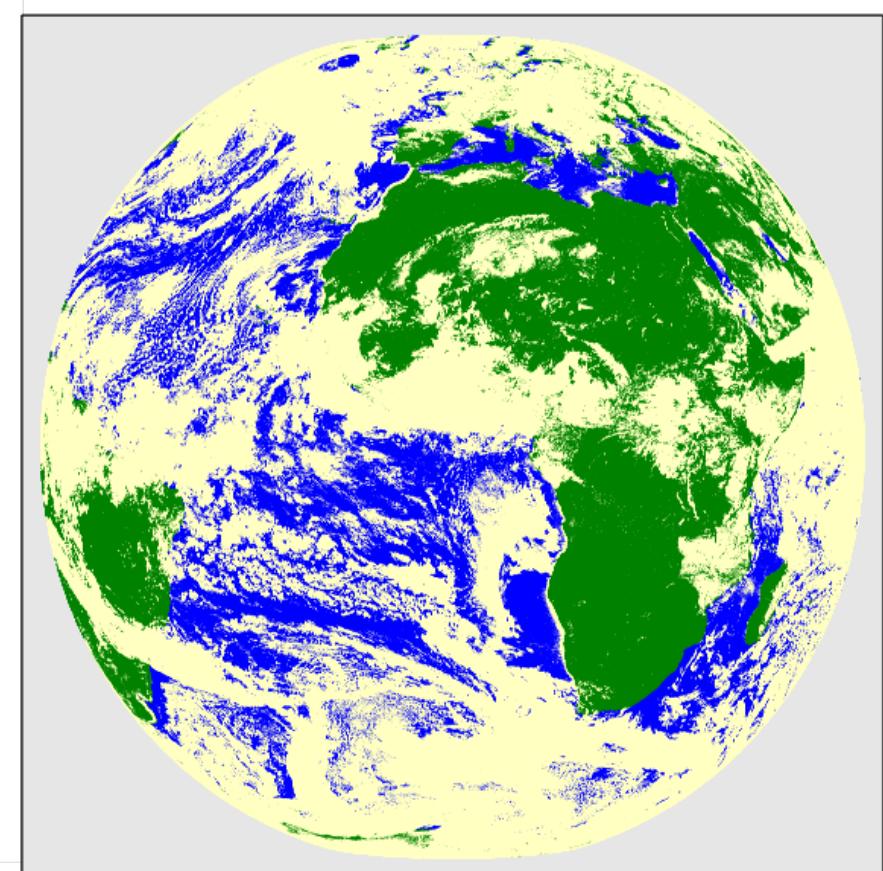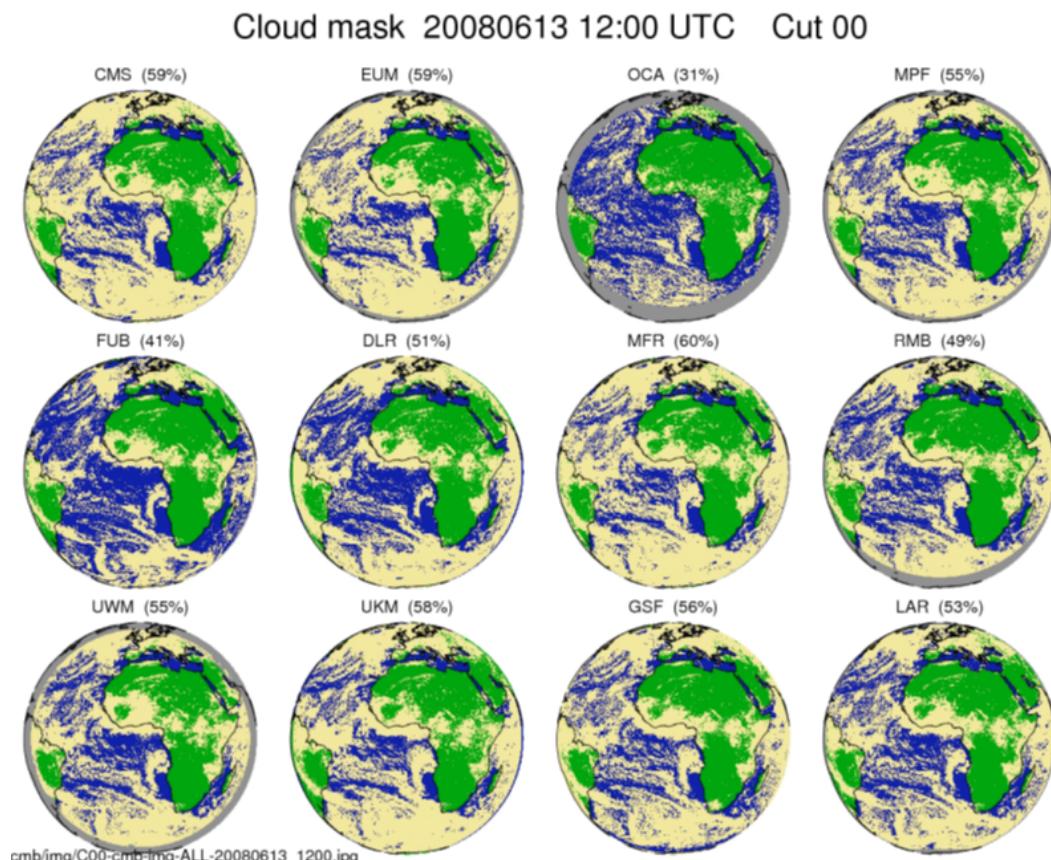
- Prototypes available for evaluation
  - Using MSG/SEVIRI data
- Preliminary threshold tuning with prototypes
  - For prompt tuning with Himawari-8/-9 products
- Evaluation of prototypes
  - Using prototypes with MSG data
  - Compare with MODIS
  - 2011.12.28 - 2012.1.10, 2012.3.28 - 2012.4.10, 2012.6.27 - 2012.7.10, 2012.9.27 - 2012.10.10

Evaluation results (vs MODIS)

Phase/Type		Accuracy or Hit Rate
Mask (Ac.)		0.85
Type	Opaque (H.R.)	0.66
Type	Semi-transparent (H.R.)	0.80
Phase	Ice cloud (H.R.)	0.98
Phase	Liquid water cloud (H.R.)	0.94

Height	Bias (km)	Standard deviation (km)	number
Low opaque	-0.10	1.34	2296940
High/mid opaque	0.31	1.33	1375505
Opaque	0.05	1.34	3672445
Semi-transparent (intercept or radiance rationing)	2.38	3.34	877586

		Observation	
		Yes	No
Detection	Yes	Correct detection	False alarms
Detection	No	Misses	Correct negatives
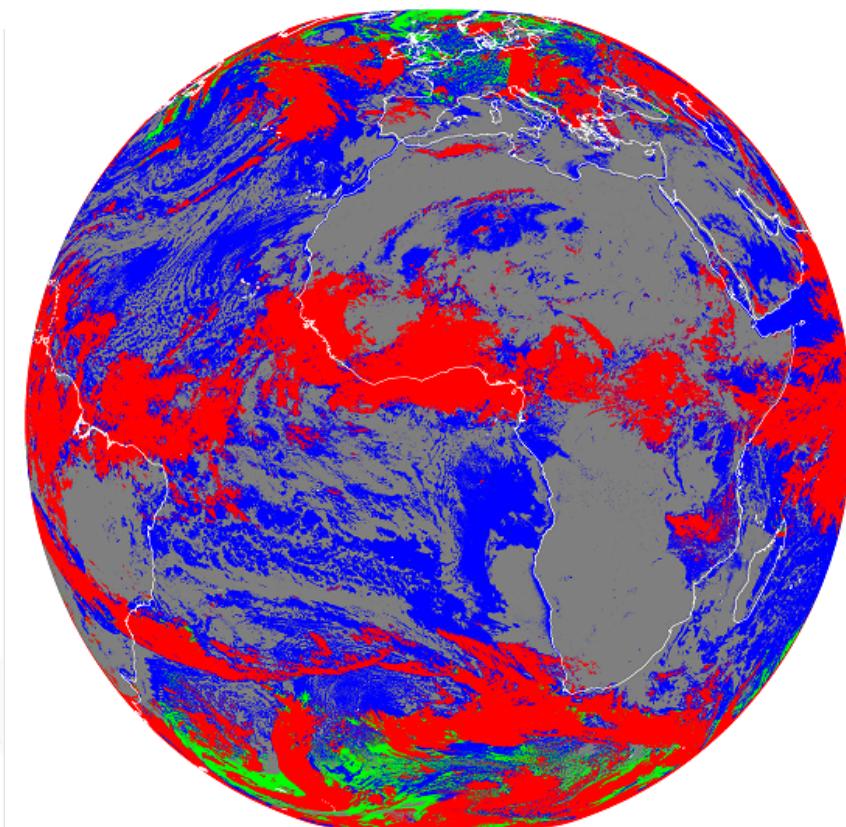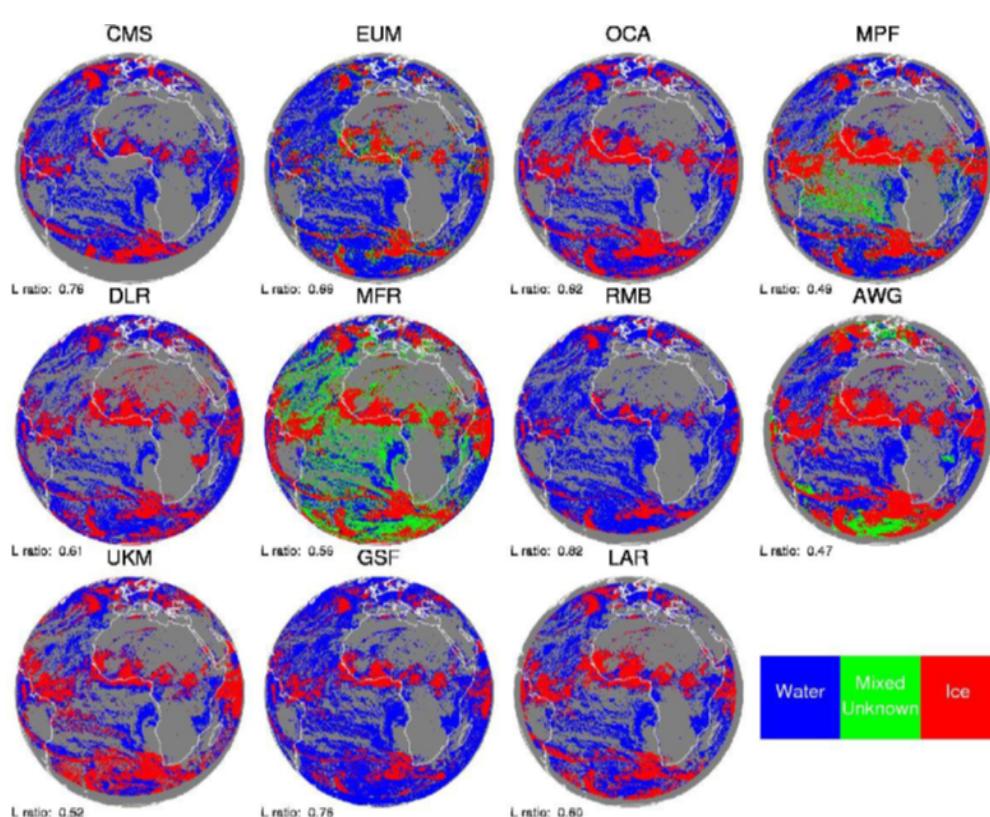
Mask		Accuracy				
		Winter	Spring	Summer	Autumn	All
All region		0.86	0.85	0.85	0.85	0.85
Respective	Sea	0.86	0.85	0.85	0.86	0.85
Respective	Snow/Ice	0.86	0.81	0.72	0.86	0.81
Respective	Dessert	0.87	0.86	0.86	0.89	0.87
Respective	Vegetation	0.86	0.84	0.83	0.83	0.84
Respective	Others	0.86	0.82	0.86	0.84	0.84

Result for a golden day
(Cloud mask)

Ratio of cloud pixels: 59%
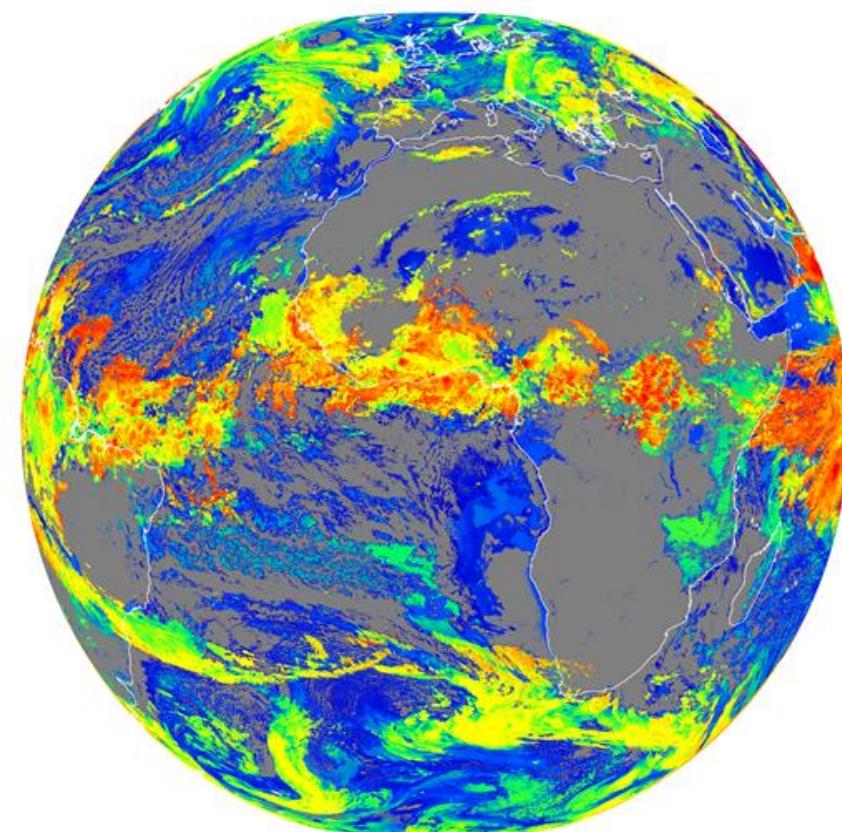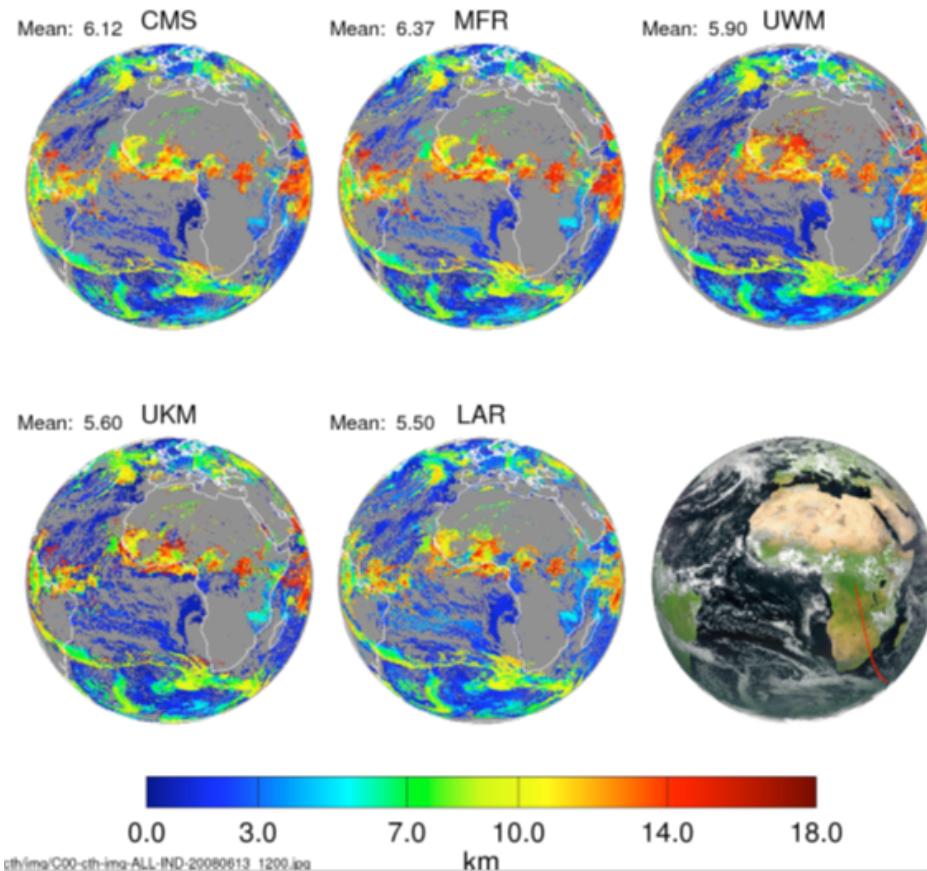
Result for a golden day
(Cloud phase)
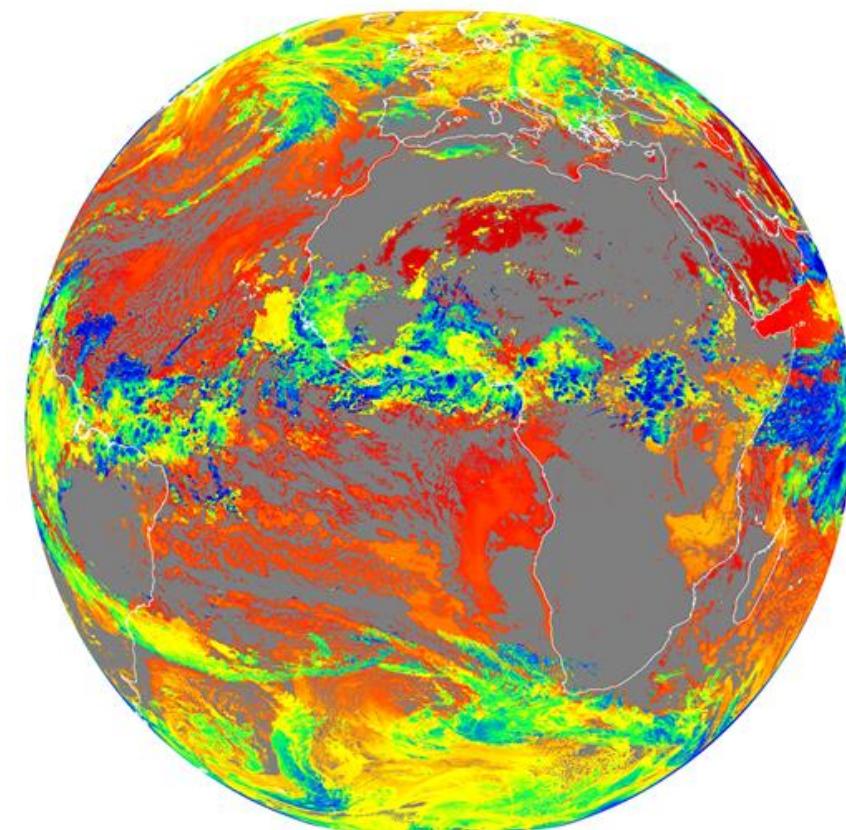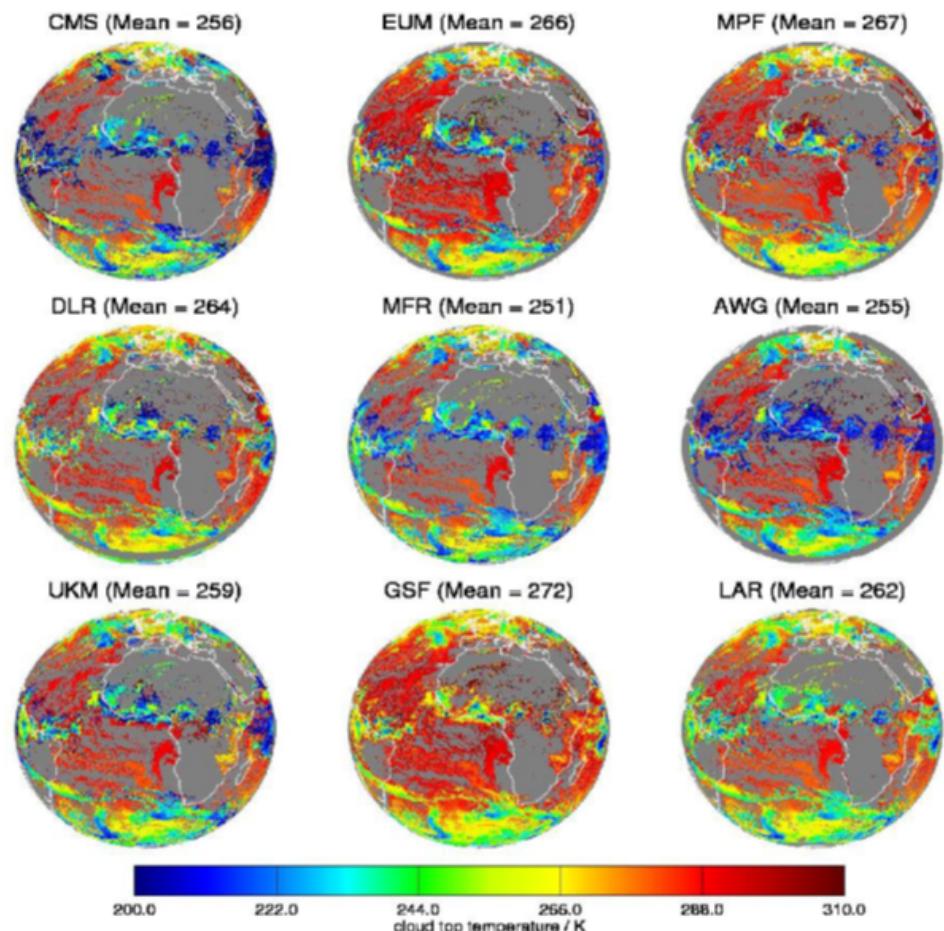

Ratio of water cloud pixels:
52% (water/(water + ice))
49% (water/(water + ice + mixed))

Result for a golden day
(Cloud top height)

Mean height: 5.12 km
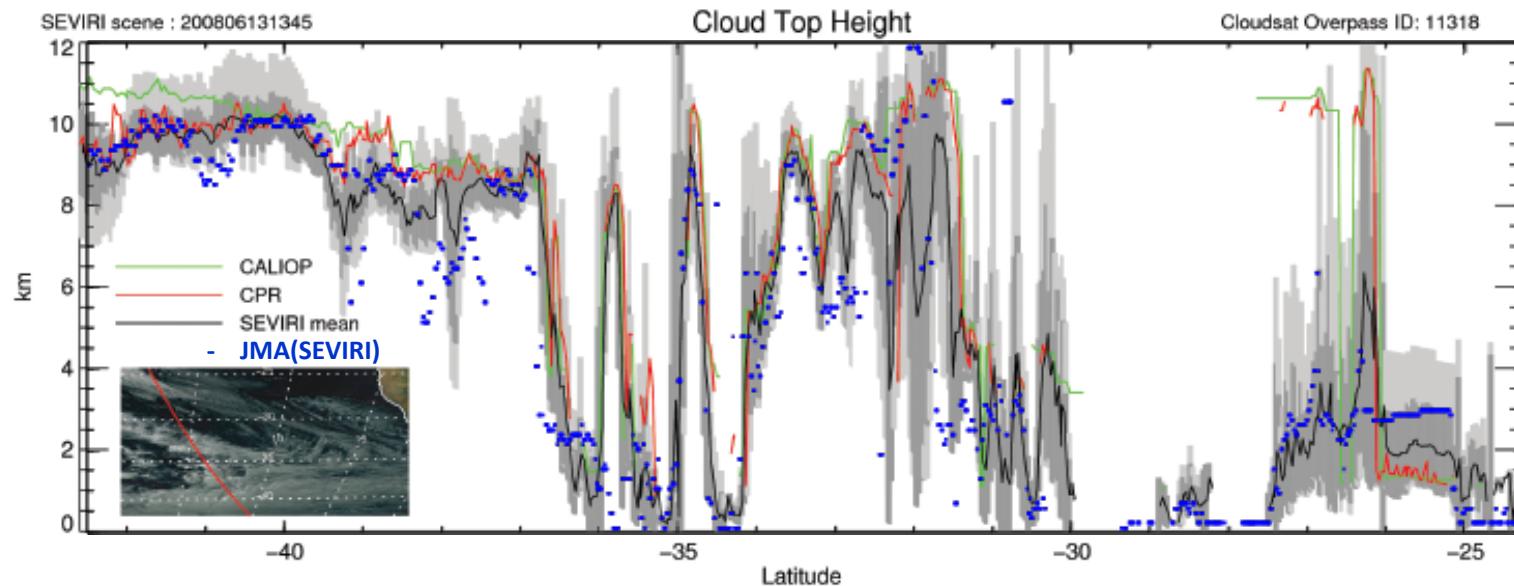
Result for a golden day
(Cloud top temperature)

CMS (Mean = 256) EUM (Mean = 266) MPF (Mean = 267)
DLR (Mean = 264) MFR (Mean = 251) AWG (Mean = 255)
UKM (Mean = 259) GSF (Mean = 272) LAR (Mean = 262)

200.0   222.0   244.0   266.0   288.0   310.0
cloud top temperature / K

Mean temperature: 262 K

Result for a golden day
(Cloud top height with Cloudsat and CALIPSO)

Summary

- Himawari-8 will be launched during the latter half of this year.
- Operation of Himawari-8 will start from (northern) summer 2015.
- Prototypes of cloud products can be calculated.
- Preliminary tuning using MSG/SEVIRI were carried out.
- Evaluation results are (vs MODIS):
  - Cloud mask (accuracy): 85%
  - Cloud phase (hit rate): 97%
  - Cloud top height (bias (standard deviation)):
    - -0.1 to 0.3 km (1.3km) for opaque clouds
    - 2.4 km (3.3 km) for semi-transparent clouds

Acknowledgement

- To EUMETSAT
  - MSG/SEVIRI data
  - RTTOV
- To NWC SAF and NOAA/NESDIS
  - Algorithm
- To NASA
  - MODIS data
  - CALIOP data
- To Tokyo University
  - RSTAR