Verification and Case Studies of JMA's Rapidly Developing Cumulus Area (RDCA) Product

Japan Meteorological Agency

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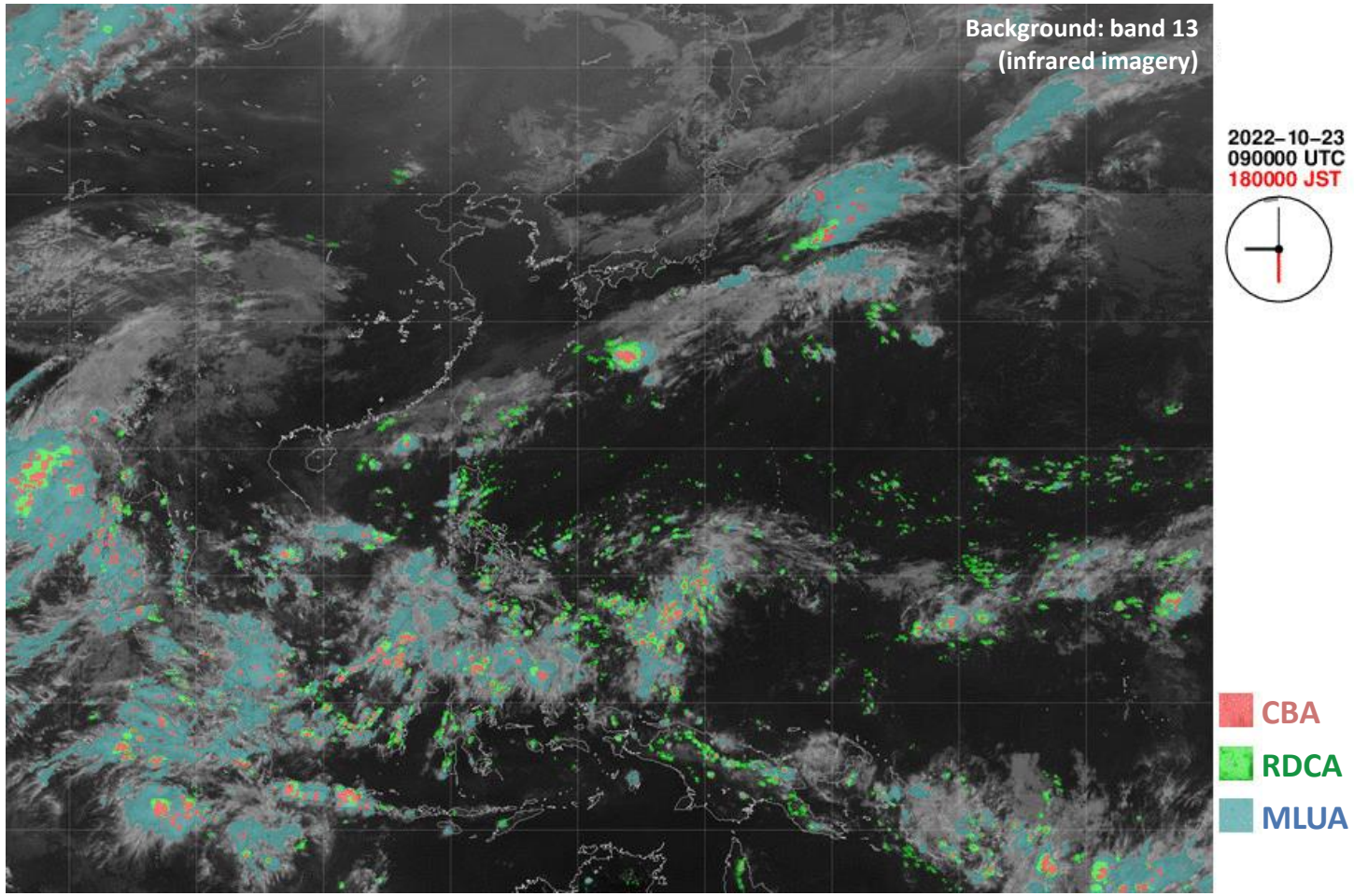
RDCA Product Overview

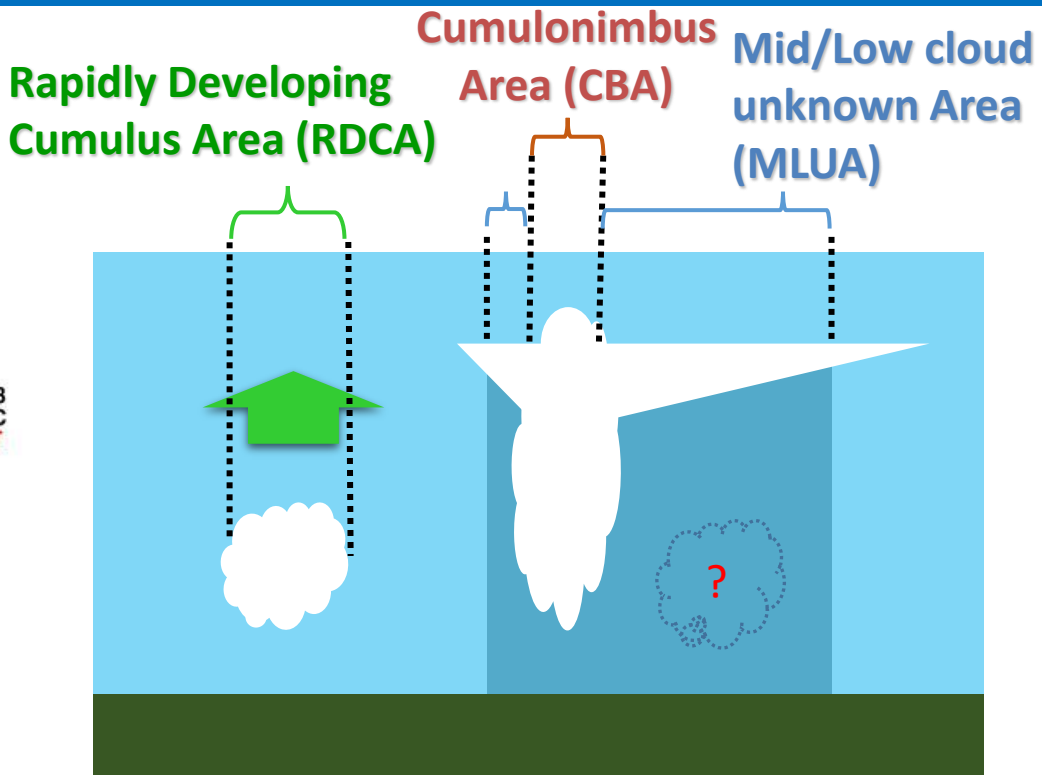
Convective Cloud Information (CCI)

— CBs, RDCAs and MLUAs



0900 UTC on 23 Oct. ~ 0900 UTC on 24 Oct. 2022

https://www.data.jma.go.jp/mscweb/technotes/msctechrep62-2.pdf



CCI for Asia & Western Pacific area

- Utilized bands of Himawari-8/9 AHI:
  - B03, B08, B10, B11, B13, B15, B16 for RDCAs
  - B03, B13, B15 for CBs & MLUAs
- Horizontal resolution:
  - 0.1° for RDCAs
  - 0.04° for CBs & MLUAs
- Temporal resolution: 10 min.

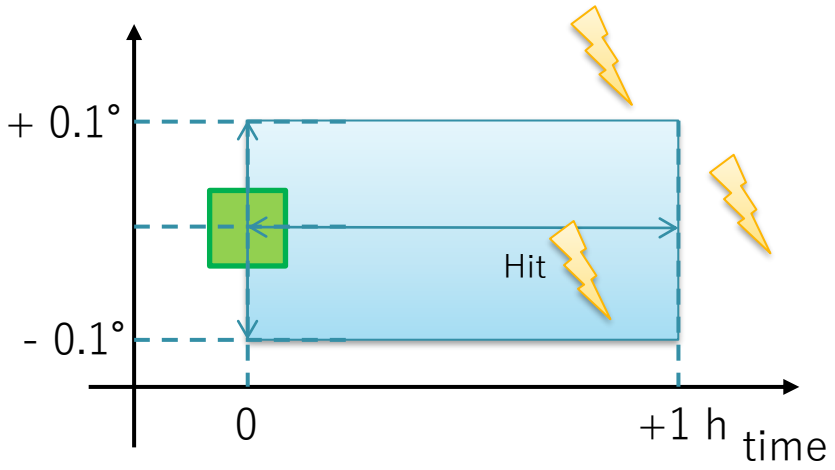
Verification of RDCA Product

Method

		Lightning		TOTAL
		YES	NO	
RDCA	YES	a or aa : *HIT*	b : *FALSE*	a + b : *Number of RDCA*
	NO	c : *MISS*		
TOTAL		aa + c : *Number of Lightning*		

a: Lightning is observed within an hour in ±1 grid (0.1 degree) of RDCA after RDCA was determined.

aa: RDCA was determined within an hour in ±1 grid of lightning before lightning is observed.



POD = aa / (aa + c)
FAR = b / (a + b)

Probability of Detection (POD):
Lightning, with a prior detection of RDCA
False Alarm Rate (FAR):
No lightning, though RDCA was detected

Lightning data is WWLLN (World Wide Lightning Location Network) from the University of Washington

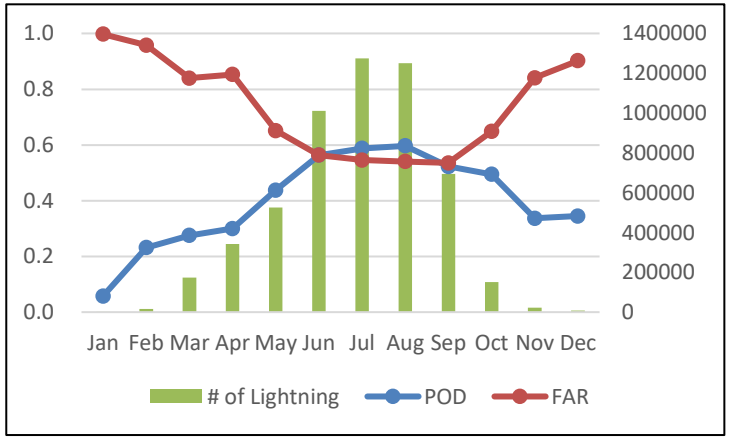
Verification of RDCA Product

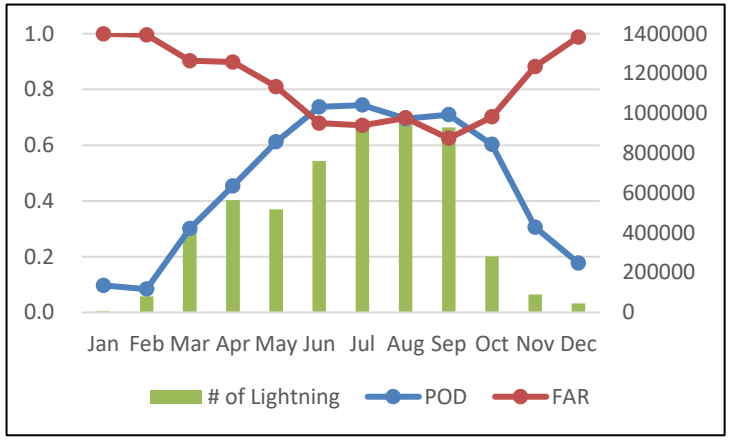
Result for mid-latitude

Daytime

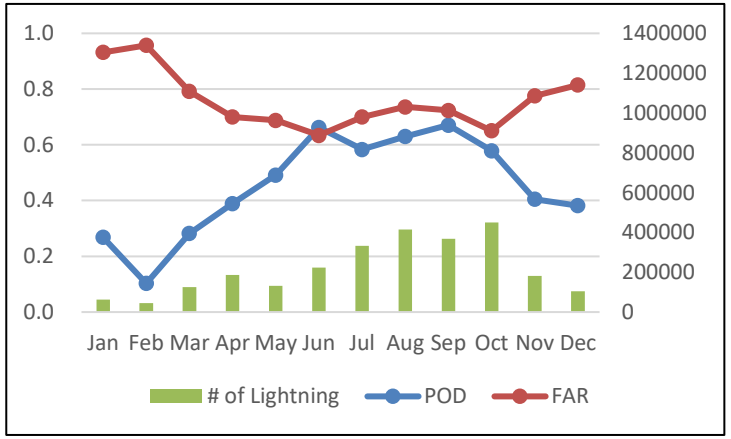
Nighttime

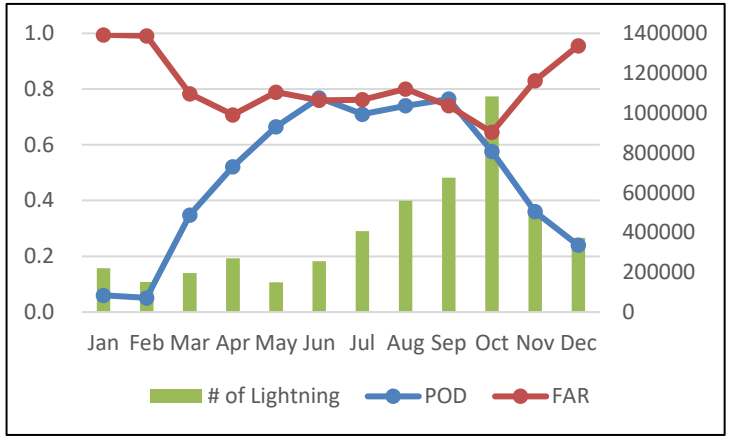
Land





Sea





In summer (Jul. ~ Aug.), when the number of lightning strikes is high, POD is high and FAR is low.
In winter season (Dec. to Feb.), when the number of lightning strikes is low, POD is low and FAR is high.

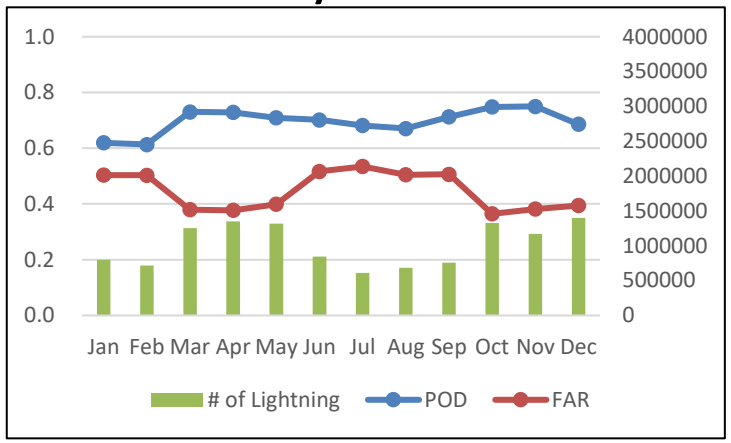
Verification of RDCA Product

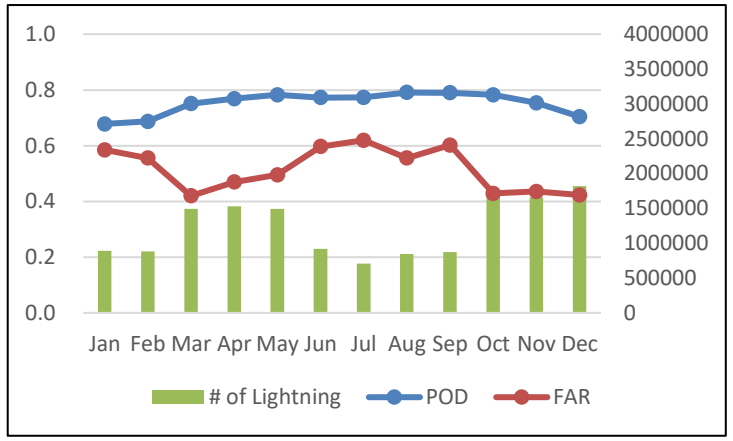
Result for tropics

Daytime

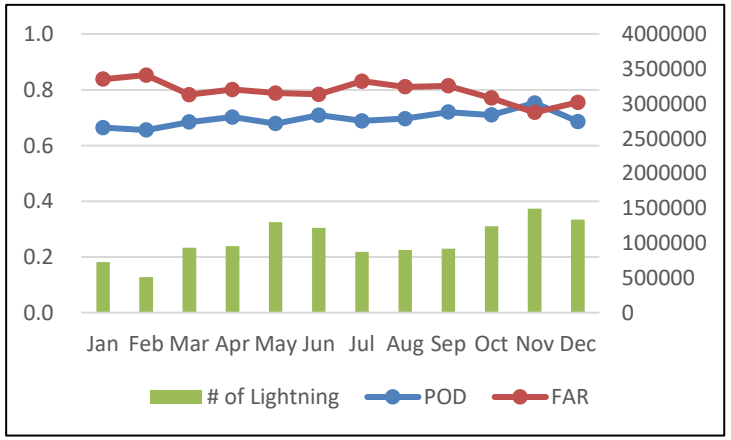
Nighttime

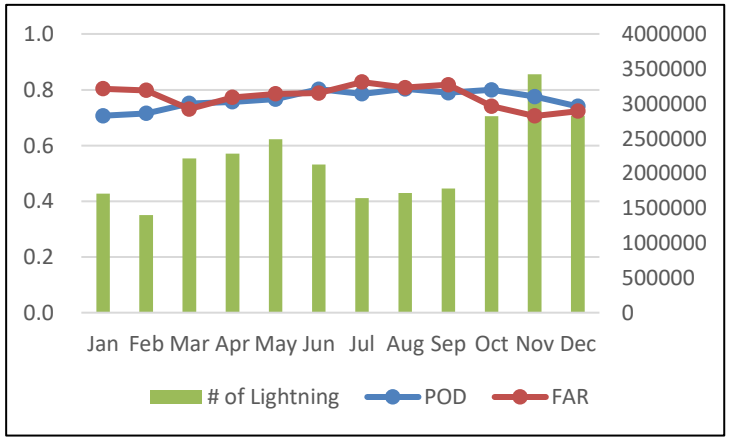
Land





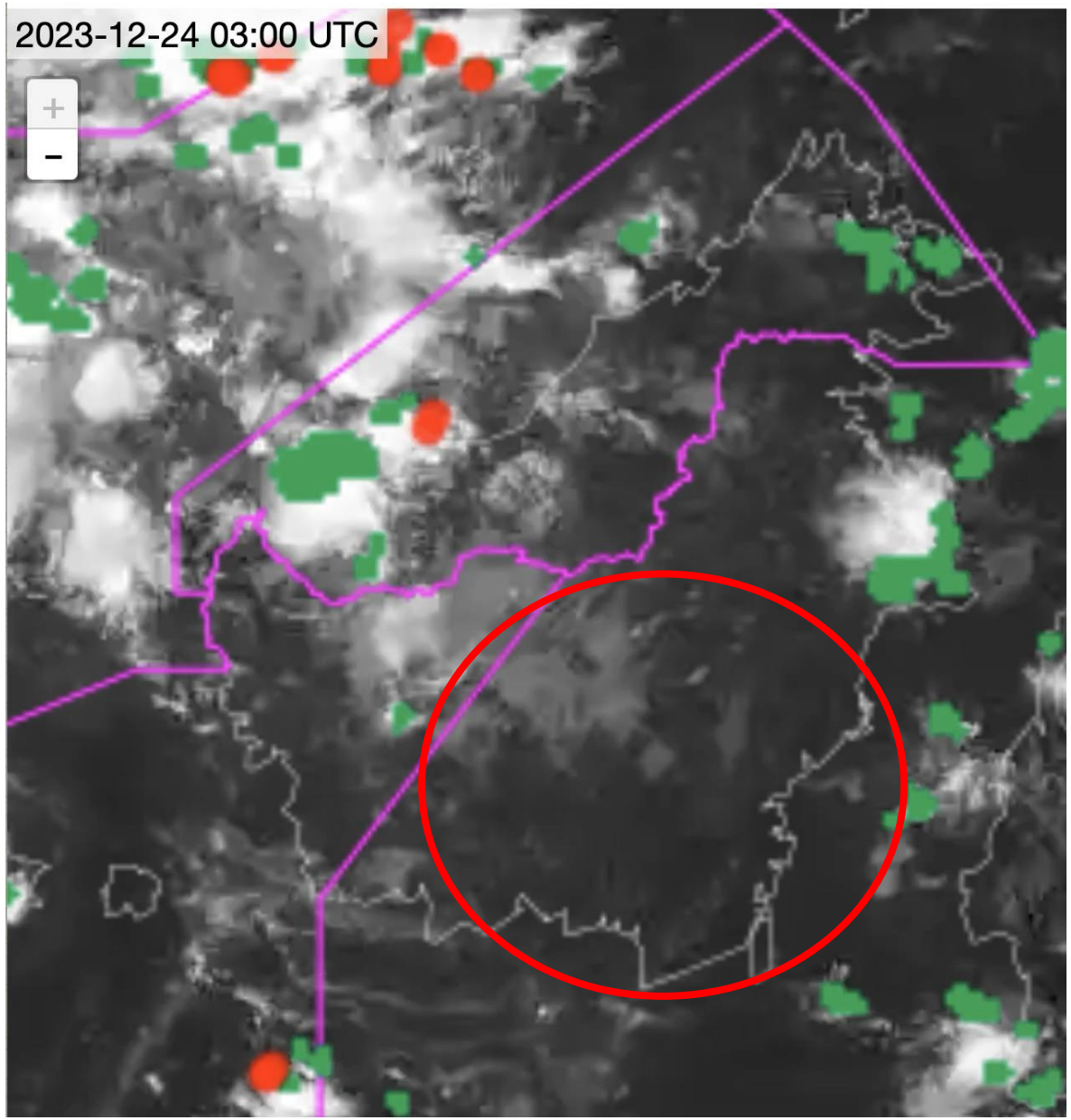
Sea





Seasonal changes are smaller in the tropics than in the mid-latitudes.
POD is similar between land and sea areas at around 70%, but FAR is higher in sea areas than in land areas.

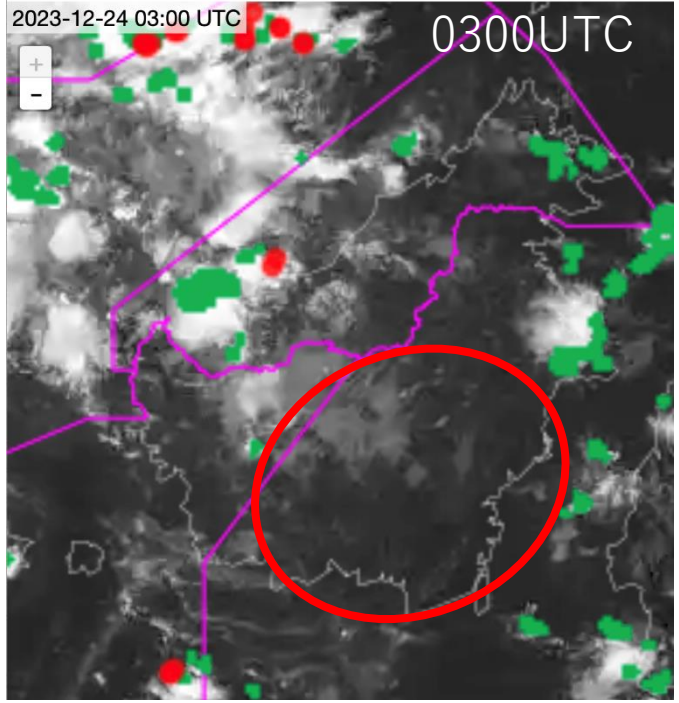
Case Study #1

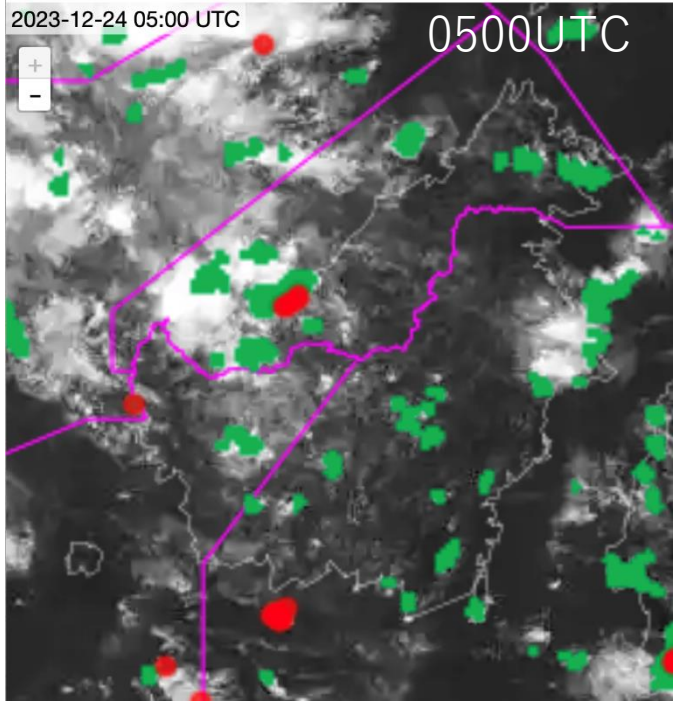


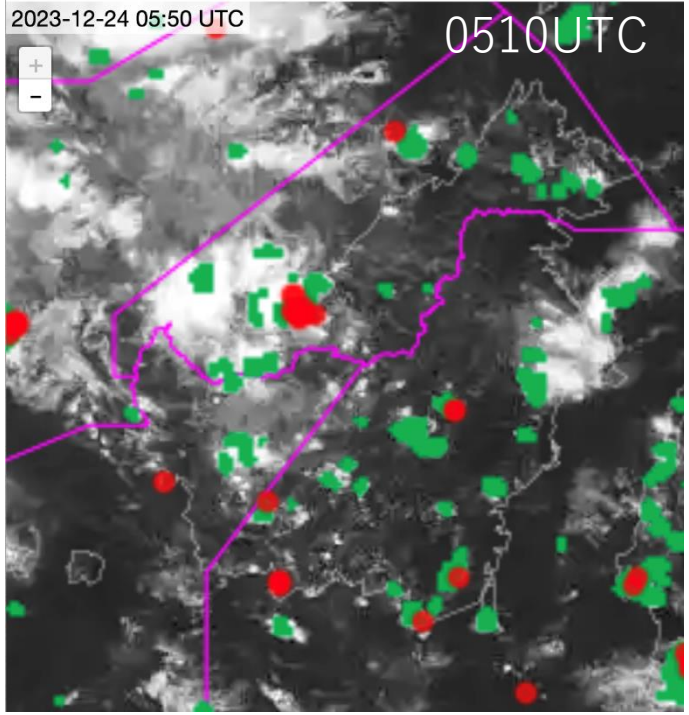
Kalimantan on 24 Dec. 2024

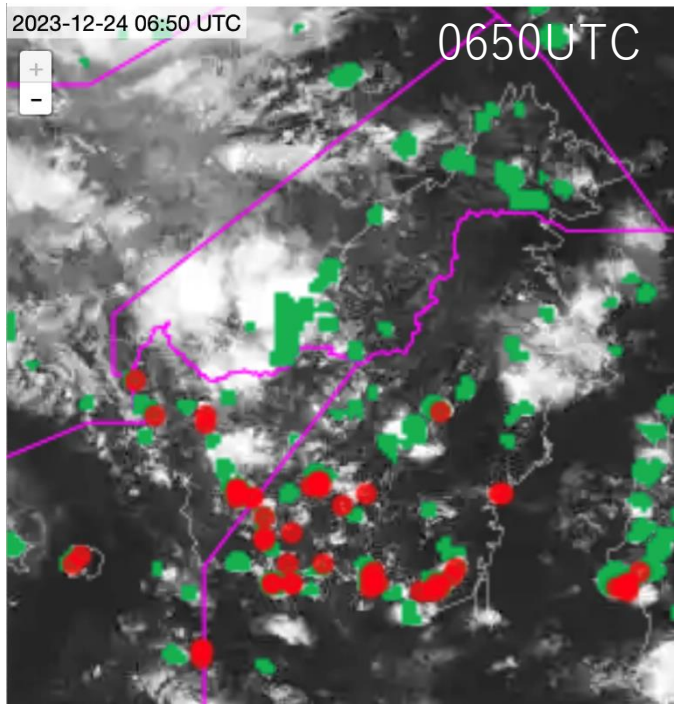
- Airmass thunderstorm in southern Kalimantan

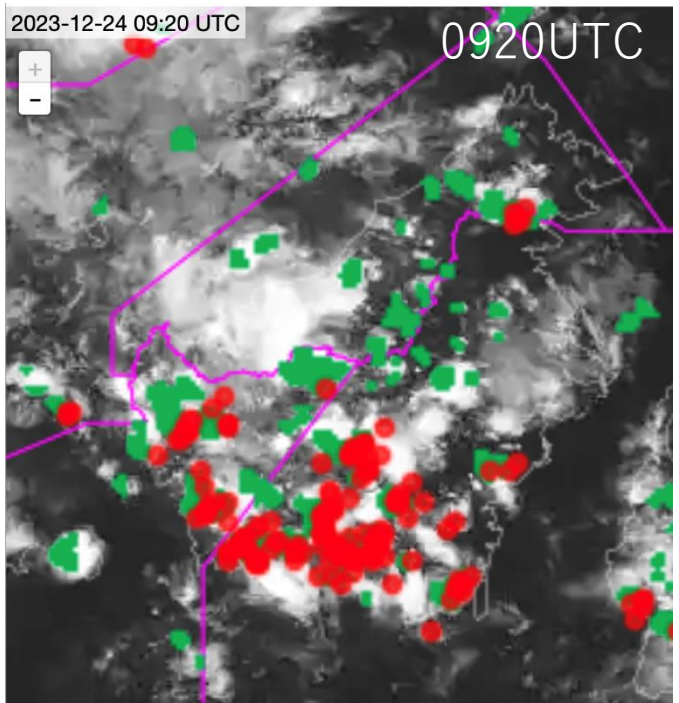
●: RDCA
●: Lightning





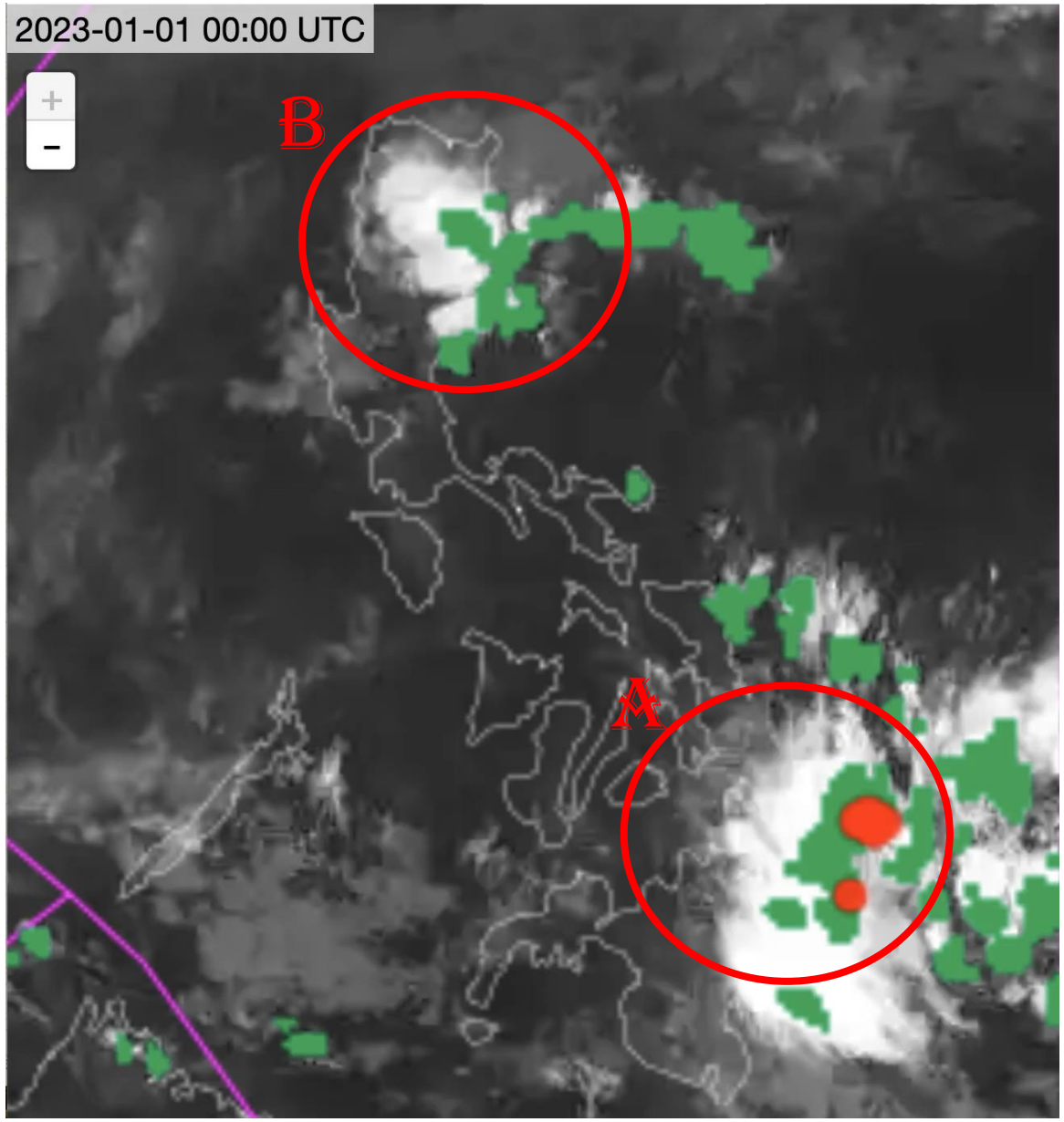






0300 UTC: No Convective Clouds
0500 UTC: Some RDCAs
0510 UTC: Some Lightnings
0650 UTC: More Lightnings
0920 UTC: Peak of # of Lightning

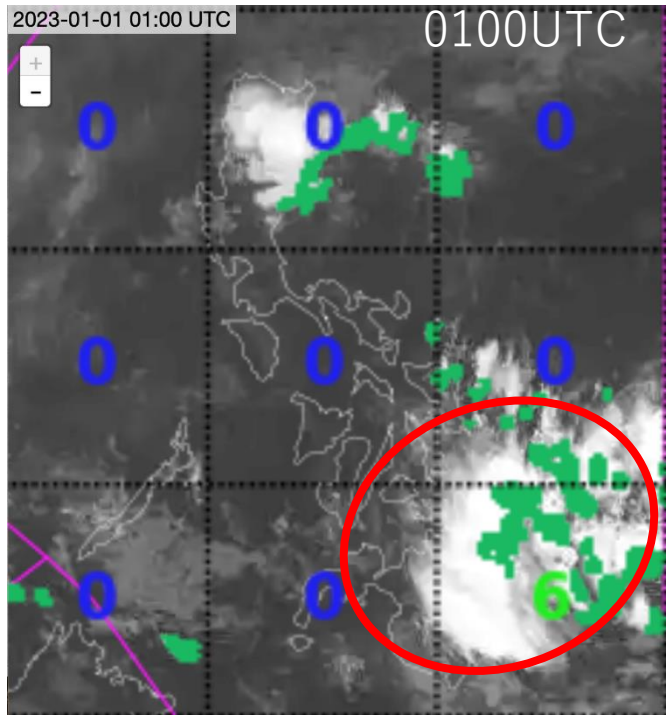
Case Study #2

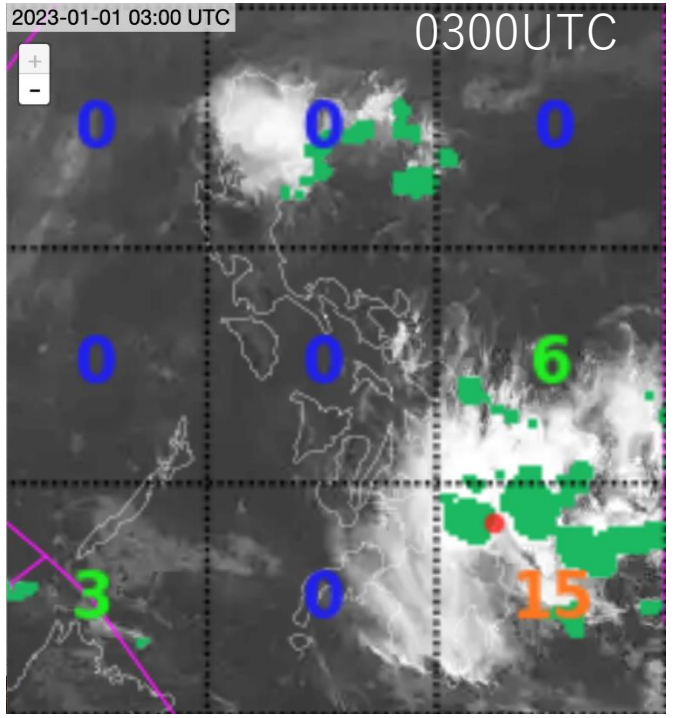


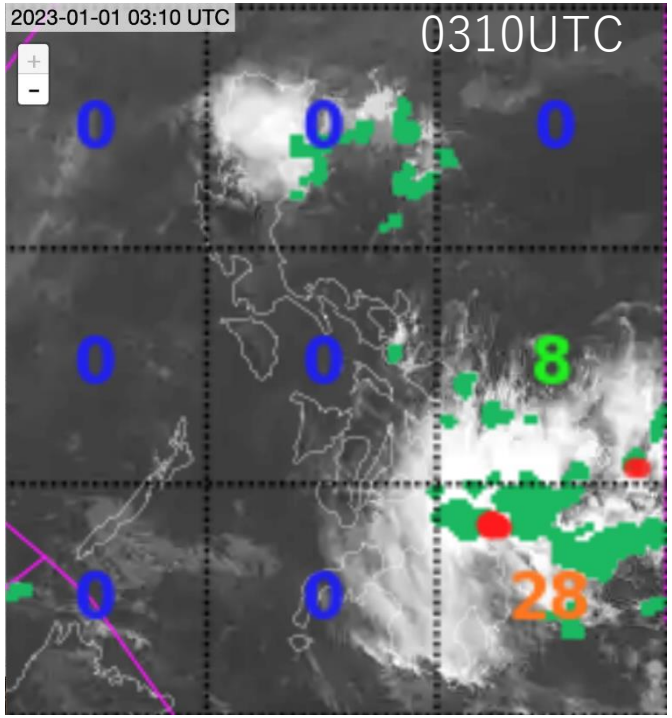
The Philippines on 1 Jan. 2023

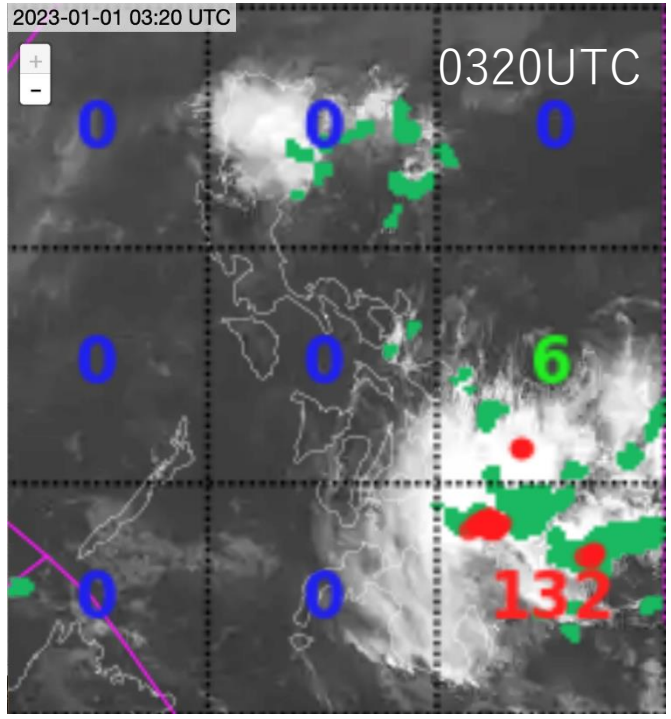
- Convective cloud advection and lightning (A)
- Convective cloud without lightning (B)

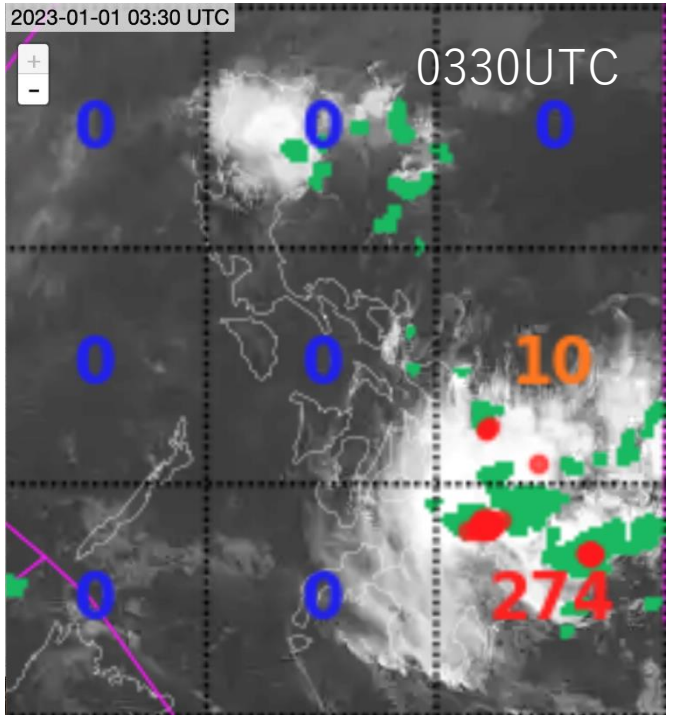
●: RDCA
●: Lightning



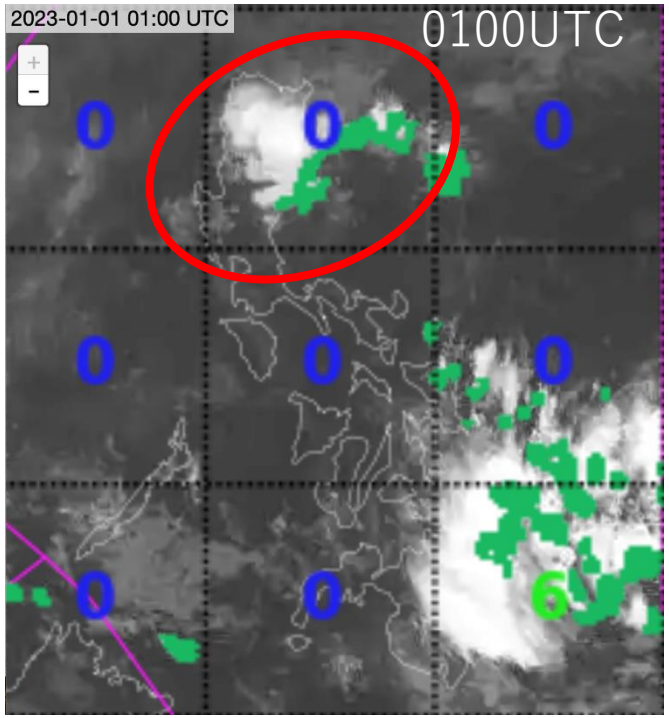


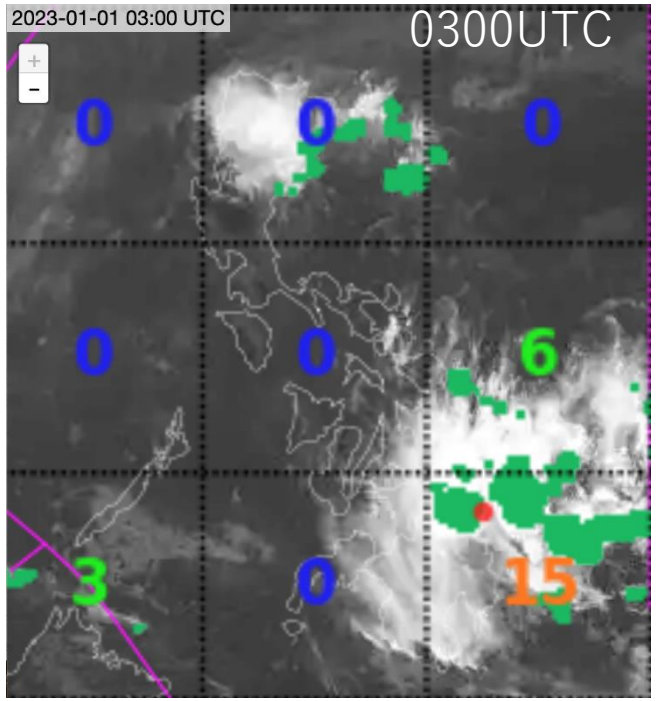




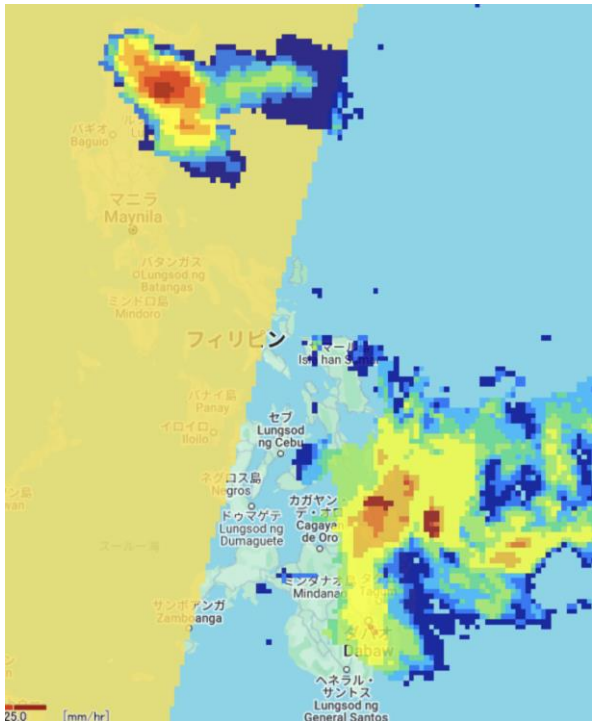


0100 UTC: RDCAs is on the east
0300 ~ 0330 UTC:
# of lightning increased all at one when convection clouds hung over the island.





GSMaP (0200-0259 UTC)



There was no lightning despite a cloud area with RDCA determination and high precipitation intensity by GSMaP from 0100 UTC to 0300 UTC.

Future Work

- RDCA determination technique has been transferred to Southeast Asian countries (Indonesia, Malaysia, Singapore, Thailand, Viet Nam) through bilateral cooperation and ESCAP/WMO Typhoon Committee project.
- In addition, the Philippines participated the project this year.
- We are grateful for the cooperation of these countries, and we will continue to work with them to further improve accuracy (especially in reducing FAR) by adjusting threshold values and re-selecting bands to be used.