The diurnal cycle of rainfall and cloud properties from Himawari-8 during the austral summer (2016-2020)

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INTRODUCTION

- The Maritime Continent is characterized by intense, deep atmospheric convection dominated by the diurnal cycle of rainfall. Sumatra presents a unique condition in the tropics. The geographical location on the western region of the Maritime Continent and the position of the Equator define the weather conditions associated with diurnally forced convection.
- Launched in 2014, Himawari-8 has been a revolutionary advance in geostationary satellite capability (Fig. 1). The high spatial (0.5-2 km) and temporal (10 minutes) resolution allow individual cloud targets to be observed in a near-continuous manner, enabling the study of the full lifecycle of the clouds, including their diurnal cycle.

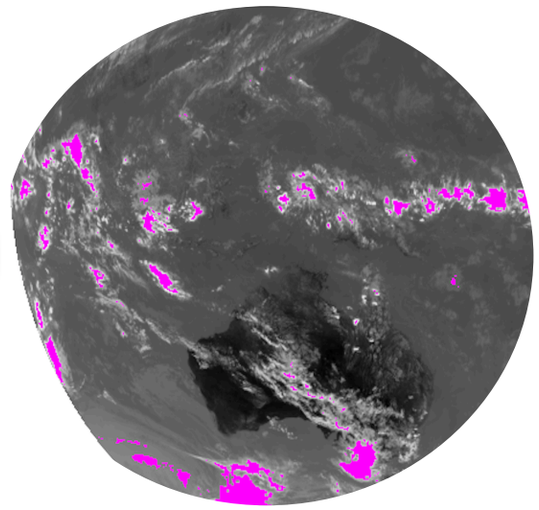

Figure. 1: Brightness temperature of 10.4 μm spectral band in shaded (Grey scale). Potential areas of rainfall associated with deep convective clouds in magenta.

MOTIVATION

The derived cloud properties from Himawari-8 AHI of five extended austral summers (November-March, 2015-2020), and satellite-based rainfall over Sumatra from the Integrated Multi-satellitE Retrievals for Global Precipitation Measurement (IMERG) have been analyzed to understand the characteristics and signatures of cloudiness at the diurnal scale over Sumatra.

METHODS

- Identification of satellite-derived potential areas of rainfall (RPA) from Himawari-8 GeoCat 1.0.3 Australian Domain Level 1 v1.0 (Lopez-Bravo, Vincent and Huang, 2021) based on thresholding in Fig. 1 (6.2, 10.4, and 12.4 μm (JMA 2015). Period: November-March, 2015-2020).
- Verification of RPA detection was performed by using satellite-derived rainfall from IMERG.
- Count of pixels that satisfy the condition of RPA (Himawari-8) and rainfall detection (IMERG).

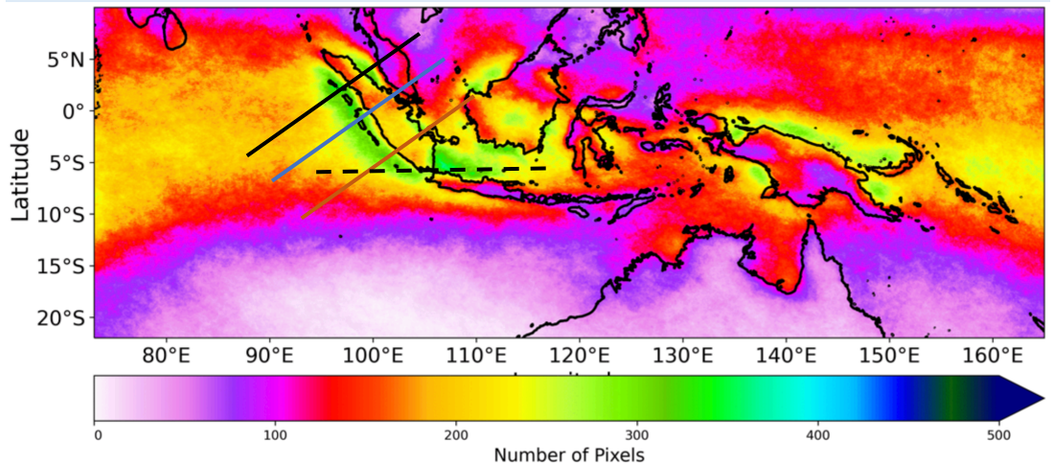

Figure 2: Diurnal cycle of cloud top associated with RPA. 00 UTC is shown to illustrate the diurnal cycle. Period: NDJFM, 2015-2020. Lines indicate the section in Fig. 3.

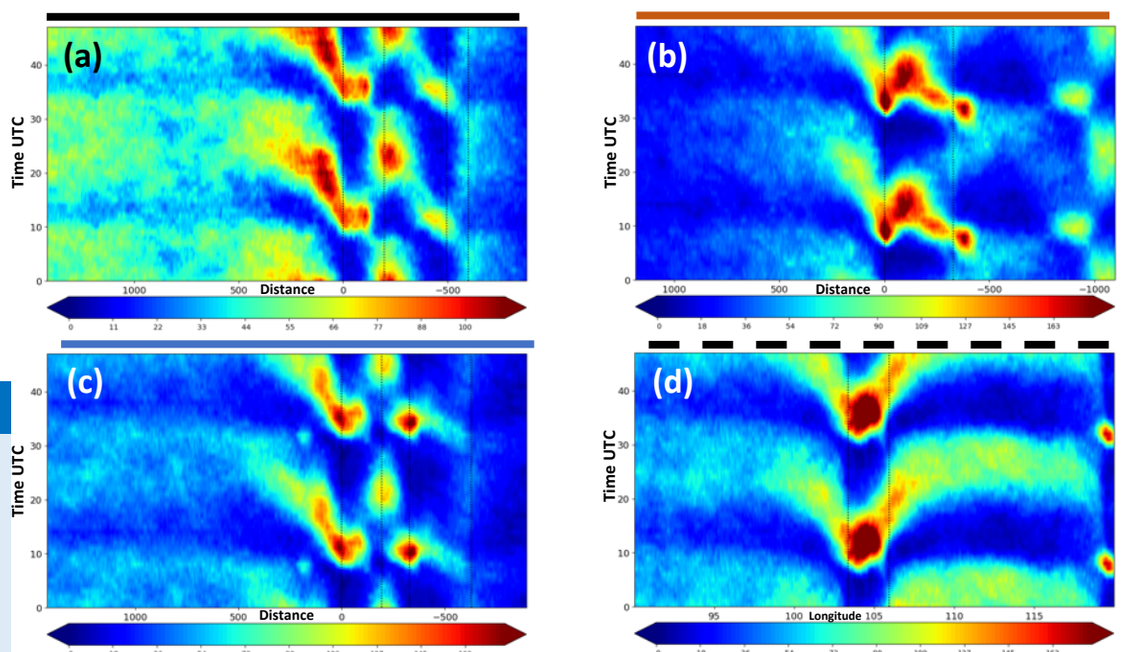

Figure 3: Number of pixels of RPA and rainfall events. (a) The northern region of Sumatra. (b) Central region. (c) Central-South, and (d) Java sea. Lines located above each subplot indicate the line colours in Fig. 2.

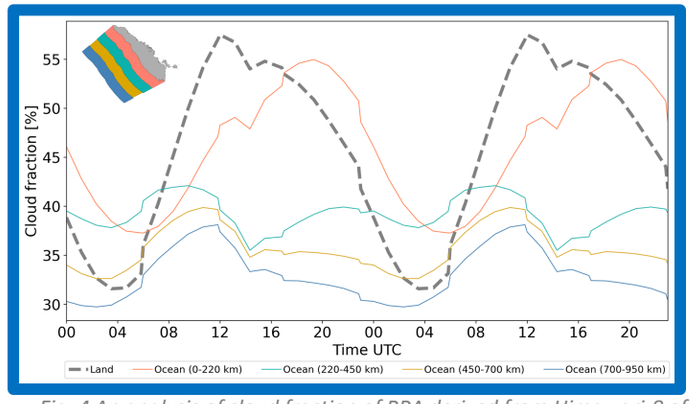

Fig. 4 An analysis of cloud fraction of RPA derived from Himawari-8 of NDJFM between 2015 and 2020 shows the diurnal cycle over Sumatra and the Indian Ocean over land (dotted grey line) and ocean (solid color lines).

RESULTS

The features of the diurnal cycle derived by satellite-derived from Himawari-8 show the diversity of diurnal responses across the Maritime Continent (Fig. 2).

The probability of detection between the detected cloud tops RPA and the estimated rainfall was approximately 81%.

The results show apparent differences in cloud population between islands, coastal and offshore areas.

Sumatra:
The West Coast exhibits a significant influence from the Indian Ocean (Fig. 4). That may affect the tropical land- and sea-breeze system (inertia–gravity wave and density currents mechanisms).
The East Coast can be described by the influence of the Malay Peninsula (Fig. 3a,b), Borneo (Fig. 3c), Java(Fig. 3d), and the influence of regional modulators of the diurnal variability, which results in an inhomogeneous structure of the cloud population linked with coastal activity in Sumatra.

FUTURE WORK

- ❖ A statistical analysis of cloud properties during the austral summer between 2016 and 2020 will be performed.
- ❖ Identification of background wind flow regimes. .
- ❖ Changes in the diurnal cycle amplitude and phase will be analysed when large-scale forcing drives the weather conditions such as active or inactive phases of MJO and equatorial wave modes.

Acknowledgements

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