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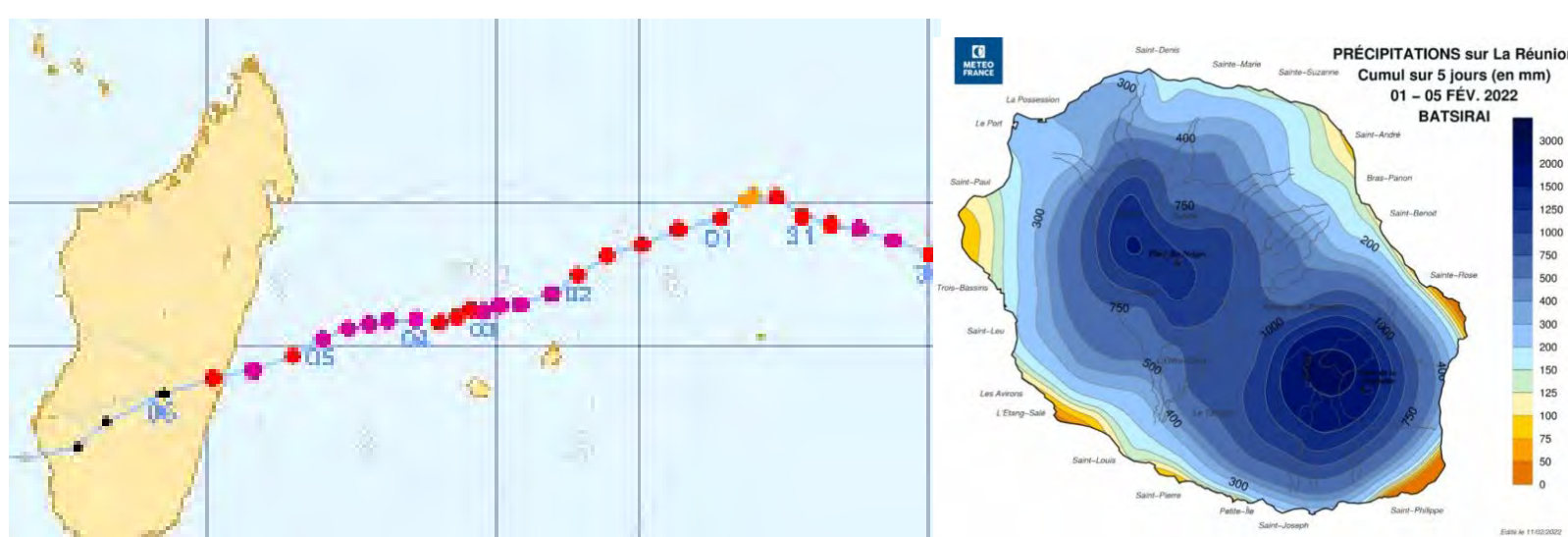
Dynamics of Orographic Precipitation Associated with the Passage of the Batsirai Cyclone nearby Reunion Island

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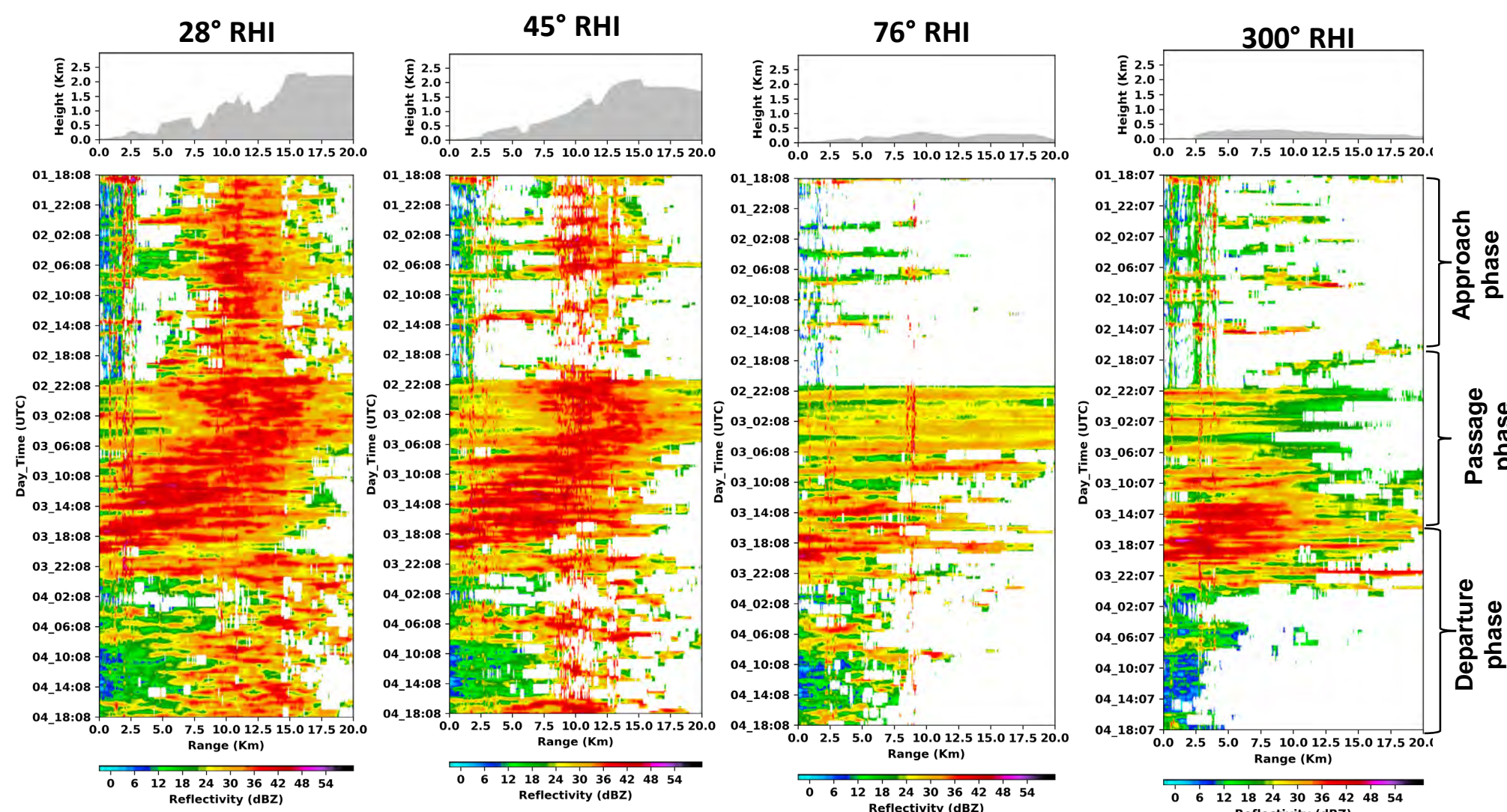
Background

- Reunion Island, known for its cyclone-prone nature and diverse topography, experienced significant impacts from Batsirai Cyclone between Feb 2-5, 2022.
- The cyclone's slow movement caused prolonged rain and wind, especially affecting the island's interior.
- Objective:** To study the dynamics of orographic precipitation associated with Batsirai cyclone through observed radar observations and modelled wind and mass fields.

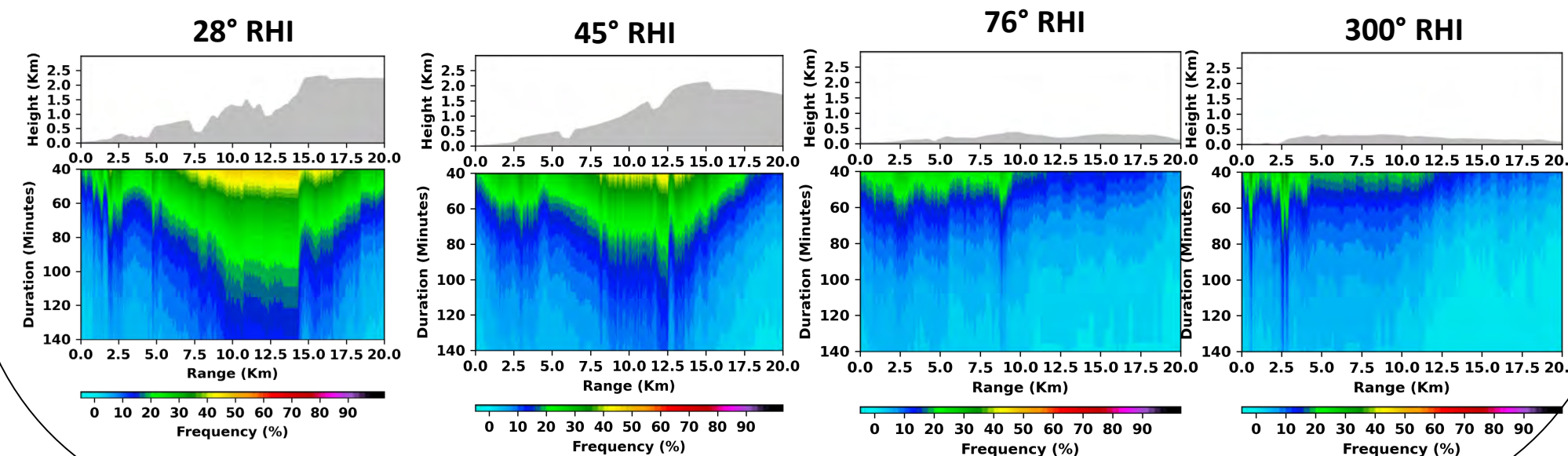


Signatures of orographic enhancement

- Throughout the lifespan of a cyclone, distinct variations in higher reflectivity become evident, especially exhibiting higher reflectivity over elevated mountains.
- The significance of orography in enhancing and sustaining precipitation is clearly observed.



Precipitation duration frequencies



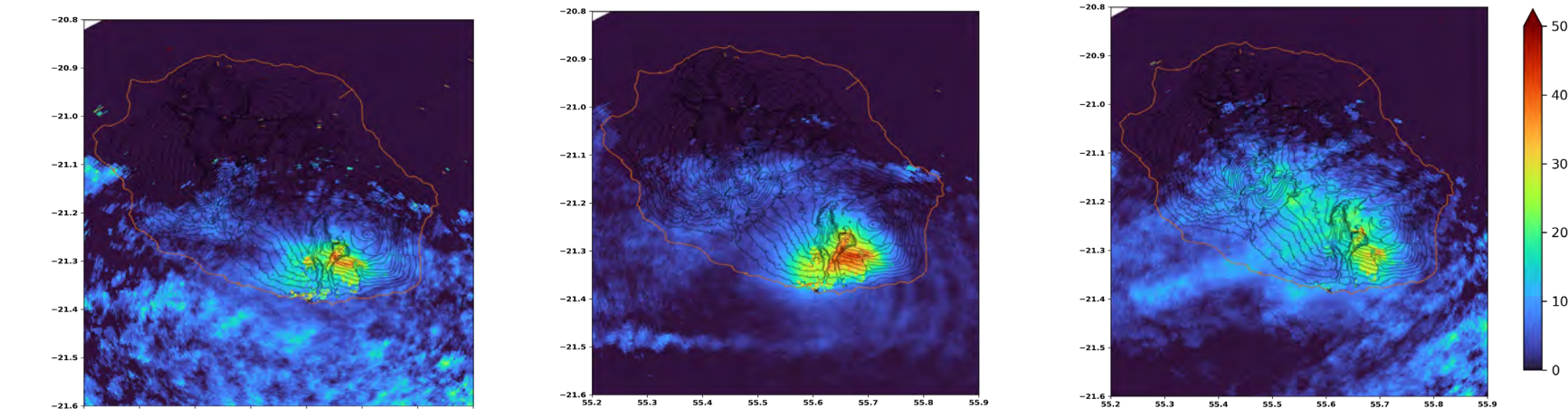
Reflectivity patterns across cyclone phases

Location frequency of intense precipitation

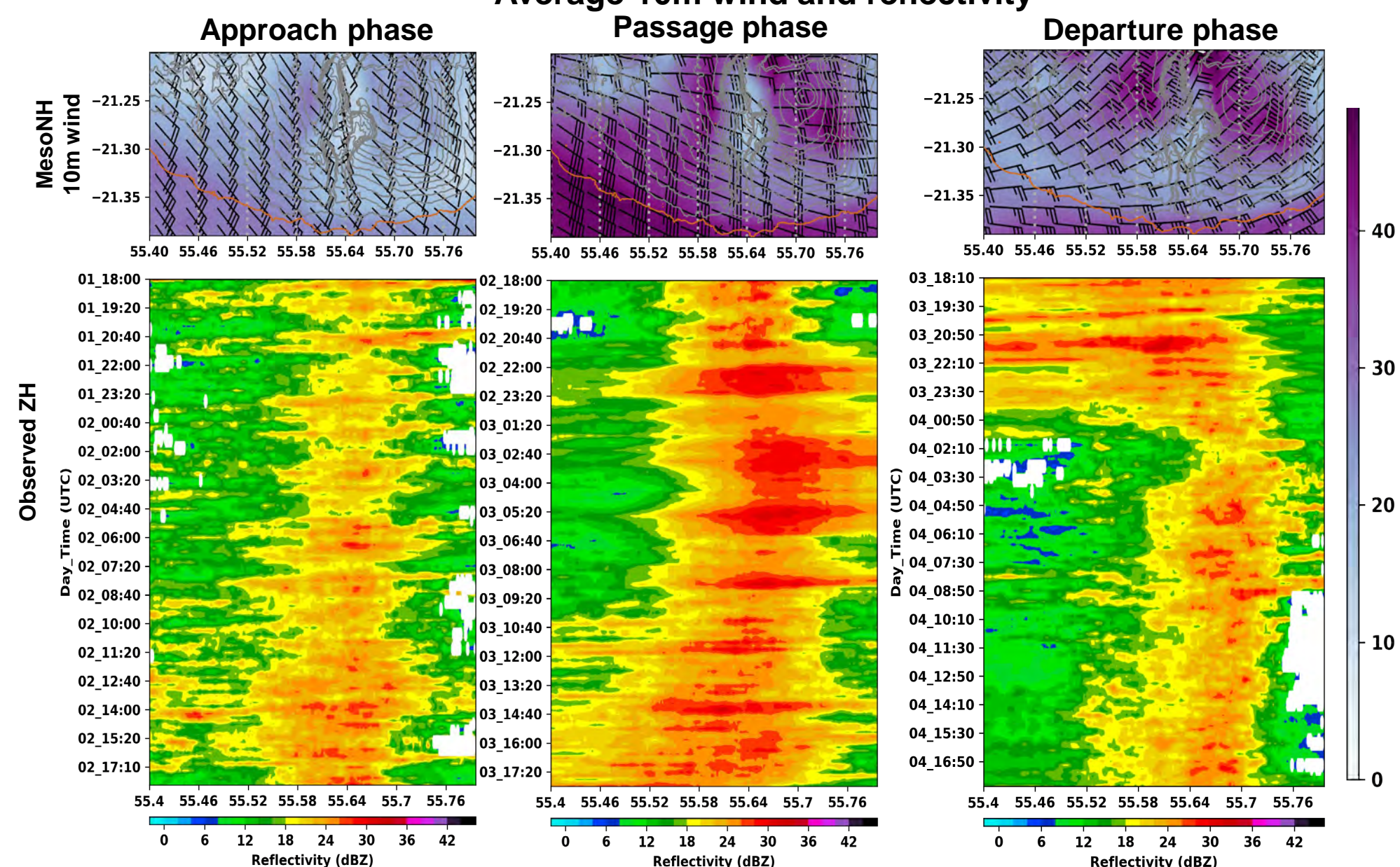
Approach phase
1 Feb 2022 18 -
2 Feb 2022 18 UTC

Passage phase
2 Feb 2022 18 -
3 Feb 2022 18 UTC

Departure phase
3 Feb 2022 18 -
4 Feb 2022 18 UTC



Average 10m wind and reflectivity



- The majority of elevated precipitation is consistently identified in the northeastern mountainous regions relative to the radar station.
- Wind patterns exhibit distinct changes throughout the cyclone's progression: originating from the southeast during approach, shifting to an easterly direction during passage, and altering to a northeasterly direction during departure. This dynamic wind behavior leads to a displacement of both the precipitation distribution,

Data and Methodology

❖ Dual polarization Doppler X-band radar :

- PPI's resolution : 125 m, range : 75 km, temporal resolution: 10 min
- RHI's resolution : 25 m, range : 50 km, temporal resolution: 20 min

❖ MesoNH (2 km model) : 10m wind simulation

- Howmoller analysis is used to visualise the evolution of preprocessed reflectivity observations.

- In the RHI scan, we select the maximum reflectivity values below 4 km altitude and aggregate them over the cyclone's lifetime.

- In PPI scans, we calculate the maximum values across 12 scan angles, average them by latitude, aggregate over cyclone phases, and compare with average 2km simulated wind.

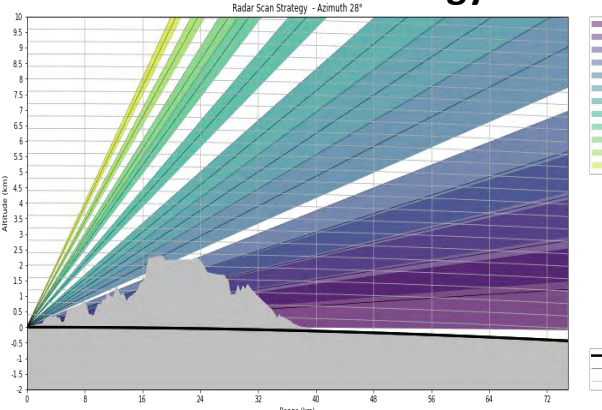
- Frequency analysis is utilized to estimate precipitation duration frequencies in RHI scans, and to identify frequent occurrences of maximum reflectivity above 30 dBZ in various cyclone phases during PPI scans.



RHI scan strategy



PPI scan strategy



Summary

- Analyzing the radar observations showed that the occurrence of high-intensity precipitation was influenced by the local topography, the movement of the cyclone, and its associated winds.
- Further comparison of observed reflectivity with 2 Km MESO-NH model wind fields revealed that the strong moisture-laden winds from the Batsirai cyclone impinged on the steep slope of Piton de La Fournaise volcano, inducing strong upward vertical motion and moisture convergence in the slopes of the mountain.

Acknowledgment

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