Microphysical Process Variability within Taiwan's Meiyu and Non-Meiyu Storms

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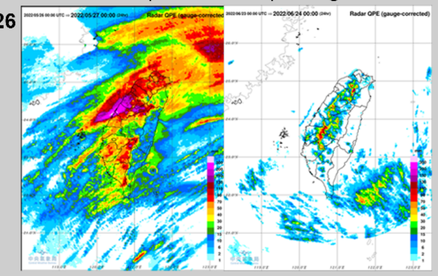
BACKGROUND

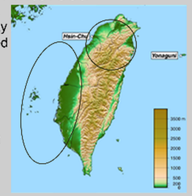
Motivation

- Extreme rainfall is a frequent occurrence in Taiwan and it is difficult to forecast.
- Understanding the processes that lead to extreme rainfall is a step towards improving forecasting.

5/26  6/23

Overview

- The Mei-Yu front is a quasi-stationary boundary in moisture and winds that leads to extreme precipitation in Taiwan's spring into summer.
- Times of interest:
  - Mei-Yu front storm on May 26 that rained over both mountains and coast
  - Non-Mei-Yu storm on June 23 that rained only over the mountains



Question/Hypothesis

- In Taiwan, how do Mei-yu precipitation processes differ compared to non-Mei-yu storms considering terrain elevation?
- Ice-based precipitation would be more prevalent in storms over high elevations, specifically mountains. This is inferrable due to there being less room for warm rain processes at higher elevations.

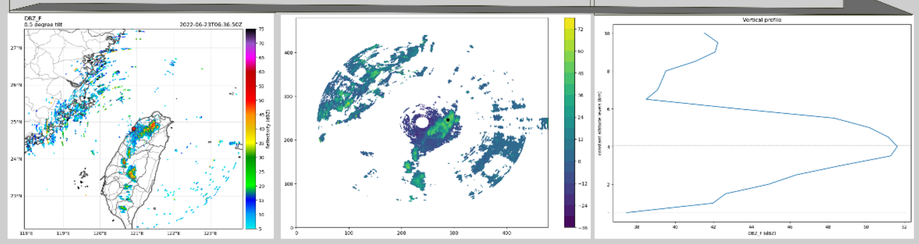
DATA AND METHODS

Radar Data Process

PPI (S-POL)
- Completely radial
- Top-down view

Gridded PPI (LROSE)
- Each point is 0.5 km horizontal by 1 km vertical

Vertical Profile
- Height vs. Reflectivity (also ZDR and KDP)
- At points >45 dBZ



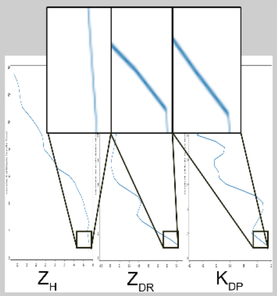
PRECIP 2022

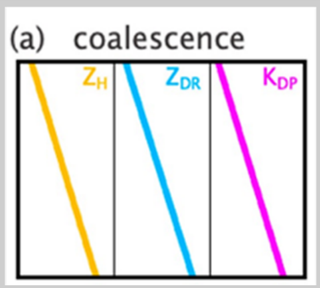
- Prediction of Rainfall Campaign In the Pacific
- Continuous S-POL from May 25th to August 10th

Methods

- Used two locations in two points in time during extreme rainfall events
- Utilized known fingerprints of precipation processes (Kumjian et al. 2022) within the 0.5 km to 4 km range

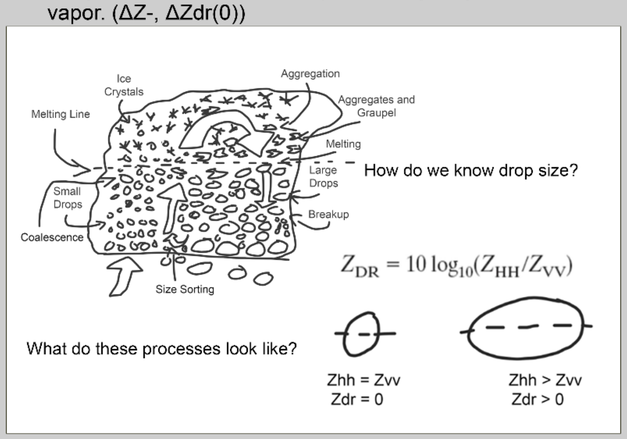
RESULTS

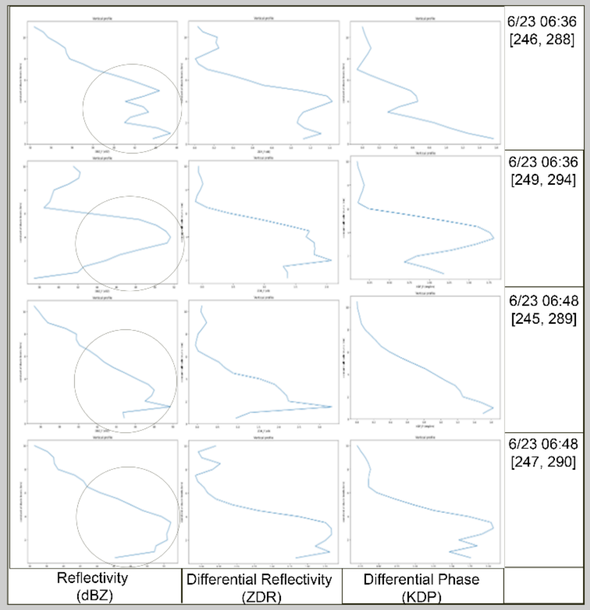




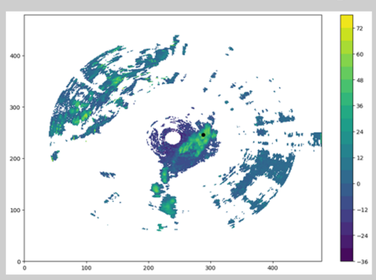
Precipitation Processes

- **Coalescence:** Drops may combine through collision which is augmented by convection. (ΔZ+, ΔZdr+)
- **Breakup:** Big drops may burst while falling because of their size. Many small drops will be produced. (ΔZ-, ΔZdr-)
- **Balance:** Coalescence and breakup are near equally prevelant. (ΔZ(0), ΔZdr(0))
- **Size Sorting:** Small drops rising or falling at different speeds than large drops (ΔZ-, ΔZdr+)
- **Evaporation:** As smaller drops fall, they may turn back into vapor. (ΔZ-, ΔZdr(0))





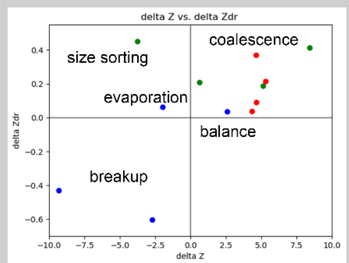
- June 23rd around 06:40 UTC
  - Reflectivity had very significant variability
  - Differential Reflectivity had significant variability
  - Differential Phase had significant variability



Profiles were taken at the black dot

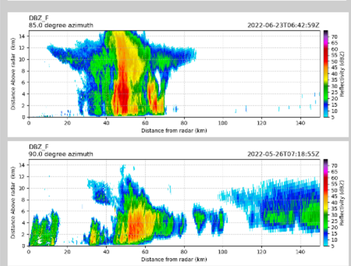
Phase Diagram

- The coastal case showed strong signs of coalescence, and they were consistent.
- When that storm was over the mountains, the signs it showed were quite variable. Signs of coalescence and size sorting were found.
- The mountain case mostly showed signs of breakup, with signs of evaporation mixed in.



Cases

- Coastal Mei-yu (5/26 09:00)
- Mountain Mei-yu (5/26 07:20)
- Mountain non-Mei-yu (6/23 06:40)



Comparison

RHI: 6/23 (top) extends up to about 15 km, and shows deep convection, while 5/26 (bottom) doesn't extend higher than 12 km. (Both mountain cases)

CONCLUSIONS

- **Coastal Mei-Yu:** Dominated by coalescence
- **Mountain Mei-Yu:** Varied, coalescence with some size sorting
- **Mountain Non-Mei-Yu:** Varied, breakup with evaporation and balance

Interpretation

- The Mountain Non-Mei-Yu case especially supports our hypothesis. Since breakup was the most prevalent process, its inferable that ice-phase processes were dominant due to big drops being just below the melting line.
- The Mountain Mei-Yu case showed some unexpected, yet very useful information. Looking at the comparison, convection wasn't deep in this case. Thus, ice-phase processes wouldn't dominate.
- The Coastal Mei-Yu case supported our claim as the warm rain process of coalescence was the most dominant.

ACKNOWLEDGEMENTS

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