Heating Profiles Derived From Cm-wavelength Radar During TWP-ICE

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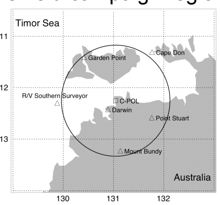
INTRODUCTION

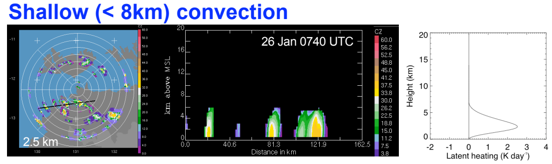
The Tropical Warm Pool-International Cloud Experiment (TWP-ICE) took place in Darwin, Australia in early 2006 in order to study the relationship between deep convection and its associated anvil and cirrus cloud. C-POL, BMRC's scanning 5-cm wavelength (C-band) polarimetric/Doppler radar, provided 3-D observations over the field campaign region. This study employs C-POL reflectivity measurements within a 120 km radius of the radar and with a 0 dBZ minimum threshold, allowing analysis of the horizontal and vertical structure of precipitation and thick anvil. TWP-ICE experienced three distinct regimes: a wet monsoon (active convection in northwesterly flow), a dry monsoon (suppressed convection in very strong westerly flow), and a break period (continental convection in easterly flow). We estimate the latent and radiative heating profiles associated with precipitating convection and thick anvil observed during each of these regimes using a statistical method in order to provide a first approximation of the separate components of diabatic heating of cloud systems that occur in the Australian monsoon.



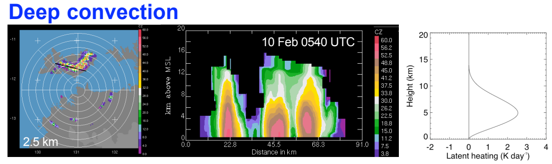
LATENT HEATING ESTIMATES

C-POL cross sections and idealized LH profiles

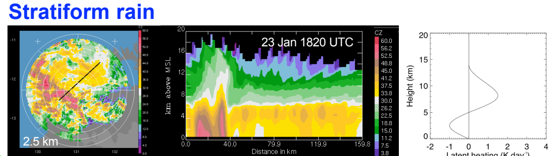
Shallow (< 8km) convection



Deep convection

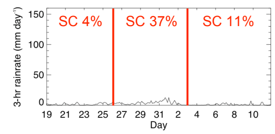


Stratiform rain

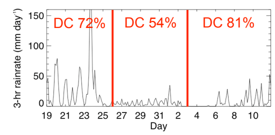


Inputs to calculation

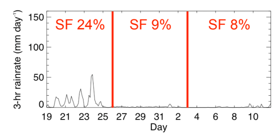
Shallow convective rain



Deep convective rain

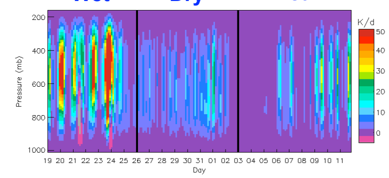


Stratiform rain



Latent heating time series

Wet **Dry** **Break**



Wet monsoon (38 mm day^{-1}) - Organized, longer-lived systems with sizeable stratiform rain amounts and more elevated heating

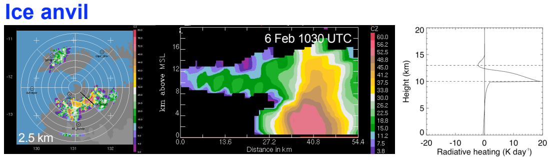
Dry monsoon (10.5 mm day^{-1}) - Weaker events with a large shallow convection component and lower level heating

Break period (8.5 mm day^{-1}) - Mostly deep convection with moderate heating at mid levels

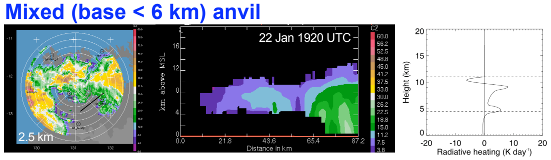
PRELIMINARY RADIATIVE HEATING ESTIMATES

C-POL cross sections and idealized RH profiles

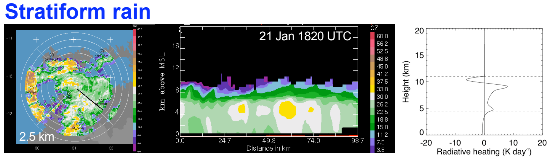
Ice anvil



Mixed (base < 6 km) anvil

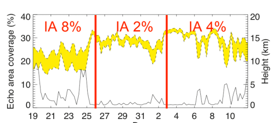


Stratiform rain

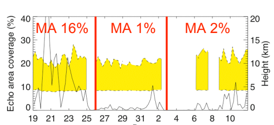


Inputs to calculation

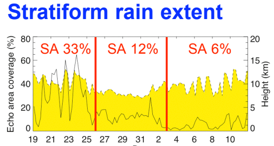
Ice anvil extent



Mixed anvil extent

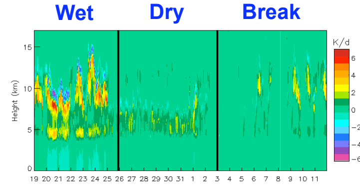


Stratiform rain extent



Radiative heating time series

Wet **Dry** **Break**



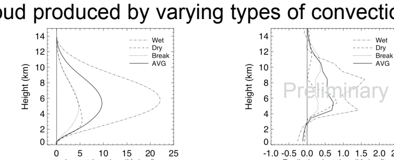
Wet monsoon (65% total echo coverage) - Stratiform rain and mixed anvil predominant with largest heating signal

Dry monsoon (19% total echo coverage) - Very little thick anvil production and upper level radiative heating because of shallow nature of convection

Break period (13% total echo coverage) - Ice anvil production preferred and more elevated heating

CONCLUSIONS

The average latent and radiative heating profiles for each regime are strongly related to the amount and area coverage of rain and thick cloud produced by varying types of convection:



- The wet monsoon had the strongest, most top heavy latent (> 20 K d^{-1}) and radiative (~1.5 K d^{-1}) heating because of the prevalence of MCSs that produce large amounts of stratiform rain and cloud.
- Deep convection and anvil production were suppressed during the dry monsoon, making the latent and radiative heating profiles bottom heavy and smaller in magnitude (e.g., 5 and ~1 K d^{-1}).
- Deep land convection during the break period caused a mid-level heating peak of 5 K d^{-1} and preferentially formed upper level ice anvil and thus more radiative heating (~0.5 K d^{-1}) above 11 km.
- Future work will refine the input heating profiles and apply the results to satellite radar observations.