The Centre for Australian Weather and Climate Research
A partnership between CSIRO and the Bureau of Meteorology

ACCESS evaluation of convective cloud system properties over the Northern Australian region

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Introduction

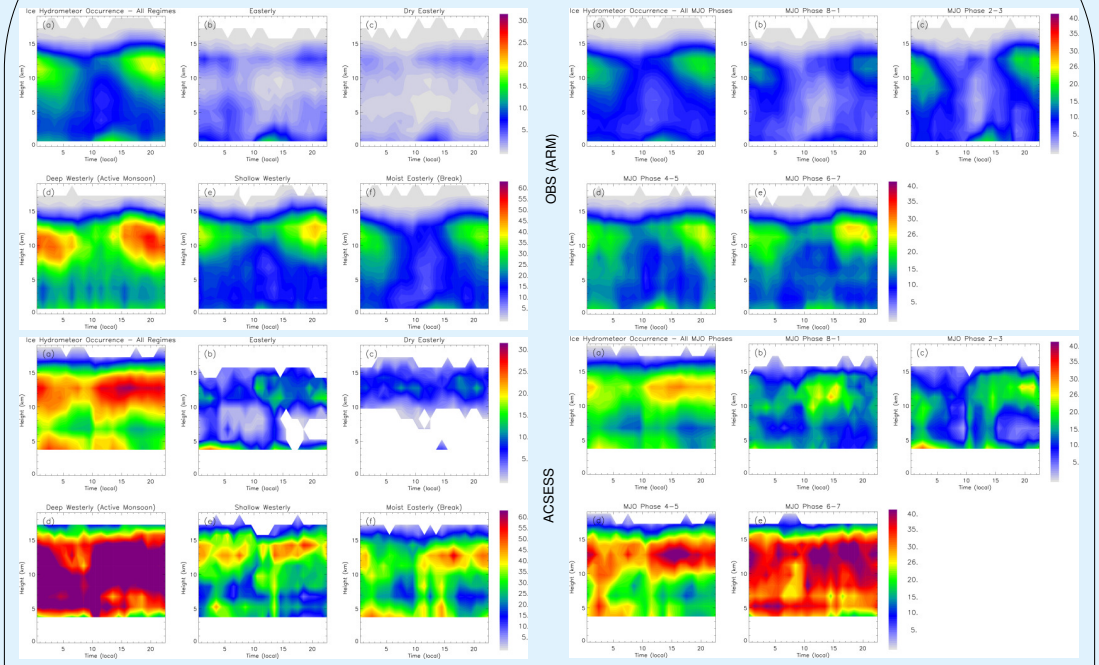
The aim here is to compare the cloud properties from the Australian ACCESS forecast model and the Darwin Atmospheric Radiation Measurement (ARM) cloud radar and lidar, and the C-band polarimetric radar (CPOL) Observations.

Variability of the statistical properties of convective clouds over Darwin is investigated in the context of large-scale atmospheric "regimes" as derived from the Darwin radiosoundings and different phases of the Madden-Julian Oscillation (MJO).

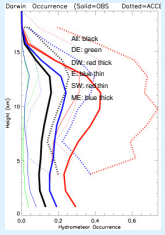
Vertical profiles of the frequency of occurrence of the convective clouds over a two wet seasons interval (2005-2007 for the OBS and 2010-2012 for ACCESS), together with the diurnal cycles are composited onto these large-scale atmospheric regimes and phases of the MJO.

Ice cloud properties at the Darwin ARM site (latitude: 12.425°S; longitude: 130.891°E)

Ice clouds occurrence frequency composited onto large scale atmospheric regimes and MJO phases from ACCESS and ARM radar and lidar observations at the Darwin ARM site for two wet seasons as described in *Protat et al. (2011)* is compared.



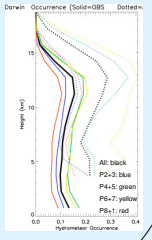
Occurrence frequency as function of Pope regimes:



A general overestimate of cloud occurrence frequency is observed in ACCESS with regards to observations, especially in the DW regime.

The diurnal cycle is well marked, peaking at the same heights, although the night peak occurs too early in the model (between 15:00-17:00LT compared to 17:00-23:00 in the OBS) and tends to persist longer.

Occurrence frequency as a function of the MJO phase



A general overestimate is also observed in ACCESS, whilst smaller than the Pope regimes.

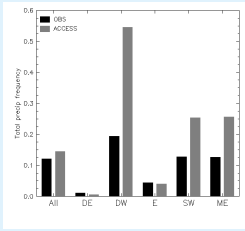
Peaks at same heights, with phase 1+8 lower than the others. The timing of the peaks is different from one phase group to the other and from the OBS:

OBS: phases 8+1 and 2+3 peak at night, after 20:00LT, the others peak before 20:00LT.

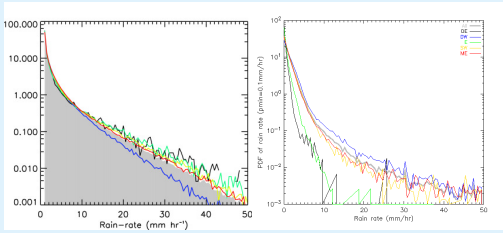
ACCESS: phases 8+1 and 4+5 peak around 15:00LT, phase 2+3 around 20:00 while phase 6+7 peaks around 12:00 and 17:00LT

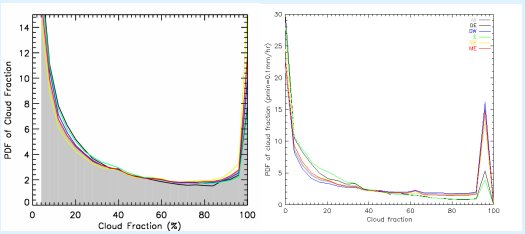
Convective precipitation and cloud properties over the area covered by the Darwin C-band polarimetric research radar (CPOL) radar (120km radius centered in Darwin)

Precipitation and convective cloud fraction occurrence frequency composited onto large scale atmospheric regimes and MJO phases from ACCESS and CPOL radar observations over the area of 120km radius centered on Darwin for two wet seasons as described in *Kumar et al. (2013)* is compared.



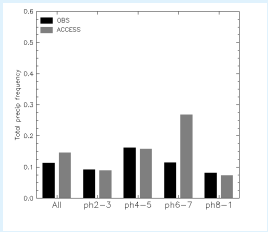
Precipitation frequency shows there is a factor of 2 in the SW and ME regimes and of 3 in the DW regime in ACCESS compared to the OBS.



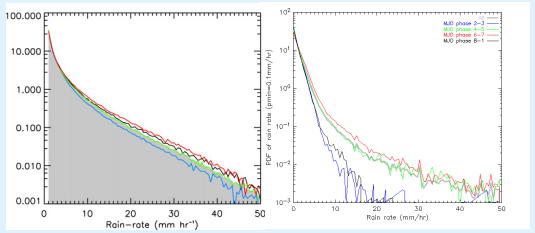


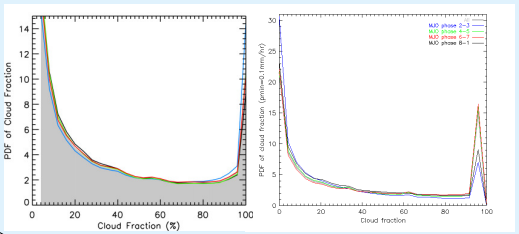
PDFs for precipitation show discrepancy between ACCESS and OBS. Only PDFs for SW and ME regimes tend to agree with the OBS. While in ACCESS, PDF for DE and E regimes are dominated by light precipitation (<1mm/hr) then quickly drops after 10mm/hr, in the OBS, the PDF remain above the mean for values >10mm/hr. PDF for DW regime remains above the mean for values >3mm/hr in ACCESS while it remains largely below the mean for values >10mm/hr in the OBS.

PDFs for convective cloud fraction show little variability among the different regimes, except at small (<4%) and large (>90%) values. Between these values, the distributions in ACCESS are comparable to those in the OBS.



Precipitation frequency is about half of those from the Pope regimes. Better agreement with the OBS, except for phase 6-7 which corresponds to the most likely and strongest rainfall events. This is consistent with the overestimate of the DW regime.





PDFs for precipitation show similar features as for the Pope regimes, with drier condition phase group (2-3 and 8-1) PDFs being dominated by light precipitation followed by a quick drop, unlike in the OBS. The other phases corresponding to wetter conditions are consistent with the OBS.

Same conclusions as for the Pope regimes on PDFs for convective cloud fraction can be drawn here for the MJO phases. Namely very little changes among the different phases except for the smallest and largest values.

Conclusion

Comparison of cloud properties produced in ACCESS and from the observations reveals a tendency for ACCESS to overestimate, especially during large-scale wet conditions. This is the case not only over the Darwin ARM site but also over the area covered by the CPOL radar.

At diurnal cycle, the frequency of occurrence of convective clouds tends to peak too early in ACCESS compared to the ARM observations although the proportion of the vertical distribution is in fairly good agreement. This strong bias is also observed in the diurnal cycle of the convective cloud system for all regimes. In addition, the diurnal cycle of model data reveals a notable occurrence of low-level clouds which is not seen in the ARM observations. These biases are observed as well in all of the large-scale regimes and MJO phases.