Shallow Structure and Organization under Suppressed Conditions in AMIE/DYNAMO

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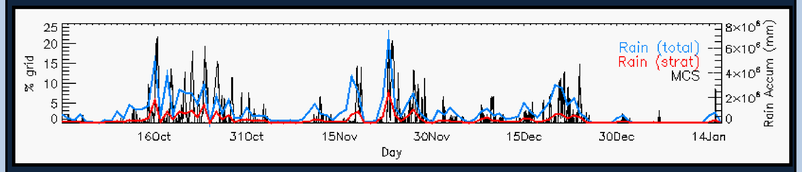
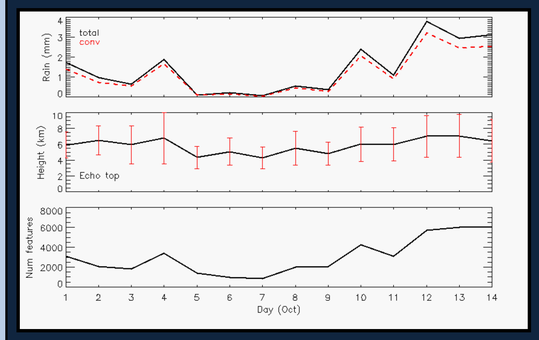
1. S-PolKa in AMIE/DYNAMO

A goal of S-Pol during AMIE/DYNAMO (Oct 2011 – Jan 2012) was to observe the convective population and its transition from shallow to deep with MJO phase. Three active phases were observed by S-Pol, separated by periods of suppressed conditions.



S-Pol is sensitive enough to detect non-precipitating clouds (minimum detectable reflectivity of roughly -20 dBZ at 10 km range) so it can be used to describe the organization and structure of boundary layer clouds during the build-up phases.

2. Suppressed Periods



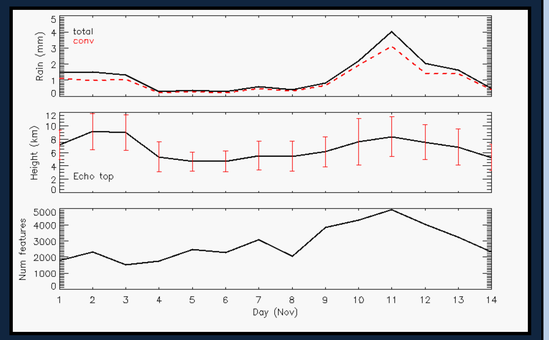
-Increasing rainfall (primarily convective), increasing echo-top heights, and increasing number of features (defined as contiguous grid points with reflectivity > 15 dBZ) with time (15 Oct start of active period/phase 1)

-Trend consistent with increasing mid-level moisture

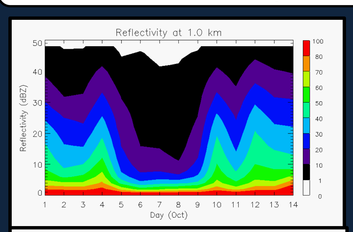
-Overall, similar trend in November as October with increasing rain, echo-top heights and number of features as near active period

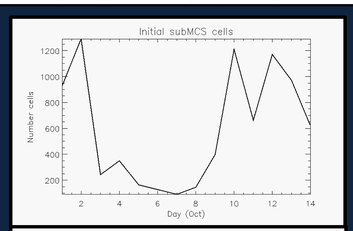
-MCS activity early (2-3 Nov)

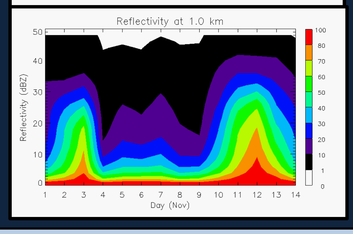
-Relatively inactive days just prior to start of active period

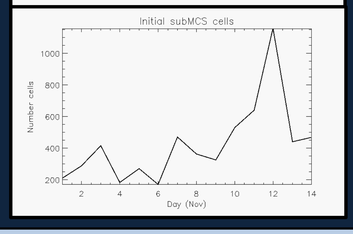


Track individual cells to determine times and characteristics of convective initiation (using TITAN-like tracking algorithm, defining sub-MCS features as those with major axes < 100 km, and convective cells determined by the Steiner et al. (1995) partitioning algorithm).

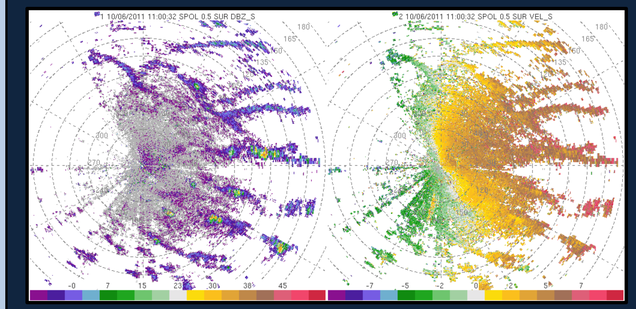








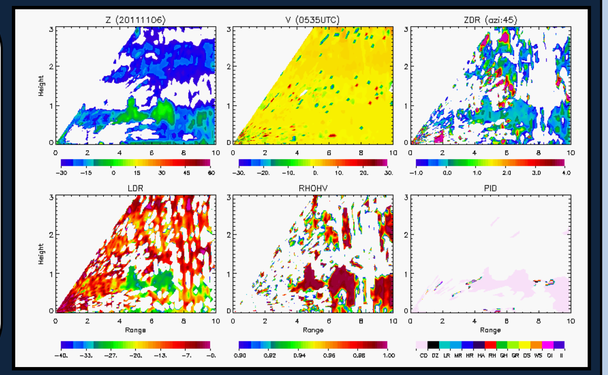
3. Cloud lines



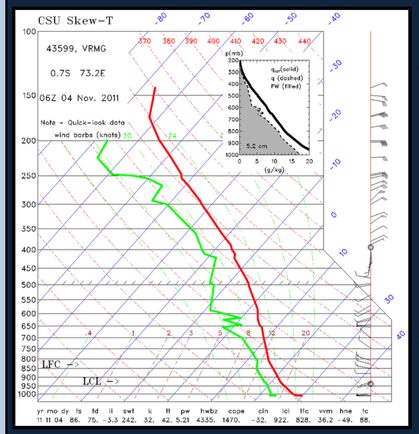
Periods when clouds oriented in lines parallel to the wind (e.g., 6 Oct (left), 4 Nov (bottom)).

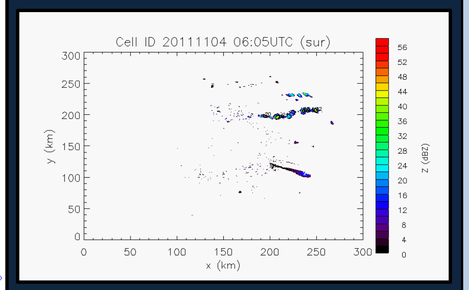
Convective initiation focused on these lines during the afternoon.

- Can observe characteristics of non-precipitating clouds forming along these cloud lines
-"Mantle echo" (Knight and Miller 1998)
-Entrainment and mixing at the tops and sides of thermals and plumes
-RHOHV near 1: homogeneous collection of scatterers
-ZDR near 0 dB: no particular orientation



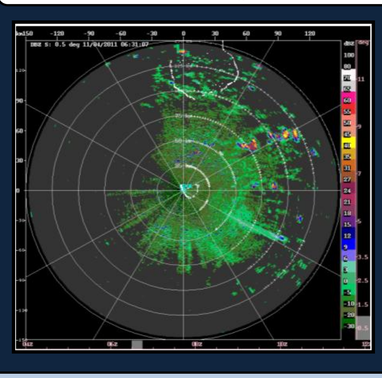
Example from 4 Nov shows relatively dry conditions throughout the column with weak surface westerlies and cells initiating along lines oriented parallel to the flow (similar to Oct example above)

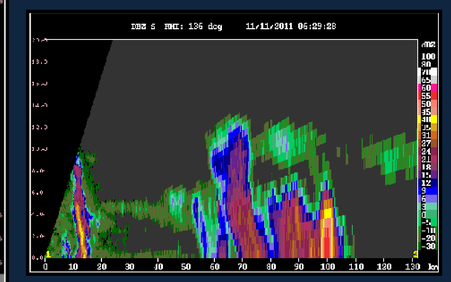




-Precipitating clouds developing along these cloud lines produced cold pools, eliminating lines

-Some new development along cold pool boundaries, but most convection shallow (dry mid-levels)



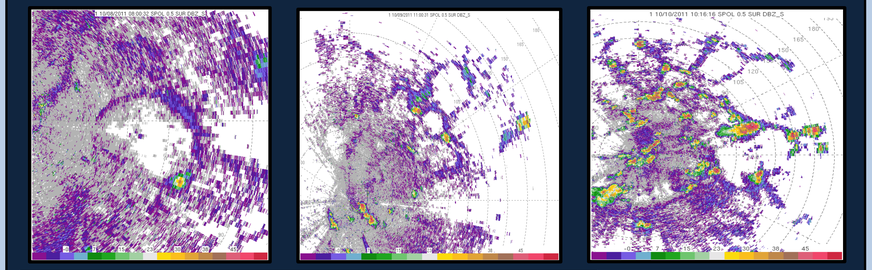


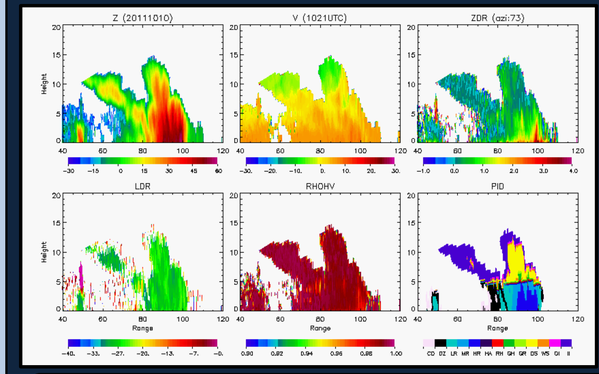
4. Cold pools

On 8 Oct 2013, dry conditions prevailed with a few shallow cells initiating along downwind edge of cold pool boundaries

On 9 Oct 2013, convective initiation at intersection of cold pool boundaries (more numerous than previous day, but echo top still < 6 km)

On 10 Oct 2013, convection again formed along intersecting boundaries (more numerous, persistent, and deeper than previous days)

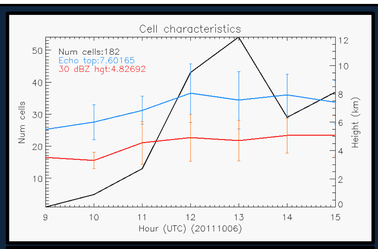


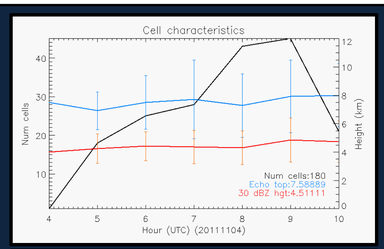


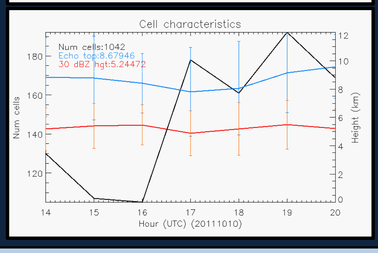
An RHI through the cell to the ENE of the radar on 10 Oct shows convection reaching 15 km in height, producing heavy rain with large drops and graupel within 1-2 km above the melting level.

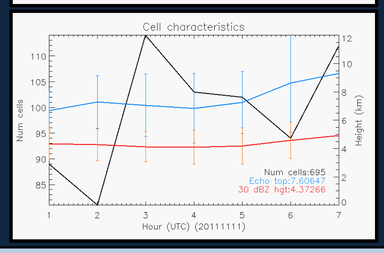
As the cold pool from this cell continued to spread, new initiation was focused on the edge of the gust front to the west that converged with the mean low-level flow.

More numerous cells identified (and deeper) during later parts of suppressed periods of Oct/Nov as convection initiates at intersecting outflow boundaries









5. Work in progress

-Characterize cloud lines, relate to environmental conditions, and properties of non-precipitating clouds that form along these lines

-Use KAZR observations to help fill in details for initial precipitation formation

-Describe characteristics of the cold pools including radius, duration, polarimetric signatures, convective initiation and relate to observations of cold pools passing over ARM site on Gan (work with Zhe Feng/PNNL modeling component)

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