STUDY OF PHYSICAL PROCESSES OF PRECIPITATION USING A VERTICAL POINTING MICRO-RADAR

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Precipitation processes are important for climate change assessment, hydrological cycle studies, and aviation applications. Hydrometeorology studies can lead to quantitative precipitation predictions using models for forecasting flood occurrences. This project investigates if there is homogeneity in rain drop size distribution from the radar observations during rain events over space and time. Drop size distribution has been used to study rainfall events for over half a decade. These studies have over the years improved the accuracy of estimates of rainfall using the vertical pointing Micro-Rain Radar-2 (MMR). Seven years of MRR data are used to investigate the variability and main characteristics of Radar reflectivity, liquid water content, rain rate, and fall velocity at different measuring heights to investigate any changing relationships in these parameters at different heights (100m, 200m, 500m, 1000m, 1500m, 2000m, 2500, 3000m). One preliminary finding suggests a correlation between liquid water content and rain rate between 100m – 500m while there was no correlation at heights higher than 500m.

Surface Climatology Relationship with Fast-Ice in the McMurdo Sound, Antarctica

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McMurdo Sound is located in Antarctica’s Ross Sea and embodies a significant oscillation of fast-ice with a recurrent quasi-annual cycle. Although various types of ice exist in Antarctica (e.g. pack-ice or glaciers) fast-ice creation and destruction is postulated as better capturing climate trends. Surface climate patterns show little connection to overall fast-ice retreat. Excluding seawater associated variations that likely contribute to fast-ice formation and melting, surface atmospheric variability in wind direction, wind speed, and air temperature do influence fast-ice retreat when wind directions and speeds experience greater variations. This study is based on 8 summers of fast-ice extent measurements and correlating them to atmospheric observations at two ground stations; the McMurdo basecamp and the Marble Point camp. Qualitative findings show annual difference in McMurdo Sound’s annual variabilities in wind direction and speed when correlations across climate collection camps show weakly correlation with temperature implying forcing by other effects. While eight years of data is rather limited to study trends, our results suggest that factors other than local winds and temperature are important. This study emphasizes the need to extend the record of fast-ice observations to better characterize climate trends across the McMurdo Sound in Antarctica.
Estimating discharge on the Mississippi river using satellite remote sensing

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The accurate measurement of river discharge is essential to water supply planning, flood prediction and understanding the global water cycle. However, in many parts of the world river discharge information is not available due to cost or accessibility is prohibited. My approach links remotely sensed data to those used in the standard discharge equations through relationships derived from USGS gage stations on the Mississippi river as a reference. The river width will be measured using Dynamic Surface Water Extent (DSWE) a U.S. Geological Survey (USGS) Landsat based product. The water surface height and slope measurements will be derived from the Jason-2 satellite altimeter. I will apply the fundamental equations of hydraulic flow resistance, and Manning’s equation to estimate the river discharge. My interest in using remote sensing to accuracy evaluating river discharge will be useful to flood prediction and provide water monitoring to those areas where in-site observation is still an issue. Furthermore using remote sensing to determine discharge could supplementary and provide useful information about the globe hydrological cycle.

Fault-related Reservoir Compartmentalization in the Oligocene Vicksburg Formation, Brooks County, Texas

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Growth faulting is common in passive margins as lithostatic overburden induces subsidence and continuous sedimentation. The presence of a glide plane favors the rotational movement of depositional strata, causing a series of normal faults that extend basinward. With incipient deposition, these growth faults tend to migrate basinward, together with the progradation of sediments. Over time, as the fault density increases, portions of what once was a continuous reservoir might become isolated. In case compartmentalization completely develops, specific portions of the reservoir may develop pressures that are completely different from adjacent parts of the target interval.

In the Gulf of Mexico Basin, various siliciclastic sedimentary successions were deposited during the Cenozoic. In particular, the Oligocene Vicksburg Formation corresponds to a deltaic depositional environment and exhibits large fault offset that induced the juxtaposition of reservoir and non-reservoir quality rocks. We hypothesize that reservoir compartmentalization is promoted by growth faulting, especially in the distal parts of the Vicksburg delta system where lithostatic overburden is the greatest. An understanding of the behavior and potential for accumulation of fault-driven isolated reservoirs in siliciclastic depositional environments could permit greater recovery of hydrocarbons and other fluids accumulated within reservoirs compartmentalized by growth faults. In order to determine how the potential of growth faulting to restrict fluid flow, two main goals will be accomplished. First, faults within the Vicksburg Formation in Brooks County will be mapped using 3D seismic data. Second, the sealing potential of the aforementioned faults will be tested through an analysis of reservoir juxtaposition and fault smearing.