Geophysical Research Abstracts
Vol. 12, EGU2010-6975, 2010
EGU General Assembly 2010

Precipitation Dynamics and Feedback mechanisms of the Arabian Desert

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The subtropical Arabian desert extends across the entire Peninsula. The Arabian desert finds itself in the downward branch of the Hadley cell with persistent subsidence. This stabilizes the atmosphere and lowers the relative humidity. The result is a strongly capped convective boundary layer and an extremely dry mid troposphere. Most of the area experience very little rainfall, generally below 100 mm per year, resulting in the largest uninterrupted sand desert in the world. However, local factors such as an unbroken 1000 km escarpment along the Red Sea, rocky mountains between 2000 and 3000 m, and gravel plains cut by wadis, causes micro climates with significant altered precipitation characteristics.

Altitude oases with annual rainfall between 200 mm and 500 mm are found on the Asir mountains in the south west and over the Jebel Akdhar mountains on the Gulf coast of Oman. This region receives most of its rainfall in the Northern Hemisphere summer driven by a monsoon trough and the ITCZ. During summer, moist surface winds from the Red Sea converges with dry easterlies triggering convection along the Asir escarpment on a daily basis. Clear mornings grow into a layer of Altocumulus stratiformis cumulogenites by noon, which usually last until sunset. This cloud deck interacts with large severe convective cells which grow to the top of the troposphere by mid afternoon.

The north experience a mediterranean climate with eastward propagating midlatitude cyclones causing wintertime rainfall. Characteristic cloud bands form over the northern interior. Vertically layered embedded convective cells that are not coupled with the surface propagate on north easterly tracks. This result in another oasis with annual rainfall exceeding 200 mm. Surface based convection causes isolated thunderstorms during spring and early summer, but cloud bases increase as the season progress until the evaporating downdraft causes dust storms.

In-situ measurements, WRF model runs, radiosonde ascends, radar and satellite data are used to explore these dynamics and the associated feedback mechanisms of precipitation over the Arabian desert.