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Impact of Foehn and radiative warming across McMurdo Dry Valleys of Antarctica during austral summers

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McMurdo Dry Valley (MDV), the largest Antarctic oasis spanning around 4800km, is a hyper-arid desert with annual precipitation less than 50 mm yr^{-1}. Frequent Foehn events over MDV impact its climate throughout the year causing sudden rise in the air temperature across the valleys. This process is more evident during summer when high frequency Foehn events lead to rise in glacial melt and consequent flooding of the MDV ephemeral streams. These streams harbour Cyanobacterial mats and associated heterotrophs which are the only life forms which survive MDV's extreme climates and flourish during the austral summers. Foehn are valley wide events that affect MDV over very large spatial scale. Previous studies done to understand the origin and impact of Foehn are mostly limited to data from few automated weather stations installed at multiple locations in MDV or modelled weather data from Antarctic Mesoscale Prediction system due to limited access to the region. In these scenario satellite remote sensing is utilized as a useful tool in understanding impact of Foehn over a large spatial and temporal scale across MDV.

The study utilizes Land Surface Temperature data from MODIS to understand the spatial changes occurring in MDV during Foehn events. The higher temperatures in MDV over summer can be explained by seasonal changes in radiative heating from incoming solar radiation. Both solar radiation (cloud cover) and Foehn frequency over the austral summer play a major role in determining the climatic conditions in MDV. The changes in LST based on intensity of Foehn and incoming solar radiation provide a useful tool to understand spatial variability in warming across MDV during Foehn and no-Foehn event.

Sudden spikes can be seen in LST across MDV during Foehn events, it is due to rise in the valley floor temperatures as result of introduction of warmer air from upper atmosphere. Results also show that there is a high spatial variability in warming. Spatial variability in warming patterns across MDV is controlled by topography, land cover, solar radiation and variability in onset and intensity of Foehn events experienced by each location. Various location of MDV have different surface energy budget depending on the land cover and the solar radiation they receive during summer which effects the unevenness in warming due to radiative flux in the region. Foehn frequency across MDV is highly variable due to synoptic scale climatic conditions across Ross sea region that cause genesis of Foehn events and also the interaction between easterly and westerly winds which causes inconsistencies in wind dynamics across MDV leading to variability in warming experienced by each location in MDV due to Foehn. Variability in LST values across MDV throughout the summer season helps in understanding these inconsistencies in warming pattern and the role played by solar radiation, topography and Foehn in influencing those.