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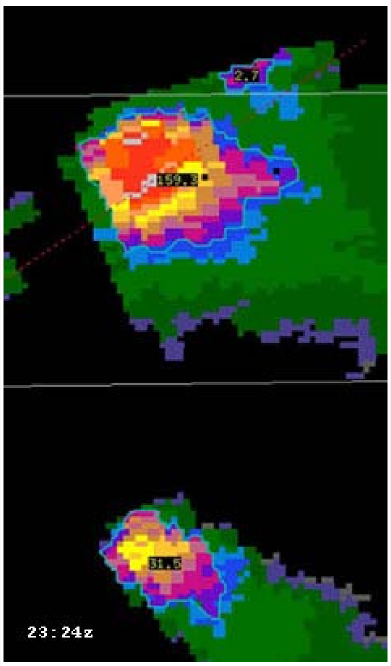
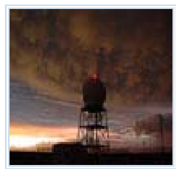
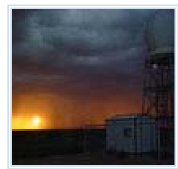
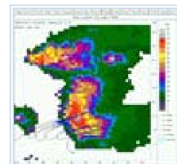


Weather Radar

C-band (5cm wavelength) Radar







C-band radar is a useful tool for the real time detection of convective clouds, their position and their movement. Radar has been identified as the primary tool utilized to conduct airborne cloud seeding operations. The basic radar displays echoes on the Plan Position Indicator (PPI) scope, which gives a horizontal cross section as the radar sweeps through each 360^{o} revolution at a fixed elevation angle. The Radar Data Acquisition System (RDAS) is interfaced with each radar operating in volume-scan mode. Under the control of RDAS the radar normally will complete a series of 360^{o} sweeps at increasing elevation angles in 3 to 5 minutes. The raw data stream is fed into RDAS where it is processed and then exported to a TITAN Linux workstation that runs TITAN. TITAN permits the radar operator to examine the three-dimensional structure of echoing clouds in real time, therefore allowing the Project Meteorologist to vector aircraft in and around echoing convection. Radar is also useful in estimating rainfall because it provides rainfall data that is equivalent of a very dense gauge network (one data point every square kilometer). Radar estimation of rainfall is, however, a complex undertaking involving determination of the radar parameters, calibration of the system, anomalous propagation of the radar beam, ground clutter and “false rainfall”, concerns about beam filling and attenuation, and the development of equations relating radar reflectivity (Z) to rainfall rate (R), where radar reflectivity is proportional to the sixth power of the droplet diameters in the radar beam.

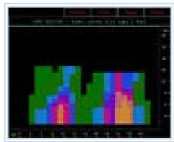
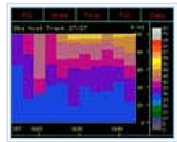
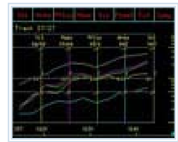
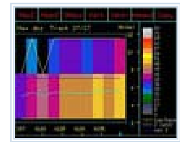
NEXRAD (10cm wavelength) radar

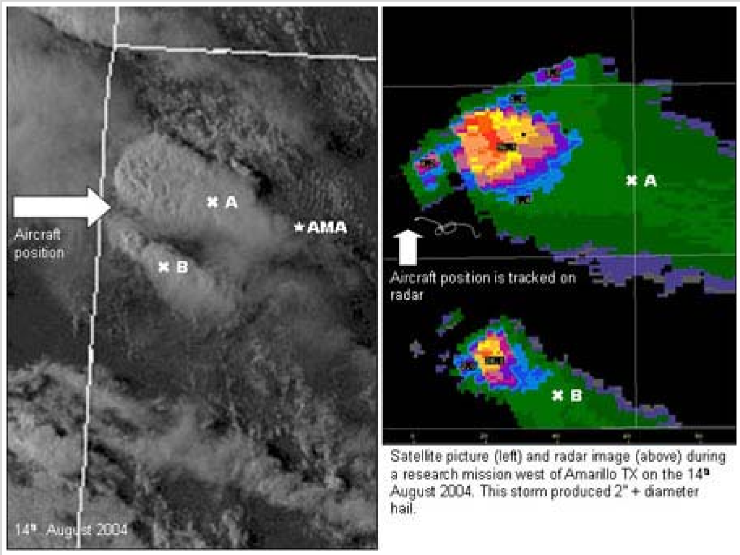
Another option for the conduct of airborne cloud seeding operaions is the WSR-88D National Weather Service (NWS) S-band (10 cm wavelength) Next Generation Weather Radar (NEXRAD). NEXRAD is a 10 cm radar that does not attenuate appreciably in heavy rain, and they are operated continuously unless they are down for maintenance. In addition, the NEXRAD radars have a clutter-removal algorithm that eliminates most of the ground clutter and false rainfall produced during periods of anomalous propagation.
This NEXRAD data has been available since April 2004 through Weather Decision Technologies (WDT). WDT receives instantaneous reflectivity data from the NWS radar sites located in the United States. NEXRAD data is run through TITAN as a graphic user interface. This data includes a better-quality radar estimated rainfall product making radar estimated rainfall a much superior product in rainfall accumulation estimation.

TITAN

Thunderstorm Identification, Tracking, Analysis, and Nowcasting (TITAN) software permits the radar operator to examine the three-dimensional structure of echoing clouds in real time. Individual echoes and groups of echoes can be tracked and their development and motion projected in time. Calculated parameters available in real time include the radar-estimated rainfall, echo heights, CAPPI slices, storm time-height profiles, histories of echo volume, area, precipitation flux, mass and vertically-integrated liquid (VIL). When these are combined with aircraft tracking, TITAN becomes a valuable tool for cloud seeding projects. The ability to identify and track echoes and calculate their properties with time makes TITAN a potential tool for the evaluation of cloud seeding experiments.

Geostationary Positioning Satellite (GPS) latitude and longitude data from each aircraft are collected and viewed on TITAN. This is accomplished using the Airborne Data Acquisition and Telemetry System (DTS). The basic design of this system consists of a GPS receiver within the aircraft and a radio modem on-board. Aircraft data such as latitude, longitude, altitude, and ground speed are transmitted to the SOAR field office and received via a UHF antenna and receiver. Data is then ingested in TITAN and displayed in the active window. The radar meteorologist is then able to vector the aircraft towards the area of interest within the vicinity of an echoing cloud.



NEXRAD radar image as viewed on TITAN 14 Aug 04 23:28Z with the research aircraft track on the southwest flank of the northernmost thunderstorm.