.

NASA Global Precipitation Measurement Mission

CSU/NOAA-ETL/NOAA-AL Front Range Pilot Project

Science and Operations Plan

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Objective of operations

The demonstration of the supersite ground validation (GV) concept for the Global Precipitation Measurement (GPM) mission will be the overarching goal of the Front Range Pilot project (FRP). The project's specific aims include the following:

(1) **Dual-wavelength radar DSD and rain rate estimate intercomparison, validation, and error characterization.** Demonstration of dual-wavelength polarimetric radar network for creating rain estimates and documenting associated errors. The project will use the S-Band CSU-CHILL radar at Greeley, CO and NOAA-ETL's X-Band radar at Erie, CO. The X-Band radar's improved phase sensitivity in light rain rates will be exploited to evaluate the S-Band radar's performance in such conditions. Contrarily, the S-Band's insensitivity to attenuation in heavy rain rates will be used to evaluate the X-Band radar's ability to correct for attenuation using its specific differential phase measurements. The combined S-band and X-band rainfall measurements and associated errors will provide the best ground truth estimate for comparison with satellite measurements.

(2) **Profiler demonstration in the supersite concept.** Selection of UHF profiler frequencies that will best complement S-Band profiler measurements at a midlatitude site and allow for the most accurate retrieval of drop size distribution characteristics. A further goal is to perform quantitative comparisons of drop size distribution (DSD) characteristics between the profilers and scanning radars in order to evaluate assumptions in the scanning radar retrieval technique (e.g., equilibrium drop shape relationship) as well as spatial variability of the DSD.

(3) **Rain rate and drop size distribution characterization in the context of supersite observations, rainfall regimes.** Demonstrate the complimentary role played by rain gauges and surface disdrometers (both 2-D video and J-W types) in determining the error characteristics of multi-frequency profiler DSD estimates and dual-frequency radar DSD and rain estimates.

(4) **Demonstration of the regime identification concept.** Operational radiosonde, satellite, and reanalysis data will be used to relate the environmental meteorology with parameter space of detailed multi-instrument microphysical observations from the pilot project.

Experimental design

Figure 1 shows the planned instrument locations for the intensive observing

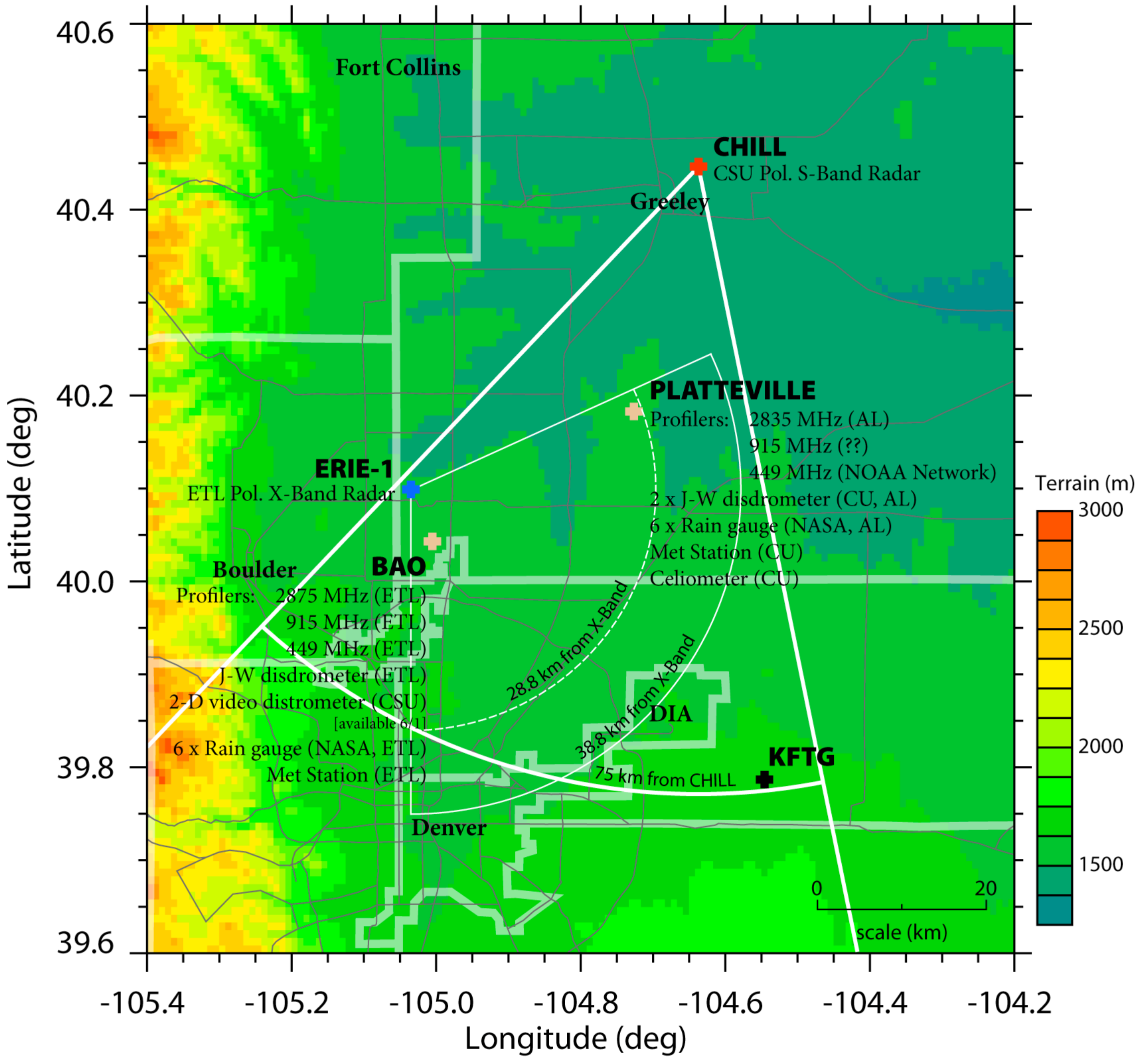

Figure 1. Map of the study areas showing the locations of experiment sites (bold plus signs) with instrument list, proposed radar scan coverage areas (white lines). Terrain (shaded), principal highways (grey lines), and county boundaries (thick opaque lines) are also shown. KFTG is the Denver NEXRAD radar site.

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period of the pilot project. The CSU-CHILL S-Band polarimetric radar will be located at its home base near Greeley, CO (marked CHILL in the figure). The NOAA-ETL X-Band polarimentric radar will be deployed to near Erie, CO (marked Erie-1). Both radars will scan narrow sectors in azimuth (discussed below) over the continuously operating ground measurement sites, where the profilers, disdrometers, rain gauges, and surface meteorological stations will be located. The ground measurement sites are located at the NOAA-University of Colorado Platteville Atmospheric Observatory near Platteville, CO, and at the NOAA Boulder Atmospheric Observatory (BAO) near Erie, CO.

Ground Measurement Sites

Both the BAO and Platteville sites will have profilers operating at 3 frequencies: one at S-Band to measure precipitation velocity spectra (and estimate DSD), and two in the UHF band: 915 and and 449 MHz. The UHF profilers will be evaluated to determine their ability: 1) to resolve both the clear air and precipitation components of the radial velocity spectra in different precipitation environments (e.g., light vs. heavy rain); and 2) in concert with the S-Band profiler data, provide dual-wavelength DSD parameter retrievals with the smallest errors. Each site will be instrumented with at least one J-W impact-type disdrometer, tipping-bucket rain gauge, and surface meteorological station. The BAO site will also have CSU's 2-D video disdrometer (after June 1).

Radar scanning

The X-Band radar will nominally scan 2 low-level PPIs and 2 RHIs covering the Platteville and BAO sites. Gate to gate resolution may be set to either 150 m or 112.5 meters, giving a maximum range of 38.8 or 28.8 km, respectively. The X-Band scan cycle will take place over a period of one to two minutes. CHILL will scan a sector of approximately 40 degrees azimuth over the entire X-Band scan sector (and the instrumented sites), and scan RHIs over the instrumented sites. CHILL will have two scanning modes depending on the rainfall regime: (1) a high-resolution 75 m range resolution low level scan mode matching with a 2-3 minute scan repeat cycle (allowing high-resolution quick scanning of surface rainfall), and (2) a standard resolution 150 m range resolution volume scan mode with a 6-8 minute scan repeat cycle (allowing storms' vertical reflectivity and microphysical structure to be scanned by CHILL).

Combining the S- and X-Band radar polarimetric measurements will allow comparison of measurements of rain rate and DSD characteristics, and evaluation of errors in those fields from both instruments. By using CHILL's unattenuated reflectivity field, it will be possible to evaluate the X-Band's self-correcting specific differential phase method of correcting for attenuation. In addition, the X-Band system's higher differential phase sensitivity in light rain will allow the quantification of errors in rain estimates in light rain from the less phase-sensitive S-Band CHILL radar. In addition, the measurements from the scanning radars will be compared with the estimates of rain rate and DSD characteristics from the surface disdrometers, profilers, and rain gauges to determine error characteristics.

Project timeline

The overall period of data collection period for the Front Range Pilot Project will be May 1, 2004 through June 30, 2004. Within that roughly two-month span, a period of intensive operations will be 15 May through 22 June. All instruments are expected to be ready for data collection during the intensive period.

Observations with a partial suite of instruments will occur outside the intensive period during May and June and perhaps later, depending on availability of hardware, staff, and funding.

Project daily operations

The operation of the scanning radars will be on a "target of opportunity" basis; the other instruments in the study will be continuously operating. The daily timeline of operations will be as follows:

- CSU-NOAA conference call at approximately 9 am will serve as a morning briefing and forecast update (radar go/no go)
- CHILL scientist/CSU scientist/student will staff radar at Greeley if CHILL operations decided upon; ETL scientists will staff the radar at Erie-1
- Radar scanning coordinated in communication with X-band scientists (via Motorola radio communications, with telephone backup)
- End of scanning decided upon through coordination of CSU-NOAA scientists

Data processing and reporting

Each group will process the data from their instrument, and make the data and derived products (such as rain maps, DSD measurements, etc.) available to the other scientists in the project in a timely manner after the project. Results from the pilot project will be presented to NASA GPM officials following the completion of the data collection and analysis phase (tentatively Fall '04).