The SuperDARN Radar Network

Figure 1. Fields of view of the northern hemisphere SuperDARN radars.

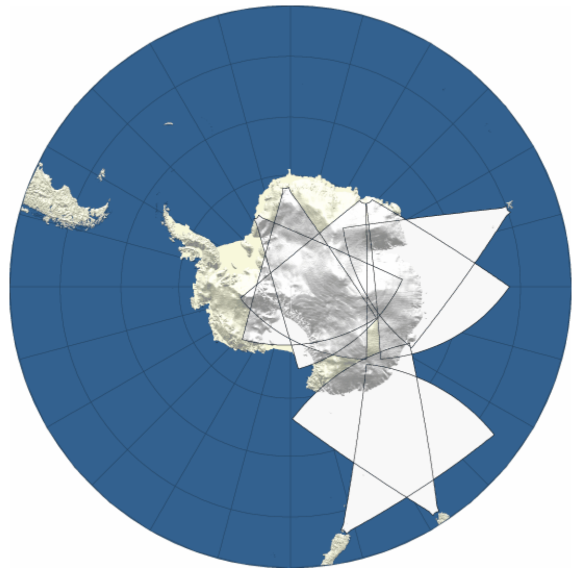

Figure 2. Fields of view of the southern hemisphere SuperDARN radars.

The Super Dual Auroral Radar Network, SuperDARN, [Greenwald *et al*., 1995] is the product of over 20 years of research and development which began in 1983 with the construction of an HF radar at Goose Bay, Labrador. In the intervening years, the HF radar technique has had a major impact on high-latitude ionospheric research in both the aeronomy and magnetospheric physics communities. During that time, SuperDARN has evolved from one radar to a network of twelve operational radars in the northern hemisphere and seven operational radars in the southern hemisphere. A view of the current coverage of the northern and southern network are shown in Figures 1 and 2. In the standard mode of operation, each radar measures the line-of-sight plasma velocity at 75 ranges along each of 16 beam directions covering an area of about 3500 km in range and about 56 degrees in azimuth. The radars operate continuously, 24 hours per day and 7 days per week and deliver images of the high-latitude convection pattern with a two-minute time resolution.

The main purpose of SuperDARN is the instantaneous mapping of the ionospheric convection pattern (see Figure 3). By providing direct measurements of convection velocities over large regions, SuperDARN provides the best means available to derive ionospheric convection patterns. Prior to the development of SuperDARN, our knowledge of convection was based primarily upon conceptual models, simulations, and empirical models that were developed from observations accumulated over time. Convection data that have been available include: single point radar observations of plasma flows, low altitude satellite observations of plasma drifts, high-altitude satellite observations of electric fields, and observations of magnetic perturbations by satellite-based and ground-based magnetometers. Each of the previously available techniques has characteristics that may cause the derived pattern to differ from the actual pattern at any given moment. SuperDARN provides direct, instantaneous, measurement of convection and hence, avoids many of the drawbacks of other techniques.

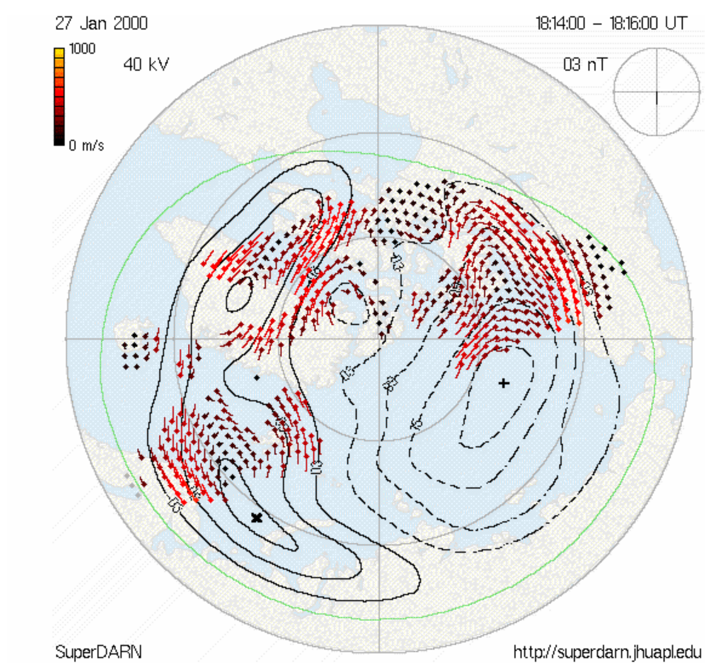

Figure 3. Ionospheric convection map derived from SuperDARN radar observations.

In addition to convection pattern measurements, SuperDARN has been used for many other types of observations. A listing of publications that rely on data from SuperDARN can be found on the SuperDARN world wide web page at the Johns Hopkins University Applied Physics Laboratory (http://superdarn.jhuapl.edu/index.html). From this same web page, SuperDARN data can be accessed by following the real-time data link and then the Java applet link. Below is an example display from the Kodiak radar:

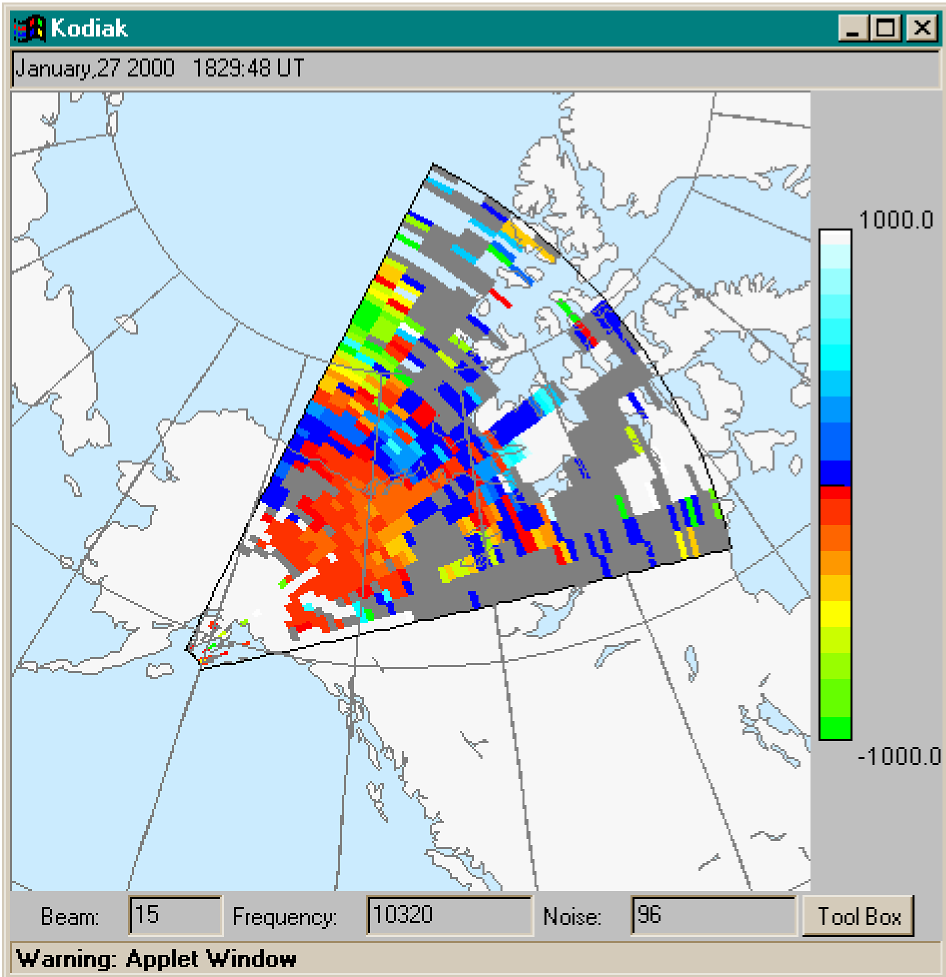

Figure 4. Geographic plot from the Kodiak SuperDARN radar.

SuperDARN radars detect three types of echoes, namely, E and F region plasma irregularities, ground scatter, and meteors. Figure 4 is a display of radar observations from about 1830 UT on January 27, 2000 as seen by the Kodiak, AK, radar, and corresponding to the same period of time that the convection map in Figure 3 was derived. It was a relatively active interval when Alaska was in the dawn sector. The gray region in Figure 4 represents the ground-scattered portion of the signal, that is, signal that is transmitted from the radar, reflects obliquely off of the lower portion of the F-region ionosphere down to the ground where it scatters back along the same path to the radar. The ground scatter is useful for obtaining the density structure of the bottom-side F-region. The colored regions represent scatter from small-scale plasma irregularities.

These irregularities are in the F-region and move with the bulk plasma velocity. The color scale corresponds to the component of the plasma velocity along the radar line of site. The red and yellow colors correspond to velocity away from the radar, while blue colors correspond to velocity toward the radar.

SuperDARN data is divided into common, special, and discretionary time periods, which are characterized as follows:

- *Common Programs*: Several standard operating modes of the radars for which all radars will be operated in the same manner. Common programs comprise 50% of the total operation and data from this type of operation are available for Key Parameters and ISTP Event Studies.
- *Special Programs*: Special operating modes are agreed upon by the PIs for the purpose of achieving specific research goals. Special programs are limited to 20% of the total operation and data from this type of operation are also available for Key Parameters and ISTP Event Studies.
- *Discretionary Operations*: Discretionary time is limited to 30% of the radar operations and is set aside for the purpose of allowing PIs to pursue personal or collaborative research goals. Data from this type of operation is available only at the discretion of the individual PIs. Those PIs that are not participating in a discretionary study may operate their radar in a Common Program or SuperDARN Special Program format.