Atmospheric Radiation Measurement Program

Facilities Newsletter – August 1999

Birds Interact with the ARM Program

With the end of summer drawing near, the fall songbird migration season will soon begin. Scientists with the ARM Program will be able to observe the onset of the migration season as interference in the radar wind profiler (RWP) data.

An RWP measures vertical profiles of wind and temperature directly above the radar from approximately 300 feet to 3 miles above the ground. The RWP accomplishes this by sending a pulse of electromagnetic energy skyward. Under normal conditions, the energy is scattered by "targets" in the atmosphere. Targets generally consist of atmospheric irregularities such as variations in temperature, humidity, and pressure over relatively short distances. (Operation of the RWP was described in more detail in the January 1999 *ARM Facilities Newsletter*.)

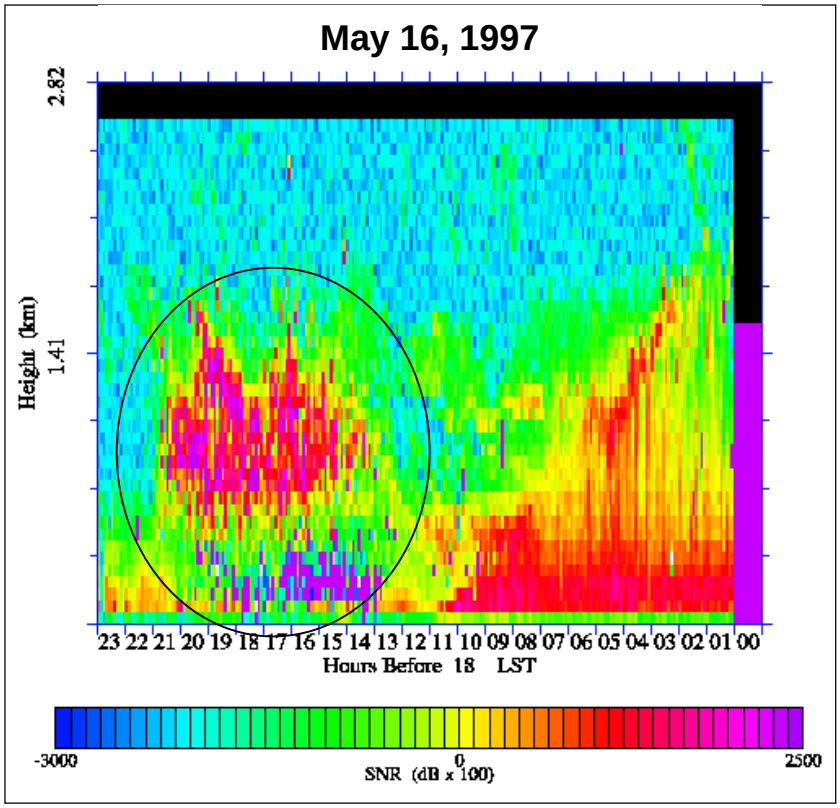

Figure 1. Plot of RWP return signal strength for May 16, 1997. Bird interference during spring migration is evident on the left side of the plot and is indicated within the circle. Bird-contaminated signals have distinct patterns shown in purple near the bottom of the plot and red and purple above.

ARM Facilities Newsletter is published by Argonne National Laboratory, a multiprogram laboratory operated by The University of Chicago under contract W-31-109-Eng-38 with the U.S. Department of Energy.

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During the spring and fall bird migration seasons, RWP beam signals are susceptible to overflying birds. The radar beams do not harm the birds, but the birds' presence hampers data collection by providing false targets to reflect the RWP beam, introducing errors into the data.

Because of the wavelength of the radar beam, the number of individuals, and the small size of songbirds' bodies (compared to the larger geese or hawks), songbirds are quite likely to be sampled by the radar. Migrating birds usually fly with the prevailing wind, making their travel easier. As a result, winds from the south are "enhanced" or overestimated in the spring as the migrating birds travel northward, and winds from the north are overestimated in the fall as birds make their way south. This fact is easily confirmed by comparison of RWP wind data to wind data gathered by weather balloons, which are not affected by birds.

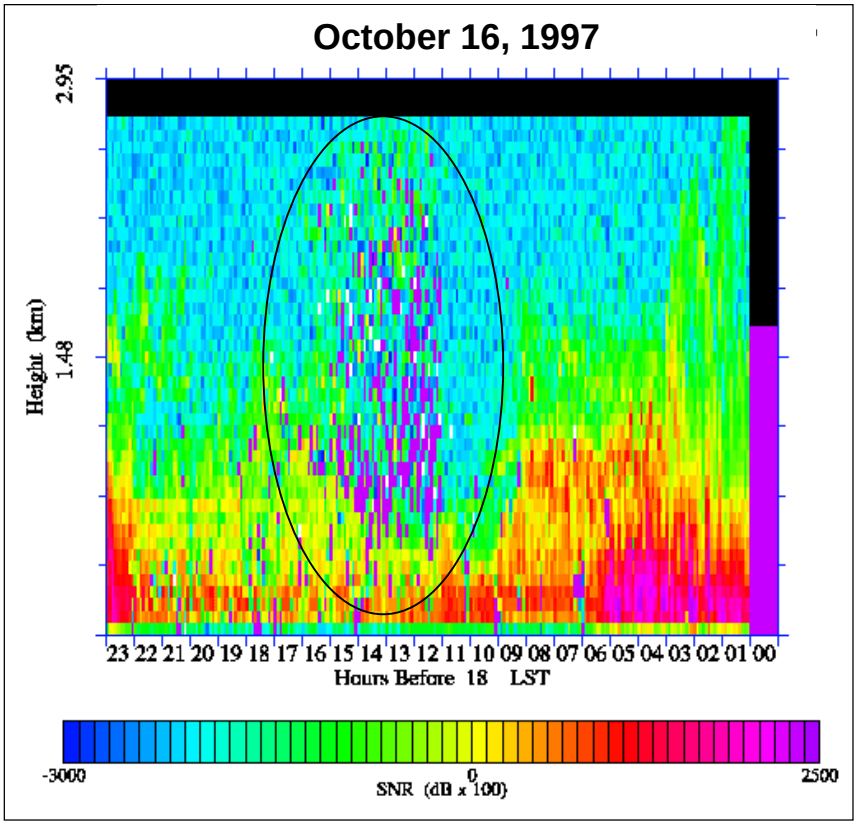

Figure 1. Plot of RWP return signal strength for October 13, 1997. Bird interference during fall migration is evident on the left side of the plot and is indicated within the circle. Bird-contaminated signals have distinct patterns shown in purple.

Wind directions can also be affected by migrating birds, because the birds sometimes travel at an angle to or against prevailing light winds. The radar picks up the more dominant signal reflected by the birds' movement and assumes that this is the correct atmospheric wind signal.

The effect on RWP data of migratory birds is a well-known problem in the RWP research community. Scientists have worked to develop computer algorithms (calculation procedures) that can detect the bird-contaminated wind

measurements collected by the RWP. Even though the return signals received from atmospheric turbulence are very different from those received from bird interference, removing the bird effects from the data is almost impossible. In a very short time span, the RWP gathers thousands of pieces of information and averages them to produce a single data point. This complex (and necessary) averaging process makes the signals from the atmosphere and the birds almost impossible to separate.

To help identify and remove bird-contaminated data, scientists can apply knowledge of songbird migration patterns. Birds usually migrate in the spring and fall, from February 15 to June 15 and from August 15 to November 30. Migration takes place mostly at night, from 30 minutes after sunset to 30 minutes before sunrise. Birds fly during the night because the atmosphere is less turbulent than during the day (when the sun heats and mixes the air). The resulting lower air resistance at night makes the air smoother and faster. Migration normally takes place no more than 2.5 miles above the ground.

Scientists use information about bird migration patterns and characteristics to create automated thresholding techniques to identify and filter data potentially affected by birds. All of the ARM RWPs have built-in processing filters provided by the manufacturer, designed to detect and remove bird-contaminated data. However, these filters are not completely successful. Therefore, scientists at Argonne National Laboratory have worked to develop algorithms that can successfully detect bird interference in the filtered and averaged ARM RWP data sets. Once implemented, the algorithms will allow ARM to provide accurate wind and temperature data sets to the research community.