US Army Corps of Engineers®
Engineer Research and Development Center

Vegetation and Snow Interaction in Cold Regions

Problem

An expected response to climate warming in cold regions is an increase in the abundance and extent of shrubs in tundra areas. Evidence suggests a pan-Arctic vegetation transition that, if continued, will alter the fundamental architecture and function of the Arctic ecosystem with important ramifications for the climate, the biota, and humans. Also, vegetation architecture strongly influences energy input to the snow (or ground) surface, which varies with space and time, and depends on species, size, and location of gaps. Radiative transfer through forest canopies is complex and energy balance modeling presents challenges to account for the large variations of energy incident on the snow surface.

Description

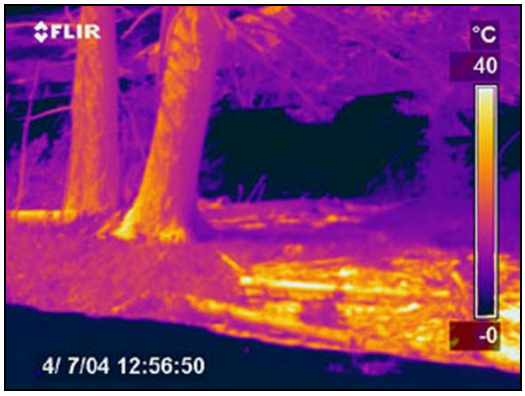
Researchers at the Engineer Research and Development Center's Cold Regions Research and Engineering Laboratory (ERDC-CRREL) are conducting ongoing research in vegetation and snow interaction ranging from the snow covers of the Alaskan Arctic to the continental United States. This work meshes with studies on military training ranges, soil biogeochemistry, atmospheric chemistry, and remote sensing of snow-covered terrain.

Snow and vegetation research at ERDC-CRREL is being conducted in the following areas:

- Albedo of forest-littered snow and its incorporation in a snow process model;
- Snow distribution around trees;
- Snow/shrub interactions in the Arctic;
- Snow depth and its relation to soil frost and water dynamics in forests;
- Spatial variability of solar and longwave sub-canopy radiation;
- Sensitivity studies of radiation/canopy/snow;
- Linking of snow and vegetation models;
- Point and distributed snow modeling in forests;
- Basin segmentation for distributed modeling in forested watersheds;
- Viewable gap fractions at the landscape and stand scale;
- Remote sensing in forested environment.

Measuring the spatial variability of longwave radiation in a deciduous tree well.

Using ERDC-CRREL's infrared camera to measure round-the-clock thermal emissions.



Infrared image showing extreme contrast between spring soil temperatures below trees (40°) and adjacent snow cover (0°).

Expected Products

Research in this area leads to greater awareness of the interaction of snow with the biosphere and atmosphere and continues to increase the knowledge necessary for solving problems associated with climate change. Associated contributions include developing new technologies and methods for investigating snow processes in forests, developing new models, collecting data sets, and coordinating technical guidelines. Products are distributed via scientific journals, conference papers, technical reports, and accessible data archives, and via ERDC-CRREL's Terrestrial and Cryospheric Sciences Branch Web site.

Potential Users

Snow and vegetation research supports customers and partners from the Army, Department of Defense (DoD), many other federal and state agencies, academia, and the private sector. The Army and DoD apply this research to better understanding terrain states to assess the impact of seasonal changes on military preparedness. Agencies such as NOAA, NASA, and NSF sponsor competitive grants to measure and understand changes in the forested environment, to validate satellite observations, and to improve predictive models. ERDC-CRREL's unique facilities as well as our technical and field expertise provide our customers access to unique research to assess new technologies for snow- and vegetation-related problems.

Program Manager

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