Title: The 1990 Forest Ecosystem Dynamics Multisensor Aircraft Campaign

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Discipline: Land

A Multisensor Aircraft Campaign (MAC) was conducted in mid-July and early September, 1990 at International Papers' Northern Experimental Forest (NEF), located approximately 56 km north of Bangor, Maine. The MAC was initiated to support the Forest Ecosystem Dynamics (FED) project, a major research activity within the Biospheric Sciences Branch at NASA's Goddard Space Flight Center. Numerous investigators from Goddard, other U.S. government agencies and universities participated in this MAC.

The 1990 FED MAC experiment design called for a suite of airborne instrument observations and supporting ground observations at several preselected locations within the NEF. Because of aircraft scheduling conflicts in 1990, the FED MAC experiments were conducted as two campaigns, each emphasizing measurements in different portions of the electromagnetic spectrum. A series of active and passive microwave measurements were emphasized in mid-July, while optical-reflective measurements were acquired in September.

During the mid-July measurements campaign, the NASA/Ames Research Center (ARC) DC-8 equipped with the Jet Propulsion Laboratory's (JPL) 3-band, quad-polarized Synthetic Aperture Radar (SAR) overflew the NEF on July 15th and 17th (i.e., before and after an ½" rainstorm event on July 16th). Also, on July 15th, the NASA/Wallops Flight Facility (WFF) P-3 aircraft carrying the Push-broom Microwave Radiometer (PBMR) and Electronically Steered Thinned Array Radiometer (ESTAR) sensors, which are used for assessing soil moisture conditions, flew several flightlines over the NEF a few hours before the DC-8 overflight. An extensive set of soil moisture measurements were made on July 15th concurrent with the P-3 and SAR overflights. Also during the mid-July field campaign, the NASA Wallops UH-1B helicopter, equipped with a pointable (2-axis) set of bore-sighted instruments including a Barnes Modular Multiband Radiometer (MMR), a Spectron Engineering SE-590 spectroradiometer, an Everest infrared temperature sensor, and a Sony CCD video camera, was utilized to collect bidirectional reflectance data over a variety of targets.

On September 8, 1990, multiple and/or concurrent overflights of the FED MAC NEF study area were completed under extremely clear atmospheric conditions by: (a) NASA ARC's ER-2 carrying JPL's Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) instrument [overflight at 11:30 - 11:45 eastern daylight savings time (EDST)]; (b) NASA's

C-130 equipped with Goddard's Advanced Solid-state Array Spectroradiometer (ASAS) and the NS-001 Thematic Mapper simulator [overflights from 09:10 - 14:30 EDST]; and (c) the NASA Wallops UH-1B helicopter equipped as summarized above [flights from 09:00 - 15:00 EDST]. Goddard's Airborne Laser Polarimeter System (ALPS) was also mounted on the helicopter, and was utilized to acquire data over numerous targets on other days when sky conditions were not ideal for making optical-reflective measurements.

FED Objectives and Long Range Goals

The overall objective of the FED research activity is to develop a better understanding of the dynamics of forest ecosystem evolution over a variety of temporal and spatial scales. Primary emphasis is being placed on assessing the ecosystem dynamics associated with the transition zone between northern hardwood forests in eastern North America and the predominantly coniferous forests of the more northerly boreal biome. The approach is to combine ground-based, airborne, and satellite observations with an integrated forest pattern and process model which is being developed to link together existing models of forest growth and development, soil processes, and radiative transfer.

Airborne measurement campaigns such as the 1990 FED MAC conducted in mid-July and early September at the NEF, are undertaken to acquire data which are needed either to improve our understanding of these processes so that the models can be updated/modified, or to compare modeled results with actual field observations.

Eventually, the results anticipated from this type of research will enable development and validation of an integrated model to usefully characterize the ecosystem dynamics of the boreal forest under a variety of conditions. A number of questions pertinent to the combined experiment may then be considered. For example, how do climatic gradients determine the spatial distribution of species within the boreal forest? What are the possible effects of global climate change on the boreal forest? Is the boreal forest a net source or sink of carbon and methane and will the present state change if climate changes? Also relevant to the issue of global change are the magnitudes of the feedbacks between climate and vegetation. The model, as formulated, can provide insights into the effects of climate change on ecosystem dynamics, but does not consider the effects of ecosystem changes on climate directly. However, the model can provide, as outputs, factors that impact climate such as albedo, evapotranspiration, and trace gas fluxes (i.e., CO_2, CH_4 and N_2). These questions are also relevant to the BOREAS (SIFE/TE/ABLE) experiment planned for the 1993/1994 time frame.