Weather, Climate, Extreme Fire Events: Examining Present and Future Fire-Induced Land Cover Change in Siberia

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Project Objectives

The overarching goals of this research are: (1) to identify the weather and climate processes that precipitate large and extreme fire events (2) to explore the degree to which current and future climate variability affect wildfire-induced Land Cover Change; and (2) to highlight the significance of the interaction between the biosphere and the climate system in support of the inclusion of biospheric models in future Atmosphere-Ocean (Biosphere) General Circulation Models.

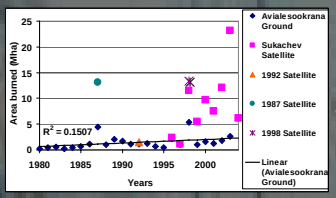
Project Description

This research project will utilize 20 years of existing NASA-derived satellite and meteorological data and Siberian ground-based extreme fire events datasets to statistically analyze the coincidence in severe fires and the meteorological and synoptic-scale weather characteristics that precipitate the conditions necessary to sustain extreme fire events.

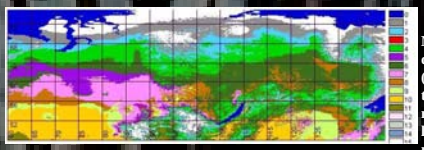
(1) First, a ground-based large fire database will be used to define the regions where extreme fire events occurred and then historic satellite imagery will be used to precisely geolocate and define area burned.

(2) Secondly, a statistical approach will be applied to discriminate the weather conditions that generate the environment necessary to sustain large and extreme fire events.

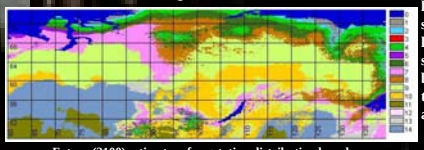
(3) Then, these relationships will be used to establish the primary connections between weather variables, area burned, and fire danger to generate future fire danger maps under climate change scenarios for 2030, 2060, and 2090.



Without a consistent area burned product, it is difficult to analyze fire regime change, fire-induced land cover change or to analyze the connections between large fire events, weather and climate (Soja et al., 2004; Sukhinin et al., 2004).



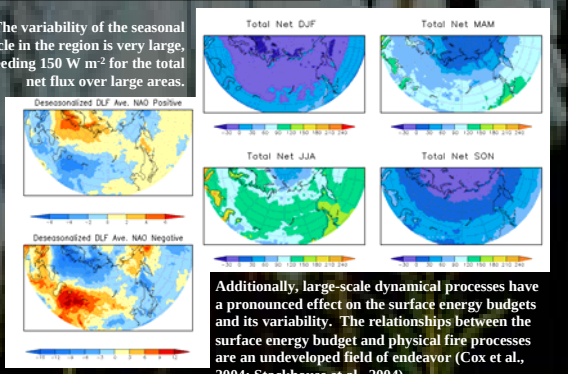
Current vegetation distribution



Future (2100) estimates of vegetation distribution based on HadCM3GGa1 (Gordon et al. 2000).

Modeled vegetation distribution change in Siberia (excluding fire): Water (0), tundra (1), forest-tundra (2), northern dark taiga (3), light taiga (4), middle dark taiga (5), light taiga (6), southern dark taiga (7), light taiga (8), forest-steppe (9), steppe (10), semidesert (11), broadleaved (12), temperate forest-steppe (13) and temperate steppe (14).

The variability of the seasonal cycle in the region is very large, exceeding 150 W m^{-2} for the total net flux over large areas.



Additionally, large-scale dynamical processes have a pronounced effect on the surface energy budgets and its variability. The relationships between the surface energy budget and physical fire processes are an undeveloped field of endeavor (Cox et al., 2004; Stackhouse et al., 2004)

(4) Lastly, phytomass and vegetation type and extent will be simulated using existing Russian bioclimatic models that have been modified to include the effects of an altered fire fire regime (Parfenova and Tchebakova, 2000; Tchebakova and Parfenova, 2000, 2004; Tchebakova et al., 2001). The estimated degree to which fire augments and modifies Land Cover Change will be quantified.

Data requirements

We intend to use best available.

Name	Expected sources	Date expected	Date acquired
Fire data			
Ground-based fire data Date of the ignition, location, and area of large fire	Avialesookrana, Leshos (for Siberia)	1980-1989 August 2006 1990-1996 December 2006 1997-2000 April 2007 2001-2004 October 2007	
Satellite-based fire data partial 1995-current historic up-to-date	Sukachev, Satellite Active Archive	 Jan. - August 2006 on a continual basis	 January 2006 On a continual basis
Meteorological / Climate data			
Monthly precip., mean mnthy temp., precip. 5-day period, dry days in month, max. temp noon, relative humidity, # days low RH monthly, mean mnthy windspeed, snow pack, 700mb height anomaly	NASA-generated long-term Global Modeling Analysis Office (GMAO) Goddard Earth Observing System (GEOS) v. 4.03 (satellite and ground-based data and Global Synoptic Climatology Network (GSCN), 2000-2004 data	1983-1990 1992-1997 May 15, 2006	1991, 1998-2004 processed for our use February 10, 2006
Russian surface station data	National Climate Data Center (NCDC) Surface Observations	1994-2004 March 2006 1987-1993 April 2006 1977-1991 May 2006	
Cloud fraction and thickness	International Satellite Cloud Climatology Project (ISCCP)		
Shortwave and longwave surface radiation data 1984-2004	NASA / NOAA Global Precipitation Climatology Project Global Energy and Water-cycle Experiment (GEWEX) Surface Radiation Budget (SRB) data		January 2006
Hadley and/or other scenario	Data available at Sukachev		Available as needed

Products expected to be made available for other NEESPI investigations

Project start date: January 01, 2006

Name	Geographic extent	Temporal extent	Basis	Dates expected
Extreme fire dataset	Siberia	1984 – 2004	Ground and satellite data	October 2006 October 2007
Statistical analysis results	Siberia	1984 – 2004	Best available data Meteorological and fire	July 2007
Bioclimatic model results	48 - 76º N latitude 60 - 140º E longitude	2030, 2060, 2090	Bioclimatic model	July 2007 – March 2008

Established partnerships with other LCLUC NEESPI projects

Wildfire Impacts on Carbon Stocks and Exchanges in Forests of Central Siberia: Quantifying Effects of Fire Intensity, Fire Severity, and Burning Conditions, 2004-2007, PI: Susan Conard

Development of an Integrated System of Ground-, Air-, and Space-based Observations of Biomass Burning in Northern Eurasia, 2004-2007, PI: Ivan Csiszar

Modeling the Carbon Dynamics of the Eurasian Boreal Forest, 2004-2007, PI: Herman H. Shugart

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