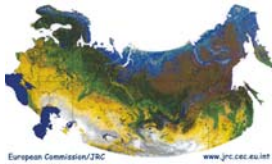


Inter-agency Northern Eurasia Earth Science Partnership Initiative (*NEESPI*) and Science Review Meeting

ATMOSPHERIC AEROSOLS AND AIR POLLUTION

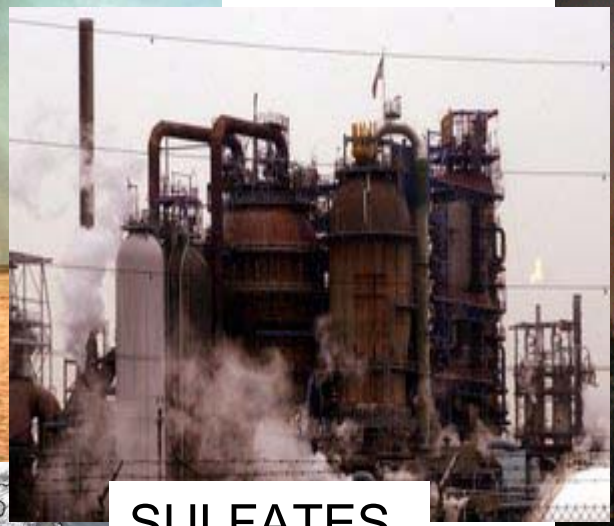
Irina N. Sokolik

School of Earth and Atmospheric Sciences
Georgia Institute of Technology
Atlanta, GA, USA

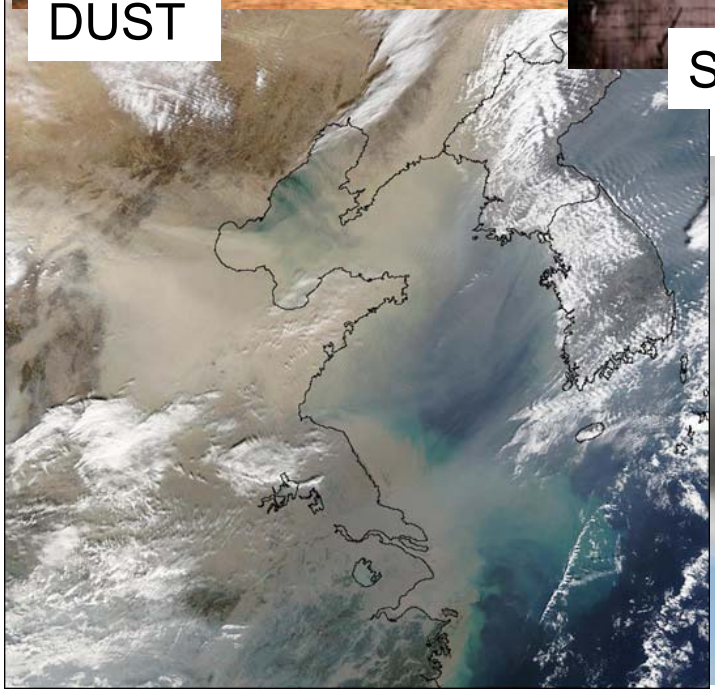
Washington DC
December 9-10, 2004

Diverse sources of natural and anthropogenic aerosols in Northern Eurasia

DUST



SULFATES

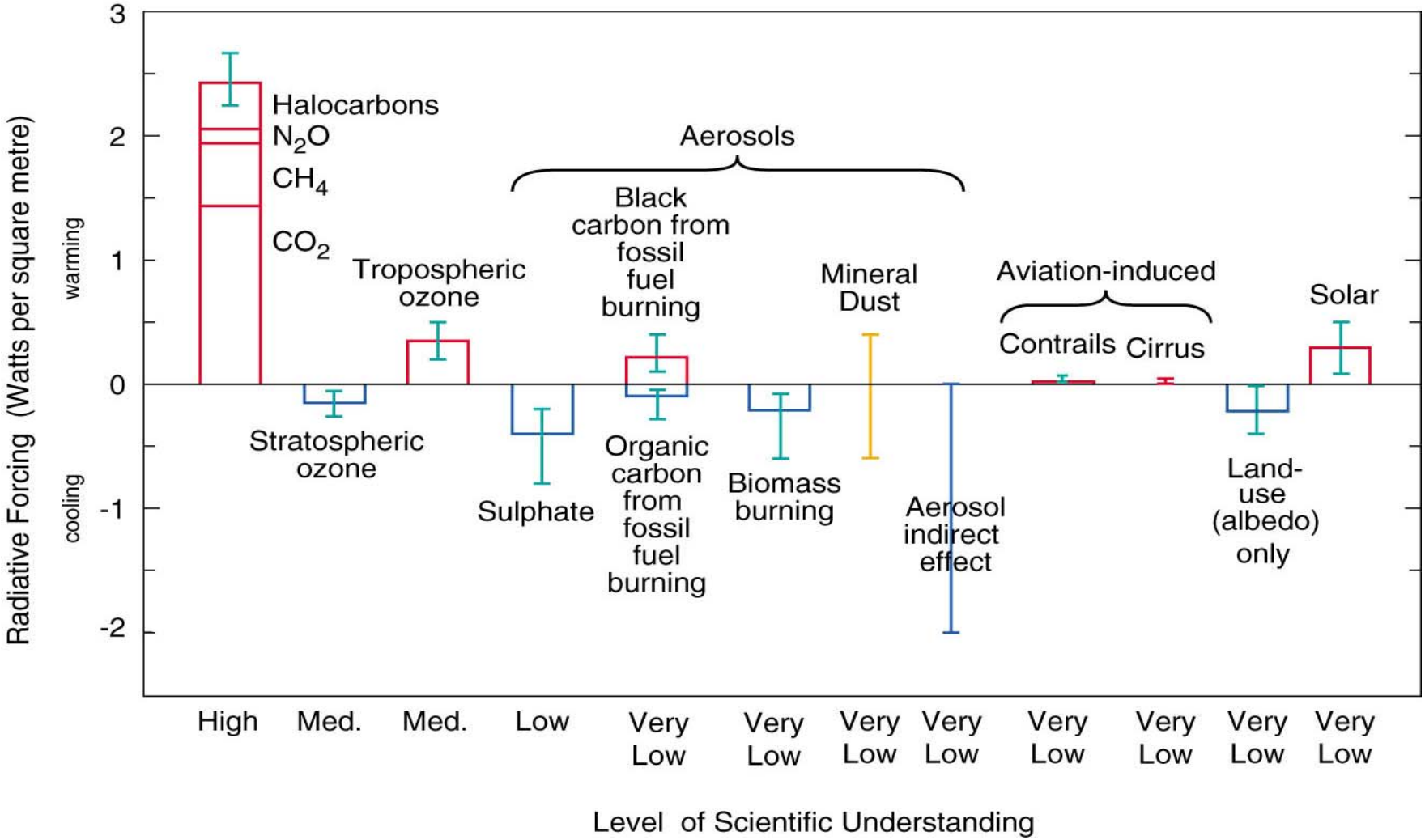


SMOKE

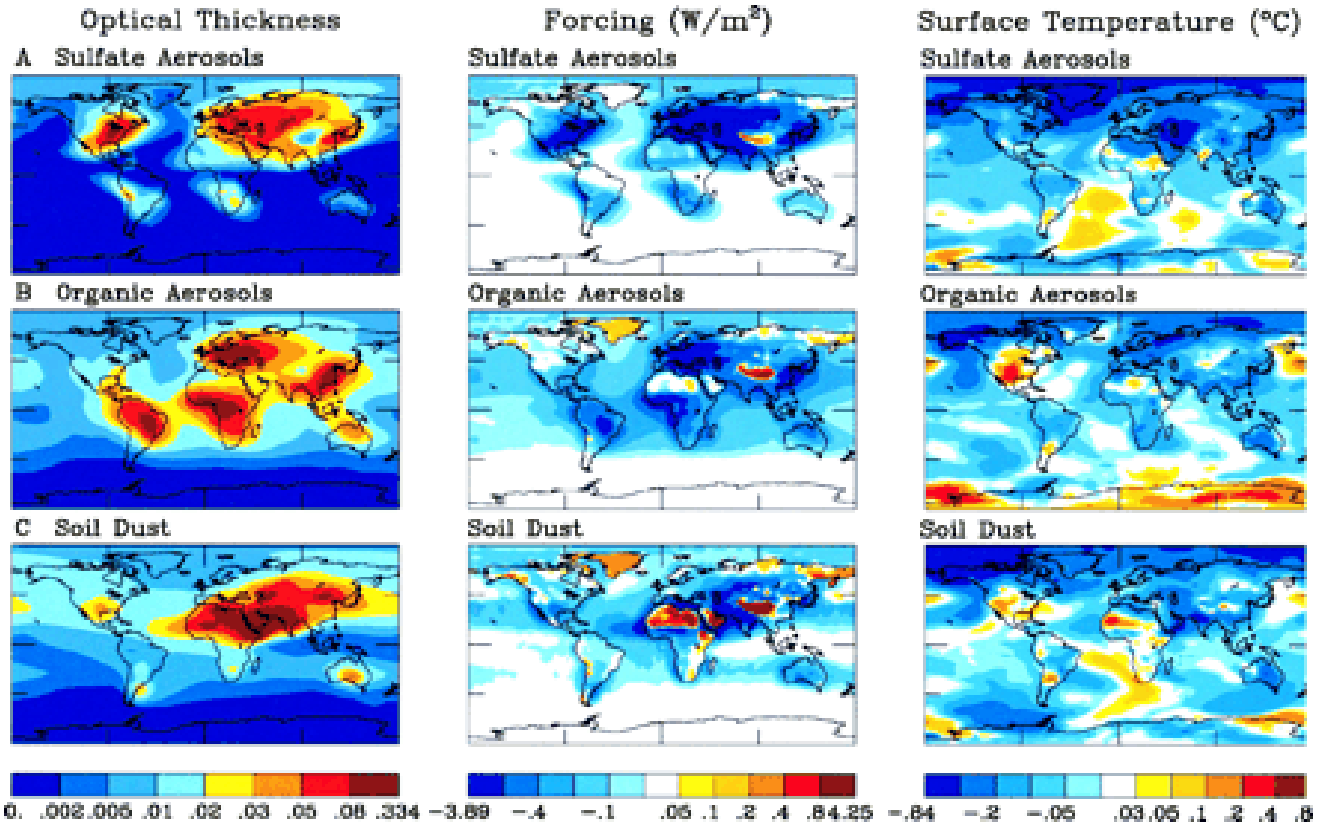
Climate radiative forcing of atmospheric aerosols

Intergovernmental Panel on Climate Change (IPCC, 2001)

global mean radiative forcing (W/m2): 2000 relative to 1750



Climate radiative forcing of atmospheric aerosols has a complex spatial distribution



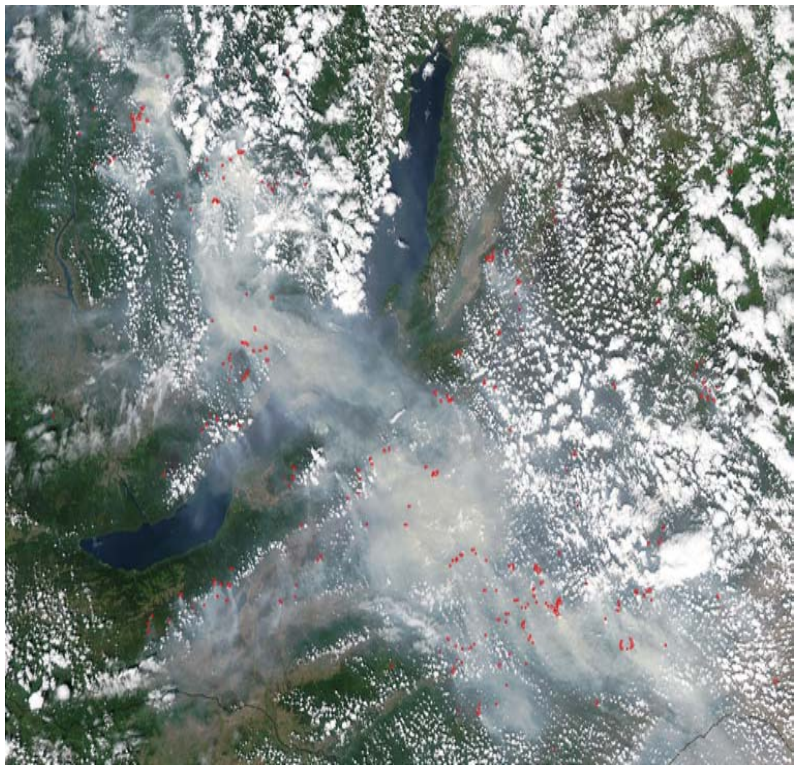
Model predicted direct radiative forcing of main aerosol species and associated temperature changes (Hansen et al)

The need for studies on a regional case-by-case basis

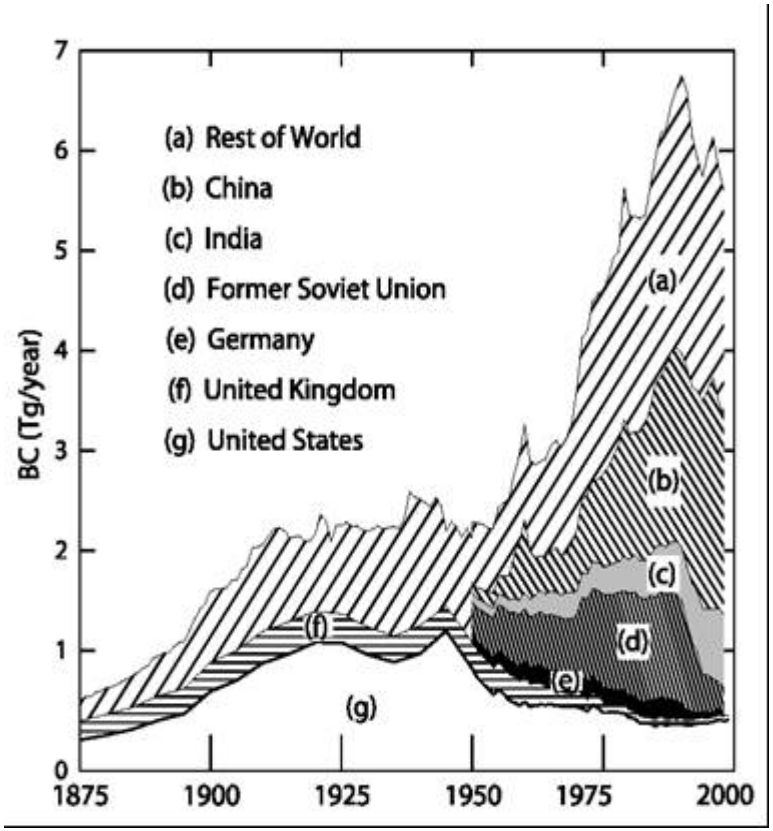
Biomass and fossil fuel burning is a large source of carbonaceous aerosols and highly uncertain

Increasing frequency of biomass burning in Northern Eurasia

Higher emissions of carbonaceous aerosols as well as trace gases (CO, CO2, etc)



Regional emissions of black carbon from fossil fuel burning (Novakov et al., 2003)



Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming (Jacobson, 1992)

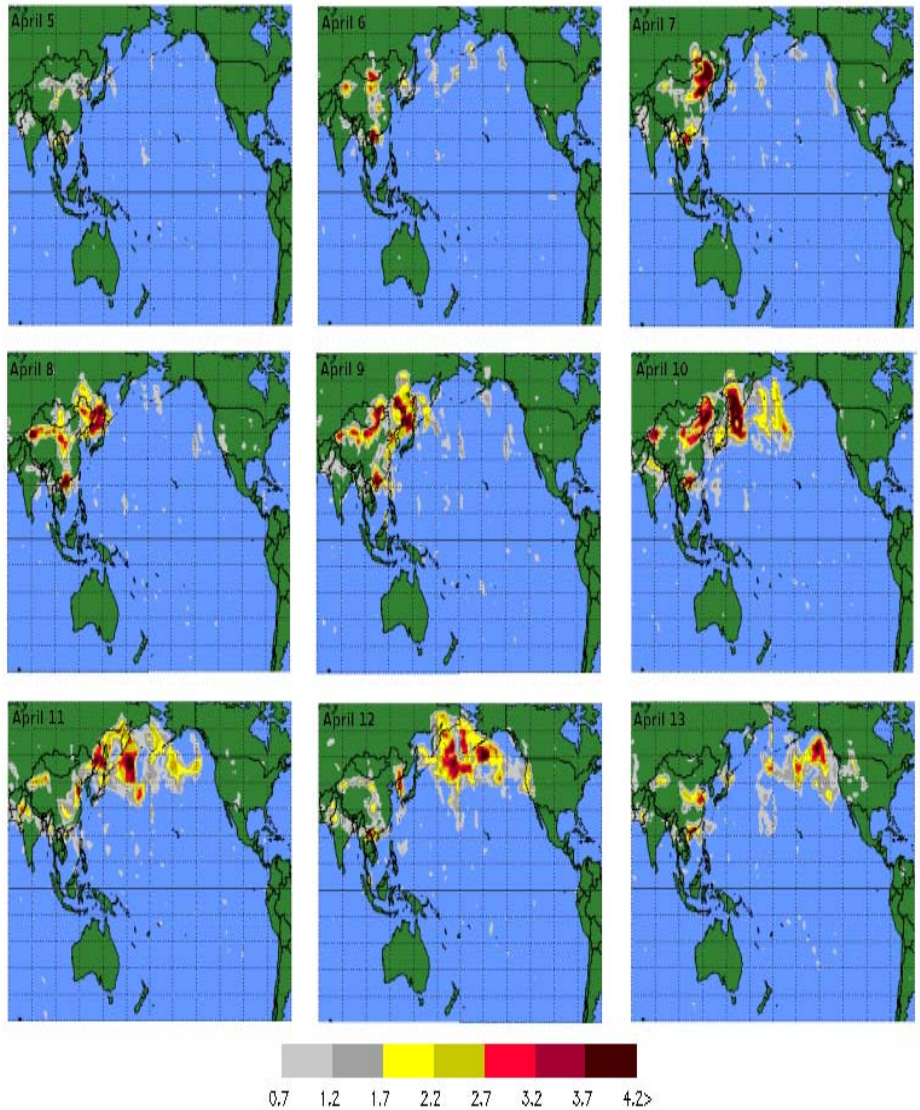
Atmospheric dust

Drying up of the Aral Sea

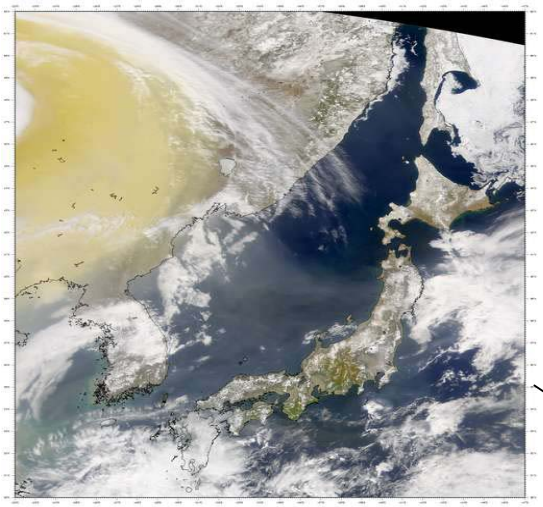
July - September, 1989 August 12, 2003

Increasing frequency of dust storms in China

Long-range transport of Asian dust

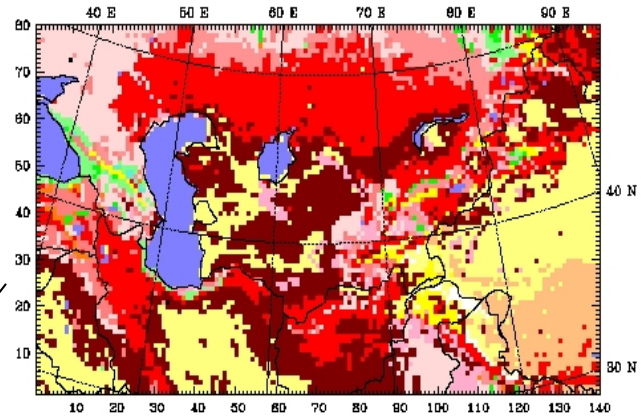


The need for an integrative framework



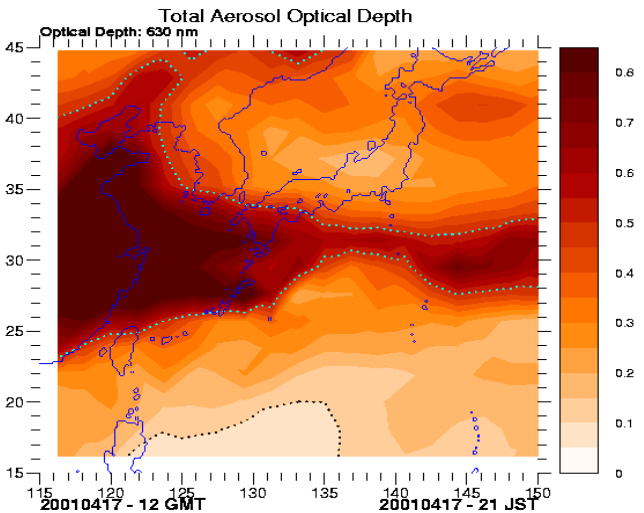
Satellite imagery

Surface data

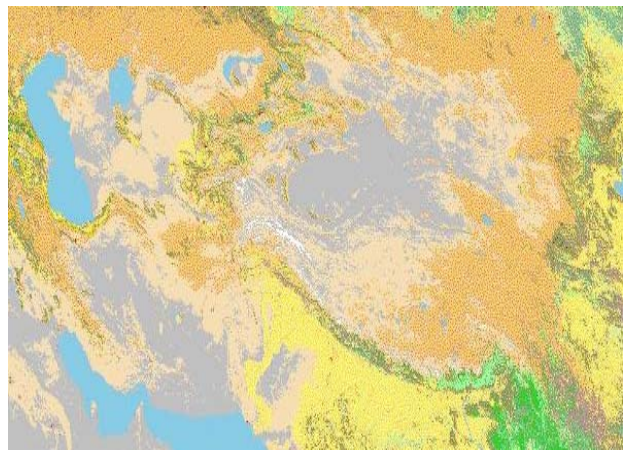


Land use change

Quantification of sources, transport and impacts of dust

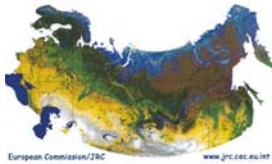


Atmospheric transport models



Vegetation cover/ soil moisture

NEESPI science questions:



- ***What are the magnitude and spatial/temporal distribution of the radiative forcing caused by atmospheric aerosols over Northern Eurasia?***

- ***How did the sources, distributions and properties of aerosols in Northern Eurasia change in recent years, and to what extent are these changes attributable to natural variability and human causes?***

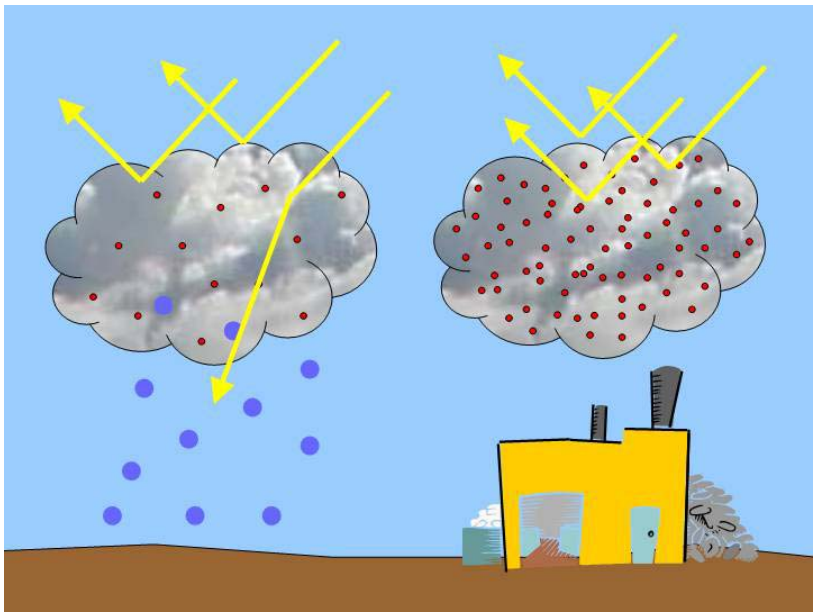
- ***How will the future land-use and land cover changes, industry development and other human-induced changes affect emissions of different aerosol types in Northern Eurasia?***

Aerosols and the hydrological cycle

Clear clouds

Dirty clouds:

more reflection of solar radiation and less rainfall



CNN.com nature

MAINPAGE
WORLD
U.S.
WEATHER
BUSINESS
SPORTS
TECHNOLOGY
SPACE
HEALTH
ENTERTAINMENT
POLITICS
LAW
CAREER
TRAVEL
FOOD
ARTS & STYLE
BOOKS
NATURE
IN-DEPTH
ANALYSIS

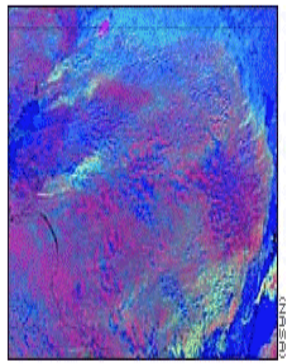
Editions | myCNN | Video | Audio | Headline News Brief | Feedback

Air pollution chokes rain, may temper greenhouse warming

ENN

By Environmental News Network staff

March 10, 2000
Web posted at: 11:36 a.m. EST (1636 GMT)



Researchers used satellite images to study the impact of air pollution on precipitation

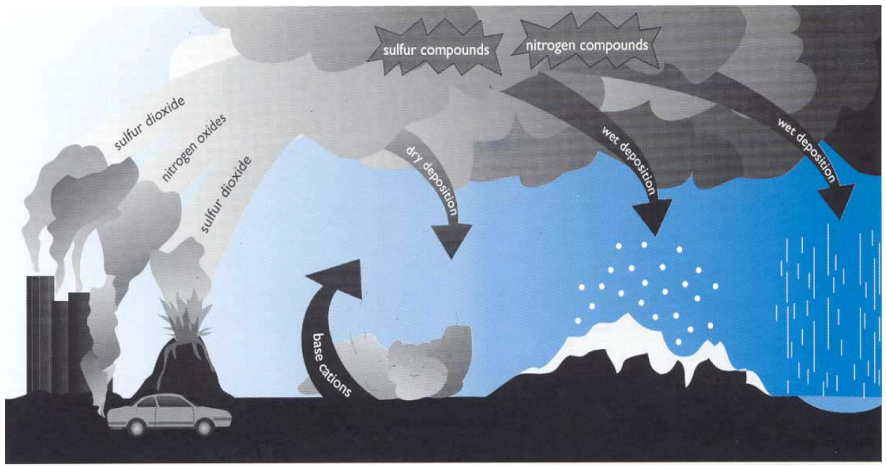
Urban and industrial air pollution stifles precipitation and may nullify greenhouse warming, according to a report by an atmospheric scientist in today's issue of the journal *Science*.

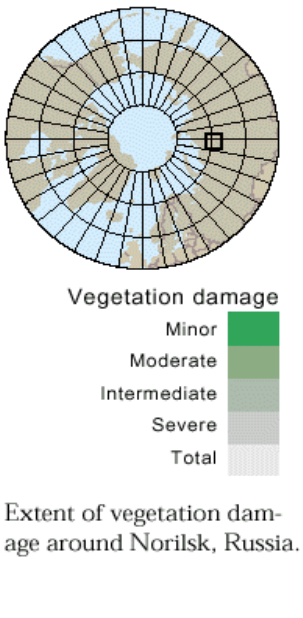
CNN.com News
CNN Sites
Search
CNN.com
Find
NATURE
TOP STORIES
New hurdles hamper Galapagos oil spill cleanu
Insight: Prius lead the hyb powered fleet
Picture: Indonesia's Mera volcano erupts
(MORE)

NEESPI science question:

What are the effects of changes of aerosol concentrations and properties on the formation of clouds, precipitation, and the overall hydrological cycle in Northern Eurasia?

Acid rain





Extent of vegetation damage around Norilsk, Russia.

Forest area and growing stock at risk from sulfur and nitrogen depositions in Russia (Nilsson and Shvidenko, 1999)

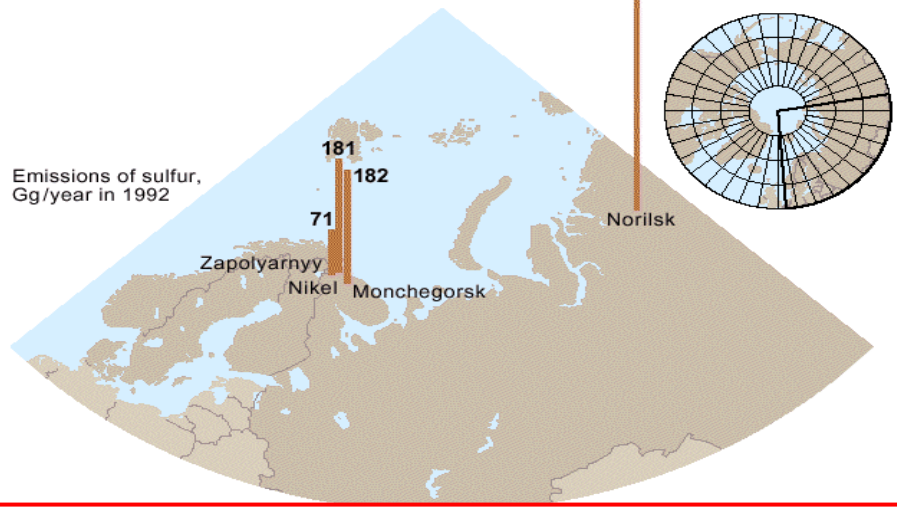
	Forested area (in million ha)	Growing stock (in billion m^3)
Sulfur		
European Russia	21.5	2.8
Asian Russia	210.0	24.5
Total	231.5	27.3
Nitrogen		
European Russia	1	0.2
Asian Russia	87	11.4
Total	88	11.6

Arctic haze

Emissions of sulfur dioxide have decreased considerably in North America and Europe after a peak in the late 1970s and early 1980s. This results from an interplay of political decisions to cut emissions, the replacement of 'dirty' fuels, and new technologies for removing sulfur from fossil fuel and for cleaning flue gases in power plants. Nonetheless, power generation and smelting remain major sources.

Metal smelters have the largest emissions within the Arctic

Production of copper, nickel and other non-ferrous metals from sulfur-bearing ores create the largest emissions of acidifying substances within the Arctic. The traditional smelting



NEESPI science question:

How do atmospheric aerosols affect the terrestrial and aquatic ecosystems in Northern Eurasia?

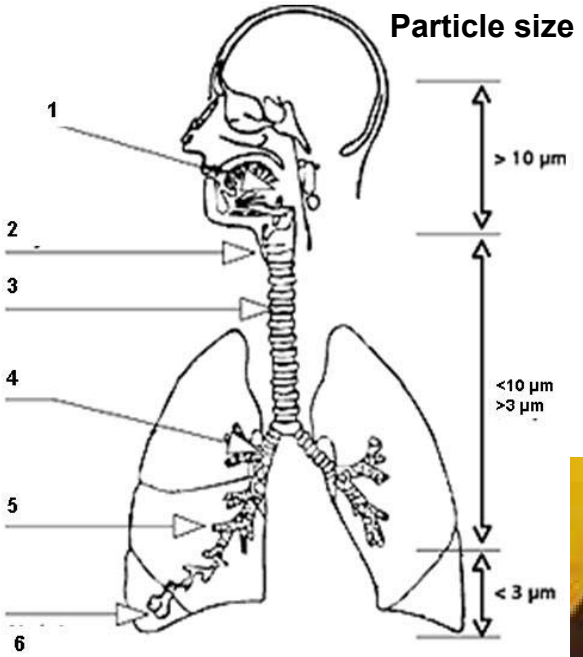
Air pollution and human health

"…What does the future hold for us?
Smog filled skies and poison cars,
And broken land with useless dust
And nature's beauty behind bars…"

Even kinds these days know about health impacts caused by air pollution

Adverse impacts of aerosols on human well-being

Health impact



Fine aerosol particles are responsible for causing the greatest harm to human health. Inhaled deep into the lungs, they can cause breathing and respiratory problems, irritation, inflammation and cancer

Agriculture impacts

Aerosols cause decrease in solar radiation in the photosynthetically active region (0.4-0.7 µm) reducing photosynthesis

⇩

Reduction in productivity

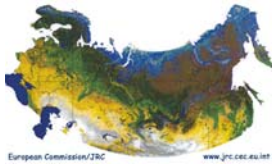
⇧

Deposition of particles on the plants shields solar radiation

NEESPI science question:

How will the projected changes in atmospheric aerosols and air pollution affect air quality and human health in Northern Eurasia?

Focus on aerosols



US Climate Change Science Program
www.climatescience.gov

Strategic Plan for the Climate Change Science Program

Table 2-1: Summary of Synthesis and Assessment Products -- Topics to be Covered.

CCSP Goal 1: *Improve knowledge of the Earth's past and present climate and environment, including its natural variability, and improve understanding of the causes of observed variability and change*

within 2 years	Temperature trends in the lower atmosphere -- steps for understanding and reconciling differences.
within 2 years	Past climate variability and change in the Arctic and at high latitudes.
2-4 years	Re-analyses of historical climate data for key atmospheric features. Implications for attribution of causes of observed change.

CCSP Goal 2: *Improve quantification of the forces bringing about changes in the Earth's climate and related systems*

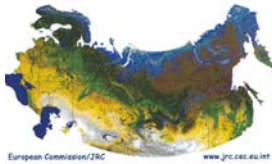
within 2 years	Updating scenarios of greenhouse gas emissions and concentrations, in collaboration with the CCTP. Review of integrated scenario development and application.
within 2 years	North American carbon budget and implications for the global carbon cycle.
2-4 years	Aerosol properties and their impacts on climate.
2-4 years	Trends in emissions of ozone-depleting substances, ozone layer recovery, and implications for ultraviolet radiation exposure and climate change.

New Priorities for the 21th Century – NOAA Strategic Plan

Understand Climate Variability and Change to Enhance Society's Ability to Plan and Respond

Outcomes	Strategic Plan Performance Objectives	NOAA Performance Measures	F B
A predictive understanding of the global climate system with quantified uncertainties sufficient for making informed and reasoned decisions on time scales of weeks to decades	Describe and understand the state of the climate system through integrated observations, analysis, and data stewardship	Determine the national explained variance (%) for temperature and precipitation for the contiguous United States using USCRN stations (GPRA)	Captur 95% o Nation Tempe and at the An Nation Precipi for the US
		Reduce the error in global measurement of sea surface temperature	New [is
	Improve climate predictive capability from weeks to decades, with an increased range of applicability for management and policy decisions	US temperature forecasts (cumulative skill score computed over the regions where predictions are made) (GPRA)	
	Reduce uncertainty in climate projections through timely information on the forcings and feedbacks contributing to changes in the Earth's climate	Reduce the uncertainty in the magnitude of the North American (NA) carbon uptake (GPRA)	Uncert Carbo +/- 0.
Climate-sensitive sectors and a climate-literate public effectively incorporating NOAA's climate products into their plans and decisions		Reduce the uncertainty in model simulations of the influence of aerosols on climate	New [Establi improv (baseli climate assessr uncerta model of how Americ influen

The need for NEESPI



- Climate change and population development in the 21th century are expected to cause increases in atmospheric aerosol concentrations. There is a clear need for improved knowledge of interactions between changing atmospheric aerosols and the Earth System to increase confidence in our understanding of how and why the climate and environment have changed

- By focusing on Northern Eurasia, NEESPI will provide breakthroughs in understanding the roles of atmospheric aerosols and air pollutants in climate change at the regional and global scales that are unlikely to be achieved without a focused inter-agency initiative