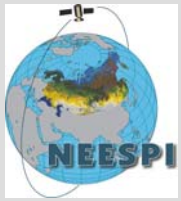


NEESPI Focus Research Center on ATMOSPHERIC AEROSOL AND AIR POLLUTION (AAAP)

Irina N. Sokolik

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

NEESPI FRC AAAP

- **Venue**:

  School of Earth and Atmospheric Sciences (EAS)
  Georgia Institute of Technology, Atlanta, USA

- **Leaders:**

  Irina Sokolik, Robert Dickinson, Judith Curry

- **Two-fold Objectives**:

✓ **Conduct, facilitate, and promote research aimed at improved understanding of interactions between changing aerosols, air pollutants and the Earth systems in Northern Eurasia**

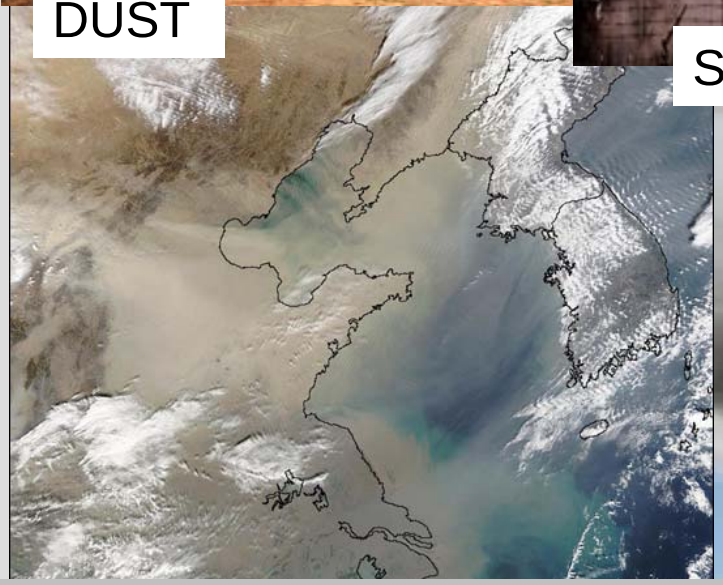
✓ **Education and training**

Northern Eurasia has the world's largest sources of natural and anthropogenic aerosols and air pollutants

DUST

SULFATES

SMOKE/CARBONACEOUS



Distinct trends in sources and spatial and temporal distributions (due to region-specific climatic, economical and political changes)

Focus of NEESPI FRC AAAP

Aerosol- and air pollution-induced interactions and feedbacks in the land biosphere-atmosphere system and their role in climate change…

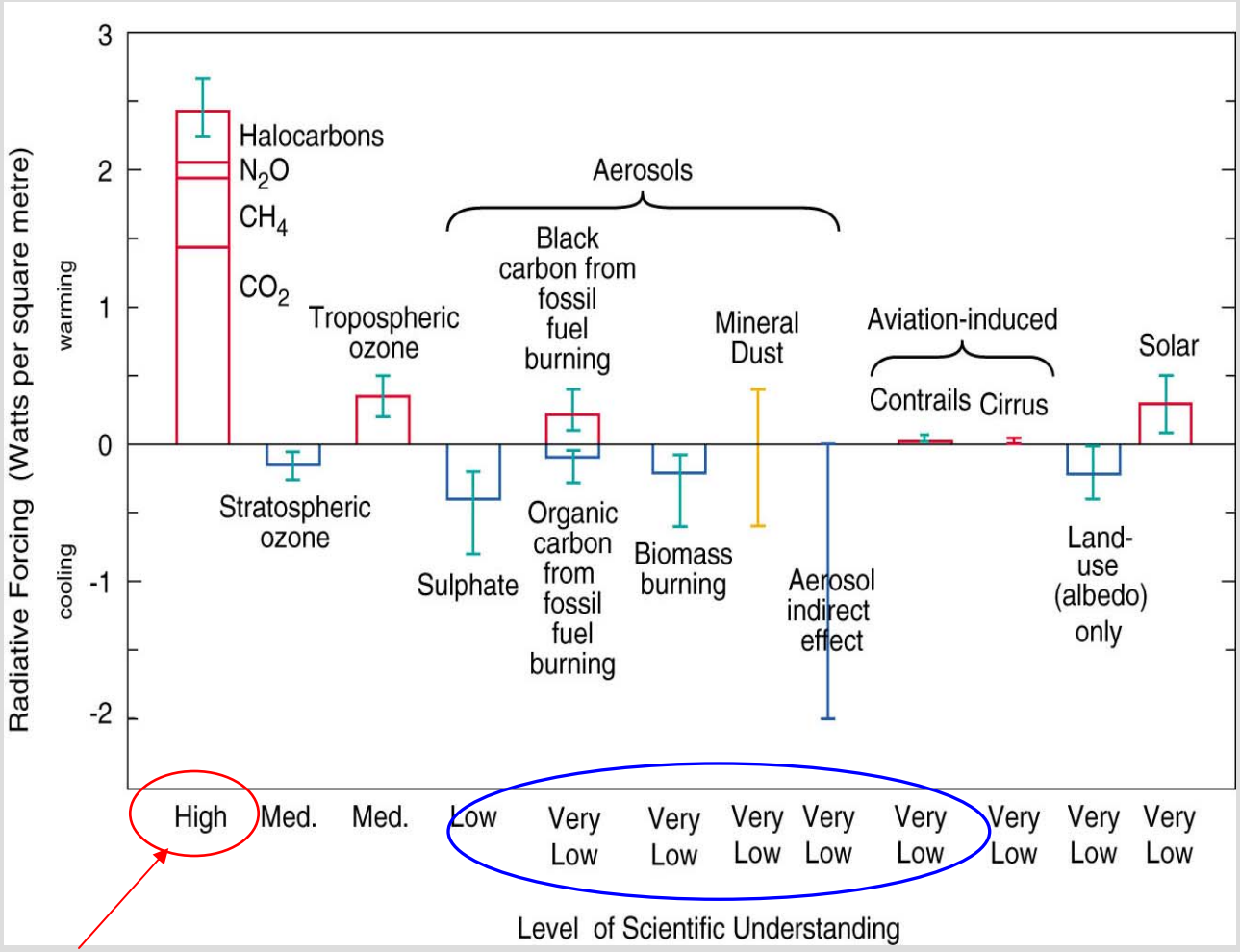
- ***What are the key aerosol- and air pollution-induced processes and feedbacks that have been affecting the energy, water and carbon fluxes over Northern Eurasia (their mechanisms, temporal and spatial scales)?***

- ***How will the future changes in terrestrial ecosystem dynamics, climate and human factors affect the above processes in Northern Eurasia?***

Climate radiative forcing of atmospheric aerosols can enhance or rival GHG warning

Intergovernmental Panel on Climate Change (IPCC, 2001)

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

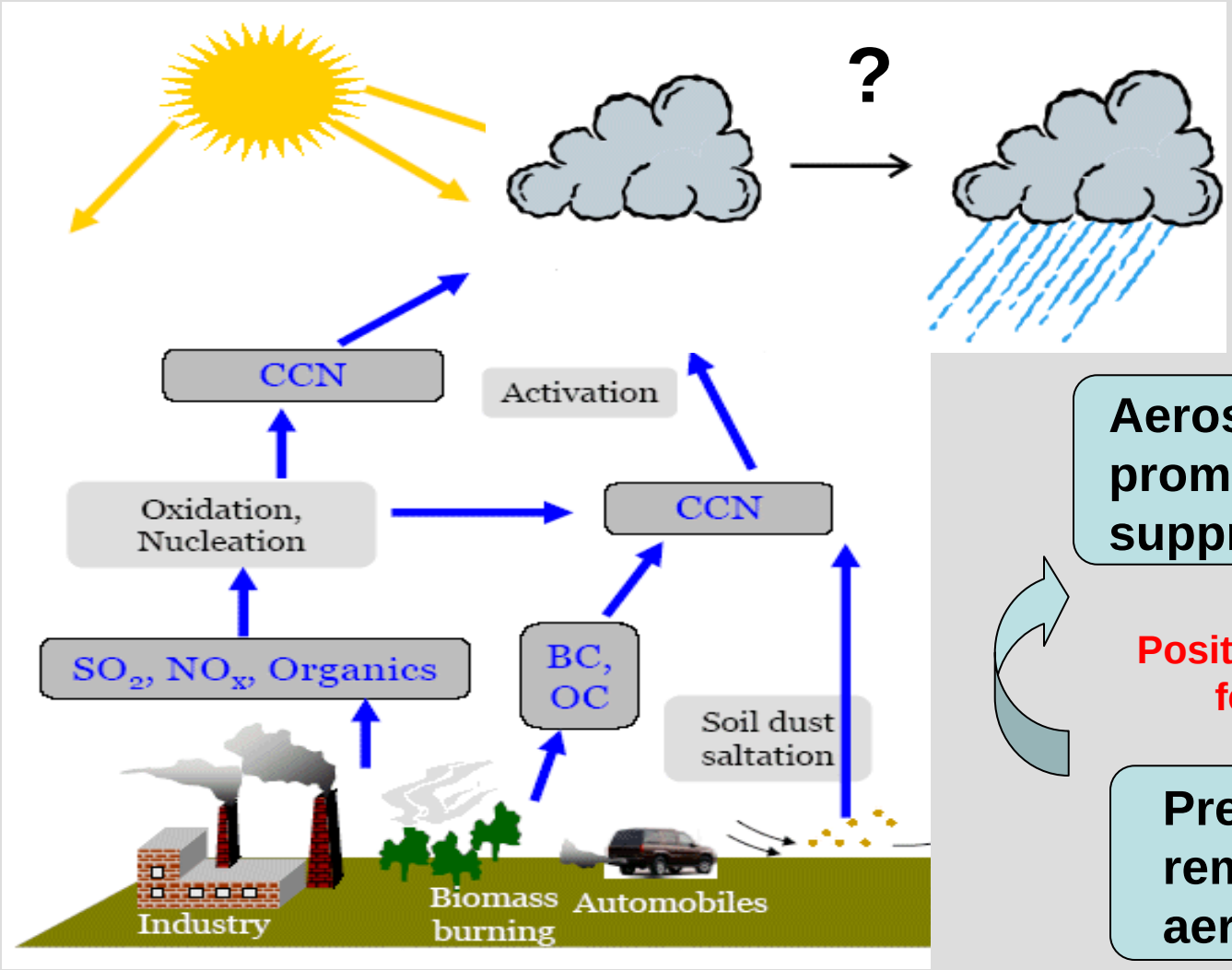


Need to know concentrations

<u>Complexity of aerosols</u>:

- **varying shape, composition and size**
- **heterogeneous distribution of sources**
- **short lifetime (up to about 2 weeks)**
- **Anthropogenic fraction vs. natural**

Aerosols- ecosystem-hydrological cycle linkages (via clouds)



Aerosols can promote or suppress precip

Positive or negative feedbacks?

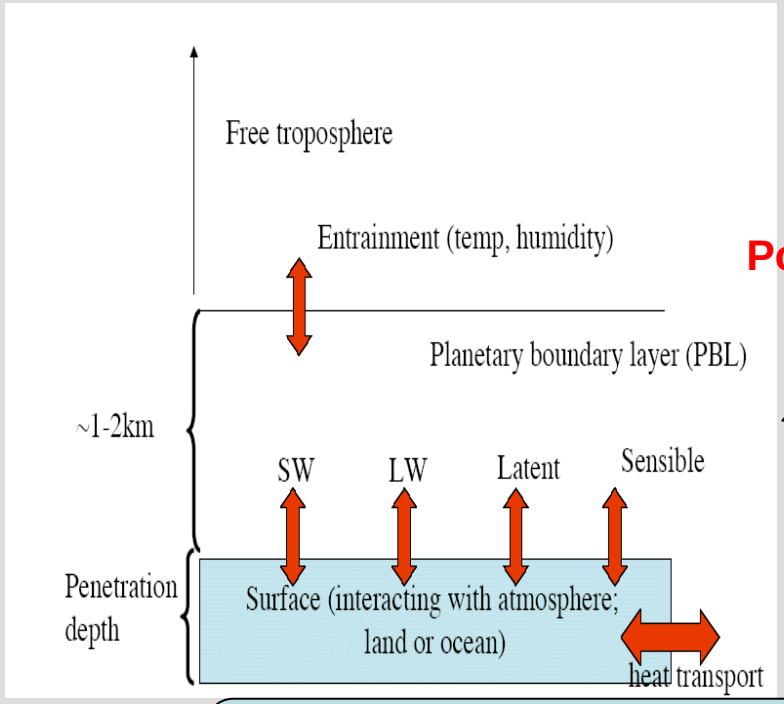
Precipitation removes aerosols

Aerosols- ecosystem-hydrological cycle linkages (via surface radiation)

Aerosols

Decrease surface SW radiation and increase LW radiation

Decrease or increase PAR radiation



Positive or negative feedbacks?

Affect land-vegetation-atmosphere interactions and aerosol sources

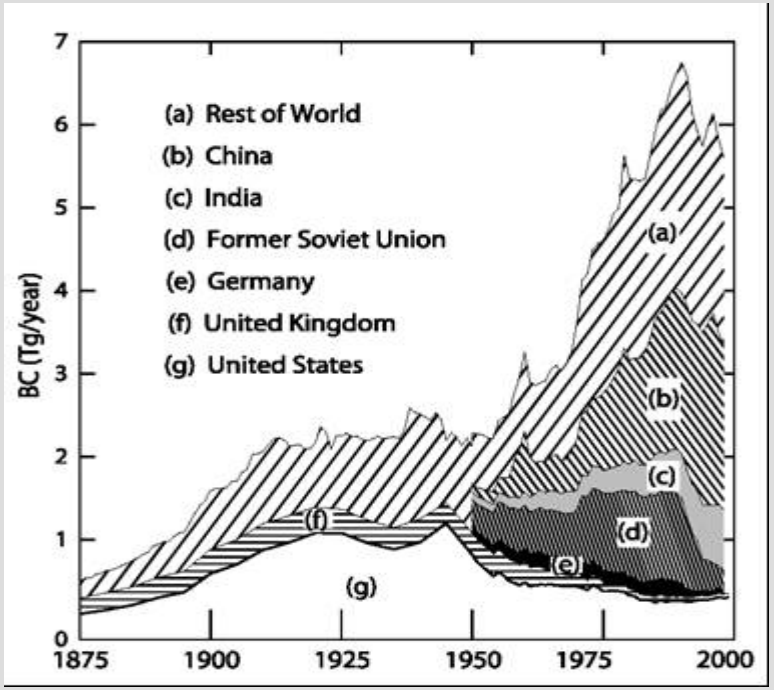
Carbonaceous aerosols from biomass and fossil fuel burning

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 et al*.)

Climate Warming Due to Soot and Smoke? Maybe Not (*Penner et al*.)

Slow down of the hydrological cycle (*Ramanathan et al*.)

NEESPI FRC on Atmospheric Aerosol and Air Pollution

- **14 funded proposals relevant to aerosol/air pollution studies**
- **Current science foci**:
  - **Impact of wind-blown desert dust on ecosystem functioning, precipitation, and energy budget**
  - **Climate forcing of urban industrial pollutants and biomass-burning smoke**
  - **Impact of aerosols on variations in the Arctic hydrological cycle**
  - **Air quality and human health:**
    Trans-Siberian observations (TROICA),
    POLLEN (allergic pollen in Europe)

UNDERSTANDING THE ROLE OF CHANGES IN LAND USE/LAND COVER AND ATMOSPHERIC DUST LOADING AND THEIR COUPLING ON CLIMATE CHANGE IN THE NEESPI STUDY DOMAIN DRYLANDS

PI: Irina N. Sokolik, Georgia Institute of Technology, Atlanta, Georgia, USA

Investigators:

Robert Dickenson, Georgia Institute of Technology, Atlanta, Georgia, USA

Yongjiu Dai, Beijing Normal University, Beijing, China

George Golitsyn, Institute of Atmospheric Physics, Russian Academy of Sciences, Moscow, Russia

International Collaborators:

Y. Shao, City University of Hong Kong, China;

B. Marticorena and G. Bergametti, CNRS/LISA/University of Paris 12, France;

D. Jugder, Institute Meteorology and Hydrology, Ulaan Baatar, Mongolia;

M. Mikami, MRI/JMA, Japan;

I. Uno, Institute Applied Mechanics, Kyushu University, Japan;

R. Bektursunova, Eurasian National University, Akmolla, Kazakhstan;

Y. Chun, Meteorological Research Institute, Seoul, Korea.

- ✓ ***The main goal is to investigate how and to what extent land-use/land cover changes and varying dust loadings and their interactions have been affecting climate of drylands in the NEESPI study domain over the past 50 years.***

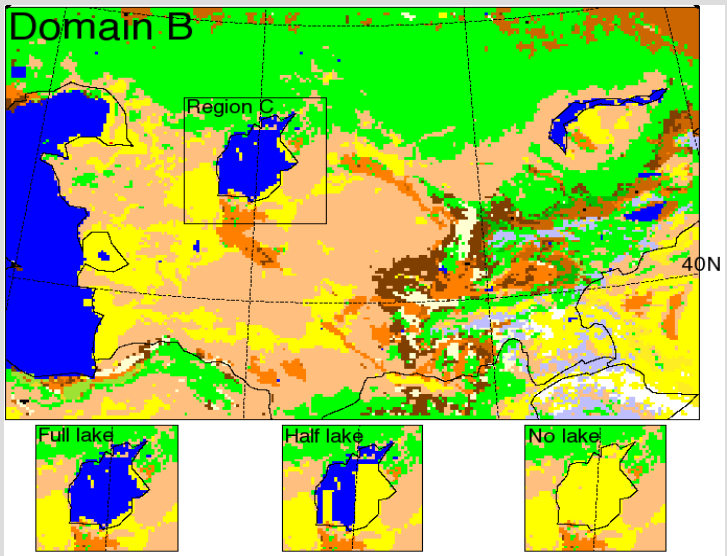
- ✓ ***Development of a suite of the models (including a regional climate model with a coupled dust emission/land module)***

- ✓ ***Development of Asian Dust Databank: 50-years climatology of dust events, climatic variables and land-use/land cover changes in Central and East Asia by merging available data from satellite, weather and monitoring stations, and historical records.***

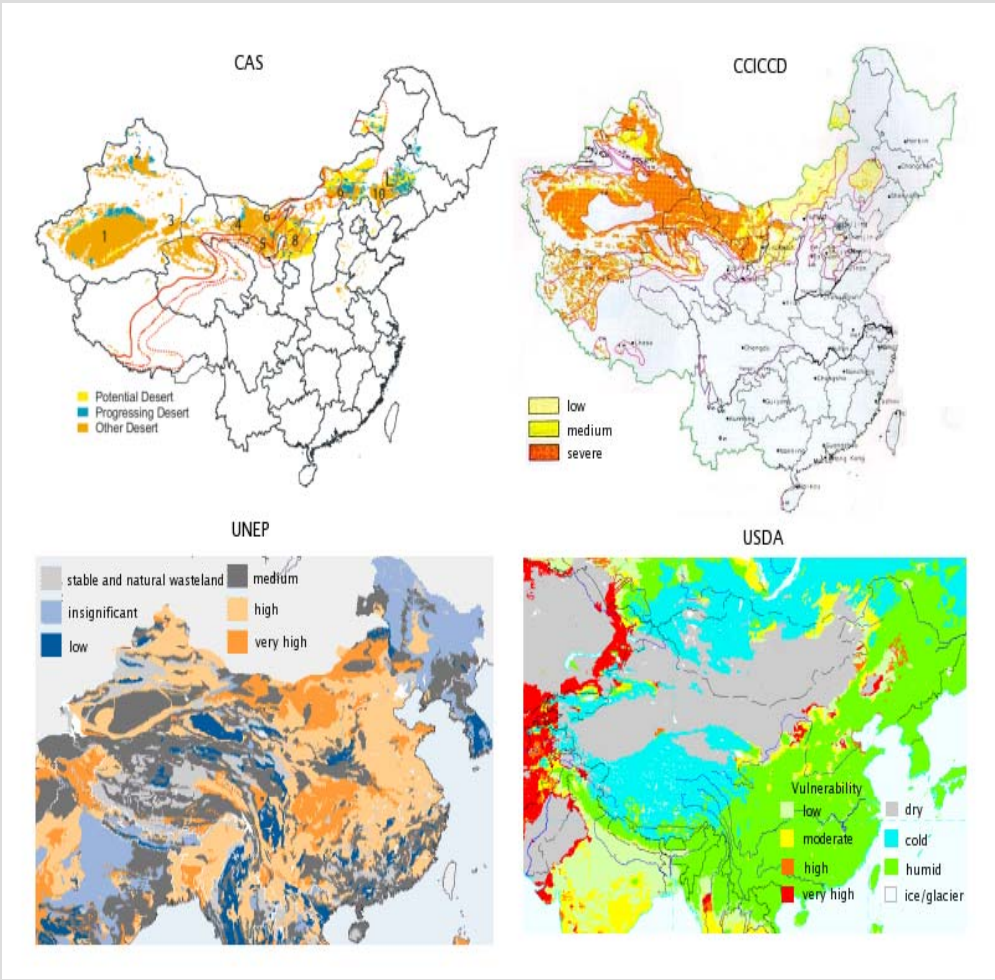
Anthropogenic vs. natural fraction of dust: Need better linkages between dust emission and land-cover/land-use change

Study	Estimated anthropogenic dust fraction
Tegen and Fung, 1996	30 - 50 %
Sokolik and Toon, 1996	~ 20 %
Mahowald et al. 2003	14 - 60 %
Tegen et al. 2004	< 10 %
Mahowald et al. 2004	0 - 50 %

Aral Sea



Desertification in China



Ongoing activities of NEESPI FRC on Atmospheric Aerosol and Air Pollution

- **Establish dedicated web site (info on funded projects, research news, discussion forum, data and modeling tools)**

- **Linkages with national and international programs:**

  ***IPY (international Polar Year): Impact of aerosols on the hydrological cycle in* Arctic (pending proposals to NSF and NASA)**

- **Leading and/or promoting collaboration on new projects/proposals:**

  Air pollution - health risk assessment – decision making

NEESPI FRC AAAP Educational Activities

- **Active involvement of grad and undergrad students:**

via funded NEESPI proposals; summer research assistantships; exchange of international students; participation in scientific meetings

- **Organization of summer schools**

- **Online educational materials:** **complete courses and review lectures (will be available at NEESPI FRC AAAP website)**

Courses: **Remote sensing of the atmosphere**

Aerosol, clouds and climate

Air pollution

- **Links to other educational resources (e.g., NCAR COMET: Dust storms)**

Educational Activities: New Initiatives

Proposal to Intellectual Introduction Project for the Discipline Innovation in China University System Ministry of Education and State Administration for Foreign Experts Affairs of China

LAND–ATMOSPHERIC INTERACTION STUDIES

Yongjiu Dai[1], Robert E. Dickinson[2], PIs

Co-Investigators: Filippo Giorgi[3], Rong Fu[2], **Irina Sokolik[2]**, **Judith Curry[2]**, Xubin Zeng[4], Shun-Lin Liang[5], Kun Yang[6], Liming Zhou[2], Gui-Lin Wang[7], Athanasios Nenes[2]

Co-Investigators (BNU): Xiaowen Li, Jingdi Wang, Daoyi Gong, Yun Xie, Jiping Liu, Xunqiang Bi, Jing Zhang, Shaomin Liu, Rui Sun

[1] ***Beijing Normal University, China*** [2] ***Georgia Institute of Technology****, USA*

[3] Abdus Salam International Centre for Theoretical Physics, Italy

[4] University of Arizona, USA [5] University of Maryland, USA [6] University of Tokyo, Japan [7] University of Connecticut, USA

Main objectives:

a) provide a major advance in understanding of how the land and atmosphere interact together to generate aerosol and cloud properties, precipitation, and soil moisture;

b) train a new generation of scientists within China and elsewhere focused on further advancing this understanding.

The need for NEESPI aerosol and air pollution studies

- **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 Systems to increase confidence in our understanding of how and why the climate and environment have changed and to develop improved predictive capabilities for integrative assessments of climate change in the future**

- **By focusing on Northern Eurasia, NEESPI has the potential to 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 international, multi-disciplinary, integrative initiative**