GOALS FOR DISCUSSION

• Identify Rationale for Water Studies across the NEESPI Region
• Status of FRC for Water Integration Studies
• Summary and a Look Forward
MAJOR SCIENTIFIC TOPICS

- Terrestrial ecosystem dynamics (fresh water systems)
- Biogeochemical cycles (wetlands, permafrost)
- Surface energy and water cycles
- Land use interactions: societal-ecosystem linkages (water use)
- Ecosystems and climate interactions
- Topics of special interest
  - Cold land region processes
  - Coastal zone processes
  - Atmospheric aerosols and pollution (aridization, salinization)

The hydrological cycle links every major component of the NEESPI system and central to the analysis of: Global change, Natural variability, Human vulnerability
Some Water Issues in NEESPI region
Disappearing of lakes in Western Siberia

- Examining temporal variability of ~10,000 West Siberian lakes and ponds
- Comparing archived Landsat data from early 1970's w/ contemporary RESURS and MODIS data

NEESPI Scientific Topics:
- Terrestrial ecosystem dynamics
- Biogeochemical cycles
- Surface energy and water cycles
- Land use interactions
- Ecosystems and climate interactions

Topics of special interest
- Cold land region processes
- Coastal zone processes
- Atmospheric aerosols


Why did the lakes disappear?

Courtesy Laurence Smith, UCLA
SAR-based Open Water Classification for Ob River Region

Open Water Classification

Blue = open water. Green = other

ERS-1
ERS-2
Coherence
JERS-1

Synthetic Aperature Radar (SAR) image
McDonald, Podest, et al.
QUANTIFICATION & ATTRIBUTION STUDIES:
Water Use/Engineering, Land use, Climate change

ARAL SEA DISAPPEARANCE LINKED TO HUMAN-INDUCED CHANGES TO UPLAND HYDROLOGY

1989
2003
Except the Caspian Sea that receives most of its runoff from the north, lake levels are decreasing despite no substantial changes in precipitation.

Climate variability? Water withdrawal? Snow line retreat? Deglaciation? All together?
Currently near-real time monitoring of 16 lakes and reservoirs across Northern Eurasia

Global Reservoir and Lake Elevation Database
Near-Real Time Monitoring of Lake and Reservoir Surface Elevations from TOPEX/POSEIDON and Jason-1 Altimetry. Charon Birkett
http://www.pecad.fas.usda.gov/cropexplorer/global_reservoir/
Changes in the hydrological cycle over the continent effect on the fresh water transport to the Arctic Ocean, and may influence on ocean thermohaline circulation

Combined Annual Discharge 6 Largest Eurasian Arctic Rivers  
--- 8% increase over period of record  
- Aggregate Trend Detectable for Arctic  
  - Temporal character complex  
  - Geography of change complex  
- Linked to NAO and global T rise  
- 18-70% Increase in River Q to 2100  

(updated from Peterson et al. 2002)
Runoff changes have complex spatial distribution.

Data source: R-ArcticNet, 57 gauges over 1936-1999.
Selected gauges have at least 60 annual discharge values.
Runoff changes have complex spatial distribution.

Direction and especially rate of change in precipitation are not consistent with runoff.

Precipitation cannot explain runoff change - especially in the north.
Runoff changes have complex spatial distribution.

Direction and especially rate of change in precipitation are not consistent with runoff.

Precipitation cannot explain runoff change - especially in the north.

ET change is minor.

Negative discrepancies coincide with permafrost regions...

Change (mm)
- Acceleration + Deceleration
1) How might the changing network configuration affect interpolated (gridded) fields?

2) Could any biases help explain the discharge increase?
Total Precipitation for 1972 from Yearly Station Network
Maximum Monthly SWE Over Pan–Arctic Basin

area = 25 million km²

Comparison of SWE from model simulations and remote sensing products
Timing and trend in the timing of spring thaw derived from SSM/I have elucidated the thaw correspondence with regional anomalies in annual NPP derived from MODIS and AVHRR. Mean annual variability in springtime thaw for Northern Eurasia (above) is on the order of ±7 days, with corresponding impacts to annual productivity of approximately 1% per day.
TREND   TOTAL $n$   # significant   % significant

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Evidence of earlier snowmelt across North Eurasia
Changes in Tien Shan Glaciers (example of deglaciation)

(a) Akshiirak glacier area changes between 1943 and 2003. Petrova Glacier terminus positions since 1869 (A), Davidova Glacier terminus positions since 1932 (B) and in 1977 (aerial photographs) before its surface elevation and terminus advanced in 1978 (b). (From Aizen et al, 2006)
NEESPI Focus Research Center for Water System Studies

• 52 funded proposals, several water-themed:
  -- Water and Land Use/Cover Change -- Cryosphere/Permafrost
  -- Hydrological Extremes -- Snow
  -- Water Use and Engineering -- Data Support
  -- Integrative -- Inland Water Quality
  -- Coastal/Shelf Systems

• Several Approaches
  - Broad-scale in situ and remote sensing
  - Modeling and geospatial analysis
  - Integrated data systems
  - Field studies
NEESPI Focus Research Centers

**NEESPI Focus Research Center for Water System Studies**

- **Venue:** Water Systems Analysis Group, University of New Hampshire, Durham, New Hampshire, USA
- **Objectives:** conduct, promote, and facilitate research aimed to improve understanding and modeling of the water cycle and water management in the Earth System focusing on Northern Eurasia
- **Links to International Projects:** GWSP, CLIC, GEWEX, GTN-H, ACIA, IPY
- **Leaders:** Vorosmarty, Lammers, Shiklomanov, Rawlins, Douglas, Xiao
- **Current Science foci:**
  - Water resources and water budgets
  - Water management
  - Variability and change of hydrological cycle
  - Interactions between Humans and hydrology
  - Monitoring of the water cycle
  - Remote sensing for hydrological research
- **Funded and pending proposals to NSF, NASA and NOAA**
- **Other relevant activities:**
  - The Focus Research Center is currently serving as the base institution for the NSF Arctic Fresh Water Initiative (CHAMP), ArcticRIMS, R-ArcticNet, IPY ArcticHydra.
GWSP – A Growing World-Wide Network

NEESPI adopted as regional focus project, bringing important high-latitude/arid/semi-arid perspectives to GWSP
SUMMARY AND LOOK FORWARD

- Environment and environmental change in NEESPI region is dominated by
  - water cycle dynamics
  - interactions of humans and water cycle
- Broad research agenda and portfolio of projects based on variety of data sets, methodologies
- Integration/synthesis critical to derive benefit from these science investments
- Collaborations will be key….e.g. GWSP, CliC
- Propose a joint GWSP-NEESPI workshop: “Transects of Water Stress” across the NEESPI domain