

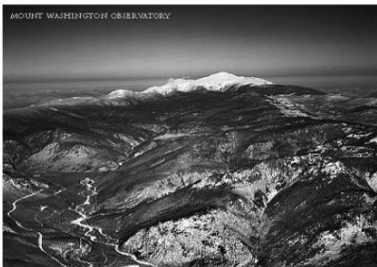
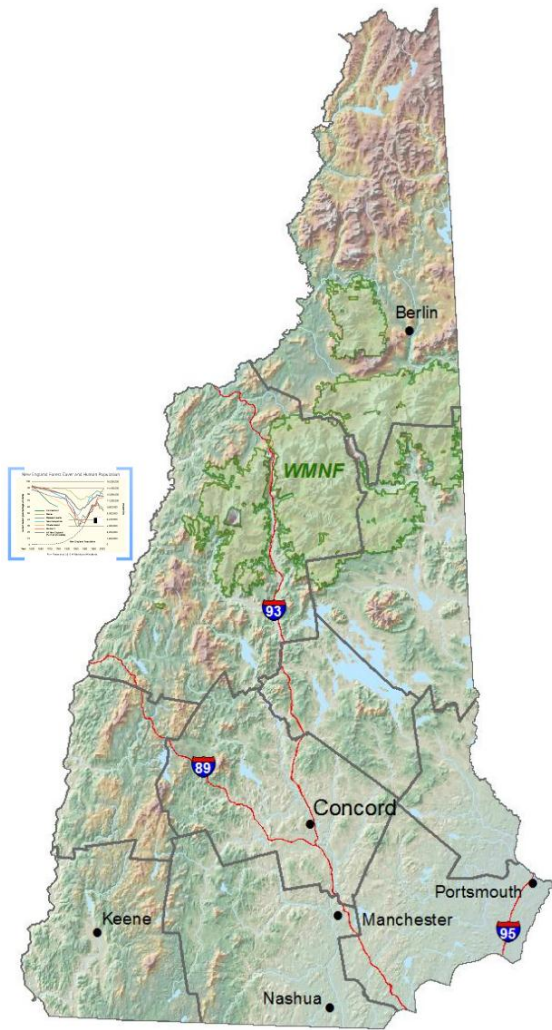


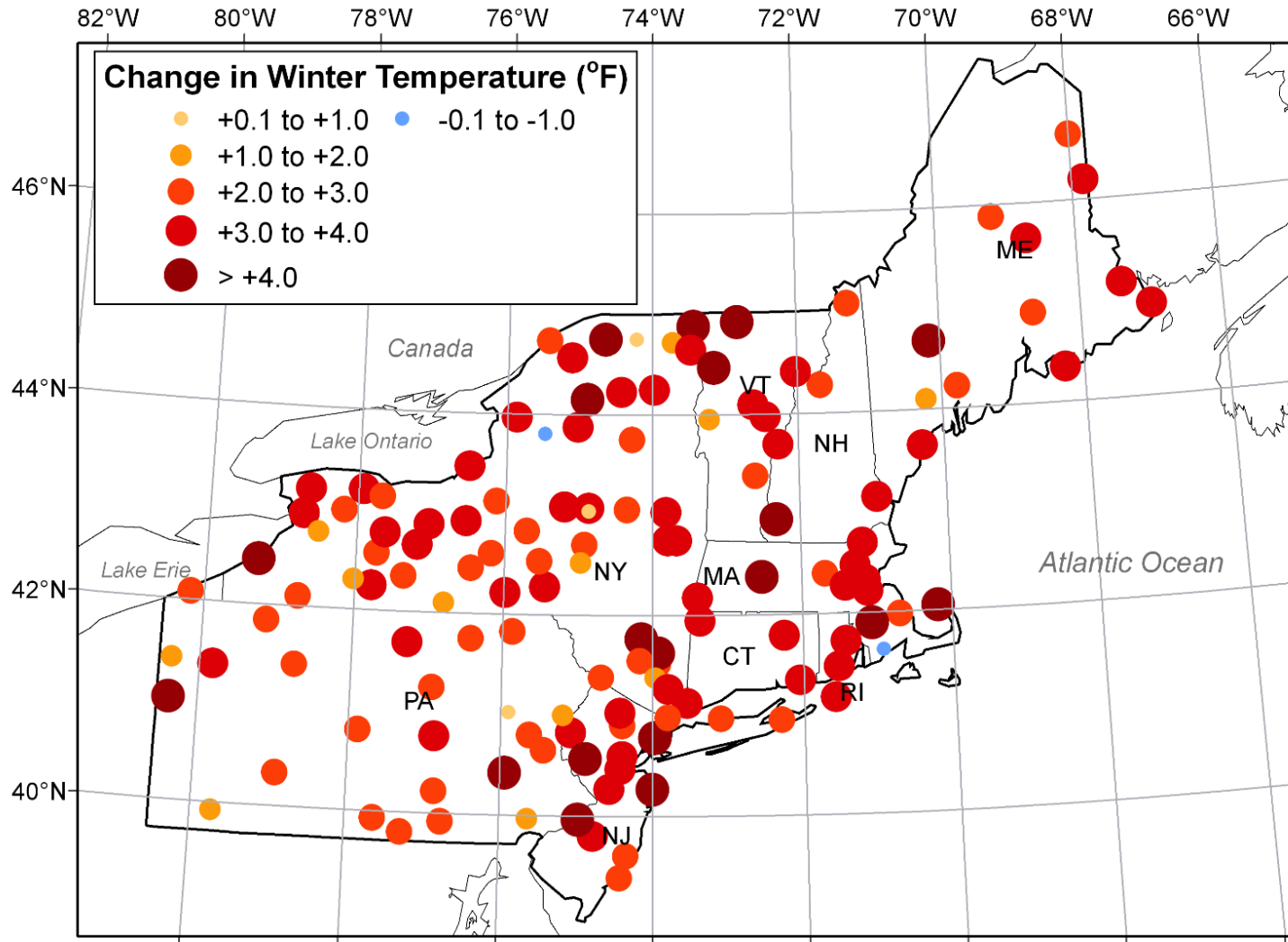
ECOSYSTEMS + SOCIETY

NH EPSCoR

Interactions Among Climate, Land Use, Ecosystem Services, and Society

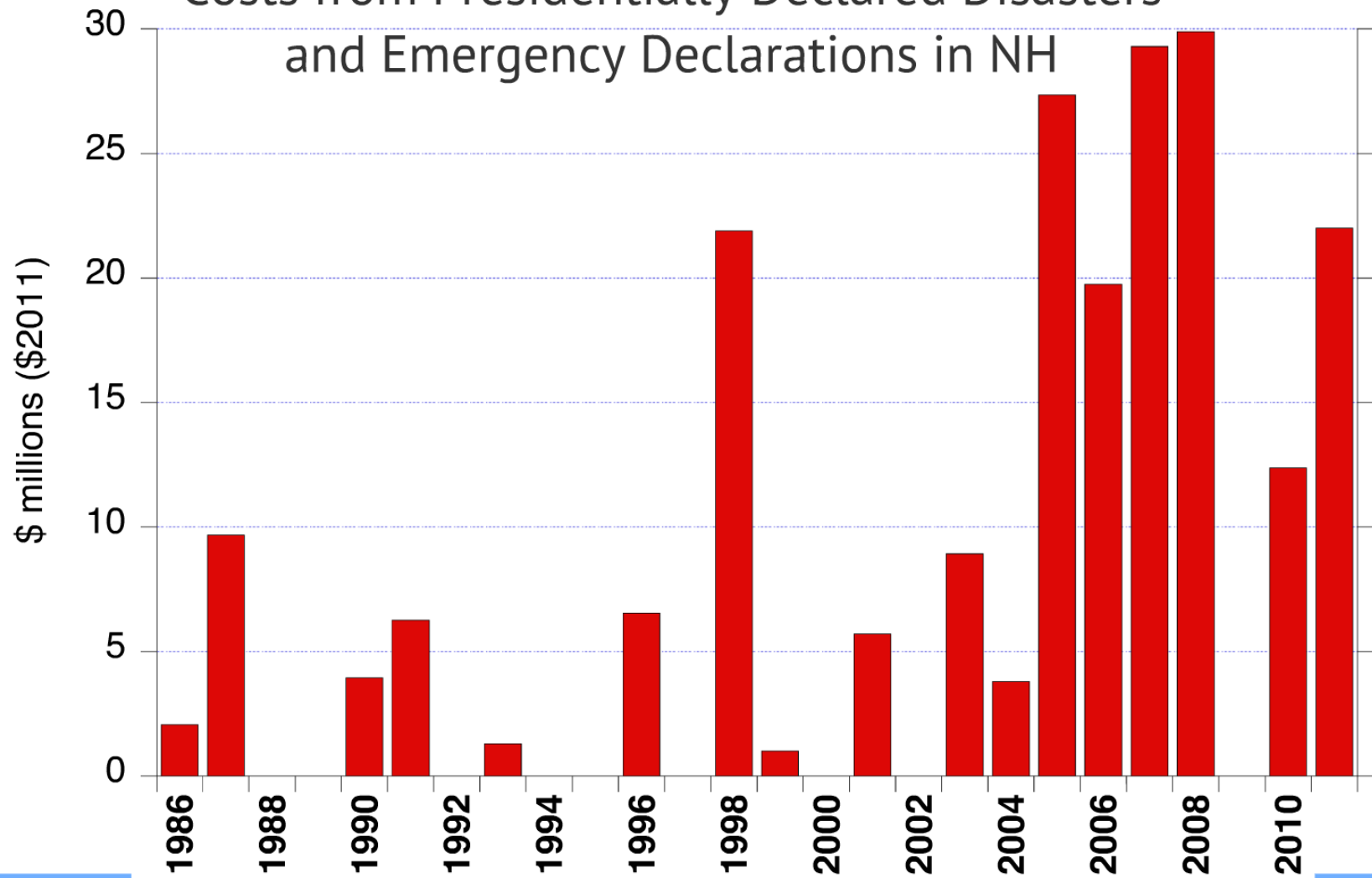
William H. McDowell, UNH
NH EPSCoR Team







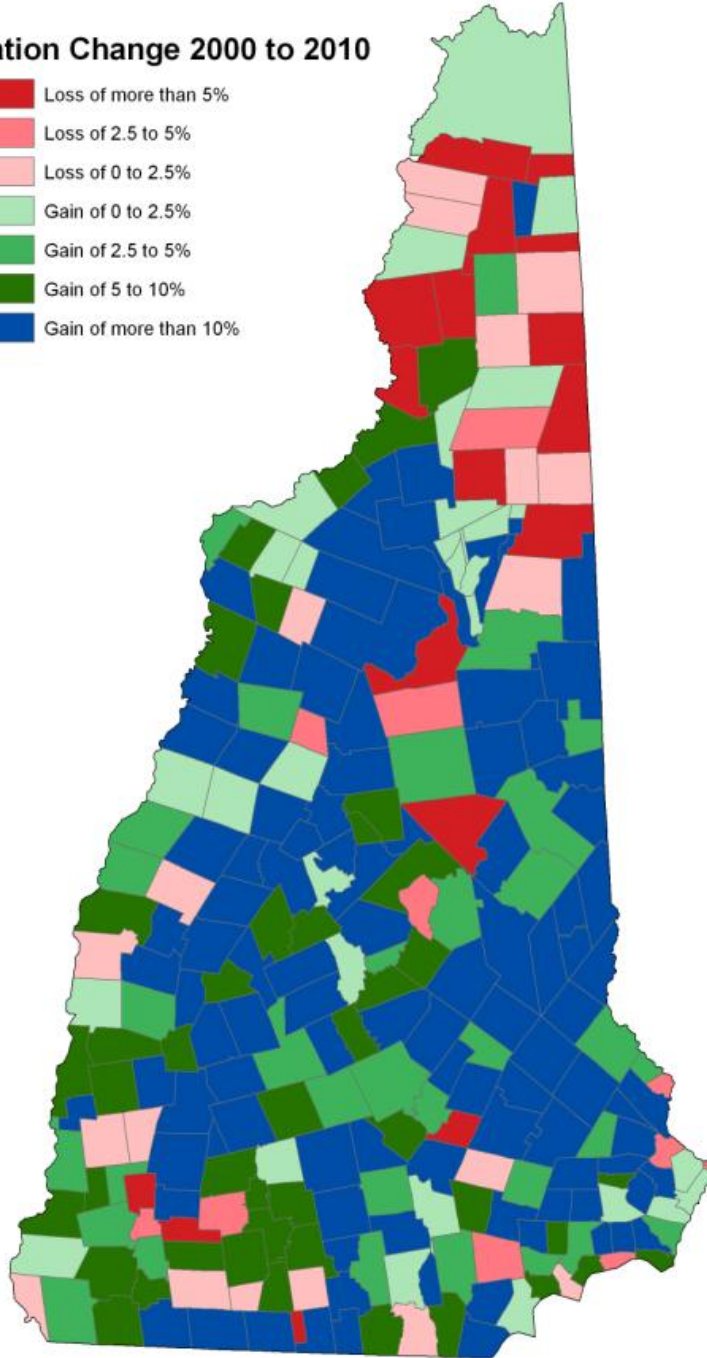
Costs from Presidentially Declared Disasters and Emergency Declarations in NH





ECOSYSTEMS + SOCIETY

Population Change 2000 to 2010



CARSEY
INSTITUTE
AT THE UNIVERSITY OF NEW HAMPSHIRE

Source: 2010 Census

Analysis: K.M. Johnson,
Carsey Institute, UNH

Source: U.S. Census Bureau, Census 2000 and 2010, PL-94



Project Goals - EPSCoR

1. To better understand complex interactions among climate, land use, ecosystem function and society. (Research Goal)
2. To build capacity for competitive research in interdisciplinary ecosystem-related natural and social sciences. (Educational Infrastructure Goal)
3. To strengthen and diversify the STEM workforce pipeline in NH. (STEM Pipeline Goal)
4. To strengthen management and policy decision capacity in New Hampshire regarding ecosystems and their services to, and interactions with, society. (Decision Capacity Goal)

Relationship Between Project Objectives





Research Program

Goal: To better understand complex interactions among climate, land use, ecosystem function, and society

Research Question: How do changing climate and human land use affect the ability of New Hampshire landscapes to provide essential aquatic and terrestrial ecosystem services to the state and region across multiple scales?



Ecosystem Services Studied

Provisioning Services

- Water supply
- Wood (timber, fiber, fuel)

Regulating Services

- Climate (carbon storage, albedo)
- Water regulation
- Water purification and waste treatment

Cultural Services

- Recreation

Supporting Services

- Soil formation
- Photosynthesis
- Nutrient cycling



Research Foci – Ecosystem Function





Ecosystem function → Ecosystem Services

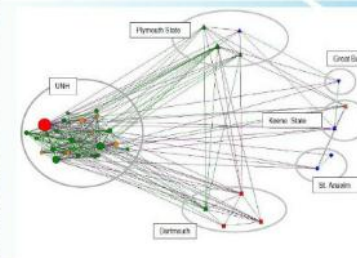
Data and Information

Headwater intensive sensor network
Distributed sensor networks
(LoVoTECS, CoCoRAHS)
Airborne hyperspectral
NH resident perceptions
via surveys & interviews
Evaluation
Additional data & info
leveraged sites
met, discharge, census, etc.
satellite



Models and Analysis

FRAMES, PnET, WRF
Land use/demographics
Ecosystem valuation
Stakeholder engagement
NH resident perceptions
Land use and climate
scenarios



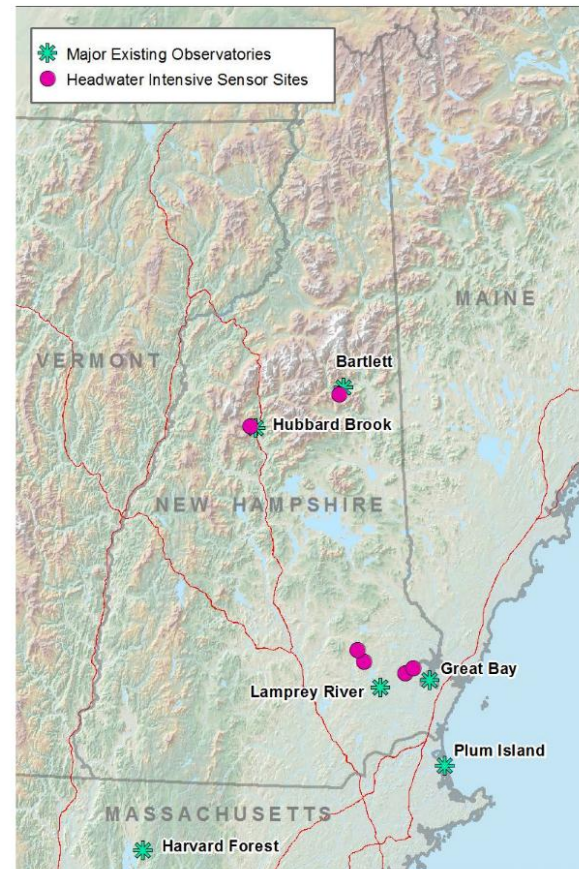
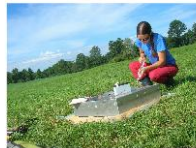


Headwater Soil Sensor Network

Headwater Intensive Sensor Sites

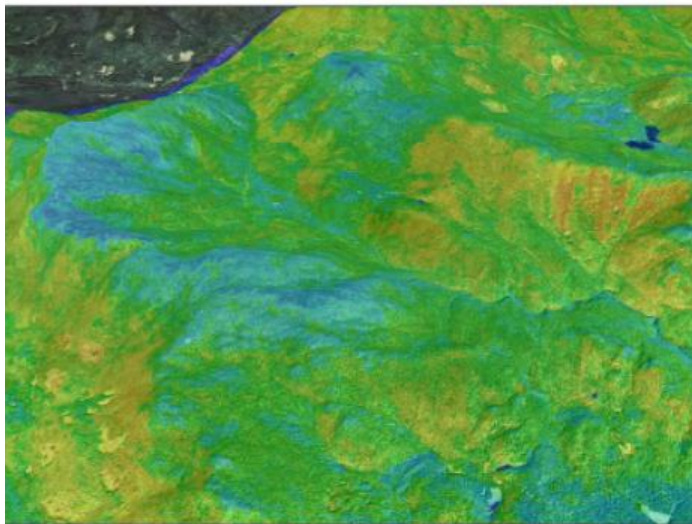
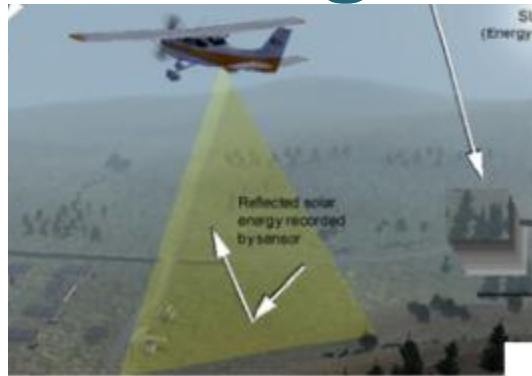
Soil Sensors:

- Continuous soil CO₂ flux
- Continuous soil T & moisture (0, 10, 30 cm)
- Manual sampling for C & N pools across soil profile (0 to ~ 50 cm)

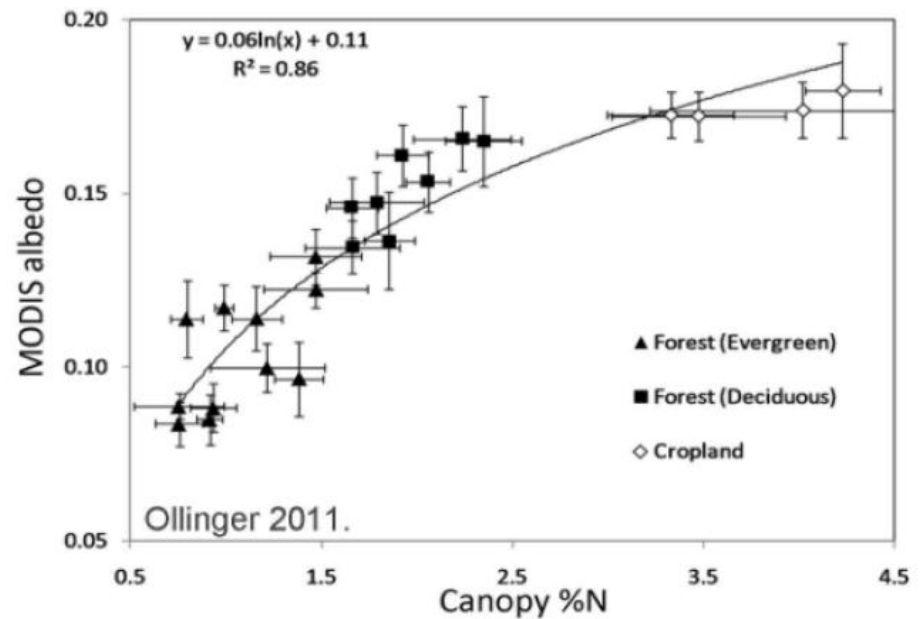




Scaling from Plot to Landscape



Collect hyperspectral imagery from ground and airborne sampling of different land uses, to obtain canopy N, albedo, and model productivity

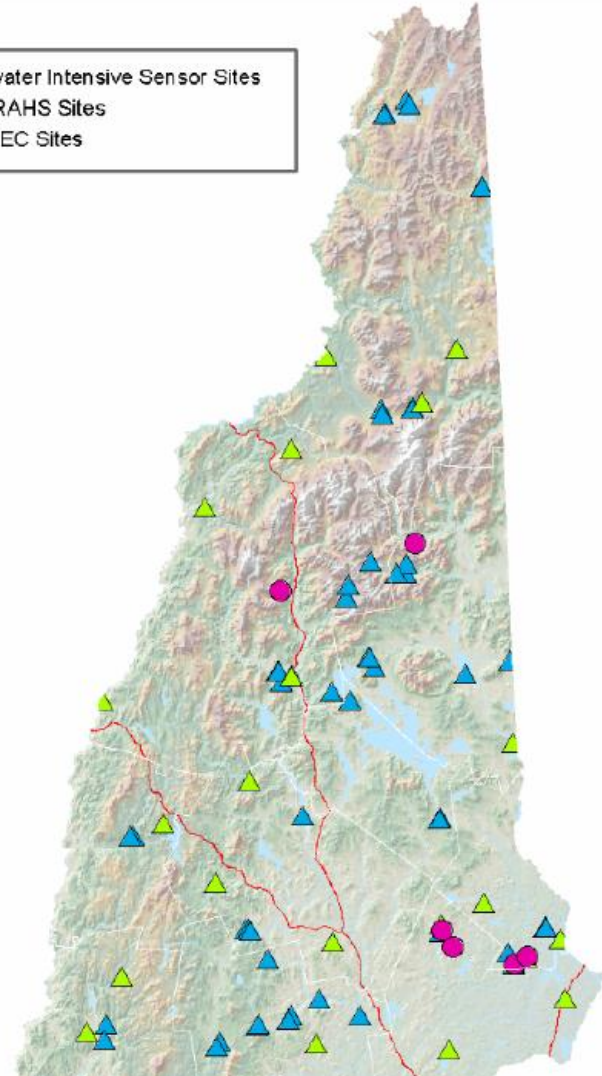


Aquatic Regional Sensor Network

Lotic Volunteer Temperature, Electric Conductivity, and Stage Sensing (LoVoTECS)



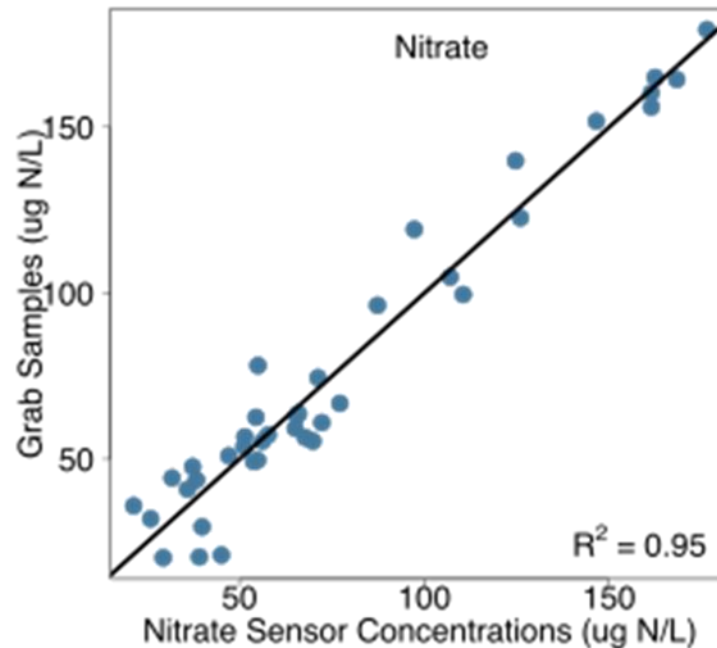
- Headwater Intensive Sensor Sites
- ▲ CoCoRAHS Sites
- ▲ LoVoTEC Sites



Headwater Intensive Sensor Sites

Aquatic Sensors (15 min intervals):

- Stage/Discharge
- Temperature
- Conductivity
- Nitrate
- Dissolved Organic Carbon
- Turbidity and Chlorophyll
- Dissolved oxygen
- pH



Sensor
validation
is critical

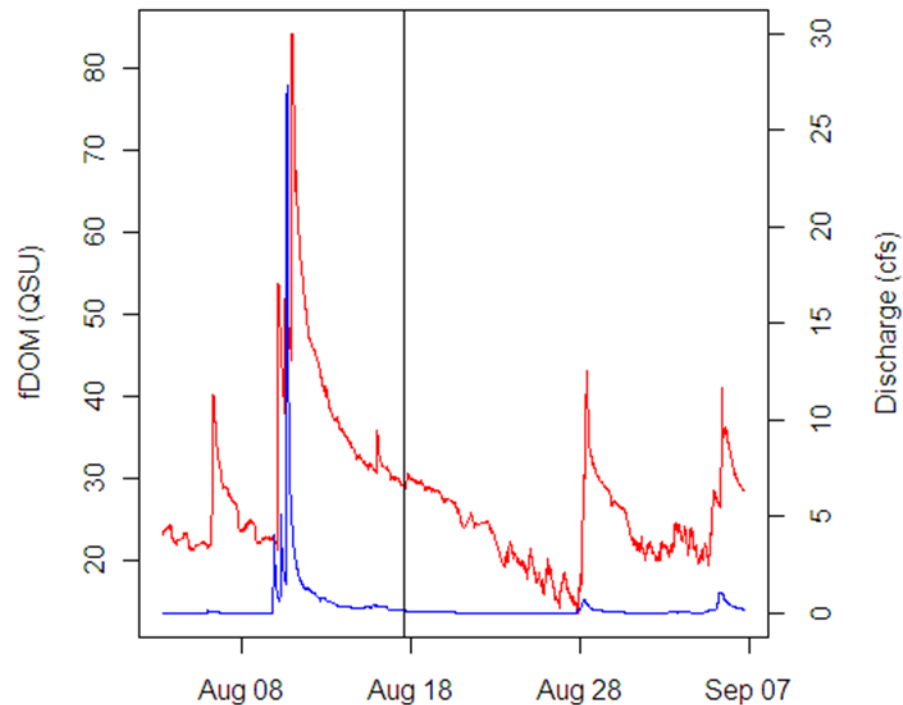


Lamprey Sites

1. Main stem at Wiswall Dam (EPSCoR with USGS/UNH SeaGrant)
2. Headwaters:
 - a. Saddleback – steep forested
 - b. Dowst-Cate – wetland forested
 - c. Wednesday Hill Brook – suburban forested
 - d. Burley Demeritt - agricultural



Novel data sets to document interactions between climatic conditions and water quality



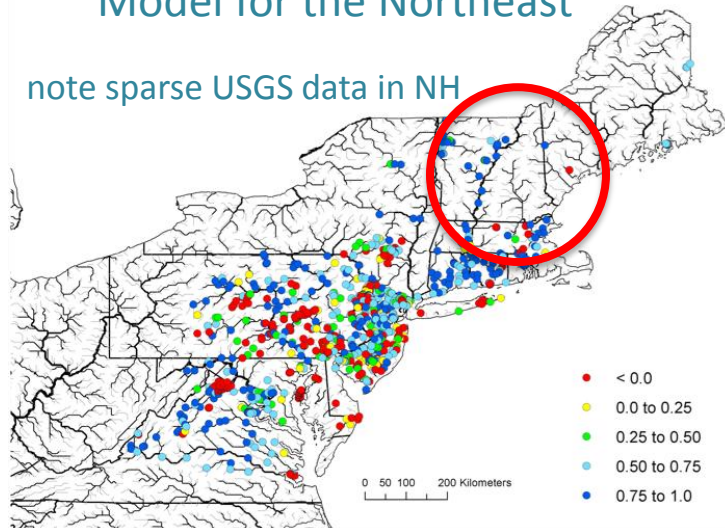
Dissolved organic
matter

Stream discharge

Scaling from Landscape to Region: FRAMES Flow and Water Temperature Model

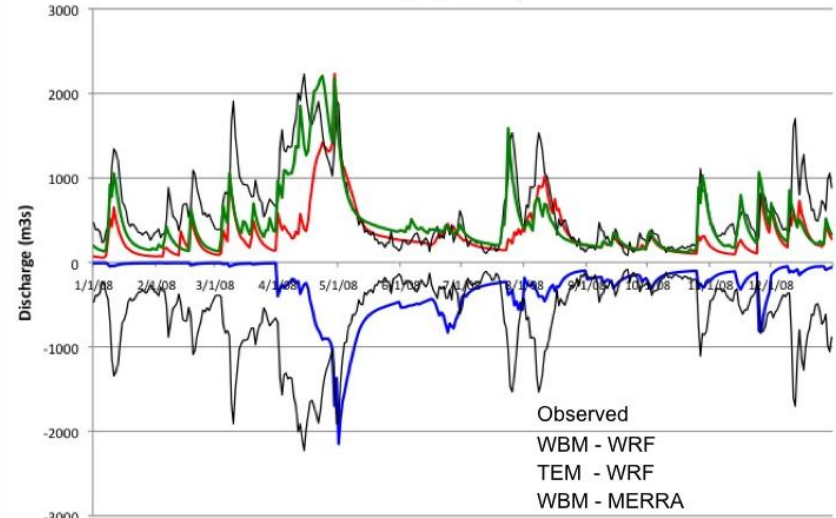
Validation of Water Temp. Model for the Northeast

note sparse USGS data in NH

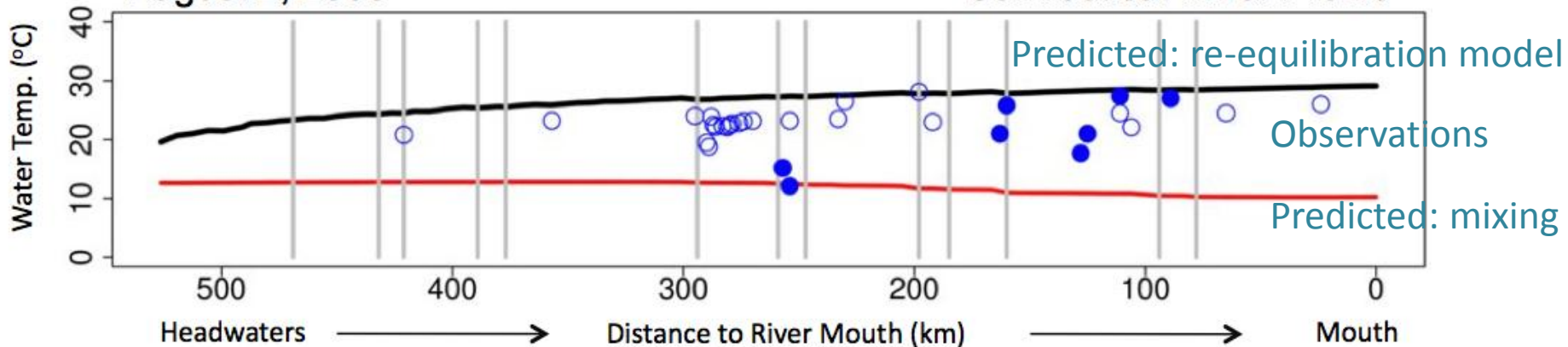


Validation of Discharge Model using different precip. data sets

Connecticut River at Montague City, MA
(20,300 km²)



August 2, 2005





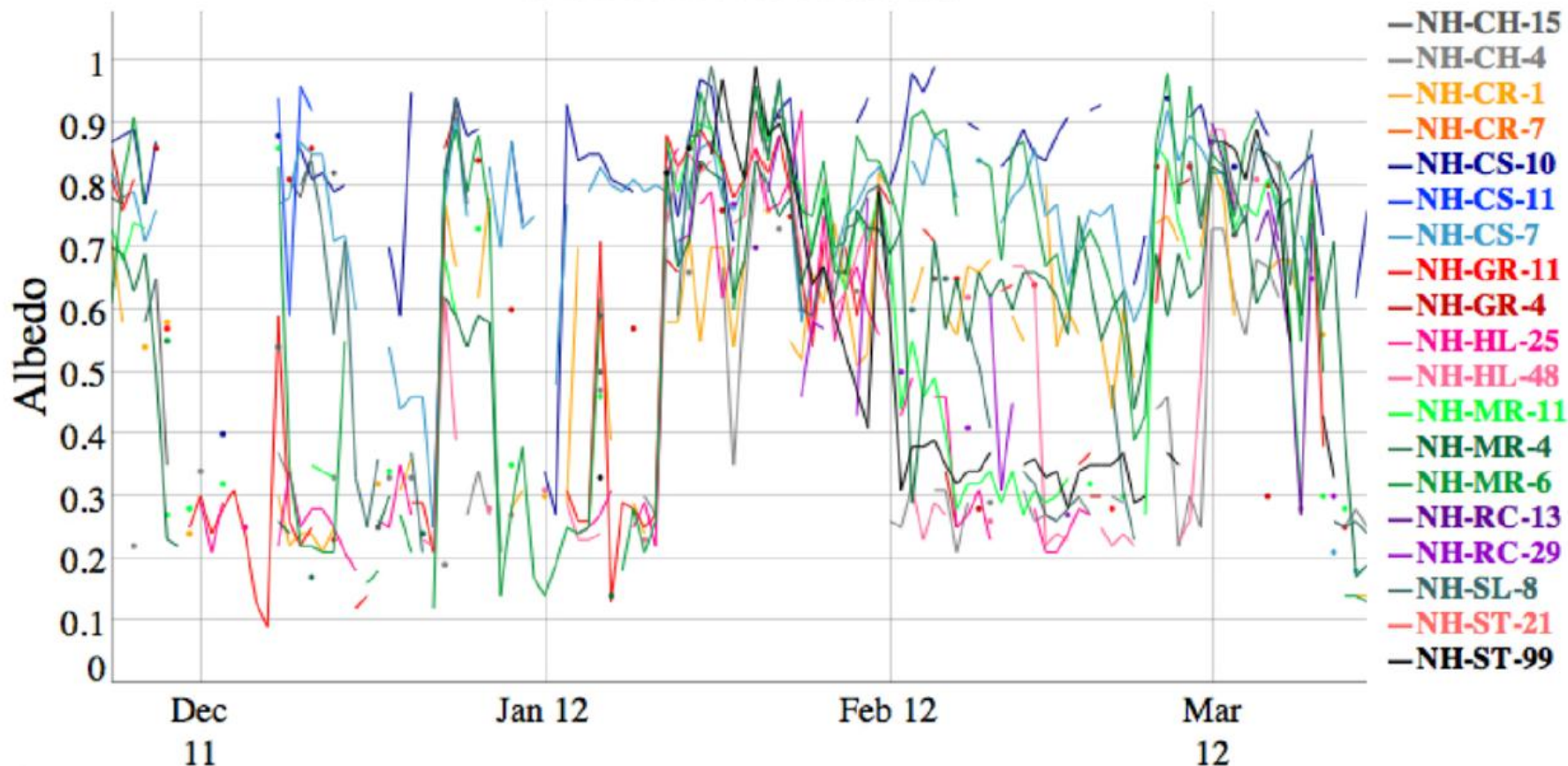
Winter albedo and climate modeling

- CoCoRAHS Network
- Towers
- Airborne hyperspectral
- Satellite (MODIS)
- Snow chemistry, structure, albedo

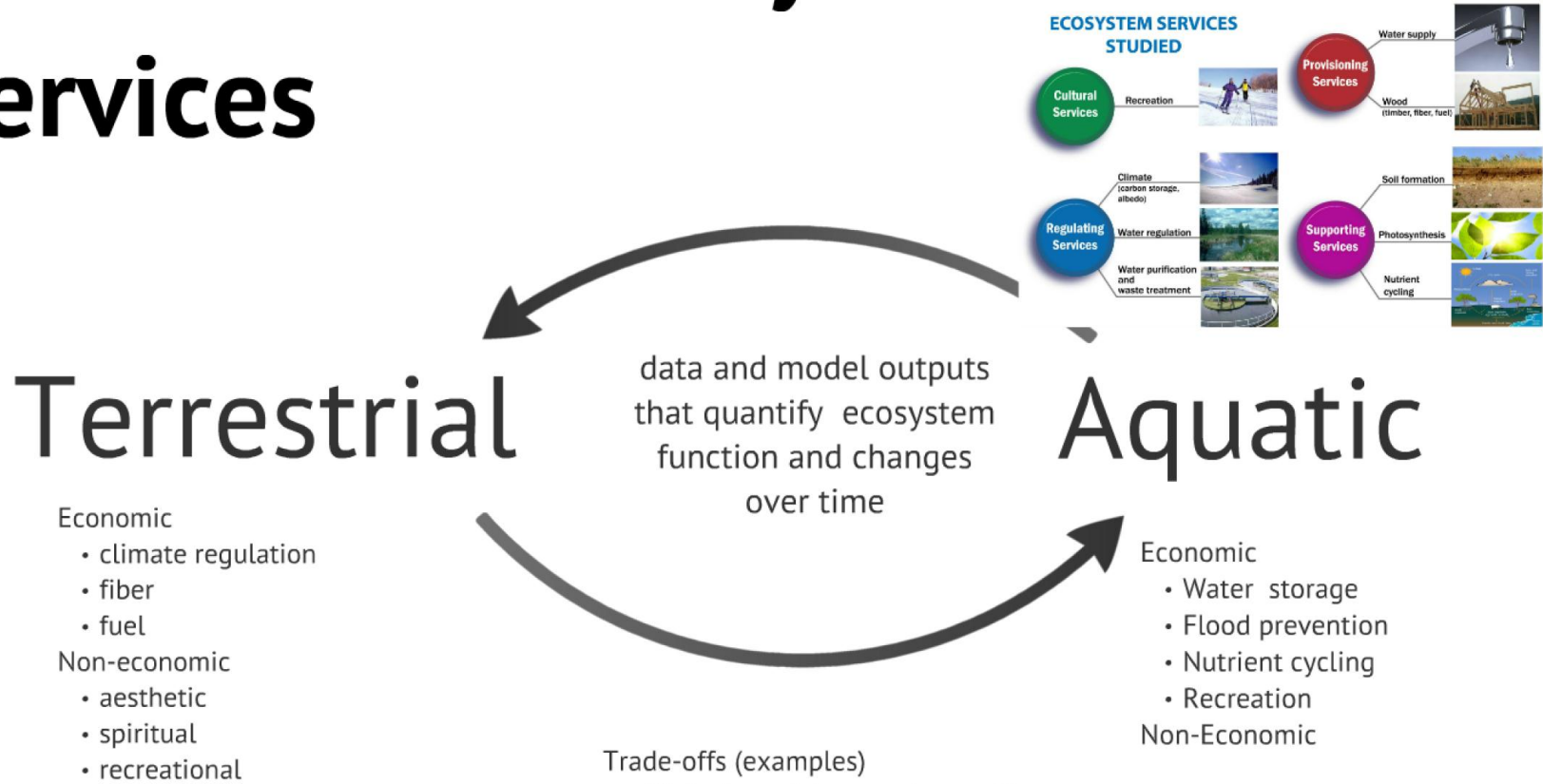


Observer network results

CoCoRAHS Albedo



Valuation of Ecosystem Services



Forest Ecosystem Services

Overview:

- Integrate terrestrial and aquatic storage benefits in a coupled ecological-economic model based on the market value of forest products and estimates of the value of ecosystem services.
- Develop the model to value changes in surface albedo.
- Compare the net social benefits of alternative harvesting regimes (open-cut harvest, partial harvest, and non-harvesting at the stand level).
- Apply the model at the regional-to-landscape scale to evaluate tradeoffs and land-use scenarios.

Case Study: White Mountain National Forest

Overview:

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Trade-offs (examples)

- Biofuel provision - water quality
- Carbon storage - Surface albedo
- Agriculture development - soil carbon - water quality and quantity



Acknowledgments

Support for the NH EPSCoR Program is provided by the NSF Experimental Program to Stimulate Competitive Research (EPSCoR) program Research Infrastructure Improvement Award # EPS 1101245.