DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

SENIOR THESIS/INDEPENDENT RESEARCH

SHOPPING GUIDE

APRIL 2015
Our general research interests lie in the domain of form finding and optimization techniques, generation of novel structural systems, the influence of conflicting design drivers on the generation of form.

Examples of senior thesis research could include:

**Biomimetic Structural Systems**

Nature has had 4 billion years to evolve. What can we distill from its systems to generate more efficient systems. How can we interpret, scale up and optimize them for the design of structures.

**Shading Structures**

1 out of 5 Americans is diagnosed with skin cancer during their life. Seeking built shade, is an effective prevention strategy to avoid the harmful effects of UVA radiations. Current shading systems are designed with a “one fits all mentality”. How can we develop a methodology that generates pre-stressed solar sails geometries that effectively shade a target area when needed?

Figures: Our renderings of an adaptive façade based on the kinetic amplification of the Aldrovande Vesiculosa (plant on the right)
Research Interests

The surface chemistry of clay minerals; contaminant adsorption and migration in soils and sedimentary environments; isolation of hazardous and radioactive waste; geologic carbon sequestration; uses of stable isotopes to understand metal biogeochemical cycling and the water cycle.

Independent Work/Senior Thesis Topics

1. Adsorption of organic contaminants (chlorinated organics, pharmaceutical contaminants or other) on clay surfaces: atomistic simulations and implications for the persistence of these contaminants in the environment.
2. Adsorption of organic contaminants at the air-water interface.
3. Inventory of shale formations used or considered for use in CO₂ sequestration, high-level radioactive waste management, deep disposal of hazardous liquid waste, and unconventional hydrocarbon production (“fracking”).
4. Geochemistry and dynamics of water confined in silica nanopores: atomistic simulations and implications for the corrosion of silicate glasses and minerals.
5. Dissolution rates of clay minerals as a function of pH, salinity, and temperature: reexamination of existing rate laws.
6. Use of molecular simulations to test the validity of existing models of osmotic water flow in semi-permeable porous media.
Independent Work/Senior Thesis Topics

1. My general expertise is in the fields of environmental fluid mechanics, boundary layer meteorology, and urban environmental studies. Students interested in these topics can talk to me to formulate questions other than the ones laid out below. I strongly encourage students to propose their own projects, and I am always happy to guide them through the process of researching and executing these projects and theses.

2. **Urban and building energy studies**: We collected data on temperature and heat fluxes in multiple roofs on the Princeton campus and the PPPL campus. A number of problems and questions can be investigated using these datasets related to the effect of urbanization on the energy balance at the earth surface and the consequences for urban microclimates and energy consumption in buildings.

3. **Urban hydrology**: The water cycle in urban areas is currently poorly understood and modeled. To improve on this, there is a need to better understand the hydrological properties of common urban materials such as brick, concrete, asphalt, … These properties include for example the depth of the water film retain by these material after rain, the potential infiltration and subsequent evaporation of water from these materials, etc.

4. **Boundary layer dynamics**: We have collected profiles of wind, turbulence, and temperature data at the Forrestal campus that go up to ~ 600 meters. Students can use the data to understand how wind speed varies seasonally and diurnally, with important implications for wind power and other applications.

5. **Atmospheric Turbulence**: using previously collected experimental data over a lake and a glacier, we are analyzing the turbulent nature of atmospheric flows near the earth surface. The aims of the studies are to: a) understand the discrepancy between the turbulent transport of momentum, heat, and moisture, b) develop novel evaporation models and investigate the “edge effect” (when the wind is coming from the land side) on lake evaporation, c) Study coherent turbulent structures near the surface and how they are affected by the thermal stability of the lower atmosphere. Many opportunities for model and theory development using these data sets are available.
Research Interests

My research addresses the coupled feedbacks between ecosystems and surface hydrology, with a focus on climate change and land degradation in semi-arid landscapes. Research in my group combines theoretical development, field observations, and simulation modeling to gain new insight into the complex controls on water balance and plant water use in drylands. Most of my current work is focused on semi-arid rangelands in developing regions; primarily the Kalahari desert in southern Africa, the southern and eastern provinces of Zambia, and at the Mpala Research Center in Kenya.

Note: Opportunities for field work during the summer (2013) exist for motivated students capable of identifying a promising research topic before the end of the spring term.

Possible (but not inclusive) Independent Work/Senior Thesis Topics:

1. Impact of climate variability on subsistence agriculture in sub-Saharan Africa
2. Strategies for efficient water use of rainfall and irrigation for dryland agriculture
3. Detection of human signatures in analyses of streamflow dynamics
5. Use of water vapor isotopes to discriminate evaporation and transpiration in land surface fluxes.
6. Lab-based analysis of the physics of isotopic fractionation during soil evaporation
7. Impact of fire on land surface hydrology
Research Interests

Computational modeling and general analysis of geological storage of carbon dioxide, as part of a broader application of Carbon Capture and Geological Storage as a carbon mitigation strategy; Environmental impacts associated with methane production from shale-gas formations and hydraulic fracturing; Modeling fluids in subsurface formations; Groundwater hydrology and groundwater contamination.

Independent Work/Senior Thesis Topics

1. Carbon management and storage of carbon in deep geologic formations, as a partial solution to the global warming problem.
2. The carbon cycle and active management of carbon flows.
3. Impacts of alternative energy systems on water resources.
4. Analysis of methane leakage along old wells and its environmental impacts.
Here are my current ideas for a project, and the extent to which it could be fully undertaken in a senior thesis would depend on the students’ capabilities and the interest of the professor overseeing the work.

1) “We can’t solve our problems with the same thinking that created them!”
   For this project, a student will learn about the water management practices of the Lower Colorado River Authority (LCRA), which provides water to the City of Austin, TX and other entities. Current practice is to use the Texas Water Availability Model (WAM) to assess the impact of proposed water management strategies. The student will study the water management strategies developed by the LCRA, and will compare their results to those obtained by a new strategy developed by the student, based on the concept of water banking. The water banking strategy, if implemented properly, should allow for proactive water management, and would be a drought-proof means for ensuring equitable water availability given unknown future inflows to LCRA’s reservoirs. This work has the potential to change water management strategies in Texas.

2) Texas has experienced a decrease in stream flow statewide, as measured by USGS gauges with records longer than 50 years. A student could analyze the streamflow records, document & map temporal/spatial trends in gauge data, and attempt to identify causes for such trends. If ambitious, a student could apply this same analysis to all USGS gauges in the United States, and make national-scale as well as regional-local scale assessments in water availability.

3) Texas uses Water Availability Models (WAMs) to determine if sufficient water is available to meet needs of water users in a given location. These models assume that the hydrology present from 1940-the mid 1990’s will be repeated in the future. I’d like to have a student investigate this assumption, using streamflow/climate data from the historical record in comparison with that measured from the mid 1990’s to present. I’d also like to use tree-ring data and other anecdotal evidence to attempt to extend the historical streamflow record backward further into the past, and then to use the new hydrology in the WAMs to get a better sense of current Texas water management programs. We could then extend the hydrology into the future using global-climate model down-scaled data and the VIC hydrologic model (based on data provided by the US Bureau of Reclamation). This work has the potential to demonstrate the fallacy of water availability modeling using a “Period of Record” approach as currently undertaken by the State of Texas.

4) Landsat imagery is available worldwide, with images available every 8-16 days. These images of the ground surface have been utilized to assess irrigation practices in the US and to quantify
evapotranspiration rates and water consumption. I’d like a student to investigate the possibility of using Landsat images to perform the following tasks: 1) remotely survey reservoirs and compute water volumes, and 2) to assess temperature differences resulting from Xeroscaping rather than from planting grass.

5) Streamflow into the Highland Lakes upstream of Austin, TX has been significantly reduced during the recent drought – yet precipitation records indicate that rainfall quantities have been relatively stable. Why is this? For this project, the student will investigate the causes of the decreased streamflow. I have my own ideas as to the causes, but I’d prefer the student develop his/her own ideas (with my consultation) and then try to prove them. This project will be of great interest to water managers, legislators, etc throughout Texas.

6) Hydrographic Survey program automation – for this project, the student will learn the techniques and methods used in sub-bottom hydrographic surveying. This effort quantifies water volumes within a lake/impoundment, and also allows for the quantification of sediment accumulation. We will explore current data collection methods (including likely field work), and then will develop improved data processing techniques to hasten report development times while increasing accuracy of the results. This project would likely involve some field work in Texas, and may therefore become a paid summer internship.

For this work, the student should be interested in computer programming and water accounting. The student will gain experience in data analysis, model execution & review, and US western-state water policy. The results of these projects could have a quick impact on water management throughout Texas, and possible nation/worldwide. Results could be published in a peer-reviewed journal, depending upon the approach undertaken and the results.
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General Topics of Research Interest:

- Design of earthquake resistant structures
- Structure-fire interaction
- Multi-hazard design (e.g. fire following earthquake)
- Design for resilient structures and communities
- Detailed studies of exemplary works of engineering
- Structural Design (in general)

Potential Thesis Topics:

_Elevated temperature response of steel bridges designed with weathering steel_
(Co-advising with Prof. Claire White)

Weathering steels, due to their high-corrosion resistance properties, are increasingly being used internationally in bridge construction. However, their material properties at high temperature are unknown, making it difficult to understand or model the structural response of weathering steel bridges affected by fire. Nor can we assess their post-fire strength. This project can examine the atomic phases (crystal structure) and microstructure of weathering steel after it has been heated and cooled. The phase changes will be identified using analytical techniques such as X-ray diffraction and scanning electron microscopy and related to the changes in mechanical properties such as yield stress and fracture toughness. Furthermore, it is unknown if the formation of the patina (rust layer) on the surface of the steel slows the rate of heating (e.g. does it protect the steel from heat to some extent?). In addition to experimental work, this project can involve finite element analyses. Examples of potential finite element studies include comparing the response of bridges designed with weathering steels to that with non-weathering steel. The post-fire strength of steel bridges based on out of plane residual deformations can be also be examined. This topic is generally unexplored and many other research paths are possible.

_Strut-and-tie model for steel plate girders_

In reinforced concrete design, the complex behavior of deep beams can be designed by simplifying the response into compression (strut) and tension (tie) paths – called “strut-and-tie models”. In the design of deep beams made of steel (used in bridges and also in buildings to transfer columns), a complex buckling model that does not ‘honestly’ represent the path of forces is typically used. A potential project can examine developing a strut-and-tie model for deep steel beams (called plate girders) to honestly and simply represent the behavior of these structures. The model also needs to be developed to be adaptable to elevated temperatures to make it more versatile. A current graduate student has begun examining this work but a Senior can branch off what has already been developed.

_Probabilistic evaluation of steel buildings subject to fire following earthquake._
Our profession of civil engineering is now asking for us to design “resilient” communities. This means that our communities, which are highly dependent on our infrastructure, not only need to withstand major events such as large earthquakes, but also recover quickly from that event so that functionality is restored. Thus, we need to consider all potential subsequent events that may occur following the initiating event. In the case of earthquakes, historical events show that fire typically follows. A current graduate project has recently adapted an open source nonlinear structural analysis software so that simulations of fire following earthquake can be made using a probabilistic approach to consider several uncertainties. This tool can be used to develop numerous studies of fire following earthquake scenarios and examine the parameters that are most sensitive to the structural response.

Community resilience following an extreme event
How does the overall structural performance of a community affect the overall community resilience including human response? I am interested in developing new research that examines a community, its general vulnerability to an extreme event, and how the structural response of the buildings, water towers, life lines, etc. affect evacuation and time for restoration.

A study of Anton Tedesko
Room E301 has the world’s largest archive of Anton Tedesko, who is credited for bringing thin shell concrete construction from Europe to the US. While David Billington and his students have done some studies of Tedesko and his works, there remains several unexplored opportunities. Some of the documents are in German, but although knowledge of this language is not essential.

Examples of Independent Work/Senior Thesis Topics Supervised:
See http://www.princeton.edu/~mgarlock
Research Interests

Structural health monitoring (SHM) and structural analysis; SHM methods and strategies; fiber optic sensors (FOS) and advanced sensory systems; smart structures and intelligent infrastructure; hazard mitigation and enhancement of safety; model-based and model-free data analysis.

Independent Work/Senior Thesis Topics

1. Student’s ideas in domains of Structural Health Monitoring, Structural Analysis, and Smart Structures are welcome; to be accepted, the ideas must be preliminary elaborated by the student
2. Assessment of performance of Streicker Bridge based on monitoring results
3. Comparative study of various monitoring systems applied to Streicker Bridge
4. Deployable smart structures
6. Testing of sensing sheets based on large area electronics
7. Structural analysis of heritage structures
Research Interests

Water pollution control, water quality modeling, determining the fate of toxic pollutants in the environment.

Independent Work/Senior Thesis Topics

1. Modeling transport and transformation of pollutants in surface and groundwater.

2. Experimental investigation of the chemical and biological transformations of pollutants in soils and sediments.


Research Interests

Natural Hazards and Risk Assessment, Stochastic Modeling, Wind Engineering, Coastal Engineering, Climate Change Impact and Adaptation, and Built Environment and Sustainability. Specifically, my current research integrates science, engineering, and policy to study hurricanes and associated weather extremes, how they change with climate, and how their impact on society can be mitigated.

Research Website: https://ninglin.princeton.edu

Possible Senior Thesis Topics

- **Hurricane Hazard Investigation and Modeling**
  1. Physical and statistical storm track and intensity
  2. Impact of global warming on hurricane characteristics and hazards
  3. Parametric wind fields
  4. Random wind fields
  5. Storm surge ensemble forecasting and long-term risk assessment
  6. Parametric storm surge prediction
  7. Observational and numerical rainfall fields

- **Structural Damage Analysis and Modeling**
  1. Wind damage to residential areas
  2. Windborne debris effects on tall buildings
  3. Rainfall penetration and damage
  4. Flood damage
  5. Multi-hazards risk assessment
  6. Damage and loss data: collection, uncertainty analysis, and applications
  7. Hazard and climate mitigation strategies, insurance, and public policy

You are welcome to discuss with me in more details about above topics and/or related ideas.
* Professor Mauzerall will be on sabbatical in AY 2015-2016; she will not be available to advise Senior Thesis for the class of 2016.

Research Interests

The objective of my research group is to utilize science to inform the development of far-sighted air quality policy. We explore linkages between air pollution and health, energy, and climate change.

Independent Work/Senior Thesis Topics

The topics below are general ideas that would need to be focussed further.

- Potential of renewable energy to displace coal and reduce emissions of air pollutants and carbon dioxide (choose specific technology, country/region, etc.)
- Benefits of methane mitigation strategies for air quality and climate change;
- Cost comparison of various methane mitigation strategies;
- Benefits of black carbon mitigation strategies for air quality and climate change;
- Comparison of adverse effects of climate change and surface ozone concentrations on global agriculture.
Research Interests

Prof. Peters works in the area of environmental geochemistry. Research in her group focuses on environmental impacts of subsurface energy technologies including hydrofracking and carbon dioxide sequestration. She is particularly interested in reactions kinetics, and her work typically combines laboratory experimentation with mathematical modeling to infer reaction rates for a variety of environmental systems. Examples include:

-- Laboratory experiments involving high-pressure reactive flows through sedimentary media. These experiments are needed to understand, for example, the potential for toxic metals and radionuclides to be released in the context of hydrofracking.

-- Scanning electron microscopy and X-ray spectroscopy for imaging minerals in geologic materials. Such imaging informs us about the pore-fluids and reactive minerals in geological materials, and it helps us to determine the extent to which important reactions will occur.

-- Mathematical simulation of geochemical reaction kinetics relevant to CO₂ sequestration. This is appropriate for a student with excellent chemistry preparation and computer programming skills (or the willingness to learn through independent study!).

Dr. Peters works closely with Research Scholar Dr. Jeff Fitts, an expert in geochemistry and spectroscopic methods. Research that would be jointly supervised by Dr. Peters and Dr. Fitts is as follows. Production of natural gas from shale formations is an expanding industry, but hydraulic fracturing, aka “hydrofracking”, produces vast quantities of flowback and production wastewaters. A resulting environmental concern is the mobilization of metals and radionuclides from the shale formation into these wastewaters. This investigation seeks to study the mobilization of barium and arsenic from fractured shale rocks using laboratory studies under a range of geochemical conditions. The overall goal is to develop geochemical models capable of forecasting contaminant levels in flowback and produced waters from shale operations based on the petrophysical properties of the shale.

![Map of Pennsylvania with barium occurrence and well locations](image1)

![Map of Pennsylvania with well locations](image2)

Figure 2. Pennsylvania maps of barium occurrence in FPW in comparison to well locations. Sources: Barbot et al. (2013), Lutz et al. (2013).
Research Interests


Independent Work/Senior Thesis Topics

Any of the above areas.

Examples of Senior Thesis Topics Supervised:

- Princeton Tunnel: The Transformation of Washington Road and Princeton Campus.
- The Rion-Antirion Bridge: a Case Study of the Private Infrastructure Concession Scheme.
- The Structural Response to Seismic Excitation and the Effectiveness of Chemical Consolidation Treatment in Adobe Structures.
- The Design of a Pedestrian Bridge for Clock Tower Place, Maynard, MA.
- Aerodynamic Stability of Multi-Box Suspension Bridge Decks.
- Seismic Retrofitting: a Study of John S. Eastwood’s Littlerock Dam.
- Rebuilding the San Francisco-Oakland Bay Bridge.
- Hostile Living Conditions: Building and Powering a Martian Habitat.
- Assessing and Improving the Effectiveness of Bamboo Reinforcement in Adobe Structures.
- Optimization of Thin-Shelled Hypar Structures: Felix Candela and the Chapel Lomas de Cuernavaca.
- Model Complexity in Computer-Aided Seismic Analysis of Steel Moment-Resisting Frames.
- The Risks and Behavior of Carbon Dioxide Leakage from Geologic Reservoirs.
Research Interest

The dynamics of the interaction between climate, soil and vegetation is the main focus of my research group. This dynamics is crucially influenced by the scale at which the phenomena are studied as well as by the type of climate, the physiological characteristics of the vegetation and the pedology of the soil. Moreover, not only the temporal aspects but also the spatial aspects of the dynamics are crucially dependent on the above factors.

Soil moisture plays a key role in the above dynamics and our group is involved in its space-time characterization. This involves a range of approaches which include challenging problems in the physics of the interaction as well on its mathematical description. It is necessary to account for the random character of precipitation, both in occurrence and intensity, as well as for the nonlinear dependence of infiltration, evapotranspiration and leakage on the soil moisture state. Our approach has been to understand and model first the balance of soil moisture at a point under the above conditions. The solution of the stochastic differential equations corresponding to the point dynamics have provided the probabilistic description of the soil-plant-climate interaction at a site. The spatial interaction between different sites with the same or with different types of vegetation is being implemented via cellular automatas operating under rules governed by the characteristics of the stress existing in the vegetation.

At larger spatial scales precipitation itself is influenced by the soil moisture present on the region and this phenomenon needs to be incorporated in the modeling scheme. At intermediate scales involving river basins, the geomorphologic characteristics of the drainage network is a commanding factor in the spatial organization of soil moisture. We are trying to link the recent advances on the scaling characteristics of the network with the dynamics of the soil moisture.

With the above framework we hope to elucidate some of the most fundamental issues of the climate-soil-atmosphere interaction which lie at the heart of hydrology.

Independent Work/Senior Thesis Topics
Research Interests

Hydrometeorology, flood hydrology, and environmental fluid mechanics, and environmental remote sensing.

Independent Work/Senior Thesis Topics

1. Hydrology, hydraulics and hydrometeorology of extreme floods.
2. Urban hydrology – hydrologic impacts of land-use change, flash flood hydrology.
3. Weather radar – rainfall estimation, weather analyses based on Doppler radar and polarimetric radar
4. Environmental sensor systems – water, carbon and nitrogen cycles; trace gages in the atmosphere.
General Research Interests

- Materials for sustainability
- Developing sustainable cement and concrete technology
- Clays and other natural materials
- Supplementary cementitious materials
- Minerals and amorphous phases for CO₂ sequestration
- Computer-based modeling of materials at the atomic, nano- and higher length scales

Example Senior Thesis Topics

*Improving the atomic structure of sustainable cementitious materials*

The US cement industry requires a significant amount of energy for the production of ordinary Portland cement clinker (550 × 10¹² British thermal units in 2000), and with the industry accounting for at least 5-8% of anthropogenic CO₂ emissions there is mounting pressure from government and society to rapidly implement sustainable cement alternatives. This undergraduate research project is part of a larger research project working to develop a new class of low embodied energy geopolymer cement by tailoring gel chemistry and additives for optimal binding properties that limit microcrack formation and propagation. The undergraduate project may involve sample synthesis and laboratory-based characterization techniques (thermal analysis and electron imaging), to discover the causes of microcracking and accelerate the design of additives (polymers and/or seeding nanoparticles) to mitigate this problem.

*Where does the water go in cement paste?*

The location of water in cement paste, and the ability to evaporate with increasing temperature dictates important performance properties of concrete (strength, shrinkage and durability). However, we do not currently know the temperature response of cement paste and associated extent of evaporation when exposed to moderately elevated temperatures (up to ~105 °C). This project involves making and analyzing (i) conventional and (ii) sustainable cement pastes exposed to elevated temperatures. The atomic structures (which are disordered, i.e., not crystalline) will be studied using X-rays and an in situ hot stage environment in Dr. White’s lab. These results will be correlated with weight loss measurements obtained using thermal analysis. The results will be of extreme importance to the research community on cement and concrete, and form part of a larger research effort on the durability of sustainable cementitious materials.

*Self-determined thesis topics*

Self-determined topics relating to the broad area of materials and sustainability are highly-encouraged. Please discuss with Dr. White.
Research Interests

The current research being carried out by my group can be found at http://hydrology.princeton.edu. Areas of interest include hydrology and water resources and their impacts from climate change (extreme temperatures, droughts and floods), satellite remote sensing of the water cycle (precipitation, evaporation, soil moisture, etc.); forecasting of seasonal (3 or 6 month ahead) climate (precipitation, temperature, and the hydrology).

There are other related topics, especially topics that may involve co-advisors, where students have particular interests. Some are listed below as co-advising topics.

Independent Work/Senior Thesis Topics

- Climate change. Example studies including projections for sustainable water resources, energy (including biofuels) and food under climate change scenarios (for specific regions or countries); Integrated Assessment studies that include water scenarios. Modeling or analysis studies using IPCC 4th Assessment climate projections.

- Climate forecasting. Evaluating the potential of using seasonal forecasting models (3 to 6 month forecasts from NOAA) for water resource and water-sensitive sectors (e.g. energy, agriculture.)

- Hydrologic modeling and remote sensing. Carry out studies related to the hydrologic cycle and climate variability at a range of scales from small regions to continents.

- Co-advising topics
  - Regional Water Quality monitoring and modeling (w. Prof Jaffe)
  - Environmental impacts and water demands of hydro-fracturing for natural gas extraction.
* Professor Zondlo will be on sabbatical in AY 2015-2016; he will not be available to advise Senior Thesis for the class of 2016.

Research Interests

My group develops and deploys novel optical instrumentation to address important areas in air quality, climate change, and meteorology. New optical light sources such as quantum cascade lasers and vertical cavity lasers provide unprecedented opportunities to probe the atmosphere. The projects help to address fundamental questions in cloud microphysics, aerosol chemistry, cirrus cloud chemistry, radiative and chemical properties of the troposphere, urban air quality, and greenhouse gas fluxes. Projects span the range from participation in international, scientific field campaigns to laboratory development of new instruments.

Independent Work/Senior Thesis Topics

1. Ammonia is one of the most important precursor species for atmospheric haze particles, but a lack of fast and sensitive measurements have hindered our ability to understand particle physics and chemistry. The effects of ammoniated aerosol particles are among the largest sources of uncertainty when predicting future climate, and ammoniated particles also play critical roles in the formation of unhealthy fine particulate matter. This project will involve laboratory studies and local field deployments of a new, ultrasensitive ammonia instrument. Emissions of ammonia are highly uncertain, and urban emissions in particular may be underestimated. To these ends, we will examine the horizontal and vertical extent of the ammonia emissions in the NYC area and help to predict its role in the formation of fine particulate matter.

2. Nitrous oxide ($N_2O$) is the third most important greenhouse gas, continues to increase rapidly in the atmosphere, and has an atmospheric lifetime greater than 100 years. While its sources include tropical soils, melting permafrost, and agricultural activities, quantifying these sources has been extremely difficult due to a lack of existing instrumentation. Thus, $N_2O$ is currently an unregulated greenhouse gas. This project will involve instrument development of a high-precision sensor using a quantum cascade laser and local field deployments to identify the extreme heterogeneity in space and time of $N_2O$ emissions.

3. Water vapor is the most important greenhouse gas in the atmosphere, but its distribution and concentration in the upper troposphere are poorly known. We have developed a fast and sensitive sensor for the NSF G-V research aircraft that is currently being deployed in a number of global field campaigns. Analyses of this dataset include identifying the spatial extent and frequency of ice supersaturated regions and the distribution of water vapor throughout the troposphere. The research will involve analyses of field data and laboratory calibrations under relevant atmospheric conditions.