Statement of Research Interests

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The mission of my research program

1) To develop a unique and innovative climate science research program with a national and international reputation.
2) To carry out climate research that balances basic theoretical and modeling work with impacts assessment and societal applications.
3) To help reduce vulnerability to and possibly take advantage of the impacts of climatic variability and climatic change on local, regional, and global scales.

Description of my research

My study focuses on various land surface processes, their representations in numerical weather prediction and climate models, and the role of land in shaping weather, climate, air quality, and water resources. I view the climate system in a holistic way, linking the atmosphere, ocean, biosphere, cryosphere, and solid earth. I use powerful methodologies such as satellite remote sensing and supercomputing simulations which are now profoundly changing research in climate system sciences. I place a strong emphasis on the societal impact of the research in climate system sciences. Specifically, I am working to answer a wide variety of research and science questions below.

- How does land shape climate, or vice versa, on all time and space scales?
- What has been the impact of human activity on the Earth?
- What is the future of our environment under climate change, land use change and water use change?
- How good are climate models in simulating biosphere–hydrosphere–atmosphere interactions?
- What are their uncertainties? How can we improve them? How can we make decision under uncertainties?
- Are current satellite datasets alone sufficient for monitoring our environmental conditions? How can we integrate satellite data in decision making process?

My past and ongoing work has been centered on modeling studies, but I am also interested in applications and observations. Examples of my research projects include:

- parameterization of terrestrial hydrological processes (soil moisture, snow cover, groundwater, evapotranspiration, and runoff) for weather and climate models;
- characterization of land cover and land use change patterns and associated biophysical properties and their effects on climate, hydrology and biogeochemistry using ground-based measurements, remotely-sensed datasets and numerical models;
- assessment of the impacts of changing climate on vegetation phenology, biogenic emissions, secondary organic aerosols, and air quality;
- study of the mechanisms of rainfall-producing convective storms and extreme events using innovative modeling methodologies;
- forecasts of river flow, flash flood, and inundation area; and
- integrated study of continental water dynamics and coastal environmental conditions using satellite data, field observations and observationally driven models.

Long-term program development plan

My long-term research plan is to continue *building and applying* an Integrated Climate Change and Environmental Prediction System Model (Figure 1).

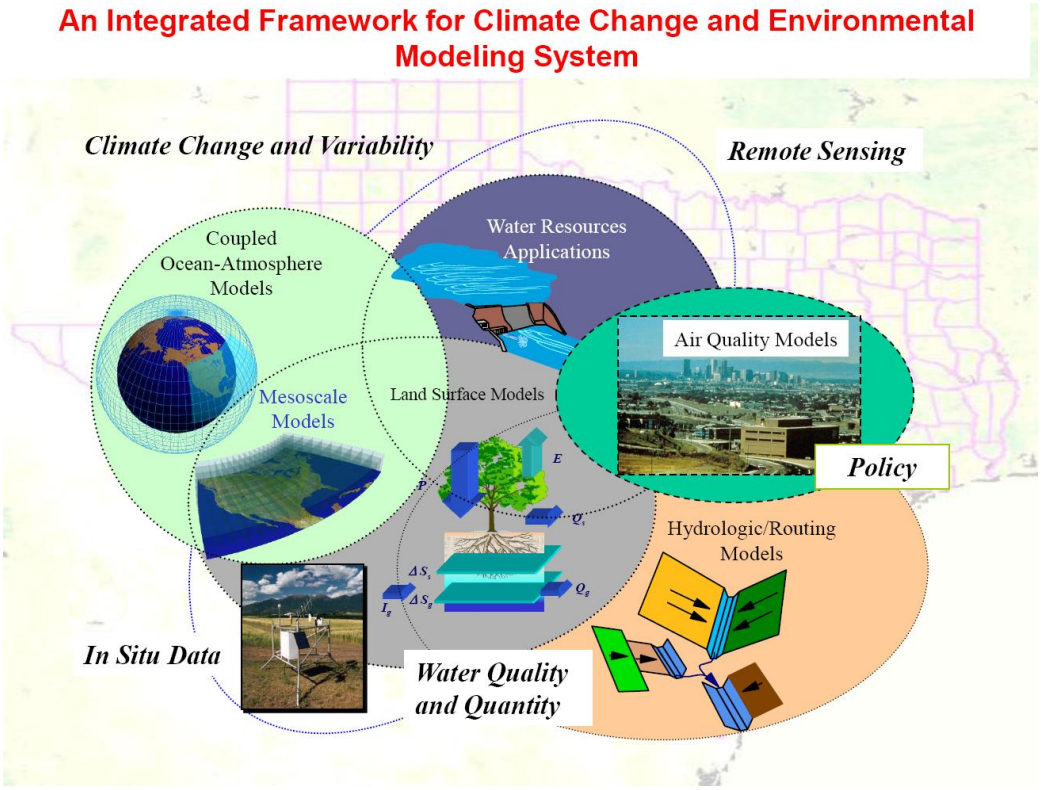

Figure 1. Schematic illustrating an integrated climate change and environmental system modeling framework that consists of multi-scale and multi-disciplinary sciences. Individual components include climate modeling, hydrologic modeling, river flow modeling, ecological modeling, remote sensing, biogeochemistry, and in situ measurements. The integrated system model is designed to benefit a wide range of applications. Although the model development has been focused on Texas and the western Gulf of Mexico coastal region, the model framework can be applied elsewhere. Model simulations will also be directly compared to measurements made at weather stations, radiosondes, eddy flux towers, rain gauges, field observations, and by weather radars, aircrafts and satellites to improve upon model calibration.

In the process of this long-term plan, my goals are:

1) To build a team with 2–3 post-doctoral researchers specializing in Earth System Science, Climatic Impacts, Adaption and Mitigation Studies, Global Climate Modeling, Regional Climate Modeling, Land–Atmosphere Interactions, and Climate Data Analysis and Interpretation.
2) To develop a dynamic graduate program with 6–8 graduate students.
3) To maintain annual external grants of $300–500k.
4) To produce 10 peer-reviewed journal papers per year, and
5) To establish wide collaborations nationally and internationally.

In summary, I would like to strengthen and broaden my engagement in collaborative research across disciplinary lines. I would like to bridge the gap between pure hypothesis-driven research and impacts-driven applications.