**Statement of Research Interests**

Zong-Liang Yang

My research has focused primarily on understanding and modeling of land surface processes, their parameterizations in numerical weather prediction and global climate models, and the role of land in shaping weather, climate, air quality, and water resources. I view land as an integral part of the earth system, which should be considered in a holistic way, linking the atmosphere, biosphere, cryosphere, ocean, and solid earth. I use powerful methodologies such as satellite remote sensing and supercomputing simulations which are now profoundly changing research in the earth sciences. I place a strong emphasis on the societal impact of the research in the earth sciences.

Specifically, I have been 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 use satellite datasets, aircraft measurements, and surface observations to improve the coupled land surface and climate models?

Examples of my past and ongoing work include:

- Developing, improving, assessing, and evaluating land surface models for weather and climate models (e.g., NCAR CLM4, Noah LSM) using observational datasets such as surface measurements and satellite datasets[1–10];
- Quantifying the role of short-term vegetation dynamics (i.e. how leaf area index depends on light, temperature, water and nutrients) on the land surface energy balance[3,4];
- Understanding the vegetation–precipitation interactions on timescales from intra-seasonal to interannual[11,13];
- Modeling biogenic emissions of volatile organic compounds (VOCs) in land surface models [12–14];
- Understanding and modeling the coupling of the hydrosphere, biosphere, and atmosphere and their impacts on air quality in a changing climate (also a focus of the NCAR BEACHON program) [11,13,15]; and
- Predicting river flow, flash flood, inundation area, and nutrient exports from upland watersheds to coastal waters[16,17].

Currently, I am working with my students to understand the spinup timescales in the NCAR CLM4 with explicit consideration of carbon and nitrogen processes. This work is especially important to the development of earth system models that require efficient spinup methodologies. Moreover, through teaching the Global Land–Atmosphere interaction Dynamics (GLAD) course using Bonan's Ecological Climatology, I have taught myself "Terrestrial Plant Ecology" (his chapters 19 to 24); see also http://www.geo.utexas.edu/courses/387H/SyllabusLAID.htm. I hope these will serve as a good foundation for me to develop collaborative projects with ecological experts.

**Long-term program development plan**

My long-term research plan is to continue *building an Integrated Environmental Modeling System* with atmosphere–biosphere interactions as the core (Figure 1).

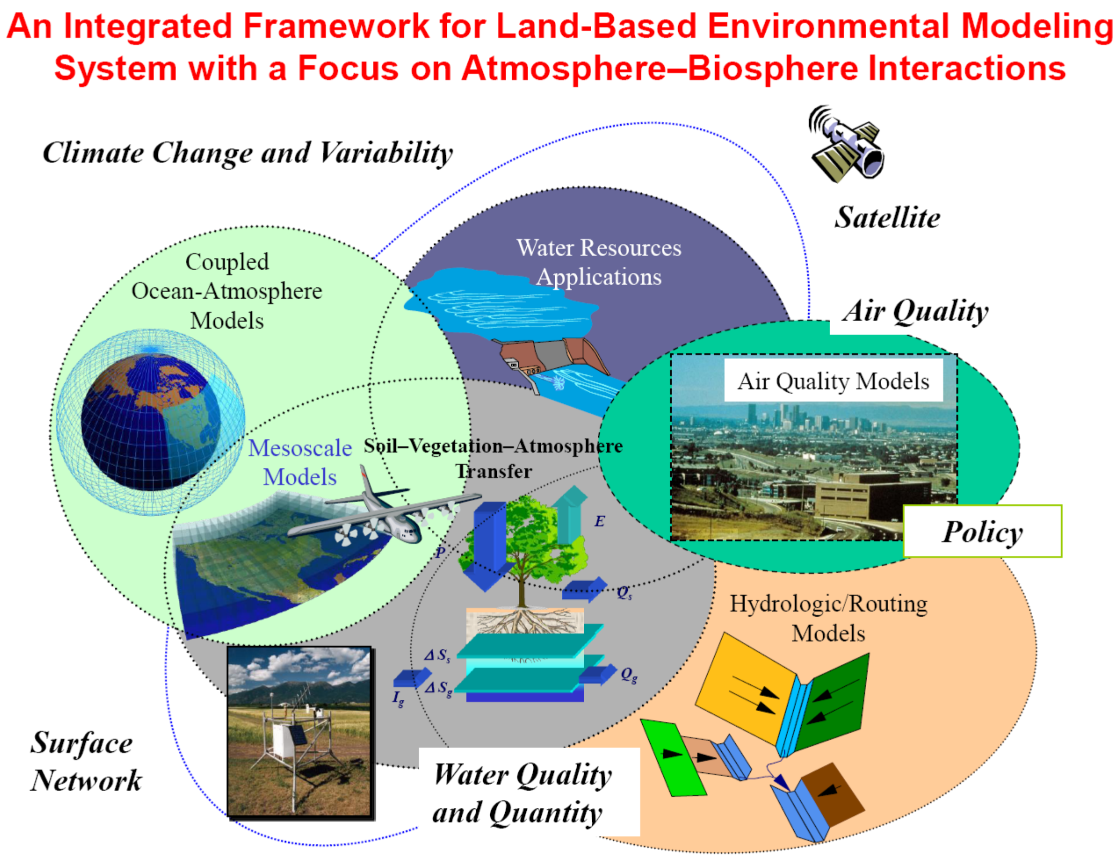


Figure 1. Schematic illustrating an integrated environmental system modeling framework that consists of multi-scale and multi-disciplinary sciences. Individual models components include atmosphere–biosphere interactions, climate modeling, hydrologic modeling, air quality modeling, and biogeochemistry, which require datasets from satellite remote sensing, aircraft measurements, weather stations, radiosondes, weather radars, and surface flux networks. This integrated system model is designed to benefit a wide range of applications such as environmental impacts assessment and policy making.

The land surface is highly complex, heterogeneous, and subject to rapid transformations by humans. Representing land-surface sub-grid-scale variability in state-of-the-art land surface models has been mostly based on tiled or mosaic approaches[18]. In these models, land–atmosphere exchanges of energy, water and carbon occurring in each tile within a land grid are assumed to be essentially independent of the fluxes over other tiles in the same grid. While these approaches can be compared and calibrated against tower flux measurements at the local scales (a few km), as is routinely done in the literature, their validity is largely unknown at the regional scales (10's to 100's km) that are typical grid sizes in climate models because regional-scale measurements of the fluxes are lacking. The network of flux towers and long-term ecological observatories is rapidly expanding in the US and across the globe. At the same time, spaceborne measurements describe the land in increasing detail and continuity. Yet ground stations and satellites measure different quantities, at very different scales, and the surface footprint of flux towers is poorly understood. A low-flying aircraft presents a unique opportunity to bridge spatial gaps between flux stations and link passive microwave to *in situ* measurements. I am looking forward to a unique opportunity not just to use research aircrafts for this purpose, but also to participate in the use of new instruments measuring regional-scale water, carbon, and nitrogen fluxes relevant to the coupled climate and environmental models.

**References (Students are underlined)**


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