Eco-Hydro-Climate Science/Engineering in SESE

Definition: An emerging frontier in Earth system science is the interaction of ecological, hydrological and climate disciplines to address growing challenges related to the evolution and vulnerability of landscapes with biotic and abiotic components. This can be addressed using observational, experimental and modeling tools developed in each discipline that are 'retooled' to treat the coupled eco-hydro-climate system. Arid and semiarid regions (deserts) are a fruitful location for these studies due to the first order interactions in water-limited regions. The American Southwest is thus an ideal laboratory for eco-hydro-climate studies and provides several case studies (Sonoran, Mojave, Chihuahuan deserts) with varying levels of human impacts. A range of tools (remote sensing, field sensors and networks, modeling, laboratory analysis) are used to test process-based hypothesis and to provide improved predictive models. Faculty involved include: Vivoni and others to be identified.

Principal Research Targets at SESE:
1. Ecohydrology and plant-water interactions in arid/semiarid landscapes.
2. Interactions of ecosystem/plant processes with water/sediment over short and long-time scales, including impact on landscape evolution.
3. Land-atmosphere interactions in vegetated (mosaic) landscapes with complex terrain; exchange of water, carbon and energy between land and atmosphere.
4. Topographic controls on surface and subsurface water transport and feedbacks to microbial, plant and nutrient distributions.
5. Co-evolution of soil, vegetation, topography mediated by water.
6. Engineering (forecast) models of the coupled eco-hydro-climate systems.

Principal Research Targets not presently at SESE: Some research directions at the forefront of this subarea and not actively pursued by current SESE faculty are as follows.
1. Regional and global scale climate modeling and analysis.
2. Terrestrial ecology with an emphasis on landscape/ecosystems interactions.
3. Ecosystem modeling (vegetation demographics) and use in global models.
4. Groundwater-riparian ecosystem interactions.

Collaborative Areas: Collaboration between this subarea and other research groups at ASU are possible, for example in SoLS, GIOS, Geography, Sustainable Engineering, Environmental Fluid Mechanics. Some examples are indicated below:
1. Role of microbiological crusts on ecohydrologic phenomena (SoLS – Garcia-Pichel)
2. Climate-hydro sensitivity of aquatic wetland ecosystems (GIOS – Childers)
3. Regional ocean-climate models for forecasting precipitation (Env. Fluid – Huang)
4. Ecohydrological transitions due to urbanization (SoLS – Grimm)
5. Sustainability of water infrastructure in urban areas (SSEBE – Westerhoff, Allenby)

Potential collaborations with CAP-LTER, Jornada LTER, Sevilleta LTER and other ecological/hydrological networks (WATERS, CZO, NEON).

Grand Challenge and Differentiation: The following constitute potential 'challenges' that unite eco-hydro-climate studies with other SESE endevours, in particular related to surface processes, continental tectonics, systems engineering and biogeosciences
1. Quantifying co-evolution of climate, mountains and ecosystems.
2. Micro to macro-scale interactions of life, water and chemistry on complex terrain.
3. Landscape-ecosystem vulnerabilities to climate warming under varying urbanization.