Climate Change and Conservation of Montane Ecosystems

Vision, 27 September 2007

Goal: Assess ecological and conservation implications of climate change for montane ecosystems.

Global warming is causing changes in the abundance and distribution of plants and animals of montane ecosystems, such as this study site at timberline in the White Mountains of California (photo by S. Weiss)

The Problem: Climate change, together with habitat loss/fragmentation and invasion of non-native species, poses profound challenges for conservation in montane ecosystems, with substantial risks to ecosystem integrity and the viability of native species.

Scientific Foundations for Conservation: The Creekside Center for Earth Observation is working to assess ecological impacts of climate change and develop conservation plans for montane ecosystems. Global climate change translates locally into corresponding shifts of microclimate gradients, with potential habitat for some species increasing and for others decreasing. For example, distributions of plant species such as big sagebrush (*Artemisia tridentata*), currently most common in warmer, drier habitat of lower elevations, are expanding in higher elevation microsites as temperature rises. At the same time, populations of higher-elevation species are becoming more fragmented and shifting from south-facing slopes to cooler north-facing slopes. Microclimate shifts also cause additional non-linear, cross-scale changes in processes such as fire cycles and pathogen outbreaks.

Elements of Conservation

- **Habitat characterization:** map current habitat using microclimatic models of key conditions (temperature, precipitation, solar exposure, soil moisture, etc.)
- **Biotic distributions**: map current distributions of native species using field studies, habitat models, and remote sensing
- **Habitat changes**: evaluate shifts in microclimate maps based on likely climate change scenarios
- **Biotic responses**: predict shifts in distribution of native species likely to result from microclimate shifts
- **Conservation planning**: develop management and mitigation plans to protect montane biodiversity and ecosystem services under future climatic conditions,
- **Education and outreach**: communicate with diverse audiences (public, landholders, resource managers, decision makers, elected officials, etc.) through various media (press, field tours, web sites, briefing papers, presentations, brochures, etc.)

Sampling high-elevation plant communities in the White Mountains. (photo by S. Weiss)

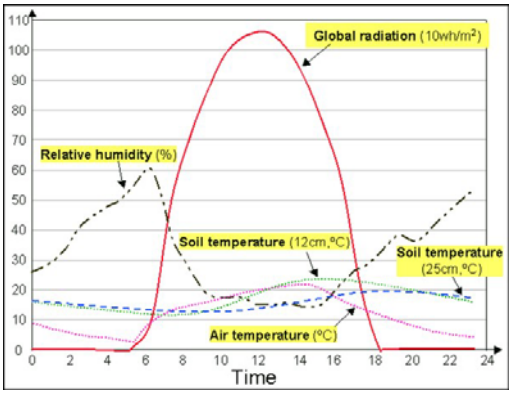
Contacts

***Stuart B. Weiss**, Ph.D., CEO and Chief Scientist, Creekside Center for Earth Observation, stu@creeksidescience.com*

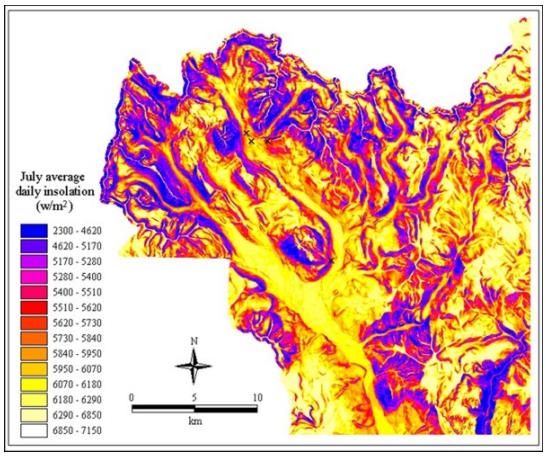
***Paul M. Rich**, Ph.D., Senior Scientist, Creekside Center for Earth Observation, paul@creeksidescience.com*

http://www.creeksidescience.com

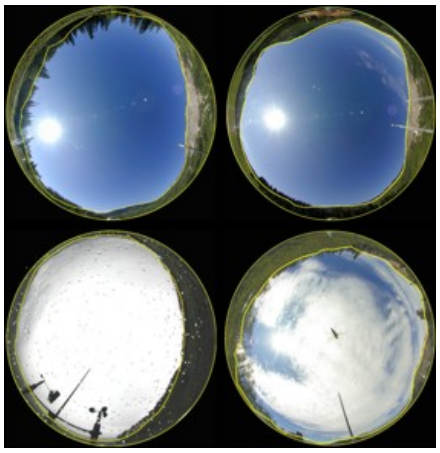
Vegetation at timberline near Rocky Mountain Biological Laboratory in Colorado. (photo by P. Rich)



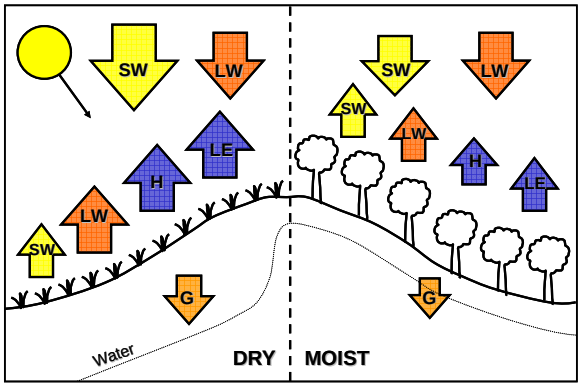
Average diurnal microclimate records for Rocky Mountain Biological Laboratory.



Insolation models for the vicinity of Rocky Mountain Biological Laboratory.



Upward-looking hemispherical photographs of topographic influences on insolation.



Energy Balance Components: shortwave radiation (SW), longwave radiation (LW), sensible heat (H), latent energy (LE), and storage (G).

Key Literature:

Fu, P. and P.M. Rich. 2000. The Solar Analyst user manual. *Helios Environmental Modeling Institute*.

Fu, P., and P.M. Rich. 2002. A geometric solar radiation model with applications in agriculture and forestry. *Computers and Electronics in Agriculture* 37:25-35.

Van de Ven, C.M., S.B. Weiss, and W.G. Ernst. 2007. Plant species distributions under current conditions and forecasted for warmer climates in an arid mountain range. *Earth Interactions* 11:1-33.

***available online*: http://www.creeksidescience.com**