Integrated Climate and Ecosystem-Response Sciences in Temperate Western Mountains

The CIRMOUNT Initiative

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Mountains as a Central Organizing Paradigm
physically coherent, ecologically distinct, socially iconic

Connectors: Water, fiber, clean air, biodiversity, recreation

Dynamic Ecosystems: Early indicators; sensitive to change
Status of America’s Western Mountains

The Need for Collaboration

• Mountains are under-instrumented for long-term climate monitoring

• Mountain research is intensive, but scattered & poorly integrated

• Societal demands are escalating, imposing new stresses on resources and community capacities

• Climate change is ignored in land-use planning and policy to the detriment of ecosystem protection and provision of resources
CIRMOUNT  The Consortium for Integrated Climate Research in Western Mountains

Grass-roots science effort
Core group from 10 agencies/universities

How it’s coming together:

→ Sierra Nevada Science Symposium (10/02)
→ Pacific Climate Workshop PACLIM (3/03)
→ Mountain Climate Sciences Symposium (5/04)
Challenges to Mountain Water & Ecosystems

1. Mountain Climate - What is it?

Lowland Situation Well-Networked:

Trends 1966+ Annual, Full Year
Trends 1966+ Feb-Mar-Apr

WRCC, Climate Prediction Center; Redmond, 2004
Of California’s 404 Coop Weather Stations

6 Stations > 2500 m
3 Stations > 2750 m
Highest is 2941 m

Edwards, 2004
Climate Trends at High Elevations

Millar et al. 2004

A. PDO

B. Min Temp

C. Precip Stream Flow

N = 3 Stns Sierra Nevada

Western North America

Diaz et al. 2003

Minimum Temperature vs. Elevation

- 50yr Trend
- Mean Minimum Temperature

°C

Elevation (ft)

°C/year

Elevation (meters)
1. Differences in measurement - Instruments, methods, exposure, vegetation, setting, or

2. Real differences in climate - Orographic, atmosphere/elevation, ENSO effects

To distinguish, measurements need to be made consistently for long periods

Redmond, 2004
Challenges to Mountain Water & Ecosystems

2. Glaciers, Snow, & Water Resources

Grinnell Glacier, MT

Compiled by Fountaine, 2004
Relative Trends in April 1 Snowpack, 1950-1997

Mote et al., 2004
Trends in Timing of Peak Snowpack

Hamlet et al., 2004
As the West warms, winter flows rise and summer flows drop.

From: Stewart, J.T., D.R. Cayan, and M.D. Dettinger (2004)
Charges toward earlier streamflow timing across western North America
J. Climate, in review
Challenges to Mountain Water & Ecosystems
3. Disturbance Regimes, (Fire, Insects, Pathogens), Biodiversity, & Climate

Annual Western U.S. Area Burned

Westerling 2004
Synchronous stand replacing fire years in Southern Rockies correspond with major drought years

Margolis et al., in prep, Slide from Swetnam
Maximum fire frequency in the giant sequoia groves approximately matches the timing of maximum temperatures AND drought frequency in western US mountains.

Swetnam, 2004
Pinyon Pine (*Pinus edulis*) began dying *en masse* in summer 2002 from drought and *Ips* bark beetle outbreak.
Mountain Pine Beetle & Lodgepole Pine in British Columbia

Photo N For Products Assn
Compiled by Logan, 2004
Fire suppression and wet climate periods fostered high tree densities, increasing vulnerability to drought stress & beetle outbreaks.

Drought and warmer temperatures further stressed trees, triggering rapid increases in bark beetle populations, which result in massive forest dieback and associated insect outbreak dynamics.

Allen, 2004
Signs of Mountain Pine Beetle Leap-Frogging into Jack Pine, SE USA, and Industrial Forest Belt

Logan & Powell 2001
Logan 2004


The consequent changes in disturbance regimes can be more important than the (direct effect of) changes in temperature and precipitation.
Meeting the Challenge
Western Mountains

OBSERVATION
Implement coordinated high-elevation climate and ecosystem monitoring

RESEARCH
Promote and facilitate interdisciplinary research on climate and effects of climate on ecosystems

DECISION SUPPORT
Provide sound climate-related science for effective land management

COMMUNICATION
Provide data and research results in effective formats for scientific, managerial, and general audiences
Accomplishments

• Climate & Water Monitoring
  - Western Regional Network Strategy in development
  - Installing high elevation stations
North American Chapter of GLORIA
Global Observation Research Initiative in Alpine Regions

Sierra Nevada, CA

White Mtns, CA

Directorate: Vienna, Austria
http://www.gloria.ac.at/res/gloria_home/

Number of Species - number unique

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Glacier National Park, MT
LAUNCHING MTNCLIM

A NEW BIENNIAL CONFERENCE
on Mountain Climates & Ecosystems

MTNCLIM 2005: March 1-4, 2005
Chico Hot Springs, Pray, MT
http://www.fs.fed.us/psw/mtnclim/

· Research Presentations
· Ongoing Working Groups
· Science/Management Forum