**Overview:**

The Southern Sierra CZO (SSCZO) is a community platform for research on critical-zone (CZ)

processes along a steep elevation transect where precipitation grades from dominantly rain

to dominantly snow and ecosystems range from oak savannah biomes to subalpine forests. Spatial

gradients in CZ properties and processes permit substitution of space for time, making the

SSCZO an excellent natural laboratory for studying how the CZ responds to disturbance and

how the water cycle drives CZ processes. The SSCZOs goals include: i) expand process-based

understanding of the CZ in a sensitive, societally crucial ecosystem; ii) establish a foundation

for long-term physical, biogeochemical and ecological studies; and iii) develop a framework

for improving Earth System Models. Proposed research builds on past results and involves a

core SSCZO team from 6 campuses, plus collaborators and cooperators from other institutions

who use SSCZO data and other resources in their research. SSCZO resources include 4 focal

sites spanning a 3000-m elevation range with gradients in climate, regolith properties, soils,

vegetation and material cycles. Measurements are intensive and detailed, including 4 flux

towers, meteorological stations, soil lysimeters, groundwater wells, and over 1000 continuous

sensors for snow depth, soil moisture, streamflow, water quality and sap flow.

**Intellectual Merit :**

The SSCZO provides a framework for defining important feedbacks between long- and short-term

CZ processes and highlights an urgent need to study them together to advance our ability to

predict CZ responses to change. To better predict how water budgets and vegetation respond

to climate warming, land management and disturbance, it will be crucial to understand how

vegetation, long-term climate and parent material jointly regulate the co-evolution of regolith

properties and ecosystem structure and function. Our conceptual framework for research consists

of three main parts: i) regulators of CZ evolution; ii) questions about regolith-biota influence

on the water cycle, ecosystems and biogeochemical fluxes, and iii) implications of CZ structure

and function for ecosystem services and sustainability. The SSCZO facilitates rapid research

progress; large elevation and climate gradients, plus our use of advanced measurement and

modeling tools, offer excellent opportunities to apply the classic state-factor approach to

quantifying interactions among climate, biota, topography, lithology, hydrology, and regolith.

The region has a long history of CZ research, including work on soil and regolith formation

and organic-matter turnover. This historical and ongoing research illustrates the strength

of the area as a model system and provides a critical knowledge base for integrated CZ research.

**Broader Impacts :**

Among the many broader impacts associated with the SSCZO, 4 stand out as potentially transformative.

First, a CZO in the Southern Sierra provides a platform for research in a landscape with vital

importance to society, yet poorly understood in its potential response to climate warming.

The twin threats of a changing climate and land-use practices raise fundamental questions

about the sustainability of CZ services in the semi-arid U.S. West, which depends heavily

on seasonally snow-covered mountains for many of these services. The data and information

developed as a result of the SSCZO will enhance the science of individuals and research groups

well beyond those identified in this proposal. Second, the SSCZO will simultaneously advance

earth system science and directly inform societal decisions about management of ecosystem

services. The Sierra Nevada provides ecosystem services, ranging from water to biodiversity,

to a large fraction of California’s and thus the nation’s population. Our growing partnerships

with federal, state, and local resource-management agencies show the interest that decisionmakers

have in using research results to improve predictive capabilities. Third, the SSCZO measurements,

research and outreach provide valuable tools and knowledge, with applications to other multi-disciplinary

earth-science observatories. The SSCZO is an important testbed for new technology. Integration

of this technology with our outreach helps generate strong interest in our science. Fourth,

the CZO team will use CZO data and lessons to enhance the science experience of thousands

of middle- and high-school students, several undergraduate students and the public. Building

and using new research infrastructure will help develop both graduate and undergraduate research

at UC Merced and partner institutions.