

## Surface Process Studies in SESE

*Definition:* Surface process research uses a variety of techniques to explore interactions between the interior of a planet or moon with its fluid envelope and biosphere. Such studies of Earth's surface concentrate on quantifying how climate, mountain building, volcanic activity, and human activity impact the co-evolution of the atmosphere, geosphere and hydrosphere. Goals of this research are to not only to understand the surficial evolution of Earth, but also to inform efforts to maintain essential life-support systems (e.g., soil, water, and air). Practically, we use various field-based remote sensing, geochronology, and modeling approaches to test process-based hypotheses. Faculty involved include: Arrowsmith, Clarke, Hartnett, Heimsath, Hodges, Shock, Vivoni, and Whipple.

*Principal Research Targets at SESE:*

1. Neotectonics and the quantification of how tectonic activity drives planetary surface evolution.
2. Earthquake recurrence in space and time and its manifestation in the landscape and the sedimentary record.
3. Volcanic eruption processes, hazards, and relations to earthquakes.
4. Quantifying how climate drives weathering processes, and influences the tectonic evolution of mountain systems.
5. Surface water hydrology on hillslopes, channels, and extreme environments.
6. The use of landscape morphology to quantify surface processes on Earth, Mars and the Moon.
7. Study of biogeochemical cycles and feedbacks between earth's biosphere and the surficial environment.
8. Life in extreme environments.

*Principal Research Targets not presently at SESE:* Some of the research directions that are at the forefront of this subarea and not actively pursued by any of the current SESE faculty are as follows.

1. Coupling landscape evolution modeling with climate models.
2. Using sedimentary geology, geochronology, and soil science to better constrain human evolution.
3. Paleoclimate reconstruction with connections to current climate change research.
4. Natural hazard prediction and quantification in response to human and climate forcing.

*Collaborative Areas:* Substantive collaboration between this subarea and other research groups, at ASU and elsewhere, occurs across several fronts; some of which are represented by the SESE faculty associated with this subarea. At ASU clear opportunities of collaboration exist with faculty at Chemistry & Biochemistry, SoLS, SHESC, GIOS, Geography, and groups in engineering.

1. Life: evolution of life as driven by the surface environment; impact of ecosystems and biological on the planet's surface;
2. Climate: paleoclimate reconstruction; atmospheric science; climate and human evolution.
3. Co-evolution of humans and the Earth's surface with lessons of the anticipating future effects.
4. Systems engineering and sensor development, with associated cyber infrastructure. Targets are high spatial and temporal resolution measurement of topography and spectral properties.
5. CO<sub>2</sub> Transport/Reaction/Storage in terrestrial and offshore reservoirs.
6. Focused outreach and education: climate change, environmental issues and human impacts.
7. Biological aspects of weathering: climate-biota feedbacks, relationships among chemical, physical and biological weathering

*Greatest Research Targets:* There are a few "great" research targets not yet being pursued by other peer programs that intersect closely enough with this subarea to be noted here.

1. Connecting the chemical and physical evolution of the mantle with surface processes.
2. Predictive modeling applied to the design of lunar and Martian exploration initiatives.
3. Coupling reconstruction and modeling of the glaciated continents with anthropology.