This project, entitled "Collaborative Research: Isotopic Fractionation in Snow (IFRACS)," is under the direction of Peter N. Blossey, in collaboration with the following proposals
Proposal No: PI Name/Institution

1260462 Douglas H. Lowenthal, University and Community College System of Nevada, Desert Research Institute
1260380 Zhiming . Kuang, Harvard College, President & Fellows of Harvard University This award is effective June 1, 2013 and expires May 31, 2016.

Riming of ice crystals in supercooled orographic clouds significantly enhances their water content and water deposited to the surface. This proposal tests the hypotheses that: 1) riming or inhibition of riming by enhanced CCN numbers can significantly impact the water isotopic composition of falling snow, and 2) the isotopic composition of water vapor, cloud water and falling snow can resolve the relative importance of vapor deposition and riming for snow growth in wintertime orographic clouds. Previous observations at DRI's Storm Peak Laboratory (SPL, 3210 m) demonstrated a relationship between ambient temperature and d18O in cloud drops near cloud base that was used to infer the mass-weighted altitudes of snow growth by both riming and vapor deposition. Inherent in this relationship is the assumption that the vapor source and air mass history are relatively constant. We intend to evaluate such inferences with a comprehensive observational and modeling study. Continuous measurement of water vapor concentration and isotopic composition and episodic sampling of cloud water and snow during winter storms will allow us to establish the validity of this approach with respect to equilibrium and kinetic isotopic fractionation. A water isotopologue-enabled version of the Weather Research Forecasting Model (WRF) will be applied in diagnostic mode to simulate the source(s) of water vapor, its potential stratification, and isotopic fractionation that occurs during transport to SPL. Higher resolution simulations of mixed-phase cloud microphysical processes using WRF with the Lin and Thompson and Morrison microphysical schemes will be used to test observation-based inferences on snow formation by riming and vapor deposition, the altitudes at which they occur, and the effects of variation of CCN number on riming, snow amount and its distribution. The modeling component will thus follow the evolution of isotopic composition as water vapor is transported from its sources and undergoes phase changes in winter storms in Colorado.

Broader Impacts
Ice-particle riming may significantly impact the water isotopic signature of falling snow. For this reason, the proposed observational and modeling study has important significant implications for climate reconstruction, which derives past temperatures from the isotopic composition of polar ice and snow, GCM modeling of the global distribution of water isotopes, and hydrological cycling. This project involves the participation and training of gradu¬ate students from DRI and Harvard in the field program and modeling studies. SPL hosts atmospheric science field courses from DRI and other institutions, including the University of Wisconsin, North Carolina State University, and Colorado State University, for undergraduate and graduate students. These classes give students experience in all facets of atmospheric research. The Pathways to Earth Science Education (PESE) program is a partnership between York College and the Bronx Community College including a week of field training at SPL that seeks to enrich and support Earth science education for college and high school students. Reports on SPL research projects have appeared on CNN, NBC, National Public Radio, National Geographic Explorer, local television stations, in newspapers across the U.S., and the NCAREOL Channel

(http://www.youtube.com/ncareol#p/u/9/Wq3ihwZITBg). SPL is integrally involved in the Steamboat Weather Summit of meteorologists from television stations around the country. These activities will coincide with the proposed winter field study at SPL.