Geophysical Research Abstracts
Vol. 15, EGU2013-6620, 2013
EGU General Assembly 2013

Spatiotemporal water transport patterns in Hurricane Sandy from high-density stable isotope monitoring

Gabriel J. Bowen (1), Derek V. Mallia (2), Stephen P. Good (1), and John C. Lin (2)

(1) Geology & Geophysics Dept. and Global Change and Sustainability Center, Univ. of Utah, Salt Lake City, UT, USA (gabe.bowen@utah.edu), (2) Dept. of Atmospheric Sciences and Global Change and Sustainability Center, Univ. of Utah, Salt Lake City, UT, USA

Tropical and extratropical cyclones play a major role in the hydroclimate, contributing to vertical, poleward, and ocean to continent water vapor transport. Stable isotope ratios of precipitation and water vapor have previously been used to diagnose modes of moisture addition, water transport and precipitation formation within such systems, and have led to the recognition that intense cyclones can produce very ^{2}H and ^{18}O-depleted precipitation. These low values have been attributed to intense rain-out and efficient recycling of moisture within well-organized cyclones, but relatively little information is available on the spatial and temporal structure of isotope distributions within cyclones, particularly for land-falling storms or those transitioning from the tropics to extratropics. We report a new H and O isotope ratio dataset for >600 precipitation samples collected from across eastern North America as Hurricane Sandy made landfall between 10/27 and 11/2/12. Sample results are complimented by results from the Stochastic Time-Inverted Lagrangian Trajectory (STILT) model, which constrain the origin and transport history of air parcels across the study domain. The results demonstrate that storm-associated waters span an enormous range of isotopic values (>21.4‰ for δ^{18}O) and exhibit strong spatial and temporal structure. Low isotope ratios (<-15‰ for δ^{18}O) were associated both with the passage of the primary cyclonic low-pressure center and with moisture derived from a pre-existing mid-latitude trough that intersected the cyclone in late October. The most striking feature of the storm-water isotope distribution was a profound asymmetry of values about the eye of the storm that developed as Sandy made landfall late on October 29th and was sustained for ~48 hours. During this time low isotope ratios occurred only to the west and south quadrants of the storm and strong gradients in isotopic composition (up to 4.2‰ per 100 km for δ^{18}O) existed in the vicinity of the storm center. We attribute this pattern to differences in moisture source and varying degrees of heavy-isotope distillation along transport paths feeding different parts of the storm. These initial results demonstrate the potential of rapid-response isotope monitoring to elucidate the structure and dynamics of water cycling within synoptic-scale systems such as Hurricane Sandy, with potential to improve our understanding of storm evolution, hydroclimatological impacts, and paleo-storm reconstruction.