2018 Birdsall-Dreiss Distinguished Lecturer

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David Boutt is an Associate Professor in the Department of Geosciences at the University of Massachusetts-Amherst. He received B.S. and M.S. degrees from the Department of Geological Sciences at Michigan State University in 1997 and 1999. His MS work focused on understanding the impacts of land-use change on groundwater quantity and quality at the watershed-scale. He earned his Ph.D. from the New Mexico Institute of Mining and Technology (Socorro, New Mexico, USA) in 2004 and held a postdoctoral position at Sandia National Laboratories before joining the faculty at UMass-Amherst in 2005. During his Ph.D. research he was awarded an AGU Horton Research Grant. Dr. Boutt's dissertation work focused on the coupling of fluid flow and deformation in fractured and faulted media through the development of discretely-coupled fluid-solid models. His current research program focuses on understanding the role of groundwater in catchment-scale hydrologic processes. This involves delineating the contribution of groundwater storage to stream flow generation, spring discharge, and hydrologic budgets. He maintains an active and dynamic research laboratory with dedicated students ranging from undergraduates to PhD students. His research interests have taken him on board the Japanese Drilling Vessel Chikyu during IODP Expedition 319 – the first riser drilling operation in IODP history – to wild of the Atacama desert in Chile. Some of his current work is focused on understanding the origin of lithium-rich continental brines in northern Chile and in the Great Basin of the western United States. Dr. Boutt has also contributed extensively to understanding the hydrogeology of a former cranberry bog that is part of the largest freshwater restoration project in New England (http://www.livingobservatory.org/). A list of his publications can be found at https://blogs.umass.edu/dboutt/. Boutt has served the hydrogeologic and broader geoscience communities by serving on proposal review panels and volunteer boards. Boutt has been a member of GSA since 1997 and has convened many topical sessions at GSA national meetings. He is currently an editor for the journal Hydrological Processes, and he was previously an associate editor for Hydrogeology journal.

Interested institutions can schedule a visit by completing the request form here. David will present one lecture on one of the topics described below. GSA's Hydrogeology Division is particularly interested in including liberal arts colleges in the itinerary. The Division pays transportation expenses, and the host institution is expected to provide local

accommodations.

Groundwater as a Buffer to Climatic Change: Dynamic Subsurface Storage of Glaciated Landscapes

The northeastern United States is experiencing rapid changes in its hydrology due to intense land-use change, urbanization, and climate change. It also possesses some of the highest density, longest term observations of hydrologic variables (streamflow, groundwater levels) in the US and world. The focus of this presentation is how small unconfined aquifer systems, and the streams to which they are connected, respond to hydroclimatic and land use changes. The research is data-driven. Physical and geochemical information is used to understand how different subsurface environments and surface-water groundwater interactions impact the sensitivity of groundwater storage to climate variability. Analysis of groundwater levels and streamflows reveal a heterogeneous response of aquifers to climate variability. This highlights the role of subsurface hydrologeologic heterogeneity to aquifer response. A long-term rise in water levels can be observed from analysis of water level trends. This is associated with an increase in precipitation and land-use change which has ultimately led to an increase in nuisance flooding. Integrating isotopic tracers into this work has improved our understanding of the role of extreme precipitation events on groundwater storage. Isotope data have also shed light on the fundamental importance of groundwater discharge to streamflow in the region. This work highlights the importance of understanding groundwater processes in generating in streamflow, with implications for water supply, baseflow generation, climate refugia, and assessing flood risk in a changing world.

Do you know where your catchment ends? The role of inter-basin groundwater flow and hydrogeologic transience in hydrologic processes

A fundamental concept in the hydrologic analysis of watersheds is that the water draining to the outlet of the basin originates within the basin itself. Groundwater hydrologists have long understood the role and impact of inter-basin groundwater flow, defined here as the subsurface transfer of water across topographic boundaries. This inter-basin transfer of water leaves a distinct impact on the hydrologic and solute budgets of the catchments. This talk addresses when and where topographic catchment divides correspond to groundwater divides and how this is affected by climatic variability and geologic heterogeneity. Examples from a range of climates and geologic environments (northern Chile, Great Basin of the United States, Trinidad and Tobago, and coastal Massachusetts) will highlight the relevance t of inter-basin flow on hydrologic and geologic processes. Additionally, the coupling of hydrologic transience and changes in groundwater storage is also discussed, since these two processes are often difficult to separate in practice. Finally, I present recommendations and suggestions for new approaches to conceptualization of hydrogeologic watershed boundaries that take into consideration both geologic uncertainty and climate variability.

Water and Lithium - The nexus of hydrogeosciences and green energy in the transition from fossil fuels

The Earth is warming at an unprecedented pace due to the release of carbon dioxide from the burning of fossil fuels. Our society is now in the great transition to a green and more sustainable energy supply. The development of portable and powerful energy storage mechanisms is essential to replace our dependence on the high-energy density fossil fuels. Lithium-ion batteries have emerged as one important technology for this purpose. The element lithium is abundant and plentiful on the planet but is rarely found at high concentrations to be of economical use. Economic deposits of lithium are found in pegmatites and closed-basin continental brines. The origin of the lithium brines and their distribution worldwide is fundamentally tied to the hydrology and hydrogeology of the host basins. This talk focuses on the multifaceted role of (ground) water in transporting, accumulating, and extracting lithium in continental brines and this discipline represents an important interface between hydrogeology, economic geology, and our green energy supplies. Field examples from Northern Chile and the Great Basin of the United States highlight the inter-disciplinary nature of the origin and evolution of continental lithium brine deposits. Many aspects of geosciences including volcanology, sedimentology, geomorphology, geochemistry, geophysics, paleoclimate, structural geology and tectonics combine with hydrogeosciences make this a particularly exciting example of the importance of earth sciences to future energy supplies. The environmental impacts of lithium brine pumping is explored and discussed in the context of balancing the sustainability of lithium-ion batteries.