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AGU-FM13

December 07 - 13, 2013

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1:40 PM-6:00 PM, Hall A-C (Moscone South), **Hydropedology: Synergistic Integration of Soil Science and Hydrology in the Critical Zone I Posters [SWIRL_GS]**	
1:40-1:40 PM	**H23F-1330. Temporal and Spatial Patterns of Preferential Flow Occurrence in the Shale Hills Catchment: From the Hillslope to the Catchment Scales** H. Liu; H. Lin
1:40-1:40 PM	**H23F-1331. Temporal stability of soil matric potential in the Shale Hills Critical Zone Observatory** H. Yu; H. Lin; W. Berger; P. Yang
1:40-1:40 PM	**H23F-1332. Resolving the High Resolution Soil Moisture Pattern at the Shale Hills Watershed Using a Land Surface Hydrologic Model** Y. Shi; D.C. Baldwin; K.J. Davis; X. Yu; C. Duffy; H. Lin

Wednesday, December 11, 2013

Time	Session Info
1:40 PM-6:00 PM, Hall A-C (Moscone South), **Connecting Natural Landscapes to Experimental and Numerical Models of Earth and Planetary Surface Evolution III Posters**	
1:40-1:40 PM	**EP33A-0858. A New Hydrologic-Morphodynamic Model for Regolith Formation and Landscape Evolution** Y. Zhang; R.L. Slingerland; C. Duffy
1:40 PM-3:40 PM, 3011 (Moscone West), **Pore Structure, Fluid Flow, and Mass Transport in Porous Media II [SWIRL_CM]**	
1:40-1:55 PM	**H33L-01. Water-Organic-Rock Reactions Recorded in Pores in Shales from the Marcellus and Rose Hill Formations *(Invited)*** S.L. Brantley; L. Jin; G. Rother; D.R. Cole; x. gu; V.N. Balashov

Thursday, December 12, 2013

Time	Session Info
8:00 AM-10:00 AM, 3022 (Moscone West), **Biophysical Functions and Process Dynamics in Soil I**	
9:00-9:15 AM	**H41L-05. The Catchment Isoscape: Theory and Experimental Evidence for the Isotopic Age of Water in a Critical Zone Observatory *(Invited)*** C. Duffy; E. Thomas; P.L. Sullivan; G. Bhatt; X. Yu
10:20 AM-12:20 PM, 102 (Moscone South), **Hydrometeorological Research at the Computational Frontier: Data-Intensive Prediction and Social Impact Assessment of Natural Disasters (Virtual Option)**	

Final ID: H23F-1330

Temporal and Spatial Patterns of Preferential Flow Occurrence in the Shale Hills Catchment: From the Hillslope to the Catchment Scales

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Body: Understanding temporal and spatial patterns of preferential flow (PF) occurrence is important in revealing hillslope and catchment hydrologic and biogeochemical processes. Quantitative assessment of the frequency and control of PF occurrence in the field, however, has been limited, especially at the landscape scale of hillslope and catchment. By using 5.5-years' (2007-2012) real-time soil moisture at 10 sites response to 323 precipitation events, we tested the temporal consistency of PF occurrence at the hillslope scale in the forested Shale Hills Catchment; and by using 25 additional sites with at least 1-year data (2011-2012), we evaluated the spatial patterns of PF occurrence across the catchment. To explore the potential effects of PF occurrence on catchment hydrology, wavelet analysis was performed on the recorded time series of hydrological signals (i.e., precipitation, soil moisture, catchment discharge). Considerable temporal consistence was observed in both the frequency and the main controls of PF occurrence at the hillslope scale, which was attributed largely to the statistical stability of precipitation pattern over the monitoring period and the relatively stable subsurface preferential pathways. Preferential flow tended to occur more often in response to intense rainfall events, and favored the conditions at dry hilltop or wet valley floor sites. When upscaling to the entire catchment, topographic control on the PF occurrence was amplified remarkably, leading to the identification of a subsurface PF network in the catchment. Higher frequency of PF occurrence was observed at the valley floor (average 48%), hilltop (average 46%), and swales/hillslopes near the stream (average 40%), while the hillslopes in the eastern part of the catchment were least likely to experience PF (0-20%). No clear relationship, however, was observed between terrain attributes and PF occurrence, because the initiation and persistency of PF in this catchment was controlled jointly by complex interactions among landform units, soil types, initial soil moisture, precipitation features, and season. Through the wavelet method (coherence spectrum and phase differences), dual-pore filtering effects of soil system were proven, rendering it possible to further infer characteristic properties of the underlying hydrological processes in the subsurface. We found that preferential flow dominates the catchment discharge response at short-time periods (< 3 days), while the matrix flow may dominate the discharge response at the time scales of around 10-12 days. The temporal and spatial patterns of PF occurrence revealed in this study can help advance the modeling and prediction of complex PF dynamics in this and other similar landscapes.