Title: **Particulate Organic Matter (POM) Transport and Transformation at the terrestrial-aquatic interface**

Matthew Ginder-Vogel,[1] Eric Roden,[1] Steven Loheide,[1] Stephanie Napieralski,[1] Ecenur Bulur,[1] Thais Altenberg,[1] Marissa Cartwright,[1] Phillipe Van Cappellen,[2] Fereidoun Nezhad,[2] Riley Mills,[2] Evan Arntzen[3]

1. University of Wisconsin – Madison, Madison, Wisconsin, USA

2. University of Waterloo, Waterloo, Ontario, Canada

3. Pacific Northwest National Laboratory, Richland, WA, USA

Contact: mgindervogel@wisc.edu

Project Lead Principal Investigator (PI): Matthew Ginder-Vogel

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Project Abstract: Over the past three years our ESS-SBR funded research has been examining particulate organic matter (POM) dynamics in near-surface sediments of the Columbia River through coupled field and lab experiments. Novel, riverbed "POM traps", designed cooperatively with the PNNL field team, were deployed in the near surface riverbed within the 300 Area. The deployment of these traps was timed to capture POM infiltration into riverbed sediments during low and high flow conditions. After deployment, materials from depth sections of each of three traps were wet sieved to obtain the fine-grained fraction (<250 μm) which was then analyzed in triplicate for POC/PON content. The trap deployments have revealed substantial POM accumulation in the upper 20 cm of sediment. Greater accumulation occurred during elevated river flow/elevation in June/July compared to February/March. Reactive transport simulations in which fluid flow and solute/colloidal POM transport were modeled using measured hourly hydrologic gradients between river and ground water provide an explanation for these results, where elevated rates of suspended POM-containing fluid flow into the riverbed lead to major POM accumulation through filtration and sorption processes. The boundary condition for suspended POM at the riverbed surface, as well as the POM filtration and sorption parameters, were constrained by a combination of in situ measurements, POM transport experiments and modest parameter fitting to produce estimates of POM accumulation that approximated observed levels of accumulation in the POM traps. Enhanced POM accumulation during periods of high fluid influx to the riverbed releases soluble labile DOC whose coupled transport and metabolism lead to periods of pore fluid dissolved oxygen (DO) depletion. These results provide a compelling illustration of how in situ (i.e. field-scale) experimentation can be coupled with modeling (i.e. the ModEx paradigm) to reveal system feedbacks and dynamics.