

**Idaho Water Resources Research Institute  
University of Idaho**

**Annual Technical Report  
2019**

## PRODUCTS

- Ali, J.A., B. Noble, I. Nandi, A.S. Kolok, and S.L. Bartelt-Hunt (2019) Assessing the accuracy of citizen scientist reported measurements for agrichemical contaminants. *Environmental Science and Technology*. Environ. Sci. Technol. 53(10): 5633-5640.
- M. Goebel, C. Cooper, C. Wardropper (2019) Coeur d'Alene River Observational Study. Summary Stakeholder Report. Available at: <https://chloewardropper.weebly.com/coeur-dalene-river-recreation-survey.html>
- Cooper, C. M., & Wardropper, C. B. (2021) Environmental, public health, and economic development perspectives at a Superfund site: A Q methodology approach. *Journal of Environmental Management*, 279, 111571. <https://doi.org/10.1016/j.jenvman.2020.111571>
- Cooper, C. M., Goebel, M. S., Wade, V. T., & Wardropper, C. B. (2021) Challenges and opportunities for communicating lead exposure risks in Idaho's Silver Valley. In press, *Case Studies in the Environment*.
- Cooper, C. M., Langman, J. B., Sarathchandra, D., Vella, C. A., & Wardropper, C. B. (2020) Perceived Risk and Intentions to Practice Health Protective Behaviors in a Mining-Impacted Region. *International Journal of Environmental Research and Public Health*, 17(21), 7916. <https://doi.org/10.3390/ijerph17217916>
- Cooper, Courtney (2020) Dissertation: Behavioral Intentions, Risk Perception, and Issue Framing: Exploring Perspectives in a Mining-Impacted Region of Northern Idaho, USA. Theses and Dissertations Collection, Digital Initiatives, University of Idaho Library. [https://www.lib.uidaho.edu/digital/etd/items/cooper\\_idaho\\_0089e\\_11918.html](https://www.lib.uidaho.edu/digital/etd/items/cooper_idaho_0089e_11918.html)
- Kayler, Z., Brooks, E., Tan, Z., Hidy, A., Blandon, K., Robichaud, P. (2021) Department of Energy Environmental Science call (\$893,231): Linking sediment biogeochemistry and novel tracers to improve Earth system and hillslope modeling of post-wildfire erosion events and legacies (*in review*)
- Fruhling, A., Bartelt-Hunt, S., Kolok, A., (2019) Evaluating Citizen Scientists' User Experience and Engagement Using a Mobile Watershed Data Management App. Volume 26, LNCS\_11786, Proceedings at HCI International, Springer. book chapters
- Godsey et al. (2020) Multiple tracers reveal sources and patterns of drinking water contamination at the urban-rural interface. IWRRRI Water Seminar Series.
- Goebel, Madeline S. (2021) Challenges and opportunities for communicating lead exposure risks in Idaho's Silver Valley. *International Association for Society and Natural Resources*
- Goebel, Madeline S. (2021) Public Perceptions of Lead (Pb) Risk and Its Management in the U.S. American Association for Geographers Annual Meeting. Virtual, April 7-11.
- Goebel, Madeline. (2021) Thesis: Public Perceptions of Lead Risk and Its Management in the U.S.
- Gouin N., Bertin A., Espinosa M.I., Snow D.D., Ali J.M. and Kolok A.S. (2019) Pesticide contamination drives adaptive genetic variation in the endemic mayfly *Andesiops torrens* within a semi-arid agricultural watershed of Chile. *Environ. Poll.* 2019 Dec ;255 (Pt 2) doi: 10.1016/j.
- Kayler, Z.E., Premke, K., Gessler, A., Gessner, M.O., Griebler, C., Hilt, S., Klemedtsson, L., Kuzyakov, Y., Reichstein, M., Siemens, J. and Totsche, K.U., (2019) Integrating aquatic

- and terrestrial perspectives to improve insights into organic matter cycling at the landscape scale. *Frontiers in Earth Science*, 7, p.127.
- Kolok, A.S., A. Bean, S.L. Bartelt-Hunt and J.M. Ali. (2019) Citizen science as a water quality monitoring tool. *Water Resources Impact* 21(2): 25-26. phosphate and atrazine spatial and temporal distribution across watersheds in Illinois as measured by citizen scientists. *Journal of the American Water Resources Association*.
- Lin, Yu-Li, (2021) Developing a watershed health index for the state of Washington. M.S. in Environmental Science (anticipated summer 2021)
- Humes, K., Brooks, E., Coats, E., Kolok, A., Ma, X., Kayler, Z (Sr. Pers.), Strawn, D.,(Sr. Pers.), Ridenhour, B., (Sr. Pers.), Stadler, T.,(Sr. Pers.), McInnis, H., (Sr. Pers.) (2021) National Science Foundation National Research Training call: (\$3,000,000) NRT-HDR: Transdisciplinary Training to Link Waterscape Data Science to Public Health Needs (*in review*)
- Ogus, T., Kayler, Z., Boylan, R., Brooks, E. (2021) Phosphorus and nitrogen transit time and age in no-tilled, tile-drained agriculture. (*in preparation* for *Agriculture, Ecosystems & Environment*)
- Woodruff, C. D., and R.J. Qualls, (2019) Recurrent snowmelt pattern synthesis using Principal Component Analysis of multi-year remotely sensed snow cover, *Water Resources Research*, 55(8): 6869-6885, <https://doi.org/10.1029/2018WR024546>

## INFORMATION TRANSFER PROGRAM

- PI R. Qualls generated PCA snowmelt pattern for Big Wood Basin of Idaho for group of basin water user stakeholders to help them improve predictions of basin streamflow runoff and water supply.
- PI R. Qualls is developing collaborations with the Natural Resource Conservation Service (NRCS) Snow Survey to quantify spatial distribution of snow cover in mountainous basins to describe conditions between gaps in ground-based SNOTEL and Snow Course observations.
- PI Qualls, generated PCA snowmelt pattern for the Bitterroot Mountains supplying the North Fork of the Clearwater River and Dworshak Reservoir, operated by the US Army Corps of Engineers (USACE).
- PI Qualls gave presentation of our Snowmelt Pattern model to the Fall Idaho Water Supply Meeting, Nov. 5-6, 2020, attended by 77 Idaho water stakeholders and agencies including Idaho Department of Water Resources, NRCS, Northwest Climate Center, USBR, USACE, Idaho Power, Idaho Water Resources Board, NWS, USDA-ARS, USFS, and others.
- PI Qualls gave Water and Climate Outlook presentations of this work to north Idaho ranch and farm stakeholders, January 2019 and 2020, Lewiston, Idaho.
- PI Qualls is interacting with National Snow and Ice Data Center (NSIDC) and Dr. Dorothy Hall (NASA MODIS Land Surface Team Snow and Ice Lead) to develop tools to use our model to process MODIS daily snow remote sensing to produce cloud-free images during the snowmelt season of mountainous watersheds.
- PI Godsey shared results from this project have already been shared directly with contacts at the Idaho Department of Environmental Quality and City of Pocatello who

were both seeking information about near-surface contamination of wells in the headwaters of the ESRP.

- The Current, IWRRRI Newsletter Volume 2, Issue 2, Fall 2019
- The Current, IWRRRI Newsletter Volume 2, Issue 1, Spring 2019
- Second Annual Water Resources Research Symposia (2019) University of Idaho, Idaho Water Institute. Moscow, ID, April 24.
- Third Annual Water Resources Research Symposia (2019) University of Idaho, Idaho Water Institute. Moscow, ID, November 12.
- Bean, A. (2019) Opportunities for Collaboration. Palouse Basin Aquifer Committee Meeting, Moscow, ID, January 17.
- Kolok, A.S. (2019) The Idaho Water Resource Research Institute. The Confluence Lab. University of Idaho. Moscow, ID, March 4.
- Topping M. (2019) Science Saturday, Moscow Arboretum Associates, Moscow, ID, August 10.

## STUDENT SUPPORT

- 3 Ph.D. Students
- 4 Masters Students
- 1 undergraduate Student
- Law Student (2019) Environmental Justice Promotion Through Experiential Outdoor Education on the River – Part 2 – HEAL. Science, Health and Engineering Policy and Diplomacy; Sustainable Development for the Americas Conference. Tucson, AZ, October 23-25, \$500.
- Graduate Student (2019) A Novel Transparent Sediment Simulant for Unveiling the Bed Topography and Interstitial Processes. 72nd Annual Meeting of the American Physical Society-Division of Fluid Dynamics. Seattle, WA, November 23-26, \$500.

## NOTABLE ACHIEVEMENTS AND AWARDS

- Woodruff & Qualls (2019) was selected by the editors of *Water Resources Research* for recognition as an outstanding paper. It was showcased with a Research Spotlight article on *Eos, Earth and Space News* (see Stanley, S. (2019), Capturing snowmelt patterns from cloudy satellite images, *Eos, 100*, <https://doi.org/10.1029/2019EO130069>) and was highlighted as a feature article on the journal's online landing page for six months following publication in July 2019, and *Water Resources Research* is a top-tier journal in hydrology.
- Woodruff & Qualls (2019) received an Altmetric Attention Score of 15, ranking it in the top 10% of all research outputs ever tracked by Altmetric.
- PI Godsey was recognized as the Fall 2020 ISU Supervisor of the Semester (of 72 nominations campus-wide) in part for her support of the student on this award through a very challenging research period.
- Godsey was also nominated for the Idaho Women of Influence awards in the Science and Technology Division in fall 2020, in part for her work on regional groundwater

quality.

- Godsey's graduate student supported on this grant, also received two Geological Society of America awards: one to support their studies through the ongoing COVID challenges, and one acknowledging the strength of their research plan building off this project.

# Assessing The Risk Of Emerging Contaminants In Managed Aquifer Recharge In Idaho's Eastern Snake River Plain

**Project Type:** Annual Base Grant

**Project ID:** 2019ID084B

## **Project Impact:**

This project partially met its two original project objectives to assess the current spatial and temporal variability in pharmaceutical and personal care product (PPCP) concentrations in recharge and discharge waters of the Eastern Snake River Plain (ESRP) aquifer. In fall 2020, we sampled the full set of operational recharge monitoring wells after COVID cancelled the early spring 2020 campaign, and we were unable to sample at the fishery. We could not assess temporal variability of PPCPs, but we added additional spatial samples from wells in two key upgradient regions feeding the ESRP that are either actively recharging their aquifers or considering future recharge programs. We analyzed almost 50 well samples for 23 emerging contaminants and found that ~60% of the wells near the managed aquifer recharge stations exhibited detectable levels. Recharge was not actively occurring when we were able to sample, so our results reflect past natural and managed aquifer recharge. Only one other well sampled in the future/planned recharge regions had detectable PPCP levels despite those same wells occasionally failing to meet safe drinking water standards for other contaminants (IDEQ, pers. comm.). Overall, these pilot results suggest that managed aquifer recharge well samples are associated with much higher rates of PPCP detection than other regional wells, even in areas of water quality concerns. Furthermore, PPCPs could still be detected four months following the end of recharge operations. This data provides a baseline for future monitoring work and is serving as pilot data for an in-progress collaborative proposal with IDEQ.

# Synthesis Of Multi-year Remote Sensing To Model Annually-recurrent Snowmelt Pattern From Mountainous Watersheds In Idaho For Runoff And Water Supply Simulation

**Project Type:** Annual Base Grant

**Project ID:** 2019ID085B

## **Project Impact:**

We implemented our PCA model to quantify the inter-annually recurrent snowmelt pattern over five watersheds in the Pacific Northwest, representing different characteristics ranging from low elevation Washington Cascades watersheds to higher Inland basins. For each, the model identified a melt pattern which was highly stable over more than 15 years. This was remarkable since the period included diverse snow conditions, including significant drought and high snowpack years.

In order to test the model's value, we ran the Variable Infiltration Capacity (VIC) streamflow runoff model over the Upper Snake Basin in its standard mode. We compared the spatial snowmelt pattern generated by VIC with daily remotely sensed snowcover which had been made cloud-free using our PCA snowmelt model. The VIC model snowmelt pattern was significantly different from the remotely sensed observed pattern. One goal was to assess whether such a difference would be found. We believe that such a difference would likely inhibit the ability of models like VIC to simulate stream flow under conditions which differed significantly from those under which it was calibrated, such as during rain-on-snow events, since rain falling on snow would behave differently than rain falling on bare or vegetated ground during such an event.

We continue to develop tools for stakeholders to implement the PCA model without significant training in the model, and to assess the additional capabilities which our PCA model will produce. We have disseminated our results to a broad array of stakeholders and continue to develop collaborations for its use.

# Watershed Scale Assessment Of Water Quality And Nutrient Retention In Conservation Agriculture

**Project Type:** Annual Base Grant

**Project ID:** 2019ID087B

## **Project Impact:**

In this project, a paired watershed approach was undertaken to understand nutrient dynamics from agricultural systems in an effort to understand and reduce the risk of contamination. Using a numerical model of multi-year phosphorus (P), nitrogen (N), and hydrologic data, we determined that the watershed that employed largely conventional till (direct seed) mediated the variability in P transit time (59 years on average) and age (80 years). The watershed in which conventional agriculture was largely practiced was more variable whereby transit time was as short as 4 years and as long as 79. Age spanned 3 to 80 years. P remained in the system through the soil pool, which was approximately the same age as the entire system. Precipitation was a primary driver of the phosphorus dynamics, essentially flushing available P through the conventional agriculture watershed that tilled soil thereby allowing for overland flow. In contrast, N was similar in both watersheds having transit times and ages of approximately three years. N is highly mobile and clearly moves relatively quickly through the system. Based on these findings, we know that a large pool of P is available in agricultural soil (legacy P) that is available for leaching during the hydrologic water year (i.e., primarily spring). Management that can capture the available soil P during this time can reduce the pulses of P released to the surrounding water ways that can potentially have negative downstream water quality effects. Analyses of sediment cores are ongoing and will help in understanding long-term management impacts.



## **Characterizing Water-based Recreationists' Perceptions Of Toxic Metal Contaminants**

**Project Type:** Annual Base Grant

**Project ID:** 2019ID088B

### **Project Impact:**

Our project sought to assess people's perceptions of the risks of exposure to lead (Pb). The proposed project focused empirical data collection on recreational users of the Coeur d'Alene River in northern Idaho. In order to carry out a survey of recreationalists, we first conducted a use survey of boat launches to assess when and how many people used each location over a two-week period in July 2019, and disseminated a report to river management stakeholders. Due to subsequent pandemic restrictions, we were not able to conduct an in-person intercept survey of river users. Instead, we pivoted to an online survey of the general American public focused on perceptions of risk from lead exposure. We completed data collection in December 2020 and are in the process of analysis. Project funds also partially supported a study of stakeholder perspectives on managing tradeoffs between environmental management, economic development and public health outcomes related to lead contamination within the Couer d'Alene River Basin. Results from this study were recently published in an article in the Journal of Environmental Management.