**Mini Proposal for WiCCED**

Evaluating the impact of pumping on groundwater-surface water interaction and coastal vulnerability to salinization

**Project Description:**

Groundwater-surface water (GS-SW) interactions and associated water management issues have been explored, but the complexities of the interactions are not well understood in changing systems, especially along coastlines with the added dynamics of saltwater encroachment. A better understanding of vulnerability to salinization of both groundwater and surface water resources along coasts is essential with increased water use, land use change, and climate change. One GW-SW interaction of particular interest is the impact of groundwater use on near-coast streamflow. Groundwater withdrawals have been cited as a driving factor of streamflow depletion across the United States [*Killian et al.*, 2019]. In coastal streams changes in streamflow typically correspond to the alterations in stream salinity (e.g. elevated streamflows are associated with fresher water and lower streamflows are associated with increase salinity) [*Ross et al.*, 2015]. Although studies have used numerical groundwater models to determine the impact of groundwater withdrawals on streamflow, there has been limited work evaluating the impact of these interactions on coastal salinization. In this project, we aim to assess the potential implications of groundwater pumping on streamflow water quality using a coupled groundwater-surface water model. We will also use statistical evaluations of streamflow, baseflow, and salinity records to identify groundwater-withdrawal effects along the mid-Atlantic coast.

**Research Questions:**

* What are the implications of pumping for coastal GW-SW interactions?
* If stream baseflow is decreased, how does this impact salinization in near-coast streams?
* How can we project this into the future (urbanization, sea level rise, changes in precipitation/evapotranspiration)?
* Are groundwater-level and streamflow declines occurring despite an average increase in precipitation in the mid-Atlantic?

**Tasks:**

* Modeling
  + Build a simple coupled GW-SW model to explore connectivity, pumping, and the subsequent impact on baseflow and stream salinity front using MODFLOW or HydroGeoSphere.
* Field data and statistical interrogation
  + Collect time series of stream discharge and specific conductivity [*U.S. Geological Survey*, 2019], groundwater pumping, and meteorological data.
    - Groundwater withdrawal volumes may need to be inferred from geostatistical analysis of crop irrigation needs.
  + Employ quantitative hydrograph-separation methods to determine baseflow [*Killian et al.*, 2019]. It may be possible to use the U.S. Geological Survey Groundwater Toolbox [*Barlow et al.*, 2017].
    - Streamflow partitioning (PART) method [*Rutledge*, 1993, 1998]
    - HYSEP Fixed and HYSEP Local Minimum methods [*Pettyjohn and Henning*, 1979; *Sloto and Crouse*, 1996]
    - Base Flow Index (BFI) Standard method [*Wahl and Wahl*, 1988, 1995]
  + Assess baseflow, irrigation, and stream quality trends.

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