Examining Interactions between the Built and Natural Environments (BNE) in an Arctic Community: an Utqiaġvik Sensor Array (USA)

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Within an NSF-funded Navigating the New Arctic project, we are implementing an array of environmental sensors to study the interactions between the built and natural environments in Utqiaġvik, Alaska. The sensor network elements can be divided essentially into four categories: terrestrial micrometeorology at different locations around buildings and a tundra "control;" aquatic conditions in lagoons, lakes, and ponds; geophysical surveying (including ground penetrating radar, electrical resistivity tomography, active layer depth, and LiDAR), and airborne particulate matter. Geophysical surveying back during the summer of 2021, and the first components of the terrestrial and aquatic sensor arrays were installed in June 2022; we continue to improve upon and expand the measurements. Whereas prior research has shown only a marginally significant urban heat island in Utqiaġvik, our finer scale sensor locations indicate the presence of substantive summer "hot" and "cold" spots, related to aspect and proximity to water. At a residential facility, ground thawed later at a south-facing aspect and ~four days earlier at a north-facing aspect relative to the tundra control. Ground temperatures at 30cm depth were on average 0.99˚C (up to ~5.0˚C) warmer south-facing and 1.94˚C (up to ~2.5˚C) cooler north-facing compared to the tundra. Aquatic sampling indicated generally greater NH_4^+, NO_3^-, and PO_4^- concentrations in urban water bodies compared to the surrounding tundra. Geophysical survey data additionally have mapped the spatial distribution of thaw depth, and the presence of soil water and frozen ground around three major infrastructure facilities (residential housing, hospital, and utilities compound). Very preliminary data on particulate matter identify the dramatic effect of vehicles, as well as the mitigating effect of water deposition (natural and anthropogenic). Our collaborative team includes community members, and our goal is to collectively assess and refine our data collection, in order to ultimately inform future design practices for resilient and sustainable Arctic communities.