UNDERSTANDING THE CHANGING NATURAL-BUILT LANDSCAPE IN AN ARCTIC COMMUNITY: AN INTEGRATED SENSOR NETWORK

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THREE RESEARCH COMPONENTS

1. Understand how urban system components (buildings and infrastructure) interact with the surrounding air, ground, and water conditions;

2. Generate environmental design analysis and design guidelines to address how current and future management of Utqiaġvik's built environment can be improved;

3. Study how our research team and Utqiaġvik residents communicate across disciplines and cultures to produce knowledge that is useful for residents and that informs science and social science.

TERRESTRIAL METEOROLOGICAL SENSOR NETWORK

Sensor arrays to be installed within the city of Utqiaġvik

Air temp, relative humidity, air pressure, wind speed /direction, albedo, airborne particulate matter, ground temp. & moisture content, snow depth
(plus precipitation, solar radiation)

Terrestrial sensors are being installed near Charlottesville, VA to test equipment and installation logistics, as well as to calibrate the sensor spacing and sampling frequency for environmental monitoring in Utqiaġvik – and to develop and test data acquisition, visualization, and analysis

AQUATIC SENSOR NETWORK

Understanding how infrastructure interacts with hydrology and water chemistry on a landscape scale

Multi-parameter water quality sensor to be installed in lagoons

Conductivity, temperature, pH, dissolved oxygen, algae, dissolved organic matter, turbidity

Single parameter water quality sensor – deployed in ponds, flooded ice cellars, stormwater drains

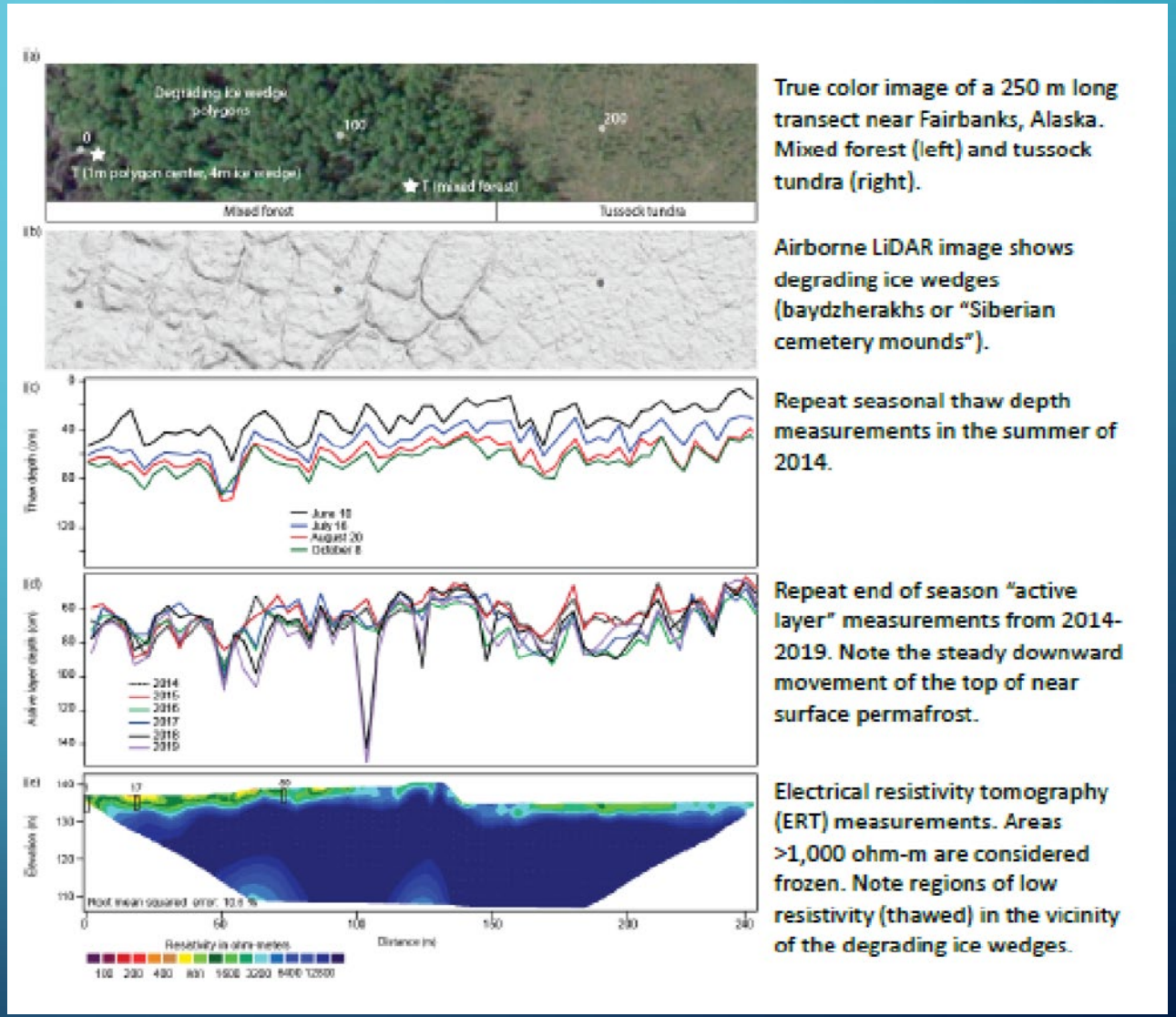
Water level, temperature, conductivity

Water quality sensors deployed with protective housing

GEOTECHNICAL SURVEYS AND MAPPING (CRREL)

Understanding how buildings and infrastructure influence permafrost ground surface deformation, variation, and stability

InSAR (Interferometric synthetic aperture radar), LiDAR, High-resolution GPS survey, Tomography (ERT), Ground penetrating radar (GPR)



True color image of a 250 m long transect near Fairbanks, Alaska. Mixed forest (left) and tussock tundra (right).

Airborne LiDAR image shows degrading ice wedges (baydzherakhs or "Siberian cemetery mounds").

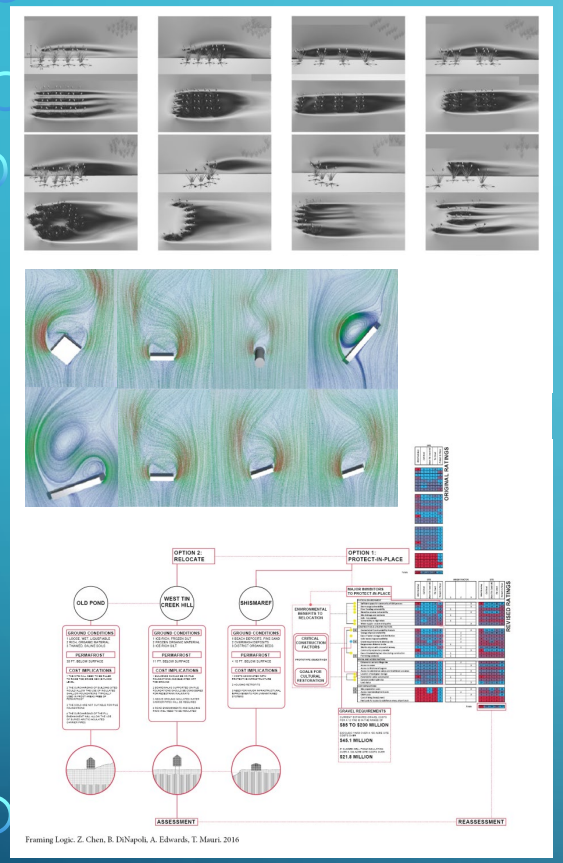
Repeat seasonal thaw depth measurements in the summer of 2014.

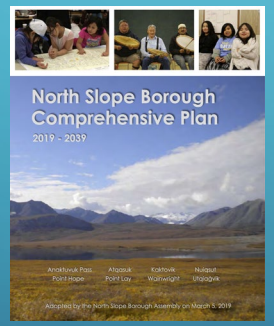
Repeat end of season "active layer" measurements from 2014-2019. Note the steady downward movement of the top of near surface permafrost.

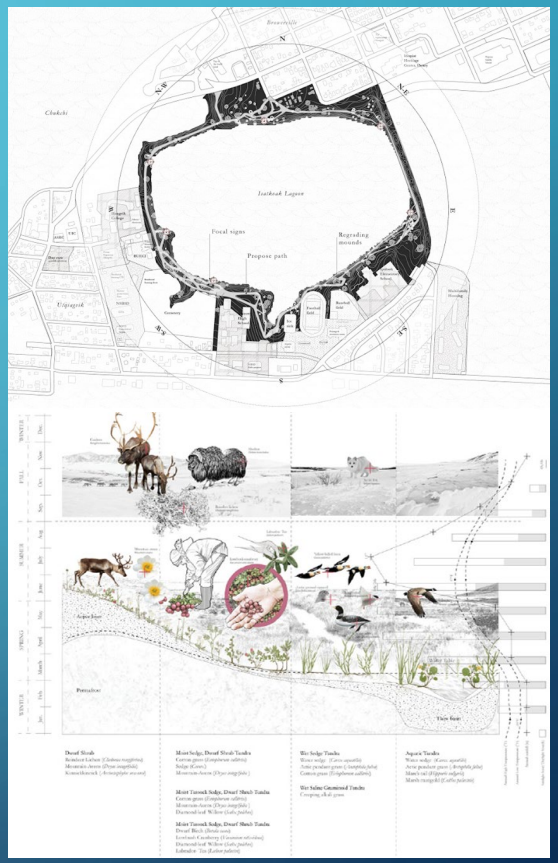
Electrical resistivity tomography (ERT) measurements. Areas >1,000 ohm-m are considered frozen. Note regions of low resistivity (thawed) in the vicinity of the degrading ice wedges.

Collaborative effort with regard to instrumentation placement - planning, science, design objectives

DESIGN ANALYSES & GUIDELINES (UVA ARCH, CCHRC)







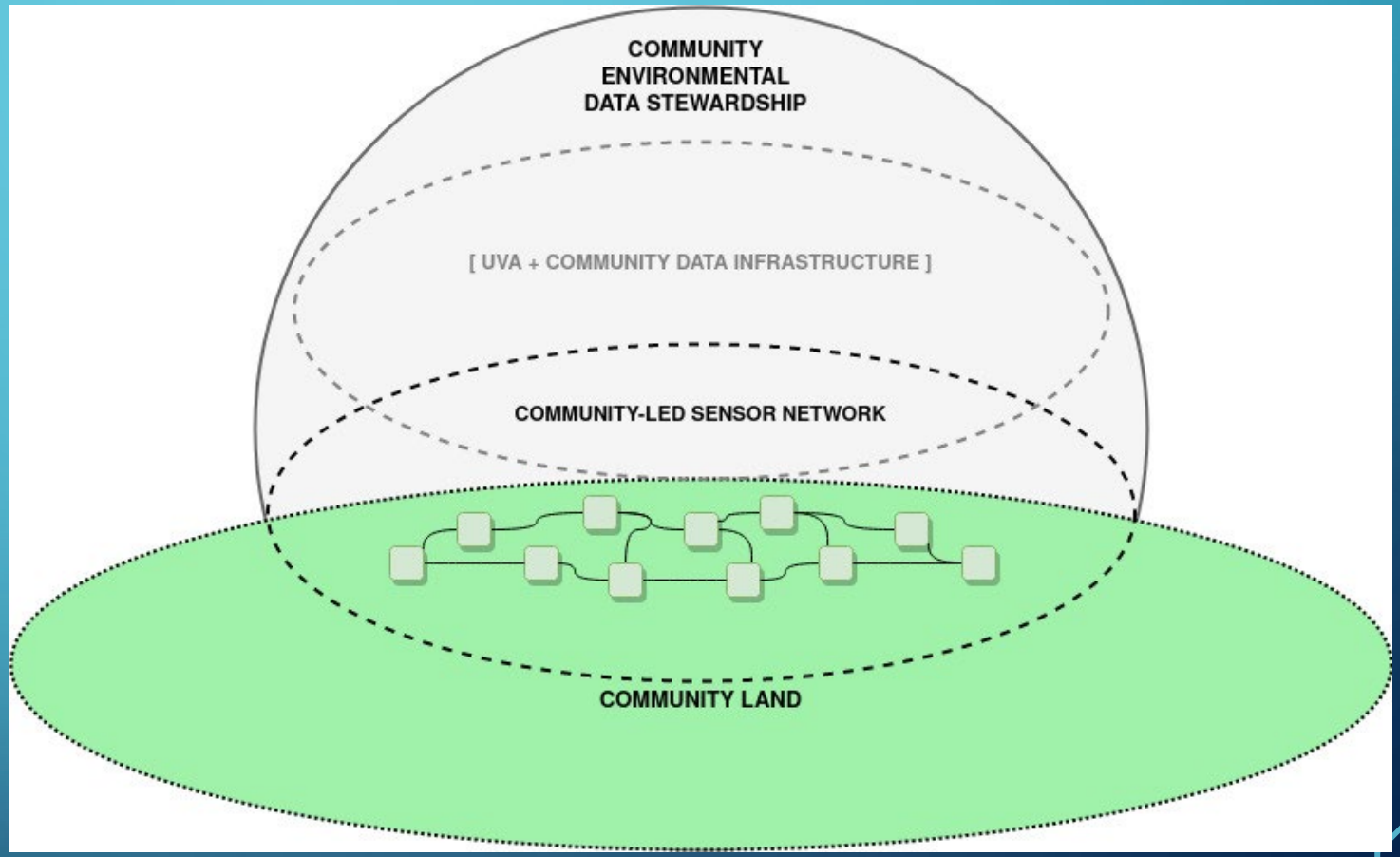
ENVIRONMENTAL:
Sensor/Survey Data, BIM (Building Information Modeling) & CFD (Computational Fluid Dynamics)

CULTURAL:
Community Design Workshops, Reference Planning Documents

BUILDINGS: **INFRASTRUCTURE:**
Understanding relative significance of design variables (form, orientation, height/depth, siting, etc.) in localized environmental conditions + translating this study into design and planning applications

DATA GOVERNANCE AND MANAGEMENT

Our collaboration will start with the establishment of a "community data stewardship“ group that would be responsible for guiding all the aspects of data management, from data collection, sharing, and communication to sustainability plans.



COLLABORATIVE PRODUCTION OF KNOWLEDGE

- Team-based production of knowledge both in theory and in practice
  1) Co-determining sensor/survey locations based on community-specific challenges and needs
  2) Incorporating culture-specific design criteria and space use to design analyses and guidelines
  3) Data stewardship and open access
  4) Action-oriented research, e.g., planning application of environmental data/survey

- Sharing different kinds of experiences and expertise
  1) Merging science, design, engineering, social science, community knowledge
  2) Youth summer work
  3) Early professional STEM training
  4) Community workshops & design charrettes

- <u>Studying our work as we go</u>
  1) Participant observation of team meetings and community workshops
  2) Interviews with collaborators and stakeholders