ITEX-AON

Understanding Tundra Ecosystem Change

Who We Are

We are ITEX-AON: the International Tundra Experiment–Arctic Observing Network

We are an NSF funded research collaboration between Grand Valley State University (GVSU), Florida International University (FIU), University of Texas at El Paso (UTEP), and the University of Alaska–Anchorage (UAA).

We are a team of botanists and terrestrial ecologists documenting vegetation change across the Alaskan Arctic.

GVSU

The GVSU team is focused on understanding tundra vegetation change.

GVSU records the base measurements at each site–tracking plant growth, timing, and ground cover change at the plot and landscape level.

FIU

The FIU team works on tundra ecophysiology.

This includes tracking methane flux at each of the four sites, as well as various spectral data via the MISP (Mobile Instrument Sensor Platform).

UTEP

The UTEP team focuses on scaling tundra vetgetation data from the plot level, to drone scale, up to the satellite level.

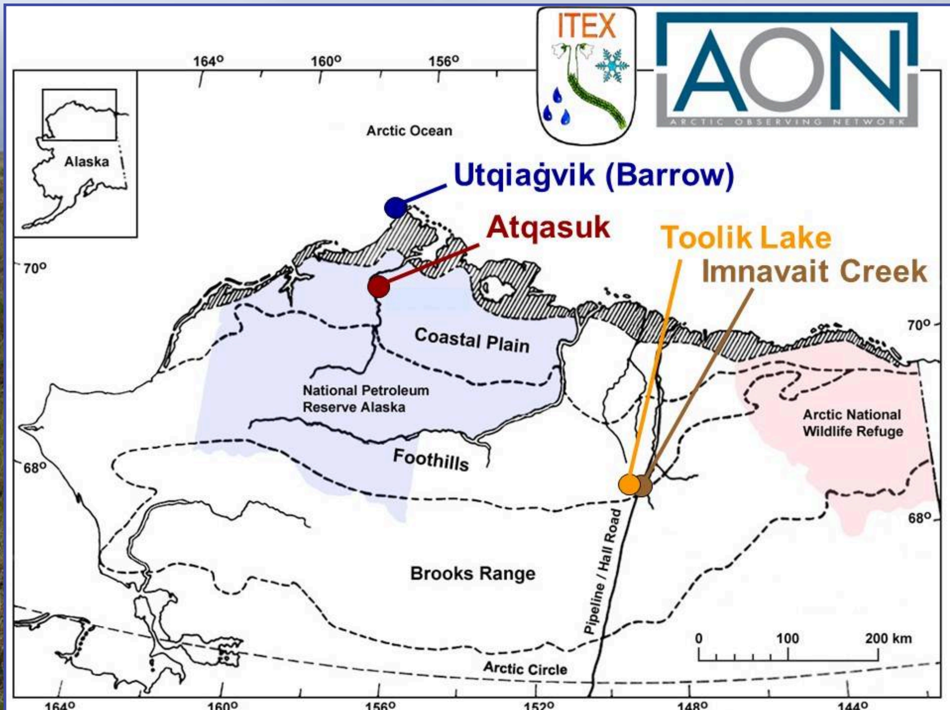
UTEP crews perform annual LiDAR measurements, manage phenocams and data, and use drones to track landscape changes.

UAA

The UAA team examines annual carbon exchange and tundra soil processes.

These measurements are coupled with other ITEX data to track how permafrost and above ground phenomena impact the carbon balance of the tundra.

Where We Work



We work on the Alaskan Arctic tundra in the beautiful North Slope Borough—the northernmost portion of the state and the furthest north you can go in the U.S.

ITEX-AON members work at four locations:

- Utqiaġvik– an indigenous Inupiat city and high tundra coastal environment formerly called Barrow
- Atqasuk– an Inupiat village and former mining town on a low Arctic coastal plain
- The Toolik Lake Field Station (and Imnavait Creek)– a research station and low Arctic environment just north of the Brooks Mountain Range

All of our work takes place on the traditional land of the Iñupiat people.

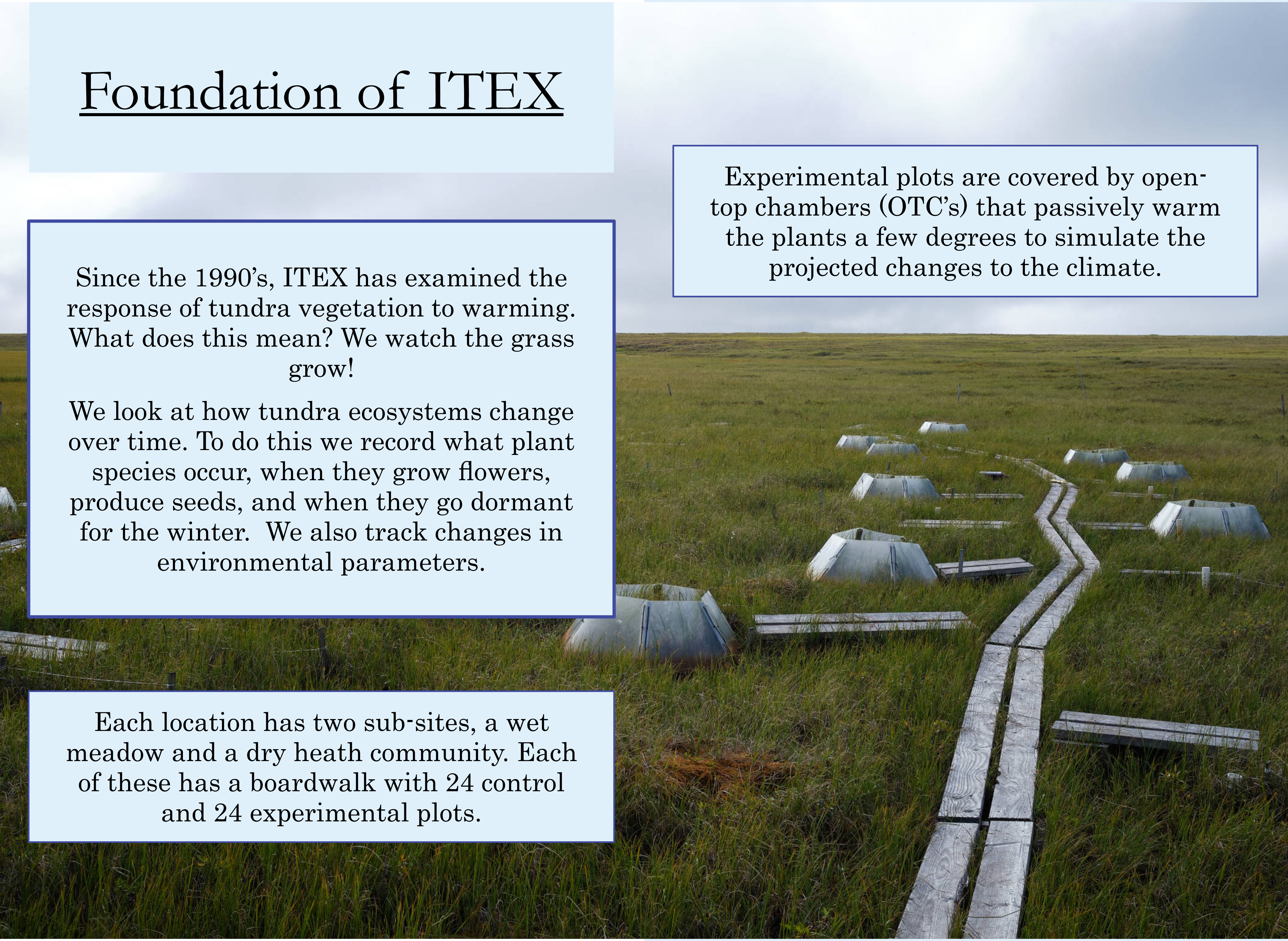
Our work is possible because of the Ukpeaġvik Iñupiat Corporation (UIC)

Foundation of ITEX

Since the 1990's, ITEX has examined the response of tundra vegetation to warming. What does this mean? We watch the grass grow!

We look at how tundra ecosystems change over time. To do this we record what plant species occur, when they grow flowers, produce seeds, and when they go dormant for the winter. We also track changes in environmental parameters.

Each location has two sub-sites, a wet meadow and a dry heath community. Each of these has a boardwalk with 24 control and 24 experimental plots.



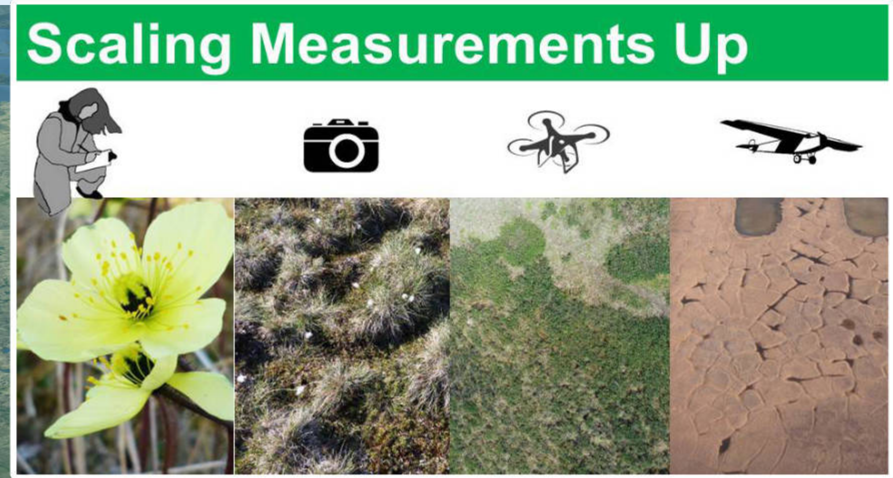
Experimental plots are covered by open-top chambers (OTC's) that passively warm the plants a few degrees to simulate the projected changes to the climate.

From the Ground, Up

GVSU

FIU

UTEP



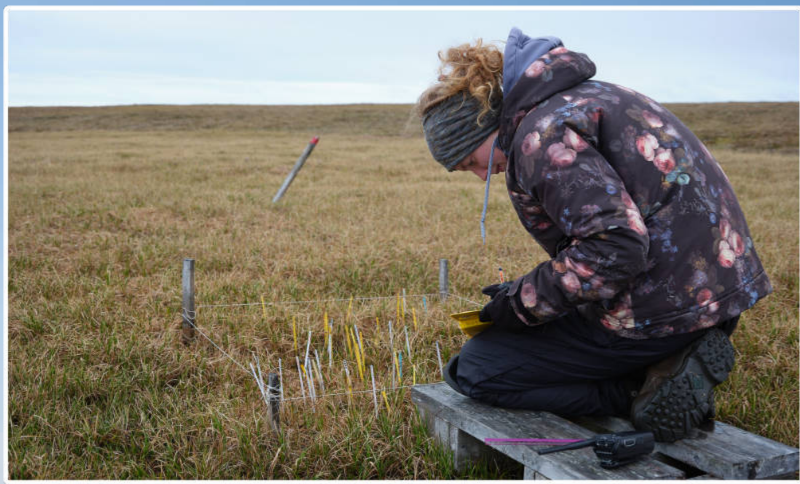
From the organismal level on the ground, up to the total landscape via satellite data, ITEX observes the changing tundra across all scales

To bridge these spatial gaps we:

- Measure and record plant life stages and species density and diversity on the ground (GVSU)
- Use multi-spectral and hyper-spectral imaging at the plot level (FIU)
- Fly drones with specialized multi and hyper spectral cameras (UTEP with GVSU)
- Use LiDAR to track landscape change (UTEP)
- Use satellite spectral data to track landscape changes from space at large scale (UTEP)

Comparing this data allows us to see trends happening across the whole Arctic!

Grand Valley State University



Dr. Bob Hollister

Lead PI and head of the GVSU Arctic Ecology Program

We are the plant people!

The GVSU crew tracks the ground level measurements of ITEX.

GVSU members work directly with the plants in the ITEX plots. They record timing of growth stages, measure plant growth, track flower and reproduction counts, and record canopy and cover changes across all plots.

Their work gives the baseline data for the whole project.

Core Mesurements: Cover

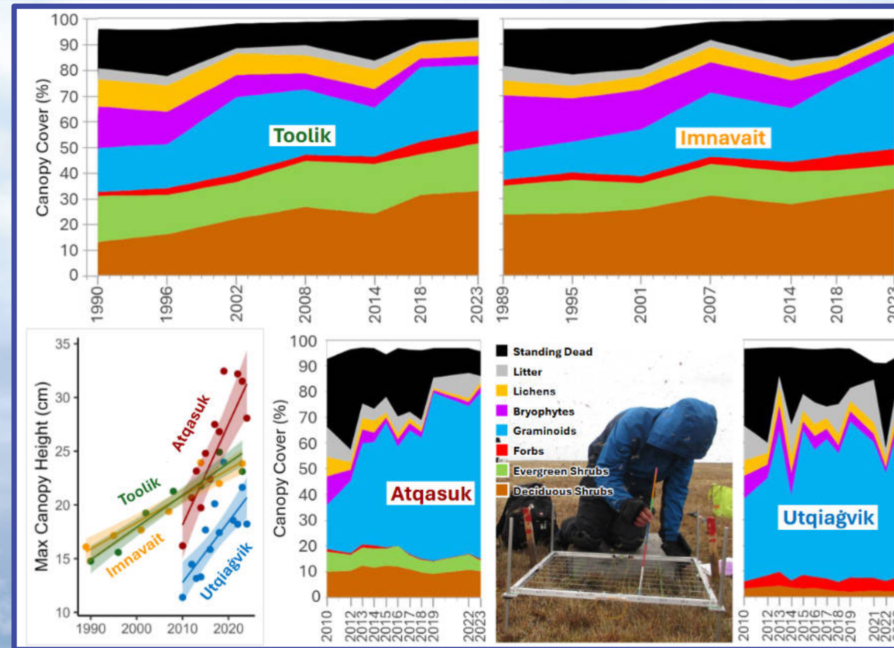


Figure: Hollister et al, 2025

Each year the GVSU crew records cover and plant density at the ITEX sites at Utqiagvik and Atqasuk. The FIU team records similar measures at Toolik and Imnavait Creek.

These measures are taken at “peak season” the time where plants are at their largest.

Since recording began in 2010, plant cover and density has increased significantly at each site. These measures can be combined with others in the network to show large scale changes in plant communities across the tundra!

Florida International University

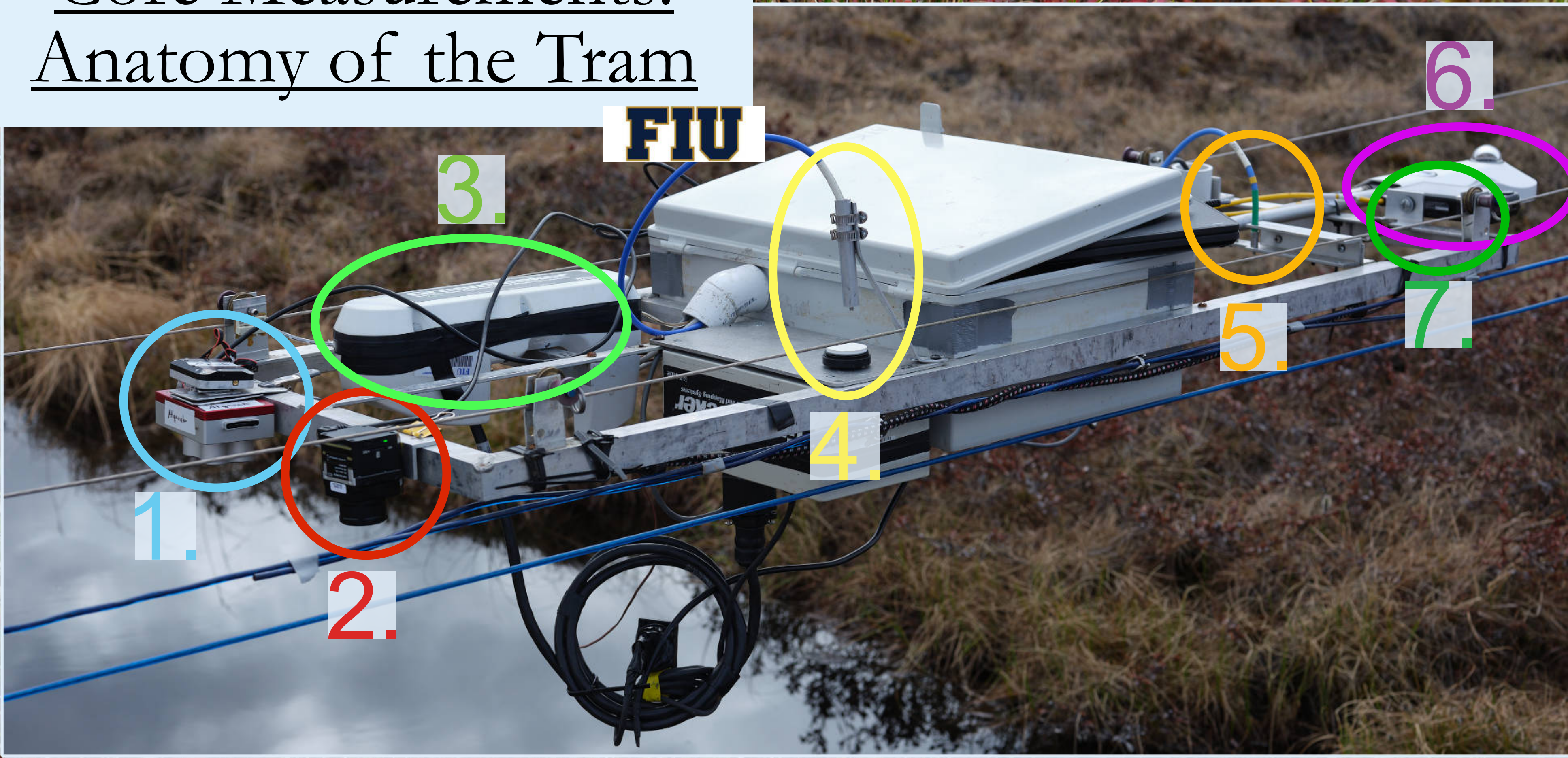
Dr. Steve Oberbauer
PI of the FIU branch of ITEX-AON

The FIU team monitors tundra health using spectral data–measurements of light absorbed and reflected by the plants. They also measure photosynthetic rates and carbon exchange of the tundra.

This data tells us about overall tundra health and plant change via sensors and provides an intermediate data type between ground and drone level.

To do this, the GVSU crew is trained in Atqasuk and Utqiagvik to run the MISP tram.

Core Measurements: Anatomy of the Tram



The MISP tram: Mobile Instrumented Systems Platform

Each ITEX site contains a 50m transect of undisturbed tundra that hold a MISP tram system. The tram runs between two towers and uses a host of sensors to collect fine-scale data on the vegetation below.

1. MicaSense–Multispectral (5 bands of light)
2. FLIR–Thermal Mapping
3. GreenSeeker–NDVI (plant health)
4. Jaz Spectrometer–Hyperspectral/full spectrum (standard)
5. Jaz Spectrometer–(recorded data)
6. NetRadiometer– Albedo (incoming vs outgoing energy)
7. Fujifilm 3D camera–Track Plant Growth Stages

University of Texas at El Paso

UTEP

Dr. Craig Tweedie

PI of the UTEP branch of ITEX-AON

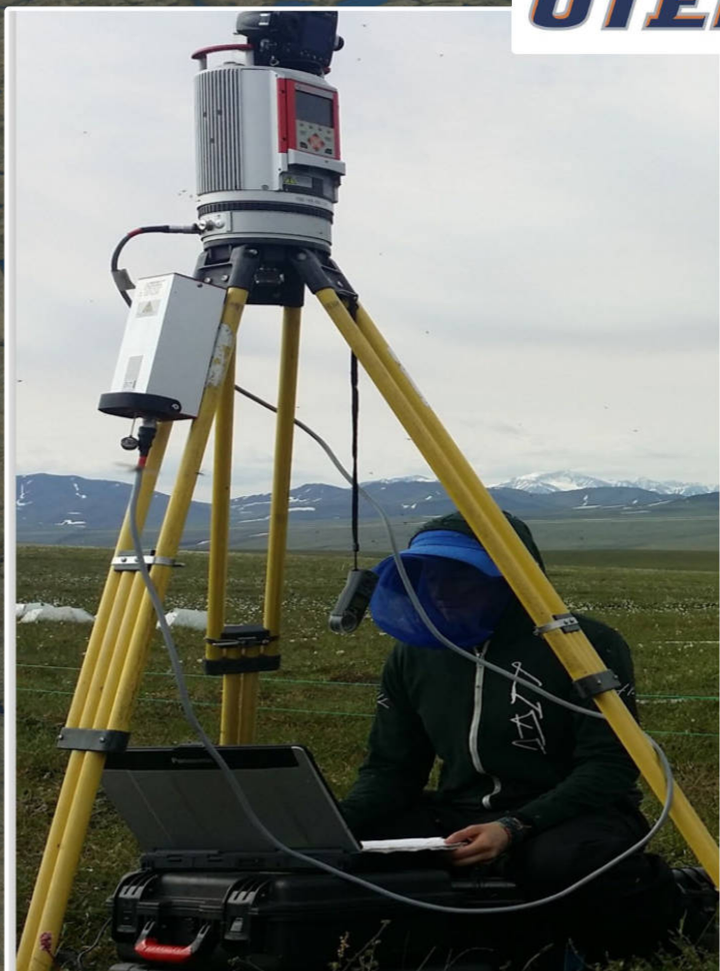
The UTEP group focuses on phenology and other ecosystem changes at the landscape scale.

Their work includes vegetation mapping and spectral analysis, phenocam (phenology camera) timelapse capture, water table change, soil temperature and moisture, and LiDAR landscape scanning.

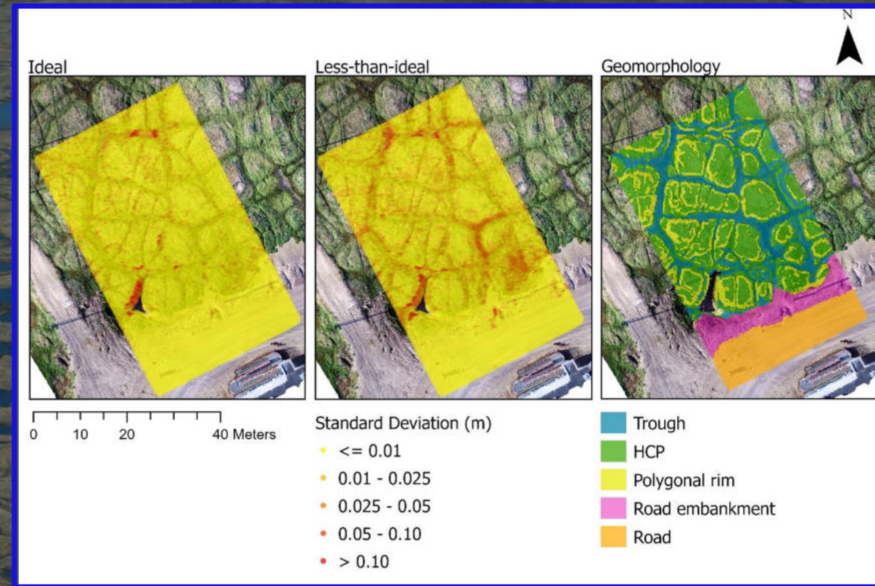
Dr. Sergio Vargas

Co-PI of the UTEP branch of ITEX-AON

Core Measurements: LiDAR



Dr. Tabby Fuson
Photo: UTEP-SEL



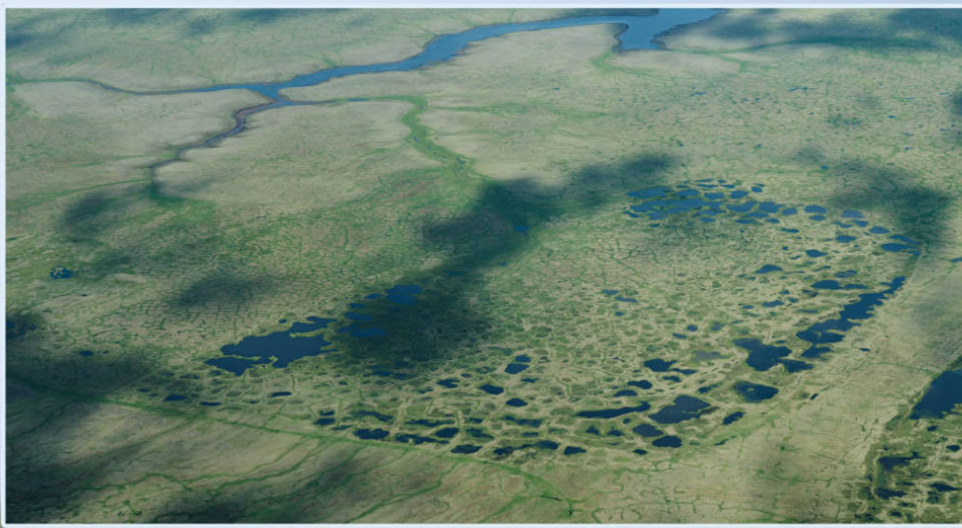
Surface Scanning with LiDAR
Figure: Fuson et al, 2025

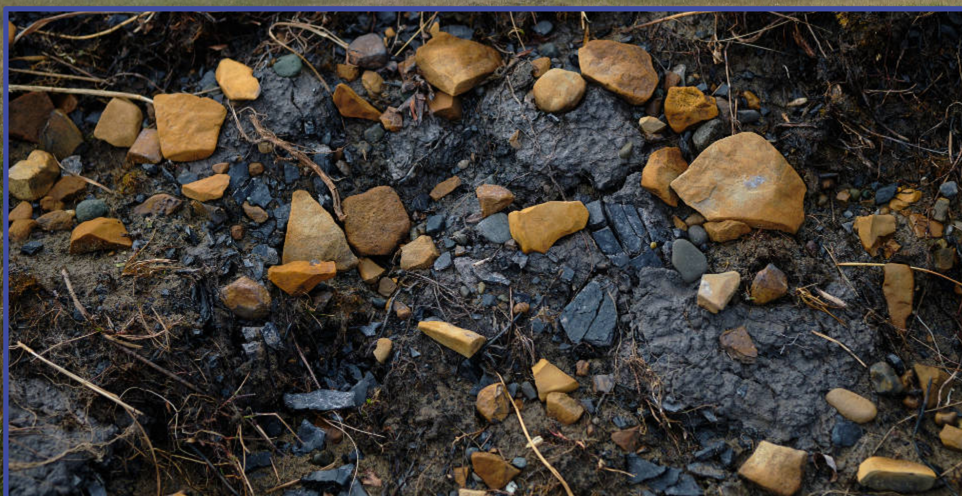
The UTEP group records seasonal scans of sites across Alaska to track elevation change associated with permafrost.

They use TLS (Terrestrial Laser Scanning) to track minute differences in land surface as permafrost is increasingly degraded.

As surface of the tundra changes, subsidence, especially along the coast, can occur as land sinks into the ground or is weathered away by storms.

University of Alaska–Anchorage





Dr. Jeffrey Welker

PI of the UAA branch of ITEX-AON (Photo: Uarctic, 2017)

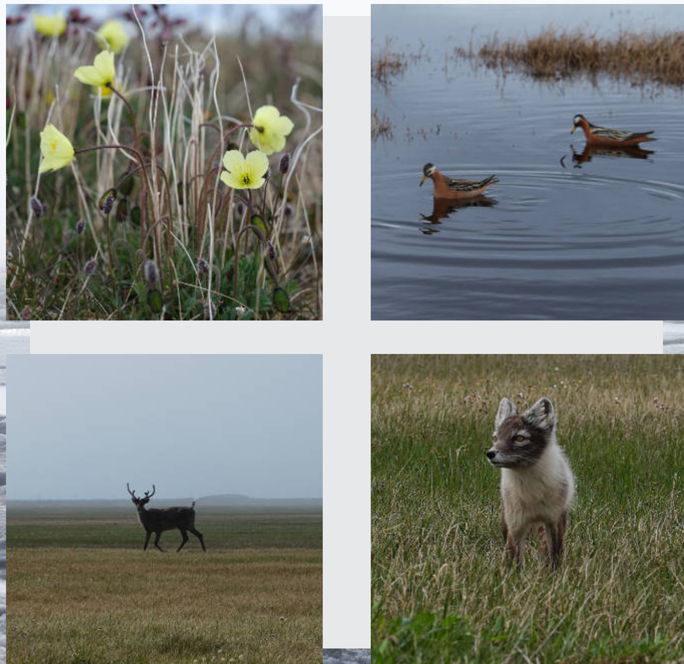
The UAA branch of the project focuses on water, carbon, and nitrogen cycling at the ecosystem level.

Their work looks at the carbon balance of the tundra ecosystem using the longterm warming experiment of ITEX as well as many one-off experiments involving fossil carbon and permafrost thaw.

The UAA group works primarily out of the Toolik Lake Field Station.

Why Study the Arctic?

The Arctic tundra isn't just snow and ice! Hundreds of species call this land home



In recent years, scientists estimate that the Arctic is changing four times faster than anywhere else. Changes here have global consequences.

Greenhouse gas emissions from thawing permafrost, sea level rise due to sea ice and glacial melt, disruption of ocean currents, and increased extreme weather events can all be attributed to the warming of the planet. Environmental change here speeds up global feedback loops potentially throwing the global planetary systems off balance.

At the local level, these changes are even more pronounced. The people here have relied on the ocean and tundra for centuries to sustain them. As the Arctic climate warms, the plants and animals they rely on can become harder to access. With climate change, history and livelihoods are at risk.

Monitoring these changes helps guide the future.

Global Implications

As ecosystems shift in response to warming, maintaining long-term monitoring programs is essential

Scientists believe that much of the future damages to the world economy via climate change are already in motion.

In 2024, estimates published in the scientific journal *Nature* by Kotz et al, titled *The Economic Commitment of Climate Change* show that by 2049, climate change will have costed the global economy between 19 and 59 trillion dollars.

The trends identified from long-term ecosystem monitoring projects will prove invaluable in the fight against climate change.

A 2025 study by Lemieux et al surveyed hundreds of Arctic specialists to find what the largest threats and barriers to Arctic conservation are today.

In this time of widespread funding shifts, keeping long-term monitoring projects like ITEX-AON alive will help provide the basis of climate knowledge to the future!

Persistent and Emerging Threats to Arctic Biodiversity and ways to Overcome Them: a Horizon Scan. Lemieux et al, 2025

For More Information:

Scan the QR codes below!

ITEX-AON: Why Are Changes in the Arctic Important?

ITEX-AON: Publications

ITEX-AON: Explore Data

ITEX-AON

Understanding Tundra Ecosystem Change

Get Involved!

To learn more about ITEX-AON, our members, and our research, scan the QR code below!

Or visit our website:

https://www.gvsu.edu/itex-aon/