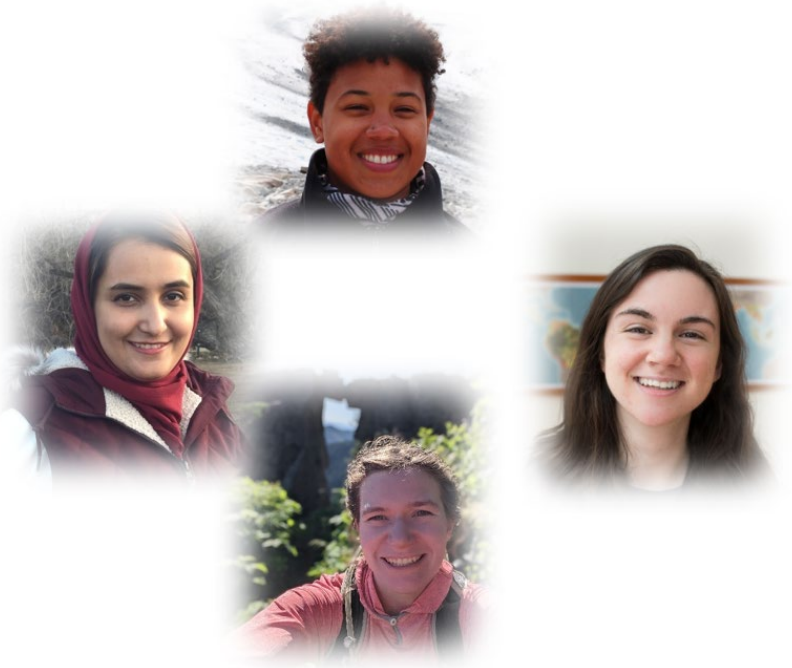
US Permafrost Association
2020 Annual Report



2020 USPA-PYRN Educational Fund (UPEF)
Annual Scholarship Winners
USPA Investing in Our Future Cryosphere Leaders

FEBRUARY 28, 2021

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February 28, 2021

The following document is the 2020 Annual Report of the United States Permafrost Association. The report details USPA's 2020 activities and contains 28 individual reports from agencies, universities, institutes, and engineering and research organizations that are involved in the scientific and engineering investigations of permafrost. This year's report includes an appendix with internet links to many organizational publications. I encourage you to take some time to read the report and to share it with other colleagues.

I want to thank our 2020 institutional and corporate members and sponsors for their continuing support (organizational logos are illustrated in the report). Also, our more than 200 individual members are recognized and thanked as well. Without these organizations and members, we would not be able to provide services to our members, the general public, and the next generation of permafrost scientists and engineers. If you have not taken the opportunity to renew your membership for 2021, it is easy to do so on the USPA website. I also want to thank the 2020 Board members and the chairs of the Membership and Communications committees for their help and guidance that they provided throughout the year.

It has been an honor to serve as the 2020 President of USPA. I am looking forward to 2021, our Regional Conference on Permafrost (RCOP) conference, hopefully the end of the pandemic, and sharing our collective expertise to advance the science and engineering of permafrost forward.

Sincerely yours,

John P. Zarling, Ph.D., P.E.
Past President, USPA

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Citation:
Brown, J., Wilson, S, & Lilly, M.R. (Eds.) 2021. US Permafrost Association 2020 Annual Report, US Permafrost Association. Fairbanks, Alaska. 24 pages.

The Year in Review

Due to COVID-19 restrictions, the Annual Meeting of the U.S. Permafrost Association (USPA) was held virtually on December 15 to coincide with the Fall Meeting of the American Geophysical Union (AGU) in San Francisco, CA. Participating in the meeting were approximately 50 members including Board and Committee members. Recording of the Zoom meeting, organized by Kevin Schaefer with the assistance of John Zarling and Cathy Wilson, is available on the USPA website. Results of the Board of Directors elections were announced. During the past year and in order to provide opportunities for increased diversity, the Board approved two additional elected Board positions. The 2020 ballot resulted in John Thornley, President-Elect, Susan Wilson, Secretary for a second term; and Jessica Ernakovich and Michelle Walvoord as new Members-at-Large. Anna Wagner was appointed by the Board to fill the remaining new position. Continuing on the Board are: John Zarling, Past-President; Peppi Croft, Treasurer; Torsten Mayrberger, Member-at-Large, Kevin Schaefer and Edward Yarmak, both U.S. Representatives to the Council of the International Permafrost Association and Fritz Nelson as representative of the IPA Executive Committee. These latter three attended the virtual IPA Council meeting in June 2020. Helena Bergstedt was selected to replace Matthew Whitley as PYRN Board Member. Mark Bennett retired from the Board and his services, as well as those of Matthew, are gratefully acknowledged.

USPA-PYRN Education Fund (UPEF) provided four grants to cover registration costs associated with the AGU Fall Meeting. These awards were made to: Raven Mitchell (Michigan State University), Allison Tryka (Portland State University), Mary Farina (Montana State University), and Sara Sayedi (Brigham Young University). The UPEF Committee, chaired by Kelsey Nyland, was responsible for solicitation of applications and the review process. See appendix for testimonials of the awardees' experiences in their virtual AGU sessions.

The USPA appointed Peppi Croft of Shannon and Wilson Incorporated in Fairbanks as the chair of the Permafrost Engineering Education Program (PEEP). We thank Margaret Rudolph, the retiring Chair, for her many innovative contributions to the PEEP.

The Diversity, Equity, and Inclusion Advisory (DEI) Committee, chaired by Cathy Wilson, was organized during the year.

The Membership Committee, chaired by Jerry Brown, reported a final 2020 membership of 224, an increase from last year's 171. Included are three new Lifetime Members, 51 student/PRYN members, and ten Corporate and nine Institutional members. Membership represents 47 universities, seven federal agencies, two state agencies, 30 States and members from several other countries (see attached map for additional demographics). Nicholas Hassan, University of Alaska graduate student, the U.S. National Representative on the PYRN Council, replaces Stephanie James on the Committee as the PYRN representative.

USPA continued to develop plans for the IPA Regional Conference on Permafrost (RCOP) and 19th International Conference on Cold Regions Engineering (ICCRE) under the leadership of Tom Douglas. Due in large part to COVID-19, the conference has been delayed to October 24-29, 2021 as an all-virtual meeting with some potential in-person events in Boulder, Colorado and elsewhere. The conference theme is "Permafrost Dynamics in Polar and Alpine Environments" and is co-organized by USPA, UC Boulder and the American Society of Civil Engineers. The conference website is accessible through the USPA website and includes the growing list of sponsors. The ASCE's Cold Regions Engineering Division, is completing the review of 35 papers, under the leadership of Jon Zufelt, that are to be published in its proceedings volume.

With the coordination of the Communications Committee (CC), chaired by

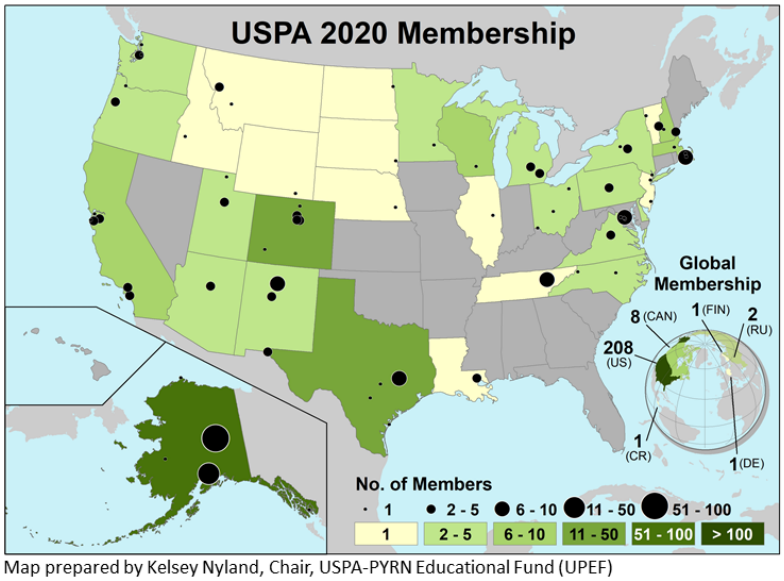
Michael Lilly, the American Geosciences Institute (AGI) continued to provide the monthly catalog of world-wide, permafrost literature. In 2020, the Permafrost Monthly Alert (PMA) program added 850 accessions including 545 conference abstracts. For 2020, PMA content inquiries (views by individual readers) exceeded 12,900 user visits and since starting in 2012 has exceeded 82,000 user views of information, not counting access to the AGI COLD public reference database.

For the third consecutive year, CC member Kristina Levine, student at Texas A&M University and supported by GWS, once again prepared a compilation of permafrost-related presentations for the AGU Fall Meeting. This year, Kristina was also helped by Yirlen Arias, University of Costa Rica and supported by GWS. The 300 abstracts were presented as virtual papers and posters over an 11-day period and the listing was posted on the USPA and Facebook websites. Among those presenting were 49 USPA members including 14 students.

Michael Lilly, President, Geo Watershed Scientific (GWS), informed the USPA that the growing and extensive technical, administrative staff and fiscal accounting support provided to USPA, would by necessity be scaled backed. The Board of Directors of the U.S. Permafrost Association fully appreciates the circumstances leading up to this decision and expresses its gratitude to Michael and the GWS staff for its dedicated support starting in 2002 with the formation of the U.S. Permafrost Association.

This report was compiled and edited by Jerry Brown, Chairman, USPA Membership Committee and assisted by Susan Wilson, USPA Secretary. Reports by member organizations are presented first, followed by nonmember reports. A compilation of Internet links, websites and references referred to in the reports is appended.

U.S. Permafrost Association Membership



Map prepared by Kelsey Nyland, Chair, USPA-PYRN Educational Fund (UPEF)

States	30
Universities	47
Federal agencies	7
State agencies-AK	2

Demographics	
Female	86
Male	134
Scientists	174
Engineers	46

Institutional Member Reports

Geophysical Institute Permafrost Laboratory- University of Alaska

The GIPL continued observations of permafrost temperatures at our network of permafrost observatories in Alaska and Russia (Vladimir Romanovsky, Colby Wright, Alexander Kholodov, Dmitry Nicolsky, and Louise Farquharson). Due to travel restrictions related to the COVID-19, we were not able to visit our sites in the Seward Peninsula, Utqiaġvik, Kaktovik, Kotzebue, and in the Canadian Archipelago this year. The rest of the sites in Alaska were visited and data collected. Many of our sites, including the sites in Utqiaġvik, Seward Peninsula, Selawik area, and in the Canadian Archipelago are still transmitting data in a near-real time mode. These data, as well as the data collected at other stations, can be viewed and downloaded from our Lab website. The temperature of permafrost at almost all sites is still rising and taliks started to develop at almost 30 sites in Interior Alaska.

We used these observational data to improve our high-resolution permafrost dynamics models for Alaska (Nicolsky, Matvey Debolskiy, Marchenko, Romanovsky, and Farquharson). We focused on a high-resolution ecotype-based modeling of the ground temperature and permafrost distribution in the Seward Peninsula and in the Brooks Range, Alaska (to be submitted). Modeling results are based on the assimilation of various observations, (i.e., temperature, snow depth, active layer thickness), conducted by GIPL, USGS, NPS, NRCS, USArray, and other groups. Modeling studies indicate a severe degradation of permafrost except for the Arctic coast of Alaska. The ecotype-based permafrost modeling is to be applied to the Interior of Alaska; about twenty ground temperature profilers were installed this year around Fairbanks. Some preliminary results of this effort may be viewed at our modeling website.

With a recently received NSF award focusing on sustaining the USArray in Alaska, ground temperature monitoring is to be conducted at about 45 seismic sites in the North Slope and Southwest Alaska (Nicolsky and Kholodov). The USArray temperature profilers primarily supplement the existing network and provide data in the remote underrepresented locations. The additional data will provide better ground truthing of permafrost and temperature conditions in Alaska.

During 2020, the GI Permafrost Laboratory began work on two new NSF NNA projects: "*Arctic Urban Risks and Adaptations (AURA): a co-production framework for addressing multiple changing environmental hazards*" in collaboration with colleagues at the University of Alaska Anchorage (Nicolsky, Farquharson, and Wright), and "*Resilience and adaptation to the effects of permafrost degradation induced coastal erosion*" in collaboration with colleagues at Penn State, Missouri University of Science and Technology and the University of Idaho (Nicolsky, Farquharson, Romanovsky, Kholodov, and Wright). As part of the AURA project, lab members co-lead workshops with the Fairbanks Borough, Municipality of Anchorage, and City of Whitehorse in order to learn more about the needs of each entity in relation to predicting future hazards related to permafrost degradation, wildfire, and winter rain events. As part of the *Resilience* project, lab members conducted community visits to Wainwright and participated in Zoom-based meetings with the community of Point Lay to discuss concerns related to permafrost degradation and its ongoing impact on infrastructure. The lab is also set to begin on a new NSF NNA Track 2 project in early 2021: "*Planning for Infrastructure Resiliency and Adaptation amid Increasing Mass-Movement Risks across the Cryosphere*".

Submitted by Vladimir Romanovsky

Institute of Northern Engineering, Water and Environmental Research Center, University of Alaska

In 2020, INE and WERC researchers continued to conduct research at the convergence of permafrost science and engineering with a focus on how climate change, land use change, infrastructure, hydrology, ecosystem shifts and disturbances

interact in terrestrial and aquatic systems to impact permafrost evolution, degradation, and feedbacks from local landscapes to the circum-Arctic.

During the last year, INE and WERC researchers published an essay on Coastal Permafrost Erosion in NOAAs 2020 Arctic Report Card (Jones et al.) submitted as part of the NSF-funded Permafrost Coastal Systems Network, a paper in Nature Climate Change describing a new application in remote sensing to detect methane emissions from northern permafrost-region lakes (Engram et al.), a paper in Environmental Research Letters on the recent role of beaver activity controlling surface water dynamics in ice-rich permafrost terrain (Jones et al.), a paper in JGR Biogeosciences that focused on vegetation and permafrost responses to tundra fires in the Noatak River Basin in Northwest Alaska (Gaglioti et al.), a paper in Water Resources Research summarizing more than three decades of snow survey data collection efforts in two northern Alaska watersheds (Stuefer et al.), and the 2nd edition of Permafrost in our Time (Yoshikawa) "Siberian permafrost" (in Russian) in cooperation with the Yakutsk Permafrost Institute (M. Zheleznyak) and Sakha Republic government (M. Prisiazhnyi).

Field research accomplishments in 2020 include ongoing monitoring and enhanced instrumentation of frozen debris lobes (FDLs) in the southern Brooks Range, Alaska. that will threaten the Dalton Highway embankment in 2021 (Darrow); drilling and installation of permafrost monitoring stations on several mountains in South America (Chile and Peru), Mexico, and Hawaii (Yoshikawa); and establishment of the Teshekpuk Lake Observatory (TLO) as a UAF-permitted research station. A new Circumpolar Active Layer Monitoring (CALM) grid was established at the TLO (Site U60) in August 2020. Mikhail Kanevskiy started working on the DoD-funded project “AKRO-CRREL Soil and Water Sample Analyses (2020-2021).” This study includes cryostratigraphic mapping and collecting samples of ground ice and frozen soils in the new CRREL Permafrost tunnel at Fox.

New projects that started during this reporting period include a recently funded Department of Defense Environmental Security Technology Certification Program project to develop the Arctic Environmental and Engineering Data and Design Support System (Stuefer and Darrow) and an NSF-funded project to continue support for long-term data collection to study the carbon, water, and energy balance at flagship observatories in Alaska and Siberia (Walter Anthony and Stuefer). Benjamin Barst, Research Assistant Professor, and Melissa Ward Jones, post-doctoral researcher under the mentorship of Yuri Shur, joined INE/WERC in 2020.

Submitted by Ben Jones and William Schnabel

National Snow and Ice Data Center, University of Colorado

The NSIDC initiated a new area of research focusing on the release of mercury from thawing permafrost [Schaefer et al.]. Mercury bound to frozen organic matter in permafrost represents the largest reservoir of mercury on the planet. As permafrost thaws, the decay of organic matter will resume and release the stored mercury into the environment. In a future of unconstrained burning of fossil fuels, the annual release of mercury from thawing permafrost will rival current anthropogenic emissions, but persist for centuries. In contrast, if we meet the Paris Accord warming target, the permafrost will not release much mercury.

We are exploring new ways to use remote sensing to study permafrost dynamics, focusing on lidar and radar. In the Yukon-Kuskokwim Delta, the peat plateaus heave up during permafrost formation. We measure height with lidar and use a soil expansion model to estimate permafrost thickness, with a median thickness of 39 m.

We continue to develop Interferometric Synthetic Aperture Radar (InSAR) techniques to measure the surface subsidence resulting when the active layer thaws. NASA funded the project as part of the Arctic Boreal Vulnerability Experiment (ABoVE). We combine airborne L-band and P-band radar to simultaneously estimate ALT and soil moisture

for 66 flight lines in Alaska and northwest Canada. We released Version 3 of the product in December 2020, which is available at ORNL.

Submitted by Kevin Schaefer

International Arctic Research Center, University of Alaska

COVID-19 significantly impacted our field research programs in 2020 as travel to many of our field sites was extremely limited, if not entirely eliminated. NASA ABoVE field project to quantify thermokarst and related carbon release following the historically largest tundra fire on the North Slope (the Anaktuvuk River Fire) by Go Iwahana is now in the final extended stage. In addition to the Anaktuvuk River fire, permafrost sampling for analyses of GHG/carbon/ice content and monitoring of thaw depth, surface moisture and displacement were conducted along the Dalton Highway, near Utqiaġvik, Kougarok in the Seward Peninsula, and Fairbanks (Iwahana et al.). Laboratory studies continued following the 2017 and 2018 visits to the Barrow Permafrost Tunnel in Utqiaġvik by researchers from University of Washington (PI: J. Deming) and University of Alaska (Co-I: H. Eicken). The project is a comprehensive effort to explore the biological diversity and genomics of bacterial, algal, and viral communities in a permafrost cryopeg and sea-ice brines with several papers published/submitted (Cooper et al. 2019; Zhi-Ping Zhong et al. 2021).

Four US DOE Laboratories (Los Alamos, Sandia, Pacific Northwest, and National Renewable Energy) along with UAF formed the Arctic Lab Partnership (ALPs). The goal of the ALPs working groups is to identify actionable pathways for collaborative, multi-organizational research and development efforts that address important and compelling arctic challenges. In summer 2020, a series of meetings with DOE and UAF stakeholders took place to help define the challenges and opportunities broadly related to science, security and energy. Within the ALPs Science working group, two white papers focusing on Coastal & Marine Ecosystem processes (co-led by Hajo Eicken) and Terrestrial Science (co-led by Bob Bolton) were produced. This work is being continued under the auspices of the newly established DOE Arctic Energy Laboratory at UAF.

The collaboration between IARC and the Chinese State Key Laboratory of Cryospheric Sciences is continuing under several scientific themes. Researchers from IARC and the Institute of Northern Engineering (UAF) attended a workshop in Lijiang, China, focused on "Cryospheric Changes in a Warming Climate: Filling the Gap Between Observations and Decision Making." As part of this collaboration, Bob Bolton and Tonghua Wu (SKLCS) are leading an effort comparing the discontinuous permafrost and moisture conditions found on the Seward Peninsula and on the Qinghai-Tibetan Plateau. In 2020, we had planned to install additional monitoring stations on the Seward Peninsula, but were unable to move forward due to COVID-19.

Long-term micrometeorological flux studies at Poker Flat Research Range, UAF have been conducted since 2010 in collaboration between IARC and Japan Agency for Marine-Earth and Technology (JAMSTEC). Monitoring and research activities are now supported also by the Arctic Challenge for Sustainability II (ArCS II) project, in which the active layer and permafrost monitoring at multiple locations were installed.

Submitted by Bob Bolton

University of Virginia

The newly formed University of Virginia (UVA) Arctic Research Center recently received funding from the NSF Navigating the New Arctic program for the project entitled "Understanding the Changing Natural-Built Landscape in an Arctic Community: An Integrated Sensor Network in Utqiaġvik, Alaska." The project collaborators come from four separate colleges at UVA: Howard Epstein and Claire Griffin (Department of Environmental Sciences, College of Arts and Sciences), Matthew Jull and Leena Cho (College of Architecture), Caitlin Wylie (School of Engineering and Applied Sciences), and Luis Felipe Rosado Murillo (School of Data Sciences). Collaborators outside of UVA

include the Cold Regions Research and Engineering Laboratory (CRREL), the Cold Climate Housing Research Center (CCHRC), the North Slope Borough (NSB), the Tagiugmiullu Nunamiullu Housing Authority (TNHA), the Ukpeagvik Inupiat Corporation (UIC), and TRIBN Consulting. The project will utilize cooperative knowledge production along with a network of terrestrial/aquatic sensors and geophysical surveys to assess interactions among built and natural components of Utqiaġvik to inform design efforts and planning decisions.

A subset of the Arctic research group at UVA (Epstein, Griffin, and Kelcy Kent) continues to collaborate on an NSF-funded project led by Anna Liljedahl to study the dynamics of ice-wedge degradation and aggradation in polygonal landscapes of the Alaskan North Slope and Coastal Plain. Field studies include three Alaska locations: Jago River in ANWR, Deadhorse / Prudhoe Bay, and Utqiagvik. Our group is focusing on the ecology and biogeochemistry of the dynamic ice-wedge complexes, examining the vegetation, and carbon and nitrogen cycling components in soils and surface water, as ice wedges degrade and potentially re-stabilize.

Submitted by Howard Epstein

Woodwell Climate Research Center

In 2020 WCRC permafrost research focused on using remote sensing data to detect pan-Arctic changes in landscape characteristics associated with climate change and permafrost thaw, including changes in vegetation, surface water, ground freeze/thaw, and carbon fluxes across the northern permafrost region (Arctic Carbon Monitoring and Prediction System-Arctic MaPS; Susan Natali, Brendan Rogers, Jennifer Watts, Anna Virkkala, Rachel Treharne). We are also using satellite data to map methane craters and thermokarst across the Yamal and Gydan peninsulas (Gregory Fiske, Scott Zolkos, Susan Natali), and leading studies of the impact of climate warming on glacier melt and permafrost thaw in landslide-generated tsunamis in Alaska (Anna Liljedahl). We are working with Harvard University Belfer Center Arctic Initiative to bring this research to the policy community, have partnered with ESRI to develop a new data visualization and mapping tool, and will be developing shared spatial analysis tools via the Permafrost Discovery Gateway (Anna Liljedahl). Woodwell's scientists contributed to numerous academic and media reports and presented our permafrost research at several scientific meetings including the Permafrost Carbon Network, NASA ABoVE, and the American Geophysical Union meetings.

Submitted by Susan Natali

American Geosciences Institute

American Geosciences Institute continued to produce the Permafrost Monthly Report. AGI published *Geosciences Supporting a Thriving Society in a Changing World*, a product of the Critical Issues program. This booklet outlines the issues facing society ranging from climate change to workforce needs and is distributed to the national campaigns to encourage decision-makers to draw on the expertise of geoscientists. AGI also expanded its Career Compass infographic series to include one for *Geological Engineer*. The Career Compass infographics provide easy-to-read, one-page overviews of strategies for how students can obtain the skills needed for a geoscience career. The AGI webinar series saw increased activity during 2020 with more than 400 attendees for *Mapping Displacement and Subsidence with Time-Series Radar*.

Submitted by Sharon Tahirkheli

Center for Snow and Avalanche Studies

CSAS continues to monitor snow and hydrologic conditions at the high Colorado Mountains at our Senator Beck Study Basin (SBB) in the Northern San Juan Mountains. Our near 20-year climate/energy balance and stream gauge data continues to inform water managers, researchers, and modelers. The Colorado Dust-on-Snow Program continued to assess and report conditions throughout Colorado on behalf of the water management and researcher community. We taught a number of week-long university field courses

as well as the annual Snow School for Water Managers. CSAS is hosting the NASA SnowEx campaign in its efforts to develop a snow-sensing satellite and instrumentation. SBB is the highest elevation site and one of two sites with a focused albedo effort. We are supporting Zoe Courville, CRREL, in her fourth year in SBB, who is conducting research on dust-in-snow, microbes in dust, snow surface roughness and subsequent melt rates through sublimation and evaporation.

Submitted by Jeff Derry

University of Texas at El Paso, Systems Ecology Laboratory

UTEP's Systems Ecology Lab (SEL) is comprised of an interdisciplinary team of faculty, staff, postdocs and students who i.) examine the biophysical properties and processes that control ecosystem structure and function and ii.) develop novel technologies for the environmental sciences. The SEL team maintains research focused on Arctic field-based education, technology development, and terrestrial, coastal, and nearshore environments funded by NSF, NASA, NOAA, DHS, and Microsoft. The NSF-funded International Tundra Experiment (ITEX) - Arctic Observing Network (AON) initiative focuses on documenting and understanding terrestrial ecosystem change at plot to regional scales through *in situ* field data collection and scaling using remote sensing. Our participation in the NSF-funded Beaufort Lagoon Ecosystems Long Term Ecological Research (BLE-LTER) project is focused on exploring the fate and transport of land-lagoon exports from runoff and coastal erosion. We are partnered to the new NSF-ACCELNET project Permafrost Coastal Systems Network (PerCS-Net) that links our coastal erosion measurements to an international community focused on synthesis and exchange. Our contribution to the NOAA-CESSRT funded project focuses on developing innovative remote sensing methods for monitoring coastal change and improving the derivation of marine biogeochemistry using ocean color remote sensing. Projects funded by the NASA Arctic Boreal Vulnerability Experiment ABoVE project, focus on using plot to regional scale hyperspectral reflectance data for vegetation productivity and other variables to AVIRIS-NG airborne data and commercial satellite imagery, and the development of new methods for linking canopy solar induced fluorescence (SIF) and physiological function for high latitude vegetation.

Education grants from NSF-IUSE, and DHS's Arctic Domain Awareness Center (ADAC) support field-based learning opportunities for students from across the nation (virtual in 2020). Under contract to NSF-RSL's new contractor, Battelle Arctic Research Operations, we maintain a series of web mapping and information systems that provides the who, what, where, and when for NSF Arctic logistics (Arctic Research Mapping Application) and the US Arctic Observing Network (Arctic Observing Viewer). The majority of our data is archived at the NSF Data Center, the Oak Ridge National Laboratory's Distributed Active Archive Center, and the Ecological Spectral Information System at the University of Wisconsin. Although the lab was active throughout 2020 working remotely, field data collection was significantly impacted by the COVID-19 pandemic. We are grateful to the Ukpeaġvik Inupiat Corporation Science LLC for both access to their lands for our research and for maintaining several critical time series measurements in 2020 when we could not be present in the field.

Submitted by Craig Tweedie

U.S. Arctic Research Commission

In its "Report on the Goals and Objectives for Arctic Research 2019-2020," the U.S. Arctic Research Commission (USARC) encouraged support for demonstration projects to address engineering design of Arctic infrastructure. Engineers and planners need decision-support tools, with regularly updated information, to plan, design, and construct infrastructure in a rapidly changing Arctic environment. Such tools will supersede outdated planning tools and guidance documents, will increase value engineering via cost reduction, and may serve as the archetype for tools designed for non-Arctic regions. In

response, the Department of Defense's Environmental Security Technology Certification Program (ESTCP) released a call for proposals on the topic "Infrastructure resiliency Arctic engineering design tool," and in 2020, awarded ~$2M to Kevin Bjella, CRREL, for a revision of the DoD's Unified Facilities Criteria 3-130 (Arctic and Sub-Arctic Construction) and ~$1.8M to T. Scott Rupp, University of Alaska Fairbanks for an Arctic environmental and engineering data and design support system.

In other news, between August 2020 and January 2021, President Trump appointed seven new commissioners to the USARC. The Commission, which debuted its new website in November, continues to publish a daily "Arctic Update" newsletter. Subscribe at www.arctic.gov.

Submitted by John Farrell

Corporate Member Reports

Arctic Foundations, Inc.

AFI is a manufacturer of thermosyphon devices that are used to maintain and augment permafrost soils. In late August 2020, AFI entered into a contract with CRREL to perform research and development services with regard to the advancement of thermosyphon technology. The work is threefold; investigate and improve the performance of thermosyphons, improve linear infrastructure by further development of thermosyphons, and investigate the extension of structure life by retrofitting existing thermosyphons. In the last four months of 2020, an instrumented test section was installed at the CRREL Farmer's Loop Test Site, thermosyphons were manufactured and shipped to the CRREL in Hanover, NH, for controlled testing, a 330-meter, flat-loop evaporator thermosyphon was installed with instrumentation at Wainwright, AK, we assisted CRREL researchers in Fairbanks with a solar-powered, hybrid thermosyphon installation, and planned the retrofit of existing thermosyphons on a structure at Nunam Iqua, AK, to extend the life of the facility. Fieldwork during the COVID-19 pandemic was severely curtailed and difficult; however, we were fortunate to be able to safely initiate and maintain these tasks.

Submitted by Ed Yarmak

ABR, Inc.—Environmental Research & Services

Founded in Fairbanks, Alaska in 1976, ABR has provided biological and ecological consulting services for over 40 years to an array of private and public sector clients across Alaska. ABR is a triple bottom line company which means that in pursuit of our organizational mission—to provide honest, reliable scientific research and exceptional client service—we maintain three measures of success: economic viability, environmental stewardship, and social responsibility. 2020 brought an exceptional series of challenges, but ABR researchers were able to undertake some summer field projects along the Alaska road system and at remote locations in northwestern Alaska. ABR researchers also took advantage of the unexpected "desktop" and writing time to tie together a series of basic and applied studies of permafrost ecosystems now published in the literature.

Led by Aaron Wells, ABR's Ecological Land Survey (ELS) team synthesized over 3,500 km² of detailed ecosystem and geomorphic mapping performed on Alaska's North Slope over the last 26 years. Integrated Terrain Unit (ITU) mapping provides a baseline for monitoring permafrost geomorphology against a backdrop of climate change and ongoing industrial activity. ABR vegetation scientists Gerald (J.J.) Frost and Ina Timling coauthored a new publication exploring the link between permafrost thaw and tundra shrub expansion in the North Slope foothills near the Toolik Field Station. The study was a collaboration with University of Alaska Fairbanks and Alaska Department of Natural Resources, and funded by the National Science Foundation (NSF). Frost also led an international working group which developed two peer-reviewed reports on global tundra vegetation dynamics as part of the National Oceanic and Atmospheric Administration (NOAA) Arctic Report Card, and the American Meteorological Society's State of the Climate

Report. Frost also continues to lead studies of ecosystem conditions and permafrost-related changes on the Yukon-Kuskokwim Delta as part of the NASA Arctic Boreal Vulnerability Experiment (ABoVE).

Submitted by J.J. Frost

Alaska Ecoscience

Alaska Ecoscience participated in four collaborative research projects in 2020. With Yuri Shur's upper permafrost project, Jorgenson continued thermophysical monitoring at several boreal thermokarst sites. More extensive fieldwork in northern Alaska was reduced due to COVID-19 restrictions. With Tom Douglas's SERDP climate change impacts project in central Alaska, Jorgenson monitored soil, vegetation and thermal regimes of north-facing black spruce permafrost ecosystems and thermokarst peatlands on the Tanana Flats. As part of an ABoVe permafrost hydrology project, Jorgenson conducted drone mapping of three thermal erosion gullies in central Alaska, as well as maintained dataloggers and time-lapse cameras. With Anna Liljedahl's polygonal ecosystems project, the work focused on analyzing ecological responses to ice-wedge degradation at the Jago River site in northern Alaska.

Submitted by Torre Jorgenson

Geo-Watersheds Scientific

Geo-Watersheds Scientific (GW Scientific) was active in a number of collaborative research projects in 2020. A joint effort with Texas A&M University (TAMU), Geology and Geophysics Department, the TAMU Geology and Geophysics Department Advisory Council (GEODAC) and Campbell Scientific and the TAMU Soltis Center in Costa Rica helped establish a real-time monitoring network of the facilities spring-fed water supply source and system for the research facility. Another collaborative project was started in 2020 as a joint effort between Campbell Scientific, the Alaska Department of Transportation and Public Facilities, and the University of Alaska Transportation Center (UATC) to develop and demonstrate lower-cost Road Weather Information Systems (RWIS). UATC is evaluating the power, communications and data quality for the stations and their applicability to remote off-grid sections of Alaska transportation networks. Another joint project is being conducted with the Cold Climate Housing and Research Center (CCHRC) to evaluate high groundwater levels in the discontinuous permafrost area that the facility is located and how to reduce impacts to the facility.

Submitted by Michael R. Lilly

Agency/ Organization Reports

Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys

The Division of Geological & Geophysical Surveys (DGGS) continued to collaborate with other scientists on a number of permafrost-related topics. Efforts are underway to generate a 3D permafrost map of the Goldstream Valley using electromagnetic resistivity surveys. Other studies with the University of Alaska Fairbanks linking methane emissions to permafrost degradation are ongoing. Together with UAF, historic and prehistoric landslides have been detected in the Fairbanks area. An effort is underway to map these features and understand their history and particularly their relation to degrading permafrost. DGGS is working with the Department Environmental Conservation to outline the interaction between permafrost terrain and pollutant transport, and to summarize what contractors unfamiliar with permafrost need to know prior to starting work in permafrost regions. DGGS is involved in discussions related to the dynamics of gravel removal from the Sagavanirktok River. Most gravel is extracted from the west side of the river near the Dalton Highway, but river migration toward the highway may be the greatest threat to the road and access to Prudhoe Bay in the future. Together with the USGS, DNR is examining permafrost degradation on the Tanana River floodplain at the Bonanza Creek LTER using seismic sensors to detect regions of permafrost degradation. DNR is using repeat lidar surveys

to confirm the finding's spatial distribution by tracking surface collapse. The study of frozen debris lobes (FDLs) entered the next phase of investigations following relocation of the Dalton Highway. The old road embankment was left in place with instruments to investigate the force of FDL as it pushes against the embankment.

A new Navigating the New Arctic study is underway to investigate the effects of infrastructure on the tundra ecosystem. DNR will assist, in the Prudhoe Bay and Point Hope areas, with repeat lidar elevation datasets to characterize surface collapse and hydrological changes. A paper was published on the relation between the presence of tall shrubs, changing hydrology, microbiological environment and permafrost degradation along first order creeks in the arctic tundra. The long-term implications of talik development in the coldest regions in Alaska are very poorly understood, but some of the effects are already observed as increased winter discharge and changing aufeis patterns in and along major Arctic rivers.

Submitted by Ronald Daanen

American Society of Civil Engineers

The ASCE Cold Regions Engineering Division (CRED) has five technical committees that assess and report on effects of cold regions environments upon engineering design, construction, and operations. The Publication Committee of CRED is responsible for editing the peer-reviewed Journal of Cold Regions Engineering (Jon Zufelt, editor) that published 33 refereed papers in 2020 on topics related to permafrost and seasonal frost, ice engineering, construction, environmental quality, snow and ice control, and cold regions materials. The Frozen Ground Committee of CRED completed the monograph Frost Action in Soils – Fundamentals and Mitigation in a Changing Climate (Sally Shoop, editor) and it is available from ASCE Publications. The Environmental and Public Health Engineering Committee of CRED is currently updating the Cold Regions Utilities Monograph that is widely used as a reference by engineers working in permafrost regions. The update of the monograph is a daunting task and the single document may be broken up into several sections in order to produce products that can be used by the engineering community. CRED has several members assisting the U.S. Permafrost Association with the planning and organization of the 2021 Regional Conference on Permafrost/19th International Conference on Cold Regions Engineering (RCOP/ICCRE) planned for October 24-29, 2021 at Boulder, Colorado. Additionally, CRED is coordinating the reviews and publication of the full papers to be presented at RCOP/ICCRE.

For 2020, Robert Tsigonis (Lifewater Engineering Co., Fairbanks, AK) received the Harold R. Peyton Award for Cold Regions Engineering and Aaron Dotson (University of Alaska Anchorage) received the Can-Am Civil Engineering Amity Award. Additionally, Yuri Shur (University of Alaska Fairbanks) presented the Eb Rice Lecture to a packed house in Fairbanks on January 15, 2020.

Submitted by Ed Yarmak

Oak Ridge National Laboratory

The Next-Generation Ecosystem Experiments (NGEE) Arctic project is improving the representation of tundra ecosystems in Earth System models. Our team of more than 140 participants is doing this through a coordinated series of model-inspired investigations being conducted in permafrost landscapes near Utqiaġvik and Nome, Alaska. Our goal is to support the US Department of Energy by delivering a process-rich model in which the evolution of Arctic ecosystems in a changing climate can be modeled at the scale of a high-resolution Earth system model grid cell. A major outcome of our research so far has been the integration of field campaigns, modeling, and data synthesis to simulate the interactions between disturbance-related processes and dynamic vegetation (e.g., shrubs) that are missing from or poorly represented in models. Six new source-code modules will be evaluated against multiscale measurements using the International Land Model Benchmarking (ILAMB) software package. Select NGEE 2020 publications are appended.

Furthermore, now in our ninth year, we are committed more than ever to creating a safe, secure, open, and inclusive project where people are welcomed, valued, and respected for their many talents. This commitment has spurred our team amid the global COVID-19 pandemic to continually consider and re-evaluate our best practices for field work. We have learned to welcome feedback from team members that span graduate students to senior scientists, from the indigenous communities where we are privileged to do our science, and from other scientific teams, large and small, that also work across the tundra. Our commitment to field safety reinforces the message that we trust our colleagues, and that they are empowered, accountable, physically and emotionally safe and secure, free from harassment, that they respect local culture and knowledge, and that we benefit from continuous conversations, even when those conversations prove difficult. Our goal in this area is to leave an enduring scientific legacy where "*everyone has the right to feel safe and secure...everyone is valued and has opinions that matter…everyone deserves to be heard…everyone is responsible for ensuring a respectful workplace."*

Submitted by Stan Wullschleger

U.S. Army Cold Regions Research and Engineering Laboratory

CRREL researchers, based in Fairbanks and Hanover, continued a wide range of field and laboratory investigations (individual activities are presented in the alphabetical order of PI):

Robyn Barbato continues to study gas exchange and emergent microbial communities from thawing permafrost. She and her colleagues are developing a geospatial platform to predict soil activity in the Subarctic and Arctic.

Amanda Barker is continuing her efforts to characterize the speciation of iron in permafrost on the North Slope of Alaska to improve understanding of landscape-scale permafrost active layer dynamics.

Ben Barrowes is developing a ground conductivity meter mounted on an unmanned aerial system (UAS) operating in the electromagnetic induction (EMI) regime to measure subsurface permafrost location, depth, and thickness. This sensor is meant to fill a gap between ground-based and large-scale, helicopter-based conductivity sensors. A drone mounted sensor weighing less than 8 pounds was developed that has acquired preliminary conductivity data from sites in New England that match existing models of ground response.

Kevin Bjella is investigating improved methods to reduce extensive foundation construction while maintaining soils/rock in the frozen state. Tests are being conducted to ascertain the effectiveness of expedient surface insulation for maintaining the frozen state. Surveys are ongoing analyzing differential frost heave occurring with horizontal infrastructure over warm ice-rich soils. Design and construction continues with Phase V expansion of the CRREL permafrost tunnel.

Tom Douglas continues to expand the CRREL active layer monitoring network and with other CRREL researchers are working to characterize the microbiologic characteristics of the newly expanded Permafrost Tunnel in Fox. They are also investigating how surface water chemistry relates to permafrost thaw events in the High Arctic.

Susan Frankenstein is developing methods to predict the seasonal state of the terrain. She is developing new thermal conductivity equations that incorporate the unique soil matrix found in the Arctic as well as new soil strength algorithms. Results will be used to determine vehicle mobility and infrared sensor performance for identifying buried objects.

Jeremy Giovando and Chandler Engel developed a frozen soil model (FSIM) which predicts reduced infiltration based on soil temperature and volumetric moisture content. The development of FSIM is a breakthrough to estimate flow enhancement from frozen soils in hydrologic models (HEC-HMS). FSIM allowed quantification of the potential flow enhancement for the Willow Creek watershed (eastern Idaho) from frozen soils during large precipitation events.

Christopher Hiemstra continues collaborations with NASA's SnowEx effort to advance

remote sensing and measurements of snow in boreal and Arctic terrains under unique frozen ground and snow-canopy interactions. Efforts to quantify vegetation and ground surface impacts of thaw and localized thermokarst since 2014 are ongoing.

Theodore Letcher continues to evaluate simulated frozen soil processes in the authoritative Land Information System configureation of the NOAA land surface model against *in situ* soil probe data contained within the Soil Climate Analysis Network distributed across the CONUS.

Sally Shoop reports that CRREL participated in the recently published update of Army Regulation 70-38. It was a major rewrite of the AR, last updated in 1979, and reflects changes in climatic criteria to address atmospheric, terrestrial, and biological consideration for the design and performance of materiel for worldwide operation. Shoop served as editor of the ASCE monograph on frost action.

Anna Wagner and her team, in collaboration with Arctic Foundations Inc, Anchorage, are undertaking research to advance the technology of thermosyphons for use in cold regions. The project includes testing several configurations in the field and a full-scale laboratory experiment, retrofitting thermosyphons, and testing to increase the heat transfer capabilities of thermosyphons using reflective coatings.

Submitted by Tom Douglas

U.S. Geological Survey

In 2020 the U.S. Geological Survey continued research in the public interest to provide sound science for decision support to conserve land and water. There are approximately 25 permafrost researchers at the USGS located across the United States in multiple science centers and funded by multiple programs. USGS researchers advanced the understanding of carbon dynamics of lake environments in interior Alaska and Canada in partnership with colleagues as part of the NASA Arctic-Boreal Vulnerability Experiment (ABoVE). Hydrologic connectivity between lakes and the terrestrial environment was shown to play an important role in lake dissolved organic matter (DOM) biogeochemistry, and decreasing connectivity driven by ongoing climate change is impacting the chemistry and quality of lake DOM in the Yukon Flats Basin. Researchers also showed that lake biogeochemical processes were active through the winter, and an under-ice survey of CO_2 and CH_4 in 13 lakes reveals a wide range of concentrations and isotopic compositions that generally tracked landscape position, oxygenation, and organic matter content. A novel methodology for estimating gross primary productivity (GPP) of shallow lakes from remotely sensed lake color was developed.

USGS researchers and collaborators estimated potential future releases of mercury (Hg) from thawing permafrost and to the atmosphere using a coupled carbon-Hg mechanistic model under high (RCP8.5) and low (RCP4.5) greenhouse gas emissions scenarios. Results indicate minimal impacts under RCP4.5, but significant impacts at RCP8.5.

The USGS compiled and analyzed electrical resistivity and borehole NMR datasets to map spatial variability in permafrost and thaw features in interior Alaska. Additional long-term passive seismic monitoring has been used to track changes in subsurface water and ice content at high temporal resolution and across a large area at a collapse-scar bog complex in Alaska. These geophysical results provide new understanding of how subsurface thermal and hydrologic conditions relate to *in situ* greenhouse gas concentrations and surface fluxes, such as deep permafrost thaw beneath thermokarst lakes and methane hotspots.

USGS conducted integrated field observations and modeling investigations to assess the vulnerability of continuous permafrost in boreal Alaska, generally considered resilient, to talik formation after wildfire. Talik development beneath the Dall City Fire 2004 burn scar was confirmed to extend 4-5 meters below the surface using a combination of noninvasive and borehole geophysical methods. Comparison of this study's findings with coarse scale panarctic

modeling projections of talik formation in the study region revealed that localized talik formation outpaced predictions by > 100 years, even under the high emission scenario, RCP 8.5. This study's findings raise critical issues regarding representation of extreme permafrost thaw phenomena in large-scale predictive earth system models. A new USGS project, termed ABRUPT, was begun to examine the implications of talik formation on greenhouse gas fluxes, particularly in the winter season.

USGS, in collaboration with National Park Service and university researchers, continued to examine how permafrost controls surface water discharge and temperature and, thus, controls biological communities in streams in the Brooks Range. USGS is evaluating permafrost degradation and aggradation related to channel migration in the Colville River Delta, including mapping the probability to encounter taliks with high pore-water salinity. In the Eastern North Slope, USGS is assessing the interactions between permafrost and water to distinguish shallow and deep groundwater flowpaths and the influence on water quality and quantity.

USGS continues to be a part of the larger permafrost research community by contributing to several international synthesis efforts to: (1) describe the role of groundwater flow processes in the Arctic initiated by permafrost thaw and the direct impacts on stream discharge, constituent transport, infrastructure damage, and Northern water supply, (2) develop a conceptual framework for hypothesis-driven investigations of controls on the biogeochemical response to thaw across diverse northern regions, (3) monitor a suite of above ground and subsurface environmental variables on the North Slope of Alaska through the USGS Climate and Permafrost Observing Network. Many of these permafrost research and monitoring efforts are explained in a new USGS fact sheet available in 2021.

Submitted by Mark Waldrop

University Reports

George Washington University

GWU is responsible for coordinating the Circumpolar Active Layer Monitoring (CALM) program that comprises a network of sites that has been funded by NSF since the early 1990s to monitor active layer and near-surface permafrost response to climate change. There are approximately 150 actively reporting CALM sites throughout the polar and select midlatitude regions maintained by participants from 11 countries. Nikolay Shiklomanov (GW) is the lead PI on the project assisted by senior personnel, Dmitry Streletskiy, Frederick Nelson, Nathan Moore, and Anna Klene, and includes Kelsey Nyland as a GWU Postdoctoral Scientist. In anticipation of the first southern regional conference on Permafrost (SouthCOP) held in December 2019, there was a concerted effort to update records from Antarctic sites (CALM-south). During 2020, despite limited access to CALM sites for many participants due to COVID-19, there are some summer data available thanks to collaboration with indigenous and other communities local to CALM sites in Alaska and Russia. Additionally, GW Geography Masters student Tanni Sarker, successfully completed and defended her thesis in May 2020 which examined land cover and land use change in areas of development and abandonment in the Russian European North. A pan-Arctic infrastructure database was assembled and, with CALM data, is being used to evaluate impacts of permafrost degradation on infrastructure. More information about the program and recent data updates can be found at the program website.

Submitted by K.E. Nyland, D.A. Streletskiy, and N.I. Shiklomanov

Michigan State University

Fritz Nelson continued a program of research with MSU graduate student Raven Mitchell and recent graduates Clayton Queen (MS 2018) and Kelsey Nyland (PhD 2019), including publications and CALM data-management activities. We managed to make

progress in 2020 despite COVID-19, primarily through Skype and Zoom. Our field season was severely curtailed by the pandemic. Raven, who defended her M.S. thesis in June and is now in MSU's doctoral program, recently won an award in the AGU Cryosphere Section's "Flash Freeze" competition for her proposed work on periglacial geomorphology in northern British Columbia. Raven and Fritz were recipients of the American Association of Geographers' Melvin Marcus Award for their work on cryoplanation landforms. We published a series of papers about cryoplanation and nivation in *Canadian Journal of Earth Sciences*, *Quaternary Research*, and *Permafrost and Periglacial Processes* (Nyland et al.; Queen et al.). A biographical article about Stephen Taber's 1935 work in Alaska is in press with *Permafrost and Periglacial Processes*, and another paper about the late MSU Professor Dieter Brunnschweiler's landmark work in 1964 on altiplanation in Alaska is in review. Vasily Tolmanov (M.S. 2020, Moscow State University) will join us this coming year in the MSU doctoral program and will participate in both our CALM and geomorphology projects.

Submitted by Fritz Nelson

Penn State University

In 2020, Ming Xiao and collaborators continued two ongoing research projects and initiated a new project on permafrost coastal erosion, permafrost degradation and its impact on infrastructure and community, and *in-situ* measurements using distributed acoustic sensing. The project team planned to hold the "2020 Workshop on Arctic Coastal Communities, Hazards Remediation, and Resilience. The workshop was organized by four NSF Arctic network projects: PCE-RCN; Arctic Network for Coastal Community Hazards, Observations, and Integrated Research (AHCHOR RCN); Arctic COASTal Community and Environmental Resilience International Interdisciplinary Research Coordination Network (Arctic-COAST RCN); and Permafrost Coastal Systems Network (PerCS-Net), but was postponed to late 2021. Currently, the organizing committee is planning small-scale online workshops with specific geographic focuses on the North Slope Borough (NSB) and Yukon-Kuskokwin Delta, and specific audience (industry, government, and local communities). The smaller and targeted Zoom-based workshops will occur in the spring 2021 and will be used to prepare for the larger in-person workshop in late 2021. A paper on the review and synthesis of permafrost coastal erosion remediations was published on *Environmental Research Letters.* A collaborative NNA PIPER project by PSU, UAF, MST, and U Idaho continued in 2020. The goal of this research project is to understand the complex interrelationships and mutual impacts of continued climate change in the Arctic among the following components: permafrost degradation and coastal erosion, civil infrastructure and development, and community well-being and socio-demographic and cultural resilience. A new NSF project "SitS: Collaborative Research: Understand and forecast long-term variations of in-situ geophysical and geomechanical characteristics of degrading permafrost in the Arctic" was initiated with collaboration of PSU, UAF, and Virginia Tech. The goal of this project is to understand and forecast long-term variations of *in-situ* geophysical and geomechanical characteristics of the active layer and permafrost in Arctic Alaska using innovative distributed acoustic sensing (DAS) technology and modeling.

Submitted by Ming Xiao

University of Alaska Anchorage, Department of Civil Engineering

UAA, led by Thomas Ravens, has developed an arctic capable coastal geomorphic change model called Arctic X beach. The model couples the open-source, non-arctic coastal geometric change model, X beach, with a thermal model and determines the potential sediment transport and geomorphic change at the coast considering storm surge height and wave condition. The thermal model determines the temperature and phase of the coastal soil and sediments. Potential geomorphic change determined by X beach is only actualized if the soil and sediment are

determined to be thawed by the thermal model. The model enables the forecasts of arctic coastal erosion and serves as a tool for designing measures to control Arctic coastal erosion using thermal and mechanical measures.

Another area of research, led by Joey Yang, is the local subsidence of deep permafrost surrounding oil wells on the North Slope. Extensive laboratory testing was conducted to analyze the physical and mechanical properties of permafrost cores. Models of permafrost-well casing interactions were established to predict the thaw subsidence, soil-casing interface behavior, and stress/deformation behavior of well casing. Yang also initiated a project to document the permafrost degradation and associated deformation or failure in the ground as well as the built infrastructure in Bethel, Alaska. This project employs geophysical testing, including Electric Resistivity Tomography, Ground-Penetrating Radar survey, Multi-Channel Spectral Analysis of Seismic Wave (SASW), and ground temperature monitoring to map the permafrost and local thaw. Distresses and damage to roads and buildings will be surveyed to understand the impact of permafrost degradation on the built environment.

Submitted by Zhaohui (Joey) Yang

University of Alaska Fairbanks, Alaska Geobotany Center

Under the NSF grant "The Navigating the New Arctic: Evolution and adapting to change in Ice-Rich Permafrost Systems (NNA-IRPS)", we are expanding studies in the Prudhoe Bay region and initiating studies at Point Lay. Three main observatories are planned: Roadside IRP Observatories (RIRPOs) and Natural IRP Observatory remote from infrastructure (NIRPO) at Prudhoe Bay and Village IRP Observatory (VIRPO) at Point Lay. Researchers from the UAF Institute of Northern Engineering, Geophysical Institute, Institute of Arctic Biology, and International Arctic Research Center will work with and the Point Lay community, the Cold Climate Housing Research Center, the North Slope Regional Housing Authority, and North Slope Borough planners to collaboratively produce adaptive housing strategies and actionable knowledge that is relevant to Point Lay and other arctic villages. A permafrost and infrastructure symposium will bring together US-Canadian science and engineering expertise.

Due to the severe limitations on travel imposed by the COVID-19, a single nine-day self-contained expedition was made to the vicinity of Prudhoe Bay at Deadhorse from 12–20 August 2020. Participation was limited to four people and included Donald A. (Skip) Walker (IAB, UAF), Mikhail Kanevskiy (INE, UAF), post doc Helena Bergstedt Post-Doctoral Fellow in Remote Sensing of Permafrost Landscapes (INE), and graduate student Emily Watson-Cook (Department of Biology and Wildlife, UAF). The project established a field camp at Mile 405 on the Dalton Highway.

Several key publications appeared in 2020 (Frost et al. on Arctic greening and Raynolds et al. on landscape impacts in the Arctic National Wildlife Refuge.

Submitted by Donald "Skip" Walker

University of New Hampshire

Arctic researchers and students at University of New Hampshire (UNH), representing the physical, biological, and social sciences, have organized around a research and scholarship initiative: *UNH Arctic*, and includes members working directly on permafrost-related activities. UNH continues to coordinate the New England Arctic Network (NEAN), a regional initiative that combines the academic expertise in Arctic research across New England. Under the leadership of Ruth Varner, UNH was part of a $12.5M award from NSF for a Biology Integration Institute (UNH subaward $3.6M), called EMergent Ecosystem Response to ChanGE Biology Integration Institute (EMERGE) focused on feedbacks between the biology and geochemistry of emergent gas fluxes from thawing permafrost peatland in northern Sweden. Varner co-authored five permafrost-related papers and presented an invited keynote at Bolin Days 2020. Alexander Shiklomanov and the UNH

Water Systems Analysis Group led a team to develop a new online data visualization and manipulation system for the pan-Arctic—Tree Ring Integrated System for Hydrology (https://trish.sr.unh.edu/)— as part of an NSF OPP-funded project. Michael Palace continues his work on remote sensing of boreal forests and peatlands with a collaborative NASA ABoVE project. Claire Treat moved to a new position at the Alfred Wegener Helmholtz Institute in Potsdam, Germany, to study the role of non-growing season processes in the methane and nitrous oxide budgets in pristine northern ecosystems. Steve Frolking continues to work on a Navigating the New Arctic (NSF) project related to the patterns and processes of peat expansion in the Arctic. Jessica Ernakovich and a team from Dartmouth, the National Center for Atmospheric Research, and UNH were awarded $1.5M from NSF Office of Polar Programs to study plant–microbe–mineral feedbacks in permafrost soils under simulated thaw on the North Slope. Ernakovich continued to lead the Permafrost Microbiome Network and to collaborate with the Permafrost Carbon Network (PCN) as part of the steering committee.

Stacey Doherty successfully defended her master's focusing on the microbial ecology of permafrost. N. Niloufar Kashi, PhD candidate, is studying soil nutrients with permafrost thaw. Kathryn Bennett completed her MS degree on the isotopic composition of dissolved and emitted CH_4 from thaw ponds in northern Sweden. She is co-leading a synthesis with Varner and the PCN on stable carbon isotope emissions from high latitude ecosystems. M. Florencia Fahnestock, PhD candidate, published a paper on mercury dynamics in Stordalen Mire and is co-leading a synthesis of mercury in permafrost with the PCN network. Sophia Burke defended her PhD on the seasonal and interannual controls of ebullitive flux from a subarctic thaw pond system. Bianca Rodríguez-Cardona defended her PhD on carbon and nitrogen dynamics in fluvial systems across biomes and participated in the 2020 Polar Literacy Principles Workshop (Department of Marine and Coastal Science, Rutgers University). PhD candidate Clarice Perryman published on methane oxidation in permafrost peatlands.

Submitted by Jessica Ernakovich on the behalf of *UNH Arctic*

Network Reports

Permafrost Carbon Network

The Permafrost Carbon Network hosted its 10th Annual Meeting in a virtual format on November 10, 2020. We welcomed more than 200 participants from across the globe and discussed what is the current, bottom line provided by science synthesis on topics central to the permafrost carbon-climate feedback? This included brainstorming where there is convergence and where there is controversy and where new surprises could arise. Four panels were structured around the topics of:

1) How much carbon is stored in the permafrost region and how vulnerable is it?

2) How much carbon will be released through gradual climate warming and abrupt permafrost thaw?

3) Are increases in Arctic carbon emissions already occurring?

4) Integrating permafrost science into climate policy.

Major science synthesis highlights from the PCN in 2020 include a synthesis with a first estimate of thermokarst (abrupt thaw) carbon emissions using numerical models (Turetsky et al.). Another science highlight shows the that widely-used land models project near-surface drying of the terrestrial Arctic despite increases in the net water balance driven by climate change (Andresen et al.). A third synthesis product assessed the potential for mobilization of old soil carbon after permafrost thaw **(**Estop-Aragonés et al.**).**

Submitted by Christina Schaedel

Permafrost Young Researchers Network (PYRN)

As indicated above, two PRYN members are now formally represented in the USPA: new Board member Dr. Helena Bergstedt and Nicholas Hasson, University of Alaska graduate student on the Membership Committee. At the international level, a group

of PYRN members joined other Early Career Researchers (ECR) from the PAst Global changES Early-Career Network (PAGES-ECN), the United States Association of Polar Early Career Scientists (USAPECS), and the Young Earth System Scientists (YESS) to successfully complete a group review of the Second Order Draft (SOD) of the IPCC AR6. This review was a continuation of past efforts, and many of the ECRs have continued on to organize a group review of the second order draft of the WGII contribution. For more information on the project, see the APECS newsletter on its website (https://www.apecs.is). As a result of COVID-19 restrictions, PYRN launched an online seminar series that can be found on the PYRN YouTube channel. The first presentation was by Evan Wilcox (Wilfrid Laurier University and Alfred Wegener Institute) on Influences of Thermokarst Lake Water Balances. The second was a presentation by Rúna Magnússon (Wageningen University, NL) on how Extreme summer precipitation increases permafrost thawing depth. Hopefully this series will continue, as more research is conducted by ECRs. PYRN continues to provide updates on its website of permafrost activities around the globe, including the posting of jobs, student opportunities, research positions, conferences, and scholarships.

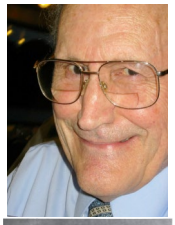
Submitted by Matthew Whitley, retiring USPA PYRN Board Member and Representative

Permafrost Collaboration Team

The Permafrost Collaboration Team (PCT) of the Interagency Arctic Research Policy Committee (IARPC) focuses on advancing understanding of processes controlling permafrost dynamics and the impacts on ecosystems, infrastructure, and climate feedbacks. During the 2020 reporting period, the PCT made progress toward improving understanding of ground ice content of permafrost across the Arctic. The PCT team leaders (Miriam Jones, USGS; Christina Schädel, NAU; and Benjamin Jones, UAF) organized a smaller group of international permafrost researchers to develop a survey designed for data holders and data users to be sent out in the coming fiscal year. The PCT also held a monthly seminar on the results of a Denali Commission report, Statewide Threat Assessment, the aim of which was to understand threats of permafrost thaw, including flooding and coastal erosion, on infrastructure and communities. A meeting in February on an NSF-funded Navigating the New Arctic (NNA) project with a focus on ground ice aimed to integrate plot-level data with landscape and regional-level change while also coordinating, collaborating, and co-developing knowledge through other circumpolar collaboration efforts such as Rapid Arctic Transitions due to Infrastructure and Climate (RATIC) and Terrestrial-Multidisciplinary drifting Observatory for the Study of Arctic Climate (T-MOSAiC). The NNA project is also working with village and regional partners on the North Slope of Alaska to better address the needs of the people living on rapidly thawing.

Submitted by Meredith LaValley (IARPC)

In Memoriam to U.S. Permafrost Colleagues



Oscar Ferrians, USGS, December 19, 2019
Memorial Link

Wayne Tobiasson, USA CRREL, August 14, 2020
Memorial Link

Corporate and Institutional Members and Sponsors

We thank our past and new Corporate and Institutional members, sponsors and donors both in Alaska and in the "Lower 48" for their continued involvement and generous support.

Links and Citations

Overview

- PMA https://www.uspermafrost.org/monthly-alerts.shtml
- AGU Abstracts 2020 https://www.uspermafrost.org/publications/AGUindexs/AGU_Fall_2020_Permafrost_Abstracts_Index.pdf
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American Geosciences Institute

- https://www.americangeosciences.org/policy/critical-needs/2020

Center for Snow and Avalanche Studies

- https://snowstudies.org/

University of Texas El Paso, Systems Ecology Lab

- Arctic Research Mapping Application https://armap.org/
- US Arctic Observing Network www.arcticobservingviewer.org

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Permafrost Young Researchers Network (PYRN)

- APECS https://www.apecs.is
- https://pyrn.arcticportal.org/

Permafrost Collaboration Team (PCT)

- 2020 Annual Report https://www.iarpccollaborations.org/members/documents/20038
- PCT Team Page https://www.iarpccollaborations.org/members/people/teams/2663
- About IARPC https://www.iarpccollaborations.org/about.html
- IARPC Request Account https://www.iarpccollaborations.org/request-account.html

In Memoriam of USPA Members

Oscar Ferrians

- https://www.wenatcheeworld.com/tributes/in_memoriam/oscar-john-ferrians/article_b1908ee0-aeaf-5dcd-9a10-075a261b27c2.html

Wayne Tobiasson

- https://www.vnews.com/wayne-tobiasson-obit-vn-082020-35816000

2020 USPA-PYRN Education Fund AGU Awardee

I am **Sayedeh Sara Sayedi**, a PhD candidate at **Brigham Young University**. My research is about subsea permafrost carbon stocks and climate change sensitivity. With the help of the USPA, I had the opportunity to present at the AGU2020. Even though AGU2020 was completely virtual, it was a great experience. During our session, I presented my work and had the opportunity to learn about others' research. More than 70 participants were in our session and we had a great discussion at the end with all presenters and participants. It is always great to meet other researchers and become familiar with the latest research that is conducted around the world.

My name is **Raven Mitchell** and I am a PhD Student at **Michigan State University**. This fall I had the great opportunity to virtually attend the AGU annual meeting. I presented two posters where I received valuable input from Arctic researchers via the live chat forum. This feedback will help to improve my research going forward. In addition, I participated in the Student Flash Freeze Competition sponsored by the Cryosphere Specialty group where I was awarded a mini-grant to help fund my future research. I am grateful to the USPA for supporting my participation in this important experience.

My name is **Allison Trcka** and I am a Masters student at **Portland State University**. I am researching the topography and climate of rock glaciers. My experience at the AGU meetings was unique. Due to work, I was not able to attend most of the meeting. Typically, I would have missed sessions that I was interested in, but due to the meeting being virtual I was able to go back and attend all the sessions that I missed. It was nice to go back and re-watch and read the oral presentations and posters as many times that I want.

My name is **Mary Farina** and I am a PhD student at **Montana State University**. I attended the virtual AGU Fall Meeting 2020 through support from USPA UPEF. The virtual conference format provided a unique opportunity to connect with others in the permafrost community and spend more time with individual presentations and posters. I presented on the resilience and vulnerability of the regional carbon sink in Alaska and Canada. This was a helpful experience in terms of learning new ways to convey research findings in pre-recorded presentations, and I received valuable feedback on flux model comparisons. This was a great chance to connect with researchers from many different institutes!

The USPA welcomes all in the Permafrost and Cryosphere research and engineering communities to contribute, attend, and benefit from the upcoming 2021 Regional Conference on Permafrost and 19th International Conference on Cold Regions Engineering. The Conference will be held virtually from October 24-29, 2021. October 24 will be focused on the American Society of Civil Engineering and Permafrost Young Researchers Meetings while the remainder of the week will consist of roughly four hours of presentations, panels, and interactive events. A call for abstracts is planned in March, 2021. Registration will open soon after. This Regional Conference is an official conference of the International Permafrost Association and we look forward to welcoming participants from many of the 26 member countries. Dr. Thomas Douglas – Conference Chair

https://www.uspermafrost.org/21rcop/

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