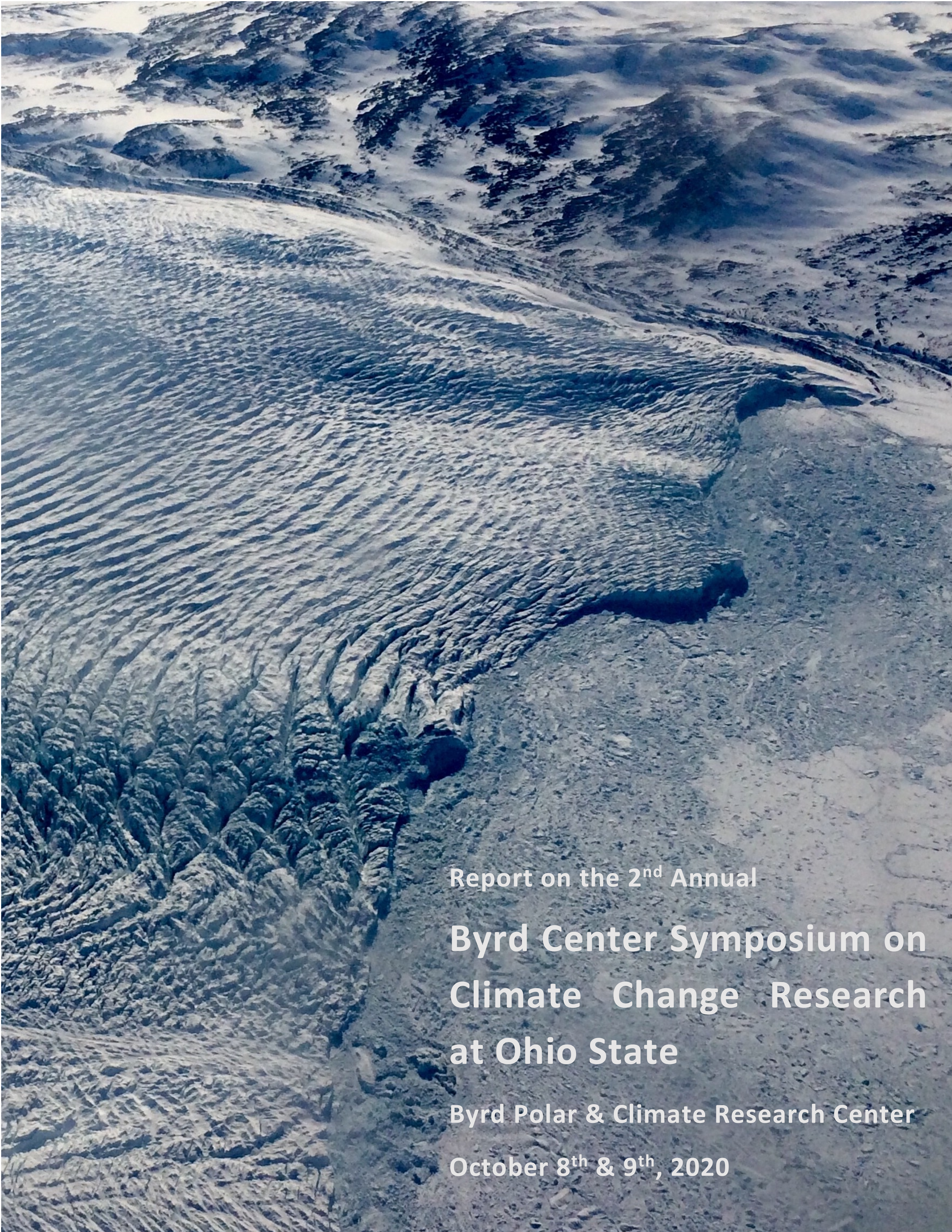

Report on the 2nd Annual

Byrd Center Symposium on Climate Change Research at Ohio State

Byrd Polar & Climate Research Center

October 8th & 9th, 2020

Contents

Report Citation

This report may be cited as:

Byrd Polar and Climate Research Center. 2020. Report on the 2nd Annual Byrd Center Symposium on Climate Change Research at Ohio State. Columbus, Ohio. 17 pp

Cover photo: A glacier calving front in Greenland. Credit: Michalea King.

Symposium Schedule

Thursday, October 8th (via Zoom)

7:00 pm Symposium Introduction and Keynote Speaker: Richard Alley, Pennsylvania State University, *Falling dominoes? Ice, climate, sea level and our future*

Friday, October 9th (via Zoom)

8:50 am Welcome: Ian Howat

9:00 Speaker: Dr. Aparna Bole, University Hospitals Rainbow Babies and Children's Hospital, *Climate and Public Health*

9:45 Breakout Session One:

- Agriculture and Food Security
- Building Environment, Urban Systems, Transportation, and Cities
- Climate and Public Health
- Climate Justice and Equity

11:30 Poster Session/Lunch

1:30 pm Speaker: Dr. Marta Jarzyna, Department of Evolution, Ecology and Organismal Biology, Ohio State University, *Climate and Biodiversity*

2:20 Breakout Session Two:

- Biodiversity, Ecosystems, and Ecosystem Services
- Climate Change: Variability and Extremes
- Surface Water Resources and Accessibility
- Engaging with the Public and Policy Makers

Symposium Objectives and Overview

This year marked the 60th anniversary of the Byrd Center's founding and the Institute of Polar Studies. The original mission of the center was to bring together and support interdisciplinary research around the Earth's cold regions, to know what was happening at the ends of the earth. However, the Center's research showed that "what happens at the poles doesn't stay at the poles", and our mission has evolved into providing society with critical information about the Earth's systems. The purpose of this year's symposium is twofold; the first is to celebrate six decades of impact and, second, to bring together Ohio State's vast breadth of expertise to bear on climate science, justice and communication.

This year's keynote speaker, Professor Richard Alley, serves both of these objectives. Among Ohio State's most prestigious scientist alums, Dr. Alley's lecture illustrated the influence the Byrd Center and its scientists on shaping his extraordinary career. The talk also provided a clear description of how climate change is a fully interdisciplinary challenge, linking nearly every aspect of human endeavor from the poles to the equator. Thus, he presented a call to action to bring together expertise from across our large University to address this crisis through collaborative, interdisciplinary and imaginative research. Over 190 individuals attended Dr. Alley's virtual talk.

The Friday activities consisted of two overview talks on particularly salient climate change topics: Public Health and Biodiversity, followed by breakout discussions on these and other topics determined by the symposium organizing committee. Between these morning and afternoon sessions was a poster session highlighting a range of research projects from across campus, including from several students.

The breakout sessions consisted of six science topics with additional breakouts on climate justice and science communication. The science topic breakouts were designed to bring together researchers with common interests to identify the key science questions where Ohio State can make transformative impacts through collaborations as well as barriers to forming collaborations. The breakouts on Climate Justice and Communication with the Public and Policy Makers were designed to facilitate sharing of ideas and resources among a diverse group of researchers.

How do we promote interdisciplinary collaboration at OSU?

All breakout session registrants were asked to complete a survey which included a question about barriers to forming collaborative research teams at Ohio State. This question was also discussed in the breakout sessions. Three recommendations were prominent in these discussions:

1. Make it easier to find researchers with a specific interest, expertise and, most importantly, willingness to collaborate.

The single most common issue cited as preventing interdisciplinary collaborations was the difficulty in simply finding other researchers with the desired expertise and interest around campus. While OSU's size provides an advantage, it also makes it difficult to discover and interact. Department website personnel pages do not typically provide enough detail about current activities or availability to collaborate. Centers and Institutes, such as Byrd, are attempting to forge these connections through these events. In addition, the suggestion was made for a Facebook-style interface for discovering researchers looking to collaborate in climate science and other disciplines. There have been consistent recommendations for a similar tool over the last decade.

2. Secure faculty time to lead large proposals.

Another common barrier is faculty time, since faculty have teaching and service obligations on top of current research activities, limiting the ability and willingness to lead large, interdisciplinary proposals. Grant support staff can remove some of the burden in proposal team management and document preparation and review, but the Principal Investigator still must commit a large amount of time to producing an effective proposal. Seed grants to provide release time for faculty, or salary for research scientists, targeted at specific funding opportunities, along with effective proposal support, would help mitigate this barrier.

3. Target seed funds for research staff working with more than one faculty member.

Collaborations around emerging ideas can be hard to get going without funding. Even when collaborative proposals are funded, too often researchers end up working independently on their parts, with little actual collaboration. Meaningful and effective collaborations could be enabled by providing funding for research staff (postdocs, associates, etc.) who's pilot work would be supervised by multiple PIs and collaborative research, facilitated by an interdisciplinary center. For example, seed funding could be provided for a researcher at the Byrd Center to work with a faculty member in CFAES and another in ASC on a climate and agriculture-related topic. The expectation would be that this researcher's pilot studies would lead to a collaborative proposal.

Breakout Sessions: Key Interdisciplinary Science Questions and Collaborative Teams

Each breakout discussion was aimed at identifying a key interdisciplinary science question that could be addressed by a collaborative research team at Ohio State. These are presented below.

Climate Change, Agriculture and Food Security

Facilitator: Brian Snyder, Executive Director, Initiative for Food and AgriCultural Transformation (InFACT)

How do soil quality and climate change interact and, together, impact human health?

Soil is the nexus of food security, public health and climate, governing carbon sequestration, crop quality, nutrient density, and microbiome diversity. How we utilize the soil is largely dependent on public policy, farm size, design and diversity. Understanding how soil is changing will require novel approaches, including remote sensing at large scales combined with networks of continuous ground measurements (e.g. a MesoNet), and assessments of farming methods from a broadly systemic perspective, including societal health outcomes.

Potential collaborating OSU centers include the Initiative for Food and AgriCultural Transformation (InFACT)

Discovery Theme, Carbon Management and Sequestration Center, State Climate Office of Ohio, and Center for Applied Plant Science (CAPS). Numerous faculty in all colleges and schools are already working on issues related to this topic and are in need of an interdisciplinary research program to knit their efforts together into a broad vision of environmental, economic and human health.

Biodiversity, Ecosystems, and Ecosystem Services

Facilitator: Marta Jarzyna, Assistant Professor, EEOB

How do ecosystems and biodiversity change with climate at different spatial and temporal scales?

Substantial uncertainty exists around how climate influences various ecosystems, from microbiomes to forests, due to a lack of observations at multiple temporal and spatial scales.

Understanding how ecosystems have responded to abrupt climate changes in the past would inform predictions of future change. In addition to a high-resolution record of climate, the Byrd Center's collection of tropical and mid-latitude ice cores offers a unique palaeobiological record, including pollen and microbes, spanning multiple continents. The temporal perspective provided by the ice cores can be merged with the multi-scale spatial information provided by field observations and remote sensing.

Potential key collaborators include the ice core paleoclimate group at the Byrd Center, the Center of Microbiome Science, the Museum of Biological Diversity and faculty in multiple colleges units studying ecosystem change.

Climate Variability and Extremes:

Facilitator: Peter Craigmile, Professor, Department of Statistics

What is the range of future extreme regional climate events and what will be the impact on agriculture, infrastructure and society?

Our projections of future climates, and the associated range of extremes, are based on limited observations from the relatively recent past. While abrupt changes have been found in the paleoclimate record and in climate model runs using historical forcings, it is harder to quantify and assess extreme climate events, such as droughts and flooding, particularly at the regional spatial scales that impact economies. Improved assessment of climate model uncertainties through comparison to the paleoclimate record, data assimilation and statistical analysis are needed, followed by an evaluation of the cascading impacts of possible extremes on society.

The State Climate Office of Ohio and multiple faculty in the Atmospheric Sciences Program in the Department of Geography are engaged in multi-scale climate and weather modeling, as well as human impacts. Multiple faculty within the Department of Statistics, Department of Geography, the School of Earth Sciences, and the Department of Civil, Environmental and Geodetic Engineering, as well as Translational Data Analytics (TDA) Institute, have expertise in model assessment and data assimilation. Faculty using climate models to study the impacts to food systems and economies are in multiple units within CFAES, as well as other colleges and units. Further collaborations can be found in the Risk Institute at the Fisher School of Business, through the Sustainability Institute and through InFACT.

Surface Water Resources and Accessibility

Facilitator: Michael Durand, Professor, School of Earth Sciences

How can we collect data on water availability, hazards and quality at local to regional scales to provide actionable, real-time information for decision-making?

The sustainability, efficiency and equitability of decisions around water are limited by data. A framework is needed for merging the growing capabilities of remote and in situ monitoring across spatial scales to produce real-time water information for monitoring agricultural drought, urban and rural floods, and water quality. While the cascade of physical and conceptual models to achieve this framework exist, there is still important science to be done in how to leverage such a framework to produce meaningful predictions and avoid garbage in-garbage out. Important work remains to be done for some sensors and low-level remote sensing methods as well. The merging of remote sensing with analytical chemistry remains a largely unexplored area of research with high potential.

OSU has extensive expertise in watershed hydrology, environmental geochemistry and remote sensing across multiple colleges and units, particularly in the School of Earth Sciences, the School of Environment and Natural Resources, and Department of Civil, Environmental and Geodetic Engineering. Multiple units within the College of Engineering have expertise in sensor network design and these broader objectives intersect with the activities of the Global Water Institute, the Sustainability Institute, the Water Resources Center, the Translational Data Analytics Institute and InFact.

Climate Change and Public Health

Facilitator: David Kline, Assistant Professor, Department of Biomedical Informatics

How can cascading models of future climate and public health be effectively coupled and applied to inform interventions and assess health risks?

The impacts of climate change on public health are wide ranging and successful assessment and mitigation will require an interdisciplinary effort that understands the complexities of both socio-political systems and climate. In particular, closer collaborations need to be fostered between climate modelers, statisticians, epidemiologists, and interventionists to ensure rigorous assessments of risk and effectiveness.

OSU has extensive public health modeling expertise in the Colleges of Arts and Sciences, Medicine and Public Health, while those focusing on intervention policy and mitigation are found in the School of Environment and Natural Resources, the Department of Geography and the John Glenn College of Public Affairs.

Building Environment, Urban Systems, Transportation, and Cities

Facilitator: Elena Irwin, Professor, Dept. of Agricultural, Environmental and Development Economics

How does interaction between natural and built infrastructure influence the impacts of climate change?

Despite building evidence of benefits, new green infrastructure projects lag demand, while projects that do go forward are not always designed in ways that maximize their benefits. It is unclear what the constraints (financial, environmental, etc) are on (local, state, federal in US context) for these limitations.

How does climate change impact socioeconomic outcomes/disparities (health, inequality, right/ability to move and/or migrate)?

It is known that climate change impacts labor, education, health outcomes and mortality and even recreation and exercise, with unequal impacts on different socioeconomic groups. However, it is unclear how these impacts interact and cascade, such as through disinvestments that foster inequalities, which then increase vulnerabilities of certain populations. Also unclear is how these impacts change demographics through migration.

How does climate change affect energy and transportation systems and how do mitigation efforts transform these systems?

Both climate change and efforts to mitigate those changes have a transformative impact on energy and transportation systems, with external variables such as market forces, socioeconomic inequality and unintended consequences, making it difficult to predict its evolution. Further, the COVID-19 crisis has demonstrated how a climate shock might dramatically affect urban systems.

OSU centers addressing these questions are the Sustainability Institute, Center for Urban Regional Analysis, the Knowlton School of Architecture and faculty across multiple colleges.

Poster Presentations

Listed in order presented

FEVer Bugfixes and Improvements

Devan Agrawal, AgrawalD22@columbusacademy.org

During my REU experience with the Byrd Polar and Climate Research Center, I programmed with the Fluid Earth Viewer (FEVer) Team and coded new features, new formats of the application's UI (User Interface), and various bug fixes. It really was an amazing experience as I truly learned that I don't need to be completely knowledgeable in anything (in this case, new programming languages) to reach my goals and accomplish tasks.

ICP-SFMS determination of ultra-trace metal concentrations in water matrices to study a variety of environmental processes

Paolo Gabrielli, gabrielli.1@osu.edu

Metals are used as proxies of multiple environmental processes in the Earth's system. For instance, Al, Ba, Cs and Rare Earth Elements (REE) are useful to reconstruct sources, transport and deposition of aeolian dust deflated from dry areas; As, Bi and Cd are tracers of volcanic ash; Ir, Pt and Os are proxies of cosmic material; Pb, Zn, Cu and Sb are anthropogenic contaminants that are now globally dispersed. While the occurrence of trace metals is relatively common in the environment, their abundance is however extremely low, in particular in hydrological systems, with concentrations ranging from hundreds of nanograms per gram (100 × 10-9 g/g) to the sub-femtogram per gram level (0.1 × 10-15 g/g), spanning at least nine orders of magnitude. Detection and reliable determinations of trace elements remain therefore a formidable analytical challenge. Inductively Coupled Plasma-Sector Field Mass Spectrometry (ICP-SFMS) is now a mature technique that can overcome these analytical problems, provided that an extraordinarily careful control of contamination is performed during the sample preparation. ICP-SFMS can determine 30-40 trace metals in a few milliliters of water over a few minutes. In this way it is possible to obtain trace metal concentrations and elemental ratios that are within 20% and 5% of uncertainty, respectively, at the tens/hundreds picogram per gram level (10-100 × 10-12 g/g). This technology, as well as the infrastructure and experience to control contamination, are available at the Byrd Polar and Climate Research Center for the analysis of water-based matrices and to train students to become independent in operating this technique and interpreting geochemically the results obtained.

Elemental composition and number of single nano- and micro- particles in Antarctic Taylor Glacier ice during the last climatic cycle measured by single particle-inductively coupled plasma mass spectrometry

Madeleine Lomax-Vogt

The number and chemical composition of aeolian particles affect the climate by reflecting, scattering, or absorbing solar radiation or by acting as ice and cloud condensation nuclei. Single particle-ICP-MS was used to measure the number and composition of thousands of individual nano- and micro- particles entrapped in

Taylor Glacier ice spanning the last glacial-interglacial transition (9-44 kyr BP). Unlike bulk analysis (which measures the average concentration of elements), mineral types were determined from spICP-MS data using the ratio of elements detected in particles.

Estimating Digital Terrain Models from ArcticDEM Digital Surface Models and its Source Imagery

Tianqi Zhang, zhang.9323@osu.edu

Retrieving the bare ground elevation is essential for monitoring dynamic changes of earth surface, e.g., melting of glaciers, canopy height growth, surface deformation caused by earthquakes. A recent developed digital elevation model (DEM), ArcticDEM, generated from stereo-pairs of optical satellite imagery, brings the public a great opportunity in accessing high-resolution and high-quality observations of the pan-arctic surface. However, dense canopy prevents ArcticDEM from returning the terrain yet reflecting the canopy surface elevation. To exploit more potentials from ArcticDEM, here we proposed a model by integrating unsupervised clustering, morphological operation with spatial interpolation to produce high-resolution digital terrain models (DTMs) at three study sites in Alaska. We further designed synthetic scenarios to evaluate the spatial interpolation under varying levels of topographic and canopy cover conditions. Our results indicate that, 1) unsupervised clustering combined with morphological operation effectively removes vegetated pixels; 2) the generated DTMs at three study sites help decrease the root mean square errors, mean absolute errors between ArcticDEM and referred LiDAR-derived DTMs by 53-86.5% and 51.9-79.2% respectively; 3) the resultant canopy height models (CHMs) achieve comparable results to LiDAR-derived counterparts; 4) the optimal spatial interpolation for DTM prediction is case-dependent, while natural neighbor generally predicts more reliable DTMs than other examined techniques with no constraints on vegetation distribution and topography conditions. The presented model input stereo-imagery and its generated DSM only therefore is expected to be generalized to other study regions with similar known information.

Improving the Accessibility of Fluid Earth Viewer

Adelyn Arens, arens.28@osu.edu

Iron behavior and bioavailability in glacial meltwater runoff into the Ross Sea, Antarctica

Christopher Gardner, gardner.177@osu.edu

Examining the Sensitivity of Monthly Temperature Forecast Models to Multiple Sources of Soil Moisture Data

Zack Leasor, leasor.4@osu.edu

A neglected role of precipitation frequency in determining spring phenology

Jian Wang, oscarwang1993@gmail.com

Climate change, particularly as associated with global warming, has substantially advanced plant spring phenology and further regulated carbon cycling over the last few decades. A common assumption for current large-scale models is that spring leaf unfolding date (LUD) is controlled by the accumulation of heat, regardless of other climate factors. Synthesis of satellite data, flux measurements, and ground observations reveals an important but unexplored role of precipitation frequency (Pfreq), that tightly controlling the effect of precipitation, in determining spring LUD in the Northern ecosystem (>30°N). The underlying mechanism is possibly related to the water stress from the atmosphere (i.e., vapor pressure deficits and potential evapotranspiration) to soil (i.e., soil moisture). Pfreq variations explained nearly 30% inter-annual changes in LUD during 1982-2015, higher than the effect of precipitation amount and solar radiation. Our results highlight that the need for a comprehensive understanding of precipitation responses to spring phenology, which is necessary for improved projections.

Mitigation of the Water Crisis within Navajo Tribal Communities through the Sustainable Village Water Systems Model

Tom Darrah, darrah.24@osu.edu

The COVID-19 crisis has highlighted the fundamental importance of secure access to clean water, sanitation and hygiene (WASH) to ensuring public health. Extended drought and changing climate already threaten the productivity of agriculture on the Navajo Nation, which will only worsen with increasing temperatures and changing rainfall patterns. Water resource use and sustainable management are essential to WASH and agriculture and require both scientifically based use strategies and sound business models for ongoing operation. Our Team's Sustainable Village Water Systems (SVWS) model combines all of these components – development of secure water access, WASH, agriculture, as well as sustainable business enterprises in agriculture and water services.

Intercropping of walnut orchards as a mitigating measure for climate change

Vladimir Ivezić, vivezic@fazos.hr

The significance of intercropping is in the cultivation of plant species in systems that are less susceptible to stress. The aim of our research is to investigate the yields in the intercropped system of walnut and wheat. The field trial was set up in Croatia in an 11-year-old walnut orchard with an alley width of 8m, wheat was sawn in 6m wide strips. The field trial consisted of three plots – a) control plot of wheat without walnuts, b) walnut orchards with intercropped wheat and c) walnut orchard without intercropped wheat.

The walnut orchard has 10 rows of walnuts of the same length. However, the walnut yield of the first five rows was always around 30% of the total yield, while the last five rows had around 70% of the total walnut yield. The wheat was sown in the 4 alleys in between the first five rows to increase the productivity of this low productive area. The walnut yield in the intercropped area was 378 kg/ha which was almost half of the yield of walnuts in rows that were not intercropped (746 kg/ha). However, in addition to walnuts, the first five rows also had wheat. On the wheat control plot, the yield was 6.7 t/ha while the wheat yield within the walnut orchard was 4.5 t/ha (since only 75% of the intercropped area was covered with wheat). However, the first five rows of walnut gave 67% of wheat yield compared to the wheat control plot and 51% of walnut yield compared to the walnut control plot. Altogether it comes out that the intercropped plot had a land equivalent ratio (LER) of 1.18 i.e. intercropping in these low productive rows of walnut have increased its production by 18%.

Mountain temperature changes from embedded sensors spanning 2000m in Great Basin National Park, 2006-2018

Bryan Mark, mark.9@osu.edu

Mountains of the arid Great Basin region of Nevada are home to critical water resources and numerous species of plants and animals. Understanding the nature of climatic variability in these complex environments, especially in the face of unfolding climate change, is a challenge for resource planning and adaptation. Here we utilize an innovative, high-resolution Embedded Sensor Network (ESN) to investigate small-scale climatological conditions in Great Basin National Park (GBNP). The ESN was installed in 2006 and has been continuously maintained by students during annual research training expeditions. It is comprised of 29 Lascar sensors that log hourly observations of near-surface temperature, dewpoint and relative humidity at locations spanning multiple topographic, hydrological, and ecological gradients within the park. From a maximum of ~4000 m elevation atop Wheeler Peak, the sensor locations are distributed: (1) along a multi-mountain ridgeline to the valley floor ~2000 m lower; (2) alongside two streams in adjoining eastern-draining watersheds; and (3) among multiple ecological environments including sub-alpine forests, alpine lakes, sagebrush meadows, and a rock glacier. After quality checking all available hourly observations, we develop and analyze a preliminary decade-long climatology for GBNP and report on key patterns of variability observed. From 2006 to 2018, GBNP experienced an average near-surface lapse rate of –5.81°C/km. Average daily minimum temperatures in GBNP have increased by 2.06°C over the last decade. Spatial and temporal variability is evident in average temperatures, ground lapse rates and diurnal temperature ranges. There is a significantly positive trend in daily maximum, minimum and mean temperatures for all elevations, but the trend in daily maximum temperatures above3500 m was significantly greater than the positive trends at lower elevations, suggesting that daytime forcings may be driving enhanced warming at GBNP's highest elevations. This study offers an alternative, low-cost methodology for sustaining long-term, distributed observations of conditions in mountainous environments at fine resolutions.

Rebuilding the Fluid Earth Viewer web application to improve engagement

Em Zhan, zhan.153@osu.edu

The Fluid Earth Viewer (https://fever.byrd.osu.edu/) is a web application that uses an interactive globe to display weather and climate datasets in an intuitive manner for science communication. However, it struggles to keep users engaged because of subpar rendering performance and inconsistent views during pan and zoom interactions. We are rebuilding the Fluid Earth Viewer from the ground using the WebGL low-level graphics API to substantially improve performance and thus engagement.

Examining the Sensitivity of Monthly Temperature Forecast Models to Multiple Sources of Soil Moisture Data

Alexander Ihle, ihle.14@buckeyemail.osu.edu

Previous research has demonstrated that soil moisture improves baseline temperature forecasts at lead times ranging from one month to one season. This increase in forecast skill is most evident during the warm season when persistent anomalous temperatures are influenced by antecedent soil moisture conditions. To account for the increasing availability of soil moisture data, this study examines the sensitivity of forecast models to varying data sources. Soil moisture data from direct in situ measurements and land surface models are considered in addition to the Standardized Precipitation Index (SPI) as a proxy estimate. These data are integrated into forecasts to examine how the data source impacts model performance. Soil moisture is used in quantile regression models to predict temperatures at monthly and seasonal timescales across CONUS. Results suggest improvements in monthly temperature forecast skill occur in many regions when soil moisture is included with persistence as a predictor variable. There is evidence that predictive skill varies significantly according to the source of soil moisture data. Evidence also suggests that forecast models tend to be more sensitive to changes in the period of record than changes in the input soil moisture data type.

Developing Impacts-Based Drought Thresholds for Ohio

Zhiying Li, li.8254@osu.edu

Drought monitoring is critical for water management, hazard prediction and mitigation, and agriculture outlook. Various drought indices have been developed to characterize the drought development, magnitude and potential impact, and a fixed set of drought threshold is commonly applied nationwide. However, for regional application, the most appropriate drought indices may vary from state to state, and the fixed drought thresholds may not properly reflect local drought conditions. Therefore, the aim of this study is to identify suitable drought index and develop impacts-based drought threshold that are appropriate for drought monitoring in Ohio. Three commonly used drought indices, including Standardized Precipitation Index (SPI), Standardized Precipitation-Evapotranspiration Index (SPEI) and Z-Index were examined. Drought impacts were assessed using corn and soybean yields, streamflow, and drought impact reports. The drought thresholds were tailored according to the drought response to yield loss in Ohio. Three representative drought events were used to evaluate the drought indices and thresholds. Our results show Z-index has the highest correlation with streamflow among the three indices, and it also performs best in identifying the drought onset among the three indices. However, there is no significant difference among the three indices in terms of the maximum correlation with crop yield. The United States Drought Monitor (USDM) tends to indicate milder conditions than the impacts-based drought thresholds, and the drought maps generated by Z-index match best with the USDM archives in terms of drought percent area and drought evolution. The proposed set of drought thresholds can better characterize the drought response to yield loss compared with the drought category adopted by the USDM. This study provides an operational methodology and a new set of localized drought thresholds to diagnose the onset, development, and impact of drought. This methodology can be easily applied to other regions to improve drought monitoring.

Farmer Adaptation to a Changing Climate in the Eastern Corn Belt Region

Shelby Taber, taber.42@buckeyemail.osu.edu

Climate change in the eastern Corn Belt Region (ECBR) is projected to bring higher temperatures, more variable and extreme levels of precipitation, and longer growing seasons. While these possibilities imply opportunity for increased production, managing change sustainably will be increasingly challenging. We conducted a survey of farmers in the ECBR to assess how farmers are currently adapting, and how likely they are to adapt to projected changes in planting and harvesting dates, annual rainfall, and conservation payments. Preliminary results indicate that, compared to earlier assessments of climate beliefs in the Midwest, less farmers are now unsure that climate change is happening, and more believe the changes are caused by humans. The most concerning climate impact was more frequent extreme rainfall events, while the least concerning was higher nighttime temperatures. However, overall concern, and interest in adaptation was still relatively low. The most popular adaptation to date was planting more resilient varieties of crops already grown, while the least popular was changing the type of crop insurance bought. Regardless of the climate scenario presented, 28% of respondents opted to not make any adaptations, and these individuals were older and more likely to be using conventional tillage. Among those who reported an intention to make at least one adaptation, the most popular response was to install more drainage tile. The total number of adaptations reported in a given scenario increased as the probability of experiencing the changing climate conditions increased, and as the respondent reported higher levels of education, experiencing more climate impacts, and plans to pass on their farm to a family member. The implications of these findings for future policy and programming will be discussed.

Monitoring cyanobacterial harmful algal blooms at high spatiotemporal resolution by fusing Landsat and MODIS imagery

Yongquan Zhao, yongquanzhao181@gmail.com

Toxic Cyanobacteria-rich Harmful Algal Blooms (CyanoHABs) are severe environmental issues impacting water environment, aquatic life populations, and surrounding wild and human lives. Given their fast-changing variations in space and time, frequent monitoring of CyanoHABs with sufficient spatial details and coverage is needed to understand their impacts. However, current monitoring activities based on in situ or satellite data do not meet this requirement due to the limited spatial coverages of buoy measurements and the compromise between spatial resolution and temporal frequency of satellite observations. In this study, we develop a Spatial-Temporal Image Fusion (STIF) approach to enable high spatial-temporal resolution monitoring of CyanoHABs. The proposed approach consists of two steps: (1) a new CyanoHAB spectral index called Broad Wavelength Algae Index (BWAI) was developed for fine-but-sparse (Landsat) and coarse-but-frequent (MODIS) satellite images, and (2) the Landsat and MODIS derived BWAI images were fused by the Robust Adaptive Spatial and Temporal Fusion Model (RASTFM) to generate fine-and-frequent Landsat-like BWAI images. Our results show that the proposed BWAI index is with higher similarity and correlation with the reference Cyanobacteria Index (CI) images and in situ observations than the comparative algae indices devised for broad wavelength sensors. Moreover, the 30-m Landsat-like BWAI image series provide more accurate and detailed results than their 500-m MODIS counterparts and greatly improve the temporal frequency over Landsat-based algae indices, demonstrating the contribution of the improved spatial-temporal resolution achieved by the proposed STIF approach. Consequently, this research fills the gap of high spatiotemporal resolution monitoring of CyanoHABs and paves a new way of assessing water environment in a timely and detailed manner.

Constraining Ice Shelf Basal Channel Evolution Melt Rates

Allison Chartrand, chartrand.8@osu.edu

Discussion on Climate Justice and Equity

Facilitator: Joel Wainwright, Department of Geography

Discussion focused on the following three questions:

1. What does "Climate Justice" mean to you?
2. What are the fundamental barriers to achieving 'climate justice' on a planetary scale?
3. What would be necessarily for us to overcome these barriers?

Responses to the first question were relatively uniform; responses to questions 2 and 3 were not. So, after briefly establishing a working definition of climate justice—addressing the climate crisis in a way that deepens social justice—we discussed the other two questions (first in small groups, then as a whole). Yet we were unable to reach any substantive consensus on either question. Participants agreed that climate change is driven by the wealthy, and it is mainly the poor who will suffer. This daunting problem pervades nearly every aspect of our world. Yet, indeed, there is currently no clear strategy for a common program to confront this injustice. In the face of this gap, some advocated further collaborations between climate scientists and social and behavioral scientists.

Discussion on Engaging with the Public and Policy Makers

Facilitator: Robyn Wilson, Professor, School of Environment and Natural Resources

Discussion started with asking why engagement so often fails, with the common response being the public's desire for simple answers to complex problems and policymakers' bias for convenient narratives that fit political objectives. This challenge is increased by abundant disinformation and the reality that many audiences are not receptive because they are socio-economically insulated from the impacts of climate change. Further, few policymakers have scientific backgrounds, resulting in a divide between those who provide information and those who should apply it. All of these issues are analogous to those currently faced in the public health policy around the COVID-19 pandemic.

Engagement could be improved by providing more forums where researchers and policymakers interact, and where challenges are discussed as opportunities in terms of tangible costs and benefits. Support should be provided to create professional and accessible data visualizations that convey complex information effectively, and optional training in science communication for researchers, students and faculty should be provided. This activity should be incentivized by grant agencies and as part of faculty promotion.

Following on this question, the group discussed ways to better communicate complicated scientific results in order to make them consumable and actionable. Visual aids, as mentioned above, tangible evidence (ice cores, tree rings, etc.) and demonstrations are most effective. The evidence should also be compelling for the audience. Another strategy is to use local examples and analogies familiar to the audience that show interconnectedness of the Earth System, starting with the importance of the information rather than the details. Storytelling also helps people identify with victims and transport them into alternative realities, so telling the story of the person impacted by climate change can be powerful. Finally, rather than only presenting problems, it is important to provide practical, individual-level solutions.

Center education and outreach staff are critical for facilitating engagement through their knowledge of best practices and avenues of communication to a wider, more diverse audience. Frequent interaction between researchers and outreach professionals should be commonplace and be viewed as critical as the research activity itself.

In the current, politically charged climate, the question "Do you believe in climate change?" should be avoided, with “belief” replaced by an understanding of the scientific method and of the available evidence. Providing an understanding of the scientific process is as important, if not more, than presentation of the facts.

Lastly, the group discussed ways for overcoming public distrust of scientists/science and the spread of mis/disinformation. Firstly, OSU should provide media literacy training to both students and the public to enable them evaluate content for trustworthiness. Secondly, institutes and organizations should have consistent messaging around what is known about outstanding problems and the best ways to solve them, describing uncertainties in clear terms (i.e. probabilities). Finally, social/mass media communications should be coordinated by trained professionals, but with close interaction/oversight by the research team to prevent the sensationalistic headlines that are incentivized by the modern media “click bait” landscape. At the same time, researchers should engage to add information or correct misinformation on popular sites such as Wikipedia.

Synthesis and Paths Forward

The symposium demonstrated both the extent of the climate change crises and the breadth of expertise available at Ohio State to understand and confront it. We have identified a set of interdisciplinary science questions with transformative potential, that, while challenging and complex, are well within our reach through collaborative research. Importantly, we have identified some of the barriers to forming these collaborations and ways to remove them. The next step will be to use the tools available to build active collaborations around the nuclei of these ideas. The Byrd Center and its partner Centers and Institutes are committed to pushing these forward.

While all of these science questions are global in scope and impact, they are also directly relevant to the prosperity of Ohio, advancing our mission as a land-grant University. Further, a common thread was the need for information about the future climate of the Ohio region and beyond. This highlights the clear need for expertise in atmospheric modeling and data assimilation that can support interdisciplinary investigations into climate impacts, response and mitigation. Currently at Ohio State, such expertise is limited, and regional climate prediction is not the research focus of any faculty members.

The symposium also allowed us to discuss the role of the climate crisis in worsening social inequalities. In many ways, answering the scientific questions seem easy when compared to something as intractable as climate justice and equity. However, no matter how uncomfortable or discouraging, it is critical that scientists confront the broader implications of climate change beyond their specific research in order to maintain perspective. The University should promote and facilitate these discussions among the entire community in order to make progress.

Also important is effectively communicating our science. This symposium offered the opportunity to share “what works” learned from experience, as well as study and training. At Ohio State and through its Centers, resources are available for maximizing the impact of our science through effecting outreach and engagement. Further training of scientists in effective communication and close partnerships with outreach professionals should be prioritized in OSU’s research culture.

Acknowledgements

Planning for the Byrd Center’s second symposium on climate change research at Ohio State began almost immediately after the first. A committee led by David Bromwich and consisting of Jason Cervenec, Michele Cook, Stephen Coss, Ian Howat (ex officio), Marta Jarzyna, Stacy Porter and Steven Quiring devised the initial symposium plan based on feedback from the community. Jason Cervenec and Karina Peggau translated this plan into a virtual format, including devising the structure of the poster sessions and breakouts. Michael Cicarella created and maintained the symposium registration system, email and web communications.

Thank you to our speakers, Richard Alley, Aparna Bole and Marta Jarzyna, for their excellent talks, and to our Breakout Discussion facilitators for productive discussions. We also thank all those that participated in the discussions and look forward to future collaborations.

We thank the Ohio State Office of Research and the Sustainability Institute for their support.

The Ohio State University

BYRD POLAR AND CLIMATE
RESEARCH CENTER