Focus Area 1:

Changing Subseasonal to Seasonal (S2S)

Weather Patterns

Jeffrey Basara

Associate Professor

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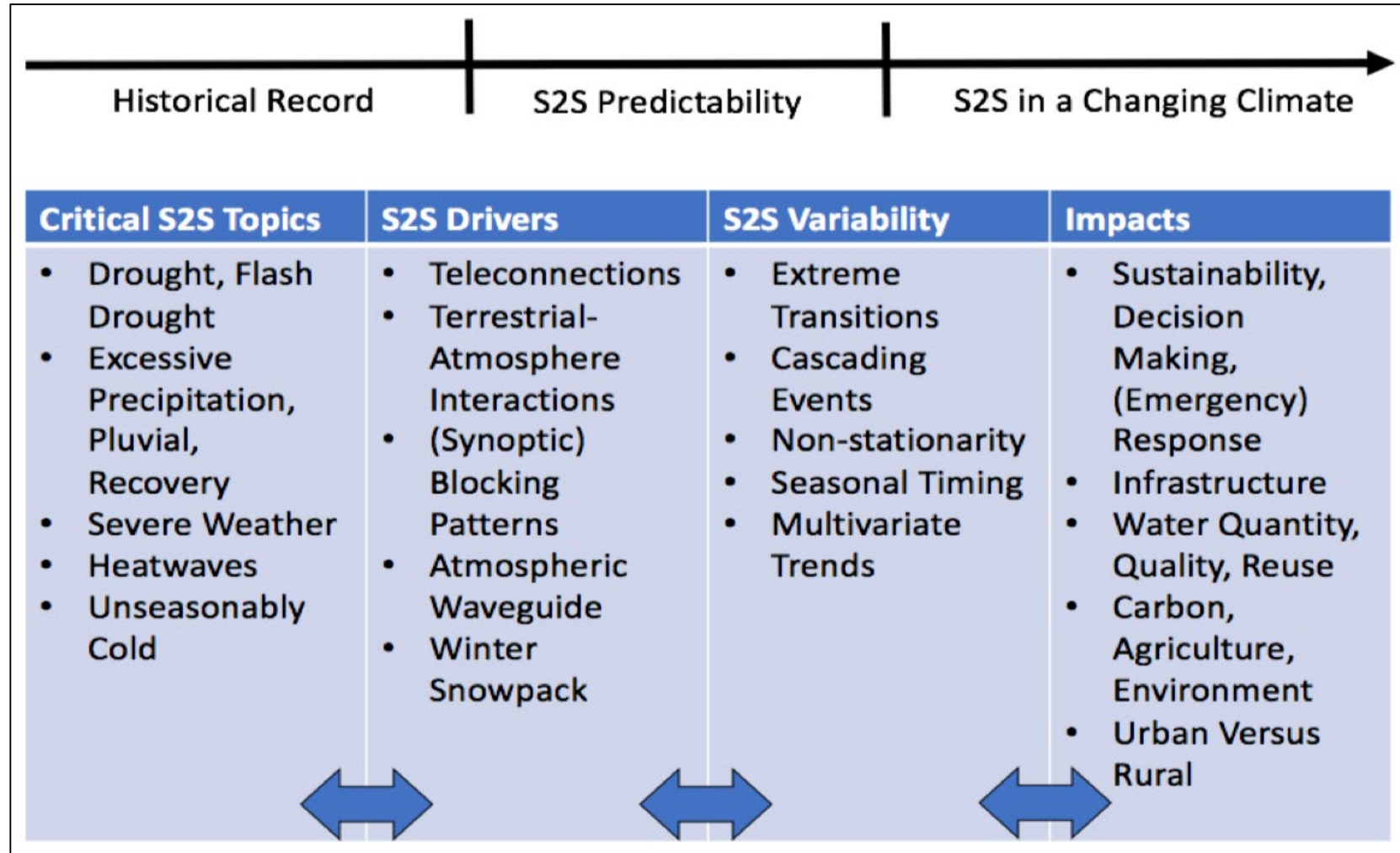
University of Oklahoma

S2S: WHAT IS SUBSEASONAL TO SEASONAL (S2S)?

Subseasonal to Seasonal spans timescales from weeks to months.

At the interface between weather and climate.

May include significant events embedded within more extended "patterns".

"Limited" Predictability.

Historical Record	S2S Predictability	S2S in a Changing Climate

Critical S2S Topics	S2S Drivers	S2S Variability	Impacts
• Drought, Flash Drought • Excessive Precipitation, Pluvial, Recovery • Severe Weather • Heatwaves • Unseasonably Cold	• Teleconnections • Terrestrial-Atmosphere Interactions • (Synoptic) Blocking Patterns • Atmospheric Waveguide • Winter Snowpack	• Extreme Transitions • Cascading Events • Non-stationarity • Seasonal Timing • Multivariate Trends	• Sustainability, Decision Making, (Emergency) Response • Infrastructure • Water Quantity, Quality, Reuse • Carbon, Agriculture, Environment • Urban Versus Rural

Goals and Objectives

Research Question: **What key features and feedback processes (e.g., synoptic blocking, teleconnections, surface-atmosphere exchange, snowpack,etc.) drive S2S events in space and time?**

Research Question: **How can we improve the predictability of critical S2S processes and events? A)**

Research Question: **What S2S thresholds and baselines are needed to improve or protect infrastructure, water (quality, quantify, reuse), carbon (e.g., agriculture), and overall societal needs?**

- S2S Objective 1. Understand the basic processes driving changes in S2S patterns.
- S2S Objective 2. Improve models and predictions of basic S2S process and events.
- S2S Objective 3. Develop the data necessary for managing water, carbon and water cycles, and infrastructure in OK.
- S2S Objective 4. Create the S2S data repository and delivery system for the S3OK team, stakeholders, and future end users.

The S2S Team

Dr. Yuting Zhou
Department of Geography
Oklahoma State University

Dr. Jason Furtado – **FA Co-Lead**
School of Meteorology
University of Oklahoma

Dr. Jeffrey Basara – **FA Lead**
School of Meteorology
School of Civil Engineering and Environmental Science
University of Oklahoma

Dr. Elinor Martin
School of Meteorology
University of Oklahoma

Dr. Joseph Ripberger
Department of Political Science
University of Oklahoma

- **Postdoctoral Scientist – Dr. Jordan Christian**
- **6 Graduate Students**

RESEARCH FOCUS AREA 1: S2S
CHANGING SUBSEASONAL TO SEASONAL WEATHER PATTERNS

Progress to Date

- **Understanding Processes**
- **Predictability/Change**
- **Impacts**
- **Extreme Events**

Focus Timelines

1. **Years 1-4**
2. **Years 2-5**
3. **Years 2-5**
4. Years 1-5

Historical Record → S2S Predictability → S2S in a Changing Climate

Critical S2S Topics	S2S Drivers	S2S Variability	Impacts
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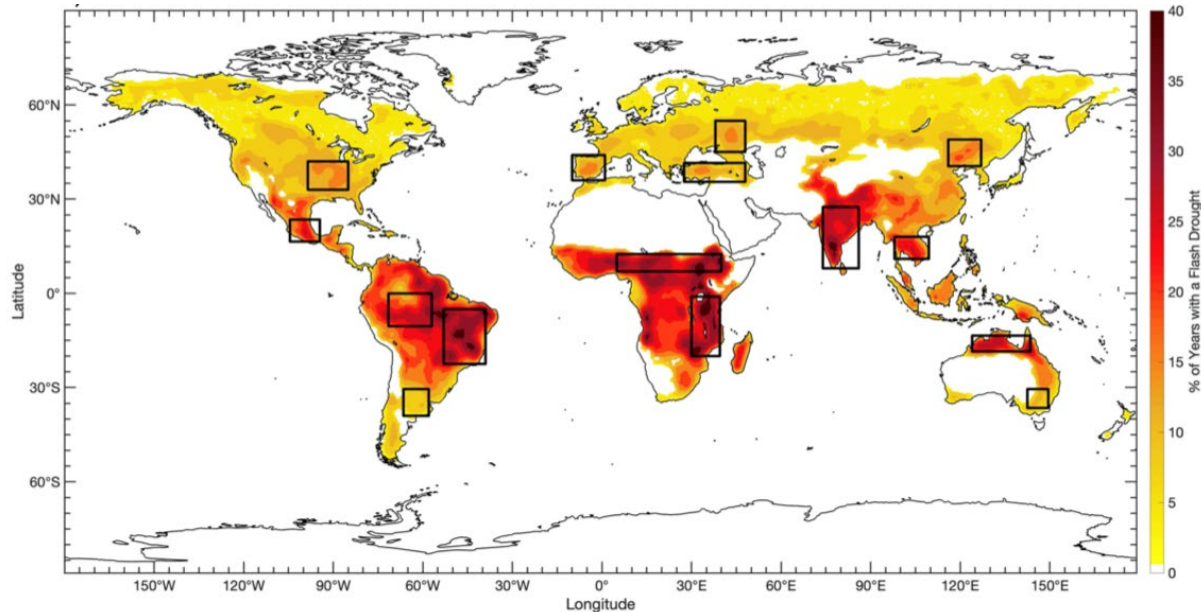## S2S : RESEARCH PROGRESS – FOCUS ON PROCESS

Flash Drought Dynamics

Dr. Jordan Christian
Postdoctoral Scientist
School of Meteorology
University of Oklahoma

High Resolution Flash Drought from Satellite/Vegetation Observations →
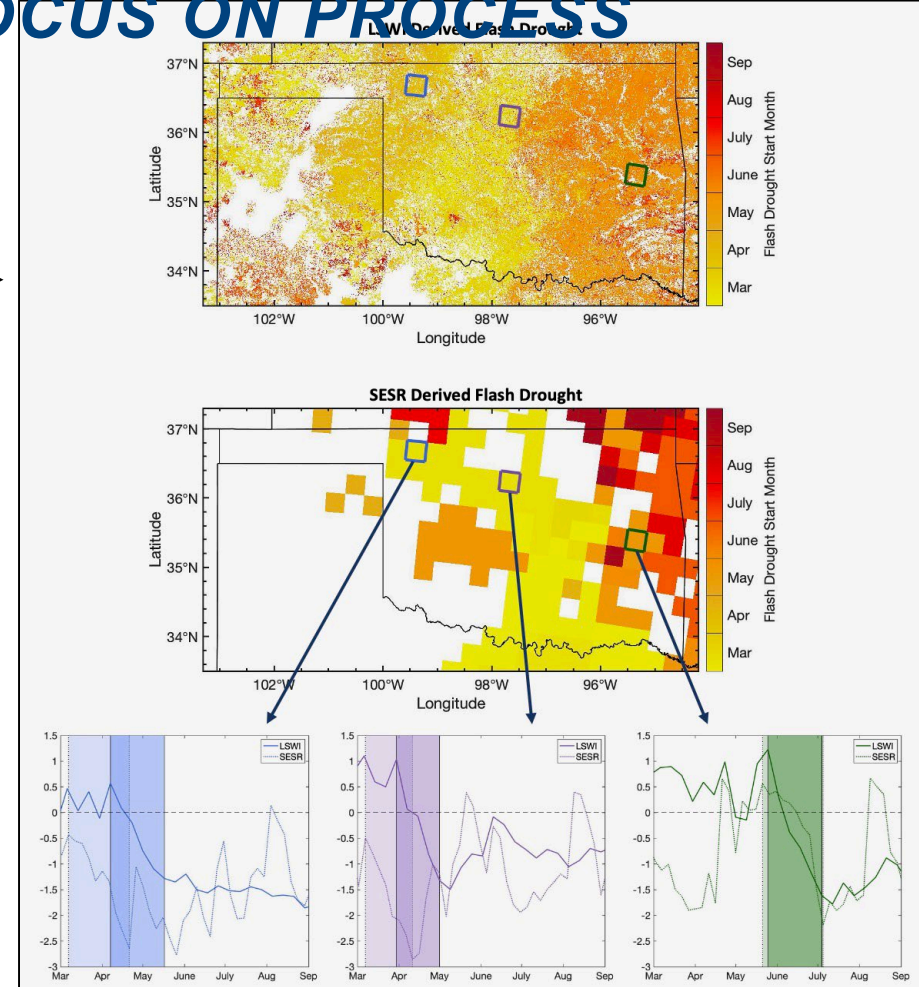
← Global Climatology of Flash Drought

Christian, J., **Basara, J. B.**, Hunt, E., Otkin, J., **Furtado, J., Xiao, X**. and R. Randall, 2021: Global Distribution, Trends, and Drivers of Flash Drought Occurrence. *Nature Comms.,* **12,** 6330 (2021). https://doi.org/10.1038/s41467-021-26692-z.

Christian J. I., J. B. Basara, L.E.L. Lowman, **X. Xiao,** D. Mesheske, and **Y. Zhou**, 2021: Flash Drought Identification from Satellite-Based Land Surface Water Index. *Remote Sensing Applications: Society and Environment,* In review.
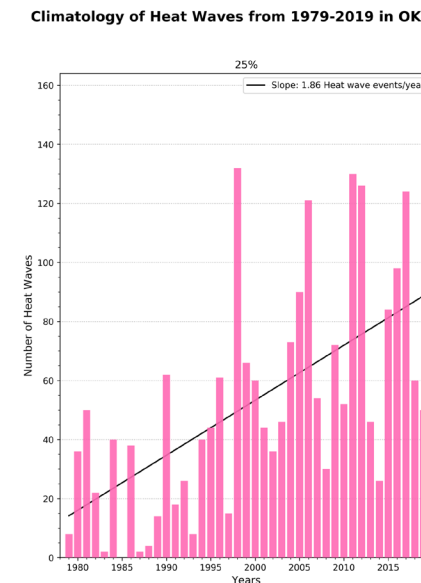
S2S : RESEARCH PROGRESS – FOCUS ON PROCESS

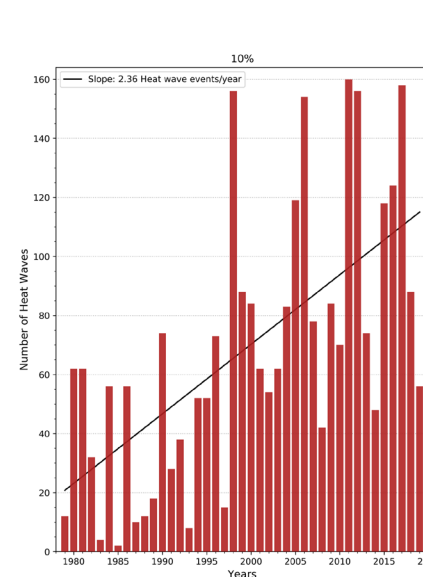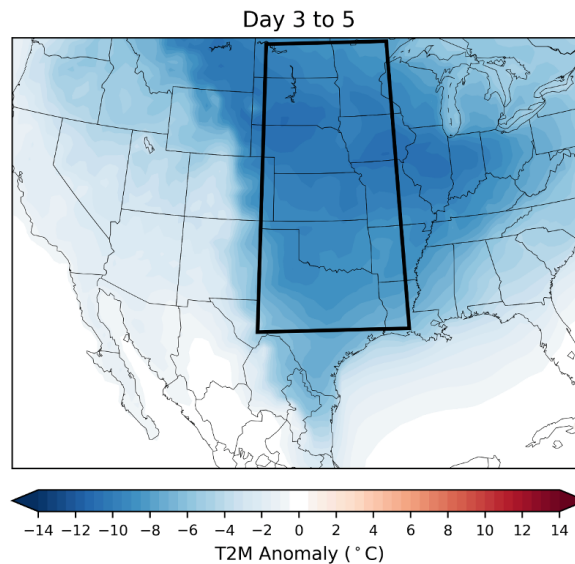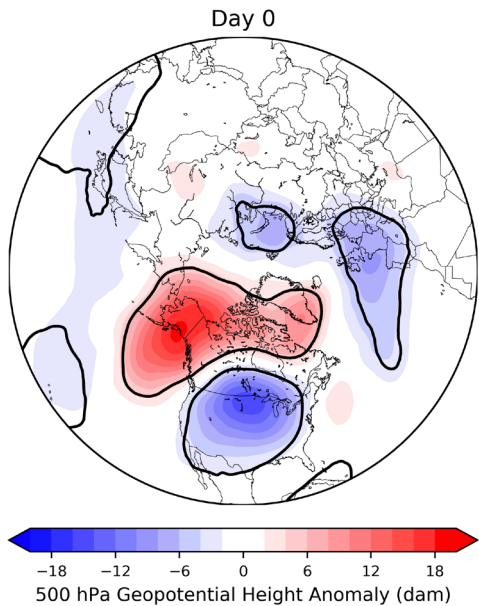**Drivers and Predictability of Cold Snaps in the Great Plains**

Ollie Millin
Graduate Research Assistant
School of Meteorology
University of Oklahoma

Heat Waves in the Southern Great Plains

Taylor Grace
Graduate Research Assistant
School of Meteorology
University of Oklahoma

Day 0

Day 3 to 5

500 hPa Geopotential Height Anomaly (dam)

−18 −12 −6 0 6 12 18

T2M Anomaly (°C)

−14 −12 −10 −8 −6 −4 −2 0 2 4 6 8 10 12 14

Climatology of Heat Waves from 1979-2019 in OK

10%

Slope: 2.36 Heat wave events/year

25%

Slope: 1.86 Heat wave events/year

50%

Slope: 1.30 Heat wave events/year
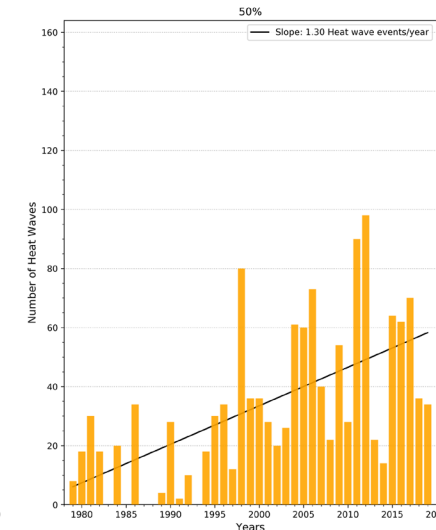
Millin, O. T., J. C. Furtado, J. B. Basara, 2021: Characteristics, Evolution, and Formation of Cold Air Outbreaks in the Great Plains of the United States. *J. Climate*. https://doi.org/10.1175/JCLI-D-21-0772.1

Taylor was awarded the **2nd Place Student Oral Presentation Award** at the 34th Symposium on Climate Variability and Change – AMS 2022

RESEARCH FOCUS AREA 1: S2S
CHANGING SUBSEASONAL TO SEASONAL WEATHER PATTERNS

S2S : RESEARCH PROGRESS – FOCUS ON PROCESS

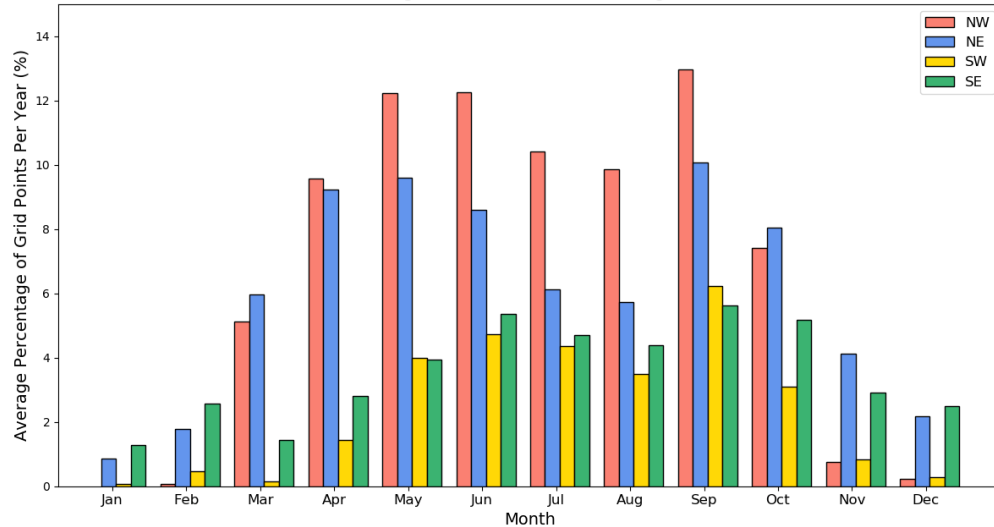**S2S Precipitation Transitions: Drought to Pluvial – Pluvial to Drought**

Bryony Puxley
Graduate Research Assistant
School of Meteorology
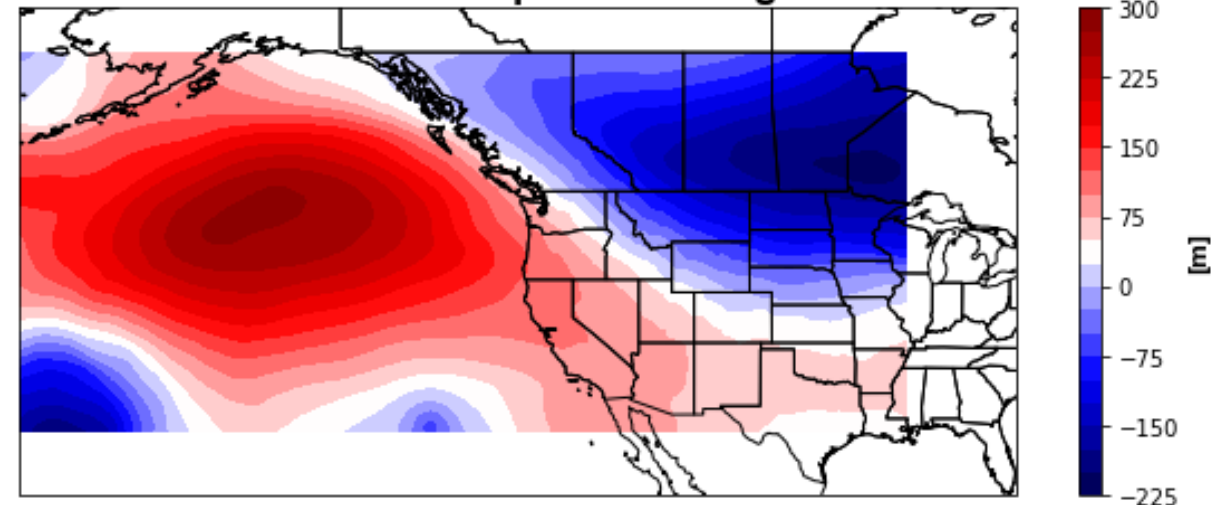University of Oklahoma

The October 2020 Ice Storm

Alyssa Woodward
Graduate Research Assistant
School of Meteorology
University of Oklahoma

Key Results: Location/timing of precipitation whiplashes (especially Fall transitions) and links to wildfires.

Key Results: Earliest ice storm on record, major impacts across sectors, links to large-scale dynamical processes.

Impacts of the Research

- **Example** - Flash drought research has improved methods to identify and monitor occurrence from local (i.e., in Oklahoma) to global. Was published in a high impact journal (Nature Communications), was featured as a Nature Highlight, has received significant media coverage, and has directly impacts research collaborations with other S3OK teams (TWCD, SI, SD, V-MWQ)

- **Example** – Cold air outbreak research has advanced scientific understanding across the weather/S2S/climate research but also tangible impacts across infrastructure and socio-economic impacts. Jason Furtado presented at the Society for Risk Analysis Annual Meeting in December 2021.

A Meteorological Evaluation of the February 2021 North American Cold Wave

Co-Authors: Jason Furtado, Oliver Millin, Jeffrey Basara Rationale: For about two weeks in February 2021, widespread r...

Jason Furtado
School of Meteorology, University of Oklahoma
Associate Professor

1:00 PM - 1:15 PM CST (Wed, Dec 8)

APPLIED RISK MANAGEMENT | RISK COMMUNICA... · RISK ASSESSMENT · DEVELOPMENT · CLIMATE ADAPTATION (PREPAREDNESS)

SYMPOSIUM

W57 - Symposium: Exploring the Complexity of Extreme Weather Events: Risk Perceptions, Communication, State Capacity, and Societal Response During the February 2021 Cold Weather Event

Co-Authors: Andrew Fox, Jeff Basara, Kuhika Gupta, Joseph Ripberger, Muralee Muraleetharan, Warigia Bowman Rationale: T...

Warigia M. Bowman
University of Tulsa College of Law
Associate Professor

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Research Scientist

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Kuhika Gupta
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Paul Moses, PhD
University of Oklahoma
Assistant Professor

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Professor

Joseph Ripberger
University of Oklahoma

RESEARCH FOCUS AREA 1: S2S
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Summary of Progress

Research Component	Primary Goal	Key Accomplishments	Status
S2S Obj. 1: Understand the basic processes driving changes in S2S patterns.	Identify key features and feedback processes driving S2S events in space and time	1) Initial/mature analyses of all critical topics underway or completed. 2) Multiple articles in review or published.	**ON SCHEDULE**
S2S Obj. 2: Improve models and predictions of basic S2S process and events.	Evaluate S2S predictability across spatial and temporal scales.	1) Predictability assessments in S2S hindcast/forecast systems are underway 2) Examination of S2S extremes in climate model simulations have begun.	**ON SCHEDULE**
S2S Obj. 3: Develop the data necessary for managing water, carbon and water cycles, and infrastructure in OK.	Identify which environmental variables (and understanding) are most important to each sector in space, time, and magnitude	1) Engaged other S3OK teams to identifying preliminary needs. 2) Developed initial datasets for several features and extreme events (e.g., 2020 Ice Storm)	**ON SCHEDULE**
S2S Obj. 4: Create the S2S data repository and delivery system for the S3OK team, stakeholders, and future end users.	Identify what critical S2S datasets and applications are needed by stakeholders/team/users and build the repository	1) Ever growing list of identified and analyzed cases. 2) S2S team directly engaging stakeholders.	**ON SCHEDULE**

Future Plans

- Transition from **Process Understanding** to **Predictability and Change** – especially in Years 2-3.

- Address Process and Predictability under the full S3OK umbrella (e.g., flash drought, whiplash events → wildfires, heatwaves, etc.)

- Analysis of Extreme Events and Impacts with S3OK teams (i.e., 2020 Ice Storm – **SI** , 2021 Deep Freeze - **SD**, 2021 Flash Drought - **TCWD**, etc.).

- Structured engagement with S3OK teams via focused/collaborative projects (e.g., the Little River Watershed Study).

- Continued development of the S3OK event database – significant opportunities for collaboration.

EPSCoR OKLAHOMA