2022 US CLIVAR Summit

Welcome and Introduction

Mike Patterson, Program Director

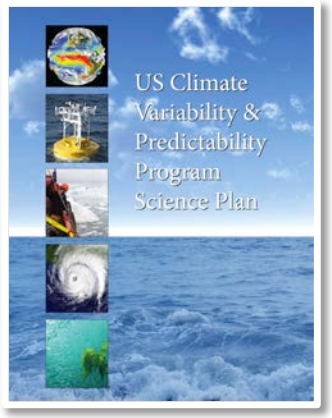
Meeting Objectives and US CLIVAR Update

Gudrun Magnusdottir, Scientific Steering Committee Chair

Summit Meeting Format and Objectives

- The Panels met virtually in Summer 2021 addressing their respective **near-term implementation priority topics.**
- With individual panel sessions completed, the Summit assembles all Panels for a **series of plenary sessions to explore emerging and priority topics** identified by the SSC and Panels last year.
  - Updates on US and International programs and evolving agency priorities **to provide context for community planning**
  - Special session on Diversity, Equity, and Inclusion **to inform scoping of next step DEI efforts and collaborative opportunities**
  - Science sessions:
    - The Air-Sea Transition Zone
    - Cloud Processes in the Climate System
    - Climate and Health *(PPAI Session)*
    - Enabling Open Science in the Age of Big Data
    - Sea Level and Coastal Flood Risk Prediction
    - Stratosphere-Troposphere Interactions
    - Hybrid Physics-AI Forecast Models
  - Panel breakouts **to identify action items to advance US CLIVAR community activities addressing the session topics**
- Summit Report will incorporate 2021 Panel Meeting and 2022 Summit sessions and resulting action items **to advance science goals**.

Science Plan Implementation



Strategic Approaches

- Science Goals set by the Scientific Steering Committee (SSC)
- Research Challenges defined by the SSC
- Near-Term Priorities established by the Implementation Panels
- Implementation Activities developed by the Panels and broader community through open calls

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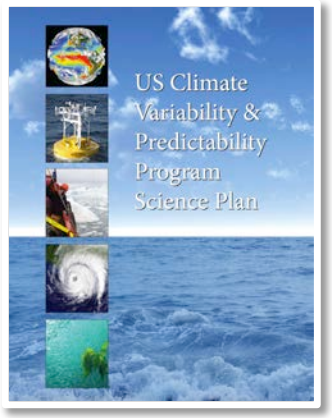
Science Plan Implementation



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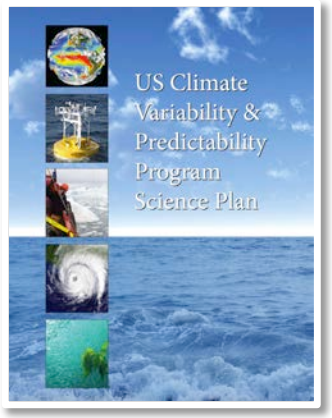
US CLIVAR's Coordination Role

US CLIVAR facilitates coordination among scientists to accelerate research progress collectively beyond individual investigator efforts to:

- Assess the state of understanding
- Identify gaps in understanding and programmatic impediments
- Recommend next-step actions to make progress
- Plan and implement those actions

Science Plan Implementation



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A Grass-Roots Approach

Sponsoring agency programs, with specific mission interests,

empower the community, represented by a steering committee and its implementation panels,

to prioritize, plan, and implement activities to further scientific progress toward goals and research challenges,

employing open calls for membership, working groups, workshops & conferences

How Does US CLIVAR Advance the Science?

Defines requirements for the ocean and climate observing systems

- e.g,. Tropical Pacific Obs System (TPOS 2020), pan-Atlantic Meridional Overturning Circulation network, high-latitude observing networks in the Arctic and Southern Ocean, deep ocean observing strategy, global coupled ocean-atmosphere boundary layer obs system, developing integrated ocean observing of physics-bgc-biology, integrating from open ocean into and across the coasts

Guides and identifies best practices for process studies and model development

- promote use of observations with models; make data available for broad community use

Implements Climate Process Teams to evaluate and improve climate models

- survey modeling center needs, capitalize on process studies and new observational data, evaluate biases across models, develop and implement demonstrated improvements in parameterizations and techniques

Coordinates model experiments to understand climate predictability

- determine protocols for multi-model experiments; promote community analysis of outputs

Assesses and addresses data needs for community-wide scientific research

- advocate for free and open data policies and practices, and adherence to them
- explore and promote mechanisms for improved storage, discovery, access, and use of data
- inform and drive requirements for quantifying data uncertainties – “to complete the data”

Engages producers and users of climate information to inform research directions

- understand use of and needs for analysis and predictions, targeting efforts to better enable use in applications decision making, communicating uncertainties to improve utility of information

Promotes inclusiveness

- enable interdisciplinary collaborations and ensure diversity of expertise, institutional affiliation, gender, race/ethnicity, and career stage in participation
- understand barriers to participation and expand reach of program to underrepresented scientists

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Challenges and Opportunities

Contributing to Federal Earth System Predictability Priority

- Help implement r&d on predictability of Earth's water cycle and precipitation extremes and associated biosphere and human interactions
- Organize interagency-sponsored study on observing and modeling air-sea transition zone at all scales for harnessing earth system predictability

Implementing New Research Challenge on Climate at the Coasts

- Collaborate with ocean bgc and biology communities to enhance US marine ecosystem prediction capability
- Coordinate community activities and collaborations with coastal observing and regional modeling programs to advance monitoring, understanding, and prediction of sea level variability and change across US coasts

Sustaining and Growing the Ocean Observing System

- Address risks of no-to-slow growth, as current systems drop and upcoming networks await deployment
- Define US contributions to the next generation GOOS and enable resourcing
- Capitalize on momentum from OceanObs'19 Conference, US federal Ocean Research Priority, and UN Decade of Ocean Science for Sustainability

Developing Approaches to Increase Diversity, Equity, and Inclusion

- Evaluate progress in ongoing DEI measures: expertise, inst. affiliation, gender parity, career stage, persons w/ disabilities
- Establish DEI Task Team to scope and recommend actions to engage/expand participation of underrepresented and/or minoritized groups (e.g., BIPOC – Black, Indigenous, and People of Color)
- Explore science questions regarding equity in access to climate information and addressing environmental justice

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Research Challenges

Decadal Variability & Predictability	Climate & Extreme Events	Polar Climate Changes	Climate & Carbon/ Biogeochemistry	Climate at the Coasts
				White Paper - July 2021 AMS & OSM Town Halls
• Decadal modes • Overturning circulation • Warming hiatus • Expanding tropics • Initialized predictions • Large ensembles	• Tropical cyclones & hurricanes • Heat waves/cold outbreaks • Drought • Heavy precipitation & floods	• High-latitude surface fluxes • Southern Ocean stratif. & transport • Ocean-ice sheet interactions • Arctic-midlatitude atmos. connections	• Carbon cycle sensitivity • Coupled physical & bgc processes • Carbon hot spots • Ocean carbon modeling	• Forecasting West Coast marine ecosystem and fisheries response to ENSO • Sea level hot spots on the US East Coast: Exploring user needs
• Multi-year predictability • Stratosphere influences	• S2S predictability of severe storms • Drought & wildfire predictability	• Arctic Ocean & Sub-Arctic Seas circulation • Coevolution of atmos, ocean, sea ice in the New Arctic	• Next-gen physical-bgc-biological ocean obs system • Earth system reanalysis	• Marine ecological forecasting at US coastlines • Sea level & inundation at US coasts

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Research Challenges

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• Multi-year predictability (March Wksp) • Stratosphere influences (Summit Session)	• S2S predictability of severe storms (2020-21 PPAI Sessions) • Drought & wil predictability	• Arctic Ocean & Arctic Seas circu (June Wksp) • Coevolution of atmos, ocean, sea ice in New Arctic (Town Hall)	• Next-gen phys bgc-biological obs system (2021 Wksp) • Earth system reanalysis (May Wksp)	• Marine ecological forecasting at US coastlines (April Wksp) • Sea level & inund at US coasts (Summit Session)

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COVID-Related Challenges for the Climate Science Community

Interruption, cancellation, and postponement of observational deployments and field campaigns

- Recall of UNOLS and NOAA ships to ports; stand-down of UNOLS vessels for ~5 months with downstream scheduling impacts over subsequent two years
  - GO-SHIP 13.5N line cancelled in Mar 2020, again in Jan 2022 due to Omicron surge
  - RAPID-MOCHA array turn-around cruise cancelled and rescheduled
  - SMODE field campaign postponed by more than a year
  - EXPORTS cruise cancelled and rescheduled
- NCAR and NASA aircraft field campaigns postponed for more than a year
  - PRECIP2020 field campaign postponed two years to summer 2022
  - ACCLIP field campaign postponed from summer 2021 to summer 2022
- Slip in satellite launch schedules, e.g., for SWOT, PACE

Cancellation, postponement, and move of science meetings to virtual

- More than 60 climate science meetings, workshops, training programs, and conferences impacted in first year of planned meetings, workshops, and conferences
- Impact on collaborations and networking – especially important for early career scientists

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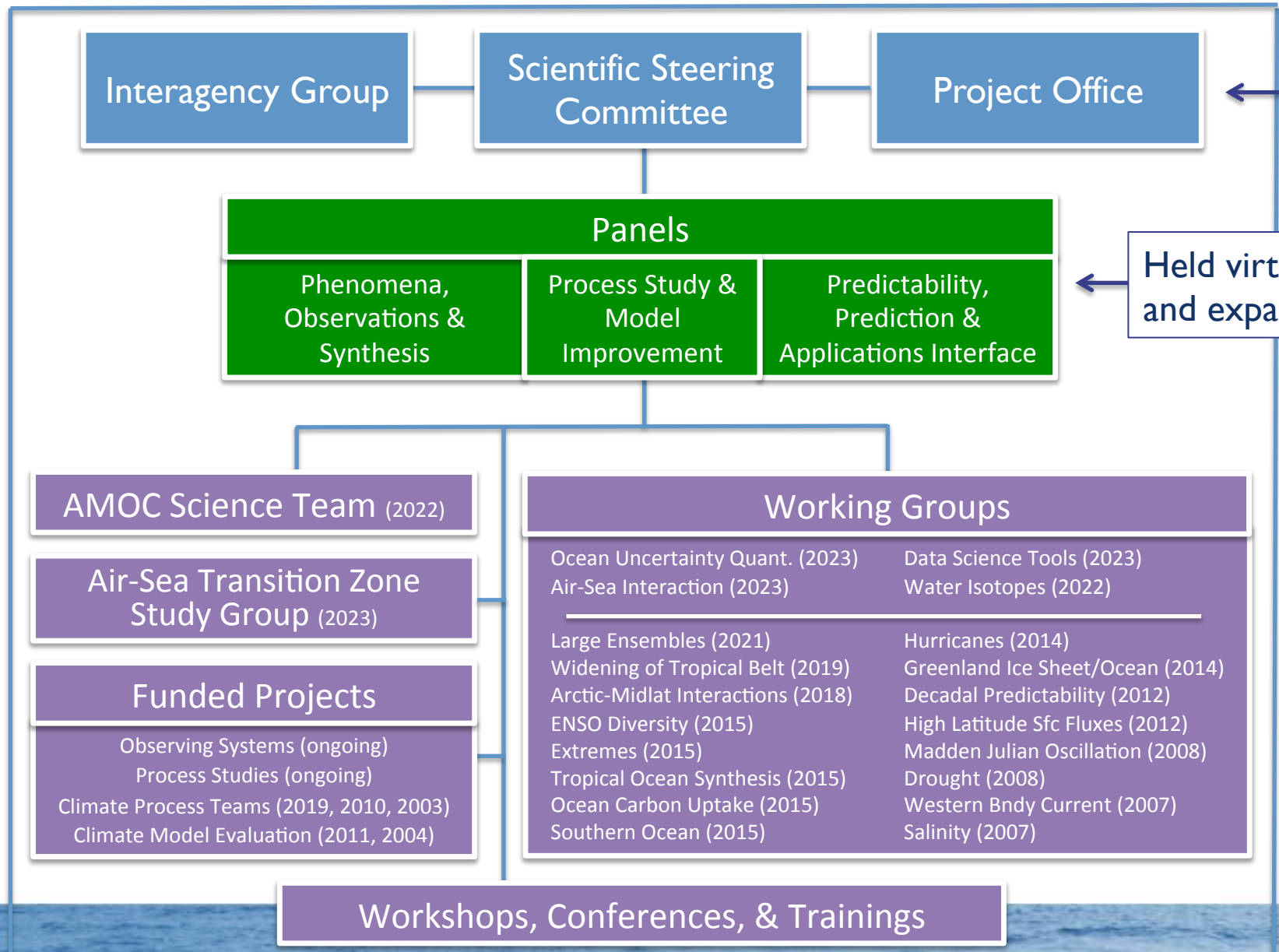
COVID Organizational Impacts

IAG, SSC, & Panels continued to meet virtually and uninterrupted



Moved to remote
Postponed move and hirings

Held virtual mtgs in 2021-22 and expanded webinar series

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COVID Organizational Impacts

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Interagency Group

Scientific Steering Committee

Project Office

Moved to remote
Postponed move and hirings

Panels

Phenomena, Observations & Synthesis

Process Study & Model Improvement

Predictability, Prediction & Applications Interface

Held virtual mtgs in 2021-22 and expanded webinar series

Delayed sunsetting

AMOC Science Team (2022)

Now starting

Air-Sea Transition Zone Study Group (2023)

Funded Projects

Observing Systems (ongoing)
Process Studies (ongoing)
Climate Process Teams (2019, 2010, 2003)
Climate Model Evaluation (2011, 2004)

Working Groups

Ocean Uncertainty Quant. (2023)
Air-Sea Interaction (2023)
Data Science Tools (2023)
Water Isotopes (2022)

Large Ensembles (2021)
Widening of Tropical Belt (2019)
Arctic-Midlat Interactions (2018)
ENSO Diversity (2015)
Extremes (2015)
Tropical Ocean Synthesis (2015)
Ocean Carbon Uptake (2015)
Southern Ocean (2015)
Hurricanes (2014)
Greenland Ice Sheet/Ocean (2014)
Decadal Predictability (2012)
High Latitude Sfc Fluxes (2012)
Madden Julian Oscillation (2008)
Drought (2008)
Western Bndy Current (2007)
Salinity (2007)

Extended

Many rescheduled to 2022

Workshops, Conferences, & Trainings

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2022 Open Community Workshops, Conferences, & Trainings (all hybrid)

Mar

Societally-Relevant Multi-Year Climate Predictions Workshop*
28-30 March in Boulder, Colorado

Daily to Decadal Ecological Forecasting along North American Coastlines Workshop
12-14 April in Woods Hole, Massachusetts

Apr

US AMOC Science Team Meeting*
25-28 April 2022 in Woods Hole, Massachusetts

The Pattern Effect Workshop
10-13 May in Boulder, Colorado

May

Future of the US's Earth System Reanalysis Effort Workshop*
16-18 May in Boulder, Colorado

Ocean Salinity Conference*
6-9 June in New York City, New York

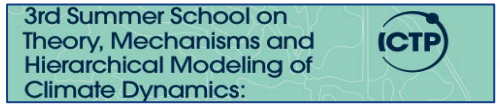
June

Whither the Gulf Stream Workshop
15-17 June in Woods Hole, Massachusetts

Circulation of the Arctic and Sub-Arctic Seas Workshop*
27-30 June in Seattle, Washington

WCRP Regional Sea Level Change and Coastal Impacts Conference
11-13 July in Singapore (Agency Support TBD)

July



CLIVAR ENSO Summer School*
18-29 July in Trieste, Italy

CLIVAR/GOOS – From Global to Coastal Ocean Observing Workshop*
August 8-12 (TBD) in Trieste, Italy

Aug

Spring 2022 Workshop Call to be issued in March; requests due in April for events to be held in 2023

US CLIVAR Working Groups

- Panel-driven and grass-roots activities that address pressing scientific topic of broad, multi-agency interest
- Activities have included:
  - building new trans-disciplinary collaborations
  - producing state of the science consensus
  - developing data repositories
  - identifying useful metrics and diagnostics
  - coordinating modeling experiments
  - developing communication platforms and training programs

Fall 2022 New WG Call

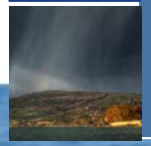
- **issued in September**
- **requests due in October reviews by SSC**
- **selection by IAG in November**
- **New starts in early 2023**

- Pre-Summit webinars provided updates on each of four WGs:

Ocean Uncertainty Quantification WG (2020-2023)
Co-chairs: Kyla Drushka (U. Washington), Shane Elipot (U. Miami), & Aneesh Subramanian (U. Colorado)

Air-Sea Interactions WG (2019-2023)
Co-chairs: Larry O'Neill (OSU) & Hyodae Seo (WHOI)

Emerging Data Science Tools WG (2019-2023)
Co-chairs: Amy Braverman (Cal Tech/JPL), Bo Li (U Illinois) & Mike Pritchard (UC-Irvine)



Water Isotopes WG (2018-2022)
Co-chairs: Kim Cobb (Georgia Tech), David Noone (U Auckland) and Adriana Raudzens Bailey (NCAR)

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US CLIVAR at
2021 Fall AGU, 2022 AMS, and 2022 Ocean Sciences Meetings

Fall AGU Meeting

- Interagency Town Hall – Precipitation Processes and Predictability
- US CLIVAR-IARPC Town Hall – Strategy for Understanding the Coevolution of the Atmos, Sea Ice, and Ocean in the New Arctic
- Intl. CLIVAR-coordinated Session – Interaction of Tropical Basins: Processes, Pathways, & Prediction

AMS Annual Meeting

- US CLIVAR Town Hall – Climate at the Coasts
- Climate Variability & Change Conference Session – Ken Mooney's Legacy

Session Proposals for 2022 Fall AGU and 2023 AMS Mtgs in April

Ocean Sciences Meeting

- US CLIVAR Town Hall – Climate at the Coasts
- US CLIVAR-IARPC Town Hall – Changing Circulation of the Arctic Ocean and Sub-Arctic Seas
- POS Panel Session – Advances in Data Science for Ocean Uncertainty Quantification
- POS Panel Session – The Arctic Ocean's Changing Beaufort Gyre

Summit Agenda

Monday, March 14		Presenters
08:30	Welcome, meeting objectives, and US CLIVAR update	Mike Patterson & Gudrun Magnusdottir
09:15	International CLIVAR	Gokhan Danabasoglu
10:30	Agency updates	Agency Managers
11:15	Panel breakouts	
13:00	**Science Session: The Air-Sea Transition Zone**	Conveners: Chidong Zhang, Patrick Taylor, Jinbo Wang, & Baoqiang Xiang
	Introduction	Chidong Zhang
	Study Group on observing the air-sea transition zone: Motivation, context, charge, and current status	Carol Anne Clayson
	Air-sea-ice and wind-curent interactions: Strategies for the future	Sarah Gille
	TPOS equatorial process studies	Billy Kessler
	Plenary discussion	
14:25	Panel breakout	
15:30	**Science Session: Cloud Processes in the Climate System**	Conveners: Hailong Wang, Charlotte DeMott, Aaron Levine, & Patrick Taylor
	Introduction	Charlotte DeMott
	Process-oriented model diagnostics and observational constraints on cloud feedback and climate sensitivity	Hui Su
	Understanding moist convection-environment interaction from high-resolution modeling and observations	Yang Tian
	Assessing cloud-aerosol interactions as a source of climate predictability	Po-Lun Ma
	Plenary discussion	
16:55	POS and PSMI Panel breakouts	

Summit Agenda

Monday, March 14		Presenters
15:30	**PPAI Science Session: Climate and Health**	Conveners: John Nielsen-Gammon, Haiyan Teng, Matt Newman, & Dillon Amaya
	Introduction	Dillon Amaya
	NIH's strategic plan framework: Intersections with climate	Lee Hall and Larry Fine
	How climate scientists think about climate prediction	John Nielsen-Gammon
	NSF efforts in climate and health	Anjuli Bamzai
	Climate and health: A GeoHealth perspective	Ben Zaitchik
	Discussion	

Note: No Evening Networking Event

Tuesday, March 15		Presenters
08:00	**Plenary Session: Diversity, Equity, and Inclusion**	Conveners: Mike Patterson, Chidong Zhang, & Gudrun Magnusdottir
	Introduction	Mike Patterson
	NASEM and OSB DEI efforts	Susan Roberts & Claudia Benitez-Nelson
	AGU Dei efforts	Billy Williams
	Discussion	
10:00	**Science Session: Enabling Open Science in the Age of Big Data**	Conveners: Michelle Gierach, Charlotte DeMott, Sophie Clayton, Victor Gensini, & Fred Bingham
	Introduction	Sophie Clayton
	Working towards open science in NASA's Earth Science Division	Katie Baynes
	Scaling climate data analysis in the cloud with Google Earth Engine	Tyler Erickson
	Transforming to open science	Chelle Gentemann
	Plenary discussion	
11:25	Panel breakouts	

Summit Agenda

Tuesday, March 15		Presenters
13:00	**Science Session: Sea Level and Coastal Flood Risk Prediction**	Conveners: Shane Elipot, Jacob Wenegrat, Antonietta Capotondi, & John Callahan
	Introduction	Antonietta Capotondi
	The North Atlantic sea surface height triple impacts the frequency of flooding events along the US East Coast	Denis Volkov
	2022 interagency sea level rise and flood risk projections for the US	Billy Sweet
	Storm surge and sea level rise effects on groundwater	Holly Michael
	Plenary discussion	
14:25	Panel breakouts	
15:30	**Science Session: Stratosphere-Troposphere Interactions**	Conveners: Gudrun Magnusdottir, Amy Butler, & Qinghua Ding
	Introduction	Amy Butler
	Overview of current understanding of the role of stratosphere-troposphere interactions in S2S prediction	Jason Furtado
	The Strateole 2 campaign and the implications for its measurements	Martina Bramberger
	Current research and challenges of stratospheric climate intervention	Simone Tilmes
	Plenary discussion	

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Summit Agenda

Wednesday, March 16		Presenters
08:00	**Science Session: Hybrid Physics-AI Models**	Conveners: Sergey Frolov, Colin Zarzycki, & Matt Newman
	Introduction	Sergey Frolov
	AI added hybrid parameterizations	Tapio Schneider
	ML to identify/correct systematic model error	William Crawford
	ML climate prediction/attribution: Use and best practices	John Albers
	Plenary discussion	
09:25	Panel breakouts	
11:30	**Panel Summaries and Next Steps**	
	POS Panel	Panel Co-chairs
	PSMI Panel	Panel Co-chairs
	PPAI Panel	Panel Co-chairs
	Next Steps and Closing Remarks	Chidong Zhang
12:30	**Summit Adjourns**	

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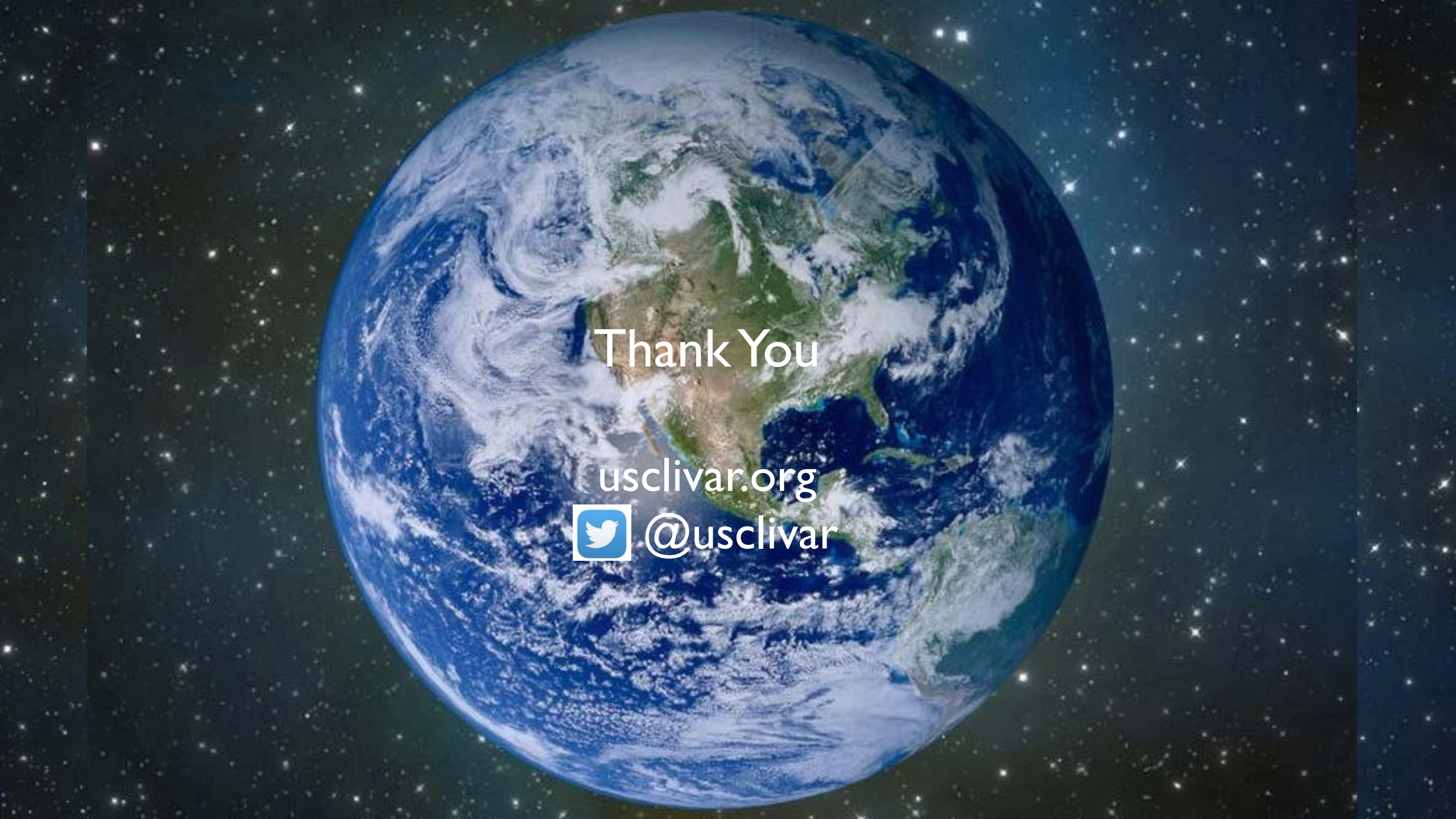
Thank You
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