American Physical Society
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March Meeting 2023 Featured Presentations
Climate, Environment and Energy

System Models Dynamics of Arctic Ice Mélange, Helping Improve Forecasting of Sea Level Rise

March 6, 9:24 a.m. PST, Room 208

Famed for driving iceberg formation, the geophysical process known as glacial caving also creates a unique, soft material called ice mélange. Studying this granular mixture's physical dynamics is important for accurately predicting sea level rise. But because ice mélange is composed of various forms of icebergs and sea ice with different properties, it is hard to model its behavior. Here, Justin Burton and colleagues will share an experimental system that can simulate ice mélange from tidewater glaciers, like those in Greenland. The group used polypropylene as an ice mélange-like substitute and placed it in a narrow tank emulating a fjord, describing the material's fluid flow, velocity and friction under different conditions. The team's insights could inform and enhance geoscientists' efforts to characterize climate change's impact on sea level rise.

Researchers Contextualize the Varying Properties of Layers in an Important Oceanic Arctic Staircase

March 6, 12:06 p.m. PST, Room 414

Arctic staircases are sets of oceanic layers that differ in temperature and salinity and that transport heat towards sea ice. These phenomena can be used to track ocean heat in the Arctic Basin, including the Beaufort Gyre. But it is not clear exactly how Arctic staircases develop or what influences their layers' thickness. Here, Nicole Shibley and colleagues will explain that the Beaufort Gyre's Arctic staircase and its layers' thickness — or thinness — likely depends on the way that warmer water crosses the cooler Gyre, dissipating heat and salt. Based on their findings, the team hypothesizes that this staircase's properties may be applied to better understand changing water properties in the Arctic Basin.

Model Reveals Atmospheric CO_2-Driven Tipping Point With Potential for Global Warming of Six Degrees Celsius
March 6, 1:18 p.m. PST, Room 414

Due to human-caused climate change, the world is rapidly approaching several tipping points where Earth's climate will be damaged irreversibly. To implement successful policies that slow global warming and avoid tipping points, policymakers and scientists need as much information as possible about the geophysical and atmospheric dynamics that propel global warming forward. This talk by Alex Mendez and colleagues delves into the role that atmospheric carbon dioxide (CO_2) concentration has in driving global temperatures to various tipping points. Using an energy balance model and mathematical analyses to simulate how atmospheric CO_2 will change under various carbon emission and capture rates, the researchers discovered a previously unidentified way in which atmospheric CO_2 levels could impermanently rise. Because of the greenhouse effect, this transient rise would still catalyze a drastic global surface temperature increase — regardless of whether CO_2 levels then declined. The model describes this interaction and its severe consequences, as well as suggesting more rigorous strategies that could avert the CO2 concentration-dependent tipping point.

Scientists Develop a Way to Disentangle Energy of Enormous Ocean Currents
March 6, 3:36 p.m. PST, Room 414

Much like atmospheric circulation and weather systems, ocean currents are silos of kinetic energy that massively influence Earth's climate. Typically, scientists study ocean currents' kinetic energy by examining box-shaped regions in the sea less than 1,000 kilometers in extent. However, regional analyses are difficult to extrapolate to a global picture. Here, Hussein Aluie and colleagues will share a new coarse-graining technique that can finally evaluate the energy of ocean currents of all sizes, both smaller and larger than 1,000 kilometers. During their analyses, the researchers discovered that the Antarctic Circumpolar Current — which is 9,000 kilometers in diameter — is the most energetic current. The group says that their methodology will enable better contextualization of the impact that the ocean's circulation has on the planet's climate system.

A Way to Harvest Solar Energy and Sea Salt Simultaneously
March 6, 5:12 p.m. PST, Room 315

In this talk, Peixin Dong will propose a system that can simultaneously harvest solar energy with solar panels and salt from sea water. With a 3D numerical model, Dong investigated how

factors like the installation height and coverage area of solar panels would affect the evaporation rate of open-air seawater evaporation ponds underneath. The findings could inform designs of joint solar energy and salt generation plants.

Investigating a New Way to Sort Plastics for Recycling
March 7, 4:48 p.m. PST, Room 132

Before plastics can be recycled, recycling facilities need to separate the different types from one another. Currently, recycling facilities use properties like density or spectral signature for sorting, but it is difficult to quickly separate large volumes of plastic waste based on these properties. In this talk, Kalman Migler and colleagues will describe their measurements of how the kinetic friction of several kinds of plastics depends on temperature. Investigating how this property differs from one type of plastic to another could potentially let researchers develop new ways for recycling facilities to sort plastics in the future.

Study Explains Why Some PFAS Pollutants Are Resistant To Foaming Separation
March 8, 9:12 a.m. PST, Room 127

Health-threatening chemical pollutants that last forever and accumulate in the body called per- and polyfluoroalkyl substances (PFAS) can still be found in a variety of items and resources like non-stick cookware and drinking water. Foam separation has emerged as a promising strategy to remove PFAS from water because it doesn't create additional waste products as these carcinogenic compounds migrate to the air-water interface. Yet, much is not understood about how foam fractionation works on the molecular level when it removes PFAS. More specifically, it is unclear why foam fractionation is less effective on short-chain PFAS, which have less carbon molecules. This talk by Muchu Zhou and colleagues will explore why foam fractionation success changes depending on varied-chain length PFAS. The findings, which they will also share at a poster session, could help improve short-chain PFAS removal and have implications for improving the safety of global water resources.

Energy-Saving Smart Windows Made With 2D Materials
March 8, 11 a.m. PST, Exhibit Hall (Forum Ballroom)

Materials that can sense and adapt to their environments may be crucial to smart, sustainable architectural designs. During this poster session, Qian Wang and colleagues will present a new method of making 2D materials like graphene sense and respond to environmental triggers. They demonstrated this method by constructing windows that can open and close

automatically in response to small changes in room climate throughout the day, which could be used in energy-saving smart housing. More generally, the work provides insight into the mechanisms behind bending in 2D materials and could also be useful for soft robotics, tissue engineering and other applications.

Ultrafiltration Membranes With Tunable Pores Could Improve Wastewater Reclamation
March 8, 11 a.m. PST, Exhibit Hall (Forum Ballroom)

Water scarcity is a global health concern. Experts consider wastewater reclamation one solution for addressing this issue. But which methods are best for wastewater treatment is still up for debate. In this poster session, Kshitij Sharma and colleagues unveil a methodology for better membrane filtration of wastewater, demonstrating how tuning membranes' pore sizes improves standardized filtration of nonorganic and organic waste. The technique for creating these ultrafiltration membranes could be applied in industrial and municipal settings where waste water disposal is necessary, the team says.

Harvesting Energy From Turbulent Fluids
March 9, 5:24 p.m. PST, Room 307

Birds and fish take advantage of the energy naturally found in the turbulent motions of air and water to ease their flying and swimming. In this talk, Yagmur Kati and colleagues will describe how they investigated whether humans might also be able to take advantage of turbulent flows by teaching an object to react to the erratic motions of turbulent fluids in certain ways to generate energy. Through numerical simulations and analytical calculations, they showed that rotational motions of a neutrally buoyant body — an object with the same average density as the fluid it is in — could allow energy to be harvested from turbulent fluid motion efficiently. They suggest that further investigating this question using machine learning techniques could help find an optimal way for the buoyant object to harvest energy.