UNIVERSITY of HAWAI'I MĀNOA

Department of Atmospheric Sciences Seminar Announcement

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SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY

A Machine Learning Approach Toward a "Seamless" Understanding Droughts, Heatwaves and Fire Weather from Sub-Seasonal to Decadal Scales

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You are invited to our weekly online Atmospheric Sciences Fall 2021 seminars via Zoom meeting.
When: September 22, 2021 at 3:30PM HST
Meeting admission: 3:15PM HST

Register in advance for this meeting:
https://hawaii.zoom.us/meeting/register/tJwlcOmtpz8iGtFAfj1LmB2t-J89CV76hI1s

After registering, you will receive a confirmation email containing information about joining the meeting.
Please save this information for future seminars.

Abstract:

The National Earth System Prediction Capability (ESPC) aims to improve earth system prediction from sub-seasonal to decade scales, with emphasis on "seamless" prediction. Yet, our understanding of weather-climate connection, especially in a changing climate, is still in its infancy. For example, it is not clear what weather patterns are responsible for dry spells and heat waves during the warm season over continental United States (US), and which of these patterns are responsible for extreme droughts and stronger and longer fire season? How do decadal climate variability and anthropogenic forced climate change affect the intensity and frequency of extreme fire weather?

In this seminar, I will report our recent and ongoing studies to explore these questions through machine learning approaches. To assess the influence of weather patterns on droughts and fire weather, we use multivariate Self-Organization Map to characterize the weather patterns responsible for dry and wet spells, their associated atmospheric thermodynamic condition and moisture transport, and their contributions to warm season droughts and decadal variability of the land surface aridity and fire weather. We also use a constructed flow analogue approach to determine the relative influence of natural climate variability and anthropogenic forced change on the increase of heatwaves and fire weather in recent decades over Western US, including those that contributed to the 2020 August Camp Fire, California's largest wildfire on record.

The analyses suggest that, although many weather patterns can contribute to dry spells and moderate droughts, extreme droughts are largely caused by an increased frequency and persistence of a few leading weather patterns that are responsible for strong dry spells climatologically. Thus, understand the causes behind the changes of these few weather patterns is central for determining predictability of the extreme droughts. On the other hand, for the same weather patterns, the probability distributions of surface temperature and vapor pressure deficit (VPD) in the recent decades have changed significantly over the western US, leading to higher probability of heatwaves and fire weather, compared to earlier decades. Consequently, at least two-thirds of the increase of the fire weather over western US during recent decades is attributable to climate change, whereas only one third or less of the increase of fire weather is attributable to changing weather patterns. Thus, climate variability and changes can have significant impact on weather and sub-seasonal forecasts.