Department of Atmospheric Sciences
Ph.D. Dissertation Announcement

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Summer Atmospheric Heat Sources over the Tibetan Plateau

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You are invited to a Zoom meeting.
When: November 5, 2021 at 12:00PM HST

Register in advance for this meeting:
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Abstract:

The spatial-temporal characteristics of the summer atmospheric heat sources over the Tibetan Plateau (TP) are revisited in the first part of this dissertation, applying various bias-corrected datasets, including reanalyses, gauge observations, and satellite products. Compared to previous studies focused on the eastern TP, this study pays special attention to the heat sources over the data-void western plateau. The total heat source showed insignificant trends over the eastern and central TP (ETP/CTP) during 1984–2006, whereas exhibited an evident increasing trend over the western TP (WTP). The interannual variation of total heat over the central-eastern TP is dominated by the variation of latent heat from precipitation. However, over the western TP, the variation of the total heat is highly correlated with net radiation and surface sensible heat.

The remote forcings and impacts of the interannual variations of summer heat sources over the central, eastern, and western TP are investigated in the second and third parts with observational analyses and numerical experiments. The summer heat source variability is affected by different remote forcings across the TP from east to west. The ETP precipitation (i.e., latent heating) is likely modulated by North Atlantic Oscillation (NAO) and associated SST anomalies through large-scale wave trains propagating from Western Europe to East Asia. On the other hand, the increased CTP precipitation is primarily driven by a developing La Niña through generating southerly wind anomalies to the south of the CTP, enhancing moisture transport and precipitation over the southern CTP. The increased WTP sensible heating is linked to the tropical western Pacific cooling, central Pacific warming, and North Atlantic cooling. These anomalous SST conditions produce a high-pressure anomaly over the WTP, raising the ground-air temperature difference, thereby enhancing the WTP sensible heat.

The results in the third part show that the ETP, CTP, and WTP heat sources have different impacts on regional climate and teleconnection. A warming center in northwestern Asia and a cooling center in western Europe are connected with the ETP heating. The CTP heating is related to northeastern Asian warming and increased rainfall in East China. The WTP heating is linked to the warming in southeastern China and the polar region of central Asia. The linear wave-train responses to the TP heating forcings exhibit notable differences. The ETP heating generates an upper-level wave train propagating eastward to the northwestern Pacific. The wave train excited by the CTP heating is confined to East Asia. The WTP heating produces a wave train that splits into two branches: the northern one propagating northeastward to the Arctic region and the southern one propagating eastward to coastal northwestern Pacific.

The fourth part presents 22 CMIP6 models' performances and future projections for the eastern-TP summer precipitation and sensible heat flux. Nearly all models can well simulate the observed climatological precipitation pattern (1979–2014) but overestimate the mean by 65%. For sensible heat, nearly half of the models can hardly capture the spatial structure. The multimodel ensemble mean of selected high-performance models projects that, under the medium emission scenario (SSP2-4.5), the summer precipitation will likely increase by 2.7% per degree Celsius global warming due to the future enhancement in surface evaporation and vertical moisture transport that are partially offset by weakening ascending motion. The projected sensible heat will likely remain unchanged, associated with the likely unaltered surface wind speed.