香港中文大學
The Chinese University of Hong Kong

IEES
Institute of Environment, Energy and Sustainability, CUHK

Workshop on
Does the Earth climate get drier or wetter when it warms?

Date: June 15, 2018 (Friday)
Time: 4:30pm - 5:30pm
Venue: 902, 9/F, Yasumoto International Academic Park, The Chinese University of Hong Kong
Speaker: Professor Aiguo Dai
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Abstract

Paleoclimate records seem to suggest a dusty atmosphere and possibly drier continents during cold glacier periods, which appear to be the opposite of current climate model projections of a warmer and drier climate by the end of 21st century. The model projected drying is mainly due to large ubiquitous increases in evaporative demand for moisture (or potential evapotranspiration or PET) resulting from increased water vapor deficit in a warmer climate with near-constant relative humidity. This evaporative demand decreases when the climate cools in model simulations. Thus, climate models tend to suggest that the Earth's climate should get drier (wetter) when it warms (cools), at least in terms of surface water balance over land. In this talk, I will discuss some of the key issues involved in this debate, including the dependence on the measure of dryness or aridity one uses, and the transient vs. equilibrium change patterns for temperature (T) and precipitation (P). Global-mean P, evaporation (E), and runoff (R) all increase with T in climate models, thus by these measures the climate should get wetter as it warms. However, the dryness or aridity over land is more commonly measured by the P/PET ratio, which takes the water supply (P) and demand (PET) into account and thus is a better measure of the surface water balance. By this P/PET ratio, climate models suggest drier (wetter) continents as the climate warms (cools). Furthermore, we found that the

probability density function PDF) flattens for R, soil moisture and other drought indices by the end of the 21st century, leading to increased drought frequency even without a change in the mean. Some studies suggest that the subtropics were wetter than today during some warmer periods in the past, possibly due to changes meridional temperature gradients and the Hadley circulation. This would be the opposite to the model-projected general drying in the subtropics by the end of the 21st century due to the enhanced drying by the subsidence of the Hadley circulation as the vertical gradient of water vapor increases in a warmer climate. Here we investigate one possible explanation: the difference in the transient (for the 21st century) and equilibrium (for the warm Pliocene) response to CO2 increases. In the NCAR CESM1 model, we found the transient and equilibrium T and P change patterns are quite similar; thus they cannot explain the different subtropical response to global warming during the Pliocene and the 21st century.

~All are Welcome~