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S1&S2C Presentation

S1&2C-1

Risk of emergence of aridification is reduced by archiving the 1.5K temperature goal

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Global warming observed over the last century is significant and will continue for the decades to come, particularly over the land surface. As a consequence, aridity, defined as a ratio of atmospheric water supply (precipitation; P) and demand (potential evapotranspiration; PET), will rise (i.e. aridification), which can induce land degradation and desertification. However, when the aridification would emerge from natural variability of aridity (designated as the time of emergence for aridification; ToEA) remains unknown despite the importance of ToEA for designing and implementing mitigation policies. In this study, we estimate ToEA based on integrated climate projections of 27 global climate models (GCMs) and identify where the ToEA would be determined before the global warming becomes 1.5ºC and 2.0ºC above the pre-industrial level under the representative concentration pathway 4.5 (RCP4.5) and 8.5 (RCP8.5) scenarios. At the 2.0ºC warming level, the ToEA is likely to occur by more than half of projections over 34.1% and 24.4% of the total land surface under the RCP4.5 and RCP8.5 scenarios, respectively. About two-thirds of those regions would be liberated from the likely occurrence of ToEA under both RCP scenarios by lowering the warming level to 1.5ºC. Early action for accomplishing the 1.5ºC temperature goal is needed to reduce the likelihood that the society faces to emerging aridification and related potential impacts.

S1&2C-2

Shifting urban heat island clock in Megacity: A case study of Hong Kong

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With increasing level of urbanization in the near-future, exact assessment of the impact of urbanization on urban warming such as urban heat island (UHI) is a critical process to adapt regional climate and environmental change. However, our understandings of UHI mainly relied on the intensity or magnitude of UHI. The present study first evaluates the impact of urbanization on UHI duration changes by comparing three stations with different rate of urbanization such as highly-developed and developing urban area over Hong Kong from 1990 to 2015. Results show the climatology of UHI intensity in highly-developed is much higher than that of developing area, but the climatology of the UHI duration is similar with each other. Over the past 25 years, however, the UHI duration has been increased only in the developing urban area from 2.8 to 7.5 hours. Both earlier UHI starting and later UHI ending time concurrently contributes to the lengthening of UHI duration. The difference of UHI duration change between two areas are supported by the population and nightlight changes from space. Positive changes in nightlight, which suggests enhancing economic infrastructure at there, only placed in the developing urban area. Our results suggest changes in UHI duration should be included in the assessment of regional climate change as well as urban planning in the Megacity.

S1&2C-3

Consecutive record-breaking high temperatures marked the handover from hiatus to accelerated warming

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Closely following the hiatus warming period, two astonishing high temperature records reached in 2014 and 2015 consecutively. To investigate the occurrence features of record-breaking high temperatures in recent years, a new index focusing the frequency of the top 10 high annual mean temperatures was defined in this study. Analyses based on this index shown that record-breaking high temperatures occurred over most regions of the globe with a salient increasing trend after 1960s, even during the so-called hiatus period. Overlapped on the ongoing background warming trend and the interdecadal climate variabilities, the El Nino events, particularly the strong ones, can make a significant contribution to the occurrence of high temperatures on interannual timescale. High temperatures associated with El Nino events mainly occurred during the winter annual period. As the Pacific Decadal Oscillation (PDO) struggled back to its positive phase since 2014, the global warming returned back to a new accelerated warming period, marked by the record-breaking high temperatures in 2014. Intensified by the super strong El Nino, successive high records occurred in 2015 and 2016. Higher frequencies of record high temperatures would occur in the near future because the PDO tends to maintain a continuously positive phase.

S1&2C-4

Interannual variations and trends in remotely sensed and modelled soil moisture in China

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In this study, a multi-satellite merged product (ESA CCI) and two model-based simulations from the Community Land Model 4.5 (CLM4.5) and Global Land Data Assimilation System (GLDAS) were used to investigate interannual variations and trends in soil moisture in China between 1979 and 2010. These three datasets show consistent drying trends for surface soil moisture in northeastern and central China, as well eastern parts of Inner Mongolia, and wetting trends in the Tibetan Plateau, which are also identified by in situ observations. Trends in the root zone soil moisture are in line with those of surface soil moisture seen in the CLM4.5 and GLDAS simulations obtained from most areas in China (78%-88%) except for northwestern China and southwest of the Tibetan Plateau. It can be seen that the drying trend intensifies with increasing soil depth. Compared to temperature, precipitation is the primary factor responsible for these trends, which controls the direction of soil moisture changes, while increasing temperatures can also enhance soil drying during periods of decreased precipitation.

S1&2C-5

Amplified summer warming in Europe-West Asia and Northeast Asia after the mid-1990s

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Regional temperature changes are a crucial factor in affecting agriculture, ecosystems and societies, which depend greatly on local temperatures. We identify a nonuniform warming pattern in summer around the mid-1990s over the Eurasian continent, with a predominant amplified warming over Europe-West Asia and Northeast Asia but much weaker warming over Central Asia. We find that the phase shift of Atlantic Multi-decadal Oscillation (AMO) in the mid-1990s is responsible for the zonally nonuniform warming. The AMO induces the zonal discrepancy in temperature changes through modulating decadal variability of the Silk Road Pattern (SRP), which is an upper-tropospheric teleconnection pattern over the Eurasian continent during summer. Our findings have important implications on decadal prediction of regional warming pattern in the Eurasian continent based on the predictable AMO. Furthermore, the temperature variations induced by decadal and interannual SRP variability are compared and discussed.

S1&2C-6

Monitoring satellite-based drought over East Africa Analysis and its inter-annual relationship with ENSO

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Climate variability such as El Niño Southern Oscillation (ENSO) Pacific Decadal Oscillation (PDO) drives drought due to lack of precipitation (i.e., meteorological drought), and prolonged meteorological drought leads to soil moisture drought (i.e., agricultural drought) and low water level of dam/stream flow (i.e., hydrological drought). El Nino/La Nina have had a dominant impact on rainfall variability over the horn of Africa. The horn of Africa which was already regions vulnerable to drought has suffered drought damages such as reduced crop yield, water shortage, heat wave (socioeconomic drought) for recent 20 years. The purpose of this study is to identify the relationship between climate variability and drought over the horn of Africa using in situ and satellite observations, and climate reanalysis data on a short time scale and decadal time scale. Drought indices including the Standardized Precipitation Index (SPI), Scaled Drought Condition Index (SDCI), and Evaporative Stress Index (ESI) were used to analyze the inter-annual changes in the relationship between ENSO and drought for recent years. Decadal changes in the relationship between ENSO and East African rainfall was also identified using the Global Precipitation Climatology Centre (GPCC) precipitation data. Drought variables such as Normalized Difference Vegetation Index (NDVI), Land Surface Temperature (LST), and Evapotranspiration (ET) from Moderate Resolution Imaging Spectroradiometer (MODIS) and total precipitation from Tropical Rainfall Measuring Mission (TRMM), Global Precipitation Climatology Project (GPCP) and GPCC during the long rain season (March-May) and short rain season (October-December) were used to analyze the characteristics of drought for ENSO. In this study, 1) spatial-temporal distributions of the correlations between three drought indices and DJF-mean ENSO index were identified, 2) the evolutionary process of drought was analyzed as ENSO index changes, 3) The change of the relationship between East African rainfall and DJF-mean ENSO was identified during a long-term period. Especially, we focused on identifying an impact of ENSO for not only meteorological drought but also agricultural drought and the time lags between precipitation and other drought variables. Drought vulnerable regions also were identified through examining the spatial distribution of the correlations between drought and ENSO. Global climate models (GCMs) tend to expect weakening Walker circulation and zonal Sea Surface Temperature (SST) gradients in the future. However, further examinations are required to better understand the dynamical mechanisms of intensified ENSO teleconnection in 2000s during the long rain season.