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Review on the Data Application and Climate Variability in China for Various Timescales

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Abstract: Temperature and precipitation are two main variables in climate changes. Spatial-temporal resolutions of temperature and precipitation, and recent studies on climate variability in China are summarized and discussed in this review. Recent 100-year datasets are used to reveal quasi-20-year and quasi-70-year oscillations in eastern China, as well as precipitation pattern shift in China. An oscillation with the timescale of 70-80 years is introduced in eastern China, derived from 500-year and 1000-year proxy and observation records. Finally, it is noted that more research achievements on climate change in China depend upon developing or reconstructing long-term series, studying in regularity and mechanism, as well as upon prediction and service etc.

Key words: China; climate change; data; variability

Changes in Torrential Rain Days in Ningxia Under Climate Warming

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Abstract: By using the summer torrential rain days data in Ningxia, the Yinchuan sounding data and the NCEP/NCAR reanalyzed data, the evolutionary characteristics and the cause of torrential rain days in Ningxia were analyzed under the background of climate warming. The results show that both annual torrential rain days and annual mean temperature displayed consistent increasing trends. Further analysis results indicate that atmospheric potential instability has grown in the daytime in both July and August and in the nighttime in July, but weakened in the nighttime in August after the climate warming of Ningxia. Therefore, the climate warming not only caused more distinctive diurnal variation of the vertical distribution of atmospheric temperatures in Yinchuan, but also resulted in the increase of torrential rain days and in more obvious diurnal variation of the torrential rain in Ningxia.

Key words: climate change; torrential rain days; atmospheric circulation; formation mechanism; Ningxia

Snow Cover Variation in the Past 45 Years (1959-2003) in the Tianshan Mountains, China

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Abstract: Meteorological data at 17 weather stations in the Tianshan Mountains from 1959 to 2003 were analyzed to explore the variations in temperature and snow cover. The abrupt change test for snow depth was performed using Mann-Kendall statistic. The spatial distribution of maximum snow depth was calculated by employing GIDS interpolation and DEM data. The results show that mean temperature in winter had a rising trend at a rate of 0.44 °C/10 a. The minimum temperature in winter increased more evidently at a rate of 0.79 °C/10 a. The maximum snow depth has obviously deepened at a rate of 1.15 cm/10 a in the past 45 years, and it was about 16% higher than the average during 1991-2003. The Mann-Kendall statistic test of snow depth indicates that the abrupt change occurred in 1976. The maximum increment for snow cover depth occurred in Zhaoshu (Kunes) (39.3%) and Nilka (39.7%) in the west Tianshan Mountains. In contrast, the snow cover depth reduced by 17% in Barkol in the east Tianshan Mountains. There was a primary change periodicity of about 2.8 years in snow cover. In addition, snow cover days with a depth more than 10 cm increased distinctly, however, there was no obvious advance or delay in snow beginning and ending dates.

Key words: snow cover; Tianshan Mountains; climate change; North Atlantic Oscillation

Changes of Warmer Winter and Winter Temperature over China During 1956-2005

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Abstract: A reasonable warmer winter index (IWWI) in the framework of the three equiprobability categories (i.e. warmer, normal and colder categories) is proposed based on the winter temperature data observed at 565 stations in China during 1956-2005, where IWWI is defined as the ratio of the station number of warmer category over the total number of stations. The results suggest that the trend of IWWI was consistent with that of the winter temperature on decadal time scale, and their rates of change were 10%/10 a and 0.4 °C/10 a, respectively. It is found that only 13 warmer winter events in total were detected by IWWI over the past 50 years, and 85% of them occurred after 1986.

Key words: warmer winter index; winter temperature; interdecadal variation

Variations in Frequency and Intensity of Strong Tropical Cyclones Affecting China During 1957-2004

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Abstract: Based on tropical cyclone track dataset in the western North Pacific from China Meteorological Administration (CMA), variations in frequency and intensity of tropical cyclones (TCs) in the western North Pacific, affecting-China TCs (ACTCs) and landfall TCs (LTCs) achieving a typhoon intensity during 1957-2004 were studied. Frequencies of strong tropical cyclones showed significant decreasing trends from 1957 to 2004 and the linear trend was much greater when the intensity was stronger. There was no linear trend in the portion of strong tropical cyclones achieving a typhoon (TY) intensity, while those reaching a strong typhoon (STY) and a super typhoon (SuperTY) intensity showed decreasing trends during 1957-2004. The maximum intensities of TCs, ACTCs and LTCs all decreased during the period of 1957-2004. The mean intensities of TCs and ACTCs displayed decreasing trends and the mean intensity of LTCs achieving a TY intensity also showed a decreasing trend.

Key words: strong tropical cyclone; affecting China tropical cyclone; landfall tropical cyclone; China

Probability Distribution of Precipitation Extremes over the Yangtze River Basin

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Abstract: Based on the daily observational precipitation data of 147 stations in the Yangtze River basin for 1960-2005, and the projected daily data of 79 grids from ECHAM5/MPI-OM in the 20th century, time series of precipitation extremes which contain annual maximum (AM) and Munger index (MI) were constructed. The distribution feature of precipitation extremes was analyzed based on the two index series. Research results show that (1) the intensity and probability of extreme heavy precipitation are higher in the middle Mintuo River sub-catchment, the Dongting Lake area, the mid-lower main stream section of the Yangtze River, and the southeastern Poyang Lake sub-catchment; whereas, the intensity and probability of drought events are higher in the mid-lower Jinsha River sub-catchment and the Jialing River sub-catchment; (2) compared with observational data, the averaged value of AM is higher but the deviation coefficient is lower in projected data, and the center of precipitation extremes moves northwards; (3) in spite of certain differences in the spatial distributions of observed and projected precipitation extremes, by applying General Extreme Value (GEV) and Wakeby (WAK) models with the method of L-Moment Estimator (LME) to the precipitation extremes, it is proved that WAK can simulate the probability distribution of precipitation extremes calculated from both observed and projected data

quite well. The WAK could be an important function for estimating the precipitation extreme events in the Yangtze River basin under future climatic scenarios.

Key words: precipitation extremes; ECHAM5 model; probability distribution model; Yangtze River basin

Projection of Future Precipitation Extremes Change (2001-2050) in the Yangtze River Basin

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Abstract: Daily maximum rainfall (R1D) was higher in the Jialing River basin, the Taihu Lake area and the mid-lower main stream section of the Yangtze River basin in the 1990s, and there was a good relationship between ECHAM5/MPI-OM model simulation and the observed data about extreme precipitation (R1D). Under the IPCC SRES A2, A1B, and B1 scenarios, R1Ds are all projected to be in increasing trends in the upper Yangtze River basin during 2001-2050, and R1D shows a more significant increasing tendency under the A2 scenario when compared with the A1B scenario before 2020. With respect to the middle and lower Yangtze River basin, an increasing tendency is projected before 2025, and since then the increasing tendency will become insignificant. There might be more floods to the south of the Yangtze River and more droughts to the north in the next decades.

Key words: Yangtze River basin; extreme precipitation; daily maximum rainfall; the year 2050; projection

Decoupling of Aerosol Absorption Coefficient in the Spring of 2006 at an Urban Site in Beijing

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Abstract: A statistic regression approach was used to estimate the wavelength exponents of black carbon (BC) and dust particles, and further to separate the contributions of the two types of aerosols to the total light absorption coefficient measured in the Beijing urban area in the spring of 2006. The results show that the wavelength exponent (α) of black carbon aerosol at urban site was approximately -0.92, which is in agreement with the value of -0.8 ± 0.2 reported in related studies. The decoupling analysis of the measured light absorption coefficients during the three floating dust periods (March 25, March 27, and April 9) demonstrates that, on average, the light absorption caused by dust particles took up about 32.8% of the total light absorption at 520 nm wavelength, and by black aerosol more than 60%. This indicates that the black carbon was still the

major contributor to the total aerosol light absorption in Beijing urban area even during the floating dust periods.

Key words: dust particle; black carbon; absorption coefficient; wavelength exponent

Assessment of Water Availability in a Central-European River Basin (Elbe) Under Climate Change

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Abstract: The Elbe region is representative of humid to semi-humid landscapes in Central Europe, where water availability during the summer season is the limiting factor for plant growth and crop yields, especially in the loess areas with high crop productivity having annual precipitation lower than 500 mm. This paper summarizes the results of the first phase of the GLOWA (GLObal WATER)-Elbe project and tries to assess the reliability of water supply in the German part of the Elbe river basin for the next 50 years, a time scale relevant for the implementation of water and land use management plans. One focus of the study was developing scenarios which are consistent with climate and land use changes considering possible uncertainties. The concluding result of the study is that nature and communities in parts of Central Europe will have to deal with considerably lower water resources under scenario conditions.

Key words: water resources; land use change; climate change; vegetation

Impact of Climate Warming in the Past 20 Years on Agriculture in Different Regions of China

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Abstract: Based on the China Rural Statistical Yearbook of 1984-2003 published by State Statistics Bureau, and the annual temperature in the same period, impacts of temperature change, agricultural input, and planting area on grain production were analyzed for different regions of China during the last 20 years. The results show that the main characteristic of climate warming has obviously promoted the increase of grain yield in Northeast China, but to some extent suppressed it in North China, Northwest China and Southwest China, and shown no obvious effect on it in East China and Central-South China. The increase in agricultural input facilitated the grain production obviously in various regions in the early stage of the past 20 years, but showed no obvious effect in the late stage. The continuous reduction in sown area had a significant negative

effect on the grain production in East China and Central-South China.

Key words: climate change; agricultural input; grain production

Climate Change and Its Impacts on Grain Production in Jilin Province

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Abstract: The climate observation data, reanalysis data, and grain/soybean yields per unit area were used to analyze and interpret the impact of climate change on grain production. The results show that Jilin Province was located in a remarkable increase area of temperature during the growing season (May-September) from 1948 in the middle latitudes of the Northern Hemisphere. The mid-west and south of Jilin Province and Liaoning Province were located in a clear linear decrease tendency area of annual precipitation, wherein a warm/dry tendency of climate change dominated, while the east of Jilin Province lay in a clear linear decrease tendency area of annual precipitation. The climate warming played an important role in continuous increase in the grain yield per unit area since the 1980's in the main grain production areas of Jilin Province, however, from the end of the 20th century to the beginning of the 21st century, the beneficial effect seemed to be not obvious any longer, the grain yield per unit area fluctuated with annual precipitation.

Key words: Jilin Province; climate change; grain production

Railway Construction Techniques Adapting to Climate Warming in Permafrost Regions

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Abstract: The climate warming, which has an evident effect on the warm/ice-rich permafrost, should be considered in the engineering design of the Qinghai-Tibet Railway in permafrost areas. Based on the rule mentioned above, many design ideas and measures such as cooling embankment and controlling of heat conduction, radiation and convection were proposed during the construction of the Qinghai-Tibet Railway to reduce the permafrost temperature and to reduce the impact of climate warming on the railway. These measures ensure the stability of the railway embankment in permafrost regions.

Key words: Qinghai-Tibet Railway; climate warming; railway construction

Response of the Melting Urumqi Glacier No. 1 in Eastern Tianshan to Climate Change

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Abstract: Current glacier recession under the global warming has aroused world-wide attention. Initiated from 1958, the observations of Urumqi Glacier No. 1 at the headwaters of Urumqi River in eastern Tianshan promise the best datasets of the glacier and the climate changes in China. Taking Urumqi Glacier No. 1 as an example, we analyzed the response of the glacier to the climate change. The results show that over the past 50 years, the glacier has changed remarkably in the aspects of snow-firn stratigraphy, ice formation zone, ice temperature, area and terminus position, etc. These changes are apparently the results of temperature rise in this area. The glacier recession continued throughout the entire observed time period, and showed an accelerated tendency since 1985. Meltwater runoff also increased 84.2% over the last 20 years.

Key words: glacier melting; climate warming; Tianshan; Urumqi Glacier No. 1

Climate Warming and Energy Consumed for Winter Heating in Xi'an

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Abstract: The accumulated negative temperature, the first heating date, the last heating date, heating duration, collective heating area and energy consumption for winter heating in Xi'an during 1986-2002 were comprehensively analyzed. The results show that under the global warming, winter in Xi'an became warmer and heating duration shorter. With the development of economy, the area and energy consumption for collective heating increased continually. In the meantime, the energy consumption per unit area for winter heating decreased year by year, but it did not match the winter temperature well because the energy was not proportionally consumed according to the change of temperature. In order to conserve energy effectively, heating in winter should be timely adjusted according to actual temperature change.

Key words: climate warming; energy consumption; heating; energy conservation