



**Global Change Research
of the Young Scientists of the
China Meteorological Administration**

Presented at the
International Young Scientists' Global Change Research Conference

November 5-8, 2006
Beijing, PR China

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INTRODUCTION

The China Meteorological Administration (CMA), host of the International Young Scientists' Global Change Conference (5-8 November 2006), has enjoyed great success in fostering global change research within its observation networks, research branches, and numerous facilities. As the coordinating organization for the Young Scientists' Conference, it is our great pleasure to provide an opportunity to highlight some of the outstanding research being conducted by the young scientists of the CMA. Each of these young researchers presented a poster presentation to the international research community gathered for the Young Scientists' Conference. We are pleased to present the abstracts of these presentations in this volume.

Roland Fuchs *Director,
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Uncertainties in homogenization of radiosonde temperature timeseries: A case study in eastern China

Various approaches for homogenization of radiosonde temperature timeseries (RTT) have been developed; it greatly improves climatic records. However, there is inconsistency between the different approaches with even same data. The disagreement among different homogenization approaches leads to confusion in our understanding in trend of upper-air temperature. Uncertainties, thereby, still remain in homogenization of RTT. In this work, uncertainties in homogenization of RTT were illustrated by disagreement between two approaches performing at 6 sample stations in eastern China for 1958-2003. One is GUO-procedure developed in CMA, consisting of using station history information (metadata) and statistics (two-phase regression), another is Automatic homogenization system for RTT (Auto-sys) developed in Met Office.

Results from GUO-procedure and 100-member ensemble from the Auto-sys were compared. The time series from two methods are basically well matched. However, some disagreement has also been clarified. The documented breakpoints, recorded in metadata, were sometime not identified by the Auto-sys. By contrast, several breakpoints detected by Auto-sys after the 1980's were not by GUO-procedure. And also, even if warming trend has been evidenced by both approaches at lower-mid troposphere with closely amplitude, median trend of Auto-sys's results was larger than that from GUO-procedure at mid-upper troposphere but much smaller at lower stratosphere.

To address uncertainties in testing task, Microwave Sounding Units (MSU) satellite products were used as independent reference series. Agreement between the MSU and Auto-sys product was generally lower for stratosphere than for lower-troposphere. Impact of parameter setting in the approaches has been investigated by defining new indices. Several parameters, likely neighbors reference setting and timing of metadata events, giving higher uncertainty in the performance. As point of view, further analysis is required to investigate these conclusions more robustly. To absolutely confirm this result requires additional efforts to recover metadata series.

NOTES

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Zonally seasonal oscillations of the Asia-Pacific climate in the subtropics

With daily mean NCEP\NCAR reanalysis data, this paper discovers that the propagating directions of zonal disturbances, namely the meridional wind over subtropical North Pacific, are reversed with the seasonal change between summer and winter, and the seasonal precipitation variabilities, calculated with the monthly CMAP precipitation data, show that it is distinct and significant for the northeastern Pacific (160.0W-115.0W, 22.5-45.0), and varies opposite to the one for the eastern Asia monsoon region (110.0-140.0E, 22.5-45.0N). Because the zonal wind also presents the reverse change over the subtropical North Pacific from summer to winter, the zonally seasonal oscillations exist between the eastern Asia and the northeastern Pacific, and the climate of the northeastern Pacific may be called the unusual monsoon climate. This paper makes clear the dynamic causes of the unusual monsoon climate employing the theories of the exchanges between westerly and easterly angular momentum and the mean vertical circulation of Asian-Pacific region. In addition, a similar climate also exists in the region from the eastern Atlantic to Mediterranean Sea.

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Satellite data assimilation in GRAPES

In this presentation, direct assimilation of satellite radiances and atmospheric motion vectors (AMVs) from geostationary satellite data are discussed. In 2001, CMA launched a national key-project to develop a new generation of NWP system: GRAPES (Global/Regional Assimilation PrEdiction System), including variational data assimilation (3DVAR, 4DVAR), regional meso-scale numerical prediction system and global medium-range weather prediction system. In GRAPES-3DVAR, the direct assimilation of ATOVS radiances is being developed. The direct assimilation experiments have demonstrated positive impacts on forecast skills in the northern and southern hemisphere. FY2C is the first operational meteorological satellite of China, which was launched on 19 Oct 2004. With the improvements in the image navigation and calibration algorithm, together with the improved AMV derivation scheme, the accuracy of the high density AMVs derived from FY2C is expected to be improved. Impact trials have also been conducted, showing neutral to positive impact in global forecast quality. Finally, ongoing research and future plans are also discussed.

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Impact of using a town energy budget (TEB) scheme on the simulation of the urban meteorology environment

The town energy budget (TEB) scheme for atmospheric mesoscale models was successfully coupled with a regional boundary layer model (RBLM) developed by Nanjing University. To compare the simulation ability between TEB and the traditional land surface process in RBLM, three cases of different seasons have been simulated. The simulation results were compared with many conventional and non-conventional observation data. The results indicate that the TEB scheme could clearly improve the simulation of RBLM, especially regarding temperature and some surface fluxes. Furthermore, the simulation ability of the urban heat island is greatly improved with use of the TEB scheme.

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Interannual variability and climatology significance of zonal-wind shear in the troposphere

The monthly values of the zonal-wind vertical difference or zonal-wind shear (ZWS) between 200 hPa and 850 hPa were used to assess the interannual variability of the tropospheric circulation anomalies. Seven regional indices of ZWS with a standard deviation more than 5 m/s were constructed. These regions are located in the central equatorial Pacific, eastern equatorial Pacific, north and south subtropical Pacific, the equatorial Atlantic, subtropical Arabia and northeast Asia. The interannual variability of ZWS indices at the first 5 regions in the equatorial-subtropical Pacific and equatorial Atlantic are strongly correlated with the ENSO cycle, which reflects the impact of tropical ocean temperature anomaly on the tropospheric circulation in the lower latitudes. The last two ZWA indices, which are the signals of the climate system variation over South Asia and northeast Asia, differ significantly from the ENSO index in the interannual timescale. By analyzing land precipitation and temperature field of the whole world and comparing the tropical and subtropical ZWS indices with the AO index, the last two ZWS indices could well represent anomalous model of land precipitation and temperature field in the middle and high latitude.

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Abrupt changes of precipitation in the Delingha region, northeastern Tibetan Plateau over the last 1000 years

High-resolution and long timescale climate records developed from proxy data are particularly important for the investigation of long-term climate variations and abrupt changes. The northeastern Tibetan Plateau is a region which has a unique concentration of tree-ring records of 1000 years and therefore it provides a remarkable source for studying past environmental changes. Based on these tree-ring data, we have reconstructed annual precipitation of the last 1000 years in the Delingha region. In the present study, we investigate the variations and abrupt changes of the precipitation. The smoothing t-test and smoothing F-test methods were used to search for possible abrupt changes in the mean value and the standard deviations of the precipitation. Significant abrupt changes were detected during the last 1000 years, and most of these changes have a close relationship with solar activity suggesting that solar activity probably played an important role in influencing these precipitation changes. The time and the direction of abrupt changes of precipitation coincided well with the variations of solar activity. It is evident that precipitation decreased significantly during the periods of the Wolf, Spörer, Maunder and Dalton minima of solar activity, and the t-test verified the existence of statistically significant differences within these periods. The abrupt changes of precipitation in the last century may link with the inter-decadal changes of the East Asia Summer Monsoon. Abrupt changes the Delingha occurred ahead of those in eastern China, which may be an important indicator for long-term changes in forecasts of precipitation.

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Edge influence on vegetation diversity in the Minjiang River Valley of China and its implication under global change

Landscape boundary has become a hotspot of global change research because these boundaries often serve as indicators under global change scenarios. Effects of climatic change and land-use practices on vegetation diversity have drawn more and more attention during recent decades. The main objective of this study was to estimate how far the edge effects on vegetation penetrate into the forest and agricultural field in the arid valley of upper reaches of Minjiang River, southwestern China and its implication under global change. Three types of boundaries (10 transects) were investigated and sampled. Moving split-window techniques (MSWT) were employed for data analysis. When the window width reached 6-10, the curve became relatively smooth and one or two peaks could be detected. The depth of edge influence (DEI) on vegetation diversity varied between 12-30 m in the agricultural field and 6-22 m in the forest. DEI on secondary forest was difficult to estimate because of microclimate and topography in the arid valley of Minjiang River. It implied that climatic warming and land-use practices would have more serious effects on agricultural ecosystems than on forest ecosystems, and the effects of global change on secondary forest were uncertain. The results will provide further knowledge for understanding the interaction between forest and arid agriculture in the arid valley and the effects of global change.

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A simulational study on precipitation in south China during the east Asian winter monsoon

By using the improved regional climate model (RegCM_NCC), a ten-year (1991-2000) simulation for winter has been undertaken over East Asia. Based on the NCEP reanalysis and station data, analysis has been performed to evaluate the model's capability to reproduce the precipitation in South China during the East Asian winter monsoon. The results show that the model can well simulate the basic characteristics of the winter monsoon circulation, such as the location and intensity of the cold surface high pressure as well as the wind pattern and winter monsoon intensity. The simulated occurrence frequency and the regions of the cold surge are also consistent with the observation. The simulated distribution and the interannual difference of the precipitation over South China are compared against the observations. The features of the simulated moisture transport and heat budget are also in good agreement with the results derived from NCEP reanalysis data. In addition, the differences of rainfall and circulation patterns in some abnormal winters that were affected by ENSO events are investigated. The deficiency of the simulation and the possible cause are also discussed.

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Impacts of climate change on urban human death toll

Various diseases caused the deaths of approximately 250,000 people aged 25 to 74 in Beijing between 1994-2000. Daily maximum and minimum temperature and monthly meteorological data in Beijing were used to examine the influence of extreme temperature on the urban death rate. Results show that there is a good linear variability between the extreme temperature threshold on urban death and extreme temperature threshold days from 1951 to 2004. Then, a forecast and evaluation model was built according to the optimal subset regression method. Finally, future mortality in Beijing was evaluated quantitatively using the climate model's forecasting data.

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A sub-tropic Summer Monsoon Index and its relation with rainfall over China

Using daily NCEP/NCAR reanalysis dataset and observation rainfall data in China for the 1971-2000 period, a sub-tropical summer monsoon index is defined by meridional moisture transport of the total atmosphere based on discussion regarding climate characteristics of moisture transport. Results show that the advance and retreat of the east Asia summer monsoon can be reflected by the intra-seasonal variation of moisture transport averaged over 110°-120°E. The sub-tropical summer monsoon index, defined by the difference of meridional moisture transport between South China and North China, can be a description of intensity of sub-tropic summer monsoon. High index corresponds to strong (weak) sub-tropical summer monsoon. And the new index is well related to the summer rainfall over the middle and lower reaches of the Yangtze River. In addition, the convergence of moisture transport from the west Pacific via the South China Sea and that from the North China may be responsible to the anomalous excessive summer rainfall over the middle and lower reaches of the Yangtze River.

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The statistical characteristics of the Dryness/Wetness Index grid dataset of eastern China for the last 500 years

In eastern China, there are density records of climate descriptions in historical documentary for the last several centuries. To investigate the changes of large-scale drought or flood events over longer time scales, we established the grid dataset of Dryness/Wetness Index (DWI) over eastern China [106.5-121.5°E, 25-40°N] with the spatial resolution of 0.5°_0.5°. The original dataset we used is the *Yearly Charts of Dryness-Wetness in China for the Last 500 Years*, which covers the summer season from May to September for 531 years from AD 1470 to 2000.

The Kriging method was used to interpolate the sites data to the grid data. The EOF method was applied to test the statistical characteristics of the grid dataset, and the results were compared with the meteorological observation data of 160 stations in China over the time period from 1951 to 2000. Power spectrum analysis, singular spectrum analysis and wavelet analysis methods were also carried out to investigate the climate characteristics of the established grid dataset. Multi-scale signals on abrupt changes of these two parts were detected with the scanning *t*-test, the *F*-test and the Lepage test methods.

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An analysis of seasonal and inter-annual variability of leaf area index during 1982 to 2004

Using AVHRR (1982-1999) and MODIS (2000-2004) leaf area index (LAI) products from 1982 to 1999, seasonal and inter-annual variability of LAI in China were analyzed. The results indicate that LAI in most of China increased at a different ratio while decreases were observed in some area of Tibetan Plateau, the south of Xinjiang, Yunnan, and Sichuan Provinces and part of northeastern China. With the correlative degree method, it is demonstrated that temperature is the most closely related to the LAI change in China in this period. It also shows that such LAI change has a close relationship with soil moisture and precipitation as well. We compared the multi-year-averaged monthly LAI from AVHRR during 1982-1999 with the monthly LAI from MODIS during 2000-2004, finding that in winter, the LAI from AVHRR agrees to the LAI from MODIS, but in summer, during which the vegetation is growing up, the LAI from AVHRR is larger than from MODIS. The LAI from AVHRR is in good agreement with MODIS in each month in arid and semi-arid region. This long-term LAI data can be used in land surface models. Analysis was conducted to examine how sensitive land surface parameters are to LAI inter-annual variability. The result shows that the response is mainly in the range of $\pm 15\%$, but for the fraction of the direct beam absorbed by canopy, the relative error is even larger than 40%, which suggests that the inter-annual difference of LAI must be considered in climate models.

NOTES

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Differences of influences of tropical western Pacific SSTA and Rossby wave propagation on the East Asian monsoon in the summers of 1993-1994

The differences of synoptic climatology and circulation anomalies associated with the East Asian summer monsoon anomalies between 1993 and 1994 are analyzed based on the National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) reanalysis dataset, Hadley center SST data and rainfall data. The results show that the East Asian monsoon was weak in 1993. Meanwhile the Asian subtropical westerly jet and subtropical high were located southward. The moisture coming from the Bay of Bengal and South China Sea was transported northward to near 35°N. East Asian countries experienced low temperatures and a cool summer in 1993. On the other hand, the East Asian monsoon was strong in 1994. The Asian subtropical westerly jet and subtropical high were located northward. Furthermore, the subtropical high intensified and controlled Japan continuously during the July-August period. The moisture was transported northward up to 45°N. East Asian countries suffered record-breaking heat waves and drought during the summer monsoon season of 1994. The physical processes involved in the discrepancy of East Asian monsoon in 1993 and 1994 are investigated. It is found that the discrepancy of East Asian monsoon in 1993 and 1994 are induced by the overlapping roles played by the propagation of Rossby wave in Asian subtropical westerly jet and a wave train of the Pacific-Japan teleconnection pattern that is generated by SSTA in the Tropical Western Warm Pool.

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Analysis of optical characteristics of physical processes in rocket-triggered lightning

The comparison is made between high-speed photography data in rocket-triggered negative lightning with two techniques. The analysis shows: 1) the initial speed of upward positive leader (UPL) in altitude-triggered negative lightning (ATNL) is about one order of magnitude lower than that in classical-triggered negative lightning (CTNL), while the triggering height of ATNL is higher than that of CTNL; and 2) the afterglow time of metal-vaporized part of the lightning channel can endure about 160~170ms, so the luminosity of the air-ionized part can reflect the characteristics of the current in the lightning channel better than that of the metal-vaporized part. According to the different characteristics of the luminosity change of the lightning channel, together with the observation of the electric field changes, three kinds of processes after return-stroke (RS) can be distinguished: the continuous decrease type without M component, the isolated type and the continuing type with M component. They correspond to different wave shapes of the continuous current. The geometric mean of the interval of RS with M component is 77ms, longer than that of RS without M component, which is 37ms. And the initial continuous current (ICC) with M component also has longer duration than the ICC without M component. The distinction between the relative luminosity of the lightning channel before RS and that before M component is obvious. The former is very weak or even cannot be observed, while the latter is still considerable luminous.

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Reanalysis of lightning activity as an indicator of climate change

It is an issue of great attention but yet not very clear whether lightning activities increase or decrease on a warmer world. Reeve and Toumi (1999) presented that lightning activities in global land and the Northern Hemisphere land have positive response to the increase of wet bulb temperature at 1000hPa. Is this positive response restricted only to wet bulb temperature or in land? What is the response of global lightning activities (in both land and ocean) to the global surface air temperature variation like? This paper, based on the 5-year or 8-year OTD/LIS satellite-based lightning detecting data and the NCEP reanalysis data, makes a reanalysis of the response of the global and regional lightning activities to temperature variations. The results show that on an inter-annual time scale the global total flash rate has positive response to the variation in global surface air temperature, with the sensitivity of $17 \pm 7\%K^{-1}$. Also, the seasonal mean flash rate of continents all over the world and that of continents in the Northern Hemisphere have sensitive positive response to increase of global surface air temperature and wet bulb temperature, with the sensitivity of about $13 \pm 5\% K^{-1}$, a bit lower than estimation of $40\% K^{-1}$ in Reeve and Toumi (1999). However, the Southern Hemisphere and other areas like the tropics show no significant correlation.

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Regional yield simulation for winter wheat in north China based on assimilating remote sensing data

Accurate crop growth monitoring and yield forecasting are significant to food security and sustainable development of agriculture. However, regional crop growth simulation faces difficulties in determining the spatial distribution of some model parameters and initial conditions. In this study, regional biomasses at turn-green stage of winter wheat were re-estimated by linking WOFOST model and Soil Adjusted Vegetation Index (SAVI) synthesized from remote sensing data. Moreover, we proposed a way of combining evapotranspiration derived from satellite remote sensing data to a crop grow simulation model. Thus, the regional initial available soil water and irrigation at earing stage were re-initialized and re-estimated using remote sensing data. Those methods were well applied to simulate the growth and development for winter wheat at local site. After regionalizing of weather data, crop model parameters and initial conditions, those methods were used to estimate winter wheat yields in North China during the growing season from 2001 to 2002 at the scale of 0.25 degrees. The results showed that both soil water and final winter wheat yields estimation were improved and the relative root mean square error decreased from 0.63 without remote sensing data to 0.20 with remote sensing data for 32 sites. The relative errors of the aggregated yields for three provinces were -4.9%, 4.3% and 8.6%, respectively. These results illustrated that remote sensing data can be used to improve winter wheat yield simulation at the regional scale.

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Large-scale low-frequency rainfall regimes and their transition modes in summertime over China

Seven large-scale low-frequency rainfall regimes (LFRRs) in summertime are identified for China in a 10-dimensional phase space by using a 40-year daily precipitation dataset. Corresponding to the local extrema of observed probability density in phase space, the LFRRs are characterized by the persistence and transitions that reflect the spread and jump features of low-frequency rainfall centers. The LFRRs are generally consistent with summer monsoon rainbelts on the intraseasonal timescale, and there exist the preferred transition relationships between the LFRRs. Four LFRRs' transition modes (LFRRTMs), which are the dominant components of the inter-annual and intra-seasonal variability of summer rainfall in China, are further induced. Analyses of atmospheric circulation system show that the anomalies of the subtropical high over the western Pacific (SHWP) and blockings in mid-high latitudes, the low-latitude circulation anomalies, and the wavetrains over the East Asia-Pacific region (EAPWs), play crucial roles in the occurrence and transitions of the LFRRs. Moreover, the evolution of the SHWP and blockings, the distribution and movement of the EAPWs, and the intra-seasonal variability of the East Asian-Pacific jet stream may be principal factors of the formations of the LFRRTMs.

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Numerical seeding experiments on cold frontal convective clouds

Based on the reasonable simulation of a precipitation event on March 31st, 2004, seeding effects through directly adding ice crystals in the simulated clouds were studied. The results showed that 30 minutes after seeding surface rainfall started to increase, at 80 minutes the Net Increase Rainfall (NIR) reached a peak, then after 120 minutes NIR decreased to a minimum. The seeding effects could last 10 hours, and dissipate with the natural clouds dissipating. The seeding effects of adding ice crystals in the cloud developing stage were better than those in cloud mature stage. The difference of NIR caused by the seeding agent dose in different seeding experiments was relative small. Supercooled raindrops were quickly transferred into graupels by injecting artificial ice crystals. Then graupels grew mainly through riming supercooled cloud water and collecting raindrops. Thus precipitation developed in prior, the melting of graupels caused the surface rainfall increase. The release of latent heat was changed by the phase change of hydrometeors in the cloud, which further influences the dynamic and thermodynamic field of cloud. "Dynamic seeding" and "static seeding" are correlative each other.

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Analyses of Asian-African summer monsoon pre- and post-global warming in the 1980s

The American CO₂ Information Analyses Centre monthly mean surface temperature anomalies grid data, American NASA monthly precipitation grid data, the northern hemispheric sea level pressure data from National Climate Centre of China Meteorological Administration, and American NCEP/NCAR reanalysis global grid data are used to study the Asian-African summer monsoon in response to the global warming event in the 1980s. The result showed that after middle of the 1980s the global warming increased. Compared with 1980-1985, 1990-1995 rainfall over northern Africa increased, most areas of northern China increased, central and south India increased and north India decreased remarkably. The total rainfall amount variation in northern China and the north African Sahel indicated that the rainfall during 1990-1995 increased, but far smaller compared with the cooling event in the 1960s. The difference charts of meridional monsoon cells between 1990-1995 and 1980-1985 showed that the African summer monsoon was reinforced somewhat after global warming in the 1980s, but the Indian summer monsoon weakened and the East Asian summer monsoon changed little. On the basis of wavelet analysis of land-sea thermal contrast and precipitation over northern China and the Sahel, respectively, it showed that in the 1960s there were different in-phase inter-decadal time-scale signals and they interacted to reinforce inter-decadal oscillation, thus the inter-decadal oscillation played key role during this period. In contrast, in the 1980s there existed different inter-decadal time-scale signals which appeared out of phase, so they counter-acted with each other to weaken the variation. In addition, inter-annual variability reinforced remarkably in the 1980s and became the most important signal and thus played key role in this warming event. In the 1960s inter-annual signals were quite weak. Therefore, in comparison with global cooling in the 1960s, the response of Asian-African summer monsoon to the global warming in the 1980s was much complicated, not a simple out-of-phase of inter-decadal oscillation.

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Influence of climate change on winter wheat productivity in different climate regions of China during 1961-2000

The crop model WOFOST was tuned and validated with observed meteorological data as well as winter wheat growth and yield data of 50 stations in 12 provinces in China from 1998 to 2003. The results show that most simulated growth dates and yields lie within $\pm 15\%$ range of the observed data, which shows that the genetic parameters determined are generally reasonable in most winter wheat regions of China. Overall, the results demonstrate that the WOFOST model predicts potential winter wheat yields and growth reasonably well in China under current climatic conditions. By assuming constant winter wheat varieties and agricultural practices, the parameterization obtained by the tuning was then used to model the impacts of climate change on winter wheat growth for 50 stations using long term weather data from 1961 to 2000. Over the last 40 year period, the simulated potential yield of winter wheat in north China is increased by 2.3%, while it is decreased by 1.6% in south China. Thus the climate change shows positive influence on the potential yield of winter wheat over most regions of north China, while it has adverse effects in south China. In north China, the accumulated minus temperature of winter is increased by 29.3° C/decade, which is the main reason for the increased potential yield of winter wheat. In south China, one possible reason for the decreased simulated yield is shorter growing season caused by the increasing mean temperatures.

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Equilibrium response of tropical atmospheric circulation to extra-tropical SST anomalies

A coupled climate model is used to explore the response of the tropical atmosphere circulation to the positive SST anomalies in the extra-tropics. The results indicate that the locally enhanced convection in the tropics is an important factor to form anomalous atmosphere circulation. The Hadley circulation is enhanced in winter, but weakened in summer. The tropical atmosphere circulation anomalies are mainly linked with the changes of local convection, both in winter and in summer. The convection changes have a relationship with local maximum SST anomaly, and are accompanied with changes of large scale atmosphere circulation.

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Precipitation characteristics in the future climate

Daily precipitation data from climate change simulations using the latest generation of coupled climate system models are analyzed for potential future changes in precipitation characteristics. For the emission scenarios SRES B1 (a low projection), A1B (a medium projection), and A2 (a high projection) during the 21st century, all the models consistently show a shift towards more intense and extreme precipitation for the globe as a whole and over various regions. For both SRES B1 and A2, most models show decreased daily precipitation frequency and all the models show increased daily precipitation intensity. The multi-model averaged percentage increase in the precipitation intensity ($2.0\% \text{ K}^{-1}$) is larger than the magnitude of the precipitation frequency decrease ($-0.7\% \text{ K}^{-1}$). However, for very heavy precipitation ($>50 \text{ mm day}^{-1}$), the percentage increase in frequency is much larger than the increase in intensity ($31.2\% \text{ vs. } 2.4\%$), so that there is a shift in the frequency distribution of precipitation towards increased extremes. The climate model-projected increases in daily precipitation intensity are, however, smaller than that based on simple thermodynamics ($\sim 7\% \text{ K}^{-1}$). Multi-model ensemble means show that precipitation amount increases during the 21st century over high latitudes, as well as over currently wet regions in low- and mid-latitudes more than other regions. This increase mostly results from a combination of increased frequency and intensity. Over the dry regions in the subtropics, precipitation amount generally declines because of decreases in both frequency and intensity. This indicates that wet regions may get wetter and dry regions may become drier mostly because of simultaneous increase (decrease) of precipitation frequency and intensity.

NOTES

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Characteristics and risk evaluation of droughts in the northeast China under global change

Global change and its effects on the life-supporting system of the earth and sustainable development has drawn more and more attention in the world. Frequent droughts have happened in northeast China, leading to huge economic losses, destruction of ecological and environmental resources and food shortages. To understand the droughts that have occurred in this region, the characteristics and risk evaluation of historical drought events were summed and analyzed using statistical methods and the data sources from the statistical annuals, chorography, literature and Internet information, etc. The result showed that the frequency of droughts in this region was usually one per 3-5 years before 1950's, and it changed into one in less than 3 years from 1950 to 1999. During the last ten years, spring droughts happened continuously in each year. Until 2003, some regions had continuously suffered the severe and extreme droughts for five years. Recently, the droughts tended to expand from the west to the east, which has normally less suffered drought than the west. According to the statistical results, the mean area impacted by drought was about 6 million hm^2 and up to 30% of the total cultivated area. Approximately 1.3 million hm^2 was without harvest per year in this region during 1999-2002. During 2000-2002, the yield losses and damage due to droughts were more than 13 million tons and the losses for economic crops was more than 9 billion yuan per year. Based on above analysis, we concluded that the droughts occurring in northeast China presented the following properties, 1) increased frequency; 2) increased area affected; 3) influence content deepening and 4) losses and damage heavier and heavier with time. It is implied that global change would have even more serious effects on northeast China in the future.

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A preliminary study of high correlations between Asian dust events and biological productivity in the western

With global climate warming, aridification, and ecological environment worsening, the generation and development of dust storm events as well as their harm appear more clearly. Previous studies have suggested that one of the possible factors that affect the seasonal changes of the phytoplankton distribution on the western North Pacific is the components and fluxes of aerosol depositions transported long-distance from the Asian continent. The relationships between the number of continental dust event days and the sediment-trap fluxes at KNOT (a mooring site in the western North Pacific) were investigated in this study by using the 701-site dust event records in China during 1997-2000 and the sediment-trap observational data at KNOT. It was found that the best links exist between dust events that occurred in the Badain Juran desert region and sediment fluxes. The correlation coefficients of three kinds of dust events (Dust storm, Blowing dust and Floating dust) to three sediment fluxes (LMF, Opal and TMF) are 0.66~0.78, 0.62~0.65, 0.62~0.68, respectively. A possible mechanism of continental dust particle settling from sea surface into the sea was estimated. The correlation of dust events to the Pennate diatom is better than the links to the centric Diatom. The results of this work provide important scientific evidence for the study of the air-sea interaction and the global cycle of CO_2 .

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Possible mechanism of the effect of convection over the Asian-Australian "land bridge" on the east Asian summer monsoon onset

The Asian-Australian "land bridge" is an area with the most vigorous convection in the Asian monsoon region in boreal spring, where the onset and march of convection are well associated with the onset of the East Asian summer monsoon. The convection occurs over Indo-China Peninsula as early as mid-April, which exerts critical impact on the evolution of monsoon circulation. Before mid-April, there are primarily sensible heating to the atmosphere over Indo-China Peninsula and Indian Peninsula, so the apparent heating ratios over them decrease with height. However, after mid-April, it changes into latent heating over Indo-China Peninsula due to the onset of convection, and the apparent heating ratio increases with height in mid- and lower- troposphere. The vertical distribution of heating ratio and its differences between Indo-China Peninsula and Indian Peninsula are the key factors leading to the splitting of boreal subtropical high belt over the Bay of Bengal. Such mechanism is strongly supported by the fact that the evolution of the vertical heating ratio gradient above Indo-China Peninsula leads that of 850hPa vorticity over the Bay of Bengal. Convections over Indo-China Peninsula and its surrounding areas further increase after the splitting. Since then, there is a positive feedback lying among the convective heating, the eastward retreat of the subtropical high and the march of monsoon, which is a possible mechanism of the advance of summer monsoon and convection from Indo-China Peninsula to South China Sea.

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The validation of CoLM on semi-arid territory of west-northern china and Tibet plateau

A off-line validation experiment is done with common land model at zhangye site of typical semi-arid territory as well as Anduo and MS3478 site of Tibet plateau. The results show that the numerical simulation of land surface process of typical semi-arid territory is pretty good by common land model. The daily and seasonal variety of soil temperature vertical profile is exactly simulated, in detail, the coefficient between simulation and observation of ground surface temperature is 0.885 (residual standardization variance is 0.873), the coefficient between simulation and observation of the soil temperature at 5cm depth is 0.944 (residual standardization variance is 0.891). On the Tibet plateau, the simulation of net solar radiation and sense heat flux by the model is generally good, but latent heat flux is wholly bigger than observation. Actually, during Game-Tibet monsoon experiment, the energy imbalance [3,11,12] problem has existed. So, it is not true to say that the model's simulation is not good.

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Simulated effects of climate and land use change on net primary processes of loess hilly landscape in arid and semiarid area of Northwest China

A vegetation-soil-integrated-model (VSIM) to simulate net primary production at watershed scale was used to explore the effect of climate and land use change on the primary production processes in arid and semi-arid in northwest China. Based on analyzing the trends of climate change for 50 years of the Zhifanggou watershed, a loess hilly landscape, 4 climate scenarios, which included 20% changes in daily precipitation, 2° increase chosen arbitrarily, synthesized 20% increase in precipitation and 2° increase in temperature were used for sensitive tests during period of 1990-1999. The NPP was more sensitive to temperature increase than to the change of precipitation, soil water condition was affected by precipitation significantly and decreased while temperature increased. NPP reduced dramatically for 2° increase in the average air temperature for all vegetation, and grasses and sub-shrubs behaved more sensitive than others. NPP still declined under 20% increased in precipitation and 2° increased in temperature,

To analyze the effect of land use on NPP, we performed simulations under current land use patterns and 3 land use change scenarios for changing farmland of steep slope to woodland, shrub and grassland respectively. The NPP decreased when sloped farmland steeper than 25° was replaced by natural grassland, while increased when replaced by shrub or woodland. Changing farmland of steep slope to natural grassland had little impact on runoff, but evapotranspiration decreased, so as to improve soil water content. When replaced by shrub and woodland, evaporation and runoff decreased distinctly, and transpiration increased significantly that caused soil water content to decrease. Although changing sloping farmland to shrub and woodland had a distinct impact on reducing runoff and controlling soil erosion, a combination of shrub and natural grass are still recommended because of the greater evapotranspiration of woodlands which will induce excessive use of soil water influencing normal growth of vegetation.

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Typhoon affecting East China over the past 500 years

Severe typhoon disasters endanger the public safety of coastal metropolises, district and even national security, and not only cause human casualties and economic losses, but also cause negative influences on social psychology and stability, resulting in ecosystem decay, which consequently impedes sustainable social and economic development. Based on reconstructed historical typhoon data in the last five centuries, this paper summarized the number of extreme typhoon disasters in East China since 1450. It is discovered that more than 1400 typhoon disasters occurred over that period, with 44 typhoon disasters causing over 10,000 human deaths in each disaster. The most destructive typhoon disaster happened in 1696 in Shanghai, with a death toll of over 100,000 people. It is demonstrated that there is an oscillation ascending trend in the TC series and the inter-annual and inter-decadal variations are discerned. Based on the trend and oscillation analysis there is a rising trend of typhoon disaster in East China in the next decade.

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Anomalous perturbation kinetic energy of Rossby wave along East Asian westerly jet and association with summer rainfall in China

The response of East Asia circulation during summer to anomalous perturbation kinetic energy of Rossby wave along East Asian Westerly Jet (PKE) and association with rainfall pattern in China are investigated using the NCAR/NCEP reanalysis dataset and 160 stations monthly rainfall in China during 1958-2003. It had been found out that anomalous PKE in summer intensified (weakened) was related with the EAWJP (East Asian Westerly Jet Position) moved to Southern (Northern) than normal as well as the EAWJI (East Asian Westerly Jet Intensity) was strengthened (weakened) than normal. The rainfall pattern in China, mid-high latitude circulation over East Asia and East Asian Summer monsoon (EASM) circulation are discussed for the intensified or weakened anomalous PKE of Rossby wave along East Asian Westerly Jet during summer. The results showed that while PKE looked stronger than normal, the subtropical high over western Pacific at 500hPa moved to further south than normal that means East Asian summer monsoon circulation at 850hPa looked weaken than normal, the main rainfall belt in China occurred over Yangtze River Valley during summer. While PKE looked weaker than normal, the subtropical high over western Pacific at 500hPa moved further north than normal that means East Asian summer monsoon circulation at 850hPa looked stronger than normal, the main rainfall belt in China occurred over South China and North China during summer. It had been found that the response of East Asia circulation in summer to anomalous PKE of Rossby wave along east asian westerly jet was going with the change of divergence-convergence over East Asia in 200hPa and vertical velocity from surface to up. When PKE looked stronger (weaker) than normal, the convergence area in 200hPa and the maxim subsidence area moved to southern (northern) of 30°N over East Asia, meantime the subtropical high over western Pacific at 500hPa moved to southern (northern) of 30°N. So, EASM looked weaker (stronger) than normal and more precipitation occurred along Huai-he and Yangtze river valley (in the South China and north China).

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Research and application of the routing model on WangYing Reservoir in HuBei Province

Depending on restrictions, the family of Γ function that is not an orthogonal polynomial and the family of Legendre functions that is orthogonal polynomial are used as the response functions to establish the routing model of the WangYing watershed. In the meanwhile, the Nash IUH (Instantaneous Unit Hydrograph) routing model is chosen to compare with both response functions to analyze the advantages and disadvantages further. An actual application of this model to the WangYing reservoir is given, and the verification results are satisfactory.

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Feedback of SOC stock in the terrestrial ecosystems of China to climate changes

Human capacity to predict the change of climate in future and adapt to the consequences of that change depends, in part, on a clear understanding of the mechanism for the carbon exchange between land and atmosphere. Alteration of exchange fluxes between the two, which might impose a further accelerate or mitigate that change, has an impact on the decomposition and accumulation of soil organic carbon (SOC) in terrestrial ecosystems. Thus, the understanding of feedbacks of SOC storage in terrestrial ecosystems to climate change has significant implications for the protection of climatic system behaviors and the sustainable management of terrestrial ecosystems. In this paper, the RothC model is used to simulate changes in SOC storage (0~20cm) in cropland, forestland and grassland under the climate change scenarios of SRES A2 and B1 from 2000 to 2100 projected by NCC/IAP T63 Model from the National Climate Center of the China Meteorological Administration. The results show that under the projected climate change more than half of cropland, forestland and grassland would become a carbon source while others would become carbon sinks. SOC stocks in these three types of ecosystems would be seriously reduced in Xiaoxingan Mountains, Changbai Mountains, Northeast Plain, mid-eastern and northeastern part of Inner Mongolian, North China, from the Qinling Mountains to Sichuan Basin, Guangxi Province, Guangdong Province and Southwestern China Plateau. SOC stocks of the three ecosystems would be slightly reduced in West China. SOC storage would increase in some parts of northeastern China, Qinghai, Ningxia, Gansu, east of Qinghai-Tibet Plateau, Hu'nan Province, Jiangxi Province, Zhejiang Province, and southeastern China. Under the projected climate change, the areas of cropland, forestland and grassland serving as the carbon sources is much more widely distributed than those serving as sinks. The spatial distribution of cropland, forestland and grassland either as carbon source or sink is similar under the climate changes between A2 and B1 scenarios, but with a differing magnitude of change in SOC stocks between the two scenarios.

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Volcano eruption events recorded in an ice core from the Mt. Qomolangma region?

An 80.36 m ice core covering 154 years from 1844 to 1997 A.D. was retrieved in the accumulation zone (6500m a.s.l.) of the East Rongbuk Glacier, Mount Qomolangma (Everest), Himalayas. A composite index with integrative consideration of ion (such as SO_4^{2+} , NH_4^+ , NO_3^- , Ca^{2+} and Cl^-) peaks that appeared simultaneously in the ice core was used to distinguish volcanic signals. The results indicate that most large global volcanic eruption events in the past century and half left traces in the ice core ion records although ice cores from mid-latitude or tropical glaciers would not be suitable to find volcano eruption events. This composite index was undoubtedly interfered with by dust or anthropogenic loadings, therefore, future work will focus on finding an ideal indicator or method to distinguish volcanic signals.

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Primary analysis of coupled relationship between the Qinghai-Xizang Plateau temperature and the Indian Ocean SST

Datasets including Qinghai-Xizang Plateau annual temperature of 54 observational stations and the Indian Ocean Sea Surface annual temperature during 1960-2000 have been used to analyze the characteristics of Qinghai-Xizang Plateau Temperature climate and their relationship by using SVD method. The results show as follow: 1) the temperature is lower in the middle of Qinghai-Xizang Plateau while higher around; 2) during the most recent 41 years, the trend of Qinghai-Xizang Plateau temperature ascends year by year; and 3) the teleconnection relationship between Qinghai-Xizang Plateau temperature abnormality and Indian Ocean SSTA is obvious, which probably have something on correlative wave train forced by Indian Ocean SSTA through the main coupled relationship model.

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Effects of South China Sea summer monsoon on inter-decadal variability of summer rainfall over South China

There is obvious quasi-biennial variability both in summer precipitation over South China (SCSPR) and Summer Monsoon over South China Sea (SCSSM). SCSPR inter-decadal variations mainly behave as inter-decadal variations of their averaged variance in quasi-biennial oscillation after 1970s. Commonly, the larger variance corresponds with more precipitation, and vice versa. But there is bad relation prior to this. The analysis results suggest that in the inter-decadal phase of 1953-1976, SCSPR and SCSSM exhibit weak negative correlation on the quasi-biennial timescale, whereas there is strong positive correlation on the non-biennial timescale; during 1977-2000, Tropospheric Quasi-Biennial Oscillation of SCSPR and SCSSM vary in phase, and they are not clearly related on the non-biennial timescale. Further analysis indicates that the abrupt change of general circulation in 1970s makes quasi-biennial variation of SCSPR more important in its inter-annual scale after then.

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The decadal relationship between atmospheric heat source and winter and spring snow over the Tibetan Plateau and rainfall in East China

By adopting reverse computation method, the calculation and analysis from NCEP/NCAR daily reanalysis data from 1960 to 2004 show that, atmospheric heat sources over Tibetan Plateau (TP) and its neighboring areas take on a persistent downtrend in spring and summer during the previous 50 years, especially the last 20 years. Snow depth at 50 stations over TP in winter and spring represents increased, particularly snow depth in the spring which exhibits a sharp increase after the late 1970s. A close negative correlation exists between snow cover and atmospheric heat source over TP and its neighboring areas by SVD method, namely if there is more snow on TP then there is a weaker atmospheric heat source over TP. The SVD analysis between atmospheric heat source over TP in spring and summer and rainfall at 160 stations indicates that, the former has negative correlation with precipitation in the middle and lower Yangtze River, and has positive correlation with South China and North China. From the results of SVD analysis, atmospheric heat source over TP in winter and spring and rainfall at the same 160 stations indicates that the former has marked positive correlation with precipitation in the middle and lower Yangtze River, and reversed correlation in South China and North China. In the decadal scale, the atmospheric heat source and winter and spring snow over TP has close correlation with decadal precipitation pattern shifts (southern flood and northern drought) in East China. In the end, the mechanism by which atmospheric heat source over the TP influences rainfall in East China is discussed.

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