Common Challenge

共同的挑战

5 Year Summary 2004/2008
Nansen-Zhu International Research Centre,
Beijing, China
REPORT FROM THE ADVISORY BOARD

VISION

The overarching goal of the Nansen-Zhu International Research Center (NZC) is to become an internationally acknowledged climate research and training centre with emphasis on tropical and high-latitude regions, and the interactions between these regions, for past, present and future climate.

ORGANIZATION

The Nansen-Zhu Centre is a non-profit joint venture located at the Institute of Atmospheric Physics under the Chinese Academy of Sciences (IAP/CAS) in Beijing, China.

NZC has five founders: IAP/CAS; the Nansen Environmental and Remote Sensing Center (NERSC), Bergen, Norway; the University of Bergen (UoB), Bergen, Norway; the Bjerknes Centre for Climate Research (BCCR), Bergen, Norway; and the Peking University (PKU), Beijing, China. A revised agreement was signed on November 4th 2008 in the witness of Norwegian Minister of Research and Education, HE Tora Aasland, and the Vice President of Chinese Academy of Sciences, Prof. Zhongli Ding, where also the Nanjing University, Nanjing, China, was included as a new partner represented by Prof. Xiuqun Yang.

HISTORY

Representatives from the Chinese and Norwegian authorities formally opened the Nansen-Zhu Centre on 4 November 2003. The center is based on an Agreement of Understanding between IAP/CAS, NERSC and UoB of 7 August 2001, and a Memorandum of understanding between IAP/CAS, NERSC, UoB and PKU of 5 November 2002.

BACKGROUND

NZC is set up based on the desire to run an attractive and focussed cutting edge climate research network bridging scientists from China, Norway and abroad.

Particularly, NZC aims to

- Exchange scientists and graduate students between the founding partners
- Initiate and develop joint research projects between the founding partners
- Co-ordinate and facilitate joint research proposals to be submitted to national and international funding bodies
- Stimulate and support joint publications in international peer-reviewed journals
- Develop co-operation in education and research programs

RESEARCH ACTIVITIES

NZC's strategy for the past 5 years was to integrate field observations, remote sensing products, theory and numerical modelling to develop cutting-edge research within four prioritised topics:

- Construction of past climate and climate variability based on low- and high latitude paleoenvironmental reconstructions from tree rings, marine and lake sediments, and by use of modelling.
- Development and evaluation of seasonal, inter-annual and decadal time scale climate predictability systems, and identification of low- and high latitude teleconnection patterns and mechanisms.
- Model and assess long-term climate effects of regional to global scale atmospheric events like dust storms and pollution emissions.
- Assess sources and sinks of carbon dioxide on seasonal to interdecadal time scales based on integrated use of observations and modelling.

STAFF

At the end of 2008, NZC has a total staff of 67 persons. The staffs consist of 12 full-time members with 11 research scientists and 1 administration staff, 6 part-time research scientist, 15 associated research scientists, 1 joint member and 1 post doc, 24 PhD students and 8 master students. The total number of 32 Master and PhD students includes 5 so-called jointly educated students.

PUBLICATIONS

The numbers of papers published by the NZC staffs during 2004-2008 are listed in the table:

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<th>Year</th>
<th>SCI</th>
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SCI: Science Citation Index
SCIE: Extended Science Citation Index

FOUNDING PARTNERS

- Institute of Atmospheric Physics/Chinese Academy of Sciences (IAP/CAS), Beijing, China
- Nansen Environmental and Remote Sensing Center (NERSC), Bergen, Norway
- University of Bergen (UoB), Bergen, Norway
- Peking University (PKU), Beijing, China
- Bjerknes Centre for Climate Research (BCCR), Bergen, Norway
- Nanjing University (NJU), Nanjing, China

LEADER TEAM

- Director Professor Huijun Wang, IAP/CAS
- Co-Director Professor Hege Drange *, NERSC/BCCR
- Co-Deputy Director Professor Zifa Wang, IAP/CAS
- Co-Deputy Director Professor Yongqi Gao, IAP/NERSC/BCCR
- Research school leader, Professor Tore Furevik, UoB

THE ADVISORY BOARD

- Professor Ola M. Johannessen, Director NERSC, Co-chairman NZC
- Professor Huijun Wang, Director IAP/CAS, Co-chairman NZC
- Professor Peter M. Haugan, Director Geophisical Institute/UoB
- Professor Benkui Tan, Dep. Director, PKU
- Professor Eystein Jansen, Director BCCR
- Professor Xiuqun Yang, Dep. Director, NJU
- * up to September 2008
DOCTORAL DISSERTATIONS

Over the past five years, 19 PhDs students and 5 Master students defended their theses at IAP/CAS including 7 PhD students and 1 master student making their defenses in 2008.

Seven doctor dissertations in 2008:
- Mingfeng Su - The development and application of Palmer drought model.
- Wenyuan Chang - An investigation of the interaction between air pollution and climate change by CACTUS model.
- Lijuan Chen - Analyses on seasonal climate predictability of ocean-atmosphere coupled models and the explained application.
- Caiyan Lin - Study of Applying Ensemble Kalman Filter to Dust Storm numerical forecasts.
- Chao Gao - The transport of acid and alkaline pollutants in East Asia and the neutralization of alkaline to acid rain.
- Chengming Pang - Mixing and Evolution of Aerosols through Transportation in East Asia.

One Master dissertation:
- Li Lina - Research on the effects of regional pollutants' transportation on ozone concentration in Beijing during summer time.

AWARDS

NZC staff has received 14 awards at different levels during 2004 to 2008. Here the awards at the national level are highlighted.

- Ke Fan: One Hundred Excellent Doctoral Dissertations of China (2007).

INTERNATIONAL MEETINGS AND COLLABORATION

- 27-31 October 2008: the third NZC International Summer School in Beijing, China with 70 PhD/Master students and young scientists and 23 lecturers from China, Norway, Russia, France and India (for summary report, go to http://nzc.iap.ac.cn/summer/).
- 11-22 September, 2006: The second NZC summer school, held in Finse/Bergen, Norway (10 participants from China).
- 2-3 April, 2004: The second international Dust Model Inter-comparison Project (DMIP) meeting (20 participants) in Beijing.
- 20-24 September, 2004: The first NZC summer school in Beijing (10 participants from Norway, about 40 from China.
- 27-30 October, 2004: The European Climate Forum (as one of the main hosts) (57 participants).
- NZC has extensive collaboration with Japanese institutions.

BILATERAL VISITS

NZC has close collaboration and frequent project-dependent exchange with students and researchers from NERSC, BCCR and UoB.

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ECONOMY 2004-2008

NZC receives funding partly from the Chinese and Norwegian partners, including the Nansen Scientific Society in Bergen, Norway, and partly from national and international funding agencies. NZC received 4010,000 RMB (430,000 EURO) in 2008; 4050,000 RMB (400,000 EURO) in 2007; 4000,000 RMB (410,000 EURO) in 2006; 3000,000 RMB (310,000 EURO) in 2005; 4010,000 RMB (430,000 EURO) in 2004 respectively.

PROSPECTS FOR 2009

The Board expects an expansion of the number of staff and the research activities in 2009. This increase is partly due to the newly-received top research program supported by the Ministry of Science and Technology (MOST) in China and partly due to the stable support from Norwegian partners and more funding possibilities from the European Commission (EC), the National Sciences Foundation of China (NSFC), the Research Council of Norway (RCN), the Ministry of Science and Technology (MOST), the Chinese Academy of Sciences (CAS), and the Nansen Scientific Society in Bergen, Norway.

Beijing, 3 Nov. 2008
Huijun Wang (Co-chairman)
Ola M. Johannessen (Co-chairman)
Peter Haugan
Benkui Tan
Eystein Jansen

STAFF MEMBERS

By the end of 2008, the different staff categories are:

Full-time (12 persons)
Huijun Wang (Dir.)
Zifa Wang (Dep. Dir.)
Shuanglin Li
Dabang Jiang
Ke Fan
Xiquan Wang
Jianqi Sun
Fuying Xie
Aihui Wang
Lei Yu
Jie Li
Huijun Huang (admin.)

Jointly (1)
Yongqi Gao (Co-dep. Dir.)

Part-time (6)
Xianmei Lang; Lixia Ju; Botao Zhou;
Jingzhi Su; Jinping Han, Pengyu Sun

Associated (15)
Gan Luo; Huijun Yang; Helge Drange; Ingo Bethke; Jiang Zhu;
Mats Bentsen; Meixue Yang; Odd Helge Otterå; Pucal Wang; Tianjun Zhou;
Tore Furevik; Weiwei Fu, Xiuxiang Yang; Yongfu Xu; Zhongshi Zhang

Post Doc (1)
Gbaguidi Alex Enagnon

PhD students (24)
Dong Guo; Entao Yu; Fengyu Wang; Huabin Dong; Huopo Chen;
Jianjian Fu; Jianping Huang; Jun Wang; Liming Cai; Linling Chen;
Meijing Lin; Qizhong Wu; Tao Wang; Weiling Xiang; Wenyuan Chang;
Xiao Tang; Xiaole Pan; Xin Liu; Xu Yue; Yali Zhu; Yanchun He;
Yanning Wang; Ying Zhang; Yuhong Guo

Master students (8)
Huangsheng Chen; Jingjing Xu;
Pingzhong Yan; Ting Yang; Wei Wang; Yunfei Zou; Zhuolei Qian;
Huangsheng Chen

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SCIENTIFIC HIGHLIGHTS

1. Climate Variability

Atlantic Multidecadal Oscillation (AMO) and Asian Climate

The relationship between the AMO and the Asia Climate has been investigated using the AGCM. The results indicate that the AMO warm phase induces intensified Indian summer rainfall, attributed primarily to the extratropical component of the AMO sea surface temperature anomaly (SSTA) and corresponds to warmer air temperature in East Asia (Fig.1) (Wang et al., 2008, J. Geophys. Res.).

Antarctic Oscillation (AAO) and Asian Climate

AAO is an annular mode in southern hemisphere. The linkage between the Antarctic Oscillation (AAO) to the dust weather frequency (DWF) in North China is addressed. DWF denotes the number of days of dust weather events including dust haze, blowing dust and dust storm in one year. It is found that the interannual variation of AAO plays a significant role in the dust-related atmospheric circulation during boreal spring and that AAO and DWF are highly correlated with positive AAO tending to decrease DWF in North China. Two possible mechanisms for the AAO-DWF coupling are identified, one is related to a meridional teleconnection pattern and the other is related to a regional circulation pattern over the Pacific Ocean (Fan and Wang, 2004, Geophys. Res. Lett.).

Moreover, the zonal asymmetry of AAO is studied. The normalized SLP differences between 40°S and 60°S along the longitudes (the solid line in Fig.2) is indicated that apparent zonal asymmetry exists in the normalized sea-level pressure differences between the middle and high latitudes during the boreal summer, among different longitudes, especially between the Western and Eastern Hemispheres. When the linear regression on SOI is removed in the SLP fields and then re-draw the correlation coefficient between the AAOWH and the normalized SLP differences between 40°S and 60°S in all longitudes (the dotted solid line in Fig.2), the zonal asymmetry of AAO is substantially weakened. Results show that the Southern Oscillation (SO) is responsible for part of the zonal asymmetry in AAO. The relationship between the precipitation in the East Asia and the AAO before and after removing the linear regressions on SO index (SOI) is also discussed, indicating the stable relationship between the East Asian precipitation and the zonal symmetric component of AAO (Fan, 2007, Geophys. Res. Lett.).

The possibility to use the AAO signal for the forecast of both dust climate in North China and summer precipitation over eastern China has been explored. The results show AAO is an important predictor and may be applied to climate model. Finally, relationship between AAO and the western North Pacific typhoon number (WNPTN) in the interannual variability is examined. The WNPTN is correlated with the AAO in June-July-August-September (JJAS) in 1949-1998 at -0.48 for the detrended time series, statistically significant at 99% level. The tropical atmospheric circulation as well as the sea surface temperature variability over the western Pacific associated with AAO has been analyzed. It follows that a positive phase of JJAS AAO provides unfavorable environment for the typhoon genesis, and vice versa (Fan and Wang, 2006, 2007, Sciences in China; Wang and Fan, 2007, Chin. Sci. Bull.).

Central-North China precipitation reconstructed from the Qing Dynasty and the Antarctic Oscillation

The long-term June-July relationship between Central-North China precipitation (CNCP) time series reconstructed from the Qing Dynasty Official Document and the Antarctic Atmospheric Oscillation (AAO) is examined. The analysis yields a (significant) negative correlation of -0.22. The signal of AAO in CNCP is further studied through analyses of the atmospheric general circulation variability related to AAO. It follows that AAO-related variability of convergence and convection over the tropical western Pacific can exert impact on the circulation and precipitation in North China and the
Yangtze River Valley through the atmospheric East Asia Pacific (or Pacific–Japan) teleconnection wave pattern (Fig.3). There is also an AAO-connected wave train in the vorticity field in the high troposphere over Eurasia, providing an anti-cyclonic circulation in Central-North China favourable to the decline of precipitation in positive phase of AAO (Wang and Fan, 2005, Geophys. Res. Lett.).

Decadal variations of the relationship between the summer North Atlantic Oscillation and middle East Asian air temperature
The linkage between summer (July–September) North Atlantic Oscillation (SNAO) and middle East Asian summer air temperature varies with time on decadal timescale: a strong connection appears after the late 1970s but a weak connection before the late 1970s (Fig.4). Further analysis indicates that this instable relationship may have resulted from the shift of the SNAO mode around the late 1970s (Sun et al., 2008, J. Geophys. Res.).

The Relationship between the Arctic Oscillation and the Pacific Decadal Oscillation
The relationship between the Pacific Decadal Oscillation (PDO) and the Arctic Oscillation (AO) on decadal timescale in the extended winter (November - March) is investigated in this study. The results indicate that AO plays an important role in the low frequency variability of PDO. When AO leads PDO by 7 - 8 years (Fig.5), the lagging correlation between them becomes the strongest with correlation coefficient 0.77. The leading decadal variability of AO provides a valuably precursory signal for predicting the variability of PDO. The results of regression and lagging correlation reveal the possible mechanism for the AO-PDO coupling: A strong AO would lead to an enhanced Aleutian Low that is linked to PDO by ocean-atmosphere interaction in the North Pacific, and vice versa (Sun and Wang, 2006, Chin. Sci. Bull.).

The relationship between the boreal spring Hadley circulation (HC) and the summer precipitation in the Yangtze River valley
A significantly positive correlation between HC and the summer rainfall in the Yangtze River valley is documented (Fig.6). This relationship is well supported by changes in the atmospheric general circulation and water vapour conditions related to the variation of preceding boreal spring HC. Summer situations of strengthened western Pacific subtropical high, intensified South Asian high, southward located East Asian jet and enhanced water vapour corresponding to strong spring HC provide favourable conditions for increasing precipitation in the Yangtze River valley, and vice versa.
The possible mechanism how boreal spring HC affects summer atmospheric circulations is also indicated: Analysis show that sea surface temperature anomalies in the Indian Ocean and South China Sea may play an important role in linking the spring HC and summer atmospheric circulation in the Yangtze river valley (Zhou and Wang, 2006, J. Geophys. Res.).

Relationship and its instability of ENSO-Chinese variations in droughts and wet spells

Monthly data of Self-Calibrated Palmer Drought Severity Index (PDSI) from 1951 to 2000 are calculated using historical precipitation and temperature data from 160 stations in China. It is found that changes in the temporal and spatial patterns of PDSI are similar to changes in ENSO-events over the same time period (Fig.7).

During the typical warm phase of ENSO, surface conditions are drier in most regions of China, especially North China, but wetter than normal in the southern regions of the Changjiang River, and in Northwest China. The reverse relationship holds for cold phases of ENSO. From 1951 to 2000, there are large multi-year to decadal variations in droughts and wet spells in China, which are all closely related to strong El Niño events. Analyses also suggest that during the last 2-3 decades climate changes over China, especially drying in North China and northwest China becoming wetter, are closely related to the shift in ENSO towards more warm events and global warming since the late 1970s. It is furthermore revealed that the coherency between ENSO and Chinese variations in droughts and wet spells is high during 1951-1962 and 1976-1991, but low during 1963-1975 and 1992-2000 (Su and Wang, 2006, Science in China).

Fig.7 Temporal (upper panel, dotted line) and spatial (lower panel) patterns of the leading mode of the monthly PDSI in China during 1951-2000. Also shown in the upper panel are the Southern Ocean Index (SOI, dashed line) and the normalized Darwin sea level pressure index (solid line). Maximum correlation is found when the ENSO indices lag by one year. The correlations (r=0.38 with SOI and r=0.45 with the Darwin pressure index) are significant.

2. Climate Prediction

A physically-based statistical forecast model for the middle-lower reaches of Yangtze River Valley summer rainfall

A new approach to forecast the middle-lower reaches of the Yangtze River Valley summer rainfall in June-August (JJA) is proposed. The year-to-year increment of the middle-lower reaches of the Yangtze River Valley is forecasted and hence the summer precipitation could be predicted. DY is defined as the difference of a variable between the current year and the preceding year (year-to-year increment). YR denotes the seasonal mean precipitation rate of the middle-lower reaches of the Yangtze River Valley summer rainfall. After analyzing the atmospheric circulation anomalies in winter and spring that were associated with the DY of YR, six key predictors for the DY of YR have been identified. Then the forecast model for the DY of YR is established by using the multi-linear regression method. The predictors for the DY of YR are Antarctic Oscillation, the meridional wind shear between 850hPa and 200hPa over the Indo-Australian region, and so on. The prediction model shows a high skill for the hindcast during 1997-2006, with the average relative root mean square error is at 18%. The model can even reproduce the upward and downward trends of YR during 1984—1998 and 1998—2006 (Fig.8). Considering that the current operational forecast models of the summer precipitation over the China region have the average forecast scores at 60%—70% and that the prediction skill for the middle-lower reaches of Yangtze River Valley summer precipitation remains quite limited up to now, thus this new approach to predict the year-to-year increment of the summer precipitation over the Yangtze River Valley (and hence the summer precipitation itself) has the potential to significantly increase the operational forecast skill of the summer precipitation (Fan et al., 2008, Chin. Sci. Bull.).

Fig.8 The time series for observed DY of YR (solid line) and the model simulation is for the period of 1965-1996 (dashed line), the hindcast DY of YR is for the period of 1997-2007 (dashed line) in upper panel. Unit (mm day$^{-1}$); the observed (solid line) and the model simulated (dashed line) and hindcast (dashed line) percentage anomalies of YR (%) the observed trend of YR (solid line with circle), the modeled trend of YR (dashed line with dot) during 1984-1998, and the forecasted downward trend of YR during 1998-2006 (solid line) in lower panel.

Can the climate background of western North Pacific typhoon activity be predicted by climate model?

Statistically significant relationships are found between the June-July-August western North Pacific (WNP) typhoon frequency and synchronous vertical shear of zonal wind (VSZW) (Fig.9), outgoing longwave radiation, and divergence fields in the lower and upper troposphere in the main development region of WNP typhoon. Moreover, the model possesses a large potential skill for predicting the VSZW intensity and divergence field in the lower troposphere, and the model is therefore capable of performing the real-time...
3. Paleo-Climate Simulation

Vegetation and soil feedbacks at the Last Glacial Maximum

Vegetation feedback at the Last Glacial Maximum (LGM, about 21,000 calendar years ago) remains an unresolved question. An AGCM is synchronously coupled with an equilibrium terrestrial biosphere model in the present study. The coupled model is then used to investigate the influences of vegetation and soil feedbacks on the LGM climate.

It is found that the simulated geographical distribution of vegetation at the LGM differs dramatically from the present, and glacial vegetation cover tends to be reduced on average. Vegetation feedback alone leads to an annual surface temperature decrease of 0.31°C over the LGM ice-free continental areas (Fig.10). Additional soil feedback reinforced vegetation-induced cooling over high latitude Eurasia and from the eastern Middle East eastward to the Indian Peninsula significantly. In the tropics, a terrestrial annual surface cooling of 0.45°C is produced by vegetation and soil feedbacks. It is shown that vegetation and soil feedbacks partly reduce data-model discrepancy as produced by the AGCM alone in some regions such as Central Africa, the Indian Peninsula, South China, and North Australia (Jiang, 2008, Palaeogeogr., Palaeoclim., Palaeoecol.).

Impacts of tectonic changes on the reorganization of the Cenozoic paleoclimatic patterns in China

Geologic studies have illustrated that the planetary-winddominant climate in the Paleogene is changed into the monsoon dominant one near the Oligocene/Miocene boundary in China. The evolution is marked by the changes of regional aridity/humidity contrasts. The contrasts occur between the south and the north part of China in the Eocene, and then between East China and Central Asia near the Oligocene/Miocene boundary, indicating the onset of monsoon-dominant climate in China. The impacts of the Himalaya–Tibetan plateau uplift and/or the Paratethys Sea retreat on the Asian monsoon have been well demonstrated. However, whether or not other factors have affected the above reorganization of paleoclimatic patterns remains a question to be addressed. Additional factors that should be addressed at least include the Indian Peninsular drift, the South China Sea expansion and the East China Sea transgression. Here we use the IAP-AGCM to explore their roles in the above paleoclimatic evolution. Our experiments demonstrate that the South China Sea expansion is another major forcing, in addition to the important roles of the Paratethys retreat and the Himalaya–Tibetan plateau uplift. On the contrary the impacts of the Indian Peninsular drift and the East China Sea transgression are relatively subordinate. The Himalaya–Tibetan plateau uplift plays a crucial role in the magnification of the aridity/humidity contrasts between the south and the north part of China. The Paratethys retreat, the Himalaya–Tibetan plateau uplift and the South China Sea expansion lead to the formation of the aridity/humidity contrasts between East China and Central Asia. The retreat and the uplift favour the dynamic condition, and the expansion provides the water vapour condition for the monsoon-dominant climate in China (Zhang et al., 2007, Earth and Planetary Science Letters).

Last Glacial Maximum in China: Sensitivities of climate to paleovegetation and Tibetan ice sheet

With the LGM forcings, the IAP-AGCM simulates colder and drier climate conditions with respect to the present as a whole (Fig.11). Globally averaged annual surface temperature and terrestrial precipitation are respectively reduced by 5.3°C and 29%. The IAP-AGCM LGM simulation agrees well with the PMIP AGCMs. The model underestimates, however, terrestrial cooling suggested by proxy data in the tropics. In China, it is revealed that paleovegetation can induce additional cooling and therefore reduce data-model discrepancies, and glacial-age environment over the Tibetan Plateau is an important factor for the LGM climate simulation in East Asia (Jiang et al., 2003, J. Geophys. Res.).

4. Ocean Climate and ocean tracer

Subpolar Gyre Index (SPG) and the AMOC

The importance of the AMOC in the Earth climate system has initiated sizable efforts towards the monitoring and prediction of AMOC. Recently, the satellite data based SPG has been suggested that the SPG is closely related to the...
intensity of the deep convection in the North Atlantic subpolar gyre and the simulation of the Ocean General Circulation Model (OGCM) demonstrates the SPG can be a potential indicator for the AMOC in the subtropical North Atlantic. The figure shows that the SPG and the AMOC is closely associated with the AMOC and therefore the SPG can also be used as an indicator for the AMOC even in a coupled climate model ([Gao and Yu, 2008, Atmospheric and Oceanic Science Letter]).

Ocean tracer
Radioactive contamination of the Arctic environment has received much attention in the last 10-15 years. This is caused by the fact that there are many actual and potential sources of radioactive sources within and near the Arctic region, and that the Arctic food chains are particularly vulnerable to radioactive exposure.

Important sources of the radioactive contamination in the North Atlantic-Arctic region are the nuclear bomb testing in the 1950s and 60s, the Chernobyl accident in 1986, release from the European reprocessing plants Sellafield (UK) and Cap de La Hague (France), and discharges from the Arctic coastal rivers. There is concern about whether and how the latter have contaminated the Arctic Ocean and whether and how potential accidents can lead to further contamination. The study demonstrates that the current generation of Ocean General Circulation Models is well suited to simulate the temporal and spatial distributions of man-made radioactive contamination. A series of experiments are carried out with realistic and idealized radioactive releases. The figure shows spreading of the radioactive signal released from the Sellafield nuclear reprocessing plant in the Irish Sea. The simulated pathway is broadly consistent with the known transport routes of the Atlantic Water into the Nordic Seas ([Gao et al, 2005, Tellus B]).

5. Air Quality Forecast

The Global Environmental Atmospheric Transport Model (GEATM)
GEATM model is developed to investigate the scientific issues of global aerosol transport, budget, and associated environment and climate impacts. Based on boundary layer meteorology, a new dust mobilization scheme is introduced by GEATM. The modeling results have been widely validated with ground-site observations, satellite retrievals, and it shows a good performance. The modeling skill has been distinctly improved by using the new scheme ([Fig.14]).

LIST OF PUBLICATIONS IN 2008
SCI indexed (26)


Wang, Z., F. Xie, T. Sakurai, H. Ueda, Z. Han, G.R. Carmichael et al., 2008: MICS-Asia II: Model inter-comparison and evaluation of acid deposition, Atmospheric Environment, 42(15), 3528–3542.


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