

# Chinese Ecosystem Research Network **ANNUAL REPORT**





### Message from CERN Leader

Since its establishment in 1988, Chinese Ecosystem Research Network (CERN) of Chinese Academy of Sciences (CAS) has witnessed a sound development. It has become an innovative platform for ecosystem monitoring, research and demonstration, and an important component in the national eco-environmental monitoring system, providing the researchers on ecosystems, resources and environment with abundant scientific data, and making contributions to the ecosystem restoration, environmental protection, agricultural development, disaster reduction, as well as natural resources management.

In 2006, CERN made great achievements in monitoring capacity, research project applications and capacity building. Based on CERN, Chinese Terrestrial Ecosystem Flux Observational Research Network (ChinaFLUX) was formulated successfully. 2 National 973 Programs under Ministry of Science and Technology (MOST) and 1 Key Project under National Natural Science Foundation of China (NSFC) were launched by CERN field stations and centers. 3 Knowledge Innovation Programs cross-site studies were launched by CAS. Thus, CERN capacity on monitoring and research was greatly enhanced. The working and living conditions of field stations were further improved through Infrastructure Development Project (Phase II) of CAS. So far, 33 CERN field stations have been selected as the China National Ecosystem Observation and Research Stations.

Ecosystem monitoring, research and demonstration are the three major missions for CERN. In 2006, CERN field stations and centers have made significant progress in these regards. 36 CERN field stations have carried out dynamic monitoring more than 800 ecological indicators across the national key ecosystem types. Based on CERN, *Study on Carbon Budget of Terrestrial and Marginal Sea Ecosystems in China* assessed the carbon sequestration function in relevant areas. The scientists of CERN released 1259 scientific papers in publications

both at home and abroad. Among them, based on a 25-year observation, scientists in Dinghu Mt. Research Station of Forest Ecosystem published their findings in *Science* that old-growth forests can still accumulate organic carbon in soils, which was also reported in *Nature*. Besides, CERN field stations carried out demonstration on ecosystem restoration, agricultural development and natural resource management in the Loess Plateau, northern mountains and southern red soil regions, which were highly appreciated by local governments and communities.

In 2006, CERN fulfilled the 2002-2005 capability building task of Infrastructure Development Project (Phase II). The 2001-2005 overall performance assessment on CERN field stations, centers and affiliated institutes, was successfully organized by the CERN Office of Leading Group.

From 2007, CERN begins to compile the *CERN Annual Report*, hopefully it would promote the understanding of CERN for both the national and international relevant institutions and scientists, improve academic exchange and collaboration, and further build its overall monitoring and research capacity.

On this occasion, I would like to extend our sincere thanks to friends from all circles including international ecological communities for your help and supports to the development of CERN.

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LI Jiayang Chair of CERN Leading Group Academician, Vice President of Chinese Academy of Sciences



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# **Overview of CERN**

Since early 1950s, China Academy of Sciences (CAS) has set up field stations on resources and environmental sciences to conduct monitoring, experiment and demonstration activities in different regions of China. In 1988, CAS established Chinese Ecosystem Research Network (CERN).

The creation of CERN is a milestone for the ecosystem observation and research efforts in China, which makes it possible to conduct cross-site and comparative studies at the national level, and to provide science-based information to the policymakers on national socio-economic development and ecological conservation. The standard and integrated management of CERN also provides best practice for the operation of China National Ecosystem Observation and Research Network (CNEN), which was launched by the Ministry of Science and Technology (MOST) in 2005.



Changbai Mountain © Zhao Shidong / CERN

#### **Distribution Map of Ecological Stations of CERN**



Map by Qu Cuiyu / CERN







Lu Yongxiang (left), President of CAS visited Synthesis Research Center of CERN @ Lai Pengfei / CERN

Li Jiayang (middle), Vice President of CAS, Chair of CERN Leading Group, visited one of the field stations of CERN @ Yang Ping / CERN



**CERN Structure and Governance** 

Currently, CERN consists of 36 field stations, covering major ecosystems in China, including 13 for cropland, 9 for forest, 2 for grassland, 6 for desert, 1 for marsh, 2 for lake and 3 for marine, 5 disciplinary sub-centers for water, soil, atmosphere, biology and aquatic ecosystems, and 1 synthesis research center.

The ecological stations of the same ecosystem type conduct observation, experiment and analysis according to standard protocols and operation procedures, with the same types of facilities and instruments. The sub-centers are responsible for developing monitoring protocols, calibrating instruments, data quality control and organizing the field stations for thematic studies, while the Synthesis Research Center takes charge of the service of data management and sharing, and involves the sub-centers and field stations in synthesis studies on various ecosystems.

CERN has a strong governance system, with CAS Vice President as the Chair of CERN Leading Group, eminent scientists making up the Scientific Advisory Committee, and enterprising young scientists in the Scientific Committee for guiding real practices at field stations and centers. The operation of CERN is in line with basic regulations, including *General bylaw, Best performance assessment, and Data management and sharing policy*, so as to realize an institutional and standardized management in CERN.

Watershed of Zhifanggou in Loess Pateau, Ansai Field Station © Zhang Yifei / CERN

# Long-term Ecosystem Monitoring

CERN implements long-term monitoring on water, soil, atmosphere and biological elements of major ecosystems in China, i.e. cropland, forest, grassland, desert, marsh, lake, and bay, and their important ecological processes such as the energy and matter flows according to standard protocols.

The monitoring datasets that are of high quality and collected on long-term and continuous basis provide foundation for the ecological research and demonstration activities. More than 800 ecological indicators are monitored annually at the 36 field stations under CERN.



Nutrient balance experiment in cropland of black earth © Hailun Field Station /CERN

#### **Overview of CERN Monitoring System**

#### Water Monitoring

Coverage:	31 terrestrial ecosystem field stations (13 for cropland, 9 for forest, 2 for grassland, 6 for desert, 1 for marsh)
Indicator:	soil water content, ground water table, quality of surface water, ground water and rainwater, ecosystem evapotranspiration, water surface evaporation, etc.
Approach:	automatic monitoring system for water surface evaporation, Neutron Probe, TDR, mass spectrometer, etc.
Soil Monitori	ng
Coverage:	31 terrestrial ecosystem field stations
Indicator:	organic matter, N, P, physical structure, microbe elements, moisture, heavy metal, etc.
Approach:	material properties analytical instrument, atomic absorption photometer
Atmosphere	Monitoring
Coverage:	36 terrestrial and aquatic ecosystem field stations
Indicator:	wind direction, wind speed, temperature, humidity, air pressure, soil temperature, precipitation, radiation, hours of sunshine, etc.
Approach:	meteorological station, meteorological radiation automatic observation system, microclimate monitoring system, etc.
Biology Mo	nitoring
Coverage:	31 terrestrial ecosystem field stations
Indicator:	vegetation types, plant community, habitat, litter, leaf area index, biomass, edaphon, etc.
Approach:	main observation field and supplementary field of the station
Aquatic Eco	osystem Monitoring
Coverage:	5 aquatic ecosystem field stations (2 for lakes and 3 for bays)
Indicator:	hydrology, microbe, zooplankton, phytoplankton, zoobenthos, aquatic macrophyte (lake field stations), fish (Donghu Experimental Station for Lake Ecosystem only), primary productivity, water physicochemical factors, sediment analysis, etc.
Approach:	monitoring ships, fixed point monitoring and transect sampling, and the newly Innovation scientific surveying ship for the Jiaozhou Bay Marine Ecosystem Research Station

Observation plot of water evaporation in Yucheng Field Station  $\,\odot\,$  Zhao Shidong / CERN

In 2006, CERN field stations/sub-centers acquired 0.45 GB dynamic monitoring data, including 317 MB for meteorological datasets, 22 MB for soil, 79 MB for water environment, 25 MB for biology, and 2 MB for aquatic ecosystem. The spatial data of the national climate spatial distribution amounted to 20 GB, and ChinaFLUX got 550 GB dynamic monitoring data for the carbon cycle and carbon and water fluxes of the terrestrial ecosystem.

According to the data quality result based on *CERN Best performance assessment*, in 2006, all CERN sites show a steady rise over the past 6 years and a narrowing gap of monitoring levels among field stations.

#### 2000 – 2006 Annual Monitoring Assessment for CERN Field Stations

Year	2001	2002	2003	2004	2005	2006
Field stations of terrestrial ecosystems	87.57	88.46	89.05	89.95	94.43	95.54
Field stations of aquatic ecosystems	78.28	81.8	84.55	88.16	91.15	95.00

Generally speaking, the ecosystem monitoring capacity of CERN is significantly enhanced. The creation of ChinaFLUX ensures a continuing and dynamic data collection for water, carbon and energy fluxes, as well as the dynamics of micro-meteorological factors and eco-physical process of vegetation community, and plant eco-physiology on a long-term and continuous basis, using open-chamber and eddy-covariance methods. It serves not only as an important facility to conduct observation and research on the ecosystem status and global change in China, but an integral part of FLUXNET. Besides, equipments and facilities have been upgraded by field stations, centers and their affiliated institutes with their own budget, offering great support for CERN long-term monitoring.



Underground temperature measurement © Zhang Yifei /CERN

# Long-term Ecological Research

CERN has achieved a large number of significant outputs at site and cross-site levels, based on the findings of long-term monitoring and experiment. It has become an important facility of CAS to conduct research on major scientific issues, with the high-caliber team of scientists and technicians and up-to-date facilities and instruments for monitoring and experiment.

#### Major research progress of CERN over the recent years

A brief review of the research progress of the field stations, sub-centers and Synthesis Research Center under CERN indicates that the major research results are focused on these areas, i.e. regional environmental change in China; temporal and spatial pattern of carbon and water cycling and budget for the terrestrial ecosystems in China; structure, function, pattern and process of ecosystems; ecosystem restoration and management; and eco-informatics and data-sharing. The major research progress on different ecosystem types is summarized as follows.

#### Cropland ecosystems

The best examples include: quality change of black, purple and rice paddy soil; the change of food production in northern China; C and N cycling and its environmental impact; water transfer of SPAC and GIS-based management; plant allelopathy and weed control in the cropland; eco-chemical behavior of fertilizers and pesticide pollution and the biological restoration.

#### • Forest ecosystems

The major research progress on forest ecosystems are focused in these topics, i.e. C, N cycling process of forest ecosystem, and the role of forests as carbon source or sink; the



Sunshine greenhouse © Hailun Field Station /CERN



role of forests in water retention and its physical mechanism; the response and adaptation of forests to global change; the indicative role of mosses in ecological restoration; the interactions of different species in forests; the seed bank in forest soil; breeding system and pollination biology of plants.

#### Grassland and desert ecosystems

Major research progresses range across interactions between biodiversity and stability of grassland; response of grassland in northern China and Qinghai-Tibetan Plateau to global change; the life evolution, the distribution of clonal plants along the sandy lands, and its relations with species diversity; the molecular biology for the stress tolerance of plants under extreme conditions and its adaptation strategy; the role of soil microbiotic crusts in ecological restoration and rehabilitation.

#### Marshes and aquatic ecosystems

Progress has been made in these areas, i.e. the change of cultivated marsh ecosystems; dynamic changes of coral reef ecosystem; biological N sequestration of mangrove forests in coastal areas; biological control of lake eutrophication; the response of phytoplankton to environmental change; structure and dynamics of food web in eutrophicated shallow lake; the biological drivers of P loading in shallow lake; water dynamics-eutrophication model in large-scaled shallow lake.

In 2006, the Bureau of Science and Technology for Resources and Environment, CAS conducted final reviews on the key projects of Knowledge Innovation Program under CAS based on CERN. It was found that the projects implemented by the field stations, sub-centers and the Synthesis Research Center under CERN have contributed substantially to these research progress and outputs.



Open-chamber CO2 enrichment facilities © Shenyang Field Station /CERN



Carbon flux observation tower © Dinghu Mt. Field Station /CERN



CO2 flux measurement in the alpine grassland © Lhasa Field Station /CERN



Haloxylon ammodendron, a shrub living in the desert © Fukang Field Station /CERN

#### Examples of the Key Projects of Knowledge Innovation Program under CAS based on CERN that have passed the final reviews

In November 2006, the Key Project of Knowledge Innovation Program under CAS, entitled *Study on Carbon Budget of Terrestrial and Marginal Sea Ecosystems in China*, jointly led by the Institute of Geographic Sciences and Natural Resources Research and the Institute of Atmospheric Physics, CAS, successfully passed the final review.

Since its inception in 2001, the project has set up monitoring systems to measure the water and carbon fluxes in Haibei and other 7 field stations under CERN, and established ChinaFLUX on the basis of CERN. A series of research progress and outputs have been generated, including scientific papers and monographs. It was concluded that the project has positively advanced the research of carbon flux measurement and carbon cycling in China, and provided a platform to better understand the matter cycling and regional climate response of the terrestrial ecosystem, and laid a solid basis to estimate the carbon budget of the nation. The research findings are also of great importance to define the value of carbon sink for the ecosystems in China and develop strategies on carbon management and international negotiations in addressing climate change.

In March 2006, another Key Project, entitled *NPK transfer, change and* optimal management for the major cropland ecosystems in China, led by the Institute of Soil Science, CAS, passed the final review. This project was based on the Sub-Center of Soil, and in the major cropland field stations under CERN, i.e. Hailun, Fukang, Changwu, Yanting, Yingtan, Changshu and Shenyang. It not only assessed and predicted the over-use of chemical fertilizers for the major farmland ecosystems in China, the spatial-temporal changes of risks and their underlying drivers, but proposed policy options on how to control the non-point source pollution from the farmlands. Based on the research findings about the impact of long-term fertilization to soil nutrients and the grain production, a technical procedure of rotational cropping (wheat-rice/wheat-maize) was developed and disseminated.

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CERN Scientists in a field visit to the northern deserts © CERN



Long-tailed Shrike (Lanius schach) © Zhang Yifei / CERN

#### **Core Research Areas of CERN**

# • Ecosystem structures & functions, dynamics and biodiversity conservation

It focuses on the study of structure and functions of various ecosystems, the role of biodiversity and its complexity to maintaining ecosystems, biodiversity and ecosystem functions, and the interactions between/among different ecosystem at cross-scales, based on long-term experiment and monitoring.

#### • Cross-site observation and experiment on global change

It is aimed to understand the temporal and spatial patterns of national and global environment change, reveal the response and adaptation mechanism of the ecosystems in China to global change, and advance the innovative studies of global change for the international community.

#### Mechanism and tools for ecosystem restoration

The structure and functions of various ecosystems will be explored to understand the differences of mechanism and tools of ecological restoration for different ecosystems, and to provide guidelines on ecological restoration.

#### • Ecosystem assessment and optimal management

The state and trends of different ecosystems in China will be evaluated to provide science-based ecological information to the policy-makers and the public with an objective to mitigate or eliminate the uncertainty in ecosystem management.

#### • Ecological degradation and control in ecologically fragile areas

Long-term research on the ecosystems in the ecologically fragile areas such as the deserts, Karst areas, eco-tones between farmland and pastures, will be carried out to find solutions to control land degradation.

#### Eco-informatics

With the help of eco-informatics, an automatic collecting and remote transferring system for the dynamic monitoring data, combined with an ecological modeling and fusion system, will be made available to the field stations of CERN and their affiliated research institutions to enable on-line service of data sharing and simulation.



# Demonstration for Ecosystem Management

CERN's demonstration aims to explore the key technologies for ecosystem management, carry out technological integration, select the optimal win-win model of ecological and economic benefits, so as to extend the application to a wider range and integrate the regional ecological protection and socio-economic development, based on the results of long-term monitoring and research.

In 2006, the demonstration of CERN ranged from the restoration and rehabilitation of ecologically fragile areas, to sustainable agriculture, plantation, eutrophication treatment, and marine aquaculture, which has contributed significantly to the local and regional economic development in China in term of scientific and technical support.

Hailun Agricultural Ecological Station in Heilongjiang Province continued to magnify its self-owned technology of green soybean with high output and good quality. Up to now, demonstration area amounts to 3 300 hm<sup>2</sup> in 10 townships surrounding the field station, 53 300 hm<sup>2</sup> within Hailun County and 100 000 hm<sup>2</sup> in other surrounding regions.

Through the optimal model for mixed fir plantation and demonstration of organic soil management, Huitong Station for Forest Ecosystem in Hunan Province extended their practice to Huaihua (Hunan), Nanning and Liuzhou (Guangxi Province), with a total coverage of 200 hm<sup>2</sup> and an average 12% increase of benefit on woods. The demonstration raised the awareness of ecological conservation and energy-saving of the local governments, who learnt to highlight the importance of protecting the forest biodiversity and long-term productivity in the woodlands.

Based on its previous experience and the MOST program-

Experimental plot of Luancheng Field Station © Zhang Yifei / CERN

Technological Demonstration on Raising Livestock in Xilingol Grassland, the Inner Mongolia Research Station of Grassland carried out demonstration activities on grassland fertilization, rotation grazing, and mixture sowing of perennial leguminous and gramineae on cultivated pasture.

Haibei Research Station of Alpine Meadow Ecosystem in Qinghai Province made scientific progress on the integrated control of native pasture degeneration. This practice has been carried out in 6 pilot sites in different grasslands in Dawu County, with other measures like pasture re-sowing, fenced cultivation, and weed elimination, covering a total area of 5 929 hm<sup>2</sup>. These methods greatly improved the quality indicators like grassland height, coverage, biomass, edible grass ratio and the stock capacity, with the added profit of more than 133,000 USD annually.

Donghu Experimental Station for Lake Ecosystem in Hubei Province completed the water ecosystem restoration and rehabilitation pilot project for eutrophication control in East Lake of Wuhan, setting up a 1 300 m<sup>2</sup> enclosure. The practice restored the ecosystem consisting of different types of aquatic vegetation, and reached the targets of demonstration, research and landscape ecology. This project successfully restored different vegetations, like the emergent aquatic plants (reeds, cattail and lotus), floating plants (water caltrop, water poppy and pond lily) and the submerged plants (tape grass, hornwort and watermifoil), and improved the water quality of pilot areas, which set a good example for planning and environment protection of East Lake.

The Jiaozhou Bay Marine Ecosystem Research Station synthesized and optimized the ecology-controlled technology for inshore ocean culture system (OCS). It studied the biological restoration of large algae (*gracilaria*) and sedimentary animals (*Stichopus japonicus*) in inshore OCS and initiated this restoration technology. Experiments on asparagus' biological repairing function have been made in northern seashell and fishery areas. Medium-sized pilot breeding areas of *chalamys farreri* and *gracilaria* have also been set up.



Eutrophication in Donghu Lake © Zhao Shidong / CERN

# Data Management and Sharing

Data management and sharing are the routine work of CERN. A three-tier data management and service system, i.e. the field stations-sub-centers-Synthesis Research Center, is established, in which the field stations are responsible for data collection, sub-centers for data quality management and the Synthesis Research Center for monitoring data integration, management and sharing, respectively.

So far, a series of databases have been created and made available to the network and the public, including 1) CERN metadata set; 2) CERN long-term monitoring database; 3) spatial database of the field stations; 4) monitoring database for the carbon budget of terrestrial ecosystems in China; 5) land resources database in China, and 6) 1×1 km meteorological grid database in China.

### Updating the dynamic monitoring data in CERN Synthesis Research Center

CERN Synthesis Research Center has accomplished the following tasks: 1) completing and updating the dynamic monitoring database; 2) developing all flux TS data (10HZ) management system before 2006, aperiodic flux data input and quality check for 30 minutes; 3) fulfilling 1:1 million land resource database; 4) setting up 1:1 million database for grassland resource in Qinghai-Tibet Plateau.

#### Data quality control and thematic database in sub-centers

CERN's 5 sub-centers are responsible for quality control of monitoring data and integration of thematic data by setting up standards and by comparing the data accumulated at different stations and periods, in order to ensure the integrity and consistency of the database. The Sub-Center for Soil set up the dataset for China's nutrient cycle of main cropland ecosystem; the Sub-Center for Biology established several thematic databases including chemical composition of 150 dominant plants in China, biomass in the northern grassland, and N/P stoichiometry for tracheophyte; the Sub-Center for Aquatic Ecosystems built the thematic database for lakes in the middle and lower reaches of Yangtze River.

#### Development of data and information system in field stations

The data and information system at field stations is the core of CERN data management and sharing services. With the capacity building program of the National Ecosystem Observation and Research Network, the Synthesis Research Center of CERN offered training courses to data managers in the field stations, which, after the exercise in 3 field stations of Yucheng, Fengqiu and Dinghu Mt. gradually developed their own information management systems and fulfilled the transition from text data management to database management. Most of these data and information management systems have been put into full or trial operation.

Based on the field-station-fund project under the CAS, a wireless network is developed in Yucheng Integrated Agricultural Experimental Station with automatic instruments, CDMA and VPN technologies, which makes it possible to transmit the real-time observation data and graphics to the Synthesis Research Center of CERN based in Beijing. This system provides best practice for the other field stations of CERN to establish their own automatic data transfer and wireless networks.

#### CERN data consolidation from 1998 to 2002

With the dynamic monitoring database from 1998 to 2002, the sub-centers made a quality review of the previous data focusing on supplementing the metadata, and formulated databases for 5 key elements, i.e. water, soil, atmosphere, biology and aquatic ecosystems, with complete temporal sequence and reliable quality. The 5 databases, covering 36 field stations across China, ensure a scientific data release and sharing, and provide a sound basis for CERN dynamic monitoring database at the network level.

#### CERN data sharing system release and data services

In January 2006, a press conference was organized by CERN to officially launch CERN Data Sharing System, which marks the relevant ecological databases, like



the long-term ecosystem dynamic monitoring data, spatial information of field stations and the multiple-element data, are openly accessible.

With CERN data sharing system, the field stations, sub-centers and Synthesis Research Center provide data services for various projects, like the National 973 Program, 863 Program, CAS Knowledge Innovation Program and programs of NSFC. Scientists and graduate students in many institutes and universities also make use of CERN ecological data in their research or academic dissertation writing.

In 2006, the CERN Data Management System in Synthesis Research Center provided off-line service to 140 people/times, with a total data of 14 GB. The website for the data sharing system was visited by 57 946 times. Amongst them, 40 users were administrators and 151 were registered with their real names. In addition, 710 people/times downloaded the graphics and 428 people/ times downloaded the monitoring data online.

#### **CERN Data Sharing Systems that have been patented**

- CERN Dynamic Monitoring Data Management and Information Sharing System
- Terrestrial Ecosystem Meteorological Grid Data and Information System
- CERN Field Stations Spatial Data Management and Information Sharing System
- CERN Field Station Data Management and Information Sharing System

#### Datasets that have been developed

- Catalogue of CERN Data (1998-2005)
- CERN Observation Datasets on Soil (1998-2003)
- CERN Observation Datasets on Biology (1998-2003)
- CERN Observation Datasets on Water (1998-2003)
- CERN Observation Datasets on Atmosphere (1998-2003)
- CERN Observation Datasets on Water, Soil, Atmosphere and Biology (2004)

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# **Collaboration and Exchange**

CERN field stations and centers expand academic exchange and scientific collaboration through various channels, like implementing international collaborative research, organizing conferences and workshops, receiving visits of partners, inviting guest scientists to work in CERN, setting up open-end fund, jointly training postgraduates, or offering internship, etc.

#### International Collaborative Research

The Synthesis Research Center and more than 13 field stations are involved in the international collaborative programs. The field stations included: Inner Mongolia Research Station of Grassland Ecosystem. Dinghu Mountain Research Station of Forest Ecosystem, Yingtan Ecological Experimental Station of Red Soil, Yanting Agricultural Ecological Station on Purple Soil, Yucheng Integrated Agricultural Experimental Station, Changwu Agro-Ecological Experiment Station in Loess Plateau, Ansai Integrated Experiment Station on Water and Soil Conservation, Sanjiang Plain Marsh Ecological Experiment Station, Naiman Desertification Research Station, Marine Biological Research Station at Daya Bay, Shapotou Desert Research and Experiment Station, Sanya Tropical Marine Biological Research Station and Fukang Desert Ecological Research Station. The international partners included: American Oak Ridge National Laboratory, the University of Tennessee, University of California, National Soil Erosion Research Laboratory, National Institute for Environmental Studies of Japan, EuropeAid Office, UNDP/GEF, University of Melbourne, among others.

According to rough statistics, in 2006 alone, CERN received visits about 500 foreign scholars, and the international cooperation fund exceeded 2 million USD.



CERN delegates attended the international conference held in the Philippines © CERN

#### Selected Visiting International Partners of CERN in 2006

- Oak Ridge National Laboratory, USA
- the University of Tennessee, USA
- University of California, USA
- National Soil Erosion Research Laboratory, USA
- National Sedimentation Laboratory, USA
- University of New Hampshire, USA
- National Oceanic and Atmospheric Administration, USA)
- American Great Plains Systems Research Institute, USA
- University of Quebec, Canada
- University of Alberta, Canada
- Rothamsted Research, UK
- the Max Planck Institute, Germany
- ITC, the Netherlands
- Radboud University Nijmegen, the Netherlands

- Universiteit Gent, Belgium
- University of Melbourne, Australia
- the University of Adelaide, Australia
- Lincoln University, New Zealand
- National Institute for Environmental Studies, Japan
- University of Tsukuba, Japan
- University of Tokyo, Japan
- Chiba University, Japan
- International Rice Research Institute, the Philippines
- United Nations Environment Programme
- IPCC Secretariat
- Secretariat of the Ramsar Convention
- Secretariat of the Convention on Biological Diversity

#### Academic Workshops and Training Courses

CERN field stations and centers organized a series of workshops for academic exchange, in 2006, Synthesis Research Center alone organized 3 workshops as follows:

• May 2006: International Workshop on Eddy Covariance, C, N, Water Fluxes Monitoring Technology

• July 2006: Joint Training Workshops on China's Regional  $CO_2$  Flux Data Analysis and Modeling (and the 5th Training Workshop of ChinaFLUX's) on Theory and Practice of  $CO_2$  Flux Measurement;

• August 2006: Training Workshop on Data Management and Information Sharing of China National Ecosystem Observation and Research Network.

#### **International Conferences Participated**

The scientists of CERN field stations and centers actively attended various international conferences and workshops, and some of them were invited to make keynote speeches or to be co-organizers. CERN Secretariat of Scientific Committee also coordinated some scientists to attend international conferences related to long-term ecological research, which include:

• March 2006: the 6th Conference of East Asia and Pacific Regional Network of ILTER, Tokyo, Japan

- August 2006: ILTER Coordinating Committee Meeting, Namibia
- September 2006: US LTER Network 5th All Scientists Meeting, Colorado, USA

• October 2006: 2nd Symposium on Long-Term Ecological and Biodiversity Research in the East Asia Region, the Philippines

#### **China Ecological Forum**

China Ecological Forum is an academic platform launched by CERN Synthesis Research Center. A total of 16 lectures were held in 2006, as well as two workshops entitled *Scientific Issues and Methodology on Ecosystem Assessment and Long-term Ecosystem Monitoring and Experiments* organized in spring and winter respectively. Some 36 famous ecologists both at home and abroad were invited to make presentations and discuss with scientists and graduate students, with more than 1 500 participants and 50 000 internet visitors in 2006.



Peter Bridgewater, Secretary-General of Ramsar Convention presented at the China Ecological Forum © Jiang Luguang / CERN



Prof. Sun Honglie (first left), Chair of the CERN Scientific Advisory Committee and other panel members visited the Xishuangbanna Field Station for on-site review © Yang Ping / CERN

# **Annual Major Progress**

# CERN Overall Performance Assessment from $2001 \sim 2005$

From March to July 2006, the CERN Office of Leading Group organized an overall performance assessment on 36 field stations, 5 sub-centers and the Synthesis Research Center 20 affiliated institutes of CAS according to *CERN General By-laws and the Methods for CERN Assessment and Evaluation.* 

Apart from desk analysis, the expert panel also visited the field sites and provided recommendations for better management and development to the field stations and centers. It is helpful to summarize the achievement, lessons learned and problems in past 5 years, which would provide reference for decision-making on knowledge innovation system and ecology and environment science strategies of CAS, and ensure a sound development and management of CERN in the future.

Ansai, other 7 field stations and Sub-Center for Soil were awarded as excellent field station/centers in overall performance, while 4 stations including Huitong being granted as excellent field stations in monitoring.

#### Assessment and Approval of National Ecosystem Observation and Research Stations

From April to August 2006, 14 pilot stations including Yucheng, Fengqiu and Changbai Mt. field stations under CNEN, passed through the evaluation of an expert panel and approval by Ministry of Science and Technology. So far, the existing 33 field stations from CERN, together with Huanjiang Experimental Station of Karst Ecosystem, Aksu Cropland Station and Shennongjia Forest Research Station are incorporated in the stations of CNEN, so, CERN would play a vital role to develop the basic facilities of science and technology at the national level.

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# Final Evaluation of CERN of Scientific Infrastructural Development Project (2002~2005)

To meet the needs of Scientific Infrastructural Development of CAS Knowledge Innovation Project (2002~2005), some experts were invited by the Leading Group Office of CAS and made an inspection tour on CERN's infrastructure, facilities and vehicles in conjunction with the overall performance assessment (2001~2005) from April to August 2006.

It was concluded that, with standard administration, available co-funding and reasonable financial expenditure, CERN has fulfilled the delegated tasks according to the terms of reference, and the Scientific Infrastructural Development Project (2002-2005) built promising capacity for monitoring and research and improved the living and working conditions in the field sites.

# Developing CERN Eco-environment Data and Key Common Technologies

In September 2006, the Major Project of Knowledge Innovation under CAS, entitled *Developing CERN Eco-environment Data and Key Common Technologies*, passed its final review. The project was coordinated by CERN Secretariat of Scientific Committee, and implemented by Synthesis Research Center and 5 sub-centers. It was composed of 3 themes, namely, *CERN Monitoring Regulation Research and Composition, CERN Historical Data Evaluation and Field Station Information System, and CERN Data Sharing System.* 

Over the past 3 years, the project set up metadata standards for long-term ecological data resources and developed a data sharing system for CERN. A series of books on CERN long-tem monitoring protocols were published, covering water, soil, air environment and biology in terrestrial and aquatic ecosystems, which are expected to further promote CERN ecosystem monitoring and data management capacity in a long run.



Some field stations/centers were awarded as the excellent stations/centers in overall performance at the Annual Meeting of CERN 2006 © Liang Biao / CERN



Prof. Chen Yiyu and other members at the CERN Scientific Committee Meeting 2006 © Liang Biao / CERN



# Scientific Research Projects

In 2006, some major research projects based on CERN were launched, which include:

• Scientific basis for maintaining the ecosystem of eco-tones between grassland and farmland in Northern China, under 973 Program This project was approved by the MOST in 2006, and will be implemented during 2007-2012. The Principal Investigator is Prof. HAN Xingguo, head of the Inner Mongolia Research Station of Grassland Ecosystem, which is affiliated to the Institute of Botany, CAS.

#### Process and control of soil erosion in major areas affected by water erosion in China, under 973 Program

This project was also approved by the MOST in 2006, and will be implemented during 2007-2012. Prof. LI Rui from the Institute of Water and Soil Conservation, CAS serves as the Principal Investigator, and some field stations under CERN, such as Ansai, Changwu, Yanting, Yingtan and Hailun, are participating in the project.

#### • Transect-based studies on the response and adaptation of typical terrestrial ecosystems in China to global change, under Major Program of NSFC

This project was launched in March 2006, and will be implemented during 2006-2010. The Principal Investigator is Prof. YU Guirui, head of the Synthesis Research Center under CERN. Such organizations as Synthesis Research Center, Sub-Center for Water, Sub-Center for Soil, Beijing Forest Ecological Station and Haibei Research Station of Alpine Meadow are involved in the project.

In addition to these major projects above, some field stations of CERN, including Maoxian Mountain Ecosystem Research Station, Haibei Research Station of Alpine Meadow, Changbai Mountain Forest Ecosystem Research Station, Ansai Integrated Experiment Station on Water and Soil Conservation, Jiaozhou Bay Marine Ecosystem Research Station, carried out some other projects of the National Program of Science and Technology Support, and 863 Program under MOST, and the Key and General Programs under NSFC.

In 2006, a total of 25 key projects of Knowledge Innovation under the CAS were conducted by the field stations and centers of CERN. Some key projects aims to conduct comparative and cross-site studies on the same type of ecosystems. These projects include: *Distribution patterns and geographic variance of plant diversity for the forests in eastern China; Hydrological process and vegetation restoration for the desert ecosystems in northern China, and C, N flux process and its coupling for the terrestrial ecosystems in China, among others.* 

# Key Projects of Knowledge Innovation of Chinese Academy of Sciences in 2006 (Implemented by CERN Field Stations and Center during 2007-2009)

Name of the project	Principal Investigator	Participating field stations
Matter cycling process and its environmental effect in typical wetlands	LIU Jing-shuang,SONG Changchun	Sanjiang
Matter flow process, regulation mechanism and nutrient management tools for tree plantations	WANG Silong	Huitong
H <sub>2</sub> O, C and N cycling and long-term salt transfer in the farmland of Huai-huai-hai Plains	ZHANG Jiabao, YANG Jinsong	Fengqiu
Cross-site studies on the long-term transfer process of farmland soil nutrient under thermal gradient	YANG Linzhang	Sub-Center for Soil, Hailun, Ansai, Shenyang, Yingtan and Changshu
Soil biodiversity and its ecosystem services for some major farmlands in China	LIN Xiangui	Yingtan, Fengqiu, Hailun, Taoyuan and Shenyang
Impact of soil biological functions onto the C, N dynamics and the plant roots properties in subtropical forests	FU Shenglei	Heshan, Huitong, Ailaoshan and Dinghushan
Stability of Broad-leaved Korean pines and its sustainable management	HAN Shijie	Changbai Mt.
Key process of pollutants transfer and its ecological control in lakes	QIN Boqiang	Taihu
Sustainable productivity and ecological functions for the rice paddy ecosystems	WU Jinshui	Taoyuan
Key process and its environment effect for the dryland farmland ecosystem in Loess Plateau	LIU Wenzhao	Changwu
Water quality monitoring, early-warning and eutrophication control for the Three Gorges Reservoir	CAI Qinghua	Sub-Center for Aquatic Ecosystems
Distribution patterns and geographic variance of plant diversity for the forests in eastern China	MA Keping	Changbai Mt., Beijing, Dinghushan and Xishuangbanna
Hydrological process and vegetation restoration for the desert ecosystems in northern China	LI Yan, Dong Ming	Fukang, Cele, Erdos, Inner Mongolia, Shapotou and Naiman
C, N flux process and its coupling for the terrestrial ecosystems in China	YU Guirui	Synthesis Research Center, Haibei, Yucheng and Qianyanzhou
Regulation mechanism and model regarding efficient use of water resources for the major grain production areas in northern China	ZHANG Xiying	Luancheng
Mechanism and key tools for cost-effective intensive farming in eastern China	HU Chunsheng	Luancheng
Clean cropping technologies and policies for the farmland ecosystems in Yangtze River delta	SUN Bo	Changshu
Key technologies for grassland livestock production in the Qinghai-Tibetan Plateau	WANG Shiping	Haibei
Experiment and demonstration on adaptive management and sustainable development of Xilingol grassland	HAN Xingguo	Inner Mongolia
Degradation process and its restoration for mountain ecosystems in the upper reaches of Minjiang River	LIU Qing	Maoxian
Experiment and demonstration on water resources use and integrated management in Tarim river basin	ZHANG Xiaolei	Akesu
Water cycle and water resources management of Heihe River basin	XIAO Honglang	Linze
Experiment and demonstration on water and soil conservation and sustainable ecological development in Loess Plateau	LIU Guobin	Ansai
Experiment and demonstration on the restoration and sustainable management of degraded ecosystems in Sanjiangyuan area (Source of Three-Rivers, i.e. Yangtze, Yellow and Lanchang rivers)	ZHAO Xinquan	Haibei
Experiment and demonstration on the degradation and adaptive restoration for the Karst ecosystems in Southwest China	WANG Kelin	Huanjiang

# **Research Outputs**

#### **Scientific papers**

In 2006, CERN field stations and centers released 1 259 scientific papers, amongst which, 384 were cited by SCI, 135 by EI, 714 by CSCD.

Based on a continuous 25-year observation, Professor ZHOU Guoyi from Dinghu Mountain Research Station of Forest Ecosystem published his paper *Old-Growth Forests Can Accumulate Carbon in Soils in Science*, which was also reported by *Nature*. This study challenged the classical ecological theory that old-growth forests are comparatively weaker than non-mature ones in absorbing carbon or even none, and aroused the interest of international academic society in the field of global carbon study.

Apart from that, there are many other scientific papers appearing in world authoritative publications like *Agriculture and Forest Meteorology, Oecologia, Soil Science, Biotrpica, Ecology, Global Change Biology, Environmental Pollution, Ecology Letters, Annals of Forest Science, Meteorology and Atmospheric Physics*, etc.

#### 2001–2006 CERN Scientific Paper Released in

#### **Academic Publications**

Year	SCI	EI	CSCD	Others (conference papers, non-core)
2001	133	20	840	103
2002	195	24	955	149
2003	263	43	1215	81
2004	373	48	1061	119
2005	358	69	972	129
2006	384	135	714	200
Total	1706	339	5757	781



Sub-tropical evergreen broadleaved forests near Dinghu Mountain © Zhao Shidong / CERN





#### Awards for CERN during 2001-2006

Year	National Second-Prize of Science & Technology Innovation	Provincial/Ministerial Prize of Science & Technology Innovation and Natural Sciences	Others
2001	3	5	17
2002	2	9	9
2003		13	14
2004	4	10	10
2005		11	8
2006		7	7
Total	9	54	65

Runoff observation plot in the slopes © Taoyuan Field Station / CERN



#### **Monographs and Patents**

2006 was a fruitful year for field stations and centers of CERN on works composition and innovation: 29 monographs, 7 patents, 25 patents for invention, 14 patents for utility model were published or granted; amongst them, 4 software copyrights were awarded to CERN Synthesis Research Center.

#### Awards

In 2006, CERN earned about 17 provincial Science & Technology Innovation awards, including:

• First Prize of Sci-tech Innovation in Jiangsu Province for Study on the Principles of Soil Quality Changing undertaken by Changshu Agro-Ecological Experiment Station, Yingtan Ecological Experimental Station of Red Soil, Fengqiu Agricultural Ecological Station

• First Prize of Science & Technology Innovation in Gansu Province for *Studies on the Desertification Process and its Control in North China* participated by Naiman Desertification Research Station

• Second Prize of Science & Technology Innovation in Gansu Province for *Water-saving Technology and Methods for Water Scare Oasis in Inland River* Basin undertaken by Linze Inland River Basin Research Station

• Second Prize of Science & Technology Innovation in Jiangsu Province for *Study on Internal Pollution and Sediment Dredging of Taihu Lake Substrate Sludge* by Taihu Laboratory for Lake Ecosystem Research

• Second Prize of Science & Technology Innovation awarded by the State Oceanic Administration for *High-quality Breeding Project and Key Technology for the Production of Prawn in Closed-recirculating System* by Jiaozhou Bay Marine Ecosystem Research Station

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# **Team Building**

Water measurement of soils in marshes © Sanjiang Field Station / CERN

The staff of CERN emphasizes teamwork and innovation, and is committed to the long-term monitoring, research and demonstration under the difficult conditions at the field sites. The young scientists and technicians gradually become pivot for the steady development of CERN and CAS, and contribute significantly to the national ecological and environmental studies.

According to the statistics, at the beginning of 2006, about 2 219 staff is doing research based on CERN, including 603 full-time researchers, 177 full-time technicians, and 1 339 part-time staff including guest scientists and postgraduate students.

From 2001-2006, 19 staff from CERN including the Synthesis Research Center, the Sub-Center for Atmosphere, the field stations of Changbai Mt., Fengqiu and Shenyang were granted the Outstanding Youth Fund under NSFC. While about 30 winners of CAS 100-Talents Program came from the Synthesis Research Center and the field stations of Changbai Mt., Haibei, Fukang, Gonggashan, Hailun, Changwu,

#### Full-time and Part-time Staffs in CERN Field Stations and Centers

	Full-time researcher	Full-time technicians	Guest scientists & postgraduate students
Synthesis Research Center	32	5	57
Sub-centers	27	10	75
Field stations	544	262	1207
Total	603	277	1339

Shenyang, Qianyanzhou, Huitong, Daya Bay, and Xishuangbanna.

In addition, Inner Mongolia Research Station of Grassland Ecosystem and the Synthesis Research Center both set up their Innovative Research Team with Overseas Partners under CAS. The innovation research team on *Response of Northern Grassland onto Global Climate Change*, initiated by Inner Mongolia Research Station of Grassland Ecosystem was also included into the innovative groups under NSFC, which serves as a model of team building for CERN.

#### **Postgraduate Training and Public Education**

CERN has become an important education and training base for young scientists in ecology. From 2001 to 2006, 95 post-doctorates, 498 Ph. D and 556 master candidates graduated from CERN. Furthermore, CERN field stations and centers collaborated with related universities for graduate student education with CERN facilities, some 200 Ph. D and master students completed their studies through joint programs.

CERN also turns to be a platform for raising public environment awareness and technology dissemination. 13 field stations of CERN have become education bases for teenagers and 7 stations were selected as science and technology demonstration sites.

#### Graduates from CERN Field Stations and Centers during 2001-2006

Year	Post-doctorate	Doctor	Master
2001	10	61	51
2002	14	66	75
2003	22	71	88
2004	22	100	102
2005	17	99	122
2006	10	111	118
Total	95	498	556



The Innovative Research Team with Oversea Partners on Human Activities and Ecosystem Changes had a field visit to the Three Gorges Dam © the Synthesis Research Center / CERN

# Major Events in 2006

January	A press conference was held to launch CERN Data Sharing System, which marks the ecological data of CERN are openly accessible to the scientists and the public.
March	33 Field Stations and the Synthesis Research Center of CERN joined the Project of National Ecosystem Observation and Research Network (NERN). The project was launched by MOST, lasting for 3 years, with 15.8 million USD of investment directly from the Central Government and RBM 11 million USD of co-funding from relevant sectors/institutions
March	A major project funded by NSFC and based on CERN was launched. The project entitled <i>Transect-based Study on the Response of Chinese Major Terrestrial Ecosystems to Global Change</i> engages the Synthesis Research Center, the Sub-Center for Water, and 8 field stations of CERN joined in the research.
March- July	CERN conducted Overall Performance Assessment (2001~2005) on field stations/centers. The CERN Office of Leading Group convened the relevant experts to conduct general and specific assessment, with Ansai, other 7 field stations and the Sub-center for Soil being awarded as excellent field station/ centers in overall performance, while 4 stations including Huitong being granted as excellent field stations in monitoring.
May-July	Two Projects under National 973 Program, based on CERN, were launched. The two projects are: Soil Erosion Process and its Control in the <i>Major Water</i> <i>Erosion Areas in China, and the Scientific Basis for Maintaining the Eco-tone of Farmland and Grazing Land in northern areas, and its Adaptive Management.</i> Over 10 field stations of CERN are involved in the two projects.
July	The China-US Joint-Research Center for Ecosystem and Environmental Changes was jointly established by CAS, the University of Tennessee and Oak Ridge National Laboratory. Its China country office is based in the Synthesis Research Center of CERN.
September	The 14 <sup>th</sup> Work Meeting of CERN was held in Inner Mongolia. The meeting reviewed the progress of CERN over the past 5 years in platform development, ecosystem monitoring, research, demonstration, and education. Selected stations/centers were awarded as excellent sites in overall performance & monitoring assessment.
November	25 Major Research Programs of Knowledge Innovation under CAS (Phase III) based on CERN were approved by CAS. These programs are mainly aimed to conduct comparative and cross-site studies by combining the field stations/centers of various ecosystem types.
December	Scientists of Dinghu Mt. Research Station of Forest Ecosystem of CERN published paper in <i>Science</i> . Based on long-term monitoring and experiment data, the scientific paper, entitled <i>Old-Growth Forests Can Accumulate Carbon in Soils</i> , by Professor Zhou Guoyi and his colleagues of the field station was released in <i>Science</i> and reported in <i>Nature</i> . This finding aroused great interests of the scientists both at home and abroad.
December	CERN established the 3 <sup>rd</sup> Scientific Committee (SC) of CERN and held its Annual Meeting 2006. Academician Chen Yiyu is the Chair of SC. The meeting made recommendations on producing summary report on CERN's 20-year progress, making the CERN strategy in 2020, and amending CERN's bylaw and other regulations.
December	The National Standard of Metadata for Ecological Data (GB/T 20533-2006) was formally approved and enacted. The standard, jointly developed by the Synthesis Research Center, the Sub-Center for Soil, Gonggashan, Yanting, Changwu, and Hailun field stations of CERN, was formally approved and enacted by Standardization Administration of PRC.
December	14 CERN field stations, including Taihu and Yucheng, pilot stations under MOST on ecosystem observation and research passed the review by the expert panel. As of end 2006, 33 field stations of CERN have also been listed in the China National Ecosystem Observation and Research Network (CNEN).

# Leading and Academic Organizations

#### **CERN Leading Group**

#### Chair:

LI Jiayang, Vice President of Chinese Academy of Sciences (CAS)

#### Vice Chairs:

- LI Zhigang, Secretary General of Chinese Academy of Sciences
- FU Bojie, Director of Bureau of Science and Technology for Environment and Resources, CAS

#### Members:

- KANG Le, Director of Bureau of Life Science and Technology
- LIU Jian, Vice Director of Bureau of Science and Technology for Environment and Resources, CAS
- QIU Juliang, Vice Director of Bureau of International Cooperation
- LIU Jiyuan, Director-Genaral of the Institute of Geographic Sciences and Natural Resources Research, CAS

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#### Vice Chairs:

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- YU Guirui, Director of Synthesis Research Center of CERN, Institute of Geographic Sciences and Natural Resources Research, CAS
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