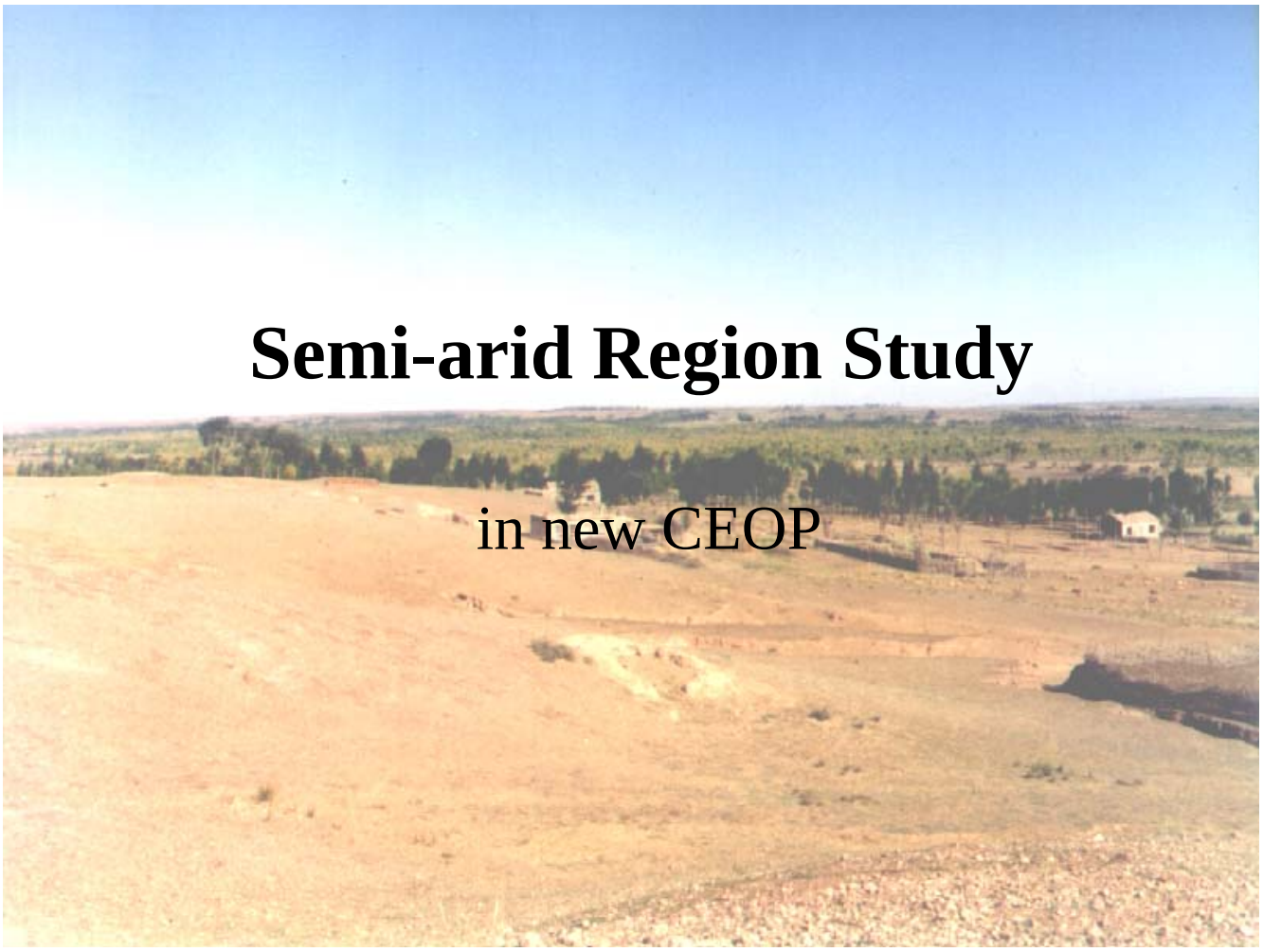


Semi-arid Region Study

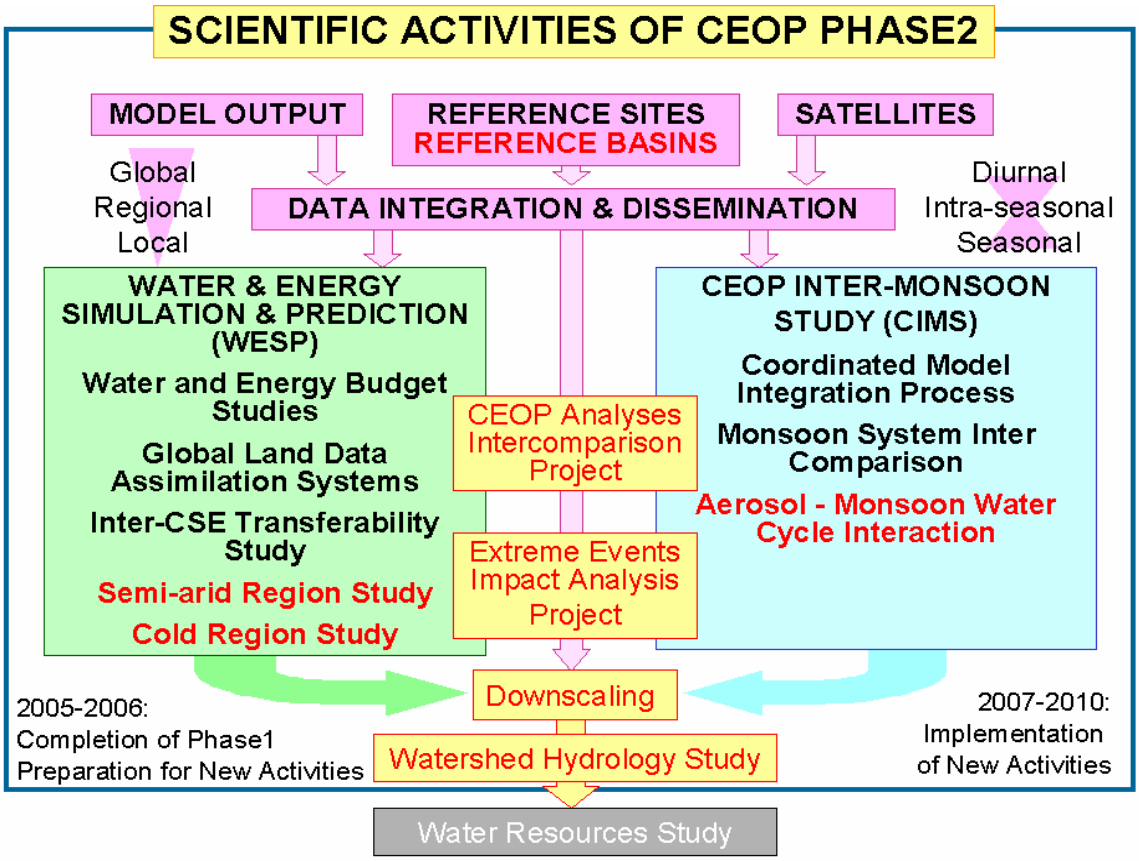
in new CEOP

Planning of semi-arid region study in new CEOP

- **Time line of initiation of CEOP semi-arid study;**
- **Composition of working group;**
- **Overall Objectives**
- **Scientific agenda**
- **Milestones to be achieved in following 2-3 years**
- **Proposed implementation steps**
- **Connections/joint activities with other projects in core activities of WCRP or ESSP**

Time line

- **An initial proposal on CEOP semi-arid study in CEOP Tokyo meeting in early 2005;**
- **Discussion and acceptance as a new element of CEOP phase II in 5th International implementation meeting for CEOP in Paris in early 2006**



Proposed membership of working group of CEOP semi-arid study

- Congbin **FU,** Institute of Atmospheric Physics, CAS/China (Chair)
- Jun **Asanuma**, Tsukuba University, Japan
- Dave **Billesbach,** University of Nebraska,USA
- David R.**Cook,** Argonne National Laboratory,USA
- Azzaya **Dologorsuren,** Institute of Meteorology and Hydrology, Mongolia
- Jianping **Huang,** Lanzhou University, China
- Pavel **Kabat,** Wageningeu University, Netherlands
- Joon **Kim,**Yonsei University, Korea,
- Toshio **Koike ,** University of Tokyo, Japan
- Huizhi **Liu,** LAPC, CAS/China
- Tilden **Meyers,** NOAA/ARL,USA
- Russell **Scott,** USDA-ARS Southwest Watershed Research Center
- Jie **Song,** Northern Illinois University, USA
- Additional members from Africa, South America, Australia etc. TBD

Funding

- **973 National project on Aridity trend of Northern China and human Adaptation from MOST;**
- **International cooperation Project on Asia and North American semi-arid region inter-comparison study from National Science Foundation of China;**
- **Aridity trend study for Northwest China from Chinese Academy of Sciences;**
- **NSF of USA;**
- **APN and START support for workshops;**

Proposed overall objectives of CEOP Semi-arid Region Study

Contributions to understanding the water and energy cycles of semi-arid regions and their role in climate system

by globally integrated analysis of CEOP reference sites data, satellite observations and the model outputs

Assist in better prediction of climate and water resources and their management in semi-arid regions where the shortage of water supply is crucial

Research Agenda

- **Atmospheric boundary layer physics and dynamics of semi-arid regions;**
- **Water and energy cycle of air-soil-vegetation system in semi-arid regions;**
- **Improvement of parameterization of land surface process for semi-arid region to be coupled in climate models;**
- **Impacts of dust aerosols on hydrological cycle and climate at regional and global scales.**

Working Plan for new CEOP

2007-2009:

1. **Evaluation of data from reference sites and comparisons among different sites of semi-arid regions and among different ecosystems;**
2. **Validation of land surface models by using CEOP reference sites data;**
3. **Analysis of satellite data in related to activities 1 and 2;**
4. **Apply current existed RCMs for semi-arid region simulation and identify the problems.**

Working Plan for new CEOP

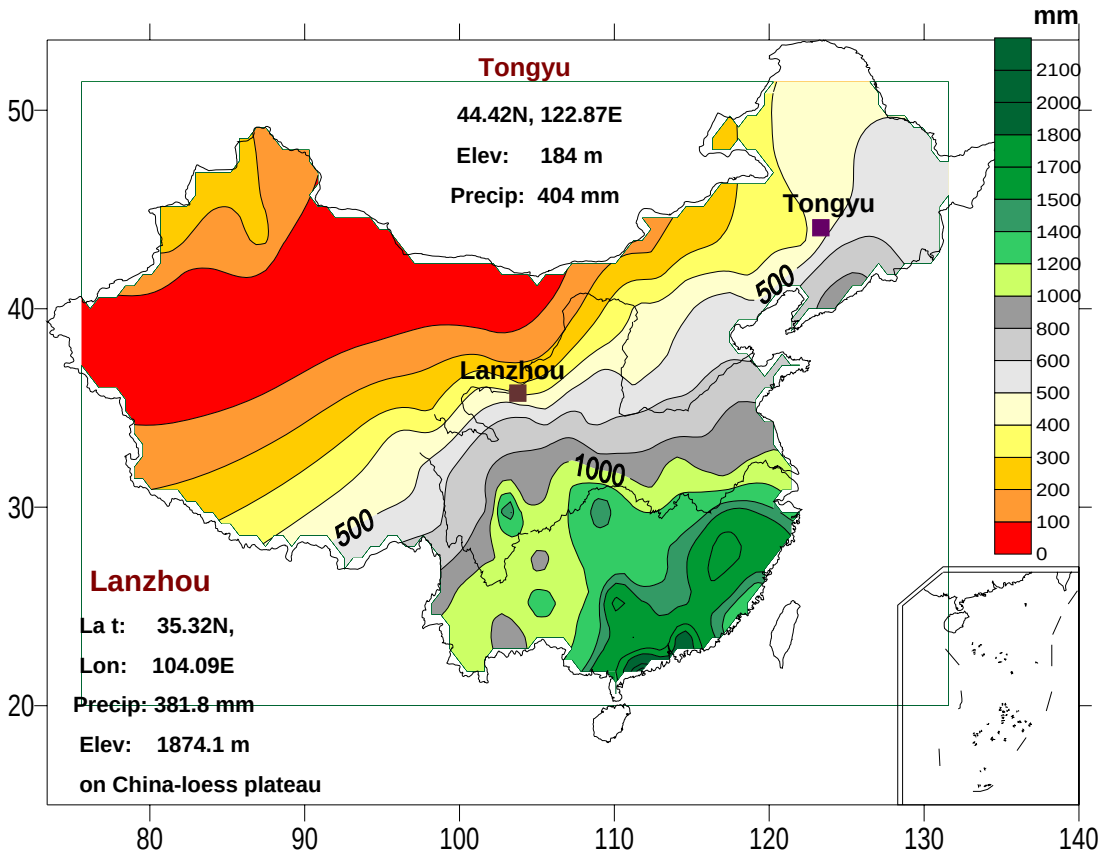
2010-2012

- **Integrated analysis of phase II data of reference sites in semi-arid regions with coordinated satellite observations;**
- **Development of a land surface model for semi-arid region, with particularly a new scheme of eco-hydrological process;**
- **Researches of impacts of dust aerosols on radiation,cloud micro-physics and hydrological process as well as the regional climate.**

Proposed Implement Strategies

- **Beginning from Semi-arid Asia,with an additional site over Loess Plateau in Northwest China;**
- **Initiating Asia and North America inter-comparison, based on analysis of existed reference sites of CEOP and then expand to other semi-arid region sites;**
- **Up scaling of site data into the region based on satellite observation;**
- **Improve and then development of land surface model and aerosol-chemical model specifically for semi-arid region**

CEOP Reference site Tongyu and Lanzhou

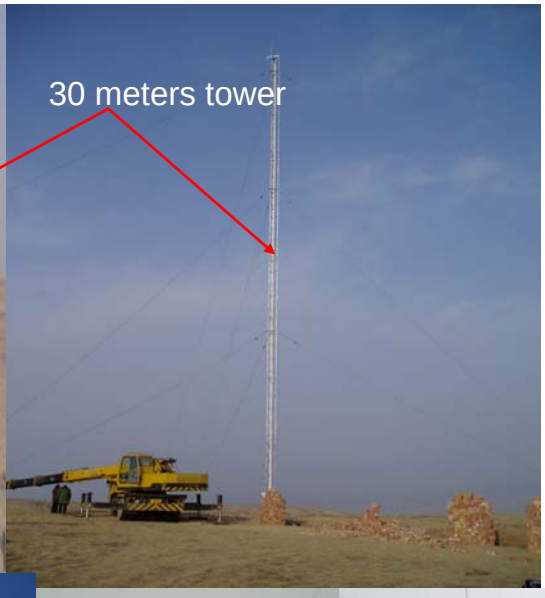


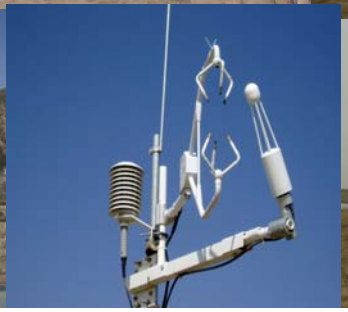
Tongyu(semi-arid) reference site, Northeastern China



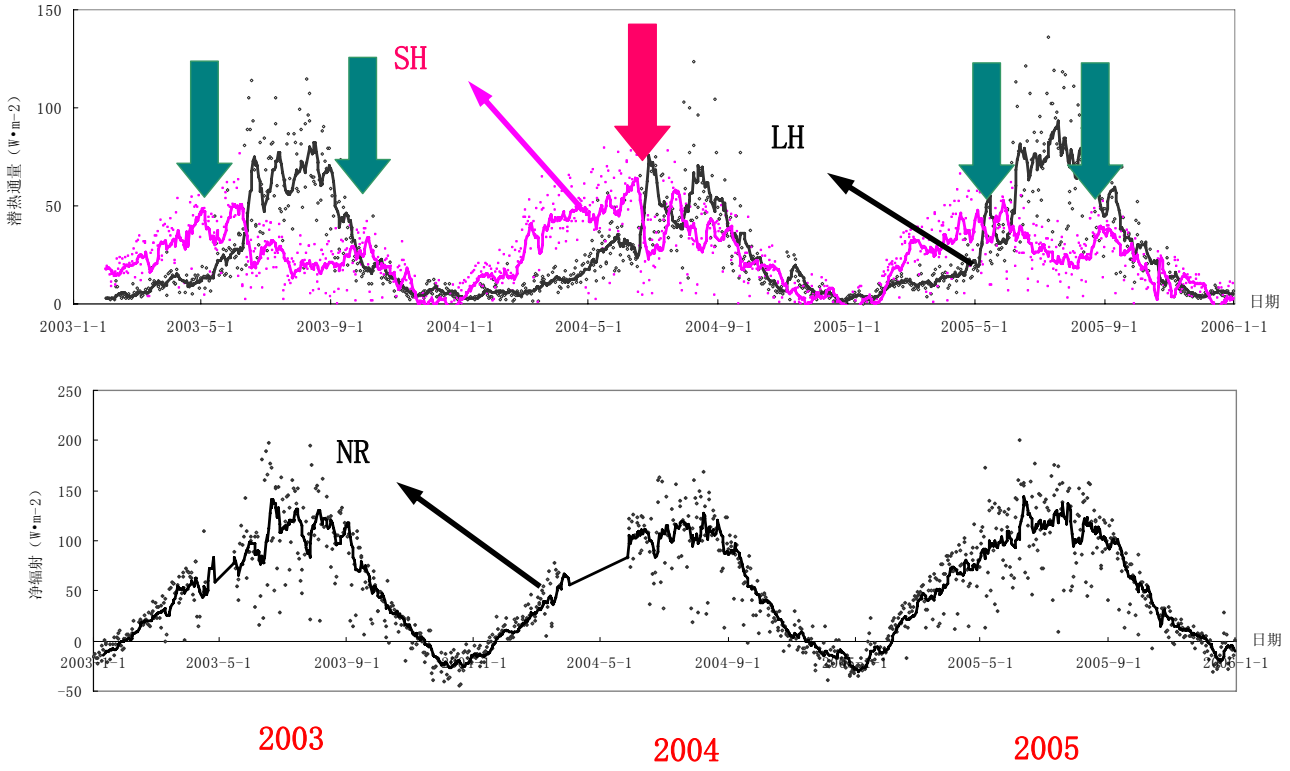


Lanzhou over Loess Plateau

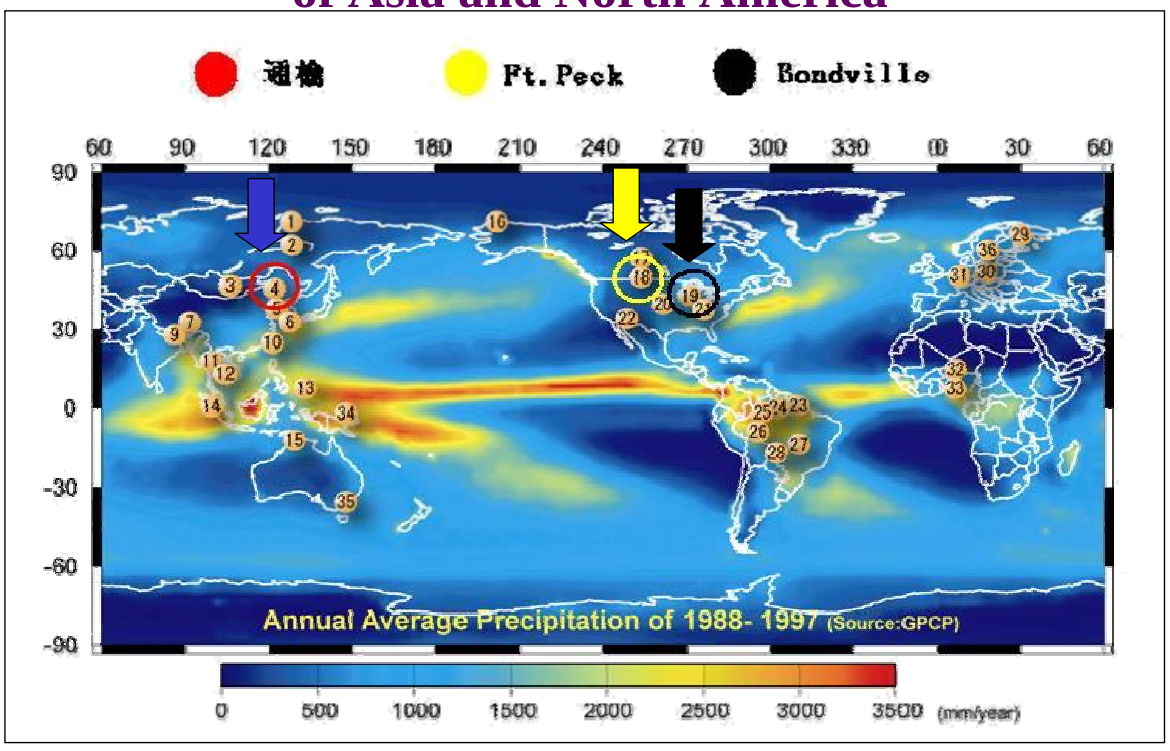


Latent heat, sensible heat and net radiation at Tonyu station



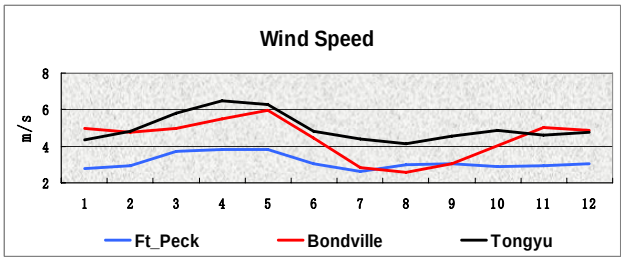
Comparison of three stations in Semi-arid areas of Asia and North America

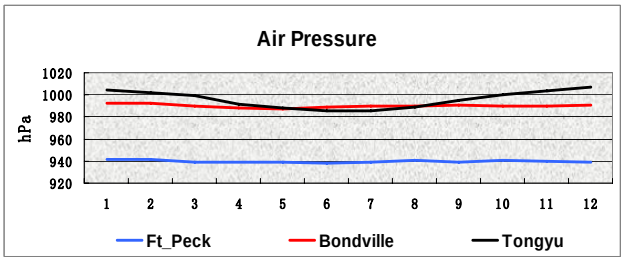


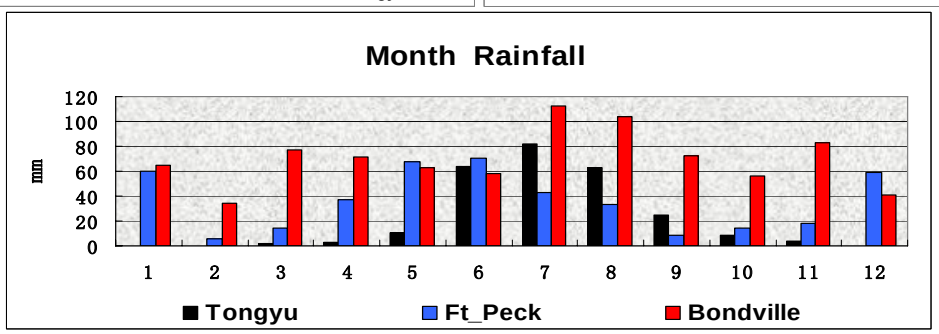
Audubon Research Ranch
Arizona
Climate: Temperate arid,
Precipitation: ~ 200mm
Vegetation: Desert grassland

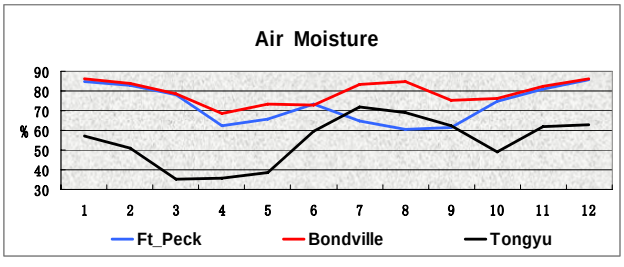
Fort Peck, Montana
Precipitation: ~ 400 mm
Vegetation: temperate grassland, LAI~2, canopy height 20~40 cm

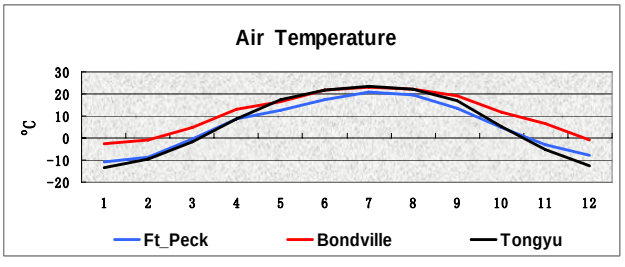
The background of these three sites





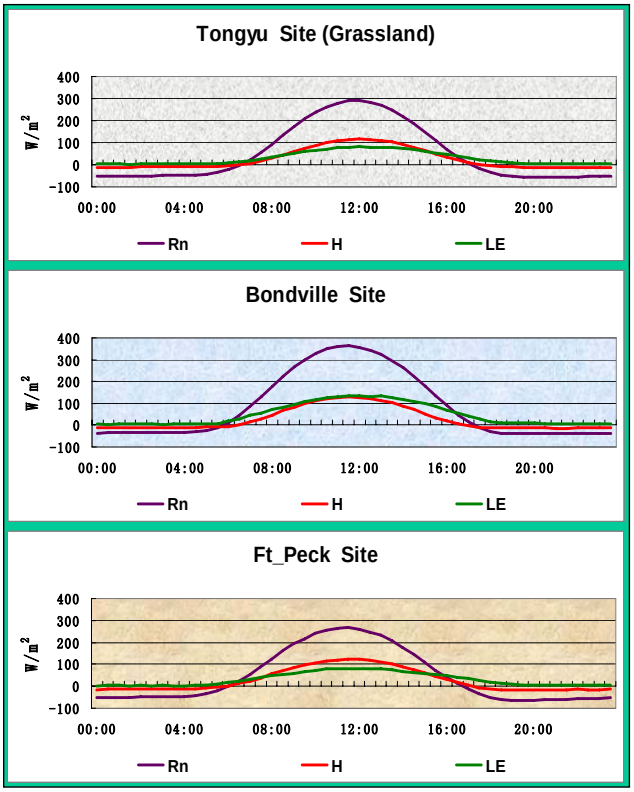




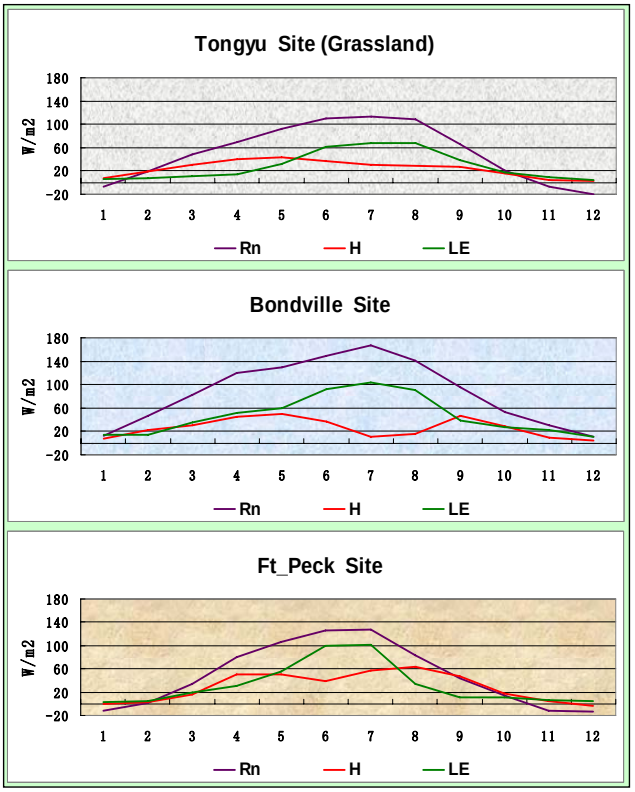


The Energy Flux In Different Semi-arid Areas

- The diurnal variation

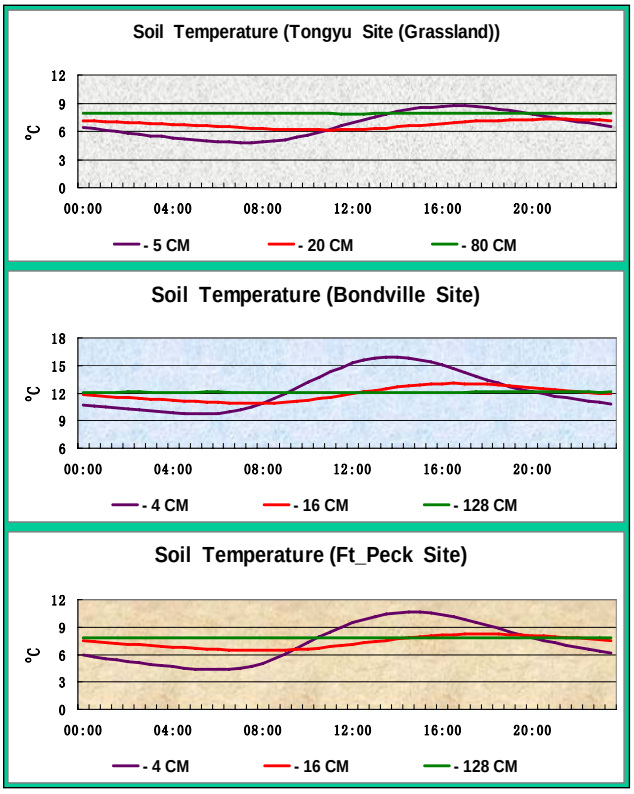


- The seasonal variation

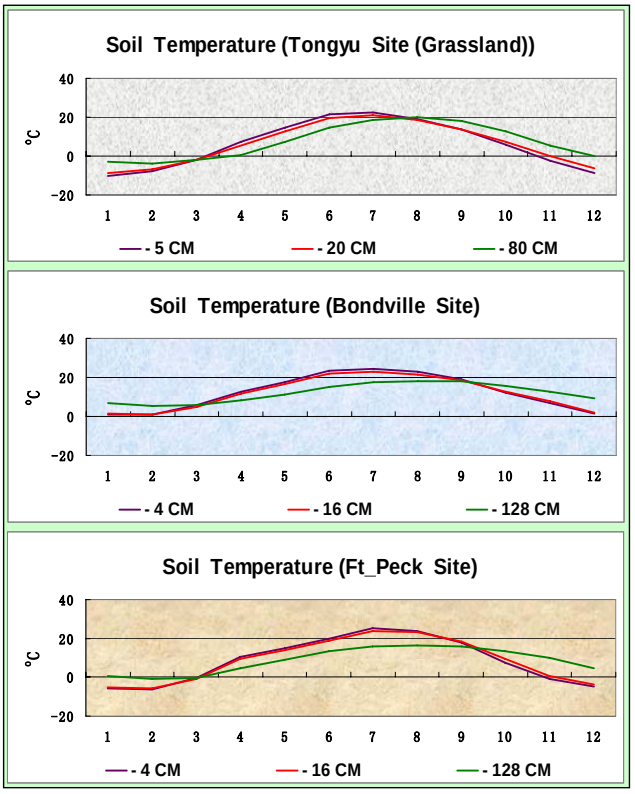


The Soil Temperature of three stations in semi-arid areas

- The diurnal variation



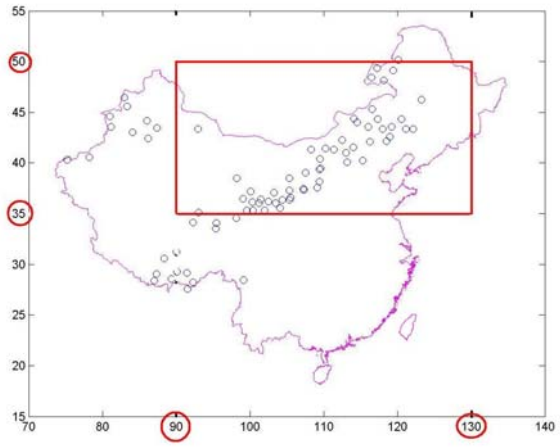
- The seasonal variation



Comparison of Semi-arid Areas In Asia And North America (Region)

Make research regions and compare two regions.

(the work is under way)

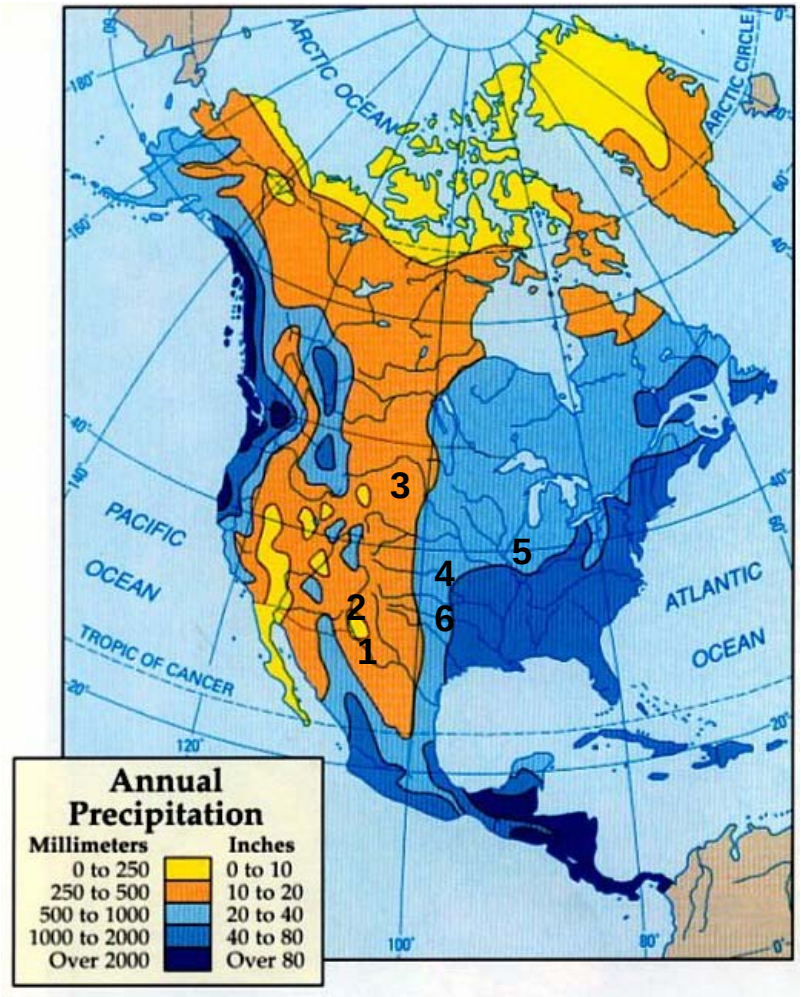


In Asia ***(35N-50N,90E-130E)***

Base on the Data from
1: the CEOP phase 2,
2: the China-Flux Station
3: the satellite data
4: the Weather Station in semi-arid region

In North America ***(35N-50N,)***

Base on the Data from
1: the CEOP phase 2,
2: the American-Flux Station
3: the satellite data
4: the Weather Station in semi-arid region



1. Audubon Research Ranch, Arizona

2. Santa Rita Mesquite, Arizona

3. Fort Peck, Montana

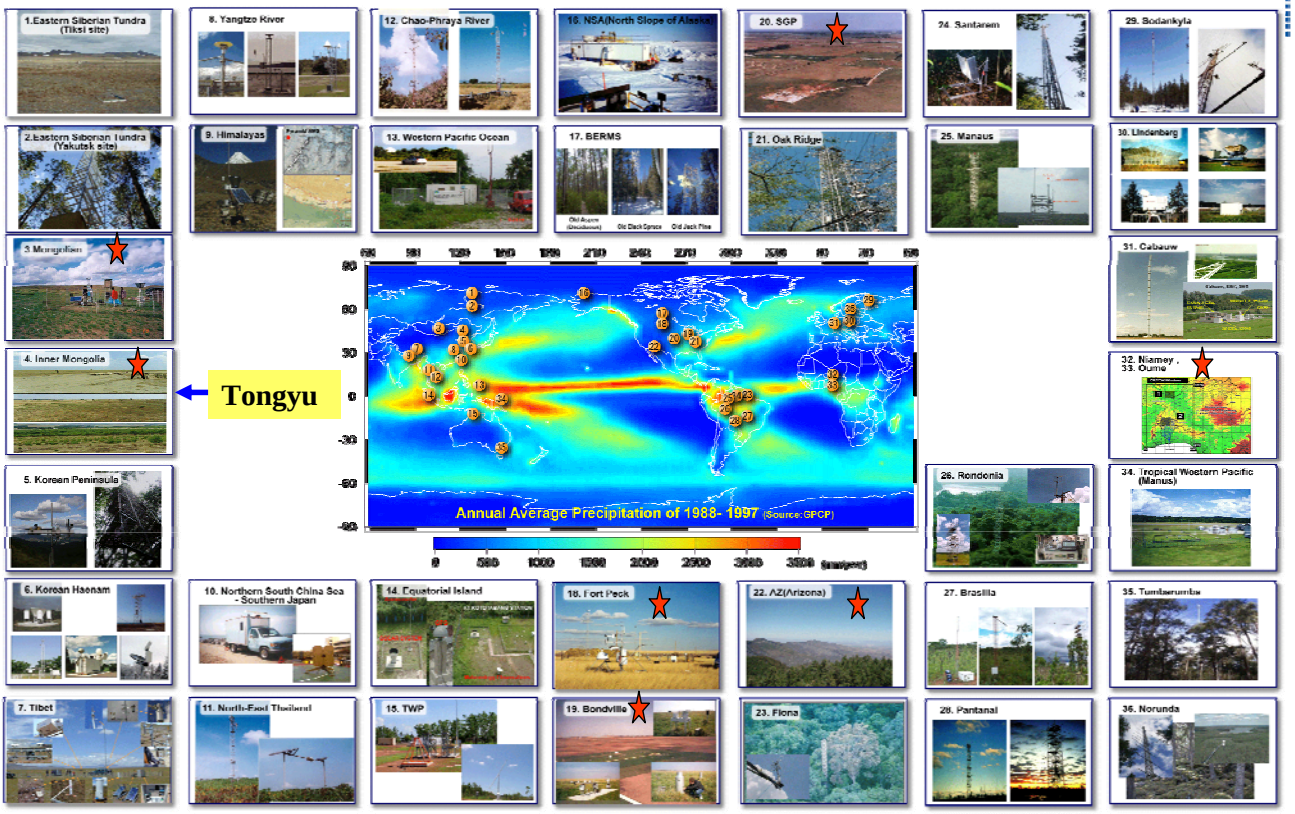
4. Walnut River Watershed, Kansas

5. Bondville, Illinois

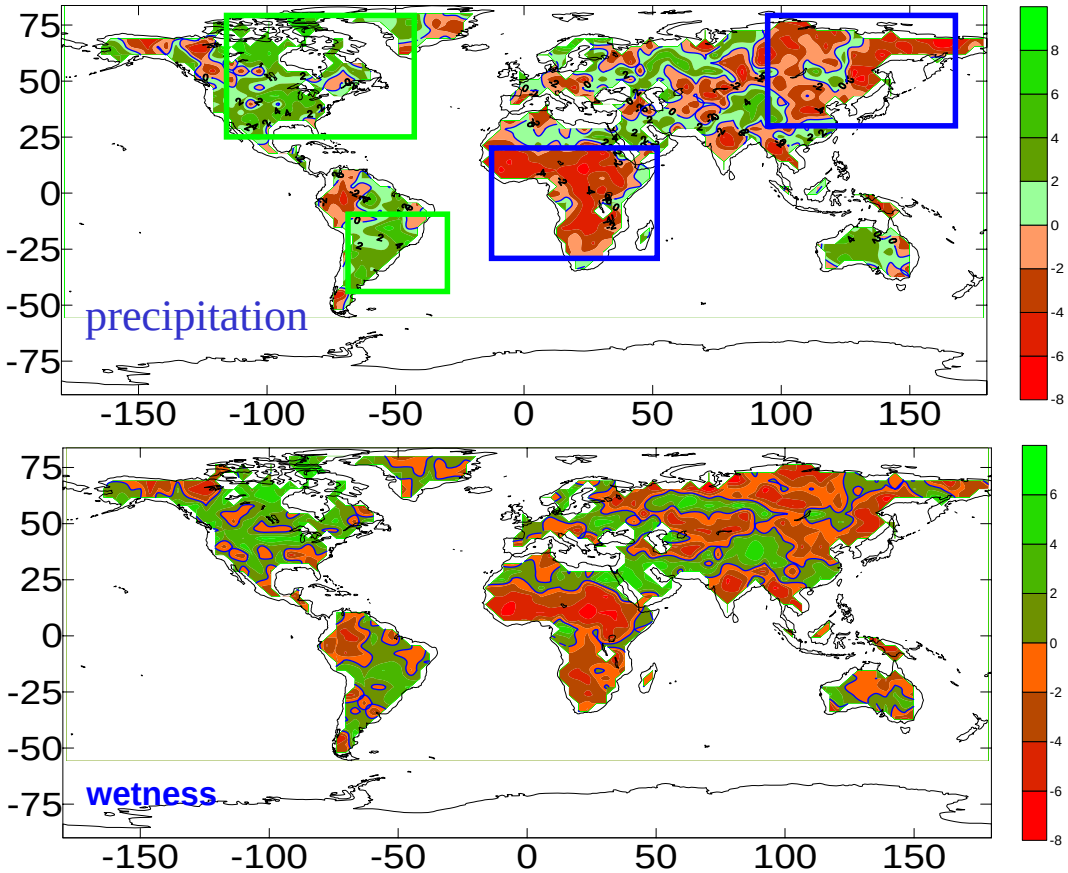
6. Southern Great Plains, Oklahoma

Potential reference sites for Semi-arid CEOP study

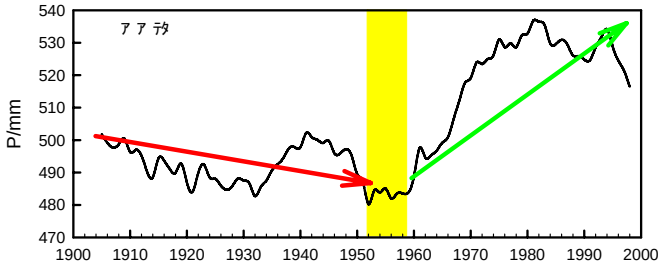
International Cooperation for the Global Coverage



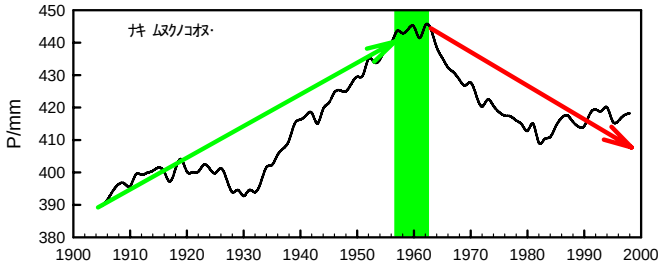
Aridity trend in 1951—2002



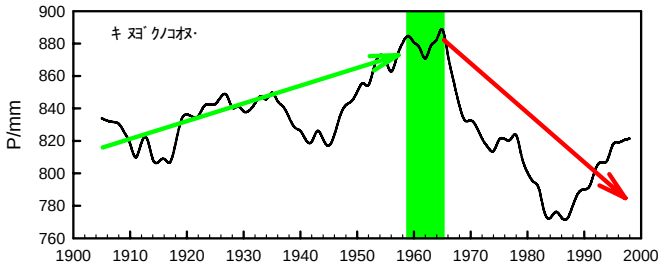
North America

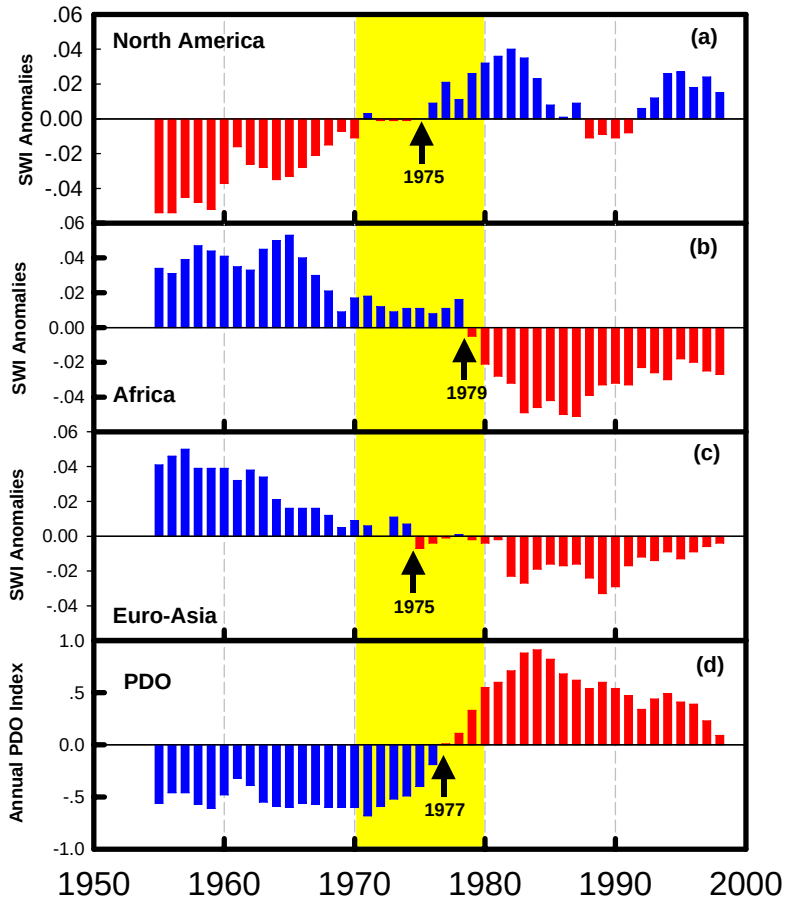


Euro-Asia



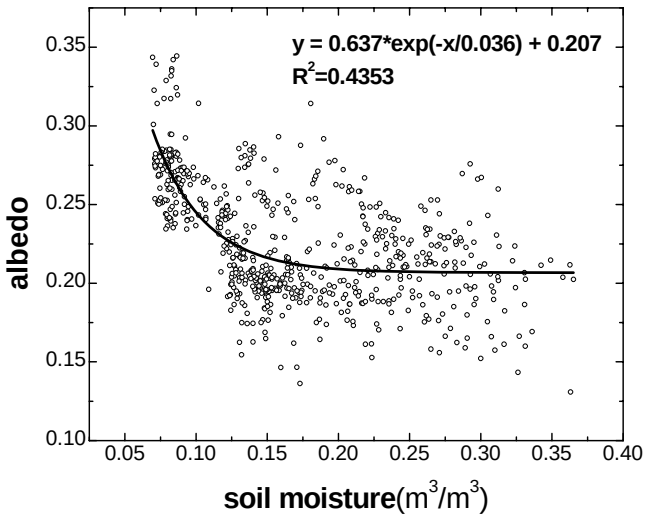
Africa



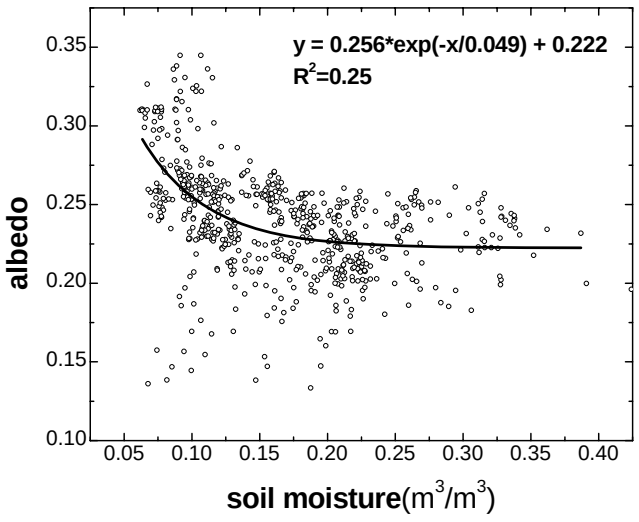


- **Evaluation of some key land surface parameters based on CEOP observations at Tongyu station over year 2003－2005**

Fitting of Surface Albedo to Soil Moisture

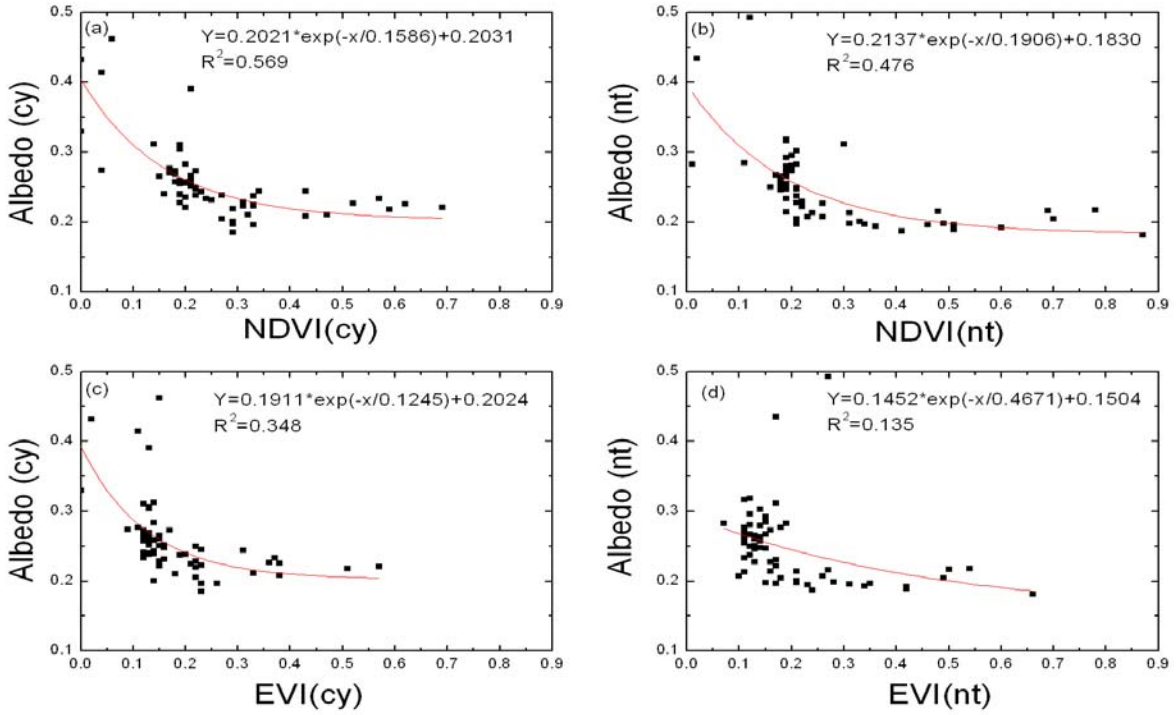


cropland



degraded-grassland

Fitting of Surface Albedo to Normalized Difference Vegetation Index (NDVI) or Enhanced Vegetation Index (EVI)



cy----cropland **nt---- degraded grassland**

aerodynamic roughness length ($Z_{0\,m}$)

Relationship of Wind Profile

neutral stratified layer:

$$\ln\frac{z-d}{z_{0m}}=\frac{\kappa u(z)}{u_*}$$

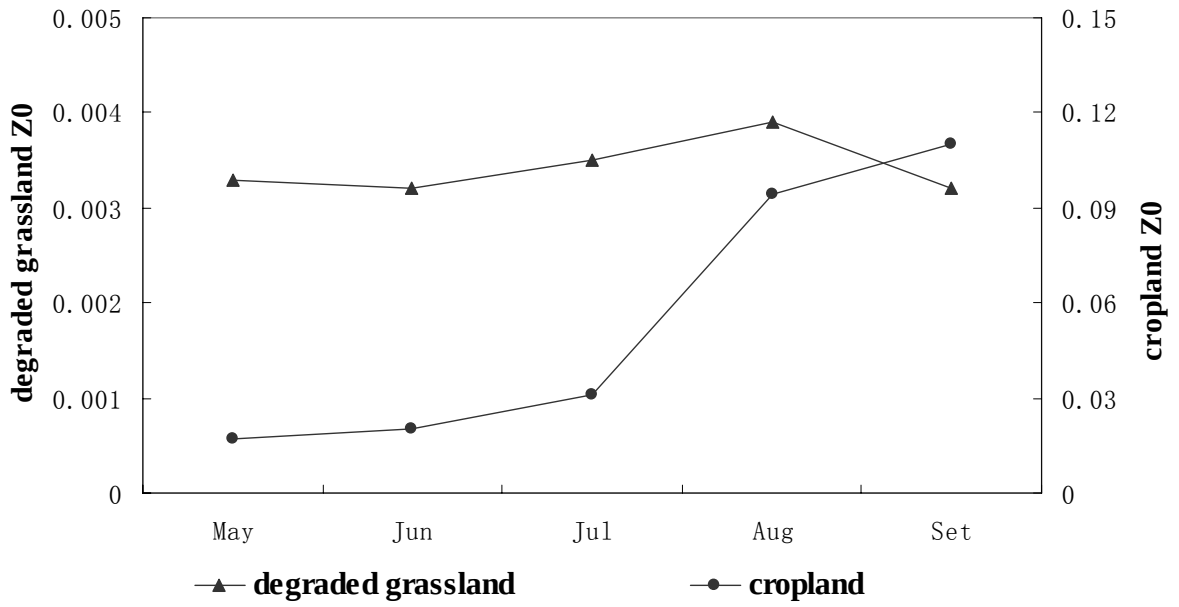
unneutral stratified layer:

$$\ln\frac{z-d}{z_{0m}}=\frac{\kappa u(z)}{u_*}+\psi_m(\zeta)$$

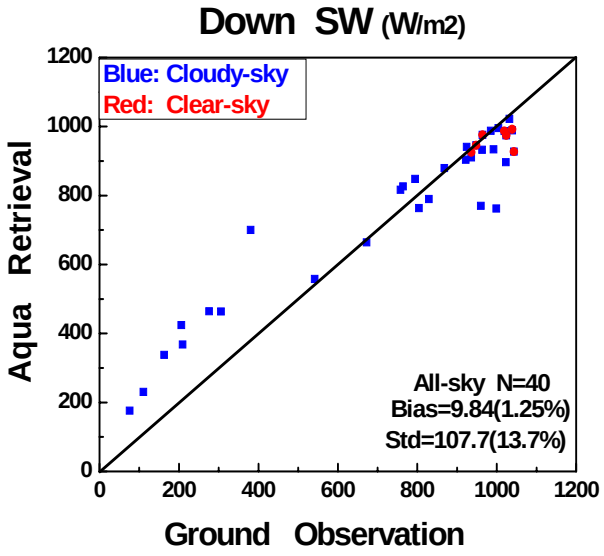
$$\zeta = z/L$$

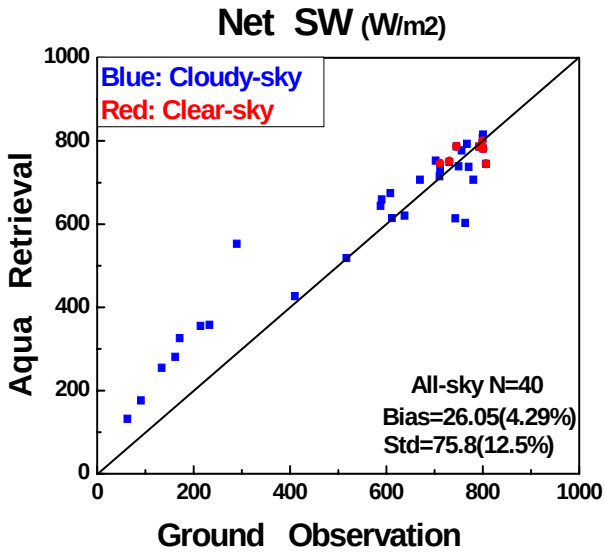
$$L=-\frac{\rho c_p\cdot u_*^3 T_a}{\kappa g H}$$ **(Monin—Obukhov lenghth)**

aerodynamic roughness length (Z_0, Unit: m)



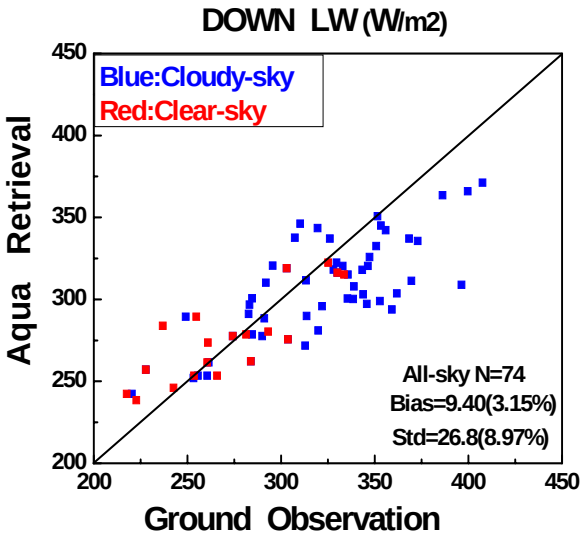
Comparison of Surface Radiative Properties

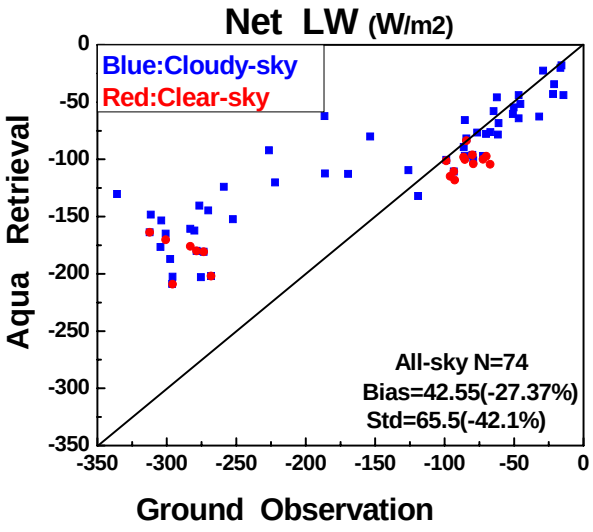




Comparison of MODIS Aqua retrieved short wave radiative properties with ground-based observation.

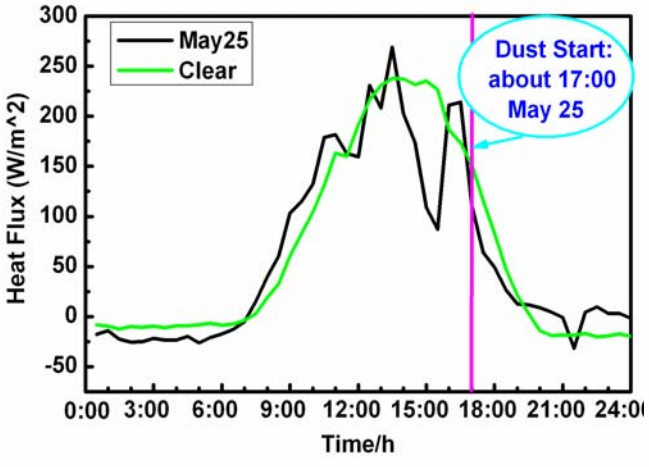
Comparison of Surface Radiative Properties

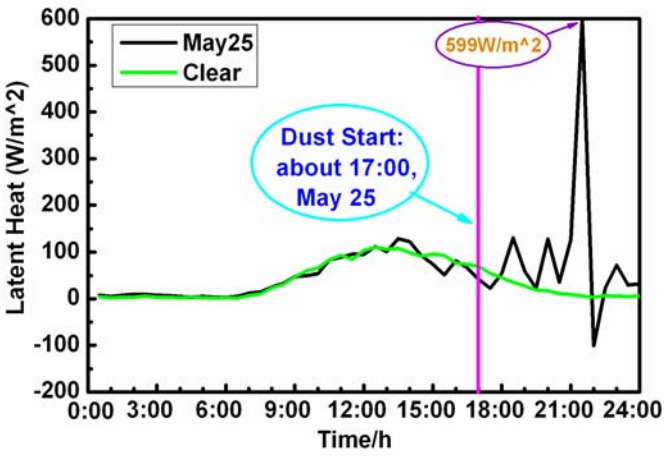




Comparison of MODIS Aqua retrieved long wave radiative properties with ground-based observation.

Effect of Dust Aerosol on Fluxes

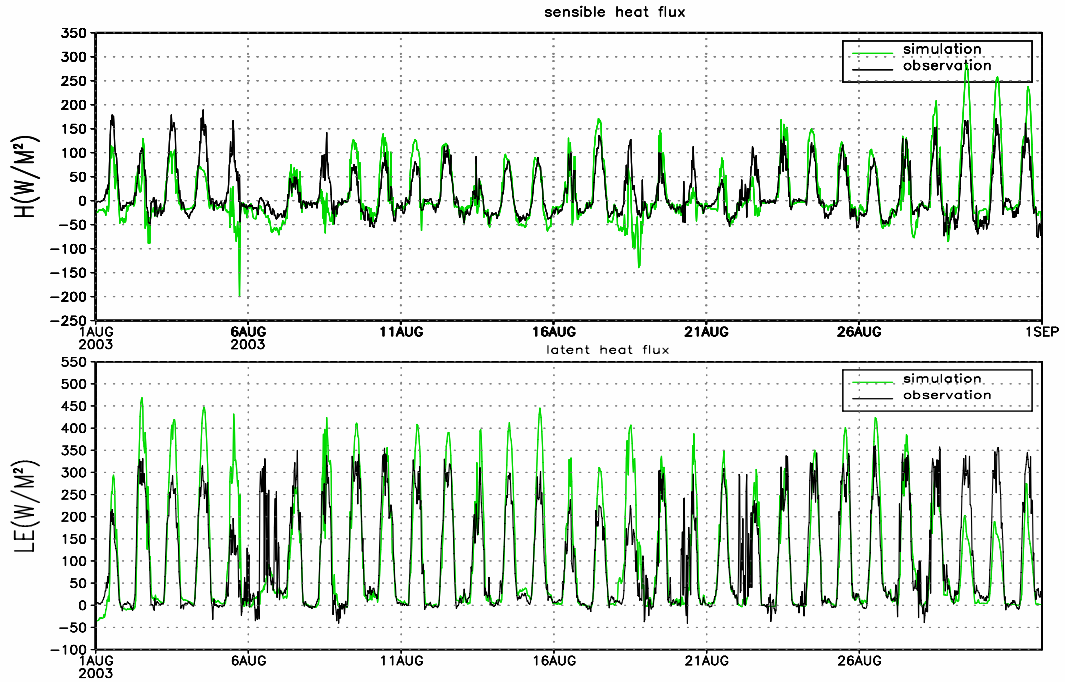




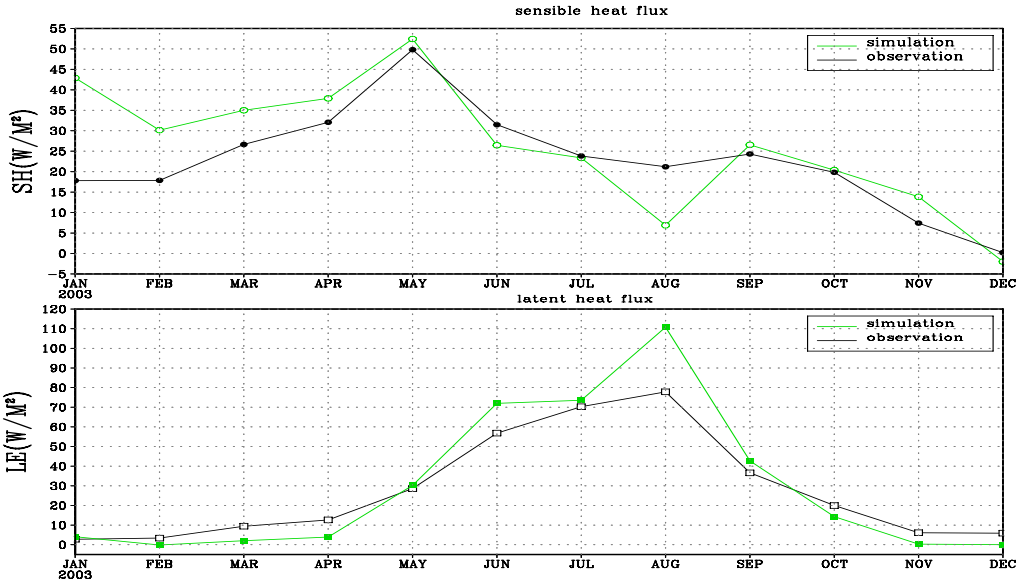
Comparison of averaged clear-sky sensible heat flux and latent heat flux with those flux in dust day.

- **Validation of land surface models (Common Land Model and SiB2) by using observed data from Tongyu stations**

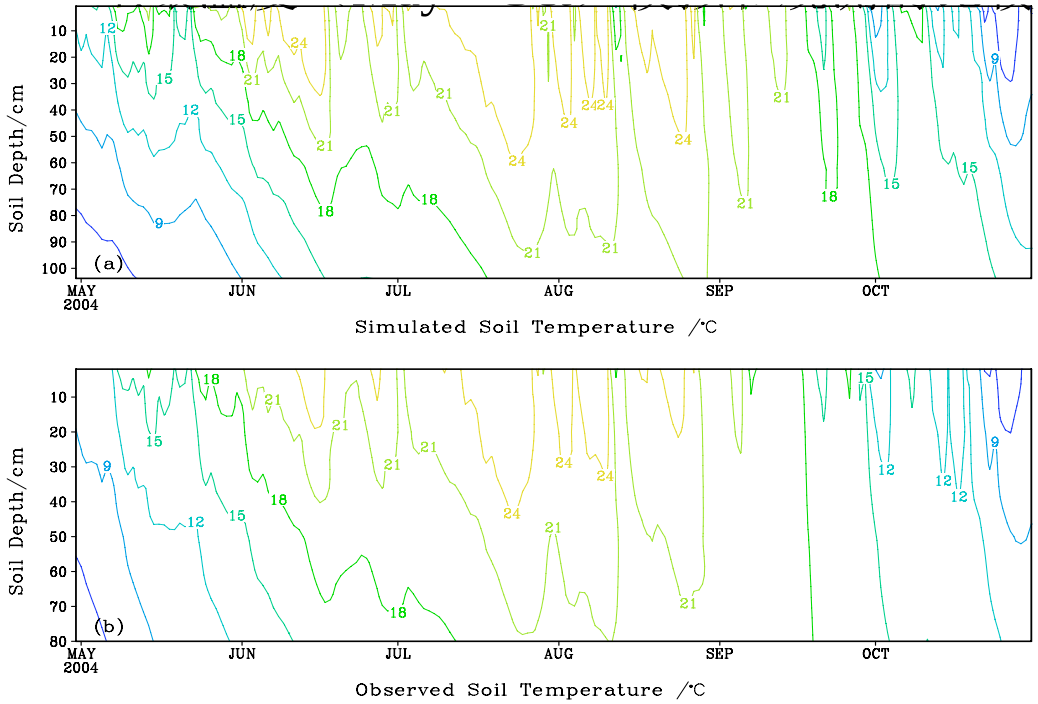
Simulation of the diurnal cycle of sensible/latent heat fluxes during Aug.2003 at cropland

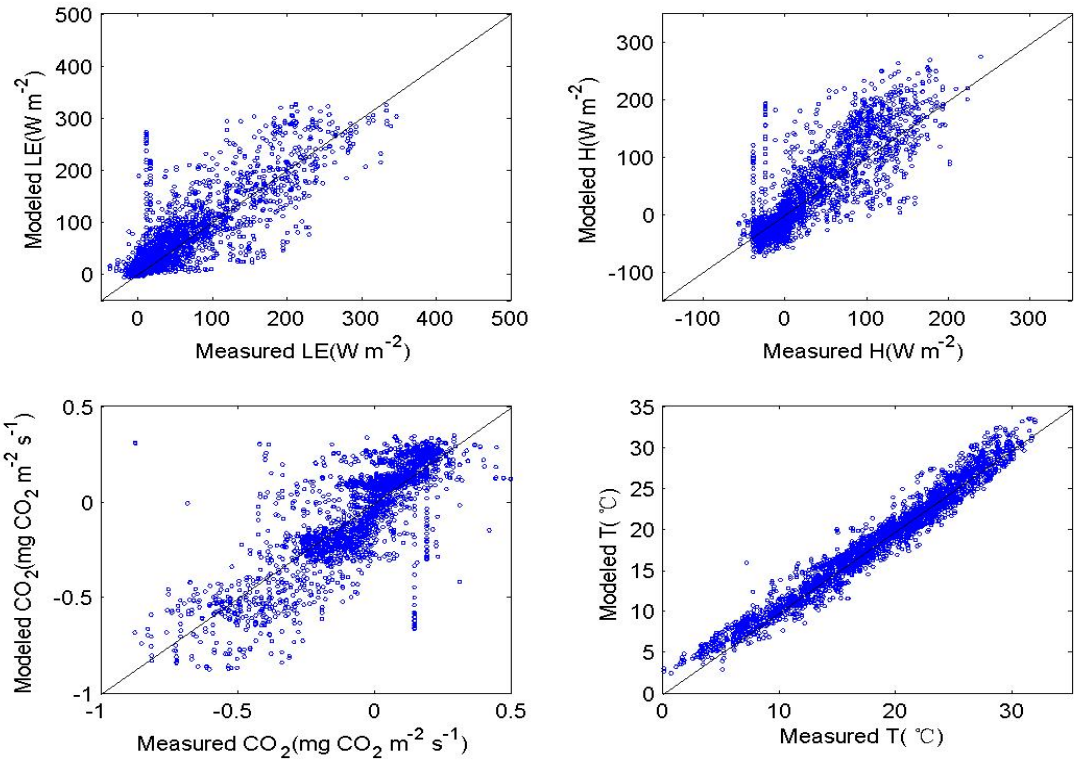


Simulation of the seasonal variation of the heat fluxes during year 2003 at degraded grassland

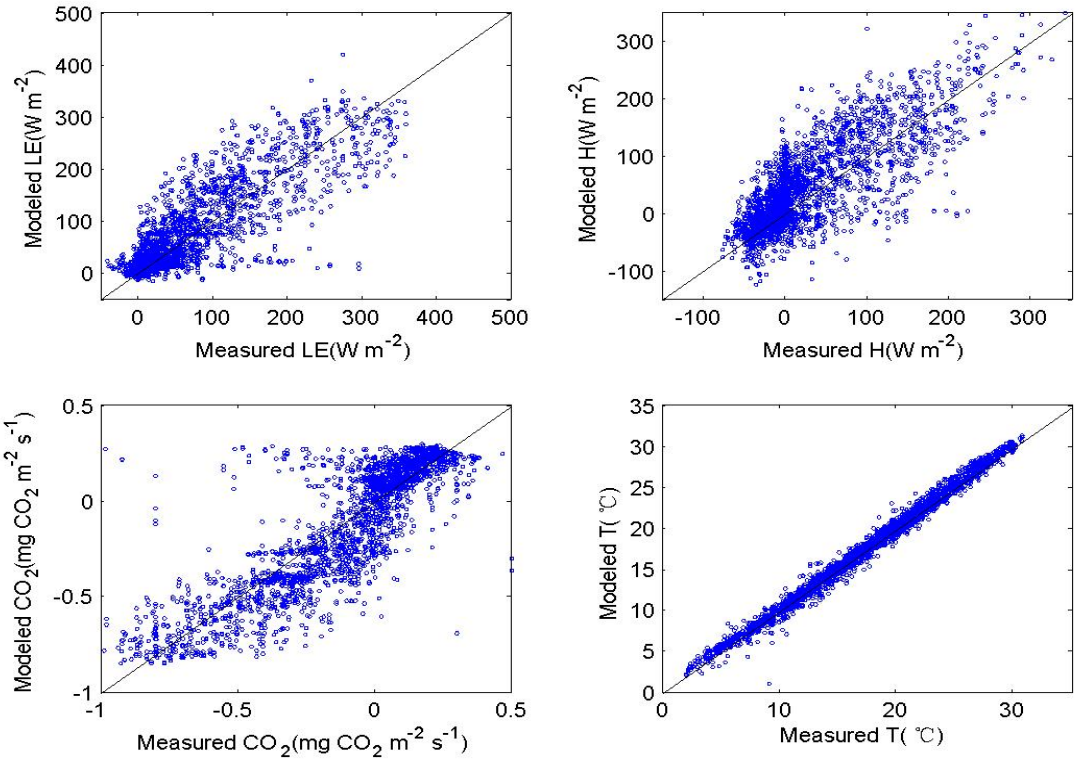


Comparison of the soil temperature profile in 2004 (May～Oct.) at degraded grassland



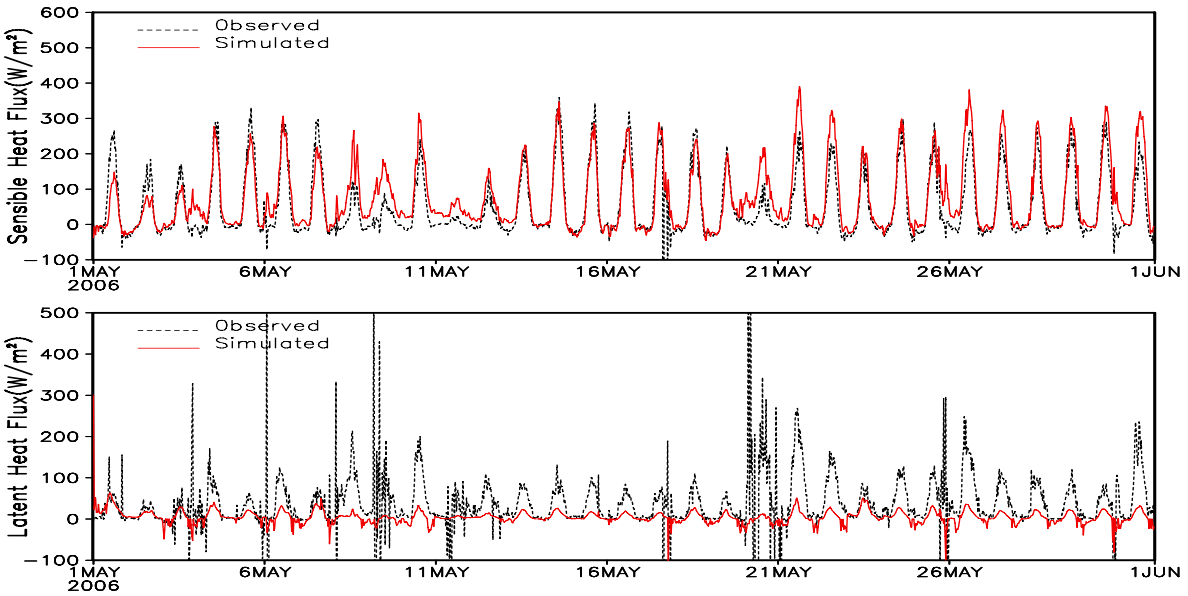


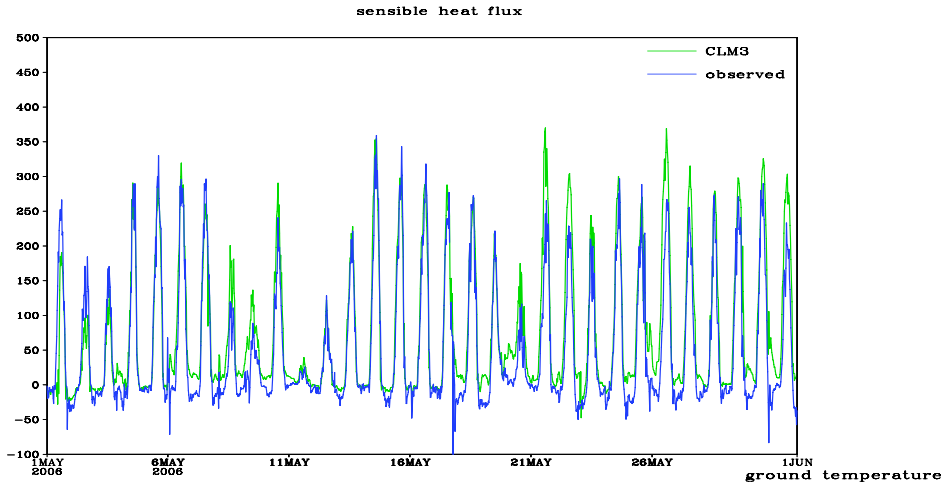
Scatter plots of latent heat flux (LE), sensible heat flux (H), and CO_2 flux modeled using SiB2 against direct measurements at degraded grassland (year: 2003).

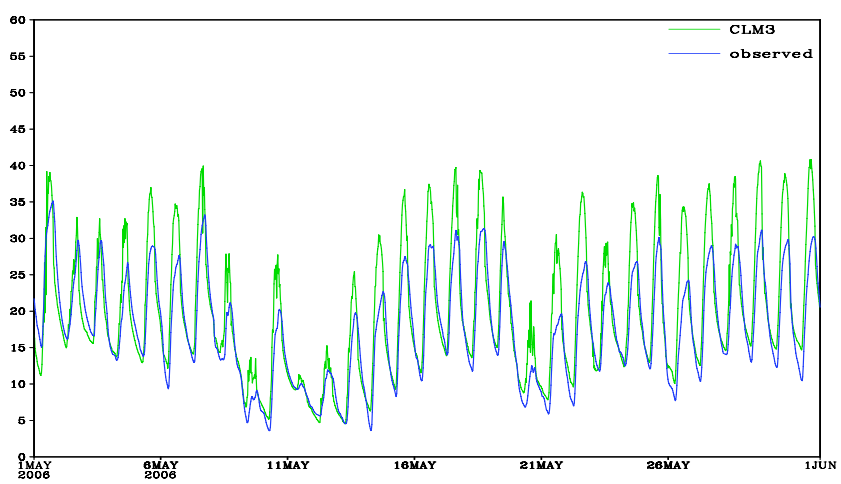


Scatter plots of latent heat flux (LE), sensible heat flux (H), and CO_2 flux modeled using SiB2 against direct measurements at cropland (year: 2003).

Comparison of simulated sensible and latent heat fluxes against observations







Planning activities for 2007-2008

- **CEOP/MAIRS joint workshop of land-atmosphere interaction in semi-arid regions and First meeting of CEOP semi-arid region working group in August 9-13, 2007, Lanzhou, China;**
- **Workshops of development of a joint MAIRS/CEOP proposal on multi-disciplinary integrated observation project in arid/semi-arid Asia in 2007-2008;**
- **A START/MAIRS/AAMP RCM training course and Workshop of RCM inter-comparison for Asia (RMIP) in Hawaii in 2008.**

International Workshop on Semi-Arid Land Surface-Atmosphere Interaction
Aug. 9-13, 2007 , Lanzhou, China

Main topics：

- **Land surface-atmosphere interactions**
- **Dust aerosol effect on hydrological cycle**
- **Climate change monitoring in semi-arid environment**
- **International cooperative field campaign over Northern East Asia**

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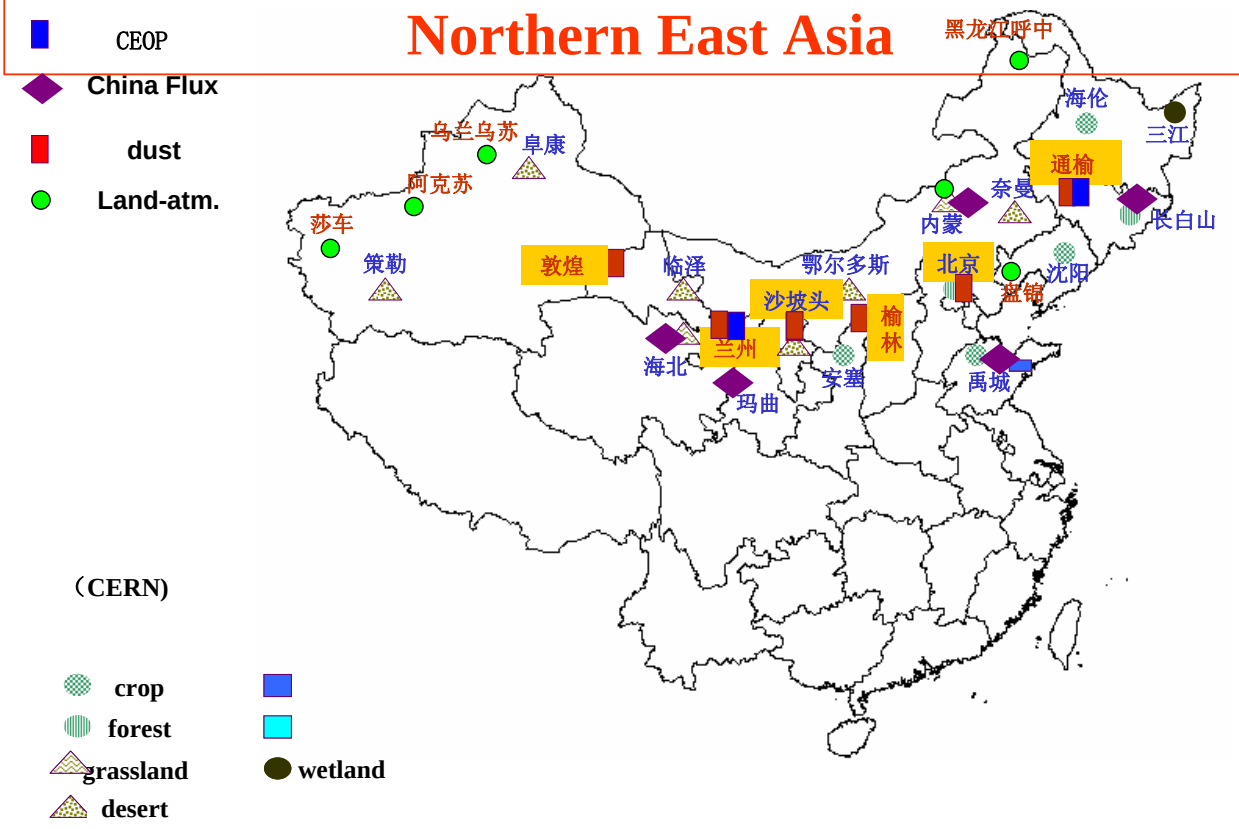
Prof. Congbin Fu（Chair）
Institute of Atmospheric Physics,
Chinese Academy of Sciences
E-mail: fcb@tea.ac.cn

Local Host:
Prof. Jianping Huang ,
College of Atmospheric Sciences
Lanzhou University
E-mail: hjp@lzu.edu.cn

CEOP/MAIRS coordinated multi- disciplinary observation project in arid /semi-arid region of Northern East Asia



Thank you