Asia-Pacific Environmental Innovation Strategy (APEIS)

Integrated Environmental Monitoring (IEM)

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Jiyuan LIU, Institute of Geographical Sciences and Natural Resources Research, CAS
Integrated Monitoring System

Satellite Observation Network

MODIS high-order products
- Land surface temperature
- Land cover / Vegetation indices
- Fires & biomass burning
- Leaf area index / FPAR
- Photosynthesis / NPP

Ecological Indices
- Water deficit index
- Aridity
- Index of desertification
- Index of dust storm

Integrated Model for Assessment of Ecological Function
- Water resources
- Carbon cycle
- Nutrient cycle
- Food Production and Security
- Disaster Protection

Detection of Ecosystem Vulnerability

GIS Data
- Digital maps
- Statistic data
- Other remote sensing data

Ground-truth Measurements
- Meteorological data
- Hydrological data
- Vegetation data
- Soil properties data

Contribution to Policy Making

Ecological Observation Network

Ground-truth Measurements

GIS Data

Detection of Ecosystem Vulnerability

Contribution to Policy Making
Coverage of MODIS data

Produced by NIES Data Center, Japan
Desertification and Dust Storm

MODIS Image: Desertification
Date: 2001/04/13

MODIS Image: Dust Storm
Date: 2002/04/01

Received by Beijing MODIS Station
Urbanization of Pearl River Delta

Produced by Beijing MODIS Station
Fire in East Siberia & East China

1. Active fire and smoke
2. New fire scar
3. Old fire scar

Taken by Beijing Station, August 8, 2002
Fire near Sumatra

Image taken by CRISP, Singapore
July 4 2001

Fire near Canberra

Image taken by CSIRO, Australia
January 18 2003
Floods in Bangladesh

Credit: Jacques Descloitres, MODIS Rapid Response Team, NASA/GSFC
Satellite: Terra
Sensor: MODIS
Date: 11-09-2002
On Sri Lanka, much of the native forests have been cleared.
Chlorophyll Concentration

Terra MODIS, 27 March 2003, UTC 03:33

Produced by CRISP, Singapore
Monitoring Water-body Changes

Changes in Water Area and Volume of East Dongting Lake

Produced by NIES Data Center, Japan
“Water level” derived by TOPEX/Poseidon between 1993 (orbit cycle 11) and 1999 (orbit cycle 267) at Datong St.

Rating curve between TOPEX/Poseidon derived “water level” and measured discharge at Datong St.

Comparison of estimated and observed discharge at Datong St. in 1998 and 1999 by TOPEX/Poseidon data

\[ y = 6366.6821 \times 1.1926 \]

\[ R^2 = 0.8241 \]
Ground-truth Ecological Observation Network

Water, heat and carbon fluxes at Yucheng observed by APEIS-FLUX network

Produced by NIES Data Center, Japan
Validation of MODIS High-order products by observations of APEIS-FLUX network

Produced by NIES Data Center, Japan
MODIS Data Processing System

Level 0,1
- Surface Reflectance
- Thermal Anomalies
- Land Cover/Land Cover Change
- Land Surface Temperature (LST)

Level 2
- Vegetation Indices (NDVI & EVI)
- Albedo 16-day L3
- Vegetation Cover Conversion

Level 3
- Leaf Area Index & FPAR
- Photosynthesis and NPP

Level 4
- Integrated Model for Land-surface Process, Ecosystem function, and Crop Production
Seasonal Change of Vegetation in 2002, Mongolia

Produced based on NASA’s products by NIES Data Center, Japan
NDVI Coverage of Beijing and Urumqi stations

08-23, July-2002,

Produced by Beijing Data Center, China
Land Use Change During Last Ten Years in China

Produced by Beijing Data Center, China
APPLICATION OF ECOLOGICAL INDICES

MODIS High-order Products
- NDVI, LAI, Surface Temp.
- Land Cover, Albedo

Ground Truth Observation Data

Heat Flux

Soil Heat Flux

Heat Budget

Water Budget

Scio-economic data
- Wind Speed
- Land Use

Water Deficit Index

Soil Nutrient Socio-economy

Dust storm

Forest Fire

Crop Production
Catchment-based Integrated Model

- Flux Tower
- Ecological Station

GIS Database
- Geographical
- Socio-economic
- Soil & Nutrients

MODIS Satellite Data

Agricultural Production Model

Carbon Cycling Model

Nitrogen Cycling Model

Water Cycling Model
- Discharge
- Soil Moisture
- Runoff and Flood
- Desertification
- Dust Storm

Simulation of Soil Water Content

Simulation of Changjiang River Discharge
Simulation of Irrigation Schedule and Water Use Efficiency
(Contribute to Agricultural Water Use Policy)

<table>
<thead>
<tr>
<th>Main items</th>
<th>Simulation</th>
<th>Measurement</th>
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<tbody>
<tr>
<td>Yield (kg/ha)</td>
<td>6608</td>
<td>6330</td>
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<tr>
<td>Weight per grain (g)</td>
<td>0.029</td>
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<td>Grain number (grain/m2)</td>
<td>22488</td>
<td>21828</td>
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<tr>
<td>Grains per ear</td>
<td>38</td>
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<td>Maximum LAI</td>
<td>6.1</td>
<td>6.4</td>
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Message from IEM

1. Large scale environmental degradation in Asia-Pacific Region caused by climate change and human activities can be detected by MODIS Network.

2. Environmental degradation in terms of area, frequency and degree in Asia-Pacific Region are found to be much severer than predicted.

3. Most environmental degradations are related with water issues, such as desertification, floods, drought, dust storm, forest fire, water shortage, water pollution, etc.


5. Establishment of regional information system communicating with decision makers in Asia-Pacific Region is proposed.
Participation Organization:

National Institute for Environmental Studies (NIES), Japan
Institute for Geographical Sciences and Natural Resources Research (IGSNRR),
Chinese Academy of Science (CAS), China
National University of Singapore (NUS), Singapore
Commonwealth Scientific & Industrial Research Organization (CSIRO), Australia
Chinese Ecosystem Research Network (CERN), China
Xinjiang Institute of Ecology and Geography (XIEG), CAS, China
Institute of Subtropical Agriculture (ISA), CAS, China
Northwest Plateau Institute of Biology (NPIB), CAS, China

Web sites:
http://www.ecoasia.org/APEIS
http://www.nies.go.jp/basin/index_e.html