DATA MANAGEMENT STRATEGY IN SUPPORT OF CEOP SCIENCE OBJECTIVES

(Session 2.2)

CEOP/IGWCO Workshop
Tokyo, Japan
28 February – 4 March 2005
SESSION 2.2 AGENDA

• Some Research Activities at BALTEX CEOP Reference Sites (Isemer)
• Concept of Climate Retrieving and Analysis System for Equatorial Island Reference Site (Darmawan)
• Seasonal and Diurnal Variations of the Exchange of Water Vapor and CO2 in semi-arid area at Tongyu, China (Liu)
• SHARE-Asia Project Meteoclimatic Research in Himalaya and Karakorum (Tartari)
• Estimating LAI from On-site Measurements of Radiation at NOAA-GAPP Reference Sites (Loehrer)
• Science Overview of the LaPlata River Basin (Mechoso)
REFERENCE SITE LOCATIONS

1. Eastern Siberian Tundra
2. Eastern Siberian Taiga
3. Mongolian
4. Inner Mongolia
5. Korean Peninsula
6. Korean Haeumam
7. Tibet
8. Yangtze River
9. Himalayas
10. Northern South China Sea - Southern Japan
11. Chao Phraya River
12. North-East Thailand
13. Western Pacific Ocean
14. Equatorial Island
15. ARM Tropical Western Pacific (Darwin)
16. ARM North Slope of Alaska (Barrow)
17. BERMS (Old Black Spruce)
18. Ft. Peck
19. Bandville
20. ARM Southern Great Plains
21. Oak Ridge
22. Mt. Bigelow
23. Caxiuana
24. Santarem
25. Manaus
26. Rondônia
27. Brazilia
28. Pantanal
29. Sodankyla
30. Lindsberg
31. Cabauw
32. Nongnda
33. Niamay
34. Oeume
35. Tumbarumba

Annual Average Precipitation of 1988-1997 (Source: GPCP)
**REFERENCE SITE DESCRIPTION**

**1D Site:**

Near surface + surface + sub-surface (Atmospheric sounding* is highly desirable)

**2.5D Site:**

A few 1D sites + surface heterogeneity with an area of at least 100 km²

**3D Site:**

1D sites network (+3D system) or 2.5D site + 3D atmosphere ** with an area of about 10⁴ km²

*The terminology in summarizing these sites is used in the following manner:

- **Sub-surface (0 to -1m):** Soil moisture and temperature profile, heat conduction and soil characteristics;
- **Surface (0 to +2m):** Four-component radiation, PAR, surface temperature, surface soil moisture, precipitation, vegetation type characteristics, snow;
- **Near surface (+2 to +10m):** Temperature, specific humidity and wind speed profiles, surface pressure, momentum, latent and sensible heat fluxes;

* Atmospheric soundings: Radiosonde, wind profile, LIDAR microwave rain radar
  ** 3D atmosphere: 3D Doppler radar, cloud radar, aerosonde aircraft.
Reference Site EOP-3 Data Flow

Data Source

Data/Doc Arrive at JOSS

Apply Auto/Manual Data/Doc Consistency Checks

- Format Verification
- Gross Limit Checks
- Exact/Inexact Dup Records
- Data/Flag/Doc Checks
- Generate Flagging and Site Statistics

Visual Inspection of Data and Plots

Merge Data

Available On-Line

JOSS Updates
Status Table and Detailed Notes
In-Situ Reference Site Data Sets and Information

Data Sets
- CEOP EOF-3 Reference Site Data Sets
- CEOP EOF-1 Reference Site Data Sets
- NASA/GMAO CEOP EOF-1 Reference Site Data Sets in GrADS Format
- Sample Reference Site Data Sets
- CEOP In-Situ Data Source Agency Links
- Baseline Surface Radiation Network (BSRN)
- GEWEX Land Processes Database Map Server

Information
- CEOP Reference Site Data Set Procedures Report (Approved by the SSC 29 July 2003)
- CEOP Reference Site Station Characteristics
- CEOP Reference Site Map
- CEOP Reference Site Rawinsonde Station Questionnaire
  - Responses

Satellite Data and Information

Data Sets
- EOF-1 Satellite Data Sets
- NASA/GMAO GRADS/DODS/ISCCP Surface T and Cloud Amount for CEOP EOF1

Information
- CEOP Satellite Data Source Agency Links

Model Output and Information

Data Policies
- Final DRAFT CEOP Reference Sites Data Release Guidelines
- BAILEX
- CAMP
- CATCH
- GAPP
- LBA
- MAGS

Data Standards Information
- Assistance for Land-Surface Modelling activities (ALMA)
- Atmospheric Model Intercomparison Project (AMIP)
- ISO/TC 211

Documents
- CEOP Implementation Plan
- Report from the 2nd CEOP Implementation Planning Meeting (DRAFT - 8 July 2003)
- WESP Major Activities Plan (1 June 2003)
- CEOP Reference Site Station Characteristics Questionnaire
- Establishment of a Global Hydrological Observation Network for Climate” GCOS/GTOS/HWRP Meeting Report (June 2000)

Other Links
- CEOP Home Page
- WCRP Home Page
- CEWEX Home Page
- CLIVAR Home Page
- CIC Home Page
- ACSYS Home Page
- Global Modelling and Assimilation Office (NASA/GSFC)
- Land Information System (NASA/GSFC)
- Model Parameter Estimation Experiment (MOPEX)
- NASA/Goddard Institute for Space Studies (GISS) Data
CEOP EOP-3 Reference Site Data Sets

To order individual data sets click on the appropriate "X" below.

Data sets that cover the complete EOP-3 period are signified by the full moon icon: ☾.

Last Updated 25 February 2005.

<table>
<thead>
<tr>
<th>CSE</th>
<th>Reference Site Name</th>
<th>Surface Meteorological and Radiation</th>
<th>Meteorological Tower</th>
<th>Soil Temperature and Soil Moisture</th>
<th>Flux</th>
<th>Soundings (Raw Format)</th>
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<tbody>
<tr>
<td></td>
<td>Norunda</td>
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<td>Sodanknya</td>
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<td>Himalayas</td>
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<td>Korean Heenam</td>
<td>X (23 Sep 2004)</td>
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<td></td>
<td>Korean Peninsula</td>
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<td></td>
<td>Northern South China Sea</td>
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</table>
Based on ISO 19115 Metadata Standards

Design for Finding and Integrating data
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Some Research Activities

at

BALTEX CEOP Reference Sites

Hans-Jörg Isemer
(International BALTEX Secretariat; GKSS; Germany)

for

Frank Beyrich (DWD, Germany)
Fred Bosveld (KNMI, The Netherlands)
Anders Lindroth (Lund University, Sweden)
Tarja Savunen (FMI, Finland)

and many collaborators
BALTEX Reference Sites for CEOP

Sodankylä (FMI)
67.4N/26.7E
T. Savunen

Norunda (Lund University)
60.1N/17.5E
A. Lindroth

Lindenberg (DWD)
52.2N/14.1E
F. Beyrich

Cabauw (KNMI)
52.1N/5.2E
F. Bosveld

Hans-Jörg Isemer, IBS, isemer@gkss.de
BALTEX Reference Sites for CEOP

Air temperature (2m)

Cabauw
9.8 C

Lindenberg
8.6 C

Norunda
5.4 C

Sodankylä
-1.0 C

Hans-Jörg Isemer, IBS, isemer@gkss.de
Sodankylä, FMI, Finland

The Surface Energy Budget
The Stable ABL
The Structure of Turbulence
Arctic Wind Energy
Icing
Ice-free Sensors
Model Validation / Verification

Tarja Savunen, Ivan Mammarella,
Bengt Tammelin, Erik Gregow
and many others

Finnish Meteorological Institute
Sodankylä

Strong Nocturnal Inversions

The 50 m Meteorological Mast at Sodankylä, Finland.
Sodankylä: Annual Cycle of Stability Classes

Pasquill-stability

32-3 m

Stability classes according pot. temperature difference
difference 32 m - 3 m

1: very lable  \( \text{d} \Theta/\text{dz} < -7^\circ \text{C} \) /km
2: lable  \(-7^\circ \text{C} < \text{d} \Theta/\text{dz} < -5^\circ \text{C}\)
3: neutral  \(-5^\circ \text{C} < \text{d} \Theta/\text{dz} < 5^\circ \text{C}\)
4: stable  \(5^\circ \text{C} < \text{d} \Theta/\text{dz} < 25^\circ \text{C}\)
5: very stable  \(\text{d} \Theta/\text{dz} > 25^\circ \text{C} /\text{km}\)
Sodankylä/Luosto: Icing Test Site
Sodankylä, FMI:
Impact of icing upon cups on the accuracy and response of a anemometer

![Image of anemometer cups with ice]
MM5-simulations vs Sodankylä mast observations

Wind speed at 47m

Max bias; 2.5 m/s
MM5 vs HIRLAM observations from Sodankylä mast. Temperature at 2-3 meters.

Temperature at 2-3 meter

-40 -35 -30 -25 -20 -15 0 1 0 2 0 3 0 4 0 5 0 6 0

Time, h

Cel.

-40 -35 -30 -25 -20 -15 0

MM5 TOGA-input (ETA5)
HIRLAM
Obs. 3m
Norunda:

*Focus on long-term *observations* of energy fluxes in a mixed pine/spruce forest in Central Sweden.*
The **Norunda** site

- Location; 60°5’ N, 17°29’ E, alt. 45 m
- ca. 100 years old stand on glacial till soil
- LAI about 4-5
- Twelve levels of u, T, CO₂ and H₂O above ground
- Three levels of flux measurements above canopy
- Two levels of radiation measurements above canopy
- Biomass & soil temperatures
Norunda:

Surface Energy Balance of Boreal Forests: Dependency on Season, Weather and Soil Moisture
Norunda: Set up for storage measurements

- 6 $T_{\text{branch}}$
- 6 $T_{\text{trunk}}$
- 8 $T_{\text{trunk}}$
- 12 $T_{\text{trunk}}$
- 3 Flux plates
- 4 $T_{\text{soil}}$
- $7 T_a \& q$
- Flux by EC; 35 m
Norunda

Surface Energy Balance of Boreal Forests: Dependency on Season, Weather and Soil Moisture

Some conclusions

• Storage in biomass and stand air is highly significant in the surface energy balance
• Inclusion of storage improves closure significantly and particularly during night-time
• The good closure at night is strong evidence that EC measurements are valid also during stable night-time conditions
Norunda

- Rn
- H+LE+Storage
- H+LE
- H
- LE

Flux (W/m²)

Date

13-Jul 14-Jul 15-Jul 16-Jul
The Surface Energy Budget

Clouds (CliwaNet)

Stable Boundary Layer Classifications
(Contribution to GABLS)

Hydrology Programme

Grassland landscape with ditches
Potential temperature

Relative to 200m potential temperature at sunset

Observed potential temperature profiles are quite well reproduced by the model (ERA40).

But for the most extreme classes with low wind and high cooling the model overestimate surface temperature by approximately 2 K.
Wind direction

Relative to 200m wind direction

Observed large wind veering with height is not reproduced by the model (ERA40)
Goal:

Monitoring of the water budget at the local (0.5 km²) and regional catchment (30 km²) scale

Observations:

• Rain amount (gauges, rain radar)
• Evapo-transpiration (turbulence, scintillometry)
• Soilwater storage (water table, TDR)
• Discharge and water supply
CABAUW is now a BSRN Station
CEOP Reference Site Lindenberg - Status Report

The Surface Energy Budget
Regional Heterogeneity
The Stable ABL (GABLS)
Humidity Structure of the ABL
Model Validation / Verification
Monitoring the Tropospheric Column
Heterogeneous landscape around Lindenberg

- 45% agriculture
- 43% forest
- 7% water
Boundary layer field site at Falkenberg (standard CEOP dataset) represents grassland / agriculture
Measurements are also performed at a forest site
LITFASS - 2003
Experimental Setup

Flux measurements at different scales

- 13 micrometeorological stations
- three large aperture scintillometers
- lidar / RASS and lidar / lidar combination at GM Falkenberg
- more than 60 flight hours with turbulence sonde Helipod
LITFASS-2003 Measurement Program - Micrometeorology

Measurements of energy budget components over major land use types

13 Sites
Helicopter borne turbulence probe Helipod
→ temperature, humidity, wind
time resolution: 0.01 s
→ turbulent fluxes of momentum, heat, and water vapour over flight legs of ~ 10 km length

27 flights = 65 flight hours
LITFASS-2003: Diurnal cycle of H and LE over farmland / forest from micrometeorological, scintillometer and Helipod measurements

Using data from DWD, GKSS, TUDD, TUBS, UBT, KNMI, WAU, UBern
Differences forest - grassland (III): Net radiation

... up to 25 %
Differences forest - grassland (IV): Sensible heat flux

... up to 100 %
Differences forest - grassland (I): Soil moisture

2003
5 years of soil moisture measurements at GM Falkenberg
LITFASS-2003: Area-averaged fluxes $H$ and $LE$ from aggregated micrometeorological measurements and Helipod compared to the operational LM

Using data from DWD, GKSS, TUDD, TUBS, UBT, KNMI, WAU
CEOP Reference Site **Lindenberg** - Status Report

- full CEOP measurement programme (soil, radiation, standard meteorology, turbulent fluxes, tower, high-res radiosoundings) during EOP-1 to EOP-4 (2001 - 2004) at GM Falkenberg (grassland), additional forest data available for 2003 / 2004

- additional measurements operational - data available upon request: wind profiler / RASS, microwave radiometer profiler, cloud radar, ceilometer, rain gauge network

- field experiment LITFASS-2003: Area averaged evaporation over a heterogeneous land surface

- measurements will be continued for CEOP Phase II
Future Issues include:

**Lindenberg**: Forest Site Data to be added to CEOP Archive

**All 4 BALTEX Sites:**
- Principally prepared for CEOP Phase II – Directions urgently required!!
- Seek funding through a major EU-FP6 proposal EURAT

**All CEOP Sites:**
Need to compile vegetation, soil characteristics and other meta data

Thank you!