CEOP Model Workshop

1. Algorithm Development, Cal./Val., and Product Generation
2. Data Assimilation – Coupling with Models
3. Data Set Integration

Toshio Koike
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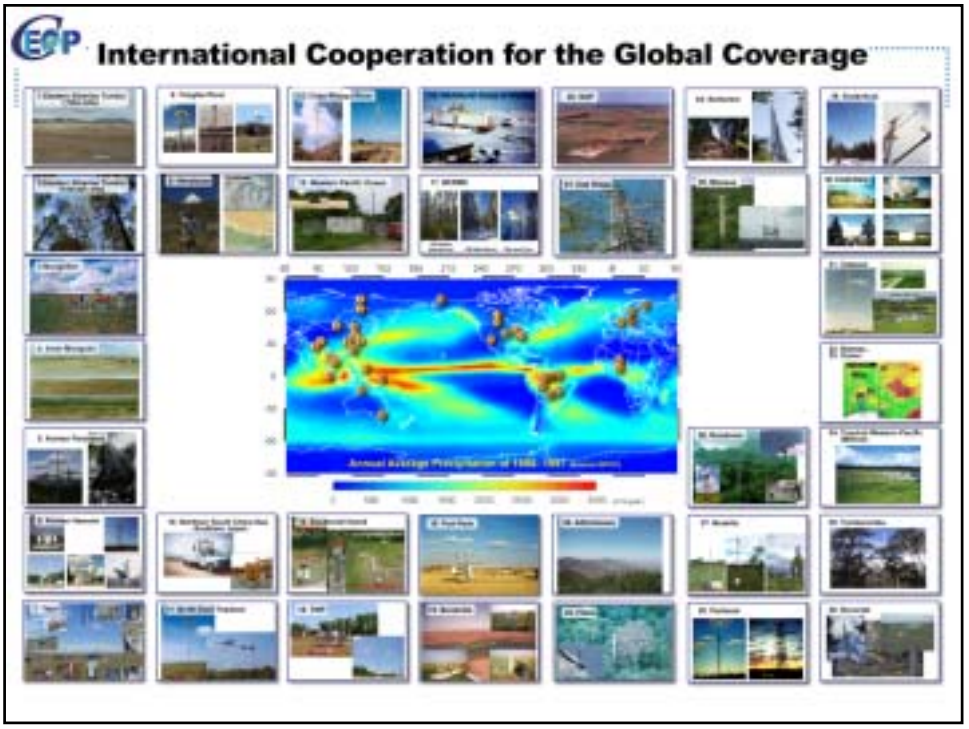
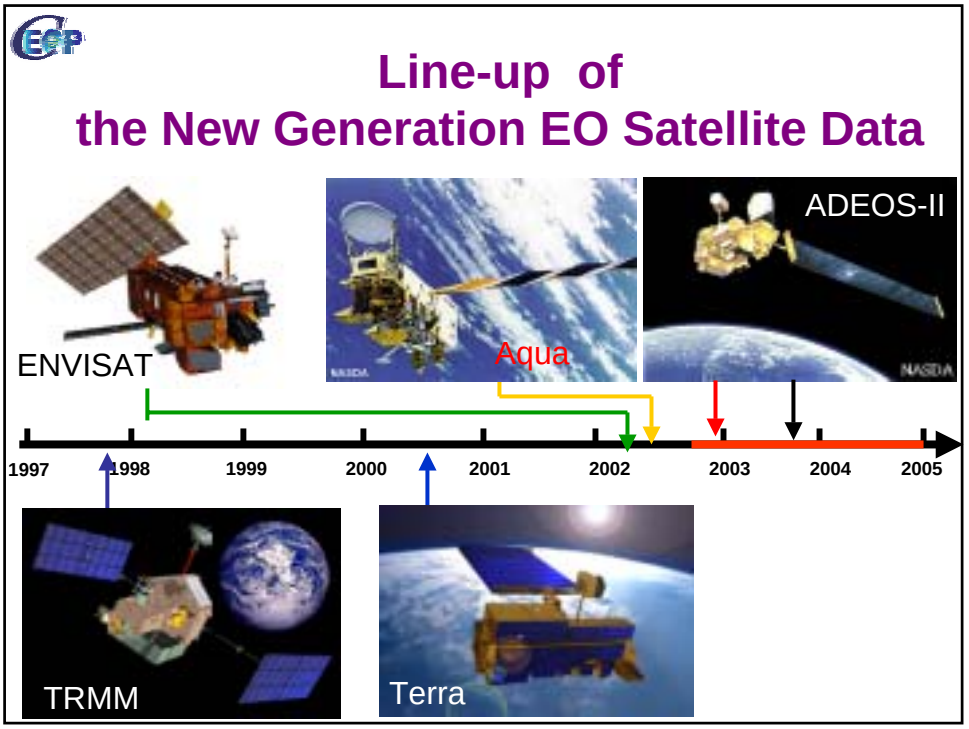
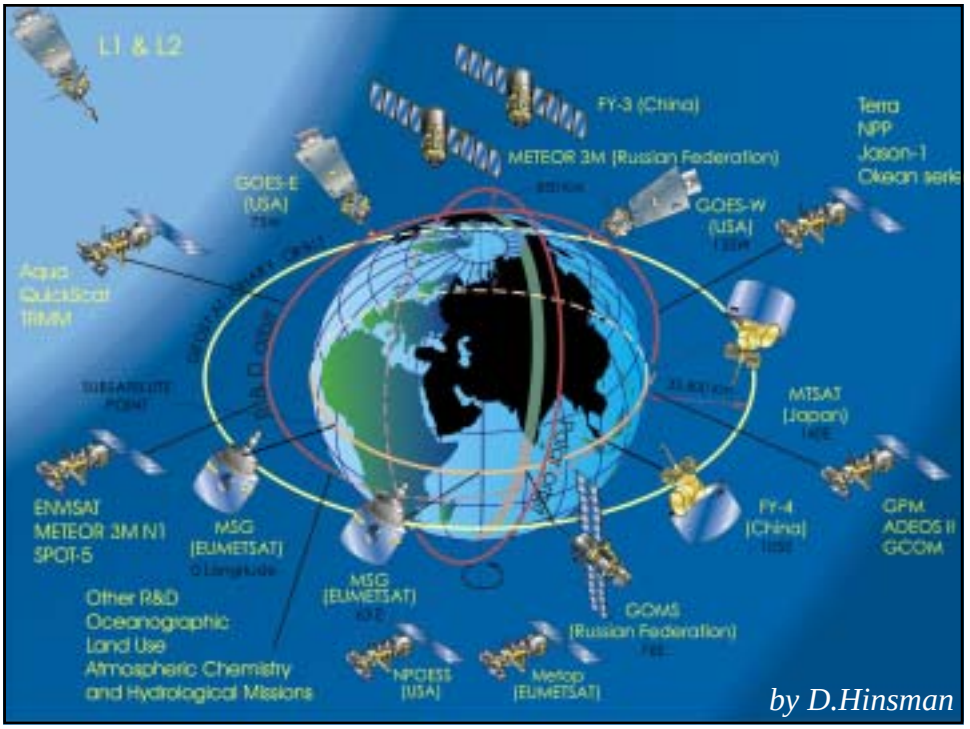
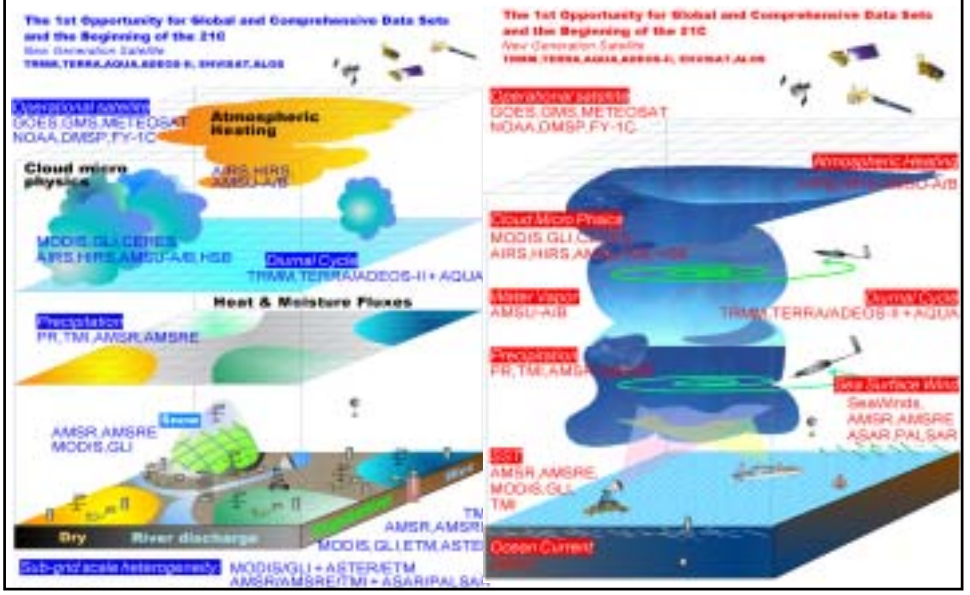
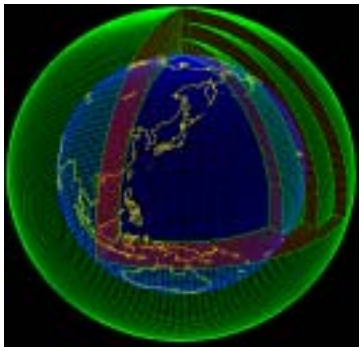

International Cooperation for the Global Coverage


Line-up of
the New Generation EO Satellite Data
ENVISAT
Aqua
ADEOS-II
NASDA
1997
1998
1999
2000
2001
2002
2003
2004
2005
TRMM
Terra



New Data Sets of the *Overall* Water Cycle by *Integrating* the Satellite Products



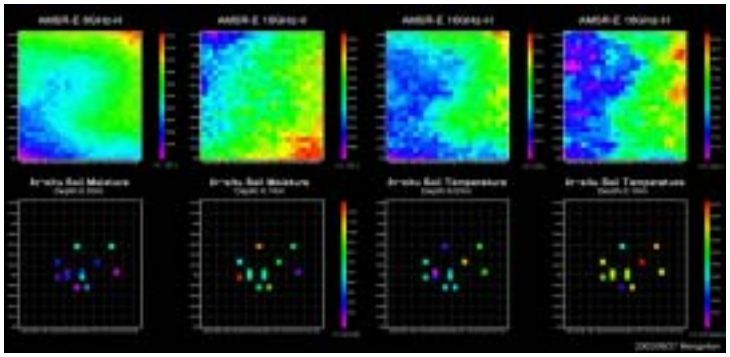


Eight Numerical Weather Prediction Centers (NWPCs), NCEP, ECPC, UKMO, ECMWF, JMA, CPTEC, BoM, NCMWF, and two Data Assimilation Center, NASA/GMAO, NASA/GLDAS provide model outputs to CEOP, and CEOP offers a globally consistent data sets for model validation and calibration.

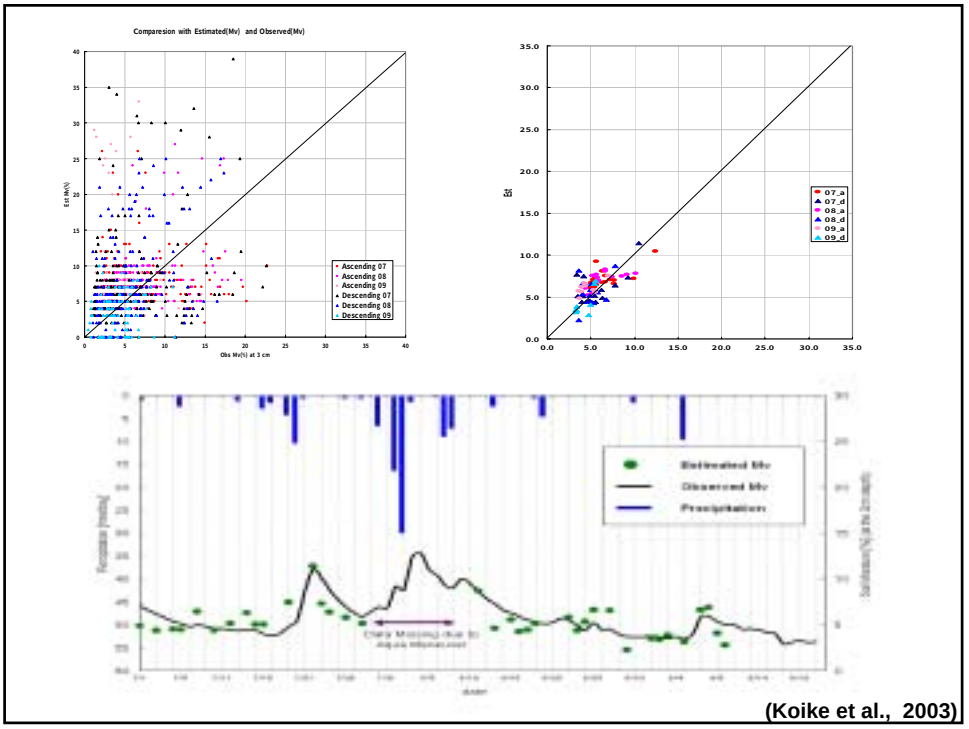
Three types model outputs are offered by NWPCs

- Model Output Location Time Series (MOLTS) at the reference sites: high temporal resolution time-series output
- Gridded Output from operational global and regional prediction models
- Output from global and regional reanalysis

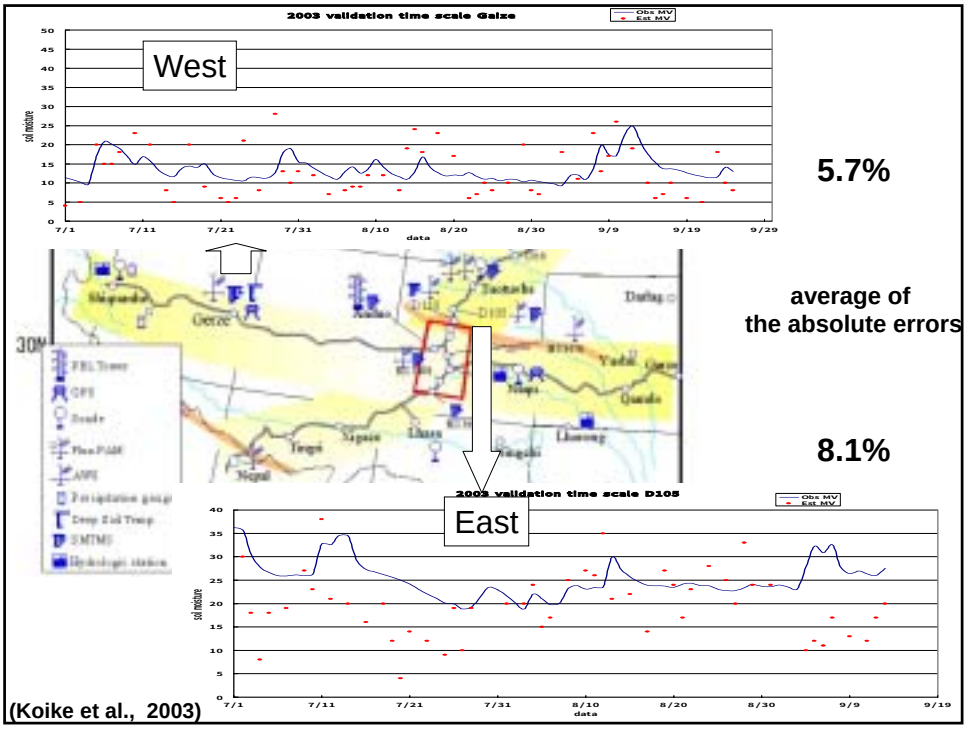
AMSR-E Soil Moisture Validation at the Reference Site in Mongolia



(Koike et al., 2003)



(Koike et al., 2003)



(Koike et al., 2003)

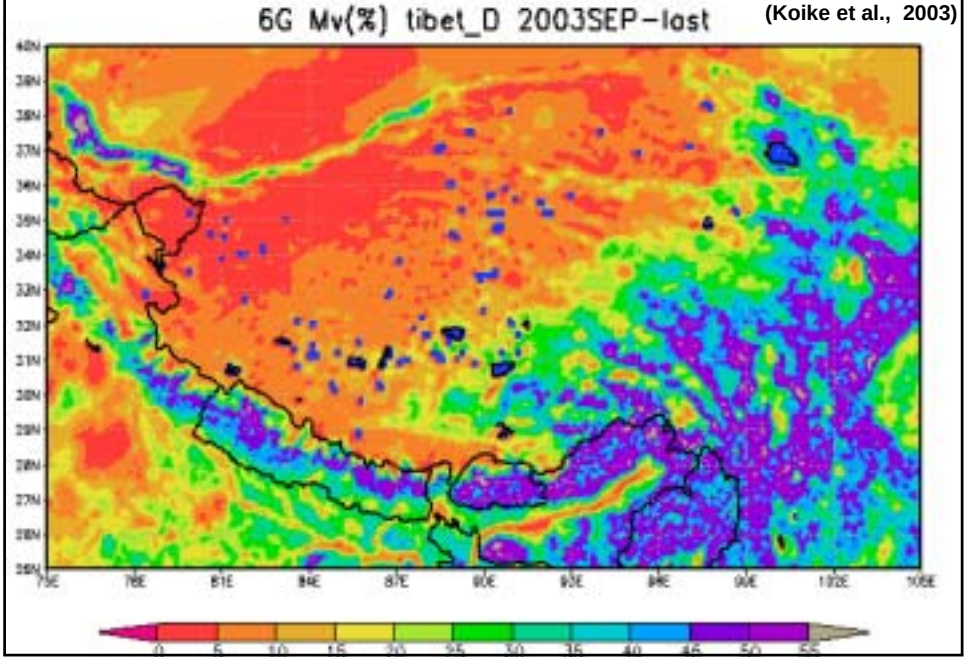
$$Error = \sum \frac{|Obs. - Est.|}{n}$$

	Mongolia											Tibet		Average
	A3	A6	C2	C4	D0	D7	E4	F2	G6	GUS	H7	D105	Gaize	
Jackson	4.2	5.7	4.8	4.9	4.4	6.7	6.1	7.5	5.9	5.0	9.5	6.1	5.2	**5.9**
Koike	3.7	3.3	3.3	3.9	3.5	4.8	3.3	2.8	4.0	4.9	4.2	11.1	4.5	**4.4**
Njoku	4.5	5.0	3.5	5.3	4.1	5.7	4.2	5.3	4.1	4.2	9.0	16.7	6.3	**6.0**
Palocia	8.1	10.8	7.0	8.3	7.5	7.7	9.7	8.4	10.6	9.9	6.1	19.8	12.9	**9.8**

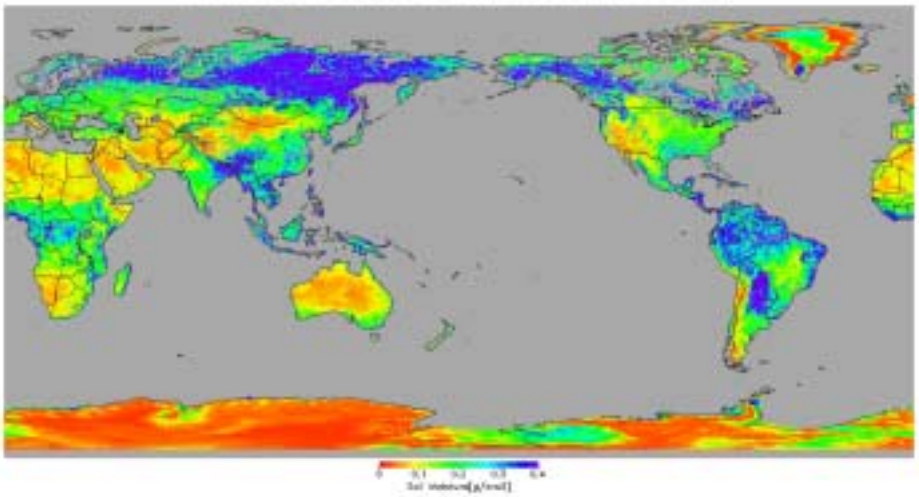
Minimum value

Seasonal Variation of the Soil Moisture in the Tibetan Plateu

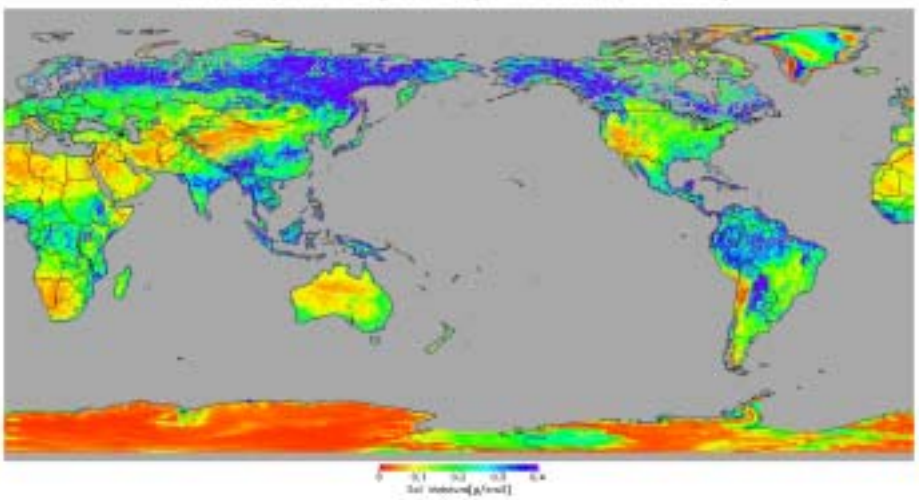
(Koike et al., 2003)



AMSR-E/SM0 5days Mean [Koike 2002/7/1-5 Dec]



AMSR-E/SM0 5days Mean [Koike 2003/7/1-5 Dec]



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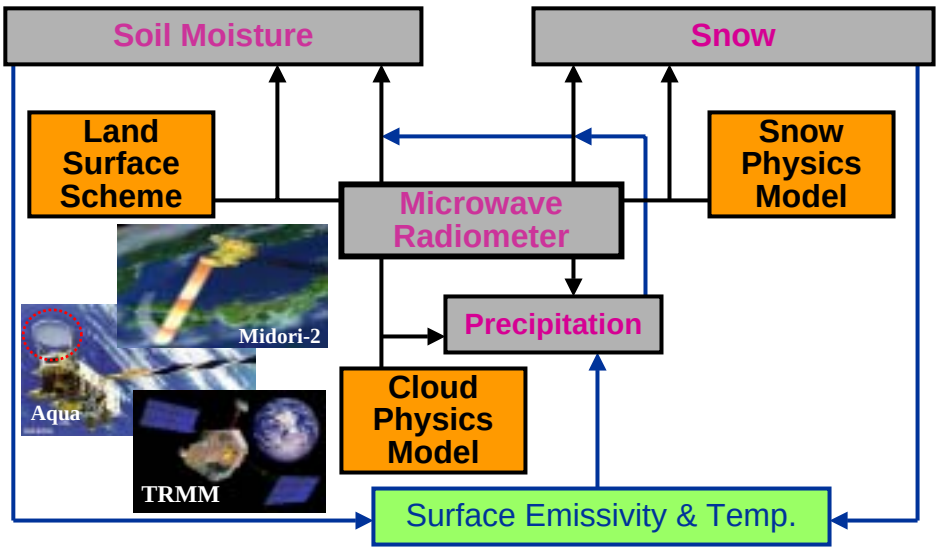
Four Dimensional Data Assimilation for Land Hydrology



LSS **Microwave RTM** **Satellite Data**

$$J = J_o + J_B$$

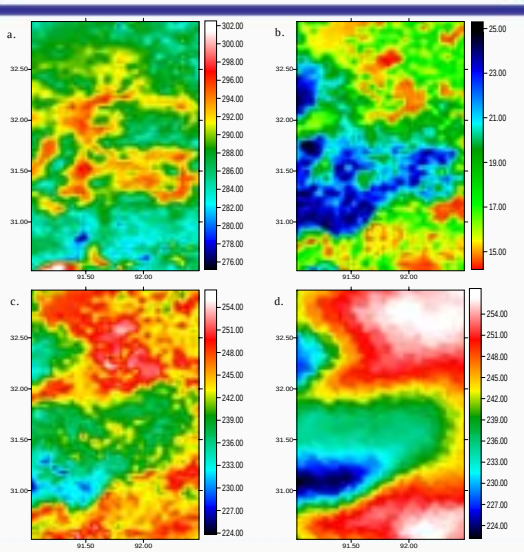
$$J(x_0) = \frac{1}{2}\sum_{i=0}^{n}(H_i[M(x_0,a)] - y_i^{O})^T R_i^{-1}(H_i[M(x_0,a)] - y_i^{O}) + \frac{1}{2}(x_0 - x_0^{b})^T B^{-1}(x_0 - x_0^{b})$$

x = State Vector	a = Calibration Parameters
x_0 = Model initial Condition	y = Observations
x_0^b = Background Field	H = Observation Operator
M = Non linear prediction model	R = Observation error covariance
B = Background error covariance	n = Time lag

MA_Game-Tibet-Result

Model Application

Pathmathevan & Koike, 2001



(a.) Estimated Surface Temperature (*K*) (b.) Estimated Soil Moisture (*v/V*) and Brightness Temperature (K) {
(c.) Estimated 10.65GHz-H (d.) Observed 10.65GHz-H } at 1.00pm on 5th of July 1998.

CEOP Down Scaling Strategy by Models and 4DDA Schemes

Mithcell, 2000

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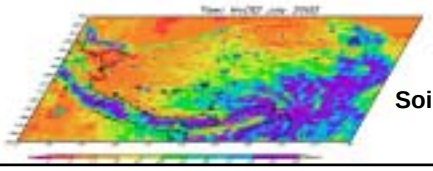
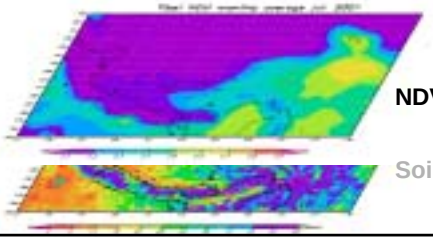
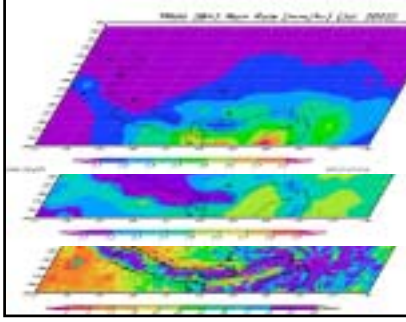


Soil Moisture



NDVI

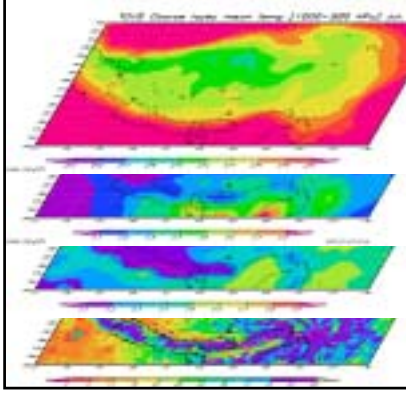
Soil Moisture



Rain Rate

NDVI

Soil Moisture

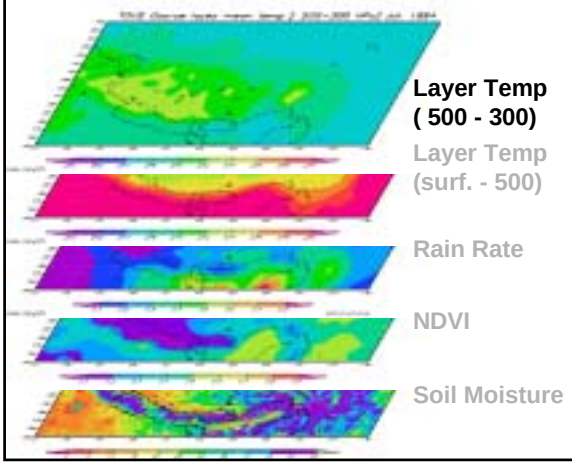


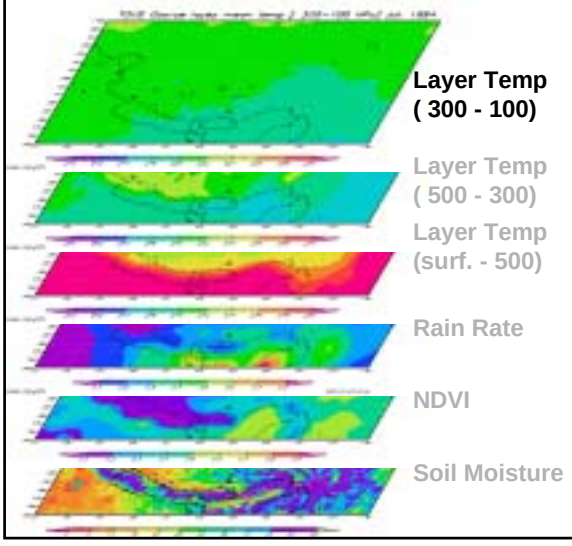
Layer Temp (surf. - 500)

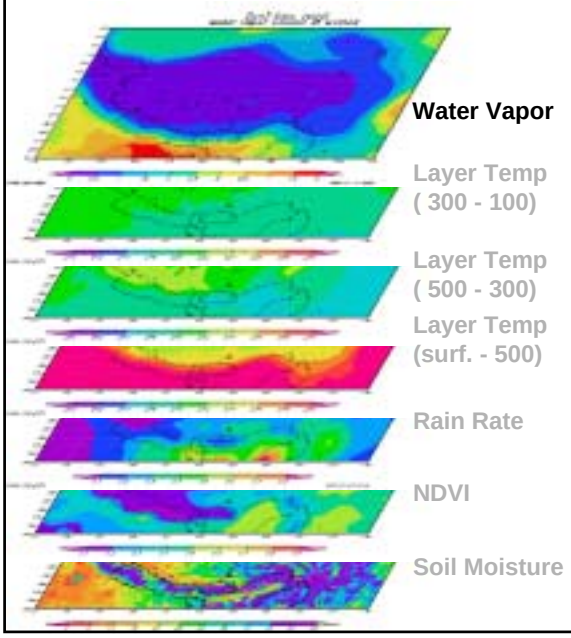
Rain Rate

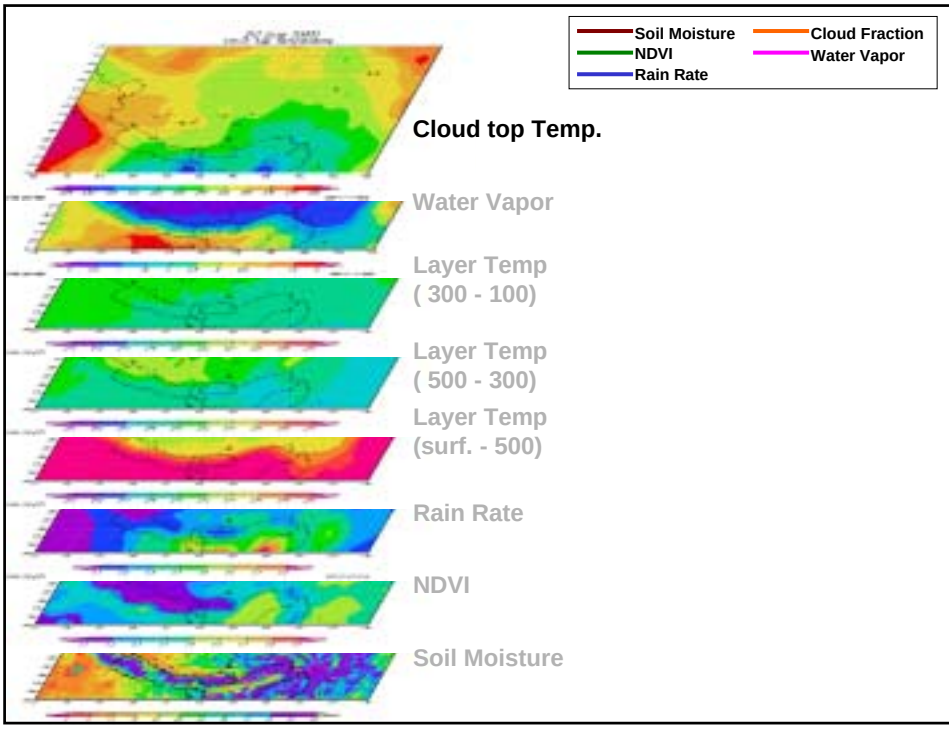
NDVI

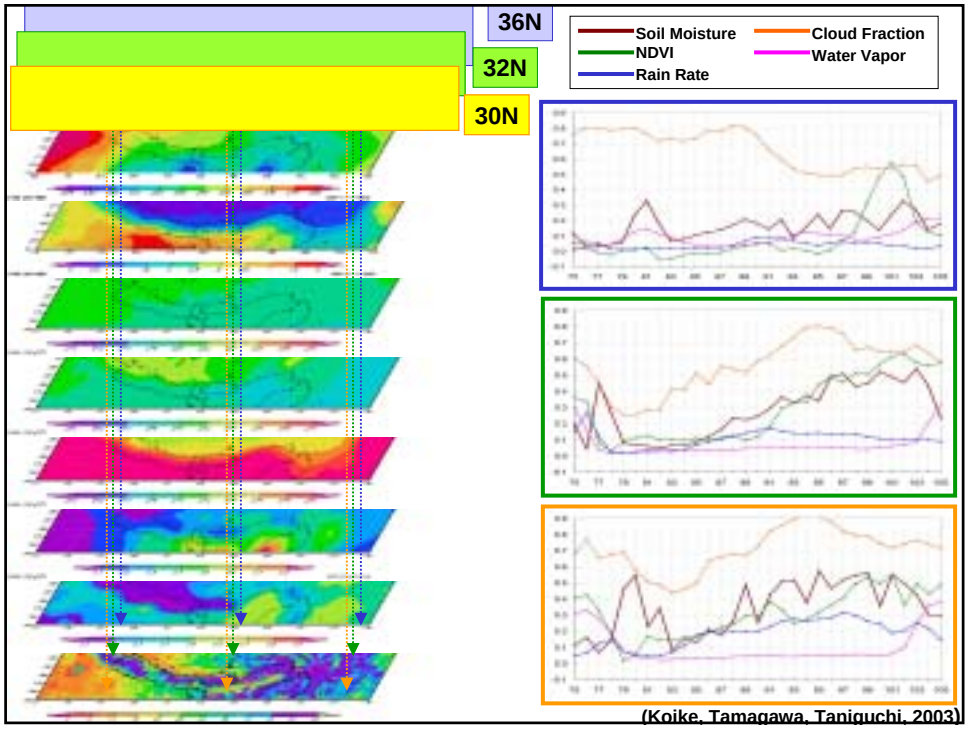
Soil Moisture


Layer Temp
(500 - 300)
Layer Temp
(surf. - 500)
Rain Rate
NDVI
Soil Moisture

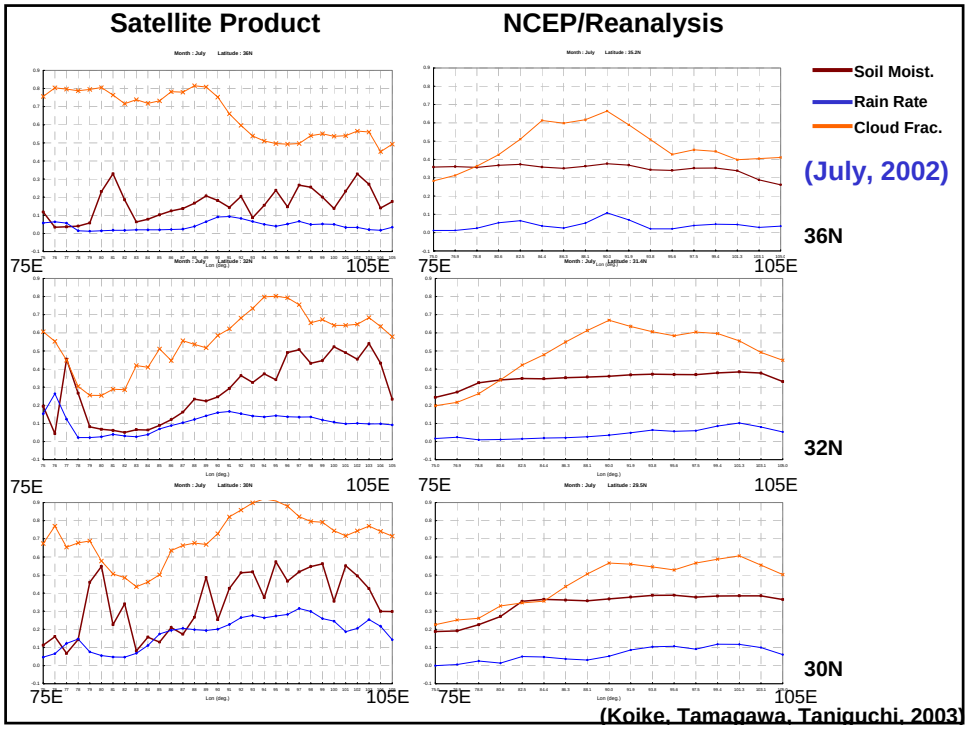

Layer Temp
(300 - 100)
Layer Temp
(500 - 300)
Layer Temp
(surf. - 500)
Rain Rate
NDVI
Soil Moisture


Water Vapor
Layer Temp
(300 - 100)
Layer Temp
(500 - 300)
Layer Temp
(surf. - 500)
Rain Rate
NDVI
Soil Moisture


Soil Moisture
Cloud Fraction
NDVI
Water Vapor
Rain Rate
Cloud top Temp.
Water Vapor
Layer Temp
(300 - 100)
Layer Temp
(500 - 300)
Layer Temp
(surf. - 500)
Rain Rate
NDVI
Soil Moisture

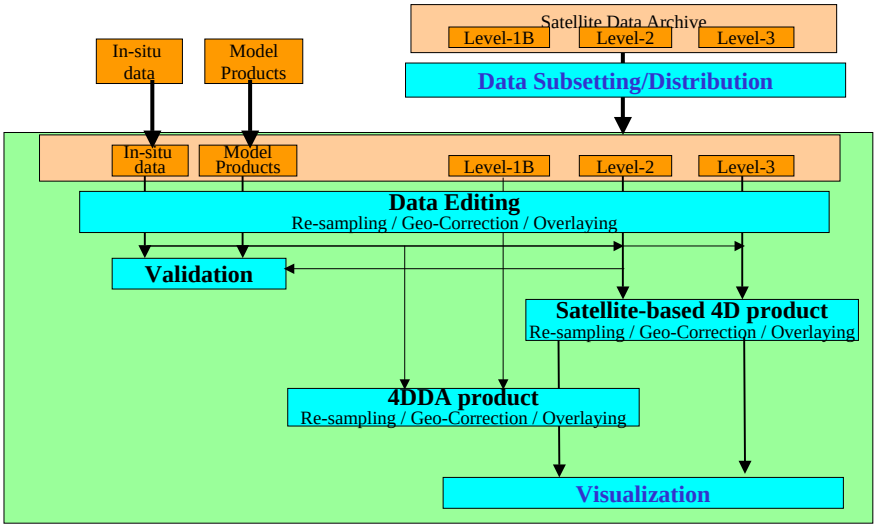


(Koike, Tamagawa, Taniguchi, 2003)



(Koike, Tamagawa, Taniguchi, 2003)

Data Set Integration



Coordinated Enhanced Observing Period (CEOP)

CEOP HP : http://www.ceop.net

CEOP Objectives:

1. Water and Energy-Cycle Simulation and Prediction
2. Monsoon System Studies

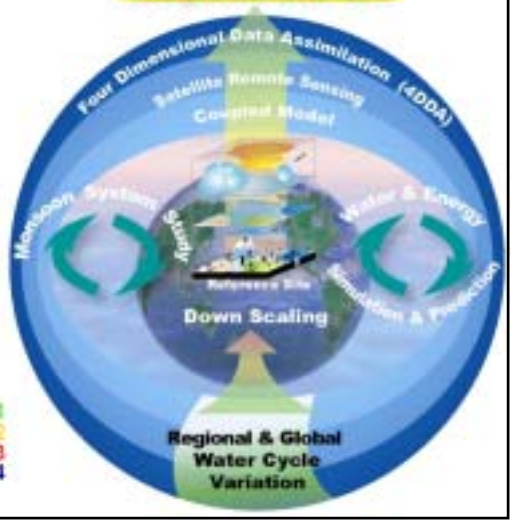
CEOP Strategy:

1. The first global integrated data sets of the water cycle with spatial consistency and climate variability, through
   - (i) the ground-based observations fro the 36 CEOP reference sites
   - (ii) the satellite observations of the entire water cycle
   - (iii) the simulations of numerical model with physical consistency
2. Challenges to inter-connection of regional water cycles and Down-scalin applications to water resources

CEOP Schedule:

EOP-1
EOP-2
EOP-3
EOP-4

Integrated Data Sets



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Cooperation with AMIP, GMPP, CLIVER….

Model Output Integration
Model Output Validation
Model Output Intercomparison