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Summary & Remarks

Session 1: Extreme Events: Detection

Professor Z. (Bob) Su
ITC, University of Twente
The Netherlands
z.su@utwente.nl
www.itc.nl/wrs

Hypothesis: **A marked increase in the frequency of extreme hydrologic events** during the past decades.

Present **Evidence on changes** in: precipitation, soil moisture, evapotranspiration, streamflow, water table, lake levels, agriculture, vegetation, and social-economic factors

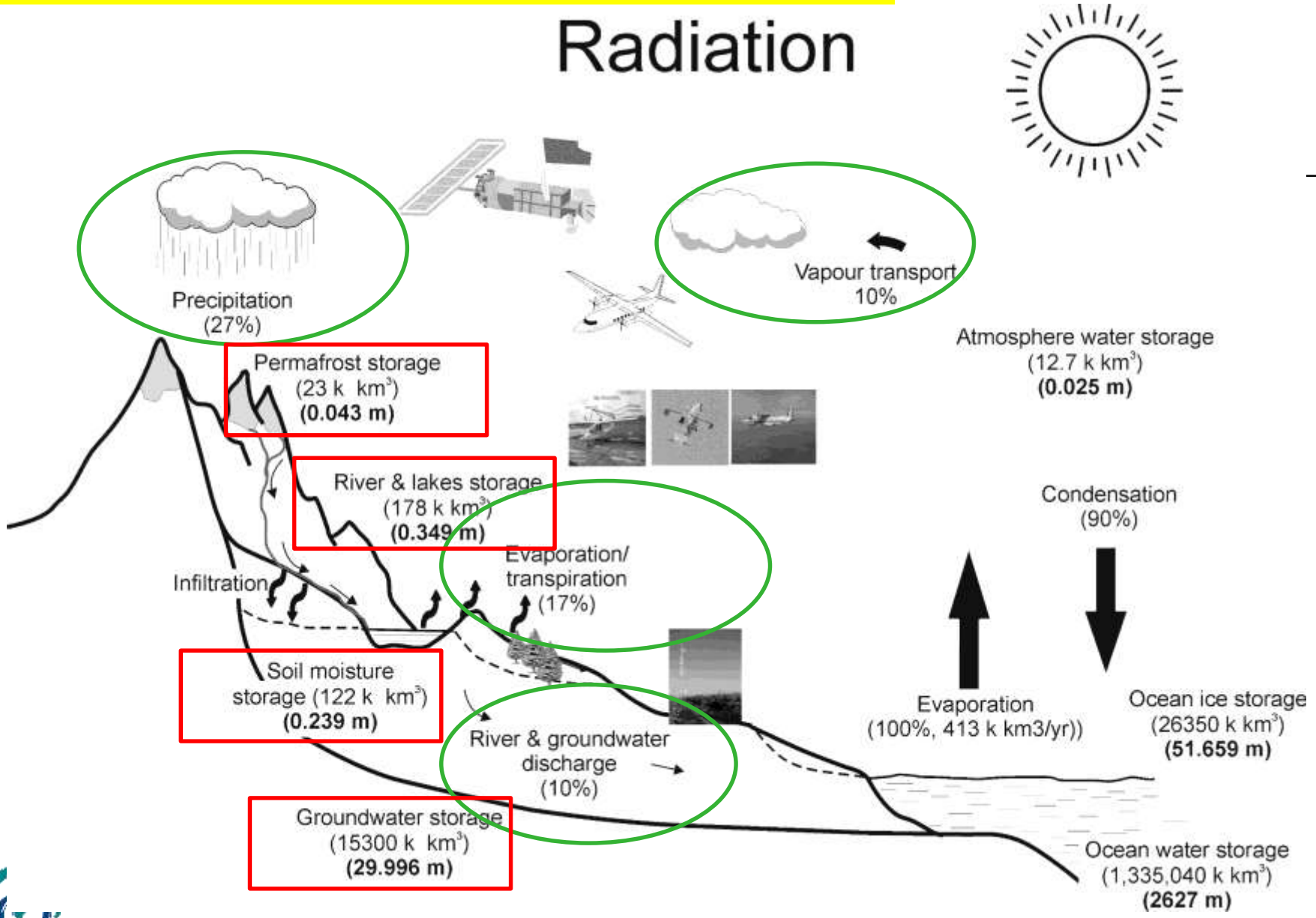
*Use **in situ*** **measurements, surveys, and satellite remote sensing** & document **errors in observations**

2 Keynotes: (M. Rodell, J. Nielsen-Gammon)
2 Orals
Posters (S1 &S2)

What are extreme events?
What are the relevant spatiotemporal scales?
What are the causes?

- GRACE & DA: Storages - Droughts/floods can be detected on monthly interval
- Bias correction: high res. SPI blend - detection of drought development
- Integration diff. system for flood monitoring & prediction
- Development of climate change adaptation measures
- Estimation of reservoir storages & monitoring soil moisture

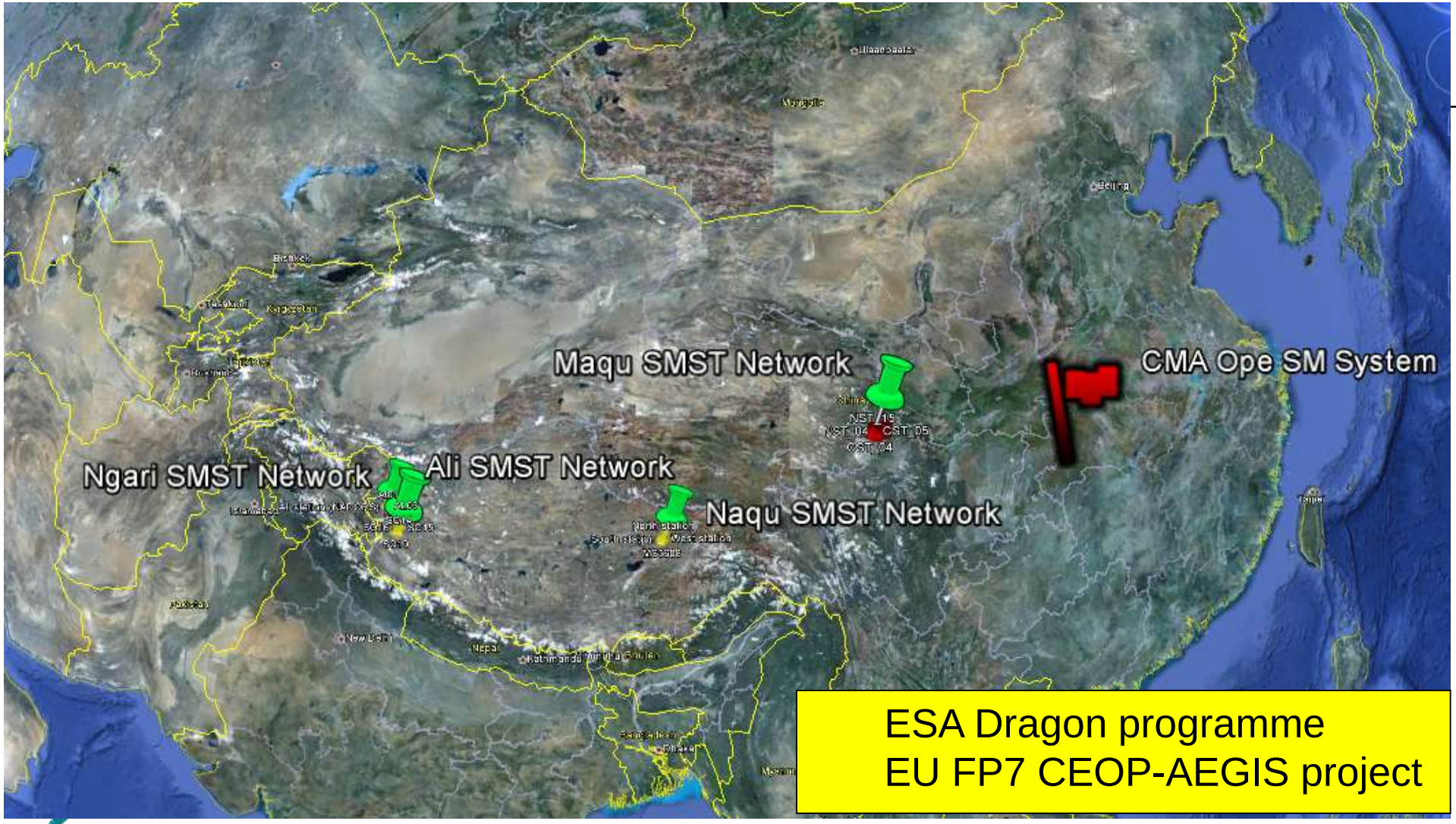
What are extreme events?



(Su, et al., 2010, Treatise on Water Science)

ITC GEO Soil Moisture Soil Temperature Networks

Tibetan Plateau observatory of plateau scale soil moisture and soil temperature (Tibet-Obs)



Su, Z., et al. 2011, HESS

ITC Earth Observation Research and Education Sites

The Role of the Tibetan Plateau in Global Climate

(Collaboration with Chinese Academy of Sciences)

GEWEX Asian Monsoon Experiment (GAME) on the Tibet Plateau (GAME/Tibet,1996-2000)

CEOP (Coordinated Enhanced Observing Period) Asia-Australia Monsoon Project on the Tibetan Plateau (CAMP/Tibet, 2001-2005)

Tibetan Observation and Research Platform (TORP, 2005 -2010)

Third Pole Environment (2009 -2019)
Coordinators: Y.Ma & T.Yao (ITP/CAS)

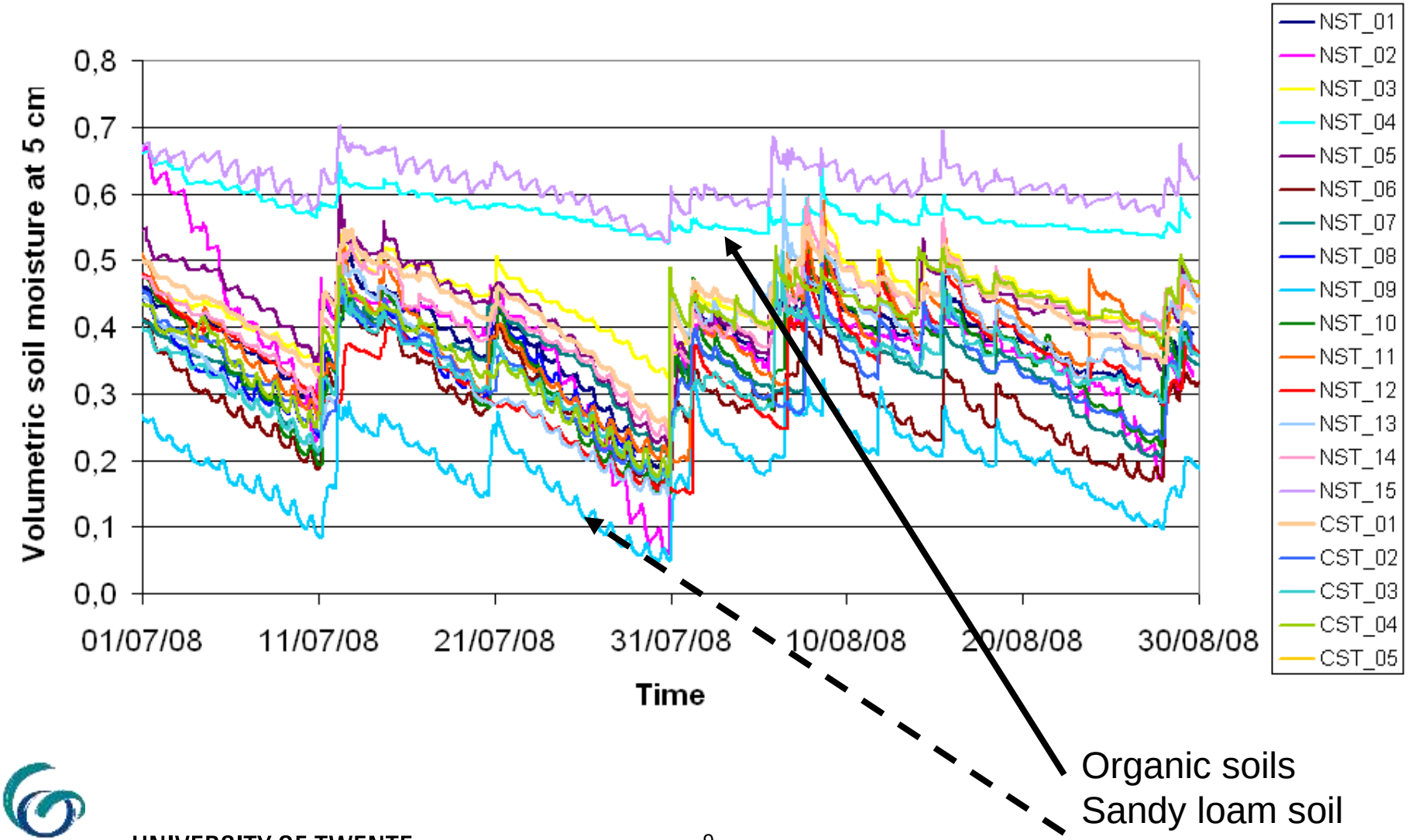
ESA Dragon programme
EU FP7 CEOP-AEGIS project

(Su, et al., 2011, HESS)

Maqu: station description

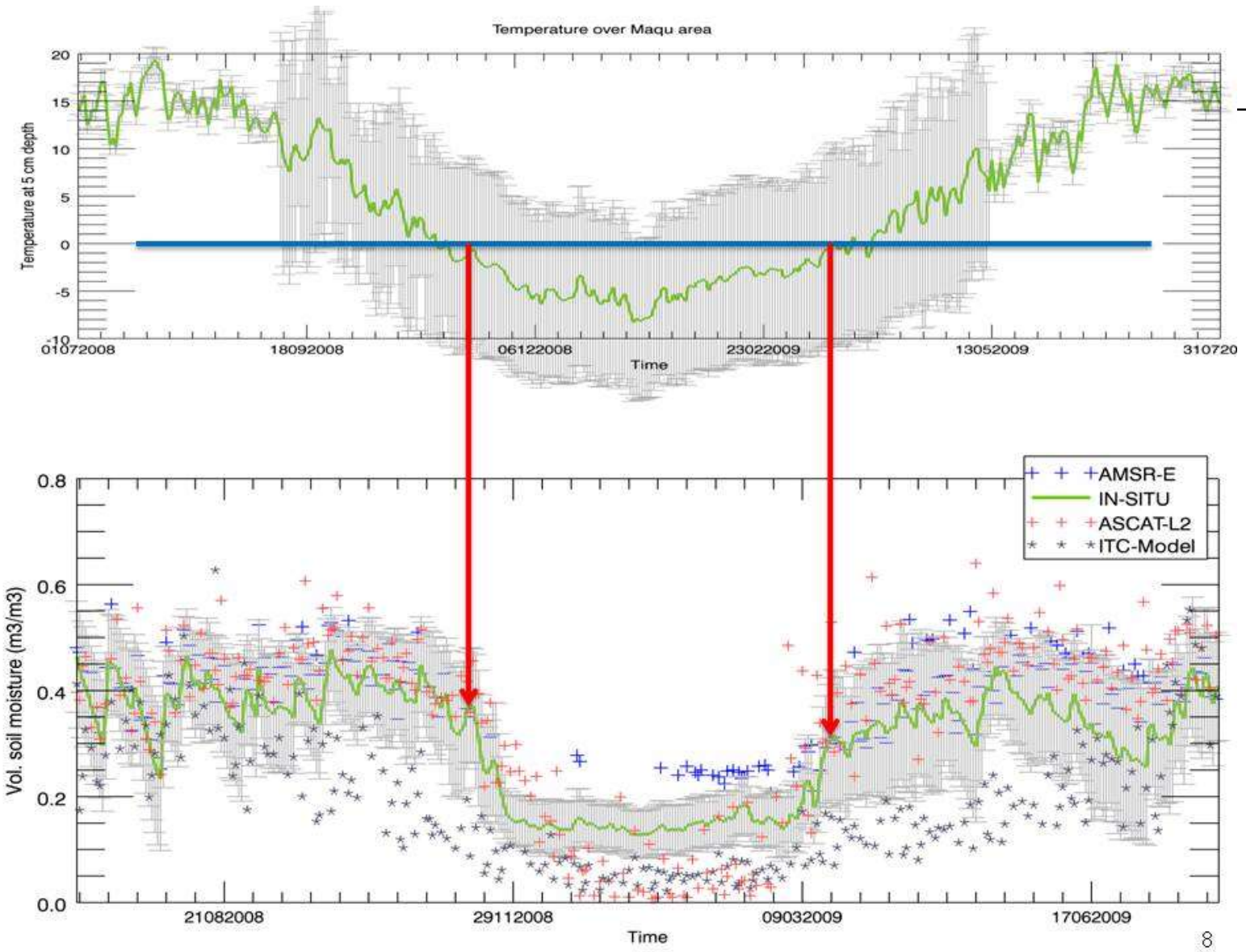
- 2/3 soil moisture & temperature probes
- 5, 10 & 20 cm deep (few profiles deep 80 cm)
- 1 datalogger
- data collected every 15 min
- memory capacity of 1 year
- completely buried
- site revisit to download data:
  - beginning and end of monsoon season in Maqu

Soil moisture at 5 cm depth of all the stations

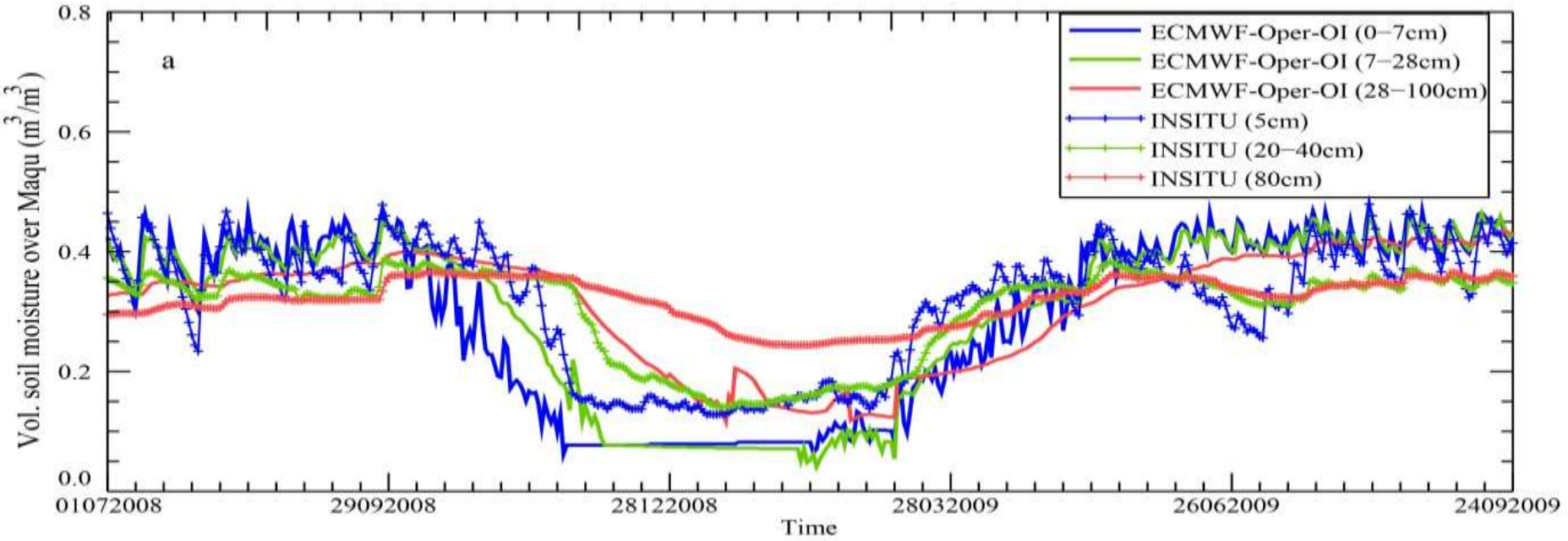


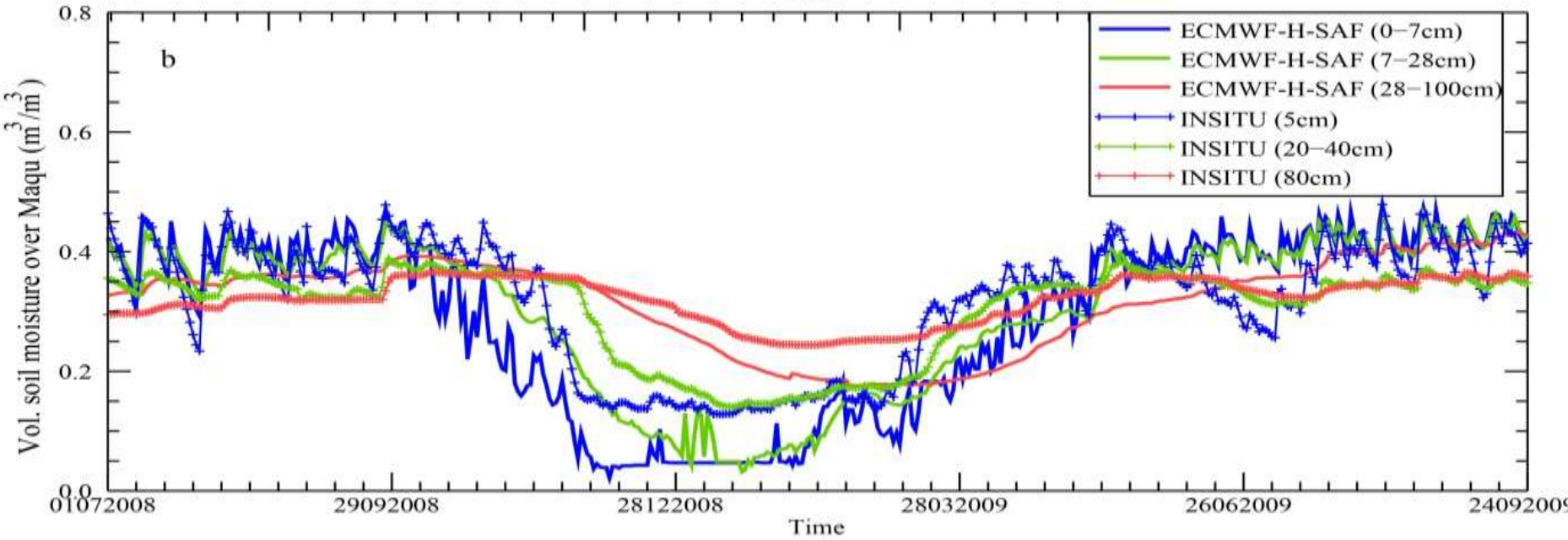
Quantification of uncertainties in global products

(Su, et al., 2011)

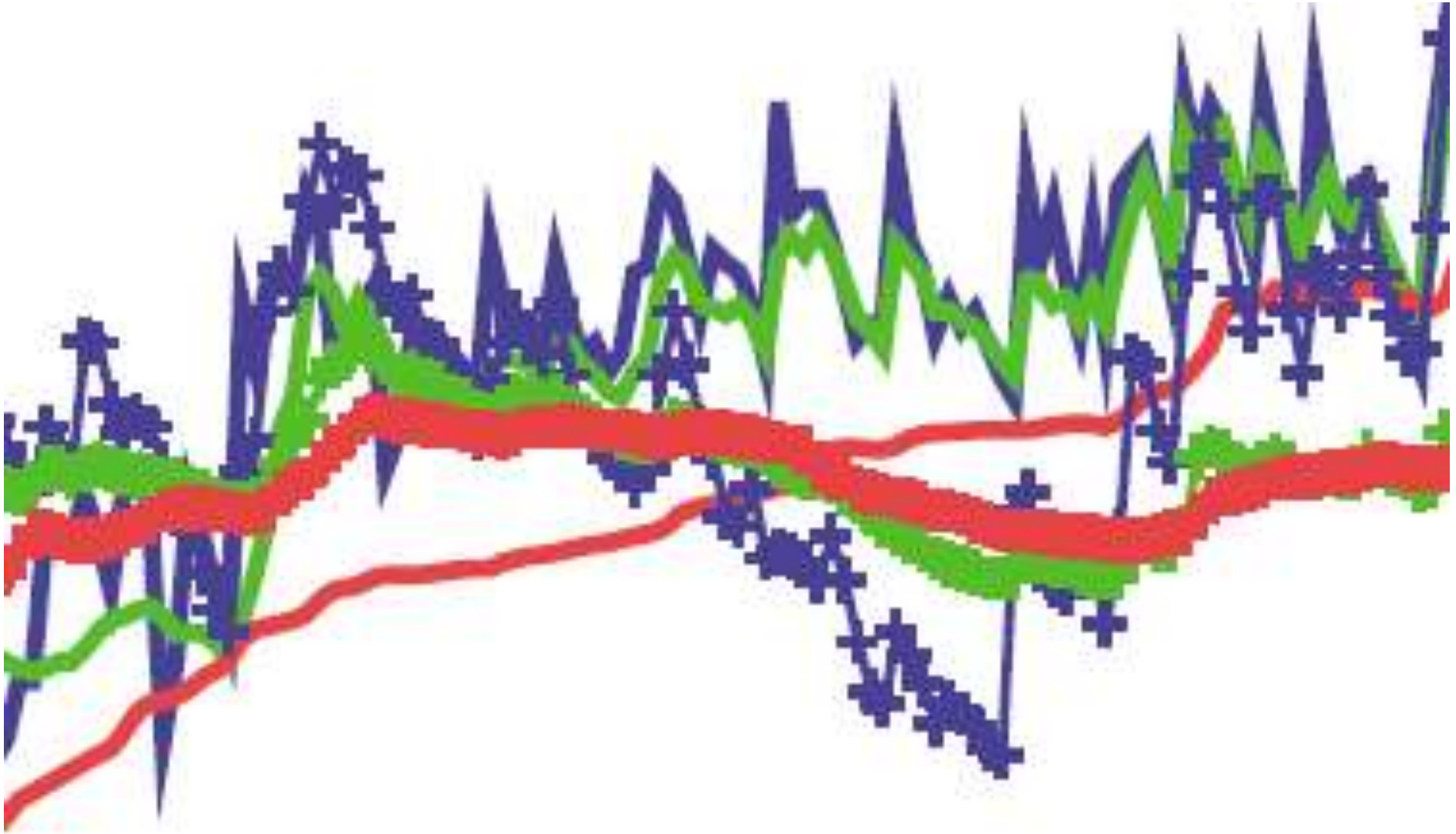


How good is soil moisture analysis/assimilation? (Su & de Rosnay, et al. 2013)





How good is soil moisture assimilation? An example in the Maqu area on Tibetan Plateau



(Su & de Rosnay, et al. 2013)

Noah LSM

N: National Centers for Environmental Prediction (NCEP)
O: Oregon State University (Dept of Atmospheric Sciences)
A: Air Force (both AFWA and AFRL - formerly AFGL, PL)
H: Hydrologic Research Lab - NWS (now Office of Hydrologic Dev -- OHD)

Characteristic for the Noah LSM is that it provides a complete description of the physical processes using a limited number of parameters.

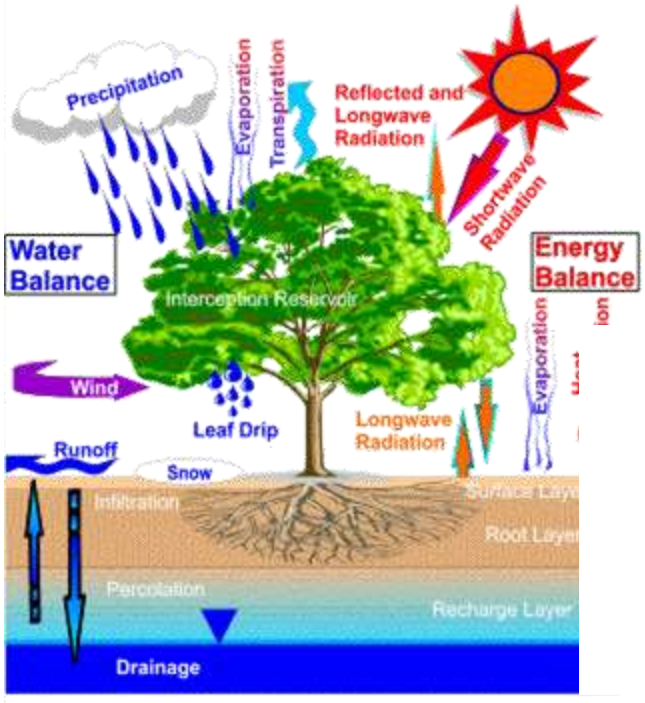
- Soil water flow;
- Soil heat flow;
- Heat exchange with the atmosphere;

(Zheng et al., 2013, JHM; 2014a,b,c in prep.)

- Snow pack.

(Malik et al., 2012, JHM; JGR, 2013; RSE, 2011)

- Frozen soil; ???



An Improved Two-layer Algorithm for Estimating Effective Soil Temperature using L-band Radiometry (Lv et al., 2013, RSE)

$$T_B = \varepsilon T_{eff}$$

$$T_{eff} = \int_0^{\infty} T(x)\alpha(x)\exp\left[-\int_0^{x} a(x')dx'\right]dx$$ (Ulaby et al. 1978; 1979)

$$\alpha(x) = \frac{4\pi}{\lambda}\varepsilon''(x) \Big/ 2\left[\varepsilon'(x)\right]^{\frac{1}{2}}$$ (Wilheit 1978)

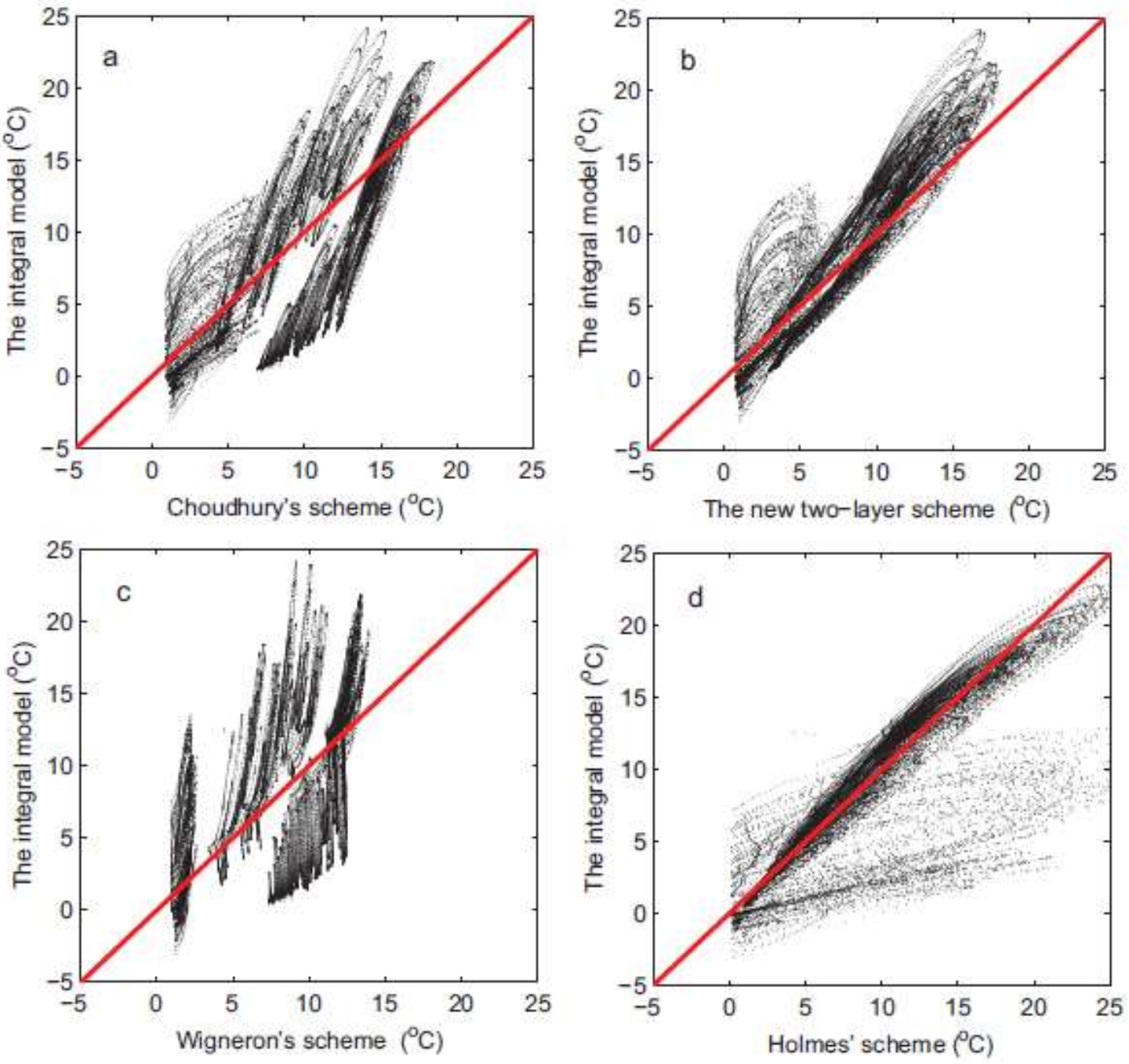
A two-layer system:

$$T_{eff} = T_0\left(1 - e^{-B_0}\right) + T_{\infty}e^{-B_0}$$

$$B_0 = \alpha_1 x_1$$

$$B_0 = \Delta x \cdot \frac{4\pi}{\lambda} \cdot \frac{\varepsilon''}{2\sqrt{\varepsilon'}}$$

$$C = 1 - e^{-B_0}$$
$$= 1 - \exp\left(-\Delta x \alpha_1\right)$$
$$= 1 - \exp\left(-\Delta x \cdot \frac{4\pi}{\lambda} \cdot \frac{\varepsilon''}{2\sqrt{\varepsilon'}}\right)$$

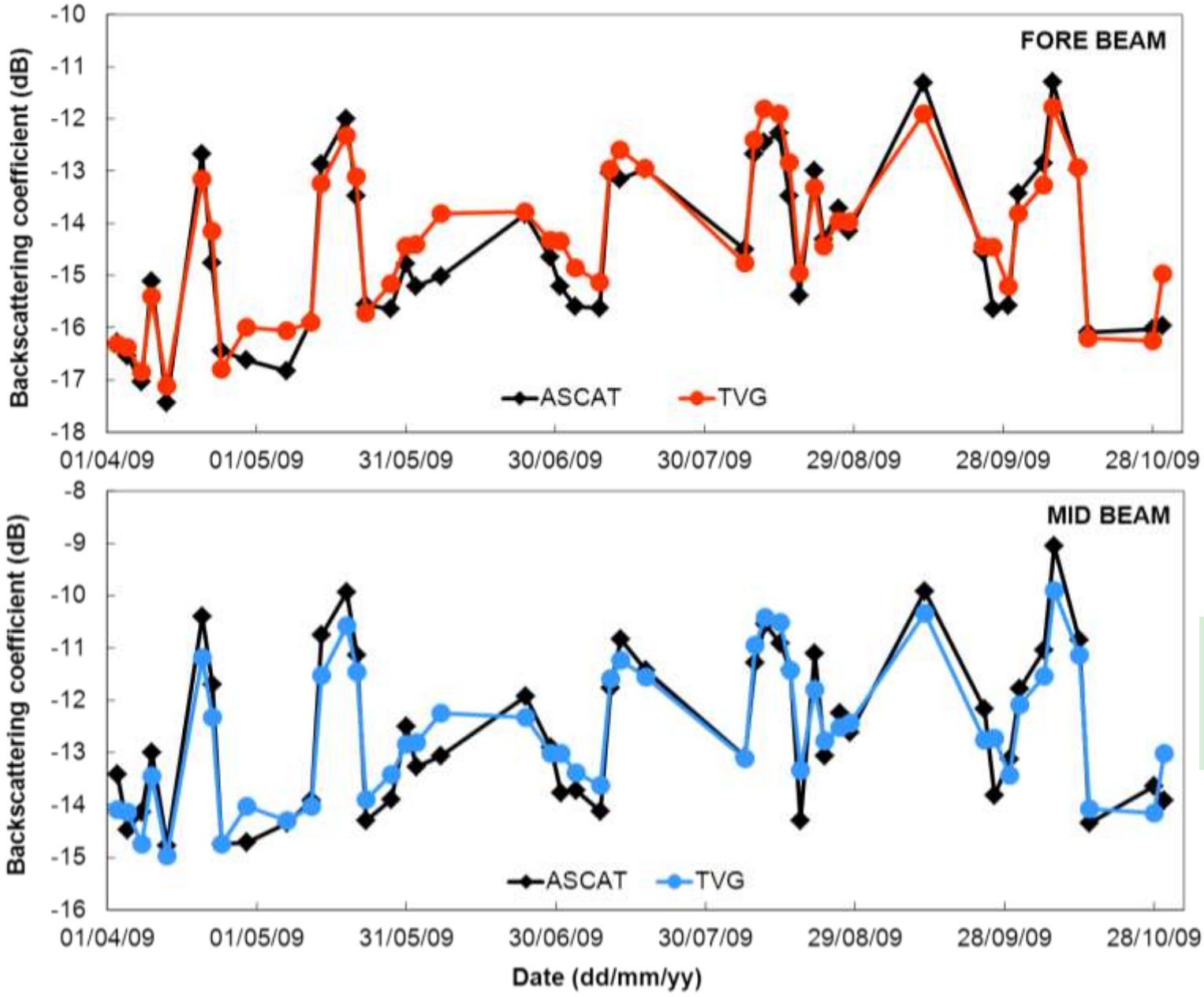

a
The integral model (°C)
Choudhury's scheme (°C)
b
The integral model (°C)
The new two−layer scheme (°C)
c
The integral model (°C)
Wigneron's scheme (°C)
d
The integral model (°C)
Holmes' scheme (°C)

SMAP – Simultaneous Modeling Of Active And Passive Microwave Signatures

- To use a single discrete scattering model to simulate both emission and backscattering, with a unique set of input parameters
- To combine the use of active and passive microwave satellite signatures to constrain the model
- To contribute to an optimal use of SMAP-like data
- To improve the soil moisture retrieval

L. Dente, P. Ferrazzoli, Z. Su, R. van de Velde, L. Guerriero, 2013, Combined use of active and passive microwave satellite data to constrain a discrete scattering model, RSE, In press

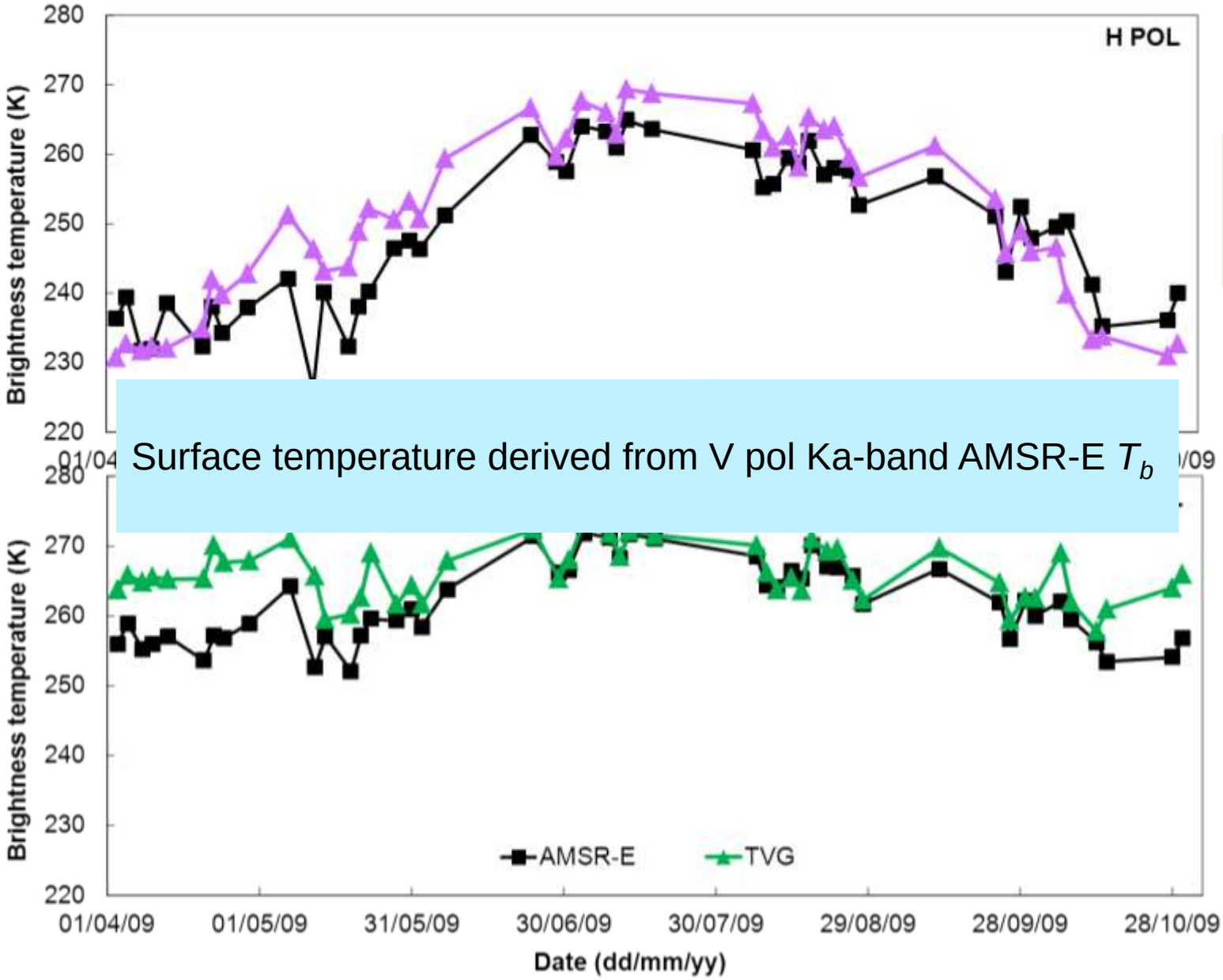
RESULTS: MODEL CALIBRATION (2009) – ACTIVE CASE



R^2 = 0.9
rmse = 0.5 dB
bias = 0.2 dB

R^2 = 0.9
rmse = 0.5 dB
bias = -0.04 dB

RESULTS: MODEL CALIBRATION (2009) – PASSIVE CASE (1)

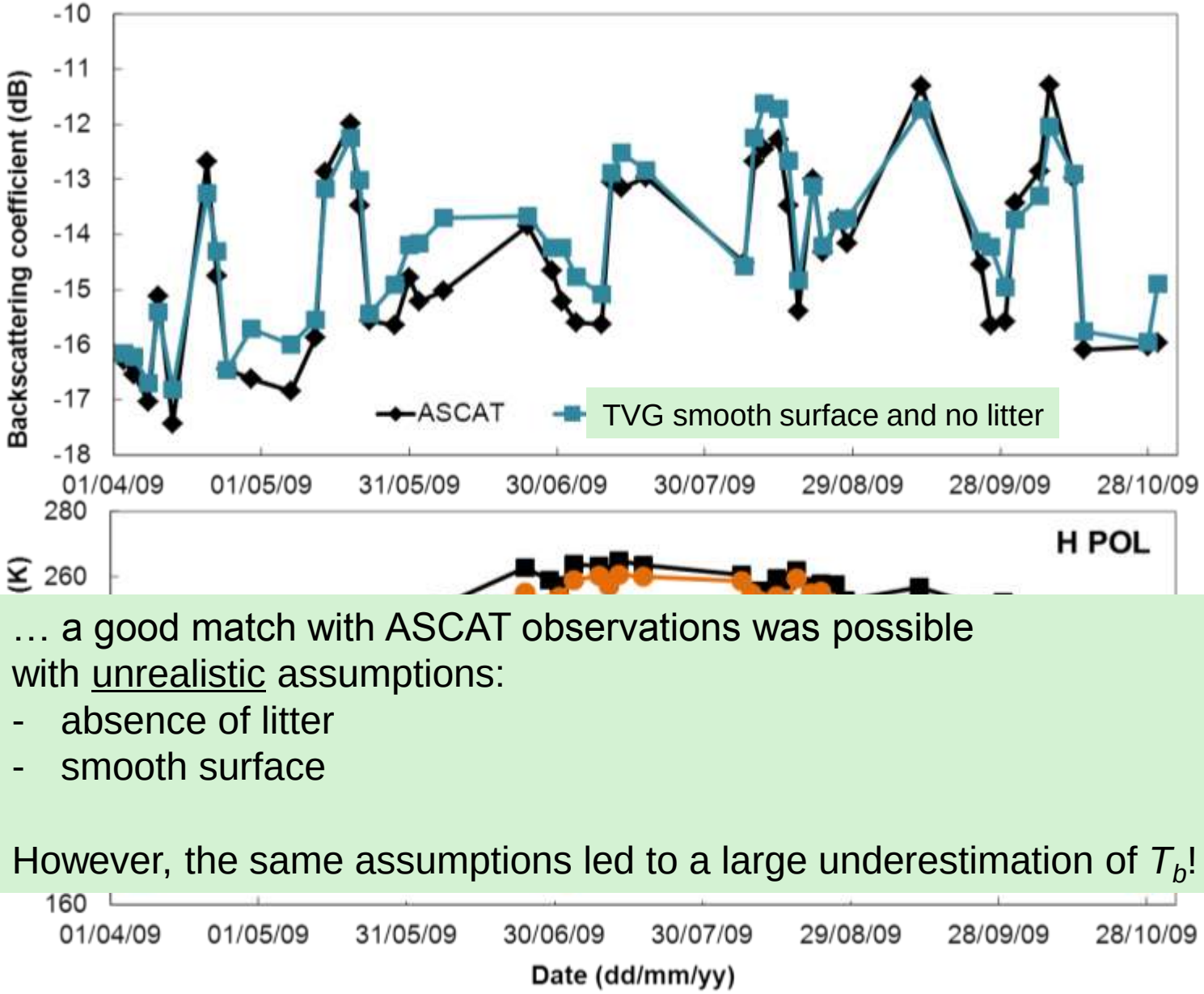


Surface temperature derived from V pol Ka-band AMSR-E T_b

R^2 = 0.8
rmse = 6.3 K
bias = 2.7 K

R^2 = 0.5
rmse = 5.9 K
bias = 4.3 K

IF ONLY THE ACTIVE MICROWAVE DATA WERE USED …



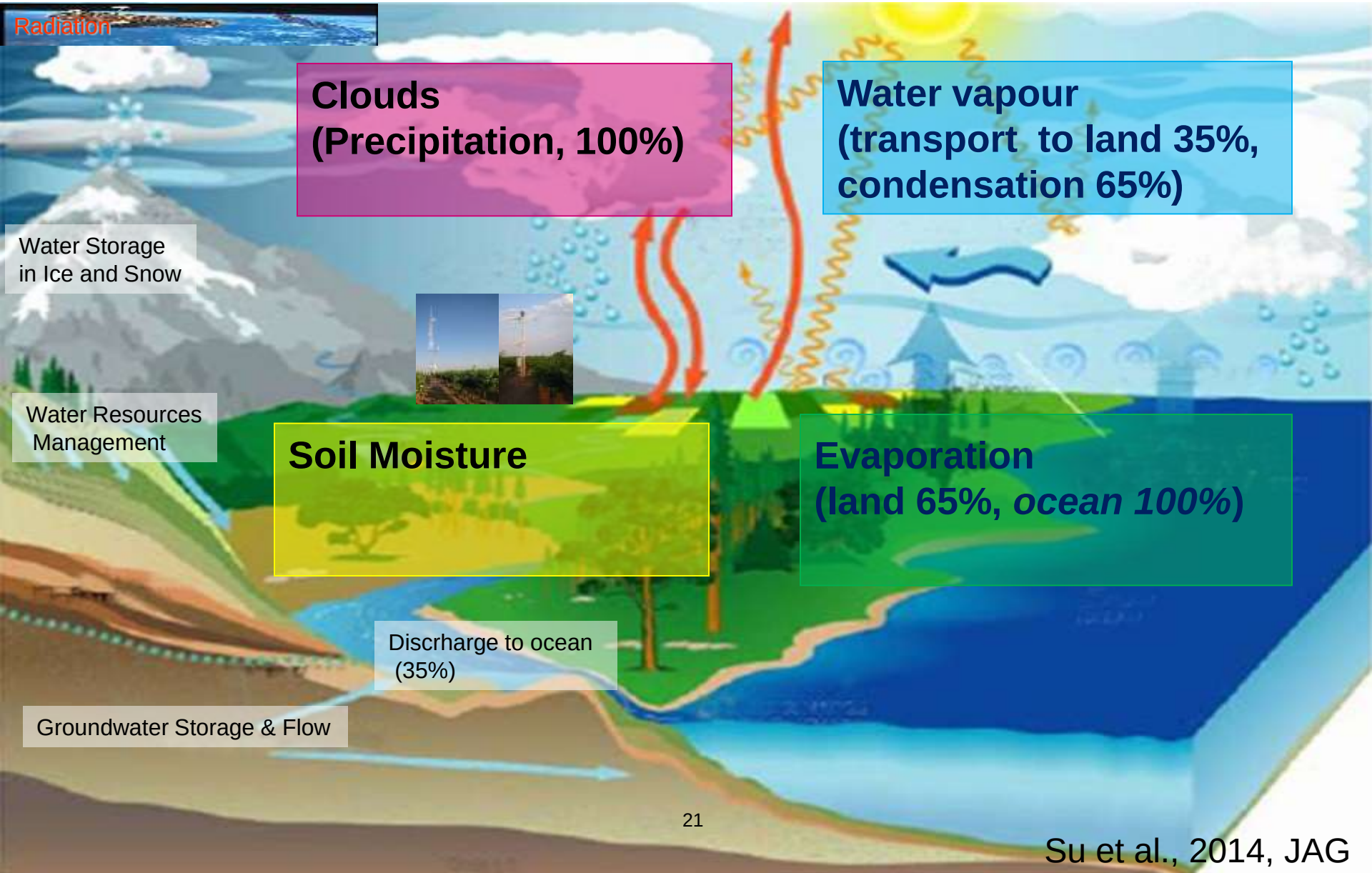
… a good match with ASCAT observations was possible with <u>unrealistic</u> assumptions:

- absence of litter
- smooth surface

However, the same assumptions led to a large underestimation of T_b!

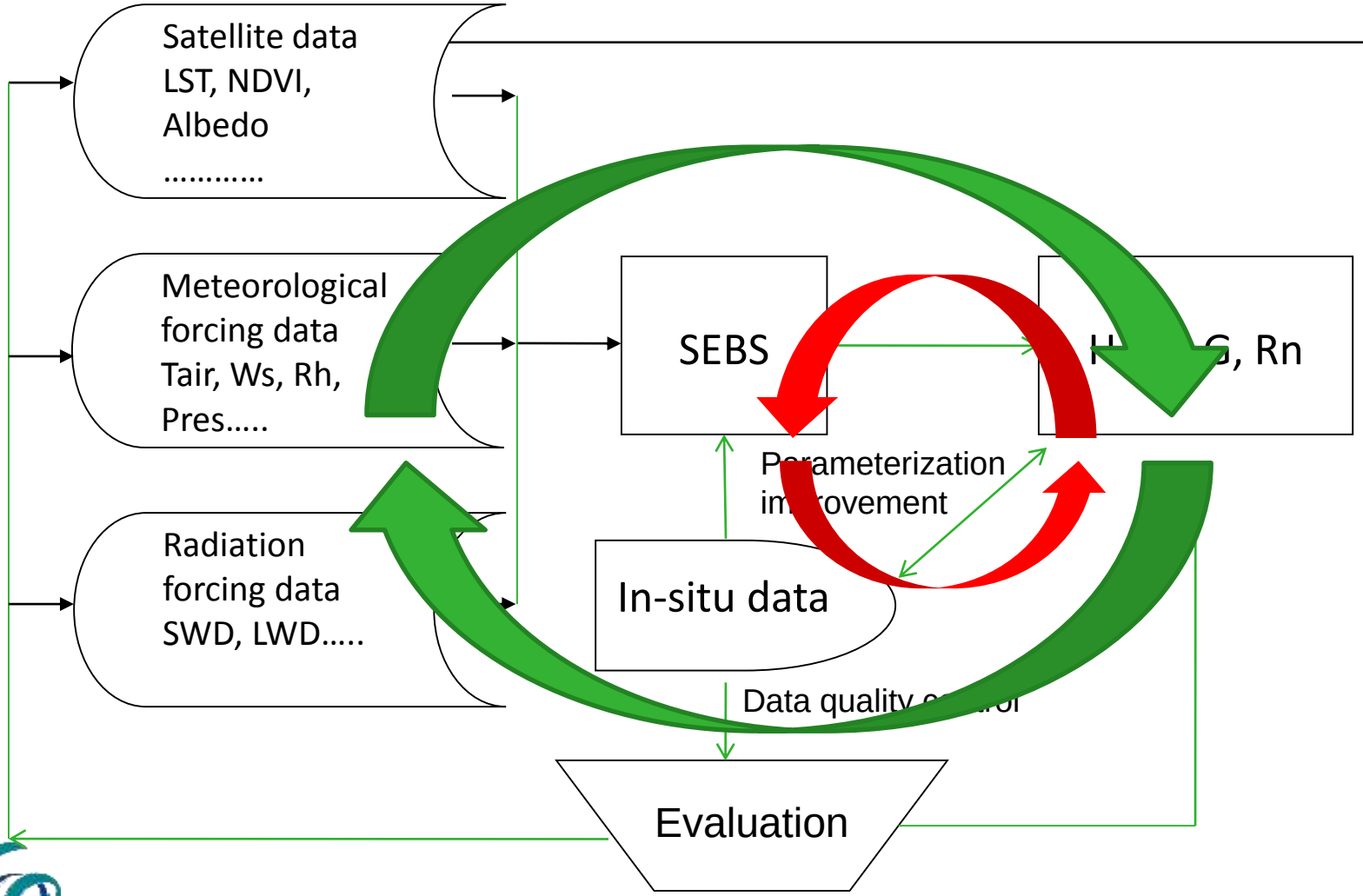
ESA STSE programme:

Water Cycle Multimission Observation Strategy (WACMOS)



Su et al., 2014, JAG

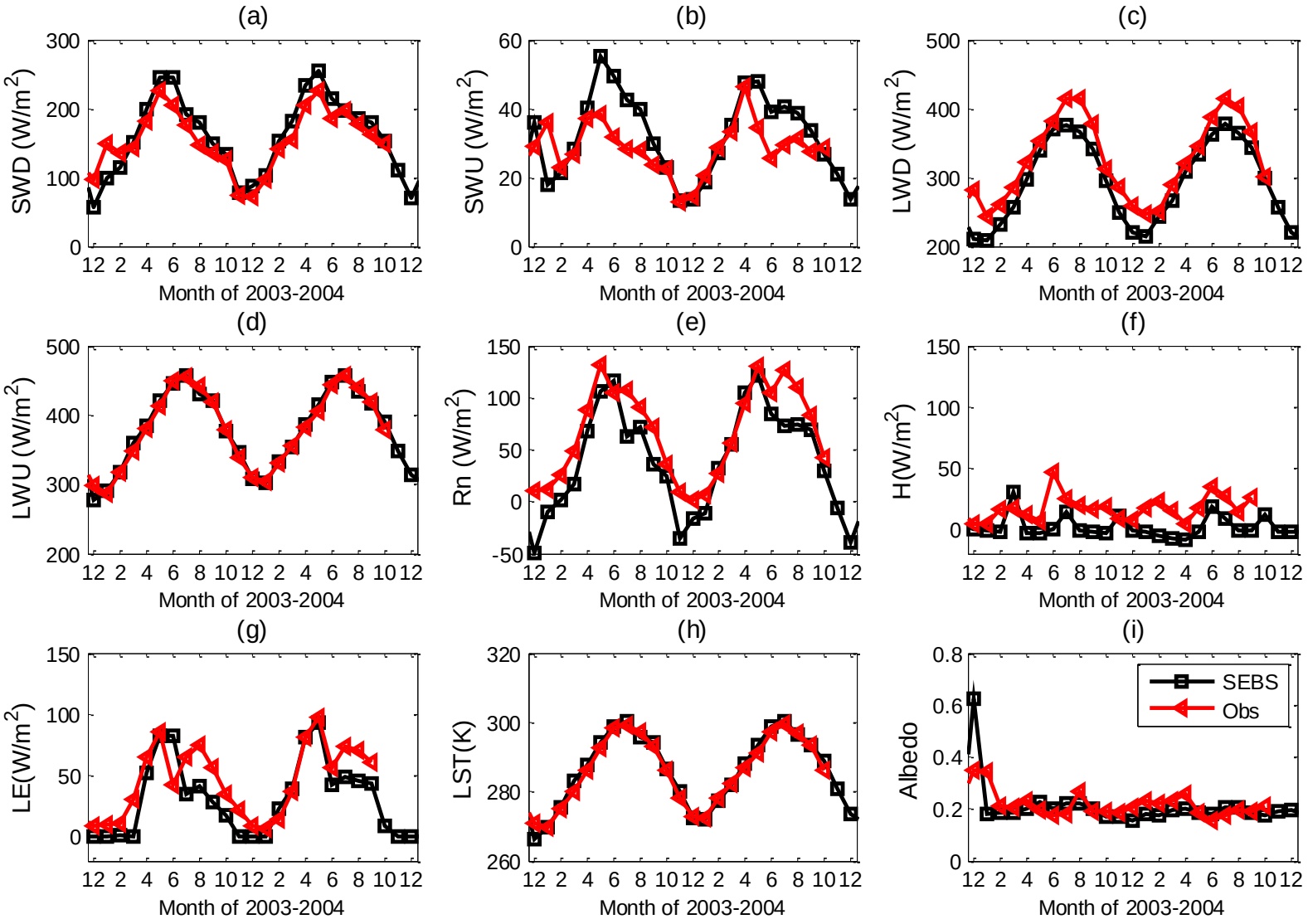
Can we observe the spatiotemporal distributions of actual land surface energy balance terms and ET?



(Processing chain developed in ESA WACMOS.org project, Su et al., 2014, JAG)

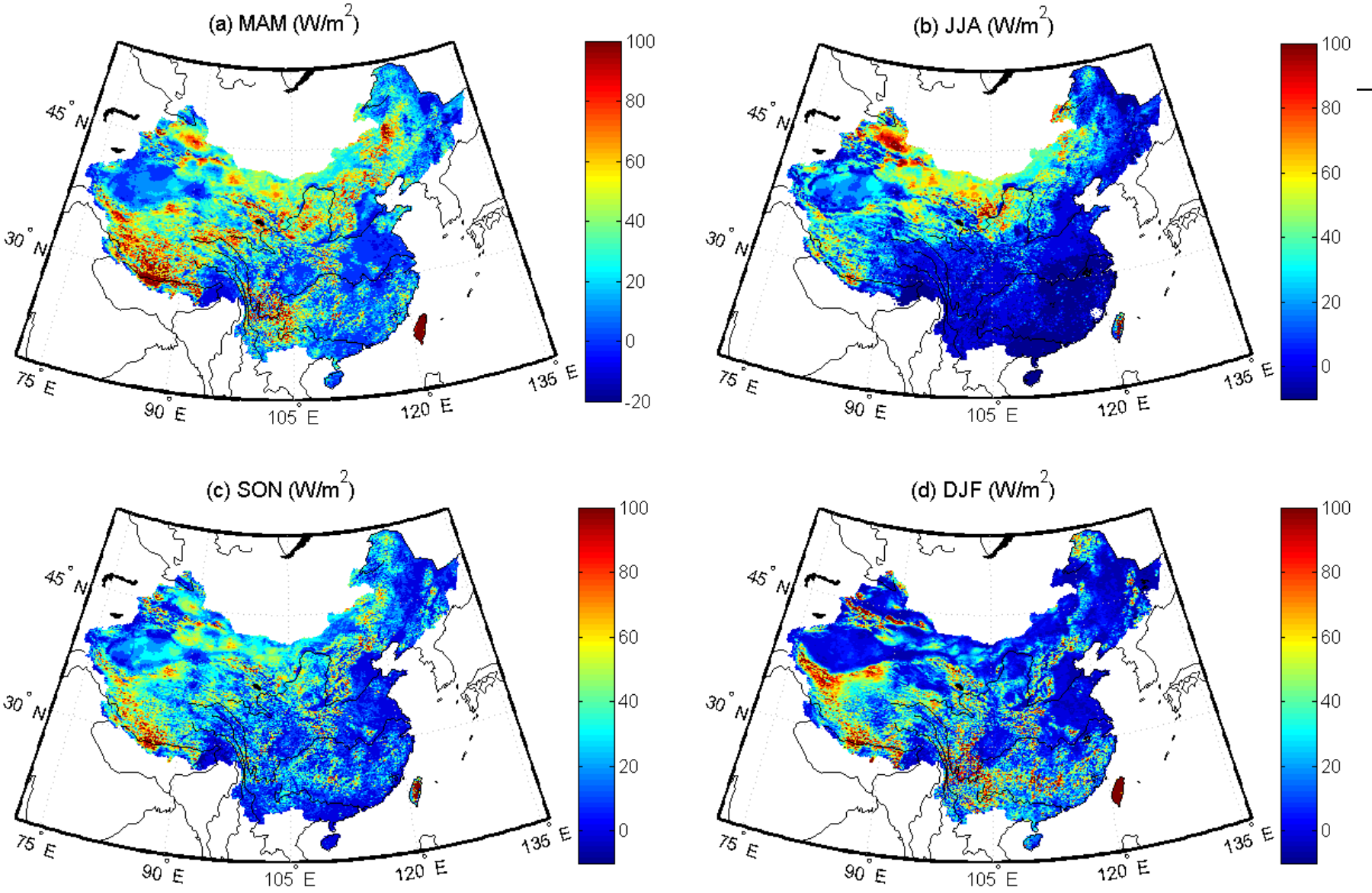
SEBS input and output variables vs measurement at Yucheng station

winter wheat and summer maize

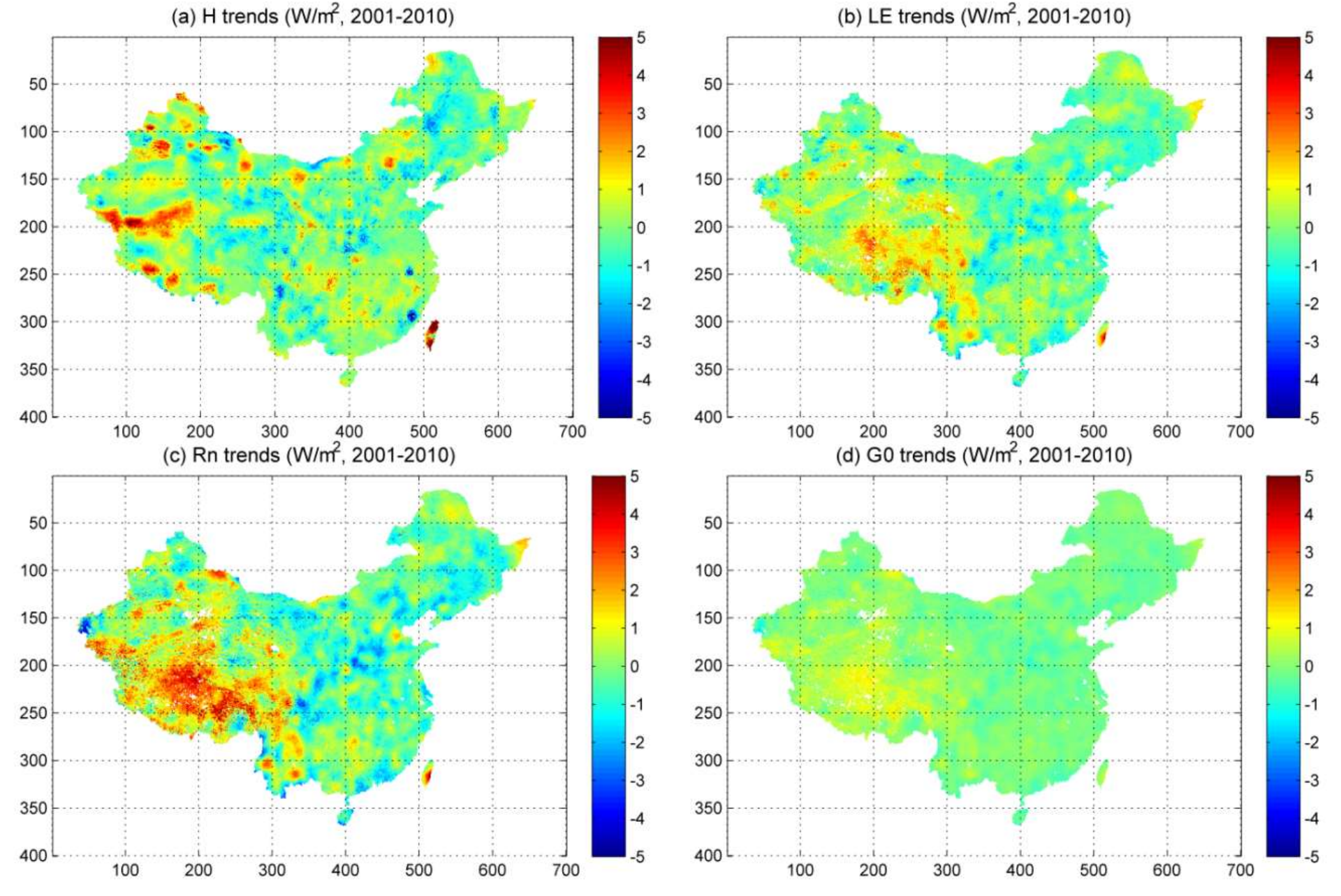


Seasonal average maps of sensible heat flux (H)

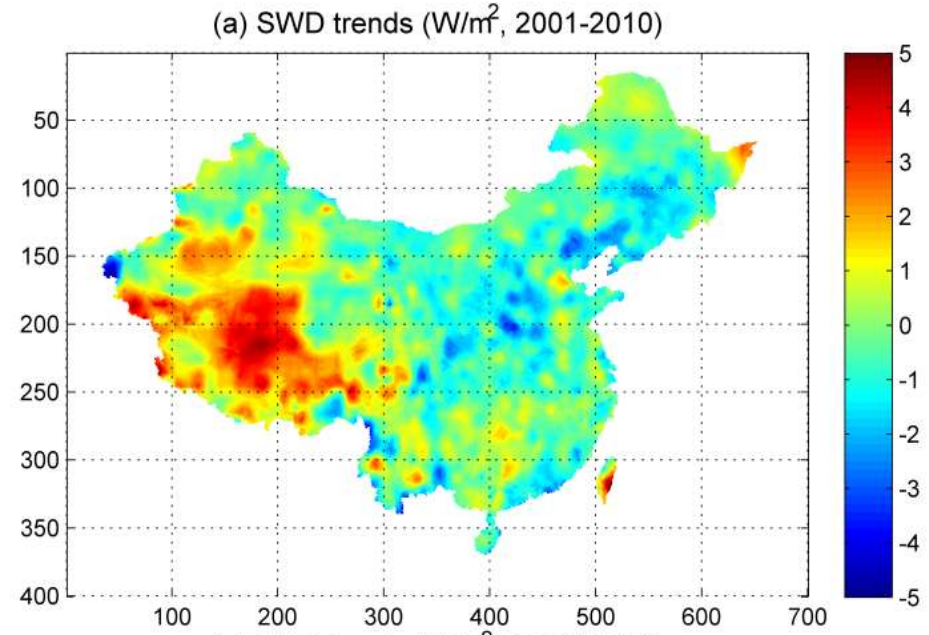
(a) Mar-May, (b) Jun-Aug,(c) Sep-Nov, (d) Dec-Feb

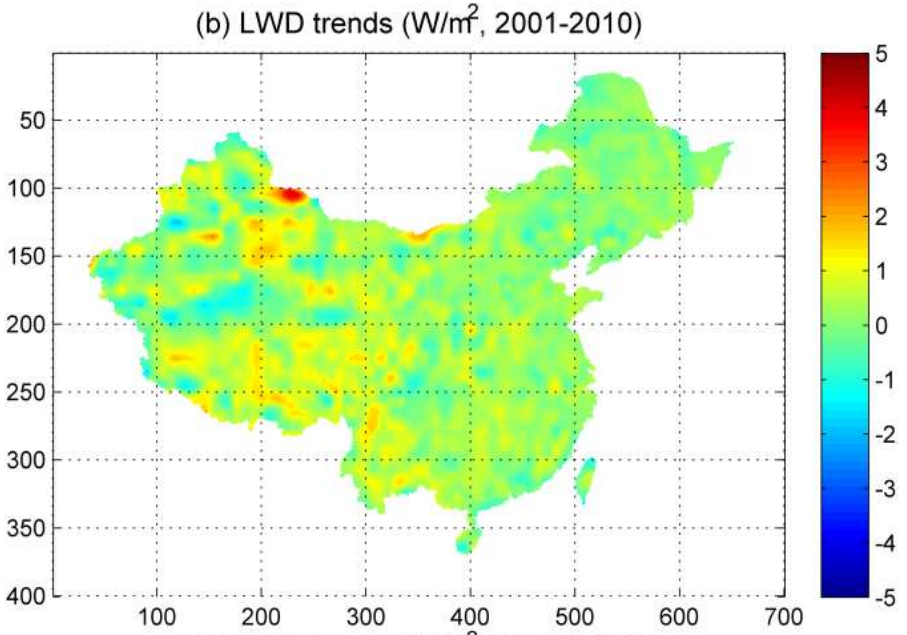


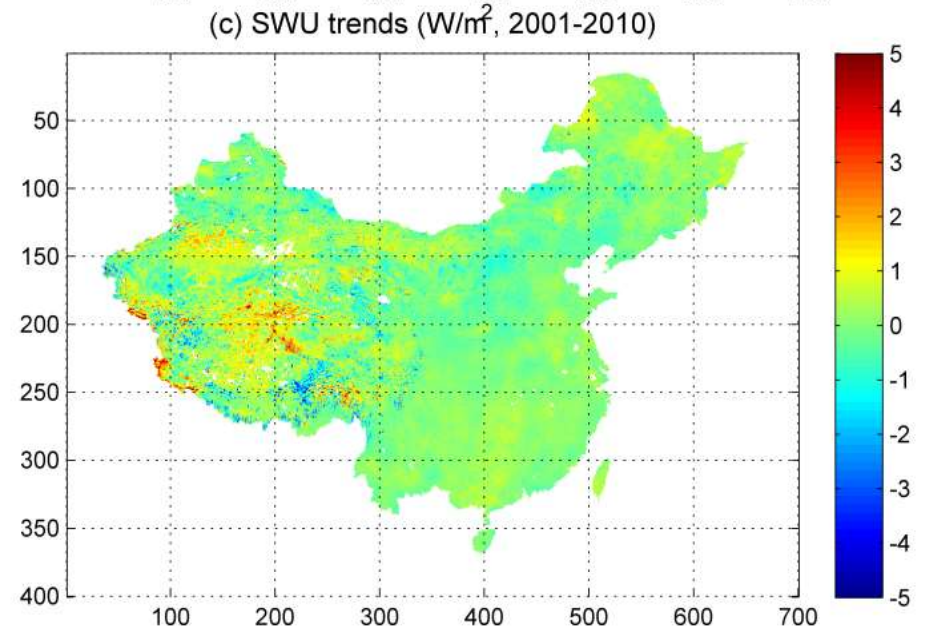
Spatiotemporal (climatic?) trends

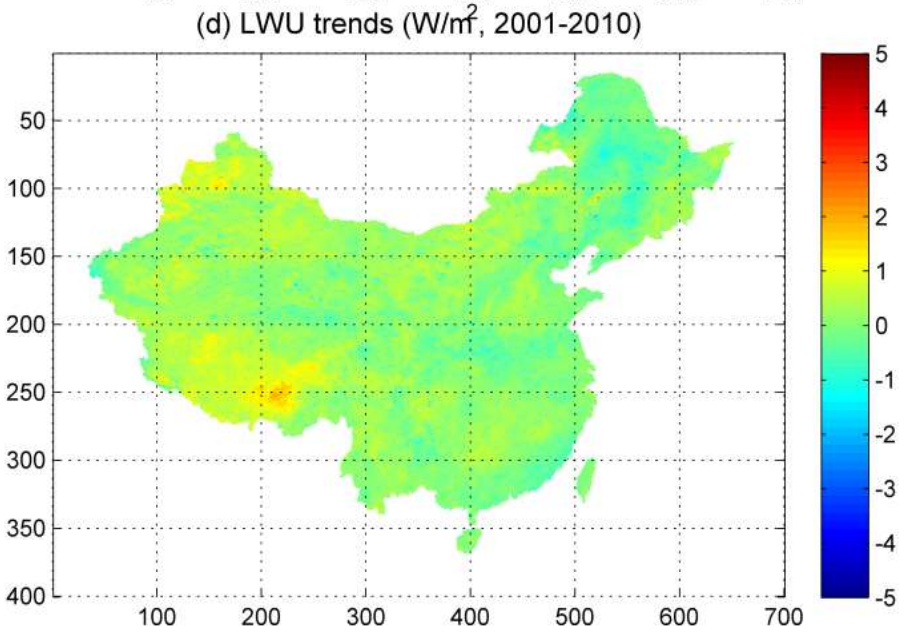


Spatiotemporal (climatic?) trends

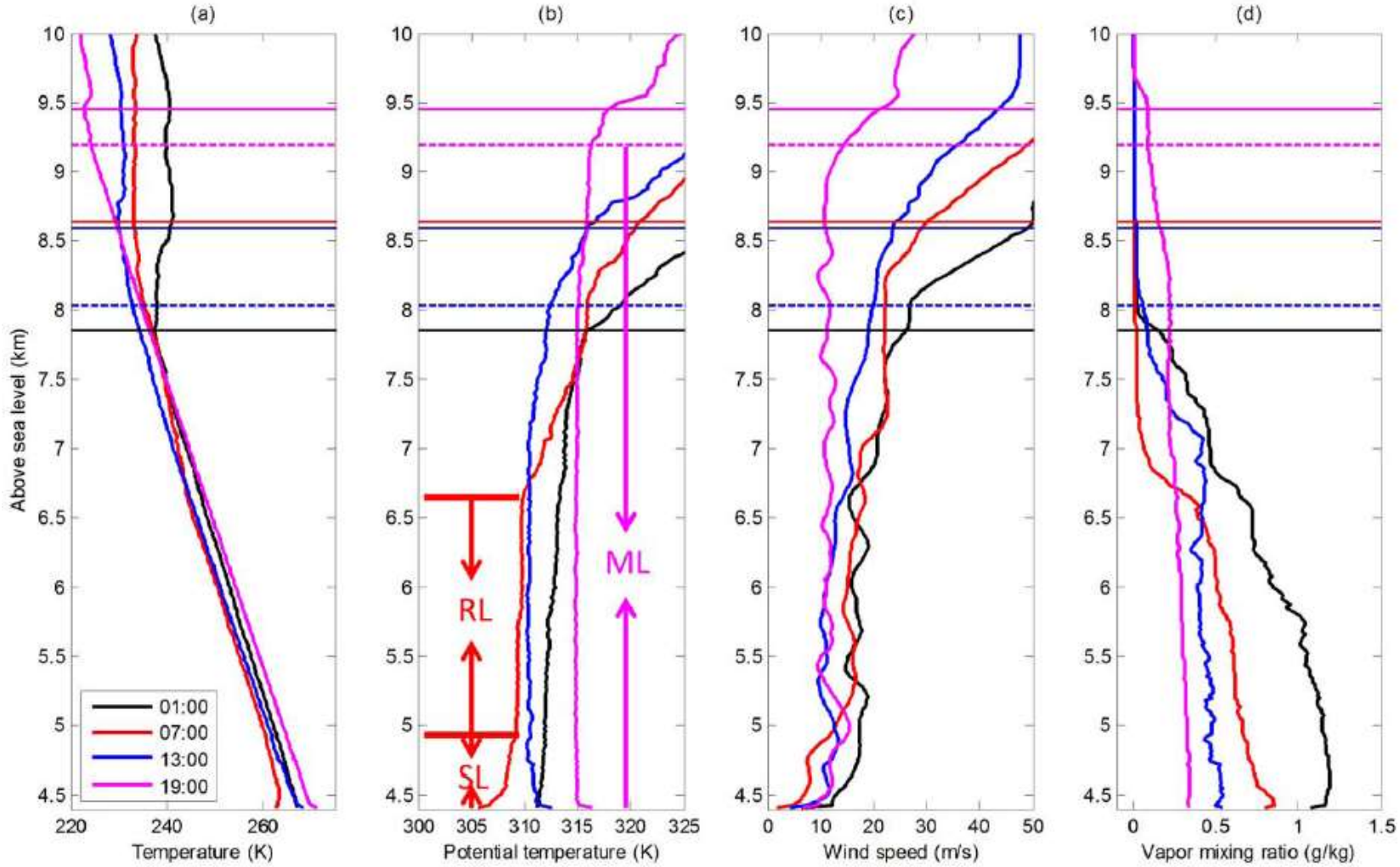








What is the characteristics of PBL on Tibetan Plateau



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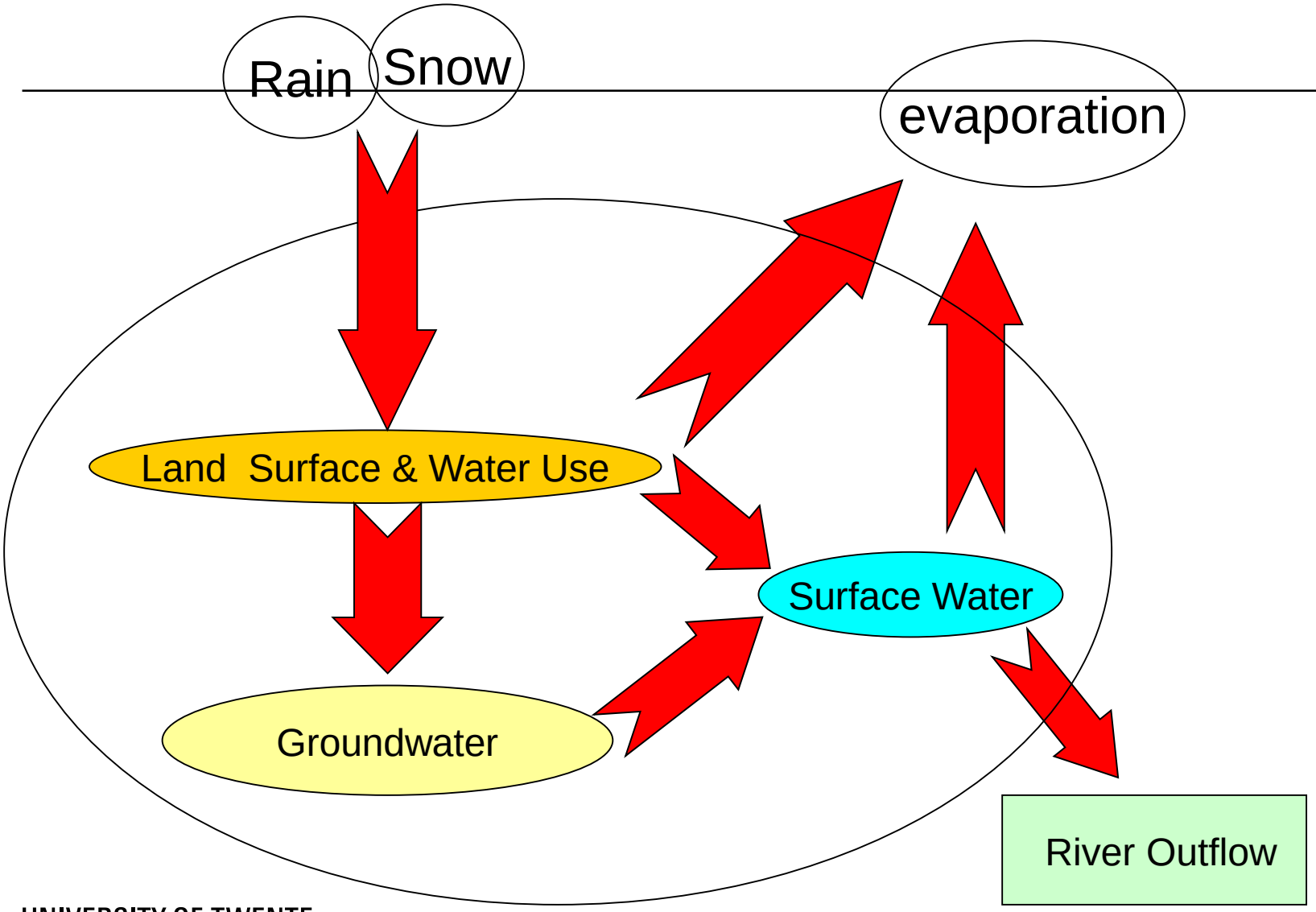
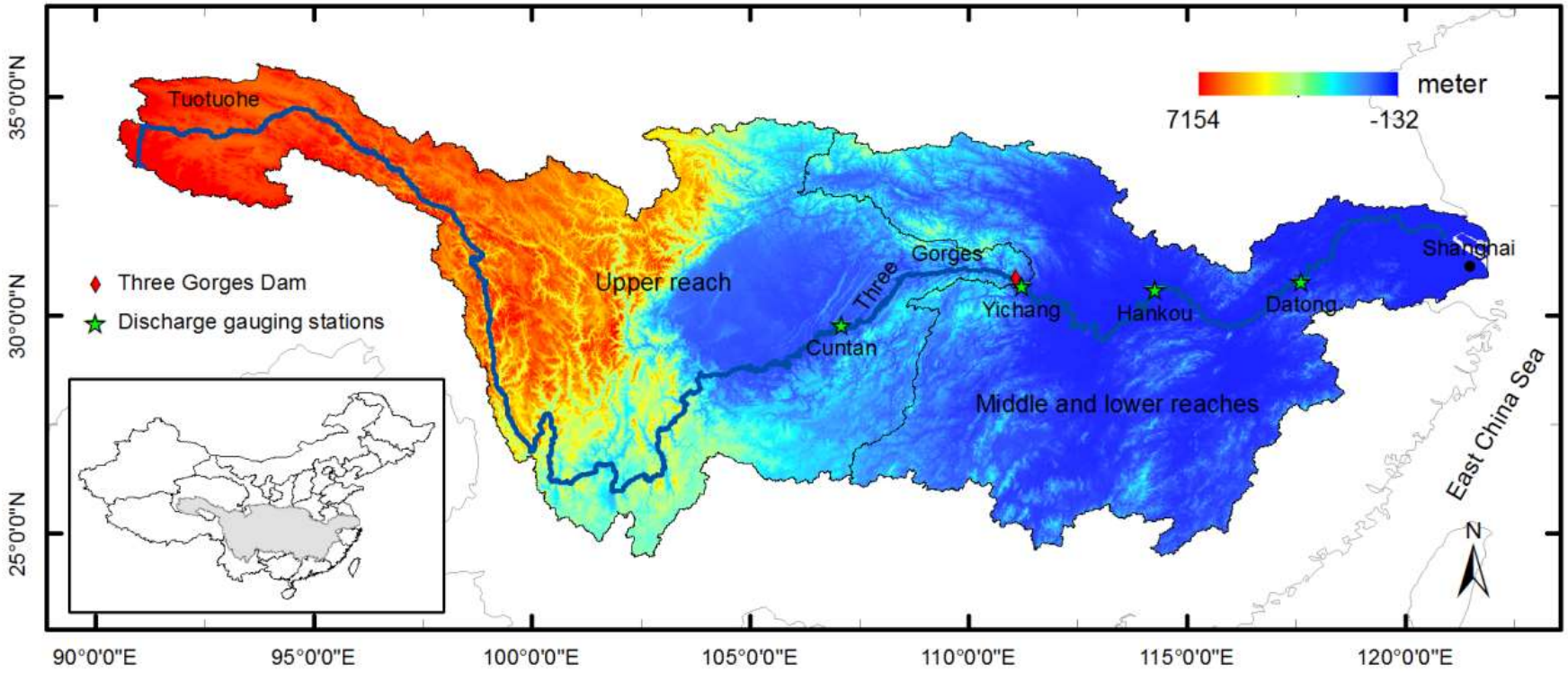
(Chen et al., 2013, PLOSone)

Never ending human activities

Changes in Water Budget



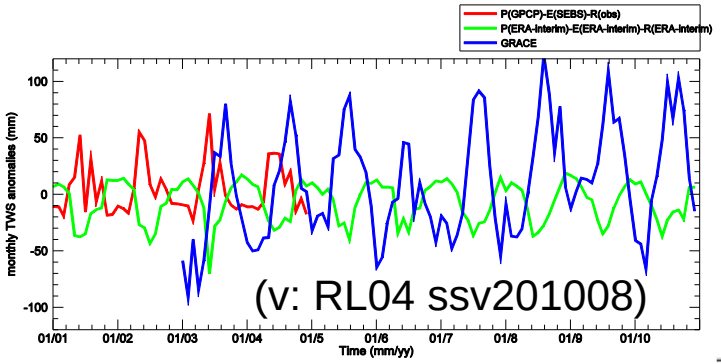
Yangtze River Basin

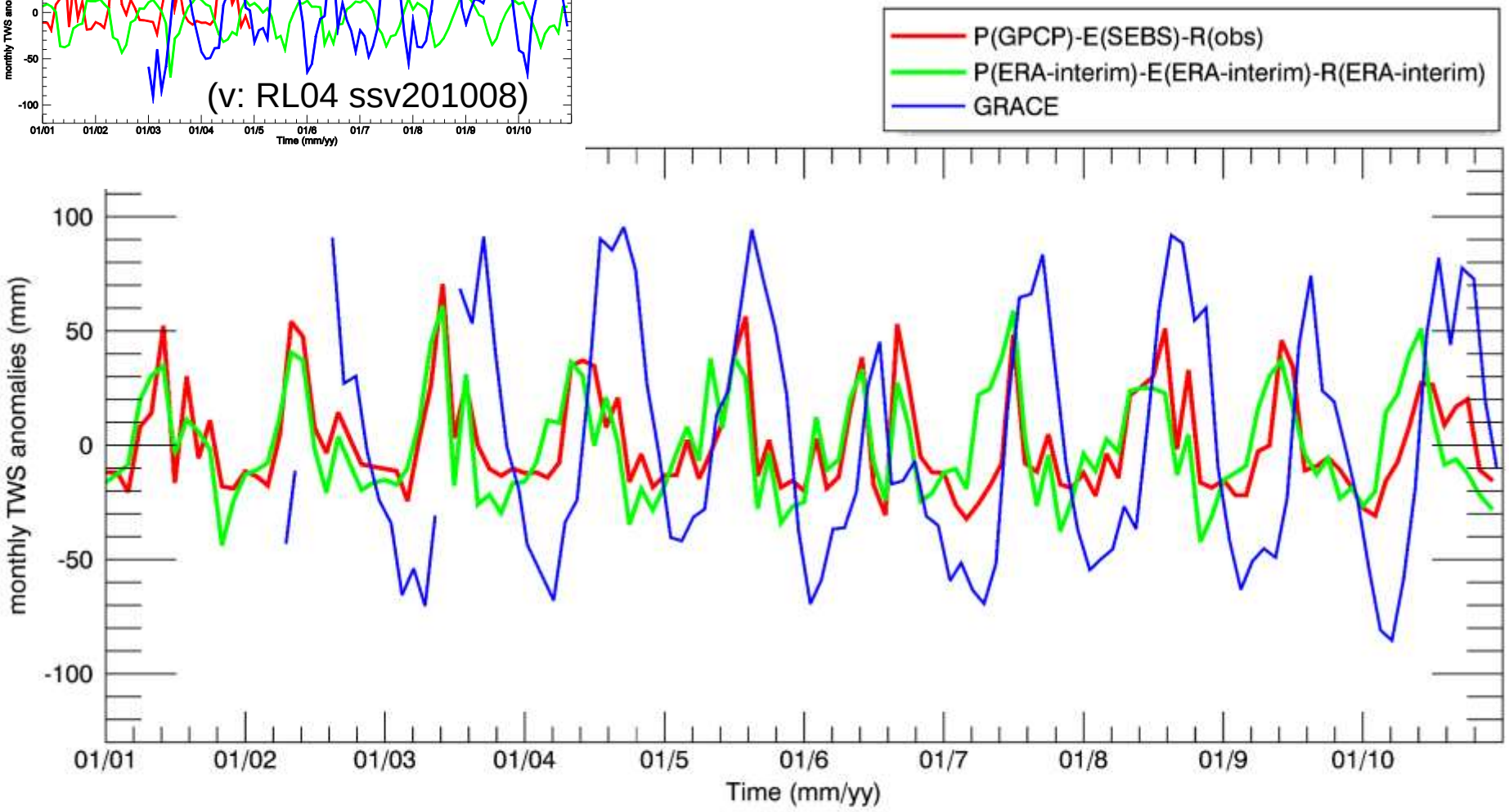


•Upper Yangtze reach, from Tuotuohe, to Yichang.
•Middle reach from Yichang to Hukou.
•Lower reach extends from Hukou to the river mouth near Shanghai.

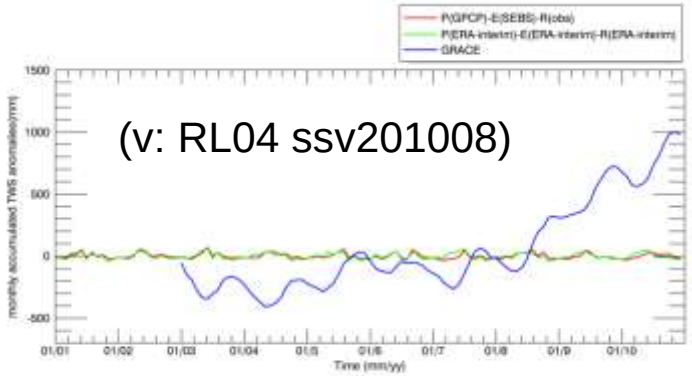
•Cuntan, Yichang, Hankou, and Datong are four gauging stations located along the mainstream of the Yangtze.

Upper reach TWS anomaly





Cumulative TWS anomaly at Upper Reach (Yichang station)

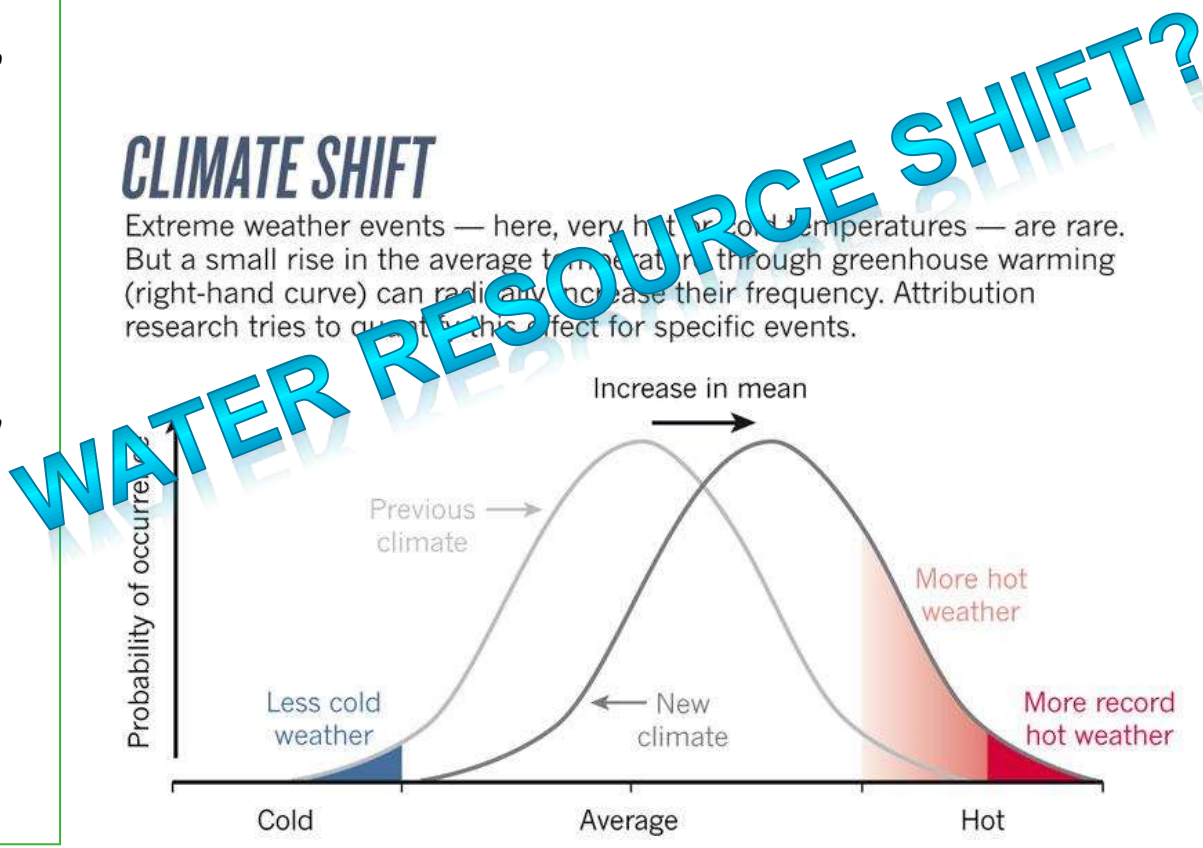


(v: RL04 ssv201008)

GRACE data
(V: RL05.DSTvSCS1401)

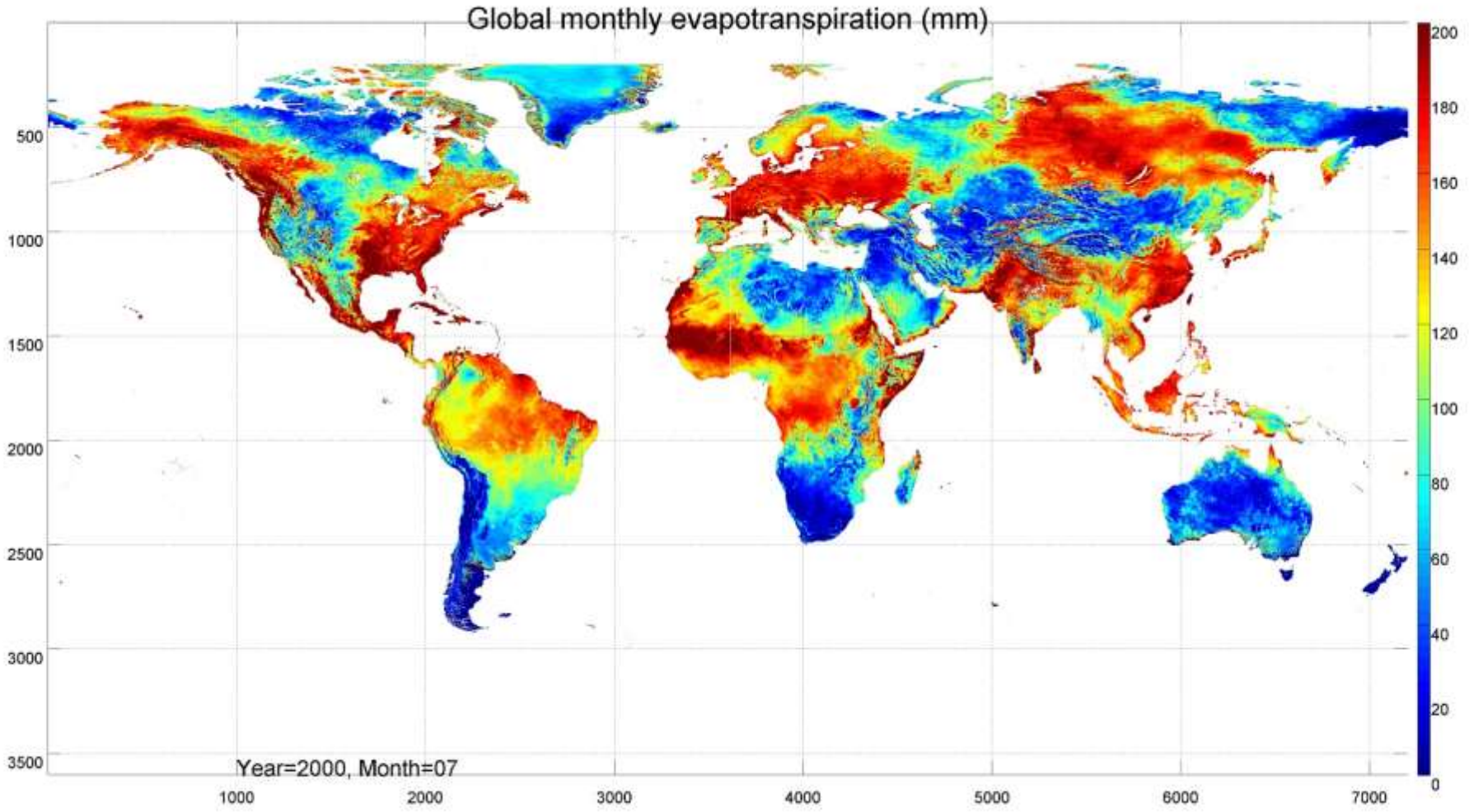
Impacts and projections in the Yangtze River Basin

- *Q1: What are observed impacts to water resources in Yangtze due to climate and human changes ?*
- *Q2: Will the changes in the Yangtze River Basin influence the East Asian monsoon patterns?*
- *Q3: What will be the spatial/temporal distribution of water (sediment) resources in 21st century ?*



ITC SEBS DERIVED GLOBAL ENERGY & ET FLUXES

(2000 to near present at 5 km*5 km spatial resolution), data access: linkendin SEBS group



A Roadmap From Process Understanding To Adaptation

Climate Change Adaptation In Water Resources

Describe

- Trends (change)
- Variability (natural cycle)
- Outliers

Understand

- Attribution (variability vs. error)
- Consistency Process (e.g. Volcanic eruption, fire/aerosol)
- Feedback links (e.g. ENSO teleconnection)

Detect

- Hot Spot
- Quality issue
- Outside Envelope

Predict

- Impacts

Adapt

- Consequences

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