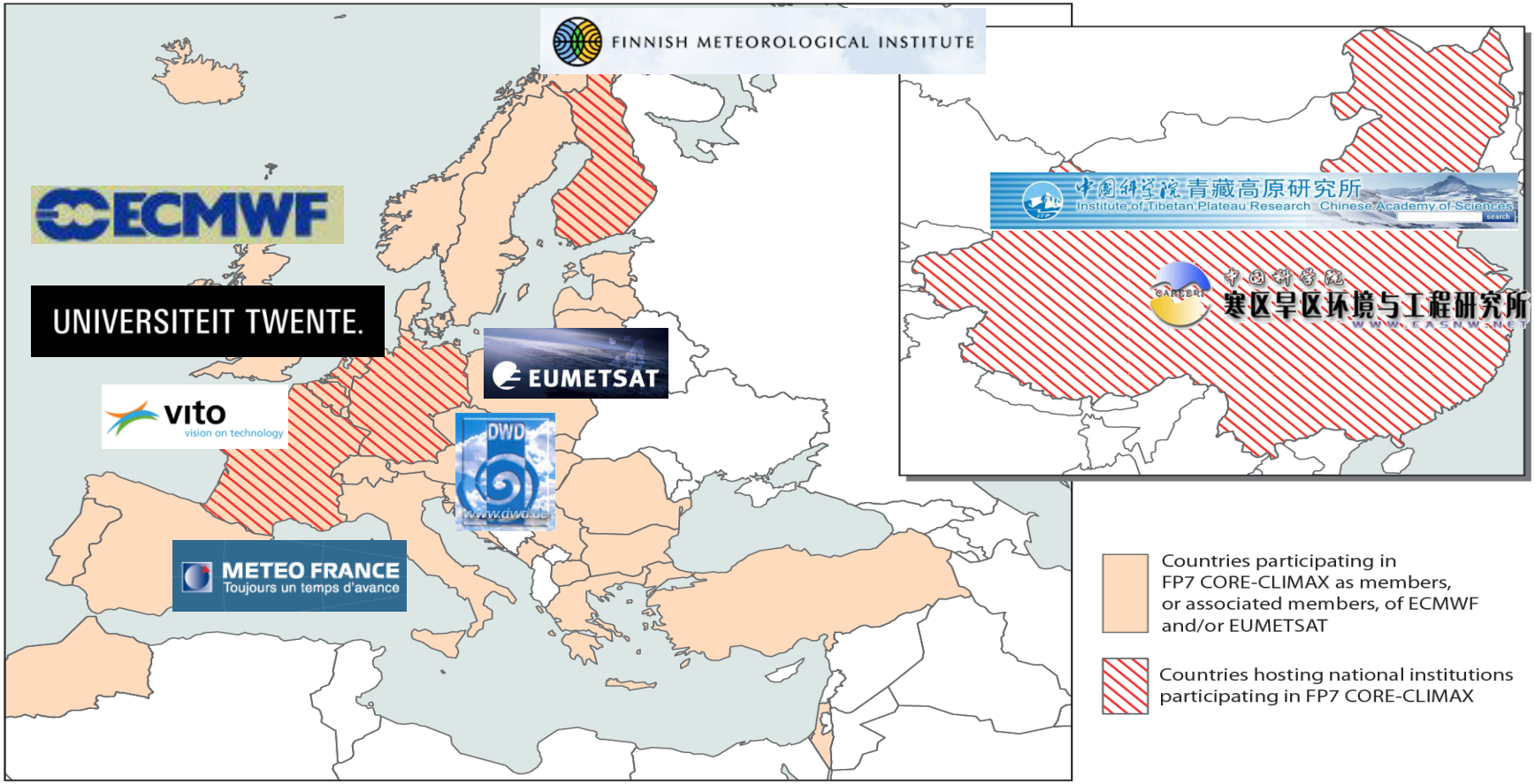
CORE-CLIMAX

COordinating Earth observation data validation for RE-analysis for CLIMAte ServiceS

CORE-CLIMAX PROJECT TEAM

Bob Su (coordinator)
University of Twente



CORE-CLIMAX Project Team

no.	Participant organization name	Country
1.	University of Twente, Faculty for Geo-information Science and Earth Observation (ITC)	The Netherlands
2.	European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)	International
3.	European Centre for Medium-Range Weather Forecasts (ECMWF)	International
4.	German Weather Service (DWD)	Germany
5.	Flemish Institute for Technological Research (VITO)	Belgium
6.	Finnish Meteorological Institute (FMI)	Finland
7.	Meteo-France (MTF)	France
8.	Chinese Academy of Sciences, Institute of Tibetan Plateau Research (ITP)	China
9.	Chinese Academy of Sciences, Cold and Arid Regions Environmental and Engineering Research Institute (CAREERI)	China

PROJECT TEAM MEMBERS

ITC/UT: Bob Su, Wim Timmermans, Yijian Zeng, Joris Timmermans, Bert Boer

EUMETSAT: Jörg Schulz, Rob Roebeling, Viju John

ECMWF: Paul Poli, David Tan

DWD: Frank Kaspar, Andrea Kaiser-Weiss, Andre Obregon

VITO: Else Swinnen, Carolien Tote, Lieven Bydekerke

FMI: Hilppa Gregow, Terhikki Manninen, Ali Nadir Arslan

MTF: Jean-Christophe Calvet, S. Lafont

ITP: Yaoming Ma, Binbin Wang

CAREERI: Jun Wen, Cai Ying, Gao Xiaoqing, Lu Shihua, Wei Zhigang, Hu Zeyong, Gao Yanhong

EC REA Project Officer & Advisory Board

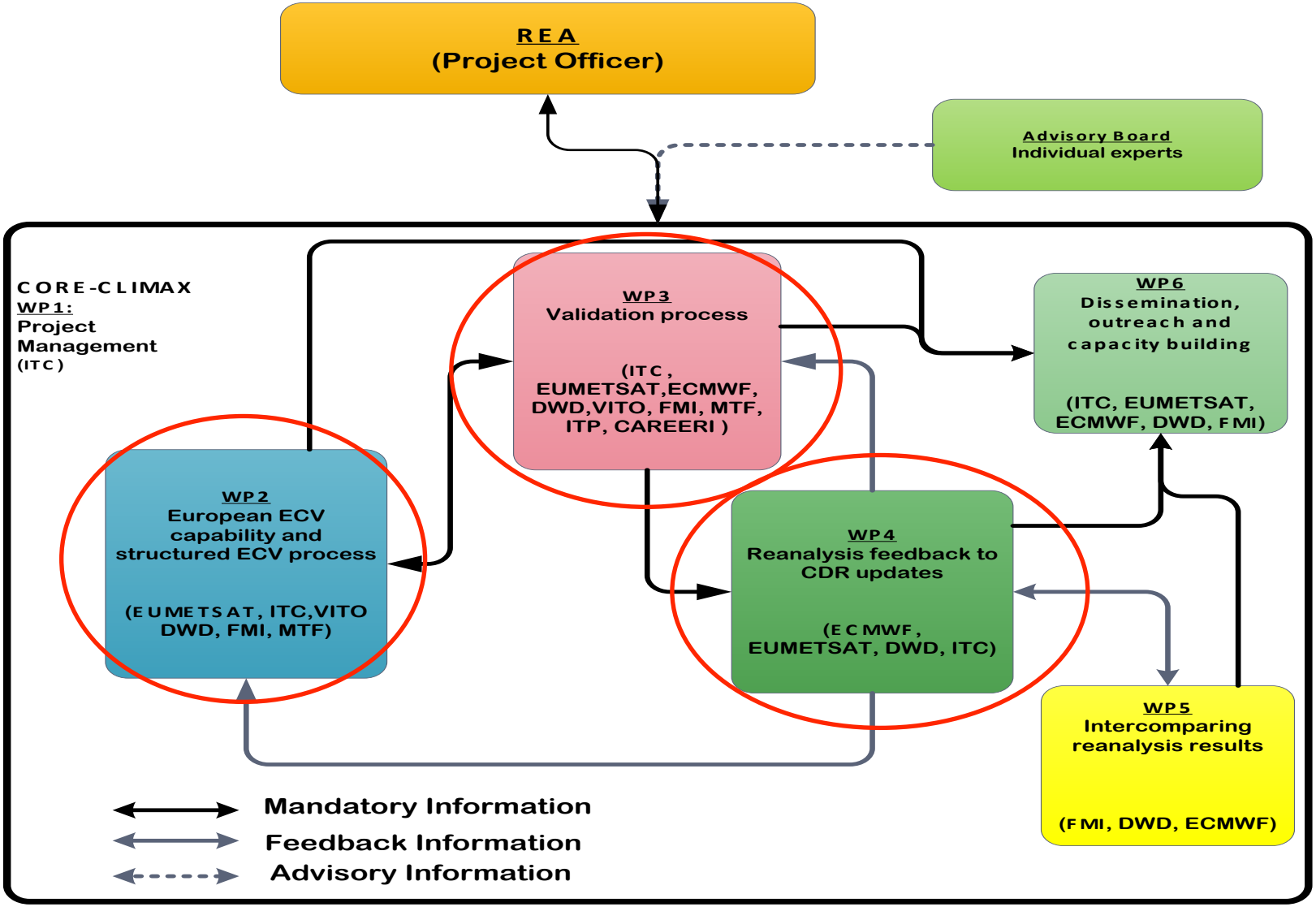
1. **REA** (Research Executive Agency): **Stijn Vermoote**

2. **Advisory Board Members**:
   - **John Bates** (NOAA/NCDC, ECVs generation process and maturity index),
   - **Michael Bosilovich** (NASA, reanalysis),
   - **Mark Dowell** (JRC, ECVs and climate service policy requests, CEOS WG Climate),
   - **Andre Jol** (EEA),
   - **Steve Noyes** (EUMETNET),
   - **Velina Pendolovska** (Policy Officer at DG CLIMA, email confirmation)

CORE-CLIMAX Project objectives

1) **Coordinate with Earth Observation and climate change projects;**
2) **Propose a structured process for delivering ECVs – *Essential Climate Variables*;**
3) **Propose a validation process aiming at qualifying the accuracy of the climate variables;**
4) **Propose a feedback mechanism ensuring that the results of the re-analysis process get appropriately reflected into updates of the CDR - *Climate data Records*;**
5) **Propose a process to compare re-analyses.**

CORE-CLIMAX work packages



Common Climate Observations

Approach proposed in CORE-CLIMAX

Three-step approach to classify the maturity of ECV CDRs:

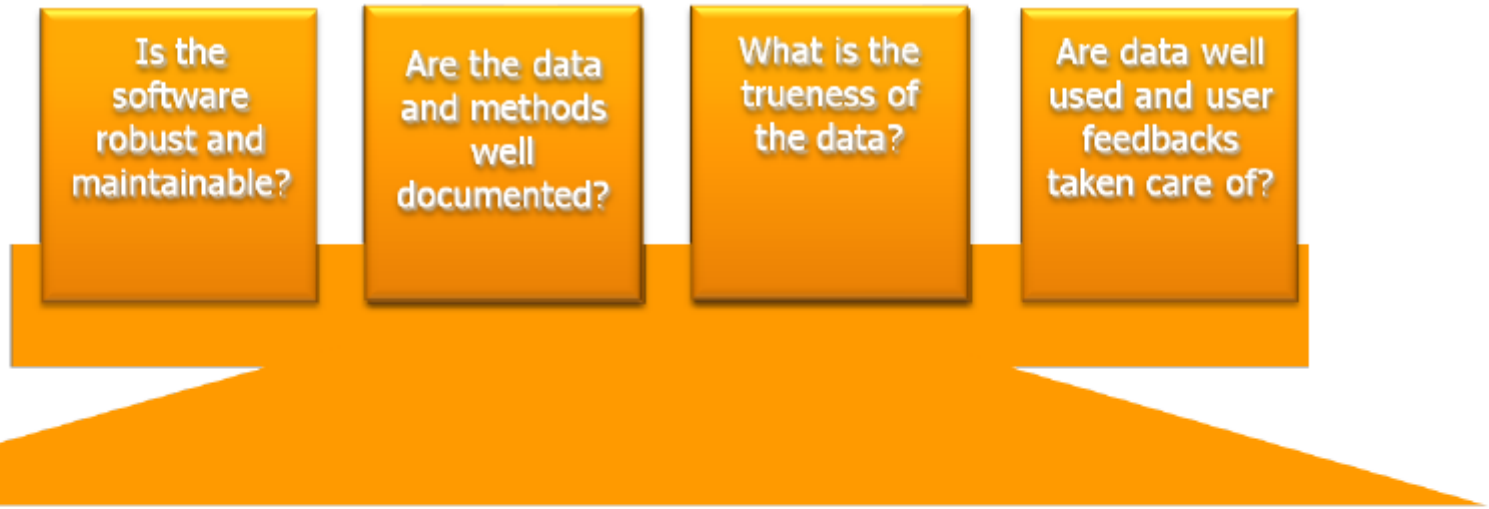
- **Data Record Inventories (DRI)**
  Contain technical specifications and also links to documented information on quality, calibration and inter-calibration *(e.g. ecv-inventory.com);*

- **System Maturity Matrix (SMM)**
  Evaluates if the production of the ECV CDR follows best practices for science, engineering and utilization;

- **Application Performance Matrix (APM)**
  Evaluates the performance of an ECV CDR with respect to a specific application.

(WP 2, J. Schulz)

The CORE-CLIMAX System Maturity Matrix



Software readiness	Metadata	User documentation	Uncertainty Characterization	Public Access, Feedback and Update	Usage
Are the codes compliant with standards, stable, portable and reproducible?	Do the metadata meets international standards, and allows provenance tracking?	Are the formal documents and peer-reviewed papers up-to-date and public?	Are the uncertainties assessed systematically in a standard manner?	Are the data, source code, and documents publicly available and regularly updated?	Are the data widely used in the scientific, and decision and policy making communities?

(WP 2, J. Schulz)

The CORE-CLIMAX Application Performance Matrix

Coverage	Sampling	Uncertainty	Stability
Are the record length and spatial coverage meeting the application's requirements?	Does the spatial and temporal sampling meet the applications requirements?	Does the random and systematic uncertainties meet the requirements?	Does the temporal stability meet the requirements?

(WP 2, J. Schulz)

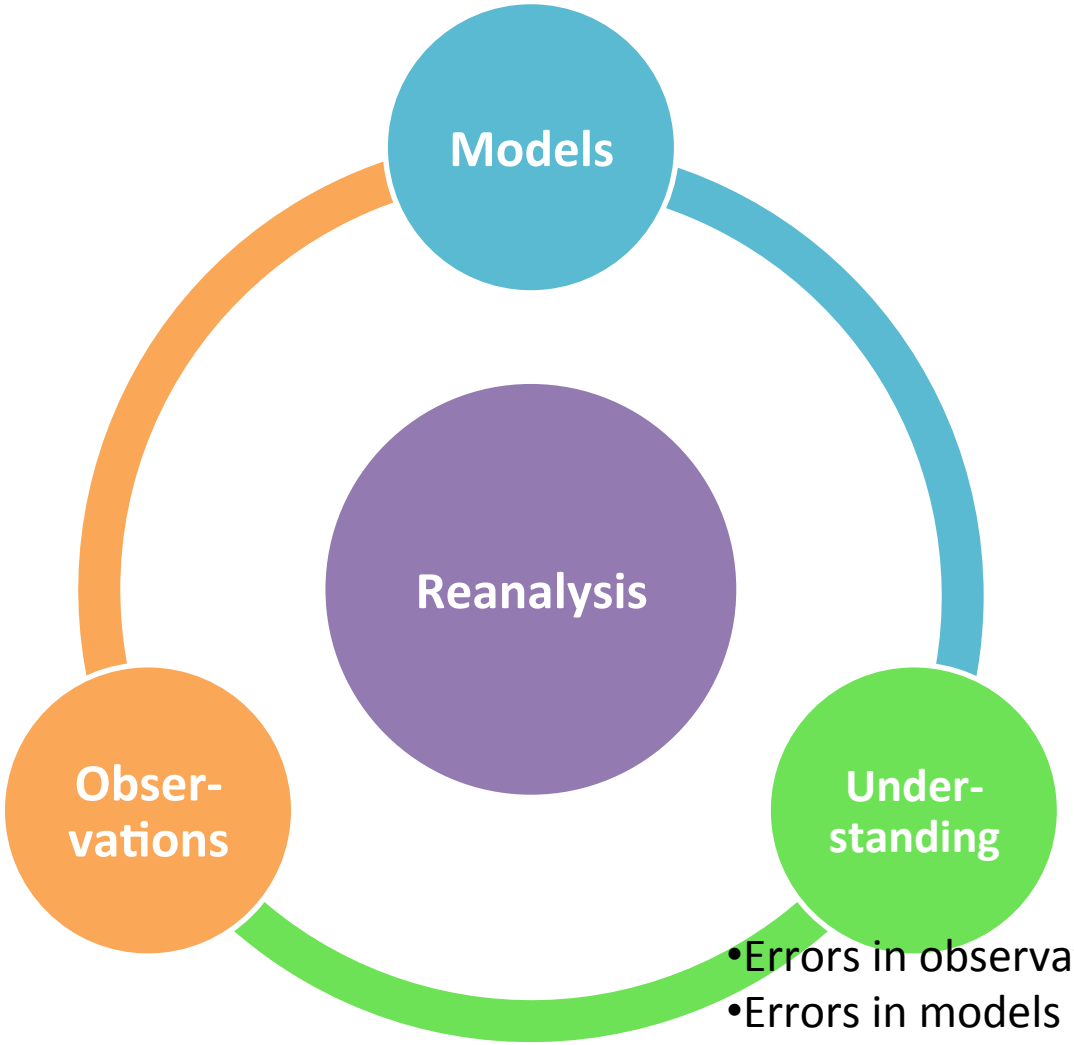
CORE-CLIMAX ECV Capacity Assessment Workshop
EUMETSAT, 21 - 23 January 2014

- 31 datasets with self assessments using SMM:
  - 24 datasets are based on satellite data (12 – SAF, 6 – CCI)
  - 6 are *in situ* datasets
  - 1 reanalysis dataset

  (16 Atmospheric datasets, 10 Land datasets, 6 Ocean datasets)

- A workshop summary report as policy briefing to the EC & other potential stakeholders
- A report on the self-assessment (after feedback by data submitters)

Reanalysis feedback to CDRs update

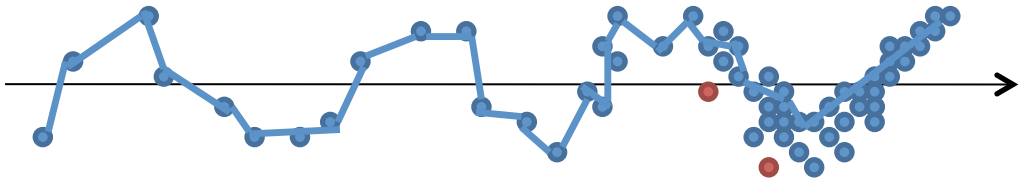


- Errors in observations
- Errors in models
- Predictability
- Variability

(WP4, P. Poli)

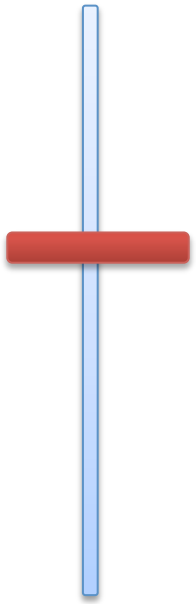
Objective: Reconstruct the past

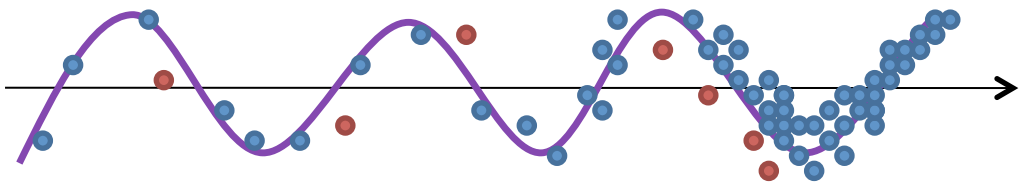
"Observations-only" climatology



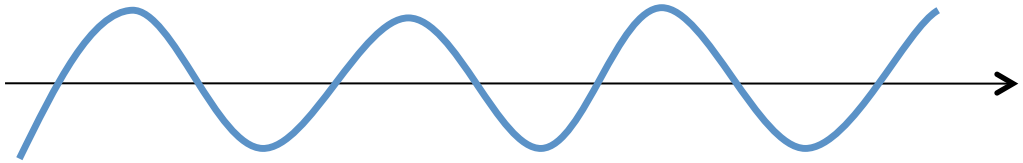
Gross exaggeration towards discontinuity

Reanalysis





"Model only" integration

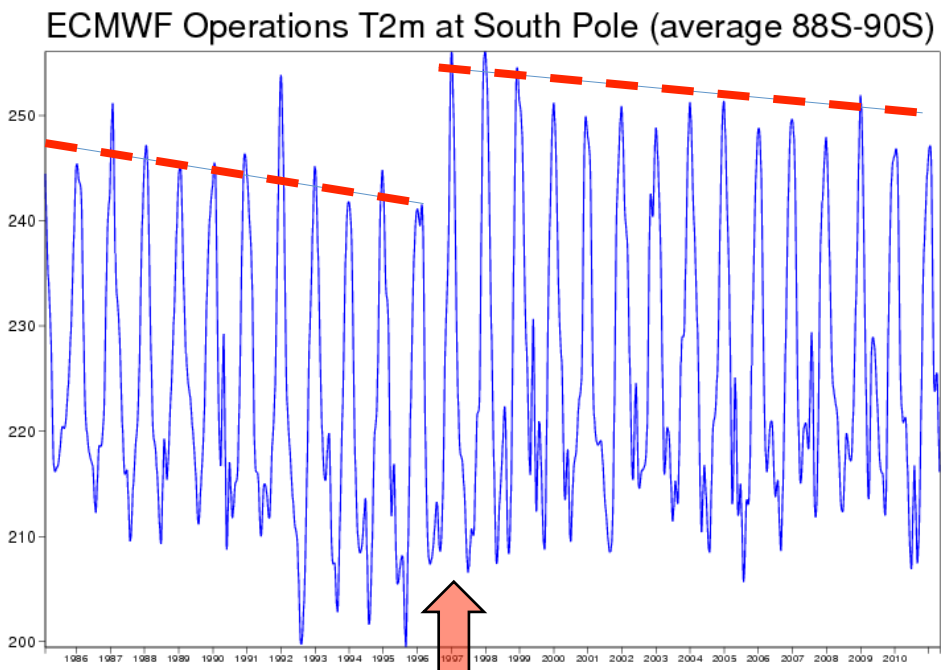


Gross exaggeration towards continuity

(WP4, P. Poli)

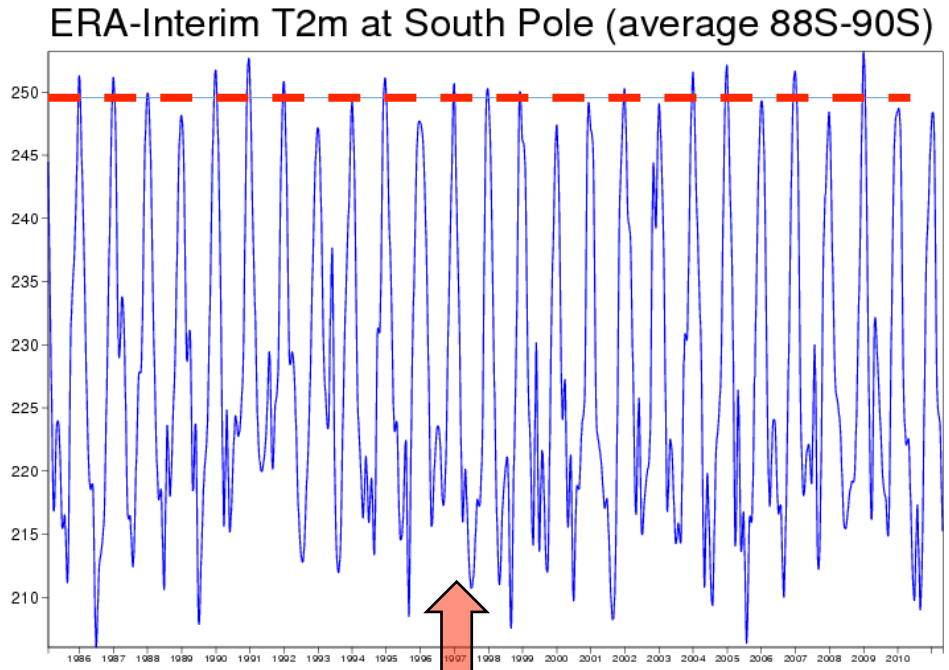
Why re-analyze?

Overall aim is a greater time-consistency of the products AND improve understanding of past events (including extremes) by using state-of-the-art models and tools



1 Feb 1985 **1 May 2011**

Was there a sudden change in South Pole summer variability in 1997?



1 Feb 1985 **1 May 2011**

… probably not

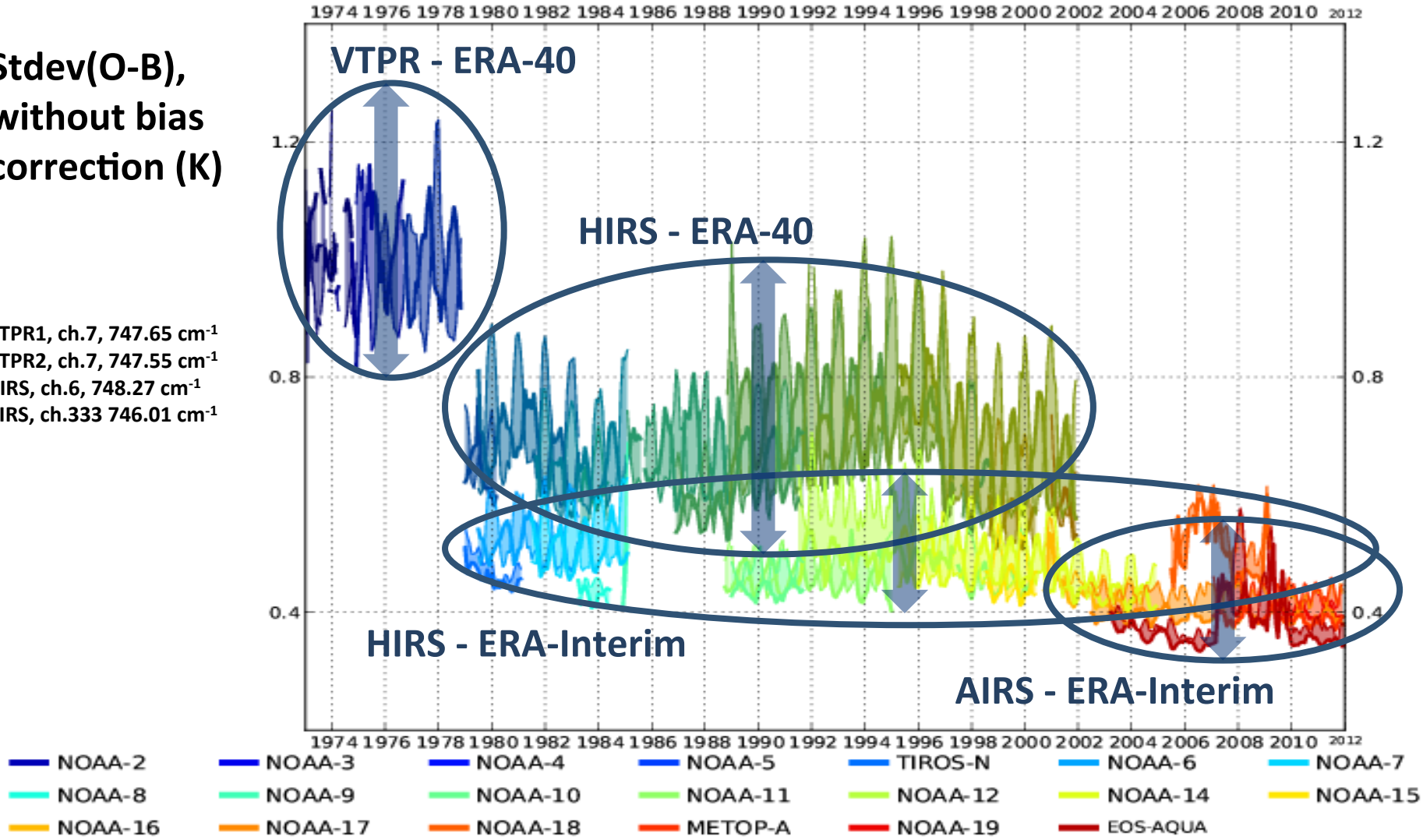
(WP4, P. Poli)

Improved quality & understanding of observations

39-year time-series (1973-2012) of observation minus reanalysis departures, for an infrared channel near 746 cm-1

Stdev(O-B), without bias correction (K)

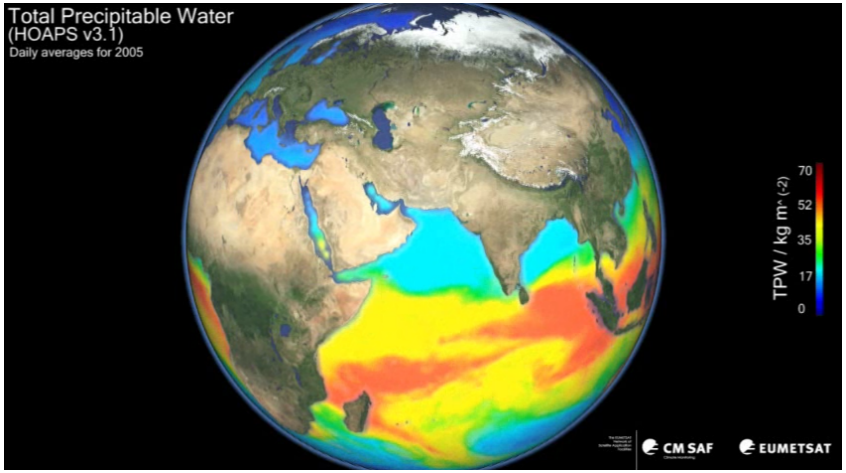
VTPR1, ch.7, 747.65 cm^{-1}
VTPR2, ch.7, 747.55 cm^{-1}
HIRS, ch.6, 748.27 cm^{-1}
AIRS, ch.333 746.01 cm^{-1}

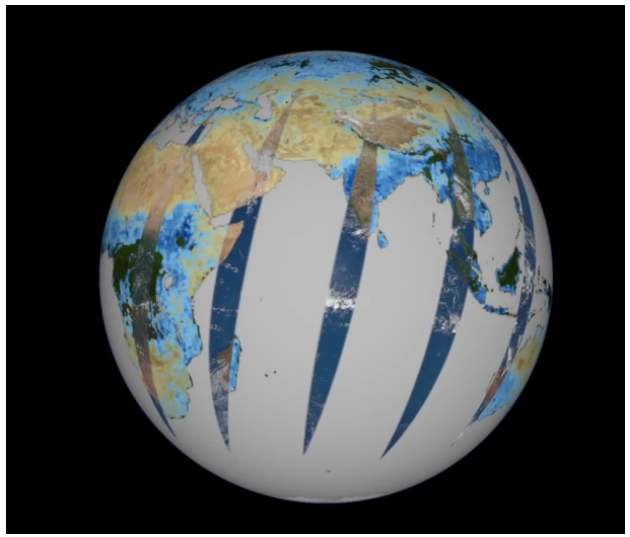


(WP4, P. Poli)

Why validate ? – consistency of ECVs

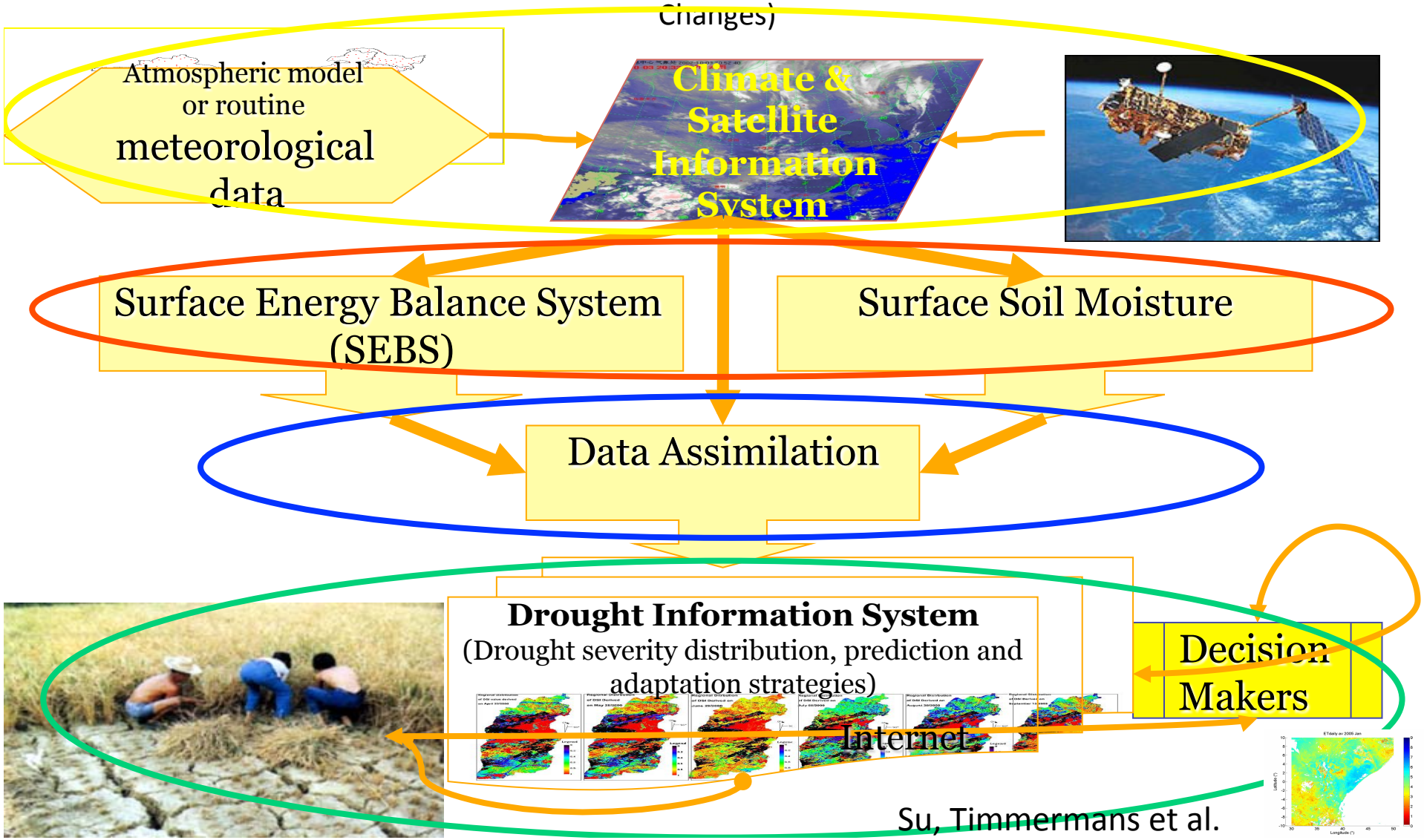
(Ex 1. Closing the Water Cycle – Total Precipitable Water & Soil Moisture)





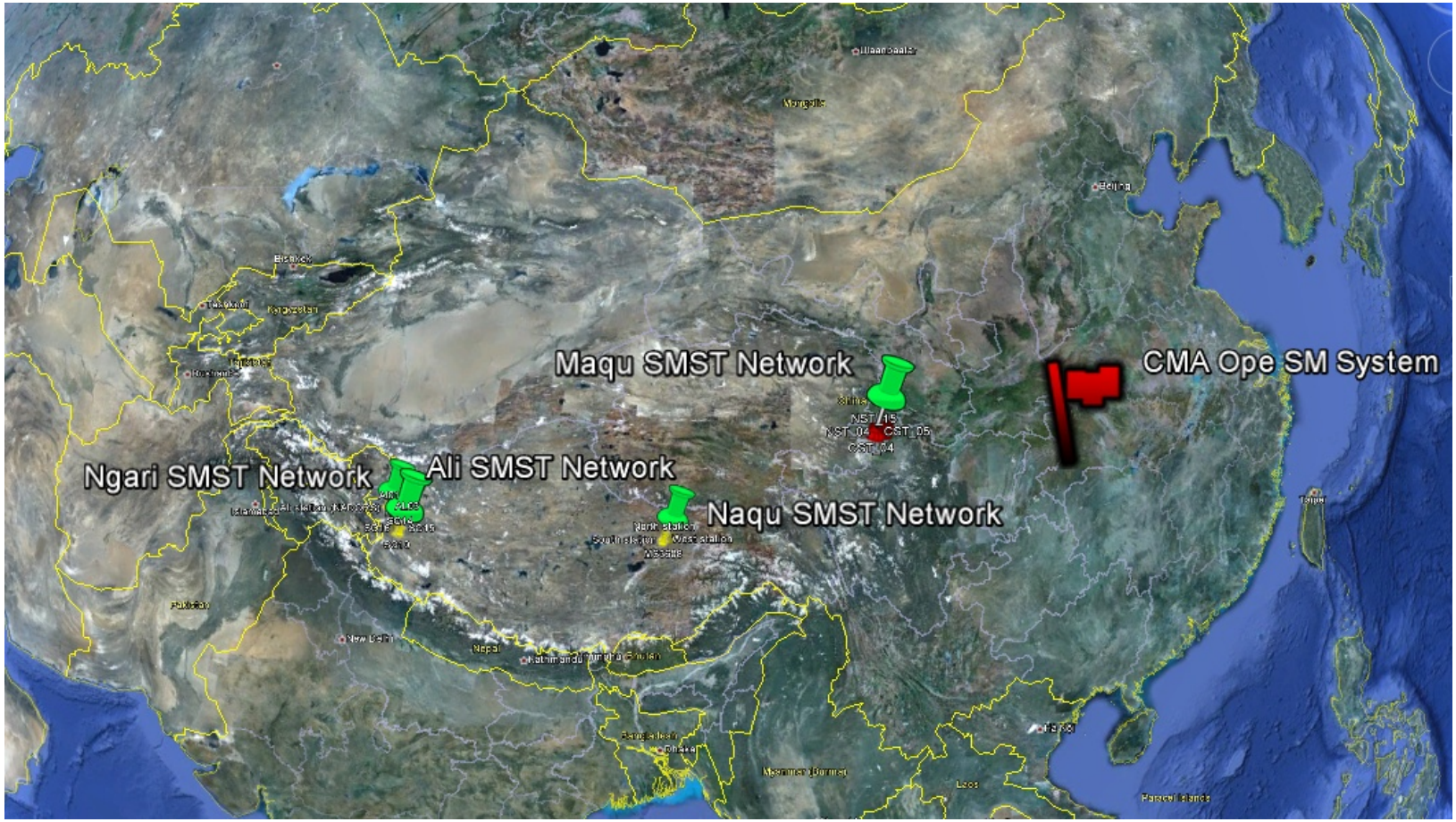
Future R&D needs – consistency of ECVs

(Ex 2: ESA Dragon Programme: Drought Monitoring, Assessment, Prediction and Adaptation under Climatic Changes)



Su, Timmermans et al.

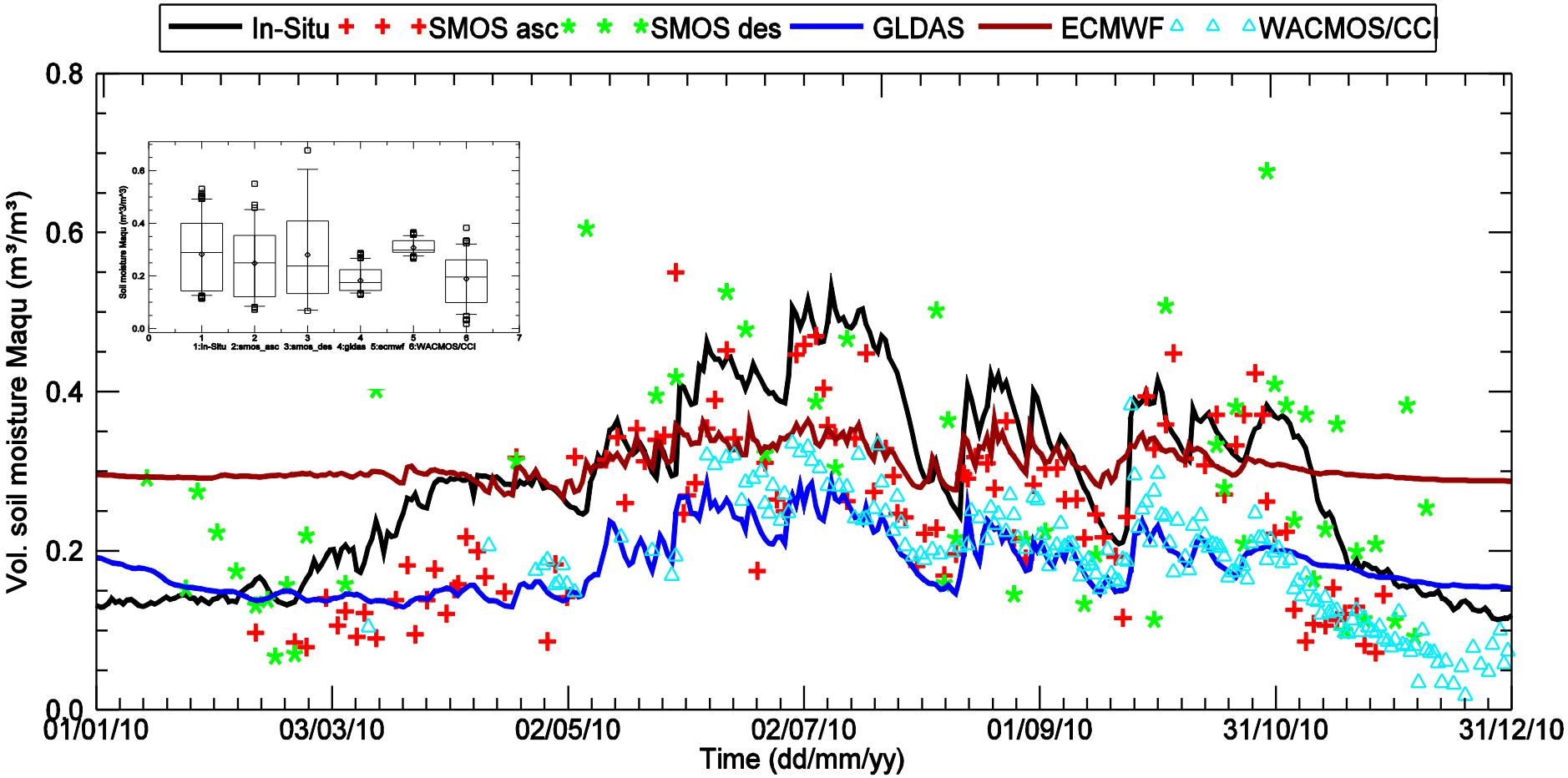
Tibetan Plateau observatory of plateau scale soil moisture and soil temperature (Tibet-Obs)



Su et al. 2011, Hydrol. Earth Syst. Sci.,

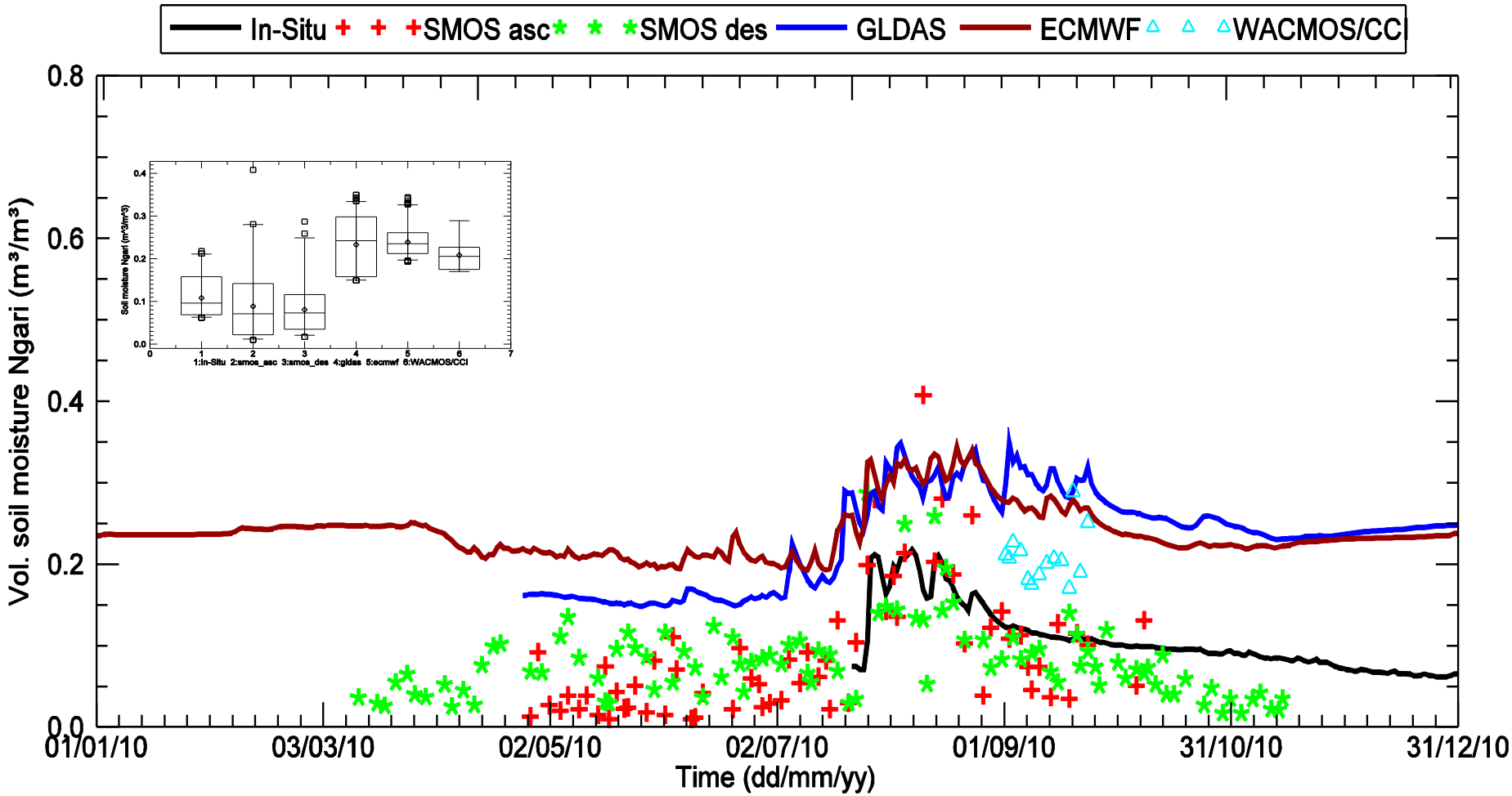
www.hydrol-earth-syst-sci.net/15/2303/2011/

Maqu SMST Network – validation results



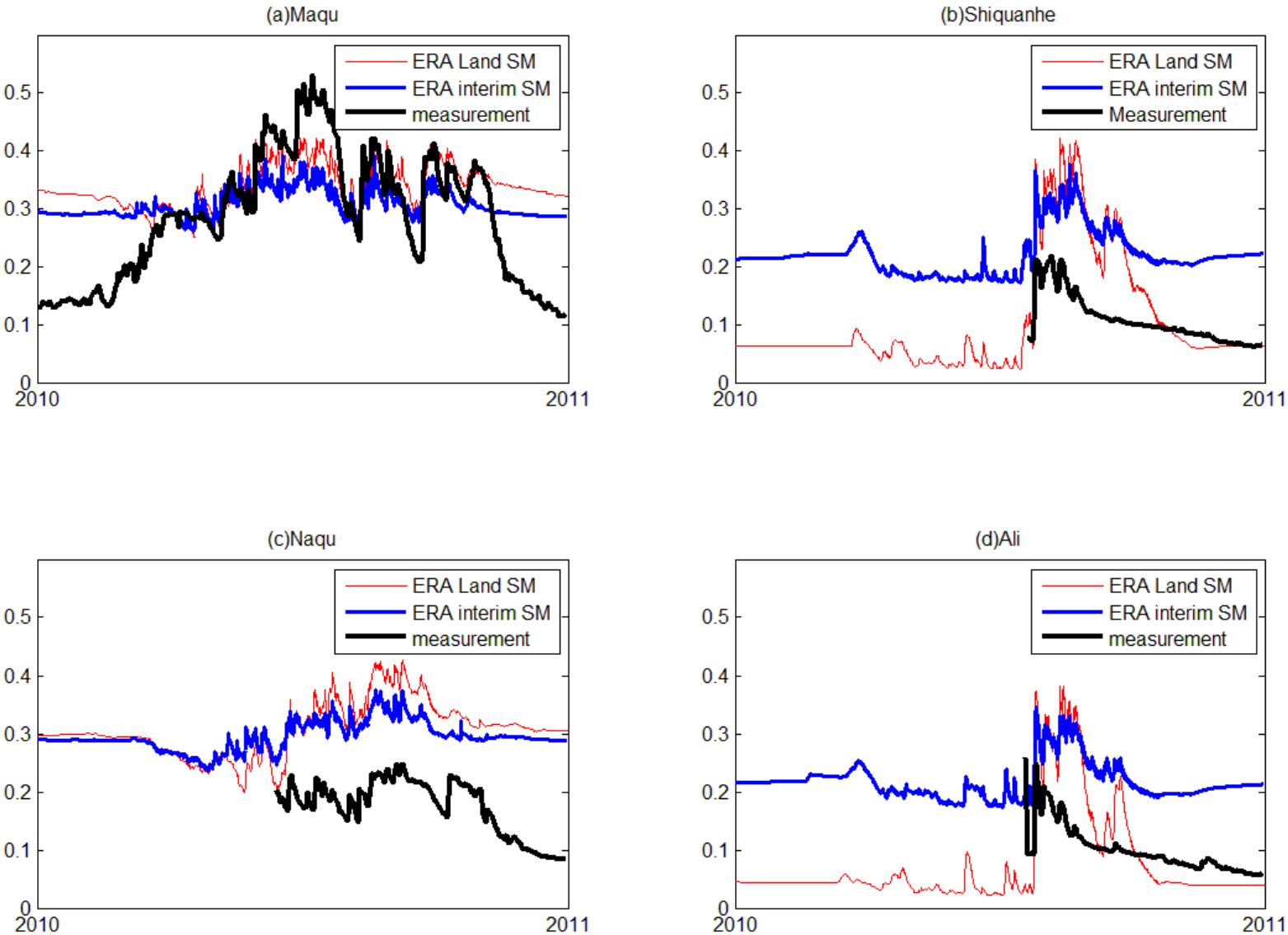
(WP3)

Ngari SMST Network – validation results



(WP3)

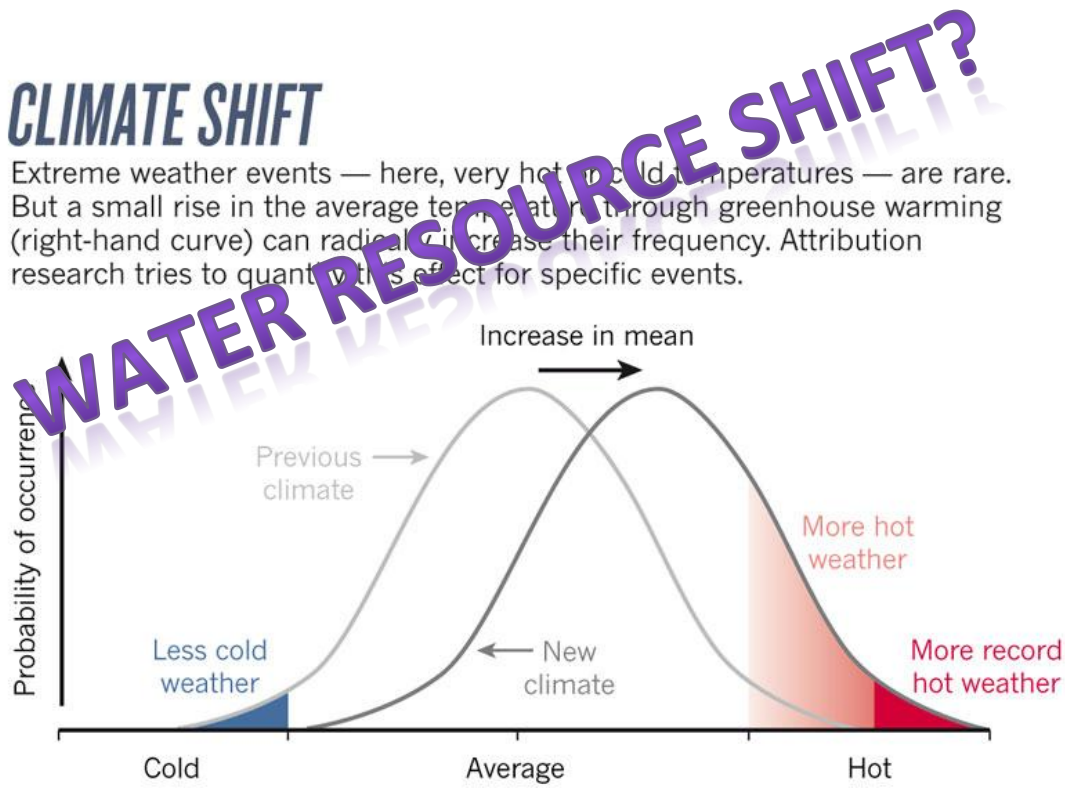
ERA-Interim/Land



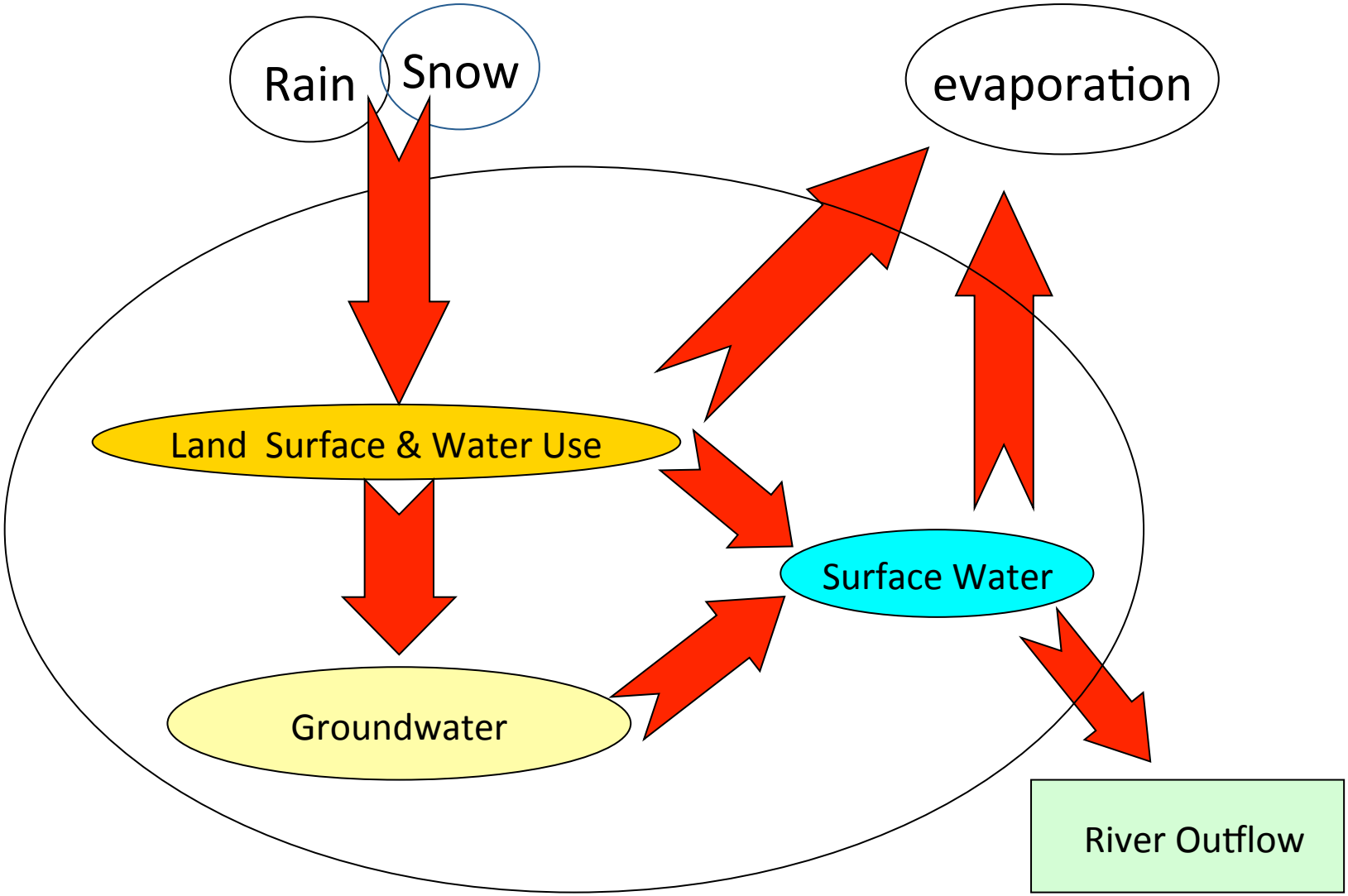
(WP3)

Impacts and projections in water resources

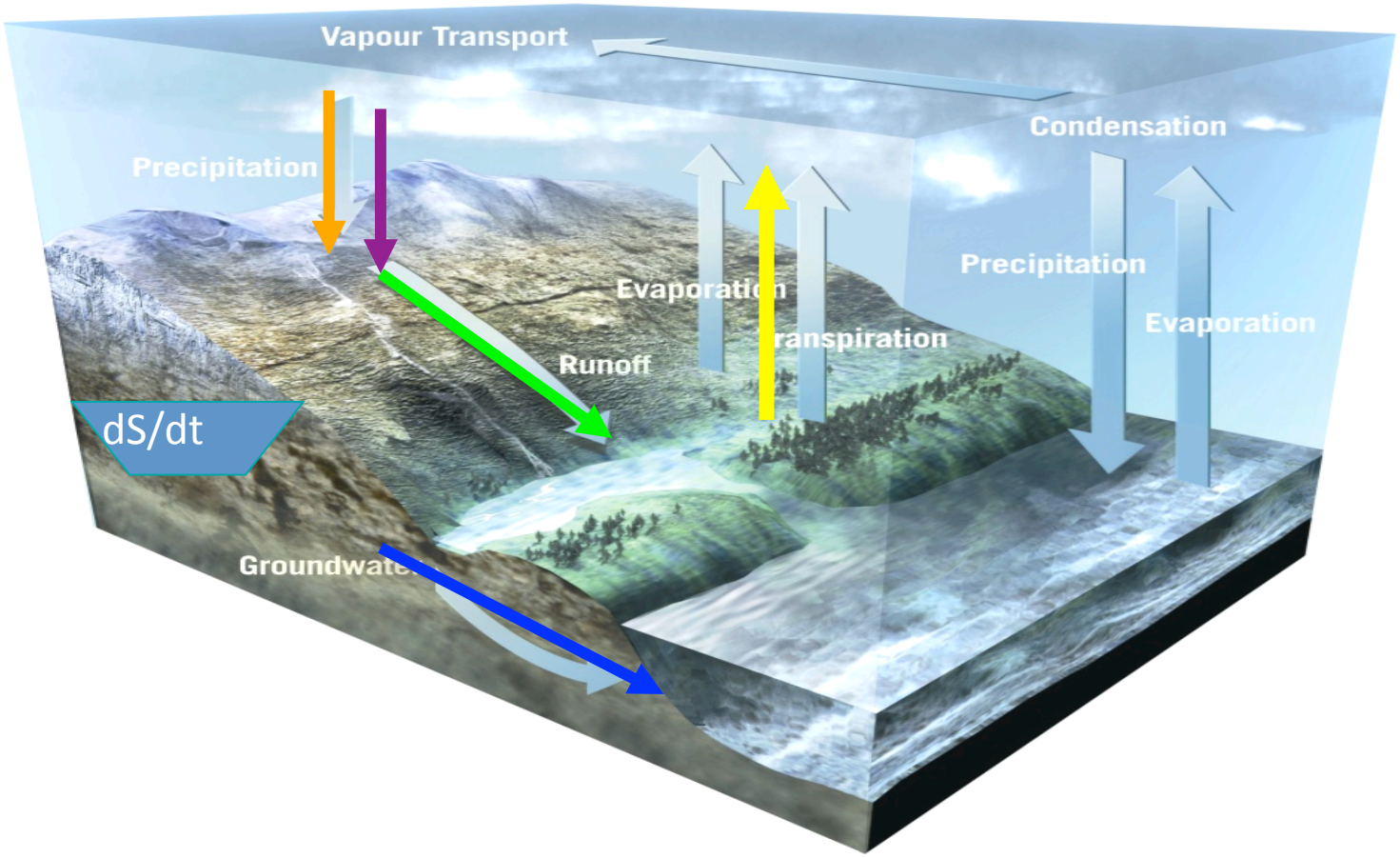
- *Q1: What are observed impacts to water resources in Yangtze due to climate and human changes ?*
- *Q2: Will the changes in the Yangtze River Basin influence the East Asian monsoon patterns?*
- *Q3: What will be the spatial/ temporal distribution of water (sediment) resources in 21st century ?*



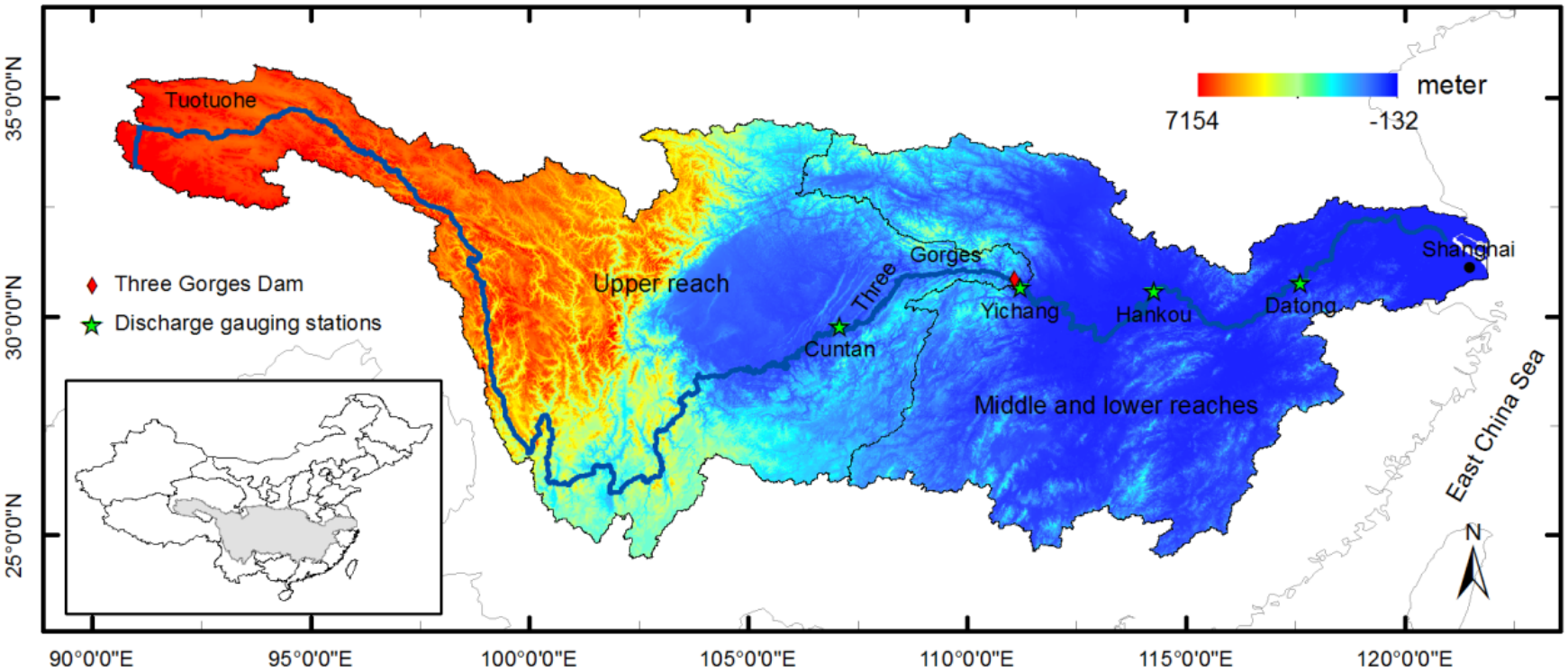
Changes in Water Budget



Spatial Water budget of the Yangtze River Basin



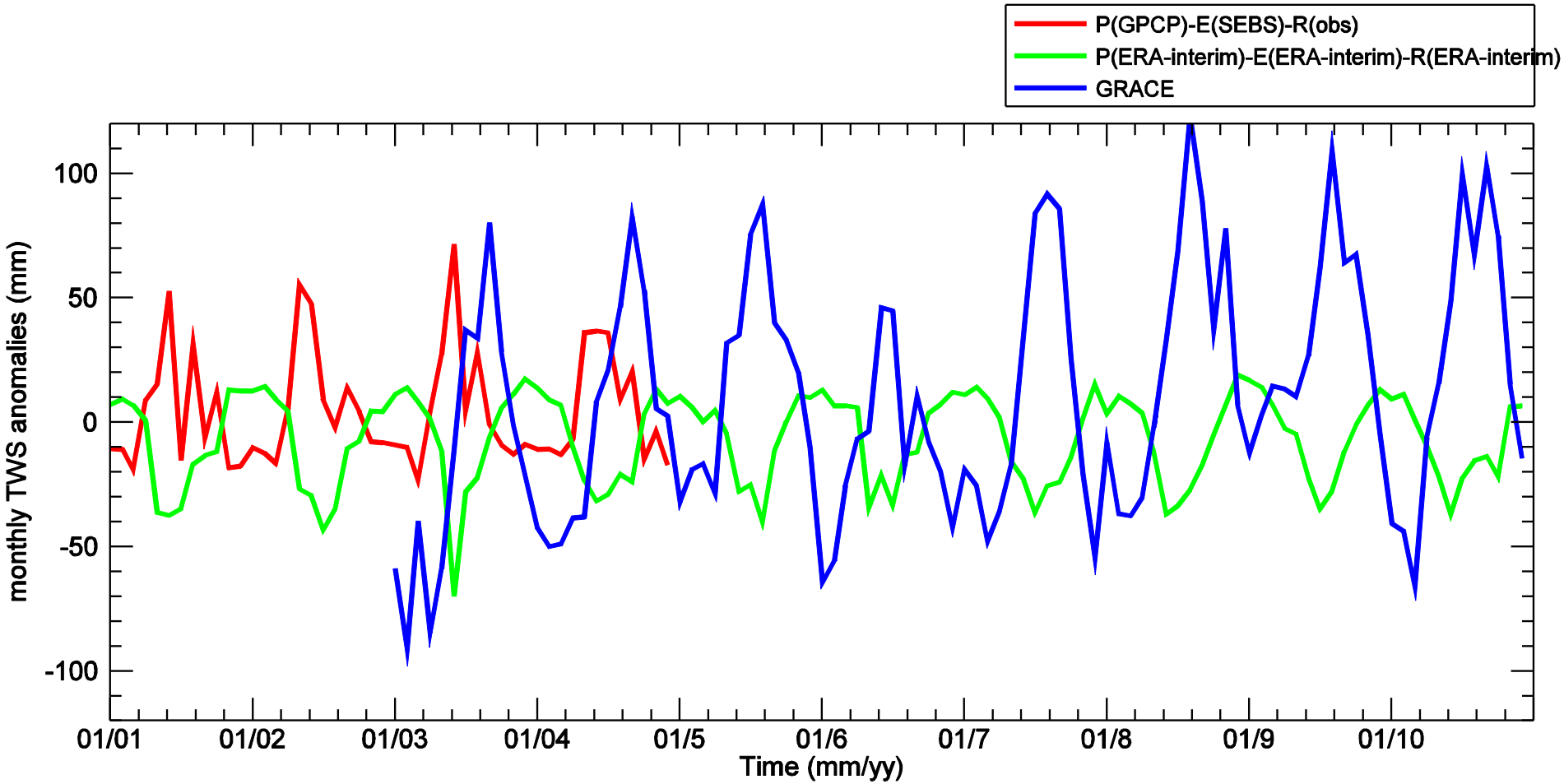
Yangtze River Basin



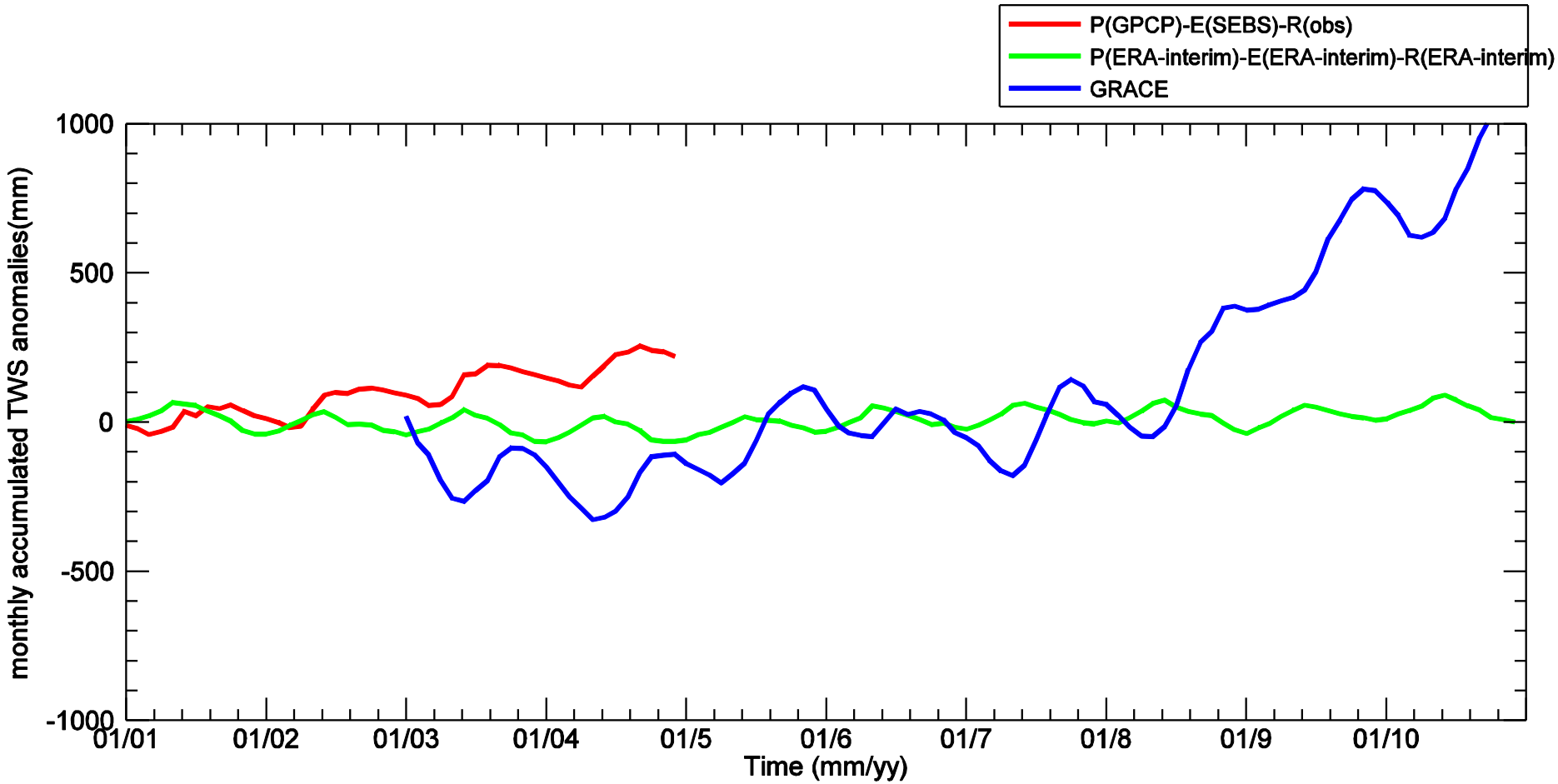
•Upper Yangtze reach, from Tuotuohe, to Yichang.
•Middle reach from Yichang to Hankou.
•Lower reach extends from Hankou to the river mouth near Shanghai.

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

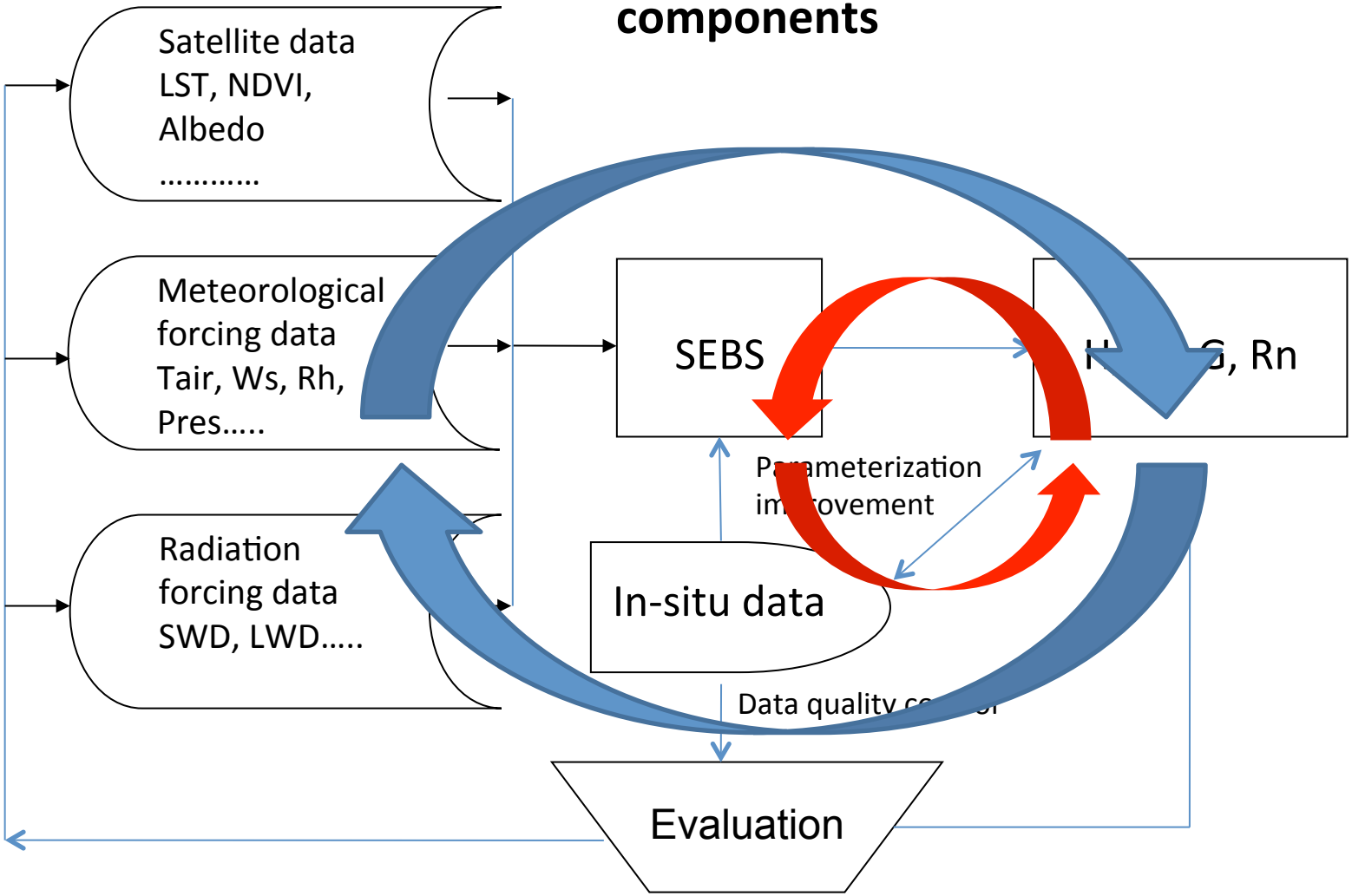
Upper reach TWS anomaly



Upper reach cumulative TWS anomaly



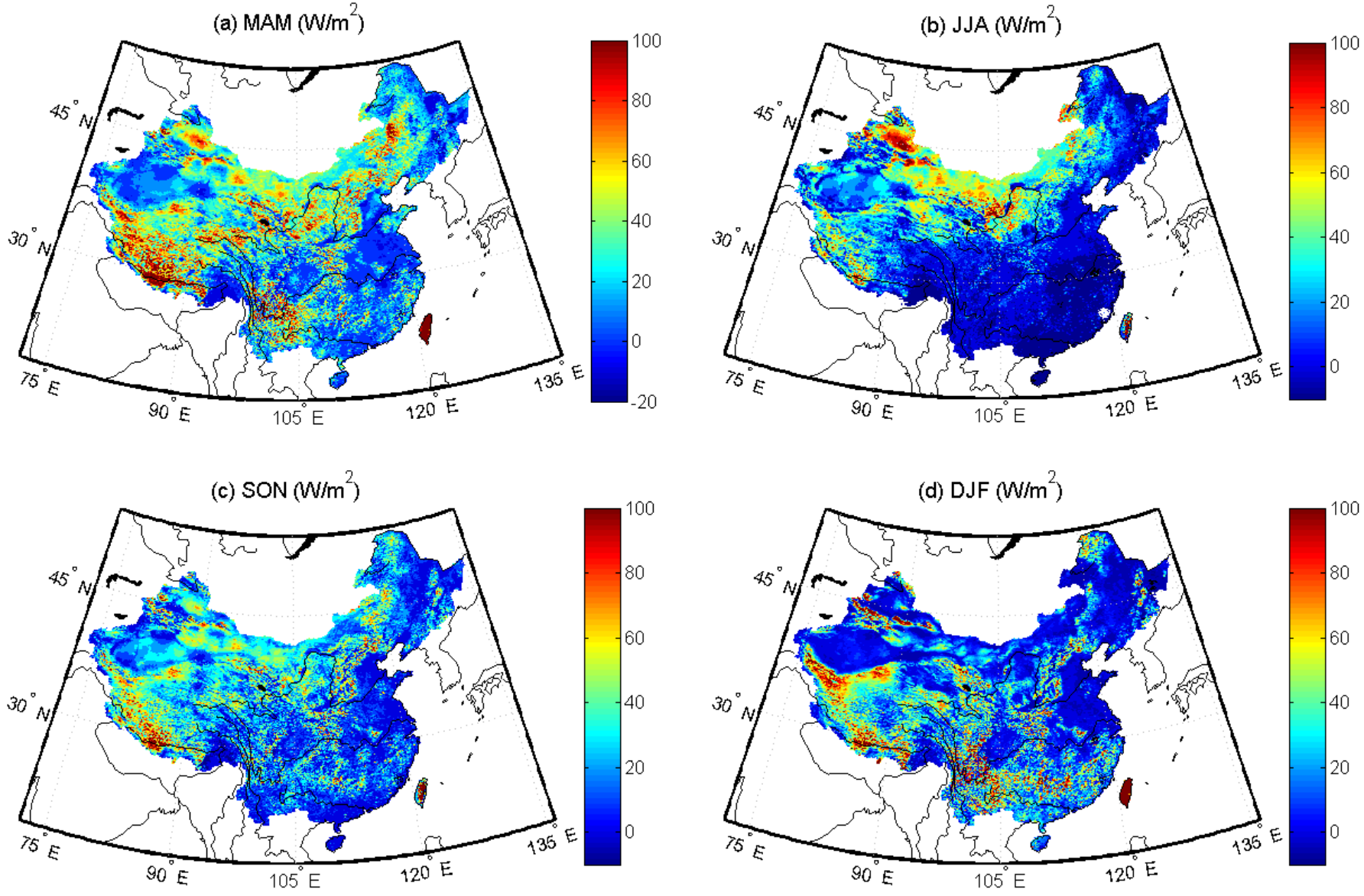
Ex 3. Use of ECVs in generating energy balance/water cycle components



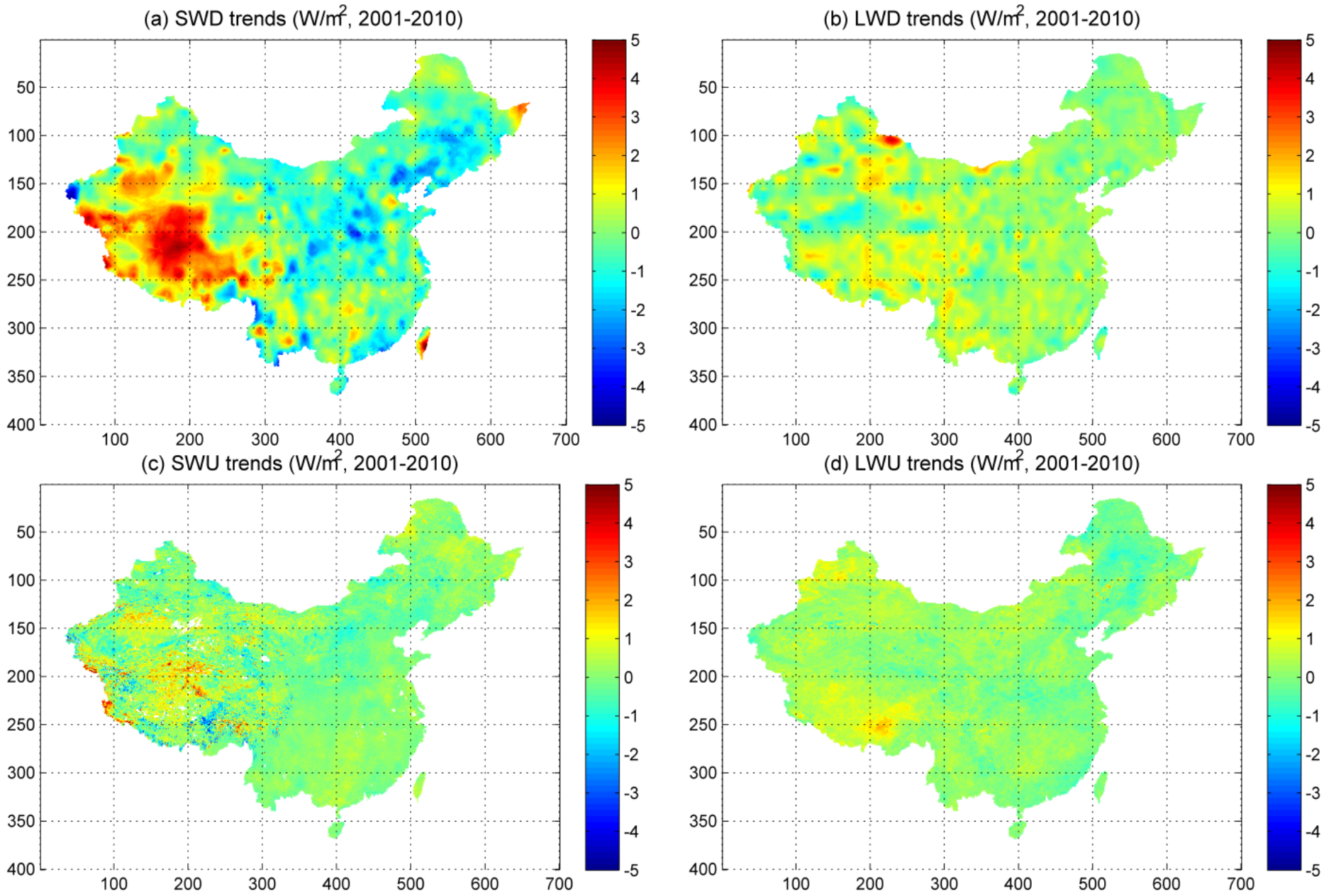
(Processing chain developed in ESA WACMOS.org project)

Seasonal average maps of sensible heat flux (H)

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



Spatial (climatic) trends



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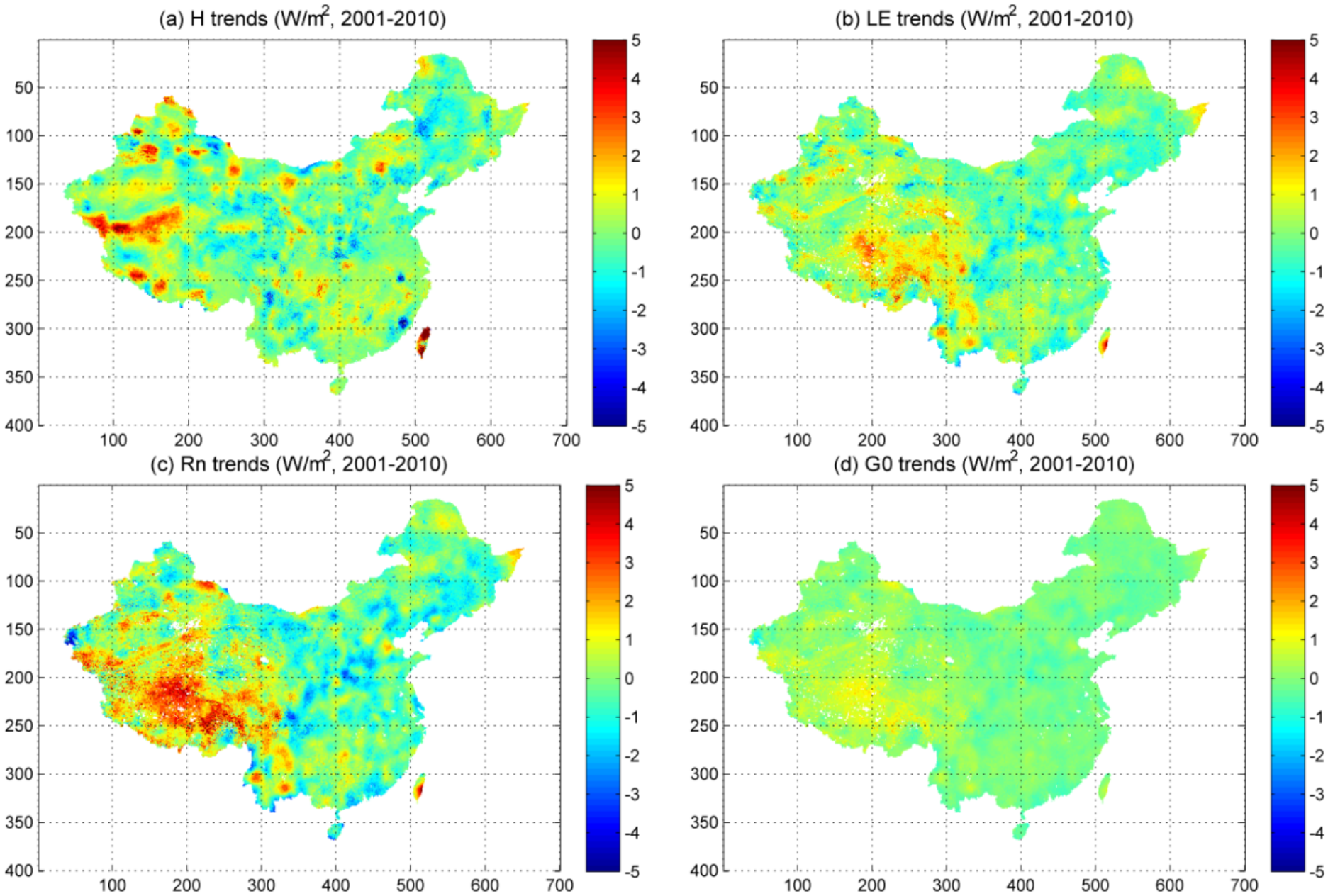

Summary

1) CORE-CLIMAX has proposed a structured process for assessing European capability in delivering ECVs;

- Using and contributing to data record inventories;
- Using an updated System Maturity Matrix approach of 'measuring' if data records are produced with best practises for science and engineering;
- Using a novel approach of an Application Performance Matrix to break down comprehensive information on data record quality into a performance index;
- The CORE-CLIMAX Capability Assessment Workshop recommended the use of SMM. (APM to be further worked out)

2) CORE-CLIMAX is proposing a validation process aiming at qualifying the accuracy of the climate variables;

3) CORE-CLIMAX is proposing a feedback mechanism ensuring that the results of the re-analysis process get appropriately reflected into updates of the CDR.

CORE-CLIMAX Capacity Building Workshop

Date: 19 - 20 March 2014
Place: Finnish Meteorological Institute (FMI), Helsinki, **Finland**

- Provide guidance and expertise in climate data records,
- Train people on the use of climate information and its associated uncertainty,
- Provide generic tools to build the bridge between the climate information and the users‘ need.

- http://www.coreclimax.eu/?q=WorkshopFMI