

Observing water from space under, at and above the global land surface

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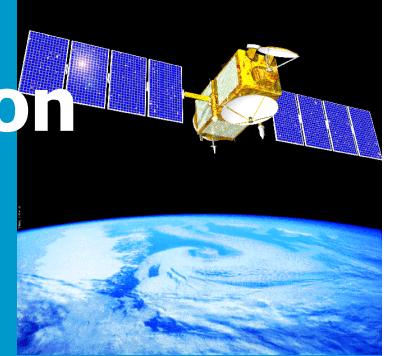


Faculty of Aerospace
Engineering



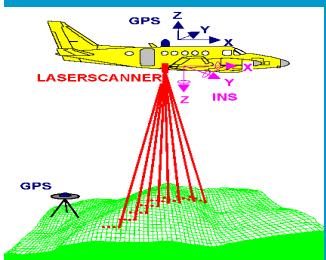


Department of Earth Observation and Space Systems (DEOS)



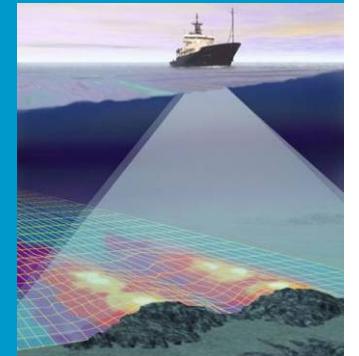
space born

airborne



- Positioning
- Gravity Field
- Remote Sensing
 - Optical
 - Radar
 - Acoustic
- Geophysical modeling

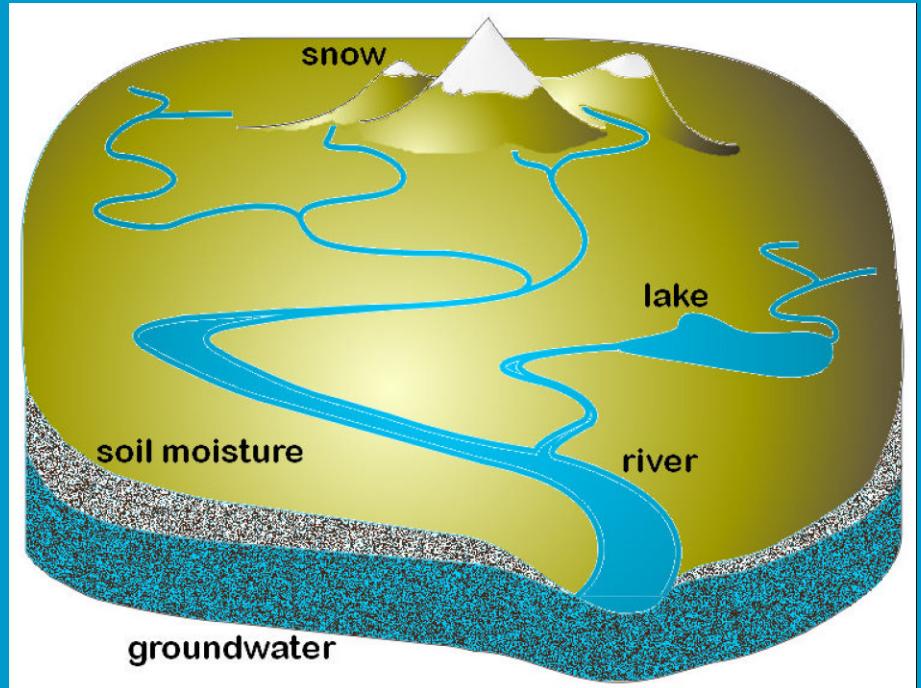
in situ



Water storage variations at river basin scale from GRACE time varying gravity

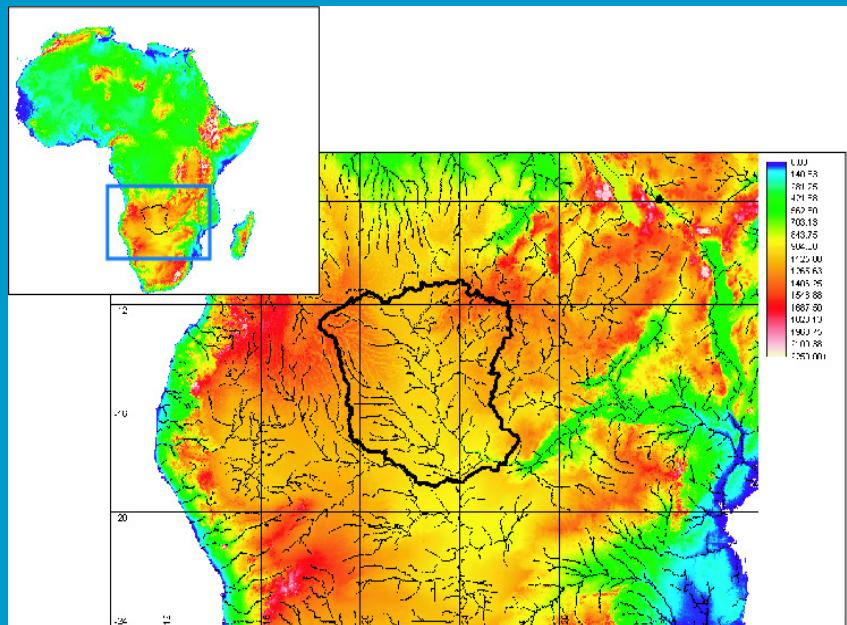
$$\Delta S = P - ET - R$$

- Known since 1800
- Difficult to close
- We cannot monitor S

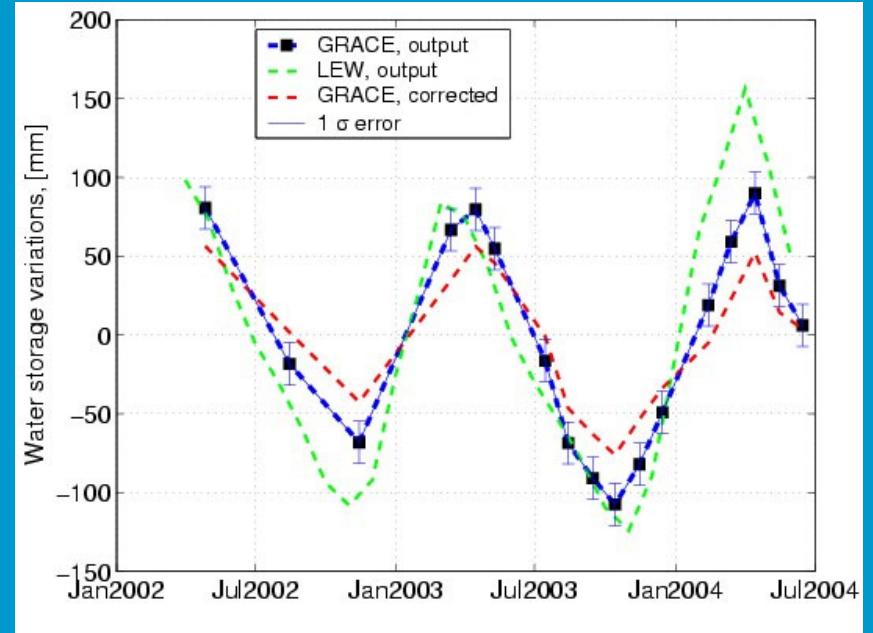


Study area: Zambezi river basin, South Africa

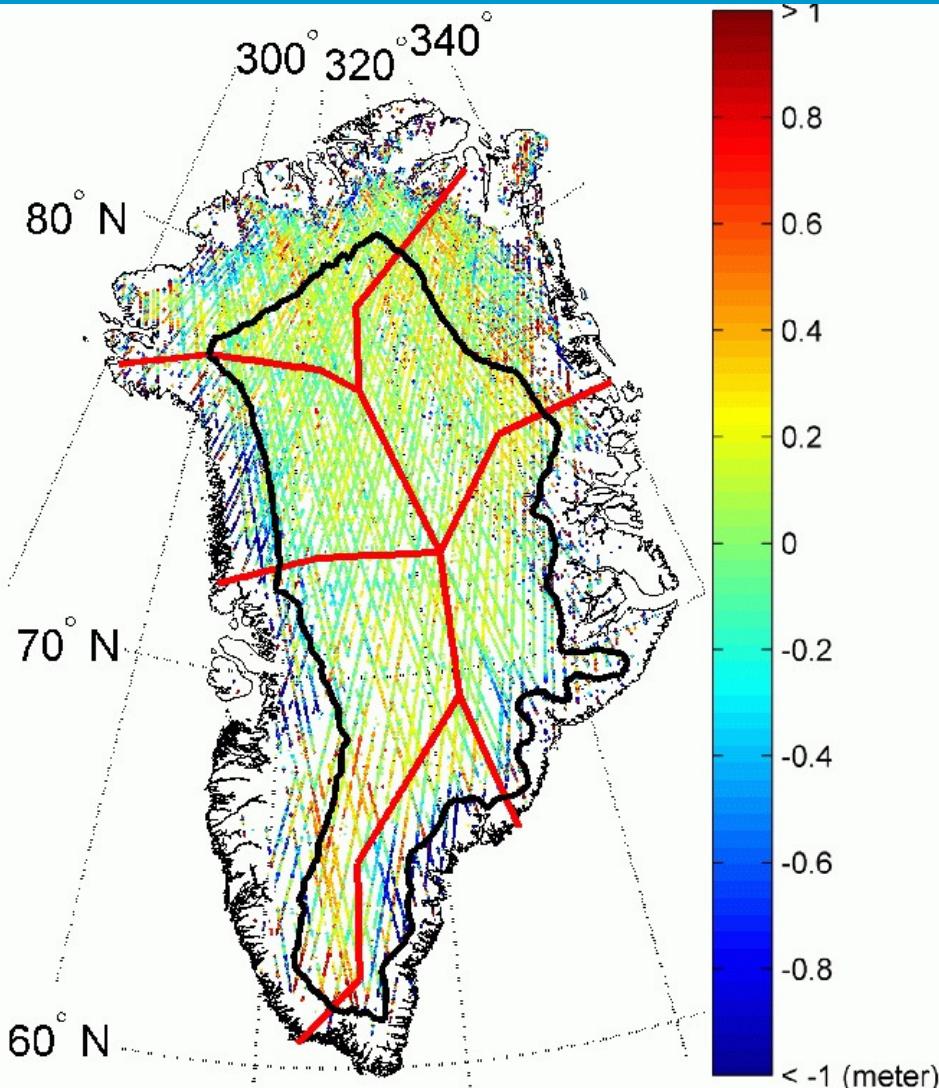
Upper Zambezi sub-catchment,
(0.5 million km²)



Regional hydrological model
versus GRACE

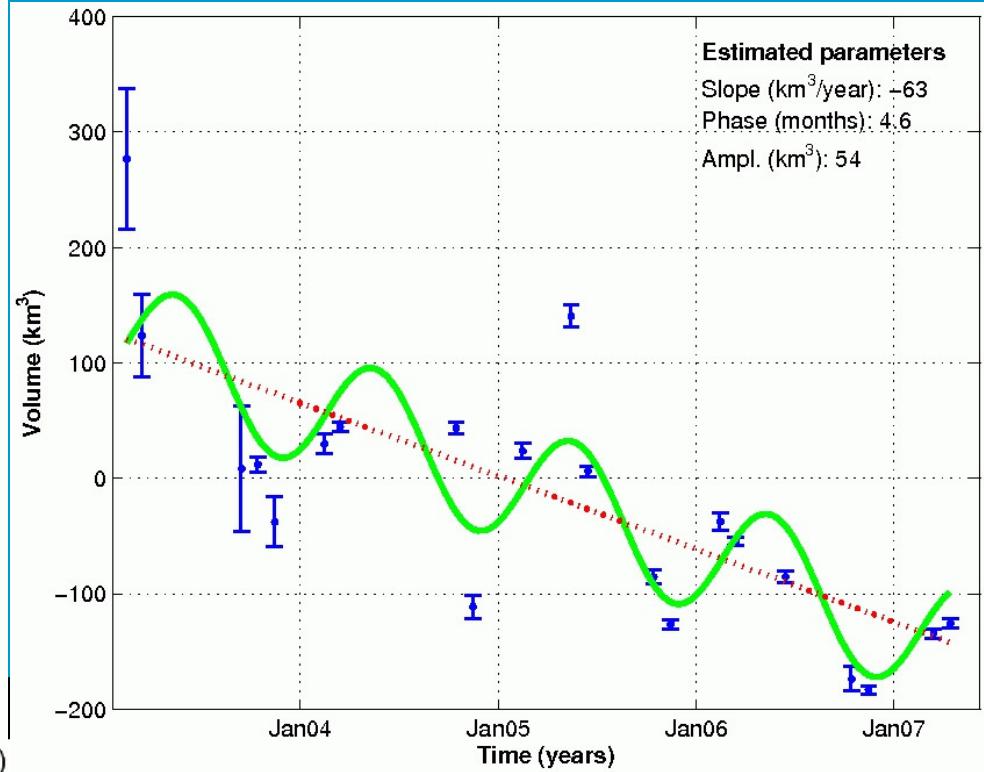


Glaciers mass balance ICESAT / GLAS



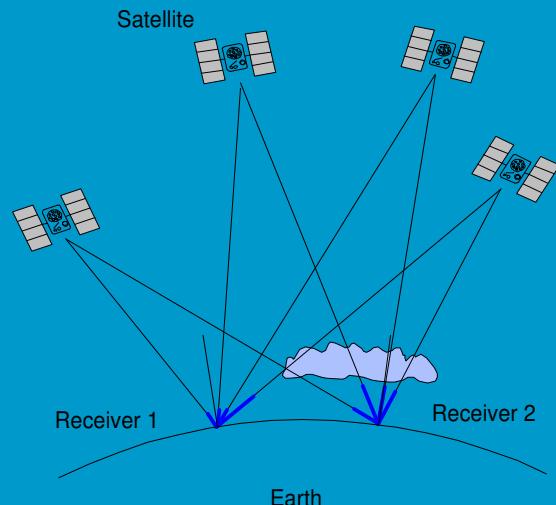
Method developed and demonstrated for Greenland

Planned extension to Tibet - Qinghai

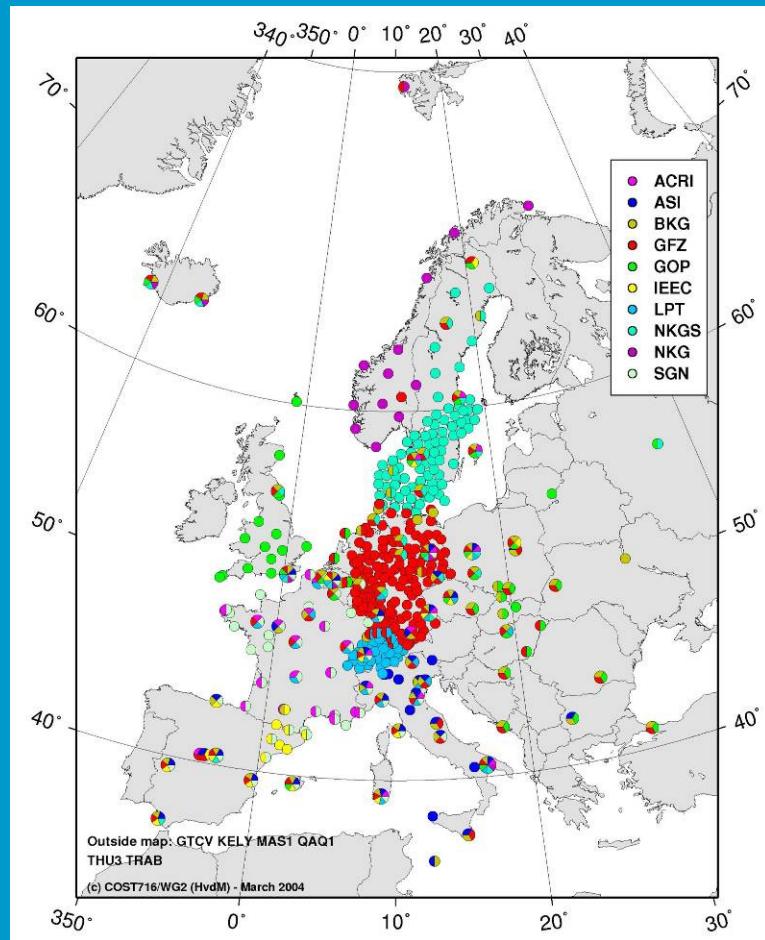


Water vapor estimation using GPS

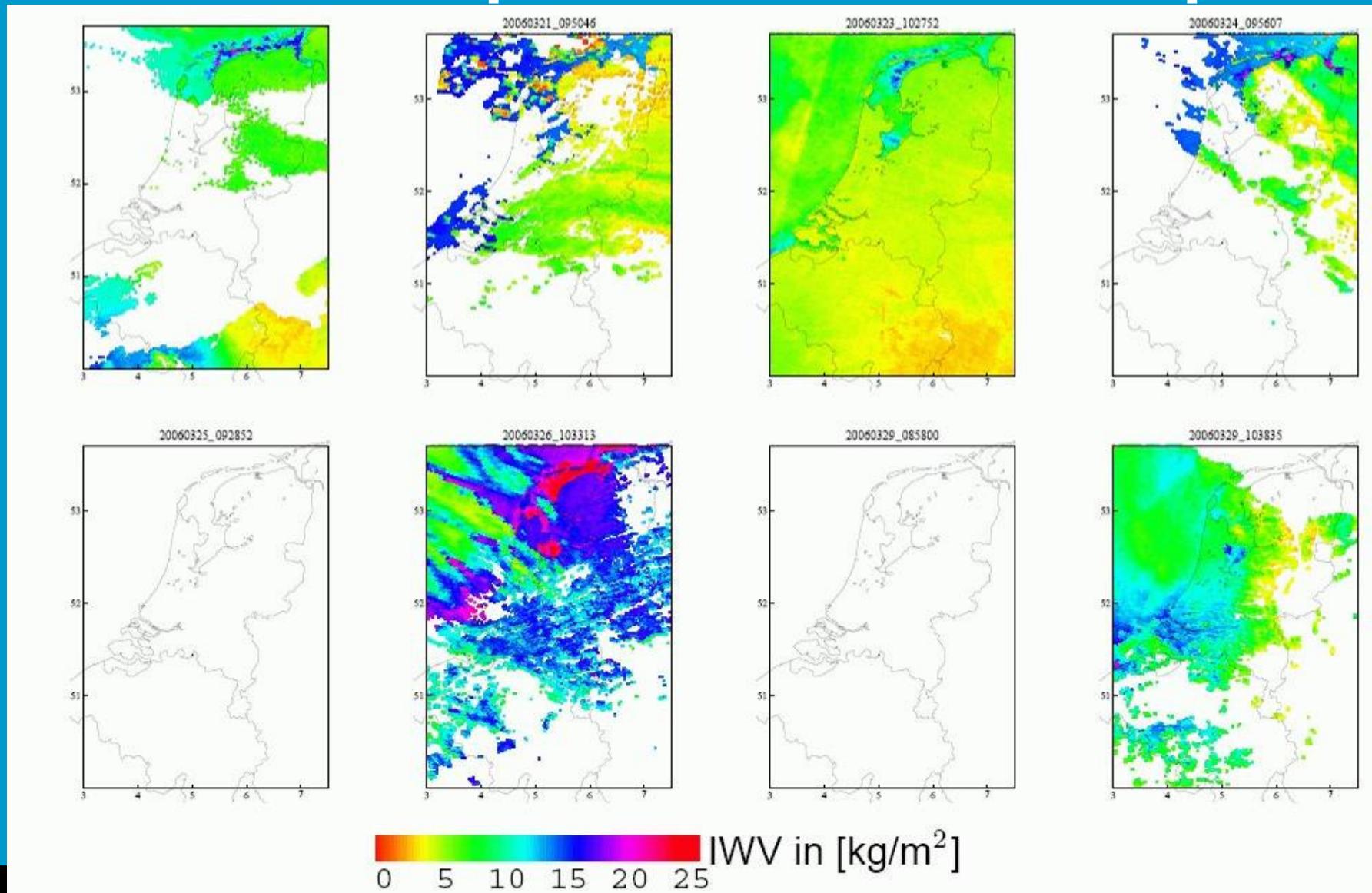
Demonstration network for the exploitation of ground based GPS for numerical weather prediction and climate applications



NRT network of 400 stations (< 1h45m)



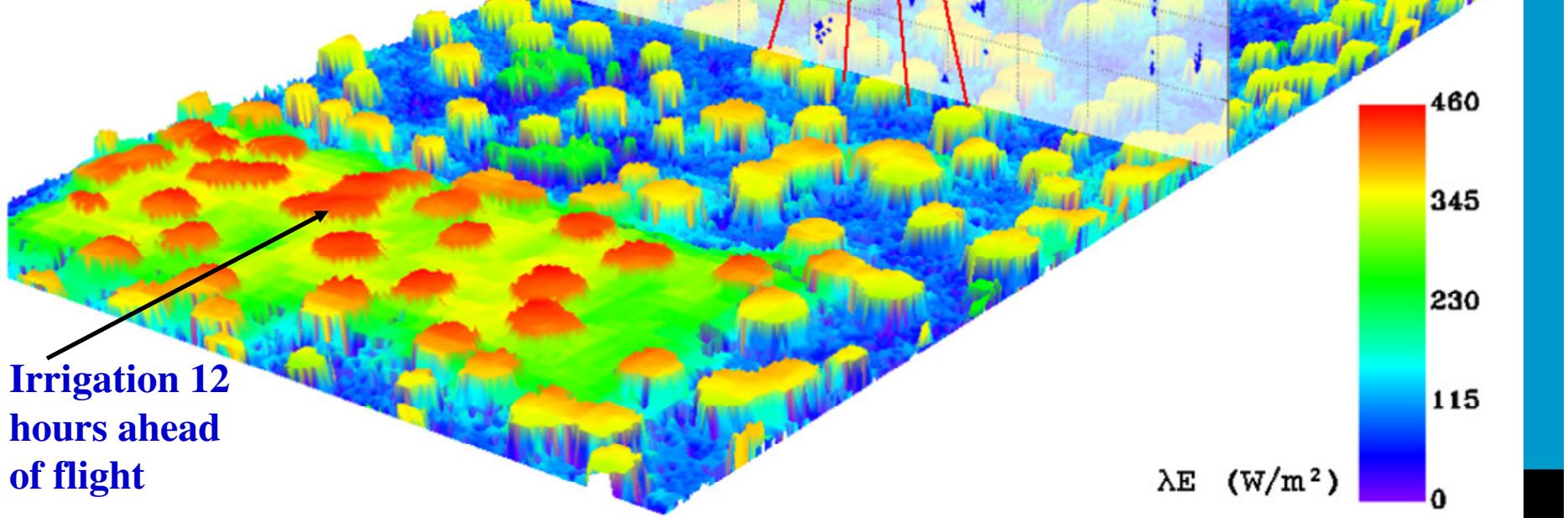
MERIS: Atmospheric Column Water Vapour



SEB + structure: Majadas del Titar

Multi spectral imagers
+ fluxes = SkyArrow
ISAFOAM

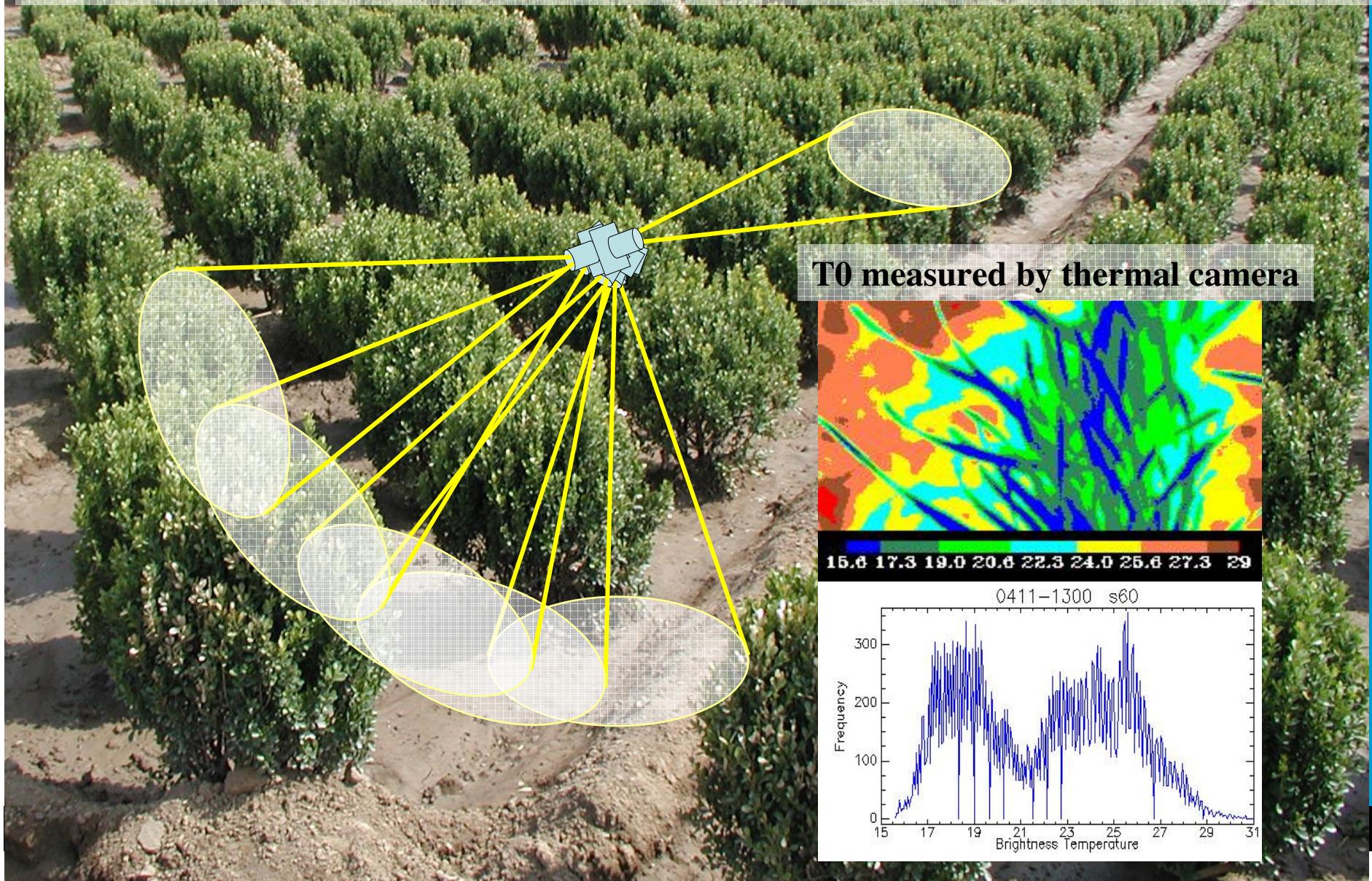
Laser altimeter =
ULP/LSIIT



ESAWAT - Rotterdam May 20th 2009



3D Vegetation: Surface temperature measurements



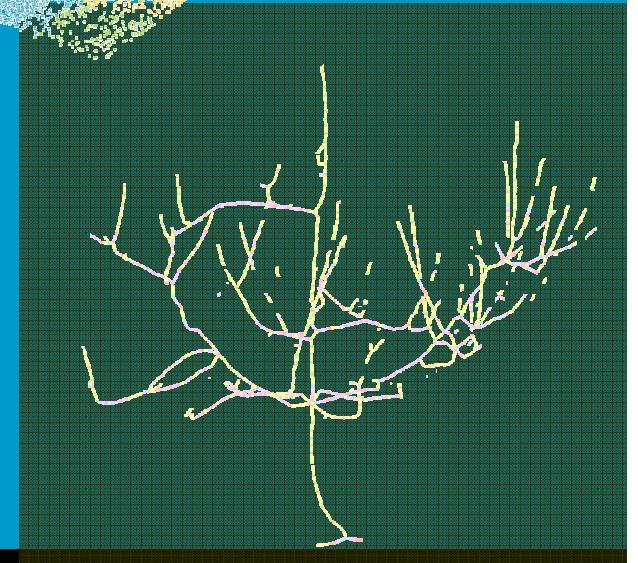
Vegetation Canopies: Estimates and Measurements

Canopy Lidars can be used to:

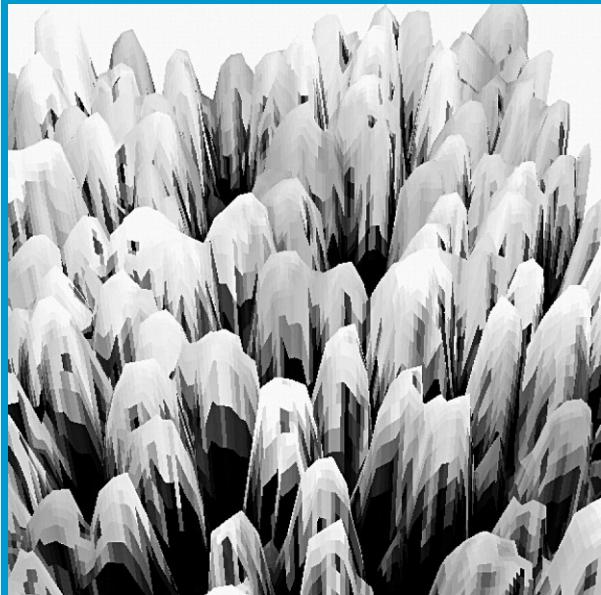
- Map Vertical Foliage Profile
- Map ground micro-relief
- Map canopy Structure
- Map canopy biomass components

Fundamental measurements:

- Canopy Gap probability ⇒ **Multi Angular Radiometry**
- Canopy Vertical Foliage Profile



Light Regime in a Forest



Function of Cover and structure



Coordinated Asia-European long-term Observing system of Qinghai–Tibet Plateau hydro-meteorological processes and the Asian-monsoon systEm with Ground satellite Image data and numerical Simulations

www.ceop-aegis.org

Coordinator: Massimo Menenti

18 Organizations in 8 countries

EU 7th Framework Program ENVIRONMENT - Improving observing systems for water resource management

Objectives



- Demonstrate an observing system to determine and monitor the water yield of the Plateau
 - Incorporate existing ground measurements and **current / future satellites**
 - Requires estimating snowfall, rainfall, evapotranspiration and changes in soil moisture
- Monitor the evolution of surface conditions and analyze the linkage with convective activity, precipitation events and the Asian Monsoon
 - Monitor snow, vegetation and surface fluxes as precursors of intense precipitation towards improving forecasts of (extreme) precipitations in SE Asia.

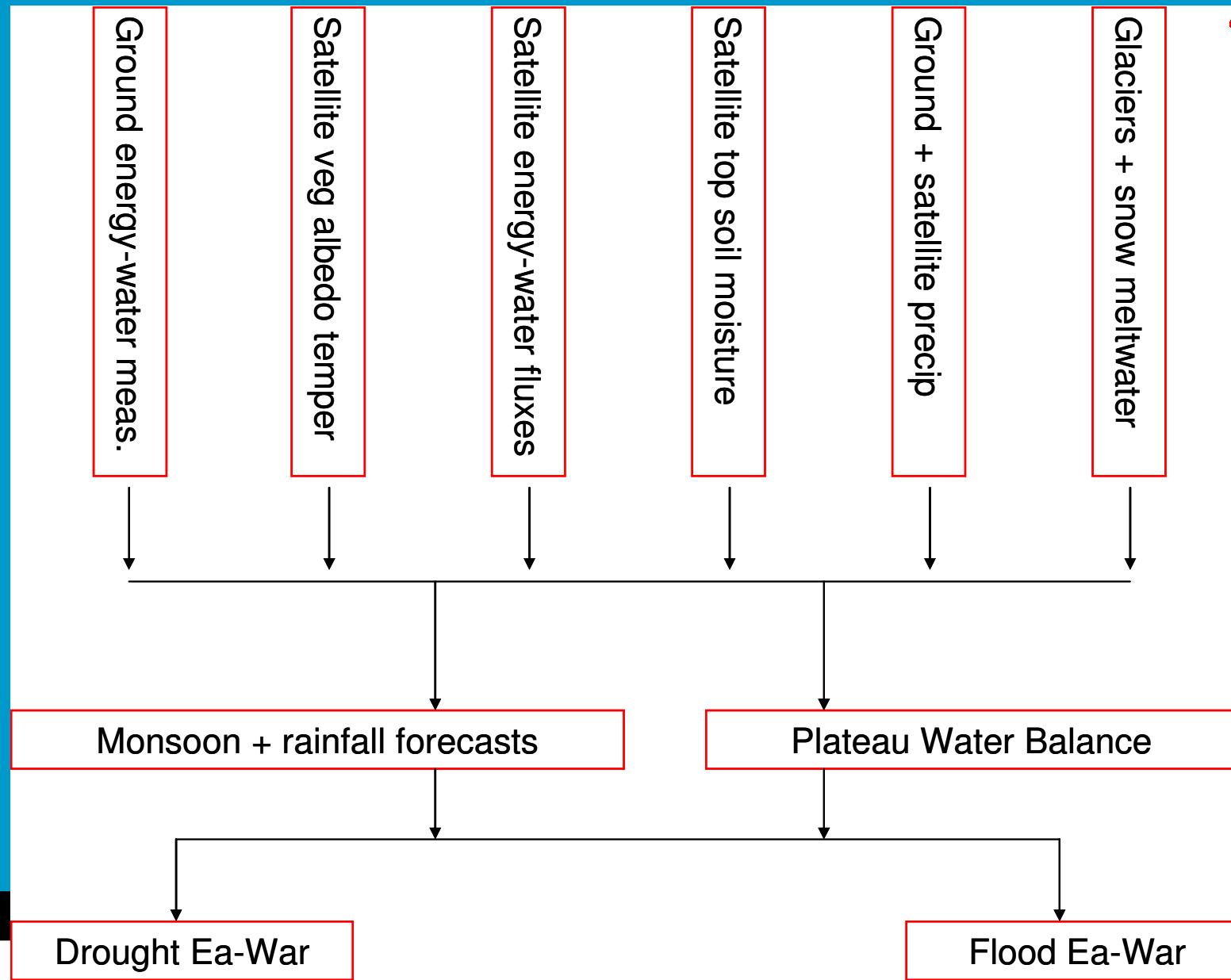
Water resources, hydrometeorology and Asian Monsoon



- Qinghai Tibet Plateau :
 - Headwater area of seven major rivers in SE Asia
 - Regulating area for the climate of China and of the Eastern Hemisphere as a whole
 - Exerts profound thermal and dynamical influences on the onset, maintenance, and withdrawal of the monsoon



Interrelation of project elements



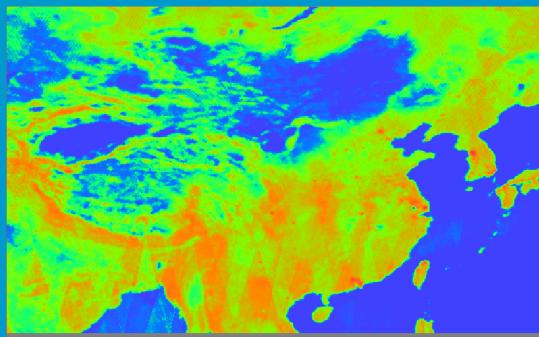
CEOP – AEGIS Participants



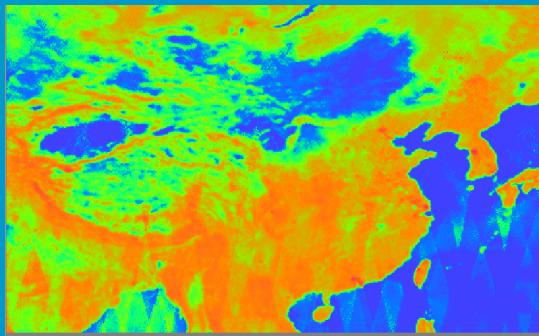
<i>Participant organization name</i>	<i>Local contact</i>	<i>Country</i>
Université Louis Pasteur LSIIT ULP	Massimo Menenti	France
International Institute for Geo-information science and Earth Observation ITC	Bob Su	The Netherlands
ARIES Space	Guido D'Urso	Italy
University of Bayreuth UBT	Thomas Foken	Germany
Alterra - Wageningen University and Research Centre	Li Jia	The Netherlands
University of Valencia UVEG	José Sobrino	Spain
Institute for Tibetan Plateau Research ITP – Lhasa, Tibet	Yaoming Ma	China
China Meteorological Administration CMA – Beijing	Liping Liu	China
Beijing Normal University BNU – Beijing	Li Xiaowen	China
National Institute of Technology NIT - Rourkela	Ramakar Jha	India
University of Tsukuba – UNITSUK	Kenichi Ueno	Japan
WaterWatch	Wim Bastiaanssen	The Netherlands
Cold and Arid Regions Environmental and Engineering Research Institute CAREERI– Lanzhou, Gansu	Wang Jian	China
University of Ferrara	Federico Porcù	Italy
Institute of Geographical Sciences and Natural Resources Research IGSNRR CAS – Beijing	Liu Changming	China
Institute for Remote Sensing Applications IRS CAS – Beijing	Liu Qinhua	China
Future Water	Walter van Immerzeel	The Netherlands
Delft University of Technology	Massimo Menenti	The Netherlands

Soil moisture results ASCAT data

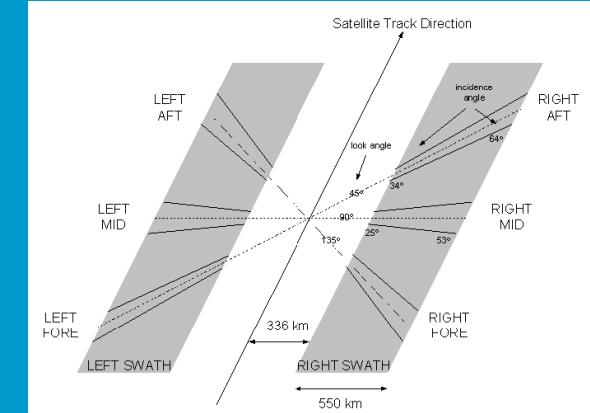
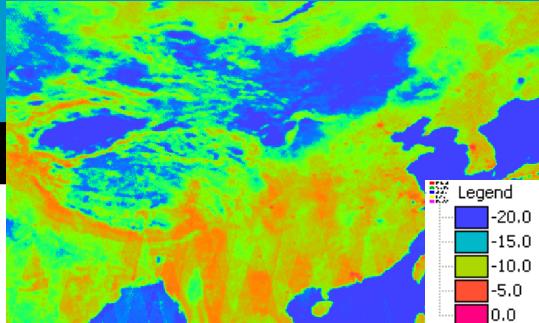
sigma zero triplet for values



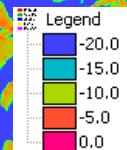
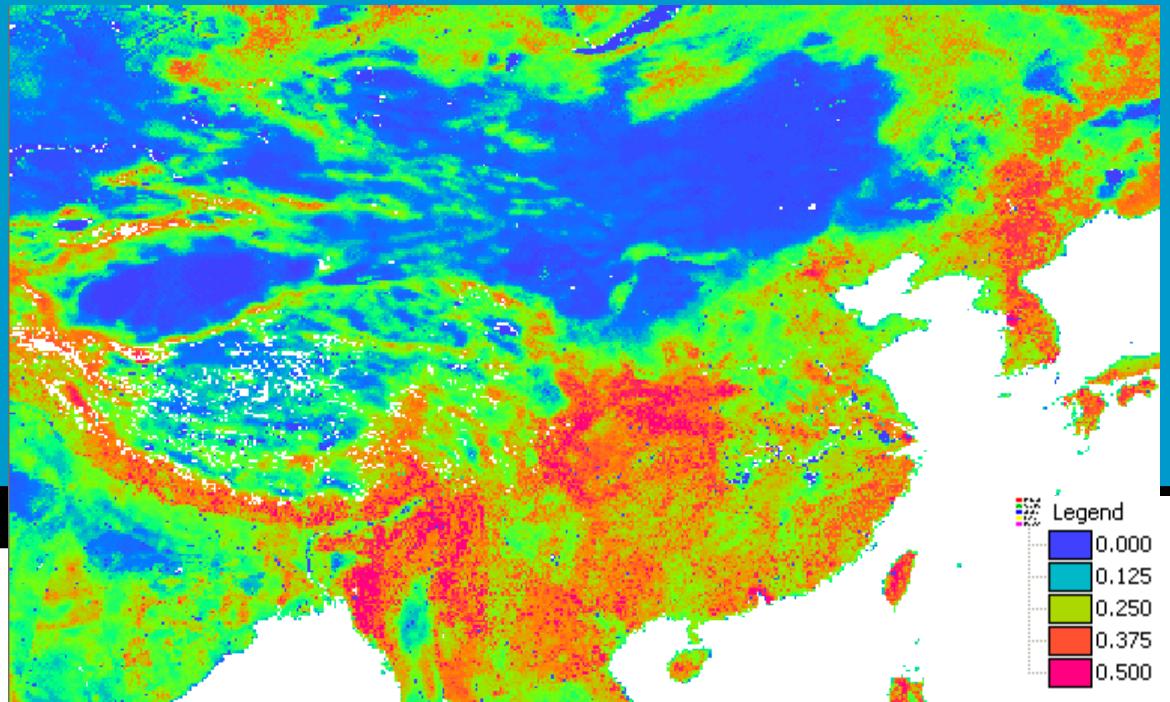
sigma zero triplet mid values



sigma zero triplet after values

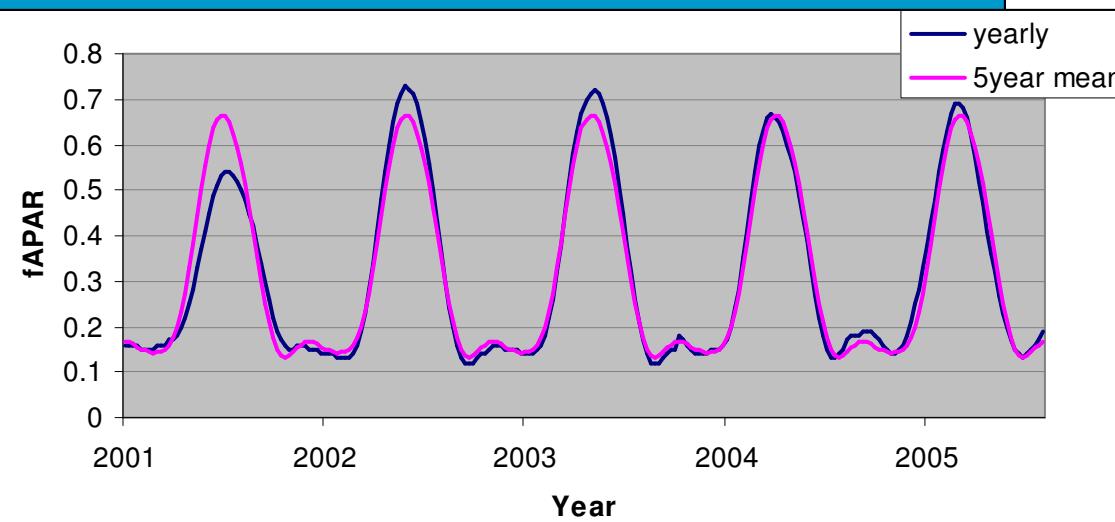
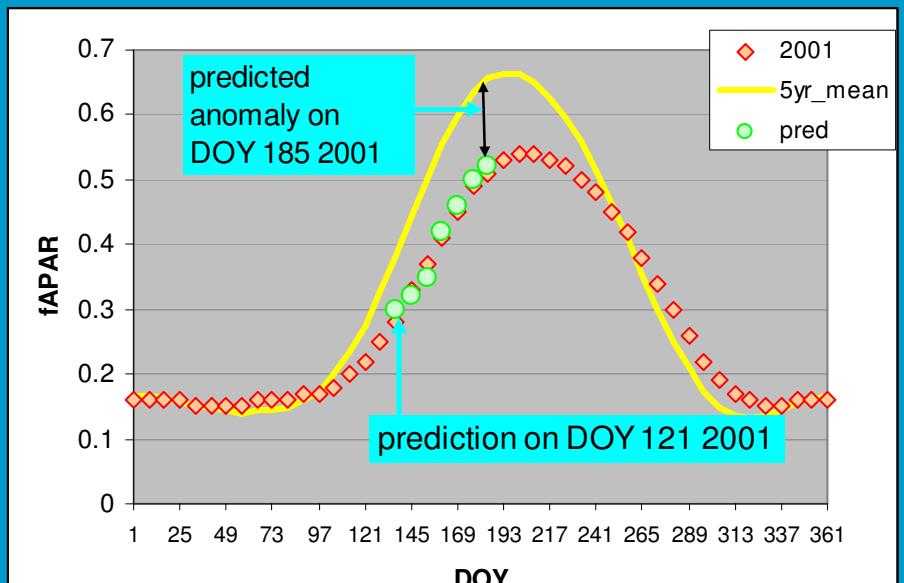


Soil moisture (m^3/m^3)



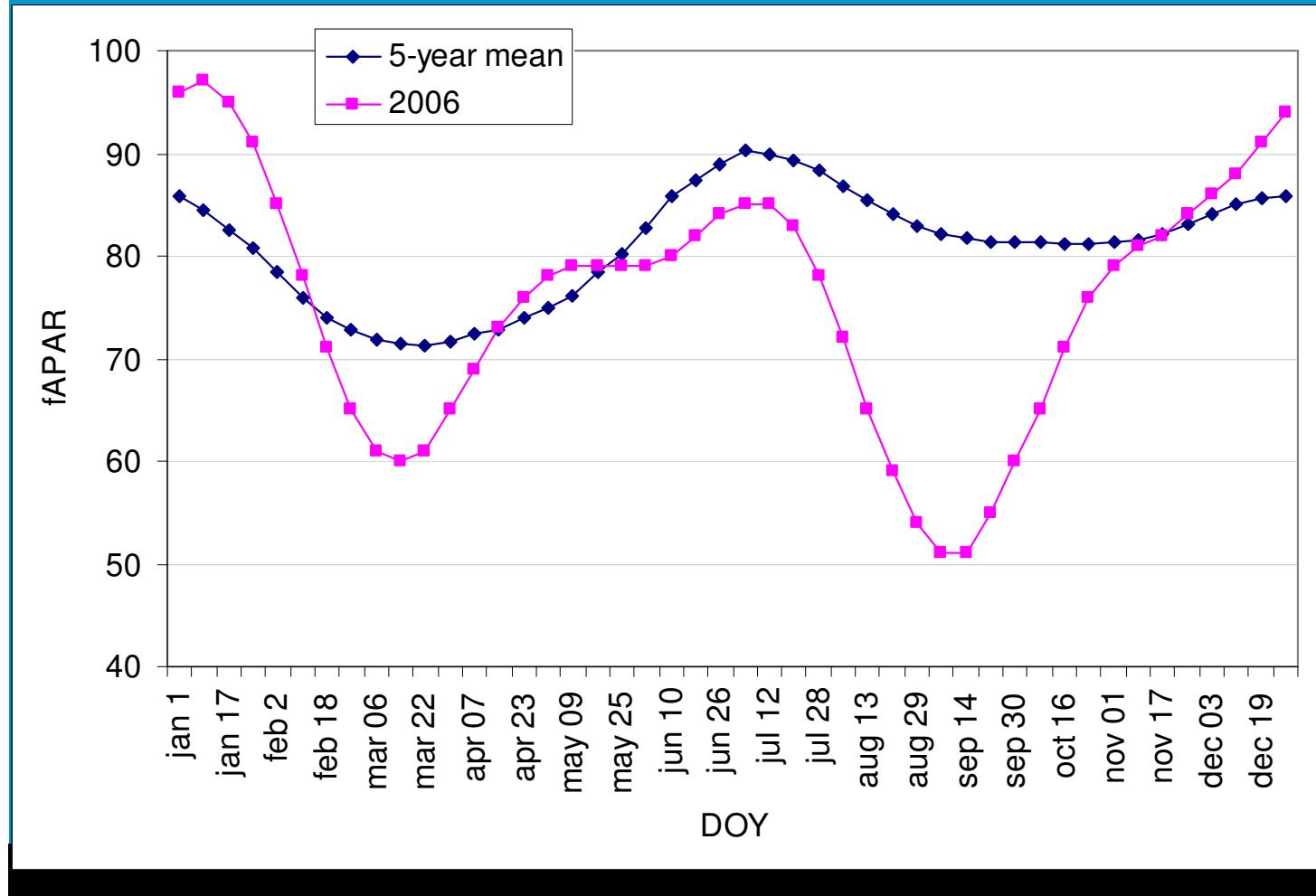
Early warning and prediction of drought events

Prediction: through modeling of time series by Fourier series, wavelets, Markov chains, etc. per pixel over entire country.



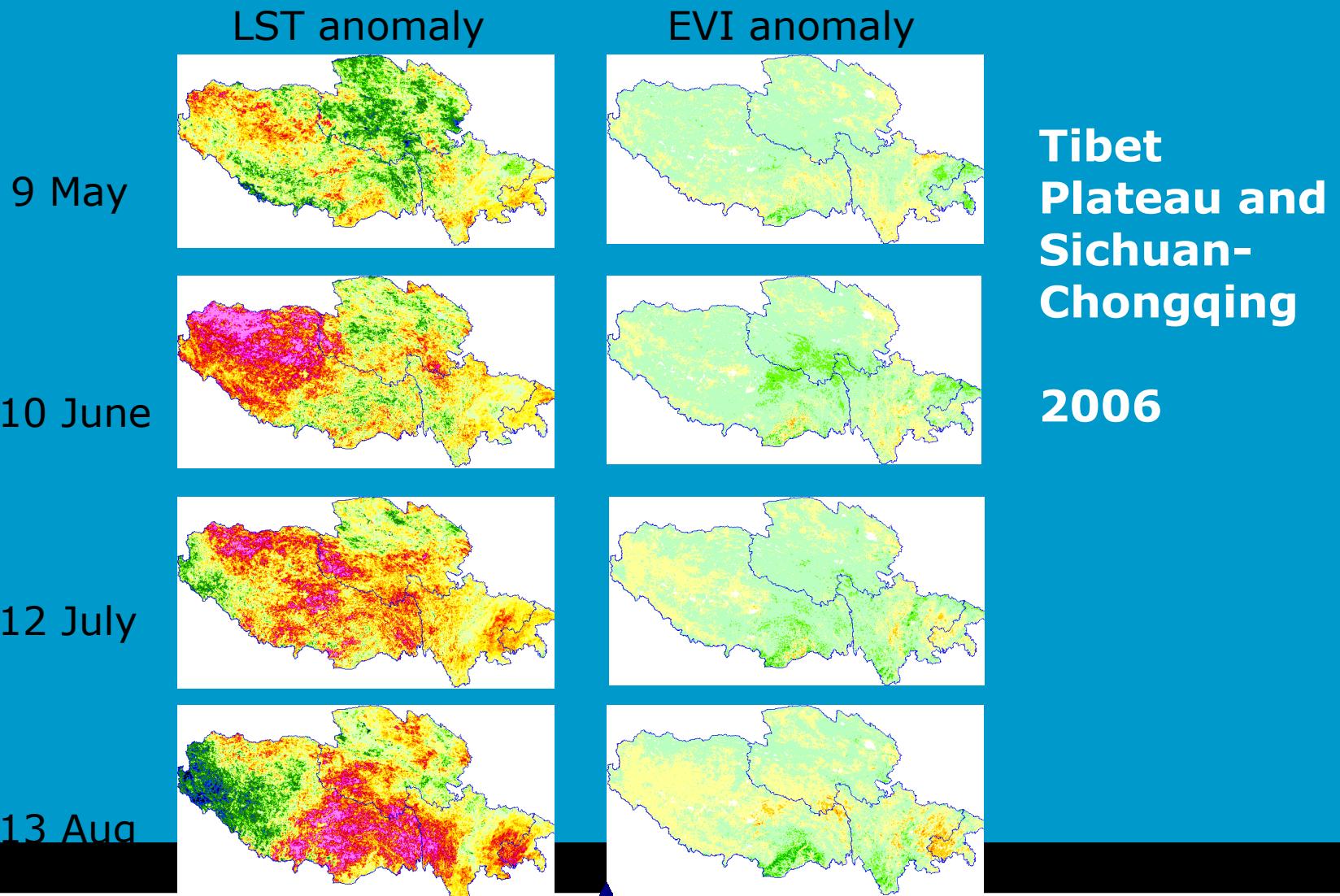
Drought monitoring and Early Warning by detecting anomalies

Anomaly: Deviation of current state from historical average

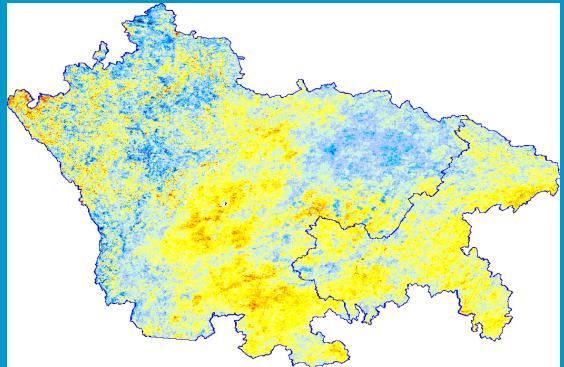


Sichuan
Chongqing
drought
2006

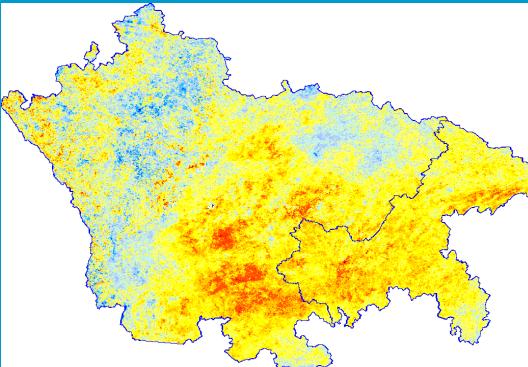
Drought monitoring and Early Warning by detecting anomalies



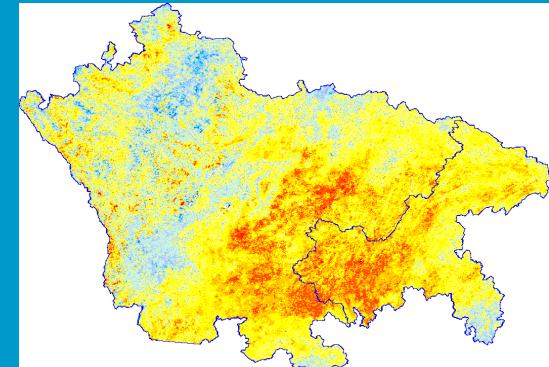
LST anomaly Sichuan-Chongqing 2006 drought



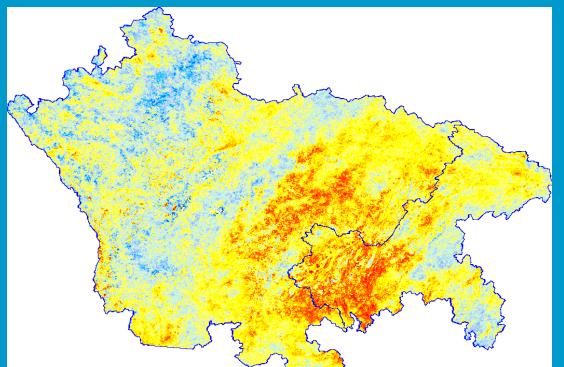
May



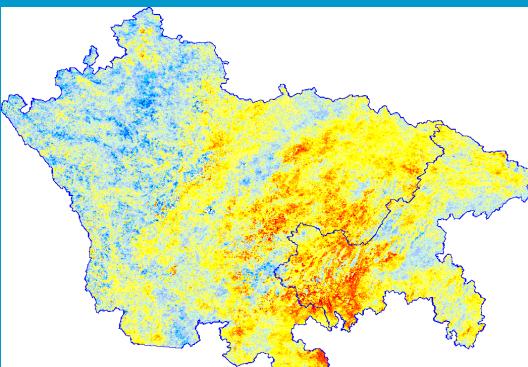
June



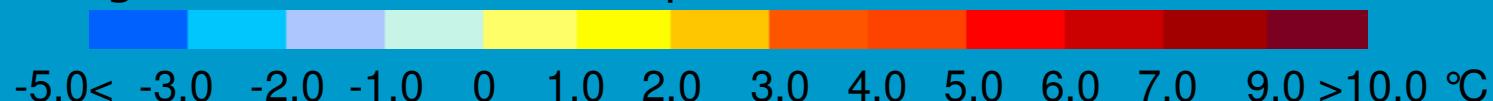
July



August



September



GAPS OBSERVATION SYSTEMS

- TIR observations at high / intermediate spatial resolution
- Full waveform LIDAR for terrestrial applications
- Multi-angular multi / hyper spectral observations

A wide-angle photograph of a natural landscape. In the foreground, there are green fields with some small bodies of water. In the middle ground, there is a large body of water, possibly a lake or a wide river, surrounded by green hills and mountains. The sky is blue with some white clouds.

Thank you!

Contact
www.ceop-aegis.org