Contributing to GEOSS

Project participants

University of Strasbourg, FR (Coordinator)
International Institute for Geo-information science and Earth Observation, NL
ARESpace, IT
University of Bayreuth, GE
Alterra - Wageningen University and Research Centre, NL
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China Meteorological Administration, Beijing, CN
Beijing Normal University, CN
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WaterWatch, NL
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University of Ferrara, IT
Institute of Geographical Sciences and Natural Resources Research, Beijing, CN
Institute for Remote Sensing Applications, Beijing, CN
FutureWater, NL
Delft University of Technology, NL
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CEOP-AEGIS is a EU-FP7 Collaborative Project / Small or medium-scale focused research project – Specific International Co-operation Action coordinated by the University of Strasbourg, France under the call ENV.2007.4.1.2 «Improving observing systems for water resource management»

Period: May 2008 – May 2012

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With 18 European and Asia research organizations and about a hundred participating scientists, the CEOP-AEGIS project contributes to the creation of highly innovative datasets on the hydrology and climatology of the Tibetan plateau. To get the most out of these datasets, an efficient and user-friendly data-sharing platform has been established to help scientists exchange ground-based and satellite-based data and information.

On a broader perspective, the CEOP-AEGIS project constitutes an important contribution to the Global Earth Observation System of Systems (GEOSS) 10-year implementation plan and contributes to several GEOSS societal benefit areas including water resources, climate, weather and disasters themes. It also contributes to the Group on Earth Observation (GEO) Architecture and Data Committee and GEO Capacity Building Committee, including such aspects as precipitation, water storage measured from space, networks of super sites, data access and data sharing, as well as capacity building.

The infrastructure presented as a new "CEOP-AEGIS Data Portal" is clearly dedicated to the "data access and data sharing" commitment. The prototype of data service designed at the University of Strasbourg consists in a complete processing chain from the data producers to the end-users, to allow the access to project information, documentation and data catalogue. The data management backend follows international standards for data storage, data model and meta data semantics, and rely on open-source solutions. The Institute for Tibetan Plateau Research hosts the hardware infrastructure in Beijing. After validation, the presented prototype will be transferred to ITP Beijing to provide a new data access service for the community.

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Multi-sensors bio-geophysical surface parameters

Ground observations are a key component of the project to provide reference data, in particular for the validation of Earth Observation based variables at both regional and continental scales. Although the landscape of the Tibetan Plateau is highly heterogeneous, observation sites of the TORP-GAME/Tibet and CAME-A/SNMR networks cover every type of land surfaces over the Tibetan Plateau. Beside standard weather station sensors, these sites also include passive and active sensors dedicated to measure the seasonal and interannual time scale of surface heat flux, momentum flux, water vapour flux, surface and soil moisture over different land surfaces of the Tibetan Plateau. Tethered balloons, radio sondes, wind profilers and PIR, tower data provide key variables to monitor the structure and characteristics of the surface and atmospheric boundary layer.

All these ground observations are invaluable sources of information to develop and validate generic algorithms designed to characterize the physical state of the land surface from satellites.

Hydrological modeling and monsoon studies

The integration of spatial information from Earth Observation into a distributed hydrological model is at the core of a prototype water balance monitoring system of the whole Tibetan Plateau.

The panопy of ground based and satellite based product is either used for forcing or calibration validation. Forcing consists of direct inputs of timely remotely sensed observations, such as precipitation, evaporation, snow, ice and vegetation cover. Snow and ice cover derived from remotely sensed multi-spectral and multi-angular imaging radiometers, many developed and operated by China, and vegetation, which can be quantified by the vegetation index (VI), derived from moderate resolution sensors.

Data assimilation and numerical weather prediction is used to estimate and validate the key variables for the hydrological model setup. The system is designed to characterize the physical state of the land surface from satellites.

Vegetation responds to drought by changing spectral properties and by increasing thermal emission since the photosynthesis and transpiration activities are reduced by insufficient water supply. In data-sparse environments, direct observations of land and vegetation by satellites have the advantage of covering large regions with frequent data acquisition and high spatial resolution, which allows monitoring dynamic environmental conditions such as rainfall, soil moisture, thermal properties and changes in vegetation growth condition. Such data can be used to detect the onset of drought and to monitor the duration and severity of drought.

Multi-sensor data have an increasing importance for the study of monsoons. The recent SMOS (Soil Moisture and Ocean Salinity) mission is particularly interesting in this respect. The GRACE (Gravity Recovery and Climate Experiment) and GOCE missions are also used to estimate changes in the total water stock of the Plateau, as well as data collected by the Jason-1 Ocean Topography mission (JOT) onboard the ice, cloud and land elevation Satellite (ICESat), used to estimate the mass balance of glaciers and snow patches.

Toward an observing system of the Plateau

Headwaters of rivers that flow down to 1.4 billion people, the Tibetan Plateau, with an area of about 470 million square kilometers and an extent of 2.5 million square kilometers, plays a determinant role in both hydrology and climate of Southeast Asia. The dynamic and thermodynamic effects of the Plateau on the atmospheric circulation also influence downstream river flow. Surface characteristics of surface radiative and convective fluxes within the Atmospheric Boundary Layer are not only determinants of the Plateau’s climate, but also exert a profound influence on the onset, maintenance and withdrawal of the Southeast Asian Monsoon. A good understanding of the linkage of land processes on the Plateau with monsoon onset and precipitation is of major relevance from both societal and environmental points of view for many Asian countries, in particular in terms of flood and drought, and also in terms of food security in a changing environment. Improving water management and predicting changes in water resources in Southeast Asia cannot rely only on existing information. There is an urgent need for reliable, long-term observations from space. Observing systems onboard current and future satellites provide regular and global coverage of surface and atmospheric properties. Imaging spectro-radiometers and passive microwave emission radiometers at low frequencies provide useful measurements of surface soil moisture. The recent SMOS mission is particularly interesting in this respect. All these observations are used to estimate the mass balance of glaciers and snow packs.

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Early warning on drought and flood

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Multi-sensors bio-geophysical surface parameters

Ground observations are a key component of the project to provide reference data, in particular for the validation of Earth Observation based variables at both regional and continental scales. Although the landscape over the Plateau is dominated by heterogeneous observation sites of the TORP-GAME/Tibet and CAMD, observations of every type of land surfaces over the Tibetan Plateau. Besides standard weather station sensors, these sites also include radiative and energy balance measurements to monitor the seasonal and inter-annual time scales of surface heat flux, momentum flux, water vapour flux, soil surface temperature and soil moisture over the different land surfaces of the Tibetan Plateau. Tethered balloons, radio-sondes, wind profilers and PIRs, tower data provide key variables to validate the structure and characteristics of the surface and atmospheric boundary layer.

All these ground observations are invaluable sources of information to develop and validate generic algorithms designed to characterize the physical state of the land surfaces from satellites.

Any multi-spectral imaging radiometer is a potential source of data to retrieve these variables, but relying on a single satellite or sensor system severely reduces the frequency of useful (cloud-free) observations. On the other hand, the synergies between multi-spectral, multi-angular imaging radiometers, many developed and operated by China and India, which could guarantee the required spatial and temporal coverage if pooled together. The latter requires going beyond the traditional single-sensor approach to retrieve by inversion of Top Of Atmosphere radiometric data. One of the main tasks conducted within GEOSS is to develop a data acquisition and processing system to use all available data sources, following a virtual satellite constellation concept, by relying on the current and growing Earth Observation capabilities of newly industrialized countries such as India and China, particularly for South and East Asia. The core of this system is a family of generic algorithms able to use any set of multi-spectral, multi-angular radiometric data to retrieve the required parameters and to temporally and seasonally the same set of land surfaces properties, i.e. snow and vegetation cover, surface albedo and temperature.

Many other satellite sensors are also used to extend the panel of key eco-hydrological products. Among others, passive microwave emission radiometers provide useful measurements of surface soil moisture. The recent SMOS (Soil Moisture and Ocean Salinity) mission is particularly interesting in this respect. The GRACE, and GOCE missions are also used to estimate changes in the total water stock of the Plateau, as well as data collected by the Geostationary Environment Monitoring Satellite (GEMS) and the Chinese L-band Satellite (CEOSAT), used to estimate the mass balance of glaciers and snow packs.

All these sources of observation are merged in a single Earth Observation System to provide a three year dataset of bio-geophysical variables at a target range of 1 to 5 kilometers. These data are validated for hydrological models, and as knowledge

Hydrological modeling and monsoon studies

The integration of spatial information from Earth Observation into a distributed hydrological model system to provide a prototype water balance monitoring system of the whole Tibetan Plateau.

The panoply of ground-based and satellite based product is either used for forcing or calibration validation. Forcing consists of direct inputs of timely remotely sensed observations, such as precipitation, evaporation, snow, ice and vegetation cover. Snow and ice coverage derived from satellite observations to polar satellites, expressed both in terms of surface and water equivalent, are also ingested as forcing variables. Vegetation cover, surface albedo and leaf area index maps are provided to follow surface changes on a monthly basis. A set of Surface Energy Balance algorithms provide the full spectrum of turbulent fluxes, and in particular the surface evaporation over all the Plateau.

All these observations are integrated using a GIS-based hydrological model to provide a complete hydrological balance of the entire Plateau. The water balance model developed to monitor the water yield of the Tibetan Plateau, called TibWatMod, is based on PCRgloWb model. It is designed to use the down-scaled PCG global Climate Change data to implement scenarios of hydrological response of the Plateau for the next decades. The use of the high resolution non-hydrostatic Numerical Weather Prediction model GRAPES helps to investigate the role of fine scale heterogeneity in underlying surface on initiation of meso-scale convections associated with heavy satellite precipitation events. Using the land-atmosphere processes influencing the monsoon precipitation events, and to help improving the heavy rainfall forecast skill of meso-scale numerical models over the Plateau and surrounding regions.

Early warning on drought and flood

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Multi-sensors bio-geophysical surface parameters

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All these ground observations are invaluable sources of information to develop and validate generic algorithms designed to characterize the physical state of the land surface from satellites.

Any multi-spectral imaging radiometer is a potential source of data to retrieve these variables, but relying on a single satellite or sensor system severely reduces the frequency of useful (cloud-free) observations. On the other hand, there is an urgent need for reliable, long-term observations from space. Observing systems onboard current and future polar and geostationary satellites have the advantage of covering large regions with frequent data acquisition and high spatial resolution, which allows monitoring with high accuracy at relatively low cost.

Observations from polar satellites, expressed both in terms of surface and water equivalent, are also ingested as forcing variables. Vegetation cover, surface albedo and leaf area index maps are provided to follow land surface changes on a monthly basis. A set of Surface Energy Balance algorithms provide operational data sets, and in particular the surface energy balance over the Plateau. All these observations are integrated using a GIS-based hydrological model to provide a complete hydrological balance of the entire Plateau. The water balance model developed to monitor the water yield of the Tibetan Plateau, called TIBETMap, is based on PRCклон-ResNet model. It is designed to use the down-sampled PCC Global Climate Change data to implement scenarios of hydrological response over different time scales.

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