HIGH-SPEED ACCESS TO DATA FROM SENSORS AND SEISMIC STATIONS USING CAREN NETWORK FOR EARTH OBSERVATION IN CENTRAL ASIA

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Abstract

Earth science is global by its nature and does not recognize national boundaries. This paper describes global collaboration on Earth observation in Central Asia using high-speed Central Asian Research and Education Network (CAREN) connected to GEANT and TEIN networks. Open access via high-speed CAREN to the geodatabase SENSOR DATA STORAGE SYSTEM http://sdss.caiag.kg/sdss/ with a web interface allows to build time series plots of the properties (like temperature, humidity or others), and monitor environment in Central Asia for users globally. Such applications as Glaciers and Climate Change monitoring, Seismic and GNSS monitoring, traffic flow analyses of research traffic via CAREN are presented.

Keywords

Central Asian Research and Education Network, monitoring stations, geo-database, glaciers monitoring

1. CAREN connectivity to GEANT and TEIN

Upgraded in 2014, CAREN’s high-speed network connectivity brings opportunities for Central Asia to participate in regional and global collaborative projects with high societal impact and direct relevance to the region, including environmental studies, seismology, telemedicine and preservation of natural and cultural heritage.

Fig. 1 Central Asian Research and Education Network (CAREN) connectivity with European GEANT and Trans-Eurasian Asian TEIN networks

2. CAIAG Monitoring Stations Network

Central Asian Institute of Applied Geosciences (CAIAG), in cooperation with GFZ German Research Centre for Geosciences, installed a network of weather, GNSS, seismic and hydro/weather stations. Using advanced ground
and remote observation techniques it allows to thoroughly studying temporal and spatial patterns in the development of natural processes and phenomena in Central Asian region. For storing huge data sets a database infrastructure was established and further developed, which contains significant amount of geo-information from various sources. At present, the geo-database SENSOR DATA STORAGE SYSTEM http://sdss.caiag.kg/sdss/ is available with a web interface for open quick access by users globally using connectivity of the Central Asian Research and Education Network (CAREN). CAREN provides high bandwidth connectivity to GEANT and TEIN networks.

Fig.1 Location of stations for monitoring network

Glaciers and Climate Change monitoring. Understanding how the environment is altering through ongoing monitoring is key to coping with the effects of climate change. Only then is it possible to devise mitigation and adaptation strategies and create early warning systems to protect lives and livelihoods. Monitoring initiatives have begun, involving glaciologists and geohazard experts across Central Asia and Europe. This international collaborative research generates large amounts of data that needs to be shared, often in short timescales from remote locations. The Gottfried Merzbacher Global Change Observatory, situated at an altitude of over 3000m in the Tien Shan glacier range in Kyrgyzstan is a joint venture between Kyrgyzstan's Central Asian Institute of Applied Geosciences (CAIAG) in Bishkek and the German Research Centre for Geosciences (GFZ) in Potsdam. Consequently, the fight to mitigate climate change relies on high-speed research networks, such as CAREN (in Central Asia), GEANT (in Europe) and TEIN (in Asia) to underpin these vital activities.

3. Seismic Monitoring

Seismic monitoring is realized both by the CAIAG stations and by the stations of other seismic network. Data acquisition and processing are carried out with program SeisComP3. This program provides a connection to International network FDSN, allowing CAIAG users to have the access to its data and giving the CAIAG data to FDSN network members.
CAREN connectivity to TEIN network provides possibility access to Sentinel Asia program and data exchange for emergency situations in the Pacific Rim on the basis of Digital Web GIS. The purpose of Sentinel Asia is to support actions on management of disasters.

4. GNSS Monitoring

GNSS (Global Navigation Satellite Systems) monitoring is carried out by all stations of the network. The data from them automatically transfer via communication facilities (Central Asian Research and Education Network, Internet, VSAT, GSM, other radio systems) to the Data center, is written to the file-server and meta-information is entered to the database.

GNSS processing is provided by the program Gamit/Globk (MIT, USA) in automatic mode under management of special programs developed in CAIAG with use of DBMS PostgreSQL.

As result, the time series and velocity vectors are calculated.

5. Hydrometeor Monitoring

Hydro-meteorological monitoring is realized by the automatic stations with sensors registering hydrometeo parameters: Air temperature and relative humidity; Wind Speed and Direction; Barometric Pressure; Snow Depth, Density, Water Equivalent; Solar short- and long-wave; Incoming and outgoing radiation; Liquid Precipitation; Soil Temperature at 6 depths; Soil Water Content at 6 depths).

Acquisition system of the Data center collects the data in defined time intervals using the satellite communication channels and places them to the data base. For this aim in CAIAG a special sensor data storage system (SDSS) was developed.
6. Sensor Data Storage System (SDSS)
The system contents meteorological and hydrological data of the CAIAG monitoring stations installed by the project Central Asian Water (CAWA) and Global Change Observatory (GCO).

SDSS represents a storing place on basis of data base PostgreSQL and serves for data management. Besides the sensor data, SDSS allows to input and edit a metadata for properties, stations, sensor devices and units of measure.

SDSS has a comfortable mechanism of Multilanguage support. Data output from DB is provided to a screen in time series plots which can be printed or saved to file for work with MicroSoft Excel.

Sensor Data Storage System (SDSS) allows to build time series plots of the properties (like temperature, humidity or others), to shift them or to change their scale.

Fig. 4 Example of temperature plot from Aksay station taken from SDSS

3. CAREN-Frankfurt data transmission traffic

CAREN NOC provides monitoring of network performance and traffic flow analyses. Following Graphs demonstrates data transmission traffic CAREN-Frankfurt and NREN traffic distribution in March 2015.

Fig. 5 Data transmission traffic CAREN-Frankfurt in March 2015
CAREN provides real-time data transmission and strengthening the cooperation and data exchange between researchers around the globe. At present, traffic flow analyses show that the main part of research traffic is going to DFN. Diagrams of data flows through the CAREN network, experience in implementing the research activities, data storage and management will be discussed.

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References


Biography

Askar Kutanov was born in 1958. He graduated Novosibirsk State University with specialization on physics in 1980. After completing post-graduate course at Kyrgyz Technical University, he defended candidate of sciences dissertation in 1988, and he defended Doctor of technical sciences dissertation in the field of Optical Information Processing in 1992. From 1993 to 1996 Dr. Askar Kutanov worked as research fellow and invited professor at Osaka University, Japan. He was appointed as President-rector of the Academy of Management under the President of Kyrgyz Republic in 1997-2004 and under his leadership Kyrgyz Research and Education Network Association (KRENA) has been established. He is Academician of the National Academy of Sciences, Kyrgyz Republic. He got State award of the Kyrgyz Republic in the field of science and technology for Kyrgyz research & education network development in 2004. At present, Prof. Askar KUTANOVI is the Regional Coordinator for EC Project Central Asian Research and Education Network (CAREN), and he actively promotes regional and international collaboration for Central Asian NRENs.