CASE STUDY - SEISMOLOGY

Broadband Seismic Monitoring for Dams

Güralp Instruments monitoring seismic activity threatening dams in the Caucasus Mountains,

Summary

The Sulak river in Dagestan, SW Russia, generates 1780 MW of power via a cascade of hydroelectric dams. The whole river lies within the seismically active Iran-Caucasus-Anatolia region which has experienced multiple M_0 6.0+ earthquakes in recent history and has the potential for a M_0 7.0+ in the near future. An array of 13 Güralp 6TD digital broadband seismometers transmitting real-time data for analysis provides an automatic remote sensing system, with Güralp instruments chosen for their ability to overcome field and network restrictions whilst simultaneously providing excellent quality data.

Fig. 1 *Chirkeisk Dam, Dagestan Republic, Russia. Although strong-motion sensors are already deployed on the dam, this project required an array of broadband seismometers to detect and characterise regional earthquakes.*

Background

Hydroelectric dams often require strong motion accelerometers to measure their vibrational response to nearby earthquakes. There are seven dams on the Sulak cascade, operated by Public Joint Stock Company RusHydro, that require broadband instrumentation to monitor seismic activity that has been advancing from the eastern Mediterranean over the last 200 years. Portable, simple-installation instruments for sites with moderate background noise were required due to the absence of suitable vault locations, to monitor the effect of earthquakes in the near-field without being affected by the dams themselves. M_0 6.0+ events have the potential to cause major structural damage to the dams as well as severe flooding downstream. Poor infrastructure required a system capable of supplying data to the RusHydro Dagestan HQ in Kaspiysk and the Dagestan Geophysical Survey in Mahachkala despite frequent power and communication interruptions.

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Güralp Solution

An array of 13 Güralp 6TD digital broadband seismometers was deployed across the region to monitor the increasing activity and potentially identify precursors to earthquakes that could cause major structural damage to the dams on the river. The 6TD was the perfect choice for RusHydro due to its portability, enabling it to be transported to remote locations and also its ability to record data to internal memory when the transmission network is interrupted. The GCF format (Güralp Compressed Format) was also the ideal way to transmit data thanks to its compact file size compared with other widely used formats e.g. miniSEED. The combination of standby memory, compact format and use of TCP protocol to avoid mixing, overlapping or loss of data packets means the Güralp solution provides an effective way of monitoring the seismic activity.

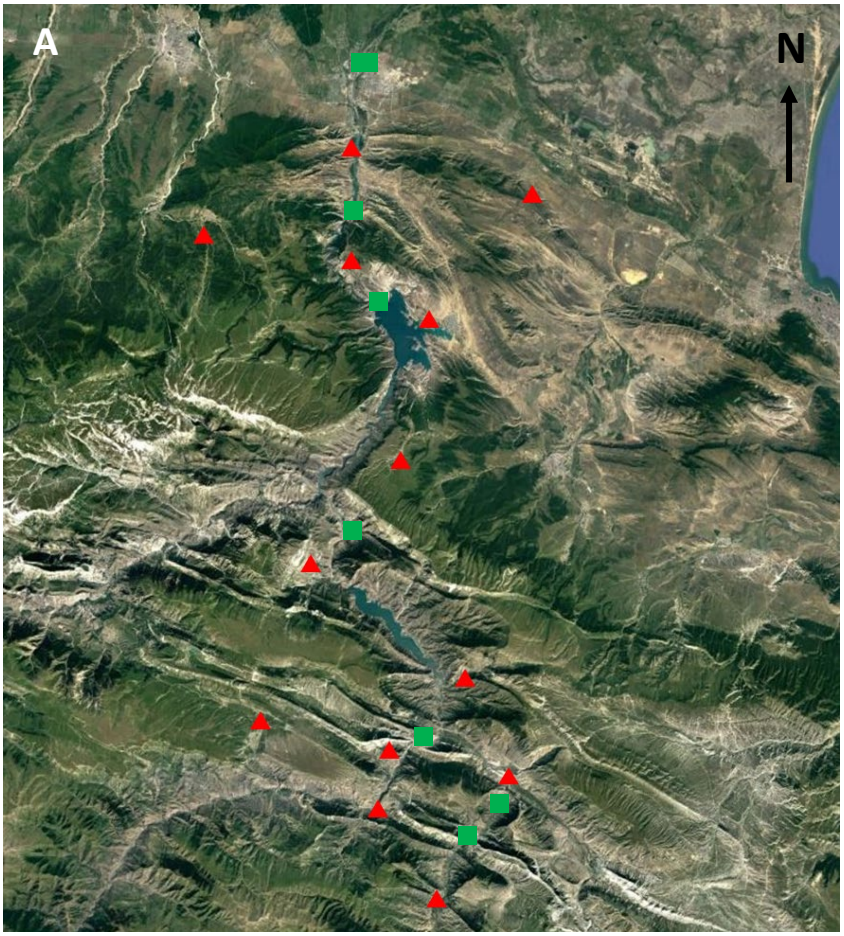

Fig 2. *Seismic Monitoring Array*

Array of 13 Güralp 6TD digital broadband seismometers spanning the length of the Sulak river (A). Dashed arrow (B) shows observed migration of seismic activity across the Iran-Caucasus-Anatolia region over the past 200 years.

Güralp 6TD digital broadband seismometer

Hydroelectric Dam

50km

Güralp Systems Ltd
Midas House, Calleva Park
Aldermaston
Reading RG7 8EA
United Kingdom

T +44 118 981 9056
F +44 118 981 9943
E sales@güralp.com

www.guralp.com