Enhancing Land Governance and Disaster Resilience in Bhutan through DrukNet

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SUMMARY

Bhutan, a nation situated at the tectonic boundary between the Indian and Eurasian plates, has undertaken significant steps to modernize its geospatial reference systems, aiming to improve land governance. DrukNet, the national network of CORS (Continuously Operating Reference Stations) managed by NLCS (National Land Commission Secretariat) is vital to these efforts by materializing permanently the national datum of Bhutan, namely their latest realization, DrukRef23, which is being currently under implementation. DrukNet is also an essential tool to monitor the dynamic geological processes taking place in Bhutan greatly contributing for disaster resilience in the country.

DrukNet initially comprised six CORS installed in 2010-2012. In the last three years this network was greatly expanded and currently is formed by 14 stations providing a continuous and accurate geospatial reference across Bhutan. This network addresses the limitations of the previous reference frame, DrukRef03, which was established in 2003 by measuring some 0- and 1-order control points and has since experienced significant internal deformations due to tectonic activities. These deformations have been measured at up to 0.6 cm/year between the southern and central regions of Bhutan, leading to substantial cumulative distortions over time.

To ensure long-term stability and accuracy, Bhutan is implementing DrukRef23, a modern and static datum aligned with ITRF2020 at the epoch 2023.5. The continuous data provided by the DrukNet network is essential to maintaining the accuracy of DrukRef23, enabling precise monitoring and adjustment of the reference frame as needed.

The implementation of DrukRef23 and the expansion of DrukNet significantly enhance Bhutan's capability to monitor and respond to environmental changes, natural disasters, and land-use

planning needs. The accurate and real-time geospatial information from DrukNet supports effective urban planning, infrastructure development, environmental conservation, and disaster management.

In this work, we present the current status of DrukNet, highlighting its expansion and the implementation of DrukRef23. We detail the methodologies employed for maintaining and updating the network, including the creation and application of NTv2 files for transforming the existing geo-referencing information from DrukRef03 into DrukRef23 and its importance for the disaster resilience in Bhutan.