

# Using NTV2 Files for Datum Transformations in Deforming Regions: The Cases of Bhutan and Chile

Rui Fernandes (Portugal), José Antonio Tárrio (Chile), Chokila Chokila (Bhutan), Gonçalo Henriques, Pedro Almeida and Marcelo Caverlotti (Portugal);

**Key words:** Cadastre; GNSS/GPS; Reference frames; Keyword 1; Keyword 2; Keyword 3

## SUMMARY

Datum transformations are critical for maintaining geospatial coherence when a new datum is established. All existing georeferenced information in the old datum needs to be converted into the new datum with minimal errors. This process has been necessary in many countries due to the implementation of modern datums based on space-geodetic techniques, materialized by GNSS (Global Navigation Satellite Systems) CORS (Continuously Operating Reference Stations).

Most of the old classical datums suffer from large internal deformations caused by the existing methodologies used to compute them in the past. The surveying errors of the angles and sides of the triangulations not compensated by simultaneous adjustments led to significant propagation errors. Moreover, in countries like Bhutan and Chile, located in regions characterized by dynamic geological processes, the static datums defined in the past have undergone degradation over time due to internal temporal deformations.

To address the challenges posed by complex datum transformations over large areas, NTV2 (National Transformation Version 2) files present an advantageous methodology. NTV2 files, containing control points and shift values, offer an alternative to traditional approaches like 7-Helmert parameters or other conformal transformations. Their advantage lies in their ability to account for regional variations in deformation, making them particularly suitable for regions with dynamic geological processes and/or where the classical datums have significant internal errors.

In this work, we present the work being done in Bhutan and Chile to estimate and apply NTV2 files to transform old classical datums into modern geocentric datums. We demonstrate that the use of conformal transformations, in particular 7-Helmert transformations, does not permit converting all existing geo-information with sufficient accuracy, which is a major issue, particularly for the

---

Using NTV2 Files for Datum Transformations in Deforming Regions: The Cases of Bhutan and Chile (12678)  
Rui Fernandes (Portugal), José Antonio Tárrio (Chile), Chokila Chokila (Bhutan), Gonçalo Henriques, Pedro Almeida and Marcelo Caverlotti (Portugal);

FIG Working Week 2024

Your World, Our World: Resilient Environment and Sustainable Resource Management for all  
Accra, Ghana, 19–24 May 2024

cadastral information which has requirements defined by law.

The creation of the NTV2 files for Bhutan and Chile is constrained by the estimated velocity fields using the positional time-series of the GNSS CORS network. They permit the removal of the internal errors caused by the tectonic processes. Although the final NTV2 grids cannot completely remove the existing errors in the definition and materialization of both datums, particularly in the old ones, they permit the minimization of such errors allowing the implementation of modern geodetic datums with a minimal disturbance in the workflow of the responsible agencies for their maintenance.

---

Using NTV2 Files for Datum Transformations in Deforming Regions: The Cases of Bhutan and Chile (12678)  
Rui Fernandes (Portugal), José Antonio Tárrio (Chile), Chokila Chokila (Bhutan), Gonçalo Henriques, Pedro Almeida  
and Marcelo Caverlotti (Portugal);

FIG Working Week 2024

Your World, Our World: Resilient Environment and Sustainable Resource Management for all  
Accra, Ghana, 19–24 May 2024