Agreement: The U.S. National Geodetic Survey and The Canadian Geodetic Survey

March 14, 2012

The U.S. National Geodetic Survey and Natural Resources Canada's Geodetic Survey Division, via conference call held 2012/02/17, **agree**:

- To ***define*** the common (a unique) vertical datum for the United States of America (USA) and Canada (CA) through use of an equipotential surface, realized through one commonly (jointly) computed geoid model, corresponding to the mean coastal sea level for North America by 2022. Adoption is subject to National decisions;
- To ***compute*** the potential W_0 of this equipotential surface using Global Positioning System (GPS) data on tidal benchmarks, by April 1, 2012 and to ***use*** this value, for the realization of geoid models in the USA and CA until 2022;
- To ***maintain*** this equipotential surface as one option to adopt as the vertical datum even if this surface diverges (departs) from the true mean coastal sea level for (around) North America over time;
- To ***monitor*** differences between the above-mentioned equipotential surface and the mean sea level via Global Navigation Satellite Systems (GNSS) on tidal benchmarks, altimetry or other means as required;
- To ***provide*** to the public, deformational velocities (*N-dot*) of the equipotential surface W_0;
- To ***collaborate*** in the realization of geoid models, through the sharing of data and related information:
- To ***compute*** updated geoid models and geoid deformation models with improved realizations as needed;
- To ***inform*** each other when large discrepancies (outside 95% confidence region) are found in overlapping regions; and
- To ***choose*** a threshold value (in alignment with both stakeholder needs and scientific integrity) in 2022, between predicted (modeled) geoid change and true geoid change (including deformation and sea level change) which will warrant new realization of the vertical datum.

The geopotential for the North American height reference system

April 16, 2012

Canada and the United States are both working towards modernizing their national height reference systems to replace CGVD 28 and NAVD 88, respectively with the objective to create a seamless height reference system across North America. As the new vertical datum will be realized by a geoid model, it is essential that Canada and USA select a common equipotential surface. Both parties have agreed that this surface should be the best fit, in a least squares sense, of the coastal mean sea level around North America.

In order to compute the mean geopotential, GPS heights and water levels at coastal tide gauges were combined with various geoid models. Given the variability of the mean sea level due to Sea Surface Topography (SST), the analysis was affected by tide gauge location and distribution, and geoid model precision and resolution. Based on comparisons at tide gauges around Canada and the United States where SST models were available, the best fit is 62,636,856.0 m^2s^{-2}. By averaging the Arctic gauges that were outside the coverage of the SST models, the geopotential would have been higher,

approaching 62,636,858.0 m^2s^{-2}. Although very little data were available around Mexico and in the Caribbean region, including more tropical data would have likely lowered the geopotential to 62,636,854.0 m^2s^{-2}. Thus, the lack of tide gauges in Arctic and tropical regions somewhat compensates itself. Estimates of the North American mean obtained with different datasets, station combinations and weighting scenarios remained within 1 m^2s^{-2} of each other depending on the particular tide gauge distribution and geoid models selected.

Understanding the importance of selecting a conventional value without delay for CGVD2013 realisation, the decision was made to select:

$$\mathbf{W_0 = 62,636,856.0\ m^2s^{-2}}$$

as the geopotential value for all geoid models in North-America until 2022. This agreed upon value of W_0 was found to be within the uncertainty of the mean estimate that best fits with mean sea level around North America. Although sea level is known to be changing, this W_0 value will be adopted as a fixed reference value until at least 2022 in order to enable consistent height determinations over the coming decade. This value could also be suitable for Mexico, the Caribbean region and Greenland. It also corresponds to the current convention adopted by the International Astronomical Union (IAU) and International Earth Rotation and Reference Systems Service (IERS).

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