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A new Canadian gravity anomaly database consistent with global models derived from gravity space missions

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The Canadian National Gravity Database (NGDB) comprises more than 10000 gravity reference stations of various orders and over 700000 gravity anomaly points that have been observed over the period of 50-60 years. Active tectonic and geodynamic processes, such as glacial isostatic adjustment (GIA), have introduced systematic errors of various magnitudes and have rendered the NGDB non-homogeneous: reference gravity values and gravity anomalies do not refer to the same epoch. This introduces systematic errors in the regional/local geoid modeling and does not allow proper integration of the global gravity models obtained from the gravimetric space missions in an all-inclusive, systematic-error-free solution. Because reprocessing and readjustment of all observations to a common epoch is prohibitive from the time/cost perspective, we use the already homogenized primary network of 64 points, known as the Canadian Gravity Standardization Network of 2000 (CGSN-2000), along with the old and non-homogeneous CGSN-1971 and we model their differences and their associated covariance matrix using a covariance function derived in this study. This covariance function is derived from real data via spectral analyses methods in a test area in western Canada. Analyses of the performance of the covariance function over the test area show that it can model very reliably the gravity differences between CGSN-1971 and CGSN-2000 and can predict gravity values in the CGSN-2000 with a precision of ąÓ6 ČÝGal at the 95 percent confidence level. The predicted correlations in the CGSN-2000 agree with those from the actual adjustment within ąÓ16.1 percent at the 95 percent confidence level. The effect of homogenization of the gravity anomalies on the Canadian geoid model across Canada varies in the range of ąÓ12 cm and follows approximately the long-wavelength pattern of the GIA signature.