

# **ARCGICE WP 4.3**

## **Recommendation for inclusion of GOCE data.**

Report by  
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### **Introduction.**

In this note we will discuss the inclusion of GOCE data in the determination of the Arctic geoid.

The GOCE satellite level 2 products will be produced of the High Level processing Facility, (HPF).

The main products of importance for ARCGICE are, cf. [RD-1],  
EGM\_GCF\_2 the spherical harmonic series  
EGM\_GVC\_2 the associated error-covariance matrix,  
EGG\_NOM\_2 gravity gradients in the gradiometer reference frame (GRF).  
EGG\_TRF\_2 gravity gradients in a local North-oriented frame.  
SST\_PSO\_2 precise science orbit, including rotation matrix information.

All these data may contribute to the determination of an enhanced geoid and enhanced estimates of associated error-estimates and error correlations.

### **Use of the spherical harmonic coefficients.**

The spherical harmonic coefficients may be directly used in the geoid computation in the so-called remove-restore step. The variance-covariance matrix must be used so that the error information is correctly propagated into the geoid error-estimates and error-covariances.

At the moment only the error-variances of the estimated coefficients are used in order to produce so-called error-degree-variances. The use of the full variance-covariance matrix is complicated, and its integration into the geoid-estimation process is difficult.

On the other hand the covariance function of the residual gravity anomalies (obtained in the remove-restore process) will include some information related to the coefficient errors.

The coefficients may also be used to improve the identification of biases in individual gravity surveys as described in [RD-2].

### **Use of the gravity gradients.**

The gravity gradients include the same information as the spherical harmonic coefficients in areas of moderately varying gravity. In areas with larger gravity variations (such as over trenches) they may include extra information.

Such areas may be identified by computing the difference between observed values and values of the gradients computed from the spherical harmonic series.

In these areas the gravity gradients may directly be used in the geoid estimation using such methods as Least-Squares-Collocation (LSC). The use may, however, require changes in existing software, where spherical approximation is used. On the other hand, the availability of ground gravity data is important for “tuning” the “downward” continuation inherent in a process where data at satellite altitude is combined with data on the ground.

### **Conclusion.**

The level 2 GOCE products may be used to compute an improved geoid in the Arctic Ocean. Both the spherical harmonic coefficients and the gravity gradients may be used. The use of the gravity gradients will primarily help in reducing the error in the region south of 84° latitude.

The optimal use may require improvements in existing software especially so that the variance-covariance information associated with the coefficients can be properly propagated into the geoid estimation process.

### **Reference Documents.**

[RD-1] GOCE Level 2 Product Data Handbook, GO-MA-HPF-GS-0110, (latest issue).

[RD-2] Forsberg, R., H.Skourup, O.B.Andersen, P.Knudsen, S.W.Laxon, A.Ridout, J.Johannesen, F.Sigismund, C.C.Tscherning, D.Arabelos and A. Braun: ARCGICE, Combination of Spaceborne, Airborne and In-Situ Gravity Measurements in Support of Arctic Sea-Ice. Mapping. Midterm Report, March, 2006.