Suggestions for improvement of user access to GOCE L2 data.

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Abstract:

ESA's has required that most GOCE L2 products are delivered in XML format. This creates difficulties for the users because a Parser written in Perl is needed to convert the files to files without XML tags. However several products, such as the coefficients of spherical harmonic coefficients are made available on standard form through the International Center for Global Gravity Field Models. The variance-covariance information for the gravity field models is only available without XML tags.
It is suggested that all XML products are made available in the Virtual Data Archive as files without tags. This will besides making the data directly usable by a FORTRAN program also reduce the size (storage requirements) of the product to about 30 %.
A further reduction of used storage should be made by tuning the number of digits for the individual quantities in the products, so that it corresponds to the actual number of significant digits.

Key-words: GOCE L2 data, Parser, XML-Products.

1. Introduction.

It is very important that potential and actual users of GOCE products have the most simple and easy access to the data, especially the L2 data. Furthermore the storage space used to hold the data should be as small as possible, e.g. eliminating non-significant digits in the elements of the products. In the following the different products will be discussed considering the possibilities for their conversion to formats which may be easily read by e.g. a FORTRAN program

A description of the products is found in (HPF, 2010).

The best illustration of the problem is by an example of a GOCE product (GO TRF) on XML-format, see Fig. 1. In Fig. 2 is shown the same data on simple tabular form, where insignificant digits have been removed. The first data-set occupies 2264 bytes of storage, while the tabular data occupies only 440 bytes.

```
<?xml version="1.0" encoding="US-ASCII"?>

<Data_Block>
 <EGG_TRF_2>
  <List_of_GG_spatial_Records count="891495">
   <GG_spatial_Record>
    <Time_Information>
     <GPS_Time>946339215.392328382</GPS_Time>
    </Time_Information>
    <Position>
     <Radius_from_Geocenter
unit="m">6633391.8630</Radius_from_Geocenter>
     <Phi unit="deg">32.276858258</Phi>
     <Lambda unit="deg">98.390138711</Lambda>
    </Position>
    <Gravity_Gradients unit="1/s^2">
     <XX>-1.36784713E-06</XX>
     <YY>-1.36469171E-06</YY>
     <ZZ>2.73254033E-06</ZZ>
     <XY>1.66872360E-11</XY>
     <XZ>7.53410110E-09</XZ>
     <YZ>6.71229476E-11</YZ>
    </Gravity_Gradients>
    <Sigmas unit="1/s^2">
     <XX>9.51246196E-12</XX>
     <YY>7.99435576E-12</YY>
     <ZZ>1.18116238E-11</ZZ>
     <XY>3.49544444E-12</XY>
     <XZ>1.03734391E-11</XZ>
     <YZ>3.96125731E-12</YZ>
    </Sigmas>
    <Flags>
     <XX>2</XX>
     <YY>2</YY>
     <ZZ>2</ZZ>
     <XY>2</XY>
     <XZ>2</XZ>
     <YZ>2</YZ>
    </Flags>
   </GG_spatial_Record>
   <GG_spatial_Record>
    <Time_Information>
     <GPS_Time>946339216.392328143</GPS_Time>
    </Time_Information>
    <Position>
     <Radius_from_Geocenter
unit="m">6633396.9730</Radius_from_Geocenter>
     <Phi unit="deg">32.210512839</Phi>
     <Lambda unit="deg">98.375138504</Lambda>
    </Position>
    <Gravity_Gradients unit="1/s^2">
     <XX>-1.36787330E-06</XX>
     <YY>-1.36468501E-06</YY>
     <ZZ>2.73255284E-06</ZZ>
     <XY>2.23996184E-11</XY>
     <XZ>7.53482594E-09</XZ>
     <YZ>6.54007040E-11</YZ>
    </Gravity_Gradients>
    <Sigmas unit="1/s^2">
     <XX>9.51246196E-12</XX>
     <YY>7.99435576E-12</YY>
     <ZZ>1.18116238E-11</ZZ>
     <XY>3.49544444E-12</XY>
     <XZ>1.03734391E-11</XZ>
     <YZ>3.96125731E-12</YZ>
    </Sigmas>
    <Flags>
     <XX>2</XX>
     <YY>2</YY>
     <ZZ>2</ZZ>
     <XY>2</XY>
     <XZ>2</XZ>
     <YZ>2</YZ>
    </Flags>
   </GG_spatial_Record>
   <GG_spatial_Record>
```

Fig. 1. 2 records on XML format.

946339215.39 6633391.8630 32.276858 98.390138 -1.367847E-06 -1.364691E-06 2.732540E-06 1.668723E-11 7.534101E-09 6.712294E-11 9.512E-12 7.994E-12 1.1811E-11 3.495E-12 1.037E-11 3.961E-12 2 2 2 2 2 2
946339216.39 6633396.9730 32.210512 98.375138 -1.367873E-06 -1.364685E-06 2.732552E-06 2.239961E-11 7.534825E-09 6.540070E-11 9.512E-12 7.994E-12 1.1811E-11 3.495E-12 1.0373E-11 3.961E-12 2 2 2 2 2 2
Fig 2. The same 2 records on tabular form.

The conversion of XML-data is done using a PARSER (HPF, 2011), which converts both L1 and L2 data. The PARSER is written Perl, and support by systems esperts will in many cases be needed in order to install the program.

As can be seen from the version number, the PARSER has had to be updated several times due to inconsistencies found by users. It would be fortunate, if the GOCE products did not need a PARSER which is also difficult to install for users who are not computer experts.

2. GOCE L2 products.

The official L2 data are the following

- SST_PSO_2 Precise science orbits with quality report
- SST_AUX_2 SH coefficients for non-tidal temporal corrections
- EGG_NOM_2 L2 gravity gradients in GRF with corrections
- EGG_TRF_2 L2 gravity gradients in LNOF with corrections
- EGM_GOC_2 Final GOCE gravity field model with error estimates and quality report

L2 products may be converted using the PARSER into the following output formats:

- TIME GG FORMAT
- SPATIAL GG FORMAT
- SP3C FORMAT
- COVARIANCE FORMAT
- ROTATION MATRIX FORMAT
- ICGEM FORMAT
- GRID FORMAT

These formats are easily used as input to e.g. a FORTRAN program, however insignificant digits have not been removed.

The gravity field models are already officially available at the standard format at ICGEM (http://icgem.gfz-potsdam.de/ICGEM/ICGEM.html). The associated Variance-Covariance matrices (VCM) are not used with XML formatting, see HPF (2010, section 5.4).

3. Data access.

The official products are available using the EOLI-SA system see, (VEGA Technologies, 2010). This is a general system, with strange features like a “Shop Cart”, known from commercial products. It is directed towards users who needs data from a limited geographical area, while many applications of GOCE will be global per definition. Most data can be downloades direcly, except the VCM. It can only be distributed via a mailed DVD, through a system which for a long period did not work.

Fortunately ESA has developed a Virtual data Archive, where the (registred) users directly may obtain the data. Even the VCM may be easily downloaded via internet.

The gravity field models are available in a NXML form (Non-XML), however not completely standardized. Here ESA should make the product available in standard form like e.g. used for EGM2008 (Pavlis et al., 2008). The format definition for the VCM permit large variations in the actual data-storage. It should also be standardised in order to ease the use of the files.

4. Conclusion:

User Access to GOCE data is difficult and scares users away. The ESA XML rule has already been broken, however ESA will not skip the XML-mistake.

Data should be made available on NXML form and XML-form, as needed.

Sice EOLISA is not suited for GOCE data applications, the NXML data should be made available in the Virtual Data Archive.

Furthermore:

1. PARSER needed to convert to Tabular form: SKIP the USE.
2. Delete excess digits in numbers
3. Files will decrease to 30% XML-size.

4. NXML files should be made available in the Virtual data Archive.

If these recommendations are followed, we will see many more users of GOCE data both in research and teaching applications. One may also consider to convert important L1 products to NXML. This would aid in users verifying/checking our basic GOCE data.

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