Detected GML Issues Related to Spatial Reference System (SRS)

Submitted by:	Shwu-Jing Chang (Taiwan/NTOU)
Executive Summary:	This paper reports SRS related GML issue detected during the test production of S-122 and S-123 datasets by NTOU.
Related Documents:	S-100 Part 10b and S-1xx product specifications using GML encoding
Related Projects:	NIPWG

Introduction / Background

NTOU has conducted tests on S-1xx compliant product specifications, for the overall planning of S-100 based data products covering Taiwan. It was found that for the produced S-122 and S-123 GML files to be displayed correctly in CARIS S-57 Composer and QGIS, the axis order needs to be swapped sometimes, between Lat/Long and Long/Lat. After comparing all the sample GML encoded datasets available from IHO website, the situations were even more confusing, due to the differences in GML encoding, especially the Spatial Reference System (SRS) and the axis order. This paper reports the findings from the trial production, observations and experiments on sample datasets of the product specifications presented in NIPWG8 and some further work, as the Action item 8/20 of NIPWG8.

Analysis/Discussion

S-100 Part 10b-9.8 states that, for S-100 datasets, "the SRS can be specified in one of two ways: (1) Using the srsName attribute of the gml:Envelope element in a feature collection implies that the same SRS is used for all geometries contained in that collection or (2) using the srsName and srsDimension attributes for individual geometry elements. Application data formats may use either method, but shall ensure that the SRS of every instance of geometry in a dataset can be determined by application software, using one method or another. Standard SRS shall be identified using the URI convention specified by OGC. For example, http://www.opengis.net/def/crs/EPSG/0/4326."

The S-122 sample dataset (US) has coordinates encoded in Long/Lat order, with srsName="EPSG:4326" added only to the gml:Envelope (at the dataset level) and one of the geometry elements. In CARIS, geometries in that dataset are displayed correctly, except the one with EPSG:4326 specified, which appears in Antarctica. Similarly, in S-123 test dataset (NL), only those features with srsName="EPSG:4326" specified, appear incorrectly near Antarctica. (See Fig.1)

The S-123 sample dataset (JS) has coordinates encoded in Long/Lat order and srsName="EPSG:4326" added only to the gml:Envelope element (at the dataset level). The S-127 sample dataset (JS) has srsName="urn:ogc:def:crs:EPSG::4326" added to all elements, and the axis order is Lat/Long. Both datasets can be correctly displayed in CARIS and QGIS. If the URN form is replaced with URI form for srsName of all elements in the S-127 dataset, the displayed locations remain correct. However, if gml:Envelope is the only element with srsName specified (either in URI or URN form), both CARIS and QGIS treat the axis ordering as Long/Lat (the internal default) and have the geometries displayed at the wrong hemisphere.

Findings described above actually match those stated in OGC documents. The axis order in the formal definition of EPSG4326 is Lat/Long. SRS identified using OGC URI form "http://www.opengis.net/def/crs/EPSG/0/4326" and URN form "urn:ogc:def:crs:EPSG::4326" means that Lat/Long axis order is respected. In the case of using "EPSG:4326", the coordinates are mostly treated as in Long/Lat axis order. Application software might try to accommodate the differences, but the way of doing this and the outcome varies. Therefore, compliance and consistency among S-100 based data products are essential.

Furthermore, the gml:Envelope specified at the dataset level is apparently not considered (by the application software used in this test) an element that other geometries in the dataset can "inherit" SRS from. GML V3.2.1(OGC 07-036) states in clause 9.8 that, "For convenience in constructing feature and feature collection instances, the value of the srsName attribute on the gml:Envelope which is the value of the gml:boundedBy property of the feature shall be inherited by all directly expressed geometries in all properties of the feature or members of the collection, unless overruled by the presence of a local srsName. Thus it is not necessary for a

geometry to carry a srsName attribute, if it uses the same coordinate reference system as given on the gml:boundedBy property of its parent feature. Inheritance of the coordinate reference system continues to any depth of nesting, but if overruled by a local srsName declaration, then the new coordinate reference system is inherited by all its children in turn." As stated in S-100 Part10b-8.2, "Within GML 3.2.1, the generic gml:FeatureCollection element has been deprecated. A feature collection is any feature class with a property element in its content model (for example member) which is derived by extension from gml:AbstractFeatureMemberType." Therefore, the dataset element should have been considered a feature collection and the SRS of its gml:Envelope should have been inherited by all geometries in the dataset.

Conclusions and Suggestions

S-100 gives guidance on GML (ISO 19136) encoding. S-100 Part 10b-9.8 has already specified various key points on the Coordinate Reference System in a rather concise way. However, issues reported in this paper, and some others found during the test production, suggest that a more detailed and clear guidance is needed to better ensure the compliance and consistency of GML encoded data products for use in navigation, as well as the broader applications aimed by S-100. Comparison of S-100 Part10 a, b and c with respect to the contents and revision history further indicates that a (normative) implementation guidance or rules for data product specifications using GML encoding should be provided.

Action required of S-100WG

The S-100WG is invited to:
  a) Note this paper;
  b) Add an implementation guidance to S-100 Part10b, or
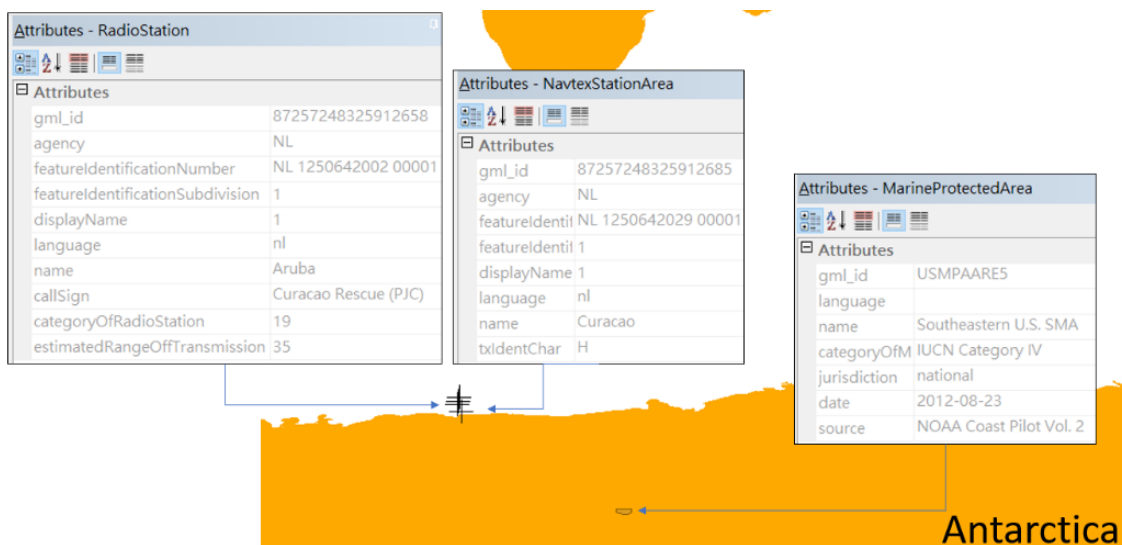 c) Take other actions as appropriate to address the detected GML issues.

Fig.1 Misplaced features of datasets S-122(US) and S-123(NL)