HiProGen A system to generate high level products

Thomas Lankester(1), Cinthia Loial(1), Steve Hubbard(1), Kaj Andersson(2), Giancarlo Pittella(3)

(1) Infoterra Ltd, Delta House, Southwood Crescent, Farnborough, GU14 0NL, UK, Email: thomas.lankester@infoterra-global.com
(2) VTT Technical Research Centre of Finland, Tekniikantie 4 B, Espoo, P.O. Box 1201, FIN-02044 VTT, Finland, Email: kaj.andersson@vtt.fi
(3) ESA ESRIN, Via Galileo Galilei – Cassella Postale 64 – 00044 Frascati, Italy, Email: giancarlo.pittella@esa.int

ABSTRACT/RESUME

The High level Product Generation (HiProGen) system was developed to demonstrate a flexible, extensible environment for the operational creation of Level 3 products. The system can automatically generate global, geocoded, geophysical products as weekly and monthly composites. In addition, ASAR mosaics and composites with arbitrary temporal and spatial coverage can be created through a Web enabled user interface. Terrestrial albedo and marine algal pigment concentration monthly composites generated by HiProGen are presented. The ability of the system to incorporate new algorithms and processing chains is discussed and illustrated with a case study of Global Algal Index generation using unmodified and modified versions of the BEAM toolkit.

1 INTRODUCTION

HiProGen was developed by an industrial consortium of Infoterra Ltd. (www.infoterra-global.com) of the UK and VTT of Finland under a TRP contract with ESA. The HiProGen project has created a demonstration system that can automatically convert low level Earth Observation (EO) data to geocoded, geophysical composites and wide area mosaic products. The system demonstrates the following features:

➢ automatic generation of Level 3 products from lower level EO data (specifically MERIS Level 1 and 2, ASAR Level 1 Wide and Global Monitoring and Level 1 ATSR-2 / AATSR);
➢ WWW enabled interface to allow users to initiate data export or new product generation;
➢ output of Level 3 products in a range of projections and data formats;
➢ a flexible architecture which allows easy extension of the system to generate new and improved Level 3 products;
➢ an expandable and portable system which can be distributed across several platforms to increase production capacity.

Five example (non-validated) terrestrial geophysical products are generated by the system as weekly and monthly global composites. These are broadband Albedo, Global Vegetation Index, fraction of Photosynthetically Active Radiation, Leaf Area Index and Net Primary Productivity. In addition the system can generate regional ASAR mosaics and weekly/monthly composites of MERIS Level 2 algal_1 and algal_2 pigment concentrations.

2 SYSTEM ARCHITECTURE

The modular architecture and Object Oriented implementation of HiProGen are key to the flexibility and extensibility of the system. The core subsystems each run in a separate Java Virtual Machine with the subsystems communicating via Java Remote Method Invocation. This allows the subsystems to be distributed across an Intranet and means that duplicate subsystems can be added as production demand requires. Processing instructions, system configuration parameters and metadata are all stored in XML formatted text files.

To ease the integration of new algorithms into the HiProGen production environment, software ‘wrappers’ are used to control different types of processing (e.g. Java, C/C++ executables and IDL batch procedures). Referring to Fig. 1, the Java process wrapper can handle processing parameters specific to running Java software. The IDL process wrapper is written to deal with running IDL batch files and likewise the executable process wrapper is designed to run '.exe' files at the command line.
In each case, the details of 'how' specific types of processing are carried out are hidden. The top level class responsible for executing processing instructions is therefore able to 'run' a Java process as easily as a command line executable. Because all the processing specific wrappers support this generic 'run' function, different types of processing can be combined in process chains and completely new processing chains can be created.

3 BEAM INTEGRATION – GAI TEST CASE

To test the flexibility of the processing model, an unmodified copy of version 2.0 of the Basic ERS & Envisat (A)ATSR and MERIS toolbox (BEAM) was integrated into the HiProGen system and used to create Global Algal Index (GAI) binned data products based on Level 2 MERIS algal_1 and algal_2 data. A modified version of BEAM 2.0 is used to create higher resolution, resampled composites of these products incorporating a flux conserving algorithm developed by NASA.

The accumulation of EO data samples into geocoded 'bins' is a simple and commonly used method for creating Level 3 weekly and monthly composite products. This only works well if all the data samples carry an equal weight. In the case of MERIS, the binning of small amounts of FR data will introduce a massive bias into the final product. This is because for every data value accumulated from an RR scene, 16 data values are accumulated from an FR scene (see Fig. 2. coverage of the North East Atlantic).

Fig. 2. Number of observations per bin using the standard binning algorithm supplied with BEAM V2.0. This 40° x 40° tile was created using algal_1 MERIS RR data covering July 2003 with a single quarter scene of MERIS FR data. Bin size is 2km x 2km. About 50 FR data samples are accumulated in each bin compared to about 3 samples of the lower resolution RR data.
The BEAM toolkit is Open Source software with an object oriented processing model specifically designed to be extended and enhanced. During development of the GAI product it was therefore possible to incorporate resampling software [1] into the BEAM toolkit. The incorporated software works out the relative area of overlap of each input data sample with each sample in the output product grid.

Comparing Figs. 2. and 3. it is clear that the distortion to the data counts caused by mixing MERIS RR and FR is eliminated by the use of area weighted resampling. In Fig. 3 it is almost impossible to distinguish the borders of the FR quarter scene from the edges of the MERIS RR swaths.

Note that processing was carried out with the PCD_17 flag 'on' in order to accentuate the edges of the swaths.

4 RESULTS

System stress testing is carried out with over 160 orbital segments of MERIS Level 1 RR data for the land products and over 140 passes of Level 2 RR data for the marine Global Algal Index (GAI) product. Processing of a single, 80°N to 70°S orbital segment takes under 100 minutes on a dual 2.4 GHz Xeon PC. In other words, the HiProGen demonstrator can geophysically process and composite input MERIS data into an output product faster than input data is acquired.

One of the requirements for the HiProGen demonstrator was that it should generate Level 3 products at the resolution of the parent instrument. For MERIS, this means output products with nominal sample sizes as fine as 300m. Tiling (highlighted in Fig. 4.) is used to cope with the high data volumes of the Level 3 products.
Fig. 4. Global Algal Index (GAI) Case 1 waters coverage for the central Mediterranean using algal_1 MERIS RR data for July 2003, incorporating a single quarter scene of MERIS FR data. Output sample size is 300m x 300m.

Fig. 5. Global land surface albedo for April 2003, Plate Carree (equi-rectangular, non-projected) map with an equatorial spatial resolution of 1.2km. The cloud masking algorithm excludes data with very high reflectance. Note the effect on ice covered areas and the Sahara desert.

5 REFERENCES