ABSTRACT

BEAM is an application suite which facilitates the utilisation, viewing and processing of the Envisat MERIS, AATSR and ASAR data products. The software is being developed by Brockmann Consult GmbH under contract to the ESA. Continued as an open source project, BEAM has become the definitive, freely available software used throughout the Envisat scientific user community. Due to its implementation in the Java programming language, it is available for the Windows, Linux, Mac OS X, Solaris and other Java-enabled operating systems and can be downloaded from the BEAM home page at www.brockmann-consult.de/beam. Initially released in December 2002, BEAM has meanwhile gone through eight release cycles and is today in use by more than a thousand end-users of MERIS, AATSR, ASAR and also MODIS data. The efficiency of BEAM to the user community was emphasised during the first MERIS User Workshop held at ESRIN in November 2003 and the Envisat Symposium held in Salzburg in September 2004. Due to the success of BEAM, ESA has granted the continuation of the BEAM project. The paper presents an outlook to upcoming releases of the software which will successively include new features like the exploitation of the synergy between MERIS, AATSR and data from other sensors using advanced co-registration functions, improved cloud screening algorithms, access to OGC/ISO-conformant web services such as EO data catalogues and geo-spatial data servers, full support of the AVNIR 2 sensor onboard the Japanese ALOS satellite, development of a Java framework for the definition of generic EO data processing chains, 3D visualisation of EO data and other geospatial information layers.

1 INTRODUCTION

BEAM is the Basic ERS & Envisat (A)ATSR and Meris Toolbox and is a collection of executable tools and an application programming interface (API) which have been developed to facilitate the utilisation, viewing and processing of ESA MERIS, (A)ATSR and ASAR data. The purpose of the BEAM is not to duplicate existing commercial packages, but to complement them with functions dedicated to the handling of Envisat MERIS and AATSR products.

The main components of BEAM are:

- **VISAT** - An intuitive desktop application to be used for visualization, analyzing and processing of Envisat MERIS, AATSR, ASAR, ERS ATSR and also MODIS and AVHRR. A presentation of the BEAM main window and some important functions is given in Figure 1.

- A set of scientific tools running either from the command line or invoked by VISAT, also entirely written in Java. This includes currently
  - pconvert - converting ENVISAT N1 and DIMAP files into
    - DIMAP
    - HDF
    - geotiff
    - Colour images (tiff, jpeg, ...)
  - map projection for batch processing
  - smile correction for MERIS
  - SMAC atmospheric correction
  - SST with user defined coefficients
  - Fluorescence line height
  - Level 3 binning and mosaicking processors

- The BEAM Java API provides software frameworks and helpers for application development and new extension modules

- Envisat MERIS/AATSR Product Access API programmed in ANSI C allowing reading access to these data products using a simple programming model.

The development of the BEAM software is targeted as an open source project and comes with full source code.
2 ARCHITECTURAL DESIGN GOALS

The primary design features of the BEAM are:

- Extensibility through software frameworks with dedicated plug-in points for extended functionality. This will allow for easy integration of new algorithms, new data product I/O formats and much more.
- An open source design which allows for distributed development resulting in a faster rate of growth, flexibility and stability.
- Portability through platform-independent design for use on all major operating systems. All components of the toolbox (except ANSI C library) are programmed in Java. The alpha release was tested successfully on Windows 95/98/NT4/2000, Linux, Solaris and MacOS X. The ANSI C API shall compile on any system with an ANSI-C compliant C compiler.
- High performance achieved by using optimized algorithms and frameworks. Image processing based on Java Advanced Imaging API (JAI).

The BEAM architecture comprises three major sub-systems:

1. the framework package – defines fully abstract interfaces and frameworks for the internal EO data models, EO data I/O, EO data processing and GUI application frameworks. The latter framework is based on the common model-view-controller (MVC) architecture.
2. the utils package – defines many ready-to-use functions and components which are frequently used in application development with special attention to EO applications.
3. a set of application specific packages which provide concrete implementations for the BEAM software
   a. the visat package – implements the VISAT application and user interface and the standard set of VISAT plug-ins (which implement the actual VISAT functionality)
   b. the processor package – implements the standard BEAM data processors
   c. the dataio package – implements the standard set of reader and writer plug-ins for the products types supported by BEAM
   d. the dataop package – implements the standard set of map projection plug-ins
**3 BEAM 3.4 RELEASE AND IBEAM**

BEAM version 3.4 has been released during the MERIS and AATSR user workshop in September 2005 in ESRIN. The main features of BEAM 3.4 are support to the reprocessed MERIS data and to AVHRR/3 products, new scientific processors, namely the cloud probability processor, an improved, flux conserving Level 3 Binning processor and a top-of-atmosphere vegetation processor. VISAT has been extended by product grabber, the possibility to re-order the bitmasks and a pin-pixel group export function, which exports a square neighbourhood around the pins.

With the increase of functionality of BEAM the necessity has become obvious to re-design the internal architecture, and by this, to prepare BEAM for future challenges. During 2006 a re-designed software package, called iBEAM, will be released to the user community. The benefit of this re-design will be an improved performance, but also new concepts such as

- Synergistic use of MERIS, AATSR and data of other sensors using advanced co-registration functions
- Access to OGC/ISO-conformant web services
- 3D visualisation of EO data

Further, iBEAM will provide continuous improvements in the line of the BEAM traditions, namely

- Development of additional EO data processors for MERIS and AATSR
- Full support of the AVNIR 2 sensor onboard the Japanese ALOS satellite
- Data format review

**3 BEAM COMMUNITY**

The BEAM community is a set of communication tools provided by the BEAM development team to the user community through the BEAM Web Site. It includes a FAQ, a set of Plug-Ins which have been provided by users or which have been developed as technology studies, and finally a wish-list, where users can register their proposals for new features to be included in a next BEAM release. Through this it is ensured that mostly demanded features are included next. Due to the vital usage of all three means a close contact between BEAM users and developers is kept and recorded.