Satellite Image Data Service – Providing New Geodata Services and Satellite Imagery

G. R. Millin, K. Kitmitto

MIMAS, The University of Manchester, Kilburn Building, Oxford Road, M13 9PL
Telephone: +44 (0) 161 275 6109
Fax: +44 (0) 161 275 0637
Gail.Millin@manchester.ac.uk, k.kitmitto@manchester.ac.uk
http://landmap.mimas.ac.uk

1. Introduction

The Satellite Image Data Service (SIDS) provides web-based access to and support for a range of satellite imagery for the British Isles for research and teaching purposes. The data archive includes a set of orthorectified satellite images from five satellites, Landsat 5, Landsat 7, Satellite Pour l'Observation de la Terre (SPOT), ENVISAT Advanced Synthetic Aperture Radar (ASAR) and European Remote Sensing (ERS). The data archive covers the UK and Republic of Ireland over a range of temporal periods from the mid 1980s to present. The data is available for download from the Landmap website for those attending a subscribed institute. The satellite imagery archive is projected to British National Grid (UK data) or Irish National Grid (Republic of Ireland data) and can be used in image processing software, in association with user's data or other mapping data such as Ordnance Survey data in a Geographical Information System (GIS) (Landmap 2006). In addition, a Digital Elevation Model (DEM) of the whole of the British Isles at 25 meter resolution is available derived from interferometric methods using ERS 1 and ERS 2 data (Kitmitto 1999).

This paper provides details of the main areas of development currently occurring at SIDS. The first is the ongoing development of the interactive mapping service (OGC and MapServer) and image streaming service (ER Mapping Image Web Server). The second is the processing of raw ASAR ENVISAT data for use by the UK academic community. If there is demand for ASAR data from institutes in the Republic of Ireland SIDS would be prepared to negotiate with ESA a license to make this data available in the future.

1.1 Providing Data Services

The traditional method of viewing and accessing data at the SIDS is to click a thumbnail tile of an image on the website and see a static screenshot. The drawback of this approach is that the data cannot really be explored prior to download or integrated with other datasets. To provide our end users with a more flexible approach of using the SIDS data archive two new services have been developed. The first was to create Open Geospatial Consortium (OGC) Web Map Services (WMS) and Web Coverage Services (WCS). The second method was to provide the SIDS archive via Image Streaming using ER Mapper's Image Web Server.

1.1.1 OGC Interactive Mapping Service

Part of the work conducted by the SIDS is to acquire, create, maintain and disseminate data to academia. The use of OGC web services enables the dissemination of data in a standard interoperable form. WMS provide online maps of georeferenced data which is a visual representation of the satellite data stored on the server. The response from the server is to provide a temporary image either in JPEG, PNG or GIF format (OGC 2006*;* Kim *et al.,* 2005). The WMS operations that an end user can request are: -

GetCapabilities – Provides metadata about the WMS
GetMap – Returns a map image in JPEG, PNG, GIF
GetFeatureInfo – Allows the end user to request information about features on the map (Kolodziej, 2003).

Additionally SIDS has created WCS which require data representing space-varying phenomena (Lee *et al.,* 2005). Obviously satellite imagery fits this description and therefore SIDS is providing sample WCS, however further development work needs to be achieved such as trying to find a solution to authenticate users that have downloaded the satellite imagery via WCS. The end user can submit a GetCapabilities, DescribeCoverage and GetCoverage request to the WCS via Hypertext Transfer Protocol (HTTP) (Cox, 2003).

1.1.2 Image Streaming Service

The Image Streaming Service is available for all the datasets in the SIDS archive via the URLs http://ims1.landmap.ac.uk/ or http://ims2.landmap.ac.uk/ . The data is in Enhanced Compressed Wavelet (ECW) format which allows compression of imagery up to 50:1 with almost no visual loss of information. This means that images that were previously too large to serve online can now be easily used and distributed with the support of ER Mappers Image Web Server. SIDS implemented the ECW ArcXML Server which processes requests in the ArcXML format to serve imagery for use by client software such as ArcExplorer and ArcGIS that supports the ArcXML protocol. An ISAPI extension to Image Web Server is required which allows detection of the standard ESRI interface calls to report the image layers available and to service an image extraction request and return a JPEG image to the requesting application in the prescribed ArcXML protocol (Image Web Server, 2005).

1.2 Expanding the Data Archive

Currently SIDS is expanding the data archive with provision of Envisat ASAR data acquired from the European Space Agency (ESA). The data was acquired as part of the Catergory -1 Principal Investigator (PI) Project ‘Monitoring the state of the British Isles with ASAR’. The main objectives of the project are:

- Provide ASAR data on the Landmap website for download in GeoTiff format projected to British National Grid
- Derive further produces from ASAR
- Create on-line educational materials for academics unfamiliar with using radar data.
- Provide the ASAR data in an interoperable form as WMS and WCS

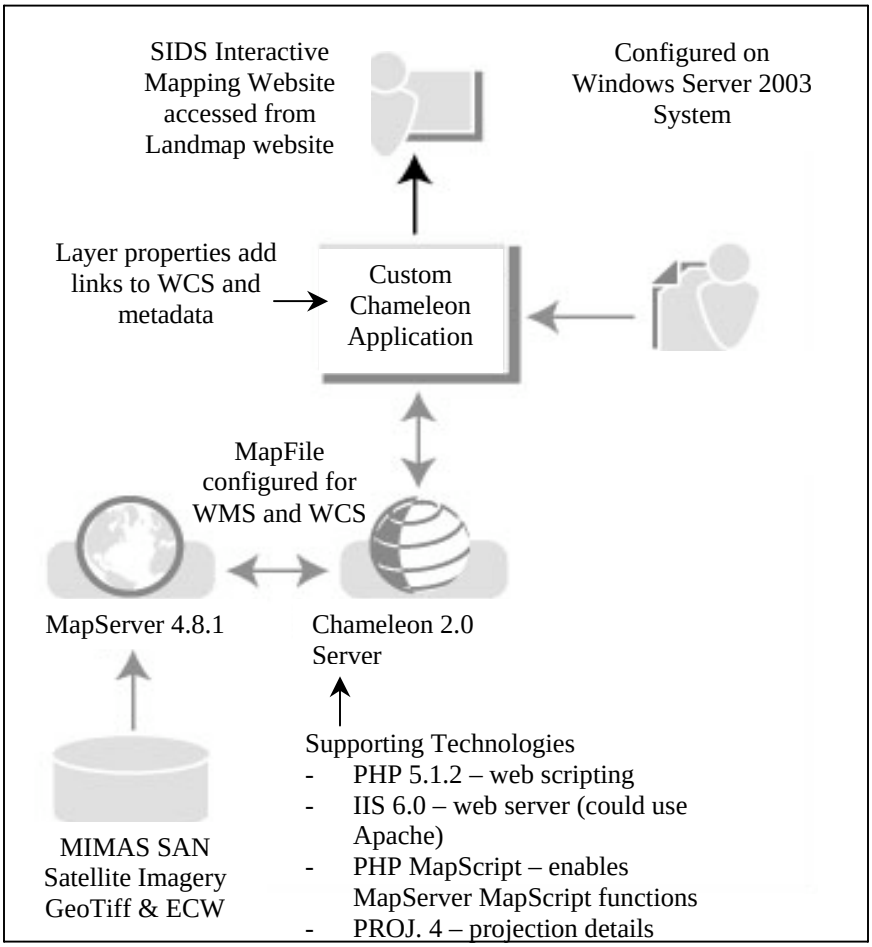


Figure 1. Configuration of MapServer and Chameleon for SIDS mapping client. Adapted from DM Solutions Group Inc. (2005 on-line http://www.dmsolutions.ca/technology/chameleon.html).

SIDS is acquiring ASAR data as the imagery is provided in five different modes providing valuable scientific data to assess and understand both natural and man-made phenomena (ESA, 2005). ASAR has enhanced capabilities compared to ERS (available for Republic of Ireland) due to acquisition in a range of polarizations and incidence angles. Also ASAR being an active sensor can obtain imagery during periods of cloud cover and at much greater temporal frequencies than optical data.

2. Methodology

2.1 WMS and WCS Mapping Configuration

The WMS and WCS on the Landmap website were configured using MapServer and Internet Information Server 6.0 as illustrated in Figure 1. SIDS customised the Chameleon 2.0 client originally developed by DM Solutions Group to provide the front end to WMS and WCS on the website http://landmap.mimas.ac.uk/download/wms.htm .

The configuration is using all open source tools freely available from the internet apart from the web server IIS 6.0 alternatively the web server Apache could be used. This setup allows us to serve all our data as OGC services, WMS and WCS. The WMS are available through the Chameleon interface; these services can also be cascaded for those who want to integrate their data with data served from SIDS. Some WCS services are available for data at lower resolutions. Full WCS services will be coming after we have implemented authentication and extraction services.

2.2 Image Streaming Configuration

The web client RightWebMap (RWM) 7.0 was customised to provide the Graphical User Interface (GUI) for the Image Streaming Service. This RWM client is a thin client requiring the installation of an Active X control that allows the streaming of images to browsers. Regrettably this is only available for Internet Explorer 6 and above and Firefox. However, the image streaming is available to ArcGIS® and other software that connect to ArcIMS services. In addition there are many available plug-ins http://www.ermapper.com/downloads/plugins.aspx that allow for the incorporation of streamed images in various software including, MapInfo®, AutoCAD® and Microsoft Office® documents.

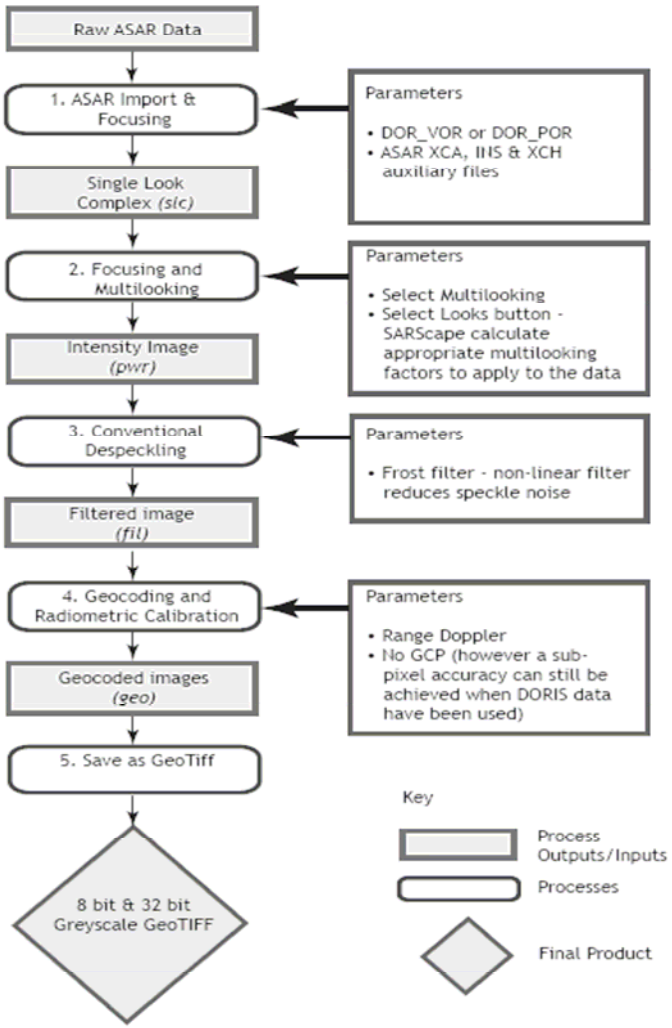
2.3 Image Processing Chain for Envisat ASAR data

The raw ASAR data was processed using SARScape which uses ENVI 4.3. as the user interface and associated image processing environment. Figure 2 provides details of the processing chain applied to the ASAR data to produce greyscale 8 bit and 32 bit imagery and 8 bit colour composite imagery.

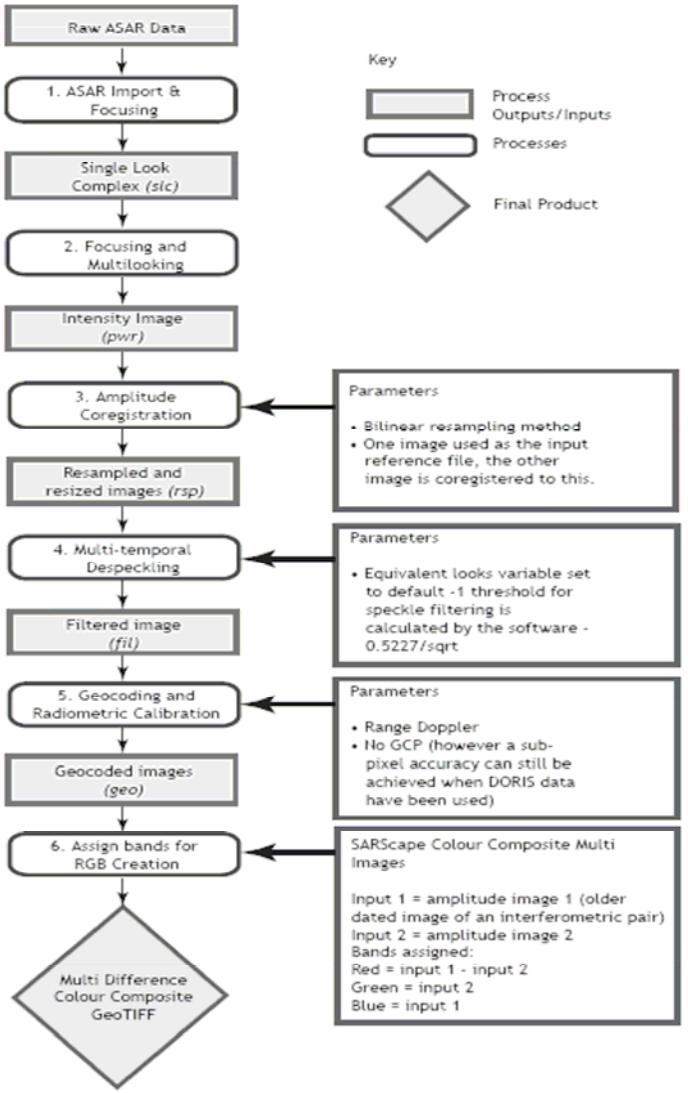
Colour Composite Images were created to provide users of radar data with instant visual indication of the change in the environment between the two images of the same area separated by time. The two images selected were for the same year separated by about six month providing contrasts between winter and summer.

SIDS is committed to acquire more ASAR data for the UK. We welcome suggestions for data and areas to be acquired for the UK. We will then produce the data so that it can be used for teaching purposes and for research. For researchers requiring a specific area with different processing methods than those applied in Figure 2 e.g. different filter during the despeckling process or different resampling method the SIDS will adapt the process to meet user’s needs. If there is demand for ASAR data from institutes in the Republic of Ireland, SIDS would be prepared to negotiate with ESA a licensing agreement to make this data available as GeoTiff’s in Irish National Grid in the future.

Product 1 - Greyscale ASAR Images

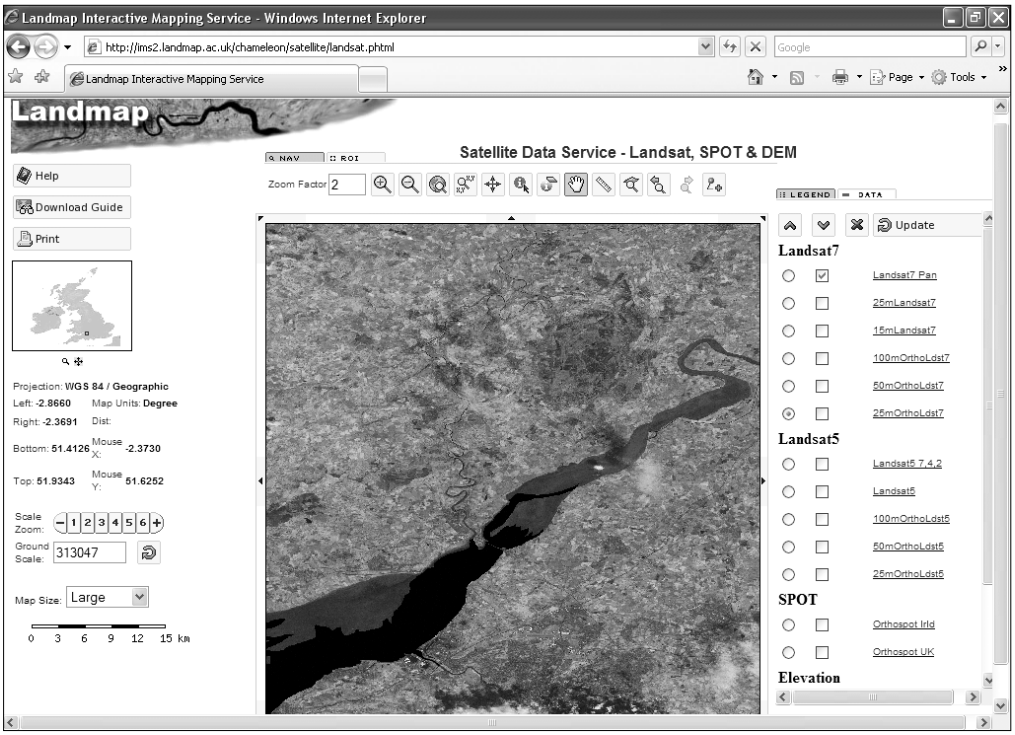


Product 2 - Colour Composite Images



4. Discussion and Conclusion

SIDS has provided two new services for the academic community the WMS and WCS (Figure 3) and also Image Streaming Service (Figure 4).



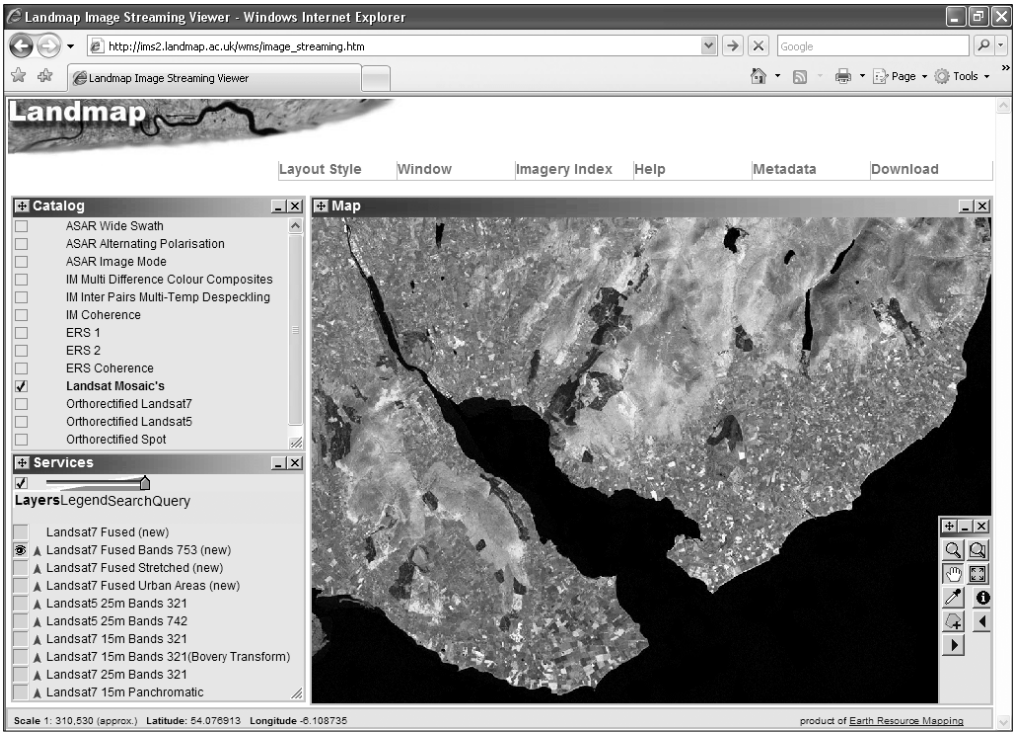


Figure 3. Customised Chameleon client for WMS and WCS.
Figure 4. Customised RightWebMap client for Image Streaming Service.

The on-line mapping services have attracted a total of 1.5 million hits, from approximately 9000 unique IP addresses, in the past year. Future plans are to extend the interfaces further by integrating the metadata XML files for each dataset into the viewers and also by creating a dynamic map extract tool. The extract tool will allow users to download via WCS the satellite imagery that appears in the viewer so that the download process is more user specific. The associated recently updated metadata file will also be downloaded and all data provided in a zip file to the end user. Possible solutions for authentication will also be explored during the forthcoming year so that SIDS can monitor who is using the WCS.

Focused on developing further the SIDS geodata infrastructure, in the forthcoming year development activities will be taking place to grid enable the SIDS archive as part of the Grid Enabling MIMAS Services (GEMS) II project funded by JISC. A demonstration use case of urban-rural change detection using data from different time epochs will be developed to show how the grid can be implemented for CPU intensive processing which would be unmanageable on a desktop.

Further data acquisition is also a priority; with plans to order additional ASAR data from ESA and provide the data online as WMS, WCS, Image Streaming and as ortho-rectified GeoTiff's. A request to JISC to provide funding to acquire annual UK coverage of optical data for 5 years has been submitted. We hope that by the time this paper is presented at GISRUK 2007 positive news about the expansion of the SIDS service would be forthcoming.

Acknowledgements

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7. References

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