Project No. 249024

NETMAR

Open service network for marine environmental data

Instrument: *Please tick*	CA	✓ **STREP**	IP	NOE

ICT - Information and Communication Technologies Theme

D5.2.1 Data Processing Services – Basic Processing Services

Reference: D5.2.1_Basic_Processing_Services_r1_20110727

Due date of deliverable (as in Annex 1): M0 + 18
Actual submission date: 27 July 2011

Start date of project: 1 February 2010 Duration: 3 years

Plymouth Marine Laboratory

Revision 1

Project co-funded by the European Commission within the Seventh Framework Programme (2007-2013)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

European Commission
Information Society and Media

	NETMAR Open service network for marine environmental data Project Reference: 249024 Contract Type: Collaborative Project Start/End Date: 01/03/2010 - 31/01/2013 Duration: 36 months
	Coordinator: Prof. Stein Sandven Nansen Environmental and Remote Sensing Center Thormøhlensgate 47, Bergen, Norway Tel.: +47 55 20 58 00 Fax. +47 55 20 58 01 E-mail: stein.sandven@nersc.no

Acknowledgements

The work described in this report has been partially funded by the European Commission under the Seventh Framework Programme, Theme ICT 2009.6.4 ICT for environmental services and climate change adaptation.

Consortium

The NETMAR Consortium is comprised of:

- Nansen Environmental and Remote Sensing Center (NERSC), Norway (coordinator).
  Project Coordinator: Prof. Stein Sandven (stein.sandven@nersc.no)
  Deputy Coordinator: Dr. Torill Hamre (torill.hamre@nersc.no)
  Quality Control Manager: Mr. Lasse H. Pettersson (lasse.pettersson@nersc.no)
- British Oceanographic Data Centre (BODC), National Environment Research Council, United Kingdom
  Contact: Dr. Roy Lowry (rkl@bodc.ac.uk)
- Centre de documentation de recherche et d'expérimentations sur les pollutions accidentelles des eaux (Cedre), France.
  Contact: Mr. François Parthiot (Francois.Parthiot@cedre.fr)
- Coastal and Marine Resources Centre (CMRC), University College Cork, National University of Ireland, Cork, Ireland.
  Contact: Mr. Declan Dunne (d.dunne@ucc.ie)
- Plymouth Marine Laboratory (PML), United Kingdom.
  Contact: Mr. Steve Groom (sbg@pml.ac.uk)
- Institut français de recherche pour l'exploitation de la mer (Ifremer), France.
  Contact: Mr. Mickael Treguer (mickael.treguer@ifremer.fr)
- Norwegian Meteorological Institute (METNO), Norway.
  Contact: Mr. Øystein Torget (oysteint@met.no)

Author(s)

- Peter Walker, PML, (petwa@pml.ac.uk)
- Morten Stette, NERSC, (morten.stette@nersc.no)
- Torill Hamre, NERSC, (torill.hamre@nersc.no)

Document approval

- Document status: Revision 1
- WP leader approval: 2011-07-25
- Quality Manager approval: 2011-07-27
- Coordinator approval: 2011-07-27

Revision History

Issue	Date	Change records	Author(s)
Draft 1	2011-05-20	First draft of the report.	Peter Walker
Draft 2	2011-07-11	Incorporate input on pilots from partners.	Peter Walker Morten Stette Torill Hamre
Draft 3	2011-07-25	Incorporate review comments	Peter Walker Torill Hamre
1	2011-07-27	First version approved by the coordinator.	Torill Hamre

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Executive Summary

The NETMAR project will develop a pilot European Marine Information System (EUMIS) that will enable users to search, download and integrate satellite, in situ and model data from ocean and coastal areas. EUMIS will be a user-configurable system offering flexible service discovery, access and chaining facilities based on open and widely adopted web GIS standards. To support smart search, it will use a semantic framework coupled with ontologies for identifying and accessing distributed data, such as near-real time, forecast and historical data, which are marked up using different, but semantically related, keywords. To support dynamic generation of new composite products and statistics suitable for decision-making, it will use web processing services that can be chained together to form workflows that perform a series of operations on input data chosen by the user.

The EUMIS pilot will target the needs of four user communities:

- Arctic operators, environmental authorities and fishery management
- Oil spill drift forecast and shoreline cleanup assessment services in France
- Ocean colour – Marine Ecosystem, Research and Monitoring users
- The International Coastal Atlas Network (ICAN)

Each user community will have a customised pilot that provides the products and services needed for their line of work. The NETMAR partners have had close contact with selected users in each community to identify and document their needs. These user requirements have been described as a series of use cases and a joint list of requirements [PTS+11], which forms the basis for the EUMIS development. As part of this process, the NETMAR partners have also identified a number of data delivery and processing services that are necessary for each pilot.

This document identifies the *processing services* which are provided by the NETMAR partners for the EUMIS pilots. These processing services cover all the requirements identified during the use case specification process. Specifically, for pilot 1, a sea ice type classification service, and for pilot 3, a service comparing ocean colour data from satellites or models with measurements from measurements from on site buoys are implemented. These services are offered through a WPS (Web Processing Service) interface, which is an open standard for web processing services.

The NETMAR project has also developed a range of processing services some of which are generic “toolkit” processes such as *reprojectImage* which will convert an image from one projection to another, optionally changing the resolution allowing 2 images using different projections to be compared or merged. These generic processing services can be built into service chains to provide more complex services such as comparing a satellite image and a model output (Figure 3-1). Where a particular, non-generic, need has been identified a specific processing service has been developed to answer it. Using a combination of these generic and non-generic services a non-technical user can simply develop sophisticated processing chains using a simple GUI (Graphical User Interface) service chaining editor developed by the NETMAR project.

The remote processing services approach allows researchers to develop workflows without installing any more software than a standard web browser; as the workflows are not tied to particular client machines they may be easily shared with other users within the community. The service based approach also allows providers to develop complex algorithms which may themselves be workflows and make them available to users without having to release installation packages or code.

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These processing services are freely available with no (or few) access restrictions; however, the data used by the processing services may come from a variety of sources, not just the NETMAR partners, and may contain sensitive information and be restricted to specific users. Processing services will be made available using standard methods (OGC WPS) allowing usage by any compatible applications not just the EUMIS portal itself. As a research project, NETMAR is not directly addressing issues of federated identity and delegation of authority. However, it will continue to monitor work on these issues during the lifetime of the project and will attempt to follow the most widely adopted standards where access control is required.

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1. Introduction

1.1. Background and project linkage

NETMAR aims to develop a pilot European Marine Information System (EUMIS) for searching, downloading and integrating satellite, in situ and model data from ocean and coastal areas. It will be a user-configurable system offering flexible service discovery, access and chaining facilities using OGC, OPeNDAP and W3C standards. It will use a semantic framework coupled with ontologies for identifying and accessing distributed data, such as near-real time, forecast and historical data.

EUMIS will also enable further processing of such data to generate composite products and statistics suitable for decision-making in different marine application domains. The processing services will also be realised using standard OGC protocols, notably WPS (Web Processing Services), and a simple to use service chaining editor will be developed as part of EUMIS. The service chaining editor will be run in a common web browser and allow users to compose their own workflows that generate new products customised to their needs. Figure 1-1 illustrates how observations, derived parameters and predictions are retrieved from a distributed service network through standard protocols, and delivered through the EUMIS portal using ontologies and semantic frameworks to select suitable products and where new products can be generated dynamically using chained processing services.

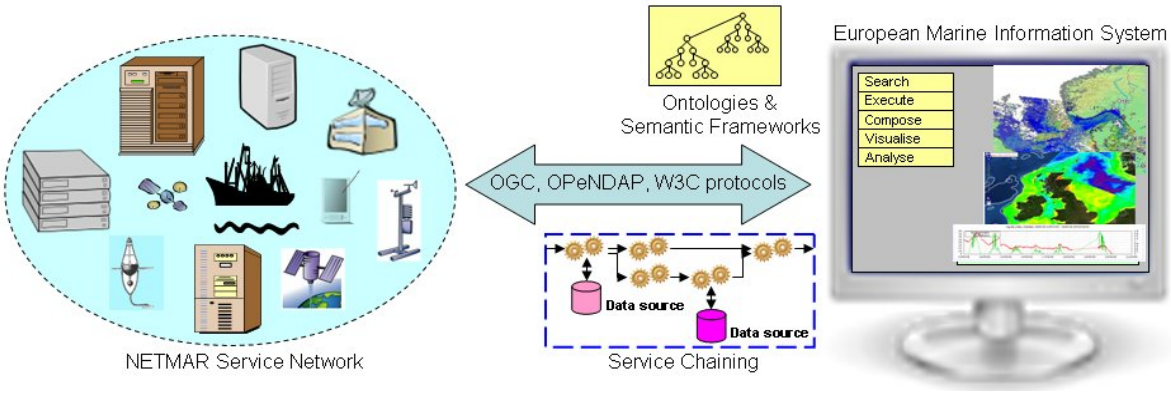

Figure 1-1 The NETMAR Service Network

The pilot EUMIS will target four user communities by developing the following pilots:

- Pilot 1: Arctic Sea Ice and Metocean Observing System
- Pilot 2: Oil spill drift forecast and shoreline cleanup assessment services in France
- Pilot 3: Ocean colour – Marine Ecosystem, Research and Monitoring
- Pilot 4: International Coastal Atlas Network (ICAN) for coastal zone management

We have had close contact with selected users in each of the targeted communities to identify and document their needs for data search and retrieval, processing and visualisation. The user needs have been defined through a set of concrete use cases specifying how the user will carry out a specific operation to solve a real-world problem and how this functionality will be tested [PTS+11]. As part of this analysis we have identified data processing services required to provide the information needed by the user. These processing services cover all the requirements identified during the use case specification process [PTS+11]. For the first phase of the pilots, only pilots 1 & 3 have identified requirements for processing services. It is intended that, once the initial services are successfully integrated, other pilots will develop and make use of processing services.

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The processing services, identified as user requirements through interviews and discussions with users (WP1), analysed and clarified as part of system architecture design (WP2), will feed into the EUMIS development (WP6) as components of service chains, and will support the evaluation of the project via the EUMIS portal in the user testing phases. Many services are also available for external use, and thus may be included in dissemination (WP7).

1.2. Objective of this report

This report documents the processing services provided by each of the NETMAR service providers (Table 1-1) that are directly related to the first phase testing of the pilots. Many other processes exist and may also be used, but are not directly related at this point.

Pilot	Requirement	Service	Provider
1	Arctic sea ice classification	getIceClassMapsAsar	NERSC
3	Compare in situ and satellite data	v.sample r.math	PML
	Compare model and satellite data	reprojectBBOX intersectBBOX reprojectImage mergeImages compareImages	PML

Table 1-1 User requirements and corresponding NETMAR processing services

Inputs and outputs are listed for each service. Where services wrap an existing piece of software such as GDAL or GRASS, exceptions raised by the software will be returned within the WPS and SOAP error constructs.

1.3. Terminology

ASAR Advanced Synthetic Aperture Radar
ENVISAT Earth Observation spacecraft, launched in 2002
GDAL Geospatial Data Abstraction Library
GRASS Geographic Resources Analysis Support System, an open source, free software Geographical Information System
KVP Key-Value Pair
OGC Open Geospatial Consortium
OPeNDAP Open-source Project for a Network Data Access Protocol
SOAP Simple Object Access Protocol
W3C World Wide Web Consortium
WPS Web Processing Service

1.4. Organisation of this report

Section 1 provides a summary of the processing services provided by the NETMAR partners. The following sections provide detailed breakdowns of the processing services provided for each pilot. These will comprise a brief description of the context of the pilot, a brief discussion of the operations (use cases) that need processing services, and all information required to access the individual services (usage restrictions, access URLs and parameter names).

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2. Services for Pilot 1: Arctic Sea Ice and Met-ocean Observing System

2.1. Description of the user group

The Norwegian Meteorological Institute is responsible for the national sea ice service in Norway. Through the operational Sea Ice Service situated in Tromsø, sea ice charts are produced using satellite information. The Sea Ice Service advices ship and icebreaker captains/ice pilots, shipping companies, national authorities, regional environmental agencies, national ice services on current and future sea ice conditions.

TOTAL E&P, Paris, is an oil company that, among others, operates in ice covered ocean areas such as the Arctic Ocean. Having access to timely and accurate observations as well as forecasts of ice and met-ocean conditions are crucial for both exploration and exploitation activities.

2.2. Work context

The Arctic Ocean and the adjacent sub-Arctic seas, including Europe's northern frontiers, have become more important as a result of the global warming and increased economic activities related to energy exploration, marine resources and transportation. Improving sea ice monitoring and forecasting, as well as the scientific understanding of the sea ice as part of the climate system is important for many user groups including European agencies and organisations (e.g. EEA, EuroGOOS). Reduced ice extent in this area during the summer period may lead to increased ship transport to and from Europe and Asia, and changes in sea ice conditions have impact on the overall sea ice climate of the Arctic Ocean as well as increasing the risk for major environmental accidents in this vulnerable environment.

There is an increasing supply of sea ice information from satellites, in situ platforms and modelling systems that can be exploited by several users groups. Both operational users and scientific users need to combine data from the available observing systems as well as from modelling systems in order to make the best possible assessment of the present and forthcoming ice situation, e.g. by assimilation of observations into forecasting models.

Still, the problems of accessing relevant information about the current sea ice situation and the how the situation develops over time remain. Typically, the data needed must be compiled from several data centres, which offer different formats that cannot readily be integrated in the user's own systems. This makes it time consuming to combine information from different sources to give a more complete picture of the current situation than can be provided from a single source. Thus, to support safe and efficient operation of the increased activity in the Arctic Ocean and adjacent seas, access, discovery and processing of information on sea ice and related data needs to be improved.

2.3. Use of processing services

Pilot 1 has defined two use cases [PTS+11]:

- P1-UC1: Develop new improved sea ice service
- P1-UC2: Search and retrieval of sea ice and met-ocean data

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Both use cases need access to the most recent as well as historical ice information such as ice concentration, ice drift and ice types, in the area of interest. Ice parameters such as these are often obtained by processing and analysing of satellite imagery. For instance, different classification algorithms can be used to extract ice type from a radar satellite image. An algorithm based on Neural Network techniques classification of ice types in ENVISAT ASAR imagery was first developed as part of PhD thesis [Zak09] and later enhanced in the EC FP7 MyOcean project [MYO11]. Using this algorithm new ice type maps can be computed on the fly when requested by the users.

For the first use case, ice type maps is generated dynamically when a user searches for ice parameters within an area and time range which is covered by an ENVISAT ASAR image. In the second use case, the processing service generating ice type maps is part of a larger service chain that combines ice parameters from multiple sources, including observations, derived parameters and predictions, into a new and improved ice chart.

2.4. Processing service descriptions

2.4.1. Arctic sea ice classification service

The Arctic sea ice classification service selects an ENVISAT ASAR scene based on a given Arctic region and date, and computes the corresponding ice classification map.

Service Type	WPS
Provider	NERSC
Access Restrictions	Freely available
Status	Testing
Catalogue Service URL	http://nport.nersc.no:8081/geonetwork/srv/en/main.home
Service URL	http://nport.nersc.no/pywps/pywps.cgi?request=GetCapabilities&service=WPS&version=1.0.0
Service WSDL	http://nport.nersc.no/pywps/pywps.cgi?WSDL

As an example, the following URL will produce the ice map shown in Figure 2-1:

http://nport.nersc.no/pywps/pywps.cgi?service=wps&version=1.0.0&request=execute&identifier=getIceClassMapsAsar&datainputs=[scenedate="20110522";sceneregion="BARENTS"]

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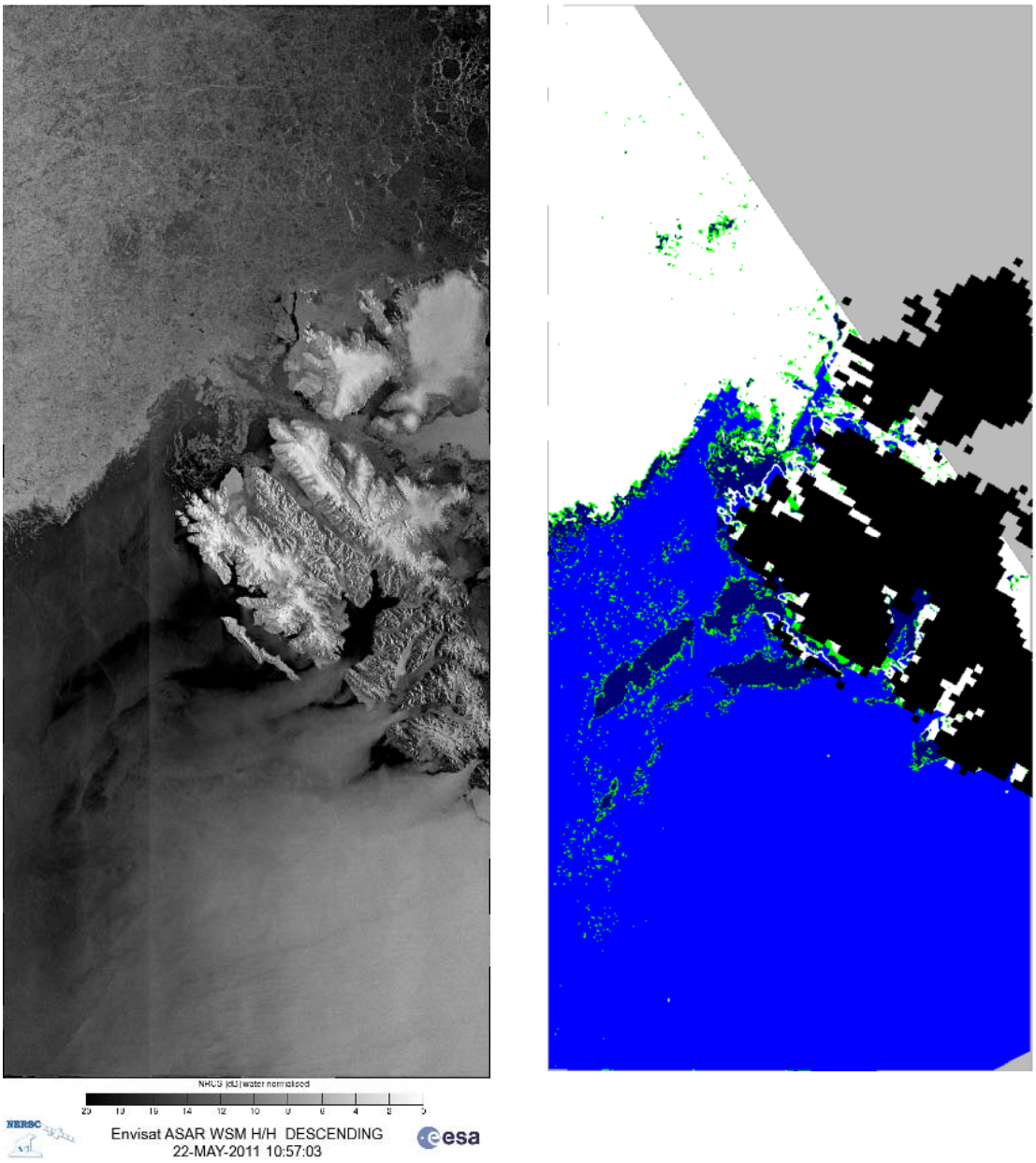

Figure 2-1 Example of ASAR image from 22 May 2011 (left) and the classified ice types (right). Legend: White: Ice; Blue: Open Water; Black: land, Green: undefined.

2.4.1.1. getIceClassMapsAsar

The getIceClassMapsAsar service generates an ice classification map (PNG file) based on an ENVISAT ASAR satellite image. The process runs a Python algorithm performing a neural network based classification of ice types in the image. The ice types are colour coded in the image returned. The resulting grid is the same as the original ASAR image and based on the satellite track.

Call Type	Synchronous/Asynchronous
Return Type	Stored on server
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://nport.nersc.no/pywps/pywps.cgi?service=wps&version=1.0.0&request=describeprocess&identifier=getIceClassMapsAsar

2.4.1.1.1. Input parameters

Parameter	sceneregion
Description	Region based on a set of predefined areas: BARENTS, KARA and LAPTEV.
mimeType	text
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

Parameter	scenedate
Description	The date of the ASAR scene in the format YYYYMMDD.
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

2.4.1.1.2. Output parameters

Parameter	output
Description	Raster image. The resulting PNG image consists of colour coded ice types for the given region and date.
mimeType	image/png
dataType	ComplexData (raster-base64)

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3. Services for Pilot 3: Marine Ecosystem, Research and Monitoring

3.1. Description of the user group

User group 3 consists of a number of different communities with a common interest in marine ecosystems.

National observatories and networks:
The Western English Channel Observatory (WECO) comprises sampling sites south of Plymouth where a range of biological, chemical physical and optical measurements are taken. Its objective is to draw together long-term in situ measurements; ecosystem modelling studies; and Earth Observation (EO) and integrate these using web-based Geographic Information System (GIS) technology.

The Chlorophyll Global Integrated Network (ChloroGIN) project aims to promote in situ measurement of chlorophyll in combination with satellite-derived estimates.

Modelling community:
Marine Ecosystem Evolution in a Changing Environment (MEECE) is a 4-year EC FP7 project that started in 2008 and includes 21 partners around Europe. MEECE aims to use a combination of data synthesis, numerical simulation and targeted experiments to boost knowledge and develop the predictive capabilities needed to learn about the response of marine ecosystems.

Operational community:
The French authorities (Prefectures) have a responsibility for operational monitoring of algal blooms.

3.2. Work context

Researchers in ecosystems need to be able to identify and use long-term time series to quantify ecosystem responses to natural variability, climate change or the impact of anthropogenic activities. Examples may include comparing long term change in zooplankton concentration to water temperature or relating optical properties to chlorophyll concentration.

There is also a need to compare the coupled physical and biological models which are being run in hindcast mode with historical EO data for validation, enabling future forecasts to observe the impacts of climate change such as changes in primary production or ocean acidification. This can be achieved using in situ data sets such as the Continuous Plankton Recorder (CPR); long term sampling stations, such as in the western English Channel, in operation for over 100 years, and satellite remote sensing for which SST data have been continuously available for approximately 30 years and ocean colour for approximately 12 years.

Operational users may find it useful to compare, in near real time, contemporary satellite and in situ data in order to provide input to water quality monitoring systems, for example, on phytoplankton chlorophyll-a concentration. Phytoplankton blooms occur each year in the Gulf of Biscay and English Channel from early spring to autumn; because some species in these blooms can cause disturbance in human activities such as aquaculture (oysters, mussels) or human health problems, regular monitoring of these areas is coordinated by Ifremer.

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3.3. Use of processing services

Pilot 3 has defined three use cases [PTS+11]:

- P3-UC1: New data service
- P3-UC2: Compare satellite and in-situ time series data
- P3-UC3: Compare satellite and model data

P3-UC1 relates to the simple service chaining aim of NETMAR and demonstrates how the processing services defined in this document may be combined using graphical tools to produce sophisticated workflows with no user coding required.

These workflows are shown in use in the other 2 use cases, comparing satellite, model and in situ data. Figure 3-1 shows a workflow developed for P3-UC3 which uses the *reprojectImage*, *mergeImages* and *compareImages* services to take an overlapping model output and satellite image using different projections and produce a statistical comparison of the common area.

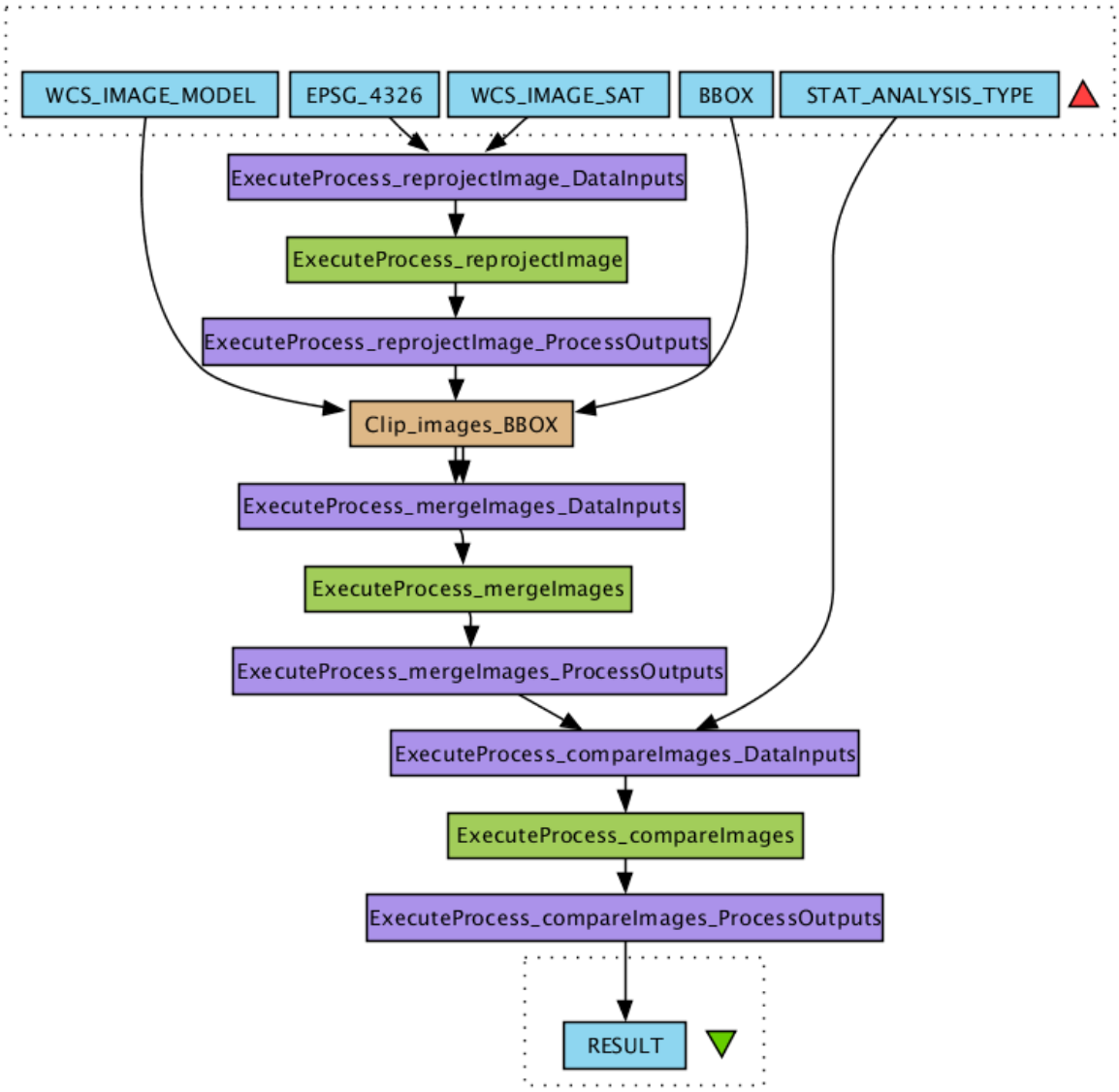

Figure 3-1 A service chain to compare a model with a satellite image.

The ability of WPS to return only a reference to the result data allows the actual movement of data between services and workflow server to be minimised as where two services are directly chained, the second will take its input directly from the first. This example was developed using the third party workflow editor, Taverna Workbench, showing that the extensions to PyWPS developed by NETMAR make it possible for users to use general standards based tools with the NETMAR processing services.

3.4. Processing service descriptions

3.4.1. GRASS raster service

The GRASS Raster Service provides a WPS interface to the standard GRASS raster processing functions. These provide a very useful “toolbox” which can be used within service chains to convert and subset data in to formats required by the more specific processing services developed explicitly for the pilot. Processes used within the pilot will be listed below but for a full list of all available processes please use the GetCapabilities link provided.

Service Type	WPS
Provider	PML
Access Restrictions	Freely available
Status	Testing
Catalogue Service URL	http://rsg.pml.ac.uk/csw
Service URL	http://rsg.pml.ac.uk/wps/raster.cgi?request=GetCapabilities&service=WPS
Service WSDL	http://rsg.pml.ac.uk/wps/raster.wsdl http://rsg.pml.ac.uk/wps/raster.cgi?WSDL

The following link shows an example execution of the r.math process to remove features below 100 from an elevation map using an HTML KVP call and returning the output image directly to the browser:

http://rsg.pml.ac.uk/wps/raster.cgi?request=Execute&service=wps&version=1.0.0&identifier=r.math&RawDataOutput=output&datainputs=[a=http://rsg.pml.ac.uk/wps/testdata/elev_srtm_30m.tif;math=output=if(a>100,a,0)]

The before and after images are shown in Figure 3-2.

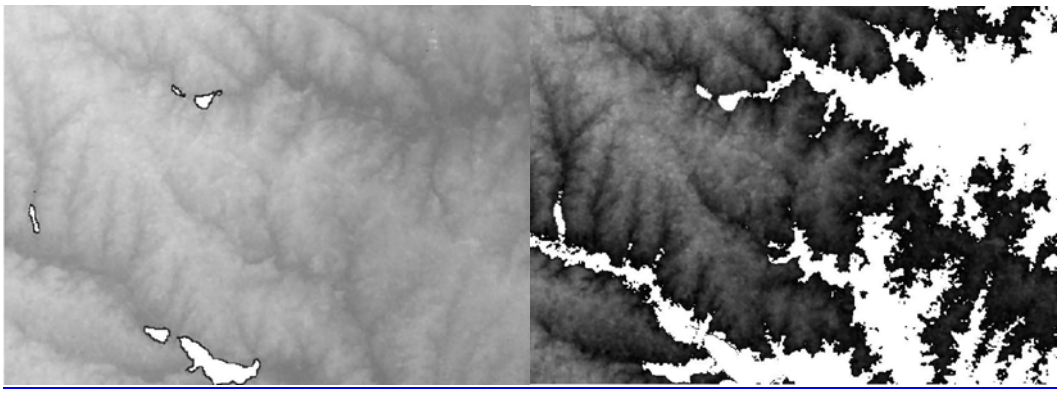

Figure 3-2 Images before and after processing.

3.4.1.1. r.resample

r.resample resamples the data values in a user-specified raster input map layer name (bounded by the current geographic region and masked by the current mask),

and produces a new raster output map layer name containing the results of the resampling. The category values in the new raster output map layer will be the same as those in the original, except that the resolution and extent of the new raster output map layer will match those of the current geographic region settings (see g.region). r.resample is intended for reinterpolation of continuous data to a different resolution rather than for interpolation from scattered data (use the v.surf.* modules for that purpose).
The method by which resampling is conducted is "nearest neighbour" (see r.neighbors). The resulting raster map layer will have the same resolution as the resolution of the current geographic region (set using g.region).

Call Type	Synchronous/Asyncronous
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://rsg.pml.ac.uk/wps/raster.cgi?service=WPS&request=DescribeProcess&version=1.0.0&identifier=r.resample

3.4.1.1.1. Input parameters

Parameter	**input**
Description	Name of an input layer
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

Parameter	**grass_resolution_ns**
Description	This parameter defines the north-south resolution of the mapset in meter or degrees, which should be used to process the input and output raster data. To enable this setting, you need to specify north-south and east-west resolution.
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#float)

Parameter	**grass_resolution_ew**
Description	This parameter defines the east-west resolution of the mapset in meter or degrees, which should be used to process the input and output raster data. To enable this setting, you need to specify north-south and east-west resolution.
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#float)

3.4.1.1.2. Output parameters

Parameter	**output**
Description	Raster resampled image
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

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3.4.1.2. r.math

A WPS compatible front end for r.mapcalc which will process up to 8 raster maps.
r.math expects its input to have the form:
result = *expression*

where *result* is the name of a raster map layer to contain the result of the calculation and *expression* is any legal arithmetic expression involving existing raster map layers, integer or floating point constants, and functions known to the calculator.

Call Type	Synchronous/Asynchronous
Provider	PML
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://rsg.pml.ac.uk/wps/raster.cgi?service=WPS&request=DescribeProcess&version=1.0.0&identifier=r.math

3.4.1.2.1. Input parameters

Parameter	**a,b,c,d,e,f,g,h**
Description	Input Layer (each letter represent a different WPS input)
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

Parameter	**grass_resolution_ns**
Description	This parameter defines the north-south resolution of the mapset in meter or degrees, which should be used to process the input and output raster data. To enable this setting, you need to specify north-south and east-west resolution.
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#float)

Parameter	**grass_resolution_ew**
Description	This parameter defines the east-west resolution of the mapset in meter or degrees, which should be used to process the input and output raster data. To enable this setting, you need to specify north-south and east-west resolution.
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#float)

Parameter	**math**
Description	String containing the r.mapcalc expression(s) to evaluate, referencing the inputs and the output by name: e.g. output=(sin(a)+cos(b))
mimeType	text/plain
dataType	ComplexData (text)

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3.4.1.2.2. Output parameters

Parameter	output
Description	Calculated raster
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

3.4.2. GRASS vector service

The GRASS Vector Service provides a WPS interface to the standard GRASS vector processing functions. Processes used within the pilot will be listed below but for a full list please use the GetCapabilities link provided.

Service Type	WPS
Provider	PML
Access Restrictions	Freely available
Status	Testing
Catalogue Service URL	http://rsg.pml.ac.uk/csw
Service URL	http://rsg.pml.ac.uk/wps/vector.cgi?request=GetCapabilities&service=WPS
Service WSDL	http://rsg.pml.ac.uk/wps/vector.wsdl

3.4.2.1. v.sample

v.sample samples a GRASS raster map at the point locations in the input file by either cubic convolution interpolation, bilinear interpolation, or nearest neighbour sampling (default).

Call Type	Synchronous/Asynchronous
Provider	PML
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://rsg.pml.ac.uk/wps/vector.cgi?service=WPS&request=DescribeProcess&version=1.0.0&identifier=v.sample

3.4.2.1.1. Input parameters

Parameter	input
Description	Data source for direct OGR access
mimeType	text/xml (GML2.1.2/KML2.2),application/dgn,application/x-zipped-shp
dataType	ComplexData (XML,base64)

Parameter	layer
Description	Layer name for direct OGR access. A single vector map can be connected to multiple database tables. This number determines which table to use. Numerical value as string
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

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Parameter	column
Description	Name of attribute column to use for comparison.
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

Parameter	raster
Description	Raster map to be sampled
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

Parameter	grass_resolution_ns
Description	This parameter defines the north-south resolution of the mapset in meter or degrees, which should be used to process the input and output raster data. To enable this setting, you need to specify north-south and east-west resolution.
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#float)

Parameter	grass_resolution_ew
Description	This parameter defines the east-west resolution of the mapset in meter or degrees, which should be used to process the input and output raster data. To enable this setting, you need to specify north-south and east-west resolution.
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#float)

Parameter	grass_band_number
Description	This parameter defines band number of the input raster files which should be processed. As default all bands are processed and used as single and multiple inputs for raster modules.
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#integer)

Parameter	z
Description	Sampled values will be multiplied by this factor
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#float)

Parameter	method
Description	Interpolation method (nearest,bilinear,bicubic)
mimeType	N/A
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

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3.4.2.1.2. Output parameters

Parameter	output
Description	Output Layer
mimeType	text/xml(GML2.1.2,KML2.2)
dataType	ComplexData(XML)

3.4.3. GDAL and other tool based services

As well as the GRASS integration documented above, NETMAR has developed wrappers for commonly used GDAL functions which allow the power of GDAL to be used in a web processing environment. This, in combination with custom services developed for the pilot but re-usable elsewhere, provides another useful toolkit.

Service Type	WPS
Provider	PML
Access Restrictions	Freely available
Status	Testing
Catalogue Service URL	http://rsg.pml.ac.uk/csw
Service URL	http://rsg.pml.ac.uk/wps/generic.cgi?request=GetCapabilities&service=WPS
Service WSDL	http://rsg.pml.ac.uk/wps/generic.wsdl

An example execution of the gdalinfo process using the HTML KVP style of call is provided below:

http://rsg.pml.ac.uk/wps/generic.cgi?request=Execute&service=WPS&version=1.0.0&identifier=gdalinfo&datainputs=[-mm=True;input=http://rsg.pml.ac.uk/wps/testdata/elev_srtm_30m.tif]

The process produces the following XML response, showing information on the input file:

```
<wps:ExecuteResponse
   xsi:schemaLocation="http://www.opengis.net/wps/1.0.0
http://schemas.opengis.net/wps/1.0.0/wpsExecute_response.xsd"
   service="WPS" version="1.0.0" xml:lang="en-CA"

serviceInstance="http://rsg.pml.ac.uk/wps/generic.cgi?service=WPS&request=GetCapabilit
ies&version=1.0.0"
   statusLocation="http://rsg.pml.ac.uk/wps/wpsoutputs/pywps-131054745080.xml">
<wps:Process wps:processVersion="1.0">
  <ows:Identifier>gdalinfo</ows:Identifier>
  <ows:Title>GDALinfo command</ows:Title>
  <ows:Abstract>GDALinfo command to check image properties</ows:Abstract>
</wps:Process>
<wps:Status creationTime="2011-07-13T09:57:37Z">
  <wps:ProcessSucceeded>PyWPS          Process          gdalinfo          successfully
calculated</wps:ProcessSucceeded>
</wps:Status>
<wps:ProcessOutputs>
  <wps:Output>
    <ows:Identifier>stdout</ows:Identifier>
    <ows:Title>Standard Output from gdalinfo</ows:Title>
    <wps:Data>
      <wps:ComplexData mimeType="text/plain">

Driver: GTiff/GeoTIFF
Files: ./pywpsInput1HLa_a
Size is 500, 450
Coordinate System is:
PROJCS["Lambert Conformal Conic",
```

```
    GEOGCS["NAD83",
        DATUM["North_American_Datum_1983",
            SPHEROID["GRS 1980",6378137,298.2572221010002,
                AUTHORITY["EPSG","7019"]],
            AUTHORITY["EPSG","6269"]],
        PRIMEM["Greenwich",0],
        UNIT["degree",0.0174532925199433],
        AUTHORITY["EPSG","4269"]],
    PROJECTION["Lambert_Conformal_Conic_2SP"],
    PARAMETER["standard_parallel_1",36.16666666666666],
    PARAMETER["standard_parallel_2",34.33333333333334],
    PARAMETER["latitude_of_origin",33.75],
    PARAMETER["central_meridian",-79],
    PARAMETER["false_easting",609601.22],
    PARAMETER["false_northing",0],
    UNIT["metre",1,
        AUTHORITY["EPSG","9001"]]]
Origin = (630000.000000000000000,228500.000000000000000)
Pixel Size = (30.000000000000000,-30.000000000000000)
Metadata:
  AREA_OR_POINT=Area
Image Structure Metadata:
  INTERLEAVE=BAND
Corner Coordinates:
Upper Left  (  630000.000,  228500.000) ( 78d46'27.41"W, 35d48'34.59"N)
Lower Left  (  630000.000,  215000.000) ( 78d46'28.63"W, 35d41'16.54"N)
Upper Right (  645000.000,  228500.000) ( 78d36'29.89"W, 35d48'33.08"N)
Lower Right (  645000.000,  215000.000) ( 78d36'32.01"W, 35d41'15.03"N)
Center      (  637500.000,  221750.000) ( 78d41'29.49"W, 35d44'54.91"N)
Band 1 Block=500x4 Type=Float32, ColorInterp=Gray
  Metadata:
    COLOR_TABLE_RULES_COUNT=5
    COLOR_TABLE_RULE_RGB_0=-3.265445e+01 1.183994e+01 255 255 0 0 255 0
    COLOR_TABLE_RULE_RGB_1=1.183994e+01 5.633433e+01 0 255 0 0 255 255
    COLOR_TABLE_RULE_RGB_2=5.633433e+01 1.008287e+02 0 255 255 0 0 255
    COLOR_TABLE_RULE_RGB_3=1.008287e+02 1.453231e+02 0 0 255 255 0 255
    COLOR_TABLE_RULE_RGB_4=1.453231e+02 1.898175e+02 255 0 255 255 0 0


      </wps:ComplexData>
    </wps:Data>
  </wps:Output>
</wps:ProcessOutputs>
</wps:ExecuteResponse>
```


3.4.3.1. gdalinfo

Wrapper for gdalinfo command. It returns image properties as extracted from the file by the gdalinfo command.

Call Type	Synchronous/Asynchronous
Provider	PML
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://rsg.pml.ac.uk/wps/generic.cgi?service=WPS&request=DescribeProcess&version=1.0.0&identifier=gdalinfo

3.4.3.1.1. Input parameters

Parameter	**input**
Description	Input image to be analysed
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

Parameter	stats
Description	Read and display image statistics. Force computation if no statistics are stored in an image.
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#boolean)

Parameter	mm
Description	Force computation of the actual min/max values for each band in the dataset.
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#boolean)

3.4.3.1.2. Output parameters

Parameter	stdout
Description	Standard output from gdalinfo
mimeType	text/plain
dataType	ComplexData (text)

3.4.3.2. reprojectCoords

reprojectCoords wraps gdaltransform to reproject a list of coordinates from one projection to another.

Call Type	Synchronous/Asynchronous
Provider	PML
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://rsg.pml.ac.uk/wps/generic.cgi?service=WPS&request=DescribeProcess&version=1.0.0&identifier=reprojectCoords

3.4.3.2.1. Input parameters

Parameter	Cords
Description	List of input coordinates in the form “x1 y1, x2 y2, x3 y3 …”
mimeType	-
dataType	ComplexData (text)

Parameter	inputSRS
Description	Input SRS in format suitable for gdaltransform
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

Parameter	outputSRS
Description	Output SRS in format suitable for gdaltransform
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

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3.4.3.2.2. Output parameters

Parameter	stdout
Description	List of output coordinates in the form “x1 y1, x2 y2, x3 y3 …”
mimeType	text/plain
dataType	ComplexData (text)

3.4.3.3. reprojectImage

Uses gdalwarp to reproject an image to a new projection. It will optionally change the resolution of the output image to allow it to match an existing grid.

Call Type	Synchronous/Asynchronous
Provider	PML
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://rsg.pml.ac.uk/wps/generic.cgi?service=WPS&request=DescribeProcess&version=1.0.0&identifier=reprojectImage

3.4.3.3.1. Input parameters

Parameter	inputImage
Description	Input image to be reprojected
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

Parameter	inputSRS
Description	Input SRS in format suitable for gdal
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

Parameter	outputSRS
Description	Output SRS in format suitable for gdal
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

Parameter	outputExtent
Description	Output extent in the form “leftx bottomy, rightx topy”
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

Parameter	outputResolution
Description	Output resolution in the form “xres yres”
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

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Parameter	outputHeight
Description	Output image height. Cannot be used with outputResolution. If 0 then will be calculated to match outputWidth
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#integer)

Parameter	outputWidth
Description	Output image width. Cannot be used with outputResolution. If 0 then will be calculated to match outputHeight
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#integer)

Parameter	noData
Description	List of source no data values in format suitable for gdalwarp
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

3.4.3.3.2. Output parameters

Parameter	outputImage
Description	Reprojected image
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

3.4.3.4. mergeImages

mergeImages will combine 2 images using the same grid into a single multiband GeoTIFF.

Call Type	Synchronous/Asynchronous
Provider	PML
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://rsg.pml.ac.uk/wps/generic.cgi?service=WPS&request=DescribeProcess&version=1.0.0&identifier=mergeImages

3.4.3.4.1. Input parameters

Parameter	inputImage1
Description	Input image to be merged
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

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Parameter	inputImage2
Description	Input image to be merged
mimeType	image/tiff,image/geotiff,image/png,image/jpeg,application/x-erdas-hfa,application/netcdf
dataType	ComplexData (raster-base64)

3.4.3.4.2. Output parameters

Parameter	outputImage
Description	Merged image
mimeType	image/geotiff
dataType	ComplexData (raster-base64)

3.4.3.5. compareImages

compareImages runs a number of predefined statistical comparisons on the 2 bands of the input image.

Call Type	Synchronous/Asynchronous
Provider	PML
Access Restrictions	Freely available
Status	Testing
Describe Process URL	http://rsg.pml.ac.uk/wps/generic.cgi?service=WPS&request=DescribeProcess&version=1.0.0&identifier=compareImages

3.4.3.5.1. Input parameters

Parameter	inputImageFile
Description	File containing image bands to be compared
mimeType	image/geotiff
dataType	ComplexData (raster-base64)

Parameter	statType
Description	Name of statistic to produce (ROC, Kappa, Wavelet SS, Wavelet MSE)
mimeType	-
dataType	LiteralData (http://www.w3.org/TR/xmlschema-2/#string)

3.4.3.5.2. Output parameters

Parameter	stdout
Description	An array of statistics suitable for plotting
mimeType	text/plain
dataType	ComplexData (text)

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4. References

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[PTS+11] Pladsen, Jan Ivar, et. al, 2011. D1.1 Use case specification and schedule for testing. NETMAR (Open service network for marine environmental data) Deliverable D1.1. European Commission Information Society and Media Directorate-General Grant Agreement Number 249024.

[Zak09] Zakhvatkina, Natalia, 2009. Arctic Ocean sea ice identification using satellite SAR data. PhD thesis, RSHU – Oceanography, St. Petersburg, Russia.

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