

EARTH OBSERVATION GRID PROCESSING ON-DEMAND



FAST ACCESS TO IMAGERY FOR RAPID EXPLOITATION - USER MANUAL

prepared by/ <i>préparé par</i>	ESA G-POD Team
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**European Space Agency
Agence spatiale européenne**

ESRIN

Via Galileo Galilei - Casella Postale 64 - 00044 Frascati - Italy

Tel. (39) 06 941801 - Fax (39) 06 94180 280 www.esa.int

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1 INTRODUCTION

1.1 *Purpose of the document*

The FAIRE service (Fast Access to Imagery for Rapid Exploitation) aims at providing a fast and easy access to SAR imagery data specifically customised for usage in SAR-based change-detection applications. Beyond the simple on-line provision of SAR data, FAIRE implements the preliminary image processing steps (image co-registration, ortho-rectification, etc) required prior to the elaboration of the actual change analysis processes.

FAIRE is accessible through ESA's G-POD environment (Grid Processing On-Demand) [R1]. The common G-POD usage principles such as authentication, service selection, job submission, etc are detailed in the G-POD generic user manual available on-line through the portal [R2].

In complement, this document provides the specific usage guidelines of FAIRE as a G-POD application component.

1.2 *Background*

Access to ENVISAT and ERS data in the context of an emergency/response application is customarily performed via the delivery of ESA standard products provided either on request or systematically. In particular, ESA User Services manage specific data supply procedures defined for emergency-responses applications such as the International Charter Space and Major Disasters.

However for applications requiring near real time access to crisis and archive data, ESA has identified the potential need for an alternative data supply mechanism fully based on systematic data products. The FAIRE system has been developed as a response to this objective and is at present under evaluation and reserved to crisis/damage mapping experts (such as crisis mapping value adding organisations) to help better access data in emergency/response situations.

1.3 *Reference Documents*

R1	G-POD Web Portal http://gpod.eo.esa.int
R2	G-POD User Manual http://gpod.eo.esa.int/G-POD_User_Manual.pdf
R3	Landsat Global mosaic http://onearth.jpl.nasa.gov/
R4	SRTM data http://www2.jpl.nasa.gov/srtm/

1.4 Table of Acronyms

AOI	Area Of Interest
ASAR	Advanced Synthetic Aperture Radar
ENVISAT	ENVIronmantal SATellite
EO	Earth Observation
FAIRE	Fast Access to Imagery for Rapid Exploitation
G-POD	EO Grid Processing on Demand

1.5 Overview of the Document

Following this introductory part, Chapter-2 describes the main user interactions with FAIRE and provides an example usage of the system on a particular case. Finally, Chapter-3 details the FAIRE service output.

2 FAIRE USAGE GUIDELINES

2.1 *Service Overview*

As outlined in the introduction, FAIRE provides on-line access to SAR imagery data specifically tailored to serving change-detection applications.

As the service main projected usage is the estimation of terrain property variations after specific “crisis events” happening (e.g. flood, fire, earthquake, etc), a FAIRE investigation will be customarily carried-out around such events in time and space through the definition of a time-period and a bounding-box respectively. The selected images acquired before the most recent image are considered part of a “historical dataset” and will be averaged together to produce a mean backscatter product. In turn, this backscatter product will be subtracted to the selected post-crisis acquisition (the “master product”) to bring to the fore the differences.

The primary output of the service is a co-registered time series of all selected images, optionally ortho-rectified beforehand using SRTM data [R4]. In addition the historical reference backscatter product and all difference products (also co-registered) are provided. When requested, the output data is provided in geo-coded form along the plate-carrée or the UTM projection.

The service output is summarised below:

- ASAR/SAR products:
 - Products in native format
 - Processed products in Geotiff format (both 8bit and 32bit) (power images)
 - Difference image in Geotiff format (32bits) (difference of dB scale images)
 - Multi-temporal composition for a visual identification of the change occurred in the temporal series (with an easy discrimination of positive and negative changes in the backscatter)¹
 - Mean backscatter reference product: Multi-temporal average of all historical products (power image)
- On request, additional data is retrieved over the area of interest (i.e., area affected by the crisis event), including:
 - Terrain features: height and slope computed from SRTM DEM
 - RGB optical mosaic derived from Landsat imagery (WMS Global Mosaic with images that have been collected during 1999-2003)

These data can assist the analysis of the ASAR/SAR imagery in deriving flood mapping.

2.2 *Imagery Datasets Accessible*

SAR Imagery datasets currently accessible through FAIRE are:

- ENVISAT ASAR IMM, acquired since June 2005.
- ENVISAT ASAR IMP, acquired since June 2005.

- ENVISAT ASAR WSM, acquired since June 2005.
- ERS-2 SAR IMM in Envisat format, acquired at Matera ground station (over Europe) since June 2007.
- ERS-2 SAR IMP in Envisat format, acquired at Matera ground station (over Europe) since June 2007.

2.3 Access to FAIRE

Authorised G-POD users can access FAIRE via the G-POD web interface [R1] from which the specific service definition page of FAIRE can be opened (see Figure 1).

This definition interface integrates different elements:

- A map through which user can select the area of interest.
- An area dedicated to the selection of the temporal range.
- An area where available products related to the selected area and temporal ranges are displayed and can be selected.
- An area where users can define additional parameters required by the application.

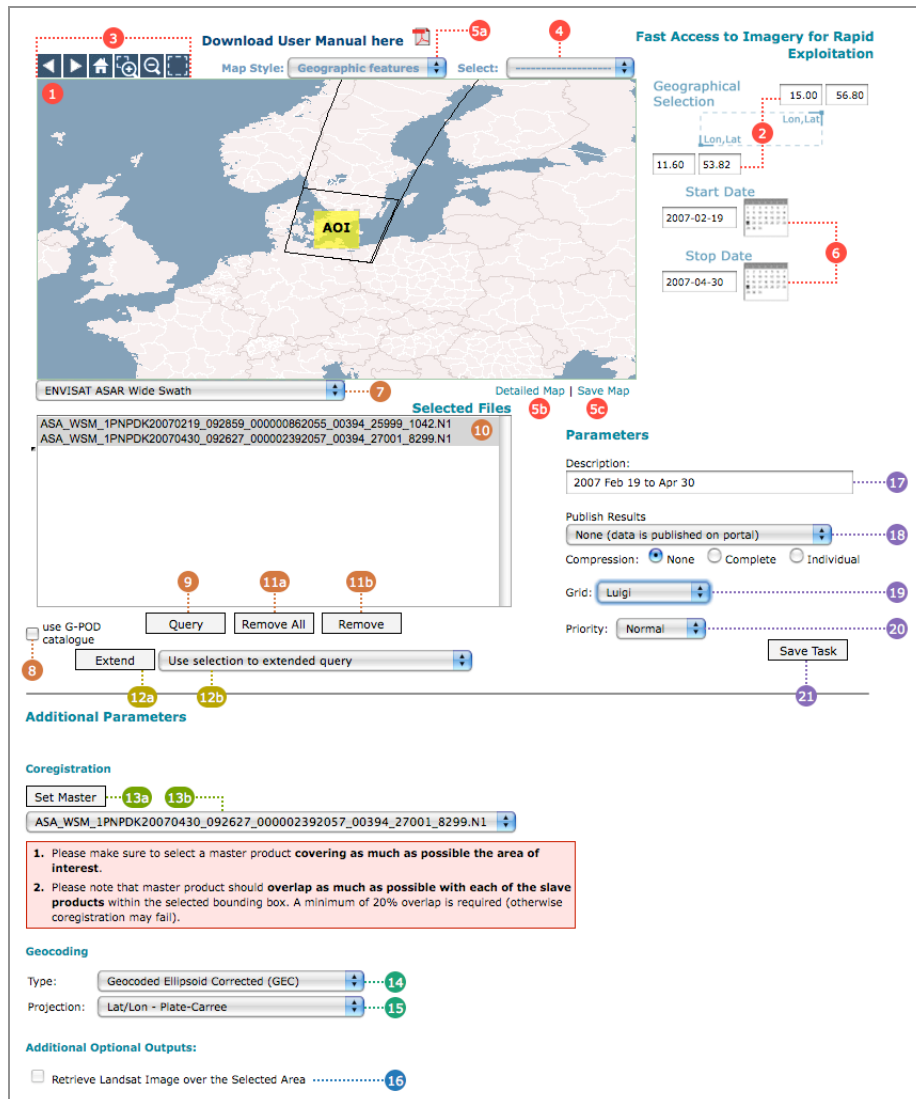


Figure 1 - FAIRE task definition page on the G-POD portal. Coloured numbers have been added to help the reader identify the different elements referred to in the text.

2.4 Description of Service Parameters

Through the dedicated Web Interface users can define all the parameters required in the processing. In the following paragraph, the red numbers within brackets refer to the coloured numbered items of Figure 1.

2.4.1 DATA SELECTION CONTROLS

2.4.1.1 Selecting the Area of Interest

The Area Of Interest (AOI) can be select both via the web map (1) or by specifying the latitude and longitude coordinates of its corners (2). Use (3) to zoom in, zoom out in the web map and select the AOI. A dropdown list containing pre-defined areas of interest (4) can also be used.

2.4.1.2 Choosing a Different Map Style

Use (5a) to select the web map style. Two options are available:

- A simple map showing country boundaries and coastlines
- A map showing different features included urban areas, water bodies, rivers, country and administrative boundaries, coastlines, topographic features.

2.4.1.3 Viewing a Detailed Map

Use (5b) to open an additional window showing a detailed map covering the selected area of interest. The map is external to FAIRE service. Any pan or zoom performed in this window does not affect the parameters of FAIRE (included the AOI). Button (5c) opens a similar window but cropped to exactly fit the bounding box (2). Right click on the image to save this map.

2.4.1.4 Selecting the Date Range

The temporal range of the products is selected using the **Start Date** and **Stop Date** controls (6). You can either enter the dates in the YYYY-MM-DD format or by picking from a calendar (click on the respective calendar symbol).

2.4.1.5 Selecting the Dataset and Issuing the Product Query

Once the Area of Interest and the temporal range are selected, you have to:

1. Select the dataset, i.e. ENVISAT ASAR WSM, ENVISAT ASAR IMM, or ERS-2 IMM like products (7);
2. Decide which catalogue to use. If the checkbox **use G-POD catalogue only** (8) is checked, the EOLI catalogue is not queried.
3. Press the **Query** button (9) to retrieve the list of available products shown in the product list (10).

2.4.1.6 Selecting Products for Processing

Products can be then selected (highlighted) by clicking on their entry in the list. A list of products can be selected using mouse-drag operations or clicking while holding down the shift key (for the selection of a continuous range) or the control key (for arbitrary selection). *Only selected products are considered for processing.*

Dataset selection and query can be repeated as many times as required (also by varying the temporal range). This allows selecting heterogeneous data (e.g., ASAR IMM and ASAR WSM products).

The footprint of the selected products are displayed on the map.

2.4.1.7 Removing Products from the Query Result List

Click on the **Remove** button (11b) to remove selected products from the product query result list. To remove all products from the query result list, click on the **Remove All** button (11a).

Note that it is not necessary to remove products from the list, since unselected products are not taken into account for the processing.

2.4.1.8 Using Query Extensions and Result Filters

The purpose of the **Extend** button (12a) is mainly to search products having the same identical ground track as the one currently selected. Selecting products of the same ground track (i.e. with identical viewing geometry) is recommended whenever possible.

Select one single product from the product list (10), select the required option in the list (12b), change the temporal range if required (see options description below), and then click on the **Extend** button (12a).

Extend options (12b):

- **Same track within list:** all products acquired with the same track as the selected one are selected. This option does not execute a new catalogue query, but selects all matching products from the present result list.
- **Same track with new time interval:** as the previous option, but in this case you are required to change the temporal range (usually by extending it). This option executes a new catalogue query and adds matching products not yet contained in the result list to the list.
- **Same pass within list:** all products acquired with the same pass (ascending or descending) as the selected one are selected. This option does not execute a new catalogue query, but selects all matching products from the present result list.

To execute a FAIRE investigation using single ground-track products, the following procedure is suggested to complete the data selection process:

- Set the geographical area (**1, 2**)
- Set a narrow temporal range including the date of the disaster event (**6**)
- Select the required dataset (**7**)
- Press the **Query** button (**9**) and manually select the product best fitting the area of interest
- Increase the temporal range (**6**) to cover a longer period and select the “same track with new interval” option (**12b**) and press the **Extend** button (**12a**)

“Last few hours” acquisitions: When the **Query** button (**9**) is pressed, FAIRE queries the ESA EOLI catalogue for the available data. For different reasons, data are registered in EOLI few hours after the acquisition. This may prevent FAIRE from displaying the very recent products despite already available in the G-POD system.

To overcome this issue, when looking for data acquired in the last few hours the following procedure is suggested:

- Select the whole world using (**4**)
- Set a narrow temporal range including the date of the last acquisition (**6**)
- Select the required dataset (**7**)
- Press the **Query** button (**9**) and manually select the required product
- Set the geographical area of interest (**1, 2, or 3**)
- Increase the temporal range (**7**) to cover a longer period and select the “same track with new interval” option (**12b**) and press the **Extend** button (**12a**)

2.4.2 COREGISTRATION PARAMETERS

After pressing the “**Set Master**” button (**13a**), all images selected at the product selection step are presented in a selectable list to let you decide which master image to be used in the co-registration process (**13b**). The master image selected by default is the last selected in the list, i.e. usually the most recent one.

Please observe the following recommendations for the selection of the master product:

- The master product should cover as much as possible the AOI.
- The master product should overlap as much as possible each one of the other selected products (minimum 30% overlap is recommended).
- When ERS-2 SAR IMM products are selected together with Envisat products, an Envisat image as should be selected as master.

2.4.3 GEOCODING PARAMETERS

Two different options are available for the geocoding **Type (14)**:

- **Geocoded Ellipsoid Corrected (GEC)**: Products are geo-coded using a flat ellipsoid.
- **Geocoded Terrain Corrected (GTC, using SRTM DEM)**: Products are geo-coded and terrain-corrected. SRTM DEM v.27 is used for terrain correction.

In general it is recommended that users select the GTC option. The so obtained results can be overlaid onto optical data and topographic maps.

The GTC option can be used for analysing time series including products with different tracks (although this should be avoided whenever possible).

Additional outputs: when the “**Geocoded Terrain Corrected (GTC, using SRTM DEM)**” Geocoding option is selected, the DEM covering the selected geographical area will be made available in the output.

If the GEC or GTC Geocoding option is selected in **(14)**, the desired projection for the geo-coded output can be selected via the **Projection (15)** among the following:

- **Lat/Lon**: Plate-Carrée projection with pixel size of approximately 0.0007 x 0.0007 degree.
- **UTM**: The UTM zone is automatically retrieved given the latitude longitude coordinates of the selected geographical area. Pixel scale is 75 x 75 meters.

2.4.4 ADDITIONAL OPTIONAL OUTPUT CONTROLS

Retrieved Landsat Imagery over Selected Area (16): Checking this option together with GTC type geocoding will result in a subset of the Landsat WMS mosaic [R3] covering the selected geographical area to be exported to the result set.

2.4.5 G-POD GENERIC TASK PARAMETERS

The **Description (17)**, **Publish results (18)**, **Grid (19)**, and **Priority (20)** are generic G-POD settings. Please refer to [R3] for more information on how to use these settings.

In particular, the **Publish results (18)** pop-down menu defines the output server (FTP, SFTP, etc.) where the results shall be made available. If the “None” option is selected, the results will be made available for HTTP download at the G-POD portal (via the “My folder” area).

Alternative sink servers may be configured through the “Edit My Profile” area of the portal (see [R2]).

2.5 *Save, Submit and Monitor FAIRE Tasks*

Once all parameters have been defined, pressing the **Save Task** button **(21)** will prepare the task for submission onto G-POD. The processing corresponding task workflow is depicted on the page.

Before a task is accepted by G-POD, a series of checks are performed. These checks regard:

- **Minimum and maximum number of selected products**. You have to select at least two products from the result list, one of which must be the master product. The maximum number

of products is by default set to 11 (i.e. one master product plus 10 pre-crisis products). This value may be overridden with a user-specific value by a G-POD administrator.

- **Maximum Area of Interest.** The maximum size of the Area of Interest is by default set to 100 square degrees. This value may be overridden with a user-specific setting by a G-POD administrator.
- **Selection of a master product.** A master product must have been selected (13a), and this master product must also be selected in the result list.
- **Validity of processing parameters.** Certain selections of processing parameters are invalid and cannot be saved:
 - Geocoding type (14) “Geocoded Ellipsoid Corrected (GEC)” and “Retrieve Landsat Image over the Selected Area” (16).
 - Geocoding type (14) “Geocoded Ellipsoid Corrected (GEC)” when products with different tracks are selected.
 - “Retrieve Landsat Image over the Selected Area” (16) when the Area of Interest exceeds the 60° northern or southern latitude.

If the defined task violates one of the above rules, you cannot save it. Otherwise, you are asked to confirm the date/time period containing the crisis event. The crisis time is assumed to be between the time of the latest selected product and the one immediately before it. The latest product should also be the master product (otherwise the confirmation dialog contains a warning).

After successfully saving the task, you are redirected to the G-POD “My Folder” section where the task processing flow is displayed. The processing flow will look as depicted in Table 1, according the selected options in the task definition (each box corresponds to a processing job; each arrow represents a job dependency):

Table 1 - Task parameters and resulting processing flows

Geocoding option	Retrieve Landsat Image over Selected Area	Tracks of selected products	Resulting processing flow
Geocoded Ellipsoid Corrected (GEC)	no	All have same track	<pre> graph LR ingest --> geo geo --> coreg coreg --> mta mta --> publish </pre>
Geocoded Terrain Corrected (GTC, using SRTM DEM)	no	All have same track	<pre> graph LR ingest --> ortho dem_prep --> ortho ortho --> coreg coreg --> mta mta --> publish </pre>
Geocoded Terrain Corrected (GTC, using SRTM DEM)	no	Products have different tracks ²	<pre> graph LR ingest --> ortho dem_prep --> ortho ortho --> mta mta --> publish </pre>

² In this case, you are recommended to skip the *coreg* step. This is done by a confirmation dialog displayed after you pressed “Save Task”.

Geocoding option	Retrieve Landsat Image over Selected Area	Tracks of selected products	Resulting processing flow
Geocoded Terrain Corrected (GTC, using SRTM DEM)	yes	All have same track	<pre> graph LR is_collect --> is_red is_collect --> is_green is_collect --> is_blue is_red --> is_rgb is_green --> is_rgb is_blue --> is_rgb ingest --> ortho dem_prep --> ortho ortho --> coreg coreg --> mta is_rgb --> publish mta --> publish </pre>

To activate the processing, press the **Submit** button.

Please refer to [R2] for further details and actions available for task submission and control.

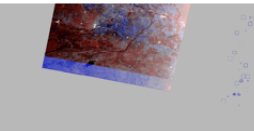
2.6 Retrieve the Results

As soon as a task is successfully concluded, you are notified by e-mail and you can retrieve the results, either from the portal or at the selected external server. From the G-POD portal in the “My folder” area, the concluded task will be visualised with a table listing the main metadata associated to the resulting FAIRE product (see example in Figure 2).

The FAIRE products are organised in folders, as further detailed in Chapter-0. When published on the G-POD portal, the folder tree can be browsed through and the individual files can be downloaded by simply activating the relevant links (see example in Figure 3 of the download browser on the G-POD portal).

Please refer to [R2] for further details on accessing the results of a G-POD Task.

ID: 120412(S_124056134845632100019534912642)
Name: 2007 Jul 3(2)
Computing Element: Luigi **Priority:** Normal (1)
Processed on: 42m 59s (2009-04-24 11:05:12) [protect]
Total Computing Time: 36m 24s



Product Metadata

Name	Value
BOUNDING BOX	80,22,88,26
DATASETNAME	ASA_WSM_1P
DESCRIPTION	2007 Jul 3
GEOCODING	GEC
INPUTPRODUCT	crisis_avg_diff_geotiff.tif,historical_av...
MASTER	ASA_WSM_1PNPDE20070807_042306_00000152206...
OPTIONS	null
PRIORITY	1
PROJECTION	+proj=lonqlat +ellps=WGS84 +datum=WGS84 +...
RESOLUTION	0.000694444
STARTDATE	2007-07-03
STOPDATE	2007-08-20

Figure 2 - When a task is concluded, its result information is presented with a preview image and metadata information. To retrieve the results click on the Files button

ID: 120412(S_124056134845632100019534912642)
Name: 2007 Jul 3(2)
Computing Element: Luigi **Priority:** Normal (1)
Processed on: 42m 59s (2009-04-24 11:05:12) [protect]
Total Computing Time: 36m 24s

name	type	size	last modified
multi-temporal_composite_browse.jpeg	JPEG Image	161.31 Kb	2009-04-24 10:51:16
Multitemporal_Images	<Folder>	829.88 Mb	2009-04-24 10:51:20
Original_Products	<Folder>	222.13 Mb	2009-04-24 10:59:36
Processed_Products	<Folder>	329.33 Mb	2009-04-24 11:01:44

Figure 3 - Results Download browser

2.7 Service Triggering Example

This paragraph provides a step-by-step example of user interactions with the FAIRE job definition interface on a typical usage scenario. Throughout the description, the red numbers within brackets refer to the numbered items of Figure 1.

The scenario depicted in this example is the following:

On August 7th 2007, SAR imagery data is required to map/classify/quantify a major flood occurred over India on that date.

Step-by-Step instructions:

1. Define the AOI covering the event:

Zoom over India and select the following AOI (using **1**, **3**, and if needed **2**); right top corner 26N 88E; left bottom corner 22N 80E.

2. Look for ASAR WSM products covering this area around the event date:

Set the temporal range (**6**): Start Date 2007 August 6th, Stop Date 2007 August 7th.

Select “ASAR WSM” dataset and press the **Query** button (**9**).

The following product appears in the product list (**10**):

[ASA_WSM_1PNPDE20070807_042306_000001522060_00305_28415_7449.N1](#)

At this stage, a candidate “crisis product” (master product) is identified and one shall now look for a corresponding historical dataset to build a SAR backscatter reference for this product:

3. Set a new temporal range back a few months preceding the event date (**6**):

Start Date 2007 June 6th, Stop Date 2007 August 7th.

Select the previously retrieved product and press the **Extend** button (**12a**) together with the option “same track with new time interval” (**12b**).

The two following products now appear in the product list:

[ASA_WSM_1PNPDE20070703_042248_000001642059_00305_27914_9753.N1](#)

[ASA_WSM_1PNPDE20070807_042306_000001522060_00305_28415_7449.N1](#)

Select both of them.

At this stage, both the “crisis product” (master product) as well as the corresponding historical dataset are identified.

4. In the **Coregistration** area, press the **Set Master** button (**13a**) and select the file [ASA_WSM_1PNPDE20070807_042306_000001522060_00305_28415_7449.N1](#) from the master list (**13b**).
5. In the **Geocoding** area, select the Type “**Geocoded Terrain Corrected (GTC, using SRTM DEM)**” option (**14**), and set the Projection to “**Lat/Lon – Plate Caree**” (**15**).
6. Check the “**Retrieve Landsat Image over the Selected Area**” checkbox (**16**).

- Assign a name to the project (17), e.g. “India flood August 2007”, define the portal as publish server (18), select a computing element (e.g. “Operational CE”) (19) and a “Normal” priority for the processing (20).

At this stage, the task is ready for being submitted. The job definition page should look like the screenshot presented in Figure 4.

- Save the task (21), and trigger the processing.

The screenshot shows the 'Fast Access to Imagery for Rapid Exploitation' task definition interface. It features a map of India with a rectangular selection box over the central region. To the right of the map, there are input fields for 'Geographical Selection' (88, 26), 'Start Date' (2007-06-06), and 'Stop Date' (2007-08-07). Below the map is a 'Selected Files' list containing two file names: ASA_WSM_1PNPDE20070703_042248_000001642059_00305_27914_9763.N1 and ASA_WSM_1PNPDE20070807_042306_000001522060_00305_28415_7449.N1. The 'Parameters' section includes a 'Description' field with 'India flood August 2007', 'Publish Results' set to 'None (data is published on portal)', 'Compression' set to 'None', 'Grid' set to 'Luigi', and 'Priority' set to 'Normal'. At the bottom, there are 'Create Task' and 'Save Task' buttons. A section titled 'Additional Parameters' includes 'Coregistration' instructions in a red box: '1. Please make sure to select a master product covering as much as possible the area of interest. 2. Please note that master product should overlap as much as possible with each of the slave products within the selected bounding box. A minimum of 20% overlap is required (otherwise coregistration may fail)'. Below this is a 'Geocoding' section with 'Type' set to 'Geocoded Terrain Corrected (GTC, using SR)' and 'Projection' set to 'Lat/Lon - Plate-Carree'. An 'Additional Optional Outputs' section has a checked box for 'Retrieve Landsat Image over the Selected Area'.

Figure 4 - Task definition screen for India flood August 2007

3 FAIRE PRODUCT DESCRIPTION

The output is organised in different folders as follows (the term `<orig_product_name>` in the file lists below refers to the original product file name without the file extension).

Root folder /

Contains a preview image of the multi-temporal analysis and up to five subfolders.

- [multi-temporal_composite_browse.jpeg](#)

Folder **Original_Products**

The folder contains for each input product:

- [<orig_product_name>.N1.gz](#)
Original file in compressed Envisat format.

Folder **Processed_Products**

The folder contains for each input product:

- [<orig_product_name>_32bit_geotiff.tif](#)
Data in 32-bit floating-point geocoded GEOTIF format. The 32 bit floating point pixels directly translate the signal power in dB.
- [<orig_product_name>_8bit_linearstretch.tif](#)
Data in 8-bit TIF format after histogram stretching.
- [<orig_product_name>_8bit_linearstretch_geotiff.tif](#)
Data in 8-bit GEOTIF format after histogram stretching.
- [<orig_product_name>_8bit_linearstretch.jpg](#)
JPEG version of the 8-bit GEOTIF.
- [<orig_product_name>_8bit_linearstretch.kmz](#)
KMZ version of the 8-bit GEOTIF.

Folder **Multitemporal_Images**

The folder contains the result of the multi-temporal analysis:

- [historical_avg.tif](#)
The historical average image in 32-bit floating point TIF format.
- [historical_avg_geotiff.tif](#)
The historical average image in 32-bit floating point GEOTIF format.
- [historical_avg.jpg](#)
JPEG version of the historical average image.
- [crisis_avg_diff_geotiff.tif](#)
The image containing the difference between the crisis product and the historical average in 32-bit floating point GEOTIF format.
- [multi-temporal_composite_geotiff.tif.gz](#)
The multi-temporal composite image in compressed RGB GEOTIF format.
- [multi-temporal_composite.jpg](#)
JPEG version of the multi-temporal composite image.

- [multi-temporal_composite.kmz](#)
KMZ version of the multi-temporal composite image.

Folder **DEM**

This folder is present only if the “Geocoded Terrain Corrected (GTC, using SRTM DEM)” geocoding option was selected (i.e. the processing job *dem_prep* was executed). It contains terrain features, i.e. height and slope computed from SRTM DEM.

- [DEM_height.gz](#)
- [DEM_slope.gz](#)

Folder **Landsat**

This folder is present only if the “Geocoded Terrain Corrected (GTC, using SRTM DEM)” geocoding option was selected and the “Retrieve Landsat Image over the Selected Area” checkbox was checked (i.e. the *ls_** jobs were executed). It contains RGB optical mosaic derived from Landsat imagery (WMS Global Mosaic with images that have been collected during 1999-2003).

- [Landsat_mosaic.gz](#)