SME-LET Announcement of Opportunities 2009: **Cal/Val and User Services – Calvalus**

Acceptance Test Plan
Version 1.2
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Change Log

Version	Date	Revised by	Change	Authors
1.0	16.09.2011	-	The initial version of this document.	N. Fomferra
1.1	10.10.2011	E. Kwiatkowska O. Faber	Level 2 processing: Added another test case with NetCDf as output format. Added another test case that uses QAA as IOP algorithm. Matchup Analysis: Added better explanation for good-pixel expression and good-record expression. Level 3 processing: Fixed spatial resolution to be 9.29 km. Fixed averaging period to be 10 days. Trend Analysis: Fixed compositing period to 32 days.	N. Fomferra M. Zühlke
1.2	31.10.2011	E. Kwiatkowska	Explicitely naming the L2W processor version to be used for the test (namely 1.3). Added a description on how to change the colour mapping in images displayed by BEAM/VISAT. Using new L3 image screenshot, the old one had artefacts caused by an invalid water mask used for the server-side processing. Added some minor improvements and fixed some typos.	N. Fomferra

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1 Introduction

Calvalus is a technology study that investigates the use of Hadoop Map-Reduce massive parallel processing on distributed data for the improvement of the cal/val cycle of processor development and validation. It also supports the evaluation of the temporal stability of the instrument by processing large time series for trend analysis.

1.1 Purpose and Scope

This document describes the plan for the final acceptance test of the Calvalus system. It is a deliverable in the ESA project 22869/09/NL/VS. The acceptance test comprises end-to-end testing of the system that has been implemented according to the user requirements baseline [AD 1] and the system technical specification [AD-3].

The focus is on a selected set of production scenarios that are typical for the cal/val cycle of instrument and processor validation:

- L1–to–L2 processing of satellite data including match-up analysis against in-situ data,
- L1 –to–L2–to–L3 processing, including long-term trend analysis.

Typically, these scenarios are computationally expensive and time-consuming if large datasets are used. Calvalus addresses this challenge. Therefore the acceptance tests described in this document provide the step-by-step procedures that demonstrate that the Calvalus system meets its initial challenge. The technical approach is described in the technical specification. This document describes how users interact with the system and what they have to expect in terms of processing performance and of downloadable results.

The acceptance tests described in the following are referred to as *end-to-end system tests*. During development of the Calvalus system, other types of extensive tests have been performed by the development team. The tests included *unit-level* testing on around 200 Java test cases, and *integration* testing, where7 Java modules continuously pulled from a versioning system, were build,unit-level tested and integrated on a build server. These are not described here.

1.2 Terms and Definitions

The following terms describe concepts used in this document with a specific meaning. Though the terms may be common in the earth observation domain some of them may be used differently in other documents and contexts.

Term	Definition
Product Files	EO data used for both, input and output of a **Processing Step**. A product may be represented by one or more physical files.
Product File Set	In this document, a product set denotes a named collection of references to **Product files**.
Production Request	A request to the processing system to produce something. A production request operates on one or more **Product Set**s and may produce a new Product Set.
Production Request Template	An incomplete **Production Request** that users may use as prototype for new processing requests, e.g. by altering single parameter values.
Production Job	The server-side process as a result of an accepted **Production Request**. The production job therefore has a limited lifespan.

Term	Definition
Production Scenario	An operational end-to-end scenario implemented into the Calvalus system. The core system contains production scenarios for **L1-to-L2 Bulk Processing**, **L2-to-L3 Bulk Processing**, for a **Match-up Analysis** and **Trend Analysis**.
Production Step	A single step in a Production Scenario that usually operates on **Product Set**s.
Processing Step	An atomic transformation of an input into an output by a **Processor** that usually operates on single **Product**s.
Processor	An implementation of an algorithm that transforms an input into an output.

1.3 Abbreviations

The following abbreviations are used within the document without repeated definition.

Abbrev.	Expansion
API	Application Programming Interface
BC	Brockmann Consult GmbH
BEAM	**Basic ERS & Envisat (A)ATSR and Meris Toolbox**
cal/val	calibration and validation
CCI	ESA Climate Change Initiative
CEOS	Committee on Earth Observation Satellites
CPU	Central Processing Unit
DEM	Digital Elevation Model
ECSS	European Cooperation for Space Standardization
EO	Earth Observation
ESA	European Space Agency
FRS	Full resolution swath
GAC	GKSS Atmospheric Correction
GAC QAA	A QAA (see below) using as input the output of GAC
GPF	Graph Processing Framework of BEAM
HDFS	Hadoop Distributed File System
I/O	Input/output
IOP	Inherent optical properties
L1, L2, L3	Level 1, Level 2, Level 3 data (CEOS classification)
LET-SME	Leading Edge Technology - Small and Medium-sized Enterprises
NASA	National Aeronautics and Space Administration
OBPG	Ocean Biology Processing Group
OGC	Open GIS Consortium
QAA	Quasi-Analytical Algorithm, see [RD-8]

Abbrev.	Expansion
RR	Reduced resolution
SoW	Statement of Work
UML	Unified Modelling Language
WPS	Web Processing Service OGC specification

1.4 References

The following documents are applicable to this document.

ID	Title	Issue	Date
[AD 1]	SME-LET 2009 - CalVal and User Services, Offer A3067 in response to Invitation To Tender/AO-1-6037/09/F/VS, LET-SME Announcement of opportunities 2009	1.0	15.09.2009
[AD 2]	Cal/Val and User Services – Calvados Requirements Baseline, ESA SME-LET AoO 2009, Brockmann Consult	1.2	30.06.2010
[AD 3]	Cal/Val and User Services – Calvalus Technical Specification, ESA SME-LET AoO 2009, Brockmann Consult	1.2	31.03.2011

The following documents are referenced in this document.

ID	Title	Issue	Date
[RD 1]	Fomferra, N.: The BEAM 3 Architecture; http://www.brockmann-consult.de/beam/doc/BEAM-Architecture-1.2.pdf	1.2	
[RD 2]	Brockmann, C., Fomferra, N., Peters, M., Zühlke, M., Regner, P., Doerffer, R.: A Programming Environment for Prototyping New Algorithms for AATSR and MERIS – iBEAM; in: Proceedings of ENVISAT Symposium 2007, ESRIN Frascati, Italy		2007
[RD 3]	Fomferra, N., Brockmann C. and Regner, P.: BEAM - the ENVISAT MERIS and AATSR Toolbox; in: Proceedings of the MERIS-AATSR Workshop 2005, ESRIN Frascati, Italy		2005
[RD 4]	Sanjay Ghemawat, Howard Gobioff, and Shun-Tak Leung: The Google File System; in: 19th ACM Symposium on Operating Systems Principles, Lake George, NY (http://labs.google.com/papers/gfs.html)		Oct. 2003
[RD 5]	Jeffrey Dean and Sanjay Ghemawat: MapReduce: Simplified Data Processing on Large Clusters; OSDI'04: Sixth Symposium on Operating System Design and Implementation; San Francisco, CA (http://labs.google.com/papers/mapreduce.html)		Dec. 2004
[RD 6]	Ariel Cary, Zhengguo Sun, Vagelis Hristidis, Naphtali Rishe: Experiences on Processing Spatial Data with MapReduce; Lecture Notes In Computer Science; Vol. 5566 - Proceedings of the 21st International Conference on Scientific and Statistical Database		2009

	Management - New Orleans, LA, USA (http://users.cis.fiu.edu/~vagelis/publications/Spatial-MapReduce-SSDBM2009.pdf)		
[RD 7]	R. Doerffer, H. Schiller: MERIS Lake Water Algorithm for BEAM and MERIS Regional Coastal and Lake Case 2 Water Project, Atmospheric Correction ATBD; ESRIN Contract No. 20436		June 2008
[RD 8]	Zhong Ping Lee, Kendall L. Carder, and Robert A. Arnone: Deriving inherent optical properties from water color: A multiband quasi-analytical algorithm for optically deep waters; APPLIED OPTICS, Vol.41,No.27		20.09.2002
[RD 9]	Bryan A. Franz, Sean W. Bailey, P. Jeremy Werdell, and Charles R. McClain: Sensor-independent approach to the vicarious calibration of satellite ocean color radiometry; APPLIED OPTICS Vol.46,No.22, 1		Aug. 2007
[RD 10]	Bryan Franz: Methods for Assessing the Quality and Consistency of Ocean Color Products; NASA Goddard Space Flight Center, Ocean Biology Processing Group http://oceancolor.gsfc.nasa.gov/DOCS/methods/sensor_analysis_methods.html		18.01.2005
[RD 11]	Janet W. Campbell, John M. Blaisdell, Michael Darzi: Level-3 SeaWiFS Data Products: Spatial and Temporal Binning Algorithms; SeaWiFS Technical Report Series, NASA Technical Memorandum 104566, Vol. 32		Aug. 1995
[RD 12]	K. Barker et al: MERMAID: The MEris MAtchup In-situ Database; ARGANS Limited (http://hermes.acri.fr/mermaid/doc/Barker-et-al-2008_MERMAID.pdf)		2008
[RD 13]	NASA OBPG: Ocean Color Level 3 Binned Products (http://oceancolor.gsfc.nasa.gov/DOCS/Ocean_Level-3_Binned_Data_Products.pdf)		
[RD 14]	CoastColour web site (http://www.coastcolour.org/)		
[RD 15]	ECSS-E-ST-40C ECSS Space Engineering - Software, European Cooperation for Space Standardization, ESA-ESTEC, Noordwijk, The Netherlands	C	06.03.2009
[RD 16]	Bryan Franz: OBPG l2gen User's Guide; (http://oceancolor.gsfc.nasa.gov/seadas/doc/l2gen/l2gen.html)		
[RD 17]	Web site of the ESA Climate Change Initiative (http://earth.eo.esa.int/workshops/esa_cci/intro.html)		
[RD 18]	OGC Web Processing Service Specification (http://www.opengeospatial.org/standards/wps)	1.0	08.06.2007
[RD 19]	Case2R source code repository at https://github.com/bcdev/beam-meris-case2	1.4.3	ongoing
[RD 20]	QAA source code repository at https://github.com/bcdev/beam-meris-qaa	1.0.2	ongoing
[RD 21]	BEAM user manual (http://www.brockmann-consult.de/beam)	4.8	ongoing

[RD 22]	Sean W. Bailey, P. Jeremy Werdell: A multi-sensor approach for the on-orbit validation of ocean color satellite data products; Remote Sensing of Environment 102 (2006) 12–23		
[RD 23]	DUE CoastColour Product User Guide, http://www.coastcolour.org/documents/Coastcolour-PUG-v2.1.pdf	2.1	

1.5 Document Overview

After this formal introduction

Chapter 2 introduces the user interfaces of the Calvalus software to be tested.

Chapter provides a detailed description of the tests to be performed.

Annex A is a description of the output product and processing parameters of the Ocean Colour CoastColour L2W Level-2 processor.

Annex B is a usage dump of the Calvalus command-line tool cpt.

2 Overview

This chapter introduces the user interfaces of the Calvalus software that are going to be tested and demonstrated, namely the Calvalus Portal and the a set of tool invoked from a Unix command line.

2.1 Calvalus Portal

The Calvalus portal is the main user interface to the Calvalus system. It is a simple, JavaScript-based web application that lets users order and manage Calvalus productions and finally download the produced results. The name *portal* is justified by the fact that it provides users a portal to the actual processing system, the Hadoop cluster comprising 20 Unix machines (quad core, 8 GB) and 120 TB of data storage.

The Calvalus system currently hosts MERIS RR Level 1b data from 2002 to 2010. Using this data set, users can order four different productions types:

1. L1 to L2 processing
2. L2 match-up analysis or point data extraction
3. L1 to L3 or L2 to L3 processing
4. L3 trend analysis

The following snapshot shows the main menu of the portal.

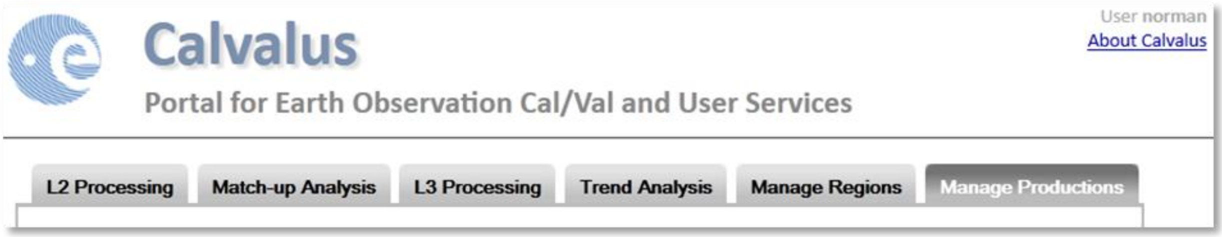


Figure 1: Main menu of the Calvalus portal

The input dataset is organised into product file sets which can be temporally and spatially filtered for all types of productions before they are passed as input to the processing system. Temporal filters are realised as date range or data list while the spatial filter is based on geographical regions. A dedicated region manager is used manage build-in and also user defined regions.

After a production request has been submitted, users can observe, cancel, stage productions and finally download the results of their productions.

At the time of this writing, the Calvalus Portal is compatible with most internet browsers. It has been developed using the Google Web Toolkit 2.3 and has been tested with Firefox 6, Chrome 13 and Internet Explorer 9.

The version of the Calvalus Portal used for the tests in this document is 1.1 released as of 27.10.2011.

2.2 Calvalus Command-line Tools

The Calvalus software distribution package comprises a number of command line tools which have been developed in order to maintain and operate the Hadoop processing system. They are currently not accessible by end-users, because they need to operate on a Unix computer with direct access to the Hadoop cluster and HDFS file system.

The most important tool is **cpt**, the Calvalus production tool. A usage dump is provided in the Annex. It is used for submitting production requests in form of XML files (OGC WPS Execute operation request) from the command line and for installing/uninstalling versioned software bundles (such as the Calvalus processing system, BEAM and BEAM processors) in the HDFS.

Other command line tools are used to install and distribute the Hadoop configuration and software to the cluster nodes and also to execute any Unix programs on the Hadoop cluster. The Unix executables that have been used so far are **l2gen** (the OC Level-2 processor from NASA's SeaDAS software package), **AMORGOS** (MERIS geo-correction tool developed by ACRI) and **childgen** (a MERIS/AATSR subsetting tool developed by BC).

There is currently no user interface for the distributed processing of Unix executables other than via the command-line. Thus there are no user-performed acceptance test for this type of tools other than a remote desktop demonstration on how these tools are operated.

3 Acceptance Tests

3.1 Acceptance Test Plan

The acceptance of the Calvalus system is based on the acceptance of the following test groups performed in the order they are given here

- Test Group 1 - Web-Application Accessibility
- Test Group 2 - Common Components
- Test Group 3 - Level-2 Processing (L2)
- Test Group 4 - Match-up Analysis (MA)
- Test Group 5 - Level-3 Processing (L3)
- Test Group 6 - Trend Analysis (TA)
- Test Group 7 - Production Management

Each test group is introduced by a feature description. For the test groups that cover the production types L2, L3, MA, TA, a brief explanation is given for the production scenario realisation using the Hadoop Map/Reduce programming model. A test group comprises one or more test cases. For each test, its aim and purpose are provided, the procedure to be followed by the user, and a description of the expected behaviour and outputs.

In the descriptions of the procedure and the expectations, the words *shall* and *should* are underlined in order to easily capture the conditions for a successful test. If a shall-condition is not fulfilled during the test, the test is considered unsuccessful.

Note: At the time of this writing the web application performs an automatic logout after **120 minutes**. An immediate login afterwards is possible.

3.2 Test Group 1– Web-Application Accessibility

3.2.1 Feature Description

The aim of this test group is simply verifying that the application is accessible using an Internet browser and that users can log in. It is the precondition for all subsequent tests.

3.2.2 Test 1.1

3.2.2.1 Aim

Test that Calvalus portal web-application is up and running at a dedicated, publicly accessible location and that users can sign in.

3.2.2.2 Set-up

Use Firefox 6, Chrome 13 or IE 9 with JavaScript enabled.

3.2.2.3 Procedure

1. Point your browser to http://www.brockmann-consult.de/calvalus/. The Calvalus log-in screen <u>shall</u> be shown in the browser.
2. Type in your user credentials (given before the tests are performed)

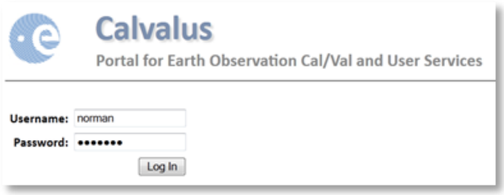


Figure 2: Login screen

3.2.2.4 Expected Results

You <u>shall</u> now be signed into the portal and facing the user interface of the Calvalus portal similar to the screenshot below. Your user name <u>should</u> appear in the upper-right most corner. By clicking on the *About Calvalus* link, a new browser window <u>should</u> open displaying some general project information. By clicking on the tabs of the main menu bar the different portal pages <u>shall</u> appear.

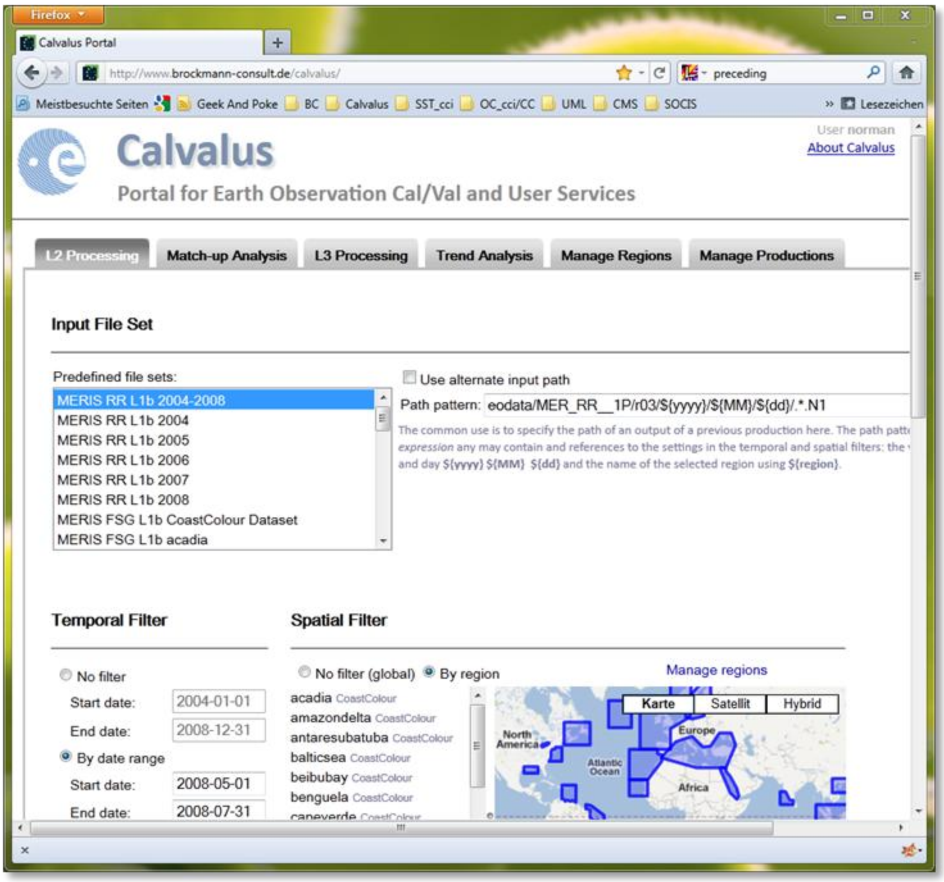


Figure 3: Calvalus portal in Firefox 6

3.3 Test Group 2– Common Components

3.3.1 Feature Description

The aim of this group of tests is to demonstrate that common user interface components are used in the Calvalus portal work, as expected. The common components are shared among four production scenarios and they work in the same way. There are seven common components which are described in the following tests.

3.3.1.1 Input File Set

An input file set comprises a list of EO data product files that are identified by a file path that may contain *regular expressions* (wildcards). A production scenario can only have a single file set as input. The current file sets comprise MERIS RR for the years 2002 to 2010, and regional subsets for the South Pacific Gyre (SPG) and North Atlantic (NA) as used by the ESA Ocean Colour CCI project. Each file set also "knows" the date range of its contained data.

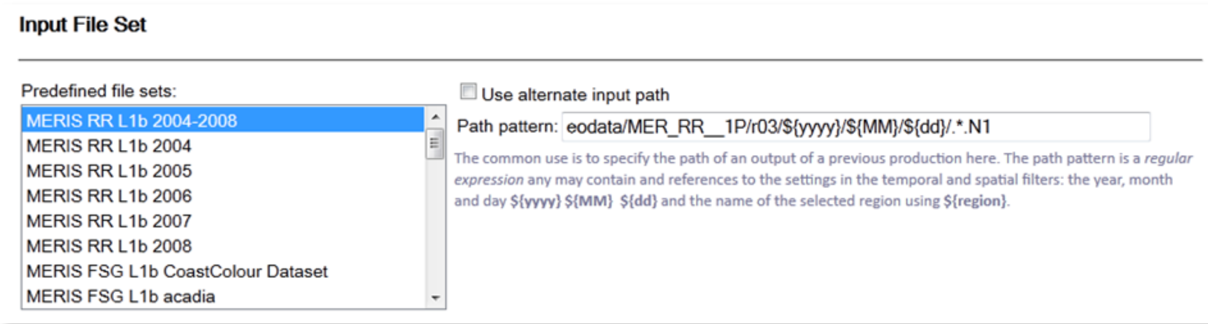
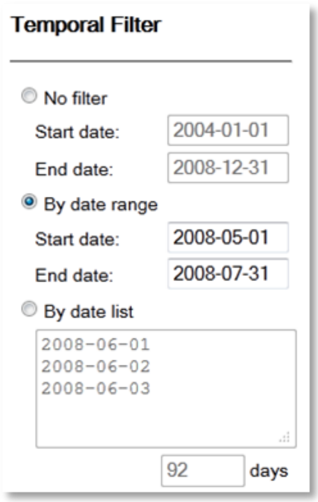


Figure 4: Input file set

Alternatively users can specify an input path in a text box. The common use is to specify the path of an output of a previous production here. The path pattern is also a regular expression and may contain the references to the settings in the temporal and spatial filters: the year, month and day **${yyyy}, ${MM}**, **${dd}** and the name of the selected region using **${region}**.

3.3.1.2 Spatial and Temporal File Filters

The files determined by the input file set can be further limited by specifying a temporal filter comprising either a date range or a list of single days. Single days are very useful for testing L2 or L3 processing on a small subset of files before ordering a larger number of files, that may take some time to process.



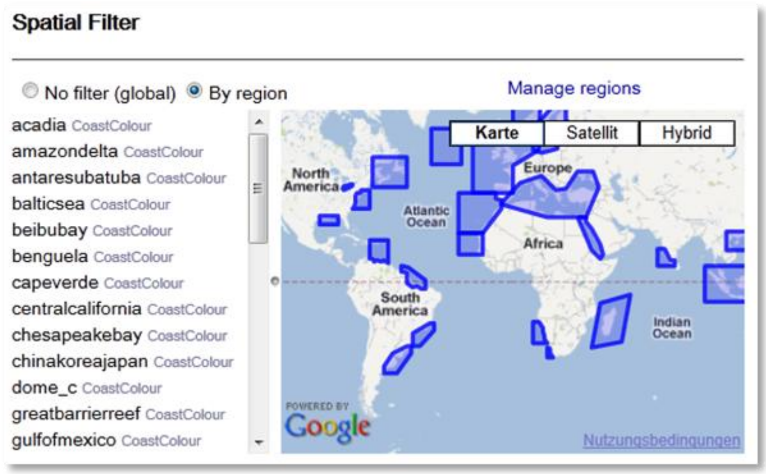


Figure 5: Temporal file filter

Figure 6: Spatial file filter

The spatial filter is used not only to filter out files but also to create spatial subsets of the input data before further processing takes place. Users can define their own regions by using the region manager (not part of the acceptance test).

3.3.1.3 Level-2 Processor and Parameters

The Calvalus system has been designed to be easily extended to new data processors developed using the BEAM Graph Processing Framework [RD-2]. One or more compiled processors are packed as Java archive files (JARs) in a *Calvalus processor bundle* and installed on the Hadoop cluster using the Calvalus **cpt** command-line tool. The processors that are currently installed are shown in the *Level-2 Processor* list.

Figure 7: Level-2 processor

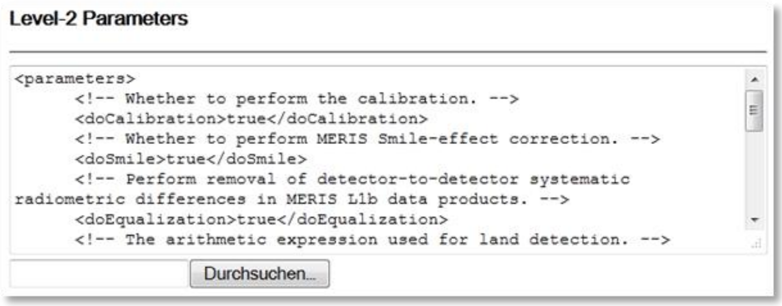


Figure 8: Level-2 parameters

The text area *Level-2 Parameters* lets user specify the processor parameters used for a L2-production. The default set of parameters is processor-dependent and read form the processor bundle's metadata.

Currently the Calvalus system uses various CoastColour processors comprising a radiometric correction and pixel classification (L1P), an atmospheric correction using neural networks (L2R), and a L2 IOP retrieval using neural networks (L2W), which includes a parameter switch to perform the QAA IOP retrieval. L2W comprises the L1P and L2R steps and also their outputs. A description of the L2W output product and tits processing parameters is given in annex A.

Note: It is planned to also integrate other processors into the portal in the near future: For example the NASA **l2gen** and ESA **MEGS (ODESA)** processors.

3.3.1.4 Output Parameters

The Level-2 and Level-3 processing production types generate data product files. The output parameters component is primarily used to specify the output EO data file format. Currently BEAM-DIMAP, NetCDF and GeoTIFF are supported. Optionally users can specify an output directory, this is especially useful if a result shall serve later as input to another production type. For example you could perform a Level-2 processing into a dedicated directory. Then for Level-3 processing provide that directory as input path to the Level-3 processing. If left empty, a temporary output directory will be used. Finally users can select whether they want to perform a staging immediately after the processing has finished. Staging is a process of copying and reformatting the output files to a user-accessible location.

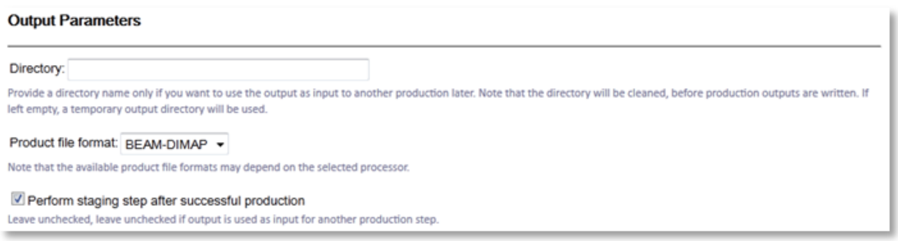


Figure 9: Output parameters

3.3.1.5 Check Request and Order Production

All four production scenarios have two common buttons, namely *Check Request* and *Order Production* located at bottom of each production tab.

Check Request is used to validate the production request, and if it is valid, display the production request that will used to order a given production. *Order Production* will first validate the production request and if it is valid, submit the order to the server.

3.3.1.6 Production Manager

As its name suggests, the production manager is used to manage scheduled, running and completed productions. Once a production request is submitted and the order accepted by the Calvalus server, the production is given a unique ID and displayed in the production table.

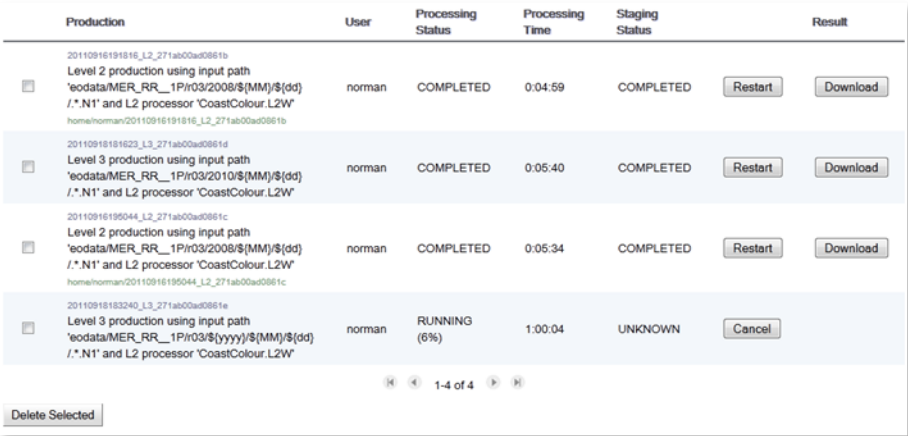


Figure 10: Production manager

Accidently submitted productions can now be cancelled while in scheduled or running state. Productions that are not used anymore can be selected and then deleted. The production request, that was used for the production can be displayed at any time by clicking on a row in *Production* column.

3.3.2 Test 2.1

3.3.2.1 Aim

Test that the input file set selection component works as expected.

3.3.2.2 Procedure

1. Click on tab *Level-2 Processing* (or any other production tab). The list box called *Input file set* shall not be empty.
2. Select different list entries. Their regular expression paths should be shown in the text field below the check box named *Use alternate input path.*
3. Select different list entries. The file sets start and end dates should be displayed in the start date / end date text boxes below the radio button *No filter* in the temporal time filter.

3.3.3 Test 2.2

3.3.3.1 Aim

Test that the temporal file filter component works as expected.

3.3.3.2 Procedure

1. Click on tab *Level-2 Processing* (or any other production tab).
2. In the component *Temporal file filter*, select *By date range*. Enter various dates, the *number of days* displayed at the bottom of the component should change accordingly.
3. Select *By date list*. Add and remove dates, the *number of days* displayed at the bottom of the component should change accordingly.

3.3.4 Test 2.3

3.3.4.1 Aim

Test that the spatial file filter component works as expected.

3.3.4.2 Procedure

1. Click on tab *Level-2 Processing* (or any other production tab).
2. In the component *Spatial file filter*, select *By region*.
3. Select various regions in the list box, regions in the map should be selected (and zoomed to) accordingly.
4. Select various regions in the map, regions in the list box should be selected accordingly.

3.3.5 Test 2.4

3.3.5.1 Aim

Test that the L2-processor components work as expected.

3.3.5.2 Procedure

1. Click on tab *Level-2 Processing* (or any other production tab). The list box in the *Level-2 processor* component must not be empty. It shall comprise at least the CoastColour processors L1P, L2R and L2W version 1.3.
2. Select different list entries. Different default processor parameters shall be displayed in the text area of the *Level-2 Parameters* component.
3. Select different list entries. Different processor descriptions should be displayed at the bottom of the processor list box.

3.3.6 Test 2.5

3.3.6.1 Aim

Test that the *Check Request* action validates the current production settings and if the settings are valid, display the request parameters.

3.3.6.2 Procedure

1. Click on tab *Level-2 Processing* (or any other production tab).
2. Use the browser to scroll down to the end of the current page and click *Check Request*. Depending on the current setting the action shall either show an error message or show the parameters of the current production.
3. You can easily cause an error if you select a time range that is out of the time range of the selected product set. *Check Request* shall show an error message.

4. Fix the time range. *Check Request* shall now show the parameters of the current production.

3.4 Test Group 3 – Level-2 Processing (L2)

3.4.1 Feature Description

The production type Level-2 Processing (L2) allows user to process a (filtered) input file set using a selected processor to an output product set. If a spatial (region) filter is applied, the input scenes are first tailored to the given region geometry, thus the outputted product files is also a subset. The result of the production is a zipped set of output files in a user selected EO data format (currently BEAM-DIMAP, NetCDF, GeoTIFF), that can finally be downloaded by the user.

For the demonstration of the Calvalus system, the CoastColour L2W processor will be used. A description of the L2W output product and its processing parameters is given in annex A.

Note: The current CoastColour L2W processor v1.3 runs only under BEAM 4.10 which will be released by the end of 2011. For this acceptance test, the CoastColour L2W processor v1.3 and BEAM 4.10-SNAPSHOT are made available. L2W user documentation is provided in the CoastColour Product User Guide [RD 7], see also http://www.coastcolour.org/documents/Coastcolour-PUG-v2.1.pdf.

3.4.2 Realisation using Hadoop

For each file in the (possibly filtered) input product file set, the Calvalus system will create a *mapper* task on a dedicated node in the Hadoop cluster. The Hadoop processing engine will try to select the node according to the location of the data in the cluster so that the tasks will most probably work data local. No *reducer* tasks are required for Level-2 processing. In its current configuration (20 nodes cluster), and in the ideal case (no other tasks running), the Calvalus system can perform a L2-processing of 20 files 20 times faster than in sequence on a single computer.

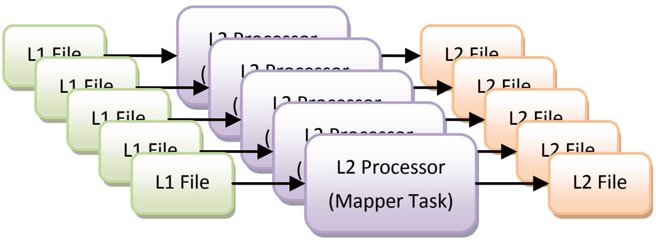


Figure 11: Level-2 Processing using Hadoop

3.4.3 Test 3.1

3.4.3.1 Aim

Test that a Level-2 Processing can be ordered and the resulting production completes in a timely manner.

3.4.3.2 Procedure

1. Click on tab Level-2 Processing.
2. From the list box *Predefined file sets* select **MERIS RR L1b 2008**
3. In the component *Temporal Filter* select *By date list*. Enter following entries **2008-06-01 2008-06-02 2008-06-03** (space separated)
4. In the component *Spatial Filter* select *By region*. Select region **northsea**.
5. In the component *Level-2 Processor* select **MERIS CoastColour L2W v1.3**.
6. In the component *Level-2 Parameters* leave the defaults.

7. In the component *Output Parameters*, make sure *Directory* is **empty**, *File format* is **BEAM-DIMAP** and *Perform staging step after successful production* is **on**.
8. Press *Check Request*. The production request should be shown now. If not, please verify that the settings are correct. If the settings are actually correct, you shall see the production request parameters now.
9. Press *Order Production.*
10. After a few seconds the *Manage Productions* tab should be automatically selected. If not, click it.
11. A new entry shall appear in the productions table.

3.4.3.3 *Expected Result*

The new entry in the production table under the *Manage Productions* tab shall look similar to the following screenshot.

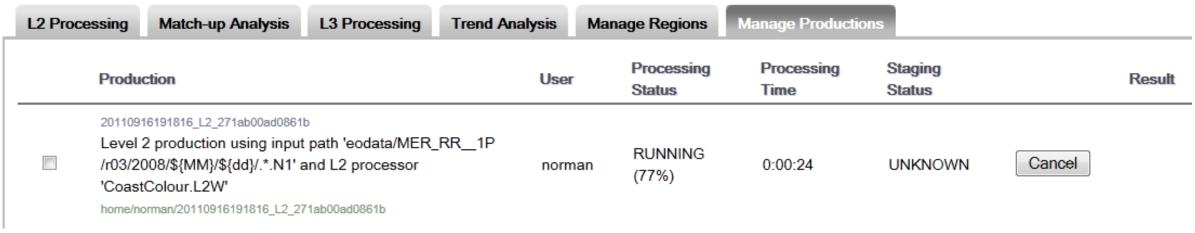


Figure 12: Level-2 production in progress

You should now see the processing status transit from SCHEDULED to RUNNING to COMPLETED. After the processing completed production you should see the staging status transiting from SCHEDULED to RUNNING to COMPLETED. The total processing time should not exceed 6 minutes and shall not take longer than 12 minutes. The production request will produce 7 ZIP-files that add up to 325 MB.

Note: It is a normal behaviour for the Level-2 processing that it progresses quickly first but then slows down when it comes to the processing of the remaining files. The reason for this is, that the entire production is only completed by the time when the last L2 task completes. And since every L1 input file will be processed on a dedicated node in the cluster, the entire L2 production waits for the last task to finish.

The total staging time should not exceed 2 minutes and shall not take longer than 6 minutes. Your production status shall now look similar to the following screenshot.

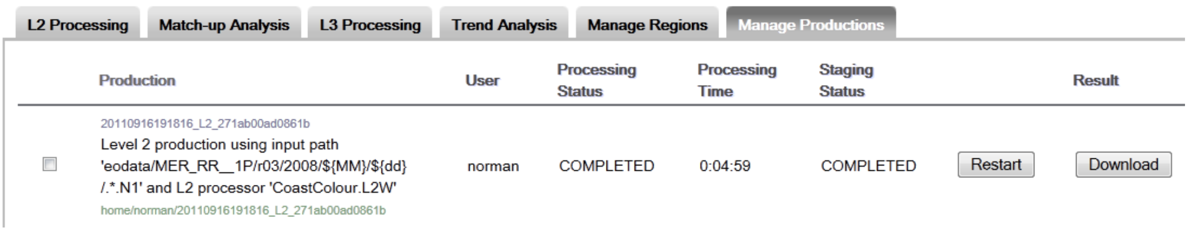


Figure 13: Level-2 production complete

3.4.4 Test 3.2

3.4.4.1 Aim

Test that Level-2 processing results can be downloaded and that the processing has been performed correctly.

3.4.4.2 Set-up

You will need **BEAM 4.9** for displaying the results of this and the following tests. If you don't have it installed please go to the BEAM home page in order to get BEAM 4.9 first.

Note: You may want to use the Unix tool **wget** (http://www.gnu.org/software/wget/) to download all the produced Level-2 output files at once.

3.4.4.3 Procedure

1. Make sure the *Manage Productions* tab is selected.
2. Click the *Download* button in the Result column of the production table. A new window shall be opened in your browser. It shall now show the outputs of the Level-2 processing. You shall be able to download the listed ZIP files.
3. Download one or more files and unpack them on your local computer. Open the unpacked files in BEAM VISAT and inspect their contents: The products shall contain all the L2W bands and datasets as described in Annex A.

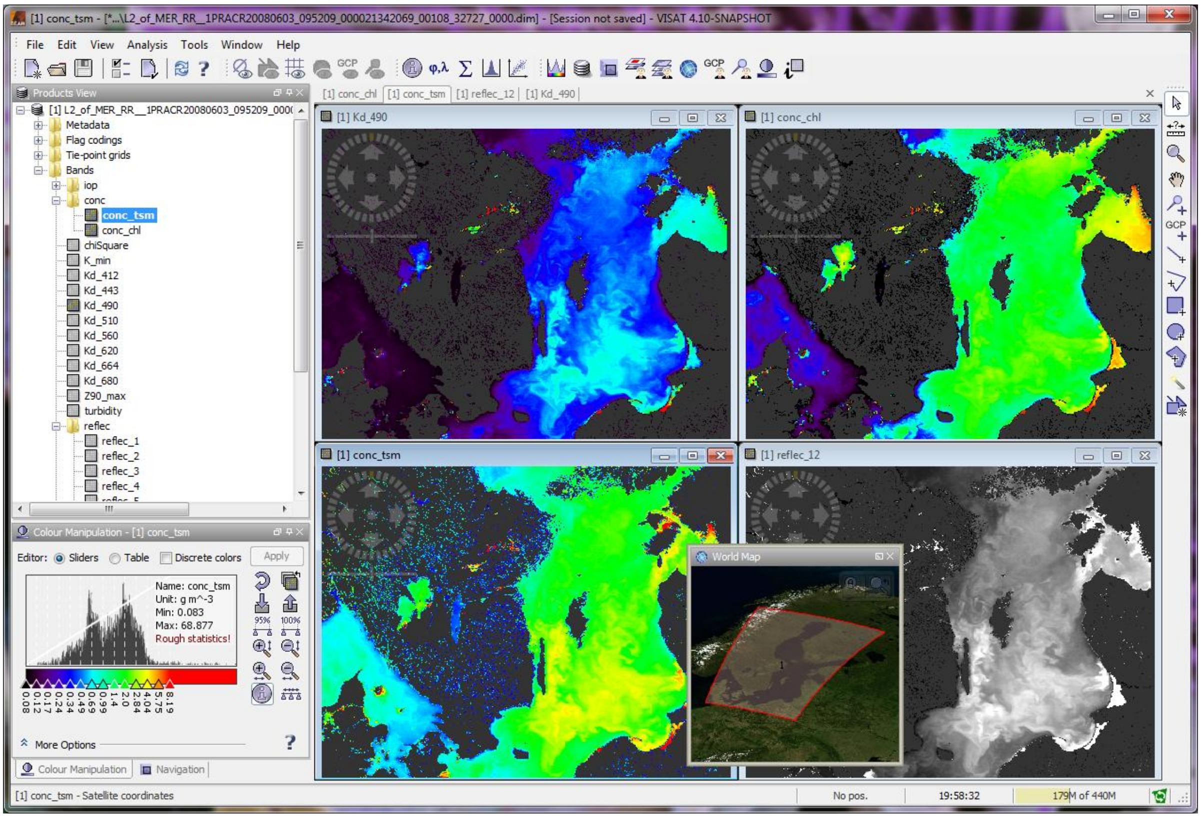
3.4.4.4 Expected Result

The following screenshot shows the resulting Level-2 files. You shall see a similar page in your browser showing 7 zip files comprising around 325 MB.

Calvalus staging area /staging/norman/20110916195044_L2_271ab00ad0861c/

Filename	Size	Last Modified
L2 of MER RR 1PRACR20080601 090622 000026432069 00079 32698 0000.zip	2675.6 kb	Fri, 16 Sep 2011 17:56:25 GMT
L2 of MER RR 1PRACR20080601 104658 000026432069 00080 32699 0000.zip	81550.1 kb	Fri, 16 Sep 2011 17:58:27 GMT
L2 of MER RR 1PRACR20080601 122734 000026432069 00081 32700 0000.zip	8937.3 kb	Fri, 16 Sep 2011 17:58:31 GMT
L2 of MER RR 1PRACR20080602 101519 000026432069 00094 32713 0000.zip	59661.5 kb	Fri, 16 Sep 2011 17:59:41 GMT
L2 of MER RR 1PRACR20080602 115555 000026432069 00095 32714 0000.zip	41510.9 kb	Fri, 16 Sep 2011 17:59:58 GMT
L2 of MER RR 1PRACR20080603 095209 000021342069 00108 32727 0000.zip	43394.3 kb	Fri, 16 Sep 2011 18:00:14 GMT
L2 of MER RR 1PRACR20080603 112415 000026432069 00109 32728 0000.zip	87044.0 kb	Fri, 16 Sep 2011 18:00:51 GMT
request.html	7.9 kb	Fri, 16 Sep 2011 18:00:51 GMT
request.xml	4.2 kb	Fri, 16 Sep 2011 18:00:51 GMT

The second file in the list (the 81 MB one) above shall look like the following in BEAM VISAT:



In order to use the same colour palettes as in the screenshot shown above, do the following in VISAT:

1. Double-click a band in order to open an image view.
2. Open the *Colour Manipulation* tool window (if you can't find it, click on the icon in the main tool bar.
3. Click the **import icon** button and select the palette **spectrum.cpd** or **spectrum_large.cpd.** Click **Open**.
4. Use the **95% icon** button to adjust the value range to be colour-coded

3.4.5 Test 3.3

3.4.5.1 Aim

Test that Level-2 processing parameters can be changed and that retrieved results are different. In this case we change the IOP retrieval algorithm of the CoastColour processor to use the QAA algorithm [RD-8].

3.4.5.2 Procedure

The procedure is the same as in Test 3.1 with the exception of step 6: In the text area Processor Parameters, scroll down the XML content until you reach the element

```
<useQaaForIops>false</useQaaForIops>
```

and change its value to

```
<useQaaForIops>true</useQaaForIops>
```

Then follow the procedure as described in Test 3.1 and 3.2 for downloading the results.

3.4.5.3 Expected Result

The result shall be similar to the one of Test 3.2; the QAA algorithm may execute faster. The geo-physical contents of the generated product will be more or less different from the ones in Test 3.2.

3.5 Test Group 4 – Match-up Analysis (MA)

3.5.1 Feature Description

The match-up analysis (MA) is a production scenario that compares reference point measurements, such as in situ observations, with corresponding extracts from Level-1 or Level-2 data. The measurement points are taken from a user-provided data table. A record in this table may not only contain the geographical coordinate of a point but also any number of reference data (in-situ data, or EO data) and measurement metadata such as the measurement time. For any variables contained in the data table which can also be found in the Level-1 or Level-2 data products, the MA will generate scatter plots and provide a linear regression of how the reference data matches the data found in the data products at given points. The following screenshot shows the MA parameters in the Calvalus portal.

Matchups are not done on single pixels but on macro pixels that include neighbours to the centre pixel that exactly corresponds to the given geographical point coordinate. In the Calvalus implementation of the MA, the macro pixels span 5 x 5 "normal" pixels or more.

All pixels in the macro pixel are screened and a list is generated of values that are compared against the reference measurement data.

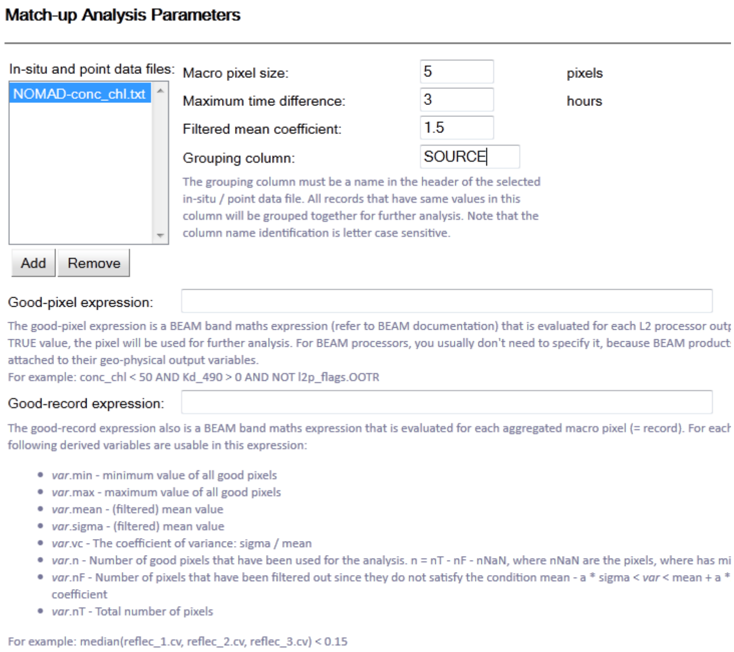


Figure 14: Match-up analysis parameters

The screening and the matchup strategy is based on the multi-sensor approach for the on-orbit validation of ocean colour satellite data products as performed by the NASA OBPG for MODIS, SeaWiFS, CZCS and MERIS ocean colour products [RD-22].

The inputs to the Calvalus implementation of the MA are

- EO data product file (e.g. MERIS scene, full orbit swath)
- In-situ / reference data file comprising point records. A point record comprises the point's geographical latitude and longitude, a measurement time, and any number of other attributes including reference variables, e.g. CHL in-situ measurements
- Macro pixel size
- Maximum time difference between EO observation and point record

- Filtered mean coefficient FMC
- Good-pixel expression and good-record expression.

The good-pixel expression is evaluated for each single pixel and is used to decide, if the pixel contributes to the macro pixel. It is evaluated in the context of the current L2 product. So it can comprise any band and flag names that are contained in the generated L2 output.

The good-record expression is evaluated in the context of the current record comprising all input fields read from the in-situ data source and the extracted and aggregated macro pixels. Thus, the good-record expression can contain references to all extracted variables and all their statistical parameters. If the variable is <name>, then <name>.min, <name>.max, <name>.mean, <name>.sigma, <name>.cv, <name>.n are all valid references. In addition to the standard BEAM maths expressions, the good-record expression also may contain the median function which has a variable arguments list: median(x1, x2, x3, ...).

3.5.1.1 Match-up Algorithm

In order to understand the effect of the various MA parameters, the MA procedure is described here:

For each **EO data product**:

- If a region geometry is given and it does not intersect with the data products (swath, coverage) boundary: skip **EO data product**
- For all **records** in the in-situ / reference data file (a record contains geo. lat/lon point, time, and any number of other attributes including reference variables, e.g. CHL in-situ measurements):
  - If a region of interest (ROI) is given and the current record point does not intersect the ROI’s geometry: **skip record**
  - Compute the EO data product’s pixel location at the record’s point
  - Compute the EO data product’s pixel time
  - If max. time difference > 0 and delta of pixel time and record time is > max. time difference: **skip record**
  - For all **variables** in the EO data product:
    - Extract n x n macro pixel area for all variables of the EO data product or, if a Level-2 processor is specified, for all output variables of the data product process to Level-2
    - For all **pixel** positions (x,y) in the macro pixel, collect the variable’s value list:
      - If a variable value at (x,y) is NaN: **skip pixel**
      - If a good-pixel expression is given and it evaluates to FALSE: **skip pixel**
      - Collect value of variable
    - Compute intermediate statistics from value list: mean, sigma.
    - If filtered mean coefficient FMC is given and > 0:
      - For all collected **variable values** x:
        - If mean - FMC * sigma < x < mean + FMC * sigma: **remove value** from list
    - Compute final statistics from value list: min, max, mean, sigma, CV.
  - Create a new record by concatenating to the in-situ / reference data record, the pixel location, the pixel time and all data product’s final variable statistics from value list: min, max, mean, sigma, CV.
  - If a good-record expression is given and it evaluates to FALSE for the new concatenated record: **skip record**

3.5.1.2 In-situ / point data format

The MA production type currently can handle two types of point data format: BEAM placemark (XML) files and TAB separated, plain text, CSV files.

The BEAM placemark files can easily be used to extract point data records from the Calvalus EO data archive. Users can create placemark files by using setting pins into images using BEAM VISAT and then exporting the pins into a file.

Calvalus expects in-situ data to be provided as a CSV file. The following rules apply to valid in-situ CSV files:

- Empty lines and comment lines introduced by a '#' character are ignored.
- The first non-empty and non-commented line is the header line. It contains the TAB separated names of the columns. The following names (all letter case insensitive) have a special meaning:
  - 'LAT' or 'LATITUDE' provide the geographical WGS-84 latitude of the measurement's point location. This column is mandatory, it must exist.
  - 'LON' or 'LONG'or 'LONGITUDE' provide the geographical WGS-84 longitude of the measurement's point location. This column is mandatory, it must exist.
  - 'TIME' or 'DATE' provide the measurement's data take time in the format 'yyyy-MM-dd hh:mm:ss'. This column is optional, however it must exist for applying the max. time difference criterion.
  - Column names that are letter case-insensitive equal to a variable in a Level-2 output product will create match-up pairs for which scatter plots and regression parameters are computed in the MA. Such columns are optional. If no such pair exists, the MA degenerates to a simple point data extraction process.
- All subsequent non-empty and non-comment lines are data records comprising values for each column.
- Values can be missing, in this case two separators follow each other. A missing numerical value can also be indicated using the token 'NaN' (not-a-number, again letter case insensitive).

3.5.2 Realisation in Hadoop

Similar to the L2 production type, the MA production scenario creates a *mapper* task for each file in the (possibly filtered) input product file set on a dedicated node in the Hadoop cluster.

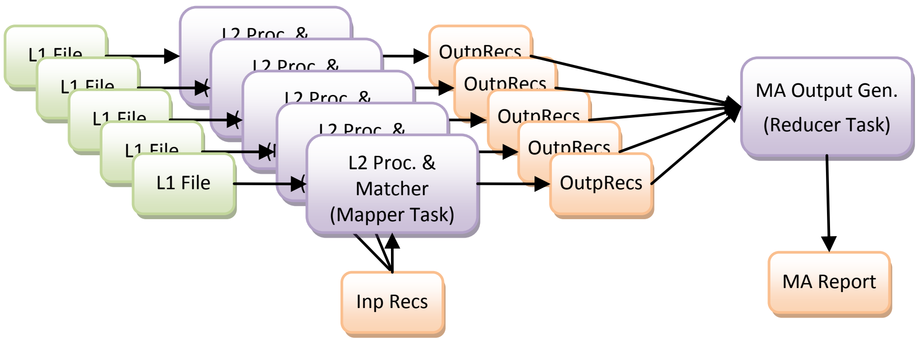


Figure 15: MA production type in Hadoop

The mapper task reads in the in-situ / point data records and creates output records using the L1 input file processed to L2. All output records are passed to a single Reducer task, which aggregates the records, computes statistics and generates the plots. Again, the Hadoop processing engine will try to select the node according to the location of the data in the cluster so that the tasks will most probably work data local. The Calvalus system can process a 1000 Level-1 input files in a few minutes, because the L2 processing is only performed on sub-regions given by the point records and the macro pixel's size.

3.5.3 Test 4.1

3.5.3.1 Aim

Make sure MA works with most parameters set to default values. The test matches NOMAD in-situ data with two outputs of the current version of the CoastColour processor (conc_chl, Kd_490) using MERIS RR data of May-July 2007 comprising 1490 full orbit files. The output comprises extracted data records and scatter plots for matching reference and EO data variables.

3.5.3.2 Setup

The NOMAD in-situ data file is provided for the test. The following shows an extract of this file. It is a plain text file using TAB separators:

ID	LAT	LONG	SOURCE	TIME	CRUISE	CONC_CHL	KD_490
1595	-61.599	-62.598	NOMAD	2000-02-22 13:30:00	amlr2000	0.283	0.04498
1596	-61.45	-62.299	NOMAD	2000-02-22 17:00:00	amlr2000	0.118	0.03131
1599	-61.3	-59.59	NOMAD	2000-02-24 13:35:00	amlr2000	0.389	0.04595
1601	-61.449	-58.3	NOMAD	2000-02-25 13:30:00	amlr2000		0.13322
1604	-61.149	-57.003	NOMAD	2000-02-27 18:00:00	amlr2000		0.08816

3.5.3.3 Procedure

1. Make sure the *Match-up Analysis* tab is selected.
2. From the list box *Predefined file sets* select **MERIS RR L1b 2007**
3. In the component *Temporal Filter* select *By date range*. Enter *Start date* **2007-05-01**, and *End date* **2007-07-31**
4. In the component *Spatial Filter* select **No filter (global)**
5. In the component *L2-Processor* select **MERIS CoastColour L2W v1.3**
6. In the component *L2-Parameters* leave defaults (for time being)
7. In the component *Match-up Analysis Parameters* you need to specify an in-situ file first. Therefore, press **Add** button found below the list box *In-situ and point data files*. A dialog shall pop-up prompting for a file to be uploaded. Browse the file **NOMAD-conc_chl.txt** that comes with the test data distribution. After pressing **OK**, the file shall appear in the list box. Make sure, the new entry is selected.
8. Leave all MA parameters to their default values, except for *Grouping column*. Set this to **SOURCE**, so that the name "NOMAD" will be used in the generated MA report.
9. Scroll to the end of the page and press the *Check Request* button. A dialog box shall appear showing the production parameters .
10. Now press the *Order Production* button to submit the production request. After a few seconds you shall be redirected to the Manage Productions tab of the portal. The production progress can be observed now. You shall see the production state changing from SCHEDULED to RUNNING and finally, after a few minutes, to COMPLETE. A *Download* button shall appear by that time. After pressing it, the portal shall direct you to a personal space from where the new, resulting report file (a ZIP) can be downloaded.

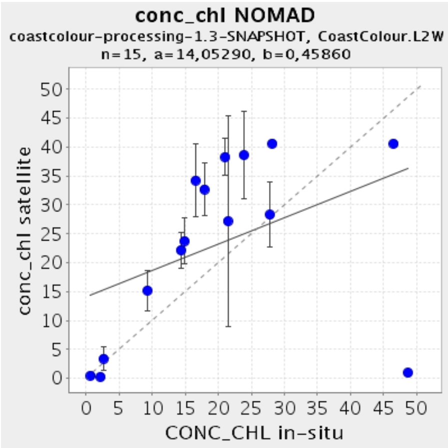
3.5.3.4 Expected Results

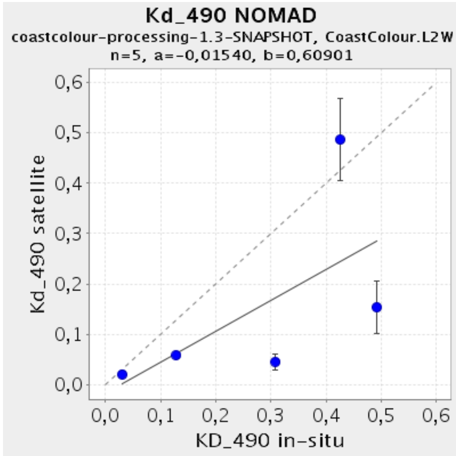
The MA should not take longer than 6 minutes and shall not exceed 12 minutes.

The output of the MA is a report comprising the following elements:

1. CSV file comprising of measurement from all pixel within the macro pixels
2. CSV file comprising aggregated values (mean and sigma) for each macro pixels
3. XML report with attached XSD file allowing for viewing the XML in a browser
4. scatter plot of reference versus satellite measurements for each matched variable (conc_chl, Kd_490)

The scatter plots shall look similar to the ones shown below:





3.5.4 Test 4.2

3.5.4.1 Aim

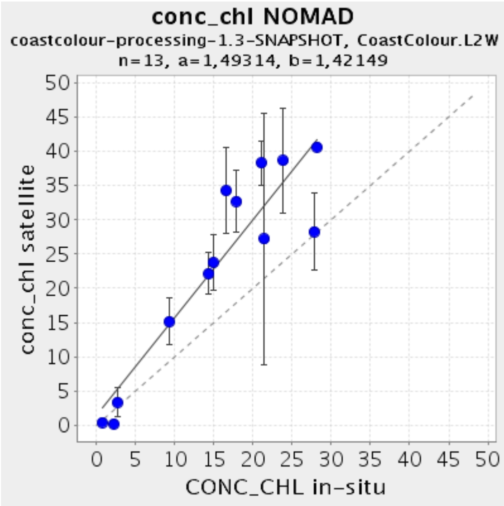
Similar to Test 4.1, except that the MA parameters are changed in order to constrain the generated match-up records.

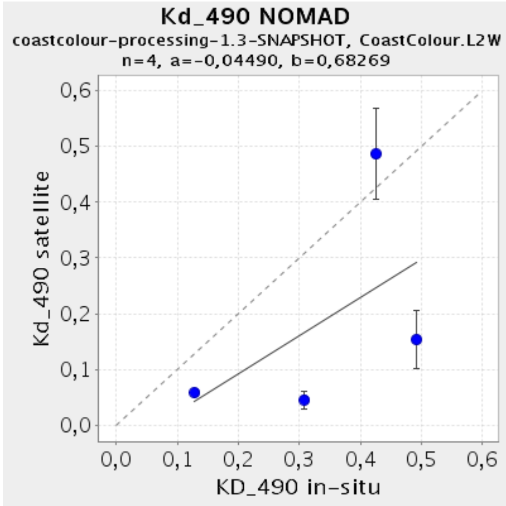
3.5.4.2 Procedure

Same as in Test 1, but in Step 8 set the *Good-record expression* to the value **CONC_CHL < 40**. This should filter out all reference records whose in-situ reference value for chlorophyll A is below 40 mg m^{-3}.

3.5.4.3 Expected Results

Similar to Test 4.1, but with constrained output records. The scatter plots shall now look similar to the following:





3.6 Test Group 5 – Level-3 Processing (L3)

3.6.1 Feature Description

The production type Level-3 Processing (L3) allows user to process a (filtered) input data product file set using a selected Level-2 processor to one or more Level-3 data products. The result of the production is a zipped set of output files in a user selected EO data format (currently BEAM-DIMAP, NetCDF, GeoTIFF), that can be downloaded by the user.

For the demonstration of the Calvalus system, the Level-2 processor for L3 is again the CoastColour L2W processor (same as for L2 and MA). A description of the L2W output product and its processing parameters is given in annex A.

Following, Level-3 Parameters need to be set up. The L3 production type can generate many L3 output variables at the same time. Users simply add a new variable using the Add button below the table of variables. The list of available variables is specific to the selected L2 processor.

The pixels used for the L3 products must pass a test given by the *good-pixel expression*. This expression is a BEAM band maths expression that may contain all the bands and flags contained in the L2 output products.

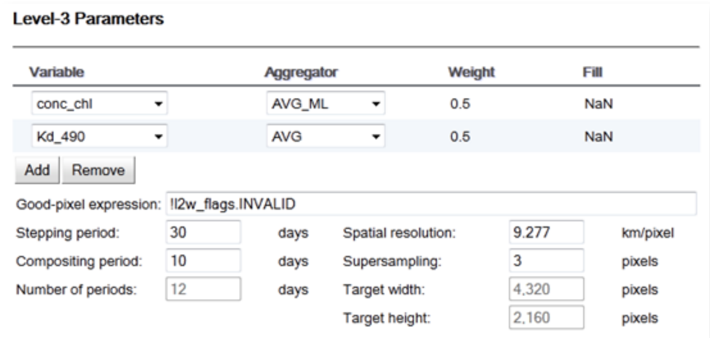


Figure 16: Level-3 parameters

The time range used for generating the L3 output products is given by the *Temporal Filter* selection (see chapter Common Components). The frequency L3 output files are produced is determined by the parameter *stepping period*, e.g. every 30 days. The resulting number of L3 products is the number days of the total time range divided by the number of days given by the *stepping period*. The actual number of input product days that are used to produce each L3 output file is given by the parameter *compositing period*, which must equal to or less than the *stepping period*, e.g. 4-days, 8-days, monthlies.

The default *spatial resolution* is 9.28 km per output pixel resulting in a grid resolution of 4319 x 2190 pixels for global coverage Level-3 products. Finally the *supersampling* parameter can be used to reduce or avoid the Moiré-effect which occurs in output images if the binning grid is only sparsely filled by input pixels. This situation usually occurs if the spatial resolution used for the binning is similar to the input pixel resolution. The *supersampling* subdivides every input (Level-2) pixel in n x n super sub pixels which all have the same values but different and unique geographical coordinates. This way, an input pixel may be distributed to more than one adjacent bin cell.

The binning algorithm implemented in Calvalus is the same that is used by the NASA OBPG for creating the SeaWiFS and MODIS ocean colour Level-3 products [RD-11].

3.6.2 Realisation in Hadoop

As for L2 and MA, the L3 production scenario creates a *mapper* task for each file in the (possibly filtered) input product file set on a dedicated node in the Hadoop cluster. The mapper task reads in the input product, processes it to Level-2 data, and according to the binning parameters, performs a spatial binning of the data. The output of the mapper are spatially aggregated bin cells. A number of reducer tasks are then responsible for the temporal binning at the individual bin latitude ranges. They get the spatially binned outputs from all the mappers, perform the temporal binning and output bin cells for each bin latitude range. A special formatter task is used during the staging process to

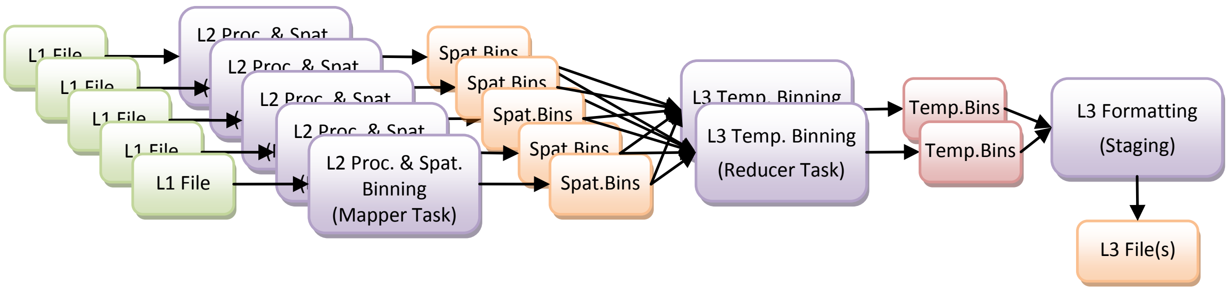


Figure 17: L3 production type in Hadoop

collect all the latitude bin ranges parts and compile the final binned data product.

The Calvalus implementation of the OBPG binning algorithm is very efficient. The binning scheme is a perfect use case for the Hadoop map reduce programming model. Data locality is in most cases fully exploited. Level-2 processing is performed on-the-fly, no intermediate files are written.

3.6.3 Test 5.1

3.6.3.1 Aim

Make sure L3 works with most parameters set to default values. The test will process MERIS RR Level-1 data of 10 days in Summer 2010 to Level-2 ocean colour products and then create a binned Level-3 product for the North Sea region.

3.6.3.2 Procedure

1. Click on the tab *Level-3 Processing*
2. Select the *Input file set* **MERIS RR L1b 2002-2010**
3. In the *Temporal Filter* component, select **By date range**, enter **2010-08-01** to **2010-08-10**
4. Select **By region** in the *Spatial Filter* component, select **northsea**
5. In the component *Level-2-Processor* select **MERIS CoastColour L2W v1.3**
6. In the component *Level-2-Parameters* leave defaults

7. In the component *Level-3-Parameters* add the variable **conc_chl**, leave default parameterisation, namely *aggregation method* **AVG**, *weight* coefficient **1.0**, *fill value* **NaN**.
8. Add another variable **Kd_490**, leave default parameterisation, namely *aggregation method* **AVG**, *weight* coefficient **1.0**, *fill value* **NaN**.
9. Leave *Good-pixel expression* **!l2w_flags.INVALID**
10. Leave *stepping period* **30**, change *compositing period* to **10**
11. Change spatial resolution to **3** km/pixel, target size should now be **1230 x 930** pixels.
12. Change *supersampling* to **3** pixels
13. Press the *Check Request* button. You should see the production request now.
14. Now press the *Order Production* button to submit the production request. After a few seconds you shall be delegated to the Manage Productions tab of the portal. The production progress can be observed now. You shall see the production state changing from SCHEDULED to RUNNING and finally, after a few minutes, to COMPLETE. A *Download* button shall appear by that time. After pressing it, the portal shall redirect you to a personal space from where the new, resulting report file (a ZIP) can be downloaded.

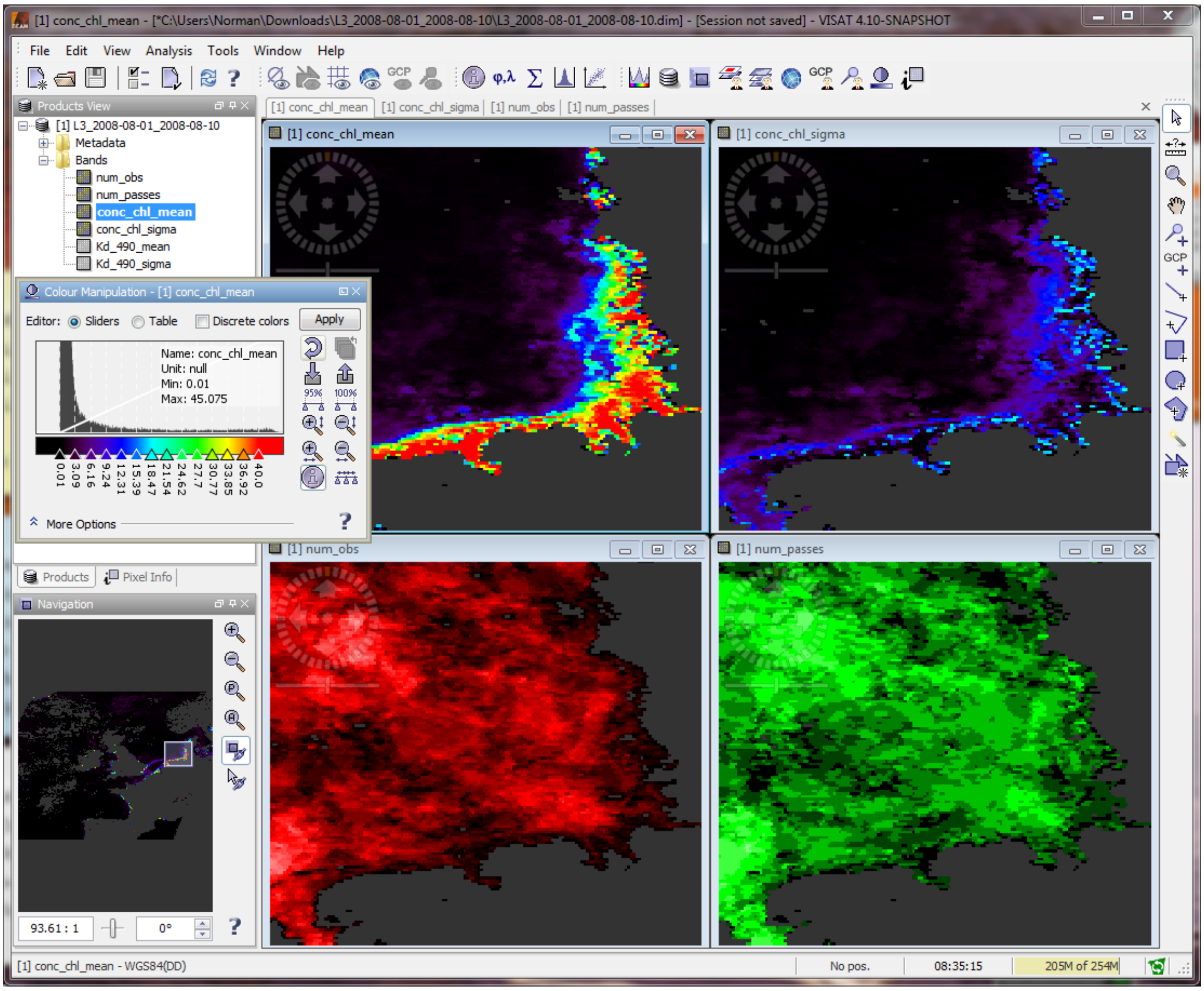
3.6.3.3 Expected Results

The generation of the Level-3 product should be done after 6 minutes; it shall take no longer than 12 minutes. After pressing the download button you shall see the following results in a new browser window:

Calvalus staging area /staging/norman/20110918181623_L3_271ab00ad0861d/

Filename	Size	Last Modified
L3_2010-08-01_2010-08-10.zip	10335.5 kb	Sun, 18 Sep 2011 16:22:14 GMT
request.html	10.9 kb	Sun, 18 Sep 2011 16:22:14 GMT
request.xml	5.0 kb	Sun, 18 Sep 2011 16:22:14 GMT

The file on the list should have about 10 MB after downloading and unpacking, and it shall look the following after opening in BEAM VISAT:



3.6.4 Test 5.2

3.6.4.1 Aim

The goal of the second L3 production type test is the production of a single global 10-day Level-3 product. Around 150 full orbit MERIS RR products (82 GB) will be used and they will be processed to ocean colour Level-2 and to Level-3 binned files.

3.6.4.2 Procedure

1. Click on the tab *Level-3 Processing*
2. Select the *Input file set* **MERIS RR L1b 2002-2010**
3. In the *Temporal Filter* component, select **By range**, enter **2008-05-01** to **2008-05-10**
4. Select **No filter (global)** in the *Spatial Filter* component
5. In the component *Level-2-Processor* select **MERIS CoastColour L2W v1.3**
6. In the component *Level-2-Parameters* leave defaults
7. In the component *Level-3-Parameters* enter the same values as for Test 5.1, but change spatial resolution to **9.28** km/pixel, target size shall now be **4320 x 2160** pixels.
8. Press the *Check Request* button. You should see the production request now.
9. Now press the *Order Production* button to submit the production request. It will now take a while before you are redirected to the Manage Productions tab of the portal; but it should not take longer than a minute.

3.6.4.3 *Expected Results*

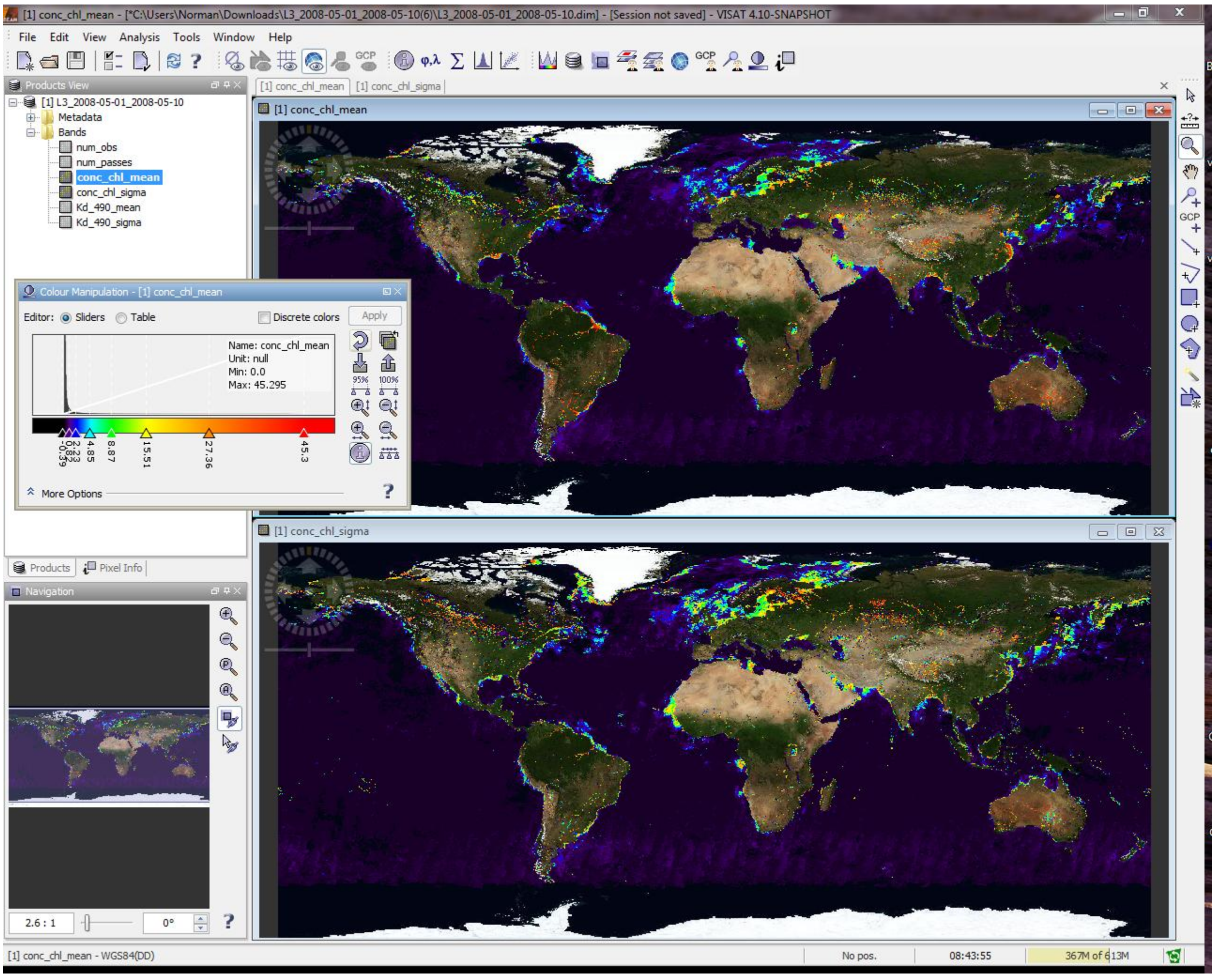
The Level-2 processor L2W usually requires 20 minutes to process a full orbit of MERIS RR L1b product to L2. Ignoring computation time used for binning (negligible compared to L2 processing), the 150 L1b files would take **50 h** when processed in sequence. Calvalus should take no longer than **1.5 h** and shall not exceed **3 h**.

The output of the production shall be similar to the one of Test 5.1. The L3 output file is now 10 times larger (92 MB):

Calvalus staging area /staging/norman/20111027155753_L3_33a543b5948465/

Filename	Size	Last Modified
L3_2008-05-01_2008-05-10.zip	60022.5 kb	Thu, 27 Oct 2011 15:26:27 GMT
request.html	10.8 kb	Thu, 27 Oct 2011 15:26:27 GMT
request.xml	5.0 kb	Thu, 27 Oct 2011 15:26:27 GMT

This is how the global L2W IOP L3 product shall look in BEAM VISAT:



3.7 Test Group 6 – Trend Analysis (TA)

3.7.1 Feature Description

The TA production type is used to create time-series of Level-3 data. It has therefore the same parameters as the ones described in the previous chapter. However, the time range for a meaningful analysis will be typically many months; and the compositing period is usually significantly smaller than the stepping period. For example, the TA automatically performed by the OBPG for the SeaWiFS and MODIS ocean colour products uses a stepping period of 32 days and a compositing period of 4 days. The *spatial resolution* is fixed to 9.28 km, the *supersampling* fixed to 1.

In opposite to L3 production type, the temporal bin cells for a compositing period are all aggregated and averaged. So every compositing period results in a single value for each variable forming a time series over the entire time range of the analysis.

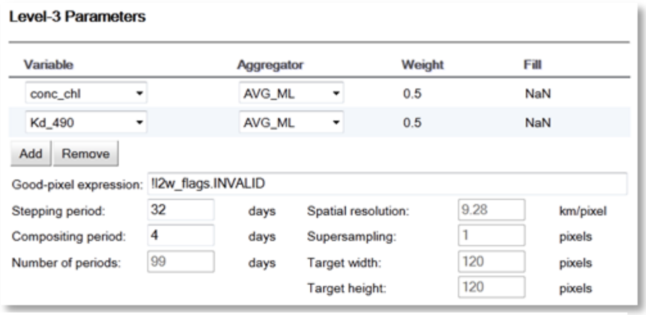


Figure 18: TA parameters

3.7.2 Realisation in Hadoop

The TA production type is implemented the same way as the L3 production type with the exception that the temporal bin cells output by the *reducer* tasks are all averaged again. So every compositing period results in a single value for each variable forming a time series over the entire time range of the analysis.

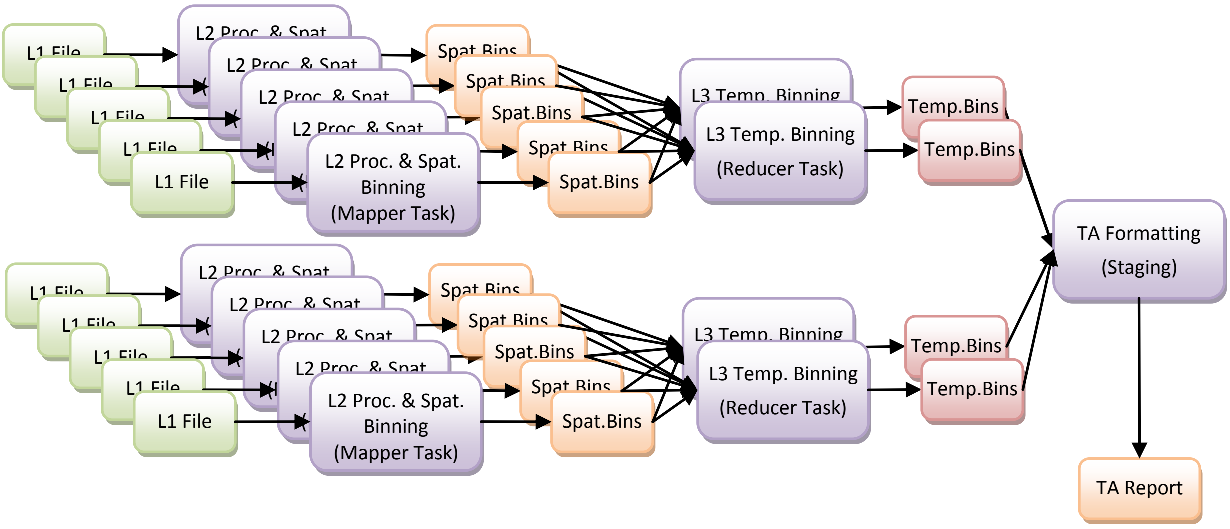


Figure 19: TA production type in Hadoop

3.7.3 Test 6.1

3.7.3.1 Aim

Make sure TA works with most parameters set to default values. The test will perform a TA on 7 years of MERIS RR data for the South Pacific Gyre region as used by the ESA Ocean Colour CCI project.

3.7.3.2 Procedure

1. Click on the tab *Trend Analysis*
2. Select the *Input file set* **MERIS RR L1b 2002-2010**
3. In the *Temporal Filter* component, select **No filter**
4. Select **By region** in the *Spatial Filter* component, select **South_Pacific_Gyre (OC_cci)**
5. In the component *Level-2-Processor* select **MERIS CoastColour L2W version 1.3**
6. In the component *Level-2-Parameters* leave defaults
7. In the component *Level-3-Parameters* add the variable **conc_chl**, leave default parameterisation, namely *aggregation method* **AVG**, *weight* coefficient **1.0**, *fill value* **NaN**.
8. Add another variable **Kd_490** or **tsm_conc**, leave default parameterisation, namely *aggregation method* **AVG**, *weight* coefficient **1.0**, *fill value* **NaN**.
9. Change *Good-pixel expression* to **!l2w_flags.INVALID && conc_chl < 100**
10. Leave *stepping period* **32**, and also *compositing period* to **4** resulting in **99** periods
11. Press the *Check Request* button. You should see the production request now.
12. Now press the *Order Production* button to submit the production request. In the *Manage Productions* tab, you shall now be able to observe the production progress of the new TA production.

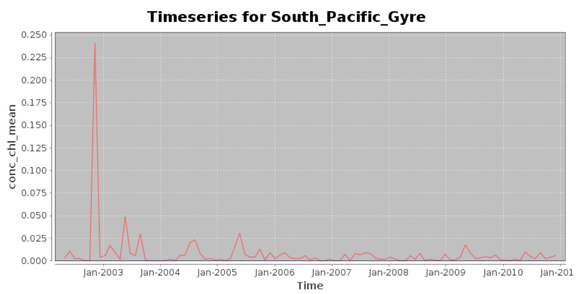
3.7.3.3 Expected Results

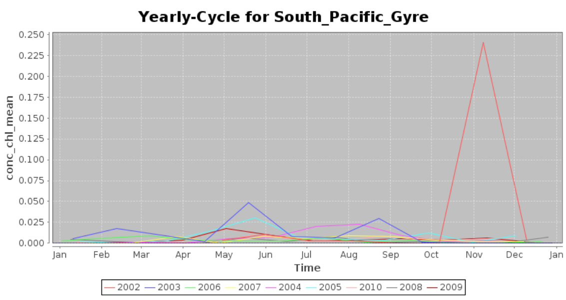
The TA will compute 99 periods for the South Pacific Gyre region and thus output 99 data points (including mean and sigma) for the geophysical variables. The TA should take no longer than **0.5 h** and shall not exceed **3 h**. The ouputs shall look similar to the following screenshot on the right.

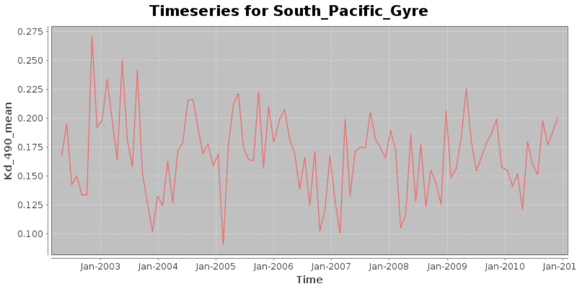
The following table shows examples of the genareted plots. You shall be able to look at the same when opening the **request.html** file that is generated as part of the report.

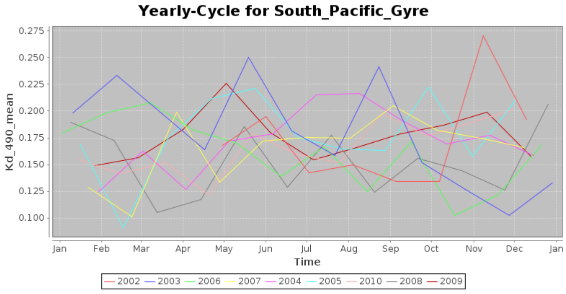
Calvalus staging area /staging/norman/20110919115952_TA_271ab00ad08622/

Filename	Size	Last Modified
South Pacific Gyre.csv	9.2 kb	Mon, 19 Sep 2011 10:26:46 GMT
Timeseries-South Pacific Gyre-Kd 490 mean.png	42.0 kb	Mon, 19 Sep 2011 10:26:49 GMT
Timeseries-South Pacific Gyre-Kd 490 median.png	47.5 kb	Mon, 19 Sep 2011 10:26:50 GMT
Timeseries-South Pacific Gyre-Kd 490 mode.png	36.8 kb	Mon, 19 Sep 2011 10:26:50 GMT
Timeseries-South Pacific Gyre-Kd 490 sigma.png	12.4 kb	Mon, 19 Sep 2011 10:26:49 GMT
Timeseries-South Pacific Gyre-conc chl mean.png	23.1 kb	Mon, 19 Sep 2011 10:26:48 GMT
Timeseries-South Pacific Gyre-conc chl median.png	31.7 kb	Mon, 19 Sep 2011 10:26:49 GMT
Timeseries-South Pacific Gyre-conc chl mode.png	21.1 kb	Mon, 19 Sep 2011 10:26:49 GMT
Timeseries-South Pacific Gyre-conc chl sigma.png	14.0 kb	Mon, 19 Sep 2011 10:26:48 GMT
Yearly cycle-South Pacific Gyre-Kd 490 mean.png	59.8 kb	Mon, 19 Sep 2011 10:26:49 GMT
Yearly cycle-South Pacific Gyre-Kd 490 median.png	66.8 kb	Mon, 19 Sep 2011 10:26:50 GMT
Yearly cycle-South Pacific Gyre-Kd 490 mode.png	53.8 kb	Mon, 19 Sep 2011 10:26:50 GMT
Yearly cycle-South Pacific Gyre-Kd 490 sigma.png	14.7 kb	Mon, 19 Sep 2011 10:26:49 GMT
Yearly cycle-South Pacific Gyre-conc chl mean.png	37.0 kb	Mon, 19 Sep 2011 10:26:48 GMT
Yearly cycle-South Pacific Gyre-conc chl median.png	48.6 kb	Mon, 19 Sep 2011 10:26:49 GMT
Yearly cycle-South Pacific Gyre-conc chl mode.png	30.8 kb	Mon, 19 Sep 2011 10:26:49 GMT
Yearly cycle-South Pacific Gyre-conc chl sigma.png	16.2 kb	Mon, 19 Sep 2011 10:26:48 GMT
request.html	12.1 kb	Mon, 19 Sep 2011 10:26:50 GMT
request.xml	5.0 kb	Mon, 19 Sep 2011 10:26:50 GMT






Timeseries for South_Pacific_Gyre
Kd_490_mean
Time
Jan-2003
Jan-2004
Jan-2005
Jan-2006
Jan-2007
Jan-2008
Jan-2009
Jan-2010


Yearly-Cycle for South_Pacific_Gyre
Kd_490_mean
Time
2002
2003
2006
2007
2004
2005
2010
2008
2009

Annex

Annex A: CoastColour L2W Processor (version 1.3)

CoastColour L2W Output Product

The following table lists L2W specific geophysical variables and datasets:

Name	Description
iop_a_pig_443	Absorption coefficient at 443 nm of phytoplankton pigments
iop_a_ys_443	Absorption coefficient at 443 nm of yellow substance
iop_bb_spm_443	Backscattering of suspended particulate matter at 443 nm
iop_a_total_443	Total absorption coefficient of all water constituents at 443 nm
K_min	Minimum down-welling irradiance attenuation coefficient
Kd_λ	Downwelling irradiance attenuation coefficient at λ, where λ is one of 412, 443, 490, 510, 560, 620, 664 and 680
turbidity	Turbidity in FNU (Formazine Nephelometric Unit)
Z90_max	Inverted value of k_min
conc_chl	Chlorophyll concentration (mg m^{-3}).
conc_tsm	Total suspended matter dry weight (g m^{-3}). tsm_conc = tsmConversionFactor · $b\_tsm^{tsmConversionExponent}$
chiSquare	A low value in the product indicates a higher success in the retrieval and that the conditions, which have led to the measured spectrum, are in (sufficient) agreement with the conditions and the bio-optical model used in the simulations for training the neural network. A value above a threshold of spectrumOutOfScopeThreshold (default is 4.0) triggers the out of training range == out of scope flag.
l1_flags	Quality flags dataset from L1b product
l1p_flags	CoastColour L1P pixel classification
l2r_flags	CoastColour L2R atmospheric correction quality flags
l2w_flags	CoastColour L2W water constituents and IOPs retrieval quality flags

The following table lists the flag coding for the **l1p_flags** dataset:

Bit#	Name	Description
1	CC_LAND	Pixel masked as land
2	CC_COASTLINE	Pixel masked as coastline
3	CC_CLOUD	Pixel masked as cloud
4	CC_CLOUD_SPATIAL	Pixel masked by spatial cloud filter
5	CC_CLOUD_BUFFER	Pixel masked as cloud buffer
6	CC_CLOUD_SHADOW	Pixel masked as cloud shadow

7	CC_SNOW_ICE	Pixel masked as snow/ice
8	CC_LANDRISK	Potential land pixel
9	CC_GLINTRISK	Risk that pixel is under glint

The following table lists the flag coding for the **l2r_flags** dataset:

Bit#	Name	Description
1	-	Not used
2	ATC_OOR	Atmospheric correction out of range
3	TOA_OOR	TOA reflectance out of range
4	TOSA_OOR	TOSA reflectance out of range
5	SOLZEN	Large solar zenith angle
6	ANCIL	Missing/OOR auxiliary data
7	SUNGLINT	High sun glint retrieved
8	INVALID	Invalid pixels

The following table lists the flag coding for the **l2w_flags** dataset:

Bit#	Name	Description
1	WLR_OOR	Water leaving reflectance out of range
2	CONC_OOR	Water constituents out of range
3	OOTR	Spectrum out of training range
4	WHITECAPS	Risk for white caps
8	INVALID	Invalid pixels

CoastColour L2W Parameters

The following table lists the available processor parameters of the L2W processor.

Parameter	Default Value	Description
doCalibration	true	Whether to perform the calibration
doSmile	true	Whether to perform MERIS Smile-effect correction
doEqualization	true	Perform removal of detector-to-detector systematic radiometric differences in MERIS L1b data products
brightTestWavelength	865	Wavelength of the band used by the brightness test in the CoastColour cloud screening
brightTestThreshold	0.03	Threshold used by the brightness test in the CoastColour cloud

		screening
averageSalinity	35	The average salinity of the water in the region to be processed
averageTemperature	15	The average temperature of the water in the region to be processed
cloudIceExpression	l1p_flags.CC_CLOUD || l1p_flags.CC_SNOW_ICE	The arithmetic expression used for cloud/ice detection
landExpression	l1p_flags.CC_LAND	The arithmetic expression used for land detection
outputReflec	false	Toggles the output of water leaving radiance reflectance
landExpression	l1p_flags.CC_LAND	The arithmetic expression used for land detection
outputReflec	false	Toggles the output of water leaving radiance reflectance
invalidPixelExpression	l2r_flags.INVALID	The arithmetic expression defining pixels not considered for water processing
useQaaForIops	false	If enabled IOPs are computed by QAA instead of Case-2-Regional. Concentrations of chlorophyll and total suspended matter will be derived from the IOPs.
qaa.aLowerBound	-0.02	The lower bound of the valid value range of 'A'
qaa.aUpperBound	5.0	The upper bound of the valid value range of 'A'
qaa.bbLowerBound	-0.02	The lower bound of the valid value range of 'BB'
qaa.bbUpperBound	5.0	The upper bound of the valid value range of 'BB'
qaa.aphLowerBound	-0.02	The lower bound of the valid value range of 'APH'
qaa.aphUpperBound	3.0	The upper bound of the valid value range of 'APH'
qaa.adgUpperBound	1.0	The upper bound of the valid value range of 'ADG'. The lower bound is always 0
qaa.divideByPI	true	If selected the source remote reflectances are divided by PI

Annex B: Usage of the Command Line Tool cpt (version 0.3)

```
usage: cpt [OPTION]... REQUEST

The Calvalus production tool submits a production REQUEST to a Calvalus
production system. REQUEST must be a plain text XML file conforming to the
WPS Execute operation request (see
http://schemas.opengis.net/wps/1.0.0/wpsExecute_request.xsd). OPTION may
be one or more of the following:

-e,--errors                     Print full Java stack trace on exceptions.
-q,--quiet                      Quiet mode, only minimum console output.
-c,--config <FILE>              The Calvalus configuration file (Java
                                properties format). Defaults to
                                'C:\Users\Norman\.calvalus\calvalus.config'.
-B,--beam <NAME>                The name of the BEAM software bundle used
                                for the production. Defaults to 'beam-4.10-SNAPSHOT'.
-C,--calvalus <NAME>            The name of the Calvalus software bundle
                                used for the production. Defaults to 'calvalus-0.3-201109'.
    --copy <FILES>              Copies FILES to '/calvalus/home/<user>'
                                before any request is executed. Use character ';' to separate
                                paths in FILES.
    --deploy <FILES-->BUNDLE>   Deploys FILES (usually JARs) to the
                                Calvalus BUNDLE before any request is executed. Use the
                                character string '-->' to separate list of FILES from BUNDLE
                                name. Use character ':' to separate multiple paths in FILES.
    --install <BUNDLES>         Installs list of BUNDLES (directories,
                                ZIP-, or JAR-files) on Calvalus before any request is
                                executed. Use character ':' to separate multiple entries in
                                BUNDLES.
    --uninstall <BUNDLES>       Uninstalls list of BUNDLES (directories or
                                ZIP-files) from Calvalus before any request is executed.
                                Use character ',' to separate multiple entries in BUNDLES.
    --kill <PID>                Kills the production with given identifier PID.
    --help                      Prints out usage help.
```