	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 1</p> <p>Version 1.0 1 Dec 2011</p>
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ESA Climate Change Initiative (CCI)

System Requirements Document (SRD)

for the Essential Climate Variable (ECV)

Greenhouse Gases (GHG)

Written by:

GHG-CCI team esp. System Engineering Team (SET) and Earth Observation Science Team (EOST)

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**System Requirements Document
(SRD)**Version 1.0
1 Dec 2011for the Essential Climate Variable (ECV)
Greenhouse Gases (GHG)**Change log:**

Version Nr.	Date	Status	Reason for change
Draft 0.1	17. Oct. 2011	Initial Draft for project internal discussion.	New document.
Draft 0.2	21. Oct. 2011	Improved Draft for SET.	To consider minor initial comments from EOST/ECA team.
Draft 0.3	18. Nov. 2011	Improved Draft for further iteration within SET/EOST.	SET inputs added. Modified by EOST.
Draft 1.0	24. Nov. 2011	Improved Draft for further iteration within SET/EOST.	Minor edits.
Version 1.0	1. Dec. 2011	First version.	To generate the first version of this document.



	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 3</p> <p>Version 1.0 1 Dec 2011</p>
---	--	---

Table of Contents

1	Overview	4
2	CCI System Requirements from GHG-CCI	6
2.1	High Level Description of the Algorithm Development and Data Processing	8
2.2	General CCI System requirements	11
2.3	System processing requirements.....	12
2.4	Scientific Processor related requirements.....	14
2.5	Requirements related to the verification.....	15
2.6	Archiving related requirements	17
2.7	User Interface related requirements.....	18
2.8	Recommendations	19
3	References	25

	ESA Climate Change Initiative (CCI) System Requirements Document (SRD) for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)	Page 4 Version 1.0 1 Dec 2011
---	--	---

1 Overview

The GHG-CCI project aims at generating global satellite derived data sets of atmospheric CO₂ and CH₄ information useful for climate relevant applications in particular for constraining regional surface fluxes (emission and uptake) via inverse modeling of these two important anthropogenic greenhouse gases (GHG) (see GHG-CCI User Requirements Document **/URD GHG-CCI v1/**).


Within the GHG-CCI project two types of algorithms to retrieve CO₂ and CH₄ information from satellite data are distinguished:

- **“ECV Core Algorithms” (ECAs):**
 - These are algorithms for retrieving near-surface sensitive column-averaged mixing ratios of CO₂ and CH₄, denoted XCO₂ and XCH₄, from SCIAMACHY/ENVISAT and TANSO/GOSAT.
- **“Additional Constraints Algorithms” (ACAs):**
 - These are algorithms for retrieving CO₂ and CH₄ information from satellite data with no or limited near-surface sensitivity. They have the potential to deliver important additional constraints when used in a (inverse modelling) framework that exploits satellite data to infer information on surface fluxes. This is because they can constrain CO₂ and CH₄ in upper layers, i.e., layers above the Planetary Boundary Layer (PBL). In addition, there are potentially other important climate relevant applications.

During the first two years of this GHG-CCI project (Sept. 2010 – Aug. 2012) a so-called Round Robin (RR) exercise will be conducted to identify, if possible, one ECA algorithm per data product for further development and use within the CCI program (see **/RREP GHG-CCI v2/**). Preliminary results indicate that one baseline algorithm can be recommended for some of the products but not for all. For certain products, esp. for those derived from the recently launched GOSAT satellite, it likely has to be recommended to further develop and use two or more algorithms (“ensemble approach”) especially in order to deal with small but potentially significant biases of the satellite retrievals which cannot be reliably quantified to the level of accuracy needed for the envisaged climate applications.

For ACAs (which are not in competition in contrast to ECAs) a number of criteria have been defined (see **/RREP GHG-CCI v2/**) which need to be fulfilled for the corresponding algorithm / data product for further development and use within the CCI program.

The GHG-CCI RR phase ends end of August 2012. The final selection results will therefore be available end of August 2012.

	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 5</p> <p>Version 1.0 1 Dec 2011</p>
---	--	---

Because GHG-CCI is in “research mode” with an extended RR phase (compared to other ECV projects), GHG-CCI has no Task 5 (System Specification, key deliverables: IODD, DPM, SRD, etc.). Therefore, the GHG-CCI SRD, i.e., this document, is not a contractually required project deliverable. It has however been decided at GHG-CCI Progress Meeting 3 (PM 3) in October 2011, that GHG-CCI shall prepare a SRD because this is an important document required in the context of the ongoing specification of a “CCI System” by ESA (see agenda and presentations of 2nd CCI Co-location meeting, 12-14 Oct 2011, ESRIN, available from <http://www.esa-cci.org/>).


At present even high-level CCI System requirements are not available. The specification of the CCI System is ongoing using the available SRDs of the individual ECV projects. The first goal will be to formulate high-level requirements. The main purpose of this document is therefore to provide high-level requirements for GHG-CCI.

According to ESA, Level 0-1 processing and the implementation of Level 0-1 algorithm improvements is an activity which is performed outside of CCI (this activity is covered by other projects, most notably by the corresponding ESA sensor Quality Working Groups (QWGs)). CCI is however expected to give feedback to Level 0-1 processing, i.e., to report issues and to propose solutions. Therefore, Level 0-1 processing requirements are not formulated in this SRD. It is assumed that appropriate Level 1 (L1) data exist and can be used. In contrast, Level 1-2 processing is a key priority for CCI. For GHG-CCI focus is on accurate retrieval of atmospheric CO₂ and CH₄ information from satellite radiances (L1 data product). As explained above, the GHG-CCI core data products are those generated with ECAs. In addition, ACAs are also covered, albeit with lower priority. Level 1-2 issues and how to optimally use the Level 2 (L2) products is therefore an aspect which needs to be covered by this SRD.

For this SRD the following assumptions have been made:

- The “CCI System” is assumed to consist of three major components:
 - The CCI Operational (Level 1-2) Processing System, in the following referred to as CCI-SYS-PS. For GHG-CCI this system will generate the GHG-CCI L2 products from the L1 products (and other input data sets).
 - The CCI Archiving System, referred to as CCI-SYS-AR, which needs to archive all GHG-CCI L2 data products.
 - The CCI User Interface, referred to as CCI-SYS-UI. Via this system the GHG-CCI data products shall be made available to all interested users.

To implement the “CCI System” in a cost efficient manner this document provides the relevant input for GHG-CCI related aspects in terms of background information and high-level requirements. Detailed requirements per algorithm / data product can only be provided after the GHG-CCI RR phase is finished, i.e., after Aug 2012, when the algorithm selection results are available.

	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 6</p> <p>Version 1.0 1 Dec 2011</p>
---	--	---

2 CCI System Requirements from GHG-CCI


The following requirements have been formulated specifically to cover the needs of the GHG-CCI project. Most of them are however likely also applicable for other ECV projects. They have been formulated as generic as possible.

At present only high-level requirements are given. Detailed requirements can be formulated after the GHG-CCI RR is finished, i.e., after Aug 2012.

In the following initial high-level requirements are listed. This list is not yet complete and needs to be extended / modified during CCI Phase 1 and likely needs adjustment also in later phases (e.g., to consider new sensors etc.).


A schematic overview how the GHG-CCI data product and/or scientific data processing systems can be integrated into the CCI System is given in **Figure 1**. The key aspects illustrated in **Figure 1** are the following:

- Recommendation to use existing Level 2 data products: High-quality global long-term Level 2 GHG-CCI data products are currently being generated and used by the GHG-CCI Earth Observation Science Team (EOST). These data products should be used by the “CCI System” in an optimal way. They shall be archived by the CCI System and made available to all interested users along with the appropriate documentation. This ensures that useful or at least potentially useful data can be made available via the CCI System already very early in the project. Once “System generated” data products exist which are of higher quality, they can be used to replace the Level 2 data products currently generated at the scientific institutions using the scientific data processors. See also “Option A” in **Figure 1**.
- Recommendation to use the state-of-the-art scientific data processors (“algorithms”) within the CCI System with as little modifications as possible: The scientific algorithms, which are currently being further developed within CCI Phase 1 and used to generate quality assessed global multi-year data sets, are highly complex and evolving. For a number of important reasons (see also **/Buchwitz et al., 2011/**) it is not recommended to re-implement these algorithms by external non-experts (see also below). The most efficient way to use these existing scientific processors within the CCI System is via “copy, install and run”, i.e., by copying them onto the System, installing them, and directly using them for Level 1-2 processing in the same way as they are currently used at the GHG-CCI scientific institutions. As shown in **Figure 1**, the part of the CCI System relevant for GHG-CCI is the “Off-line Processing System” (see below). Appropriate measures to ensure traceability of the algorithms and products will be taken. The key benefits for GHG-CCI are availability of all relevant input data (satellite, ECMWF, etc.), assumed enhanced processing power, large storage space, etc. compared to the systems currently used by the GHG-CCI research institutions. See also “Option B” in **Figure 1**.

	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 7</p> <p>Version 1.0 1 Dec 2011</p>
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The CCI System has not yet been defined. It is assumed (see **/ESA CCI Description, 2009/**) that (at least large parts of) the CCI System will be implemented by industry based on the documentation generated by the CCI Phase 1 teams during Phase 1. It is assumed that this also includes a (re)implementation of the (scientific) algorithms being further developed by scientific retrieval experts during Phase 1. This part of the CCI System is referred to as “On-line Processing System” in this document.

For GHG-CCI a (re)implementation of the highly complex and evolving scientific retrieval algorithms is neither recommended (see **/Buchwitz et al., 2011/**) nor possible (GHG-CCI has no Task 5 (System Specification) during Phase 1, i.e., important documents such as the Detailed Processing Model (DPM) will not be generated by GHG-CCI). GHG-CCI can therefore not be part of the assumed “On-line Processing System” as defined above. The part of the CCI System relevant and appropriate for GHG-CCI is referred to as “Off-line Processing System” in this document. This sub-system shall be designed such that the scientific algorithms can be used essentially as they are currently used at the scientific institutions for global multi-year satellite data processing with as little code modifications as possible (ideally none). Detailed requirements (operating system, compilers, other software, needed memory and disc space, etc.) can be provided after algorithm selection (i.e., after August 2012). In case requirements are needed earlier, preliminary requirements can be established earlier (in this case this has to cover all relevant algorithms currently being developed and assessed within GHG-CCI Phase 1). GHG-CCI has no Near-Real-Time (NRT) processing requirements. Off-line processing is therefore sufficient. All GHG-CCI System requirements given in this document refer to the “Off-line Processing System”. GHG-CCI has no requirements for the assumed “On-line Processing System”.

	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 8</p> <p>Version 1.0 1 Dec 2011</p>
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2.1 High Level Description of the Algorithm Development and Data Processing


Unlike for some other ECVs, the GHG algorithm development is on-going and the algorithms are still maturing. Therefore, strong involvement of scientific institutes developing these algorithms for the production of the GHG database is needed. Strong involvement of the scientific retrievals experts will also be important in the future as (i) all algorithms shall be continuously improved, in order to (better) meet the demanding user requirements and (ii) to consider instrument degradation, which typically also requires frequent algorithm optimization.

As explained, it is assumed that at least large parts of the CCI System will be implemented by industry including (re)implementation of the retrieval algorithms (see **/ESA CCI Description, 2009/**). As also explained, implementation by industry is not recommended for GHG-CCI. Implementation by industry would require a fully documented Detailed Processing Model (DPM) and accompanying information (not available from GHG-CCI in Phase 1). This would have to be updated for every new version of the processor. Furthermore, the implementation requires many iterations with industry. Experience shows that this option is costly and error prone. It also lengthens the time between the implementation of product improvements and the availability to the user.

We therefore propose a direct implementation of the scientific algorithm into an “Off-line Processing System” (see **Figure 1**) of the CCI Operational Processing System. In this way it is ensured that algorithm improvement and changes can be continuously fed into the operational system and be available for (re-)processing. The direct implementation was already shown to work in the development of the SCIAMACHY operational Level 2 processor. A strict version control and verification regime ensures here the traceability and correctness of all products.

On a high level, the direct implementation of algorithms for the GHG CCI works as follows:

1. Upon recommendation of the algorithm developer, a (new) *reference* version of the processing algorithm is generated together with the ATBD and specification of input data.
2. The algorithm is integrated into the “Off-line Processing System” (see **Figure 1**) of the CCI Operational Processing System.
 - Note: One very efficient and therefore very attractive way to achieve this is via remote access of the GHG-CCI retrieval experts simply using “copy, install and run” of the scientific processor. This requires that the “Off-line Processing System” offers an equivalent computer environment as currently used by the GHG-CCI research groups.

	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 9</p> <p>Version 1.0 1 Dec 2011</p>
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3. A verification, based on a representative data set (details To Be Defined (TBD)), is done by comparing the results of the reference algorithm with that of the integrated algorithm.
4. If the verification is successful, the complete data set will be re-processed by the “Off-line Processing System” of the CCI system.

In the following section we will define the high level requirements that are needed for this approach. We will use the following definitions:

- *Retrieval Algorithm*: Retrieval method as described in the ATBD.
- *Prototype*: Software implementation of the retrieval algorithm as described in the ATBD by the scientific developers.
- *Scientific Processors*: This produces the GHG-CCI output products, using defined inputs. It contains the prototype and associated software to read external data, Level 1 data, etc.
- *Operational Processing System*: The CCI System’s (Level 1-2) processing system. This system is assumed to consist of several sub-systems. For GHG-CCI the “Off-line Processing System” is the most relevant.
- *Operational Implementation*: For GHG-CCI this is the implementation of the Scientific Processors in the CCI System’s “Off-line Processing System”. The prototype is directly integrated into the system, i.e. the code base used for the algorithm is identical to that used in the scientific processors. It likely may have additional/different interfaces for input data and the output to the archiving system.
- *Verification*: The verification is the comparison of the results of the scientific processor and the operational implementation with a representative data set. Note that the aim of the verification is to prove the correct transfer of the prototype into the operational environment and is as such a functional test. The accuracy of the data (in the sense of the deviation from the physical truth) is *not* tested with the verification. The scientific processor is the reference, i.e. the operational processor has to produce the same result as the scientific processor within TBD limits.

The approach lined out here ensures that the best quality products are available to the user: The validation done within the GHG-CCI ensures the product quality of the scientific processors and the verification ensures the proper integration into the operational processor and closes the loop with the validated product.

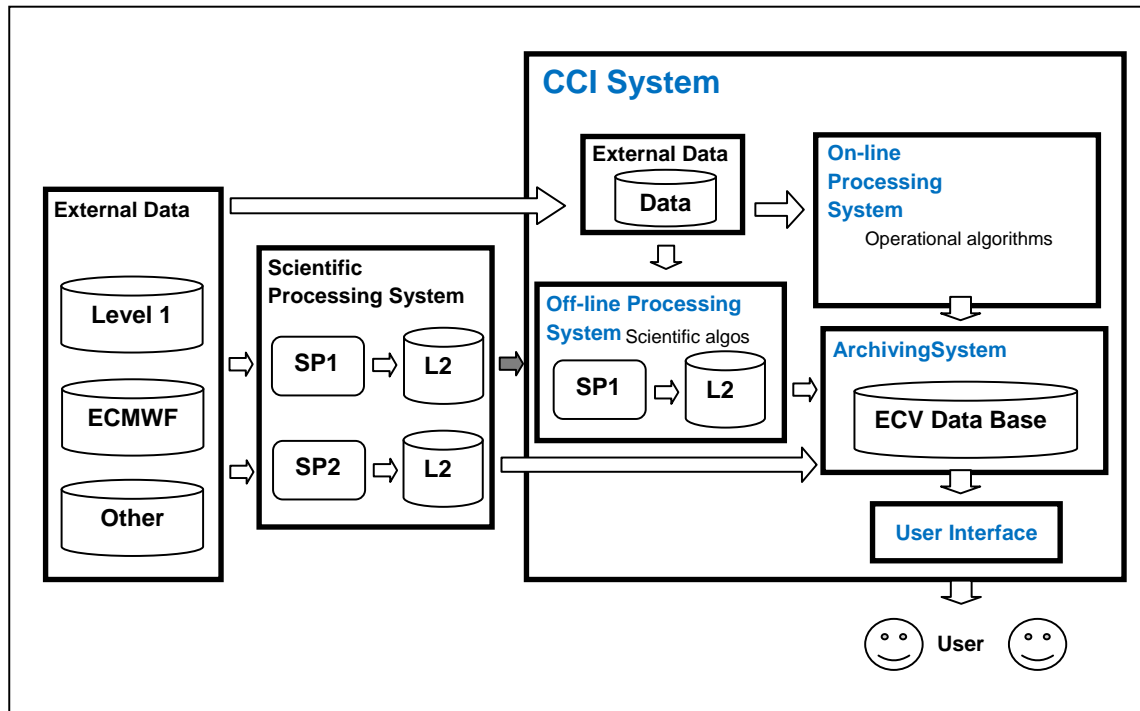



Figure 1: Schematic overview of the CCI System and the proposed approach to integrate the existing GHG-CCI “Scientific Processing System”, consisting of Scientific Processors (SPs) (SP1, SP2, ...) as implemented at the various GHG-CCI research institutions. Two options are proposed how to deliver the GHG-CCI Level 2 (L2) data products to the system’s Archiving System, which is assumed to contain the ECV data base (e.g., the GHG-CCI L2 data products). **Option A:** Via transfer of externally (i.e., at the GHG-CCI research institutes) generated L2 data to the ECV data base. **Option B:** Via transfer of the SP systems to the CCI System ideally via “copy, install and run” on/to an “Off-line Processing System”, which is an assumed sub-system of the CCI System. Which of the two options is the best may depend on the GHG-CCI algorithm selected to produce a given GHG-CCI data product. In the figure this is illustrated using “Scientific Processor 1” (SP1, performing L1-2 processing), which is transferred to the CCI System’s “Off-line Processing System”, and SP2 which produces Level 2 data externally to be (more or less directly) transferred to the CCI System’s Archiving System (containing the “ECV Data Base”, which can be accessed by interested (external) users).

	ESA Climate Change Initiative (CCI) System Requirements Document (SRD) for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)	Page 11 Version 1.0 1 Dec 2011
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2.2 General CCI System requirements


In this section very general CCI System requirements are listed. Only a few key requirements are listed in this early version of this document.

A CCI System is required which can deliver important ECV data sets as soon as possible to interested users. Initially, i.e., as long as “System internally generated” data product of better quality / longer time series are not available, the system shall be able to make best use of the existing state-of-the-art data products generated outside of the CCI System (i.e., those generated during Phase 1 by the scientific processing systems located at the various GHG-CCI research institutions). These products shall be archived via the CCI systems archiving system and made available to users via the CCI user interface.

REQ-GHG-SYS-GEN-001	Use of existing L2 data requirement: The CCI system shall be able to accept, archive and make available existing (Level 2) state-of-the-art high-quality data products generated outside of the system as long as system-generated better data products are not available.
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Within GHG-CCI Phase 1 only existing satellites are considered. Future sensors need to be considered in future Phases of CCI:

REQ-GHG-SYS-GEN-002	Future sensors requirement: The CCI system shall permit to also consider future sensors.
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	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 12</p> <p>Version 1.0 1 Dec 2011</p>
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2.3 System processing requirements


The GHG algorithms are still under development and it cannot be said at present, which algorithms will be chosen at the end of the GHG-CCI Round Robin period (which finishes end of August 2012). The GHG-CCI algorithm selection will be based on the criteria given in **/RREP GHG-CCI v2/**. The design of the CCI System should not limit the type of algorithm that can be implemented.

For GHG-CCI the proposed solution for Level 1-2 processing, as already explained, is to use the (complex and evolving) state-of-the-art scientific retrieval algorithms with as little modifications as possible, ideally by using the latest versions “as they are” using “copy, install and run” of the Scientific Processors to/on the CCI System’s “Off-line Processing System”. This may be achieved via remote access by the GHG-CCI experts or by other means.

It shall also be possible to make optimum use of new algorithms, which may be available in the future for current satellites, but also for future satellites.

This results in the following requirements:

<p>REQ-GHG-SYS-PRO-001</p>	<p>General retrieval algorithm requirement:</p> <p>The CCI System’s GHG-CCI retrieval algorithms shall be identical with the state-of-the-art scientific algorithms selected during GHG-CCI Round Robin (RR) and being continuously improved by the GHG-CCI EOST as part of CCI.</p>
<p>REQ-GHG-SYS-PRO-002</p>	<p>“Off-line Processing System” requirement:</p> <p>The CCI System shall consist of a sub-system which permits to install and run the existing (evolving) scientific processing systems (with as little software changes as possible).</p> <p>This sub-system is referred to as “Off-line Processing System” in this document.</p> <p>Note: Remote access by the GHG-CCI retrieval experts is recommended for installation and for running the processing (at least in order to ensure correct implementation).</p>

	ESA Climate Change Initiative (CCI) System Requirements Document (SRD) for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)	Page 13 Version 1.0 1 Dec 2011
---	---	--

REQ-GHG-SYS-PRO-003	Data Ingestion The “Off-line Processing System” of the CCI operational processing system shall be able to ingest all required input data as defined in the /DARD GHG-CCI v1/ and the prototype documentation.
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In order to ensure highest quality data sets also in the future it is important to reprocess the entire satellite data set when improved algorithms and/or improved input data will be available:

REQ-GHG-SYS-PRO-004	Reprocessing requirement: The CCI system shall permit reprocessing of the entire data sets in TBD time when improved retrieval algorithms will become available.
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REQ-GHG-SYS-PRO-005	Flexibility: It shall be possible to easily add additional algorithms into the “Off-line Processing System” of the CCI operational processing system. Note: This shall include new ECAs, ACAs, and algorithms for future satellite sensors.
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GHG-CCI has no NRT requirements (envisaged availability: several months up to 1 year or more after sensing, depending on algorithm and instrument stability). The resulting data products, generated “off-line” via the “Off-line Processing System”, shall be thoroughly quality checked by GHG-CCI EOST.

Transfer of the GHG-CCI (Level 2) data products to the archiving system / user interface shall only take place if high data quality is ensured or if at least sufficient knowledge about the data quality has been established so that the user can be reliably informed about the data quality.

	<p style="text-align: center;">ESA Climate Change Initiative (CCI)</p> <p style="text-align: center;">System Requirements Document (SRD)</p> <p style="text-align: center;">for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p style="text-align: right;">Page 14</p> <p style="text-align: right;">Version 1.0 1 Dec 2011</p>
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2.4 Scientific Processor related requirements

It is important that the scientists (retrieval experts), who have developed the GHG-CCI retrieval algorithms, lead the algorithm development also in the future.

In order to ensure highest quality data sets also in the future it is important to recognize that algorithm development is a continuous process which should not be interrupted:


<p>REQ-GHG-SCI-PRO-001</p>	<p>Continuous algorithm improvement requirement:</p> <p>The CCI system retrieval algorithms shall be continuously improved.</p>
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In order to ensure product traceability and product integrity, the following requirements are needed:

The version used to generate the GHG data in the ECV must be known at all times for traceability and error tracking:

<p>REQ-GHG-SCI-PRO-002</p>	<p>Version Control:</p> <p>The scientific processors shall be version controlled.</p>
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Note that more requirements likely have to be added here in the future. At this stage only additional recommendations are given in **Section 2.8**. They are not mandatory, as explained in **Section 2.8**, and shall only be formulated as requirements if the appropriate resources are available to implement them.

	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 15</p> <p>Version 1.0 1 Dec 2011</p>
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2.5 Requirements related to the verification

For processing and re-processing, a fixed point in the algorithm development has to be chosen and documented

<p>REQ-GHG-VER-PRO-001</p>	<p>S/W freeze:</p> <p>Before the operational implementation of a scientific processor, the development of this processor has to be frozen and no changes (except for bug fixing) are allowed until the operational implementation is verified.</p> <p>Note: Version control systems have the ability to maintain more than one development branch. If the scientific developer wants to further develop the algorithm, a separate branch can be set up that could later be merged for the next operational implementation. However, it is important, that the reference is not changed during verification.</p>
<p>REQ-GHG-VER-PRO-002</p>	<p>Verification Set-Up:</p> <p>The scientific processor is the reference for the operational processor.</p>
<p>REQ-GHG-VER-PRO-003</p>	<p>Reference Changes:</p> <p>During S/W freeze only fixes of severe bugs (i.e. those that directly impact the quality of the product) are allowed. <i>Any change of the reference implies a re-start of the verification on a representative data set.</i></p>
<p>REQ-GHG-VER-PRO-004</p>	<p>Verification Set-Up:</p> <p>In the verification the same input data shall be used for the scientific processor and the operational processor.</p>
<p>REQ-GHG-VER-PRO-005</p>	<p>Verification Success Criteria:</p> <p>The verification is regarded as successful, when all product entries of products generated with the operational processor and the scientific processor agree within TBD limits. The limits are TBD by the algorithm developer.</p>

	<p style="text-align: center;">ESA Climate Change Initiative (CCI)</p> <p style="text-align: center;">System Requirements Document (SRD)</p> <p style="text-align: center;">for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p style="text-align: right;">Page 16</p> <p style="text-align: right;">Version 1.0 1 Dec 2011</p>
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<p>REQ-GHG-VER-PRO-006</p>	<p>Verification Documentation:</p> <p>The verification shall be documented in a <i>Verification Report</i>. It shall contain the chosen approach and the justification, the selected verification data set and the verification results. The report will become a deliverable within the GHG CCI.</p>
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	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 17</p> <p>Version 1.0 1 Dec 2011</p>
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2.6 Archiving related requirements


It is important that all data products are archived and that also previous data product versions can be made available (for sensitivity studies, ongoing studies based on previous versions where a consistent time series is required, etc.):

REQ-GHG-SYS-ARC-001	<p>Overall archiving requirement:</p> <p>The CCI system shall archive the latest version of all ECV data products but also previous versions.</p>
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A mechanism is needed to decide which data will be archived (and subsequently made available to users):

REQ-GHG-SYS-ARC-002	<p>Data quality evaluation requirement:</p> <p>A mechanism needs to be established to decide which existing data products shall be archived in the CCI archiving system.</p>
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Other requirements: How to actually transfer data products to the Archiving System, etc.:
TBD.

	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 18</p> <p>Version 1.0 1 Dec 2011</p>
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2.7 User Interface related requirements

All data contained in the archive shall be made available to interested users:

<p>REQ-GHG-SYS-UI-001</p>	<p>General user interface requirement:</p> <p>The CCI system shall make available all data contained in the CCI archive to all interested users.</p> <p>Specifically:</p> <p>The entire ECV data set shall be made available but also sub-sets only if requested (e.g., specific time periods and regions) for the latest version of a given ECV product and also for previous versions.</p>
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Communication:

<p>REQ-GHG-SYS-UI-002</p>	<p>User interface communication requirement:</p> <p>The CCI system user interface shall provide a service to respond to user requests (questions, feedback) by e-mail, phone and other means.</p>
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	ESA Climate Change Initiative (CCI) System Requirements Document (SRD) for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)	Page 19 Version 1.0 1 Dec 2011
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2.8 Recommendations

In this section additional recommendations are given.

They mostly refer to the scientific prototype development and its use in an “operational environment”. They are (not yet) formulated as requirements but may be formulated as requirements in the future once the algorithms are more mature and the resources will be available to implement them.

Note that the existing scientific processing systems are already used by the GHG-CCI retrieval experts to process global multi-year satellite data sets and to generate the corresponding data products. As explained in this document, GHG-CCI would benefit from installation and running these systems on the “Off-line Processing System” of the CCI System. This “Off-line Processing System” needs to be designed such that the scientific processing systems can be installed and used with as little code modifications as possible. Ideally no changes shall be required (except likely adjustments for input/output data). The resulting data products will not be automatically transferred to the systems user interface but only after quality check. Processing will be entirely “off-line” as currently done at the research institutes. Therefore, no additional mandatory software engineering related or other requirements need to be formulated at this stage. Nevertheless, some recommendations are listed below to guide the future development of the scientific algorithms. To what extent they can be considered depends among others on the available resources (during Phase 1 and follow-on phases).

REC-GHG-SYS-PRO-001	<p>Flexibility:</p> <p>The algorithm core should be independent from the ingestion of data and from the writing of data, i.e. a change of input or output data format shall not imply changes to the data processing algorithms.</p> <p>Note: This can be achieved by implementing separate input and output layers that transform the data to/from an internal representation that is used in the algorithm core.</p>
REC-GHG-SYS-PRO-002	<p>Data Output</p> <p>The operational processor shall be able to write output data in the specified output format (baseline netCDF 4)</p>

**System Requirements Document
(SRD)**Version 1.0
1 Dec 2011for the Essential Climate Variable (ECV)
Greenhouse Gases (GHG)

The processor shall be configurable by the user (=operator). Especially it should be possible that only a certain product is generated to accommodate different development speed of the algorithms.

REC-GHG-SYS-PRO-003	Configuration: <ul style="list-style-type: none">⤴ The operational processor shall be configurable by the user (details TBD)⤴ The user shall be able to run only a subset of operationally implemented prototypes.⤴ The source of input data for the shall be user-selectable⤴ The destination of output data of the shall be user-selectable
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The operational processor shall handle errors in a defined way:

REC-GHG-SYS-PRO-004	Error Handling: <p>The operational processor shall provide error messages in case of errors. The errors shall be in categorised with respect to the seriousness, e.g. "Informational", "Warning", "Error", "Crash". Serious errors preventing the further processing should be given out in real time.</p>
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REC-GHG-SYS-PRO-005	Error Handling: <p>The operational processor shall be able to handle prototype error messages (details TBD)</p>
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REC-GHG-SYS-PRO-006	Error Handling: <p>The operational processor shall handle errors gracefully and abort the processing in a defined way and with meaningful error messages</p>
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**System Requirements Document
(SRD)**Version 1.0
1 Dec 2011for the Essential Climate Variable (ECV)
Greenhouse Gases (GHG)**REC-GHG-SYS-PRO-007****Error Handling:**

The operational processor shall check the consistency of initialisation data and configuration data and alert the user in case of inconsistencies.

REC-GHG-SYS-PRO-008**Data Safety:**

The operational processor shall not overwrite existing data without user interaction.

Albeit no NRT processing is foreseen, the processor must have some robustness against errors:

REC-GHG-SYS-PRO-009**Robustness:**

Missing input data shall not lead to an abortion of processing. The concerned data product should be logged with a meaningful error message for later inspection and re-processing.

REC-GHG-SYS-PRO-010**Robustness:**

Failure of any prototype implemented in the operational processor shall not lead to the abortion of the processing of the other operational implemented prototype. Or in other words: The failure of one product generation chain shall not lead to the failure of other product generation chain. The failure of the prototype algorithm should be logged with a meaningful error message for later inspection and re-processing.

The generated products should give quality indications

REC-GHG-SYS-PRO-011**Q/A and monitoring:**

The operational processor shall provide information about the quality of the product. In case quality information is provided by the prototypes, it has to be able to handle this information (details TBD)



System Requirements Document (SRD)

Version 1.0
1 Dec 2011

for the Essential Climate Variable (ECV)
Greenhouse Gases (GHG)

REC-GHG-SYS-PRO-012

Catalogue (TBC):

The operational processor shall provide (TBD, e.g. quality flags) information about the product and make it available to the archive for discoverability and data browsing by the user.

REC-GHG-SYS-PRO-013

Processor architecture:

The operational processor shall make use of standard libraries and compilers. Wherever possible, non-commercial software shall be used

REC-GHG-SYS-PRO-014


Processing Environment:

The operational processor shall be able to run under Linux operating systems.

REC-GHG-SYS-PRO-015

Processing Environment Documentation:

For the operational processor, all libraries needed, programming language used and any restrictions on the system architecture shall be documented.

	<p>ESA Climate Change Initiative (CCI)</p> <p>System Requirements Document (SRD)</p> <p>for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p>Page 23</p> <p>Version 1.0 1 Dec 2011</p>
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The version used to generate the GHG data in the ECV must be known at all times for traceability and error tracking:


<p>REC-GHG-SCI-PRO-001</p>	<p>Version Control:</p> <p>The scientific processors shall be version controlled.</p> <p>If possible this shall be done using an established system (e.g. subversion, git, etc.). If possible it shall be ensured that any version of the scientific processor can be run again with reproducible results.</p> <p>Note: This requires version control not only for the prototype software but for all auxiliary programs and all configuration and input files. In cases were a unique identification of input files is ensured by the data provider (e.g. operational Level 1b product), it is sufficient to track the version number in a VERSION file that is under version control (TBC).</p>
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The scientific processor should not pose severe restrictions on the operational implementation, e.g. if possible it should not be necessary to acquire licenses for commercial S/W.


<p>REC-GHG-SCI-PRO-002</p>	<p>Prototype architecture:</p> <p>The prototype shall make use of standard libraries and compilers. Wherever possible, non-commercial software shall be used</p>
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<p>REC-GHG-SCI-PRO-003</p>	<p>Processing Environment:</p> <p>The prototype shall be able to run under different (Linux) operating systems.</p>
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<p>REC-GHG-SCI-PRO-004</p>	<p>Processing Environment Documentation:</p> <p>For each prototype algorithm, all libraries needed, programming language used and any restrictions on the system architecture shall be documented.</p>
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	<p style="text-align: center;">ESA Climate Change Initiative (CCI)</p> <p style="text-align: center;">System Requirements Document (SRD)</p> <p style="text-align: center;">for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)</p>	<p style="text-align: right;">Page 24</p> <p style="text-align: right;">Version 1.0 1 Dec 2011</p>
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<p>REC-GHG-SCI-PRO-005</p>	<p>Error Handling:</p> <p>The scientific processor shall provide error messages in case of errors. The errors shall be in categorized with respect to the seriousness, e.g. “Informational”, “Warning”, “Error”, “Crash”. Serious errors preventing the further processing should be given out in real time.</p>
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	ESA Climate Change Initiative (CCI) System Requirements Document (SRD) for the Essential Climate Variable (ECV) Greenhouse Gases (GHG)	Page 25 Version 1.0 1 Dec 2011
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3 References

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**System Requirements Document
(SRD)**

Version 1.0
1 Dec 2011

for the Essential Climate Variable (ECV)
Greenhouse Gases (GHG)

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