



Sentinel Collaborative Ground Segment (CollGS)

German National Response to ESA Questionnaire

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Introduction

Purpose and Scope

This document responds to the ESA questionnaire on Sentinel Collaborative Ground Segment initiatives. It describes national plans and requirements consolidated by the German Aerospace Center (DLR) in its capacity as the German space administration.

This document – and similar documents from other ESA member states – will contribute to the detailed missions operations layout of the Sentinel -1, -2 and -3 mission. DLR expects that ESA will consider this input in developing the Sentinel high level operations plan (HLOP).

The content has been compiled based on known plans and requirements from national institutions and industry. The document provides an overview of the intentions of German entities to access and to work with GMES Sentinel data.

References

Applicable References

The following documents are applicable to the extent specified herein.

Ref-ID	Author(s) or Doc-ID	Document Title	Issue and/or Date
AD01	ESA / Potin	GOCS-5 Presentation: Collaborative Ground Segment Process / Status	Berlin / 13.12.2011
AD02	DLR / Maass, Diedrich, Schreier	DLR Collaborative Ground Segment	Berlin / 13.12.2011
AD03		GMES Space Component – Draft Operations Concept (ESAPB-EO(2010)56,REV.1)	ESA/PB-EO(2010)56, rev. 1, November 2010

Table 0-1: Applicable Documents

Abbreviations

Abbreviation	Definition
CGS	Core Ground Station
DFD	Deutsches Fernerkundungsdatenzentrum (= German Remote Sensing Data Center) of DLR
DFEP	Demodulator and Front End Processor
DLR	Deutsches Zentrum für Luft- und Raumfahrt / German Aerospace Center
EC	European Commission
EDRS	European Data Relay Satellite
EO	Earth Observation
EOC	Earth Observation Center of DLR consisting of DFD and IMF
EOP	Earth Observation Programmes – ESA Directorate
ESA	European Space Agency
ESRIN	European Space Research Institute
EU	European Union

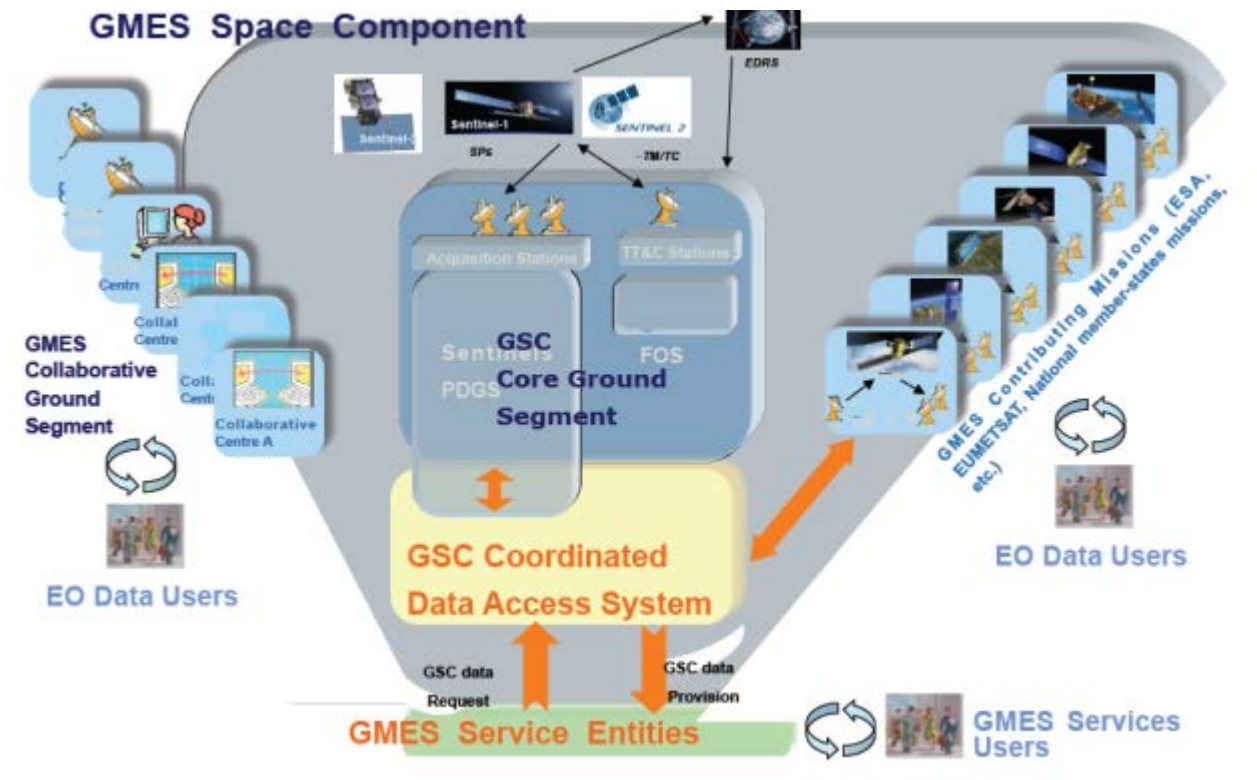
Abbreviation	Definition
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
GCS	GMES Core Station
GIO	GMES Initial Operations Phase
GMES	Global Monitoring of Environment and Security
GOCG	GMES Operations Consultation Group
GS	Ground Segment
GSC	GMES Space Component
IMF	DLR Institut für Methodik der Fernerkundung (Remote Sensing Technology Institut)
IPF	Instrument Processing Facility
L0	Level-0 Product
L1	Level-1 Product
L2	Level-2 Product
LAN	Local Area Network
LBR	Low Bit Rate
LTA	Long-term Archive
MPC	Mission Performance Center
NRT	Near Real-Time
OLCI	Ocean and Land Colour Instrument
PAC	Processing and Archiving Center
PDGS	Payload Data Ground Segment
PDMC	Payload Data Management Center
PDS	Payload Data Systems
SLSTR	Sea and Land Surface Temperature Radiometer
SRAL	SAR Radar Altimeter
TBC	To Be Confirmed
TBD	To Be Defined
VfG	National framework for satellite based geoinformation (<i>“Verbund für fernerkundungsgestützte Geoinformation“</i>)
WAN	Wide-Area Network
WASCAL	West African Science Service Center on Climate Change and Adapted Land Use
WWW	World Wide Web

Table 0-2: Abbreviations and Terms

1. Sentinel Ground Segment

1.1 The Sentinel Core Ground Segment

ESA is responsible for implementing the ground segment of the GMES Space Component. The ground segment consists of the flight operations segment (FOS) and the Payload Data Ground Segment (PDGS). The implementation of both elements will be shared with EUMETSAT. ESA will operate the FOS for Sentinel-1 and Sentinel-2, and EUMETSAT for Sentinel-3 and Sentinel-4 & -5. For the PDGS, ESA is in charge of the data flow and products of Sentinel-1 and Sentinel-2 as well as for the land products of the Sentinel-3 satellite. Accordingly, EUMETSAT manages the Ocean and Atmosphere part of the Sentinel-3 satellites, and the entire data flow and products for the Sentinel-4 and -5 payloads. These elements form the GSC Core Ground Segment (see figure below):



ESA integrates the products from the Sentinel missions with those of the GMES contributing missions, i.e. those earth observation missions, operated by third parties that contribute space-based data for the GMES services. Access to these data – including the ESA heritage mission and the new Sentinel data – is provided through the GSC Coordinated Data Access System (GSCDA). In addition, some GMES Services access data directly from the original data sources (i.e. satellite data provider), mainly in cases of time critical applications.

The GMES Core Ground Segment primarily serves the GMES services and other users (science and commercial applications) that rely on the standard products defined by ESA. The data policy applicable to the access and use of the Sentinel data is currently developed by the European Commission and ESA.

DLR expects that all data of the GMES Sentinels provided through the core ground segment will be available openly and free-of-charge for any user and any application¹.

The Core Ground Segment has been designed based on specified requirements defined by the precursor projects for the GMES Services.

All Sentinel missions will be operated in a highly systematic manner aiming at achieving frequent, global coverage. All Sentinel-3 data, and Sentinel-1 and -2 data in certain pre-planned regions, will be available in less than 3h from sensing. Based on the geographic location of the ground receiving stations, this time may be 1h for some areas. However, the core ground segment will have limited capacity to support near real time requirements. Quasi-real-time data (~better than 1 hour) require a direct downlink to Core or Collaborative Ground Stations and are generally not part of the ESA Core Ground Segment.

This access would cover all areas of the globe for all Sentinels. However, certain limitations are given by the satellite and Core Ground Segment layout (Status as of end April 2012):

- The SAR instrument on Sentinel-1 in imaging mode has a duty cycle of 25 min/orbit. This means, that not all land and coastal areas of the globe can be covered in every orbit. In order to guarantee coverage of certain areas of the globe with Sentinel-1 SAR data, for national applications, requirements need to be stated on the guaranteed coverage of these areas.
- The High Level Operations Plan (HLOP) will ensure global coverage with Sentinel-1 of all land masses (and major islands) regularly (details to be defined).
- By default, Sentinel-1 will be operated in the interferometric wide-swath mode (IWS) over land areas, the IWS or Extra wide-swath (EWS) mode over polar areas, oceans or seas, if imaged in high-bit-rate mode, wave mode (WM) otherwise. Requirements for the other modes need to be specified explicitly.
- Sentinel-2 optical data is acquired over all land and coastal areas, as well as over major islands. All data is taken in daylight conditions (seasonal dependence), independently of cloud cover. This provides for a theoretical 10-day (exact) repeat cycle (1 satellite) or 5 day cycle (2 satellites). Actual imaging frequency will depend on cloud cover.
- Sentinel-3 OLCI is always on during daylight parts of the orbit over land and oceans globally.
- Sentinel-3 SLSTR is always on over land and oceans globally, the visible channels only out-of-eclipse.
- Sentinel-3 SRAL is a dual frequency Ku/C band Radar Altimeter, with SAR mode and open loop tracking: The ESA GMES Core Ground Segment guarantees access to standard Sentinel products from all Sentinels after 1 hour (over Europe) or after 3 hours (outside Europe). This figure might be better in some cases. The timing defines the accessibility at the ESA electronic pick-up point (i.e. an internet server at an ESA station or PAC).
- The direct readout of Sentinel data from national acquisition stations would only cover the direct acquisition in line-of-sight of this station (e.g. no data recorder dumps for national stations).
- The X-band downlink system will only be switched on/off 2 times (on average) per orbit (tbc by ESA). This means that only a limited amount of direct X-Band data readouts (i.e. direct acquisition stations) can be supported per orbit.

1.2 The Sentinel Collaborative Ground Segment

The programme declaration of the ESA GSC Programme grants participating states of the ESA Programm "access rights to Sentinel data". It states that

"National utilisation of Sentinel data by Participating States will be supported by the right of data access, with agreed priorities in terms of operations planning. For this purpose a high level operations plan will be prepared, in the context of the Sentinel data policy consistent with the GMES data policy, for the Sentinel missions which consolidates all such national requests (i.e. from public user organisations), in addition to those from GMES services".

Ground segment facilities complementing the ESA core ground segment to support national use of the Sentinel data are referred to as "collaborative ground segment". This may include additional downlink stations, additional data links and distribution systems, additional processing and archiving facilities that may or may not offer the standard Sentinel data products. Potential conflicts between different access

¹ Some access restrictions to protect the security interest of the EU may apply. Terms of use may prohibit use of the data for applications violating EU law or the interest of the EU or its member states.

plans due to technical limitations of the satellites. Priorities will be agreed to solve such conflicts both between the GMES Services and national services, as well as amongst the national services.

The main activities expected in the collaborative ground segment are:

- Direct acquisition of data from the Sentinel satellites, either through X-Band stations or via the European Data Relay Satellite system (EDRS)
- Production of Sentinel data products, complementing the Sentinel data products generated by the ESA PACs in the core ground segment, e.g. higher-level products
- Operations of dedicated access points – including mirror archives – to allow certain user communities a faster and/or customized access to either standard and/or collaborative data products
- Operations of special access mechanisms and/or user interfaces, directly obtaining the data from the core ground segment
- Performing ground based validation and calibration of the Sentinel performance, driven by campaigns or permanently, requiring special modes of Sentinel operations and/or access to Sentinel data.

Such activities may be carried out by different players, including public sector/government entities, private/commercial entities and scientific institutions. ESA has therefore requested national delegations to compile requirements that need to be considered in the development of the HLOP and the ESA interfaces. DLR has compiled the requirements in section 4 based on input from national stakeholders.

The set-up and the operations of collaborative ground segment is not funded by the GMES budgets of ESA or the European Commission. Any national use of Sentinel data that requires additional infrastructure and/or services must be supported with appropriate resources, typically national resources. ESA aims at supporting such national access by supporting appropriate interfaces and making software components available.

In implementing collaborative ground segment functions, technical and administrative agreements on the duties of ESA and the collaborative ground segment owner/operator need to be signed. The details of such agreements are still to be defined.

1.3 The ESA Questionnaire to the Collaborative Ground Segment

In order to define the High Level Operations Plan (HLOP) for the Sentinel-1, Sentinel-2 and Sentinel-3 missions, ESA is currently reviewing the requirements from:

- The GMES Core Services
- National collaborative ground segments (including this document, presenting requirements of Germany)
- Requirements from other European entities (e.g. EMSA, EEA)
- A Sentinel specific background mission, collecting inputs also from international organizations or platforms such as GEO (e.g. the GEO Geohazard Supersites).

Of interest for ESA and therewith to be covered in this document for the German requirements, are those tasks, which have a direct implication to the HLOP and/or the layout and operations of the ESA Core Ground Segment (currently only requirements for the Sentinel-1, Sentinel-2 and Sentinel-3).

Examples for such requirements with direct implications on HLOP or Ground Segment design are:

- Frequent acquisitions or acquisitions at a specific time over high-priority areas by Sentinel-1 SAR. Acquisitions in specific non-standard modes.
- X-Band and LCT/Ka-Band EDRS link programming (and instrument programming) to provide direct access through national X-Band stations or via EDRS (the appropriate link within and outside Europe).
- Access to large volumes of Sentinel data through the data access mechanism at the ESA PACs that necessitates high-capacity network infrastructure in the ESA core ground segment network (point-to-point or other).
- Specific demands on annotation and formatting of Core Ground Segment standard products to support the generation of derived collaborative data products or cal/val activities.

2. Goal of the German collaborative ground segment activities

The German government aims at maximizing the availability and usefulness of GMES information, data and infrastructure for institutions, companies and citizens in Germany². German activities in the frame of the Collaborative Ground segment also serve that objective.

Regarding satellite data reception, systematic production of satellite data and data provision, technical infrastructure available at the German Remote Sensing Data Center (DLR-DFD) is of particular relevance.

The following capacities are currently available:

- Data reception at DLR Neustrelitz. This can support regional near real time data delivery and associated time critical services (e.g. maritime security).
- Data reception at the DLR station in Inuvik, Canada, possibly complemented by other DLR international stations. This can support global data acquisition for all Sentinel-missions.
- Data reception through the European geostationary EDRS relay satellite system in Oberpfaffenhofen/Weilheim and Neustrelitz. This may support rapid access to global data acquisitions.
- Processing and archiving services for Sentinel-1, -2, and -3 data may be implemented to support information services. DLR-DFD has been selected as Processing and Archiving Center (PAC) of the ESA Core Ground Segment for Sentinel-1 and -3 OLCI data products.
- Operations of a European Long Term Archive (LTAC) for Sentinel data.

DLR is interested in complementing the functions, which are contracted to DLR and German partners in the framework of the core ground segment, with national initiatives in the framework of a collaborative ground segment.

Regional initiatives in Germany support the set-up – and partly the operation – of national collaborative ground segment activities aimed at improving the usability of GMES Sentinel data. These include initiatives of Bavaria and Mecklenburg–Vorpommern, national activities to ensure a better access to geoinformation and national or European research grants. Resources for the build-up and operation of activities or infrastructure (e.g. X-Band stations) with partner countries are looking at arranging support from these bilateral collaborations or from the partner countries' users.

² Cp. „GMES Maßnahmenprogramm“, available at <http://www.d-gmes.de/gmes-massnahmenprogramm> (German only).

3. Response to ESA Questionnaire

3.1 Background

The ESA Questionnaire on Sentinel Collaborative Ground Segment initiatives was provided to the participants of the GMES Operations Consultation Group (GOCG) Meeting 5, December 13th, 2011.

The objective of this questionnaire is to enable ESA to make a preliminary assessment on the Sentinel collaborative ground segment initiatives planned by partners in the coming years.

The result of this consultation will allow ESA to better define the process for supporting the setup of these initiatives.

ESA identifies the following point-of-contacts for this questionnaire:

- Pierre.Potin@esa.int
- Bianca.Hoersch@esa.int

The questionnaire addresses the following four topics:

1. Sentinel Mission Data Acquisition and (NRT) Production
2. Sentinel Collaborative Data Products
3. Data Product Dissemination and Access
4. Development of Innovative Tools and Applications

One further topic of relevance in this context is

5. Calibration/Validation activities

3.2 Overview of national requirements

The national requirements of Germany are presented in two categories. These categories are employed to support ESA in developing the HLOP to maximize the benefit of the Sentinels.

- | |
|--|
| <p>(p) Primary requirements are considered of high priority. They are based on a need articulated by several or principal national users and/or are needed in support of planned activities that have a high probability of being implemented after the launch of the Sentinels.</p> <p>(s) Secondary requirements are based on a need articulated by individual national users and/or may be needed to support activities that are not fully defined. DLR requests that ESA attempts to meet these secondary requirements according to its best effort.</p> |
|--|

The principal requirements of Germany are:

1. Reception of data from Sentinel-1, -2, and -3 should be supported via X-band data link at the DLR station in Neustrelitz (p), Inuvik (p), Chetumal (s), O'Higgins (s).
2. Reception of data from Sentinel-1 and -2 should be supported via Ka-band data link at the DLR stations in Oberpfaffenhofen/Weilheim and Neustrelitz.
3. Near-Real-Time generation of standard products (i.e. using ESA-furnished processors) should be possible at Oberpfaffenhofen (p), Neustrelitz (p), Inuvik (s).
4. Access to lower-level (level-0, -1a and -1b) products of the GMES Core Ground segment (p).

5. Coverage of specific areas, including requirements of acquisition times, frequencies and modi (p, s). See below and corresponding data files for details.
6. All Sentinel data handled by the ESA Core ground segment should be available to users in Germany efficiently, rapidly and flexibly (p). DLR is interested in engaging in a discussion with ESA and the European Commission how this can best be realized, technically. Our current assumption is that a substantial subset of the Sentinel data will need to be served at one or more mirror site(s) in Germany, most likely at DLR Oberpfaffenhofen. This should be anticipated in ESA's network design, unless other technical solutions are pursued.

In addition to the above requirements DLR encourages ESA to develop an offer for third-party providers to host processing modules on an IT infrastructure integrated with the GMES Core Ground Segment. This would enable systematic production of large data volumes into value-added products in-line to the data stream. Distribution of (generally much smaller) products instead of transferring large data volumes to other processing centers could dramatically reduce network load and data transmission costs. Also, separating data-handling from algorithmic and product design reduces the entrance barrier to using these data and thus supports the objectives of the GMES programme to develop the market for EO services.

Also, DLR suggests opening the GMES data portal as a "GMES Service Store" to third-party providers.

4. Response Tables per Category

4.1 Sentinel Mission Data Acquisition and (NRT) Production

ESA requirement: Local/Regional stations complementing the Core X-band and Ka-band station network with the potential following activities:

- *(NRT) data processing and distribution for Sentinel-1 and/or Sentinel-2*
- *Elaboration of (NRT) products tailored to particular coverage / region, particular services, etc.*

(Please also use template b. for products / algorithms, if relevant)

4.1.1 X-Band Data Reception at Neustrelitz for national use (p)

Name	German Aerospace Center (DLR), German Remote Sensing Data Center (DFD) Dept. National Ground Segment, Neustrelitz, Germany
Activity	X-band data reception and processing of Sentinel-1 over Europe to support near real time services for e.g. maritime security, emergency response and ocean surveillance. (Sentinel-2 and -3 data acquisition and processing needs to be defined).
Benefit	<p>Core Service(s)</p> <ul style="list-style-type: none"> Reduced response time for GMES Emergency Management and Security services. <p>European Institutions</p> <ul style="list-style-type: none"> May support services for/of EMSA and FRONTEX. <p>National Institutions/Services</p> <ul style="list-style-type: none"> NRT applications in downstream services, including Downstream Services embedded in a national collaborative ground segment. Service activities and projects at national, European and international level. New services to be established in collaborations with universities, value adding companies and other users <p>Other</p> <ul style="list-style-type: none"> Support of Service development and provision of <ul style="list-style-type: none"> national users (e.g. in the maritime domain: marine, police, border control), national value adding companies and ... with special NRT products and products derived from sensor fusion.
Planning	<p>Activity starts asap after Sentinel launch. Continues projects at national and European level.</p> <p>Funding: National Project Maritime Security/Safety 2012-2021 (maritime security); national partners, European operational projects (e.g. EMSA)</p>
Expectation from ESA	<ul style="list-style-type: none"> data acquisitions must cover the entire wadden sea, ideally the entire German bight, but at least 20km beyond any coast. DFEP licenses Processor licenses: S1 (S2, S3 – processor licenses tbc). I/F for tasking and stations reports
Requirements Sentinel-1	<p>Areas of interest (AOI):</p> <ul style="list-style-type: none"> High-rate data acquisitions in all coastal areas, at least including the wadden sea and possibly the entire German bight. NRT: Europe Recorder (if possible): East African coastal areas, North east passage higher priority for AOI (if procurable) Mode VV+VH;HH+HV <p>see also attached shape files</p>
Requirements Sentinel-2	<p>Areas of interest (AOI):</p> <ul style="list-style-type: none"> NRT: Europe, European waters Recorder: variable AOI, Central Crisis Information System in Germany (during natural and environmental disasters, for humanitarian relief activities and civil security issues worldwide)

4.1.2 X-Band data reception for international use with local partners for maritime and emergency services at (s)

- O'Higgins (Antarctic Peninsula) with Chilean partners: ARMADA, INACH, tbc
- Inuvik (Canada) Canadian partners: MDA, CCRS, CSA, tbc
- Chetumal (Mexico) with Mexican partners: CONABIO, CONACYT, tbc

Name	German Aerospace Center (DLR), German Remote Sensing Data Center (DFD)
Activity	X-band data reception and processing of Sentinel-1, (-2 and -3 tbc) data to support near real time services for e.g. maritime security over the Arctic/Antarctic Oceans and in the Caribbean,
Benefit	Other <ul style="list-style-type: none"> • Service activities and projects at national and international level. • New services to be established in collaborations with universities, value adding companies and governmental users • Downstream Services embedded in a national local ground segment. • Involvement of national local government agencies and value adding companies
Planning	start of activity: 2012 (Definition of activities with cooperation partners), 2014 ff (operations) Close Cooperation with local entities funding: national German & international cooperation partners
Expectation from ESA	Required from ESA: <ul style="list-style-type: none"> • DFEP licenses • Processor licenses: S1, (S2, S3 tbc) • I/F for tasking and stations reports (all at ESA special conditions)
Requirements Sentinel-1	Areas of interest (AOI): <ul style="list-style-type: none"> • NRT: Antarctic Peninsula polar ocean, North Polar Ocean/ NW-Passage/ Canadian waters, Caribbean • Mode VV+VH;HH+HV • Recorder: S2 and S3 data over Antarctic peninsula area and parts of South America, Canada, Central America,

4.1.3 Ka-Band Data Reception in Oberpfaffenhofen/ Weilheim and Neustrelitz

Name	German Aerospace Center (DLR), German Remote Sensing Data Center (DFD)
Activity	Ka-band data reception and processing of Sentinel-1a and -2a data over entire EDRS acquisition area to support near real time services for e.g. maritime security and emergency response.
Benefit	<p>Core Service(s)</p> <ul style="list-style-type: none"> • Reduced delivery times may support GMES EMS and Security Service <p>Downstream Service(s)</p> <ul style="list-style-type: none"> • Reduced delivery times may support Downstream Services <p>European Institutions</p> <ul style="list-style-type: none"> • Activities requiring rapid data access for EU institutions, e.g. EMSA, FRONTEX <p>National Institutions/Services</p> <ul style="list-style-type: none"> • Support of ... <ul style="list-style-type: none"> ○ national users (e.g. in the maritime domain: marine, police, border control), National Project Maritime Security/Safety 2012-2021 ○ Disaster Mapping: ministerial VfG- initiative ○ national value adding companies and ... with special NRT products and products derived from sensor fusion.
Planning	<p>start of activity: 2011 (Procurement Ka-Band antenna, Oberpfaffenhofen), operations: asap after Sentinel-1a/2a launch</p> <p>funding: DLR, VfG-initiative</p>
Expectation from ESA	<p>Required from ESA:</p> <ul style="list-style-type: none"> • DFEP (adapted to Ka-Band input; tbd) licenses • I/F for tasking/ EDRS management and stations reports <p>(note: possible ESA contracts to Sentinel-PACs to directly acquire EDRS data streams in the framework of the Core PDGS are treated separately)</p>
Requirements Sentinel-1	<p>Areas of interest (AOI):</p> <ul style="list-style-type: none"> • Maritime security : East African coastal areas, West-African coastal areas; North East passage/Siberia • Emergency Mapping: priority areas in visibility of EDRS <p>see also attached shape files</p>
Requirements Sentinel-2	variable AOI in visibility of the EDRS, defined by Crisis Information Requirements in Germany (during natural and environmental disasters, for humanitarian relief activities and civil security issues worldwide)

4.1.4 Near Real Time Product Generation: Maritime Service

Name	German Aerospace Center (DLR), Remote Sensing Technology Institute (IMF), German Remote Sensing Data Center (DFD)
Activity	<p>NRT SAR processing and maritime services providing higher level products, e.g.:</p> <p>Maritime services:</p> <ul style="list-style-type: none"> • ship detection • Maritime Security/Safety 2012-2021 • oil detection (EMSA) • wind, sea state and ice products • high level product delivery – CONOPS (Concept of Operations) <p>Access to Sentinel-1 data from any of the German NRT access stations (X-Band and Ka-Band) of DLR (see above). For the international locations please see benefit named in station template above.</p>
Benefit	<p>Downstream Services embedded in a national collaborative ground segment:</p> <p>Maritime services:</p> <ul style="list-style-type: none"> • Ship Detection: for national, European and international maritime organisations (e.g. for German Navy, German Federal Police; EU: EMSA, FRONTEX) • Ice service (German Maritime and Hydrographic Agency - BSH, Germany) • Wind service for German Weather Service - DWD • Sea State products for German Weather Service - DWD, German Maritime and Hydrographic Agency - BSH, German Navy • Oil services for BfG • Commercial services in cooperation with companies • Science through DLR and National Project Maritime Security/Safety 2012-2021
Planning	<p>Start: Continuation of ongoing national and European projects; Sentinel-1 processing about 6 months after launch</p> <p>Funding: National Project Maritime Security/Safety 2012-2021, Industrial Partners, European Institutions</p>
Expectation from ESA	<ul style="list-style-type: none"> • NRT data downlink to Neustrelitz Ground Station (X-band) (p) & NRT Ka-Band transmission (s, see above) • Licenses for Sentinel-1, processor • Frequent coverage of North Sea, Baltic Sea, and Eastern Mediterranean to the Somalian Coast with Sentinel-1 (regions see shp-file)
Requirements Sentinel-1	<p>Areas of interest (AOI) for NRT access:</p> <ul style="list-style-type: none"> • European coastal and ocean waters • East African coastal areas, North east passage • Mode VV+VH;HH+HV

4.1.5 Near Real Time Product Generation: Civil Crisis Mapping and Emergency Response
(p)

Name	German Aerospace Center (DLR), German Remote Sensing Data Center (DFD)
Activity	NRT Sentinel data processing of global regional Sentinel data to support near real time services for civil crisis mapping and emergency response, e.g. landslides earthquake, storms, technological disasters, volcanic eruption, humanitarian crisis, tsunamis Access to Sentinel-1, -2. (- 3, tbc) data from any of the German NRT access stations (X-Band and Ka-Band) of DLR (see above)
Benefit	Emergency response and civil crisis mapping activities at national, European and international level. Support to GMES Core Service: emergency mapping Downstream Services: regional or national services in Europe European Institutions: MIC/EC, JRC National Institutions: German Civil Protection (BBK), Technical Relief Organizations (THW) Others: Support of International Charter Space and Major Disasters (quick data access and value adding); Scientific community; Public
Planning	Expected Start of Activity: Activity already started based on existing satellite data; Sentinel data acquisition and processing about 6 months after launch Funding: National Funding through VfG-Initiative
Expectation from ESA	<ul style="list-style-type: none"> • NRT X-Band data downlink to Neustrelitz Ground Station & NRT Ka-Band downlink (see above) • Licenses for Sentinel -1, -2 (and – 3, tbc) processors • Availability of NRT-data (> 1h, > 3h) of all Sentinels from ESA ground segment • Availability and quick processing of all Sentinel archive data for change detection analysis
Requirements Sentinel-1	Area of Interest: hotspot areas for natural hazards worldwide with special focus on the following areas: <ul style="list-style-type: none"> - Germany/Europe - Africa (esp. Western and Southern Africa) - Indonesia - Chile HH-polarization for flood detection, VV-polarization for the detection of oil spills
Requirements Sentinel-2	<ul style="list-style-type: none"> • Same AOI as for Sentinel-1

4.1.6 Near Real Time Product Generation: InSAR Processing of Geo-Risk Areas

Name	German Aerospace Center (DLR) Remote Sensing Technology Institute (IMF)
Activity	NRT InSAR processing of Geo-Risk areas (Volcanoes, Earthquakes) and Cities with ground subsidence problems Provision of optimally processed TOPSAR interferometry products Access to Sentinel-1 data from any of the German NRT access stations (X-Band and Ka-Band) of DLR (see above)
Benefit	1) Fast data processing → lower latency in crisis situations, 2) Higher level products → widen community of application users Users: e.g. National (BGR), European (ESA, Terrafirma-Project) and international (GEO) institutions. GEOSS lead project.
Planning	Two FP7-Proposals for core functions and demonstration are planned for funding of core activity: "GEO-Supersites Processing with TS-X" and "Takeup of Sentinel-1 data" Further funding or contribution is required to connect to S-1 and to expand and maintain the service.
Expectation from ESA	<ul style="list-style-type: none"> • NRT X-Band data acquisition at Neustrelitz Ground Station & NRT Ka-Band in Neustrelitz and Oberpfaffenhofen (see above) • Sentinel-1 processor license Alternative: fast path data link to Core Ground Segment
Requirements Sentinel-1	1.) E.g. Five volcanic sites (covered by FP7 projects): min. 20 scenes per year + acquisition in case of emergency; timeliness: min. 1 h; AOI (see Annex) a) Mediterranean volcanos: Mode: Stripmap, b) Iceland volcanos: Mode: IWS 2.) Selected cities where deformation is expected and could cause severe damage, e.g. coastal cities More sites can easily be added if funding and processing capacity allows.

4.2 Sentinel Collaborative Data Products

German institutions and service providers intend to develop products and services based on Sentinel data. In most cases, these activities merely require full and open access to Sentinel data. Assuming that the Joint Principles for a GMES Sentinel data policy³ are implemented, these activities will not require ESA support beyond adequate technical access mechanisms. Some of the products currently planned will, however, require data acquisitions that should be considered in developing the HLOP. Several of the planned applications listed below do not serve needs of government institutions in Germany directly. They are included here to support ESA in developing a HLOP that best supports a broad range of applications and thus achieving the GMES objectives.

For the HLOP especially the Sentinel 1 products and applications are of relevance regarding either the timeliness (maritime security) or the needed acquisition mode (urban footprint, ice velocity). Other applications request a certain frequency of acquisition (soil moisture).

Products

	Acquisition Requirements			Products	Special Use / regional focus
	spatial coverage (see shp-files for detail)	temporal coverage	Level / Mode		
Sentinel-1	Global land areas	annually	Stripmap SLC	global urban footprint (see 4.2.6)	GEO network, UN-HABITAT, World Bank, EEA, JRC, DWD, the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) or state environment agencies
	Geohazard Supersites	Frequent (>20/a)	L0 / Stripmap	Deformations (interferometric products)	Scientific users in the GEO Geohazard Supersites
	Sparsely vegetated regions (see shp-file)	Frequent (>2 per week)	L1B	global soil moisture (see 4.2.7)	For planning through use in hydrologic or climatologic, as well as biomass models
	Greenland and Antarctic coasts	>2 / a	L1b SLC/ Stripmap	Ice velocity fields (see 4.2.10)	Cryospheric science community, climate Change research in polar regions
	local, typically fits within standard product	frequent in case of flooding	L1	flood mapping (see 4.2.8)	Core Service (GMES EMS), Downstream Services and European Institutions (MIC/EC, JRC) as well as other users, e.g. national institutions: German Civil Protection (BBK), Technical Relief Organisations (THW)
	global oceans		L1 / WV	ECV Sea state (see 4.2.9)	Climate scientists
	Tropical forests globally	Frequent coverage during dry season		Forest monitoring (see 4.2.18, 4.2.19)	
	Regions in North Africa and Central Asia (see shp-file)	1 coverage during dry season		Integrated Water Management (see 4.2.20)	
	Central Europe, Alps	Frequent coverage during snow season	L1B	Runoff and hydropower (see 4.2.23)	

³ ESA/PB-EO(2009)98, rev. 1

Sentinel-2	Germany	4 per year (Apr., May/June, Sept., Nov.)	L1C	Imperviousness (see 4.2.12)	For planning, e.g. BBSR or state environment agencies
	Germany	3-5 cloud free coverages during April-August	L1B	Grassland, Peatland monitoring (see 4.2.21, 4.2.22)	
	Germany /European inland lakes; European Seas		L1+L2	Inland water and shore quality Ocean colour (see 4.2.11, 4.2.15)	National+ European maritime organizations, state environmental agencies, national environmental authorities
	Tropical forests globally	Frequent coverage	L1B	Forest monitoring (see 4.2.18, 4.2.19)	
	Main agricultural areas globally (see shp-file)	Monthly coverage		Agricultural Downstream Services (see 4.2.17)	
	Regions in North Africa and Central Asia (see shp-file)	Bi-monthly coverage		Integrated Water Management (see 4.2.20)	
	Agricultural areas	Frequent coverage	L1B	Precision agriculture (see 4.2.24)	
Sentinel-3	global	daily	L1B OLCI + L2 SLSRT	ECV fire disturbance (burnt areas / hot spots) Flood (see 4.2.13, 4.2.14)	GOFC-GOLD regional networks, Flood and Fire risk management service, German Civil Protection (BBK), Technical Relief Organisations (THW)
		daily	L1 + L2 OLCI	Ocean Color (see 4.2.15)	Germany (and continental Europe) inland lakes

4.2.1 Compatibility for other Missions: Global Reference Image Database of Sentinel-2 as Standard Reference

Name	German Aerospace Center (DLR) Remote Sensing Technology Institute (MF)
Activity	Global Reference Image Database based on Sentinel-2 During the (fully automatic) processing of (optical) (satellite) image data the absolute and in particular relative geometric accuracy is typically strongly improved by image matching techniques. E.g. this is foreseen for the ground processing of EnMAP (Environmental Mapping and Analysis Program; www.enmap.org ; future hyperspectral satellite mission) data. Therefore, a highly accurate global reference image database (REF) is essential. Such a REF will be generated for the Sentinel-2 mission itself and should be the standard REF for other mission as well, e.g. for EnMAP. With this activity we support, that the REF of Sentinel-2 mission will become the standard REF also for other future missions by applying it for the correction of e.g. EnMAP data.
Benefit	The usage of the global reference image database (based on Sentinel-2 data) in the processing of the various mission data will not only heavily improve in particular products based on change detection and fusion methods but also improve the absolute geometric accuracy of various mission data. Such products are generated in a scientific and commercial framework on national, European, and international level.
Planning	Schedule (concerning the usage in the EnMAP ground segment): Based on the current launch date of EnMAP (12/2015) detailed information on the global reference image database (REF) (based on Sentinel-2 data) should be available no later than 12/2013 and the REF should be available no later than 03/2015. Funding for the usage in the EnMAP ground segment from national sources, 2008-15
Expectation from ESA	Global reference image database (REF) generated based on Sentinel-2: <ul style="list-style-type: none"> - DLR access to REF (e.g., test data and real data, via FTP or hard disk, at most one month after availability) - Detailed information on REF (e.g., format (image and meta data), schedule for generation, expected and achieved accuracies, at most one month after availability) should be provided to DLR. - Right for free use of REF for DLR in EnMAP ground segment (e.g., for all activities concerning image matching including generation and delivery of products based on REF) <ul style="list-style-type: none"> - Remark: Fully automatic access to all Sentinel-2 Level 1C products (e.g., FTP (directory based) access to complete archive) is expected, if e.g. further Sentinel-2 products (beside REF) needed for fully automatic image matching activities.

4.2.2 Add-On Service for Sentinel-1: Improved Geometric and Radiometric Correction (Ortho-Products)

Name	German Aerospace Center (DLR) Remote Sensing Data Center (DFD)
Activity	S1 SAR product refinement: Geometric and radiometric improvement of standard S1 SAR products (ortho-rectification, calibration and incidence angle correction based on high resolution TanDEM-X DEM) Add-on service to core-services
Benefit	Supports every land use application Focus on scientific use, commercial service requires special agreements Downstream service Support of European and national institutions
Planning	Service and infrastructure exist, supports TerraSAR-X, RADARSAT-2 and ENVISAT-ASAR, adaption of algorithms and preparation to Sentinel-1 data: 12 months before launch
Expectation from ESA	Interface to S1 standard SAR processor Alternatively online provision of single complex products from core ground segment

4.2.3 Add-On Service for Sentinel-1: High Level Interferometric Products

Name	German Aerospace Center (DLR) Remote Sensing Technology Institute (IMF)
Activity	<p>Development of higher level interferometric products:</p> <p>Full spectral and polarimetric exploitation of TOPS data for persistent scatterer interferometry</p> <ul style="list-style-type: none"> 1a) coregistered stacks of TOPS scenes for PSI and SBAS 1b) interferometrically optimal spectral processing 1c) optimized processing for different types of point scatterers with respect to their polarimetric characteristic 1d) atmospheric correction for absolute geolocation 1e) atmospheric correction for InSAR 1f) point scatterer detection and characterisation for PSI 1g) InSAR coherence quicklooks and prediction to support scenes selection before ordering <p>2) support for FP7 project "Take up of Sentinel-1 Data"</p>
Benefit	<ul style="list-style-type: none"> - High quality TOPSAR processing → avoid signal processing artefacts at less experienced users. - full spectral exploitation of TOPS data - provision of higher level InSAR products - improved precision (geolocation and deformation estimation) - increasing user domain because expert processing is provided as a service
Planning	<ul style="list-style-type: none"> - DLR funded activity and (expected) FP7 project activity + some external support required to serve users outside the FP7 context - Many algorithms are available in the DLR operational InSAR and PSI processor GENESIS - Some algorithms need to be developed, however have a strong relation (synergy) to actual projects e.g. Terrafirma (ESA) and FP7 "Take up of Sentinel-1 Data" (EU)
Expectation from ESA	<ul style="list-style-type: none"> - Local installation of an operational Sentinel-1 / TOPS processor with full documentation on algorithms and configuration. - user training, e.g. in a workshop. - Direct and easy-to-use access to the RAW data archive

4.2.4 Add-On Service for Sentinel-2 and Sentinel-3: Thematic Mask Generation

Name	German Aerospace Center (DLR) Remote Sensing Data Center (DFD)
Activity	<p>Development of improved pre-processing masks and data quality routines based on fuzzy approach</p> <p>For the generation of thematic L2 products based on Sentinel-2 and Sentinel-3 data, all disturbing influences from the imagery, as well as surfaces which hinder the information retrieval should be excluded. In particular, this includes:</p> <ul style="list-style-type: none"> - clouds - cloud shadows - topographic shadows - bright surfaces (saturated pixels) - bright surfaces (salt pans, deserts) - land-water masking - ice and snow <p>Therefore the aim is to:</p> <ul style="list-style-type: none"> - detect all failures in the data (saturation, bad pixels, ...) - classify undesired surfaces (e.g., exclude all water pixels) - provide masks following a fuzzy approach <p>By providing fuzzy masks, the user is enabled to adjust detection thresholds depending on the tasks. In addition, the overall characterization of errors and the calculation of the corresponding uncertainty budget is foreseen as essential part of the data quality control.</p> <p>All of these products are foreseen to be produced global over land for every daytime scene</p>
Benefit	<p>The availability of improved masks for L1 and L2 products derived from Sentinel-2 and 3 is of <i>general interest</i> to the user community, as is the characterization of uncertainties and overall data quality.</p> <p>As a systematic global processing is foreseen, all GMES products will benefit, e.g.:</p> <ul style="list-style-type: none"> - Sentinel-2 standard L2 Vegetation products - SLSTR L2 Geophysical Land product - OLCI L2 Land Color Product - Mapping of burnt areas - Land use / land cover maps
Planning	<p>Parts of the planned activities are under development for AATSR, MERIS, SPOT Vegetation. The required adaptation to Sentinel-2, OLCI and SLSTR could start when test data are available.</p> <p>Regarding data quality analysis, parts are in development for the German EnMAP mission, and can be tailored to the optical Sentinel fleet.</p>

	The scope of the activities depends on the availability of funding.
Expectation from ESA	<p>Access to all level 1B products from Sentinel-2 MSI, Sentinel-3 OLCI and SLSTR.</p> <p>Priority access to the global archived data for bulk processing.</p> <p>In the course of the further enhancement of the Sentinel ground segment, DLR would be ready to support ESA in the implementation of these algorithms in the core ground segment.</p>

4.2.5 Add-On Service to Sentinel-2 and Sentinel-3: Atmospheric Correction

Name	<p>German Aerospace Center (DLR)</p> <p>Remote Sensing Data Center (DFD)</p> <p>Remote Sensing Technology Institute (IMF)</p>
Activity	<p>Improvement of atmospheric products and atmospheric corrections for optical Sentinel fleet</p> <p>(1) Improvements of Sentinel-2 atmospheric correction with regard of: - ozone retrieval using synergies with Sentinel-5 precursor</p> <p>As no systematic atm. processing is currently foreseen for Sentinel-2, the generation of L2A products within the collaborative ground segment is a huge benefit for all subsequent thematic processors.</p> <p>(2) Improvements of Sentinel-3 OLCI & SLSTR L1B and L2 product generation w.r.t.: - subpixel cirrus identification using synergies with Sentinel-2 - cirrus optical thickness estimation with Sentinel-2</p> <p>With Sentinel-2b the combined swath of 600 km results in a further improvement regarding ground coverage and temporal resolution.</p> <p>(3) Improvements of future Sentinel-5 L2 trace gas products generation w.r.t.: - cloud type estimation with Sentinel-2 - subpixel cloud and cirrus detection using synergies with Sentinel-3 (higher spatial resolution) - cirrus altitude estimation with Sentinel-2</p> <p>All of these products are foreseen to be produced: - global (land & ocean) - for every daytime scene</p> <p>Follow-up developments based on the operational GOME-2 processing (for EUMETSAT) for the Sentinel-5 Precursor are already foreseen at DLR. For Sentinel-2, a prototype processor for atmospheric correction already exists at DLR.</p>
Benefit	<p>The availability of improved L1 and L2 products derived from Sentinel-2, 3 and 5 is of general interest to the user community.</p> <p>As a systematic global processing is foreseen, all GMES users will benefit, e.g.</p> <ul style="list-style-type: none"> - generation of biophysical (e.g., chlorophyll) and LU/LC maps with atmospheric influence removed - trace gas estimates without the influence of clouds - characterization of cirrus effects for climate studies

Planning	As parts of the proposed developments already exist, or will exist at the time of launch, the proposed activity will start when Collaborative Ground Segment is available. The scope of the activities depends on the availability of funding.
Expectation from ESA	Access to all level 1B products from Sentinel-2 MSI, Sentinel-3 OLCI and SLSTR and Sentinel-5 Precursor. Priority access to the global archived data for bulk processing. In the course of the further enhancement of the Sentinel ground segment, DLR would be ready to support ESA in the implementation of these algorithms in the core ground segment.

4.2.6 Value-Adding Product Sentinel-1: Global Urban Footprint

Name	German Aerospace Center (DLR), Remote Sensing Data Center (DFD),
Activity	Global Urban Footprint global annual inventory of settlements; input to climate modeling, sustainable urban development, population distribution, vulnerability studies, risk management
Benefit	Supports climate studies, urban and regional planning, disaster mitigation <ul style="list-style-type: none"> ▪ Downstream service ▪ Contribution to Task SB-04 "Global Urban Observation and Information" of Group on Earth Observations (GEO) ▪ Potential partners: GEO network, UN-HABITAT, World Bank, EEA, JRC, DWD, the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) or State Environment Agencies
Planning	Service and infrastructure exist, current data source is TanDEM-X and RADARSAT-2, adaption of algorithms and preparation to Sentinel-1 data: 6 months before launch, annual full global coverage evaluation throughout the mission lifetime
Expectation from ESA	Generation and provision of at least one coverage per year of Sentinel-1 data in Stripmap Mode (80 km swath width, 5x5 m spatial resolution), ideally during summer season.

4.2.7 Value-Adding Product Sentinel-1: Soil Moisture

Name	German Aerospace Center (DLR), Remote Sensing Data Center (DFD)
Activity	<p>Large scale processing of global and regional soil moisture products based on algorithms of TU-Vienna (IPF) from Sentinel-1 data</p> <p>(1) Testing of Sentinel-1 based soil moisture retrieval algorithms delivered by TU Vienna at DFD-BI and DFD-LA</p> <p>(2) Installation of performance optimized soil moisture processing chains in the ground segment (BI)</p> <p>(3) Integration of Sentinel-1 derived soil moisture data products in DFDs value adding chains and application projects</p>
Benefit	<p>The availability of Sentinel 1 derived soil moisture data is of <i>general interest</i> to the user community; according to the GEO SBA Analyses soil moisture is an essential variable needed in several user communities</p> <p>As a systematic global processing is foreseen, all GMES users will benefit.</p> <p>Some particular examples are:</p> <ul style="list-style-type: none"> - integration of soil moisture products in hydrologic or climatologic, as well as biomass models - derivation of Basin Water Index and generation of information products and catchment saturation - scaling studies in combination with the already existing ERS-SCAT and METOP-ASCAT as well as shorter Envisat ASAR GM and WS time series
Planning	<p>Preparations for the activity would start in the context of a (so far not yet evaluated) EU FP7 proposal jointly submitted between DFD, TU Vienna, and other partners (Sentinel Hydrology).</p> <p>The scope of the activities depends on the availability of national funding and third party funding.</p>
Expectation from ESA	Access to all level 1B global products from Sentinel-1.

4.2.8 Value-Adding Product Sentinel-1: Global Flood Mapping

Name	German Aerospace Center (DLR) Remote Sensing Data Center (DFD)
Activity	Global Flood Mapping Processing of Sentinel-1 data with AFD (automatic flood detection) processor; systematic classification and extraction of water surfaces from Sentinel-1 data; comparison with reference water areas; delineation of flooded areas (flood masks) Integration of Sentinel-1 derived flood masks in DFDs value adding chains and ZKI services/products
Benefit	Quick availability of flood extent extracted from Sentinel-1 data for services and applications in the field of early warning, flood monitoring, flood management and disaster response. Utilization of synergetic effects between X-Band and C-Band radar data due to similar approach for TerraSAR-X and Sentinel-1. Advancement of the DFD/ZKI service and product portfolio
Planning	The proposed activity will start when Collaborative Ground Segment is available. Methodology has to be implemented for TerraSAR-X, and will then be transferred to Sentinel-1 C-band data. The scope of the activities depends on the availability of funding.
Expectation from ESA	NRT data downlink of relevant Sentinel-1 data to DLR receiving stations. Access to level 1B products from Sentinel-1.

4.2.9 Value-Adding Product Sentinel-1: Essential Climate Variables Sea State

Name	German Aerospace Center (DLR) Remote Sensing Data Center (DFD)
Activity	The generation of the Essential Climate Variables (ECV) “Sea State” based on SAR wave mode data from the Sentinel-1 focus on two level 3 products: <ul style="list-style-type: none"> - Global significant wave height, wavelength, wave period - Global individual wave height Derivation of sea state parameters from the Sentinel-1 wave mode data is a continuous activity which has been presented in the ERS/SAR and ENVISAT/ASAR wave mode data. The sea state products will be delivered in standard data format, e.g., NetCDF or BUFR to users. The global mean and maximum wave height will be also delivered as global maps.
Benefit	The SAR wave mode data is available since 1991 when the ERS-1 was launched and it will be also available in the Sentinel-1 mission. Design of the sea state products closely follow the GCOS-128 guidelines (Global Climate Observing System (GCOS) 2009) suggested for the ECV. The long enough time series ensures that sea state parameters derived from the SAR wave mode data can contribute significantly wave climate research apart from the Radar Altimeter.
Planning	The activity has been conducted for the ERS-2/SAR and ENVISAT/ASAR. Algorithms to derive the sea state products have been implemented on the previous ESA SAR data. It will start when the first Sentinel-1 level1B products are available. It is expected that the first sea state products can be delivered after 2 years following validation and improvement.
Expectation from ESA	Access to all level 1B products from Sentinel-1.

4.2.10 Value adding product Sentinel-1: High level geophysical products of Antarctic and Greenland outlet glaciers and ice shelves

Name	German Aerospace Center (DLR) Remote Sensing Technology Institute (IMF)
Activity	Monitoring of outlet glaciers and ice shelves by means of InSAR and feature/speckle tracking Process the Sentinel-1 data into high resolution velocity fields. Mapping and monitoring of the grounding line. Monitoring ice shelves and glacier termini changes.
Benefit	Provision of high level geophysical products to cryospheric science community. These will be valuable components needed for ice sheet mass balance estimations, climate change issues and sea level rise contribution from polar areas.
Planning	A national collaboration with the Alfred Wegner Institute for polar research (AWI) is ongoing as well as international. We are active members of the WMO Polar Space Task Group which coordinates space agencies in satellite data acquisitions over polar areas. The work will be partially carried out with DLR internal resources. Additional DLR-external funding is envisaged.
Expectation from ESA	Access to Sentinel-1 data L1b SLC
Requirements Sentinel-1	Areas with special interest a) Greenland outlet glaciers (~25 outlet glaciers around the coast) b) Antarctic Peninsula (E and W coast) and Antarctic outlet glaciers Mode: Stripmap because of the higher azimuth resolution needed for 2D velocity fields generation. The TerraSAR-X data revealed this as a robust method for large area mapping. Two repeat pass coverages /year. For some super test sites several repeat pass coverages will be needed. c) Antarctic Ice shelves Mode: IWS

4.2.11 Value-Adding Product Sentinel-2: Inland Water / Shore Quality

Name	German Aerospace Center (DLR) Remote Sensing Technology Institute (IMF); Brockmann Consult;
Activity	Applications of Sentinel-2 data for the investigation and derivation of ecological relevant parameter maps with main focus on inland waters including the littoral zone (shore). Deduction of states regarding the water quality, silt and reed accumulation.
Benefit	Maritime service activities and projects at national, European and international level. Downstream Services embedded in a national collaborative ground segment. Supporting national users (federal and state environmental agencies, national environmental authorities,), value adding companies and European maritime organisations.
Planning	Tbd. National and European funding
Expectation from ESA	Access to Sentinel-2 standard products, Level-1 and 2. Sentinel-2 acquisitions of the European Seas (Baltic, Mediterranean, North Sea)
Requirements Sentinel-1	Area of Interest: Germany Europe
Requirements Sentinel-2	Sentinel-2 acquisitions of European Seas; Regular data product access to Sentinel-2 data.

4.2.12 Value-Adding Product Sentinel-2: Mapping of Imperviousness

Name	German Aerospace Center (DLR) Remote Sensing Data Center (DFD)
Activity	Mapping of Imperviousness; Annual mapping of impervious surface in Germany using Sentinel 2 data; input for sustainable urban development, hydrology and ecology studies, and regional and urban planning.
Benefit	<p>An annual German imperviousness map supports researchers in the field of environmental sciences, hydrology, ecology and climatology. Local, regional and national governmental organisations will benefit from the proposed product as part of their monitoring and planning activities. Great benefit can be expected from repeated mapping (yearly). This enables the monitoring of change of imperviousness, which is important information for the above mentioned research and planning activities, but is currently not available.</p> <p>The <i>Verbund für fernerkundungsgestützte Geoinformation (VfG)</i>, initiated by the Federal Ministry of the Interior (BMI) which is responsible for the coordination of remote sensing based geo-information for national, state and local governments, identified imperviousness as a key product needed by German governmental organizations. Examples of such organisations are the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) or State Environment Agencies.</p>
Planning	<p>The algorithms to map impervious surface are currently available and can handle different sensor types generically. Therefore, only a short adaptation phase for Sentinel-2 will be required before processing can start. Further development is required regarding the operational use of multi-temporal imagery, which will reduce the need of auxiliary data during processing.</p> <p>Funding has been allocated by VfG and BBSR for the development of key geo-information products from remote sensing, including the imperviousness map.</p>
Expectation from ESA	<p>For this product, the generation and provision of 4 cloud free Sentinel-2 coverages of Germany per year is required. The minimum required coverage has to be recorded within a short period of time in early summer months (May/June). The three additionally requested coverages are each to be recorded in the seasons spring (April), autumn (September) and winter (November). Extensive tests have shown that the availability of seasonal data significantly improves the results of imperviousness modeling.</p> <p>The data need to be received as geo-referenced radiance (Level 1-C). Data delivery is required at least once each year.</p>

4.2.13 Value-Adding Product Sentinel-3: Essential Climate Variables Burnt Areas / Hot Spot

Name	German Aerospace Center (DLR), Remote Sensing Data Center (DFD)
Activity	<p>The generation of the Essential Climate Variables (ECV) "Fire Disturbance" based on OLCI and SLSTR data from Sentinel-3 focus on two level 3 products:</p> <ul style="list-style-type: none"> - burnt area (BA) - hot spot detection <p>The "Fire Disturbance" product will be delivered as global maps especially as input to climate models. The active fire mapping will continue present activities which are based on (A)ATSR, MODIS, AVHRR or geostationary satellites (MSG, GOES, ..).</p> <p>The final processor design will be based on the results of the ESA-CCI Project "Fire Disturbance" where DLR is partner of the consortium.</p>
Benefit	<p>All "Fire Disturbance" products will be publicly available, as well as the algorithms and associated documentation. The design will closely follow the GCOS-128 guidelines (Global Climate Observing System (GCOS) 2009) suggested for ECV and FCDR.</p> <p>The GOFD-GOLD regional networks will benefit from the proposed products as well as the GSE Risk-EOS (Flood and Fire risk management service).</p>
Planning	<p>The activity will start after the successful end of the ESA-CCI Project "Fire Disturbance" when the best practice algorithms for determining BA's is established. When the first Sentinel-3 level1B products are available, the development of the pre-processing chain can start. It is expected that the first "Fire Disturbance" products can be delivered after 2 years following validation and improvement.</p>
Expectation from ESA	<p>Access to all level 1B products from OLCI; Access to all level 2 products from SLSRT; A continuous flow of data is mandatory for deriving hot spot information and BA maps.</p>

4.2.14 Value-Adding Product Sentinel-3: Flood Service

Name	German Aerospace Center (DLR) German Remote Sensing Data Center (DFD)
Activity	Continuous monitoring of large areas worldwide with Sentinel-3 ; automatic detection of large-scale floods (with OLCI sensor) and active fires (with SLST sensor)
Benefit	Service continuity and enhancement of the Global Flood Service which is currently developed based on MODIS data Facilitation of a permanent Flood Service based on Sentinel-3 (OLCI sensor) for the GMES user community (incl. the Core Service (GMES EMS), Downstream Services and European Institutions (MIC/EC, JRC) as well as other users, e.g. national Institutions: German Civil Protection (BBK), Technical Relief Organisations (THW) but also the scientific community and the public.
Planning	The proposed activity will start when Collaborative Ground Segment is available. The scope of the activities depends on the availability of funding.
Expectation from ESA	Access to Sentinel-3 core data products.

4.2.15 Value-Adding Product Sentinel-3: Ocean Color

Name	German Aerospace Center (DLR) Remote Sensing Technology Institute (IMF)
Activity	Continuation of the expertise and experience in ocean color remote sensing, focus water quality under the successor aspect of OLCI regarding MERIS. Operational derivation of quantitative and qualitative information about the ecological quality of open waters (Baltic and North Sea) including the coastal zones. Introduction of harmful Blue Algae as a new not yet regularly established and monitored parameter. Main focus on the development of regionally specific algorithms and processing chains for the Baltic Sea with special respect to the coastal zone. Including of provision of regular SST-products due to the very high interest from water quality user side. Operational processing and services: Continuation of MERIS-based services at DLR's Dept. National Ground Segment in Neustrelitz
Benefit	Maritime service activities and projects at national, European and international level. Downstream Services embedded in a national collaborative ground segment. Supporting national users (federal and state environmental agencies, national environmental authorities), value adding companies and European maritime organizations.
Planning	Tbd. National and European funding
Expectation from ESA	regular (daily) access to Sentinel-3 standard products, Level-1 and 2. Area of Interest: Germany and Europe: inland lakes

4.2.16 Calibration/Validation Site for Sentinel-1, Sentinel-2 and Sentinel-3: DEMMIN

Name	German Aerospace Center (DLR) German Remote Sensing Data Center (DFD)
Activity	DEMMIN Cal/Val services providing quality checks for Sentinel data and products , e.g. for: <ul style="list-style-type: none"> CGS basic products (e.g. radiometric and geometric accuracy) Land services: vegetation monitoring for agriculture and forestry (vigour, leaf area index, evapotranspiration) specific products based on sensor fusion dynamic land/ water masks
Benefit	Cal/Val of Downstream Land Services embedded in a national collaborative ground segment: <ul style="list-style-type: none"> usage of the already established and well equipped DEMMIN test site research: meteorology, hydrology, climate change
Planning	start: after availability of first data/products funding: DLR internal
Expectation from ESA	<ul style="list-style-type: none"> Access to Core GS products (S1, S2, S3) Access to information on acquisition and processing details (e.g. documentation, all available metadata) support/promotion of DEMMIN site by ESA consideration of DEMMIN as a test site for further ESA managed cal/val campaigns (as AgriSAR 2006)

4.2.17 Agricultural Downstream Services

Name	GAF AG
Activity	Provision of Services on agricultural monitoring
Benefit	Development of the Downstream market for GMES in the agricultural domain
Planning	No details provided
Expectation from ESA	Monthly coverage of main agricultural domains (see shp-file) with Sentinel-2

4.2.18 Forestry Downstream Services

Name	GAF AG
Activity	Provision of Services in forestry
Benefit	Development of the Downstream market for GMES in the forestry domain
Planning	No details provided
Expectation from ESA	Bi- to tri-monthly coverage of tropical forests in Africa and South-East Asia (see shp-file) with Sentinel-2

4.2.19 Downstream Services for REDD monitoring

Name	Remote Sensing Solutions GmbH
Activity	<p>Pilot Service supporting international climate protection - REDD</p> <p>Providing Products/Information (incl. via Smart Phone App) on :</p> <ul style="list-style-type: none"> – Deforestation and forest degradation (logging and fire) – Burnt areas
Benefit	<ul style="list-style-type: none"> • Better and rapid assessment of fires, fire impact, and logging activities to support NGOs and governments • Expected benefits from Sentinel-1 and -2 <ul style="list-style-type: none"> ○ Higher spatial resolution ○ Improved temporal resolution ○ Improved spectral resolution providing more accurate maps
Planning	Service development funded through APPS4GMES (2012-2014)
Expectation from ESA	<ul style="list-style-type: none"> • 3-5 cloud free coverages with Sentinel-2 (Level1b) of regions of interest in Brazil, Southern Africa and Southeast Asia during the respective dry seasons, • Frequent Sentinel-1 coverages within the same period • Access to data (incl. contributing missions) via portal

4.2.20 Downstream Services for integrated water management

Name	GAF AG
Activity	Provision of Services for integrated water management
Benefit	Development of the Downstream market for GMES in the water management domain
Planning	No details provided
Expectation from ESA	<p>Sentinel-1: 1 coverage during dry season of arid and semi-arid regions in North-Africa and Central Asia (see shp-file)</p> <p>Sentinel-2: Bi-monthly coverage of arid and semi-arid regions in North-Africa and Central Asia (see shp-file)</p>

4.2.21 Downstream Services for grassland monitoring

Name	Remote Sensing Solutions GmbH
Activity	<p>Grassland monitoring</p> <p>Products on :</p> <ul style="list-style-type: none"> • Grassland use and ploughing of grasslands • Grassland biodiversity indicator

Benefit	<ul style="list-style-type: none"> Assessment of grassland biodiversity Reporting duties i.e. Natura2000, FFH Monitoring, Cross Compliance etc. Support of renewable energy regulations
Planning	Service development funded through APPS4GMES (2012-2014)
Expectation from ESA	3-5 cloud free coverages of Sentinel-2 data (Level 1b) of Germany during the vegetation period April-August

4.2.22 Downstream Services for peatland monitoring

Name	Remote Sensing Solutions GmbH
Activity	Peatland monitoring Providing Products/ Information on: <ul style="list-style-type: none"> Carbon content in peatlands and possible emission factors Peatland degradation and recultivation
Benefit	Better assessment of peatland status to support <ul style="list-style-type: none"> re-wetting and recultivation reporting duties in the context of green house gas emissions Expected benefits from Sentinel-1 and -2: <ul style="list-style-type: none"> Higher spatial resolution Improved temporal resolution Improved spectral resolution providing more accurate maps
Planning	Service development funded through APPS4GMES (2012-2014)
Expectation from ESA	<ul style="list-style-type: none"> 3-5 cloud free coverages of Sentinel-2 data (Level 1b) of Germany during the vegetation period April-August Access to data (incl. contributing missions) via portal

4.2.23 Downstream Services for runoff-management

Name	VISTA Remote Sensing in Geosciences GmbH Anton-Ferstl-Str. 11 82234 Weßling, Germany
Activity	Pilot for water quantity – monitoring of the snow cover for modeling of runoff and hydropower prediction Providing Products on : <ul style="list-style-type: none"> Daily information on snow cover and snow water equivalent for Central Europe and the Alps Detection of melting snow (e.g. critical rain on snow situations) Daily simulations and forecasts of hydro power generation
Benefit	<ul style="list-style-type: none"> Improvements for early warning and flood forecast Long year experienced information service for Flood Forecast Centers in D, CH, and A. Assessment of hydrologic situation (national & European)

	<ul style="list-style-type: none"> Improved spatial resolution of snow water equivalent through model approach Support of renewable energy regulations
Planning	<ul style="list-style-type: none"> APPS4GMES: 3-years project funded by the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology <ul style="list-style-type: none"> Started in April 2012 a collaboration of five Bavarian companies for the development and demonstration of operational services in the scope of GMES. Facing the challenges of data transfer, data volume, information retrieval and quality of linked services Basic development of service was done during GSE Polar View (2005 – 2012) by use of ENVISAT ASAR WSM Further adaption for using RADARSAT planned
Expectation / support from ESA	<ul style="list-style-type: none"> Rapid availability (3h from sensing) of Sentinel-1 datasets (Level1b) Reliable availability of Interferometric Wide Swath Mode (IWS) for Central Europe and Alpine Areas Support of national activities for Collaborative Ground Segments, regarding data access, provision of sub-tiles (small datasets)

4.2.24 Downstream Services for precision agriculture

Name	<p>VISTA Remote Sensing in Geosciences GmbH Anton-Ferstl-Str. 11 82234 Weßling, Germany</p>
Activity	<p>Pilot for agriculture – Products for agricultural measures within precision agriculture</p> <p>Providing Products on :</p> <ul style="list-style-type: none"> Atmospheric corrected of Sentinel-2 data optimized for land applications Automatic classification of surface cover types (agricultural areas, forested areas, bare soil, water, urban, cloud, fog) Bio-physical maps on leaf area index, leaf angle distribution, chlorophyll content of agricultural areas
Benefit	<ul style="list-style-type: none"> Better assessment of plant parameters and status <ul style="list-style-type: none"> to support sustainable yield increases to optimize plant production measures to provide economic and ecologic benefits to farmers Support of food security Expected benefits from Sentinel-2 <ul style="list-style-type: none"> Higher spatial resolution Improved temporal resolution Improved spectral resolution providing more accurate maps of Leaf area index and chlorophyll content

<p>Planning</p>	<ul style="list-style-type: none"> • APPS4GMES: 3-years project funded by the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology <ul style="list-style-type: none"> ○ Started in April 2012 ○ a collaboration of five Bavarian companies for the development and demonstration of operational services in the scope of GMES. • Facing the challenges of data transfer, data volume, information retrieval and quality of linked services • Basic development of service was done within ESA IAP Talking Fields (2010 - 2013) with Landsat and RapideEye data
<p>Expectation / support from ESA</p>	<ul style="list-style-type: none"> • Rapid availability (3h from sensing, Level 1b) of Sentinel-2 • Access to data (incl. contributing missions) via portal • Data access: provision of sub-tiles (small datasets)

4.3 Data Product Dissemination and Access

ESA requirement: Particular regional or thematic data access nodes and mechanisms, potentially including:

- *redistribution services of Sentinels products, systematically received from the Core Ground Segment, becoming additional pick-up points (e.g. mirror sites)*
- *regional online data servers and data pick-up points for specific user communities, etc.*

Summary:

- National Mirror Site for Product Dissemination and Access (VfG: Verbund für Geoinformation)
- Regional Mirror Site for Alpine Product Dissemination and Access
- Regional Mirror Site for West African Product Dissemination and Access (WASCAL)

4.3.1 Mirror Site for National Product Dissemination and Access (VfG: Verbund für Geoinformation)

Name	German Aerospace Center (DLR) German Remote Sensing Data Center (DFD) Oberpfaffenhofen and Neustrelitz, Germany
Activity	Mirror site for National Sentinel-1, Sentinel-2 and Sentinel-3 products. The need for a German national access to selected Sentinel data is based on the national initiative (<i>Verbund für fernerkundungsgestützte Geoinformation, VfG</i>), initiated by the Federal Ministry of the Interior (BMI), which may become responsible for the coordination of remote sensing based geo-information for national, state and local governments, identified imperviousness as a key product needed by German governmental organizations. The geographic coverage of VfG is primarily the territory of Germany and coastal interest areas. Also selected other areas of German national interest might be included in this archive (tbc). The temporal coverage is tbd and depends on the products generated from the basic data.
Benefit	Providing an additional pick-up point for the support of geoinformation services in Germany, primarily for: <ul style="list-style-type: none"> • national public authorities • national value adding companies • Science and application research
Planning	The concept for VfG has been developed and discussions on financing and schedule are proceeding. Input of Sentinel-data asap after launch.
Expectation from ESA	Access to S1, S2, S3 Core GS products over Germany and other geographic priority areas NRT Product access in selected cases (see corresponding entries in this document)

4.3.2 Mirror Site for Regional Alpine Product Dissemination and Access

Name	German Aerospace Center (DLR) German Remote Sensing Data Center (DFD) Oberpfaffenhofen, Germany in cooperation with EURAC, Bozen, Italy and Joaneum Research, Graz, Austria
Activity	Mirror site for Regional Sentinel-1, Sentinel-2 and Sentinel-3 products and services in the Alpine area. Based on a transnational cooperation, a focus will be given to geoscientific applications and public services in the alpine area (e.g. snow, glaciers, land use, alpine disasters). Therefore, a special access to standard and customized Sentinel-data and products (plus those from other missions) will be provided through portals based on regional/temporal (i.e. alpine) mirror archives of the Sentinel-data and products.
Benefit	Providing an additional pick-up point for the support of... <ul style="list-style-type: none"> • geoinformation services for the alpine areas • national public authorities • national value adding companies
Planning	Planning has started on concepts of an Alpine data center in the framework of various collaborative projects
Expectation from ESA	Access to S1, S2, S3 Core GS products. NRT Product access in some cases required (preferably NRT data reception at DLR's NRT X-Band and Ka-Band stations in Neustrelitz and Oberpfaffenhofen, see above))

4.3.3 West African Product Dissemination and Access (WASCAL)

Name	German Aerospace Center (DLR) German Remote Sensing Data Center (DFD) WASCAL Competence Center, Ouagadougou, Burkina Faso
Activity	<p>Regional Sentinel-1, Sentinel-2 and Sentinel-3 products, systematically received from the CGS</p> <p>WASCAL (West African Science Service Center on Climate Change and Adapted Land Use) is a large-scale program designed to help tackle this challenge and thereby enhance the resilience of human and environmental systems to climate change and increased variability. It does so by strengthening the research infrastructure and capacity in West Africa related to climate change and by pooling the expertise of ten West African countries and Germany.</p> <p>Funded by the German Federal Ministry of Education and Research (BMBF), WASCAL is coordinated by the Center for Development Research (ZEF, Bonn University), and is implemented in a collaborative effort by West African and German partners.</p> <p>WASCAL will also include an environmental satellite data acquisition component, which will include – as a further development – an X-Band data acquisition station. DLR is in charge of this part of WASCAL.</p>
Benefit	<p>Providing an additional pick-up point for the support of</p> <ul style="list-style-type: none"> • geoinformation services for West Africa in the context of WASCAL • national public authorities of the West African countries • National German authorities and research institutions (ZEF, BMBF, Universities) • national and international value adding companies
Planning	start 2013
Expectation from ESA	Access to S1, S2, S3 CGS products

4.4 Development of Innovative Tools and Applications

ESA requirement: Development of particular innovative tools or 'Apps' by and for the general public

4.4.1 Geo Data-Webserver

Name	German Aerospace Center (DLR) German Remote Sensing Data Center (DFD)
Activity	New User Interfaces (Geo Data-Webserver), e.g. for maritime services: NRT Ship detection products
Benefit	enhanced access to and dissemination of products from the NRT Downstream services of the DLR NRT data center (Neustrelitz), e.g. for maritime community
Planning	start: 6 months after launch funding: National Project Maritime Security/Safety 2012-2021
Expectation from ESA	S1, S2, S3 Core GS products, attached to the NRT Services (see corresponding entry in this document)

4.4.2 Earth Observation Image Library EOLib

Name	German Aerospace Center (DLR) German Remote Sensing Data Center (DFD)
Activity	Integration of the Earth Observation Image Librarian (EOLib) system with the Sentinel PDGS to provide next-generation Image Information Mining (IIM) search and annotation tools enabling image content-based searches on image raster data, time series, metadata, and other related geo-information
Benefit	For all users and communities: - improvement data assessment and promotion of the utilization of archived EO data by providing content based search capabilities.
Planning	EOLib is a project being developed at the German Remote Sensing Data Center under ESA contract. Integration into the DLR Multi-Mission Payload Ground Segment and ESA MMFI starts in Q4/2012 and continues until 2014. From 2015 onwards, funding for infrastructure and operations is to be assessed.
Expectation from ESA	Access to the Sentinel EO data being archived, as well as processing resources within the Sentinel PDGSs for basic feature extraction. Additional integration points (Catalogue, Web-Portal, etc.) will be identified with the analysis to be performed in the Phase 1 of the EOLib project until Q3/2012.

Appendix A Original Category Descriptions from ESA

Abbreviation in this document	Original Description by ESA
Name	Name <i>Name of organisation, institution, company, consortium</i>
Activity	Activity <i>Objective, high level description of activity, station location, etc</i>
Benefit	Benefit <i>For user communities, GMES services, at national level, ESA, etc.</i> <i>Please specify within the following categories:</i> - Core Service(s) - Downstream Service(s) - European Institutions - National Institutions/Services - Other
Planning	Planning <i>Expected start of activity, schedule, availability of (national) funding</i>
Expectation from ESA a. Sentinel Mission Data Acquisition and (NRT) production	Expectation / support from ESA <i>Elements developed as part of the Core GS: standard instrument processor software executable license; intention to procure demodulator / front end processor (DFEP) at recurrent cost, etc.</i>
Expectation from ESA b. Sentinel Collaborative Data Products	<i>Privileged access to Sentinel core data products, dedicated access link to core products (rough order of data volume to be provided); verification of user documentation related to collaborative products; advertisement or distribution of collaborative products by GSC Core ground segment: use of the GSC network and data dissemination; use of ESA developed toolbox to host collaborative product processing algorithms; use of Processing On-Demand Infrastructure to host collaborative product processing algorithms; provision of specialized interfaces (e.g. for catalogue access, HMA); (mutual) access to cal/val infrastructure and data.</i>
Expectation from ESA c. GSC Data Product Dissemination and	<i>Pick-up points, networks (timeliness to be provided), etc.</i>



Access	
Expectation from ESA d. Development of Innovative Tools and Applications	<i>Advertisement of these collaborative tools / applications may be established in terms of WEB portal links, coupled interfaces for information of interest to GSC user community, during workshops, etc.</i>
Requirements Sentinel-1	High level description of observation requirements (Sentinel-1) <i>Area of interest (preferably shape files), SAR mode, polarisation, revisiting frequency, etc.</i>

