

ESRIN/Contract No. 4000117984/16/I-NB

STSE Arctic+

Theme 3 – Fresh Water Fluxes

ESA Contract No. 4000117984/16/I-NB

with

**Technical University of Denmark – National Space Institute
(DK)**

STSE Arctic+

Theme 3 – Fresh Water Fluxes



ORIGINAL N° 1



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CONTRACT

Between:

The EUROPEAN SPACE AGENCY,
(hereinafter called "the Agency" or "ESA"),

located at: 8-10 rue Mario Nikis,
75015 Paris,
France,

represented by Mr Johann-Dietrich Wörner, its Director General,
through its establishment

The European Space Research Institute (ESRIN),

located at: Via Galileo Galilei,
Casella Postale 64,
00044 Frascati (Roma),
Italy,

of the one part,

and:

Technical University of Denmark – National Space Institute
(hereinafter called "the Contractor" or "DTU"),

whose Registered Office is at:

Elektrovej
Building 327
2800 Kgs. Lyngby
Denmark

represented by Mr. Kristian Pedersen, its Director

of the other part,

the following has been agreed:



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ARTICLE 1 - SUBJECT OF THE CONTRACT – APPLICABLE DOCUMENTS**1.1. Subject of the Contract**

The Contractor, as further described in the Statement of Work in Appendix 2, undertakes to develop prototypes in the field of Fresh Water Fluxes within the scope of the STS – Arctic+, to deliver the software and documentation as described herein, and to make an oral presentation of the results.

1.2. Applicable Documents

The work shall be performed in accordance with the following documents, listed in order of precedence, in case of conflict:

- a) The Articles of this Contract and its Appendix 1 (Payment Plan and Advance Payment(s) and other Financial Conditions);
- b) The General Clauses and Conditions for ESA Contracts (herein referred to as GCC), reference ESA/REG/002, rev. 2 not attached hereto but known to both Parties and available on <http://emits.sso.esa.int/emits/owa/emits.main>) “reference documentation” – “administrative documents”, as amended by this Contract;
- c) Appendix 2 hereto: The Statement of Work, reference EOP-SA/0332/DFP-dfp, issue 1, dated 22/07/2015
- d) Appendix 3 hereto: The Standard Requirements for Management, Reporting, Meetings and Deliverables (Rev 1 : 2014-07) and its Annex A: Layout for Contract Closure Documentation;
- e) The Minutes of the negotiation meeting held on 19/5/2016, not attached hereto but known to both Parties;
- f) The Contractor’s Proposal reference ArcFlux, issue 2.0, dated 19/04/2016, not attached hereto but known to both Parties

ARTICLE 2 - DELIVERY**2.1. Place and Dates of Delivery****2.1.1 Documents**

The Contractor shall, during the performance of this Contract, deliver all documentation and reports specified in Appendix 2, in the required number of paper copies and in an electronic file. These shall be sent to the Agency’s Technical Officer mentioned in Article 5, Clause 5, Sub-Clause 5.1 a) of the Contract, unless otherwise specified, in accordance with the following specific provisions:

- 2.1.1.1 The draft versions of the final documents as defined in Appendix 2 shall be submitted for approval, in electronic format, to the Agency’s Technical Officer specified in Article 5, Clause 5, Sub-Clause 5.1 a) of the Contract, not later than To+ 18 [i.e. 1 March 2018].
- 2.1.1.2 The finalised versions thereof shall be issued not later than four (4) weeks after the approval of the draft versions, as follows:
 - in two (2) paper copies and in two (2) copies on CD-ROM shall be sent to the Agency’s Technical Officer specified in Article 5, Clause 5, Sub-Clause 5.1 a) of the Contract and
 - one (1) paper copy and one (1) copy on CD-ROM shall be sent to the ESA Information and Documentation Centre – ESTEC Library, Postbus 299, 2200 AG Noordwijk, The Netherlands.

2.1.2 Software

The object code relevant to the software, mathematical models, data files, design files and computer programmes, specified in Appendix 2 shall be delivered to the Agency’s Technical Officer specified in Article 5, Clause 5, Sub-Clause 5.1 a) of the Contract, not later than To+ 18 [i.e. 1 March 2018].

2.1.3 Contract Closure Documentation

The Contract Closure Documentation (Appendix 3, Annex A) shall be delivered in one (1) set of documentation each, to the Agency's authorised representatives not later than the time of submitting the invoice(s) for the Final Settlement (see also Article 3.2.2).

ARTICLE 3 - PRICE & PAYMENT

3.1. Price

The price of this Contract amounts to:

€ 199,981
(One hundred ninety-nine thousand nine hundred eighty-one EURO),

broken down per Contractor and Subcontractor(s) as follows:

Company Name	Type P/SI	Vendor Code	Country (ISO Code)	Total Amount in euro
DTU	P	1000000428	DK	95,000
LEGOS/CNRS	Si	1000005453	FR	51,981
ENVEO	Si	1000000448	AT	53,000

3.1.1 The type of price is the following:

A Firm Fixed Price as defined in Section 2.1 of Annex II to the GCC.

3.1.2 The above amount does not include any taxes or duties in the Member States of the Agency.

3.1.3 The price is deemed to include all applicable fees for licences to be purchased and delivered in the frame of the Contract, indicating the Agency as the end user. The price is further deemed to include any and all licence fees payable according to Clause 43.7 of the GCC.

3.1.4 The price is Delivered Duty Paid for all deliverables, exclusive of import duties and VAT in accordance with the INCOTERMS 2010, to the addressee(s) specified in Article 5, Clause 5, Sub-Clause 5.1 a) of the Contract. Reference to INCOTERMS in this provision is exclusively for the purpose of price definition.

3.2. Payment

3.2.1 General provisions

The Payment Plan applicable to this Contract is specified in Appendix 1 hereto.

In the event that the achievement of a milestone is delayed but the milestone is partially met at the milestone planning date foreseen, the Agency may as an exception, effect a payment against an approved confirmation of the partially achieved milestone, not exceeding the value of the work performed at the date of payment.

Payments shall be made within thirty (30) calendar days of receipt at ESA-ESRIN Finance Payment Office of the documents listed and fulfilment of the requirements as specified in 3.2.2 below¹. Only upon fulfilment of these requirements shall the invoice be regarded as due by the Agency.

Payments shall be made by the Agency in EURO to the account specified by the Contractor. Such account information shall clearly indicate the IBAN (International Bank Account Number) and BIC/SWIFT (Bank Identification Code). The Parties agree that payments shall be considered as effected by the Agency on time if the Agency's orders of payment reach the Agency's bank within the payment period stipulated in the paragraph above.

¹ This is reflected in esa-p as "30 days upon receipt by ESA, in esa-p, of both the confirmation and the invoice" see in Industry Portal at http://www.esa.int/about_Us/industry/esa-p_for_suppliers (under "1. FAQ for Suppliers")



Any special charges related to the execution of payments will be borne by the Contractor.

Any questions concerning the latest status of due invoices can be addressed to the ESA Payment Officer (mail to: esa.payment.officer@esa.int).

If applicable, invoices shall separately show all due taxes or duties.

In the case of invoices submitted by the Contractor which are free of VAT, reference shall be made to the number indicated on the VAT Exemption Form which the Agency provided to the Contractor when forwarding two (2) originals of the present Contract for signature. On invoices submitted via esa-p, the number shall be put in the respective field 'VAT Exemption Number'.

3.2.2 Requirements for invoices being regarded as due:

Progress Payment(s):²

- Milestone Achievement Confirmation (MAC) hereinafter referred to as "confirmation" with supporting documentation, attached in esa-p. The supporting documentation shall justify the actual achievement of the milestone(s) as defined in the Payment Plan specified in Appendix 1 hereto.

and

- Invoice(s);

Final Settlement:

- Confirmation, with supporting documentation attached in esa-p. The supporting documentation shall justify the actual achievement of the milestones as defined on the Payment Plan Specified in Appendix 1 hereto.

and

- Invoice(s);

and

- Receipt and/or acceptance, by the Agency, of all deliverable items, of the services to be rendered and other obligations to be fulfilled, in accordance with the terms of this Contract;
- The Contract Closure Documentation using the template provided in Appendix 3, Annex A.

3.2.3 Implementation of payments conditions

The Contractor shall ensure that all invoices and confirmations, are submitted for payment exclusively through the Agency's esa-p system.

The Contractor undertakes to adhere strictly to the instructions contained in esa-p (including those for billing taxes and duties, where applicable) when submitting invoices and confirmations through the esa-p system.

The Agency shall credit the account of the Contractor to the Contractor's benefit and to the benefit of the Contractor's Subcontractor(s).

The Contractor shall be responsible for approving or rejecting, within ten (10) calendar days of receipt, the relevant Subcontractor('s) (s') invoices and related supporting documents (e.g. MACs, Cost Reports).

The Contractor shall also be responsible for paying the accounts of its Subcontractor(s) for this Contract in accordance with the applicable law and normal commercial practices.

The Contractor shall indemnify the Agency against any claims arising from such Subcontractor(s), caused by the Contractor's failure to pay the Subcontractor(s). The Contractor shall supply to the Agency, upon request, evidence of payments made to its Subcontractor(s).

² For detailed information on how to submit and approve invoices, MACs and APR in esa-p you may consult the following two Quick Guides:

http://esa-p-help.sso.esa.int/QUICK_GUIDE_How_to_SUBMIT_a_MAC_or_INV_or_ADV.pdf

http://esa-p-help.sso.esa.int/QUICK_GUIDE_How_to_APPROVE_a_MAC_or_INV.pdf

The Agency reserves the right to visit the Contractor's and/or Subcontractor(s)'s premises and ascertain the progress of the work being performed under the Contract, prior to making the progress payment concerned.

The Contractor shall, upon request at any time by the Agency, submit the payment conditions / provisions of individual Sub-Contracts to the Agency for approval (if requested before the Sub-Contract is placed) or verification.

3.2.4 Absence of user account for esa-p:

If the Contractor has no access to the Agency's esa-p system at the time of signature of the present Contract, an immediate request for an esa-p user account shall be made by the Contractor to the ESA Helpdesk (idhelp@esa.int), specifying a contact name, the company name, and the ESA Contract number.

3.2.5 In case of esa-p not being operative:

Should the Contractor find the Agency's esa-p system technically inoperative at the moment of submission of the invoices, the Contractor may submit invoices in paper format in two (2) copies to the ESA Financial Operations Department of the responsible ESA establishment ESA-ESRIN Finance Payment Office, together with justifying documentation as required by the Contract.

Should the Contractor find the Agency's esa-p system technically inoperative at the moment of submission of the confirmation, the Contractor may submit the confirmation in paper format in three (3) copies to the Agency's Technical Officer mentioned in Article 5, Clause 5, Sub-Clause 5.1 a) of the Contract. A template confirmation form can be obtained upon request to the ESA Helpdesk (idhelp@esa.int).

3.2.6 Questions related to the esa-p system:

Any questions concerning the operation of esa-p shall be addressed to the ESA Helpdesk (idhelp@esa.int).

Any questions concerning the latest status of due invoices can be addressed to the ESA Payment Officer (mailto:esa.payment.officer@esa.int).

ARTICLE 4 - ITEMS PRODUCED OR PURCHASED UNDER THE CONTRACT

4.1. The following provisions apply to any items other than those items which fall within the scope of Article 2 of the Contract.

4.2. The title to the property of any items produced under the Contract, including electronic components, special jigs, tools, test equipment, and which are paid for under the Contract, with an individual or batch value in the national currency equivalent to, or above 5,000 Euro, shall pass to the Agency unless otherwise decided by the Agency.

In view of the above, all such items are to be delivered to the Agency at the end of the Contract. They may also be delivered at an earlier stage if so requested by the Agency where this will not cause a problem to the Contractor in completing the work specified in the Contract.

4.3. The Contractor shall maintain an inventory of all such items (called "Contract Inventory") and shall mark those items as falling under this Article of the Contract.

The inventory shall be updated and made available to the Agency during the execution of the Contract. A final issue of that inventory shall be submitted with the final contractual deliverables as foreseen in Appendix 3, Annex A, Table 2.1.2.

If that inventory also includes any of those items which fall within the scope of Article 2 of the Contract, these items are to be clearly set apart.

4.4. Upon completion of the work specified in the Contract, the Agency shall take decisions regarding the final destination and the final owner of each of the items listed in the Contract Inventory, apart from those which are governed by the provisions of Article 2.

The Agency shall be free to choose amongst the following options with respect to final destination and final owner:

- a) the right to claim delivery to the Agency and transfer of ownership – with issue of appropriate instructions concerning packing and shipment (at the Contractor's expenses),
- b) the right to claim transfer of ownership and to negotiate with the Contractor a loan agreement if the Contractor is interested in keeping and using an item that the Agency wants to acquire ownership of without delay, with loan conditions making the Contractor responsible for the custody, the delayed delivery and the risks involved (at the Contractor's expenses),
- c) the right to extend the custody of an item to the Contractor (for instance: as a protection measure for further work contracted by the Agency) and to postpone its delivery to the Agency and the associated transfer of ownership – on conditions to be negotiated,
- d) the renunciation of any rights to claim delivery and to claim transfer of ownership, leaving definitively the item in the possession and in the ownership of the Contractor, with or without financial compensation for the Agency (e.g. repurchase by the Contractor) and with or without special instruction,
- e) the right to request the Contractor to dispose of an item on conditions to be negotiated.

The decisions taken by the Agency shall lead to instructions or negotiations, as the case may be.

4.5. The Contractor shall comply with the Agency's instructions and with the agreements referred to in Article 4.4 above.

4.6. This process will be recorded as per the relevant part of the Contract Closure Documentation.

ARTICLE 5 - COMPLEMENTS AND AMENDMENTS TO THE GCC

The General Clauses and Conditions for ESA Contracts, ref. ESA/REG/002. REV 2 (GCC) apply to this Contract with the following complements and amendments:

PART I: CONDITIONS APPLICABLE TO ESA CONTRACTS

CLAUSE 2: APPROVAL AND ENTRY INTO FORCE

For the purpose of this Contract the authorised representative of the Director General is Mr Maurice Borgeaud, Head of the EO Science, Applications & Future Technologies Department (EOP-S)

CLAUSE 5: THE PARTIES' REPRESENTATIVES

Sub-Clause 5.1: The Agency's Representatives

The Agency's representatives are:

- a) Mr Diego Fernandez for technical matters or a person duly authorised by him ("Technical Officer").

All correspondence for technical matters will be addressed as follows:

	To:	With copy to:
Name	Mr Diego Fernandez	Mrs. Nathalie Boisard
Telephone No.	+39 06 94 18 06 76	+39 06 94 18 08 13
Fax No.	+39 06 94 18 06 02	+39 06 94 18 03 82
e-mail address	diego.fernandez@esa.int	nathalie.boisard@esa.int

- b) Mrs Nathalie Boisard (IPL-POE), for contractual and administrative matters, or a person duly authorised by her (the Agency's Contract Officer)..

All correspondence for contractual and administrative matters (with exception of invoices as mentioned in Article 3.2) will be addressed as follows:

	To:	With copy to:
Name	Mrs. Nathalie Boisard	Mr Diego Fernandez
Telephone No.	+39 06 94 18 08 13	+39 06 94 18 06 76
Fax No.	+39 06 94 18 03 82	+39 06 94 18 06 02
e-mail address	nathalie.boisard@esa.int	diego.fernandez@esa.int

Sub-Clause 5.2: The Contractor's Representatives

The Contractor's representative is:

- a) Mr Ole Baltazar Andersen for technical, contractual, and administrative matters or a person duly authorised by him ("Technical Officer").

All correspondence for technical matters will be addressed as follows:

	To:
Name	Ole Baltazar Andersen
Telephone No.	+45 45 25 97 54
Fax No.	+45 45 25 97 75
e-mail address	oa@space.dtu.dk

CLAUSE 9: KEY PERSONNEL

The Contractor's key personnel is listed in the Contractor's proposal referred to in Article 1.2 above.

CLAUSE 10: SUB-CONTRACTS

Part of the work is to be sub-contracted to the Subcontractors listed in Article 3.1 above.

CLAUSE 11: CUSTOMER FURNISHED ITEMS (CFI)

It is not foreseen that the Agency will provide any items in accordance with Clause 11 of the GCC to the Contractor.

CLAUSE 12: ITEMS MADE AVAILABLE BY THE AGENCY

Data originating from ESA Sea Level CCI, ESA Sea-Ice CCI and ESA Cryovex campaigns are currently available to DTU researchers and might be used it is not foreseen that the Agency will have to make any items available to the Contractor in accordance with Clause 12 of the GCC.

CLAUSE 13: CHANGES

The template of a Contract Change Notice (CCN) is attached hereto as Appendix 4.

CLAUSE 14 : TIME-LIMITS FOR THE PROVISION OF DELIVERABLES AND SERVICES

The Contractor may mark the deliverables documents with the following:

" © [COMPANY NAME] [YEAR OF PUBLICATION]

The copyright in this document is vested in [COMPANY NAME].

This document may only be reproduced in whole or in part, or stored in a retrieval system, or transmitted in any form, or by any means electronic, mechanical, photocopying or otherwise, either with the prior permission of [COMPANY NAME] or in accordance with the terms of ESA Contract No. 4000xxxxx/XX/XX/xx."



CLAUSE 15: HANDLING, PACKING AND TRANSPORT, TRANSFER OF OWNERSHIP AND RISK

The following provision is added as Sub-Clause 15.3.6 of the GCC:

Should in the execution of the Contract a need arise to provide the Agency with information which is subject to export control laws and regulations, the Contractor shall secure that such information is only passed on to the Agency in accordance with the provisions of such export control laws and regulations.

CLAUSE 17: PENALTIES/INCENTIVES

Penalties for late delivery do not apply, and similarly they will not apply in the subcontract(s) that may be placed by the Contractor.

CLAUSE 27: PRICING

Sub-Clauses 27.3 and 27.4 do not apply, unless in case of termination as per Clause 30 of the GCC.

CLAUSE 34: APPLICABLE LAW

The substantive law referred to in Clause 34 of the GCC is the law of Denmark. The scope of its applicability is as laid down in the said Clause of the GCC.

CLAUSE 35: DISPUTE RESOLUTION

The arbitration proceedings referred to in Clause 35 of the GCC shall take place in Copenhagen, Denmark.

PART II: CONDITIONS CONCERNING INTELLECTUAL PROPERTY RIGHTS FOR ESA STUDY, RESEARCH AND DEVELOPMENT CONTRACTS

For the purpose of this Contract:

- Part II, Option A of the GCC shall apply, as modified by the special provisions below.
- The free licenses provided for the benefit of ESA in the present Contract and in Part II of the GCC, shall be deemed granted through signature of the present Contract and without the need to implement a separate license.

The following provisions are added:

CLAUSE 36: GENERAL

The following provision is added to Sub-Clause 36.2 of the GCC:

The term “documentation” as defined in Annex IV to the GCC shall be interpreted to also include data files, CAD files, EXCEL® files and similar electronic files, which shall not be considered as “software” in the sense of Clause 42 of the GCC.

The electronic files containing these items shall be delivered to the Agency in the format agreed with the ESA Technical Officer.

CLAUSE 37: INFORMATION TO BE PROVIDED

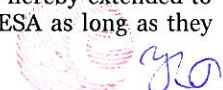
The following provision is added to Sub-Clause 37.2 of the GCC:

The Contractor shall not mark any documents as “Proprietary Information” unless agreed in advance with the Agency. Any request from the Contractor shall be submitted accompanied by an appropriate justification.

CLAUSE 38: DISCLOSURE

The following provision is added to Sub-Clause 38.2 of the GCC:

The access rights granted to the Agency’s employees under Sub-Clause 38.2 of the GCC are hereby extended to contractor personnel providing technical, management, legal or administrative support to ESA as long as they have signed an engagement of confidentiality.



CLAUSE 43: BACKGROUND INTELLECTUAL PROPERTY RIGHTS

In pursuance of the requirements of Clause 43.1 of the GCC, the following is recorded:

- a) The Agency, on the basis of evidence provided by the Contractor, recognises the following information to be provided by the Contractor as Background Intellectual Property:

Name/Description	Owner
CryoPortal software (database and modules for handling and accessing time series of ice velocity maps and mass fluxes for outlet glaciers)	ENVEO
Software for SAR and Optical Satellite data analysis	ENVEO

The Background Intellectual Property owned by the Contractor or a third party shall remain the property of the owner. Background Intellectual Property to which the Agency requires access for the sole purpose of technical or legal inspection during the execution of this Contract shall be treated as Proprietary Sensitive Information as set forth under 6.1.2 and 6.1.3 above.

- b) The Contractor has stated that the Background Intellectual Property will not affect any of the Agency's rights related deliverable items due under this Contract to the effect that the Agency can use all deliverables of this project within the intended use/objective of the ITT detailed in [AD-1 to AD-4] without needing access to the listed Background Intellectual Property.
- c) If the Contractor has not identified Background Intellectual Property Rights by the end of the Contract, all Intellectual Property Rights produced and used in connection with during the execution of the Contract are treated as arising from work performed under the Contract, unless and until the Contractor provides the Agency with evidence of the relevant Background Intellectual Property rights.

Notwithstanding the above, the following is agreed: if the Contractor, after the signature of the Contract, invokes the existence of any additional Background Intellectual Property to be used for the purposes of the present Contract, the Contractor shall provide conclusive evidence to the Agency of the existence of this Background Intellectual Property and shall justify the reasons for which the existence of this Background Intellectual Property was not invoked before the Contract signature.

If conclusive evidence and appropriate justification are provided by the Contractor, the Parties shall formalise a Contract Change Notice to specify in detail which Information has been recognised as Background Intellectual Property.

Conversely, if such evidence and justification are not provided, all information delivered shall be deemed as having been generated in the frame of the Contract.

Sub-Clauses 43.4 and 43.7:

For the purpose of Sub-Clauses 43.4 and 43.7 of the GCC, the term "Agency Project" shall refer to the activities under this contract.

Done in two originals, one for each Party to this Contract,

In: Lyngby.....

In: Frascati

On: 29/7 2016.....

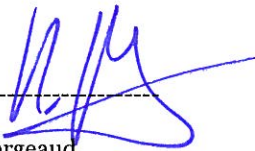
On: 26/7/2015.....

For DTU Space

For the European Space Agency (ESA)



Kristian Pedersen
Director



Maurice Borgeaud,
Head of the EO Science,
Applications & Future Technologies Department

APPENDIX 1: PAYMENT PLAN

PRIME CONTRACTOR PAYMENT PLAN		
Milestone Description	Scheduled dates	Payment in Euros To DTU [DK]
Milestone 1: Upon successful completion of Task 1 and acceptance of relevant deliverables	01 January 2017	59,994
Milestone 2: Upon successful completion of Task 3 and acceptance of relevant deliverables	01 August 2017	99,991
FINAL: Upon successful completion of the Contract and acceptance of all related deliverables	01 March 2018	39,996
TOTAL		199,981



DTU

APPENDIX 2: STATEMENT OF WORK

(Reference EOP-SA/0332/DFP-dfp, issue 1, dated 22/07/2015)



ESRIN

DOCUMENT

Via Galileo Galilei
Casella Postale 64
00044 Frascati
Italy
T +39 06 9418 01
F +39 06 9418 0280
www.esa.int

Support to Science Element (STSE) Arctic+

- An ESA-CliC initiative -

Statement of Work

Prepared by	ESA
Reference	EOP-SA/0332/DFP-dfp
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Distribution	EMITS



European Space Agency
Agence spatiale européenne

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1 INTRODUCTION

1.1 Scope

This activity is part of ESA’s [URL1] Support To Science Element (STSE) [URL2], a component of the Earth Observation Envelope Program (EOEP-4), aiming to reinforce the scientific component of the ESA Living Planet programme. STSE covers scientific support for both future and on-going missions, by taking a pro-active role in the formulation of new mission concepts and by offering a multi-mission support to the scientific use of ESA Earth Observation (EO) mission data and to the promotion of the achieved results. This Statement of Work (SoW) establishes the tasks to be performed within the Arctic+ projects.

This document will be part of the contract and shall serve as an applicable document throughout the execution of the work. It presents the background and objectives of the project, the tasks to be undertaken by the Contractor, the deliverables to be produced and the schedule of milestones to be achieved. During execution of the project, the Contractor shall comply with the requirements and tasks set out in this document.

This activity is a direct response to some of the major discussion points gathered during the ESA/CliC scientific consultation meeting on Earth Observation and Arctic Research Priorities held on 20 January 2015 at the Fram Centre in Tromsø, Norway.

The meeting aimed at reviewing and discussing the existing scientific knowledge gaps and research priorities areas for the Arctic where EO may contribute for the next decade.

The outcome of this workshop was reported in a document [URL4], which will contribute to guide ESA's scientific activities on Arctic research for the time frame 2017-2021.

This Activity aims at contributing to the development of a strong Arctic component in upcoming ESA EO programmes, with the ultimate goal to foster a coordinated European approach to Arctic science and research through a strong collaboration with EC DG-RTD and national programmes, aligning programming and developing a coherent work plan of complementary investments.

Arctic+ will focus on five separate Themes:

- Theme 1: Snow on sea ice;
- Theme 2: Sea ice mass intercomparison;
- Theme 3: Freshwater fluxes;
- Theme 4: The Arctic ocean-atmosphere-sea-ice interactions;
- Theme 5: Contributions to the Year of Polar Prediction (YOPP).

Within this Activity, ESA plans to support five independent studies (one for each of the above themes).

In this context, Arctic+ aims at supporting the scientific community and to value-adding companies of ESA Member States to carry out leading edge research activities to advance the use of ESA and non-ESA EO missions towards the achievement of major scientific challenges identified by the CliC and Cryosphere community for the next decade.

The Arctic+ studies aim at setting up a solid basis for larger actions in the time frame 2017-2021.

1.2 Structure

The document is organized in five sections:

- Section 1: introduces the project. It outlines the scope of the procurement and the structure of the document; this section also lists the common reference documents as well as the web sites that are relevant for this procurement;
- Section 2: presents the problems faced and establishes the objectives of the project;
- Section 3: provides a generic description of the project tasks;
- Section 4: contains management and reporting activities;
- Section 5: includes the schedule and milestones.

1.3 Reference Documents (RDs)

The following documents can be consulted by the Contractor as they contain relevant information:

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1.4 Relevant Websites

[URL1] ESA web site: www.esa.int

[URL2] STSE web site: www.esa.int/stse

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ESA-CLIC STSE Arctic+ Arctic Cryosphere

Date 11/06/2015

European Space Agency
Agence spatiale européenne



[URL3] CryoSat web site: <https://earth.esa.int/cryosat>

[URL4] http://due.esrin.esa.int/stse/files/document/Arctic_Agenda_2015_v8.pdf

1.5 Acronyms and Abbreviations

AD	Applicable document
ADB	Actions database
AMOC	Atlantic Meridional Overturning Circulation
ATBD	Algorithm theoretical basis documents
BRO	Brochure
CliC	Climate and Cryosphere
DIR	Directory
DS	Dataset availability
DS-UM	Dataset user manual
DVP	Development and validation plan
EDS	Experimental dataset
EMI	Electromagnetic Interference
EO	Earth Observation
EOEP	Earth Observation Envelope Program
ESA	European Space Agency
FR	Final review
FWF	Freshwater fluxes
GCOS	Global Climate Observing System
IAR	Impact assessment report
ITT	Invitation to tender
IPP	Year of Polar Prediction
KO	Kick-off
MR	Monthly report
MTR	Mid-term review
MV-TN	Modelling and validation technical note
PAR	Preliminary analysis report
PGICs	Peripheral glaciers and ice caps

PM	Progress meeting
PMP	Project management plan
RD	Reference document
RB	Requirements baseline
SAR	Synthetic Aperture Radar
SIAR	Scientific and impact assessment report
SMOS	Soil Moisture and Ocean Salinity
SoW	Statement of work
SR	Scientific roadmap
STSE	Support to Science Element
TDP	Technical data package
TN	Technical note
VIR	Validation and intercomparison report
VR	Validation report
WCRP	World Climate Research Programme
WP	Work package
WS	Workshop minutes
WWRP	World Weather Research Programme



2 PROJECT BACKGROUND AND OBJECTIVES

2.1. Background

ESA and EC RTD have recently put in place a strategic partnership on the Arctic. The scope of the strategic partnership is to coordinate activities, align work programmes in fields of common interest and to have a coherent work plan and activities to be carried out with the objectives of supporting the definition and implementation of the future EU Arctic Policy, contributing to the creation of an integrated observation system for the Arctic, establishing a European Arctic science programme, and enabling the development of Arctic climate services.

In this context, Arctic+ is an ESA-CliC collaboration that makes part of the ESA-EC partnership for the Arctic.

The Arctic is a complex region, encompassing different physical and biogeochemical processes and interactions among several components of the Earth system (e.g., sea ice, ocean, glaciers, ice caps, the Greenland Ice Sheet, snow, lakes and river ice, permafrost, vegetation, complex interactions with the atmosphere, people, etc.). Changes in the Arctic have a strong impact on the Earth's climate system, the global energy budget, the ocean circulation, the water cycle, gas exchanges, sea level, and biodiversity (AMAP, 2011). Considering that all of Earth's inter-connected components respond to changes in air temperature, the Arctic is a sensitive indicator of climate variability and change.

The global climate system is revealing evidence of rapid change, largely amplified over recent decades [REF1; REF2; REF3]. Possible explanations exist, with several stating that current changes complement one another and lead to cascading effects on a global scale; other changes may function individually and act as local or regional climatic contributing factors. In both situations, the explanations may refer to either natural variability of the climate system or to anthropogenic-related drivers. In this context, the Arctic region, highly sensitive to climate variations and extremely responsive to external forcings, is experiencing rapid changes. Understanding the different processes, its variability and the different feedback mechanisms within the Arctic system, (i.e. interactions between ocean, sea ice, atmosphere and land) represents a mandatory step towards better predictions, EO being a critical tool to provide part of the required observations.

As reported [REF3], observed changes in the Arctic show that over the last three decades (1979-2015) the Arctic sea ice has continued to decrease in extent at a rate of 3.5-4.1 % per decade, with loss of perennial ice extent occurring at a rate of 11.5% ($\pm 2.1\%$) per decade. At the same time, average winter ice thickness has decreased by 1.3-2.3 m (1980-2008), this being consistent with the decrease in perennial and multi-year ice extent. Satellites have revealed that peripheral glaciers and ice caps (PGICs) have continue to shrink worldwide, with most of the ice loss occurring for glaciers in Alaska, the Canadian Arctic and the periphery of the Greenland ice sheet [REF4; REF5]. Satellite data, complemented by climate modelling, also suggests that mass loss from the Greenland Ice Sheet has been accelerating since mid-1990s [REF6; REF7] and is now one of the largest mass contributor to sea level rise. Satellite records (1967-2012) also show that the annual mean snow-cover extent in the Northern Hemisphere has decreased significantly, with the greatest change occurring in June (-40% to -66%) [REF3]. Satellite records of NDVI since 1982 have shown

increasing greenness over large parts of the Arctic where summer warmth has increased [REF8], consistent with ground-based and airborne observations of increases in forest-type vegetation. The limited observations of freshwater ice in lakes and rivers indicate that due to later freeze-up and earlier break-up, the duration of the lake-ice season has shortened. For example, model simulations and satellite synthetic aperture radar (SAR) observations for over 400 lakes near Barrow, North Slope of Alaska indicate that between 1991-2011, lake-ice season duration decreased by ~1 day per year, lake ice thickness declined by a total of 18-22 cm, and fewer lakes froze to the bed (grounded ice), with an overall reduction in grounded ice of 22% [REF9]. Following an increase in permafrost temperatures in most regions during the last decades, general ice-rich permafrost degradation has been observed from both *in situ* and satellite observations, with significant changes in the Russian European North. There, warm permafrost up to 15 km thick completely thawed and the southern boundary of the discontinuous permafrost moved northwards by 80 km, while that of the continuous permafrost advanced northwards by 50 km [REF3].

Despite considerable research progress in understanding the Arctic region over the last decades, many gaps remain in observational capabilities and scientific knowledge. These gaps limit present ability to understand and interpret on-going processes, prediction capabilities and forecasting in the Arctic region, thereby hampering evidence-based decision making. Addressing these gaps represents a key priority in order to establish a solid scientific basis for the development of future information services for the Arctic.

In this context, on the 20th January 2015, ESA and the Cryosphere project of the World Climate Research Programme (CliC-WCRP) organised a scientific consultation meeting in Tromsø with the main objective of gathering recommendations from the scientific community on the most pressing priorities for Arctic research, where EO may contribute in the coming decade. The workshop resulted in a report [REF10] listing a number of different priority areas that will contribute to establish a strong focus on Arctic research in the next components of ESA EO programmes for the period 2017-2021.

In order to put words in actions, this ITT aims at addressing some of these priorities as an starting point for future larger activities. In particular, with this ITT, five priority areas will be addressed at feasibility and demonstration level with the ultimate target of establishing a solid scientific basis to initiate larger research actions from 2017.

It is worth mentioning that ESA is at present time supporting a number of research and application projects addressing different priority areas that complement the selected priorities of this ITT. In addition, further actions will follow in the future to address other topics.

2.1 Objectives

Arctic+ aims at advancing towards the achievement of some of the most pressing priorities in Arctic science, where EO and ESA data may contribute. In particular, the main overarching project objective is threefold:

- 1) Supporting the development of novel EO-based products and enhanced data sets responding to the needs of the Arctic science community;

- 2) Fostering new Earth system scientific results addressing the main priority areas of Arctic research, where space technology may provide a valuable input;
- 3) Preparing a solid scientific basis for stating larger development activities addressing the priorities of the Arctic science community in the timeframe 2017-2021.

This shall involve the collaboration among the different scientific communities involved in Arctic process studies, modellers and EO experts, as well as coordinating with existing EC and national projects addressing Arctic science and the GEO cold region initiative. Coordination with the projects of the future calls on the Arctic under the Horizon 2020 WP 2016-17 – expected to be published in October 2015 – shall be considered as well.

In this context, in the medium and long-term, the objectives of the project include:

- To foster the scientific exploitation of EO-based geo-information products (maximising the use of ESA data) to respond directly to the needs of the Arctic scientific community in the context of five selected thematic areas;
- To support existing international and national efforts to improve the observation, understanding and prediction of ocean-sea-ice-atmosphere processes at different spatial and time scales demonstrating the capability of EO and ESA data to respond to the needs of the Arctic research community;
- To support the establishment of a solid scientific basis for the development of potential future operational services for the Arctic;
- To develop a Scientific Roadmap as a basis for further ESA activities in support of the Arctic research and applications to be further developed and consolidated within future actions in the context of the ESA-EC partnership for the Arctic.

2.2 **Brief Description of the *Arctic+* Themes**

2.3 **Theme 1: Snow on Sea Ice**

Snow on sea ice was identified by the Global Climate Observing System (GCOS) as a major source of uncertainty in both ice thickness and ice concentration retrieval from satellite data. As such, a much larger effort should be put into using all available data (active/passive microwave, optical, *in situ*/airborne observations) to quantify key snow parameters (e.g., thickness, density). Snow parameters are not only important for processing of remote sensing data but also for thermodynamic (and even some dynamic) processes. Due to its low thermal conductivity, the presence of snow on sea ice greatly modifies its thermodynamics, affecting seasonal accretion and ablation rates [REF11]. Because of its high albedo compared with that of sea ice, snow dominates the surface shortwave energy exchange. Also, by smoothing the ice surface, snow greatly modifies the ice-air drag coefficient and the bulk transfer coefficients for latent and sensible heat. It also has a first-order effect on the microwave properties of the surface,

leading to ambiguity in retrievals of sea-ice type and concentration from satellite data. Snow thickness on sea ice is still poorly known and current thickness estimation with satellite passive microwave radiometer data has poor accuracy due to the sensitivity of the microwave wavelengths to ice surface roughness [REF12]. Activities towards improved estimation of snow thickness over sea ice (e.g., based on dual-frequency SAR, combined laser and radar altimetry) are needed. The availability of complementary data from CryoSat-2 and AltiKa (35.75 GHz) and also from the forthcoming Sentinel-3 (13.57 GHz altimeter) along with scatterometers may offer a starting point to explore this capability. In addition, the availability of ICESat-2 mission from 2017 in combination with CryoSat-2 may allow snow depth retrieval in cold conditions.

In this context the primary objectives of this Theme are:

- Explore, develop and validate different approaches to retrieve snow thickness over sea ice, maximizing the use of ESA data in synergy with additional datasets;
- Based on a thorough experimental analysis, identify the best option and implement a prototype processor;
- Develop an experimental dataset over the Arctic;
- Validate the experimental dataset with *in situ* data and perform an impact assessment on the utility of the data;
- Develop a scientific roadmap for the future evolution of this Theme.

2.4 Theme 2: Sea Ice Mass

Sea-ice mass is an important measure of quantity because it offers the most direct link to environmental changes. In fact, changes in other attributes, such as sea-ice extent or thickness, can arise with no net change in sea-ice mass amount (and vice versa).

Satellite observations have delivered routine assessments of sea-ice extent for decades and historically, relatively sparse airborne or submarine-based observations of sea-ice thickness have been used to develop estimates of sea-ice volume change. Over the past decade, a range of satellite-based estimates of sea-ice thickness has become available from a number of sensors, making systematic assessments of regional and basin-scale volume trends in the Arctic [REF13; REF14; REF20; REF21].

Converting sea-ice volume into sea-ice mass is a rather complex task. Sea ice is often covered by snow of different density and thickness and this complicates retrievals and assessments of the sea-ice mass. To determine with some degree of accuracy the contribution of snow to the observed satellites parameters (e.g. change of elevation) and distinguish between fluctuation of snow and ice mass, climatological models have to be used.

However, given the variety of satellite - and model-based approaches for estimating changes in sea-ice extent, thickness, and snow depth, differences between assessments of sea-ice mass balance are to be expected. A formal inter-comparison exercise to establish



the extent to which these various measurements agree is therefore timely, and will lead to improved confidence in assessments of sea-ice mass balance.

In this context, the primary objectives of this Theme are:

- Review and identify all different data products (*in situ*, satellite observations), models, approaches and methods used nowadays to compute sea-ice mass;
- Perform an initial inter-comparison exercise with focus on the accuracies and uncertainties of different approaches;
- Explore and demonstrate possibilities to compute a reconciled estimate (e.g., ensemble approaches, weighted averages, triple collocation) of the sea-ice mass and sea-ice mass multi-decadal evolution based on existing methods, data and models;
- Prepare for a formal inter-comparison exercise aimed at assessing and reconciling different estimates and move towards a community multi-decadal assessment of ice mass evolution and its impacts;
- Develop a scientific roadmap for the future evolution of this Theme.

2.5 Theme 3: Freshwater fluxes

Freshwater fluxes (FWF) play an important role in ocean stratification and circulation. In the Arctic and sub-polar North Atlantic, they are also important for marine productivity. Changes in ocean circulation, in the strength of the Atlantic Meridional Overturning Circulation (AMOC) in particular, can have impacts on the climate system at global scale. As a consequence, oceanographic observational transects have been established to monitor the strength of the AMOC at key latitudes. However, these observations provide limited information on the causes of change. Large fluxes of freshwater are transported out of the Arctic Ocean each spring via sea-ice export through the Fram Strait. Riverine runoff into the Arctic Ocean (the riverine coastal domain) is also a key contributor to the FWF and nutrient balance of the Arctic that can be better estimated by a combination of satellite altimetry, river outline mapping, near-simultaneous space imagery, and *in situ* measurements.

In the last two decades, FWF from the Greenland Ice Sheet and Canadian Arctic have been steadily increasing into both the Arctic and North Atlantic Oceans. Finally, precipitation-evaporation (P-E) also plays a central role in modulating the FWF and, as a consequence, the hydrography of the region. Observational evidence from both satellites and *in situ* data indicates significant changes in the freshwater balance of Arctic seas. Satellite altimetry can provide information on geostrophic flow, ocean circulation and mesoscale variability.

Synthetic Aperture Radar (SAR) data have proved to be invaluable for accurately tracking sea-ice transport, while Soil Moisture and Ocean Salinity (SMOS) might provide measurements of surface salinity changes (despite the fact that L-band radiometry presents problems of sensitivity in high-latitude cold waters). Combined with data on sea-surface temperature, this provides important information about thermohaline flow and mixing of surface waters. The mass imbalance of the Greenland Ice Sheet, and hence its freshwater input into the Arctic Ocean can be determined from satellite altimetry. Thus, a

combination of satellite observations can provide key information about FWF into and out of the Arctic seas.

In this context, the primary objectives of this Theme are:

- Identify the mayor challenges and knowledge gaps in the estimation of the Arctic freshwater budget;
- Explore, develop and validate different approaches to address those challenges and enhance current approaches to compute the freshwater budget of the Arctic maximizing the use of ESA data;
- Compute a multi-year assessment of the Arctic freshwater budget based on the developed methodology;
- Validate the results, compute uncertainty of the estimates and compare the obtained results with existing alternative estimates;
- Develop a scientific roadmap for future research activities in this domain

2.6 Theme 4: Ocean-atmosphere-sea-ice interactions

The Arctic Ocean has been a “serene region” for decades with the sea-ice layer dampening waves. However, this situation is changing as summer sea-ice extent is diminishing. The rapid loss of summer sea-ice cover is changing the way that the sea ice, ocean and atmosphere interact at different levels.

The reduction of sea-ice cover extent fosters the formation of internal waves in Arctic waters that could perhaps accelerate the loss of sea ice. [REF15] report that Arctic waters along continental shelves are becoming more turbulent as the summer sea ice disappears and waves start churning the water as in other oceans. These underwater waves have different impacts on the Arctic Ocean. On one hand, they increase the turbulent behaviour of the ocean, making it more productive and bringing nutrients from deep waters closer to the surface. On the other hand, a more turbulent Arctic Ocean could accelerate the melting of Arctic sea ice. In particular, unlike any other ocean basins, the Arctic is fresh and cold at the surface from melted ice, while it is very salty and slightly warmer below. If turbulence mixes these waters, the warmer surface could accelerate the melting of sea ice.

Furthermore, a reduced sea-ice extent increases the forcing of the atmosphere on the ocean surface augmenting the fetch and surface sea state that interacts with the sea ice and may affect the formation rates. In particular, ice break-up enhances ice melt rate by increasing the area of open water for absorption and providing a larger surface area for lateral melting. Wave conditions also alter the refreezing process [REF16]. If the current trend in sea-ice extent reduction continues, a larger fetch for wave development will be available. This increased fetch will promote the formation of larger waves of lower frequency and higher energy [REF17] waves that were associated with a reduced ice cover in the Arctic Ocean during recent years [REF18]. Since lower-frequency waves propagate farther into the ice pack, there is potential for more wave energy to affect a larger area of sea ice and



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potentially increase the break-up of the sea ice cover [REF19]. The consequences and magnitude of this feedback mechanism remain an open question.

Storms, characterized by strong winds and high waves, may also play a major role in this process, leading to vertical mixing processes that can affect the cold halocline layer and possibly contribute to a positive feedback that affects sea-ice formation. Understanding the impact of these events on climate is still unknown and needs to be investigated.

In this context, the objectives of this Theme are:

- Identify the major challenges, knowledge gaps and problem areas to better understand, characterise and monitor the sea-ice-ocean interactions in the Arctic;
- Explore the potential of EO technology to understand, characterise and monitor these processes, maximising the use of ESA data;
- Develop and implement a number (at least two) science cases to investigate (at least: 1) the feedback effect of sea-ice and sea-state and 2) the impacts of storms on sea-ice) and explore and demonstrate the potential of EO technology to address and monitor these processes;
- Validate and perform an impact assessment of the test cases results;
- Generate a scientific roadmap for further evolution of this Theme.

2.7 Theme 5: Contributions to Year of Polar Prediction (YOPP)

Over the next several years, attention will be focused on this through the World Weather Research Programme (WWRP) Polar Prediction Initiative, which is stimulating the "Year of Polar Prediction (YOPP) in 2017-18" – with some large Arctic drifting ice camp (Mosaic), icebreaker, and augmented *in situ* measurements. The YOPP will be supported trilaterally by the EU, US and Canada, and the collection of space agencies in the Polar Space Task Group.

The YOPP aims at enabling a significant improvement in environmental prediction capabilities for the Polar Regions and beyond, by coordinating a period of intensive observing, modelling, verification, user-engagement and education activities. The YOPP is one of the key elements of the Polar Prediction Project. YOPP is scheduled to take place from mid-2017 to mid-2019. In particular, YOPP will:

- Cover an extended period of coordinated intensive observational and modelling activities in order to improve polar prediction capabilities on a wide range of time scales in both polar regions;
- Strongly engage in forecast-stakeholder interaction, verification and a strong educational component;
- Foster relationships with partners, provide common focussed objectives, and be held over a bit more than a one-year period in association with a field campaign providing additional observations;
- Coincide with, support, and draw on other related planned activities for polar regions;
- Be implemented in three different stages: a preparation phase (2013-2017), YOPP itself (mid-2017 - mid-2019), and a consolidation phase (2019-2022).



The main objectives for YOPP are to:

- Improve the polar observing system to provide good coverage of high-quality observations in a cost effective manner;
- Gather additional observations through field programmes aimed at improving understanding of polar key processes;
- Develop improved representation of polar key processes in uncoupled and coupled models used for prediction, including those which are a particular hindrance to high-quality prediction for the polar regions, such as stable boundary layer representation, surface exchange, and steep orography;
- Develop improved data assimilation systems that account for challenges in the Polar Regions such as sparseness of observational data, steep orography, model error and the importance of coupled processes (e.g., atmosphere-sea ice interaction);
- Explore the predictability of sea ice on time scales from days to a season;
- Improve understanding of linkages between Polar Regions and lower latitudes and assess skill of models representing these.
- Improve verification of polar weather and environmental predictions to obtain quantitative knowledge on model performance and on the skill of operational forecasting systems for user-relevant parameters, and efficiently monitor progress;
- Improve understanding of the benefits of using existing prediction information and services in the polar regions, differentiated across the spectrum of user types and benefit areas;
- Provide training opportunities to generate a sound knowledge base on polar prediction related issues.

There is a significant potential to link existing ESA efforts and planned R&D activities to this initiative (e.g., assimilation of CryoSat-2/SMOS NRT thickness) and newly tailored Sentinel products (e.g., albedo or ice surface temperature products from Sentinel-3 and Sentinel-2).

In this context, the objectives of this Theme are:

- Study the potential contribution of ESA data to the objectives of the YOPP;
- In particular, explore and demonstrate the potential offered by:
 - Archived (ERS-1, ERS-2, ENVISAT) and new data (e.g., from CryoSat, SMOS, ADM-Aeolus) and related product as part of the potential core datasets for improving regional and global prediction within the objectives of YOPP.
 - Long-term data records generated as part of the ESA Climate Change Initiative.
 - The Sentinel data that will be available in the YOPP timeframe;
- Demonstrate through a number of test cases the validity of the proposed contributions;
- Establish eventually new user requirements and recommendations for new datasets and novel products.
- Generate a roadmap to start dedicated activities in support of the YOPP in 2017.



3 GENERIC DESCRIPTION OF THE PROJECT TASKS

In the following, a generic description for each of the tasks to be carried out in the context of *Arctic+* is provided. The proposed tasks are common to all Themes. Any possible departure from the presented structure shall be properly justified by the Contractor.

The projects shall be completed within a maximum of 18 months from kick-off.

- Task 1: Scientific Requirement Consolidation;
- Task 2: Dataset collection;
- Task 3: Development and Validation;
- Task 4: Prototype Demonstration and Impact Assessment;
- Task 5: Scientific Roadmap.

Task 1: Scientific Requirements Consolidation

Description:

In this task, the Contractor shall consolidate the preliminary scientific requirements for the investigated Theme. This shall include:

- A detailed review, assessment and analysis of the main scientific challenges, knowledge gaps and scientific problems to be addressed in the project.
- A survey of all accessible associated datasets (space, airborne and *in situ*) to be used for development and validation (problems such as the lack of sufficient datasets shall be investigated and practical solutions identified);
- A survey of current and on-going initiatives (e.g., CliC activities) and projects (e.g., EC, national) related to the investigated Theme and a clear description of the added value of the work to be carried out with respect to existing activities;
- An analysis and identification of the best candidate test areas to be used in successive tasks for development and validation of the prototype products. This shall include a complete analysis and description of the available data over those test areas.

This Task shall be complemented by a consolidated risk analysis pointing out which risk areas could affect the final success of the project (as concerns the considered Theme) and the proposed solutions.

On the basis of such analysis, the Contractor shall then derive a consolidated, coherent and complete view of the scientific and operational requirements associated with the topic in consideration. Moreover, the Contractor shall describe in detail the technical and scientific constraints for the methods and models to be developed.



Deliverables:

- Requirement Baseline (RB): This document shall capture the outcome of the above tasks and preliminary analysis, and include a complete and detailed description of the information requirements concerning the investigated Theme. The RB will represent the basis for all the activities to be carried out during the project.

Task 2: Dataset Collection

Description:

A database of suitable products based on Earth Observation (EO), airborne, *in situ* data and relevant ancillary information shall be collected over the areas of interest in order to perform the required work. The database shall be made accessible on a project webpage and described in detail in a user manual.

Any restrictions in the use of any type of datasets (e.g., proprietary campaign data) shall be communicated to ESA in due time.

The datasets shall be used in later tasks for development and validation purposes.

Deliverables:

- Dataset;
- Dataset Description: this document provides a detailed description of the dataset as well as related metadata.

Task 3: Development and Validation

Description:

In this task, the Contractor shall explore, analyse, develop and test and select the necessary methods and algorithms to derive the required based products and develop the target test cases relevant to the Theme in question.

Major scientific efforts shall be devoted to this task to perform a thorough experimental analysis on different test sites in order to develop the suitable algorithms and novel prototype products.

The final methods and algorithms shall be selected on the basis of a detailed experimental



analysis of the potential alternative methods and approaches supported by a sound inter-comparison and validation.

In this context, a detailed experimental error analysis for testing and verifying all the different implementation choices and ultimately evaluate the accuracy and reliability of the developed methods and products shall be carried out under different sites, assumptions or conditions that could affect or influence the performances of the methods and the final accuracy of the products.

A detailed description of the final version of the algorithms (including related data sources, processing steps and output data) shall be reported by the Contractor in the form of an ATBD. This shall also include a scientific analysis of the results driving to specific development choices and trade-offs (including technical considerations justifying the selected methodologies).

In addition, when required by the Theme objectives, a detailed cross-comparison of the resulting products/estimates with existing EO-based equivalent/alternative datasets shall be performed in order to gain a thorough understanding of the range of validity, limits and benefits of the different existing products in the relevant thematic area.

The Contractor shall also report a detailed description of the error and validation analysis as well as the cross-comparison experiment exercise into the Validation Report (VR).

Deliverables:

- ATBD: This document shall describe in detail all the algorithms, methods and models implemented for the selected Theme. The report shall also include all related input data and its sources, processing steps and output data. In addition, this document shall report a scientific analysis of the results driving to specific development choices and trade-offs for all the algorithms implemented for developing the whole suite of target products. Technical considerations justifying the selected methodologies shall be also provided.
- Product VR: This document shall describe all the experimental error analysis and validation activities carried out.

Task 4: Prototype Demonstration and Impact Assessment

Description:

On the basis of the developed methodology, the target prototype products shall be generated (hereinafter called experimental dataset) and the proposed application shall be demonstrated over a number of selected areas and suitable time frames.

The geographical areas and the time frames to be covered by the dataset shall be representative of the faced scientific problem and application, allowing a complete demonstration of the feasibility of the proposed methodology and its potential value in terms of scientific and operational potential returns.

This experimental dataset shall be integrated into the project dataset generated in Task 3 and the user manual shall be updated accordingly. The experimental dataset shall be publicly available via the project website.

On the basis of the resulting dataset, the Contractor shall interpret, analyze and quantify the impact and benefits of the results obtained in the context of the considered Themes. This shall include:

- Comparison of the results with existing and current state of the art results quantifying the improvement of the development methods and models;
- Analyse the errors/uncertainties;
- Investigate the potential of the derived product to enhance the current knowledge and state-of-the-art in the context of the relevant Theme;
- Determine the benefit and impact of the obtained results on the specific test areas considered in the project in close collaboration with the relevant scientific and user communities;
- Determine the general potential benefit and impact of the results on the scientific and operational areas addressed by the project.

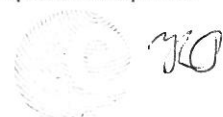
Deliverables:

- Experimental dataset publication on the web;
- Updated dataset user manual;
- Impact Assessment Report (IAR): This document shall collect the final findings and results of the Impact Assessment.

Task 5: Scientific Roadmap

Description:

In this task, the Contractor shall define a Scientific Roadmap for fostering future developments aimed at transferring the outcomes of the *Arctic+* project (as concerns the investigated Theme) into future scientific activities for the time frame 2017-2021 and where applicable, into pre-operational services in the future. In this context, the consultation with scientific and existing operational organisations which operated in the Arctic is considered fundamental. Note that at least the following issues shall be considered:



- Providing a critical analysis of the project results obtained vs. the specific scientific objectives of the project and the challenges associated to the Theme.
- Identifying the required additional scientific work and developments to further advance towards achieving the overarching scientific objectives of the Theme;
- Identify potential observational gaps (satellite, in-situ) that may be addressed in the future by novel products, new datasets, in-situ campaigns and or even future missions;
- Investigate the potential for integrating the project results into existing or planned large scientific initiatives;
- Define a solid scientific agenda and development and evolution plan for the project in the timeframe 2017-2021.
- Identify and coordinate with the relevant projects and teams at international, EC and national level that may be relevant for a potential project evolution in the time frame 2017-2021, ensuring that the proposed roadmap fits within planned projects and initiatives in preparing the future;
- Defining a potential plan for fostering a transition from research to operational activities, when relevant;

Deliverables:

- Scientific Roadmap (SR): This document shall define strategic actions for expand the work done under Arctic+ towards larger scientific activities in the period 2017-2021 in support of Arctic research.

4 MANAGEMENT, PROMOTION AND COORDINATION

4.1 6.1 Promotion and coordination

The Contractor shall:

- Promote the Project(s) results within the relevant scientific and/or operational communities;
- Promote the resulting products, methods and datasets to the user community;
- Represent the project at scientific conferences and other international forums through scientific presentations and exhibitions;
- Based on the results provide multimedia content to be used for communication, educational and promotional purposes, such as image files, animations, presentation slides, etc.;
- Submit at least one paper to an international peer-reviewed journal.



In addition and as a minimum, the following items shall be delivered (the contents and format of all promotional material shall be submitted to ESA for approval):

Project Website: before the end of Task 1 a website for the project shall be developed. The contents of the website shall be submitted to ESA for approval. This website shall also provide a direct access to the different products and datasets developed during the project. This shall include an internal webpage (password protected, accessible to ESA and consortium members) for supporting management and documentary activities.

The project webpage content shall be maintained and updated by the Contractor at least every month to include updated deliverable items and content for the duration of the contract.

The Contractor shall also coordinate with the relevant projects and teams at international (e.g., CliC), EC (e.g., existing projects or project originated from the future calls on the Arctic under the Horizon 2020 WP 2016-17 – expected to be published in October 2015) and national level that may be relevant for the project and in particular for preparing a SR (Task 5) for further developments in this domain, ensuring that the proposed activities are well coordinated with existing projects and initiatives in preparing the future.

4.2 6.2 Management and reporting

The Contractor shall provide at least the following management deliverables:

- Monthly Executive Summary Progress Reports (maximum one page);
- Final Report for public access;
- Executive summary of the project summarising relevant achievements.

The schedule of planned activities shall comply with the milestones reported in the table below. In addition, a Progress Meeting (PM) will take place every three months (by video or teleconference).

The following meetings shall be planned:

Meeting name	ID	Venue	Schedule
Kick Off Meeting	KO	N/A	KO (by teleconference)
Mid-Term Review	MTR	Contractor premises	KO+8 months
Final Review	FR	ESRIN	KO+18 months

The Contractor shall provide electronic versions of all presentations, hand-outs, deliverables, reports and presentations for each progress meeting **at least one week in**



advance of the meeting, via the website. All material required to conduct the meeting shall be accessible by all participants of the meeting (ESA and others).

The Contractor shall provide electronic versions of all final presentations and meeting minutes (including presentation slides and word processor documents) made at every meeting at the project website within 2 weeks following each progress meeting.

Electronic copies of the hand-outs used during each progress meeting, including at least the meeting agenda, a contact list for all meeting attendees and minutes from the previous progress meeting, shall be provided by the Contractor.

The following table summarises the deliverables for all the tasks:

Activity	Deliverable
Scientific Requirement Consolidation	<ul style="list-style-type: none"> • Requirement Baseline (RB)
Dataset Collection	<ul style="list-style-type: none"> • Dataset • Dataset User Manual
Development and Validation	<ul style="list-style-type: none"> • Algorithm Theoretical Basis Documents (ATBD) • Product Validation Report (VR)
Prototype Demonstration and Impact Assessment	<ul style="list-style-type: none"> • Experimental Dataset • Updated Dataset User Manual • Impact Assessment Report (IAR)
Scientific Roadmap	<ul style="list-style-type: none"> • Scientific Roadmap (SR)
Promotion	<ul style="list-style-type: none"> • Project website • Publications • Presentations • Communication material
Management	<ul style="list-style-type: none"> • Executive Summary Progress Reports • Final Report • Executive Summary

5 DATA ACCESS

It is the responsibility of the Contractor to secure access to the relevant data sets (i.e. satellite or campaign) required for this activity. Bidders or team members who are not already registered users of ESA data may register by following instructions found on the Earth Observation Data Access portal (<https://earth.esa.int/web/guest/pi-community/apply-for-data>). Further information may be obtained by sending an e-mail to eohelp@esa.int.

It is worth noting that the work to be performed in *Arctic+* will require the availability of additional data sources (satellite data, ancillary information and airborne or *in situ* measurements) beyond ESA data. Accordingly, the Contractor shall have granted access to the required data sets to perform the project.

All potential restrictions in the use of the non-ESA, or non-ESA third party missions, data used in the project shall be communicated to ESA in due time.

Data procurement can be quoted, but all the procurement with the ESA budget will be property of ESA and will only be put at the disposal of the Contractor in the framework of the project. Terms and conditions from the Data Distributors are to be fully understood and strictly fulfilled.

Due to the Research and Development (R&D) nature of the present activity, the Contractor shall explore the possibility of acquiring non-ESA data required for the project at an R&D compatible price.

APPENDIX 3: STANDARD REQUIREMENTS FOR MANAGEMENT, REPORTING, MEETINGS AND DELIVERABLES (Rev 2: 2015-06)

This document contains standard requirements for Management, Reporting, Meetings and Deliverables for contracts to be placed by the Agency. The applicable Statement of Work (Appendix 2 to the Contract) has priority over the present document in case of conflict.

1. MANAGEMENT

1.1. General

The Contractor shall implement effective and economical management for the Project. His nominated Project Manager shall be responsible for the management and execution of the work to be performed and, in the case of an industrial team, for the coordination and control of the industrial team's work.

1.2. Access

- a) During the course of the Contract the Agency shall be afforded free access to any plan, procedure, specification or other documentation relevant to the programme of work. Areas and equipment used during the development/testing activities associated with the Contract shall also be available for inspection and audit.
- b) The Contractor shall notify the Agency at least three weeks before the start of any test programme, or as mutually agreed, in order to enable the Agency to select those tests that it wishes to witness. The Agency shall notify the Contractor of its visit at least one week in advance.

2. REPORTING

2.1. Minutes of Meeting

- a) The Contractor is responsible for the preparation and distribution of minutes of meetings (see ECSS-M-ST-10C Rev. 1 section 5.2.2 for more details) held in connection with the Contract. Electronic and paper versions shall be issued and distributed to all participants, to the Agency's technical representative (4 copies) and to the ESA Contracts Officer (1 copy), not later than ten (10) days after the meeting concerned.
- b) The minutes shall clearly identify all agreements made and actions accepted at the meeting together with an update of the Action Item List (AIL) and the Document List. The minutes shall be signed.

Note: This clause may be restricted to progress meetings if specifically expressed.

2.2. Documents List

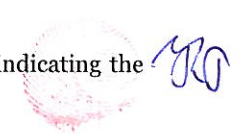
The Contractor shall create and maintain a Document List, recording all the documents produced during the work, including reports, specifications, plans and minutes. The list shall indicate the document reference (with unique identifier), type of document, date of issue, status (draft or approved by the Agency), confidentiality level and distribution. This list shall be maintained under configuration control.

2.3. Action Item List (AIL)

The Contractor shall maintain an Action Item List (AIL, see ECSS-M-ST-10C Rev.1 section 5.2.2.1 for more details), recording all actions agreed with the Agency. Each item shall be uniquely identified with reference to the minutes of the meeting at which the action was agreed and will record generation date, due date, originator and the person instructed to take action. The AIL shall be reviewed at each progress meeting.

2.4. Bar-Chart Schedule

- a) The Contractor shall be responsible for maintaining the bar-chart for work carried out under the Contract, as agreed at the kick-off meeting.
- b) The Contractor shall present an up-to-date chart for review at all consequent meetings, indicating the current status of the Contract activity (WP's completed, documents delivered, etc.).



- c) Modifications of the schedule shall be contractually binding only if approved in writing by the Agency's representative for contractual and administrative matters.

2.5. Risk Register

- a) The Contractor shall be responsible for maintaining a risk register, agreed at the kick-off meeting. This register shall identify potential risks, their likelihood and severity, and propose meaningful mitigation measures (see ECSS-M-ST-80C for more details).
- b) The Contractor shall present an up-to-date risk register in his progress reports for review at progress meetings.

2.6. Progress Reports

Every month, the Contractor shall provide a Progress Report to the Agency's representatives, covering the activities carried out under the Contract (see ECSS-M-ST-10C Rev.1 section 5.2.2.2 for more details). This report shall refer to the current activities shown on the latest issued bar-chart and shall give:

- a.1 action items completed during the reporting period
- a.2 a status report on all long lead or critical delivery items
- a.3 a description of progress: actual vs. schedule, milestones and events accomplished
- a.4 reasons for slippages and/or problem areas, if any, and corrective actions planned and/or taken, with revised completion date per activity
- a.5 events anticipated during the next reporting period (e.g. milestones reached)
- a.6 expected date for major schedule items
- a.7 milestone payment status
- a.8 status of risks.

2.7. Problem Notification

The Contractor shall notify the Agency's representatives (Technical Officer and Contracts Officer) of any problem likely to have a major effect on the time schedule of the work or to significantly impact the scope of the work to be performed (due to e.g. procurement problems, unavailability of facilities or resources, etc.).

2.8. Technical Documentation

- a) As they become available and not later than the dates in the delivery plan, the Contractor shall submit, for the Agency's approval, technical notes, engineering drawings, manufacturing plans, test plans, test procedures, specifications and Task/WP reports.
- b) Technical documentation to be discussed at a meeting with the Agency shall be submitted two (2) weeks prior to the meeting.
- c) Technical documents from Subcontractors shall be submitted to the Agency only after review and acceptance by the Contractor and shall be passed to the Agency via the Contractor's formal interface to the Agency.
- d) Tests carried out under the Contract shall be performed according to test plans and test procedures approved by the Agency's Technical Officer (see ECSS-E-ST-10-02C and ECSS-Q-20C Rev.1 for more details).

3. MEETINGS

- a) The kick-off meeting shall take place at the Agency's premises.
- b) Progress meetings shall be held at approximately 2- to 3-monthly intervals, alternating between Agency premises and Contractor premises.
- c) The final presentation shall take place at the Agency's premises.
- d) Additional meetings may be requested either by the Agency or the Contractor.

- e) The Contractor shall give to the Agency prior notice of any meetings with Third Parties to be held in connection with the Contract. The Agency reserves the right of participation in such meetings.
- f) With due notice to the Contractor the Agency reserves the right to invite Third Parties to meetings to facilitate information exchange.
- g) For all meetings with the Agency, the Contractor shall ensure that proper notice is given at least two (2) weeks in advance. For all other meetings, the Contractor shall inform the Agency, which reserves the right to participate. The Contractor is responsible for ensuring the participation of his personnel and those of the Subcontractor(s), as needed.
- h) For each meeting the Contractor shall propose an agenda in electronic form and shall compile and distribute handouts of any presentation given at the meeting.

4. DELIVERABLES

This section specifies the generic deliverables that can be envisaged. The actual list of deliverables under the Contract is specified in the Statement of Work which may include, delete or add deliverables with respect to those specified in this Chapter.

4.1. Documentation

- a) In addition to the documents to be delivered according to section 2 here above, the following documentation shall also be deliverable. In the case of alternative choices herein, the Statement of Work specifies which ones are applicable.
- b) All documentation deliverables mentioned hereunder (including all their constituent parts) shall also be delivered in electronic form in a format agreed by the Agency (PDF format and the native format, and in other exchange formats where relevant (e.g. CAD, drawings, databases)).
- c) All the documentation shall be delivered on computer readable media (e.g. CD-ROM, DVD-ROM) as agreed by the Agency with an additional two (2) paper copies.
- d) The draft version of the documentation shall be sent to the Technical Officer in three (3) copies not later than two (2) weeks before the documentation is to be presented. The final version shall be provided in a number of copies specified in the Statement of Work.

4.1.1. Final Report

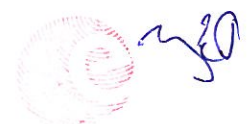
- a) The Final Report shall provide a complete description of all the work done during the activity and shall be self-standing, not requiring to be read in conjunction with reports previously issued. It shall cover the whole scope of the activity, i.e. a comprehensive introduction of the context, a description of the programme of work and report on the activities performed and the main results achieved.
- b) For phased contracts, a Final Report shall be produced at the end of each Phase in accordance with the above definition, describing the work and results of that Phase and previous Phases. It becomes the Final Report in case the Agency decides not to proceed with the subsequent Phase(s).

4.1.2. Technical Data Package

Each (design and development) contract shall be completed with a Technical Data Package. For a contract with Phases, the Technical Data Package shall be provided at the end of a Phase in the case that the Agency decides not to proceed with the next Phase. The Technical Data Package consists of the final versions of all approved technical documents.

4.1.3. Summary Report

For each (design and development) contract, one Summary Report shall be produced. It shall summarise the findings of the Contract concisely and, informatively. The Summary Report shall be approximately 20 pages or 6000 words.



NOTE:

The Agency may request the Contractor to produce the Summary Report in the form of a paper suitable for publishing in a technical journal.

4.1.4. Executive Summary Report

The Executive Summary Report shall concisely summarise the findings of the Contract. It shall be suitable for non-experts in the field and should also be appropriate for publication. For this reason, it shall not exceed five (5) pages of text and ten (10) pages in total (1500 to 3000 words).

4.1.5. Abstract

Each (study) contract shall also be completed with an Abstract, summarising the work performed. It shall be suitable for application at symposiums or technical journals, normally not exceeding three (3) to four (4) pages of text with coloured illustrations or photographs where appropriate.

4.1.6. Brochure

A Brochure is intended for marketing purposes. It shall be concise and it shall include a short description of the work performed and applications of the development, a photograph or functional drawing if applicable, technical fact sheet, estimate of availability (delivery time) and a contact point for marketing purposes.

It shall contain one (1) or two (2) pages of text (i.e. up to about 700 words).

4.1.7. Photographic Documentation

Photographic documentation comprises photographs of hardware under manufacture, showing major progress, as well as of tests and test set-ups. Videos presenting the functioning of hardware/test set-up and relating test activities may also be included in this category.

4.1.8. Contract Closure Documentation

The Contract Closure Documentation is a mandatory deliverable, due at the end of the Contract (or at the end of a Phase in case the Agency decides not to proceed with the following Phase). For the avoidance of doubt, "end of the Contract" shall mean the finalisation of a series of tasks as defined in the Statement of Work attached to this Contract. Therefore, work performed under Riders or Contract Change Notices adding new tasks with respect to the original contract shall require separate Contract Closure Documentation. The contents of the Contract Closure Documentation shall conform to the layout provided in Annex A hereto.

4.2. Hardware

Hardware (incl. test equipment and control electronics) built or purchased under the Contract, together with an Operation Manual, shall be a deliverable item after completion of the associated activities at the Contractor's premises, unless otherwise agreed in writing by the Agency.

4.3. Computer Programs and Models

Computer programmes, mathematical models of any type (e.g. closed-form, worksheets, XML, CAD/CAE) and HDL models developed or procured under the Contract shall be a deliverable, unless the Agency agrees otherwise in writing. Re-used or proprietary software embedded in the deliverable product and required for its correct functioning shall also be deliverable.

4.4. Project Web Page

The Contractor shall produce a Project Web Page which shall be suitable for public internet access.

5. COMMERCIAL EVALUATION (SPACE MARKET)

The Commercial Evaluation is a report containing an analysis and evaluation of the potential in the space market of the output (products) of the Contract.



The report shall identify the maturity of the output of the subject activity with respect to the market and, if applicable, describe the required additional work and the level of funding required for the product to reach a marketable level.

Annex:

Annex A: Layout for Contract Closure Documentation (in its latest version)

**ANNEX A: LAYOUT FOR CONTRACT CLOSURE DOCUMENTATION
(Rev 1 : 2014-07)**

for
ESA Contract No. [INSERT NUMBER]
“[INSERT ACTIVITY TITLE]”,
hereinafter referred as the “Contract”

Section 1 – Parties, Contract Duration and Financial Information

Contractor	[CONTRACTOR NAME AND COUNTRY]		
Sub-Contractor(s) <i>(state if not applicable)</i>	[NAME AND COUNTRY]		
Contract Duration	From:	Phase 1	from:
	To:		to:
		Phase n	from:
			to:
Total Contract Price <i>(including all CCNs, Work Orders, Call of Orders)</i>	EUR		
and Total Contract Value <i>(in case of co-funding; state if not applicable)</i>	EUR		
Broken down as follows:	Original Contract Price	XXX EUR (XXX EUR)	
	and original Contract Value <i>(in case of co-funding; state if not applicable)</i>	EUR	
	CCN x to n	EUR	in total
	Work Order x to n	EUR	in total
	Call-Off Order x to n	EUR	in total

Section 2 – Recapitulation of Deliverable Items

2.1 Items deliverable under the Contract

If any of the columns do not apply to the item in questions, please indicate “n/a”.



Table 2.1.1 – Items deliverable according to the Statement of Work and Article 2 of the Contract

Type	Ref. No.	Name / Title	Description	Replacement Value (EUR)/ Other	Location ⁽¹⁾	Property of	Rights granted / Specific IPR Conditions ⁽²⁾
Documentation							
Hardware							
Software			<i>(Delivery in Object code / Source code?)</i>				
Other							

Table 2.1.2 – Items deliverable under Article 4 of the Contract (if applicable)

The “Contract Inventory” of items produced or purchased under the Contract (other than those falling under the Article 2 of the contract) with an individual or batch value equivalent or superior to 5.000 euros is as follows:

ESA DECISION •						
Item Name	Part/ Serial Reference Number	Location	Value	Transfer ownership to ESA (delivery at end contract or delivery postponed to end of loan agreement)	ESA renunciation to claim ownership and delivery (with/without financial compensation or special instructions)	Leave in (Sub-) Contractor’s Custody and postpone transfer of ownership to ESA

Table 2.1.3 – Fixed Assets

With regard to Fixed Assets the following declaration is made:

[OPTION 1:]

No Fixed Asset has been acquired under the Contract by the Contractor and/or its Sub-Contractor(s).

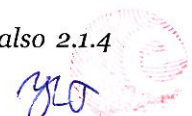
[OPTION 2:]

Fixed assets, acquired under the Contract by the Contractor and/or its Sub-Contractors are listed in the List of Fixed Assets attached below. The Contractor certifies that all its obligations with regards to Fixed Assets have been fulfilled. The Agency will inform the Contractor of its decision with respect to the disposal of Fixed Assets items.

¹ In case the item is not delivered to ESA, please indicate the location of the deliverable and the reason for non-delivery (e.g. loan agreement, waiver, future delivery, etc.)

² e.g. IPR constraints, deliverable containing proprietary background information (see also 2.1.4 below)

- To be completed by ESA



Item Name	Value	Life time in years	TBD	ESA DECISION		
				TBD	Deliver to ESA	Leave under (Sub-) Contractor's Control

Table 2.1.4 – Customer Furnished Items and Items made available by the Agency

[Option 1]

There was no Customer Furnished Items or Items made available by the Agency.

[Option 2]

Any Customer Furnished Items and/or Items made available by the Agency to the Contractor and/or its Subcontractor(s) under the Contract, are listed in the following List of Customer Furnished Items and Items made available by the Agency. The following tables certify which of the items have been returned to the Agency and which of the items remain in the custody of the Contractor, and/or a Sub-Contractor(s) and/or a Third Party for further ESA work or for other purposes.

Customer Furnished Items

Item Name	ESA Inventory Number	Location	Insurance Value	ESA DECISION		
				Confirmation of Receipt	Deliver to ESA or to another entity	Leave at (Sub-) Contractor's Disposal under a loan agreement

Items made available by the Agency

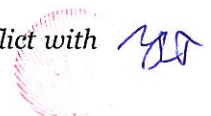
Item Name	ESA Inventory Number	Location	Replacement Value	Deliver to ESA or to another entity	Leave at (Sub-) Contractor's Disposal under a loan agreement

Table 2.1.5 – Background Information used and delivered under the Contract (see Clause 43 of the General Clauses and Conditions)

The following background information has been incorporated in the deliverable(s):

Proprietary Information <i>(title, description)</i>	Owner <i>(Contractor / Subcontractor(s)/ Third Party -ies)</i>	Affected deliverable <i>(which documents, hardware, software, etc.)</i>	Description impact on ESA's rights to the deliverable (1)	Other comments

¹ if not explicitly stated otherwise, the contractual stipulations shall prevail in case of conflict with the description provided in this table



Section 3 – Statement on Intellectual Property Rights generated under the contract

[OPTION 1 : NO Intellectual Property Rights generated under the Contract]

In accordance with the provisions of the above Contract [insert Contract Number], [insert Company name] hereby certifies both on its own behalf and on behalf of its consortium/Sub-Contractor(s), that no Intellectual Property Rights (as defined in Annex IV of the General Clauses and Conditions for ESA Contracts, ref. ESA/REG/002, Rev. 1, the “GCC”) have been generated in the course of or resulting from work undertaken for the purpose of this Contract. [END OF OPTION 1]

[OPTION 2 : Intellectual Property Rights generated under the Contract]

The Agency’s rights in the Intellectual Property Rights listed in the table below shall be in accordance with the General Clauses and Conditions for ESA Contracts, ref. ESA/REG/002, Rev. 1, the “GCC” - Part II provisions, as amended by the Contract [insert Contract Number].

In accordance with the provisions of the above Contract, [insert Company name] hereby certifies both on its own behalf and on behalf of its consortium/Sub-Contractor(s) that the following Intellectual Property Rights (as defined in Annex IV of the "GCC") have been generated in the course of or resulting from work undertaken for the purpose of this Contract:

Intellectual Property Rights (“IPR”) suitable for registration (i.e. “Registered Intellectual Property Rights” as per definition in Annex IV of the “GCC”)	Current status <i>[delete non applicable options]</i>
<i>[insert title of IPR # 1 and give a short description]</i>	Registered : <i>[insert information on registration granted]</i>
	In the process of being registered: <i>[insert information on registration process]</i>
	Foreseen for registration: <i>[indicate timeline]</i>
	Not foreseen for registration: <i>[indicate reason]</i>
<i>[insert title of IPR # 2 and give a short description]</i>	Registered : <i>[insert information on registration granted]</i>
	In the process of being registered: <i>[insert information on registration process]</i>
	Foreseen for registration: <i>[indicate timeline]</i>
	Not foreseen for registration: <i>[indicate reason]</i>
<p>Should any Intellectual Property Rights be indicated as being foreseen for registration or in the process of registration, the Contractor undertakes to notify the Agency's Technical Officer when:</p> <ul style="list-style-type: none"> - registration of any such IPR(s) is rejected - registration of any such IPR(s) is obtained (and will provide the registration details) 	
<p>Intellectual Property Rights ("IPR") not suitable for registration (i.e. not being "Registered Intellectual Property Rights" as per definition in Annex IV of the "GCC")</p>	
<i>[insert title of corresponding IPR]</i>	<i>[give a short description of such IPR]</i>
<i>[insert title of corresponding IPR]</i>	<i>[give a short description of such IPR]</i>



Section 4 – Output from / Achievements under the Contract

4.1. Technology Readiness Level (TRL)

Indicate the TRL of the technology developed under the Contract using the classification given below (for additional information on definitions, please refer to ECSS-E-AS-11C).

Initial TRL	Planned TRL as activity outcome	Actual TRL at end of activity
1	Basic principles observed and reported	
2	Technology concept and/ or application formulated	
3	Analytical and experimental critical function and/ or characteristic proof of concept	
4	Component and /or breadboard validation in laboratory environment	
5	Component and /or breadboard critical function verification in a relevant environment	
6	Model demonstrating the critical functions of the element in a relevant environment	
7	Model demonstrating the element performance for the operational environment	
8	Actual system completed and accepted for flight 'flight qualified'	
9	Actual system 'flight proven' through successful mission operations	

NOTE: The TRL shall be assessed by ESA. The Agency's responsible Technical Officer shall verify TRLs 1-4 while TRLs 5-9 shall be assessed through an ESA-internal formal procedure.

4.2. Achievements and Technology Domain

.....
Provide a concise description (max 200 words) of the achievements of the Contract and its explicit outcome (including main performances achieved): please refer to the final documentation (e.g. Final Report)

Please indicate the Technology Domain (TD 1 to 25) of the development (please tick off):

1	On-Board Data Systems	14	Life & Physical Sciences
2	Space System Software	15	Mechanisms & Tribology
3	Spacecraft Electrical Power	16	Optics
4	Spacecraft Environment & Effects	17	Optoelectronics
5	Space System Control	18	Aerothermodynamics
6	RF Payload and Systems	19	Propulsion
7	Electromagnetic Technologies and Techniques	20	Structures & Pyrotechnics
8	System Design & Verification	21	Thermal
9	Mission Operations and Ground Data Systems	22	Environmental Control Life Support
10	Flight Dynamics and GNSS	23	EEE Components and Quality
11	Space Debris	24	Materials and Processes
12	Ground Station System & Networking	25	Quality, Dependability and Safety
13	Automation, Telepresence & Robotics		

4.3 Application of the Output/ Achievements

Please tick off as appropriate:

Possible use in programme:

.....
Please indicate the service domain (see table) relevant to a possible application

1	Earth Observation
2	Science
3	Human Spaceflight and Exploration
4	Space Transportation



5	Telecommunications
6	Navigation
7	Generic Technologies and Techniques
8	Security
9	Robotic Exploration

Actual use in programme:

.....
Please describe the specific programme and application or mission for which the output of this Contract is or will be used.

4.4 **Further Steps/Expected Duration**

Please tick off as appropriate:

No further development envisaged.

Further development needed:

.....
Please describe further development activities needed, if any, to reach TRL 5/6 including an estimate of the expected duration and cost.

4.5 **Potential Non-Space Applications**

.....
Describe any potential non-space applications or products that may benefit from the technology that has been developed. Emphasize potential markets and customers where known.

.....
Describe the principle features of technology that would be required in a technology demonstrator for any identified non-space application. Include an estimate of the resources in time and money that would be required.

<p>The above statements provided in the various sections of this Annex A "Layout for Contract Closure Documentation" for ESA Contract No. 4000xxxxxx/XX/XX/xx <i>[insert the corresponding contract number]</i> have been made after due verifications.</p> <p>If required by ESA, an updated version shall be provided for incorporating amendments requested by ESA.</p>	
<p>Name of Contractor: <i>[insert contractor name]</i></p>	
<p>Authorised signatory: <i>[insert Authorised signatory full name]</i></p>	<p><i>[signature of the Authorised signatory]</i></p>
<p>Date: <i>[insert date]</i></p>	




APPENDIX 4: CONTRACT CHANGE NOTICE

For submission of a change as per Clause 13 of the General Conditions, the Contractor shall submit his proposal in the format of a CCN using the cover page included below. The form shall be filled with the following information as a minimum:

- The Contractor's name and the Contract number
- The title of the area affected by the change (Work Package reference, new work, etc.)
- The name of the initiator of the change (Contractor or ESA)
- The description of the change (including Work Package Descriptions, WBS, etc.)
- The reason for the change
- The price breakdown in €, if any (breakdown by company, Phase, etc., including PSS-A2 and PSS-A8 forms)
- The Milestone Payment Plan for the CCN if any
 - Effect on other Contract provisions
 - Start of work - end of work (including contractual delivery dates and overall planning, milestones, etc.)
 - A CCN Form, as per the format below, signed by the Contractor's representatives

The Contractor shall, on request of the Agency, provide additional documentary evidence. At the request of either Party, the proposed change may be discussed at a Change Review Board, consisting of both the Contracts Officer and the Technical Officer of each Party.

	DIRECTORATE:	Contractor:	
		Contract No.:	
CONTRACT CHANGE NOTICE No.		DATE:	Page: Page 1 of 27
TITLE OF AREA AFFECTED (WORK PACKAGE ETC):		WP REF:	
		INITIATOR OF CHANGE:	
DESCRIPTION OF CHANGE			
REASON FOR CHANGE			
PRICE BREAKDOWN (Currency)/PRICE-LEVEL			
EFFECT ON OTHER CONTRACT PROVISIONS		START OF WORK	
		END OF WORK	
CONTRACTOR'S PROJECT MANAGER:		CONTRACTOR'S CONTRACTS OFFICER:	
DATE:		DATE:	
[DISPOSITION RECORD OR OTHER AGREED CONDITION RECORDED WITH THE CCN APPROVAL]			
ESA CONTRACTS OFFICER: Nathalie Boisard			
DATE:			

