Launchpad for a UK Climate Data from Space (UK-CDS) infrastructure

1. Introduction

1.1. Background

A long term goal for the UK space sector, as expressed in the Space Innovation and Growth Strategy Action Plan, is to "*Position the UK at the leading edge of exploitation of a wealth of institutional Earth observation data by creating a Climate Services Centre for Europe in the UK*".

To realise this goal then the UK must develop and demonstrate a "seamless supply chain for climate data from space", exploiting existing infrastructure to develop better multi-layer, multi-data services for specific sectors. This will generate growth and export UK capability to a large (£12.3bn in 2010/11) and strongly-growing (estimated 9.8% pa in 2015) world-wide climate services market. The concept of "seamless supply" implies sustained, trusted, robust, accessible, timely, highly usable flows of climate-quality data to multiple types of users, including commercial climate services.

The UK Space Agency set up a working group (see below) and studies to focus on the critical steps that are needed to bring climate data from space towards sustainability, essential for both direct and indirect (societal benefit) economic impact. This has leveraged further investments in entities which are directing activities towards these goals.

1.2. Achievements to Date

The world leading climate science, meteorological and industrial capability in the UK, together with previous HMG investments in the JASMIN-CEMS facility at Harwell, has resulted in significant national achievement:

- *RESEARCH SUCCESS*
    - ESA Climate Change Initiative (CCI) – the UK leads the Sea Surface Temperature ECV, Ocean Colour ECV, Open Data Portal projects as well as the Climate Modelling User Group. The UK also has supporting activities in several other ECVs. This capability provides the underpinning activity to produce and access ECVs in a research environment.
    - UK scientists have brought EO data into the Intergovernmental Panel on Climate Change reports in a much stronger route.
    - Research findings on EO climate data are regularly reported in the media.
- *OPERATIONAL SUCCESS*
    - EC funded Copernicus Climate Change Service (C3S) – the UK is leading four of the seven Sectoral Information System projects recently procured by the C3S-entrusted entity ECMWF, in the sectors of Water, Energy, Agriculture & Insurance; and has significant wins with the UK Met Office such as Seasonal Forecasting.
- *SERVICES INITIATION*
    - Institute for Environmental Analytics (IEA) – funded by the HEFCE Catalyst Fund the IEA is made of organisations across the whole supply chain. It addresses wider

environmental challenges, but has already initiated case studies specifically concerning climate with end users such as Sainsbury's.
    - NERC has initiated pilot climate service stakeholder projects and is working with NERC centres including the National Centre for Earth Observation to further develop the research base to climate services.
- *EXPERT ADVICE*
    - Climate Data from Space Stakeholder Group (CDSSG) – funded by the UKSA this group is made up of UK experts from academia, government and industry. Group outputs address key parts of the supply chain in the form of case studies e.g. climate data for environmental consultancies and seasonal forecasts.

2. The Opportunity

2.1. The Need

In order to establish the UK at the leading edge of climate data provision, it needs to cement its place in sustained climate data provision. This requires:

- Underpinning of a first tranche of infrastructure (hardware, software) that can sustain and make accessible, high quality, trusted climate data for the UK community.
- The UK to support its community to play a full role in the C3S service, with the likely benefits outlined below.

2.2. Opportunity to Secure UK Lead in Climate Data Operationalisation

Whilst the UK has success in the research production of ECVs (Essential Climate Variables), the operational production of climate data (i.e. "operationalising the ECVs currently available in research environments) will be funded by the C3S through competitive Europe procurements, with a separate contract / project for each ECV. ECV projects will allow specific processing chains and algorithms to be "operationalised" to allow reliable and robust data feeds into the C3S. The opportunity is to consolidate the UK "ownership" of its current lead ECVs and to attract other ECVs into utilising the UK JASMIN/CEMS & CCI Portal environment. This would place UK as the major hub for operational space derived ECV production in Europe, with the majority of the funding being provided in the long term through EC contracts.

In order to make this attractive for more of the ECVs, there are shared tools that will be needed across multiple ECV projects and the UK has the opportunity to put these in place alongside the JASMIN-CEMS infrastructure. On the other hand no one ECV project will have the capacity to fund the implementation of such tools and therefore there is a compelling opportunity for the UK to take a lead so that shared benefits and economies of scale can be realised across the ECV provision activities. Specifically the following tools are required:

- *Orchestrator Dashboard*: To allow engineers and data producers to visually check on processor and data output status
- *Provenance generator*: This would compile a provenance file when a processor completes, listing the data inputs, the algorithms used and their version numbers

- *Comment collection*: For collecting comments on data (including provenance) and its use from data users – we assume CHARMe with some adaptions

- *In a future phase of this work it is envisaged that a common **orchestrator** would bring efficiency savings in operations of the processing systems:* This will involve software tools to schedule and execute the data processing chains, automatically scanning for input and output data

2.3. The Benefits

Funding this initiative would allow the UK to:

- Offer higher impact bids to ECMWF in their imminent ECV procurement, giving the edge over European competitors. The UK could potentially win work across 6 of the 9 ECV projects bringing in UK revenues of €3M by mid-2018, with potential follow on revenues of €1M per year in the period 2018-2023 during C3S operations.
- Offer higher value bids for the CCI+ programme in the period 2017-2021, giving powerful, efficient, and flexible processing capability for CCI+ ECV projects in the "big data" era of Sentinel satellites.
- Take a European lead in the operational provision of ECV data, to be used in support of commercial climate services, policy decision making and wider research concerning the impact of climate change.
- Prepare for efficient exploitation of Sentinel 3 data, where the UK has world-leading science expertise.

The risks associated with funding this additional capacity are low - STFC have considerable experience with procuring, operating and supporting users of the infrastructure, including supporting the academic teams already processing ECVs using the NERC funded JASMIN-CEMS infrastructure. The UK academic teams are key players in the CCI ECVs and the chance of success in bids to C3S is extremely good.

Without core investment the risk is that any one C3S project alone cannot contribute sufficient funding to support the activity. Even when several C3S projects are combined, we do not anticipate that the C3S will procure hardware to be used within the projects - an existing capability for input data storage management and intermediate data processing is assumed. A core capability is essential to maintain UK's leadership position in provision of climate quality variables derived from space data.

3. Technical Implementation

3.1. What is Proposed?

A dedicated extension to the JASMIN-CEMS infrastructure, the "UK-CDS zone" will provide:

1. The data storage and compute capacity required to start-up at least 4 operational ECV processing projects
2. The priority access to storage and compute nodes needed for the operational nature of the C3S data processing

3. Separation of concerns from the rest of the JASMIN-CEMS infrastructure, which is NERC funded for use by the UK academic community.
4. A baseline of system support to enable project leads to set-up and maintain processing environments on the JASMIN infrastructure.

3.2. Who is it for?

The UK-CDS zone provides dedicated infrastructure and software support to the UK Climate Data from Space community. This will allow projects to be supported which offer regular production or reprocessing of climate data from currently flying satellite instruments and related historical instruments. Projects using the CDS-zone will be expected to support the UK community with access to appropriate climate data products and contribute to the development of UK-sponsored applications. The CDS-zone includes some specific resource for proposed C3S ECVs during the pre-operational phase, in line with the currently tendering C3S projects, in order to provide rapid and substantive support to the UK community in the event of successful bids. After the initial two year period , the use of JASMIN for this purpose should be reviewed with the community and stakeholders (NERC, STFC, UKSA).

4. Governance model

- The governance arrangements have been approved by the UK Space Agency, NCEO, and STFC RAL.
- The CDS will be overseen by a strategic body, the UK CDS Steering group, and managed day-to-day by the CEDA JASMIN-CEMS team.
- The UK CDSS Steering Group will consist of the Head of EO Strategy at the UK Space Agency (Beth Greenaway), the Director of NCEO (John Remedios), the lead for the JASMIN-CEMS team (Victoria Bennett) and the CDSSG co-ordinator (Claire MacIntosh).
- The CEDA JASMIN_CEMS team will (led by Victoria Bennett) will monitor approved projects on the system, manage the storage and data processing operations on a day-to-day basis, facilitate and steer software development initiatives, and procure and manage external sub-contracts where appropriate.
- The UK CDS Steering Group will meet at least once per year, normally at times aligned with CDSSG meetings. The group will also provide advice as necessary outside of these times; requests from outside the management team should be directed via the CEDA JASMIN-CEMS team or the CDSSG co-ordinator.
- For decisions outside of the scope of the normal day to day running of the CDS-zone are required, the JASMIN-CEMS team will discuss these with the steering group, with final decisions resting with the funding bodies (UKSA and NCEO).
- The Climate Data from Space Stakeholder group will provide community feedback to the steering group via its usual regular meetings, which will inform the development and direction of the CDS-zone.
- These governance guidelines will be reviewed by the above parties at the end of the first year of operation.