

Discussion Paper: Climate Data from Space in the UK

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Purpose and Status of this Discussion Paper

Ruth Boumphrey

The Space Innovation and Growth Strategy recommended the UK develop a strategy to secure leadership in technologies and services related to climate-change validation, adaptation and mitigation. The resulting document proposed a number of recommendations and actions, and has since been integrated into the Space Agency's Earth Observation Strategy. This paper has been developed, at the request of the UK Space Agency, to promote discussions between UK parties with an interest in delivering those actions, and as a basis for discussion with others. Whilst the UK has world-leading expertise in climate data, this expertise is held across a large number of organisations and developed through diverse national and international projects with wider partnerships. This paper has no official status, but it is hoped it will promote discussions leading to long-term and deep commitments to deliver important actions to meet national and international climate data needs.

Summary

Andy Shaw and Chris Merchant

The recent "Space Innovation and Growth Strategy" (IGS) paper *Leadership in Climate Technologies and Services* executive summary (Feb 2013) recommends: *"The UK should act quickly to develop operational climate related information services including satellite and other observations and measurement data. The UK should establish a seamless supply chain for these services"*

This discussion paper presents a view about the elements required to create a "seamless supply chain" for space-based climate data to supply sustained, robust climate services.

Creating such a supply chain will represent a significant UK contribution to implementing climate monitoring architectures called for internationally [1]. Beyond this, it can be positioned to provide a world-leading component of the coming Copernicus Climate Service [2], and be an essential platform on which industry can build commercial climate services, catalyzed through the Satellite Applications Catapult Centre (SACC). Much of what is required already exists, and it principally needs focused effort to integrate people and components in order to begin.

For these reasons, an aspiration for a UK initiative in providing Climate Data Records (CDRs) from space is sketched out here, that addresses this IGS recommendation concretely.

A range of UK activities are relevant. These are presently not linked so as to create a "seamless supply chain" across a range of climate data from space in which the UK has world-

leading capability. 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. In [1], the idea was expressed as “bringing the same continuity to long-term and sustained climate observations that we have today for weather observations”.

Recent infrastructure investments at Harwell mean that necessary physical elements for proof-of-concept implementation of seamless supply exist within current and imminent activities in the UK. It is necessary to frame and co-ordinate these activities appropriately (dual use) to prove the concept of a seamless supply chain. Co-ordination with existing climate-data-from-space capacity across Europe will avoid duplication.

In brief, the elements in the supply chain are: secure EO data supply; common services at “level 1” made freely available to UK activities to build CDRs; CDR projects, variously funded; common services for data distribution, etc; specific interfaces to particular users, including support for commercialization.

A first step might be to develop a proof-of-concept demonstration of the system..

The ultimate goal is that the UK creates a *seamless supply chain for climate data from space* aiming to ensure that there is a significant UK role in “provision of essential climate variables” that inform future climate services.

IGS recommendations and actions

We take the view that the objective of a UK strategy for Climate Data from Space should essentially be to make the IGS recommendation 6 a practical reality:

...the UK [should] secure world leadership in technologies and services related to climate change validation, adaptation and mitigation. This should include verifying international carbon agreements. The UK should ensure that it leverages its world-class research and modeling capabilities in climate change to full economic and social effect and support ESA's contribution to climate change through its recently established ESA Climate Office at Harwell.

The most efficient route to this will be through a coordinated effort from several UK partners including UKSA, UK MetOffice, NPL, NERC (NCEO) and the Space Applications Catapult, with support from government departments. A ‘Climate Data from Space Coordination Group’ representing these and other key stakeholder interests has been informally constituted by UKSA. This Action Group will consider responses to this discussion paper and catalyze further action as appropriate.

Concept for a “Seamless Supply Chain for Climate Data” in UK

IGS: *“The UK should act quickly to develop operational climate related information services including satellite and other observations and measurement data. The UK should establish a seamless supply chain for these services.”*

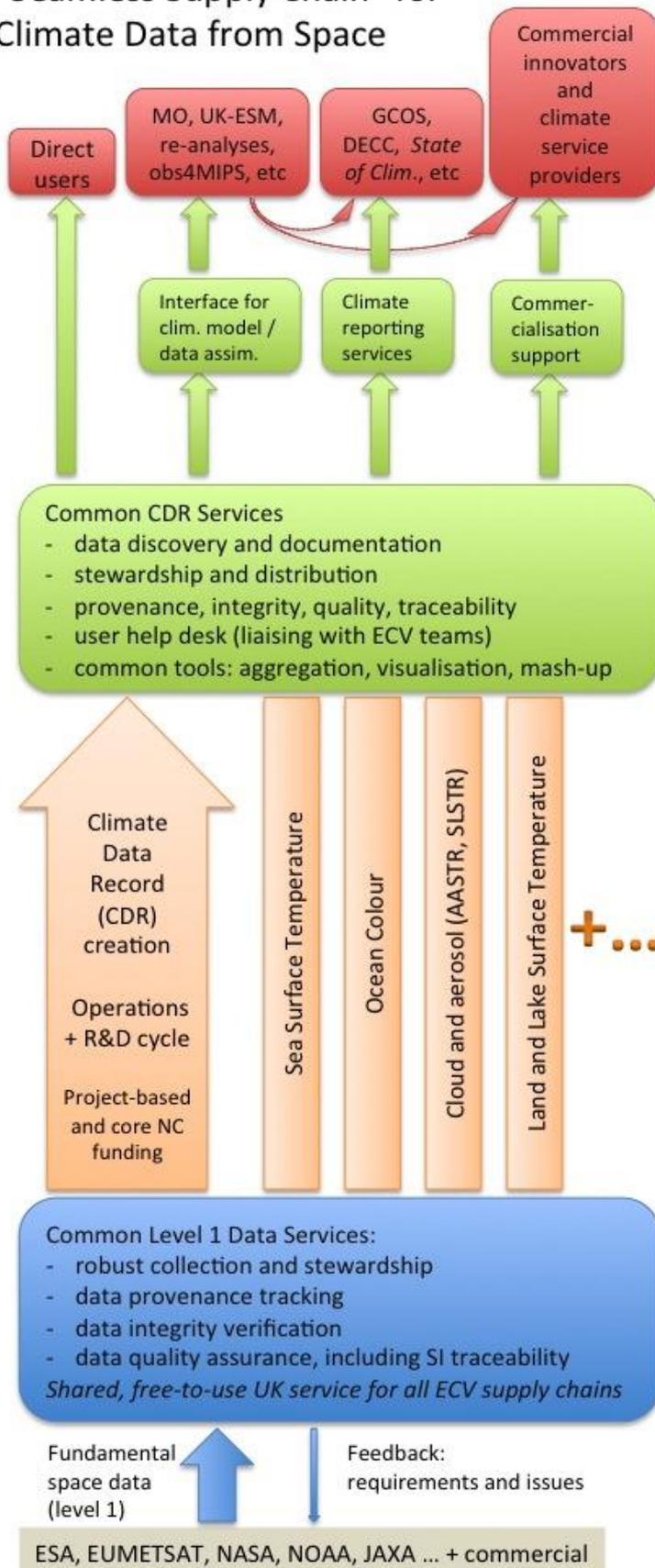
Recent investments and imminent activities allow the supply chain

EO data → EO science → Climate Data Records (CDRs) → Service-Providers/Users

to be developed readily on a proof-of-concept scale. Doing this should be seen as positioning for future growth with a clear plan for long-term sustainable funding within the Copernicus

Climate Service. The nature of such a “seamless supply chain” and existing and foreseen elements that can contribute to it are illustrated in the diagram overleaf.

“Seamless Supply Chain” for Climate Data from Space



Elements existing and/or foreseen that can contribute

Earth System Grid Fed. via CEDA
 Met services & re-analyses
eg. ERA-Clim2
 NCEO/UK-ESM collab.
 UKMO Climate Service

Space Catapult
 CCI Climate Modellers' User Group

Environmental Virtual Obs.
 Clim. Info. Platform (CLIP-C)

CEDA / CEMS / NEODAAS
 CCI Ph 2 Data Portal project
 UK commercial activities

Some immediate examples:

Climate Change Initiative Ph 2 (ESA)
 ESA DUE (e.g., GlobTemperature)
 NCEO EO data activities (NERC)
 GloboLakes (NERC)
More eg.s from UK-EOF review ...

With supply chain in place for some ECVs, can add project-based and/or sustained additional ECV streams extremely cost effectively

Centre for Env. Data Archival (CEDA)
 Clim. & Env. Monit. from Space (CEMS)
 NERC EO Data Acq. An. Ser. (NEODAAS)
 UK commercial data integrity services
 QA4ECV (FP7 project, NPL)

UK Collab. Ground Segment (*proposed*)
 Surf. Temp. & Temp. Synergy (*proposed*)
 UK involvement in ESA Quality WGs
 UKSA in CEOS WG Climate

The “seamless supply chain” is on the left of the schematic, with data flowing from bottom (input of space data) to top (outputs to a range of users and innovators). Note the following in interpreting this schematic:

- Size is not an indication of importance. The impetus for the whole comes from the small red boxes at the top: users. Trustworthy, sustained provision of climate data from space for climate services (commercial and public) and climate science is the important goal. The schematic concentrates on the supply chain to achieve this.
- The interfaces to users and for commercialization support (green boxes) need to be significantly elaborated as part of making the supply chain “seamless” to the users.
- The common level 1 (blue) and common level 2 (green) layers need to be sustained and free to exploit for UK developers (at least for non-commercial space data) to maximize the supply chain as a platform for innovation.
- The layer relating to creation of climate data records can comprise a mix of sustained and project based funding. Projects will achieve much more for a given resource working within this framework than outside it, fostering innovation in CDRs.
- The CDR examples given include supply chains based on visible/IR data streams, including the future Sentinel 3 data streams¹. These are real examples where UK EO science is well placed. However, the framework is not intended to be limited to these examples or these sorts of data streams.

The right-hand side collects existing or imminent activities within the UK roughly level to the part of the supply chain where they have relevance. (It is probably an incomplete list.) **It is striking that there are existing and foreseen elements that map onto almost every element of this seamless supply chain.**

Thus, the authors propose, in broad terms, that over the next year UKSA should aim to:

- Achieve an initial implementation of this seamless supply chain using existing and imminent elements (inevitably constrained by what is possible within those elements, but nevertheless a convincing demonstration). Actions towards this:
 - Organize a UK level discussion about this possible way forward – which is a purpose of this discussion paper.
 - Gain commitment from UK parties to contribute by linking what they already are doing or expect to do.
 - Help the CDS Coordination Group pursue these objectives.
 - Develop a single identity and presentation of the whole supply chain
 - Engage the full range of users via this identity.
- Champion a national aim to contribute a seamless supply chain for Climate Data from Space within the Copernicus Climate Service.
 - Part of the task involves co-ordination with European partners involved in a similar “business”, to ensure co-operation and avoid duplication/displacement.
 - While ESA have no mandate for sustained CDR production in the long run, UKSA can influence highly relevant R&D and prototyping within ESA programmes²

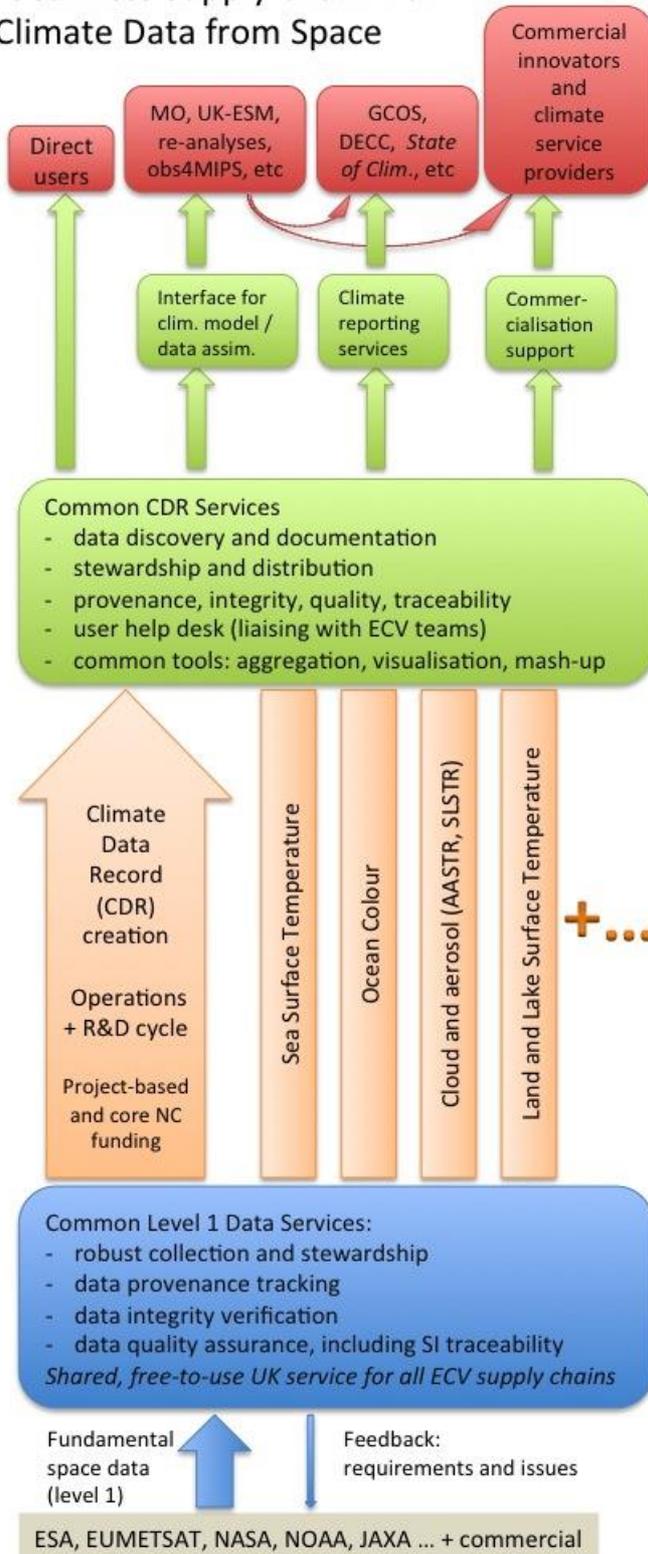
¹ The provision of Sentinel data to the UK EO and climate community is essential. The Collaborative Ground Segment and access to processing next to these data at CEMS is *sine qua non*.

² For example, the UK should act coherently to take advantage of the Data Portal activity in CCI Phase 2 (to be called in 2014), e.g. UK lead, implementation at CEMS, efficient co-operation/integration with centres/activities in Germany.

Co-ordination with international efforts

Duplication and displacement of relevant activities elsewhere need to be avoided. The diagram below presents the supply chain again, with the right column listing UK points of contact into relevant groups and activities in Europe.

“Seamless Supply Chain” for Climate Data from Space



- 20C Re-analysis (ECMWF)
- Euro Climate Attribution (UKMO)
- CCI Climate Modellers’ User Group (UKMO)
- CLIP (STFC)
- UK lead in ESA programmes relevant to CDRs:
 - Reading, SST CCI
 - PML, Ocean Colour CCI
 - Reading/Leicester, GHRSSST PO
 - UCL, DUE GlobAlbedo, CryoSat
 - InfoTerra, TropForest ...
- Multiple international science teams, advisory roles, working groups
- EUMETSAT SAF network –
 - eg. UKMO in Climate Monitoring SAF
- QA4ECV (Proj. Off. at NPL)
- QA4EO (NPL)
- Metrol. for EO & Clim. (NPL)
- UK members in ESA committees:
 - eg. Earth Sci. Adv. Grp. (ESAC), Quality WGs
 - CEOS WG Climate (UKSA)
 - CEOS WG Cal/Val (NPL)
 - Gen. for Sat. Instr. Calib. (STFC/NPL)

The “seamless supply chain” will be a UK contribution to the “climate monitoring architecture” (CMA) requirement expressed in [1]. The CMA emphasizes the need for sustained commitment, including

data stewardship and “sustained expert understanding of both new and legacy climate sensors”. For this reason, scientific/academic partnership within a supply chain that is effectively linked to commercial and other users is required. The CMA also emphasizes the integration of metrological aspects (traceability, trustworthiness of data, etc) into the Earth observation process. As the IGS, the “seamless” aspect required for effective exploitation, expressed as a need for “an end-to-end system”.

The CMA decomposes the system at its highest level to “4 pillars”. The vision presented here includes an interface to support commercial activities, which is not mentioned in the CMA. But in other regards, these CMA pillars map onto the grey (sensing), blue+orange (CDR creation), green (application support) and red (use of data for decision making) strata of the figures shown above.

Interface to commercial activity via Satellite Applications Catapult

An important task in developing and expanding this work will be to establish the market prospects and business models that can create a sustaining and sustainable operational data system, and in clearly articulating the wider economic impact from such a system. It is anticipated the group might draw on Catapult expertise for this aspect of the work.

Implementation Plan

Implementation will be taken forward by establishing a project officer who, as a first task, will develop an implementation plan.

References

1. *Strategy Towards an Architecture for Climate Monitoring from Space*, (2013). Dowell, Lecomte, Husband, Shulz, ohr, Tahara, Eckman, Lindstrom, Wooldridge, Hilding, Bates, Ryan, Lafeuille and Bojinsky. A joint report of the Committee on Earth Observation Satellites, the Coordination Group for Meteorological Satellites and the World Meteorological Organisation.