ECMWF Copernicus Procurement

Invitation to Tender

Copernicus Climate Change Service Volume II

Support for climate reanalysis including satellite data rescue

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1 Introduction

ECMWF as the Entrusted Entity for the Copernicus Climate Change Service (C3S) invites tenders for activities to support climate reanalysis by extending the coverage and quality of input data from the data-sparse past. This document describes the scope and technical requirements for two separate Lots:

Lot 1: Satellite data rescue. The objective for this Lot is to recover and assess a selection of early satellite data records and to prepare these data records for use in climate reanalysis, including development of forward models as needed for data assimilation. Activities in this Lot shall build on outcomes of the FP7 ERA-CLIM and ERA-CLIM2 projects (www.ecmwf.int/en/research/projects). In particular, these projects generated a rudimentary inventory of early data records from space that are potentially useful for climate reanalysis (see Annex I in Saunders *et al.* 2017). Based on this inventory, a list of data records recommended for data rescue was produced by considering potential impact and feasibility of use in data assimilation (Saunders *et al.* 2017). The recommended data records are listed in Table 1 below. It includes data from early passive infrared and microwave sensors, wind estimates retrieved from imagery, and several high-quality reprocessed radiance datasets.

Lot 2: Historic upper-air data. The objective for this Lot is to develop and maintain a quality-controlled global database containing all known digitised *in-situ* upper-air weather observations made prior to 1979, together with metadata and information needed for data assimilation such as bias adjustments and uncertainty estimates. Activities in this Lot shall build on outcomes of the FP7 ERA-CLIM and ERA-CLIM2 projects. In particular, these projects included a global data rescue effort focussing on early upper-air weather observations (Stickler *et al.* 2014), including important work on data quality assessment and development of bias adjustments for the data (Haimberger *et al.* 2017), and assessment of the potential impact of the early *in situ* upper-air observations on centennial climate reanalyses (Hersbach *et al.* 2017).

Deliverables from both Lots shall be used as input for future climate reanalyses, including the next-generation C3S global reanalysis ERA6 which is scheduled to go into production by 2021. Access to all datasets and associated documentation shall be provided via the C3S Climate Data Store.

Table 1: Satellite data records recommended for data rescue based on potential value for climate reanalysis. Adapted from Saunders et al, 2017.

Sensor	Satellite	Period	Primary sensitivities	Availability
Early infrared sensors				
PMR	Nimbus-6	1975-1976	Stratospheric temperature	Univ. Oxford, Met Office and ECMWF
HIRS-1	Nimbus-6	1975-1976	Temperature & humidity	NASA, ECMWF
MVIRI	Meteosat-1 → -4	1978-1995	Surface and cloud top temperature and upper tropospheric humidity	EUMETSAT
IRIS	Nimbus-3,-4	1970-1971	Temperature, humidity and trace gases	Nimbus-4 at NASA (copy at ECMWF)
VTPR	NOAA-2 → -5	1972-1979	Temperature and humidity	ECMWF (used in ERA-40 and JRA-55)
HRIR	Nimbus-1,-2,-3	1964-1970	Cloud cover and surface emission	NASA
MRIR	Nimbus-3	1969-1970	Water vapour, clouds, surface and atmospheric temperature	NASA
SIRS	Nimbus-3,-4	1969-1971	Temperature profiles	NASA
THIR	Nimbus-4 → -7	1970-1985	Water vapour and surface	NASA
Early microwave sensors				
SMMR	Nimbus-7	1975-1983	Sea-ice, TCWV, ocean surface wind, cloud LWP	Under development by CM SAF

SSM/T-2	DMSP F-8→F-15	1992-2008	Upper tropospheric humidity	Under development by CM SAF
Reprocessed radiance data				
HIRS-2/3/4	NOAA/MetOp	1979 - present	Temperature and water vapour profile	New FCDR under development by FIDUCEO
SSU	TIROS-N/NOAA	1979-2006	Stratospheric temperature	FCDR at NOAA CLASS
MSU	TIROS-N/NOAA	1978-2007	Temperature	CDR at NOAA
SSM/I	DMSP F-8→F-15	1987 -present	Sea-ice, TCWV, ocean surface wind, cloud LWP	CM SAF
SSMIS	DMSP F-16→F-19	2003-present	Sea-ice, TCWV, ocean surface wind, cloud LWP	CM SAF
MVIRI	Meteosat-5→-7	1991-2017	Surface and cloud top temperature and upper tropospheric humidity	EUMETSAT
AMSU-B / MHS	NOAA/MetOp	1999-present	Water vapour profiles	CM SAF
Reprocessed wind retrievals				
AVHRR	NOAA/MetOp	1978-present	Polar winds	CIMSS/EUMETSAT
MVIRI	Meteosat-1→-4	1978-1995	Atmospheric motion vectors	EUMETSAT

2 Technical requirements

2.1 Lot 1: Satellite data rescue

ECMWF intends to award a framework agreement with a single multi-annual service contract (maximum duration of 34 months and an end date not later than 30 June 2021) for activities in support of satellite data rescue. The objective is to extend the coverage and quality of input satellite data records available for climate reanalysis, and to improve the impact of such data by targeted development of forward modelling capability, quality control and bias correction schemes.

2.1.1 Scope of service

The selected Contractor for this Lot shall:

- Develop and maintain a complete inventory of known candidate satellite data records requiring data rescue;
- Obtain, assess, develop and deliver the ERA-CLIM2 recommended datasets listed in Table 1;
- Develop an understanding of reanalysis requirements, including those related to forward modelling, quality control, bias modelling and bias correction;
- Develop and apply methods for quality assessment of satellite data, using independent observations and modern reanalyses including ERA5;
- Develop forward modelling capacity for early-era and reprocessed satellite observations using RTTOV;
- Assess, and take steps to minimise, the uncertainties associated with the forward modelling for the datasets addressed;
- Provide guidance on quality control and bias modelling for the datasets addressed;
- Provide guidance on uncertainties associated with the data, including estimates of radiometric noise characteristics;
- Provide any other guidance needed to prepare the data for use in reanalysis and/or for validation purposes;
- Provide the datasets in a format to be agreed with ECMWF, together with comprehensive technical documentation;
- Build upon outcomes of the ERA-CLIM, ERA-CLIM2 and FIDUCEO (www.fiduceo.eu) projects, as well as any other relevant prior research;

- Liaise and collaborate with EUMETSAT and its CM SAF, as well as other data providers as needed.

2.1.2 Specification of work

The list of satellite data records in Table 1 serves as the basis for the specification of work in Tasks 2-7. An indication of work required to fully prepare each of those data records for use in reanalysis is presented in Table 2 below. This table also contains an initial prioritisation of data records, based on their potential impact on the quality of future climate reanalyses.

The task specifications listed in Table 2 are indicative, based on a preliminary assessment by ECMWF of prior and/or current work being undertaken by EUMETSAT in its CM SAF or internal programme activities, by the H2020 FIDUCEO project, or at ECMWF as part of reanalysis development work carried out under the ERA-CLIM2 project and/or in the context of the Copernicus programme.

Bidders are expected to verify the current status of each data record listed in Table 2 and ascertain plans and timelines of all parties involved. Accordingly, bidders shall prepare as part of their proposal a detailed work plan with clear delineation of activities, coordinated timelines and appropriate deliverables. *Bidders shall avoid any potential duplication of work.*

Table 2: Indicative work requirements for each of the data records in Table 1. Green cells indicate tasks required in the work plan for this Lot. Orange cells indicate work that may be required in the work plan, depending on assessment of current status by the bidders. Blue cells marked LP are 'nice to have' but low priority. Grey cells indicate tasks that should not be part of the work plan since they have been (or will be) completed elsewhere (EUMETSAT, CM SAF, FIDUCEO, ECMWF). Grey cells marked NA are not applicable. Sensors in bold are considered highest priority by ECMWF.

Sensor	**Task**					
	2 Data provision	**3** Quality assessment	**4** RT modelling	**5** Quality control	**6** Uncertainty assessment	**7** Bias modelling
Early infrared sensors						
PMR	✓	✓	?	✓	✓	✓
HIRS-1	EUMETSAT	EUMETSAT	?	?	EUMETSAT	✓
MVIRI	EUMETSAT	✓	?	?	✓	✓
IRIS	?	✓	✓	✓	✓	✓
VTPR	✓	ECMWF	✓	✓	✓	✓
HRIR	✓	LP	LP	LP	LP	LP
MRIR	✓	LP	LP	LP	LP	LP
SIRS	✓	LP	LP	LP	LP	LP
THIR	✓	✓	✓	✓	✓	✓
Early microwave sensors						
SMMR	CM SAF	✓	CM SAF	?	?	✓
SSM/T-2	EUMETSAT	✓	✓	✓	FIDUCEO	✓
Reprocessed radiance data						
HIRS-2→-4	FIDUCEO	✓	?	ECMWF	FIDUCEO	ECMWF
SSU	?	✓	✓	✓	✓	✓
MSU	✓	ECMWF	✓	ECMWF	✓	ECMWF
SSM/I	CM SAF	✓	CM SAF	ECMWF	CM SAF	ECMWF
SSMIS (imaging channels)	CM SAF	✓	CM SAF	ECMWF	CM SAF	ECMWF

MVIRI	EUMETSAT	✓	?	?	?	✓
Reprocessed wind retrievals						
AVHRR	EUMETSAT	✓	NA	?	?	NA
MVIRI	EUMETSAT	✓	NA	?	?	NA

Task 1: Satellite data rescue inventory. Develop and maintain an up-to-date global inventory of known satellite data records that require some form of data rescue, as a resource for coordination of current and future data rescue activities. The inventory shall contain descriptive information about each data record, its physical state and location, stewardship, available documentation, any existing assessments and applications, potential value for climate reanalysis, and any other useful information to help clarify information content and potential value of the data records. See Annex I in Saunders *et al.* 2017 for a rudimentary version of such an inventory.

Deliverables expected: Database containing satellite data rescue inventory; bi-annual updates; documentation. A first version shall be delivered within 6 months of the start of contract.

Task 2: Provision of early and reprocessed satellite datasets. Obtain and provide access to the datasets listed in Table 2, in a format to be agreed with ECMWF. Fill gaps in existing datasets where possible. Document data formats.

Deliverables expected: Data access; technical documentation, preliminary assessment of potential use in reanalysis.

Task 3: Assessment of data quality. Select data quality metrics appropriate to reanalysis applications of the data. Identify and document unavoidable data gaps and periods of reduced coverage. Assess data quality by comparing with independent observational datasets and with modern reanalyses (ERA5) using community tools (*e.g.* the NWP SAF Radiance Simulator) for forward modelling.

Deliverables expected: Initial report on data quality assessment for each dataset. Following completion of tasks 4, 5 and 7: Final report on data quality assessment.

Task 4: Development of forward modelling to support reanalysis. For the radiance datasets identified in Table 1, review and assess currently available radiative transfer coefficients, or generate new coefficients. Take steps to improve RT modelling where, for instance, new measured spectral characteristics become available or where there is significant uncertainty in the specification of the spectral characteristics of satellite radiometers. Provide estimates of uncertainties in RT modelling, due to fast model parameterisations, uncertainties in spectral characteristics of the radiometers, and uncertainties in the underlying spectroscopy.

Deliverables expected: Optimised RTTOV radiative transfer coefficients for early-era and reprocessed datasets. Report on assessment of uncertainties in radiative transfer modelling.

Task 5: Quality control. Develop quality control schemes based on the initial data quality assessment of Task 1, and a knowledge of the application of the data for reanalysis. Such schemes should take account of likely causes of degradation in data quality (which may include, for example, transient calibration errors) as well as the radiative impact of clouds.

Deliverables expected: Reports, in the form of Algorithm Theoretical Basis Documents (ATBDs), on quality control schemes, for each of the datasets addressed.

Task 6: Uncertainty assessment. Assess the uncertainties associated with the data, including an assessment of the radiometric noise characteristics of the data and a comparison of these characteristics with closest equivalent satellite instruments, where available, for all of the datasets

addressed.

Deliverables expected: Reports on the uncertainties associated with the datasets.

Task 7: Bias modelling. Assess biases relative to reanalyses. Assess performance of bias models currently used in climate reanalysis (see Dee and Uppala, 2009). Develop improved bias models where required, and assess the performance of these models for a representative subset of each dataset.

Deliverables expected: Report on assessment of current bias correction schemes for the datasets addressed, and report on improved bias models for future reanalysis applications.

2.2 Lot 2: Historic upper-air data

ECMWF intends to award a framework agreement with a single multi-annual service contract (maximum duration of 34 months and an end date not later than 30 June 2021) for development and maintenance of a quality-controlled global database containing all known digitised *in-situ* upper-air weather observations made prior to 1979, together with metadata and information needed for data assimilation such as bias adjustments and uncertainty estimates. The objective is to provide C3S users with access to quality-assured observations of upper-air weather data for temperature, wind and humidity.

Potential bidders for this Lot are strongly encouraged to familiarize themselves with the activities ongoing under C3S_311a: Collection and Processing of *In Situ* Observations. Many of the requirements specified in this section are similar to those for the 4 Lots in C3S_311a, which are all closely linked with each other. Volume II (Specification) of the C3S_311a ITT can be downloaded at the following link: http://climate.copernicus.eu/file/1718/download?token=v7QQUYVM.

The Contract Award Notices for the C3S_311a ITT lots are available at the following links:

http://ted.europa.eu/udl?uri=TED:NOTICE:181204-2017:TEXT:EN:HTML,
http://ted.europa.eu/udl?uri=TED:NOTICE:218770-2017:TEXT:EN:HTML.

2.2.1 Scope of service

The selected Contractor for this Lot shall:

- Focus on upper-air in-situ weather observations made with a variety of instruments prior to 1979 and extending as far back as possible;
- Ensure maximum use of existing data sources and archives in Europe and elsewhere;
- Make suitable arrangements with data providers as needed to collect and/or broker their data, addressing technical aspects, data access and use licenses;
- Consult with producers of global and regional reanalyses on their needs regarding data quality and required detail of metadata;
- Avoid any duplication of work with activities in the C3S_311a Lots;
- Coordinate with C3S_311a Lot 1 on availability of historical upper-air datasets, and how to establish permanent links with data rescue activities;
- Ensure maximum consistency with the common data model and metadata conventions used in C3S_311a Lots 2 and 3;
- Ensure maximum consistency with the technical infrastructure developed in C3S_311a Lot 3;
- Build on prior work undertaken in the FP7 ERA-CLIM and ERA-CLIM2 projects;
- Provide a uniform data service to users via the C3S Climate Data Store in either 'push' or 'pull' mode;
- Develop a governance structure and operating rules for the historic upper-air database to allow continued operation of data services after the end of contract.

2.2.2 Specification of work

Bidders are free to reorganise the work described below in their proposal, by defining work packages, tasks and deliverables as they deem appropriate.

Task 1: Source inventory and data collection. Create inventory and secure access to existing historical upper-air archives and/or data collections. At minimum include data available at NCEP, the IGRA dataset and the latest version of the CHUAN dataset (Stickler *et al.* 2014). Take note of the merged collection of upper-air datasets developed at ECMWF within the context of the ERA-CLIM and ERA-CLIM2 projects.

Deliverables expected: Inventory of sources including data collection status (within 2 months of start of contract; periodic updates).

Task 2: Data model development. Develop a data model consistent with the common data model used in C3S_311a Lots 2 and 3, with adaptations (if needed) for the early instrumental record. Prioritize metadata required for data assimilation in climate reanalysis. Include unique identifiers for data sources and data records. Include accessible links to additional metadata about instruments, station history, etc. when possible.

Deliverables expected: Documentation of data model (within 4 months of start of contract).

Task 3: Database management. Database initial design and updates. Develop data ingest procedures. Develop operational rules and governance process. Initial data ingest. Process and ingest new datasets when available, including outcomes of data rescue activities. Update database content based on results of data quality assessments (see Task 4).

Deliverables expected: Datasets; database + technical documentation + user guide (first version within 9 months of start of contract; periodic updates).

Task 4: Data quality assessment. Develop observation error estimates, apply duplicate identification and homogenization adjustments. Ensure the ability to sift data quality by application of baseline quality checks. Make use of feedback information and departures generated in climate reanalyses; alternatively calculate departures from reanalyses by interpolation. Identify likely duplicate records among datasets. Provide a ranking of those records on preferred usage in reanalysis based on well-defined criteria, e.g. based on data quality, completeness, and closest match with original data records. Provide estimates on the evolution of biases using state-of-the-art methods, at minimum for temperature data. Develop data record corrections for any other quantities (such as location, date, time) on the level of individual ascents where possible.

Deliverables expected: Technical reports.

Task 5: Data services. Provision of database access via the CDS. Provision of technical support for CDS users of the database.

Deliverables expected: Database access; user support; technical documentation; user guides.

3 Other Requirements

3.1 Schedule

A detailed time plan and schedule shall be included in the tender response. The proposed time plan and schedule shall address the main tasks, inputs, outputs, intermediate review steps, milestones, deliverables and dates. Regular progress meetings will be held with ECMWF during the contract to assess project status, risks and actions.

ECMWF has to prepare annual Implementation Plans, which must be approved by the European Commission before they can enter into force. The implementation plans will take full stock of service reviews, performed thoroughly on an annual basis, as well as of the continuously evolving user requirements and corresponding service specifications. The successful tenderer shall therefore provide each year for ECMWF approval an updated detailed plan of proposed activities including Deliverables and Milestones, using the Work Package table template in Volume IIIB, which will form part of this Implementation Plan. The successful tenderer has to report on a quarterly and annual basis (for more details please see Volume V Framework Agreement for this ITT).

3.2 Meetings

ECMWF will organise meetings at 12- to 18-month intervals to bring together all C3S service providers. The successful tenderer is expected to attend these meetings. The successful tenderer is required to attend monthly teleconference meetings to discuss C3S service provision, service evolution and other topics that cut across different aspects of C3S.

In addition, the successful tenderer for Lot 2 is required to participate in any coordination meetings held by the contractors for C3S_311a Lots 1, 2, 3 and 4.

The cost of attending these meetings shall be covered by the successful tenderer and shall be included in the tendered price. The cost of organising and attending any additional meetings required to carry out the contracted activities shall also be covered by the successful tenderer and shall be included in the tendered price.

4 Tender Format

General guidelines for the tender are described in Volume IIIB. Specific requirements to prepare the proposal for this particular tender are described in the next sub-sections.

4.1 Page Limits

As a guideline, it is expected that individual sections of the tenderer's response do not exceed the page limits listed below. These are advisory limits and should be followed wherever possible, to avoid excessive or wordy responses.

Section	*Page Limit*
Executive Summary	2
Track Record	2 (for general) and 2 (per entity)
Quality of resources to be Deployed	2 (excluding Table 1 in Volume IIIB and CVs with a maximum length of 2 pages each)
Technical Solution Proposed	30 (Table 2 in Volume IIIB, the section on references, publications, patents and any pre-existing IPR is excluded from the page limit and has no page limit)
Management and Implementation	10 (excluding Table 3, Table 5 and Table 6 in Volume IIIB) + 2 per each Work package description (Table 4 in Volume IIIB)
Pricing Table	No limitation

Table 3: Page limits

4.2 Specific additional instructions for the tenderer's response

The following is a guide to the minimum content expected to be included in each section, additional to the content described in the general guidelines of Volume IIIB. This is not an exhaustive description and additional information may be necessary depending on the tenderer's response.

4.2.1 Executive Summary

The tenderer shall provide an executive summary of the proposal, describing the objectives, team and service level.

4.2.2 Track Record

The tenderer shall demonstrate for itself and for any proposed subcontractors that they have experience with relevant projects in the public or private sector at national or international level. ECMWF may ask for evidence of performance in the form of certificates issued or countersigned by the competent authority.

4.2.3 Quality of Resources to be Deployed

The tenderer shall propose a team providing the skills required for providing operational services that meet the technical requirements set out in Section 2. The team shall include a Service Manager with at least 5 years of experience in management of large-scale projects. The tenderer shall describe the experience of the Service Manager and of the technical project team in performing activities related to the various aspects of this tender.

4.2.4 Technical Solution Proposed

The tenderer shall give a short background to the proposed solution to demonstrate understanding of that solution and of the C3S context. This section shall also include information on any other third-party suppliers that are used as part of the technical solution, and a statement of compliance for each requirement formulated throughout this document, describing how the proposed solution maps to the requirements.

4.2.5 Management and Implementation

The tenderer shall provide a detailed implementation plan of proposed activities for the duration of the framework agreement. Deliverables should be consistent with the technical requirements specified in Section 2. The number of milestones is not restricted, but they should be designed as markers of demonstrable progress in service development and/or quality of service delivery. Adjustments to the proposed implementation plan can be made on an annual basis depending on needs for service evolution, changed user requirements, or other requirements as agreed between the European Commission and ECMWF.

As part of the general project management description the tenderer shall consider the following elements (this is not an exhaustive list):

- Monthly teleconferences with ECMWF and a proposal for involvement of ECMWF in major contract reviews shall be provided as part of the management plan.
- A proposed payment plan shall be provided as part of the proposal. The payment plan shall be based on six-monthly payments for routine services work packages and shall be based on milestones completion and associated deliverables for development related activities.
- The following management aspects shall be described: task and resources planning and tracking, quality assurance and control, communication management (ECMWF, stakeholders, internal communication), conflict resolution, subcontractor management, personal data management and risk assessment and mitigation plans.
- A list of sub-contractors describing their contribution and key personnel, legal names and addresses shall be provided. The tenderer shall describe how the Framework Agreement, in particular Clause 2.9 has been flowed down to all their sub-contractors.

As part of the general contract management description, the Tenderer shall include the following elements in line with the reporting and planning requirements as laid down in the Terms and Conditions of the Framework Agreement. The table below provides the template to be used by the tenderer to describe the complete list of deliverables, milestones and schedules for the management work package (eg.WP0, *cf*. template in Volume IIIB Section 4.5). All milestones and deliverables shall be numbered as indicated and document deliverables shall be periodically updated and versioned as described in the table.

Deliverables for this work package shall include the following reports:

WP0 Contractual Obligations Template				
#	*Responsible*	*Nature*	*Title*	*Due*
D0.y.z-YYYYQQ	Tenderer	Report	Quarterly Implementation Report QQ YYYY *QQ YYYY being the previous quarter*	Quarterly on 15/01, 15/04, 15/07 and 15/10
D0.y.z-YYYY	Tenderer	Report	Annual Implementation Report YYYY *YYYY being the Year n-1*	Annually on 28/02
D0.y.z	Tenderer	Report	Final report	60 days after end of contract
D0.y.z-YYYY	Tenderer	Other	Preliminary financial information YYYY *YYYY being the Year n-1*	Annually on 15/01
D0.y.z-YYYY	Tenderer	Report	Draft Implementation plan YYYY *YYYY being the Year n+1*	60 days after signing of contract for Year N+1 Annually on 28/02
D0.y.z-YYYY	Tenderer	Report	Finalised Implementation plan YYYY *YYYY being the Year n+1*	Annually on 31/10
D0.y.z-YYYY	Tenderer	Other	Copy of prime contractor's general financial statements and audit report YYYY *YYYY being the Year n-1*	Annually
D0.y.z-YYYY	Tenderer	Other	Letter from auditor specific to contract YYYY *YYYY being the Year n-1*	Annually

Tenderers shall provide preliminary versions of the completed tables as part of their bid.

5 Additional information

5.1 References

Dee, D. P. and S. Uppala, 2009: Variational bias correction of satellite radiance data in the ERA-Interim reanalysis. Q. J. R. Meteorol. Soc., 135: 1830–1841. doi:10.1002/qj.493

Haimberger, L., and Coauthors, 2017: Bias adjustments for global radiosonde data back to 1939. ERA-CLIM2 deliverable D4.2, available at https://drive.google.com/file/d/15fG_WQtQiVrTar1pZ8ADTUgwP_LW9qCc/view

Hersbach, H., and Coauthors, 2017: The potential value of early (1939–1967) upper-air data in atmospheric climate reanalysis. Q. J. R. Meteorol. Soc., 143: 1197–1210. doi:10.1002/qj.3040

Saunders, R., P. Rayer and P. Poli, 2017: Update on Satellite Datasets for ERA-CLIM2. ERA-CLIM2 deliverable D3.9, available at https://drive.google.com/open?id=1ZhWfmmyUq8GPG4Lh7_RyRImyH3vdJlsD

Stickler, A., and Coauthors, 2014: Description of the ERA-CLIM historical upper-air data. Earth Syst. Sci. Data, 6, 29–48. doi:10.5194/essd-6-29-2014.

5.2 Acronyms

AMSU	Advanced Microwave Sounding Unit
ATBD	Algorithm Theoretical Basis Document
AVHRR	Advanced Very High Resolution Radiometer
CDR	Climate Data Record
CDS	Climate Data Store
C3S	Copernicus Climate Change Service
CHUAN	Comprehensive Historical Upper-Air Network
CM SAF	EUMETSAT Climate Monitoring-Satellite Application Facility
CIMSS	Cooperative Institute for Meteorological Satellite Systems
DMSP	Defense Meteorological Satellite Program
ECMWF	European Centre for Medium-Range Weather Forecasts
ERA-CLIM	European Reanalysis of Global Climate Observations
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FCDR	Fundamental Climate Data Record
FIDUCEO	Fidelity and uncertainty in climate data records from Earth Observations
HIRS	High-resolution Infrared Radiation Sounder
HRIR	High-resolution Infrared Radiometer
IGRA	Integrated Global Radiosonde Archive
IRIS	Infrared Imaging Spectrograph
ITT	Invitation to Tender
LWP	Liquid Water Path
MHS	Microwave Humidity Sounder
MRIR	Mid-Infrared Instrument
MSU	Microwave Sounding Unit
MVIRI	Meteosat Visible Infra-Red Imager
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
NOAA CLASS	NOAA Comprehensive Large Array-data Stewardship System
NWP SAF	EUMETSAT Numerical Weather Prediction Satellite Application Facility
PMR	Pressure Modulator Radiometer
RT	Radiative Transfer
RTTOV	Radiative Transfer for TOVS
SIRS	Satellite Infra-Red Spectrometer
SSM/I	Special Sensor Microwave/imager
SSMIS	Special Sensor Microwave - Imager/Sounder
SMMR	Scanning Multichannel Microwave Radiometer
SSM/T	Special Sensor Microwave - Temperature

SSU	Stratospheric Sounding Unit
TCWV	Total Column Water Vapour
THIR	Temperature-Humidity Infrared Radiometer
TIROS	Television Infrared Observation Satellites
TOVS	TIROS Operational Vertical Sounder
VTPR	Vertical Temperature Profile Radiometer