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Options to Advance Co-ordination and Analysis of Climate Data in Europe

Prepared for the Environmental Protection Agency

By

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The Global Climate Observing System (GCOS) is a globally coordinated network of observing systems for climate, and is designed to support national and international requirements for global observations. The GCOS Implementation Plan is a key document describing what actions Parties to the United Nations Framework Convention on Climate Change (UNFCCC) should undertake in order to ensure a comprehensive climate observation system is in place. This report provides a comparative assessment of approaches taken to addressing the state of European climate observations systems and related data analysis by five selected European countries. It reports on approaches to climate observations and analyses in Ireland, Switzerland, Germany, the Netherlands and Austria, and explores options for a more coordinated approach to national responses to climate observations in Europe.

The preliminary findings indicate that:

- Climate monitoring *mus*t be a long-term uninterrupted activity. Many of the countries report that certain observations are under continuous threat of termination and no mechanism currently exists to assure their funding support over time scales relevant for climate studies. Complete and regular detailed analysis should be carried out and reported on all ECV observations, including satellite data records where appropriate.
- There is a high degree of variance in terms of reporting between National Communications under the UNFCCC requirements and more in depth state of the climate reports that have recently been published by the countries presented in this report.
- To date, Switzerland, Germany and Austria are the only European countries that have established national GCOS Secretariats, while others such as The Netherlands have appointed coordinators.
- With the exception of countries presented in this study, most European countries, including Ireland, are not afforded an opportunity whereby all relevant national agencies and institutions meet regularly to exchange information on national GCOS activities.

Enhanced cooperation in relation to national GCOS activities within Europe would promote and assist a more coherent response to GCOS requirements and provide a platform for mutual learning and support.

In order to tackle these challenges in Europe, we recommend that:

- Existing gaps could be addressed by a ***new pan-European GCOS initiative*** that aims to promote joined-up-thinking and better coordination by European countries in the development of GCOS actions.
- As part of this initiative there should be ***an annual pan-European forum*** in terms of GCOS actions in Europe based on the *roundtable* meetings approach employed by a number of the countries described in this report.
- Such a coordinated initiative would be valuable in ensuring that European countries provide coherent inputs for ***the new GCOS implementation plan***.
- A comparative study should be carried out across European countries in relation to the challenges they face in analysing and reporting on the status and trends in climate observations. Moreover a first pan-European synopsis of ECV status and trends should be compiled by integrating the findings from existing reports. Based on the lesson learned, this study should produce ***a set of guidelines to assist nations report on climate status and trends*** more comprehensively and coherently.
- A pan-European review of ***how national in-situ networks are resourced*** should be carried out. Consideration should be given to co-funding and multilateral support of observations of certain ECVs.
- **Support, funding and coordination for the above actions should be explored and sought through JPI Climate's transnational research initiatives** as its remit spans all aspects of climate from observations to mitigation and adaptation.

Scope and aim of this document

Systematic, high-quality observations of the atmosphere, oceans and land are required to improve the understanding of climate characteristics and consequences of climate change. This report provides a comparative assessment of approaches taken to addressing the state of European climate observations systems and related data analysis by five selected European countries. This research reports on approaches to climate observations and analyses in Ireland, Switzerland, Germany, the Netherlands and Austria, and explores options for a more coordinated approach to national responses to climate observations in Europe.

The Global Climate Observing System (GCOS) is designed to ensure that the observations and information needed to address climate-related issues are obtained systematically and made available to all potential users. It is a system of organizations that builds on existing observing systems and includes all global observation programmes related to climate matters. Climate measurement series are an important basis for studies by international climate experts, and contribute to an improved scientific understanding of the climate system. The key aspects addressed in this report are: an assessment of approaches to develop a national GCOS, the generation of Essential Climate Variable (ECV) products and an evaluation of how observation networks are reporting on the advancement of such products; a comparative summary of the differences and synergies in terms of reporting on climate observations; an overview of relevant European initiatives and recommendations on how identified gaps might be addressed in the short to medium term. The findings of this research are based on literature reviews as well as a dialogue with and inputs from relevant parties in the GCOS secretariat and those working on coordination of the European Space Agency's Climate Change Initiative.

A brief overview of GCOS and ECVs

The development and maintenance of appropriate climate observations and analysis systems is an essential part of a country's response to climate change. The key aim of these systems is to improve knowledge of the climate and thereby inform policy development for options to stabilize greenhouse gas concentrations in the atmosphere through the framework of the United Nations Framework Convention on Climate Change (UNFCCC). It is essential that these national efforts are linked to corresponding European and global networks. In support of national observation efforts, GCOS responds to the objectives and requirements of systematic observations as specified by UNFCCC and its Kyoto Protocol.

UNFCCC

Signatories to the UNFCCC are obliged to provide National Communications at regular intervals detailing what programme of measures are being employed to implement the Convention (UNFCCC, 2006). Developed countries have recently reported on these as part of their 6th National Communications to the UNFCCC. In order to enhance the comparability of this information, it is essential that these reports contain accurate, consistent and internationally coherent data. Part of that reporting involves informing on the state of climate observation systems and associated analyses, which further supports the work on research and systematic observation under the Subsidiary Body for Scientific and Technological Advice (SBSTA).

SBSTA

This is one of two permanent subsidiary bodies to the UNFCCC established by the Conference of the Parties (COP) [1]/Parties to the Kyoto Protocol (CMP)[2]. The SBSTA supports the work of the COP and the CMP through the provision of timely information and advice on scientific and technological matters as they relate to the Convention or its Kyoto Protocol. This body carries out methodological work under the Convention and the Kyoto Protocol, and promotes collaboration in the field of research and systematic observation of the climate system. In addition, it plays an important role as the link between the scientific information provided by expert sources such as the Intergovernmental Panel on Climate Change (IPCC) on

[1] The COP is the supreme decision-making body of the Convention. A key task for the COP is to review the national communications and emission inventories submitted by Parties. Based on this information, the COP assesses the effects of the measures taken by Parties and the progress made in achieving the ultimate objective of the Convention.

[2] The Conference of the Parties, the supreme body of the Convention, shall serve as the meeting of the Parties to the Kyoto Protocol. The CMP reviews the implementation of the Kyoto Protocol and takes decisions to promote its effective implementation.

the one hand, and the policy-oriented needs of the UNFCCC on the other. It works closely with the IPCC, sometimes requesting specific information or reports from it, and also collaborates with other relevant international organizations that share the common objective of sustainable development.

GCOS

Established in 1992 as an initiative of the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the United Nations Environment Programme (UNEP) and the International Council of Science (ICSU), the Global Climate Observing System (GCOS) is a globally coordinated network of observing systems for climate, and a programme of activities that support and improve those corresponding networks. It is designed to meet the evolving national and international requirements for global observations. GCOS experts have introduced the widely-accepted concept of the 50 so-called Essential Climate Variables (ECVs), which are considered as the minimum set of key variables needed to describe the Earth's climate system on a global scale. A large number of research and operational systems provide important contributions to observe those variables. These observations may be ground-based, airborne or from satellite systems. Furthermore, it has issued a set of GCOS Climate Monitoring Principles (GCMPs) and an Implementation Plan (GCOS, 2004, update in 2010)[3] that GCOS members should adopt. A new implementation plan will be published in 2016 with verifiable and costed actions and specific requirements for climate products[4]

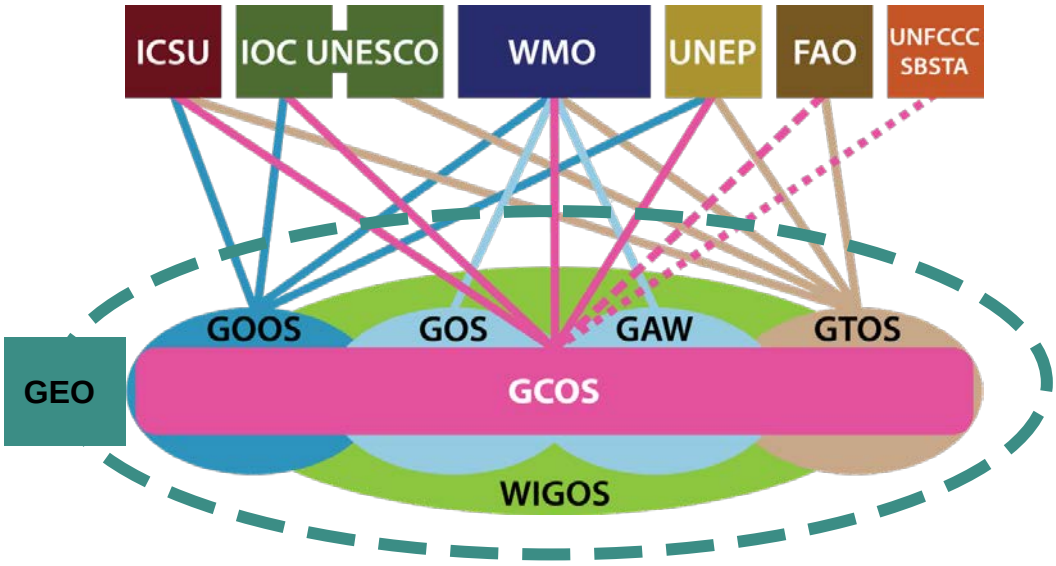


Figure 1: The GCOS framework and linkages with other international institutions (GCOS, 2014, pers. comm., 24 June). (ICSU: International Council of Science; IOC: Intergovernmental Oceanographic Commission; WMO: World Meteorological Organisation; UNEP: United Nations Environment Programme; FAO: Food and Agriculture Organisation; SBSTA: Subsidiary Body for Scientific and Technological Advice; GEO: Group on Earth Observations; WIGOS: WMO Integrated Global Observing System; GOOS: Global Ocean Observing System; GOS: Global Observing System; GAW: Global Atmosphere Watch; GTOS: Global Terrestrial Observing System).

[3] GCOS, (2010) Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (Update). GCOS Report 138. WMO/TD No 1523. WMO, Geneva, pp 186.

[4] http://www.wcrp-climate.org/JSC35/documents/GCOS.pdf

An outline of best practice in advancing implementation of GCOS by selected countries in Europe

As important as the systematic collection and management of climate data is their regular analysis and the reporting of status, trends and projections (Dwyer, 2012)[5]. For example, in Ireland, a series of Environmental Protection Agency (EPA) studies focusing on climate change indicators have been produced since 2000. Recent research has concentrated on ECVs as part of Ireland's response to the GCOS, as well as work on phenological observations and networks. These advancements in terms of measurement and analysis of ECVs are fundamental to providing information on trends and changes in the climate system. Similar research has been carried out and associated reports have been published in four other European countries (Switzerland, Germany, The Netherlands, Austria), which are further analysed in this study.

Governance, institutional context and coordination at a national level:

- GCOS activities and interests in any country normally cut across many departments and agencies, rather than being limited to any one agency such as a meteorological service. It is therefore desirable and efficient for GCOS to have, if possible, a single contact in each nation who can coordinate amongst the relevant agencies and represent the views of all, or at least most, of them on a regular basis. Currently, there are 25 National GCOS Coordinators.
- To date, Switzerland, Germany and Austria are the only European countries that have established their own national GCOS Secretariats.
- *National GCOS Roundtable*[6] meetings are currently operating in Switzerland, Germany and Austria. The Netherlands have made recommendations for the organisation of a *Roundtable* meeting with interested parties (e.g. scientific institutes and programmes on climate research) on how to strengthen climate monitoring in and by the Netherlands. They also plan the formation of a national platform for the coordination of climate monitoring in 2014. In Ireland, Dwyer (2013)[7] has recommended the establishment of an advisory committee to steer national climate observation requirements. These coordinated approaches to national GCOS activities promote long-term strategic planning to ensure continuous and representative observations (e.g. by identifying the risk of discontinuity ahead of time and engaging in remedial action).
- In addition to National Communications, a number of European countries have begun publishing GCOS reports. These reports, prepared by National Climate Observing Systems contributing organisations, were developed in response to UNFCCC conclusions from 2005 and 2007 of the SBSTA, and present the progress made in the implementation of GCOS on a national level, and give an overview of the observations made according to the list of ECVs.
- In term of information provision and ease of accessibility, Switzerland[8], Germany[9] and Austria[10] host a designated national GCOS website.

[5] Dwyer, N. (2012) *The Status of Ireland's Climate, 2012.* Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford, Ireland: http://www.epa.ie/pubs/reports/research/climate/CCRP26%20-%20Status%20of%20Ireland%27s%20Climate%202012.pdf

[6] A *Roundtable* meeting is an annual multi-agency assembly which provide an opportunity for information exchange between the different partners.

[7] Dwyer, N. (2013). The Status of Ireland's Climate. http://www.epa.ie/pubs/reports/research/climate/CCRP26%20-%20Status%20of%20Ireland%27s%20Climate%202012.pdf

[8] http://www.meteoschweiz.admin.ch/web/en/meteoswiss/international_affairs/gcos/swiss_gcos_office.html

[9] http://www.dwd.de/bvbw/appmanager/bvbw/dwdwwwDesktop?_nfpb=true&_pageLabel=dwdwww_zusammenarbeit&T17401110631149743806488gsbDocumentPath=Navigation%2FOeffentlichkeit%2FKlima__Umwelt%2FKlimaueberwachung%2FGlobal%2FGCOS%2Fhome__node.html%3F__nnn%3Dtrue

[10] Available in German only at: http://www.zamg.ac.at/cms/de/topmenu/ueber-uns/internationales/gcos/1.-runder-tisch-gcos-oesterreich

A synopsis of the current state of play in terms of National Communications and actions by selected European countries

National Communications

The core elements of the National Communications include the details of the activities a country has undertaken to implement the Convention and information on emissions and removal of greenhouse gases (GHGs) National Communications contain information on national circumstances, vulnerability assessments, financial resources and transfer of technology, and education, training and public awareness, and information on policies and measures (UNFCCC, 2014)[11]. In terms of GCOS activities, these reports also include a *Research and systematic Observations* section, including: emerging scientific findings, research planning activities, research priorities and gaps, research capacity building activities particularly in developing countries, regional climate change research networks and relevant communication issues and details of systematic observations of ECVs (FCCC/SBSTA/2007/4)[12].

Reporting

At national level, this reporting process can provide a tool for national planning, monitoring and evaluation, interdepartmental coordination and communication. At the international level, national reports can provide a way to assess national and international progress towards the objectives of the Convention and to identify where such progress could be strengthened (Ellis et al., 2010)[13].

- Beyond reporting requirements, developing and implementing climate related national programmes as required by the Convention involves processes and information that can be resource and capacity intensive.
- The reporting of the development of climate observations by countries in their National Communications is limited by the relatively rigid structure of the template that is characterised by text boxes and tables listing the number of observing infrastructure in each county. National reports tend to focus on positive aspects such as new developments, with little attention given to existing challenges and gaps in data analysis. This study has identified that more detail and critical analysis is provided by the national GCOS programme-related reports published independently of the National Communications.
- Regular analyses and the reporting of status, trends and projections are critical in adding value to collected observations. In Ireland, for example, long-time series, many include more than 50 years of data, exist for a number of the atmospheric and hydrological variables, yet only partial analyses have been carried out (Dwyer, 2013)[14]. Reporting of status and trends has only commenced in recent years in all the countries analysed but no systematic reporting framework is in place and there is no clear reporting cycle for updates. There are numerous barriers and challenges to providing such comprehensive reports. These include, but are not limited to, the lack of a clear mandate to undertake the analyses, limited human and financial resources, data challenges including non-digital historical data, inhomogeneous data and difficulties of data access.
- Although countries are responding to GCOS requirements at a national level, there is, however, lack of coordination at a European level with inconsistencies in terms of reporting. Comparative analysis of these reports can be challenging with different levels of depth provided by various countries. It would be useful to carry out a comparative study across European countries in relation to the challenges they face in reporting, identify common approaches and produce guidelines to assist nations report more comprehensively and coherently on climate status and trends.

[11] UNFCCC website: http://unfccc.int/national_reports/items/1408.php

[12] UNFCCC, 2007, Report of the Subsidiary Body for Scientific and Technological Advice on its twenty-sixth session

[13] Ellis, J., Moarif, S., and Briner, G. (2010). Core elements of national reports. COM/ENV/EPOC/IEA/SLT(2010)1. http://www.oecd.org/environment/cc/45409866.pdf

[14] *Ibid* Note 7.

Other Gaps in Climate Observation Systems

- Many elements of the selected countries' climate observation infrastructure are robust – however, there are a number of gaps and areas where improvements are necessary. For example, in Ireland no long-term national observation programmes exist for a number of the ECVs. A prioritisation and costing exercise should be carried out with regard to implementing appropriate programmes over time (Dwyer, 2013)[15]. In Switzerland, there is a clear need for action with regard to the infrastructure for cryospheric climate observations to ensure the sustainability of measurements of glaciers, permafrost and snow (Seiz and Foppa, 2007)[16]. In terms of data accessibility, it is highly desirable that datasets are freely available in a timely manner. Many national data policies contain conditions on data exchange and use, including financial charges for non-public duty usage. Initiatives such as the European Infrastructure for Spatial Information (INSPIRE), and the Global Earth Observations System of Systems (GEOSS) are making some progress in the area of data accessibility.
- Assessments of future climate change remain subject to numerous uncertainties. Relevant research activities require a high-quality climate observations database, and it is therefore essential that existing long-term data series for the most important variables should be continued (Seiz and Foppa, 2007)[17].
- A necessary prerequisite to efficiently and sustainably implement GCOS at a national level is to have an integrated view of all relevant climate variables. However, there are many inconsistencies between countries in relation to the depth of the analyses they report on and publish. It is important that the countries report on the status of their climate observation systems to supplement the synopses presented by the National Communications. The countries examined in this study are at different stages of reporting in-depth analyses of their GCOS progress to-date. The Swiss were pioneering in this respect with the publication of their first inventory of long-term climatological data series and international data centres, including an assessment of their future prospects in 2007[18]. Ireland published its first synthesis of the status of the climate, based on an analysis of ECVs, in 2013 (Dwyer, 2013)[19]. In 2013, Germany launched its inventory report on national climate observing systems; it was the first ever broad compendium of German climate observations addressed to climate research and decision makers (Deutscher Wetterdienst, 2013)[20]. Similarly, Austria has just published its first comparable report titled *Global Climate Observing System Bericht Österreich,* which provides a synthesis and review of Austria's ECVs (GCOS Austria, 2014)[21].
- In relation to sustainability and resourcing, the operation of the in-situ monitoring systems is funded by a mix of long-term (service-based) and short-term (project-based) commitments from various national and international sources. In principle, service-based funded monitoring efforts are to be preferred in view of the demand for long-term uninterrupted time series. However, when carefully managed, project-based monitoring can yield valuable contributions. New climate observations in particular are mainly financed on an ad-hoc basis through short-term national and international programmes.

[15] *Ibid* Note 7.

[16] Seiz, G., Foppa, N., 2007. National Climate Observing System (GCOS Switzerland).Publication of MeteoSwiss and ProClim. http://www.meteoschweiz.admin.ch/web/en/meteoswiss/international_affairs/gcos/uebersicht_klimabeobachtung/nationales_klimabeobachtungssystem.Par.0027.DownloadFile.tmp/nationalclimateobservingsystem.pdf

[17] *Ibid* Note 16.

[18] *Ibid* Note 16.

[19] *Ibid* Note 7.

[20] Deutscher Wetterdienst (2013). German Climate Observing Systems. Inventory report on the Global Climate Observing System (GCOS). Self-published by DWD, Offenbach a. M., 130 pages.

[21] GCOS Austria (2014). Global Climate Observing System Bericht Österreich. http://www.zamg.ac.at/cms/de/topmenu/ueber-uns/internationales/gcos/gcos-bericht

An overview of some relevant existing European coordination initiatives

- CLIPC (Climate Information Platform for Copernicus) is a *short-term* (three year) FP7-funded project running until 2016 providing access to climate information of direct relevance to a wide variety of users, from scientists to policy makers and private sector decision makers. The CLIPC consortium brings together 22 institutions in Europe working on *developing and making available datasets* on climate observations and modelling, and on impact analysis. In terms of in-situ observation, the pre-operational Copernicus climate service, including CLIPC and other downstream service projects, currently fulfils a *de facto* coordination role (ESA, 2014, pers. comm., 14 May).
- The European Space Agency's (ESA) Climate Change Initiative (CCI), running from 2009-2016, is providing stable, long-term, global *satellite-based ECV data products* for climate modellers and researchers. The essential feature of the programme is the systematic generation of ECVs that can be derived from space based observations (currently 12), and ensuring their regular update. Before CCI, no single programmatic framework existed that unified all such activities within Europe and/or ensured their continuous implementation at the scale and consistency necessary to meet UNFCCC needs.
- The Integrated Carbon Observation System (ICOS) features a network of national focal points that serve as a country liaison in relaying information between the country's greenhouse gas (GHG) research and measurement community and other stakeholders. This promotes the exchange of best practices in terms of developing cutting-edge GHG measurement techniques and processes.
- The EuroArgo Research Infrastructure coordinates and strengthens the European contribution to the international Argo programme. The Argo network is a global array of autonomous instruments, deployed over the world ocean, reporting subsurface ocean properties. The Euro-Argo Research Infrastructure is made up of a Central Research Infrastructure and distributed national facilities, currently comprised of 25 member organisations. This structure is flexible with variable contributions form members, but all act under one unifying coordination structure.
- JPI Climate (Joint Programming Initiative Climate: "Connecting Climate Knowledge for Europe) a collaboration between 14 European countries (including Ireland, Switzerland, Austria, Germany and The Netherlands) aims to harmonise and coordinate their climate research, in addition to funding new transnational research initiatives. JPI Climate actively promotes better connections between countries and disciplines and better connectivity of climate knowledge to enhance its societal relevance. Current research efforts often are fragmented along national boundaries and not well coordinated. Transnational coordination of the research base aims to overcome research fragmentation, to make better use of public R&D resources and to facilitate cross-border collaboration between top scientists. This initiative promotes supporting activities such as joint workshops, training, creation of joint platforms for enhanced sharing of expertise, data access, interoperability, and identification of gaps and deficiencies in the European observational networks and inclusion of new observational parameters in the activities (JPI Climate, 2011)[22]. JPI Climate offers an opportunity as a useful mechanism to improve coordination of GCOS activities in Europe; although its current focus is somewhat more in the modelling and projections sphere rather than observations, participating nations could develop a coherent proposal to promote and further the observations component of its strategic research agenda (GCOS, 2014, pers. comm., 24 June). The most recent relevant call for transnational funding closed in November 2013[23].

[22] JPI Climate (2011). Joint Programming Initiative Connecting Climate Change Knowledge for Europe: Strategic Research Agenda.
[23] JPI Climate Joint Call for Transnational Collaborative Research Projects

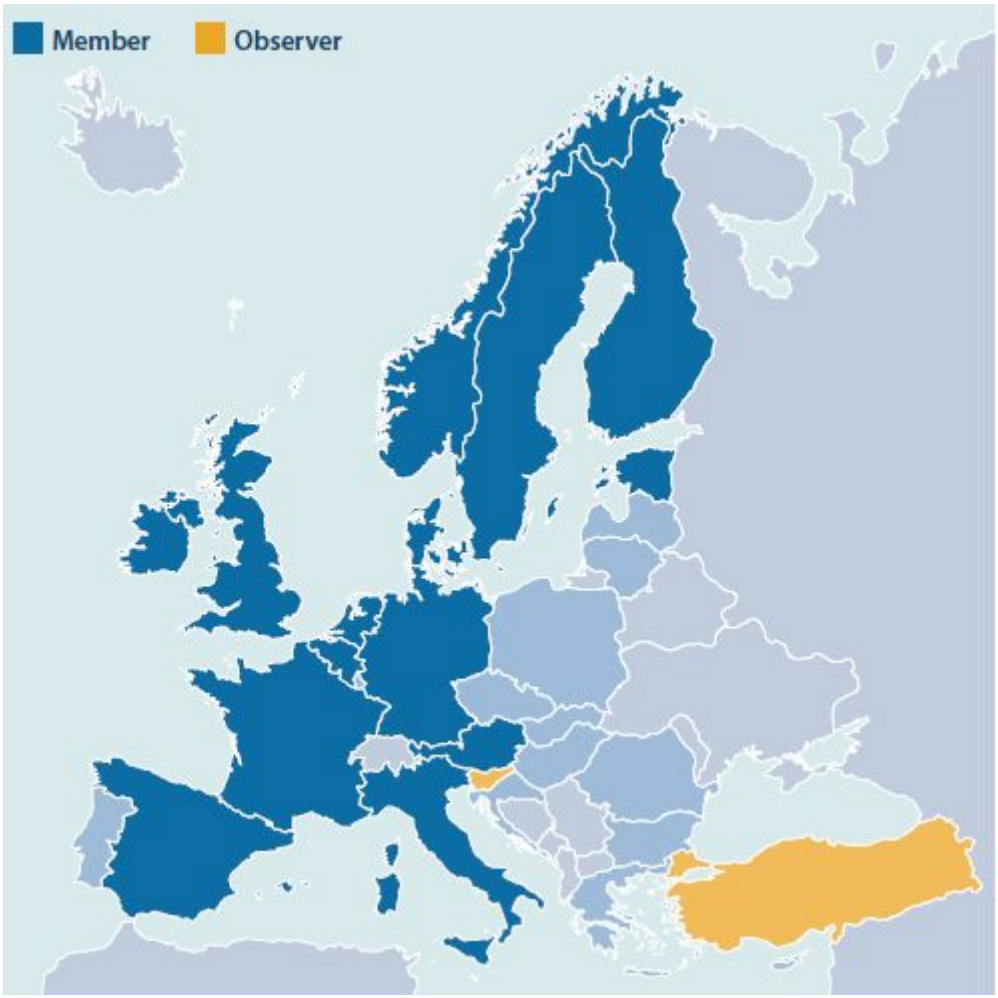


Figure 2: JPI Member and Observer countries *Source*: ERA Portal Austria (http://era.gv.at/)

Results and recommendations

Almost all climate observing networks, systems, data centres and analysis centres are funded, managed and operated by national entities within their own requirements, plans, procedures, standards and regulations. Needs of the UNFCCC and other users for global climate observations and products can only be addressed if plans are developed and implemented in a coordinated manner by national organizations (GCOS, 2014)[24]. GCOS is far from being fully implemented, and not all of the ECVs are observed continuously and comprehensively. Resolving financial issues related to long-term continuity is an issue in a number of countries. Above all, it requires continued engagement for coordinated implementation and long-term commitment.

The preliminary findings of this critical analysis indicate that:

- Climate monitoring *mus*t be a long-term uninterrupted activity. Many of the countries report that certain observations are under continuous threat of termination and no mechanism currently exists to assure their funding support over time scales relevant for climate studies. Complete and regular detailed analysis should be carried out and reported on all ECV observations, including satellite data records where appropriate.

[24] http://www.wmo.int/pages/prog/gcos/index.php?name=NationalActivities

- There is a high degree of variance in terms of reporting between National Communications under the UNFCCC requirements and the GCOS-type reports that have recently been published by the countries presented in this report. The former merely provide a synopsis of the current status in each country. The latter, however, provide a great level of synthesis and detail regarding critical analysis and prospects for future advancements of national GCOS activities.
- To date, Switzerland, Germany and Austria are the only European countries that have established national GCOS Secretariats, while others such as The Netherlands have appointed coordinators.
- With the exception of countries presented in this study, most European countries, including Ireland, are not afforded an opportunity whereby all relevant national agencies and institutions meet regularly to exchange information on national GCOS activities.
- There is, as yet, no equivalent platform at a pan European-scale that embodies the best practice demonstrated by the national *Roundtable* meetings (i.e. Switzerland, Germany and Austria). From 2000 to 2006, regional workshops were introduced but have since ceased as there was no lead either from the GCOS office or from the regions themselves, momentum was lost and in the absence of a clear mandate and adequate financial resources follow-up actions were not taken. GCOS would be keen to support revitalisation of these regional workshops in an improved form (GCOS, 2014, pers. comm., 24 June).

Enhanced cooperation in relation to national GCOS activities within Europe would promote and assist a more coherent response to GCOS requirements and provide a platform for mutual learning and support.

In order to tackle these challenges in Europe, we recommend that:

- Existing gaps could be addressed by a ***new pan-European GCOS initiative*** that aims to promote joined-up-thinking and better coordination by European countries in the development of GCOS actions. The GCOS Secretariat is supportive of the establishment of such a coordination mechanism indicating that it is much needed, and welcome (GCOS, 2014, pers. comm., 24 June). In addition, the GCOS Cooperation Mechanism (GCM), established to identify and make the most effective use of resources available for improving climate observing systems, could act as an advisor and help address considerable demands for improved climate observing networks.
- As part of this initiative there should be ***an annual pan- European forum similar to the Roundtable mechanism*** in terms of GCOS actions in Europe employed by the countries outlined in this report. Observer status could be given to specific non-European countries to share best-practise and promote consistency across regions.
- Such a coordinated initiative would be valuable in ensuring that European countries provide coherent inputs for ***the new GCOS implementation plan***.
- A comparative study should be carried out across European countries in relation to the challenges they face in analysing and reporting on the status and trends in climate observations. This would include an analysis of the approaches taken and the experience gained by the teams compiling the national reports in the five countries discussed in this report. Moreover a first pan-European synopsis of ECV status and trends should be compiled by integrating the findings from these reports. Based on the lesson learned, this study should produce ***a set of guidelines to assist nations report on climate status and trends*** more comprehensively and coherently.
- A pan- European review of ***how national in-situ networks are resourced*** should be carried out. Consideration should be given to co-funding and multilateral support of observations of certain ECVs.
- **Support, funding and coordination for the above actions should be explored and sought through JPI Climate's transnational research initiatives** as its remit spans all aspects of climate from observations to mitigation and adaptation. It is a long-term initiative; incorporates both in-situ and space-based observations; it is supported by national governments; it has relevant European institutions with observer status (e.g. ESA, European Environment Agency), is flexible and has working groups which can be set up to address common issues of interest.

Conclusions

The development and maintenance of appropriate climate observations and analysis systems is an essential part of a country's response to climate change. The Global Climate Observing System (GCOS) is a globally coordinated network of observing systems for climate, and is designed to support national and international requirements for global observations. The GCOS Implementation Plan is a key document describing what actions Parties to the UNFCCC should undertake in order to ensure comprehensive climate observation systems are in place.

In Europe there is no co-ordinated approach for responding to GCOS requirements. States are required to report on their observation systems via the National Communications to the UNFCCC, but these lack the detail required to understand the challenges and successes in national observation systems. Some countries have setup *roundtable* meetings which provide an opportunity for information exchange between the different national partners involved in climate observations and there have also been endeavours to provide more detailed information through independent reports on the status and trends in national observing systems and in the climate itself. However, such developments are somewhat ad hoc in nature and lack any overarching framework and coordination.

Such shortcomings and gaps could be addressed by a new pan-European GCOS initiative with the aim of promoting joined-up-thinking and better coordination by European countries in the development of GCOS actions. Support, funding and coordination for this should be explored and sought through JPI Climate's transnational research initiatives as its remit spans all aspects of climate from observations to mitigation and adaptation.