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| WEATHER CLIMATE WATER | A picture containing text, clipart, ceramic ware, porcelain  Description automatically generated**World Meteorological Organization**  **COMMISSION FOR WEATHER, CLIMATE, WATER AND RELATED ENVIRONMENTAL SERVICES AND APPLICATIONS**  **Second Session** 17 to 21 October 2022, Geneva | **SERCOM-2/INF. 5.5(1b)** |
| Submitted by: Chair of SC-CLI  15.IX.2022 |

## CHECKLIST FOR CLIMATE SERVICES IMPLEMENTATION

**8582/2020/S/CS/Checklist**

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| **Checklist for Climate Services Implementation** |

This checklist is for National Meteorological and Hydrological Services (NMHSs) to self-assess progress with respect to climate services implementation and identify areas where support is needed. The checklist refers to the [Country-focused results based framework for WMO contribution to the GFCS](https://library.wmo.int/doc_num.php?explnum_id=3166#page=90) approved by the WMO sixty-eighth session of the Executive Council ([abridged report](https://library.wmo.int/index.php?lvl=notice_display&id=19656#.X3sjSGgza70) pp. 82–92).

The checklist consists of “YES/NO” self-assessments as to the degree to which actions have been taken or outputs generated. These actions or outputs are grouped into the categories of:

 Governance

 Basic Systems

 User Interface

 Capacity Development

 Provision and Application of Climate Services

 Monitoring and Evaluation

Within each grouping, actions or outputs are listed under the “Basic, Essential, Full, Advanced” headings. Ideally simultaneous actions will be taken in all categories, moving from left to right, from “Basic” to “Advanced”.

Key next steps, where such actions or outputs have not been completed, may be candidates for further effort and/or technical support. Please review each section and select the option that applies by checking the respective box (double-click on the appropriate grey box, select “checked” as “Default value”, then OK).

Objective: Institutional, technical, financial, and human resources mobilized for climate services planning, implementation and results monitoring targeting climate-sensitive national priorities.

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| --- | --- |
| **Governance** | |
| 1. | Name of your country |
| 2. | Does the NMHS in your country participate in the identification of climate-sensitive national development priorities in:   Nationally determined contribution (NDC) to the Paris agreement: YES  NO   National Adaptation Plan (NAP): YES  NO   National Development Policy or Strategy: YES  NO   National Disaster Risk Management (DRM) Strategy YES  NO   National sectoral policies and strategies (e.g. food security, health, etc.): YES  NO |
| 3. | Has the NMHS in your country participated in the capacity assessment of key stakeholders (including NMHSs and NHSs) by:   Identifying key stakeholders for improving climate-related outcomes in priority sectors (UIPs focused on GFCS priorities: health, agriculture and food security, WRM, energy, DRM): YES  NO   Identifying key climatic factors of socio-economic significance at the national levels, establishing baseline knowledge based on capacity assessments and co-define with stakeholders climate information needs for sectoral decision-making at national level: YES  NO   Identifying feasible climate services for meeting priority needs and capacity needs/requirements for their development and delivery: YES  NO |
| 4. | Does the NMHS in your country participate in the implementation of national plans/frameworks (e.g. NAPs or national action plans) by:   Verifying status of and consulting/supporting development and/or implementation of NAP and other plans listed in point 1 above reflecting priority needs: YES  NO   Co-developing national action plan for climate services (if appropriate, depending on status of/prospects for NAP) in response to priority needs: YES  NO   Establishing institutional mandates for providing climate services as well as for using climate services, with the aim to mainstream efficient and well-informed climate risk management practices at all levels: YES  NO |
| 5. | Has the NMHS in your country undertaken resources reviews of relevant ongoing and planned partner projects by:   Consulting lists of planned or ongoing major adaptation (and mitigation) investment programmes (GEF, GCF, Adaptation Fund, PPCR, development banks, RECs): YES  NO   Jointly meeting with national government Ministries/Departments and their counterpart(s) major international organizations (UNDP, IFIs, WFP, FAO, WHO etc.) as necessary to articulate NMHS needs to support development decisions: YES  NO   Negotiating access to financing from ongoing programmes and/or contributing to the development of new proposals to address identified needs: YES  NO | |
| 6. | Does the NMHS in your country participate in national planning, coordination, information sharing and monitoring structures by:   Identifying/establishing/engaging in an appropriate national governance mechanism to ensure coordination for climate services (there may already be one for NDCs, NAPs, DRM, etc.): YES  NO | |
| **Basic Systems (observing networks, data, data management, monitoring, and forecasting systems)** (Note: see [Table 1](#table1) on categorization of NMHSs) | |

7. Adequate observing networks, data, data management, monitoring, and forecasting systems:

\*Note: The capabilities are incremental by moving from left to right columns in the table (i.e. competencies related to the category “Essential” include the ones related to “Basic” etc.)

\*\*Note: Section 7(a) refers to the assessment of observing networks in the context of climate services

 Establish an internal management structure to integrate all basic systems into a functioning observing system: YES  NO

 Establish national requirements for observational needs to support climate services: YES  NO

 Perform gap analysis by matching observational needs against existing national capabilities: YES  NO

 Develop national observing strategy for weather and climate in order to address identified gaps YES  NO

 Aware of climate monitoring principles (Annex 3) YES  NO

 Adhere to climate monitoring principles (Annex 3) YES  NO

(a) Observing networks

| **BASIC** | **ESSENTIAL** | **FULL** | **ADVANCED** |
| --- | --- | --- | --- |
|  Operate and maintain adequate national observing systems, in support of the weather-related application areas of the WMO[[1]](#footnote-2) Rolling Review of Requirements:  YES  NO   Develop complete inventory of existing national observing systems and their metadata by completing and updating national entries in OSCAR[[2]](#footnote-3)/Surface:  YES  NO |  Undertake to improve station density based on established and known national requirements:  YES  NO   Improve observations through compliance with WIGOS regulatory and guidance material:  YES  NO   Observing network delivers against ECVs[[3]](#footnote-4):  YES  NO   Formal partnership agreements established with external (non-NMHS) entities operating third party; observing networks under guidance on minimum set of requirements for use in local climate services:  YES  NO |  Adoption of long-term strategy for managing observing network and its change, including relocation of stations, establishment of automated observations that meet climate observation requirements and standards, and protection of long-term observing stations:  YES  NO |  Improve and strengthen national observing network based on national observing strategy, the relevant Regional WIGOS[[4]](#footnote-5) Implementation Plan and the EGOS-IP[[5]](#footnote-6):  YES  NO |

(b) Data and data management

| **BASIC** | **ESSENTIAL** | **FULL** | **ADVANCED** |
| --- | --- | --- | --- |
|  Collect and store data and metadata in relational databases (OSCAR/Surface):  YES  NO   Conduct data rescue:  YES  NO   Apply quality control processes to climate data:  YES  NO   Conduct data management including weather forecasting and warnings, quality assurance /quality control, using Quality Management Framework principles:  YES  NO   Apply when necessary spatial temporal interpolation to ensure data continuity:  YES  NO   Create, archive and document climate datasets of the appropriate length, time resolution and units:  YES  NO   Assess climate data homogeneity and adjust inhomogeneous time series where possible:  YES  NO   Comply with the standards set and the recommendations made by WMO :  YES  NO |  Historical as well as real time observations in the atmosphere, the oceans, over land and ice of the ECVs prepared by GCOS[[6]](#footnote-7) and partners for climate purposes, exchanged freely for use in RCCs[[7]](#footnote-8) for at least one Global Surface Network site:  YES  NO   Adopt well documented strategy including vision and operating manual for ensuring security, integrity, retention policy and technology migration for data archival process and systems:  YES  NO   Register data in WIS[[8]](#footnote-9):  YES  NO |  Ensure all further observations are accumulated into time series:  YES  NO   Identify additional required data that can be accessed from regional and global sources:  YES  NO   Document and register rescued and non-rescued data in the WMO-GFCS I DARE[[9]](#footnote-10) portal:  YES  NO   Use Data Management Systems that are compliant with WMO Specifications as recommended by the Commission for Climatology:  YES  NO |  Identify and engage research to improve data availability:  YES  NO |

(c) Monitoring

| **BASIC** | **ESSENTIAL** | **FULL** | **ADVANCED** |
| --- | --- | --- | --- |
|  Identify and retrieve adequate climate data from different sources to generate climate products:  YES  NO   Compute basic climate products, such as World Weather Records, Climatological Standard Normals , and other basic statistics i.e. anomalies, standard deviations, percentiles contingency tables, etc.:  YES  NO |  Compute Climate Indices and derived products for the monitoring of climate change and climate extremes using ETCCDI[[10]](#footnote-11) (and other tools such as iTacs[[11]](#footnote-12) for example) and NCMP[[12]](#footnote-13) approach:  YES  NO   Generate generic monitoring products (i.e. drought monitoring, climate watch, etc.):  YES  NO   Compute sector-specific Climate Indices and other sector-oriented climate products:  YES  NO   Create value-added products, such as graphics, maps and reports to explain climate characteristics and evolution, according to the needs of specific sectors such as health, agriculture, water and disaster management:  YES  NO   Comply with the standards set and the recommendations made by WMO:  YES  NO   Register in WIS operational climate monitoring data and products that are recommended by WMO for regional or global climate monitoring activities:  YES  NO   Apply QMS[[13]](#footnote-14) principles:  YES  NO |  Apply multi-variate statistical analysis to provide space-time distribution of climate patterns and identify statistical relationships across multiple variables:  YES  NO   Create integrated, continually updated data product time series, e.g. combining satellite observations and reanalysis with station data:  YES  NO   Produce gridded data sets based on peer-reviewed techniques and complying with WMO recommended practices:  YES  NO   Generate and manage consistent and systematic information on Extreme Weather and Climate Events complying with the WMO recommended practices:  YES  NO |  Identify and engage research to improve monitoring and related products:  YES  NO   Publish regular, quality controlled authoritative information on the status of climate relevant to policy making for climate adaptation:  YES  NO   Simulation of past climate and generate model-based analysis and Reanalysis:  YES  NO   Statistical and dynamical downscaling, using advanced empirical techniques and regional climate models:  YES  NO   Maintain, update regularly and make available for global access high quality peer-reviewed ECV datasets and document the underlying uncertainty assessment:  YES  NO |

(d) Forecasting systems

| **BASIC** | **ESSENTIAL** | **FULL** | **ADVANCED** |
| --- | --- | --- | --- |
|  Participate in RCOFs[[14]](#footnote-15):  YES  NO   Disseminate climate outlooks provided by GPCs[[15]](#footnote-16), RCCs and RCOFs:  YES  NO |  Create value-added products, such as graphics, maps and reports to explain climate forecasts and climate model information:  YES  NO   Develop and/or provide monthly, seasonal and longer scale climate predictions, using both empirical and dynamical approaches:  YES  NO   Generate value-added forecast products for national scales based on RCC and GPC products:  YES  NO   Conduct and/or contribute to RCOF sessions:  YES  NO   Register forecasting products in WIS:  YES  NO |  Generate sub-seasonal and seasonal forecast products:  YES  NO   Run climate models within the adequate domain and with adequate parametrization and scenarios:  YES  NO   Downscale climate prediction and projection products:  YES  NO   Interpret annual to decadal climate prediction products:  YES  NO   Coordinate RCOFs and NCOFs[[16]](#footnote-17) and assist users in forecast interpretation:  YES  NO |  Evaluate the performance of climate models output and quantify the associated uncertainties:  YES  NO   Run Global and/or Regional Climate Models (sub-seasonal to decadal and longer):  YES  NO   Locate, select and retrieve climate forecasts and climate models output generated by Regional Climate Centers, Global Producing Centers and other institutions to complement self-produced climate products:  YES  NO   Provide large scale data resources as input to modelling, research, applications, etc.:  YES  NO   Host GPCs/RCCs:  YES  NO   Guide/lead process improvement studies for RCOFs and NCOFs:  YES  NO   Create future climate projections using different scenarios:  YES  NO   Apply statistical and geo-statistical analysis, including downscaling/ calibration, to monitor the spatial distribution and temporal evolution of model output:  YES  NO   Develop tailored products for decision support in priority sectors:  YES  NO   Apply recalibration procedures to model outputs:  YES  NO   Make skill assessments publicly available:  YES  NO   Identify and engage research to improve forecasting and related products:  YES  NO |

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| **User Interface** |

8. Decision-support tools and systems (identified, designed and improved, including any necessary research)

| **BASIC** | **ESSENTIAL** | **FULL** | **ADVANCED** |
| --- | --- | --- | --- |
| Identify the top five most prominent sectoral users groups (list in the order of priority):  –  –  –  –  -   Interact with users, to meet requests (for basic climatology questions):  YES  NO   Assist users to interpret/use climate predictions and products:  YES  NO   Get periodic feedback from users on the usefulness and effectiveness of the information, products and services provided (including through NCOFs):  YES  NO   Establish effective relationships and communication channels with users:  YES  NO |  Interact with users to identify their requirements for, and provide advice on, climate information and adequate and viable products for their application:  YES  NO   Conduct and evaluate user satisfaction on a regular basis (e.g. meetings, surveys):  YES  NO   Revise climate services and the means of communication based on user feedback:  YES  NO   Develop and apply in partnership with users applications to facilitate the understanding and use of existing climate products and services:  YES  NO |  Co-design and co-develop products with users:  YES  NO |  Work with sector-based research teams to develop applications models (e.g. to combine climate and agriculture information and produce food security knowledge products):  YES  NO   Jointly (with sector-based research teams) develop software and product suites for customized sector-specific climate products:  YES  NO |

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| **Capacity development** |

9. Capacity development services

Identify a source of and invest in capacity development assistance and training to support the capacity development needs emerging from the other activities (see section [4](#four) in Governance):

 Neighbouring or other NMHS for basic education and cross-discipline operational training: YES  NO

 RTC[[17]](#footnote-18), Education and/or Research Universities/institutions/organizations: YES  NO

 RCC: YES  NO

 GPC: YES  NO

 other: YES  NO

Involve users, if possible, from the other sectors in training events: YES  NO

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| **Provision and Application of Climate Services** |

10. Decision-support products and services (established or strengthened)

| **BASIC** | **ESSENTIAL** | **FULL** | **ADVANCED** |
| --- | --- | --- | --- |
|  Data services (unless prohibited under current mandate and legislation):  YES  NO   Access remote sensing and reanalysis products (i.e. EUMETCast):  YES  NO   Weather forecasting products:  YES  NO   Conduct basic climate diagnostics and climate analysis (staff will have some proficiency in climate statistics, or be able to reliably use statistical software (e.g. Climate Database Management System)):  YES  NO   Basic statistics (graphs, counts, etc.) on extremes, frequency of occurrence, spatial means for temperature (Max, Min, Mean), precipitation, and possibly relative humidity, evapotranspiration, thunder days, sunshine duration, cyclones, etc., climatological normal:  YES  NO   Regularly conduct NCOF sessions:  YES  NO   Conduct climate watch programmes and disseminate early warnings:  YES  NO |  Climate monitoring products:  YES  NO   Targeted dissemination of climate products to priority sectors (i.e. those based on data; regional and national climate monitoring products if available; seasonal outlooks provided by RCOFs and RCCs):  YES  NO   Generic seasonal forecasts:  YES  NO   Update/Improve/Develop products and services based on users’ feedback and requirements:  YES  NO |  Sub-seasonal forecasts:  YES  NO   Tailoring of products received from RCCS and in some cases GPCs for national applications:  YES  NO   Tailored seasonal forecasts (to address user needs):  YES  NO |  Climate change projections:  YES  NO   Helpdesk function:  YES  NO   Provide products that can directly be plugged-in decision-support tools including for policy development:  YES  NO   Diversified channels of communication used to disseminate climate products (e.g. radio, social media):  YES  NO   Provide products relevant to neighbouring or other countries:  YES  NO |

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| **Monitoring and Evaluation** |

11. Monitoring of benefits resulting from climate services:

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| --- | --- | --- | --- |
| **BASIC** | **ESSENTIAL** | **FULL** | **ADVANCED** |
|  Identify climate-sensitive user sector outcomes and associated variables to measure them i.e. disaster losses, crop yields, hydropower:  YES  NO   Identify sources of this information:  YES  NO |  Establish ongoing monitoring systems for documenting user outcomes:  YES  NO   Establish baselines of sectoral outcomes for continuous evaluation of climate services:  YES  NO |  Socio-economic analysis of cost-benefits of climate services conducted in collaboration with users:  YES  NO |  Investment plans of climate-sensitive sectors based on results of socio-economic analysis of cost-benefits of climate services:  YES  NO   Policy response as an outcome of the results of the socio-economic analysis of cost-benefits of climate services:  YES  NO |

12. Please indicate to which user communities/sectors your NMHS provides climate products/information, and for those sectors to which services are provided, rank the status of the services and indicate the type of products provided:

| **USER** | **INDICATE IF YOU PROVIDE CLIMATE SERVICES** | **RANK THE STATUS OF CLIMATE SERVICES FOR EACH SECTOR\*** | **INDICATE THE TYPE OF PRODUCTS PROVIDED TO THE SECTORS** | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DATA SERVICES** | **CLIMATE MONITORING** | **CLIMATE ANALYSIS AND DIAGNOSTICS** | **CLIMATE PREDICTIONS** | **CLIMATE CHANGE PROJECTIONS** | **TAILORED PRODUCTS** |
| Government | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Local authorities | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Scientific | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Commercial | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Water resources | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Agriculture | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Fisheries | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Forestry | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Transport | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Energy industry | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Human Health | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Tourism (incl. coastal zone) | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Recreation, sport | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Aviation | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Maritime transport | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Environmental protection | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Building | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Finance and insurance | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |
| Emergency planning and response | YES  NO |  | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO | YES  NO |

\* **1**=initial engagement with sector, **2**=definition of needs, **3**=co-design of products, **4**=tailored products accessible for use, **5**=climate services guide policy decisions and investment plans in sectors, **6**=documentation of socio-economic benefits

**Annexes**

**1.** **Table 1. Categorization of NMHSs**   
(Source: Commission for Climatology Guidelines for NMHSs on capacity development for climate services)

| **Level of service** | **Weather servicers** | **Climate services** | **Hydrology services** | **Description of capacity needed to achieve service level** |
| --- | --- | --- | --- | --- |
| Category 1-  Basic |  Weather observations   Weather Data Management   Interaction with users of weather data and products |  Climate observations   Climate Data Management   Interaction with users of climate data and products |  Hydrological observations   Hydrological data management   Interaction with users of hydrology data and products |  Small network of quality controlled observations   Basic data processing, archiving and communication systems   Little or no backup / offsite storage, or contingency options   Staff: observers and some meteorologists trained to Basic Instruction Package (BIP)   No 24 /7 operation   Rudimentary Quality Management System   No research and development |
| Category 2- Essential |  Medium-range (synoptic scale) forecasts and warnings   Established links with media and disaster risk reduction (DRR) communities |  Seasonal Climate outlooks   Climate monitoring |  Hydrological data products for design and operation of water supply structures   Water level and flow monitoring   Short-term flow forecasts (low flows)   Flood forecasting |  Able to take and integrate observations from other parties   Well established protocols for emergencies, backup of data and minimum offsite facilities   Staff: observers and meteorologists trained to BIP standards   24/7 operation.   Well established quality management system   Able to access most numerical weather prediction data/products from other centers   Small research and development unit   Some partnerships as junior members |
| Category 3-  Full |  Specialized weather products for a wide range of sectors   Well integrated into DRR communities and mature links with media |  Specialized climate products   Decadal climate prediction   Long-term climate projections |  Seasonal stream flow outlooks   Specialized hydrology products |  Advanced observation equipment   Ability to run its own numerical prediction suite   Research and development unit   Well educated/trained staff   Own training group   Developed library and information services   Active partnerships with NMHSs taking a leading role |
| Category 4- Advanced |  Customized weather products   Weather application tools |  Customized climate products   Climate application tools |  Customized hydrology products   Hydrology application tools |  Advanced observations   Leading Research and development team   Well-developed Education and training Unit |

**2. List of acronyms**

|  |  |
| --- | --- |
| DRM | Disaster Risk Management |
| ECV | Essential Climate Variables |
| EGOS-IP | WMO Implementation Plan for the Evolution of Global Observing Systems |
| ETCCDI | Expert Team on Climate Change Detection and Indices |
| FAO | United Nations Food and Agriculture Organization |
| GCF | Green Climate Fun |
| GCOS | Global Climate Observing System |
| GEF | Global Environment Facility |
| GFCS | Global Framework for Climate Services |
| GPC | Global Producing Center of WMO |
| I-DARE | International Data Rescue |
| IFI | International Financial Institutions |
| iTACS | Interactive Tool for Analysis of the Climate System |
| NAP | National Adaptation Plan |
| NCMP | National Climate Monitoring Products |
| NDC | Nationally Determined Contribution to the Paris Agreement |
| NCOF | National Climate Outlook Forum |
| NMHS | National Meteorological and Hydrological Service |
| OSCAR | Observing Systems Capability Analysis and Review Tool |
| PPCR | Pilot Program for Climate Resilience |
| QMS | Quality Management System |
| RCC | Regional Climate Center of WMO |
| RCOF | Regional Climate Outlook Forum |
| RECs | Regional Economic Commissions |
| RTC | Regional Training Center |
| UIP | User Interface Platform |
| UNDP | United Nations Development Programme |
| WFP | World Food Programme |
| WHO | World Health Organization |
| WIGOS | WMO Integrated Global Observing System |
| WIS | WMO Information System |
| WMO | World Meteorological Organization |
| WRM | Water Resource Management |

**3. Global Climate Observing System climate monitoring principles**

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| --- |
| (Revised Reporting Guidelines as agreed by the UNFCCC (Bali, December 2007) Decision 11/CP.13)  Effective monitoring systems for climate should adhere to the following principles:  (a) The impact of new systems or changes to existing systems should be assessed prior to implementation;  (b) A suitable period of overlap for new and old observing systems is required;  (c) The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e. metadata) should be documented and treated with the same care as the data themselves;  (d) The quality and homogeneity of data should be regularly assessed as a part of routine operations;  (e) Consideration of the needs for environmental and climate-monitoring products and assessments, such as Intergovernmental Panel on Climate Change assessments, should be integrated into national, regional and global observing priorities;  (f) Operation of historically-uninterrupted stations and observing systems should be maintained;  (g) High priority for additional observations should be focused on data-poor regions, poorly-observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution;  (h) Long-term requirements, including appropriate sampling frequencies, should be specified to network designers, operators and instrument engineers at the outset of system design and implementation;  (i) The conversion of research observing systems to long-term operations in a carefully-planned manner should be promoted;  (j) Data management systems that facilitate access, use and interpretation of data and products should be included as essential elements of climate monitoring systems.  Furthermore, operators of satellite systems for monitoring climate need to:  (a) Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system;  (b) Take steps to sample the Earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be resolved. |
| Thus, satellite systems for climate monitoring should adhere to the following specific principles:  (a) Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained;  (b) A suitable period of overlap for new and old satellite systems should be ensured for a period adequate to determine inter-satellite biases and maintain the homogeneity and consistency of time series observations;  (c) Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured;  (d) Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national metrology institute, should be ensured;  (e) On-board calibration adequate for climate system observations should be ensured and associated instrument characteristics monitored;  (f) Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate;  (g) Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed-mode analysis, should be established and maintained;  (h) Use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when these exist on decommissioned satellites;  (i) Complementary in situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation;  (j) Random errors and time-dependent biases in satellite observations and derived products should be identified. |

**4. References**

1. High Level Task Force Report – [*Climate Knowledge for Action: A Global Framework for Climate Services*](https://library.wmo.int/index.php?lvl=notice_display&id=5439%23.XJNdGq6nGos#.YxjHt3ZBw2x)(WMO-No. 1065)

2. [WMO Capacity Development Strategy And Implementation Plan](https://library.wmo.int/doc_num.php?explnum_id=7871)

3. [Table 1](#table1). Categorization of NMHSs capabilities.

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1. WMO – World Meteorological Organization [↑](#footnote-ref-2)
2. OSCAR – Observing Systems Capability Analysis and Review Tool [↑](#footnote-ref-3)
3. ECVs – Essential Climate Variables [↑](#footnote-ref-4)
4. WIGOS – WMO Integrated Global Observing System [↑](#footnote-ref-5)
5. EGOS-IP – WMO Implementation Plan For The Evolution Of Global Observing Systems [↑](#footnote-ref-6)
6. GCOS – Global Climate Observing System [↑](#footnote-ref-7)
7. RCC – Regional Climate Center [↑](#footnote-ref-8)
8. WIS – WMO Information System [↑](#footnote-ref-9)
9. I-DARE – International Data Rescue [↑](#footnote-ref-10)
10. ETCCDI – Expert Team on Climate Change Detection and Indices [↑](#footnote-ref-11)
11. iTacs – Interactive Tool for Analysis of the Climate System [↑](#footnote-ref-12)
12. NCMP – National Climate Monitoring Products [↑](#footnote-ref-13)
13. QMS – Quality management system [↑](#footnote-ref-14)
14. RCOF – Regional Climate Outlook Forum [↑](#footnote-ref-15)
15. GPC – Global Producing Center of WMO [↑](#footnote-ref-16)
16. NCOF – National Climate Outlook Forum [↑](#footnote-ref-17)
17. RTC – Regional Training Center [↑](#footnote-ref-18)