



COUNTRY HYDROMET DIAGNOSTICS

Informing policy and investment decisions for high-quality weather forecasts, early warning systems, and climate information in developing countries



2022 Update

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Acknowledgement

The prototype of the Country Hydromet Diagnostics (CHD) was developed in 2020 as a priority action of the Alliance for Hydromet Development and under WMO leadership and with guidance from a multi-party Working Group. The 2022 update reflects lessons learned and feedback from the CHD road-testing with 16 countries that took place in 2021, further consultations with Working Group members, WMO Secretariat staff and members of the Alliance for Hydromet Development. Grateful thanks are extended to all of those involved in the original process and in the preparation of this update.

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1. Purpose and development of the CHD

The [Country Hydromet Diagnostics](#) (CHD) provides a high-level strategic assessment of National Meteorological and Hydrological Services (NMHS), their operating environment, and their contribution to high-quality weather, climate, hydrological and environmental services and warnings. It integrates existing approaches, standards and data and uses a peer review approach. The CHD has been developed as a priority action of the [Alliance for Hydromet Development](#) under WMO leadership and with guidance of a multi-party Working Group.

The CHD informs policy and investment decisions for high-quality weather forecasts, early warning systems, and climate information in developing countries, particularly guiding Alliance for Hydromet Development members with the provision of a big-picture assessment, indicating where investments and further assessments are needed. Through the CHD, developing countries benefit from better targeted and aligned investments as the assessment of maturity levels indicates where additional focus and support are needed.

The CHD's peer-review approach follows the example of other organizations, including the OECD process for the peer review of members' development assistance. As peers, advanced NMHSs from developed and developing countries undertake the diagnostics, following the tool's methodology. The CHD enables coherent, standardized, and authoritative assessments across countries.

The CHD has been developed through a phased and learning approach. The [CHD prototype](#) was developed in 2020 as a priority action of the Alliance for Hydromet Development under WMO leadership and with guidance of an international multi-stakeholder Working Group. In 2021, [Alliance members supported the CHD road-testing with 16 countries](#) that served as peer reviewers or reviewed countries¹. Due to the COVID-19 pandemic, the peers conducted all the assessments remotely. Peer-reviewers drew on existing datasets, in particular from WMO's Community Platform, to perform the diagnostics. Reviewers collaborated with the country's WMO Permanent Representative and their teams, respective country stakeholders, and Alliance members to obtain additional information necessary to complete the full assessment. The reviewers prepared the CHD reports in consultation with the WMO Secretariat support team, which moderated the process, ensuring consistent application of the tool across all countries. The road-testing was completed in June 2021, and its results were summarized in the first [Hydromet Gap Report](#), issued by the Alliance for Hydromet Development in July 2021. All [country assessments](#) from the road-testing phase are publicly available on the Alliance for Hydromet Development website. The 2022 CHD update reflects lessons learned and feedback from the CHD road-testing, further consultations with Working Group members, WMO Secretariat staff and members of the Alliance for Hydromet Development.

Countries and Alliance members participating in the road-testing welcomed the CHD as an effective tool and process. They valued the CHD as an "authoritative" assessment by peers that established the big picture and corresponding gaps and provided a common basis for more detailed analysis during project preparation.

2. CHD 2022 update and systematic implementation going forward

The 2022 update retains the structure of the initial CHD prototype, including the 10 *Elements*, to provide a maturity level assessment across the operations of a National Meteorological and Hydrological Service (NMHS). The updated tool includes two additional *Indicators* that inform the elements and many additional *Data Sources*, largely drawing on existing WMO resources. In particular, during 2021 WMO initiated a large-scale data collection campaign to update the WMO Community Platform, informed by the CHD prototype and identified data gaps.

The 2022 update retains the initial focus on meteorological services. Hydrology is considered primarily from the downstream user angle and the contribution of NMHSs to hydrological services according to mandate and country requirements. The term 'NMHS' is used throughout to recognize this and the

¹ Afghanistan, Austria, Chad, China, Côte d'Ivoire, India, Kyrgyz Republic, Liberia, Maldives, Morocco, Myanmar, Nigeria, North Macedonia, Sierra Leone, Switzerland, and Turkey.

frequent co-location of meteorological and hydrological services.

As part of the 2022 update standardized process guidance has been developed and CHD delivery principles have been firmed up. This will allow for systematic, coherent and scaled-up CHD implementation going forward.

3. CHD delivery principles

CHD delivery period: Once the peer reviewer has been identified and contracted, the CHD is expected to be completed within three months.

Peer reviewer selection: During the peer reviewer selection process, close attention is given to the suitability of the peer relationships, including fostering South-South cooperation as appropriate. The final decision about the peer reviewer lies with the WMO Permanent Representative of the reviewed country. The reviewers provide the peer review services on a cost-recovery basis.

In-country work: While the review is expected to be conducted in country, there may be circumstances when in-country assessments are not feasible (for instance, during the global pandemic, since 2020). On some occasions, an in-country visit may not be required because of the extent of knowledge of the peer-reviewer about the NMHS concerned. The process guidance given below assumes that the early steps of the CHD are performed remotely to minimise the cost and time of in-country attendance.

Degree of specificity of recommendations in the CHD: The CHD includes the assessment of the maturity levels of the 10 *Elements* and general recommendations on how to advance maturity. More detailed recommendations and proposed activities to improve maturity levels need to occur through specific project preparation follow-up work.

Publication of CHD assessment results by mutual agreement: The results of the CHD assessments are made publicly available by mutual agreement of the WMO Permanent Representatives of both the reviewed and reviewer country. This follows the practice established during the road-testing phase. It ensures transparency, visibility and maximum use of the CHD assessments.

Continuous improvement: The CHD and its implementation are regularly reviewed to ensure that lessons learned are captured and that the tool and peer review selection process are improved over time. Based on the feedback of the peer reviewers and reviewed countries, the tool is updated on an annual basis.

4. CHD standardized process guidance

Stage 1 Identify Peer Reviewer		Stage 2 Information Gathering				Stage 3 Validation & Analysis		Stage 4 Closure	
Step 1 Establishing pool of peer reviewers	Step 2 Selecting peer reviewer for specific assignment	Step 3 Kick-off	Step 4 Data review	Step 5 Synthesis & investigation	Step 6 Draft CHD	Step 7 Refine draft CHD	Step 8 Finalize CHD	Step 9 Share CHD results	Step 10 Lessons learned & continuous improvement

Stage 1 – Identifying the peer reviewer

Step 1 – Establishing the pool of peer reviewers

- The WMO Secretariat establishes a list of peer reviewers and regularly updates the list. This is done in coordination with major initiatives that provide resources to conduct CHDs such as [SOFF](#), in dialogue with the interested NMHSs, and according to transparent criteria.
- Emphasis will be given to promoting South-South peer review arrangements, as demonstrated in the CHD road-testing phase, while accounting for established and desired relationships between the supported countries and their peers.

Step 2 – Selecting the peer reviewer for the specific assignment

- Regular calls for expressions of interest to the pool of peers are issued based on incoming demand from beneficiary countries.
- The beneficiary country decides on the peer reviewer in collaboration with the respective Alliance member and/or funding initiative (e.g. SOFF).

Stage 2 – Information gathering (performed remotely)

Step 3 – Kick-off

- Development of tailored terms of reference (ToR) to conduct the assessment in a specific country strictly following the CHD tool (mandatory 10 *elements* and *indicators*, as defined), decision on report language and translation/interpretation resources required, and communications platforms and protocols.
- Based on the agreed ToR, the WMO Secretariat establishes the contract for cost-recovery peer review services.

Step 4 – Data review

- Collation of data sources. Using the CHD tool, the peer reviewer undertakes an initial desk review using the following sources and any other considered of relevance, such as:
 - WMO Community Platform country profile information, including results of 2021 data campaign.
 - WMO Checklist for Climate Services Implementation and WMO Hydrology Survey, noting that these checklists contain information beyond the specific focus of the CHD.
 - WMO Service Delivery Progress Model based on WMO-No. 1129 Strategy on Service Delivery (use most appropriate WMO language version as a base for discussion). This serves as input for Elements 9 and 10 and can either be done offline as a self-assessment or interactively online with the NMHS.
 - Agency reports (e.g., Annual Reports to Government)
 - Information on current projects aiming at building NMHS capacity, as required through briefings from project partners (including Alliance members)
 - Internal and external reviews and evaluations – copies of reports to be requested as needed, including expert reports from current and previous capacity-building projects involving Alliance members.
 - Information on key partnerships in-country relevant to NMHS functions
 - Information on the distribution of NMHS functions across agencies (e.g., hydrology,

aviation, climate services, observations).

This step ensures that a) available resources are used efficiently without duplication of effort, b) additional burden on NMHSs is reduced through avoiding redundant information requests, and c) conflicting information is resolved into a definitive report that can be trusted by all parties as a basis for further work. The step is not intended to be exhaustive but rather to ensure due diligence.

Step 5 – Synthesis and investigation

- Synthesize existing information (non-interactive desktop approach)
- Evaluate gaps and conflicts in the information available
- As needed and as feasible, close existing data and information gaps and resolve ambiguities in existing information (interactive). For cost-effectiveness, begin this process remotely if possible, understanding that in-country follow-up may be required.

Step 6 – Draft Country Hydromet Diagnostics assessment report

- The CHD report consists of an overview table with the maturity level for each of the ten *elements* of the meteorological value cycle and a narrative for each of the elements describing critical capacity gaps.
- With the information from the previous steps in hand, prepare draft CHD report which will be discussed with the reviewed NMHS through an interactive process.
- The WMO Secretariat will provide feedback and, as needed, technical support, to the peer reviewers to ensure that their reviews are consistent with the CHD guidance and across countries.

Stage 3 – Validation and analysis (performed in-country if feasible)

Step 7 – Refine draft CHD report

- Interview selected stakeholders (including a range of strong and weak relationships, including key users and sponsors).
- Interview NMHS's operational and technical staff.
- Discuss draft CHD report with the head of the NMHS, including possible areas for clarification and any sensitive matters.

Step 8 – Finalize CHD report

- Present revised CHD report to the head of the NMHS and the respective Alliance member and, if applicable, to funding initiative and/or Alliance member, focusing on key issues from the validation process and any sensitive matters. Agree on the finalization process.
- Complete CHD report.
- Share final CHD report with the country, the funding initiative and/or Alliance member for follow-up advisory services and integration in consequent project preparation support.

Stage 4 – Closure

Step 9 – Share CHD results

- The WMO Secretariat updates the WMO Community Platform with any new information gained during the CHD, working with NMHS.
- WMO Secretariat, funding initiative and the Alliance for Hydromet Development make the CHD report publicly available on their websites.

Step 10 – Capture lessons learned and continuous improvement

- The WMO Secretariat seeks feedback on the process from the peer-reviewed and peer reviewer NMHSs and the Alliance member, and, if applicable, the funding initiative.
- The envisioned biennial Hydromet Gap Reports of the Alliance for Hydromet Development communicate the CHD results and track progress over time.

5. Country Hydromet Diagnostics – 2022 tool update

Critical Hydromet Value Cycle Element		Maturity level	Indicators	Primary data sources	2022 Update Notes
Element	Description				
1. GOVERNANCE AND INSTITUTIONAL SETTING	The level of formalization of the NMHS mandate and its implementation, oversight, and resourcing.	<p>Level one: Weakly defined mandate; serious funding challenges; essential skills lacking; little formalized governance and future planning.</p>	1.1. Existence of Act or Policy describing the NMHS legal mandate and its scope.	<ul style="list-style-type: none"> WMO Community Platform (WMOCP): (i) Legislative act regulating meteorology (none, law, decree, other); (ii) Title of primary legislative act determining NMHS functions; (iii) NMHS areas of responsibilities. (Data Collection Campaign 2021 Part 1, Q 4-5) 	Added WMOCP as an acronym and references to 2021 Data Collection Campaign throughout. The updated WMO survey and responses are available from the WMO Secretariat.
		<p>Level two: Effort ongoing to formalize mandate, introduce improved governance, management processes and address resource challenges.</p>	1.2. Existence of Strategic, Operational and Risk Management plans and their reporting as part of oversight and management.	<ul style="list-style-type: none"> WMOCP: (i) NMHS development/ strategic plan in place; (ii) Main priority areas. (Data Collection Campaign 2021 Part 2, Q 2-9). Operational & Risk Management Plans. 	Added Operational and Risk Management Plans as data source.
		<p>Level three: Moderately well mandated, managed and resourced and clear plans for, and sufficient capacity to address operational gaps.</p>	1.3. Government budget allocation consistently covers the needs of the NMHS in terms of its national, regional, and global responsibilities and based, among others, on cost-benefit analysis of the service. Evidence of sufficient staffing to cover core functions.	<ul style="list-style-type: none"> Agency reports, evidence from capacity building projects, interviews. Data Collection Campaign 2021 Part 1, Q 6-7 WMOCP: Studies on the social and economic benefits of weather, climate, and water services were undertaken in the last ten years (Yes/No). 	Added data sources and modified indicator to strengthen wording on core functions and staffing.
		<p>Level four: An effective service but with a few shortcomings related to its mandate, governance, and resourcing and in the process to address the gaps.</p>	1.4. Proportion of staff (availability of in-house, seconded, contracted-out) with adequate training in relevant disciplines, including scientific, technical, and information and communication technologies (ICT). Institutional and policy arrangements in-country to support training needs of NMHS.	<ul style="list-style-type: none"> WMOCP & data available from the WMO survey on the Status of Human Resources of NMHSs (WMO Education and Training Programme, published 2017 and due to be updated in 2022). Any supplementary evidence of in-country institutional arrangements aligned with NMHS functions and aspirations. 	Added WMOCP. Emphasis on the importance of training policies and institutional arrangements and capacity-building activities that reflect reasonable country capacity.
		<p>Level five: Strong and comprehensive mandate, highly effective governance, secure funding, and readily available skillsbase.</p>	1.5. Experience and track record in implementing internationally funded hydromet projects as well as research and development projects in general.	<ul style="list-style-type: none"> Institutional reports identified during Data review step, evidence from capacity-building project. Data Collection Campaign 2021 Part 7, Q6. 	Reframed data sources around evidence from Data review step, added Data Collection Campaign 2021.

<p>2. EFFECTIVE PARTNERSHIPS TO IMPROVE SERVICE DELIVERY</p>	<p>The level of effectiveness of the NMHSs in bringing together national and international partners to improve the service offering.</p>	<p>Level one: Works in isolation and does not value or promote partnerships.</p> <p>Level two: Limited partnerships and mostly excluded from relevant finance opportunities.</p> <p>Level three: Moderately effective partnerships but generally regarded as the weaker partner in such relationships, having little say in relevant financing initiatives.</p> <p>Level four: Effective partnerships with equal status in most relationships and approaching relevant funding opportunities in a coordinated manner.</p> <p>Level five: NMHS is regarded as a major national and regional role player. It has extensive and productive partnerships and is viewed as an honest broker in bringing parties together and provide national leadership on relevant finance decisions.</p>	<p>2.1. Effective partnerships for service delivery in place with other government institutions.</p>	<ul style="list-style-type: none"> Data Collection Campaign 2021: Part 1, Q8 (consultative platform), Part 4, Q3) (WIGOS partnerships) Partnerships identified in the Data review Step. 	<p>Added Data Collection Campaign 2021, added partnerships data source, specified service delivery focus.</p>
			<p>2.2. Effective partnerships in place at the national and international level with the private sector, research centres and academia, including joint research and innovation projects.</p>	<ul style="list-style-type: none"> Data Collection Campaign 2021: Part 7 Q 5-8,11 WMOCP: (i) legislation on private sector providing information and services along the value chain (ii) Formal agreements between the public and private sector in relation to service delivery, operation, and maintenance of networks, observation data; (iii) Consultative platform for the public sector, private sector, academia, and civil society to foster regular cooperative dialogue. 	<p>Added Data Collection Campaign 2021.</p>
			<p>2.3. Effective partnerships in place with international climate and development finance partners.</p>	<ul style="list-style-type: none"> Partnerships and arrangements are identified in the Data review Step. Data Collection Campaign 2021: Part 7, Q8 (sources of research funding) 	<p>Added data sources.</p>
			<p>2.4. New or enhanced products, services or dissemination techniques or new uses or applications of existing products and services that culminated from these relationships.</p>	<ul style="list-style-type: none"> Partner reports identified during the Data review step, validated by NMHS interview. 	<p>Added data source.</p>

3. OBSERVATIONAL INFRASTRUCTURE	The level of compliance of the observational infrastructure and its data quality with prescribed WMO regulations and guidance.	<p>Level one: No or limited, basic surface observations and no upper-air observations.</p> <p>Level two: Basic network, large gaps, mostly manual observations with severe challenges and data quality issues.</p> <p>Level three: Moderate network with some gaps with respect to WMO regulations and guidance and with some data quality issues.</p> <p>Level four: Comprehensive mostly automated network providing good traceable quality data fully compliant with WMO regulations and guidance.</p> <p>Level five: Comprehensive and highly automated advanced network including additional measurements and remote sensing platforms providing excellent data fully compliant with WMO regulations and Guidance.</p>	3.1. Average horizontal resolution in km of both synoptic surface and upper-air observations, including compliance with the Global Basic Observing Network (GBON) regulations.	<ul style="list-style-type: none"> WMO Observing Systems Capability Analysis and Review (OSCAR) database. 	Simplified description of data source.
		3.2. Additional observations used for nowcasting and specialized purposes.	<ul style="list-style-type: none"> OSCAR database Evidence from WMO Checklist for Climate Services Implementation and WMO Hydrology Survey. 	Added data source.	
		3.3. Standard Operating Practices in place for the deployment, maintenance, calibrations and quality assurance of the observational network.	<ul style="list-style-type: none"> External reviews and NMHS interview Data Collection Campaign 2021: Part 4, Questions 2-6 (WIGOS) Evidence from Climate checklist and WMO Hydrology Online Survey. 	Added data sources.	
		3.4. Implementation of sustainable newer approaches to observations.	<ul style="list-style-type: none"> Data Collection Campaign 2021: Part 2, Q 4, Part 4, Q 6-8, Part 7, Q 12,15-17 	Added additional indicator 3.4 and data sources.	
		3.5. Percentage of the surface observations that depend on automatic techniques.	<ul style="list-style-type: none"> OSCAR database 		

<p>4. DATA AND PRODUCT SHARING AND POLICIES</p>	<p>The level of data and product sharing on a national, regional and global level.</p>	<p>Level one: No observational data is shared internationally, either because not available to be shared or due to the lack of data sharing policies or practices, or the existing infrastructure does not allow data sharing.</p>	<p>4.1. Percentage of GBON compliance – for how many prescribed surface and upper-air stations are observations exchanged internationally. Usage of regional WIGOS centres.</p>	<ul style="list-style-type: none"> Data Collection Campaign 2021: Part 4, Questions 2-6 (WIGOS) GBON regulations and WIGOS Data Quality Monitoring System, which provide real-time statistics on data exchange at an hourly resolution. 	<p>Added data sources, refined wording of maturity levels for clarity.</p> <p>GBON compliance definitions are currently under further development by the WMO Secretariat.</p>
		<p>Level two: A limited amount of GBON compliant data is shared internationally. The existing data sharing policies or practices or the existing infrastructure severely hamper two-way data sharing.</p>	<p>4.2. A formal policy and practice for the free and open sharing of observational data.</p>	<ul style="list-style-type: none"> WMOCP Part 5 data and Data Collection Campaign 2021: Part 4, Questions 2-6 (WIGOS) Data Policy Survey also contains information on cost recovery policies; Res 60 Survey: data available on provision of climate data and products on a commercial basis; type of users; the basis for the price established; who retains the revenue; approx. net annual revenue. 	<p>Added data sources</p>
		<p>Level three: GBON data sharing compliance with regards to either surface or upper-air data and a data policy and practices and infrastructure in place that promote the free and open use of data for research and academic purposes as well as the in-house use of external data.</p>	<p>4.3. Main data and products received from external sources in a national, regional and global context, such as model and satellite data.</p>	<ul style="list-style-type: none"> Reports identified during the Data review step, NMHS interview (preferably validated with in-person staff interviews). Data Policy Survey WMOCP Part 5 data and Data Collection Campaign 2021: Part 4, Questions 9-14 	<p>Added data sources.</p>
		<p>Level four: Fully meeting GBON data sharing compliance with a data policy and practices and infrastructure in place. These support free and open sharing of data nationally and, for some products, regionally or internationally as well as the in-house use of external data.</p>			
		<p>Level five: Exceeding GBON data sharing compliance and additional data (marine, radar, etc.) contributing to regional and international initiatives with policies that promote free and open two-way sharing of data and products on a national, regional and global basis.</p>			

<p>5. NUMERICAL WEATHER PREDICTION MODEL AND FORECASTING TOOL APPLICATION</p>	<p>The role of numerical weather prediction model output and other forecasting tools in product generation. Whether local modelling is sustainably used to add value to model output from WMO Global Data-processing and Forecasting System (GDPFS) centres.</p>	<p>Level one: Forecasts are based on classical forecasting techniques without model guidance and only cover a limited forecast time range.</p> <p>Level two: Basic use of external model output and remote sensed products in the form of maps and figures, covering only a limited forecast time range.</p> <p>Level three: Prediction based mostly on model guidance from external and limited internal sources (without data assimilation) and remoted sensed products in the form of maps, figures and digital data and cover nowcasting, short and medium forecast time ranges.</p> <p>Level four: Digitized model output from internal (with data assimilation) and/or external (regional) sources and remote sensed products and data used and value-added through post-processing techniques extended into longer ranges.</p> <p>Level five: Optimal combination of global, regional and local models, remote sensed data, post-processing techniques and automated probabilistic product generation over weather and climate time scales with minimal human intervention supported by up-to-date verification statistics.</p>	<p>5.1. Model and remote sensed products form the primary source for products across the different forecasting timescales.</p>	<ul style="list-style-type: none"> • Reports identified during the Data review step, supplemented by direct interview with NMHS (preferably in-person discussion with forecasters). • For internal modelling, look for 'operational' aspects, including model verification, robust ICT processes including change processes, case studies, and continuous improvement processes. • See also WMO-No.485, Manual on the Global Data-processing and Forecasting System, and WMO-NO. 305, Guide on the Global Data-processing and Forecasting System (GDPFS) (revised version expected during 2022-23). • For 5.2 – 5.3, use Data Collection Campaign 2021: Part 4, Q 17-21 (models) 	<p>Revised <i>element</i> description to reflect the role of GDPFS in driving global prediction.</p>
			<p>5.2. a) Models run internally (and sustainably), b) Data assimilation and verification performed, c) appropriateness of horizontal and vertical resolution.</p>		<p>Strengthened emphasis on sustainability of modelling, in line with GDPFS principles.</p>
			<p>5.3. Probabilistic forecasts produced and, if so, based on ensemble predictions.</p>		<p>Added data sources and note on 'operational' local modelling, deleted some not directly relevant information.</p>

6. WARNING AND ADVISORY SERVICES	NMHS' role as the authoritative voice for weather-related warnings and its operational relationship with disaster and water management structures.	<p>Level one: Warning service not operational for public preparedness and response.</p> <p>Level two: Basic warning service is in place and operational but with limited public reach and lacking integration with other relevant institutions and services.</p> <p>Level three: Weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies.</p> <p>Level four: Weather-related warning service with strong public reach and standard operational procedures driving close partnership with relevant institutions, including disaster management agencies.</p> <p>Level five: Comprehensive, impact-based warning service taking hazard, exposure and vulnerability information into account, with strong public reach. It operates in close partnership with relevant national institutions, including disaster management agencies and registered Common Alerting Protocol alerting authorities.</p>	6.1. Warning and alert service cover 24/7.	<ul style="list-style-type: none"> Data Collection Campaign 2021 Part 6: Q3 (Does the warning and alert Service of your NMHS cover 24/7?) 	Added data sources, clarified wording of maturity levels.
			6.2. Hydrometeorological hazards for which forecasting and warning capacity is available and whether feedback and lessons learned are included to improve warnings.	<ul style="list-style-type: none"> Data Collection Campaign 2021: Part 6 Q16-27 (MHEWS) Reports identified during the Data review step 	Added data sources.
			6.3. Common alerting procedures in place based on impact-based services and scenarios taking hazard, exposure and vulnerability information into account and with registered alerting authorities.	<ul style="list-style-type: none"> Data Collection Campaign 2021: Part 1 Q 13, Part 6 Q16-27 Reports identified during the Data review step 	Added data sources.
7. CONTRIBUTION TO CLIMATE SERVICES	NMHS role in and contribution to a national climate framework according to the established climate services provision capacity.	<p>Not Applicable: Climate Services provided by another party.</p> <p>Level one: Less than basic Capacity to provide Climate Services.</p> <p>Level two: Basic Capacity for Climate Services Provision.</p> <p>Level three: Essential Capacity for Climate Services Provision.</p> <p>Level four: Full Capacity for Climate Services Provision.</p> <p>Level five: Advanced Capacity for Climate Services Provision.</p>	7.1. Where relevant, contribution to climate services according to the established capacity for the provision of climate services.	<ul style="list-style-type: none"> Data Collection Campaign 2021: Part 2 Q4, Part 4 Q18, Part 5 Q2, 11, 16-17, Part 7 Q11 Drawing on the WMO Checklist for Climate Services Implementation 	Added data sources. Note that the Climate Services checklist contains information that may be useful also for other CHD Elements.

<p>8. CONTRIBUTION TO HYDROLOGY</p>	<p>NMHS role in and contribution to hydrological services according to mandate and country requirements.</p>	<p>Level one: No or very little meteorological input in hydrology and water resource management.</p>	<p>8.1. Where relevant, standard products such as quantitative precipitation estimation and forecasts are produced on a routine basis according to the requirements of the hydrological community.</p>	<ul style="list-style-type: none"> • Data Collection Campaign 2021: Part 5 Q 5. Part 6 Q2, 10 • Detailed data on hydrology has been collected through the WMO Hydrology Online Survey (2020). • Other evidence collected during the Data review step showing the maturity of the NMHS contribution to hydrological services. 	<p>Added reference to the whole value chain in 8.2</p>		
		<p>Level two: Meteorological input in hydrology and water resource management happens on an ad hoc basis and or during times of disaster</p>	<p>8.2. SOPs in place to formalize the relation between Met Service and Hydrology Agency, showing evidence that the whole value chain is addressed.</p>			<p>.Added separate indicator 8.3 to reflect the importance of data sharing agreements in the specific hydrological context. The situation in each country may be different, but the NMHS will always have a role in encouraging sharing of relevant data, which may be across local or international borders between multiple agencies.</p>	
		<p>Level three: There is a moderately well-functioning relationship between the meteorological, hydrological and water resources communities but considerable room for formalizing the relationship and SOPs.</p>	<p>8.3. Data sharing agreements (between local and national agencies, and across international borders as required) on hydrological data in place or under development.</p>				<p>Added data sources, added narrative description.</p>
		<p>Level four: The meteorological, hydrological and water resources sectors have a high-level formal agreement in place and an established working relationship. Data sharing takes place, but institutions still tend to develop products and services in isolation.</p>	<p>8.4. Joint projects/initiatives with hydrological community designed to build hydrometeorological cooperation.</p>				
<p>Level five: The meteorological, hydrological and water resources sectors have robust SOPs and agreements in place to work closely in developing new and improved products and providing seamless and advanced services.</p>							

<p>9. PRODUCT DISSEMINATION AND OUTREACH</p>	<p>The level of effectiveness of the NMHS in reaching all public and private sector users and stakeholders.</p>	<p>Level one: Dissemination using only limited traditional channels such as daily newspapers and the national broadcaster with little control over messaging and/or format.</p>	<p>9.1 Channels used for user-centred communication and ability to support those channels (for example, does the NMHS operate its own television, video or audio production facilities? Does it effectively use cutting-edge techniques?).</p>	<ul style="list-style-type: none"> • WMOCP: communication channels used to disseminate products and services (TV, radio, printed media, web app, social media, mobile phone app, others). • Data Collection Campaign 2021: Part 5 Q9 	<p>Added data sources, broadened description of support for channels.</p>
		<p>Level two: Traditional communication channels and a basic dedicated website is used to disseminate forecasts and basic information.</p>	<p>9.2 Education and awareness initiatives in place.</p>	<ul style="list-style-type: none"> • Data review and interview NMHS • Service Delivery Progress Model results (Q1b) 	<p>Added interview (no WMO data sources identified).</p> <p>Added data sources WMO-1129 Service Delivery Plan contains a multi-lingual assessment tool for NMHS and reviewer use. This also gives information for 10.1, 10.2, 10.3</p>
		<p>Level three: A moderately effective communication and dissemination strategy and practices are in place, based only on in-house capabilities and supported by user-friendly website.</p> <p>Level four: A large fraction of the population is reached using various communication techniques and platforms, in collaboration with partners, and a user-friendly and informative website and apps. Outreach and education activities occur regularly.</p> <p>Level five: Advanced education, awareness and communication strategy, practices and platforms in place using various technologies tailored to reach even marginalized communities and in close cooperation with several partners.</p>	<p>9.3 Special measures in place to reach marginalized communities and indigenous people.</p>	<ul style="list-style-type: none"> • Data review and interview NMHS 	<p>Added interview (no WMO data sources identified).</p>

<p>10. USE AND NATIONAL VALUE OF PRODUCTS AND SERVICES</p>	<p>Accommodation of public and private sector users and stakeholders in the service offering and its continuous improvement.</p>	<p>Level one: Service development lacks any routine stakeholder feedback practice.</p> <p>Level two: Service development draws on informal stakeholder input and feedback.</p> <p>Level three: Services development draws on regular dialogue with major stakeholders.</p> <p>Level four: Service development draws on survey data and regular dialogue based on formal relationships with major stakeholders to ensure continuous improvement.</p> <p>Level five: Strong partnerships, formal and objective survey and review processes exist with all major stakeholders enabling service co-design and continuous Improvement.</p>	<p>10.1 Formalized platform to engage with users in order to co-design improved services.</p>	<ul style="list-style-type: none"> • Service Delivery Progress Model results (Q1) • Data Collection Campaign 2021 (Part 5 Q6) • 10.1 WMOCP: only in relation to climate products 	<p>Added data sources WMO-1129 Service Delivery Plan contains a multi-lingual assessment tool for NMHS and reviewer use.</p>
			<p>10.2 Independent user satisfaction surveys are conducted, and the results used to inform service improvement.</p>	<ul style="list-style-type: none"> • Service Delivery Progress Model results (Q1-4) • NMHS interview 	<p>Added data sources WMO-1129 Service Delivery Plan contains multi-lingual assessment tool for NMHS and reviewer use.</p>
			<p>10.3 Quality management processes that satisfy key user needs and support continuous improvement.</p>	<ul style="list-style-type: none"> • Data Collection Campaign 2021 (Part 5 13-21 Part 6 Q23-27) • Service Delivery Progress Model results (Q4) • Key user interviews (e.g., aviation, marine, other industry) 	<p>Added additional indicator and data sources based on aviation discussions.</p> <p>Added data sources WMO-1129 Service Delivery Plan contains a multi-lingual assessment tool for NMHS and reviewer use.</p> <p>Note: Amendment 75 to Annex 3 (ICAO, 2010), raised the recommended practice pertaining to Quality Management Systems for aeronautical meteorology to the status of a standard, that is, a binding requirement for all Members/contracting States.</p> <p>WMO also recognizes development in other sectors where partner organizations are requesting the implementation of QMSs for the delivery of products and services applicable to those sectors.</p>