| **Country Hydromet Diagnostics**  **Annex III B. Country Hydromet Diagnostics matrix.**  **Table I. Country Hydromet Diagnostic matrix.** | | | | |
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| **Critical Hydromet Value Cycle Element** | | **Maturity level** | **Indicators** | **Suggested additional data sources (Note: for all indicators, WMO will provide any available relevant information based on data submitted by Members)** |
| **Element** | **Description** |  |  |  |
| **1. GOVERNANCE AND INSTITUTIONAL SETTING** | The level of formalization of the NMHS mandate and its implementation, oversight, and resourcing. | **Level one:** Weakly defined mandate; serious funding challenges; essential skills lacking; little formalized governance and future planning.  **Level two:** Effort ongoing to formalize mandate, introduce improved governance, management processes and address resource challenges.  **Level three:** Moderately well mandated, managed and resourced and clear plans for, and sufficient capacity to address operational gaps.  **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.  **Level five:** Strong and comprehensive mandate, highly effective governance, secure funding, and readily available skills base. | 1.1. Existence of Act or Policy describing the NMHS legal mandate and its scope. | * Available acts or policies |
|  |  |  | 1.2. Existence of Strategic, Operational and Risk Management plans and their reporting as part of oversight and management. | * Operational & Risk Management Plans. |
|  |  |  | 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. | * Agency reports, evidence from capacity building projects, interviews. |
|  |  |  | 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. | * Any supplementary evidence of in-country institutional arrangements aligned with NMHS functions and aspirations. |
|  |  |  | 1.5. Experience and track record in implementing internationally funded hydromet projects as well as research and development projects in general. | * Institutional reports identified during Data review step, evidence from capacity-building project. |
| **2. EFFECTIVE PARTNERSHIPS TO IMPROVE SERVICE DELIVERY** | The level of effectiveness of the NMHSs in bringing together national and international partners to improve the service offering. | **Level one:** Works in isolation and does not value or promote partnerships.  **Level two:** Limited partnerships and mostly excluded from relevant finance opportunities.  **Level three:** Moderately effective partnerships but generally regarded as the weaker partner in such relationships, having little say in relevant financing initiatives.  **Level four:** Effective partnerships with equal status in most relationships and approaching relevant funding opportunities in a coordinated manner.  **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. | 2.1. Effective service delivery partnerships in place with other government institutions. | * Data Collection Campaign 2021：Part 1, Q8 (consultative platform), Part 4, Q3) (WIGOS partnerships) * Partnerships identified in the Data review Step. |
|  |  |  | 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. | * 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. |
|  |  |  | 2.3. Effective partnerships in place with international climate and development finance partners | * Partnerships and arrangements are identified in the Data review Step. * Data Collection Campaign 2021： Part 7, Q8 (sources of research funding) |
|  |  |  | 2.4. New or enhanced products, services or dissemination techniques or new uses or applications of existing products or services that culminated from these relationships | * Partner reports identified during the Data review step, validated by NMHS interview. |

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| **3.** **OBSERVATIONAL INFRASTRUCTURE** | The level of compliance of the observational infrastructure and its data quality with prescribed WMO regulations and guidance. | **Level one:** No or limited, basic surface observations and no upper-air observations.  **Level two:** Basic network, large gaps, mostly manual observations with severe challenges and data quality issues.  **Level three:** Moderate network with some gaps with respect to WMO regulations and guidance and with some data quality issues.  **Level four:** Comprehensive mostly automated network providing good traceable quality data fully compliant with WMO regulations and guidance.  **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. | 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.[[1]](#footnote-2) | * WMO Observing Systems Capability Analysis and Review (OSCAR) database. |
| 3.2. Additional observations used for nowcasting and specialized purposes. | * OSCAR database * Evidence from WMO Checklist for Climate Services Implementation and WMO Hydrology Survey. |
| 3.3. Standard Operating Practices in place for the deployment, maintenance, calibrations and quality assurance of the observational  network. | * External reviews and NMHS interview * Data Collection Campaign 2021**：**   Part 4, Questions 2-6 (WIGOS)   * Evidence from Climate checklist and WMO Hydrology Online Survey. |
| 3.4 Implementation of sustainable newer approaches to observations. | * Data Collection Campaign 2021**：**Part 2, Q 4, Part 4, Q 6-8, Part 7, Q 12,15-17 |
|  |  |  | 3.5. Percentage of the surface observations that depend on automatic techniques. | * OSCAR database |

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| **4. DATA AND PRODUCT SHARING AND POLICIES** | The level of data and product sharing on a national, regional and global level. | **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.  **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.  **Level three:** Partial GBON data sharing compliance with regards to either surface or upper-air data. A data policy in place that promote the free and open use of data for research, as well as the in-house use of external data.  **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.  **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. | 4.1. Percentage of GBON compliance – for how many prescribed surface and upper-air stations are observations exchanged internationally. Usage of regional  WIGOS centres. | * 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. |
| 4.2. A formal policy and practice for the free and open sharing of observational data. | * 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. |
| 4.3. Main data and products received from external sources in a national, regional and global context, such as model and satellite data. | * 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 |

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| **5. NUMERICAL WEATHER PREDICTION MODEL AND FORECASTING TOOL APPLICATION** | 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. | **Level one:** Forecasts are based on classical forecasting techniques without model guidance and only cover a limited forecast time range.  **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.  **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.  **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.  **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. | 5.1. Model and remote sensed products form the primary source for products across the different forecasting timescales. | * 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) |
| 5.2. a) Models run internally (and sustainably), b) Data assimilation and verification performed, c) appropriateness of horizontal and vertical resolution. |
| 5.3. Probabilistic forecasts produced and, if so, based on ensemble predictions. |

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| **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. | **Level one:** Warning service not operational for public preparedness and response.  **Level two:** Basic warning service is in place and operational but with limited public reach and lacking integration with other relevant institutions and services.  **Level three:** Weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies.  **Level four:** Weather-related warning service with strong public reach and standard operational procedures driving close partnership with relevant institutions, including disaster management agencies.  **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. | 6.1. Warning and alert service cover 24/7. | * Data Collection Campaign 2021   Part 6: Q3  (Does the warning and alert Service of your NMHS cover 24/7?) |
| 6.2. Hydrometeorological hazards for which forecasting and warning capacity is available and whether feedback and lessons learned are included to improve warnings. | * Data Collection Campaign 2021:   Part 6 Q16-27 (MHEWS)   * Reports identified during the Data review step |
| 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. | * Data Collection Campaign 2021:   Part 1 Q 13, Part 6 Q16-27   * Reports identified during the Data review step |
| **7. CONTRIBUTION TO CLIMATE SERVICES** | NMHS role in and  contribution to a national climate framework according to the established climate services provision capacity. | **Not Applicable**: Climate Services provided by another party  **Level one**: Less than basic Capacity to provide Climate Services  **Level two**: Basic Capacity for Climate Services Provision  **Level three**: Essential Capacity for Climate Services Provision  **Level four**: Full Capacity for Climate Services Provision  **Level five**: Advanced Capacity for Climate Services Provision | 7.1. Where relevant, contribution to climate services according to the established capacity for the provision of climate services. | * 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 |

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| **8. CONTRIBUTION TO HYDROLOGY** | NMHS role in and contribution to hydrological services according to mandate and country requirements. | **Level one:** No or very little meteorological input in hydrology and water resource management.  **Level two:** Meteorological input in hydrology and water resource management happens on an ad hoc basis and or during times of disaster  **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.  **Level four:** The meteorological, hydrological and water resources sectors have a high-level formal agreement in place and an established working relationship and data sharing take place, but institutions still tend to develop products and services in isolation.  **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. | 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. | * 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. |
| 8.2. SOPs in place to formalize the relation between Met Service and Hydrology Agency, showing evidence that the whole value chain is addressed. |
| 8.3. Data sharing agreements (between local and national agencies, and across international borders as required) on hydrological data in place or under development. |
| 8.4. Joint projects/initiatives with hydrological community designed to build hydrometeorological cooperation. |
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| **9. PRODUCT**  **DISSEMINATION AND OUTREACH** | The level of effectiveness of the NMHS in reaching all public and private sector users and stakeholders. | **Level one:** Dissemination using only limited traditional channels such as daily newspapers and the national broadcaster and with little control over messaging and/or format.  **Level two:** Traditional communication channels and a basic dedicated website is used to disseminate forecasts and basic information.  **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.  **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.  **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. | 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?). | * 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 |
| 9.2 Education and awareness initiatives in place. | * Data review and interview NMHS * Service Delivery Progress Model results (Q1b) |
| 9.3 Special measures in place to reach marginalized communities, indigenous people, the youth and the elderly. | * Data review and interview NMHS |

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| **10. USE AND NATIONAL VALUE OF PRODUCTS AND SERVICES** | Accommodation of public and private sector users and stakeholders in the service offering and its continuous improvement. | **Level one:** Service development lacks any routine stakeholder feedback practice.  **Level two:** Service development draws on informal stakeholder input and feedback.  **Level three:** Services development draws on regular dialogue with major stakeholders.  **Level four:** Service development draws on survey data and regular dialogue based on formal relationships with major stakeholders to ensure continuous improvement.  **Level five:** Strong partnerships, formal and objective survey and review processes exist with all major stakeholders enabling service co-design and continuous  Improvement. | 10.1 Formalized platform to engage with users in order to co-design improved services. | * Service Delivery Progress Model results (Q1) * Data Collection Campaign 2021 (Part 5 Q6) * 10.1 WMOCP: only in relation to climate products |
| 10.2 Independent user satisfaction surveys are conducted, and the results used to inform service improvement. | * Service Delivery Progress Model results (Q1-4) * NMHS interview |
| 10.3 Quality management processes that satisfy key user needs and support continuous improvement. | * 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) |

1. In the context of SOFF support, the GBON-related indicators of the CHD will be assessed in detail through the GBON National Gap Analysis and the GBON National Contribution Plan. [↑](#footnote-ref-2)