

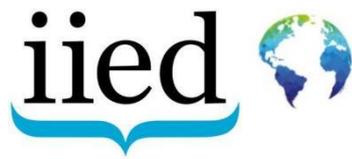
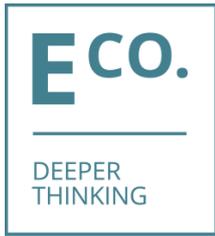
COUNTRY HYDROMET DIAGNOSTICS

North Macedonia 2021 peer review



Peer Reviewer
ZAMG, Austrian Meteorological Service





Baastel
30 Years Promoting
Sustainable Development



ZAMG
Zentralanstalt für
Meteorologie und
Geodynamik

TECHNICAL ADVISORY SERVICES FOR THE PREPARATION OF GCF COUNTRY PROGRAMMES

Technical Assistance to North Macedonia

DELIVERABLE: REVIEW REPORT, COUNTRY HYDROMET
DIAGNOSTICS

Prepared for:

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ACRONYMS

AMS	Automatic meteorological stations
AWS	Automatic weather stations
BUR	Biennial Update Report
CIS	Climate Information Services
CMC	Crisis Management Centre
DRR	Disaster Risk Reduction
EWS	Early Warning System
FAO	Food and Agriculture Organisation
GCF	Green Climate Fund
GFCS	Global Framework for Climate Services
MAFWE	Ministry of Agriculture, Forestry and Water Economy
MoEPP	Ministry of Environment and Physical Planning
MoU	Memorandum of Understanding
NDA	National Designated Authority
NEA	National Extension Agency
NFCS	National Framework on Climate Services
NMS	National Meteorological Services
NMHS / UMHR	National Hydro Meteorological Service
SOP	Standard Operating Procedure
UNFCCC	United Nations Framework Convention on Climate Change
WBG	World Bank Group

WMO

World Meteorological Organisation

1. INTRODUCTION

The Country Hydromet Diagnostics responds to the need for a standardized, integrated and operational tool and approach for diagnosing National Meteorological Services, their operating environment, and their contribution to high-quality weather, climate, hydrological and environmental information services and warnings. The Diagnostics is an umbrella tool that draws on and adds value to existing WMO assessment material by synthesizing existing approaches and data into an easily interpretable form, validating the information provided by WMO Members through a peer review process, and obtaining missing information.

The Diagnostics aims at informing policy and investment decision-making, in particular guiding investments of the members of the Alliance for Hydromet Development. The Alliance brings together major development and climate finance partners behind a joint commitment to strengthen developing country hydromet capacity. Through the Diagnostics, developing countries are expected to benefit from better targeted and aligned financial and technical support.

The Country Hydromet Diagnostics is based on the ten most critical elements of the hydromet value cycle, grouped under four categories – (i) enablers, (ii) observation and data processing system, (iii) service and product production and dissemination, and (iv) user and stakeholder interaction.

The 10 elements of the Diagnostic are defined as follows:

A. Enablers

- 1. Governance and institutional setting** - The formalization of the NMS mandate and its implementation, oversight, and resourcing.
- 2. Effective partnership to improve service delivery** - Effectiveness of the NMS in bringing together national and international partners therefore improving the service offering. This includes the academic, research, private sector and climate and development finance institutions.

B. Observation and data processing system

- 3. Observational infrastructure** - The level of compliance of the observational infrastructure and its data quality with prescribed standards.
- 4. Data and product management, sharing, and policies** - The nature of data and product sharing on a national, regional, and global level.
- 5. Numerical model and forecasting tool application** - The role of numerical model output and forecasting aids such as remotely sensed products in product generation; whether models are run internally and if the value-added compared to global models is determined.

C. Service and product production and dissemination

6. Warning and advisory services - NMS role as the authoritative voice for weather-related warnings and its operational relationship with disaster and water management structures.

7. Contribution to climate services - NMS role in and /or contribution to a national climate framework according to the established climate services provision capacity. The assessment on this point will be based on, and complement the recently completed work on, the capacity assessment of climate information services in North Macedonia.

8. Contribution to hydrology - NMS role in and contribution to hydrological services according to mandate and country requirements.

9. Product dissemination and outreach - Effectiveness of the NMS in reaching all public and private sector users and stakeholders.

D. User and stakeholder interaction

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.

For each value cycle element, a limited number of standardized indicators is used, and each indicator uses explicitly defined data sources. The assessment of these critical elements of the National Meteorological Service should lead to their maturity level. Note that Level 5 is the highest attainable maturity level in the CHD assessment.

The Diagnostics draws as much as possible on primary data (self-reported and other sources of quantitative data), but to inform the peer review requires additional data, in particular data from country user/client surveys. The WMO Community Platform provides the primary source of data information requirements for the Diagnostics and the results of the Diagnostics will be integrated in the Platform adding substantial value.

In that context, a draft prototype of the CHD has been developed and the Republic of North Macedonia, a developing country, has been identified to test drive it, noting that Meteorological and Hydrological services are both provided by the “Hydrometeorological Service of the Republic of North Macedonia, (Uprava za hidrometeoroloski raboti-UHMR)” under the authority of the Ministry of Agriculture, Forestry and Water Economy.

The Republic of North Macedonia is a small (25,713 km², UN rank as 145 by territory dependency), landlocked country that is located in the middle of the Western Balkans. It has a diverse topography. In spite of the relatively small area of the Republic of North Macedonia, due its location and the orography, the country has a diverse climate, with eight climatic regions, spanning a spectrum from a sub-Mediterranean and to an alpine mountainous.

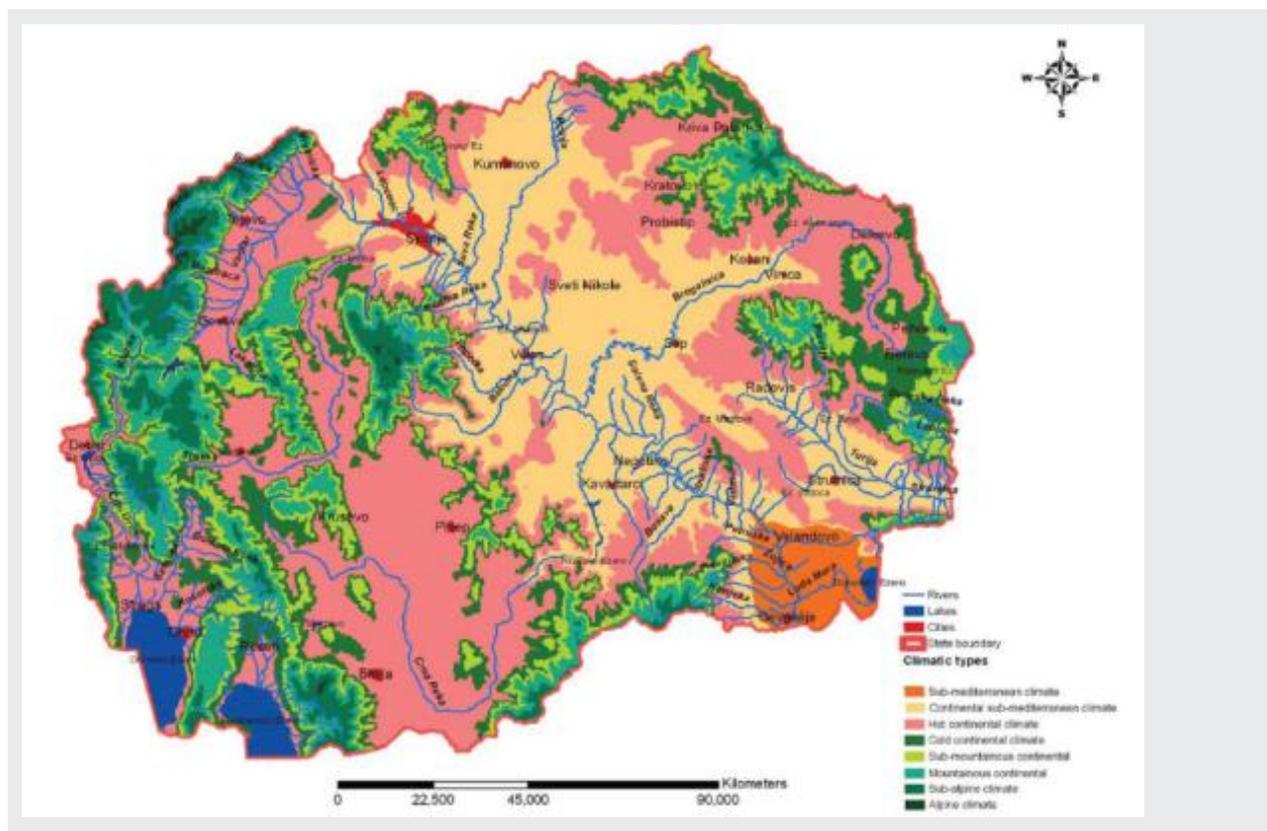


Figure 1: Climate Zones in North Macedonia.

The average annual temperature values range between 20.6 to 24.3 degrees in the summer and 0.9 to 4.9 degrees in the winter. However, temperatures can soar up to 45 degrees in the summer and fall down to -30 degrees in the winter.

Precipitation is characterized by uneven spatial and temporal distribution over the country, because of the complex orography. Average annual precipitation ranges between 400 to 1000 mm.

To assist with the assessment of the critical elements of the value chain, The Zentralanstalt für Meteorologie und Geodynamik of the Republic of Austria has been engaged to play the peer reviewer role. In addition to the Country information available in WMO database, multiple interviews were performed with experts from the Hydrometeorological Service itself, as well with representatives of different national and international stakeholders. In the case of the latter, a user's questionnaire was developed. Various documents and reports related to the Republic of North Macedonia have been reviewed for information of interest in this peer review.

This report is presented along the ten most critical elements of the hydromet value cycles with an indication of their respective maturity level and some high-level recommendations to help lift up that maturity level.

2. GOVERNANCE AND INSTITUTIONAL SETTING

In North Macedonia, hydrometeorological services are provided by a single Service: the National Hydrometeorological Service of the Republic of North Macedonia (UHMR). The Service is under the Ministry of Agriculture.

The Service acts according to the National Law of Hydrometeorological Activities from 2008, with additional Corrections and Completions from 2011 and 2015 (the detailed list is to be found in annex 4). However, it should be mentioned here, that the meteorological services for aviation are not provided by UHMR, but by a division inside the Macedonian Navigation Department in the Ministry of Transport. The Permanent Representative nominate(d) experts for the Technical Commission for Aeronautical Meteorology with WMO., but other than that, the working relations include only basic data sharing (observation data from the airports, radar imagery by request). Certain roles of the UHMR are also described in other laws, such as the law of Waters and the law of Environment. However, the role of the UHMR is far of being sufficiently emphasized in these additional laws. Currently, another relevant law is about to be ratified - the law of climate action. However, also here, the role of UHMR according to this law, is limited to the context of health and biodiversity, and subjects like climate monitoring and climate research, are not addressed at all, nor these activities are delegated to the UHMR, as it is a major part of the core activities of any NMS in the world.

Though the different departments might have Strategic, Operational and Risk Management plans or at least, some ideas related to these plans, there is no general plan for service as a whole and no organised reporting as for their outcomes.

The regular budget of UHMR is provided by the Government. Additional indirect source of income is added value services - services for the private market, additional processing of the data, archive data, etc. However, this money is not paid directly to the UHMR, but to the Ministry of Finance and then indirectly is included in the overall budget (but only partially). A proper cost center accounting system should be required in this case.

Despite the relatively large total number of employees (170), the “professional core” is much smaller, at whole and each department separately. By Core professional, the authors mean people with an educational background in Meteorology and Hydrology, either technical (complying with WMO’s BIP-MT requirements) or academic (complying with WMO’s BIP-M requirements), according to WMO Publication no.1083. The estimated number of this personal does not exceed 25 20-25 people. Though the professional level of the purely professional staff is quite high, still their number of professionals falls short to meet even the basic needs of each field of activity and thus, it is the main limiting factor for lifting up the maturity level.

In addition to the limited number of professional staff, there is a lack of young professionals. The professional staff is mostly at or nearing retirement age, with very little or no new openings for new and younger specialists. This also implies that there are very few or no students (“the future generation”) studying in the relevant fields. This situation might result in an eventual further downgrading of the maturity level.

There is quite a large experience in the implementation of internationally funded hydromet projects and research and development projects in general (UNDP, GIZ, FAO, GWP, Swiss Government,

World Bank, etc.), but there are some concerns about the sustainability of these projects in the future, due to lack of sufficient resources for their maintenance. It seems that most projects are coordinated more on the departmental level, rather than the overall management level, with little consultation with the users of the services produced eventually by these projects. A better coordination between the different sectors of UHMR, could ensure much better results from these separate projects.

Based on the assessment using the tools of the CHD, the Governance element of the hydromet value cycle has been set to **Maturity Level 3**.

3. EFFECTIVE PARTNERSHIPS TO IMPROVE SERVICE DELIVERY

UHMR is providing services for different other governmental and state institutions. There are several good examples of cooperation between UHMR and other entities: with the Crisis Management Center (CMC) (providing forecasts and warnings, from the forecasting and the Hydrological Departments, with a regular communication), the Water Department at the Ministry of Environment and Physical Planning (MEPP) (research, planning and regular communication with the hydrology department), some departments of the Ministry of Agriculture, Forestry and Water Economy with the department of Agrometeorology at UHMR (Forecasts and research). Some staff members of UHMR are regular participants in different governmental committees regarding assessment of damages from weather disasters, water management, climate change, agricultural planning, energy, construction, etc.

However, it seems that there are many more possibilities, than currently exploited - from the Extension Services and Phytosanitary departments at the Ministry of Agriculture, Forestry and Water Economy through the Ministries of Economy and Environment and Physical Planning (MEPP) and to strengthening the cooperation with Crisis management units. The limiting factor here is, besides others (Non adequate IT infrastructure, issues with the stations maintenance) , the previously mentioned too low number of experts at UHMR, who are unable to cope with the additional work required, as a result of such possible partnerships, as it can be seen in comparison with other similar sized NMSs around the world,

There are no official partnerships with academia at the organisational level (the departments for Natural Sciences, Agricultural Sciences, Forest Sciences, Landscape Design and Environmental Sciences, Civil Engineering, etc.). Most partnerships with academia are mostly performed on a personal basis and for temporary purposes. As for the private sector, there are some partnerships with several companies, such as the heating company of Skopje, the National Tobacco Company, the Agricultural Insurance sector, the Hydro-electrical Sector, building companies, etc. However, most of these partnerships are limited for data and services delivery by UHMR for these organisations.

UHMR has a rich background of cooperation with many international organisations - a project with UNDP and FAO for improving the services for farmers (a dedicated website for farmers with improved forecasts and consultancy), projects with WMO, GIZ, the Swiss Embassy in North Macedonia and others to improve the hydrological station network at the main river basins.

The sustainability of these projects must be the prerogative for any further development. Mostly, these projects are time-limited and hence, there are some question marks over their further sustainability, according to the statements of the interviewees from different developing agencies, though the

sustainability of these projects was never assessed by UHMR or by the agencies themselves. As for others (and potential additional ones), they are again only partially effective, due to the available professional staff size as well as due to issues with the IT infrastructure and insufficient staff.

As for WMO initiatives, the UHMR participates, among others, in improvement of the forecasting abilities for flooding and flash floods (including participation at WMO's WFFGS programme, Drought Management System for SEE, South-East European Multi-Hazard Early Warning Advisory System and different cooperation schemes dealing with trans-boundary rivers), projects for upgrading the Automatic Station Network, seasonal forecasting with WMO's SEEVCC centre, participating in Meteoalarm, SEECOF and also at the Informal Conference of East-Europe NMS Directors and more.

Based on the above, the reviewers have graded the maturity level related to effective partnerships to improve services delivery of the UHMR at **Level 2**.

4. OBSERVATIONAL INFRASTRUCTURE

The UHMR has 20 surface stations (according to the WMO OSCAR project: <https://www.wmo-sat.info/oscar/>) registered in the WMO Observing System Capability Analysis and Review Tool for Surface (OSCAR/Surface) but only 14 of them are reporting through the Global Telecommunication System (GTS) of WMO. Only a few of them have high availability (over 80%), others have issues with their availability. Until a few years, UHMR was operating a single upper air station, from the Skopje airport, but due to renovation of the airport, the station was disassembled and not yet reestablished in another place.

The Global Basic Observing Network (GBON) criteria¹ regarding North Macedonia, require a defined set of surface observations to report permanently on time. This criterion is fulfilled (14 out of 20 stations). However, the second part of the criteria also requires reports from a single upper air station, currently unavailable, as mentioned in the previous paragraph.

Currently (as for 2020) there are 16 main synoptic stations (manual + AWS), 7 climatological stations, 90 precipitation stations, 24 phenological stations, total number of 51 Automatic Weather Stations (AWS) (with a total staff of 65 observers). The network is only partially maintained - with a priority to the AWS and the Synoptic Stations. However, the network is not homogeneous around the country and there are areas, which are not represented by stations. There is no updated UHMR specific library of stations manuals and regulations - some of the documents are in English, some remain from the Yugoslav Period and many are absent.

Maintenance is performed only partially according to a Standard Operating Procedure (SOP), but due to constraints (a small number of technicians - only 2, shortage of spare parts as well problems with reaching the less accessible areas of the country, due to quite old vehicles), the SOP can be followed only partially. Again, the maintenance is performed mostly only for the Synoptic and AWSs.

Basic three-level quality check of the data is being performed, but, due to very small numbers of relevant staff, only some field calibration is being performed and there is no access to a national or a foreign calibration lab. There is also no formal system of choosing the optimal location of new stations,

¹ See https://ane4bf-datap1.s3.eu-west-1.amazonaws.com/wmod8_gcoss3fs-public/3a_aopc-24-gbon_icgwigos_jan_2019.pdf?tSO_Ga.kZK2ydXHMVMTctsfbQAjags1i for more

involving also stakeholders outside of the service. The rule-book for the observation network is very old and outdated, so it needs a complete update.

Though the real time data is relatively easily accessible, there is a lack of a modern and up-to-date general database management system, allowing different users inside and outside of the organisation an easy access to the data. The UHMR makes use of CLIDATA software, but it is installed only on one computer and actually can be used only by one administrator/user. As for the metadata, there is no fully digital database available.

In addition, UHMR operates quite old two dual-wave rain radars from 1986 (WSR-74, produced by the USA, located in Gjuriste) and 1993 (MRL-5, produced by the Russian Federation, located in Topolcani). Due to their advanced age, proper management is a daily challenge and naturally, the products derived are much inferior in comparison with modern standards, both in resolution and products.

The real-time data is free for use. In case when the historical data are requested by external users for specific purposes, a fee for their preparation applies according to Pricelist published in the Official Gazette. There is no possibility for a secured access for external users.

Considering the above, the Maturity level of the observational infrastructure is assessed to be at **Level 2**.

5. DATA AND PRODUCTS SHARING AND POLICIES

North Macedonia, as a Member of the World Meteorological Service, is obliged, according to resolution 40 of the XII congress of WMO, to “provide on a free and unrestricted basis essential data and products which are necessary for the provision of services in support of the protection of life and property and the well-being of all nations, particularly those basic data and products, as, at a minimum, described in Annex 1 to this resolution, required to describe and forecast accurately weather and climate, and support WMO Programmes”. Thus, UHMR is sharing internationally its mandatory surface observations (via the website of WMO as well as the WMO OSCAR system - <https://www.wmo-sat.info/oscar/>), through the GISC in Offenbach, Germany. The main issue hampering this sharing are different technical issues related to IT.

As for the national data policy, generally speaking, everyone is obliged to pay for the data, according to the plan adopted by the Government of the Republic of North Macedonia. However, the revenue is retained by the government, rather than the UHMR itself and the current revenue amounts to only 5-7% of the regular budget of UHMR.

Another issue regarding the sharing of data is the data accessibility. In order to get any data from UHMR, especially historical data, due to the above-mentioned lack of a modern data management system, the accessibility is far from immediate.

UHMR receives internationally shared data from WMO's GISC in Offenbach, as well products from EUMETSAT (products of 12 channels, from RGB to IR and WV, including Airmass, Microphysics, Day Microphysics, Night Microphysics, Convective Clouds, Natural Colour, Dust, Ash, Night Clouds, Snow, Fire detection, Precipitation rate, Cloud mask) and ECMWF (EC Charts, Meteograms, cross sections, probabilistic maps, etc.). Other shared data, UHMR receives, are related to transboundary water.

The maturity level of the Data and Products Sharing and Policies is, therefore, assessed to be at **Level 3**.

6. NUMERICAL MODEL AND FORECASTING TOOL APPLICATION

The UHMR has an access to Global models through their internet sites. The forecasters are making a use of the automated prepared maps, available on the sites, but do not have the capacity (or the time availability) to produce self-tailored model products (During the preparation of the report, METCAP was in the process of installation on the computers of the Forecasting Centre. In addition, the forecasting centre is also running its own regional model (WRF-based) on its computers. The model was installed and maintained with the help of an external advisor. The forecasters use this model, in the same way as they use the global models. Though the subjective feeling of the forecasters of the quality of this model is good, they use it only as a “second opinion”. In addition, there is no systematic verification and validation procedure of the model or the global models.

No model or special additional measurements for nowcasting are available. The forecasters are also using the Ensemble forecasts produced by ECMWF to a high degree.

As for satellite data, the forecasters continue to use EUMETSAT’s site, as their main tool, though a new visualisation tool was recently installed - METCAP. However, again due to a sufficient IT maintenance, there are already concerns as for its future use.

Due to the above-mentioned lack of a modern central data management system, the forecasters mostly prefer the use of the manual synoptic stations, rather than the AWSs.

In addition, in the framework of the SEE-MHEWS Project, a dedicated tool is being developed CIP (Common Information Platform) by ECMWF for nowcasting and early warning

The maturity level for numerical model and forecasting tool application is assessed at **Level 3**.

7. WARNING AND ADVISORY SERVICES

UHMR produces two main kinds of warnings: general and hydrological.

The forecasting centre provides early warnings and warnings for the wide public. The Common Alerting Protocol (CAP) was partially adapted, but due to the very limited number of staff of the forecasting department (5 - all of them are forecasters on shifts), CAP, impact-based forecast and risk-based warning were not implemented. Moreover, though UHMR has joined Meteo-Alarm a few years ago, due to IT issues, only recently UHMR was able to reactivate its part of this project and start delivering warnings to the general European Warning System, but only according to the old warning protocol.

Like with forecasts, there is no systematic validation process of the warnings.

As for Hydrology, there is a system of early warnings and warnings produced by the Hydrology section for the larger rivers catchments, but it is completely a separate system than the meteorological one (more details in chapter 9 dealing with hydrology). The separation of the systems might create a general feeling of the lack of “a single voice” for UHMR. Moreover, there might be discrepancies between the two systems,

The warnings are issued as emails and they are sent to the crisis management centre, different ministries, municipalities, regional councils, etc. However, all of the warnings (as well as the forecasts) are sent to the entire list of users, without sub-lists, according to interest and need. The warnings are used for preparatory steps as well coping in real time with extreme events. The different stakeholders quite frequently contact the forecaster on duty for consultation and advisory.

The maturity level for warning and advisory services assessed at **Level 2**.

8. CONTRIBUTION TO CLIMATE SERVICES

The first and arguably the most important climate service, any NMS has to provide is simply climate data - observations and related statistics. The UHMR is providing climatic data, but due to the already above-mentioned IT issues, the access is not immediate (only by request and then a period between a week and up to a month, depending on the data requested). In addition, a very large part of the historical data (including metadata) exists only in paper and not yet digitized. Metadata is not provided for the users.

UHMR also participates in various working groups and provides information related to climate and related issues, such as water, agriculture, DRR, etc. However, due to a limited number of experts as well as other constraints (IT, observations gaps as well tools), the UHMR produces only a limited number of climatic and agrometeorological products - basic statistical analysis (norms, averages, etc.) and also other analysis, such as risk analysis for drought, probability of rainfall intensity, etc. Nevertheless, UHMR contributes to the National Adaptation Plan.

As for climate prediction, UHMR participates in the South East European Climate outlook forum and jointly issues a seasonal forecast. Considering market structure in North Macedonia, there would be a high potential for a stronger participation in long-term climate prediction based on UHMR data and services. Adequate resources and training for these activities would have to be provided for this purpose.

The maturity level for contribution to climate services is assessed at **Level 2**.

9. CONTRIBUTION TO HYDROLOGY

North Macedonia is a country with a very complicated topography and with a lot of water bodies. Thus hydrological services should be of a very high importance in this country.

Since UHMR is a hydrometeorological Service, hydrology and meteorology sit under the same umbrella. Therefore, the Hydrology department receives all the data from the Observation System (including Surface observations and radars).

The hydrology department is heavily involved with forecasts of flooding and flash floods in most of the main river basins of the country, but does it quite separately from the forecasting and the Climatology Departments, contacting them only ad hoc, according to the events and their severity. Hydrology is using the forecasts, issued by the forecasting centre, in order to know about approaching extreme rainfall amounts and bases its work procedures also on the climatological rainfall amounts maps, provided by the Meteorology Department. Currently, there is only a partial coverage of the main river basins with measurement equipment and moreover, no possibility to perform a dull verification of the Hydrological Products. In addition, as part of the SEE-MHEWS project..It is planed to provide CIP for floods (Macedonian pilot basin is Vardar river).

As previously mentioned, water issues have a very strong impact on the country and thus the Hydrology Department at UHMR could play even a stronger role in supporting the national decision-making procedures and through it, also the forecasting and meteorology Departments. Naturally, adequate resources should be allocated for this purpose - both in terms of manpower as well the Hydrological Stations network.

Considering the above, the maturity level of Contribution to Hydrology has been assessed as **Level 2**.

10. PRODUCT DISSEMINATION AND OUTREACH

The dissemination of information is made through UHMR's official internet site (www.uhmr.gov.mk) as well as a separate internet site dedicated for farmers, developed with the aid of FAO. The Website is responsive and provides much information, however, in some sections, probably to IT constraints, there are missing fields and info pages. The exposure of this website could have been wider, if news and general updates were uploaded there with a higher frequency (the current last news are from 9 months ago).

In addition, the Hydromet also operates its own Facebook page, though it does not enjoy a wide audience or high levels of engagement (around 6,000 followers, with on average, just a few likes for each post). The page is showing mostly only forecasts and rarely also hydrology news. The UHMR does not use Instagram, Tweeter or LinkedIn.

Product dissemination is also made through Radio, TV, emails, SMSs. However, for the forecasting department, there is a lack of User List management (according to needs and interest), so that everybody gets everything, relevant or irrelevant. As for other reports, they are sent only by request (or by prearranged agreement), though the potential audience might be larger.

From time to time, experts from UHMR are interviewed on TV and Radio, but only on request. The forecasters are only appearing via phone calls and some other experts are sometimes interviewed, but only by request. The UHMR does not operate its own TV/YouTube Channel.

Before the COVID-19 pandemic, the UHMR was hosting groups of school children and students for visits. In actuality, the potential for outreach activities is quite wide (some were already performed as part of projects with international agencies), and with a proper defined policy, they can be much expanded to include different parts of the Macedonian population, according to age and/or occupation.

In addition, the UHMR might play a more leading role in Meteorological and Hydrological Education, whether it is on the level of high school education or higher education, through a cooperation with

academia, the ministry for education and different interested institutes. Proper resources should be provided for these highly important outreach and education activities.

Considering the above, the maturity level for Product Dissemination and Outreach is assessed at **Level 2**.

11. USE AND NATIONAL VALUE OF PRODUCTS AND SERVICES

The UHMR has no formal process for conducting surveys and it lacks a platform for co-designing services with users. There is an informal feedback and input from some of the central stake holders, but more on a departmental level, rather an organisational one. According to interviews conducted, those who receive forecasts and warnings, are mostly satisfied, though different sectors and users would prefer to have more tailored products for their own specific needs. As for users requiring data from the UHMR, the main claim (besides the price), is the quite long process required to acquire data from the UHMR.

Actually, through a brief survey of different stakeholders, both in the Government as well as in the private sector (see Annex 3 for the list of those stakeholders consulted), it seems that there is quite an abundance of potential users all around the country, with a high need and interest with the data and products of UHMR - from agriculture, through energy and to environmental protection. A proper organisational policy should be consolidated for this purpose.

The maturity level of the Use and National Value of Products and Services is assessed as **Level 2**.

ANNEX 1: SUMMARY OF THE ASSESSMENT AND KEY RECOMMENDATIONS TO LIFT UP THE MATURITY LEVELS

Maturity Level	Element of the Value Cycle	Key Recommendations to lift up the Maturity level
3	Governance and Institutional setting	<p>Reconsider the position of the UHMR in the Governmental System (perhaps as a general governmental service).</p> <p>Revise the existing laws regarding Meteorological Services, with a stronger mandate in different fields .</p> <p>Elaborate specific rulebooks and guidelines deriving from the law on UHMR's activities</p> <p>Credit receipts from additional services to UHMR's budget</p> <p>Develop and implement a strategy for recruitment and retention of professional staff</p> <p>Build together with academia two long-term projects: recreating an academic program in meteorology (including scholarships) as well as a program for "completing the meteorological education" for new employees coming from close fields (physics, geography, etc.). Adapting the educational curricula according to the WMO requirements of BIP-M.</p> <p>Create a special committee, headed by the PR, with representatives from all UHMR's departments, main stake holders and the donor organizations, to meet regularly and coordinate all the international projects, UHMR is involved with.</p> <p>Conduct functional analysis of organizational units/ assignment of staff/ protocols of workflow.</p> <p>Implement a quality management system at UHMR, if possible, aspire towards ISO 9001 accreditation.</p> <p>Create a rewarding system for additional activities (performance in media, participation in additional projects, etc.)</p>

2	Effective partnerships to improve service delivery	<p>Establish stakeholder group with partners in government, academia and the private sector to identify fields of common interest and needs</p> <p>Formalize the partnership with the different departments of the Ministries of Agriculture, Environment and Economy</p> <p>Formalize and strengthen the partnership with the Universities for joined research projects</p> <p>Seek for opportunities with private sector (energy, construction and agriculture), both in the form of new business opportunities as well in the form of joined research and a two-sided data and info flow</p>
2	Observational infrastructure	<p>Consider outsourcing of observational network maintenance, with UHMR retaining inspection role.</p> <p>Updating the Rulebook for the Station Network.</p> <p>Updating the library for stations manuals and regulations.</p> <p>Seek opportunities to upgrade weather radar network, and then join EUMETNET OPERA.</p> <p>Reinstate the upper-air station and resume twice daily sounding operations.</p> <p>Purchase a modern, state-of-the-art Data Management system with a comfortable access for internal and external users.</p> <p>Re-establish instrument calibration using nearby partner.</p> <p>Create a national committee for the national station network, headed by UHMR's experts together with the main governmental and private stakeholders.</p> <p>Develop partnerships with the owners of other observation networks.</p>
3	Data and product sharing and policies	<p>Through a modern data management system (mentioned in the previous indicator), creating an easy access for users, inside and outside of UHMR.</p> <p>Reconsider with the government the free and open data policy</p>

2	Numerical model and forecasting tool application	<p>Providing the forecasters ready access to real-time and historical observation data.</p> <p>Perform regular NWP model verification (perhaps as a cooperation with the academia)</p>
2	Warning and advisory services	<p>Designate an experienced forecaster for warning verification and validation.</p> <p>Upgrade the warning distribution system, according to the updated CAP.</p> <p>Create sub-lists of users, according to their needs.</p> <p>Consider use of other distribution formats - SMS, Viber, Telegram, etc.), according to a prior needs assessment</p> <p>Formalize the partnerships with emergency response agencies.</p>
3	Contribution to climate services	<p>Increase resources allocated to climatology and agrometeorology.</p> <p>Make the data archive easily accessible on the internet.</p> <p>Digitize the remaining historical paper data and metadata.</p> <p>Perform a homogenization of the historical data (perhaps through partnership with academia).</p> <p>Develop catalogue of climate products and services for different groups.</p>
2	Contribution to hydrology	<p>Increase resources allocated to climatology</p> <p>Establish operational collaboration between meteorologists and hydrologists, including real-time access rainfall data</p> <p>Establish routine hydrological product verification</p> <p>Provide real time data on mutual internet platform with meteo data</p>
2	Product dissemination and outreach	<p>Finalize the upgrade of the website</p> <p>Establish a focal point for media relations with a meteorological/hydrological background</p>

		<p>Hold regular meetings with the Media and involve them more as a reach partner to build public awareness</p> <p>Install TV and radio Studio</p> <p>Give online webinars/lectures by UHMR experts</p> <p>Develop learning partnerships with academia</p> <p>Develop partnership with the Ministry of Education to foster hydrometeorological education at high schools</p>
3	Use and national value of products and services	<p>Designate a focal point for service users</p> <p>Actively manage users list to increase reach and engagement</p> <p>Develop and implement regular users' satisfaction surveys</p> <p>Establish action plans for continuous improvement based on user feedback</p>

ANNEX 2: LIST OF INTERVIEWED PERSONS (NHMS)

Name	Department	Position
Todorovski Ivica	General	(former) Director
Acevski Kostadin	General	(Current) Director
Alcinova Monevska Suzana	Division for Climatology and Climate Change	Head and International Adviser to the PR
Stevkova Silvana	Meteorology	Deputy Head
Stojov Vasko	Hydrology	Head
Karanfilovski Aleksandar	Division for Database Management	Head
Basovski Goran	Division for Agrometeorology	Associate
Avramovska Rada	Forecasting and Early Warning	Head

ANNEX 3: LIST OF INTERVIEWED PERSONS (OTHER ENTITIES)

Name	Entity	Position
Mirta Ylber	Ministry of Environment and Physical Planning (MEPP)	Head of Water Department
Dimoska Zajkov Ljupka	Ministry of Environment and Physical Planning (MEPP)	Deputy Head of Water Department
Andonov Petar	Ministry of Agriculture, Forestry and Water Economy Extension Office	Independent Officer for Rural Development
Sireta Zlatko	Ministry of Agriculture, Forestry and Water Economy Extension Office	Assistant Head of Agriculture and Rural Development
Cadikovska Lidija	Ministry of Agriculture, Forestry and Water Economy International Cooperation	Head
Musalevski Aleksandar	Ministry of Agriculture, Forestry and Water Economy Cabinet of the Ministry	Advisor
Simonovska Lile	Ministry of Agriculture, Forestry and Water Economy Water Department	Head
Dzerkovska Nadica	Ministry of Agriculture, Forestry and Water Economy Phytosanitary	Head
Stardelova Valentina	Ministry of Economy	Head

	Energy Department	
Atanosovski Panche	Energy Agency	Senior Advisor
Kodzoman Anita	UNDP	Head of Energy, Environment and Disaster Risk Management Unit
Zdraveski Nikola	UNDP	Junior Assistant
Kostovski Igor	UNDP	Monitoring Officer
Zdraveva Pavlina	UNDP	Climate Change Projects Manager
Kull Daniel	World Bank	Senior Disaster Management Specialist
Slavskova Radmila	FAO	Communication and Monitoring Analyst
Arguello Lopez Carmen	FAO	GCF Advisor
Arsov Spire	FAO	National Team Leader
Dodeva Stanislava	Swiss Agency for Development and Cooperation (SDC)	National Programme Officer at Swiss Cooperation Office
Memedov Samir	GIZ North Macedonia	Country Coordinator
Jankolovska Vesna	RTV (Macedonian Radio)	Journalist
Trajkovska Suzana	MTV (Macedonian Television)	Journalist
Manaievski Igor	TV5 (Macedonian Television)	Journalist
Panovski Dejan	GWP Mediterranean	Country Project Coordinator

Mukaetov Dushko	SS. Cyril and Methodius University, Faculty of Agricultural Sciences and Food	Professor
Chukaliev Ordan	SS. Cyril and Methodius University, Faculty of Agricultural Sciences and Food	Professor
Nikolov Nikola	SS. Cyril and Methodius University, Faculty of Forest Sciences, Landscape Architecture and Environmental Engineering	Professor
Dimov Zoran	SS. Cyril and Methodius University, Faculty of Agricultural Sciences and Food	Professor
Milevski Ivica	SS. Cyril and Methodius University, Faculty of Natural Sciences	Professor
Dr. Veljanoska Sarafiloska Elizabeta	Hydrobiological institute	Manager
Spirkovski Zoran	Hydrobiological institute	Fishery and Water quality expert
Pavlevski Vlatko	JSC Power Plant of North Macedonia	Head of Office for Hydro Power and Renewables
Ivanovski Antonio	JSC Power Plant of North Macedonia	Chief Engineer for thermal plants
Trpkovski Zdravko	TRIGLAV Insurance	Head of Insurance Development Unit
Blazhevska Magdalena	TRIGLAV Insurance	Independent underwriter for crops and animals

Blazev Dragan	TIMEL Project Energy and Infrastructure	Senior Engineer
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ANNEX 4: LIST OF REVIEWED DOCUMENTS

Name	Date	Language	Status
The law on the hydrometeorological activity	Gazette 103/2008	Macedonian	Law
Corrections and completions of the law on hydrometeorological activity	Gazette 53/2011	Macedonian	Law
Corrections of the law on hydrometeorological activity	Gazette 51/2011	Macedonian	Law
Corrections and completions of the law on hydrometeorological activity	Gazette 149/2015	Macedonian	Law
The Law on Environment and ammendments	Gazette 53/2005, 81/2005, 24/2007, 159/2008, 83/2009, 48/2010, 124/2010, 51/2011, 123/2012, 93/2013, 187/2013, 42/2014 and 44/2015	English	Law
Law on Waters Consolidated Version	Gazette 87/2008, 6/2009, 161/2009, 83/2010, 51/2011, 44/2012, 23/2013, 163/2013, 180/2014, 124/2015, 146/2015, 52/2016	English	Law
Law on Climate Action	2021	English	Law
Technical Advisory Services for the Preperation of the GCF Country Programmes - Technical Assistance to North Macedonia. Deliverable 3: Report on Capacity Assessment of Climate Information Services in North Macedonia	29.09.2020	English	Report

Ready to Respond - Diagnostic Report, Emergency Preparedness and Response Assessment for North Macedonia	2021	English	Report
Budget 2020		Macedonian\English	Inner report
HMS-Struktur		Macedonian/English	Inner Report
Major Users		English	Document
ToR Country Diagnostics North Macedonia		English	Contract