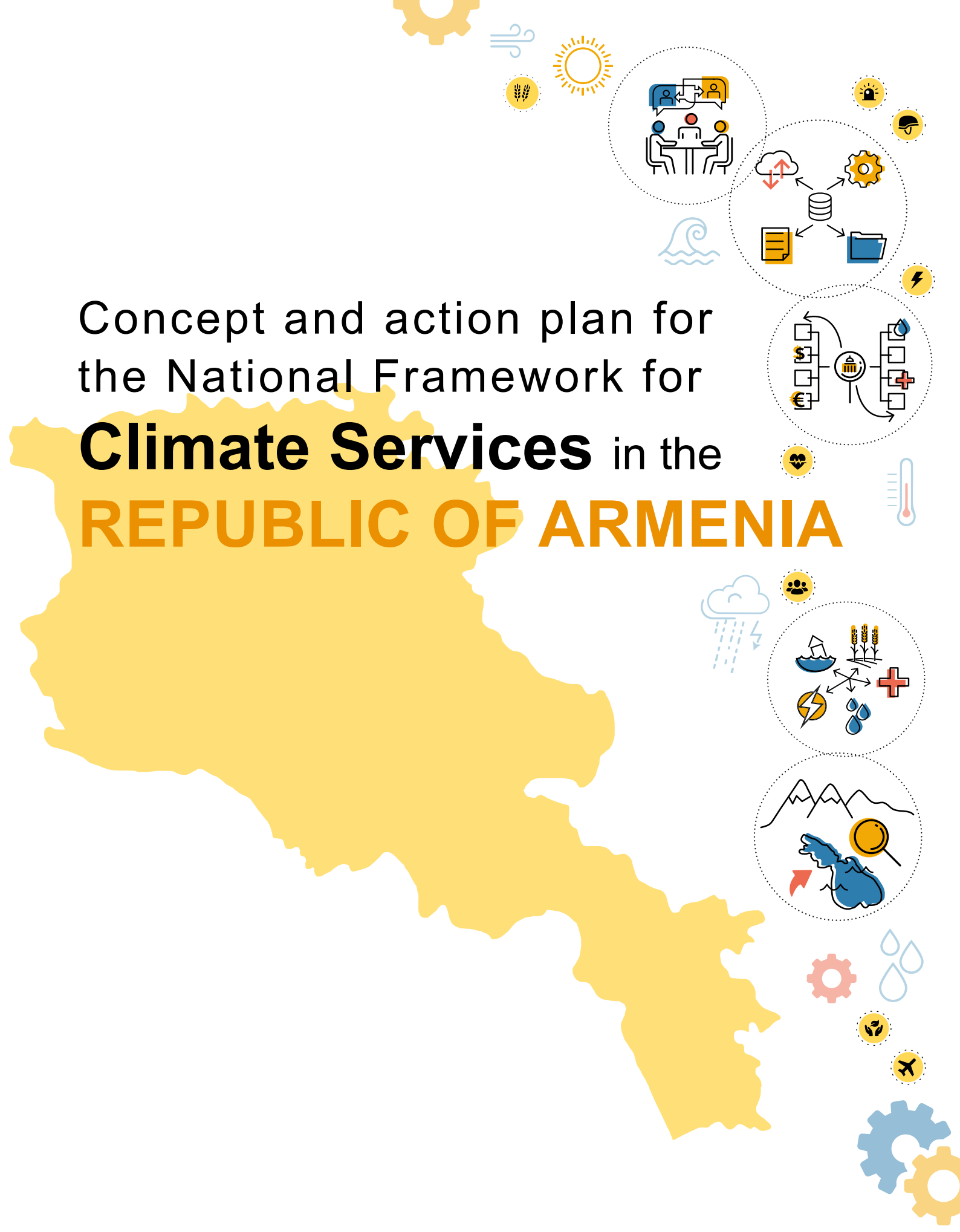
Concept and action plan for the National Framework for **Climate Services** in the **REPUBLIC OF ARMENIA**



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GFCS GLOBAL FRAMEWORK FOR CLIMATE SERVICES

GFDRR
Global Facility for Disaster Reduction and Recovery

REPUBLIC OF ARMENIA
MINISTRY OF ENVIRONMENT

zoï environment network

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Abbreviations

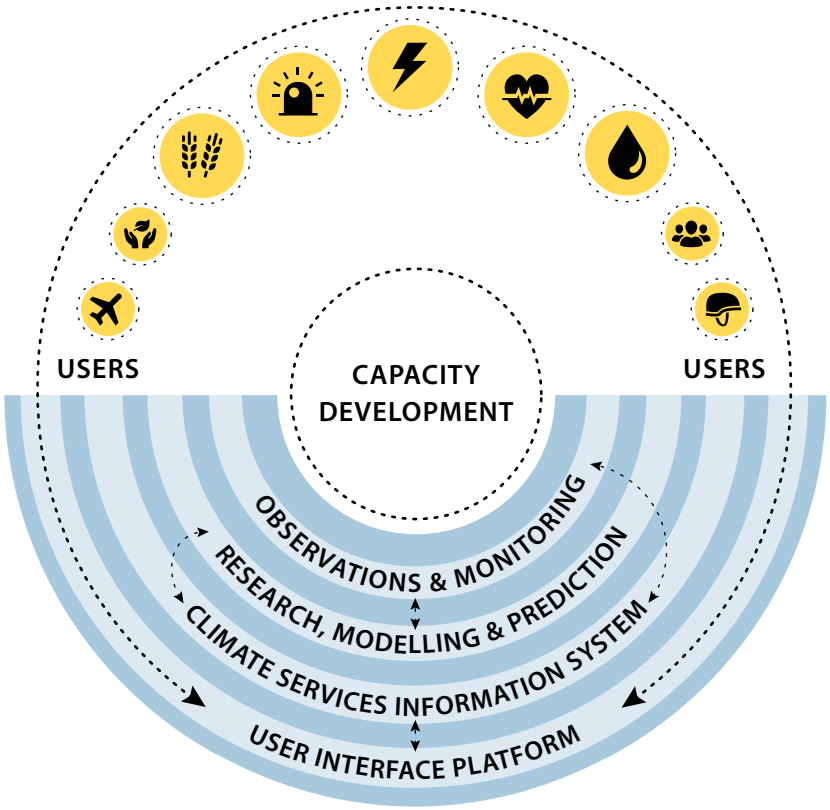
CONOPS	Concept of operations
DRR	Disaster risk reduction
EU	European Union
GCF	Green Climate Fund
GEF	Global Environmental Facility
GFCS	Global Framework for Climate Services
HMC	Hydrometeorology and Monitoring Center
NFCS	National Framework for Climate Services
SMS	Short message service
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WMO	World Meteorological Organization

INTRODUCTION

The vision of the Global Framework for Climate Services (GFCS)[1] is to enable better management of the risks of climate variability and change and adaptation to climate change through the development and incorporation of science-based climate information and prediction into planning, policy and practice on the global, regional and national scales. Climate observations, along with complementary socioeconomic and other data, must be effectively integrated to develop and provide users of climate services – farmers, public health officials, disaster risk reduction managers, water resources administrators and others – with information that will help them minimise losses due to climate variability and change and to manage natural and human systems effectively.

The GFCS accelerates and coordinates the technically and scientifically sound implementation of measures to improve climate-related outcomes. With its broad participation and reach, the framework enables the development and application of climate services to assist decision-making at all levels in support of addressing climate-related risks. The GFCS focuses on developing and delivering services in five priority areas that address issues basic to the human condition and present the most immediate opportunities for benefitting human safety and well-being. These are: agriculture and food security; disaster risk reduction; energy; health; and water.

Figure 1.1 Functional components (pillars) of the Global Framework for Climate Services



Source: modified from World Meteorological Organization. Step-by-step Guidelines for Establishing a National Framework for Climate Services. Geneva, 2018

1 https://gfcs.wmo.int/

Box 1.1 Pillars of the Global Framework for Climate Services

OBSERVATIONS AND MONITORING

Effective climate services require observations of various types, of adequate quality and quantity and at the right place and time. Both surface-based and space observations are needed for physical and chemical climate variables of the atmosphere, land and oceans, including hydrologic and carbon cycles and the cryosphere. In addition, delivering useful climate services also requires the availability of socioeconomic, biological and environmental data.

RESEARCH, MODELLING AND PREDICTION

During the past few decades, national and international investments in climate observations, research and modelling have resulted in significant progress in experimental and practical climate prediction and projection. Systematic conversion of existing climate knowledge into practical solutions requires a change in how climate research is conducted. In order to meet the diverse needs for climate services, professional networks should be developed to unite climate researchers and practitioners in the field.

CLIMATE SERVICES INFORMATION SYSTEM

The information system is the principal mechanism through which information about climate – past, present and future – is archived, analysed, modelled, exchanged and processed. It produces and delivers authoritative climate information products through operational mechanisms, technical standards, communication and authentication. Its functions include climate analysis and monitoring, assessment and attribution, prediction (monthly, seasonal, decadal) and projection (centennial scale).

USER INTERFACE PLATFORM

The user interface platform offers structured means for users, researchers and climate service providers to interact and ensure that user needs are met. The objective of the user interface platform is to promote effective decision-making in view of climate considerations. The need to make climate-related decisions will be the driver for providers and users to develop more useful climate information.

CAPACITY DEVELOPMENT

The GFCS aims to develop the capacity of countries to apply and generate climate information and products relevant to their particular concerns. Since many countries lack policies, institutions or human resources to enable them to take advantage of new or existing climate data and products or to establish a national dialogue on these issues, the capacity development component can be seen as a foundation that links and supports the other four pillars.

Source: adapted from www.wmo.int/gfcs/

The GFCS is promoted and facilitated by the World Meteorological Organization (WMO) in cooperation with the GFCS Partner Advisory Committee. The World Bank has supported the conceptualisation and establishment of a National Framework for Climate Services (NFCS) in Armenia through the Disaster Risk Management program financed by the Japan–World Bank Program for Mainstreaming Disaster Risk Management in Developing Countries. *Modernizing Weather, Climate and Hydrological Services: A Road Map for Armenia*, prepared as part of this project,[2] recommends the conceptualisation and development of an NFCS among important steps to modernise weather, climate and hydrological services in the country.

The NFCS work started in December 2019 with the support of Zoï Environment Network, a Switzerland-based international non-profit organisation specialising in environmental information, communication and capacity-building, and has been carried out in close cooperation with Armenia's Hydrometeorology and Monitoring Center under the Ministry of the Environment.

After a kick-off mission to Yerevan in January 2020, Zoï organised a series of in-depth interviews with selected users of climate services in Armenia, representing governmental, non-governmental, business and academic organisations. These were reflected in and followed by a baseline study of the current status of hydrometeorological and climate information and services in Armenia and a series of online consultations in June and July 2020. In order to allow room for an exchange of opinion, the consultations were organised by thematic clusters, bringing together in total close to 150 participants from various sectors. The strong interest among stakeholders has helped add many valuable insights to the discussions and findings.

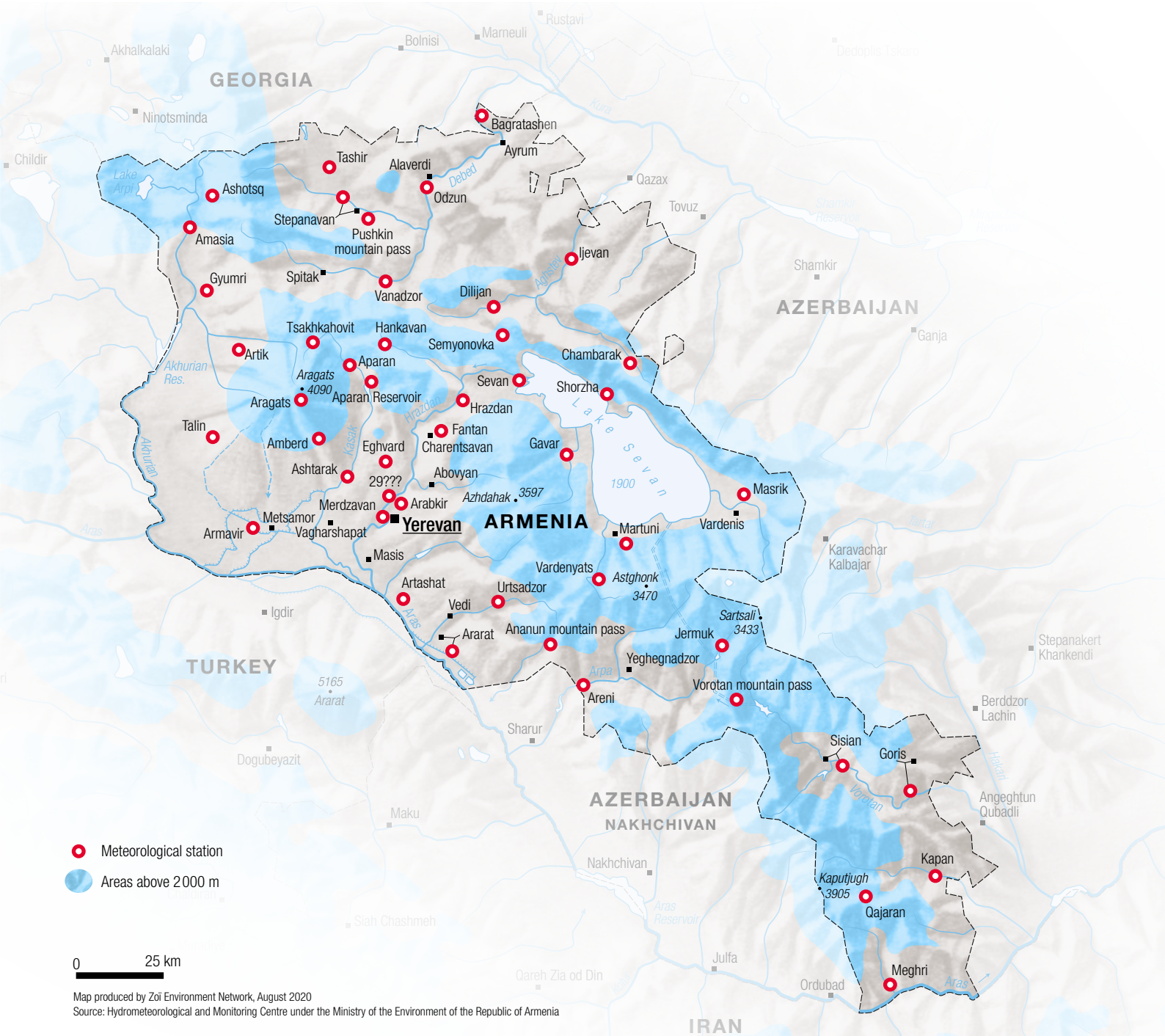
These insights, combined with the results of the baseline study and in-depth interviews[3], formed the basis for the development of the NFCS concept and action plan. An online review of draft documents by Armenian stakeholders in October 2020 helped further develop the concept and action plan. The final results are presented in this publication.

2 World Bank. Modernizing Weather, Climate and Hydrological Services: A Road Map for Armenia. Washington, DC, September 2018

3 See Zoï Environment Network, World Bank, Hydrometeorological and Monitoring Center under the Ministry of the Environment of the Republic of Armenia. Baseline analysis and summary of online consultations for the National Framework for Climate Services in the Republic of Armenia, Geneva, 2020.

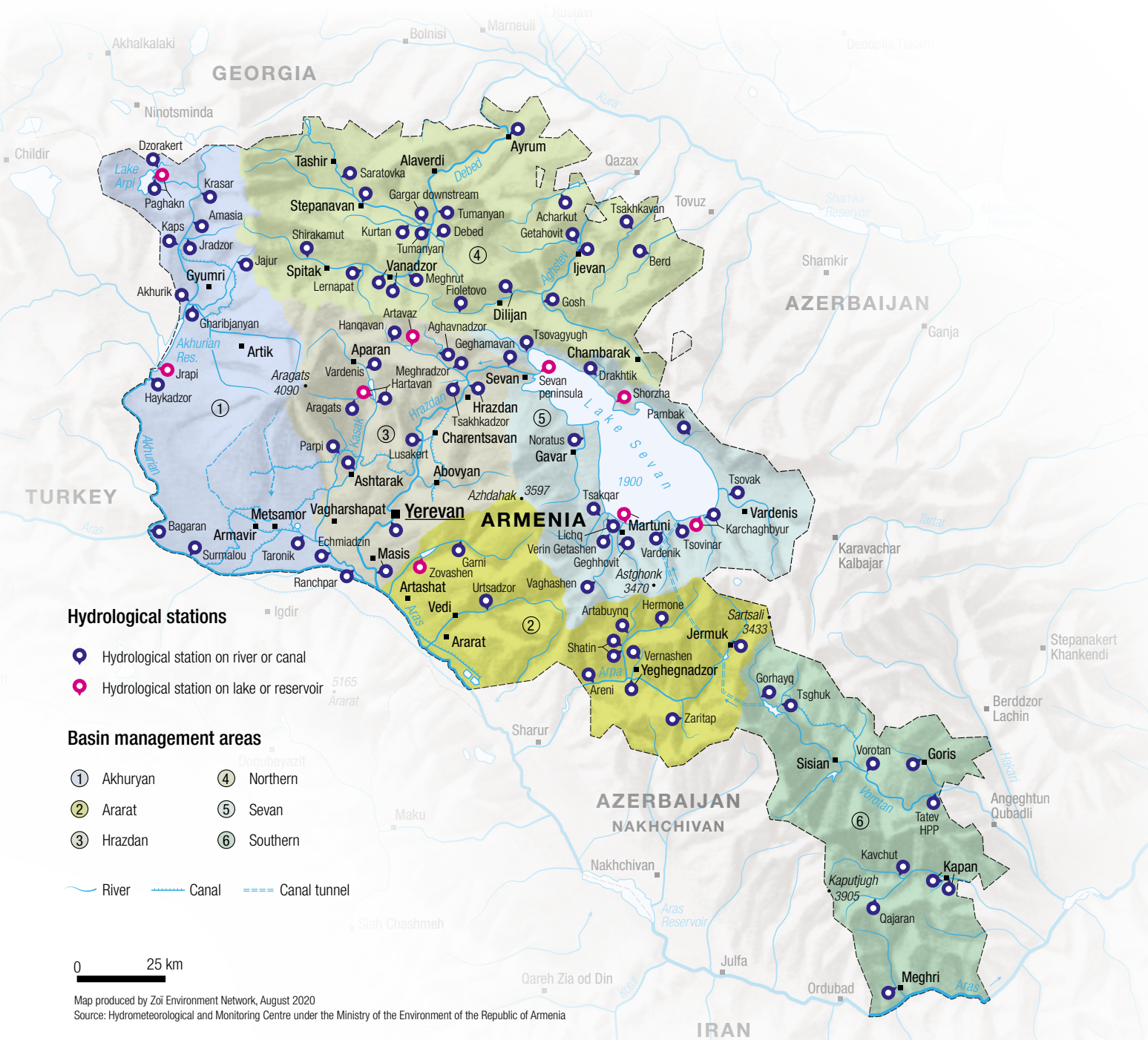
CLIMATE SERVICES AND USER PERSPECTIVES IN ARMENIA

Figure 2.1 National meteorological monitoring network



Map produced by Zoï Environment Network, August 2020
Source: Hydrometeorological and Monitoring Centre under the Ministry of the Environment of the Republic of Armenia

Figure 2.2 National hydrological monitoring network



The network of the Hydrometeorology and Monitoring Center (HMC)[4] provides observations on air, surface waters, soil, crops, pastures, the ozone layer, and ultraviolet radiation; and maintains actinometric and upper air stations (Figures 2.1 and 2.2). The HMC also manages data inventory and storage.

4 The Hydrometeorology and Monitoring Center under the Ministry of the Environment of the Republic of Armenia was established in early 2020, and fully integrated the previously separate Armenian Hydrometeorological Service. Besides hydrometeorology, HMC is also responsible for monitoring environmental quality and the state of forest resources.

The HMC weather forecasts and other products use actual observations at meteorological posts, the outputs of global and regional weather prediction models, radiosonde observations, and radar and satellite data.

A number of other governmental entities, private companies, non-governmental and other organisations also collect limited data and provide specific services (Figure 2.3, Table 2.1).

Figure 2.3 Institutional landscape of climate services in Armenia

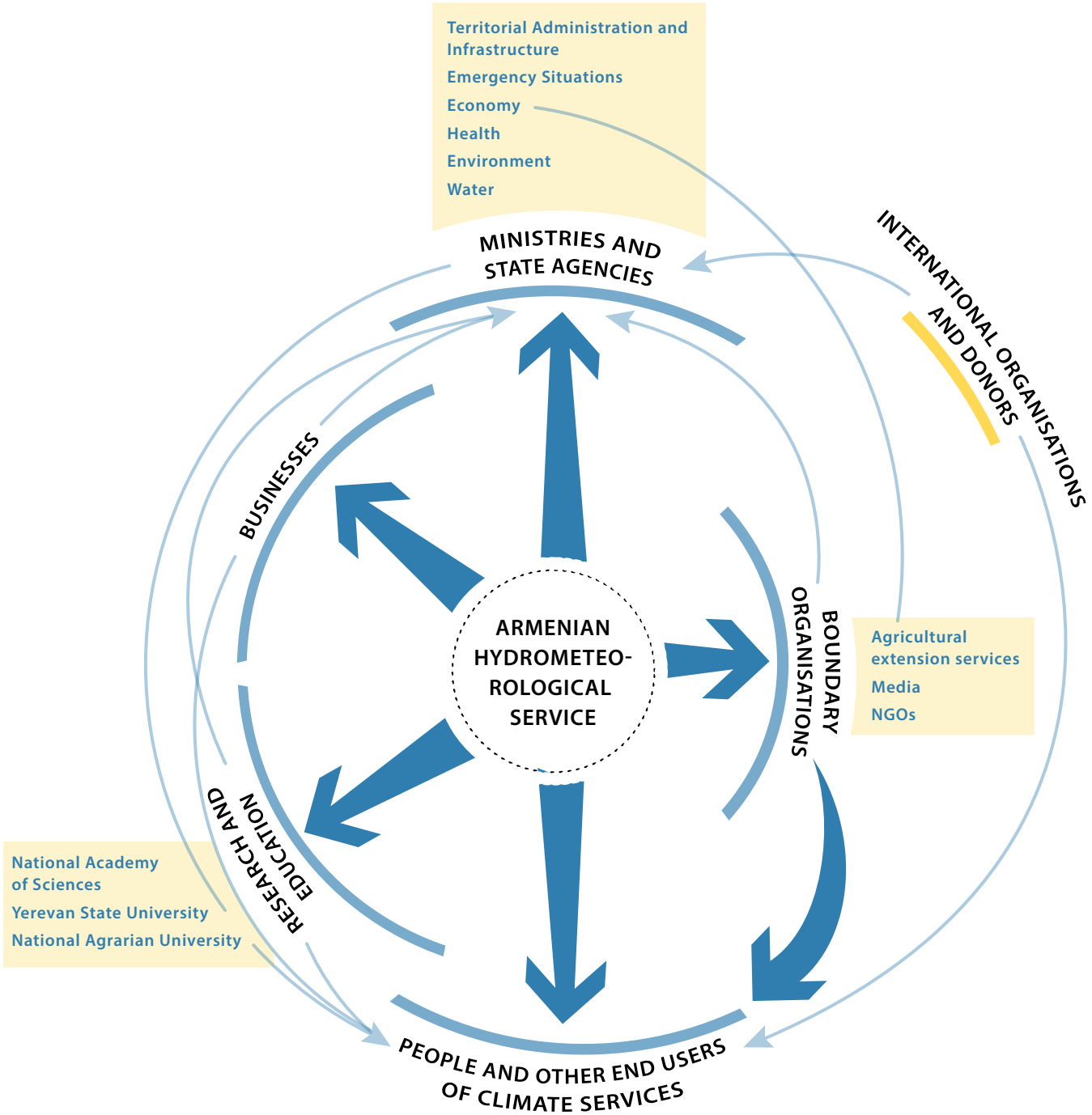


Table 2.1 Hydrometeorological data and information products in Armenia[5]

		Information products			Key users		
	Observations	Hydro-meteo	Climate	Sector-specific	General/ national	Regional/ local	Sectoral
AUTHORITIES [a]							
Hydrometeorology and Monitoring Center	•	•	•	•	•	•	•
Water Committee under the Ministry of Territorial Administration and Infrastructure		•		•	•	•	•
Jrar [b]	•	•		•			•
Electric Power System Operator [b]	•					•	•
Armenian Nuclear Power Plant	•					•	•
Renewable Resources and Energy Efficiency Fund	•	•		•			•
Research Institute of Spa Treatment and Physical Medicine under the Ministry of Health				•	•	•	•
Ministry of Emergency Situations		•	•			•	
Ministry of Defence	•						•
Zvartnots Aero-Meteorological Centre	•	•		•			•
RESEARCH AND DEVELOPMENT							
A. Alikhanyan National Science Laboratory (Yerevan Physics Institute) [c]	•	•		•	•	•	•
UNDP Climate Change Programme			•		•		
BUSINESS							
Geocom [d]		•		•	•	•	•
Centre for Agribusiness and Rural Development [c]	•	•		•		•	•
Solar / wind energy investors / projects	•	•		•			•
Tourism / sports companies	•					•	•

a Including entities acting on behalf of state authorities
b Closed joint stock company
c Foundation
d Limited liability company

5 The table is based on discussions and consultations held in the course of the NFCS study as well as on other available sources. The list of information products and their producers is not exhaustive.

Numerous users of hydrometeorological and climate services surveyed by the project, as well as the HMC itself, have indicated a number of gaps in the current set-up and capacities (Table 2.2), which are also opportunities to build in Armenia a modern and efficient climate service framework.

Today, most observation technologies and monitoring equipment are out of date due to the lack of systematic funding and upgrades. More automated monitoring would improve the quality and reliability of data, and the networks for both meteorological and hydrological measurements need to be expanded to cover more locations to meet the needs and expectations of users. In part, such expansion and the operation of an expanded network could only be achieved in partnership with sectoral, private and international partners. Complementary data can and should be collected through a broader use of remote sensing and by expanding the practice of regular field expeditions complementing the fixed observation network.

At the moment, users in their daily work lack data about a variety of subjects such as surface water, groundwater, snow cover, soil temperature and moisture, and solar radiation. Some of these data are not collected for the reasons above, or not collected at the required volume and resolution, or are simply not easy to find and access for users outside of the narrow hydrometeorological community.

Data accuracy remains an issue as does the comparability of observations by different operators, a situation that will only increase if observation networks continue to integrate new equipment and more partners, but such an expansion also offers possibilities for enriching the data exchange among the networks.

Technical and human capacities need to be improved to enhance the availability, quality and accuracy of forecasts for users with a range of needs – data on stream flow, floods and natural hazards on very short lead times for disaster risk management, including nowcasting for protection from hail; information on long-term and seasonal patterns, drought and heat forecasts for agriculture; winter temperatures for pipeline operations; and snowfall data for ski tourism. The sustainable management of Lake Sevan includes the determination and maintenance of its optimal water level, and research is needed on the likely climate impacts on the lake ecosystem, including eutrophication and biodiversity loss and on public health.

The HMC regularly provides available information to organisations with data contracts, but makes only limited data available online or through social media. Thus most climate and hydrometeorological data are difficult to obtain, and are not properly marketed. Users often do not know what information is available, how it can be acquired or how much it would cost. There still is an overall lack of interaction between the providers of climate information and the users who, as a rule, are not involved in shaping and developing climate products and services.

Agriculture and tourism need localised and real-time information to support their day-to-day operations, while researchers and many sectors require area-specific time series for long-term planning. Newly emerging agricultural insurance schemes depend on the availability of area-specific histories of damage from natural hazards, while farmers need ways to access information relevant to their specific crops and practices.

Despite considerable efforts, a significant gap remains between climate science and sectoral practitioners at the national, marz and local levels. While modelling and the development of long-term climate projections are still linked to specific, mostly international, projects, they are yet to find their way into sectoral and business planning.

To effectively deliver climate services to users, Armenia needs modern and effective communication channels. Upgraded, user-oriented websites, a new approach to mass media, the active use of social media, messenger and targeted applications are all widely demanded – and can dramatically improve access to the information that may already be available but remains hidden in data repositories. Meeting these demands will, however, require building stronger capacities among both providers and users of information.

And there is considerable room for expanding HMC interactions with users of climate services through the regular collection of feedback,

co-designed workshops and other forms of dialogue. The community of interested users can not only help conceive and shape innovative and relevant products, but also add value to them with their thematic expertise as was suggested in the discussions on agriculture, health and emergencies.

Lack of resources remains a major constraint, as modern technologies are costly while low salaries make the state sector unattractive for qualified specialists. Thus all sources of potential funding are to play a role in upgrading the technological and human capacities to bring climate services up to the expectations of Armenian users.

Table 2.2 Summary of user-identified gaps and opportunities for NFCS development[6]

	Water	DRR	Agro	Energy	Health*	Other
OBSERVATIONS AND DATA						
Out-of-date monitoring infrastructure	•	•	•	•		
Lack of observations at specific locations	•	•	•	•	•	
Lack of automated monitoring		•	•		•	•
Reduced scope of field expeditions	•					
Insufficient use of remote sensing	•		•			
Insufficient or unavailable data, including on:	•	•	•	•	•	•
Water balance (incl. flow and evaporation)	•					•
Groundwater	•					•
Water reservoirs		•				•
Snow cover	•		•			
Soil temperature and moisture			•			
Solar radiation				•		
Issues of data comparability	•	•		•		
Issues of data accuracy						•
Insufficient data exchange among networks	•	•			•	•

* Including recreation and tourism

6 The fact that some sectors do not identify gaps does not necessarily mean the gaps do not exist. Not all sectors identify out-of-date infrastructure as an issue, for instance, but participants from these sectors may have focused on products and services higher up in the value chain.

Table 2.2 Summary of user-identified gaps and opportunities for NFCS development (cont..)

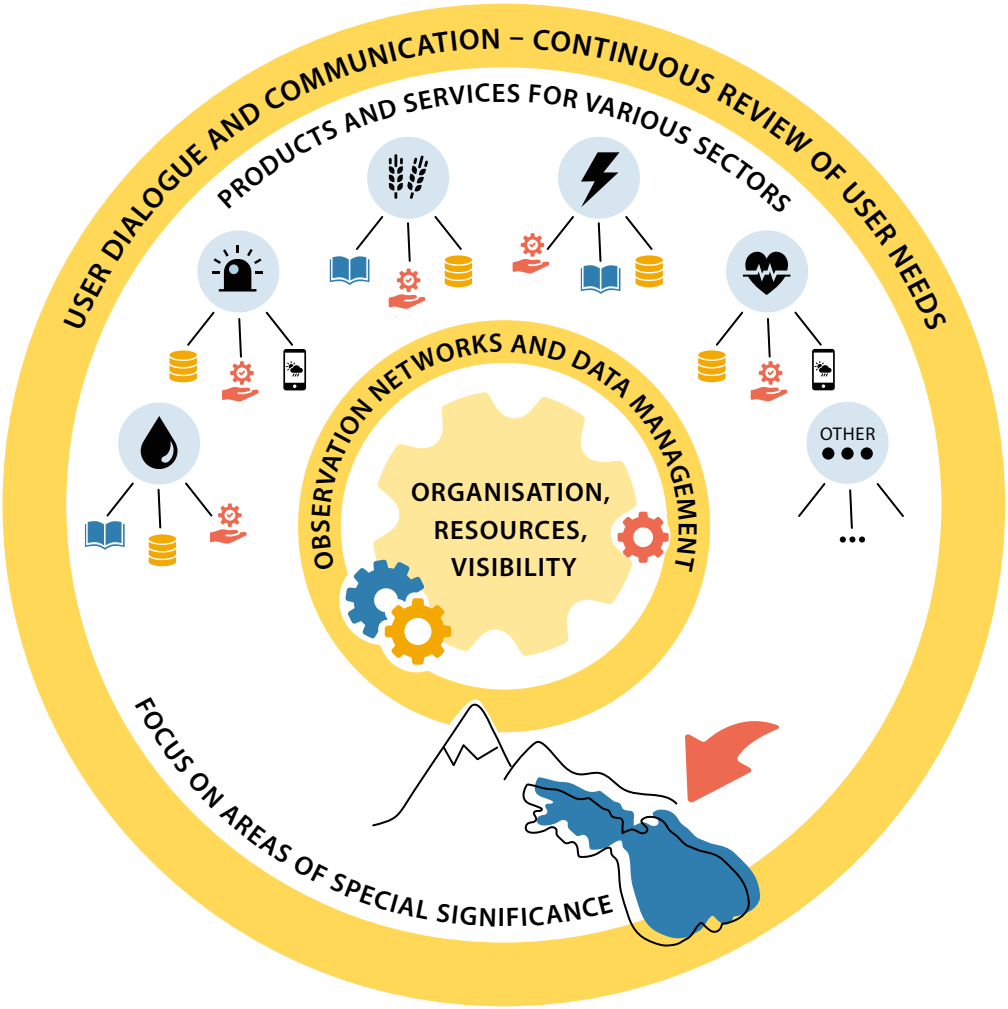
	Water	DRR	Agro	Energy	Health*	Other
RESEARCH, MODELLING, FORECASTING						
Lack of capacities for, and accuracy of:						
Flow modelling and forecasting	•					
Flood risk forecasting and mapping		•				
Hazard modelling and short-term forecasting		•	•			
Long-term and seasonal forecasting			•			
Full-scale drought monitoring			•			
Winter temperature forecasting				•		
Short-term snow forecasting					•	
Need to study climate impacts on Lake Sevan					•	
USER INTERFACE AND COMMUNICATION						
Users unaware of what data exist	•		•			
Users unaware of how to access and use data	•	•	•			•
Suboptimal data-access modalities	•		•	•		•
Lack of access to:						
Real-time data		•	•		•	
Location-specific data		•	•		•	•
Seasonal climate information		•	•			
Multi-year time series			•			•
Hazard damage history and statistics		•	•			
Lack of user awareness of climate impacts	•		•		•	
Need for modern communication channels		•	•		•	•
Need for improved early warning communication		•	•			
Room for dialogue with users and co-producers			•		•	•

* Including recreation and tourism

CONCEPTUAL ELEMENTS OF THE NATIONAL FRAMEWORK FOR CLIMATE SERVICES

The baseline assessment and the analysis of user perspectives collected through interviews and consultations identify several directions in which climate services in Armenia can be advanced.

Figure 3.1 Conceptual elements of NFCS Armenia



The elements depicted in Figure 3.1 include both cross-cutting actions such as improved dialogue with users, strengthening governance, sustainability and visibility of the NFCS, and actions involving specific sectors or areas:

- strengthening the interface and dialogue with users of climate information and services by bringing them into the NFCS design and implementation, building their capacities and improving communication with them;

- building long-term partnerships with key sectoral recipients of NFCS products and services, identifying the needs, co-designing and co-producing specific products and services together;

- zooming in on areas of special significance for Armenia by focussing climate services on high mountains and Lake Sevan;

- modernising and expanding the observation and data basis for hydrometeorological and climate services;

- shaping and sustaining an effective governance and sustainability model of the National Framework for Climate Services in Armenia.

The action plan in the Annex outlines specific actions for each of the NFCS elements. Fuller descriptions of each area follow.

USER DIALOGUE AND COMMUNICATION

The HMC is genuinely interested in expanding the range, reach and quality of its services, but a relatively small proportion of users of such services has clear ideas of what information they are already receiving, what else can be requested and under what conditions, and how the information and services can serve their interests. Ongoing dialogue with the user community is thus the necessary precondition for the design of a framework that can fully serve users' interests. Interaction through user interface platforms and similar mechanisms is a crucial element of NFCS design, and a dialogue with different types of users needs to be established in a participatory and interactive manner. Ideally, such a dialogue should address different groups (from politicians to mass media to individual users).

Similarly, users from various sectors, regions, backgrounds and levels of capacity – from national authorities to individual farmers – need to be integrated into a regular NFCS dialogue. Once established, it will allow for a regular sampling and monitoring of user feedback and collecting inputs for new climate products and services, and will help build capacities of users themselves in order to cultivate further demand. Most importantly, it will allow for the reverse engineering of climate products, data and information based on a first-hand understanding of what users really need and want.

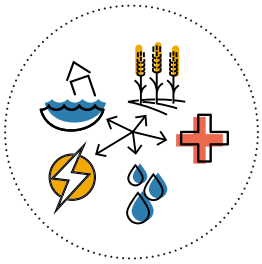
As a practical matter, face-to-face round-table meetings could be held several times a year, each time focusing on a different set of issues common to a particular user group and/or economic sector. Such a rolling agenda will ensure the continuity of user dialogue and help avoid discussions so broad as to render them uninteresting. In addition to sampling user demand and to helping design new, and fine-tune existing, climate information services accordingly,

such meetings can also serve as communication tools to promote NFCS potential and results (→ see Sector-oriented products and services).

Tools for understanding NFCS users and their needs include the active use of market research instruments such as online or offline surveys and focus group studies to collect user feedback. Regular offline surveys can be outsourced to professional marketing agencies or other specialised organisations, or performed on the margins of face-to-face meetings and on other appropriate occasions. Online tools for monitoring user needs and the impact of information should be integrated into the digital user interface at the HMC and other organisations delivering climate information.

In the age of e-governance,[7] users are increasingly accustomed to getting what they are looking for fast and in a straightforward manner. The digital end of the NFCS user platform should be easy to access and use, and should respond to the range of needs – from basic data accessible in a simple form to more comprehensive and detailed information from scientific research. Practical solutions here include continuously investing in developing and modernising the HMC website, and expanding the set of digital communication channels with its users to cover social media, messenger channels and subscription groups. Other modern data access channels (such as SMS or push messages and mobile applications) should also be assessed and activated. An important element in facilitating digital user interface is providing clear and accessible online information about the availability of, and mode of access to, the various data sets, products and services.

Finally, not all potential users understand the need, value and possibilities of getting specific hydrometeorological and climate-related information, and the full demand for information within specific user groups is yet to be created. Raising awareness and building capacities of current and potential users will help shape the future market for climate services, contribute to a sustainable model for providing them (→ see Organisation, resources and visibility), and improve the impact of climate information altogether.



SECTOR-ORIENTED PRODUCTS AND SERVICES

The GFCS focuses on five sectors that are key beneficiaries of climate services worldwide: agriculture and food security, disaster risk reduction, energy, water and health. All these sectors are highly relevant in Armenia, and all of them exhibit a palpable demand for hydrometeorological and climate information. The latter however needs to be customised to support sector-specific needs and decision-making (Box 3.1).

Meeting these demands requires engaging in an ongoing dialogue (← see User dialogue and communication) to identify needs and priorities in each sector, and opportunities for co-design and co-production of innovative products and services.

From the NFCS conceptualisation process, it is already apparent that the range of forecasting services is to be dramatically expanded, and the quality and reliability improved. This will require a dramatic increase in technological and human capacity coupled with a sober analysis of what needs to be done in house compared to what can be based on European, international and other external sources.[8]

7 For information on e-governance and open data with respect to sharing environmental information in Armenia, see PricewaterhouseCoopers. Sharing and Dissemination of Environmental information: draft country maturity report: Armenia. Implementation of the Shared Environmental Information System principles and practices in the Eastern Partnership countries (ENI SEIS II East). European Environment Agency, Copenhagen, July 2019.

Box 3.1 User demand for sector-oriented climate products and services

WATER RESOURCES MANAGEMENT

- improved modelling and forecasting of river flow
- regular provision of data for water balance (precipitation, river flow, lake and reservoir volume, groundwater, evaporation)

DISASTER RISK REDUCTION AND MANAGEMENT

- improved modelling of natural hazards
- improved hazard forecasting with ultra-short lead time
- flood-risk forecasting modelling and mapping for various return periods
- modernisation of early warning communication online channels and through mobile applications

AGRICULTURE AND FOOD SECURITY

- localised short-term, seasonal and long-term forecasts
- full-scale drought monitoring and forecasting
- easy access to real-time data, historical trends, seasonal averages at specific locations, per crop type, per agricultural practice
- assessment of the state of development of agricultural crops
- historical data on damage to crops (for insurance purposes)
- customised climate services for agricultural producers in cooperation with private providers, research organisations, extension and similar services

OTHER SECTORS

- improved winter forecasts for planning gas consumption
- other customised climate data services for energy operators
- analytical support to the revision and climate-proofing of construction norms and regulations[9]
- provision of localised data and short-term forecast to tourism operators
- modelling and forecasting of health impacts from climate- and weather-dependent deceases
- communication products marketing recreational resources and regional climate
- data and analytical support to assessment of future environmental impacts

These ideas are to be further explored and defined through a continued dialogue with the respective sectors.

But improving forecasting capacities alone will not address sectoral needs. The design of sector-oriented services will require specialised thematic expertise from these very sectors; and indeed, organisations and professionals from water management, agriculture, health, emergency situations, tourism, environmental science and elsewhere are able and willing to cooperate with hydrometeorology and climate professionals and add value to their results.

Finally, in several of the surveyed sectors there is still a lack of understanding of the sectoral implications of the unfolding climate change, and often a vague understanding of Armenia's future climate. Here room for action and cooperation is everywhere: from building basic awareness to providing analytical support for the revision of sectoral norms, standards, policies and strategies to adapt them to forthcoming climate realities.

8 See the discussion of in-house vis-à-vis outsourced forecasting solutions in World Bank. Modernizing Weather, Climate and Hydrological Services: A Road Map for Armenia. Washington, DC, September 2018.

9 For instance, the state standard RA CN II-7.01-2011 Construction Climatology.

CLIMATE SERVICES FOR AREAS OF SPECIAL SIGNIFICANCE

The topographic and environmental variations in Armenia create areas of particular importance in terms of their roles, and sensitivity to the availability and quality of hydrometeorological information required for their sustainable management, development and use.

High mountains occupy large part of Armenian territory, yet today they are only served by six weather stations. Even though elevations of 2,500–3,000 metres above the sea level comprise about 13 per cent of Armenia and supply meltwater from accumulated snow to reservoirs in spring, these areas have no observations at all. Agricultural production is gradually forced upwards due to climate change, and especially at elevations above 2,000 metres meteorological stations are increasingly needed to support crop cultivation, e.g., in vineyards and stone-fruit gardens.

In 2019, the WMO High Mountain Summit[10] committed to the goal that people living in mountains shall have open access to and use of fit-for-purpose hydrological, meteorological and climate information services that address their needs to adapt to and manage the threats caused by climate change. The Summit announced an Integrated High-mountain Observation, Prediction and Services Initiative with user-centred goals with international coordination and multidisciplinary approaches. The initiative will consist of a series of collective, intensive campaigns of analysis and forecasting demonstration projects in key mountain ranges and headwaters around the world, including those with transboundary foci, and will make it possible to co-design solutions, build capacity, and support and facilitate investments by actively engaging users, providers and producers of information to address the most pressing issues in mountain regions and downstream. It is highly sensible for Armenia to take active part in this initiative.

Sevan, the largest lake in the southern Caucasus and one of the great freshwater high mountain lakes of Eurasia, is an Armenian natural and cultural treasure. Among its many qualities, Lake Sevan is essential to the Armenian economy and Armenian nature, providing water for the croplands of the Ararat Valley as well as for hydropower, recreation and tourism, and supporting rich biological diversity. The water volume and surface area of Lake Sevan have varied significantly over the past century, and the ecosystem faces pressure from water withdrawals, hydropower and mining in the basin, pollution by municipal wastewater and small industries and extensive agricultural activities (both, crop production and livestock). Climate change is adding stress through increasing air temperature and evaporation and reducing streamflow in the basin.[11] With continuing water pollution, lake eutrophication is likely to intensify, with toxic algae blooms increasing risks for fish and the safety of lake-dependent water supplies.

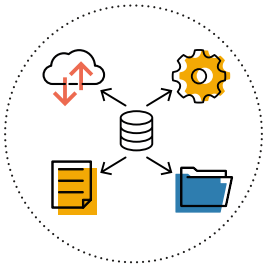
The lake's strategic and socioeconomic importance underscores the need to continue integrated studies and modelling of the lake ecosystem. This work can inform proper lake management under climate change, the revision of management targets and the restoration of the lake's ecological balance. The NFCS should also target improvements in the hydrometeorological information base for such modelling and assessment (for instance, direct management of evaporation, automated monitoring of water quality, assessment of groundwater flows), and ensure straightforward access to the resulting data.[12]

10 https://highmountainsummit.wmo.int

11 See projections of water balance for Lake Sevan in Republic of Armenia, Ministry of Environment. Fourth National Communication on Climate Change under the United Nations Framework Convention on Climate Change. Yerevan, 2020.

12 For instance, through the SEIS-Sevan portal http://seis-sevan.am

For improving climate services for areas of special significance, dialogue, co-design and cooperation with regional and local authorities and communities in these areas will be particularly important.



OBSERVATIONS AND DATA MANAGEMENT

Observations are essential and without a well-functioning ground network, the quality of analysis, modelling and user interface is irrelevant. Armenia must strengthen and modernise the state meteorological and hydrological observation network to respond to modern requirements and the expectations of users. These improvements entail the significant financial challenges[13] of providing new equipment for existing stations and establishing stations in new locations. High-performance modern meteorological radars are needed to enable improved nowcasting.

Increased governmental financing and international support[14] can address some of these challenges, but others will require cooperation to pool the resources of several providers. This may include building and strengthening connections with other state networks, regional and local governments, as well as partnering with private providers and users of data in the domains of agriculture and tourism, for example.

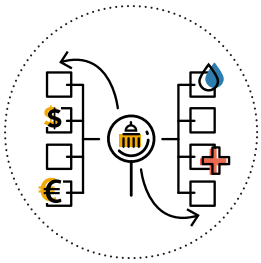
Improved use of data from remote sources (satellite imagery, drone observations) as well as the expanded scope of field expeditions can complement the ground network, the density of which may never be fully sufficient, regardless of the level of investment.

Observation programmes and protocols may need to be revised to respond to the demands for solar radiation, water volume in snow and others, and operators may need to harmonise their different observation protocols to ensure smooth interoperability and data exchange.

And modernised data management needs to move to more professional software, and to follow proper quality-control procedures to ensure the accuracy of both raw and processed data. Ultimately, Armenia needs an integrated data management system as is common practice among hydrometeorological services worldwide.

13 See resource estimates in World Bank Group. Modernizing Weather, Climate and Hydrological Services: A Road Map for Armenia. Washington, DC, September 2018.

14 Throughout 2020, the UNDP Disaster Risk Reduction Programme will modernise 23 automated weather stations in six regions of the country.



ORGANISATION, RESOURCES AND VISIBILITY

In order to optimally serve users along the climate information value chain, a clear structure and governance mechanism of the NFCS will have to ensure that mandates of the various providers of climate services are well aligned and complementary. A place for the framework will need to be found in Armenia's institutional and legal structure, and a mandate and resources established for coordinating functions. A transparent and realistic model of financing will need to sustain the services, realistically based on a mix of state funding, public-private partnerships, user- and case-specific payment for services and international assistance.

A full-fledged discussion of an NFCS governance and sustainability model may be somewhat premature until an ongoing dialogue with users has been established (← see User dialogue and communication), but stakeholders clearly see the HMC as the main body responsible for the coordination and delivery of hydrometeorological and climate-related information. In turn, taking a proactive approach, the HMC is willing to pioneer these efforts in order to better serve Armenian users, sectors and regions. This same dialogue should help shape an NFCS inter-agency – and, ideally – inter-sectoral coordination mechanism, whereby the representatives of producers and users of information can contribute to strategic decisions about NFCS development and can monitor its progress. This approach will also provide the political, financial and intellectual support from the government, Armenian institutions and the international community to ensure the necessary qualitative shifts.

Climate information services, not having been defined in Armenian legislation, are a gap but also an opportunity to secure the necessary political mandate for NFCS activities. The improved legal and normative base should also codify the financial model and help ensure both the sustainability of climate services and the responsibilities for providing them. Along the way, certain HMC capacities need to be established or strengthened on the administrative level, such as those for public and media relations and communication as well as those analytically supporting the development of user- and sector-oriented products. Both the organisational and the financial aspects of NFCS development should be well aligned with the forthcoming HMC concept of operations (CONOPS)[15] for hydrometeorology.

Visibility among decision makers is to play an important role in supporting the legal and political mandates for NFCS work. At all levels, decision makers should be clearly informed about the benefits and the needs of climate-related information services, and about how to address and support them. Continuously explaining the benefits of climate services and maintaining their visibility vis-à-vis those making political, legislative or financial decisions is crucially important for the Framework's sustainability. To the extent possible, decision makers should be directly integrated into user-focused NFCS activities and the governance mechanism (← see User dialogue and communication).

In reality, however, this will offer only limited opportunities to engage with some of them face-to-face and on a regular basis, while reaching others will require targeted, evidence-based information to demonstrate the added value of climate information and its potential for preventing or reducing damage or providing benefits. An understanding of the socioeconomic benefits of NFCS may generate support and

15 See World Bank. Weathering the Change: How to Improve Hydromet Services in Developing Countries? Washington, DC, 2019.

participation among users and donors. Developing this understanding will entail the systematic monitoring of the uses of climate services and the collecting of user feedback to gather sufficient evidence. This approach also offers the opportunity to nurture successful cases.

Mass media are important users of NFCS services themselves, but are also an important channel for engaging politicians and the general public. Regular networking with the media may improve the efficiency of broadcasting not only of climate information, but also of knowledge about the NFCS as a reliable means of producing and accessing it. Reaching out to Armenia's population through social media, and targeted work through blogosphere opinion leaders may be extremely productive in raising NFCS visibility too. The NFCS will need a comprehensive and systematic visibility and communication strategy addressing various target audiences at all levels – from the public to the Government and the international community – through appropriate communication channels.

Drawing the attention of the international community is highly important for the Framework's development and sustainability, and a systematic approach to multilateral and bilateral donors can help ensure their support. Of particular significance are specialised multilateral funds such as the Global Environmental Facility and the Green Climate Fund that have already supported national adaptation action in Armenia.[16] Many of the proposed NFCS actions can find their place in the National Adaptation Plan currently being developed.

16 See UNDP, UNEP, GEF. National Adaptation Plan process in focus: Lessons from Armenia, 2018 and GCF. Adaptation Planning support for Armenia through UNDP, 2018.

ANNEX Action plan for the establishment of NFCS in the Republic of Armenia

	Cost[3]	Time frame, years		Potential funding sources		
		1 – 2	3 – 5	HMC	Other domestic	International
1 USER DIALOGUE AND COMMUNICATION						
1.1 Regular dialogue with users and providers of climate services through meetings, round tables and electronic platforms[1]	$	●		●		
1.2 Systematic collection and analysis of user feedback by the HMC (surveys, focus groups, online)	$	●		●		
1.3 Capacity-building for various user groups to understand and use the available climate and hydrometeorological information[1]	$$	●		●	●	●
1.4 Making available through various channels clear information about available data and conditions for accessing them	$	●		●		
1.5 Improving user-friendly online access to essential data, including localised real-time, summary and long-term data series	$$	●	●	●		●
1.6 Broad and targeted dissemination of information about climate change	$	●	●	●		●
1.7 Modernisation and expansion of HMC communication channels and tools (i.a., social media, mobile applications etc.)	$	●		●		
2 SECTOR-ORIENTED PRODUCTS AND SERVICES						
2.1 Continuous dialogue with key sectors for co-design, planning and co-production of climate services (cf. action 1.1)[1, 2]	$	●		●		
2.2 Improving capacities and delivering climate services for the water resources management sector[1, 2]	$$	●	●		●	●
2.3 Improving capacities and delivering climate services for the disaster and risk reduction sector[1, 2]	$$	●	●		●	●
2.4 Improving capacities and delivering climate services for the agriculture and food security sector[1, 2]	$$	●	●	●	●	●
2.5 Improving capacities and delivering climate services for the health sector[1, 2]	$	●	●		●	●
2.6 Improving capacities and delivering climate services for other sectors[1, 2]	$	●	●	●	●	●
2.7 Assessing potential of satellite-based forecasting, from European, international and other sources, for various sectors[1]	$	●		●		
2.8 Sector-oriented long-term data series and projections of climate change impacts[1]	$	●		●		●

	Cost[3]	Time frame, years		Potential funding sources		
		1 – 2	3 – 5	HMC	Other domestic	International
3 CLIMATE SERVICES FOR AREAS OF SPECIAL SIGNIFICANCE						
3.1 Integrated modernisation and extension of data and services in high mountain areas[1]	$$		●	●	●	●
3.2 Projections of climate change and impacts in high mountain areas	$	●		●		●
3.3 Active participation in WMO High-mountain Observation, Prediction and Services Initiative (case studies, capacity-building)	$	●		●		●
3.4 Strengthening regular monitoring, integrated hydrological and biological studies and data accessibility on Lake Sevan[1]	$$		●	●	●	●
3.5 Modelling the future to inform management options of the Lake Sevan ecosystem under climate change[1]	$		●	●		●
4 OBSERVATIONS AND DATA MANAGEMENT						
4.1 Extensive modernisation (including automation) of HMC observation networks and data management	$$	●	●	●	●	●
4.2 New observation facilities (automated weather and gauging stations, radars) for the HMC and other providers and operators[1]	$$	●	●		●	●
4.3 Data exchange and intercalibration protocols between the HMC and other (state-owned or private) observation networks[1]	$	●		●	●	
4.4 Extension of solar radiation, lightning and snow observations	$$		●		●	●
4.5 Expansion of regular HMC field expeditions	$$		●	●	●	
4.6 Assessment of the potential for using satellite and drone imagery to complement field observations	$	●		●		
4.7 Integration of hydrometeorological observations with unified environmental monitoring and co-production of services[1]	$		●	●	●	
4.8 Modernisation of HMC data management and archiving, establishment of an integrated data management system	$$	●	●	●	●	●
4.9 Strengthening of data quality control and the introduction of a modern quality management system	$	●		●		●

	Cost[3]	Time frame, years		Potential funding sources		
		1 – 2	3 – 5	HMC	Other domestic	International
5 ORGANISATION, RESOURCES AND VISIBILITY						
5.1 Budget needs assessment and a financial sustainability model for NFCS actions[2]	$	●		●		●
5.2 Assessment and improvement of the legal base for hydrometeorological and climate services[1]	$	●	●	●	●	●
5.3 Assessment of modalities and implementation of public-private partnerships in the field of climate services[1]	$	●	●	●	●	●
5.4 Institutional strengthening of the HMC (analytical capacities for climate services, public and media relations, communication)	$$	●		●	●	
5.5 Strengthening of higher and continuing education in NFCS-relevant domains	$	●	●		●	●
5.6 Consistent NFCS funding package for the international donor community (UN including GEF and GCF, EU, bilateral assistance[1]	$$	●	●	●	●	●
5.7 Integration of NFCS actions into the design and implementation of the National Adaptation Plan[1]	$	●		●		●
5.8 Developing and implementing a comprehensive NFCS visibility and communication strategy at all levels	$	●		●		●

Notes

1 Co-production or coordination with other sectors or service providers.

2 A number of initial ideas of climate products and services for the various sectors, identified through NFCS user interviews and consultations, are summarised in box 3.1. These are to be further explored and defined through a continued dialogue with the respective sectors.

3 $ – low budget requirements, $$ – moderate to significant budget requirements.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