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ZAMG
Zentralanstalt für Meteorologie und Geodynamik

DELIVERABLE

Action plan with short-, medium- and long-term goals and investments

Support development of a service delivery strategy
and investment plan for the
Albania Institute of Geosciences, Energy, Water and Environment
under the Technical Assistance on Reducing Risk
and Building Resilience (P149745)

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1 Background

To help reduce Albania's vulnerability to natural hazards and limit the human and economic impacts of disasters, the Albania Disaster Risk Mitigation and Adaptation Project (AL-DRMAP, 2008-2013) included a component that supported the Institute of Geosciences, Energy, Water and Environment (IGEWE) to improve its severe weather observation and forecasting services. The project primarily financed the modernization of 40 automated hydro-meteorological monitoring stations across the country. It also supported improvement of the IGEWE website to improve information accessibility, as well as digitized historical climate data. AL-DRMAP was designed as the first phase of a World Bank Adaptable Program Lending (APL) instrument.

The World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR) is providing the technical assistance grant "Reducing Risk and Building Resilience" to build on the accomplishments of AL-DRMAP and prepare the involved institutions for potential future investment opportunities. For IGEWE, technical assistance is being provided to review the current status of hydro-meteorological services, including all hydro-met monitoring stations and networks, data transmission, performance of hydro-meteorological forecasting, and plans and arrangements for their operation and maintenance. This includes assessing whether the hydro-met services are consistent with WMO standards. Furthermore, the component intends to build the capacity of IGEWE through assessing its institutional structure, staff capacity, budget allocation and cost recovery measures, business process, etc., and through providing training and recommendations for improvements.

Recognizing the need to focus on service-delivery, IGEWE has embarked on the development of a long-term service delivery strategy. It intends to align itself with global and European good practice, and to develop an investment plan that supports this transition.

2 Project Objective

The objective of this project is to support IGEWE in its development of a service delivery strategy. This strategy includes capacity development and investment plans to achieve a modern service-focused national meteorological and hydrological service (NMHS).

IGEWE appears to be caught in a cycle common to many NMHSs in developing countries: poor quality of service delivery leads to a lack of recognition by the government and the public, resulting in insufficient investment and thus an inability to improve service delivery. Despite the completed procurement of modern equipment and technology under AL-DRMAP, IGEWE currently does not have a strategic plan for their activity, future development, accompanying technical design, and specifications for a modern weather, climate and hydrological forecasting delivery system.

At the same time, hydro-meteorological services in Albania are shared between IGEWE, the Military Meteorological Service (MMS) and Albcontrol (formerly known as National Air Traffic Agency, NAT) Met Service. While IGEWE is the recognized national lead, represents Albania in the WMO and has Memorandums of Understanding with these other agencies, a more integrated approach between the agencies is needed for overall improved national service delivery.

The development of this strategy and the investment plan will provide IGEWE with a clear vision and shall catalyze support to escape this cycle and to transform into a modern and service-focused institution.

3 Approach and Methodology

The applied methodology follows the recommendations and guidance of the WMO Strategy for Service Delivery and its implementation plan (WMO, 2014). The implementation plan provides a flexible methodology for the evaluation of the current service delivery practices, which serves as guidance for developing more detailed methods and tools that will enable IGEWE to improve the service delivery process. The approach consists of three steps:

(i) an assessment of the current level of the IGEWE service delivery (sub task 1);

(ii) development of the action plan to improve service delivery (sub task 2); and

(iii) an assessment of the resources required to implement the strategic action plan (sub task 2)

The Service Delivery Progress model (SDPM), defined in Appendix 1 of the WMO Strategy for Service Delivery and its Implementation Plan (WMO, 2014) served as a tool for the assessment. The results are summarized in the *Report on the IGEWE's current level in the SDPM (Deliverable 1)*. The deliverable describes the current development level of IGEWE, Albcontrol MET and MMS for each element of the SDPM with specific evidence provided wherever possible.

To get a better insight, prerequisites, capacities and operational procedures were identified. The current status of the observational network, data transfer, handling of observation data including storage and exchange as well as the processes of issuing weather forecasts, warnings, flood forecasts and risks assessment had to be investigated. All current practices were systematically reviewed against the definitions provided in the SDPM. The answers to the questions of each of the six strategic elements justify the current status of the service delivery processes in the SDPM in an objective way. The assessment was carried out in close cooperation with IGEWE, Albcontrol MET and MMS.

The results of the assessment form the baseline for the development of the service delivery strategy in order to achieve a modern service-focused national meteorological and hydrological service.

The user of weather-, climate-, water- and environment-related information is central to an effective service delivery. Users take many forms – from the general public to government ministries, the military or private industries. The role of the services is to identify these users, including intermediaries, to understand their needs and to determine how these needs can be met, either individually or in partnership with other providers and partners.

The user needs and requirements were collected during a user workshop at IGEWE, meetings and discussions with users and customers (e.g. civil protection, KESH Hydropower Company) and separate meetings with Albcontrol Met and MMS.

Gaining knowledge of users is of marginal use if such knowledge is not integrated into the design, development and delivery of services. Linking service development and delivery to user needs necessitates an operating model that delivers forecasts and information at the time and in the manner specified by the user, and furthermore provides the necessary user support. Users will have different requirements, so the key is to develop an operating model that is flexible and adaptable to wide-ranging and evolving user demands. This includes the development and adaptation of the workforce, systems, and technical as well as physical infrastructures of IGEWE, Albcontrol MET and MMS. NMHSs with service-oriented cultures produce products and services with the user in the

centre of the development process. This means that NMHSs need processes and tools for translating requirements into tangible products and services. Moreover means for verifying the fulfilment of user needs and expectations are required.

The identification of the gaps between the current level of service delivery on the one side and the user needs and requirements on the other is necessary to link the development of products and services and their delivery to the user needs. The fundamentals of the services of IGEWE, current practices, services and products as well as the current state in the SDPM for each strategy element had to be reviewed against the user needs in order to define the gaps based on the user needs and requirements.

The user needs and requirements and the results of the gap analysis are summarized in the report on the *Identification of gaps between the current service delivery level of IGEWE and the user needs and requirements* (technical note).

Building on this the action plan for improved service delivery will be developed. Actions to improve the level of service delivery are deduced for each of the six elements of the SDPM based on the gap analysis. These actions shall enable IGEWE to advance through the levels of the SDPM.

Despite the investments in modern observational systems and technology under AL-DRMAP, this assessment revealed an urgent necessity to improve the basic tasks and operational processes at IGEWE. Skilled staff and adequate financial resources (core funding) shall be provided by the government.

The present deliverable deals with the development of the action plan for improved service delivery. Section 4 contains the development of the action plan and detailed description of the action items; section 5 lines out the assessment of the resources required for the successful implementation of the strategic action plan. Finally a summary and recommendations are given in section 6 of the deliverable.

4 Action plan to improve service delivery

Making the necessary changes to improve service delivery within NMHSs requires a structured approach, outlined in a clearly articulated action plan that includes milestones, deliverables and the identification of the appropriate level of resources.

These changes are separated into specific actions, projects or programs, which make it easier to fully analyze, understand and manage the impact that each change will have on the efficiency of internal processes as well as on costumers and users. Each change can then be linked to achieving the desired outcome.

As more significant changes are made, staff with specialist skills in project or program management may be required to take over the task of implementing the change. Some of these changes may be implemented quickly with only limited effort. Examples include the harmonization of the products, the strengthening of the coordination between IGEWE, Albcontrol MET and MMS, or the enhanced interaction with users based on feedback from user surveys or user workshops.

Other changes may require a series of actions over medium or long timescales, so it is important that they are documented and tracked through to completion. Milestones for the implementation of the strategy can be set for the short term (2 years), medium term (6 years) and long term (10 years).

The key deliverables resulting from the implementation of the strategy over the short term will include: an assessment of the current level of service delivery (see *Report on the IGEWE's current level in the SDPM*); putting in place the necessary action plan to start improving the service delivery level, which should include strengthening user interaction through, for example, surveys, focus groups or workshops for each user group; and an assessment of the resources required to implement the action plan (current deliverable).

Over the medium term, the implementation plan aims at gaining at least one level in the service delivery matrix, accompanied by the documentation of the process. Over the long term, the aim of the strategy is to develop or strengthen a service culture. In the function of a service provider a routine in service delivery shall be established for all programs and activities. This will result in a tangibly better perception of the services by users and customers.

4.1 Overview of the action plan

The identification of the gaps between the current level of service delivery on the one hand and the user needs and requirements on the other one serves as the basis for the development of the action plan. The plan comprises actions required for the improvement of service delivery and moreover essential actions for the enhancement of the capabilities of the Met services. There is an urgent need to improve the basic tasks and procedures at IGEWE like the continuous and reliable operation of the hydro- meteorological station network. Concurrently the government shall provide skilled staff and adequate financial resources for the core funding of IGEWE. Otherwise it is impossible to fulfill the requirements of the users and costumers.

Despite the completed procurement of modern equipment and technology under AL-DRMAP, IGEWE is currently not able to operate a modern weather, climate and hydrological forecasting delivery system. The implementation of the actions is therefore crucial for the state of the art provision of data and climate services, hydro-meteorological warnings and forecasts to key users like the civil protection and the general public.

The hydro-meteorological services in Albania are shared between IGEWE, Albcontrol Met and MMS. Comparing the Met services of Albania the forecasting staff holds different skill levels and the organizational capacities are considerably different between the institutions. For the optimum use of the available resources it is recommended to share the workload between the services and thus avoid parallel activities. Each institution shall focus on their strengths and key competencies more systematically. A more integrated approach through reinforced coordination and collaboration between the agencies should lead to an overall improved national service delivery.

Table 1 gives an overview on the actions plan for the improvement of the service delivery. Main actions are separated in sub actions. Actions and sub actions shall be implemented on the short term (2 years), medium term (2-6 years) and the long term (6-10 years).

Actions		Time frame
Number	Title	
A 1	**Coordination between IGEWE, MMS and Albcontrol MET**	
A 1.1	Responsibilities and resources	short
A 1.2	Product harmonization	short
A 1.3	Data exchange	short
A 1.4	Regular update of the MoU, product list and agreement on data exchange	medium/long
A 2	**Optimization of the meteorological and hydrological network**	
A 2.1	Assessment of available resources for network maintenance	short
A 2.2	Prerequisites for data storage	short
A 2.3	Prerequisites for quality control	short
A 2.4	Preconditions of station sites	short
A 2.5	Network design	short
A 2.6	Review of station locations	medium
A 2.7	Installation and procurement	medium/long
A 2.8	Infrastructure and protection measures	medium/long
A 2.9	Interfaces for applications	long
A 3	**Operational service**	
A 3.1	Maintenance	All
A 3.2	Calibration of rating curves	medium/long
A 3.3	Data quality control	medium/long
A 3.4	Data services	medium/long
A 4	**Network extension**	
A 4.1	Weather radar	medium/long
A 4.2	Lightning detection	medium/long
A 4.3	Special instrumentation for Rinas International Airport	All
A 5	**Forecasting tools**	
A 5.1	Exploitation of DEWETRA platform	short/medium
A 5.2	Numerical modeling	medium/long
A 5.3	Nowcasting	medium/long
A 5.4	Implementation of a meteorological visualization platform	long
A 5.5	Enhanced flood forecasting system for the major rivers	medium/long

A 6	**User engagement**	
A 6.1	User surveys	All
A 6.2	User workshops	All
A 6.3	Disposition of a service point	medium
A 6.4	Documentation of user needs and requirements	medium
A 6.5	Customer relationship management	long
A 7	**User-oriented service development**	
A 7.1	Work instructions documents	All
A 7.2	Service-level agreements with users	All
A 7.3	User survey on communication of product/service changes	short
A 7.4	Communication of product/service changes	medium
A 7.5	Development of a formal user information system	long
A 8	**Monitoring of service performance**	
A 8.1	Basic training on verification methods	short
A 8.2	Qualitative evaluation of products	short
A 8.3	Encouragement of user feedback	short
A 8.4	Establishment of a framework for quantitative verification	medium
A 8.5	Advanced training on verification methods	medium
A 8.6	Quantitative verification	medium/long
A 8.7	Quarterly verification reports	medium/long
A 8.8	Towards impact-based verification	long
A 9	**Quality management**	
A 9.1	Documentation of service delivery process	short
A 9.2	Design of a quality management system (QMS)	medium
A 9.3	Implementation of the QMS	long
A 10	**Training and networking**	
A 10.1	Visits to other National Hydro-meteorological Services (NHMS)	All
A 10.2	Participation in training courses	All
A 10.3	EUMETNET membership	short
A 10.4	ECMWF membership	medium
A 11	**Strategy and capacity building**	
A 11.1	Strategy for the development of the National Hazard Center	short
A 11.2	Funding acquisition	All
A 11.3	Update of the IGEWE Web Site	short/medium
A 11.4	Structured development of commercial products	medium/long
A 11.5	Individual training plans	medium/long
A 11.6	Job descriptions	short
A 11.7	Appraisal interviews and regular team meetings	All
A 11.8	Implementation of formal process for suggestions for improvement	medium

Table 1: Action plan for the improvement of service delivery of Albanian Met Services.

4.2 Detailed description of action items

The improvement of the service delivery within the Met services requires a structured approach, outlined in a clearly articulated action plan that includes detailed actions items, milestones and deliverables. The section contains the detailed description of the action items. The appropriate levels of resources are identified in section 5.

A 1 Coordination between Met Services

A 1.1 Responsibilities and resources (short term)

The duties of a hydro-meteorological service shall be conjointly shared between IGEWE, the Military Meteorological Service (MMS) and Albcontrol MET under consideration of each institute's strengths and fields of expertise. The agreement shall result in the formulation of a Memorandum of Understanding (MoU) between each of the services, or in an update of an existing MoU if it is already in place. Joint efforts are recommended to encourage political decision makers to allocate appropriate resources which guarantee a best possible realization of the duties.

Deliverable: Formulation or update of MoUs.

Milestone: Signing of the MoU by IGEWE, MMS and Albcontrol.

A 1.2 Product harmonization (short term)

A harmonization of products and services offered by each of the weather services helps to avoid duplications. For example, there is no need to issue three different weather outlooks with a similar forecast horizon of four to seven days. Instead, concentrating each institute's individual efforts on its respective, jointly agreed duties and goals will result in a higher efficiency, less confusion and a better reception by the customers. This harmonization process shall result in the formulation of a document which contains a list of products issued by each institute.

Deliverable: Product list

Milestone: Agreement on Product list signed by IGEWE, MMS and Albcontrol

A 1.3 Data exchange (short term)

Accompanying (A 1.2), a coordination of acquired data shall avoid a duplication or multiplication of individual measuring sites within the nation-wide station network. An exchange of real-time observational data is crucial for an optimization of forecasting and in particular warning activities. If the responsibilities for the deployment and maintenance of the station network and other instruments are unequally distributed among the weather services, this must be reflected in the distribution of the appropriate funding, probably agreed upon on the level of the responsible Ministries. Ideally, the weather services can eventually agree on a display of all observational data on a jointly operated homepage.

Milestone: Agreement on data exchange signed by IGEWE, MMS and Albcontrol.

A 1.4 Regular update of the MoU, product list and agreement on data exchange (medium and long term)

The MoU between the weather services, including the agreement on data exchange, shall be updated in regular intervals, preferably on an annual basis. The product list shall be updated whenever changes arise.

Deliverable: Formalized process for the updates of the MoU and product lists

Milestone: Annual updates of the MoU, frequent updates of the product list

A 2 Optimization of the meteorological and hydrological network

A 2.1 Assessment of available resources for network maintenance (short term)

An internal self-evaluation of IGEWE shall shed light on the number of meteorological and hydrological stations which can realistically be operated and maintained with the available staff and financial resources. The outcome of such an analysis may be that either the existing station network needs to be reduced or that additional resources need to be allocated in order to safeguard its functionality. An estimation of the expected time expenditure and costs per station, based on previous experiences, may provide a basis for a more precise assessment. Assuming different feasible funding scenarios, additional resources can be allocated and it is possible to estimate the number of stations that can successfully be operated.

Deliverable: Document on personal and financial resources necessary for the operation of the station network based on different feasible funding scenarios.

Milestone: Completion of the Assessment

A 2.2 Prerequisites for data storage (short term)

The necessary steps to store the acquired data shall be outlined and conducted. These include (but are not limited to) the availability of a fail-safe data server, an estimation of the memory requirements, and the specification of an interface which makes retrievals fast and easy.

It is strongly recommended to use MCH, the Meteorological, Climatological and Hydrological Database Management System (DBMS), an open source solution for small NMHSs that do not have any DBMS or other solutions to digitize, store and process large amount of data. MCH is provided by WMO and has been made available to IGEWE within the framework of the IPA 2012 project “Building resilience to disasters in Western Balkans and Turkey”, funded by the European Commission (IPA project task: 3.1.2). MCH DBMS builds on the same databases (MySQL) currently used in the Institute. It therefore provides an easy solution to gather all data under a unique platform and to automatically synchronize the databases.

A staff member shall be identified who carries the prime responsibility for any issues related to data storage, and shall be given adequate resources for it.

Deliverable: Comprehensive documentation for administrators and users of MCH DBMS.

Milestone: Full installation and operational application of MCH DBMS at IGEWE.

A 2.3 Prerequisites for quality control (short term)

The necessary steps to perform a real-time quality control of incoming data shall be outlined and conducted. These include (but are not limited to) the specification of a data format which facilitates a fast real-time processing and a draft of algorithms to eliminate obviously erroneous data and to flag suspicious data.

A staff member shall be identified who carries the prime responsibility for any issues related to quality control, and shall be given adequate resources for it.

Deliverable: Implementation plan for a quality control system for real-time and climatological applications.

Milestone: Completion of the implementation plan of the quality control system for real-time and climatological applications.

A 2.4 Preconditions of station sites (short term)

Automatic stations with real-time data transmission pose new challenges and need new prerequisites compared to manual stations. Most notably, a sufficient telecommunication network for the data transfer and sufficient power supply for a continuous operation are absolutely necessary. Further factors to be considered are representativeness of a station for its surroundings, the fulfilment of standards according to WMO criteria, the availability of the necessary infrastructure for data transmission, accessibility for repair and maintenance work, and the possibility to take protection measures against damages due to vandalism or hydro-meteorological hazards. Making use of the expertise of the staff members and the respective WMO recommendations, detailed check lists of prerequisites for possible sites of meteorological and hydrological stations, respectively, shall be developed. The documents will then set the basis for the following design of the station network.

Deliverable: Check list of requirements for sites of meteorological and hydrological stations.

Milestone: Completion and use of the check lists.

A 2.5 Network design (short term)

Based on the self-evaluation from (A 2.1), the future design of the network of meteorological and hydrological stations shall be outlined. The ultimate goal is an automatization of manual stations in order to make their data available not only for climatological purposes but also in real-time for forecasting and warning duties. The time horizon for such a venture critically depends on the available resources and shall be realistically projected, based on the self-evaluation from (A 2.1) and under various feasible funding scenarios.

Whenever a formerly manual station is automatized, a period of parallel manual and automatic measurements with a length of at least one year must be maintained to enable a homogenization of the time series. If stations need to be relocated or abandoned because they are difficult to operate, the resources for maintenance are insufficient, or for any other reasons, top priority shall be given to a maintenance of stations with a long historic record (>30 years).

In case of completed automatization of a station (i.e., after at least one year of parallel measurements), its former observer shall be encouraged to act as a caretaker. His/her tasks would include the execution of basic maintenance work (e.g., cleaning of sensors), the signaling of dysfunctions, and acting as a contact person for the IGEWE technicians in exchange for an adequate remuneration.

Deliverable: Document on network design and roadmap towards an automated network.

Milestone: Completion of the network design and roadmap.

A 2.6 Review of individual station locations (medium term)

An examination of the current sites of all meteorological and hydrological stations according to the check lists from (A 2.4) shall ensure an optimization of their long-term functionality. Eventually, the land owner needs to support the installation, ideally by acting as a caretaker afterwards – see (A 2.5). Stations with rather short historic records (<30 years) may be relocated if one or several of these factors strongly favor this step. If finding an alternative location is not possible, a station must ultimately be abandoned, especially if its maintenance and repair cannot be conducted under acceptable efforts and costs.

Priority is that stations with long historic records (>30 years) shall be kept at their same site unless very grave reasons make relocation necessary. In any case of relocation, parallel measurements must be ensured for at least one year to allow a successful homogenization – see (A 2.5) again.

Deliverable: Catalogue with each station's name, identification number, position (geographical coordinates), height above sea level, and a map of its surroundings. It shall be amended by pictures from various directions upon its installation and continuously logged with its failure and maintenance history and any other relevant meta-information (inventory of sensors) afterwards.
Milestone: Completion of the review of individual station locations

A 2.7 Installation and procurement (medium and long term)

Based on the previous action items, in particular (A 2.4) to (A 2.6), procurement, installation of new stations or relocation of existing ones to their new sites shall be accomplished as soon as the personnel and financial resources allow it, but within ten years the latest. It is recommended that the station network shall be reduced in case the available resources would not allow fully deploying it within this time frame, as a proper maintenance afterwards would also be very unlikely in that case.

A core team of technicians shall be identified, either by further training of staff members who already have some appropriate experience or by employment of new staff with a strong background, and shall be given the primary responsibility to pursue the installation process. They shall be given support of other staff members as well as external experts (e.g., from the manufacturer) if necessary.

Deliverable: Annual report on the installation and relocation of hydro-meteorological stations.
Milestone: Relocation and installation of hydro-meteorological station completed.

A 2.8 Infrastructure and protection measures (medium and long term)

Natural hazards like floods or man-made problems like vandalism and theft resulted in damage of meteorological and hydrological stations in the past. A certain exposure to natural hazards is in the nature of things for hydrological stations, hence the potential for protective measures is limited here and certain losses in case of flooding events must be anticipated. For meteorological stations, these risks may be largely reduced by a considerate choice of station sites in (A 2.4), e.g. a location at safe distances from riverbeds, trees or any kind of loose items. The installation of a lightning rod minimizes the risk of direct lightning strikes. Fencing of station sites impedes vandalism and theft. Hydrological stations, or at least their mobile equipment, may also be placed into a basic lockable shelter. Such protective measures shall be accomplished for all stations as soon as the available manpower and funding allow.

Deliverable: Amendment to the annual report on the installation and relocation of hydro-meteorological stations (A 2.7).
Milestone: Protection measures for the station network completed

A 2.9 Interfaces for applications (long term)

Observations of the hydro-meteorological stations are stored in the MCH DBMS (A2.2). The provision of documented state of the art interfaces (web based) to the stored data is essential for the use of the data in different applications.

A staff member shall be identified who carries the prime responsibility for any issues related to the data interfaces, and shall be given adequate resources for it.

Deliverable: Comprehensive documentation for users of the interfaces for applications.
Milestone: Completion of the applications interfaces.

A 3 Operational service

A 3.1 Maintenance (short, medium and long term)

Usually, either the staff member responsible for quality control or the forecaster on duty will be the first person to notice missing or erroneous data. They shall immediately contact the station's caretaker in such a case, who may solve easy problems (e.g., cleaning a dirty sensor or a clogged rain-gauge) on his/her own. Otherwise the caretaker has a look at it as soon as possible and reports back to specify the problem at hand. For bigger problems requiring repair work, the responsible IGEWE team will have to head to the station. If the repair is beyond their possibilities, they in turn need to inform the manufacturer.

In case of the failure of a single station, the whole chain from the appearance of a problem to its repair – or its reporting to the manufacturer – shall be accomplished within two days, and the core team of technicians at IGEWE will suffice to perform these steps. In case of multiple failures, which may happen in particular during a large-scale flooding event, emergency plans must be created which regulate how the other staff of IGEWE can support the core team next to their regular work. It is emphasized that the maintenance of automatic stations is an operational service, and hence at least service schedules for stand-by duty must be created in advance in order to cater for such emergency scenarios or to take into account holidays or other absence times of individual staff members.

Deliverable: Formalized and documented procedures for station maintenance

Milestone: Sustainable and reliable maintenance of the station network realized.

A 3.2 Calibration of rating curves (medium and long term)

The calibration of rating curves starts as soon as the hydrological stations are deployed and may be an ongoing and never-ending work, as the occurrence of various water levels cannot be planned in advance. An adequate amount of buffer time shall be given to IGEWE staff to seize each opportunity for field work on the calibration.

Milestone: Completion of the calibration of the rating curves.

A 3.3 Data quality control (medium and long term)

The quality control process of incoming data shall ensure that obviously erroneous data are immediately removed and suspicious data are immediately flagged for a closer manual inspection, to be conducted as soon as possible. Basic algorithms, projected in (A 2.3), may compare incoming data of a given parameter to its climatological range of values, to its respective values at neighboring stations, and to its respective values at previous time steps in order to identify erroneous or suspicious values. Experience shows that new sources of errors may appear over time, and that the algorithms may need to be continuously adapted and refined based on new experiences. New data sources in the future will also require new control algorithms. Similar to maintenance, data quality control must also be seen as an operational service, albeit a little less time-critical.

Deliverable: Formalized process for data quality control

Milestone: Operational data quality control implemented.

A 3.4 Data services (medium and long term)

Access to present and past weather as well as climate information extracted from the data archives of IGEWE to internal users, to external specific users, customers and the general public shall be provided. Climate services in general are defined as the dissemination of climate information to the public or a specific user. Much of the information can be made freely

available for immediate download from the Website. Charges may apply for specialized climate services such as certified extracts, confirmations of or expertise on extreme weather events, for data subscriptions and custom analyses, or for sector-specific services like for the health and the energy sector.

Custom data services and bundled data products include weather station data and gridded data sets. These services additionally comprise a number of real-time forecast and observation products that can be used as input for other applications or for publication on commercial and private web sites.

Deliverable: Catalogue of IGEWE data products and services.

Milestone: Implementation of data services and climate services at IGEWE

A 4 Network extensions

A 4.1 Weather radar (medium and long term)

The successful operation of nowcasting systems (A 5.3) strongly relies on the availability and reliability of real time input data (stations, radar and lightning sensors). Weather radars provide spatial information about the location and intensity of precipitation systems at very high temporal resolution. A variety of instruments for this purpose are available on the market, from low cost systems to high end radars (X-Band or C-Band). The use of modern dual pol capabilities is recommended. A weather radar (X-Band) was installed in 2015 close to Durres. Radar images are available at IGEWE, but the maintenance of the system is currently insufficient. A failure of the Durres radar on November 2 was not repaired until mid-December 2015.

For the coverage of large parts of the Albanian territory, including the catchments of the major rivers, at least two additional weather radars are required. An indispensable prerequisite for the installation of additional radars is the assurance of the maintenance and the access to spare parts. An availability of appropriate sites accessibility and infrastructure (electric power) is essential. Storage of the radar data at IGEWE or external providers is recommended. Weather radars are cost-intensive in their acquisition and maintenance. Therefore a long planning time and a considerable amount of external funding will be necessary.

A participation in the EUMETNET program OPERA is recommended – see also (A 10.3) for a membership in EUMETNET. The objectives of OPERA are (i) the provision of a European platform wherein expertise on operationally-oriented weather radar issues is exchanged, and (ii) the development, generation and distribution of high-quality pan-European weather radar composite products on an operational basis. The operational radar data exchange with the neighboring countries shall be established, the Opera data center (Odyssey) could provide a platform for the data exchange. On national level a close cooperation with Albcontrol is proposed for the extension of the radar network.

Deliverable: Documentation of radar site identification and selection.

Deliverable: Tender for the procurement of additional weather radars.

Milestone: Completion of the network extension.

Milestone: Participation in EUMETNET OPERA program.

A 4.2 Lightning detection (long term)

A lightning detection sensor was recently installed at the IGEWE building. The installation of two additional sensors in the north and the south of the territory is recommended, if appropriate sites and resources are available, in order to achieve coverage of entire Albania. Real time data transmission is obligatory, the storage of the lightning data at IGEWE or external providers is recommended.

Deliverable: Site identification and selection.

Deliverable: Selection and installation of additional sensors.

Milestone: Completion of the installation of additional lightning sensors.

A 4.3 Special instrumentation for Rinas International Airport (short and medium term)

Starting and landing aircraft are particularly exposed to certain weather hazards. While the presence of fog, icing or snow can be assessed by the observer or forecaster on site, it is often difficult to estimate the vertical wind shear at low levels above the ground, a large amount of which may result in dangerous turbulence. In the more distant future, installation of a LIDAR or SODAR unit is advisable. However, these instruments are cost-intensive in their acquisition and maintenance; hence a long planning time and a considerable amount of external funding will be necessary.

As a bridging operation, the installation of additional automatic stations on hilltops near the airport is recommended. The comparison of their wind measurements with those at the airport will help to assess the amount of vertical wind shear across the lowest few hundred meters.

Since Albcontrol has a particular interest in the installation and reliable operation of these stations, negotiations between IGEWE and Albcontrol on this issue are encouraged. For example, Albcontrol may agree to partly or fully fund the purchase and maintenance of these stations.

Deliverable: Document on meteorological instrumentation of RINAS airport

Milestone: Installation of automatic stations.

Milestone: Installation of a LIDAR or SODAR unit.

A 5 Forecasting tools

A 5.1 Exploitation of DEWETRA platform (short and medium term)

Actions shall be taken to exploit the possibilities of the DEWETRA platform, which is in use at IGEWE, to overlay station measurements with remote sensing (satellite, radar) data or forecast fields from numerical weather prediction models. A meeting with other weather services using DEWETRA, most notably from Italy, is recommended to get updated about the latest status and to stimulate the process of adopting and exchanging know-how. Albcontrol Met and MMS shall be provided access to the platform, if necessary accompanied by an adjustment of the MoU between the Met services.

Deliverable: Documentation on the advanced use of the DEWETRA system including regular revision after changes to the system.

Milestone: Adoption of DEWETRA system for all operational services.

A 5.2 Numerical modeling (medium and long term)

Developing an own numerical weather prediction (NWP) model is a very laborious and lengthy process, and it is therefore not recommended for a small weather service with limited resources like IGEWE. Instead, a stronger collaboration within the South-East European Consortium for Operational weather Prediction (SEECOP) is encouraged. SEECOP is a collaborative initiative

between the weather services of Bosnia and Herzegovina, Macedonia, Montenegro, Serbia and Albania. Its overarching goals are running a joint NWP model (the Nonhydrostatic Multiscale Model on B-Grid, NMMB, provided by NCEP), fostering its operational use for meteorological and hydrological forecasting and warning, concentrating related research and development activities, and exchanging and deepening the knowledge on NWP modeling.

On the short term, IGEWE will benefit a lot from a regular exchange with weather services which are more experienced in numerical modeling, most notably the hydro-meteorological Institute of Montenegro. On a longer term, it will gain enough expertise to contribute to the joint developments. Operating and developing a fine-meshed NWP model together with neighboring countries will greatly improve the quality and accuracy of forecasts and warnings in Albania.

Next to these activities, a full exploitation of the WMO access to ECMWF products and a regular membership at ECMWF with access to further data including ensemble information are encouraged as soon as possible.

Deliverable: Formalized collaboration with or accession to SEECOP.

Milestone: Operational use of the joint NWP system (NMMB) at the Albanian Met Services.

A 5.3 Nowcasting (medium and long term)

Numerical modeling is the optimum method for weather forecasting with lead times of several hours to days, but NWP models are typically updated only two or four times a day and cannot react to unexpected developments in-between. In particular, the data assimilation for the initial state and the model integration need a few hours of time and NWP information may in individual cases already be outdated right in the moment when it is available.

For forecasts at very short lead times of minutes to a few hours, a purely statistical extrapolation of the actual state – so-called “nowcasting” – is usually superior to NWP output. However, such nowcasting techniques critically rely on a real-time availability of observational data, namely station observations, radar fields and satellite images. These products are of immense help to the forecasters on duty in situations when “human nowcasting” is required, first and foremost in situations of severe weather. In addition, these observational data may also be merged into an integrated automatic nowcasting system, which does not only provide the best overall display of latest observational data but can also be used for automatic forecasts on a gridded basis.

Such automatic grid-point estimates at a high spatial and temporal resolution and a very high update rate are very interesting for various customers to optimize their activities. For example, operators of a wind park strongly benefit from such detailed wind forecasts, energy suppliers from temperature forecasts, and operators of hydropower plants from precipitation forecasts. It is very likely that the development of such automatic nowcasting will attract new customers whose funding will multiply reward the investment. Various national weather services of Europe have substantial expertise in the development of automatic nowcasting tools. It is therefore strongly recommended to seek their advice and sound the possibilities of (external) fundings for collaboration and assistance.

Milestone: Use of adequate nowcasting techniques in daily forecast process at the responsible Met Service.

Milestone: Implementation and operation of a nowcasting system.

A 5.4 Implementation of a meteorological visualization platform (long term)

It is recommended to implement a common hydro-meteorological workplace in the forecast rooms of the Met Services and National Centre for Forecast and Monitoring of Natural Risks at IGEWE which can display real time observations (stations, radar, and satellite), NWP and

nowcasting products. The system should be open for modern web technologies. Met services shall share all available data sources via the system. The system provides the basic information for all products and warnings.

Deliverable: Selection of the visualization platform.

Milestone: Implementation of a common meteorological workplace at the Met services.

A 5.5 Enhanced flood forecasting system for the major rivers (medium and long term)

Flash floods and river flooding are the primary weather-related hazards in Albania, especially in the rainy season in autumn and winter. The need of civil protection agencies for timely warnings of high water levels is obvious. In addition, also operators of hydropower plants have a strong interest in accurate precipitation forecasts for their catchments, as their proper dam operations can not only maximize their profit margin but may also help to reduce the flooding impact further downstream.

These needs have in recent years resulted in the development of hydrological and hydraulic models for the major rivers across Europe, jointly accomplished by meteorologists and hydrologists. Next to knowledge about topography, soil characteristics and land use, such rainfall-runoff models also require very accurate and frequently updated precipitation estimates across a river catchment. It is therefore obvious to couple refined automatic precipitation forecasts, provided by a nowcasting system as proposed in (A 5.3) for the first few hours and by an NWP model as proposed in (A 5.2) afterwards, with a hydrological model in order to obtain the best estimates for expected water levels.

Since KESH operates a number of dams along the Drin River, this catchment is best suited for the development of a prototype flood forecasting model which can act as a showcase for other major rivers. A discussion with KESH is strongly recommended to explore possibilities of such a project, including funding contributions from KESH e.g. for the maintenance of meteorological and hydrological stations in the Drin catchment or the development of the rainfall-runoff model. Besides, addressing other European (hydro)-meteorological services with expertise on hydrological- and hydraulic modelling is encouraged again.

Potentially concerned inhabitants, communities, water suppliers, operators of infrastructure and governmental administration authorities expect to a greater extend reliable and timely information about possible flooding. An enhanced flood forecasting solution will be beneficial to them and also to urban and infrastructure planners, risk managers and disaster response or emergency services personnel during extreme rainfall events.

Deliverable: Description of the enhanced flood forecasting system

Milestone: Prototype of real time flood forecasting model for the Drin catchment.

Milestone: Enhanced flood forecasting modelling of the major Albanian rivers.

A 6 User engagement

A 6.1 User surveys (short, medium and long term)

A questionnaire for users and customers shall be designed to discover their needs, requirements and wishes. Organization of a “kick-off survey” is recommended within the first years. Then such surveys shall be repeated in regular intervals (yearly).

Deliverable: Design of a questionnaire and realization of “kick-off survey” (short term)

Deliverable: further user surveys on a regular basis (medium and long term)

Milestone: Realization of user surveys in regular intervals

A 6.2 User workshops (short, medium and long term)

Users and customers shall be invited to a user workshop at IGEWE after the first survey. The aim of this workshop is to demonstrate which products are available, how they are created, which input data are used, and what these products therefore can or cannot do. This enhances the understanding and improves the interpretation of products among users. User workshops shall be repeated regularly.

Deliverable: Report on "kick-off user workshop" (short term)

Deliverable: Reports on further user workshops on regular basis (medium and long term)

Milestone: Organization of user workshops on a regular basis.

A 6.3 Disposition of a service point (medium term)

A staff member responsible for the handling user requests and product related information shall be defined. The service point acts as a first level support for general requests and forwards remaining issues to specialists.

Milestone: Installation of a service point.

A 6.4 Documentation of user needs and requirements (medium term)

A central document shall be created and maintained which collects user feedback (feedback log). This document shall also be used to help determine any action taken in response to the feedback.

Deliverable: Documentation of the user needs and requirements.

Milestone: Implementation and use of the feedback log.

A 6.5 Customer relationship management (long term)

Customer relationship management (CRM) is an approach to managing the interaction with current and future users and customers. The main components of CRM are building and managing customer relationships through marketing, observing relationships as they mature through distinct phases, managing these relationships at each stage and recognizing that the distribution of value of a relationship to users and customers is not homogenous.

A CRM system comprises all the tools, technologies and procedures to manage, improve, or facilitate sales, support and related interactions with customers and users throughout the NHSM.

Deliverable: Description of the CRM System

Milestone: Adoption of CRM-like approaches in the daily workflow.

Milestone: Implementation of an appropriate CRM system

A 7 User-oriented service development

A 7.1 Work instructions documents (short, medium and long term)

Work instruction documents shall be created and maintained for each product defined in (A 1.2) including steps to create them. Their purpose is to keep involved staff members updated about what is required to ensure a consistent and branded output.

Deliverable: Formulation of work instruction documents

Milestone: Regular updates of work instruction documents

A 7.2 Service-level agreements with users (short, medium and long term)

Service-level agreements (SLAs) shall be created and documented which defines exactly the rights and duties of both parties in the service delivery process, namely the Met Services as a provider of products and services, and their customers and users.

Deliverable: Formulation of SLAs with users.

Milestone: Regular updates of SLAs with users.

A 7.3 User survey on communication of product/service changes (short term)

A survey shall be conducted in order to find out how users of IGEWE products would wish to have changes in their delivery communicated. This includes the means of communication, the necessary lead times, and other issues which may be brought up by the users.

Deliverable: Design of survey forms and distribution among customers and users.

Milestone: Implementation of the survey.

A 7.4 Communication of product/service changes (medium term)

Based on the results from the survey in (A 7.3), the way changes in products and services are communicated shall be adapted to the user needs and wishes. User needs shall be stored in an informal document in order to make them readily available to all staff members and allow smooth adaptations.

Deliverable: Informal documentation of user needs and wishes about the communication of product/service changes.

Milestone: Successful communication of product/service changes.

A 7.5 Development of a formal user information system (long term)

The whole process how changes in product and service delivery are communicated shall be formalized. This means standardization wherever possible while still keeping in mind individual users' special needs and desires. It must be guaranteed that any changes are communicated in advance with a sufficient lead time.

Deliverable: Formal documentation of user needs and wishes about the communication of product/service changes.

Milestone: Successful implementation of the user information system.

A 8 Monitoring of service performance

A 8.1 Basic training on verification methods (short term)

The participation in a basic training on verification methods shall be enabled for at least one staff member, who is given primary responsibility for verification. The most relevant contents of this training shall be condensed into a document which sketches possibilities of verification of the existing products and delineates necessary steps which need to be done to enable and facilitate first verification efforts. They include possible changes or amendments of products which might be necessary to define by mutual agreement with the users in (A 7.4).

Deliverable: Document on possible ways of verification of existing products.

Milestone: Basic training on verification methods successfully completed.

A 8.2 Qualitative evaluation of products (short term)

The quality and accuracy of routinely issued products, for example forecast and warning bulletins, shall be internally evaluated by staff members shortly afterwards. Ideally the person who was responsible for this product will be able to assign a little working time on such an evaluation, though the irregular schedules of shift work, holidays or other absence times may

sometimes prevent this. Insights from this evaluation shall be stored in compact form in a running document in order to distill sources of recurring quality deficits and enable the whole team to benefit from this knowledge.

A discussion process between staff members is strongly encouraged for this purpose. This may result in brief presentations about weather events with a particularly high impact, and how they were reflected in the issued products. Main emphasis shall be put on a collective learning process, avoiding accusations of individual mistakes. For a meteorologist involved in operational meteorology, hardly anything is as teaching as a forecast that went wrong!

Deliverable: Running document on quality and accuracy of products, filled with short notes on a daily basis.

Milestone: Routinely qualitative evaluation of the products and services.

A 8.3 Encouragement of user feedback (short term)

Along with the internal evaluation of (A 8.2), also customers and users shall be encouraged to send feedback on the (perceived) quality and accuracy of products. The efforts for the customers to provide such feedback shall be kept to a minimum, since the easiness of the procedure will correlate with the readiness of the customers to follow such a call. A formalization of this process is therefore not necessary. Even an informal note, e.g. sent via email, may provide precious hints on possible shortcomings which might easily be mitigated. A strong and dedicated interaction with users is recommended in order to keep their motivation high to send further feedback.

Deliverable: Running document on quality issues addressed by customers and users, and reactions taken.

Milestone: Intensified dialogue and interaction with users.

A 8.4 Establishment of a framework for quantitative verification (medium term)

Following the knowledge from (A 8.1), the base for a quantitative verification framework shall be laid. This includes an identification of applicable skill scores and necessary steps to compute them from contents from the issued products.

Deliverable: Plan for a quantitative verification framework.

Milestone: Framework for quantitative verification established.

A 8.5 Advanced training on verification methods (medium term)

At least the staff member who has been assigned primary responsibility for verification shall be given the opportunity to participate in an advanced training course on verification methods. Again, the most relevant contents of this training shall be summarized in a document which is made accessible to all staff members. This document shall also present ways to apply these advanced verification knowledge to IGEWE products.

Deliverable: Document on an application of advanced verification methods to existing products.

Milestone: Advanced training on verification methods successfully completed.

A 8.6 Quantitative verification (medium and long term)

Based on the prerequisites from (A 8.4) and (A 8.5), a quantitative and running verification system of products shall be implemented.

Deliverable: Description of the verification system.

Milestone: Operational implementation of the verification system

A 8.7 Quarterly verification reports (medium and long term)

Verification results shall be processed into quarterly verification reports, to be provided to interested users. These results may initially be mainly composed of qualitative evaluations and shall bit by bit be replaced by the most relevant verification scores as the quantitative verification framework is set up in (A 8.4) and (A 8.6). Special articles in form of case studies on high-impact situations or other instances of particularly interesting weather can be included.

Deliverable: Quarterly verification reports.

Milestone: Implementation of routinely verification reports.

A 8.8 Towards impact-based verification (long term)

The impact of a weather event is composed of its intensity and the vulnerability of the affected area. This means that the impacts of the same weather event may vary considerably, depending on where it occurs. This is obvious in case densely and sparsely populated areas are compared. However, it may also mean that for example wind gusts of the same strength have a higher impact in a usually sheltered valley than on a chronically wind-exposed coast. The strengths of impact-based verification are its more direct relation to consequences on aspects of everyday life, and the possibility to know about impacts even in the absence of limited and arbitrarily placed weather stations. The most challenging aspect is a definition of proper predictors which enable a quantitative, and hence objective, verification. In many cases, predictors will need to be reduced to a binary form, namely the occurrence or non-occurrence of certain impacts which were predicted with a certain probability. Efforts shall be conducted to enable an implementation of such an impact-based verification.

Deliverable: Impact-based verification of selected severe weather events and floods

Milestone: Implementation of impact-based verification methods.

A 9 Quality management

A 9.1 Documentation of service delivery process (short term)

A document that describes the process of service delivery shall be compiled. Each step of the service delivery process is assessed and documented. This document forms part of the future quality management system (QMS) documentation process. This approach stands out as a useful tool to improve the overall effectiveness of products and services and customer/user satisfaction.

Deliverable: Documentation of the service delivery process

Milestone: Completion of the documentation of the service delivery process

A 9.2 Design of a quality management system (QMS) (medium term)

A quality management system (QMS) comprises the organizational structures, procedures, processes and resources whose development and successful implementation is necessary for the management of an organization’s delivery of products and services. The documentation (A 9.1) is used to assess and analyze the service delivery process in order to determine where problems may exist and how to correct them in a more effective manner. The QMS should support the stages and elements of the Strategy and complement the SDPM as a guide to service delivery development. The WMO Guide to the Implementation of a QMS for National Meteorological and Hydrological Services provides advice and information.

Deliverable: Concept of the QMS

Milestone: Completion of the concept of the QMS.

A 9.3 Implementation of the QMS (long term)

The QMS as outlined in (A 9.2) shall be implemented. The ultimate goal of a QMS is to encourage and support the continuous enhancement of products and services, focusing on quality control, quality assurance and quality improvement. Twinning and mentoring have been recognized by WMO as effective methods for assisting members requiring expertise, advice and assistance on how to implement a QMS.

After the implementation if the QMS service delivery processes are continually improved taking into account feedback from staff, customers and users.

Deliverable: Implementation of the QMS

Milestone: Completion of the implementation of the QMS

A 10 Training and networking

A 10.1 Visits to other NHMSs (short, medium and long term)

The community of meteorologists and hydrologists organised in NHMSs holds expertise, knowledge and best practises which is significant for operational services. IGEWE should establish contact with neighbouring and other NHMSs whenever this is possible. This could happen for example through personal contact at conferences, official approach or with the assistance of WMO. Visits to hydro-meteorological services of neighbouring countries shall be planned on a frequent basis to enhance cross-border collaborations and keep updated about recent developments that may be of interest for each country.

An optimum solution would be to organize an informal conference on a yearly basis, to be held in another southeast European country each time. The SEECOP consortium – see (A 5.3) – may be the best framework to organize such a yearly meeting. In addition, visits of individual staff members to other European – in particular western European – weather services may provide valuable insight into procedures or the handling of certain issues where those weather services may have gained special expertise.

Deliverables: Reports of visits to other NHMSs

Milestone: Establishment of the contacts to other NHMSs

A 10.2 Participation in training courses (short, medium and long term)

Training courses, e.g. those provided by ECMWF, EUMETSAT or EUMETCAL, are an ideal opportunity to enhance personal and institutional knowledge. Some of the courses can be undertaken online, others require personal presence. Blended courses are a combination of both; they consist of an online and a classroom phase. The EUMETNET project EUMETCAL organizes blended courses (http://www.eumetcal.org). In addition the US COMET Program (http://www.comet.ucar.edu) for the support of education and training for the environmental sciences provides useful training material.

Essential training courses are agreed in the individual training plans for the staff members. At least two staff members per year shall be given the opportunity to apply for training courses which match their personal work profile best. It is recommended to organize a joint training program for the staff of IGEWE, Albcontrol Met and MMS. Successfully completed courses can be used for the competency assessment of the staff (e.g. forecaster of the services) according to international guidelines (WMO competency assessment).

Deliverable: Survey of relevant training courses for the IGEWE staff.

Deliverable: Schedule for training courses, yearly updated.

Milestone: Establishment of a national training program.

A 10.3 EUMETNET membership (short term)

An application for a membership at EUMETNET shall be submitted at the earliest possible occasion. EUMETNET provides a framework to enable the weather services to work together, share ideas and best practice, and to share the costs of major infrastructure investments. The additional benefit of cooperating through EUMETNET is that it provides a collective 'voice' for its members when communicating with the EU or its various agencies and bodies. EUMETNET runs programs like EMMA/Meteoalarm (European Multi-services Meteorological Awareness) or OPERA (Operational Program for the Exchange of Weather Radar Information). Therefore the participation to EUMETNET programs is recommended.

Milestone: EUMETNET membership and participation to EUMETNET programs

A 10.4 ECMWF membership (medium term)

An application to a membership at ECMWF as full member or co-operating state shall be submitted at the earliest possible occasion. The ECMWF membership guarantees access to global numerical weather prediction for up to about 2 weeks, ensemble forecasts, monthly and seasonal forecasts. The membership to ECMWF is subject to available financial resources. Alternatively the restricted ECWMF access provided by WMO should be fully exploited.

Milestone: ECMWF membership of IGEWE.

A 11 Strategy and capacity building

A 11.1 Strategy for the development of the National Centre for Forecast and Monitoring of Natural Risks (short term)

Joint development and discussion of the strategy of the National Centre for Forecast and Monitoring of Natural Risks together with civil protection, other official sources of information (IGEWE, MMS, Albcontrol Met) and key users (e.g. hydropower companies and infrastructure operators) is important. Initially, the center should deal with hazards from extreme weather, drought, floods, forest fire and earthquakes. During the strategy development process the responsibility for the different awareness types – contribution from different partners – needs to be clarified. The results from (A 1.2) – the product harmonization – shall be brought into discussion. The concentration of each contributor on its respective, jointly agreed duties and goals according to its knowledge and capacities will raise efficiency and improve reception of the warnings by the customers. This harmonization process shall result in the formulation of a document which contains a list of awareness parameters issued by each institution.

The National Hazard Center aims to operate the national multi hazard early warning system in the future. The center shall collect the warnings from the different official sources of information, generates reports and is responsible for communication of warnings and alerts to civil protection and via different channels to the general public. The systems shall use existing European systems like EFFAS, EFFIS and METEOALARM, the implementation shall follow the recommendations of WMO and UN-ISDR.

It is suggested to look for best practice examples in Europe, to establish a close cooperation and coordination with neighboring countries, and to develop partnerships at national level. The membership to EUMETNET METEOALARM (A 10.3) integrates the warnings on a European level.

Deliverable: List of awareness parameters, thresholds and responsible institutions.

Deliverable: Strategy of the national hazard center.

Milestone: Implementation of the national multi hazard early warning system.

A 11.2 Funding acquisition (short, medium and long term)

The annual budget of IGEWE is provided by the Polytechnic University of Tirana. The budget comprises staff salary, operational duties, network maintenance of manual stations, costs for infrastructure and telecommunication, WMO contributions and administration. Currently, no funds are available for the major investments or the maintenance of the automatic station network. Additional budget is required for the further automatization and adaptation of the network (optimization of the station network, radar, lightning detection and instrumentation of the airport) and the implementation of nowcasting systems and flood forecasting models. For the fulfillment of the official duties of an NHMS an increase of the annual budget is required. However, it is critical that the national financing is increased in order to sustain the development of IGEWE achieved by the recent investments and expected improvements due to the implementation of the action plan. International development programs provide possible funding sources for investments. Capacity building initiatives could be part of twinning and consulting projects. Different budget scenarios and implications are discussed in the next section.

Milestone: Long term plan for the development of budget and human resources.

Milestone: Successful acquisition of external funds.

A 11.3 Update of the IGEWE Web site (short and medium term)

The website update aims at strengthening institutional and technical capacities for the development of IGEWE. The activities are designed to modernize the website in order to improve the quality of station data management, the data availability and access for the general public and specific groups of users. Existing data services and climate services would become more user-friendly. Actual weather information including satellite, radar and lightning images shall be included. The operational provision of data services and climate (A 3.4) and the national multi-hazard early warning system (A 11.1) shall be considered for the website development.

Deliverable: Concept for the modernization of the website.

Milestone: Modernization of the IGEWE website.

A 11.4 Structured development of commercial products (medium and long term)

The action comprises the decision about design, production and dissemination of commercial and non-commercial products and services. Prerequisites are the enhancement of the forecasting capacities in general and training of staff regarding development of new products and services as well as sales and marketing (A 10). The identification of users, user needs and use cases is required. Activities start from the actual product catalogue. A thorough market analysis, economic and non-economic viability analysis and an accurate preparation of business plans are the prerequisite for commercial success. Actions are accompanied by appropriate marketing activities.

Deliverable: Business plans for commercial products.

Milestone: IGEWE starts commercial activities

A 11.5 Individual training plans (medium and long term)

A gap analysis based on existing competencies should be carried out in order to identify areas requiring training. Based on the findings of the gap analysis training plans are compiled for each team member of the Met services. The results shall additionally lead to the development of national training modules to ensure that all staff members have the opportunity to learn and develop these skills (A 10). The individual training plans for staff members shall follow the

recommendations for competencies being developed by the WMO Technical Commissions. Various competency frameworks can be found at: https://www.wmo.int/pages/prog/dra/etrp/competencies.php.
The Training plans shall be updated on an annual basis (see A 10.2)
Deliverable: Training plan for each staff member
Milestone: Provision of training courses, establishment of a national training program for staff members of all Met Services.

A 11.6 Job descriptions (short term)

The development of coherent and consistent job description of the staff members is obligatory. Existing job descriptions shall be adopted, updated and completed in regular intervals. New or improved skills may be required for the strategy for improved service delivery. While technical knowledge and capabilities are necessary to develop products and services, other skills such as communication, presentation, consultation with users and customers as well as the analysis of their needs will also be required. These new skills should be clearly defined as required competencies in the job description documents of staff working in service delivery. The WMO Public Weather Services Program (https://www.wmo.int/pages/prog/amp/pwsp/index_en.html) has developed very useful competency requirements for staff of NMHSs working in product and service development and delivery.
Deliverable: Updated and completed job description for each staff member.
Milestone: Job descriptions for each staff member in place.

A 11.7 Appraisal interviews and regular team meetings (short, medium and long term)

Appraisal interviews are a useful instrument to jointly reflect on the developments and events of the recent past, to set out new goals for the near future, and to give employees an opportunity to express wishes and to suggest improvements. They are also a good opportunity to jointly develop the individual training plans as recommended in (A 11.3). Appraisal interviews shall be conducted with each staff member on a yearly basis. Their results shall be summarized by the supervisor and signed by both, the supervisor and the employee, to guarantee that both parties can agree with the outcome.
Furthermore, regular team meetings provide an opportunity for information exchange between department leaders and their staff on formal as well as informal issues. Department leaders shall use this occasion to present, explain and discuss their plans and strategies for the near future. It is recommended to schedule team meetings on an annual basis as well.
Deliverable: Protocol of annual appraisal interviews with each staff member
Milestone: Completion of the appraisal interviews (annual basis)

A 11.8 Implementation of formal process for suggestions for improvement (medium term)

Advanced NHMSs integrate a formal process for suggestions for improvement in the structures needed for the advancement of the organization, the involved processes and the orientation towards costumers and users. The process shall ideally be part of the quality management system (A 9).
Deliverable: Formal process for suggestions for improvement (QMS Document)
Milestone: Implementation formal process for suggestions for improvement

5 Assessment of the resources

5.1 Annual budget of IGEWE (core funding)

The core budget of IGEWE is provided by the Polytechnic University of Tirana and amounts about 1 Million USD. In the year 2015 about USD 410.000 were assigned to the Department of Climate and Environment and the Department of Water Economy. IGEWE received a constant budget during the last five years. The core budget numbers are given in table 2. Costs for administration, infrastructure, electricity etc. are not provided on the department level.

Budget	**Amount**	**Comment**
Salary	270.000 USD	department staff in headquarter (Tirana)
Salary	64.000 USD	observers meteorology and climate
Salary	40.000 USD	observers hydrology
traditional station network	6.500 USD	sensor repair, field trips, discharge measurements etc.
automatic station network		contract expired
Fuel	8000 USD	station visits, field trips
telecommunication	11.000 USD	
WMO membership fee	13.000 USD	membership to international organizations

Table 2: Budget figures of the Department of Climate and Environment and the Department of Water Economy. Administrative costs, costs for infrastructure, electricity etc. are unlisted.

At present no funds are foreseen in the core budget for the maintenance of the automatic station network. The contract for maintenance expired due to the end of the World Bank project.

Table 3 contains the actual number of staff members of both departments. 20 persons (academic staff: 17, technician: 3) are employed. Academic staff is only about 70 percent of their work time available for the institution (operational work, project work, proposals), about 30 percent of the working time is reserved for activities prescribed by the university (teaching, etc.). The team of the National Centre for Forecast and Monitoring of Natural Risks consists of staff members from both departments.

IGEWE staff	20
Department Climate and Environment	7
academic staff	6
Technician	1
Department Water Economy	13
academic staff	11
Technician	2
National Centre for Forecast and Monitoring of Natural Risks	8
Department Climate and Environment	3
Department Water Economy	5

Table 3: Number of staff members of the Department of Climate and Environment and the Department for Water Economy. Staff of the National Centre for Forecast and Monitoring of Natural Risks is provided by both departments.

5.2 Current strategy of IGEWE

The current version of the strategies of IGEWE in the field of meteorology and hydrology envisages a major expansion of the institute. It is planned to increase the staff number of both departments from actually 20 to 50 at the end of 2017 (short term), to 72 in 2020 (medium term) and to 88 in 2025 (long term). Table 4 shows the staff planning for the next 2, 6 and 10 years according to the strategy of IGEWE.

	2015		2017		2020		2025
Department of Climate and Environment	7		25		37		46
difference			+18		+12		+9
Department of Water Economy	13		25		35		42
difference to 2015			+11		+10		+7
Total staff number	20		50		72		88
difference to 2015			+30		+22		+16

Table 4: Short-, medium- and long term staff planning based on the existing strategy.

The planned increase of the number of employees results in a substantial raise of the staff costs by a factor of 2.5 (short term) till the end of 2017, by a factor of 3.5 till 2020 (medium term) and a factor of 4.5 on the long term. According to the actual strategy of the departments it is assumed that the maintenance work is carried out by the IGEWE technicians. The costs according to the existing IGEWE strategy are shown in table 5. Total costs include staff costs inclusive observers, investments in the station network, infrastructure at IGEWE, maintenance and monitoring.

Cost statement (USD)	Short Term	Mid Term	Long Term
Department Water Economy	1.516.400.-	2.450.000.-	2.756.000.-
Department Climate and Environment	1.723.200.-	2.924.520.-	3.612.200.-
Total costs	3.239.600.-	5.374.520.-	6.368.200.-

Table 5: Cost statement (USD) based on the existing strategy. The required amount of external funding is highlighted in blue.

It is very unlikely that the existing strategy of IGEWE can be implemented under the current and future economic and financial conditions of Albania. A more realistic financial scenario has to be selected**.**

5.3 Realistic budget projections and additional funding

For a sustainable fulfillment of the official duties an increase of the annual core budget of at least USD 300.000 over the next four years is required. Otherwise the action plan cannot be successfully implemented.

The automatization and the professional maintenance of the hydro-meteorological network allow the reduction of the salary of the observers to 1/2 on the medium term and to 1/4 on the long term, relative to the present state. On the long term observes have to take over only responsibility for the control of station and simple local maintenance work. A large part of the maintenance shall be carried out with the assistance of an external company. The costs for maintenance, repair works and calibration of the existing and planned hydro-meteorological network (manual and automatic, including the existing radar) are estimated between USD 300.000 now and USD 400.000 per year in future.

The selected scenario includes the recruitment of new staff members listed below over the short and medium term. Additionally there is an urgent need for the replacement of the retirements. In 2016 the retirement of three staff members of the Department of Water Economy is foreseen.

- 2 skilled technicians (also on disposal for hydrological measurements)
- 1 meteorologist and climatologist
- 2 hydrologists
- 1 IT specialist (Data Management and Exchange, Data Services)
- 1 or 2 specialists (financed by commercial activities, depending on commercial success)
- 5 staff members, replacement of the retirement

The recruitment for the new staff members is gradually planned for the period 2016 to 2018.

All staff members must be principally involved in the realization and implementation of the action plan and have to be available for operational duties. Table 6 contains the details on the development of the budget of the Department for Climate and Environment and the Department for Water Economy according to the selected scenario.

budget position	2015	2017	2020	2025
salary staff	270.000	310.000	350.000	400.000
salary observers weather/climate	64.000	64.000	30.000	15.000
salary observers hydrology	40.000	40.000	20.000	10.000
traditional station network	6.500	50.000	50.000	0
automatic station network, radar	0	250.000	350.000	400.000
Telecommunication	11.000	15.000	20.000	25.000
international expenses	13.000	25.000	75.000	80.000
training/travel	0	30.000	30.000	40.000
required annual budget		784.000	925.000	970.000
difference (relative to 2015)		+384.000	+525.000	+570.000
realistic core budget (+10 %/year)	400.000	484.000	645.000	970.000
required external contribution to the annual budget		300.000	280.000	0

Table 6: Projections of the IGEWE required annual core budget (highlighted in blue) for the period 2015 to 2025. Last line shows the required external contribution to the annual budget (highlighted in red).

The budget projections were developed under the assumption that an increase of the core budget provided by the Polytechnic University of Tirana to about ten percent per year is feasible. Even under consideration of the annual increase of the core budget subsidies from external funding bodies are required for the financing of the running costs (required core budget, see table 6). The values in the last line of table 6 specify the essential external contribution to the annual budget of IGEWE. The amounts are decreasing according the gradually increase of the core budget.

Furthermore the implementation of the action plan requires additional investments in the enhanced automatization and adaptation of the observational network, the network extension (radar, lightning detection and instrumentation of the airport), infrastructure (server, pc, storage) as well as the implementation of a nowcasting system and an advanced flood forecasting system for the major rivers.

Potential funding authorities of the required investments are national institutions (special budget from the university, civil protection or other ministries) and international development programs. Capacity

building initiatives could additionally be part of further twinning and consulting activities. However, it is crucial that the national financing is increased in order to sustain the development of IGEWE achieved by the recent investments and expected improvements due to the implementation of the action plan.

Tables 7 and 8 show the estimation of the total costs for realization of the action plan separated for the three phases (short, medium and long term). The estimates are provided according to the order of the investments (minimal and optimal investment costs, for details see table 9). The annual contributions from the Polytechnic University of Tirana are considered. The last lines of the respective tables specify the required amount of external funding (highlighted in blue).

	short term	medium term	long term
budget of departments	1.570.000.-	3.700.000.-	3.900.000.-
investment (minimum)	100.000.-	2.000.000.-	1.350.000.-
Sum	1.670.000.-	5.700.000.-	5.250.000.-
budget of departments university contribution	925.000.-	2.500.000.-	3.550.000.-
external funding	745.000.-	3.200.000.-	1.700.000.-

Table 7: Costs statement of the implementation of the action plan (short, medium, and long term). Numbers are based only on smaller investments. The required amount of external funding is highlighted in blue.

	Short term	Medium term	Long term
budgets of departments	1.570.000.-	3.700.000.-	3.900.000.-
investment (optimal)	250.000.-	3.350.000.-	2.000.000.-
Sum	1.820.000.-	7.050.000.-	5.900.000.-
budget of departments University contribution	925.000.-	2.500.000.-	3.550.000.-
external funding	895.000.-	4.550.000.-	2.350.000.-

Table 8: Costs statement of the implementation of the action plan (short, medium, and long term). Numbers are based on higher investments. The required amount of external funding is highlighted in blue.

Table 9 shows details of financing and related investments necessary for the implementation of the action plan. Only rough estimates are possible for the costs of the further automatization of the network. These costs strongly depend on the results of the preparatory work (A 2.1 to A 2.5).

Finally table 10 contains the time schedule for the realization process of the action plan.

	Title	Time frame	Investments (USD)	Financing	Comments
A 1	**Coordination between IGEWE, MMS and Albcontrol MET**				
A 1.1	Responsibilities and resources	short		Bud	
A 1.2	Product harmonization	short		Bud	
A 1.3	Data exchange	short		Bud	
A 1.4	Regular update of the MoU, product list and agreement on data exchange	med/long		Bud	
A 2	**Optimization of the meteorological and hydrological network**				
A 2.1	Assessment of available resources for network maintenance	short		Bud	
A 2.2	Prerequisites for data storage	short		Bud	
A 2.3	Prerequisites for quality control	short		Bud	
A 2.4	Preconditions of station sites	short		Bud	
A 2.5	Network design	short		Bud	
A 2.6	Review of station locations	med		Bud	
A 2.7	Installation and procurement	med/long	1.500.000.-	Ext	costs depends on results of A2.1-A2.5, includes servers etc.
A 2.8	Infrastructure and protection measures	med/long	100.000.-	Ext	
A 2.9	Interfaces for applications	long	100.000.-	Ext	
A 3	**Operational service**				
A 3.1	Maintenance	all		Bud	subsidies form external funding
A 3.2	Calibration of rating curves	med/long		bud	
A 3.3	Data quality control	med/long		bud	
A 3.4	Data services	med/long	75.000.-	Ext/bud	CAPEX ext, OPEX bud

A 4	**Network extension**				
A 4.1	Weather radar	med/long	Min 500.000.- Max 1.500.000.-	Ext	Depend on number/type of radars investments in infrastructure. (CAPEX and OPEX)
A 4.2	Lightning detection	med/long	Min 20.000.- Max 100.000.-	Ext	depends on number/type of sensors (CAPEX and OPEX)
A 4.3	Special instrumentation for Rinas International Airport	all	Min 300.000.- Max 1.000.000.-		wind stations, Sodar RASS/Lidar, ceilometer, Present Weather Sensors (CAPEX only)
A 5	**Forecasting tools**				
A 5.1	Exploitation of DEWETRA platform	short/med		Ext, Bud	
A 5.2	Numerical modeling	med/long		Ext, Bud	consortium fee,
A 5.3	Nowcasting	med/long	180.000.-	Ext	nowcasting System (CAPEX and OPEX)
A 5.4	Implementation of a meteorological visualization platform	long	200.000.-	Ext	IGEWE, MMS, Albcontrol MET
A 5.5	Enhanced flood forecasting system for the major rivers	med/long	Min 400.000.- Max 700.000.-	Ext	depending on model choice (CAPEX and OPEX)
A 6	**User engagement**				
A 6.1	User surveys	all		Bud	
A 6.2	User workshops	all		Bud	
A 6.3	Disposition of a service point	med		Bud	
A 6.4	Documentation of user needs and requirements	med		Bud	
A 6.5	Customer relationship management	long		Bud	
A 7	**User-oriented service development**				
A 7.1	Work instructions documents	all			
A 7.2	Service-level agreements with users	all		Bud	
A 7.3	User survey on communication of product/service changes	short		Bud	
A 7.4	Communication of product/service changes	medium		Bud	
A 7.5	Development of a formal user information system	long		Bud	

A 8	**Monitoring of service performance**				
A 8.1	Basic training on verification methods	short		Bud/Ext	
A 8.2	Qualitative evaluation of products	short		Bud	
A 8.3	Encouragement of user feedback	short		Bud	
A 8.4	Establishment of a framework for quant. verification	med		Bud	
A 8.5	Advanced training on verification methods	med		Bud	
A 8.6	Quantitative verification	med/long		Bud	
A 8.7	Quarterly verification reports	med/long		Bud	
A 8.8	Towards impact-based verification	long		Bud/Ext	
A 9	**Quality management**				
A 9.1	Documentation of service delivery process	short		Bud	
A 9.2	Design of a quality management system (QMS)	med		Bud	
A 9.3	Implementation of the QMS	long		Bud	
A 10	**Training and networking**				
A 10.1	Visits to other National Hydro-meteorological Services (	all		Bud	
A 10.2	Participation in training courses	all		Bud	
A 10.3	EUMETNET membership	short		Bud	
A 10.4	ECMWF membership	med		Bud/Ext	
A 11	**Strategy and capacity building**				
A 11.1	Strategy for the National Hazard Center	short		Bud	
A 11.2	Funding acquisition	all			
A 11.3	Update of the IGEWE Web Site	short/med	75.000.-	Bud/Ext	40.000.- short term
A 11.4	Structured development of commercial products	med/long		Bud	
A 11.5	Individual training plans	med/long		Bud	
A 11.6	Job descriptions	short			
A 11.7	Appraisal interviews and regular team meetings	all			
A 11.8	Implementation of formal process for suggestions for improvement	med			

Table 9: Details of financing and related external investments for the implementation of the action plan (Abbreviation, Bud: annual budget including subsidiaries, Ext: external funding). Annual budget includes always subsidiaries form external funds.

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
A 1	**Coordination between IGEWE, MMS and Albcontrol MET**										
A 1.1	Responsibilities and resources										
A 1.2	Product harmonization										
A 1.3	Data exchange										
A 1.4	Regular update of the MoU, product list and agreement on data exchange										
A 2	**Optimization of the meteorological and hydrological network**										
A 2.1	Assessment of available resources for network maintenance										
A 2.2	Prerequisites for data storage										
A 2.3	Prerequisites for quality control										
A 2.4	Preconditions of station sites										
A 2.5	Network design										
A 2.6	Review of station locations										
A 2.7	Installation and procurement										
A 2.8	Infrastructure and protection measures										
A 2.9	Interfaces for applications										
A 3	**Operational service**										
A 3.1	Maintenance										
A 3.2	Calibration of rating curves										
A 3.3	Data quality control										
A 3.4	Data services										
A 4	**Network extension**										
A 4.1	Weather radar										
A 4.2	Lightning detection										
A 4.3	Special instrumentation for Rinas International Airport										
A 5	**Forecasting tools**										
A 5.1	Exploitation of DEWETRA platform										
A 5.2	Numerical modeling										
A 5.3	Nowcasting										
A 5.4	Implementation of a meteorological visualization platform										
A 5.5	Enhanced flood forecasting system for the major rivers										
A 6	**User engagement**										
A 6.1	User surveys										
A 6.2	User workshops										
A 6.3	Disposition of a service point										
A 6.4	Documentation of user needs and requirements										
A 6.5	Customer relationship management										

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
A 7	**User-oriented service development**										
A 7.1	Work instructions documents										
A 7.2	Service-level agreements with users										
A 7.3	User survey on communication of product/service changes										
A 7.4	Communication of product/service changes										
A 7.5	Development of a formal user information system										
A 8	**Monitoring of service performance**										
A 8.1	Basic training on verification methods										
A 8.2	Qualitative evaluation of products										
A 8.3	Encouragement of user feedback										
A 8.4	Establishment of a framework for quantitative verification										
A 8.5	Advanced training on verification methods										
A 8.6	Quantitative verification										
A 8.7	Quarterly verification reports										
A 8.8	Towards impact-based verification										
A 9	**Quality management**										
A 9.1	Documentation of service delivery process										
A 9.2	Design of a quality management system (QMS)										
A 9.3	Implementation of the QMS										
A 10	**Training and networking**										
A 10.1	Visits to other National Hydro-meteorological Services (NHMS)										
A 10.2	Participation in training courses										
A 10.3	EUMETNET membership										
A 10.4	ECMWF membership										
A 11	**Strategy and capacity building**										
A 11.1	Strategy for the development of the National Hazard Center										
A 11.2	Funding acquisition										
A 11.3	Update of the IGEWE Web Site										
A 11.4	Structured development of commercial products										
A 11.5	Individual training plans										
A 11.6	Job descriptions										
A 11.7	Appraisal interviews and regular team meetings										
A 11.8	Implementation of formal process for suggestions for improvement										

Table 10: Time schedule for the implementation of the action plan. Coloured bars show short term (blue), medium term (green) and long term (orange) actions.

6 Summary and recommendations

Hydro-meteorological services in Albania are traditionally shared between IGEWE, MMS and Albcontrol Met. IGEWE is officially recognized as the national lead, represents Albania in the WMO and has MoUs with the other agencies.

Rather unusual for a European NMHs, IGEWE is organized as a research unit of a university, namely the Polytechnic University of Tirana. It is caught in a cycle common to many NMHSs in developing countries: poor quality of service delivery leads to a lack of recognition by the government and the public, inadequate basic funding, an insufficient accomplishment of the official duties, and consequently an inability to improve service delivery.

Despite the completed procurement of modern equipment and technology under AL-DRMAP, IGEWE currently does only partly have a realistic and comprehensive strategic plan for their activities, future developments, the accompanying technical design, and specifications for a modern weather, climate and hydrological forecasting delivery system. The current version of the strategies of IGEWE envisages a major expansion of the institute in the field of meteorology and hydrology. The foreseen enhancement of the forecasting capabilities at IGEWE aims at the operation of a national weather, climate and hydrological forecast system and the development of a national institute providing all required information, products and services.

However, the proposed approach does not sufficiently take into account the obvious synergies between the activities of the existing institutions and ignores the urgent need of their intensified cooperation for an integrated and coordinated approach. The existence of parallel structures will be extended. A harmonization of products and services offered by each of the weather services is missing. The plan is also associated with enormous costs and includes a large increase in the number of staff members, while it remains unclear how the necessary massive funding can be achieved. Problems to mitigate the current lack of forecasting capacities at IGEWE are not sufficiently addressed, either.

The integration of IGEWE into the organization of a university offers advantages and disadvantages. Research results can more easily be exploited and integrated into operational processes, products and services through the close relationship to science and technological progress. However, the main focus is laid on research and education, while operational activities are usually of lesser importance. Only seventy percent of the working time of the staff members is assigned to operational tasks. About thirty percent of their working time is reserved for academic activities, such that staff members are not fully available for operational duties. Additional hurdles are the lack of proper development and the missing career paths of staff members without scientific positions. The absence of career opportunities in the operational units and departments makes such positions particularly unattractive for staff members and applicants under the institutional framework of a university.

At a first glance the establishment of an independent NHMS without affiliation to the Polytechnic University of Tirana would provide a way out of the dilemma. The new institution would comprise the competencies of the three Met Services and replace the agencies. However, such a realization would further inflate the costs, implicate high risk through the transformation process, and does therefore presently not seem feasible.

Instead, a strategy and a corresponding action and investment plan are developed which support IGEWE with a clear vision to transform into a modern and service-focused institution in close cooperation and coordination with MMS and Albcontrol Met.

- **Recommendation 1: Sharing of the work between existing services**
  Taking into account the actual economic and financial conditions is recommended in order to use the available resources in an optimal way, to harmonize their products and services, and to eliminate the parallel activities currently in place.

  The quality and efficiency of services and products, and therefore their reception by users and customers, political decision makers and the general public, will benefit from improved coordination and collaboration between the agencies. Each institution can better introduce its own strengths and key competencies under such an integrated approach. Its implementation is therefore also essential for the fulfillment of the official duties of IGEWE according to WMO standards.

- **Recommendation 2: Increase of the annual budget of IGEWE**
  An increase of the annual budget of IGEWE is required for a sustainable fulfillment of the official duties (see table 11). The annual budget is provided by the Polytechnic University of Tirana. Budget comprises staff salary, operational duties, maintenance of the manual station network, infrastructure and telecommunication, and the WMO fee and administration. No funds are assigned yet to the maintenance of the automatic station network, investments in additional equipment and technology, and the membership to international organizations like EUMETNET or ECMWF.

  Efforts shall be undertaken to reel in funding bodies who agree to cover parts of the operational costs, for example special budgets from the university, civil protection or other ministries, or international development programs, at least for some years during the adaptation phase of the network. However, it is critical that the basic national funding is increased to sustain the development of IGEWE achieved by the recent investments and expected improvements due to the implementation of the action plan.

annual budget (USD)	short term	medium term	long term
university contribution	925.000.-	2.500.000.-	3.550.000.-
external funding	645.000.-	1.200.000.-	350.000.-
required annual budget	1.570.000.-	3.700.000.-	3.900.000.-

Table 11: Projection of the annual budget of IGEWE for the period 2016 to 2025. The required external contribution to the annual budget is highlighted in blue.

- **Recommendation 3: Additional funding for investments**
  Additional funding is required for essential investments like the further automatization and adaptation of the observational network, the network extension (radar, lightning detection and instrumentation of Rinas airport), the implementation of nowcasting systems and advanced flood forecasting systems. Table 12 contains the costs of planned investments (for details see table 9.)

investments (USD)	short term	medium term	long term
minimum	100.000.-	2.000.000.-	1.350.000.-
optimal	250.000.-	3.350.000.-	2.000.000.-

Table 12: Investments for the period 2016 to 2025 (minimum and optimum version). For details table 9.

- **Recommendation 4: Network design and operation**
  The design and operation of the observational network according to user needs and requirements are of great importance. Central point is a further automatization of the hydrological and meteorological stations, which makes data available in real-time and allows reducing the number and costs of observers. This position of the budget can then be shifted to the maintenance of the automatic station network, which shall be shared with the technicians of MMS and Albcontrol Met. Outsourcing of larger parts of the maintenance work to private companies is proposed in addition, but skilled technicians are still needed at IGEWE for the preparation of the tender, the support and the acceptance of the maintenance work. It is essential for the quality of the observations that the functionality of the existing automatic network is ensured before the observers at the automatic stations sites are reduced. The preservation of long time series, which are important for the documentation of climate chance, must be given top priority.

- **Recommendation 5: Extension of the National Hazard Center**
  A joint extension of the National Hazard Center together with civil protection, other contributors and key users is recommended. Responsibilities for different risks need to be clarified between the contributing partners. The center shall cover meteorological and geophysical hazards like floods, landslides, drought, forest fires, heat waves or cold waves, thunderstorms, hail, windstorms, snow, ice, high waves, and earthquakes by collecting, displaying and distributing the warnings from different official sources of information. The center is responsible for the communication of warnings and alerts to civil protection and via different channels to the general public. A national multi-hazard early warning system shall emerge from these activities in the future. Its implementation shall use existing structures in Europe, benefit from “best practices”, and follow the recommendations of WMO and UN-ISDR. A close cooperation and coordination with neighboring countries and a development of partnerships at a national level are recommended. The membership to EUMETNET will eventually integrate the warnings into the pan-European METEOALARM platform.

- **Recommendation 6: Update of the IGEWE Website**
  The update of the IGEWE website aims at strengthening the capacities for the development of IGEWE. A modernization of the website bases on responsive design will improve the quality and availability of station data for the general public and specific groups of users. Additional observational data like satellite, radar and lightning images shall be included. Existing data services and climate services would become more user-friendly.

- **Recommendation 7: Capacity building**
  A gap analysis based on existing competencies shall identify areas requiring training and allow the compilation of individual training plans. The development of national training modules ensures that all staff members have the opportunity to learn and develop their skills. It is proposed that the individual training plans follow the recommendations for competence development provided by the WMO Technical Commissions. The learning success shall be evaluated according to the WMO competency assessment. The great practical experiences of senior forecasters and observers have to be taken into account for the assessment of the competencies.

- **Recommendation 8: Numerical Weather Prediction, enhance regional cooperation**
  A stronger collaboration within the South-East European Consortium for Operational weather Prediction (SEECOP) is encouraged to jointly run and develop a numerical weather prediction model together with neighboring states, an effort which would otherwise exceed the possibilities for a

small weather service with limited resources like IGEWE. Furthermore, a full exploitation of the WMO access to ECMWF products and application to a regular membership at ECMWF with access to further data including ensemble information are strongly recommended.

- **Recommendation 9: Implementation of Nowcasting systems**
  Nowcasting techniques are superior to NWP output for very short lead times of minutes to a few hours, and are crucial for severe weather warnings. They critically depend on a real-time availability of observational data, which is therefore of immense importance for the forecasters on duty. In addition, these observational data may also be merged into an integrated automatic nowcasting system with a high spatial and temporal resolution and a very high update rate. Such a system is very important for warnings and interesting for various customers to optimize their activities. Taking into account that flash floods and river flooding are the primary weather-related hazards in Albania, in particular coupled rainfall-runoff models for major rivers would be greatly helpful for civil protection, operators of hydropower plants, urban and infrastructure planners, risk managers and disaster response or emergency services. It is very likely that the development of such an automatic nowcasting system will attract new customers whose funding will multiply reward the investment. Various NMHSs in Europe have substantial expertise in the development of automatic nowcasting tools and, in particular, coupled rainfall-runoff models. It is strongly recommended to benefit from their expertise and sound the possibilities for collaborations.

- **Recommendation 10: Commercial activities**
  Start with the structured development of commercial products. Prerequisites are the successful enhancement of the forecasting capacities, identification of user needs, and training of staff regarding development of new products and services, sales and marketing. A thorough market analysis, economic and non-economic viability analysis, an accurate preparation of business plans, and appropriate marketing activities are a key to commercial success. The revenues can then be used for the recruitment of new staff members.

7 Acknowledgement

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8 Abbreviations

Albcontrol	National Air Traffic Control of Albania
Albcontrol MET	Albcontrol Met Service
ANP	Air Navigation Plan
CP	Civil Protection
CAPEX	Capital expenditure
GFDRR	Global Facility for Disaster Reduction and Recovery
IGEWE	Institute of Geosciences, Energy, Water and Environment
KESH	Albanian Power Corporation
MMS	Military Meteorological Service of Albania
MoU	Memorandum of Understanding
NMHS	National meteorological and hydrological service
NMS	National meteorological service
OLA	Operational Level Agreement
OPEX	Operational Expenditure
OPMET	Operational Meteorological
SLA	Service Level Agreement
SDPM	Service Delivery Progress Model
SOP & DOC	Standard Operations Procedures and Documents
TWR/ACC/APP	Air Traffic Control Tower/Area Control Center/Approach
WMO	World Meteorological Organization
ZAMG	Zentralanstalt für Meteorologie und Geodynamik

9 References

World Meteorological Organization, 2014: The WMO strategy for service delivery and its implementation plan, WMO-No. 1129

ZAMG, 2014: Report on the IGEWE's current level in the SDPM (Deliverable), 29 pp.

ZAMG, 2014: Identification of gaps between the current service delivery level of IGEWE and the user needs and requirements (technical note), 16 pp.

10 Annex: Deliverables and Milestones

A 1 Coordination between Met Services
A 1.1 Responsibilities and resources (short term) Deliverable: Formulation or update of MoUs. Milestone: Signing of the MoU by IGEWE, MMS and Albcontrol.
A 1.2 Product harmonization (short term) Deliverable: Product list Milestone: Agreement on Product list signed by IGEWE, MMS and Albcontrol
A 1.3 Data exchange (short term) Milestone: Agreement on data exchange signed by IGEWE, MMS and Albcontrol.
A 1.4 Regular update of the MoU, product list and agreement on data exchange (medium and long term) Deliverable: Formalized process for the updates of the MoU and product lists Milestone: Annual updates of the MoU, frequent updates of the product list
A 2 Optimization of the meteorological and hydrological network
A 2.1 Assessment of available resources for network maintenance (short term) Deliverable: Document on personal and financial resources necessary for the operation of the station network based on different feasible funding scenarios. Milestone: Completion of the Assessment
A 2.2 Prerequisites for data storage (short term) Deliverable: Comprehensive documentation for administrators and users of MCH DBMS Milestone: Full installation and operational application of MCH DBMS at IGEWE.
A 2.3 Prerequisites for quality control (short term) Deliverable: Implementation plan for a quality control system for real-time and climatological applications. Milestone: Completion of the implementation plan of the quality control system for real-time and climatological applications.
A 2.4 Preconditions of station sites (short term) Deliverable: Check list of requirements for sites of meteorological and hydrological stations. Milestone: Completion and use of the check lists.
A 2.5 Network design (short term) Deliverable: Document on network design and roadmap towards an automated network. Milestone: Completion of the network design and roadmap.
A 2.6 Review of individual station locations (medium term) Deliverable: Catalogue with each station's name, identification number, position (geographical coordinates), height above sea level, and a map of its surroundings. It shall be amended by pictures from various directions upon its installation and continuously logged with its failure and maintenance history and any other relevant meta-information (inventory of sensors) afterwards. Milestone: Completion of the review of individual station locations

A 2.7 Installation and procurement (medium and long term) Deliverable: Annual report on the installation and relocation of hydro-meteorological stations. Milestone: Relocation and installation of hydro-meteorological station completed.
A 2.8 Infrastructure and protection measures (medium and long term) Deliverable: Amendment to the annual report on the installation and relocation of hydro-meteorological stations (A 2.7). Milestone: Protection measures for the station network completed
A 2.9 Interfaces for applications (long term) Deliverable: Comprehensive documentation for users of the interfaces for applications. Milestone: Completion of the applications interfaces.
A 3 Operational service
A 3.1 Maintenance (short, medium and long term) Deliverable: Formalized and documented procedures for station maintenance Milestone: Sustainable and reliable maintenance of the station network realized.
A 3.2 Calibration of rating curves (medium and long term) Milestone: Completion of the calibration of the rating curves.
A 3.3 Data quality control (medium and long term) Deliverable: Formalized process for data quality control Milestone: Operational data quality control implemented.
A 3.4 Data services (medium and long term) Deliverable: Catalogue of IGEWE data products and services. Milestone: Implementation of data services and climate services at IGEWE
A 4 Network extensions
A 4.1 Weather radar (medium and long term) Deliverable: Documentation of radar site identification and selection. Deliverable: Tender for the procurement of additional weather radars. Milestone: Completion of the network extension. Milestone: Participation in EUMETNET OPERA program.
A 4.2 Lightning detection (long term) Deliverable: Site identification and selection. Deliverable: Selection and installation of additional sensors. Milestone: Completion of the installation of additional lightning sensors.
A 4.3 Special instrumentation for Rinas International Airport (short and medium term) Deliverable: Document on meteorological instrumentation of RINAS airport Milestone: Installation of automatic stations. Milestone: Installation of a LIDAR or SODAR unit.

A 5 Forecasting tools
A 5.1 Exploitation of DEWETRA platform (short and medium term) Deliverable: Documentation on the advanced use of the DEWETRA system including regular revision after changes to the system. Milestone: Adoption of DEWETRA system for all operational services.
A 5.3 Nowcasting (medium and long term) Milestone: Use of adequate nowcasting techniques in daily forecast process at the responsible Met Service.
Milestone: Implementation and operation of a nowcasting system.
A 5.4 Implementation of a meteorological visualization platform (long term) Deliverable: Selection of the visualization platform. Milestone: Implementation of a common meteorological workplace at the Met services.
A 5.5 Enhanced flood forecasting system for the major rivers (medium and long term) Deliverable: Description of the enhanced flood forecasting system Milestone: Prototype of real time flood forecasting model for the Drin catchment. Milestone: Enhanced flood forecasting modelling of the major Albanian rivers.
A 6 User engagement
A 6.1 User surveys (short, medium and long term) Deliverable: Design of a questionnaire and realization of “kick-off survey” (short term) Deliverable: further user surveys on a regular basis (medium and long term) Milestone: Realization of user surveys in regular intervals
A 6.2 User workshops (short, medium and long term) Deliverable: Report on “kick-off user workshop” (short term) Deliverable: Reports on further user workshops on regular basis (medium and long term) Milestone: Organization of user workshops on a regular basis.
A 6.3 Disposition of a service point (medium term) Milestone: Installation of a service point.
A 6.4 Documentation of user needs and requirements (medium term) Deliverable: Documentation of the user needs and requirements. Milestone: Implementation and use of the feedback log.
A 6.5 Customer relationship management (long term) Deliverable: Description of the CRM System Milestone: Adoption of CRM-like approaches in the daily workflow. Milestone: Implementation of an appropriate CRM system
A 7 User-oriented service development
A 7.1 Work instructions documents (short, medium and long term) Deliverable: Formulation of work instruction documents Milestone: Regular updates of work instruction documents

A 7.2 Service-level agreements with users (short, medium and long term) Deliverable: Formulation of SLAs with users. Milestone: Regular updates of SLAs with users.
A 7.3 User survey on communication of product/service changes (short term) Deliverable: Design of survey forms and distribution among customers and users. Milestone: Implementation of the survey.
A 7.4 Communication of product/service changes (medium term) Deliverable: Informal documentation of user needs and wishes about the communication of product/service changes. Milestone: Successful communication of product/service changes.
A 7.5 Development of a formal user information system (long term) Deliverable: Formal documentation of user needs and wishes about the communication of product/service changes. Milestone: Successful implementation of the user information system.
A 8 Monitoring of service performance
A 8.1 Basic training on verification methods (short term) Deliverable: Document on possible ways of verification of existing products. Milestone: Basic training on verification methods successfully completed.
A 8.2 Qualitative evaluation of products (short term) Deliverable: Running document on quality and accuracy of products, filled with short notes on a daily basis. Milestone: Routinely qualitative evaluation of the products and services.
A 8.3 Encouragement of user feedback (short term) Deliverable: Running document on quality issues addressed by customers and users, and reactions taken. Milestone: Intensified dialogue and interaction with users.
A 8.4 Establishment of a framework for quantitative verification (medium term) Deliverable: Plan for a quantitative verification framework. Milestone: Framework for quantitative verification established.
A 8.5 Advanced training on verification methods (medium term) Deliverable: Document on an application of advanced verification methods to existing products. Milestone: Advanced training on verification methods successfully completed.
A 8.6 Quantitative verification (long term) Deliverable: Description of the verification system. Milestone: Operational implementation of the verification system
A 8.7 Quarterly verification reports (medium and long term) Deliverable: Quarterly verification reports. Milestone: Implementation of routinely verification reports.

A 8.8 Towards impact-based verification Deliverable: Impact-based verification of selected severe weather events and floods Milestone: Implementation of impact-based verification methods.
A 9 Quality management
A 9.1 Documentation of service delivery process (short term) Deliverable: Documentation of the service delivery process Milestone: Completion of the documentation of the service delivery process
A 9.2 Design of a quality management system (QMS) (medium term) Deliverable: Concept of the QMS Milestone: Completion of the concept of the QMS.
A 9.3 Implementation of the QMS (long term) Deliverable: Implementation of the QMS Milestone: Completion of the implementation of the QMS
A 10 Training and networking
A 10.1 Visits to other NHMSs (short, medium and long term) Deliverables: Reports of visits to other NHMSs Milestone: Establishment of the contacts to other NHMSs
A 10.2 Participation in training courses (short, medium and long term) Deliverable: Survey of relevant training courses for the IGEWE staff. Deliverable: Schedule for training courses, yearly updated. Milestone: Establishment of a national training program.
A 10.3 EUMETNET membership (short term) Milestone: EUMETNET membership and participation to EUMETNET programs
A 10.4 ECMWF membership (medium term) Milestone: ECMWF membership of IGEWE.
A 11 Strategy and capacity building
A 11.1 Strategy for the development of the National Centre for Forecast and Monitoring of Natural Risks (short term) Deliverable: List of awareness parameters, thresholds and responsible institutions. Deliverable: Strategy of the national hazard center. Milestone: Implementation of the national multi hazard early warning system.
A 11.2 Funding acquisition (short, medium and long term) Milestone: Long term plan for the development of budget and human resources. Milestone: Successful acquisition of external funds.
A 11.3 Update of the IGEWE Web site (short and medium term) Deliverable: Concept for the modernization of the website. Milestone: Modernization of the IGEWE website.

A 11.4 Structured development of commercial products (medium and long term) Deliverable: Business plans for commercial products. Milestone: IGEWE starts commercial activities
A 11.5 Individual training plans (medium and long term) Deliverable: Training plan for each staff member Milestone: Provision of training courses, establishment of a national training program for staff members of all Met Services.
A 11.6 Job descriptions (short term) Deliverable: Updated and completed job description for each staff member. Milestone: Job descriptions for each staff member in place.
A 11.7 Appraisal interviews and regular team meetings (short, medium and long term) Deliverable: Protocol of annual appraisal interviews with each staff member Milestone: Completion of the appraisal interviews (annual basis)
A 11.8 Implementation of formal process for suggestions for improvement (medium term) Deliverable: Formal process for suggestions for improvement (QMS Document) Milestone: Implementation formal process for suggestions for improvement