

Evaluation report of questionnaire

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Introduction

The technical information summarized in this document is derived from the outputs of the 9 national knowledge exchange expert workshops, on flood and ice forecasting, that were organized by dedicated partner within the activity 5.1. in each of the 9 partner countries (ECONOMICA in Austria, NIMH BAS in Bulgaria, CW in Croatia, STASA in Germany, OVF in Hungary, NIHWM in Romania, SHMU in Slovakia, UL in Slovenia, UHMC in Ukraine).

This evaluation report summarizes mainly the results of the questionnaires prepared in WP5 of the DAREFFORT project, supporting information gathering from stakeholders, but also summarizes some of the conclusions and recommendations from the knowledge exchange expert workshops.

The number of questionnaires received from stakeholders participating organisations are summarised in Table 1.

Table 1 The number of received questionnaires

No.	Country	Number of received questionnaires
1	Austria	8
2	Bulgaria	19
3	Croatia	29
4	Germany	6
5	Hungary	9
6	Romania	20
7	Slovakia	64
8	Slovenia	24
9	Ukraine	8

The following tables, presented in this document, reflect the information on hydrological data and forecasts synthesized by countries. The resulting conclusions are intended to contribute to the improvement of future hydrological forecast and warning products, in order to better serve and support the needs of different stakeholders, in their activities.

1 Channels of delivery

This section aimed at investigating how respondents get access to hydrological data and forecasts products.

It was found that most of the respondents receive information regarding hydrological forecasts and warning products directly from hydrological service, and / or from hydrological service websites.

Table 2 shows a summary of the primary / easiest ways of access for the different stakeholders.

Table 2 Percent of persons using hydrological information and / or hydrological forecasts received on different communication channels.

No	Country	Channels of delivery (% of respondents)							
		Directly from hydro-logical service	Hydrological service web-site	Other websites	Television	Radio	Newspaper	Mobile phones	Other sources
1	Austria	62.5	100.0	25.0	0.0	0.0	0.0	12.5	0.0
2	Bulgaria	31.6	47.4	26.3	15.8	5.3	5.3	0.0	15.8
3	Croatia	37.9	37.9	27.6	41.4	31.0	13.8	37.9	3.4
4	Germany	100.0	66.7	50.0	33.3	33.3	16.7	16.7	0.0
5	Hungary	22.2	77.8	55.6	0.0	0.0	0.0	22.2	0.0
6	Romania	90.0	35.0	10.0	0.0	0.0	0.0	5.0	0.0
7	Slovakia	51.6	56.3	10.9	17.2	17.2	4.7	37.5	18.8
8	Slovenia	16.7	70.8	20.8	29.2	29.2	12.5	12.5	29.2
9	Ukraine	100.0	100.0	87.5	0.0	0.0	0.0	0.0	0.0

2 Usage, understanding and usefulness of hydrological information and forecasts

2.1 Understanding of hydrological information and forecasts

Table Error! Reference source not found.number 3 reflects the ease of understanding of the hydrological information and forecasts for the respondents, grouped by country. Most of them find it easy to understand the information, although in Croatia and Slovenia the level of understanding is neutral for 30% of the respondents, and in Hungary 22.2 % consider difficult to understand hydrological information and forecasts products.

Table 3 The ease of understanding of the hydrological information and forecasts by country

No	Country	The degree of understanding (% of respondents)		
		Easy	Neutral	Difficult
1	Austria	75.0	25.0	0.0
2	Bulgaria	78.9	21.1	0.0
3	Croatia	69.0	31.0	0.0
4	Germany	100.0	0.0	0.0
5	Hungary	77.8	0.0	22.2
6	Romania	95.0	5.0	0.0
7	Slovakia	95.3	4.7	0.0
8	Slovenia	66.7	33.3	0.0
9	Ukraine	100.0	0.0	0.0

2.2 Usage of hydrological information and forecasts

The frequency of use of hydrological information and forecasts, by different stakeholders in their activities, is described in table number 4. Most of the respondents use the information on a daily basis and a large percent use it weekly.

The whole sample of respondents from Germany and 90% of the sample from Romania use the information daily.

Table 4 The frequency of use of hydrological information and forecasts

No	Country	The frequency of use (% of respondents)			
		Daily	Weekly	Once a month	Rarely
1	Austria	75.0	50.0	0.0	0.0
2	Bulgaria	63.2	15.8	26.3	15.8
3	Croatia	48.3	10.3	20.7	20.7
4	Germany	100.0	0.0	0.0	0.0
5	Hungary	44.4	11.1	22.2	22.2
6	Romania	90.0	10.0	0.0	0.0
7	Slovakia	65.6	12.5	9.4	12.5
8	Slovenia	33.3	50.0	4.2	12.5
9	Ukraine	62.5	75.0	12.5	0.0

2.3 Usefulness of hydrological information and forecasts

Table number 5 reflects the perception of the respondents on the usefulness of hydrological information and forecasts. Most of the respondents consider it very useful, especially the respondents from Germany (100%)., while 65% from the respondents in Croatia find it only useful. Some of the stakeholders from Slovakia and Slovenia indicated that for them the hydrological information and forecasts products are not useful, it will be good to further investigate if this is due to the fact that they don't need to use such information in their activities, or current available products does not provide the specific information they need.

Table 5 The usefulness of hydrological information and forecasts

No	Country	The degree of usefulness (% of respondents)		
		Very useful	Useful	Not useful
1	Austria	75.0	25.0	0.0
2	Bulgaria	42.1	52.6	0.0
3	Croatia	34.5	65.5	0.0
4	Germany	100.0	0.0	0.0
5	Hungary	77.8	22.2	0.0
6	Romania	75.0	25.0	0.0
7	Slovakia	73.4	25.0	1.6
8	Slovenia	45.8	50.0	4.2
9	Ukraine	62.5	37.5	0.0

Compared to the situation from 3-4 years ago, most of the respondents consider the current hydrological information and forecast products to be more useful, or about the same, as shown in table number 6.

Table 6 The usefulness of hydrological information and forecasts compared to previous period

No	Country	The current usefulness of hydrological information and forecasts (% of respondents)			
		More useful	About the same	Less useful	Don't know / No comment
1	Austria	37.5	50.0	0.0	12.5
2	Bulgaria	63.2	15.8	0.0	15.8
3	Croatia	37.9	41.4	0.0	17.2
4	Germany	50.0	50.0	0.0	0.0
5	Hungary	44.4	11.1	0.0	44.4
6	Romania	50.0	45.0	5.0	0.0
7	Slovakia	45.3	45.3	1.6	7.8
8	Slovenia	66.7	12.5	4.2	16.7
9	Ukraine	75.0	25.0	0.0	0.0

3 The availability and quality of the hydrological information and forecast

3.1 The current availability of hydrological information and forecasts

Compared to 3-4 years ago, most of the respondents consider the current availability of hydrological information to be slightly improved, as shown in table number 7.

Table 7 The availability of hydrological information and forecasts compared to previous period

No	Country	The current availability of hydrological information and forecasts (% of respondents)				
		Significantly improved	Slightly improved	About the same	Less available	Don't know / No comment
1	Austria	12.5	75.0	0.0	0.0	12.5
2	Bulgaria	42.1	36.8	0.0	0.0	15.8
3	Croatia	27.6	51.7	17.2	0.0	6.9
4	Germany	16.7	66.7	16.7	0.0	0.0
5	Hungary	33.3	11.1	22.2	0.0	33.3
6	Romania	45.0	30.0	20.0	0.0	5.0
7	Slovakia	31.3	39.1	21.9	0.0	7.8
8	Slovenia	41.7	29.2	16.7	0.0	12.5
9	Ukraine	100.0	0.0	0.0	0.0	0.0

3.2 The quality of hydrological information and forecasts

The quality of hydrological information and forecast products, in terms of accuracy, timeliness and access, perceived by the respondents from the participating countries is summarized in table number 8.

The accuracy and timeliness of the current information is considered good by the vast majority of the respondents in each country (100% in Germany and Ukraine, 79% in Slovenia, 75% in Romania, Slovakia and Austria).

However, in some countries the accuracy is considered not satisfactory by an important percent of the respondents (44,8 % in Croatia, 12,5 % in Austria and 10% in Romania). A significant percentage of the sample from Hungary consider the accuracy of information very good (44,4%).

Table 8 The perception on quality of hydrological data and forecast products

Country	Quality of hydrological information and forecasts (% of respondents)				
		Very good	Good	Bad	Very bad
Austria	Accuracy	12.5	75.0	12.5	0.0
	Timeliness	37.5	62.5	0.0	0.0
	Access	25.0	75.0	0.0	0.0
Bulgaria	Accuracy	26.3	68.4	0.0	0.0
	Timeliness	36.8	47.4	5.3	0.0
	Access	47.4	42.1	0.0	0.0
Croatia	Accuracy	20.7	24.1	44.8	0.0
	Timeliness	24.1	72.4	3.4	0.0
	Access	44.8	55.2	0.0	0.0
Germany	Accuracy	0.0	100.0	0.0	0.0
	Timeliness	16.7	83.3	0.0	0.0
	Access	33.3	66.7	0.0	0.0
Hungary	Accuracy	44.4	55.6	0.0	0.0
	Timeliness	33.3	66.7	0.0	0.0
	Access	22.2	55.6	22.2	0.0
Romania	Accuracy	20.0	75.0	10.0	0.0
	Timeliness	35.0	65.0	5.0	0.0
	Access	45.0	55.0	0.0	0.0
Slovakia	Accuracy	23.4	75.0	0.0	1.6
	Timeliness	35.9	56.3	6.3	1.6
	Access	59.4	40.6	0.0	0.0
Slovenia	Accuracy	16.7	79.2	0.0	4.2
	Timeliness	33.3	58.3	4.2	4.2
	Access	45.8	50.0	0.0	4.2
Ukraine	Accuracy	0.0	100.0	0.0	0.0
	Timeliness	0.0	100.0	0.0	0.0
	Access	0.0	100.0	0.0	0.0

In terms of timeliness, the hydrological information and forecasts are generally considered good (100% Ukraine, 83% Germany, 72% Croatia).

The access of hydrological information and forecasts is rated as good by most of the respondents and very good by most of the respondents from Bulgaria and Slovakia.

4 The minimum warning lead time required

In order to properly make decisions and take actions in the case of a forecasted hydrological events, or to satisfy the needs for their decision support process specific to different activities, most of the stakeholders need a minimum warning lead time of 12 - 24 h, as shown in table number 9.

This category is followed by the one that needs 3-6 h as minimum warning lead time.

62,5 % of the respondents in Ukraine needs more than 3 days of warning lead time, in order to make decisions and take action, while 20% of the stakeholders from Slovakia and Slovenia can adapt and benefit even from hydrological warnings with a lead time of 30 minutes.

Table 9 The minimum required warning lead time

No	Country	Warning lead time (% of respondents)						
		30 min	1 hour	3-6 hours	12-24 hours	2-3 days	More than 3 days	Other
1	Austria	0.0	12.5	25.0	62.5	25.0	0.0	0.0
2	Bulgaria	0.0	0.0	5.3	52.6	36.8	10.5	5.3
3	Croatia	10.3	10.3	10.3	37.9	13.8	3.4	10.3
4	Germany	16.7	16.7	16.7	33.3	33.3	16.7	16.7
5	Hungary	0.0	11.1	33.3	33.3	11.1	0.0	11.1
6	Romania	5.0	5.0	30.0	45.0	20.0	15.0	0.0
7	Slovakia	20.3	21.9	31.3	18.8	0.0	3.1	4.7
8	Slovenia	20.8	29.2	12.5	12.5	4.2	0.0	16.7
9	Ukraine	0.0	12.5	12.5	50.0	0.0	62.5	0.0

5 Stakeholder assistance requirements

In general we could consider that for the standard hydrological information products, and for the classic deterministic hydrological forecasts products, in general there is no need for a special assistance for understanding and use such kind of products.

However, in some particular situations, for some special products it is recommended to provide for the stakeholders some assistance, training and guidance on the interpretation and use of these products, especially for the new generation of ensemble and probabilistic type of hydrological forecasting products.

Most respondents indicated that they do not require assistance and / or training for the interpretation, understanding and proper use of the hydrological information and forecasts, except for those in Hungary (55,6%).

Table 10 Stakeholder assistance requirements

No	Country	Assistance requirements (% of respondents)	
		Yes	No
1	Austria	0.0	100.0
2	Bulgaria	36.8	63.2
3	Croatia	17.2	79.3
4	Germany	0.0	100.0
5	Hungary	55.6	44.4
6	Romania	20.0	80.0
7	Slovakia	28.1	71.9
8	Slovenia	33.3	66.7
9	Ukraine	0.0	100.0

6 Suggestions for implementing e-learning tools

Some of the stakeholders have previous experience in using e-learning tools in general and a few for supporting training activities in the field of hydrological monitoring and forecasting (Hungary, Slovenia, Germany, Romania).

These previous experiences include: using electronic materials, training for conducting risk assessments, e-courses on flash-floods , EFAS webinars (Slovenia).

Based on their previous experience, the respondents made some recommendations for the subject and thematic of e-learning courses:

- explain accuracy of forecasts; limitations of forecast accuracy due to input data;
- the uncertainty of predictions and how to deal with it;
- Interpretation of hydrological forecasts;
- use of ensemble forecasts;
- forecasting methodologies and hydrological forecasting models;
- flood forecasting system simulator tools.
- hydrological monitoring networks implementation;
- selection criteria of monitoring stations;
- databases and query options; recommendations for data exchange;
- reliability of hydrological data;
- automatic data quality control and quality assurance;
- statistical methods for analysing hydrological data.

They also mentioned some available online platforms suitable and accessible for implementing e-learning tools: Moodle, Mooc, Web platforms edX, Quora, Coursera.

Another specific recommendation, highlighted during the discussions based on previous experiences, in order to have good results in using E-learning type approach, is needed to organize and provide online technical support for the users of the E-learning tools.

7 Suggestions to improve the effective dissemination of the hydrological information and forecasts

In order to improve the effective dissemination of the hydrological information and forecasts, most of the respondent stakeholders suggest the use of dedicated mobile application tools and web-services capable to provide real-time updates of the warnings (Slovenia, Croatia, Romania, Slovakia, Bulgaria). Romania, Austria, Slovenia and Slovakia mentioned also the electronic distribution of the information via SMS and e-mail.

For a wider audience of users, the respondents from Bulgaria, Croatia and Romania proposed also social media as an appropriate distribution tool.

Respondents from Slovakia, Croatia and Slovenia suggested the direct delivery to interested parties, to the district and municipal administrations at risk. Respondents from Slovakia also suggest to provide hydrological information and forecasts as open data and the unification of format of hydrological and other types of warnings issued by SHMU system, that enables rapid modelling and issuing warnings more precise for specific location.

Improving the effective dissemination of the hydrological information and forecasts by a greater presence on TV, involving as many participants as possible from different professions, creating web portals with customization of different categories of users is suggested by the respondents from Croatia.

Some respondents from Romania mention that in order to warn the population in the shortest time in case of an emergency situation generated by dangerous hydrological phenomena, it is necessary to interconnect the hydrological warnings and threshold exceedance information from the monitoring systems data (hydrometrical stations, reservoirs) with the real time warning system for the population (RO-ALERT).

8 Suggestions for development of new hydrological information and forecast products

Among the most suggested recommendations for new hydrological information and forecast products or product enhancements, we could mention the following:

- Improved radar products for hydrological applications.
- Improved quantitative precipitations forecasting products, especially for high intensity rainfall events.
- Archives with historical data.
- Hydrological forecasts joint with flood risk maps products, and a portal at hydrological service website focusing on emergency events related to floods, droughts, forest fires, warnings.
- Ensemble forecasts shared between countries, propose a unified definition and naming of the ensemble members in order to use the ensembles from upstream countries for forecasting in downstream countries.
- Improved hydrological diagnosis and forecasting ice on rivers phenomena products.
- Improved products for inflows into water reservoirs and better accuracy of forecasts for small river basins.
- Development of mobile applications for dissemination of monitoring and forecasting data.

- Creation of working groups on online platforms, for improving the cooperation between forecasting services and main stakeholders.

9 Conclusions

In most of the participating countries, interested stakeholders use the hydrological information and forecasts received directly from hydrological service or from dedicated web-sites on a daily or weekly basis, they find it easy to understand and they find it useful or very useful. The current availability of hydrological information and forecasts is improved compared to the past.

The quality of hydrological information and forecast products, in terms of accuracy, timeliness and access, perceived by the respondents from the participating countries is considered good by most of the respondent stakeholders.

According to the warning lead time mentioned by the most of the stakeholders In order to properly make decisions and take actions in the case of a forecasted hydrological event (12 - 24 h, or 3 - 6 h). It is necessary to further improve the flash floods forecasting and warning methodologies in order to increase the warning lead time for flash floods, but without increasing too much the false alarm rate.

Although most respondents do not require additional assistance and / or training for the interpretation, understanding and use of the hydrological information and forecasts products, in countries like Hungary, Bulgaria, Slovenia, Slovakia, there is a significant percentage of the interested stakeholders that need additional assistance.

For the implementation of E-learning tools some popular and easy to use online platforms are suggested and the main subjects proposed are related to the accuracy of forecasts and use of ensemble forecasts, and in general description of hydrological forecasting methodology.

The use of dedicated mobile applications and web services capable to provide real time updates of the warnings are among the most popular suggestions for the improvement of the dissemination of the hydrological information.

New radar products and quantitative precipitation forecasts products are needed in order to improve in the future the hydrological forecast performance.