Interreg
Danube Transnational Programme
DAREFFORT

Evaluation of the possibilities of establishment of the international forecasting system's result exchange platform

WP3 Deliverable 3.2.2

April, 30th 2020

STASA Steinbeis Applied Systems Analysis GmbH
Stuttgart, Germany

Dr. Philipp Liedl, Dr. Dirk Meyer, Kim Schwarz

Introduction

One of the objectives of DAREFFORT is the exchange of measured hydrological and meteorological data of the countries in the Danube catchment. Beyond the exchange of measured data, the present deliverable will focus on the exchange of hydrological and meteorological **forecasts**. It is already common practice to exchange these forecasts between neighbouring countries for rivers flowing through both. In most cases this is done through bilateral agreements. However, as this project is about the whole Danube catchment area and the cooperation of the countries in this area, this deliverable is about an exchange of these forecasts in the whole catchment area. Therefore, a survey was performed with the hydrological and also meteorological institutes to evaluate the possibilities, perspectives and efforts of establishment of a Danube wide exchange platform for forecasting results. The related questionnaire can be found in the appendix of this document. In this deliverable the answers of the individual countries are documented in detail in chapter 1, as stated by the institutions in the countries and summarized in chapter 3. In chapter 2 examples of relevant existing international platforms are presented. Summary tables can be found in the appendix (chapter 4). The questions of the survey are listed in chapter 5 in the appendix.

1 Analysis of the current exchange of forecasting results and the perspectives

Based on the questionnaire the following chapters summarizes possibilities, perspectives and efforts of establishment of a Danube wide exchange platform for forecasting results.

1.1 Austria

In Austria, the forecasting institutes of the individual federal states completed separate questionnaires. The answers are listed individually below.

1.1.1 Styria

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

Styria is running two international forecasting models, one for the Mur and one for the Raab river. For the Mur system, all forecasting results of the model are delivered to Slovenia, Hungary and Croatia each hour. For the Raab system, which is operated together with Burgenland, the results are delivered to Hungary also each hour. The benefit is on the side of the downstream country. The Danube-wide exchange provides a larger picture of possible flood events. Meteorological parameters (precipitation and temperature) and hydrological parameter (discharge) are the most important parameters to exchange. The interval is dependent on the operation mode of the systems. For selected gauges it makes sense to exchange ensemble forecasts.

Meteorological forecasts

Styria does not currently use meteorological forecasts from other countries, even if this would be possible. The exchange of forecasting results would have the advantage that the uncertainties of meteorological forecasts can be better estimated. Styria can think of using meteorological forecasting results from an existing international platform. The most important parameters would be precipitation and temperature.

Technical capabilities

Hydrology

In Styria, forecast results can only serve as additional information. There is no need to imply the forecasts of other countries directly into the own forecast model. It would be possible to provide hydrological forecasts for DAREFFORT in the same way as measured data. This would be done via an FTP server and the data format would be the DFS file format used by DHI-software. The forecasts are assigned to the hydrological stations and can be delivered as time series. It would not be a big effort to send hydrological forecasts to an exchange platform.

Data Policy

There should be a common Austrian position on the issue of whether hydrological forecasts should be sent. No restrictions are known.

1.1.2 Tirol

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

Tyrol has an automated mutual data exchange of discharge forecasts for selected gauges with Bavaria. The advantages of exchanging forecasts with other countries are the display of a range of discharges (due to different hydrological models and input data) and simplified communication in the event of flooding. An exchange across the Danube currently has hardly any recognisable advantages for Tyrol. The bilateral exchange between upstream and downstream riparian is more sensible and sufficient. Tyrol would be able to incorporate hydrological predictions, but the upstream riparian region of Switzerland does not currently provide any forecasts as no representative model for the Inn is operated in Switzerland. In order to be able to install forecasts, there are a number of prerequisites: rapid provision, reliability, automatic data exchange and, if necessary, technical consultation on the model results. When using the same meteorological forecasts, the exchange of ensemble forecasts can be useful.

Meteorological forecasts

Up to now, Tyrol has not received any meteorological forecasts. For Tyrol, too, there are currently no recognisable advantages of exchanging meteorological forecasts between the countries, as these forecasts cannot be coordinated with the local weather services. However, the institute would be able to use the forecasts. The ZAMG models already use ECMWF models. As a direct model, however, the forecasts from international platforms are unsuitable for the Alpine region due to the low spatial resolution.

Technical capabilities

Hydrology

Forecasts could be passed on via a Web API. The forecast results are assigned to the hydrological stations and can be delivered as time series. However, an exchange platform is not considered to be useful, but rather bilateral exchange.

Data Policy

Since a bilateral exchange already takes place and this is sufficient for Tyrol, there is no information on data policy

1.1.3 Lower Austria

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

Lower Austria is already exchanging hydrological forecasts with various countries. Discharge and water level are received once per hour for the Danube at the gauge Passau from the LfU in Germany. From Czech Republic lower Austria receives forecasts for the Dyje and Morava (once a day discharge and water table). Hydrological forecasts for the Danube are transmitted to Slovakia. Four times a day discharge and water level are sent.

By integrating the forecasts of other countries into the own model, the special knowledge of the upstream model and the experts can be used, which is expected to improve the forecast results. The exchange of forecast results throughout the Danube basin can help downstream countries to improve the model of these countries, if not already done through bilateral exchange. The most important parameters are water level and discharge which are exchanged once per hour. Other parameters depend on the pursued objective (water quality modelling...)

Meteorological forecasts

So far, the hydrological institute of Lower Austria does not receive meteorological forecasts from other countries. The expected direct benefit is small, as it can be assumed that each national institute will be able to produce the best meteorological forecast for its own country. The use of other meteorological forecasts could be compared with the use of additional ensemble members and can illustrate the variability and uncertainty of weather events. The institution cannot currently include meteorological forecast in the predictions either, but using meteorological forecasts from already existing international platforms is an option. For this the model structure needs to be adjusted to make use of other meteorological forecasting results, which needs financial resources which are limited. Precipitation and temperature in an hourly interval would be the most useful parameters.

Technical capabilities

Hydrology

The use of forecasts from other countries is already operational. Prerequisites for this are the use of the same data format or the ability to convert data into the desired format (which should not be a problem at all). The Institute would be able to provide forecasts in the same way as measured data. All data are processed via BMLRT (Austrian hydrographical central office). All standard data formats used by Wiski (Kisters) are possible (e.g. zrxp, csv, xml, WaterML, ...). The effort to deliver hydrological forecasting results is depending on the requirements for data format or other conditions, 1 - 5 working

days. The implementation of new hydrological forecasting results from other countries in the models would require a project for which external services are needed. As this is not a concrete plan, costs can only be estimated at € 10,000 – € 20,000. There is no actual demand at the moment for using further hydrological forecasting results from other countries in the forecasting models of Lower Austria.

Data Policy

In accordance with BMLRT (Austrian hydrographical central office) Lower Austria is ready to provide hydrological forecasts. It is important that there is no liability accepted for the correctness of the forecasts. The publication of the forecasts is not allowed. In exceptional cases a publication can be agreed upon, for this a written agreement is necessary.

1.1.4 Upper Austria

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

Upper Austria is also already exchanging forecasts with other countries. The institute receive forecasts from Germany from the LfU and pass on forecasts within Germany to Lower Austria. Overall, the downstream countries benefit from the forecasts. Although forecasts are exchanged throughout the Danube basin the downstream countries have a benefit and get the best forecasting results of local catchment areas and would have the possibilities to compare the own (hydrological) results with the results of the national organization. Especially the discharge is the relevant parameter for the exchange. The interval depends on the catchment area and the forecasting time period. Exchanging ensemble forecasts is useful, but it has to be the same records (ensemble dataset) - to avoid overlapping of different datasets.

Meteorological forecasts

So far, Upper Austria does not use meteorological forecasts from other countries. More results would provide a better estimate of the uncertainty of the results. However, the decision which concrete forecasting value is the best will also be more difficult. To include meteorological forecasts, extra converters and tasks are needed. The institute can also imagine using data from existing international platforms. However, the availability of the data must be guaranteed. The most important parameters are precipitation and temperature. The transfer interval should be between hourly and six times a day.

Technical capabilities

Hydrology

Hydrological forecasts from other countries can already be used (Germany Danube, Inn river Salzach river). The software and the format must be the same or data has to be converted. The institute could send the forecasts with a few adjustments in the system (software) the same way as the measured data. The format would be .zrxp (Kisters) and the data would be associated with the position of the hydrological stations. For the measurement stations (gauge) with existing forecasting results the results can be delivered as time series. Sending or using hydrological forecasts from other countries would require a project which takes a few days to implement.

Data Policy

The decision whether hydrological forecasts are passed on to other countries lies with Austria. There are no special policy restrictions known. There can be only data exchange with government institutions and no data exchange with third parties. Concerns are the wrong use of data and wrong interpretation of quality or accuracy of result and the liability.

1.1.5 Carinthia

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

In Carinthia hydrological forecasting results of the Drava River are shared with the Slovenian Environment Agency (ARSO) and the Verbund Hydropower AG and Federal Hydrographic Department of Tyrol. The results are transmitted textual per E-Mail or by phone during flood events at irregular intervals (usually after model runs). The peak discharge and its time of occurrence is the most important parameter of interest. The purpose of the exchange is the discussion of the predicted peak discharge. The synopsis of results is used to evaluate different model outcomes. If the hydrological forecasts are exchanged throughout the entire Danube basin More information can be used to assess the hydrological situation. Most interesting are a hydrograph of discharge and accumulated precipitation per selected catchment areas for the Drava River. The requirement is a detailed model of the Drava River and there is no experience with ensemble forecasts so far. Maybe it would make sense to receive a few important ensemble results.

Meteorological forecasts

For meteorological forecasts ZAMG-INCA data is the only input used. If there would be input from other countries more information can be used for the assessment of the hydrological situation. So far, the institution is unfortunately limited to the model environment and cannot include other meteorological forecasts. In the future, it's planned to enable the integration of further forecasts, because there is an interest in the use of further input data. The bottleneck is the current system environment, which does not allow the integration other platforms. It is planned to upgrade the system environment within the next two years. The main interests are precipitation, temperature, evaporation, snow line and snow-water equivalent

Technical capabilities

Hydrology

The institute uses HBV as hydrological model, which runs independently based on meteorological input data (rainfall and temperature). Therefore, there is no possibility at the moment to include other results to the model itself. It would be possible if the models were harmonized. The model is currently not operated continuously. The model is manually started in the case of a flood event. Therefore, an automatic exchange is not intended now. It is planned to implement a regularly operating model, where model results can also be exchanged by a Web-API (e.g. TopoSoft TSTP) or FTP as ASCII files.

There are results for 82 river points, where most belong to hydrological measuring stations and a few to other important positions (e.g. after river mouths). In future, it is planned to enable the transmission of time series.

Data Policy

The institution is in general interested in an exchange. This should be coordinated by the Ministry BM LRT.

1.1.6 Salzburg

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

Salzburg is already exchanging forecasts with Germany/Bavaria. The institute also sends forecasts to the responsible federal states of Austria, Upper Austria, Lower Austria, Styria. Advantages are various redundancy in the forecasts. Hydrological forecasts of other countries can already be used. FEWS is the system in use, on which workflows for hydrological forecasts are running. The file formats must be defined. For exchanging forecasting results parameters should be the result of a designed system for simple exchange; there should be a lot of information from metadata (calculation routine, input data, etc.) The exchange file formats of ensemble forecasts is rather not useful, because the variety is too big. Metadata information would be very important.

Meteorological forecasts

Meteorological forecasts from other countries are not yet available to Salzburg. The advantage would be that one would have different meteorological input. Forecasts from other countries could already be used and the institute can also imagine using existing international platforms. Parameters should be the result of a designed system for simple exchange file formats; there should be a lot of information from metadata (calculation routine, input data, etc.)

Technical capabilities

Hydrology

Hydrological forecasts can be transmitted in the same way as measured data. The format would be *zrxp and *xml. Hydrological forecasts are located to the position of hydrological measuring stations and could be delivered for selected stations as time series. The effort to deliver hydrological forecasting results depends on the amount of stations and data exchanged. A calculation of the technical effort is not possible. The effort to use hydrological forecasting results of other countries depends on the exchange file format and the FEWS system.

Data Policy

Salzburg is not willing to provide hydrological forecasting results to an exchange platform for the countries in the Danube catchment. The hydrograph events are short, because of the rivers in the Federal state Salzburg – max. catchment size is around 6000 km. Also, to be considered is the liability for the data.

1.1.7 Viadonau

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

Water level forecasts of viadonau are published in the internet (website), on a mobile app and are so available to everybody. There is no specific exchange. Viadonau provides hydrological measured data and forecasts to "danubeportal.com" and so to everybody interested. Generally downstream countries can benefit from exchanging hydrological forecasts. The discharge is the most important parameter and the exchange of ensemble forecast would also make sense.

Technical capabilities

Hydrology

Viadonau can import and visualize hydrological forecasts from other countries but cannot include the data into the own forecast calculation. That would require a software updates and special configuration. Viadonau provides data via several websites and mobile apps (viadonau.org or danubeportal.com). The format of the data is .txt. The forecasts are assigned to hydrological stations and can be delivered as time series. Sending hydrological forecasts requires little effort, while implying hydrological forecasts from other countries requires a large effort.

Data Policy

It has to be stated by viadonau, that within the last years several projects and initiatives worked on building up exchange platforms. These platforms usually stopped working when the project ended. Viadonau considers these platforms as not sustainable and is not willing to put special efforts with such projects anymore. There are no restrictions for the data, because data is already publicly available.

Other notable information

Viadonau again wants to mention the serious concern about a number of databases and exchange platforms that have been established in the last years and quickly stopped working with the end-date of the project behind it.
Hydrologists usually think in long time periods like decades or centuries so there is no interest in filling databases or exchange platforms that stop working after a few months.

1.2 Bulgaria

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

The NIMH in Bulgaria does not yet exchange hydrological forecast results. Therefore, the institution neither supply nor receive forecasts from other countries. However, there is an interest in exchanging hydrological forecasts as this would improve the forecasting of transnational rivers. Considering the Danube catchment, an exchange of forecasting results would improve the results and extend the lead time for extreme events. The most important forecasting parameters exchanged in the Danube are considered to be air temperature, precipitation and discharge.

Bulgaria is currently not able to use hydrological forecasts of other countries for its forecasts. A pre-condition for this would be bilaterally signed agreements.

Meteorological forecasts

In contrast to hydrological forecasts, NIMH already receives meteorological forecasting results. The WMO provides the minimum and maximum temperature and the main weather symbols of other countries for some cities once per 24 hours. In addition, NIMH has access to the ECMWF and use its forecasts in the daily work. Receiving further forecasting results from other countries could allow motion-tracking of the meteorological processes. For this purpose, air temperature and precipitation should be exchanged in 1h, 3h, 6h, 24h intervals.

At the moment NIMH is not able to integrate meteorological forecasting results into the own forecasts. A prerequisite for using meteorological forecasts is a username and password for the platform to access it.

Technical capabilities

Hydrology

Within the framework of the DANUBE Project - WATER, the institute provides the forecast information in 24-hour intervals, via FTP (discharge) for the end points of the main Danube tributaries on Bulgarian territory. The data format is ASCII. The hydrological forecasts of the NIMH are assigned to the position of hydrological measuring stations. Technical requirements to deliver hydrological forecasting results would be staff and a remote FTP server. The technical requirements to receive hydrological forecasting results would be staff und storage.

Data Policy

The NIMH would provide forecasting results for the countries involved in the project. The hydrological forecasting results should be distributed only to project partners and in the database only the most recently published ones should be visible for the partners.

Meteorological forecasting Institute

NIMH already provides meteorological forecasting results to the WMO: the minimum and maximum temperature and the main weather symbols for some cities once per 24 hours. It is not possible to provide the forecasting results for the DAREFFORT project in the same way as the measured data.

1.3 Croatia

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

The DHMZ in Croatia already exchanges forecasting results with other countries.

Receiving hydrological forecasting results:

Slovenia (ARSO) sends results from the hydrological forecasting model for most downstream hydrological station. ARSO sends the parameters water level and discharge in hourly time step every hour in the data format Mike11 (.dfs0).

Hungary (OVF) sends the forecasts for selected points on Mura, Drava and Danube. The data is the water levels in 6-hourly time step hydrological forecast once a day in the xml format.

Sending hydrological forecasting results:

To Bosnia and Herzegovina (AVP) the DHMZ is sending hydrological forecast for two hydrological stations, hourly. DHMZ also runs the Una River model, which is connected to the Croatian Sava forecast model, hourly. After each run the whole model (setup and result files) is compressed and put on a FTP server so it can be downloaded and processed (Mike11 file formats).

To Sava Commission DHMZ are sending forecasted Sava model's results for the Sava-FFWS. It contains discharge and water level forecast for 141 hydrological stations. The parameters are precipitation, temperature and snow water equivalent. All forecasted values have hourly time steps and are send hourly in txt format.

Croatian largest rivers – Danube, Drava and Sava are transboundary rivers with significant catchment areas upstream of Croatia. The neighbouring upstream countries Slovenia and Hungary model parts of the catchments and send downstream forecast results which serve as inputs for the forecasting models of DHMZ. Bosnia and Herzegovina use the Sava River forecast results of Croatia as the downstream boundaries for the models of the Una and Vrbas Rivers which are inflows to Sava River.

All the participating countries have benefits, because each country has the best forecasting results for the corresponding area which can serve as the optimal input for the respective model.

Exchanging hydrological forecasting results for the whole Danube catchment would rise awareness of hydrological conditions in Danube basin on larger scale, propagation and regime of flows from source to mouth and improve the overall understanding of hydrological cycle in that region. It could also enable development of a large-scale forecasting model that would cover the whole Danube catchment.

It would also be an opportunity for each country to improve the forecasting results at the outlets of the country by assimilating the data to measurements of downstream cross-border profiles (hydrological stations), which would be in best interest for both.

The most important forecasted parameters to exchange would be the discharge and water level, preferably in hourly time steps. Exchange interval can be reduced to a few runs per day If available it would be also useful to exchange ensemble forecast.

Meteorological forecasts

The DHMZ does not receive meteorological forecasting results from other countries.

Sharing of meteorological forecasting could provide an advantage in allowing earlier detection of weather instabilities, which can improve the preparation for significant flood events. In addition, countries with fewer resources for meteorological modelling can use the forecasting results of other countries. An already existing platform that could be used is the ECMWF ensemble forecast.

The most important forecasted parameters that should be exchanged are precipitation, temperature, snow depth, evapotranspiration in an hourly frequency. The interval of forecast exchange depends on the frequencies of the model runs.

Technical capabilities

Hydrology

The transferred data is made available on an FTP server in the data formats dfs0, txt or csv. Hydrological forecasts are assigned to the position of hydrological measurement stations. It would only require slightly adjustments of similar processes which are already established to exchange forecasting results with other partners on an exchange platform.

The DHMS has implemented hydrological forecasting results of other countries in the models. To include forecasting results of other countries the data should be in the same format (or needs to be converted) as the input of the forecasting software. For example it is Mike11 time series format (.dfs0) for existing Sava River basin model. Also, consultancy from someone experienced in model development is needed to be able to make adjustments to the existing models. For further modifications in the future additional consultant expertise would be needed.

Meteorology

Meteorological forecast results of other countries could only be used with significant effort and expert consultancy. The models of other countries used for the national meteorological forecast have to be adjusted to suit to the national model.

Data Policy

The DHMZ would exchange the forecasts on a platform for exchange within the Danube catchment. This would require that the ownership of the input data remains the property of the providers and that the data is not passed on to third parties without authorization. Additionally, data providers should not be responsible for the consequences of using their data in other applications and forecasting systems.

Meteorological forecasting Institute

Current provision of forecasting results for other countries

The DHMZ is sending meteorological forecasts from Aladin and ECMWF models to Bosnia and Herzegovina in txt format:

ECMWF – 2 times a day:
- Temperature with 3-hourly timestep
- Accumulated 3-hourly precipitation

Aladin – 4 times a day:
- Temperature with 1-hour timestep
- Accumulated 1-hour precipitation

Additionally, DHMZ sent Aladin precipitation in GRIB format, 4 times a day to (South East Europe Flash Flood Guidance System) and Aladin accumulated precipitation and temperature in hourly time step, grib formats, 4 times a day to the SAVA Commission

Technical requirements

Meteorological forecasts could also be provided by an upload to a FTP-Server, like measured meteorological data**.**

Data Policy

The DHMZ would exchange the forecasts on a platform for exchange within the Danube catchment. This would require that the ownership of the input data remains the property of the providers and that the data is not passed on to third parties without authorization. Additionally, data providers should not be responsible for the consequences of using their data in other applications and forecasting systems.

1.4 Czech Republic

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

In the Czech Republic there is already an exchange with Austria and Slovakia. Austria delivers once a day (or each time the forecast is updated) hourly forecast discharge. CHMI provides for Austria six forecasting profiles, three of the profiles are situated in Austria, but calculated by the Czech institute. With Slovakia there is a bilateral exchange of hourly predicted flow rates. The CHMI delivers forecasts for five profiles, one of the profiles is situated in Slovakia, but calculated by the CHMI.

The forecasting results of other countries are necessary to have control about the incoming flow of tributaries. It can be calculated also in the own country, but mostly with less data and less knowledge of the river basin, so the results may be less accurate. In the case of the Czech Republic as an upstream country, benefits are different from downstream countries. The hydrological model covers also the Austrian and Slovakian part of Morava catchment and the institution receives all input data from foreign colleagues. Main benefit of forecast exchange for the CHMI could be seen in feedback from a wider range of users. To exchange the forecasting results within the whole Danube catchment gives an overview of all the tributaries incoming flow from local hydrologists with the best knowledge of the river basins. It would be a source of inspiration and a possibility to compare the results.

To include hydrological forecasts from other countries several requirements must be fulfilled: data exchange procedure, adjustment of the current forecasting process, adjustment of the hydrological model. Adjustment of Delft-FEWS platform.

The most interesting forecasted parameter to exchange would be hourly discharge. Data must be transferred immediately after the forecast is updated. During floods it is beneficial to provide users with the information about next supposed time of forecast update. It would also make sense to exchange ensemble forecasts.

Meteorological forecasts

CHMI does not receive meteorological forecasting results from other countries, but uses various NWP models (ALADIN, ICON, ECMWF, GFS). The institution would also be able to integrate meteorological forecasts of other countries into the own models. Obtaining meteorological forecasts would improve the accuracy, as local models are more accurate.

The most interesting meteorological forecasted parameters are hourly precipitation and hourly temperature.

Technical capabilities

Hydrology

The institute CHMI is able to provide forecasting results the same way as measured results in the file formats waterML2.0, .txt, .csv. The hydrological forecasting results are assigned to the position of hydrological measuring stations. The forecasts could be delivered as time series per measuring station. It requires setting an export method on the database and setting the transmission session in the main exchange computer. To use hydrological forecasting results of new countries an extra data exchange point has to be set up, a script to get the data into common database is programmed and changes in the hydrological model by its author/administrator need to be done. Additionally, changes in pre and postprocessing scripts and order changes in Delft-FEWS platform are necessary.

Data Policy

CHMI would provide hydrological forecasting results for the countries of the Danube catchment, but it is important that there is no responsibility for incorrect interpretation of forecast, because it includes high uncertainties.

Meteorological forecasting Institute

Current provision of forecasting results for other countries

The Czech Hydrometeorological Institute provides a daily dissemination of 16 NWP products to the LACE member institutes (Regional Co-operation for Limited Area modelling in Central Europe). Forecasts with 3h step are run till 72h, except the run from 18h UTC, which goes till 54h. Parameters: Temperature at 2m, at levels 500 and 850 hPa; Geopotential height at levels 500 and 850 hPa; Mean sea level pressure; Wind direction and speed and Wind gusts at 10 m; Low, medium and high cloud cover; Convective, stratiform and total precipitation; Snowfall-line height.

Technical requirements

Meteorological forecasting result could be provided via FTP-Server as grid data.

Data Policy

For example, the data policy of the LACE (Regional Co-operation for Limited Area modelling in Central Europe) could be used.

1.5 Germany

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

Germany (LfU) and Austria exchange hourly discharge and discharge forecast results for the transnational catchments Inn, Salzach, Danube, and more. Forecasts up to 96 h (status 2019) from an automatic model are delivered every hour. The advantages of exchanging forecasts are the best information available for forecast in downstream countries are included, for example best information about regulated discharge from reservoirs. In the Danube catchment area, it would have the advantage that a continuous forecast with the same meteorological input or even ensemble forecasts (ECMWF) would be possible. For the LfU it would also make sense to exchange ensemble forecasts.

Meteorological forecasts

The LfU buys forecast products from ZAMG (Austria): precipitation, hourly rate and twice daily. Advantages can be that forecasts are optimized for regions, for example alpine und pre-alpine regions. Additionally, meteorological forecasting results from an international platform (ECMWF) are used. However, the LfU does not obtain these directly from ECMWF but from national forecast centres from German Weather Service. This way, the data is masked for the region and in the same format as the national forecast. Throughout the Danube catchment the input data for the water balance model should be passed on.

Technical capabilities

Hydrology

The LfU is able to integrate hydrological forecasts from other countries into its own forecasts. A prerequisite for this is that the time resolution is the same as in the hydrological model. Furthermore, the lead time must be long enough (i.e. the same as in the models) and a common data exchange format must be used. The most important parameter is hourly discharge. It would be possible to offer the forecast results in the same way as the measured data. The forecasts have a format based on csv (e.g. LARSIM data format LILA/KALA). Other formats would also be possible but have to be implemented first. Hydrological forecasts can be provided as time series per station. Only a small (technical) effort would be necessary to deliver and implement hydrological forecasting results.

Data Policy

The LfU passes on its forecasts under the condition that there is a disclaimer. Furthermore, data may not be distributed to third parties and it has to be stated that the hydrological forecasts have the character of automatically created, unchecked and raw data.

Other information's

In case with Austria it seems to be easier for the LfU to exchange forecasts directly between the forecast's centres without international platform.
The calculation of an ensemble forecast on the base of the same meteorological forecast would be interesting.

1.6 Hungary

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

OVF receives hydrological forecasts daily from Bulgaria, Romania, Serbia and Slovakia. Data is obtained via email or through the Hungarian Meteorological Service. The two parameters OVF mostly receives are water level and discharge forecasts. OVF provides water level and discharge (for some countries) forecasts daily to Romania, Slovakia, Bulgaria, Austria, Croatia and Serbia with a forecasting range varying up to 1-6 days. Forecasts of neighbouring countries are useful for result comparison and the forecasts of the upstream stations could assist to improve the water level forecasts prepared for the lower stream stations (it could give additional information for example on the amount of water that is planned to be retained by dams on the upper reaches of the river). Exchange of water level and discharge forecasts would be useful. Hourly resolution would be the best but 6, 12, 24 hourly resolution

is just as good. It is important to know the effect of human interventions, for example operation of hydropower plants and dams, discharge of the dams. The OVF does not prepare ensemble forecasts

Meteorological forecasts

The OVF does not receive any meteorological forecast from neighbouring countries, but OVF uses ECMWF precipitation forecasts in its operational forecasting activity. Exchange of meteorological forecasts could be beneficial for improving the precipitation forecasts. The precipitation forecasts of neighbouring countries with the performed local adjustments to the numerical forecasts based on terrain, natural endowments and the current weather conditions could improve the coarse resolution of the ECMWF precipitation. The more results you are able to compare, the more accurate your forecast will be. At the moment the OVF cannot use meteorological forecasting results of other countries, but the system could be developed. OVF uses ECMWF forecasts in the operational forecasting activity. Also, additional support to hydrological forecasts is assured by global GFS model predictions, which are available (free of charge) on the website of NOAA. Forecasts of precipitation and air temperature would be beneficial. Hourly resolution would be the best but 6, 12, 24 hourly resolution is just as good.

Technical capabilities

Hydrology

The OVF already uses hydrological forecasts of some neighbouring countries in its operational forecasting activity. The system can automatically receive forecasts for 6 UTC in the morning. Furthermore, forecasts for any time can be used manually.
It is possible for OVF to provide hydrological forecast results like measuring data in the same format as observed properties are going to be exchanged, pursue the recommendations of WMO. The forecasts are assigned to the position of the hydrological measuring stations and the hydrological forecasts could be delivered as time series per measuring station. The condition for the use of hydrological forecasts is that the time resolution of the exchanged forecasts should be adequate so the OVF are able to insert the forecasts into the model. In order to use the exchanged forecasts, the forecasts should arrive before the start of the calculations.

Data Policy

Hydrological forecasts can be provided if the source is cited by the users.

1.7 Moldova

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

The State Hydrometeorological Service (Hydrological Centre) of Moldova receives and delivers information on flow water and water levels, especially during flood events. This exchange takes place with

Ukraine and Romania. The advantage of this exchange is that it allows to know the hydrological situation of transborder rivers. It also allows to solve more efficiently emergency situations in case of floods. The main parameters to be exchanged are flow water and water level (daily). For Moldova it makes no sense to exchange ensemble forecasts.

Meteorological forecasts

The State Hydrometeorological Service (Hydrological Centre) of Moldova receives and delivers meteorological information such as wind speed, temperature, precipitation and snow. This exchange takes place with Romania and Ukraine. This leads to an improvement in meteorological forecasting. The institution also already uses international platforms with meteorological forecast results. A bottleneck can sometimes be the financial support. The most important parameters are precipitation, temperature and wind.

Technical capabilities

Moldova is able to integrate hydrological forecasts from other countries into the own forecasts. Which requirements have to be met has to be discussed and analysed. The hydrological and meteorological forecasts will be delivered via the web and are assigned to the position of the hydrological monitoring stations and can be delivered as time series. There is no (technical) effort to implement the hydrological forecasts of other countries.

Data Policy

The State Hydrometeorological Service (Hydrological Centre) of Moldova is willing to exchange hydrological and meteorological forecasts without restrictions.

1.8 Romania

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

The NIHWM exchanges hydrological forecasts with neighbouring countries in real time, for selected forecast points. This exchange is based on existing bilateral data exchange agreements. In general, Romanian National Hydrological Forecast Centre provide every day official short and medium term hydrologic forecasts (with a lead time up to 7 days) hydrological forecasts both for interior rivers and for the Romanian sector of the Danube. For NIHWM it is very important to exchange hydrological forecasting results for the transboundary River basins, with neighbouring countries, both for short response time River Basins (e.g.: Upper Tisza, Upper Siret and Prut River Basins with Ukraine), and for longer response time River Basins (e.g. Danube – upstream entrance in Romania). As a downstream country on the Lower Danube the NIHWM could also benefit not only from forecasts exchanged with neighbouring countries, but also with other countries from the Upper and Middle Danube River Basin. This could help to extend the hydrological warning lead time and increase the accuracy especially during extreme flood events. Hydrological forecast elaboration on the Romanian sector of the Danube is

very important also during low flow periods, for Cernavoda nuclear power plant, navigation and other water users. The exchange of hydrological forecasting results within the whole Danube catchment could provide great benefits also for the low water forecasts lead time and accuracy. The prerequisites for this are standard exchange format, or a common agreed format and communication channel. The data must be updated periodically (for example, daily). The regularity has to be determined depending on the hydrological conditions.

The most important parameters are water level and discharge. These can be updated daily with timestep between 1 hour and 24 hours. A forecast lead time of 3 - 5 days would be very useful. Or at least 48h for the Upper Danube, 3 - 5 days for the Middle and Lower Danube. It would also make sense to exchange ensemble forecasts. It is currently a common understanding between experts in the field of hydrological forecasts, that ensemble forecasts are the best way to deal with the unavoidable meteorological and hydrological forecasts related uncertainty.

Meteorological forecasts

Official meteorological forecasts directly from other countries are not currently received by the NIHWM. The institution uses NWP products and official meteorological forecasts and warnings received from the Romanian National Administration of Meteorology. As a country within the Lower Danube River Basin, it is important to have meteorological forecasts results for the entire Danube River Basins. Currently, forecasts products from other NWP and/or other countries are not used directly as input to hydrological models, but they are used within the analysis / decision process in order to establish what future scenarios of precipitation are taken in consideration when the hydrological warnings and forecasts are elaborated. On a recently implemented research project NIHWM uses ECMWF ensemble forecast with 15 days lead time, as input into a hydrological model for the Upper Prut River basin. The hydrological model was developed in cooperation with Ukraine in the EAST AVERT transboundary EU project. For short and medium term, one important priority of NIHWM is to extend and improve the cooperation in regional projects with operational hydrological forecasting components / objectives (e.g. SEEFFG, EFAS, SEE-MHEWS-A). As parameters, the amount of precipitation and the air temperature should be exchanged as a minimum. For good results with the hydrological models, it is needed to have NWP data with a high spatial and temporal resolution (e.g. 4km spatial resolution and hourly temporal resolution). Other parameters might be needed depending on the complexity of the hydrological model.

Technical capabilities

Hydrology

NIHWM is already using hydrological forecasts from other countries in the existing operational forecasting models and methodologies, but it is important to mention that NIHWM plans to improve the National Forecasting System capabilities in the next 3 – 5 years, for a better integration and use of hydrological forecasts from other countries. Hydrological forecasts could be made available as time-series, similar like the observed data. The data format needs to be a common agreed format (e.g. csv). The results are mainly assigned to hydrometric stations but can also be configured for special locations like reservoir inflow, rivers confluence or other locations. With some exceptions, official hydrological forecasts cannot currently be delivered as time series. The hydrological model output is currently mainly used internally, in the process of elaboration of official hydrological warnings and forecasts. For the stations included in the official daily hydrological forecast report it may be possible in the near future to provide forecasts, as time series with 24-hour time step. Furthermore, in the medium term it is planned to develop the national forecasting system to include ensemble hydrological forecasting

capabilities, at that time delivering the forecasts as time series for selected stations will be possible. The estimated technical effort to enable the institution to send forecast products is 2-3 months of development, with internal resources. After the National Flood Forecasting System upgrade process, in the next 4 – 5 years, the effort will be significantly reduced. Regarding the use of external forecasts, NIHWM already uses hydrological forecasting results from other countries, and it is also planned to further develop the forecasting system functionalities in the near future for better use and integration of external forecasts results the effort to use external forecasts will not be important. At the moment NIHWM estimates that 1 -2 months development with internal resources, for a limited external forecast product use and integration are needed. After the National Flood Forecasting System Upgrade process, in the next 3 – 4 years, the effort will be significantly reduced.

Data Policy

The NIHWM could exchange selected official forecast products for selected stations, and also the warning messages. The prerequisite for this exchange, is to have a clear indication of the source / provider of the hydrological forecast and warning.

1.9 Serbia

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

The RHMSS already exchanges hydrological forecasts once a day with Hungary, Romania and Bulgaria. With Hungary the RHMA exchanges forecasts for the next two to four days for the Danube and the Tisza. Romania sends forecasts for the Banat and tributaries of the Tisza. The RHMSS sends Romania forecasts for the Sava, the Great Morava and the Danube. The forecasts for the Danube are also sent to Bulgaria. From Bulgaria the RHMSS receives forecasts to the Ruse stations. The benefit is a daily clear picture of the hydrological situation and the forecasts of the shared rivers. For the Danube, sharing the forecasts means a better risk management in extreme hydrological situations. The main forecast parameters that are shared are water level and discharge once a day. During a flood wave the parameters should be shared more often. Ensemble forecasts do not make sense for the RHMSS at the moment but are a possibility in the future.

Meteorological forecasts

So far, the RHMSS does not receive meteorological forecasts from other countries. An advantage in the exchange of meteorological forecasts would be more accurate announcements of meteorological extremes in the area of neighbouring countries from the basin, although some first indication exists through the EU meteoalarm. However, the institution uses the products of the ECMWF and DWD in the operational use for the prediction of precipitation and temperature conditions and as initial condition for launching many models. The parameters precipitation, rain intensity and thermal gradient should be exchanged once a day, more often in extreme conditions.

Technical capabilities

Hydrology

The RHMSS is able to integrate hydrological forecasts from other countries into its prediction. The forecast results could be made available via FTP server or Web API. The data format has to be determined. The hydrological forecasts are assigned to the positions of the hydrological monitoring stations. The data can only be provided as time series for some hydrological profiles.

Data Policy

After discussing the necessary details, RHMSS would be willing to provide hydrological forecasts as well. These hydrological forecasts can be used solely for the purpose of managing the risk of extreme hydrological events in the Danube basin.

Meteorological forecasting Institute

RHMSS does not provide forecast to other countries. Depending on the format it would be possible to provide meteorological forecasts in the same way as the measured data in the DAREFFORT project. This would be done via an FTP server. The data format still has to be specified.

1.10 Slovakia

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

The SHMU already exchanges forecasts data with several countries. Every hour the institute receives the forecasts for Kromeriz, Straznice, Ladná and Moravský Svaty Jan/ Hohenau station from the Czech Republic. The SHMU sends the discharge of the Šaštín Stráže and Moravský Sv. Ján stations to the Czech Republic every hour. Austria sends every hour predicted discharges for the stations Ybbs, Kienstock, Korneuburg, Wildungsmauer and Thebnerstrassl. From Ukraine the SHMU will receive every 24 hours predicted peak of flood wave (water level and discharge). Additional the SHMU provides once a day the forecasts in the frame special international report HYDRA HYFOR containing the forecasts for 5 station on Danube (Devin, Bratislava, Medvedov, Komárno, Štúrovo,) 1 station on Morava river (Moravský Svatý Ján) and 1 station for Bodrog (Streda nad Bodrogom). These forecasts are available for all Danube countries. The exchange with neighbouring countries provides an outlook on the hydrological situation in these countries and better preparation for flood situations. In the Danube catchment area, forecasts from neighbouring countries could be used to be better prepared for upcoming flood situations. SHMU assumes that each country can better and more appropriately adapt its part of the river to national needs and conditions. The main parameters to be exchanged are discharge in hourly steps and hourly update frequency. It would also make sense to exchange ensemble forecasts.

Meteorological forecasts

In the frame of the international exchange SHMU receives meteorological data from the ECMWF. The advantage is that it is an additional input for hydrological models to calculate hydrological forecasts for comparison. The meteorological parameters most needed are precipitation and air temperature in hourly steps. SHMU is the member of ALADIN consortium and make meteorological forecast only for national service.
SHMU does not send meteorological forecasts to other countries. Within the DAREFFORT project no meteorological forecasts shall be exchanged. Meteorological forecasts were not intended to be provided for the DAREFFORT project. Goal of the project is to exchange hydrological data, not meteorological forecasts.

Technical capabilities

Hydrology

SHMU can use for hydrological forecasts, forecasts from other countries. Prerequisite for this are stable data formats and matching time steps and update frequency. Hydrological forecasts can be provided in the same way as measured data. The data format would be xml. Forecasts are associated with the position of hydrological monitoring stations and can be provided as time series. As a technical effort, various points would be involved: implement the forecasts to database, changes in hydrological model structure, quality analysis of external forecasts, changes in forecasting methods and methodologies.

Data Policy

If the following conditions are met, SHMU can also pass on hydrological forecasts. Hydrological forecasts would be provided only for hydrological stations defined in the project:
Data use is allowed only for specified and agreed purpose, for Danube HIS and so for the project or exchange platform and for the Project partners – other hydrological forecast services for the official duties and the own research (not agreed yet).
Restriction: Not for commercial use, not for redistributing for other parties/bodies without data provider permission.

The SHMU also expresses concerns about the exchange of hydrological forecasts. It must be ensured that neither the originating hydrological service nor the country (data provider) is liable in any way how the forecast or measured data is used by the receiving hydrological service or country (data receiver). The data provider is not liable for any damage related to usage of measured or forecasted data by data receiver.

Meteorological forecasting Institute

SHMU does not send meteorological forecasts to other countries. Within the DAREFFORT project no meteorological forecasts shall be exchanged. Meteorological forecasts were not intended to be provided for the DAREFFORT project. Goal of the project is to exchange hydrological data, not meteorological forecasts.

1.11 Slovenia

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

ARSO exchanges forecasts data with national experts from other countries for professional use only. There is an hourly exchange of forecasted discharge values with Austria over the Mura and Drava River. Additionally, every hour ARSO sends forecasted discharge values of the Sava River to Croatia. The data exchanges strengthen the collaboration between expert services and brings additional information for the national hydrological service.
The main parameter to be exchanged on a Danube Basin level should be forecasted discharge for selected forecasting sites.

Meteorological forecasts

ARSO does not receive meteorological forecasts from other countries, but uses various NWP models (ALADIN, ICON, ECMWF, GFS). However, usage of more local models would bring additional perspectives for upcoming weather events. Precipitation, air temperature, ET and snow related forecasted parameters should be exchanged.

Technical capabilities

Hydrology

Hydrological forecasts of other countries can be integrated into the hydrological forecasting system of ARSO. However, the forecasting information to be implemented within the system demands adjustment of the automated working process. The hydrological forecasts cannot be transferred analogously to the measured data, it would be provided via FTP. A Web API is under development. The data format would be ASCII: txt or json. The forecasts are assigned to hydrological measuring stations and can be delivered as time series. In order to send data to an exchange platform, an automatic process to deliver the required formats must be established. To use forecasts from other countries an automatic process to get the data is needed.

Data Policy

ARSO would make the data available for professional use by hydrological forecasting and water management expert services. The hydrological forecasts (forecasted discharge values) should not be available to the general public. The forecast source should be easily recognized on the exchange platform.

Meteorological forecasting Institute

Currently, ARSO does not send forecasts from its NWP model to other countries. The model grid data could be provided in GRIB format via an FTP server. The prerequisite for data exchange would be a bilateral agreement between institutions. At this stage there are no concerns about these agreements.

1.12 Ukraine

Hydrological forecasting Institute

Current exchange of forecasting results with other countries

Hydrological forecasts

The UHMC is exchanging hydrological forecasts with Slovakia, Romania, Moldova, Hungary and Belarus. This exchange leads to an increase in flood warning time. In the Danube River Basin, the exchange could lead to an improvement in the quality of information about the current and expected hydrological situation, especially during flood situations. Water level, discharge and precipitation should be exchanged every four hours. It would also be useful to exchange ensemble forecasts. Here the experience of other countries is interesting and which ensembles are used.

Meteorological forecasts

The UHMC already receives meteorological forecasts and emergency warnings twice a day. This leads to a better quality of the forecasts. UHMC could also consider using meteorological forecasts from an already existing international platform. Bottlenecks for this are the coding. The most important parameters should be chosen according to WMO standards.

Technical capabilities

Hydrology

Hydrological forecasts of other countries can be partially integrated into the forecasts of the UHMC. A prerequisite for using other forecasts is the creation of a common modern forecasting system. Hydrological forecast results could be made available via FTP server, the format of which depends on the model. Hydrological forecasting results are assigned to the position of hydrological measuring stations and can be delivered as time series depending on the model. The amount of technical effort required to deliver and receive data depends on the model.

Data Policy

International regulations would apply as data policy restrictions.

Other notable information's

Further comments will appear when modelling begins. Technical and methodological consultations will be of great importance.

Meteorological forecasting Institute

The Meteorological forecasting centres of Ukraine provide forecasts for Moldova, Hungary, Poland and Belarus. The data are made available through an FTP server. The data format depends on the request. The data policy would be according to WMO regulations and international agreements.

2 Relevant Existing International Exchange Platforms

The following section gives a brief overview on the participation of countries in the Danube catchment in a selection of other relevant international exchange platforms. Since this section has only informational character, the list of existing platforms presented here does not claim to be exhaustive. The short descriptions of the platforms are directly retrieved from public information provided by the platforms.

In Table 1 the participation of countries in these platforms are summarised.

EFAS

The aim of the European Flood Awareness System (EFAS) is to support preparatory measures before major flood events strike, particularly in the large trans-national river basins and throughout Europe in general. EFAS is the first operational European system monitoring and forecasting floods across Europe.

The platform provides complementary, added-value information (e.g. probabilistic, medium range flood forecasts, flash flood indicators or impact forecasts) to the relevant national and regional authorities. Furthermore, EFAS keeps the Emergency Response Coordination Centre (ERCC) informed about ongoing and possibly upcoming flood events across Europe.

Since 2012 EFAS is running fully operational as part of the Copernicus EMS. More information about EFAS and their activities can be found under https://www.efas.eu

Almost all countries in the Danube catchment actively participate in providing data to EFAS (except Moldova), and also by using the products of the EFAS platform.

Sava FFS

The establishment of a joint Flood Forecasting and Warning System in the Sava River Basin (Sava FFS) is a component of the project "Improvement of Joint Actions in Flood Management in the Sava River Basin".

The project between 2016 and 2018 was funded by the Western Balkans Investment Framework (WBIF) and implemented by the World Bank.

The project provides an integrated forecasting system, covering the complete Sava River Basin. The beneficiary countries are Bosnia and Herzegovina, Croatia, Montenegro, Serbia and Slovenia, while the entire process is coordinated by ISRBC in accordance with the Protocol on Flood Protection to the Framework Agreement to the Sava River Basin.

More information about Sava FFS and their activities can be found under https://www.savacommission.org/project_detail/24/1

All countries in the Danube catchment which are also in the Sava river basin use Sava FF to send data to the platform, and also have access to the provided data of Sava FFS.

SEEFFG

Flash Flood Guidance System (FFGS) is an important tool for providing the operational forecasters and disaster management agencies with real-time informational guidance products pertaining to the threat of flash flooding. FFGS is a robust system designed to provide the necessary products to support the development of warnings for flash floods from rainfall and/or snow melt events using remote sensing observations of precipitation (e.g., radar and satellite-based rainfall estimates), temperature, snow cover extent and hydrological models. To assess the threat of a local flash flooding, the FFGS is designed to allow product adjustments based on forecaster experience with local conditions, incorporation of other information (e.g., NWP output), real time meteorological data and any last minute local observations (e.g., non-traditional rain gauge data) or local observer reports. Within the scope of global FFGS implementation, the South-East Europe FFG (SEEFFG) regional project has being implemented and is operational at its Regional Centre hosted by the Turkish State Meteorological Service. Albania, Bosnia and Herzegovina, Croatia, Moldova, Montenegro, Romania, Serbia, Slovenia, and North Macedonia are currently participating in the regional project.

SEE-MHEWS-A

WMO is currently implementing the project 'South-East European Multi-Hazard Early Warning Advisory System (SEE-MHEWS-A)'. Detailed Implementation Plan for SEE-MHEWS-A is available under

https://ane4bf-datap1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/ckeditor/files/SEE-MHEWS-A_Implementation_Plan_2018-01-05_FINAL_1.pdf?Dm2eQRxFswt6QAC3tOxvtaXD8Jwibcub

which provides guidelines for development of the technical part of the system and for all activities necessary to establish advisory system operations.

From the Danube basin countries, the National Meteorological and Hydrological Services of Croatia, Hungary, Moldova, Romania, Slovenia, Ukraine and Bulgaria (Serbia is considering) are partners to the SEE-MHEWS-A project. These countries have agreed to exchange meteorological and hydrological data, information, forecasts and advisories under the SEE-MHEWS-A. For this, a policy was developed and signed by majority of the project partners at the end of last year (further signatures are expected soon). This Policy provides the technical and conceptual principles required to promote data, information, forecast, and warning exchange and interoperability within the SEE region. Establishment of this Policy will facilitate the access and dissemination of relevant hydrological and meteorological data, information, forecasts, and advisories exclusively for the purpose of the SEE-MHEWS advisory system unless agreed otherwise by the Signatories.

The SEE-MHEWS-A will furthermore set up 3-4 limited area numerical weather prediction models in ECMWF, covering the whole SEE region, with forecasts to be available for all the project partners. Hydrological models will be implemented during the current SEE-MHEWS-A project phase for a pilot river catchment in Bosnia and Herzegovina, but this is planned to be expanded to cover other river catchments from the region during further phases of the project. Both meteorological and hydrological forecasts will be available to the project partners via SEE-MHEWS-A Common Information Platform, which is under development.

Table 1 Participation of countries in selected other international forecasting platforms

	EFAS		Sava FFS		SEEFFG		SEE-MHEWS-A
	Send data	Use results	Send data	Use results	Send data	Use results	Involvement in implementation
Austria	Yes	Yes					
Bulgaria	Yes	Yes	No	No	No	No****	project partner
Croatia	Yes	Yes (have access)	Yes	Yes (have access)	only meteorological	Yes (have access)	project partner
Czech Republic	Yes (discharge)	Yes (warnings)	No	No	No	No	
Germany	Yes	Yes (warnings and reports)	No	No	No	No	
Hungary	Yes***	Yes (warnings)	No	No	No	No	
Moldova	No	Yes	No	No	Yes	Yes	project partner
Romania	Yes*	Yes	No	No	No**	Yes	project partner
Serbia	Yes	Yes	Yes	Yes	No**	Yes (have access)	considered as project partner
Slovakia	Yes	Yes	No	No	No	No	
Slovenia	Yes	Yes	Yes (forecasts)	yes	No	Yes	project partner
Ukraine	Yes	Yes	No	No	No	No	project partner

Sava countries

* selected stations
** could change in the near future
*** stations selected for DanubeHIS
**** not SEEFFG, but BSMEFFG

3 Summary of the Survey Results and Outlook of the Possibilities of an International Forecasting Results Exchange Platform

This chapter summarises the results of the survey. In total there have been 18 replies from 12 countries, as in Austria there are different authorities responsible for hydrological forecasts regarding Danube river. In order to avoid an over-weighting of the Austrian replies, the answers of the Austrian authorities are comprised in the comparative tables 5-7. The questions regarding advantages of exchange of forecasting results have been asked as open questions, not multiple choice. Therefore, it is not possible to carry out a statistical evaluation of the answers. Rather a descriptive summarisation of the answers given in the survey is provided.

3.1 Possibilities of exchanging forecasting results with other countries on a forecasting results exchange platform

Exchange of Hydrological forecasts

The exchange of forecasts between individual countries is already part of the daily routine of most of the forecasting institutes. But these are almost all based on exclusive bilateral contracts. Depending on the catchment situation, countries receive forecasts from other countries, send it to other countries or both. This is shown in an overview in Table 2.

The individual responses of the countries regarding **benefits of existing bilateral exchange** of forecasts are summarised in Table 5. The results show that bilateral exchange of forecasting results is common practice between the countries in the Danube catchment, and by all 12 countries benefits are mentioned. Nevertheless, the benefits mentioned are different, and there is no common view.

Benefits of **existing bilateral exchange** mentioned in the survey are the improvement of the forecasting results for transnational rivers (mentioned in 6 of 12 countries). Each country has the best forecast for the corresponding area, because the specific conditions and regional particularities are known best by local institutes (mentioned in 7 of 12 countries). Using the forecasts can therefore lead to an improvement in the forecasting systems of transnational rivers. For the data passed on, feedback from other countries can be obtained (mentioned in 3 of 12 countries). In addition, risk management can be improved (mentioned by 4 of 12 countries).

However, the DAREFFORT project does not focus on bilateral cooperation but on cooperation in the exchange of data in the entire Danube catchment area. Therefore, in the survey the **benefits of a Danube wide exchange of forecasts** have been also addressed. The different benefits and perspectives of a Danube wide exchange of forecasts mentioned by the countries are shown in Table 6.

Benefits and perspectives of exchanging hydrological forecasting results within whole Danube catchment that have been mentioned in the replies of the survey are the improvement of the forecasting results (mentioned in 5 of 12 countries), extended lead time (mentioned in 3 of 12 countries), overall understanding of the catchment (mentioned in 4 of 12 countries). Furthermore, it was mentioned in replies of two countries that such a platform could be a step to enable the development of a large-scale forecasting model. Moreover 3 of 12 countries mentioned a possible improvement for the risk

management by exchanging hydrological forecasts in the whole catchment. From Romania it is mentioned that it could also help for forecasts in low water periods. In Austria a benefit could be seen to help downstream countries to improve their own models, if not already done by bilateral exchange.

Benefits and perspectives of a Danube wide exchange platform for forecasting results are seen by 11 out of 12 countries. However, the mentioned benefits are very heterogenous (Table 6). Moreover there also arguments against a Danube wide forecasting results exchange platform have been raised in the survey (Table 6): Bilateral exchange could be sufficient, and more easy to operate. Also, several initiatives and projects in the past with similar approached stopped operation after the project period and haven't been successful on the long term.

Taking into account the benefits of bilateral exchange of forecasting results and the fact that this is already common practice, almost all downstream countries have benefits in using hydrological forecasts from their neighbouring upstream countries.

Additionally, almost all countries mention potential benefits of a Danube wide exchange platform for forecasts. **However, the opinions of what the benefits of a Danube wide exchange platform for forecasts could be, are very heterogenous, and there is no common view visible at this point.**

Nevertheless, if such a platform could be established, for most countries, the exchange should be automated in certain time intervals, in a defined data format and on a regular basis. From a technical point of view in some countries a software update / improvement or an update of the national forecasting model is necessary to use input data from other countries. The details are shown in Table 9.

The hydrological forecasting results that are proposed in the replies of the survey to be exchanged on a potential forecasting results exchange platform are summarised in Table 8. All countries mention that forecasting results of discharge would be an important hydrological parameter to be exchanged. Forecasts of water level is mentioned by 8 of 12 countries.

The exchange of ensemble forecasts is also considered as useful by 9 of 12 countries (Table 8). Ensemble forecasts are usually based on many different input scenarios. This has some advantages, such as better estimation of the probability of the occurrence of predicted hydrological results. However, the prerequisites and boundary conditions of ensemble forecasts are very different in each country. An exchange of ensemble forecasts requires a high degree of coordination to be useful. The forecasts, but especially the boundary conditions and scenarios, must be standardised in order to use ensemble forecasts across countries.

Meteorological forecasts used by hydrological institutes

Meteorological forecasts from other countries are also already used and passed on in some countries. However, this is much rarer than for hydrological forecasts. In contrast, many countries obtain data from ECMWF. The details are shown in Table 3 and Table 4.

The benefits mentioned in the survey of exchanging meteorological forecasts in the whole Danube catchment is shown in Table 7. As a benefit, 9 out of 12 countries mention that inaccuracies in the own models can be identified and the accuracy can be improved by exchanging meteorological forecasts. Meteorological forecasts in neighbouring countries often serve as input for national hydrological forecasts. To use meteorological forecasts directly from the neighbouring countries, calculated by a model which is optimally adapted to the neighbouring country's area, instead of calculating own forecasts is

advantageous because of a higher accuracy. Weather instability can be detected earlier, and the warning time is improved, however this is only mentioned by 2 of 12 countries.

Precipitation is mentioned by 11 of 12 countries as an important meteorological parameter for hydrological forecasts. Air temperature is also mentioned by a majority (10 of 12 countries). Additionally, snow depth, and evapotranspiration are mentioned by 3 countries, wind and rain intensity by only one country each (Table 8).

However, Table 9 shows that only few countries are currently able to use meteorological forecasts from other countries for their own forecasting models.

Meteorological forecasts, if exchanged at all, currently are mainly exchanged by FTP server (5 out of 12 countries mentioned FTP server as used method). In these cases, the data policy requirements are similar to those for hydrological forecasts (see below). It should be mentioned that in this survey the focus was on the exchange of meteorological forecasts for hydrological forecasting purposes, not on meteorological forecasting purposes in general.

Technical capabilities to exchange hydrological forecasts

Most of the countries are or would be technically able to use hydrological forecasts from other countries (11 out of 12 countries, 14 out of 18 institutions, Table 9). Most countries could provide hydrological forecasts via FTP server, in few cases via Web-API. The data formats differ. Proposed formats are ASCII files, csv, xml, DFS file format. Almost all forecasts are assigned to hydrological measuring stations and can be delivered as time series for a specific measuring station. More information about data formats can be found in Table 10. Because of the many different data formats harmonization of the exchange of forecasting results might be more challenging than the exchange of measured data.

The efforts for countries to be able to send hydrological forecasts to other countries in the future or to use forecasts from other countries are very different. Sending forecasts seems to require much less effort, the answers vary for most of the countries and institutions from no effort to little effort. However, regarding the usage of forecasts from other countries there are very different answers and requirements. For some countries which already use hydrological forecasts from other countries, there is little, or no effort involved to additionally use forecast of more countries. For some, major changes to the forecasting model are required in addition to technical changes in order to use forecasts from other countries. Also cost issues are mentioned by some countries.

Data Policy regarding exchange of hydrological forecasts

Handling of data policy topics is very different in the countries in the Danube catchment. One restriction is that the forecasts can only made available under the condition that forecasting results are only used by other forecasting institutes and not passed on to third parties (mentioned by 5 out of 12 countries). A minor restriction is that the source of the forecasts should be cited (mentioned by 3 countries). For several countries it is important that the institutions are not made responsible for the correctness and the correct use of the data, so liability is an important topic to consider (5 out of 12 countries mentioned this). No liability issues or data restriction issues are only seen by one country (Moldova).

3.2 Conclusion

In summary, the **bilateral exchange of hydrological and also meteorological forecasts** between countries has different benefits and is already common practice between neighbouring countries on a bilateral basis.

In addition, there are several arguments for the exchange of forecasts on a **Danube wide forecasting result exchange platform**. Particularly downstream countries Croatia, Romania, and Bulgaria see an additional benefit of a Danube wide forecasting result exchange platform for improving hydrological forecasting and Romania, and Bulgaria also in extending the lead time.

Regarding the efforts for implementing such a platform, the technical capabilities and efforts but also issues regarding data policy have to be considered.

As the technical requirements for an exchange of forecasting results vary widely - even more than of measuring results - there are challenges in implementing a Danube-wide exchange platform for forecasting results regarding the harmonization of data formats and data exchange interfaces.

Not only the formats would have to be harmonized, but also the exchange intervals for forecasting results, because the exchange has to be adapted to the many different forecasting models which are currently in use in the Danube catchment.

The survey shows that also the exchange of ensemble forecasts between countries is seen as useful. But the prerequisites and boundary conditions of ensemble forecasts are very different in each country. An exchange of ensemble forecasts therefore requires a high degree of coordination and harmonization. The forecasts, but especially the boundary conditions and scenarios, must be standardised in order to use ensemble forecasts across countries.

Regarding data policy, precise guidelines would be very important in order to make an exchange of forecasts across the whole Danube basement possible. Especially the liability for the results is an issue which hinders the exchange of the results. Therefore, this has to be addressed in a data policy agreement, e.g. by stating that the forecasting institutes are not liable for the forecasting results or the products that result from further processing and adding a statement that the forecast results have the character of unproved raw data. In addition, also the exchange of forecasting results free of charge is an issue for some of the countries.

The results show that exchanging forecasting results requires at least as much effort in coordination and harmonization as the exchange of measured data, because of a large variety of data formats and forecasting models, and prerequisites for using them.

Whereas bilateral exchange of forecasting results is already common practice in the Danube catchment the results of this deliverable show that there could be additional benefits of a Danube wide exchange platform for forecasting results, but there is no common view about these benefits. This is reflected by the heterogenous answers about particular benefits of a Danube wide exchange platform for forecasting results.

4 Appendix A

Table 2 Overview of the exchange of hydrological forecasts between countries.

	Austria	Bulgaria	Croatia	Czech Republic	Germany	Hungary	Moldova	Romania	Serbia	Slovakia	Slovenia	Ukraine	Belarus	Bosnia a. Herze-govina
Austria Styria		–	→	–	–	→	–	–	–	–	→	–	–	–
Austria Tyrol		–	–	–	↔	–	–	–	–	–	–	–	–	–
Lower Austria		–	–	←	←	–	–	–	–	→	–	–	–	–
Upper Austria	↔	–	–	–	←	–	–	–	–	–	–	–	–	–
Austria Carinthia	↔	–	–	–	–	–	–	–	–	–	→	–	–	–
Austria Salz-burg	→	–	–	–	↔	–	–	–	–	–	–	–	–	–
viadonau		–	–	–	–	–	–	–	–	–	–	–	–	–
Bulgaria	–		–	–	–	–	–	–	–	–	–	–	–	–
Croatia	–	–		–	–	←	–	–	–	–	←	–	–	→
Czech Republic	↔	–	–		–	–	–	–	–	↔	–	–	–	–
Germany	↔	–	–	–		–	–	–	–	–	–	–	–	–
Hungary	→	↔	→	–	–		–	↔	↔	↔	–	–	–	–
Moldova	–	–	–	–	–	–		↔	–	–	–	↔	–	–
Romania	–	↔	–	–	–	↔	↔		↔	–	–	↔	–	–
Serbia	–	↔	–	–	–	↔	–	↔		–	–	–	–	–
Slovakia	↔	–	–	↔	–	↔	–	–	–		–	↔	–	–
Slovenia	↔	–	→	–	–	–	–	–	–	–		–	–	–
Ukraine	–	–	–	–	–	↔	↔	↔	–	↔	–		→	–

→ The country in the row sends forecasts to the country in the column
← The country in the row receives forecasts from the country in the column
↔ The country in the row sends forecasts to and receives forecasts from the country in the column
– no communication

Table 3 Overview of the exchange of meteorological forecasts directly (in a bi-lateral way) between countries.

	Austria	Bulgaria	Croatia	Czech Republic	Germany	Hungary	Moldova	Romania	Serbia	Slovakia	Slovenia	Ukraine	Bosnia and Herze-govina	Belarus	Poland
Austria Styria		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Austria Tyrol		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Lower Austria		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Upper Austria		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Austria Carinthia		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Austria Salz-burg		–	–	–	–	–	–	–	–	–	–	–	–	–	–
viadonau		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Bulgaria	–		–	–	–	–	–	–	–	–	–	–	–	–	–
Croatia	–	–		–	–	–	–	–	–	–	–	–	→	–	–
Czech Republic	–	–	–		–	–	–	–	–	–	–	–	–	–	–
Germany	←	–	–	–		–	–	–	–	–	–	–	–	–	–
Hungary	–	–	–	–	–		–	–	–	–	–	–	–	–	–
Moldova	–	–	–	–	–	–		↔	–	–	–	↔	–	–	–
Romania	–	–	–	–	–	–	–		–	–	–	–	–	–	–
Serbia	–	–	–	–	←	–	–	–		–	–	–	–	–	–
Slovakia	–	–	–	–	–	–	–	–	–		–	–	–	–	–
Slovenia	–	–	–	–	–	–	–	–	–	–		–	–	–	–
Ukraine	–	–	–	–	–	→	→	–	–	–	–		–	→	→

→ The country in the row sends forecasts to the country in the column
← The country in the row receives forecasts from the country in the column
↔ The country in the row sends forecasts to and receives forecasts from the country in the column
– no communication

Table 4 Overview if countries send meteorological data to international platforms or use products of those.

	LACE member	ECMWF	ALADIN, ICON, GFS
Austria Styria	–	–	–
Austria Tyrol	–	–	–
Lower Austria	–	–	–
Upper Austria	–	–	–
Austria Carinthia	–	–	–
Austria Salzburg	–	–	–
viadonau	–	–	–
Bulgaria	–	←	–
Croatia	–	←	←
Czech Republic	→	←	←
Germany*	–	←	←
Hungary	–	←	–
Moldova	–	←	–
Romania	–	←	–
Serbia	–	←	–
Slovakia	←	←	←
Slovenia	–	←	–
Ukraine	–	–	–

* Receive ECMWF data via German Weather Service

→ The country in the row sends forecasts to the institution in the column
← The country in the row receives forecasts from the institution in the column
↔ The country in the row sends forecasts to and receives forecasts from the institution in the column
– no communication

Table 5 Benefits of exchanging hydrological forecasts between countries in general, as it is done today bilaterally

	hydrological				
	improve forecast of transnational rivers	**each country has the best forecasting results for the corresponding area**	**Feedback about the model from other countries**	**better risk manage-ment**	**benefit for downstream countries**
Austria Styria					✓
Austria Tyrol			✓	✓	
Lower Austria	✓	✓			
Upper Austria					✓
Austria Carinthia	✓				
Austria Salzburg			✓		
viadonau					✓
Austria (summarised)	(✓)	(✓)	(✓)	(✓)	(✓)
Bulgaria	✓				
Croatia		✓			
Czech Republic		✓	✓		
Germany		✓			
Hungary	✓		✓		
Moldova		✓			
Romania	✓				
Serbia		✓		✓	
Slovakia	✓	✓		✓	
Slovenia	✓				
Ukraine				✓	

Table 6 Benefits and perspectives of exchanging hydrological forecasting results on a Danube wide exchange platform

	improve results	extend lead time	overall understanding of the catchment	enable development of a large-scale forecasting model	low water periods	help downstream countries to set or improve own models	Improvement of risk management	Arguments against exchanging forecasts basin wide
Austria Styria			✓					
Austria Tyrol								Bilateral exchange sufficient and more useful
Lower Austria						✓		
Upper Austria						✓		
Austria Carinthia			✓					
Austria Salzburg								
viadonau						✓		Platforms and initiatives tried to build platforms like this several times in the last years, but these platforms stopped working fast after the end of the projects
Austria (summarised)			(✓)			(✓)		
Bulgaria	✓	✓						
Croatia	✓		✓	✓				
Czech Republic	✓		✓					
Germany				✓				for existing bilateral exchanges (Austria) it seems easier to exchange the forecast directly and not via a platform
Hungary								
Moldova							✓	
Romania	✓	✓			✓			
Serbia							✓	
Slovakia							✓	
Slovenia			✓					
Ukraine	✓	✓						

Table 7 Benefits of exchanging meteorological forecasts in the whole Danube catchment

	meteorological		
	earlier detection weather in stability/ improve warning time	improve accuracy/show uncertainty	forecasts are optimized for regions
Austria Styria		✓	
Austria Tyrol			
Lower Austria		✓	
Upper Austria		✓	
Austria Carinthia		✓	
Austria Salzburg		✓	
viadonau			
Austria (summarised)		✓	
Bulgaria			
Croatia	✓		
Czech Republic		✓	
Germany			✓
Hungary		✓	✓
Moldova		✓	
Romania	✓	✓	
Serbia		✓	
Slovakia		✓	
Slovenia		✓	
Ukraine		✓	

Table 8 Forecasting parameters that are proposed to be exchanged

	Hydrological forecasts			Meteorological forecasts					
	Discharge	**Water level**	**Ensemble forecast**	**Precipitation**	**Air temperature**	**snow depth**	**evapo-transpiration**	**wind**	**Rain intensity**
Austria Styria	✓		yes	✓	✓				
Austria Tyrol			maybe						
Lower Austria	✓ Hourly	✓ Hourly	yes	✓ Hourly	✓ Hourly				
Upper Austria	✓		yes	✓ Hourly	✓ Hourly				
Austria Carinthia	✓		maybe	✓	✓	✓	✓		
Austria Salzburg			no						
viadonau	✓								
Austria	✓	(✓)	maybe	✓	✓	(✓)	(✓)		
Bulgaria	✓			✓ 1h,3h,6h,24h	✓ 1h,3h,6h,24h				
Croatia	✓ Hourly	✓ Hourly	yes	✓ Hourly	✓ Hourly	✓ Hourly	✓ Hourly		
Czech Republic	✓ Hourly		yes	✓ Hourly	✓ Hourly				
Germany	✓ Hourly		yes						
Hungary	✓ Hourly	✓ Hourly	no	✓ Hourly	✓ Hourly				
Moldova	✓ Daily	✓ Daily	yes	✓	✓			✓	
Romania	✓ Daily	✓ Daily	yes	✓	✓				
Serbia	✓ Daily	✓ Daily	future	✓ Daily	✓ Daily				✓
Slovakia	✓ Hourly	✓ Hourly	yes	✓ Hourly	✓ Hourly				
Slovenia	✓ 6h		no	✓	✓	✓	✓		
Ukraine	✓ 4h	✓ 4h	yes	✓ 4h					

Table 9 Ability of using hydrological and meteorological forecasting results of other countries

	Country is technically able to use hydrological forecasts	Precondition	Country is technically able to use meteorological forecasts	Precondition
Austria Styria	no	only additional input	yes	
Austria Tyrol	yes	automated, timely, consultation possible	yes	
Lower Austria	yes	data format,	no	adjust model structure
Upper Austria	yes	software and format has to be the same	yes	some conversions
Austria Carinthia	no	harmonized data	no	planned for the future
Austria Salzburg	yes	data format,	yes	
viadonau	no	software update and configuration		
Austria	(yes)	see above	(yes)	see above
Bulgaria	no	bilateral agreement	no	username, password to access the platform
Croatia	yes	input format of the forecasting software	no	significant effort
Czech Republic	yes	regular data transfer, data exchange procedure, adjustment of the current forecasting process, adjustment of the hydro-logical model. Adjustment of Delft-FEWS platform	yes	
Germany	yes	time resolution, lead time long enough, common data format used	yes	
Hungary	yes	time resolution must fit	no	
Moldova	yes			
Romania	yes	standard format, periodic update	no	
Serbia	yes			
Slovakia	yes	stable data format, matching time steps and update frequency	yes	
Slovenia	yes			
Ukraine	partly			

Table 10 Technical capabilities for the exchange of hydrological and meteorological forecasts with other countries

	Proposed delivery method for forecasting results	Proposed data format for hydrological forecasts	Proposed data format meteorological forecasts	Geographical assignment of hydrological forecasts	time series
Austria Styria	FTP	DHI		hydrological measuring station	yes
Austria Tyrol	Web-API			hydrological measuring station	yes
Lower Austria	like measured data	all Wiski formats (zrxp, csv, xml, WaterML, …)		hydrological measuring station	yes
Upper Austria	like measured data	.zrxp		hydrological measuring station	yes
Austria Carinthia	future web API/FTP	ASCII files		hydrological measuring station (mainly)	not yet
Austria Salzburg	like measured data	*zrxp; *xml		hydrological measuring station (mainly)	yes, for selected
viadonau		txt		hydrological measuring station	yes
Austria	see above	see above	see above	hydrological measuring station	(yes)
Bulgaria	FTP	ASCII		hydrological measuring station	yes
Croatia	FTP	dfs0, txt or csv		hydrological measuring station	
Czech Republic	FTP	waterML 2.0, txt, csv	grid data	hydrological measuring station	yes
Germany	FTP	csv		hydrological measuring station	yes
Hungary	FTP	csv		hydrological measuring station	yes
Moldova	web			hydrological measuring station	yes
Romania	FTP	csv		most hydrological measuring station	some
Serbia	FTP/Web-API			hydrological measuring station	some
Slovakia	FTP, Web API	xml		hydrological measuring station	yes
Slovenia	FTP	ASCII, txt, json	grid-data		
Ukraine	FTP	depends on the model		hydrological measuring station	some

5 Appendix B – Questionnaire

Questionnaire for Hydrological Forecasting Centres

Exchange of hydrological and meteorological forecasting results

1 Exchange of hydrological forecasting results with other countries

1.1. Do you already exchange hydrological forecasting results with neighbouring countries, either receiving, delivering or both? If yes, please specify which countries, which parameters are exchanged and in which interval.

1.2. What are or can be the benefits of exchanging hydrological forecasting results with neighbouring countries?

1.3. What could be the benefits and perspectives of exchanging hydrological forecasting results within whole Danube catchment?

1.4. Are you able (methodologically / technically) to include hydrological forecasts from other countries in the forecasts of your institution?

1.5. Which requirements must be fulfilled to be able to include hydrological forecasts from other countries in the forecasts of your institution?

1.6. Which forecasted parameters should be exchanged within whole Danube catchment and in which interval (e.g. water level, discharge)?

1.7. Would it make sense to exchange ensemble forecasts?

2 Exchange of meteorological forecasting results with other countries

2.1 Do you already receive meteorological forecasting results from other countries? If yes, please specify which countries, which parameters are exchanged and in which interval.

2.2 What are or can be the benefits of receiving meteorological forecasting results of other countries?

2.3 Are you able (methodologically / technically) to include meteorological forecasts from other countries in your forecast?

2.4 Can you think of using meteorological forecasting results from an existing international platform (e.g. WMO, ECMWF, …)?

2.5 Are there bottlenecks of using an existing international platform for meteorological forecasting results?

2.6 Which forecasted parameters should be exchanged within whole Danube catchment and in which interval (e.g. precipitation)?

3 Technical requirements of hydrological forecasting results exchange

3.1 If your institution also provides measured hydrological data to DAREFFORT project: Would it be possible to provide the forecast results in the same way as the measured data?

3.2 If not, how would you provide forecast results?

A) by FTP

B) by Web-API

C) others, please specify

3.3 In which data format forecast results could be delivered to an exchange platform for hydrological forecasts?

3.4 To which geographical positions are the hydrological forecasts of your institutions assigned?

A) to the position of hydrological measuring stations

B) to other positions, please specify

3.5 Does hydrological forecast data could be delivered as time series per measuring station?

3.6 Which (technical) effort would be required for your institution to deliver hydrological forecasting results to an exchange platform?

3.7 Which (technical) effort would be required for your institution to use hydrological forecasting results from other countries in the forecasting models of your institution?

4 Data Policy issues of hydrological forecasting results exchange

4.1 Is your institution willing to provide hydrological forecasting results to an exchange platform for the countries in the Danube catchment?

4.2 Which data policy restrictions would apply for the hydrological forecasting results of your institution/country with respect to such a results exchange platform?

4.3 Are there any concerns (e.g. legal restrictions, liability) about exchanging forecast data within Danube catchment?

5 Other notable information

Here is room for additional information and comments

Questionnaire for Meteorological Forecasting Centres

Possibilities of providing meteorological forecasting results on a Danube wide exchange platform

1 *General*

1.1. Do you already provide meteorological forecasting results to other countries? If yes, please specify which countries, which parameters are provided and in which interval.

2 *Technical requirements*

2.1 If your institution also provides measured meteorological data to DAREFFORT project: Would it be possible to provide the forecast results in the same way as the measured data?

2.2 If not, how would you provide forecast results?

A) by FTP

B) by Web-API

C) others, please specify

2.3 In which data format forecast results could be delivered to an exchange platform for meteorological forecasts?

2.4 To which geographical positions are the hydrological forecasts of your institutions assigned?

A) to the position of hydrological measuring stations

B) Grid-data

C) to other positions, please specify

3 *Data Policy*

3.1 Which data policy restrictions / requirements apply to deliver forecasts to an international exchange platform?

4 *Other notable information*

Here is room for additional information

Contact STASA Steinbeis Angewandte Systemanalyse GmbH
Lange Straße 8
70173 Stuttgart
Germany

Internet: www.stasa.de
Email: liedl@stasa.de
Tel: +49 711 50448861
Fax: +49 711 50093240

Editors: Dr. Philipp Liedl (managing director)
Dr. Dirk Meyer
Kim Schwarz