Interreg
Danube Transnational Programme
DAREFFORT

Geographically referenced dataset of identified gaps and bottlenecks

WP3 Deliverable 3.2.4

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1 Introduction

One of the goals of the DAREFFORT project is to eliminate the shortcomings of the existing forecasting practices as well as to improve the exchange and availability of hydrological and meteorological data among the countries in the Danube River Basin. In this regard, gaps and bottlenecks related to information flow and exchange of the data among countries were identified. Thus, Deliverable 3.2.4 presents analysis of flow data among neighbouring countries in the Danube River basin based on the collected information from 12 national and two regional reports as well as a detailed questionnaire, about the countries' hydrological and meteorological data availability, recording methods and coverage with the monitoring networks, coding and national database system, data flow, forecasting time intervals and accuracy, response times, cross-border issues and data dissemination etc., prepared in the frame of the project Activity 3.1 (Output 3.1, Deliverable 3.1.3).

2 Analysis of the information flow among neighbouring countries

Analysis of the information flow and exchange of the data among neighbouring countries was conducted based on the information about the data availability with respect to data exchange and improvement of forecasting conditions prepared in the frame of the project Activity 3.1 and corresponding Output and Deliverables.

As we know, along the course of the Danube River there are numerous border crossings. At these borders, it is particularly important to have a good exchange of data or even forecasts. If there is no good bilateral cooperation, this can be a bottleneck for a successful flood forecast for the entire Danube River basin. Many countries mentioned that already exchange their data via bilateral agreements.

Figure 1 indicates the border crossings, at which a flow of information should happen along the Danube and its tributaries. In the following, only the flow of information along the Danube and the main tributaries is described and illustrated. There are also further flows of information, e.g. between Ukraine and Slovakia. A comprehensive data transfer can lead to an improvement of the forecast results for each individual country.

First, the border crossings along the course of the Danube (1) is analysed. From the origin of the Danube in Baden-Wurttemberg the Danube River flows to Bavaria. From there the first border to another country, Austria, is crossed. From Austria the Danube flows further to Slovakia and along the Slovakian-Hungarian border. Flow of information between these countries is based on bilateral agreement with respect to national data policies. From Hungary, the Danube flows along the border between Croatia and Serbia. As for the countries mentioned before an exchange of information and knowledge is recommendable. The Danube from Serbia flows along the border between Serbia and Romania, then along the border between Romania and Bulgaria and finally, it meets a triangle of Romania, Moldavia and Ukraine, where an information flow is also of high importance. The countries mentioned above are all involved in the DAREFFORT project, so the project could provide a good basis for a better flow of information and national cooperation.

The border crossings of the larger tributaries of the Danube River are also shown in Figure 1, as they also have a considerable influence on the flood forecast.

The Inn (2) originates in Switzerland and continues to flow into Austria and Bavaria. The exchange of Information between Switzerland and especially between Austria and Bavaria are of high importance for the flood forecasting for the Danube River. Between Austria and Bavaria there is already a well-established exchange and flow of information regarding flood forecasting.

From Italy to Austria, from Austria to Slovenia, then along the Hungarian-Croatian border flows the Drava (3). It finally flows into the Danube in Croatia. A good flow of information should take place between these countries, which are connected by the Drava.

The Sava (4) flows from Slovenia to Croatia, then Bosnia and Herzegovina and Serbia. Information exchange between these countries is therefore also of high importance. For the Sava River there is already an established network of data exchange provided by SavaHIS.

The Morava (5) flows from the Czech Republic along the border between Austria and Slovakia.

The Tisza (6) flows from Ukraine along the border between Ukraine and Romania to Hungary, a short stretch of river on border between Slovakia and Hungary and finally to Serbia, from where it flows into the Danube.

The Prut (7) flows from Ukraine to Romania. These tributaries should also have a flow of information between the respective countries.

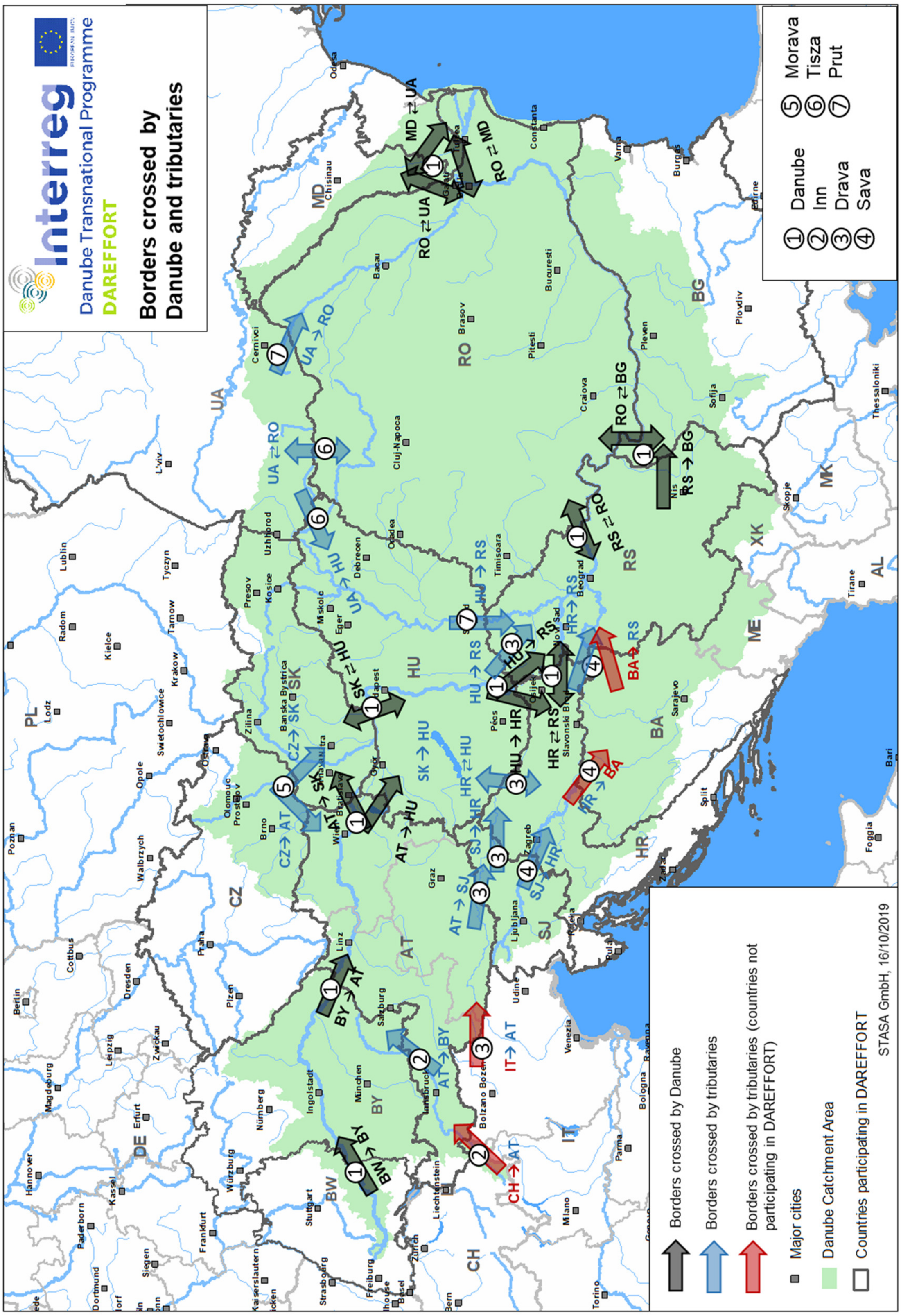

Figure 1: Necessary information flow along Danube River and its main tributaries

3 Bottleneck analysis of the update frequencies for real time hydrological and meteorological exchange of data

Based on the information about the update frequencies of real time hydrological and meteorological data among Danube River Basin countries (see Output 3.1), gaps and bottlenecks were identified.

Results of the analysis show that the availability of data of individual country as well as the update frequency, differs greatly between countries along the Danube River. If a downstream forecasting centre works with national data with a higher frequency than an upstream country can deliver, this will be a bottleneck in cross-country data exchange. In this case, data from the upstream country cannot be used optimally by the downstream countries. Figures 2 and 3 show the variables foreseen to be transmitted in the DanubeHIS and their update frequency.

Figure 2 presents the hydrological variables, namely water level (h), discharge (Q) and water temperature (tw), their update frequency and marked possible bottlenecks in data transfer. The upper and middle course countries Germany, Czech Republic, Austria, Slovakia, Hungary, Slovenia, Croatia and Serbia all have an update frequency of one hour or less and provide water level, discharge and water temperature data. Therefore, there should be no bottlenecks here. Romania supplies data once or twice a day, which is much rarer than the neighbouring country Serbia. Since Serbia is the upper-lying country, there is no bottleneck in the data flow in this case. Romania, Serbia and Ukraine all have an update frequency of one to two times per day, and the upper stream countries provide the data in equal or higher frequency, so there are no bottlenecks in data transfer in this case. Regarding exchange of the data with Bulgaria, the problem arises, since Bulgaria does not supply any water temperature, which can lead to a major bottleneck in the data exchange. Moldova has a higher update frequency (every 15 minutes) than the surrounding countries. However, since Moldova does not use flood forecasting model (see Figure 5) there is no direct bottleneck here either. However, if Moldova want to process the data of the surrounding countries in the future, the update frequency of the surrounding countries is too low compared to their own frequency.

Regarding meteorological data and its update frequency, the bottlenecks look similar to those recognised for hydrological data (Figure 3). Germany, Czech Republic, Austria, Slovakia, Hungary, Slovenia, Croatia and Serbia all have an update frequency of one hour or less. There should be no problems with the exchange of information and data between these countries. However, individual countries provide different variables. The necessary variable needed in the frame of DAREFFORT project is precipitation (P), which is provided by all of the countries. At the border crossing between Croatia and Serbia there is a large difference between the update intervals of meteorological data. In Croatia, they are significantly higher comparing to Serbia. However, Croatia does not need data from Serbia with respect to flood forecasting, so there is no bottleneck here. Unlike hydrological data transfer, there is also no bottleneck between Bulgaria and Romania as both provide the required precipitation at the same frequency. On the other hand, Moldova has a higher update frequency of meteorological data than Ukraine and Romania. Here a bottleneck would arise, if Moldova would use a hydrological model for which they would need input variables from neighbouring countries. Ukraine also has a slightly higher update frequency of the meteorological data than Romania, so the data frequency is too low for Ukraine and a bottleneck could appear.

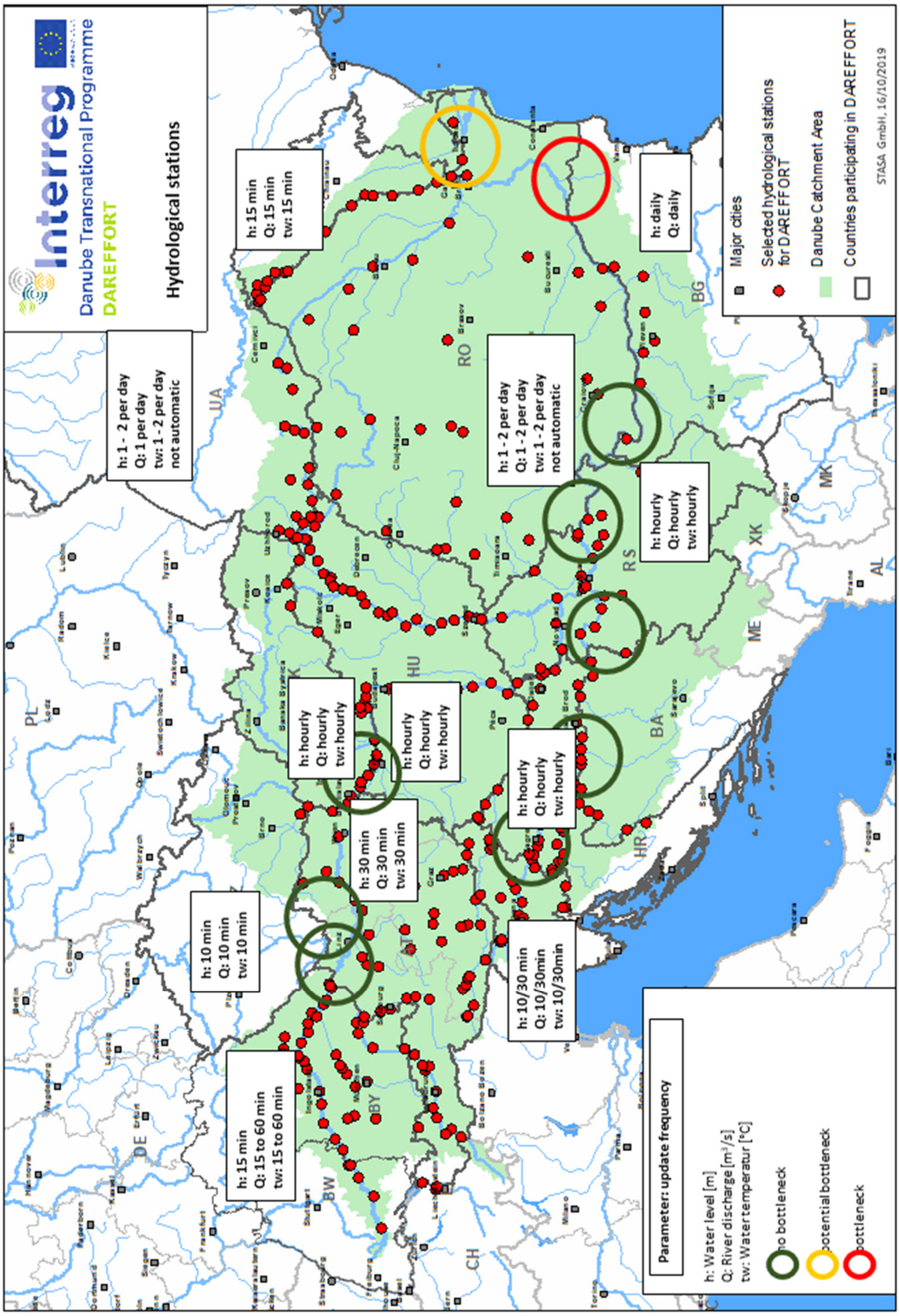

Figure 2: Update intervals for hydrological stations and recognized bottlenecks in data transfer

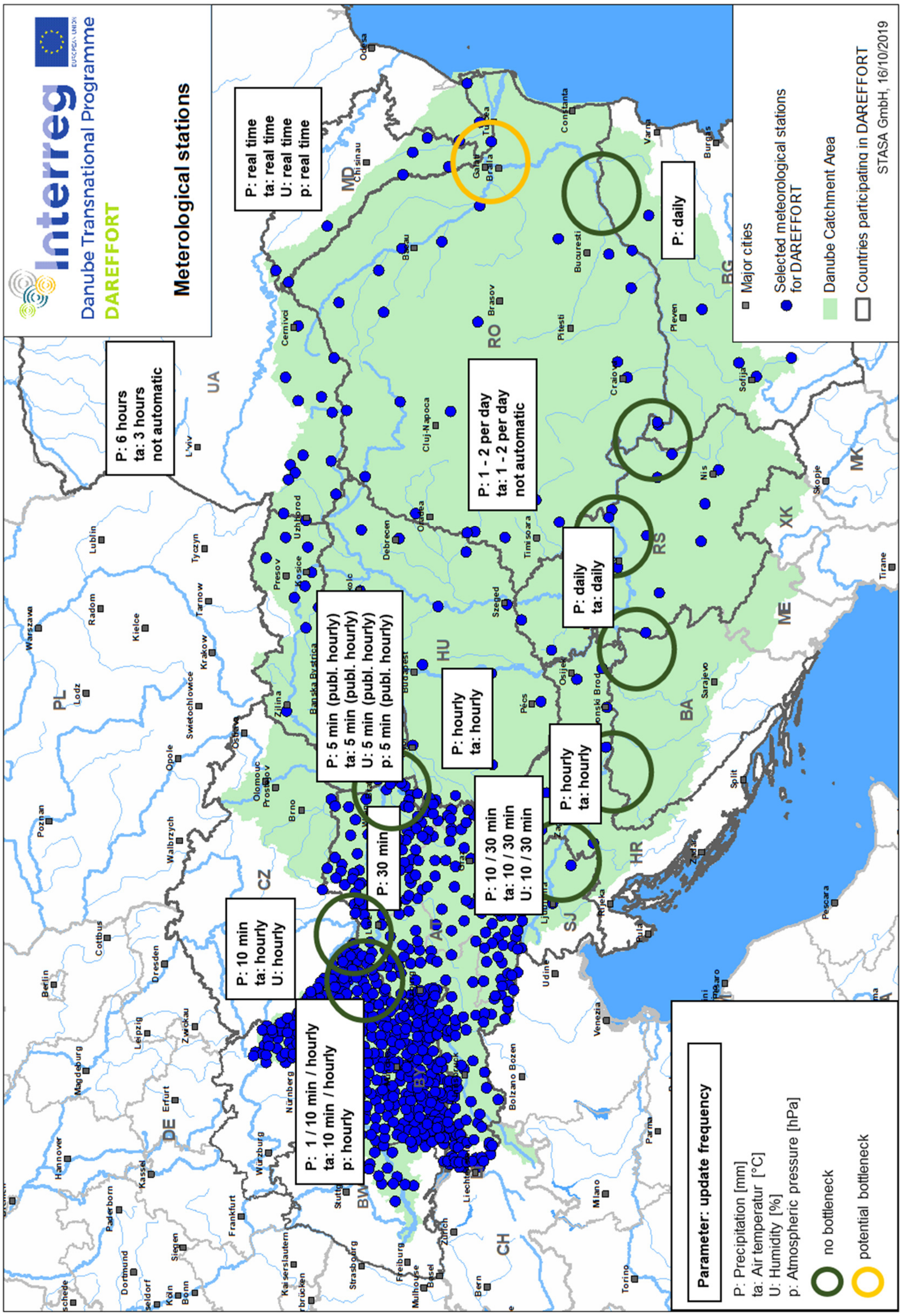

Figure 3 Update intervals for meteorological stations and recognized bottlenecks in data transfer

The largest differences between the variables and the update frequency of the data are for ice data. These are shown in Figure 4. If there is no fixed update interval, this was described with “yes” in Figure 4. In some countries (e.g. Slovenia and Croatia) no ice data is recorded at all. In some countries ice data are recorded by an observer and in the others by automatic stations. Furthermore, the intervals vary strongly, namely from five minutes, over daily, up to only publishing the ice data in yearbooks. In addition, also measured variables vary strongly. All these differences can be a bottleneck for predictions of ice conditions.

The density of measuring stations and the frequency of data updates is crucial for the improvement of forecasting systems and the data exchange in the future. In general, it can be stated that a high temporal and spatial measurement density in the catchment area is important for a good flood forecast. This applies not only to the measurements in the country under consideration, but also to the upper reaches. Therefore, a high measuring frequency and a high station density is important to avoid bottlenecks.

Analysis demonstrates that currently the countries use very different hydrological and hydraulic models, which are presented in Figure 5. If a Danube-wide forecast is desired in the future, the measured variables of all of the Danube River countries are needed in a high frequency and density. An alternative way would be to exchange forecasting results. The forecast data of the border regions could then be passed on to the next country as an input data. However, in some countries, there are separate models for individual river basins and in the others, only one model for the entire country is available. However, some of the countries, such as Austria, Slovenia and Croatia, already use similar hydrological and hydraulic models. In order to make a common hydrological forecast for the entire Danube River basin possible, this would have to be further coordinated and expanded.

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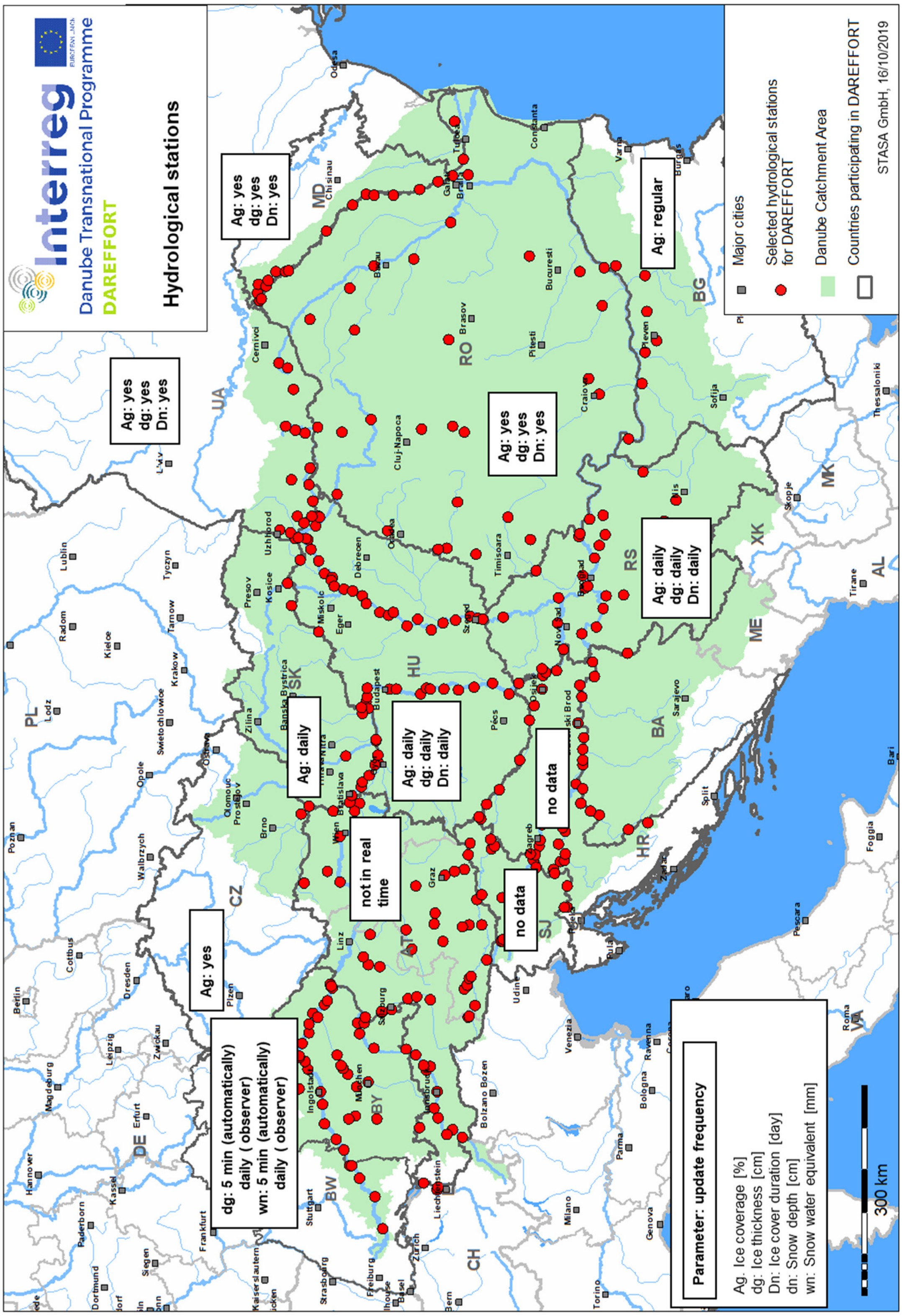

Figure 4: Update intervals of ice data at hydrological stations. "Yes" indicates there is no fixed update interval.

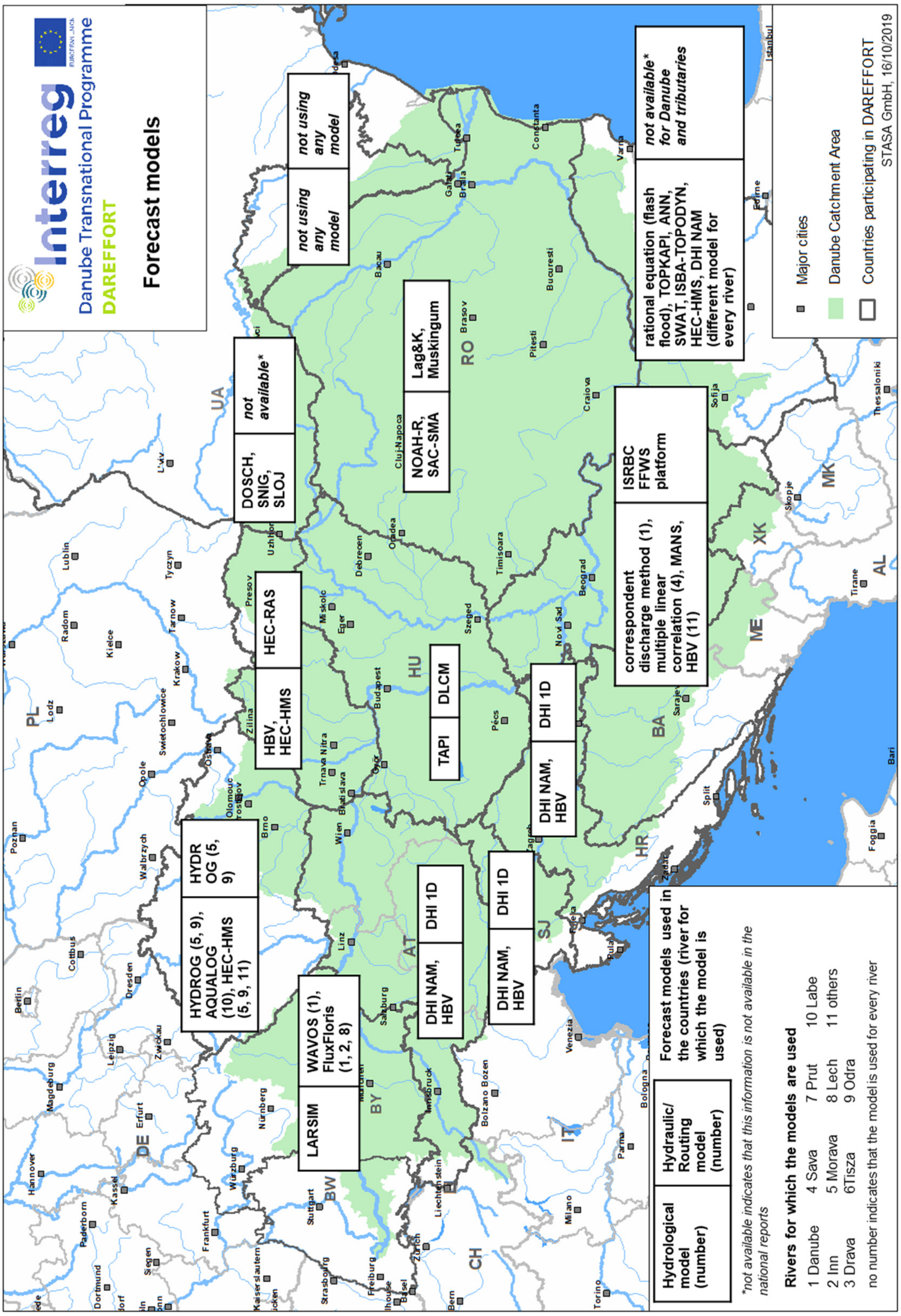

Figure 5: Forecast models used in individual countries