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Weather?

Use of precipitation nowcasting in hydrological forecasting systems

Photo: Borut Podgoršek, MORS, Slovenia

CENTRAL EUROPE COOPERATING FOR SUCCESS.

INCA-CE
Nowcasting for Central Europe

EUROPEAN UNION
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Introduction

In Central Europe, floods are natural disasters causing the greatest economic losses. One way to partly reduce the flood-related damages, especially loss of lives, is a functional objective forecasting and warning system that incorporates both meteorological and hydrological models. Success of the hydrological forecast is strongly dependent on the success of the precipitation forecast obtained usually as the output from numerical weather prediction models. The precipitation nowcasting, which is derived from the extrapolation of radar echo, can improve the first hours of the precipitation forecast significantly. Thus, the use of precipitation nowcasting in hydrological forecasting systems can result in more precise hydrological forecasts.

Water disaster struck in Slovenia in September 2010
Photo: MORS

About flood forecasting ...

Predictability of flood events

Floods can be divided to several groups according to their origin which is connected closely to their predictability. Briefly, we can speak about three main types of floods typical for Central Europe.

1. Floods caused by stratiform (long-lasting regional) precipitation or snow melting

These floods usually occur on all watercourses in areas exposed to the precipitation with high impacts along middle or large-size river. The causal precipitation hits areas of the size of thousands square kilometres. Such precipitation type is relatively well predicted by numerical weather prediction models. Water level raise is usually not so rapid (comparing to other flood types). That is why the hydrological forecasts of these floods are relatively successful.

2. Floods caused by both stratiform and convective precipitation

These floods hit large areas as well. Due to the presence of convection the exact spatial and temporal distribution of precipitation calculated by numerical weather prediction models is problematic. Therefore, the hydrological forecast can result in significant error - the precipitation can finally affect a different catchment than expected.

Difference in forecasting of large-scale floods and flash floods

Large scale floods

Large-scale precipitation is much better predictable than precipitation connected with storm activity.

Inputs: Time series in 1 hour step. Data from raingauges are usually sufficient.

Outputs: Time development of water stages, accuracy of forecast is »in cm«

Forecast is updated in several hours step.

Flash floods

Estimation of measured and predicted precipitation is very difficult and uncertain.

Inputs: Time series in 5-10 minutes step, radar data necessary.

Output: Results evaluated as »Danger of flash flood exists / does not exist«.

Forecast needs to be updated every 5-10 minutes due to the rapid development of storm.

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3. Flash floods

Flash floods originate from storm rain (frequently over 100 mm during several hours), lasting only one or few hours. Such floods happen on water courses with small catchments and relatively narrow valleys. A sudden rise of water level in a very short time period is characteristic for this flood type. Flash floods are usually considered as unpredictable. Development of nowcasting techniques holds some hope. Testing the possibility of flash flood predictability is one of the main goals of INCA-CE project.

The existing flood protection system mostly suits very well for large catchments. In small catchments, the interval between torrential rain occurrence and the following flood discharge in watercourse is very short, thus an efficient forecast is difficult in case of flash flood. Moreover, a flash flood forecasting system can produce considerable amount of false alarms.

The process of discharge forecast creation

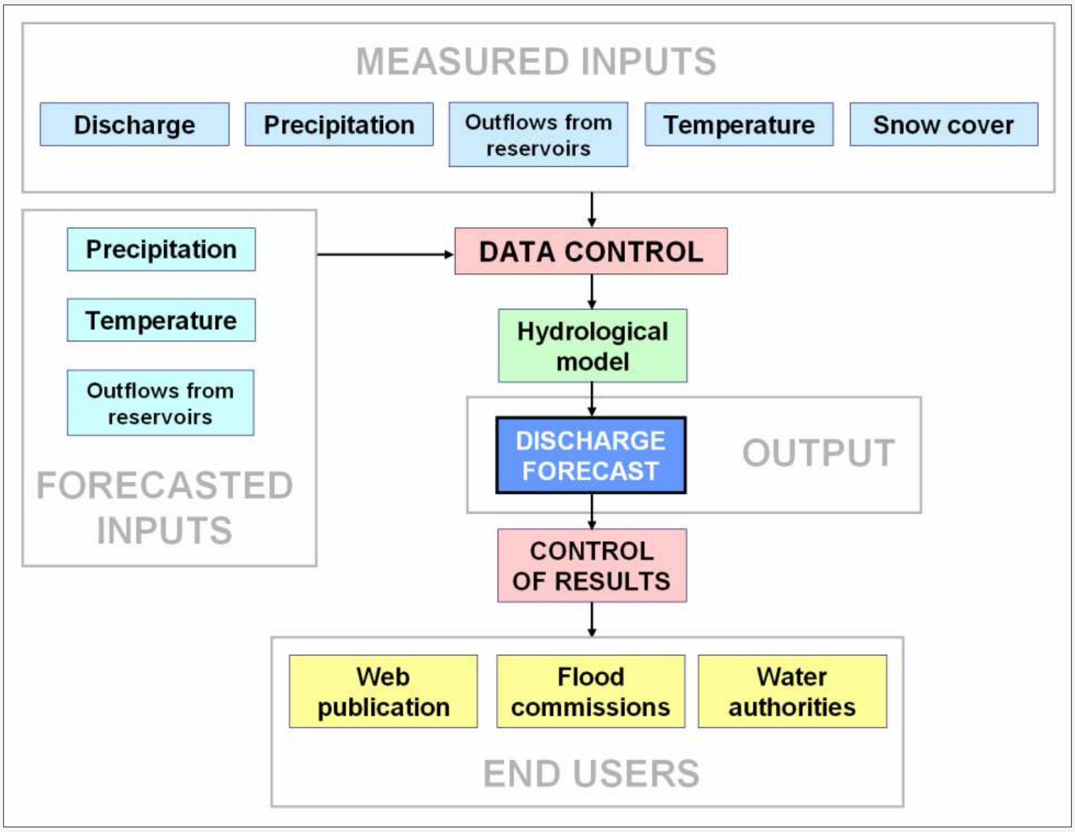
Discharge forecast plays the key role in the question of floods. Its aim is to warn inhabitants of the coming emergency and to minimize flood damages.

The ability to forecast river flows requires a deeper understanding of natural processes. Water on the Earth is in permanent cycle, in which it keeps changing its state. This cycle is powered by solar energy and gravitation power. Big hydrologic cycle means the exchange of water between ocean and mainland. Water evaporates above the oceans and is transferred in the form of clouds over the mainland. There it falls back onto the ground as precipitations and flows back to the oceans. Little hydrologic cycle means water exchange either over oceans or over mainland.

A catchment is an area from which water flows to a single certain point on the river. The amount of water flowing from the catchment through a defined river profile depends on a wide range of factors. In Central Europe, precipitation is the most important one. However, there is no linear relation between rainfall and discharge. This relation is influenced by many climate and geographic factors. Moreover, anthropological factors have to be taken into account.

To define the resulting outflow, the hydrological model for the simulation of rainfall-runoff process must be used. There is a wide range of these models and the development of them is still being in progress. Apart from operative hydrology they are used in project and design activities, and in research. The model simplifies the reality concerning the infiltration intensity, surface and soil water flow and other processes.

The quality of forecast depends on the quality and quantity of input information of which the most important is precipitation, especially the precipitation forecast. In the winter season, the hydrologic model inputs include air temperature, information about snow cover and its water content as well. Apart from these meteorological inputs, the models take into account also the hydrologic inputs, such as water levels, discharges and manipulations on reservoirs. The hydrologic



The scheme of the discharge forecast preparation and usage

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forecast is preceded by meteorological forecast. For the calculation of precipitation and temperature forecasts, the numerical weather prediction models (NWP models) are used. These models are based on equations describing the atmospheric processes.

Precipitations can be measured by using raingauge stations providing relatively precise information; however, they relate only to the location of the device. Another way to measure precipitations is the use of meteorological radars. They are able to offer continuous spatial information about precipitations over catchments, although the quantitative information about the precipitation amount is rather poor. Therefore, the combination of radar and raigauge measurement is the proper input for hydrological models. Precipitation nowcasting is obtained by the extrapolation of the radar data and usually leads to more precise prediction of rainfalls for the first hours of the predicted period than provided by the NWP models.

It is necessary to stress that hydrological forecast is created under the conditions of significant uncertainty. The error of (not only) predicted data can be great. These facts must be taken into account in the process of the interpretation of the resulting discharge forecast. The adaptivity principle enables the successful operation of the hydrological model in the conditions of uncertainty. During the flood event, the situation development in the catchment is continually monitored, the hydrological model outputs are continually compared with the real development and the model approaches more to reality. Therefore, it is recommended to update the forecasts according to the measured data as often as possible, taking into account the weakening predictability with increased lead time.

A typical lead time of the discharge forecasts for middle-sized and large catchments is 48 hours. These forecasts are published on the web sites. During the flood, the discharge forecast can be a crucial information for decision makers including water management and flood emergency commissions responsible for the measures to mitigate the flood damages, like the discharge control of reservoirs, construction of flood walls or deploying of sand bags, etc.

At the end, it is necessary to highlight the necessity of good communication between the meteorologists, hydrologists and end-users of the forecasts. The better the understanding of the process of discharge forecast creation, the more beneficial is the usage of such information. ▪

The life of hydrological forecast

Father:	Precipitation forecast
Mother:	Hydrological model
Child:	Discharge forecast
Place of birth:	Flood Forecasting Service
Place of living:	Watergauge station
Idol:	Measured discharge time series

- Some children are born into hard conditions of upper mountainous catchments, other live their lives peacefully in flat areas situated downstream.
- It doesn't matter only where the children are born, but also in which time. In peace they can live in steady flow. But in war their lives can be very complicated and full of various obstacles.
- Some children have a successful life and some have not...
- Children of modest parents (who have made only short plans) are much more successful than children of grandiloquent ambitious parents (this relates mainly to fathers).
- It is an interesting phenomenon that the birth-rate increases rapidly in war (death-rate as well).
- Another interesting phenomenon is that during war children usually grow older rapidly. The older children, the less usable. The adults are not usable at all (exceptions exist).
- The original sin of these children is uncertainty, which has sometimes fatal consequences.
- In war some children make great deeds which save human lives. These children are celebrated as heroes and became legends. Their memorials can be found in many flood reports and hydrological books.

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Use of precipitation nowcast in operational hydrology – pilot implementations

Austria

Hydrological application of INCA fields in Austria

Austria's national weather service ZAMG has historically its main focus on meteorology and geophysics and therefore does not do any hydrological modelling itself. However, there is a long lasting and very close collaboration with provincial hydrological services and universities. On the one hand, INCA precipitation analyses and forecasts are delivered automatically so that an operational flood warning and forecasting system can be operated elsewhere. On the other hand, ongoing research in joint projects helps to improve both the meteorological and hydrological models. This article deals with the role of the parameterization of precipitation-elevation effects in INCA and how it can be used to optimize the output fields.

Figure 1 Left: Analysis domain (black frame) and catchment areas (red frames) of Upper Enns (SW) and Upper Steyr (NE). Right: Areal view of Upper Steyr catchment area in the Totes Gebirge mountain range. The lakes in the foreground are Altausseer See and Grundlsee. Source: Google Earth.

The question of the importance of elevation effects has recently been addressed in the „Hydrocast“project[1], together with the Institute of Water Management, Hydrology and Hydraulic Engineering of the University of Natural Resources and Applied Life Sciences in Vienna.

Taking into account the elevation effects is indispensable for an accurate modelling of precipitation in mountainous terrain. A physically consistent parameterization of precipitation elevation effects has been used in INCA since 2008, with the parameterization being based on the relation of mountain to valley precipitation of single pairs of nearby stations.

A widely used technique for quality evaluation of the analysis fields (and of the method used) is the Cross Validation (CV) where a whole set of analyses is produced with a one-station observation being left out in every single analysis. Comparing the analyzed values at the location of the missing station with the actual (omitted) observations therefore enables us to estimate the local analysis error. If this technique is employed for a great number of stations and for a longer period of time, an evaluation that is sound in statistical terms can be obtained.

A major drawback of this method, however, is that a higher level of detail is punished: the higher the resolution and the more variable the analyzed fields, the more the statistical measures may be deceptive. This means that the reason for a poor result is not necessarily to be found in the analysis method, but rather in an ineligible method of evaluation.

The approach adopted in Hydrocast is different from the classical CV: INCA precipitation analyses serve as an input for a hydrological model, which in turn computes runoff values that are compared to observed runoffs at river gauges. In this way, integral measures can be obtained that allow for the assessment of analysis quality over a whole catchment or sub-catchment. By recycling the runoff information from the hydrological model back into INCA, an iterative process can be established that allows making adaptations in the parameterization of elevation

[1] *The funding of the Hydrocast project by the Austrian Academy of Science is gratefully acknowledged.*

dependence (2-way coupling). The investigation has been done with more than 40 experiments for the catchments of upper Enns and upper Steyr rivers in the Austrian Alps (see Figure 1), using 15 min analyses of the period 2003-2006. A number of fundamental parameters describing the parameterization have been varied as well as parameters like the annual variation and the dependence of prevailing flow directions.

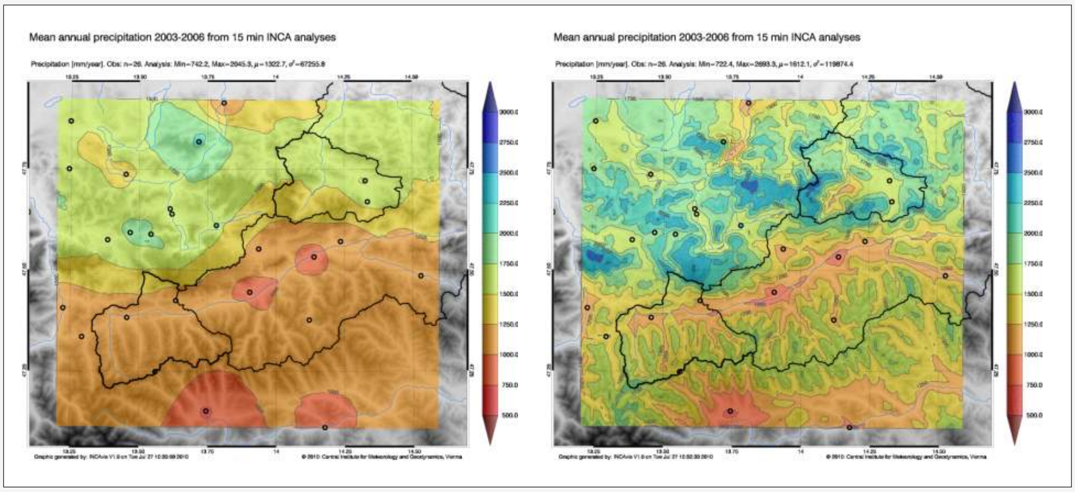


Figure 2: Mean annual precipitations 2003-2006 in the analysis domain. Left: no elevation dependence used. Right: with elevation dependence.

Figure 2 shows the mean annual precipitation in the investigated area with and without utilization of elevation dependence. The increase of variance in the right field is evident, which – as mentioned above – makes the classical CV claim the right field be “worse”. However, this is in contrast to Figure 3, where the median of the simulation errors of single gauges shows that the analysis quality is improved by $\approx$ 60 % when elevation dependence is used.

The experiments performed confirm on the one hand that using a parameterization of elevation effects in INCA is a very profitable technique. On the other hand, it has been found that a fine tuning of the elevation dependence can further improve the results in specific situations, although it is a quite tricky task. It is the consideration of the annual variation of elevation dependence in the first place (to a limited extend also the consideration of prevailing weather situation in terms of flow direction) that shows the highest potential for improvements.

Bica, B., M. Herrnegger, A. Kann and H.-P. Nachtnebel, 2011: HYDROCAST - Enhanced estimation of areal precipitation by combining a meteorological nowcasting system with a hydrological model. Österreichische Akademie der Wissenschaften, 2011 (ISBN-Online: 978-3-7001-7041-9) and DOI (Doi:10.1553/hydrocast2011).
Haiden, T, and Pistotnik, G., 2009: Intensity-dependent parameterization of elevation effects in precipitation analysis. Adv. Geosci., 20, 33-38.

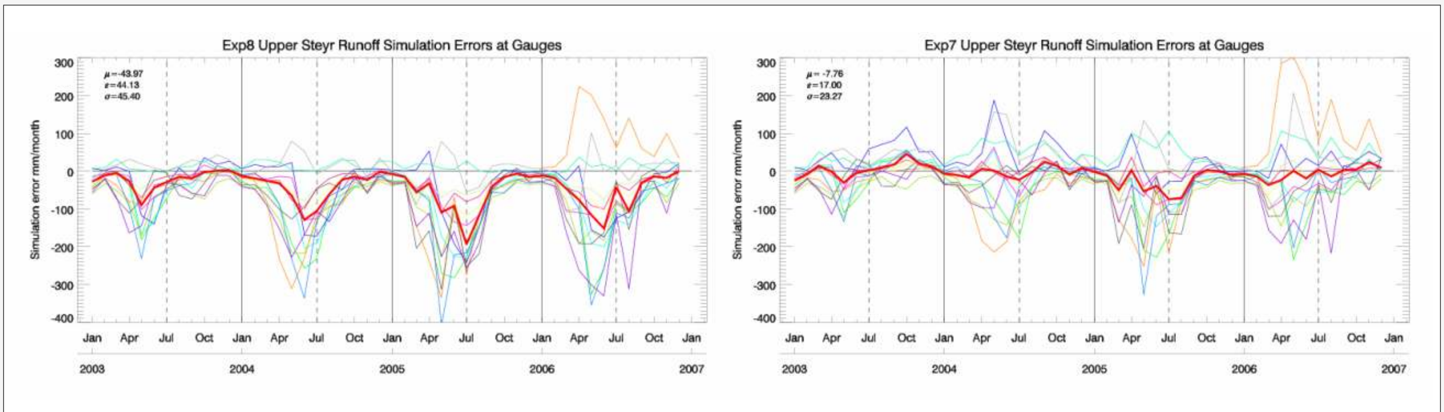
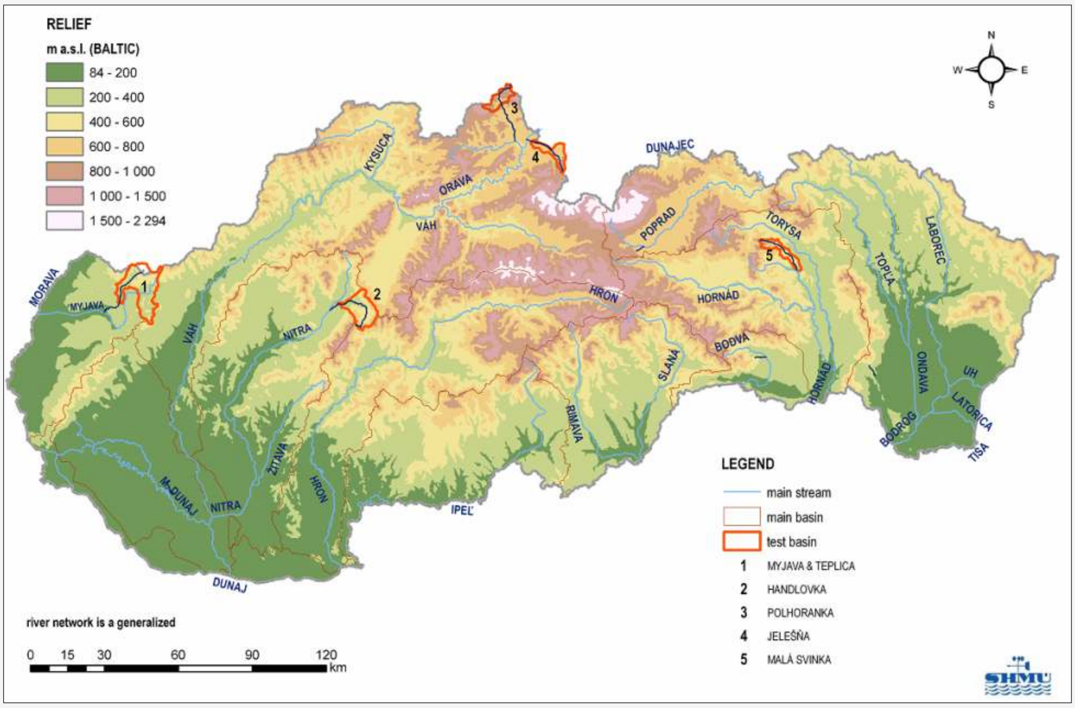


Figure 3: „Ensemble“ of simulation errors at gauges in the catchments of Upper Steyr (thin lines) and median of all gauges (bold red line) from 2003 to 2006. Left: no elevation dependence used. Right: with elevation dependence.

Slovakia

Nowcasting data as an input to hydrological models in Slovak conditions



Selected pilot areas (river basins) are Myjava, Polhoranka, Jelešňa, Handlovka and Mala Svinka

In last years, the necessity for flash flood forecasting increases. As inputs for this type of hydrological forecast, the nowcasting data seem the best option.

Five independent watersheds with different natural conditions in various parts of Slovakia have been chosen as pilot areas. Flash floods have occurred in every pilot basis in previous 20 years. In every pilot basin, raingauge and watergauge stations must be localized.

For the implementation of nowcasting in operational hydrology, two independent tools will be used:

1. **HRON** model derived from HBV hydrological modelling system and optimized for Slovak conditions. This will represent a "classic" hydrological modelling. It is a model with semi-distributed parameters based on a cascade of linear reservoirs, which is used to route the discharge from the upper sub-basin. The HRON model requires basic meteorological and hydrological input data (basin averages in hourly or daily time step) of precipitation, air temperature, discharge (required for model calibration and validation) and long-term monthly average of potential evapotranspiration and air temperature.

2. **HEC-HMS** hydrological model joined with the system of watershed saturation based on the CN method. This system is already in use in the Czech Republic. This system could work with current natural conditions of watershed and could accept spatial rainfall data which are not limited to a close neighbourhood of precipitation station. This modelling system requires spatial data of measured precipitation and spatial precipitation forecast. Due to a very short response time of small watershed, nowcasting precipitation analyses are necessary. Spatial fields of temperature and potential evaporation are the other input data.

The whole forecasting and warning system will be a combination of many components (models). As an input to the system we will get the data from nowcasting or meteorological models plus analyses of precipitation field (combination of raingauge station measurement and radar measurement). These data together with the actual natural condition in the watershed are the inputs into rainfall–runoff model, which calculates the amount of outflowing water and the shape of hydrograph (time and value of culmination). If the predicted water level in the closing profile will exceed the warning level, a warning message will be created and disseminated to stakeholders (civil protection, Slovak Water Management Company, Ministry of the Environment and Local Administration) via telephone and e-mail, and via internet to the public. ■

Poland

Implementation of MIKE 11 in the Raba River catchment

The Raba River is a Carpathian tributary of the Vistula River. The location of the Raba River catchment is shown in figures below. Generally, the river flows in a north-west direction. Its total catchment occupies an area of 1,537.1 km² and its length is about 132 km. There is a water reservoir Dobczyce located on the river, above which the water level station Stróża is situated. Stróża is a closing profile of our studies and it defines the catchment of 644.09 km2.

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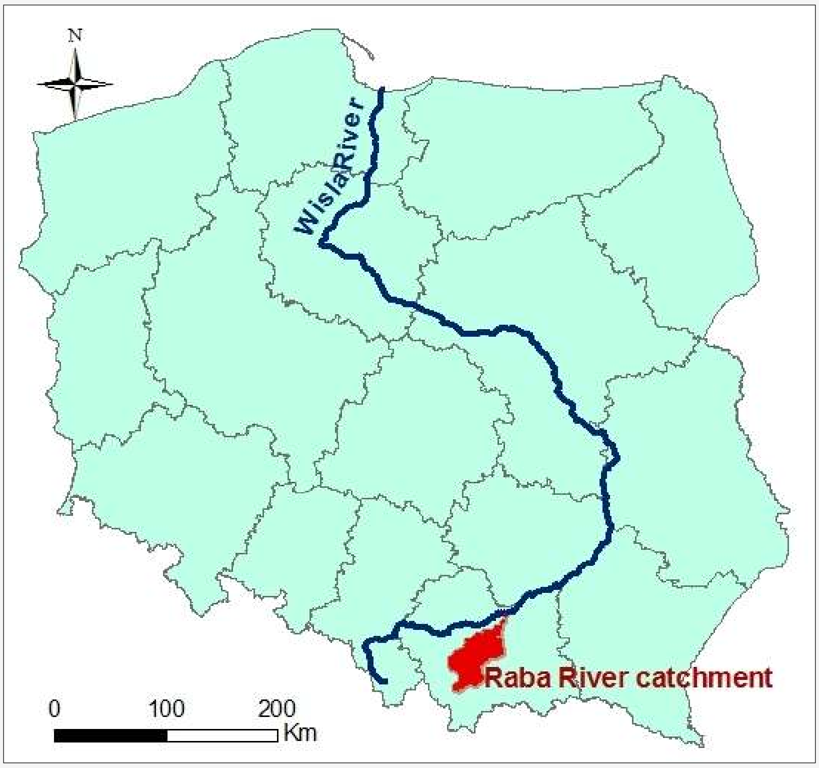
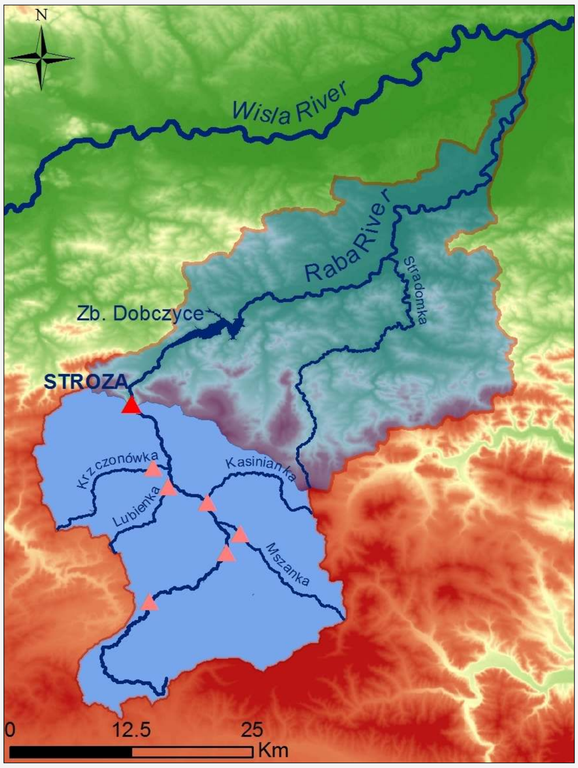


Location of the Raba River catchment



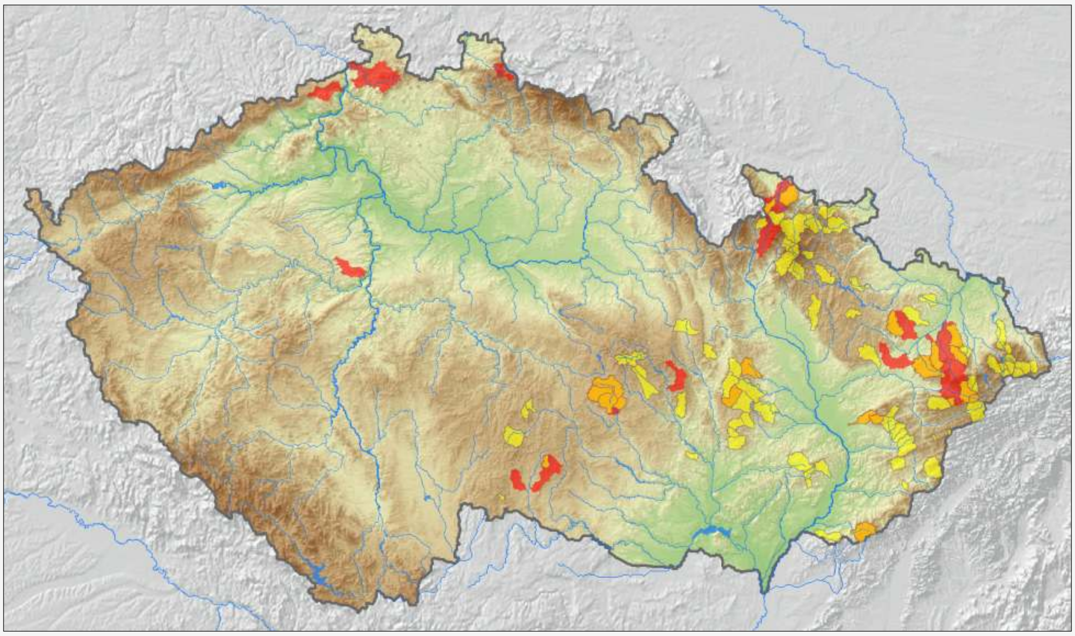
The upper Raba River catchment – water level stations

A conceptual rainfall-runoff model MIKE 11-NAM (built in DHI) will be implemented. The NAM model describes the land phase of hydrological cycle. The NAM rainfall-runoff model results will be used for inflow forecasting of the Dobczyce reservoir and also as an input for the hydrodynamic model. It is expected that implementing INCA-CE in operational hydrology will improve the quality of forecasts.

Flood wave on the Raba River near Stróża (closing profile of the NAM model), Photo: Piotr Sadowski

NAM is a lumped, conceptual rainfall-runoff model which consists of a set of linked mathematical equations, which describe in a simplified form the behaviour of the land phase of hydrological cycle with parameters that represent average values for the entire catchment. The parameters of the NAM model cannot, in general, be obtained directly from measurable quantities of catchment characteristics, and hence model calibration is needed. The model simulates the hydrological behaviour of the catchment as closely as possible. The process of model calibration is normally done either manually or by using computer-based automatic procedures. In manual calibration, a trial and error parameter adjustment is made. In this case, the goodness of fit of the calibrated model is basically based on a visual judgement by comparing the simulated and the observed hydrographs.

For the purpose of the INCA-CE project, the model was calibrated according to the meteorological and hydrological data (from the period: 01.11.2005 – 01.11.2010). The values of potential evapotranspiration were obtained from the EUMETSAT's SAF on Land Surface Analysis. When the model starts working in



Catchments chosen for pilot implementation in operational hydrology within the Czech Republic. Yellow colour: Fuzzy model; red colour: HYDROG model; orange colour: both methods.

operational hydrology, the forecasted data obtained from INCA will be used. ■

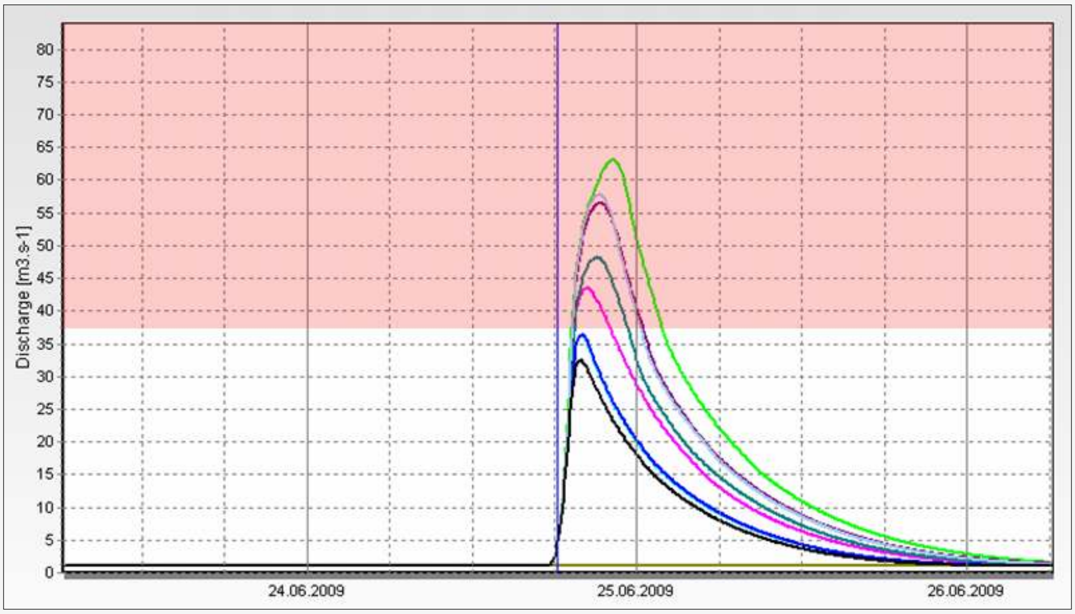
Czech Republic

Pilot implementation of flash flood forecasting systems

In the Czech Hydrometeorological Insitute, two methods for the estimation of the danger of flash flood occurrence have been put in the testing operation:

1. **HYDROG** model. This model is used in routine for the calculation of discharge forecasts for the whole Morava and Odra Rivers basin within the Flood Forecasting Service for many years (the model for the upper part of the Odra catchment was set into operation in 2001). Hydrological forecasts for more than 30 watergauges are issued daily. The experiments concerning flash flood forecasting proved that with the use of precipitation nowcasts some flash floods can be predicted several tenths of minutes in advance. Within the INCA-CE project, the HYDROG model will be put in testing operation on 20 catchments (see the map).

2. **Fuzzy model**. This model was developed in the Technical University of Brno. The model uses MATLAB Fuzzy Logic Toolbox. Fuzzy logic is one of the artificial intelligence methods. These methods are able to cope with the indeterminacy of natural phenomena better than deterministic approaches. The fuzzy model created for flash flood forecasting uses geomorphologic characteristics of the catchment and the data describing the causal precipitation as inputs. The estimation of the peak discharge is the main output. The model was tested on 90



Example of the probabilistic discharge forecast of the flash flood. The red field depicts the area of above-limit discharge. The probability of limit discharge exceedance is derived from the set of predicted peak discharges.

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catchments, using the data from the summer season 2009 when the Czech Republic was hit by a great number of flash floods.

Various precipitation nowcasts will be used as inputs for both models. So far, three methods of nowcasting are calculated operationally at the Czech Hydrometeorological Institute – COTREC, CELLTRACK and INCA. The estimation of precipitation amount is based on the combination of raingauge measurement and the data from meteorological radars. For the improvement of precipitation estimates, the radar and raingauge data from neighbouring countries are used as well. The probability of limit discharge exceedance is derived from the set of peak discharges calculated for each term of the forecast. The forecasts are updated every 5 minutes.

Nowadays, the HYDROG and Fuzzy models are verified on historical data. Both systems will be put in testing operation in the summer season 2012.

Flood events

Austria

Some regions of Burgenland, the easternmost state of Austria, have been regularly affected by floods in the last years. Especially in 2009, there were severe floods in the southern districts of Oberwart, Güssing and Jennersdorf as also in the northern district of Neusiedl, which is the region almost completely surrounding a well-known Lake Neusiedl. Flood forecasting, precipitation measuring and weather observation gained increased importance at that time. The hydrologic service, being part of the tasks of the office of the state government, had to work closely together with the operations managers at district and state levels and was in daily contact with them in the critical phases of flooding. Now, after such practical experience, there exists a close network between hydrologists and experts in crisis management, which enables short-term communication in crisis situations at all times.

A special technical instrument was developed recently by hydrologists: a new "water portal" of Burgenland, which is an internet-platform including permanent water level measurement, precipitation rate, water temperature, flood plain and several other features. It provides valuable information to the central emergency control centre and operations managers as well as to the general public (http://wasser.bgld.gv.at/). This website will be extended continually in the future. Another cross-border project called "ProRaaba" will enable to predict floods for nearly the whole Burgenland. At the end of 2011, it will be possible by using weather forecast to predict floods for up to six days in advance at the rivers Rabnitz, Güns, Pinka, Strem, Lafnitz and Raab. This will bring a new standard to flood protection. Floods will not be avoided by this data file, but the fear of flash floods will be minimized. Calculation of drain speed and estimative return of normal water level are additional features of this file.

Slovakia

Flood event in June 2011 in the Male Karpaty mountain region

A wet and warm front from the south-west created ideal conditions for storm activity on 7 June 2011 in the western part of Slovakia. The storm began after 11:30 UTC and culminated between 12:00 and 14:30 UTC in the south-eastern part of the Malé Karpaty mountain range. The short-term rain intensity exceeded the value of 120 mm/h. The total measured precipitation during the flood was from 60 to 104 mm. The hydrological response started one hour after the culmination of rain, which was most intensive in the watersheds of Parná and Gidra, where the culmination discharge significantly exceeded Q100. The water

Flood event in June 2011 in the Male Karpaty mountain region

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Two flood events in the Żywiec District in June 2010

Floods in the Somogy County, 15-18 May 2010

level of Gidra increased about 2 m, of Parná about 1.5 m. The total flood wave duration did not exceed six hours. The property damage was estimated in million euros.

Poland

Two flood events in the Żywiec District in June 2010

In May and June 2010, two floods occurred in the Żywiec District. The fist one happened on 16 May and the second one on 2 June. The rainfall was caused by low pressure in south-eastern Europe. The daily amount of rainfall reached 100 mm during the first flood and 50 mm during the second one. As a result of intense rainfall and floods, many roads and bridges were destroyed. The estimated damage to the district and municipal infrastructure amounted to 90 million zloty.

Czech Republic

Flood event in the Beskydy Mountains in May 2010

In the second half of May 2010 and in early June 2010 heavy rainfalls were recorded for this season in the wider area of Central Europe. The largest amount of rainfall during the second decade of May occurred in the Beskydy Mountains. The highest daily rainfall totals were recorded on 16 and 17 May 2010. From the hydrological point of view, the worst flood situation was in the Olše basin, roughly from the Karviná town to the Odra River estuary. An interesting hydrological attraction was a clash of waves of the rivers Odra and Olše.

Flood event in the Beskydy Mountains in May 2010

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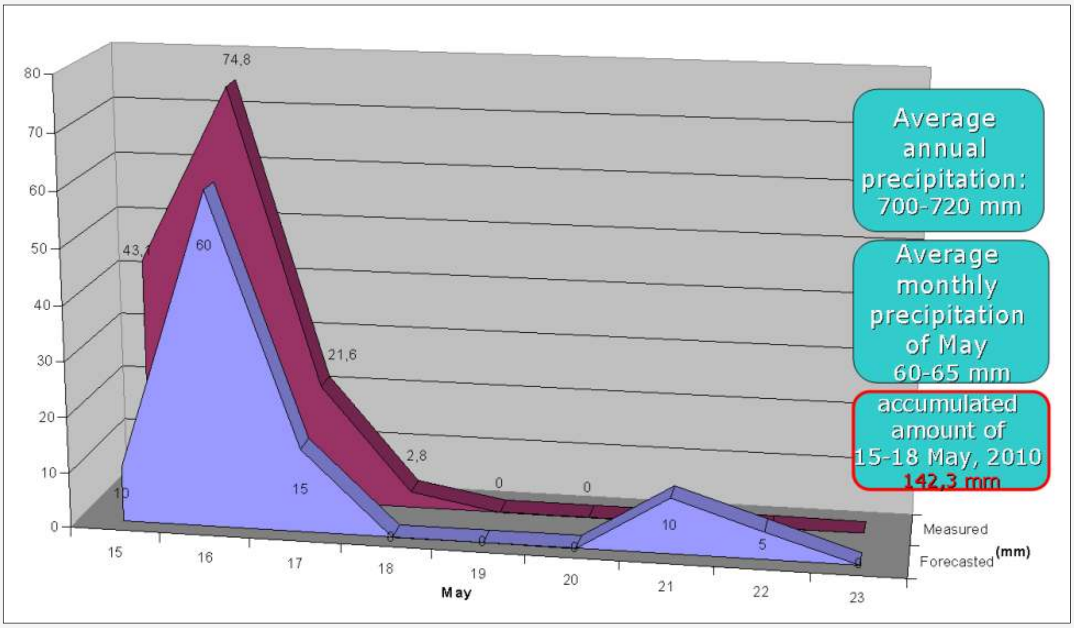


Forecasted and measured precipitation at Kaposvár

Hungary

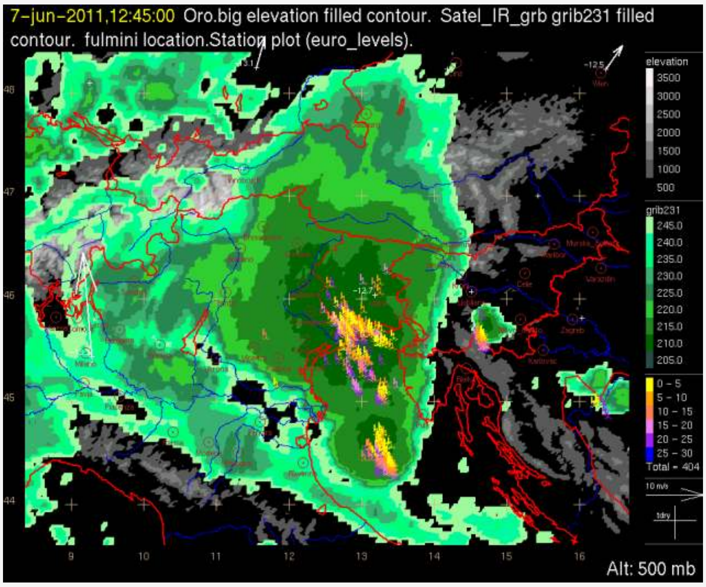
Flood event in the catchment of the Kapos River

During the period 15-18 May 2010, a high amount of precipitation occurred in the catchment of the Kapos River. The water level at Kaposvár was rising 6-7 cm hourly and rapidly reached the critical level. Therefore, in the endangered parts of the town it was necessary to lock the flood gates, raise the heights of dikes and build the revetments. The activities carried out (resource use, identification of endangered areas, etc.) greatly relied on the micro-regional weather forecast system of the Hungarian Meteorological Service. The forecasts helped the interventions to be more effective. It also contributed to the reduction of damages. The figure below illustrates the accuracy of the forecast.

Germany

Flash flood in the community of Motzlar/Thuringia

An extreme rain event resulted in a flash flood in the community of Motzlar/Thuringia in the evening of 29 June 2011. The analysis of the radar data from the German Meteorological Service showed a rainfall of 100 mm within two hours. The water level in many flooded streets reached 150 cm. Several cars were dragged more than 300 meters away by the flood and two people were saved from the top of their cars. The Ulster River reached its flood warning limit. An oil barrier had to be constructed to capture oil from destroyed tanks in the area. The property damage was estimated at about 1 million euros.



Infrared from Eumetsat MSG satellite at 12:30 UTC with lightening related to the flood in Lignano

Flash flood in the community Motzlar/Thuringia
Photo: Heiko Matz, Source: www.thueringer-allgemeine.de

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High waves due to strong bora wind in Piran, 2 March 2011

Flooding in Lignano (Italy) on 7 June 2011

Slovenia

High waves in Piran

A strong bora wind was blowing due to an intensified pressure gradient in the Northern Adriatic region between 1-3 March 2011. The bora with a maximum speed of about 120 km per hour caused high waves in the Gulf of Trieste. On 1 and 2 March, the mean peak wave height measured on the oceanographic buoy in front of Piran was 2.57 meters. The highest wave in that period was 4.78 meters high, which was the maximum in a 10-year measuring period. High breaking waves splashed against the exposed parts of the coast. In the area of Punta Piran, the sea water crashed over jetties and reached houses at the seafront. High waves were breaking the shore jetties and brought a lot of rocks to the road. The marine authority closed the Port of Koper due to unsafe navigation conditions.

Italy

Flood event in Lignano on 7 June 2011

On 7 June 2011, a low pressure over the British Isles induced a southwestern warm low level flow over the Friuli Venezia Giulia (FVG) region. Although it was not a well defined front, a cloud system from the Apennines reached FVG during the late morning, creating heavy thunderstorms along the coast. Despite a quite low potential instability (DT500=-1oC and CAPE=310J/kg at 11UTC), the amount of rainfall was remarkable, affecting mainly Lignano: cumulative precipitation of 82 mm, with a peak rate of 42 mm in less than two hours. The Civil Protection intervened in numerous flooded basements and on roads.

Past events

WP leader meeting in Bratislava

To reinforce the link between the individual work packages, a meeting was organised in February 2011 at SHMI in Bratislava, where the work package leaders discussed about the interdependence of the work packages. The bidirectional information flow between pilot implementations and INCA model development as well as the general internal communication strategy were considered to be very important.

Technical meeting at Zywiec

The transregional meeting established a closer cooperation among partners involved in pilot implementations in operational hydrology – Poland, Slovak Republic and Czech Republic.

Progress Meeting 2

The 2nd progress meeting was hosted by CHMI and took place in Kutna Hora (CZ) from 4 to 6 May 2011. At the reunion of all project partners, a considerable progress made during the preceding six months was presented. The status of INCA development and operational

INCA-CE Progress Meeting 2 in Kutna Hora, Czech Republic
Photo: Rok Kršmanc

Road safety meeting in Sierndorf, Austria
Photo: Josef Neuhold

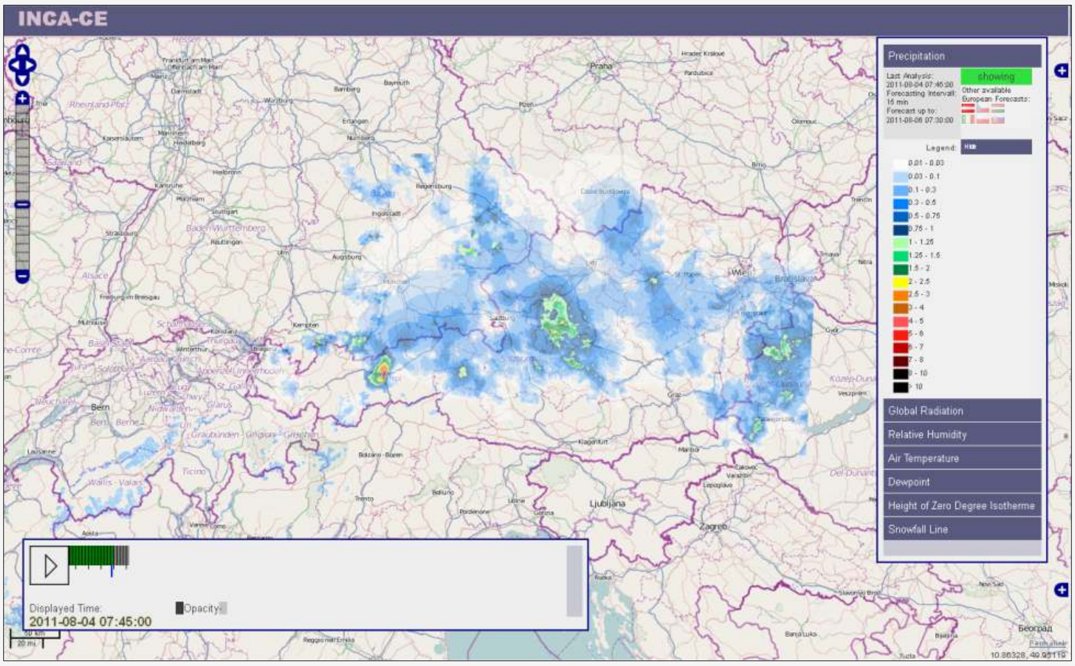
integration of weather services was reported. Pilot implementations in hydrology, civil protection and road safety were also shown by many partners. An additional highlight at this meeting was the scientific session, where current research activities on nowcasting at the partner institutions were presented.

Civil protection meeting at the Lake Balaton

The transregional working group meeting on civil protection in Balatonföldvár at the Lake Balaton (HU) was organised in June 2011. During this meeting, progress was made on the transregional strategy and approach for the implementation of nowcasting information at civil protection authorities. At the end of the meeting, a press conference was held and in consequence, three newspaper articles were published in local media.

Webportal meeting in Vienna

The webportal meeting in July 2011 in Vienna brought together all partners who provide INCA forecasts and who will visualise nowcasting information through the webportal. The main focus of



INCA-CE web portal (first version), showing an INCA precipitation forecast for Austria

2nd Technical Meeting in Usti nad Labem

this meeting was the technical implementation of the webportal and drafting of a plan for the implementation and later continuous amelioration.

Technical meeting at Ústí nad Labem

The project partners participating in tasks concerning operational hydrology shared their experience in setting the flood forecasting systems in pilot catchments.

Road safety meeting in Sierndorf, Austria

In August, members of the transregional working group on road safety held a meeting at a road maintenance centre in Lower Austria to discuss about current and further activities. Especially, the work towards a trans-boundary strategy document was planned and current pilot implementations as well as future plans were discussed.

Civil protection working group meeting at Lake Balaton, Hungary
Photo: DMDSC

Upcoming events

European Conference on Severe Storms

Palma de Mallorca, 3-7 October 2011: Several presentations of results from INCA-CE are scheduled.

Progress meeting 3

This meeting will be jointly hosted by ARSO and CGS plus in Ljubljana from 9-11 November 2011.

Project outlook

In the current phase of the project and also for the forthcoming months, a special focus is given on improving the INCA nowcasting model. Work is being done on the precipitation nowcasting, wind gusts and topographic wind effects, and other research topics. In conjunction with INCA development, the pilot implementations will be expanded and the feedback circles will guarantee an efficient exchange of information between model developers and authorities using the provided nowcasting information.

Parallel to these core activities, the partnership will work on the documentation of the nowcasting system, the experiences gained, and the preparation of training material will also start.

Project Identity Card:

Title: INCA-CE — Integrated Nowcasting System for the Central European Area
Acronym: INCA-CE
Programme: Central Europe
Duration: 1 April 2010 – 30 September 2013 (42 months)
Partnership: 16 partners from 8 Central European countries
Lead Partner: Central Institute for Meteorology and Geodynamics (ZAMG)
Webpage: http://www.inca-ce.eu/

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INCA-CE Nowcasting for Central Europe
EUROPEAN UNION EUROPEAN REGIONAL DEVELOPMENT FUND

The eight laws of hydrological forecasting by Mr. Murphy

1. The flood always hits on Sunday at 02:00 a.m. when there is nobody in the forecasting centre.
2. If law 1 does not apply then the flood comes when the staff is windsurfing on the nearby lake.
3. If one is lucky one meets only once in a lifetime the flood that is greater than the design flood.
4. If one is unlucky this happens regularly.
5. The 100-year flood returns every ten years minimum twice.
6. When the big flood comes, the online data collection system fails within minutes.
7. When the big flood comes, all our precious hardware breaks down in maximum T hours, when T is one fifth of the concentration time of the catchment.
8. The probability of the joint occurrence of unfixable computer bugs in the code of our forecasting model and the big flood is one.

Source: András Szöllösi-Nagy, Learn from your errors – if you can, ISBN 978-90-73445-263-9

Painting by Edward Hicks, 1846

The first known hydrologist-forecaster was Noe. He successfully predicted the world flood which occurred five thousand years ago. He also realised the first known structural flood measure to protect his family and various animals from the consequences of the flood. Unfortunately, the forecasting system developed by Noe disappeared.

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