HORA – AN AUSTRIAN PLATFORM FOR NATURAL HAZARDS AS A NEW WAY IN RISK COMMUNICATION

Heinz Stiefelmeyer[1], Thomas Hlatky[2]

ZUSAMMENFASSUNG

HORA ist ein bundesweites Risikozonierungssystem (www.hochwasserrisiko.at) für Naturkatastrophen mit den derzeitigen Schwerpunkten Hochwasser und Erdbeben. Dieses europaweit einzigartige PPP-Projekt wurde in Zusammenarbeit mit dem Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMLFUW) und dem Verband der Versicherungsunternehmen Österreich (VVO) an mehr als 25.000 Flusskilometern in vier Jahren gemeinsam umgesetzt. Nutznießerinnen und Nutznießer dieser Kooperation sind die Bürgerinnen und Bürger, wenn es darum geht, wichtige Informationen zur Überflutungsgefahr beispielsweise des Eigenheims oder eines Industriebetriebes, einer Infrastruktureinrichtung etc. bereitzustellen.

Keywords: Naturgefahr, Öffentlichkeitsbeteiligung, Risikokommunikation, Prävention

ABSTRACT

The internet-based platform "HORA – Flood Risk Zoning Austria" is an Austria-wide risk zoning system for natural disasters, presently with the priorities of floods, earthquakes and hail (www.hochwasserrisiko.at). This project – also as a ppp-modell - is unique in Europe and, in the course of four years, has been jointly implemented by the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) and the Austrian Insurance Association (VVO) on more than 25.000 river kilometres. The beneficiaries of this cooperation are to be the citizens of this country when it comes to provide important information for example on the risk of flooding of one's home or of an industrial enterprise or an infrastructure facility. So, in addition to obtaining easy and quick information about any risk of flood via a digital internet hazard map, which serves as a first risk assessment as well, this tool can also be used to optimise and set priorities in the required flood control at the municipal, provincial and federal levels.

Keywords: natural hazards, public participation, risk communication, prevention, awareness

[1] Dr. Heinz Stiefelmeyer, Head of Division flood protection, Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW), Marxergasse 2, 1030 Vienna, Austria, (Phone: +43/1/711-00/7138; e-mail: heinz.stiefelmeyer@lebensministerium.at)
[2] Dr. Thomas Hlatky, Grazer Wechselseitige Versicherung, Herrengasse 18-20, 8011 Graz, Austria (Phone: +43/316/8037/538; e-mail: thomas.hlatky@grawe.at)

INTRODUCTION

Following the devastating floods in 2002, Austria again had to cope with several major flood incidents in 2005 and 2006. The total losses for 2005 amounted to some 100 million euros in insurance claims and about 560 million euros in damage to the country's economy. These sums were not as extreme as the record figures of 2002, when approximately three billion euros of damage were inflicted on the Austrian economy, and about 400 million euros were paid out as the result of insurance claims. Nonetheless, the figures reveal the need for a comprehensive common solution to the problem of insurance provision in the light of such devastating events; a solution in which private insurance providers, policyholders and the state shall have to share the burden.

As a first step in this direction, the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) together with the association of Austrian insurance companies (VVO) has developed HORA, a nationwide zoning system for natural disasters with a special focus on the potential likelihood of flooding (see fig. 1). HORA contributes towards improving awareness of pertinent risks among the people, which also helps curtail potential losses in the future. The Internet access to HORA's digitalized risk map is free of charge.

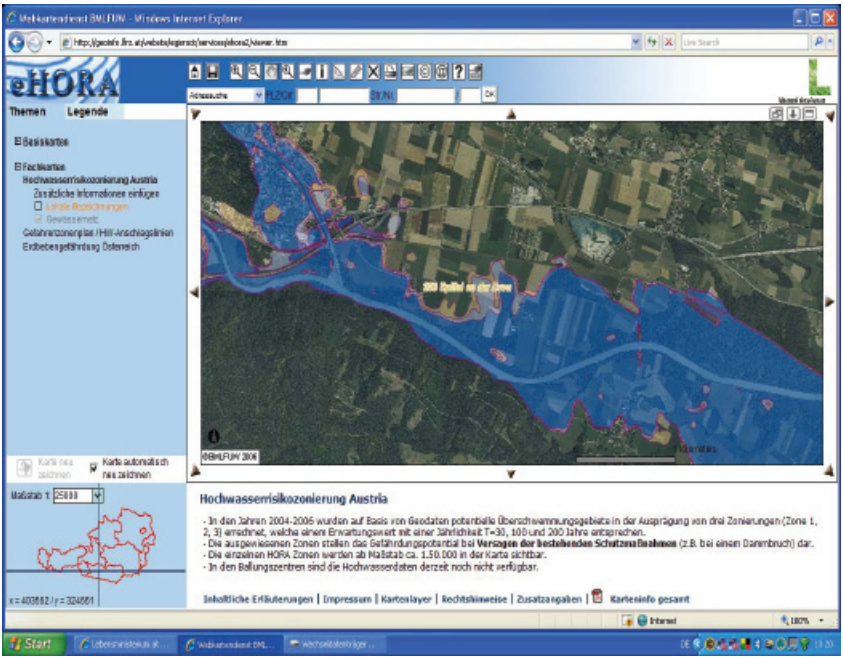

Fig. 1: Flood risk zoning Austria (HORA)

THE HORA MODEL

In the beginning the aim of HORA is to identify flood areas which provide information on 30-year, 100-year and 200-year flood events relative to the river network recorded on a scale of 1:500.000 with a total length of more than 25.000 km. To achieve this aim organisational and technical works had to be performed.

The ppp-model

The Federal Ministry for Agriculture, Forestry, Environment and Water Management (BMLFUW) and the Association of Austrian Insurance Companies (VVO) have agreed after extensive preparatory work to work jointly towards the establishment of a flood and natural disaster risk zoning system in Austria. There is a common interest in setting up a freely accessible system, in which areas affected by floods and other natural disasters can be rapidly and uniformly identified throughout Austria and this information made available. Thus in the long term efforts should be made to avoid damage from natural disasters such as floods by the implementation of the appropriate measures, e.g. in spatial planning, local building regulations and in general damage prevention.
The system conforms to the current state of the art, particularly in the field of geoinformation systems and geobase data. It is primarily based on a probabilistic method and is therefore not capable of replacing or acting as a substitute for local hazard maps. It is expressly not intended to produce an instrument for the enforcement or establishment of historical claims against regional administrative bodies or other legal entities and it can never replace the necessary local risk assessments or evaluations either in the past or in the future.
The subject of a contract between BMLFUW and VVO is the implementation of the project "Flood risk zoning Austria" (HORA). The results are made available in an open system with a free access and free of charge for everyone. Subsequently, the greatest possible level of updating shall be constantly ensured and maintained. The rapid integration of other available natural disaster risk data will be sought, wherever it is available in digital form. The BMLFUW undertook to make available the relevant experts to deal with the integration of the federal and regional offices concerned and to provide a cost estimate for the external services. In the event of the implementation of the project, the VVO undertook to accept the costs, in particular those for the calculation of the flood zones for the flood network across the stated length as well as those for the generation of the hydrological computer model. With regard to the level of the cost contribution, the VVO submitted a quotation as soon as an estimate of the level of the probable costs is available.
A steering committee was formed, which decided on all important content-related, financial and organisational issues of the project requirements and made up of two representatives from both the BMLFUW and from the VVO. The steering committee reached its decisions on a consensual basis and drew up the project organisation and project structure and the time sequence for the project within the framework of the project requirements it also drew up the budget and the technical content of the scope of supply. The inclusion of specialists from different regional administrative bodies and departments as well as experts from the reinsurance industry was in particular expressly required for clarification and support in respect of any legal and technical issues which may have arised at any phase of the project. The contracting parties undertake not to offer advantages of any kind to third parties, directly or indirectly, nor to accept gifts for themselves or for others, directly or indirectly, or to acquire or have promised other such advantages for themselves or others which are or could be regarded as unlawful practice or bribery.

The hydrological model

The probability with which a certain block of land is immersed in water during a flood event can be calculated by means of hydraulic engineering methods. These have traditionally relied on statistical figures, which are known to be very inaccurate, especially when major events such as flooding are concerned. The Vienna University of Technology (TU) (Institute of Hydraulic and Water Resources Engineering) has dedicated many years to developing more accurate, process oriented risk assessment techniques. The starting points was to identify different flood-triggering processes and to divide them into specific categories as long-duration rainfalls, short-duration rainfalls, storms, rain following snow and snow melting.
Now that the TU team has for the first time assessed the overall runoff for all Austrian water bodies comprising 10.000 individual zones, HORA has since 2003 also benefited from this know-how. The new procedure basically consisted in analysing the aforementioned data derived from 1.000 water level readings all over Austria and matching them with data from the relevant governmental departments in the provinces. Then the data were matched with further specific information (geology, precipitation, hydraulic engineering, etc.) to also take account of the processes triggering floods. By means of mathematical regionalisation models these data were finally transferred to ungauged stretches of watercourse so as to produce the runoff data for 30-, 100- and 200-years events.

The hydraulic model

Runoff data was converted into water levels and flooding zones at the Institute for Applied Water Resources Management and Geoinformatics (IAWG) based in Ottobrunn near Munich. IAWG is the only scientific institution in Europe where such a complex task had already been successfully tackled before and which also has adequate computing capacities.
The hydraulic task was carried out in several steps. At first during the pre-processing, cross-sections, which were necessary for hydraulic calculations, were determined along the complete river network at short distances. Then one-dimensional, stationary non-uniform computation was used to determine the energy head line and water surface elevation in river sections and design discharges, derived from hydrological analyses for various return periods, were used. Parameters, which were necessary for the modelling process, were defined by evaluation of results from already existing hydraulic calculations in various studies. Water-depths, as the result of the above mentioned calculations in defined cross-sections, were then distributed equidistantly by using interpolation techniques during the post-processing, thus enabling the computation of closed polygons of the associated inundation-areas for each return period of the design discharge which was taken into account.
A multitude of various geo-related data was used to carry out the hydraulic calculations. Apart from the digital elevation model (DEM) using 840 million points and the digital slope model (DSM) consisting of approx. 3.4 billion points, an accurate and consistent river network, containing more than 5,000 basin divides, as well as more than a thousand topographical maps (ÖK50), which were geo-referenced, formed the basis of the calculations.
The Vienna based LFRZ (IT Competence Centre for Agrarian- Land- Forest- and Water Issues) was responsible for the IT development and the administration of the HORA Webgis homepage as well as for its user-friendliness. On the internet version the user can zoom to a scale of 1: 5,000 and a conventional web browser is all that is needed to use this geographic information system.

THE RESULTS

The results of the hydrological and hydraulic calculations are available as:

- discharges (HQ_T) for various return periods (30, 100 and 200 years) at each node of the river network
- vectorial presentation of the river network with scaled line widths and colours representing flood peak discharges (return period 30, 100 and 200 years)
- vectorial presentation of flood plain boundaries for flood peak discharges with a return period of 30, 100 and 200 years covering Austria's whole river network (scale 1:500,000)
- grid-based topography of water depth covering Austria's whole river network (scale 1:500,000) for various return periods (30, 100 and 200 years)

The overall goal was to achieve suitable accuracy for large-scale flood risk mapping and regionalisation techniques were used to determine flood peak discharge (HQ_T). Nevertheless, this approach does not provide the accuracy obtained by detailed experts' survey, for example, using rainfall-runoff models. The determined HQ_T values therefore do not replace design values based on more detailed studies which take into account local aspects in a more specified way.

Corresponding to the objectives of the HORA (Floodwater Risk Analysis Austria) the stated flood peak discharges (HQ_T) are regarded as "expected values" which are reached or exceeded with a probability of 50 %. Uncertainties, deriving from inaccurate stage-discharge relations or transfers to cross-sections without discharge registration, are not taken into account by an increase in the stated values; however they represent a certain variation of the given values. Thus HQ_T values (HORA values) are not to be regarded as "design values" but are most likely values which can differ from design values.

Hydraulic calculations for river basins of the presented size using models and data of the above mentioned accuracy have not yet been carried out. This task could only be solved by using a high degree of automation in the work flow. Over the past years the underlying pre- and post-processing algorithms have been developed and constantly improved. Numerous quality checks, based on experience, were incorporated for plausibility control of interim and final results. Hydraulic modelling is less accurate than in detailed studies but it would have been far too expensive and time consuming to apply more accurate methods to the river network in question.

The accuracy of the model results was mainly defined by the uncertainty of the used data, uncertainty in parameterization, as well as uncertainties of the used model. Extreme value statistics combined with regionalisation techniques were used as a basis for the hydrological input data. Uncertainty also exists due to the selection of the most suitable theoretical probability distribution and parameter estimation procedure as well as because of the spatial transfer of statistical values, derived from observation at gauging stations to the nodes of the entire river network.

Furthermore, the real topographic conditions could only be covered as far as the grid base (10 x 10 m) of the digital elevation model would allow, nevertheless the real bathymetric conditions of the synthetically generated cross-sections of rivers were only charted approximately.

In particular the influence of existing flood protection structures was not included in the hydraulic calculations despite the fact that they, in some cases, can considerably influence the extension of flood plains. Some model parameters, e.g. hydraulic roughness, were calibrated randomly for selected river reaches and furthermore, determined for the predominant part of the river network by using a specially developed parameterization.

One-dimensional methods, neglecting the velocity components contrary and vertical to the main flow direction, were used for the calculation of water level elevations. Although one-dimensional calculation does not necessarily have to be inferior to two-dimensional methods when regarding accuracy of flood plain mapping, reductions in modelling accuracy have to be expected especially when dealing with meandering rivers or complex current systems.
The influence of storage basins and the effect of retention structures were considered only approximately. The exact value of HQ_T also depends on basin management which was not taken into account. Statistical extrapolation to rare flood events (return period larger than 30 years) also includes some uncertainty and remaining uncertainty is also caused by hydrological regionalisation due to spatial heterogeneity in river basins.
Despite the above mentioned uncertainties and the lack of detail, the advantages of the presented solution predominate particularly because the now existing data was determined in a homogenous way using comprehensible methods and they are now available for Austria's entire river network. As a result of the calculations unitary statements to various problems can be made. Figure 2 shows the spatial dimension of regions endangered by floods on community level, as well as the proportion of buildings situated within the zone of a 200-year event, when neglecting the effect of existing flood protection structures thus showing the potential risk of structure failure. Seen from this point of view, more than 240,000 buildings, i.e. more than 10 % of Austria's total, are potentially endangered by floods.

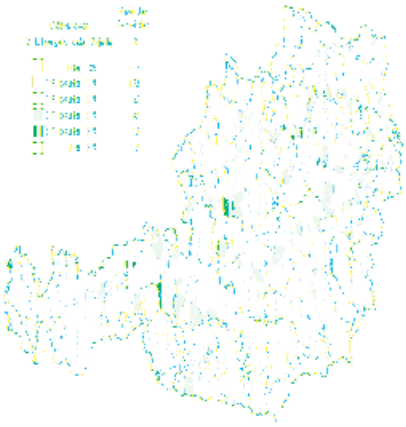

Fig. 2: spatial dimension of regions endangered by floods on community level

Furthermore, by means of an easily accessible internet site and due to its user-friendly design, a reasonable public awareness for flood risk was created which will clearly reduce future damage during floods. More than 60 million visitors within the first eighteen months demonstrate the enormous public interest in data dealing with natural hazards.

CONCLUSIONS

A central finding of the 2002 flood, caught up from the study "FloodRisk", was that, besides raising people's risk awareness, indicating the limits of active measures of risk protection and the necessity of the adapted use of endangered areas, a "risk partnership" between state, insurance companies and individuals would play an even greater role in the future. HORA is playing an important part in this cooperation and is a Europe-wide unique project in the cooperation between the state and the private sector and a striking example of Public Private Partnership in Austria. So, in addition to obtaining easy and quick information about any risk of flood via a digital internet hazard map, which serves as a first risk assessment as well, this tool can also be used to optimise and set priorities in the required flood control at the municipal, provincial and federal levels.

Since the beginning in 2003 the main partners BMLFUW and VVO are working together with a significant number of external partners (e.g. Geoforschungszentrum Potsdam, Bauhaus Universität Weimar, SwissRe, MunichRe, AON Rück, ZAMG, GBA and many others) to provide an open platform for a risk zoning and mapping tool in Austria. Main principle of cooperation in HORA is to create win-win situations for every single partner. Data input is usually done by public institutions, development costs are covered by private initiative. The results of HORA projects are available for further use within the HORA partnership for every member. Actually flood, earthquake and hail risk zones are available for free for public and private use. Also a tool, showing all digitalised hazard maps (from the Federal Water Engineering Administration) is available (example see fig. 3). Developments in 2008 are planned on storm and thunderbolt. HORA is actually the most sophisticated implemented risk zoning and mapping tool in Europe covering the entire surface of a country and is for public and private use.

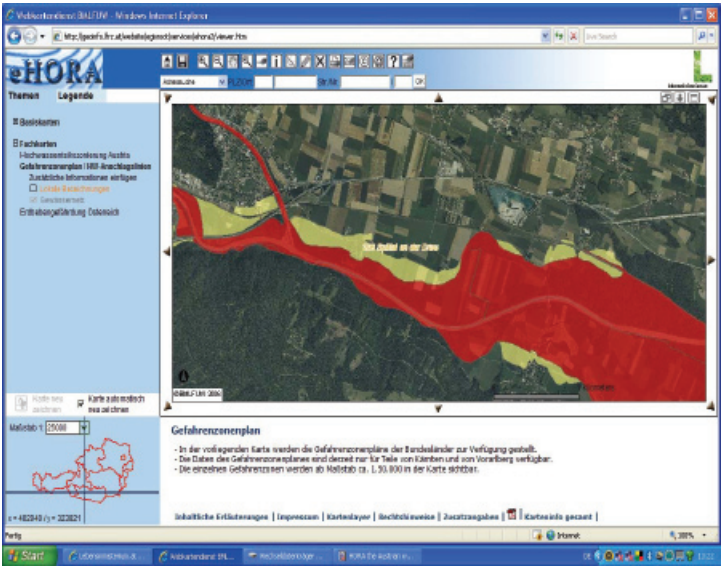

Fig. 3: Hazard map (same scale, same region as Fig. 1)

To the BMLFUW the project is not only a milestone in the field of risk communication, but also reflects Austria's leading role in the water sector as such. HORA advances parts of the EU Flood Directive which is being adopted and requires more information for the public. What counts for the insurance companies is, apart from higher risk awareness of the people, an improved realising and assessment of potential dangers as a basis of insurability.

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