SOUTH EAST EUROPE
Transnational Cooperation Programme

Danube FLOODRISK

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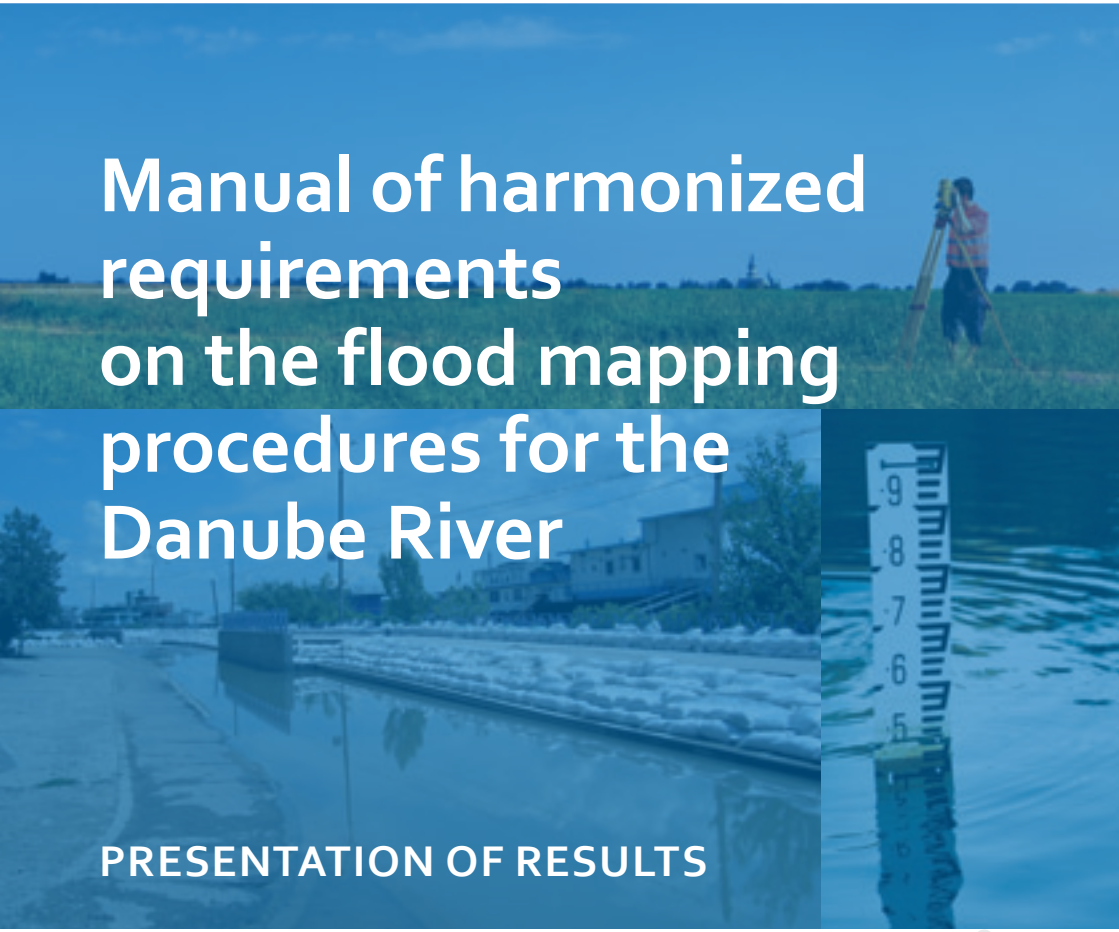

Manual of harmonized requirements on the flood mapping procedures for the Danube River

PRESENTATION OF RESULTS

Jointly for our common future

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1 Introductory remarks

This document describes the harmonization of the presentation concerning the hydraulic modelling results as well as the risk mapping results and calculations. The harmonization of data and methods is described in the manual "Manual of harmonized requirements on the flood mapping procedures for the Danube River - Data and methods".

The data resulting from the aforementioned processing steps are the main input for map production. The provision of this data must follow the agreements concerning the harmonization of data (especially with respect to attributes data formats and metadata), only a few additional requirements are mentioned in this document.

The intention of the effort is the production of a printed atlas and a CD version of printable maps at a scale of 1:100 000. Also it is intended to publish the maps in a web-based information system. The information and recommendations given here are focusing on regional-scale maps rather than on detailed flood and risk maps. Local-scale maps may need additional considerations.

The atlas should be strongly related to the EU-flood risk management directive.

2 Content of a printed atlas

The print version of a flood atlas should contain a text section. It should describe the project, the assumptions made in the modelling and the methodology used.

Hazard and risk maps of the complete Danube stretch are the central section of the atlas, pilot regions and example maps in more detailed scale should not be integrated.

For the binding an open able ring binding is recommended to allow for later replacement of maps, also the atlas should include a DVD with the data.

A detailed legend page should be included ant the end.

3 GIS formats (technical specifications)

This chapter describes - from a practical point of view - requirements for the data input to be used for map production for both, the printed atlas version and the web-based GIS. For reporting data to authorities it is recommended to follow the geospatial standards as described by OGC and the INSPIRE directive.

To gain a homogeneous atlas product, the data used for the production should have the same level of detail and need to be adjusted at the borders.

4 Results of hydraulic modelling

Hydraulic modelling results are the most important information to be provided on the maps.

Hydraulic modelling is mainly accomplished by using 1D- or 2D-hydraulic modelling software tools. These tools usually use their own data formats, which need to be converted to standard GIS-ready data formats.

Since in most comparable projects in Europe the data formats defined and described by ESRI have successfully been used they are also recommended here as standards. This recommendation is not an endorsement of ESRI software as such. The formats can be produced by most of the standard software tools common in flood modelling projects.

That means, all data need to be made compatible according to these formats. In particular the following thematic topics are concerned:

- Data of inundation depths
- Data of inundation outlines
- Data of damage potential
- Data of elements at risk
- Data of population risk
- Data of flood protection measures

4.1 Data of inundation depths

Inundation depths should be provided in a rasterized format according to the ESRI-GRID specification (ASCII or binary raster files both work). Alternatively (or additionally) they might be provided as polygons.

For the rasterized format the cell values, i.e. the inundation above the surface, must be in the units of cm. Grids should be delivered as integer grids. The raster cell size must be a multiple of 1 (in the coordinate system of the original data source).

For the data, provided as polygons, the inundation depth must be presented classified in four classes as given in Chapter 0.

Raster data extents (i.e. the horizontal extent of the area) must be "snapped" either to full or half meters. That means a raster cells edge must round to a full or half meter in the coordinate system of the source data.

4.2 Data of inundation outline

Inundation outlines must be kept twice: as polygons and polylines. Polylines must be attributed with information on those lines which are not actually outlines of the respective flood outline but required for a correct polygon topology. The reason for this is to have the possibility to include outlines of floods as lines indicating the maximum extent of a flood scenario, or to have the possibility to fill the polygon of the same scenario with a particular symbol or pattern.

The polyline and polygon vectors must have the identical vertices.

The line symbol on the map should indicate inside (water) and outside direction. This fact is important in situations where the position of the line itself does not indicate clear enough where the "dry" side and where the "wet" side would be. It is thus important to have the proper direction of the line already in the geospatial data.

5 Provision of results of flood risk modelling

5.1 Potential economic damages

Potential economic damages have to be based on asset maps derived according to the BEAM-approach (see Chapter 7.2 of the "Manual of harmonized requirements on the flood mapping procedures for the Danube River - Data and methods") and with the use of appropriate damage functions or vulnerability curves. They must be calculated in Euro currency. Results must be delivered unclassified (in the sense of not being in categories). The data model must

have the possibility to summarize the values by country and other administrative sub-divisions. It is thus important to have the data in geodatabase format of ESRI or in any database structure allowing this type of analysis.

5.2 Elements at risk (critical infrastructure)

Critical Infrastructure Objects will be shown either as point objects (such as power plants, hospitals, etc.) or line objects (such as dams, roads, rails etc. of a significant extent). The objects must be delivered with attributes indicating which flood extent these objects are exposed to. This has to be preferably a geodatabase structure according to ESRI specifications or another compatible format following the OGC simple feature specification.

5.3 Population exposure

Population exposure should be based on internationally comparable data and be allocated to the settlement area, using the "living place" approach. Exposure results have to be summarized also in table form for each individual flood hazard scenario (30-year, 100-year, extreme).

6 Flood protection measures

These data include mostly levees, in some cases also mobile protection devices. If available, the data should be attributed with the level of protection.

7 Background data

The Background data do not contain direct information about flood-extend and consequences. They serve for facilitating the orientation in the map and should ensure a homogeneous view of the atlas. In order to have identical level of detail of the river-network it is recommended the ICPDR Main rivers-dataset (rivers >500 km2) to be used. The trans-boundary rivers and the national parts of the Danube-polygon must be harmonized at country borders. To ensure the most appropriate appearance of the maps, data from external available sources may be used as background data.

8 Generalisation issues

Data should be generalized for cartographic purposes. It is also a requirement when results have to be prepared for display in web applications. Many GIS tools provide automated algorithms, e.g. during the conversion of rasterized model output to vectorized representations. The results of these automated procedures can produce unfavourable or even false results, so preferable more enhanced methods should be applied. The results should have the same level of detail in all the project area; this has to be considered especially if the delivered GIS-data have a different level of detail.

9 Topology Issues

The geospatial data has to be delivered in topologically correct geometries. That means in particular, that vector layers must not intersect or overlap where it would logically make no sense, e.g.:

- The outline of the 30-year-flood must not exceed the outline of the 100-year-flood, etc.
- The line of flood protection measures designed to a level of a 100-year flood must not be intersected by the extent of a 30-year flood.

The requirement is to implement the topology rules in an ESRI-based geodatabase or any other compatible, topology capable environment.

10 Coordinate systems and Coordinate transformation

Each dataset participating in printed map layouts or geospatial web applications must have a complete definition of its coordinate system. This must either be in EPSG format (or EPSG-code) or ESRI (ArcGIS) compatible prj-files.

11 Metadata

Each dataset which is used for printed map or web applications should be accompanied by INSPIRE conformal metadata.

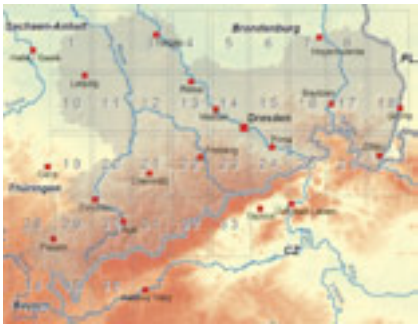
12 Hazard and Risk Map layout for printed atlas

The map layout should follow the guidelines listed below, they relate to a scale of 1:100 000:

- Size of page, including space for binding: DIN A3 (420 * 297 mm)
  Pages can be in landscape and portrait format, the best usage should be aspired, i.e. the less pages the better, but all pages should be in a identical orientation
- Languages: English/Latin writing and national language for countries with other character sets (e.g. Bulgaria)
- Coordinate systems: common European coordinate system and additionally grid of lat/long.
- Each sheet actually comprises of two maps: a hazard map (extreme event with inundation depth, other recurrence intervals as outline) and a risk map (extreme event), these maps should be printed on facing pages.
- The maps will overlay to provide good readability for all areas, the overlapping area should be between 1 and 2cm

12.1 Index map and Indicator map

The printed version of the atlas must include an indicator or index map. This indicator map should also be part of the individual map sheets of thee atlas, where the extent of the sheet is indicated within the context of the entire atlas extent.



Example of an index map for the introductory text

Example of an indicator map on an individual map sheet, including a reference rectangle

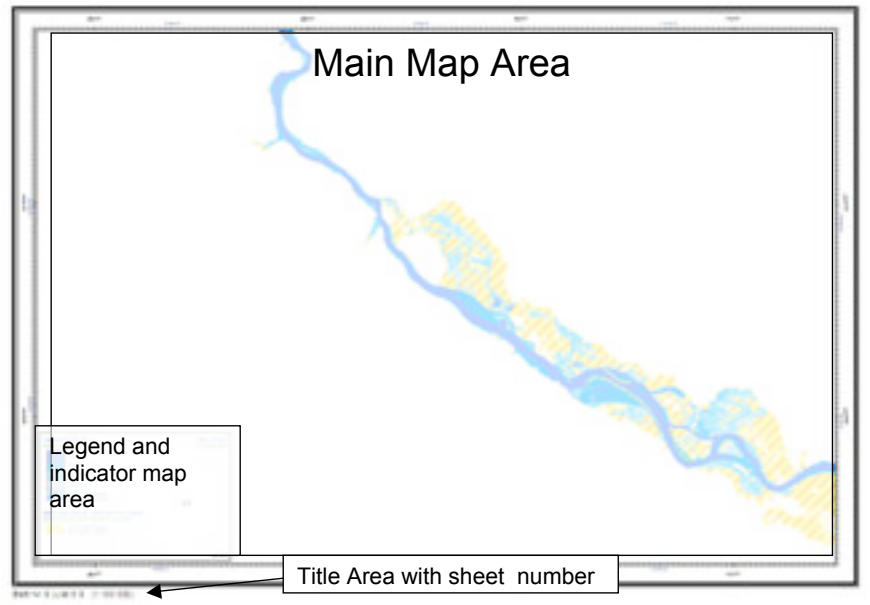
12.2 Map Layout Composition

Numerous best practice examples for flood hazard and risk maps at regional scales (1:100.000) exist for major rivers in Europe:

- Rhine-Atlas of 2001
- Atlas of Saxony 2004
- Elbe-Labe-Atlas 2006
- Odra-Risk maps 2008

A layout of the hazard and risk maps should comprise of various elements:

- Main map area
- Map title
- Map frame
- Legend and indicator map area, also including the scale bar
- Page information and a footmark giving the information on the original scale (1: 100 000)



The map frame should have two coordinate system grids: geographic (longitude/latitude) and an European system (e.g. LAEA 32, Lambert Equal Area 32). Overlapping text must be omitted.

	Map frame detail with a geographic and a metric coordinate system grid

12.3 Topographic background

The intention of the topographic background is to help map users to get a quick orientation. It should not be in the focus of the map. However, it must help the reader to quickly get an orientation.

Because the maps cross many borders, it is highly desirable to have a unified data source as it can be found for example in popular web applications (Google Maps, Bing Maps, etc.). To ensure a homogeneous appearance, vector data are preferred for the topographic background

As minimum information should be displayed:

- ICPDR-river-network plus national Danube polygons
- Roads/railroads
- Dikes
- Settlement areas (similar than asset layer)
- Shaded relief (decision on availability of final map) from SRTM
- Gauge station information may be included

Rasterized topographical background

Background based on commercially available vector data

12.4 Flood protection measures

Following symbols and colours for dikes are suggested; the colours in this and the following tables are given in two different colour models, the rgb and the CMYK-system. The later one is usually preferred by printing offices and should be preferred therefore. The colours in this document can only be considered similar as there has no colour adjustment process being performed during printing.

Symbol	Class	r	g	b	C	M	Y	K
	dikes designed for floods < HQ_{100}	221	236	204	13	7	20	0
	main dikes designed for floods ≥ HQ_{100}	106	178	28	58	30	89	0

12.5 Symbolization for inundation

Floods scenarios (return periods) are to be shown either in full colours or in lines indicating the maximum extent.

- Different shades of blue should be used for inundation depth of extreme flood
- Bicolour line should be used for other flood extents (HQ30 or HQ100)

Symbol	Class	r	g	b	C	M	Y	K
	>4m	99	140	255	61	45	0	0
	2m-4m	41	186	255	84	27	0	0
	0.5m-2m	115	222	255	55	13	0	0
	< 0.5m	191	232	255	25	9	0	0
	flood extent for HQ_{100}	217	0	11	15	100	96	0
		240	147	114	6	42	55	0

12.6 Potential damage

As only one map should be printed, it is recommended to use the extreme event to display all risk related information

The potential monetary damages will be shown on the risk map as full colour themes.

- Industry and transport: high, medium, low (shades of magenta)
- Settlement: high, medium, low (shades of red)
- Agriculture and Forestry: high, low (shades of yellow)
- Others: high, low (shades of green)
- Colours like Atlas of Saxony with adjustments

Pre-dominant Land Use	Damage Potential Class	r	g	b	C	M	Y	K
Industry	high	192	91	117	25	64	54	0
	medium	201	133	150	21	48	41	0
	low	244	143	169	4	44	34	0
Settlement/ Residential	high	237	28	36	7	89	68	0
	medium	247	160	132	3	37	48	0
	low	252	210	193	1	18	24	0
Forestry/ Agriculture	high	255	229	54	0	10	79	0
	low	255	247	143	0	3	44	0
Others	high	152	230	0	40	10	100	0
	low	209	255	115	18	0	55	0

12.7 Affected population

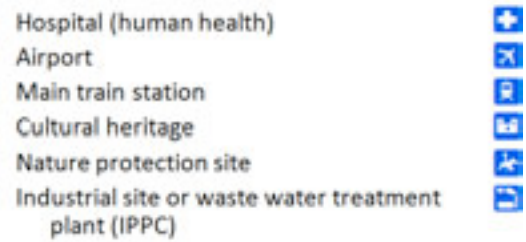
For the display of affected population stickman like symbols should be used, allocated to the statistical units (NUTS2-region). Information about the total and the proportion of the affected population should be given.

Example for map symbols showing the affected population

12.8 Elements at risk

Concerning the elements at risk only the main elements can be displayed, for web display additional objects may be shown, depending on the scale.

Following elements and symbols are recommended:



Example for map symbols for risk elements

13 Map layout for CD-publication

The printed atlas should be published also as a CD-ROM (or DVD) application with the maps in PDF format. The PDF format has to have page control elements allowing for easy browsing between maps and between maps and text elements.

Information for the best print scale (1: 100 000) and format (DIN A3) need to be included.

14 Map layout for web based publication

The data must be prepared for an easy to use web mapping application for the general public. This platform has to have a multi-language interface. An example for such a web-based presentation could be www.floodrisk.eu.

Minimum requirements:

- All languages of Danube catchment
- Search function for cities etc.
- WMS capable of various coordinate systems
- Normal web mapping features like zoom, measure, print
- Detailed documentation of data integrated (meta data provision)

Options:

- Integration into European context, usage of a joint platform
- Integration of past event data

15 Explanatory Text

The printed atlas as well as the web presentation must be accompanied by an explanatory text. This text has to be written in a way understandable for the general public. Both methods for deriving hazard and risk information must be covered by this text. It should further summarize the most important results and findings (statistical analysis), e.g. the number of people potentially exposed to flood hazards, or the magnitude of potential economic damages. Where appropriate, illustrating figures and tables should be incorporated.

The explanatory text must be printed in English and in the languages of the participating partners. The amount of text for each language should be about 2 pages, to provide enough information on one side and not to be too exhaustive on the other side.

16 Contributors

The content of this document had been discussed and decided on in the harmonization workgroup of the Danube FLOODRISK project.

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Stakeholder oriented flood risk assessment for the Danube floodplains

Project partners

MEF – Ministry of Environment and Forests (RO)
UBA-A – Federal Environment Agency Austria Ltd. (AT)
VD – via donau, Austrian Waterway Company (AT)
MOEW – Ministry of Environment and Water (BG)
VKKI – Central Directorate for Water & Environment (HU)
VITUKI – Environmental Protection and Water Management Research Institute (HU)
DEF – Danube Environmental Forum (HU)
ISPRA – Higher Institute for Environmental Protection and Research (IT)
TUCEB – Technical University of Civil Engineering of Bucharest (RO)
RWNA – "Romanian Water" National Administration (RO)
DDNI – "Danube Delta" National Institute for Research and Development (RO)
CESEP – Centre for Environmentally Sustainable Economic Policy (RO)
SWME – Slovak Water Management Enterprise, state enterprise (SK)
CroWa – Croatian Waters, Legal entity for water management (HR)
IJC – "Jaroslav Cerni" Institute for the Development of Water Resources (RS)
JVP SV – Public Water Company „Srbijavode" (RS)
JVP VV – Public Water Management Company "Vode Vojvodine" (RS)

MAFWM – Ministry of Agriculture, Forestry and Water Management (RS)
RHMSS – Republic Hydrometeorological Service of Serbia (RS)

Observers:

ICPDR – International Commission for the Protection of the Danube River (AT)
JRC – European Commission - DG Joint Research Center (IT)
BfG – Bundesanstalt für Gewässerkunde (DE)
LfU – Bavarian Environmental Agency (DE)
RPT BWL – Regional Council Tübingen (DE)

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