

# HENRY

Hydraulic Engineering Repository

Ein Service der Bundesanstalt für Wasserbau

---

Article, Published Version

**Dewals, Benjamin; Archambeau, Pierre; Ercicum, Sébastien; Piroton, Michel**

## **Flood risk in Liege area: A transnational perspective**

HydroLink

---

Verfügbar unter/Available at: <https://hdl.handle.net/20.500.11970/109291>

Vorgeschlagene Zitierweise/Suggested citation:

Dewals, Benjamin; Archambeau, Pierre; Ercicum, Sébastien; Piroton, Michel (2015): Flood risk in Liege area: A transnational perspective. In: HydroLink 2015/3. Madrid: International Association for Hydro-Environment Engineering and Research (IAHR). S. 87-89. [https://iahr.oss-accelerate.aliyuncs.com/library/HydroLink/HydroLink2015\\_03\\_SPH\\_in\\_Hydraulics.pdf](https://iahr.oss-accelerate.aliyuncs.com/library/HydroLink/HydroLink2015_03_SPH_in_Hydraulics.pdf).

### **Standardnutzungsbedingungen/Terms of Use:**

Die Dokumente in HENRY stehen unter der Creative Commons Lizenz CC BY 4.0, sofern keine abweichenden Nutzungsbedingungen getroffen wurden. Damit ist sowohl die kommerzielle Nutzung als auch das Teilen, die Weiterbearbeitung und Speicherung erlaubt. Das Verwenden und das Bearbeiten stehen unter der Bedingung der Namensnennung. Im Einzelfall kann eine restriktivere Lizenz gelten; dann gelten abweichend von den obigen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Documents in HENRY are made available under the Creative Commons License CC BY 4.0, if no other license is applicable. Under CC BY 4.0 commercial use and sharing, remixing, transforming, and building upon the material of the work is permitted. In some cases a different, more restrictive license may apply; if applicable the terms of the restrictive license will be binding.



# FLOOD RISK IN LIEGE AREA: A TRANSNATIONAL PERSPECTIVE

BY BENJAMIN DEWALS, PIERRE ARCHAMBEAU, SÉBASTIEN ERPICUM AND MICHEL PIROTTON

Liege is located at the heart of the Meuse basin, which covers parts of France, Belgium, Germany and the Netherlands. Considering explicitly this transnational context when conducting flood risk analysis in the area of Liege sheds light on specific features and management opportunities which might otherwise be overlooked. Within a basin-wide collaborative approach, future flood risk was estimated along the course of the Meuse and adaptation measures were evaluated, particularly for the protection of the city of Liege.

Liege is characterized by a complex setting of rivers and artificial waterways, involving the Meuse, its main tributary river Ourthe, a major derivation channel, as well as the Albert canal connecting the Meuse to the harbour of

Antwerp. The main structure controlling the flow is Monsin dam (see photograph) situated downstream of the city.

In the context of the European project AMICE, a basin-wide approach has been developed for flood risk analysis. As the focus of the project was primarily on impact analysis of climate change, transnational climate scenarios were

derived for two time horizons (2050 and 2100) and, by means of hydrological modelling, they were translated into hydrological scenarios (Dewals et al. 2013). From this early stage of the research, the main stakeholders (e.g., water authorities) were involved and shared their views on the modelling approach.

Next, existing models were coupled to perform the first coordinated hydraulic modelling from the headwaters to the mouth of the river Meuse. Compared to the development of a new basin-wide harmonized hydraulic model, this approach lead to a higher acceptance by the water authorities, as the results rely on tools they have been familiar with for many years. For a "wet" climate scenario, the computations revealed increases in flood levels significantly

**“Liege shows a significant flood risk for the time horizon 2100”**

Monsin dam downstream of Liege during floods in February 2002





**Benjamin Dewals** is an Associate Professor in Hydraulic Engineering and Water Resources

Management at the University of Liege where he received his PhD in 2006. His main research interests cover flood risk management, fluvial hydraulics and reservoir sedimentation. He conducted research in several leading European institutions, including at EPFL (Switzerland) and in Germany. He is a member of the IAHR Europe Regional Division leadership team and of the IAHR Flood Risk Management Committee.



**Pierre Archambeau** obtained his PhD from the University of Liege in 2006, for several new

contributions to physically based hydrological modelling and flood hazard modelling. He is continuously working on several hydraulic and hydrological modelling projects and is currently the main developer of the WOLF modelling system, which simulates hydrological flow, fluvial processes and flow on hydraulic structures



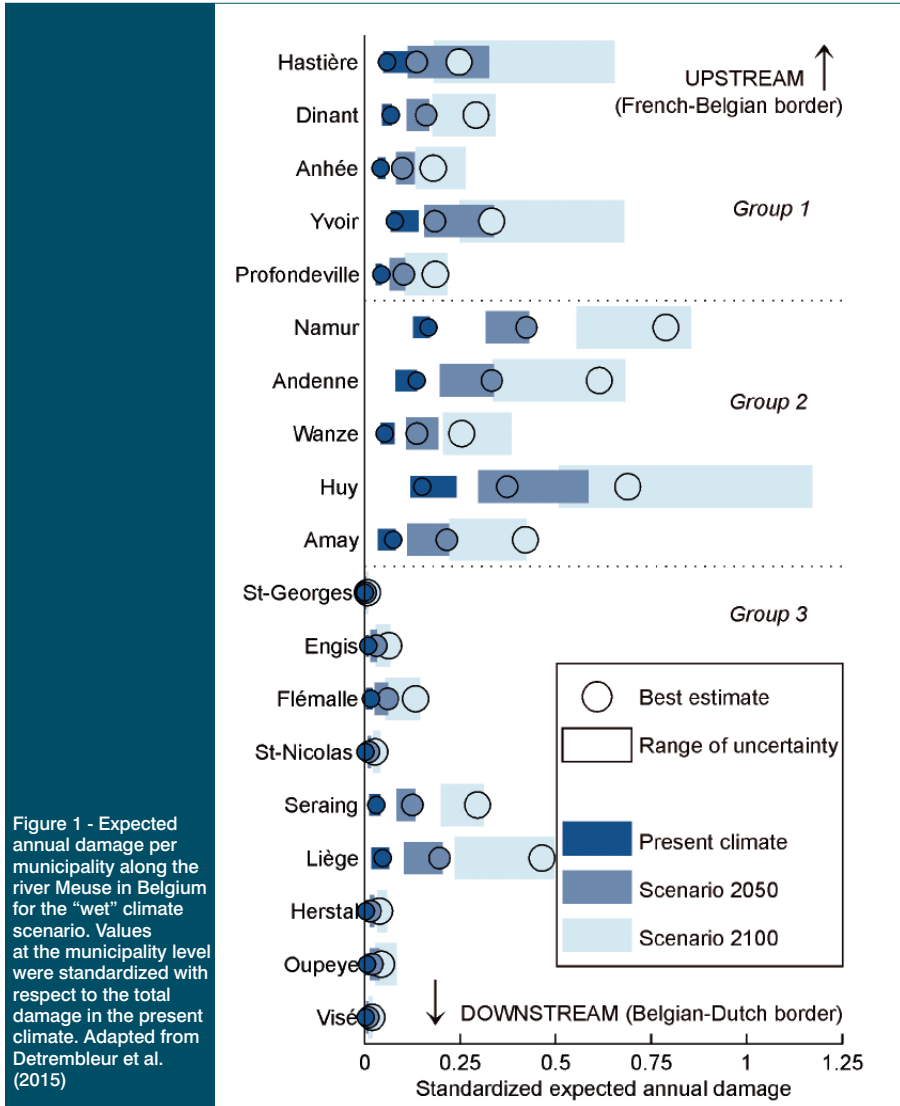
**Sébastien Ericum** obtained his PhD from the University of Liege in

2006, where he is now an Assistant Professor. He is also in charge of the Engineering Hydraulics Laboratory, an experimental facility of about 1500 m<sup>2</sup> in which composite modelling is largely promoted for studying flows and transport processes of interest in environmental and civil engineering. He is a member of the IAHR Hydraulic Structures Committee Leadership Team.



**Michel Piroton** obtained his PhD from the University of Liege in 1994. He

is currently Full Professor and vice-president of Aquapôle, an interdisciplinary research centre in water sciences and engineering. He coordinates a group of about 15 researchers contributing to the development of the modelling system WOLF and to experimental research in hydraulic engineering and fluvial hydraulics.



higher in the central part of the Meuse basin compared to the upper and lower parts. This results from the narrower shape of the valley as the river crosses the Ardennes massif close to the French-Belgian border and in most of the Belgian part of the Meuse.

The hydraulic modelling results were subsequently used for damage estimation and computation of flood risk (e.g., Ernst et al., 2010). The distribution of flood risk across all the municipalities along the river Meuse in Belgium is displayed in Figure 1 (Detrembleur et al. 2015). Flood risk is generally higher in the upstream municipalities (groups 1 and 2), in which the protection levels are relatively lower and inundations are more frequent. Nonetheless, Liege shows a significant flood risk for the time horizon 2100 ("wet" climate scenario), due to (i) the high values of future flood discharges (about 30 % higher than in the

present climate) and (ii) the very high water depths in the floodplains in case of flood protections overtopping, as a result of mining subsidence.

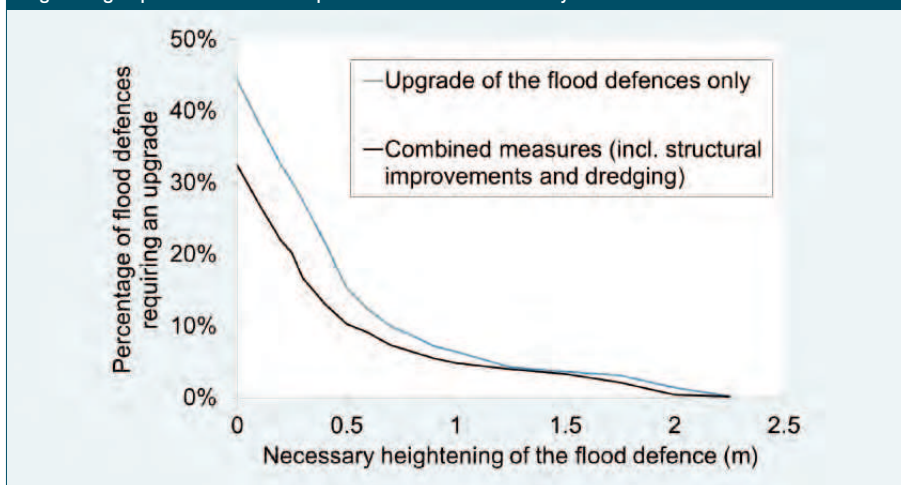
Flood risk analysis is inherently affected by a substantial level of uncertainty. A distributed uncertainty analysis conducted at the level of the municipalities along the Meuse reveals that both the magnitude of the uncertainty and its main origin vary significantly in space and in time (Figure 1). In most locations, damage estimation and flood frequency analysis were the main sources of uncertainty, while inundation modelling contributed less to the overall uncertainty (Detrembleur et al. 2015). Different adaptation measures were analysed for flood risk management in the city of Liege. An adaptation of the existing flood defences appears technically feasible to preserve the current protection standard of the city under the

future “wet” climate projected for 2100. Indeed, only 45 % of the defences need some upgrade, among which only 10 % require a heightening exceeding 70 cm (Figure 2). Dredging of the main riverbed and structural improvements to increase the hydraulic efficiency of Monsin dam (see photograph) constitute useful complementary measures but are not sufficient on their own to protect the city of Liege (Figure 2). Computations also showed that dynamic storage upstream of the city is not a realistic option as the storage capacity of the floodplains is far too low. Similarly, large dams situated further upstream in the basin were shown to have a vanishing effect in Liege (Bruwier et al. 2015). Spatial planning may also play a vital role in reducing flood risk, but mostly in less densely urbanized municipalities, in which new developments may account for up to one half of the estimated future flood damage (Beckers et al. 2013).

#### ACKNOWLEDGEMENT

Parts of the research described here were funded by the NWE Interreg IVB Program, as

Figure 2 - Portion of the overall flood defences in Liege which require an upgrade exceeding a given heightening to preserve the current protection standard of the city under the future “wet” climate



well as by “Service Public de Wallonie (SPW, Belgium) and Rijkswaterstaat (RWS, the Netherlands).

#### REFERENCES

Beckers, A., et al., 2013. Contribution of land use changes to future flood damage along the river Meuse in the Walloon region. *Nat. Hazards Earth Syst. Sci.* 13(9): 2301-2318.  
Bruwier, M., et al., 2015. Assessing the operation rules of a reservoir

system based on a detailed modelling chain. *Nat. Hazards Earth Syst. Sci.* 15(3): 365-379.  
Detrembleur, S., et al., 2015. Impacts of climate change on future flood damage on the river Meuse, with a distributed uncertainty analysis. *Nat. Hazards* 77(3): 1533-1549.  
Dewals, B., et al., 2013. Impact of climate change on inundation hazard along the river Meuse. *Transboundary Water Management in a Changing Climate - Proc. AMICE Final Conference*, CRC Press, 19-27.  
Ernst, J., et al., 2010. Micro-scale flood risk analysis based on detailed 2D hydraulic modelling and high resolution geographic data. *Nat. Hazards*, 55(2): 181-209.



## 4<sup>th</sup> IAHR EUROPE CONGRESS

### Water Engineering and Research



Abstract submission open until 15<sup>th</sup> October 2015

27 - 29 July 2016  
LIEGE, BELGIUM

[www.iahr2016.ulg.ac.be](http://www.iahr2016.ulg.ac.be)