# Contrasting levels of surprise and levee effect between municipalities in the 2021 flood in Belgium

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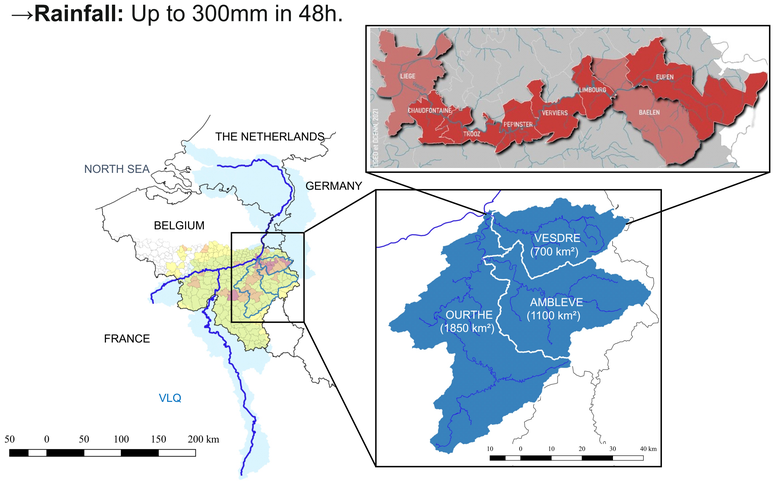
## Case study - Vesdre valley (Belgium)

→**July 2021 flood: 8 out of 10** most affected municipalities are along the Vesdre.

→**Rainfall:** Up to 300mm in 48h.

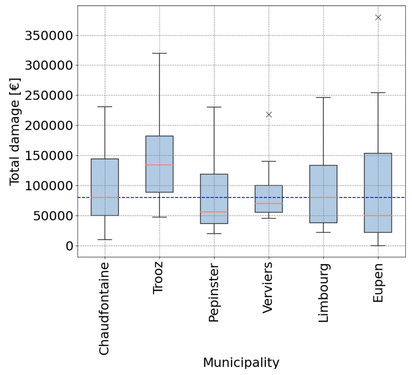



## Data

1. **Official flood hazard maps**
2. **Field survey by water authority (SPW, 2021)**
   → Pointwise inundation depths (n = 15,583)
   → Inundation extent
3. **Field survey by ULiége (2022-2023)**
   → 300* in-depth interviews
4. **Hydrological assessment**

## Binomial Logistic regression

**Flood loss data available for:** 132 entries
**Dependent variable:** Total loss [€] (Building+content)
**Threshold:** 80,000 € (Median)




## Comunity level variables

Data suggest that **community response capacity** varies among municipalities.

→ **Overwhelming Effect**

$$OE = \frac{n° \ flooded \ buildings}{n° \ buildings \ in \ the \ municipality}$$

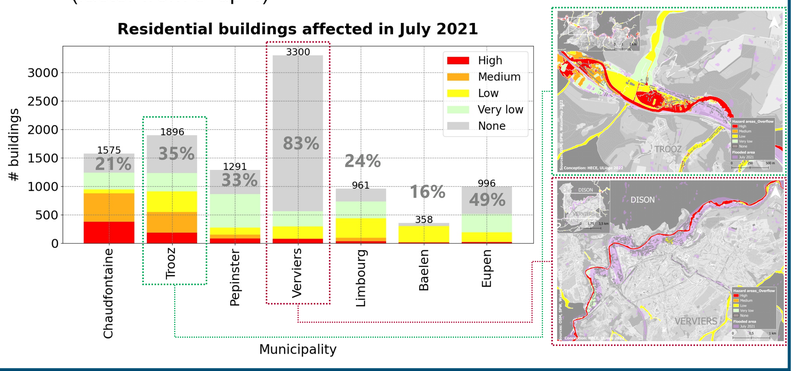
OE varies from **12%** to **45%**.

→ **Surprise Effect**

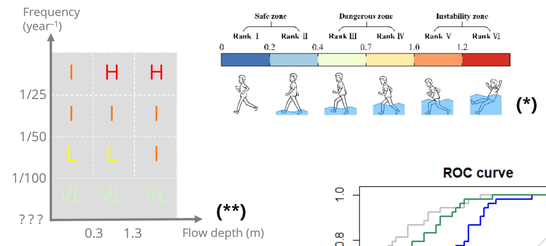
$$SE = \frac{n° \ flooded \ buildings}{n° \ buildings \ in \ official \ hazard \ zone}$$

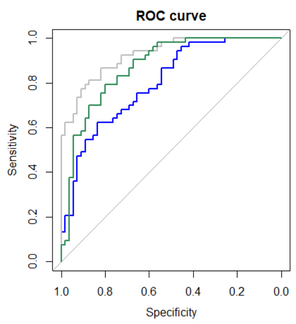
SE varies from **16%** up to **83%**.

→ **Flood rarity** = $Q_{peak}/Q_{100}$ (factor from **3**˜ up **4**)




## Building level variables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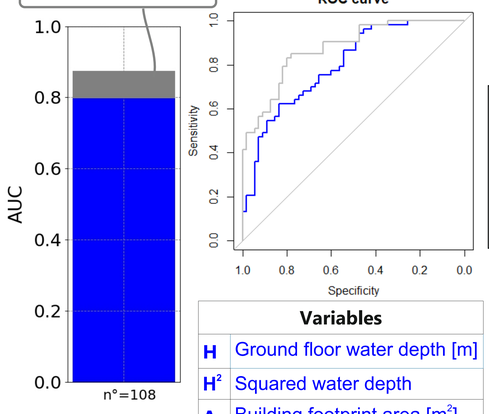





| Variables | |
|---|---|
| **H** | Ground floor water depth [m] |
| **H²** | Squared water depth |
| **A** | Building footprint area [m²] |

**Criteria for considering variables**

1. Significant (<10%)
2. Physical meaning
3. Improve accuracy
4. Not multicolinearity

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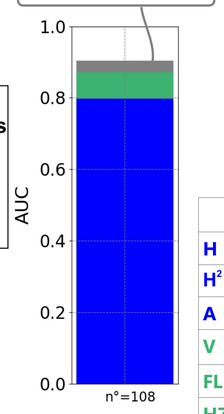


| Variables | |
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| **H** | Ground floor water depth [m] |
| **H²** | Squared water depth |
| **A** | Building footprint area [m²] |
| **V** | Velocity score (*) |
| **FL** | Finishing level |
| **HZ** | Official Hazard zone (**) |

## Building level variables + Community level variables


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TESTED BUT NOT SIGNIFICANT

| Variables | |
|---|---|
| **S** | Presence of sediments |
| **C** | Presence of contaminants |
| **GL** | Ground floor level [m] |
| **BT** | Building type |
| **FL** | Number floors |
| **BS** | Building structure |
| **YY** | Year of construction |
| **PD** | Heating system distribution |
| **PT** | Heating system type |
| **LM** | Level of maintenance |
| **FE** | Flood experience |
| **ISD** | Index of socioeconomic disparity |

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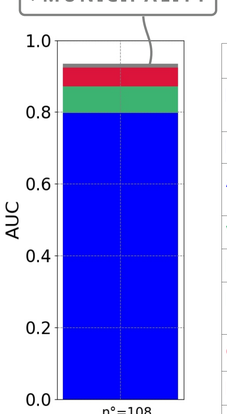


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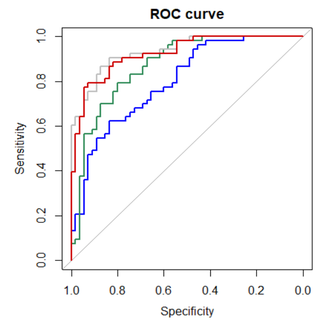
| **FL** | Finishing level |
| **HZ** | Official hazard zone (**) |
| **OE** | Overwhelming effect |
| **FR** | Flood rarity [$Q_{peak}/Q_{100}$] |
| **OW** | Official warning |




$$Sensitivity = \frac{TP}{TP + FN}$$

$$Specificity = \frac{TN}{TN + FP}$$

AUC: Area under the ROC curve