Flood Risk Mapping in Europe, Experiences and Best Practices

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Outline

1. Background: floods in Europe and FRM-Directive
2. Flood maps: what do they present?
   • Hazard maps
   • Risk maps
3. Maps and potential use: hazard cycle, users and information content
4. Conclusions
1. Background: Floods in Europe

Between 1998 - 2002:
- 100 major floods
- 25 billion Euro’s insured damage
- 0.5 mill. people displaced,
- 700 fatalities

(EEA, 2004)
2002 floods: trigger to a joint approach

mid 2003:
Best Practices on flood prevention, protection and mitigation
2004: start of European policy

July 2004: EU-Commission:
- Communication on Flood Risk Management
- Expert circles (EXCIMAP)
- Flood action programme:
  - Facilitate exchange of information, knowledge and experiences (Floodsite, ERANET)
  - Targeting approach to funding
  - Proposal for legal instrument (Directive)

Aim: framework for the assessment and management of flood risks, → reduce adverse consequences for human health, environment, cultural heritage and economic activity.

Member states are free to formulate goals of protection, select measures and organization.

However are obliged:

- Preliminary risk assessment (2011)
- Flood hazard and flood risk maps (2013)
- Flood risk management plans (prioritized measures) (2015)
- Report progress to EC, periodically review of maps and plans every 6 years

Basic principles?!
2. Flood maps, what do they present?

Possible content (EU Flood Risk Management Directive)

- Potential flood extent
- Probability of flooding
- Depth of flooding
- Potential damage, affected, environmental consequences
- Vital services and infrastructure
- Flood risk (probability x consequences)
- Hazardous locations (depth/velocities)
- Locations of vulnerable citizens (elderly, children)
- Evacuation routes and shelters
2a. Flood hazard maps

For areas with significant risk, for 3 types of floods:

- floods with a **low** probability, or extreme events scenarios;
- floods with a **medium** probability (recurrence period about 100 years);
- floods with a **high** probability, where appropriate.

Showing:

- the flood **extent**;
- water **depths or water level**, as appropriate;
- where appropriate, the flow velocity or the relevant water flow.
2b. Flood risk maps

potential adverse consequences:

- the indicative number of inhabitants potentially affected;
- type of economic activity of the area potentially affected;
- IPPC-installations
- protected areas cf WFD that may be threatened by flooding;
- other information which the Member State considers useful, such as:
  - (...)  
  - other significant sources of pollution.
Different types and hierarchy of maps

1. Flood prone area
   - Flood probability, depth, rise, progress, current velocities
2. Scenario’s
   - Hazard
     - Fatal water level
     - Surface
   - Risk
     - Land use
     - Infrastructure
     - Inhabitants
     - Pollutants
     - Flood probability
3. (Environmental) damage
4. Casualties
5. Evacuation
6. Risk
Potential flood extent
Scenario’s → max. depth of flooding

For specified scenario:
- failure locations, dimensions,
- hydraulic conditions/ frequency
- terrain topography and roughness
Hazard: progress, rate of rise
Hazard as combination of:
- Current velocity
- Depth
- Debris
## Hazard

<table>
<thead>
<tr>
<th>Process</th>
<th>low intensity</th>
<th>medium intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debris flow</td>
<td>--</td>
<td>$D &lt; 1 \text{ m}$ and $\nu &lt; 1 \text{ m/s}$</td>
</tr>
<tr>
<td>Static flooding</td>
<td>$h &lt; 0.5 \text{ m}$</td>
<td>$0.5 &lt; h &lt; 2 \text{ m}$</td>
</tr>
<tr>
<td>Dynamic flooding</td>
<td>$q &lt; 0.5 \text{ m}^2/\text{s}$</td>
<td>$0.5 &lt; q &lt; 2 \text{ m}^2/\text{s}$</td>
</tr>
<tr>
<td>Bank erosion</td>
<td>$t &lt; 0.5 \text{ m}$</td>
<td>$0.5 &lt; t &lt; 2 \text{ m}$</td>
</tr>
</tbody>
</table>

$D =$ thickness of debris front; $\nu =$ flow velocity (flood or debris flow); $h =$ flood depth (m); $q =$ specific discharge ($\text{m}^3/\text{s}/\text{m}$); $t =$ extent of lateral erosion

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### Intensity:
- high
- medium
- low

<table>
<thead>
<tr>
<th>Probability:</th>
<th>high</th>
<th>medium</th>
<th>low</th>
<th>very low</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### Hazard:
- high
- medium
- low
- very low
Potential damage

Damage in euro /m²
Flood risk map for insurance

- GK1: very low risk ( < 1/200)
- GK2: low risk (1/50 – 1/200)
- GK3: medium risk (1/10 – 1/50)
- GK4: high risk (>1/10)

Risk = probability!
Risk / vital objects
Social vulnerability

- Age
- TV and Radio
- Own car
- Unemployment
- House owner
Evacuation routes
## 3. Type of map and potential use: the “hazard cycle approach”

<table>
<thead>
<tr>
<th>Avoid</th>
<th>Reduce probability</th>
<th>Reduce consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial planning</td>
<td>Dikes, dams, storm surge barriers</td>
<td>Contingency plans</td>
</tr>
<tr>
<td><strong>Pro-action</strong></td>
<td><strong>Prevention</strong></td>
<td><strong>Preparation</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Response</strong></td>
<td><strong>Recovery</strong></td>
</tr>
</tbody>
</table>

- **Jos van Alphen**
- **8 May 2008**
Avoid

Spatial Planning:
- Hazard zones
- Building codes
Prevention

• Build and maintain flood defences:
  – sea walls
  – storm surge barriers
  – Dikes/ embankments
Prepare

- Emergency and contingency planning
- Shelters
Response

- Early warning
- Evacuation
- Emergency repair
Repair and recovery

- Repair damage
- Insurance
Potential users:

• Authorities responsible for:
  – Land use planning
  – Flood protection
  – Emergency planning

• Companies responsible for vital services (electricity, gas, water, sewerage, communications, transport, hospitals)

• Insurance

• Citizens and businesses
# Flood maps, users and content

<table>
<thead>
<tr>
<th></th>
<th>Extent/ probable</th>
<th>Depth</th>
<th>Velocity/ Debris</th>
<th>Progress/ Rise</th>
<th>Vulnerability</th>
<th>Risk objects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use planning (Avoid)</td>
<td>E</td>
<td>d</td>
<td>(d)</td>
<td></td>
<td></td>
<td>(d)</td>
</tr>
<tr>
<td>Flood risk management (Planning (Prev.))</td>
<td>E</td>
<td>E</td>
<td>d</td>
<td>d</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>Emergency planning (Prepare/ responses)</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>d/E</td>
<td>d/E</td>
</tr>
<tr>
<td>Insurance (Recover)</td>
<td>E</td>
<td>d</td>
<td>d</td>
<td></td>
<td></td>
<td>E</td>
</tr>
<tr>
<td>Public awareness</td>
<td>E</td>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td>E</td>
</tr>
</tbody>
</table>

E = Essential

d = Desirable
Conclusion

• Flood risk maps are vital for land use planning, preparation, response and general awareness in flood prone areas
• Flood risk maps contain specific types of information (extent, depth, ..), depending on their primary purpose
• Different types of maps require increasing types of background information (flood level, surface, land use, population densities and groups, vital services, highways)
Any questions?

Vragen ?????
2. Integrated Flood Risk Management policy and measures ("safety chain")