Signals without action: a value chain analysis of Luxembourg's 2021 flood disaster

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1. WHY THIS MATTERS

Early Warning System performance is shaped by how institutional structures and procedural thresholds determine whether available signals lead to action, not by forecast accuracy alone.

During Luxembourg's July 2021 floods, strong forecast signals were available from 7 July. Anticipatory action remained limited.

How did institutional design shape whether forecast signals led to protective action?

2. EVENT AT A GLANCE

- **€145M+** insured damages
- **6,500+** homes inundated
- **105.8L/m²** rainfall in 24h, new record
- **>6 hours** between red flood alert and first Crisis Unit

The July 2021 floods were Luxembourg's costliest disaster on record.

3. RESEARCH APPROACH

How was the event analysed?

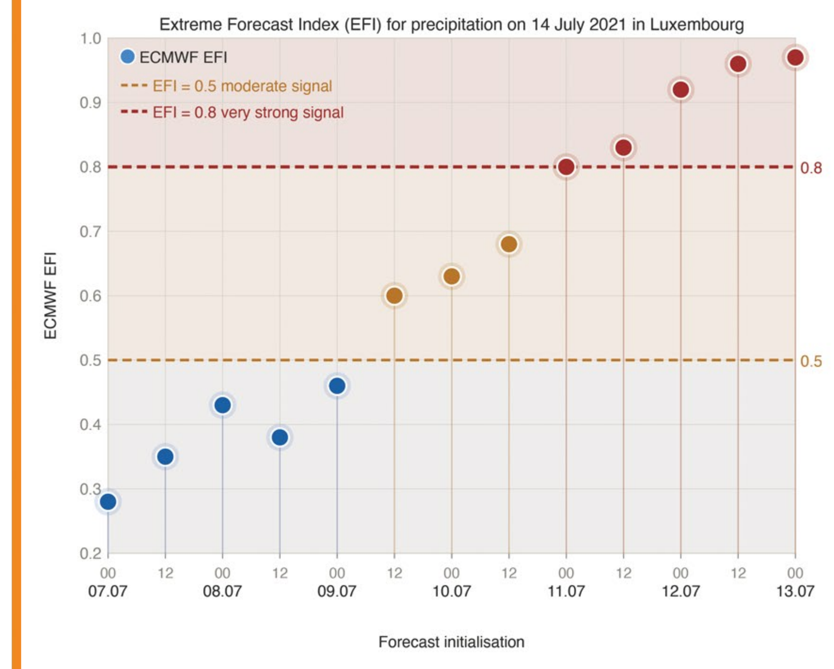
WMO WWRP HIWeather Value Chain framework

→Database questionnaire
structured analysis across the warning chain
→ Event reconstruction
→ Independent analysis
→ Waterdrop Model
Applied retrospectively using forecasts, warnings, and institutional records

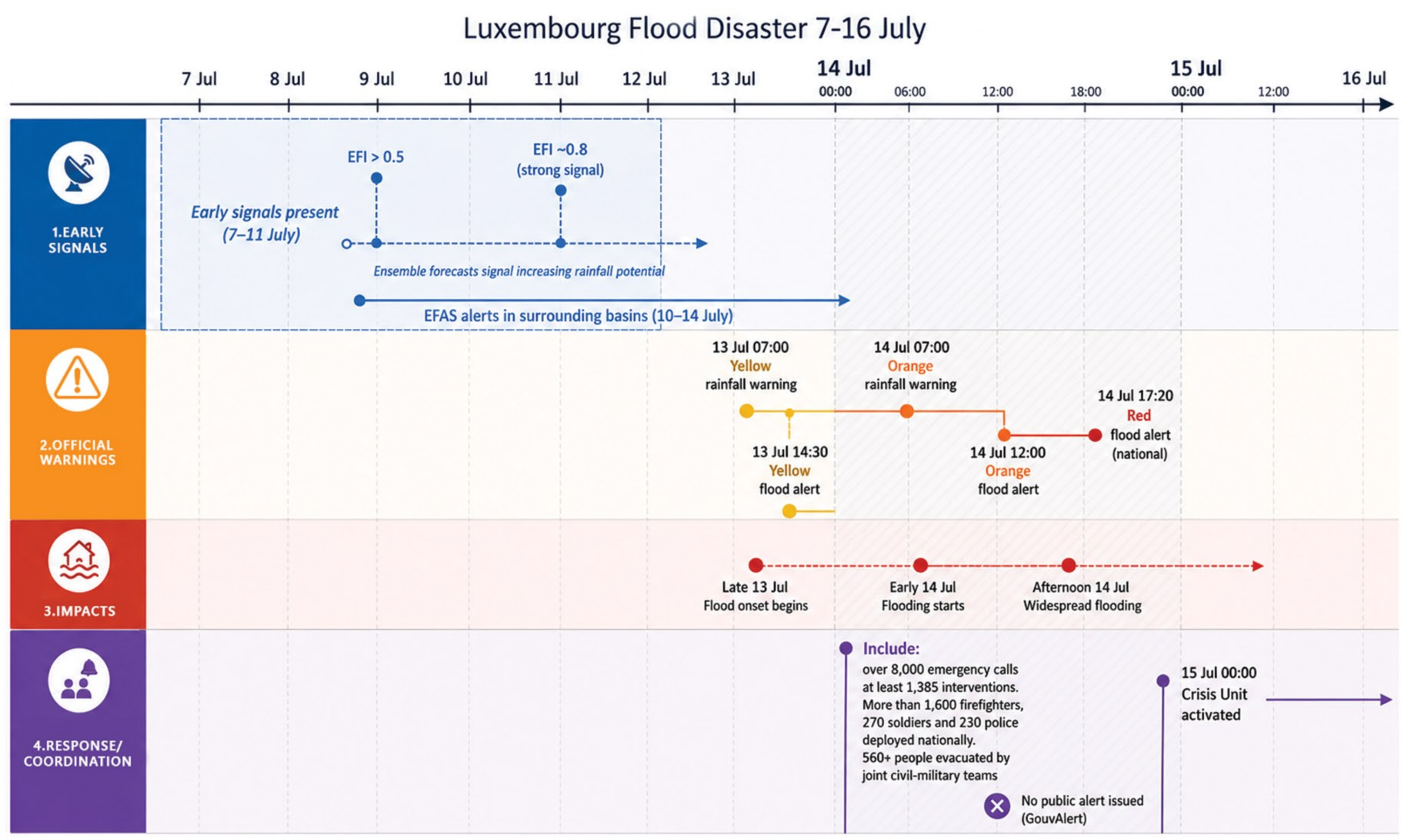
4. INSTITUTIONAL CONTEXT

- **MeteoLux** Weather Service, based at Findel Airport (single official station)
- **AGE** Hydrological Service
- **CGDIS** Grand-Ducal Fire & Rescue, operational emergency response
- **HCPN** High Commission for National Protection
- **Crisis Unit** Activated by Prime Minister

5. EXTREME FORECAST INDEX

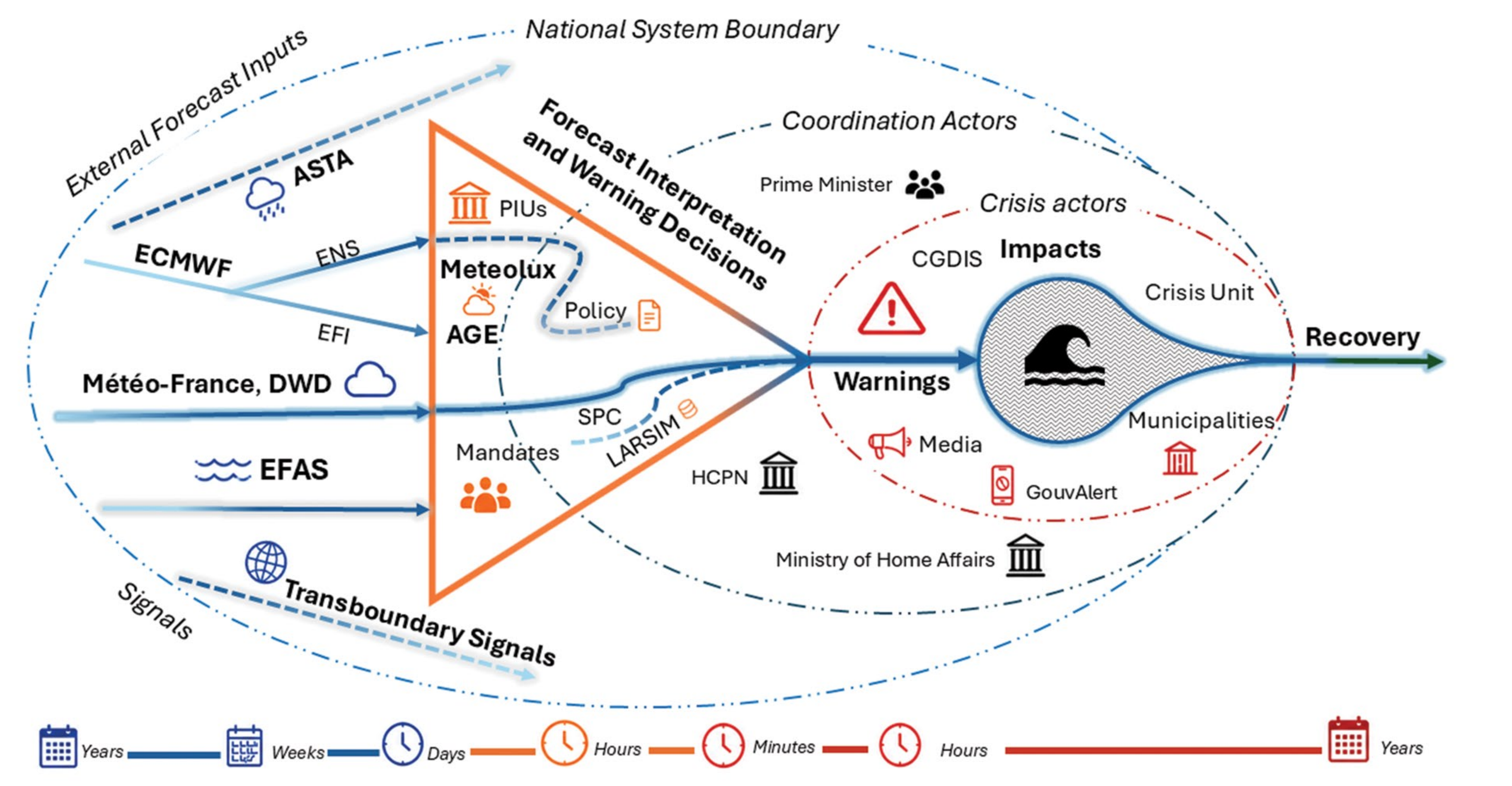


6. WARNING TIMELINE



Warning Timeline Forecast signals present from 7 July. Official alerts issued across 13-14 July

7. WATERDROP MODEL



Waterdrop Model How institutional design determines which signals can lead to action

8. KEY FINDINGS

1. Early forecast signals existed
2. Warnings remained tied to deterministic thresholds
3. Available information was not fully used
4. Thresholds delayed warning escalation
5. Coordination followed impact, not risk
6. Public alerting systems were not effectively used
7. Institutional design shaped the outcome
8. No independent post-event review was conducted

The signals existed.
The procedures were followed.
The mandates were respected.
The system performed as designed.
That was the problem.

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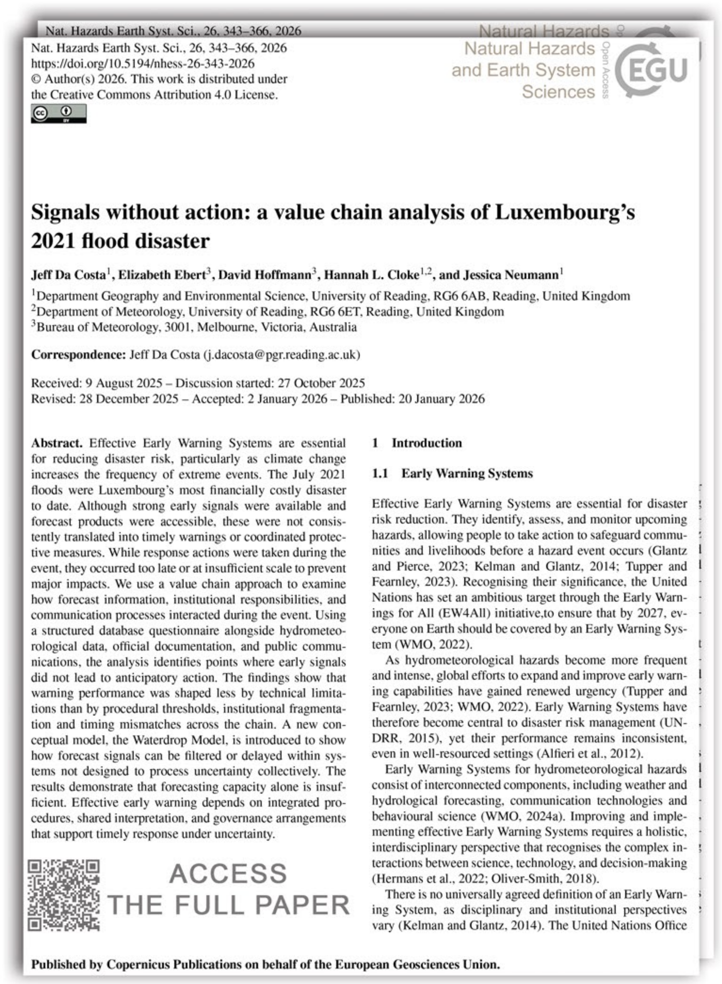

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