

1 Motivation

Communities face multiple hazards—landslides, flash floods, debris flows, river overflows—often triggered by the **same extreme events**.
Prediction is not enough: what’s needed is a **Multi-Hazard Early Warning System (MH-EWS)** that delivers **timely, actionable alerts**.

Our aim

- **Couple a hydrological–geotechnical model** to capture multi-hazard processes.
- **Regional integration** for real-time, coordinated decisions.
- **Install new sensors** in under-monitored areas (rain and soil moisture).
- **Web platform** for real-time data, forecasted data and hazard maps.
- **Operational MH-EWS**, co-designed with UPC; ARANTEC and local stakeholders for usability and adoption.

2 Study Area

- Val d’Aran: headwater region (620 km²) in the Garona River
- A significant flood-landslide event occurred on June 18, 2013

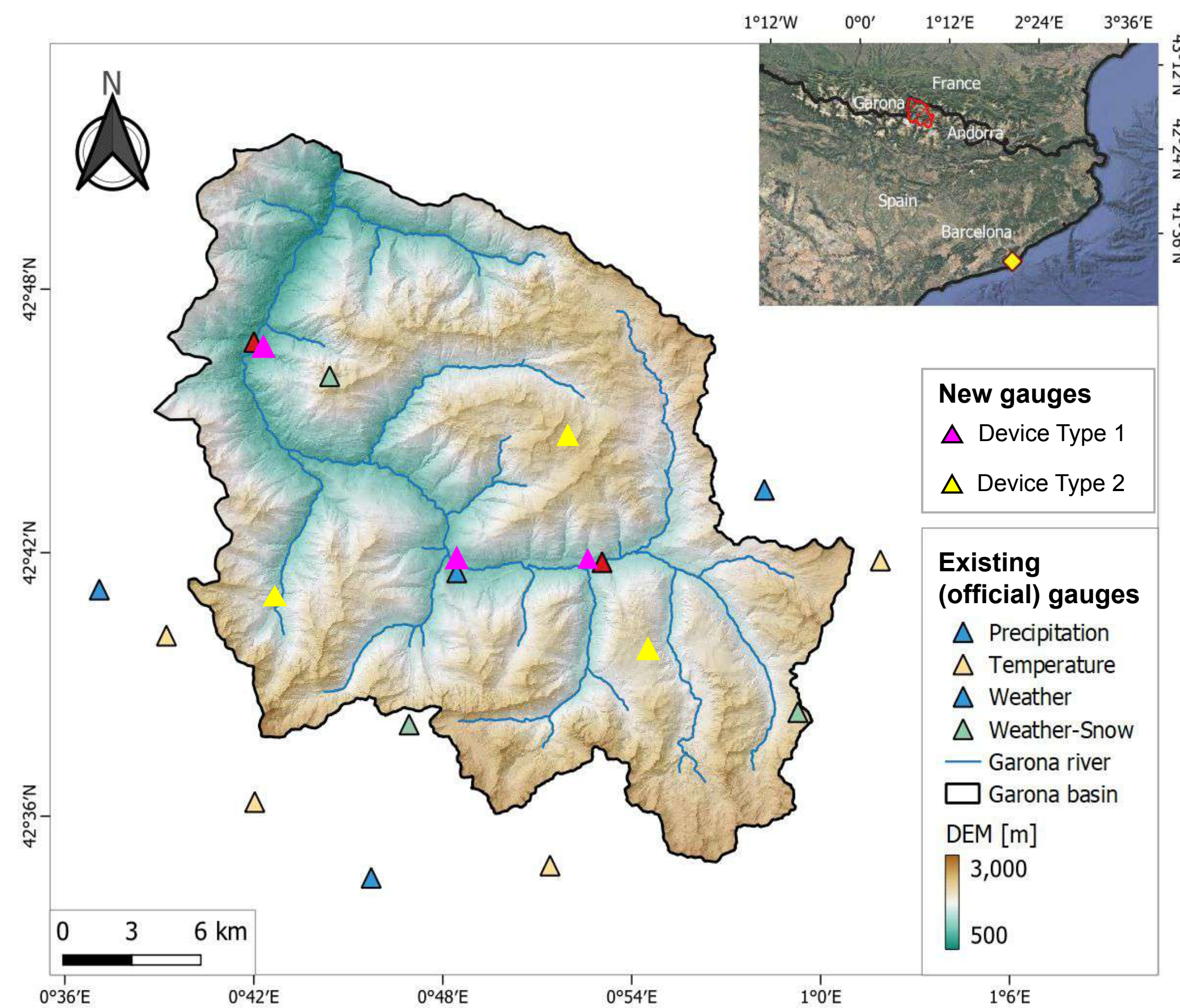


Figure 1. Gauge locations of the existing sensors and the new devices. Type 1 measuring relative humidity, soil moisture and temperature, and Type 2 measuring the same variables plus precipitation

4 IoT Monitoring

- Strategic densification covers previously unmonitored “blind spots”.
- LoRa-based telemetry soil-moisture and AWS data in real time with quality control.
- Continuous observations validate and calibrate the coupled hydro-geotechnical model and its forecasts.



Figure 4. Installation of device.

3 Modelling framework

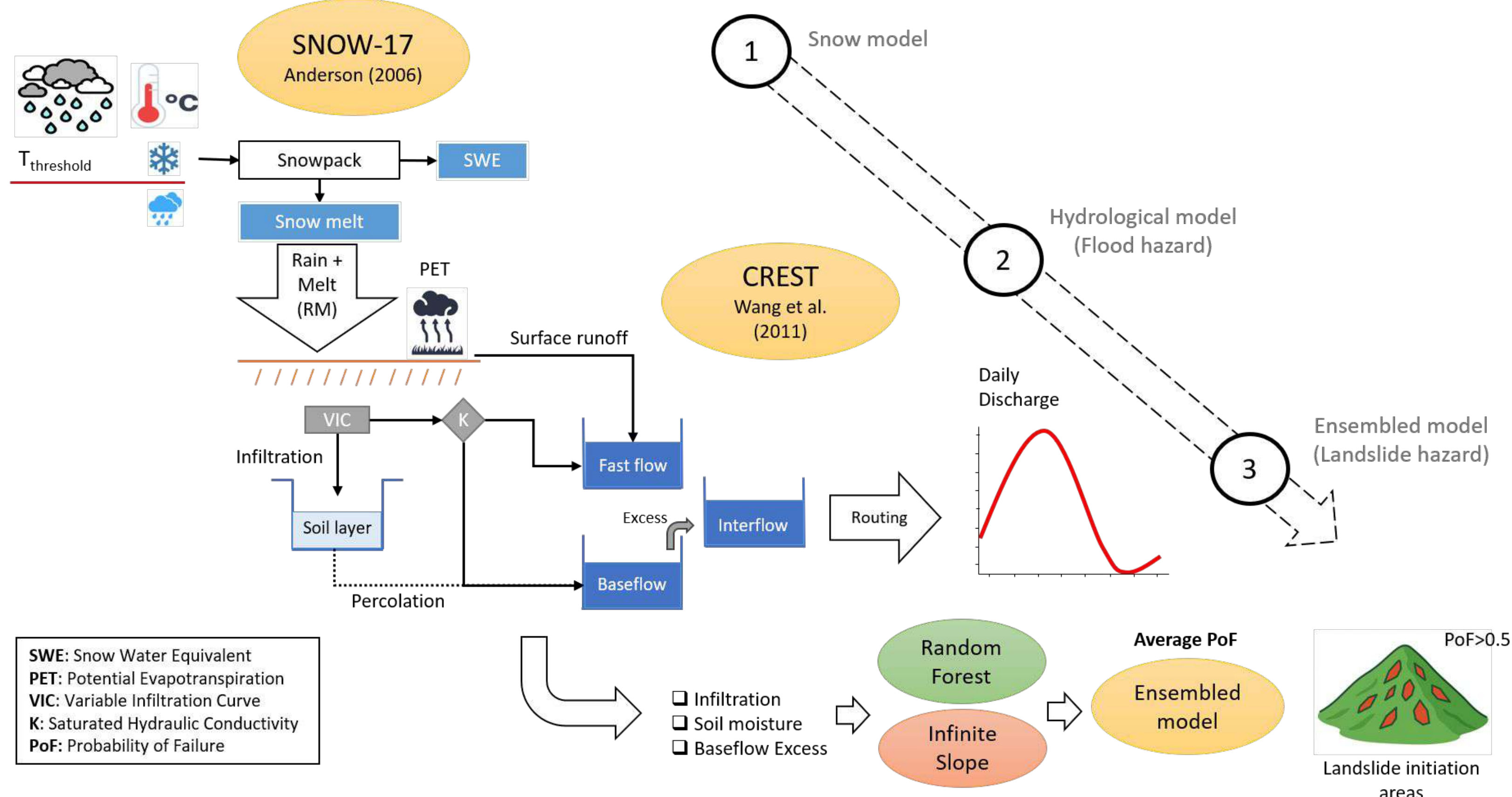


Figure 2. Coupled modelling scheme for multi-hazard analysis.

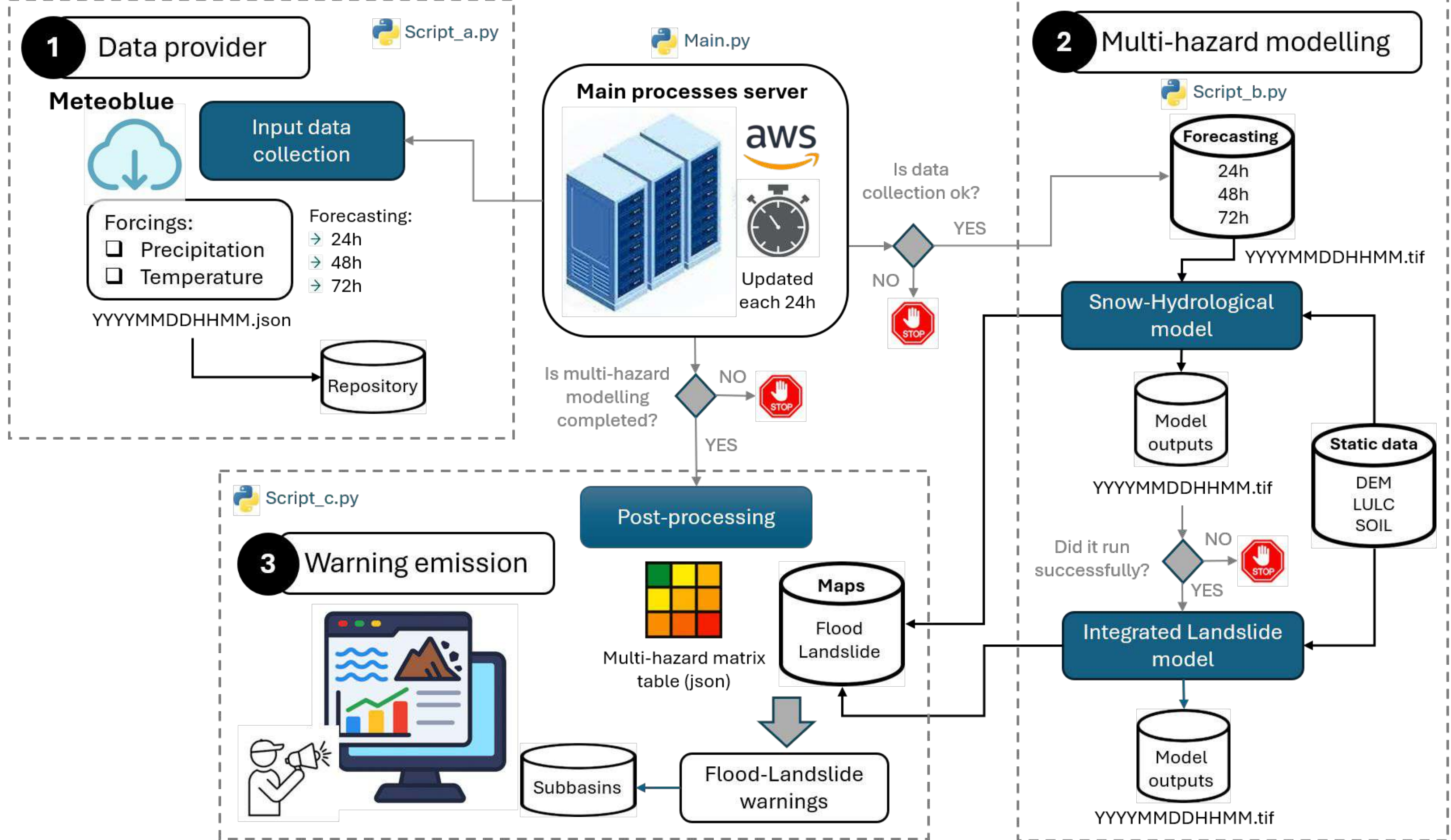


Figure 3. Implementation of Early Warning System scheme.

5 IoT Platform

- Map-based view of hazard levels by zone with a 3-day forecast for floods and landslides.
- Automated alerting via phone calls, SMS, email and push notifications from configurable thresholds.
- Live access to the station network and other key layers (radar/snow, exposure, safe routes) for operations.

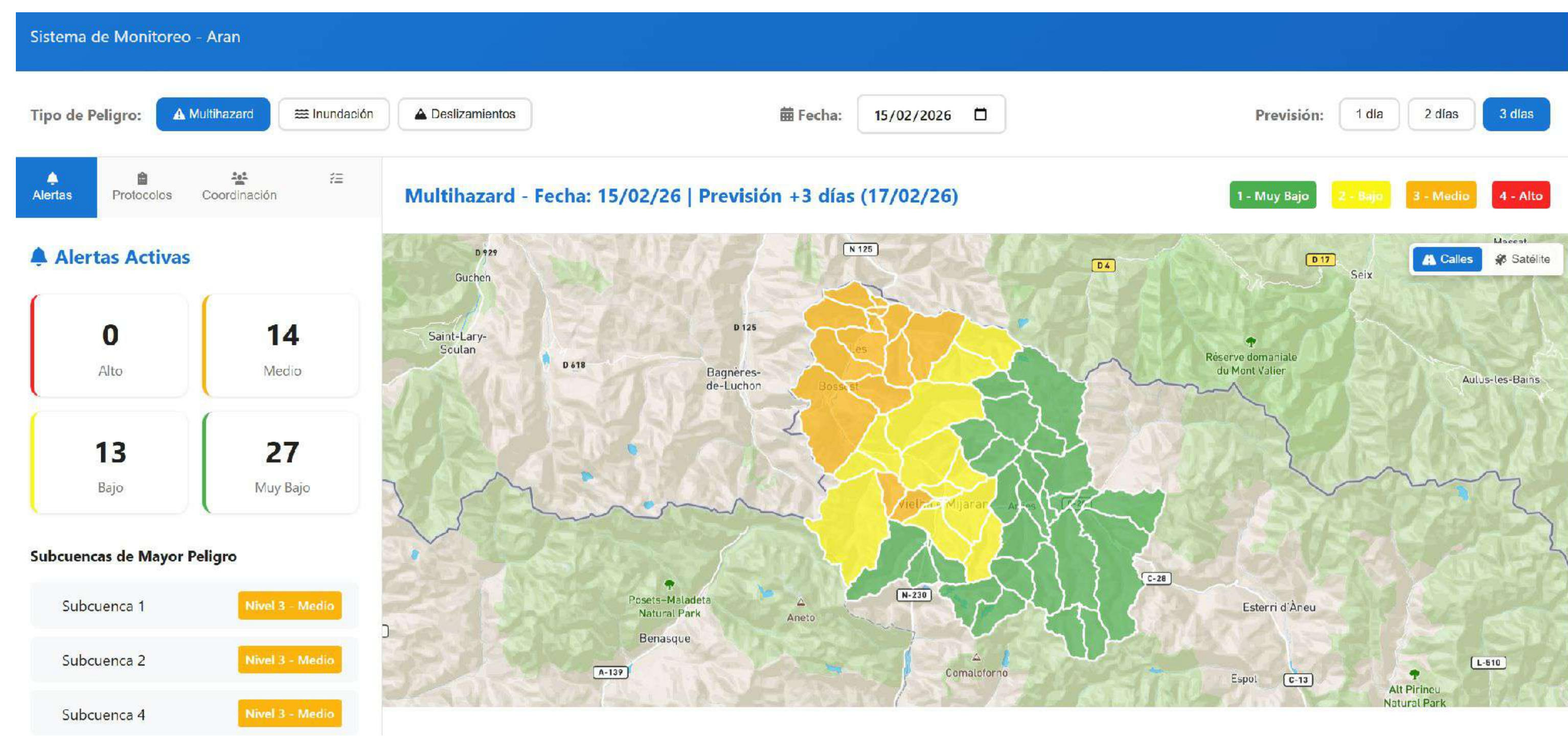


Figure 5. Prototype of IoT Platform.

6 Awareness & Preparedness

- Partnership with the local high school for student research projects using DEM2 data and tools.
- Workshops, light drills, and co-creation of public materials (infographics, safe-route maps, short videos).
- Student-led design and construction of a functional rain gauge prototype, with data integrated directly into The HuT platform.
- Dissemination of project results and risk awareness content through The HuT web and mobile platforms.



Figure 6. School visit to Arantec's facilities