

Next-Generation Earthquake Early Warning: Empowering Communities Through Local Emergency Plans

Aldo Zollo

University of Naples Federico II



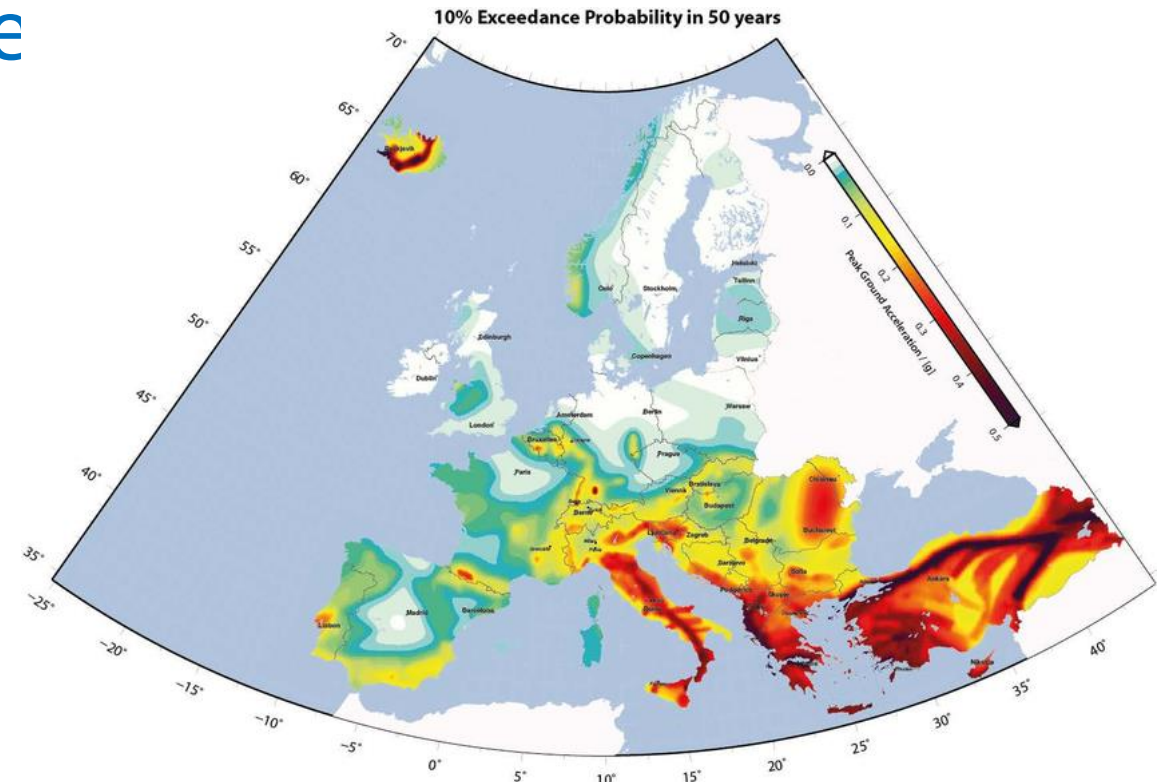
Empowering Communities with Earthquake Early Warning and Rapid Response

Relevance

- Earthquakes in Euro-Mediterranean Area: Timely alerts matter !
- Integrating seismology into local emergency plans.
- Role of the EU (e.g., Gobeyond project) in advancing impact-based early warning for geo-hazards.

Problems

- Earthquake events strike suddenly with little pre-event mitigation time.
- Significant damage and casualties often occur within seconds or minutes.
- Community resilience depends on rapid, reliable information.



Improving earthquake preparedness isn't just about technology—it's also about aligning with local authorities, stakeholders, and citizens.

Current Earthquake Early Warning (EEW) and Rapid Response Capabilities

Earthquake Early Warning Systems

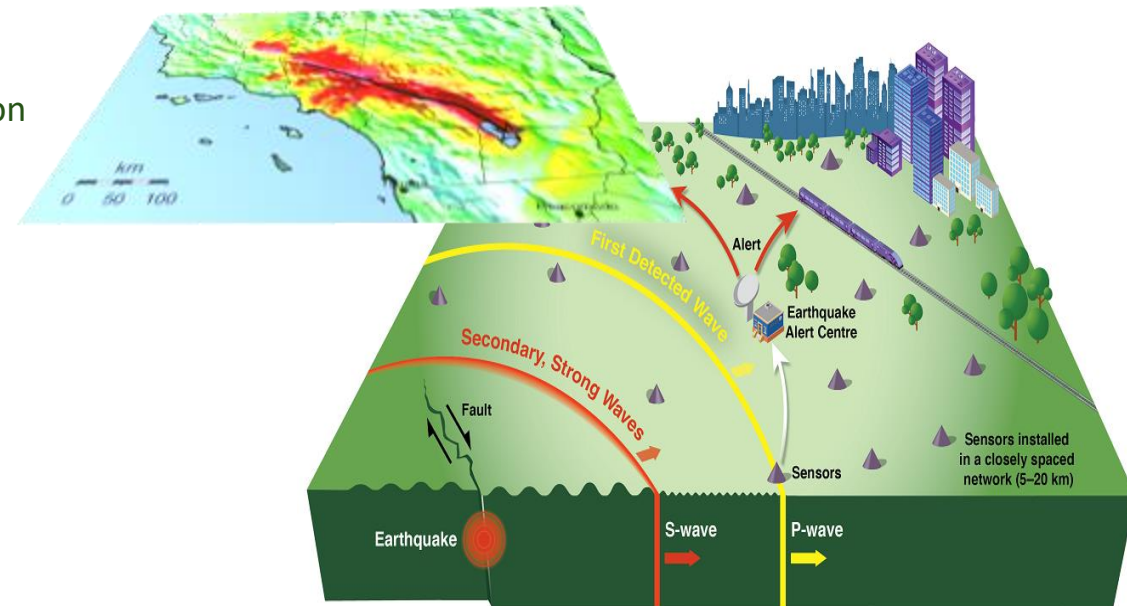
- Real-time seismic monitoring networks: Traditional strong-motion sensors, broadband stations.
- Data processing: Modern algorithms (e.g., P-wave detection for magnitude and location).
- Global vs. Regional coverage: Progress in Italy, Greece, Turkey, Japan, California, Mexico.

Rapid Response Frameworks

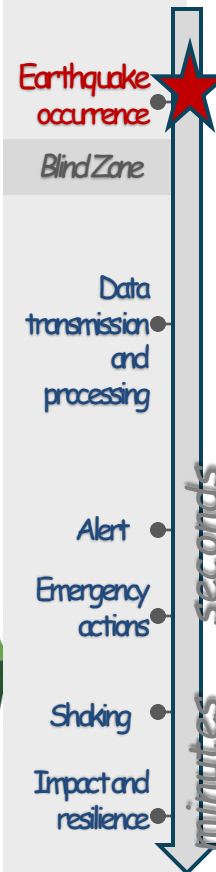
- Automated ShakeMaps: Near-real-time intensity distribution maps.
- Cloud-based data processing for quicker turn-around.
- Integration with other hazard frameworks (e.g., multi-hazard early warning platforms).

Operational Examples

- Japan's nationwide EEW system (via JMA).
- Mexico's SASMEX public alert system.
- Europe's growing interest: Earthquake monitoring by EMSC, EPOS, and national agencies.



<https://earthquakescanada.nrcan.gc.ca/eeew-asp/system-en.php>



Europe is at the forefront in research but real-time, large-scale operational EEW/Rapid Response is still developing

Where Technology is Heading

Sensor Technologies

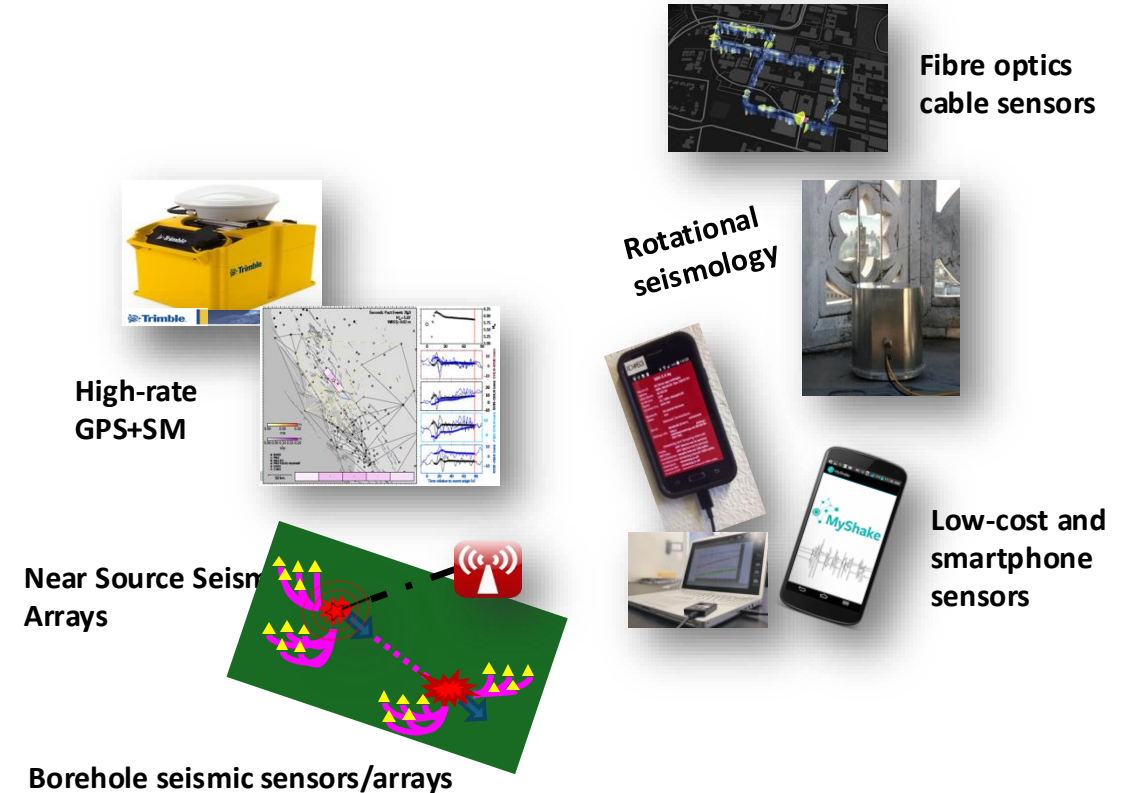
- Low-cost MEMS accelerometers, Fiber Optical cables (DAS) & IoT sensor integration.
- Crowd-sourced data (e.g., smartphone-based detection via apps like MyShake).
- Densified sensor networks to improve detection and reduce latency.

Data Processing and AI

- Machine learning algorithms for faster and more accurate event characterization.
- Integration of real-time data streams with historical earthquake catalogs.
- Predictive modeling for ground shaking and impact estimation.

Communication Channels

- Smartphones, wearables, and direct device-based alerts (bypassing traditional mass-media delays).
- Satellite-based broadcast, cell broadcasting (e.g., public alert systems integrated in 5G networks).
- Multi-lingual, multi-platform alerts to ensure inclusiveness.



These innovations reduce detection time (latency) and expand coverage, critical for saving lives.

Linking Technology with Preparedness and Response

Local Emergency Plans Integration

- Tailoring EEW protocols to local contexts: safe zones, evacuation routes, designated shelters.
- Training drills and public education to ensure individuals react appropriately to alerts.
- Collaboration with local authorities, civil protection agencies, NGOs.

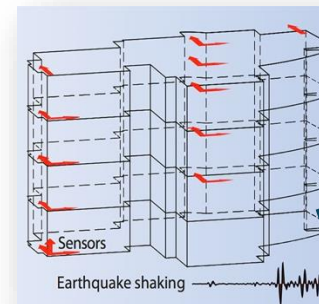
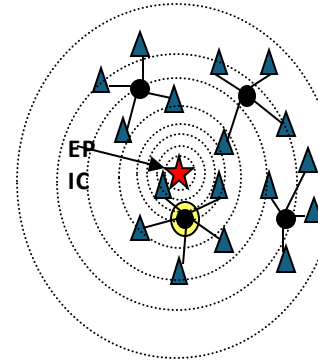
Inclusivity & Accessibility

- Designing alerts for vulnerable groups (elderly, disabled, children).
- Partnering with schools, hospitals, and community centers to ensure readiness.

Case Study or Example

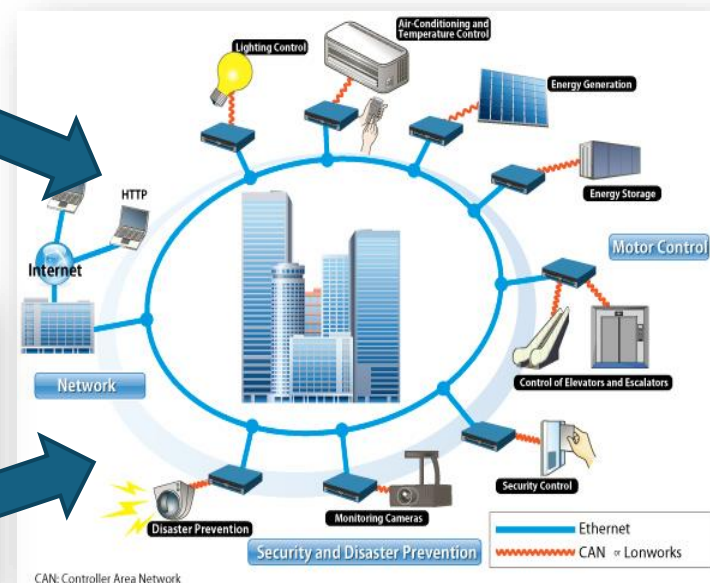
- EU-funded pilot project that successfully integrated early warning into municipal plans → Gobeyond's demonstration sites.

Quake-Shake Forecast



Structural Health Monitoring and Damage Detection

Decision/Control Expert System for Real Time Risk Mitigation



technology alone isn't enough—community engagement, training, and policy integration are key.

The Next Step

Research & Funding Needs

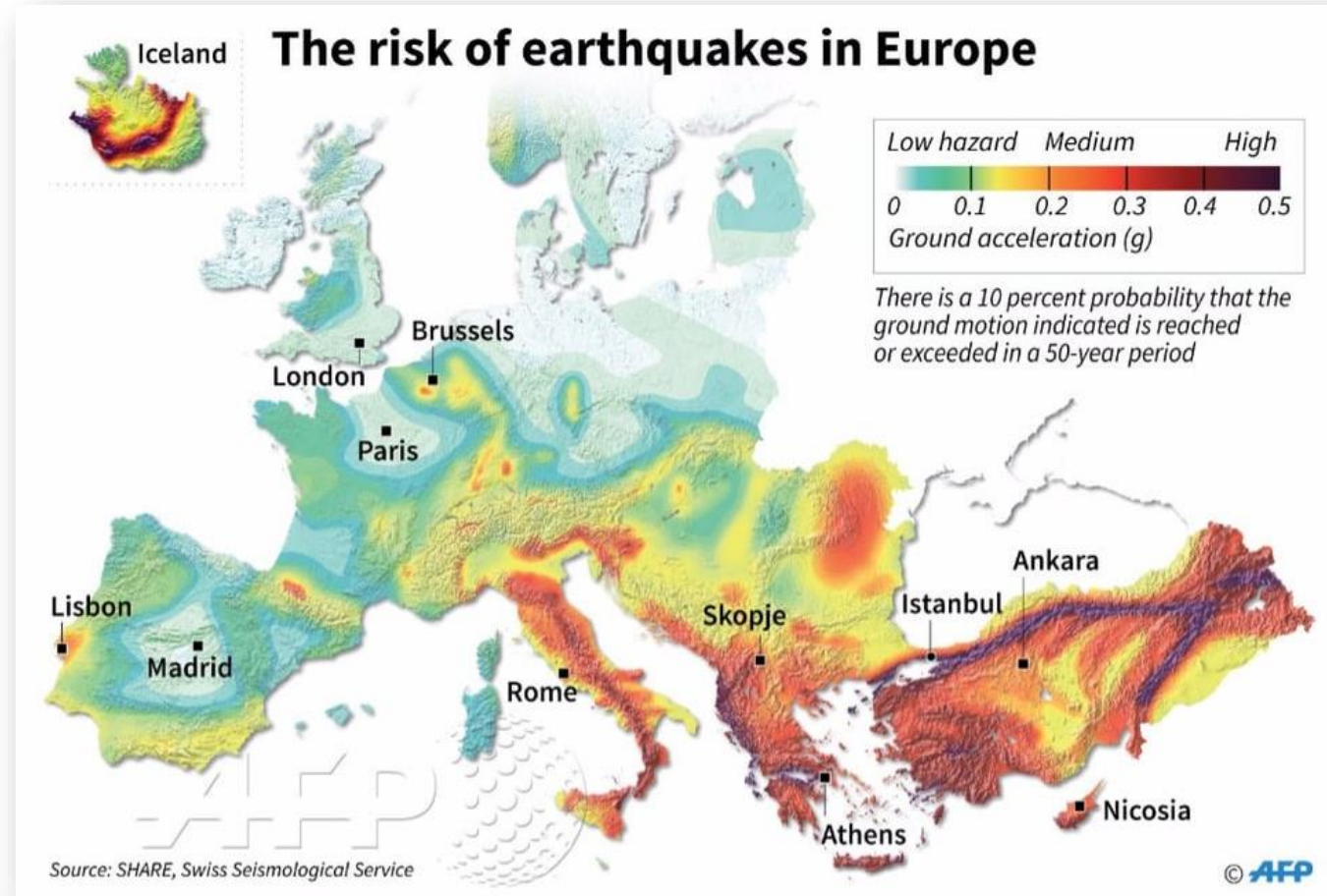
- Sustained investment in sensor networks and software development.
- Cross-border data sharing and standardization within Europe.
- Encouraging public-private partnerships for robust infrastructure.

Scaling Up & Future Prospects

- EU-led initiatives aimed at synergy across European research centers.
- Potential for expansion into a pan-European EEW system, leveraging AI and crowd-sourced data.

Key Takeaways

- **Urgency:** Earthquake risk is immediate and technology can mitigate impacts.
- **Collaboration:** Local, national, and transnational stakeholders must co-develop protocols.
- **Empowerment:** Effective early warning + robust emergency plans = resilient communities.



Collaboration both in research (e.g., big data and machine learning) and in the application (training local communities, bridging with policy-makers).