Deliverable

D8.12 External newsletter released

Deliverable information	
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Summary

So far, RISE has sent four external newsletters via the email marketing service MailChimp to its members and to the interested public. The external newsletters are sent out once a year and inform about the latest achievements reached in RISE, new publications with RISE acknowledgment, and provide further information on the topic of dynamic seismic risk. The last external newsletter was sent on the 15th of February 2023.

- Newsletter #1, March 2020: Welcome to RISE (see D8.10)
- Newsletter #2, October 2020: One Year of RISE
- Newsletter #3, October 2021: Half-time of RISE (see D8.11)
- Newsletter #4, February 2023: Ris(e)ing Numbers

Experiences of other projects proofed the effectiveness and relevance of this communications mean in terms of enhancing project visibility and stakeholder engagement. The relatively high opening-rates of the four external newsletters have demonstrated that they attract the interest of the audience (average opening rate of 55%).

As the project has grown, the number of external newsletter subscribers has also steadily risen: The first newsletter was sent to 129 subscribers, and the last to 219 subscribers. In addition, there is an increase in website visitors on the days of the newsletter publication. On average, we count about 30 website visitors daily, but on 15 February for example, 111 unique website visitors were counted.

All published external newsletters are openly accessible on the RISE website. The newsletter is also shared on Twitter to reach a broader audience of the scientific community external to RISE.

The external newsletters usually follow a similar structure:

External Newsletter
Introduction
Project overview
A closer look Insights into different research fields and their latest developments in RISE
RISE News Recent RISE news at one glance
Publications List of RISE publications, insights into RISE publications
Miscellaneous Events, links, others
Calendar Events and conferences
Icons for website, email and Twitter
Logos and disclaimer

1. Detailed content of the released external newsletters

Here is an overview of all external newsletters: publication date, opening rate, number of recipients, and content.

1.1 First external newsletter

- Released on 3 March 2020
- Opening rate 55.9%, 129 recipients
- Content of the newsletter:
  - Introduction of the RISE project
  - Welcoming message from the RISE project manager
  - "A closer look"
    - Towards optical sensing of ground motion for improved seismic hazard assessment (WP2)
    - What is Operational Earthquake Forecasting? (WP3)
  - "RISE terminology"
    - The concept of "Dynamic Risk"
  - RISE and TURNkey at the European Seismological Commission (ESC2020), call for abstracts
  - Calendar

1.2 Second external newsletter

- Released on 15 October 2020
- Opening rate 66.2%, 150 recipients
- Content of the newsletter:
  - Introduction / News in brief / Overview
  - Summary of each WP about their progress in the first project year
  - "A closer look"
    - Structural Health Monitoring: Opportunities for Integrating Sensing Data into Rapid Loss Assessment (WP4)
    - Looking into the future of forecasts (WP5)
  - "RISE terminology"
    - The concept of "Earthquake Early Warning"
  - All RISE publications at one glance
  - Calendar

1.3 Third external newsletter

- Released on 8 October 2021
- Opening rate 46.9%, 216 recipients
- Content of the newsletter:
  - Introduction / News in brief / Overview
  - Summary of each WP about their progress by the midterm of the project
  - "A closer look"
    - A solidarity-based earthquake early warning system (WP5)
  - "RISE terminology"
    - The concept of "Long-term earthquake forecasting (LEF)"
  - Miscellaneous
    - Joint session of RISE and TURNkey at the European Seismological Commission (ESC) 2021
  - All RISE publications at one glance
  - Calendar

1.4 Fourth external newsletter

- Released on 15 February 2023
- Opening rate 48.8%, 219 recipients
- Content of the newsletter
  - Introduction and newsletter overview
  - Summary of the RISE progress
  - RISE news
    - All RISE news of 2022 at one glance
  - "A closer look"
    - European ShakeMaps and Rapid Loss Assessment (RLA) (WP6)
    - Special reports on the earthquakes in Türkiye and Syria
  - RISE publications
    - List of all RISE publications in 2022
    - Insights into a research paper: "Accuracy and precision of earthquake forecasts using the new generation catalogues"
  - Miscellaneous
    - Announcement of Ian Main and his election as member of the Academia Europaea
  - Calendar

2. Appendix

2.1 First external newsletter

Did you know that more than 170 million people in Europe are exposed to significant earthquake hazard? Advances in scientific understanding and emerging technologies offer enticing opportunities to consider earthquake risk as a time-dependent process. Developing such innovative approaches and measures in order to reduce future earthquake losses is the mission of RISE. It stands for **R**eal-time earthquake r**I**sk reduction for a re**S**ilient **E**urope and is a three-year project financed by the Horizon 2020 programme of the European Commission.

The RISE Project kick off was in September 2019 and all activities are now gaining momentum. This external newsletter, published three times a year, will update everyone interested in RISE progress, share results, events, open positions and more. In addition, in each external newsletter two work packages will Elaborate on a selected task in an approachable way. In this newsletter, two reports of Prof. Andreas Fichtner and Dr. Marcus Herrmann provide further insights in their research projects.

Another way to stay informed about the project is to follow RISE on Twitter or to discover more on its website.

Do you know someone who could be interested in RISE progress and findings?
You are welcome to forward this newsletter to your contacts!

A welcoming message from RISE project manager Dr. Banu Mena Cabrera

"RISE brings together seismologists, engineers, social scientists, economists, practitioners within and outside academia under one project and one goal; to advance real-time earthquake risk reduction capabilities for a resilient Europe. To maximise the impact of the project, RISE adopts an interdisciplinary and multi-hazard users' perspective and translates all RISE outputs and deliverables into tangible products and services, useful for and used by a wide range of stakeholders. It contains a comprehensive set of communication, dissemination, exploitation, and decision-support activities. In RISE, we are ambitious to achieve our goals and make an impact on societies of Europe and beyond.

As Project Manager, I am very excited about being part of this effort and helping to manage and sustain this collaboration towards achieving RISE objectives. We hope you enjoy getting the most up to date project information through our various channels."

A closer look

"Towards optical sensing of ground motion for improved seismic hazard assessment"

Prof. Andreas Fichtner, ETH Zurich

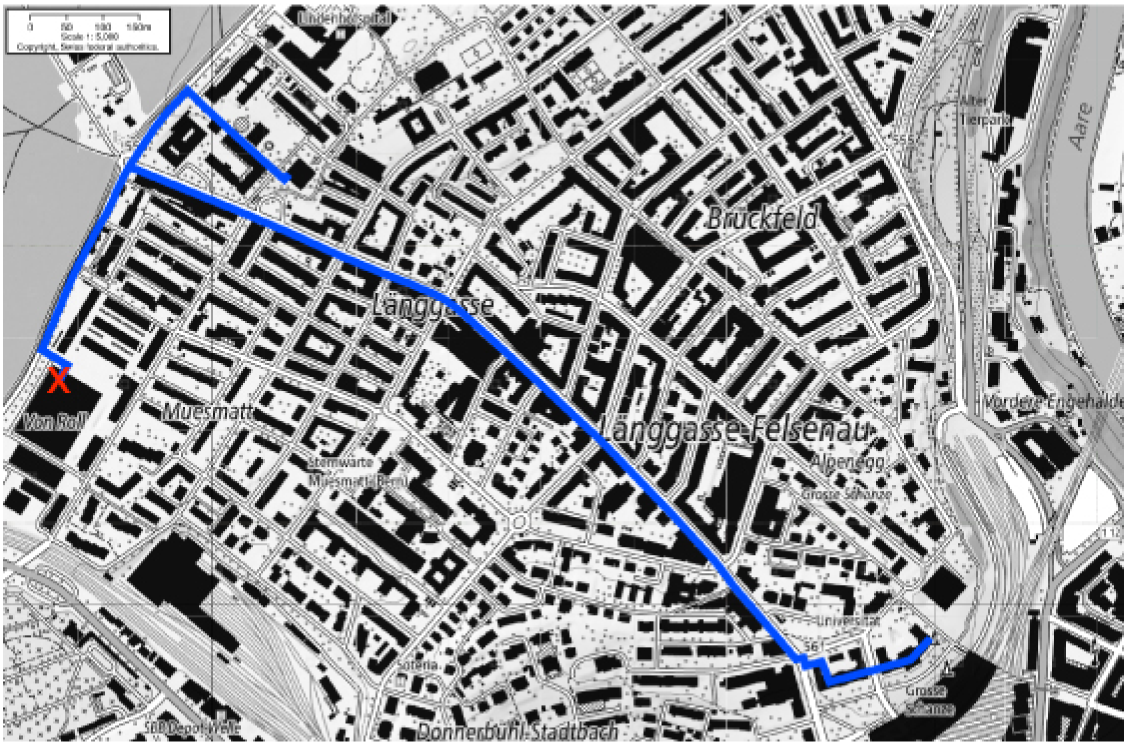
Optical fibres are the backbone of our modern communication network. Short pulses of laser light transmit enormous amounts of data, but on their journey from sender to receiver they also gather information about the optical fibre itself. In fact, microscopic displacements of the fibre slightly distort the laser pulses – an effect that has recently become detectable with highly sensitive interferometers.

This emerging technology, known as Distributed Acoustic Sensing (DAS), allows us to measure ground motion excited by a large variety of sources, such as earthquakes or landslides. Harnessing existing networks of telecommunication fibres, DAS therefore offers the opportunity to assess and potentially mitigate natural hazards in densely populated urban areas.

To explore this opportunity, RISE researchers at ETH Zurich are conducting a pilot experiment in the Swiss capital Bern, closely collaborating with the telecommunication company SWITCH. Several connected telecommunication fibres traversing the city in different directions along a 6 km long path measure ground motion every two metres, in real-time, nearly 1000 times per second (Fig. 1). Most of the observed ground motion is caused by traffic, industrial installations, and construction sites (Fig. 2).

Though the amplitude of these signals is, fortunately, much lower than the ground motion caused by destructive earthquakes, this wealth of data can be utilized to infer rock properties of the upper tens to hundreds of metres of the subsurface. Knowing these properties is essential to predict the ground motion caused by potential future earthquakes.

Research on DAS in urban environments is in its infancy, within the RISE project and worldwide. Initial results are very promising, especially in terms of the quality and unprecedented spatial resolution of the data. Yet, substantial research and development are still needed in order to process the enormous amounts of DAS data efficiently.



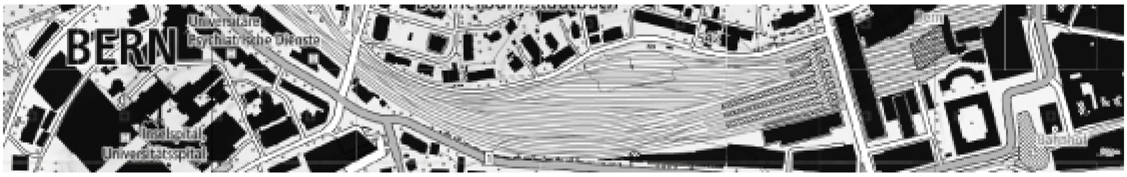


Fig. 1: Map of the north-western neighbourhoods of the Swiss capital city Bern. The position of fibre-optic telecommunication cables used in the DAS experiment are marked in blue. The red cross indicates the location of the interferometer in a building of the University of Bern.

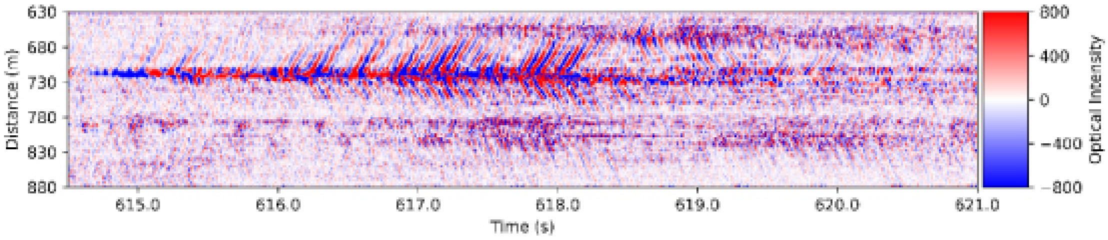


Fig. 2: Snapshot of an urban DAS recording in Bern for receivers located at distances between 630 m and 880 m from the interferometer. The record is 6.5 s long. Colours indicate strain rate in the direction of the fibre. The prominent signal corresponds to slow traffic at a speed of around 20 km/h (5.5 m/s). The more steeply dipping waves emanating from the traffic signal have a propagation speed of nearly 400 m/s, which corresponds to the shear wave velocity of the upper few tens of metres of the subsurface.

"What is Operational Earthquake Forecasting?"

Dr. Marcus Herrmann, University of Naples

To advance earthquake predictability research such as Operational Earthquake Forecasting (OEF) is one important focus of RISE. This research can benefit from the constantly evolving observational capabilities of seismic monitoring efforts, which, for instance, result in an ever-increasing amount of recorded earthquakes, especially toward smaller magnitudes. Such capabilities need to be exploited to gain more insight into the earthquake occurrence processes and, therefore, to improve earthquake forecasting.

In our first step we explore existing high-resolution earthquake catalogs that contain events with magnitudes down to $M_L 0$ or below. We started to develop an interactive tool that will facilitate and aid us in a more intuitive analysis of seismicity in five dimensions (see Figure 1).

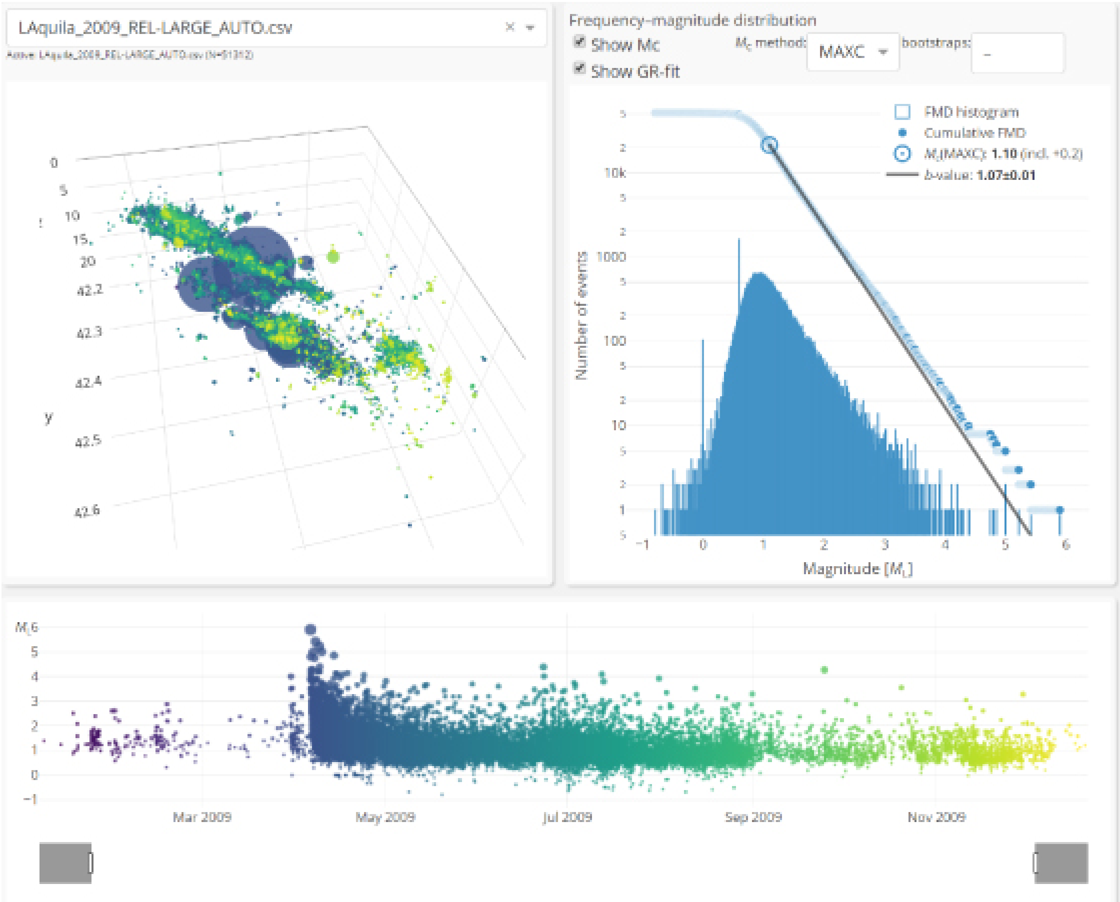


Figure 1: Screenshot of our interactive tool to explore seismic catalogs in five dimensions: spatially (rotatable 3D, top left), temporally (bottom), and magnitude-wise (Frequency-magnitude distribution, FMD, top right). Notice that the spikes in the FMD indicate magnitude errors in the example catalog of the L'Aquila sequence [Valoroso et al. 2013]. The interface runs in a web browser and can be made accessible for other researchers or the public. More analytic components and their interactions are currently being developed.

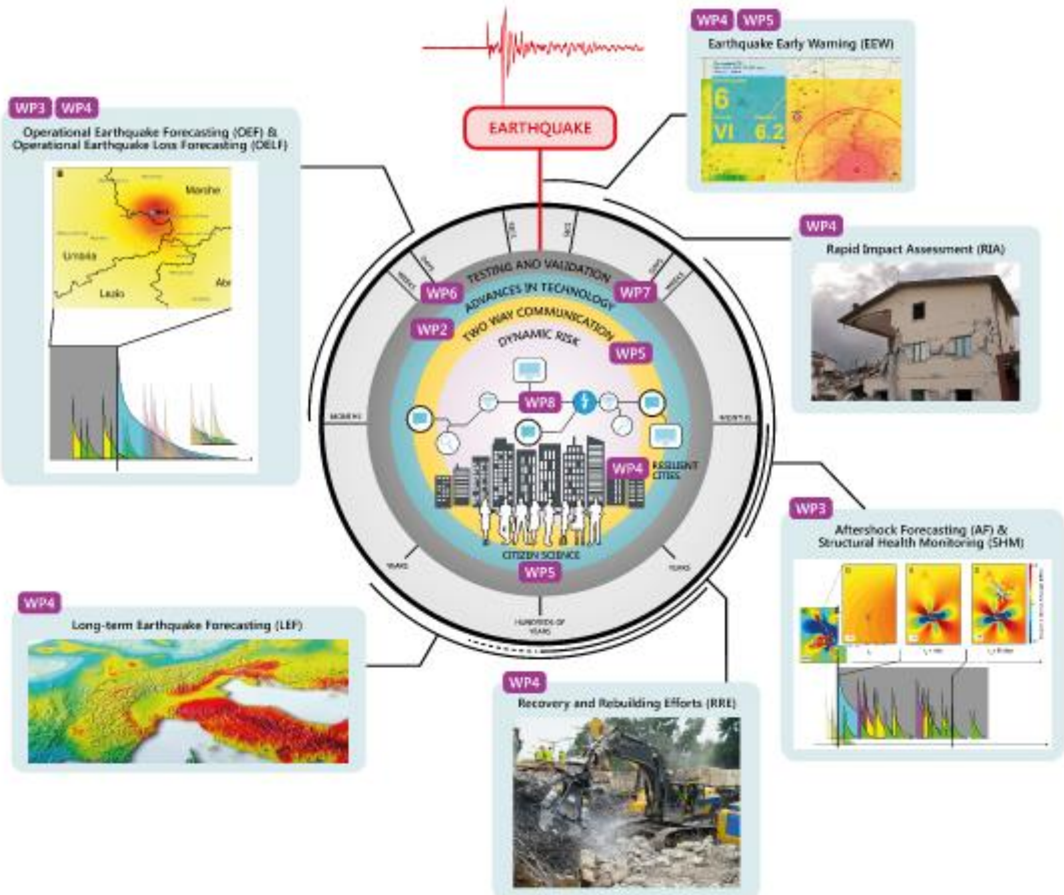
In particular, we will focus on these aspects:

1. Spatio-temporal variability in the frequency-magnitude distribution: e.g., statistical analyses of event sizes could tell us more about the state of a fault system.
2. Earthquake clustering properties: e.g., well-located hypocenters could reveal how earthquake sequences progress and how earthquakes are triggered.
3. Foreshock analysis: e.g., earthquakes prior to a larger earthquake might share a common spatial-temporal pattern. In addition, high-resolution catalogs could potentially reveal many more sequences that have foreshocks than is currently believed.
4. Limits of the current quality of earthquakes catalogs, e.g., what information are we missing?

We will adopt state-of-the-art methods (e.g., from the machine learning domain) to augment these analyses, for instance to employ a parameter selection and search for signals and patterns that are indicative of the earthquake occurrence process.

Our findings will have an impact for improving our understanding of the earthquake occurrence process. Our gained knowledge could allow us to develop innovative earthquake forecasting models, which can be stochastic, physics-based and/or of a hybrid type. Ultimately, our advances will contribute to a better mitigation of the seismic risk which will be analysed within another work package of RISE.

RISE terminology



The concept of "Dynamic Risks"

The RISE key concept and vision is to promote a shift in how earthquake risk is assessed and managed. We believe that by profiting from advances in scientific understanding and the dramatically changing technological capabilities, earthquake hazard and risk can soon be appreciated not as a constant in time, but as an evolving, integrated and dynamic risk. The dynamic risk that a structure is exposed depends on its structural type, location, occupancy, soil conditions, and topography, while people's risk is also affected by their exact location within a structure. However, dynamic risk also includes changes with time; gradually through urbanization, building stock changes and rapidly following a recent moderate or large earthquake, when the risk increases for the next days and weeks dramatically.

People's perception of — and behaviour relating to — risk is very personal and depends on far more than simply the probabilities for potential effects. Thus, good risk assessment and good risk communication must go hand in hand, with different forms of communication suitable for different timeframes and different regional contexts.

Discover here more about the main concepts of RISE to handle dynamic risks!

Miscellaneous

EU-funded projects at the European Seismological Commission

Together with a related EU-funded project TURNkey, RISE will host a session a at the 37th General Assembly of the European Seismological Commission ESC2020 in Corfu. The session is entitled "Towards operational forecasting of earthquakes and early warning capacity for more resilient societies". The session description reads as follows:

To help mitigate the risks related to earthquakes, citizens need additional protection that goes beyond building codes and retrofitting actions. These include Earthquake Early Warning (EEW) approaches and operational earthquake forecasting (OEF), but also Rapid Response to Earthquake (RRE) systems. Besides scientific and technological advances, a focus must be on improved preparedness due to more effective two-way communication of forecasts, early warning and uncertainties for users and the public.

In 2019, two new seismology and earthquake engineering related projects were awarded by the European Commission, RISE and TURNkey. In these two projects, more than 40 European institutions are collaborating on numerous aspects of improving real time seismology and its communication, and seismic risk reduction capacity. This session will give the opportunity to present and discuss first project results with the wider community. In addition, we welcome contributions on all aspects of improving earthquake resilience, including the scientific background, actual implementation scenarios and problems in communicating OEF, EEW and RRE results to stakeholders and public.

Become a part of it!

This is an excellent opportunity to learn more about the work conducted in the framework of these two European projects. We are looking forward to your contributions and encourage you to hand in your abstracts to join this session.

The abstract deadline is on 12 April 2020!

More information

Calendar

RISE related activities

6 - 11 September 2020, Corfu (Greek)
37th Assembly of the European Seismological Commission
More information

RISE related conferences

3 - 8 May 2020, Vienna (Austria)
EGU General Assembly 2020
More information

The next external newsletter will be released in September 2020. If you have anything you would like to share, please send your input to the communications team (nadja.hermann@sed.ethz.ch or michele.marti@sed.ethz.ch).

Liability claim

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Add us to your address book

Want to change how you receive these emails?
You can update your preferences or unsubscribe from this list.

mailchimp

2.2 Second external newsletter

Happy birthday, RISE - we celebrated the project's first year! It has been more than 12 months since the RISE community met for the first time in Switzerland and received an insight into the numerous work packages. In the meantime, we had to reorganize many meetings and interacted virtually instead of face-to-face. Nevertheless, RISE is progressing very well across all work packages.

After one year, first results are becoming apparent such as the deployment of a prototype array or the development of static and time-invariant exposure models for many countries. In this newsletter, let's have a closer look at the project's latest progress focusing on "Structural Health Monitoring" and related opportunities for integrating sensing data into rapid loss assessment. In addition, we are looking into the future of forecasts and its origin in 1854.

We hope you enjoy reading it!

WP Progress

WP1 | Management
...organized a new series of scientific focus meetings called "ZOOMing into RISE", where every two weeks a work package presents part of the work carried out recently. In addition, WP1 worked on the RISE Data Management Plan and opened a RISE Community Space to share open access data and publications. It updated the Project Management Plan, reflecting all achievements of the first year and planning the RISE activities for the year ahead.

WP2 | Innovation
...has successfully deployed a prototype array as a demonstrator in Bern (Switzerland) and designed an impulse generator which is currently being tested in multi-storey buildings. In the next 12 months, the existing mobile seismic shaker (a vibroseis truck) will be upgraded to perform soil-structure interaction tests.

WP3 | Advance
...focused on developing new and extending existing approaches to model seismicity. Some models have already demonstrated to improve forecasting performance and therefore, WP3 has made notable progress in the fields of earthquake forecasting. It also focused on physics-based modelling of seismicity, which is an evolving field and could attract significant interest outside of the RISE community.

WP4 | Effects
...developed static and time-invariant exposure models for 45 countries and time-invariant vulnerability models representing over 500 buildings. Furthermore, it evaluated the seismic risk reduction measures and tools developed in RISE in terms of their costs and benefits.

W5 | Society
...tested different start page designs and hazard announcements representing the diversity of elements used in multi-hazard platforms. Based on the results of the first study, it conducted seven "user-driven prototyping" workshops to understand which features of multi-hazard warning apps non-experts prefer.

WP6 | Demonstration
...could deploy low-cost medium-quality sensors based on MEMS accelerometers in several buildings by QuakeSaver and has developed frameworks for testing OELF at the national scale and RLA at the regional scale.

WP7 | Testing
...developed the modularized CSEP tool-kit which is currently in beta stage. Furthermore, a database for ground-motion model testing has been compiled and a new test metric for a designated b-value experiment is in the design phase.

WP8 | Impact
...has significantly increased the traffic on the RISE website within the first 12 months and therefore, could enhance the project's visibility. On twitter, WP8 is continuously sharing interesting content with the RISE community. In total, WP8 has published or shared 113 tweets, 2 external newsletters and 3 internal newsletters.

A closer look

Looking into the future of forecasts

Dr. Alexandra Freeman and Dr. Sarah Dryhust, University of Cambridge

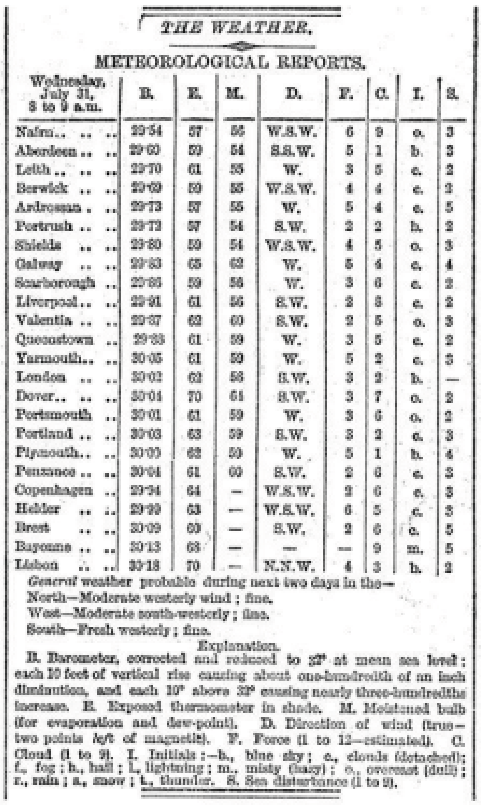
In the United Kingdom's House of Commons in 1854, a Member of Parliament stood up and made the suggestion that recent scientific advances might allow the weather in the city to be known 'twenty-four hours in advance'. The House broke into uproar and laughter - the idea was considered utterly preposterous. But with thousands of lives being lost in the country every year as a result of storms, by 1861 storm warnings were being wired to ports using the new telegraph system. So popular were they, that these 'weather forecasts' quickly became a staple part of newspaper content across the country.

Now, 160 years later, operational earthquake forecasting is in a similar position. With a proliferation of sensors that would have been considered infeasible perhaps 50 years ago alongside growing computer modelling power and expertise, geoscientists increasingly have information about potential seismic activity that could be of use in emergency and public planning. But how best to communicate that?

Over a century of experience in communicating the risk of life-threatening storms has put meteorology in a strong position to help us tackle this problem, but they are not the only ones: those used to communicating flooding, epidemics of disease and even financial market fluctuations all have lessons we can learn from.

As well as talking to communications professionals in all these fields, we are also listening to people 'on the ground' in three key RISE countries: Italy, Switzerland and Iceland. By interviewing members of the public, emergency responders and long-term planners and testing our messages and visualisations on them we will hopefully soon be able to advise on how best to get useful 'earthquake forecasts' into the hands of those who can act on them.

Hopefully as well as learning from the successes of weather forecasting, we can be prepared by its failures. Tragically the father of the weather forecast, Robert Fitzroy, beset with scepticism from scientific colleagues about his methods, funding problems from government, and complaints from those who lost business as a result of false alarms in the warnings, killed himself before he saw them become the ubiquitous and lifesaving service that they are today. With the backing of RISE and alert to these potential barriers, we hope to overcome them.



THE WEATHER.

METEOROLOGICAL REPORTS.

Wednesday, July 31, 8 to 9 a.m.	B.	E.	M.	D.	F.	C.	I.	S.
Nairn..	29·54	57	56	W.S.W.	6	9	o.	3
Aberdeen	29·60	59	54	S.S.W.	5	1	b.	3
Leith	29·70	61	55	W.	3	5	c.	2
Berwick	29·69	59	55	W.S.W.	4	4	c.	2
Ardrossan . ..	29·73	57	55	W.	5	4	c.	5
Portrush	29·73	57	54	S.W.	2	2	b.	2
Shields	29·80	59	54	W.S.W.	4	5	o.	3
Galway	29·83	65	62	W.	5	4	c.	4
Scarborough ..	29·85	59	56	W.	3	6	c.	2
Liverpool.. ..	29·91	61	56	S.W.	2	8	c.	2
Valentia	29·87	62	60	S.W.	2	5	o.	3
Queenstown ..	29·93	61	59	W.	3	5	c.	2
Yarmouth.. ..	30·05	61	59	W.	5	2	c.	3
London	30·02	62	58	S.W.	3	2	b.	—
Dover..	30·04	70	61	S.W.	3	7	o.	2
Portsmouth ..	30·01	61	59	W.	3	6	o.	2
Portland	30·03	63	59	S.W.	3	2	c.	3
Plymouth.. ..	30·00	62	59	W.	5	1	b.	4
Penzance	30·04	61	60	S.W.	2	6	c.	3
Copenhagen ..	29·94	64	—	W.S.W.	2	6	c.	3
Helder	29·99	63	—	W.S.W.	6	5	c.	3
Brest	30·09	60	—	S.W.	2	6	c.	5
Bayonne	30·13	68	—	—	—	9	m.	5
Lisbon	30·18	70	—	N.N.W.	4	3	b.	2

General weather probable during next two days in the—
North—Moderate westerly wind; fine.
West—Moderate south-westerly; fine.
South—Fresh westerly; fine.

Explanation.

B. Barometer, corrected and reduced to 32° at mean sea level; each 10 feet of vertical rise causing about one-hundredth of an inch diminution, and each 10° above 32° causing nearly three-hundredths increase. E. Exposed thermometer in shade. M. Moistened bulb (for evaporation and dew-point). D. Direction of wind (true—two points *left* of magnetic). F. Force (1 to 12—estimated). C. Cloud (1 to 9). I. Initials :—b., blue sky; c., clouds (detached); f., fog; h., hail; l., lightning; m., misty (hazy); o., overcast (dull); r., rain; s., snow; t., thunder. S. Sea disturbance (1 to 9).

Figure: One of the early weather forecasts from the UK's Met Office – before they had worked on how to communicate such information in a clear and easily-understood way to different audiences.

Structural Health Monitoring: Opportunities for Integrating Sensing Data into Rapid Loss Assessment

Yves Reuland, ETH Zurich

The extreme loads imposed by earthquakes threaten the integrity of the built environment. As not all buildings react in the same way to earthquakes, a rapid understanding of the extent of damage to buildings and its consequences on providing safe shelter for the population is a crucial contribution to an earthquake-resilient Europe. Therefore, in a similar way to doctors who examine vital functions to diagnose the health of their patients, structural health monitoring allows engineers to diagnose the integrity of buildings.

In the absence of means for direct measurements of building damage, one objective of the RISE project consists in finding indirect indicators of damage. Data-driven structural health monitoring uses damage-sensitive indicators, which are derived from the building's earthquake response providing a real-time performance indication. To this end, signal processing, statistical analysis and machine learning are used to derive performance indicators from the time-and-frequency domain representation of the response. The increasing availability of sensing hardware at low cost, combined with the ever-growing possibilities for local data processing offered by the Internet-of-Things capabilities, provide exciting opportunities towards smart structures, which support engineers and decision-makers in the immediate aftermath of earthquakes. Hence, the early response to earthquake events can be improved by comparison to the current practice of time-consuming and potentially subjective visual inspections.

Well-designed damage-sensitive indicators help to more precisely diagnose damage by providing higher-level information regarding the location and the severity of building damages. The RISE project, through the breadth of its network, offers a rare opportunity to combine building-specific values from structural health monitoring with regionally applicable building behaviour models. With the engineering knowledge of building taxonomies and damage accumulation, the automation provided by data-driven structural-health monitoring can enable rapid assessment of regional consequences to the built environment, induced by earthquake events, and further provide guidance for rapid recovery.

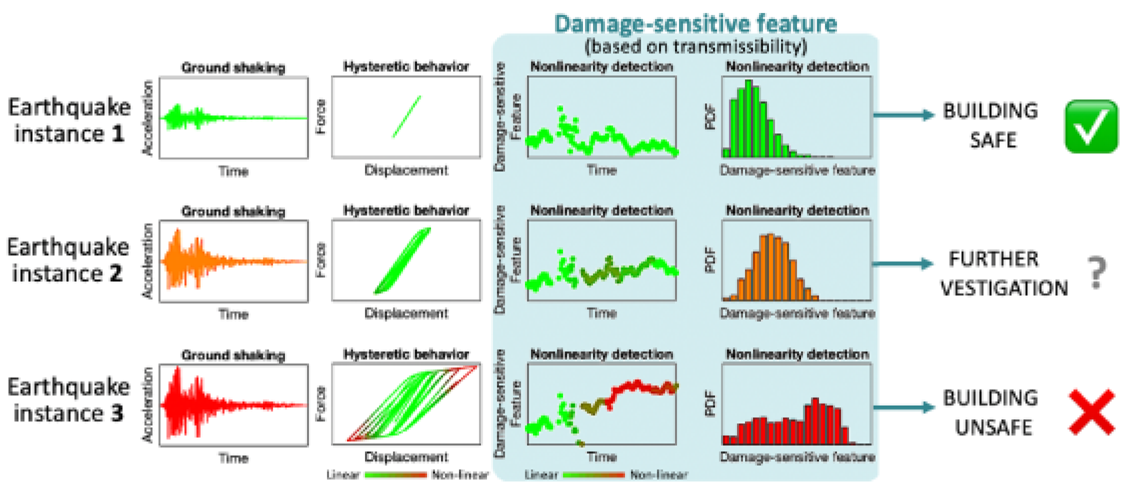
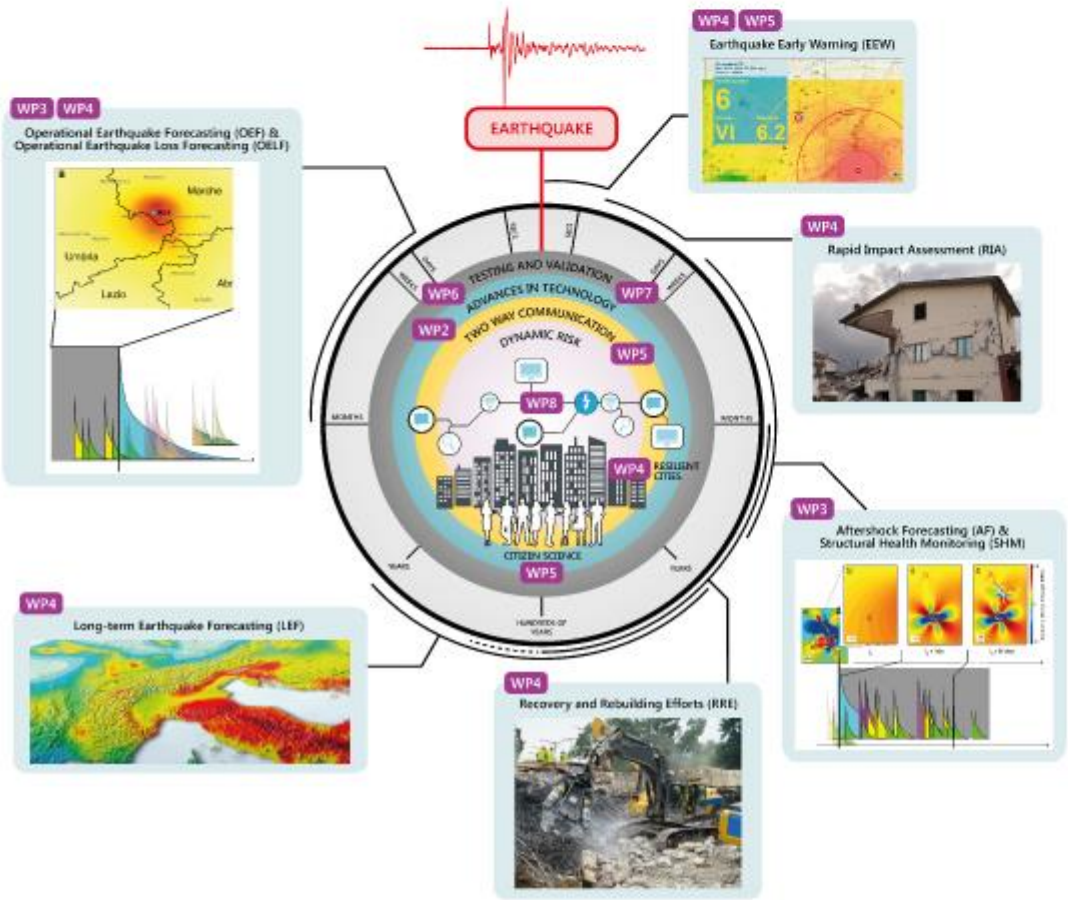


Figure: Damage-sensitive features (here transmissibility between base accelerations and rooftop accelerations) allow detecting nonlinear behaviour. Based on the distribution of the damage-sensitive feature and pre-established thresholds, the building can be tagged as safe or unsafe. Hysteretic behaviour, a direct indicator of nonlinearity, cannot be measured directly.

RISE terminology



The concept of "Earthquake Early Warning"

Earthquake Early Warning (EEW) aims to provide a warning that the shaking of an earthquake is expected before it actually arrives. The warning is issued immediately after the earthquake has occurred or while it is still ongoing. Therefore, EEW does not predict an earthquake.

EEW is possible because electromagnetic waves travel much faster than seismic waves. Therefore, alerts based on the signals captured by seismic sensors close to the epicentre arrive at distant sites before the damaging seismic waves.

EEW can save lives if the public reacts appropriately to the warning and it can protect infrastructure by triggering automated shutdown procedures. However, EEW usually can only provide some seconds warning time before the earthquake strikes. It is possible to rapidly forecast the time of arrival of seismic waves at a remote site, but the assessment of the magnitude and the strength of the earthquake is less certain. This results in the possibility that EEW issues false alerts and that it over- or underestimates the actual earthquake.

Discover here more about EEW and RISE's holistic concept of dynamic risk assessment!

Miscellaneous

All RISE publications at one glance

RISE has released 14 research articles, so far. For example, Irina Dallo dealt with the question "What defines the success of maps and additional information on a multi-hazard platform?" or Laure Fallou analysed the earthquake series in Mayotte Island with regards to citizen seismology. A Again another topic is covered by Ariana Astorga and Philippe Guéguen, who focus in their study on the analysis of long-term recovery and recovery of buildings during aftershocks, in order to detect permanent damage. Those are just three of many other publications released within the framework of RISE. In addition, a handful of other papers are shortly before release!

Would you like to know more about RISE publications? RISE has an open access research repository. We are also continuously updating our website and providing you with the latest RISE news!

Calendar

15 & 16 October 2020, digital
ICEG 2020: 14. International Conference on Earthquake Geology
More information

22 & 23 October 2020, digital
ICESE 2020: 14. International Conference on Earthquake Analysis and Structural Engineering
More information

The next external newsletter will be released in 2021. If you have anything you would like to share, please send your input to the communications team (nadja.valenzuela@sed.ethz.ch or michele.marti@sed.ethz.ch).

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2.3 Third external newsletter

Did you know that you can help to detect earthquakes? All you need is a smartphone and to install the Earthquake Network app. Everyone from all over the world can join this Earthquake network (EQN) initiative, a citizen science research project aiming to send out real-time alerts when the smartphone network detects earthquakes. Are you curious about how this works? Read in this newsletter more about the **Earthquake Network app**!

RISE has recently passed its first half, held a successful virtual Mid-Term Conference in May 2021 with large participation of RISE members and international partners and can already look back on many highlights achieved during the first project phase. In this newsletter, we list a couple of these highlights and provide an overview of all **RISE publications** which have been released so far in 2021.

Earthquake forecasting is a key aspect of the RISE project. In a short, informative article, we explain the concept of "**Long-Term Earthquake Forecasting**" (LEF).

Stay tuned for more RISE news and publications, visit our website and follow us on Twitter!

Twitter Website

WP Progress

RIS(E)ing summiteers

The first half of the RISE journey is already behind us. Step by step, we continue to move forward, always with our goals in mind. Already in the first half of the project, we have achieved crucial intermediate goals and reached milestones.

A couple of these highlights are listed below. Much more can be found in our comprehensive **mid-term report**, which is publicly available on our **website**!

Work package 1
Management

- organised a series of project internal scientific focus meetings, "ZOOMing into RISE". WP 1 also planned the RISE (online) mid-term conference in May 2021, which allowed the project members to share their results, identify challenges as well as project highlights.
- delivered the RISE-EPOS integration strategy report, that lists key areas where RISE services will be linked to EPOS services, and provides information on how to achieve long term sustainability.
- ensures a close collaboration within the project and knowledge exchange with international experts by conducting regular meetings with the management board, WP leaders and the scientific advisory board.
- compiled and submitted the mid-term report. This comprehensive deliverable contains progress reports of the work packages, including an impact assessment and an updated risk register.

Work package 2
Innovation

- established strategies for and demonstration of inclusion and processing of massive datasets in European seismic data archives and infrastructures.

- is developing a dynamic building exposure model that integrates the European exposure model developed in the previous Horizon 2020 project SERA with data on individual buildings that is continuously retrieved and updated from OpenStreetMap in near-real-time. This allows to incorporate to the model not only new information on existing buildings but also add/remove buildings when they are built/demolished.
- achieved that Distributed Acoustic Sensing (DAS) technology has been proven to be at EU Technology Readiness Level (TRL) 6: Technology demonstrated in relevant environment. DAS produces excellent data quality and increases the number of detected local events significantly. It also functions in extreme environments where the deployment of large seismometer arrays may be very challenging.

Work package 3
Advance

- improved the understanding of the earthquake generation process by investigating the space-time independence of the Gutenberg-Richter (GR) law and of more generic magnitude-frequency distributions (MFDs).
- implemented numerical codes, which translate these advancements in knowledge meaningful to improve Operational Earthquake Forecasting (OEF) models. All modelers have worked in developing the mathematical background for their models and published or have submitted several publications in international scientific journals.

Work package 4
Effects

- is improving the European database of building exposure, vulnerability and resilience models.
- is enabling harmonised European ShakeMaps using state-of-the-art methods and models.
- is developing a methodology for Operational Earthquake Loss Forecasting (OELF) accounting for evolutionary exposure and vulnerability at national scale.
- is exploring the possibility to demonstrate the use of structural health monitoring for dynamic risk assessment.

- is evaluating alternative risk mitigation measures that are being developed and improved within RISE in terms of their costs vs benefits.
- is developing an actual application of performance-based earthquake early warning.

Work package 5 Society

- is carrying out interviews and focus groups with different stakeholders in Italy, Switzerland and Iceland to review the current communication pathways for dynamic risk communication, operational earthquake forecasting (OEF) and rapid impact assessment.
- has conducted several interviews with experts working on Early Earthquake Warning (EEW) to explore the public's expectations and needs and published two studies focusing on improving earthquake information in a multi-hazard context.
- has demonstrated that "Earthquake Network" was the first operating public EEW system based on smartphones. A warning time of at least 8s was provided to users in Albania during the 2019 earthquake for intensity 6 (slightly damaging). Such a system is much cheaper than more conventional EEW systems and has well perfomed in 11 countries.
- has found out that the assumption that recipients of an early warning take protective actions is not supported by EQN users' feedback. This means that the individual risk reduction linked to public early warning systems is probably more limited than expected by seismologists.
- has shown that the combined analysis of crowdsourced and seismic data allows a fast and reliable earthquake location and that the value of felt reports is multifold. Such reports describe the effects of the earthquake and can be exploited to rapidly detect the existence of damage through the "doughnut effect", but also constrain location and magnitude of earthquakes before a seismic location is available to constrain the rupture geometry of large earthquakes. They carry important shaking level information, therefore, WP5 is working on investing them in ShakeMaps.
- illustrated the possibility to detect triggered landslides by analyzing tweets by an artificial intelligence.

Work package 6 Demonstration

- is demonstrating how an operational rapid loss assessment (RLA) system could serve civil protection departments at national and European scales.
- is connecting structural health monitoring (SHM) data with rapid loss assessment (RLA) and operational earthquake loss forecasting (OELF). WP6 is also connecting SHM data with building exposure modelling.
- developed a preliminary application of OELF accounting for damage accumulation in building classes.

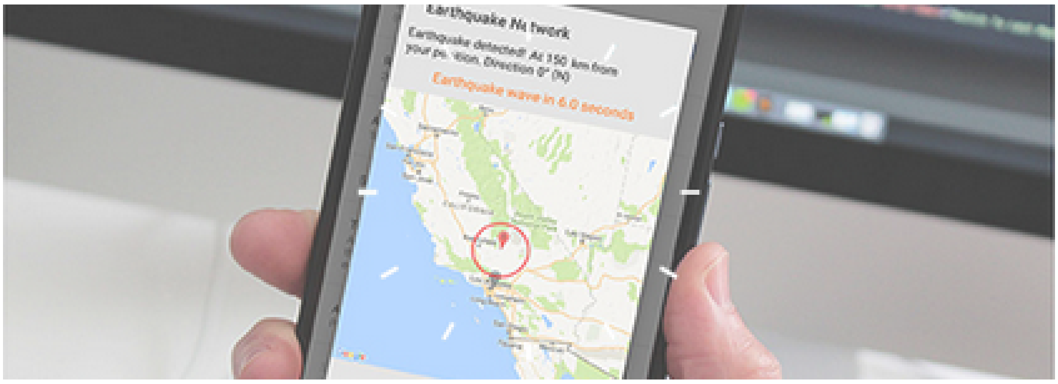
Work package 7
Testing

- designed a new community-based open-access pyCSEP software toolkit for earthquake forecast developers in collaboration with the project partner SCEC. It is a Python package to help earthquake forecast developers embed model evaluation into the model development process and is available from *https://github.com/SCEC-Code/pycsep*.
- conducted a series of virtual workshops between February and June 2021 to familiarise the RISE community of earthquake forecast modellers and testers with the hands-on use of pyCSEP.
- developed and tested methods for ensemble modeling of earthquake forecasts, including multiplicative hybrid models of physics-based and stochastic models as well as new additive ensembles based on logistic regression for Italy.

Work package 8
Impact

- has again increased the number of website visitors and twitter followers which helps to make the project more visible. In total, WP 8 has published or shared more than 170 tweets, 6 internal newsletters and 3 external newsletters.
- technically integrated the operational risk platform development and the CSEP testing center development.

A closer look



A solidarity-based earthquake early warning system

Dr. Francesco Finazzi, University of Bergamo (Italy)

Can citizens play a role in real-time earthquake monitoring and thus contribute to developing earthquake early warning systems? This question was partially answered back in 2009 when the Quake-Catcher Network (QCN) initiative showed the usefulness of dense networks of low-cost sensors in detecting and measuring earthquakes. However, QCN was restricted to the most enthusiastic citizens willing to buy and install the sensor in their homes.

Things radically changed with the smartphone revolution. Smartphones have everything needed to implement a low-cost monitoring network, and to join the network requires only a few clicks. If you are a seismologist, you would argue that smartphones are not secured to the ground (why would they be) and mainly record noise. True. Nonetheless, many smartphones connected to a network can offer reliable real-time detections and provide rapid preliminary estimates of the earthquake parameters.

All of this was first achieved in 2013 by the **Earthquake Network** (EQN) initiative (**www.sismo.app**), which implements a public smartphone-based earthquake early warning system. Citizens join the project by installing the EQN app. Through the same app, they receive early warnings a couple of seconds before the shakings occur at their location. The app immediately became popular in Central and South America, where people experience earthquakes every other day. Also, EQN was helpful to Nepalese citizens during the aftershocks of the April 2015 earthquake, which resulted in nearly 9,000 deaths. For a long time, EQN was simply recognised as a citizen science experiment. Only recently, it caught the attention of seismologists and turned into a research project.

Today, scientists of the EU-funded RISE and TURNkey projects are giving "seismological meaning" to the detections EQN has recorded throughout its history. Furthermore, they found that **the network is indeed capable of sending early warnings for damaging shaking levels**. For instance, the recent magnitude 7 earthquake on 8 September 2021, with its epicentre near Acapulco, Mexico, was detected after 5 seconds from origin time. The EQN app sent an early warning message about 10 seconds before the strong tremors occurred to people living in the nearest large city (Chilpancingo) and 55 seconds to people in Mexico City.

Whether citizens are aware or not, EQN is based on a strong solidarity principle. Smartphones detecting the earthquake are usually very close to the epicentre, where an early warning is not possible. If your smartphone is making a detection, the early warning will be useful for someone who lives a little further away from the epicentre, but not for you. However, you can expect the favour to be returned. Thanks to this spirit of collaboration, EQN has continuously grown, and new users worldwide join the network every day. Up to now, the app counts more than 8 million downloads and 1.5 million active participants globally, and EQN is for many countries the sole and only early warning system citizens can rely on.

While the number of smartphones in the network is increasing, new challenges need to be addressed. The EU-funded Horizon 2020 projects RISE and TURNkey are the perfect environment to study and implement new solutions, with EQN possibly interacting with classical monitoring networks to provide a more robust and faster early warning service across Europe and all over the world.

Read more about the EQN Project:

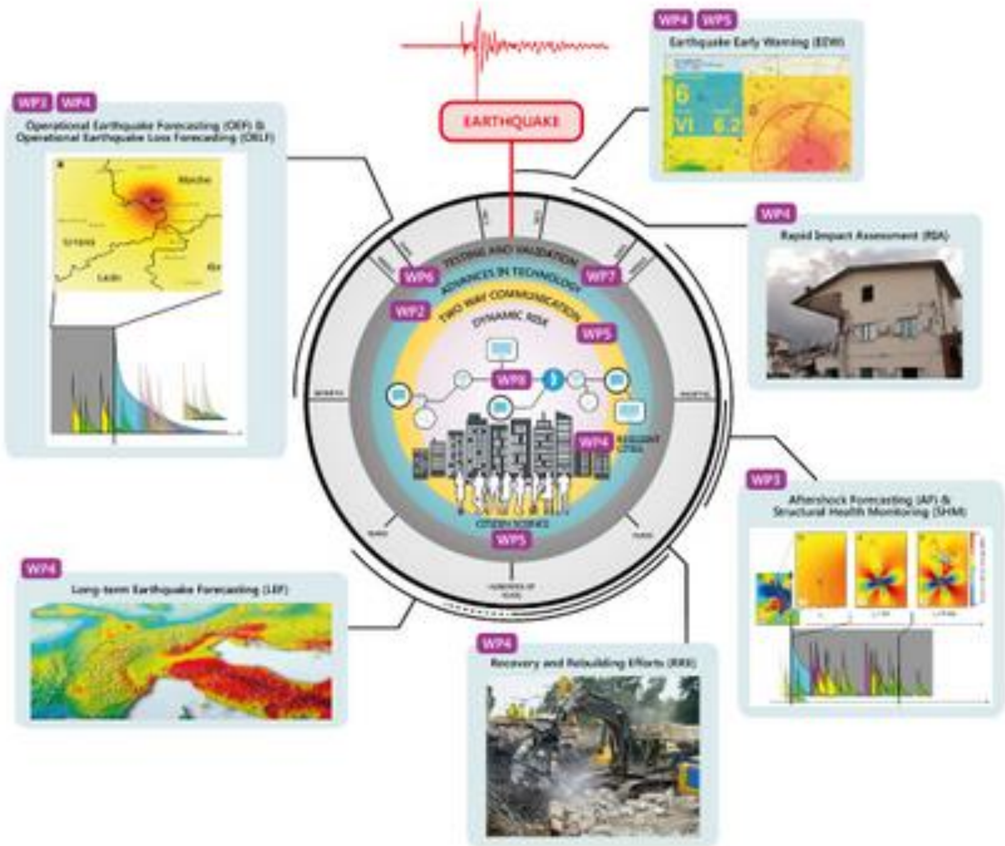
- *Bossu, R., Finazzi, F., Steed, R., Fallou, L., Bondár, I. (2021) "'Shaking in 5 Seconds!' Performance and User Appreciation Assessment of the Earthquake Network Smartphone-Based Public Earthquake Early Warning" System. Seismological Research Letters;* **https://doi.org/10.1785/0220210180**

- *Finazzi F. (2020) The Earthquake Network Project: A Platform for Earthquake Early Warning, Rapid Impact Assessment, and Search and Rescue. Front. Earth Sci. 8:243.* **doi: 10.3389/feart.2020.00243**

Smartphones that detected the magnitude 7 event near Acapulco, Mexico, on September 8th, 2021.

Pictures: © F. Finazzi

RISE terminology



The concept of "Long-term Earthquake Forecasting" (LEF)

Seismic hazard assessments describe how often and how strong the Earth shakes on average at a specific location within a certain period. It thus provides a time-independent and long term view on earthquakes, which is regularly updated, acknowledging the current state of the art in seismic hazard assessment and the most recent data. Seismic hazard considers the history of earthquakes, damage reports, wave propagation models, and present geological and tectonic conditions.

Seismic hazard assessments are needed to develop design codes and strengthen other means of disaster preparedness. Furthermore, earthquake hazard information is one of the prerequisites to defining earthquake risk, which describes the potential effects of ground motions on the built environment and consequential effects such as fatalities. RISE aims to develop tools and measures to reduce future human and economic losses caused by earthquakes. To this end, the project adopts an integrative, holistic view of risk reduction targeting the different stages of risk management. One key step of RISE will be to integrate the data of the latest European seismic hazard model (ESHM20) and the first seismic risk model for Europe for strengthening various aspects of risk management. These models will soon become available at **www.efehr.org**.

Discover **here** more about RISE's holistic concept of dynamic risk assessment!

Miscellaneous

Joint session of RISE and TURNkey at the European Seismological Commission (ESC) 2021

The co-chaired session "Towards operational forecasting of earthquakes and early warning capacity for more resilient societies" of RISE and **TURNkey** was held online on 21 September 2021. This session gave the opportunity to RISE and TURNkey projects that together involve 40 European institutions, to present and discuss first project results with the wider community. Both projects funded by Horizon 2020 are collaborating in various aspects and share common goals of improving real-time seismology, its communication and seismic risk reduction capacity.

More information about the conference available at the **ESC2021 website**!

All RISE publications at one glance

So far, RISE has released more than two dozen **research articles**, and

So far, RISE has released more than two dozen **research articles**, and another handful are currently under review. In the following, you can find an overview of this years' released publications.

Frontiers in Earth Science

- Iaccarino, A. G., Gueguen, P., Picozzi, M., Ghimire, S. (2021) Earthquake Early Warning System for Structural Drift Prediction using Machine Learning Repressors

Soil Dynamics and Earthquake Engineering

- Ghimire S., Guéguen P., Astorga A. (2021) Analysis of the efficiency of Intensity Measures from real earthquake data recorded in buildings

Seismological Research Letters

- Bossu, R., Finazzi, F., Steed, R., Fallou, L., Bondár, I. (2021) "'Shaking in 5 Seconds!' Performance and User Appreciation Assessment of the Earthquake Network Smartphone-Based Public Earthquake Early Warning" System.
- Chioccarelli, E. and Iervolino, I. (2021) Comparing Short-Term Seismic and COVID-19 Fatality Risks in Italy
- Gulia, L., Gasperini, P. (2021) Contamination of Frequency–Magnitude Slope (b-Value) by Quarry Blasts: An Example for Italy
- Mancini, S. Werner, M., Segou, M. & Baptie, B. (2021) Probabilistic Forecasting of Hydraulic Fracturing-Induced Seismicity Using an Injection-Rate Driven ETAS Model
- Mizrahi, L., Nandan, S., Wiemer, S. (2021) The Effect of Declustering on the Size Distribution of Mainshocks
- Taroni, M., Zhuang, J., Marzocchi, W. (2021) High-Definition Mapping of the Gutenberg–Richter. Value and Its Relevance: A Case Study in Italy
- Vannucci, G., Lolli, B., Gasperini, P. (2021) Inhomogeneity of Macroseismic Intensities in Italy and Consequences for Macroseismic Magnitude Estimation

Bulletin of Earthquake Engineering

- Crowley, H., Despotaki, V., Silva, V. et al. (2021) Model of seismic design lateral force levels for the existing reinforced concrete European building stock
- Dabbeek, J., Crowley, H., Silva, V. et al. (2021) Impact of exposure spatial resolution on seismic loss estimates in regional portfolios
- Skłodowska A.M., Holden C., Guéguen P., Finnegan J., Sidwell G. (2021) Structural change detection applying long-term seismic interferometry by deconvolution method to a modern civil engineering structure (New Zealand)

Bulletin of the Seismological Society of America

- Spassiani, I., Marzocchi, W. (2021) An Energy-Dependent Earthquake Moment–Frequency Distribution

International Journal of Disaster Risk Reduction

- Dallo, I., Marti, M. (2021) Why should I use a multi-hazard app? Assessing the public's information needs and app feature preferences in a participatory process

Sensors

- Guéguen P., Astorga A. (2021) The torsional response of civil engineering structures during earthquake from an observational point of view
- Guéguen P., Guattari F., Aubert C., Laudat T. (2021) Comparing direct observation of torsion with array-derived rotation in civil engineering structures

Would you like to know more about RISE publications? RISE has an **open access research repository**. We are also continuously updating our **website** and providing you with the latest RISE news!

Calendar

5 & 6 October 2021, Germany/hybrid
Second International Conference on Natural Hazards and Risks in a Changing World 2021
More information

27 September - 2 October 2021, Japan/hybrid
17WCEE: 17. World Conference on Earthquake Engineering
More information

The next external newsletter will be released in 2022. If you have anything you would like to share, please send your input to the communications team (nadja.valenzuela@sed.ethz.ch or michele.marti@sed.ethz.ch).

Liability claim
The European Commission is not responsible for any use that may be made of the information contained in this document. Also, responsibility for the information and views expressed in this document lies entirely with the author(s).

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2.4 Fourth external newsletter

Recently, the severe earthquakes in Türkiye and Syria have reminded us of how manifold the dynamics of the seismic risks are, and the ways to mitigate them. In RISE, we adopt an integrative, holistic view of risk mitigation, targeting the different stages of risk management. This includes improving short- and long-term forecasting and rapid impact assessments after earthquakes. In our last newsletters, we have already spotlighted many of these topics and what efforts the RISE community is making to contribute to them. If you want to browse through the past issues, they are all published **here**!

In this newsletter, you will learn about the latest findings concerning **Rapid Loss Assessments**: Helen Crowley tells more about ShakeMaps, and gives an insight into the European Shakemap Service. Other highlights in this issue:

- **Project overview**
  → RISE's rising numbers
- **RISE News**
  → Overview of all RISE news in 2022
- **A closer look**
  → European ShakeMaps and Rapid Loss Assessments
  → Reports on the earthquakes in Türkiye and Syria
- **Publication**
  → Last year's publications
- **Research**
  → Accuracy and precision of earthquake forecasts using the new generation catalogues

Stay tuned for more RISE news and publications, visit our website, and follow us on Twitter!

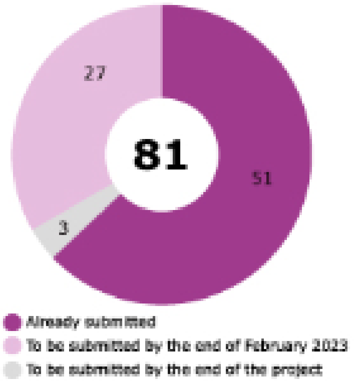
Twitter Website

Project overview

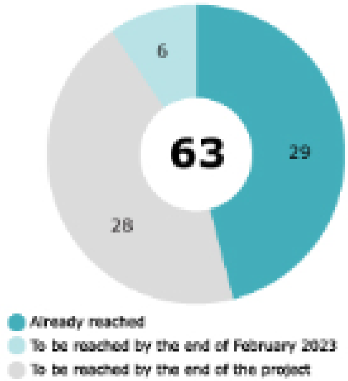
RIS(E)ing numbers

The journey of RISE will come to an end this year. So far, **RISE** has made progress in many ways, but there are still some steps to be taken before its end in May 2023. The next important date is the end of February when many deliverables are due, and milestones are achieved. Here is the status quo of some key indicators.

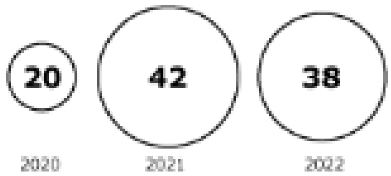
number of submitted **deliverables**



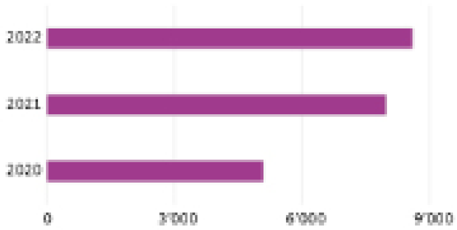
number of reached **milestones**



number of **publications** per year

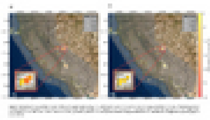


number of **website visitors** per year



RISE News in 2022

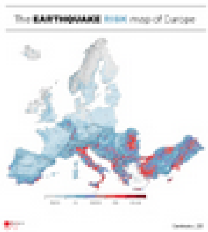
A lot was going on in 2022! We held RISE meetings in person again, conducted much research, and gained new insights. Here is an overview of the RISE **news** from 2022 in chronological order.



2022-03-08

Prospective evaluation of multiplicative hybrid earthquake forecasting models in California

A group of RISE scientists in collaboration with others prospectively evaluated the abilities of sixteen multiplicative hybrid and six "single" seismicity models to forecast M>5 earthquakes in California over the past decade. This prospective evaluation tested models developed before 2011 against earthquakes that have occurred since then. ➔ **Read more**



2022-04-28

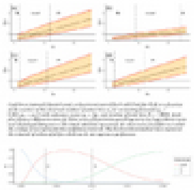
New earthquake assessments available to strengthen preparedness in Europe

In spring 2022, the update of the earthquake hazard model and the first earthquake risk model for Europe were released. These models are the basis for establishing mitigation measures and making communities more resilient. They significantly improve the understanding of where strong shaking is most likely to occur and what effects future earthquakes in Europe will have. The development of these models was a joint effort of seismologists, geologists, and engineers across Europe. ➔ **Read more**

2022-05-18

RISE Annual Meeting in Florence

The RISE annual meeting took place from 11-13 May in Italy. There were two and a half intense days in Florence with many presentations from the different work packages, discussion rounds, interactive sessions, and a poster fair. A magnitude 3.7 earthquake, which we all felt during the conference dinner, was an exciting experience in real-time! ➔ **Read more**



2022-06-30

Ranking earthquake forecasts using proper scoring rules: binary events in a low probability environment

A research group from the University of Edinburgh and the University of Bristol has published a new paper dealing with ranking earthquake forecasts by using proper scoring rules. Operational earthquake forecasting for risk management and communication during seismic sequences depends on our ability to select an optimal forecasting model. To do this, the researchers need to compare the performance of competing models in prospective experiments, and to rank their performance according to the outcome using a fair, reproducible, and reliable method. ➔ **Read more**

2022-07-26

How to fight earthquake misinformation?

Misinformation has always existed in the form of rumours, conspiracies or malicious gossip. Much has been learnt from the past on how to deal with misinformation. Nonetheless, new communication channels have amplified misinformation to a new level, allowing more people to share such information very easily and rapidly with an enormous audience. What can be done to fight earthquake misinformation and specifically to address the most common earthquake myths? ➔ **Read more**

2022-08-03

The Python pyCSEP toolkit for earthquake forecast developers

The RISE WP7 testing group and collaborators published a research article describing the Python package pyCSEP: a toolkit for earthquake forecast developers. PyCSEP provides open-source and community-based implementations of useful tools for evaluating probabilistic and simulation-based earthquake forecasts. It also includes earthquake catalogue access and filtering, evaluation methods and visualisation routines. ➔ **Read more**

2022-10-13

Earthquake early warning to handle dynamic risk

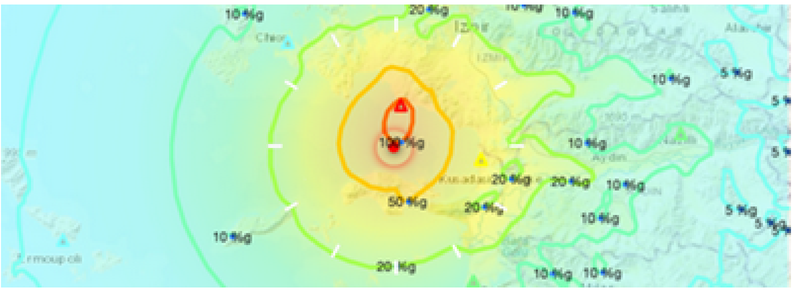
Early warning systems can support taking rapid protective action to minimize the harm to people, assets, and livelihoods. In RISE , earthquake early warning (EEW) is one of the most relevant concepts to handle dynamic risk to which earthquakes belong. To mark the International Day for Disaster Risk Reduction (IDDRR) 2022 with the focus on "Early warning and early action for all", we spotlighted one of RISE's research efforts dealing with EEW systems in more detail. ➔ **Read more**

2022-11-02

Co-producing knowledge – the RISE Early Career Scientist workshop

From October 26 to 28, early career scientists (ECS) and senior scientists of (not only) RISE explored four cross-disciplinary topics: open science, ethical implications, dynamic risk, and transdisciplinarity. To address the objectives of RISE, the workshop focused on "Bringing research to practical applications that increase society's earthquake resilience". → **Read more**

A closer look



European ShakeMaps and Rapid Loss Assessment (RLA)

Helen Crowley

Whilst it can often take days or even months for the true toll of an earthquake to be measured and reported, stakeholders such as early responders, governments, and the insurance industry all need to have an estimate of the potential magnitude of the losses much earlier than this, so that they can plan and better manage the recovery phase following the earthquake.

In the first few minutes following an earthquake, a simple qualitative assessment (e.g., no impact, minor impact, major impact) is often sufficient to understand the magnitude of the event. In the following hours, however, it becomes important to understand the impact in terms of quantitative losses (e.g., number of collapsed buildings, number of fatalities or homeless people, direct economic loss) and in the RISE Project this estimation is referred to as **Rapid Loss Assessment (RLA)**. This fast assessment of the impact of the earthquake provides first-order estimates of the losses which can be continually updated as more information and data arrive from the various remote sensors that record data from the event.

What are ShakeMaps?

ShakeMap provides an estimate of ground shaking in the area struck by an earthquake. An earthquake with a specific magnitude, location, and depth will produce a range of ground shaking levels at sites throughout the region depending on the distance from the earthquake, the local site conditions, and variations in the propagation of seismic waves from the earthquake, due to complexities in the structure of the Earth's crust. Ground shaking levels can be represented through macroseismic intensity, which is a description of the effect of the earthquake on people and structures, or through measured shaking parameters, such as the peak acceleration of the ground recorded by an accelerograph. Following an earthquake, data on the ground shaking from both observations of macroseismic intensity and recordings from seismic instruments are automatically processed and distributed via dedicated software and web services, without the need for any human intervention. These data are combined with empirical ground motion models (applied to the areas without any data), to produce maps of likely ground shaking.

European Shakemap Service

Within RISE, a **European ShakeMap service prototype** has been set up under the management and maintenance of both ETH Zurich and the National Institute for Geophysics and Volcanology in Italy (INGV). A number of web services produced by EMSC (the **European-Mediterranean Seismological Centre**) and ORFEUS (**Observatories and Research Facilities for European Seismology**) are used by the European ShakeMap system to automatically register when an earthquake above magnitude 4 occurs within Europe, and to receive any recorded strong motion data. The European ShakeMap system is fully consistent with the data and modelling protocols used in the national services for Italy and Switzerland, and there are plans to expand this harmonisation to other European countries. Future developments will include the inclusion of crowdsourced felt data, being collected by web services developed by EMSC, and which has been shown to correlate with macroseismic intensity.

EMSC's 'I felt an earthquake!' form for crowdsourcing felt data after an earthquake.

Exposure and vulnerability models can be combined with these ShakeMaps to rapidly assess the losses from earthquakes. In Europe, exposure and vulnerability models have been developed in both the Horizon 2020 **SERA project** and the RISE project, and made publicly available through the **risk services of EFEHR** (European Facilities for Earthquake Hazard and Risk). Within the RISE project a first version demonstrator of a European Rapid Earthquake Loss Assessment service has been developed that uses web services to automatically download ShakeMaps as soon as they have been published on the European ShakeMap system, retrieves the exposure models for the countries covered by the ShakeMap grid, and launches the scenario damage and risk calculations with the open source **OpenQuake-engine**.

➔ More information about European Rapid Earthquake Loss Assessment on the RISE website!

Special reports on the earthquakes in Türkiye and Syria

Various RISE members have been working on compiling background information on the events and collecting felt reports from people in these regions following the devastating earthquakes on the Turkish-Syrian border. Here is a small insight into some interesting and detailed special reports of RISE partners:

EMSC: Earthquake sequence in Turkey, 6 February 2023

- Earthquake details
- Co-seismic motion of the micro-plates (Anatolia and Arabia)
- Tide gauge observations
- Aftershock locations
- Maps of felt reports
- Epicenter location

Boğaziçi University | Kandilli Observatory and Earthquake Research Institute:
Department of Earthquake Engineering Strong Ground Motion and Building Damage Estimations Preliminary Report (v5)

- Intensity maps
- Intensity-based estimation of building damage distribution (regional scale)
- PGA, PGV, Sa(0.2s), Sa(1.0s) maps
- Spectral acceleration-displacement based estimation of building damage distribution
- Strong ground motion recordings

Swiss Seismological Service (SED) at ETH Zurich: **Classification of the 6 February 2023 earthquakes in Türkiye**

- Summary of the geological and tectonic conditions in the region of the Gaziantep earthquake
- Development of the aftershock sequence over time

Publications

RISE publications in 2022 at one glance

Openly available **research articles** and data build an important legacy of RISE. Therefore, can you find an overview of last years' released publications in the following. Certainly, there is also something that could interest you!

Frontiers in Earth Science

- Dryhurst, S., Mulder, F., Dallo, I., Kerr J.R., McBride S.K., Fallou, L., Becker J.S. (2022) **Fighting misinformation in seismology: Expert opinion on earthquake facts vs. fiction**

Seismological Research Letters

- Bossu, R., Finazzi, F., Steed, R., Fallou, L., Bondár, I. (2022) **"Shaking in 5 seconds!" Performance and user appreciation assessment of the earthquake network smartphone-based public earthquake early warning system**
- Fallou, L., Marti, M., Dallo, I., Corradini, M. (2022) **How to fight earthquake misinformation: a communication guide**
- Finazzi, F., Bondár, I., Bossu, R., Steed, R. (2022) **A Probabilistic Framework for Modeling the Detection Capability of Smartphone Networks in Earthquake Early Warning**
- Gulia, L., Gasperini, P., and Wiemer, S. (2022) **Comment on "High-Definition Mapping of the Gutenberg-Richter b-Value and Its Relevance: A Case Study in Italiy" by M. Taroni, J. Zhuang, and W. Marzocchi**
- Savran, W.H., Bayona, J.A., Iturrieta, P., Asim, K.M., Bao, H., Bayliss, K., Herrmann, M., Schorlemmer, D., Maechling, P.J. and Werner, M.J. (2022) **pyCSEP: a Python Toolkit for Eartquake Forecast Developers**

Bulletin of Earthquake Engineering

- Martakis, P., Reuland, Y., Imesch, M., et al. (2022) **Reducing uncertainty in seismic assessment of multiple masonry buildings based on monitored demolitions**
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Accuracy and precision of earthquake forecasts using the new generation catalogues

Simone Mancini, Margarita Segou, Max Werner, Tom Parsons, Greg Beroza, and Lauro Chiaraluce

Enhanced seismic catalogues represent a unique occasion to test whether we can increase aftershock predictability by feeding them into well-established short-term earthquake forecast models. In their recent **paper**, RISE modellers Simone Mancini, Margarita Segou, Max Werner, and co-authors performed a retrospective experiment to forecast the M3+ seismicity of the 2016-2017 Central Italy sequence. They took advantage of an exceptional suite of enhanced catalogues developed in the context of the NERC-NSFGEO funded project "**The Central Apennines Earthquake Cascade Under a New Microscope**", which also supported the present research. Employed datasets featured automated detections, re-evaluated magnitudes and improved hypocentral resolution by means of double-difference relocations (CAT4), as well as a machine-learning-derived catalogue of ~900,000 earthquakes (CAT5).

The group developed a set of standard Epidemic-Type Aftershock Sequence (ETAS) and state-of-art Coulomb Rate-and-State (CRS) models using catalogues featuring a bulk completeness lower by at least two magnitude units compared to the real-time catalogue. This made it possible to inform both types of forecasts considering seismic sources with minimum triggering magnitudes down to M1. Model performance was tracked by means of standard CSEP likelihood-based metrics such as the T-test and benchmarked against that of the same models when they learn from real-time data only.

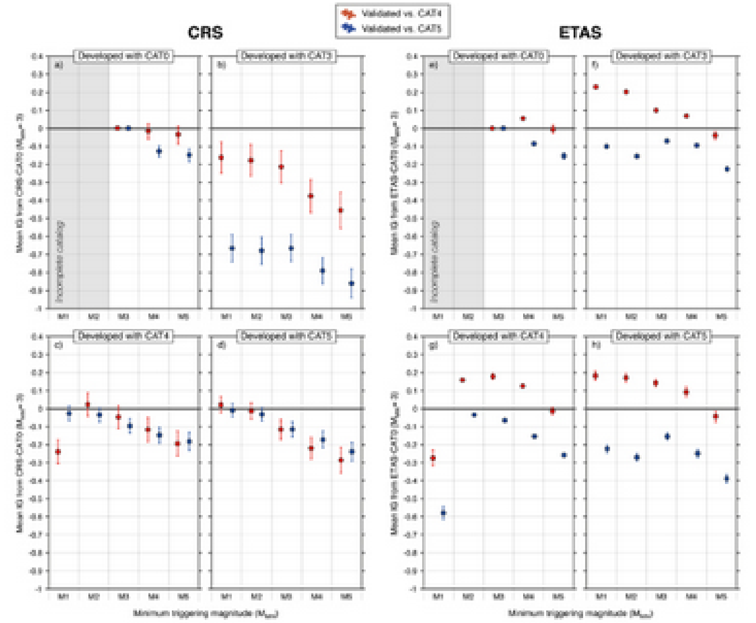

Figure 1: (a–d) Average daily information gain (IG) per earthquake from the CRS model informed by the real-time catalogue (CAT0) for a cumulative 3-month forecast horizon. Each of the CRS models developed with enhanced catalogs is presented in five versions implementing a different minimum triggering magnitude (MMIN) from M5 to M1. The MMIN values for CRS-CAT0 range from M5 to M3 due to the more limited completeness of the real-time catalog (gray shaded area). A model is deemed more informative than the reference if its mean IG is positive and if its error bars do not cross the IG=0 line. Red and blue symbols indicate models validated versus CAT4 and versus CAT5, respectively. Panels (e–h) same as the left panels but for the set of ETAS realizations.

Despite the impressive amount of additional information provided by the enhanced catalogues, this new set of models did not show statistically relevant improvements compared to the near real-time counterparts in terms of average daily information gain (Figure 1). Nonetheless, the incorporation of the triggering contributions from small magnitude detections of the enhanced catalogues (usually referred to as 'secondary triggering' effects) was clearly beneficial for both types of forecasts, at least until fault lengths typical of M~2 source events.

By means of targeted sensitivity tests, researchers clarified the reasons behind such results. First, it turned out that the typical spatial discretizations of forecast experiments (≥ 2 km) hamper the ability of models to capture the highly localized (i.e., sub-kilometric) secondary triggering patterns revealed by the new generation catalogues. Second, seismic catalogues resulting from different workflows present remarkable differences, such as magnitude inconsistencies or different location uncertainties, even at moderate magnitudes that might only be reflected in models by ad hoc parameter calibrations. Third, the current likelihood-based validation metrics revealed to be extremely susceptible to the choice of input (learning) and target (to be forecast) seismicity and to the extent and resolution of the grid used to evaluate models.

The results of these experiments are a first important step towards understanding how to improve the design of future earthquake forecast protocols, especially once these will exploit next-generation seismic catalogues in operational mode, as well as of the most appropriate methods to evaluate their skills.

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Miscellaneous

Congratulations, Ian Main!

Prof. Ian Main from the University of Edinburgh and work package 2 leader in RISE has recently been elected as a member of the Academia Europaea, the Pan-European Academy of Sciences, Humanities and Letters. The **Academia Europaea** aims to advance and propagate excellence in scholarship in the humanities, law, the economic, social, and political sciences, mathematics, medicine, and all branches of natural and technological sciences anywhere in the world for the public benefit and for the advancement of the education of the public of all ages.

Furthermore, the Academy's goals are to promote European research, advise governments and international organisations in scientific matters, and further interdisciplinary and international research. We congratulate Ian on his membership!

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Lugano (Switzerland)

17-20 April 2023
Seismological Society America Annual Meeting
San Juan (Puerto Rico)
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23–28 April 2023
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