Supplement of "Developing, testing, and communicating earthquake forecasts: current practices and an elicitation of expert recommendations"

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Supplement of

Developing, testing, and communicating earthquake forecasts: current practices and an elicitation of expert recommendations

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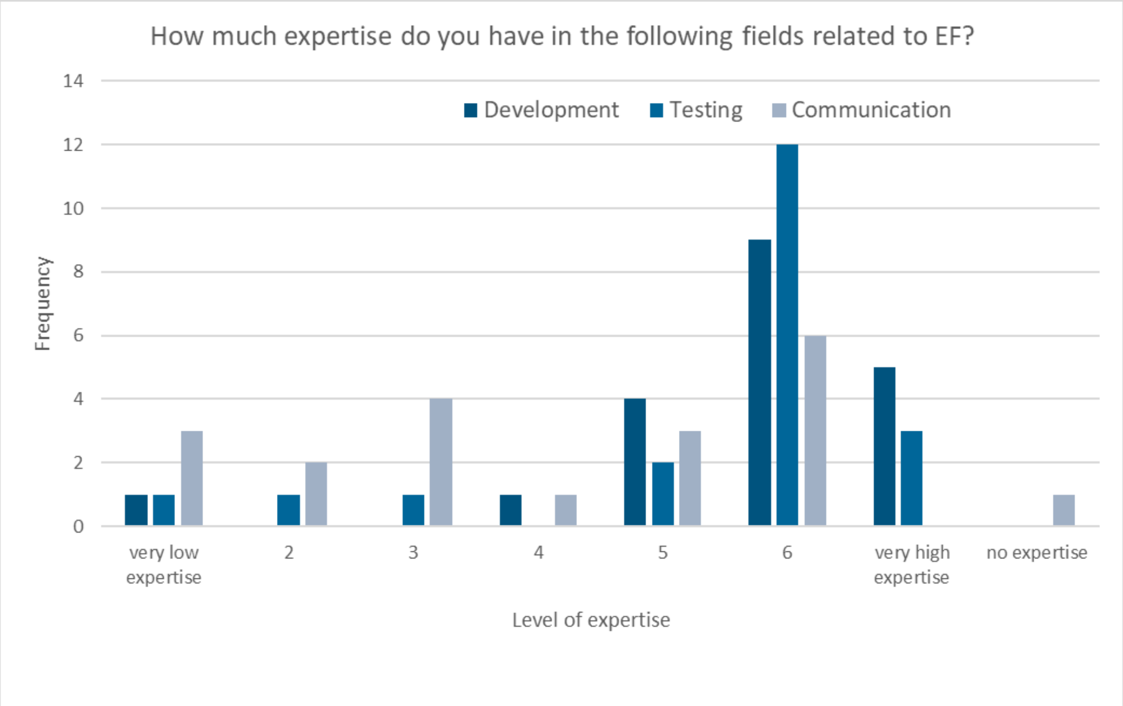
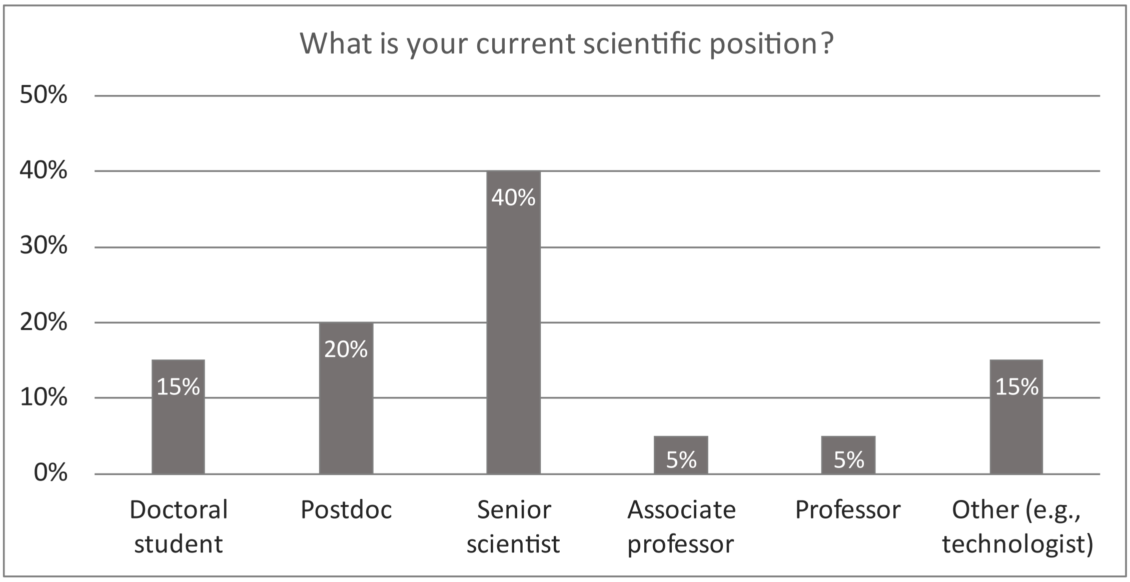
Supplement A: Delphi Study – Survey Round 1

In total, 20 experts filled in the first round of the survey. The mean age was 45.9 years (SD=13.0), and 70% were male and 30% female.

A1 – Background participants: Expertise



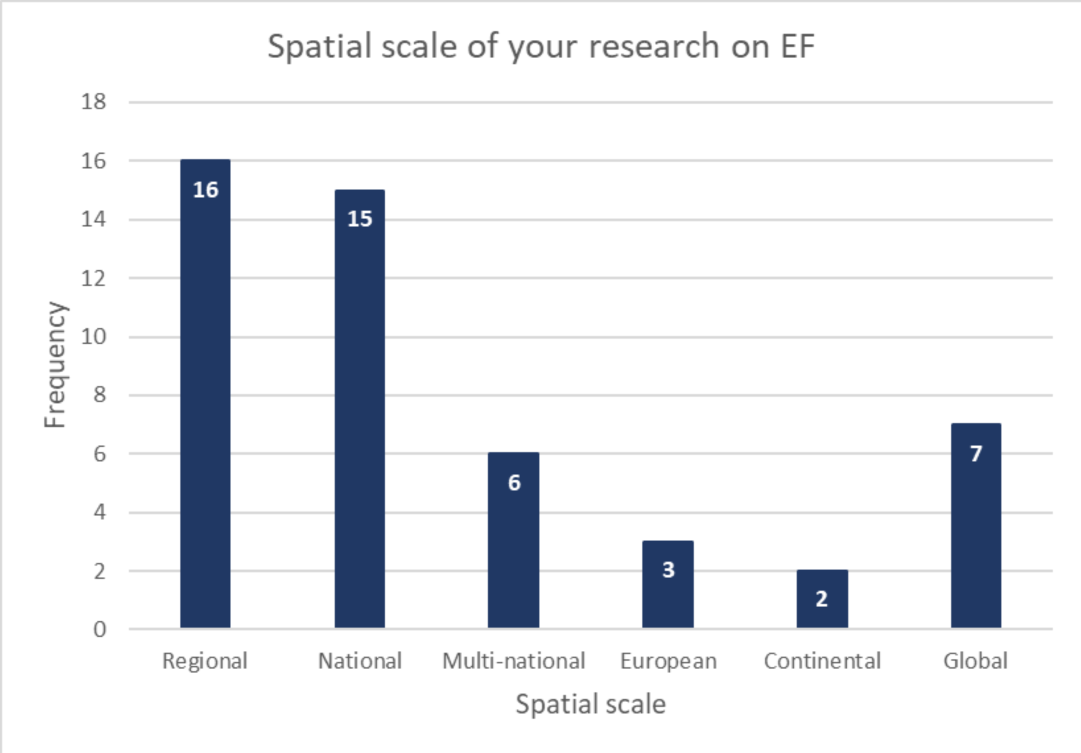
A2 – Background participants: Work position



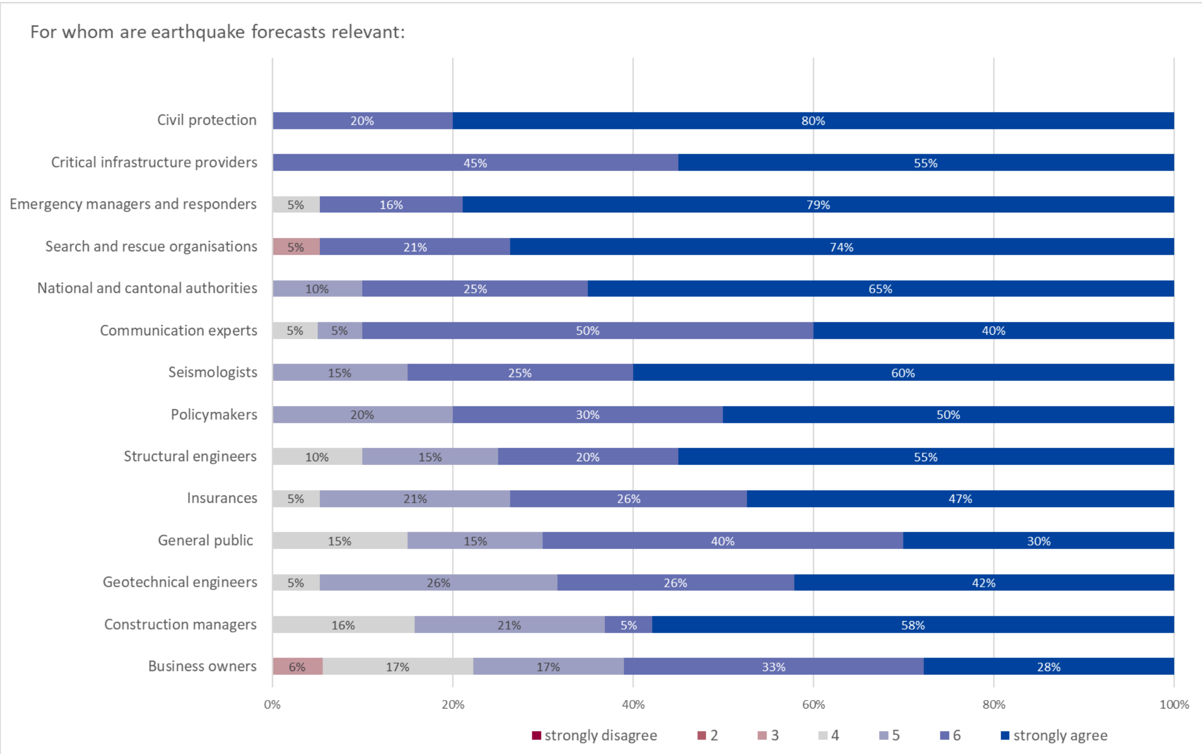
Years of experience:

- 15%: 1-5 years
- 35%: 6-10 years
- 25%: 11-20 years
- 25%: >20 years

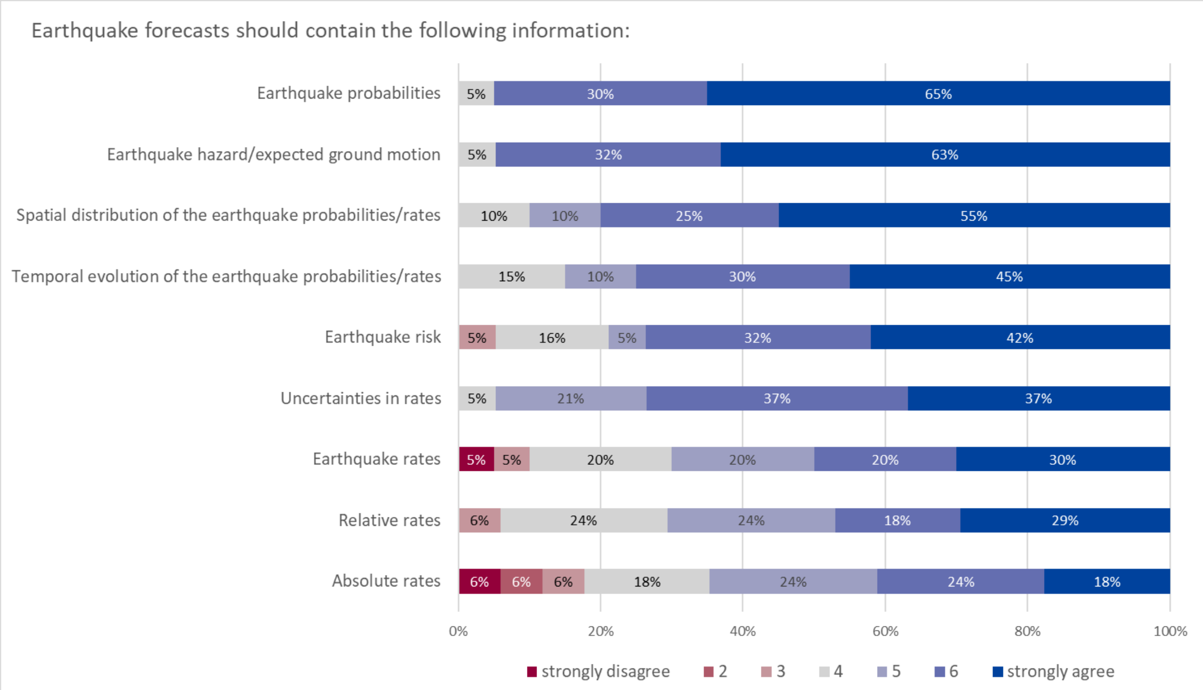
A3 – Background participants: Spatial scale of research



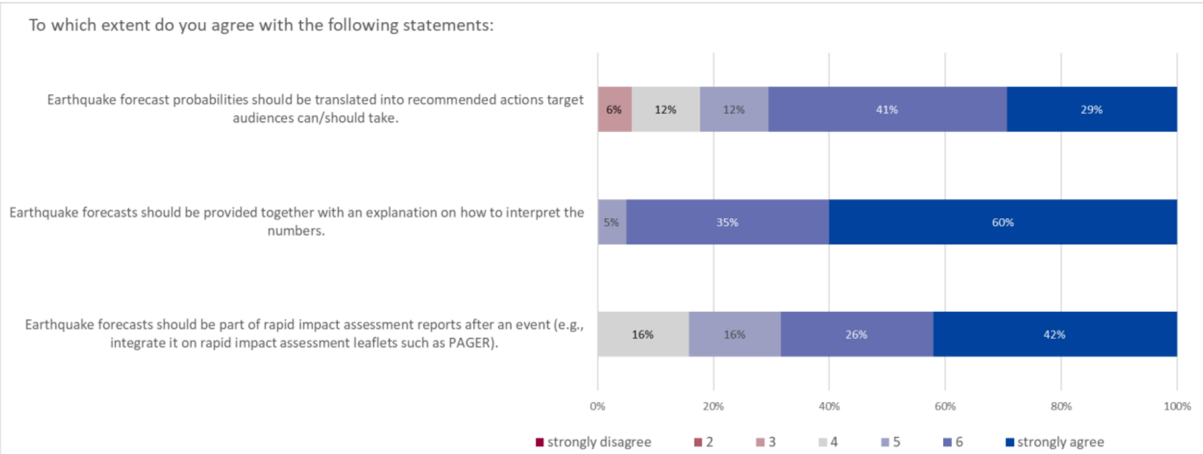
A4 – Communication: Target audiences



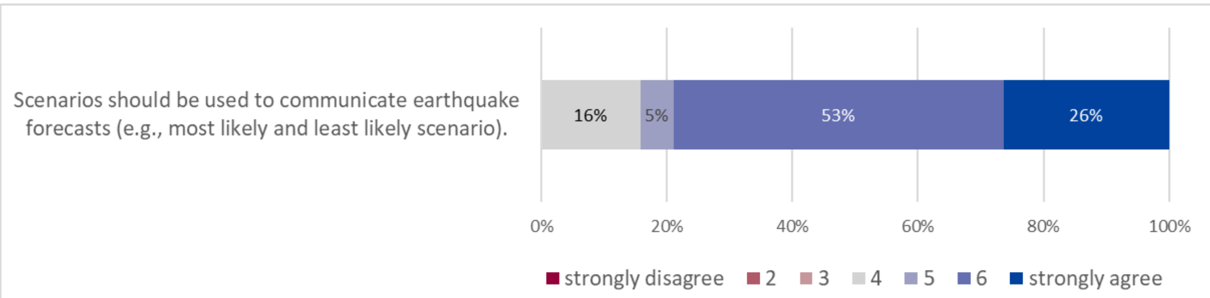
A5 – Communication: Information content



A6 – Communication: General statements



A7 – Communication: Scenarios



How many and for which probabilities should one develop scenarios?

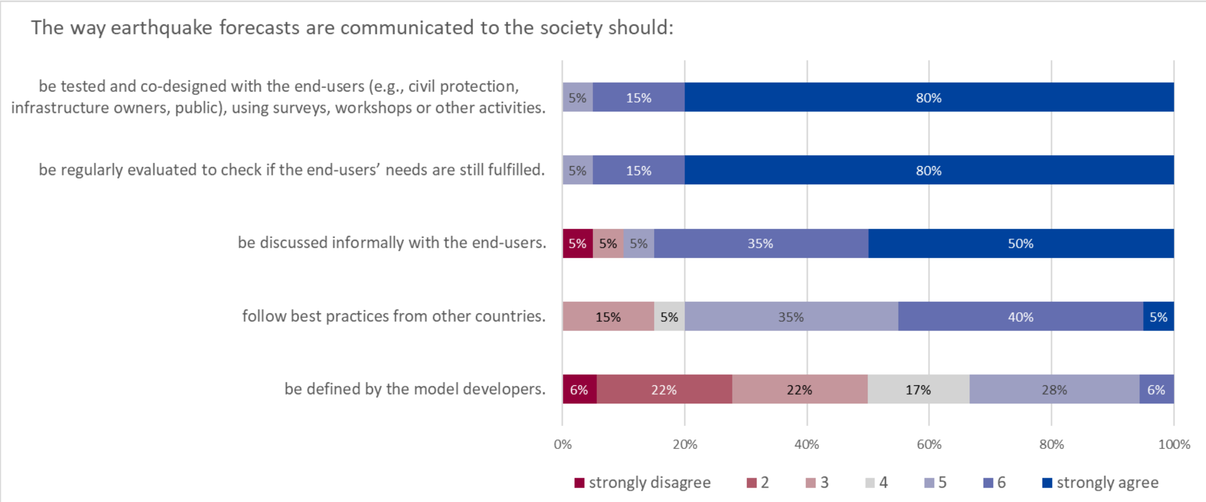
- **Good practice**: The three scenarios scheme used by NZ and US works well for aftershocks:
  - 1 - high probability sequence decays
  - 2 - medium probability of similar level of shaking
  - 3 - low probability high-impact scenario.

- Suggested option:
  - Probability of a stronger or similar magnitude aftershock **within the next day, week, month**
  - Probability of another event above an agreed magnitude that would be considered significant in the area (historical context)
  - (Optional) Probability of no more 'significant' events

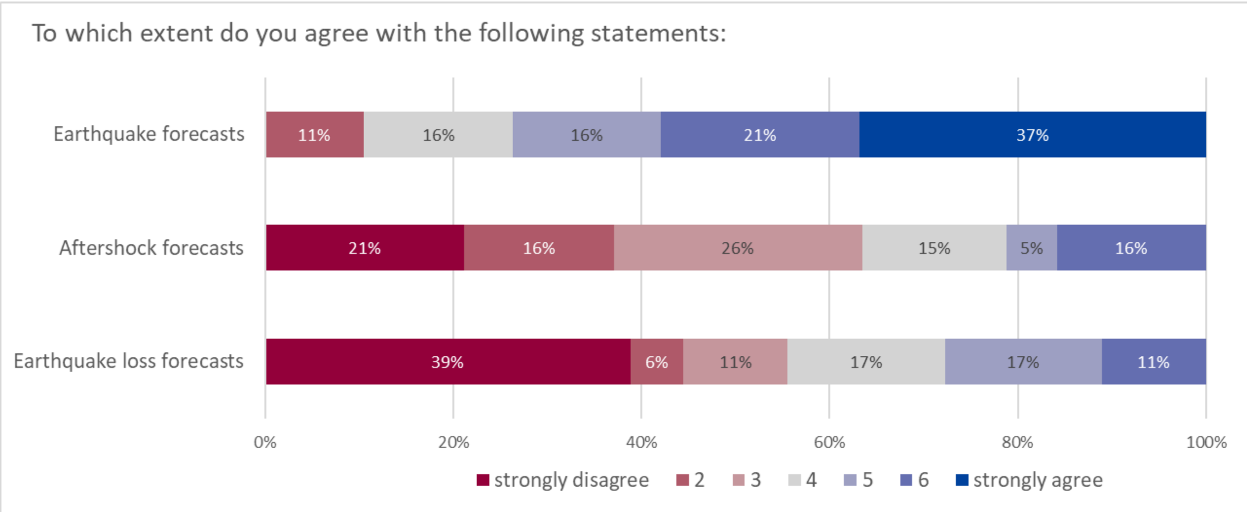
- **Time frame should change** with time since the mainshock: One week at first, then one month after a month.
- The scenarios **should be based on impact of the possible outcomes**.
- **Consistent template** for scenarios

- I think this **should depend on user needs**, rather than expert opinions.
  - People are most interested in a worst case (e.g., larger or more damaging aftershock)
  - Emergency managers interested in what could happen in the next month
  - Decision-makers want scenario impacts described

A8 – Communication: Testing



A9 – Communication: What should be communicated?



A10 – Communication: Magnitude threshold

Magnitude threshold for earthquake forecasts regularly published

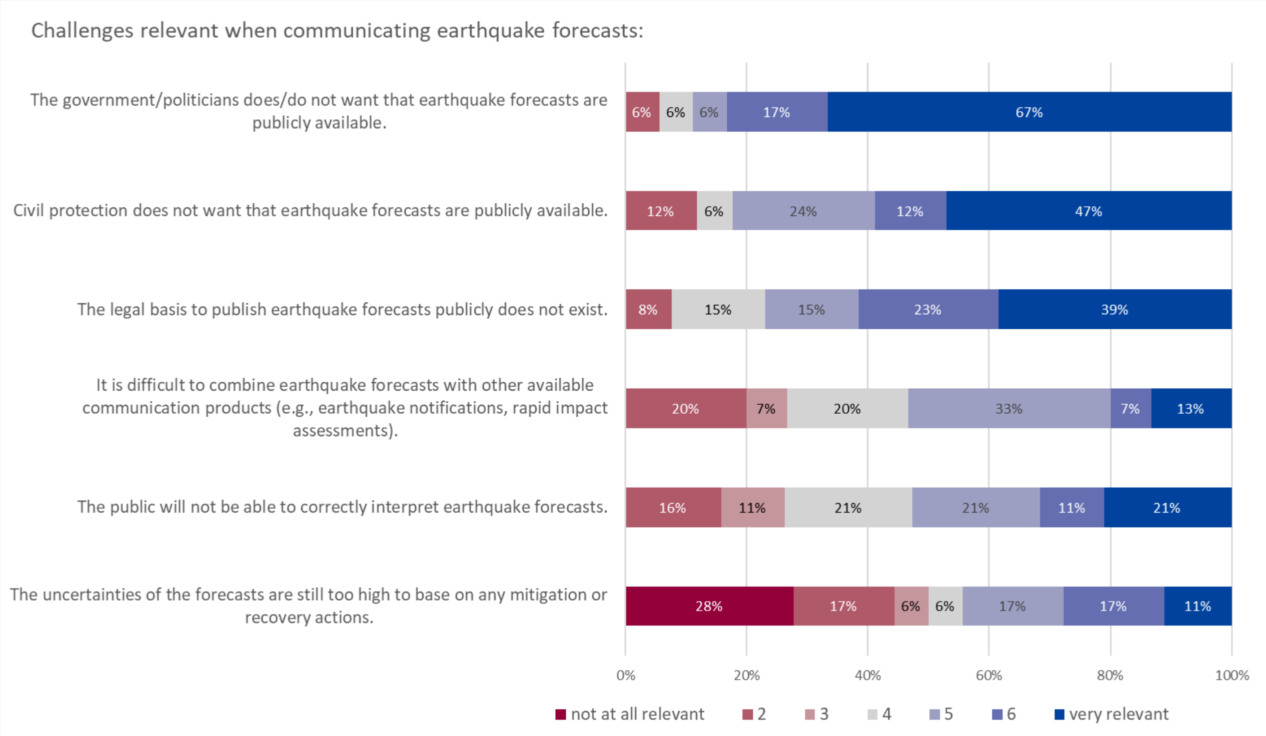
- M2.5 or M3 and above (5x) → felt earthquakes
- M3 or M3.5
- M4 and above (6x)
- M5 and above (5x) → damaging earthquakes
- Multiple forecasts: 4.0+, 5.0+, 6.0+ (to satisfy diverse target audience, and imply the stark probability difference between various thresholds)
- *"When talking to user groups, we have found that users generally want a forecast of ground shaking, so a ground motion threshold might be better. A ground shaking forecast is better than a loss forecast, because technical users (e.g. utility operators) can do a much better job of calculating their losses due to a given level of ground shaking than we can."*
- Depends on…
  - Seismicity in the region
  - Public awareness and past experiences
  - Building structure and vulnerability
  - Damage the earthquake caused

A11 – Communication: Aftershock magnitude threshold

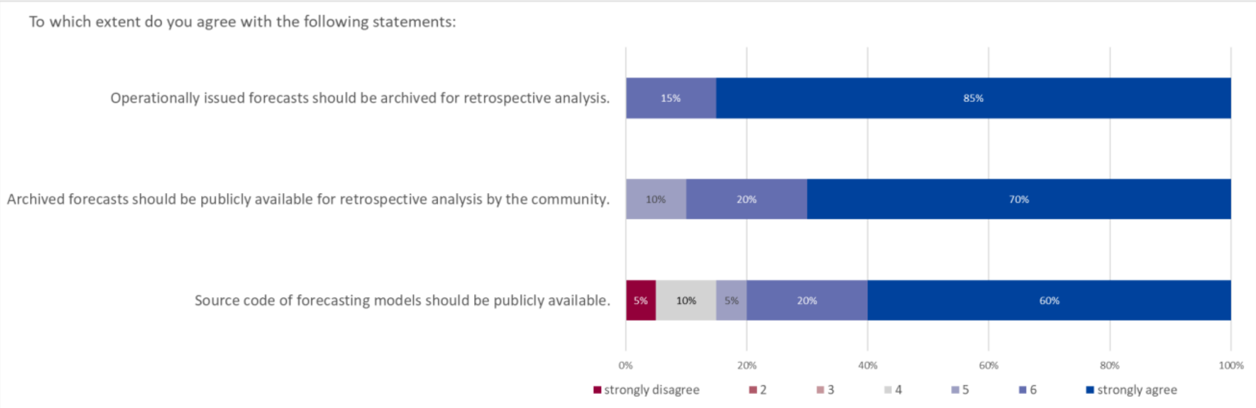
If only communicated after certain events, from which magnitude on should aftershock forecasts be disseminated and why?

- Felt events
- M4.0
- M4.5 or M5 (3x)
- M5+, as those are the most
  - M5 is a nice level for automatic/triggered forecasts, since you expect aftershocks of around M4, and these will be felt. Also will not overwhelm a system with small events
  - Increase public awareness
- M6+
- Earthquakes considered as damaging earthquakes in the specific region (3x)
- I would disseminate aftershock forecasts when observing a significative increase of the occurrence probability.
- Depends …
  - on the area
  - on the background seismicity
  - what data are reliably available
  - losses/damage

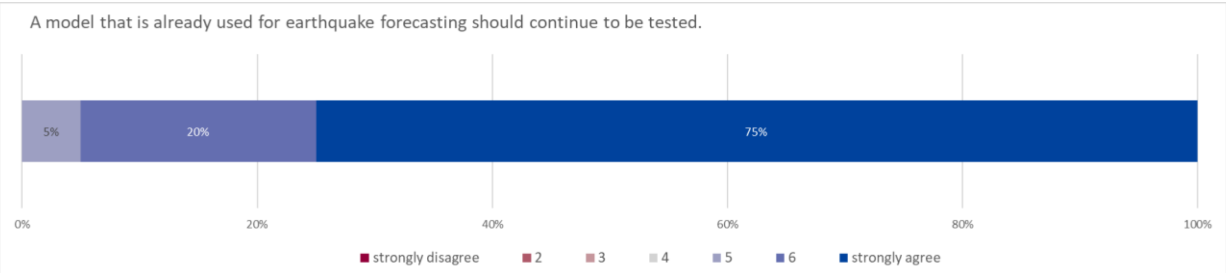
A12 – Communication: Challenges



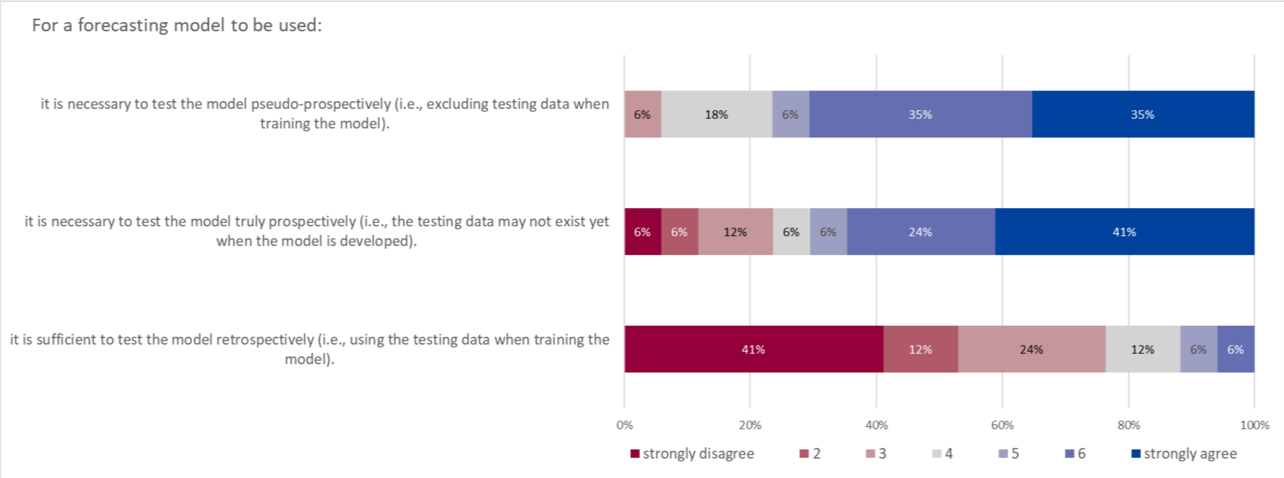
A13 – Model testing: General statements



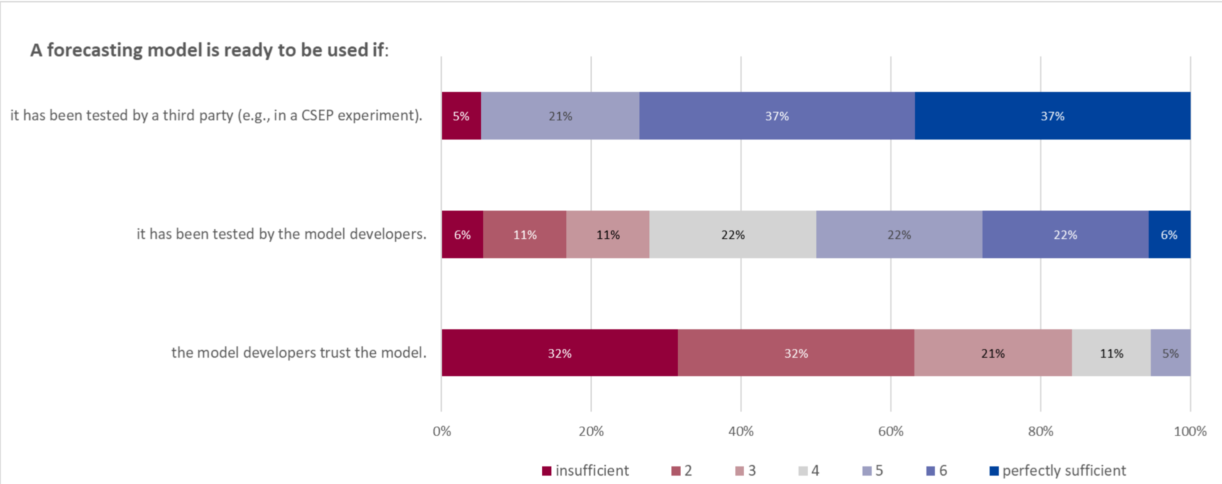
A14 – Model testing: Frequency of testing



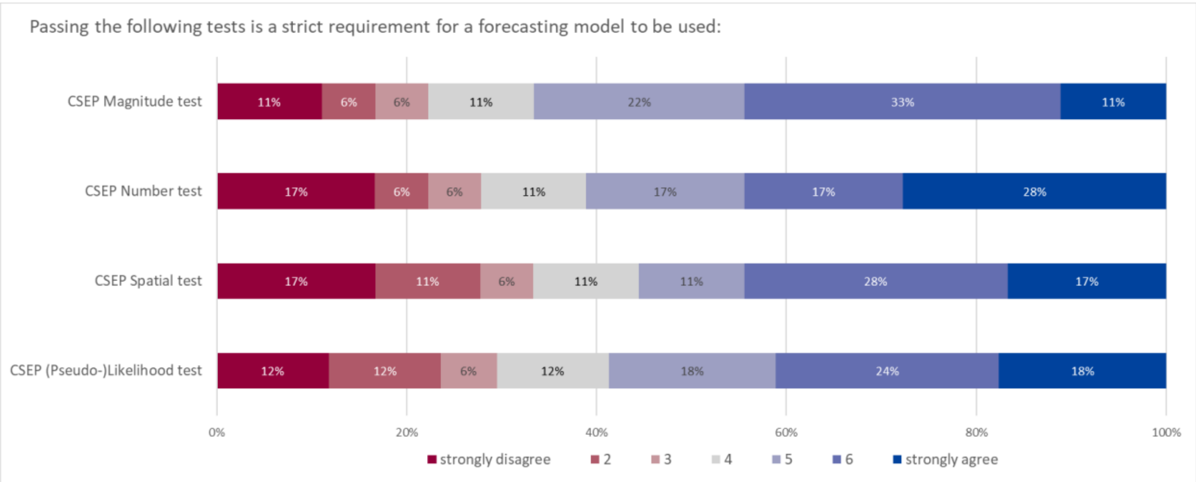
A15 – Model testing: Testing procedure



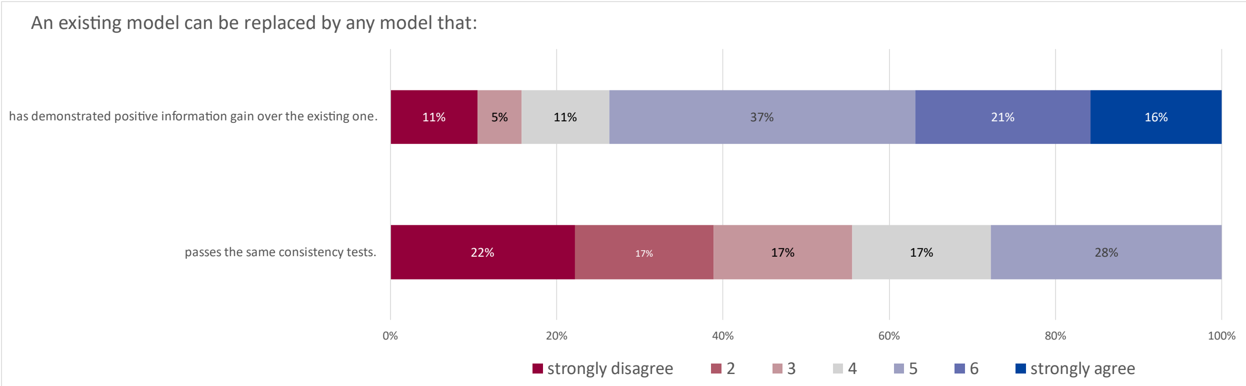
A16 – Model testing: Ready for use



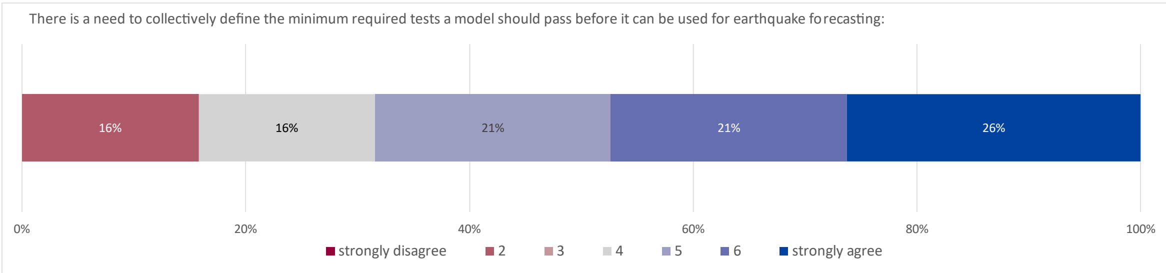
A17 – Model testing: Required test



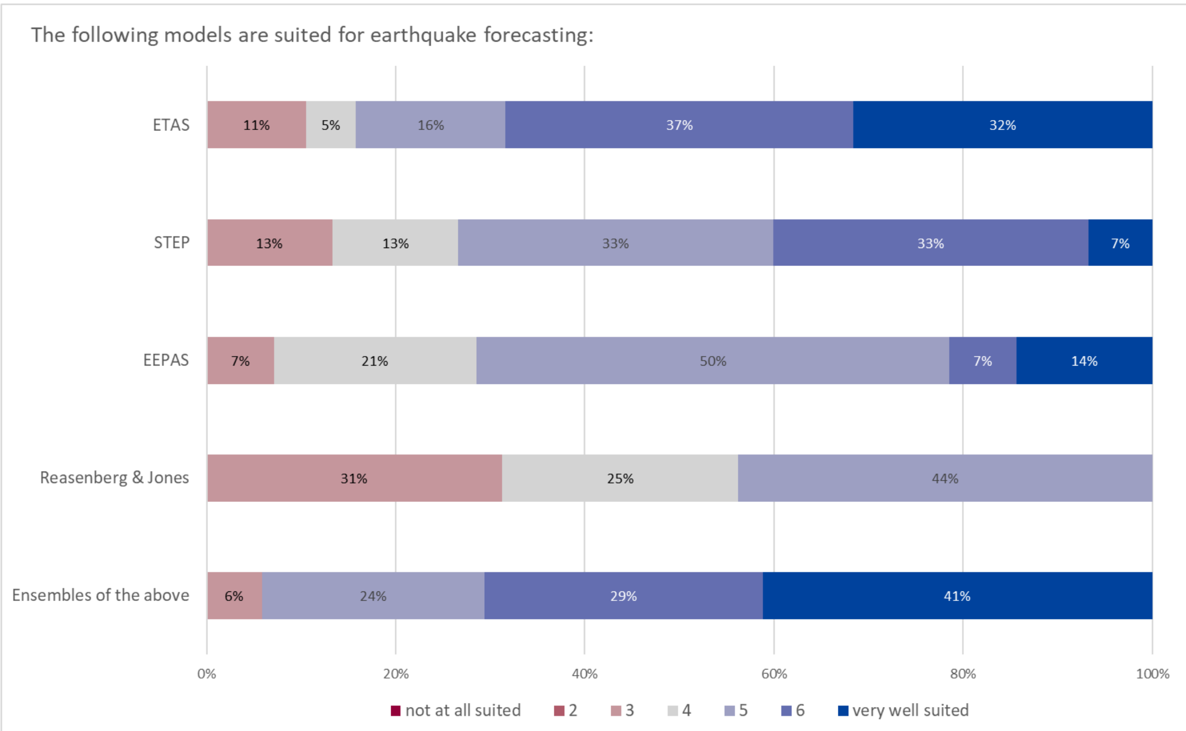
A18 – Model testing: Replacing a model



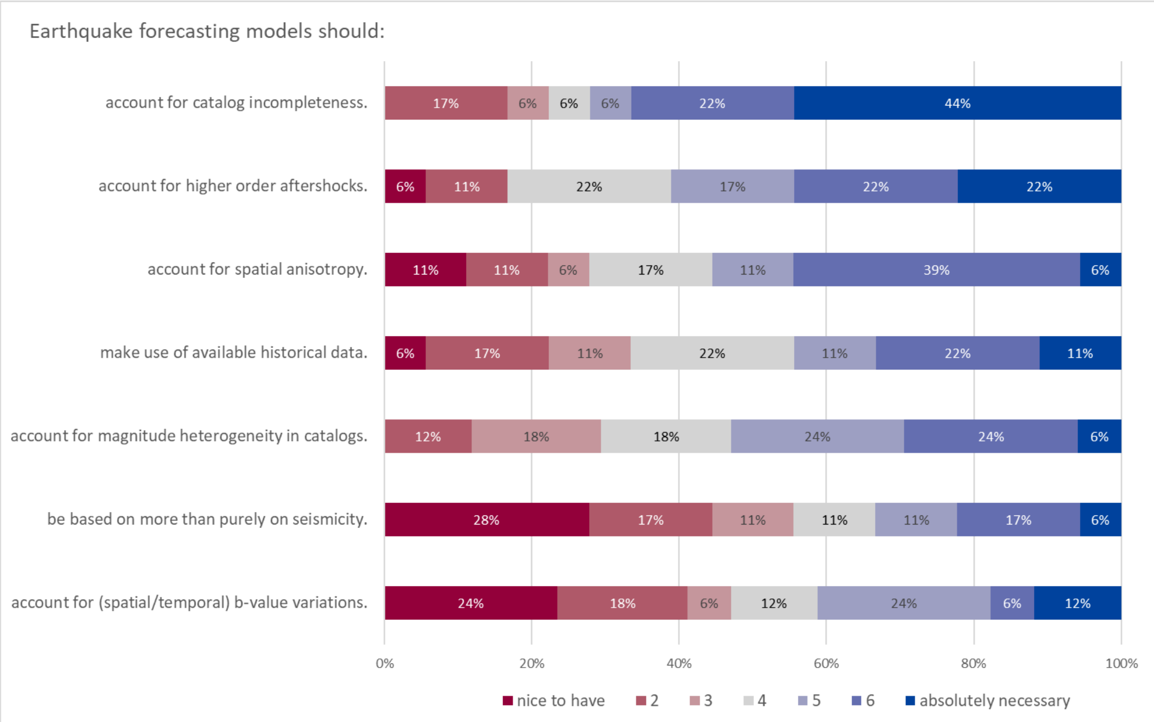
A19 – Model testing: Minimum required tests



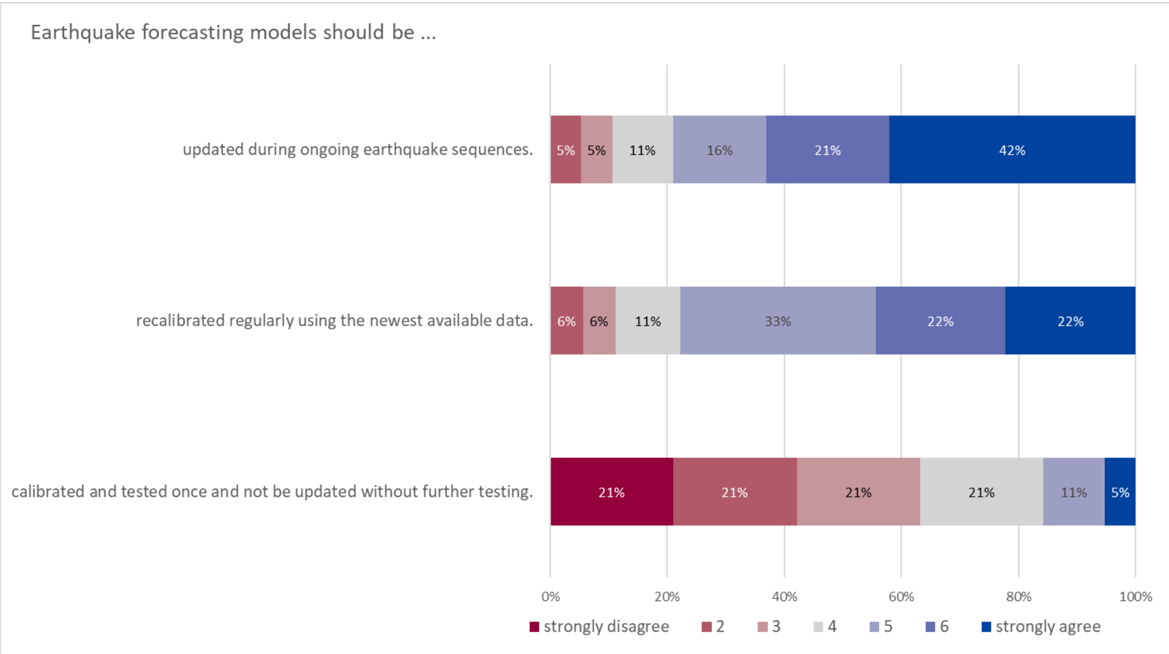
A20 – Model development: Suited models



A21 – Model development: Issue to consider



A22 – Model development: Updating and recalibration

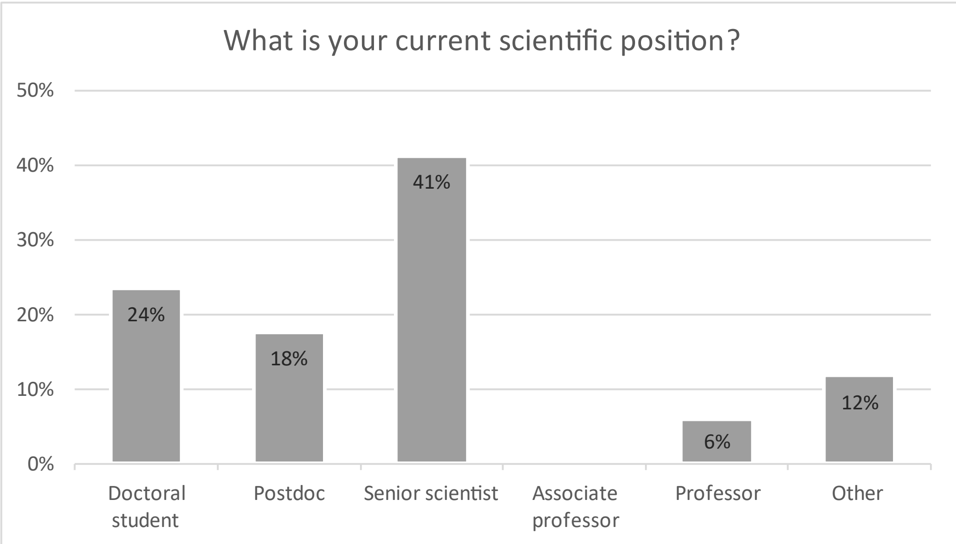


Supplement B: Delphi Study – Survey Round 2

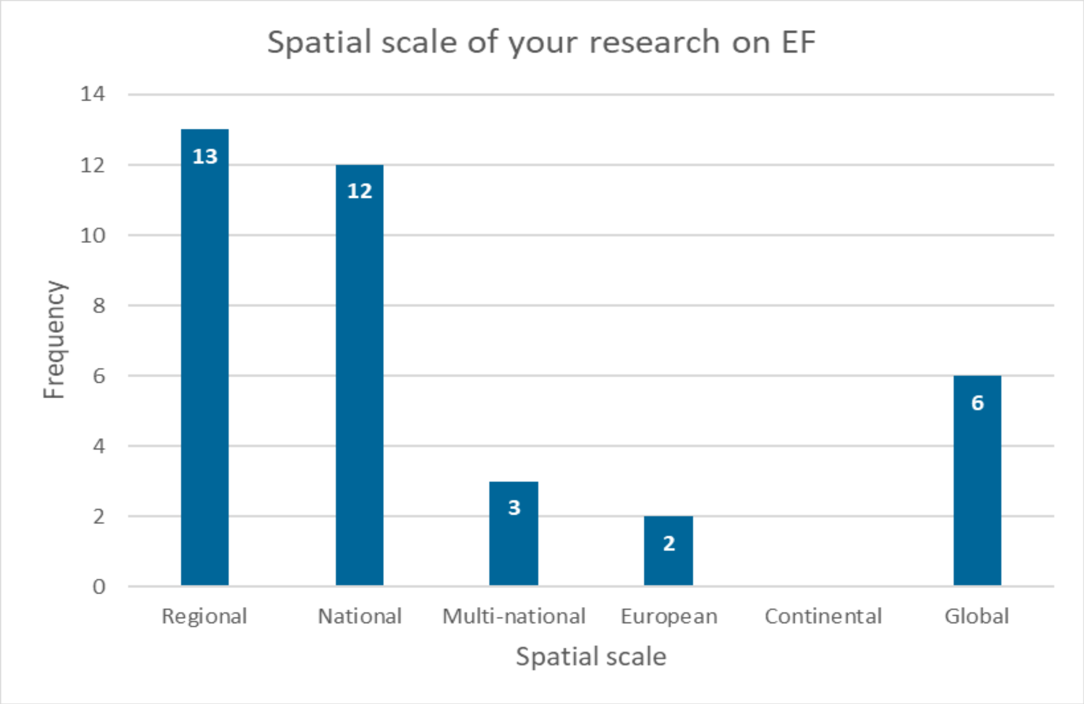
In total, 17 experts filled in the second round of the survey. The mean age was 44.7 years (SD=15.1), and 70.6% were male and 29.4% female.

B1 – Background participants: Expertise

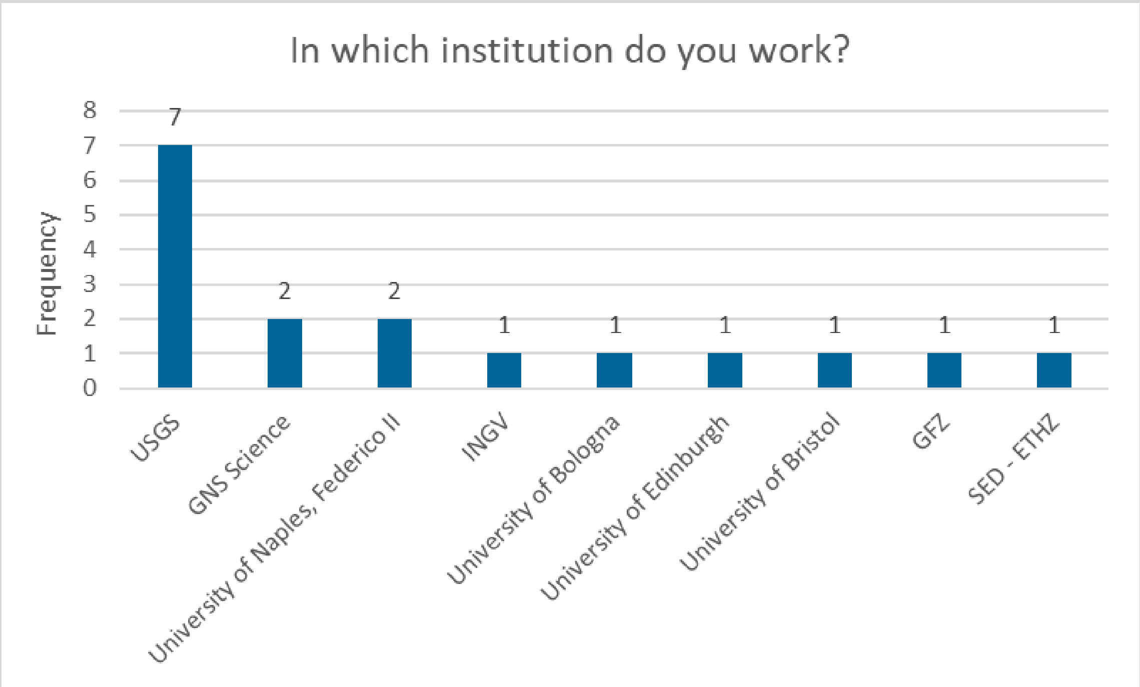
B2 – Background participants: Work position



B3 – Background participants: Spatial scale of research



B4 – Background participants: Institution

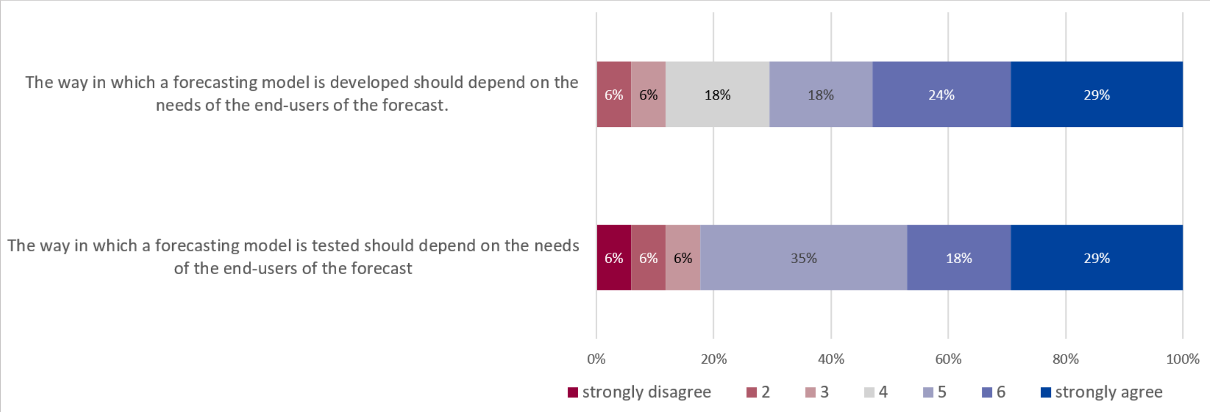


Years of expertise working on EF

- 1-5 years: 2 participants
- 6-10 years: 8 participants
- 11-20 years: 4 participants
- > 20 years: 2 participants

B5 – Interdependencies: Role of the end-users

There is no consensus but a tendency towards an agreement that the development (M=5.4; SD=1.5) and testing (M=5.2; SD=1.8) of earthquake forecasting models should depend on the end-users' needs.



B6 – Interdependencies: Relevance of certain pieces of information for different end-users

In yellow highlighted are the information that more than 70% of the participants agreed to be relevant for the various end-users.

For the following user groups the following pieces of information are important [in percentage]:

	General public	Civil protection	Critical infrastructure providers	Emergency responders	Decision makers	Duty seismologist	Insurance companies
Earthquake probabilities	82.4	94.1	100	82.4	94.1	94.1	100
Absolute earthquake rates	71.6	88.2	82.4	82.4	82.4	88.2	88.2
Relative earthquake rates (relative to a normal day)	58.8	52.9	47.1	47.1	64.7	64.7	82.4
Uncertainties in probabilities/rates	58.8	64.7	88.2	64.7	82.4	94.1	100
Spatial distribution of the earthquake probabilities/rates	94.1	100	100	88.2	100	88.2	94.1
Temporal evolution of the earthquake probabilities/rates	88.2	100	100	94.1	100	94.1	100
Earthquake hazard/expected ground motion	82.4	100	100	88.2	94.1	64.7	82.4
Uncertainties in earthquake hazard/expected ground motion	58.8	88.2	94.1	58.8	88.2	64.7	88.2
Earthquake risk	70.6	94.1	82.4	64.7	100	52.9	100
Uncertainties in earthquake risk	47.1	76.5	76.5	52.9	88.2	52.9	94.1

B7 – Interdependencies: Relevance of certain pieces of information when developing forecasting models

In yellow highlighted is the information that more than 70% of the participants agreed to be relevant for the various end-users when developing forecasting models. In purple highlighted is the information that more than 70% agreed to be not relevant for the different end-user groups.

When developing a forecasting model for the following user groups [y-axis], the following pieces of information [x-axis] are important [in percentage]:

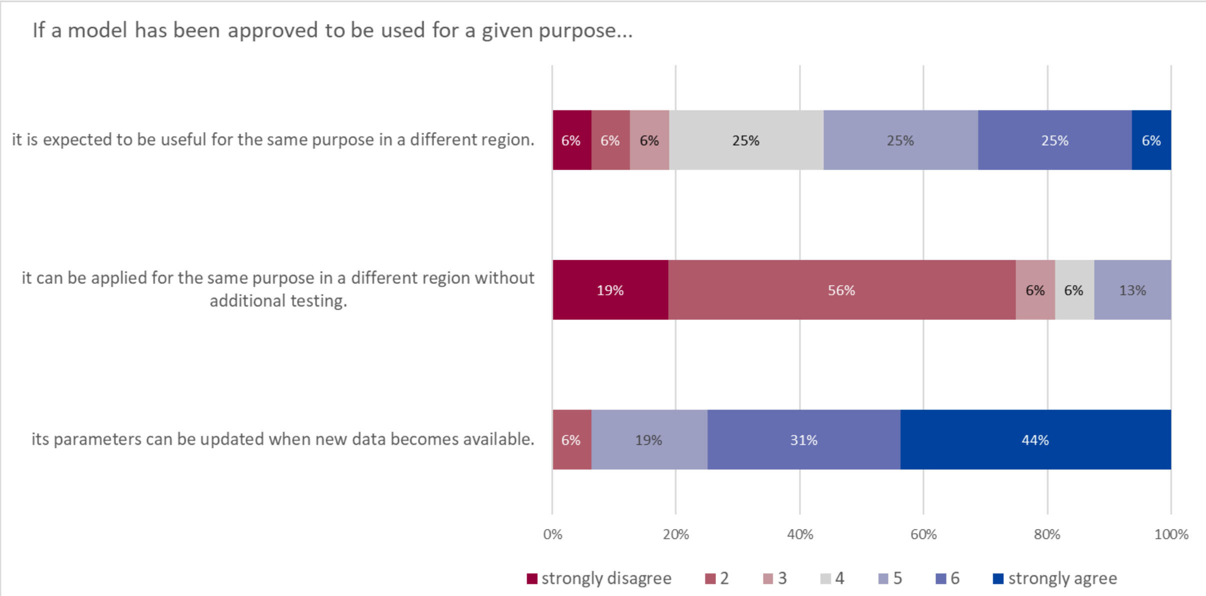
	General public	Civil protection	Critical infrastructure providers	Emergency responders	Decision makers	Duty seismologist	Insurance companies
Catalog incompleteness	58.8	58.8	58.8	58.8	64.7	94.1	70.6
Magnitude heterogeneity in catalogs	35.3	41.2	41.2	35.3	41.2	76.5	47.1
Higher order aftershocks	70.6	82.4	70.6	82.4	82.4	76.5	82.4
Available historical data	52.9	52.9	58.8	47.1	58.8	70.6	58.8
More than just seismicity	35.3	47.1	52.9	47.1	58.8	58.8	47.1
Spatial anisotropy	35.3	47.1	47.1	41.2	47.1	76.5	58.8
(Spatial/temporal) b-value variations	17.6	23.5	23.5	17.6	29.4	58.8	29.4
Uncertainty of model parameters	35.3	35.3	52.9	35.3	47.1	76.5	52.9
Geodesy	23.5	29.4	29.4	23.5	29.4	52.9	29.4
Faults	58.8	58.8	70.6	52.9	58.8	76.5	52.9

B8 – Model development: Choice of ONE simple base model

14 participants chose ETAS model, one participants the smoothed seismicity model, and two participants indicated that they do not know. Thus, 82.4% agree that the ETAS model is most useful for a maximum number of end-users. The other models – Reasenberg & Jones, EEPAS, STEP, machine learning based models, mixed point process, coulomb/rate-and-state – were chosen by no one.

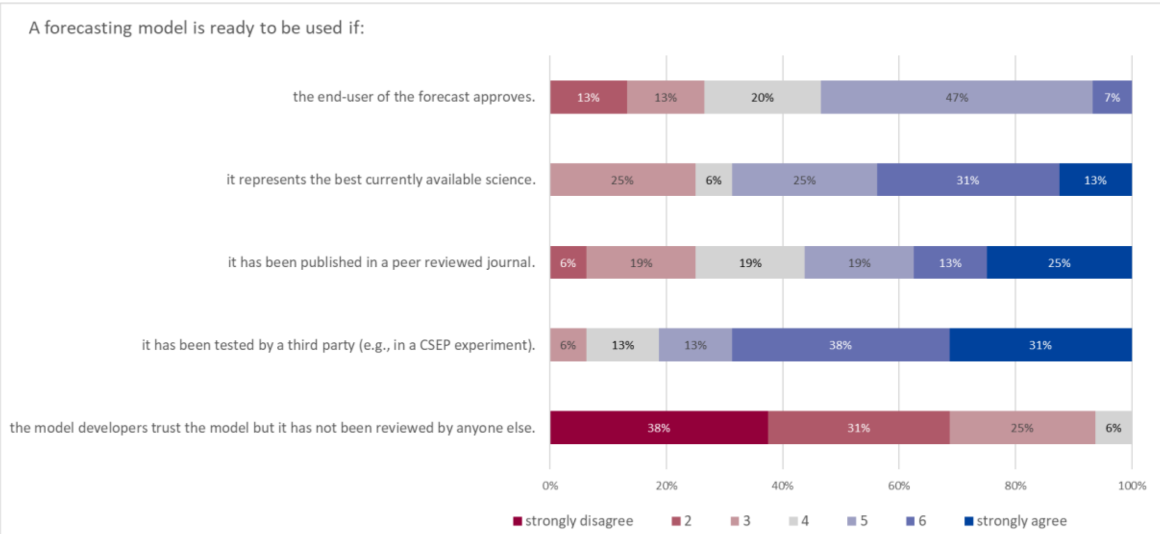
B9 – Model development: General statements

Participants agree that, if a model has been approved to be used for a given purpose, the parameters can be updated when new data becomes available (75%). They also agree that additional testing is needed if a model will be applied in a different region (75%).

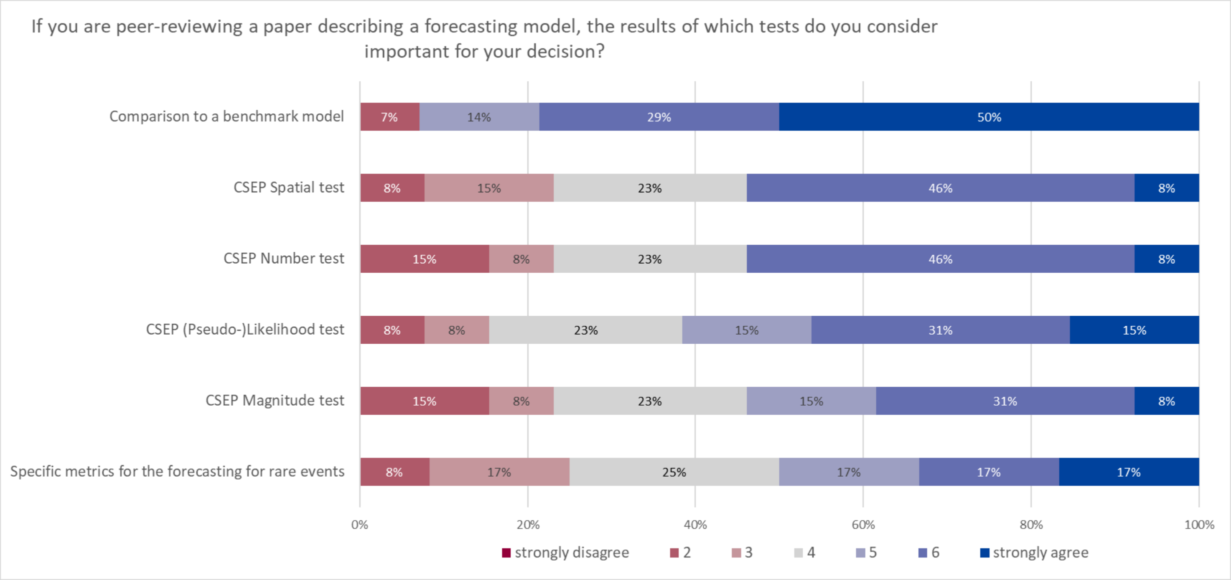


B10 – Model testing: Ready to be used

Participants agree that a forecasting model is ready to be used if it has been tested by a third party (~70%), and not if only the developer trusts the model without anyone else reviewing it (~70%). They are undecided whether it depends on the approval by the end-users (80%). There is dissent about whether it is enough that the model has been published in a peer-reviewed paper or represent the best currently available science.

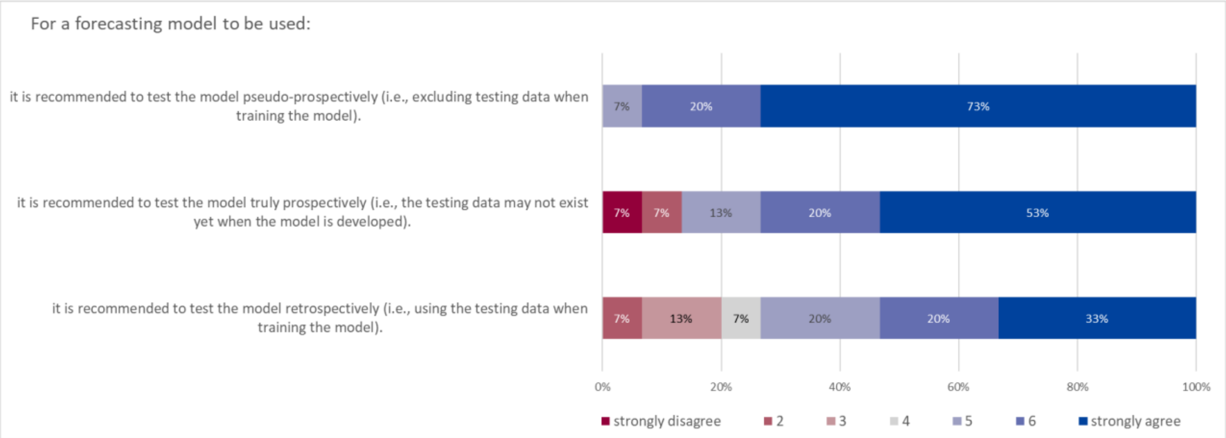


B11: Model testing: Peer-reviewing

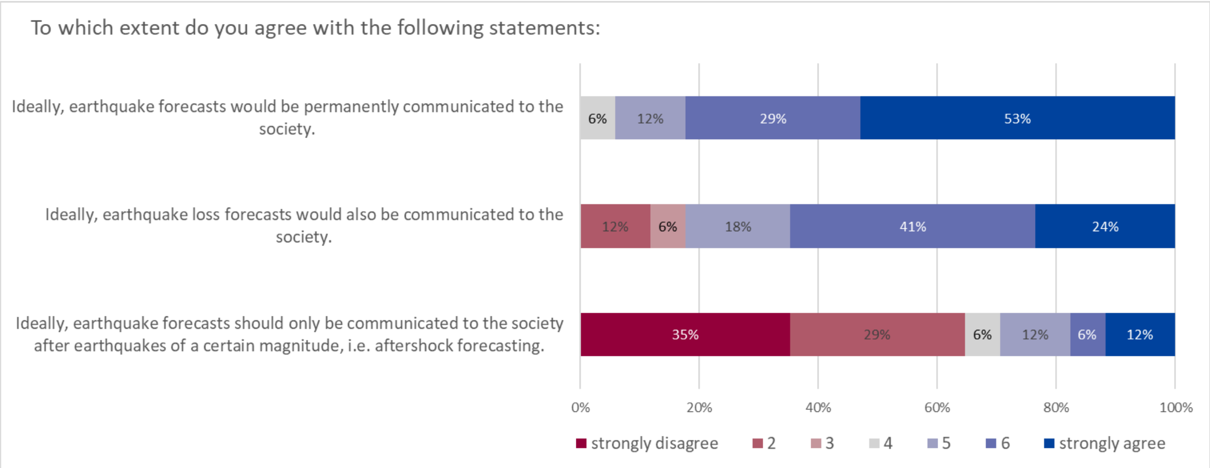


B12: Model testing: Recommendations for the use

Experts agree that it is recommended to test the model pseudo-prospectively (93%) and truly prospectively (73%). But there is only a tendency towards an agreement that it is recommended to test the model retrospectively.



B13: Communication: What should be communicated

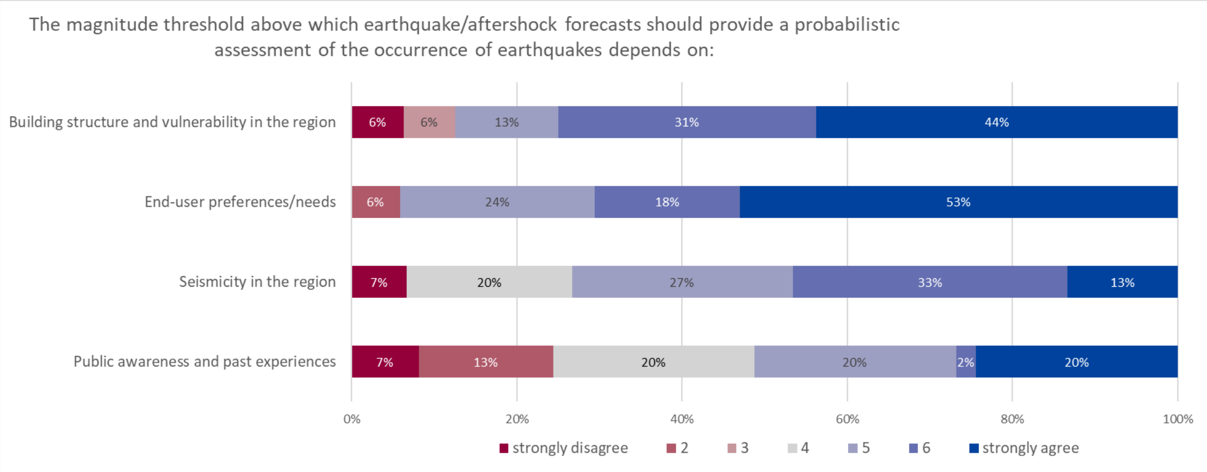


B14: Communication: Magnitude thresholds

Experts agree that the magnitude threshold above which earthquake/aftershock forecasts should provide probabilistic assessment of occurrence of earthquakes depends on the building structure and vulnerability in the region (75%) and end-users' preferences/needs (71%). There is also a tendency towards an agreement that the seismicity in a region should be considered. There is a dissent that it should depend on public awareness and past experiences.

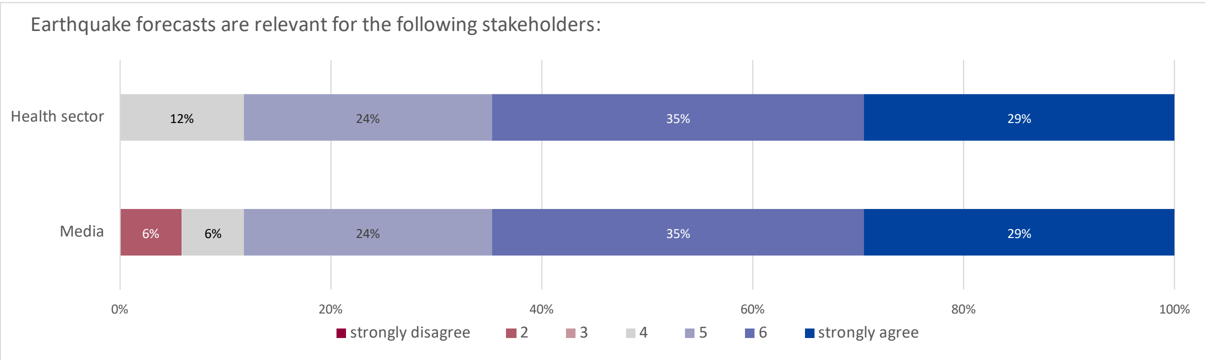
The experts could also add a comment or further ideas:

- Completeness threshold, or magnitude level that would likely be felt
- There is no scientific basis to choose the minimum magnitude
- I don't know what you mean by public awareness and past experiences
- Just provide it for several thresholds



B15: Communication: Additional stakeholders

In the first survey round, these two end-users were mentioned in the comment field to be also important. The second survey reveals that there is a tendency towards an agreement that these end-users are relevant to communicate earthquake forecasts to.

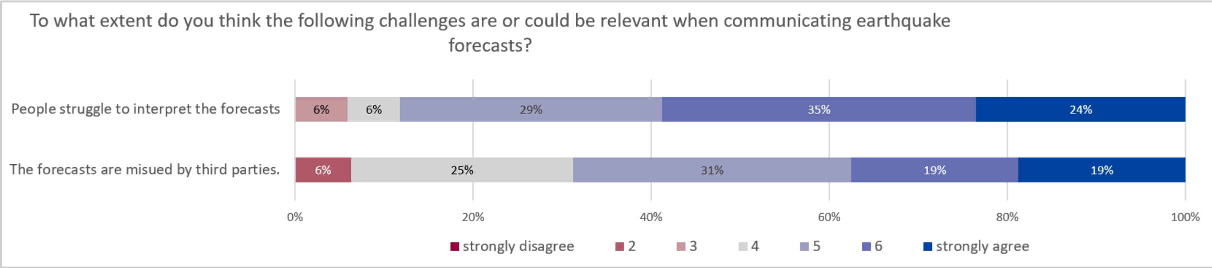


B16: Communication: Combination with other products

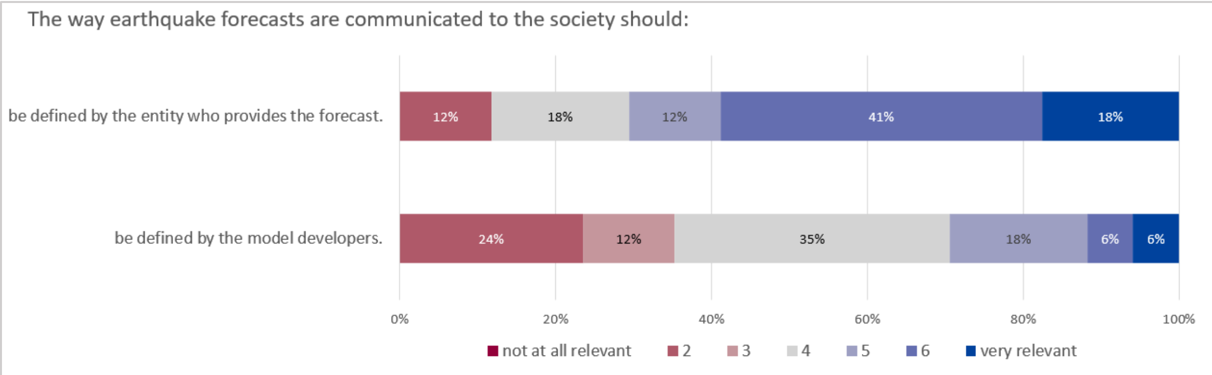
In summary, their answers revealed that i) a one-page summary for key stakeholders might be useful; ii) the forecasts should come from the same source as the other communication products (e.g., notifications, rapid impact assessments); iii) providing a menu of available products on a website/app allows users to pick the products they need; and iv) provide the forecast or a link to the forecast in the general earthquake notification.

B17: Communication: Additional challenges

Experts in the first survey round were asked to add further challenges not covered by our list. These were now assessed in the second survey round. There is no consensus but a tendency towards an agreement that these challenges might be relevant.



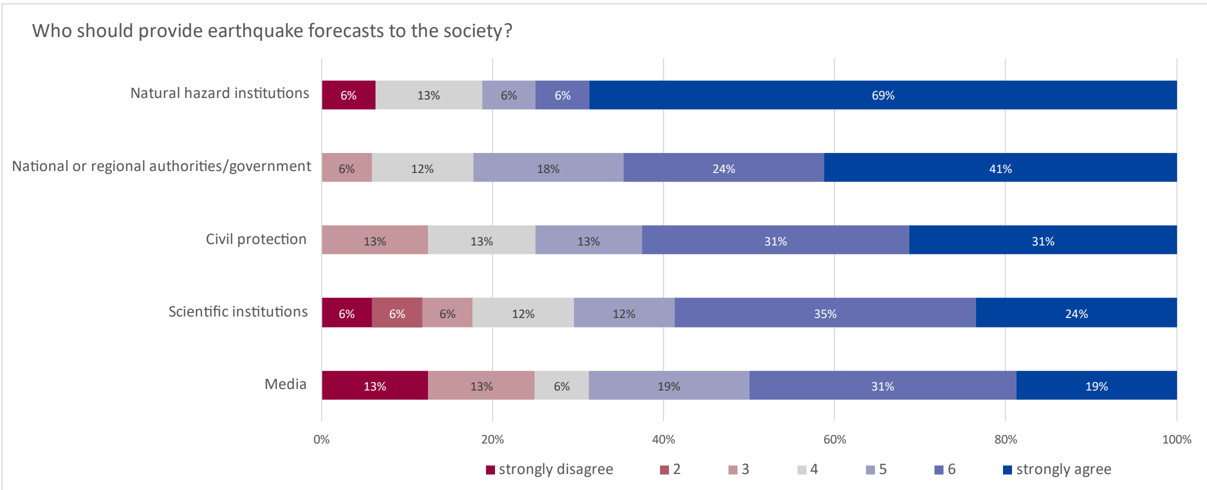
B18: Communication: Responsibility



B19: Communication: Source

Experts agree that Natural Hazard Institutions should communicate earthquake forecasts to the society (75%). Also the national or regional authorities/government (65%) and civil protection (62%) show a tendency towards an agreement. They were also able to add comments:

- Strongly depends on the country in question as to what institution people trust.
- Trusted sources
- Whatever institution is authorised to provide them
- Communication experts



Supplement C: Delphi Study – Questionnaires

C1 – Survey round 1

Introduction page

Welcome and thank you for participating in this survey

The aim of this survey is to assess the scientific consensus of issues related to the development, testing, and communication of operational earthquake/aftershock forecasts. All experts who complete the survey are invited to a workshop on April 5, 2023 at 19:00 CET where the results will be presented and discussed jointly. Afterwards, with the goal that the expert group can converge towards a general consensus, all participants are invited to revisit their opinions in a second, adjusted survey.

This survey will take about 20 minutes to complete. Participation is voluntary and you may withdraw at any time. All information you provide will be analysed anonymously, in accordance with the Swiss Federal Act on Data Protection. The results of the survey will be used for research purposes, published in project reports and scientific journals, and presented at conferences in an anonymised way. Thus, no data can be linked to your person.

If you have any questions, please contact leila.mizrahi@sed.ethz.ch or irina.dallo@sed.ethz.ch.

- ☐ I voluntarily participate in this study and agree to the processing of my personal data in accordance with the information mentioned above.

Definition

In this survey, we define an 'earthquake forecast' as a probabilistic assessment of earthquake occurrence in a specified space-time-magnitude domain, and the focus of the survey lies on time-dependent earthquake forecasts.

General questions

1. How much expertise do you have in the following research fields related to earthquake forecasting?
   [1=very low expertise to 7=very high expertise; no expertise]
   a. Developing earthquake forecasting models
   b. Testing earthquake forecasting models
   c. Communicating earthquake forecasts (to the society)

2. What is your current scientific position?
   a. Doctoral student
   b. Postdoc
   c. Senior scientists
   d. Associate professor
   e. Professor
   f. Other, please specify: ______________________________

3. How many years have you been working on earthquake forecasting?
   [textbox]

4. Which is the spatial scale of your research on earthquake forecasting?
   [multiple choices possible]
   a. Regional
   b. National
   c. Multi-national
   d. European
   e. Continental
   f. Global

5. What is your year of birth (e.g., 1980)?
   [textbox]

6. What is your gender?
   a. Female
   b. Male
   c. Non-binary
   d. Other

Developing forecasting models

7. The following models are suited for earthquake forecasting:
   [1=not at all suited to 7=very well suited; I don't know]
   a. Reasenberg & Jones
   b. ETAS
   c. EEPAS
   d. STEP
   e. Ensembles of the above
   f. Other, please specify: ________________

8. If you indicated above that one or more of these models are not suited, please indicate why.
   [textbox]

9. Earthquake forecasting models should be…
   [1=strongly disagree to 7=strongly agree; I don't know]
   a. calibrated and tested once and not be updated without further testing.
   b. recalibrated regularly using the newest available data.
   c. updated during ongoing earthquake sequences.

10. How often and when should the model be recalibrated or updated?
    [textbox]

11. Earthquake forecasting models should (note the scale from 'nice to have' to 'absolutely necessary'):
    [1=nice to have to 7=absolutely necessary; I don't know]
    a. account for catalog incompleteness.
    b. account for magnitude heterogeneity in catalogs.
    c. account for higher order aftershocks.
    d. make use of available historical data.
    e. be based on more than purely on seismicity.
    f. account for spatial anisotropy.
    g. account for (spatial/temporal) b-value variations.

h. Others, please specify: ____________________

Testing forecasting models and communications

12. A forecasting model is ready to be used if:
    [1=insufficient to 7=perfectly sufficient; I don't know]
    a. the model developers trust the model.
    b. it has been tested by the model developers.
    c. it has been tested by a third party (e.g., in a CSEP experiment).

13. Passing the following tests is a strict requirement for a forecasting model to be used:
    [1=strongly disagree to 7=strongly agree; I don't know]
    a. CSEP Number test
    b. CSEP Spatial test
    c. CSEP Magnitude test
    d. CSEP (Pseudo-)Likelihood test
    e. Other, please specify: ____________

14. For a forecasting model to be used, …
    [1=strongly disagree to 7=strongly agree; I don't know]
    a. it is sufficient to test the model retrospectively (i.e., using the testing data when training the model).
    b. it is necessary to test the model pseudo-prospectively (i.e., excluding testing data when training the model).
    c. it is necessary to test the model truly prospectively (i.e., the testing data may not exist yet when the model is developed).

15. There is a need to collectively define the minimum required tests a model should pass before it can be used for earthquake forecasting.
    [1=strongly disagree to 7=strongly agree; I don't know]

16. A model that is already used for earthquake forecasting should continue to be tested.
    [1=strongly disagree to 7=strongly agree; I don't know]

17. An existing model can be replaced by any model that…
    [1=strongly disagree to 7=strongly agree; I don't know]
    a. passes the same consistency tests.
    b. has demonstrated positive information gain over the existing one.

18. Please specify what is required to justify replacing an existing model with a new one.
    [textbox]

19. To which extent do you agree with the following statements:
    [1=strongly disagree to 7=strongly agree; I don't know]
    a. Source code of forecasting models should be publicly available.
    b. Operationally issued forecasts should be archived for retrospective analysis.
    c. Archived forecasts should be publicly available for retrospective analysis by the community.

Communication

20. To which extent do you agree with the following statements:

[1=strongly disagree to 7=strongly agree; I don't know]

   a. Earthquake forecasts should be permanently communicated to the society.
   b. Earthquake forecasts should only be communicated to the society after earthquakes of a certain magnitude, i.e. aftershock forecasting.
   c. Instead of earthquake forecasts, we should communicate earthquake loss forecasts to the society.

21. Earthquake forecasts should provide a probabilistic assessment of the occurrence of earthquakes for magnitude … and above. Please indicate the magnitude threshold and justify your choice.
    [textbox]

22. If only communicated after certain events, from which magnitude on should aftershock forecasts be disseminated and why?
    [textbox]

23. Earthquake forecasts are relevant for the following stakeholders:
    [1=strongly disagree to 7=strongly agree; I don't know; randomized]
   a. Search and rescue organisations
   b. Structural engineers/building assessors
   c. Geotechnical engineers
   d. Critical infrastructure providers
   e. Emergency managers and responders
   f. Communication experts
   g. Business owners
   h. Construction managers
   i. Insurances
   j. Policymakers
   k. Civil protection
   l. National and cantonal authorities
   m. Seismologists
   n. General public
   o. Others, please specify: ____

24. Earthquake forecasts should contain the following information (for the society):
    [1=strongly disagree to 7=strongly agree, I don't know]
   a. Earthquake probabilities
   b. Earthquake rates
   c. Absolute rates
   d. Relative rates
   e. Uncertainties in rates
   f. Spatial distribution of the earthquake probabilities/rates
   g. Temporal evolution of the earthquake probabilities/rates
   h. Earthquake hazard/expected ground motion
   i. Earthquake risk
   j. Others, please specify: ____

25. Scenarios should be used to communicate earthquake forecasts (e.g., most likely and least likely scenario).
    [1=strongly disagree to 7=strongly agree, I don't know]
    a. If we use scenarios, how many and for which probabilities should one develop them (e.g., "this scenario or a more severe one could occur with a probability of X percent within Y days.").
       [textbox]

26. To which extent do you agree with the following statements:
    [1=strongly disagree to 7=strongly agree; I don't know]
    a. Earthquake forecasts should be part of rapid impact assessment reports after an event (e.g., integrate it on rapid impact assessment leaflets such as PAGER).
    b. Earthquake forecasts should be provided together with an explanation on how to interpret the numbers.
    c. Earthquake forecast probabilities should be translated into recommended actions target audiences can/should take.

27. To which extent do you think the following challenges are or could be relevant when communicating earthquake forecasts?
    [1=not at all relevant to 7=very relevant; I don't know]
    a. The government/politicians does/do not want that earthquake forecasts are publicly available.
    b. Civil protection does not want that earthquake forecasts are publicly available.
    c. The public will not be able to correctly interpret earthquake forecasts.
    d. The legal basis to publish earthquake forecasts publicly does not exist.
    e. It is difficult to combine earthquake forecasts with other available communication products (e.g., earthquake notifications, rapid impact assessments).
    f. The uncertainties of the forecasts are still too high to base on any mitigation or recovery actions.
    g. Others, please specify: ____

28. The way earthquake forecasts are communicated to the society should:
    [1=strongly disagree to 7=strongly agree; I don't know]
    a. be defined by the model developers.
    b. follow best practices from other countries.
    c. be tested and co-designed with the end-users (e.g., civil protection, infrastructure owners, public), using surveys, workshops or other activities.
    d. be regularly evaluated to check if the end-users' needs are still fulfilled.
    e. be discussed informally with the end-users.

Last comments

29. Have we missed anything that is important with regards to earthquake forecast modelling, testing, or communication?
    [textbox]

Next steps

Thank you for taking the time to complete the survey. We will now analyse the results and present them at the workshop on April 5, 2023, at 19:00 CET. We are looking forward to discuss the survey results, especially the controversial statements, with you there.

If you are not able to attend the workshop but are interested in the results and second round of the survey, please indicate here your email address so that we can contact you:

[Textbox]

If you have any questions, please contact leila.mizrahi@sed.ethz.ch or irina.dallo@sed.ethz.ch.

By clicking “Continue”, you will be forwarded to the last page and your answers will be saved.

C2 – Survey round 2

Introduction page

Welcome and thank you for participating in this survey

The aim of this survey is to assess the scientific consensus of issues related to the development, testing, and communication of operational earthquake/aftershock forecasts. The findings will be used to compile a document with good practice recommendations by earthquake/aftershock forecasting experts.

This survey will take about 20 minutes to complete. Participation is voluntary and you may withdraw at any time. All information you provide will be analysed anonymously, in accordance with the Swiss Federal Act on Data Protection. The results of the survey will be used for research purposes, published in project reports and scientific journals, and presented at conferences in an anonymised way. Thus, no data can be linked to your person.

If you have any questions, please contact leila.mizrahi@sed.ethz.ch or irina.dallo@sed.ethz.ch.

- ☐ I voluntarily participate in this study and agree to the processing of my personal data in accordance with the information mentioned above.

Definition

In this survey, we define an 'earthquake forecast' as a probabilistic assessment of earthquake occurrence in a specified space-time-magnitude domain, and the focus of the survey lies on time-dependent earthquake forecasts.

General questions

2. How much expertise do you have in the following research fields related to earthquake forecasting?
   [1=very low expertise to 7=very high expertise; no expertise]
   a. Developing earthquake forecasting models
   b. Testing earthquake forecasting models
   c. Communicating earthquake forecasts (to the society)

30. What is your current scientific position?
   a. Doctoral student
   b. Postdoc
   c. Senior scientists
   d. Associate professor
   e. Professor
   f. Other, please specify: ______________________________

31. How many years have you been working on earthquake forecasting?
   [textbox]

32. Which is the spatial scale of your research on earthquake forecasting?
   [multiple choices possible]
   a. Regional
   b. National
   c. Multi-national

    d. European
    e. Continental
    f. Global

33. What is your year of birth (e.g., 1980)?
    [textbox]

34. What is your gender?
    a. Female
    b. Male
    c. Non-binary
    d. Other

35. In which institution do you work? __________

Interdependencies between developing, testing, and communicating

36. To what extent do you agree with the following statements?
    [1=strongly disagree to 7=strongly agree; I don't know]
    a. The way in which a forecasting model is developed should depend on the needs of the end-users of the forecast.
    b. The way in which a forecasting model is tested should depend on the needs of the end-users of the forecast.

37. Matrix. For the following user groups [y-axis] the following pieces of information [x-axis] are important:

    User Groups:
    a. General public
    b. Civil protection
    c. Critical infrastructure providers
    d. Emergency responders
    e. Decision makers (national & cantonal authorities, policymakers)
    f. Duty seismologists
    g. Insurance companies

    Information pieces:

    a. Earthquake probabilities
    b. Absolute earthquake rates
    c. Relative earthquake rates (relative to a normal day)
    d. Uncertainties in probabilities/rates
    e. Spatial distribution of the earthquake probabilities/rates
    f. Temporal evolution of the earthquake probabilities/rates
    g. Earthquake hazard/expected ground motion
    h. Uncertainties in earthquake hazard/expected ground motion
    i. Earthquake risk
    j. Uncertainties in earthquake risk

38. Matrix. When developing a forecasting model for the following user groups [y-axis], the following pieces of information [x-axis] are important:

User Groups:

a. General public
b. Civil protection
c. Critical infrastructure provides
d. Emergency responders
e. Decision makers (national & cantonal authorities, policymakers)
f. Seismologists (who interact with end users)
g. Insurance companies

Information pieces:

i. catalog incompleteness.
j. magnitude heterogeneity in catalogs.
k. higher order aftershocks.
l. available historical data.
m. more than just seismicity.
n. spatial anisotropy.
o. (spatial/temporal) b-value variations.
p. Uncertainty of model parameters
q. Geodesy
r. Faults

Developing forecasting models

39. If you had to choose **one** simple base model to produce forecasts which is useful for a maximum number of end users, which one would you choose?
[signle choice]
g. Reasenberg & Jones
h. ETAS
i. EEPAS
j. STEP
k. Machine learning based models
l. Mixed point process
m. Smoothed seismicity model
n. Coulomb/rate-and-state
o. I don't know

40. If a model has been approved to be used for a given purpose…
[1=strongly disagree to 7=strongly agree]
a. its parameters can be updated when new data becomes available.
b. it can be applied for the same purpose in a different region without additional testing.
c. it is expected to be useful for the same purpose in a different region.

Testing forecasting models and communications

41. A forecasting model is ready to be used if:
[1=strongly disagree to 7=strongly agree; I don't know]

d. the model developers trust the model but it has not been reviewed by anyone else.
e. it has been tested by a third party (e.g., in a CSEP experiment).
f. it has been published in a peer reviewed journal.
g. it represents the best currently available science.
h. the end-user of the forecast approves.

42. If you are peer-reviewing a paper describing a forecasting model, the results of which tests do you consider important for your decision?
[1=strongly disagree to 7=strongly agree; I don't know]
    f. CSEP Number test
    g. CSEP Spatial test
    h. CSEP Magnitude test
    i. CSEP (Pseudo-)Likelihood test
    j. Specific metrics for the forecasting of rare events
    k. Comparison to a benchmark model
    l. Other, please specify: ____________

43. For a forecasting model to be used, …
[1=strongly disagree to 7=strongly agree; I don't know]
    d. it is recommended to test the model retrospectively (i.e., using the testing data when training the model).
    e. it is recommended to test the model pseudo-prospectively (i.e., excluding testing data when training the model).
    f. it is recommended to test the model truly prospectively (i.e., the testing data may not exist yet when the model is developed).

Communication

44. To what extent do you agree with the following statements:
[1=strongly disagree to 7=strongly agree; I don't know]
    a. Ideally, earthquake forecasts would be permanently communicated to the society.
    b. Ideally, earthquake forecasts should only be communicated to the society after earthquakes of a certain magnitude, i.e. aftershock forecasting.
    c. Ideally, earthquake loss forecasts would also be communicated to the society.

45. The magnitude threshold above which earthquake/aftershock forecasts should provide a probabilistic assessment of the occurrence of earthquakes depends on:
[1=strongly disagree to 7=strongly agree; I don't know]
    a. End-user preferences/needs
    b. Seismicity in the region
    c. Building structure and vulnerability in the region
    d. Public awareness and past experiences
    e. Others, please specify: ______________________________________

46. Earthquake forecasts are relevant for the following stakeholders (We are only listing those that were newly suggested in the last survey):
[1=strongly disagree to 7=strongly agree; I don't know; randomized]
    a. Health sector
    b. Media

47. How would you combine earthquake/aftershock forecasts with other existing communication products (e.g., rapid impact assessments, earthquake notifications after an event)?

    ____

48. To what extent do you think the following challenges are or could be relevant when communicating earthquake forecasts? (We are only listing those that were newly suggested in the last survey)
    [1=not at all relevant to 7=very relevant; I don't know]
    a. The forecasts are misused by third parties.
    b. People struggle to interpret the forecasts.

49. The way earthquake forecasts are communicated to the society should:
    [1=strongly disagree to 7=strongly agree; I don't know]
    a. be defined by the model developers.
    b. be defined by the entity who provides the forecast.

50. Who should provide earthquake forecasts to the society?
    [1=strongly disagree to 7=strongly agree]
    a. Civil protection
    b. Scientific institutions
    c. National or regional authorities/government
    d. Natural hazard institutions (e.g., Seismological Services)
    e. Media
    f. Others, please specify: ________________________

Last comments

What do you want to achieve in the coming three to five years regarding earthquake/aftershock forecasting at your institution (e.g., operational earthquake forecasts; new model)?

[textbox]

Any final comments?
[textbox]

Next steps

Thank you for taking the time to complete the second survey. We will now analyse the data and summarize the findings of the two surveys and the workshop in the RISE project deliverable.

Would you be interested in another workshop to discuss the survey results?

a. Yes
b. No, it is enough to receive the results and report

If you have any questions, please contact leila.mizrahi@sed.ethz.ch or irina.dallo@sed.ethz.ch.

By clicking "Continue", you will be forwarded to the last page and your answers will be saved.