Coastal Research Library 42

Carlos Coelho
Caroline Hallin
Francisco Sancho
Paulo A. Silva *Editors*

Coastal Dynamics 2025

Volume 2

OPEN ACCESS

Springer

Coastal Research Library 42

The aim of the Coastal Research Library (CRL) is to disseminate accurate information to both the public and research specialists around the world on all aspects of coastal issues in an effort to maintain or improve the quality of our planet's shoreline resources. By covering the entire field of coastal research [e.g., geology, biology, ecology, geomorphology, physical geography, climate change, coastal evolution and shoreline change, littoral oceanography, hydrodynamics and AI modeling, sea-level change, beaches and dunes, coastal hydraulics, erosion, waves, flooding, environmental (resource) management (law), policy and planning, coastal and marine engineering, GIS and remote sensing, socio-economic topics, coastal hazards and extreme storms, anthropogenic change, etc.], the scope of the CRL is broad with a unique cross-disciplinary nature that encompasses all subjects relevant to natural and engineered environments (freshwater, brackish, or marine) and the protection/management of their resources in the vicinity of coastlines around the world. This book series offers current cutting-edge coastal research from the world's leading scientists and is relevant to professionals, academics, and stakeholders, as well as the general public.

The CRL tends to focus on topics linked to complex multidisciplinary problems and contentious issues that surround the coastal environment and occur within the coastal zone. Welcome additions to the series can include: Contributed Volumes, Handbooks, Monographs, Proceedings, Professional Books, Textbooks, and others.

We invite you to submit your new proposals to CRL Series Editor: Chris Makowski, Ph.D. Email: cmakowski@cerf-jcr.com

Carlos Coelho · Caroline Hallin ·
Francisco Sancho · Paulo A. Silva
Editors

Coastal Dynamics 2025

Volume 2

Springer

Editors
Carlos Coelho
Civil Engineering Department
University of Aveiro
Aveiro, Portugal

Caroline Hallin
Water Resources Engineering
Lund University
Lund, Sweden

Francisco Sancho
Hydraulics and Environment Department
National Laboratory for Civil Engineering
Lisbon, Portugal

Paulo A. Silva
Physics Department
University of Aveiro
Aveiro, Portugal

ISSN 2211-0577 ISSN 2211-0585 (electronic)
Coastal Research Library
ISBN 978-3-032-15476-7 ISBN 978-3-032-15477-4 (eBook)
https://doi.org/10.1007/978-3-032-15477-4

This work was supported by the Coastal Dynamics 2025 conference.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Risk Communication by Coastal Geoscientists

Ana Matias[1(✉)], Bruno Pinto[2], A. Rita Carrasco[1], and Neide Areia[3]

[1] CIMA/ARNET - University of Algarve, Faro, Portugal
ammatias@ualg.pt
[2] MARE/ARNET - University of Lisbon, Lisbon, Portugal
[3] CES - University of Coimbra, Coimbra, Portugal

Abstract. Storms often harm coastal communities, a situation expected to worsen due to climate change and urban development. Effectively communicating with diverse audiences is thus critical for adapting to and attenuating increased coastal risks. This research focuses on risk communication by Coastal Geoscientists and Engineers, aiming to assess their perspectives and practices. The method used was an online questionnaire, with data collected in 2022–2023. The sample (n = 133) average age was 45, with slightly more men and mostly from Europe. About 95% of participants reported engaging in public communication, and most do coastal risk communication. Direct interaction with audiences such as public talks (74%) is preferred over indirect communication, and 79% had at least one annual contact with a journalist. Participants believe decision-makers should be more informed about risk location, frequency of occurrence, and how to engage citizens with coastal risk. However, this does not align with their top communication subject (coastal physical processes). Some significant differences were found in how gender, professional roles, and scientific backgrounds influence perceptions and priorities in coastal risk communication.

Keywords: Science Communication · Geoscience outreach · Coastal Risk · Engagement with society

1 Introduction

Storms on coastal areas often damage urban shorelines, placing coastal communities at immediate risk. In 2020, 2.15 billion people lived in the near-coastal zone and 898 million in the low-elevation coastal zone globally [1]. Consequently, significant areas, infrastructures and people are at risk from coastal hazards including storm surges, inundations, waves, and coastal erosion. Furthermore, the coastal risk is likely to increase in the future due to climate change and ongoing coastal development [1, 2]. Hence, scientific and management organizations bear ethical obligations to provide useful information about the risks people face when benefiting from being in coastal areas.

Communicating with diverse audiences is critical for adaptation to, and mitigation of increasing coastal risks and developing plans for integrated coastal management [3]. Though studies have been addressing the complexity and putting forward best practices in risk communication (e.g., [4]), there is still a lack of tailored science communication

C. Coelho et al. (Eds.): CD 2025, COASTALRL 42, pp. 471–476, 2026.
https://doi.org/10.1007/978-3-032-15477-4_71

strategies efficient at engaging citizens in coastal risk and thus augmenting the success of the coastal adaptation processes [5].

Communication of coastal risks, as with all other scientific areas, relies on the joint efforts of several professional groups (including scientists, science communicators, journalists, policy-community mediators, and decision-makers). The current research is focused on an informal scientific field - Coastal Geoscience and Engineering (CGE). CGE, defined by [6], encompasses professionals working on coastal processes, integrating expertise across physics, geomorphology, engineering, and management. CGE has many topics suitable for public engagement with science, such as the impact of storms, tidal currents, coastal management, coastal evolution, sea-level rise, ecosystem services, and climate change.

The main objectives of this research were to have an international depiction of science communication done by CGE, identify their perspectives for communication, and assess what they think and how they do risk communication.

2 Methods and Sample

The method to collect data was a self-administered online questionnaire with 25 closed questions, taking an average of 10 min to complete. A comprehensive description of data collection and analysis can be found in [7]. Experts' names were extracted from three major international conferences: Coastal Sediments 2019, Coastal Engineering 2020, and Coastal Dynamics 2021. Data was collected between September 2022 and March 2023. Of the 975 contacts extracted from the proceedings, 133 responses were obtained (14% response rate).

Most respondents were male (n = 71, 53.4%), with a mean age of 45.4 (SD = 11.2). The sample average age was 45 and closely balanced between Natural Sciences (51%) and Engineering. Main participants' career status were researchers (n = 57, 42.9%), Assistant/Associate Professors (n = 22, 16.5%) and Full Professors (n = 19, 14.3%). Most participants were from the European continent (n = 95, 71.4%), even though North America and Oceania had over 10 replies in each case.

Experts' perceptions and attitudes towards science communication, reported practices and opinions about coastal risk communication were assessed using descriptive statistics. Mann-Whitney U tests were conducted to find potential differences according to sociodemographic characteristics (gender, professional category, and scientific background). In the case of gender, the analyses exclusively focused on male and female participants due to the limited representation (3.8%, n = 5) of other genders (e.g., non-binary).

3 Results and Discussion

3.1 Perspectives and Practices of Science Communication

Only 5% of respondents to the survey said they do not communicate with a lay audience. In other studies, the percentage of researchers who do not communicate is higher, as reported by [8] regarding geoscientists (24%); [9] regarding Portuguese geoscientists

(11.5%); [10] concerning USA climate scientists (27%); and [11] on UK scientists (26%). Most CGE participants (79%) consider science communication as part of their job. Nevertheless, they identified barriers to these activities, the most frequent was the lack of time due to other obligations (as recorded by [9, 11]). Direct interaction with audiences is preferred (e.g., lectures, talks, 74%), over indirect ways of communication (media and social media). The public sector (e.g., municipalities, 55%) and school students (43%) were the main audiences. About 79% had at least one contact per year with a journalist, a value comparable to results obtained by other studies [10, 12]. For most aspects of science communication, differences in opinion according to gender, age, and professional category were not significant. However, it was found that more women perceived the lack of communication training as an obstacle, and had a greater tendency towards hands-on activities. The interaction with journalists was significantly more frequent among men, professors, and older individuals.

3.2 Risk Communication

The majority (82%) of participants engaged in coastal risk communication, focusing on the type of coastal hazards (59%), such as severe storms and sea-level rise (Fig. 1).

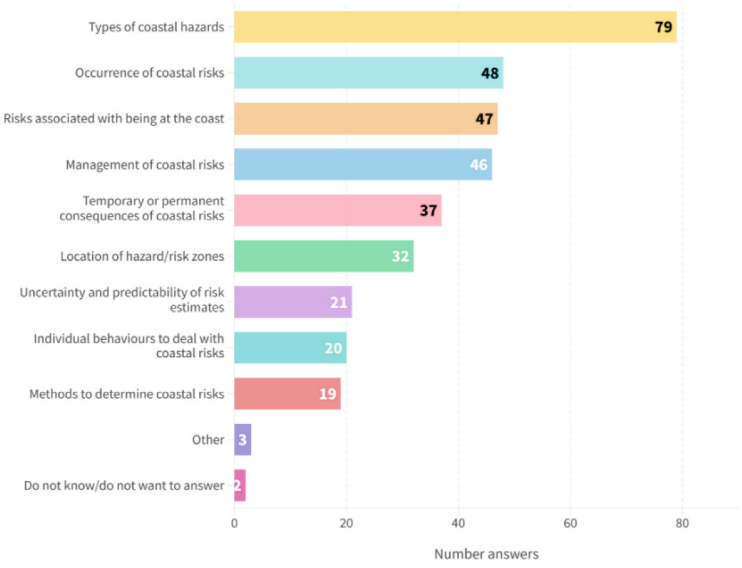

Fig. 1. Prevalence of participants' responses regarding coastal risk topics for communication. Note that multiple answers were allowed, therefore the sum is greater than 100%.

The least relevant topic was the methods to determine coastal risks (48%). Notably, 30% considered that individual behaviours in dealing with coastal risks are a less relevant topic for communication (Fig. 1). Men and women generally share similar perceptions and attitudes toward coastal risk communication, however, women more frequently signed the importance of communicating individual behaviours to deal with coastal risks.

Professors were marginally more likely to prioritise the description of 'Types of coastal hazards', as a primary topic for communication. On the other hand, researchers more frequently identified the risks associated with being at the coast, as a primary focus, a difference that reached statistical significance. Experts with an engineering background showed a greater emphasis on technical aspects of coastal risks. For example, they more frequently identified the 'Occurrence of coastal risks' as a main topic, with a marginally significant difference. Furthermore, 'Methods to determine coastal risks' were prioritised significantly more often by engineering experts. These findings suggest that scientific background significantly influences experts' priorities and attitudes toward coastal risk communication.

Participants think decision-makers should be more informed about risk location, the frequency of occurrence, and how to engage citizens with risk (Fig. 2). However, this does not align with the participants' top communication subject to decision-makers, which were the physical processes of coastal risks.

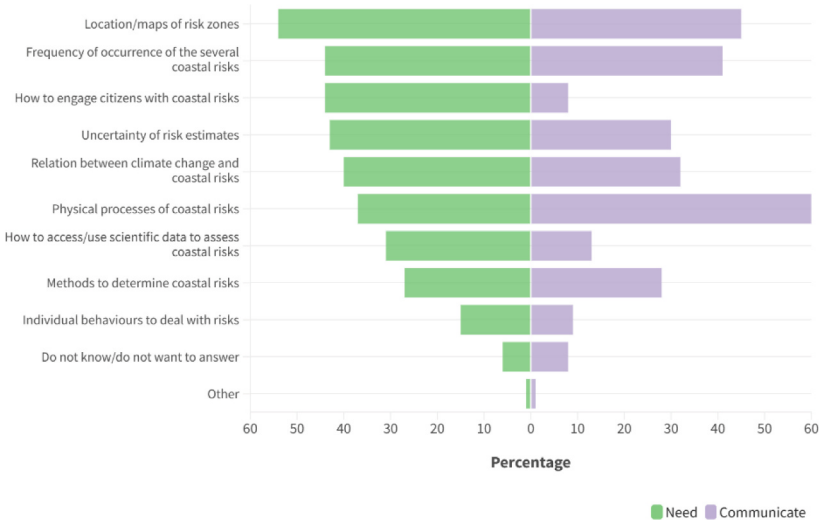

Fig. 2. Topics of coastal risk that researchers think decision-makers should know more about (left-hand side, green) and that researchers have communicated (right-hand side, violet).

The analysis of gender in experts' perceptions revealed no statistically significant differences. Notable differences emerged between researchers and professors in their perceptions of decision-makers' informational needs. Researchers prioritised 'Location/maps of risk zones', while professors 'Uncertainty of risk estimates'. Regarding communicated topics with decision-makers, professors were more likely to have addressed 'Methods to determine coastal risks' and the 'Relation between climate change and coastal risks'. These findings suggest that professors focus on methodological and contextual aspects of coastal risks, while researchers highlight spatial and participatory elements, reflecting a local approach. Experts from the natural sciences were more likely to prioritise 'Location/maps of risk zones' as a critical need for decision-makers, though

this difference was marginally significant. Conversely, engineers reported more frequent communication about the 'Uncertainty of risk estimates'. This significant discrepancy indicates that engineering experts place greater emphasis on addressing uncertainties in risk assessments, while natural sciences experts prioritise spatial information.

4 Conclusions

This study shows that 73% of the inquired researchers on coastal geoscience and engineering have been active in science communication for at least 1/year. Even considering that more productive researchers may communicate more [10] and that the sample is biased towards the more productive researchers, it is reasonable to conclude that CGE researchers are considerably active in science communication. Topics that are communicated, including risk assessment and impacts of climate change, are mainly tangible issues rather than more abstract science concepts. The findings suggest that the scientists involved in coastal risk are open and willing to communicate, and intend to engage with society and help citizens make informed decisions.

Overall, some significant differences were found in how gender, professional roles, and scientific backgrounds influence perceptions and priorities in coastal risk communication. Understanding these differences is essential for developing interdisciplinary and effective coastal risk communication strategies.

The study may have limitations concerning the sample size and representativeness of the community of coastal geoscientists and engineers. The number of participants was lower than desired and it is possible that the sample is not representative of the community.

The insights stress the importance of considering diverse perspectives in developing tailored and effective communication strategies for coastal risk management. Since there is little previous information about the public communication of coastal geoscientists and engineers, further studies should be done, if possible with a higher number of respondents, to enhance knowledge about this important and increasingly relevant area of science communication.

Acknowledgements. The authors are grateful to the people who voluntarily and anonymously contributed to this study by answering the questionnaire. This study had the support of the Fundação para a Ciência e Tecnologia (FCT), through the strategic projects UID/MAR/00350/2020 (CIMA) - DOI https://doi.org/10.54499/UIDP/00350/2020, and UID/MAR/04292/ 2020 (MARE) - DOI https://doi.org/10.54499/UIDB/04292/2020, and the project LA/P/0069/2020 granted to the Associate Laboratory ARNET – DOI https://doi.org/10.54499/LA/P/0069/2020. B. Pinto was supported by the contract CEECIND/03059/2017, N. Areia by 2020.01127.CEECIND/CP1627/CT0003, and A.R. Carrasco by CEECINST/00052/2021/CP2792/CT000. This is a contribution to the projects TraceLands (ID PP0090200, funded by the European Space Agency) and C-Land (Ref CEXC/4647/2024, funded by FCT).

References

1. Reimann L, Vafeidis AT, Honsel LE (2023) Population development as a driver of coastal risk: current trends and future pathways. Camb Prisms: Coast Futures 1(e14):1–12

2. van Dongeren A et al (2018) Introduction to RISC-KIT: Resilience-increasing strategies for coasts. Coast Eng 134:2–9
3. Areia NP, Costa PJM, Tavares AO (2022) Social engagement in coastal adaptation processes: development and validation of the CoastADAPT scale. Environ Sci Policy 133:107–114
4. Árvai J (2014) The end of risk communication as we know it. J Risk Res 17(10):1245–1249
5. Attems MS, Thaler T, Snel KAW, Davids P, Hartmann T, Fuchs S (2020) The influence of tailored risk communication on individual adaptive behaviour. Int J Disast Risk Reduct 49:101618
6. Vila-Concejo A et al (2018) Steps to improve gender diversity in coastal geoscience and engineering. Palgrave Commun 4:103
7. Matias A, Pinto B, Areia NP, Carrasco AR (2024) Insights into the public engagement of coastal geoscientists. Environ Sci Policy 162:103943
8. Liverman D, Jaramillo M (2011) Communicating environmental geoscience - an international survey. Episodes 34:25–31
9. Rodrigues J, Castro C, Costa e Silva E, Pereira DI (2023) Geoscientists' views about science communication: predicting willingness to communicate geoscience. Geosci Commun 6:15–25
10. Entradas M, Marcelino J, Bauer MW, Lewenstein B (2019) Public communication by climate scientists: what, with whom and why? Clim Change 154:69–85
11. The Royal Society (2006) Survey of factors affecting science communication by scientists and engineers. Data Report 05/013, London, UK
12. Peters HP et al (2008) Science communication: Interactions with the mass media. Science 321(5886):204–205