2022

# WORKSHOP REPORT

## Advancing Resilience to Sea Level Rise: Leading Practices and Current Challenges

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# NOTE FROM CO-CHAIRS

Seas are rising, and so is action in coastal communities to prepare. The uncertain timing of rising seas, difficulties evaluating long-term rise while facing more immediate causes of flooding such as typhoons and fluvial flooding, and simply the threat of permanent inundation of coastal zones settled for hundreds or thousands of years presents unprecedented challenges. As in all sectors impacted by anthropogenic climate change, working with others facing novel challenges to share progress and difficulties, collaborate regionally, and build competence and confidence in finding solutions can be invaluable.

In 2021, we initiated a process to develop practitioner-led workshops to share information among planners, engineers, policy experts, and their partners working locally across the globe to address sea level rise. To our knowledge, such a gathering had never before taken place. Working with an international organizing committee we developed a list of practitioners to invite. Two virtual workshops identically structured took place in consecutive weeks in February 2022.

This report presents the findings of these workshops and includes commonalities and differences among practitioners in all corners of the globe, and sources of success and difficulty to date. It also points to the next steps needed to address knowledge gaps, prepare leaders and communities to take action together, and ensure indigenous and disadvantaged communities are fully included in planning.

Many questions remain unresolved. For this, a strong consensus among participants emerged regarding the need for a "community of practice" to broaden and deepen collaboration globally, regionally, and locally as seas continue to rise. Our work to collaborate on this critical issue is just beginning.


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# EXECUTIVE SUMMARY

Local, regional, and national governments around the globe are concerned about sea-level rise (SLR) over the 21st century. They will need to plan adaptation responses that suit local circumstances and ensure equitable futures for all communities, especially those most vulnerable to the direct and indirect impacts of rising sea levels.

However, the complexity of climate science, uncertainty of SLR projections, and the newness of climate adaptation planning complicates assessing associated risks and potential impacts. Discrepancies between data sources and scarcity of localized information hinder the effective translation of science into actionable policies and complicate communications about possible responses. Collaboration among practitioners and between the scientific community and practitioners is essential to address these barriers.

Aware of this need and in preparation for the World Climate Research Programme's (WCRP) July 2022 conference, David Behar, Climate Program Director at the San Francisco Utilities Commission and co-chair of WCRP's Sea Level Rise Grand Challenge, and Dr. Daniella Hirschfeld, Assistant Professor at Utah State University, convened an international Organizing Committee comprised of leading scientists and practitioners working in SLR adaptation to design a workshop for, and by, the SLR practitioner community.

## WORKSHOP DESIGN & CHARACTERISTICS

Three principles guided the workshop design: 1) inclusive, 2) value-adding, and 3) externally relevant. In line with these principles, the organizing committee invited people from various disciplines within science, practitioner, and boundary-spanning communities with a wide range of professional experience. We also sought participation from diverse cultural, geographical, and resourced contexts.

Due to its global nature and to accommodate multiple time zones, this workshop was held twice and called Workshop A and Workshop B. Workshop A welcomed participants from Africa, the Caribbean, Central America, Europe, the Middle East, North America, and South America. Workshop B welcomed participants from Asia, Oceania, and Pacific Islands.

In Workshop A, more than half of the participants were from high-income countries in North America and Western Europe. As such, shared challenges and opportunities tended to reflect contexts with more access to expertise, resources, and local capacity oriented toward rational

and technocratic planning approaches. In Workshop B, though many participants were from Australia and New Zealand, shared challenges and opportunities reflected contexts dealing with more exposure to threats from higher sea levels, less expertise, fewer resources, and a dearth of local capacity. Generally, their approaches to planning were more inclusive and oriented toward incorporating traditional ecological knowledge (TEK) and community input.

## IMPORTANT THEMES & KEY TAKEAWAYS

**DAY 1** of the workshop centered on science and its relationship to decision-making and planning. We found that practitioners did not respond exclusively about science but how science weaves into their work. Important science themes emerged from the day:

- **Need for local and downscaled data**
- **Better understanding of compound interactions associated with SLR**
- **Need to identify triggers and thresholds for developing adaptation planning**
- **Temporal misalignments between science and policy**

Other practitioner work-related themes emerged related to communications and the cost of (in)action. Further, practitioners discussed the need for a global collaboration system that integrates top-down and bottom-up information.

**DAY 2** of the workshop centered on planning and implementing SLR adaptation in the context of uncertainty. Participants acknowledged that uncertainty could paralyze adaptation action through burdensome analysis, fear of maladaptation, or interest groups that undermine scientific evidence. However, participants identified eight enabling conditions that led to adaptation success in some situating contexts. Examples of enabling conditions include: using adaptive planning approaches, acknowledging uncertainty upfront, communicating clearly about available science, and increasing local capacity to help practitioners overcome challenges.

**DAY 3** of the workshop responded to practitioner requests to discuss SLR communication skills and approaches. Participants selected the stakeholder group (e.g., government officials, built environment professions, impacted communities, etc.) session they most wanted to attend. We found that all groups and both workshops identified six common messaging approaches that worked to communicate what is at stake. The effective approaches are: 1) Make it relevant, 2) Acknowledge immediacy, 3) Expand awareness of compounding hazards, 4) Engage ancestral legacy values, 5) Empower decisions about the future, and 6) Provide financial justification.

**Though Workshop A and B shared many of the same key themes, how they were expressed was emblematic of global disparities between wealthy and low-income places, asymmetrical access to financial resources, data, and professional capacities, systemic environmental injustices related to climate change, and fractured global relationships to traditional ecological knowledge/ways of being and knowing.**

These distinctions are covered at length in the "Synthesis" section of the report.

Through a group **synthesis activity**, five science recommendations and five planning recommendations emerged. However, this work also revealed the tension between the two professions (scientist and planner) where practitioners sometimes looked to scientists to answer questions that fall outside their professional expertise. For example, scientists can provide information on the amount of temperature rise associated with certain amounts of glacial instability, but they cannot decide a local threshold for how much flooding is intolerable for living. The recommendations below attempt to delineate along these lines while recognizing that co-producing knowledge and increased collaboration between professions is essential for translating these recommendations into effective adaptation actions.

# RECOMMENDATIONS

## SCIENCE

1 **Model Compound Interactions**
Practitioners need to know how SLR will interact with other physical processes (e.g. storm surge, precipitation flooding) to impact risk

2 **Generate Localized Data**
This information can be used to inform impacts and adaptation planning.

3 **Create Data Timelines**
Different decisions need data at different temporal scales.

4 **Address Uncertainty & Probabilities**
Quantified probabilities associated with global projections can help develop using planning scenarios.

5 **Build Consistency in Reports**
An aggregated data platform and consistent explanatory language will further increase confidence in global scientific progress.

## PLANNING

6 **Embed Equity**
Centering marginalized voices and intergenerational equity will lead to more just evaluation of priorities.

7 **Engage Stakeholders**
Improved communication tools and approaches can increase stakeholder participation and support positive long term outcomes.

8 **Build Capacity**
Increased access to financing, scientific expertise, planning skills, and governance abilities will improve local level capabilities.

9 **Use Innovative Approaches**
Adaptive pathways and planning supports "no regrets" actions by moving away from timelines to tipping points and thresholds.

10 **Design with Flexibility**
The pace of climate change and SLR require that planning, policy, and physical infrastructure projects move toward a monitor-and-adapt paradigm.

## RESULTS AND NEXT STEPS

These workshops built connections between practitioner communities using a capacity-building approach. By sharing their experiences they helped one another identify new processes for translating science, incorporating uncertainty, developing new communication skills, and identifying knowledge gaps that, if filled, would support local capacity and decision-making. As a result, there was a request for more engagement in a global community of practice that co-produces knowledge designed to better support practitioner learning and needs as tides rise.

Building on the success of these workshops, the July WCRP conference - "Sea Level 2022: Advancing Science, Connecting Society" (www.sealevelconference.org) - included a significant number of practitioner participants and featured a "practitioner day" consisting of 16 talks about place-based adaptation programs, panel roundtables identifying practitioner needs from science, and lively discussion sessions with all conference participants. Through these workshops, and supported by events in Singapore, the practitioner community identified three primary next steps:

### 1 DEVELOP ONLINE ENGAGEMENT OPPORTUNITIES

Online dialogues and workshops create opportunities for scientists and practitioners to learn from each other, stay connected to case studies and leading practices, and collaborate on knowledge products better suited for context-specific decision-making.

### 2 ESTABLISH A GLOBAL COMMUNITY OF PRACTICE

A global community of practice could support longer-term collaborations, create knowledge-exchange networks that help address gaps in local capacity, and develop shared languages and practices for communicating SLR information to multi-interest stakeholder groups.

### 3 SCALE AND IMPROVE CLIMATE SERVICES TO BUILD LOCAL CAPACITY

Climate services, the provision of actionable climate information for use in planning, is best provided through co-production interactions between practitioners and technical experts. Practitioners' needs for improved science translation, uncertainty characterization, compound threat analysis, observations and data provision, adaptation policy options, and culturally diverse decision frameworks would benefit from expanded climate services that include local capacity building.

# WORKSHOP OVERVIEW

## SNAPSHOT

To welcome participants across time zones, two virtual, identically structured workshops took place in consecutive weeks in February 2022. People came from various disciplines within science, practitioner, and boundary-spanning communities with a wide range of professional experience.

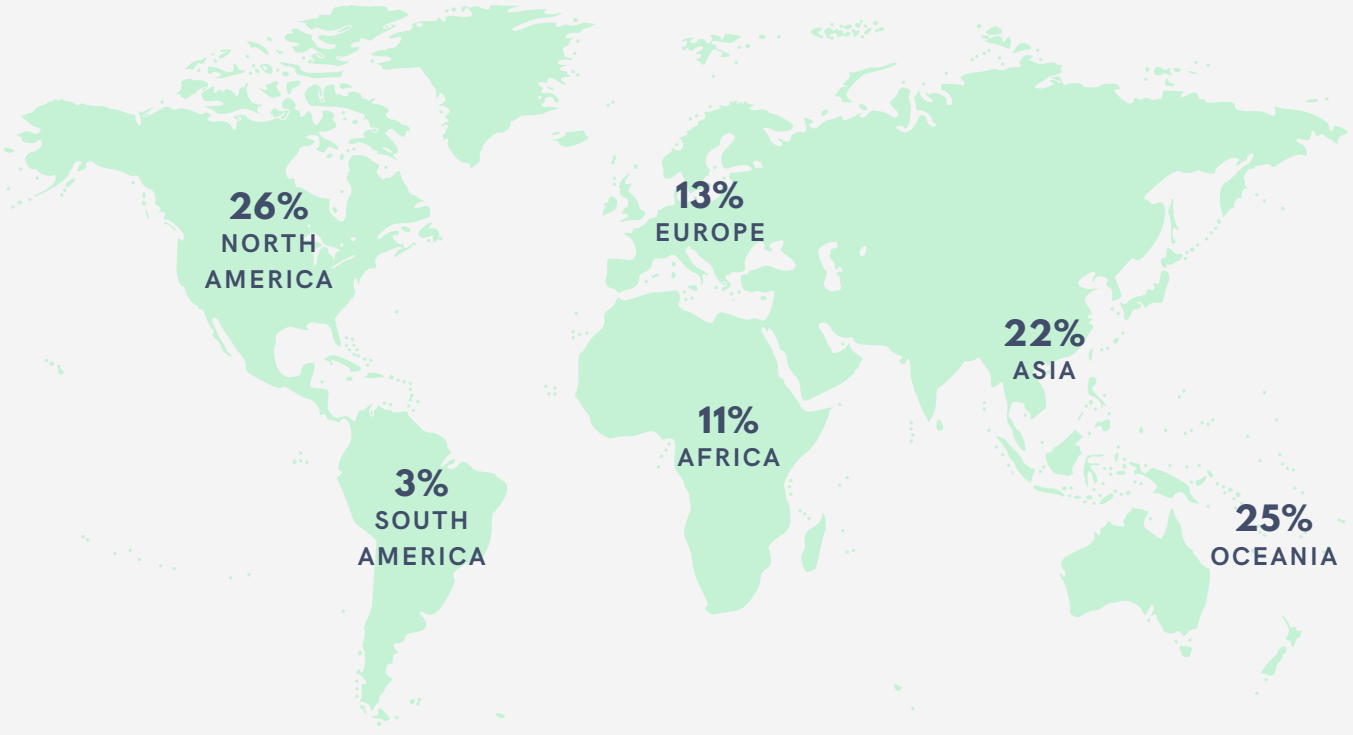
### Workshop A
February 14, 15, 16 2022

### Workshop B
February 22, 23, 24 2022

**6** Continents

**26** Countries

**69** Participants




**DAY 1**

### SCIENCE

Shared challenges in applying climate change science to decision-making

**DAY 2**

### PLANNING

Leading practices in planning for resilience amidst uncertainty

**DAY 3**

### COMMUNICATION

Moving from science to actionable knowledge for stakeholder communities

# WORKSHOP OVERVIEW

## PURPOSE, PROCESS, AND REPORT STRUCTURE

These workshops were practitioner-centered – designed for, and by, practitioners, with scientists steeped in the study of adaptation planning – to facilitate better communication, co-produce valuable insights, and develop a set of practical recommendations that can support adaptation responses on the ground. It served to build connections and learning among practitioners using SLR projections in adaptation planning in a variety of contexts (e.g. open coasts, small islands, deltas, natural infrastructure, urban vs. rural, etc.). Practitioners identified decision frameworks they use, such as "adaptation pathways" for incorporating deep uncertainty within planning and shared examples of early action to adapt to rising seas. They shared their knowledge and experiences, developed new competencies, and fostered community with colleagues navigating similar adaptation challenges.

This report provides a comprehensive review of important insights that were shared by practitioners in both workshops and across a variety of contexts. The report structure mimics the structure of the workshop which was split into two parts: Day 1 and Day 2 covered topics in Science and Planning for Adaptation and were followed by a session that synthesized those topics to develop recommendations. Day 3 explored Communication with stakeholder groups. The Synthesis provides important distinctions that illuminate how dimensions of common themes manifest in different situating contexts in Workshops A and B.

For readers who want quick overviews, each section begins with a summary, key themes and key takeaways. For deeper reading, these overviews are followed by shared successes, failures, and challenges detailing common themes.

## KEY QUESTIONS FOR PRESENTATIONS AND DISCUSSIONS

### DAY 1: SCIENCE

Share approaches to uptake of science and projections for use in planning resilience: what is working, what is not working? What are the gaps or flaws in available science from a practitioner perspective? What are the needs/challenges faced by practitioners?

### DAY 2: ADAPTATION, UNCERTAINTY, AND DECISION-MAKING

What are persistent needs/challenges faced by practitioners? What techniques have worked in framing adaptation planning under uncertainty? What time frames are communities planning for? How can practitioners work with long term (e.g. 80 years) projections with wide ranges?

### DAY 3: COMMUNICATION

How to communicate with multiple stakeholders (e.g. senior managers, high level government officials, communities, the general public) and move toward action?

# WORKSHOP OVERVIEW

## SITUATING CONTEXTS

We are shaped by our situating contexts and the interactions between them. They generate the boundaries of our imagined potential, the languages we use to communicate, and the sources of our motivation. Here we define these contexts to inform our understanding from the workshops.

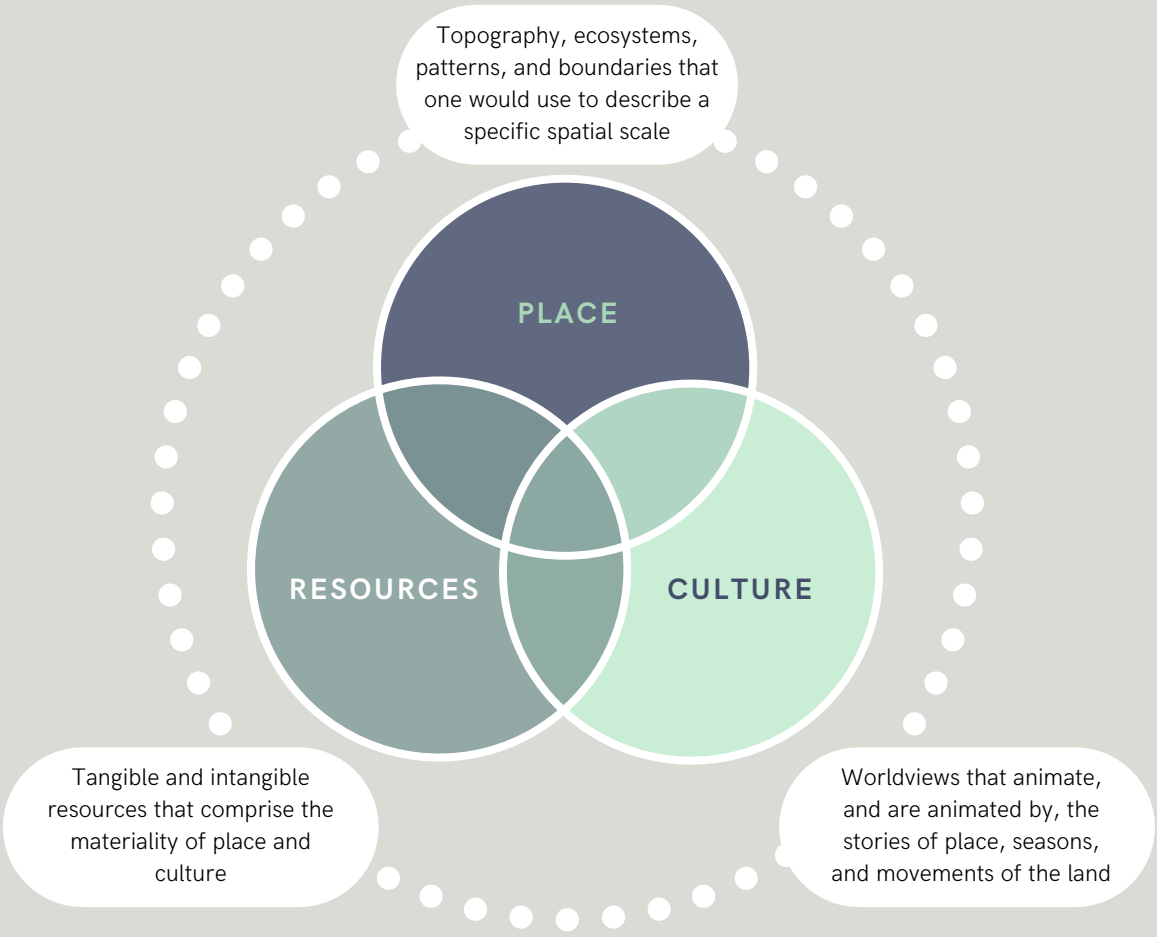
***Place*** refers to the topography, ecosystems, patterns, and boundaries used to describe a specific spatial scale. As places are shaped through physical changes and social activities, new collective identities, or cultures, emerge.

Likened to the air we breath, ***culture*** contains and creates worldviews and institutions that animate, and are animated by, the stories of place, seasons, and relationships with land and resources.

***Resources***, whether tangible in form, like people, nature, and finances, or intangible, like knowledge, power, and resilience, form the materiality of place and culture.

Observing dimensions of "Key Themes" and "Important Distinctions" between workshops revealed how these underlying situating contexts illuminated fundamental differences between planning approaches, successes and challenges, access, and outcomes.

These elements of our local experience provide a basis for understanding how common themes express differently depending on situating contexts.



# DAY 1
# SCIENCE INFORMATION FOR DECISION-MAKING

## SHARED CHALLENGES IN APPLYING CLIMATE CHANGE SCIENCE IN DECISION-MAKING

Day 1 of the workshop centered on science and its relationship to decision-making and planning. We found that practitioners moved between workshop themes and did not respond exclusively about science but how science weaves into their work. Important science themes that emerged from the day are: 1) the need for downscaled data, 2) the complex interactions with other phenomena associated with SLR, 3) the need to identify triggers and thresholds, and 4) the temporal misalignments between science and policy. Important practitioner work-related themes that emerged are: 5) communications and 6) the cost of (in)action. Further, practitioners discussed the need for 7) a global collaboration system that integrates top-down and bottom-up information.

Practitioners shared that knowledge and acceptance of sea level rise is increasing, or already widespread, amongst their communities, indicating an initial success in the science/policy interface. We also found that participants in many instances relied upon the Intergovernmental Panel on Climate Change (IPCC) reports. These reports were cited as the most credible and accessible source for global and regional scale information.

We heard from the global practitioner community about two core science needs that would improve their ability to adapt to future SLR. First, they underscored the need for more localized information and in-situ monitoring to better estimate the impacts of SLR on ecosystems, communities, assets, and critical infrastructure. Second, and relatedly, practitioners requested more information on how SLR interacts with geophysical and oceanographic processes to directly impact their coastal zones. This downscaled information would make a big difference for practitioners and their ability to manage coastal regions. Additionally, the overwhelming majority of responses pointed to the imperative for scientists and practitioners to work together to develop knowledge products at planning-relevant scales.

Finally, we found critical distinctions based on practitioners' situating contexts related to the fundamental issues of access to resources, namely paucity of local data, access to funding, and reduced capabilities and capacities. We heard from many in Workshop A about their in-house successes in developing sophisticated data visualization tools. Those in Workshop B, on the other hand, reported an over reliance on expensive consultants who generated reports but did not develop transferable knowledge and skills.

# DAY 1: KEY THEMES

What came through clearly in the discussion is that there is more than enough science, but that it is difficult to use. Practitioners predominately requested that science be translated into plain language, tailored to local conditions, communicated on planning-relevant temporal and spatial scales, and framed to inform policy and compel action.

## DOWNSCALED DATA

The most clearly articulated need for practitioners was SLR data, projections, and scenarios that respond to the uniqueness of distinct places. Global and regional averages are abundant, and sometimes conflicting, but higher resolution data is what matters most.

## COMPOUND INTERACTIONS

SLR is a complex phenomenon that compounds, and is compounded by, other global change processes. Practitioners would like models that account for multi-source contributions such as storm surge, fluvial flooding, and vertical land movement to explain future sea levels and their potential impacts.

## TRIGGERS & THRESHOLDS

One way of addressing uncertainty and the temporal lag between science generation and integration is by developing triggers and thresholds for specific adaptation responses. This is commonly associated with Adaptation Pathways (Haasnoot, 2013) that create flexible decision processes based on indicators rather than timelines.

## TEMPORAL MISALIGNMENT

The pace of climate change and its impacts are simultaneously surpassing the global capacity to respond and moving too slowly to motivate immediate action. Practitioners need information that relates to the lifespan of people, plans, and policies but developing that information takes time.

## COMMUNICATION

Common challenges of translating science into useable information for communities and decision makers included deciphering which information to use, communicating about uncertainty and risk, and developing better communication products and techniques.

## COST OF (IN)ACTION

A common question bridging science and planning was around the cost of preparing for and/or recovering from the impacts of SLR. Additionally, practitioners raised questions around who would fund it, and what types of hazard mitigation and adaptation responses are most cost-effective.

## GLOBAL COLLABORATION

A global climate collaboration platform that accepts and integrates top-down and bottom-up information could serve to establish leading practices to streamline action, increase access to information for under-resourced entities, and foster cooperation.

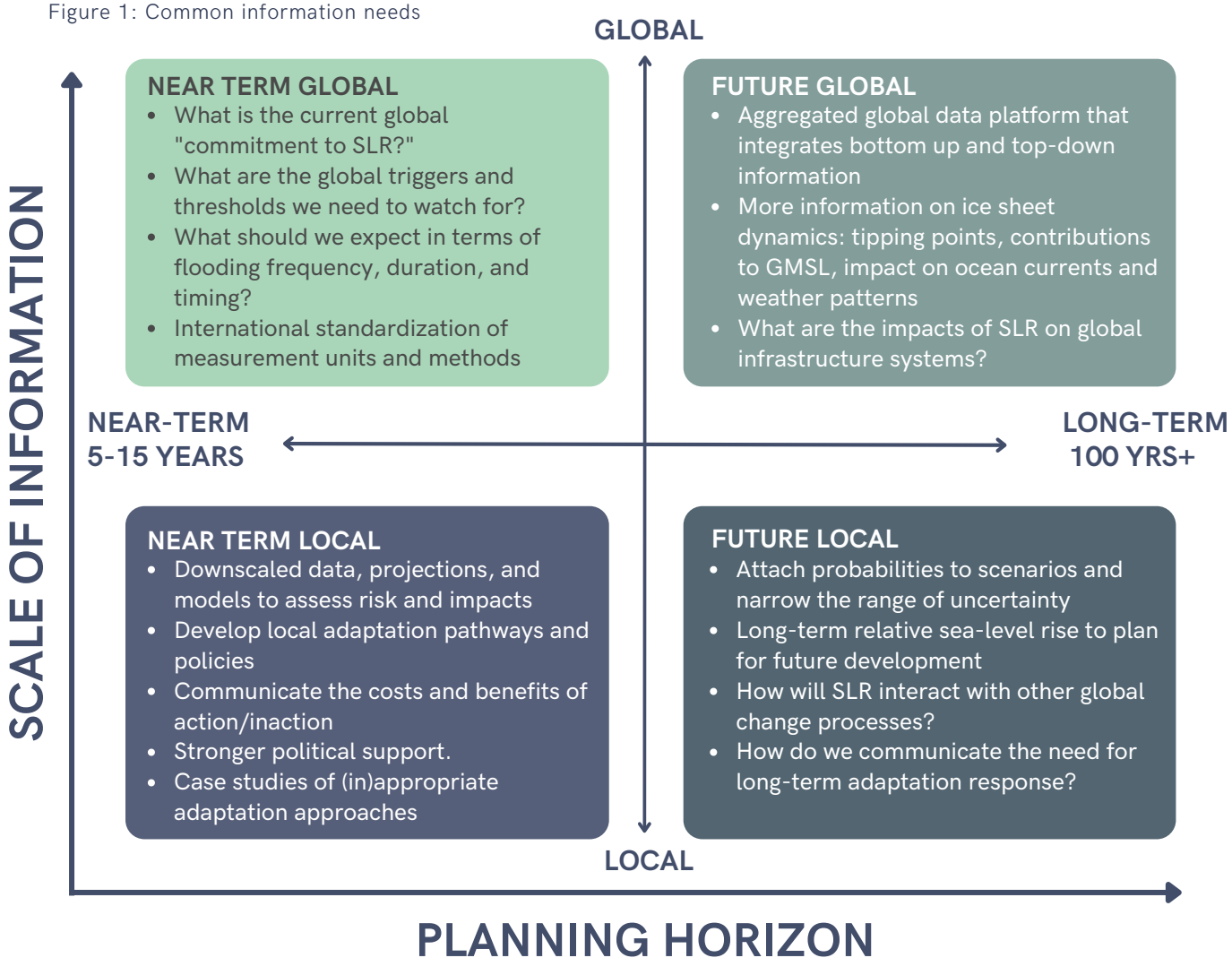
## QUESTION 1.1: What is the most important information about sea level rise you need to make decisions?

### KEY TAKEAWAYS

- Practitioners need localized information on planning and policy relevant timescales (between 5-30 years).
- Practitioners need local models showing how SLR interacts with other environmental hazards (e.g.,increased storm intensity and frequency, rising groundwater levels) and geomorphological processes (e.g., vertical land movement, erosion) to assess risk.
- There is shared concern about the uncertainty surrounding how much SLR can be attributed to different climate-induced SLR processes, specifically ice-sheet and glacial dynamics.
- Practitioners and scientists need better processes to translate information amongst themselves and communicate with stakeholder communities.

Figure 1 highlights the questions and requests common in Workshop A and B and across a variety of planning contexts. The x-axis represents the temporal scale of needed information; the y-axis indicates the spatial scale.

Figure 1: Common information needs

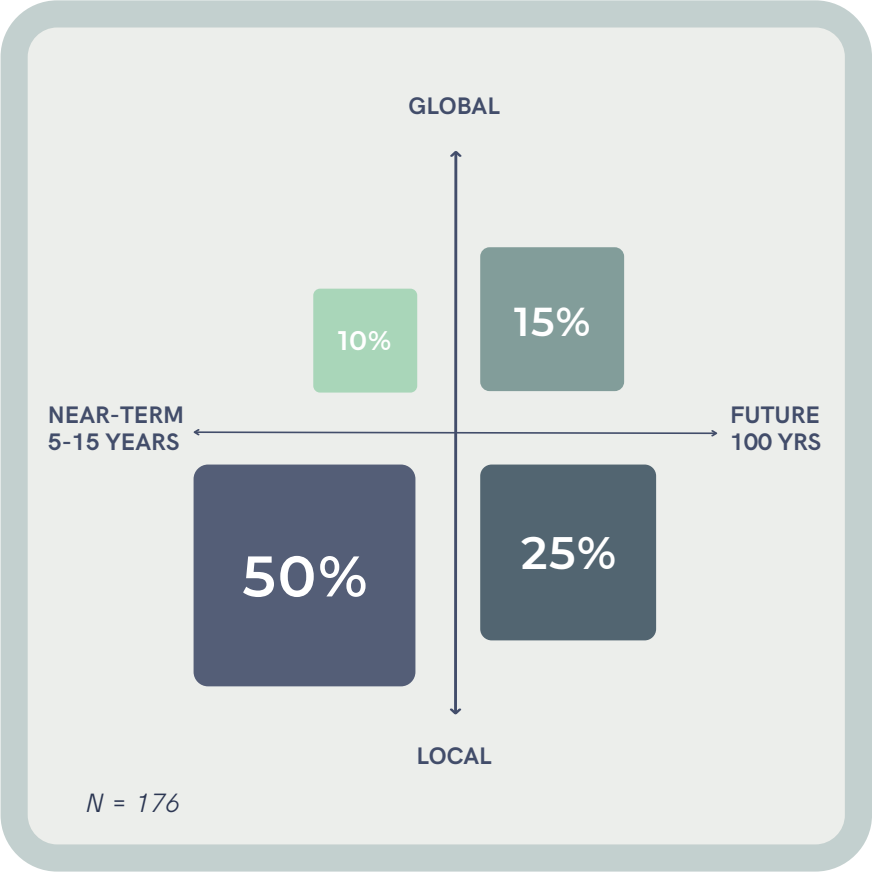


## SHARED NEEDS

**Translating SLR science into usable information on planning-relevant temporal and spatial scales emerged as practitioners' most common need.**

For most workshop participants, knowledge and acceptance of sea level rise are widespread within their situating contexts. Practitioners agree that global SLR data, projections, and models are increasingly consistent, relevant, and easily accessible. However, they struggle to translate global-scale information and century timescales into usable science that supports local decision-making.

Figure 2: Distribution of responses to Question 1




75% of responses clustered in "local," and 60% clustered in "near term." 50% of all responses clustered in "near-term, local."

To make difficult decisions regarding infrastructure investments, land use and transportation policy, and development regulations, practitioners' scientific needs have evolved beyond SLR height alone. However, the actual consequences of SLR remain uncertain due to the complex nature of sea level rise and its interactions with, and dependence on, other global change processes. In every quadrant of the information matrix above, practitioners requested clear signposts and more information on these interactions so that practitioner communities can determine thresholds and tipping points that matter regionally, translate those into potential impacts on local systems, and develop aligned adaptation strategies across contexts and scales.

Most commonly, practitioners called for more information and increased certainty on the following global trends to better estimate local impacts:

- **Timing and magnitude of contributions to SLR from ice shelf and ice sheet dynamics.**
- **Compounding impacts of SLR alongside storm surge intensity and other causes of flooding.**
- **Models that integrate vertical land movement and other geomorphological characteristics.**
- **Impacts of warming on global currents, storminess, heat and drought patterns.**

Better, or more, science is not predominantly what practitioners need. Expressed in notes and open dialogue, practitioners articulated a few areas where the science needs to catch up with planning decisions. Still, they consistently

> *When inundation levels vary from one end of the beach to the other, it all comes down to having relevant information at the local scale.*

concluded that the most sophisticated, accurate, up-to-date climate science and models do not matter if the situating context is not considered. The academic literature supports these conclusions. Research on integrating science into planning decisions and, specifically, barriers to climate adaptation, makes it clear that because practitioners are operating as individuals within complex social, financial, institutional, geophysical, and political contexts, what they need is scientific information that is locally relevant and can be communicated in ways that address their unique, place-sourced challenges (Cash et al., 2003; Rayner et al., 2005; Tribbia and Moser, 2008; Lemos et al. 2012).

### MOST IMPORTANT INFORMATION PRACTITIONERS NEED

1. Better information on contributing sources of SLR and their trends
2. How SLR interacts with other global change and regional geophysical processes
3. Thresholds and tipping points that are tied to real-time observations
4. Localized information and in-situ monitoring to better estimate the impacts of SLR on ecosystems, communities, assets, and critical infrastructure

## FAILURES AND CHALLENGES

**The main challenge faced by workshop participants was the need for more certainty in the data, projections, scenarios and analyses.**

Thematically, many of the participant requests were for more certainty, though not all requests could be addressed by scientists. Practitioners wanted likelihoods tied to different scenarios, narrowed probability ranges, and more accurate estimations of how much SLR will change depending on the source of contribution. However, the strong desire for “one number” to design and build against is a local question that must be negotiated within a particular context.

As a global society, we are facing unprecedented environmental and socioeconomic changes that cannot be easily quantified or addressed. These types of uncertainties are called "deep uncertainties" (Lempert, 2003). These make it difficult to agree on the source, relationships between driving forces, or the probability distributions used to represent uncertainty (Stanton and Roelich 2021).

Yet, in many cultural contexts, the public expects its politicians, planners, and topic experts to operate with relative certainty. Indeed, many of the decisions they make regarding large-scale infrastructure investments, land-use plans, and economic development are tied to the health and safety of millions of people.

It is nearly certain that SLR will continue well beyond 2100 (Nicholls, 2011; IPCC AR6, 2021) and, as participants indicated and research confirms, projections do not vary widely over the next 30 years. This provides a short time frame for planners to act with relative certainty. What is deeply uncertain is the rate and magnitude of change over longer timeframes, which results in a wide future window for when hazards occur (Stephens et.al, 2017, Nichols, 2011). Though frameworks exist for identifying and managing uncertainty (Lempert et al., 2003) and for adaptive coastal management specifically (Stephens et al., 2017, Sriver et al., 2018, Hasnoot et al., 2019), practitioners have limited time and resources to discover, learn, and apply these decision support tools.

In line with these requests for more certainty, practitioners identified ways current decision support tools could be improved to be more helpful, equitable and effective:

- **Enhancing hazard maps to include other dimensions of risk**
- **Including social dimensions into benefit-cost analysis to calculate the true cost of potential impacts**
- **Increasing funding for and distribution of global monitoring sites**

Figures 3 and 4 below provide examples of a mapping method presented by a workshop participant that provides more than the location of expected inundation. They map the expected depth and flooding frequency for various scenarios and provide more useful information for decision-making (Stephens et al., 2017).

Benefit-cost-analyses (BCA) are rather blunt assessment tools. Yet, practitioners report that they provide the most compelling justification for taking or delaying action. Workshop participants repeatedly asked, "how much will this cost?" but acknowledged that without integrating other social dimensions, the calculations were biased and potentially misleading. Dimensionalizing BCAs or refining the resolution of the analysis to vulnerable neighborhoods, not just critical infrastructure and assets, could lead to different decisions.

The most commonly shared challenge was a paucity of local data, stemming from the lack of monitoring stations and evaluation capacity in some of the most remote, and vulnerable locations. Many practitioners requested in-situ gauges to monitor and develop triggers and thresholds unique to local adaptive management plans.

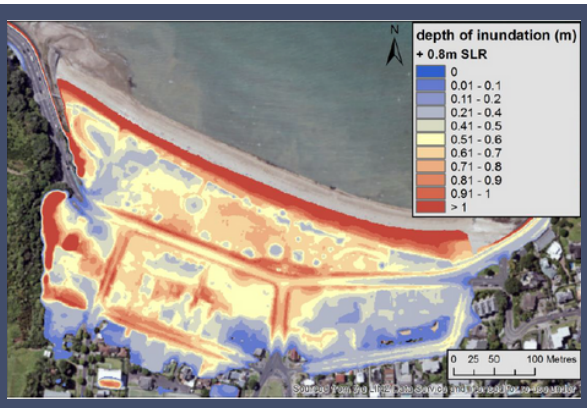



Figure 3: Depth of flooding at Mission Bay, Auckland, for a 1% AEP storm-tide at present day MSL +0.8m SLR

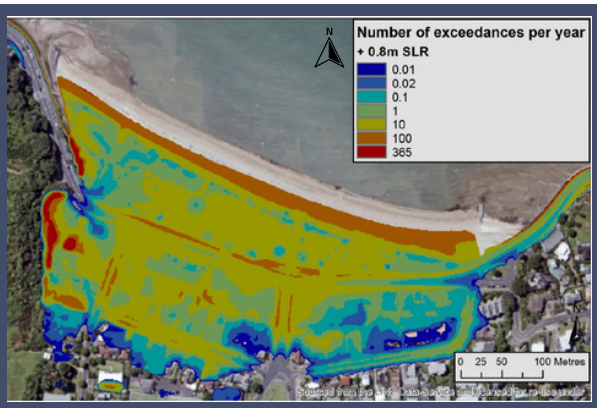



Figure 4: Frequency of flooding at Mission Bay, Auckland, for a 1% AEP storm-tide at present day MSL +0.8m SLR

Image source: *Applying Principles of Uncertainty within Coastal Hazard Assessments to Better Support Coastal Adaptation,* Stephens, S, Bell, R., and Lawrence, J. (2017)

## QUESTION 1.2: Where/How do you get the information you need? Who do you trust for reliable information?

### KEY TAKEAWAYS

- There was clear consensus that the IPCC is a credible and reliable source for global and regional SLR information.
- Practitioners reported engaging consultants or, in rare cases, in-house experts to downscale global/regional information and develop context-specific SLR projections and scenarios for impact assessments.
- Noticeably absent in the process flow diagram below are three critical steps:
  - How/when practitioners select appropriate information to use
  - How/when they decide on which projections and models for policy and planning decisions
  - Ongoing engagement processes
  - Clear processes and mechanisms for adaptive management

### PHASES AND STEPS OF INFORMATION GATHERING

Understanding the process behind the uptake of science into planning and determining the most common trustworthy sources can help us identify opportunities for interventions and improvements in addressing some of the information needs previously discussed. From more than twenty sketches and multiple source citations, a common process for obtaining and using SLR information emerged (Figure 5). It can be organized into four phases and ten steps.

The first phase, ***collection***, involves collecting information from trusted sources, conferring with colleagues or those with similar positions within one's network about which sources they use, and reconciling those data with the local context.

The second phase, ***translation***, requires practitioners to work with consultants, local academic institutions, or (rarely) in-house climate experts to downscale global and regional information into local projections, scenarios, and models that will inform planning decisions.

The third and fourth phases involve planning agencies, decision-makers, and stakeholders in processes that determine local actions. Once the global and regional data has been adapted to the local context, engineers, economists, planning and transportation departments, private companies, and residents begin the task of evaluating the potential impacts.

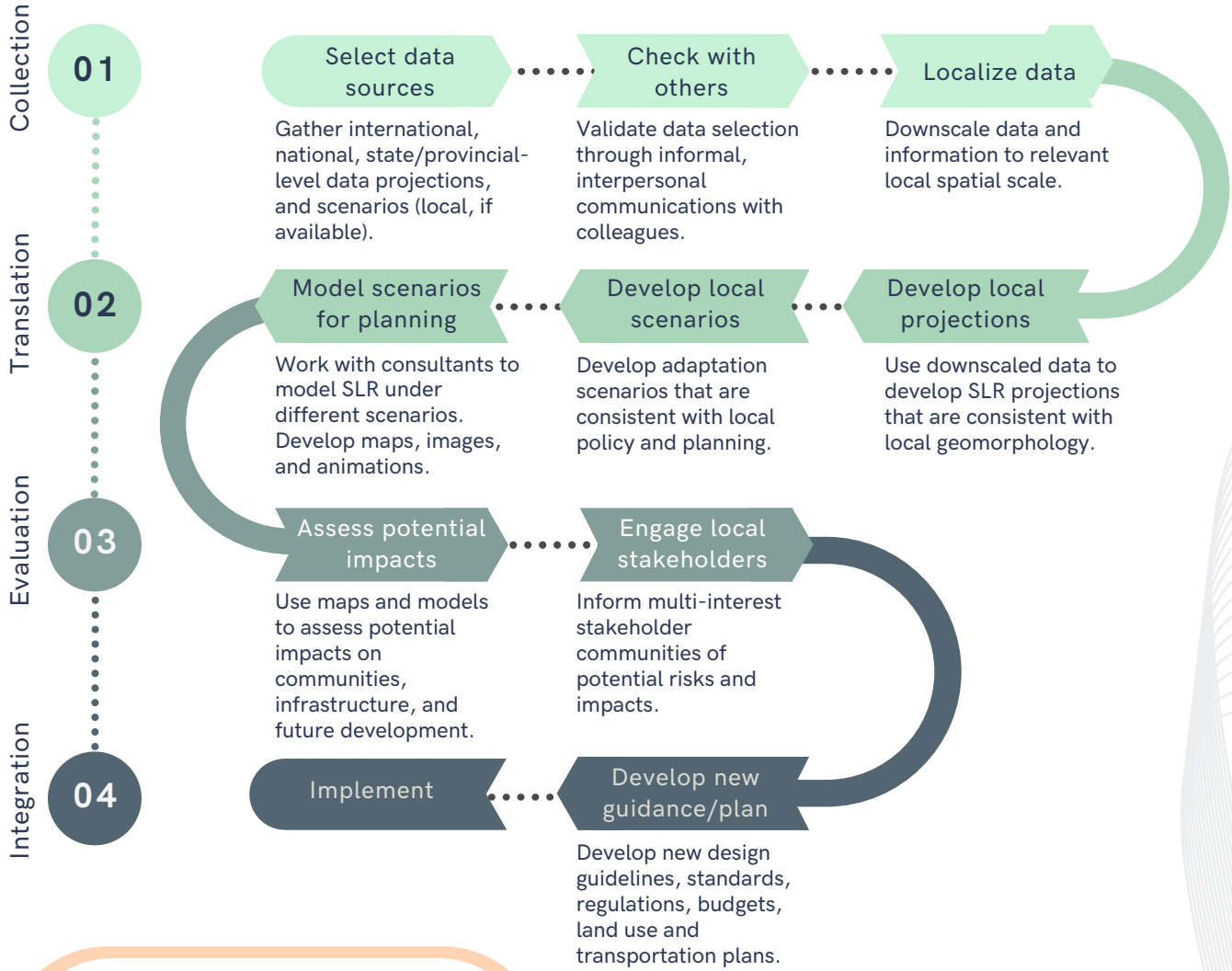
This ***evaluation*** phase establishes the premises upon which planning, budget, and investment decisions are made. Engaging local stakeholders is situated here because that is where it occurred most often in practitioners' process sketches. However, most illustrations did not include stakeholder engagement as a step in the process. Conversely, in conversations throughout both workshops, participants agreed that engaging stakeholders early and often is critical for successful planning and implementation.

Finally, the ***integration*** phase is when the analysis and decision-making are

developed into new plans, policies, and guidelines that direct new development, chart adaptation responses and budget allocation, and regulate commercial and private activities.

Absent in these phases are any formal steps for selecting which information to use or acknowledgment of how that selection process then informs the range of uncertainty embedded within localized interpretations. This likely reflects the challenges discussed in the previous section: accurately selecting and translating information are capabilities and capacities many individual practitioners or local agencies do not possess.

Figure 5 represents the generalized pattern that emerged from practitioner-generated sketches of decision-making processes that were developed during the workshops. It should not be interpreted as a recommended approach nor as a reflection of scholarly research on decision-making or information gathering processes.




Most process illustrations did not include "stakeholder engagement" despite participants repeatedly emphasizing its importance throughout all phases.

### TRUSTED SOURCES

Nearly every participant indicated that, when selecting data sources, they start with reports from the Intergovernmental Panel on Climate Change (IPCC). It was consistently cited as the most credible source for global and regional scale information and the first place most practitioners go when developing planning policy. If available, they consult national and state-level agencies for regional guidance. Practitioners indicated that, in addition to their colleagues and professional networks, they regularly consult state agencies and research institutions to gather information.

## FAILURES AND CHALLENGES

### KEY CHALLENGES WITH UPTAKE OF SLR SCIENCE INTO PRACTICE

1. Translating science into useable information for non-technical audiences
2. Access to, and local capabilities to interpret contextually relevant information.
3. Spatial and temporal misalignment between scientific research and planning relevant scales

### USEABLE SCIENCE

As practitioners diagramed their processes, the challenge with contextual relevance gained new dimensions: translating science into useable information for non-technical audiences, temporal and spatial misalignment between science production and planning relevant scales, and the need for more equitable access to data.

Though scientific journals did not feature heavily in responses, many practitioners indicated that they partner with local research institutions in the translation and evaluation phases of their processes, specifically to develop local models, maps, and risk assessments from the regional and global data sets. Consultants also feature heavily in these phases. Soliciting information and input from local experts and engaging stakeholders in decision-making processes begins later in the evaluation phase and is not represented in the collection phase.

Practitioners in both workshops expressed a desire for a **global, open source platform** that integrates information from local practitioners with national/global research initiatives.

Three key challenges during the collection and translation phases include: i) determining what information is appropriate for specific planning questions and situating contexts, ii) distilling scientific research into plain language for non-technical audiences, and iii) limitations with using imperfect information to inform additional analysis.

Embedded within these processes is the challenge of deciding which data and information to use. Practitioners indicated that the abundance of information is sometimes conflicting and that the volume of projections makes it difficult to discern which is the most accurate or appropriate for a specific context.

Additionally, practitioners who use SLR science in planning contexts reported difficulties comprehending highly technical scientific research on sea level rise and related processes. The first hurdle is translating “scientific jargon.”

## DECISION SUPPORT

Challenges with deciding which sources to use and difficulty translating them into usable information naturally led practitioners to request decision support tools and collaboration platforms. Though practitioners commonly request them, and governments and boundary organizations consistently advocate for their use by practitioners, outstanding questions remain around how well these tools can be utilized in a planning context given their complexity.

Participants reinforced findings in the literature which suggest that different settings need different SLR information to support coastal adaptation decision-making (Hinkel et al., 2019), and thus decision support tools ought to be adaptable to local situating contexts. Current tools often ignore the importance of situating contexts and neglect to consider underlying assumptions about values and rights (Moser, 2010). Improved tools could meet the needs of participants.

When one researcher asked how their agency could better support the integration of science into planning, practitioners replied that they did not need more, or more frequent information, rather they needed improved translation to ensure the science that underpins action is clear, accessible, and relevant in an environment where governments and communities need to work together. Translated information can include key takeaways, relevant implications, and visualizations all contextualized into their specific unique situating contexts.

## DATA VISUALIZATION

Maps and animations are types of decision support tools that are invaluable to helping practitioners communicate complexity. Help developing those graphics and visual aids emerged as one of the most essential needs for practitioners.

Communicating complex climate interactions and trends inherently imbued with uncertainty requires designers to understand which trends are the most important and have the skill to make effective design choices to communicate them (Gerst et al., 2020, Harold et al., 2016). Additionally, the viewers must be familiar with probabilities and have the visual literacy to interpret uncertainty. Even summaries like the IPCC reports directed at policy makers have been criticized as being inaccessible to non-technical audiences (Harold et al., 2016).

## SCALAR MISALIGNMENT

Underpinning the sensemaking process is the misalignment of scientific knowledge and planning relevant scales.

According to workshop participants, centennial timescales and globally aggregated means do not align with the local, decadal decisions that planners have to make. Nor do they align with psychological timeframes people can relate to that would compel near-term action (Gifford, 2011; Zhao and Luo, 2021). Furthermore, these timescales do not align with election cycles that must meet constituent priorities or with democratic, deliberative, community engagement processes that attempt to coalesce multi-interest stakeholders over time. Relatedly, there is a mismatch between the pace and scope of knowledge production and the continuously evolving issues planners must address over time (Vogel, 2016).

## QUESTION 1.3: What is working, what is not, and what is needed?

### KEY TAKEAWAYS

- Localized, relevant data and SLR information is challenging to access and incorporate into planning decisions.
- Increased opportunities for global collaboration could begin to fill gaps in access to information, capacity building and communication.

## QUESTION 1.3a: What are the gaps, flaws, or constraints, either in the sea level rise information itself, or in the way you obtain it?

> *Data is expensive to produce when it does not exist; and lower resolution or imprecise when it is freely available.*

### GAPS, FLAWS, AND CONSTRAINTS

**Too narrowly focused on SLR height alone**

Practitioners need better information on co-occurring/compounding hazards and other geophysical processes.

**Scientific language can be indecipherable to stakeholder communities**

It is difficult to translate scientific literature into common language formats that can be incorporated into existing norms, routines, codes and practices.

**SLR information is not easily adapted to different planning contexts**

Infrastructure, land use, and transportation planning each have distinct decision contexts. Equally important are the different geophysical and social conditions within which these decision contexts nest. As such, SLR information needs to be delivered in contextually relevant formats.

**Science access is resource constrained**

Low-income countries and other administrative units have difficulty accessing relevant local data that is also affordable.

**New science is difficult to incorporate**

- There is temporal misalignment between the speed with which science is updated (i.e. every few years) and with which planning occurs (i.e. often over 1-3 decades)
- An abundance of information, which is sometime conflicting, makes it difficult to decipher which sources to use.

**The politicization of science slows progress**

The quality of the science does not matter without political buy-in and long-term institutional support for integrating it into planning.

## QUESTION 1.3b: What would you need to do, or ask for, to fill the gaps?

### NEEDS

**Models that incorporate complexity**

- High resolution modeling multiple flooding factors (e.g. storm surge, fluvial flooding)
- Dynamic models that incorporate changes in policy and adaptation action

**Better products and processes for assessment**

- Accessible BCA methodologies to evaluate the costs of action vs. inaction
- Risk maps that integrate social and economic data
- Investment in local science production, sustained monitoring, and evaluation

**Context relevant communication**

- Simple storylines for communities, not more data
- Repository of adaptation case studies across contexts
- Translating and dealing with uncertainty

### OPPORTUNITIES

**Exchange information across learning networks to develop capabilities**

- Foster science-practitioner dialogues and knowledge co-production
- Create an international data, methodology, technology exchange for under-resourced countries
- Develop a centralized network to support information sharing and help with sourcing technical experts
- Create downscaled climate "shops" at local level so all agencies use the same information
- Collaborate on funding proposals and work with practitioners to simplify processes

**Increase local engagement**

- Co-produce knowledge and collaboratively define problems
- Engage on strategy development
- Dialogue on potential futures

## QUESTION 1.3c: What is working well?

### GOOD STARTS AND SHARED FUTURES

**IPCC provides credible and reliable information**

IPCC is considered the most credible source of information on SLR over time. Projections and impacts are communicated at different scales, and regionally downscaled projections in the recent Assessment Report (AR6) provide a solid starting point for localized analysis.

**Maturing policy context**

- Increasing acceptance of SLR as a real and imminent threat across political spectrums.
- Inclusion of SLR in planning documents, regulations, and decision-making processes.

**Communicating science through shared experiences**

Connecting science to lived experience, local histories, and traditional ecological knowledge (TEK) helps practitioners communicate and engage with stakeholder communities in ways that inspire action and cultivate local "ownership."

**Increased local collaboration**

Collaboration between government entities, jurisdictions, and communities reduces redundancies and mitigates against maladaptation by incorporating multiple perspectives into problem solving.

**Flexible approaches to integrating science for near-term planning**

- Increasing availability of localized data helps focus on short-term impacts.
- Incremental (10cm) projections clearly display scenarios for place-based decision-making.
- Probabilistic scenarios provide flexibility in choosing "a" number rather than "the" number.

**Creative and engaging visual communications**

Using art and interactive online modeling tools helps communicate potential impacts.

# DAY 2
# PLANNING ADAPTATION AND DEALING WITH UNCERTAINTY

## SHARING SUCCESSES, FAILURES, AND THE CONDITIONS THAT SUPPORT OR HINDER PLANNING AMIDST UNCERTAINTY

Day 2 of the workshop centered on planning and implementing SLR adaptation in the context of uncertainty. Uncertainty is a complex concept that participants said could paralyze adaptation action through burdensome analysis, fear of maladaptation, or interest groups that undermine scientific evidence by pointing out the unknowns. The dimensions of uncertainty – location in the analysis (e.g. in the model), level (or severity) of uncertainty, and the nature of our understanding of the phenomenon (Stephens et al., 2017) – further complicate understanding and practitioner abilities to translate these ranges into actionable policies and plans.

We learned from practitioners about eight en/disabling conditions that led to success in some situating contexts and failure in others. The first set of conditions, which pertain to people and those living in the coastal zone, include1) Community Engagement [Trust], 2) Communications, and 3) Acceptance and understanding of SLR. A large cluster of conditions fit into the umbrella of 4) Capacity and include: 5) Access to Funding, and 6) Government Siloes. Two conditions related to implementation include 7) Regulatory Context and 8) Infrastructure Design.

The practitioners agreed that community engagement, citizen trust, and an acceptance of the reality of SLR are necessary ingredients for forward progress. Specifically, participants acknowledged the barrier of overcoming "near-term v. long-term" priorities and mentalities. Many participants also brought up the relationship between exposures to hazards and the urgency this created amongst citizens. Workshop participants recognized the importance of clear communication and acknowledging uncertainty upfront, and the critical role that maps and plain language translations of science play in securing buy-in and funding.

The theme of capacity was woven into many layers of Day 2 and was iteratively brought up by workshop participants. The biggest capacity challenge that came up repeatedly was access to funding for planning and implementation. Additional challenges included having sufficient capabilities to integrate science into the planning process, implement complex planning processes, and break down the siloes between different sectors and levels of government. Ultimately, it was clear that building local capacity is crucial to support ongoing efforts to adapt to sea level rise.

Workshop participants discussed three important types of implementation. First, they identified two approaches - adaptation pathways and scenario planning - to move forward conceptually with planning given existing uncertainties. Second, examples of incorporating SLR into land-use regulations and local laws were touted as successes. Third, the idea of designing adaptive infrastructure that can withstand future risks, or can be changed to meet future conditions, was seen as an area with great potential as well as possible maladaptation risks.

Though Workshop A and B thematically shared many of the same key en/disabling conditions, how the themes express themselves within different contexts was emblematic of systemic environmental injustices related to climate change and a fractured global relationship to traditional ecological knowledge/ways of being and knowing.

# DAY 2: KEY THEMES

The eight themes below appeared repeatedly in responses to the questions posed to the practitioners on i) planning for the impacts of SLR, and ii) implementing adaptation actions. They were cited as examples of where practitioners had successes and failures, and were indicated as enabling and disabling conditions for change.

## ENGAGEMENT

Successfully engaging communities in SLR planning processes increased community support and engendered a sense of ownership over projects. However, weak or poorly run engagement led to resistance and, in some cases, maladaptation.

## COMMUNICATION

Developing more sophisticated visual communication tools, like interactive maps and animations, helped connect potential impacts to "real-life" conditions. Securing buy-in and funding was difficult without basic maps or plain language translations.

## ACCEPTANCE OF SLR

Increasing public acceptance of SLR as a real phenomenon enabled politicians to enact new policies and integrate SLR into their agendas. The more direct experience residents have with impacts related to rising water levels, the more willing they are to take action.

## CAPACITY

One of the most consistently reported barriers to planning and implementing adaptation actions is the lack of local capacities and capabilities, especially at a governmental level for undertaking various aspects and phases within an adaptation process.

## GOVERNMENT SILOES

Overcoming siloes within government, challenges that cross jurisdictions, and building trust amongst agencies and levels of authority were consistently identified as successes to celebrate, common systemic failures, and conditions that can support or inhibit progress.

## ACCESS TO FUNDING

There is too much need and not enough available capital, or jurisdictions do not have in-house capability to complete complex funding applications. Overcoming these barriers enabled better outcomes; however, access disproportionally favors higher-income places.

## INFRASTRUCTURE

Planning for and implementing infrastructure responses to SLR were cited as successes. Conversely, over-reliance on hard infrastructure, engineering solutions, and perceived short-term benefits were listed as disabling conditions.

## POLITICAL/REGULATORY CONTEXT

Generating and maintaining political will for integrating SLR science into policies, plans, and codes was seen as a key enabling or disabling condition for success.

## QUESTION 2.1: What successes and challenges have you encountered when *planning for the impacts of SLR?*

### KEY TAKEAWAYS

- The most frequently cited "success" across both workshops improved relationships through stakeholder engagement.
- More frequent experience of disasters related to flooding and SLR, and the resulting acceptance of this as a real threat, was commonly listed as an enabling condition for planning for future impacts of SLR.
- Temporal misalignment between decision-making timelines, the pace of climate change, and cognitive processes are the most entrenched obstacles to planning for the impacts of SLR.
- The fundamental economic principle of discounting and the social principle of individual rights appear as disabling conditions that complicate or prevent climate action.

### SHARED SUCCESSES

**Improved relationships through stakeholder engagement was the most frequently cited "success" in both workshops.**

Improved relationships with stakeholders (particularly on the part of government) is noted as both a successful outcome and an enabling condition for success. There was strong emphasis placed on developing a "sense of ownership" with impacted communities and enhanced multi-jurisdictional, or interagency, cooperation. Other shared successes in both workshops include:

- **Adopting adaptation planning and/or imbedding climate actions into other planning processes**
- **Cultivating political buy-in from elected officials**
- **Securing financial support from local and/or international funding sources**
- **Starting or completing comprehensive climate change and SLR plans**

The second most cited enabling condition was increased support from elected officials and a favorable political context.

Improved relationships unlocked new funding and created better outcomes, while increased collaboration brought dynamic perspectives and helped avoid maladaptive approaches. For example, one workshop participant from Canada described that by bringing together coastal managers, the public works department, a group of city council members from impacted communities, and the planning agency, they were able to design innovative approaches to rebuilding and maintaining a coastal road that met multiple stakeholder needs and approached rebuilding and maintenance in a new way.

**More frequent experience of flooding disasters, and the resulting acceptance of rising seas as a real threat, was commonly listed as an enabling condition for planning for future impacts.**

Practitioners reported that the more often extreme events disrupted daily life, the more willing communities were to take action and participate in planning process that had longer time horizons than emergency responses.

## FAILURES AND CHALLENGES

**Temporal misalignment between decision-making timelines, the pace of climate change, and cognitive processes are the most entrenched obstacles to planning for the impacts of SLR.**

For some, sea level rise, like climate change more broadly, is a phenomenon that exists outside of immediate attention because it does not pose an imminent threat. In this context, making the case for early action is difficult. For others, managing crises related to increased frequency of sunny-day flooding and other environmental disasters also obscures the ability to plan for the future. While exposure to the most immediate impacts of SLR or other flooding drivers may motivate residents to take action, it simultaneously reallocates resources - including attention - to emergency response rather than long-term planning. Practitioners in both workshops provided examples of how this judgmental discounting, a form of present bias (Zhao and Luo, 2021) in decision-making can undervalue future (temporal) or distant (spatial) risk factors. This leads to the prioritization of actions that are temporally and spatially closer over those that are more distant (Gifford, 2011) and presents barriers to planning for the impacts of SLR.

> *We have legal and moral obligations to restore salmon habitats. This requires more natural shoreline; a fact that puts us at odds with property owners who want bulkheads out of their concern about rising seas.*

The most common of the eight themes were:

- **Over-reliance on traditional infrastructure and engineering solutions in some locations where more flexible approaches could be used.**
- **Inability to influence development because of bureaucratic inertia and lack of political will.**
- **Inability to secure funding for planning processes, pilot projects, or large-scale adaptation actions.**
- **Lack of local capacities and resources to translate global information to a local scale, engage communities, or apply for funding.**

**Two additional themes emerged as disabling conditions that call some fundamental principles within our value systems into question:**

### DISCOUNT RATES

In neoclassical cost-benefit analysis, the economic function of discount rates introduces justice issues across spatial and temporal scales. One example is that without equity weighting, low-income countries are "worth less" than high-income countries and therefore, not worth saving under "Optimal Policies" generated by some integrated assessment models.

### INDIVIDUAL RIGHTS

Addressing climate change requires collective action, but since the 18th century, many societies have enshrined individual rights with little attention paid to developing civic responsibilities. One manifestation of this along shorelines and the banks of tidal rivers is the tension between private property and public protection.

## QUESTION 2.2: As you plan, how do you contend with future ranges of sea level rise and the uncertainty embedded in the projections?

### KEY TAKEAWAYS

- Use scenario planning as an instrument for community engagement, negotiation, and long-term resilience.
- Design adaptive capacity into infrastructure plans so that they respond to the changing needs of communities for the next 50-100 years
- Embrace flexible planning and decision-making approaches to future scenarios.
- Incorporate SLR ranges into land use regulation, development guidelines, and infrastructure design.
- Communicate honestly about uncertainty and what frameworks and approaches are being taken to reduce it.

Of five shared approaches to dealing with uncertainty, the three below were the most common. Together, they indicate a shift from *predict and act* to *monitor and adapt*.

1

### INCORPORATE ADAPTATION PATHWAYS (AP) AND OTHER UNCERTAINTY APPROACHES:

In line with this recommendation, workshop participants suggested to:

- Take “no regrets” actions now.
- Move away from estimated timelines toward triggers and thresholds.
- Backcast to determine the last moment to take action with available resources and knowledge - with the hope that technology will improve enough over time so that the investment is smaller by waiting.

2

### USE SCENARIO PLANNING

Participants in both workshops recommended using high-end scenarios, but for different reasons and with different justifications.

- Participants in Workshop A use high-end scenarios to start conversations and negotiations about what is reasonable to prepare for, design, and finance. Practitioners in Workshop B use extreme scenarios to frame an opportunity for increased resilience to hazards they have already encountered.

3

### DESIGN ADAPTIVE INFRASTRUCTURE

Practitioners recommended using high-end SLR values for design purposes but stressed the importance of demonstrating the adaptive capacity of the infrastructure asset over time. In practice, the cost-benefit analysis of this approach may indicate that it is cost prohibitive. Additionally, uncertainty around future SLR ranges and interactions with other climate factors may result in maladaptation and stranded assets.

## UNCERTAINTY

Uncertainty is a multidimensional concept that can be defined by: the location in the analysis (i.e., in the model), the level of uncertainty (i.e., degree or severity of ignorance), and the nature of uncertainty (i.e., the source of uncertainty) (Lempert, 2003, ; Stephens et al., 2017).

Hoi An, Vietnam
Image Credit: Toomas Tartes, *Unsplash CC*

### 4 DISCUSS UNCERTAINTY, DON'T SHY AWAY FROM IT

Practitioners recommended communicating honestly with stakeholder groups about uncertainty, acknowledging the unpredictability of the new climate paradigm, and assuring them that as science changes, so will the responses.

This invitation to embrace uncertainty and develop the capacity of stakeholder groups to understand it, can move communities out of paralysis and into a collaborative conversation on adaptive responses. It also creates the conditions to move away from "predict and act," toward "monitor and adapt." There is an added opportunity to enroll local communities as signal spotters that can monitor thresholds and engage in broader adaptation efforts.

> *It's important to lead with what we DO know before we talk about what we DON'T know.*

### 5 INCORPORATE SLR INTO LAND USE REGULATION AND BYLAWS

Land-use planning and regulation is stifled by business as usual approaches to housing and economic development. It was routinely mentioned as an overlooked lever for integrating SLR into broader planning efforts. However, a few practitioners from both workshops reported recent success with incorporating SLR into land-use regulation and development guidelines as a way of dealing with uncertainty. New policies in the Philippines, Singapore, United Kingdom, New Zealand, Australia, the United States, Denmark, and Canada are in their early days yet and are working to evaluate the efficacy of these approaches.

## QUESTION 2.3: What successes, or difficulties, have you had *implementing adaptation measures?*

### KEY TAKEAWAYS

- There is increasing acceptance of SLR as a real threat to livelihoods and, in response, many jurisdictions are incorporating adaptation actions into planning processes.
- In addition to common challenges shared previously, practitioners struggled with implementing specific adaptation measures due to issues with project viability, design and construction, and competing interests of multiple stakeholders.
- Practitioners widely held an economic justification for early adaptation action. Research supports this justification by suggesting that early action can provide up to $11 in savings for every $1 spent.
- Some places were concerned by a bias toward hard infrastructure approaches rather than investment in multi-benefit, nature-based solutions.

### SHARED SUCCESSES

#### MATURING POLICY

**Updating regulations to incorporate SLR into institutional processes and design guidelines helps normalize adaptation actions across planning contexts.**

A maturing policy context and increased political support for taking action on SLR provided favorable conditions for upgrading policies, regulations, and guidelines. Working at this level can shift focus away from the politicization of climate change and slowly transform norms, values, and what is considered acceptable. By using these institutional levers of change, SLR could be depoliticized and incorporated into a new civic identity.

HURRICANE SANDY RECOVERY

A house being rebuilt on Ortley Beach, New Jersey 2014.

Getty Images

Some examples of updated policies and regulations include:

- **Embedding criteria for SLR and storm surge into planning timelines**
- **Adopting regulations that promote living shorelines**
- **Changing post-disaster guidelines to avoid rebuilding in hazard zones**

There were also examples of success with designing, initiating, or completing discrete adaptation actions on the ground:

- **Planning or building traditional protective solutions like dikes, pumps, and sea walls**
- **Elevating structures and designing homes for easy evacuation during a flooding event**
- **Restoring mangrove forests, wetlands, and other ecosystem services to mitigate the impacts of SLR**
- **Constructing large-scale, nature-based geo-engineering projects**

## SECURING FUNDING

**The business case for hazard mitigation connects updating building codes to cost-effectively boosting safety and speeding up a functional recovery.**

In addition to favorable political and regulatory contexts that enable action, securing funding and increasing trust were dominant themes in "successes" and "enabling condition" for implementing action.

Investing in disaster mitigation now saves money and lives later. The ability to conduct benefit-cost analyses and communicate the financial case for action, or the cost of inaction, stood out as critical drivers for unlocking investment in adaptation. A widely accepted economic justification for preemptive action comes from a 2018 National Institute of Building Sciences (NIBS) study that found that every $1 invested in disaster mitigation saves society $6 (NIBS, 2018). However, this nearly ubiquitously referenced 6:1 savings is only the overall benefit-cost ratio for federal grants. An updated NIBS study in 2019 found that building at or above the newest building codes could result in up to $11 savings for every $1 invested. For hurricane surge specifically, building above existing codes provides an overall 7:1 benefit-cost ratio.

The two settings where building trust mattered most were within government and impacted coastal communities.Successful stakeholder engagement and trust building with impacted communities were enabled through increasing transparency in planning processes, developing better communication materials, and designing inclusive decision-making. Improved relationships with other departments and levels within government yielded more dynamic funding proposals and cross-jurisdictional cooperation. In coastal communities, better stakeholder engagement approaches gave residents agency over the collective response to SLR in their neighborhoods and fortified a sense of organized self-determination.

# INVESTING IN MITIGATION SAVES LIVES AND MONEY

Adopting the latests building codes and setting stricter/higher minimum requirements ("above-code design") improves disaster resilience and provides the greatest benefit-to-cost ratios (BCRs).

BCR for adopting and building up to current codes

**$1 INVESTED: $11 SAVED**

BCR for building "above-code" for Hurricane Surge

**$1 INVESTED: $7 SAVED**

*"Mitigation Saves: Mitigation Saves up to $13 per $1 Invested," National Institute of Building Sciences, 2021*

## FAILURES AND CHALLENGES

Similar challenges emerge in implementing adaptation actions as with planning for the impacts of SLR: absence of local capacity and capability to undertake various phases within an adaptation process, the temporal misalignment between the pace of climate change, policy-making processes and election cycles, and the tension between balancing individual rights and freedoms with collective interests – especially concerning private property.

Though there were repeated challenges in negotiating between short-term and long-term priorities and access to funding, practitioners' main difficulties with implementing specific adaptation measures were issues with project viability, design and construction, and competing interests of multiple stakeholders.

Difficulties with implementing specific adaptation actions:

### PROJECT VIABILITY

Appropriateness of fit, scale, and long-term sustainability of the projects based on place and rate of climate change.

### DESIGN AND CONSTRUCTION

Proposed design and construction disrupt daily life and can have negative, near-term economic impacts.

### COMPETING INTERESTS

Community values – whether ancestral preservation or desire for experimentation – conflict with conservative approaches favored by experts and elected officials.

## INSTITUTIONALIZED FINANCIAL ACCOUNTABILITY

Though not mentioned often, the absence of institutionalized financial accountability and feedback mechanisms appear as a disabling condition in planning for and implementing adaptation actions. Insurance coverage and bond ratings are powerful economic instruments for incentivizing global behavior change and could be essential in providing signals about emerging climate risks (Collier et al., 2021). However, in the face of increasing frequency of catastrophic losses and global climate uncertainty, securing financial protection could lead to inequitable, privatized markets rather than distributing collective risk.

# DAY 3
# COMMUNICATING THE CASE FOR ACTION

## MOVING FROM SCIENCE TO ACTIONABLE KNOWLEDGE FOR STAKEHOLDER COMMUNITIES

Day 3 of the workshop was unique in that, based on a pre-conference survey, it provided a robust space for practitioners to discuss the topic of SLR communication. The day was designed to allow participants to choose the stakeholder group session they most wanted to attend. This led to four groups broadly under the categories of: 1) government officials, 2) built environment professionals, 3) impacted communities, and 4) general public. Participants selected a group either because it reflected their professional role or because they wanted to learn how to better communicate with others in that role.

We found that all groups and both workshops identified six common messaging approaches that worked to communicate what is at stake. The effective messages, which are further discussed on page 32 are: 1) Make it relevant, 2) Acknowledge immediacy, 3) Expand awareness of compounding hazards, 4) Engage ancestral legacy values, 5) Empower decisions about the future, and 6) Provide financial justification.

We also found that certain approaches were more successful at gaining support from important audiences, while others were less successful. Among the less successful approaches were ones that left out the public, such as erratic and one-off meetings, and ones that were too cumbersome, such as competitive grants. Successful approaches embraced complexity, such as demonstrating multi-benefit infrastructure, and allowed for deep community engagement such as immersive visuals. These different approaches are presented in a visual graphic on page 34.

On Day 1 and Day 2 of the workshop, the place and resource aspects of participants' situating contexts exerted a lot of influence on access to information, availability of local expertise, and capacity to take action. On Day 3, the culture and place aspects provided insights into effective messaging and their interpretation into action or paralysis. For example, most participants reported that stories about place or collective histories are successful at emotionally connecting people to the relevance of a project or initiative in ways that rational justifications, like science or benefit-cost-analyses, fail to accomplish. This suggests, and research confirms, that "more and better" science alone is not what is needed; rather, it is connecting that information to the lived experiences within local cultures and places that motivates action.

# EFFECTIVE MESSAGING

**ACROSS ALL STAKEHOLDER GROUPS, THERE WERE SIX COMMON APPROACHES TO MESSAGING THAT WERE SUCCESSFULLY USED TO COMMUNICATE WHAT IS AT STAKE.**

### 1 Make it relevant

Connecting SLR to memories about loved places, cultural identities, and impacts on daily life in quantifiable terms helps stakeholder communities relate the risks associated with SLR to their lived experience.

### 2 Acknowledge immediacy

For many communities, SLR is a temporally distant threat, therefore of little concern to current realities. It is more effective to connect the impacts SLR has today on public health, livelihoods, and property values.

### 3 Connect SLR to compounding hazards

SLR is often communicated as one of many challenges of climate change. However, sharing its relationship to other hazards that people experience more regularly, like precipitation-based flooding, rising groundwater tables, and increased storminess, helps people connect long term threats to today's conditions.

### 4 Engage legacy values

Framing near-term actions on climate change as a dimension of ancestral legacy has the potential to attract people's attention to climate change and motivate people to respond more generously.

### 5 Empower decisions about the future

Fear-based messaging is generally an ineffective tool for motivating genuine personal engagement. A more effective message is one that acknowledges the current reality and frames actions as agency over what is to come.

### 6 Provide financial justification

Financial justification for action is not the most compelling message for all stakeholder groups, but for elected officials, government decision-makers, and people with fiduciary responsibility over budgets and projects, knowing that investment today saves money tomorrow provides a quantitative case for action.

## QUESTION 3.1: What are the key messages you have used or heard to communicate what is at stake?

### KEY TAKEAWAYS

- Practitioners identified six effective approaches to messaging that are also supported by academic literature on motivations for climate action (previous page).
- Many of the effective messages below work dynamically to provide a motivating argument to take action or can be used retrospectively to justify a decision.
- Though compelling, some of the messages below have previously appeared as barriers to planning and implementation. For example, depending on the context, government liability and risk of stranded assets may delay action rather than promote it.
- Not all stakeholder communities are motivated by the same messages. It is important to design communications that meet the intended audience where they are.

## EFFECTIVE STAKEHOLDER MESSAGING:

### GOVERNMENT OFFICIALS

**Preparing for SLR has multiple co-benefits**

Government officials and those advocating on behalf of SLR preparedness have found success in initiating actions when they are tied to multiple, tangible benefits like protection of livelihoods or reduced nuisance flooding.

**Government has a legal liability to reduce risk to the public**

Used as justification for government decisions or as a request for government to take action, legal liability for impacts related to climate change and sea level rise is a motivating communication tactic.

### BUILT ENVIRONMENT PROFESSIONALS

**Avoid lock-in and stranded assets**

The financial liability of stranded assets and/or the reputational risk associated with large infrastructure projects that cannot adapt quickly to changing conditions provide compelling arguments for flexible design.

**Risk to critical infrastructure and number of people impacted**

The most effective way to influence built environment professionals or generate support for their ideas is by visually communicating the quantified risk to people and critical assets.

### IMPACTED COMMUNITIES

**Alarmist futures***

Fear does not tend to motivate proactive behavior; it motivates reactive behavior. In this context, this tactic has been used to motivate people to move away from places where their lives are at risk.

### GENERAL PUBLIC

**Resonate with community values**

Resonating with community values was critical to communication, planning, and implementing climate action throughout the workshop report.

**This messages was only found to be effective amongst participants from island nations, both small and large.*

## QUESTION 3.2: What approaches have you used/seen that resonate and achieve buy-in from important audiences?

Four approaches commonly appeared across all stakeholder groups: 1) Engaging stakeholders, 2) Visual Storytelling, 3) Communicating benefits and consequences, and 4) Using scientific, technical or financial rationale. The table below shows which strategies were more and less successful.

## QUESTION 3.3: What challenges or barriers have you encountered in your communications?

### KEY TAKEAWAYS

- Communication challenges often mirror challenges in planning for impacts of SLR and implementation. Most importantly: translating technical climate science for public audiences.
- For governmental officials, outside interests and pushback from communities create barriers in communication and influence outcomes.
- In impacted communities and the general public, the opposite aspects of urgency (today's threats) and non-criticality (long-term threats) can each disincentivize action on SLR for different reasons.
- For built environment professionals, the bias toward hard infrastructure and engineered solutions makes proving the value of nature-based solutions (NbS) difficult.

## STAKEHOLDER SPECIFIC CHALLENGES AND BARRIERS

### GOVERNMENT OFFICIALS

**NIMBYism**
"Not in my backyard"
Residents resistant to change can actively disrupt planning processes or promote a counter-narrative that slows progress.

**Institutional inertia**
Calcified bureaucratic processes and top-down management structures can stifle innovative approaches.

**Influence of business interests**
Business interests can exert an outsized influence by using their financial capital and investment potential as leverage.

**Politicization of climate change**
In some contexts, current political climates turn evidence-based policy changes into party-based decisions.

### BUILT ENVIRONMENT PROFESSIONALS

**Hard-infrastructure bias**
Familiarity breeds trust in engineered solutions that quickly provide benefits, but might not be fit-for-purpose in the long term.

**Communicating the value of NbS**
Extended time frames for maturation, returns that go unrealized by investors today, and non-human benefits make the case for NbS difficult.

**Technical know-how**
When communicating with other stakeholder groups, the absence of a common technical vernacular impedes communication.

**Multi-actor coordination**
Technical experts are not typically trained as process facilitators and encounter difficulty when coordinating amongst multiple actors.

### IMPACTED COMMUNITIES

**Engaging multiple value systems**
When engaging with impacted communities, reconciling multiple, and sometimes divergent, value systems can slow or halt progress.

**Urgency**
Imminent threats create conditions where the approach of a dominant but inequitable value system may have an advantage over others.

### GENERAL PUBLIC

**Consultation fatigue**
It is difficult for practitioners and community members to strike a balance between consistent and duplicative engagement.

**Non-criticality**
It is challenging to communicate the need for action to groups who do not feel the concern operates on timescales that are relevant to them.

## COMPELLING COMMUNICATIONS

### MORE THAN SCIENCE

> *Is the information we get useful? Are we constrained by what the "local" agencies produce? Maybe storylines would work better than probability distributions.*

Workshop participants reported that better communication about science helped them foster public and political buy-in, discuss uncertainty without seeding doubt, articulate the impacts of global sea-level rise locally, and help communities make decisions about their near-term and long-term security. Why, in the face of mounting scientific evidence on climate change's devastating and asymmetrically distributed impacts, are many still left unpersuaded to take immediate action? In a recent essay on implicit injustice and hidden norms within our knowledge production paradigms, Sheila Jasanoff pointedly asks this same question (Jasanoff, 2021). Her three conclusions, listed below, are supported by key takeaways and successful approaches identified by practitioners throughout the workshops.

**1** **SCIENCE NEEDS TO CONSIDER WHOSE PURPOSE AND CONTEXTS IT SERVES**

Every stakeholder group confirmed that when complex information is communicated in "real terms" and at local levels, such as more flooding days that interrupt transportation or maps of at-risk communities and critical infrastructure, is more likely to motivate action than a probability distribution.

**2** **SCIENCE NEEDS TO GIVE ATTENTION TO WHO SOCIETIES TRUST AND HOW THEIR WORLDS ARE REPRESENTED**

Every stakeholder group except built environment professionals mentioned that third party (i.e. not the agency or company engaged in the project) video campaigns about how local communities are being affected by, and adapting to, sea level rise are very successful strategies for delivering information, cultivating buy-in, and motivating action amongst residents.

**3** **KNOWING CLIMATE SYSTEM SCIENCE WILL NOT REVEAL THE INJUSTICES OF CLIMATE CHANGE**

Engaging stakeholders in a meaningful, legitimate, and empowered process over time was the most effective way to fully understand the risks and impacts of an affected community, cultivate buy-in on approaches, and develop a local sense of ownership over projects and agency over their futures.

## COMPELLING COMMUNICATIONS

### CONNECTING TO CULTURE

**For practitioners at the workshops, culture was the most relevant situating context when managing communications.**

In defining which approaches worked and which did not, the most successful were those that engaged deeply with local culture, solicited and integrated local value systems, and demonstrated benefits beyond economic and performance advantages. Messages that were successful at communicating what was at stake awakened a person or community to their sense of history, relationship to place, and responsibility to future generations. Approaches that were routinely marked as unsuccessful failed to enliven those relationships or draw on cultural contexts for inspiration and guidance for solutions. Unsuccessful messages were technocratic and further fragmented economic, social, and environmental interactions.

Though other barriers exist in access to resources for undertaking participatory processes, such as the physical incapability of traveling to be with communities in their places, almost all identified communication barriers are grounded in specific manifestations of culture. The cultures of governments could be participatory and enabling or pro forma and dispiriting. The language of a group can inspire solutions through oral traditions and awareness of local context or be so technical as to limit understanding. The relationships to place could be defined by self-interest and value-extraction or cultivating a legacy of care for future generations to enjoy.

The role of influencers within a cultural context received a lot of attention. Influencers, in this context, do not predominantly represent the social media variety, though they are included. These are business interests, developers, local environmental advocates, NIMBYs, tribal leaders, grandparents, and children. In both workshops and across contexts, they appeared friendly and formidable, able to raise public awareness or capture political processes.

Research confirms that engaging with legacy values like stewardship of place and benefaction can motivate more generous actions (Wickersham et al, 2020). One example provided by a workshop participant of an effective communication approach was "Intergenerational knowledge co-production and sharing." The dynamic between elders and younger generations helped to build social cohesion and transfer values associated with a place.

By connecting science and planning decisions to the aspirations and identities within a cultural context, communicating the case for action is much easier and more effective.

## WHY IS IT SO DIFFICULT?

**Some barriers to successful communication are rooted in the dominant knowledge production paradigm that privileges expertise and specialization over "non-scientific" approaches that integrate multiple ways of knowing.**

**The most commonly shared challenge and barrier to effective communication was the translation of science into relatable vernaculars, visuals, and relationships.**

This is also a prevalent theme of the workshops. However, as explored in depth throughout the report, much of the disconnect between science and practitioner communities is grounded in artificial boundaries between knowledge and application.

The types of knowledge creation and generation that career academics reward have defined end-points that explore specific aspects of complex phenomena and may not be relevant to the questions, decisions, or time scales practitioners need (Vogel et al., 2016). Conversely, practitioners operate in highly complex environments that have to mitigate tradeoffs between public and private interests, balance scarce resource allocation, can be influenced by political agendas, and need to respond iteratively to questions over time.

> *Where I work, we don't talk about 'climate change.' It is too political. But we can get new legislation passed if we are 'protecting citizens and the economy from environmental threats.' It is all about framing.*

This fundamental disconnect sources from a dominant knowledge production paradigm that has, until recently, been reluctant to integrate alternative ways of knowing. The purview of science is to maintain objectivity and, to the extent possible, provide unbiased results that can be methodologically repeated with consistency (Miller, 2001). In that endeavor, and discussed throughout the workshops, there exists a high degree of uncertainty. Managing that uncertainty in the science community and dealing with it in the practitioner community is already filled with challenges. According to some workshop participants, even though engaging with cultural values, traditional ecological knowledge, and community wisdom generates better outcomes, it further complicates an already intensive, under-resourced sensemaking process.

The stakeholder-specific barriers to communication articulated on page 35 reflect dimensions of this paradigm but go further to articulate the cultural contexts in which these barriers exist. For some governments, institutional inertia and the politicization of climate change are barriers to change. The difficulty built environment professionals have in understanding and communicating the value of nature-based solutions is related to a rationalist approach but can conflict with local cultural values. The paradoxically opposite aspects of "urgency" experienced by impacted communities and "non-criticality" experienced by the general public create similarly challenging conditions where near-term concerns outweigh long-term benefits.

## COMMON CHALLENGES

**Common challenges shared by every stakeholder group and across both workshops broadly reflect the themes that repeated on Day 1 and Day 2 of the workshop:**

- **Needed Approaches**
  - Better stakeholder engagement
  - Accessible visual communication
- **Difficulty Communicating**
  - Near term / Long term
  - Non-economic costs & benefits
- **Disabling contexts**
  - Self-interest v. Public good
  - Politics of climate change and belief it is real
  - Lack of knowledge/capacity
  - Government inertia

# SYNTHESIS
# COMMON WORKSHOP THEMES SITUATED IN CONTEXT

Though Workshop A and B shared many of the same key themes, how they expressed was emblematic of global disparities between wealthy and low-income places, asymmetrical access to financial resources, data, and professional capacities, systemic environmental injustices related to climate change, and fractured global relationships to traditional ecological knowledge/ways of being and knowing. This section illuminates these distinctions and concludes with recommendations and next steps.

Throughout the workshops, practitioners described a fundamental barrier to the uptake of science into practice that is missing from much of the academic literature on the topic:

**Depending on their situating context, practitioners face significant gaps in local capacity and capabilities.**

This cross-cutting theme expresses as differences in developing new knowledge, interpreting the abundance of available information, fundraising for adaptation, integrating different belief systems and ways of knowing, and engaging multi-interest stakeholders.

## KEY TAKEAWAYS

- Generally speaking, those with greater economic resources have more sophisticated scientific capabilities and the capacity for long-term planning. In comparison, those with fewer financial resources struggle with access to fundamental data at relevant scales and struggle with balancing providing essential services today with future concerns.
- Dominant economic and cultural paradigms help perpetuate the environmental and social injustices accompanying climate change and sea level rise.
- In both workshops there were requests for regular global collaboration, shared knowledge platforms for integrated learning, and access to professional networks that could inexpensively support balancing the resource divide and help build capacity.
- Practitioners from different situating contexts have distinct orientations to relationship building, stakeholder engagement, and integrating alternative perspectives and worldviews as part of their planning processes.

## IMPORTANT DISTINCTIONS

### DATA, UNCERTAINTY, AND TRANSLATION OF CLIMATE SCIENCE.

**The nature of successes and failures between the two workshops are highly context-dependent and point to asymmetries in access to data, development of planning processes, the capabilities, or presence, of expertise, and accessible funding.**

Access to downscaled data is an essential asset for planners around the world. However, there are glaring differences in the availability, resolution, and ability to translate information into planning relevant scales for local jurisdictions. Some participants have developed sophisticated data visualization tools and increased in-house capacity for downscaling science to local conditions but had difficulty selecting the appropriate level of detail when attempting to bridge administrative siloes.

Managing the abundance of data and information on sea level rise was a shared challenge met with different capabilities to address it. For example, an online tool created by a local university helped one practitioner move forward on developing policy and local design guidelines rather than remaining stuck in early planning efforts and attempts to pin down the most accurate future projection. However, in less-resourced contexts, tools for selecting which global or regional projection to use for a specific planning question are unavailable. Furthermore, integrating uncertainty into long term planning processes requires a level of scientific and data literacy that is often absent.

In addition to the common approaches to dealing with uncertainty outlined in the previous section, participants in Workshop A generated an extended list of ways to deal with uncertainty. The top three were:

1) keep up to date with the science,
2) use cooperative planning strategies,
3) use different ranges of SLR for different scenarios.

Each requires higher-level capabilities, capacities, and access to resources than many practitioners in Workshop B had available to them.

> *I use ClimateCentral.org, because it is the only platform that shows my island!*

Participants in Workshop B from small island nations and lower-income places noted that because they have fewer in-situ monitoring resources or local capacity for analysis, they rely heavily on international organizations to develop localized information. This gap in local capacity can lead to detrimental impacts on the ground. Because of the reliance on third-party consultants and international organizations, modeling is a costly and time-consuming process that doesn't build local capacity.

Planners who work under these constraints reported being underprepared and under-resourced when attempting to plan for and implement measures that could save lives and local economies. Lacking data and technology for complex visualization, they develop narratives that translate basic science into lived experiences so less formally educated communities living in coastal settlements can relate to the threat more immediately. This conversation is often

connected to how ecosystems and weather patterns have changed and the negative impacts those changes have had on their subsistence livelihoods and cultural identity.

## FUNDING, FINANCE, AND ACCESS TO RESOURCES

**The funding gap for adaptation continues to grow, so it is no surprise that securing financial assistance is an issue for all participants, regardless of their country's GDP. However capital distribution, access to funding mechanisms, and economic vulnerability vary across contexts.**

Today, climate change and flooding disasters disproportionately impact low-income and small island nations. However, through earthquakes, subsidence, and relative sea level rise, small island nations and other resource-constrained jurisdictions have developed adaptive capacities despite and, in some cases, because of limited access to resources. Perseverance and innovation borne from necessity were reported as enabling contexts for planning for the impacts of SLR, though it comes with limitations.

Participants in Workshop A were primarily concerned with identifying creative funding sources, while many in Workshop B worked to address the systemic environmental injustices related to limited access to global financial flows. Participants in both workshops shared concerns about barriers to applying for funding and the expertise required to submit successful proposals; however, the disparities between high-income countries and low-income countries were evident by orders of magnitude. A group of practitioners from low-income countries reported that they are unwilling or unable to borrow for adaptation financing and question the environmental and social justice implications of allocating scarce resources to a problem perpetuated by countries with much higher carbon emissions.

In Workshop A, practitioners acknowledged that wealthier jurisdictions get better access to funding because they have the staff and expertise to apply. Representatives in lower-income countries with limited country-level staff, let alone city-level staff, are concerned about wealthier countries having disproportionate access to capital when they are more immediately vulnerable to the impacts of SLR and financially incapable of meeting the demand.

> *Short-term economic struggles are difficult enough to manage without trying to incorporate hypothetical climate situations.*

## THE ROLE OF RELATIONSHIPS

Underpinning the differences in capacity and capabilities is access to relationships and networks that can help fill the gaps in knowledge and expertise. Participants from under-resourced contexts emphasized the need for international collaboration and institutional knowledge sharing more than those with more resources. They suggested that, in the absence of local capacity, there is an opportunity for workshops and conferences to help build connections between practitioners from different contexts so that they can learn from each other rather than continuously relying on expensive consultants. Conversely, it was evident that practitioners from better-resourced contexts have robust relationships with academic institutions, topic experts, and in-house colleagues with technical expertise.

## LIBERAL ECONOMIC PRINCIPLES AND CONTEXTUAL (MIS)ALIGNMENT

Self-interest at the expense of collective protection was an important disabling condition shared by both workshops, specifically in coordinating public actions on private land. However, dimensions of this theme express differently in specific contexts.

The right to private property and efficient economic productivity are fundamentally intertwined principles of liberal economic theory. Private property is seen as essential to prosperity and thus attaches monetary value to land, resources, and the economic output one derives from it.

Global financial systems rely on benefit-cost analysis to evaluate loans, investments, and bond ratings, mechanisms upon which adaptation financing depends. This disproportionately disadvantages low-income countries and those whose costs to mitigate and adapt to sea level rise outweigh traditional economic arguments for retreating or relocating entirely. Workshop participants from those contexts articulated the frustration and negative psychological impacts this approach has on their cultures and communities.

As previously discussed, the discount rate function artificially minimizes future events' economic damages.  BCA is not a values-aligned approach in cultural contexts that consider generational legacies in terms of ancestral responsibility to stewarding place for future generations and have non-monetary relationships to resources.

## EMERGING CONCERN

Governments' legal liability for lost property value due to sea level rise.

This presents in two specific ways:

- **Maintaining uncertainty to minimize accountability**

  Hesitancy to develop and distribute highly accurate hazard maps for fear of economic liability.

- **Reinterpreting eminent domain, takings clause, and just compensation**

  Wealthy people with high-value coastal properties suing the government for failing to take actions that would have protected their investments.

  Coastal communities are suing local jurisdictions for decreasing property values associated with “increasing awareness of sea-level rise.”

However, private property ownership is problematic for people living in resource-poor places because their homes and coastal businesses are the most significant asset.  seas rise and the value of these assets depreciates, they cannot migrate inland without losing everything.

Nugget Point Lighthouse, Ahuriri Flat, New Zealand
Image Credit: Zane Carter, *Unsplash CC*

## BEYOND CONSULTATION

Practitioners from New Zealand discussed the importance of, and challenges with, integrating traditional Māori knowledge, or *mātauranga*, into their planning and decision-making processes. The Environmental Protection Agency regularly incorporates this approach into its work. Doing so has increased biodiversity, prevented infrastructure from being destroyed in floods, and saved taxpayers millions of dollars. (Cernansky, 2021).

## ENGAGING WITH STAKEHOLDERS AND INTEGRATING ALTERNATIVE WAYS OF KNOWING

**Participants from both workshops agree that engaging stakeholders is critical to success in planning and implementing adaptation actions. Still, there were contrasts between engagement approaches and outcomes based on the situating contexts in which engagement processes operated.**

Dimensions of these challenges manifest differently across contexts. For example, some coastal Aboriginal communities in Australia are reluctant to move their homes or build sea walls that would obscure their view of the ocean but protect their communities. This resistance stems from cultural values entwining ancestral legacy and generational stewardship of their place with livelihoods that depend on those relationships. Similarly, fishermen in Philippines island communities were reported reluctant to relocate away from the sea despite current flooding. For many, the ancestral home they maintain is the family's primary economic asset. To block the sea, or leave their homes would be severing aspects of their identity, independence, and livelihoods.

To successfully engage communities and move toward action, practitioners from Canada, New Zealand, Australia, South Africa, and the Philippines stressed the importance of starting with indigenous perspectives as the value-system underpinning how climate change and SLR impacts are conceptualized. Relating to historical narratives and proverbs connect the threat of SLR to lived experience and cultural legacies. These approaches often contest hard infrastructure and engineering in favor of nature-based solutions that restore ecologies and relationships.

Conversely, the few mentions of TEK in Workshop A from predominantly Western European countries referred to the rarity and difficulty of integrating TEK into planning processes Still, they pointed to the value it provides when it is present. For example, one participant in Workshop A admitted that, to the detriment of their planning processes, the inclusion of indigenous communities was often tokenized rather than fully participatory. These more technocratic, rational planning process that were justified by benefit-cost analysis or risk reduction were met with community resistance that practitioners indicated may result in increased community vulnerability.

# RECOMMENDATIONS

We asked workshop participants to draft recommendations that addressed the challenges and opportunities we covered in the first two days. The recommendations below synthesize and uplift the most common, and salient, contributions.

## DAY 1: SCIENCE

1 **Model Compound Interactions**
Practitioners need to know how SLR will interact with other physical processes (e.g. storm surge, precipitation flooding) to impact risk.

2 **Generate Localized Data**
This information can inform impacts and adaptation planning.

3 **Create Data Timelines**
Different decisions need data at different temporal scales.

4 **Address Uncertainty & Probabilities**
Quantified probabilities associated with global projections can help develop using planning scenarios.

5 **Build Consistency in Reports**
An aggregated data platform and consistent explanatory language will increase confidence in global scientific progress.

## DAY 2: PLANNING

6 **Embed Equity**
Centering marginalized voices and intergenerational equity will lead to more just evaluation of priorities.

7 **Engage Stakeholders**
Improved communication tools and approaches can increase stakeholder participation and support positive long-term outcomes.

8 **Build Capacity**
Increased access to financing, scientific expertise, planning skills, and governance abilities will improve local capacity.

9 **Use Innovative Approaches**
Adaptive pathways and planning support "no regrets" actions by moving away from timelines to tipping points and thresholds.

10 **Design with Flexibility**
The pace of climate change and SLR requires that planning, policy, and physical infrastructure projects move toward a monitor-and-adapt paradigm.

# NEXT STEPS

## THE CHALLENGES PRESENTED BY SEA LEVEL RISE REQUIRE GLOBAL COLLABORATION

These workshops identified multiple ways science and practitioner communities can work together to develop adaptation responses, from problem definition and data collection to planning, funding, and implementation. Listed below are three concrete ways to foster connections participants made during the workshop and support capacity building across disciplines and contexts.

### 1 DEVELOP ONLINE ENGAGEMENT OPPORTUNITIES

Online dialogues and workshops create opportunities for scientists and practitioners to learn from each other, stay connected to case studies and leading practices, and collaborate on knowledge products better suited for context-specific decision-making.

### 2 ESTABLISH A GLOBAL COMMUNITY OF PRACTICE

A global community of practice could support longer-term collaborations, create knowledge-exchange networks that help address gaps in local capacity, and develop shared languages and practices for communicating SLR information to multi-interest stakeholder groups.

### 3 SCALE AND IMPROVE CLIMATE SERVICES TO BUILD LOCAL CAPACITY

Climate services, the provision of actionable climate information for use in planning, is best provided through co-production interactions between practitioners and technical experts. Practitioners' need for improved science translation, uncertainty characterization, compound threat analysis, observations and data provision, adaptation policy options, and culturally diverse decision frameworks would benefit from expanded climate services that include local capacity building.

# APPENDIX

# WORKSHOP DESIGN
# BY AND FOR PRACTITIONER & SCIENCE COMMUNITIES

## RATIONALE

Local, regional, and national governments around the globe are concerned about SLR over the 21st century and are tasked with developing appropriate adaptation responses. These must align with their specific spatial context regarding available resources, providing the right level of safety, addressing uncertainties, and ensuring consideration of the most vulnerable communities over time. As with most climate change challenges, collaboration between the scientific community and practitioners is essential to achieving thoughtful and timely responses as well as ensuring efficient use of scarce resources in implementing adaptation measures.

## PURPOSE

The primary aim of the workshops was to facilitate a much-needed exchange between practitioners working on coastal adaptation and the SLR science community. Secondary goals for the workshops included deepening collective understanding of the state of adaptation practice, offering practitioners a chance to learn from one another, and developing organized feedback to the scientific community from practitioners. These goals were explicitly motivated by the workshop's original intent: to inform the World Climate Research Programme's (WCRP) Sea Level Rise conference entitled "Sea Level 2022: Advancing Science, Connecting Society."

This conference, working to "bridge climate science and society," a core objective of the WCRP Strategic Plan, benefitted from the workshops and the global practitioner community they helped to galvanize. Additionally, a recent survey of adaptation practitioners (Hirschfeld et al., 2022) pointed to a greater need to understand the state of climate adaptation planning practice.

These workshops were designed for, and by, practitioners and practitioner partners from other sectors to facilitate better communication, co-produce valuable insights, and develop a set of practical recommendations that can support adaptation responses on the ground. It utilized a global network of relationships from committee members to reach out to practitioners in all inhabited regions. In practice, the workshop built connections and learning among practitioners using SLR projections in adaptation planning in various contexts (e.g., open coasts, small islands, deltas, natural infrastructure, urban vs. rural). It identified decision frameworks in use such as "adaptation pathways" for incorporating deep uncertainty within planning and shared examples of early action to implement adaptation to rising seas. Participants had opportunities to share their knowledge and experiences, develop new competencies, and foster community with colleagues navigating similar adaptation challenges.

## DESIGN PRINCIPLES & PROCESS

### INCLUSIVE

Our commitment to inclusion guided the design, development and facilitation of these international workshops. Integrating multiple perspectives, approaches, and lived realties into the workshops helped broaden our understanding and ability to develop appropriate responses to SLR in a variety of contexts.

To accommodate as many practitioners from around the world as possible, the workshop was hosted twice, and at different times. Understanding that many of the participants have multiple work and family commitments, and that people were joining us virtually, we made sure that the format allowed for them to attend without having to look for additional child care, take days off of work, or add to the "zoom fatigue," many are experiencing in the transition to remote work. Additionally, in cultivating the invitation lists for speakers and participants, we aimed for gender representation, diversity in disciplines, geographies, and cultures, and a range of professional experience.

### VALUE-ADDING

Based in regenerative design principles, the workshop's primary aim was to add value to the lives of individual participants, their immediate working environment, and the professional communities they participate in. To fulfill on this aim we first conducted two design surveys that asked practitioners what their goal for attending would be, what would add value to their practice, what output would create the most value for a broader community of practice, and which structure would help fulfill on these goals and fit into their schedules. The results listed below directly informed the structure (workshop instead of conference), the content (science, planning, and communication), and the output (report with embedded recommendations).

### EXTERNALLY RELEVANT

This report includes recommendations and key insights that practitioners can easily use to justify their work, new areas of research, and opportunities for funding. These workshops were informed

## DESIGN SURVEY

We received 35 responses from practitioners around the world. Their responses reflected a desire to build competencies through shared experiences and work together to produce something relevant for a broader audience. These goals and desires reflect key themes in the workshops: developing capacity, shared learning, and better communication.

## BUILD CAPACITY

### PRIMARY GOAL FOR ATTENDING

The two tied goals for attending were to build professional capacity and acquire knowledge. To do so, they selected a workshop structure rather than a conference or symposium.

## DEVELOP RECOMMENDATIONS

### MOST RELEVANT OUTPUT

The "Top 10 Recommendations" shared in this report reflect the first pass at a larger effort to bring together science and practitioner audiences around shared endeavors.

## COMMUNICATE EFFECTIVELY

### PRACTITIONER REQUESTED TOPIC

Workshop Day 3 was developed in response to practitioners' requests for developing their communication skills with stakeholder groups.

by a pressing need for collaboration between practitioner and science communities in planning adaptation responses to sea level rise and related coastal hazards. As such, these workshops intended to catalyze new partnerships, build international connections for shared learning, and nurture a nascent community of practice that transcends the boundaries of nations and science. To support these forward-looking goals, we asked participants to complete a reflection survey so that we could better support this work in the future. In it we asked them to assess their personal development over the course of the workshop, provide three pieces of information or connections they could put to work immediately, and what tangible impacts those could have on their work and communities. Additionally, we asked if they would support and participate in the development of a global community of practice.

In addition to the new skills and networks they reported building, more than 50% of respondents remarked on how the format had given them the experience of being in community and that there was comfort in shared challenges. A common response to the question, "What are three concrete ideas, pieces of information, or connections that you can put to work tomorrow? " was,

> *We are not alone!*

Another common response was the usefulness of case studies in helping participants frame their approaches and strengthen their arguments for more resources. Participants also noted how helpful it would be to have a repository of case studies, both successes and failures, to continue their shared learning online.

## REFLECTION SURVEY

We received 43 completed surveys from participants in both workshops. Responses indicated a shared eagerness to develop a global community of practice and share knowledge and experiences across contexts. All participants reported increased capacities and capabilities and were excited to share those developments with their colleagues and communities.

**81%**
**WANT TO JOIN A GLOBAL COMMUNITY OF PRACTICE**

**60%**
**WANT TO HELP FORM AND NURTURE ITS GROWTH**

> *I will use information from the workshop, specifically the problems others are facing, to validate and strengthen the case for additional resources to support adaptation in my work to senior officials.*

# WORKSHOP STRUCTURE

## FORMAT, AGENDA, AND SPEAKERS

| | DAY 1<br>SCIENCE | DAY 2<br>PLANNING | DAY 3<br>COMMUNICATION |
|---|---|---|---|
| 30 MIN | **Plenary +<br>Lightning Talks** | **Plenary +<br>Lightning Talks** | **Plenary +<br>Lightning Talks** |
| 65 MIN | **Breakout Discussion:**<br>***Understanding and Translating Sea Level Science for Resilience Planning***<br>What is the most important information about sea level rise that you need in order to make decisions?<br>Where do you get your sea level rise information from? Who do you trust for reliable information?<br>What are the gaps, flaws, or constraints, either in the sea level rise information itself, or in the way you obtain it? | **Breakout Discussion:**<br>***Planning and Adaptation Action – Leading practices in planning for resilience amidst uncertainty***<br>What successes, or difficulties, have you encountered when planning for the impacts of SLR?<br>As you plan, how do you contend with future ranges of sea level rise and the uncertainty embedded in the projections?<br>What successes, or difficulties, have you had implementing adaptation measures? | **Breakout Discussion:**<br>***Communicating Adaptation – Recommendations for communicating challenges and building buy-in.***<br>What are the key messages you have used/heard to communicate what is at stake?<br>What approaches have you used/seen that resonate and achieve buy-in from important audiences? What made them successful?<br>What challenges or barriers have you encountered in your communications? |
| 30 MIN | **Group Reflection** | **Synthesis Exercise** | **Group Reflection** |
| 30 MIN | **Optional Networking** | **Optional Networking** | **Next Steps + Closing** |

## LIGHTNING TALKS

| | DAY 1 | DAY 2 | DAY 3 |
|---|---|---|---|
| WORKSHOP A | **Fiona McLay**, Scotland<br>**Darryl Colenbrander**, South Africa<br>**Abby Sullivan**, U.S.A<br>**Adam Parris**, U.S.A. | **Erin Derrington**, Northern Mariana Islands<br>**Katie Hagemann**, U.S.A.<br>**Potlako Khati**, South Africa<br>**James Brand**, U.K. | **CJ Bodnar**, U.S.A.<br>**Tamsin Lyle**, Canada<br>**Anders Edstrand**, Denmark |
| WORKSHOP B | **Gordon Smith**, Canada<br>**Kathleen McInnes**, Australia<br>**Anthony Kiem**, Australia | **Noel Mendana**, Philippines<br>**Rob Bell**, New Zealand<br>**Charles Rodgers**, Philippines<br>**Peter Schultz**, U.S.A. | **Lau Jamero**, Philippines<br>**John Rainbird**, New Zealand<br>**Neale Farmer**, Austrailia<br>**Jose Beya**, New Zealand |

# WORKSHOP PARTICIPANTS

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# WORKSHOP PARTICIPANTS

## WORKSHOP B

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## WORKSHOP FUNDERS

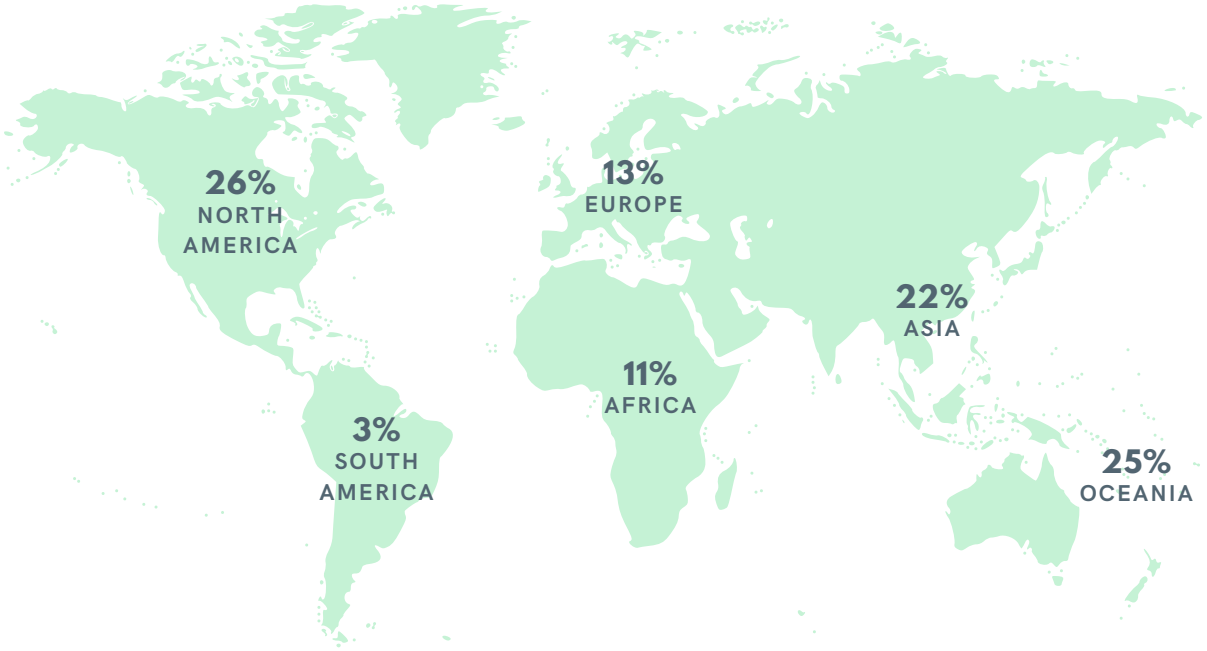
# WORKSHOP DEMOGRAPHICS

## SNAPSHOT OF PARTICIPANT GEOGRAPHIES AND PROFESSIONS

**6** Continents

**26** Countries

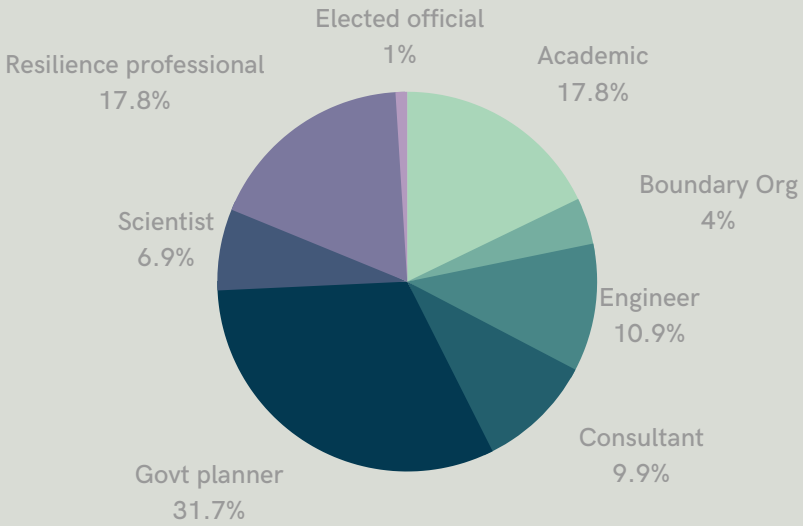
**69** Participants




Though it was highly global in its nature, there was an overrepresentation of practitioners from high-income countries with predominantly Western cultural identities. Participants from South America, Africa, the Middle East and Southeast Asia shared that there were very few professional local sea level rise experts; however we can be sure there are far more than we were able to reach through our networks.

## PROFESSIONAL LIFE

We actively sought participation from multiple disciplines, professions, and levels of career experiences. This variety enriched the conversation and created an atmosphere of deep learning and sharing. From this, participants relayed that they gained better understanding and appreciation of other perspectives and were able to see the challenges and opportunities for collaboration more clearly.



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## WORKSHOP ORGANIZING COMMITTEES

These workshops and report would not have been possible without the commitment and creative contributions of the organizing committees. We are grateful for their time, knowledge, and deep expertise that stretches across disciplines and around the globe.

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