



Short Communication

Earth observation and coastal climate services for small islands

Lena Rölfer*, Gundula Winter, María Máñez Costa, Louis Celliers

Climate Service Center Germany (GERICS), Helmholtz-Zentrum Geesthacht, Fischertwiete 1, D-20095 Hamburg, Germany

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ABSTRACT

The workshop on Earth Observation and Coastal Climate Services for Small Islands, held in Guadeloupe in November 2019, brought together 35 participants constituting stakeholders predominantly from the Caribbean with representation from the Pacific and Indian Ocean region, as well as providers of climate and earth observation services. The workshop was jointly organized by the Climate Service Center Germany – Helmholtz Zentrum Geesthacht and the University of the French Antilles in Guadeloupe. The aims of the workshop were to: (1) recognize the common challenges and data needs of small islands in relation to risk reduction and climate change adaptation; (2) identify development needs for additional data services; and (3) identify useful methods for the dissemination of such services. The workshop format combined participatory methods, individual presentations, plenary discussions and group work. The presentations highlighted regionally (for the Caribbean) and globally available data sources as well as location specific case studies.

1. Introduction

Earth observation and climate services are the basis for informed decision-making in the face of current and emerging risks from climate change and associated extreme events. Small islands¹ are at high risk and already suffering the impacts of extreme events, such as tropical cyclones, droughts, floods and (marine) heat waves, which are likely to worsen due to climate change and subsequent sea-level rise (Pörtner et al., 2019). Freshwater resources on small islands are particularly vulnerable to climate change because they are limited in size and easily compromised (Holding et al., 2016).

The high climate change risks facing small islands are also due to high inherent vulnerability to hazards. A large proportion of economic assets as well as 29% of the population across all SI live within 5 m elevation of mean sea level (UN-OHRLS, 2017), i.e. in the low-lying coastal plains or on atoll islands. Global warming and anthropogenic pressures stress the fragile ecosystems, both marine and terrestrial, which many small islands rely on for subsistence and income from fishing, marine aquaculture, agriculture and tourism. Population growth and economic development in coastal areas contribute to the vulnerability of SI, and further increase the risks posed by climate change. The IPCC AR5 reconfirms the high level of vulnerability of

small islands to multiple stressors, both climatic and non-climatic (*high confidence; robust evidence, high agreement*) (Nurse et al., 2014). The AR5 identified that the distinction between observed and projected impacts of climate change is often not clear in the literature on small islands. Improved baseline monitoring of island systems and downscaling of climate-model projections would heighten confidence in assessing recent and projected impacts.

Despite extensive knowledge of the challenges facing small islands, two major knowledge gaps remain that relate to 1) the limited understanding of the complexity of small island systems in terms of the spatial diversity, and 2) temporal dynamics in response to climate variability and change (Duvat et al., 2017). It is also recognized that a temperature increase above the 1.5 °C limit, agreed at the Paris Conference of the Parties in 2015, will make the natural and human systems of small islands even more vulnerable (Mycoo, 2018).

2. Small islands are unique

Small islands are characterized by diverse bio-physical (e.g. volcanic or atoll island), geographical (e.g. remoteness), cultural and political landscapes. Even so, workshop participants identified challenges shared by many small islands, but which are different from developed

Abbreviations: SI, Small Islands

* Corresponding author.

E-mail address: lena.roelfer@hzg.de (L. Rölfer).

¹ This paper simply uses the more geographically focussed term “small island(s)” and avoids using the well-known “Small Islands Development State” (SIDS) and the relatively little-used “Small Island State” (SIS). The term small islands in this context implies sovereign small islands states irrespective of their developmental status.

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mainland states. Most of these challenges result from the relatively small land area, population and economy compared to mainland states. The small area and population size make them vulnerable to extreme events when, for example, cyclones cause widespread damage across the entire country, which causes disproportionate economic losses with respect to Gross Domestic Product. Any climate mitigation and adaptation efforts are constrained by limitations in the availability of local resources, including human resources and capacity. Because of the small population, there is a proportionally smaller pool of skilled people to contribute to earth observation and climate services development. However, the development of such services for small countries does not require proportionally less (to the small land mass) human resources.

Even in a highly connected world, small islands are often disadvantaged by geographical isolation from each other and from the continental states. This could also be an opportunity and the perceived isolation is a feature of small islands exploited by the tourism industry. Because of limited local resources, small islands are highly dependent on imported goods causing the economy to stagger when disasters damage trade hubs such as ports and airports. Local economies also rely heavily on natural resources for tourism, agriculture and fishing that all add pressure to fragile ecosystems that are slow to recover from natural and anthropogenic disasters. Even the cost-benefit of tourism needs to be carefully considered when planning sustainable development of small islands and an appropriate climate change adaptation response.

The proportion of the ocean area compared to the land of small islands is vast. The average exclusive economic zone of ~666,000 km² in the ocean is almost 28 times the one of the average land area (UN-OHRLLS, 2013). Participants noted that a more appropriate definition of their countries, therefore, would be Large Ocean States instead of Small Island States. Therefore, marine observations and coastal climate services are of particular importance to them, especially with regard to increasing sea surface temperatures and ocean acidification.

Workshop participants identified important social and socio-political dynamics that set small islands apart from mainland states. Some of the challenges include the political dynamics of small islands, issues of familial kinship, often strictly hierarchical and patriarchal cultures and communities, coupled with the complex dynamics of such relationships. Because of the unique socio-political composition and character of small islands, there often appears a uniquely local style of bureaucracy and governance.

3. Small islands and information services

These small island-specific challenges highlight the need for accessible and context specific climate and earth observation services to support effective decision-making. The workshop participants identified a number of appropriate pathways to improve climate and earth observation services and to increase their uptake in decision-making. Due to the unique challenges, small islands should not solely look to mainland states for adaptation strategies but should instead draw upon local traditional and indigenous knowledge. In many island settings Western knowledge and culture replaced or prevailed over traditional and indigenous knowledge. However, the increasingly rapid onset of climate change poses unprecedented challenges to which traditional knowledge may not be able to sufficiently respond. A balance of indigenous and scientific knowledge should be used to plan adaptation and building resilient communities.

Participants identified a general shortage of information services for their use within decision-making processes. From a service provider perspective, reasons for this include a general lack of data, or the inaccessibility of data, for example, where historic data are still only available as paper records. Simple methods for *in situ* data collection and the validation of earth observations and climate services are achievable even with few resources at low cost and are thus sustainable for long-term monitoring.

Furthermore, suitable national dissemination channels are often

absent or inefficient in transferring the information to end-users and other stakeholders. To avoid the latter, co-designing climate and earth observation services with users is critical. Conversely, decision- and policy-makers often need to attend to other immediate short-term policy issues and do not prioritize long-term climate change adaptation planning, due to short political cycles. It remains a significant challenge to achieve an appropriate and proportionate effort between long-term adaptation planning and shorter-term pragmatic and political strategies for management.

Climate resilient communities are established through actions based on understanding of the changing world and their capacity to act appropriately. To increase the uptake of climate and earth observation services, participants suggested capacity building and awareness raising amongst decision-makers and managers. Results-based management (e.g. United Nations Population Fund, 2019) can be a promising framework to promote the use of earth observation and climate services. The inclusion of actors in the private sector, in adaptation and mitigation strategies, may have a major positive impact on building favourable political and public opinions and thus advance the uptake of information services. In order to raise public awareness, participants shared experiences of framing climate change in a context that people care about, e.g., impaired learning ability of schoolchildren at higher temperatures.

4. Proposals for policy-making

The workshop was concluded by participants identifying a number of proposals for policymaking, research needs and the critical role of the media. These proposals intend to advance the development and uptake of earth observation and climate services for small islands. Participants recognised the need to pool and coordinate regional resources for scientific research relating to climate change modelling, earth and ocean observations and the development of scientific services to support climate change adaptation and transformation (see Few et al., 2017 for definition) of small island societies. This included ongoing and accelerated investment in high-resolution regional and local (small islands scale) downscaling and analysis capacities. There are opportunities to coordinate activities in regional networks and the establishment of “climate service centres” and its equivalent for earth observation.

There is a need to boost research capacity in small islands. Environmental hazards resulting from climate change will increase more in the Global South, however, the majority of research takes place either via external actors or from afar through institutions in the Global North. This presents a real risk of misrepresenting or misunderstanding the small island context and is often without local perspectives. Systematic data collection and shared databases across small island regions, e.g. Caribbean, Western Indian Ocean, South Pacific can facilitate actions such as the agro-ecological transition and is strongly encouraged. Data provision and sharing is important for the planning of appropriate policies and to share knowledge and experiences.

Scholars must work to understand patterns surrounding thresholds and critical tipping points for small islands. This will support the provision of more actionable scientific outputs specifically for policy- and decision makers. Defining such thresholds is crucial to encourage policy- and decision makers to take appropriate and decisive action. Linear and non-linear impacts, as well as the cascading effects of climate change on small island must be better understood. This is important for disentangling the driving factors and to better understand the dynamics and needs of small islands.

In terms of policy-making, participants of the meeting concluded that, especially in the case of climate and environmental hazards, scientific support for vulnerable communities should be planned well in advance. This is to ensure that scientific processes are relevant and transparent and does not infringe on people's right to be informed and involved in scientific research. This should be addressed through

adequate resources, infrastructures, institutional frameworks and legal mechanisms and may require regional collaboration to synergize the limited human and financial resources each country has. Included within this is the safeguarding of communities' right to participation and self-determination.

Climate change issues in small islands are complex and cut across social-ecological system. As such climate change adaptation requires an integrated and coherence approach that involves at least the agricultural, water, urban and rural planning sectors.

The media plays a key role in raising the profile and importance of small islands. It is the responsibility of the media, and those that work with the media, to ensure that these contents are both scientifically-based and accurate. It is also crucial to portray the views of the local populations affected, not just understandings gained from external perspectives.

In conclusion, the workshop participants emphasised the urgency for bold and appropriate actions to respond to the pending impacts of climate change on small island societies. The workshop collective produced well-informed and targeted proposals for policy-makers and for future research areas. The full set of policy-making proposals can be found in the 'Workshop Declaration' at the links below.

All workshop outputs can be found at <https://www.innovaclimate.org/workshop-on-earth-observation-and-coastal-climate-services-for-small-islands/>.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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² Louis Celliers, María Máñez Costa, Claas Teichmann, Lena Rölfer, Gundula Winter (Climate Service Center Germany), Simone Lewis (Global Water Partnership), William Skirving (NOAA/GEO Blue Planet), Martine Collard, Wilfried Segretier, Reynald Eugenie, Bernard Didier (Université des Antilles), Harry Ozier-Lafontaine, Francois Bussiere (French National Institute for Agricultural Research), Michelle Mycoo (Future Earth Coasts/University of the West Indies), Cedric van Meerbeek (Caribbean Institute for Meteorology & Hydrology), Bill Dennison (University of Maryland Center for Environmental Science), Chao-Tzuen Cheng, Hsin-Chi Li (National Science and Technology Center for Disaster Reduction Taiwan), Susan Singh-Renton (Caribbean Regional Fisheries Mechanism), Lyndonna Francis (Climate Smart Solutions Inc. Grenada), Tasheka Haynes (UNOPS Small grants), Brian-Lee Chandler (Caribbean Centre of Excellence for Sustainable Livelihoods), Greg Guannel (Caribbean Green Technology Center, University of the Virgin Islands), Floyd Homer (Trinidad and Tobago), Aboud S. Jumbe (Department of Environment, Republic of Tanzania), Cynthia Bonine (Synergile Guadeloupe), Roberto Moretti (Institut de Physique du Globe de Paris), Jérôme Roch, Elisa Rhettiere (ADEME, Guadeloupe), Maeva Vingadassalom, Axelle Daijardin (CR Guadeloupe), Jean-Louis Mansot (Délégué régional à la recherche et à la technologie, Région Guadeloupe), Philippe Hunel (Délégué régional à la recherche et à la technologie, Région Martinique), Axel Grava (The Urban Planning Network of Guadeloupe).