

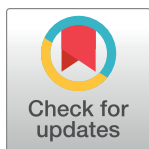
OPINION

Good practices: Co-producing integrated climate, environment and health services

Joy Shumake-Guillemot¹, Rosa von Borries^{1*}, Diarmid Campbell-Lendrum², Juli Trtanj³, Jonathan Abrahams⁴, Peter Berry⁵, S. C. Bhan⁶, Juan Castillo⁷, Yolanda Clewlow⁸, Sally Edwards⁹, David Gikungu¹⁰, Kenza Khomsi¹¹, Qi Yong Liu¹², Roché Mahon¹³, Andreas Matzarakis¹⁴, Marcella Ohira¹⁵, Judy Omumbo¹⁶, Kyu Rang Kim¹⁷, Reija Ruuhela¹⁸, Ben Ryder¹⁹, Craig Sinclair²⁰, Madeleine Thomson¹⁹, Coleen Vogel²¹

1 WHO-WMO Joint Climate and Health Office, Geneva, Switzerland, **2** World Health Organization, Geneva, Switzerland, **3** National Oceanic and Atmospheric Administration (NOAA), Washington, DC, United States of America, **4** Monash University, Melbourne, Australia, **5** Health Canada, Ottawa, Canada, **6** India Meteorological Department, New Delhi, India, **7** Pan American Health Organization, Washington, DC, United States of America, **8** United Kingdom Met Office, London, United Kingdom, **9** World Health Organization, Manila, Philippines, **10** Kenya Meteorological Department, Nairobi, Kenya, **11** General Directorate of Meteorology, Casablanca, Morocco, **12** China Centre for Disease Control, Beijing, China, **13** Caribbean Institute for Meteorology and Hydrology, Bridgetown, Barbados, **14** German Meteorological Service, Offenbach, Germany, **15** Inter-American Institute for Global Change Research (IAI), Montevideo, Uruguay, **16** The Science for Africa Foundation, Nairobi, Kenya, **17** Korea Meteorological Administration, Daejeon, Republic of Korea, **18** Finnish Meteorological Institute, Helsinki, Finland, **19** Wellcome Trust, London, United Kingdom, **20** Cancer Council Victoria, East Melbourne, Australia, **21** University of the Witwatersrand, Johannesburg, South Africa

* rvonborries@wmo.int



OPEN ACCESS

Citation: Shumake-Guillemot J, von Borries R, Campbell-Lendrum D, Trtanj J, Abrahams J, Berry P, et al. (2023) Good practices: Co-producing integrated climate, environment and health services. PLOS Clim 2(11): e0000304. <https://doi.org/10.1371/journal.pclm.0000304>

Editor: Jamie Males, PLOS Climate, UNITED KINGDOM

Published: November 28, 2023

Copyright: © 2023 Shumake-Guillemot et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Funding: The authors received no specific funding for this work.

Competing interests: The authors have declared that no competing interests exist.

The integration of climate and health sciences and services is vital to address growing health risks from climate extremes, variability, and change, as well as ecosystem changes. A 10-year strategy for advancing integrated climate and health science and services developed by a joint World Health Organization-World Meteorological Organization expert group provides the foundation for defining a set of good practices [1]. These underpinning principles can enhance the working relations between disciplines and sectors and the effectiveness of applied climate sciences.

Climate services for health are a form of partnership, defined as *the iterative process of collaboration between relevant multidisciplinary partners to identify, generate and build capacity to develop, deliver, and use relevant and reliable climate knowledge to enhance decision-making and action in the health sector*. These “services” take many forms but have the common goal to produce integrated and actionable information to protect the health of individuals and build healthy communities able to implement more resilient health systems, stemming from an evidence-based perspective of past, present, or future states of climate-related risks to society. Climate services draw upon information and knowledge not only about the climate, but weather, environment, and other health determinants provided by diverse actors. Examples of climate services may include monitoring and warning systems for population exposure to wildfire smoke, early warning systems for extreme temperatures, or forecasting infectious disease outbreak risks.

Here we synthesize a set of good practices and approaches (Fig 1) derived from experience, gap analyses, expert opinion, and evaluations and research findings on the application of climate science and development of climate services for the health sector [2]. Employing these principles can guide actors toward more successful partnerships and outcomes.

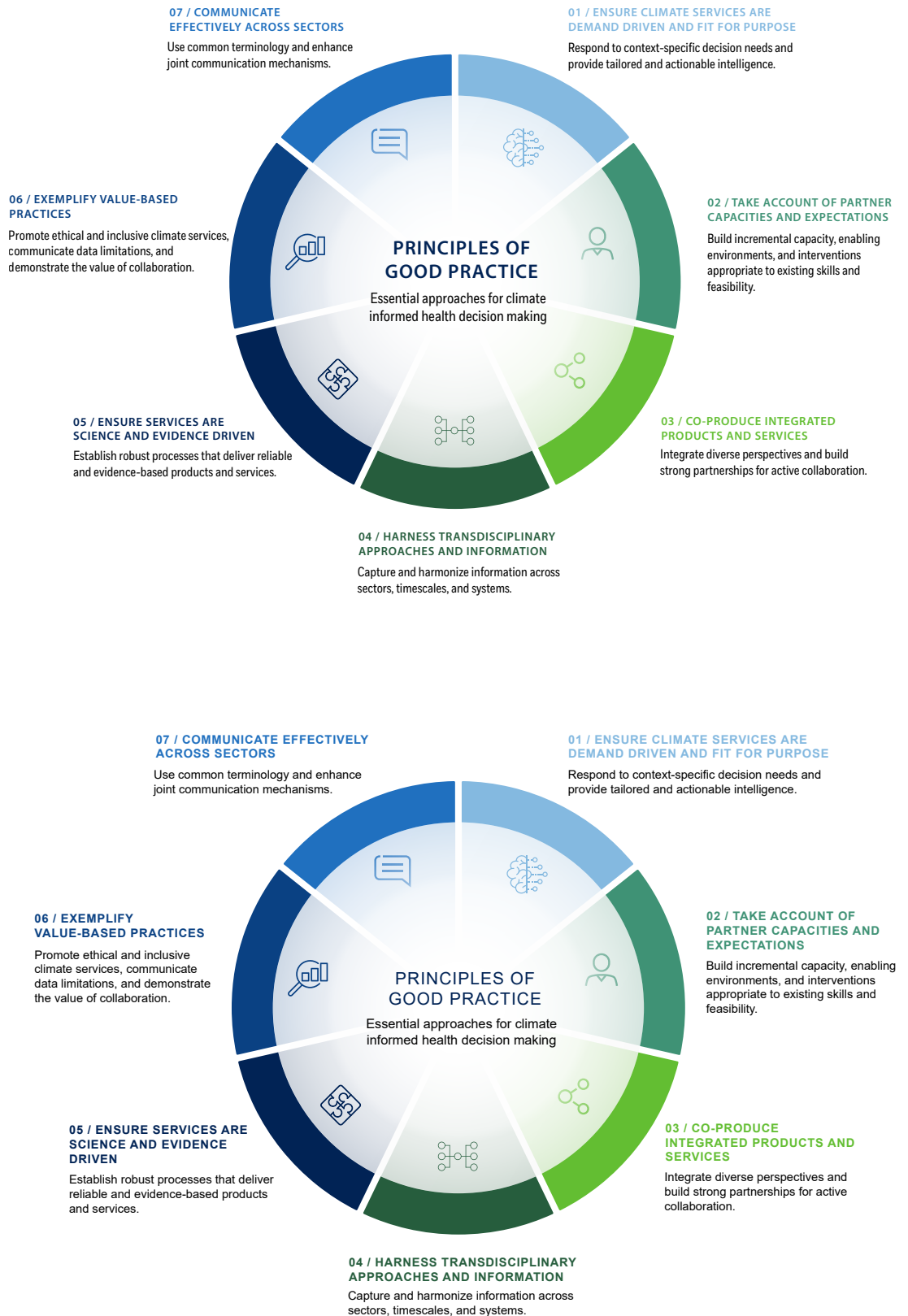


Fig 1. Good practices for implementing integrated climate, environment and health sciences and services.

<https://doi.org/10.1371/journal.pclm.0000304.g001>

Principles of good practice

Ensure climate services are demand driven and fit for purpose

The process of co-producing climate services must first and foremost be driven by what problem needs to be solved, and the specific decision and knowledge needs identified by relevant stakeholders including communities, practitioners, and health decision makers. Health risks are often highly localized to specific populations and geographies, and climate services must provide the temporal and spatial resolution of information to address these specific risks. This applies to remote areas which often lack the environmental, economic, social, and infrastructural resources, and can be isolated rapidly by extreme weather events, as well as urban areas that not only have concentrated populations with high levels of vulnerabilities but also experience micro-climates, which require local information and data to develop tailored climate services.

Take account of partner capacities and expectations

Building intersectoral collaboration and capacity calls for deliberate consideration of partner expectations and the foundational capacities, context and constraints which represent their “readiness” to co-produce climate services. This includes political will, governance mechanisms, data and technical capacity, financial resources, and available social capital that can help initiatives be more *tailored* to user needs and more readily implemented [3]. Common expectations include that products and information are of high quality, accessible and understandable, reliable, credible, responsive, timely, suitable, legitimate, and respect ethical standards. Trust and accountability between partners can be achieved by recognizing and meeting partners’ expectations and capacities.

Co-produce integrated products and services

Co-production, through collaboration and partnership, is fundamental to develop and use climate science and services that support health policies, programs, and practices. Integrating diverse perspectives, expertise, and information from different sectors and actors beyond the climate and health communities, including sub-populations, is often necessary to understand and address increasingly complex health risks and impacts. A continuous dialogue is essential to enhance capacity, develop trust and credibility, and ultimately design and sustain effective fit-for-purpose applications, such as early warnings for extreme heat events or severe storms. Co-production facilitates active collaboration and greater agility to anticipate and respond to severe weather events and unprecedented climate impacts that can strike communities and health systems.

Harness transdisciplinary approaches and information

Health risks associated with climate, weather and environmental hazards are often cascading, compounding and systemic, and may emanate from other sectors such as agriculture, water, energy, or other infrastructure. To understand and manage these climate-related health risks and inform risk management and adaptation, data and information from diverse sources, knowledge types, sectors, and disciplines, which span multiple time scales and geographic scales are often fundamental. Integrated approaches such as One Health [4], Planetary Health, and multi-hazard Health Emergency and Disaster Risk Management [5] can help break down disciplinary silos and establish integrated systems and mechanisms for collecting and using available information.

Ensure services are science and evidence driven

The health sector is an evidence-based domain with robust processes that deliver reliable research and evaluation findings. Information inputs coming from outside the health sector need to be subjected to similar scrutiny and data quality standards. An iterative science to services approach [6] can help experimental and operational climate services co-produce evidence-based products and services based on robust fundamental and mechanistic research, and evaluations.

Exemplify value-based practices

Promote ethical, equitable, and inclusive climate services. Providing ethical climate services [7] is essential if investments are to benefit and target the most at-risk populations. This includes promoting equitable access to information, and the prioritization and targeting of services and information dissemination to those most at risk. Consideration of economic, social, political, and cultural factors affecting exposure and vulnerability and the ability to participate in co-production activities and act on available information [8] is key in climate service development and delivery. Assessments and monitoring can be used to inform whether the process and outcomes meet expected criteria, and whether services and actions are sufficiently ethical, inclusive, and equitable.

Be transparent about data limitations and approaches. Recognition of data limitations and levels of uncertainty in both health and climate data is critical for developing effective and trustworthy services. Data limitations may stem from different sources, ranging from limitations or imprecision in the data collection and processing, to ambiguously defined concepts or terminology, incomplete understanding of critical processes, or uncertainty about future climate and human behaviors. Communicating and addressing data limitations and requirements can strengthen partnerships and trust building.

Demonstrate the value of collaboration. The collaboration required to co-produce climate services comes with inherent human, technical and financial resource costs. To maintain and sustain a climate service partnership over time, the value of the outcome which could not be achieved by one partner or sector alone must be demonstrated to secure financial and often political support. It must also be demonstrated that in the context of health protection this collaborative intervention is a cost-effective way of saving lives. This value can also be measured in terms of providing legitimate and authoritative information, providing space for innovation and creativity, leveraging knowledge of other disciplines. To ensure that the time and effort of the collaboration is worthwhile, steps to monitor and value the costs of collaboration as part of the pathway to viable products and services can help sustain services.

Communicate effectively across sectors

Sustained engagement between climate, health and other sectors depends upon effective communication, common terminology, and mutual understanding. Climate and health professionals play a key role in communicating health risks associated with weather, climate variability and climate change with stakeholders and the public. Joint messaging and communication can help reflect shared responsibilities and expertise. This includes using joint communication platforms and mechanisms that can accelerate transdisciplinary capacity for collaboration and mutual understanding [9,10].

Way forward

Greater investment in integrated climate and health sciences and services is vital for climate-resilient health systems and preparing at risk communities to better anticipate and respond to

climate change, extreme weather, and other environmental threats [11]. Over the last few decades pioneering scientists from National Meteorological Services, Public Health agencies, academia and increasingly the private sector, have demonstrated that co-production of applied climate services for health can save lives [2]. Remembering and employing these good practices can help climate and health actors to come together to inform collaborative and innovative solutions to the complex and dynamic health risks posed by climate change.

Author Contributions

Conceptualization: Joy Shumake-Guillemot, Rosa von Borries, Diarmid Campbell-Lendrum.

Writing – original draft: Joy Shumake-Guillemot, Rosa von Borries.

Writing – review & editing: Diarmid Campbell-Lendrum, Juli Trtanj, Jonathan Abrahams, Peter Berry, S. C. Bhan, Juan Castillo, Yolanda Clewlow, Sally Edwards, David Gikungu, Kenza Khomsi, Qi Yong Liu, Roché Mahon, Andreas Matzarakis, Marcella Ohira, Judy Omumbo, Kyu Rang Kim, Reija Ruuhela, Ben Ryder, Craig Sinclair, Madeleine Thomson, Coleen Vogel.

References

1. WHO-WMO Joint Climate and Health Programme. Global Knowledge Platform for Climate and Public Health. Available from: <https://climahealth.info/who-wmo-joint-programme/>.
2. Shumake- Guillemot J, Fernandez-Montoya L, editors. Climate services for health: improving public health decision-making in a new climate. Geneva: World Health Organization and World Meteorological Organization; 2019. <https://public.wmo.int/en/resources/library/climate-services-health-case-studies>.
3. WHO-WMO Climate Services for Health Readiness Tool. 2019. <https://climahealth.info/resource-library/climate-services-for-health-readiness-evaluation-toolkit/>.
4. WHO Newsroom. One Health. Available from: <https://www.who.int/news-room/questions-and-answers/item/one-health>. 2017.
5. Health Emergency and Disaster Risk Management Framework. Geneva: World Health Organization; 2019. Licence: CC BY-NC-SA 3.0 IGO. <https://www.who.int/publications/i/item/9789241516181>
6. WMO. Concept Note: Science in Service to Society. 2020. Available from: https://wmoomm.sharepoint.com/sites/wmocpdb/eve_activityarea/Forms/AllItems.aspx?id=%2Fsites%2Fwmoocpdb%2Feve%5Factivityarea%2FResearch%20Board%5F05709C599F5AED119561000D3ABFF826%2FConcept%20Notes%2FScience%20for%20Services%2Epdf&parent=%2Fsites%2Fwmoocpdb%2Feve%5Factivityarea%2FResearch%20Board%5F05709C599F5AED119561000D3ABFF826%2FConcept%20Notes&p=true&ga=1
7. Adams P., Hewitson B., Vaughan C., Wilby R., Zebiak S., Eitland E., et al, 2015. Call for an ethical framework for climate services. *WMO Bulletin* 64, 51–54.
8. Gumucio T., Hansen J., Huyer S., Van Huysen T., 2020. Gender-responsive rural climate services: a review of the literature. *Climate and Development* 12, 241–254. <https://doi.org/10.1080/17565529.2019.1613216>
9. WHO-WMO Global Knowledge Platform for Climate and Public Health. Available from: <https://climahealth.info/>.
10. National Integrated Heat Health Information System. Available from: <https://www.heat.gov/>.
11. WHO Guidance for climate resilient and environmentally sustainable health care facilities. Geneva: World Health Organization; 2020. Licence: CC BY-NC-SA 3.0 IGO <https://www.who.int/publications/i/item/9789240012226>.