United Nations
Framework Convention on
Climate Change

Mapping of how Research Gaps Identified by the SBSTA since SBSTA 22 are being addressed by the Scientific Community

Information note by the SBSTA Chair, presented at the 18th meeting of the research dialogue, SBSTA 64.

Presented by the UNFCCC secretariat,

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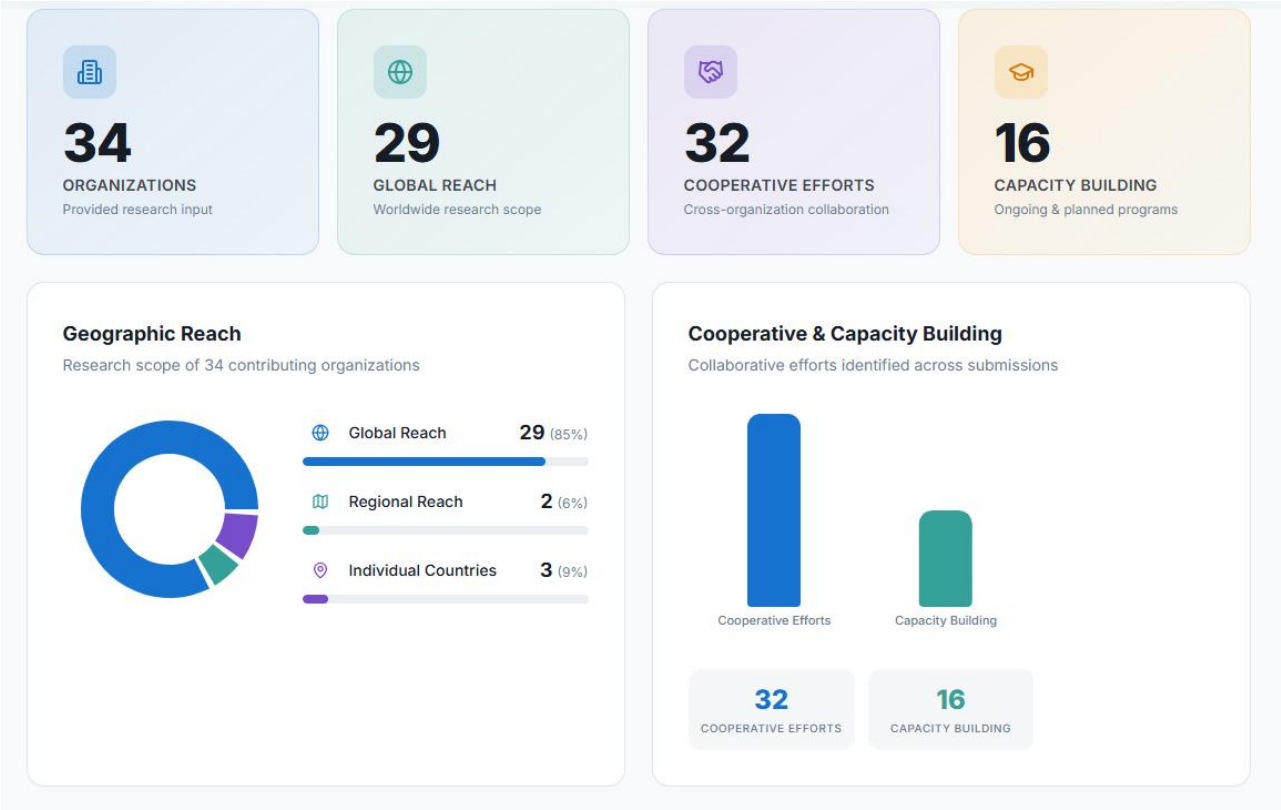
Approach and input



1 Open Invitation → 2 Multi-Channel Outreach → 3 34 Organizations → 4 32 Cooperative Efforts

Five Categories of Research Gaps

**Conclusions from 20 SBSTA sessions were mapped, and analyzed into five thematic categories.

1

Understanding Climate Change, related Data & Scenarios

Near-term prediction, high-resolution regional information, climate models, and scenario development.

2

Adaptation, Loss & Damage, Extreme Events

EWS, climate services, cascading risks, adaptation effectiveness, and impacts on vulnerable groups.

3

Ecosystems & Nature-Based Solutions

NbS implementation, ocean and cryosphere impacts, terrestrial carbon, and ecosystem tipping points.

4

Mitigation, Related Technologies & GHG Reporting

GHG emissions and removals, CDR technologies, and reporting methodologies.

5

Cross-Cutting Areas

Adaptation-mitigation synergies, equity in modelled pathways, and Indigenous and local knowledge.

CATEGORY 1

Understanding Climate Change, Data & Scenarios Development and use

Near-Term Prediction

- Near-term scenario benchmarks, Annual to Decadal Climate Updates providing multi-year predictions, & initiatives on scenario exploration such as SCI.
- Research linking El Niño/La Niña and Arctic-driven changes to weather patterns.

Climate Scenarios Development

- SSP framework evolution
- Efforts such as CMIP (with advances in model complexity, resolution, and bias reduction), AR 6 Scenario explorer (3,000+ quantitative scenarios available); IAMC efforts on multi-model intercomparison, Scenario Compass, & role of AI & ML.
- Geophysical model development, e.g simulation of ice mass balance.

Downscaled Information

- Efforts at regional and national level, e.g. CORDEX-high-resolution regional climate information.
- ENGAGE, DCSALE, CCAFS Data portal and ecosystem focused efforts such as in the HKH.
- Digital Earth systems for extremes, and downscaling efforts consistent with PA pathways.

Attribution Science

- Advances in statistical methods and overall efforts for attributing climate extremes, and attribution of anthropogenic drivers to extreme events; e.g. ISIMIP impact attribution.
- Attribution of monsoons (CLIVER-GEWEX Monsoon panel, and other regional studies).

CATEGORY 2

Adaptation, Loss & Damage, and Extreme Events

Dynamics of extreme events

Studies on advances in detection and attribution of extremes, such as heatwaves, droughts, wildfires. AI and ML efforts to identify regime shifts.

Adaptation Effectiveness

Empirical studies and indicator-tools to assess actions and linking adaptation outcomes to SDGs, the Sendai Framework, and NAPs. Research on limits to adaptation, from structural inequalities and constrained capacity.

Early Warning & Climate Services

Efforts for timely and accessible information and warnings; incl role of Earth observation, digital twins, and crowd-sourced data to enhance EWS. Co-produced climate services in support of anticipatory action.

Cascading & Transboundary Risks

Remote sensing and systems analysis that improve detection of multisector risks across supply chains, shared river basins, and cryosphere-dependent systems.

Impacts on Vulnerable Groups

Studies focusing on Indigenous Peoples, women, children, and low-income populations- differentiated exposure, climate induced-mobility, and structural constraints. Impacts on health, livelihoods and contribution to inequalities.

Impacts at 1.5 C

Integrated modelling efforts (at local and regional level) that identify risks across water, agriculture and health. Studies on critical threshholds, such as heat stress

CATEGORY 3

Ecosystems & Nature-Based Solutions

Nature-Based Solutions

Research on approaches covering adaptation and mitigation, incl ecosystem restoration, SLM, enhancing blue carbon ecosystems; and Integrated modelling efforts exploring land-use pathways and supporting spatial prioritization for combined adaptation, mitigation, and biodiversity benefits.

Ocean & Cryosphere

Research on impacts and risks on related ecosystems (marine heatwaves, glacier retreat, sea ice loss, ocean circulation, permafrost thaw) and management efforts. Observational advances in support monitoring of cryosphere change and ecosystem risks.

Terrestrial emissions and removals

Research on role of high-carbon ecosystems, as emmision sources and sinks, carbon stocks and flux estimates across forests, soils, and permafrost and associated remote-sensing and multi- model approaches.

Vulnerability, tipping Points and resilience of ecosystems

Studies on understanding thresholds, feedback mechanisms and interlinkages of ecological processes, and pathways for reducing vulnerabilities. Research on tipping dynamics.

CATEGORY 4

Mitigation, Related Technologies & GHG Reporting

GHG Emissions & Sinks

Research on GHG emissions from various sources and information on sinks.

Studies on multi-sector GHG emission analysis and accounting approaches. Quantification of CO_2, CH_4, and N_2O fluxes across atmosphere, ecosystems, and ocean, including Arctic permafrost and wetlands

Carbon Dioxide Removal (CDR)

Studies assessing CDR approaches (both novel and conventional), role in near-and long-term (models and net-zero pathways), limitations and its advancement.

Research on feasibility, risks, governance and MRV.

Equity in Mitigation Pathways

Research on equity considerations in pathways.

Efforts such as DESIRE framework, DSCALE, JustMIP integrating various parameters.

Frameworks considering standards of living and fair emission shares.

Platforms allowing users to explore pathways- such as En-ROADS,.

Cross-Cutting Areas and IPCC Outputs' Desk Review

CATEGORY 5

Cross-Cutting Areas

- Co-benefits and trade offs with sustainable development. Multi-model analysis of co-benefits with air quality, health, and energy; trade-offs with food security and land-use
- Knowledge of Indigenous Peoples and local knowledge systems including collaborative research and case studies, and studies on methodological approaches for consideration of various forms of knowledge. Experiences such as fire response in the Arctic, drought resilience in the Himalayas, conservation in the Amazon.

IPCC Filling Knowledge Gaps Since AR4

- Earth system models and SSPs
- Regional climate information
- Attribution science
- Climate risks and services
- Equity and sustainable development considerations
- Indigenous and local knowledge integration

Cooperation & Capacity-Building Initiatives

Regional Networks

Africa Data Hub, Hindu Kush Himalaya Springs Alliance, and global partnerships supporting data-sharing and institutional capacity.

Capacity Building

Workshops and training on GIS, satellite monitoring, AI and high-resolution modelling, with dedicated early-career researchers initiatives.

Open Knowledge Sharing

Open-access repositories and scenario databases improve data accessibility across regions and institutions.

All inputs are available on the 18th Research Dialogue webpage. A full list of contributing organizations is in Annex I of the information note.

Information note mapping how research gaps identified by the SSTA are being addressed

"The note is not exhaustive of all research efforts undertaken by the scientific community during the review period. It reflects input from the 34 research and scientific organizations and there are variations in the scope, format and depth of input shared"