Global Precipitation Experiment



Robert (Jeff) Trapp (University of Illinois, US), Annalisa Cherchi (National Research Council, Italy), Hindumathi Palanisamy (WMO), and the WCRP GPEX Science Leadership 46th Session of the WCRP Joint Scientific Committee (JSC-46) 12-16 May 2025

nternational Science Council



Joint Scientific Committee (JSC)

Lighthouse Activities

- Digital Earths
- Explaining and Predicting Earth System Change (EPESC)
- Global Precipitation EXperiment (GPEX)
- My Climate Risk (MCR)
- Research on Climate Intervention
- Safe Landing Climates (SLC)

Ongoing Activities and Fora

- Fixed-term projects
- Rapid updates, syntheses, assessments, gap analysis
- Conferences and workshops
- Diversity and capacity building: ECRs, regions
- Communications and outreach

WCRP Lighthouse Activities

- aims at addressing priority science questions
- transdisciplinary in nature
- integrating across WCRP and collaborating with partners, to accelerate advances in new science, technologies, and institutional frameworks

Core Projects

- Atmospheric Processes And their Role in Climate (APARC)
- Climate and Cryosphere (CliC)
- Climate and Ocean Variability, Predictability and Change (CLIVAR)
- Earth System Modelling and Observations (ESMO)
- ▶ including the Coupled Model Intercomparison Project (CMIP)
- Global Energy and Water Exchanges (GEWEX)
- Regional Information for Society (RIfS)
 including the Coordinated Regional Climate Downscaling Experiment (CORDEX)

WCRP Academy

https://www.wcrp-climate.org/gpex-overview



International Offices

Support

Unit

Global Precipitation Experiment - GPEX

History/timeline

2020: USGCRP first explored the concept of GPEX

2021: WCRP JSC decided to pursue this initiative

2022: GPEX Tiger Team was appointed, and white paper was submitted

2023: Science Team was appointed; GPEX was launched as a WCRP LHA in October; Science Plan was finalized in November

2024: Science Team was appointed as Interim SSG; SSG and WG Co-Chairs were appointed

2024 (December): 1st in person SSG meeting & joint GPEX-US agencies workshop

2025 (January): new co-chairs and SSG in place





Global Precipitation Experiment - GPEX

Motivation

Despite progress in the past few decades, the improvement of precipitation prediction skill remains slow.



GPEX Science Plan: scientific questions

Q1: What are the <u>sources and magnitude of uncertainties in quantitative precipitation estimates</u> over global land and ocean, particularly in regions of vulnerable populations and limited observing capabilities, and how can we address them?

Q2: <u>How is precipitation produced by complex moist processes and their interactions with</u> atmospheric dynamics and other components of the Earth system?

Q3: What are the <u>sources of precipitation biases in climate models</u> and <u>how can we reduce them</u> to improve predictions and projections of precipitation at different temporal and spatial scales?

Q4: How can we <u>enhance regional and local capacity building</u> for precipitation observations, process understanding, prediction services (e.g., early warning systems), projection, and applications?

Zeng et al., 2025, Global Precipitation Experiment—A New World Climate Research

Programme Lighthouse Activity DOI: <u>https://doi.org/10.1175/BAMS-D-23-0242.1</u>



Key elements of GPEX Science Plan



 World Climate Research Programme
 Zeng et al., 2025, Global Precipitation Experiment—A New World Climate Research Programme Lighthouse

 Activity
 DOI: https://doi.org/10.1175/BAMS-D-23-0242.1

GPEX Implementation: WCRP's Years of Precipitation

- The central phase of GPEX is the WCRP Years of Precipitation for 2–3 years with coordinated global field campaigns focusing on precipitation drivers over different regions and seasons.
- Activities are planned over the three phases (before, during, and after the Years of Precipitation) spanning a decade.
- YoP planning phase needs to engage scientists from different regions to articulate refined and regionally relevant objectives and plan logistics for field campaign activities.







David McNew, Getty Images





Zeng et al., 2025, Global Precipitation Experiment—A New World Climate Research Programme Lighthouse Activity DOI: https://doi.org/10.1175/BAMS-D-23-0242.1

4 main scientific questions/objectives addressed focusing on 4 main precipitation drivers organized into 4 WGs with specific activities, all contributing to the objectives

Working Group (WG)s of GPEX

WG1: Co-ordinated field campaigns

WG2: P-Relevant Data Development

WG3: P Modeling, Prediction, and Process Understanding

WG4: National/Regional Activities & Capacity Development



GPEX endorsement of anchor projects

Criteria for GPEX endorsement* of anchor projects

- Must be precipitation focused
- Must involve two or more countries.
- Must be funded at least a total of USD 5 million (equivalent)
- *Must be open to collaborations*
- Must provide data dissemination and access plan
- Must include capacity development plan(definition, how your project plans to support capacity development – provide examples : such as adhering to the SDGs).
- Roadmap and coordination plan with tangible GPEX objectives.



Pic: rain gauges and soil moisture sensors during the IFloodS campaign

* Subject to GPEX SSG review and approval.

WG1: Coordinated Field Campaigns Co-Chairs: Fred (Marty) Ralph, Samson Hagos

Coordinate global field campaigns with in situ, airborne, and satellite measurements of the atmosphere, land, and ocean, focusing on different precipitation drivers

Primary Activities:

- Engaging with scientists and funding agencies to identify potential projects for each precipitation driver across the globe
- Submitted proposal for consideration of AR-Recon as GPEX anchor project (atmospheric river)
 - Approved by GPEX SSG as of 10 May 2025!





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Current and planned activities, proposals under development



WG2: Precipitation-Relevant Databases

Co-Chairs: Akiyo Yatagai, Hui Su

Focus on activities that will add values to existing efforts, through partnerships:

- Acknowledge that a wide range of global and regional precipitation datasets already exists.
- Contribute to the systematic evaluation of such datasets as well as aid the establishment and/or expansion of global and regional precipitation – e.g. Intercomparison of data sets focusing on regions based on different GPEX precipitation drivers- AR regions as example.
- Emphasize the development of low-cost, easy-to-maintain instruments for enhancing global precipitation-relevant measurement network.
- Work with other projects and interact with data users on the further assessment and quantification of uncertainties of gridded precipitation products (including reanalysis) at different spatiotemporal scales.



WG3: Precipitation Modeling, Prediction, and Process Understanding

Co-Chairs: Hayley Fowler, Maria Laura Bettolli

With a focus on the four precipitation drivers:

- Coordinate multi-scale precipitation analysis and forecasts, and support the establishment of multi-model databases, along with common evaluation metrics;
- Support research on precipitation predictability, prediction techniques, and applications at various time scales.
 - How do specific processes affect model performance at various resolutions?
 - What are the limits (in space and time) to the predictability of precipitation?



Extreme precipitation in East Asia- Anomalous air temperature at 850 hPa, Ho et al., 2018



WG4: National/Regional Activities and Capacity Development

Co-Chairs: Jakob Steiner, Toru Terao

Establish capacity development as the link between GPEX Science and beneficiaries:

- Inform GPEX strategies from the bottom up based on existing regional/local needs and capacities
- Work with other projects to support the capacity development by entraining scientists and graduate students, particularly from the Global South.
- Work with other projects to **make precipitation datasets available for resource-challenged scientists** in the Global South.
- Support existing national/regional activities and/or the establishment of new activities, partly through capacity building.



Some other activities of the GPEX SSG in 2025

- Submitted two GPEX-themed session proposals for the CMIP Community Workshop
- Met with representatives from KIT to discuss field campaigns and collaborations
- Engaged with leadership of the WWRP to discuss anchor-project collaborations, joint development of science questions, and enhancements of observations during upcoming field campaigns
- Presented GPEX objectives to organizers of the Thunderstorm Intensification from Mountains to Plains (TIM) project
- Upcoming in June: meeting with NCEP & ECMWF model developers/developers of precipitation products



World Climate Research Programme Global Precipitation Experiment

- Are you aware of a precipitation related field campaign that might be willing to be a GPEX anchor programme? Please write to us at <u>hpalanisamy@wmo.int</u> (Hindumathi)
- GPEX is interested in collaborating with modelling, forecasting and data centres. Please write to us at <u>hpalanisamy@wmo.int</u> (Hindumathi)



Thank You



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www.wcrp-climate.org







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