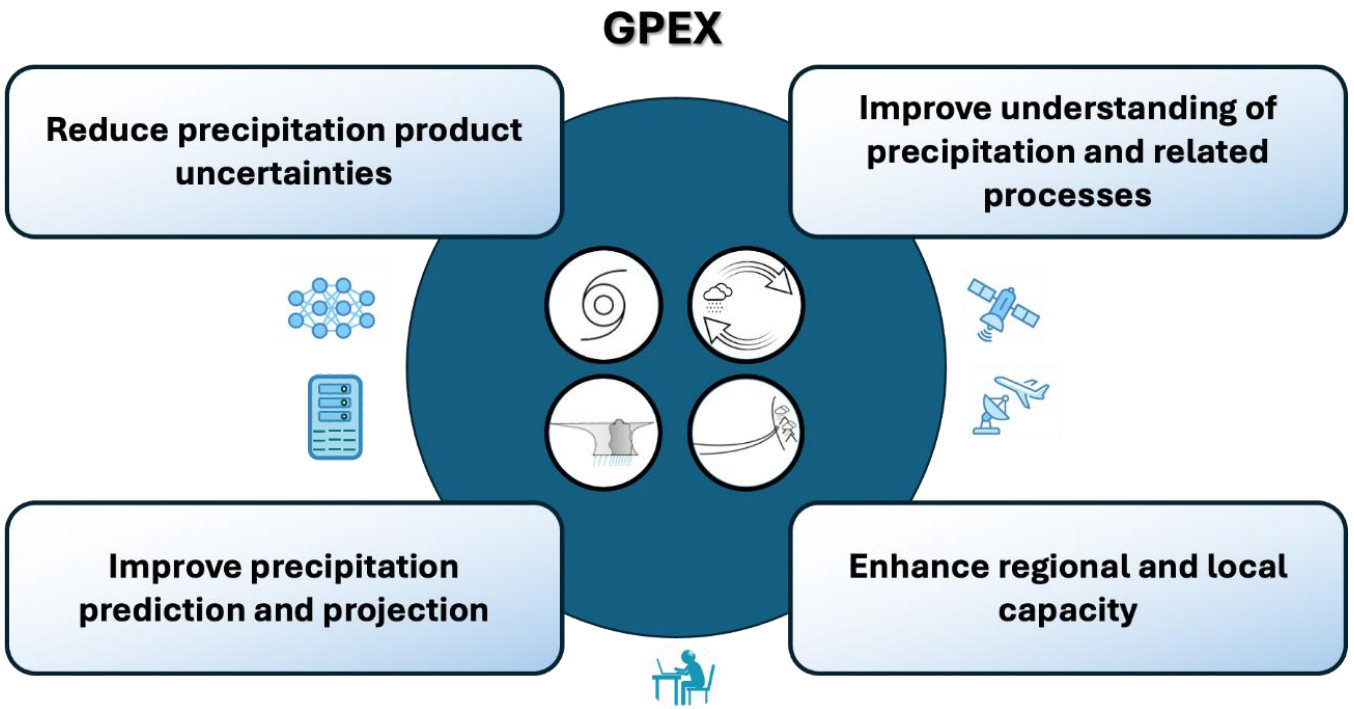
Global Precipitation Experiment



Hindumathi Palanisamy, Annalisa Cherchi, Robert (Jeff) Trapp and the WCRP GPEX Science Leadership

Eighth WMO International Workshop on Monsoons, IITM Pune
18 March 2025

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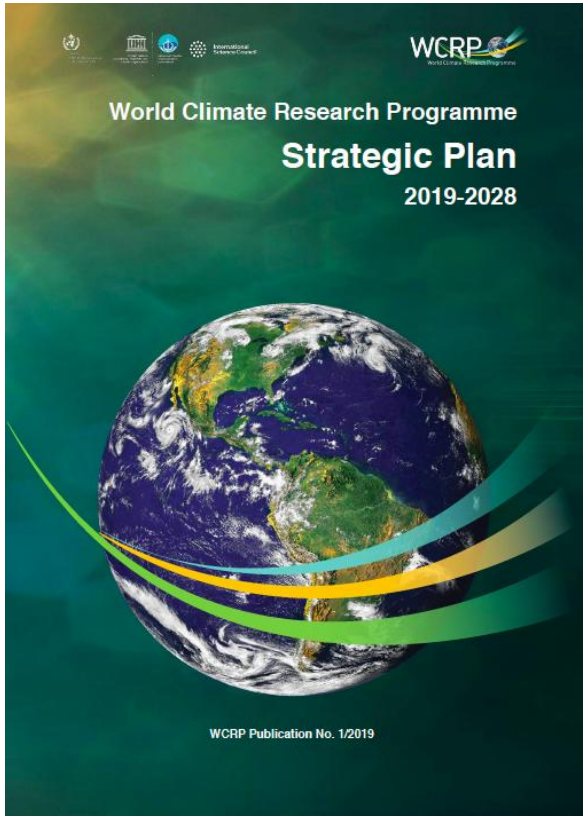
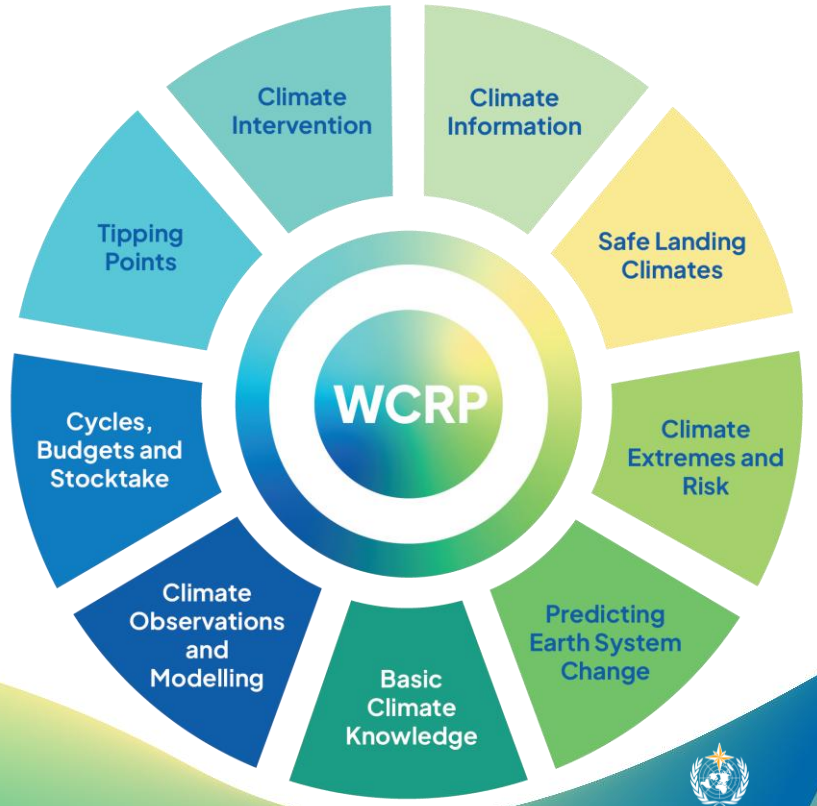


The Mission (*what we do, our purpose*)

Coordinate and facilitate international climate research to develop, share, and apply the climate knowledge that contributes to societal well-being.



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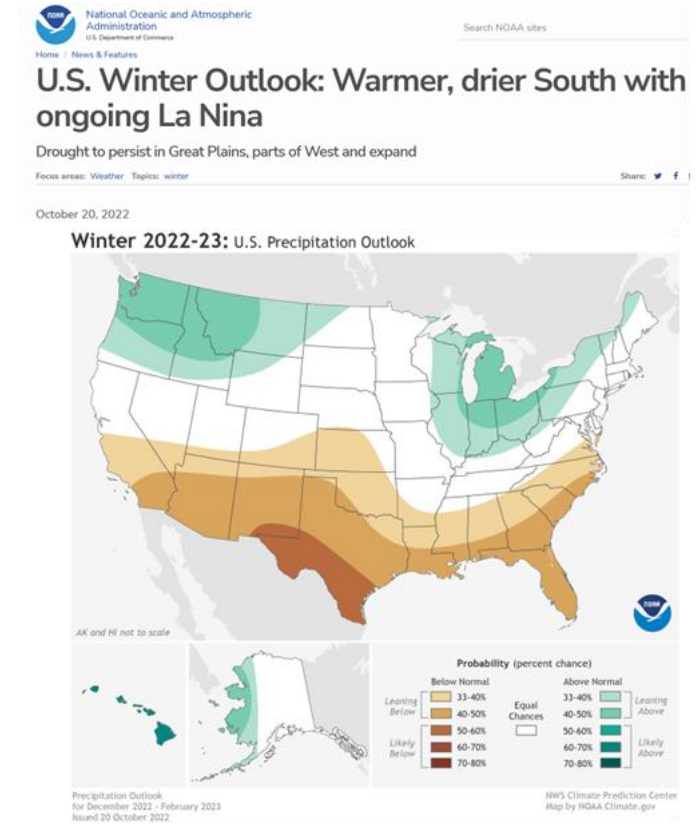
Motivation

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

History

- 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.



NCEP & others failed in seasonal prediction for 12/2022- 2/2023.

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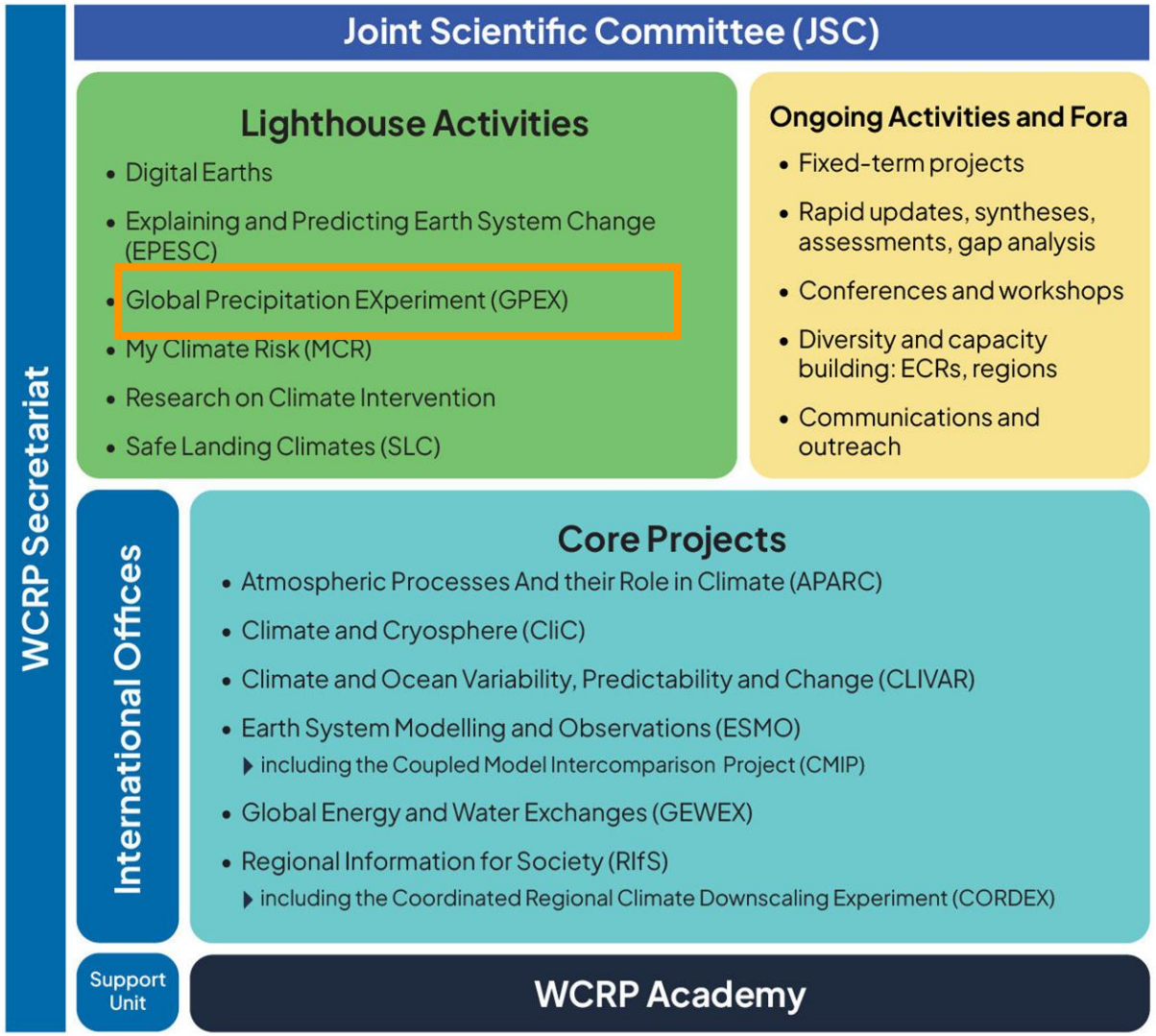
WCRP Organizational Structure



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

Global Precipitation EXperiment (GPEX) aims at taking on the challenge of improving precipitation predictions around the world, including polar and high-mountain regions.

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

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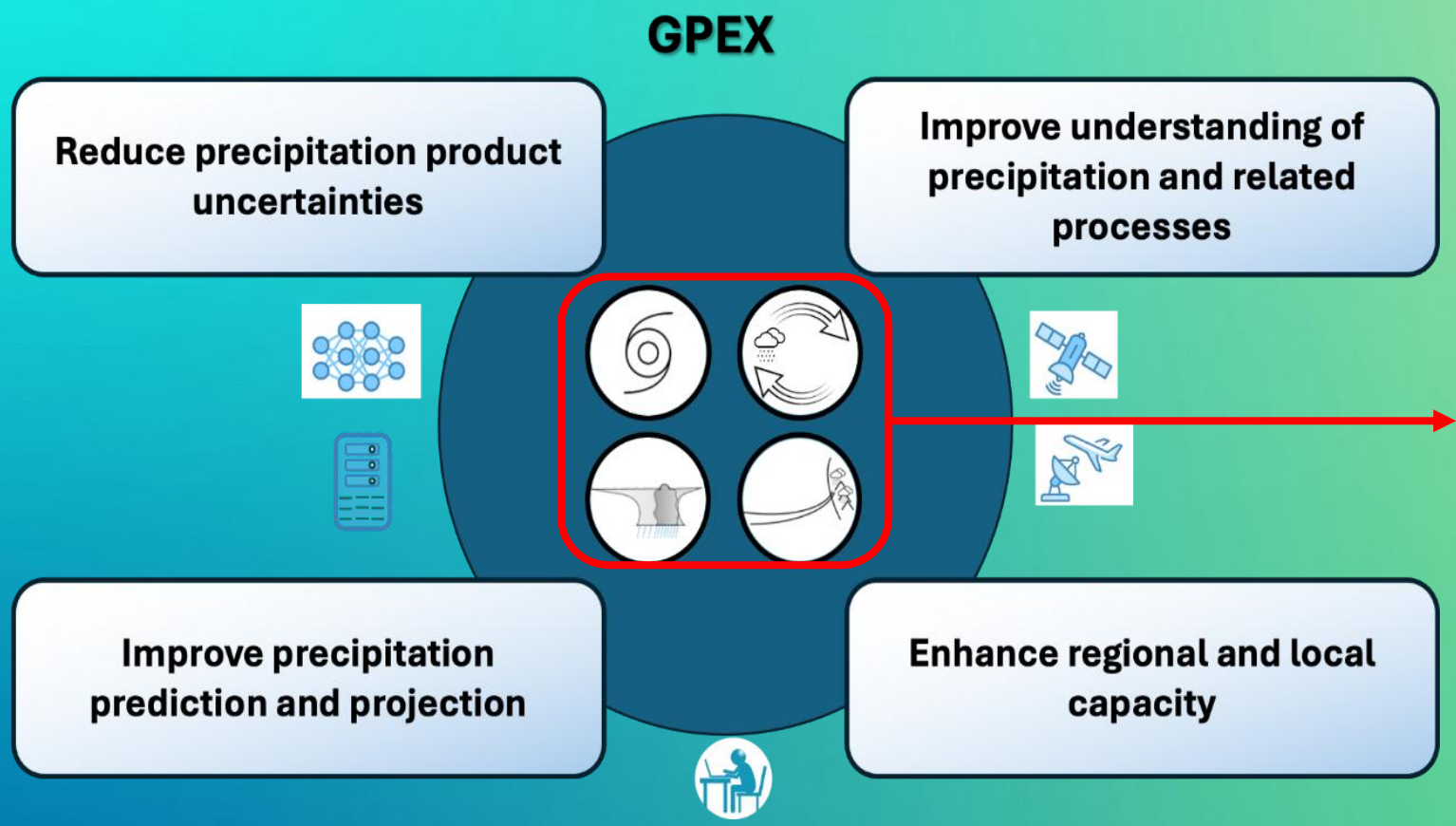
Key elements of GPEX Science Plan



- Atmospheric rivers
- Mesoscale convective system
- Tropical cyclones
- Monsoons precipitation

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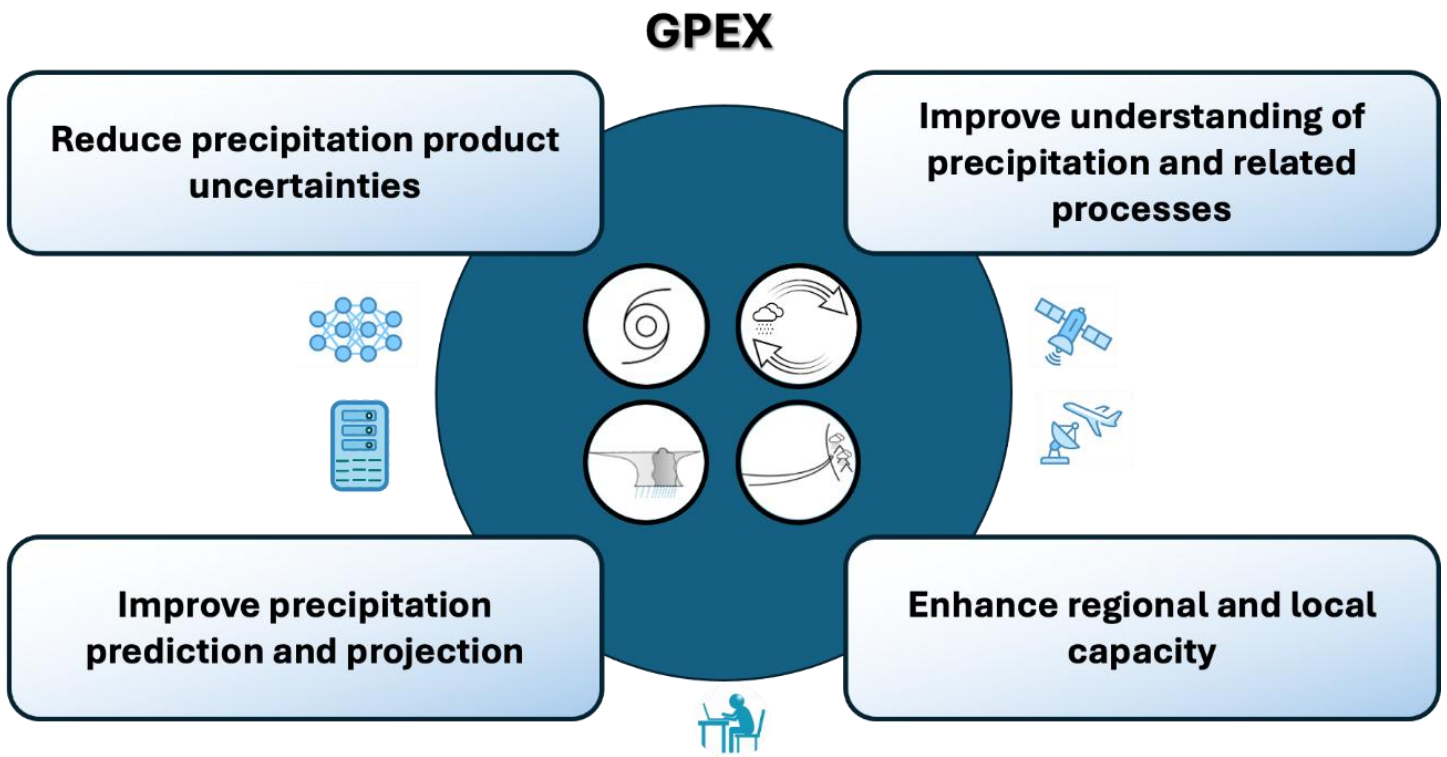
Zeng et al., 2025, Global Precipitation Experiment—A New World Climate Research Programme Lighthouse Activity

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

Key elements of GPEX Science Plan



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

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

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

Q4: How can we enhance regional and local capacity building 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

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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.**

Credit: Steve Zumwalt

David McNew, Getty Images

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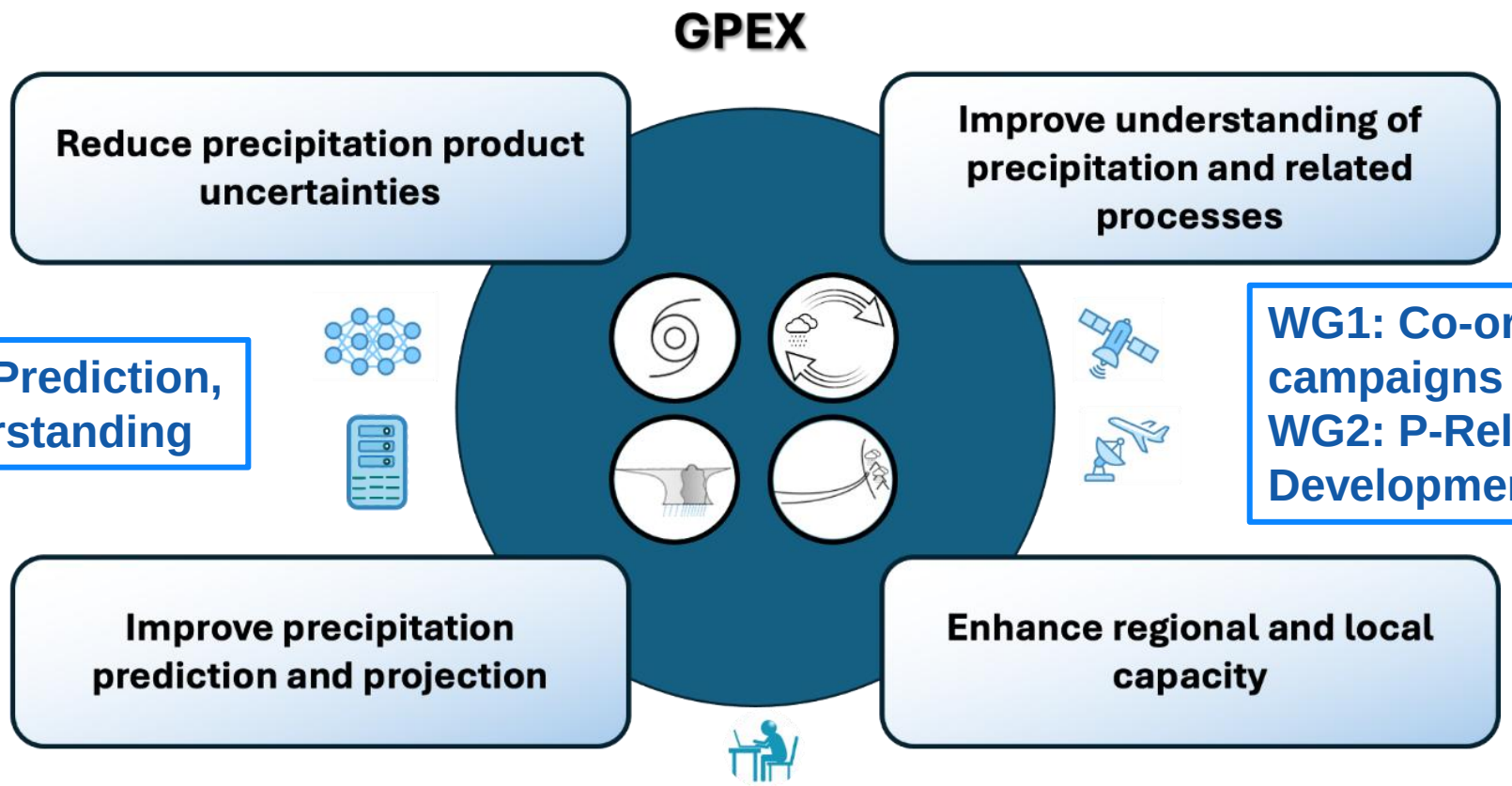
LIGHTHOUSE ACTIVITIES

Working Group (WG)s of GPEX



WG3: P Modeling, Prediction, and Process Understanding

WG1: Co-ordinated field campaigns
WG2: P-Relevant Data Development

WG4: National/Regional Activities & Capacity Development

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

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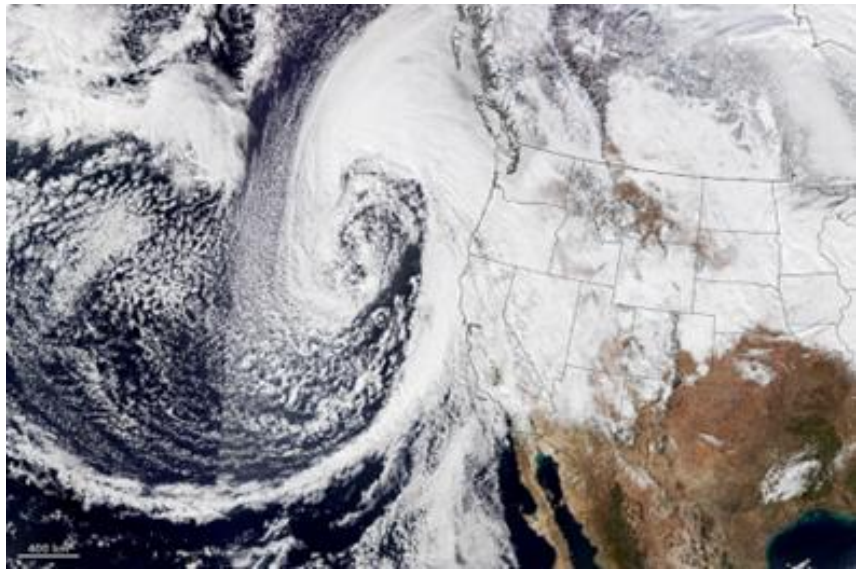
WG1: Co-ordinated Field Campaigns

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:

- atmospheric rivers,
- mesoscale convective systems,
- monsoons,
- tropical cyclones

These occur over different seasons and between seasons over different regions.

Primary Activity: Engage with scientists and funding agencies to identify potential anchor projects for each precipitation driver.

Ongoing discussions

- AR-Recon (already funded) as anchor for AR
- US: Pacific/Atlantic/US - TEPEX
- Europe: Atlantic/Europe
- Asia (AsiaPEX): Pacific/Indian/Asia
- Africa: Hi-Africa?
- Arctic: ?

WG1: 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

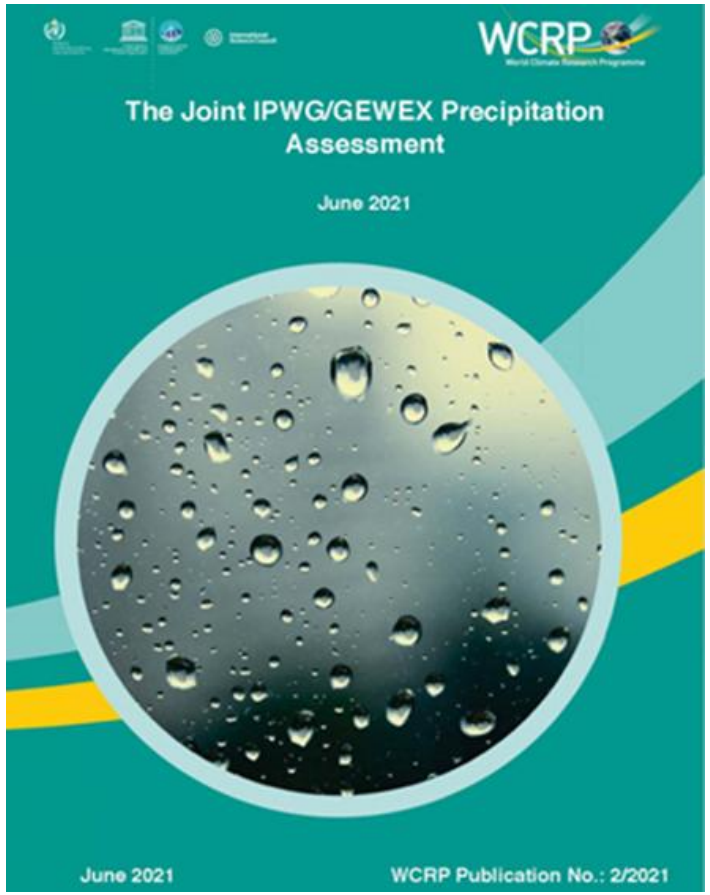
** Subject to GPEX SSG review and approval.*

WG2: Precipitation-Relevant Databases

Co-Chairs: Akiyo Yatagai, Hui Su

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

- **Acknowledging** that a wide range of global and regional precipitation **datasets already exist**.
- will 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.
- will work with other projects and interact with data users on the further **assessment and quantification of uncertainties of gridded precipitation product**s (including reanalysis) at different spatiotemporal scales.

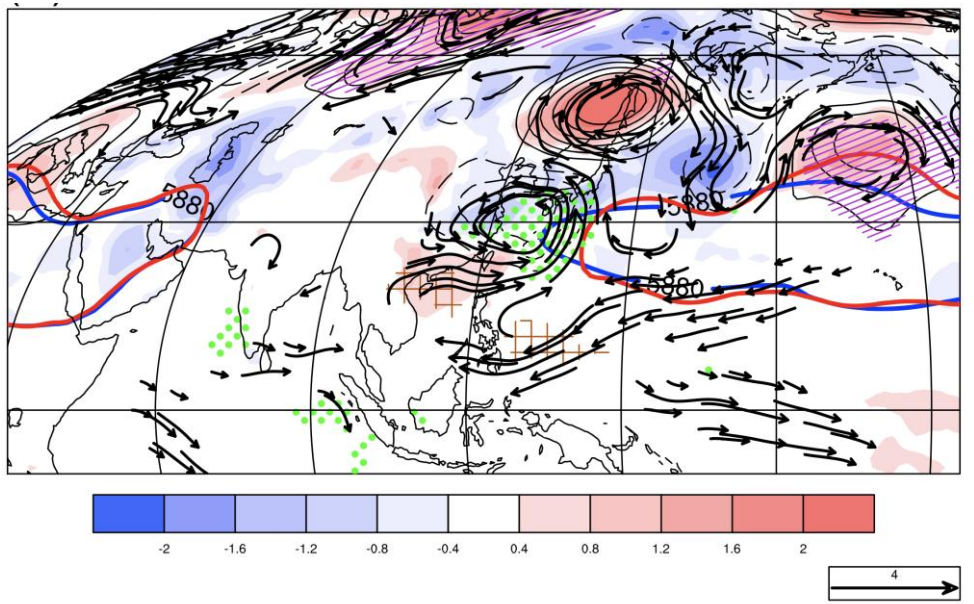


WG3: Precipitation Modeling, Prediction, and Process Understanding

Co-Chairs: Hayley Fowler, Maria Laura Bettolli

- 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

WG4 Vision: 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.

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Implementation and Timeline

- Pre-YoP Phase (e.g.,Years 1-3): YoP planning; seek and encourage large GPEX-endorsed anchor projects for the global field campaigns
- YoP (e.g., Years 4-6): Focus on all four activities
- Post-YoP (e.g., Years 7-9): Focus on activities using new measurements.

GPEX activities for a decade will be completed and fully integrated into WCRP Core Projects.

GPEX Strategy: **Focus on a few activities, and do them well, with strong partnership**

World Climate Research Programme
Global Precipitation Experiment

- *We are looking for new Working Group members to join us!*
  https://www.wcrp-climate.org/news/wcrp-news/2272-open-call-gpex-2025

- *Precipitation related field campaigns – willing to be a part of GPEX anchor programme? Please write to us at hpalanisamy@wmo.int (Hindumathi)*

- *GPEX is interested in collaborating with modelling, forecasting and data centres. Please write to us at hpalanisamy@wmo.int (Hindumathi)*

Thank You

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