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The PANGEA Scoping Study Final Report

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Documentation Revision Date: 2025-02-18

Dataset Version: 1.1

Summary

This dataset provides the final report from the PAN tropical investigation of bioGeochemistry and Ecological Adaptation (PANGEA) scoping study. PANGEA is one of the two scoping studies funded by NASA in 2023 to identify the scientific questions and develop the initial study design and implementation concept for a new NASA Terrestrial Ecology field campaign. This report provides 1) the scientific rationale; 2) an initial study design concept; 3) a presentation of science questions, goals, and objectives; 4) the rationale in terms of state-of-the-art, relevance, and expected advances; 5) implementation concepts; and 6) other information to enable NASA to fully evaluate the project. This report outlines the PANGEA concept, including the PANGEA science themes, science questions, the scientific and technical advancement arising from PANGEA, the critical role of NASA remote sensing, PANGEA's research strategy and study design, PANGEA's capacity-building and training priorities, community engagement strategy, ability to enable Earth Action, and technical and logistical feasibility. The PANGEA concept reflects the voices of many and was developed in collaboration with over 800 individuals representing over 300 organizations from 42 countries across five continents. This report is provided in five languages including English, Spanish, French, Portuguese, and Indonesian.

This dataset consists of five data files in portable document format (PDF); one file for each of the five languages.

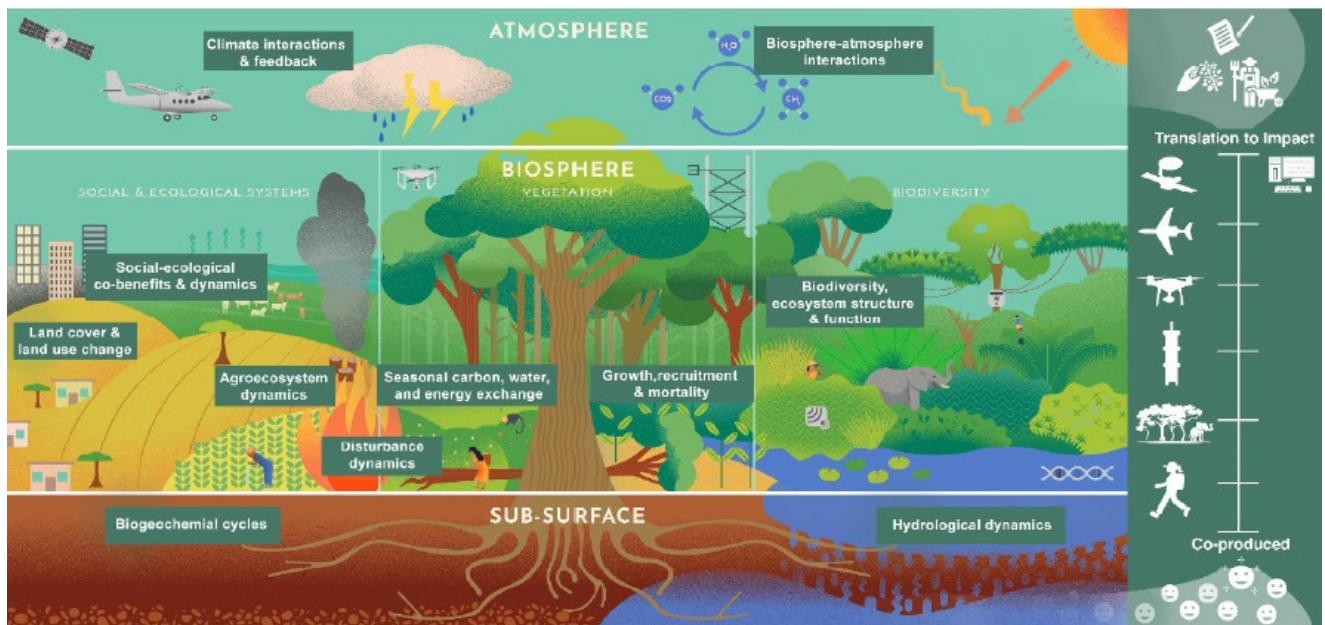


Figure 1. PANGEA measurements and scaling. PANGEA takes an integrated and transdisciplinary approach to science and applications, and will collect ground, tower, drone, and aircraft data in tropical forest landscapes across Africa and the Americas. Modeling and satellite remote sensing analyses will integrate this information to advance understanding of forests pantropically.

Citation

Ordway, E.M., M.M. Keller, M. Longo, R. Negron-Juarez, Y. Feng, H. Stouter, I.N. Rivera, A. Alencar, A. Bey, R.K. Braghieri, A. Cardoso, K.D. Chadwick, J.D. Fuentes, R. Eckert, L. Fatoyinbo, A. Ferraz, L. Guild, M.S. Johnson, E. Kane, L.S. Koutika, Y. Li, J. Liu, I.B. Mccubbin, F. Meunier, C.E. Miller, H.C. Muller-Landau, T. Nkuintchua, M. Nunes, L.B.S. Takougoum, M.J. Santos, F.D. Schneider, M. Simard, B. Sonke, C. Terrer, M. von Essen, M.Y. Wong, S.R. Worden, X. Xiao, V. Zaunbrecher, M. Bauters, P. Boeckx, J. Bowen, I. Chiari, O. Csillik, G. Diez, M. Doroso, D.D. Pugley, W. Hubau, A.E. Ochoa, E. Gora, A. Hoyt, J.C. Jintiach, V. Maqque, C. Perryman, Z. Pierrat, L. Saraiva, D. Singh, I. Tanshi, J. Thompson, and H. Verbeeck. 2025. The PANGEA Scoping Study Final Report. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2405>

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1. Dataset Overview

This dataset provides the final report from the PAN tropical investigation of bioGeochemistry and Ecological Adaptation (PANGEA) scoping study. PANGEA is one of the two scoping studies funded by NASA in 2023 to identify the scientific questions and develop the initial study design and implementation concept for a new NASA Terrestrial Ecology field campaign. This report provides 1) the scientific rationale; 2) an initial study design concept; 3) a presentation of science questions, goals, and objectives; 4) the rationale in terms of state-of-the-art, relevance, and expected advances; 5) implementation concepts; and 6) other information to enable NASA to fully evaluate the project. This report outlines the PANGEA concept, including the PANGEA science themes, science questions, the scientific and technical advancement arising from PANGEA, the critical role of NASA remote sensing, PANGEA's research strategy and study design, PANGEA's capacity-building and training priorities, community engagement strategy, ability to enable Earth Action, and technical and logistical feasibility. The PANGEA concept reflects the voices of many and was developed in collaboration with over 800 individuals representing over 300 organizations from 42 countries across five continents. This report is provided in five languages including English, Spanish, French, Portuguese, and Indonesian.

Related Dataset:

Reed, S.C., A.F. Feldman, N.P. Hanan, D.J.P. Moore, D.S. Ojima, W.K. Smith, K. Wessels, C. Amaral, F. Babst, J. Biederman, M.E. Litvak, N. MacBean, B. Poulter, R.L. Scott, A. Babst-Kostecka, Z. Fu, J.K. Green, R.F. Kokaly, R.J. Swap, S.P. Serbin, C.J. Tucker, L. Wang, J.D. Watts, G.M. Wolfe, A. Flores, J.R. Leaf, R. Washington-Allen, K. Prentice, E. Kachergis, J. Reyes, J. Ryan, M. SanClements, H. Loescher, A. Leidner, T. Swetnam, and B. Cook. 2025. The ARID Scoping Study Final Report. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2408>

Acknowledgements:

PANGEA was funded by the NASA Terrestrial Ecology Program (Grant 80NSSC23K1019 to the University of California, Los Angeles).

The scoping of PANGEA was very much an international community effort. It would not be possible without the contributions of an untold number of individuals. We are deeply grateful to all who have contributed their ideas, time, energy, resources, and funding to scope this urgently needed field campaign. Specifically, we acknowledge additional funding support and resources beyond NASA that made this international scoping effort possible. This includes the USFS-International Programs, the University of California-Los Angeles (UCLA), the Governors' Climate and Forests Task Force (GCF-TF), the Wildlife Conservation Society (WCS), the International Institute for Tropical Agriculture (IITA), Alliance Bioversity International and CIAT, the Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF), the Pontificia Universidad Católica del Perú (PUCP), University of Yaoundé I, Penn State University, the Instituto Nacional de Pesquisas da Amazônia (INPA), the Congo Basin Forest Partnership (CBFP), the Congo Basin Institute (CBI), the Congo Basin Science Initiative (CBSI), and the NASA SERVIR Southeast Asia Hub. Marcos Longo and Robinson Negrón-Juárez were supported as part of the Next Generation Ecosystem Experiments-Tropics, funded by the U.S. Department of Energy, Office of Science, Office of Biological and Environmental Research. LBNL is managed and operated by the Regents of the University of California under prime contract number DEAC02-05CH11231.

2. Data Characteristics

There are five files in this dataset in PDF format. The PDF files provide the same report describing the scoping efforts and recommendations of PANGEA in five languages including English, Spanish, French, Portuguese, and Indonesian.

File naming convention: PANGEA_Scoping_White_Paper_V1.1_X.pdf where X is English, Spanish, French, Portuguese, or Indonesian.

3. Application and Derivation

PANGEA proposed a multi-scale tropical forest campaign to:

- Answer globally relevant and urgent science questions emphasizing comparisons among the major tropical forest formations on our planet through effective analyses and interpretation of remote sensing observations (satellite and airborne) combined with ground-based measurements and environmental and ecosystem modeling.
- Provide information that will contribute to tropical forest conservation and regeneration, and climate change mitigation and adaptation.
- Ensure transdisciplinary collaborations and the building of new relationships among diverse partners, including scientists from the US and countries with tropical forests, international space agencies, Indigenous peoples and local communities, decision-makers, and action-taking communities in the tropics.
- Train and Educate the next generation of scientists and the broader workforce from the US and from tropical countries where field research will be based.
- Establish a legacy of open data and open science to strengthen partnerships among scientists and institutions in the US, tropical countries, and other countries as the basis for future research and applications.

Refer to the report in PDF format included in this dataset for additional information.

4. Quality Assessment

Not applicable.

5. Data Acquisition, Materials, and Methods

PANGEA will investigate variation between and within Earth's two largest tropical forests in the Americas and Central Africa while integrating

datasets and research from existing and complementary activities across the tropics. PANGEA's research questions focus on five thematic areas, Biogeochemical Cycles; Biodiversity; Climate Interactions and Feedbacks; Social-Ecological Systems; and Disturbance Dynamics. Informing climate mitigation and adaptation strategies and biodiversity conservation requires answering three critical questions:

1. What are the patterns of recent (5-30 years) and ongoing change in tropical forest landscape states, dynamics, and feedback, and how do they vary geographically?
2. What processes control heterogeneity in the vulnerability of tropical forest landscapes to structural and functional change in the Anthropocene?
3. How will ongoing and projected future changes in tropical forest landscapes alter feedback to local, regional, and global climates and social-ecological systems?

To address the above questions, PANGEA's objectives are to:

1. Characterize and quantify heterogeneous tropical forest responses to climate and land-use changes;
2. Address calibration, validation, and algorithm development needs to ensure measurements can be accurately retrieved from satellite remote sensing datasets over tropical forests, ultimately advancing the global utility of satellite missions;
3. Constrain model uncertainty of predictions of tropical carbon fluxes and other biogeochemical cycles, biodiversity, and forest-climate feedback by improving process understanding and advancing remote sensing data-model integration.
4. Develop new capabilities for monitoring carbon, biodiversity, and agriculture using satellite remote sensing and support the development of tools to translate science into action.
5. Train the next generation of scientists and leaders to continue this work beyond PANGEA.

PANGEA's coordinated multi-scale campaign integrates drone and aircraft measurements (e.g., AVIRIS, LVIS, small-footprint lidar, UAVSAR, CARAFE) with ground measurements (e.g., flux tower and chamber measurements, trait measurements, animal movement, bioacoustics, and Indigenous Ecological Knowledge) to advance understanding of tropical forest systems and the utility of satellite remote sensing to measure and monitor them. The PANGEA campaign would be executed over 6 to 9 years, beginning in 2026 following the science definition phase. PANGEA obtains the Baseline, Threshold and Descope Essential Scientific Measurements from the PANGEA Science Objectives:

- Baseline: PANGEA measurements encompass ~3-6 tropical African and ~3-6 tropical American landscapes that capture the end of the wet season and the end of the dry season.
- Threshold: PANGEA measurements encompass 2 tropical African and 2 tropical American landscapes that capture the end of the wet season and the end of the dry season.
- Descope: PANGEA measurements encompass 2 tropical African landscapes that capture the end of the wet and dry seasons, which will be compared with information for the American tropics collated from existing data, other projects and campaigns led by collaborators, commercial data-buys, and deployable drones. This descope option partially meets PANGEA objectives while accounting for potential funding restrictions or geopolitical uncertainty.

PANGEA will include a core and extended domain. The extended domain will encompass pan-tropical forests and will be prioritized for satellite remote sensing and modeling analyses. PANGEA's core domain will focus on tropical biomes in Africa and the Americas. Both the core and extended domains will encompass moist tropical forests, including flooded forests, wetlands, and peatlands. The extended domain will enable the inclusion of existing datasets and opportunistic collection in Asia and Australia.

Refer to the report in PDF format included in this dataset for additional information.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[The PANGEA Scoping Study Final Report](#)

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

None.

8. Dataset Revisions

Version	Release Date	Revision Notes
1.1	2025-02-18	Updated to meet new programmatic requirements.
1.0	2025-01-17	Initial release.



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