Building the Map of Life: Improved Environmental Data for Biodiversity Studies

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Understanding and Predicting the Biotic Response to Climate Change

...high confidence that climate change will result in extinction of many species and reduction in the diversity of ecosystems[1]

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- Species Distribution Modeling (where do species live?)
- Demographic Models (how do populations respond?)
- Physiological Studies (put frogs in boiling water?)

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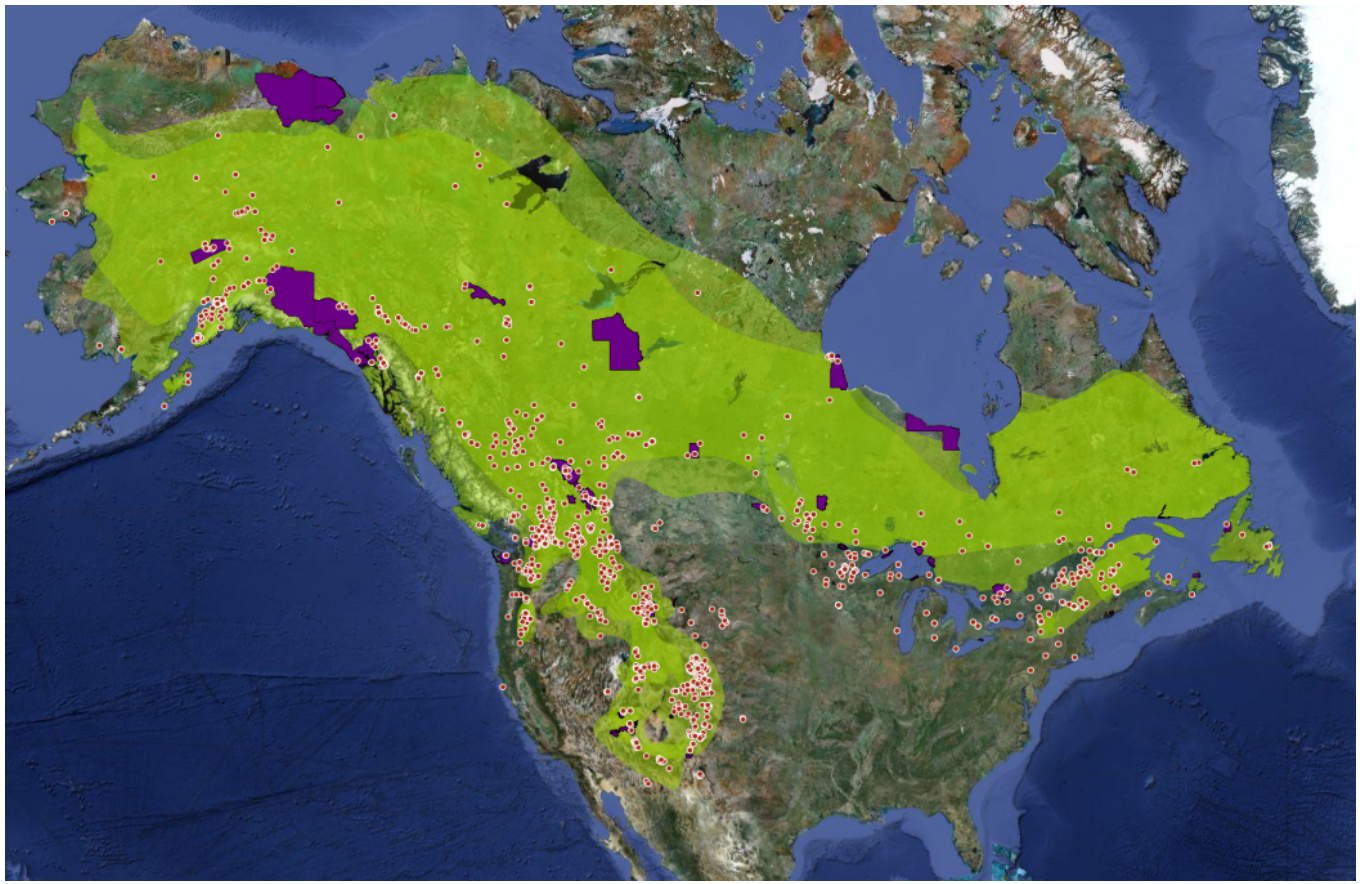
Map of Life (mappinglife.org): Gathering Global Biodiversity Data

150m records for 50k species



e.g. American Three-toed Woodpecker (*Picoides dorsalis*)

Map of Life (mappinglife.org): Gathering Global Biodiversity Data

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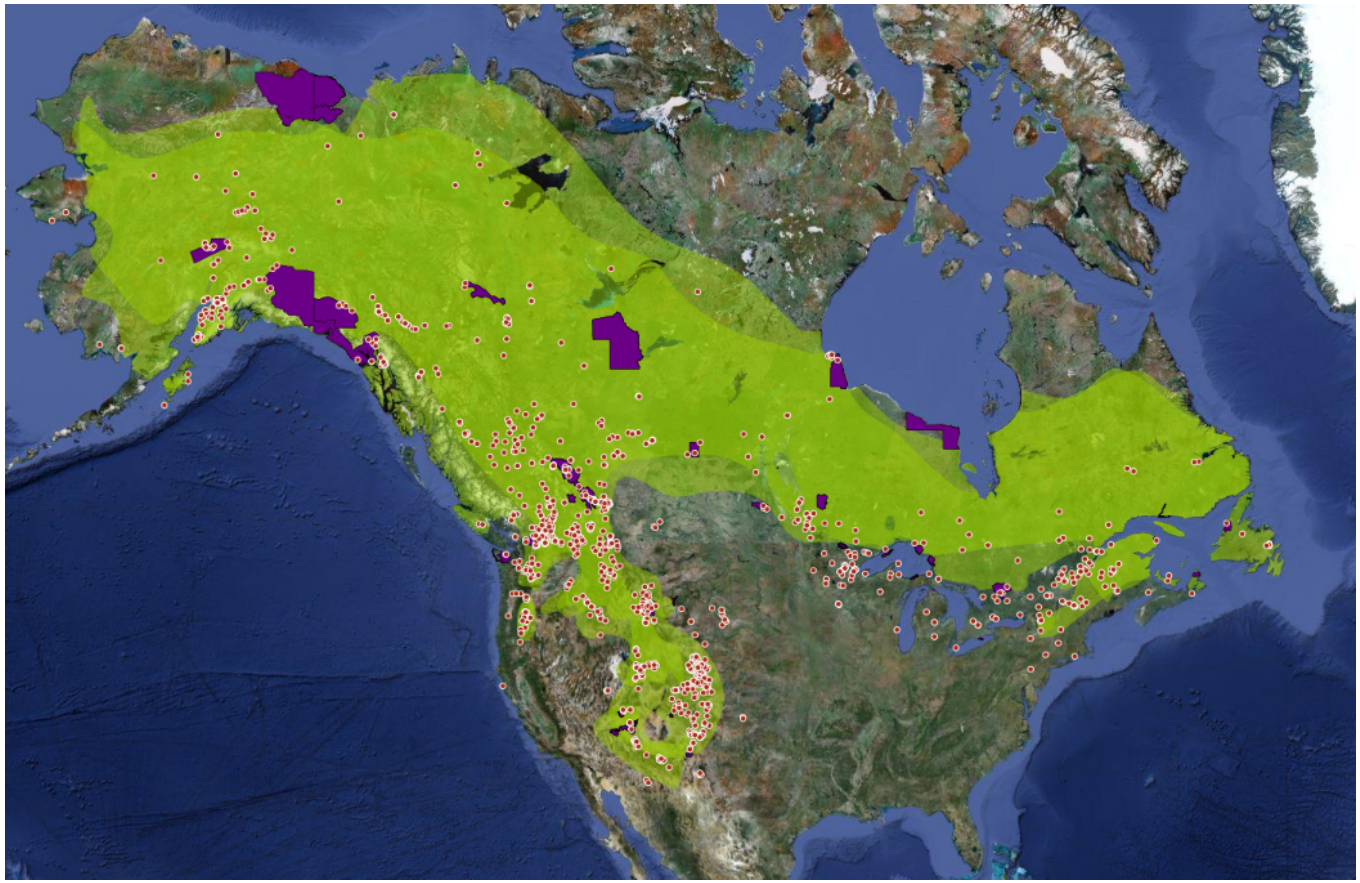

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High Resolution Environmental Data: Climate Surfaces

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High Resolution Environmental Data: Climate Surfaces

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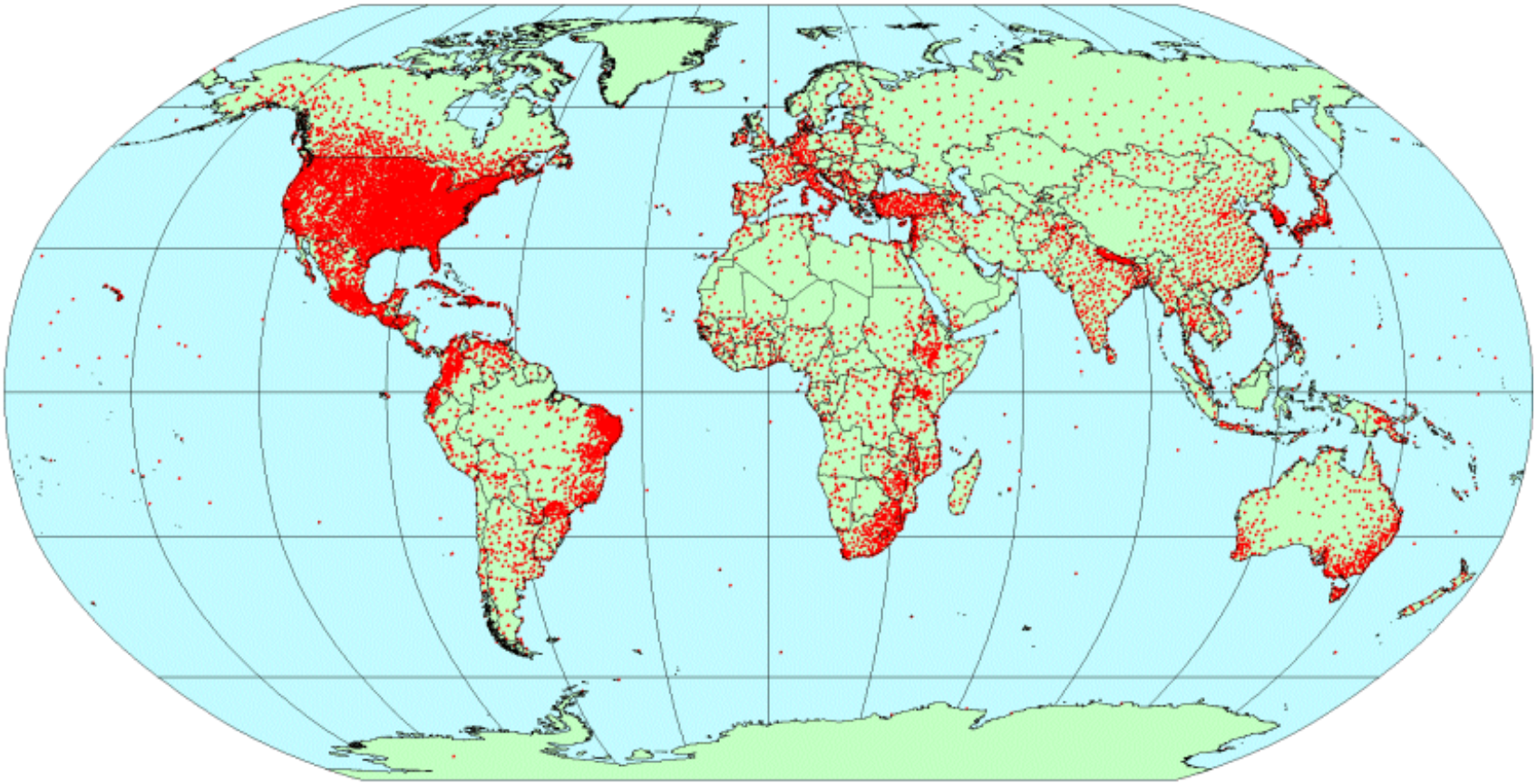
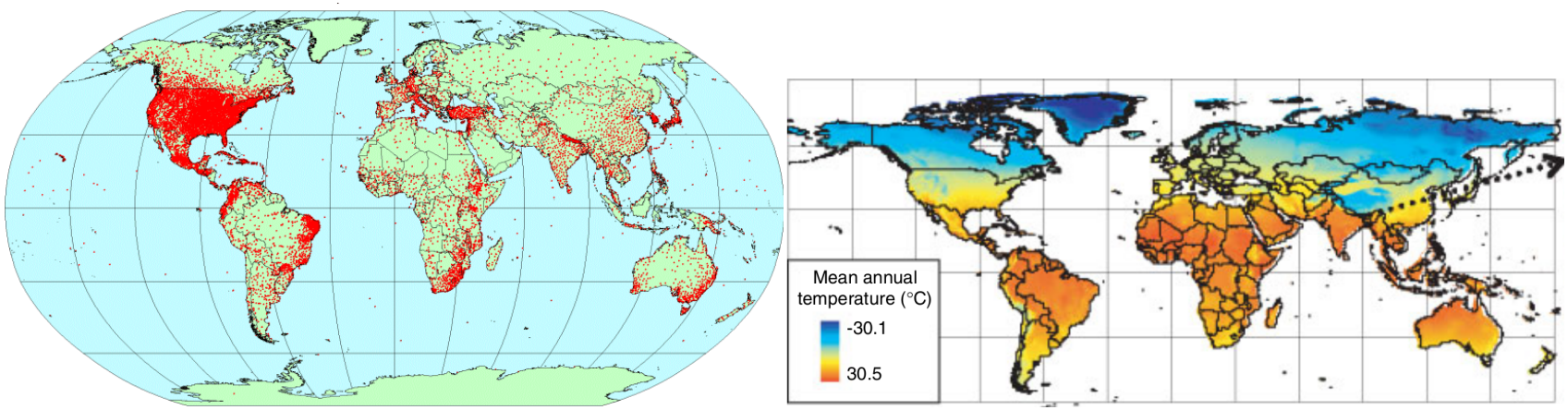


Global Weather Station Network

High Resolution Climate Surfaces: WorldClim[2]

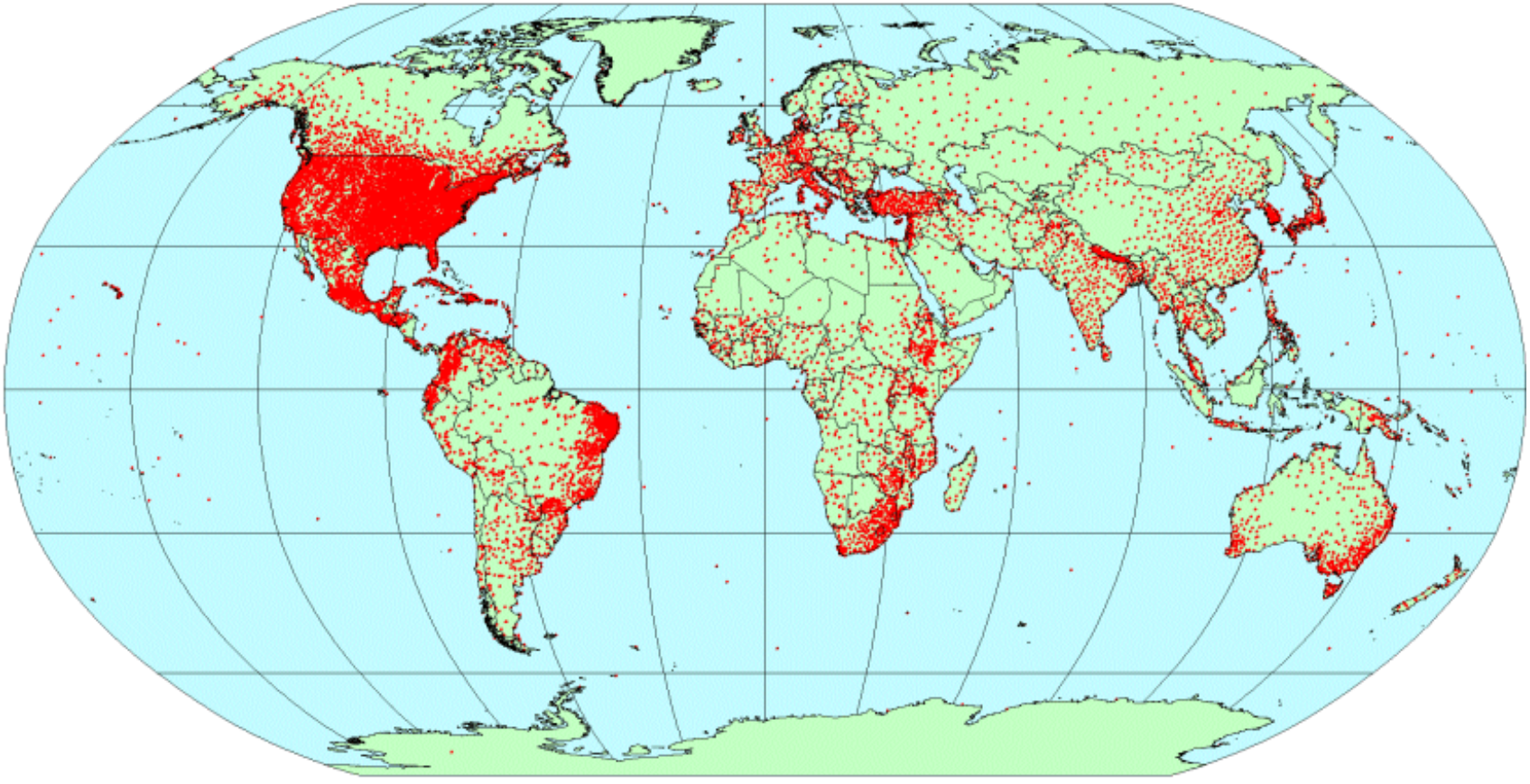
Station Locations → Continuous Grid



- Global ≈1km resolution monthly T_{max}, T_{min}, and PPT.
- 6,500+ citations since 2005

[2] *International Journal of Climatology* (2005). 25(15):1965–1978

High Resolution Climate Surfaces: WorldClim



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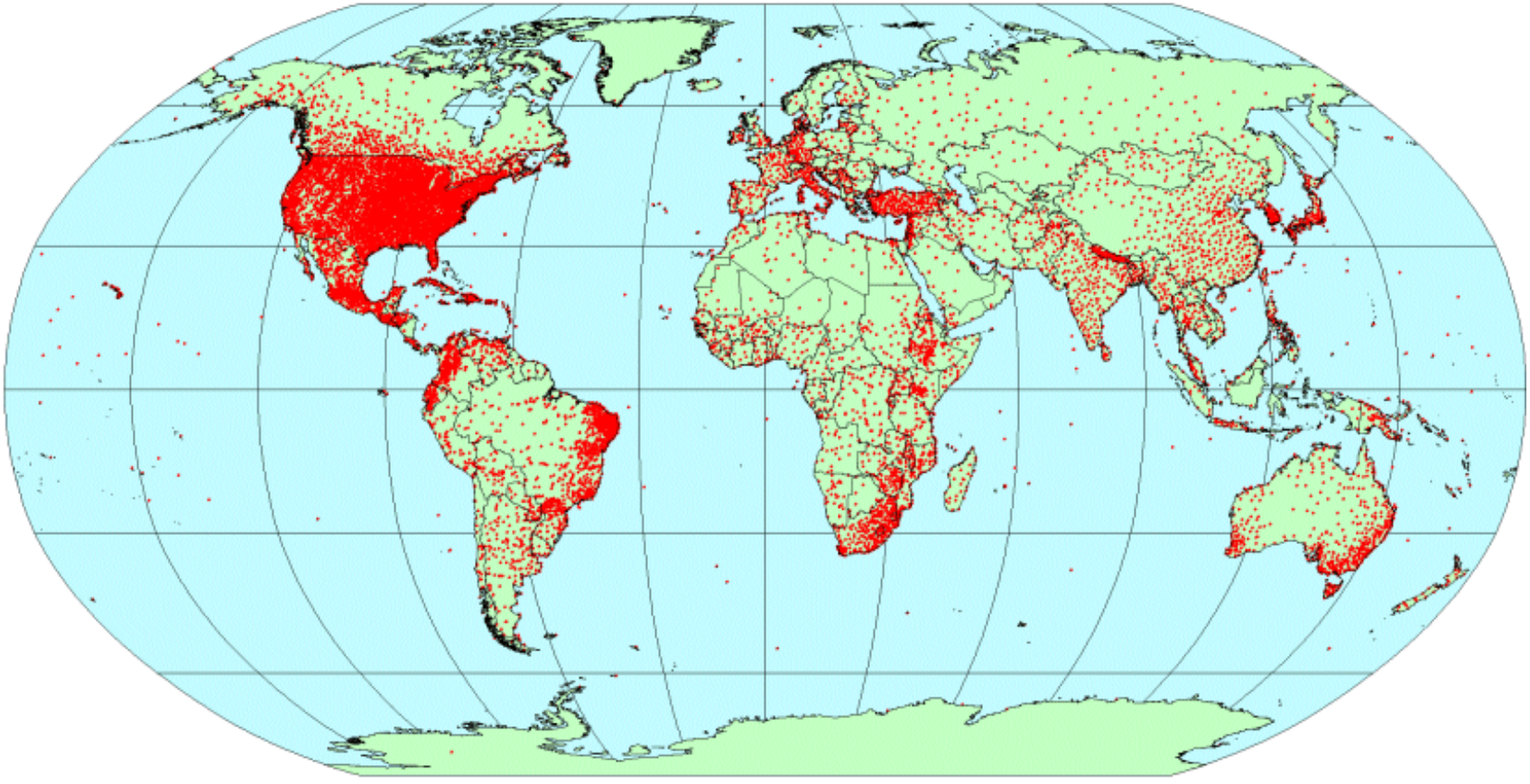
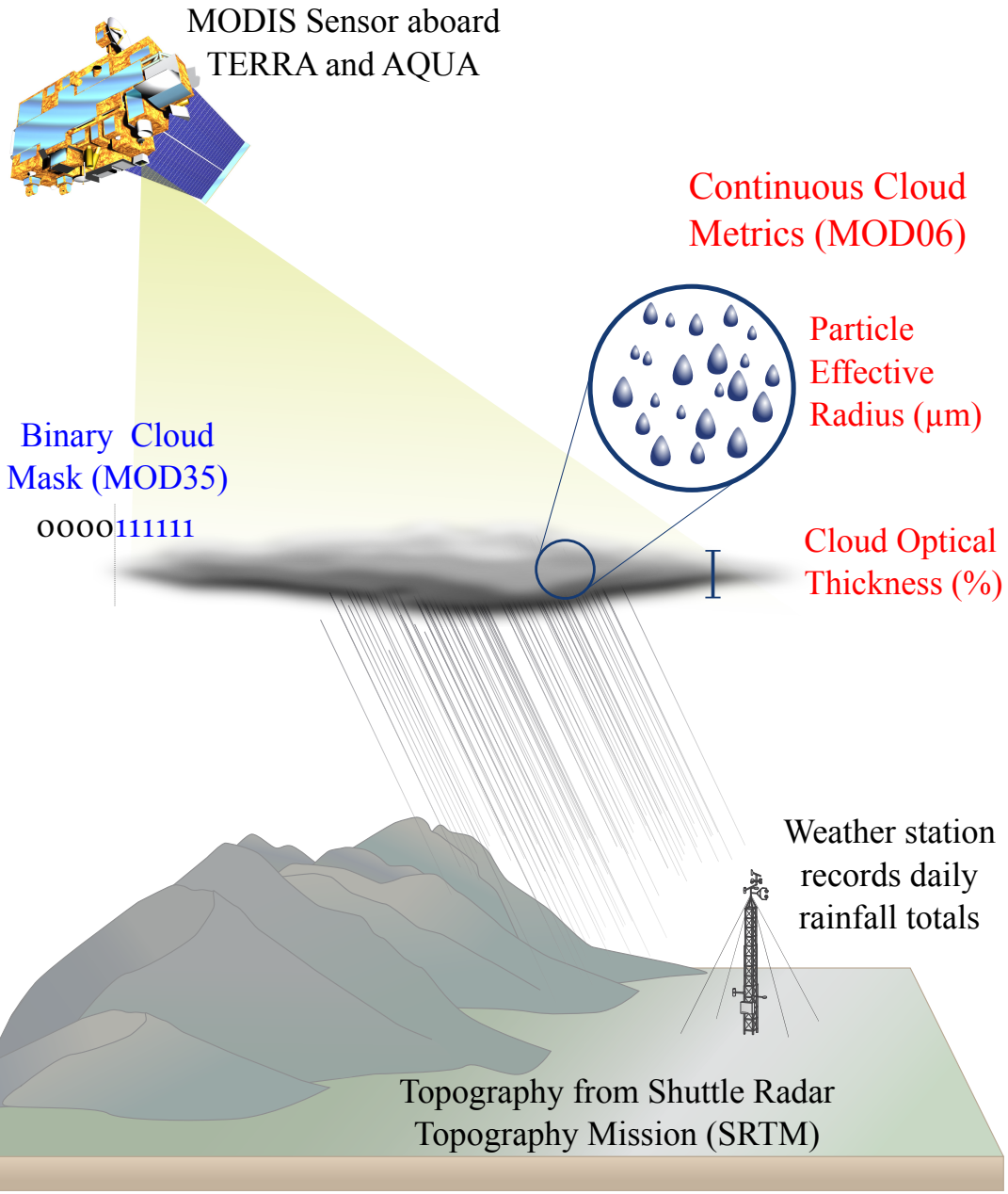


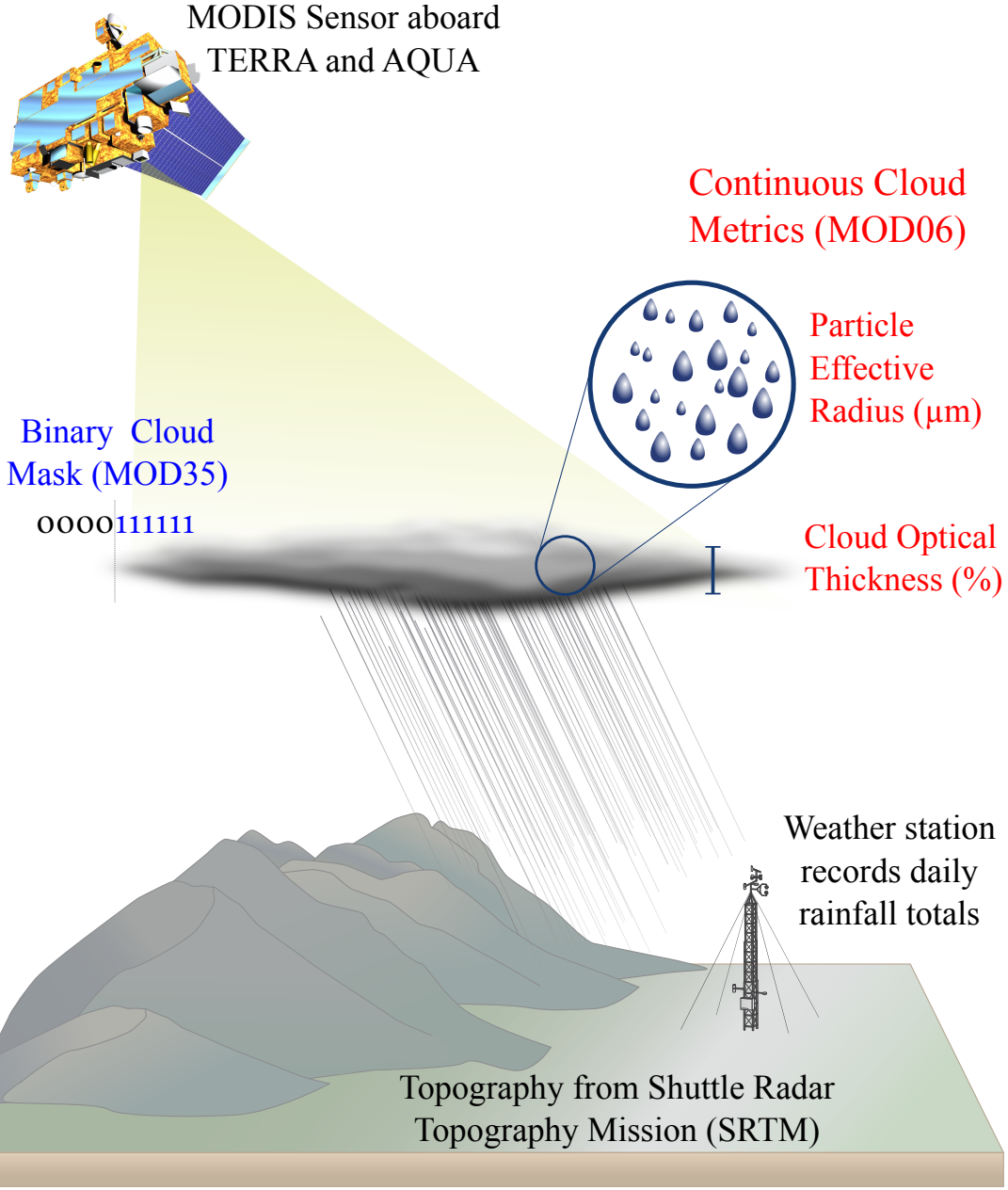
Global Weather Station Network

Can satellite observations help fill the gaps?

MODIS Satellite Cloud Data

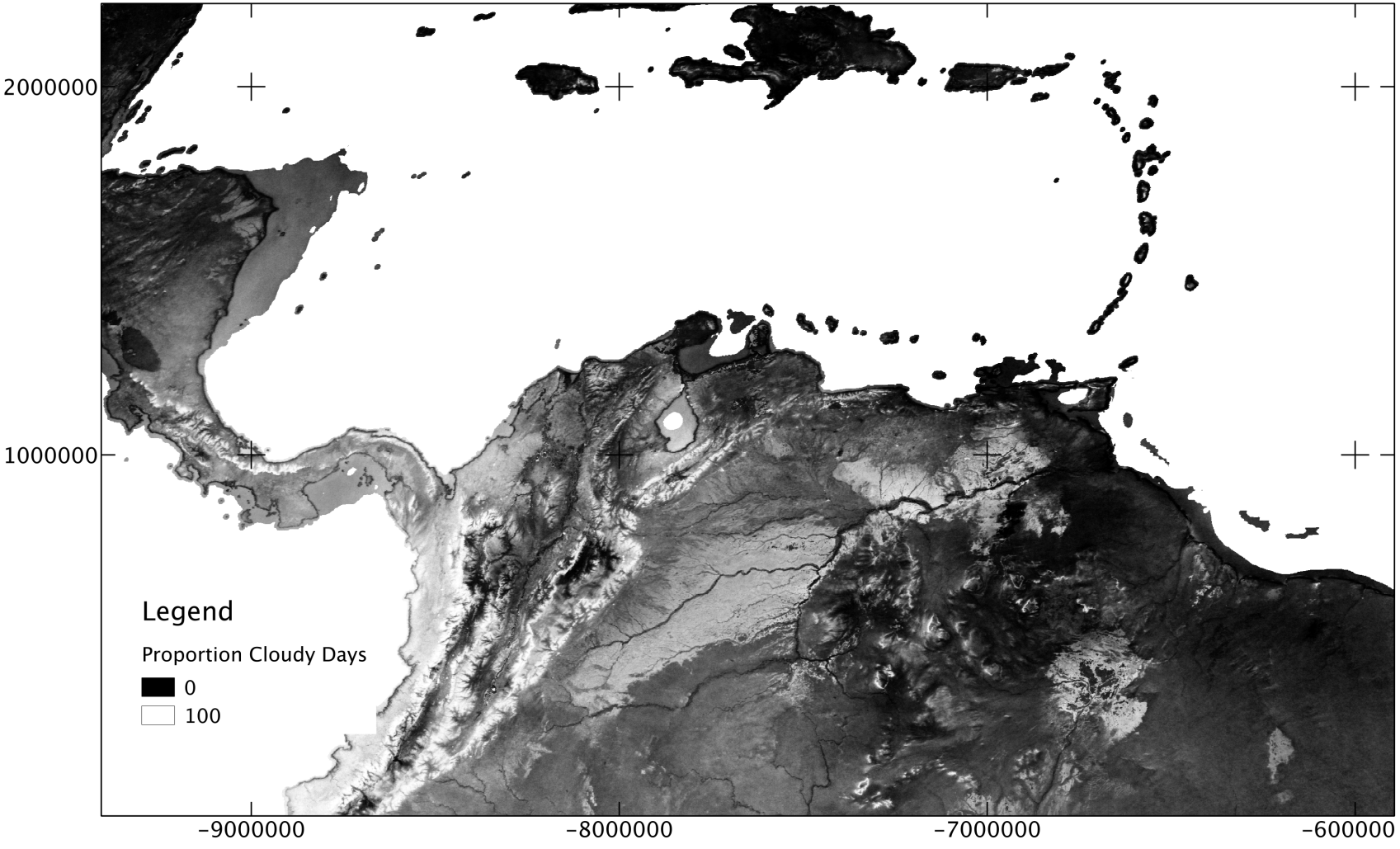


MODIS Satellite Cloud Data ≈140TB

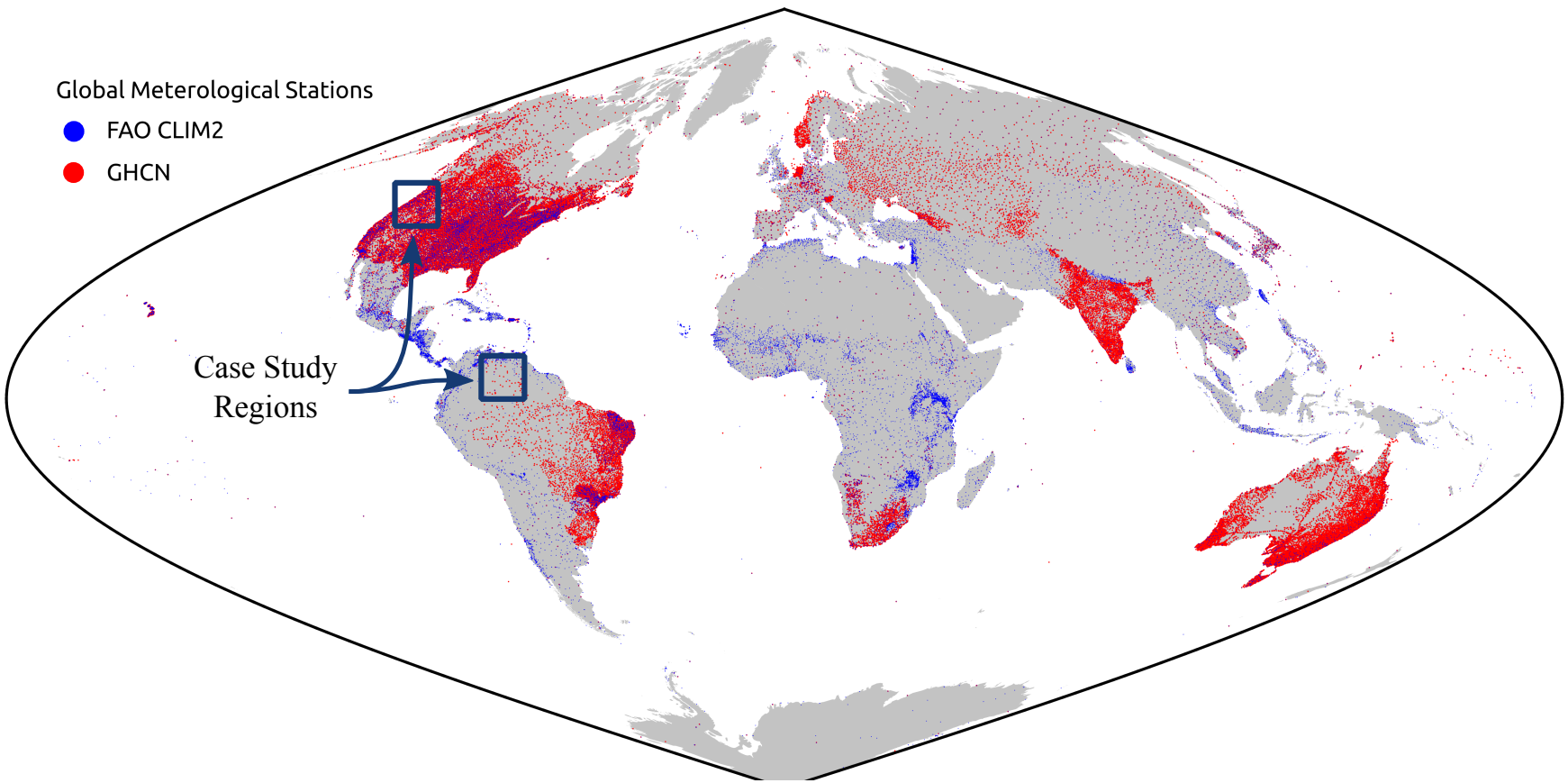


Pleiades
Supercomputer

Frequency of Cloudy Days (%)

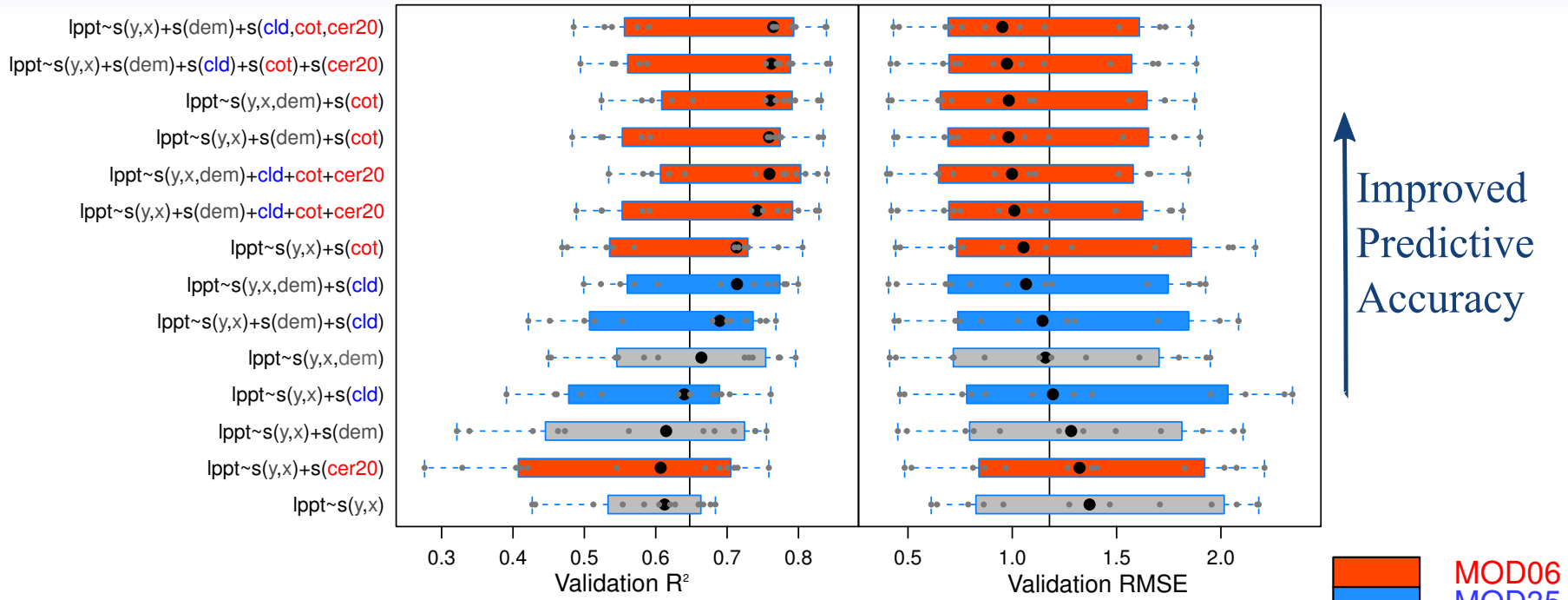


Case Studies: Oregon and Venezuela[3]

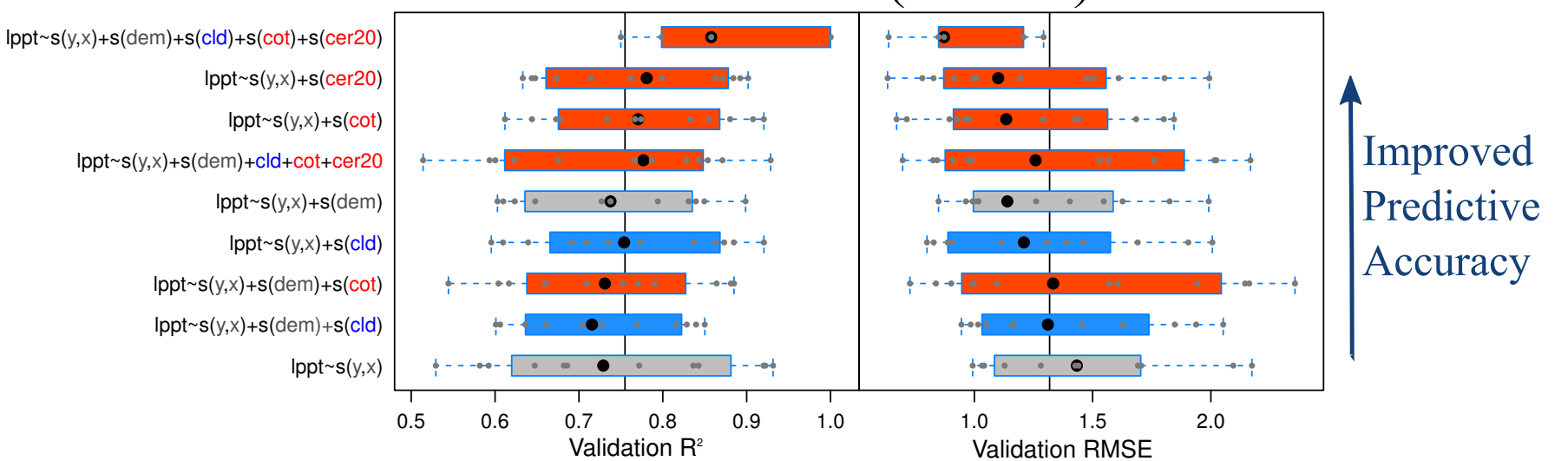


3 Wilson, AM, et. al (2013) 6th International Conference, International Biogeography Society, Miami, FL

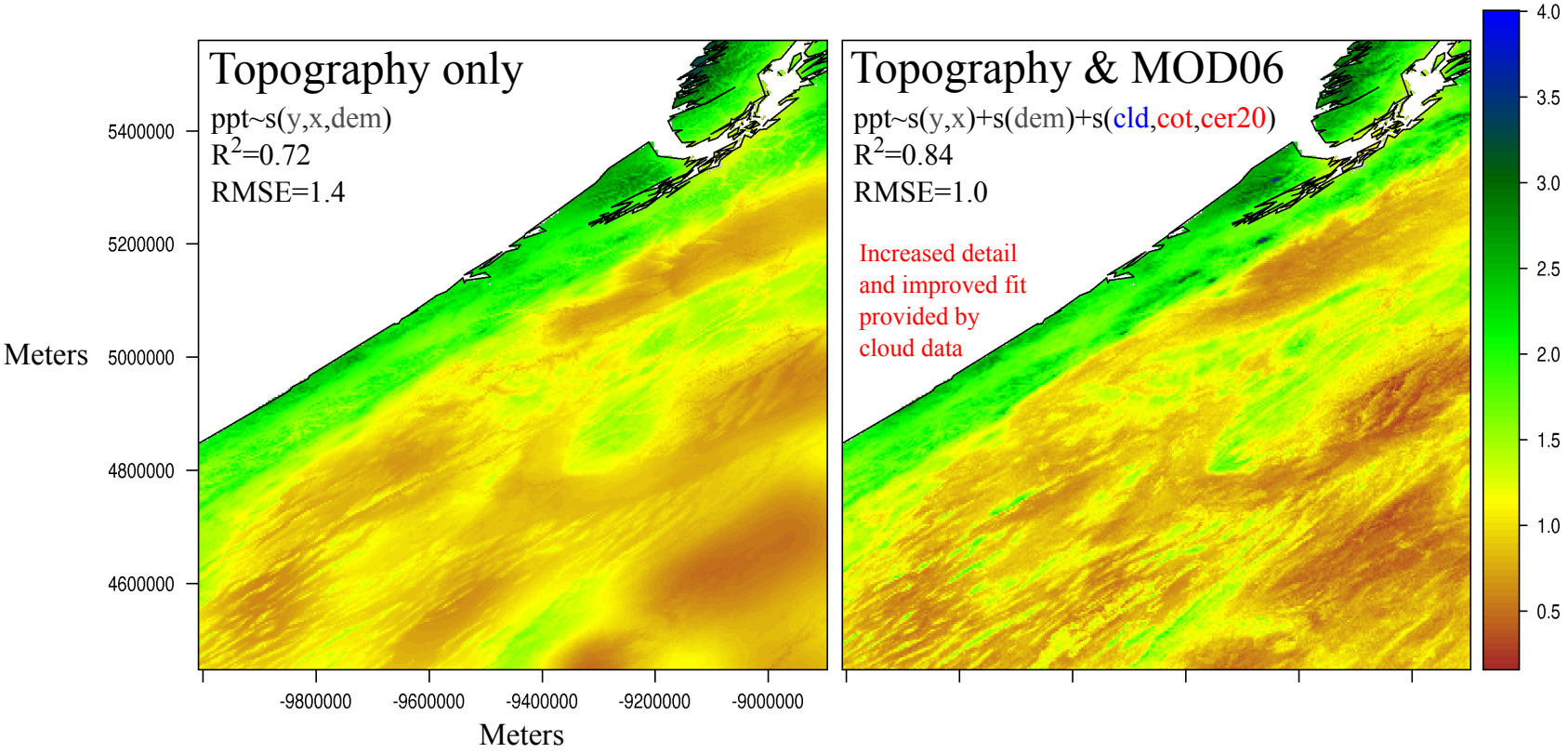
Pacific Northwest (h09v04)



Venezuela (h11v08)



MODIS Cloud → Improved Predictions & Spatial Detail



Predictions for mean March precipitation (H09V04) using a GAM with elevation (left) and MOD06 cloud parameters (right).

Summary & Next Steps

Summary:

1. Global high-resolution environmental data vital for assessing biotic response to climate change
2. Satellite observations improve climate interpolations

Next Steps:

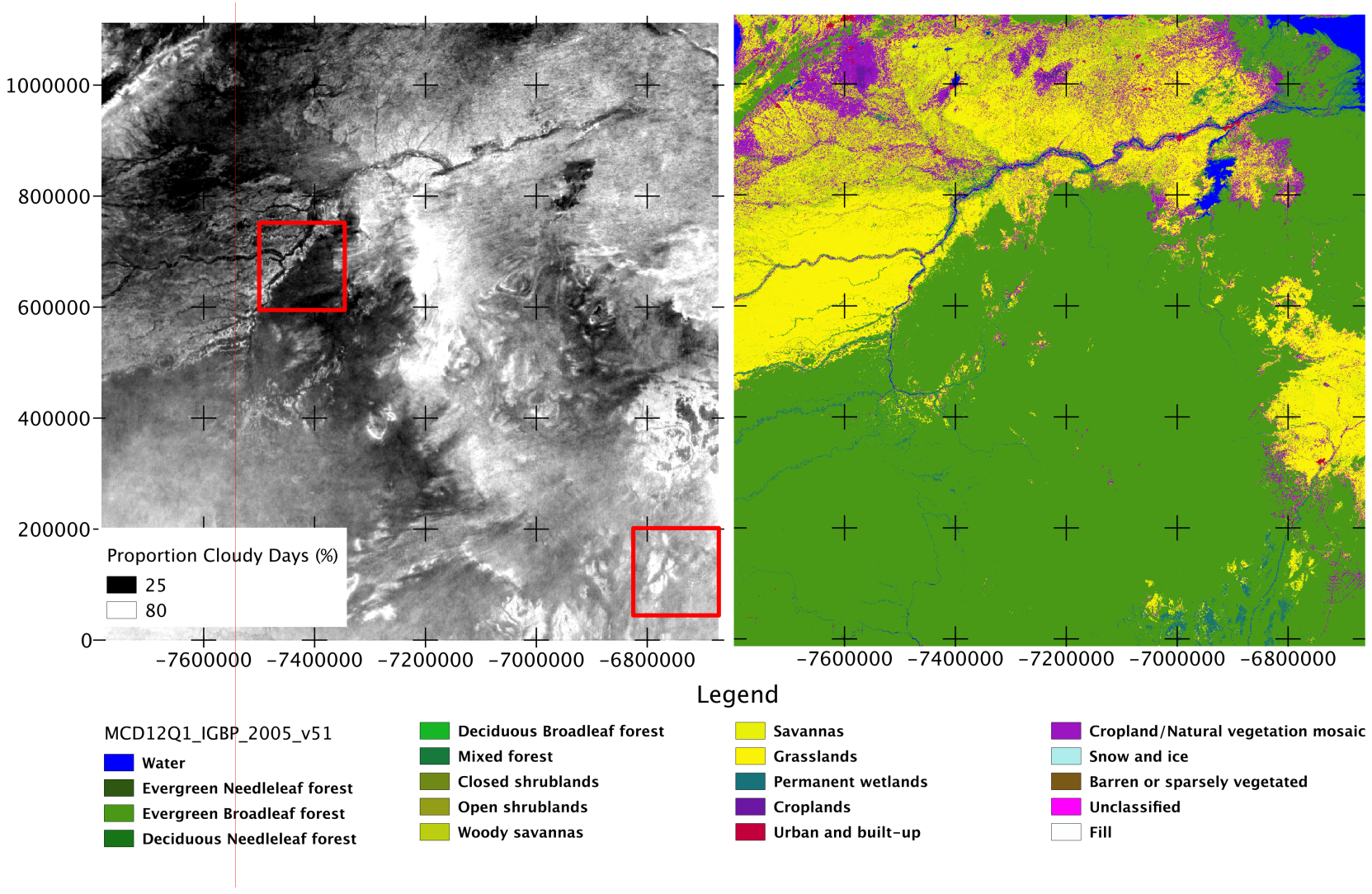
- More test regions → global analysis
- 

Global Layers Project
- Map Of Life: distributional data → multi-scale models

Do cloud metrics improve predictive accuracy?

- Monthly climatologies from GHCN
- H09V04 (Oregon) and H11V08 (Venezuela)
- GAMs including X, Y, & elevation, plus MOD35 and MOD06
- Validation: repeated random 10% sub-sampling $\rightarrow$ R^2 & RMSE.

MODIS Cloud Mask Landcover Bias (Venezuela)



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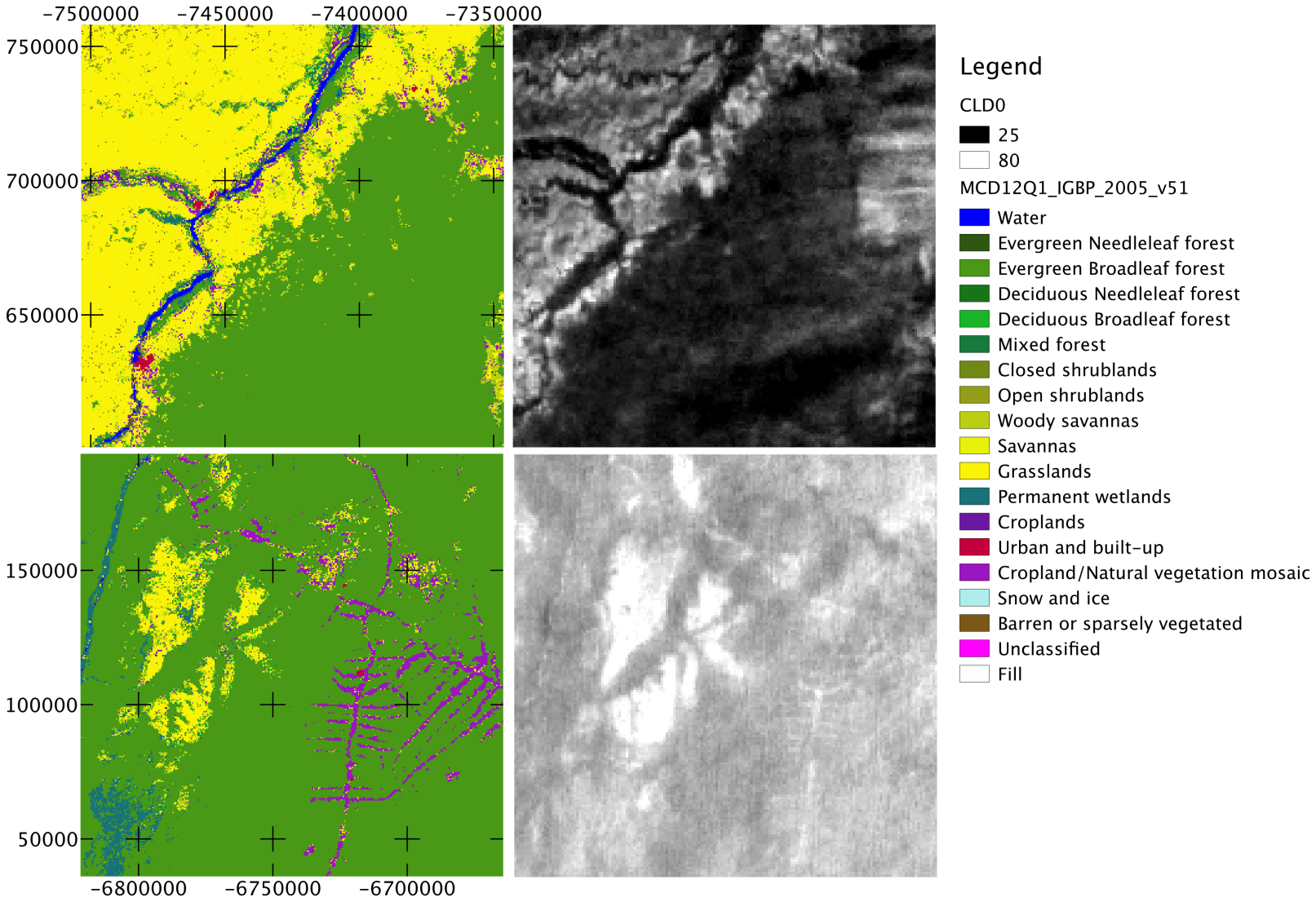

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