An Overview of the WRF Pre-Processing System (WPS)

Michael Duda

Basic WRF Tutorial
14 – 18 July 2025

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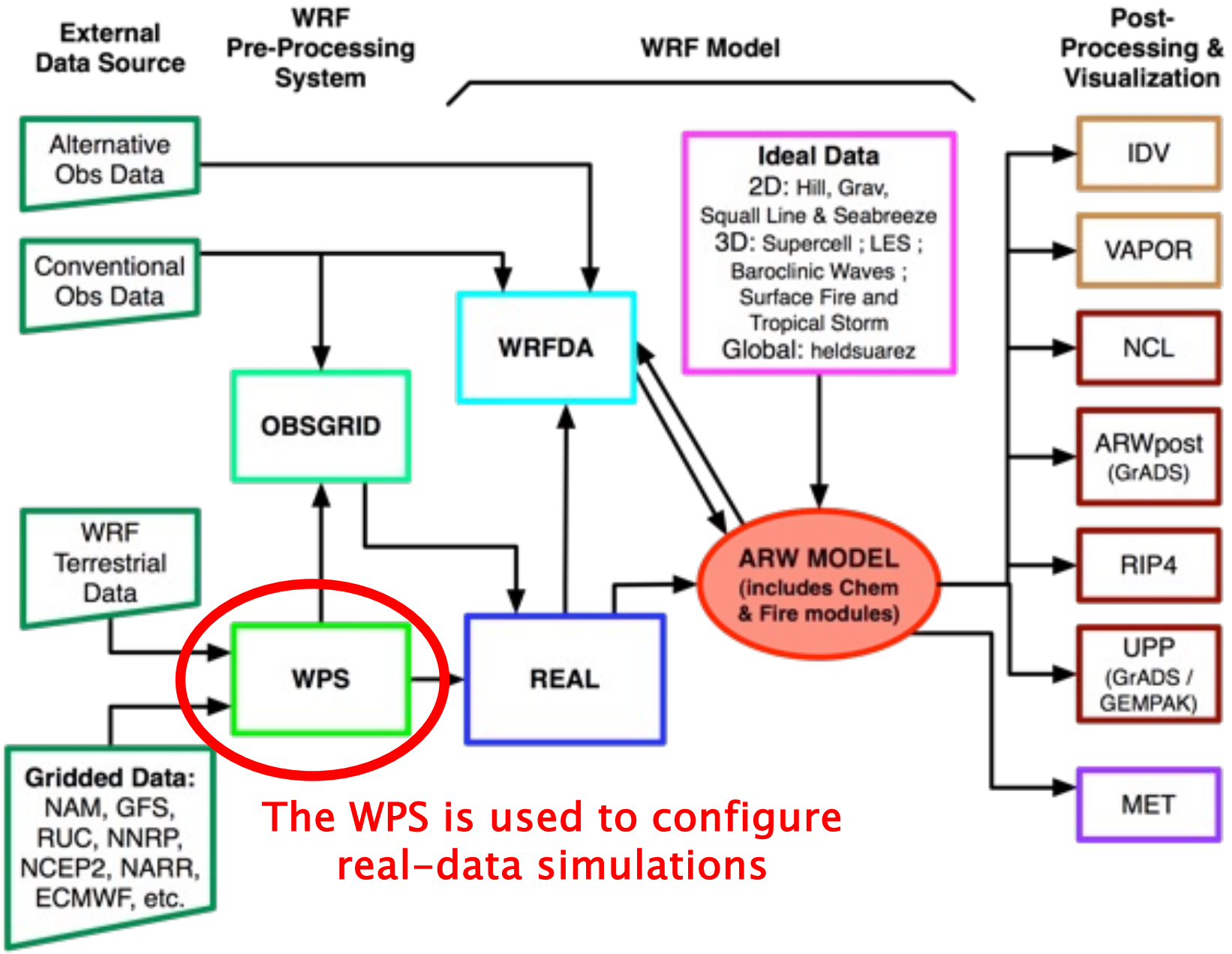
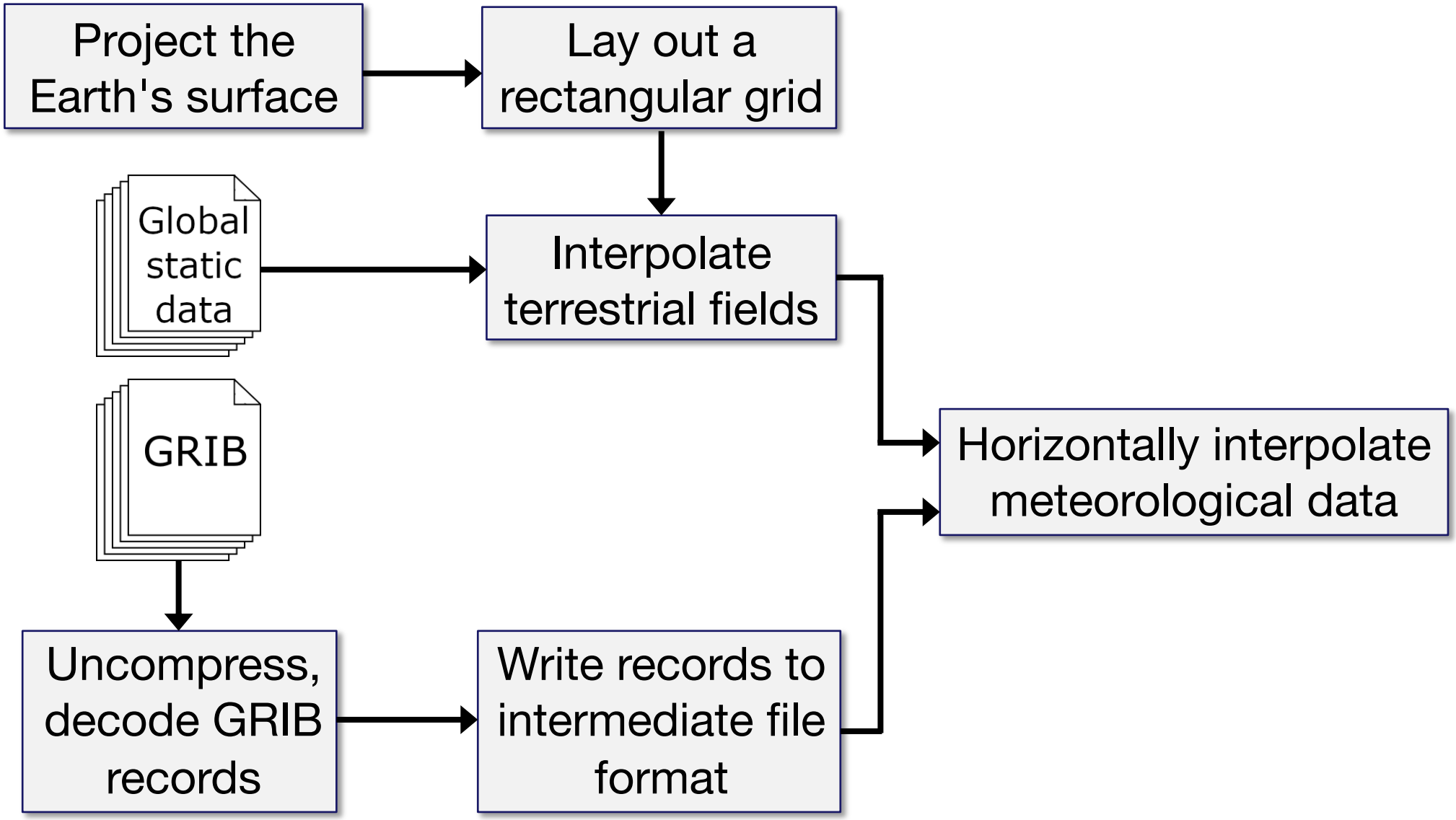
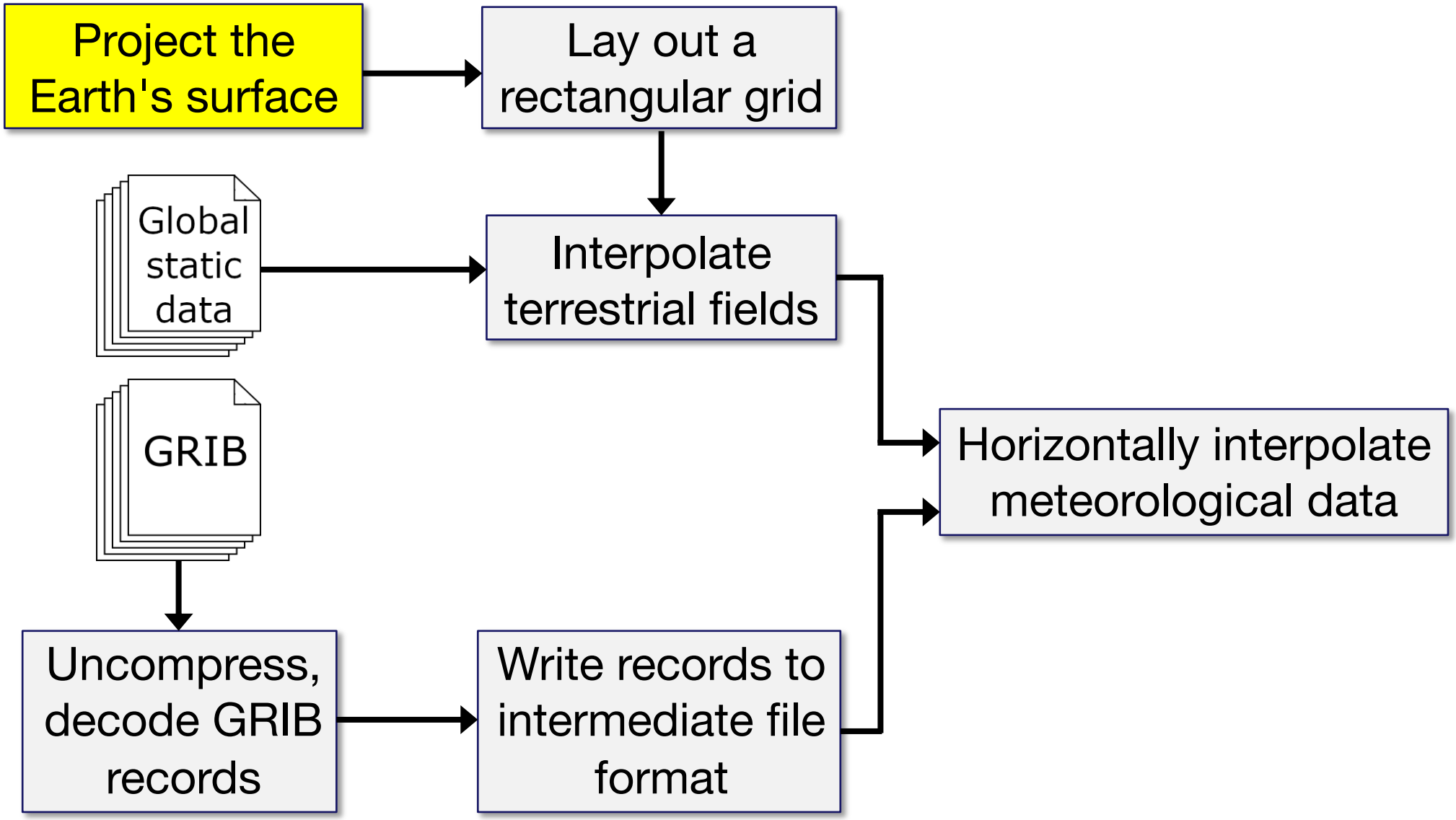
WRF Modeling System Flowchart



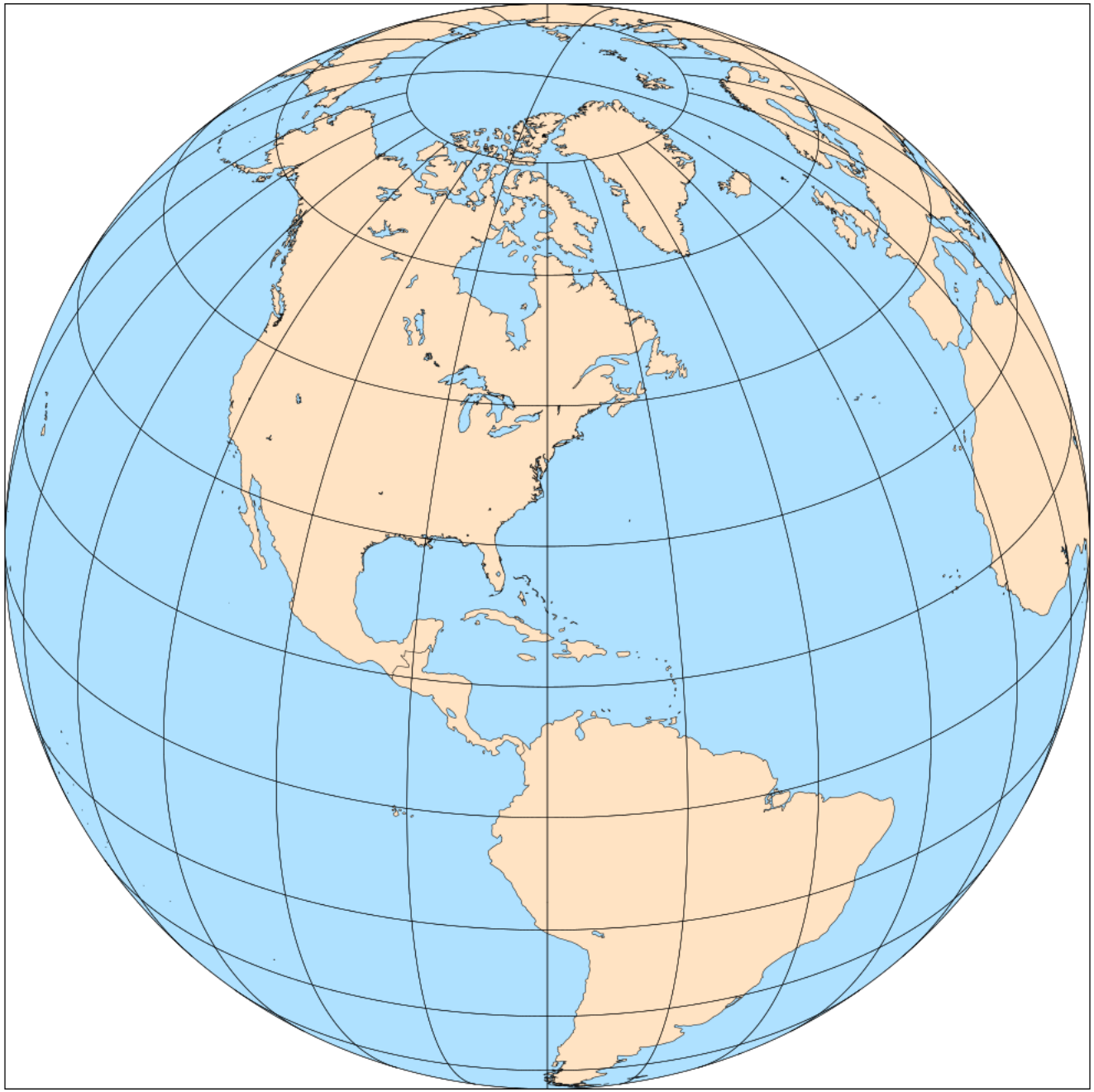
WPS Flowchart



WPS Flowchart



Projecting the Earth's surface



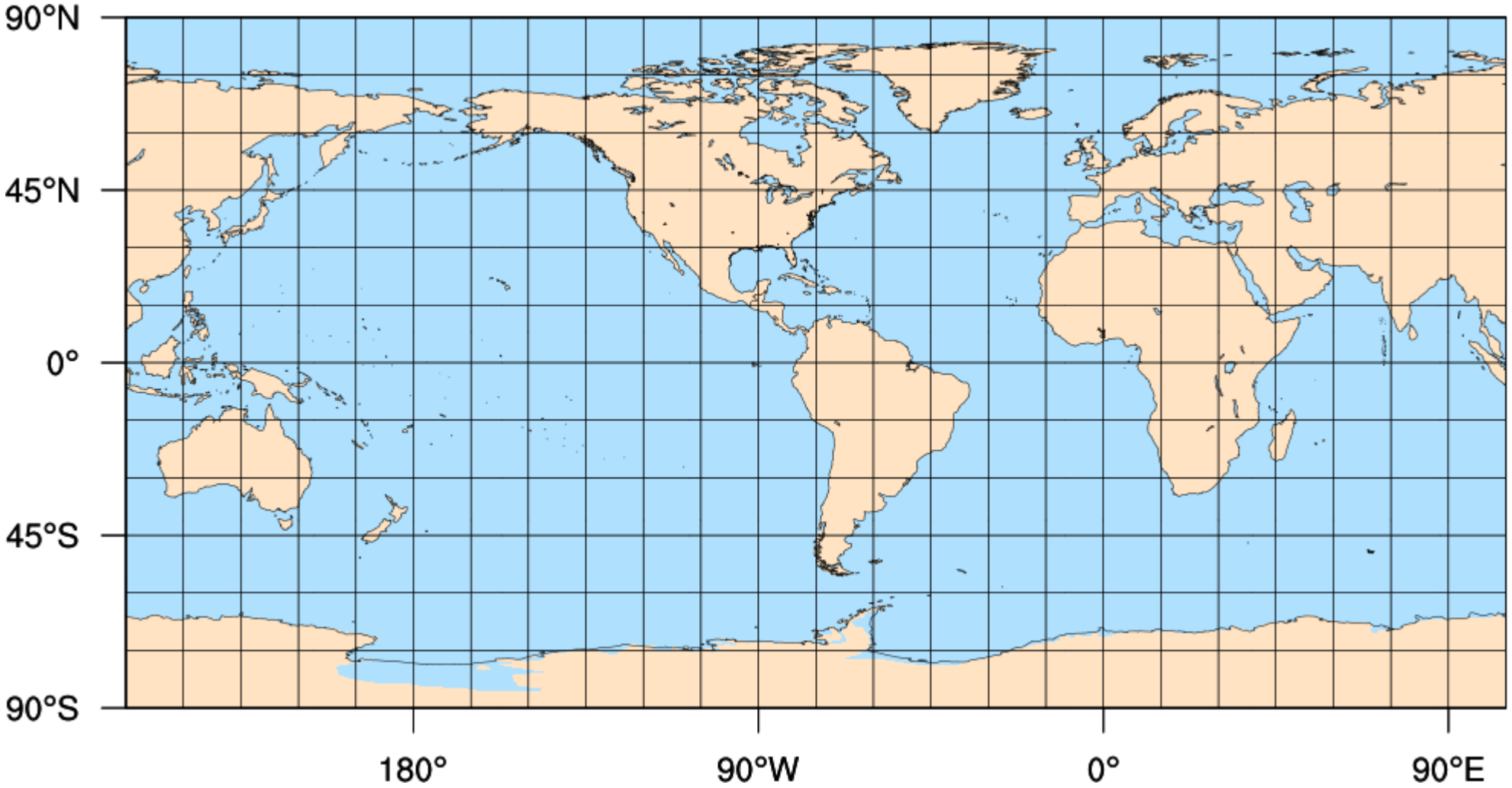
Defining rectangular domains with minimal distortion can be challenging on the surface of a sphere*

Projecting the region of interest onto a plane simplifies this task.

* *The WRF model assumes a spherical Earth with radius 6370 km*

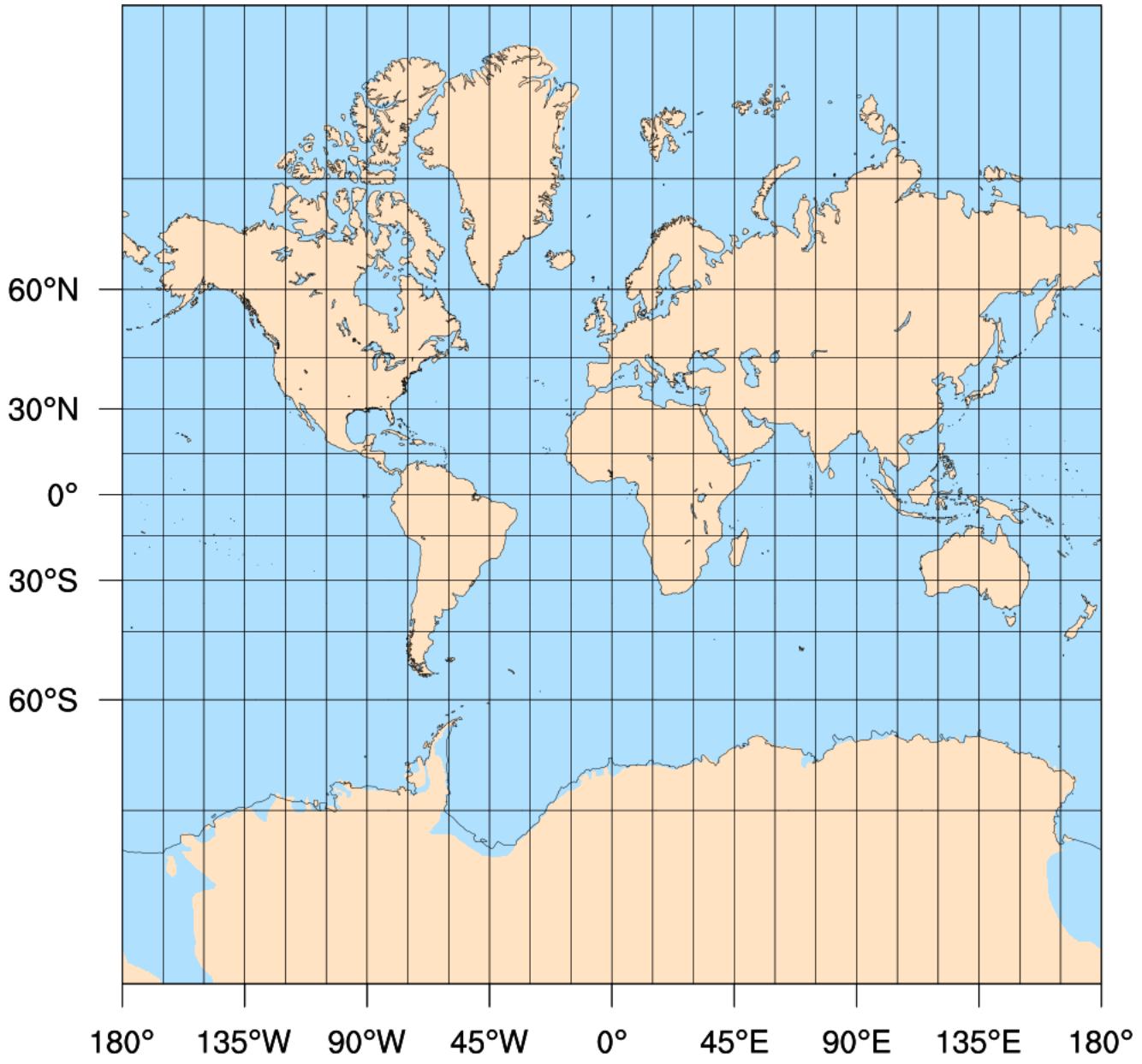
Projecting the Earth's surface

Cylindrical equidistant ("latitude-longitude") projection



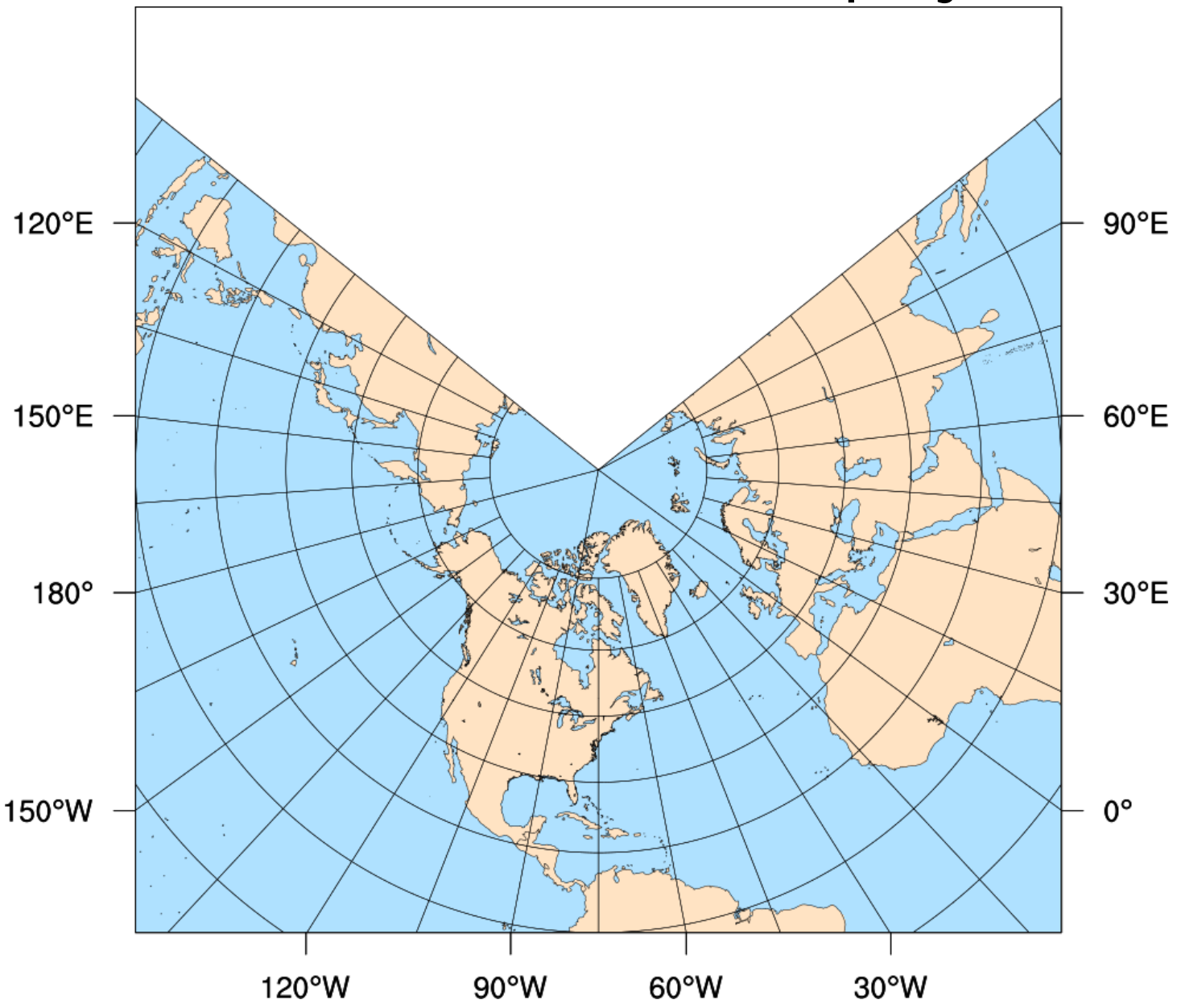
Projecting the Earth's surface

Mercator projection



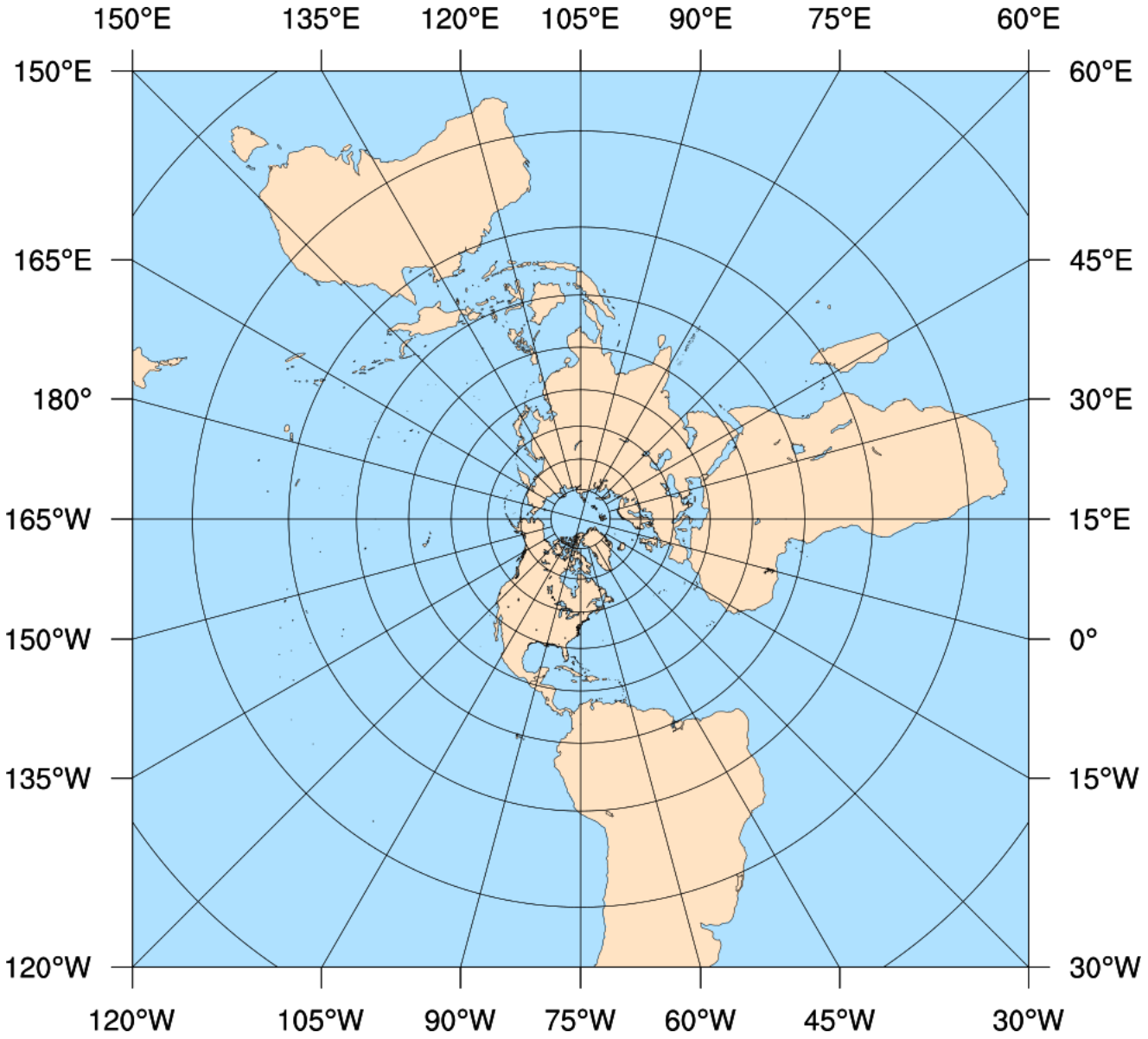
Projecting the Earth's surface

Lambert conformal conic projection

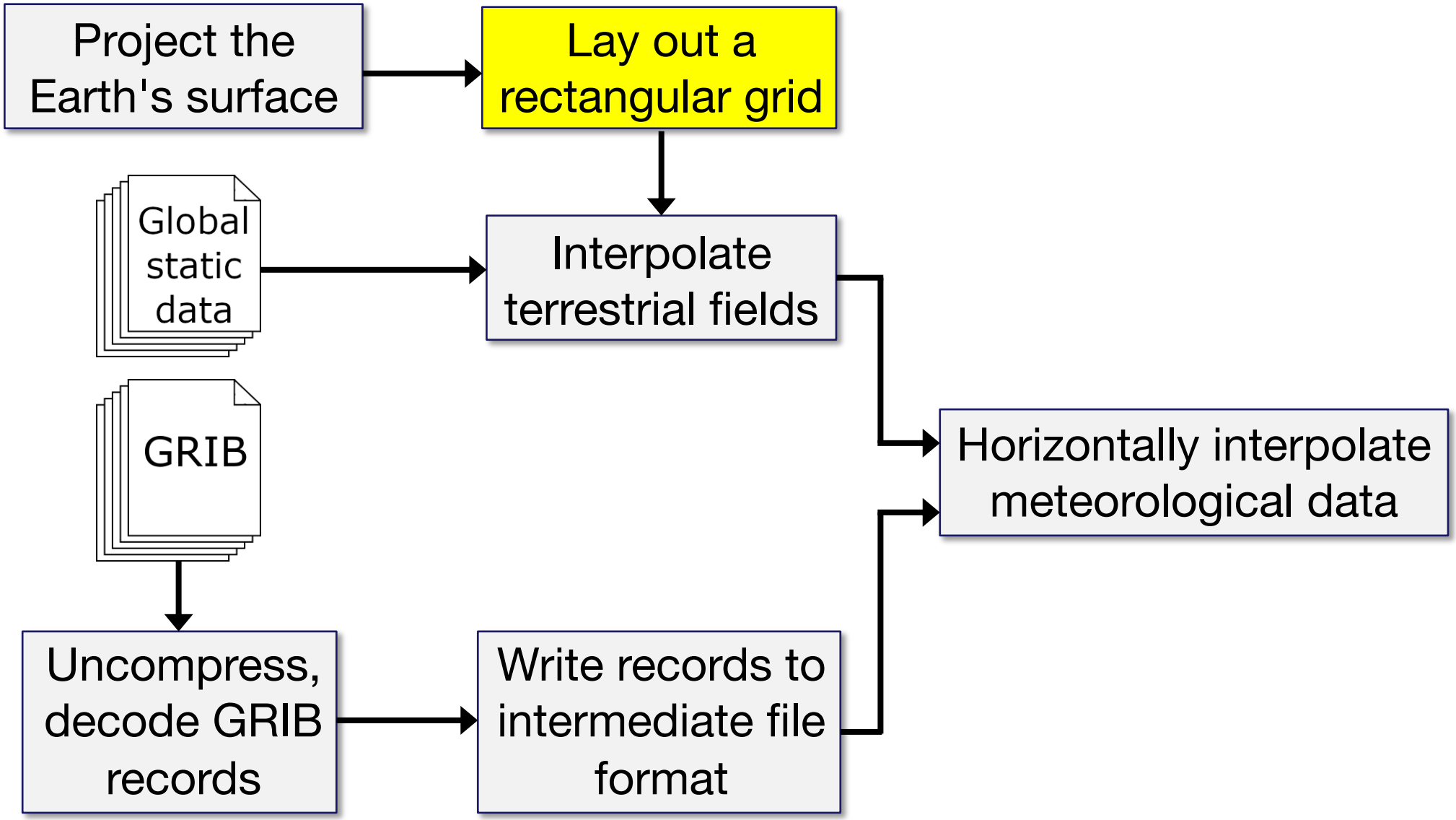


Projecting the Earth's surface

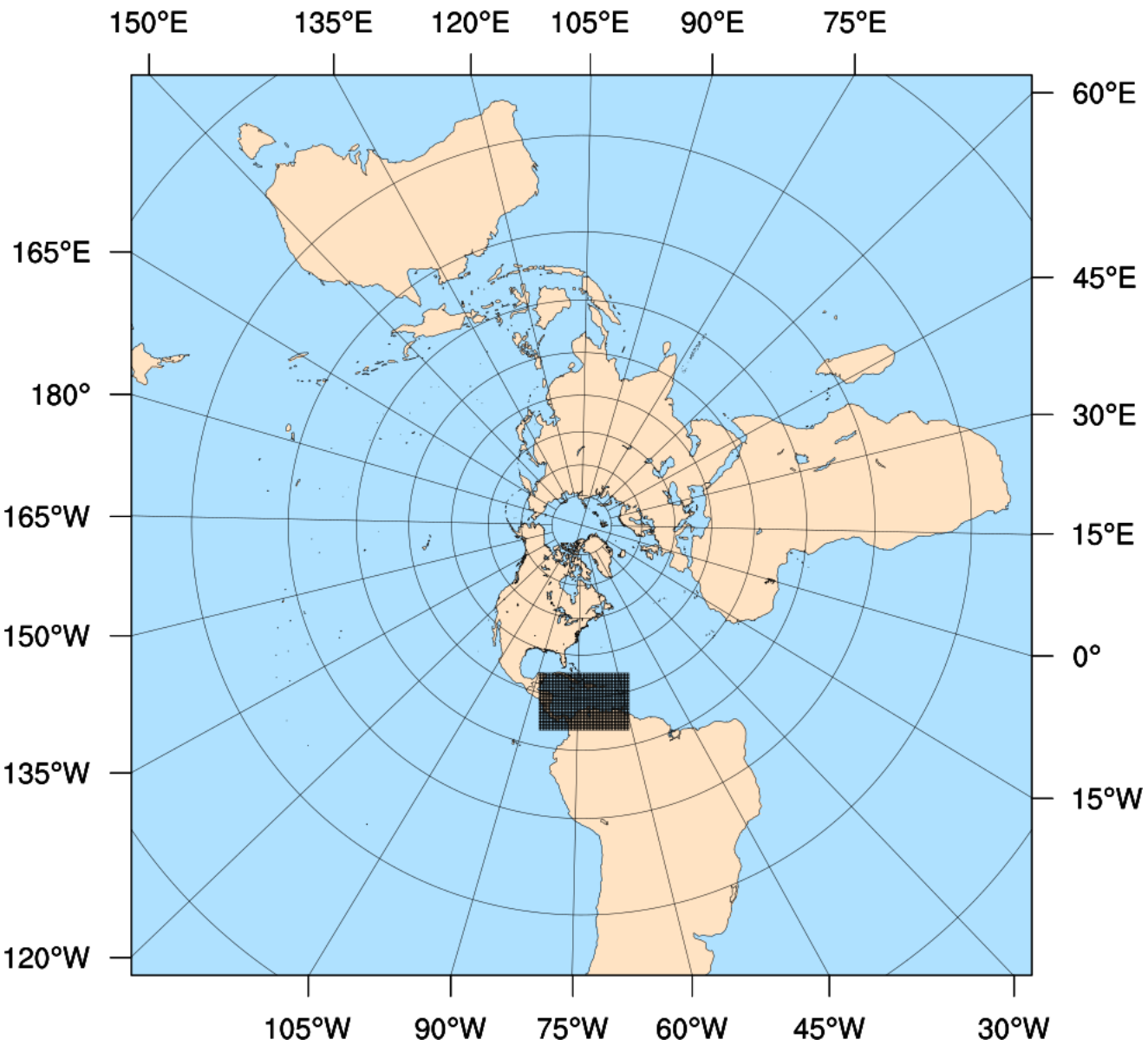
Polar stereographic projection



WPS Flowchart

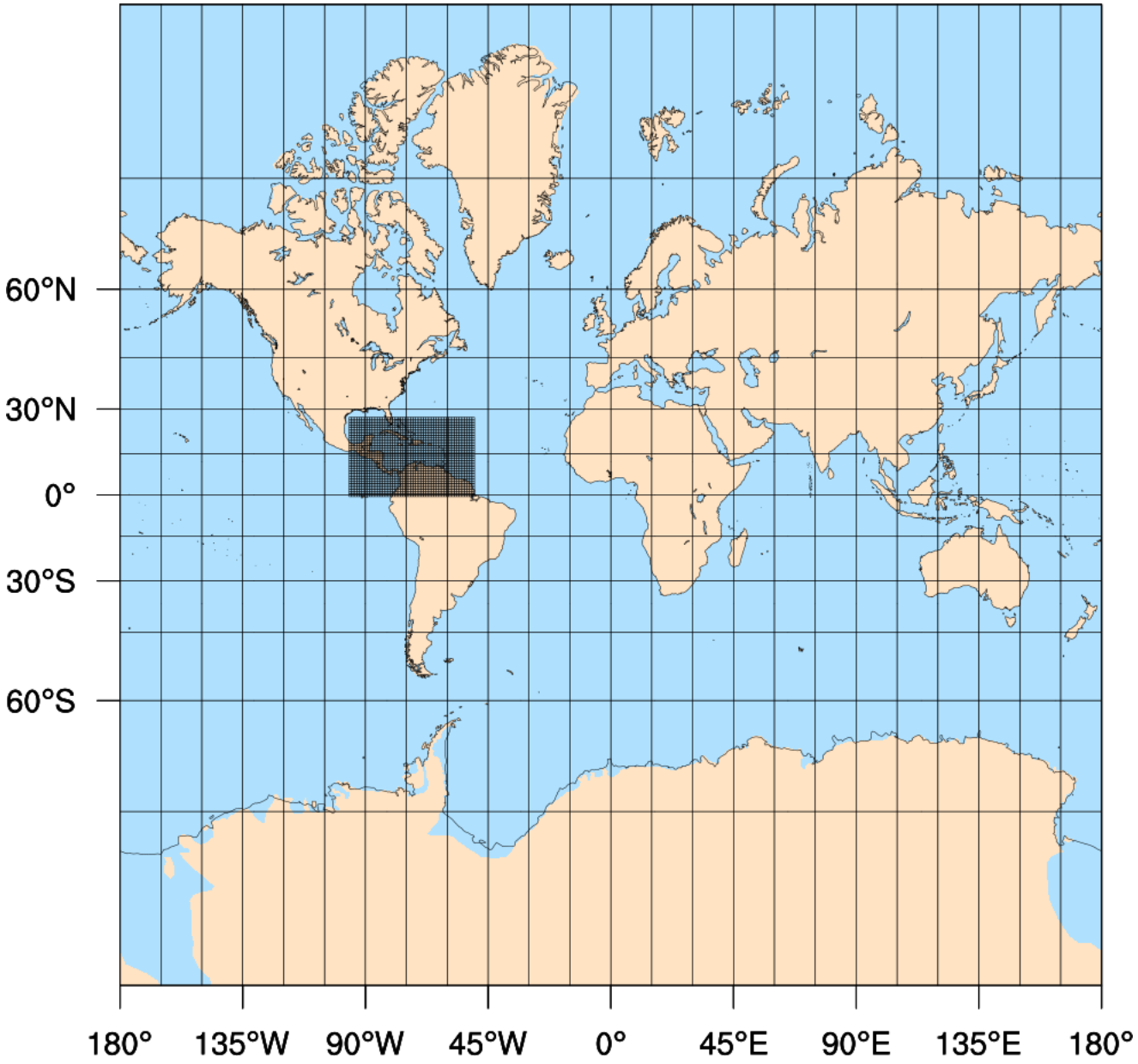


Laying out a simulation grid



For a rectangular domain over the Caribbean, a polar stereographic projection may not be ideal: scale distortion across the domain is non-trivial

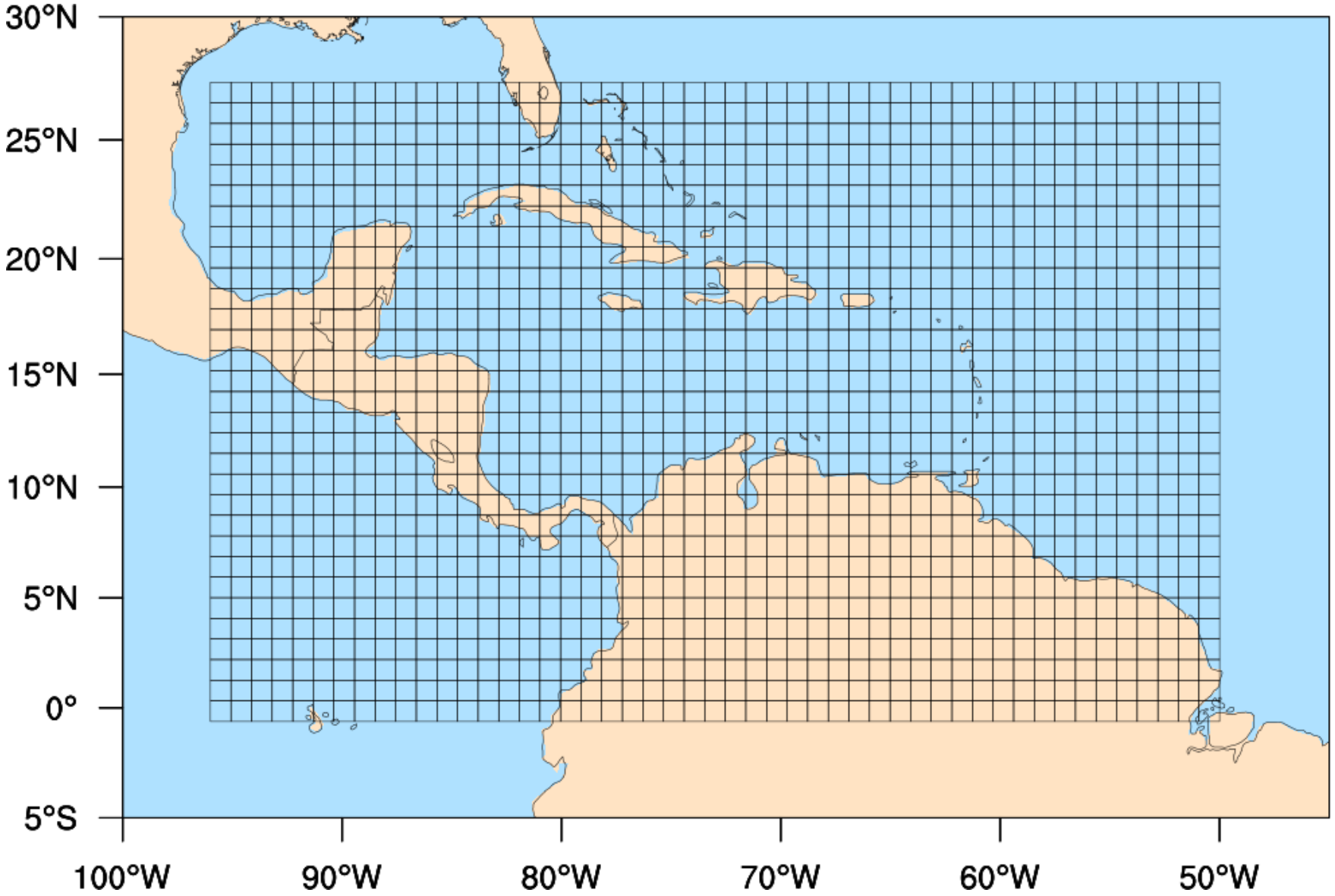
Laying out a simulation grid



However, the Mercator projection does work well for lower latitudes

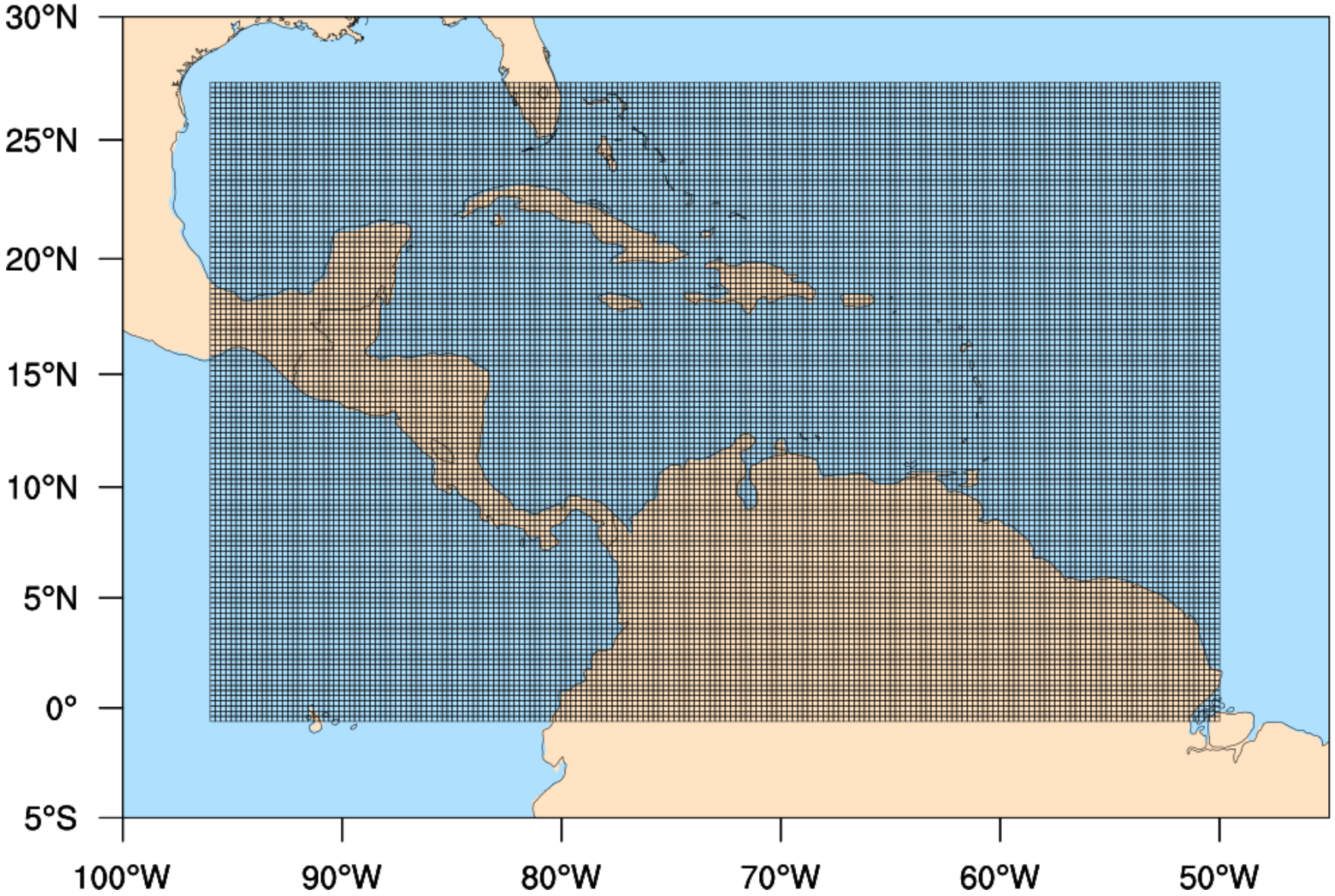
Laying out a simulation grid

49x31 cells, 104 km grid distance

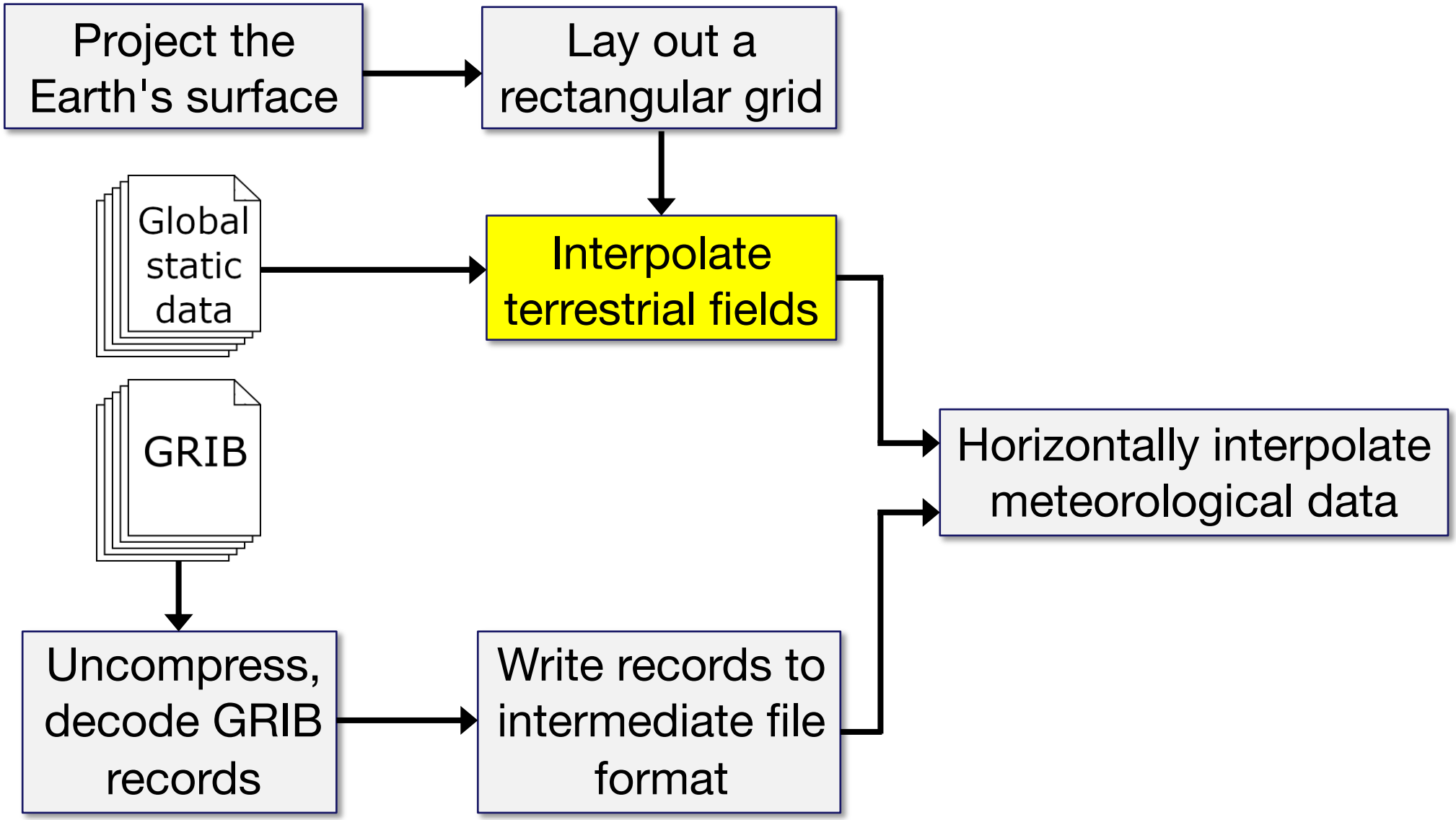


Laying out a simulation grid

196x124 cells, 26 km grid distance

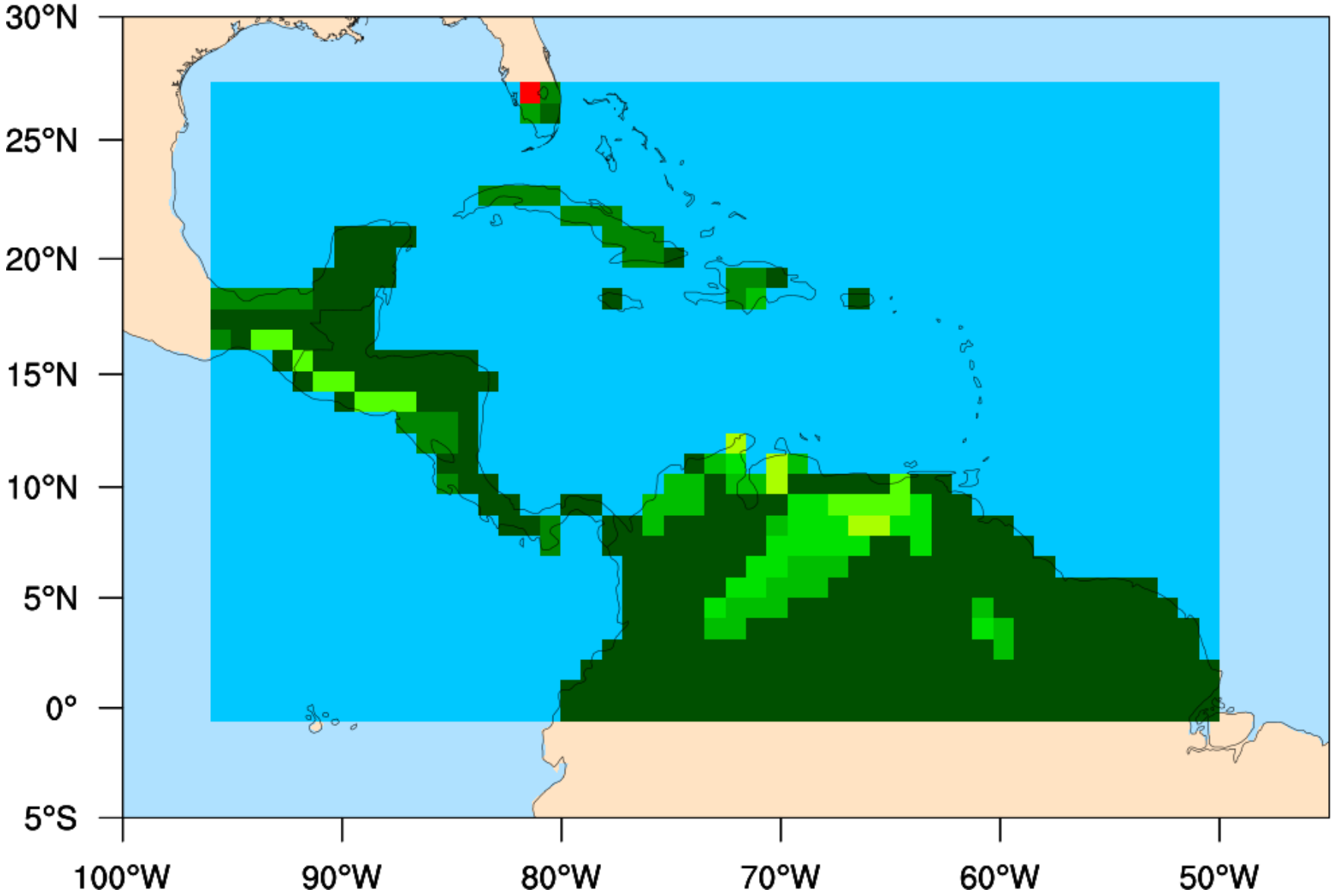


WPS Flowchart



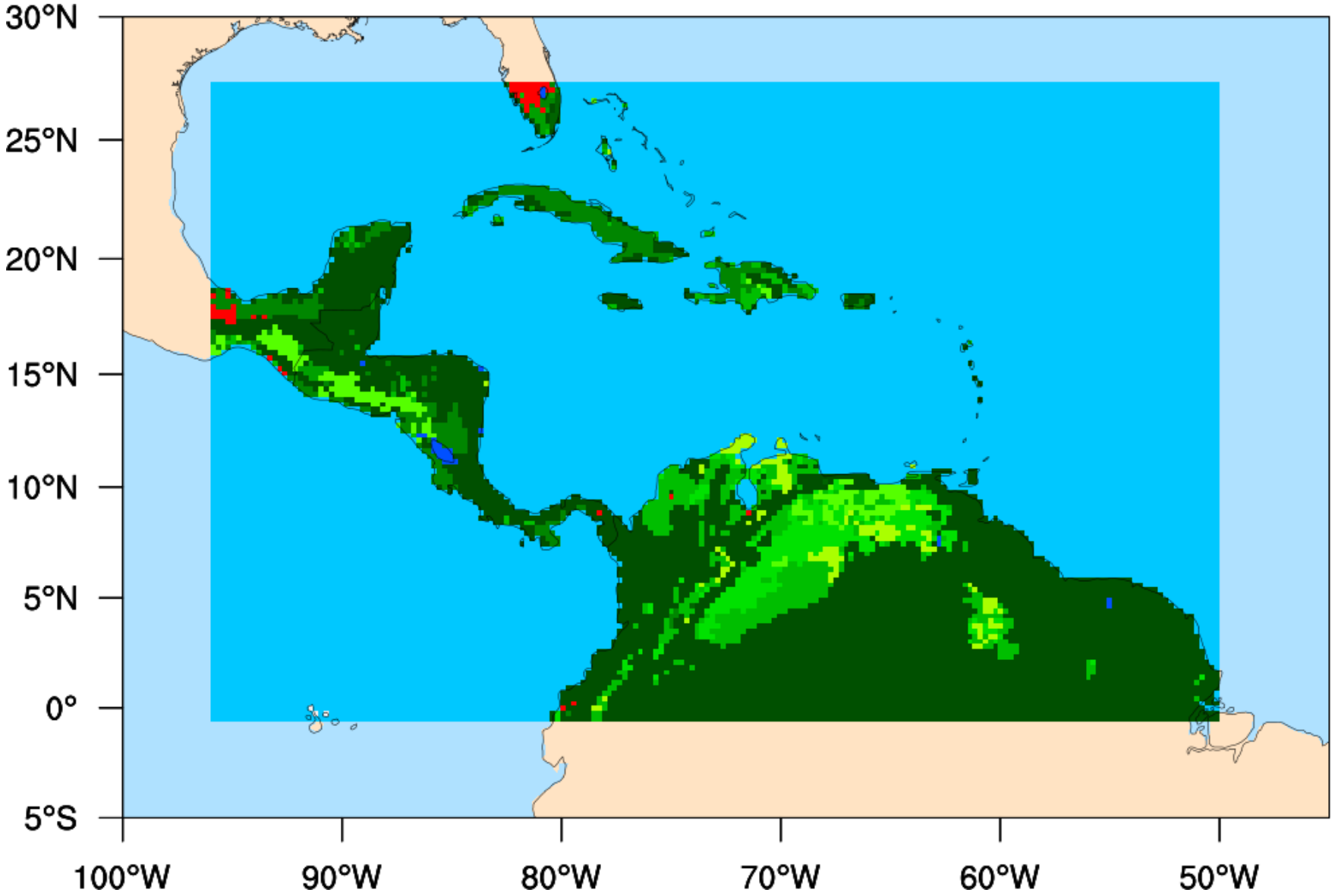
Interpolating terrestrial fields

Land-use category, 104 km grid



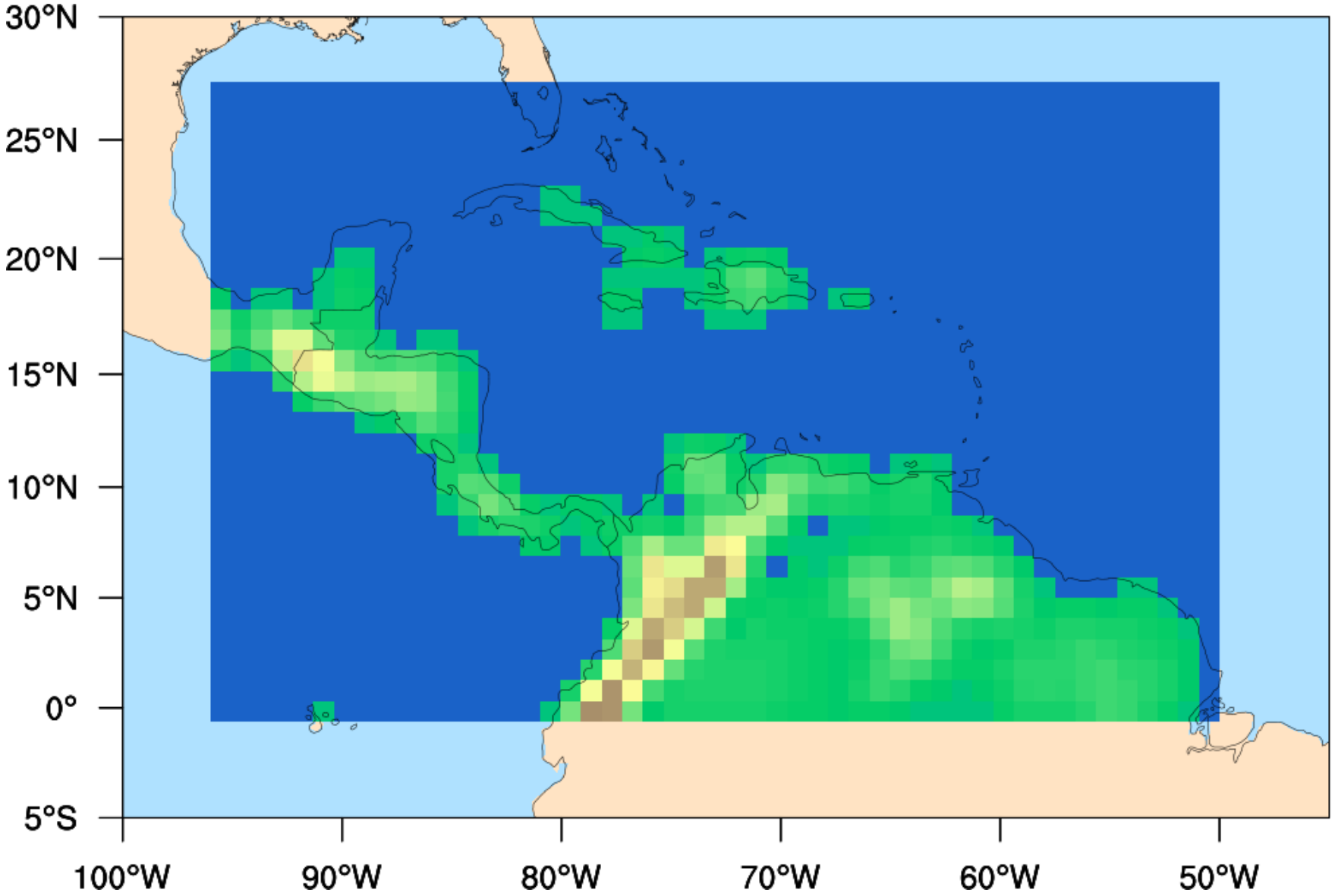
Interpolating terrestrial fields

Land-use category, 26 km grid



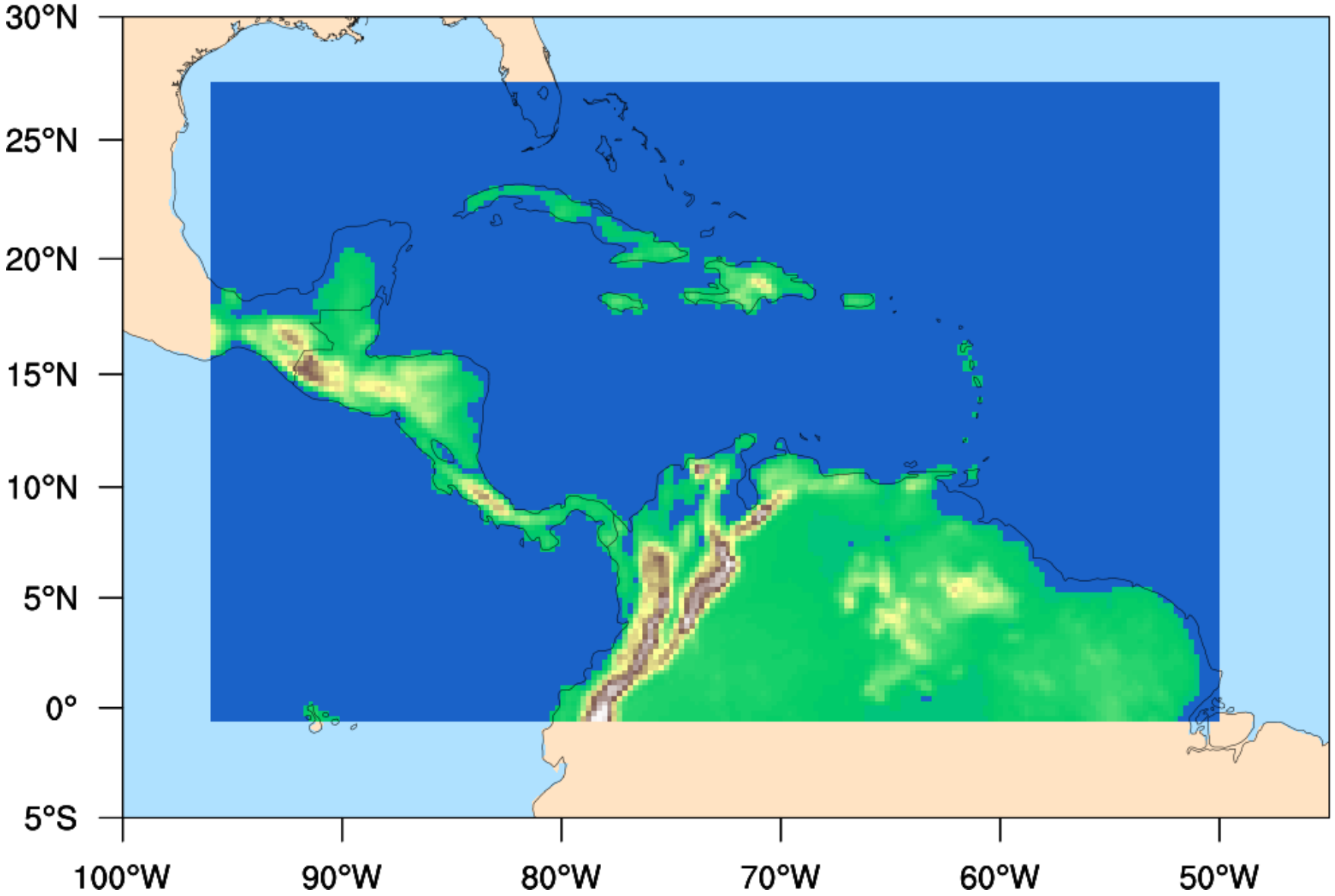
Interpolating terrestrial fields

Terrain elevation, 104 km grid

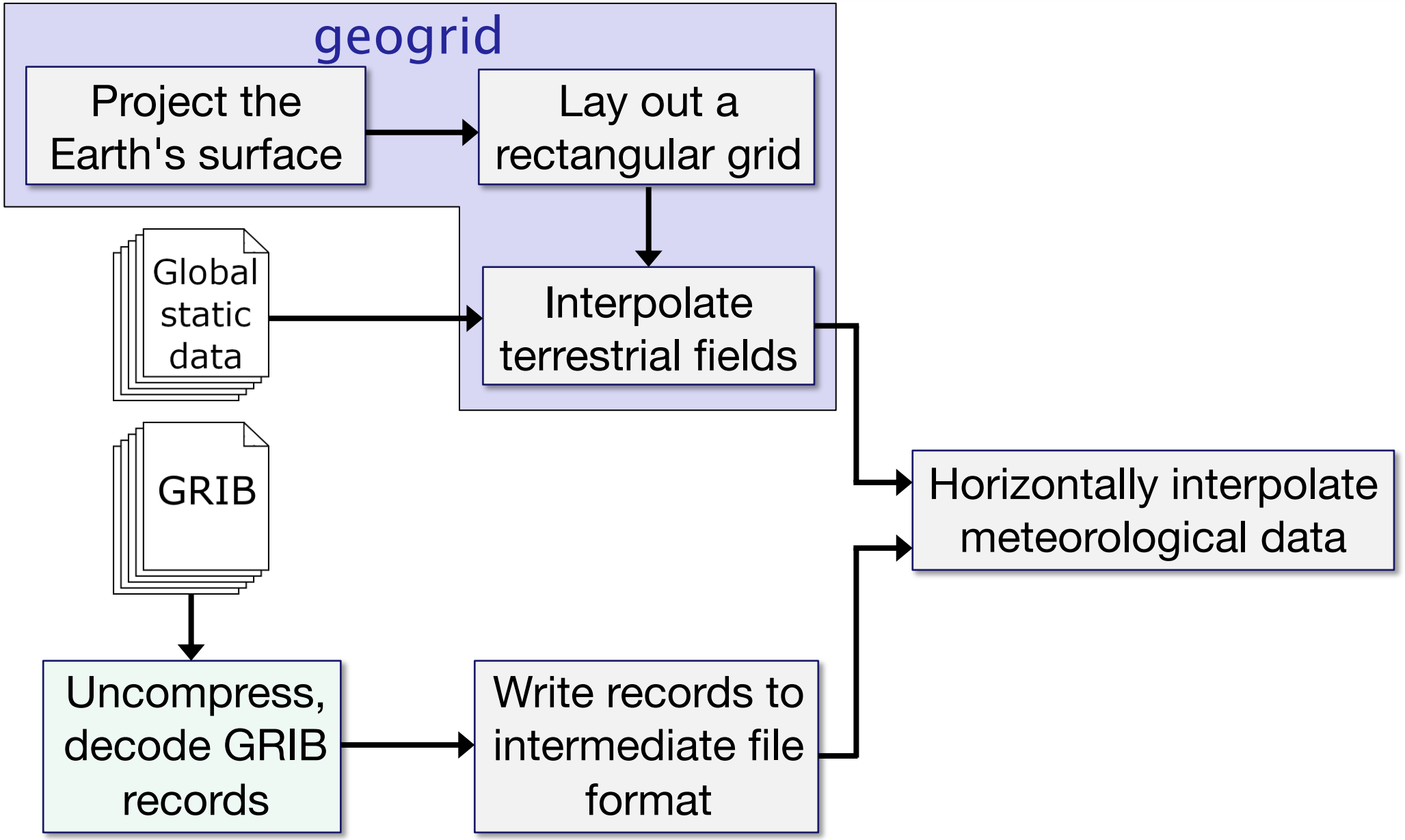


Interpolating terrestrial fields

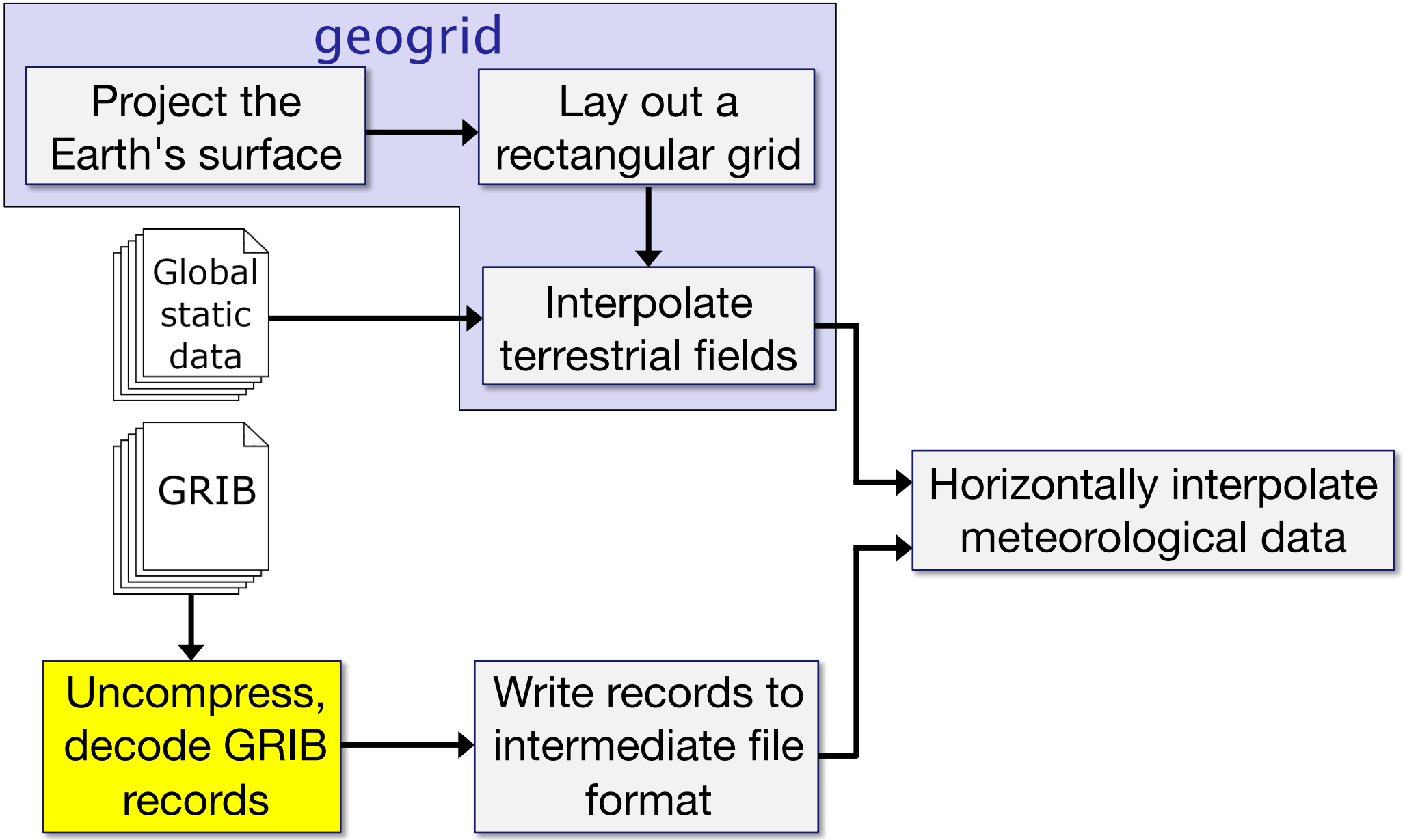
Terrain elevation, 26 km grid



WPS Flowchart



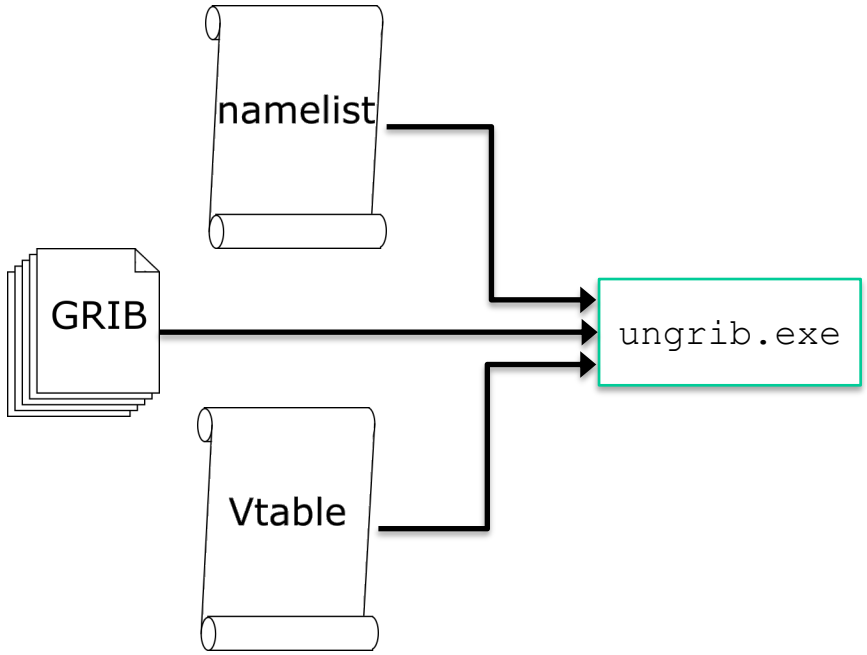
WPS Flowchart



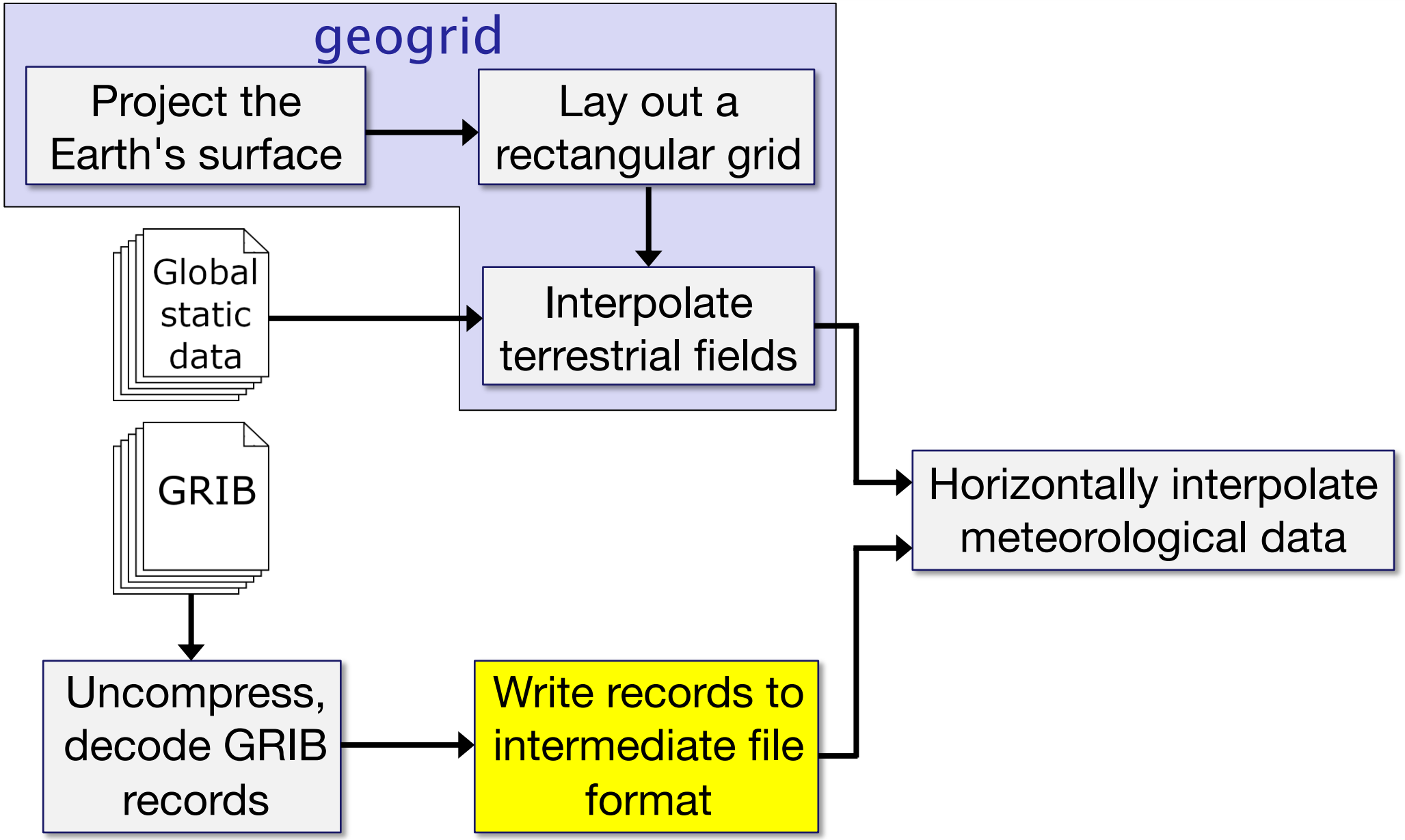
Uncompressing and decoding GRIB records

Historically, many meteorological datasets were (and still are) distributed in a WMO-standard format called GRIB

- **G**eneral **R**egularly-distributed **I**nformation in **B**inary
- Fields are typically compressed with a lossy compression algorithm
- Fields are identified by code numbers



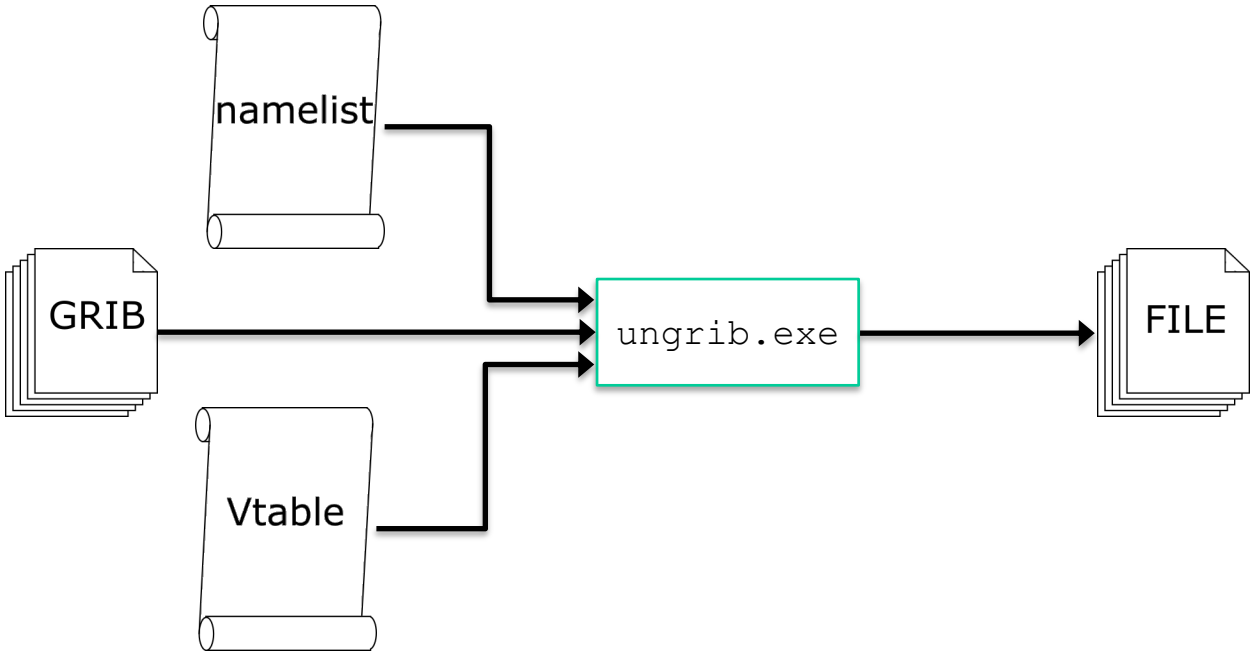
WPS Flowchart



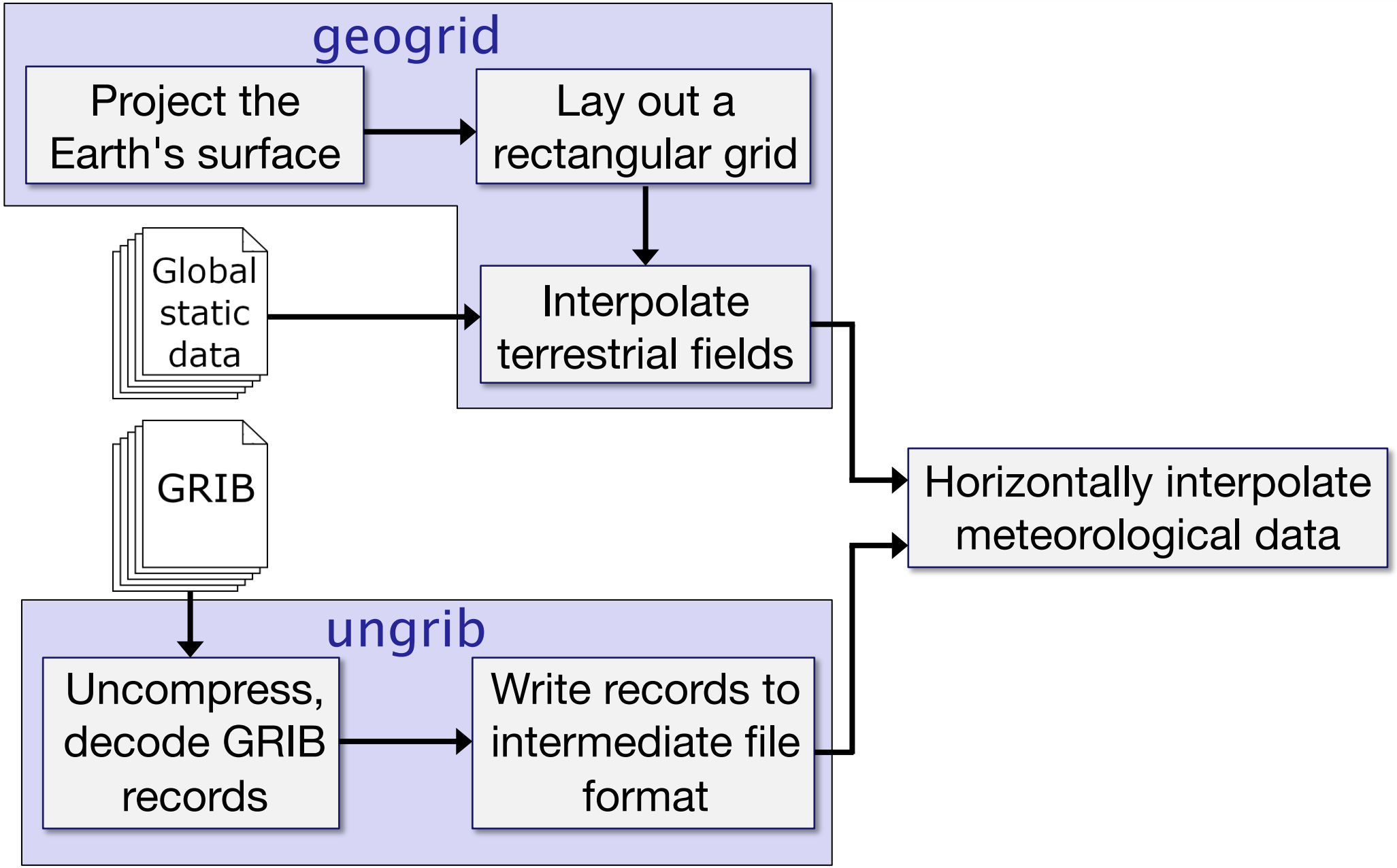
Uncompressing and decoding GRIB records

Writing to an "intermediate" file format provides a target to which other non-GRIB datasets may be converted

If the "intermediate" file format is simple enough, writing tools to, e.g., bias-correct fields becomes easier



WPS Flowchart



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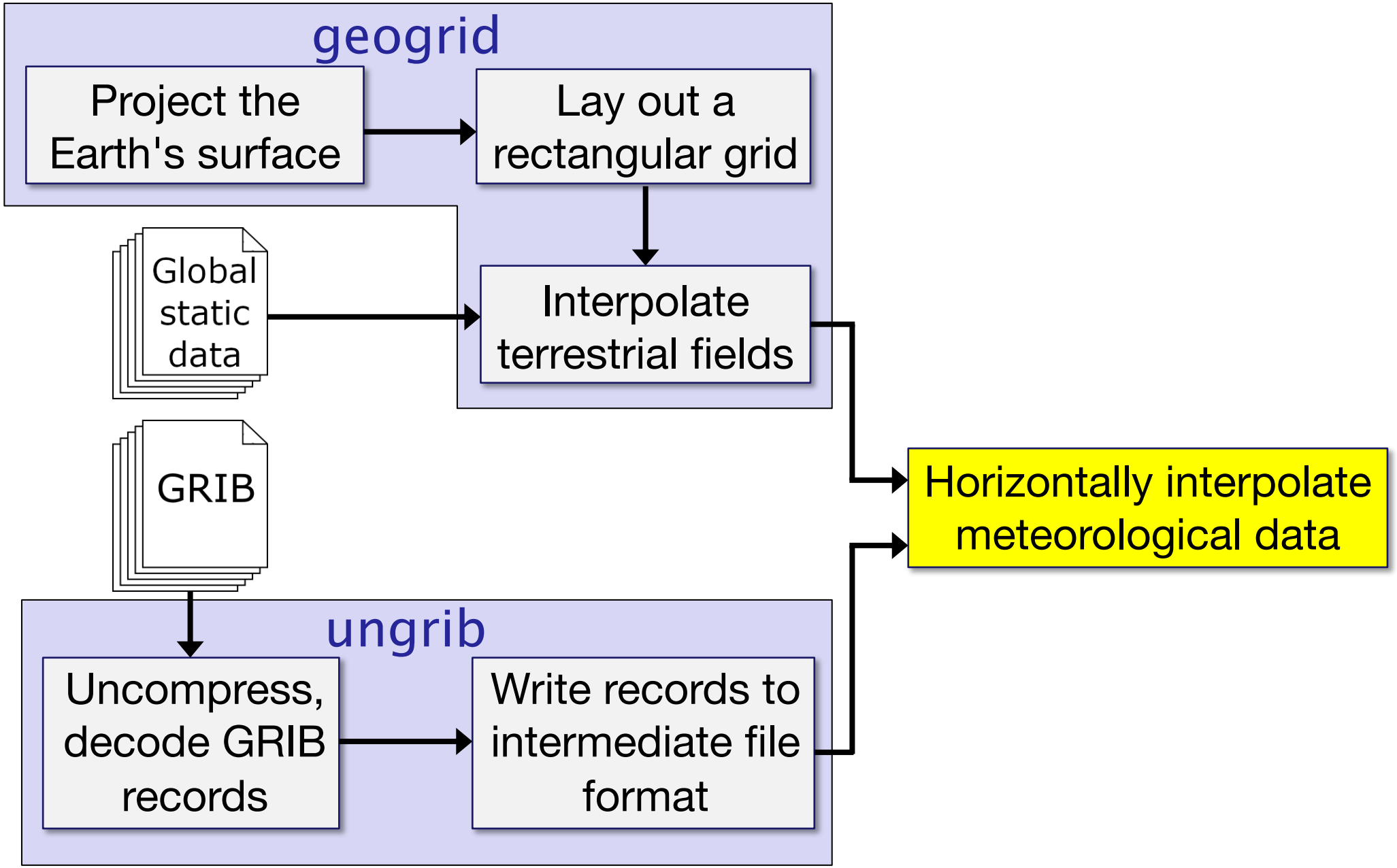
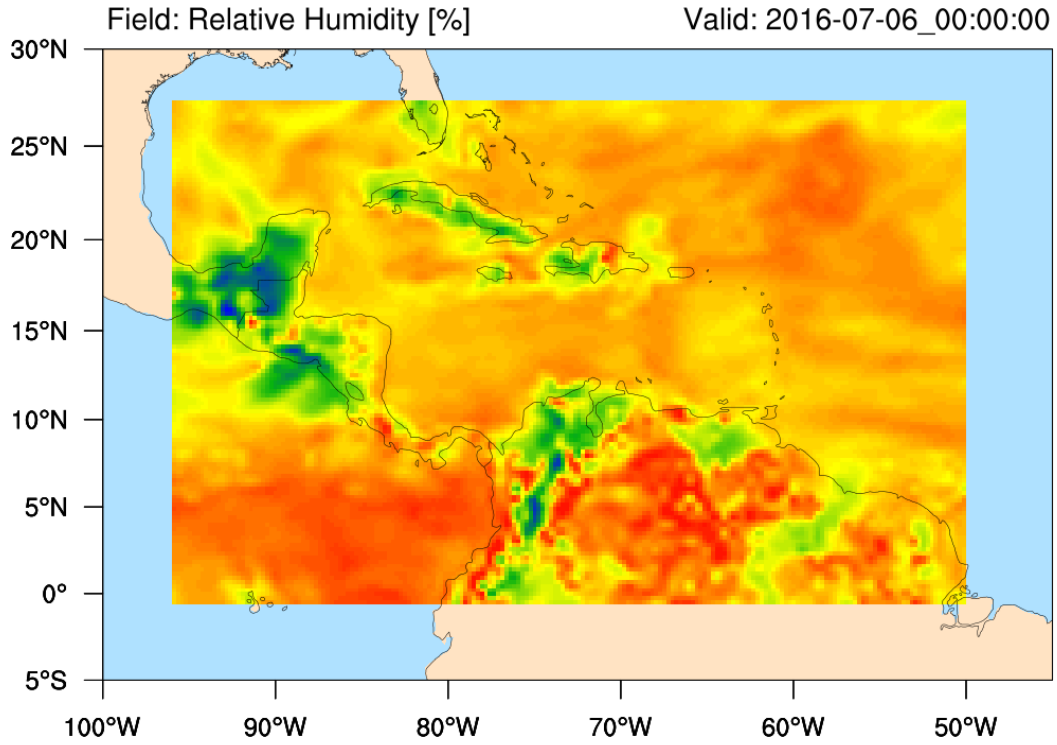


Horizontally interpolating meteorological data

The rectangular grid defined by the *geogrid* program provides a target to which we can interpolate meteorological fields

- Model ICs and LBCs will be derived from these interpolated, time-varying fields

Temperature
Humidity (R.H. or S.H.)
Winds
Z
P_{SFC}, P_{MSL}
SST
Soil temperature
Soil moisture
(Plus a few others…)



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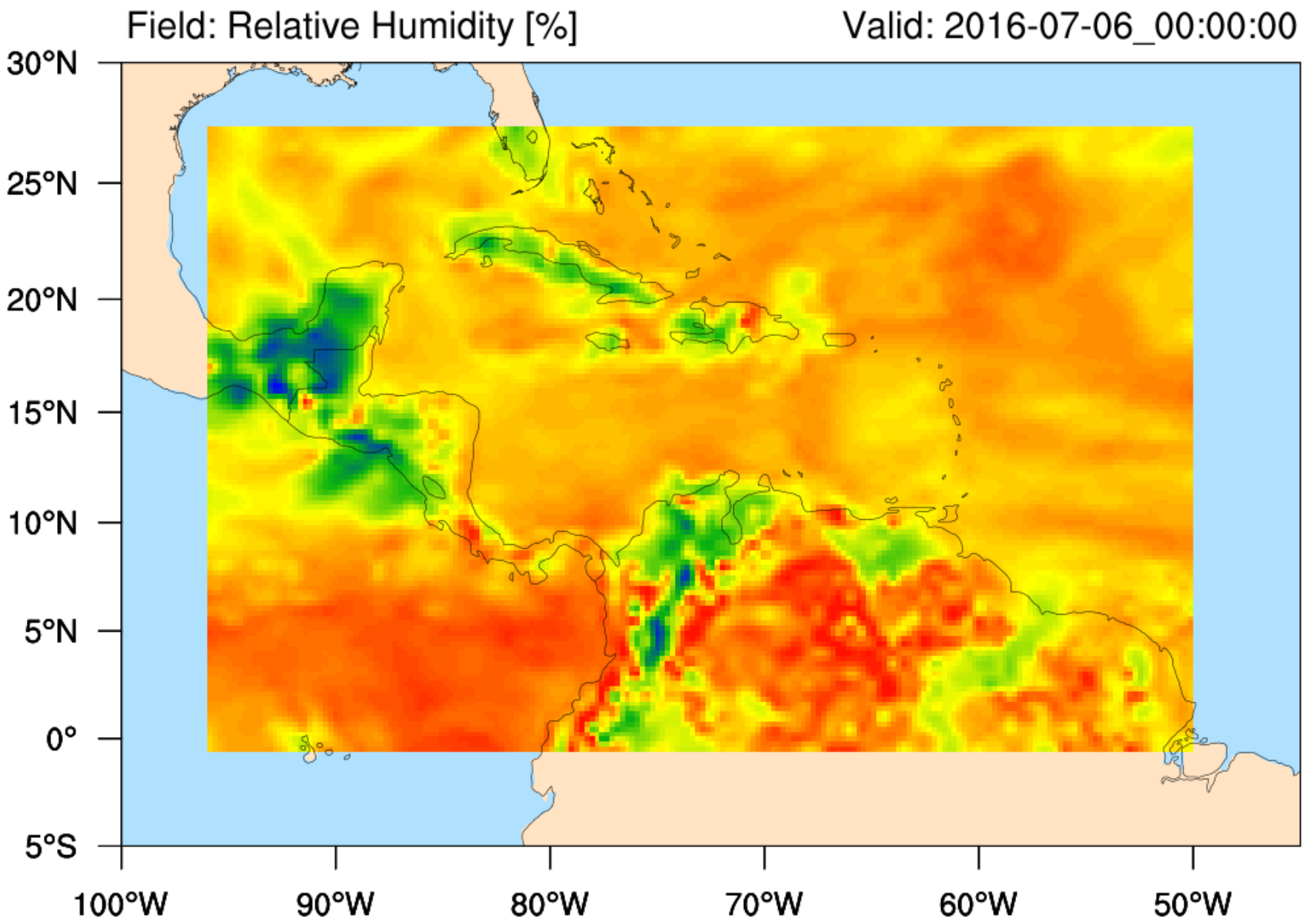

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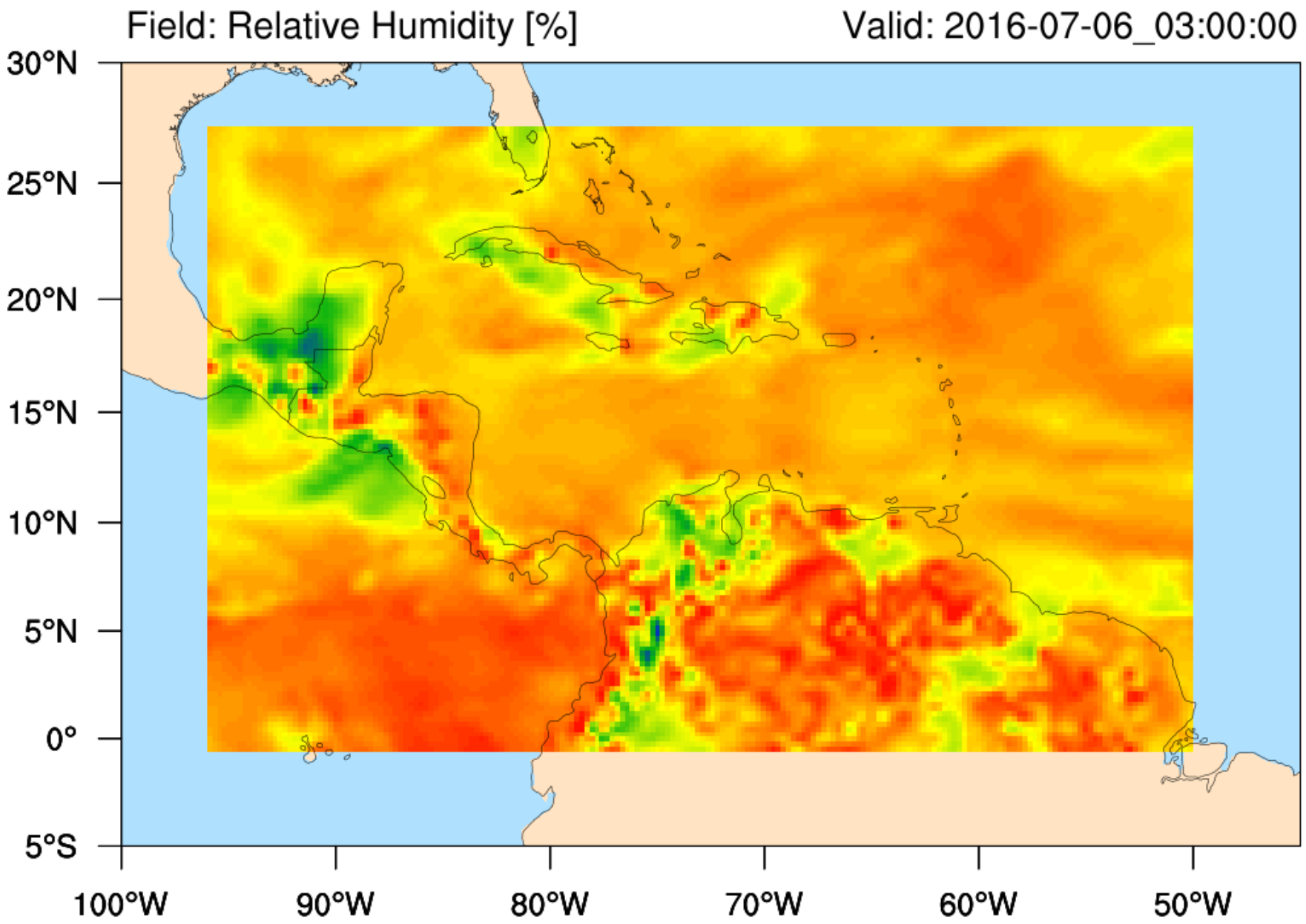

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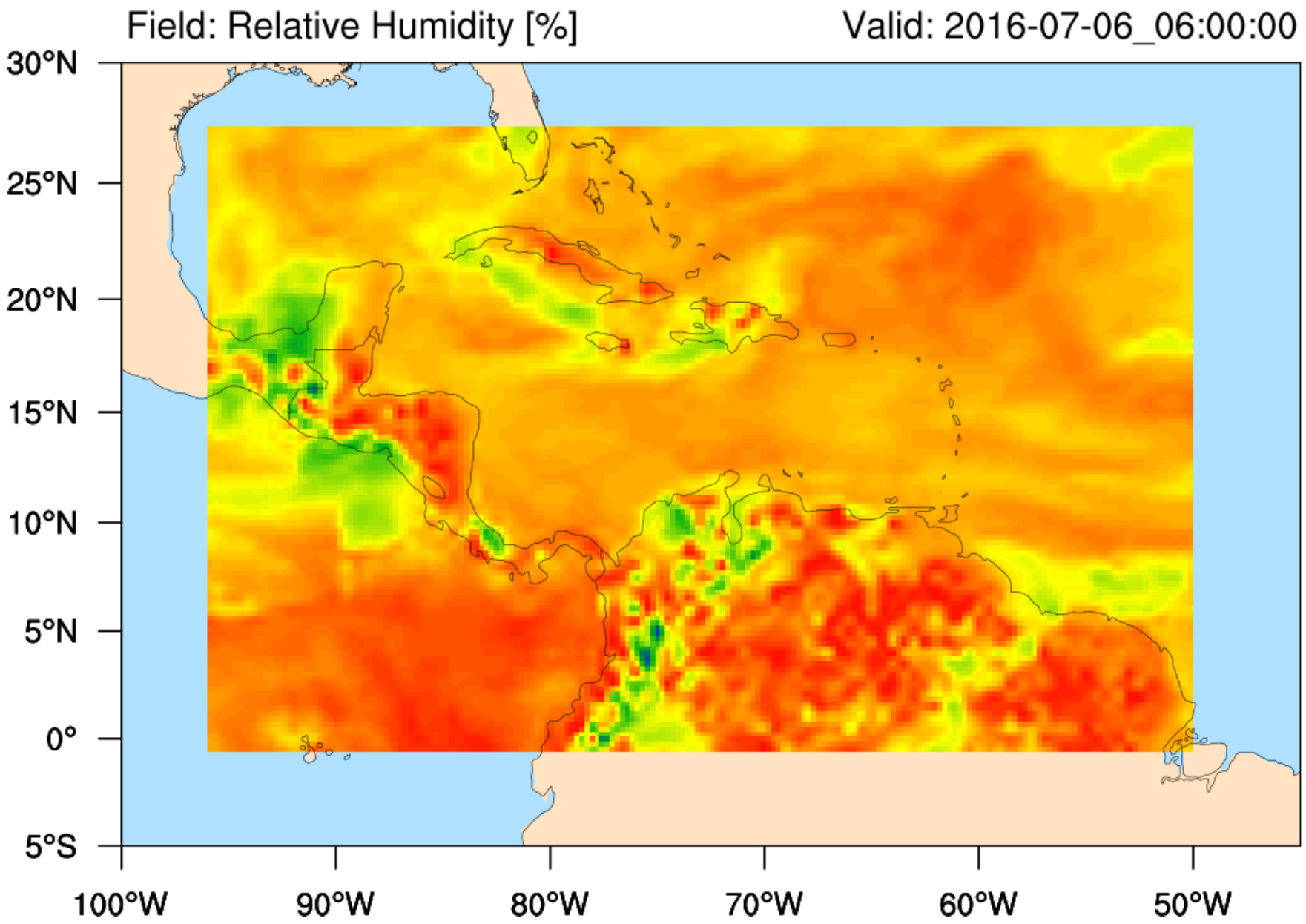

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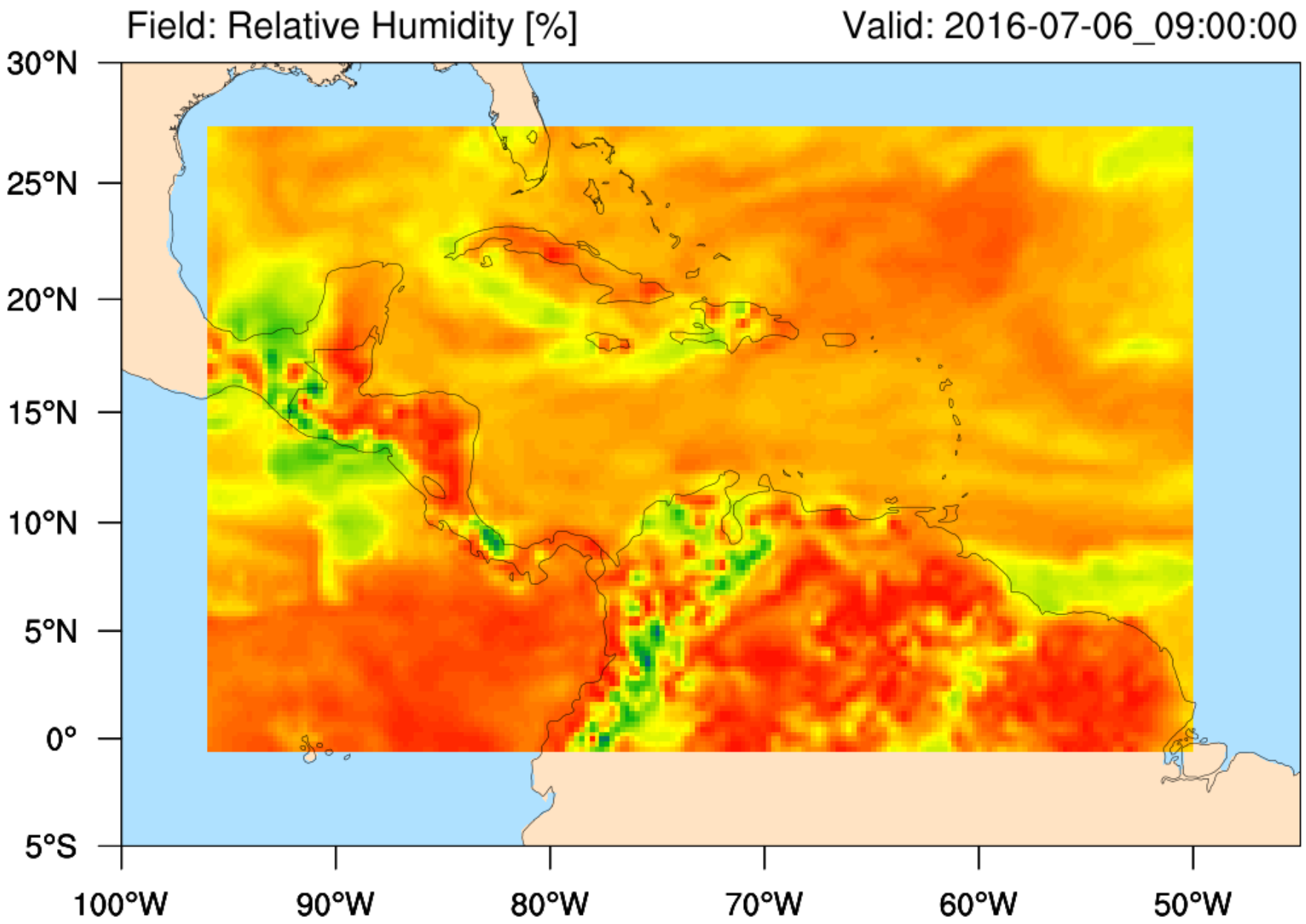

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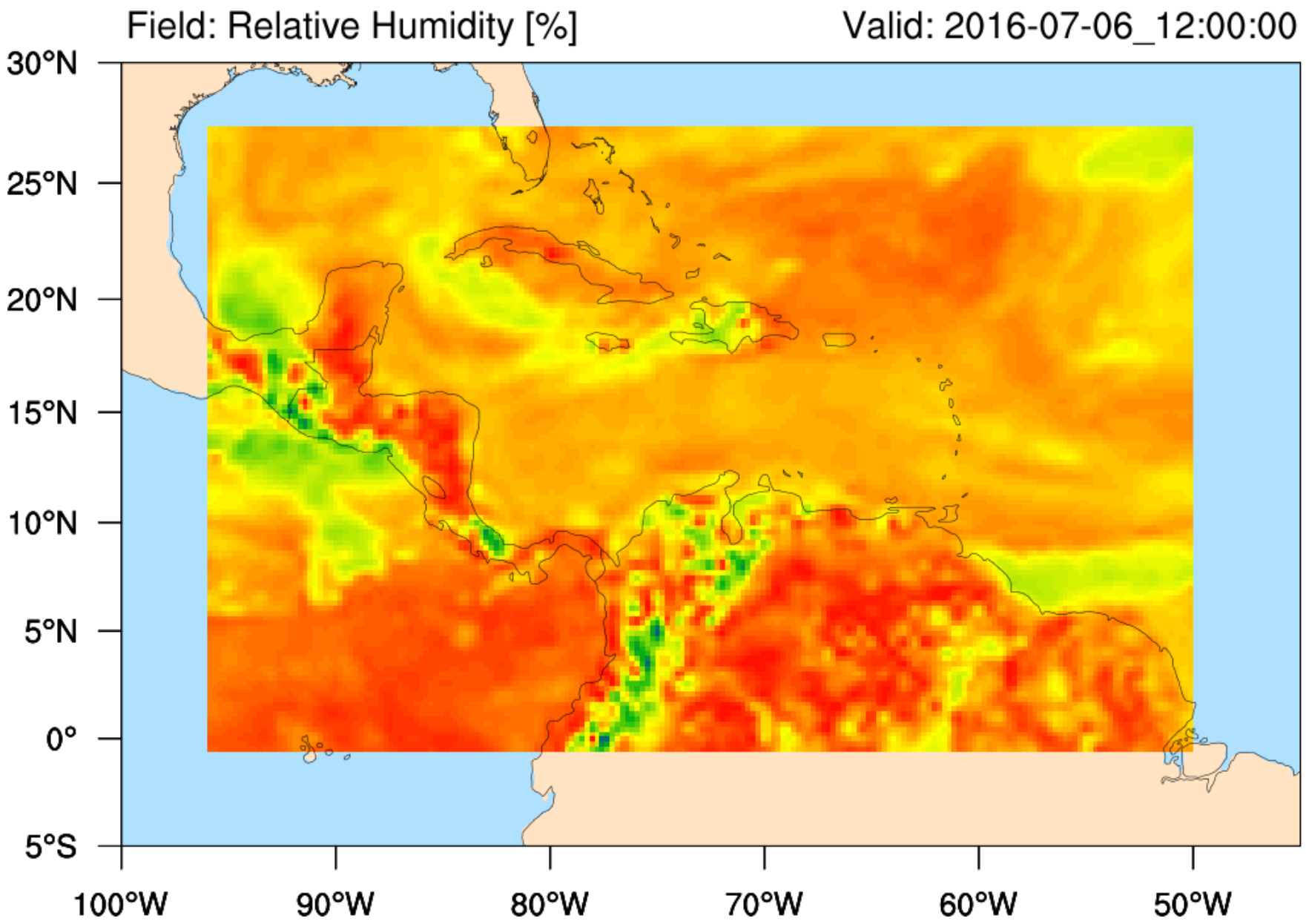

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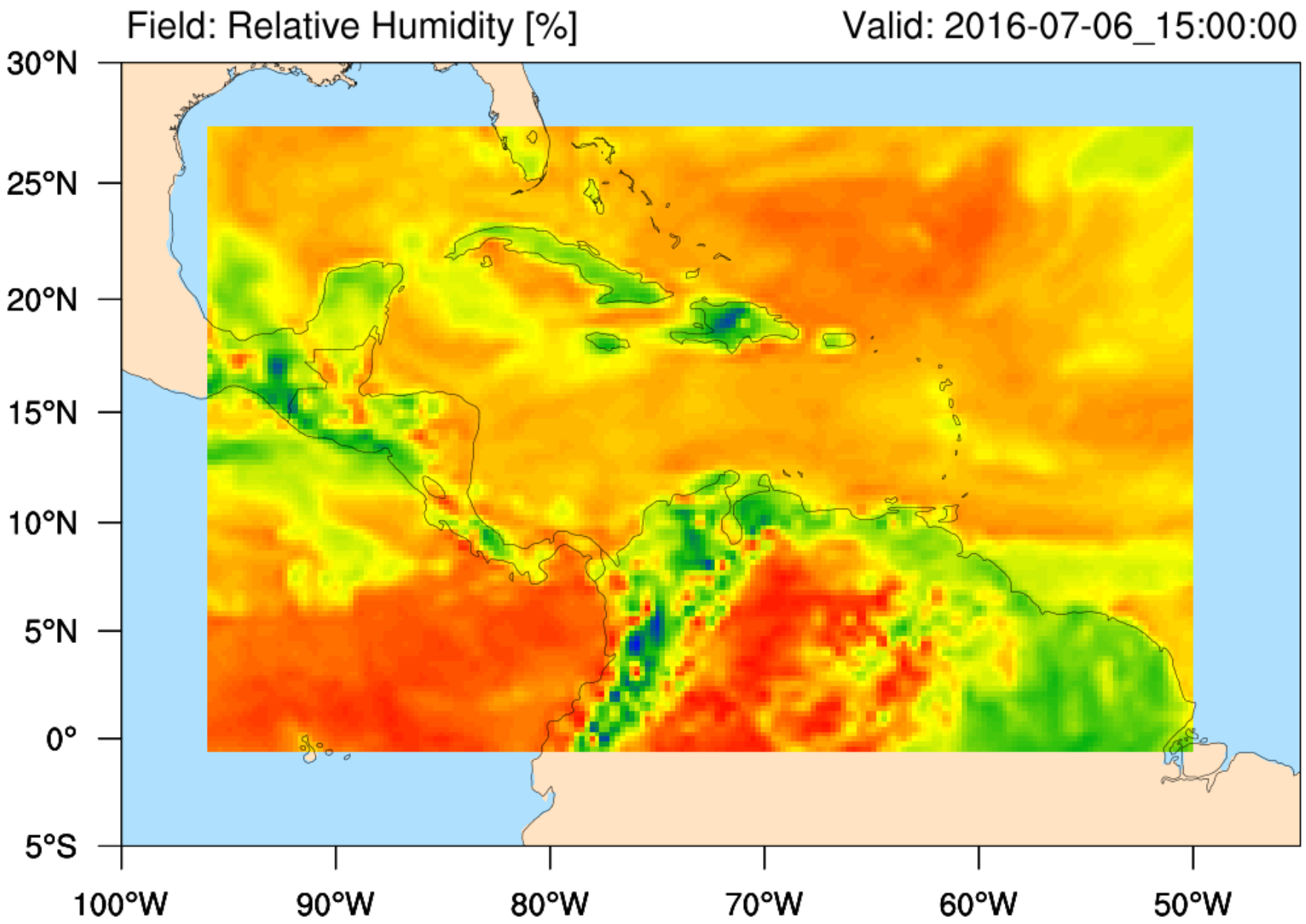

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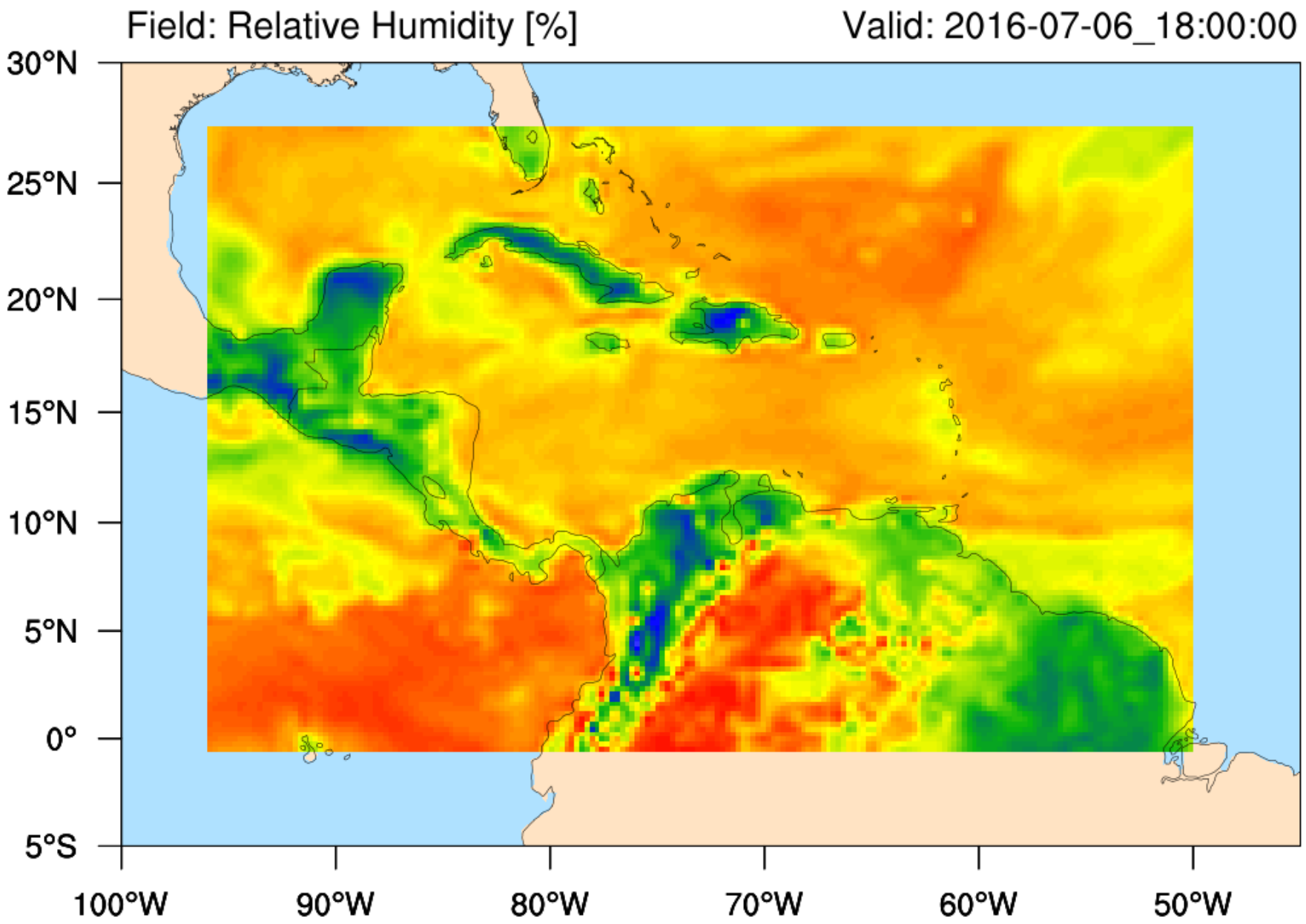

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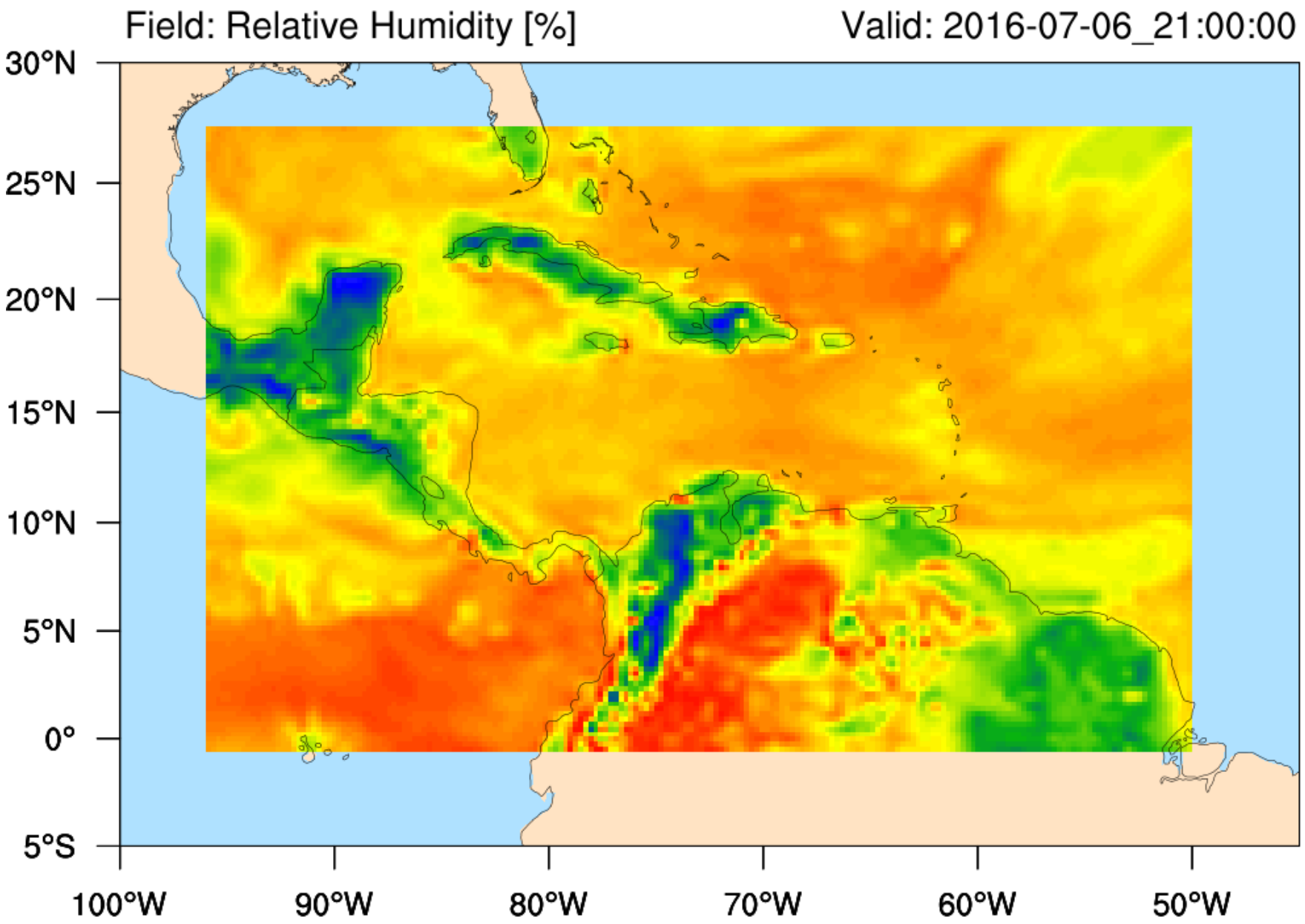

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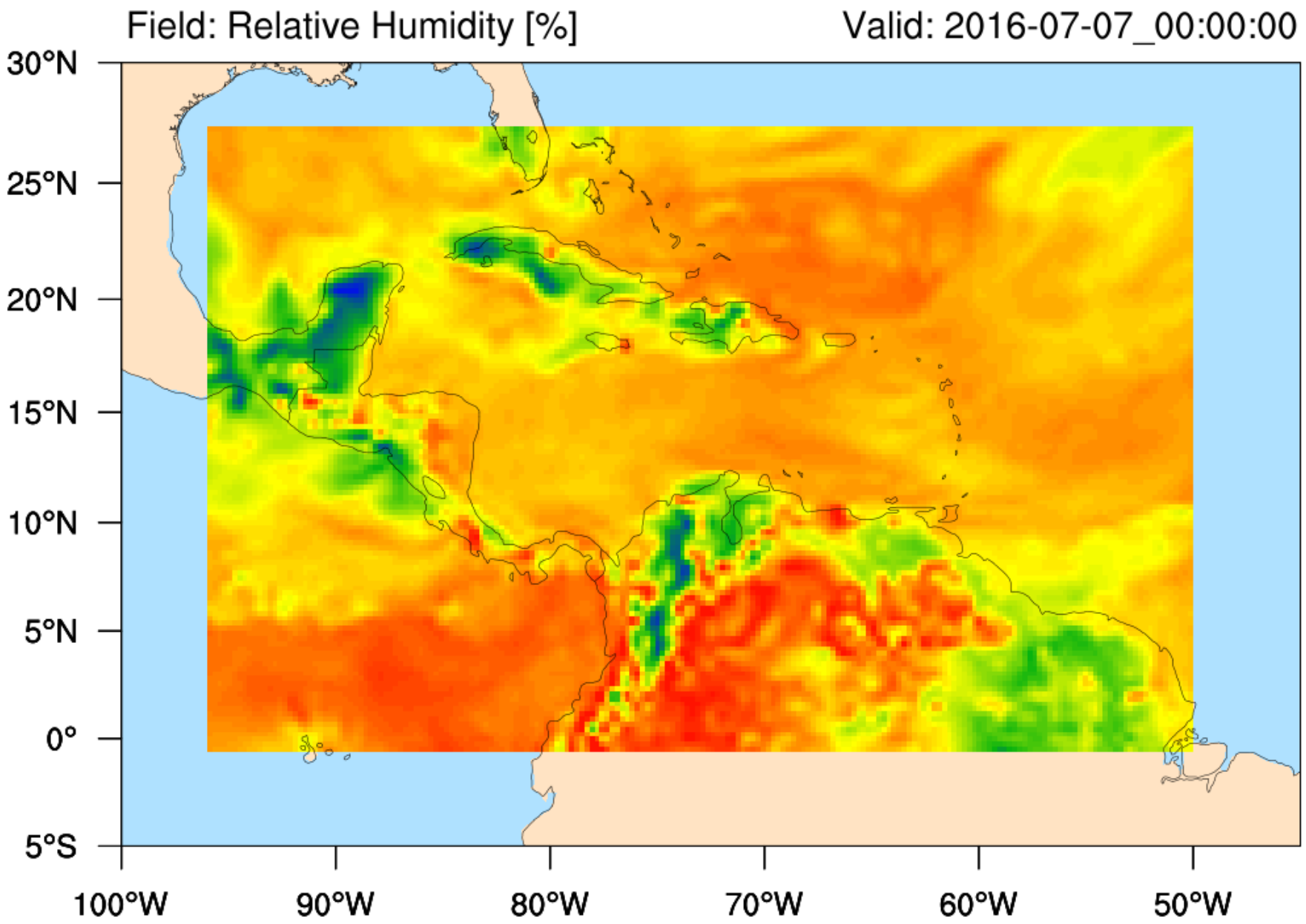

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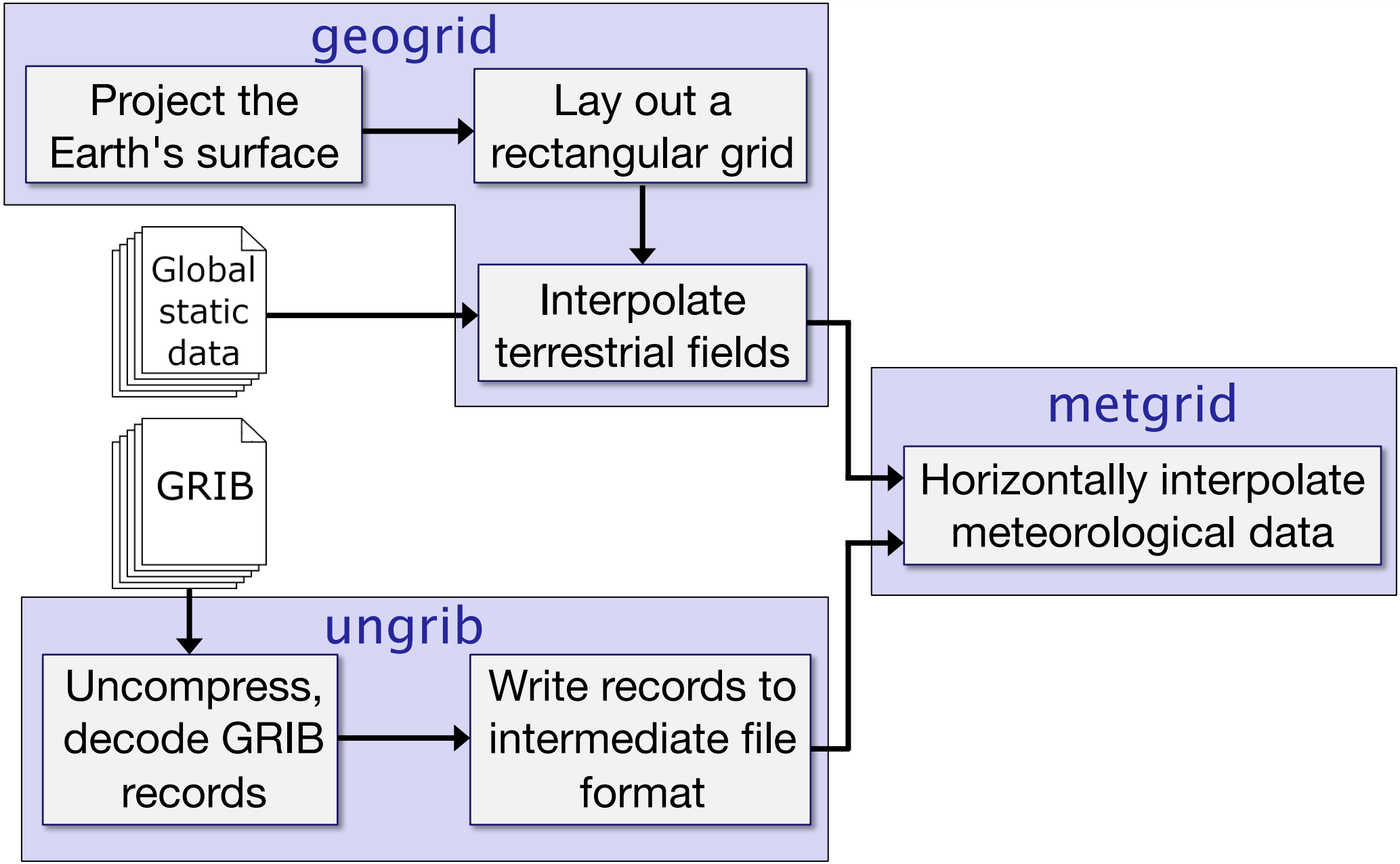
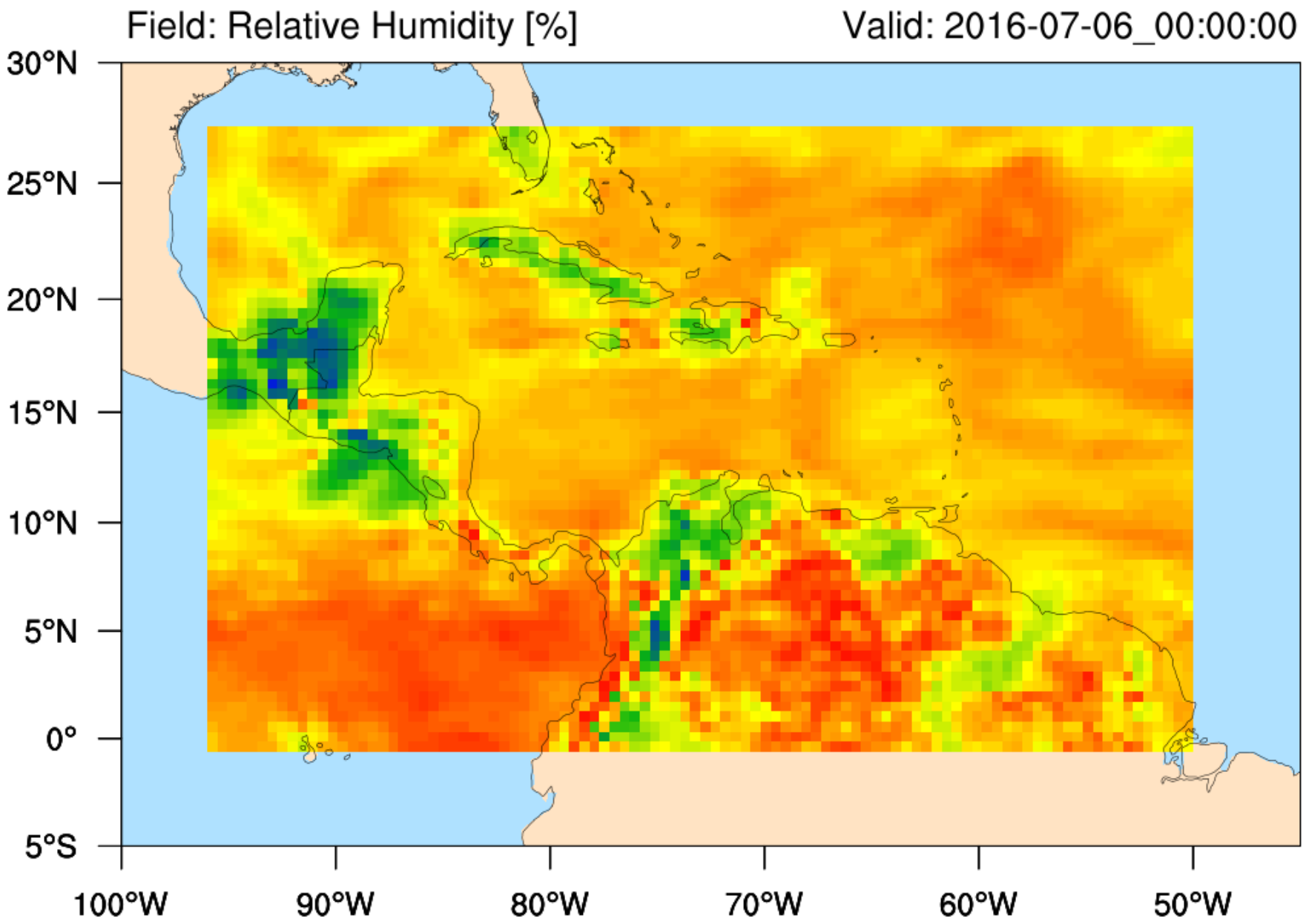


Horizontally interpolating meteorological data

If we have atmospheric state variables interpolated to every grid point in our model domain for time periods covering our simulation duration, *why do we need to run the WRF model?*

Horizontally interpolating meteorological data



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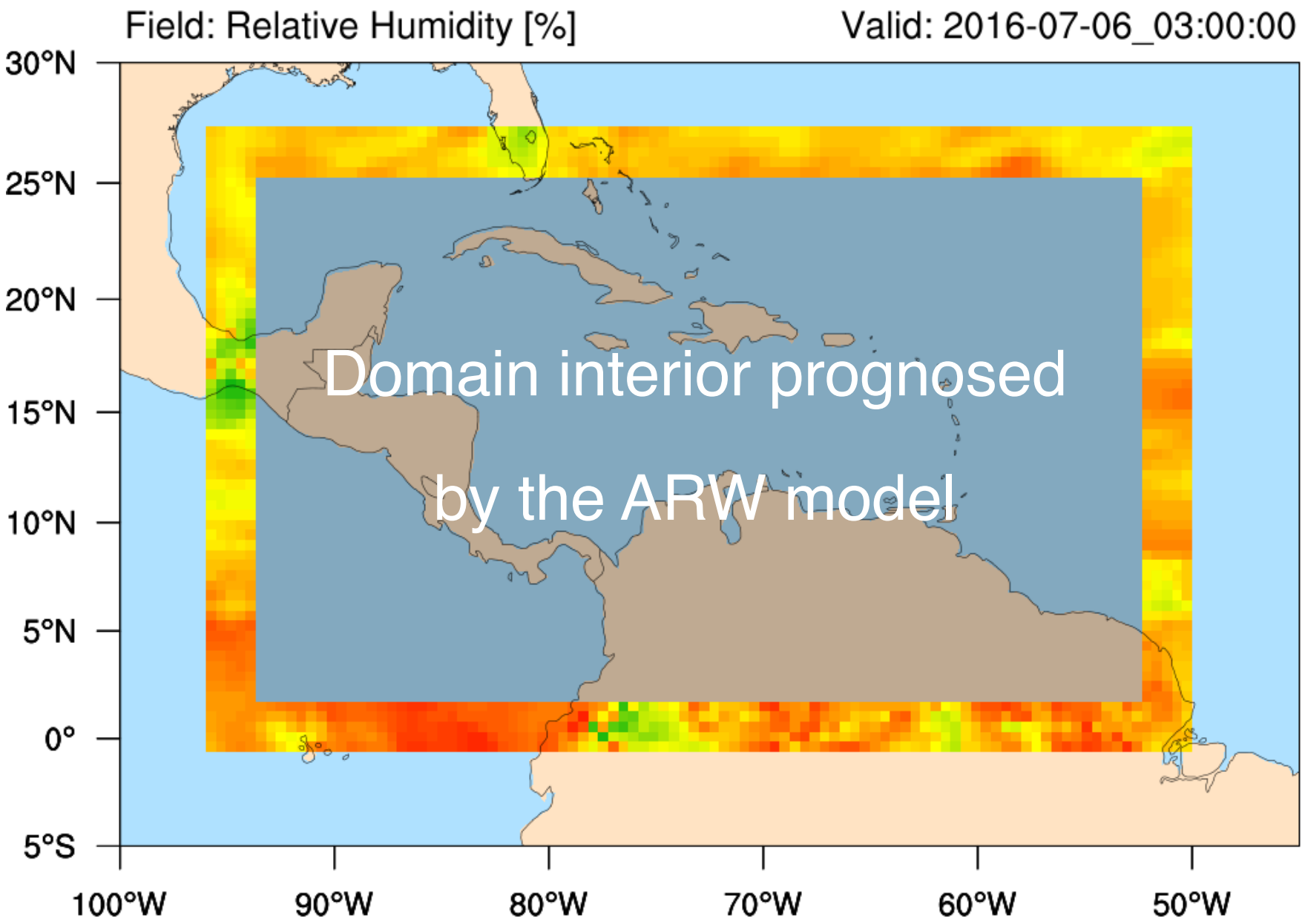

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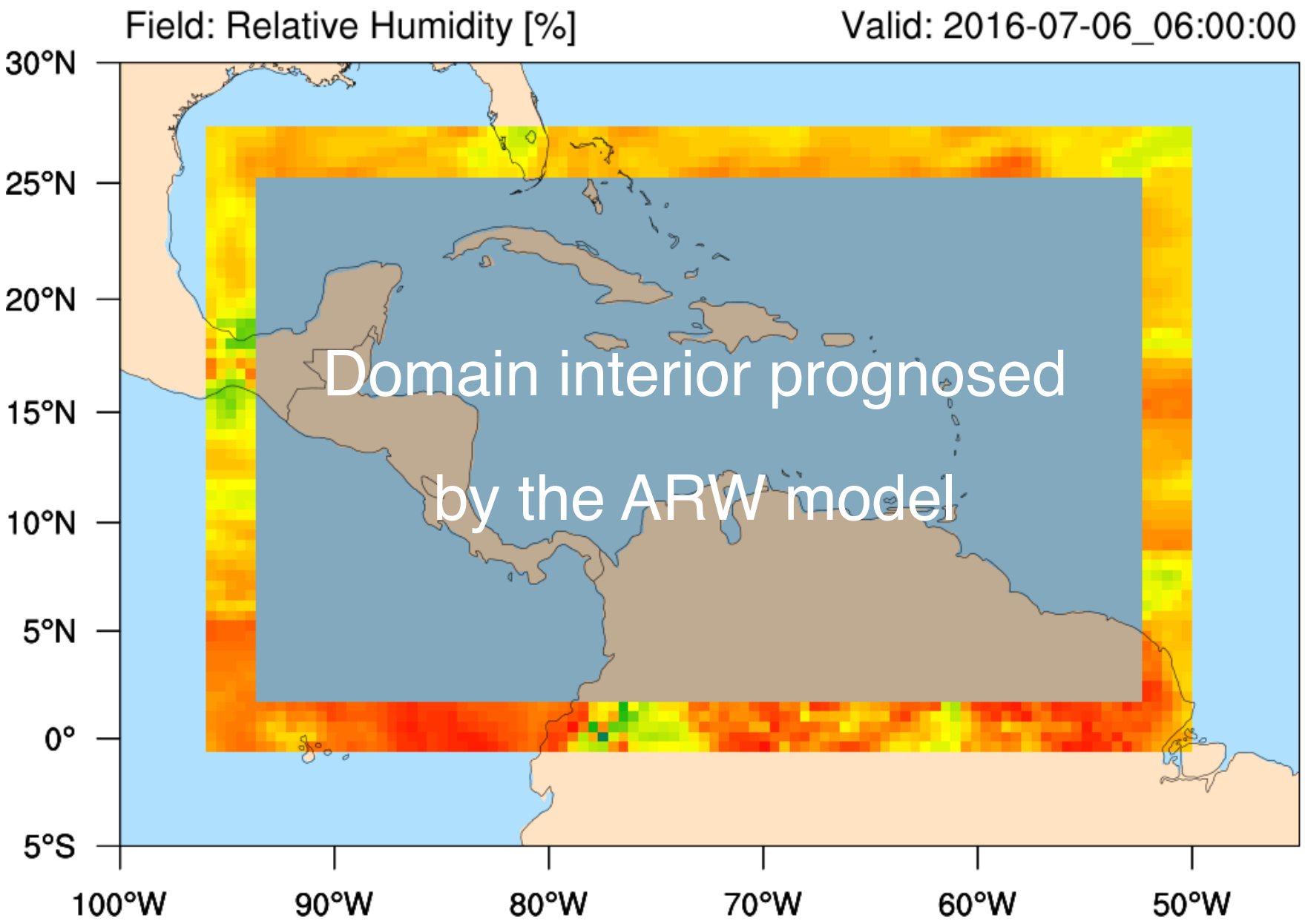

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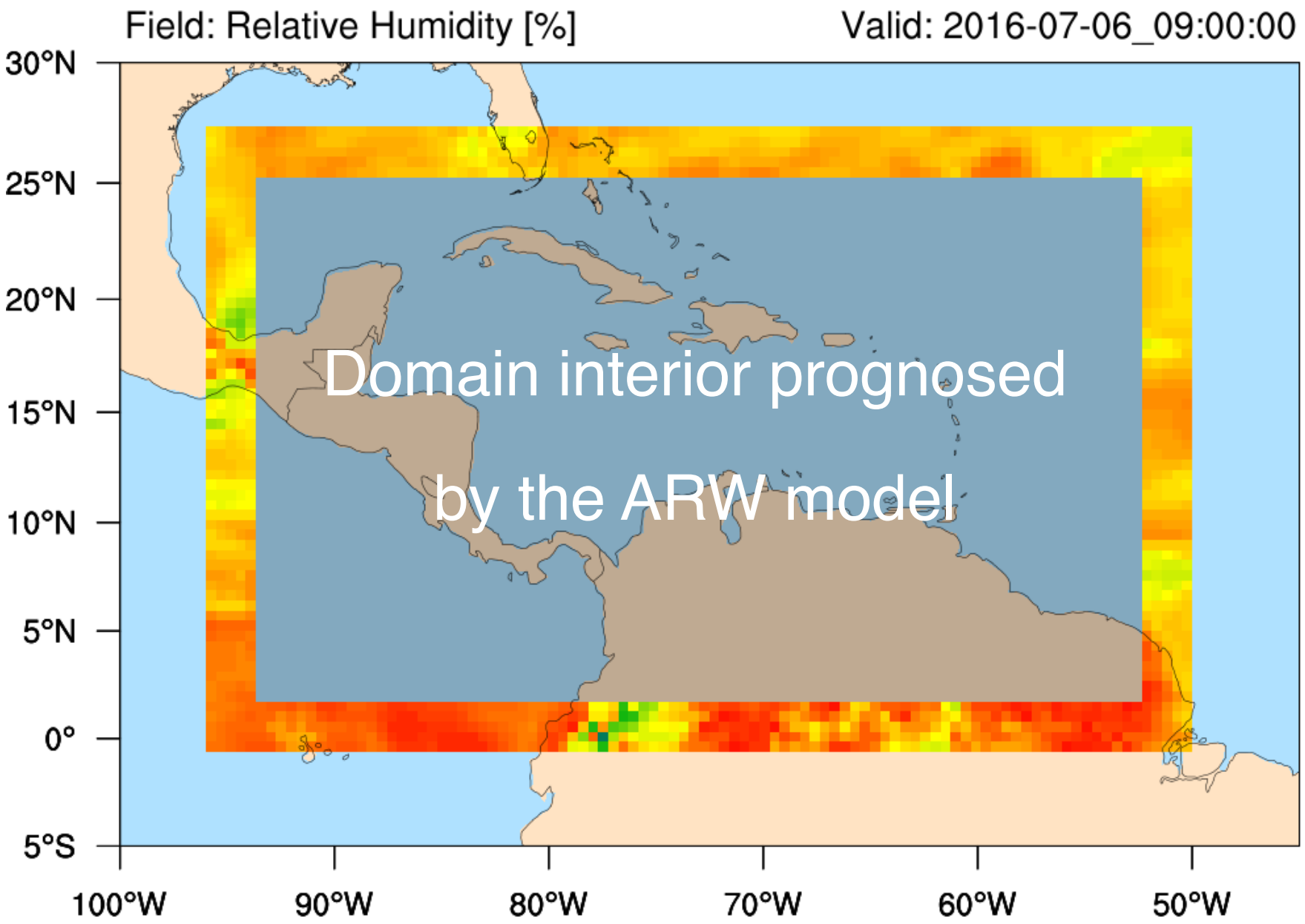

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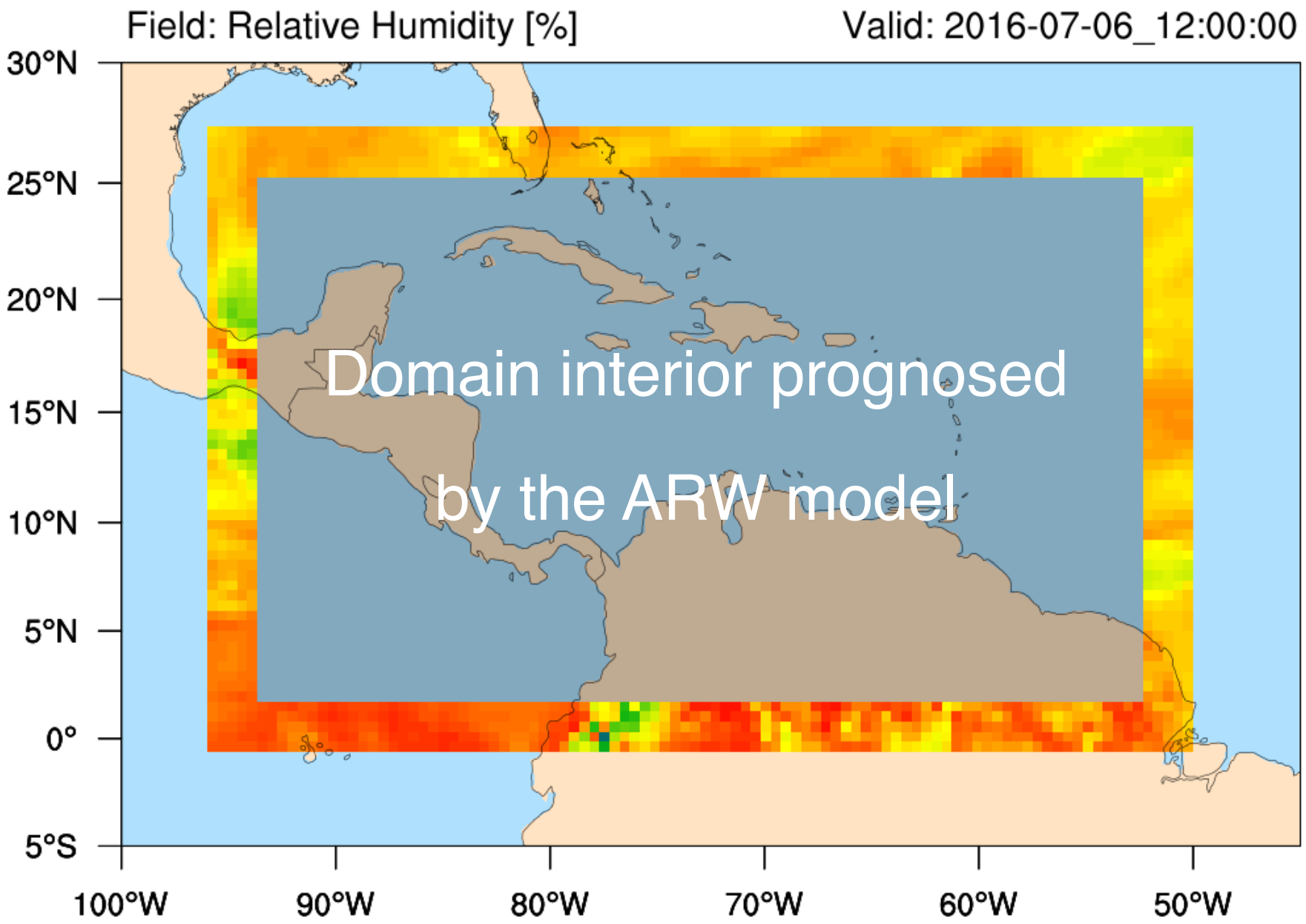

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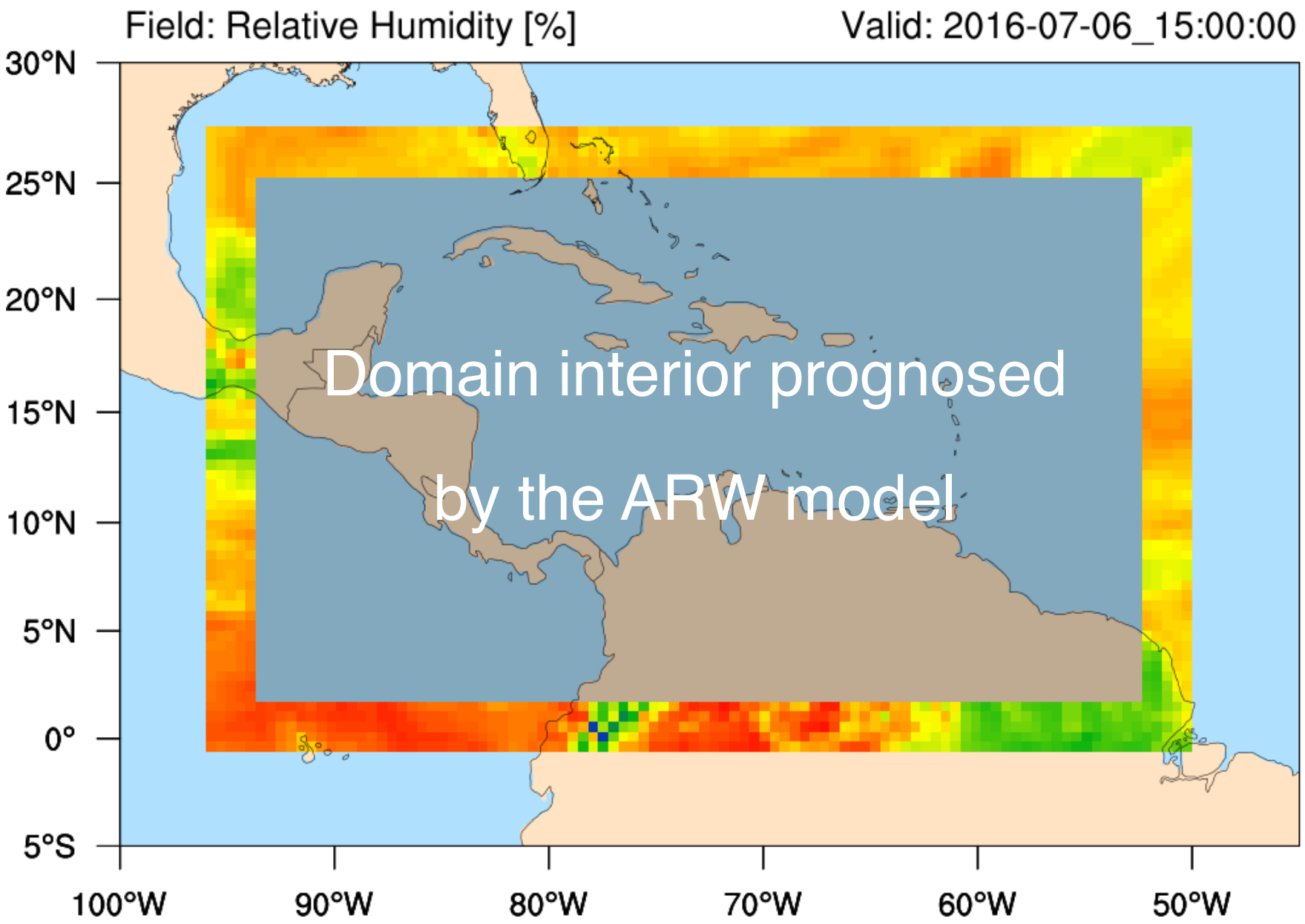

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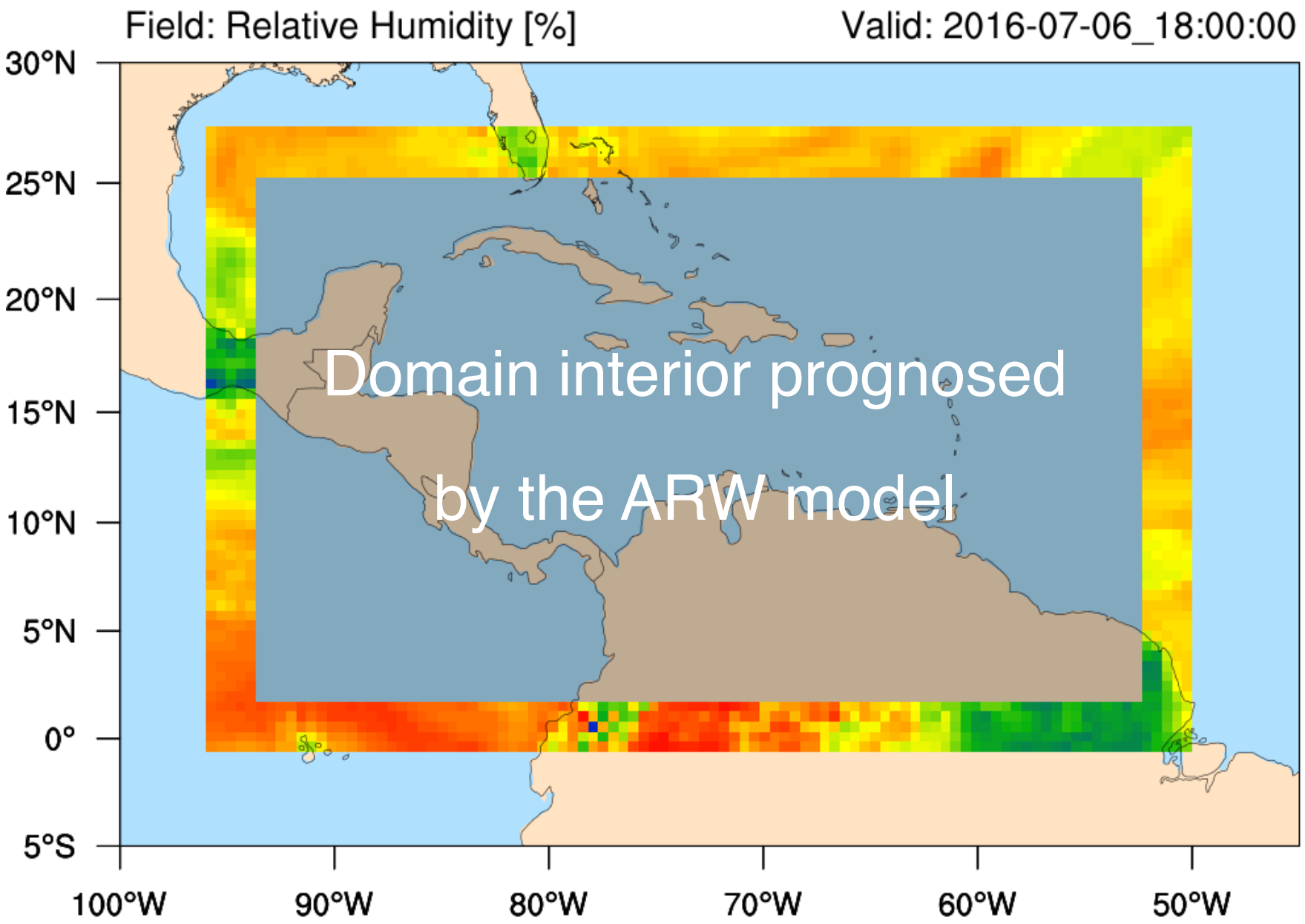

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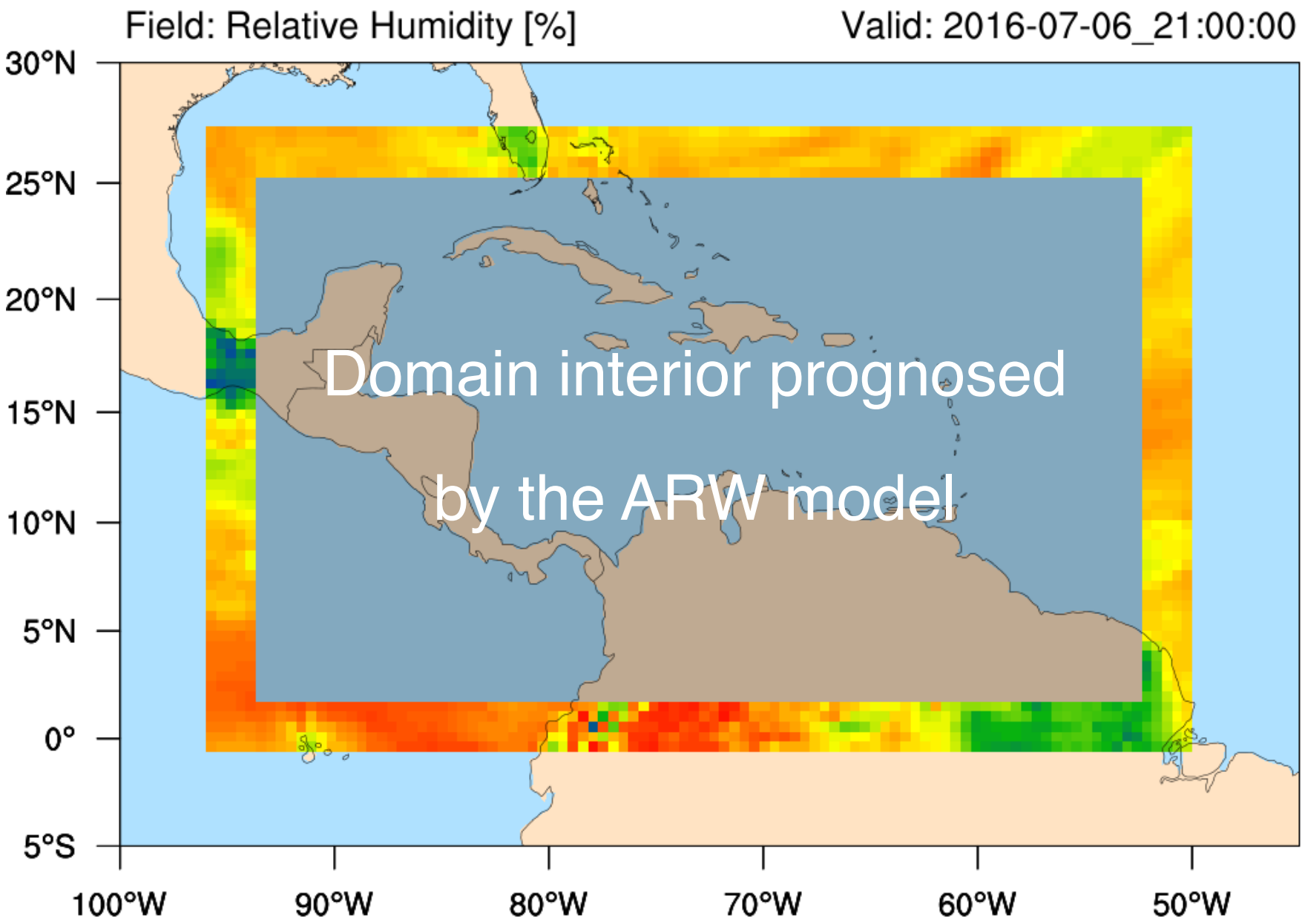

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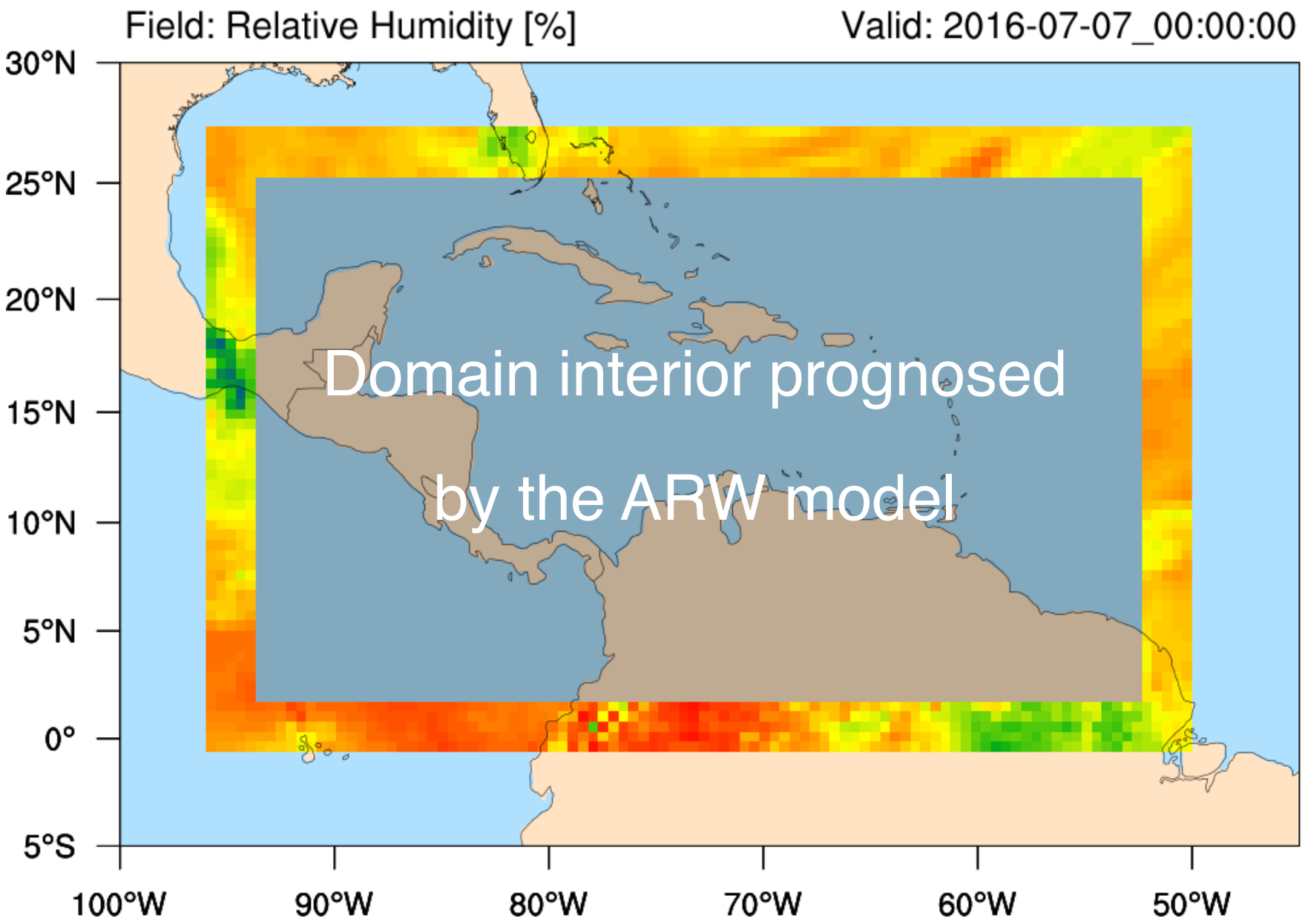

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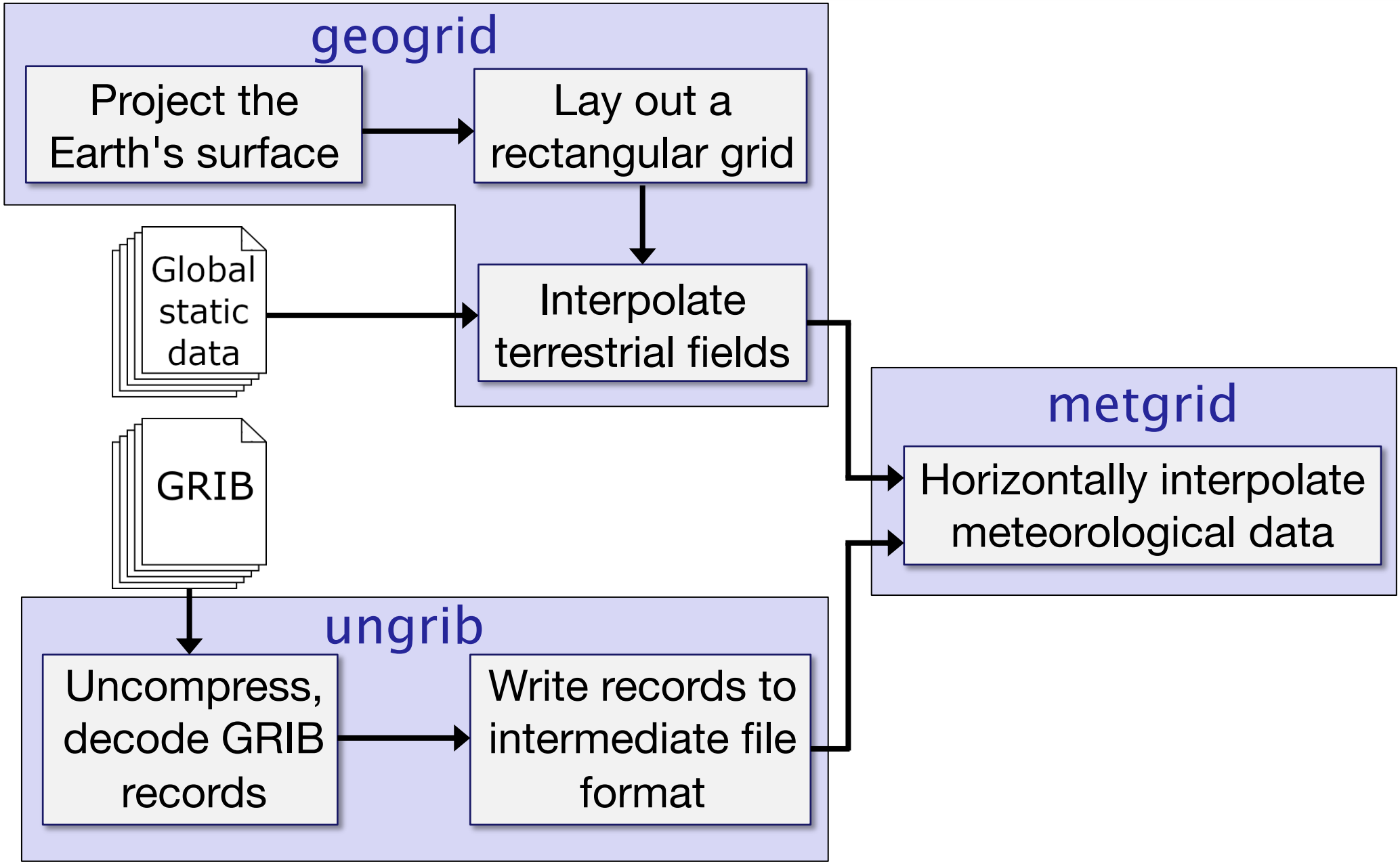
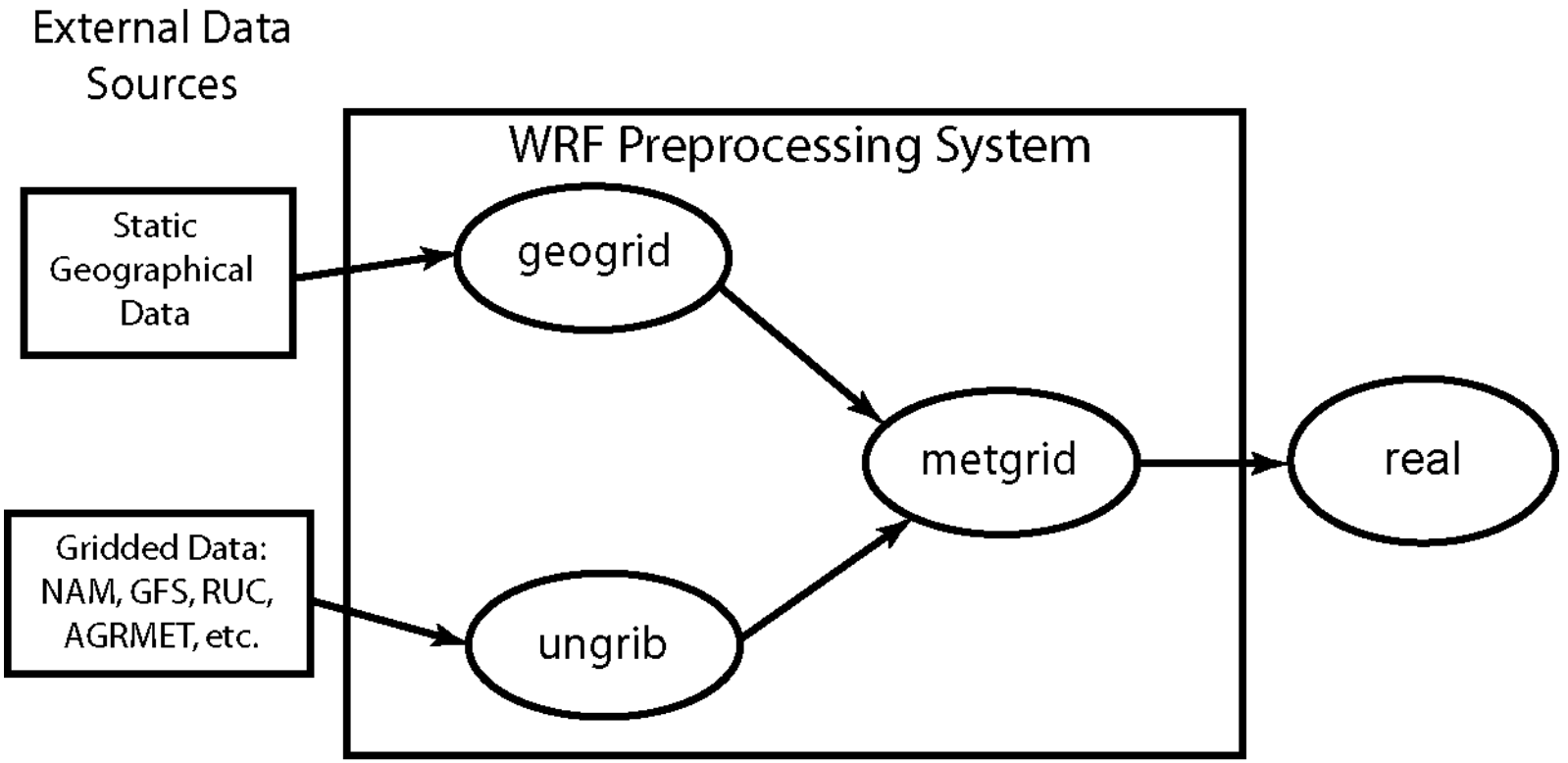


And finally…

Vertical interpolation to WRF eta levels is performed in the *real* program



The End.