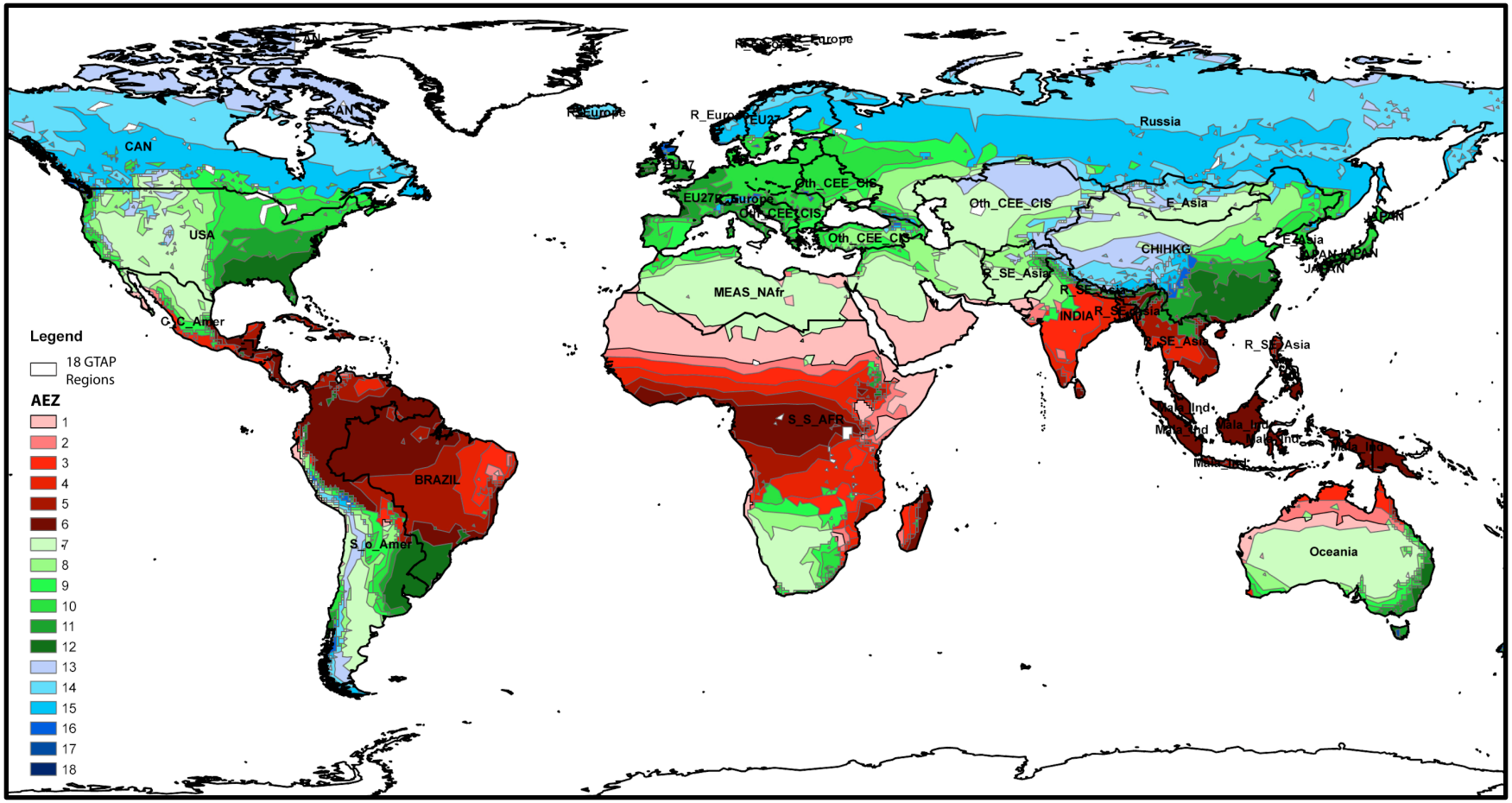
Updating GTAP's Soil and Biomass Carbon Stocks Estimates

Holly Gibbs, Assistant Professor, UW-Madison
Sahoko Yui, Graduate Student, UC-David

ARB, September 14, 2011

GTAP Regions and AEZs



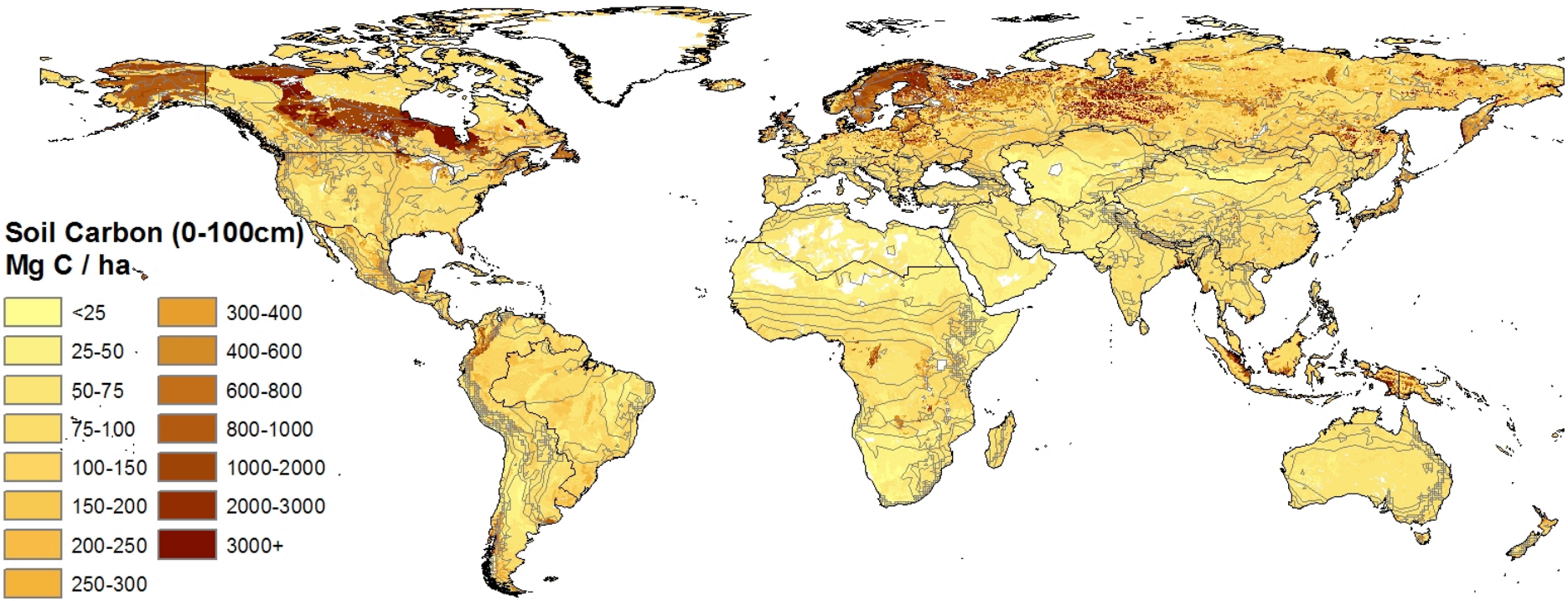
Weighted average soil and biomass carbon stocks for each of the 203 unique regions

Our Approach

- Analyze best available, spatially-explicit data
- Provide unique soil C and biomass estimate for GTAP land pools
- Consider future needs and provide range of values and options when possible
- Stress compatibility with GTAP / TEM parameters

All results are preliminary and for discussion only

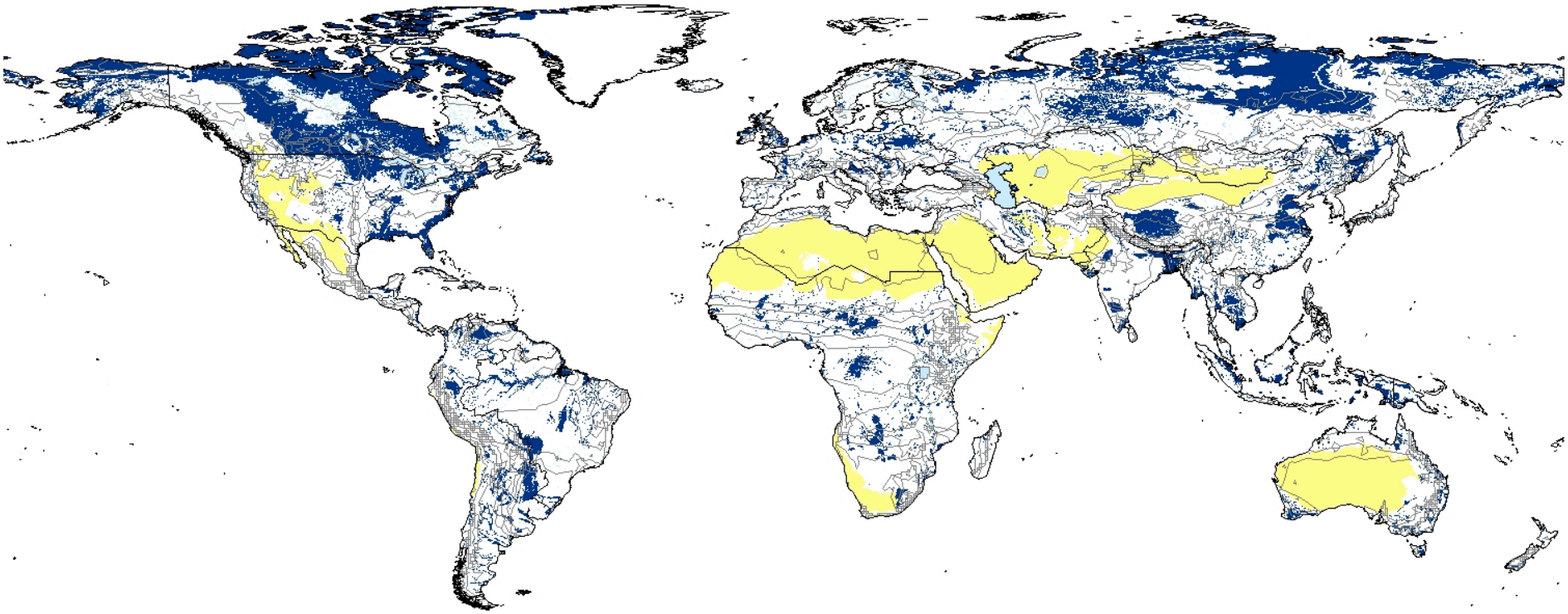
Soil Carbon, 30 and 100cm depths



Harmonized World Soil Database – HWSD

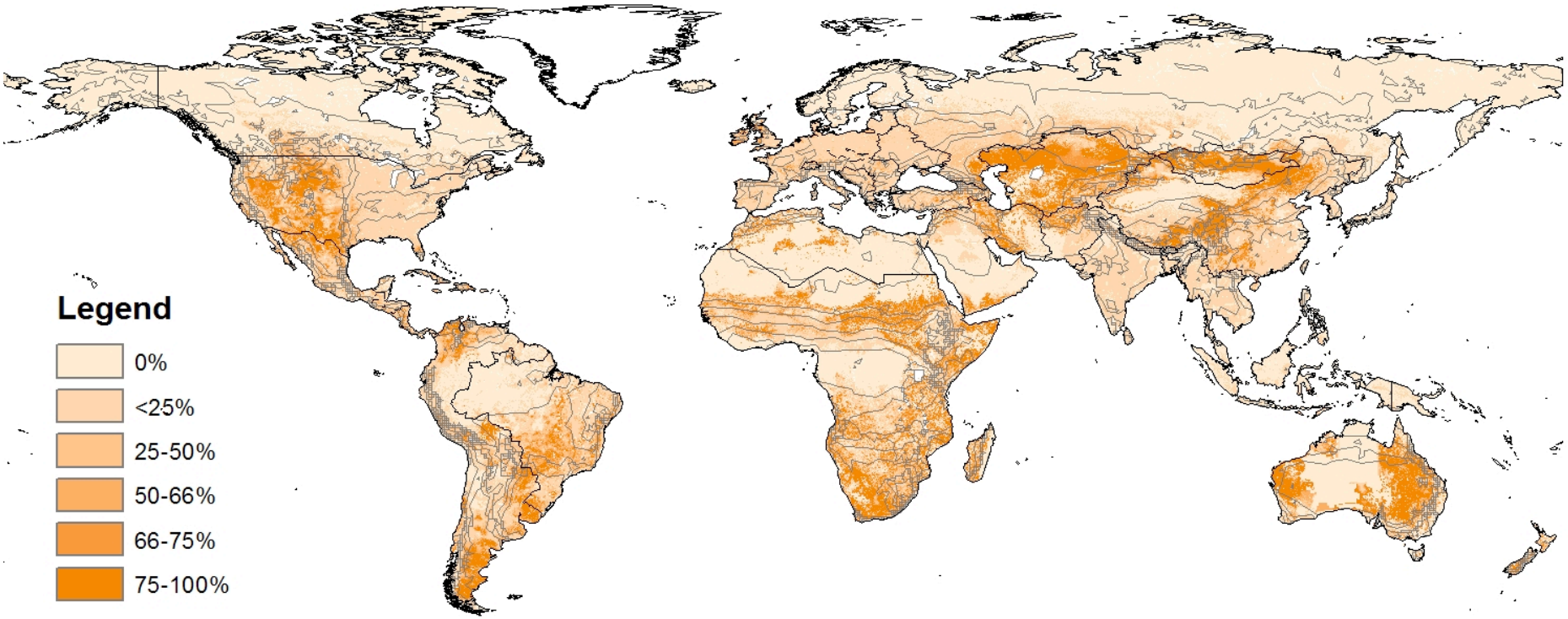
Used to estimate pasture, crop and forest carbon stocks

Aggregate Soil Carbon Filter



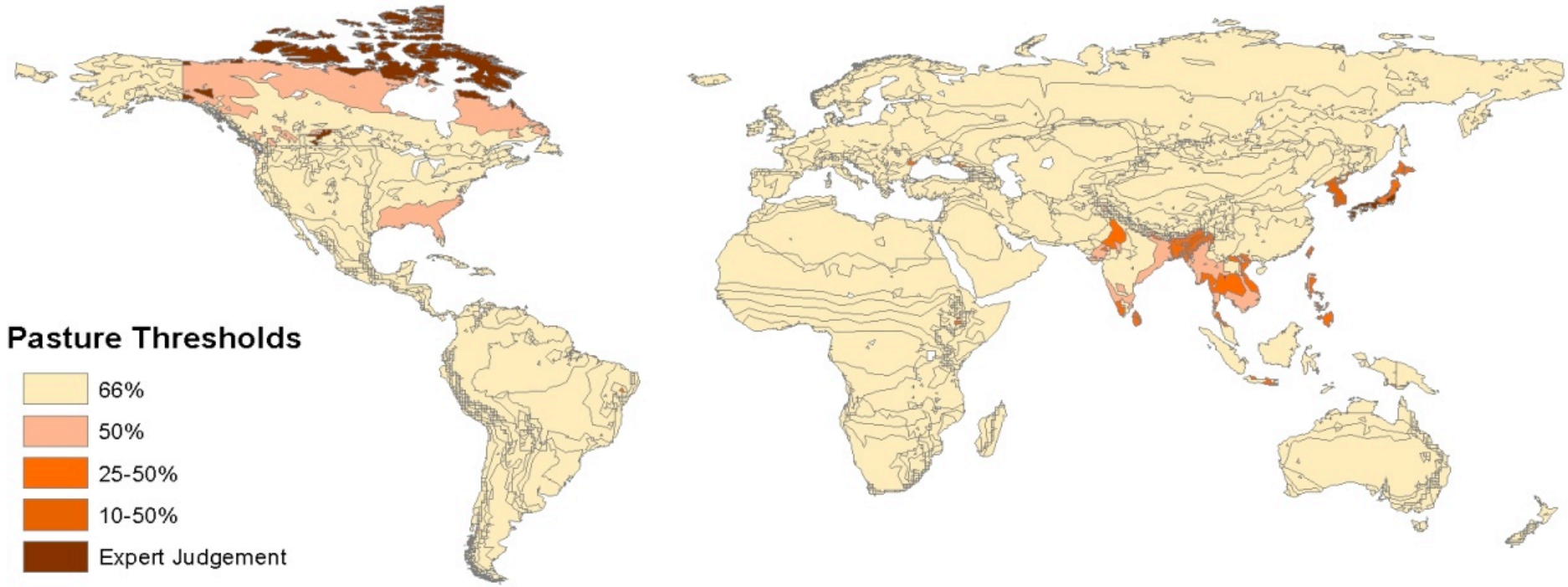
- Unable to remove slopes > 5% this iteration
- NOTE that many studies show that sleep slopes, peatlands, wetlands and floodplains are converted to agriculture around the world

Pasture Cover Data



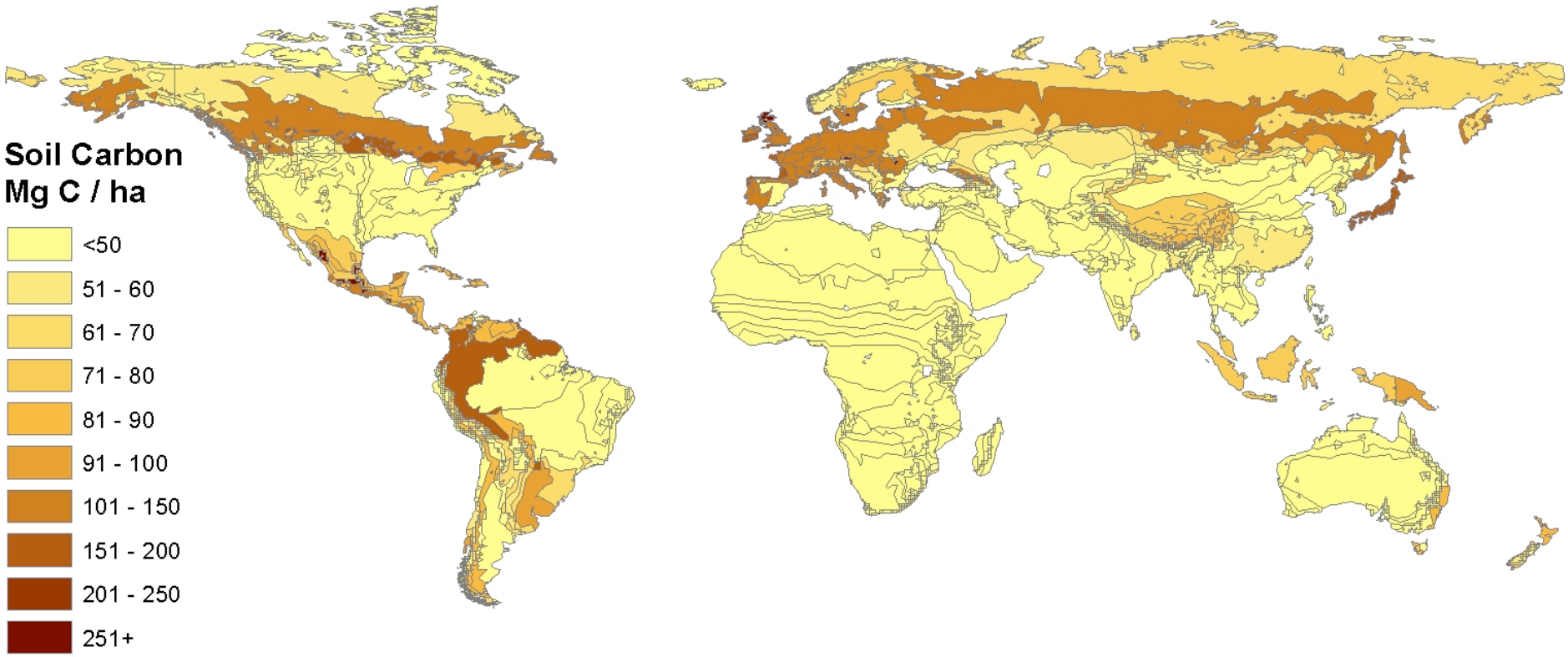
- SAGE pasture data for year 2000
- Higher resolution than M3 beta version for year 2004
- Goal is to identify pure pasture pixels

Pasture Thresholds

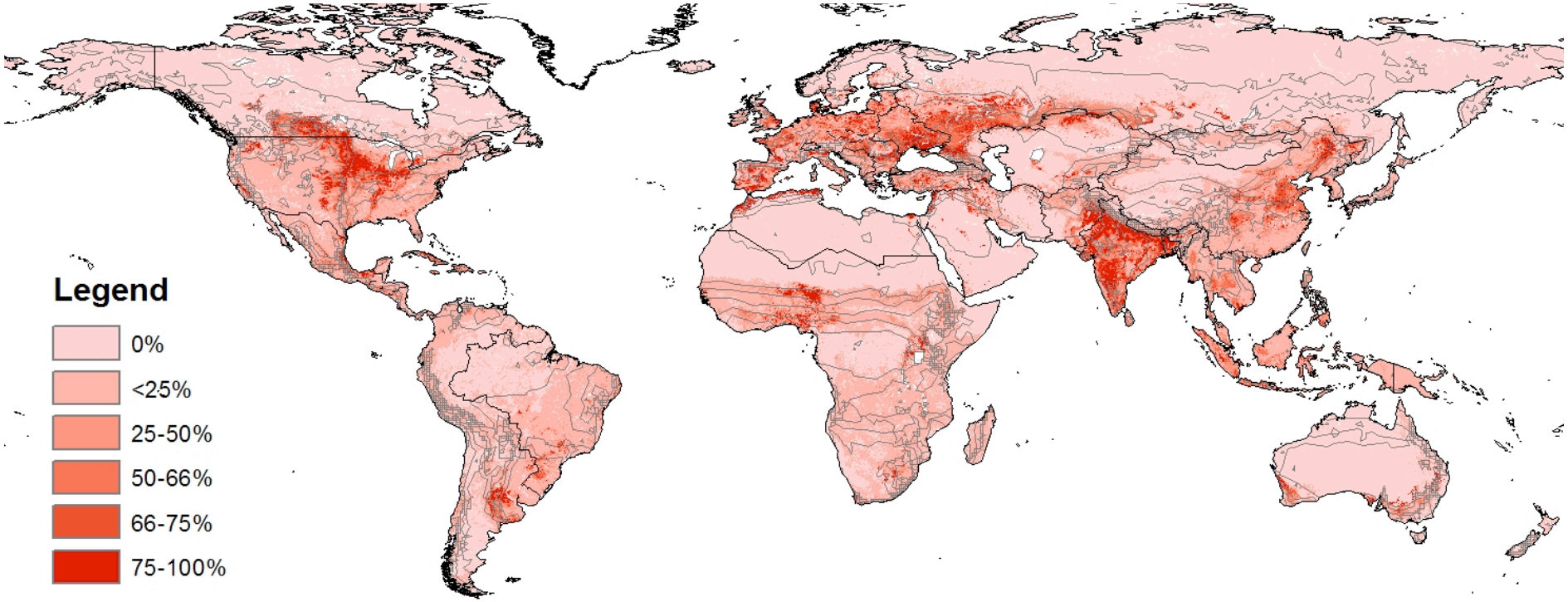


- Used 66% threshold to identify pure pasture pixels
- Recursively added 50%, 25% and 10% to capture all regions
- Expert judgment used for a small number of regions with zero pasture-

Pasture Soil Carbon Results

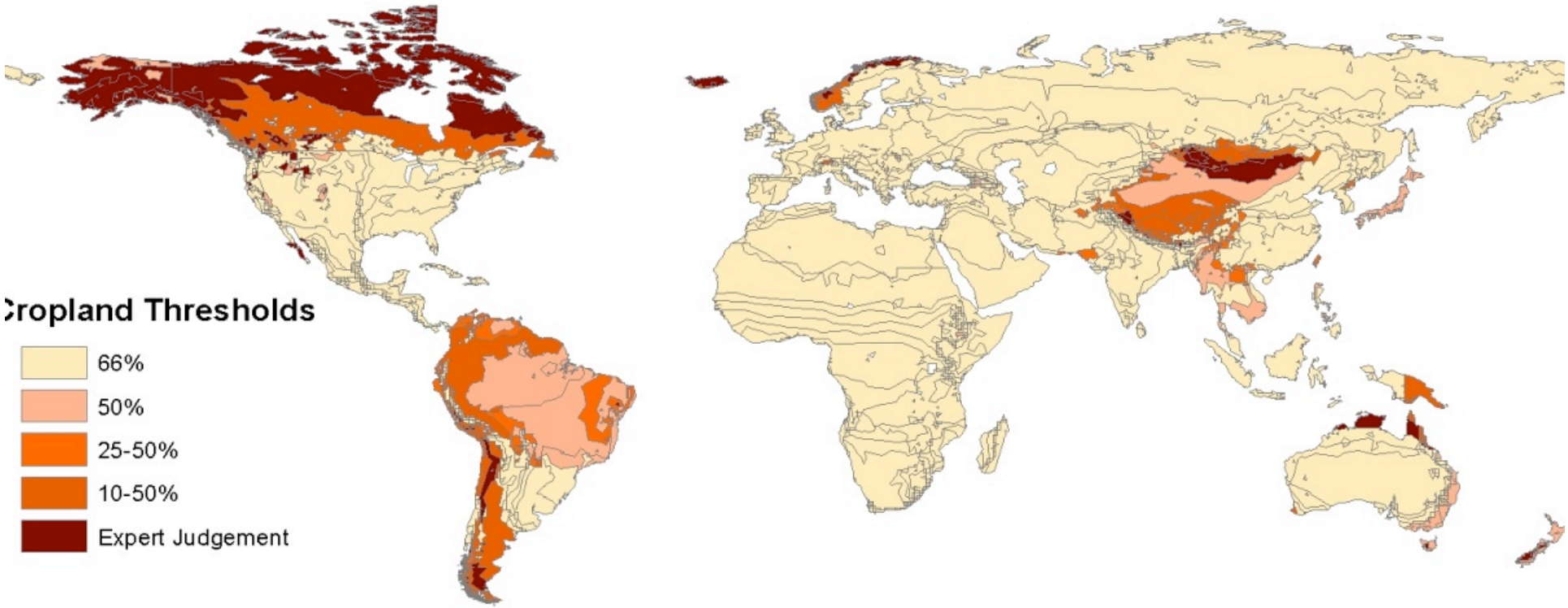


Cropland Cover Data



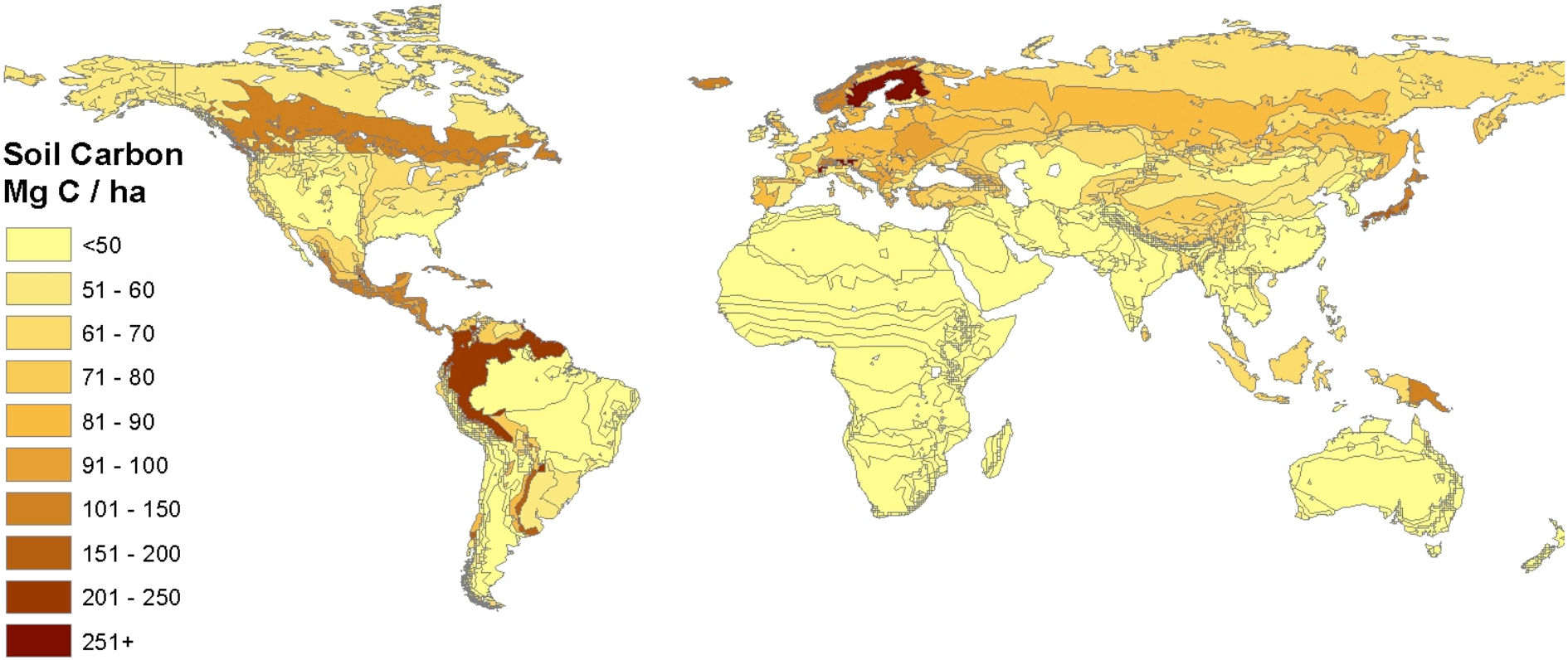
- SAGE cropland data for year 2000
- Higher resolution than M3 beta version for year 2004
- Goal is to identify pure cropland pixels

Cropland Thresholds



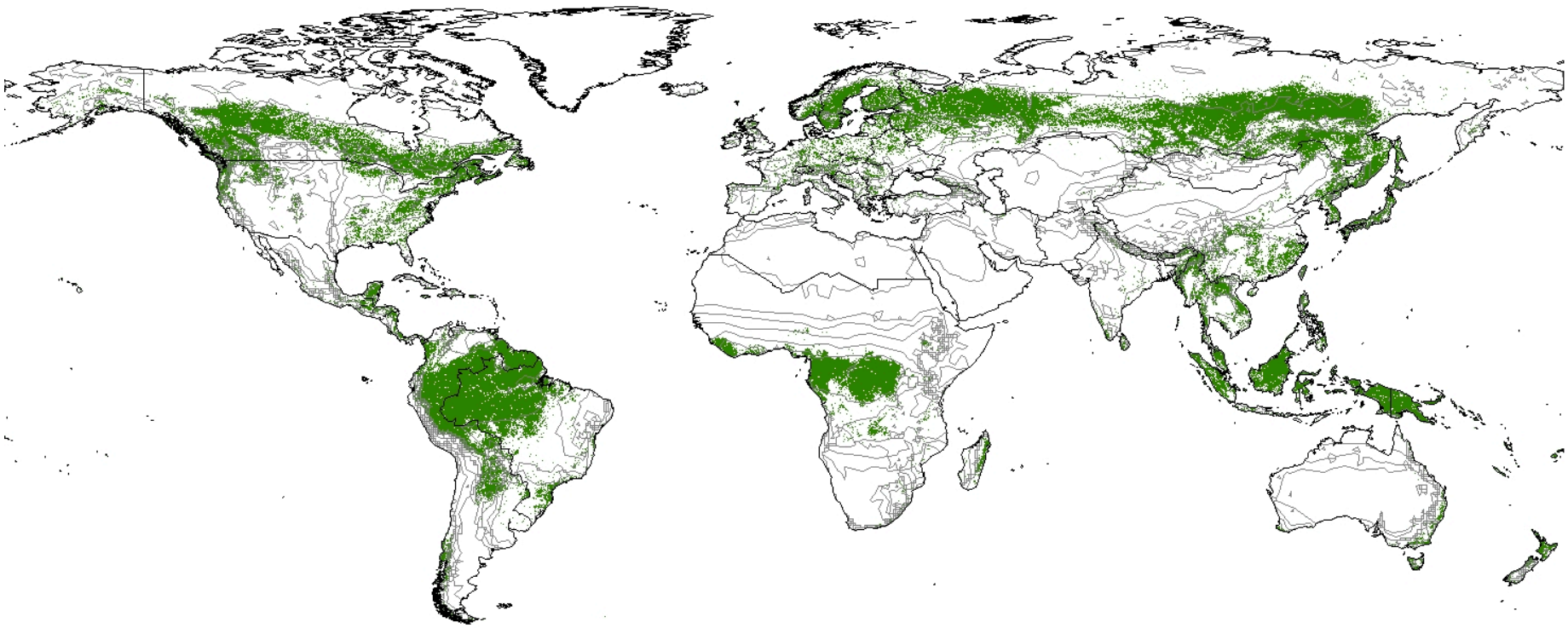
- Used 66% threshold to identify pure pasture pixels
- Recursively added 50%, 25% and 10% to capture all regions
- Expert judgment used for a small number of regions with zero pasture-

Cropland Soil Carbon



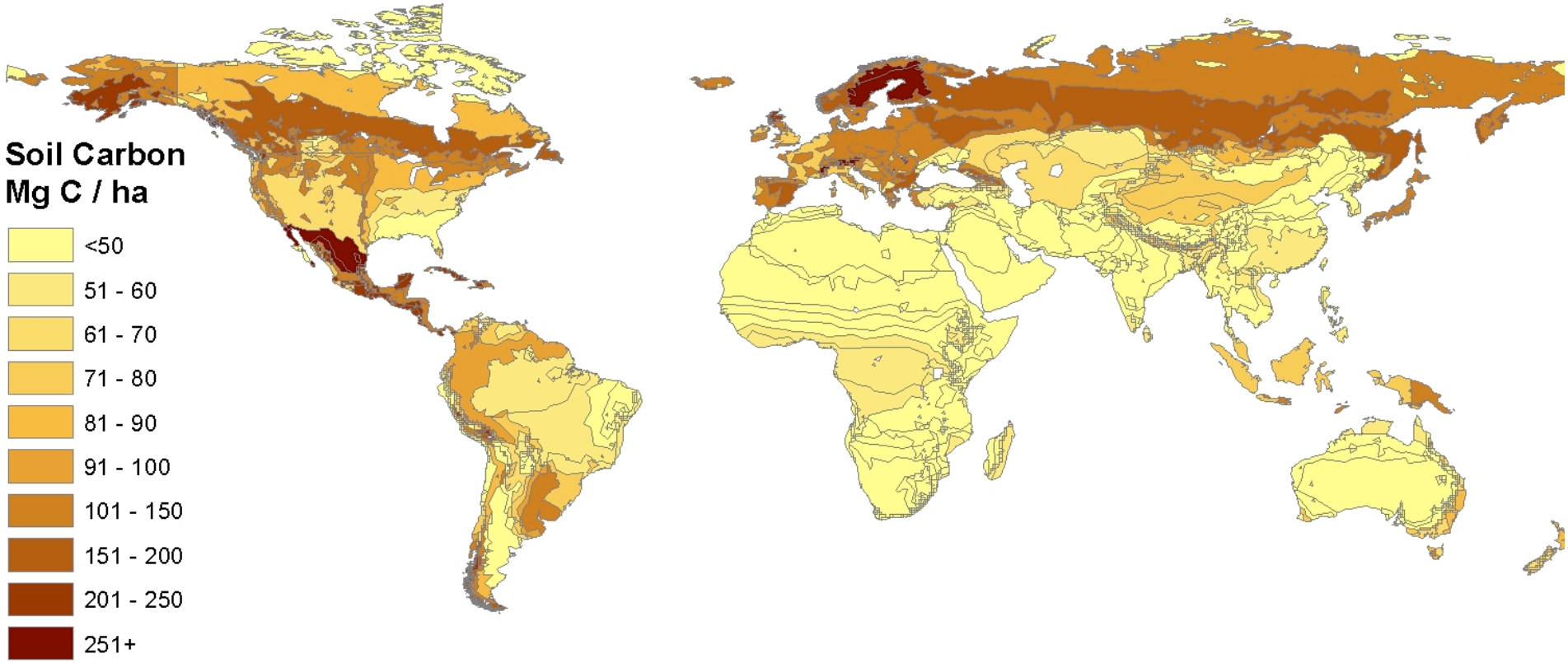
- Map for 66% threshold shown here
- Will lower threshold to fill in missing values
- **Crop carbon not included for CARB, only GTAP working paper**

Forest Cover Data



- MODIS forest cover for 2007-2010
- Mark Friedl, Boston University, provided most stable map of forest cover

Forest Soil Carbon

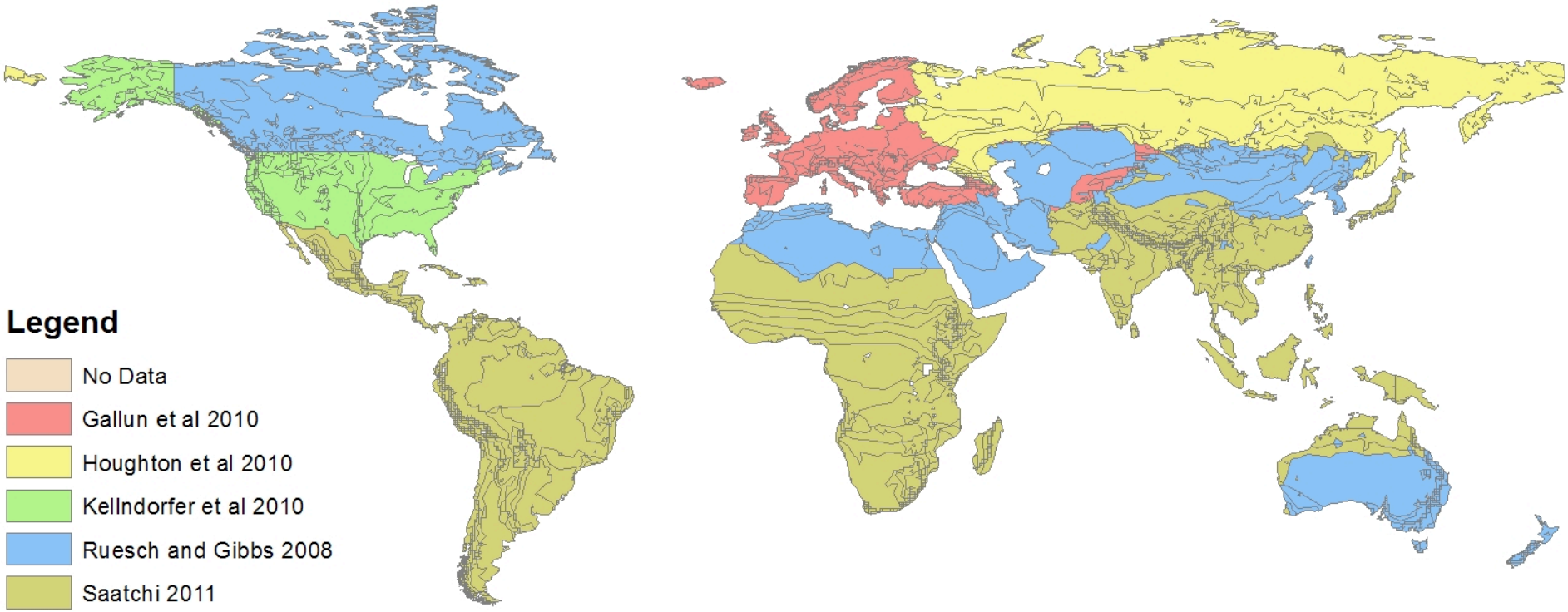


Peat Soil Carbon

- Used wetland filter plus an additional > 500 Mg C / ha filter in Indonesia and Malaysia to separate peat soils
- Identify best available literature value for emissions factors (ICCT, Page et al)
  - See Plevin et al. (2011)

Sources of Forest Biomass Data

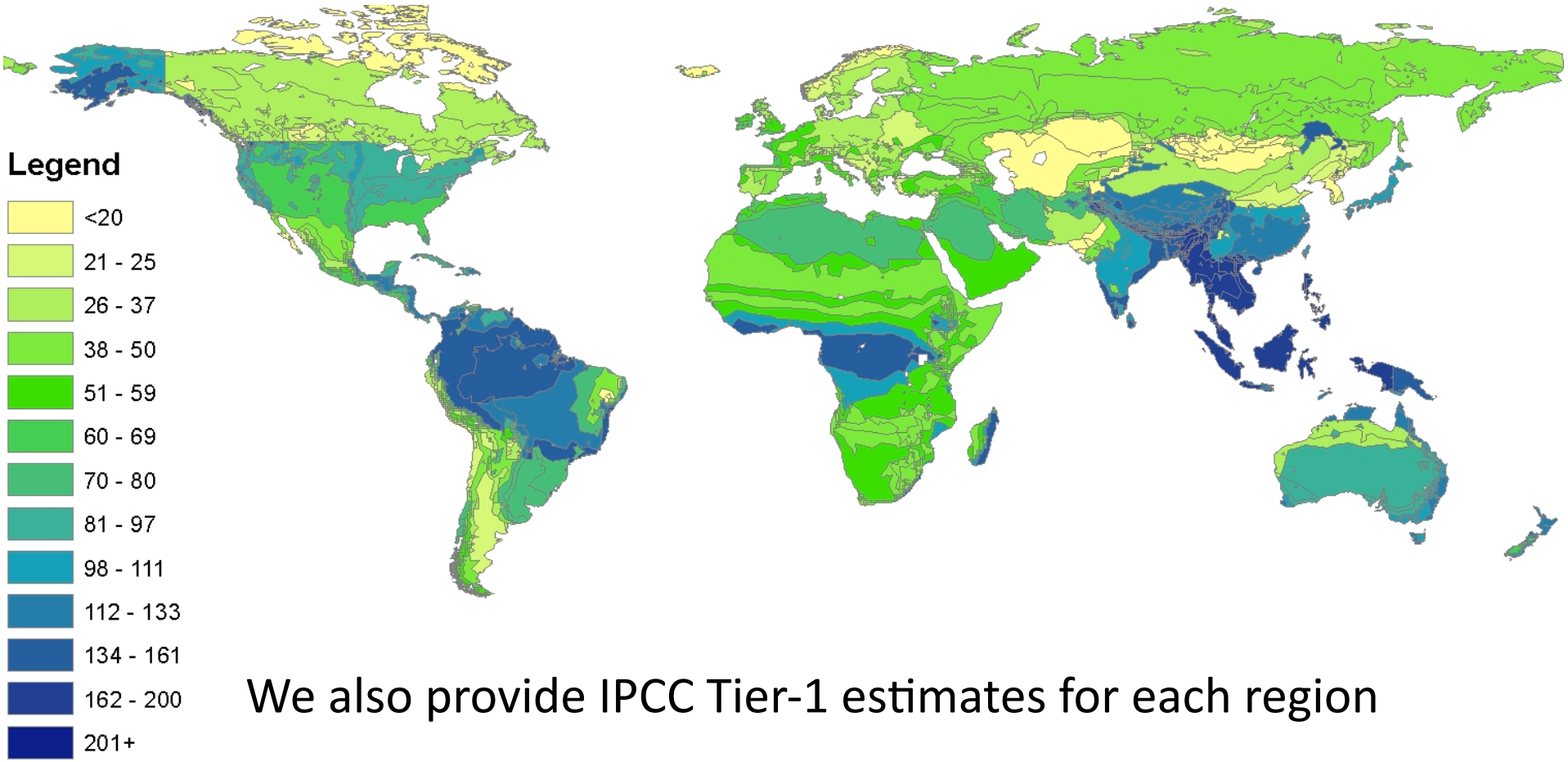
aboveground and belowground living biomass carbon



<u>Other Biomass Carbon Pools</u>

IPCC default values for litter
CDM, USDA and literature values for deadwood
IPCC default values for foregone sequestration

Forest Biomass Carbon

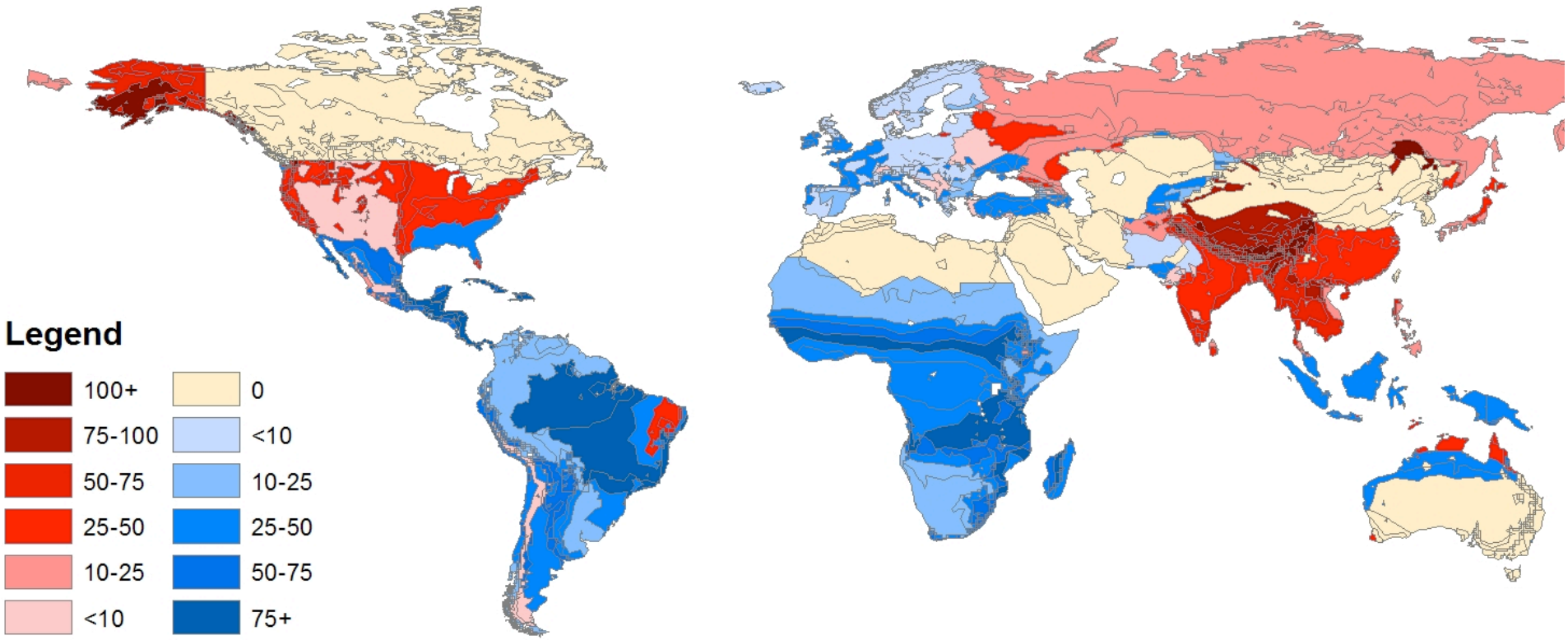


We also provide IPCC Tier-1 estimates for each region

Comment on Satellite-based estimates

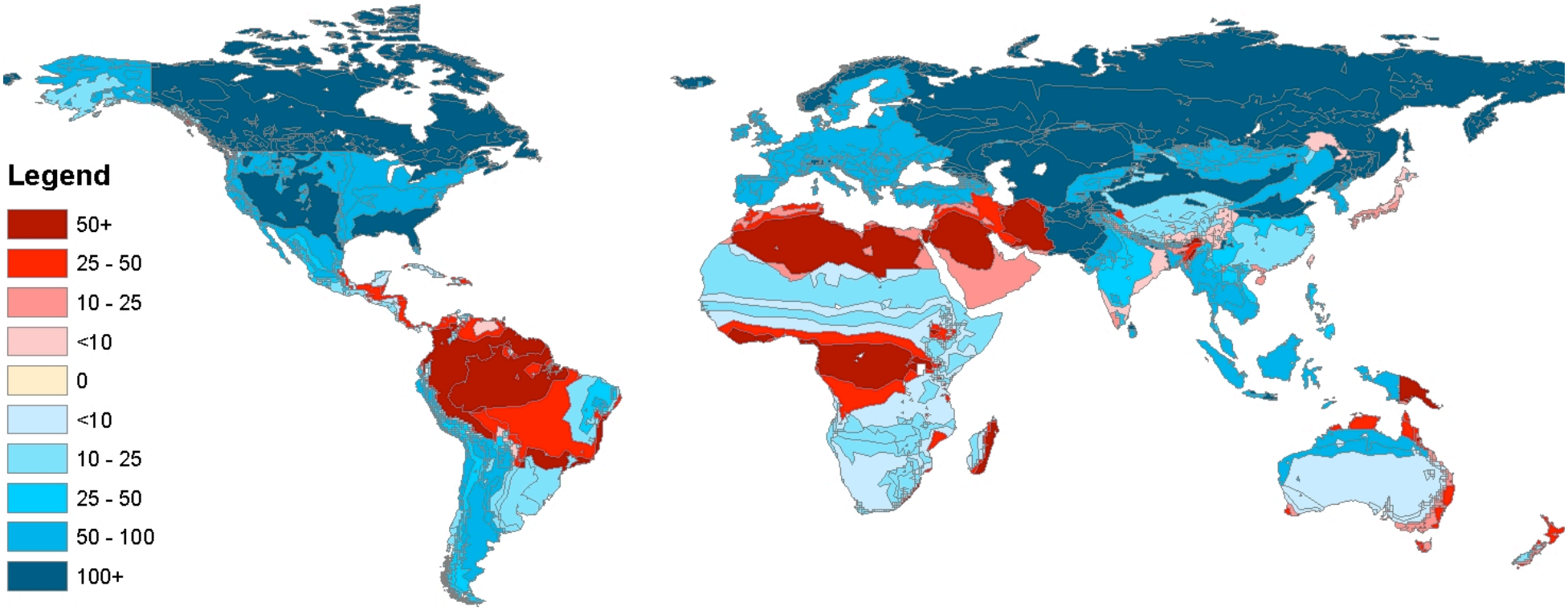
- New satellite-based estimates produce lower values than traditional "paint-by-number" or field based approaches
  - Satellite-based approach captures a range of forest conditions within a pixel
    - Non-forest, degraded forest, regrowing and so on
    - Gaps and surface heterogeneity (small streams)
    - Satellite approach likely an improvement because it captures spatial variation but further evaluation is needed…

Absolute difference between CARB / Gibbs and IPCC Tier-1



Red = Estimates higher than IPCC Tier-1
Blue = Estimates lower than IPCC Tier-1

Absolute difference between Updated CARB (Gibbs & Yui) and WHRC Analysis



Red = Estimates higher than IPCC Tier-1
Blue = Estimates lower than IPCC Tier-1

Future Refinements for C stocks

- Use national soils data for US, Canada and Australia
- Improve estimates of pasture biomass
- Estimate carbon stocks for forests likely to be cleared rather than average values
- Include unmanaged land within GTAP
- Reconsider removing slopes and wetlands