Blue-Green Red Alert?

Team Globolakes
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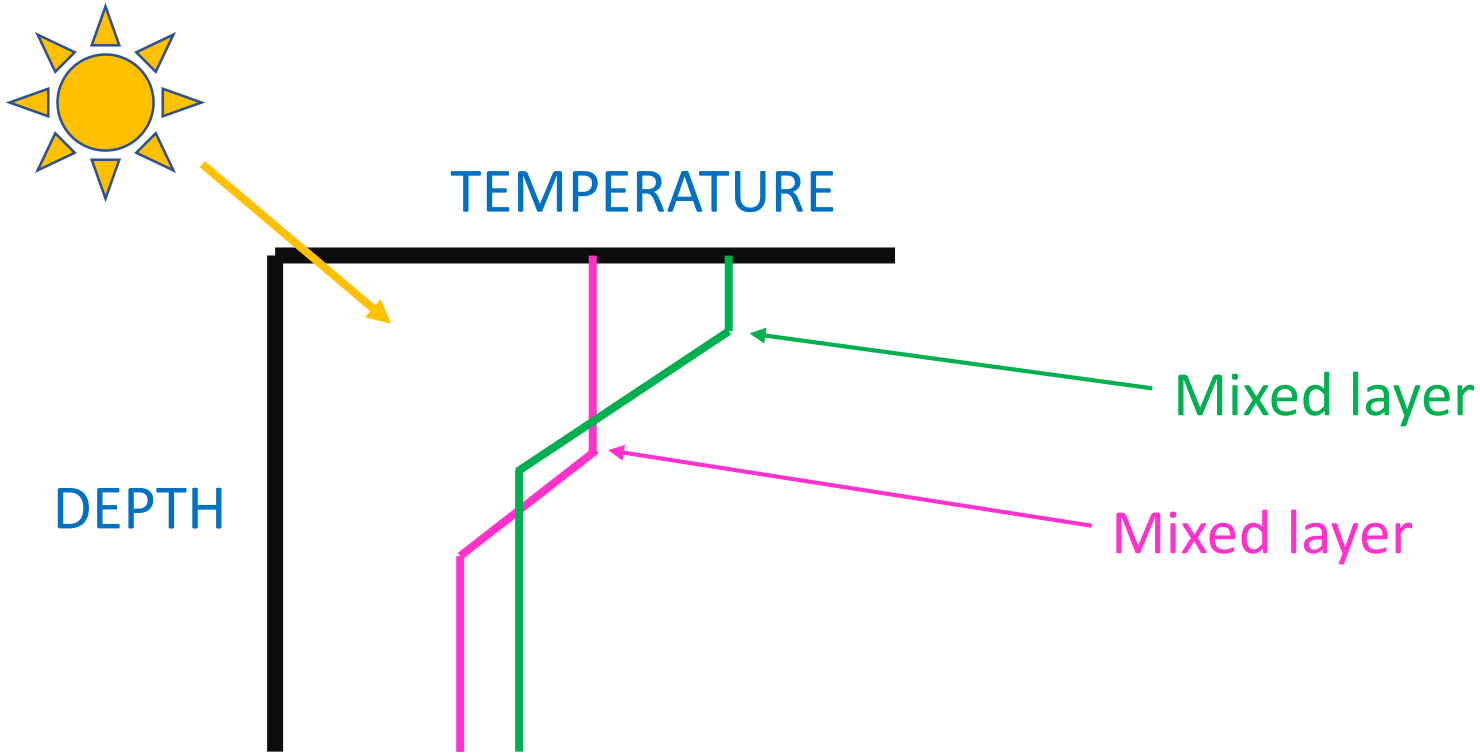
Questions

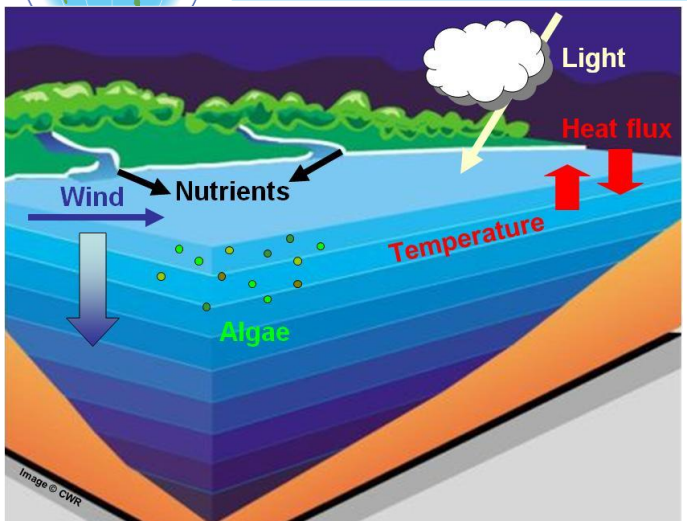
- What are the ‘background controls’ on phytoplankton growth around the world?
- How will climate change impact these controls?

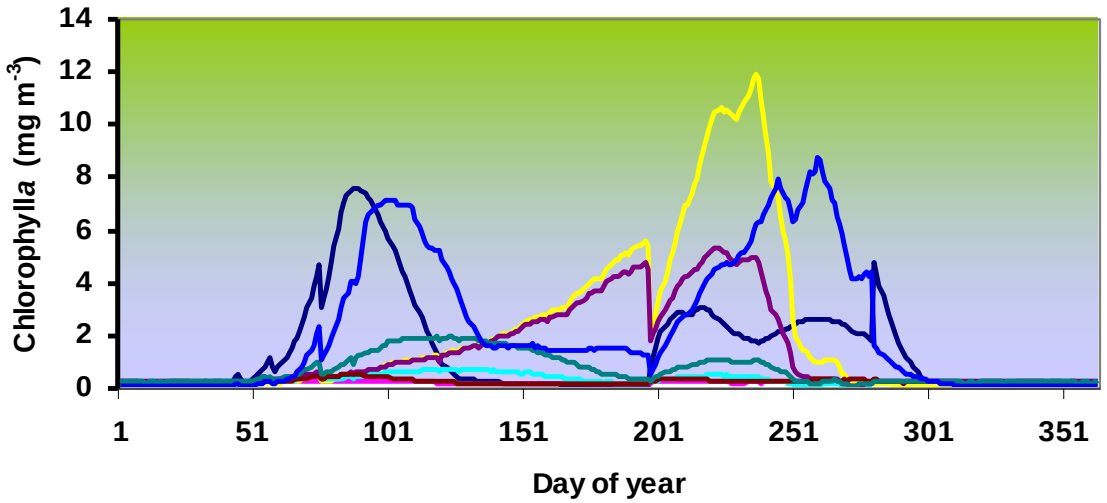


Methodology

- Define an idealised lake with identical: area (4000 km^2), depth (13.9 m), light attenuation (1 m^{-1}), residence time (~1 year) and nutrient loading
- Use meteorological data from global 2° grid for current (1996-2005) and future (2090-2099) using GCM (HadGEM2-ES) output for RCP6.0 scenario
- Calibrate and validate lake physics model (FLake) with Globolakes lake surface temperatures
- Run FLake to generate present day and future daily temperature profiles
- Use two different nutrient loading scenarios: Low/**High**
- Run a phytoplankton model (PROTECH) using FLake temperature profiles to simulate phytoplankton community composition

Phytoplankton community modelling: PROTECH



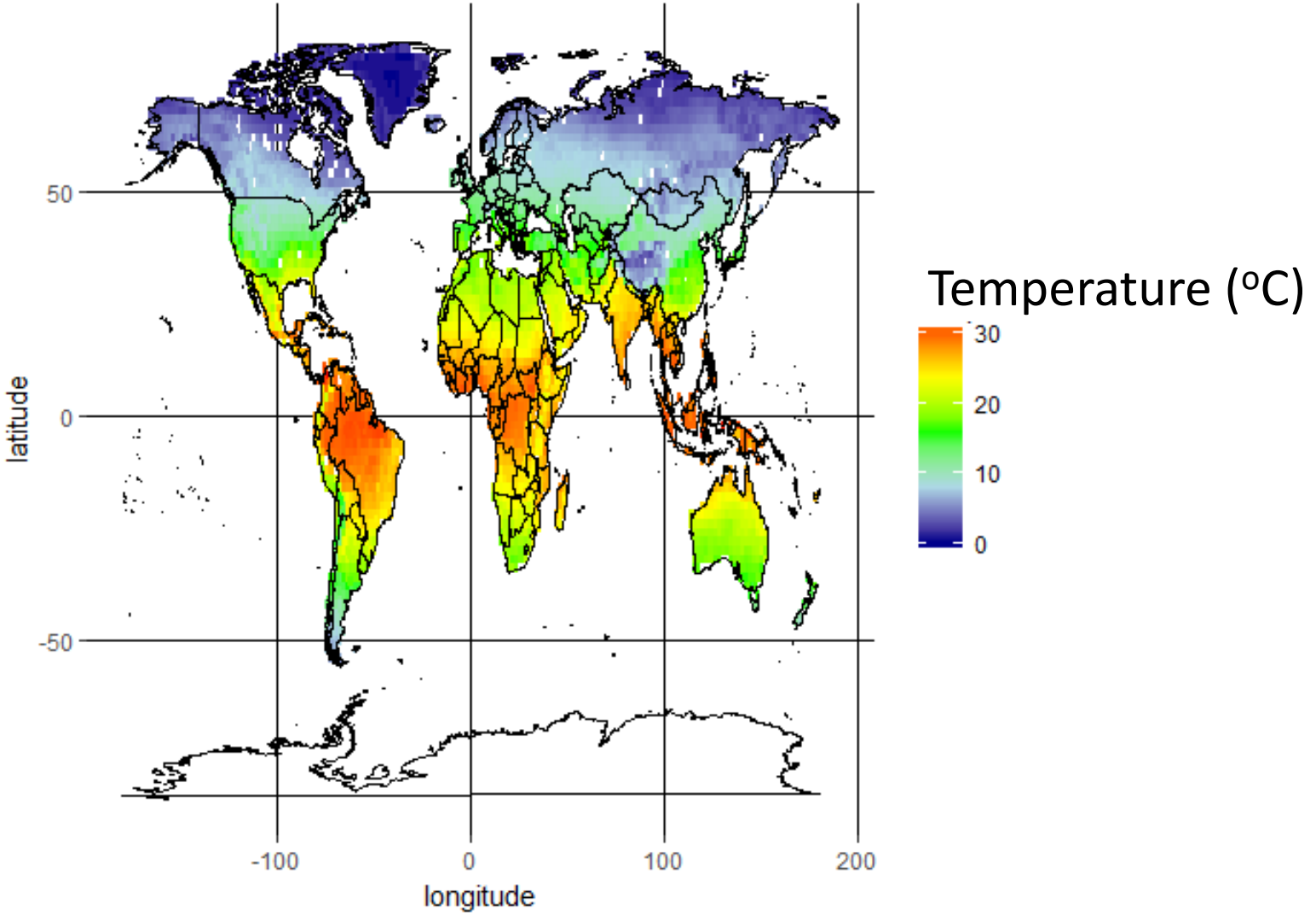


PROTECH

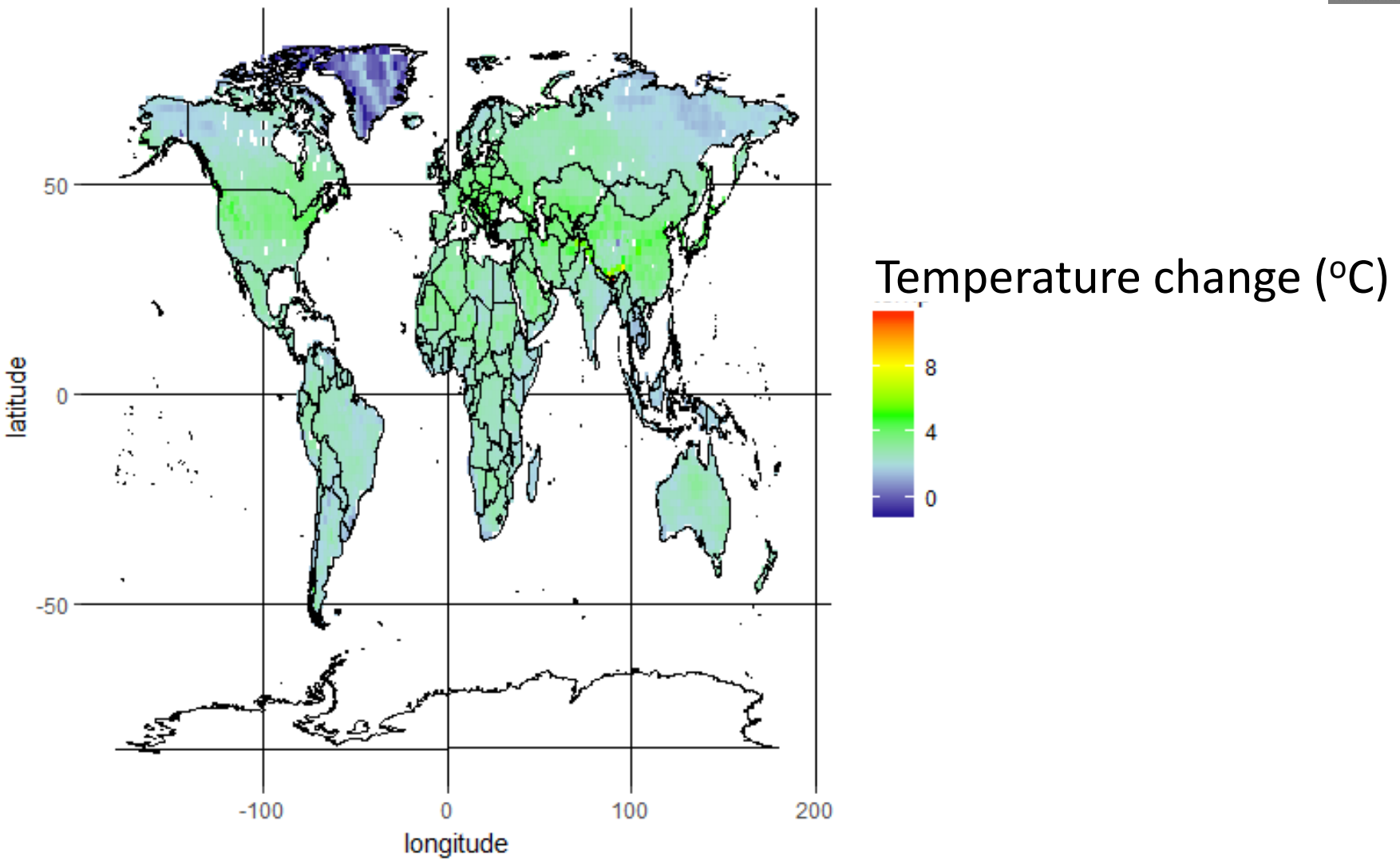
Phytoplankton community simulation model

20 species of phytoplankton

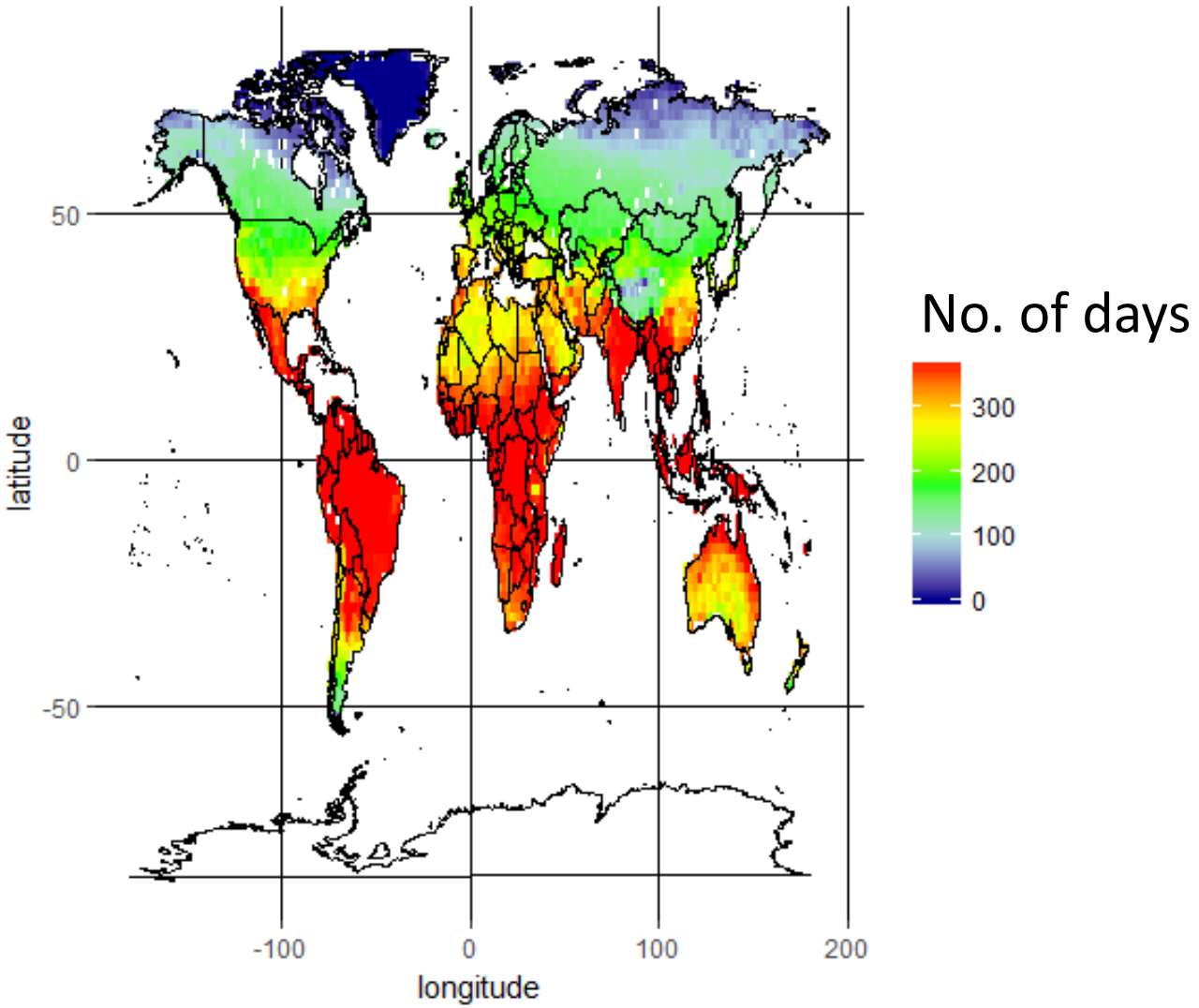
Annual average mixed layer temperature 1996-2005



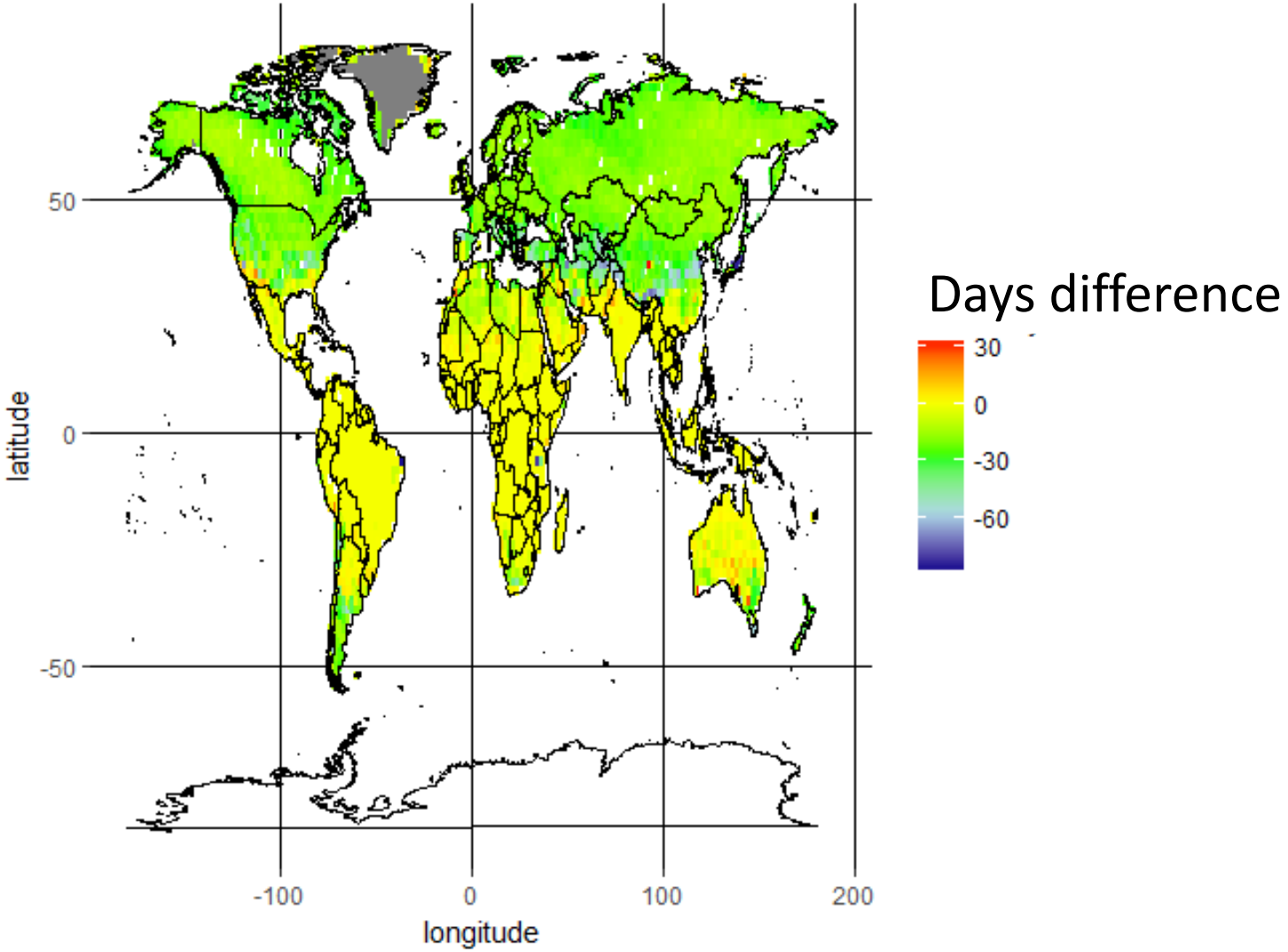
Future-present difference annual mixed layer temperature



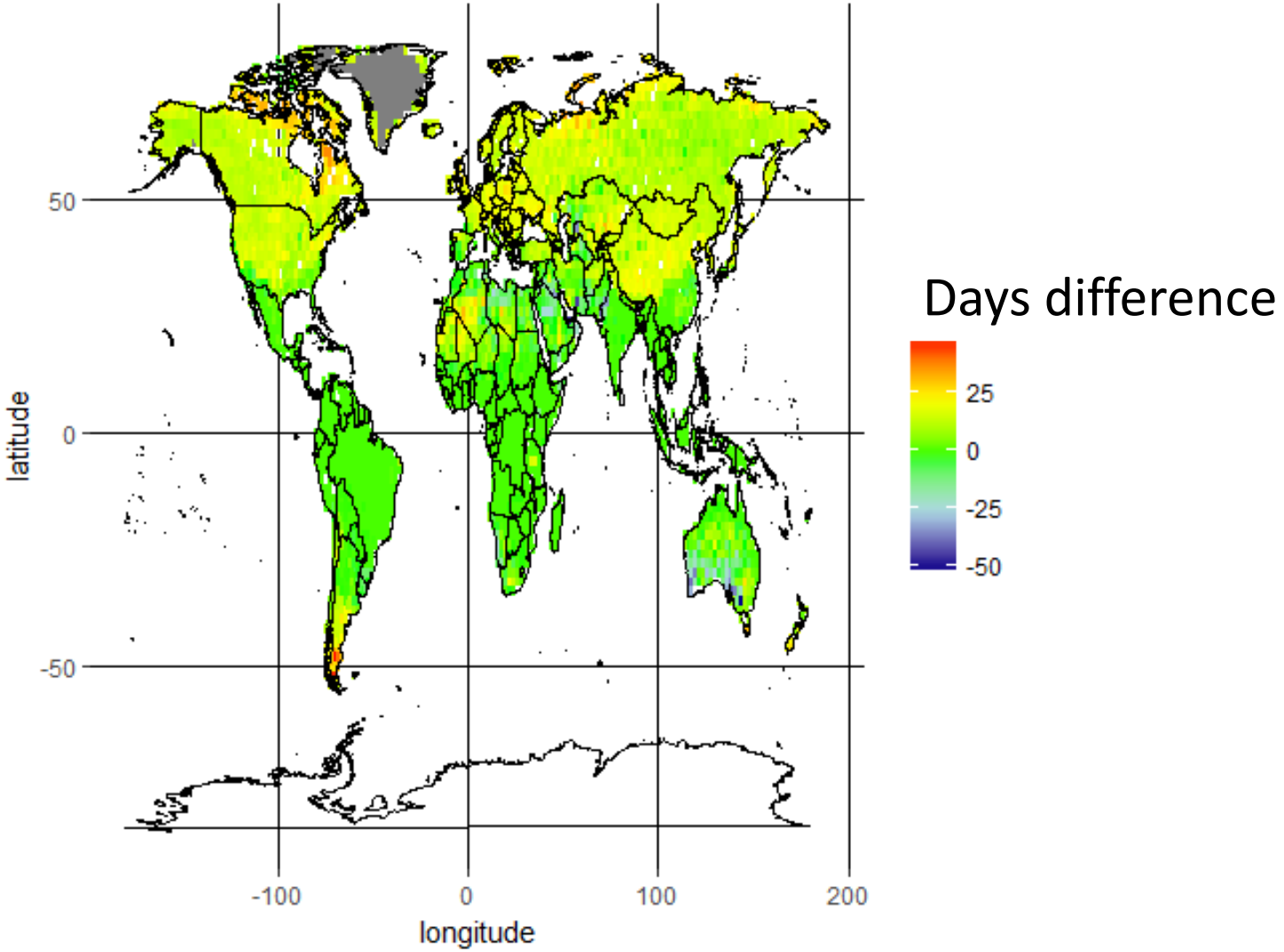
Present day total no. of ‘normally’ stratified days



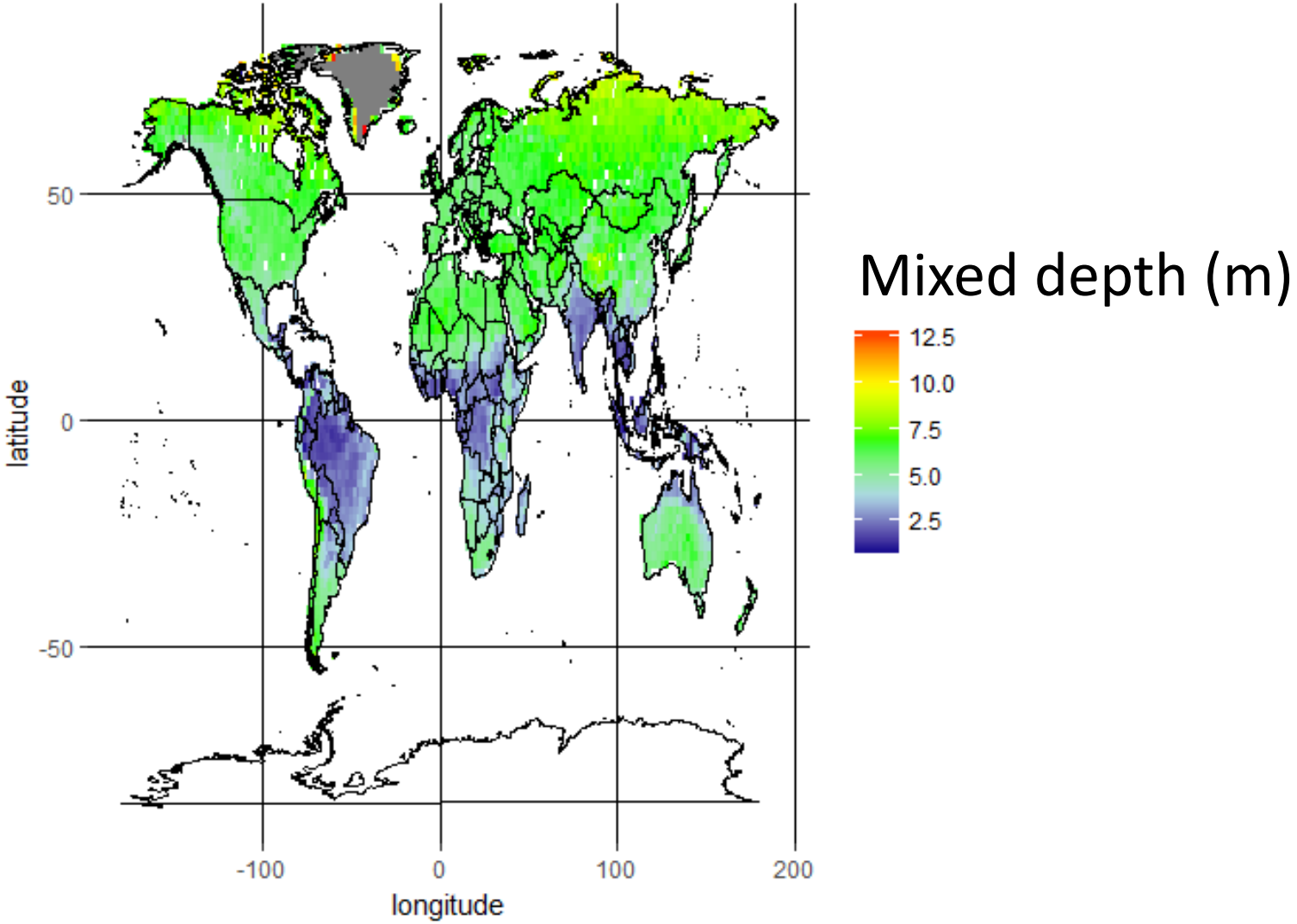
Future-present difference in start of normal stratification



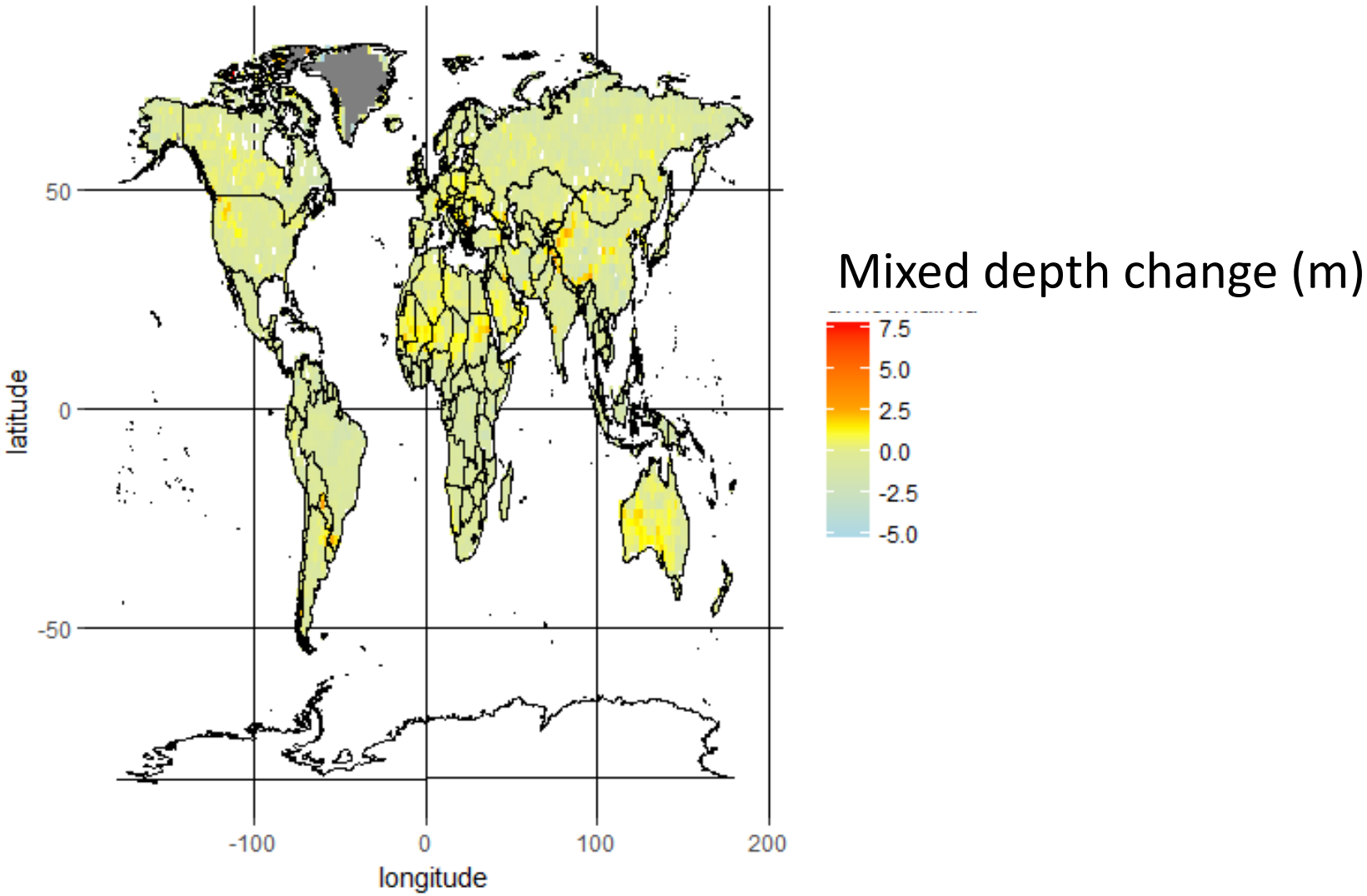
Future-present difference in end of normal stratification



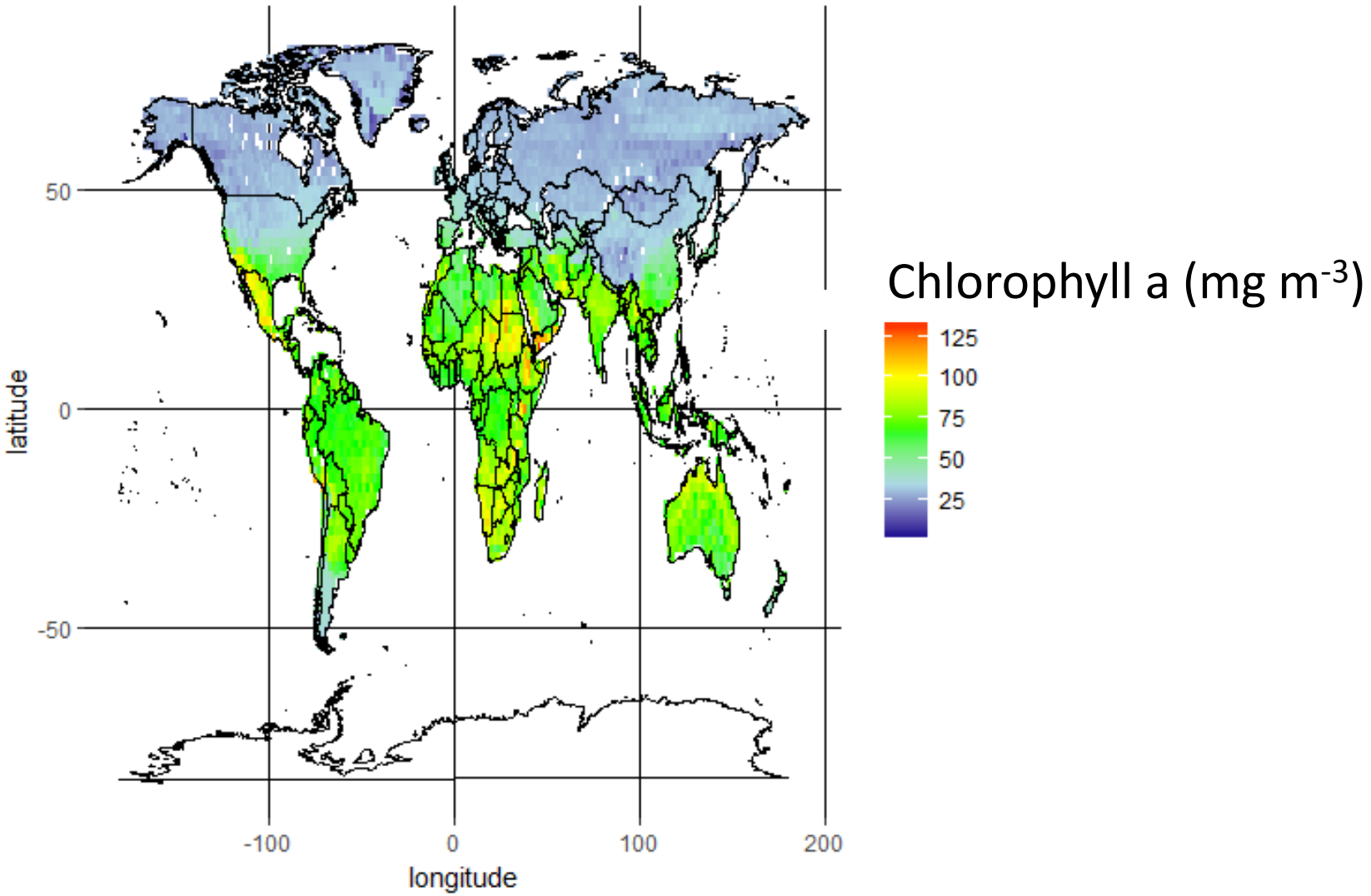
Present day average ‘normal’ mixed depth



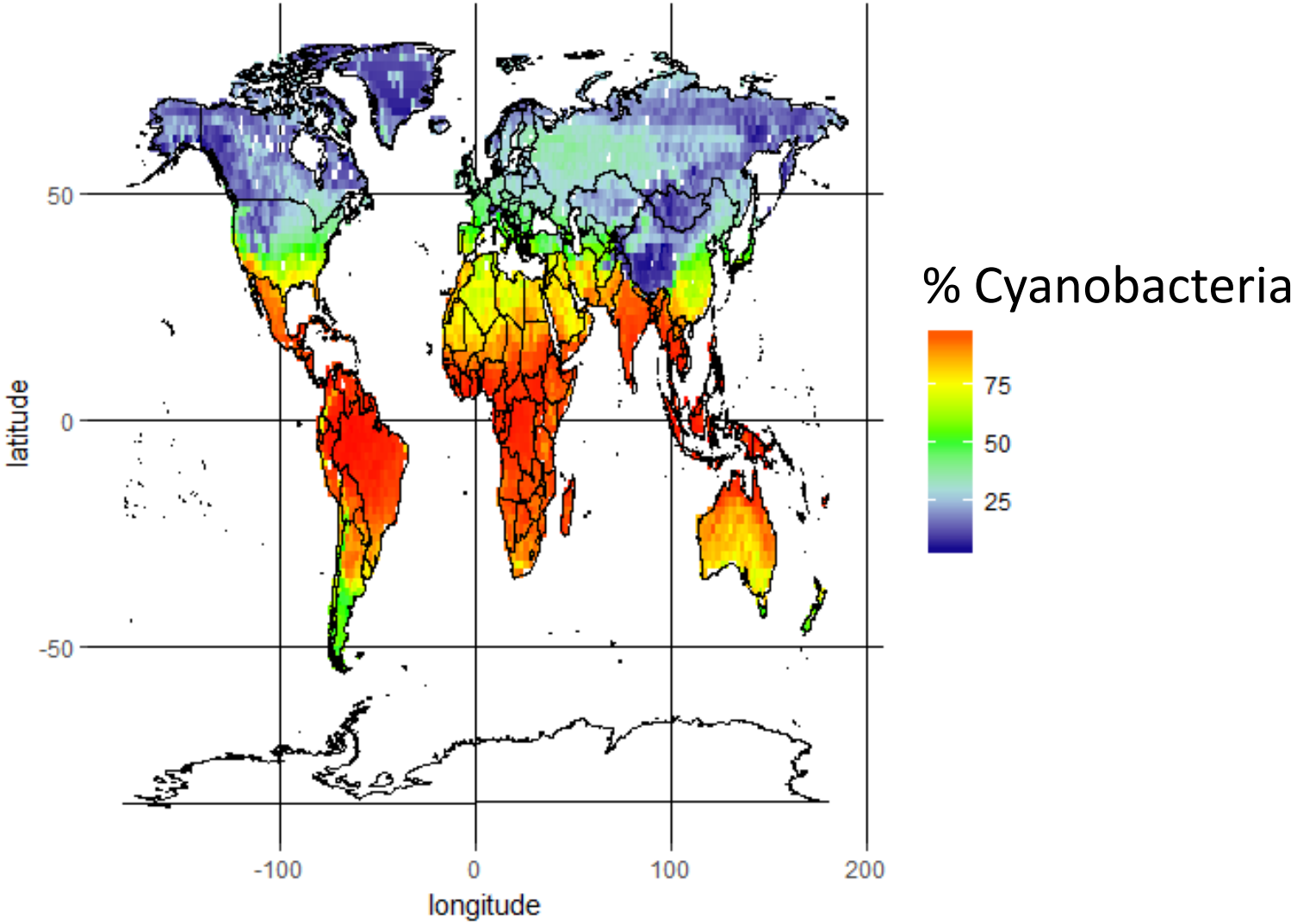
Future-present difference in ‘normal’ mixed depth



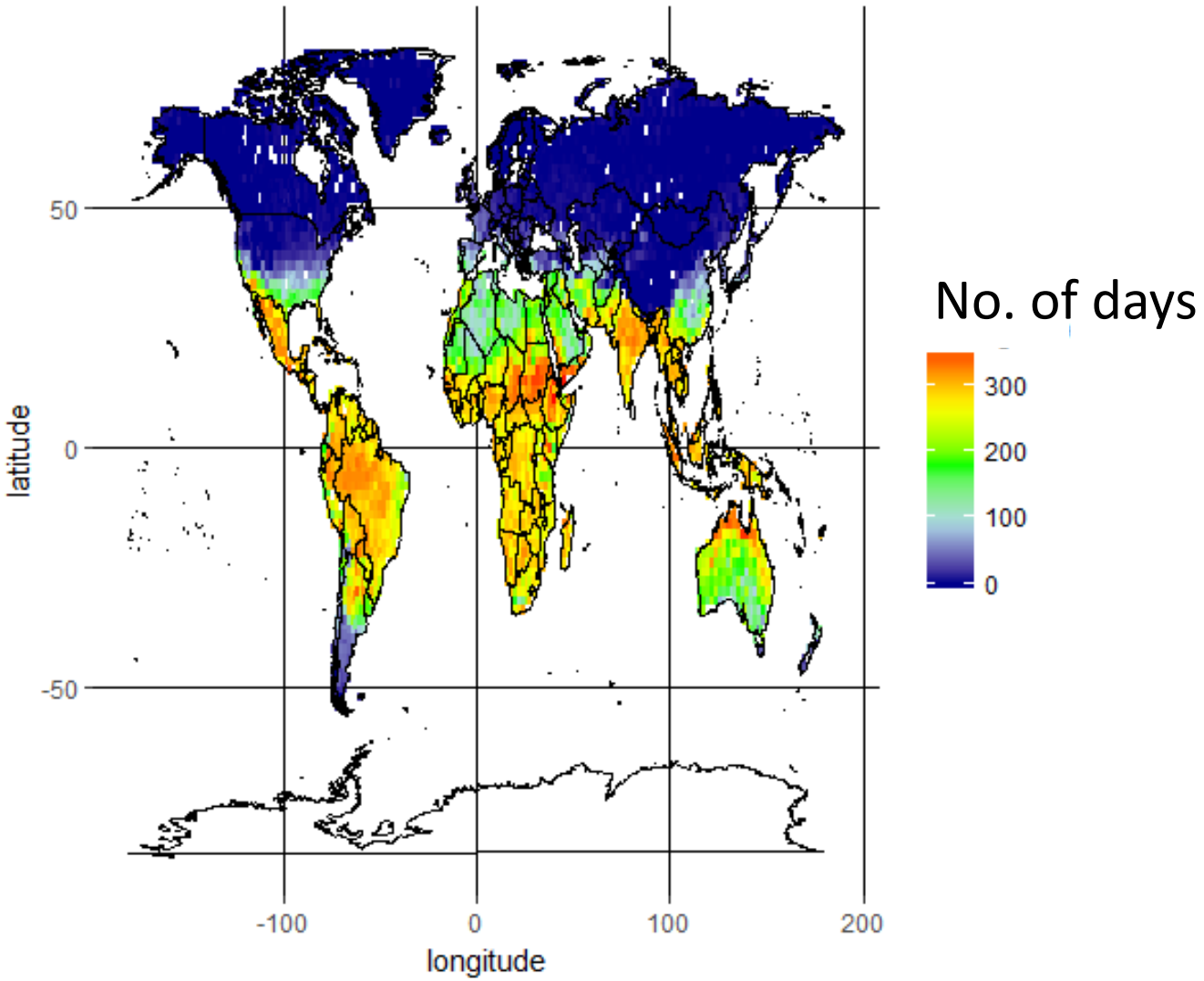
Present day annual phytoplankton biomass



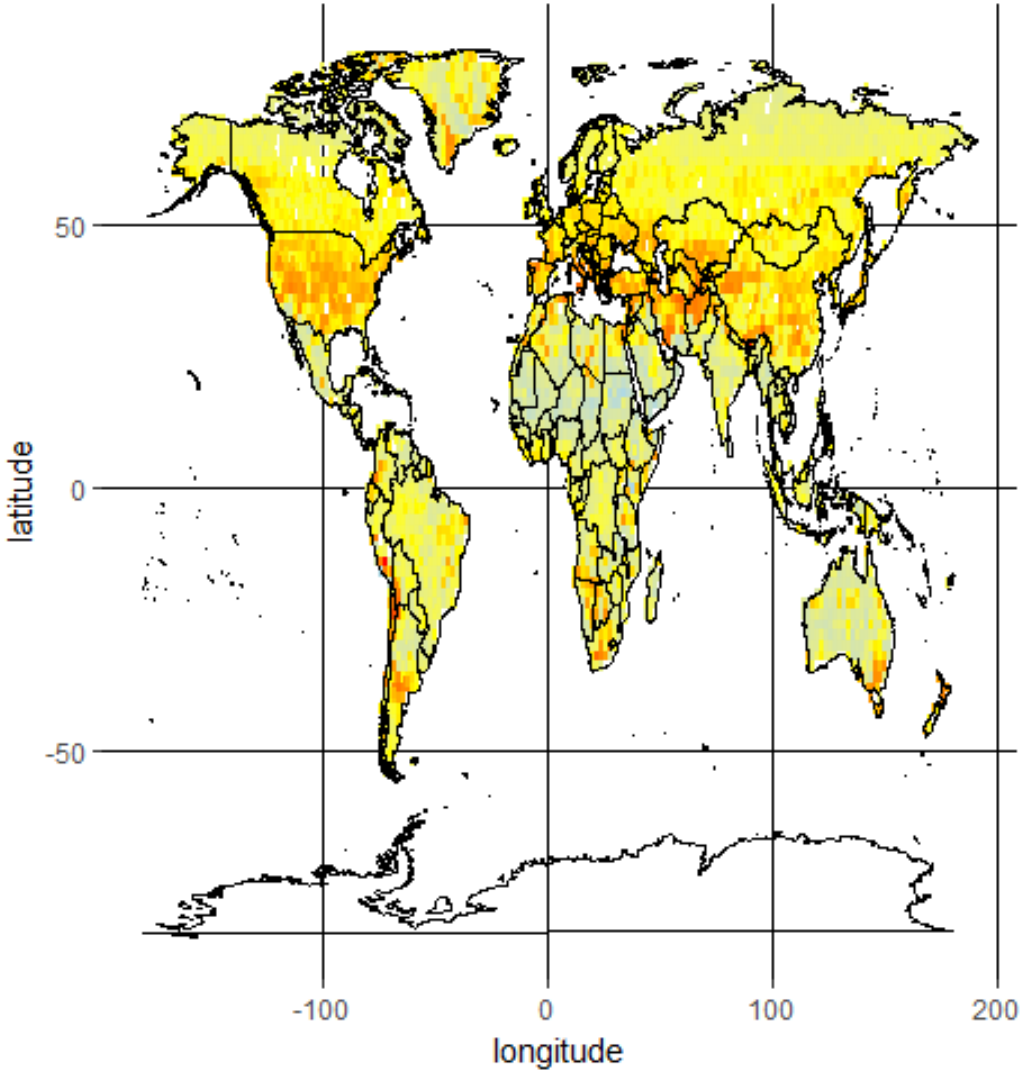
Present day annual percentage Cyanobacteria



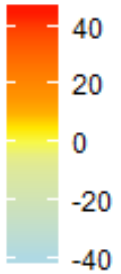
Present day no. of days Cyanobacteria > 50 mg m^{-3}



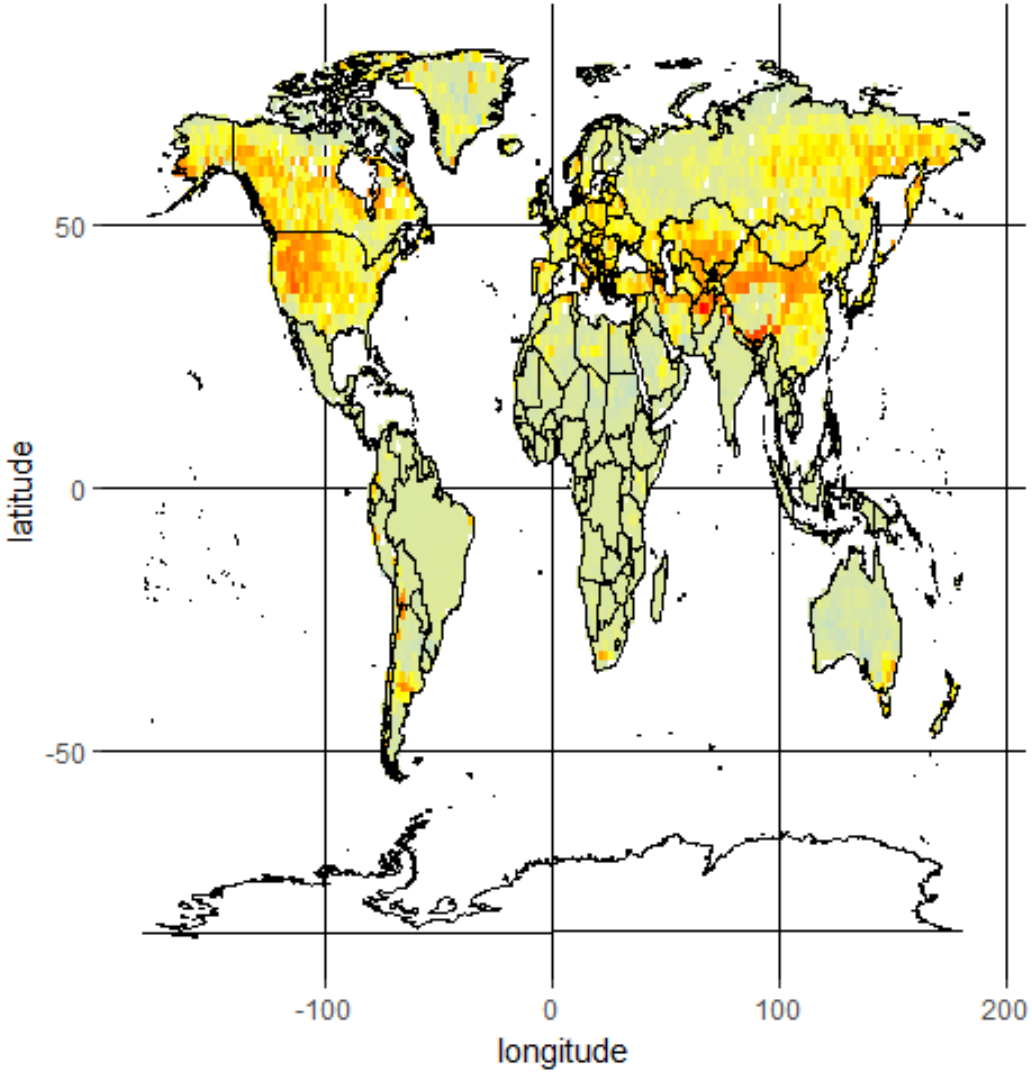
Future-present difference in annual phytoplankton biomass



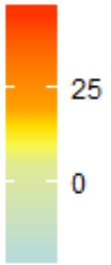
Change in chlorophyll *a* (mg m^{-3})



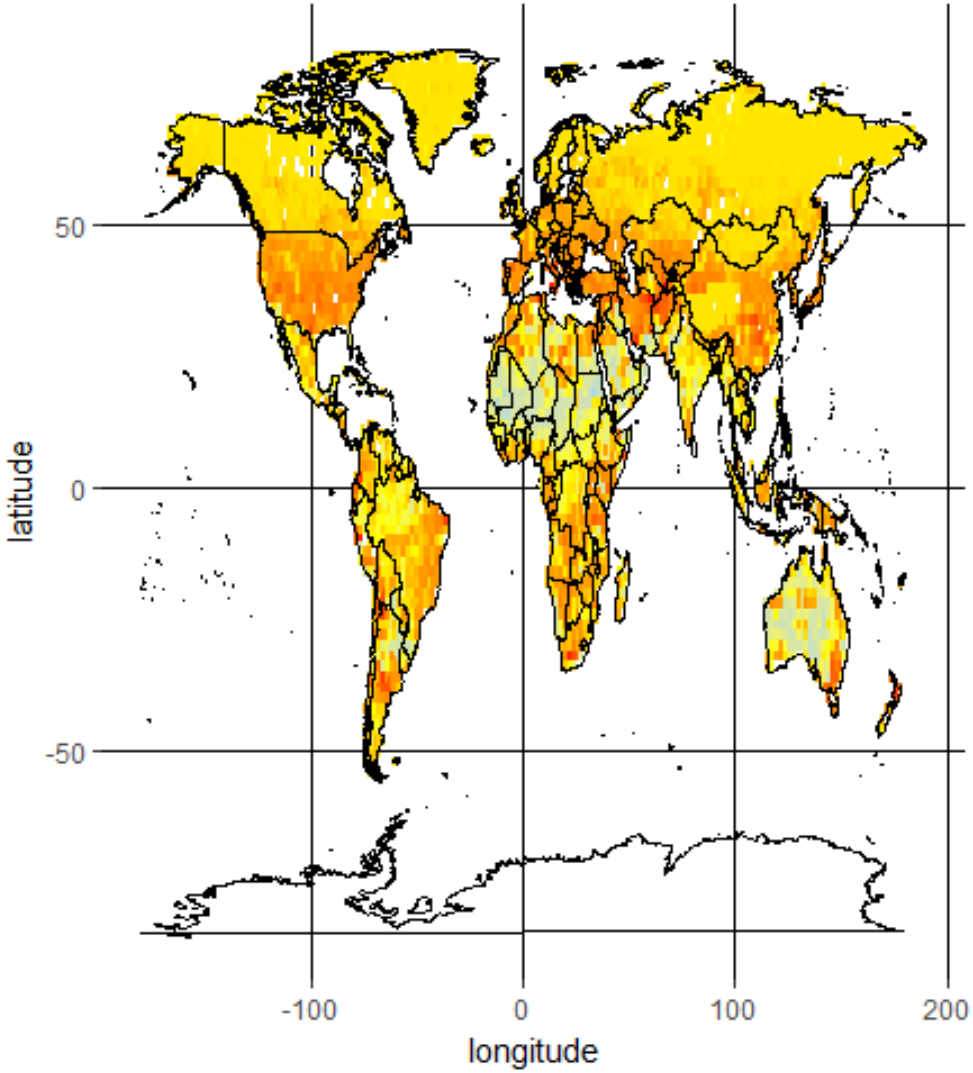
Future-present difference in percent Cyanobacteria



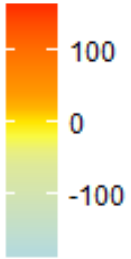
Change in % Cyanobacteria



Future-present difference in no. of days with Cyanobacteria > 50 mg m^{-3}



Change in no. of days Cyanobacteria > 50 mg m^{-3}



Summary

- Under present climate large geographical variation in algal biomass and species composition (for the same nutrient loading)
- Implies much less nutrient loading required to produce the same algal biomass in some parts of the world than others
- Lakes will stratify earlier and for longer, with shallower mixed depths
- Temperate-zone phytoplankton communities will be most affected by climate change
- Some increase in phytoplankton biomass
- Large increase in cyanobacterial blooms

Thank you

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This research was funded by the Natural Environment Research Council (NE/E009328)

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