Vegetation-climate feedbacks in the Pleistocene using iCESM1.3 and BIOME4

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COLLEGE OF SCIENCE
Geosciences

HEISING-SIMONS FOUNDATION

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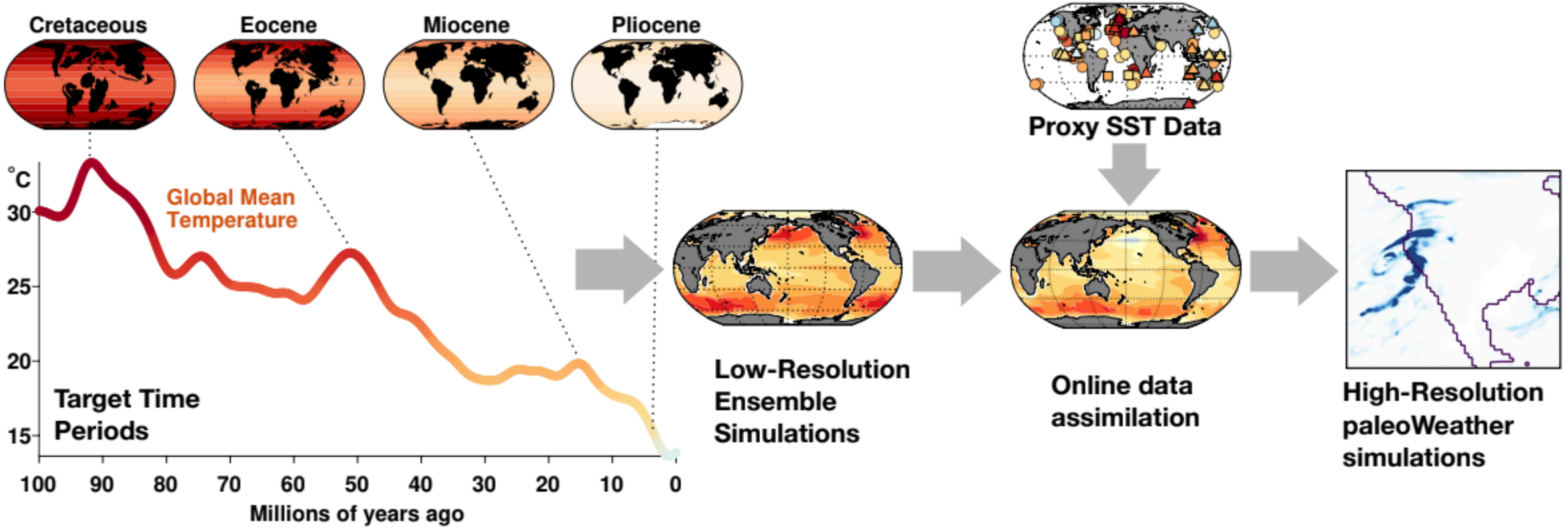
The paleoWeather project



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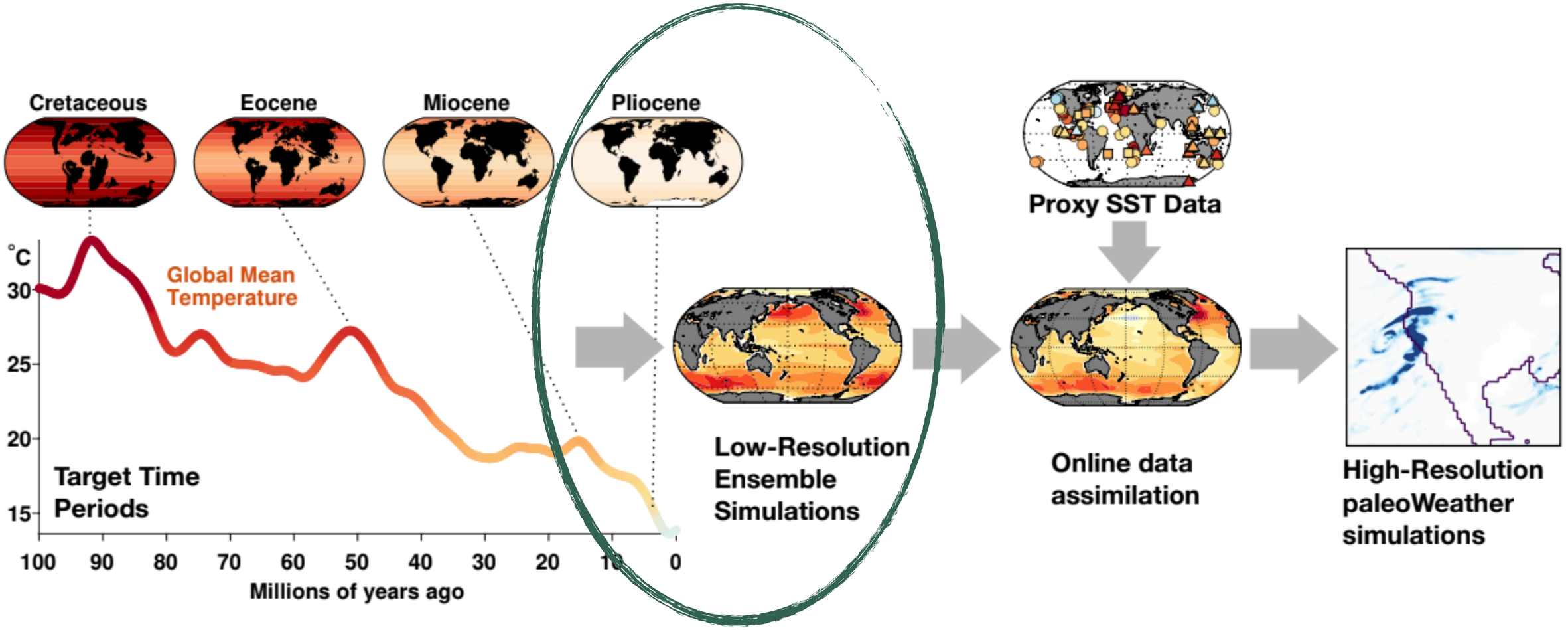
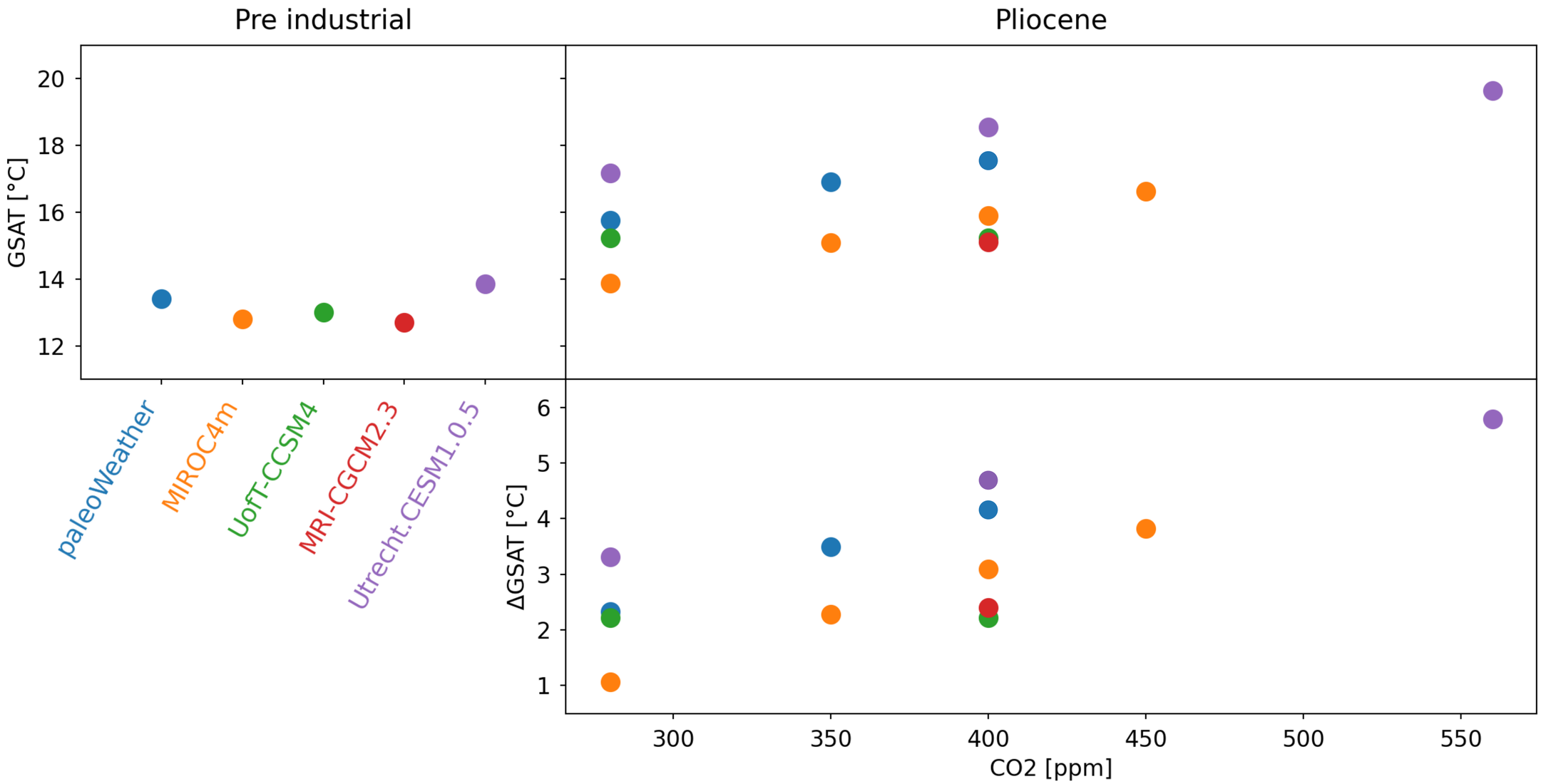
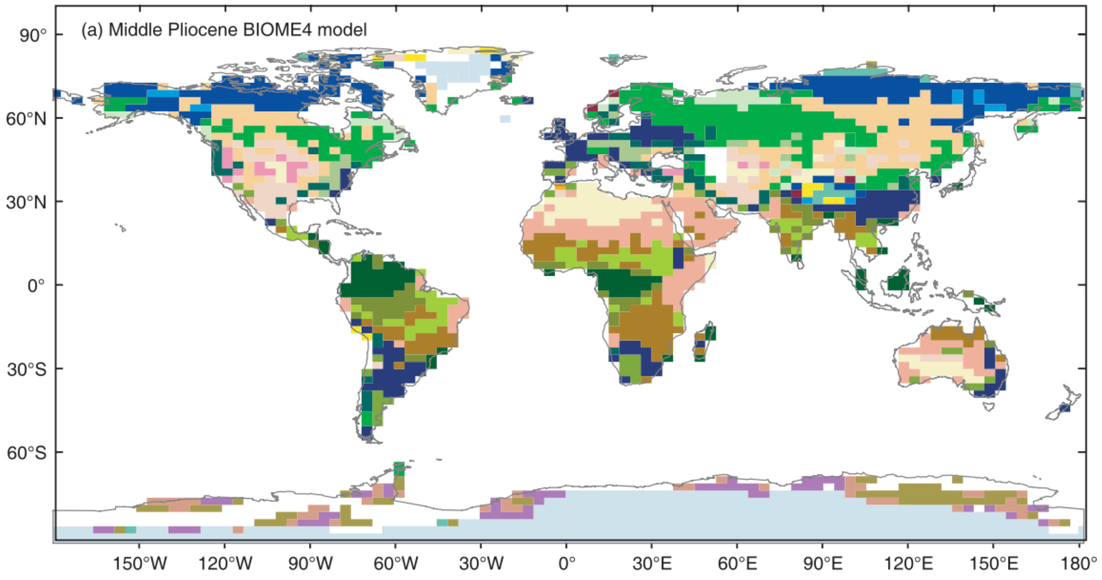


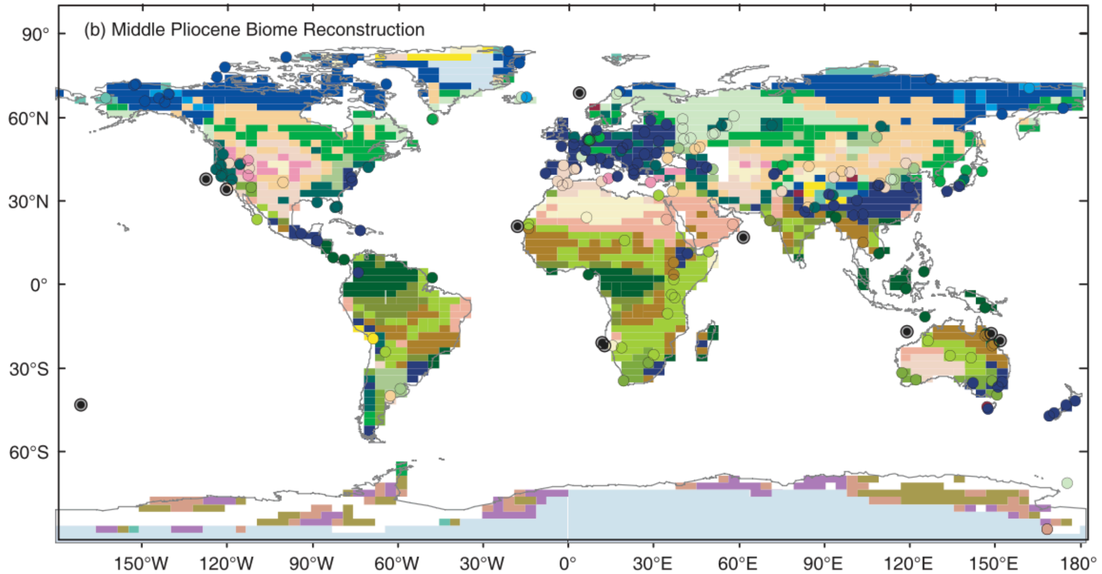
Pliocene temperature response across models



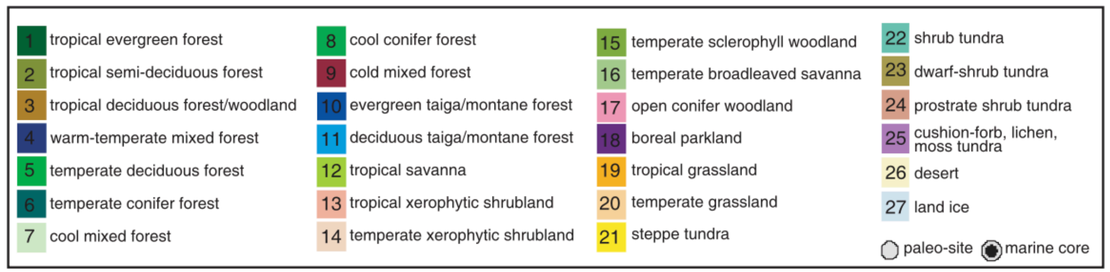
Pleistocene vegetation

- Standard vegetation maps based on Biome4 forced by HadAM3 GCM
- Regional corrected using proxy data



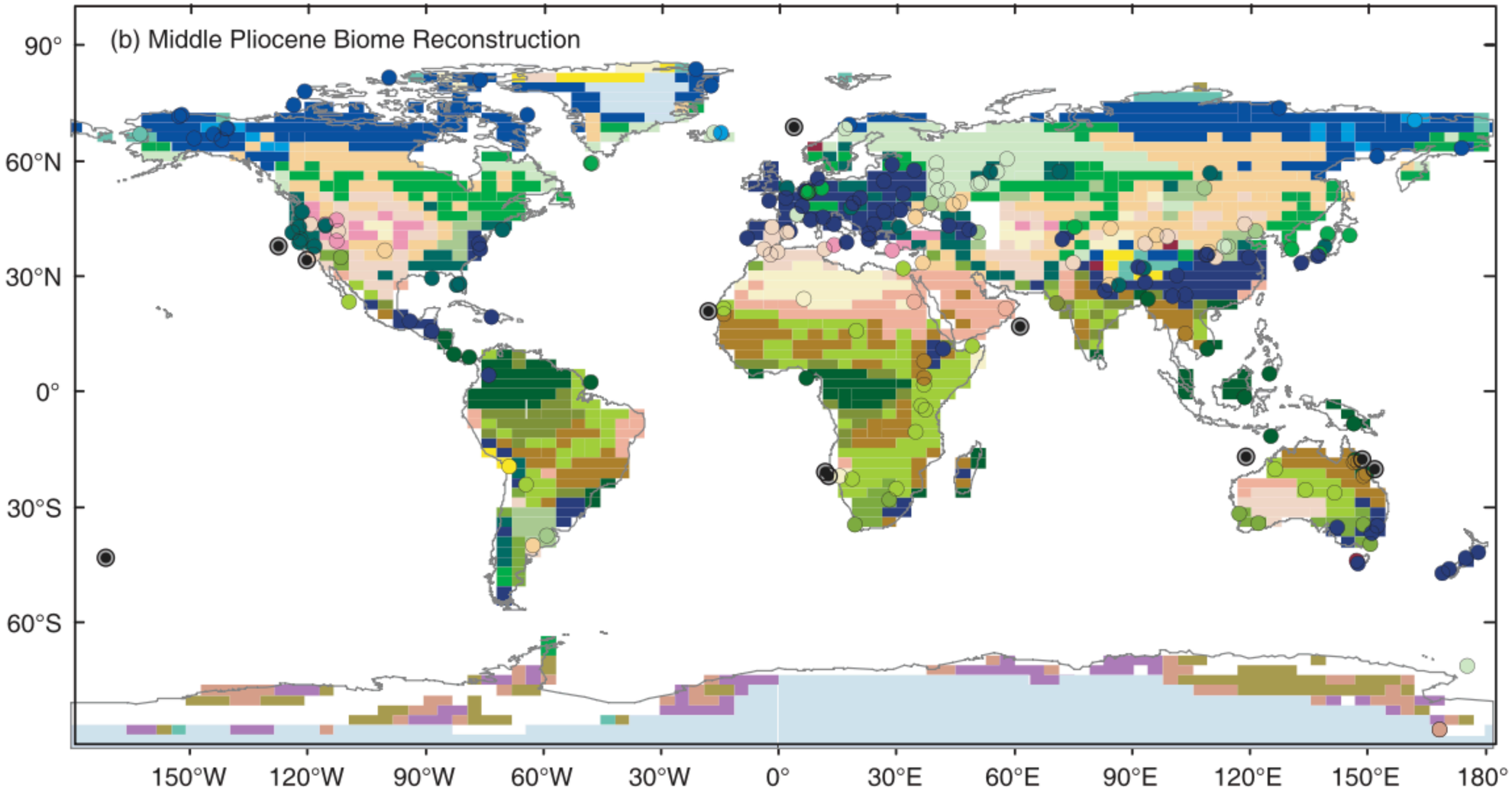


Salzmann et al. (2008)



Pleistocene vegetation

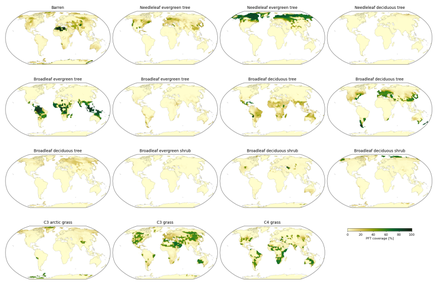
- Several places are not well constrained by the proxy data



Salzmann et al. (2008)

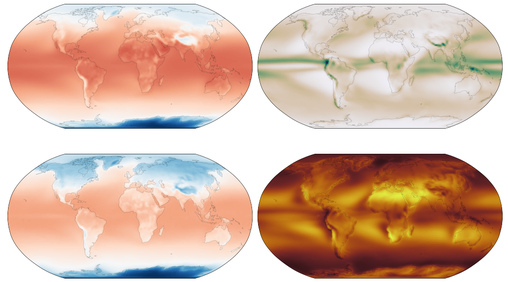
Model experiment setup

Base



CESM PlioMIP Standard Vegetation
(Feng et al. 2020)

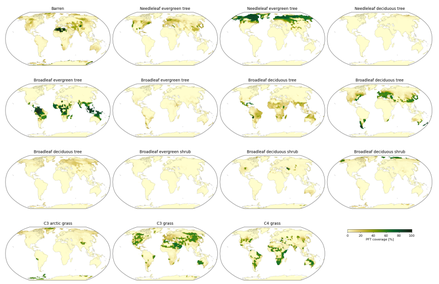
CESM



Biome4

Model experiment setup

Base



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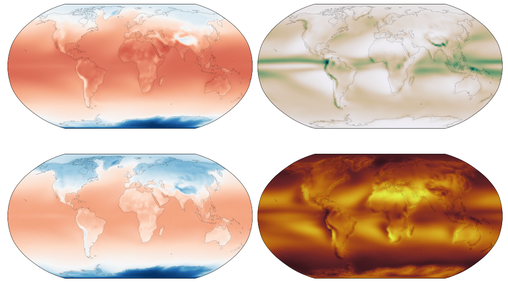
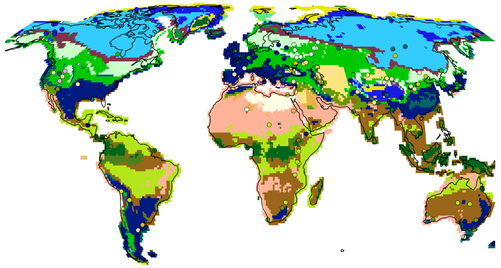
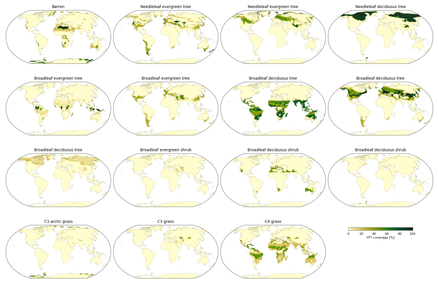


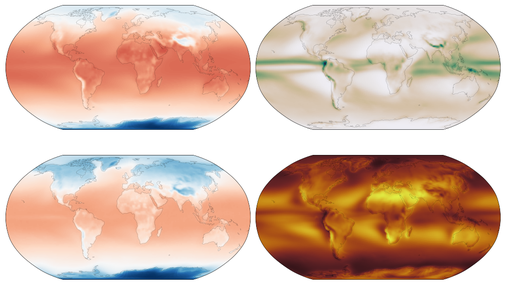
Biome4

Veg

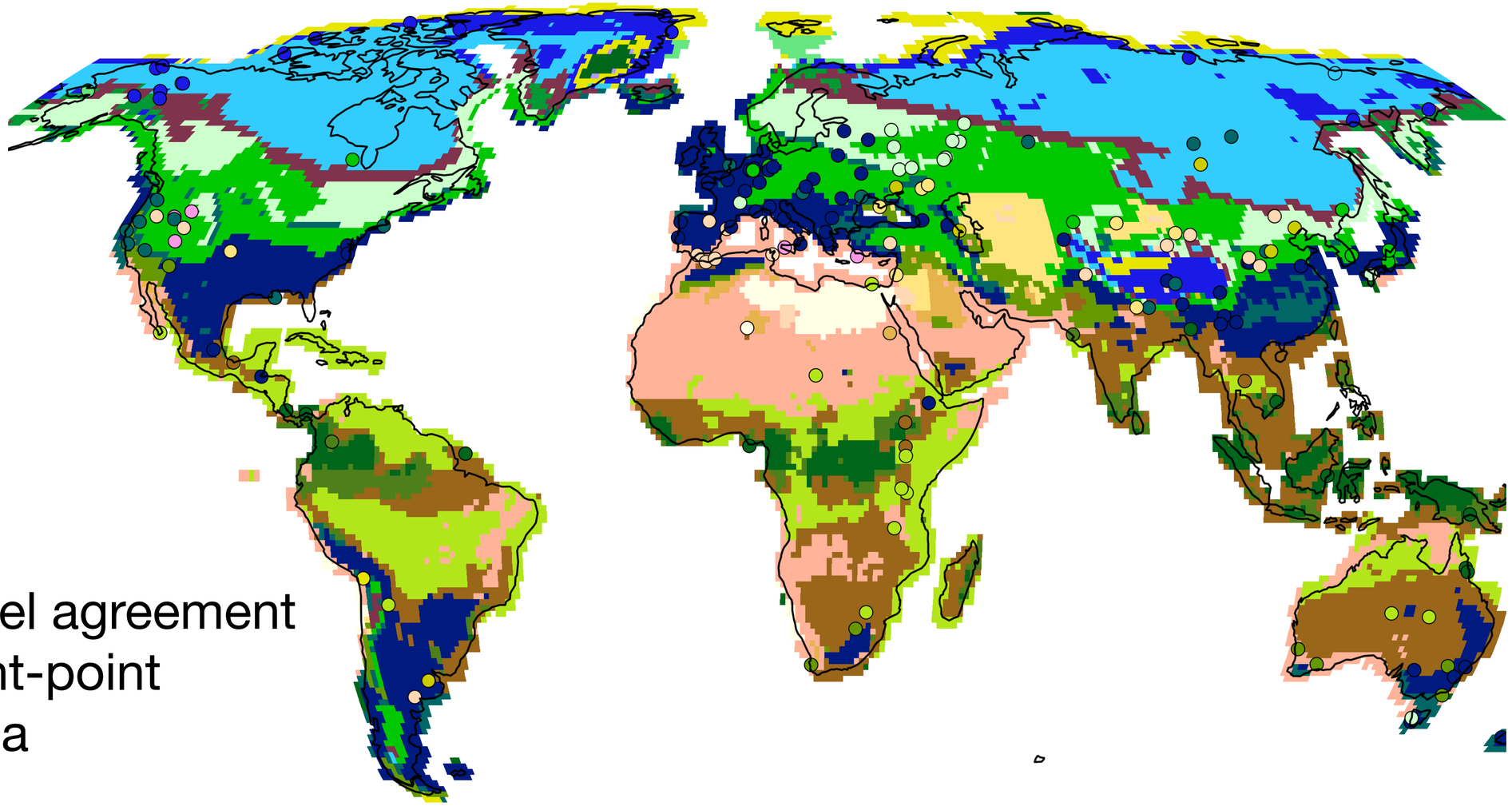




CESM



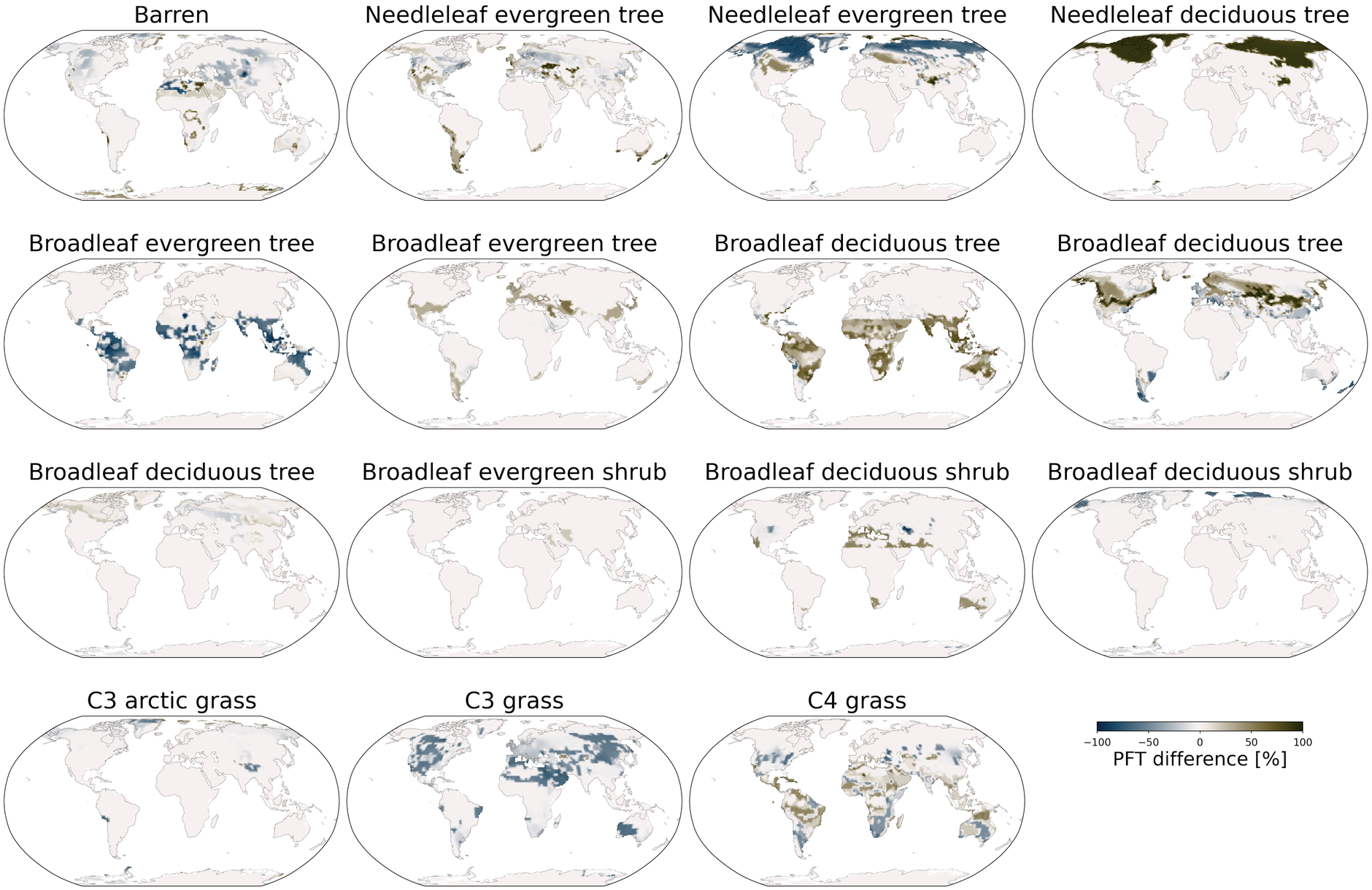
Updated vegetation compared to proxy data



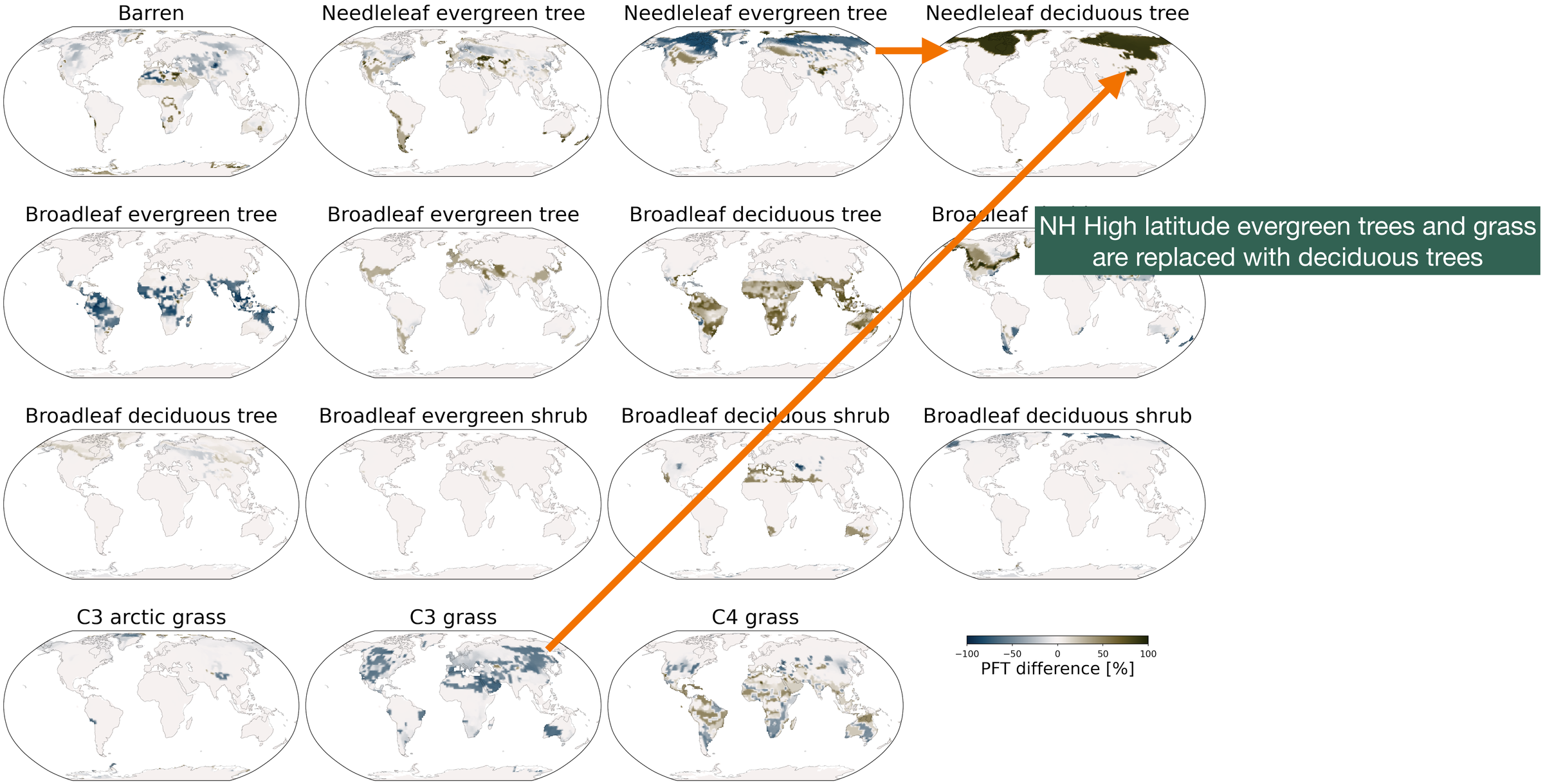
Proxy-model agreement
41.7% point-point
0.279 kappa

- Tropical evergreen broadleaf forest
- Tropical semi-evergreen broadleaf forest
- Tropical deciduous broadleaf forest and woodland
- Temperate deciduous broadleaf forest
- Temperate evergreen needleleaf forest
- Warm-temperate evergreen broadleaf and mixed forest
- Cool mixed forest
- Cool evergreen needleleaf forest
- Cool-temperate evergreen needleleaf and mixed forest
- Cold evergreen needleleaf forest
- Cold deciduous forest
- Tropical savanna
- Tropical xerophytic shrubland
- Temperate xerophytic shrubland
- Temperate sclerophyll woodland and shrubland
- Tropical deciduous broadleaf forest and savanna
- Temperate evergreen needleleaf open woodland
- Cold parkland
- Tropical grassland
- Temperate grassland
- Desert
- Graminoid and forb tundra
- Low and high shrub tundra
- Erect dwarf shrub tundra
- Prostrate dwarf shrub tundra
- Cushion forb tundra
- Barren
- Ice

Updated vegetation (veg400 - base400)

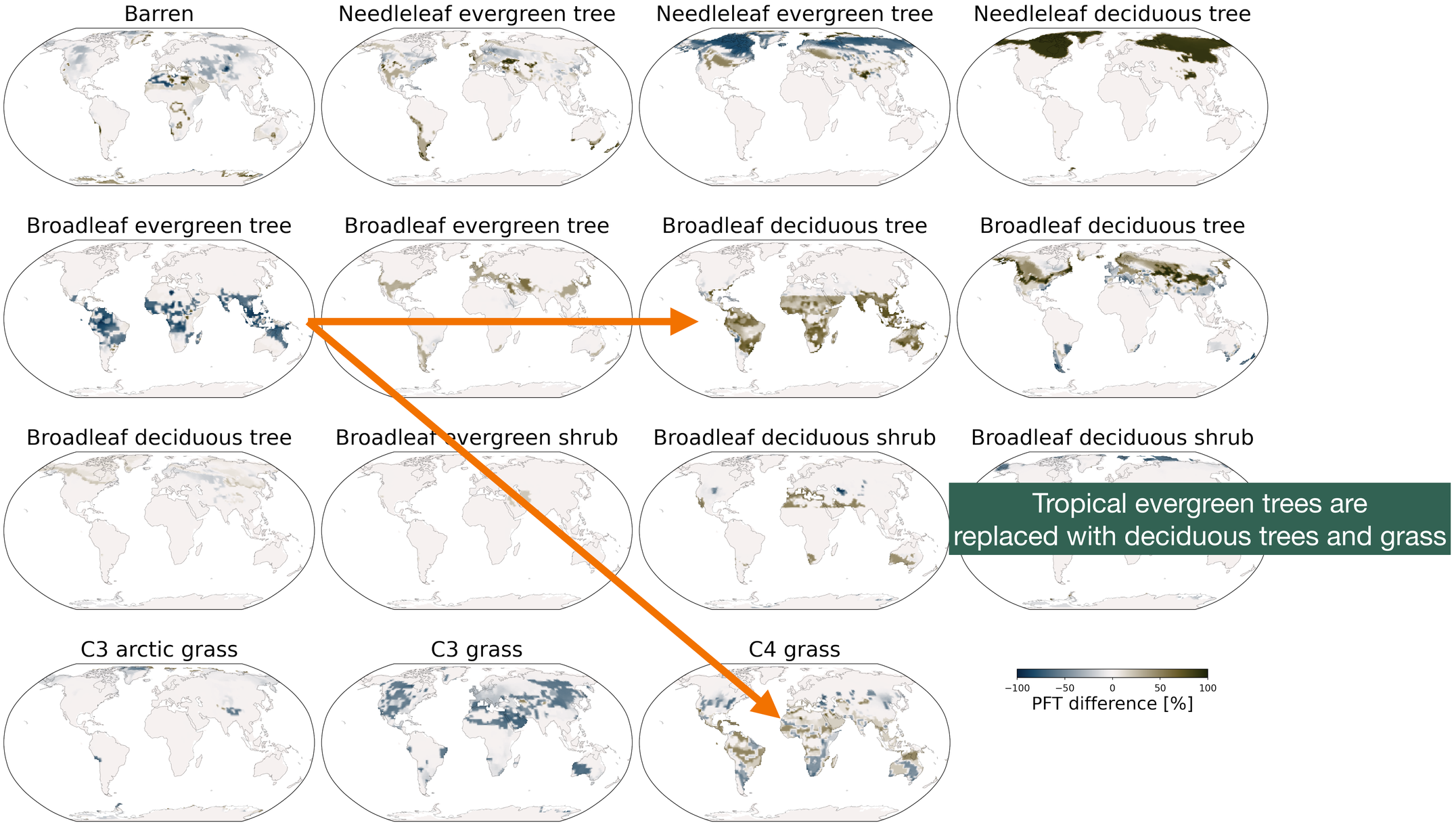


Updated vegetation (veg400 - base400)



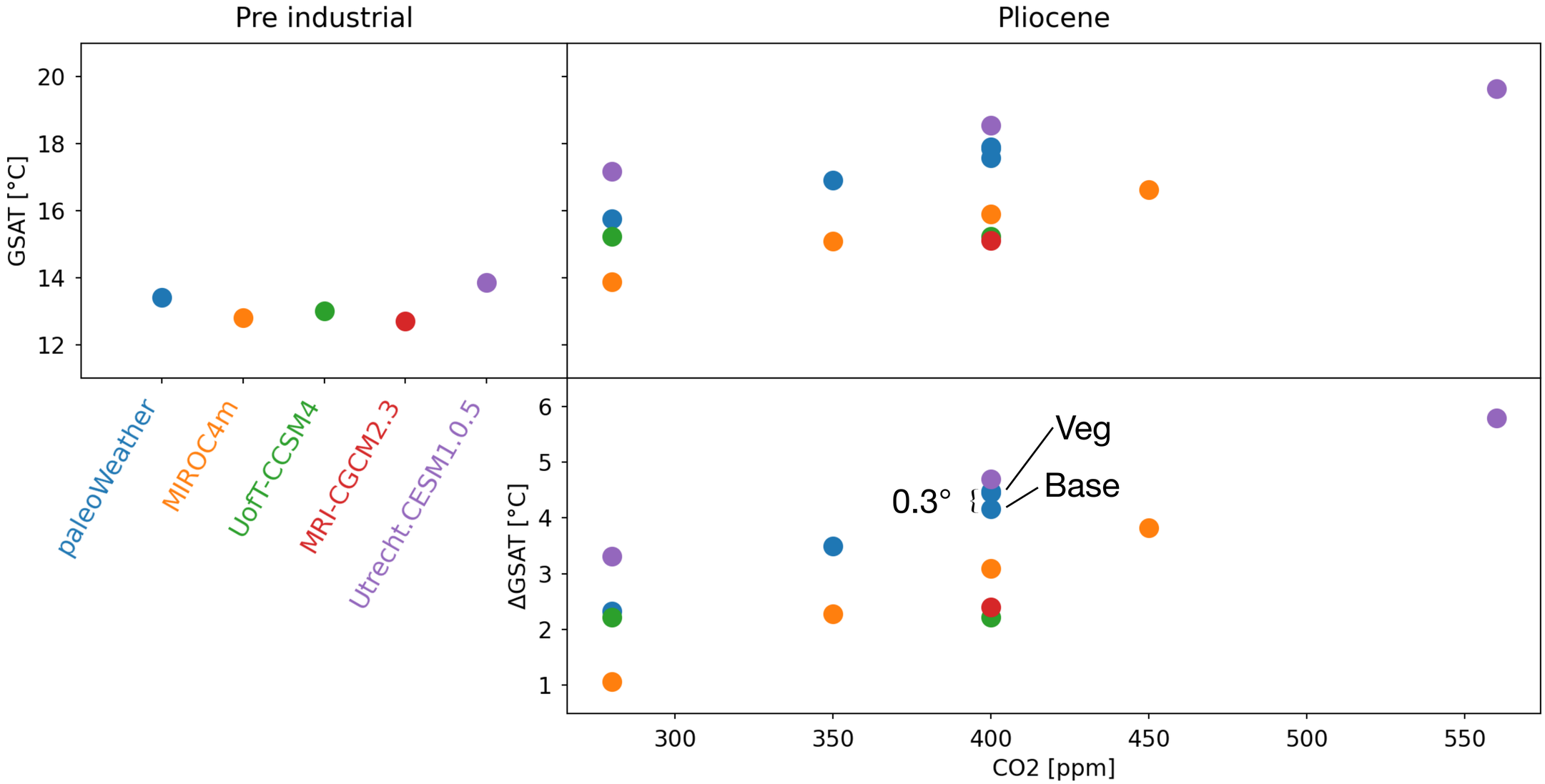
NH High latitude evergreen trees and grass are replaced with deciduous trees

Updated vegetation (veg400 - base400)



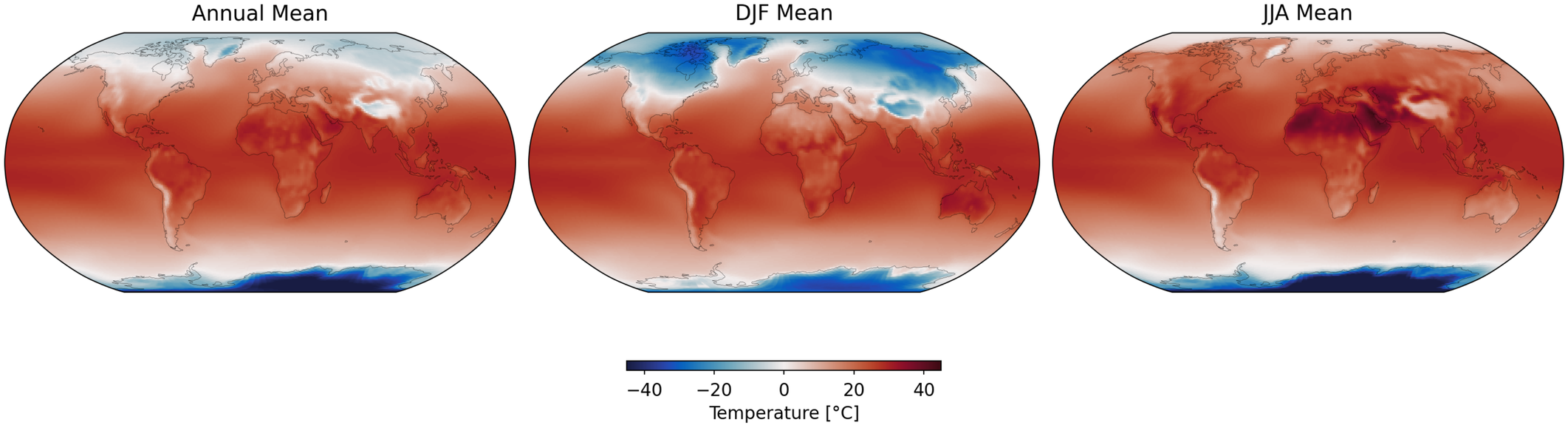
Tropical evergreen trees are replaced with deciduous trees and grass

Pliocene temperature response across models

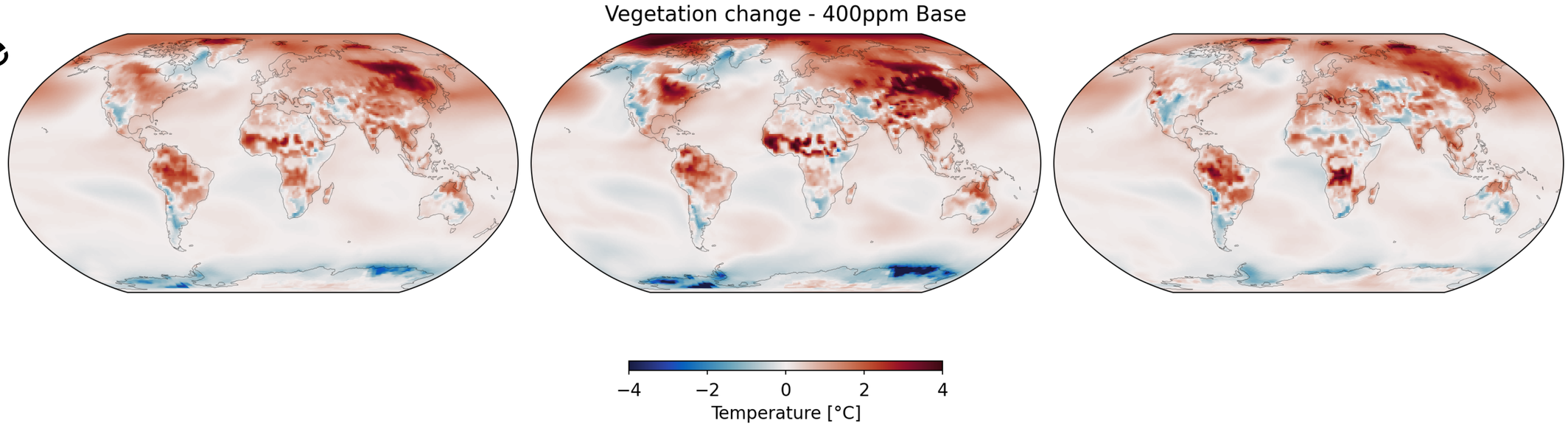


Temperature increases due to change in vegetation

Base



Veg - Base



Temperature increases due to change in vegetation

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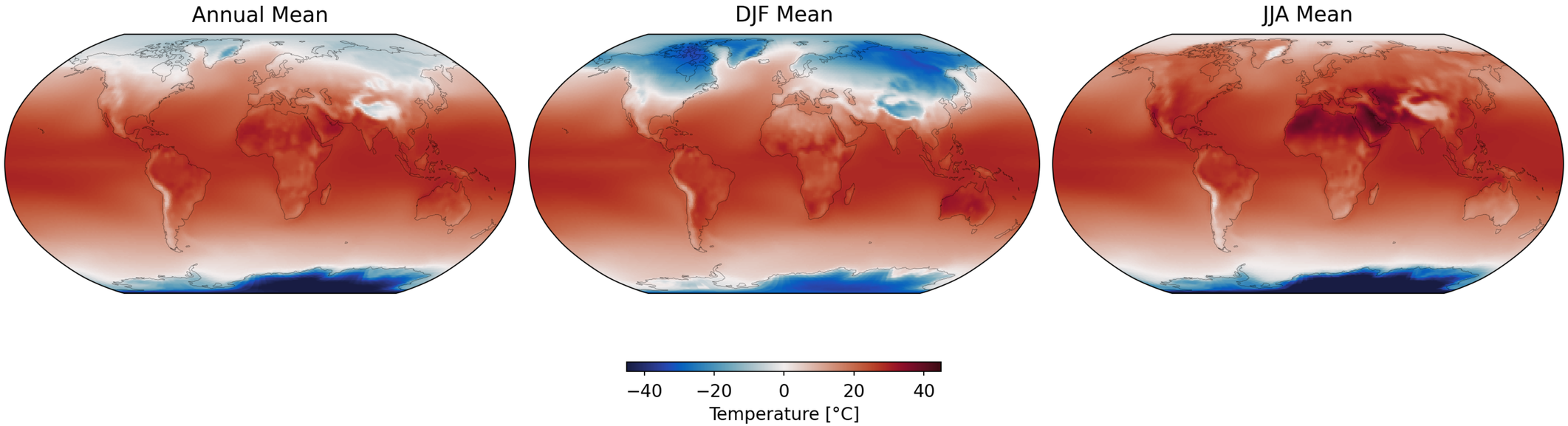
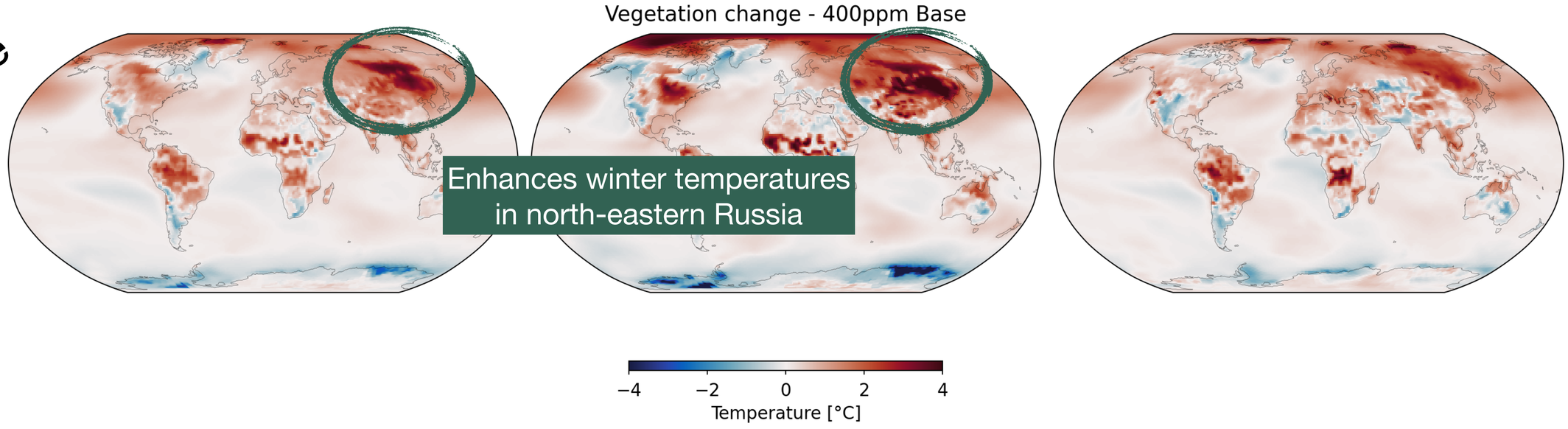
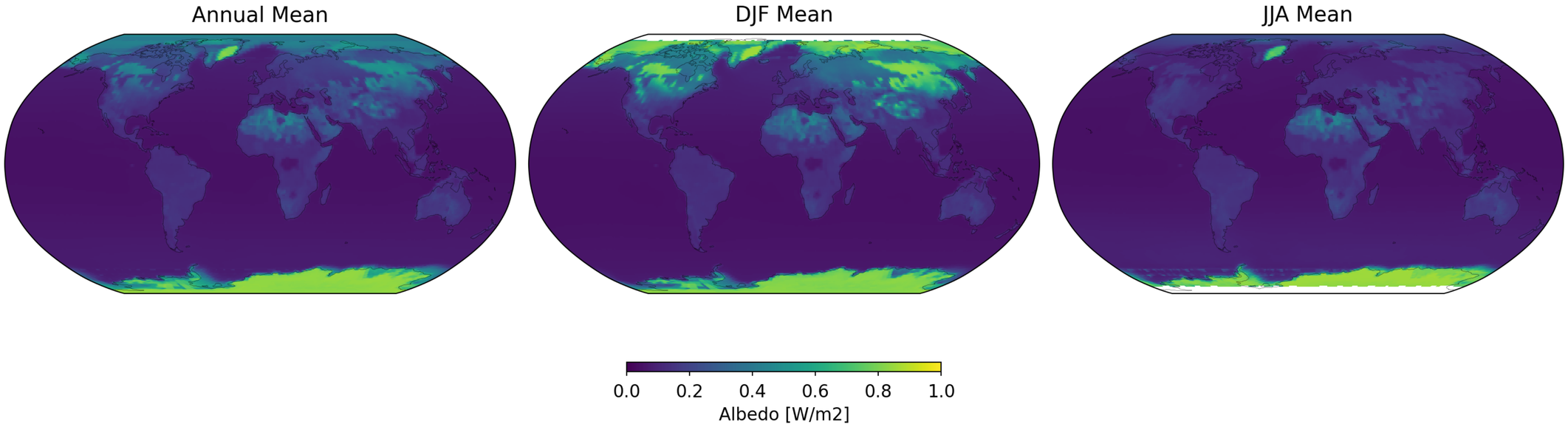


Veg - Base

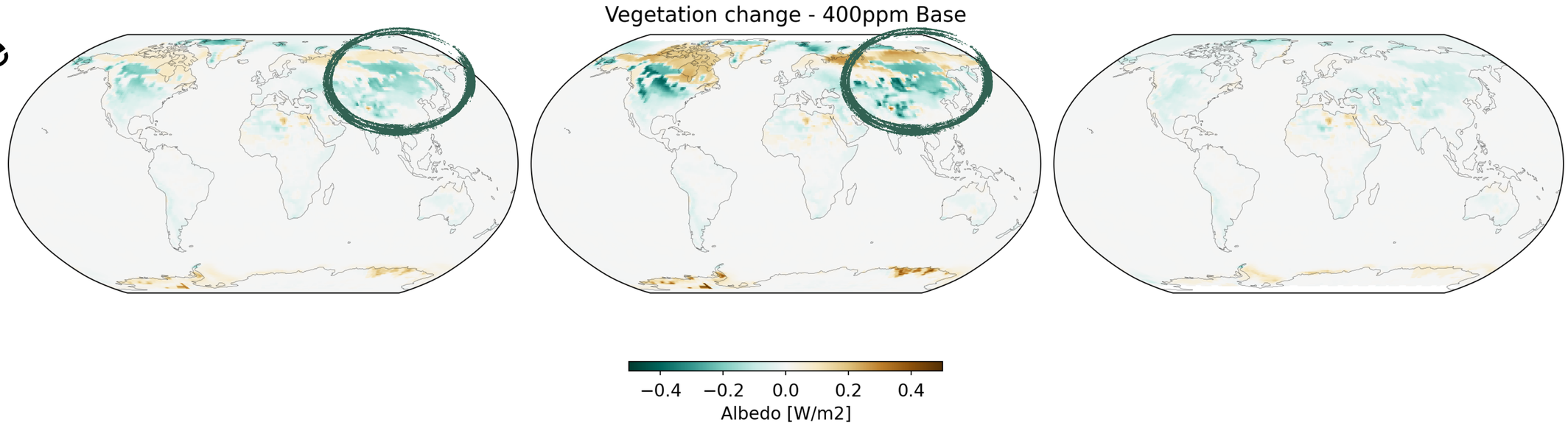


North-eastern Russia temperature change due to lower albedo

Base



Veg - Base



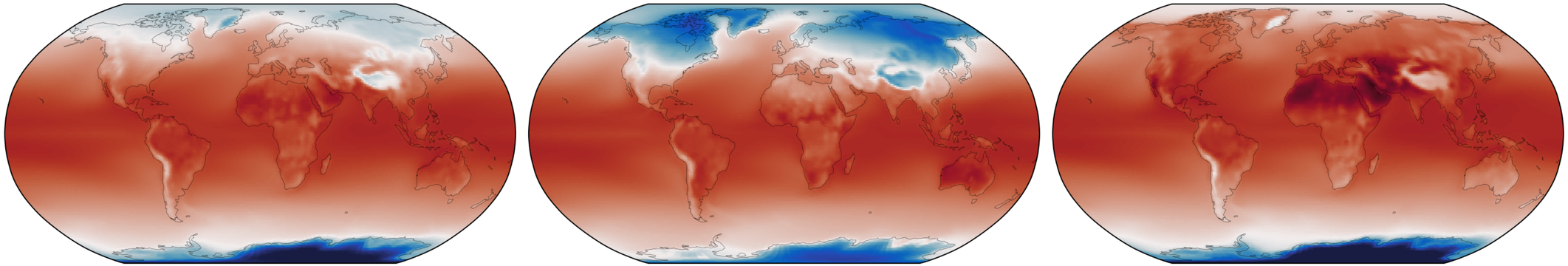
Tropical temperatures increase

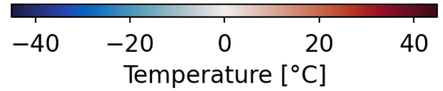
Annual Mean

DJF Mean

JJA Mean

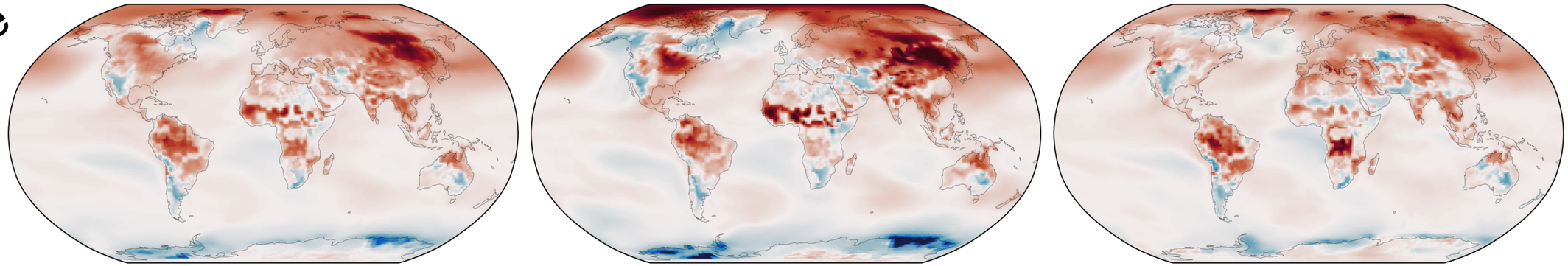
Base

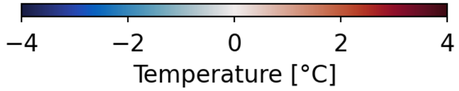




Vegetation change - 400ppm Base

Veg - Base





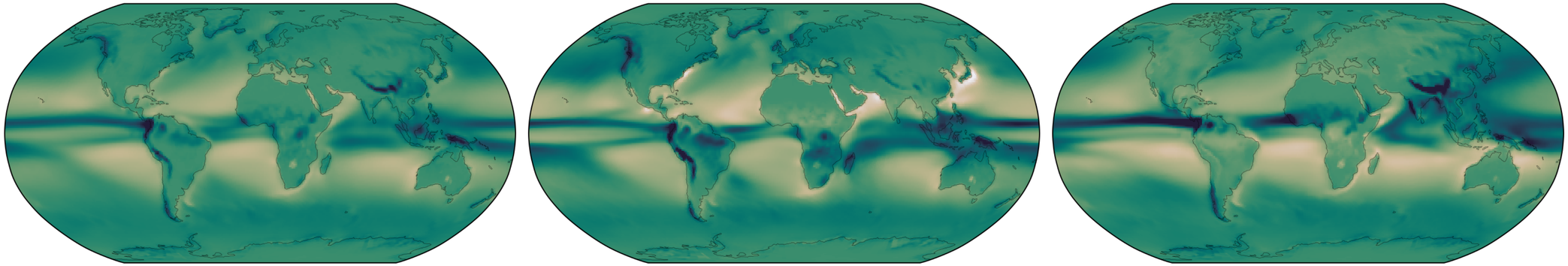
and the tropical region get wetter

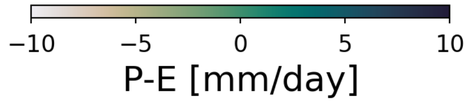
Annual Mean

DJF Mean

JJA Mean

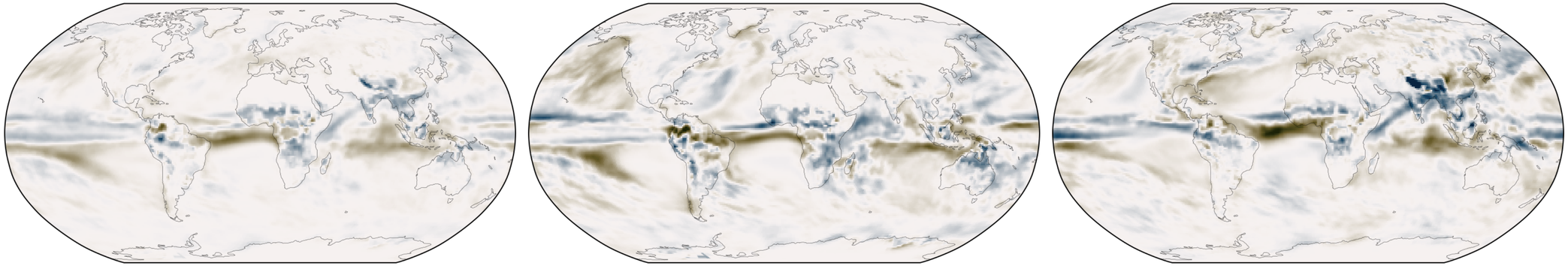
Base

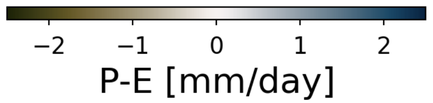




400Vege - 400Base

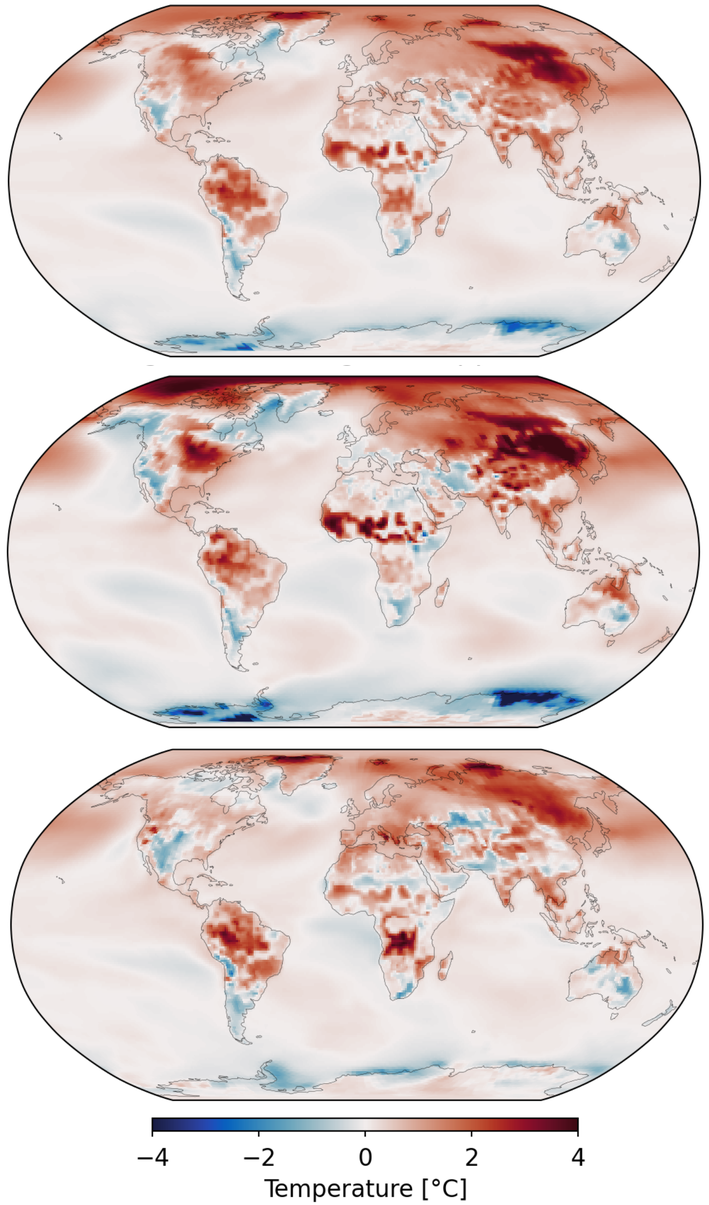
Veg - Base





What we learned so far

- Different Pliocene vegetation scenarios can result in mean global temperature changes of up 0.3°C.
- Deciduous forests cause strong warming in Northern Russia, most likely due to lower albedo during winter months
- Replacing tropical evergreen trees with deciduous trees and grass possibly enhances temperature and P-E
- Vegetation is important, especially on a local scale



Thank you!

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