



# Climate Change Velocity: Past, Present, and Predicted

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## GOALS

- Model paleoclimate space over the last 55 million years based on data from the lab of David Beerling (Beerling et al., 2011)
- Calculate the velocity of climate change (Loarie et al., 2009) between key points in our climatic history using methods proposed by Hamann et al. (2015).

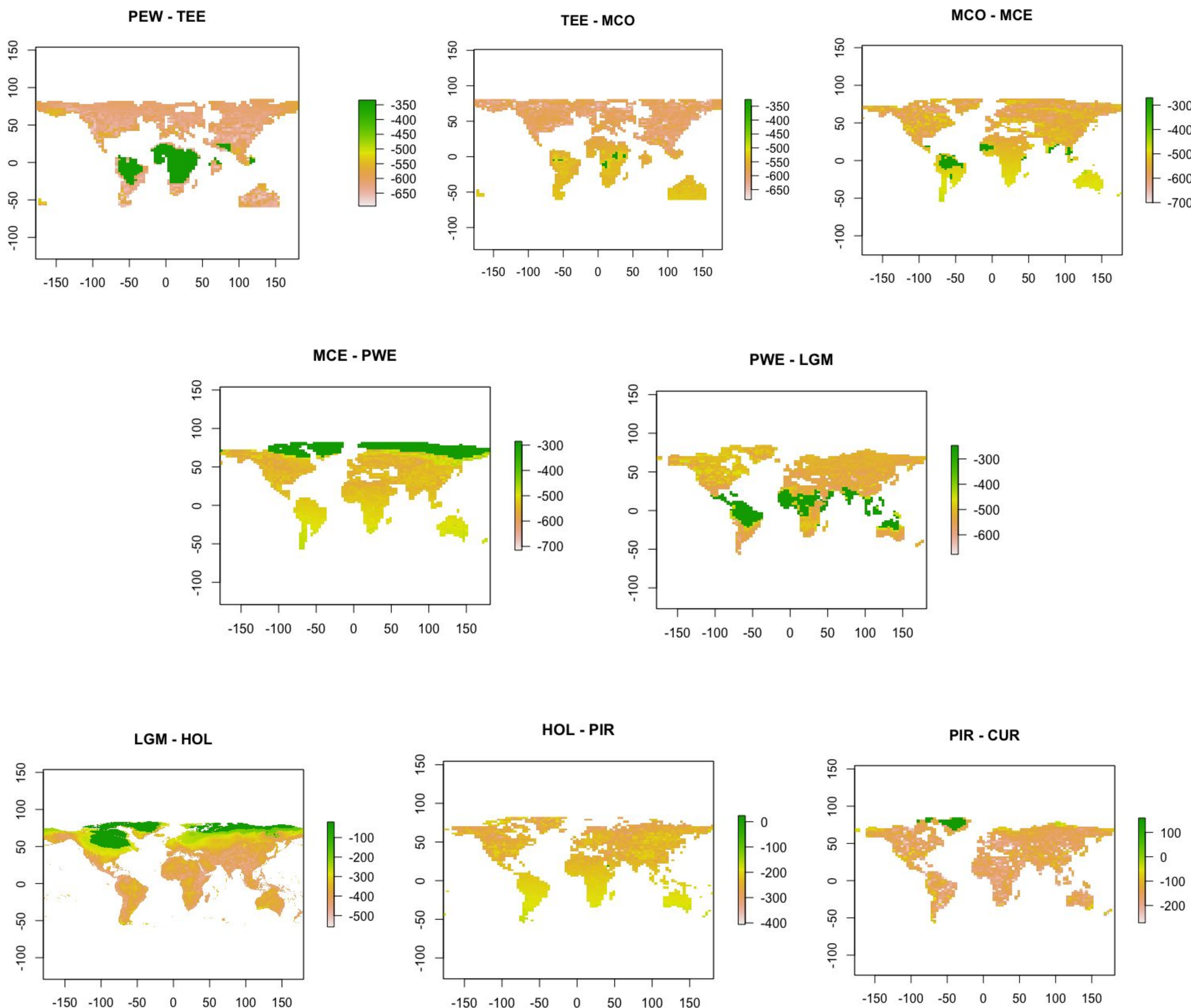
$$\frac{^{\circ}\text{C/yr}}{^{\circ}\text{C/km}} = \frac{\text{km}}{\text{yr}}$$

- Use RCP8.5 climate predictions to predict the velocity at which climates may change in the next 50 years.
- Use Random Forest and current WWF biome classifications to predict potential past biome analogues.

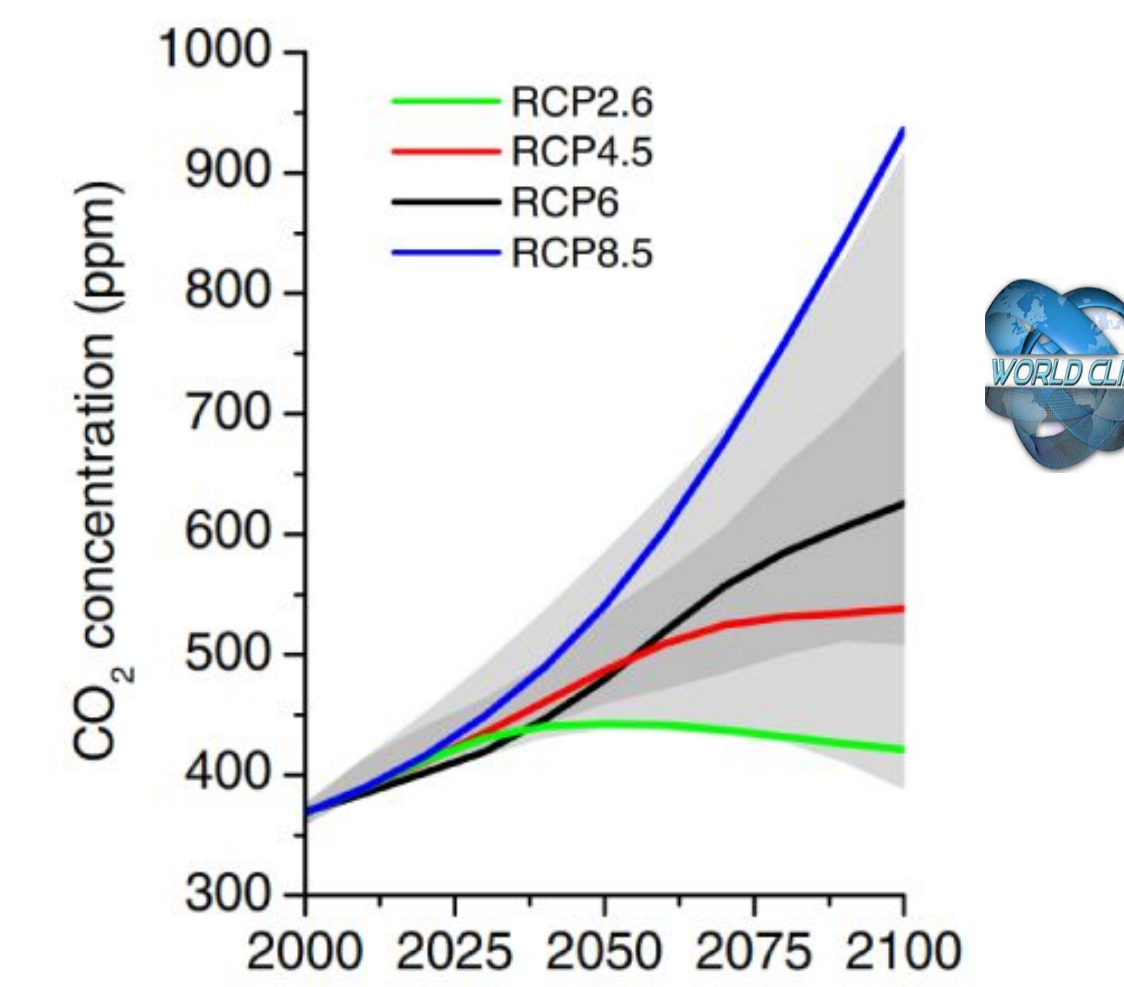
## CLIMATE CHANGE VELOCITY

PEW: Peak Eocene Warmth (55 mya)  
 TEE: Terminal Eocene Event (33 mya)  
 MCO: Miocene Climatic Optimum (15 mya)  
 MCE: Miocene Cooling Event (10 mya)  
 PWE: Pliocene Warming Event (3 mya)  
 LGM: Last Glacial Maximum (22,000 ya)  
 HOL: Mid-Holocene (6,000 ya)  
 PIR: Pre-Industrial Revolution (300 ya)  
 CUR: Current (0 ya)

Era	Epoch	Time Scale
QUATERNARY	HOLOCENE	Present
	PLEISTOCENE (ICE AGE)	10,000 years ago
NEOGENE	PLIOCENE	1.8 million years ago
	MIOCENE	5.3 million years ago
TERTIARY	OLIGOCENE	23.8 million years ago
	EOCENE	33.7 million years ago
	PALEOCENE	54.8 million years ago
		65 million years ago

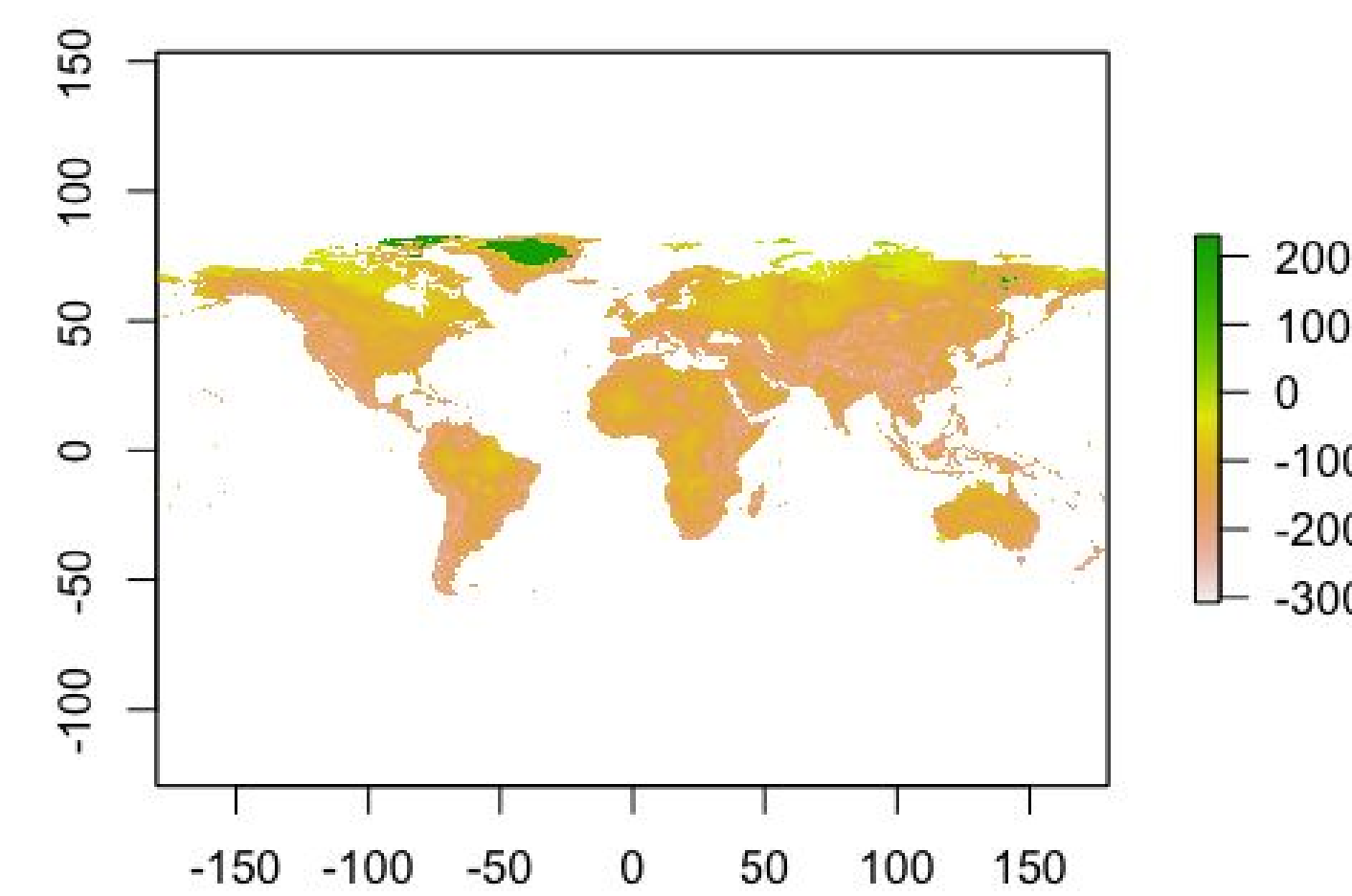


## CLIMATE PREDICTIONS

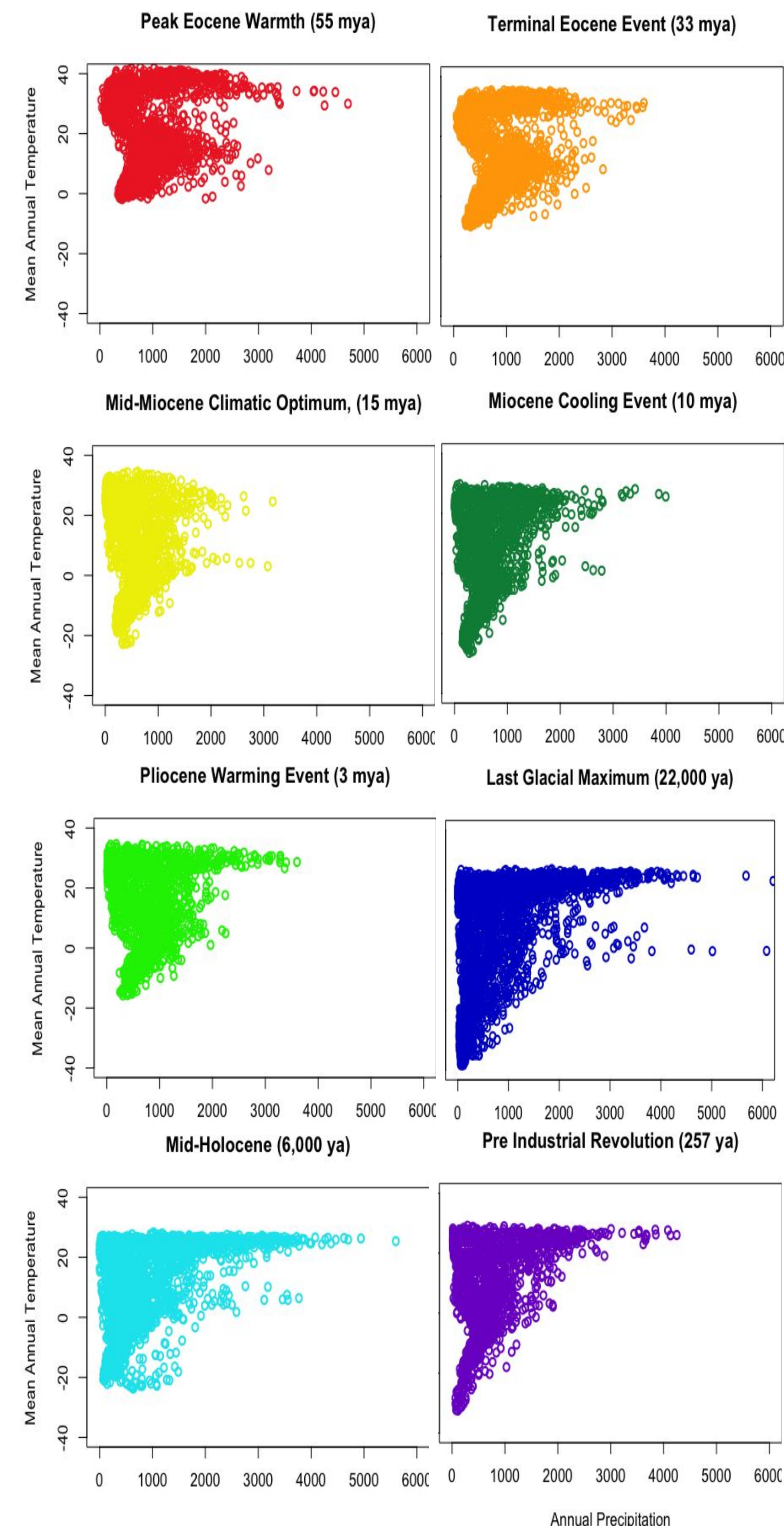


(Detlef P. van Vuuren et al, Climatic Change, 2011)

CUR - FUT.50

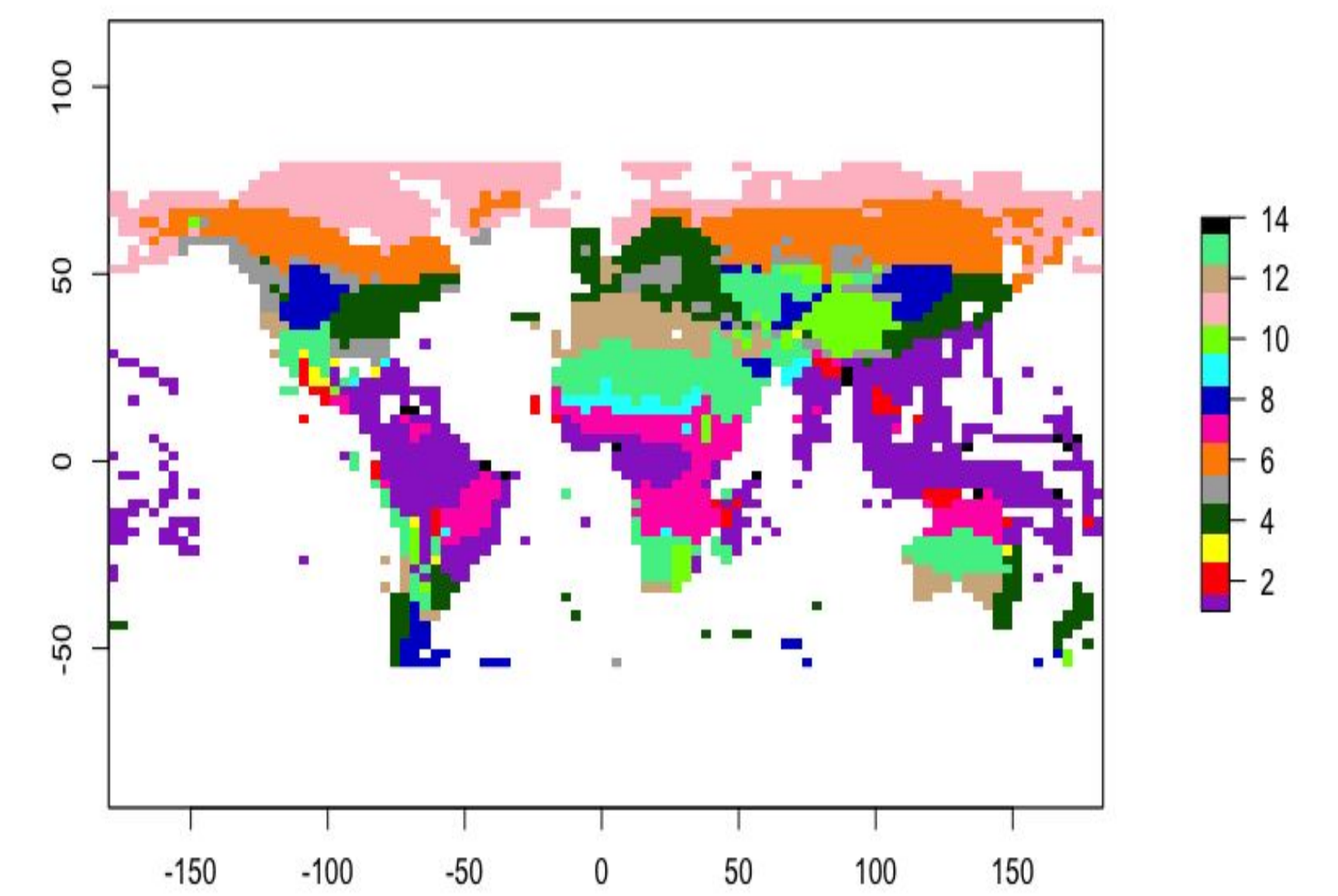


## CLIMATE SPACE



## CURRENT BIOME DISTRIBUTION

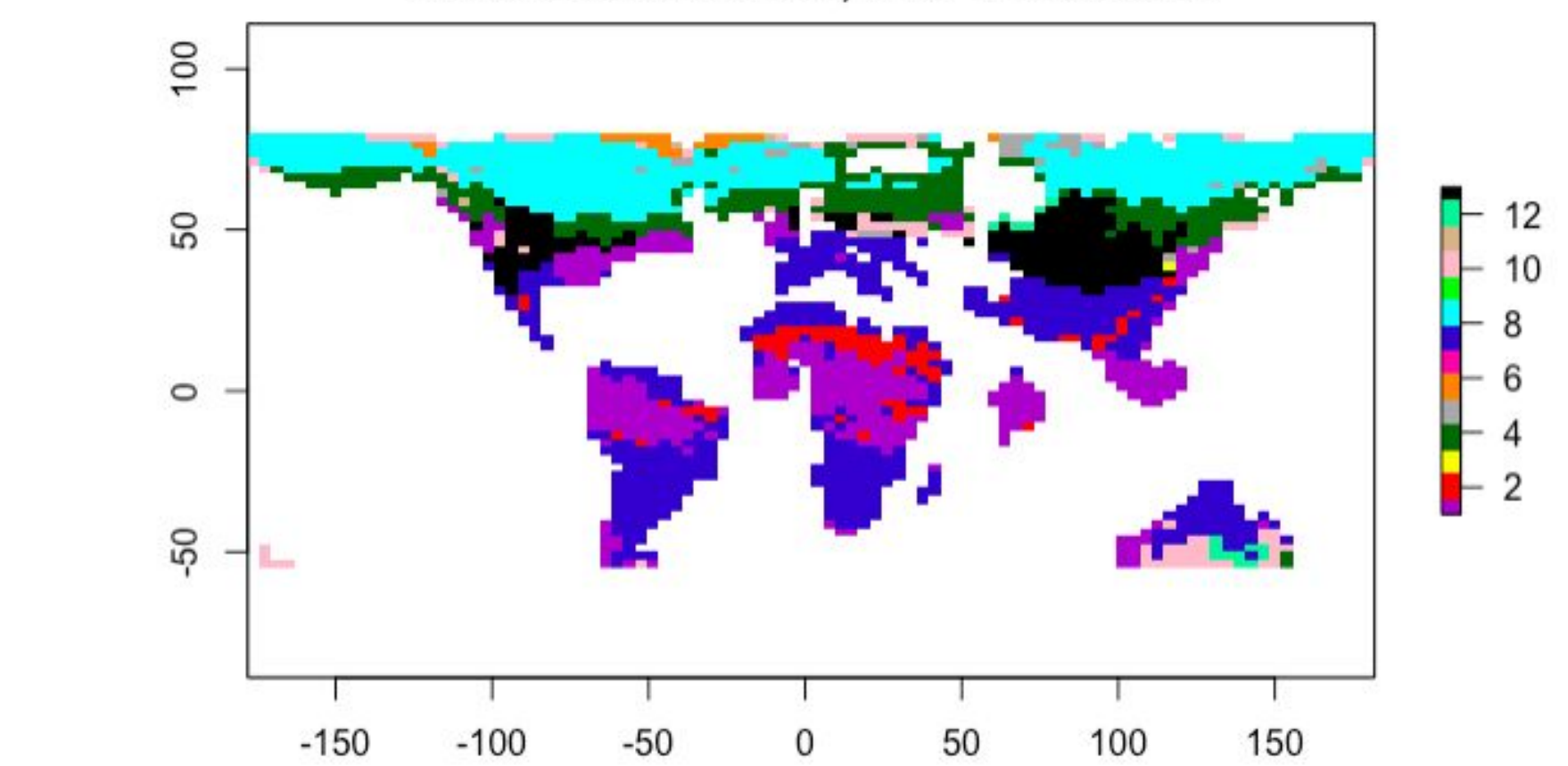
Current, WWF Predictions



- 1= Tropical & subtropical moist broadleaf forests
- 2= Tropical & subtropical dry broadleaf forests
- 3= Tropical & subtropical coniferous forests
- 4= Temperate & mixed forests
- 5= Temperate conifer forests
- 6= Boreal forests/taiga
- 7= Tropical & subtropical grasslands, savannas & shrublands
- 8= Temperate grasslands, savannas, & shrublands
- 9= Flooded grasslands & savannas
- 10= Montane grasslands & shrublands
- 11= Tundra
- 12= Mediterranean forests, woodlands & scrub
- 13= Deserts & xeric shrublands
- 14= Mangroves

## BIOME PREDICTIONS

Peak Eocene Warmth, WWF Predictions



## NEXT STEPS

- Calculate multivariate climate change velocity.
- Improve and complete Random Forest biome predictions.

## REFERENCES

- Beerling, D. J., & Royer, D. L. (2011). Convergent cenozoic CO2 history. *Nature Geoscience*, 4(7), 418-420.
- Hamann, A., Roberts, D. R., Barber, Q. E., Carroll, C., & Nielsen, S. E. (2015). Velocity of climate change algorithms for guiding conservation and management. *Global Change Biology*, 21(2), 997-1004.
- Loarie, S. R., Duffy, P. B., Hamilton, H., Asner, G. P., Field, C. B., & Ackerly, D. D. (2009). The velocity of climate change. *Nature*, 462(7276), 1052-1055.