

Heat Stress on Livestock in New England



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Citations

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- Oleson, K. W., et al. (2013).: Technical Description of version 4.5 of the Community Land Model (CLM), NCAR Technical Note NCAR/TN-503+STR, National Center for Atmospheric Research, Boulder, CO, 1-422, doi:10.5065/D6RR1W7M.
- Buzan, J. R., K. Oleson, and M. Huber (2015), Implementation and comparison of a suite of heat stress metrics within the Community Land Model version 4.5, *Geosci. Model Dev.*, 8(2), 151-170, doi:10.5194/gmd-8-151-2015.

Abstract

Heat stress is the measure of thermal load on humans and animals for example pigs, cows, and sheep. It is suggested that heat stress has a negative influence on an animal's performance. In this study, we predict the effects of heat stress on livestock, focusing on New England in order to examine the regional effect of climate change. We use the Community Earth System Model (CESM 1.2.0), a global climate model that is maintained by the National Center for Atmospheric Research (NCAR), which is supported by the NSF. We calculate heat metrics; such as humidity index for comfort (THIC) for the early and late 21st century. Our results indicate that in the future heat waves in New Hampshire will look like heat waves today in Georgia.

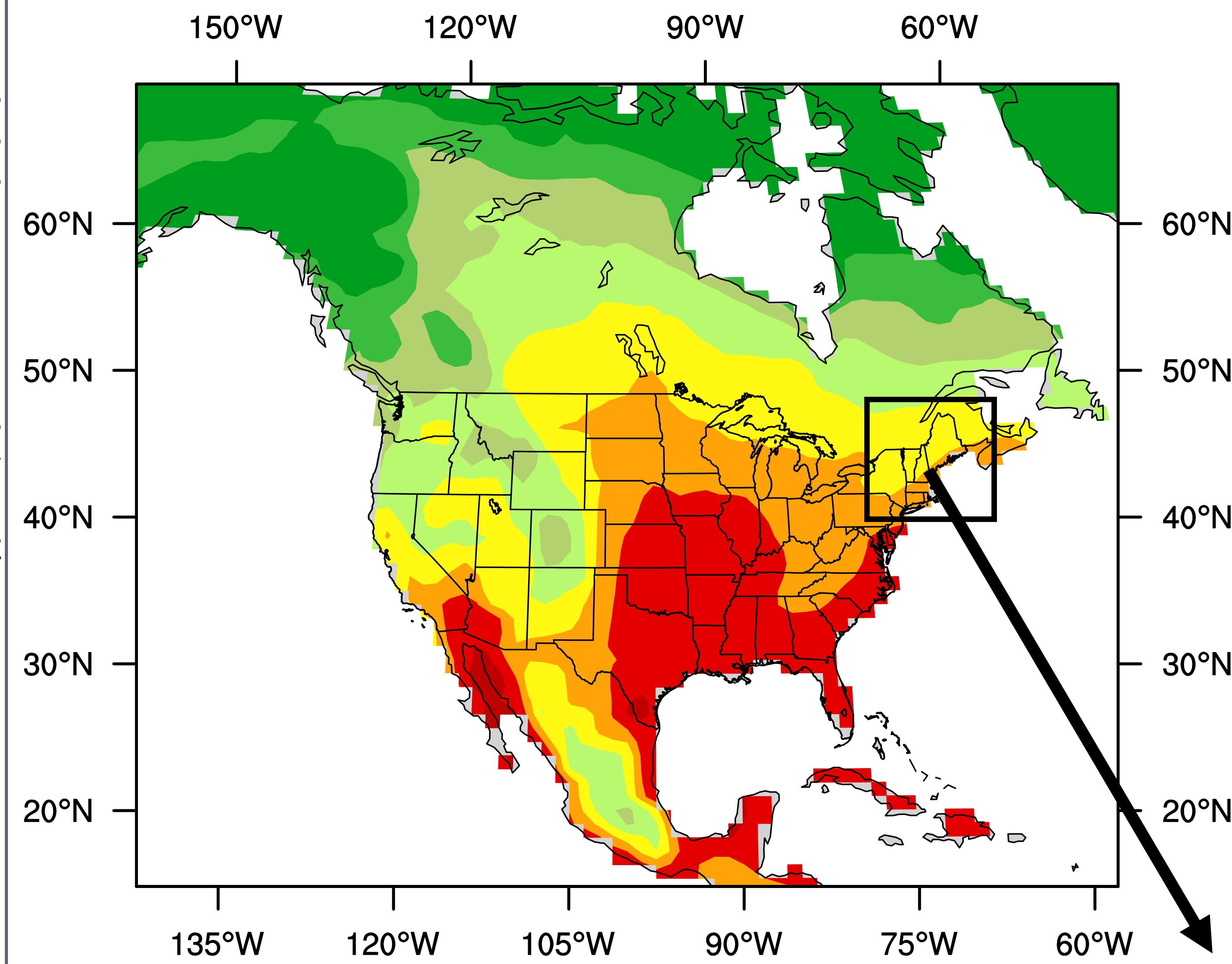
Methods

- We used the Community Land Model version 4.5 (Oleson et al., 2013) to map our projections.
- We used representation concentration pathway 8.5. (Meinshausen et al., 2011). This is a combination of greenhouse gases that create a radiative forcing of 8.5 W/m^2 by the end of the 21st Century.
- The atmospheric forcing dataset is from Community Atmospheric Model (CAM4).
- A $1^\circ \times 1^\circ$ resolution finite volume grid was used.
- The simulation was from 2005 to 2100. We mapped 2005-2024 and 2081-2100.

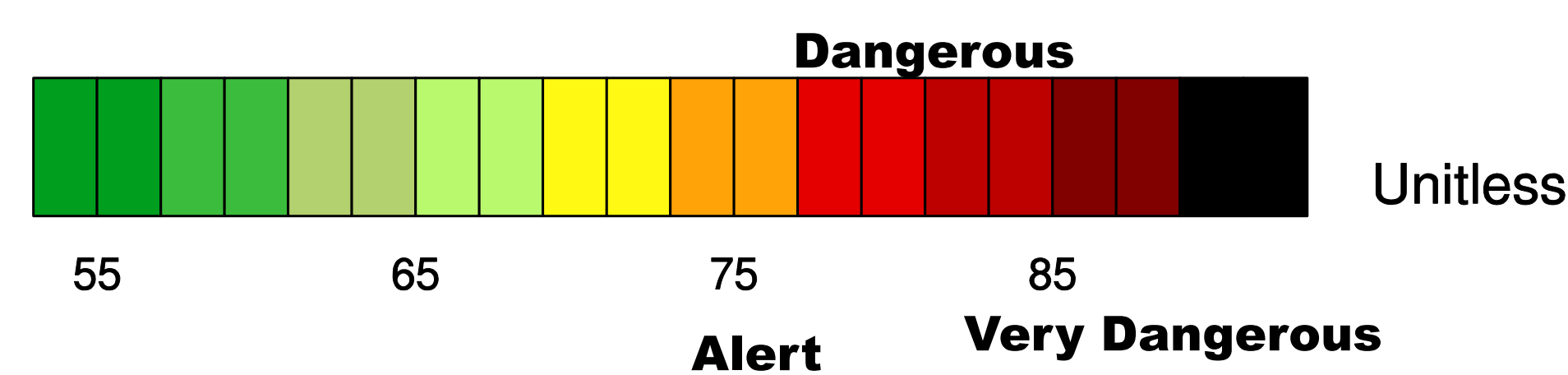
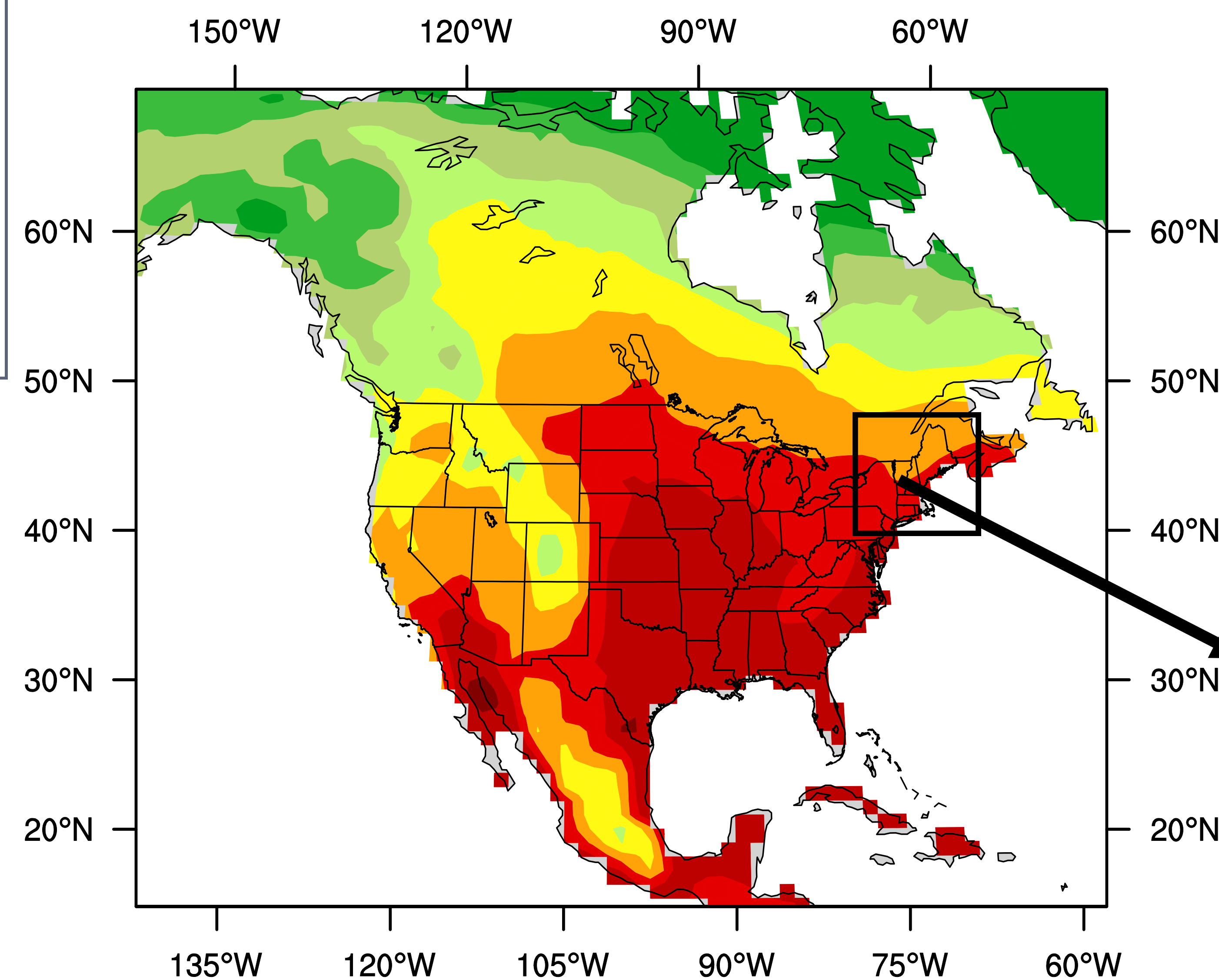
What is THIC?

- The temperature humidity index for comfort (THIC) indicates the conditional threat levels for animals: 75 is alert, 79-83 is dangerous and 84 and above is very dangerous (Buzan et al., 2015).
- THIC is a modification of the Temperature humidity index which is unitless because it is a measure of heat load. Heat load is equal to energy per time.
- The index is applied to explain behavioral changes in animals as a result of discomfort (Buzan et al., 2015).

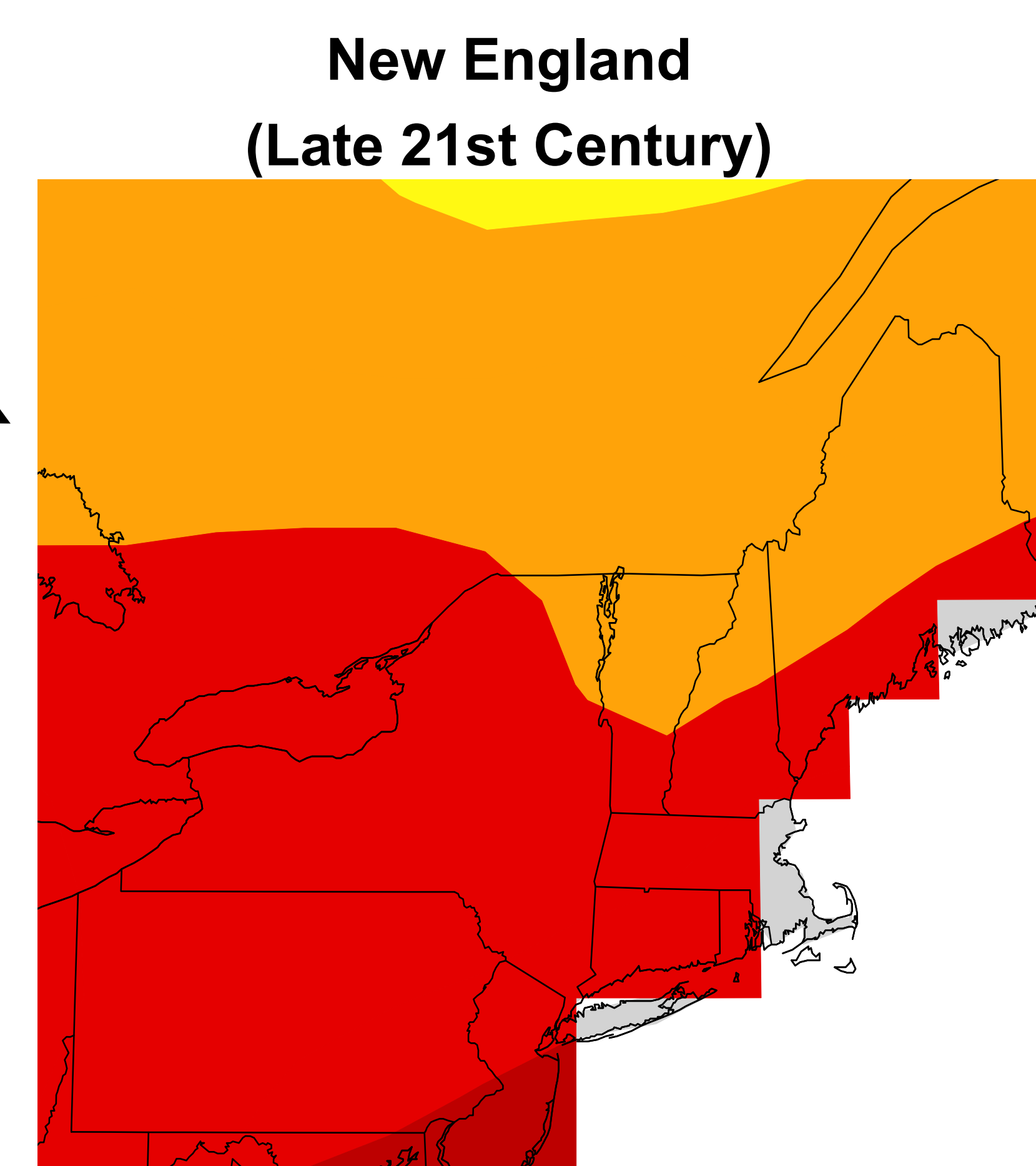
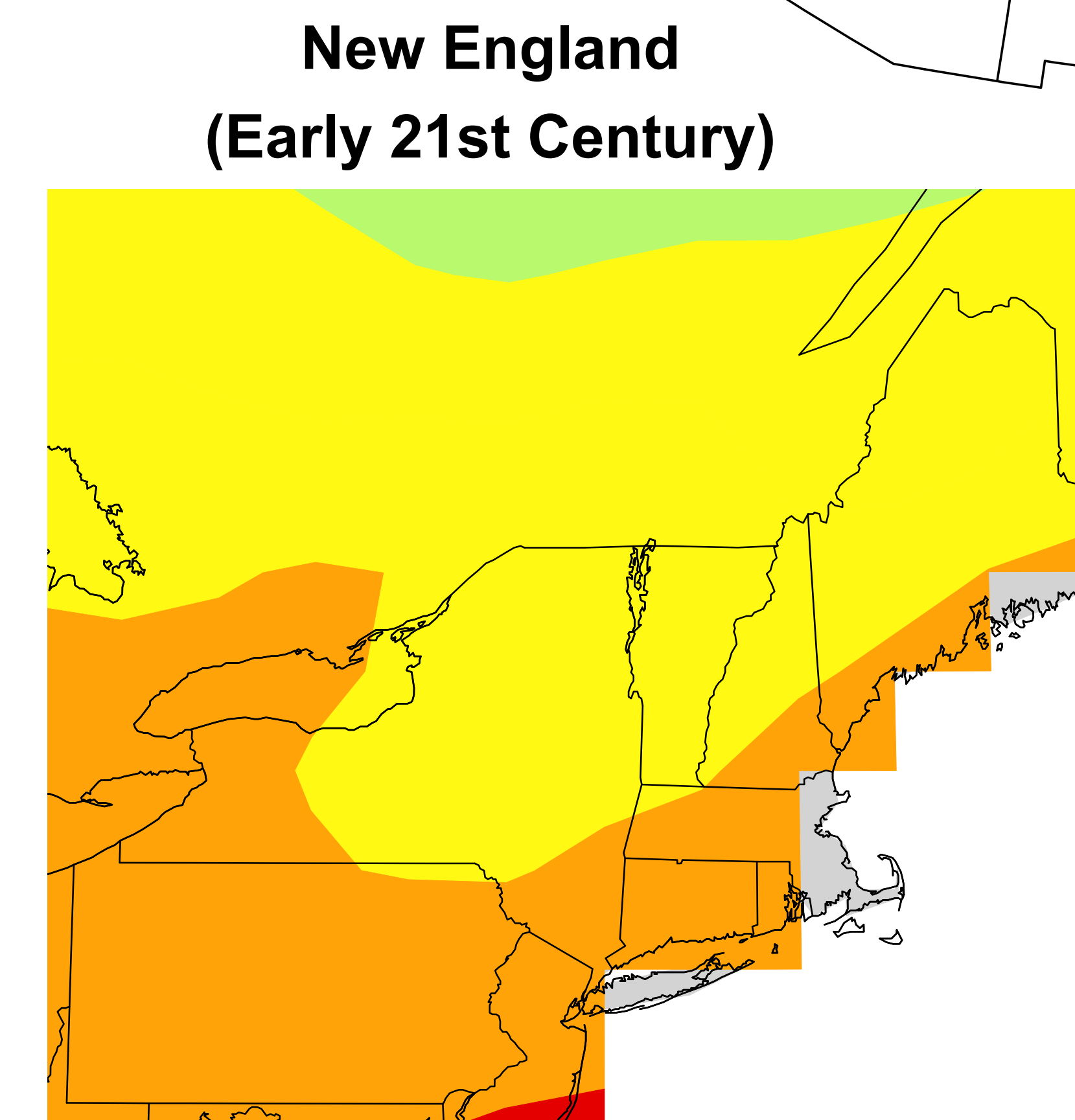
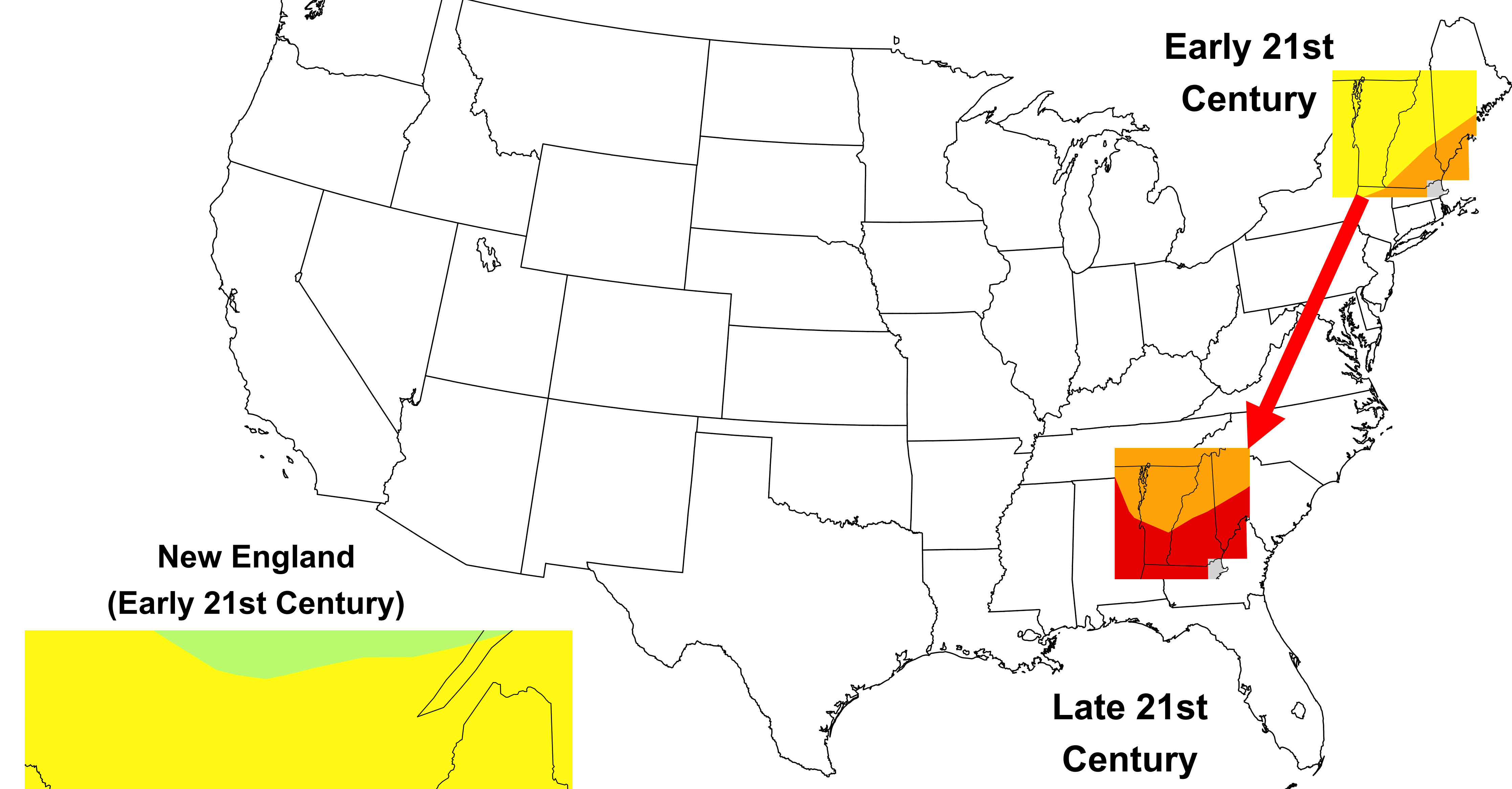
THIC 90th Percentile (Early 21st Century)



THIC 90th Percentile (Late 21st Century)



“Feels Like” Climate Projection



Conclusion

- In the New England Region, the threshold levels will increase from a range of 73-79 to a range of 79-88 by the late 21st century.
- These results and past studies imply that a rise in levels will lead to an increase in heat stress.
- An increase in heat stress will have a negative effect on animals, inhibiting their performance and output.

Future Work

- Analyze additional heat metrics such as wet bulb temperatures, and swamp cooler efficiency
- Include data for the middle of the century
- Higher resolution using Weather Research Forecast models
- Perform a significance test