Homework 1

GEOG 430, Climate Change Ecology

Due Friday, February 3, 2017

Your name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Please answer the following questions in a different font (**like this**) to help me find your answers. You may work in a group (except where noted below), but your answers and your words must be your own.

Please turn in a printout to me by 11:59 pm on the due date.

**I. Climate variables important to species**

Select two of your favorite plant species and two animal species, one each from two of these biogeographic regions: tropics, midlatitudes, Arctic. Investigate these species on the web, in books, etc., to determine which aspects of climate affect these species. Describe the specific climate variables (i.e., beyond just mean annual temperature or precipitation, if possible) that influence these species. (5 points per species)

Please cite your sources (points will be deducted if you don’t).

1. Plant species 1: (common name, scientific name, range, climate variables)

2. Plant species 2: (common name, scientific name, range, climate variables)

3. Animal species 1: (common name, scientific name, range, climate variables)

4. Animal species 2: (common name, scientific name, range, climate variables)

**II. Climate velocity**

A. Download Loarie et al, Nature, 2009 (http://www.nature.com/nature/journal/v462/n7276/full/nature08649.html) and answer the below questions.

5. Conceptually, what is climate velocity? (2 points)

6. Write down the formula for the climate velocity at a given location, being sure to indicate the units of each term. (2 points)

7. Conceptually and in general terms, define the spatial gradient of temperature shown in Figure 1c. (2 points)

8. Using Figure 1c as a guide, describe in general where the spatial gradient is highest, and why? Lowest, and why? [Figure 1 contains information about how climate velocity and its components were computed for California. You may wish to familiarize yourself with the topography of California.] (2 points)

9. Where in Figure 1d is projected climate supposed warm fastest (i.e., where is the temporal gradient highest)? (2 points)

10. Explain the contrast in climate velocity in the Central Valley versus in Northwest California. (2 points)

11. Figure 2 shows a global map of climate velocity. Indicate where climate velocity is high versus low, what the high and low values are (including units), and explain why. (2 points)

12. Why is climate velocity important for estimating impacts of climate change on plants and animals? (2 points)

13. Loarie et al. use mean annual temperature for estimating climate velocity. Why might this not be the best measure for assessing impacts to plants and animals? (2 points)

B. The below figure is from the Summary for Policymakers in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), Working Group 2 (Impacts, Adaptation, and Vulnerability). Study the figure and answer the below questions.



14. How do you think “species movement” is defined? Consider the different species groups along the x axis. (2 points)

15. Why can some groups of species move more quickly than others? (2 points)

16. What does the figure tell you about climate velocity versus the speed at which species can move? What are the differences among species groups? (5 points)

17. Compare “global average” climate velocities and those from “flat areas”. Which are greater, and why? (2 points)

18. Why are RCP 8.5 climate velocities greater than velocities from other RCPs? (2 points)

**III. Niches and climate change**

19. Consider a hypothetical animal species that prefers warm, wet conditions. Draw a two-dimensional diagram that has temperature on the x axis from “cold” to “hot”, precipitation on the y axis from “dry” to “wet”, and draw a polygon that represents the fundamental niche space occupied by this species. (2 points)

20. Draw a second polygon with a dotted line on the diagram indicating a possible realized niche of this species. Why did you draw the polygon where you did? (2 points)

21. Future climate change

a. Given expected warming, how will the geographic locations associated with the species’ current fundamental niche change? In other words, what space will these current species locations occupy in the future (draw another polygon on the niche diagram with a dashed line)? Your first polygon (solid line) indicates the climatic conditions suitable for this species; this new dashed polygon indicates the climate of locations currently occupied by the species. (3 points)

b. On your diagram, indicate the locations that will become unsuitable for this species in the future. (2 points)