Tasks: Readings of "IPCC Emissions Scenarios" report, *Python Scripting* Chapter 8 (with exercise), and *Saving a Million Species* chapter 9 & 10

READINGS AND EXERCISES

IPCC Emissions Scenarios – IPCC 2000 - https://archive.ipcc.ch/pdf/special-reports/spm/sres-en.pdf

Description of text:

The Intergovernmental Panel on Climate Change is an entity under the United Nations that utilizes climate experts and the latest science to publish descriptive climate reports. The IPCC has developed several different climate scenarios that are frequently referenced in predictive studies. These scenarios account for many different variables that will impact climate into the future, such as population growth and industrial development. The four main global "storylines" for future climate change developed by the IPCC are the A1, A2, B1, and B2 scenarios.

A1 - an integrated world, characterized by:

1. Large, rapid economic growth on a global scale
2. Rapid technological progress globally
3. A population peak of 9 billion of 2050, which then declines slowly
4. A more globalized, integrated world:
    a. Leveling of global standard of living
    b. More cooperative / socially and culturally integrated nations

A2 - a divided world, characterized by:

1. Regional economic growth
2. Fragmented and slow technological progress
3. Continuously increasing population
4. A more divided world of independent, self-reliant countries

B1 - an integrated world, characterized by:

1. Large, rapid economic growth on a global scale
    a. Specifically with rapid change towards an information economy globally (meaning economic growth is not leading to large emissions)
2. Rapid tech progress, specifically for clean and resource-efficient technologies
3. A population peak of 9 billion of 2050, which then declines slowly
4. A more globalized, integrated world:
    a. Established global solutions to environmental, economic, and social sustainability
    b. More balanced equity and standard of living globally

B2 - a divided world, characterized by:

1. Intermediate levels of economic growth
2. Less rapid tech progress than A1 and A2, but more diverse and local
3. Continuously increasing population at a lower rate than A2
4. A more divided world, but one where countries handle sustainability individually

Note: The A1 scenario has 3 sub-scenarios, shown on the graph below. These scenarios are A1FI (fossil fuel intensive), A1B (balanced between fossil and renewable sources), and A1T (renewable focused).

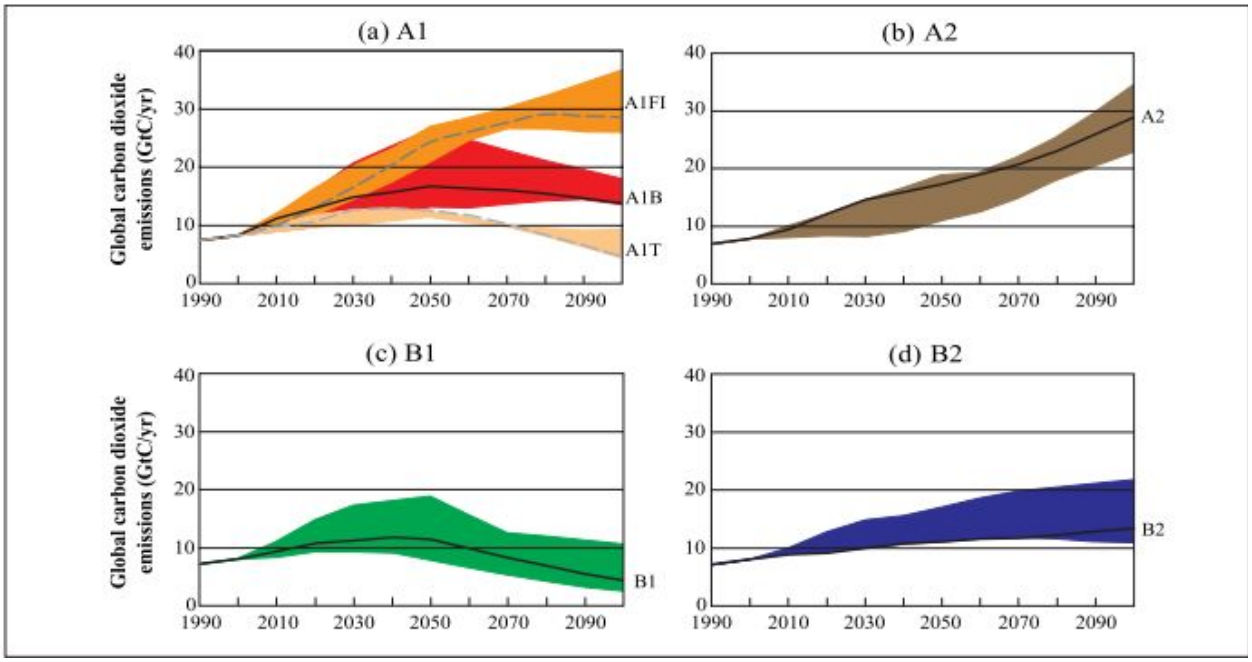

Figure 1: global CO2 emissions over time for the 4 different scenarios.

Overall, the B scenarios are more sustainability focused, leading to less emissions. The A1B and A1T scenarios also lead to low emissions due to the shift away from fossil fuels. With my temperature data, I used A2 and B1 scenario data to offer a contrast, since they are pretty opposite

Pika Data

I finally managed to make the gifs for my two climate scenarios with my pika data. The process:

- I had my pika habitat data as points, this was so that they could be selected individually (instead of as very globby shapefiles)
- Based on studies I have read, I chose <=16 degrees C summer temperature as my cutoff for suitable pika habitat
- This led to having nearly 10 million data points, which made thing very slow going
- At first, I tried selecting based on the point's attributes - I had integrated the temperature of each point in each scenario at each time frame in order to make this easy to do
- The selection seemed to work, but the new layer was output unchanged from the original
- Eventually, I figured out that my dataset was just too big and had to be split up
    - Using 8 cookie cutter layers (my temperature shapefiles for <=16 C blocks), I split each cookie cutter into 2 halves, then selected points that were intersecting with the layer
    - This lead to having 16 sets of points, all of which represented pika habitat with <=16 degrees C summer temperature
- Using ImageMagick, I then used screenshots of my data sets to finish making the gifs

- I had wanted to make heatmaps of my data sets, which would have looked much better in gif form, but this would take a lot of sitting and waiting which I didn't find time for. I would have to merge the 16 point data sets into 8, then wait for ArcGis Pro to apply symbology. ArcGis tends to crash at this point, which means that the symbology has to be reapplied.

Saving a Million Species Chapter 9 & 10

Chapter 9: Extinctions in Deep Time and Climate Change

This chapter focuses on extinctions prior to 50 million years ago, in “deep time” on the geologic scale. Since marine environments are much richer when it comes to fossil quantity, (due to better preservation) most extinction data focuses on the oceans. Extinction rates can be explained using variables, of which climate change (and CO2 levels in particular) is one of importance. Mass extinctions are stages of time where extinction rates are unusually high compared to the adjacent time periods, and there have been five total mass extinctions that we know of in the Earth’s history. These extinction events are triggered by both extraterrestrial and terrestrial factors. Terrestrial factors include thing like sea level changes, volcanoes, and temperature changes, while extraterrestrial factors are things like meteorite impacts and cosmic flux. Across many studies, volcanic actively has been strongly associated with extinction rates to outgassing causing global warming, and extreme eruptions causing global cooling due to ash ejecta. Studies have also found that in a greenhouse climate, extinction rates are generally higher than in an icehouse climate, showing a positive correlation between temperature and extinction.

Chapter 10: Paleogene Extinctions and Climate Change

This chapter focuses on extinctions within the past 50 million years, in relatively modern time on the geologic scale. Two eras in particular are put into focus: the Paleocene-Eocene Thermal Maximum (PETM) and the Eocene-Oligocene boundary (E-O boundary). The PETM was an intense global warming period (beginning about 55 mya) that offers an example which we can compare to our current warming event, while the E-O boundary was a long term transition to an icehouse climate (beginning about 35 mya). While the PETM offers a case study for how rapid, short term warming impacts the planet, the E-O boundary can help us see how long term changes impact species. The PETM is characterized by a 4-9 degree increase in temperature over just 10,000 years, impacting every facet of global climate. The E-O boundary is characterized by several cooling and glaciation events spread over millions of years. Both the PETM and E-O boundary led to major extinction, but this extinction has been seen to be offset by origination rates of new species, leading to low net diversity changes despite high

extinction. While climate change leads to high extinction, it also leads to the development of new species.

Python Scripting Chapter 8

- Chapter 8 focuses on reading and writing shapefile data to the console
    - Most of this chapter involved used search cursors from last chapter in order to go through a shapfile's data table to access and print specific information
    - The first example set up a search cursor on a shapefile consisting of rivers, adding up every segment length using a loop, then printing the result
    - The second example involved printing the x and y coordinates of dams from a point feature class, using the same methods (search cursor in a loop)
    - The third example illustrated how using nested for loops is best when accessing multipart features - the first loop operates at the level of the feature while the second loop accesses data within the feature.
    - I also learned about creating a feature class using python and a text file consisting of coordinates. The steps are to [1] create a blank feature and [2] populate with data by looping through the text file coordinates
    - Examples are shown in slides