Introduction to Climate Feedbacks Activity

Name(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Learning objective:** Utilize systems thinking to examine how feedbacks within the climate system influence global equilibrium temperature.

**Questions:**

1. Draw a feedback loop that corresponds to the following process, and identify it as a positive or a negative feedback:

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| (a) The ice-albedo feedback: Rising temperatures cause sea ice to begin to melt. Low albedo sea water that was previously underneath high albedo ice is now exposed. As a result, more solar radiation is absorbed at this location. This raises local water temperatures and causes even more ice to melt. | (b) Warming temperatures cause permafrost in Siberia to melt, which causes a release of carbon dioxide and methane (both potent GHGs) that was previously locked underneath the permafrost. |
| (c) Rising temperatures cause sea level rise. Now, a larger fraction of the globe is covered in ocean. | (d) Rising temperatures cause the soil to dry out. Some of the shrubs that previously colonized a location die out leaving bare soil in their place. |

*In order to draw the feedback loop for (d), you will need the following information:* Plants take water from the soil into their roots and lose this water through their leaves to the atmosphere, a process called transpiration. This is important because when soil water and surface water evaporate rather than running off to rivers and oceans, moisture is recycled into the atmosphere where it can form more rain. This locally generated precipitation can be an important factor that helps to sustain a local ecosystem.

1. As a group, come up with your own feedback loop. Identify a feedback that might exist among different components of the Earth systems, draw the loop, and identify it as a positive or negative feedback.
2. Choose one of the feedbacks above to examine in greater detail. You cannot choose the ice-albedo feedback, because we discussed this in lecture. There are two parts to this question about how Earth Systems interact to give rise to uncertainties:
   1. Identify at least three components of the Earth System (“systems”) that must interact together to give rise to a climate feedback response. Explain how these systems all interact to give the final feedback response of “warming” or “cooling.”
   2. For the feedback that you just considered, give two examples that could cause the magnitude of the feedback to be uncertain. For both, explain whether your example would make for a stronger feedback (i.e., bigger warming or cooling) or a weaker feedback (i.e., smaller warming or cooling).