Abstract: The tectonic history and the climate driven erosional processes acting in a region are the primary controls on the evolution of a landscape. Quantifying these controls is essential to our understanding of uplift and erosion histories in mountain ranges. While tectonic processes are generally dependent on the location of plate boundaries, the controls on erosion are less constrained. We implement a numerical modeling approach to investigate these processes by coupling a high-resolution climate model, Weather Research and Forecasting Model (WRF), and a landscape evolution model, Landlab. The Andes act as the climatic setting for this study, due to the variation in climate along the length of the orogen, and serve as a natural laboratory to test controls on erosion. With the help of the hydrologic model WRF Hydro, we pass discharge and topography data between the models, which allows for a feedback relationship to form between topography and precipitation. We will test these feedbacks between topography and climate by monitoring topographic metrics and erosion histories. This work provides a necessary next step in landscape evolution modeling by using an actively evolving climate to model real precipitation dynamics. This next step allows for modeling more accurate representations of precipitation and the role orography and precipitation play in shaping one another.

**Methods**

1. **How do different climate regimes affect developing topographies?**
2. **What is the role of erosion and Landlab updates topography, which is fed back into WRF?**
3. **What is the role of discharge maps in WRF Hydro?**

**Figure 1:** Flowchart depicting model coupling and input parameters. Blue squares and arrows represent model relationships and green squares and arrows represent model inputs. Coupling will be asynchronous to accommodate for the variable timesteps required for each model component.

**Figure 2:** Conceptual design of the model coupling process. WRF creates a precipitation map from a climate model run using Landlab topography as an input. WRF - Hydro creates discharge maps by routing precipitation through the Landlab topography. Discharge maps are input into Landlab, this discharge causes erosion and Landlab updates topography, which is fed back into WRF.

**Figure 3:** Initial topography input into WRF. Five low elevation, low relief topographies created in Landlab are placed at varying latitudes and climate regimes along South American coast. Elevations between each Landlab topography are interpolated to create a continuous mountain range and avoid atmospheric circulation around the base of each simulated mountain.

**Future Work:**

The next steps will be to run sensitivity tests and initial runs to determine appropriate values for:

- erosion threshold
- simulation length
- uplift rate
- model communication frequency

Once appropriate parameter values are finalized we will begin performing fully coupled model runs and analyze results to answer:

1. How do different climate regimes affect developing topographies?

2. How do landscape and climate coevolve during the development of topography?

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