South America is host to many powerful natural wonders, from the Amazon River to the Andes Mountains. But on the continent’s western coast, South America is also susceptible to a deadly and unpredictable force of nature: earthquakes.

As the home of the world’s largest recorded earthquake, South America is the perfect place to research these phenomena. In 1960, an earthquake struck off the coast of Chile, causing widespread landslides, building collapses, and fatal tsunamis that struck as far away as Hawaii and Japan. This earthquake was the largest ever recorded, at a 9.5 on the moment magnitude scale (a measure of the energy released and successor to the Richter scale).

Large earthquakes, such as the recent 2010 9.0 magnitude Tohoku earthquake in Japan or the 2004 9.2 magnitude Sumatran earthquake, are called megathrust earthquakes. These events are distinguished by their relative rarity and power, often causing loss of life and millions of dollars in damages.
“Pieces of the Earth’s crust are always moving and interacting with each other. Sometimes, like in Japan, Alaska, and Indonesia, these massive sheets of rock are colliding, with one eventually diving, or subducting, under the other.” explains geology intern Alexis McAdams. “And with that type of motion comes earthquakes. We’ve found that areas where the plates collide faster, larger earthquakes tend to happen. Areas like South America.”

McAdams is working with Dr. Linda Warren at St. Louis University to better understand these destructive earthquakes. The researchers primarily use records from the Global Centroid Moment Tensor (gCMT) catalog, an active archive of global earthquakes started in 1976 by scientists at Harvard. “Much research into megathrust earthquakes has and continues to be done by scientists around the world,” McAdams admits. “But we are using these records to look at the stress state of the South American plate.”

The stress state is a relative measurement of where tectonic forces are pushing the hardest. For example, the Pacific Ocean plate is moving eastward, towards and under the South American continental plate, which is itself moving westward. Therefore, the dominant stress for this collision is oriented in the west-east direction. “Smaller earthquakes, when taken together, can reveal to us where the strongest or weakest stress is pointed in 3 dimensional space,” clarifies McAdams. “And if we can find out how those orientations are related to megathrust earthquakes, perhaps we can better understand why and when these earthquakes happen when they do.”

McAdams hopes to eventually expand this research to other areas around the globe, such as Japan or Sumatra. “Understanding these megathrust earthquakes is critical because of the destruction they cause. The more we can understand about these events, the better prepared humankind will be in the future.”

Alexis McAdams