One of the most important sources of year-to-year climate variation in the Southwest is the El Niño phenomenon of the tropical Pacific Ocean. El Niño is a natural but largely unpredictable condition that results from complex interplay among clouds and storms, regional winds, oceanic temperatures, and ocean currents along the equatorial Pacific.

Diagram

Description automatically generatedUnder "normal" conditions, the tropical trade winds blow from east to west, ponding up warm water in the western Pacific. In the eastern Pacific, the trade winds pull up cold, deep, nutrient-rich waters along the equator from the Ecuadorian coast to the central Pacific (see Figure 1). The warmth of the western Pacific results in a particularly vigorous hydrologic cycle there with towering cumulus clouds and tropical storms that "radiate" atmospheric waves and disturbances across vast regions of the globe. Heat and moisture lofted into the upper atmosphere by the clouds and storms are distributed by high-altitude winds across vast regions of the globe.

Figure . Pacific under "normal" conditions. Source: "Effects of El Niño on Streamflow, Lake Level, and Landslide Potential". <http://geochange.er.usgs.gov/sw/changes/natural/elnino/>. Published July 10, 1997.

Diagram

Description automatically generatedDuring an El Niño, this situation is disrupted and the trade winds weaken, thus reducing the upwelling of cool waters in the eastern Pacific and allowing the pool of warm water in the west to drift eastward toward South America. As the central and eastern Pacific warms, atmospheric pressure gradients along the equator weaken, and the trade winds diminish even more. As the waters of the central and eastern Pacific warm, the powerful tropical Pacific storms begin to form farther east than usual (see Figure 2). As the distribution of storms spreads east along the equator, their influence on global weather systems also changes. Most notably, for our purposes, the jet stream over the North Pacific Ocean is invigorated and pulled farther south than normal, where it collects moisture and storms and carries them to the southwestern United States and northern Mexico.

Figure . Pacific under El Niño conditions. Source: "Effects of El Niño on Streamflow, Lake Level, and Landslide Potential". <http://geochange.er.usgs.gov/sw/changes/natural/elnino/>. Published July 10, 1997.

