1 Global Climate Models and Land Management

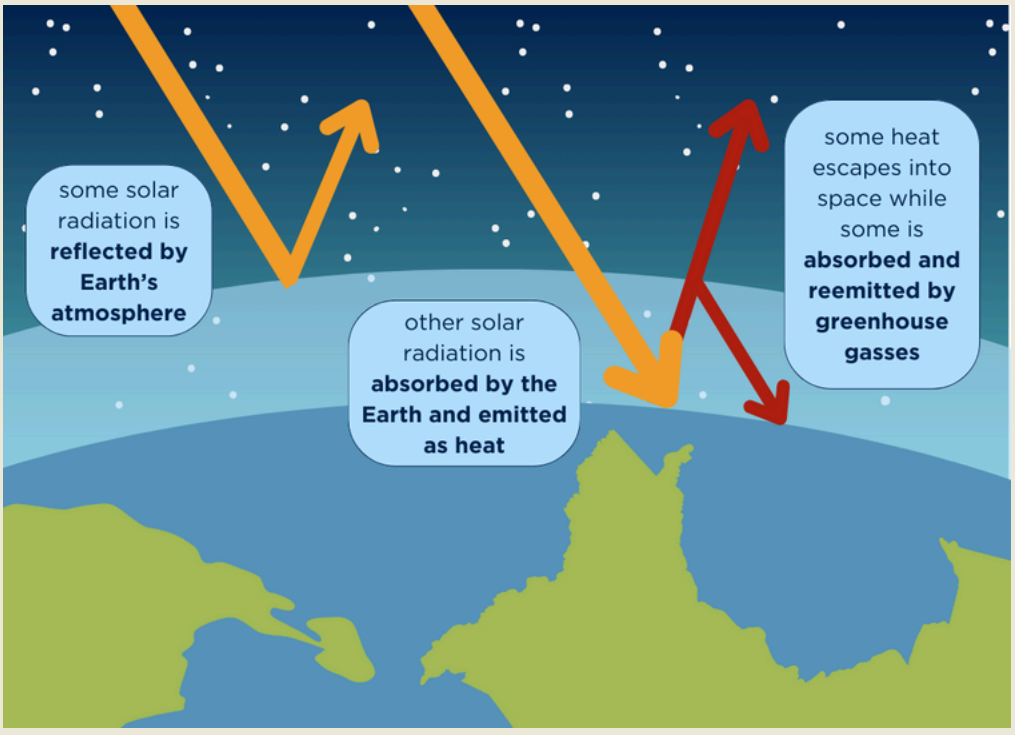
Climate Fundamentals

Understanding what "climate" refers to and the difference between climate and weather is fundamental to understanding climate change. **Weather** describes short-term atmospheric conditions, while **climate** is the long-term average of weather conditions. Weather can fluctuate from hour-to-hour, day-to-day, or week-to-week. One might say that it is cold today or that it will be a rainy week. Climate, on the other hand, is used to describe the weather conditions of a region in more general terms. For example, one might say Sacramento has mild, rainy winters. Not every winter day in Sacramento is rainy, but on average, Sacramento winters are wet.

Decades-long trends in weather conditions show that the Earth's climate is getting warmer. Since 1880, when global temperature records begin, the average global temperature has risen 1.9°F (1.1°C), with two-thirds of that warming occurring since 1975.[1] While that number might sound small, imagine how much extra energy it would take to heat up all of the Earth's land, oceans, and atmosphere. This factsheet discusses where this extra energy is coming from, how it is changing Earth's climate, and how these changes are impacting California.

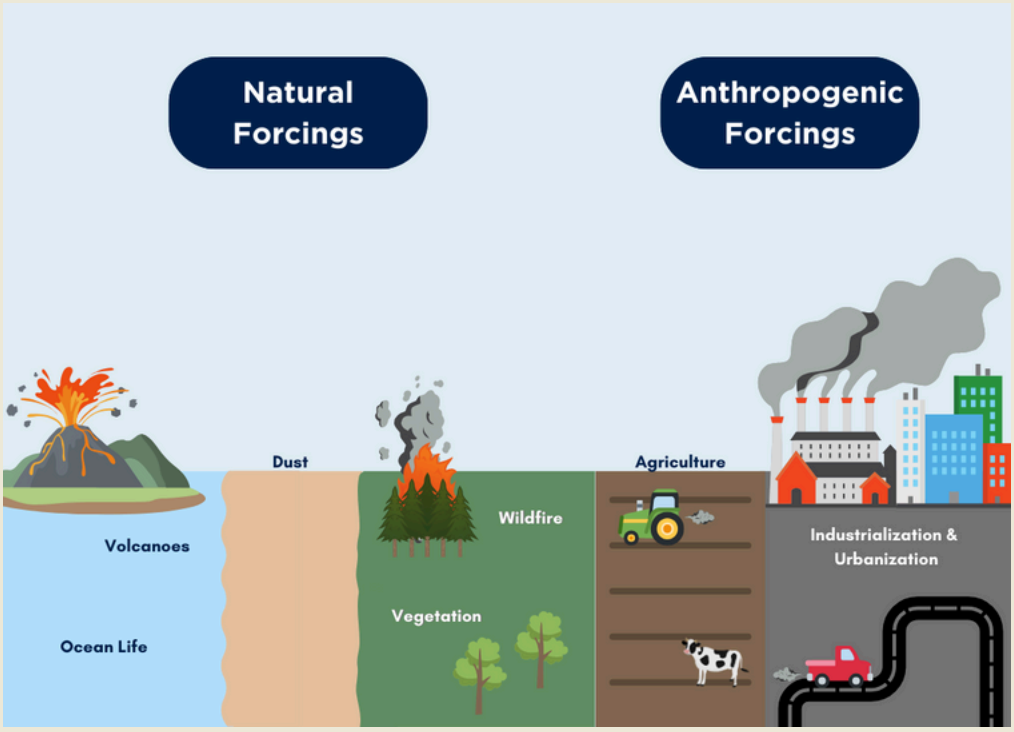
Earth's Energy Budget and Anthropogenic Forcing

The Earth receives energy from the Sun in the form of solar radiation, about 70% of which is absorbed by the Earth's atmosphere and surface allowing the Earth to warm and life to flourish. The solar radiation that is absorbed by Earth's surface is re-radiated back into the atmosphere in the form of heat. **Greenhouse gasses** — which include carbon dioxide, methane, nitrous oxide, and water vapor — trap some of this heat and prevent it from escaping into space. This process is known as the **greenhouse effect**, and it plays a key role in keeping the Earth's atmosphere a habitable temperature. However, when the amount of greenhouse gasses in the atmosphere increases, so does the ability of the atmosphere



(USDA California Climate Hub)

This figure provides a simplified representation of the heat-trapping effects of greenhouse gasses in the Earth's atmosphere.



(USDA California Climate Hub)

This figure illustrates the major examples of natural and anthropogenic forcings. Adapted from Nature.

to trap more heat. This throws off the balance of **Earth's energy budget**, the flow of energy into and out of the Earth system, and increases global temperatures. The imbalance in Earth's energy budget is referred to as **radiative forcing**. The things that cause increases in greenhouse gasses can be either **natural forcings**, like volcanoes and forest fires, or they can be **anthropogenic forcings**, which are caused by human activities like fossil fuel burning.

Climate Changes in California

The anthropogenic forcings that are increasing Earth's temperatures are also changing California's climate. Since 1895, California's average temperature has increased 2.5°F, higher than the average global temperature increase of 1.9°F, with the most extreme temperatures occurring in the summer.[2] In the future, California is expected to get hotter and will experience more frequent and severe heat waves.[3] Although year-to-year fluctuations in precipitation are a feature of California's current climate, climate change will bring greater interannual variability. Extreme rain events are projected to become more common,[4] increasing the risk of flooding during wet years, while lower precipitation during dry years, combined with the drying effects of increased temperatures, will increase the risk of drought in dry years. Another concerning trend for California's water supply is the shift from snow to rain. Usually, mountain snowpack provides the state with a long-lasting supply of surface and groundwater, melting slowly into the summer, but California's snowpack is rapidly decreasing. In fact, California's snowpack is expected to decrease by one third by 2050 and by over half by 2100.[5] Together, these climate changes will impact the ability of California's natural and working lands to continue providing economic, cultural, and ecological value to the state and its people and threaten infrastructure and human health.

1. NASA. World of change: Global temperatures. *NASA*. https://earthobservatory.nasa.gov/world-of-change/global-temperatures
2. California Office of Environmental Health Hazard Assessment. (2023) Air Temperatures. *California Office of Environmental Health Hazard Assessment*. https://oehha.ca.gov/climate-change/epic-2022/changes-climate/air-temperatures#:~:text=Statewide%20annual%20average%20air%20temperatures,(%C2%B0F)%20since%201895.
3. Gershunov and Guirguis. (2012) California heat waves in the present and future. *Geophysical Research Letters*.
4. Swain et al. (2018) Increasing precipitation volatility in twenty-first century California. *Nature Climate Change*.
5. State of California. Summary of projected climate change impacts on California. *California Climate Adaptation Strategy*. https://climateresilience.ca.gov/overview/impacts.html

Recommended Citation: Oxarart, A. Parker, L. USDA California Climate Hub (2024). Global Climate Models and Land Management: Climate Fundamentals [Fact sheet].