

# The secrets of the best rainbows on Earth

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Rainbow over east Oahu. Credit: Steven Businger

Rainbows are some of the most spectacular optical phenomena in the natural world and Hawai'i has an amazing abundance of them. In a new publication, an atmospheric scientist at the University of Hawai'i at Mānoa makes an impassioned case for Hawaii being the best place on Earth to experience the wonder of rainbows. He begins by highlighting

the Hawaiian cultural significance of rainbows, he reviews the science of rainbows and the special combination of circumstances that makes Hawai'i a haven for rainbows.

"The cultural importance of rainbows is reflected in the Hawaiian language, which has many words and phrases to describe the variety of manifestations in Hawai'i," said author Steven Businger, professor in the UH Mānoa School of Ocean and Earth Science and Technology. "There are words for Earth-clinging rainbows (uakoko), standing rainbow shafts (kāhili), barely visible rainbows (punakea), and moonbows (ānuenuē kau po?), among others. In Hawaiian mythology the rainbow is a symbol of transformation and a pathway between Earth and Heaven, as it is in many cultures around the world."

## **Why is Hawai'i the rainbow capital of the world?**

The essential ingredients for rainbows are, of course, rain and sunlight. To see a rainbow on flat ground the sun must be within about 40 degrees of the horizon. As the sun rises to higher angles in the sky during the morning, the height of the rainbow diminishes until no rainbow is visible above the horizon. The pattern is reversed as the sun lowers in the afternoon, with rainbows rising in the east and the tallest rainbows just prior to sunset.



Rainbow over Honolulu Harbor with what appears to be its reflection. However, the reflected bow is not what it appears to be. See the paper for explanation.  
Credit: Minghue Chen

Hawai'i's location in the subtropical Pacific means the overall weather pattern is dominated by [trade winds](#), with frequent rain showers and clear skies between the showers.

Businger outlines four additional factors affecting the prevalence of rainbows throughout the islands.

"At night a warm sea surface heats the atmosphere from below, while radiation to space cools cloud tops, resulting in deeper rain showers in the morning that produce rainbows in time for breakfast," said Businger.

Another critical factor in producing frequent rainbows is Hawai'i's mountains, which cause trade wind flow to be pushed up, forming clouds and producing rainfall. Without mountains, Hawai'i would be a desert with a scant 17 inches annual rainfall.

A third factor conducive to rainbow sightings is daytime heating, which drives island-scale circulations. During periods of lighter winds, showers form over the ridge crests over Oahu and Kauai in the afternoon, resulting in prolific rainbows as the sun sets.

Due to the remoteness of the Hawaiian Islands, the air is exceptionally clean and free of pollution, continental dust, and pollen. This is the fourth factor that contributes to the numerous bright rainbows with the full spectrum of colors.



An example of supernumerary bows beneath the primary bow. Credit: Matt Champlin

## Chasing rainbows

As Businger pursued his passion for finding and photographing these beautiful light displays, he began to imagine a smartphone app with access to Doppler radar data and high-resolution satellite data that could alert users when nearby conditions become conducive for [rainbow](#) sightings.

"After a few years of false starts, Paul Cynn and I finally connected with Ikeyso, a Hawaiian [smartphone app](#) developer in April of 2020. I am very excited to say that our app, called RainbowChase, is now available to the public for free," said Businger.

**More information:** Steven Businger, The Secrets of the Best Rainbows on Earth, *Bulletin of the American Meteorological Society* (2020). [DOI: 10.1175/BAMS-D-20-0101.1](https://doi.org/10.1175/BAMS-D-20-0101.1)

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