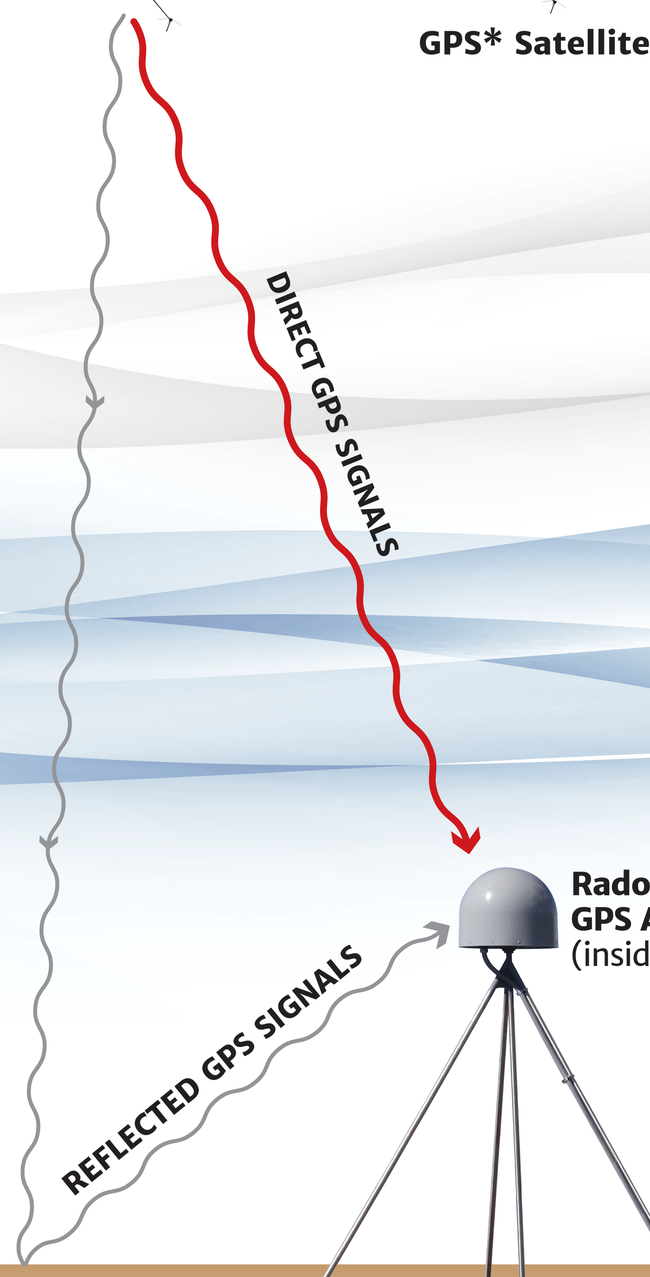
What GPS Can Tell Us About Earth

High-precision GPS stations measure natural phenomena and hazards.

GPS* Satellites



Reflected signals give us information about Earth's water cycle.

Snow Depth

GPS provides remote **snow depth measurements** in hard-to-reach areas.

Ice Height

Changing ice heights indicate **how much freshwater** is stored by or being lost from glaciers.

Sea Level

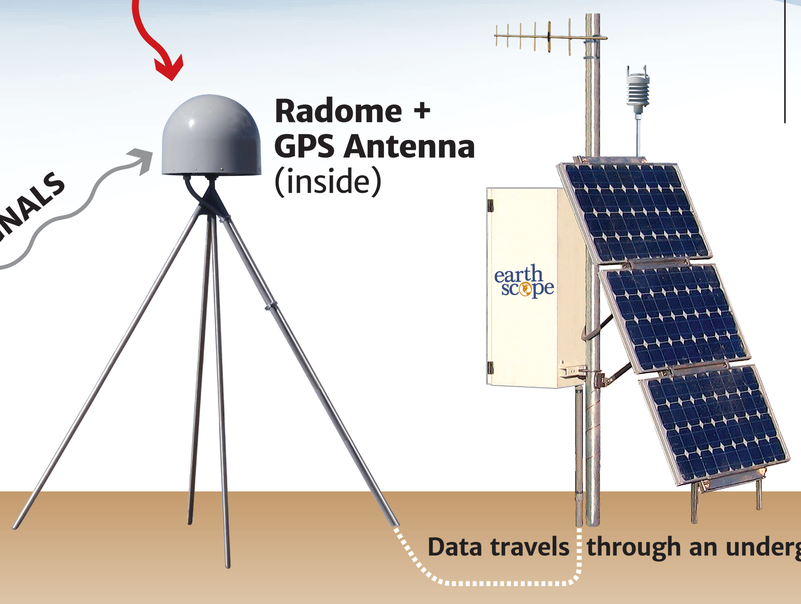
As a **tide gauge**, GPS can measure local, regional, and global changes in sea level.

Vegetation

GPS can measure the onset of **plant growth**, plant aging, maximum vegetation growth, and the length of the growing season.

Soil Moisture

Soil moisture measured over broad regions indicates **how much precipitation** evaporated back into the atmosphere.



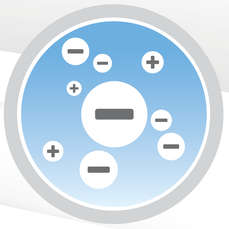
Radome + GPS Antenna (inside)

Data travels through an underground cable

GPS signals sense information about the atmosphere.

Ionosphere

The GPS satellite signal is delayed by charged particles caused by solar storms. This layer can also be displaced by tsunamis, yielding information for **tsunami early warning**.



Troposphere

The GPS satellite signal is delayed by water vapor that can turn into rain. This informs **forecasting of flash floods and hurricanes**.

Mission Cal/Val

Measuring the delay in the GPS satellite signal as it passes through the atmosphere is important for **calibrating and validating** satellite datasets.

What's in the Box?

- Comms (e.g., radios)
- GPS Receiver
- Batteries

What's on the Box?

- Comms Antenna
- Meteorological Pack

Solar Panels

GPS positions give us information about Earth's many systems.

Tectonics

GPS measures Earth movements as small as millimeters per year; it's sensitive enough to record the **slow motions of plate tectonics**.

Water Resources

The ground moves up and down slightly in response to changes in lake, snow, and groundwater levels, useful in **monitoring drought and recovery**.

Glaciers

Glaciers weigh down and depress Earth's surface, which rebounds as glaciers melt away. This motion gives information about **Earth structure** and **changes in ice, snow, and shorelines**.

Earthquakes

GPS measures both the slow build-up to and the rapid movement during an earthquake, crucial for **hazards assessments** and earthquake and tsunami **early warning systems**.

Volcanoes

Many volcanoes inflate and deflate like a balloon as **magma pressures** fluctuate. GPS also measures **ash plume height** based on changes in the satellite signals traveling through the ash.

* GPS is the U.S. global navigation satellite system (GNSS). The principles here can be extended to all GNSS systems.

UNAVCO

NSF NASA

earth scope