# Graduate Project Topics – Spring 2025

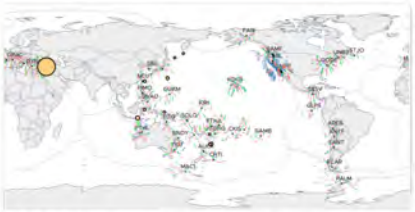
## Scientific GPS/GNSS Monitoring via Mobile Phone

**Project Advisor: Prof Dennis Akos**

# Scientific GPS/GNSS Monitor Station

## Motivated by the GUARDIAN (GNSS-based Upper Atmospheric Realtime Disaster Information and Alert Network) project (conducted with JPL)

- GUARDIAN is a near-real-time (NRT) ionospheric monitoring software for natural hazards warning.
- GUARDIAN uses NRT total electronic content (TEC) time series to allow users to explore ionospheric TEC perturbations due to natural and anthropogenic events on Earth and characterize potential natural hazards.
- GUARDIAN aims to supplement the existing natural hazards early warning systems (EWS) and is currently the only software capable of providing multi-GNSS NRT TEC time series over the Pacific region to the general public and scientific community.
- Martire, L., Krishnamoorthy, S., Vergados, P., Romans, L. J., Szilágyi, B., Meng, X., Anderson, J. L., Komjáthy, A., Bar-Sever, Y. E. (2023) The GUARDIAN system - a GNSS upper atmospheric real-time disaster information and alert network, GPS Solutions 27(32), DOI 10.1007/s10291-022-01365-6



**2023 Kahramanmaraş Earthquakes**

On the 6th of February 2023, two high-magnitude earthquakes (7.8 and 7.5) struck the Kahramanmaraş region (Republic of Türkiye), leading to more than fifty thousand deaths in the Republic of Türkiye and Syria.

**2022 Hunga Volcano Eruption**

The Hunga volcano on the islands of Hunga Tonga and Hunga Ha'apai erupted on January 15, 2022, producing the largest ionospheric signal ever observed. Atmospheric waves produced by the eruption circled the globe several times.

**2017 Geomagnetic Storm**

On September 7-8, 2017, a severe geomagnetic storm (Kp -8) triggered severe ionospheric disturbances. These disturbances caused severe disruptions in satellite navigation and radio communication, and are visible in the noise in TEC time series around the world.

**2012 Haida Gwaii Tsunami**

On October 27, 2012 an earthquake of moment magnitude 7.8 occurred on the Haida Gwaii archipelago off the west coast of Canada. A tsunami alert was issued in the US State of Hawaii and over 100,000 people were evacuated. Gravity waves from the tsunami reached the ionosphere hours before the tsunami reached the coast of Hawaii.

https://guardian.jpl.nasa.gov/examples/20121028_haida_gwaii/

# Scientific GPS/GNSS Monitoring via Mobile Phone

**Project goal: explore, assess, design and test field deployable GPS/GNSS monitor stations, via the Android mobile phone, to significant add to the data volumes of GUARDIAN**

- Current GPS/GNSS monitor stations cost many thousands of dollars yet the latest Android mobile phones now provide GPS/GNSS across **multiple satellite navigation constellations** and **multiple frequencies**.
- The incorporation of such sensors would great expand the data available to GUARDIAN
- Android mobile phone is the most prevalent GPS/GNSS receiver in the world (well in excess of 1B devices)
- Objective will be to: (a) assess the potential Android mobile phone platform for quality of the scientific data; (b) Develop a low-cost node (GPS/GNSS receiver, processing component, communication element) which could be deployed widely to significantly expand data collection capabilities.

**Designed in the Pixel6/7/8**

*from: https://www.techinsights.com/blog/teardown/google-pixel-6-pro-teardown*