Master's thesis project at the Department of Space, Earth and Environment

How does climate variation impact the rotation of the Earth?

Background: The El Niño-Southern Oscillation (ENSO) is a recurring climate phenomenon that has a strong influence on weather. It involves changes in the temperature of waters in the central and eastern Pacific Ocean, that evolve in between three different phases: El Niño (warming of the ocean surface), La Niña (cooling of the ocean surface), and a neutral phase between these events. The United States National Oceanic and Atmospheric Administration (NOAA) regularly monitors ENSO by combining both oceanic and atmospheric variables in the Multivariate ENSO Index (MEI). MEI time series are publicly available for the period 1979 to present.

Project description: The objective of this thesis work is to study the influence of such major climate phenomenon on the Earth's rotation, and in particular its velocity, thus the length-of-day (LOD). We will use the LOD time series measured by Very Long Baseline Interferometry (VLBI). VLBI is a radio astronomy technique which observations are used to estimate Earth Orientation Parameters, including the LOD.

Method: The relation between LOD and ENSO has been studied in various publications using simple decompositions of the LOD time series or the Singular Spectral Analysis. This proposed work focuses on the study of the relation LOD vs. MEI using a different statistical tool, e.g. wavelet-based semblance analysis, and on the determination of potential delays between the components of LOD and MEI.

The students should have an interest in Earth science and applied mathematics with an emphasis on time series analysis, and have some basic knowledge in Matlab and/or python.

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Figure 1: Representation of the wintertime Multivariate ENSO Index (MEI) during El Niño and La Niña events. Source: NOAA - https://psl.noaa.gov/enso/mei/

Figure 2: One of the three telescopes at the Onsala Space Observatory that routinely participate in geodetic VLBI experiments.