

- **Project Abstract:**

Ionosphere is the layer of the atmosphere which consists of high electron concentrations and extends from 90 to 1000 km above Earth's surface. The dense electron concentration forms a highly conductive plasma structure that varies with respect to changes in time, frequency, position, Sun's activity and geomagnetic field. The ionospheric variability plays an important role both at sky and ground wave communications in High Frequency band and at military and civilian satellite communications. Prior to the last ten years, monitoring of the ionosphere and forming models by developing the theoretical equations with the experimental observations have been accomplished by expensive and complicated instruments and experimental systems operated both from land and space. Global Positioning System (GPS), which is allowed to be in civilian use in the last ten years, provides a rapidly developing and promising means of efficient monitoring of the Ionosphere. GPS is composed of 24 satellites that orbit the Earth transmitting signals 24 hours at an altitude of 20,000 km. These signals at two different carrier frequencies are refracted and slightly distorted by the Ionosphere. The Earth-based GPS receivers register these modifications on the satellite signals. The variations and disturbances of the Ionosphere can be obtained effectively and efficiently by monitoring and computing the Total Electron Content (TEC) between the satellite and the receiver from the signals registered by the GPS receiver. The first goal of this project is to obtain time varying local TEC maps of Turkey by the joint use of signals registered by the receiver network. The second goal of the proposed project is tomographic imaging of the ionosphere using GPS data. Monitoring the variations of ionosphere with the proposed position and time resolution will be tried for the first time in the literature. The images and variations will be stored in a database. Subject specific and original signal processing techniques and software will be developed for the construction of the data base, mapping and ionospheric tomography. Developed techniques will be tried on the constructed database. The third goal of the proposal is the detailed analysis of variations over the local ionosphere for the purpose of a possible earthquake precursor. For this purpose, variations in the local ionosphere before major earthquakes will be examined and a robust earthquake alarm signal will be generated. The researchers of the proposed project consists of six professors from Hacettepe University and Bilkent University, Departments of Electrical and Electronics Engineering, who are all experts in their own subdisciplines and four researchers (three of them are Ph.D.s) from General Command of Mapping (GCM) who are all highly experienced in the establishment and operation of GPS stations, and the collection and geodesic and seismic analysis of GPS data. The previously collected and new GPS data will be supplied by GCM. The project will be completed in two years. This study will be the first in the open literature in terms of duration and time resolution of the ionospheric monitoring. Very important and original techniques will be developed in this project. The results of this project will be submitted to SCI cited journals and they will be presented in conferences. The scientific outcome of this project, with the results and original techniques and software, will have a significant impact on both national and international literature. The reliable and accurate prediction of highly destructive earthquakes hours before their impact is extremely beneficial both economically and socially. Development of the innovative techniques and algorithms of this proposal will make Turkey a leader in this very important and current subject.