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## **Ionospheric Research Perspectives and Challenges: 1975-2015**

### Abstract:

Ionospheric research activity has blossomed in the last half century. Prior to the space age, beginning roughly in 1958 with the launch of Sputnik, ionospheric phenomena were derived from a loosely organized network of vertical incidence ionosondes. Contributions from radio amateurs and radio astronomers were also significant. Radar investigations of the moon and the analysis of satellite signals had led to a basic understanding of the electron content in the topside of the ionosphere, including structural basis for transionospheric scintillation. Topside sounders led the way to development of improved ionospheric maps. Thomson (incoherent scatter) radar studies have provided the best image of the ionospheric profile. Over-the-horizon radar and HF communications led to the necessity for development of improved ionospheric models to support these activities. The imperatives of national defense also had a dramatic impact in a number of areas. A considerable effort has been applied to understanding of the transionospheric path including total electron content variations, satellite scintillation effects, and the impact of disturbances on GNSS systems such as GPS. Realistic ionospheric channel models, improved modems, and other refinements have enabled communications over the ionospheric path to be resilient in the face of various categories of disturbance. Still, there is a significant lack of forecasting capability for solar-terrestrial drivers in ionospheric models and in the nowcasting and forecasting of medium and small scale structures such as TIDs. Advances in data assimilation have helped but a complete solution to this vexing problem is not yet in hand. Surprisingly, more research is needed in many areas. Taking a trip down memory lane, and using the IES volumes from 1975 to the present as a guide, we can trace the rather substantial growth in our understanding of the ionospheric personality. Much of this has been spawned by technological innovation that has led to a better understanding of the underlying physics. In looking over the papers submitted to IES2015, while there are some notable exceptions, one is struck with the fact that many of the topical areas are the same over the last four or five decades. The sizable number of papers submitted to IES2015 is clear evidence to support the fact that ionospheric study is still a challenging discipline with a healthy constituency.