Ionospheric forecasting: State-of-the-practice and state-of-the-art

The ionosphere is increasingly important with the proliferation of space-based activities and technologies, expanding society's dependence on trans-ionospheric radio signals and broadening the reach of space weather impacts. At the same time, more capable observations of the Earth's upper atmosphere have revealed complexities that challenge our understanding and ability to model this critical region, especially the charged component.

Powerful new understanding has been created based on improved models of the ionosphere, yet exciting opportunities to utilize diverse observations, fuse data and models, and bring to bear cutting-edge data science techniques remain unexplored. We will provide an overview of what is currently the 'state-of-the-art' in ionospheric nowcasting and forecasting and emerge the trends and gaps that indicate the fruitful future directions.

This talk focuses on the state of knowledge of the complexity and predictability of the ionosphere, including the 'memory' of the system and ways that this knowledge has been manifested in existing models. We will place particular emphasis on the use case of ionospheric scintillation prediction ([1] and extension through the NASA Frontier Development Laboratory (FDL) [2]). Further, we will discuss findings of the Heliosphere to Earth Atmosphere Rendering Through Building Excellent Artificial-intelligence Training (HEARTBEAT) project in the Defense Agency Research Projects Agency (DARPA) Space Environment Exploitation (SEE) program to make ionospheric predictions out to 72 hours. Finally, we will examine the data science (i.e., considering the full data lifecycle—collection, management, analysis, and communication) and technological needs for ionospheric specification and prediction, placing emphasis on the "Integrated Science Data Analytics Platform" as an environment that enables the confluence of resources for scientific investigation [3,4].

References

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