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RAL Low-cost Ionosonde System

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Ionosondes continue to be important for the study of the ionosphere; they are relatively cheap and simple to install and operate, so can be distributed widely across the globe; they can give information on plasma density, structure and motion; their direct measurements of electron densities are also important for calibrating other more complicated observation methods such as incoherent scatter radar, satellite beacon tomography and radio occultation.

The low cost of sounders, however, is relative to facilities such as space-based instrumentation and incoherent scatter radars; one type of ionosonde widely used for monitoring costs in excess of €150,000, representing a significant investment for many organisations. A new instrument design is under development at RAL for a low-power sounder using pulse-coding techniques to get good signal-to-noise. The design uses COTS components wherever possible, and has a projected cost in the region of €6,000 for the simplest version, making such a system accessible to all. The design is tiered so that the simplest version would give information about layer heights and electron densities, but adding multiple receivers would enable plasma velocities and echo direction to be determined, increasing the science output.

The intention is that sounders of this new design be installed widely, in particular in developing nations. This would be especially beneficial for study of the equatorial and low-latitude ionosphere, which is relatively poorly understood because of a relative lack of instrumentation in this region. A wide range of studies would be enabled or enhanced by a much denser network of ionosondes across Africa, South America and Asia including: study of planetary-scale oscillations and gravity waves in the ionosphere; investigation of longitudinal variation in the equatorial electrojet and equatorial anomaly; examination of mechanisms for vertical coupling in the atmosphere with, for example, global thunderstorm activity being concentrated in Africa and South America; the study of ionospheric scintillation mechanisms and occurrence in the equatorial region; thorough characterisation of ionospheric variability on a wide range of spatial and temporal scales across a wide range of longitudes.