A Comparison of Duct Climatologies Based on Various Data Sources

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Ducting is the trapping of Radio Frequency (RF) energy in an atmospheric waveguide. For low-elevation radar and radio communication systems, it is the most dramatic environmental impact on RF coverage. Consequently, the climatology of ducting events is important for RF system design and analysis.

Mesoscale factors play a major role in ducting climatology. In coastal areas, the land/sea flows and inversion-layer formation determine the occurrence rate, strength, duration and extent of ducting events. The vertical scales over which humidity gradients (and, consequently, trapping layers) form can be quite small, with changes over the span of a few meters having potentially large impacts on RF propagation. Consequently, one would desire measurement and modeling techniques that capture the RF-significant features; namely, temporal dependence on frontal-passage time scales, spatial sampling across the land/sea boundary, fine vertical resolution for profiles that extend at least as high as the typical inversion layers and particular sensitivity to humidity gradients.

Until recently, such data were not available on a global, climatological scale. Instead, the databases typically used in RF engineering analysis were coaxed from twice-daily radiosonde observations during the 1970's and 1980's at discrete, mostly over-land, locations. Nevertheless, these databases are still widely used for the design and analysis of maritime RF systems.

Today, however, there is a growing set of meteorological datasets from which an improved RF climatology might be derived. Radiosondes use better sensors and more vertical levels are reported. Numerical weather predictions (NWP) – both mesoscale analyses and global reanalysis – are improving vertical resolutions and their ability to resolve humidity gradients. Furthermore, NWP data have the potential of giving near-global coverage at horizontal and temporal resolutions that far exceed any measurement-based approach.

Currently, there is no single source that provides all the qualities required for global "ground truth" ducting statistics. However, existing data can be inter-compared to determine the strengths and weaknesses of various data for computing duct climatology. This talk will compare ducting statistics derived from various datasets, with an aim towards quantifying the limitations of each individual dataset. An attempt will also be made to shed light on how "ground truth" may be approached by judiciously combining information from multiple sources.