Ducting conditions associated with offshore flow and maritime air interactions during CASPER East Field campaign

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The CASPER Field campaign took place from October - November 2015. During this period of time, extensive observations were taken on and offshore Duck, NC. Among the observations made during the field campaign were soundings, low-level turbulence, and electromagnetic wave (EM) propagation measurements, all across the coastline and on moving platforms such as research vessels and aircrafts. These measurements were coordinated in time and space, which makes the CASPER dataset unique for model validation related to EM propagation studies.

One of the main research goals of CASPER is to study the spatial and temporal variability of refractive conditions affecting EM propagation in coastal regions. The Navy's Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS) has proven to be a useful tool for this application. The focus of this study is to assess the mesoscale-scale variability of both the elevated trapping layer and the evaporation ducts as a result air mass modifications due to the complex flow patterns in the coastal region.

In this study we choose two cases (22 October 2015 and 1 November 2015) during the CASPER field campaign in which COAMPS agreed very well with observations in forecasting the ducting conditions. The 3-dimensional and time evolving COAMPS fields provide additional information not available from observations and will be analyzed in-depth. We investigated the interactions of the coastal land and the marine flow and the resulting ducting conditions. On 22 October, 2015, the dry coastal offshore flow interacted with the moist marine environment and the land-based ducting layer was advected over the maritime environment. As the dry air advects over the coastal ocean, the cold dry land boundary layer undercuts the warm moist marine boundary layer resulting in a region with both surface based and elevated ducts where the two air masses meet.

On November 01, 2015, the onshore flow early in the day resulted in increasing duct height towards the ocean. This is in contrast with the October 22 case with multi-level detached duct layers. Later in the day, warm air advection from the south above 500 m led to a decrease of the duct height. When the moisture reaches the lower levels the surface-based ducts over land disappear, ultimately resulting in elevated ducts at around 400 m.

The very complex mesoscale interactions between the continental and the marine air masses greatly affects the location and evolution of ducts in this region. The ability to correctly forecast duct location and duration is critical for strategic applications.