

Evaporation and Elevated Duct Properties over the Subtropical Eastern Pacific Ocean Region Using MAGIC Data

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Electromagnetic wave propagation that behaves differently from that in the standard atmosphere is known as anomalous propagation (AP). Ducting is one type of AP in which the radio and microwaves become trapped within a nearly horizontal layer known as the duct. This energy trapping leads to enhanced propagation range and weak propagation loss of electromagnetic energy within the duct. A corresponding reduction in the electromagnetic signal strength also occurs above or below the duct. Knowledge on ducting is imperative for radar and communication applications such as ship-to-ship and ship-to-shore radio communication and radar based ocean navigations. Ducting also affects the ground-to-satellite radio links and radar based precipitation measurements. Strong vertical gradients in temperature and/or moisture create favorable conditions for ducting.

Evaporation and elevated ducts are the most common ducts observed over the ocean. The present study intends to characterize these two types of ducts along a track of around 4000 km between California coast and Hawaii in the eastern Pacific Ocean using one year (2012-2013) of ship based observations during the Marine ARM (Atmospheric Radiation Measurement) GPCI Investigation of Clouds (MAGIC) campaign. MAGIC employs the cargo vessel Spirit instrumented with ship level and remote sensing measurement capabilities together with extensive rawinsonde measurements along the 4000 km track. The ship level in situ measurements and the rawinsonde data are the primary data source for this study. A marine surface layer model, adapted from the COARE surface flux scheme, is used to diagnose evaporative duct properties.

A gradual transition from stratocumulus clouds (Sc) off California coast to cumulus (Cu) in the trade wind regime takes place along MAGIC track. MABL height and capping inversion characteristics are significantly different in the two regimes. This study shows that deeper evaporation ducts, averaged to about 15 m, frequently forms near Hawaii coast in comparison with that of California coast where the average evaporation duct is only about 7 m. About 78% of duct heights are below 20 m and deeper ducts (> 20 m) are more common under stable condition. On average the evaporation duct strength is between ~ 25 - 35 M units near Hawaii. But near to California coast it is around 15 M units.

In the longitude range between 125°W - 140°W , the MABL is frequently found to be decoupled. The characteristics of the elevated ducts are significantly different in the two regimes west and east of the decoupling region. Approximately 70-80% of elevated ducts occur below 1.5 km east of the decoupling region. West of region, almost equal percentage of ducts forms at heights above 1.5 km. The

percentage occurrence of duct height at east of the decoupling region is maximum within 1-1.5 km, but the distribution peaks at 1.5-2 km height range further to the west.