Dynamics of the elevated land plume over the Arabian Sea and the Northern Indian Ocean during northeasterly monsoons and during the Indian Ocean experiment (INDOEX)

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1. Introduction

[1] We describe the dynamics of the formation of an elevated land plume over the Arabian Sea and northern Indian Ocean observed during the 1999 Indian Ocean Experiment (INDOEX). The presence of the elevated plume above the marine boundary layer for a depth of about 2000 m could be inferred from the thermodynamic profiles of the lower troposphere obtained from research vessels in 1997, 1998, and 1999, and in the lidar data obtained from aircraft during the INDOEX. Formation of the elevated plume was investigated further using a three-dimensional high-resolution mesoscale modeling system. The plume extends for hundreds of kilometers and its strength and coherence is influenced by the diurnal variation of the upwind continental boundary layer. INDEX TERMS: 9340 Information Related to Geographic Region: Indian Ocean; 3339 Meteorology and Atmospheric Dynamics: Ocean/atmosphere interactions (0312, 4504); 3322 Meteorology and Atmospheric Dynamics: Land/atmosphere interactions; 4247 Oceanography: General: Marine meteorology; KEYWORDS: Indian Ocean, Air/Sea Interactions, Land/Atmosphere Interactions, Marine Meteorology, Boundary layer processes

2. Observations

[4] There were two pre-INDOEX ORV Sagar Kanya cruises in this region, one in 1996–97 from December 26 to January 31, 1997 and the other from February 19 to March 30, 1998, both during northeast monsoons. During the INDOEX field phase (January to March, 1999), two research vessels, ORV Ron Brown and ORV Sagar Kanya were deployed along with numerous observational platforms that included several research aircraft, surface based soundings and satellites. Observations discussed here pertain to those observed from the two ships, and from the French aircraft Mystere, which was equipped with a downward looking lidar [Ramanathan et al., 2001].

[5] In the 1997 cruise, 47 CLASS (Cross-chain Loran Atmospheric Sounding System) sondes were launched from ORV Sagar Kanya’s transit from 15 N to 15 S. Boundary layer heights were derived from the thermodynamic profiles. They indicated the variability of the marine boundary layer (MBL) heights ranging from 400 m to 1100 m depending on the location as shown in Figure 1. Here ‘D’ refers to ‘daytime’ (~2 pm LT), ‘E’ refers to ‘evening’ conditions (~5 pm LT), and ‘N’ refers to ‘nighttime’ conditions (~6 am LT or 8 pm LT), and the solid line is a