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The Spatial and Temporal Representativeness of Atmospheric Observations of Greenhouse Gases at the Namib Desert Atmospheric Observatory

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Continuous observations of trace species such as greenhouse gases (GHGs) made from ground-based stations contain excellent information in the time domain but no direct information about the spatial distribution of GHGs. Generally a rule-of-thumb is used for inferring horizontal length scales for specific time intervals, but this is approximate and does not give any indication about the specific contributions of advection and surface fluxes to GHG variability. We consider the first year of measurements from a new coastal background site in Namibia, the Namib Desert Atmospheric Observatory(NDAO) and apply a quantitative approach using footprints and back-trajectories to calculate a site-specific time to spatial scale conversion function. The extent of both horizontal and vertical transport exhibits seasonality and synoptic influence. The historical NOAA GHG flask record from nearby site GBB is also compared to the global background to assess how well regional and global trends are represented by observations at NDAO. Based on the results of the HYSPLIT and TM3 transport models, during austral summer the site receives marine boundary layer air with a greater extent of horizontal transport than in austral winter, when air masses are sourced from greater height and are more likely to be terrestrially influenced. This conclusion is supported by the trace gases and meteorological parameters measured at the station.