Passive tracer transport relevant to the TRACE A experiment

T. N. Krishnamurti, M. C. Sinha, M. Kanamitsu, D. Oosterhof, H. Fuelberg, R. Chatfield, D. J. Jacob, and J. Logan

J. Geophys. Res., 101, 23,889-23,908, 1996

Abstract

This paper explores some of the mechanisms governing the accumulation of passive tracers over the tropical southern Atlantic Ocean during the northern hemisphere fall season. There has been a pioneering observation regarding ozone maxima over the South Atlantic during austral spring. The understanding of the formation of this maxima has been the prime motivation for this study. Using a global model as a frame of reference, we have carried out three kinds of experiments during the period of the Transport and Atmospheric Chemistry Near the Equator--Atlantic (TRACE A) project of 1992. The first of these is a simple advection of total ozone (a passive tracer) in time using the Florida State University global spectral model. Integration over the period of roughly 1 week showed that the model quite closely replicates the behavior of the observed total ozone from the total ozone mapping spectrometer (TOMS). This includes many of the changes in the features of total ozone over the tropical and subtropical region of the southern Atlantic Ocean. These studies suggest a correlation of 0.8 between the observed ozone over this region and ozone modeled from "dynamics alone," i.e., without recourse to any photochemistry. The second series of experiments invoke sustained sources of a tracer over the biomass burn region of Africa and Brazil. Furthermore, sustained sources were also introduced in the active frontal "descending air" region of the southern hemisphere and over the Asian monsoon's east-west circulation. These tropical experiments strongly suggest that air motions help to accumulate tracer elements over the tropical southern Atlantic Ocean. A third series of experiments address what may be required to improve the deficiencies of the vertical stratification of ozone predicted by the model over the flight region of the tropical southern Atlantic during TRACE A. Here we use the global model to optimally derive plausible accumulation of burn elements over the fire count regions of Brazil and Africa to provide passive tracer advections to closely match what was observed from reconnaissance aircraft-based measurements of ozone over the tropical southern Atlantic Ocean.