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SHADOZ (Southern Hemisphere Additional Ozonesondes): Classification of ozonesonde profiles using self-organizing maps

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Ozone profiles from balloon-borne ozonesondes are used for development of satellite algorithms and in chemistry-climate model initialization, assimilation and evaluation. An important issue in the application of these profiles is how best to treat variations where varying photochemical and dynamical influences can cause the ozone mixing ratio in the tropospheric segment of the profile to change by of a factor of 2-3 within a day. Clustering techniques are an ideal way to approach the statistical classification of profile data and we apply self-organizing maps (SOMs) to tropical tropospheric SHADOZ data, hypothesizing that the data will sort according to various influences on ozone, namely anthropogenic sources like biomass burning, meteorological conditions, and stratospheric or extra-tropical intrusions. Self-organizing maps use a learning algorithm to reveal the most prominent features of a data set by finding their own sets of averages according to a specified number of clusters. SOMs have been determined for the 1998-2009 SHADOZ profiles over Ascension Island (7.98S, 14.4W) and Natal, Brazil (5.42S, 35W), in a progression of 2x2 to 4x4. The 2x2 SOM over Ascension, which creates 4 clusters, reveals that deviations from the average ozone in the free troposphere include both increased ozone resulting from seasonal biomass burning in Africa and locally reduced ozone brought about by convective lifting of unpolluted boundary layer air. Expanding to a 4x4 SOM shows how biomass burning influences the yearly cycle of tropospheric ozone at Ascension Island and captures the seasonality of ozone at both Ascension Island and Natal. Comparing Ascension Island and Natal using a 4x4 SOM at each site reveals similarities in mid-tropospheric ozone, but shows differences in lower tropospheric ozone due to Ascension Island being closer to African biomass burning and more affected by descent from the mean Walker circulation, with less convective activity, than Natal.