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The importance of the time response of Electrochemical Concentration Cell (ECC) ozone sondes for measurements of tropical upper tropospheric and lower stratospheric ozone

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Accurate measurements of ozone in the upper tropical troposphere and lower stratosphere (UTLS) are challenging for most measuring systems, yet of great importance for the understanding of the chemical and dynamical processes in this region.

Balloon-borne observations using Electrochemical Concentration Cell (ECC) ozone sondes are the most widely used in situ technology to measure vertical profiles of ozone in networks such as the Southern Hemisphere ADditional Ozonesondes (SHADOZ) network of tropical and subtropical ozone sonde stations.

The tropical upper troposphere and the layers of near-zero ozone within the ozone hole are most sensitive to processing and preparation variations that may affect the accuracy and possibly trend estimates of ozone in low ozone regions. It is now appreciated that the complex chemistry within the ECC used to detect ozone exhibits two different time constants (τ_{fast}≈20 s, τ_{slow}≈25 min), which modify the response of the ECC during a profile. Although not well understood, the chemistry of the slow reaction is likely to represent what has conventionally been assumed a constant "background current". The fast reaction causes some delay in the response of the ECC to changes in the vertical profile of ozone. Here we show how correcting for both improves the estimate of the lowest ozone concentration in the upper troposphere as well as the steepness of the gradient in the transition into the stratosphere. The steady state bias, which describes the contribution of the slow reaction, is the largest source of uncertainty overall; the response time of the fast reaction dominates the uncertainty in the region of the sharp gradient of ozone above the tropopause.