Ozonesondes from the West Pacific

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Overview

Thirty-three ozonesonde profiles were taken in Manus Island, Papua New Guinea (fig. 1), as part of the CAST campaign in February 2014. Manus is hypothesized to be close to a source region of ozone-deficient air that can reach the TTL (Heyes et al., 2008). Other campaigns (Kley et al., 1996; Rex et al., 2014) have reported very low, almost zero, concentrations of ozone in the TTL. This campaign did not observe any near-zero ozone, and evidence casts doubt upon the existence of near-zero ozone in the TTL. However, a region of air with unusually low ozone compared to the rest of the campaign was observed in the TTL between 21—23 February (fig. 2), which was traced back to an area of deep convection to the east of Manus.

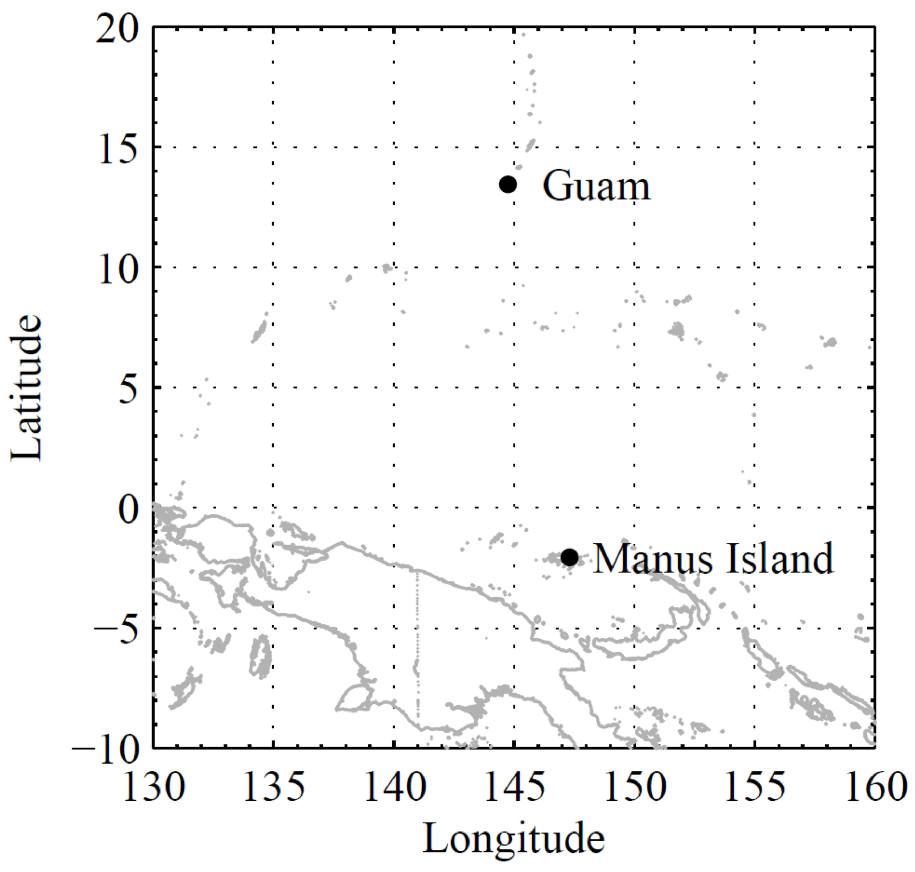

Figure 1: Map of the CAST/CONTRAST/ATTREX campaign sites. The ground campaign was on Manus Island, the aircraft were based in Guam.

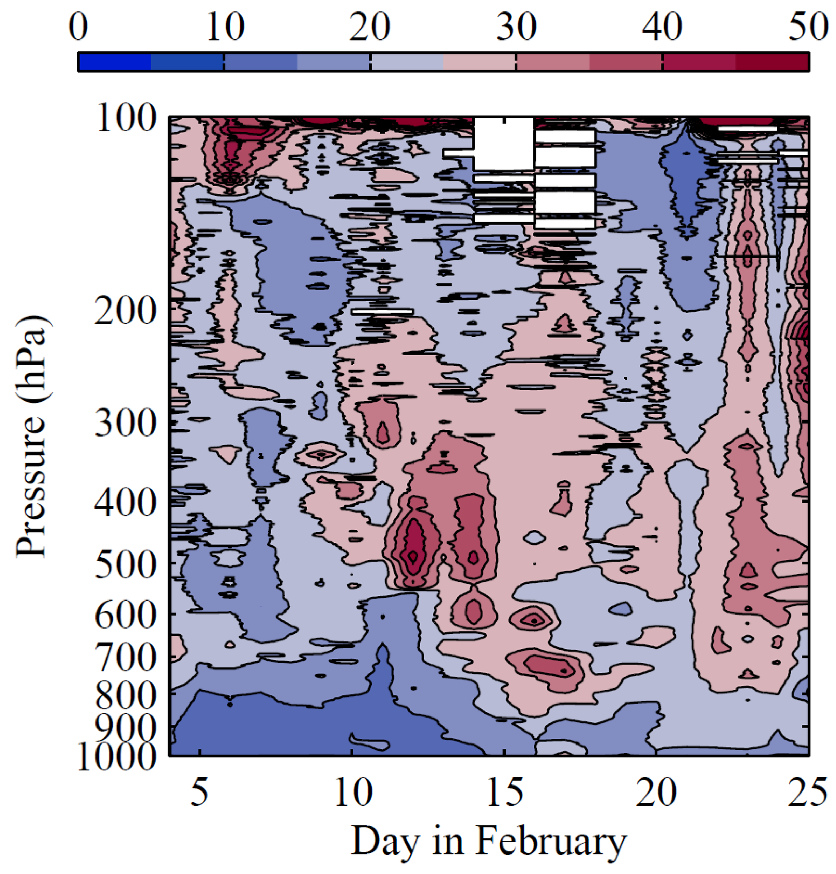

Figure 2: A time series of the ozone concentrations as measured by the ozonesondes. The low ozone is visible in blue between 21—23 February.

Verification

A contamination event during the campaign necessitated careful treatment of the ozone profiles: the behaviour of the ozonesondes' background currents—the residual current that is not because of ozone—requires characterizing. An experiment, where sondes of different levels of contamination were put into a bell jar, was devised, so the background current could be measured at different pressures.. This led to a new "hybrid" background current correction to be devised.

The correction to the profiles was verified by comparing the profiles with measurement made by the NCAR Gulfstream V aircraft. The new correction is more accurate than the other corrections found in the literature (fig. 3).

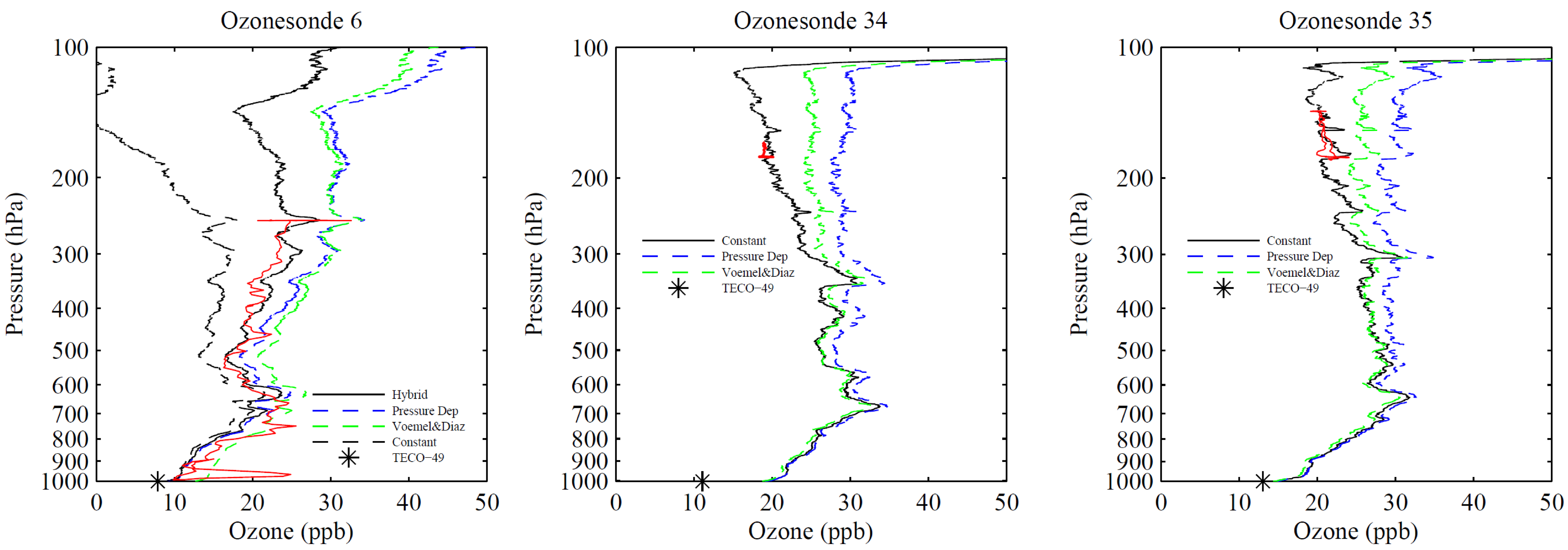

Figure 3: Ozonesonde profiles with collocated Gulfstream V measurements. Aircraft data is in red. The black line is the "hybrid" correction, while the other lines are the other standard corrections found in the literature.

Analysis

The low ozone concentrations of the 21—23 February in the TTL (fig. 2) were of particular interest. The low ozone coincided with a jet of high-velocity easterly winds in the TTL (fig. 4). A HYSPLIT back-trajectory analysis (fig. 5) showed it originated in an area of deep convection (see satellite image in fig. 6).

Modelling work using WRF is currently being done to further understand how the ozone concentrations are affected by the deep convection.

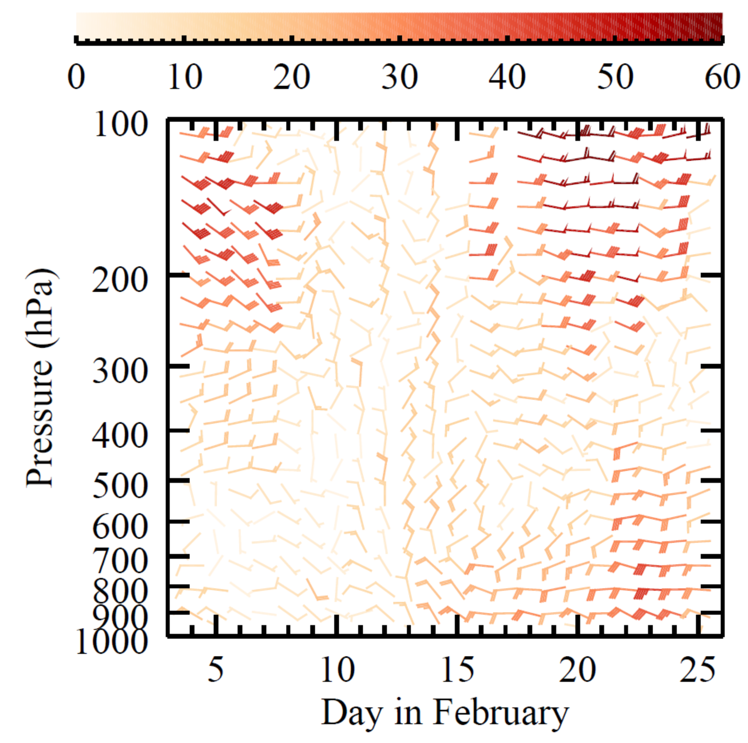

Figure 4: A timeseries of wind speed as measured by the ozonesondes. An easterly jet is visible at the same time as the low ozone in fig. 2.

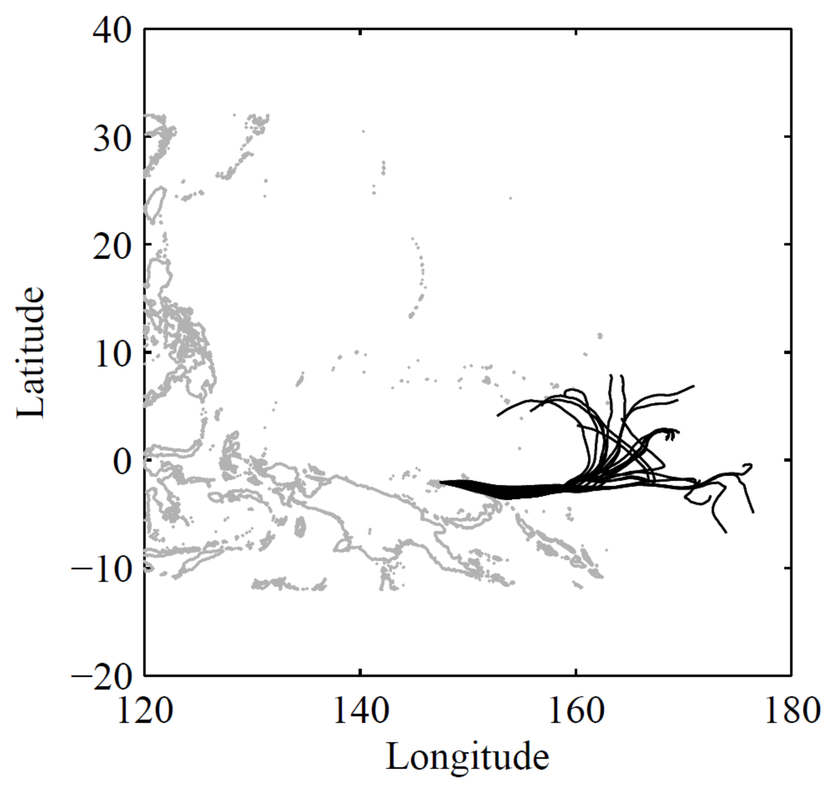

Figure 5: HYSPLIT back-trajectories of air masses initiated in the TTL over Manus on 22 February

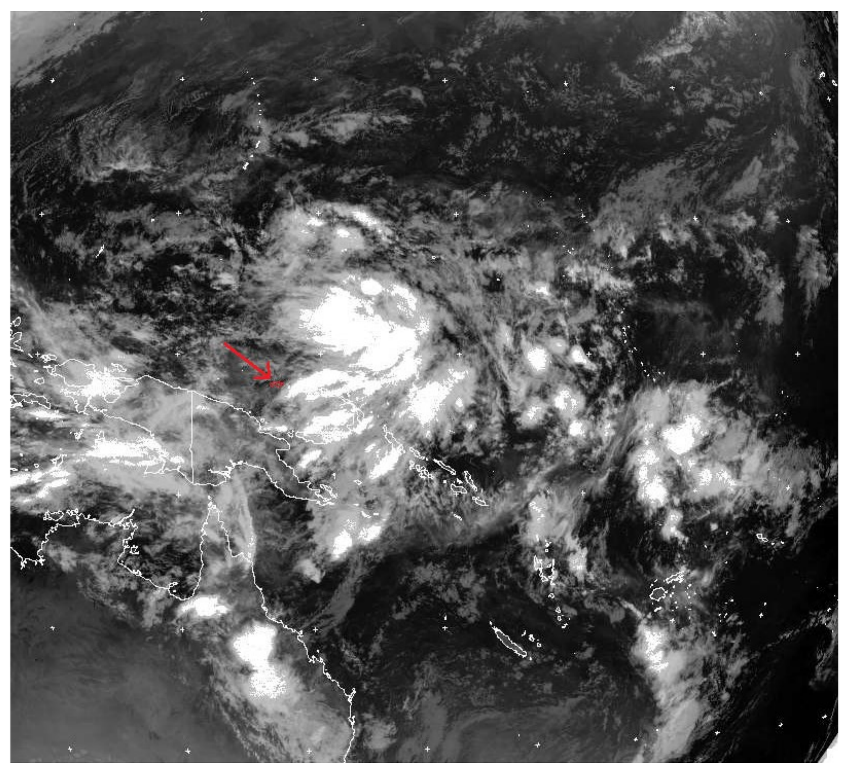

Figure 6: Satellite image from 19 February. The trajectories in fig. 4 come from the bright area of deep convection

References

Heyes, W. J., Vaughan, G., Allen, G., Volz-Thomas, A., Pätz, H. W., and Busen. (2009). Composition of the TTL over Darwin: local mixing or long-range transport? *Atmospheric Chemistry and Physics*, 9 (20):7725-7736,

Kley, D., Crutzen, P. J., Smit, H. G. J., Vömel, H., Oltmans, S. J., Grassl, H., and Ramanathan, V. (1996). Observations of Near-Zero Ozone Concentrations Over the Convective Pacific: Effects on Air Chemistry. *Science*, 274(5285):230-233.

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