Supplementary Information



Figure S1: Time series of total lightning NO emissions from M2GMI averaged over the region 15 S to 15 N and 150 to 250 E.



Figure S2: Same as Figure 1 except for ATom 1 (summer 2016).



Figure S3: Same as Figure 2 except for JJA.



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Figure S4: Same as Figure 4 but for each layer.



Figure S5: Same as Figure 5, except for the H_2O_2 photolysis (a) and $HO_2 + O_3$ (b) reactions.



Figure S6: Longitudinal difference in NO₂ during El Niño events (MEI > 0.5) as compared to neutral years (-0.5 < MEI < 0.5) averaged between 15S to 15 N. The anomalies in the pressure velocity are shown by the contour lines.



Figure S7: Zonal mean of the fraction of the total OH loss rate attributable to the reaction of CO with OH.



Figure S8: First EOF of OH in the PBL level for DJF (a) and JJA (b). The contribution of the first EOF to the total variance is also indicated. The 1st Principal Component time series (c) is also shown for DJF (blue) and JJA (red) while the MEI is shown in black.



Figure S9: Correlation of the indicated OH production reaction with the MEI for the PBL layer.



Figure S10: Correlation of the indicated OH production reaction with the MEI for the UFT layer.



Figure S11: First EOF of TCOH for M2GMI and the CCMI models evaluated here for DJF. The contribution of the first EOF to the total variance is also indicated.



Figure S12: Time series of the first EOF of TCOH for the models evaluated here for DJF as well as the MEI time series. The r^2 value of the correlation between the time series for the individual models and the MEI is also shown.



Figure S13: Fractional change in TCOH for positive phases of the NAO (a) and PNA (b), defined as having an index greater than 0.4, as compared to neutral years (index between -0.4 and 0.4). Note that, for emphasis, the x-axis is shifted in panel b to center the map over the Pacific Ocean.



Figure S14: Partial correlation of the Australian monsoon (a) and IOD (b) during the indicated season taking into account the correlation of each with the MEI.



Figure S15: Absolute difference in TCOH between years with an Australian monsoon index in the 75th percentile or higher and those years with a monsoon index between the 25th and 75th percentile.



Figure S16: Same as Figure 18 except for the PNA (a), the Scandinavian (b), Tropical Northern Hemisphere (c), East Atlantic (d), East Atlantic/Western Russian (e), West Pacific (f), and East Pacific/North Pacific (g) patterns during DJF.



Figure S17: Same as Figure 18 except for the North American (a), North African (b), Indian (c), Western North Pacific (d), South African (e), and South American (f) monsoons during the indicated season.