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Biogeochemical trace gas and O2 concentrations in central Siberia from a 300-m tall tower: Seasonal, synoptic and diurnal scale variability

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We present the first results from 19 months of semi-continuous measurements of biogeochemical trace gases (CO2, CO and CH4) and O2, measured at the Zotino Tall Tower Observatory (ZOTTO: 60°48'N, 89°21'E) in the forest of central Siberia. We estimated CO2 and O2 seasonal cycle amplitudes of 26.7 ppm and 149 per meg (31.3 ppm), respectively. The linear trend in CO2 from 2005-2007 was 1.49 ppm yr-1, which is less than the trends observed at Shetland Islands, Scotland (2.17 ppm yr-1), and at the marine boundary layer (2.0 ppm yr-1). The west-east gradient of about -6 ppm (in July 2006) between Shetlands and ZOTTO reflects the summertime continental uptake of CO2 which is consistent with regional modelling studies. We found the oceanic component of the O2 seasonal amplitude ("Atmospheric Potential Oxygen", APO) to be 30 per meg, significantly smaller than the 95 per meg observed at Shetlands, illustrating a strong attenuation of the oceanic O2 signal over the continental interior. A comparison with the TM3 atmospheric transport model showed a very good agreement with the observed phase and seasonal amplitude in CO2, however, the model exhibited greater O2 and APO amplitudes (35 per meg (19%) and 21 per meg (41%) greater respectively). In the first two months of measurements on the completed tower (Nov and Dec 2006, to 300 m height), we observed several events with clear vertical concentration gradients in all measured species except CO. During 'cold events' (below -30°C) in November 2006, we observed large vertical gradients in CO2 (up

to 22 ppm) suggesting a strong local source. The same pattern was observed in CH4 concentrations for the same events. The diurnal vertical CO2 gradients in April-May 2007 allowed us to estimate the average night-time respiration flux of 0.04ś0.02 mole of C m-2 d-1 which is consistent with the earlier eddy covariance measurements in 1999-2000 in the vicinity of the tower.