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Impact of future ozone on the terrestrial biosphere: comparisons with the effects of climate change and CO2 increase

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In the carbon cycle, the present-day sinks due to the continental biosphere and the oceans are of the same magnitude, however the future response of the continental biosphere to modifications such as climatic change is, nowadays, highly uncertain. Many atmospheric parameters are able to significantly affect the terrestrial carbon sink and several of them are subject to perturbations due to human activities. Among others: (a) Elevation of CO2 is known to have a fertilizer effect on photosynthesis; (b) Anthropogenic emitted NOx can have a fertilizer effect however it could also have adverse effect on productivity through acid rain; (c) Future climate change can reduce the global efficiency of the vegetation to absorb CO2; (d) Ozone, formed by photochemical reactions involving NOx and VOCs, is responsible for a physiological alteration and a leaf injury on many plants and thus reduce the carbon sequestration (Felzer et al., Climatic Change, 2005). Future levels of surface O3 in emerging regions (e.g. Tropical Africa, Latin America, South East Asia) are expected to increase, and can hence have a significant negative impact on crops and forests. Here we examine the potential impact of O3 deposition on the global terrestrial biosphere for recently developed future scenarios of atmospheric composition and we compare it with the effects of future climate and CO2 on plant productivity. Ozone levels are computed using the multiscale tropospheric chemistry-transport modelling platform LMDz-INCA/CHIMERE. These ozone exposure distributions are then used by a global dynamic vegetation model ORCHIDEE in order to quantify the changes in net primary production of vegetation under several present and future conditions. Results are discussed in detail for regions of interest having both high O3 precursor emissions and large vegetation cover. The effect of ozone changes at the 2030 horizon on the terrestrial biosphere is shown to be

weak compared with that of climate and CO2.