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Supplement of

Impact of future land-cover changes on HNO_3 and O_3 surface dry deposition

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A. Dry deposition evaluation

Hardacre et al. 2015 have compared the ozone dry deposition simulated by 15 global models with long term dry deposition measurements. In the Figure S1, we superimposed the results obtained with LMDz-INCA in Europe and North America for the year 2007 to the results gathered by Hardacre et al. 2015. The ozone flux simulated by LMDz-INCA and discussed in this paper lies within the range of other global models. If model/data discrepancies of up to a factor of 2 are noticed accordingly to Hardacre et al. 2015, no systematic bias from LMDz-INCA is shown.

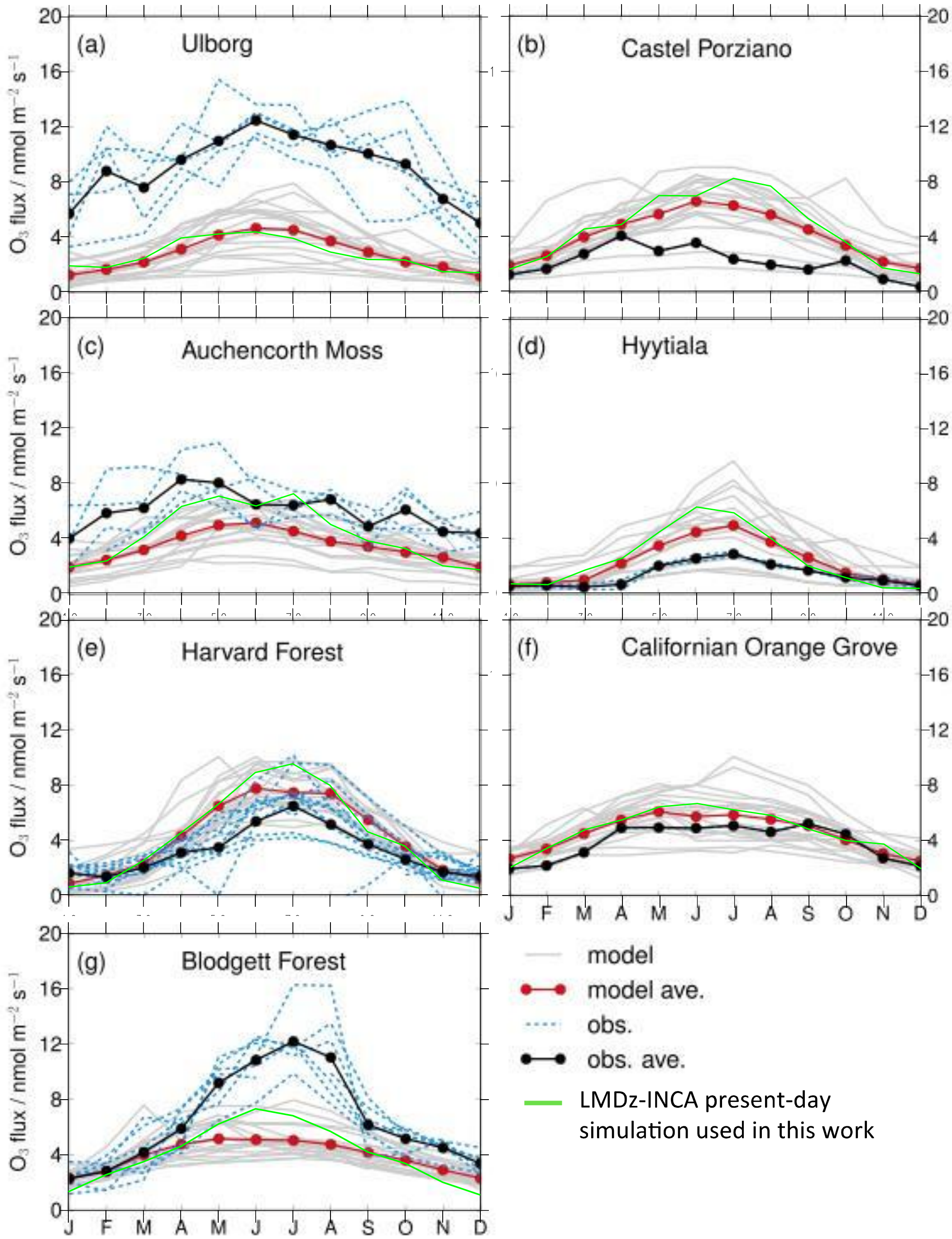

Figure S1: Measured and modeled monthly average O3 dry deposition fluxes at Ulborg (a), Castel Porziano (b), Auchencorth Moss (c), Hyytiala (d), Harvard Forest (e), Californian citrus orchard (f), and Blodgett Forest (g). Grey lines show results from 15 individual models, blue lines show observations for different years, green lines represent the present day simulation performed with LMDz-INCA and used as a reference in this work. This figure was adapted from Figure 8 in Hardacre et al. 2015.

B. Sensitivity Tests

Sensitivity tests were carried out in order to investigate the relationship between each land type and dry deposition calculation in the LMDz-INCA model, giving keys and insights to better understand the impact of future land-use changes and climate on dry deposition.

Set-Up

One set of five simulations is performed in order to assess the sensitivity of dry deposition to land cover types. Each run uses a different vegetation map containing only one land-type covering the whole Earth continental surface (except over main desertic regions like Sahara, Gobi, Antarctica and Arctic regions): agriculture, grassland, deciduous forest, coniferous forest and barren land. We use the present-day climate, biogenic and anthropogenic emissions in every sensitivity tests. We mention that a change in surface type linked to an expansion of agricultural areas is considered as a land cover change (LCC) and is not associated with a change in nitrogen oxides due to the use of fertilizers (LU). The rest of the set-up is the same than present-day simulation presented in the core of the paper.

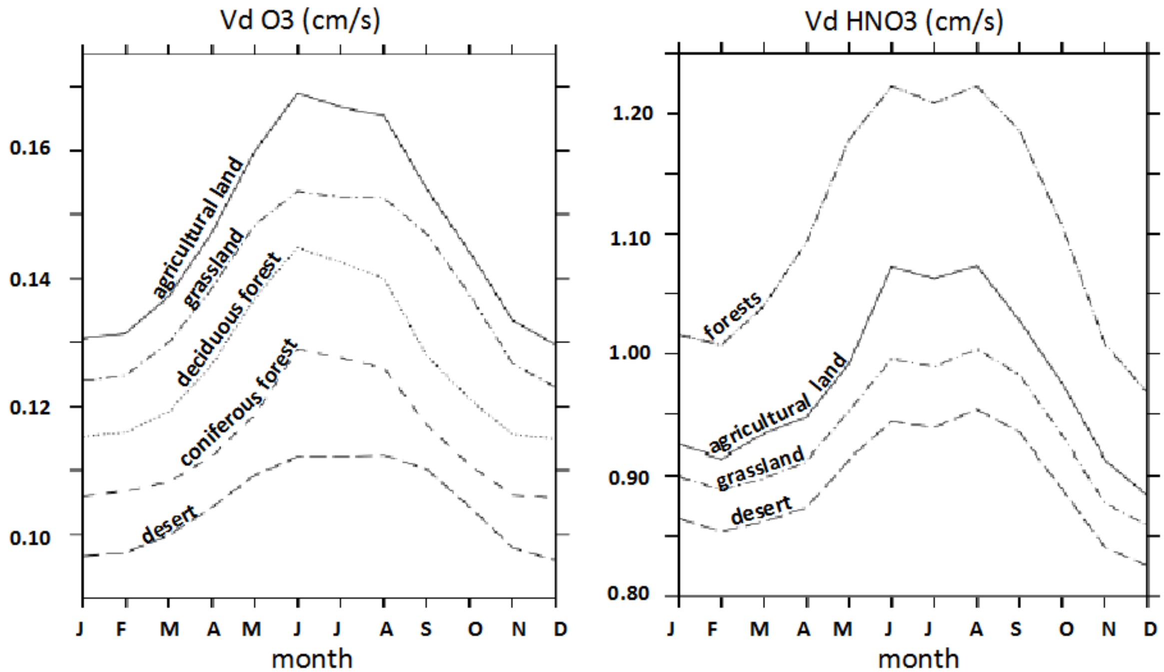

Figure S2: Globally averaged monthly dry deposition (cm/s) calculated for ozone and nitric acid vapor for the main vegetation types.

Sensitivity tests show a hierarchy in the type of land covers regarding deposition efficiency throughout the whole year and in every continental region: the calculated HNO_3 dry deposition is maximal over forests (deciduous and coniferous) and minimal over bare soil (entire ranking: Deciduous, Coniferous > Agriculture > Grasslands > Bare soil). This is due to the strong dependency of V_{d,HNO_3} to surface roughness over land (typically zo=1 m for forests and zo=0.001-0.1 m for agriculture), when highest surface roughness combined with high wind speed give a high HNO_3 deposition velocity (Walcek et al., 1986). On the other hand, O_3 dry deposition is maximal over small canopies vegetation and minimal over bare soil (entire ranking: Agriculture > Grasslands > Deciduous > Coniferous > Bare soil). Values found in tests of sensitivity are also consistent with typical ozone deposition velocities exposed in the review by *Wesely and Hicks*, [1999]. For instance, in Europe and North America, we calculate a maximum December-February mean O_3 dry deposition velocity at the surface of 0.4 cm/s and 0.8 cm/s on average during the June-August period over cropland. Over deciduous forests, V_{d,O_3} maximum value is about 0.2 cm/s and 0.5 cm/s respectively corresponding to the winter and summer periods.

C. DJF and JJA seasonal means of dry deposition, surface concentrations and deposited fluxes for O_3 and HNO_3 (present-day simulation)

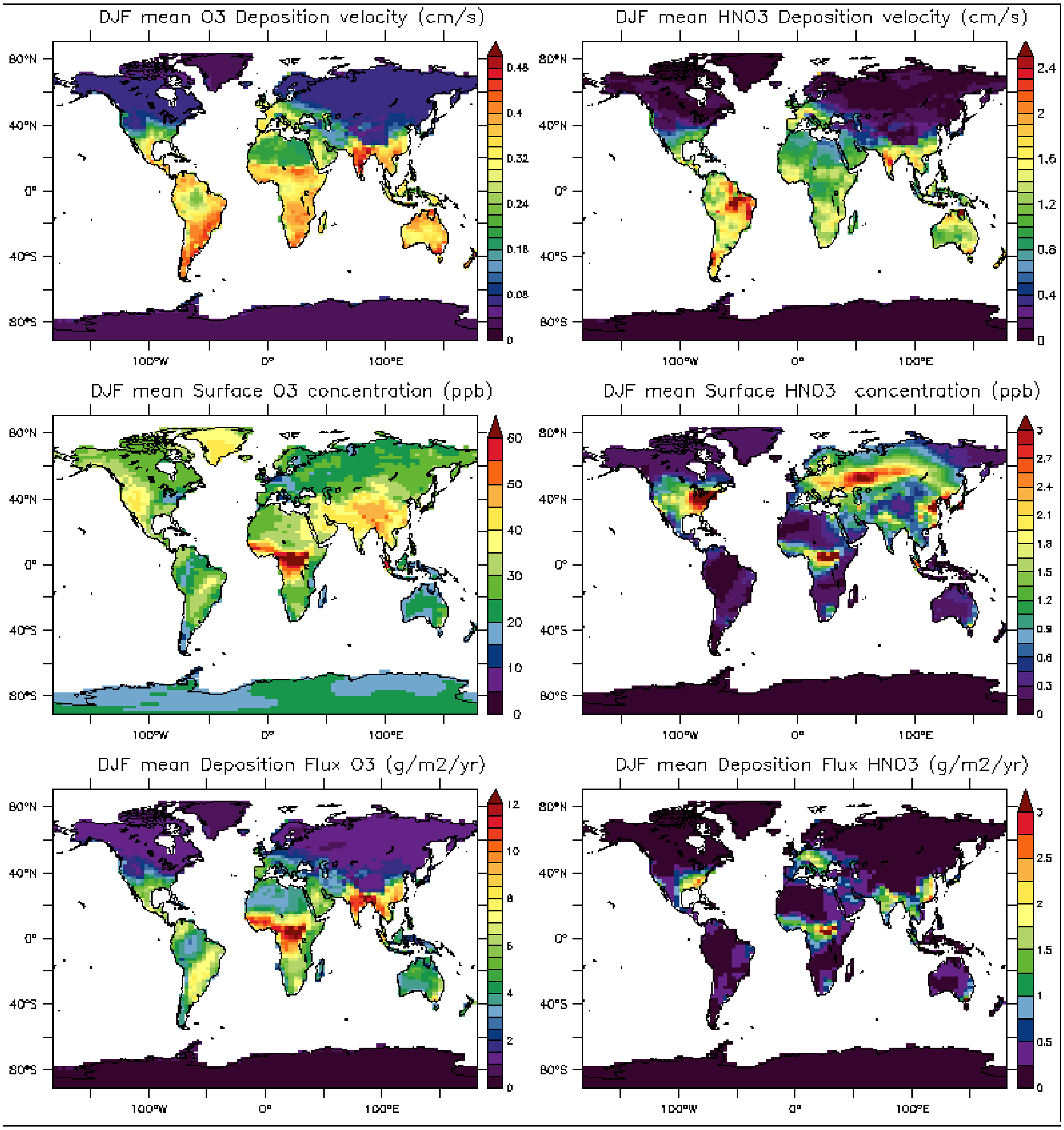

Figure S3: Deposition rate at the surface (cm/s), surface concentration (ppbv) and deposition flux (g/m²/yr) calculated for ozone (left-hand column) and HNO3 (right-hand column).in December-January-February

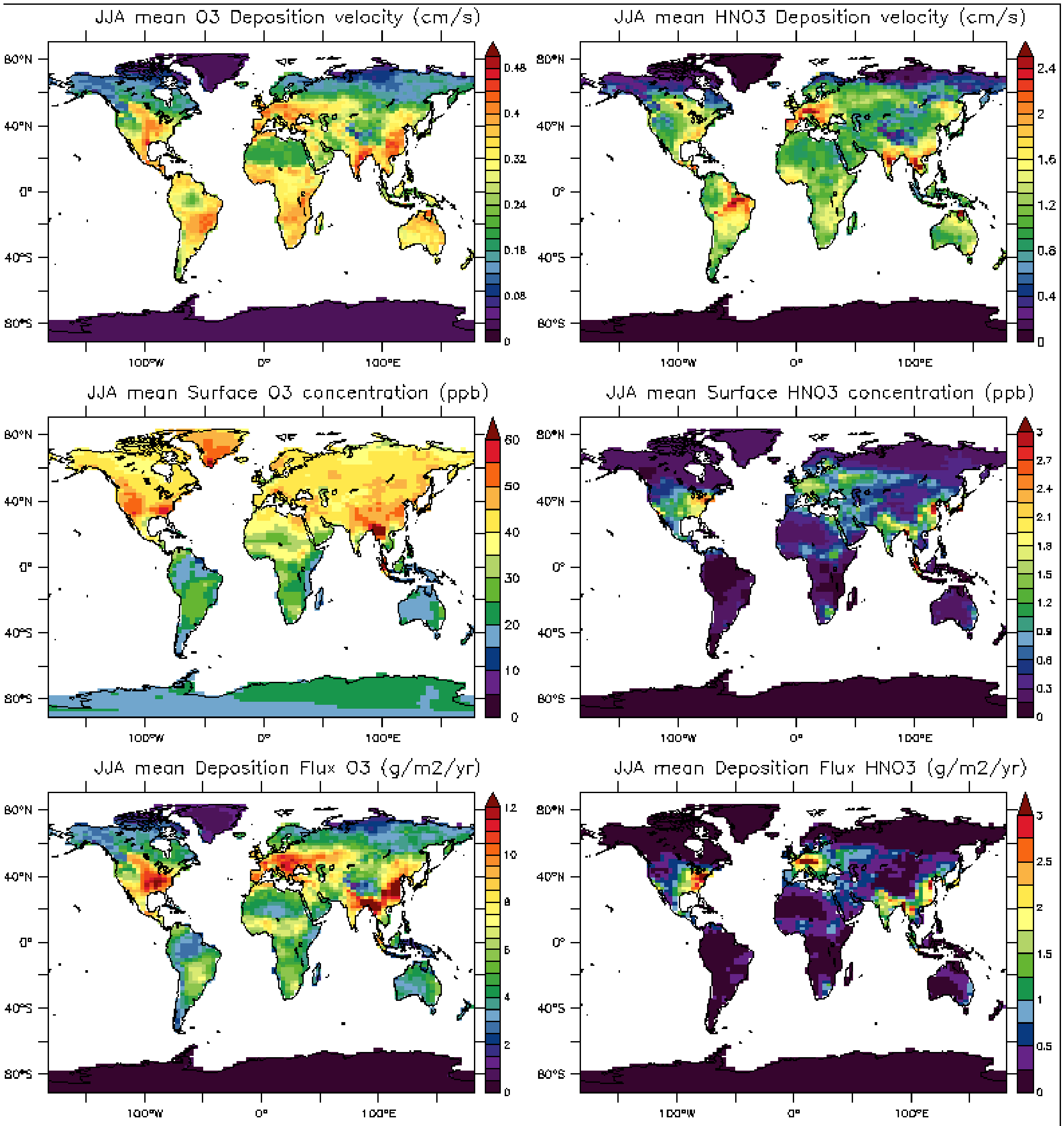

Figure S4: Same than Figure S3 for June-July-August.