Supplement of Atmos. Chem. Phys. Discuss., 15, 18459–18485, 2015
http://www.atmos-chem-phys-discuss.net/15/18459/2015/
doi:10.5194/acpd-15-18459-2015-supplement

Atmospheric Chemistry and Physics
Discussions
Open Access

Supplement of

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

T. Verbeke et al.

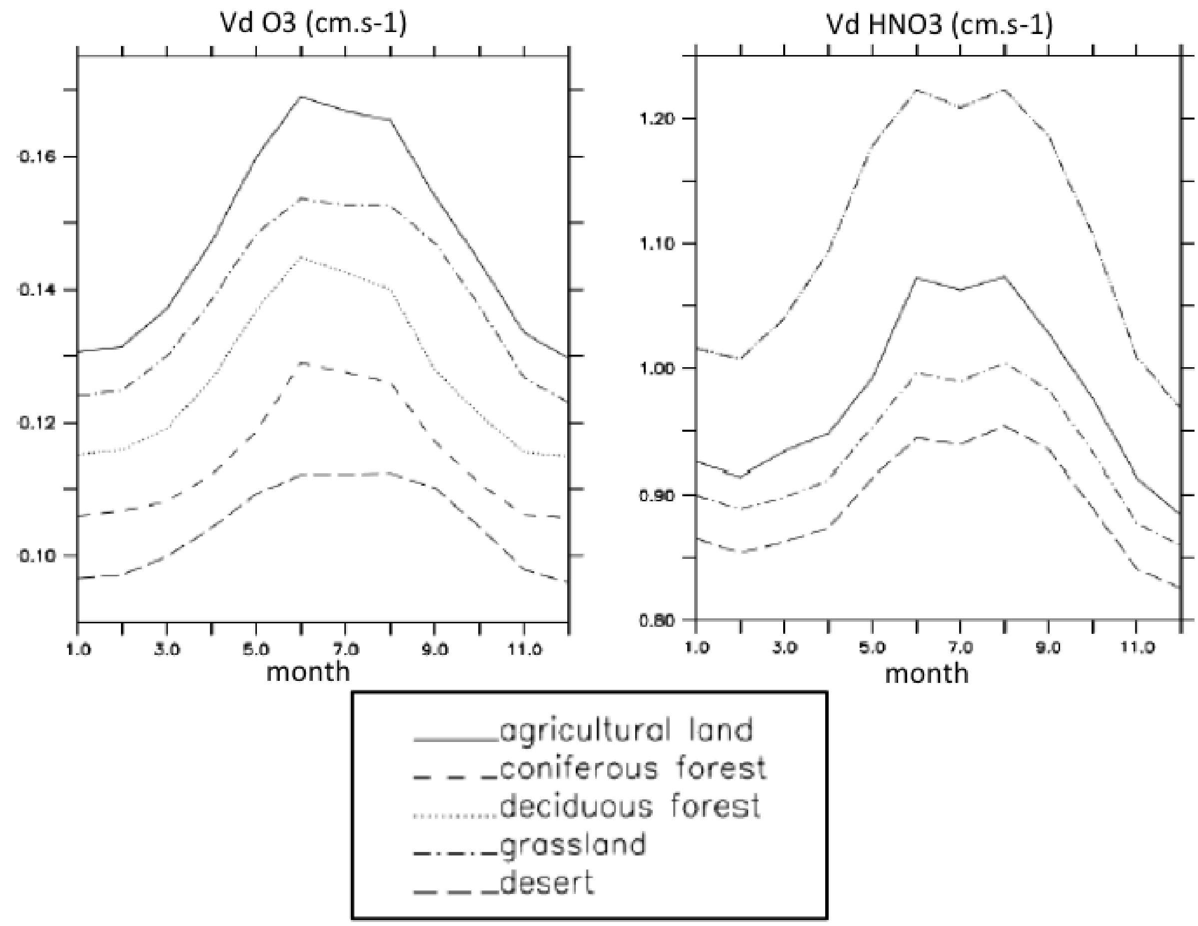
Correspondence to: J. Lathière (juliette.lathiere@lsce.ipsl.fr)

A. 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.

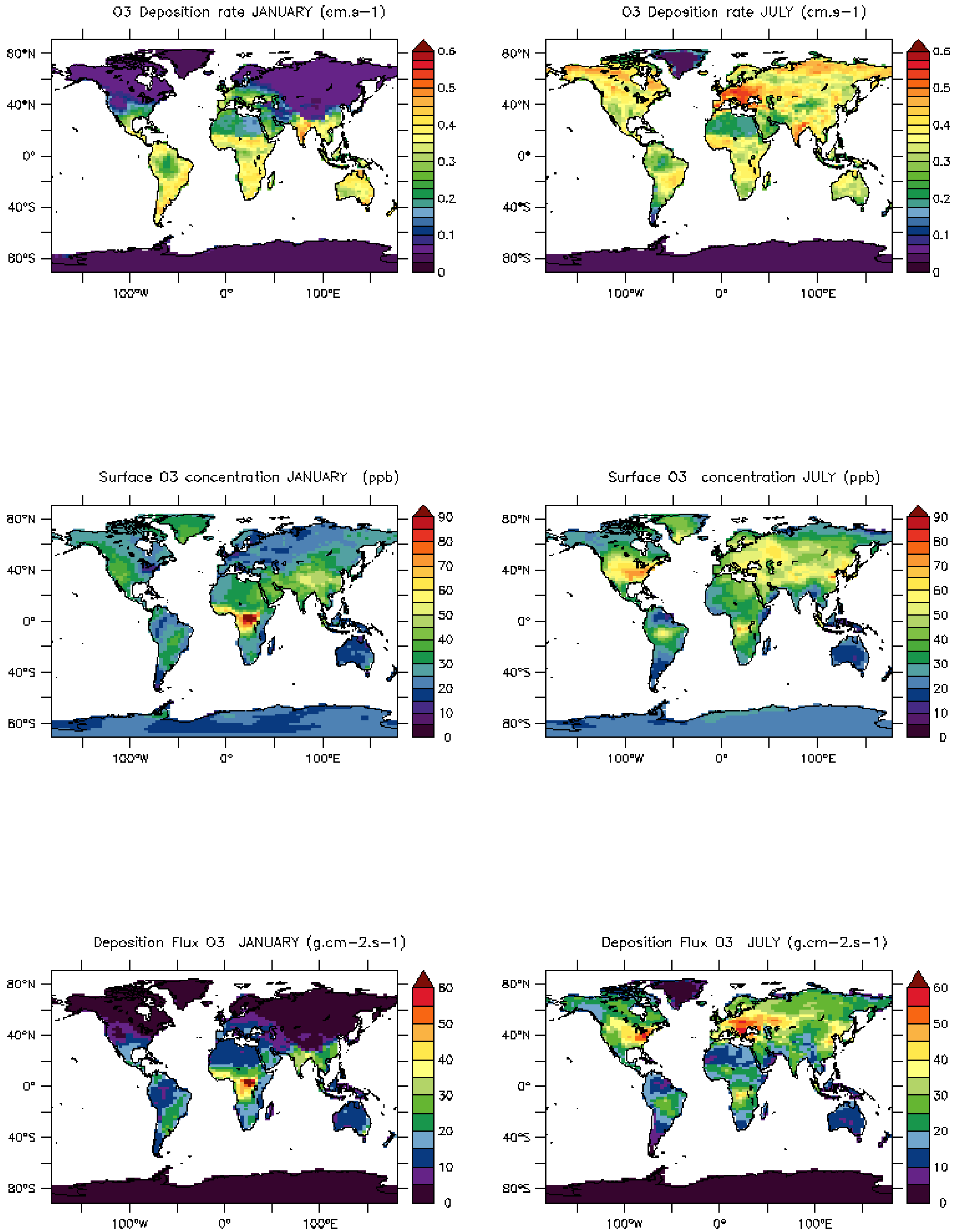
Set-Up

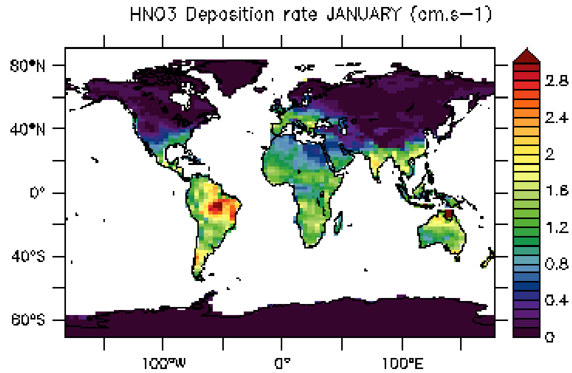
One set of five simulations is performed in order to assess the sensitivity of dry deposition to land cover types. Each run uses a different vegetation map containing only one land-type covering the whole Earth continental surface (except over main desertic regions like Sahara, Gobi, Antarctica and Arctic regions): agriculture (A), grassland (G), deciduous forest (D), coniferous forest (C) and barren land (B). We use the present-day climate, biogenic and anthropogenic emissions in every sensitivity tests. We mention that a shift in type of surface involving agriculture expansion 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.

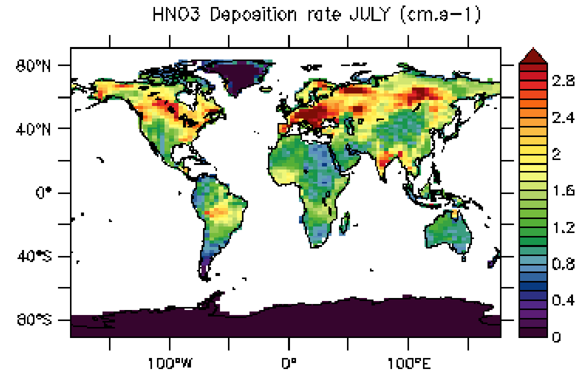


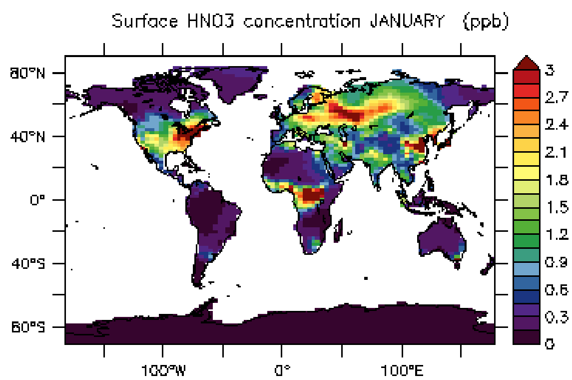
Sensitivity tests show a hierarchy in the type of land covers regarding deposition efficiency throughout the whole year and in every continental region: the calculated HNO3 dry deposition is maximal over forests (deciduous and coniferous) and minimal over bare soil (entire ranking: Deciduous, Coniferous > Agriculture > Grasslands > Bare soil). This is due to the strong dependency of VdHNO3 to surface roughness over land (typically, zo=1m for forests and zo=0.001-0.1m for agriculture), when highest surface roughness combined with high wind speed give a high HNO3 deposition velocity (Walcek et al., 1986). On the other hand, O3 dry deposition is maximal over small canopies vegetation and minimal over bare soil too (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 calculated a maximum December-February mean O_3 dry deposition velocity of 0.4 cm/s and 0.8 cm/s on average during the June-August period over cropland. Over deciduous forests, VdO_3 maximum value is about 0.2 cm/s and 0.5 cm/s respectively corresponding to the winter and summer periods.

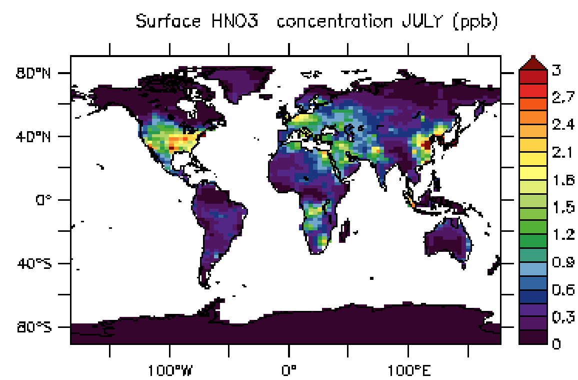
B. Monthly means of dry deposition, surface concentrations and deposited fluxes in January and July for O3 and HNO3 (present-day simulation)

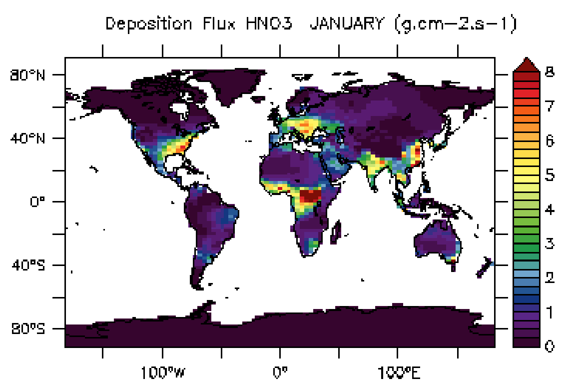

O3 Deposition rate JANUARY (cm.s−1)
O3 Deposition rate JULY (cm.s−1)
Surface O3 concentration JANUARY (ppb)
Surface O3 concentration JULY (ppb)
Deposition Flux O3 JANUARY (g.cm−2.s−1)
Deposition Flux O3 JULY (g.cm−2.s−1)
80°N
40°N
0°
40°S
80°S
100°W
0°
100°E
0 0.1 0.2 0.3 0.4 0.5 0.6
0 10 20 30 40 50 60 70 80 90
0 10 20 30 40 50 60

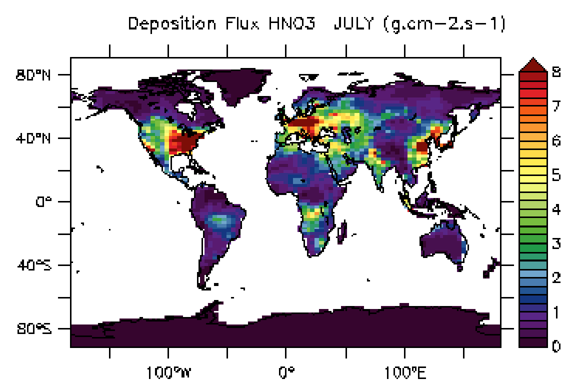

HNO3 Deposition rate JANUARY (cm.s−1)
80°N
40°N
0°
40°S
80°S
100°W
0°
100°E
2.8
2.4
2
1.6
1.2
0.8
0.4
0


HNO3 Deposition rate JULY (cm.s−1)
80°N
40°N
0°
40°S
80°S
100°W
0°
100°E
2.8
2.4
2
1.6
1.2
0.8
0.4
0


Surface HNO3 concentration JANUARY (ppb)
80°N
40°N
0°
40°S
80°S
100°W
0°
100°E
3
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0


Surface HNO3 concentration JULY (ppb)
80°N
40°N
0°
40°S
80°S
100°W
0°
100°E
3
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0


Deposition Flux HNO3 JANUARY (g.cm−2.s−1)
80°N
40°N
0°
40°S
80°S
100°W
0°
100°E
8
7
6
5
4
3
2
1
0


Deposition Flux HNO3 JULY (g.cm−2.s−1)
80°N
40°N
0°
40°S
80°S
100°W
0°
100°E
8
7
6
5
4
3
2
1
0

34