Supplementary Material for: *Influence of Amazonian deforestation on the future evolution of regional surface fluxes, circulation, surface temperature and precipitation.*

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S1 Methodology for the comparison between modelling studies

Nobre et al (2009) showed with their deforestation experiments that the mean changes in precipitation are in first-order approximation determined by the extent of deforestation, although the geometry of the deforestation pattern also plays a role. For this reason, on Fig. 7 we displayed the changes in surface temperature and in precipitation reported in the studies listed in Tables 3 and 4 against the percentage of deforestation implemented in the corresponding simulations. We defined this percentage of deforestation as the surface fraction of the rainforest which is removed on average over the Amazonian region, compared to the vegetation distribution of year ∼2000. In the two following sections, we present how the percentage of deforestation was calculated for each of the reported experiments.

S1.1 Calculation of the percentage of deforestation in the partial deforestation experiments

Our control simulation, that of both Moore et al (2007) and Walker et al (2009), as well as the PROVEG scenario of Correia et al (2008) use land cover maps representative of the vegetation distribution of the late 1990s or the early 2000s. Thus, the land cover map implemented in our control simulation is based on data from the Moderate-Resolution Imaging Spectroradiometer project (MODIS) that were collected in 2000/2001 (Hansen et al, 2003). The land-cover map of the control experiment of Moore et al (2007) and Walker et al (2009) was derived from satellite observations conducted in 2004 by the Instituto Nacional de Pesquisas Especiais (INPE), while that used for the PROVEG scenario of Correia et al (2008) is based on observations collected in 1997. We therefore

Reference	Description of the experiment in the original publication	Percentage of deforestation	Method of calculation
Moore et al (2007)	Business-as-Usual complete deforestation	12% 100%	Adapted from the Fig. 3 of Walker et al (2009)
Walker et al (2009)	complete deforestation except over Protected Areas	55%	Adapted from their Fig. 3
Correia et al (2008)	CEN2033 DESFLOR	23% 100%	value given at www.csr.ufmg.br/ simamazonia/ total deforestation
This study	DEF_50% DEF_A2 DEF_TOT	33% 66% 100%	fraction of trees over the Amazonian region as compared to the control

Table S1: Methodology for the calculation of the percentages of deforestation in each RCM deforestation experiment.

consider that these three maps represent the same state of the land cover, and assign them the same percentage of deforestation of zero. They therefore constitute baseline scenarios for the calculation of the percentage of deforestation in the corresponding deforestation experiments. This is done following a methodology explained below and summarized in Table S1.

The percentage of deforestation p in our deforestation experiments is calcuted as follows: $p = (1 - f_{def}/f_{ctl}) \times 100$, where f_{ctl} represents the average fraction of the grid cells of the Amazonian region (as defined on Fig. 1) that is occupied by trees in our control experiment, and f_{def} corresponds to the same fraction in the deforestation experiments. In their Figure 3, Walker et al (2009) report the percentages of deforestation implemented in their simulations and those of Moore et al (2007). Unlike us, they attributed a percentage of deforestation of 17% to their control scenario, because they considered that the zero-percent level corresponds to a pre-deforestation state. We consistently adapted the percentages of deforestation they report to the scale of deforestation that is used in this study.
The land cover map used by Correia et al (2008) for their CEN2033 experiment was produced by Soares-Filho et al (2006), who estimated that it represents a decline of forests by 23% as compared to 2001 (information available at http://www.csr.ufmg.br/simamazonia/) We therefore attributed a percentage of deforestation of 23% to this experiment.

S1.2 Validity of the comparison between recent and old control vegetation maps

We equally assigned a percentage of deforestation of 100% to the reported total deforestation experiments which were conducted with Global Circulation Models (GCMs, listed in Table 3) or with Regional Climate Models (RCMs, listed in Table 4), because they all implemented a vegetation map in which the whole Amazonian forest is replaced by pastures or grasslands. Unlike the land cover maps used in the RCM control experiments, which represent the vegetation distribution of the late 1990s or the early 2000s, most of those used in the GCM control simulations represent the state of the land cover as it was observed between the early 1970s and the early 1980s. Since intense deforestation started in the early 1970s in Amazonia, and Soares-Filho et al (2006) estimated that the cumulated deforested area amounted to 837,180 km^2 in 2001 (i.e $\sim$13% of the original extent of the forest, see their Supplementary Material), one may argue that these GCM experiments cannot be directly compared to those conducted with RCMs. Yet, we believe that the concerned GCMs can hardly capture such changes.

Grid cells of these GCMs indeed cover a surface of 65,000 to 420,000 km^2, in which, for most of these models, only the dominant vegetation type is represented. As deforestation is scattered within Amazonia, and is characterized by a fragmentation of the forest following the so-called 'fishbone pattern' rather than by its large-scale replacement, we do not expect the land cover maps representing the vegetation distribution of years 1970 and 2000 in these coarsely-resolved GCMs to be substantially different. Eventually, this should thus have a negligible influence on the comparison we conducted. Our finding that RCM studies do not not systematically show a lower climate sensitivity to total deforestation than GCM studies, underlined in Section 4.3 of the article, tends to support this argument.

Unlike the other GCM studies, Medvigy et al (2011) used a mesoscale resolution (25 km) over South America, but since the land cover map from their control experiment is based on satellite imagery data from 1992-1993, the comparison between their total deforestation experiment and those conducted with RCMs remains meaningful.

S1.3 Validity of the comparison between experiments of Amazonian versus tropical deforestation

In their total deforestation experiments, a few of the reported GCM studies use vegetation maps in which tropical forests are replaced by grasslands in both Amazonia and Indonesia (Henderson-Sellers et al, 1993), or in the whole tropical belt (Polcher and Laval, 1994a,b, Sud et al, 1996, Zhang et al, 1996, Voldoire and Royer, 2004, 2005). The literature dedicated to the investigation of remote effects of tropical deforestation suggests that these experiments can still be compared to those which implemented Amazonian deforestation only, and that the significant climatic changes simulated over the Amazonian region are almost exclusively due to local land cover changes. Hence, in their modelling study

Avissar and Werth (2005) found only limited, likely non-significant impacts of deforestation occurring in Central Africa and Southeast Asia on the Amazonian climate.
Another factor supporting the validity of our comparison is that the seven GCM studies that implemented deforestation in other tropical regions than Amazonia do not simulate systematically different mean changes in surface temperature and precipitation, compared to the other reported GCM studies. The changes in surface temperature they found indeed range from -0.11 to +3.8°C (median = 0.6°C), while for precipitation they range from -1.61 to +1.08 mm/d (median = -0.74 mm/d). For comparison purposes, we recall that the simulated changes in surface temperature for the whole set of 28 studies range from -0.5 to 3.8°C with a median value of +1.3°C, while for precipitation they range from -3.3 to +1.08 mm/d, with a median value of -0.74 mm/d.

S2 Complementary Analyses

S2.1 Estimate of the spread within the results from different studies

To assess whether the spread between the estimates of the changes in surface temperature and precipitation is statistically different within the "oldest" or the "newest" studies (see section 4.1 of the article), we use three different methods. Firstly, we compare the ranges between the first and ninth deciles of the simulated changes within each category of studies. Secondly, we perform two two-tailed Student's T-tests to test the null hypothesis that the mean of each category is different from 0, which gives us 95%-confidence intervals for the distribution of the simulated changes in surface temperature and precipitation in each category of studies. Finally, we perform two two-tailed Wilcoxon tests to test the same null hypothesis, but without implicitly assuming that the simulated changes are normally distributed within each category. For both T-tests and Wilcoxon tests, we compare the spreads of the computed 95%-confidence intervals for "oldest" and "newest" studies.

All of these three estimates agree that the spread between the estimates of the changes in surface temperature is smaller within the "newest" than within the "oldest" studies (Fig. S1, left part). For precipitation, only the Student's T-test shows less conclusive results.

S2.2 Discrimination between GCM studies using only the criterion of the publication date

To assess whether our conclusions regarding the influence of the historical development of climate models on the simulated results are sensitive to the method chosen to distinguish between "oldest" and "newest" studies (Section 4.1 of the article), we conducted the same analysis but applying the sole criterion of the publication date to discriminate between the two categories of studies. As discussed in the article, the results from this supplementary analysis still show that the spread in the deforestation-induced changes in

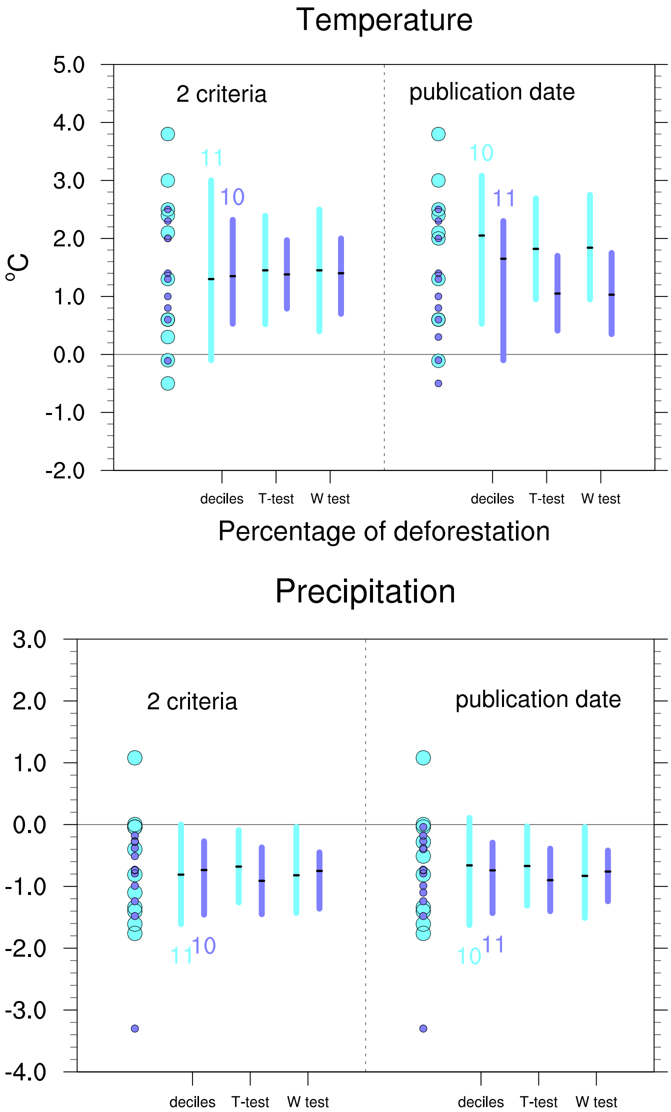

Figure S1: Effects of the historical development in modeling on the evolution of the uncertainty about the mean surface temperature (*top*) and precipitation (*bottom*) changes over Amazonia following total deforestation, estimated by different methods. *Left panel*: Estimates from oldest (big light blue dots) and newest GCMs (small dark blue dots) and range between the first and ninth deciles of each category (two leftmost vertical bars), as shown on Fig. 7 of the article. Other estimates of the spread are calculated with a T-test (two vertical bars in the middle) and a Wilcoxon test (two vertical bars on the right), which are used to test the hypothesis whether the mean (or median) of the two categories of models are different from 0. The computed 95%-confidence intervals are shown here. Numbers indicate the number of studies included in each category. *Right panel*: Same as the left panel, but models are discriminated in two categories according to the sole criterion of the publication date.

precipitation is reduced within the new studies compared to the old ones (right panels of Fig. S1). This is indicated by all of the three spread estimates we used.
However, regarding surface temperature the ranges between the first and ninth deciles of both "oldest" and "newest" studies are similar when considering the sole criterion of the publication date. This shows that the reduction in the spread within the "newest" studies compared to the "oldest" ones, as presented in Fig. 7a of the article, comes from the closest agreement between the latest studies of each series of experiments realised with the same GCMs. Besides, the mean of the "newest" studies is lower than that of the "oldest" studies when one only considers the criteria of the publication date.

S2.3 Influence of GCM development on the uncertainties about the effect of total deforestation on relative changes in precipitation

Similarly to the analysis conducted in the Section 4.1 of the article, we investigated whether the historical development in modeling had an influence on the simulated relative changes in precipitation induced by total deforestation. These were calculated as percentages of the annual mean rainfall amounts simulated in the control simulation, on average over the Amazonian region. The values for these relative changes in precipitation were reported in only 9 of the "oldest" studies listed in Table 2 the article, and 11 of the "newest" ones.

Both of these two categories show very close median relative changes in precipitation: -14% for the oldest studies and -15.6% for the newest ones (Fig. S2). A Wilcoxon-test gives us 60% confidence that these two medians are not statistically different. The spread between the first and ninth deciles of the "newest" studies is reduced compared to that of the "oldest" ones (from 28.2 to 23%, Fig. S2). This conclusion is confirmed by a Student's T-test and a Wilcoxon test (Fig. S3). If we consider the sole criterion of the publication date, the range between the first and ninth deciles of each category of studies is similar, but both the T-test and the Wilcoxon test indicate a reduced spread for the "newest" studies (Fig. S3).

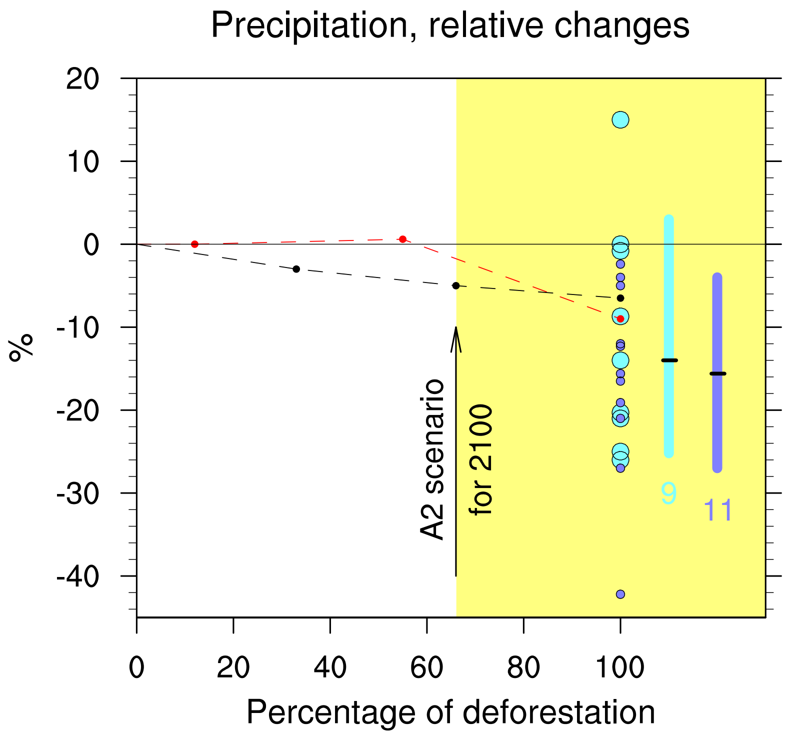

Figure S2: Relative changes in annual mean precipitation against percentage of deforestation, as simulated in this study and reported in previous ones. Big light blue dots represent the results from the "oldest" GCM studies, and the small black blue ones those from the "newest" GCM studies. Small markers stand for the results from our study (in black) or from the RCM study of Correia et al (2008) (in red). The 0% level of deforestation refers to present-day land cover. The vertical bars show the range between the first and ninth deciles for the "oldest" (light blue bar) and the "newest" studies (black blue bar). The horizontal black lines inside each bar indicate the median for each category of models, while the numbers above or below the bars indicate how many models were included in each category.

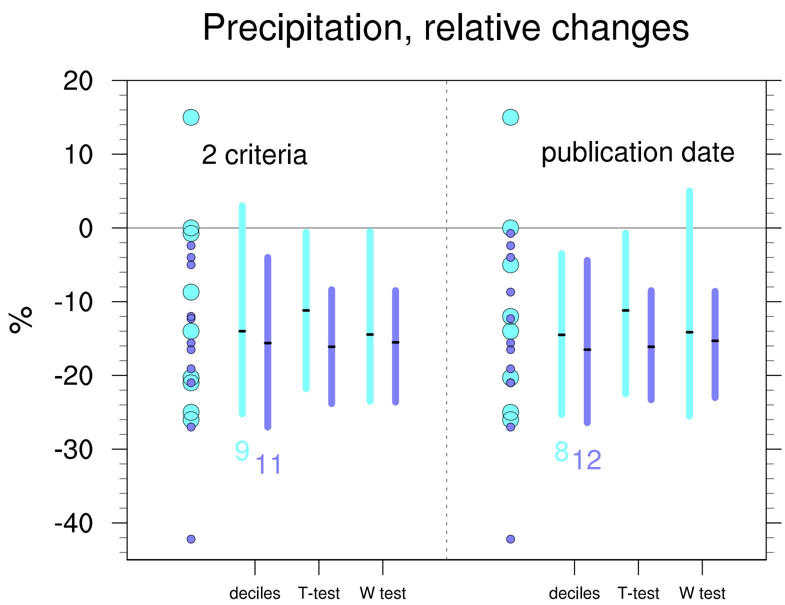

Figure S3: Same as Fig. S1, but for relative changes in annual mean precipitation.

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