**Simple guide to the reconstruction of the results 2011-2016 for Amazonia biome**

Ten tabs are presented in ***WORKSHEET\_FREL\_C***. These files, combined, provide all the data and calculations necessary for the reconstruction of the results for all years in the period 2011-2015, the adjusted values (increments and corresponding emissions) for this period, as well as the adjusted values for all years prior to 2011 of the values used in the construction of both FREL A and FREL B (same as in BUR II).

**TAB 1: 2011\_2015\_FULL DATA**

This TAB contains all the deforestation polygons observed in the period from 2011-2015, which are detailed in tabs D\_2011, D\_2012, D\_2013, D\_2014 and D\_2015 (the total in each one of these five tabs correspond to the total in tab NUVEM\_2, columns B and C, rows 25 – 29, for the annual increments and associated CO2 emissions for 2011 - 2015. The class\_name in column A provides the year associated with the observed polygon (e.g., d2011 indicates that the deforestation polygon was identified in 2011). Some of the polygons identified in a given year in the period considered may have been observed in year t (as indicated in column A), but the area associated with that polygon was cloud covered in previous year(s). Column B (ano\_nv) indicates the year since that area was last seen without clouds. For example, for a deforestation polygon identified in 2011 (d2011) and with ano\_nv = 2009, this implies that area of the polygon identified in 2011 was under clouds since 2009 (no observation of that area in 2009 **and** 2010). The adjusted increment approach takes this into account, assuming that an allocation of the area deforested only to year 2011 could overestimate the annual deforestation. So, the area of the polygon (and associated emissions) are distributed evenly among years 2009, 2010 and 2011. Column J (area\_ha) of the file in this TAB provides the area of the deforestation polygon in hectares, whereas column G provides the forest physiognomy associated with the polygon (c\_pret), with the total biomass (living biomass + litter) indicated in column I (c\_c\_2i) in tonnes of CO2. Hence, the area associated with each deforestation polygon and the corresponding emission are provided in this TAB.

**TAB 2: ANO2011\_NUVEM2009 *(YEAR2011\_CLOUD2009)***

The data in this TAB 2 is a subset of the data in TAB 1, sorting out only those deforestation polygons identified in year 2011 and whose areas were under clouds since year 2009. So the list contains only part of the deforestation polygons observed in 2011. Column J contains the area of the deforestation polygons observed in 2011 that were under clouds since 2009. The 6,821 polygons of this nature have a total area of 21,903.38 ha (refer to line 6823, column J), and associated total emission of 15,917,617.89 tonnes CO2 (refer to line 6823, column K). This total area and total emission, distributed equally among years 2009, 2010 and 2011 yield an area of 7,301.13 ha/year and emission of 5,305,872.63 tonnes CO2 (refer to lines 6823 and 6824, columns J and K, respectively; and tab NUVEM, columns O, P, Q, R row 13 for increment, and row 25 for emission).

**TAB 3: NUVEM *(CLOUD)***

This TAB contains the distribution of the areas of the deforestation polygons identified at years 2011, 2012, 2013, 2014 and 2015, among the years when those areas were persistently covered by clouds.

Here we provide the example for year 2011.

The data in lines 5-14, columns B to Q refer to the areas distributed since 1996 (some deforestation polygons observed in 2011 had their areas under clouds since 1996, but these were very excepcional). Only an area of 1 ha has been observed under these conditions (refer to column R – Total area, line 5) – this total, distributed in 16 years, originated the value of 0,06 ha allocated in line 5 to years 1996 (column B) until 2011 (column Q). Other deforestation areas identified in 2011 that were cloud covered in previous years are:

* 1.41 ha with clouds since 2000 (so this total was divided by 12, originating the value of 0.12 ha allocated in line 6 to years 2000 (column F) until 2011 (column Q);
* 0.08 ha with clouds since 2002 (so this total was divided by 10, originating the value of 0.01 ha allocated in line 7 to years 2002 (column H) until 2011 (column Q);
* 4.54 ha with clouds since 2004 (so this total was divided by 8, originating the value of 0.57 ha allocated in line 8 to years 2004 (column J) until 2011 (column Q);
* 14.26 ha with clouds since 2005 (so this total was divided by 7, originating the value of 2,04 ha allocated in line 9 to years 2005 (column K) until 2011 (column Q);
* 239.95 ha with clouds since 2006 (so this total was divided by 6, originating the value of 39.99 ha allocated in line 10 to years 2006 (column L) until 2011 (column Q);
* 5,030.42 ha with clouds since 2007 (so this total was divided by 5, originating the value of 1,006.08 ha allocated in line 11 to years 2007 (column M) until 2011 (column Q);
* 12,130.39 ha with clouds since 2008 (so this total was divided by 4, originating the value of 3,032.60 ha allocated in line 12 to years 2008 (column N) until 2011 (column Q);
* 21,903.38 ha with clouds since 2009 (so this total was divided by 3, originating the value of 7,301.13 ha allocated in line 13 to years 2009 (column O) until 2011 (column Q); and
* 29,208.56 ha with clouds since 2010 (so this total was divided by 2, originating the value of 14,604.28 ha allocated in line 14 to years 2010 (column P) until 2011 (column Q)

Line 15, columns B to Q provide the total areas allocated to years 1996 (column B) to 2011 (column Q), adding to 68,533.99 ha.

The data in lines 17-26, columns B to Q refer to the emissions distributed since 1996 (some deforestation polygons observed in 2011, associated with the areas indentified in lines 5-14, columns B to Q. The procedure of distribution of emissions is the same as that carried out for the distribution of areas among the years with persistent cloud cover. The information below is provided just for completeness and transparency sake.

The total emission in line 17, column R, equal to 832.20 t CO2 was equally distributed among years 1996 to 2011, resulting in an annual emission of 52.01 t CO2 (832.20/12). Other emissions associated to the deforested areas under clouds in previous year(s) follows:

* 1,151.67 t CO2 associated with area under clouds since 2000 (so this total was divided by 12, originating the value 95.97 t CO2 allocated in line 18 to years 2000 (column F) until 2011 (column Q);
* 70.61 t CO2 associated with area under clouds since 2002 (so this total was divided by 10, originating the value 7.06 t CO2 allocated in line 19 to years 2002 (column H) until 2011 (column Q);
* 2,600.70 t CO2 associated with area under clouds since 2004 (so this total was divided by 8, originating the value 325.09 t CO2 allocated in line 20 to years 2004 (column J) until 2011 (column Q);
* 8,324.41 t CO2 associated with area under clouds since 2005 (so this total was divided by 7, originating the value 1,189.20 t CO2 allocated in line 21 to years 2005 (column K) until 2011 (column Q);
* 184,341.24 t CO2 associated with area under clouds since 2006 (so this total was divided by 6, originating the value 30,723.54 t CO2 allocated in line 22 to years 2006 (column L) until 2011 (column Q);
* 3,923,804.35 t CO2 associated with area under clouds since 2007 (so this total was divided by 5, originating the value 784,760.67 t CO2 allocated in line 23 to years 2007 (column M) until 2011 (column Q);
* 9,417,959.83 t CO2 associated with area under clouds since 2008 (so this total was divided by 4, originating the value 2,354,489.96 t CO2 allocated in line 24 to years 2008 (column N) until 2011 (column Q);
* 15,917,617.89 t CO2 associated with area under clouds since 2009 (so this total was divided by 3, originating the value 5,305,872.63 t CO2 allocated in line 25 to years 2009 (column O) until 2011 (column Q); and
* 17,359,798.75 t CO2 associated with area under clouds since 2010 (so this total was divided by 2, originating the value 8,679,899.37 t CO2 allocated in line 26 to years 2010 (column P) until 2011 (column Q).

Line 27, columns B to Q provide the total emissions allocated to years 1996 (column B) to 2011 (column Q), adding to 46,816,501.65 t CO2.

This same procedure, adopted for years 2012, 2013, 2014 and 2015 lead to the following results:

**Table 1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Total Area Reallocated 1996-year (ha) | Line | Column | Total Emission Reallocated 1996-year (t CO2) | Line | Column |
| 2011 | 68,533.99 | 15 | R | 46,816,501.65 | 27 | R |
| 2012 | 13,037.47 | 41 | S | 7,766,829.01 | 52 | S |
| 2013 | 28,467.38 | 15 | AM | 18,419,287,44 | 27 | AM |
| 2014 | 52,828.18 | 44 | AN | 34,430,034.39 | 58 | AN |
| 2015 | 96,620.42 | 77 | V | 64,496,446.94 | 92 | V |
| TOTAL | 259,487.43 | 104 | V | 171,929,088.00 | 112 | V |

**TAB 4: NUVEM\_2 *(CLOUD\_2)***

The data (area) in lines 3-7 columns B (1996) to U (2015) reproduce those presented in TAB NUVEM for year 2011, in line 15, column R; for year 2012, in line 41, column S; for year 2013, in line 15, column AM; for year 2014, in line 44, column AN; and for year 2015, in line 77, column V. Line 8 presents the distribution of the areas from year 1996 (column B) until year 2015 (column U). The data in column V reproduce the values presented in column Total Area Reallocated 1996-year (ha) in table 1 above.

The data (emission) in lines 11-15 columns B (1996) to U (2015) reproduce those presented in TAB NUVEM for year 2011, in line 27, column R; for year 2012 in line 52, column S; for year 2013, in line 27, column AM; for year 2014, in line 58, column AN; and for 2015, in line 92, column V. Line 16 presents the distribution of the emissions from year 1996 (column B) until year 2015 (column U). The data in column V reproduce the values presented in column Total Emission Reallocated 1996-year (t CO2) in table 1 above.

Lines 24 to 43, columns I to Q provide the following information for years 1996 to 2015, respectively:

Regarding the total area of deforestation from 2011-2015 reallocated to previous year(s), the following information is provided in columns J to M:

Lines 39 to 43, column J provide the total area of deforestation (increment) identified in each year from 2011 to 2015, respectively. So, for year 2011, the total area (increment) of deforestation totals 536,621.30 ha (line 39). Of these, an area of 68,533.99 ha was identified as being under clouds in previous year(s) (refer to line 39, column M – area(-)) and is thus discounted of the total area, leaving a total of 468,087.31 ha that is not reallocated. However, year 2011 gains area from years 2011, 2012, 2013, 2014 and 2015, as follows – refer to TAB NUVEM: 25,986.87 ha (see line 15, column Q); 5,872.74 ha (see line 41, column Q); 875.20 ha (see line 15, column AJ) ; 341.68 ha (see line 44, column AJ); and 242.61 ha (see line 77, column Q). These five values total 33,319.10 ha (refer to line 39, column K – (area +) in this TAB), which are added to the remaining total for year 2011, of 468,087.31 ha, resulting in a total of 501,406.41 ha (see line 39, column M in this TAB).

A summary of the information for all years are provided in Table 2 (for areas) and Table 3 (for emissions).

**Table 2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| YEAR | Area (-)  (refer to table 1) | Area (+)  (ha) | Lines/Columns in TAB NUVEM  Total in TAB NUVEM\_2 | Final area (ha) =  Total area of deforestation – area(-) + area(+) |
| 2011 | 68,533.99 | 25,986.87  5,872.74  875.20  341.68  242.61  33,319.1 | Line 15 column Q  Line 41 column Q  Line 15 column AJ  Line 44 column AJ  Line 77 column Q  Total line 39 col K | 536,621.30 – 68,533.99 + 33,319.10 = **501,406.41** |
| 2012 | 13,037.47 | 5,872.74  13,579.87  3,982.87  3.531.33  26,967.33 | Line 41 column R  Line 15 column AK  Line 44 column AK  Line 77 column R  Total line 40, col K | 411,569.64 – 13,037.47 + 26,967.33 = **425,499.51** |
| 2013 | 28,467.38 | 13,579.87  24,179.44  20,114.67  57,873.98 | Line 15 column AL  Line 44 column AL  Line 77 column S  Total line 41, col K | 508,450.53 – 28,467.38 + 57,873.98 = **537,857.10** |
| 2014 | 52,828.18 | 24,179.44  36,293.33  60,472.77 | Line 44 column AM  Line 77 column T  Total line 42, col K | 483,206.86 – 52,828.18 + 60,472.77 = **490,851.45** |
| 2015 | 96,620.42 | 36,293.33  36,293.33 | Line 77 column U  Total line 43, col K | 584,383.03 – 96,620.46 + 36,293.33 = **524,055.94** |
| Total | 259,487.44 | 214,926.50 |  | **2,479,671.56** |
|  | Note: the difference between area(-) and area(+) of 44,560.96 ha is reallocated to years prior to 2011, as indicated in lines 24 to 38, column K (in tab NUVEM\_2). | |  | Note: the original total, without the realocation, results in 2,524,232.50 ha (see lines 39-43, column J, ta4 NUVEM\_2). The same total results from the allocation of data to previous years (see lines 24-43, column M, TAB NUVEM\_2). |

**Table 3**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| YEAR | Emission (-)  (refer to table 1) | Emission (+)  (t CO2) | Lines/Columns in TAB NUVEM  Total in TAB NUVEM\_2 | Final emission  (t CO2) =  Total emission from deforestation – emission (-) + emission (+) |
| 2011 | 46,816,501.65 | 17,157,415.71  3,482,721.09  563,743.61  210,087.42  153,480.60  21,567,448.43 | Line 27 column Q  Line 52 column Q  Line 27 column AJ  Line 58 column AJ  Line 92 column Q  Total line 39 col O | 310,756,847.84 – 46,816,501.65 + 21,567,448.43 = **285,507,794.61** |
| 2012 | 7,766,829.01 | 3,482,721.09  8,788,613.12  2,860,368.23  2,641,330.63  17,773,033.07 | Line 52 column R  Line 27 column AK  Line 58 column AK  Line 92 column R  Total line 40, col 0 | 226,677,950.38 –7,766,829.01+ 17,773,033.07= **236,684,154.44** |
| 2013 | 18,419,287.44 | 8,788,613.12  15,634,095.62  13,736,801.50  38,159,510.24 | Line 27 column AL  Line 58 column AL  Line 92 column S  Total line 41, col O | 282,107,628.10 –18,419,287.44+ 38,159,510.24= **301,847,850.91** |
| 2014 | 34,430,034.39 | 15,634,095.62  23,936,793.23  39,570,888.85 | Line 58 column AM  Line 92 column T  Total line 42, col O | 268,450,746.13 –34,430,034.39 + 39,570,888.85= **273,591,600.59** |
| 2015 | 64,496,446.94 | 23,936,793.23  23,936,793.23 | Line 92 column U  Total line 43, col O | 328,224,900.10 – 64,496,446.94 + 23,936,793.23 =  **287,665,246.39** |
| Total | **171,929,099.44** |  |  | **1,385,296,646.93** |
|  |  | |  | **Note:** The emissions without adjustments total 1,416,218,072.55 t CO2 (lines 39 to 32, column N in file NUVEM\_2). The same total results from the adjusted values (see lines 24 to 43, column Q). It results from the sum of the emissions from 2011-2015 (1,385,296,646.93) and the total 30,921,425.62, distributed to years 1996 – 2010 (see lines 24 to 38, column Q in file NUVEM\_2). |

**TAB 5: Final\_Table\_Cloud\_Adjust**

This table is a synthesis of the information provided in the previous TABs, and refers also to be data in the modified submission of the FREL C for Amazonia.

The data in rows 4 – 23, **columns C and D**, reproduce values from TAB **NUVEM\_2**, lines 24-43, **column M**; and lines 24 – 43, **column Q**, respectively.

Data in lines 4 – 18, **column E**, provide the estimated adjusted increment for years 1996 – 2010 using data from 2011-2015, i.e. adding to the adjusted deforestation increments in Table 1 of the FREL A and FREL B submission (reproduced in **column J**, lines 4 to 18), the corresponding values in lines 4 – 18 in **column C**. The values for the period 2011 - 2015 in rows 19-23 are the **adjusted** increments of deforestation, i.e. they exclude the increments that should have been allocated to years prior to 2011, totaling 44,560.94 ha (sum of values in **column C**, lines 4 – 18).

**NOTE 1: in the original submission of FREL C, the annual adjusted deforestation increments in Table 1, for years 1996-2010, reproduce the values in Table 1 of the FREL A and FREL B submission, i.e., they have not been adjusted considering the redistribution of data from analysis of data from 2011-2015 (redistribution of area according with data in column C, lines 4 – 18). This means that an area of 44,560.94 ha has been “lost” in the original FREL C submission.**

**NOTE 2: Column J, line 23, gives the total increments from 1996-2010 without the redistribution of increments from 2011-2015 (25,534,164.17 ha). Line 24 gives the total increments from 1996 – 2010 with the redistributed increments from 2011 – 2015 (25,578,725.11 ha). Line 25 gives the difference between these two values (44,560.94 ha, as indicated in note 1) and line 27 gives the percent difference of 0.17%. This implies that the “lost” increment responds for only 0.17% of the total increments of deforestation from 1996 – 2010.**

Data in lines 4 – 18, **column F**, provide the annual adjusted CO2 emissions from deforestation for years 1996 – 2010 using data from 2011-2015, i.e. adding to the adjusted annual CO2 emissions from gross deforestation in Table 1 of the FREL A and FREL B submission (reproduced in **column K**, lines 4 to 18), the corresponding values in lines 4 – 18 in **column D**. The values for the period 2011 - 2015 in rows 19-23 are the **adjusted** CO2 emissions from gross deforestation, i.e. they **exclude** the CO2 emissions that should have been allocated to years prior to 2011, totaling 30,921,425.62 t CO2 (sum of values in **column D**, lines 4 – 18).

**NOTE 3: in the original submission of FREL C, the annual CO2 emissions from gross deforestation in Table 1, for years 1996-2010, reproduce the corresponding values in Table 1 of the FREL A and FREL B submission, i.e., they have not been adjusted considering the redistribution of data from analysis of data from 2011-2015 (redistribution of emissions according with data in column D, lines 4 – 18). This means that a total of 30,921,425.62 t CO2 has been “lost” in the original FREL C submission.**

**NOTE 4: Column J, line 31, gives the total CO2 emissions from 1996-2010 without the redistribution of the CO2 emissions from 2011-2015 (13,619,391,994.93 t CO2). Line 32 gives the total CO2 emissions from 1996 – 2010 with the redistributed increments from 2011 – 2015 (13,650,313,420.55 t CO2). Line 33 gives the difference between these two values (30,921,425.62 t CO2), as indicated in note 3) and line 34 gives the percent difference of 0.23%. This implies that the “lost” t CO2 responds for only 0.23% of the total CO2 emissions from 1996 – 2010.**

**Column G**, lines 4 to 23, provides from line 4 – 18, the values in the original FREL C submission (which corresponds to the values in the FREL A and FREL B submission) and the **unadjusted** CO2 emission values for 2011 – 2015. Hence, this column provides the values without any “loss” of emissions and corresponds to the CO2 emissions from the **observed increments** of gross deforestation from 2011 – 2015.

**NOTE 5: Observe that in case no adjustment is made to the values of 2011 – 2015 (see values without adjustment in tab NUVEM\_2, column C, lines 26 – 30) and the values in the original FREL C submission are maintained (see column K, lines 4 – 18), the FREL C value would be exactly the same (751,780,503.37 t CO2 – see line 25 in column G).**

**Column H**, line 4 is the sum of the difference between the unadjusted emissions (column F for 1996-2010, lines 4 to 18) (same as in the original FREL C submission = FREL A and FREL B submission) and the corresponding adjusted values in column G for years 1996 – 2010 (column G), using data from 2011 – 2015 data. **Column H**, line 19, is the sum of the difference between the adjusted values for 2011 – 2015 (column F, lines 19 – 23, as in the original FREL C submission) and the corresponding unadjusted values for the same period (column G).

This guide also provides information regarding the data in ***Table 8 - Emission estimates from gross deforestation using the carbon maps in the II and III National GHG Inventories*** *using the same carbon pools and their difference (see columns C to H, lines 37 – 51, for years 2001 – 2015); and using the carbon map of the III GHG National Inventory including the dead wood pool, and their difference (see columns I - L*, rows37 to 51).

Information regarding the data in ***Table A.2: Emission estimates from PRODES and FREL deforestation adjusted data (in ha) and related CO2 adjusted emissions (tCO2), using data from 2011-2015*** from rows 60 to 86, colums A to K.