The PRIMAP-hist national historical emissions time series (1850-2015) (v1.2, updated December 2017)

1 Recommended citation

Gütschow, J.; Jeffery, L.; Gieseke, R.; Gebel, R. (2017): The PRIMAP-hist national historical emissions time series v1.2 (1850-2015). GFZ Data Services. https://doi.org/10.5880/PIK.2018.003

2 Content

3 Use of the dataset and full description

Before using the dataset, please read this document and the article describing the methodology, especially the section on uncertainties and the section on limitations of the method and use of the dataset.

Gütschow, J.; Jeffery, L.; Gieseke, R.; Gebel, R.; Stevens, D.; Krapp, M.; Rocha, M. (2016): The PRIMAP-hist national historical emissions time series, Earth Syst. Sci. Data, 8, 571-603, https://doi.org/10.5194/essd-8-571-2016

Please notify us (johannes.guetschow@pik-potsdam.de) if you use the dataset so that we can keep track of how it is used and take that into consideration when updating and improving the dataset.

When using this dataset or one of its updates, please cite the DOI of the precise version of the dataset used and also the data description article which this dataset is supplement to (see above). Please consider also citing the relevant original sources when using the PRIMAP-hist dataset. See the full citations in the References section further below.

4 Support

If you need support in using the dataset or have any other questions regarding the dataset, please contact johannes.guetschow@pik-potsdam.de.

5 Abstract

The PRIMAP-hist dataset combines several published datasets to create a comprehensive set of greenhouse gas emission pathways for every country and Kyoto gas covering the years 1850 to 2015, and all UNFCCC (United Nations Framework Convention on Climate Change) member states, as well as most non-UNFCCC territories. The data resolves the main IPCC (Intergovernmental Panel on Climate Change) 1996 categories. For CO_2 from energy and industry, time series for subsectors are available.

The PRIMAP-hist v1.2 dataset is an updated version of

Gütschow, J.; Jeffery, L.; Gieseke, R.; Gebel, R. (2017): The PRIMAP-hist national historical emissions time series v1.1 (1850-2014). GFZ Data Services. https://doi.org/10.5880/PIK.2017.001.

Please consult the Changelog below for a detailed description of the changes between versions.

6 Sources

UNFCCC National Communications and National Inventory Reports for developing countries: UNFCCC (2017b)

UNFCCC Biennal Update Reports: UNFCCC (2016b)

UNFCCC Common Reporting Format (CRF): UNFCCC (2017a) (processed CRF2017 data: Jeffery et al. (2018a)), UNFCCC (2016a) (processed as described in Jeffery et al. (2018b))

BP Statistical Review of World Energy: British Petroleum (2017)

CDIAC: Boden et al. (2017)

EDGAR versions 4.2 and 4.2 FT2010:: JRC and PBL (2011), Olivier and Janssens-Maenhout (2012)

FAOSTAT database: Food and Agriculture Organization of the United Nations (2016)

Houghton land use CO_2: Houghton (2008)

RCP historical data: Meinshausen et al. (2011)

EDGAR-HYDE 1.4: Van Aardenne et al. (2001), Olivier and Berdowski (2001),

HYDE land cover data: Klein Goldewijk et al. (2010), Klein Goldewijk et al. (2011)

SAGE Global Potential Vegetation Dataset: Ramankutty and Foley (1999)

FAO Country Boundaries: Food and Agriculture Organization of the United Nations (2015)

7 Files included in the dataset

PRIMAP-hist_v1.2_14-Dec-2017.csv: With numerical extrapolation of all time series to 2014.

PRIMAP-hist_no_extrapolation_v1.2_14-Dec-2017.csv: Without numerical extrapolation of missing values and not including the groups mentioned below.

8 Notes

Emissions from international aviation and shipping are not included in the dataset.

9 Data format description (columns)

9.1 "scenario"

Always "HISTORY".

9.2 "country"

ISO 3166 three-letter country codes or custom codes for groups:

Table 1: Additional "country" codes.

Code	Region description
EARTH	Aggregated emissions for all countries.
ANNEXI	Annex I Parties to the Convention
NONANNEXI	Non-Annex I Parties to the Convention
AOSIS	Alliance of Small Island States
BASIC	BASIC countries (Brazil, South Africa, India and China)
EU28	European Union
LDC	Least Developed Countries
UMBRELLA	Umbrella Group

9.3 "category"

IPCC (Intergovernmental Panel on Climate Change) 1996 categories for emissions

Table 2: Category descriptions using IPCC 1996 terminology.

Category code	Description
CAT0	National Total
CATM0EL	National Total excluding LULUCF
CAT1	Total Energy
CAT1A	Fuel Combustion Activities
CAT1B1	Fugitive Emissions from Solid Fuels
CAT1B2	Fugitive Emissions from Oil and Gas
CAT2	Industrial Processes
CAT2A	Mineral Products
CAT2B	Chemical Industries
CAT2C	Metal Production
CAT2D	Other Production
CAT2G	Other
CAT3	Solvent and Other Product Use
CAT4	Agriculture
CAT5	Land Use, Land Use Change, and Forestry (LULUCF)
CAT6	Waste
CAT7	Other

9.4 "entity"

Gas categories using global warming potentials from either Second Assessment Report (SAR) or Assessment Report 4 (AR4).

Table 3: Gas categories and used global warming potential

Code	Description
CH4	Methane
CO2	Carbon Dioxide
FGASES	Fluorinated Gases (SAR)
FGASESAR4	Fluorinated Gases (AR4)
HFCS	Hydrofluorocarbons (SAR)
HFCSAR4	Hydrofluorocarbons (AR4)
KYOTOGHG	Kyoto greenhouse gases (SAR)
KYOTOGHGAR4	Kyoto greenhouse gases (AR4)
N2O	Nitrous Oxide
PFCS	Perflurocarbons (SAR)
PFCSAR4	Perflurocarbons (AR4)
SF6	Sulfur Hexafluoride

9.5 "unit"

Unit is either Gg or GgCO_2eq (CO_2-equivalent according to the global warming potential used).

9.6 Remaining columns

Years from 1850-2015.

10 Changelog

10.1 v1.2 (December 2017)

The v1.2 release uses new input data. CRF data have been updated to the 2017 and 2016 releases, CDIAC and BP data have been updated to their 2017 releases and the UNFCCC Non-Annex I data have been updated to the status of August 2017.

10.1.1 Changes in PRIMAP-hist source creation

- The method to fill gaps in time series has been changed. In v1.1 gaps in higher priority time series were linearly interpolated to enable the calculation of trends for the combination of time-series from different data sources even if the time-series contained only few data points. This method can not be used any more as we now include UNFCCC data for China which has data for only three years. Linear interpolation overestimates emissions in the late 1990s where the Asian financial crisis lead to declining emissions (with a steep increase after the crisis). In v1.2 gaps are filled with data from lower priority time series (where available) in the following way: the linear trend for the gap period is calculated both for the time series with the gap and the time series used to fill the gap. Then the deviation from the trend is calculated for the time series used to fill the gap. Scaling factors between the two time series are calculated for the left and right boundary of the gap. They are capped using the same bound as for the extension with lower priority time series (a factor of 3 (1/3)). The final time series to fill the gap is constructed as the sum of the linear trend of the higher priority time series and the scaled deviation from trend of the lower priority time series. The scaling uses a linear interpolation between the scaling at the left and right boundaries. This change affects all countries that have reported only a few years under UNFCCC2017B data, however for most countries the differences are small. Details are presented in the *noteworthy changes* section.
- Changes in extrapolation trend calculations: in some cases the time span to calculate linear trends for the extrapolation starting points have changed.

  - LULUCF, CO_2, future extrapolation: FAOSTAT LULUCF data has a change in methodology in 2011 (inclusion of forest degradation and regrowth) leading to abrupt changes in estimates of emissions and removals. To avoid calculating an average over data calculated using different methodologies we shorten the period to calculate the average to 4 years (2011 - 2014). The average is used to extrapolate data to 2015.
  - LULUCF, all gases. The trend used to calculate the starting point for extrapolations to the past is now calculated over 20 years instead of 30 years to avoid the use of different unharmonized data sources in the trend calculation.
  - BP data is only used to amend a single year to energy CO_2 time series. We therefore no longer use a trend calculation to determine the starting point for the extrapolation but use the last data point of the higher priority source directly.
- Historical extrapolation for LULUCF, CH_4: until v1.1 we used EDGARHYDE data for the extrapolation. However, for some regions the EDGARHYDE data have non-zero emissions only between 1960 and 1985 - 1990 which is inconsistent with other sources. We therefore switched to RCP data which is available on a level of 5 regions. As RCP data is defined starting in 1850 the linear interpolation for 1850 - 1890 is no longer necessary.

10.1.2 Changes in data sources and preprocessing

10.1.2.1 Input source updates

- CRF data has been updated to the 2017 release with the 2016 release used as backup for missing 2017 data.
  - The last data year is now 2015 for all categories and gases
  - CRF data since 2015 follows the IPCC2006 guidelines. Therefore reported emissions have changed, especially for fugitive emissions and CH_4 and $N\_2\$O$ from agriculture and land use. See also Jeffery et al. (2018b) and Jeffery et al. (2018a).
- CDIAC fossil CO_2 data has been updated to the 2017 release, last data year is 2014.
- BP fossil CO_2 data has been updated to the 2017 release, last used data year is 2015.
- UNFCCC detailed by party data has been updated to August 2017: several countries are included for the first time with sufficient data to be used in PRIMAP-hist. Some countries have updated and extended data. However, some time-series seem to be constructed from data-points that were calculated using different methodologies and therefore show large discrepancies. Other data show strong fluctuations or deviate strongly from third party sources. In several cases we excluded data from use in PRIMAP-hist as we could not identify the source of the fluctuations and discrepancies. Details are presented in the *noteworthy changes* section.

10.1.2.2 Changes in preprocessing

- CRF2016 and 2017 data is reported using new tables. The sectors in these tables are similar to but not exactly the IPCC2006 sectors. The new reporting format makes a conversion to IPCC1996 sector definitions used for PRIMAP-hist necessary. Depending on the reporting this is not perfectly possible for all countries. However, this mainly influences category 3 which has very small emissions. For details we refer to Jeffery et al. (2018b).

10.1.3 Further bug fixes

- none

10.1.4 Known problems

- For Mauritius, the first data point for CH_4, category 6 (waste) in the UNFCCC2017 dataset is very low compared to the other data points. This influences the final dataset. As the low data point is in line with EDGAR data we do not remove it.
- There is no CH_4 and N_2O land use data for Egypt, Grenada, Haiti, and Singapore in PRIMAP-hist v1.1. The only available data source is FAO, which has only zero values in its current version and is thus not used for the PRIMAP-hist source.

- The (former) Netherlands Antilles are not included in the country mask used for Houghton (2008) downscaling thus there is no Houghton (2008) based data.
- The country mask used in the downscaling of Houghton (2008) data treats Taiwan as a part of China and thus does not deliver data for Taiwan. As none of the data sources used for PRIMAP-hist has land use data for Taiwan we have no option to downscale Taiwan from China.

10.1.5 Noteworthy changes

The noteworthy changes are grouped by dataset or processing which induced the change

- CRF (UNFCCC Annex I)
  - The new reporting guidelines introduce changes in emissions estimates for all countries which vary in strength and sectors affected. Countries with smaller changes are grouped while for countries with larger changes or changes that are specific to a single country we explain the changes individually. For a more comprehensive discussion of the CRF2017 data see Jeffery et al. (2018b).
  - Several countries exhibit changes in several sectors where relative changes are large for some sectors and gases but differences in economy wide GHG emission estimates are small: Canada, Czech Republic, Germany, Denmark, Spain, France, Luxembourg, Netherlands, Norway, New Zealand, Poland, Slovakia, USA.
  - Several countries exhibit changes of emissions estimates which are mainly in the agricultural sector: Greece, Croatia, Hungary, Ireland, Liechtenstein, Lithuania, Latvia, Portugal, Slovenia, Sweden.
  - Australia: Total CH_4 emissions are much lower under the IPCC2006 guidelines used for CRF 2017 data than under the 1996 guidelines used for CRF2014 data which is the basis of v1.1. The largest change is in the agricultural sector. N_2O emissions are much lower in CRF2017 than in CRF2014 as well.
  - Austria: Total CH_4 emissions are higher under the IPCC2006 guidelines used for CRF 2017 data than under the 1996 guidelines. Total CO_2 emissions are almost unchanged, however, CAT1 emissions decreased significantly while CAT2 emissions increased. Total N_2O emissions are much lower.
  - Belgium: Total CH_4 emissions are higher under the IPCC2006 guidelines used for CRF 2017 data than under the 1996 guidelines.
  - Bulgaria: Total CH_4 emissions are much lower in 1990 under the IPCC2006 guidelines used for CRF 2017 data than under the 1996 guidelines. This leads to different historical emissions. Total N_2O emissions are much lower.
  - Belarus: Total CH_4 emissions are higher under the IPCC2006 guidelines used for CRF 2017 data than under the 1996 guidelines. Total N_2O emissions are significantly lower.
  - Cyprus: Total CH_4 emissions are much lower under the IPCC2006 guidelines used for CRF 2017 data than under the 1996 guidelines, especially for CAT6. This leads to different historical emissions. Total N_2O emissions are much lower as well where CAT4 is the main source.
  - Iceland: CH_4 from land use drastically increased under IPCC2006 guidelines and significantly increased total emissions.
  - Kazakhstan: Changes due to changed data in the industrial processes sector.
  - Monaco: Energy CO_2 is lower in CRF2017 than in CRF2014
  - Malta: Changes due to changed data in several sectors and gases.
  - Russia: Increased emissions mostly due to higher non-CO2 emissions from the energy sector.
  - Turkey: Changes due to changed data mainly in the waste and agricultural sectors.
  - Ukraine: Lower emissions due to changed data in several sectors and gases
- UNFCCC2017B (UNFCCC for Non-Annex I)
  - for several countries UNFCCC data is available which was not available for v1.1.
    - Countries which now use UNFCCC data but show no strong changes in total emissions: Guatemala, Togo.
    - Some countries have newly available UNFCCC data, however, the sector resolution is not sufficient to be used for CO_2 in categories 1 and 2: Albania, Egypt (CAT2 only), Chad.
    - Countries with newly available UNFCCC data where PRIMAP-hist total emissions are corrected downward significantly (individual sectors / gases / years can also shown increased emissions): Albania, China (especially energy CO_2), Cuba, Ethiopia, India, Kenya, Niue,

Saudi Arabia, Thailand.
    * Countries with newly available UNFCCC data where PRIMAP-hist emissions are corrected upward significantly (individual sectors / gases / years can also shown decreased emissions): Morocco, Marshall Islands, Montenegro (post 1990), Malaysia, Saint Vincent and the Grenadines, Lebanon (CAT4).
  - Some countries have extended or modified data
    * Extended and modified data: Brazil (total emissions corrected downward, but individual sectors / gases corrected upward), Mauritius (small changes), Kyrgyzstan (significant differences for most sectors and gases), Uzbekistan (small changes), Uruguay (lower emissions, mainly from CAT4 and CAT6)
    * Extended data: Argentina (recent emissions corrected upward), Bosnia and Herzegovina (recent emissions corrected upward), Peru (no major changes), Singapore (much higher emissions in recent years),
  - We excluded some existing and new data. Some data might be included again in future versions of the PRIMAP-hist dataset if discrepancies to other sources and between years can be understood and the data verified.
    * Belize: single years show emissions with a factor of 20-50 over the other years and EDGAR data for several sectors and gases. Data removed completely.
    * Chile: We exclude the UNFCCC2017B data and only use BUR data as the UNFCCC data contains additional data points which do not fit the BUR data and presumably were generated using a different methodology than used for the BUR data. This impacts emissions estimates for several sectors and gases.
    * Central African Republic: single year with emissions which strongly differ from other years (factor of ~100). Presumably using different methodology and from older National Communication. Remove completely as remaining data only covers a period of 8 years.
    * Dominica: single year with emissions which strongly differ from other years (factor of ~100). Presumably using different methodology and from older National Communication. Remove completely as remaining data only covers a period of 6 years.
    * Ecuador: factor ~100 discrepancies with EDGAR and FAO in CAT4, N_2O. Similar discrepancies in other sectors. As several years are affected, we remove data completely. Emissions are changed compared to v1.1.
    * Ethiopia: UN data for CAT1(A4), CH_4, N_2O seems to contain a mistake as it is inconsistent with the preceding and following years and the figures in the national communication. The tables in the national communication (The Federal Democratic Republic Of Ethiopia: Ministry of Environment and Forest (2015)) contain the presumably erroneous data. We remove 1997 - 2004 for CAT, CH_4 and N_2O.
    * Jordan: single year with higher (factor 3) emissions in CAT6 (CH_4, N_2O) influencing the CATM0EL KYOTO GHG results. We remove UNFCCC data completely as only 2 data years remaining.
    * Kenya: CAT4 N_2O data is almost 0 in 1994 compared to significant emissions in later years. Potentially using different methodology and from older National Communication. This strongly influences economy wide emissions and is not in line with other sources. We remove 1994 data. This changes emissions compared to v1.1
    * Kiribati: CAT4 N_2O data is very high for a few years and not in line with EDGAR and FAO. This strongly affects the CAT0 results. We remove UNFCCC data completely.
    * Kyrgyzstan: HFCs data seems to have a unit error. HFCs data are removed and EDGAR are data are used.
    * Niger: scaling of CDIAC due to UNFCCC data is extreme, especially as based on only two data points. We completely remove UNFCCC data.
    * Paraguay: strong fluctuations for CH_4 and N_2O data (CAT4 and CAT6) which dominate the KYOTO GHG time-series. We remove UNFCCC data completely.
    * Zimbabwe (ZWE): Energy CO_2 is much higher than other sources for one of the three available data points. We remove UNFCCC data completely as only 2 years remaining.
- CDIAC2017
  - Four countries have major adjustments of recent emissions:
    * Afghanistan: emissions for energy CO_2 have been corrected downward. In the 2016 release, 2013 emissions were above 20Mt while for the 2017 release they are roughly 10Gt. BP data is in line CDIAC and extends the downward trend for 2015. Economy wide Kyoto

GHG emissions are corrected downward by about 1/3rd.
    * Botswana: Emissions have strongly increased and are much higher than calculated in PRIMAP-hist v1.1. Consequently 2014 emissions have changed from PRIMAP-hist v1.1 and 2015 emissions have increased further from 2014 emissions (based on BP2017 data).
    * Mongolia: Emissions for energy CO_2 have been corrected downward. In the 2016 release, 2013 emissions were above 45Mt while in the 2017 release they are roughly 20Gt. BP data is in line CDIAC and extends the downward trend for 2015. Economy wide Kyoto GHG emissions are corrected downward by about 1/5th.
    * Tonga: Emissions for 2013 are much lower than in CDIAC2016. This has significantly decreased 2013 and 2014 total emissions.
  - CDIAC emissions have changed for several small states, especially small island states, also for historical years. The changes differ in affected years and strength over countries. Some larger countries have been corrected as well. Affected countries are: Anguilla, Antigua and Barbuda, Belize, Cook Islands, Comoros, Cape Verde, Dominican Republic, Fiji, Federated States of Micronesia, Iran, Kiribati, Saint Kitts and Newis, Lesotho, Macao, Nigeria, Palau, People's Democratic Republic of Korea, Singapore, Suriname, Seychelles, Turks and Caicos Islands, Trinidad and Tobago, Samoa, Yemen, Zimbabwe.
  - Additional historical years for Andorra lead to changes in extrapolation with EDGARHYDE data for energy CO_2.
  - CDIAC contains data for Tuvalu in the 2017 release. Former releases did not contain data for Tuvalu.
- Processing
  - Gap filling algorithm:
    * Singapore: According to CDIAC data energy CO_2 emissions were decreasing from 2011 to 2007. This was not visible in v1.1 as the gap between 2000 and 2010 in UNFCCC data was interpolated linearly and not filled with CDIAC trends as in v1.2.
    * Other countries affected: Armenia, Azerbaijan, Colombia, Costa Rica, Dominican Republic, Peru, Peoples' Democratic Republic of Korea, Uruguay

10.2 v1.1 (March 2017)

The v1.1 release contains mostly bug fixes. To keep the dataset up to date we also included some updated data sources. The methodology remained unchanged apart from the minor changes described below.

10.2.1 Changes in PRIMAP-hist source creation

- South Sudan now has individual data for some sectors. For these sectors, South Sudan is treated as any other country during the source creation while timeseries for other sectors and gases are downscaled from Sudan data.
- Sources with scarce data points for several countries (BUR2015, UNFCCC2017) are now interpolated before the creation of the PRIMAP-hist dataset such that the linear regression used to match lower priority data sources can be computed. Before the last data point was used directly.

10.2.2 Changes in data sources and preprocessing

10.2.2.1 Input source updates

- FAOSTAT data has been updated to the January 2017 version.
  - The last data year is now 2014 for all categories except for forest land emissions where it is 2015. However, for the PRIMAP-hist dataset we use the aggregate land use time series which has 2014 as the last data point.
  - There are significant changes in historical emissions for several countries.
    * Land use data for several countries is very different from the 2015 version of FAOSTAT data.

        * Manure management CH_4 and N_2O emissions for a lot of (mostly developed) countries were adjusted down by a large margin. This is not a general adjustment though, as some countries' emissions were adjusted upward, while others remained unchanged.
        * For some economies in transition, pre-1990 emissions are higher than in the 2015 FAOSTAT data.
- CDIAC fossil CO_2 data has been updated to the 2016 release
- BP fossil CO_2 data has been updated to the 2016 release
- UNFCCC detailed by party data has been updated to January 2017
    - Data has not changed much compared to the version used for PRIMAP-hist v1.0
    - For Kazakhstan, HFCs and PFCs data for the years 1990 and 1991 with very high emissions were removed from the UNFCCC data repository. In consequence Kazakhstan's historical (pre-1992) emissions for HFCs and PFCs are much lower in v1.1 than in v1.0.

10.2.2.2 Changes in processing

- FAOSTAT
    - In version 1.0 negative data were removed from the FAOSTAT dataset during processing. This has been fixed. It only affected land use CO_2. Where data were negative for part of the time series they were replaced by zero while time series completely consisting of negative data were discarded such that Houghton data was used.
    - In v1.0 single subcategories were linearly extrapolated during category aggregation such that time series for all categories covered the same time frame. When the linear extrpolation lead to emission estimates of these subcategories to increase backwards in time, the linear regression was replaced with a linear path to zero emissions in the first year with data (1961). In v1.1 this has been changed such that in those cases a constant extrapolation is used instead of a linear extrapolation to zero. This affects emission estimates from "Field burning of agricultural residues" (IPCC1996 category 4F) and to a lesser extent subsectors of the "Agricultural soils" sector (IPCC1996 category 4D). CH_4 and N_2O emissions are affected. Only a few countries are affected by the change.
- CDIAC
    - A bug in the downscaling of regions to countries was fixed. This affected Indonesia (though not concerning the growth rates used in the PRIMAP-hist dataset, just the absolute values), Timor-Leste, Latvia and Estonia (cement only), and Palau prior to 1992.
    - Downscaling of Italy and San Marino as a region to individual countries now uses EDGAR emissions from appropriate sectors instead of GDP data.
- UNFCCC
    - A bug in the routine that read the csv files exported from the UNFCCC website lead to omitting the second block in the non-standard csv files. This bug has been fixed. Consequently some countries now have one to three additional data points added at the end of the time series.
    - Data for Viet Nam and Peru are now contained in the UNFCCC dataset with enough data to meet our minimum requirements. UNFCCC data for these two countries is therefore included in PRIMAP-hist v1.1.

10.2.3 Further bug fixes

- In v1.0 a few countries were missing in the downscaled Houghton data. Some countries are still not available as they are missing in the country mask used to convert the gridded vegetation data to countries. For details see Section Known problems below.
- In some cases the Composite Source Generator removed the first or last data point of a time series. This bug has been fixed.

10.2.3.1 Known problems

- For Mauritius, the first data point for CH_4 for different sectors in the UNFCCC 2017 dataset is very low compared to the other data points. This influences the final dataset.

- For Micronesia, the last data point for CH_4 and N_2O from the agricultural sector (and all subsectors) is very low. This influences the final dataset.
- For Saint Kitts and Newis, N_2O emissions from the agricultural sector in the last years are much higher than the rest of the data. This influences the final dataset.
- There is no CH_4 and N_2O land use data for Egypt, Grenada, Haiti, and Singapore in PRIMAP-hist v1.1. The only available data source is FAO, which has only zero values in its current version and is thus not used for the PRIMAP-hist source.
- The (former) Netherlands Antilles are not included in the country mask used for Houghton (2008) downscaling thus there is no Houghton (2008) based data.
- The country mask used in the downscaling of Houghton (2008) data treats Taiwan as a part of China and thus does not deliver data for Taiwan. As none of the data sources used for PRIMAP-hist has land use data for Taiwan we have no option to downscale Taiwan from China.
- Due to the additional year in FAO (2014) some developed countries have very low land use CH_4 emissions in 2014 compared to the period with CRF data. This will be solved in the next revision of PRIMAP-hist where CRF2015 and CRF2016 will be used. A number of possible reasons account for the differences between FAO and CRF data, which likely differ between countries. Land-use CH_4 emissions are dominantly from biomass burning. The FAO (Food and Agriculture Organization of the United Nations (2016)) calculate non-CO2 from biomass burning using the tier 1 methodology of IPCC 2006 guidelines (IPCC (2006)) and activity data from GFED4 (Giglio et al. (2017)). National inventories (CRF2014) are often based on country specific emissions factors and data for burned areas. The national inventories may also exclude natural disturbances and have different definitions than FAO for managed land areas. Land use N_2O emissions are subject to similar differences in data.
- UNFCCC data for Ecuador (aggregate sectors and gases) is much higher than third party data, but only covers a few years. The resulting time series is thus discontinuous.

10.2.4 Noteworthy changes

- Aruba: historical CO_2 emissions are lower than in v1.0 because CDIAC emissions have been adjusted downward for the years prior to 1998.
- Australia, Belize, Botswana, Guinea-Bissau, Namibia, Papua New Guinea, Zimbabwe, Mongolia: changes in CH_4 and/or N_2O emissions due to the change in extrapolation of FAO data for subsectors of the agricultural sector.
- Bosnia and Herzegovina: pre-1990 CDIAC data has changed leading to higher pre-1990 CO_2 emissions in PRIMAP-hist.
- Eritrea: historical CO_2 emissions are higher than in v1.0 because CDIAC emissions have been adjusted upward for the years prior to 1998.
- Federated States of Micronesia and Saint Helena, Ascension, and Tristan da Cunha: emissions have increased due to an increase in FAO agricultural CH_4 and N_2O emissions.
- India: energy related CO_2 is lower starting in 1977 due to changes in CDIAC data.
- Palau, Timor-Leste: higher historical emissions due to the bugfix in CDIAC downscaling.
- Peru: the UNFCCC data that is now used as the first priority source differs from the third party sources used in PRIMAP-histy v1.0.
- San Marino: changes in historical emissions due to the changed key data for downscaling of San Marino from Italy in CDIAC.
- Sudan, South Sudan: the availability of data for South Sudan changed the time series from the previous time series which were based on downscaling using population data.
- Vanuatu had zero CO_2 emissions before 1960 in PRIMAP-hist v1.0 because CDIAC2015 had zero data for a few years before 1960. Now the data is non-zero as these data points are not contained in CDIAC2016.
- For several countries data for the last two years has changed as additional data points from updated CDIAC, FAOSTAT, UNFCCC, and BP data replace extrapolated data.
- Land use data for the period of 1991 - 2014 has changed for several countries. The first reason is that we now use Houghton data for all years where they are available and not obtained through extrapolation (see Section 2.4.1 of the data description paper). The second reason is that the FAO data changed massively.

References

Boden, T. A., Andres, R. J. and Marland, G.: Global, Regional, and National Fossil-Fuel CO2 Emissions, doi:10.3334/CDIAC/00001_V2017, 2017.

British Petroleum: BP Statistical Review of World Energy 2017. [online] Available from: http://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review-2017/bp-statistical-review-of-world-energy-2017-full-report.pdf, 2017.

Food and Agriculture Organization of the United Nations: FAO GEONETWORK. Country boundaries of the world (vector version) (FGGD) (GeoLayer). (Latest update: 04 Jun 2015), [online] Available from: http://ref.data.fao.org/map?entryId=18329470-472d-11db-88e0-000d939bc5d8 (Accessed 13 July 2015), 2015.

Food and Agriculture Organization of the United Nations: FAOSTAT database, [online] Available from: http://www.fao.org/faostat/en/#data, 2016.

Giglio, L., Randerson, J., Werf, G. van der and Halota, A.: Global Fire Emissions Database, [online] Available from: http://www.globalfiredata.org (Accessed 14 March 2017), 2017.

Houghton, R. A.: Carbon Flux to the Atmosphere from Land-Use Changes: 1850-2005, [online] Available from: http://cdiac.ornl.gov/trends/landuse/houghton/houghton.html (Accessed 3 November 2016), 2008.

IPCC: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4, Agriculture, Forestry and Other Land Use, Prepared by the National Greenhouse Gas Inventories Programme, edited by H. Eggleston, L. Buendia, K. Miwa, T. Ngara, and K. Tanabe, IGES, Japan., 2006.

Jeffery, M. L., Gütschow, J. and Gieseke, R.: PRIMAP-crf: UNFCCC CRF data in IPCC 2006 categories, doi:10.5880/pik.2018.001, 2018a.

Jeffery, M. L., Gütschow, J. and Gieseke, R.: PRIMAP-crf: UNFCCC CRF data in IPCC 2006 categories, Earth System Science Data Discussions, 2018b.

JRC and PBL: Emission Database for Global Atmospheric Research (EDGAR), release version 4.2, doi:10.2904/EDGARv4.2, 2011.

Klein Goldewijk, K., Beusen, a. and Janssen, P.: Long-term dynamic modeling of global population and built-up area in a spatially explicit way: HYDE 3.1, The Holocene, 20(4), 565–573, doi:10.1177/0959683609356587, 2010.

Klein Goldewijk, K., Beusen, A., Van Drecht, G. and De Vos, M.: The HYDE 3.1 spatially explicit database of human-induced global land-use change over the past 12,000 years, Global Ecology and Biogeography, 20(1), 73–86, doi:10.1111/j.1466-8238.2010.00587.x, 2011.

Meinshausen, M., Smith, S. J., Calvin, K., Daniel, J. S., Kainuma, M. L. T., Lamarque, J.-F., Matsumoto, K., Montzka, S. a., Raper, S. C. B., Riahi, K., Thomson, A., Velders, G. J. M. and Vuuren, D. P.: The RCP greenhouse gas concentrations and their extensions from 1765 to 2300, Climatic Change, 109(1-2), 213–241, doi:10.1007/s10584-011-0156-z, 2011.

Olivier, J. and Berdowski, J.: Global Emissions sources and sinks, in The climate system, edited by J. Berdowski, R. Guicherit, and B. Heij, pp. 33–78, Balkema Publishers/Swets & Zeitlinger Publishers, Lisse, The Netherlands., 2001.

Olivier, J. and Janssens-Maenhout, G.: Part III: Greenhouse gas emissions, in CO2 emissions from fuel combustion – 2012 edition, OECD Publishing., 2012.

Ramankutty, N. and Foley, J. A.: Estimating historical changes in global land cover: Croplands from 1700 to 1992, Global Biogeochemical Cycles, 13(4), 997–1027, doi:10.1029/1999GB900046, 1999.

The Federal Democratic Republic Of Ethiopia: Ministry of Environment and Forest: Ethiopia's Second National Communication to the UNFCCC, The Federal Democratic Republic Of Ethiopia: Ministry of Environment; Forest. [online] Available from: http://unfccc.int/resource/docs/natc/ethnc2.pdf, 2015.

UNFCCC: National Inventory Submissions 2016, [online] Available from: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/9492.php, 2016a.

UNFCCC: Submitted biennial update reports (BURs) from non-Annex I Parties, [online] Available

from: http://unfccc.int/national_reports/non-annex_i_natcom/reporting_on_climate_change/items/8722.php, 2016b.

UNFCCC: National Inventory Submissions 2017, [online] Available from: http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/10116.php, 2017a.

UNFCCC: UNFCCC Greenhouse Gas Inventory Data - Detailed data by Party, [online] Available from: http://di.unfccc.int/detailed_data_by_party, 2017b.

Van Aardenne, J. A., Dentener, F. J., Olivier, J. G. J., Goldewijk, C. G. M. K. and Lelieveld, J.: A 1 x 1 deg resolution data set of historical anthropogenic trace gas emissions for the period 1890-1990, Global Biogeochemical Cycles, 15(4), 909–928, doi:10.1029/2000GB001265, 2001.