

INEMA V2.0

INEMA dataset has been updated and maintained with the support from AQ-WATCH project and CR2.

This new release of the INEMA emission dataset considers emissions for vehicular, point sources (industrial, energy, and other sectors), residential, forest fires, and agricultural waste burning sectors estimated for 2015-2020 and spatially distributed onto a 0.01°x0.01° high-resolution grid. For all sectors, the pollutants included are CO₂, NO_x, SO₂, CO, VOCs, NH₃, PM₁₀, and PM_{2.5}. Also, CH₄, N₂O, and black carbon are included for transport, forest fires, agricultural waste burning, and residential sources.

To consult the main methodological considerations and results of the previous version of INEMA, review the article by Alamos et al.(2022).

What's new on this version

- Time period has been updated from 2015-2017 to 2015-2020
- Inclusion of two new sectors: forest fires (IPCC 4A1b.iii) and agricultural waste burning (IPCC 3F)
- Reclassification of emission sectors as the following IPCC categories:
 - Energy sector reclassified as 1A1 category
 - Industrial sector reclassified as 1A2, 1A4a, 1A4c and 2 categories
 - Mining sector reclassified in 1A2 and 2 categories
 - Transport sector reclassified as 1A3b category
 - Residential sector reclassified as 1A4b sector
 - Agricultural waste burning as 3F category
 - Forest fires as 4A1b.iii category
- New emission factors and activity data sources were used on the residential and transport sectors.

The main changes made for each of the sectors are detailed below.

TRANSPORT

For a complete description of the transport sector's methodology and principal emissions estimation results, consult Alamos et al.(2022) and Osses et al. (2022).

The estimation of the **emission factors** (EF) has changed. Instead of considering zero slopes for the EFs calculation, the average of the slopes is used.

The new EF is calculated taking the following consideration:

- Load: 0.5 [-]
- Slope: average of all slopes
- Technologies: PFI and DPF for light cars. EGR and DPF+SCR for heavy trucks and buses
- Mode: Urban Peak, Highway and Hot

Please take note that we are taking into consideration only hot emissions.

Activity data has also been updated. We use fuel consumption to apply a correction factor to the activity levels, considering the effects of COVID-19 on the years 2018-2020.

Emission estimation for new compounds has been computed.

- Maps for SO_x, N₂O, NO, NO₂, NH₃ have been added.
- non-exhaust PM_{2.5} emissions have been added. These correspond to emissions from tire-brake wear and surface wear emissions. PM_{2.5} 1A3b sector emissions considers just exhaust emissions. Non exhaust emissions for PM_{2.5} and PM₁₀, are reported separately.

RESIDENTIAL

For a complete description of the residential sector's methodology and principal emissions estimation results, consult Alamos et al.(2022). the principal changes on this version for the residential sector are:

- Inclusion of N₂O emissions, considering IPCC (2006) tier 1 Emission factor
- Updated activity data sources for Aysén and Los Lagos region, as information from Instituto forestal (INFOR) is now available (Reyes, 2022).
- The penetration factor (PF) (percentage of households with firewood consumption) estimation method was updated. We calculate the interannual urban-rural communal PF considering a linear interpolation of the PF between the years that have survey estimates. CASEN 2015, INFOR surveys, and recent inventories for specific communes with decontamination plans (Valdivia, Temuco and Padre las Casas) are considered. From the last year, with an available survey, the PF remains constant (the trajectory is not imputed), implying that for all regions without an INFOR survey, the PF is constant for the entire period according to the CASEN 2015 survey.
- The spatial distribution method was updated from using population density to households density and excluding all homes located in buildings with more than two floors due to the impossibility of using a wood heating system

POINT SOURCES (Industry, Mining, Energy)

For a complete description of the point sources sector's methodology and principal emissions estimation results, consult Alamos et al.(2022).

The principal change in this version for the point Sources sector is the reclassification of sectors onto multiple IPCC categories. For this objective, it is necessary to disaggregate the emissions of each establishment between emissions associated with energy consumption (IPCC category 1A) and those from industrial processes (IPCC category 2). This disaggregation is only available for the years 2019 and 2020. For the years 2015-2018, the proportion of their emissions corresponding to each process is allocated as follows:

- For all establishments on 2015-2018 records that report emissions in 2019, the emission proportion of that year is imputed. If they did not report on 2019, the 2020 proportion is used (preference is given to 2019 since 2020 is not representative due to pandemic).
- For establishments that report from 2015 to 2018 but did not report on 2019-2020, the disaggregation of their emissions is conducted by imputing the average emission ratio (energy/ industrial process) of the IPCC sub-sector to which they belong.

FOREST FIRES

Activity data was retrieved from the National Forest Corporation (CONAF), which registers the following data for every forest fire: lat/lon coordinates (point), total burning surface (hectares); type of forest burned; start and end date of the burning.

Activity data is estimated as tons of types of forests burned per grid. To estimate activity data from CONAF's information, the following process was done:

- Calculate total tons burned per forest fire from the surface burned. For this, load factors (ton/ha) associated with the different types of forests are used. Load factors are obtained from MMA (2022, updated from CARB 2004)
- Reclassify CONAF types of burned forests onto the following categories (for which there are estimates of load factors and emission factors): Pine, Eucalyptus, Wooded, Scrub, Grassland and others.

Emission factors for CO₂, CO, CH₄, N₂O and NO_x are obtained from IPCC (2006) and MMA (2022, updated from CARB 2004), and are available for the same types of burned forests of the load factors listed before. MMA (2022) does not account for VOC emission factors, so AP.42 mean wildfire emission factor was considered for all types of forest burned.

Taking this on account is not recommended to estimate NMVOC from CH4 and VOC emissions, because emission factors of these compounds come from different information sources.

The **spatial distribution** is done considering:

- For forest fires with a burned area bigger than 200 Hectares CONAF fire records register the perimeter (polygon) of the forest fire.
- When no perimeter is available (forest fires smaller than 200 has) the distribution is done by imputing circular buffers of the size of the declared area of the forest fire around the recorded coordinates.

Finally, forest fire surfaces are spatialized onto the INEMA's grid map.

AGRICULTURAL WASTE BURNING

Activity data was retrieved from the National Forest Corporation (CONAF), which registers the following data for every agricultural waste burning: rural property name; lat/lon coordinates (point), total burning surface (hectares); type of burn; start and end date of the burning. Activity data is estimated as tons of types of burn per grid. To estimate activity data from CONAF information, the following process was done:

- Calculate tons burned from the surface. For this, load factors (ton/ha) associated with the different types of burned waste are used. Load factors are obtained from MMA (2022, updated from CARB 2004;2005)
- Reclassify CONAF types of burned waste into the following categories (for which there are estimates of load factors and emission factors): wheat; barley; oats; corn; other crops; vegetation and branch; pine waste; eucalyptus waste; other species waste.

Emission factors are obtained from MMA (2022, updated from CARB 2004; 2005, and are available for the same types of burned waste of the load factors listed before. The following adjustments were made to the MMA emission factors.

- MMA (2022) does not account for VOC emission factors for wood waste, so AP.42 mean prescribed fire emission factor was considered for these categories
- MMA (2022) does not account for SO2 emission factor for barley, so the EF of other crops were assigned to these categories

The **spatial distribution** is done around the corresponding coordinate points by using a secondary boundary given by the rural property limits. When no confident secondary boundary is available, the distribution is done by imputing circular buffers of the size of the

declared burnt area around the recorded coordinates. Finally, burnt surfaces are spatialized onto the INEMA's grid map.

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