**Hestia Fossil Fuel Carbon Dioxide (FFCO2) Data Product - Los Angeles Basin, Version 2.5, WRF grid**

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# HESTIA DATA PRODUCT FOR URBAN REGIONS

The Hestia-LA Basin version 2.5 FFCO2 emissions represent emissions due to the combustion of fossil fuel and cement production in the five counties of the LA Basin (Los Angeles, Orange, San Bernardino, Riverside, Ventura). The emissions are generated using a bottom-up/engineering approach and are tied to results generated by the Vulcan Project, an effort to quantify space/time-resolved FFCO2 emissions for the entire United States landscape. A large number of data sources are combined to best estimate FFCO2 emissions at fine scales such as air quality emissions data, traffic flow data, building information, sociodemographic information, and fuel statistics. The native spatial resolution of the Hestia FFCO2 emissions data product is a combination of points, lines, and polygons dictated primarily by the underlying data sources and the Vulcan FFCO2 emissions output. The output made available here places this information into a regularized grid at hourly and annual temporal resolutions.

# CITATION AND DATA USE POLICY

DISCLAIMER

This research was conducted as part of National Institute of Standards and Technology grant 70NANB14H321 and 70NANB16H264. This data product is provided as a public service and assumes no liability whatsoever for use of the data. The data is provided “AS IS” and makes NO WARRANTY OF ANY TYPE, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION NO WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR USE, AND NO WARRANTY OF NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. Users are solely responsible for ensuring the accuracy, currency, and other qualities for use of this public dataset or for any products derived from or in connection with this data product.

FUNDING ACKNOWLEDGEMENT

The Hestia data product represents many years of development with support from the Purdue Showalter Trust, the National Aeronautics and Space Administration, and the National Institute for Standards and Technology. If you use the Hestia data product in your research, we kindly request that you cite the database and peer-reviewed paper establishing the data product (citations below) and acknowledge the funding agencies that have supported the Hestia development as follows: “The Hestia data product was made possible through support from Purdue University Showalter Trust, the National Aeronautics and Space Administration grant 1491755, and the National Institute of Standards and Technology grant 70NANB14H321 and 70NANB16H264.”

CITATION

Please cite both the dataset and peer reviewed publications.

Dataset citation: [TBD to update]

Gurney, K.R., R. Patarasuk, J. Liang, Y. Zhou, D. O’Keeffe, M. Hutchins, J. Huang, Y. Song, P. Rao, J.R. Whetstone (2018), Comparison of Global Downscaped Versus Bottom-up Fossil Fuel CO2 Emissions in Urban Areas, National Institute of Standards and Technology (Accessed: 2018-MM-DD) [DOI TBD from NIST]

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FAIR USE DISCLAIMER

The Hestia data product is an estimation of fossil fuel CO2 (FFCO2) emissions at very fine scales in time and space. It should be considered a “climatology” of emissions rather than the “weather” of emissions such that the estimates represent “typical” emissions at a given time and place (average conditions). Hence, it is not appropriate to use the data in comparison to short-term “campaign style” atmospheric measurements (e.g. 5 days of continuous monitoring at a specific location) without consideration of and reference to the mismatch between the measurement and the Hestia estimation approach. Users are encouraged to contact Kevin Gurney for updates and consultation on such potential use.

**SECTORAL COMPOSITION**

The Hestia-LA Basin version 2.5 FFCO2 emissions represent emissions due to the combustion of fossil fuel and cement production in the the five counties of the LA Basin (Los Angeles, Orange, San Bernardino, Riverside, Ventura). The emissions are generated using a “bottom-up” engineering approach and are tied to results generated by the Vulcan Project, an effort to quantify FFCO2 emissions for the entire United States landscape (http://vulcan.project.asu.edu/). The native spatial resolution of the Hestia FFCO2 emissions data product is a combination of points, lines, and polygons dictated primarily by the underlying data sources and the Vulcan FFCO2 emissions output. The Hestia FFCO2 emissions data product version 2.5 (V2.5) for the LA Basin are placed into a regularized continuous gridded landscape for ease of analysis and incorporation into atmospheric transport modeling efforts. In addition to the total in each gridcell for a unit of time, emissions are available for nine individual sectors. For further details, see publication citation provided above.

**DATA FILE NAMES AND FILE STRUCTURE**

The Hestia-LA V2.5 FFCO2 emissions are generated using two time-resolutions: annual and hourly for the 6 year timespan of 2010 to 2015, inclusive. The 0.1° x 0.1° gridded FFCO2 emissions are stored in double-precision (8-bit) binary files (ending with ".bin") and represent the emissions resulting from integration of all point, line, and polygon elements within a gridcell (using area or length proportions for line and polygon elements that straddle gridcells). Each of the hourly emissions files contain 8760 (for the years other than 2012) or 8784 (for the year 2012) grid arrays, each of which has 17181 double-precision values and was arranged in the same order as the grid cell sequence in shapefile "Socab\_Domain.shp". All the gridded FFCO2 emissions are in units of kilograms of carbon (kgC)/gridcell and the hourly emissions are in local time.

The gridded output files follow a naming convention that indicates time, time resolution, and sectoral information. The files start with the prefix “WRF.VY” followed by a sector designation, then either “annual” or “hourly” to designate the time resolution. Lastly, the calendar year of the data is listed in numeric format. The files are binary files and all are gzipped to simplify network transfer. For example, “WRF.VY.nonroad.hourly.2012.bin.gz” refers to the nonroad sector with hourly time resolution, for the year 2012.

**DATA FILE CHECKSUMS**

To ensure correct interpretation and processing of the Hestia results, Table 1 provides totals for individual year/sector/time resolution combination files.

***Table 1.*** *Total FFCO2 emissions in each of the year/sector/time resolution files in the Hestia-LA V2.5 fileset. (MtC = million metric tonnes of carbon)*

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| **Filenames for year 2010** | **Total (MtC)** |
| WRF.VY.airport.annual.2010.bin | 0.56 |
| WRF.VY.airport.hourly.2010.bin | 0.56 |
| WRF.VY.cement.annual.2010.bin | 0.06 |
| WRF.VY.cement.hourly.2010.bin | 0.06 |
| WRF.VY.cmv.annual.2010.bin | 0.41 |
| WRF.VY.cmv.hourly.2010.bin | 0.41 |
| WRF.VY.com.annual.2010.bin | 1.94 |
| WRF.VY.com.hourly.2010.bin | 1.94 |
| WRF.VY.elecprod.annual.2010.bin | 5.12 |
| WRF.VY.elecprod.hourly.2010.bin | 5.12 |
| WRF.VY.ind.annual.2010.bin | 8.17 |
| WRF.VY.ind.hourly.2010.bin | 8.17 |
| WRF.VY.nonroad.annual.2010.bin | 1.25 |
| WRF.VY.nonroad.hourly.2010.bin | 1.25 |
| WRF.VY.onroad.annual.2010.bin | 18.18 |
| WRF.VY.onroad.hourly.2010.bin | 18.18 |
| WRF.VY.railroad.annual.2010.bin | 0.2 |
| WRF.VY.railroad.hourly.2010.bin | 0.2 |
| WRF.VY.res.annual.2010.bin | 3.02 |
| WRF.VY.res.hourly.2010.bin | 3.02 |
| WRF.VY.total.annual.2010.bin | 38.93 |
| WRF.VY.total.hourly.2010.bin | 38.93 |

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| **Filenames for year 2011** | **Total (MtC)** |
| WRF.VY.airport.annual.2011.bin | 0.56 |
| WRF.VY.airport.hourly.2011.bin | 0.56 |
| WRF.VY.cement.annual.2011.bin | 0.07 |
| WRF.VY.cement.hourly.2011.bin | 0.07 |
| WRF.VY.cmv.annual.2011.bin | 0.32 |
| WRF.VY.cmv.hourly.2011.bin | 0.32 |
| WRF.VY.com.annual.2011.bin | 1.9 |
| WRF.VY.com.hourly.2011.bin | 1.9 |
| WRF.VY.elecprod.annual.2011.bin | 4.68 |
| WRF.VY.elecprod.hourly.2011.bin | 4.68 |
| WRF.VY.ind.annual.2011.bin | 8.89 |
| WRF.VY.ind.hourly.2011.bin | 8.89 |
| WRF.VY.nonroad.annual.2011.bin | 1.23 |
| WRF.VY.nonroad.hourly.2011.bin | 1.23 |
| WRF.VY.onroad.annual.2011.bin | 17.64 |
| WRF.VY.onroad.hourly.2011.bin | 17.64 |
| WRF.VY.railroad.annual.2011.bin | 0.23 |
| WRF.VY.railroad.hourly.2011.bin | 0.23 |
| WRF.VY.res.annual.2011.bin | 3.12 |
| WRF.VY.res.hourly.2011.bin | 3.12 |
| WRF.VY.total.annual.2011.bin | 38.63 |
| WRF.VY.total.hourly.2011.bin | 38.63 |

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| **Filenames for year 2012** | **Total (MtC)** |
| WRF.VY.airport.annual.2012.bin | 0.55 |
| WRF.VY.airport.hourly.2012.bin | 0.55 |
| WRF.VY.cement.annual.2012.bin | 0.07 |
| WRF.VY.cement.hourly.2012.bin | 0.07 |
| WRF.VY.cmv.annual.2012.bin | 0.29 |
| WRF.VY.cmv.hourly.2012.bin | 0.29 |
| WRF.VY.com.annual.2012.bin | 1.93 |
| WRF.VY.com.hourly.2012.bin | 1.93 |
| WRF.VY.elecprod.annual.2012.bin | 5.41 |
| WRF.VY.elecprod.hourly.2012.bin | 5.41 |
| WRF.VY.ind.annual.2012.bin | 8.54 |
| WRF.VY.ind.hourly.2012.bin | 8.54 |
| WRF.VY.nonroad.annual.2012.bin | 1.22 |
| WRF.VY.nonroad.hourly.2012.bin | 1.22 |
| WRF.VY.onroad.annual.2012.bin | 17.38 |
| WRF.VY.onroad.hourly.2012.bin | 17.38 |
| WRF.VY.railroad.annual.2012.bin | 0.21 |
| WRF.VY.railroad.hourly.2012.bin | 0.21 |
| WRF.VY.res.annual.2012.bin | 2.89 |
| WRF.VY.res.hourly.2012.bin | 2.89 |
| WRF.VY.total.annual.2012.bin | 38.49 |
| WRF.VY.total.hourly.2012.bin | 38.49 |

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| **Filenames for year 2013** | **Total (MtC)** |
| WRF.VY.airport.annual.2013.bin | 0.58 |
| WRF.VY.airport.hourly.2013.bin | 0.58 |
| WRF.VY.cement.annual.2013.bin | 0.07 |
| WRF.VY.cement.hourly.2013.bin | 0.07 |
| WRF.VY.cmv.annual.2013.bin | 0.22 |
| WRF.VY.cmv.hourly.2013.bin | 0.22 |
| WRF.VY.com.annual.2013.bin | 1.94 |
| WRF.VY.com.hourly.2013.bin | 1.94 |
| WRF.VY.elecprod.annual.2013.bin | 4.84 |
| WRF.VY.elecprod.hourly.2013.bin | 4.84 |
| WRF.VY.ind.annual.2013.bin | 9.05 |
| WRF.VY.ind.hourly.2013.bin | 9.05 |
| WRF.VY.nonroad.annual.2013.bin | 1.21 |
| WRF.VY.nonroad.hourly.2013.bin | 1.21 |
| WRF.VY.onroad.annual.2013.bin | 17.58 |
| WRF.VY.onroad.hourly.2013.bin | 17.58 |
| WRF.VY.railroad.annual.2013.bin | 0.21 |
| WRF.VY.railroad.hourly.2013.bin | 0.21 |
| WRF.VY.res.annual.2013.bin | 2.93 |
| WRF.VY.res.hourly.2013.bin | 2.93 |
| WRF.VY.total.annual.2013.bin | 38.63 |
| WRF.VY.total.hourly.2013.bin | 38.63 |

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| **Filenames for year 2014** | **Total (MtC)** |
| WRF.VY.airport.annual.2014.bin | 0.61 |
| WRF.VY.airport.hourly.2014.bin | 0.61 |
| WRF.VY.cement.annual.2014.bin | 0.07 |
| WRF.VY.cement.hourly.2014.bin | 0.07 |
| WRF.VY.cmv.annual.2014.bin | 0.16 |
| WRF.VY.cmv.hourly.2014.bin | 0.16 |
| WRF.VY.com.annual.2014.bin | 1.83 |
| WRF.VY.com.hourly.2014.bin | 1.83 |
| WRF.VY.elecprod.annual.2014.bin | 4.9 |
| WRF.VY.elecprod.hourly.2014.bin | 4.9 |
| WRF.VY.ind.annual.2014.bin | 8.81 |
| WRF.VY.ind.hourly.2014.bin | 8.81 |
| WRF.VY.nonroad.annual.2014.bin | 1.29 |
| WRF.VY.nonroad.hourly.2014.bin | 1.29 |
| WRF.VY.onroad.annual.2014.bin | 17.73 |
| WRF.VY.onroad.hourly.2014.bin | 17.73 |
| WRF.VY.railroad.annual.2014.bin | 0.23 |
| WRF.VY.railroad.hourly.2014.bin | 0.23 |
| WRF.VY.res.annual.2014.bin | 2.42 |
| WRF.VY.res.hourly.2014.bin | 2.42 |
| WRF.VY.total.annual.2014.bin | 38.04 |
| WRF.VY.total.hourly.2014.bin | 38.04 |

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| **Filenames for year 2015** | **Total (MtC)** |
| WRF.VY.airport.annual.2015.bin | 0.65 |
| WRF.VY.airport.hourly.2015.bin | 0.65 |
| WRF.VY.cement.annual.2015.bin | 0.07 |
| WRF.VY.cement.hourly.2015.bin | 0.07 |
| WRF.VY.cmv.annual.2015.bin | 0.23 |
| WRF.VY.cmv.hourly.2015.bin | 0.23 |
| WRF.VY.com.annual.2015.bin | 2.19 |
| WRF.VY.com.hourly.2015.bin | 2.19 |
| WRF.VY.elecprod.annual.2015.bin | 4.61 |
| WRF.VY.elecprod.hourly.2015.bin | 4.61 |
| WRF.VY.ind.annual.2015.bin | 8.81 |
| WRF.VY.ind.hourly.2015.bin | 8.81 |
| WRF.VY.nonroad.annual.2015.bin | 1.29 |
| WRF.VY.nonroad.hourly.2015.bin | 1.29 |
| WRF.VY.onroad.annual.2015.bin | 17.78 |
| WRF.VY.onroad.hourly.2015.bin | 17.78 |
| WRF.VY.railroad.annual.2015.bin | 0.21 |
| WRF.VY.railroad.hourly.2015.bin | 0.21 |
| WRF.VY.res.annual.2015.bin | 2.47 |
| WRF.VY.res.hourly.2015.bin | 2.47 |
| WRF.VY.total.annual.2015.bin | 38.32 |
| WRF.VY.total.hourly.2015.bin | 38.32 |