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Geoscientific Model Development Discussions

Interactive comment on "VEIN v0.2.2: an R package for bottom-up Vehicular Emissions Inventories" *by* Sergio Ibarra-Espinosa et al.

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Response to editor Thank you for your comments. Please see our revised draft of the manuscript, in the attached file pdf, with changes marked in brown. The pdf also includes replies for Referee 1 in red and replies for Referee 2 in blue.

General Comment: The model builds upon well established methodologies, in particular those of the COPERT model. More details about the added value of VEIN (for instance in terms of mapping and use of local bottom up information) should be provided in the introduction to allow the reader to better understand the complementarity compared to COPERT or other traffic models. Since VEIN relies heavily on COPERT data and methodologies, a more explicit acknowledgment is needed indicating if such

input data are available for public use and/or if the support from COPERT developpers was granted.

Reply: We agree with you. We added the lines 5-7 and 9-10 on page 3 showing that the emissions factors of speed functions VEIN are based on Ntziachristos and Samaras (2016) and other authors. VEIN is capable of representing spatial objects. We also included acknowledgments on lines 18-20 on page 28.

Comment 1: Why is traffic count data only available for the morning rush hours (P4L1) if they are obtained from automated stations (P4L10)

Reply 1: Red and blue lines in the same paragraph on page 4 expand further on the explanation between morning traffic data and traffic counts. Basically, 4-stage travel demand models produce outputs with traffic at **each street** for peak hours. This data can be used in VEIN, the user needs to extrapolate the traffic on street to the other hours of the day, and also, days of the week. This role is played by the TF matrices play, to expand morning rush hour traffic on the streets. The data needed to build TF can be obtained from automatic/manual traffic count stations, which deliver the counts in certain points on space.

Comment 2: P6L6 if monthly average temperature is already taken into account as recommended in the COPERT methodology, how will it be improved in the future versions of VEIN ?.

Reply 2: We removed that line.

Comment 3: Sections 2.4 and 4.5 : more details should be added on the chemical speciation of emissions.

Reply 3: We added more information and the other Reviewers also made this same request. The added information is on Page 8 lines 28-32, page 9 lines 1-3, page 22 lines 25-34 and page 23 lines 1-3.

Comment 4: P14L22 : why is the green line so different from the other two in terms of

variability ? is it obtained from actual data instead of a statistical fit ?

Reply 4: The lines 3-5 on page 15 show that the distribution of vehicles by age of use can also be obtained using the function my_age results in green line on Fig. 5a. As mentioned, this data is based on fuel sales and is sourced from the Environment agency of SÃ£øPaulo CETESB.

Comment 5: P21L15 : a ratio 20.5 between estimates with VEIN and EDGAR calls for further justification. Is it for the whole MASP area or focusing only on major motorways ? A comparison of annual total emissions should be provided.

Reply 5: The 20.5 comes from the comparison between the sum of CO emissions due to transport for the same area with VEIN at 00:00 (local time) and EDGAR, covering the whole MASP area. However, on page 23 lines 25-29 we mention that an emissions inventory needs to be compared and calibrated with fuel consumption for that area. We also mention that the estimate in the manuscript is illustrative and focussed on VEIN capabilities. Nevertheless, this highlights the need for inter-comparison between inventories.

Technical comments, 1: P1L7 : define ?? factors ??.

Reply Technical comments, 1: We did not understand.

Technical comments, 2: P1L16 : add greeenhouse gases.

Reply Technical comments, 2: On page 1, lines 19-20 we mention the greenhouse gases inventories.

Technical comments, 3: P2L28 : define HC, how do they differ from VOC mentionned later in the manuscript

Reply Technical comments, 3:Great observation. Volatile Organic Compounds (VOC), now changed on the text. We are referring to hydrocarbon without methane.

Technical comments, 4: P4L28 : which is the computer programme being referred to

?

Reply Technical comments, 4: Computer programme to calculate emissions from road transport means COPERT. We changed to COmputer Programme to calculate Emissions from Road Transport on page 5, line 18.

Technical comments, 5: P8L17 : the colors can not be seen in Fig 1.

Reply Technical comments, 5: Great observation. Initially that diagram had colors, but later it became black and white. Now it is fixed.

Technical comments, 6: P13L3 : ?? defined ?? instead of ?? defend ??

Reply Technical comments, 6: We updated that phrase in page 13, line 33 and page 14, lines 1-3.

Technical comments, 8: P21L3 : replace ?? another ?? by ?? other ??

Reply Technical comments, 8: P21L3 : We edited the phrase about WRF-Chem and emissions on 9, page 23.

Technical comments, 9: P23 L14, L15 : years are missing from the references.

Reply Technical comments, 9: Thanks. Now it is fixed.

Technical comments, 10: P23L23 : the purpose of the last sentence is unclear.

Reply Technical comments, 10: That page and line belongs to the *Code Availability* section on the origin manuscript and there is no explanation for its lack of clarity.

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VEIN v0.2.2: an R package for bottom-up Vehicular Emissions Inventories

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Abstract.

Emission inventories are the quantification of pollutants from different sources. They provide important information not only for climate and weather studies, but also for urban planning and environmental health protection. We developed an open source model (named VEIN v0.2.2) that provides high resolution vehicular emissions inventories for different fields of studies. We focused on vehicular sources at street and hourly levels due to the current lack of information about these sources, mainly in developing countries. The type of emissions covered by VEIN are: exhaust (hot and cold) and evaporative considering the deterioration of the factors. VEIN also performs speciation and incorporates functions to generate and spatially allocate emissions databases. It allows users to load their own emissions factors, but it also provides emissions factors from the road transport model (Copert), the United States Environmental Protection Agency (EPA) and Brazilian databases. The VEIN model reads, distributes by age of use and extrapolates hourly traffic data, and estimates hourly and spatially emissions. Based on our knowledge, VEIN is the first bottom-up vehicle emissions software that allows input to the WRF-Chem model. Therefore, the VEIN model provides an important, easy and fast way of elaborating or analyzing vehicular emissions inventories, under different scenarios. The VEIN results can be used as an input for atmospheric models, health studies, air quality standardizations and decision making.

1 Introduction

Emissions inventory is a quantification of pollutants discharged into the atmosphere by different sources (Pulles and Heslinga, 2010). This quantification is vital for regulatory and scientific purposes, because it allows to monitor the state of the Earth's atmosphere and climate. It also allows to create air quality standards, which will protect ecosystems and human health. For instance, the Intergovernmental Panel on Climate Change (IPCC) includes a dedicated task force, separated from the other three working groups, only for the purpose of greenhouse gas emissions inventory issues (Paustian et al., 2006).

In this instance, there are several emissions inventories that use different input data and approaches for different scales. One of the most frequently used inventories is the Emission Database for Global Atmospheric Research (EDGAR; Olivier

Fig. 1.