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A multi-methodological approach to study the temporal and spatial distribution of air quality related to road transport emissions in Madrid, Spain

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The traffic-related atmospheric emissions, composition and transport of greenhouse gases (GHGs) and air toxic pollutants (ATPs), are an important environmental problem that affect climate change and air pollution in Madrid, Spain. Carbon dioxide (CO_2) affects the regional weather and particularly fine particle matter (PM) translocate to the people resulting in local health problems. As the main source of emissions comes from road transport, and subsequent combustion of fossil fuels, air quality deterioration may be elevated during weekdays and peak hours. We postulate that traffic-related air quality (CO_2, methane CH4, PM, volatile organic compounds VOCs, nitrogen oxides NO_x and carbon monoxide CO contents) impairs epidemiology in part via effects on health and disease development, likely increasing the external costs of transport in terms of climate change and air pollution.

First, the paper intends to estimate the local air quality related to the road transport emissions of weeks over a domain covering Madrid (used as a case study). The local air quality model (LAQM) is based on gridded and shaped emission fields. The European Environmental Agency (EEA) COPERT modeling system will provide GHGs and ATPs gridded and shaped emission data and mobile source parameters, available for Madrid from preliminary emission inventory records of the Municipality of Madrid and from disaggregated traffic counts of the Traffic Engineering Company and the Metropolitan Company of Metro (METRO-Madrid). The paper intends to obtain estimates of GHGs and ATPs concentrations commensurate with available ground measurements, 24-hour average values, from the Municipality of Madrid. The comparison between estimated concentrations and measurements must show small errors (e.g. fractional error, fractional bias and coefficient of determination). The paper's expected results must determine spatial and temporal patterns in Madrid. The estimates will be used to cross check the primary local emission inventory, together with the mobile source's parameters and the disaggregated transport activity data. The paper will also identify emission and concentration differences and gradients of certain magnitude/factor (e.g. comparison between estimated ATPs hourly concentrations in Madrid City Center and in the peripheries). Furthermore, because of the higher contribution of road mobile sources to GHGs and ATPs emissions in Madrid, small gradients between urban highways and residential areas will be expected.

Second, the paper objectives are to develop valid methods and approaches to measure air quality and to develop valid road transport emission inventories to assess correlations between external costs, epidemiology and emissions in order to reveal how traffic pollution affects people exposure to key contaminants and disease development, and identify susceptible emission scenarios and health impacts. We have conducted general emission inventory studies providing preliminary evidence of regional road transport air pollution impacts on external cost growth and disease development.

Third, we also aim to demonstrate short and long-term impacts of road transport emissions on external costs development using innovative multi-methodological methods interfaced with environmental chemistry and meteorology following meteorological and chemical fields with contrasting high/low traffic emissions in several linked components involving: air pollutant assessment using local measurements, height of the boundary layer, meteorological environment interactions on external costs and epidemiology, mapping of Madrid (identifying gradients of emissions), integrative causal modeling using statistical models, and trend and scenario analyses on external costs and impacts on human health. Meteorological and chemical fields will be obtained from local records collected by surface meteorological and air quality stations. These two sets of fields define the horizontal

and vertical profiles of GHGs and ATPs of Madrid based on air quality ground (initial conditions) and vertical (boundary conditions) measurements and modulate air concentration estimates