Due to the growing demand of energy consumption and the need to mitigate climate effects, natural gas has become a promising transitional source of energy to clean, climate-friendly energy sources because combustion of natural gas produces less CO2 than coal in electricity production (U.S. Energy Information Administration, 2011), although this scenario can only be achieved if the leakage rate of natural gas delivery from wells to plants is not above the 3.2% estimated threshold (Alvarez et al., 2012). Ethane (C2H6) is a hydrocarbon that is emitted during the process of oil and natural gas production, leakage in mining, storage, and distribution, along with biofuel use and biomass burning, with the major source being fugitive emissions from fossil fuel production (Xiao et al., 2008). Horizontal drilling and hydraulic fracturing provide better access to oil and gas reservoirs that would otherwise be unprofitable using conventional methods, thus providing some economic advantages. However, besides some environmental impacts of horizontal drilling and hydraulic fracturing, recent increases of these activities can potentially increase the rate of fugitive emissions of ethane into the atmosphere, thus undermining the promise of natural gas being the transitional source to clean energy. For that reason, an accurate model of ethane’s anthropogenic emission is required for policymakers to make informed decisions on regulating fugitive emission of natural gas production. Despite that, there is disagreement among the scientific community on the fossil fuel emission trends of the last four decades. We use multi-decadal ethane measurements from three independent datasets as a gas tracer to examine the trends of fossil fuel emission and to correlate it with the competing emission hypotheses.

Bottom-up and top-down studies that were done on both ethane and methane produced different conclusions on the temporal trend of fossil fuel emissions. Firn air analysis by Aydin et al. (2011) yielded a scenario where anthropogenic emission decreased 5-6 Tg yr-1 during 1980-2000. These authors used MER (3-5) to estimate the decline in methane fossil fuel emission sources to be 15-30 Tg yr-1 in the same time period. Another study using surface air sampling and analysis showed a global decline of 3.4 – 4.2 Tg yr-1 in fossil fuel ethane emission from 1984-2010 (Simpson et al., 2012). They used the same MER values as the firn air study to calculate a decline of 10-21 Tg yr-1 in methane fossil fuel emission. However, inverse modeling analyses of isotopic methane indicate that CH4 fugitive fossil fuel emissions remained nearly constant in the period 1984-2000 and increased by 21 Tg yr-1 from 2000 to 2009 (Rice et al. 2016).