

Visual Analytic Techniques for CO₂ Emissions and Concentrations in the United States

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Abstract—Climate Change has emerged as one of the grand global challenges facing humanity. The dominant anthropogenic greenhouse gas contributing to the climate change problem, carbon dioxide (CO₂), has a complex cycle through the atmosphere, oceans and biosphere. The combustion of fossil fuels (power production, transportation, manufacturing, heating, etc) remains the largest source of anthropogenic CO₂ to the Earth's atmosphere and hence, its patterns and fate in the atmosphere is of central importance to the climate change problem. Up until very recently, the quantification of fossil fuel CO₂ was understood only at coarse space and time scales. A recent research effort, called the Vulcan Project, has greatly improved this space/time quantification resulting in source data at a resolution of less than 10 km²/hr at the surface of North America. By providing visual tools to examine this new, high resolution CO₂ data, we can better understand the way that CO₂ is transmitted within the atmosphere and how it is exchanged with other components of the Earth System. We have developed interactive visual analytic tools, which allows for easy data manipulation, analysis, and extraction. The Vulcan emissions were input into a regional atmospheric transport model which produced 3D scalar fields at a resolution of 40 km² every 3 hours for the year 2002. Our visualizations consist of both 2D and 3D techniques which highlight interesting features of the CO₂ data. The visualization system is aimed for researchers and political leaders to help assist in analyzing data and enabling new policy options in mitigation of fossil fuel CO₂ emissions in the U.S.