and increased storm surge; and Asian mega-deltas, such as the Ganges-Brahmaputra and the Zhujiang, due to large populations and high exposure to sea level rise, storm surge and river flooding. Climate change has been described as a potential threat multiplier with regard to national security issues.

3. Changes in Global Climate Indicators Associated With the Rule's GHG Emissions Reductions

EPA examined [319] the reductions in CO_2 and other GHGs associated with this action and analyzed the projected effects on global mean surface temperature and sea level, two common indicators of climate change. The analysis projects that this action will reduce climate warming and sea level rise. Although the projected reductions are small in overall magnitude by themselves, they are quantifiable and would contribute to reducing climate change risks. A commenter agreed that the modeling results showed small, but quantifiable, reductions in the global atmospheric CO_2 concentration, as well as a reduction in projected global mean surface temperature and sea level rise, from implementation of this action, across all climate sensitivities. As such, the commenter encourages the agencies to move forward with this action while continuing to develop additional, more stringent vehicle standards beyond 2016.

Another commenter indicated that the projected changes in climate impacts resulting from this action are small and therefore not meaningful. EPA disagrees with this view as the reductions may be small in overall magnitude, but in the global climate change context, they are quantifiable showing a clear directional signal across a range of climate sensitivities.[320] [321] EPA therefore determines that the projected reductions in atmospheric CO_2, global mean temperature and sea level rise are meaningful in the context of this rule. EPA addresses this point further in the Response to Comments document. For the final rule, EPA provides an additional climate change impact analysis for projected changes in ocean pH in the context of this action. In addition, EPA updated the modeling analysis based on the revised GHG emission reductions provided in Section III.F.1; however, the change in modeling results was very small in magnitude. Based on the reanalysis the results for projected atmospheric CO_2 concentrations are estimated to be reduced by an average of 2.9 ppm (previously 3.0 ppm), global mean temperature is estimated to be reduced by 0.006 to 0.015 °C by 2100 (previously 0.007 to 0.016 °C) and sea-level rise is projected to be reduced by approximately 0.06–0.14cm by 2100 (previously 0.06–0.15cm).

a. Estimated Projected Reductions in Atmospheric CO_2 Concentration, Global Mean Surface Temperatures Sea Level Rise and Ocean pH

EPA estimated changes in the atmospheric CO_2 concentration, global mean surface temperature and sea level to 2100 resulting from the emissions reductions in this action using the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC, version 5.3). This widely-used, peer reviewed modeling tool was also used to project temperature and sea level rise under different emissions scenarios in the Third and Fourth Assessments of the Intergovernmental Panel on Climate Change (IPCC).

GHG emissions reductions from Section III.F.1 were applied as net reductions to a peer reviewed global reference case (or baseline) emissions scenario to generate an emissions scenario specific to this action. For the scenario related to this action, all emissions reductions were assumed to begin in 2012, with zero emissions change in 2011 (from the reference case) followed by emissions linearly increasing to equal the value supplied in Section III.F.1 for 2020 and then continuing to 2100. Details about the reference case scenario and how the emissions reductions were applied to generate the scenario can be found in the RIA Chapter 7.

Changes in atmospheric CO_2 concentration, temperature, and sea-level for both the reference case and the emissions scenarios associated with this action were computed using MAGICC. To compute the reductions in the atmospheric CO_2 concentrations as well as in temperature and sea level resulting from this action, the output from the scenario associated with this final rule was subtracted from an existing Global Change Assessment Model (GCAM, formerly MiniCAM) reference emission scenario. To capture some key uncertainties in the climate system with the MAGICC model, changes in temperature and sea-level rise were projected across the most current IPCC range for climate sensitivities which ranges from 1.5 °C to 6.0 °C (representing the 90% confidence interval).[322] This wide range reflects the uncertainty in this measure of how much the global mean temperature would rise if the concentration of carbon dioxide in the atmosphere were to double. Details about this modeling analysis can be found in the RIA Chapter 7.4.

The results of this modeling, summarized in Table III.F.3–1, show small, but quantifiable, reductions in atmospheric CO_2 concentrations, projected global mean surface temperature and sea level resulting from this action, across all climate sensitivities. As a result of the emission reductions from this action, the atmospheric CO_2 concentration is projected to be reduced by an average of 2.9 parts per million (ppm), the global mean temperature is projected to be reduced by approximately 0.006–0.015°C by 2100, and global mean sea level rise is projected to be reduced by approximately 0.06–0.14cm by 2100. The reductions are small relative to the IPCC's 2100 "best estimates" for global mean temperature increases (1.8–4.0 °C) and sea level rise (0.20–0.59m) for all global GHG emissions sources for a range of emissions scenarios. EPA used a peer reviewed model, the MAGICC model, to do this analysis. This analysis is specific to this rule and therefore does not come from previously published work. Further discussion of EPA's modeling analysis is found in the final RIA.

[319] Using the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC, *http://www.cgd.ucar.edu/cas/wigley/magicc/*), EPA estimated the effects of this action's greenhouse gas emissions reductions on global mean temperature and sea level. Please refer to Chapter 7.4 of the RIA for additional information.

[320] The National Research Council (NRC) 2001 study, *Climate Change Science: An Analysis of Some Key Questions,* defines climate sensitivity as the sensitivity of the climate system to a forcing is commonly expressed in terms of the global mean temperature change that would be expected after a time sufficiently long enough for both the atmosphere and ocean to come to equilibrium with the change in climate forcing.

[321] To capture some of the uncertainty in the climate system, the changes in atmospheric CO_2, projected temperatures and sea level were estimated across the most current Intergovernmental Panel on Climate Change (IPCC) range of climate sensitivities, 1.5 °C to 6.0 °C.

[322] In IPCC reports, equilibrium climate sensitivity refers to the equilibrium change in the annual mean global surface temperature following a doubling of the atmospheric equivalent carbon dioxide concentration. The IPCC states that climate sensitivity is "likely" to be in the range of 2 °C to 4.5 °C, "very unlikely" to be less than 1.5 °C, and "values substantially higher than 4.5 °C cannot be excluded." IPCC WGI, 2007, *Climate Change 2007—The Physical Science Basis,* Contribution of Working Group I to the Fourth Assessment Report of the IPCC, *http://www.ipcc.ch/.*