Models show injecting aerosols into the atmosphere to prevent hurricanes possibly feasible

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Hurricane Isabel (2003) as seen from orbit during Expedition 7 of the International Space Station. Credit: NASA

(Phys.org)—An international team of Earth scientists has used eight

Earth system model simulations of climate under the Geoengineering Model Intercomparison Project to predict the change in the number of hurricanes and other types of tropical storms that would occur over the next fifty years if sulfate aerosols were injected into the atmosphere to mitigate the impact of global warming. In their paper published in *Proceedings of the National Academy of Sciences*, the researchers describe the models and what they showed and suggest that such injections if done on a massive scale, might prove moderately effective—though they note that a different type of aerosol would have to be used to prevent harm to the ozone layer.

As the planet keeps warming and efforts to reduce greenhouse gas emissions enough to make a difference fail, scientist have begun turning to other ways to mitigate problems in the future related to warmer temperatures and higher ocean levels, such as an increase in the number and intensity of hurricanes. One such technique that has been discussed in public forums, is injecting aerosols into the atmosphere in areas where tropical storms form—the shadowing effect would cool the air above the ocean preventing such storms from forming. In this new effort, the researchers used standard oceanographic models to attempt to learn whether such a technique might be viable.

After inputting data meant to model an injection of sulfate aerosols over the next 50 years, in two different ways, the researchers found that the idea would likely work, but not as well as might be expected. The first modeled the impact of a volcano eruption-sized amount of aerosol injection while the second sought to mimic an increase in injection amounts to match the projected increase of greenhouse gas emissions. Because the second approach appeared to be the more likely outcome in real life, the researchers used that model to make their predictions. They found that if approximately 10 billion tons of such aerosols were pumped into the atmosphere annually, the result would be a halving of Katrina-sized hurricanes over the next half century. They equate it to mimicking a Pinatubo-sized eruption every two years—something they describe as very expensive, but doable.

Of course, they note, there is no chance that such injections will begin anytime soon, because injecting that much sulfate aerosols into the atmosphere would destroy the ozone layer. But, their findings do suggest that if another, safer aerosol could be found, such a technique might prove viable.

More information: John C. Moore et al. Atlantic hurricane surge response to geoengineering, *Proceedings of the National Academy of Sciences* (2015). DOI: 10.1073/pnas.1510530112

Abstract
Devastating floods due to Atlantic hurricanes are relatively rare events. However, the frequency of the most intense storms is likely to increase with rises in sea surface temperatures. Geoengineering by stratospheric sulfate aerosol injection cools the tropics relative to the polar regions, including the hurricane Main Development Region in the Atlantic, suggesting that geoengineering may mitigate hurricanes. We examine this hypothesis using eight earth system model simulations of climate under the Geoengineering Model Intercomparison Project (GeoMIP) G3 and G4 schemes that use stratospheric aerosols to reduce the radiative forcing under the Representative Concentration Pathway (RCP) 4.5 scenario. Global mean temperature increases are greatly ameliorated by geoengineering, and tropical temperature increases are at most half of those temperature increases in the RCP4.5. However, sulfate injection would have to double (to nearly 10 teragrams of SO_2 per year) between 2020 and 2070 to balance the RCP4.5, approximately the equivalent of a 1991 Pinatubo eruption every 2 y, with consequent implications for stratospheric ozone. We project changes in storm frequencies using a temperature-dependent generalized extreme value statistical model calibrated by historical storm surges and observed temperatures since

1923. The number of storm surge events as big as the one caused by the 2005 Katrina hurricane are reduced by about 50% compared with no geoengineering, but this reduction is only marginally statistically significant. Nevertheless, when sea level rise differences in 2070 between the RCP4.5 and geoengineering are factored into coastal flood risk, we find that expected flood levels are reduced by about 40 cm for 5-y events and about halved for 50-y surges.