

THE ATMOSPHERIC RESERVOIR

Examining the Atmosphere and Atmospheric Resource Management

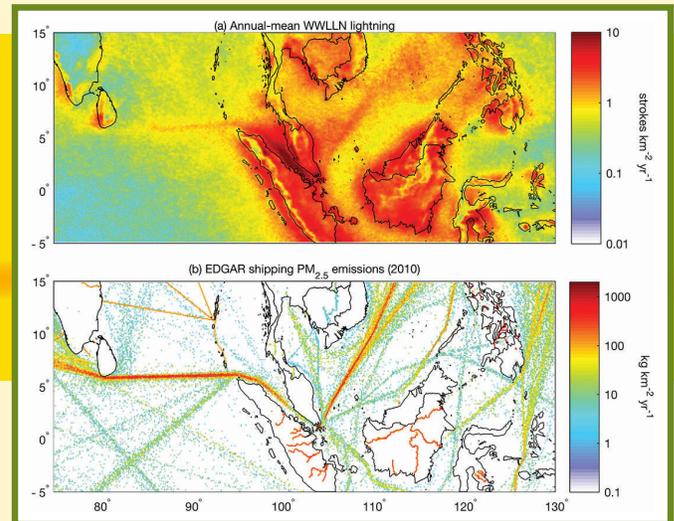
Enlightening LIGHTNING

By Mark D. Schneider

What do cargo ships in the Indian Ocean and South China Sea have in common with Houston, Texas? The Port of Houston ranks first in international commerce, but there's another less known connection. A study recently published in the September issue of *Geophysical Research Letters* shows an enhancement in lightning along major shipping routes in Asia. In 2001, a separate article described an enhancement of cloud-to-ground lightning over the Houston metropolitan area.

These two findings aren't a coincidence. Thunderstorms that develop near the Houston metropolitan area and along ocean shipping lanes contain a higher number of small aerosol particles resulting from anthropogenic (man-made) sources such as diesel engines. These particles are able to be carried higher up into a thunderstorm's convective towers resulting in the production of more ice particles. A positive charge is created by ice particles in the upper portions of a thunderstorm, while water droplets with negative charges are found in the middle and lower regions of the cumulus clouds. An increase in the concentration of ice particles results in more collisions. These collisions create electrical charges within thunderstorms releasing lightning, a form of static electricity, to equalize the electrical field.

The overall increase in ice particles due to diesel engine emitted pollutants is responsible for an approximate doubling of lightning density along the shipping routes shown in the top image (a). Note the very distinct east-west line of greater lightning density in the Indian Ocean



Courtesy of Thornton et al. 2017 *Geophysical Research Letters*

and the southwest to northeast oriented line running through the South China Sea. The bottom image (b) shows particle emissions from the diesel engine powered cargo ships. Unlike the Houston study where other factors such as an urban heat effect help enhance thunderstorm development, the Indian Ocean and South China Sea offer a "clean" environment over water where a comparison with adjacent areas with the same climate is possible. In order to accomplish this study, University of Washington co-author Joel Thornton and his research associates worked with radio wave sensors that detect lightning strikes and triangulated them to pinpoint strike locations. This use of World Wide Lightning Location Network (WWLLN) data from 2005-2016 is just the beginning of what future studies may observe.

One of the many sensors on the new GOES-16 weather satellite is the Geostationary Lightning Mapper (GLM). The GLM pinpoints locations where in-cloud and cloud-to-ground lightning occur over the western hemisphere. This allows for a more complete analysis of the overall electrical activity within thunderstorms and has other valuable implications like advanced severe weather warnings. When an observed storm has a rapid increase in lightning this can indicate that it is strengthening and becoming severe. There are also correlations between lightning and tornadic activity within thunderstorms that meteorologists are just beginning to understand.