HOW WILL REDUCTION IN AIR POLLUTION IN UNITED STATES, EUROPE AND CHINA AFFECT THE INDIAN MONSOON?

Aerosols are small solid or liquid particles suspended in the atmosphere. They alter the climate of the earth by reflecting or absorbing solar radiation. Among the aerosols released by human actions the sulphate aerosols constitute 90% of the emissions. They reflect solar radiation and hence cool both the atmosphere and the surface of the earth. Aerosols like soot are released during incomplete combustion and they heat the atmosphere by absorbing solar radiation but cool the surface of the earth by reducing the solar radiation reaching the surface. The local cooling of the atmosphere and the surface by sulphate aerosols leads to a weaker monsoon. The impact of soot on the monsoon rainfall is not so simple. Since soot heat the atmosphere it can locally enhance the monsoon rainfall. Both soot and sulfate aerosols have remote impact by altering the meridional and zonal gradient of temperature in the tropics.

We have examined the impact of reduction of emissions of sulphate aerosols by United States, Europe and China by using a Hadley Centre Global environmental model (HadGEM3)

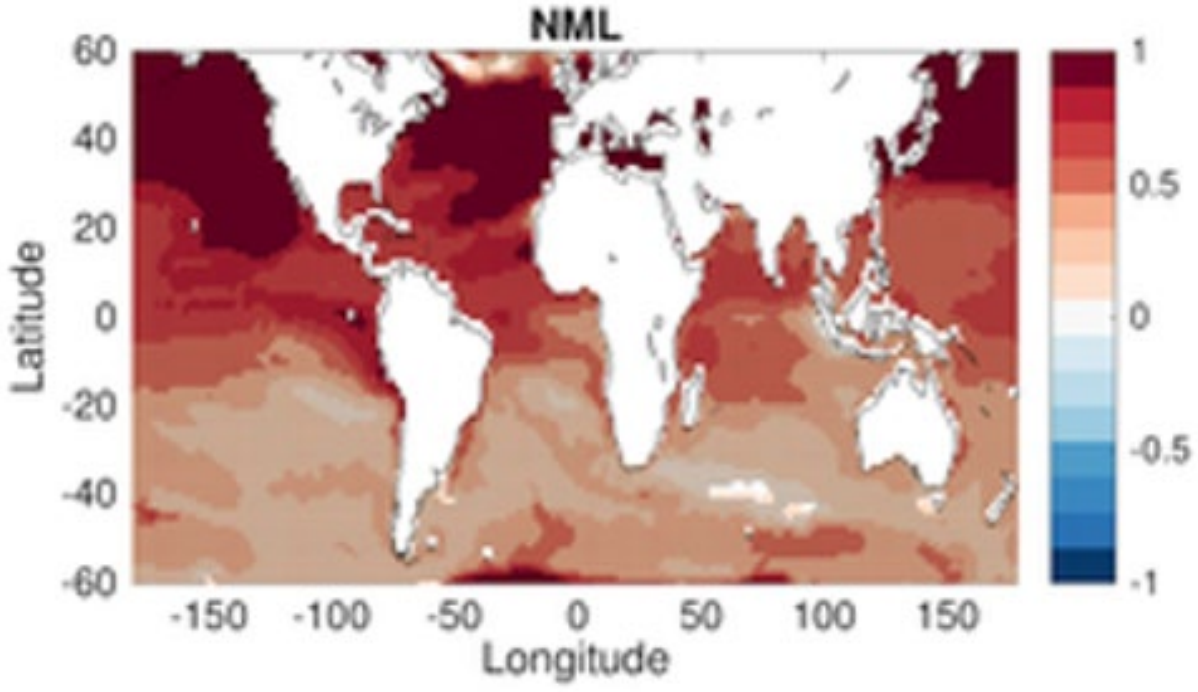

Figure 1 The change is sea surface temperature on account of cessation sulphate aerosol emissions from USA, Europe and China. The increase in sea surface temperature in the Northern Hemisphere is higher than in the Southern Hemisphere and this leads to the northward shift of the rain band and hence a higher rainfall over India.

coupled ocean model (NEMO). A 200-year simulation was conducted with this model. One simulation contained aerosol emissions all over the world. In the second simulation the aerosol emission from United States, Europe and China were removed.

In the first simulation, the presence of aerosols in the region from 25 deg north to 35 deg north reduced the meridional temperature gradient between the mid-latitudes and the equator and hence resulted in a southward displacement of the intertropical convergence zone (ITCZ) and thus reduced the monsoon rainfall over India. In the second simulation the removal of aerosols in northern midlatitudes increased the sea surface temperature in the northern hemisphere (figure 1). This increased in the meridional temperature gradient and hence caused a northward displacement of the ITCZ. The reduction of aerosol emissions in United States, Europe and India will therefore lead to increase in the Indian monsoon rainfall.

Reference:
Shawki, D & Voulgarakis, Apostolos & Chakraborty, Arindam & Kasoar, M & Srinivasan, Jayaraman, The South Asian Monsoon Response to Remote Aerosols: Global and Regional Mechanisms. Journal of Geophysical Research: Atmospheres. 10.1029/2018JD028623,2018

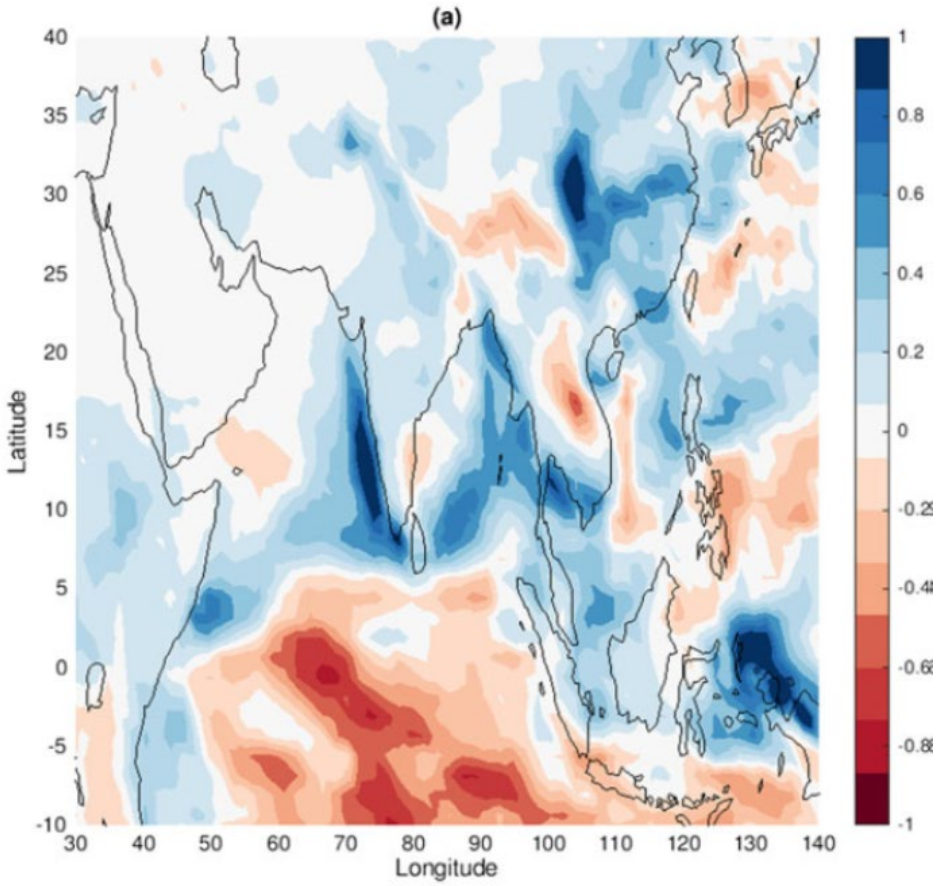

Figure 2 Change in rainfall (mm/day) during the monsoon season on account of reduction in aerosol emissions from United States, Europe and China.