



## **Effect of ship emissions on the air quality in Yangtze River Delta (YRD), China: A case study**

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The air quality in Yangtze River Delta (YRD) possessing one of the biggest port clusters has been considerably influenced by ship emissions which have not been yet controlled well. In the present study, a widespread and severe ozone ( $O_3$ ) pollution episode in September 2015 is simulated using the WRF-CHEM model to evaluate the contribution of ship emissions to the  $O_3$  and fine particulate matters ( $PM_{2.5}$ ) in YRD. The model generally performs reasonably well in simulating meteorological parameters and air pollutants against observations in YRD. Using the factor separate approach, sensitivity studies have revealed that the ship emissions increase the peak 8-h  $O_3$  concentration and the  $PM_{2.5}$  concentration by 2.8% and 12.4% on average, respectively. Additionally, ship emissions enhance the  $O_3$  level in coastal areas of Jiangsu and Shanghai as well as the central YRD, but cause an  $O_3$  decrease in southern coastal areas of Zhejiang during the  $O_3$  peak time. Ship emissions with abundant  $NO_x$  are carried inland by onshore winds and mixed with the local biogenic emissions during transport, noticeably enhancing the local  $O_3$  formation. Our studies show that stringent emission mitigation strategies need to be implemented for ship emissions to approve the air quality in YRD.