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Ozone formation induced by the impact of reactive bromine and iodine species on photochemistry in a polluted marine environment

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Reactive iodine and bromine species (RIS and RBS, respectively) are known for altering atmospheric chemistry, causing sharp tropospheric ozone (O_3) depletion in polar regions and significant O_3 reduction in the marine boundary layer (MBL). Here we use the comprehensive heterogeneous CAABA/MECCA atmospheric chemistry box model (CAABA/MECCA) to simulate the interaction between photochemistry and RBS and RIS, based on previous measurements at the Dead Sea (between N31˚50' and N31˚00', E35˚30') boundary layer. Unexpectedly, the model simulations showed that both RIS and RBS can lead to enhanced O_3 formation in a polluted marine environment under volatile organic compound (VOC)-limited conditions associated with high nitrogen oxide (NO_X= [NO] + [NO_2])concentrations[1]. Under these conditions, the daily average O_3 mixing ratio increased up to ∼44% and ∼28% for BrO and IO mixing ratios of up to ∼6.8 ppt and ∼4.7 ppt, respectively. The increase in O_3 was partially induced by enhanced $ClNO_3$ formation for higher Br_2 and I_2 emission flux. The O_3 increase was associated with an increased mixing ratio of hydroperoxyl radical to hydroxyl radical ([HO_2]/[OH]) and increased [NO_2]/[NO] with higher RBS and/or RIS. NO_X-rich conditions are typical to the polluted MBL, near coastlines and ship plumes. Considering that O_3 is toxic to humans, plants and animals and is a greenhouse gas, and that the polluted MBL covers extensive inhabited areas of the earth's surface, our findings call for adequate updating of local and regional air-quality models with the effects of RBS and RIS activities on O_3 mixing ratios in the polluted MBL.

References

[1] **Shechner, M., and Tas, E., Ozone Formation Induced by the Impact of Reactive Bromine and Iodine Species on Photochemistry in a Polluted Marine Environment Environmental Science & Technology 2017 51 (24), 14030-14037, DOI: 10.1021/acs.est.7b02860.**