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Response to the reviewer's comments

“Dramatic increase in reactive VOC emissions from ships at berth after implementing the fuel switch policy in the Pearl River Delta Emissions Control Area” by Zhen-Feng Wu et al.

Reviewer #2

The manuscript of Wu et al. with the title of “Dramatic increase of reactive VOC emission from ships at berth after implementing the fuel switch policy in the Pearl River Delta Emission Control Area” characterized the emissions of PM_{2.5}, SO₂ and VOCs from ships at berth before and after implementing the fuel switch policy with a FSC limit of 0.5% in the Pearl River Delta ECA in south China. After implementing the fuel switch policy, the EFs of SO₂ and PM_{2.5} for coastal vessels dropped 23 by 78% and 56%, however, the EFs of NMHCs increased by a factor of 15 times before implementing the new policy. The reactive alkenes overtook alkanes to become the dominant group, which led to the sharp increase of ozone formation potential. The results showed that this change may threatens ozone pollution control in the harbor cities. This is a well-written manuscript. The results could help to improve our understanding of another side of fuel switch policy and raised the concerns for reactive VOCs emissions from ships, and found river vessels might had even larger emissions of VOCs and NO_x than coastal vessels. I highly recommend this manuscript to be accepted by the journal.

Minor revisions

line 18, change “to reduce” to for reducing”;

Reply: Revised as suggested, Line 18, replaced “to reduce” to “for reducing”.

line 19, change “matters” to “matter”;

Reply: Revised as suggested, Line 19, replaced “matters” to “matter”.

line 19, change “emission” to “emissions”;

Reply: Revised as suggested, Line 19, replaced “emission” to “emissions”.

- 25 line 20, change “south” to “southern”;
- 26 Reply: Revised as suggested, Line 21, replaced “south” to “southern”.
- 27 line 21, change “a” to “an”;
- 28 Reply: Revised as suggested, Line 21, replaced “a” to “an”.
- 29 line 21, delete “in south China”;
- 30 Reply: Revised as suggested, Line 22, deleted “in south China”.
- 31 line 22, change “emission” to “emissions”;
- 32 Reply: Revised as suggested, Line 23, replaced “emission” to “emissions”.
- 33 line 22, change “coastal vessels” to “the coastal vessels”;
- 34 Reply: Revised as suggested, Line 23, replaced “coastal vessels” to “the coastal vessels”.
- 35 line 22, change “dropped” to “decreased”;
- 36 Reply: Revised as suggested, Line 23, replaced “dropped” to “decreased”.
- 37 line 23, change “the EFs of non-methane hydrocarbons (NMHCs), however, reached” to “however, the
38 EFs of the nonmethane hydrocarbons (NMHCs), were”;
- 39 Reply: Revised as suggested, Line 24, replaced “the EFs of non-methane hydrocarbons (NMHCs),
40 however, reached to” to “however, the EFs of the VOCs were”.
- 41 line 24, change “about” to “approximately”;
- 42 Reply: Revised as suggested, Line 25, replaced “about” to “approximately”.
- 43 line 24, change “emission” to “emissions”;
- 44 Reply: Revised as suggested, Line 26, replaced “emission” to “emissions”.

- 45 line 25, change “NMHCs” to “the NMHCs”;
- 46 Reply: Revised as suggested, Line 26, replaced “NMHCs” to “the VOCs”.
- 47 line 26, change “more rich” to “richer”;
- 48 Reply: Revised as suggested, Line 27, replaced “more rich” to “richer”.
- 49 line 28, change “the new policy” to “the new policy was implemented”;
- 50 Reply: Revised as suggested, Line 29, replaced “the new policy” to “IFSP”.
- 51 line 28, change “reactive alkenes” to “the reactive alkenes”;
- 52 Reply: Revised as suggested, Line 30, replaced “reactive alkenes” to “the reactive alkenes”.
- 53 line 29, change “for per kilogram of fuel burned, emitted NMHCs” to “the emitted NMHCs per kg of
54 fuel burned”;
- 55 Reply: Revised as suggested, Line 30, replaced “for per kilogram of fuel burned, emitted NMHCs” to
56 “the emitted VOCs per kg of fuel burned”.
- 57 line 29, change “about” to “approximately”;
- 58 Reply: Revised as suggested, Line 31, replaced “about” to “approximately”.
- 59 line 30, change “coastal vessels” to “the coastal vessels”;
- 60 Reply: Revised as suggested, Line 32, replaced “coastal vessels” to “the coastal vessels”.
- 61 line 30, change “river vessels” to “the river vessels”;
- 62 Reply: Revised as suggested, Line 32, replaced “river vessels” to “the river vessels”.
- 63 line 31, change “their EFs of NMHCs” to “the EFs of their NMHCs”;
- 64 Reply: Revised as suggested, Line 34, replaced “their EFs of NMHCs” to “the EFs of their VOCs”.

- 65 line 35, change “coastal or ocean-going vessels” to “the coastal or ocean-going vessels”;
- 66 Reply: Revised as suggested, Line 38, replaced “coastal or ocean-going vessels” to “the coastal or
67 ocean-going vessels”.
- 68 line 35, change “along with” to “in addition to”;
- 69 Reply: Revised as suggested, Line 38, replaced “along with” to “in addition to”.
- 70 line 35, change “river vessels” to “the river vessels”;
- 71 Reply: Revised as suggested, Line 39, replaced “river vessels” to “the river vessels”.
- 72 line 38, change “total world merchandise trade” to “the total global merchandise trade”;
- 73 Reply: Revised as suggested, Line 42, replaced “total world merchandise” to “the total global
74 merchandise trade”.
- 75 line 39, change “it is no surprise that” to “unsurprisingly”;
- 76 Reply: Revised as suggested, Line 44, replaced “it is no surprise that” to “unsurprisingly”.
- 77 line 42, change “would give rise to” to “can cause”;
- 78 Reply: Revised as suggested, Line 46, replaced “would give rise to” to “can cause”.
- 79 line 42, change “areas,” to “areas”;
- 80 Reply: Revised as suggested, Line 46, replaced “areas,” to “areas”.
- 81 line 42, change “environmental burden” to “the environmental burden”;
- 82 Reply: Revised as suggested, Line 47, replaced “environmental burden” to “the environmental burden”.
- 83 line 46, change “more” to “a more”;
- 84 Reply: Revised as suggested, Line 51, replaced “more” to “a more”.

- 85 line 47, change “brought about” to “resulted in”;
- 86 Reply: Revised as suggested, Line 52, replaced “brought about” to “resulted in”.
- 87 line 49, change “resulted” to “has resulted”;
- 88 Reply: Revised as suggested, Line 54, replaced “resulted” to “has resulted”.
- 89 line 50, change “aerosols” to “aerosols, respectively,”
- 90 Reply: Revised as suggested, Line 55, replaced “aerosols” to “aerosols, respectively”.
- 91 line 51, change “revealed” to “has revealed”;
- 92 Reply: Revised as suggested, Line 56, replaced “revealed” to “has revealed”.
- 93 line 55, change “reduce” to “be reduced”;
- 94 Reply: Revised as suggested, Line 60, replaced “reduce” to “be reduced”.
- 95 line 56, change “emission sources” to “emissions sources”;
- 96 Reply: Revised as suggested, Line 62, replaced “emission sources” to “emissions sources”.
- 97 line 67, change “VOCs” to “the VOCs”;
- 98 Reply: Revised as suggested, Line 73, replaced “VOCs” to “the VOCs”.
- 99 line 68, change “north” to “northern”;
- 100 Reply: Revised as suggested, Line 74, replaced “north” to “northern”.
- 101 line 69, change “As a matter of fact, previous” to “Previous”;
- 102 Reply: Revised as suggested, Line 75, replaced “As a matter of fact, previous” to “Previous”.
- 103 line 70, change “Meanwhile” to “In addition”;
- 104 Reply: Revised as suggested, Line 77, replaced “Meanwhile” to “In addition”.

105 line 75, change “January 1, 2017 to December 31, 2019” to “1 January, 2017, to 31 December, 2019”;

106 Reply: Revised as suggested, Line 83, replaced “January 1, 2017 to December 31, 2019” to “1 January,
107 2017, to 31 December, 2019”.

108 line 76, change “estimiated” to “estimated”;

109 Reply: Revised as suggested, Line 83, replaced “estimiated” to “estimated”.

110 line 76, change “atmosheric” to “atmospheric”;

111 Reply: Revised as suggested, Line 84, replaced “atmosheric” to “atmospheric”.

112 line 77, change “south” to “southern”;

113 Reply: Revised as suggested, Line 84, replaced “south” to “southern”.

114 line 81, change “bring about” to “result in”;

115 Reply: Revised as suggested, Line 89, replaced “bring about” to “result in”.

116 line 82, change “shut down” to “shut down,”;

117 Reply: Revised as suggested, Line 90, replaced “shut down” to “shut down,”.

118 line 82, change “emission” to “emissions”;

119 Reply: Revised as suggested, Line 90, replaced “emission” to “emissions”.

120 line 88, change “like” to “such as”;

121 Reply: Revised as suggested, Line 96, replaced “like” to “such as”.

122 line 92, change “in comparison” to “for a comparison”;

123 Reply: Revised as suggested, Line 100, replaced “in comparison” to “for a comparison”.

124 line 97, change “the fifth” to “fifth”;

- 125 Reply: Revised as suggested, Line 106, replaced “the fifth” to “fifth”.
- 126 line 98, change “the seventh” to “seventh”;
- 127 Reply: Revised as suggested, Line 107, replaced “the seventh” to “seventh”.
- 128 line 98, change “contribute near 40%” to “account for nearly 40% of”;
- 129 Reply: Revised as suggested, Line 107, replaced “contribute near 40%” to “account for nearly 40% of”.
- 130 line 99, change “nine” to “the nine”;
- 131 Reply: Revised as suggested, Line 108, replaced “nine” to “the nine”.
- 132 line 101, change “FSC” to “the FSC”;
- 133 Reply: Revised as suggested, Line 111, replaced “FSC” to “the FSC”.
- 134 line 101, change “be lower” to “have been less”;
- 135 Reply: Revised as suggested, Line 111, replaced “be lower” to “have been less”.
- 136 line 102, change “that” to “in that”;
- 137 Reply: Revised as suggested, Line 112, replaced “that” to “in which”.
- 138 line 147, change “on average decreased from $2.2 \pm 0.5\%$ ” to “decreased from $2.2 \pm 0.5\%$ on average”;
- 139 Reply: Revised as suggested, Line 167, replaced “on average decrease from $2.2 \pm 0.5\%$ ” to “decreased
- 140 from $2.2 \pm 0.5\%$ on average”.
- 141 line 148, change “though” to “although”;
- 142 Reply: Revised as suggested, Line 168, replaced “though” to “although”.
- 143 line 150, change “hydrocarbons” to “hydrocarbons,”;
- 144 Reply: Revised as suggested, Line 171, replaced “hydrocarbons” to “hydrocarbons,”.

145 line 151, change “chromatograms” to “chromatograms, than those of coastal vessels before the policy”;

146 Reply: Revised as suggested, Line 171, replaced “chromatograms” to “chromatograms, than those of

147 coastal vessels before IFSP”.

148 line 157, change “performance of combustion system” to “the performance of the combustion system”;

149 Reply: Revised as suggested, Line 178, replaced “performance of combustion system” to “the

150 performance of the combustion system”.

151 line 185, change “, and also larger” to “and higher”;

152 Reply: Revised as suggested, Line 211, replaced “and also larger” to “and larger”.

153 line 185, change “engineering vessel” to “engineering vessels”;

154 Reply: Revised as suggested, Line 211, replaced “engineering vessel” to “engineering vessels”.

155 line 185, change “crusing condition” to “cruising conditions”;

156 Reply: Revised as suggested, Line 212, replaced “crusing condition” to “cruising conditions”.

157 line 186, change “the maximum” to “a maximum”;

158 Reply: Revised as suggested, Line 212, replaced “the maximum” to “a maximum”.

159 line 199, change “individual” to “the individual”;

160 Reply: Revised as suggested, Line 229, replaced “individual” to “the individual”.

161 line 199, change “remain” to “remained”;

162 Reply: Revised as suggested, Line 229, replaced “remain” to “remained”.

163 line 210, change “before” to “before implementing the new policy”;

164 Reply: Revised as suggested, Line 232, replaced “before” to “before IFSP”.

165 line 242, change “after implementing the policy, respectively” to “, respectively, after implementing the
166 policy”;

167 Reply: Revised as suggested, Line 242, replaced “after implementing the policy, respectively” to
168 “respective, after IFSP”.

169 line 212, change “NMHCs from river vessels were” to “the NMHCs from the river vessels was”;

170 Reply: Revised as suggested, Line 243, replaced “NMHCs from river vessels were” to “the VOCs from
171 the river vessels was”.

172 line 212, change “coastal vessels” to “the coastal vessels”;

173 Reply: Revised as suggested, Line 243, replaced “coastal vessels” to “the coastal vessels”.

174 line 213, change “showed” to “shown”;

175 Reply: Revised as suggested, Line 244, replaced “showed” to “shown”.

176 line 213, change “dominated the emission of NMHCs with a share of” to “were dominant in the
177 emissions of the NMHCs at”;

178 Reply: Revised as suggested, Line 244, replaced “dominated the emission of NMHCs with a share of”
179 to “were dominant in the emissions of the NMHCs at”.

180 line 214, change “individual” to “the individual”;

181 Reply: Revised as suggested, Line 246, replaced “individual” to “the individual”.

182 line 223, change “had a share up to 70.9%” to “accounted for up to 70.9% of those emissions”;

183 Reply: Revised as suggested, Line 254, replaced “had a share up to 70.9%” to “accounted for up to
184 70.9% of those emissions”.

185 line 223, change “variety of the” to “variation in”;

186 Reply: Revised as suggested, Line 255, replaced “variety of the” to “variation in”.

187 line 224, change “big” to “large”;

188 Reply: Revised as suggested, Line 256, replaced “big” to “large”.

189 line 224, change “compositions of VOC emissions” to “the compositions the VOC emissions”;

190 Reply: Revised as suggested, Line 256, replaced “compositions of VOC emissions” to “the

191 compositions of the VOC emissions”.

192 line 225, change “only restricted” to “restricted only”;

193 Reply: Revised as suggested, Line 256, replaced “only restricted” to “restricted only”.

194 line 225, delete “can be”;

195 Reply: Revised as suggested, Line 257, deleted “can be”.

196 line 226, change “diesels” to “diesel fuels used”;

197 Reply: Revised as suggested, Line 258, replaced “diesels” to “diesel fuels used”.

198 line 226, change “sampling might also lead” to “the sampling might have also led”;

199 Reply: Revised as suggested, Line 258, replaced “sampling might also lead” to “the sampling might

200 have also led”.

201 line 228, change “potentials” to “potential”;

202 Reply: Revised as suggested, Line 260, replaced “potentials” to “potential”.

203 line 229, change “OFPs of VOCs from ship exhausts” to “OFP of the VOCs from ship exhaust”;

204 Reply: Revised as suggested, Line 261, replaced “OFPs of VOCs from ship exhausts” to “OFP of the

205 VOCs from ship exhaust”.

206 line 230, change “Formation Potentials (OFPs)” to “formation potentials (OFP)”;

207 Reply: Revised as suggested, Line 262, replaced “Formation Potentials (OFPs)” to “formation potential

- 208 (OFP)".
- 209 line 231, change "ships emission" to "ships emissions";
- 210 Reply: Revised as suggested, Line 263, replaced "ships emission" to "ships emissions".
- 211 line 232, change "reactivity," to "reactivity";
- 212 Reply: Revised as suggested, Line 264, replaced "reactivity," to "reactivity".
- 213 line 237, change "rise of" to "increase in";
- 214 Reply: Revised as suggested, Line 270, replaced "rise of" to "increase in".
- 215 line 237, change "like" to "such as";
- 216 Reply: Revised as suggested, Line 271, replaced "like" to "such as".
- 217 line 240, change "coastal vessels" to "the coastal vessels";
- 218 Reply: Revised as suggested, Line 274, replaced "coastal vessels" to "the coastal vessels".
- 219 line 241, change "OFPs" to "OFP";
- 220 Reply: Revised as suggested, Line 275, replaced "OFPs" to "OFP".
- 221 line 241, change "coastal vessels" to "the coastal vessels";
- 222 Reply: Revised as suggested, Line 276, replaced "coastal vessels" to "the coastal vessels".
- 223 line 245, change "suggests" to "suggest";
- 224 Reply: Revised as suggested, Line 279, replaced "suggests" to "suggest".
- 225 line 246, change "SOAFPs of VOCs from ship exhausts" to "SOAFP of the VOCs from ship exhaust";
- 226 Reply: Revised as suggested, Line 281, replaced "SOAFPs of VOCs from ship exhausts" to "SOAFP of
- 227 the VOCs from ship exhaust".

- 228 line 250, change “Like” to “Similar to”;
- 229 Reply: Revised as suggested, Line 286, replaced “Like” to “Similar to”.
- 230 line 251, change “SOAFPs” to “SOAFP”;
- 231 Reply: Revised as suggested, Line 287, replaced “SOAFPs” to “SOAFP”.
- 232 line 252, change “to interpret” to “in interpreting”;
- 233 Reply: Revised as suggested, Line 288, replaced “to interpret” to “in interpreting”.
- 234 line 252, delete “(IVOCs)”;
- 235 Reply: Revised as suggested, Line 288, deleted “(IVOCs)”.
- 236 line 261, change “higher” to “higher than that of the other ships,”;
- 237 Reply: Revised as suggested, Line 298, replaced “higher” to “higher than that of the other ships”.
- 238 line 262, change “has: to “had”;
- 239 Reply: Revised as suggested, Line 299, replaced “has” to “had”.
- 240 line 262, change “river vessels” to “the river vessels”;
- 241 Reply: Revised as suggested, Line 299, replaced “river vessels” to “the river vessels”.
- 242 line 262, change “test ships” to “the tested ships”;
- 243 Reply: Revised as suggested, Line 300, replaced “test ships” to “the tested ships”.
- 244 line 262, change the value” to “a value”;
- 245 Reply: Revised as suggested, Line 300, replaced “the value” to “a value”.
- 246 line 273, change “one the three ECAs newly established” to “one of the three newly established
- 247 ECAs”;

248 Reply: Revised as suggested, Line 315, replaced “one the three ECAs newly established” to “one of the
249 three newly established ECAs”.

250 line 280, change “of EFs” to “in the EFs”;

251 Reply: Revised as suggested, Line 322, replaced “of EFs” to “in the EFs”.

252 line 280, change “more” to “the more”;

253 Reply: Revised as suggested, Line 323, replaced “more” to “the more”.

254 line 288, change “did bring about largely” to “resulted in substantially”;

255 Reply: Revised as suggested, Line 332, replaced “did bring about largely” to “resulted in
256 substantially”.

257 line 289, change “for” to “due to”;

258 Reply: Revised as suggested, Line 334, replaced “for” to “due to”.

259 line 290, change “coastal vessels” to “the coastal vessels”;

260 Reply: Revised as suggested, Line 334, replaced “coastal vessels” to “the coastal vessels”.

261 line 290, change “is” to “was”;

262 Reply: Revised as suggested, Line 334, replaced “is” to “was”.

263 line 290, change “use” to “had used”;

264 Reply: Revised as suggested, Line 335, replaced “use” to “had used”.

265 line 290, change “all along and thus” to “the entire time and thus were”;

266 Reply: Revised as suggested, Line 335, replaced “all along and thus” to “the entire time and thus
267 were”.

268 line 291, change “much higher” to “high”;

- 269 Reply: Revised as suggested, Line 336, replaced “much higher” to “high”.
- 270 line 291, change “larger emission” to “high level of emissions”;
- 271 Reply: Revised as suggested, Line 336, replaced “larger emission” to “high level of emissions”.
- 272 line 292, delete “would”;
- 273 Reply: Revised as suggested, Line 337, deleted “would”.
- 274 line 292, change “how to further lower the emission” to “and further lowering the emissions”;
- 275 Reply: Revised as suggested, Line 337, replaced “how to further lower the emission” to “and further
- 276 lowering the emissions”.
- 277