

Interaction of Ozone and Sulfate in Air Pollution and Climate Change

(Taken from http://www.giss.nasa.gov/research/briefs/unger_01/)

1 In two recent studies, researchers describe how emission of ozone precursor gases (gases
2 which react to form ozone) can affect both air quality and climate forcing by increasing the
3 levels of tropospheric sulfate. Like many of their precursors, ozone and sulfate are pollutants
4 that can affect climate, agriculture, and human health. *However*, they act differently on the
5 climate, as ozone tends to warm the planet while sulfate cools it.
6 Ozone and sulfate aerosol are formed in the atmosphere from chemical reactions involving
7 gases such as sulfur dioxide, carbon monoxide and methane, which are emitted by both
8 natural and human sources. *These* include automobile traffic, power generation, industry and
9 agriculture.
10 Many of the reactions and molecules involved in the formation of sulfate and ozone overlap.
11 Sulfate is generated by the oxidation of sulfur dioxide by the hydroxyl radical or by hydrogen
12 peroxide, both of which can be derived from ozone. *Likewise*, ozone production requires the
13 presence of nitrogen oxides, which sulfate can remove by conversion to nitric acid.
14 In the future, man-made emissions of the precursor gases will change as more nations
15 industrialize, other nations implement emissions control strategies, and world population
16 grows, leading to changes in the amount of pollution that people are exposed to. Researchers
17 used the GISS ModelE to simulate a future Earth atmosphere based on an approximate
18 projection of man-made precursor emissions to simulate levels of air pollution in the future
19 and to investigate how the interaction between sulfate and ozone will affect future climate
20 changes.
21 They found that there will be large increases in pollution in subtropical regions, especially
22 Asia. Over the Indian subcontinent the surface sulfate aerosol amount will grow from around
23 400 pptv in the present day to around 2000 pptv at 2030 and the surface level ozone will
24 increase from around 35 ppbv to 60 ppbv. The potential consequences of such large increases
25 in the sulfate aerosol and ozone pollution may have serious social and economic impacts
26 across the Indian subcontinent.
27 This new insight, that ozone precursors have a surprisingly large influence on air quality via
28 sulfate and that their overall climate impact is opposite to the conventional view, is of direct
29 relevance to regulatory policy. The interconnection between ozone and sulfate can
30 complicate environmental efforts, *because* a reduction of ozone precursors will improve
31 surface air quality, but *also* impose additional positive forcing via sulfate reduction. Their
32 results suggest that regulations should address ozone and sulfate simultaneously, which *they*
33 do not currently do, as well as consider both air quality and climate.

A. Read the text and answer the following questions in English using your own words

1. How do ozone and sulfate act on the climate?
2. Which sources generate these gases? Give examples.
3. Why will man-made emissions of gasses change?
4. What are the estimated changes for the future?
5. Why is the new insight important?
6. What do future policies have to take into account?

B. Answer in Spanish

1. What do the following words refer to in the text?

These (L 8)

they (L.32).....

2. What word/s are used instead of regulatory policy?

.....

3. What kind of relation do these words express? (addition, opposition/contrast, cause/consequence, time)

However (L.4)

Likewise (L.12).....

Because (L.30)

also (L.31).....

Key

1. How do ozone and sulfate act on the climate? Ozone tends to warm the planet while sulfate cools it.
2. Which sources generate these gases? Give examples. Both natural and human sources. For example: automobile traffic, power generation, industry and agriculture.
3. Why will man-made emissions of gasses change? Because more nations will be industrialized and the world's population will grow.
4. What are the estimated changes for the future? Pollution will increase in subtropical regions, especially Asia; tthe surface sulfate aerosol amount will grow over the Indian subcontinent; the increase in the sulfate aerosol and ozone pollution will probably have serious social and economic impacts across the Indian subcontinent.
5. Why is the new insight important? Because it shows that ozone precursors influence air quality and their overall climate impact is opposite to the conventional view.
6. What do future policies have to take into account? Regulations should deal with ozone and sulfate simultaneously, as well as consider both air quality and climate.

1. These (L 8): human sources
they (L.32): regulations

2. regulations

3. However (l.4): contrast
Likewise (l.12): addition
Because (l.30): cause
also (l.31): addition