SAP 3.2"Climate Projections Based on Emissions Scenarios for long-lived radiatively active trace gases and future climate impacts of short-lived radiatively active gases and aerosols."
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PUBLIC Reviewers

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GENERAL PUBLIC COMMENTS

ExxonMobil (Haroon Kheshgi)

SAP 3.2 has the potential to clarify a number of gaps in previous assessment including the emission scenarios associated with aerosols other than sulfate in both the IPCC and SAP scenarios, and the effects of pollutant controls on climate. However, I found SAP 3.2 to not be very clear about issues such as these, and SAP 3.2 seemed to only further confuse these topics. For example, I would expect that efforts to control S-emissions would lead to higher radiative forcing, as seems to be a robust conclusion of a number of publications, and is apparent at the bottom of page 187 but not in the ES (executive summary); however, the conclusion on page 80 seems to avoid this seemingly robust conclusion in favor for a conclusion that is dependent on the subtleties of carbonaceous aerosols, is at best a partial answer, and is the exclusive answer raised to the ES. This if further confused by the fact that both the IPCC scenarios already assume stringent levels of S-emission control. In reading sections of the report, it was unclear from the language used if the sections actually were addressing the full range of aerosols, or if it was excluding sulfate. I have included some specific comments, but there is a great deal of clarification needed in this draft. -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

In general all short-lived species were considered as a group when we discussed their climate impact, primarily surface temperature since that was the statistically significant signal. We had to run up to 6 simulations of 50 or 100 years each for each climate model. To have done this for each individual aerosol was beyond the scope of this study and not really necessary since the much less time consuming radiative forcing calculations provide sufficient information.

As one can tell from the Tables in Chapter 3, the contributions of the individual aerosols depend strongly on emission assumptions, the year studied and the relative role of natural and anthropogenic contributions. In fact, at 2050, the radiative forcing due to any changes in sulfate is minimal. It only has a significant effect on radiative forcing near the end of the 21st century. However, please note that even this conclusion is highly dependent on highly uncertain emission projections.

We do report individual aerosol optical depths in Table 3.5 and individual radiative forcings in Table 3.6, Figure 3.3 and Figure 3.4 and discuss them in some detail in Sections 3.2 and 3.3. However the primary focus of this study was short-lived gases and aerosols as a group. The referenced scientific papers that resulted from this report do provide more detail. However, the role of individual aerosols depends on their highly uncertain individual emission projections, and there are no robust conclusions suitable for SAP 3.2 at this time. We do mention the well known fact that reduced sulfate leads to reduced cooling and increased global warming in Chapter 3. We do not deal with specific individual aerosols in the Executive Summary.

SPECIFIC PUBLIC COMMENTS

Executive Summary

ExxonMobil (Haroon Kheshgi)

Chapter ES; page 15, line 299: In numerous places, the term particle or particulate has been used in place of aerosol. Unless distinguishing between ground level PM, or solid (particulate) aerosols and aerosols in gerneral, I suggest that the term aerosols be used throughout this SAP. -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

We agree and have chosen to use aerosol throughout the document.

Chapter ES; page 16, line 326: There is no "standard" storyline; suggest replacing with "IPCC (2007) range of climate projections for the emission scenarios of the IPCC (2000) Special Report on Emission Scenarios". -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

We have re-written that portion to read "… IPCC climate projections for the standard scenarios considered in the 4th Assessment."

Chapter ES; page 17, line 332: It is not clear what studies are being referred to by "two of the three"; suggest adding reference or footnote defining what studies. -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

We have added a link to the relevant section in Finding 2. [see Section 3.3.4 and Figure 3.5]

Chapter ES; page 17, line 333: If this warming is due to reduction in S-emissions, then this should be stated (I am not sure how it could be due to carbonaceous aerosols since they are not included in the IPCC scenarios). The reader seems to be led here to assume that increased emissions of pollutants are projected to cause warming, when it is (if indeed this is an S-emission effect) that control of pollutants is leading to warming. -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

At 2050 it is not due to sulfate, as Table 3.6 and associated discussion demonstrate. BC and Ozone drive GFDL and BC, Ozone and their crude aerosol indirect effect drive the GISS model. NCAR had no significant warming. All of this is too much detail for the ES though it is in the (in press) Shindell et al. (2008) paper and section 3.3.3-.4. of this report.

Chapter ES; page 17, line 335: In the footnote defining "radiatively active" it is not clear that this includes scattering aerosols such as sulfate; suggest adding "…re-emit or scatter radiation…" to the footnote to clarify. -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

You are right. We now say "…absorb, scatter and re-emit radiation, ….]

Chapter ES; page 18, line 365: Some studies show that the primary effect of soot on climate is through effects on precipitation not warming; this is completely opaque to the

reader of this section and should be discussed in the ES. -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

Two of the models had no aerosol indirect effects and the the GISS model had a very crude treatment. We note "… the determination of the indirect effect[1] of aerosols on climate." as one of the two most important uncertainties in Finding 5. of the ES. In Finding 7. we now specify global warming instead of climate change.

Chapter 2

ExxonMobil (Haroon Kheshgi)

Chapter A.2; page 69, line 1462: There are 2 forms of CaCO3 and I believe that this statement is only applicable to aragonite and not to calcite which is significantly less soluble; suggest replacing CaCO3 with aragonite. -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

Chapter A.2; page 70, line 1464: Shallow water sediment dissolution, I believe, is dependent on pore-water acidity (which is quite a bit more acidic than seawater due to respiration on organic carbon deposited in sediment) and only partly dependent on sea-water acidity, therefore, "would lead to dissolution" is an oversimplification. Suggest "While ocean acidification could affect marine calcifying organisms and shallow-water carbonate sediments, …". -- Haroon Kheshgi, ExxonMobil Research & Engineering Company

This was taken as a direct quote from the findings of Chapter 10 of AR4. It is not that relevant to SAP3.2, which is focused on physical climate, and we are not really qualified to deal with ocean biogeochemistry.
A colleague who is an ocean biogeochemist says you have a good point, so we have just dropped the lines and now only retain the first part "Increasing atmospheric CO_2 concentrations lead directly to increasing acidification of the surface ocean. Multi-model projections based on SRES scenarios give reductions in pH of between 0.14 and 0.35 units over the 21st century, adding to the present decrease of 0.1 units from pre-industrial times.".

[1] The indirect effects of particles lead to an indirect forcing of the climate system through their acting as cloud condensation nuclei or modifying the optical properties and lifetime of clouds.