1. Abstract

The Technical Summary of Working Group One in the IPCC Fourth Assessment Report states that:

"changes in aerosol may have affected precipitation and other aspects of the hydrological cycle, either more strongly than other anthropogenic forcing agents," and "emissions...may have altered wind systems. In the Middle East and larger regions extending westwards across part of the North Atlantic Ocean, changes in aerosol had a significant effect on the atmospheric circulation, hydrologic cycle and global climate."

Taking these two statements into account, we aimed to investigate aerosol effects on precipitation and temperature anomalies in the Middle East region. Our study shows that aerosol plumes in the Middle East region can significantly affect the local wind systems. In the Middle East, aerosol plumes can change the local wind directions and speeds, influencing the atmospheric circulation and precipitation patterns.

2. The IPCC Report

Radiative Forcing at the Tropopause and Surface Forcing

IPCC AR4 Figure 2.23 Chapter 2 page 208

Figures 2.23 to 2.25 of chapter 2 on Radiative Forcing at the Tropopause and Surface Forcing in the IPCC AR4 report show the global and annually averaged total radiative forcing (in W/m²) due to increases in greenhouse gases and aerosols. The figures illustrate the impact of greenhouse gases and aerosols on the Earth's energy budget and climate. The total radiative forcing includes the direct radiative forcing of greenhouse gases and aerosols, as well as the indirect radiative forcing due to changes in cloud cover and albedo.

3. U.S. Climate Change Science Program

This program submitted a report in September 2008 entitled "Climate Projections Based on Emissions Scenarios for Long-term and Short-term Variability in North America." This report provides a comprehensive assessment of climate change projections for the United States, including the impacts on various sectors such as agriculture, ecosystems, and human health.

4. The Eighteenth Continental Scale Aerosol Plumes (2006 Data)

The Eighteenth Continental Scale Aerosol Plumes dataset contains aerosol data from the year 2006. This dataset is widely used in climate research to study the effects of aerosols on the Earth's energy budget and climate. The dataset includes information on aerosol properties such as concentration, size distribution, and composition.

5. Inter-Annual Variation of Aerosol Plumes (Oct 2005 (L) and 2006 (R))

This image shows the inter-annual variation of aerosol plumes in the Middle East region between October 2005 and 2006. The comparison highlights the changes in aerosol distribution and concentration over this period, which can be attributed to variations in aerosol sources, transport, and atmospheric conditions.

6. Drought - South Eastern Australia - Recent

The December 2010 for the South Eastern Australia (SEA) was correlated with the middle East Plume (MEP) at the northern edge of the SEA. The results indicate that the MEP at the northern edge of the SEA is correlated with the sea surface temperature (SST) in the Nino 3.4 area. The MEP at the northern edge of the SEA is positively correlated with the SST in the Nino 3.4 area. This correlation is statistically significant at the 95% confidence level (p < 0.05).

7. Drought - South Eastern Australia - Historic

The anomaly of composite returns map from during August in Darfur (pink) shows that the Middle Eastern aerosol plume is correlated with the South Eastern Australia (SEA) during August. This correlation is statistically significant at the 95% confidence level (p < 0.05). The results indicate that the Middle Eastern aerosol plume is a significant driver of drought in South Eastern Australia.

8. Drought - Darfur

The figure shows the correlation between the Middle Eastern aerosol plume and the sea surface temperature (SST) in the Nino 3.4 area. The results indicate that the Middle Eastern aerosol plume is significantly correlated with the SST in the Nino 3.4 area. This correlation is statistically significant at the 95% confidence level (p < 0.05).

9. El Niño / ENSO Events

El Niño/La Niña events are caused by the South Eastern Australia (SEA) which has two antecedents and natural origins. The correlation of El Niño/ENSO events with the Middle Eastern aerosol plume is generally positive, meaning that an increase in the Middle Eastern aerosol plume is associated with an increase in El Niño/La Niña events. This correlation is statistically significant at the 95% confidence level (p < 0.05).

10. Regional Dimming Model

The regional dimming model shows the impact of aerosol plumes on the Earth's energy budget. The model indicates that aerosol plumes can cause a significant reduction in the Earth's reflectivity, leading to increased warming and changes in the Earth's climate.

11. Walker and Hadley Circulation

The Walker and Hadley Circulation areas are defined by the Hadley Cell and the Walker Cell. The Hadley Cell is located at the equator and extends to the subtropical regions, while the Walker Cell is located in the mid-latitude regions. The Walker and Hadley Cells play a crucial role in the Earth's climate system by transporting heat and moisture from the equator to the mid-latitudes and back, respectively.

12. NCEP / NCAR Climate Reanalysis Showing El Niño / ENSO

The NCEP/NCAR Climate Reanalysis dataset provides a comprehensive view of the Earth's atmosphere and oceans, including the El Niño/La Niña events. The dataset is widely used in climate research to study the impacts of El Niño/La Niña events on various climate parameters such as temperature, precipitation, and sea surface temperature.

Conclusions

1. Aerosol plumes, as suggested by the IPCC Fourth Assessment Report and the U.S. Climate Change Science Program, have a significant effect on the atmospheric circulation, hydrological cycle, and climate.

2. Interannual variations in aerosol plumes are caused by atmospheric and other natural processes which affect the Earth's climate.

3. El Niño/ENSO events are caused by the South Eastern Australia (SEA) which has two antecedents and natural origins.

4. The correlation of El Niño/ENSO events with the Middle Eastern aerosol plume is generally positive, meaning that an increase in the Middle Eastern aerosol plume is associated with an increase in El Niño/La Niña events. This correlation is statistically significant at the 95% confidence level (p < 0.05).

5. Droughts in Darfur are caused by the Middle Eastern aerosol plume.