World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:11, No:05, 2017

Influence of Atmospheric Circulation Patterns on Dust Pollution Transport during the Harmattan Period over West Africa

Authors : Ayodeji Oluleye

Abstract : This study used Total Ozone Mapping Spectrometer (TOMS) Aerosol Index (AI) and reanalysis dataset of thirty years (1983-2012) to investigate the influence of the atmospheric circulation on dust transport during the Harmattan period over WestAfrica using TOMS data. The Harmattan dust mobilization and atmospheric circulation pattern were evaluated using a kernel density estimate which shows the areas where most points are concentrated between the variables. The evolution of the Inter-Tropical Discontinuity (ITD), Sea surface Temperature (SST) over the Gulf of Guinea, and the North Atlantic Oscillation (NAO) index during the Harmattan period (November-March) was also analyzed and graphs of the average ITD positions, SST and the NAO were observed on daily basis. The Pearson moment correlation analysis was also employed to assess the effect of atmospheric circulation on Harmattan dust transport. The results show that the departure (increased) of TOMS AI values from the long-term mean (1.64) occurred from around 21st of December, which signifies the rich dust days during winter period. Strong TOMS AI signal were observed from January to March with the maximum occurring in the latter months (February and March). The inter-annual variability of TOMSAI revealed that the rich dust years were found between 1984-1985, 1987-1988, 1997-1998, 1999-2000, and 2002-2004. Significantly, poor dust year was found between 2005 and 2006 in all the periods. The study has found strong north-easterly (NE) trade winds were over most of the Saheliannregion of West Africa during the winter months with the maximum wind speed reaching 8.61m/s inJanuary.The strength of NE winds determines the extent of dust transport to the coast of Gulf of Guinea during winter. This study has confirmed that the presence of the Harmattan is strongly dependent on theSST over Atlantic Ocean and ITD position. The locus of the average SST and ITD positions over West Africa could be described by polynomial functions. The study concludes that the evolution of near surface wind field at 925 hpa, and the variations of SST and ITD positions are the major large scale atmospheric circulation systems driving the emission, distribution, and transport of Harmattan dust aerosols over West Africa. However, the influence of NAO was shown to have fewer significance effects on the Harmattan dust transport over the region.

Keywords : atmospheric circulation, dust aerosols, Harmattan, West Africa
Conference Title : ICAPC 2017 : International Conference on Air Pollution and Control
Conference Location : London, United Kingdom
Conference Dates : May 25-26, 2017