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Conflict of marine and desert origin air masses over the Indo-Gangetic Plain (IGP) in relation to Indian monsoon as revealed by MODIS aerosols data

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Indo-Gangetic Plain (IGP) has been recognized as one of the hotspots linked with the aerosols-monsoon climate relationship. This relationship has been examined by different researchers with regard to studies (i) the inter-annual monsoon variability through the direct radiatve feedbacks on the hydrological cycle of the monsoon, (ii) role of the high aerosol load along sub-Himalayan region for modulating the monsoon through high altitude pump mechanism and (iii) the episodic influence of aerosols on the active-break cycle of the monsoon. In this study we focus on the studying role of east-west shift in the low aerosol/high aerosol load through monsoonal intra-seasonal and inter-annual oscillations. We used MODIS derived AOD data for 10-years (2000-2009) in respect of monthly mean and 10-days average AOD for the June-September and July - Aug periods respectively to understand the inter-annual variation of the monsoon and the intra-seasonal variability of extreme events over the region covering 70^{o}E - 95^{o}E and 20^{o}N - 30^{o}N. As expected the aerosol load along the IGP is very high in June as the moist monsoon barely reaches the IGP during this month. The AOD decreases during July and August but higher values are still present to the west of 80^{o}E, which is the boundary between conflicting air masses of desert origin and the marine origin under the normal monsoon season. However, on the inter-annual scale this zone of conflict between the two air masses shifts eastward up to 90^{o}E in weak monsoon years and westwards to 70^{o}E - 75^{o}E in years of good monsoon activity during the peak monsoon months. A few examples of such events on the monthly scale are provided for the years of draught like 2001, 2002, 2004 and 2009 and years of excess monsoon like 2003 and 2006. The study also examines the AOD fluctuations on sub-seasonal scale for 10-day averages of July and August months of contrasting years. It is found that the build up of aerosols along the IGP takes place at the beginning of the weak phase of monsoon, it peaks and decreases in the subsequent 10-days period. This suggests that the enhanced aerosols load, as a result of the invasion of desert aerosol, may feedback in the monsoon system to keep the monsoon weak. During years of excess monsoon the same thing happens in a reverse manner as the moist air mass of Bay of Bengal origin is pushed westward reducing the AOD values on IGP considerably. The season of 2006 was characterized by low AOD values along the IGP because even though the monsoon was deficit over the area the desert air mass was not present over the region. The monsoon trough being well south of the normal position, marine origin air from the Bay of Bengal persisted over the IGP. This study emphasizes that while the monsoon dynamics is responsible for this east-west migration, the feedback processes are responsible for sustaining the intra-seasonal and inter-annual variability both in AOD and monsoon activity.