Studies on Forest Fires Using DMSP OLS Data

V.KRISHNA PRASAD, YOGESH KANT AND K.V.S. BADARINATH
National Remote Sensing Agency
(Dept. of Space – Govt. of India)
Balanagar, Hyderabad – 500037

ABSTRACT

Studies related to forest fires are important in the context of trace gas emissions associated with such events. Much of the polar orbiting satellites due to their repetitive cycle have limitation in observing such events and in tropics due to cloud cover, the chance of getting cloud free image during day time becomes difficult. In order to explore the possibilities of using DMSP OLS night time data for monitoring such event, the present study has been undertaken in Central Himalayan region of India where extensive fire event has been reported in May/June, 1995. The results of the study suggests the possibility of monitoring such events using DMSP OLS night time data.

Introduction

The history of anthropogenic fires caused mainly due to shifting cultivation, poses number of fundamental questions for any assessment of global climate change. The varied fire characteristics during different phases of burning of biomass, stands as a challenging task in detecting and monitoring them so as to assess the ecological impacts on surrounding ecosystems. In tropical countries, forest fires cause extensive damage to the ecosystem and monitoring such events have been gaining importance in the global climate change point of view. AVHRR data has been widely used for biomass burning analysis for more than a decade. The capability of AVHRR to identify high temperature sources and for mapping fire activity has been well studied by previous workers (Matson and Dozier, 1981, Matson and Holben, 1984, Muirhead and Cracknell, 1984, Matson et al., 1987). Automatic procedure for hot spot detection have also been developed to evaluate operational monitoring of active fires with AVHRR data (Flannigan and Vander Haar, 1986, Lee and Tag, 1990). Since 1970’s it is known that fires can be detected in the nighttime using visible band data generated by Operational Line scan System (OLS) (Croft, 1973, 1979), however till 1992 digital data from
the OLS were not archived (Elvidge et al., 1997). The potential for identifying actively burning fire with AVHRR was first documented by Dozier (1981). Dozier showed that sub pixel high temperature targets can be identified in the short wave data (Channel 3 in AVHRR) because those features have greater effect in 3.5 – 4.0 \( \mu \text{m} \) wavelength band than in longer wave infrared bands (Dozier, 1981). The first systematic inventory of fires with OLS data was accomplished by Cahoon et al. (1992) who manually digitised fire points from film produced from nighttime OLS orbits over Africa. National Geophysical Data Center (NGDC), USA, developed digital algorithm for detection of fires which can be used to detect fires – the algorithm screens VNIR emissions observed on a single night against a known set of spatially stable light sources. Several algorithms for estimating sub pixel burn size with OLS data are available in literature for biomass burning studies (Kihn, 1996). The operational polar orbiting satellites having high resolution sensors operating in visible and IR regions of the electromagnetic spectrum are constrained by their revisit capability. The visible and IR imagery from the Defence Meteorological Satellite Program (DMSP) Operational Linescan System (OLS) instruments night time imagery record natural fires and the present study is intended to analyze the utility of these data sets for monitoring forest fires.

**Data Sets and Methodology**

The Defence Meteorological Satellite Program (DMSP) Operational Line Scan System (OLS) has the unique capability to detect low levels of Visible and Near Infrared (VNIR) radiance at night (Elvidge et al., 1997). The OLS is an oscillating scan radiometer designed for cloud imaging with two spectral bands (VIS and TIR) at 2.7km pixel resolution and acquire global day time and night time imagery of the earth with a swath of \( \sim \)3000 kms, thereby the under swath providing global coverage four times a day: dawn, day, dusk and night. The TIR band spans the 10.3 – 12.9 \( \mu \text{m} \) region. The TIR band is calibrated using an on-board black body source and views of deep space to provide 8 bit data with a temperature range of 190 to 310\(^\circ\) Kelvin, ideal for detecting and characterizing clouds. DMSP platforms are stabilized using four gyroscopes (3 axis stabilization) and platform oscillation is adjusted using a star mapper, an Earth limb sensor and a solar detector. Photo Multiplier Tube (PMT) system was first implemented to facilitate the detection of clouds at night using the visible band. The visible band PMT system facilitate the detection using moon light. With the elimination of sunlight, the light intensification helps in detecting the fires, gas flares and lights. The spectral resolution from DMSP can be ‘fine’ or ‘smooth’ – fine with spatial resolution of 0.5km and smooth with a resolution of 2.8 km. The visible telescope is sensitive to

**Study Area**

The central Himalayan forests in India comprises of varied and rich flora ranging from Sal, Teak, Chir Pine, Oak, Mixed conifers, sub-alpine and alpine meadows. The study area consists mainly of Pine forests, a cash tree yielding resin and timber and thick carpet of pine needles which cover large areas of forest land during summer season can burst into flames at the slightest spark. A large devastating fire occurred in the central Himalayan forest area comprising eight hill districts of Garhwal and Kumaon region of Uttar Pradesh state, India during May/June, 1995 (Badarinath et al., 1995). Forests in these districts cover approximately 22, 648 sq. km area. The forest fires occur red in this region in May/June, 1995. The forest fires in this region has been studied using satellite remote sensing data and it is reported that around 4,869 sq. km forest area has been affected by the fires (SAC, 1995).