

## Extra Terrestrial Remote Sensing and Geophysical Applications to Understand Kedarnath Cloudburst in Uttarakhand, India

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### Abstract

Anthropogenic activities and episodic variations in extra-terrestrial activities lead to climate change which can be disastrous. In the Himalayan terrain the influence of local changes of land uses including construction of reservoirs on the Ganges and Alaknanda rivers. Sudden rise in proton flux from the Sun was responsible for the anomalous rise in atmospheric temperature. High concentration of aerosol trapped in the atmosphere and glaciers in Indo-China border initiated the nucleation process in the concentrated water vapor to initiate the formation of clouds for the cloudburst in Kedarnath.

**Keywords:** Proton flux; Atmospheric temperature; Aerosol; Torrential rain; Kedarnath

### Introduction

The devastating flood in Uttarakhand, India in mid-June 2013 was a combined impact of cloud burst in Uttarakhand, quick melting of glacier at high altitude due to beating of ice sheet by raindrops and breaching of natural embankment of Chorabari Tal (north of Kedarnath) due to accumulation of excess surface runoff. Within 48 hours, 280 mm rainfall occurred and about five feet of snow was precipitated at higher altitudes. Apart from Uttarakhand, Himachal Pradesh, northeast Rajasthan and Delhi also received torrential rainfall. For Delhi it was an advent of early monsoon that broke the past record of 150 years. In western India, heavy rainfall occurred during mid-June in Gujarat and southern Rajasthan due to early advent of Arabian Sea branch of monsoon. The monsoon winds were pushed northeastward by an upper air current. On its way towards north northeast, the cloud gathered moisture as a result of evaporation from freshwater bodies and irrigated agricultural fields lying on its way. Climate change manifestation can be seen in the recent disaster of Kedarnath, Himalaya in India. Influence of the Sun clubbed with the anthropogenic activities may be responsible for the catastrophe. Steep rise in solar proton flux above 10 MeV for 12 days from 15<sup>th</sup> May to 26<sup>th</sup> May 2013 has been recorded by Sun Observatory Heliospheric Observatory (SOHO) satellite [1,2]. During the same period the cosmic ray intensity was recorded all-time high in Jawaharlal Nehru University (which is representing regional cosmic ray data in Space Environment Viewing and Analysis Network of Asian office of Aerospace Research). Prior to cloudburst in Kedarnath area of Uttarakhand Himalaya, the abnormal rise of the atmospheric temperature in this area was initiated by the release of heat energy from the trapped proton drift in the magnetic field line. The proton flux has the potential to be trapped for a long time in the geomagnetic field enhanced the ionization process and heating of the upper part of the atmosphere in the proximity of the Uttarakhand area [3]. After this event anomalous rise in cosmic ray was recorded. Changes in ionization affect the abundance of aerosols that serve as the nuclei of condensation for cloud formation. Rise in cosmic rays were instrumental in condensation of the cloud leads to the cloudburst in Kedarnath [4]. Improper land use change in this area along with the extra-terrestrial influence lead to rise in temperature to release the aerosol trapped in the glaciers and atmosphere in Indo China border to initiate the cloudburst [5].

### Torrential Rain Mechanism

Torrential rain represent one of the extremely strong and destructive disasters which, besides considerable losses, lead to many casualties. I propose this hypothesis based on the possible magnetic alignment of the proton particle in the atmosphere of Kedarnath of Uttarakhand India. When the solar protons enter the domain of the Earth's magnetosphere, the magnetic field becomes stronger than the solar magnetic field. In this process heat energy was generated by the Sun which is simple thermo-element generator [6].

### Result and Discussion

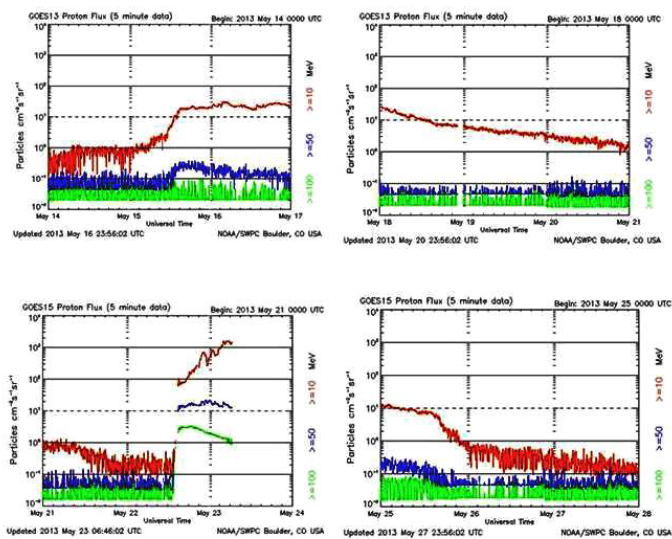
During last 100 years the mean annual surface air temperature has increased by more than 0.4°C [7]. The hypothesis is being postulated for the first time on the mechanism of the heat transfer from the charged proton to the upper and lower atmosphere of the earth [8]. Here I explain the anomalous proton flux induced heat generation in the upper atmospheric region of Kedarnath Himalaya. Protons started rising from 15<sup>th</sup> May 2013 and reached threshold value again on May 26, 2013 (Figure 1). The proton started rising from 9 AM on 22<sup>nd</sup> May, the rising trend was unabated till 26<sup>th</sup> May for five days. In the space weather in between Sun and Earth the heat transfer to cloud appearance mechanism took 20 days and 6 hours to initiate the cloudburst in Kedarnath. The heat from the Sun was captured in the Van Allen's belt, which further have acceleration to the proton [9]. Primary effect of heat transfer initiated by the proton flux from the Sun was responsible for the rise in atmospheric temperature [10,11]. It is to interfere with the transfer of hydrogen ions between the atmospheric water molecules and the aerosol particles. It is possible to understand the "proton flux hypothesis" which offers an explanation for the heat transfer from the proton to the atmospheric water vapor and aerosol. Sulphur dioxide and multicomponent composition of

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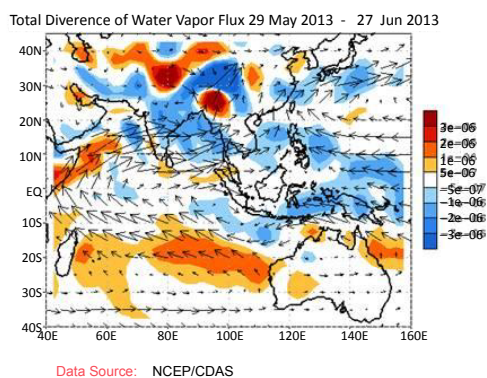
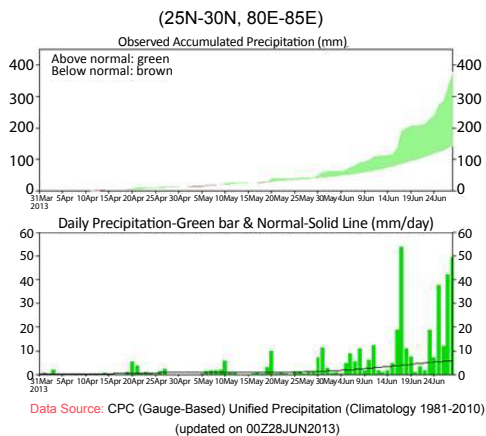
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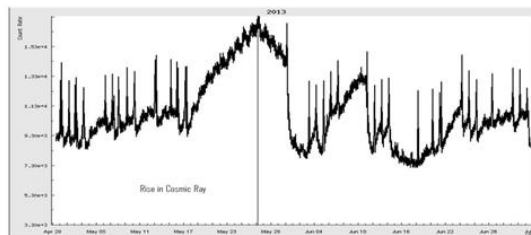


**RISE IN PROTON FLUX FROM 15<sup>TH</sup> MAY TO 26<sup>TH</sup> MAY TO ACCUMULATE HEAT IN THE GEOMAGNETIC FIELD LINE**

**Figure 1:** SOHO (Solar and Heliospheric Observatory) satellite data showing rise in Proton flux from 15<sup>th</sup> May to 26<sup>th</sup> May to accumulate heat in the geomagnetic field line.



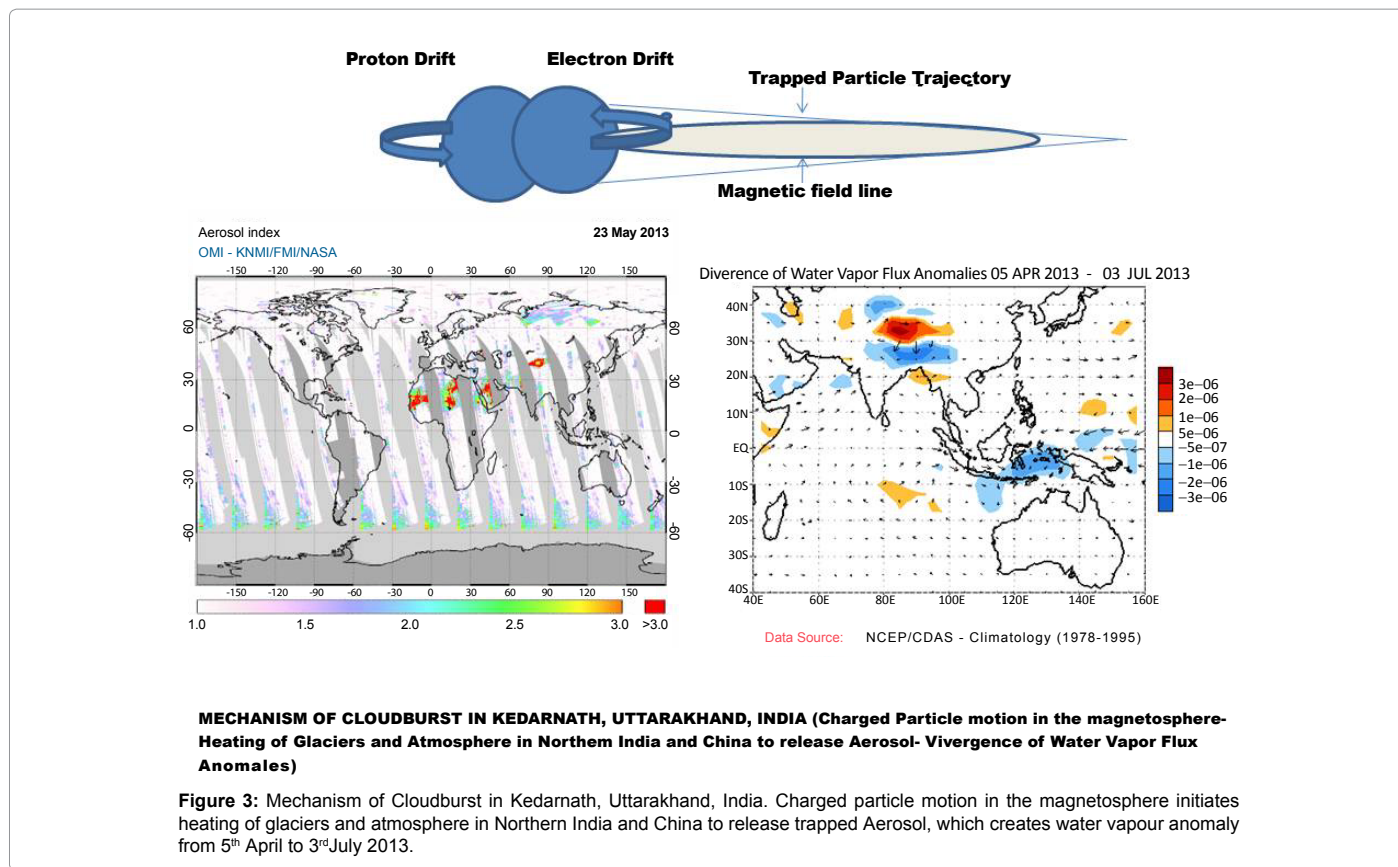
**CORRELATION OF PRECIPITATION, WATER VAPOR FLUX IN UTTARAKHAND AND RISE IN COSMIC RAY IN JNU NEW DELHI COSMIC RAY OBSERVATORY**



**Figure 2:** Correlation of precipitation, water vapour flux on Uttarakhand, India and rise in Cosmic ray in the northern India representing JNU New Delhi Cosmic Ray Observatory before the Cloudburst in Kedarnath.

organic films on the surface of atmospheric aerosol particles released from trapped glaciers and atmosphere in Uttarakhand China border was responsible preclude the formation of condensed films and that the kinetics of water condensation during the activation of aerosol to form cloud droplets [12]. Large reduction of solar proton induced heat radiation at the Earth's surface lowers atmospheric warming, increases atmospheric stability and slows down hydrological cycle and reduces

rainfall during monsoon, while increased solar proton can reverse the mechanism [13-15]. Elevated aerosol heating over the Indo-Gangetic plains in the premonsoon period, lead to a strengthening of the Indian monsoon via heat mechanism of surface-atmosphere water cycle feedbacks [16]. The heat transfer from proton to atmosphere has affected not only the atmospheric water vapor but it was responsible for the melting of glaciers which are feeding the river Ganga [17,18].



In Uttarakhand China border the SO<sub>2</sub> rich aerosol presence before the cloudburst further proves this hypothesis [19,20].

The heat transfer from proton to atmosphere has affected not only the atmospheric water vapor (Figure 2) but it was responsible for the melting of glaciers which modify the landform due to sudden flow of the water (Figure 3) in the river basin.

## Conclusion

This hypothesis provides new insights into the importance of influence of the Sun and anthropogenic activities on the climate change and precisely torrential rain as its manifestation. The model is a radical departure from previous thought, but is consistent with existing observations and warrants testing in future studies.” In general, this hypothesis does not change the general conclusions that increased proton flux from the Sun reserves trapped heat in geospecific locations which influence temporary change in the atmosphere. The new reason of cloudburst is not contradictory but rather describes the mechanism involved.

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