

Brief Report on Earthquake of 7.5 Mw on 26th October, 2015 at Northern Afghanistan

1. Introduction:

On October 26, 2015, an earthquake of 7.5 magnitude occurred near the Hindu Kush region of Northern Afghanistan, at 14:40 hrs IST. It has its epicentre near Jurm in northeast Afghanistan, 250 kilometres (160 miles) from the capital Kabul and at a depth of 213.5 kilometres, as reported by the US Geological Survey (AFP, 26 Oct 2015).

This event is categorised under the Major Earthquake, which has caused significant damage in Afghanistan, parts of Pakistan and northern states of India, including Delhi and NCR.

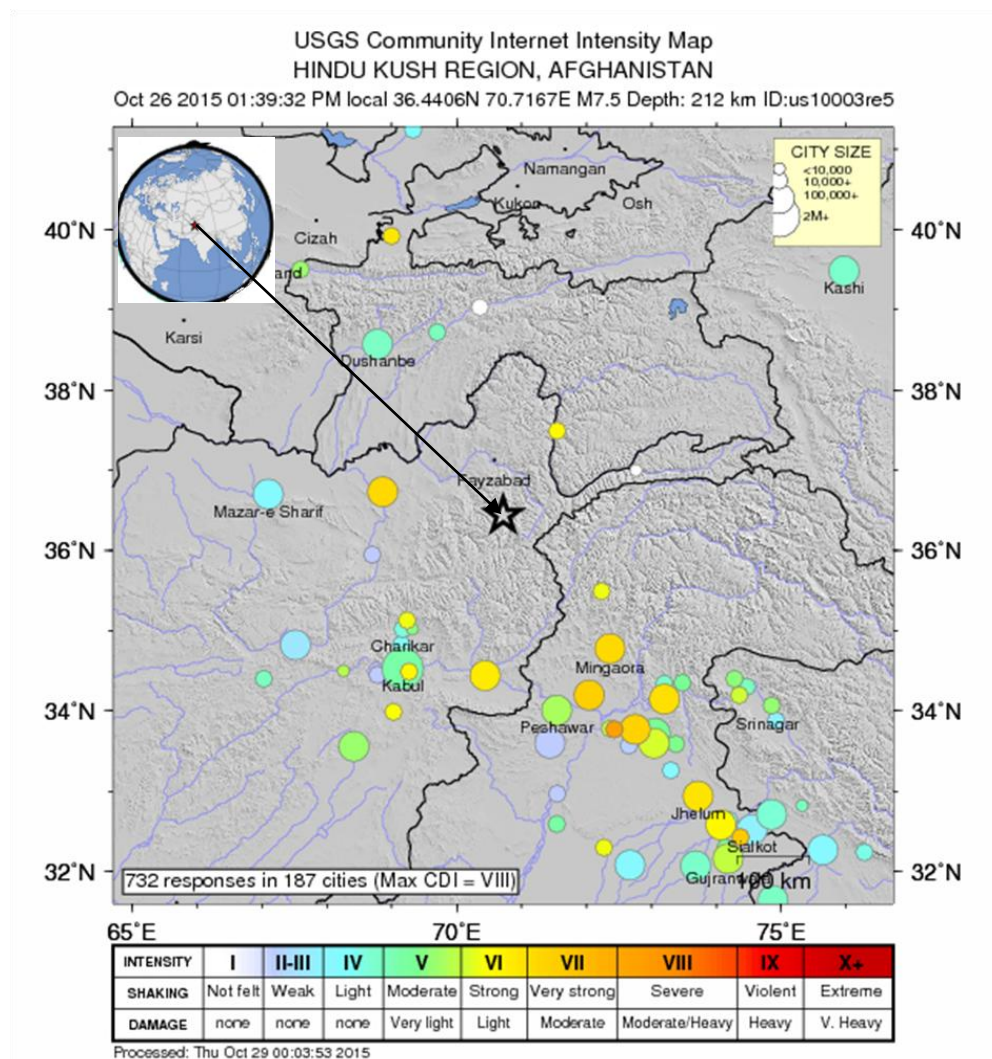


Fig.1: USGS Intensity map for the Hindu Kush region.

1.1 Regional Tectonic significance:

This earthquake is the largest earthquake in past fifty years from the Hindukush region. (National Centre for Seismology (NCS, MoES). Such event, with focal depths between 70 and 300 km, are commonly termed "intermediate-depth" earthquakes. This earthquake occurred as the result of reverse faulting at this depth below the Hindu Kush range.

Focal mechanisms indicate rupture occurred on either a near-vertical reverse fault or a shallowly dipping thrust fault. At the latitude of the earthquake, the Indian sub-continent moves northward and collides with Eurasia at a velocity of about 37 mm/yr. Active faults and their resultant earthquakes in northern Pakistan and adjacent parts of India and Afghanistan are the direct result of the convergence between the India and Eurasia plates. Seven other M 7 or greater earthquakes have occurred within 250 km of this event over the preceding century, the most recent being a M 7.4 earthquake in March 2002 just 20 km to the west of the October 26, 2015 event, and with a similar depth and thrust fault orientation (USGS,2015).

2. STUDY BASED ON INDIAN REMOTES SENSING DATA:

Satellite based study was planned for the Earthquake affected area and the order of preference was set based on the extent of the damage caused by the earthquake as per the initial media report. Six locations were identified within Afghanistan and Pakistan. Data acquisition by ISRO was also based on the International Charter Activation. The location details are mentioned in the table1 with representation in Figure 2.

Preference	Country	Cities	Latitude	Longitude
1	Afganistan	Fayzabad*	37deg ,7min 5 sec	70deg34min48sec
2	Afganistan	Taleqan*	36deg44min10sec	69deg32min
3	Pakistan	Mingora	34deg46min25sec	72deg21 min33sec
4	Afganistan	Jalalabad	34deg25min36sec	70deg27min
5	Pakistan	Peshawar	34deg00min40sec	71deg35min
6	Afganistan	Kabul	34deg32min	69deg10min

Table 1: Locations identified for study.

*Locations identified by International Charter.

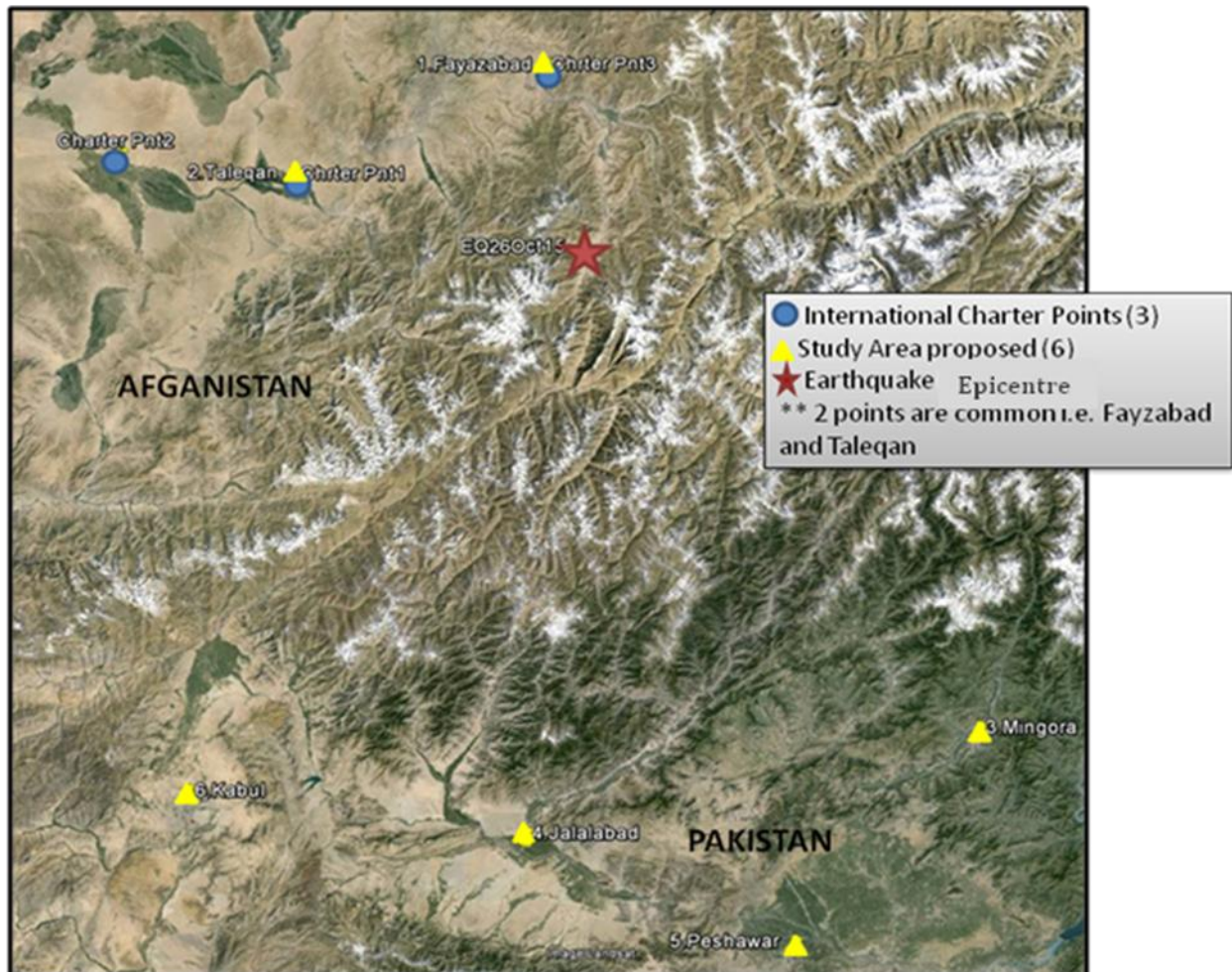


Fig. 2: Proposed study locations with box representing the present study area.

3. Study area:

The Fayzabad in Afganistan , was the worst affected place (based on the news reports) with the distance of nearly 76 km from the epicentre(fig.3) . This area was the first location covered by Cartosat & Risat-1 data and was taken for the preliminary study using these data.

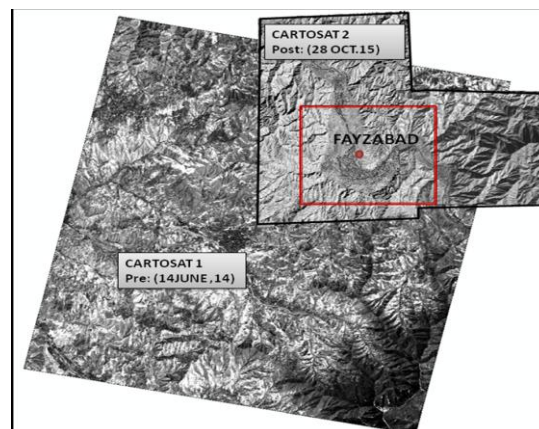


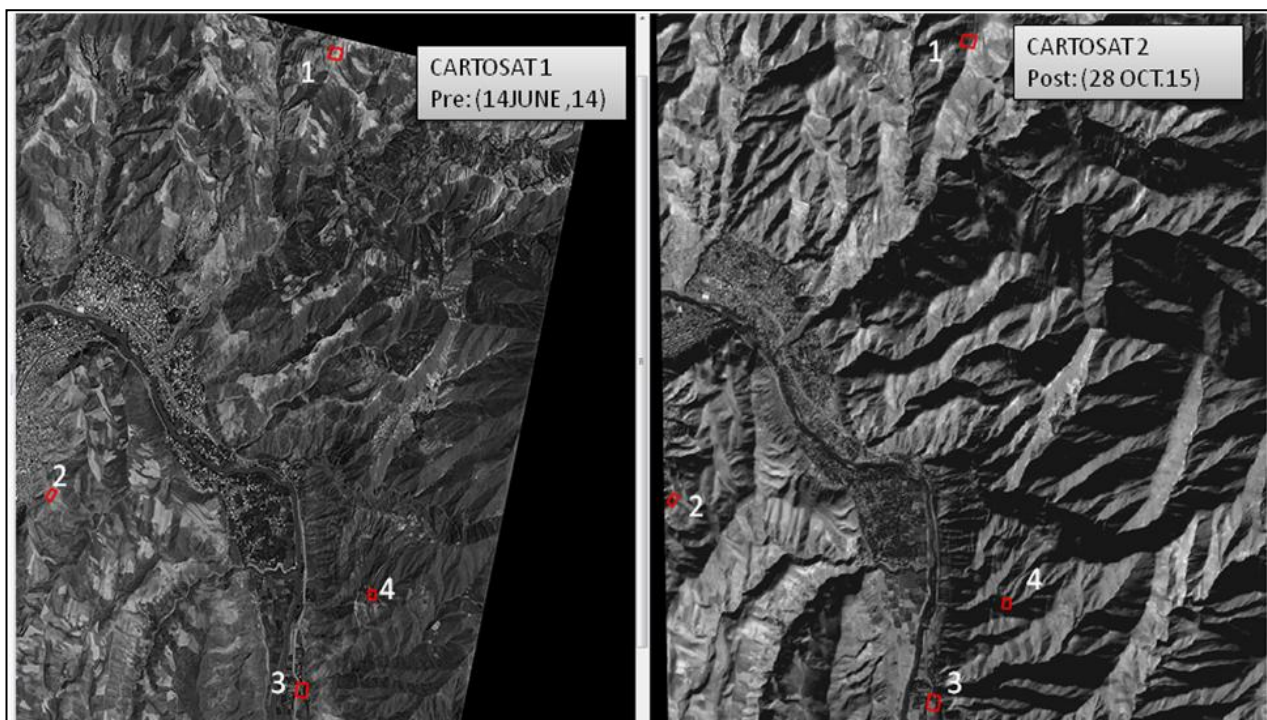
Fig.3 Study area represented in red box overlaid on Cartosat data (pre & post).

4. Data used:

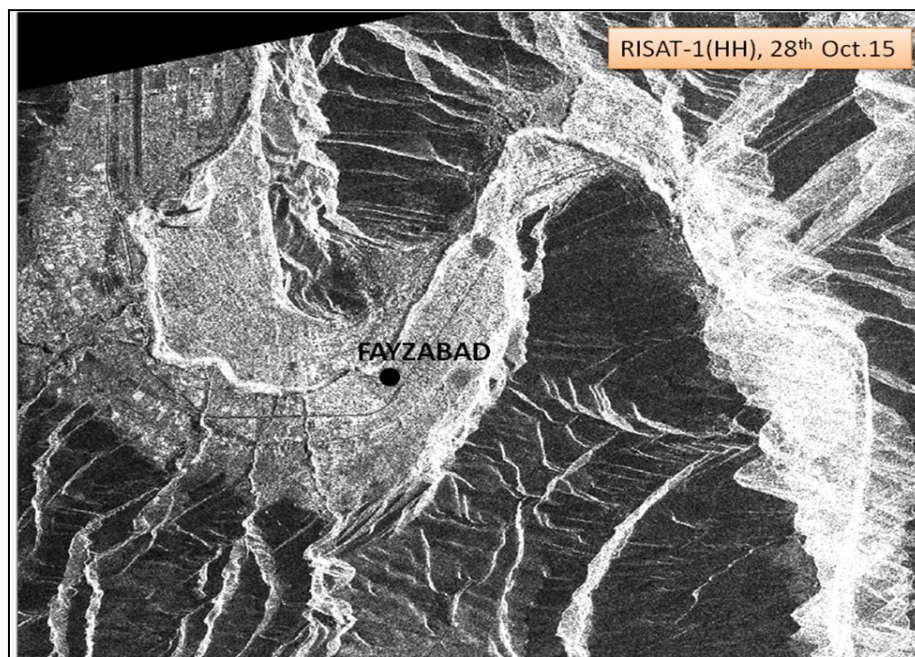
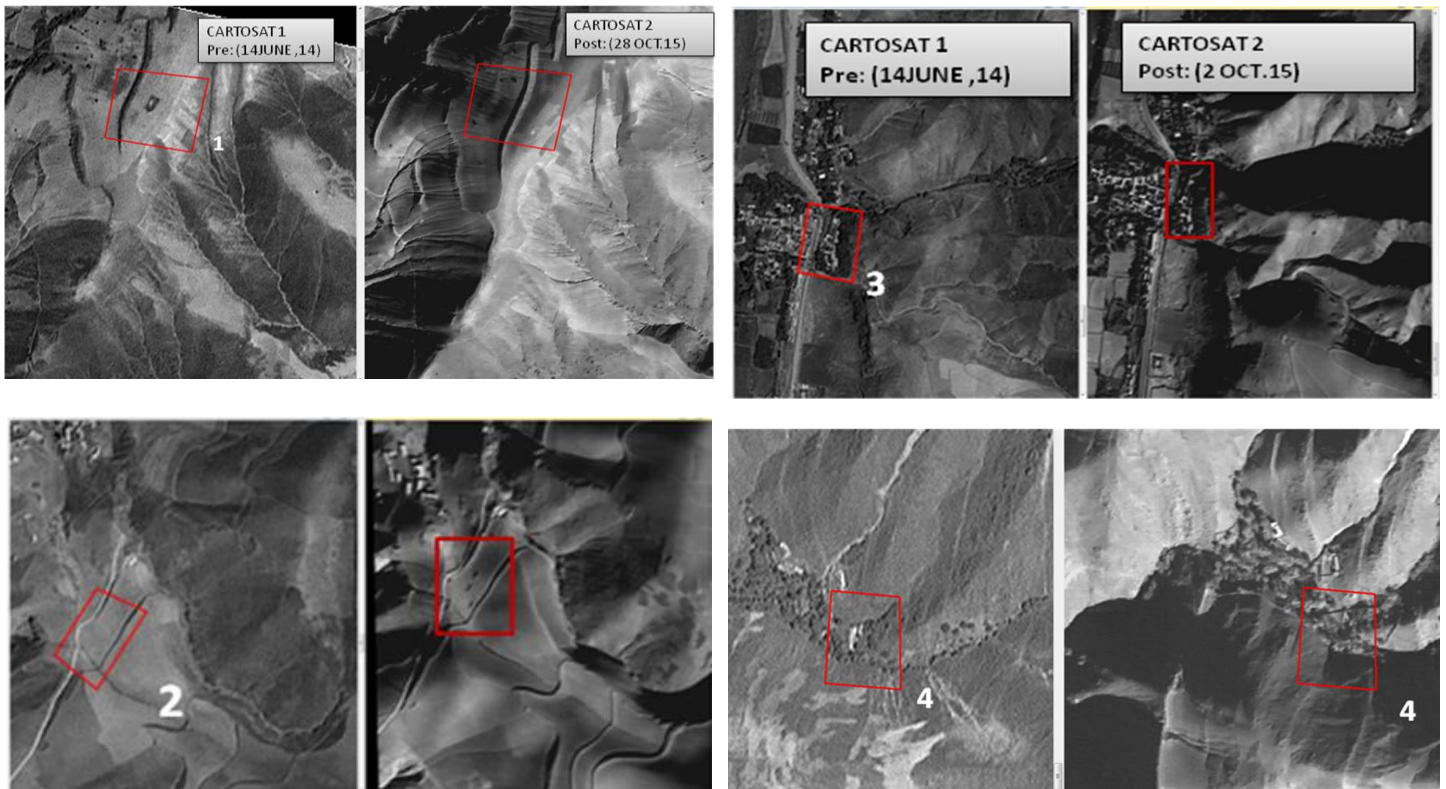
Study was carried out using Optical and Microwave sensor data, details as mentioned below:

SENSOR DATA	PATH/ROW	SPATIAL RESOLUTION	DATE OF PASS
Resoursat 2 , LISS IV(MX)	87/44	5.8 m	20-AUG-2014
CARTOSAT 1 PAN(MONO)	478/228	2.5 m	14JUN14
CARTOSAT 2 PAN(SPOT): 3 SCENES.	Orbit =47483 Product ID-154198511 Product ID-154198531 Product ID-154198541	1.0 m	28OCT15
RISAT-1 (HH,HV)	Orbit=19312	3.33(along track) 2.34(across track)	28-OCT-2015

5. OBSERVATIONS:



The settlement region of the Fayazabad does not show conspicuous damages of buildings in the post-event Cartosat and Risat-1 data. Based on the pre and post data analysis in and around Fayazabad, the locations 1 to 4 in the above figure are enlarged and shown below:



6. Limitations:

1. Since the damages caused by this earthquake are scattered, at building level and not carpet- spread type destruction, it is difficult to identify such changes in optical data (1m resolution) used in this study.
2. Further, in RISAT-1, due to foreshortening and strong backscattering identification of building-level change is difficult. The settlement area of Fayzabad has a large back scattering coefficient due to the multiple reflections and the signatures from damaged (if any) and standing buildings do not vary significantly.

7. Conclusion:

Based on the analysis of pre and post data for the event in the Fayzabad area, not many changes can be seen on the image except for some feature based changes at red-rectangled areas shown above. In order to ascertain that the changes are due to recent earthquake, high resolution optical data ($<1\text{m}$) probably for the month of August /September, 2015 can be used for analysis. Further, in order to identify building level damages (based on media reports), very high resolution (better than 0.5m) multispectral data is needed.