# Monitoring Flooding in Pakistan Using ALOS & GSMaP Data Provided by JAXA

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Serious damage has occurred in Pakistan recently due to floods and mudslides caused by heavy rain, which occurred continuously since July 29, 2010. The flood damage has spread from north to south in Pakistan. The Japan Aerospace Exploration Agency (JAXA) has made observations using the Advanced Land Observing Satellite (ALOS, "Daichi") to monitor the state of the damage.

Figure 1 shows images of Hyderabad, 1,200 km south-southwest from Islamabad, which were taken after the disaster on August 23, 2010 (left) and before the disaster on March 23, 2009 (right). It is obvious that the flooded area along the Indus river basin has greatly expanded.

Figure 2 shows the inundation area image obtained from data acquired with the Phased Array type L-band Synthetic Aperture Radar (PALSAR) onboard ALOS on August 19, 2010. The data was acquired using the ScanSAR observing mode (WB1); therefore it covered an approximately 350 km wide strip at 100 m spatial resolution. The blue color on the topographical map derived from the ASTER Global Digital Elevation Model (ASTER GDEM) shows the inundation area, which was identified by analyzing the backscattering coefficients observed before and after the flood.
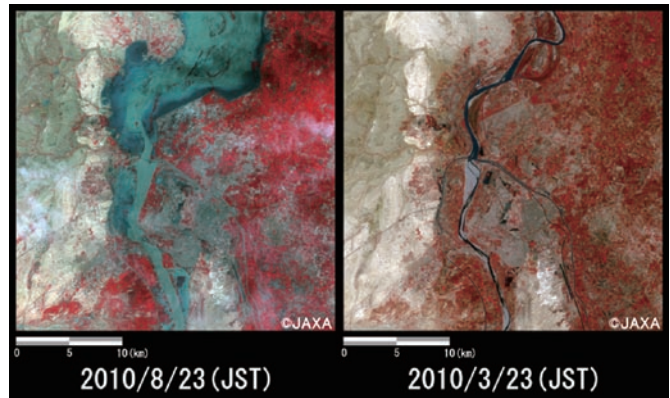


*Figure 1: Enlarged AVNIR-2 images of the swollen rivers at Hyderabad (left: August 23, 2010; right: March 23, 2010).*
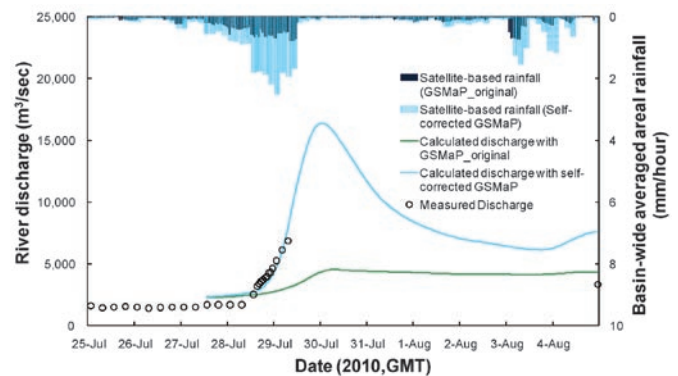


*Figure 3: Comparison of preliminary IFAS-PDHM simulations using the corrected GSMaP data with the observed in-situ river discharge data at Nowshera, Kabul River (from July 25, 0:00 to August 6, 0:00 GMT)*

A preliminary runoff analysis was done at the Nowshera hydrological station of the Kabul River, which is one of the major tributaries of the Indus River, using the Integrated Flood Analysis System (IFAS) - Public Work Research Institute (PWRI) Distributed-parameter Hydrologic Model (PDHM, grid-size 4 km) and the Global Satellite Mapping of Precipitation (GSMaP) as shown in Figure 3. The GSMaP data corrected by the ICHARM's correction method based solely on rainfall-area movement information, without regarding ground-based rainfall data, was used as the input to the IFAS-PDHM. According to the estimation of this preliminary simulation, the flash-flood runoff peak at the Nowshera point (watershed area approximately 92,000 km$^2$) appeared to be over 16,000 m$^3$/s near the time of 0:00 (GMT) on July 31, but in reality, most of the high-flow discharge must have been inundating the floodplains (valley plains) along the Kabul River.
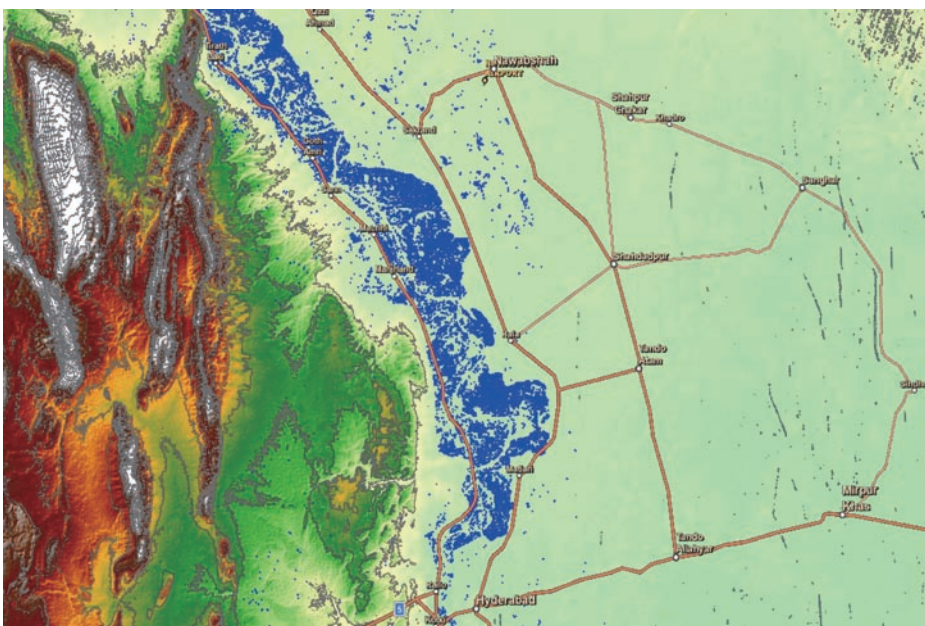


*Figure 2: Inundation area on August 19, classified by using the PALSAR overlaid on the topographical map derived from the ASTER GDEM. (JAXA, METI Analyzed by UT)*