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## Part 2: Change Detection Using Commercial Satellite Imagery to Monitor Large-scale Withdrawals of Conventional Forces

### Background

The objective of this project was to examine change detection techniques for monitoring large-scale withdrawals of conventional forces using commercial satellite imagery. The Soviet withdrawal from Afghanistan in 1988 and 1989 was used as a case study.

The number of Soviet forces rose to more than 100 000 at some times during the eight-year occupation.<sup>13</sup> Before the withdrawal began on May 15, 1988, about 22 000 Soviet troops were reportedly in the vicinity of Kabul.<sup>14</sup> The withdrawal of such a large force provided an opportunity to examine the extent to which commercially available satellite imagery would be useful to monitor withdrawals of conventional armed forces in other regions such as Europe.

SPOT satellite images of Kabul were acquired on two dates to be used as before and after images for a multitemporal analysis. The before image was acquired on November 11, 1987, with a viewing angle of 7.9°W. The after image was acquired almost one year later, on November 4, 1988. This image was acquired using a 26.2°E oblique viewing angle.

Panchromatic imagery (with 10 m resolution) was used for the analysis. The 1987 and 1988 images were registered using a digital image analysis system. Registering of two images involves transforming one image so that it geometrically matches the other. Once registered, the two single-channel panchromatic images can be combined in a single colour image using the 1987 data for the blue and green channels of the colour image and the 1988 data for the red channel.

### Change Detection Imagery

Two images of the same location acquired at different times can be displayed to show changes between the two images. An area north of Kabul airport provides a good example of how to interpret the change imagery (Figure 6). Figure 6(c) is the multitemporal overlay image. Figures 6(a) and 6(b) are the panchromatic images acquired in 1987 and 1988. The before image is displayed using the blue and green channels of a colour image display and the after image is displayed using the red channel. Changes between the two images appear as either red or cyan. If the intensity for a pixel<sup>15</sup> is greater in the 1988 data than in