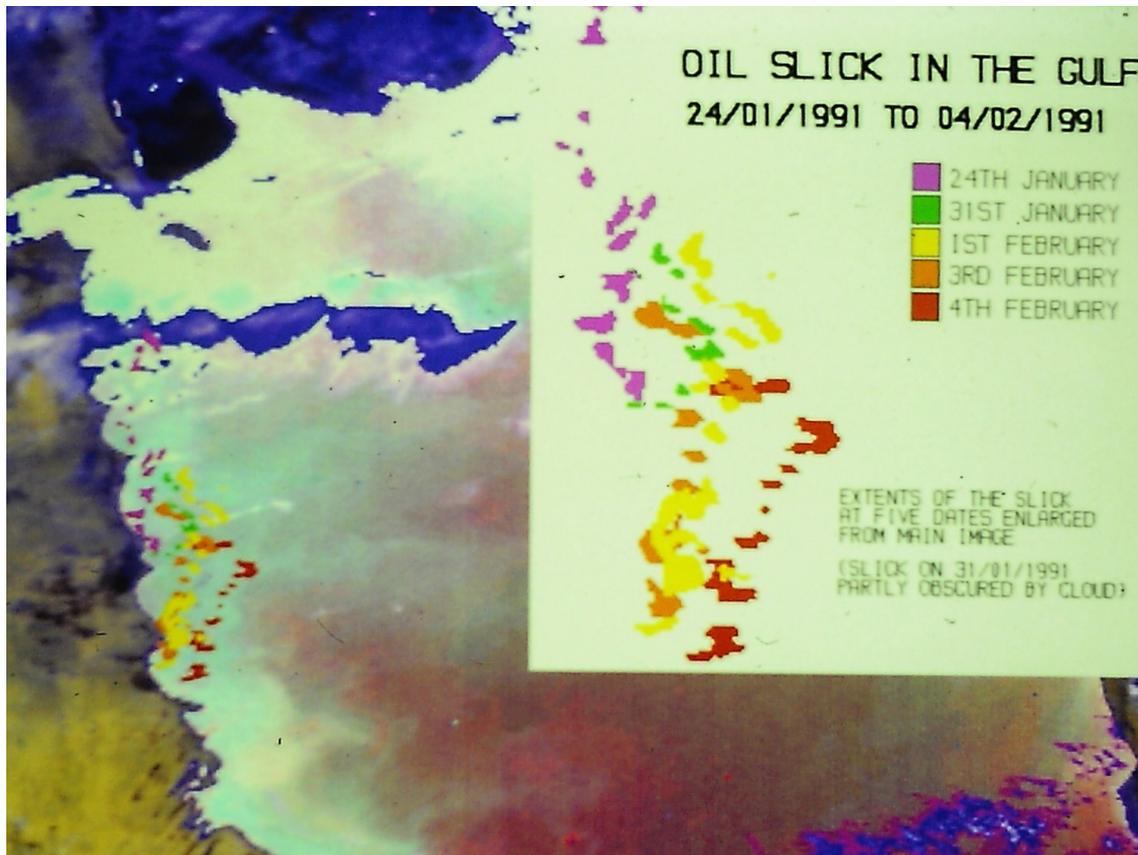


The Arabian Gulf oil slick, January and February 1991

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A large oil slick in the north-western Arabian Gulf, resulting from the deliberate release of crude oil from a terminal off the Kuwait coast, was one of the many environmental disasters associated with the recent Gulf war. Near-real-time monitoring of this slick was required in order to provide estimates of the extent and movement of the slick, which threatened huge desalination plants in Saudi Arabia and Bahrain, as well as a range of unique habitats along the Gulf coastline.

Satellite remote sensing provided an appropriate monitoring tool, especially in a war situation where independent airborne monitoring was difficult. The only currently operational sensor providing appropriate spatial, spectral and especially temporal resolution is the AVHRR on the NOAA polar orbiters. Initial study of AVHRR imagery acquired on early morning, mid-afternoon and evening passes showed that the slick was only visible at thermal wavelengths (bands 3, 4 and 5) in the afternoon images. The thick central portions of the oil slick apparently behaved as a black-body, absorbing solar heat during the day, and thus becoming significantly hotter than the surrounding water by mid-afternoon. Rapid cooling after sunset made it invisible in night and early morning imagery. Discussions with agencies operating in the Gulf area indicated that the slick rapidly differentiated into a thick tarry portion and a much more extensive thin film of more volatile oils, and it is the former portion of the slick which is observed in AVHRR imagery.

A total of twenty-one afternoon images were acquired between 16th January and 15th February 1991. Extensive cloud cover obscured the north-western part of the Arabian Gulf on many occasions, but the slick was actually observed on eight dates between 24th January and 12th February. For each image in which the slick was observable, a colour composite was prepared using

bands 1, 3 and 4 (RGB) for water areas and bands 1, 2 and 4 (RGD) for land, following segmentation of the image into water and land based on a density slice of band 2 (NIR) imagery. The image showing least geographic distortion was selected as a reference, and all other dates of imagery geometrically corrected to that image. The oil slick at each date was interpreted visually, and results compared with the previously observed position and extent to update estimates of the rate of movement and change in area.

When first observed (24th January) the slick had a surface area of about 200km². This decreased slowly to about 150km² by 4th February and then much more rapidly to only 20km² on 12th February, the last date on which it was observed. Between 24th January and 12th February the slick moved a total distance of 173km, or just over 9km per day in a generally southerly direction, although the actual daily movement varied from less than 5km to more than 20km. The observations suggest that a total of more than 240km of coastline have been polluted by this major slick, although the rate of decay of the slick was much more rapid than originally expected, and no major desalination plants were affected. It is suggested that the rapid dispersal of the slick resulted from high ambient temperatures, assisted perhaps by micro-organisms adapted to an environment naturally rich in hydrocarbons.