

## War Damage Assessment

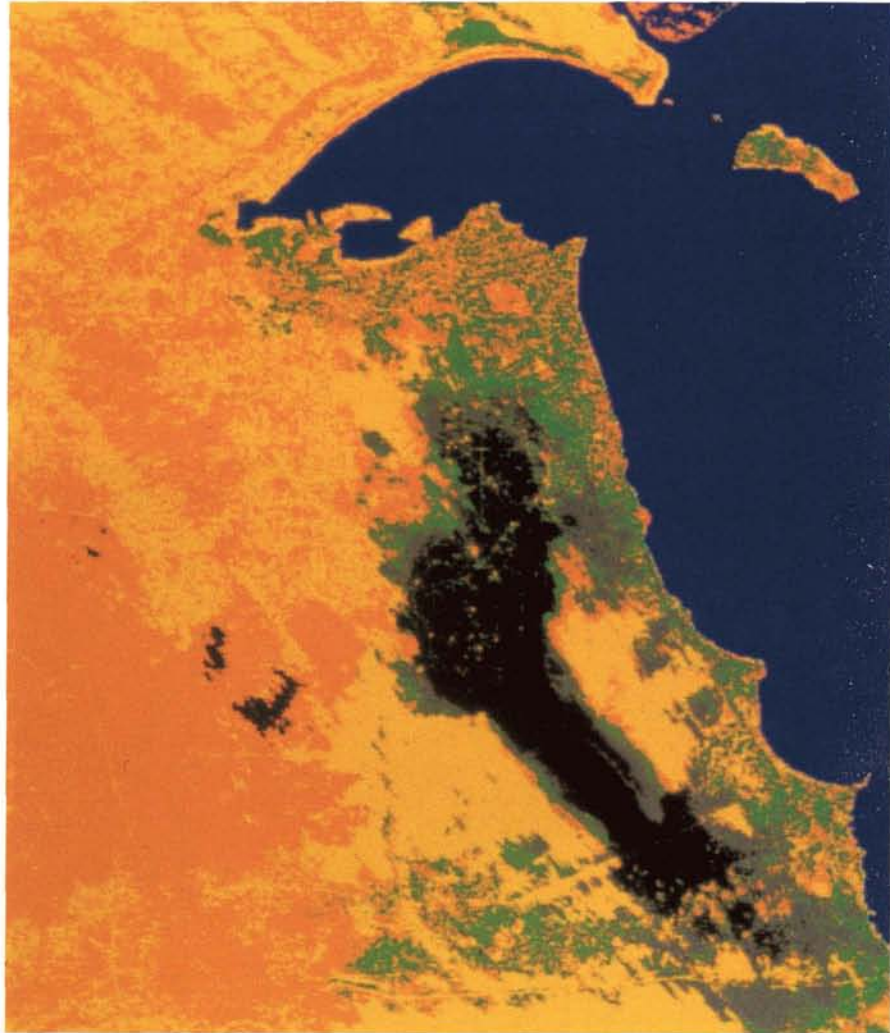
The Persian Gulf war of 1991-92 caused significant change to the desert environment of the State of Kuwait, particularly creation of hundreds of "oil lakes" by oil released from damaged wells. These lakes constitute a hazard to the Kuwaiti atmosphere, the underlying soil and ground water reservoirs. The lakes must be carefully monitored because their locations, shapes, sizes and depths are subject to rapid change from evaporation, migration of the oil, infiltration of the oil into the ground, or covering of the lakes by moving sand dunes.

An essential first step was accurate mapping of the lakes, accomplished as part of a comprehensive damage assessment of Kuwait based principally on satellite remote sensing. The two-year task was carried out as a joint project of the Boston (Massachusetts) University Center for Remote Sensing, headed by center director Dr. Farouk El-Baz, and the Kuwait Institute for Scientific Research, with funding from the Kuwait Foundation for the Advancement of Sciences.

The assessment team used prewar and postwar imagery for comparison and detection of change; the images were obtained by the Thematic Mapper aboard the NASA-developed Landsat satellite and by the French SPOT satellite. Field measurements were conducted to verify the satellite data and geographic information system methodologies were employed to correlate the data.

**At right** is a typical postwar image of a coastal area south of Kuwait City where a number of the country's major oil fields are located. The black patch in center image represents a vast layer of oil and soot deposited by the plumes of oil well fires; the mixture of oil, soot and sand has hardened into a layer of "tarcrete" up to four inches thick.

Among other damaging effects, the team reported the formation of more than 300 inland oil lakes; significant pollution of a strip of the coastal zone from oil spills; and disruption of the desert "pavement" -- a thin layer of pebbles -- and the vegetation cover. This disruption caused mobilization of fine-grained particles that became the source of dust and sand storms; many new sand dunes have formed as a result of war-related activity and they have begun to encroach on roads and farms.



The total surface area damaged by war activities is more than 5,400 square kilometers, roughly 30 percent of Kuwait's total surface area. This included some 3,500 square kilometers affected by land mines and postwar clearance of mines and unexploded ordnance; almost 1,000 square kilometers covered by tarcrete; areas totaling 500 square kilometers where desert shrubs were destroyed; and some 50 square kilometers covered by oil lakes.