Focus Earth

ERS Data Helps in Monitoring Protected Areas — An ESA-supported pilot project on the Mediterranean Coast of Turkey

(Winner of the 1998 Henry Ford European Conservation Award)

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With the uninterrupted availability of radar data from its European Remote-Sensing Satellites ERS-1 and ERS-2, ESA is providing the remote-sensing user community with a reliable and efficient means for surveying and monitoring environmentally endangered areas.

A mapping and monitoring project using ERS remote-sensing data has recently been conducted in the Köycegiz-Dalyan region, on Turkey's southwestern Mediterranean Coast (Fig. 1). This region is one of fourteen declared as Specially Protected Areas by the Turkish Government, with the aim of fostering nature conservation and protecting sites of special historical, cultural or environmental interest. The area includes the 10 km-long Dalyan Channel linking the Köycegiz Lagoon with the Mediterranean Sea, and Iztuzu Beach, one of the most important of the 17 known nesting sites for sea turtles (Caretta caretta) in the Mediterranean (Fig. 1). The oriental sweet gum tree (liquidambar orientalis) is endemic here and has been declared a protected plant due to the growing pressures on its natural environment.

Figure 1. The Köycegiz-Dalyan Protection Area and the Caretta caretta sea turtles

The primary objective of the ESA-supported pilot project was to promote the application of remote-sensing data for the conservation and sustainable management of the Mediterranean coastal zone. This required systematic surveying on a trans-national level. The main component of any effective environmental management approach is a system that supplies complete and accurate information to decision makers by exploiting up-to-date data collection and processing technology. One of the main aims of the project was therefore to develop a computer-based information system for the Turkish Mediterranean coastal zone that utilises all available and relevant data effectively – both remotely-sensed satellite data and ground-based information. Two of the main system requirements were for land-cover mapping, i.e. land-use change, vegetation productivity and biomass, and mapping of the effects of disturbances from such sources as flooding, fires, disease, and harvesting or logging. The collection of optical satellite imagery over this area is often hampered by cloud cover, but radar satellites like ERS have no such limitations, providing high-resolution images independent of cloud cover and illumination conditions (day and night).

Multi-temporal data sets of ERS-1 and ERS-2 SAR (Synthetic Aperture Radar) precision imagery covering the period between March and September 1996 were used for land-use mapping, and in particular for monitoring the distributions of different vegetation species. The work was supported by field trips, the use

of topographical maps, and aerial photography. Visual interpretation of the SAR imagery was carried out after a period of familiarisation with the satellite-gathered data and the building up of a good general knowledge of the area. Automatic (supervised) classification of the data was also attempted.

The image in Figure 2 is composed of three ERS SAR data sets acquired in the same year, but during different seasons. By assigning a specific colour to each data set, seasonal variations have become visible: on land, due to changes in soil moisture content or crop growth, and at sea due to the wind and wave conditions prevailing on the day of image acquisition. Black (low) and white (high) correspond to unchanged backscatter values over time. The mono-temporal image (Fig. 2a) shows the sea-surface conditions in two SAR images taken over the lagoon on 10 and 11 November 1995, respectively.

As the Digital Elevation Model (DEM) of the area (Fig. 2b) shows, the local terrain is quite mountainous. In the SAR images, the geographical relief is very well represented visually and the topographic and geomorphologic units are well delineated. Hill or ridge slopes facing the radar are, however, subject to some foreshortening and/or layover effects.

In Figures 2c-e, the urban areas are characterised by high and constant backscatter values, due to the presence of 'corner reflectors'. The reed belt along the lakeshore is easily discernible and its border is clearly delineated. Linear objects such as roads or rivers, being smooth or flat, are easily distinguished by their dark colours in both the monochromatic and multi-temporal images.

In the upland areas, the presence of woods - mainly red pine forest - is revealed by greyish hues. In the lowland areas, the yellow and blue tones correspond, respectively, to cereal crops and late crops like corn, sunflowers, etc. (Fig. 2). A good example is provided by Figure 2f, in which seasonal development could be compared with data obtained from the Dalaman State Production Centre. In this way, phenological development in conjunction with the crop calendar has been used successfully for the verification and testing of a crop-growth monitoring experiment. The results have subsequently been applied for the classification of crop types throughout the whole project area.

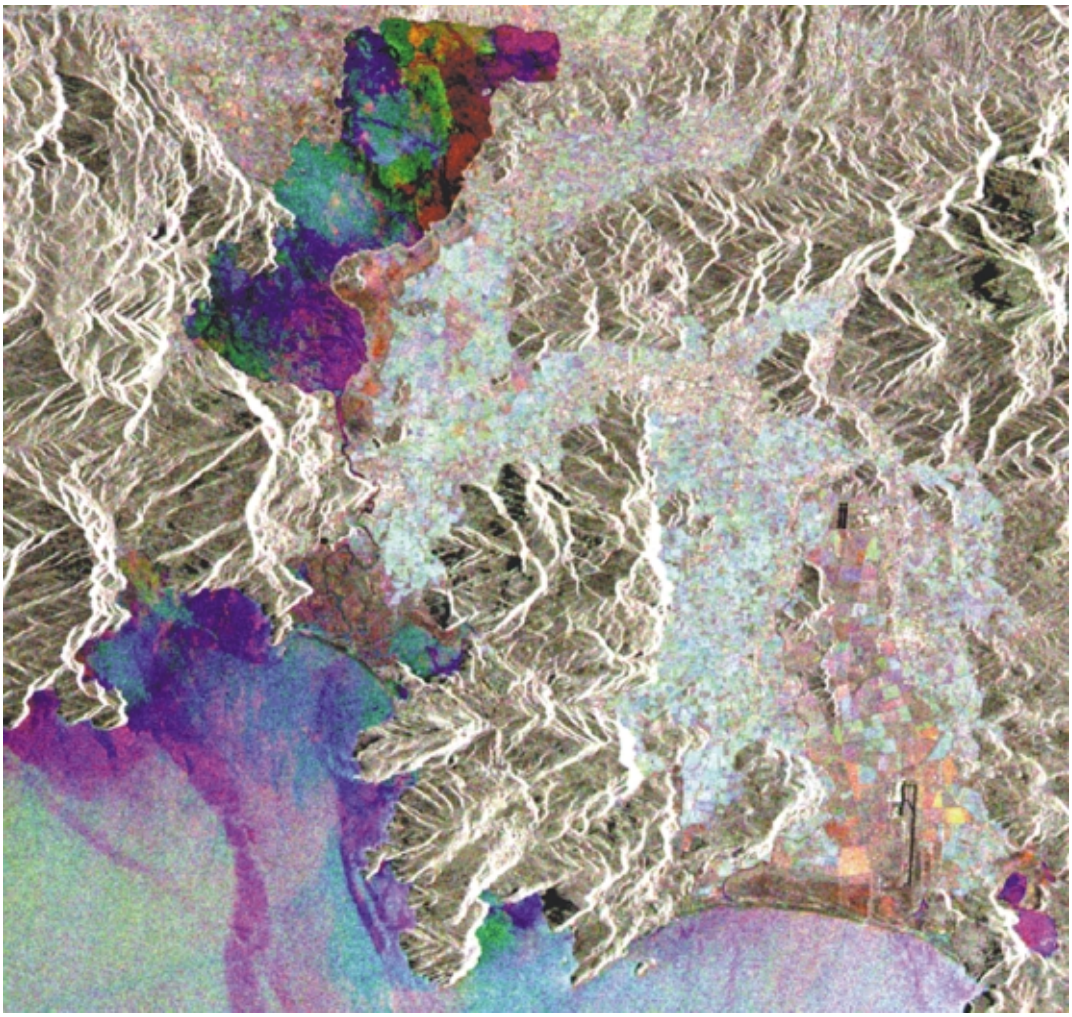


Figure 2. Multi-temporal ERS SAR image covering the period between March and September 1996, used for land-use mapping and especially the monitoring of the distribution of different vegetation species

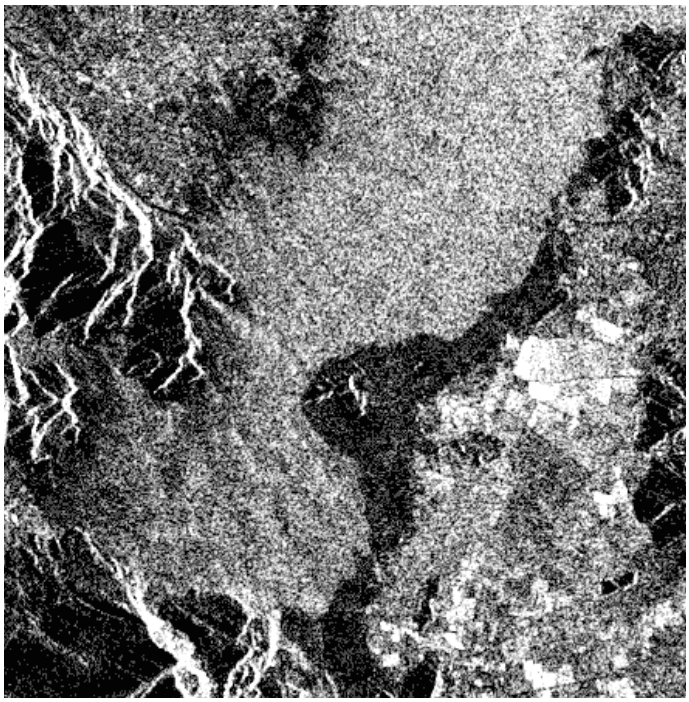


Image taken on 10 November 1995.

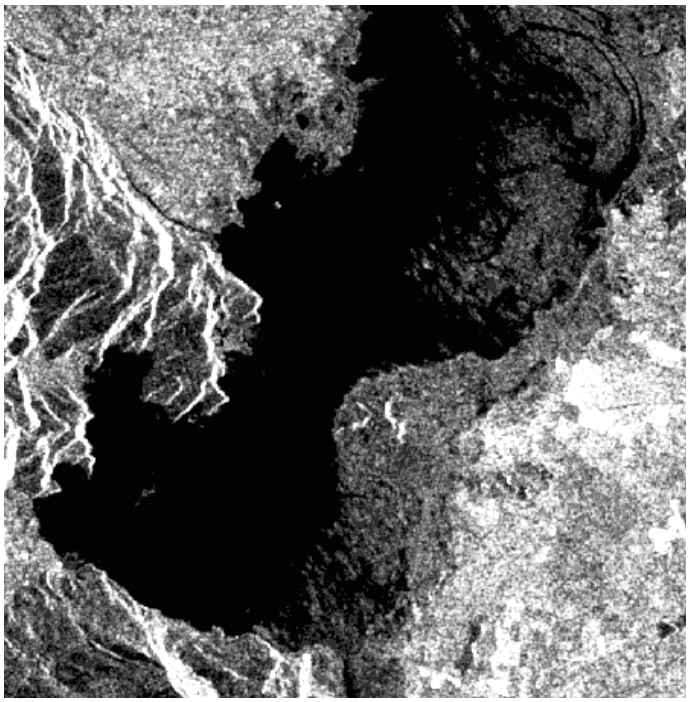


Image taken on 11 November 1995.

Figure 2a. Backscattering changes in the lake surface due to wind effects. The very frequent changes in the backscatter from a water body can be used for its clearer delineation

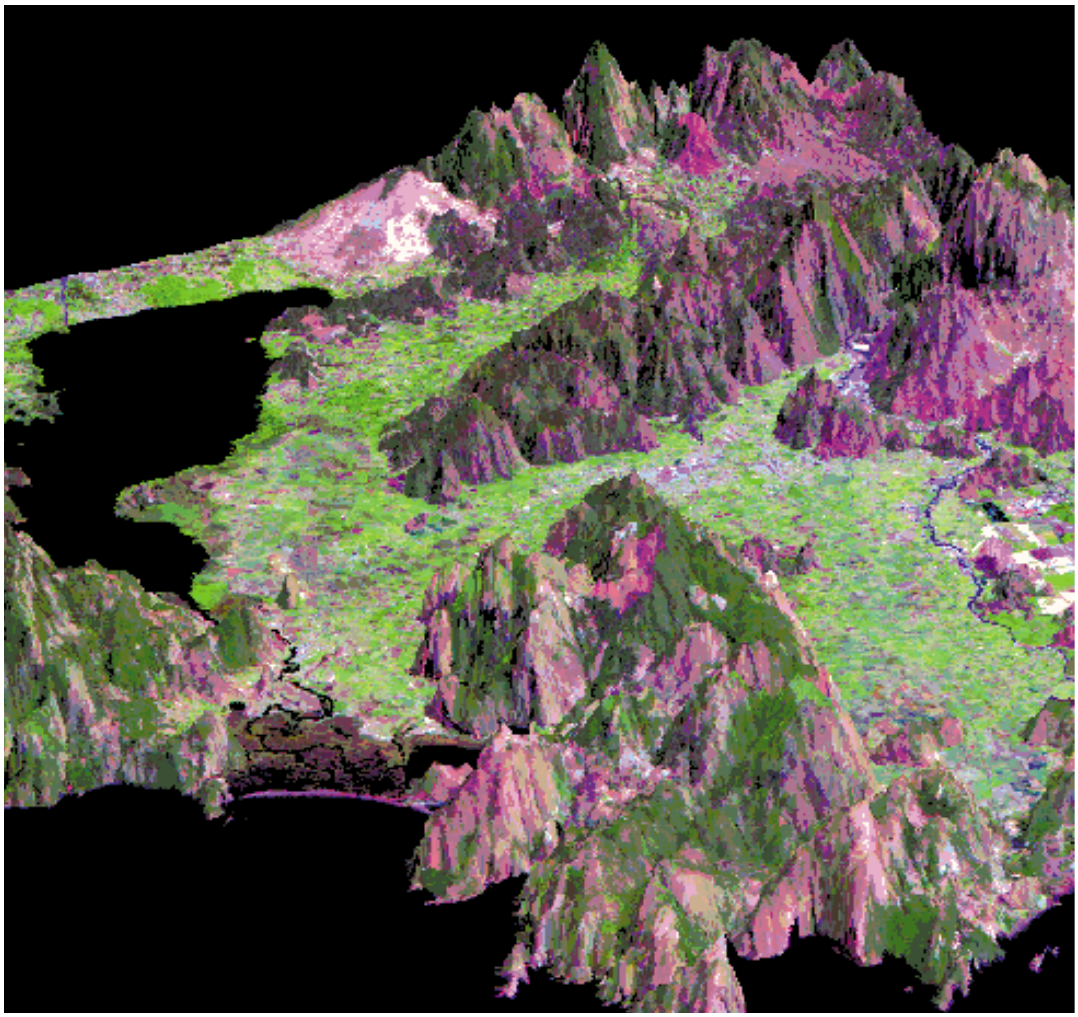


Figure 2b. An oblique view of the study area based on an irregular Triangulated Network (TIN) model and with Landsat Thematic Mapper (TM) data superimposed

Figure 2c. Urban areas are characterised by points with very high backscattering values, due to the effects of 'corner reflectors', during all observation periods

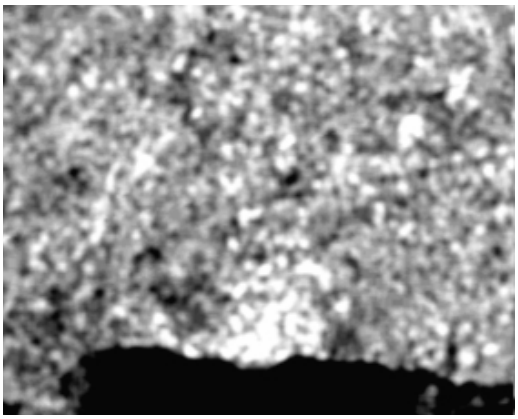
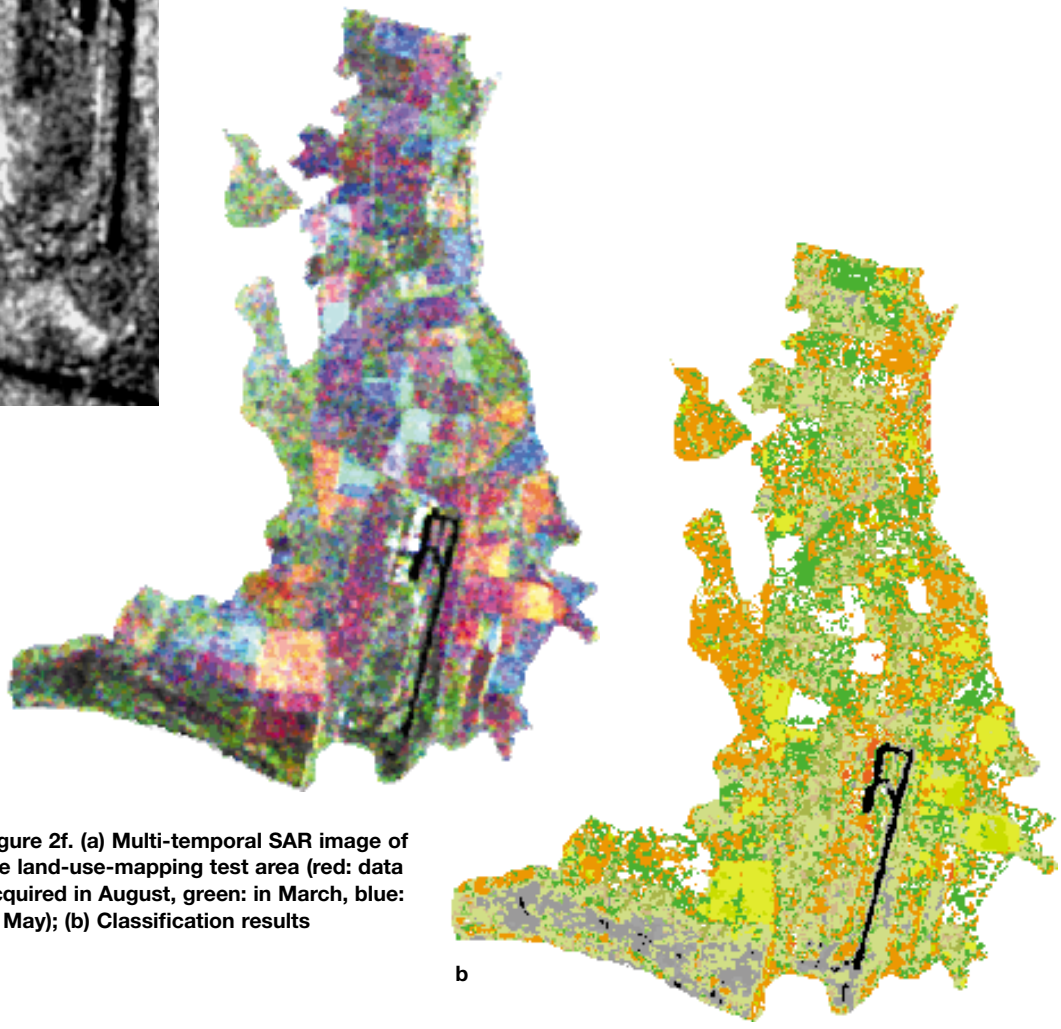


Figure 2d. Reeds along the lake shore can hide a rough water surface and hence appear in dark tones

Figure 2e. Pronounced linear features in a SAR image are often man-made structures, such as roads, airports and canals



a

b

Figure 2f. (a) Multi-temporal SAR image of the land-use-mapping test area (red: data acquired in August, green: in March, blue: in May); (b) Classification results