INTERNATIONAL BOUNDARIES - FROM MAPS TO DATABASES

Ron Adler
Center for Geodesy, Mapping and Geographical Information
1, Lincoln Street, 65220 Tel Aviv.

Abstract

This paper disscusses the use of maps in international boundary making and the transition to boundary database as a source of information and derived products.

1 Maps in boundary making

Maps have been heavily relied upon in all stages of boundary making: negotiations leading to a boundary treaty or agreement, the delimitation itself, where maps are incorporated into or annexed to the delimitation document, aid in transferring the delimitation to the terrain, and, finally, in portraying the actual location of the boundary line to the general public.
Cartographers appreciate the pronouncement of Brownlie [2] that "...a map has a probative value proportional to its technical qualities." The somewhat ambivalent attitude of international lawyers towards maps is expressed in the judgement on the Burkina Faso-Mali frontier case [3], which stated the principle: "Whether in frontier delimitations or in international teritorial conflicts, maps merely constitute information which varies in accuracy from case to case; of themselves, and by virtue solely of their existence, they cannot constitute a territorial title, that is, a document endowed by international law with intrinsic legal force for the purpose of establishing territorial rights".
In practice, maps do form a very significant part of evidence in boundary cases and are sometimes preferred to verbal descriptions which are difficult to relate to the ground [5].

The recent years show the increasing use of alternatives to maps, aerial photographs and satellite images, appropriately annotated, and orthophoto products. Indeed, the recent Peace Treaty between Israel and Jordan, as a delimitation instrument was accompanied by a set of orthophotos, which considerably facilitate the transfer of the delimitation to the ground during demarcation.
Whilst accepting the legal principle that cartographic products have no greater legal value than that of corroborative evidence, it is rather strange to find that the negotiators and adjudicators have almost never requested a quantitative analysis of the balance of errors in maps by cartographic experts, or at least a statement of the map accuracy standard to which the maps adhere.
Another common failing is the use of geographical coordinates derived from maps, without a statement specifying a geodetic datum to which the coordinates are referred. The combination of the graphical error of the map and the ambivalency of the geodetic datum could produce errors varying from tens of metres to hundreds of metres. An excellent solution to this problem is contained in the judgement in the Land, Island and Maritime Frontier Dispute, El Salvador/Honduras: Nicaragua intervening, [4] where the court recognizes the possible discrepancy of the order of 9" (approximately 270 meters) resulting from the choice of datum, and the coordinates given in the judgement serve to assist in locating the boundary points on the ground rather than to express their position.
It is believed that the future years will see a number of surveying and mapping applications growing in importance.

1. The improved quality of maps, based on modern accuracy standards.
2. Mapping, GPS controlled, derived from digital database, providing flexibility in the choice of scale, where the accuracy estimates are those pertaining to the details contained in the database and not in the graphical product derived.

3. The use of orthophoto product based on the digital data model collected.
4. The application of satellite imagery, geometrically corrected in areas where conventional or digital mapping would be difficult to obtain or would be economically unjustified.
5. A combination of GPS control for mapping with a GPS survey of the delimited boundary line, providing an unambiguous definition of the boundary line connected to the surrounding terrain.
   A "boundary datum" preferable to national datum (s).
6. A digital boundary database from which information can be supplied for a multitude of purposes, from the routine administration of the boundary to the supply of data for the settlement of any conflict which may arise.
   Various aspects of positioning and mapping international land boundaries are presented in [1].

2 Boundary database simulation.

The objective of the simulation was to create a model of a boundary digital database, containing all the relevant data and to simulate its use for the purpose of dissemination of information.
The simulated boundary[1] between two imaginary countries Giramar and Morisca was some 100 kilometers long and was delimited by 83 points. The boundary consists of several sections, each representing different character of a boundary line.

1. A traverse of straight lines between monumented points situated on prominent features, all surveyed by GPS and some also by ground survey methods (1-3, 29-43).
2. A line along a local watershed, defined by digital photogrammetric methods through stereoviewing inspection and recording of coordinates (3-16).
3. A line along the bed of a stream, recorded by digital photogrammetry, without demarcation envisaged (16-29).
4. A line defined as the middle of a river, unsurveyed, approximate coordinates digitized from an existing map (42-83).
   One of the demarcated points was chosen as the boundary datum point (31) at which static GPS observations were assumed to have been made. This point also became the central meridian of the boundary plane rectangular coordinate system, U.T.M. - like to serve the frontier area. All positional references would be given in this system, each country being free to incorporate the boundary system into its own national datum independently.

A typical survey point descrisption (sketch) was included in the database in digital form by scanning the original.
A photograph of the monumented boundary point was also scanned and can be stored in digital form.
The above digital description of the boundary (together with a digital map if possible) becomes the infrastructure of the database, the heart of a Boundary Geographical Information System, to which queries can be addressed and various information products derived.
In addition, a digital boundary diary could be created, recording various occurences along the boundary, precisely located, updated at all times and available to the neighbouring countries.

[1] The basic data for the simulation in the form of 1:50 000 topographical map sheet Baix Emporda, the coordinates of geodetic control points and a satellite image of the area were kindly provided by the Institut Cartografic de Catalunya in Barcelona.

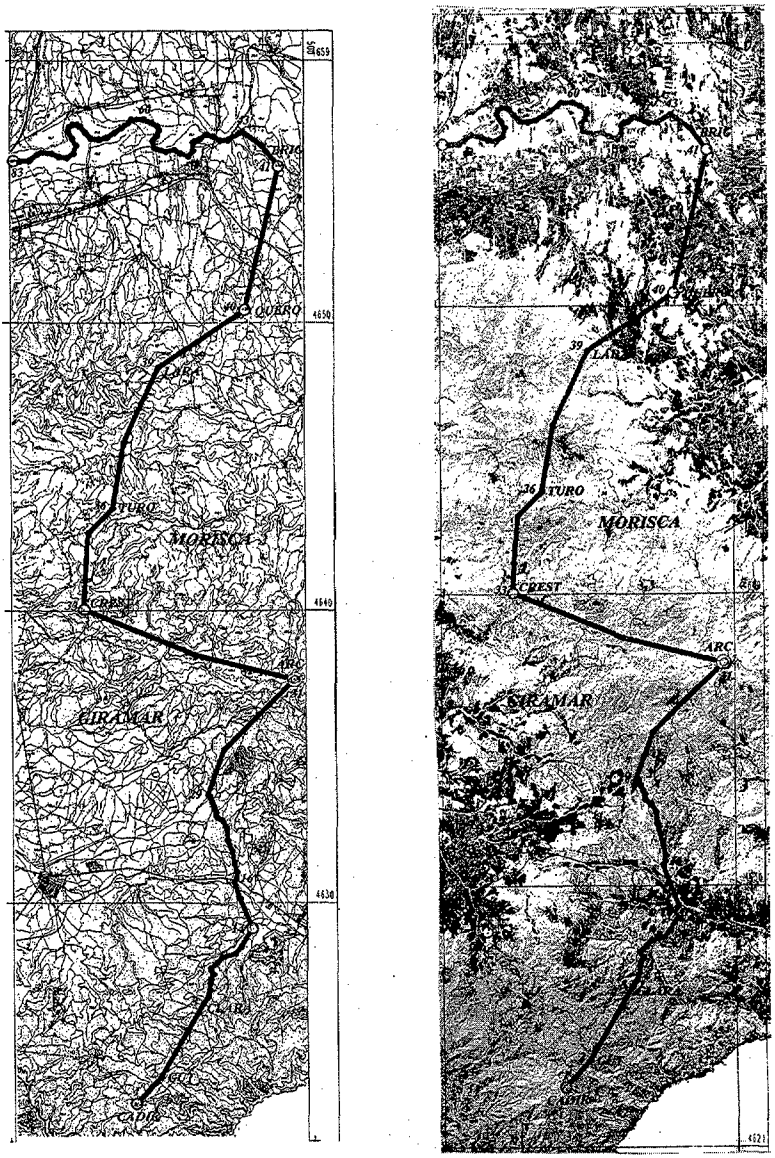

Figure 1. Simulated boundary superimposed on the topographical map, and on a satellite image (courtesy of Institut Topografic de Catalunya).

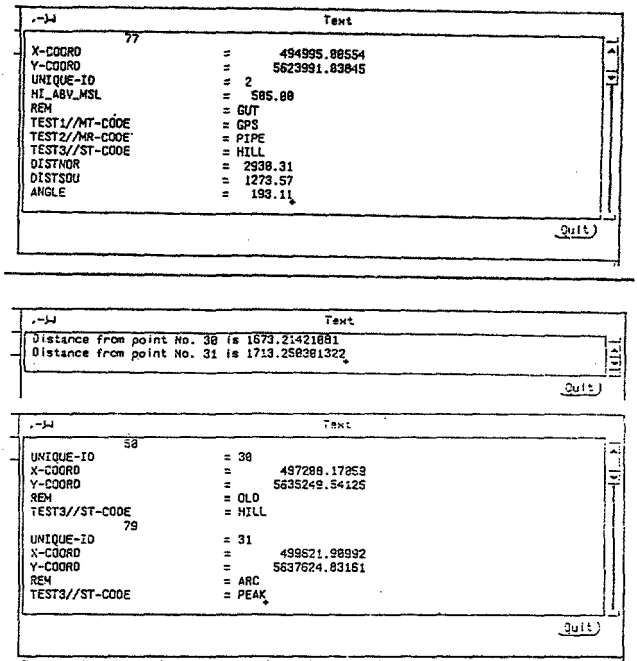

Figure 2. An example of responses to queries on the monitor display. Top: point No.2 and its attributes. Bottom: border crossing between points 30 and 31.

Dissemination of information was programmed using ARC INFO modules with the envisaged principal queries shown as selectable options.

1. Display all points. All points within specified window will be displayed on the monitor screen. A list of attributes is displayed: point ID (number), name , coordinates, elevation, survey method , type of monument, situation (sketch or photograph).
2. Query - Display attributes. Any point in the database can be selected by number or name and its attributes will be displayd on the monitor screen.
3. Query - Boundary crossing. This is a simulation of a boundary crossing occurrence. An approximate coordinate of the occurence is entered and the distances from the nearest defined boundary points will be displayed.

The simulation is intended as a model for Boundary Data Base content and its potential contribution to the permanency and stability of a boundary.

References

[1] Adler R., 1995. Positioning and Mapping International Land Boundaries, Boundary Briefing, IBRU, University of Durham, Durham.
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[3] I.C.J[2] Reports, 1986. Case Concerning the Frontier Dispute (Burkina Faso v. Mali).
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[5] Rushworth D., 1993. Cartography in Land Frontier Dispute Settlement, British Cartographic Society Symposium, Swansea.

[2] I.C.J. - International Court of Justice.