HANDLING OF RECTANGLE OBJECTS BY MAPINFO :

Principles and consequences

Jacques Paris, Novembre 1997

Internal definition of a rectangle object and a direct consequence :

MI defines a rectangle by the coordinates of two opposite corners (LL lower left and UR upper right); the sides are drawn as parallels to the window borders. I will refer to the horizontal side of the window as the "paper horizontal" because its direction is respected when the mapper window is printed.

This definition has a consequence of importance:

> when a rectangle drawn as such on a layer is displayed in a mapper with a coordsys definition different from that of the original layer, or when the coordsys of that layer is modified, the rectangle is redefined by a translation of the LL/UR coordinates in the new system followed, if displayed, by the re-drawing of its sides parallel to the sides of the redefined window.
>
> > Related issues : this definition explains why rectangles cannot be rotated. It explains also that MI is unable to rotate a dxf map by just simply giving at import time coordinates for dxf and MI points that would not respect proportionate dx and dy between the two reference points; the imported map will simply by stretched or compressed.

One has to remember that when working with projected maps, the direction of the North at any point on the map is not necessarily parallel to the vertical border of the window. In fact, with MTM or UTM projections for example, the coincidence of North and vertical side is true only along the central meridian. To the right of it true North points to the left of the vertical, the more so as one gets further away from the central meridian and from the equator; to the left of the central line, the North will tilt to the right of the vertical.

The result is an almost certain deformation of the rectangle. As by definition the sides remain parallel to the window borders, any shift in the vertical (horizontal) distance between LL and UR due to the coordinate translation will modify the vertical height (the horizontal width) of the redrawn rectangle. This can be seen in the upper part of the diagram in "One danger in..." illustration.

There is a direct impact on the area of the rectangle. A detailed numeric example is given at the end of the document, Its conclusions are rather pessimistic, the area can be increased in noticeable proportions, and a serious doubt is cast on the fiability with which MI is reporting this variable.

This behaviour - alteration of rectangles when changing coordsys - is also extremely dangerous if one wants to use MI functions based on overlay of polygons (intersecting, erasing...) because if the operation is done in a coordsys in which the rectangles have not been drawn, there will appear "slivers" or non-existent-in-the-reality "spaces". If the 5000 m rectangle was

erased by the 1000 m one (top right of "One danger..."), the thin strip over the 1000 m object will not be erased, while it would have been in the original map definition of the left part of the diagram.

Partial prevention : conversion to region

To prevent calling on the automatic drawing of sides parallel to window borders, one should avoid then using a rectangle type object. Using a region type object could be an alternative, but as it is difficult to draw really rectangular polygons, one could draw a rectangle then call on CONVERT TO REGION. The lower part of "One danger..." was drawn that way.

One can see that the small and large polygons keep their three common sides in contact, and that the large region in Lat/Lon is practically the same as in the projection; conformity in side dimensions and in area is practically reached (see example at the end).

However, the "translated" polygons are now slanted on the "paper" horizontal. One can see on the bottom right diagram (point B') that the vertical displacement of B is very similar to the increase in height of the rectangle above.

Impact on graphic scale building : the SCALEBAR.MBX controversy

Many MI users have commented on the strange results they obtain with the SCALEBAR.MBX utility included in the MapInfo releases. Most of these unacceptable output can be explained from what precedes, and by adding a comment about the Cosmetic layer.

The graphic scale obtained with this utility is made essentially of 6 rectangles set on 2 rows; these objects should have the same height and form a continuous pattern, without gap or overlaps. An example of "good" results is the top diagram of "Graphic scales drawn with...".

The user is also warned that the graphic scale objects will be created in the Cosmetic layer. One should know, but most of the time forgets it, that the Cosmetic layer coordsys is only Lat/Lon, and that, incidentally, it cannot be bounded, thus preventing the use of increased internal precision.

We have here all the ingredients for having problems : transformation of coordsys and rectangles. The conclusions are immediate : to obtain a perfectly drawn scale, one must define it only if the mapper is in Lat/Lon. Any other definition will lead to unmatched rectangles, because, if distorsions occur between projected and Lon/Lat, they happen also between Lon/Lat and projected for exactly the same reasons.

There is another situation in which one can expect good results, that of a non-earth mapper, because such a mapper does not accept another kind of coordsys and that the Cosmetic layer will have exactly the same definition as any other layer in the pile.

In other situations, one can expect distorsions such as those existing in the upper scale of the bottom box of "Graphic scales...". One can identify different heights as well as overlapping rectangles.

Conversion to region : an ambiguous answer

Converting rectangles to regions was presented as a way to protect the shape and area of the original rectangles, but with a drawback : the potential slant of the rectangle basis. Applying that conversion on the rectangles generated by scalebar.mbx in

a "projected" mapper would be useless because the coordinates defining the rectangles have already been determined with the distorsions due to the hidden transformation from Lat/Lon in the cosmetic layer to the projection in the mapper.

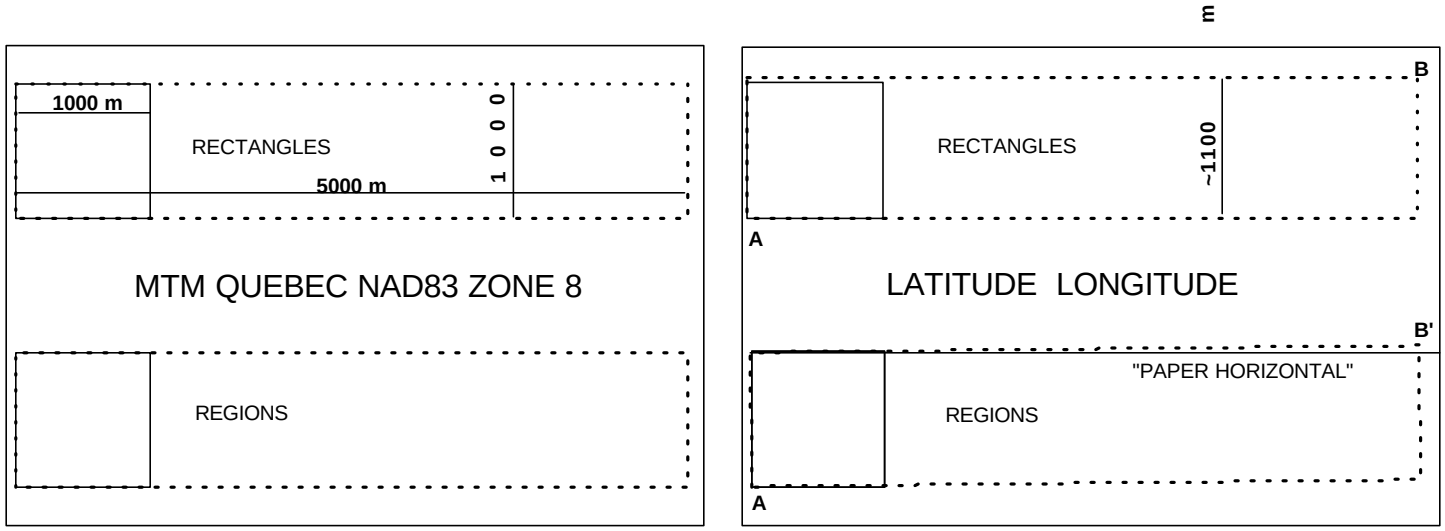
It is necessary to generate the scale in a non-projected environment, then to convert the rectangles to regions and, finally, to transport the scale in the projected mapper. The objects appear to be rectangles of the right size and snapping perfectly to each other, but there is a slant (lower scale of the bottom box of "Graphic scales...").

However, the output of that procedure is not acceptable because the rectangle to region conversion is most required when the differences in height of the scale rectangles are most visible, and that it is the situation that creates the most pronounced slant. Scalebar is not a utility that can give satisfactory results under these circumstances.

One danger in using rectangles in maps

Objects are defined in the MTM mapper, copied and pasted in the lat/lon window.

Only the **opposite corners of a rectangle** are transfered in lat/lon (A and B)
As the converted position of B is higher than the "horizontal" (see B'), the
rectangle drawn on these two points is wider than the original.



The **four corners of the region objects** are converted independently in lat/lon
The North direction of the MTM being different locally from the vertical axis
of the page, region objects are slighlty tilted on the "paper horizontal"

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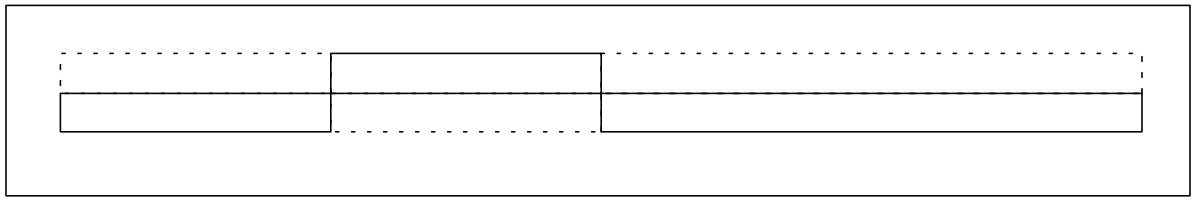
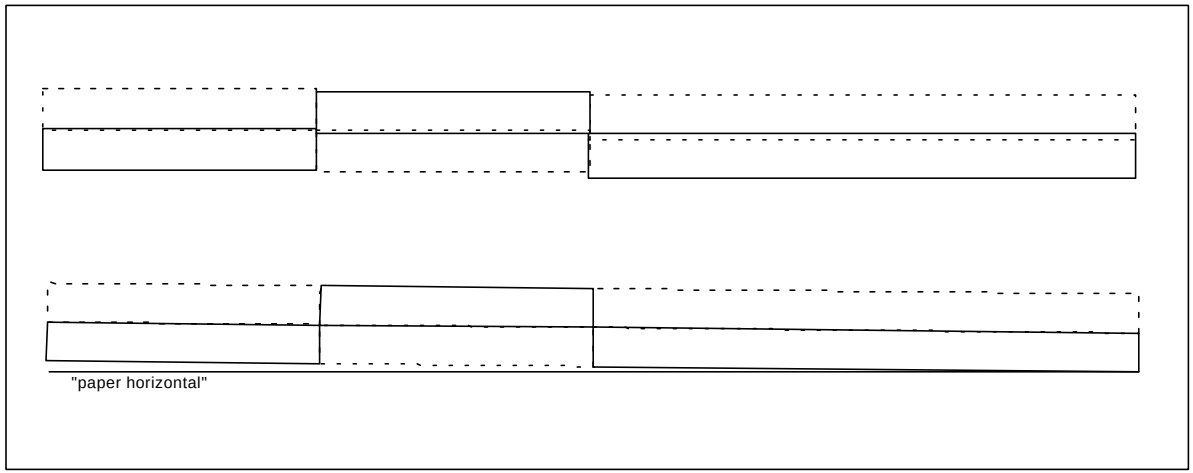
Graphic scales drawn with SCALEBAR.MBX (MI 4.1)

sections of 500 and 1000 meters

Directly into Latitude Longitude



TOP Directly into MTM QUEBEC NAD 83 ZONE 8



BOTTOM Drawn in Lat Lon, rectangles converted in polygons, copied and pasted into MTM QUEBEC

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EXAMPLE OF A CHANGE OF COORDSYS ON A RECTANGLE

All dimensions in meters and square meters

design intentions (the differences in coordinates were set equal to the intended w and h)

	w	5000	h	1000	S	5000000

		rect MTM	rect Lat/Lon	poly MTM	poly Lat/Lon
readings from OBJECTGEOGRAPHY() mbr coordinates					
LL	x	239000	239000.5	239000	239000.5
	y	5059000	5058949.9	5057000	5056949.3
UR	x	244000	243999.5	244000	243999.5
	y	5060000	5060050.7	5058000	5058050.7
area readings from AREA()					
	S	4988619.3	52514278.0	4988540.5	4988762.7
reported in the object info window					
	w	4986	4946	n.a.	4990**
	h	1000	1051	n.a.	1050**
	S	4986000*	5198246*	4989000	4988590.7
mbr dimensions calculated from readings above					
	w	5000	4999	5000	4999
	h	1000	1100.8	1000	1101.4
	S	5000000	5502899.2	5000000	5507000

*calculated from reported w and h
** from tape measure reading

observations :

1 - There are frequent discrepancies between the readings in the object info window and the results of geographic functions such as area() and objectgeography(). This applies to lengths (width or height) and areas. There are also discrepancies between reported areas and areas computed from reported w and h.

Even if this topic is not part of the subject, questions must be asked : WHY such discrepancies? WHAT values to be trusted.?

2 -The rectangle to region conversion in the MTM system is done without any noticeable change in coordinates or in area.

3 - Tansporting the rectangle in Lat/Lon creates havoc. Width, height and area are affected.

4 - Transporting the region in Lat/Lon preserves the area quite well

5 - It is worth noting that the MBR dimensions of the rectangle transported in Lat/Lon are practically the same as those of the region under the same circumstances and that is correct. But the area of the region remains at its original size while the rectangle sees its surface increase by 1/5 to 1/4 of a million square meters (depending on the source); that comes from the augmented height due to the displacement of the upper right corner.