STAR MAPS DIGITIZATION AND CONNECTION WITH DATA BASES

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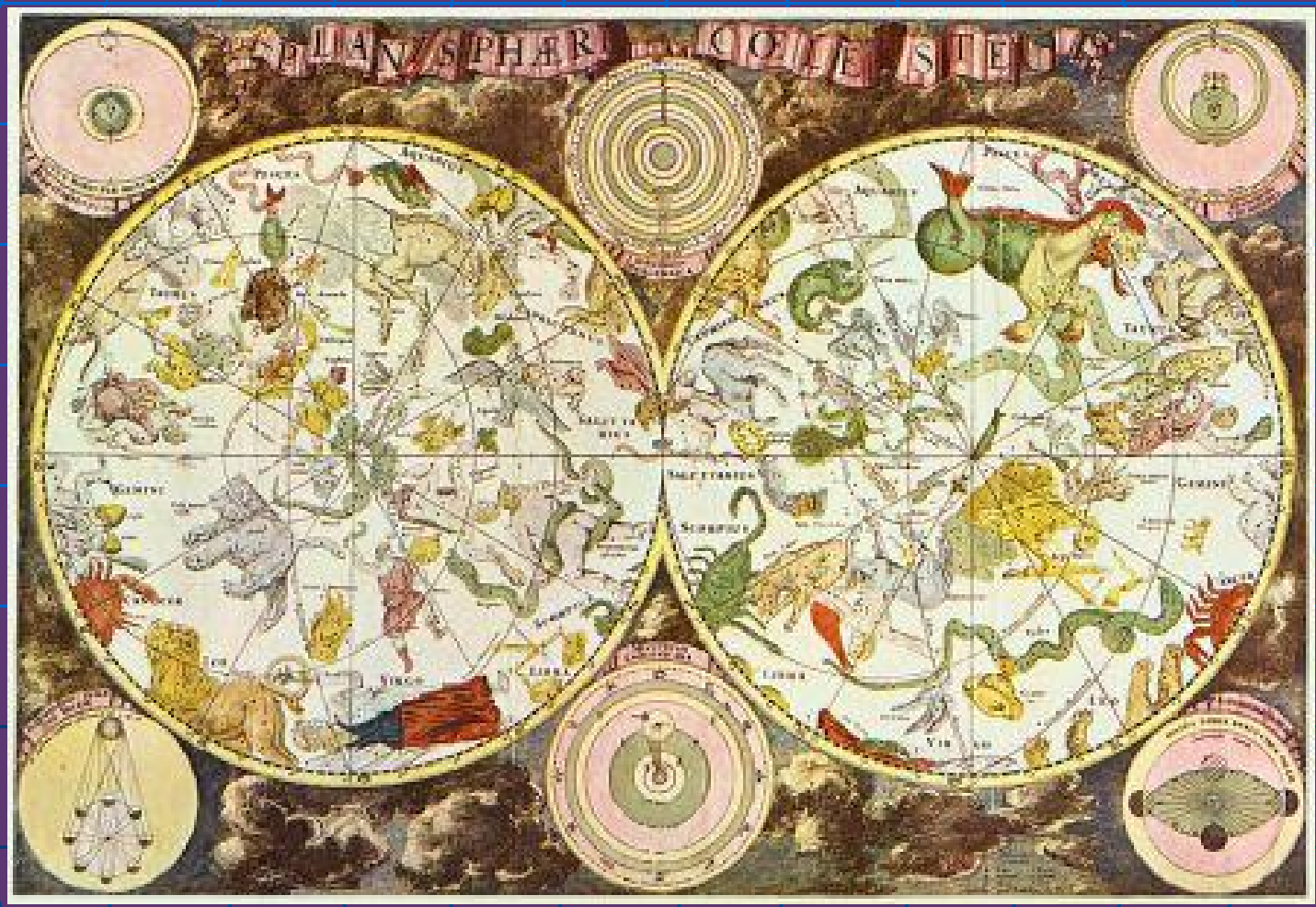
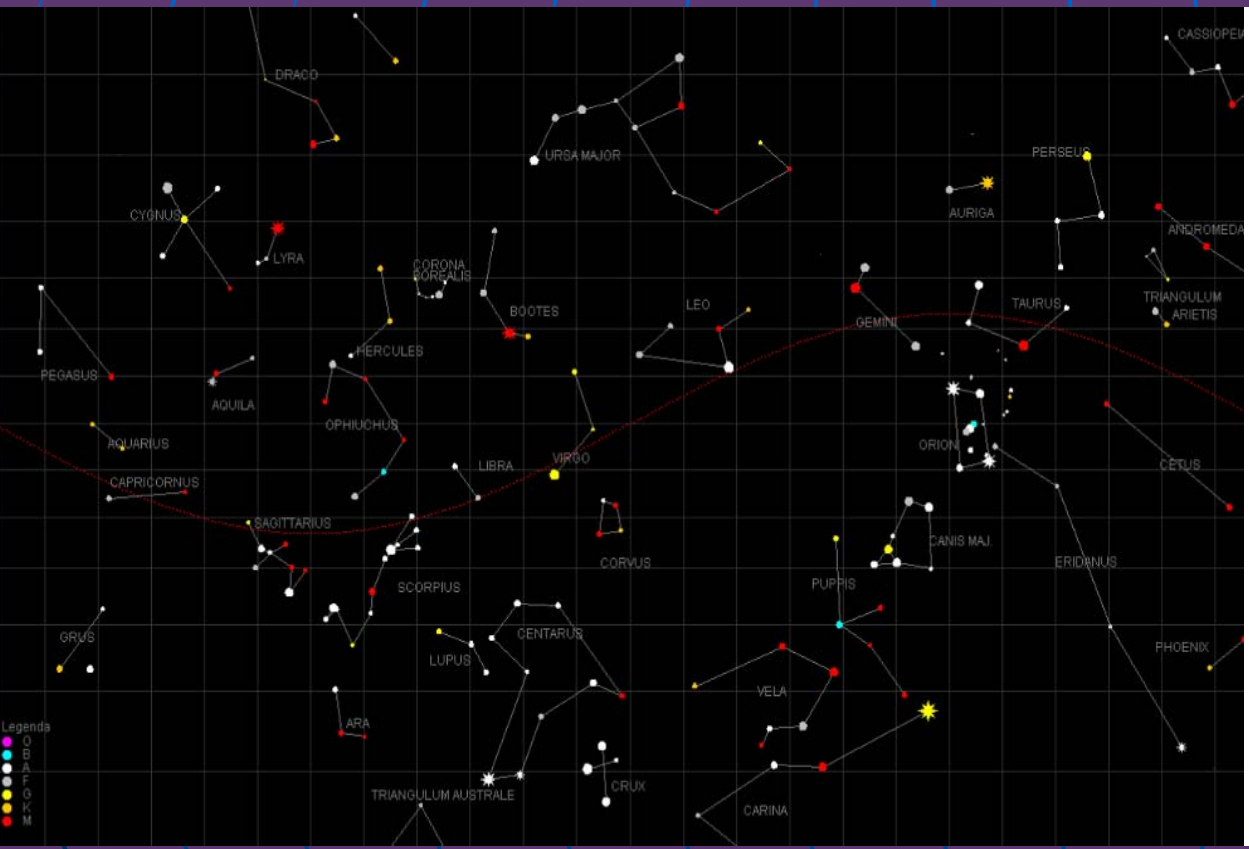
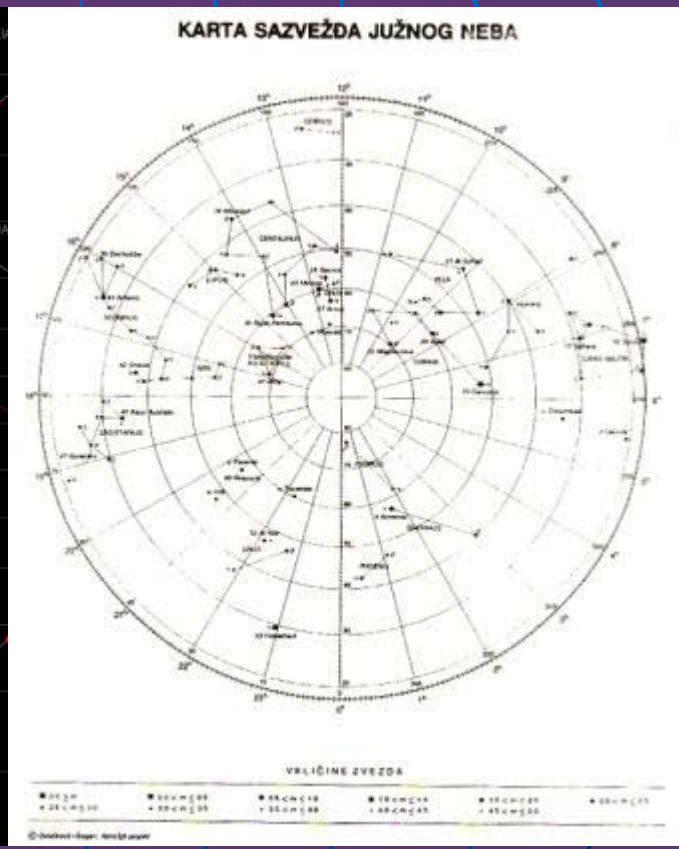
Star Maps



A star map from XVII century, Dutch cartographer Frederik de Wit.

Two main koordinate systems





Cartesian coordinate system

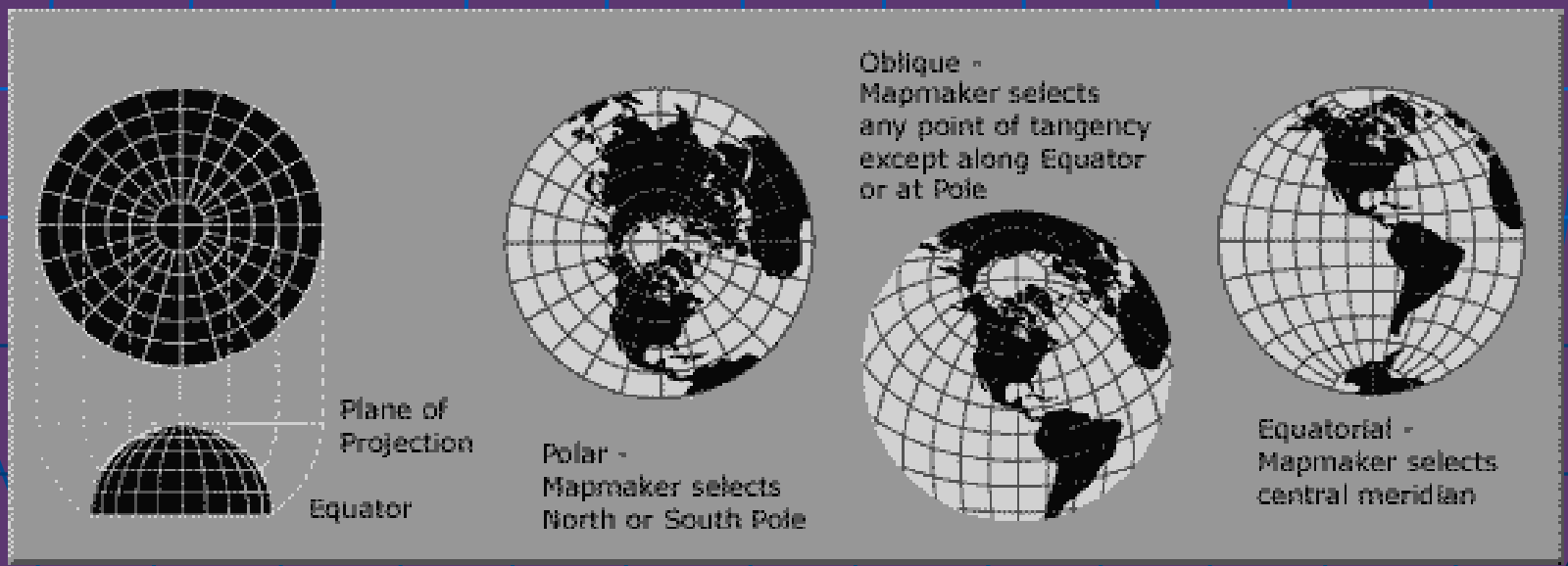
Polar coordinate system

Projections

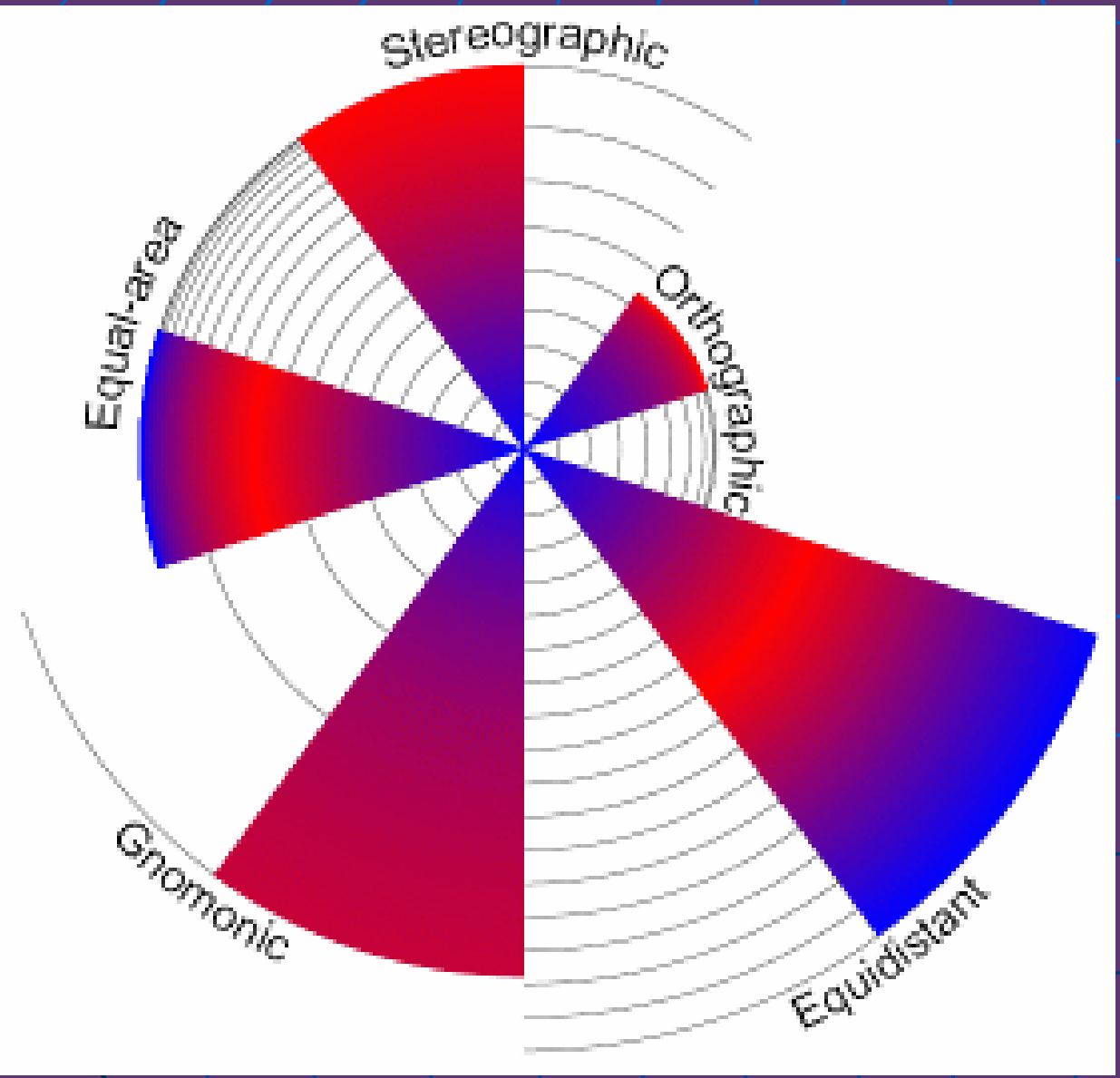
A fundamental projection classification is based on the type of projection surface onto which the globe is conceptually projected.

We distiinguish projections:

- onto a plane - Azimuthal
- onto side of a cylinder
- onto side of a cone



Azimuthal projection-Polar, Horizontal, Equatorial



Compared polar aspects of five azimuthal projections with parallels spaced 10° apart. Orthographic and stereographic stop at Equator, gnomonic is arbitrarily clipped at 20°. Equatorial zone is red, polar caps blue.

Equatorial to azimuthal system

$$(t, \delta) \rightarrow (A, z)$$

$$\begin{aligned} \cos z &= \sin\delta \sin\varphi + \cos\delta \cos\varphi \cos t \\ \sin z \sin A &= \cos\delta \sin t \\ \sin z \cos A &= -\sin\delta \cos\varphi + \cos\delta \sin\varphi \cos t \end{aligned}$$

$$(A, z) \rightarrow (t, \delta)$$

$$\begin{aligned} \sin\delta &= \cos z \sin\varphi + \sin z \cos\varphi(-\cos A) \\ \cos\delta \sin t &= \sin z \sin A \\ \cos\delta \cos t &= \cos z \cos\varphi - \sin z \sin\varphi(-\cos A) \end{aligned}$$

Transformation of coordinates

Equatorial to celestial equatorial system

$$(s = \alpha + t \qquad \text{Local sideral time} \qquad)$$

$$\begin{aligned} (t, \delta) \rightarrow (\alpha, \delta): &\qquad \alpha = s - t, &\qquad \delta \equiv \delta \\ (\alpha, \delta) \rightarrow (t, \delta): &\qquad t = s - \alpha, &\qquad \delta \equiv \delta \end{aligned}$$

(α, δ) !

epoch

Fundamental Star Catalogs (FK)

- Fundamental star catalogs materialize celestial reference systems – conventional coordinate systems for presenting star positions
  - FK4 - measurements were performed in 1963 contains 1535 stars for epoch B1950.0 to B1975.0.
  - FK5 – measurements were performed in 1988 contains 1535 stars (improved FK4), epoch J2000.0.
  - FK6 - FK6(I) and FK6(III), published in 2000; improvement of FK5 based on astrometric Hipparcos data in new reference system ICRS (International Celestial Reference System); contains 878+3272 stars, epoch J2000.0

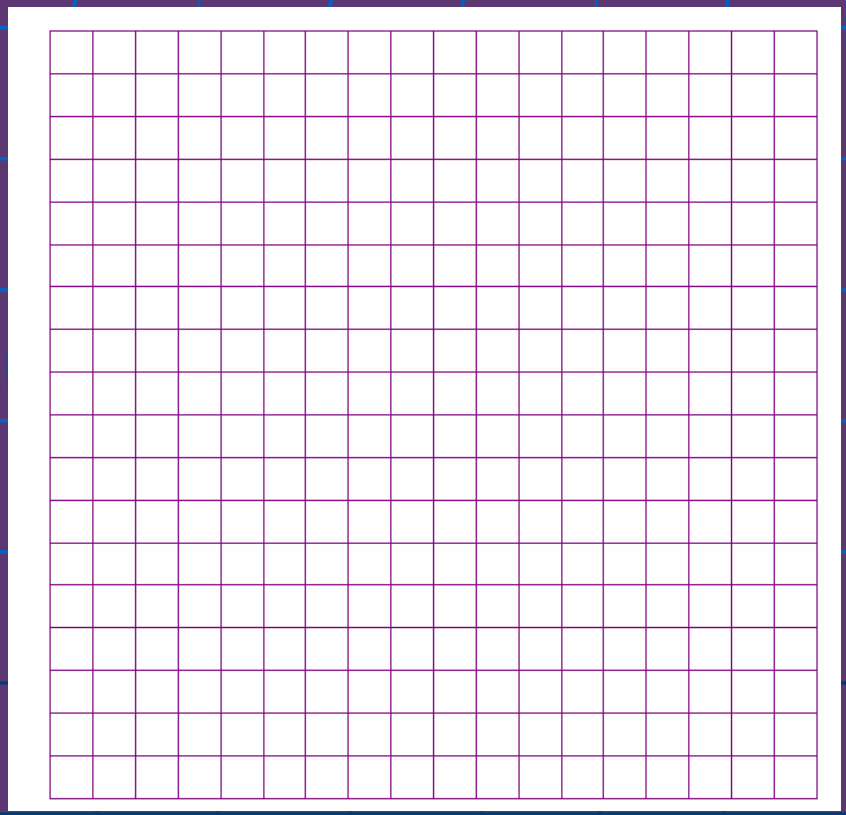
Databases

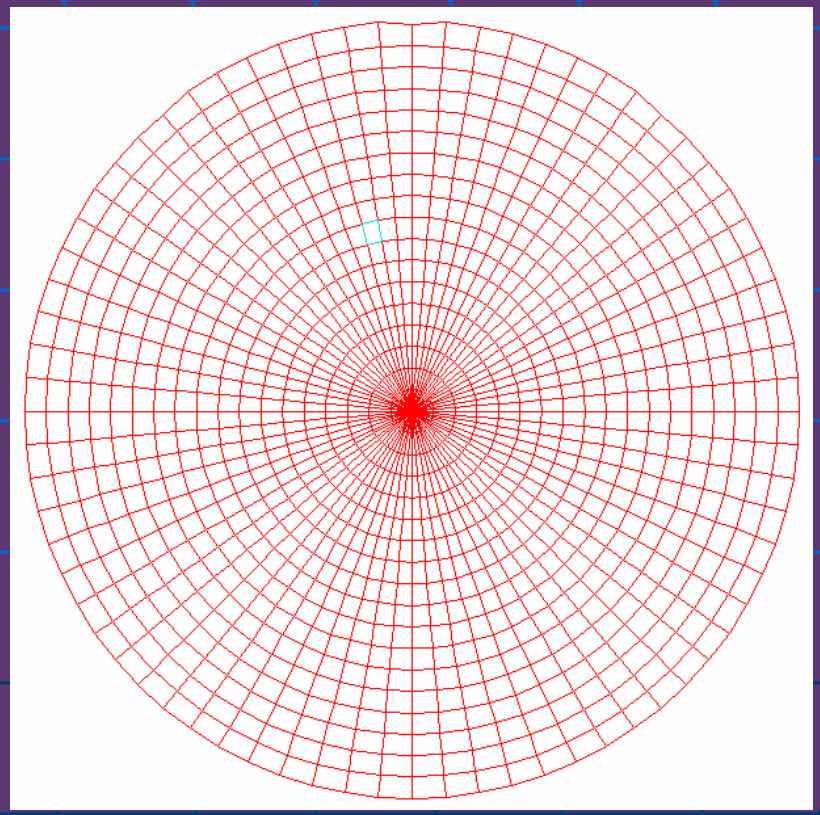
- http://cdsweb.u-strasbg.fr/
- http://ads.iucaa.ernet.in/

GIS – Geographic Information System

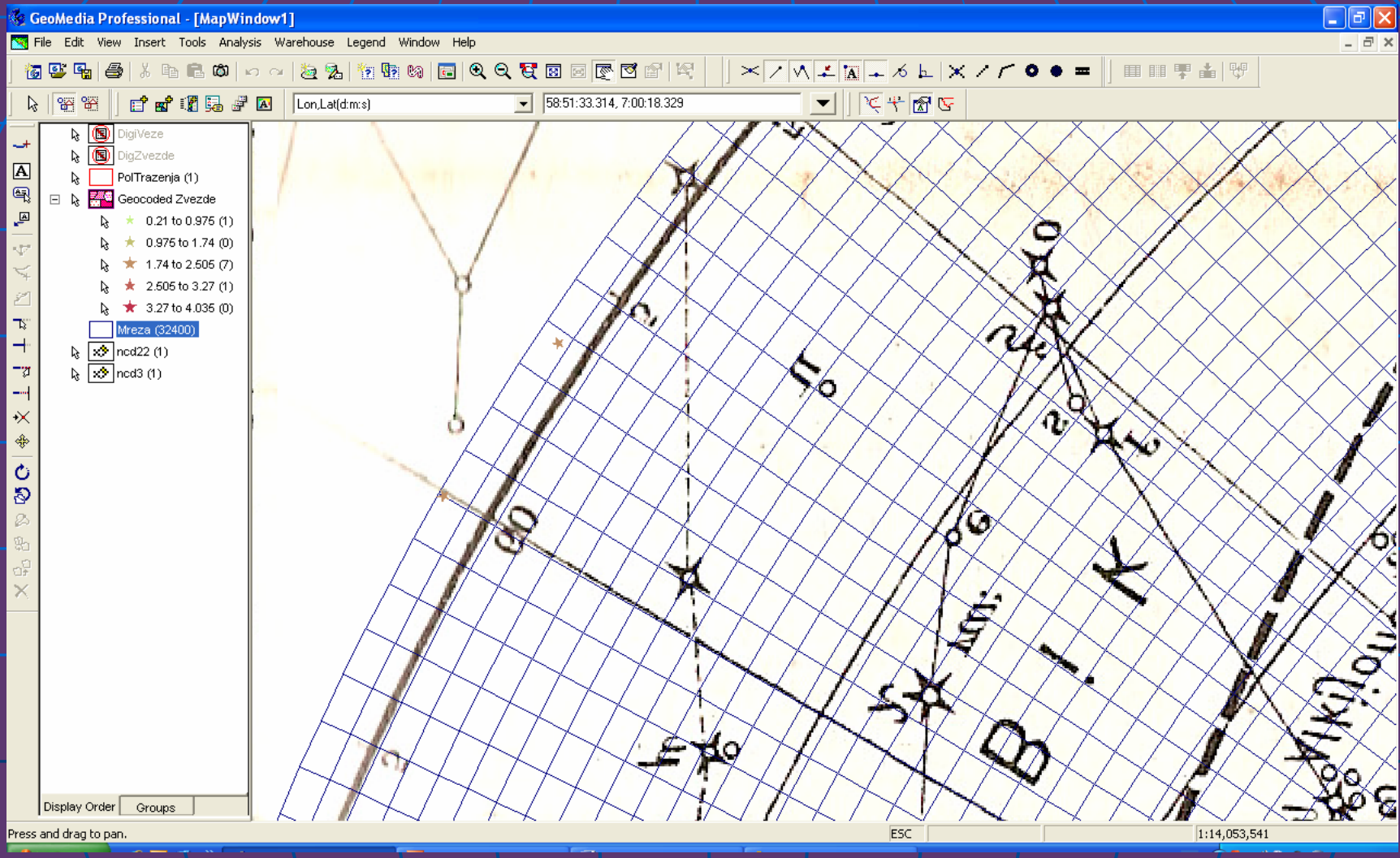
GIS software connects graphic elements with databases. Each map element is connected to one row in table of a database, from where we can read the data about this element. The software makes also possible transforming a given cartographic projection into another one.

Cartographic projections



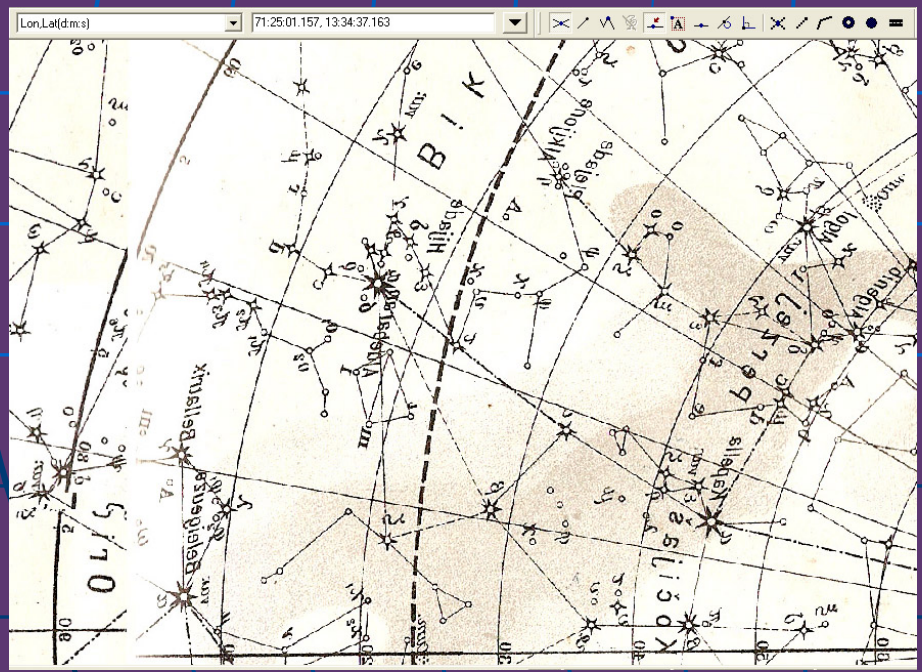


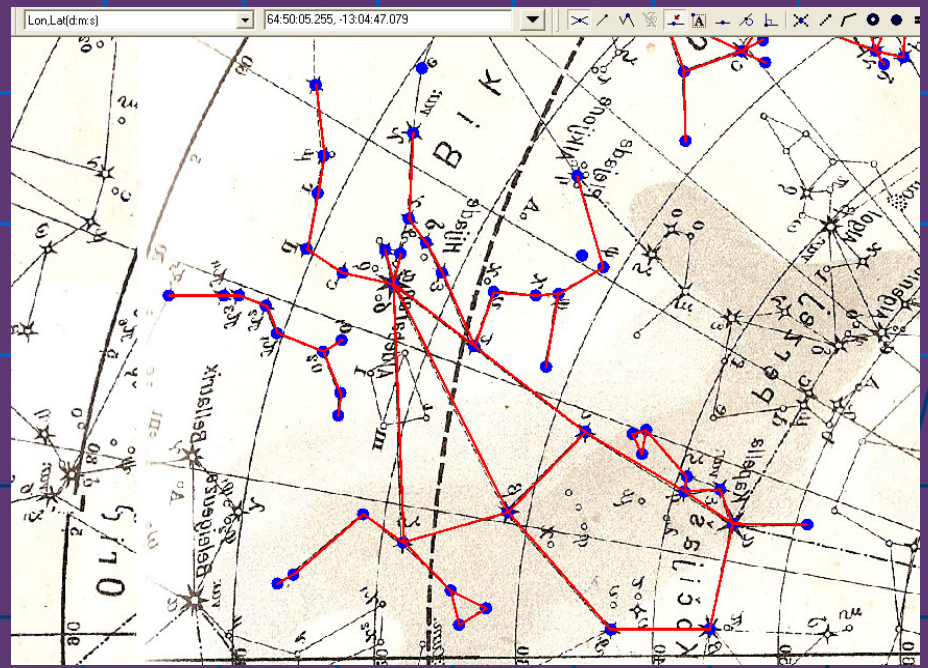
Transforming rectangular grid (left) into one corresponding azimuth-equidistant projection (right).

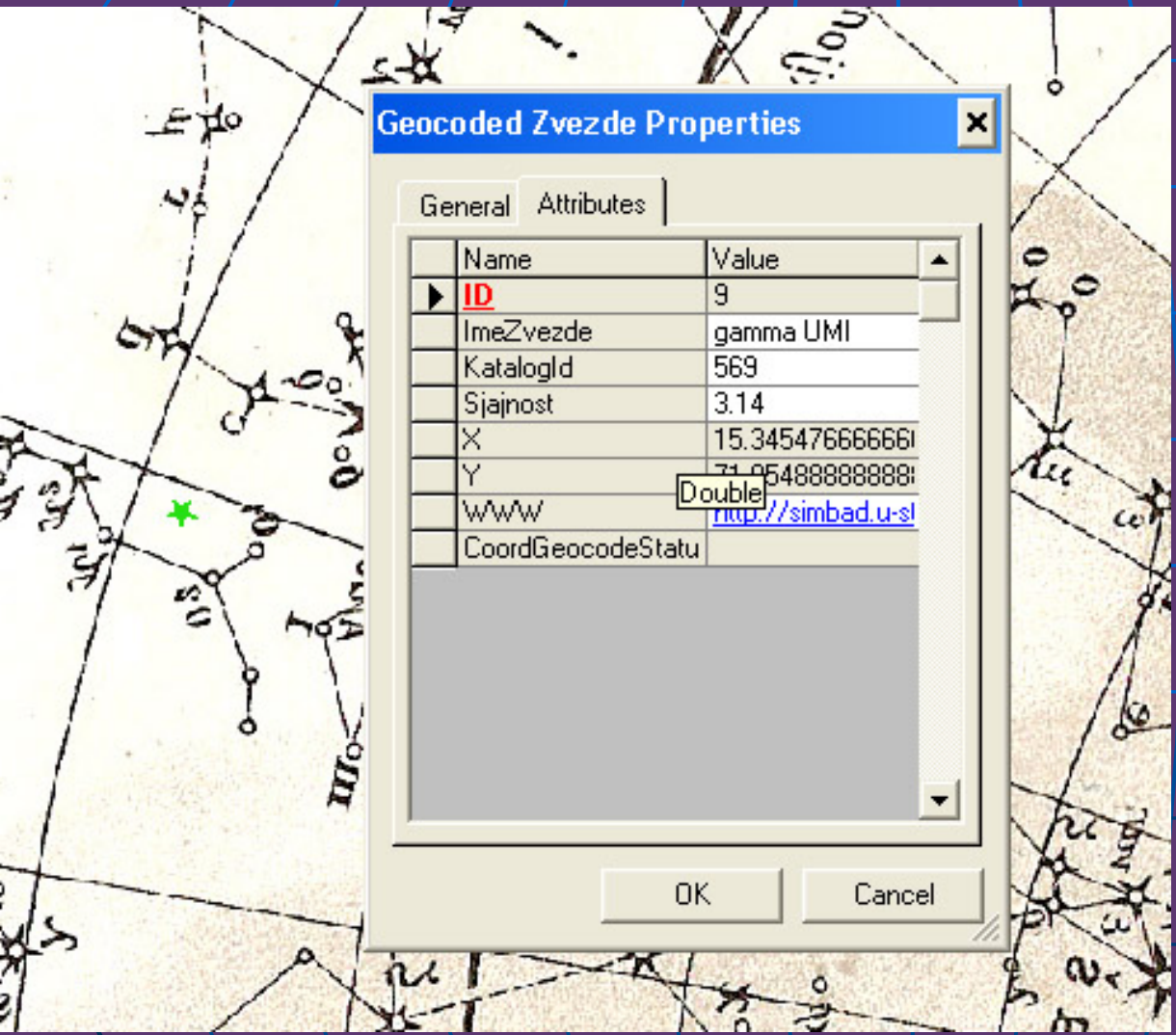


Deviations of circles of a paper map with respect to a mathematically generated grid.

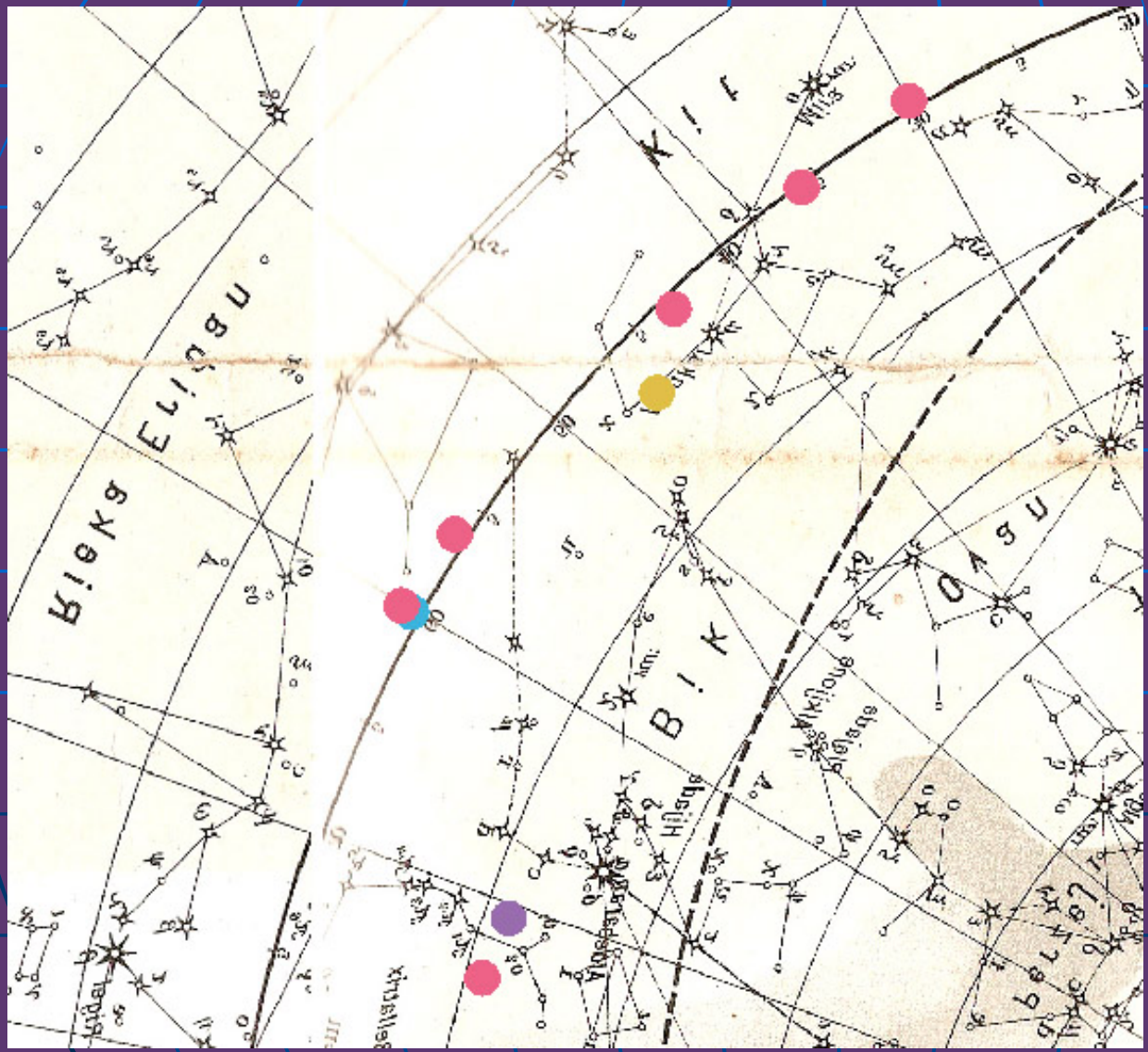
After determining map projection and generating grid mathematically the mapping of the objects to a screen is done by hand. In this way the map is georeferenced, i.e. each element from the map is assigned coordinates (longitude and latitude) .



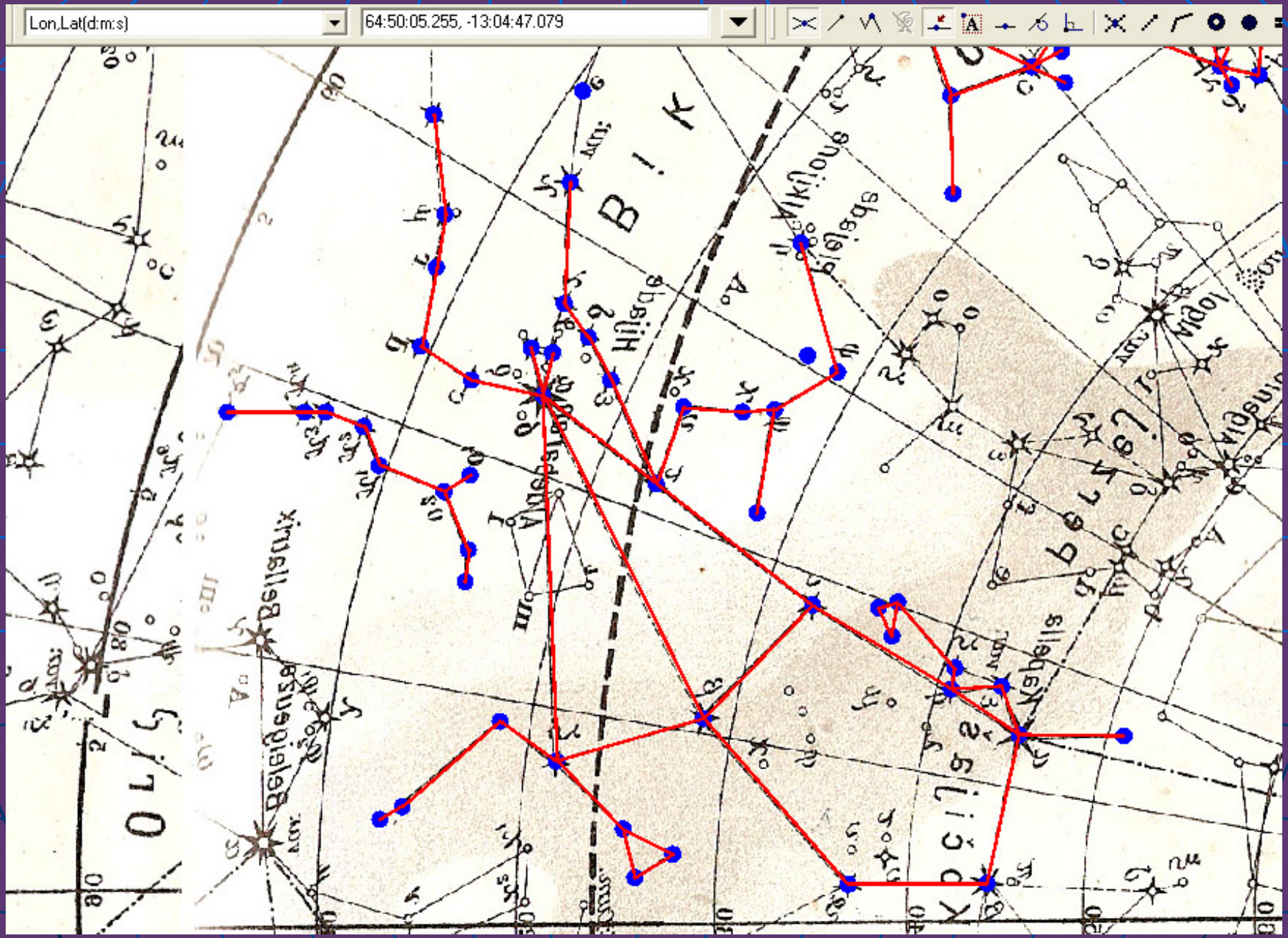


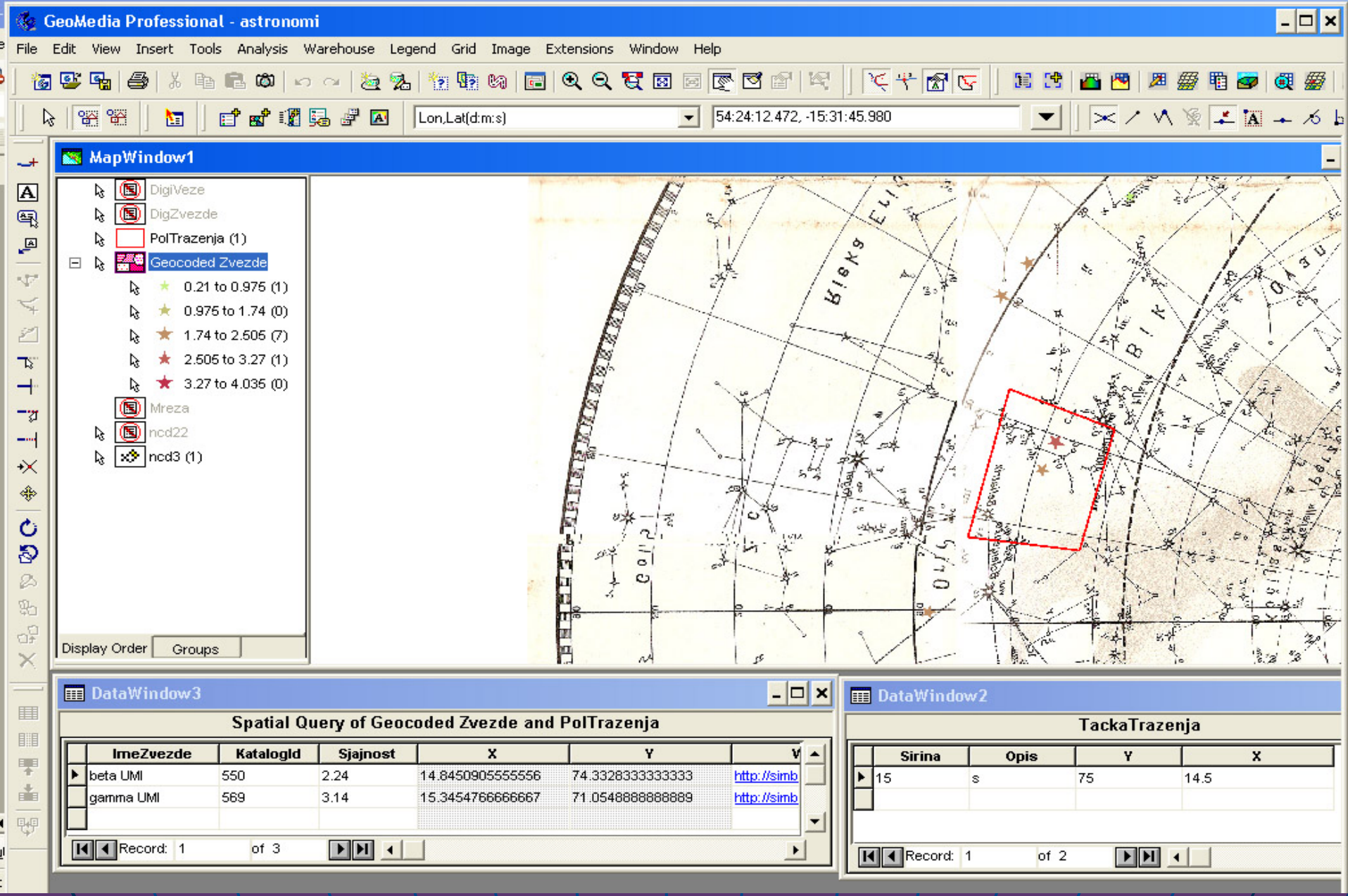


On the newly obtained map each object is connected to the database where the data on all objects are stored (name, longitude, latitude, brightness, …) as well as the link to an internet database where more data concerning the object of interest are available.



In order to have a more illustrative map we can use different colors for objects of different brightness.


Lon,Lat(d:m:s)
64:50:05.255, -13:04:47.079


GeoMedia Professional - astronomi
File Edit View Insert Tools Analysis Warehouse Legend Grid Image Extensions Window Help
Lon,Lat(d:m:s)
54:24:12.472, -15:31:45.980
MapWindow1
DigiVeze
DigZvezde
PolTrazenja (1)
Geocoded Zvezde
0.21 to 0.975 (1)
0.975 to 1.74 (0)
1.74 to 2.505 (7)
2.505 to 3.27 (1)
3.27 to 4.035 (0)
Mreza
ncd22
ncd3 (1)
Display Order
Groups
DataWindow3
Spatial Query of Geocoded Zvezde and PolTrazenja
ImeZvezde | KatalogId | Sjajnost | X | Y | V
beta UMi | 550 | 2.24 | 14.8450905555556 | 74.3328333333333 | http://simb
gamma UMi | 569 | 3.14 | 15.3454766666667 | 71.0548888888889 | http://simb
Record: 1 of 3
DataWindow2
TackaTrazenja
Sirina | Opis | Y | X
15 | s | 75 | 14.5
Record: 1 of 2

References

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- Tadić M., Matematička geografija, Beograd, Zavod za udžbenike i nastavna sredstva, 2004.
- http://www.intergraph.com