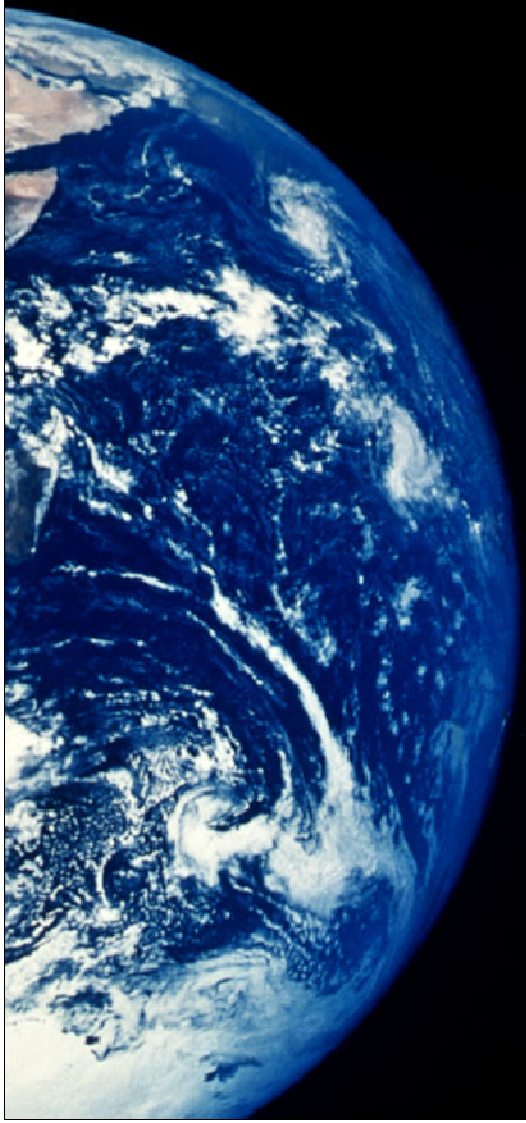
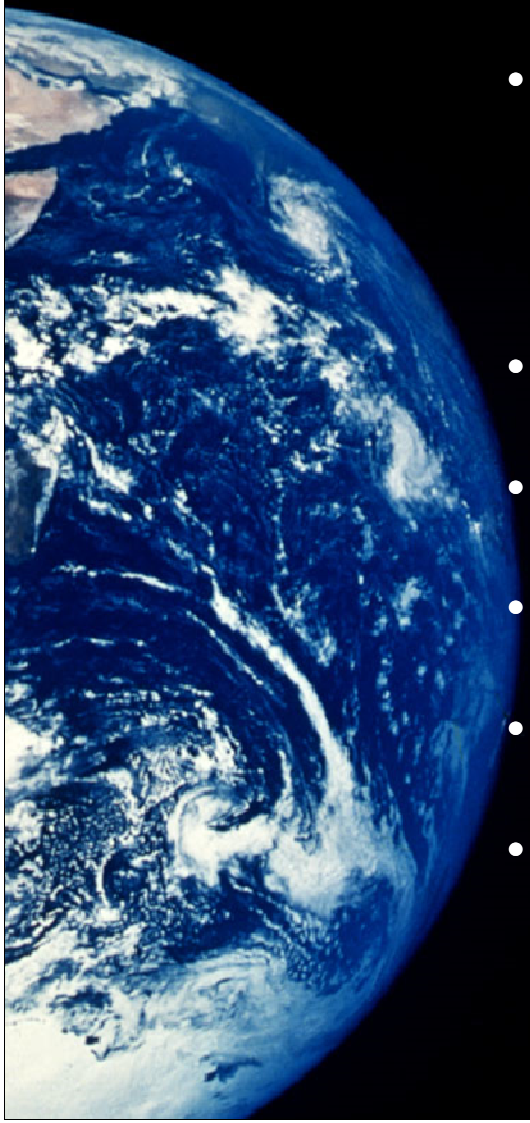
GIS and Remote sensing in geology



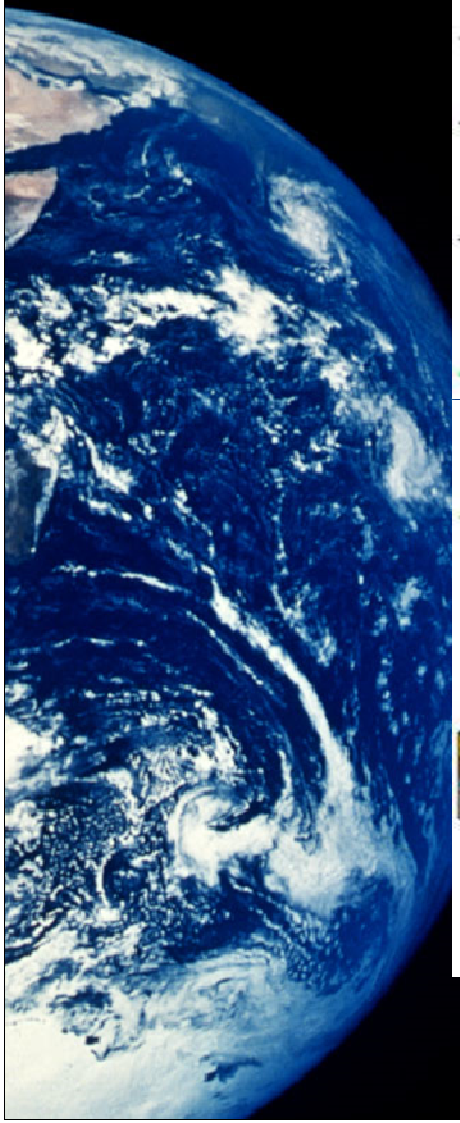
Karel Martínek
Czech Geological Survey
Charles University in Prague

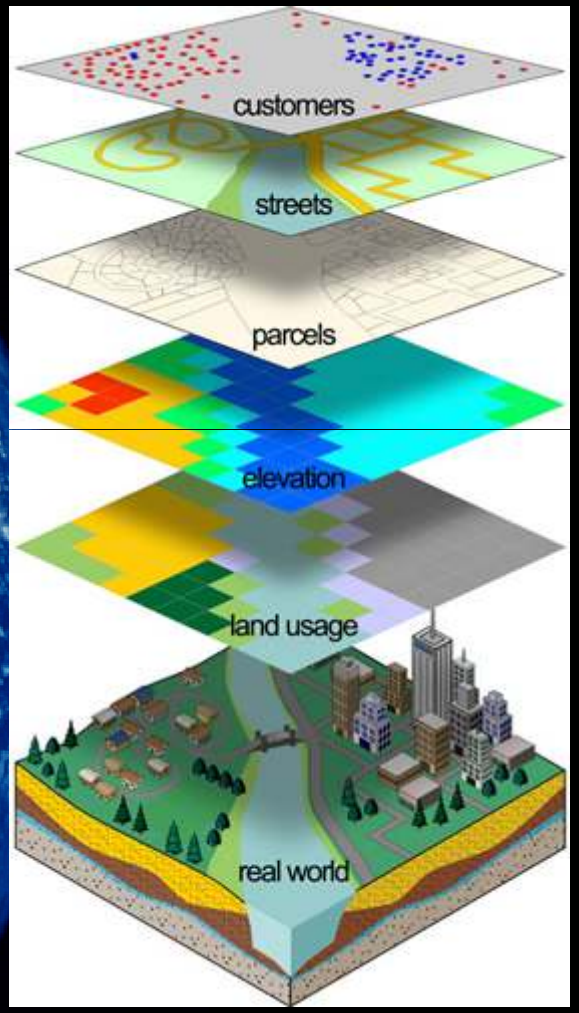
GIS and Remote sensing in geology course outline



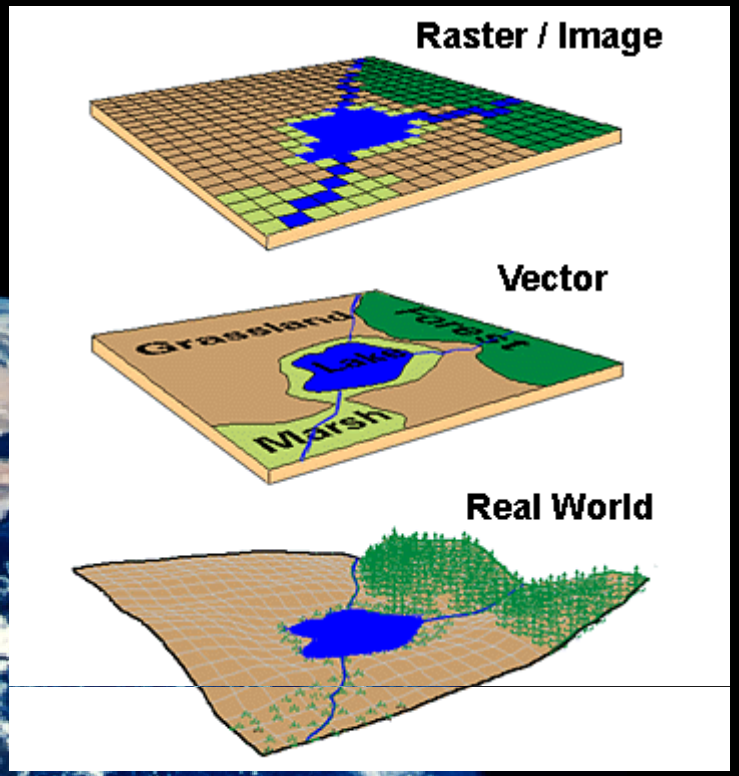
- Introduction to Geoinformation systems (GIS) and Remote sensing (RS)
- Remote sensing – basic principles
- Radar images and applications
- Image analysis
- Image interpretation
- Case studies

Geoinformation systems (GIS)



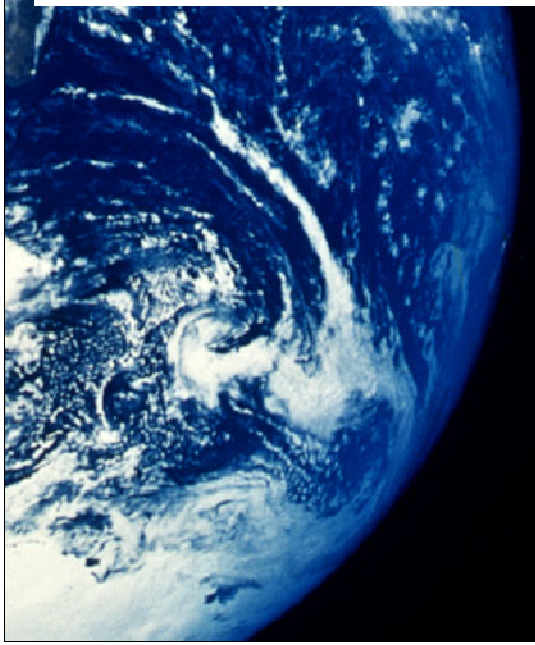


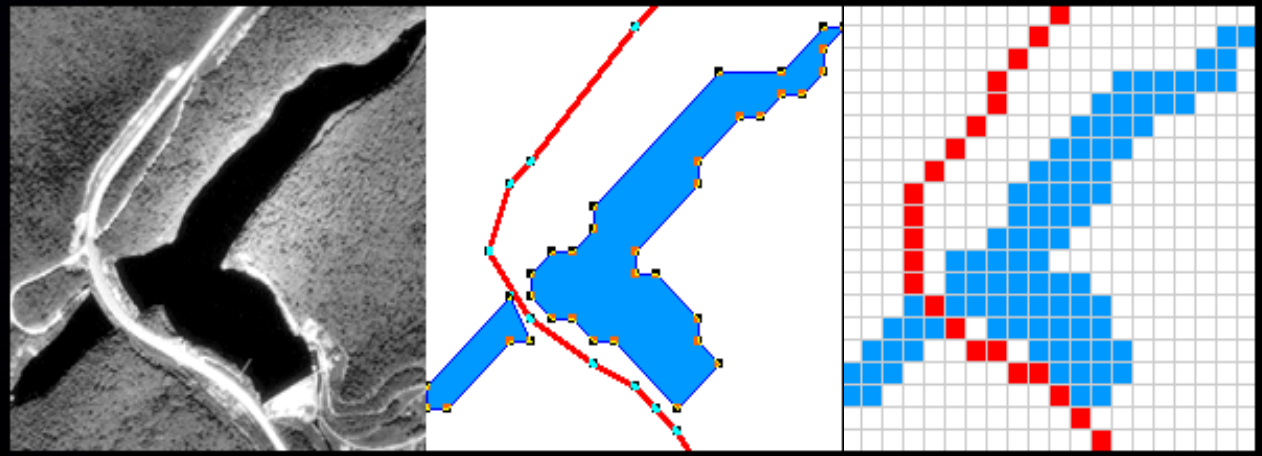
GIS combines various information on the area of interest and thus enables to better insight/ understanding of the site

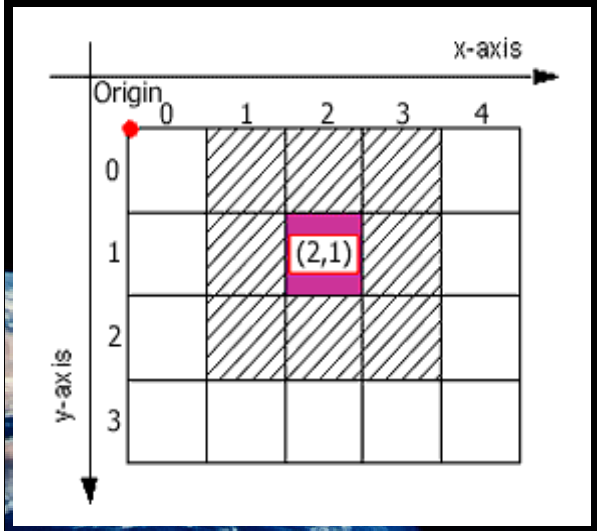


Data types

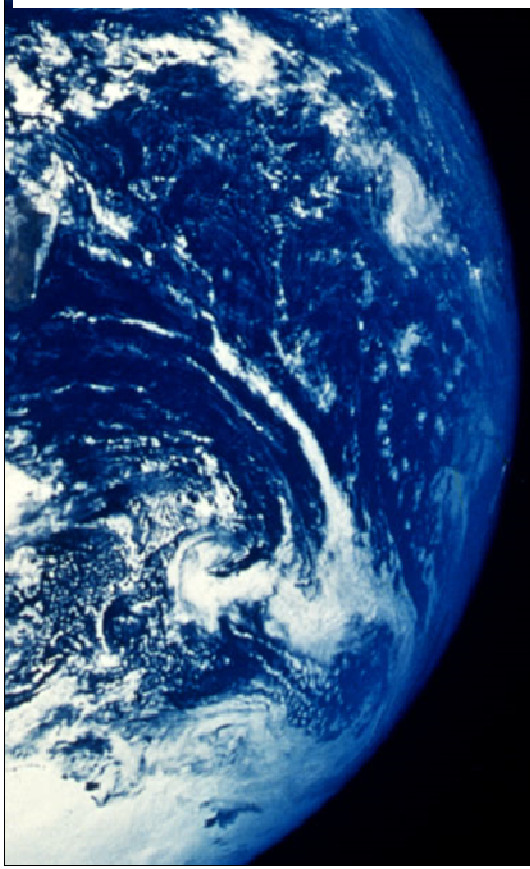
- Vector
- Raster (grid)
- Text and spreadsheet
- Pictures … any database data



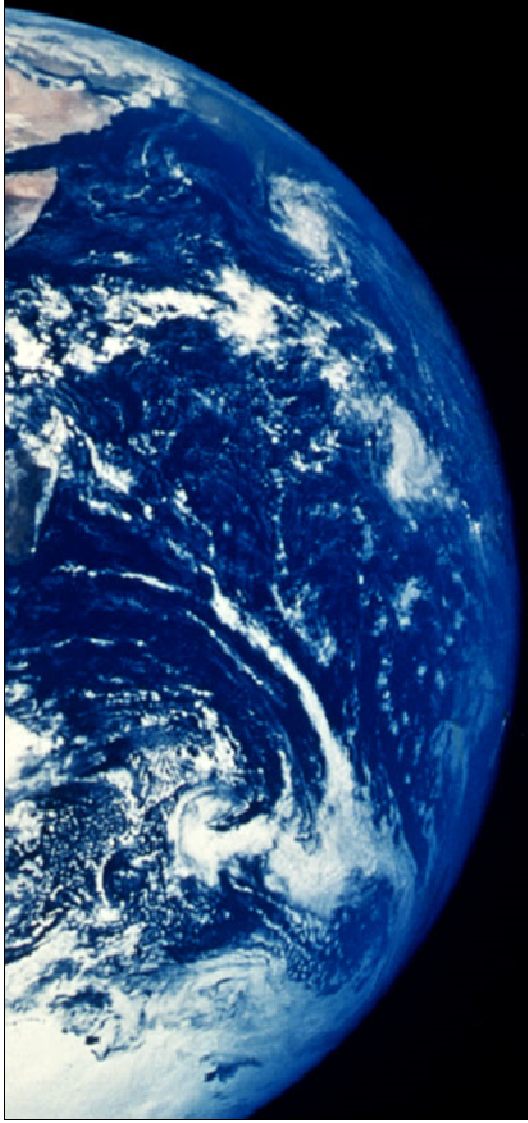


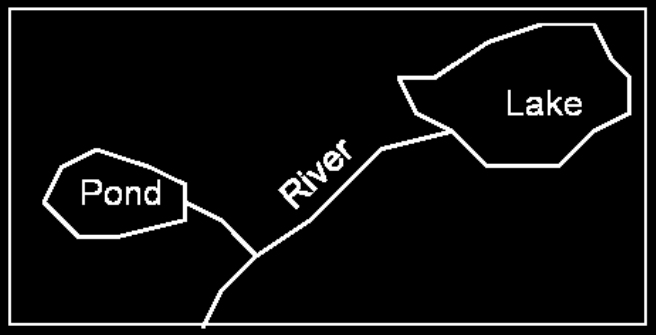


Raster data

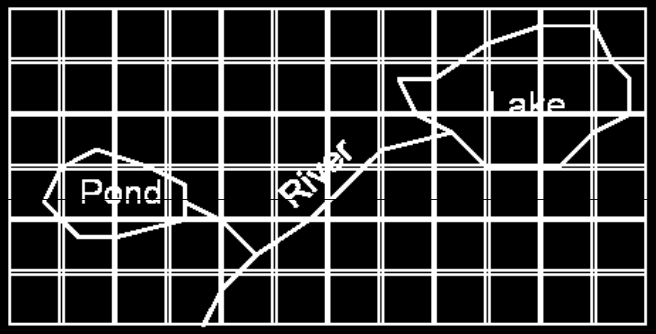


- Cell – basic object and geometric element
- 2D pixel (picture x element)
- 3D voxel (volume x element)
- Important is spatial resolution (cell size)
- Topology is simple (4/8 neighbour cells)





Reality - Hydrography



Reality overlaid with a grid

0	0	0	0	0	0	0	0	0	1	1	0
0	0	0	0	0	0	0	1	1	1	1	1
0	0	0	0	0	0	0	2	1	1	1	0
0	1	1	2	0	0	2	0	0	0	0	0
0	0	0	0	2	2	0	0	0	0	0	0
0	0	0	2	0	0	0	0	0	0	0	0

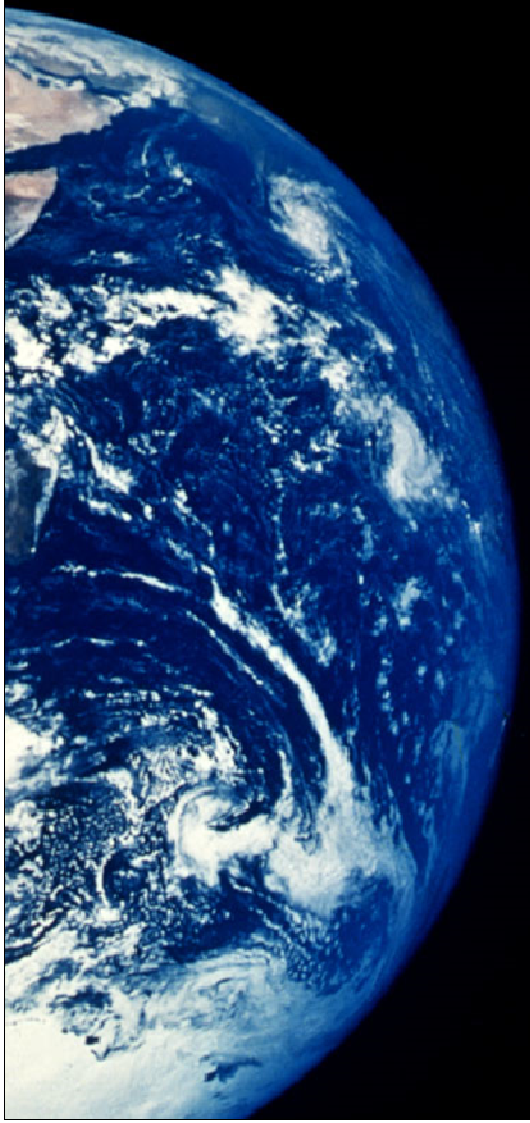
Resulting raster

0 = No Water Feature
1 = Water Body
2 = River

Raster data

- Spatial resolution

Vector plus/minus



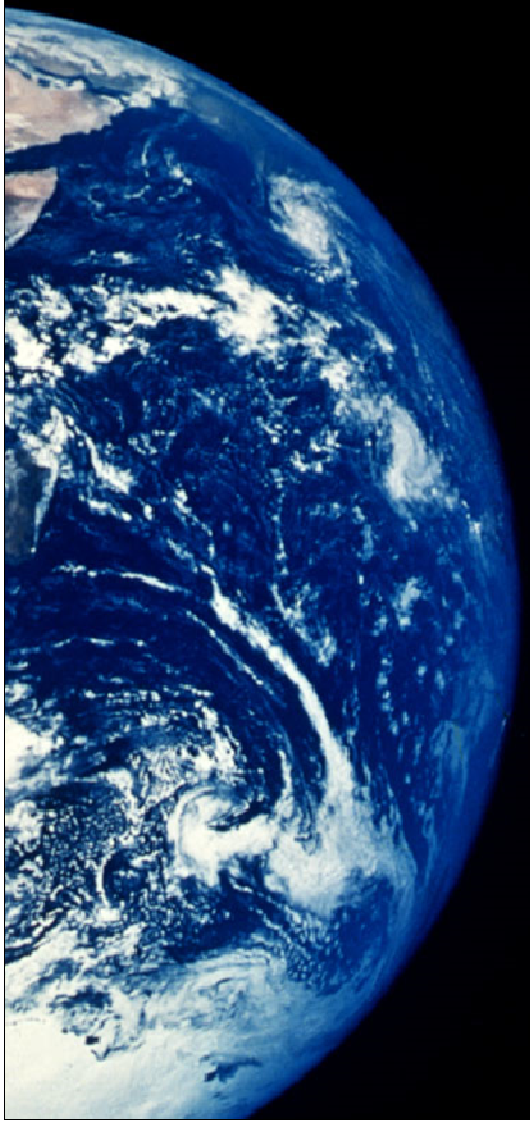
Advantages

- good presentation of features
- compact data
- good quality graphic representation
- operations using topology
- small data volume
- accurate geometric transformations (map projections)

Disadvantages

- more complex data structure
- complexity of calculations of analytic operations
- not suitable for continuous surfaces
- high software requirements

Raster plus/minus

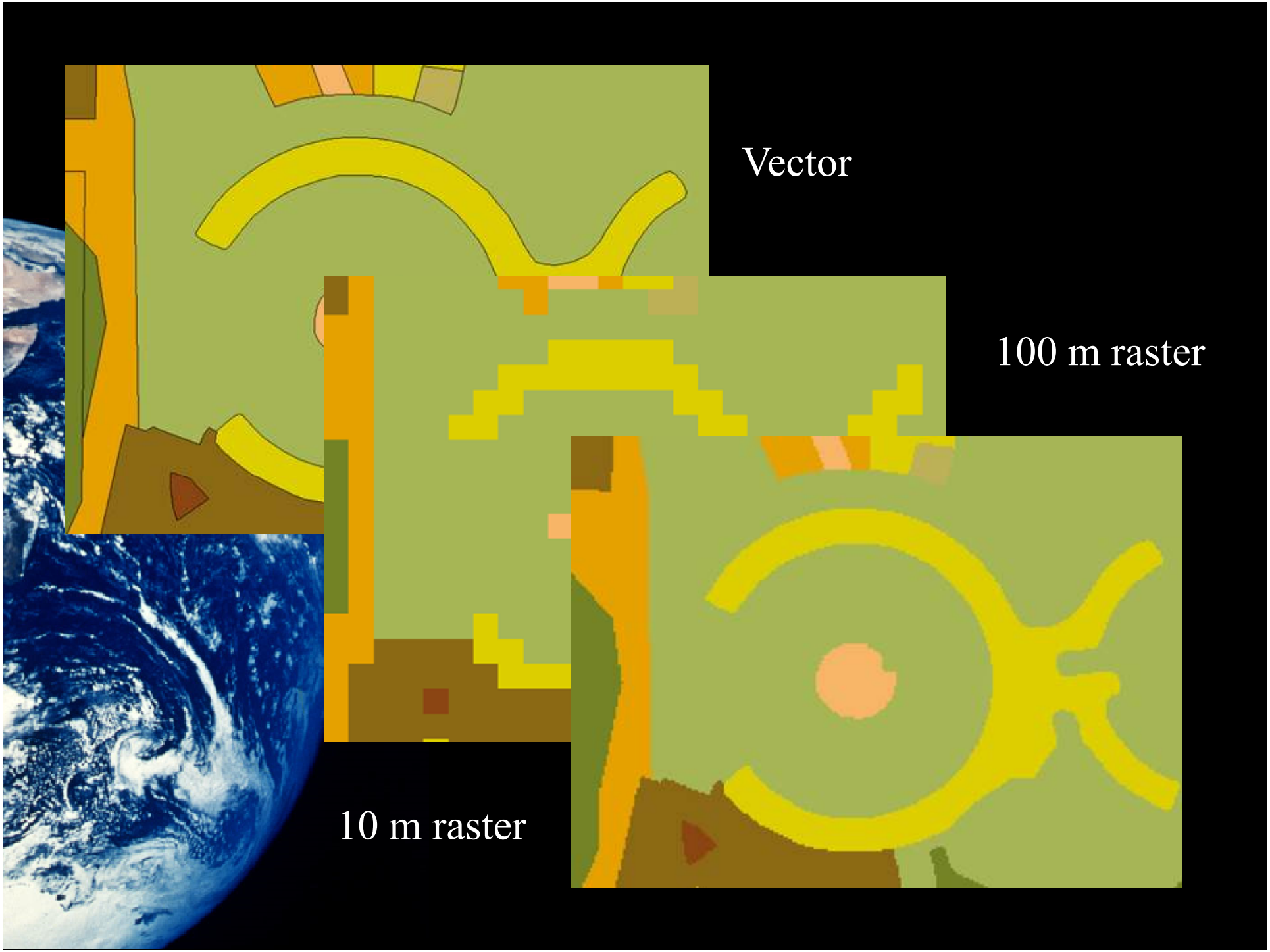


Advantages

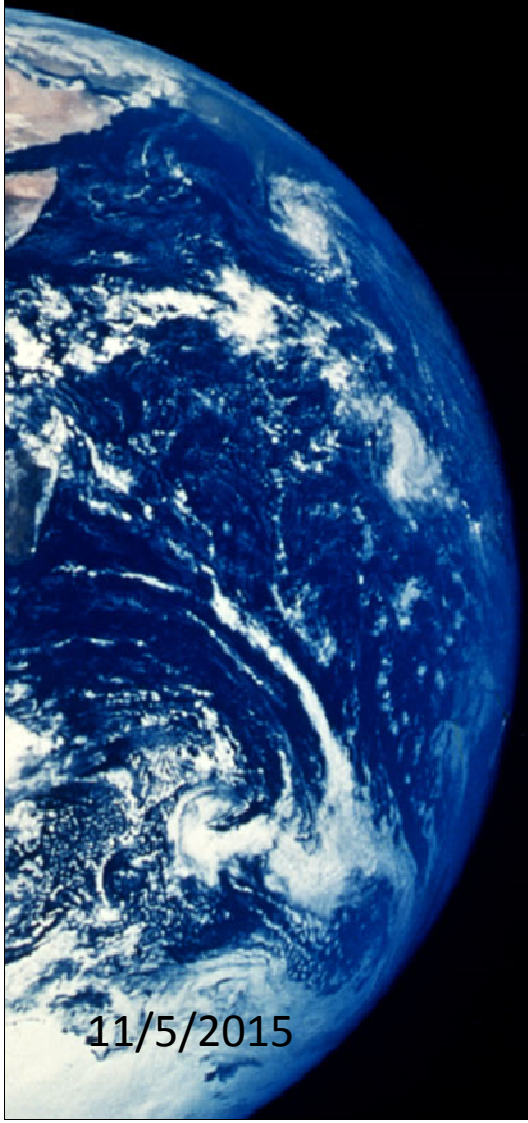
- simple data structure
- easy combination with other data (remotely sensed data – images, digital elevation models (DEMs))
- easy calculations of analytic operations
- relatively low software requirements

Disadvantages

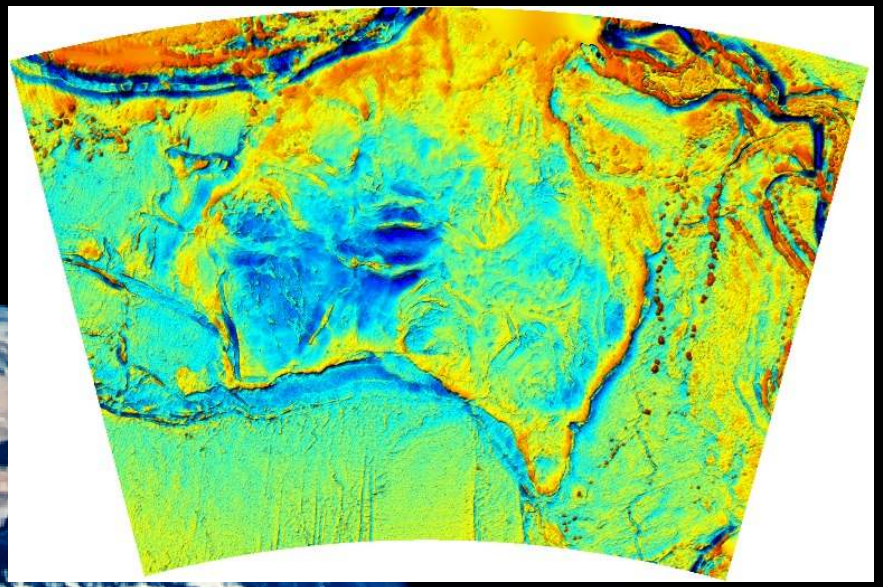
- high data volumes
- inaccurate calculations of length and area
- lower quality of graphic outputs
- low level of topology
- inaccurate geometric transformations (map projections)


Vector
100 m raster
10 m raster

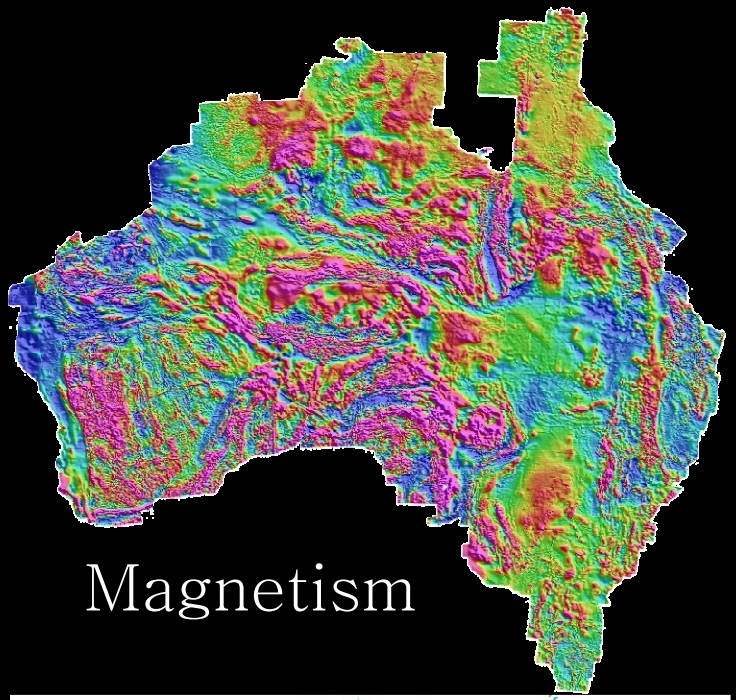
RS – Remote sensing



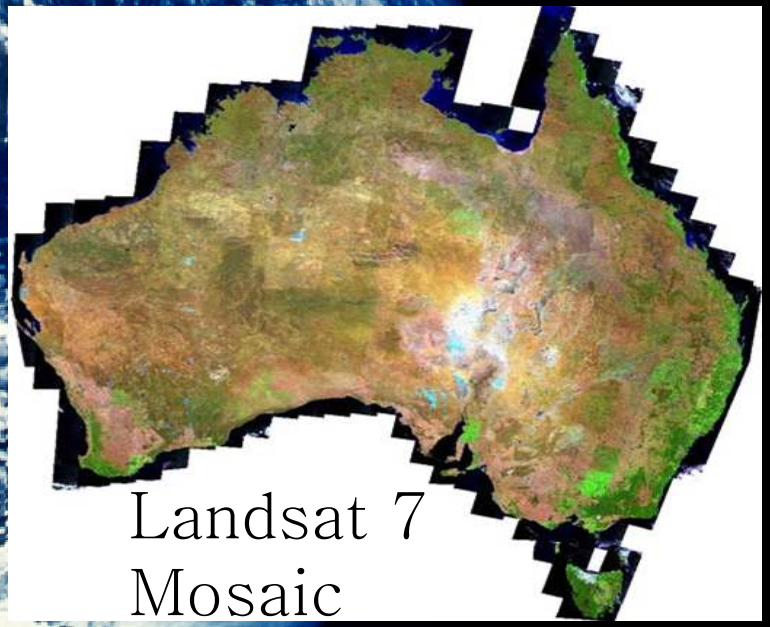
- images – raster data
- airborne, satellite, other
- panchromatic, colour – visible range (VIS), very near infrared (VNIR), short wave IR (SWIR), thermal IR (TIR), radar - microvawe
- analog vs. digital - GIS



Gravity

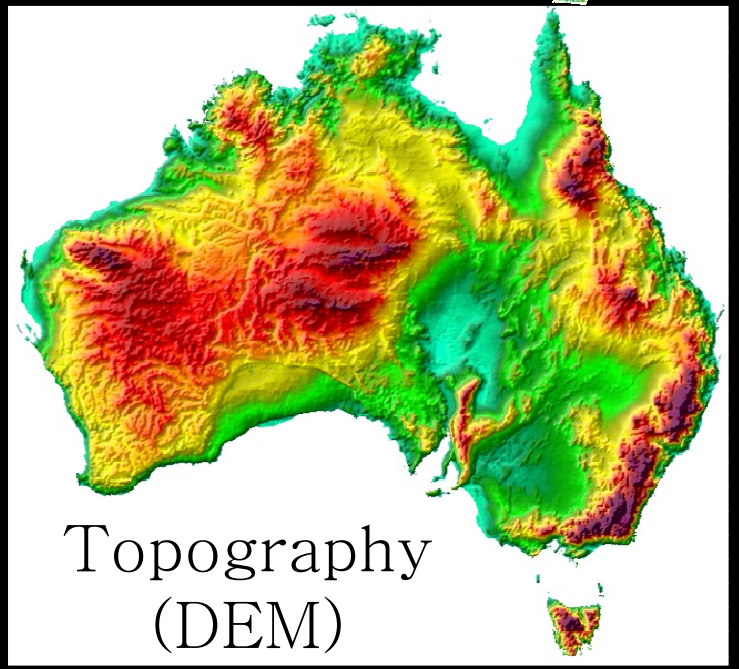


Magnetism



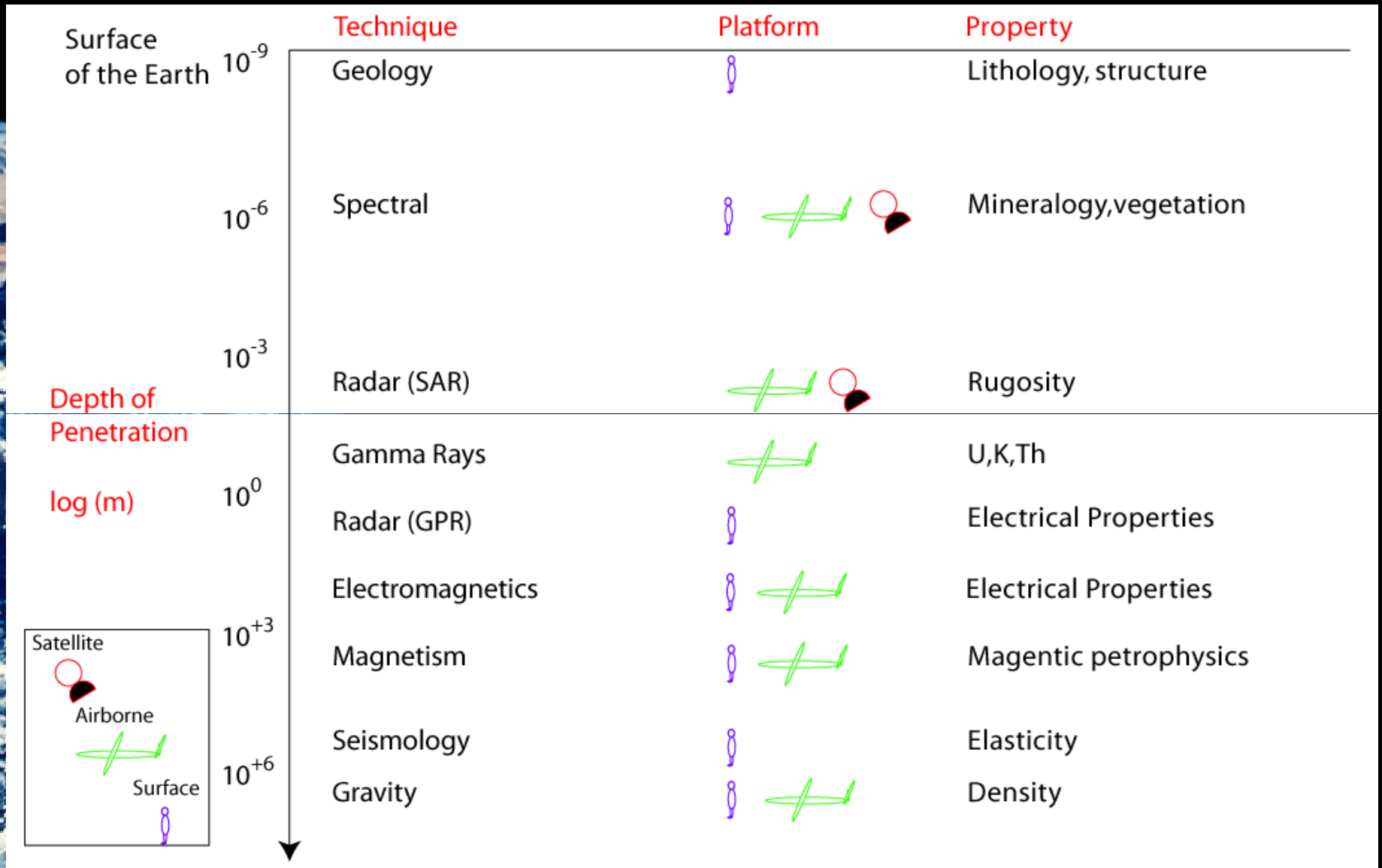
Landsat 7
Mosaic

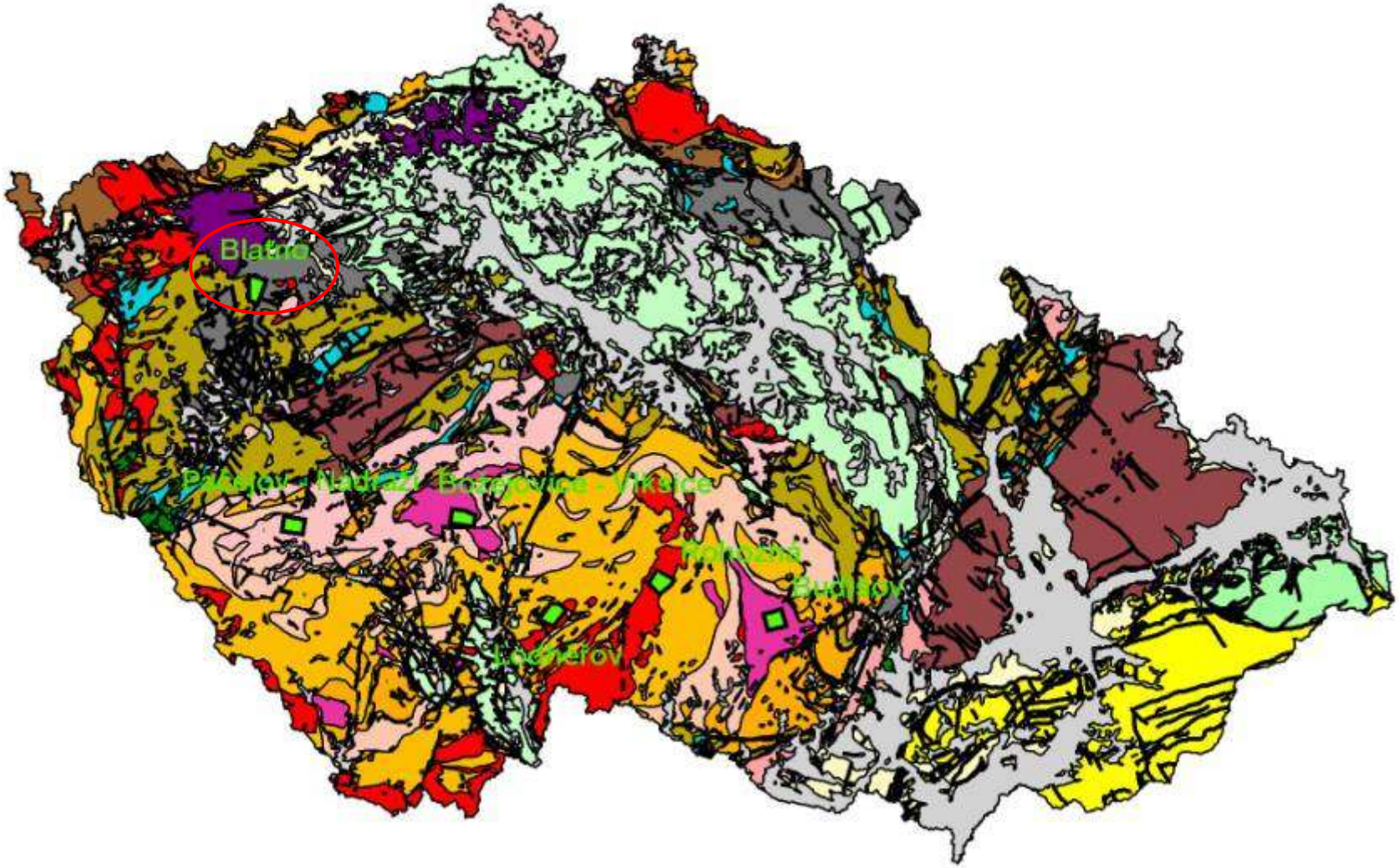
GEOSCIENCE
AUSTRALIA

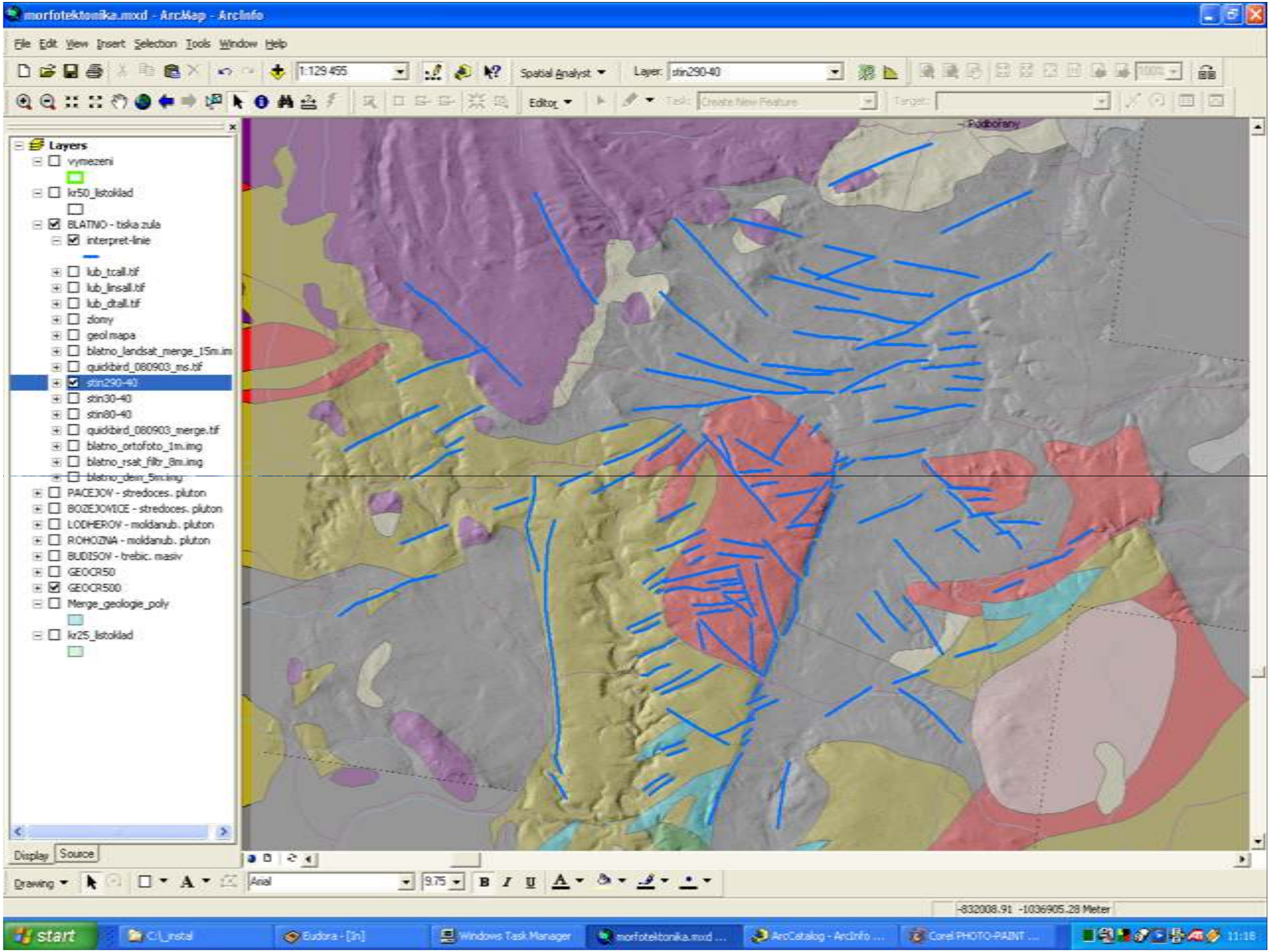


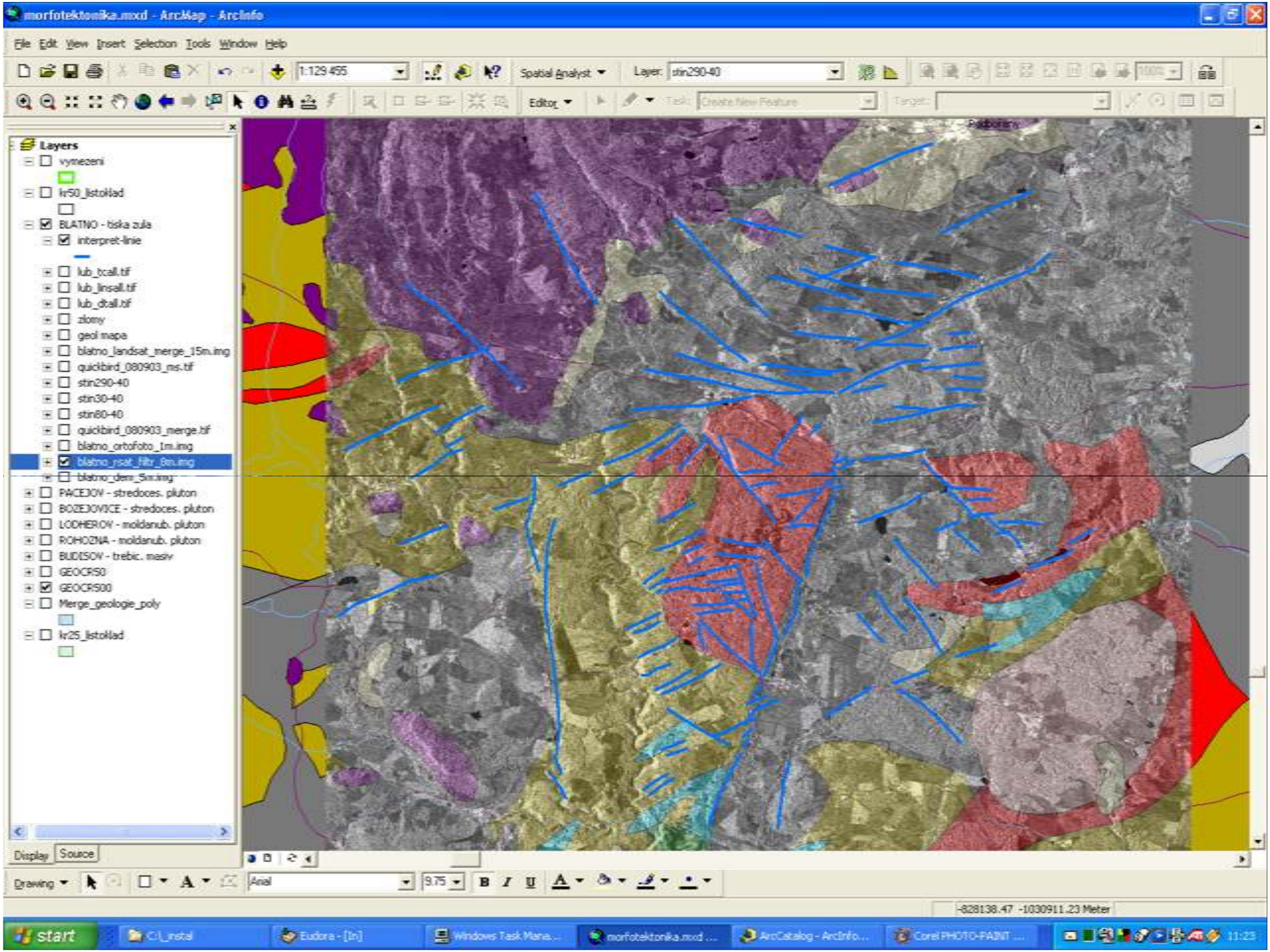
Topography
(DEM)

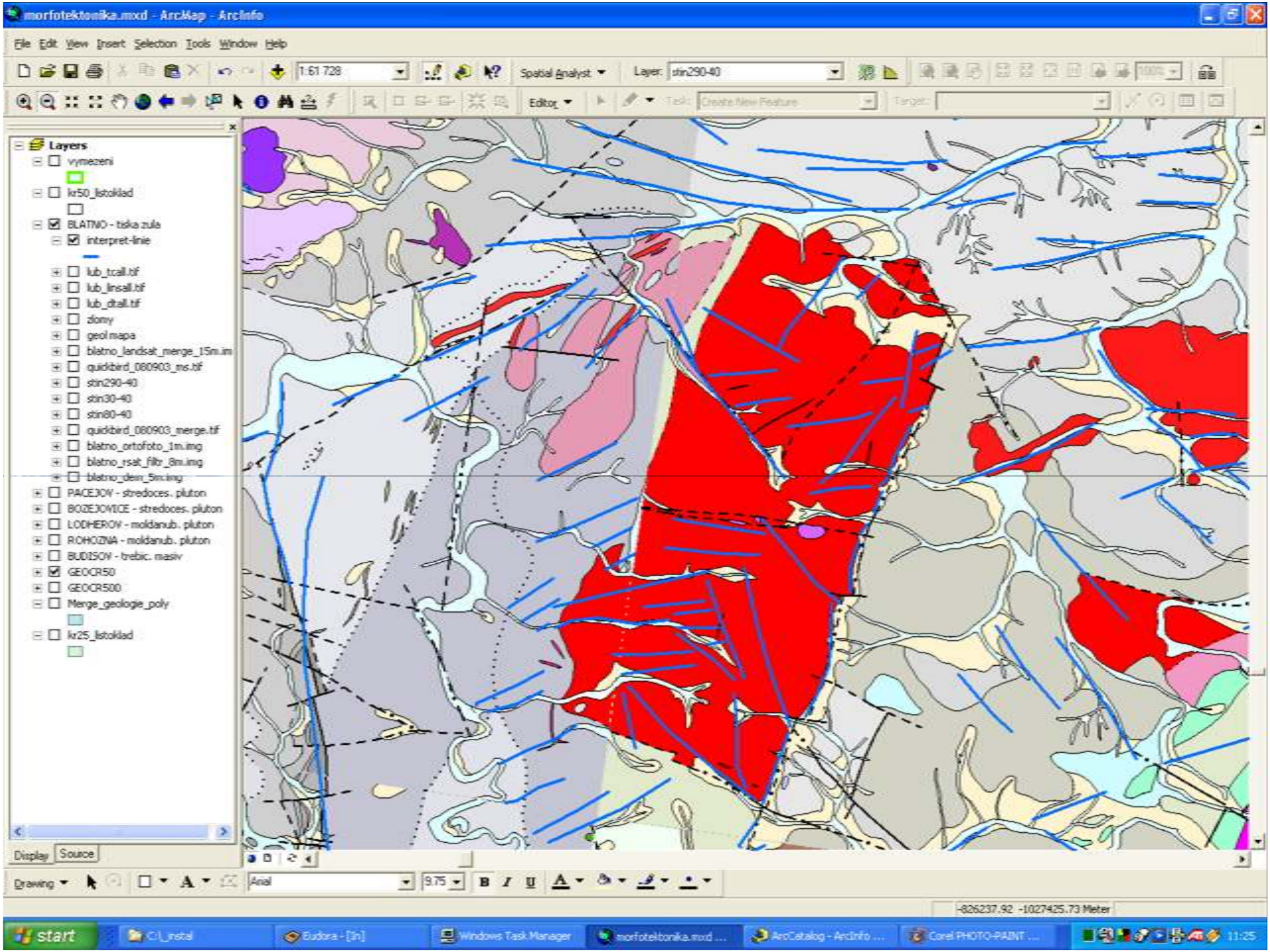
The depth of penetration of geophysical sensors

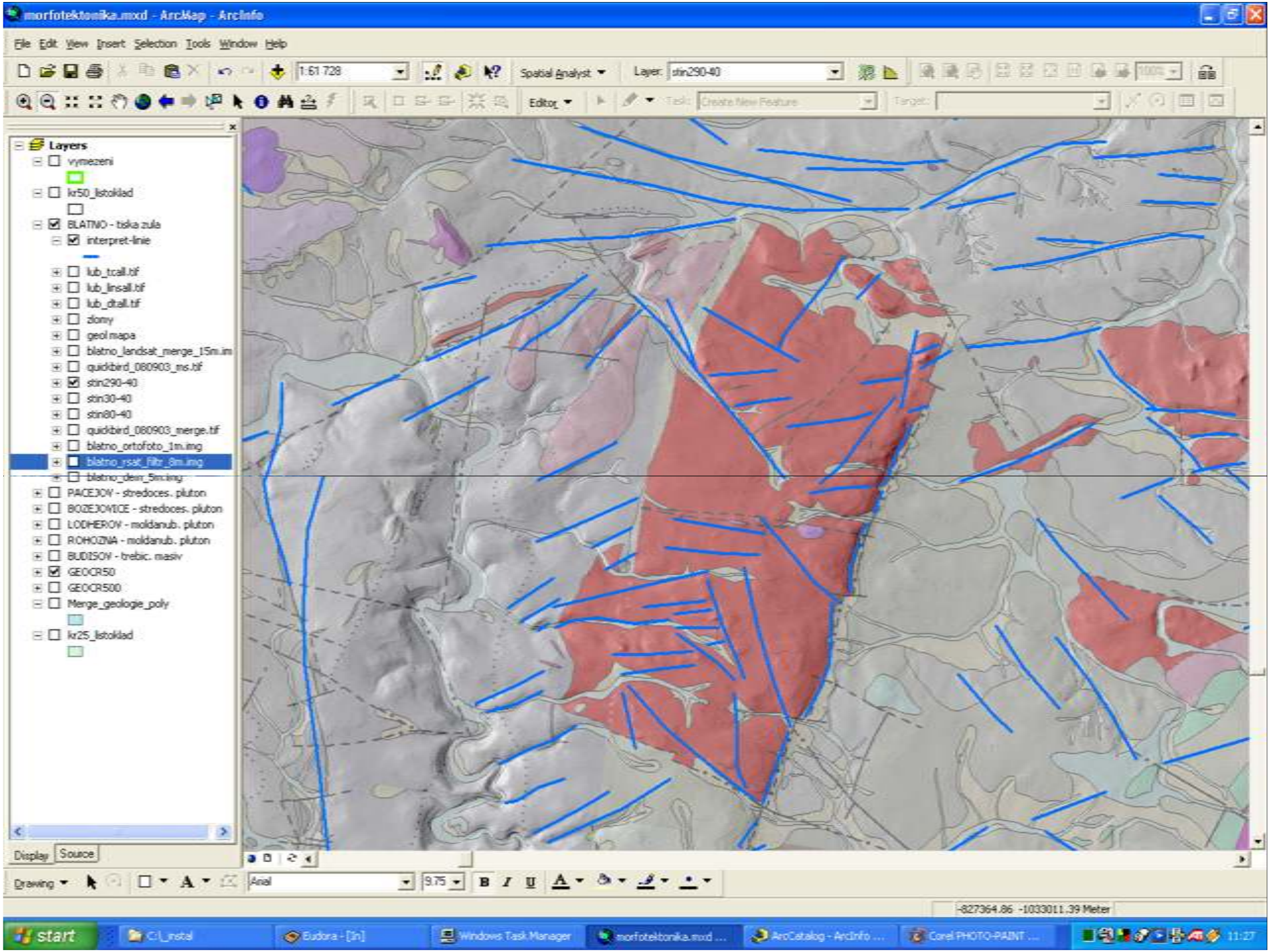



Blatno

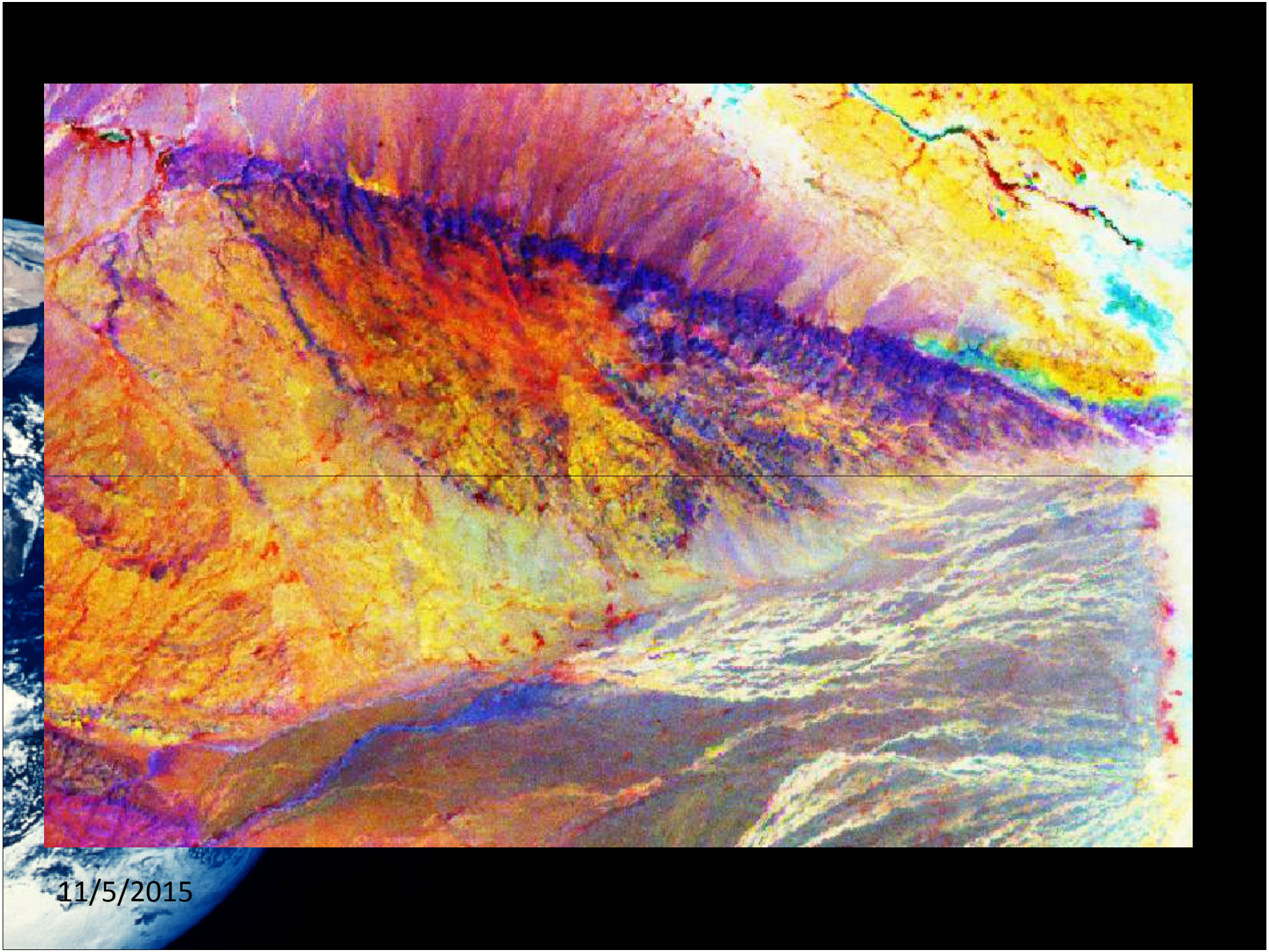

morfotektonika.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
Spatial Analyst
Layer: stin290-40
Editor
Layers
vymezeni
kr50_listoklad
BLATNO - tiska zula
interpret-linie
lub_tcall.tif
lub_linsall.tif
lub_dtall.tif
zlomy
geol mapa
blatno_landsat_merge_15m.im
quickbird_080903_ms.tif
stin290-40
stin30-40
stin80-40
quickbird_080903_merge.tif
blatno_ortofoto_1m.img
blatno_rsat_filtr_8m.img
blatno_dem_5m.img
PACEJOV - stredoces. pluton
BOZEJOVICE - stredoces. pluton
LODHEROV - moldanub. pluton
ROHOZNA - moldanub. pluton
BUDISOV - trebic. masiv
GEOCR50
GEOCR500
Merge_geologie_poly
kr25_listoklad
Display
Source
Drawing
Arial
9.75
-832008.91 -1036905.28 Meter
start
C:_instal
Eudora - [In]
Windows Task Manager
morfotektonika.mxd ...
ArcCatalog - ArcInfo ...
Corel PHOTO-PAINT ...
11:18

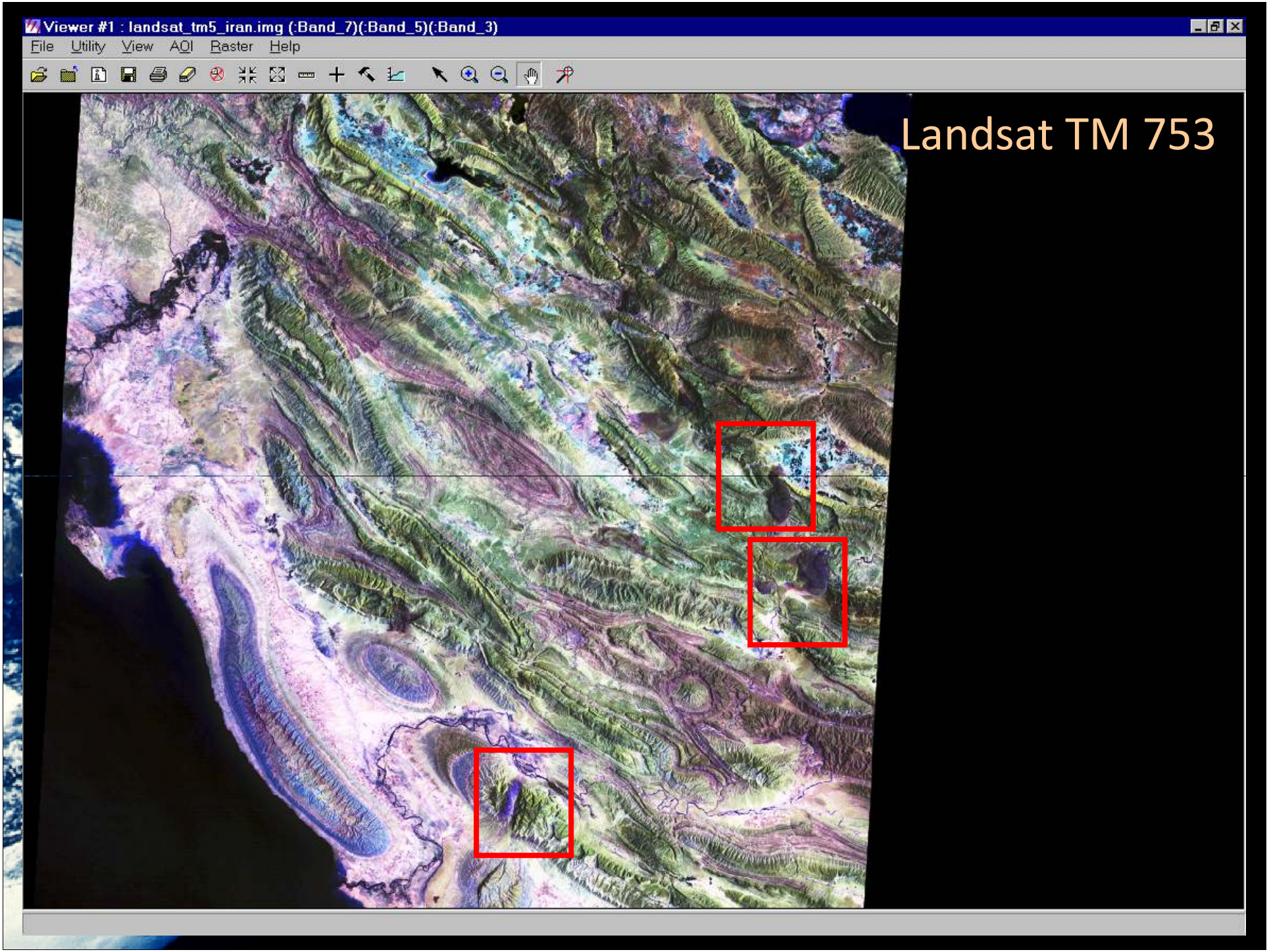

morfotektonika.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
Spatial Analyst
Layer: stin290-40
Editor
Layers
vymezeni
kr50_listoklad
BLATNO - tiska zula
interpret-linie
lub_tcall.tif
lub_linsall.tif
lub_dtall.tif
zlomy
geol mapa
blatno_landsat_merge_15m.img
quickbird_080903_ms.tif
stin290-40
stin30-40
stin60-40
quickbird_080903_merge.tif
blatno_ortofoto_1m.img
blatno_rsat_filtr_8m.img
blatno_dem_5m.img
PACEJOV - stredoces. pluton
BOZEJOVICE - stredoces. pluton
LODHEROV - moldanub. pluton
ROHOZNA - moldanub. pluton
BUDISOV - trebic. masiv
GEOCRS0
GEOCRS00
Merge_geologie_poly
kr25_listoklad
Display
Source
Drawing
Arial
9.75
-828138.47 -1030911.23 Meter
start
Eudora - [In]
Windows Task Mana...
morfotektonika.mxd ...
ArcCatalog - ArcInfo...
Corel PHOTO-PAINT ...
11:23

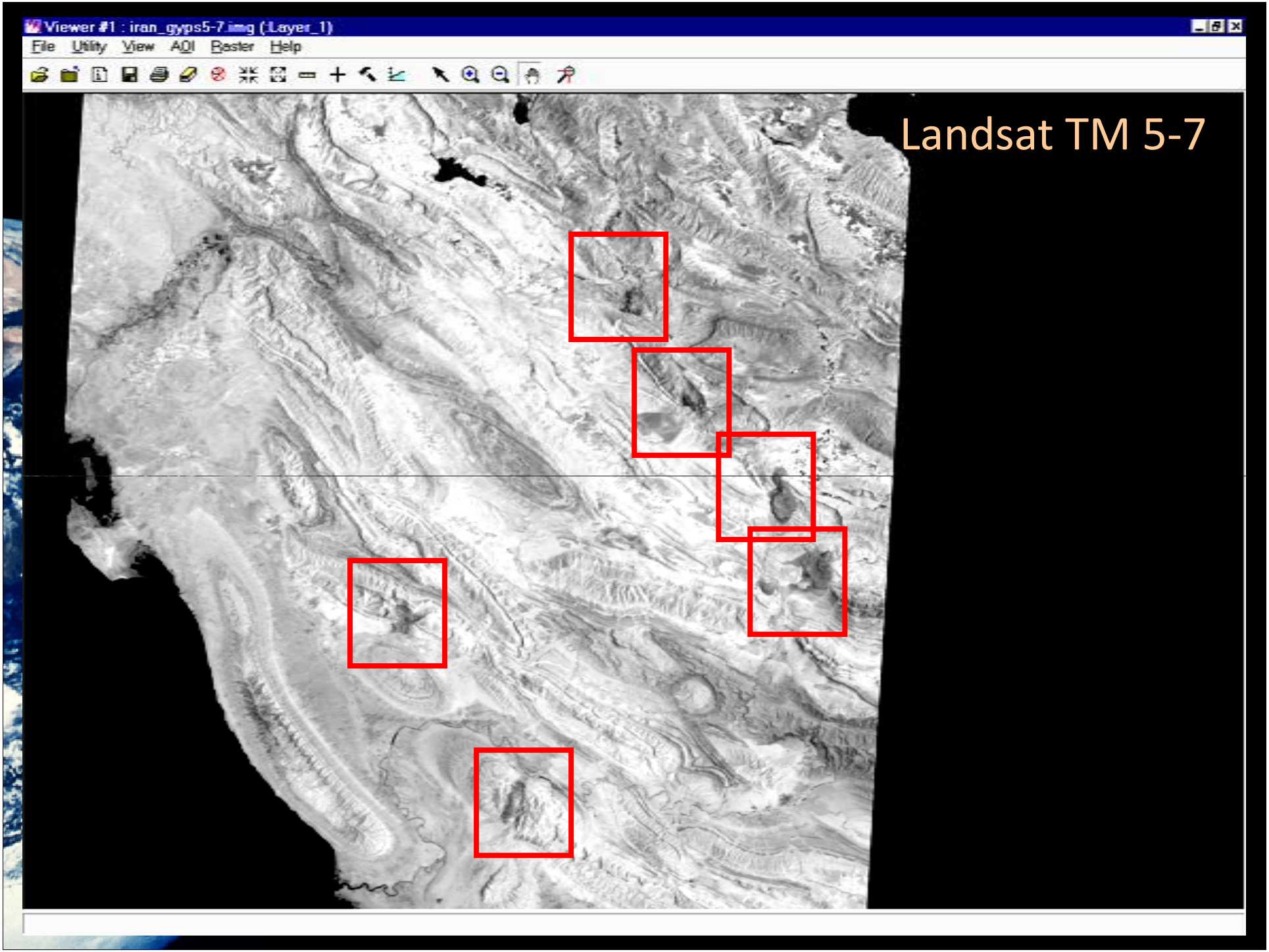

morfotektonika.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
Spatial Analyst
Layer: stin290-40
Editor
Layers
vymezeni
kr50_listoklad
BLATNO - tiska zula
interpret-linie
lub_tcall.tif
lub_linsall.tif
lub_dtall.tif
zlomy
geol mapa
blatno_landsat_merge_15m.im
quickbird_080903_ms.tif
stin290-40
stin30-40
stin80-40
quickbird_080903_merge.tif
blatno_ortofoto_1m.img
blatno_rsat_filtr_8m.img
blatno_dem_5m.img
PACEJOV - stredoces. pluton
BOZEJOVICE - stredoces. pluton
LODHEROV - moldanub. pluton
ROHOZNA - moldanub. pluton
BUDISOV - trebic. masiv
GEOCR50
GEOCR500
Merge_geologie_poly
kr25_listoklad
Display
Source
Drawing
Arial
9.75
-826237.92 -1027425.73 Meter
start
C:_instal
Eudora - [In]
Windows Task Manager
morfotektonika.mxd ...
ArcCatalog - ArcInfo ...
Corel PHOTO-PAINT ...
11:25

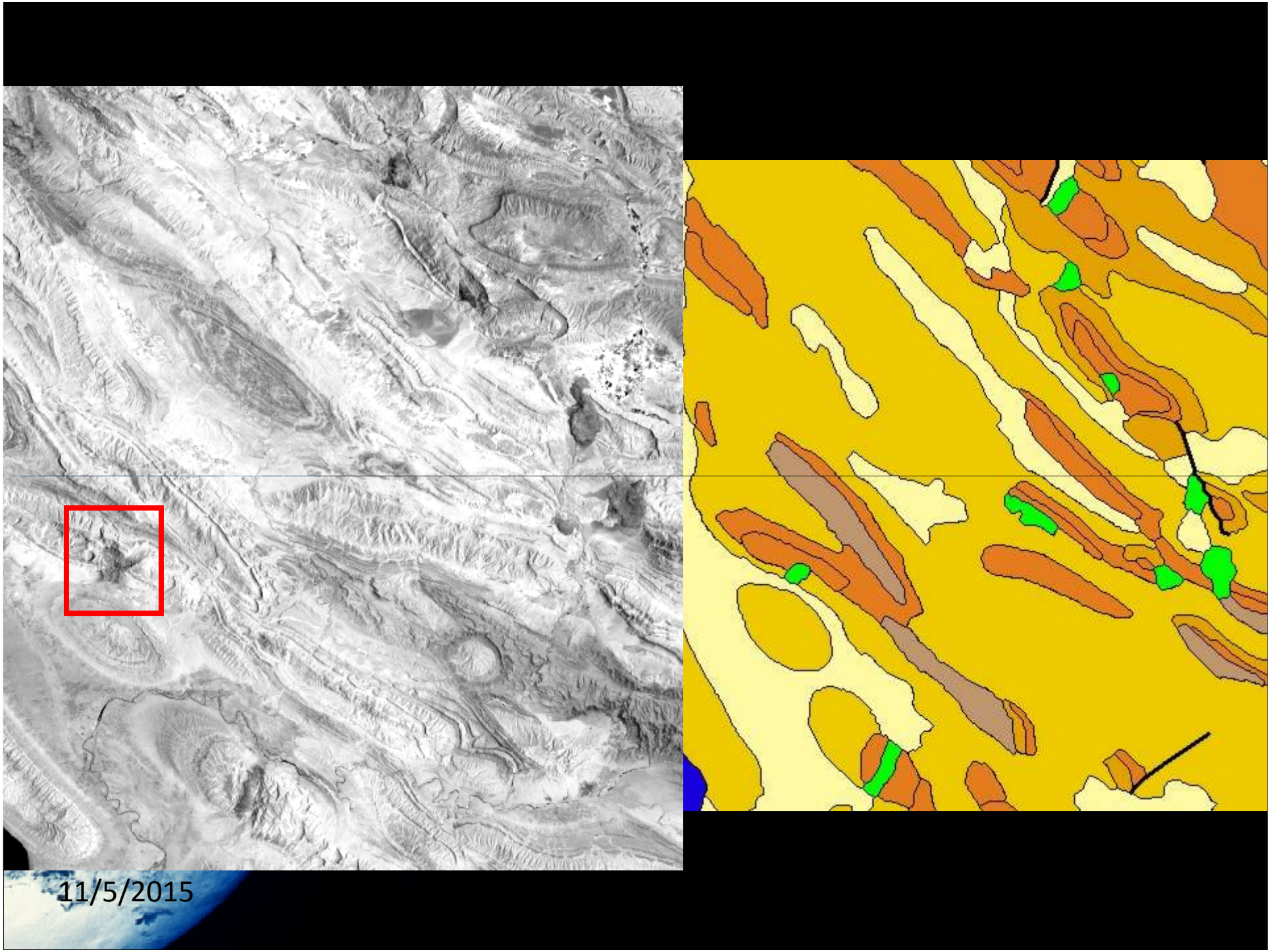

morfotektonika.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
Spatial Analyst
Layer: stin290-40
Editor
Layers
vymezeni
kr50_listoklad
BLATNO - tiska zula
interpret-linie
lub_tcall.tif
lub_linsall.tif
lub_dtall.tif
zlomy
geol mapa
blatno_landsat_merge_15m.im
quickbird_080903_ms.tif
stin290-40
stin30-40
stin80-40
quickbird_080903_merge.tif
blatno_ortofoto_1m.img
blatno_dem_5m.img
PACEJOV - stredoces. pluton
BOZEJOVICE - stredoces. pluton
LODHEROV - moldanub. pluton
ROHOZNA - moldanub. pluton
BUDISOV - trebic. masiv
GEOCR50
GEOCR500
Merge_geologie_poly
kr25_listoklad
Display
Source
Drawing
Arial
9.75
-827364.86 -1033011.39 Meter
start
C:_instal
Eudora - [In]
Windows Task Manager
morfotektonika.mxd ...
ArcCatalog - ArcInfo ...
Corel PHOTO-PAINT ...
11:27

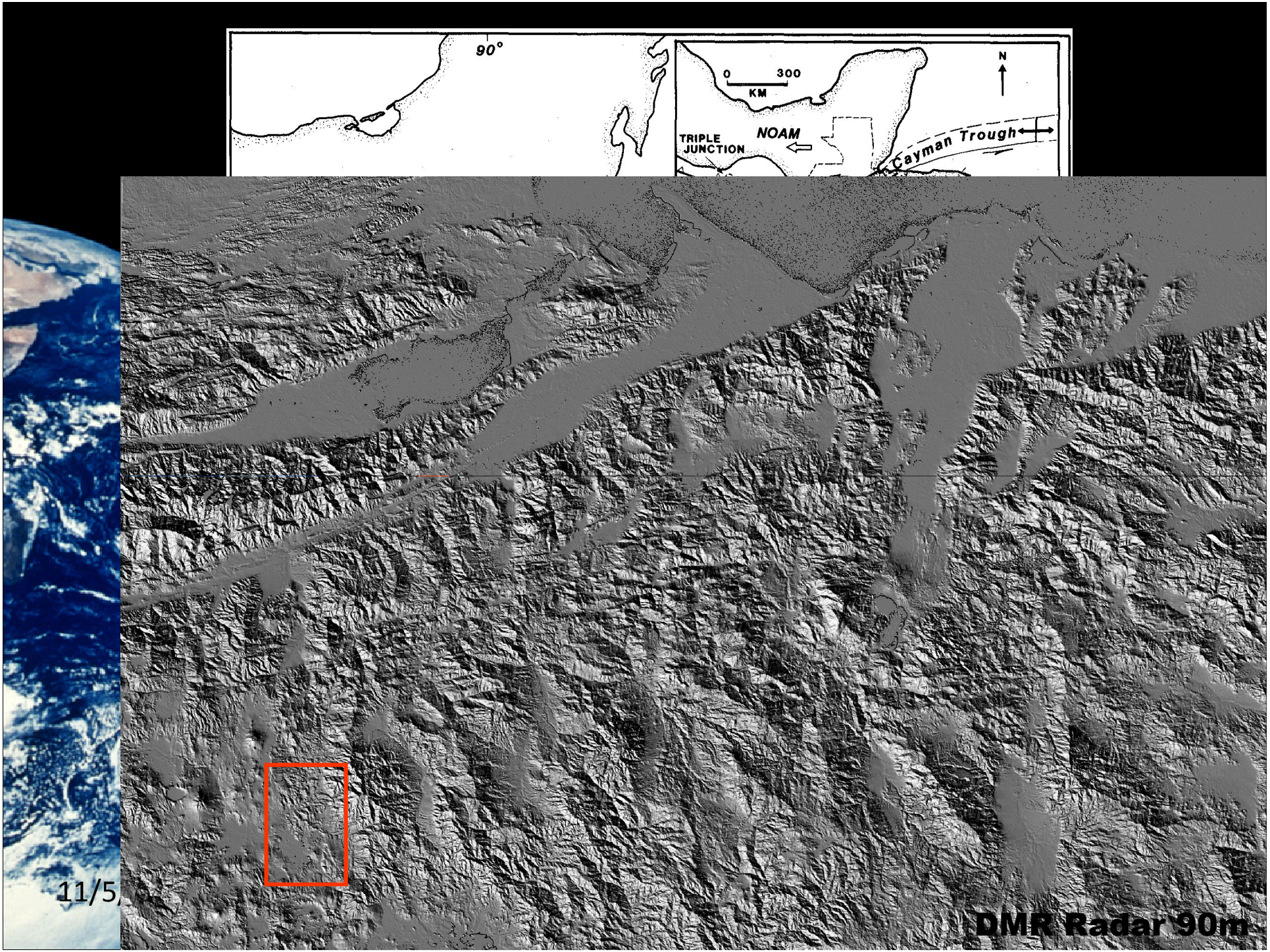
11/5/2015

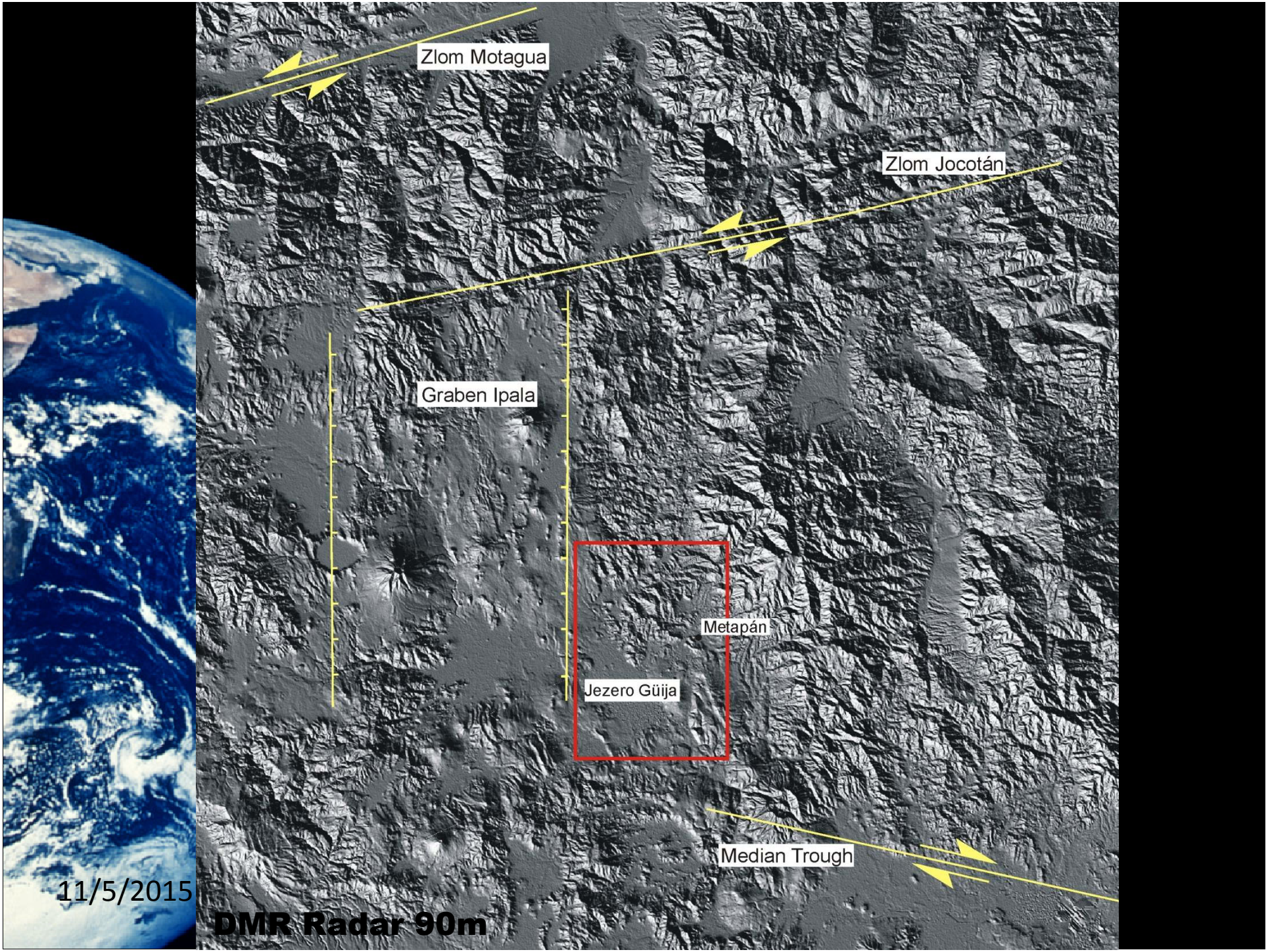

11/5/2015

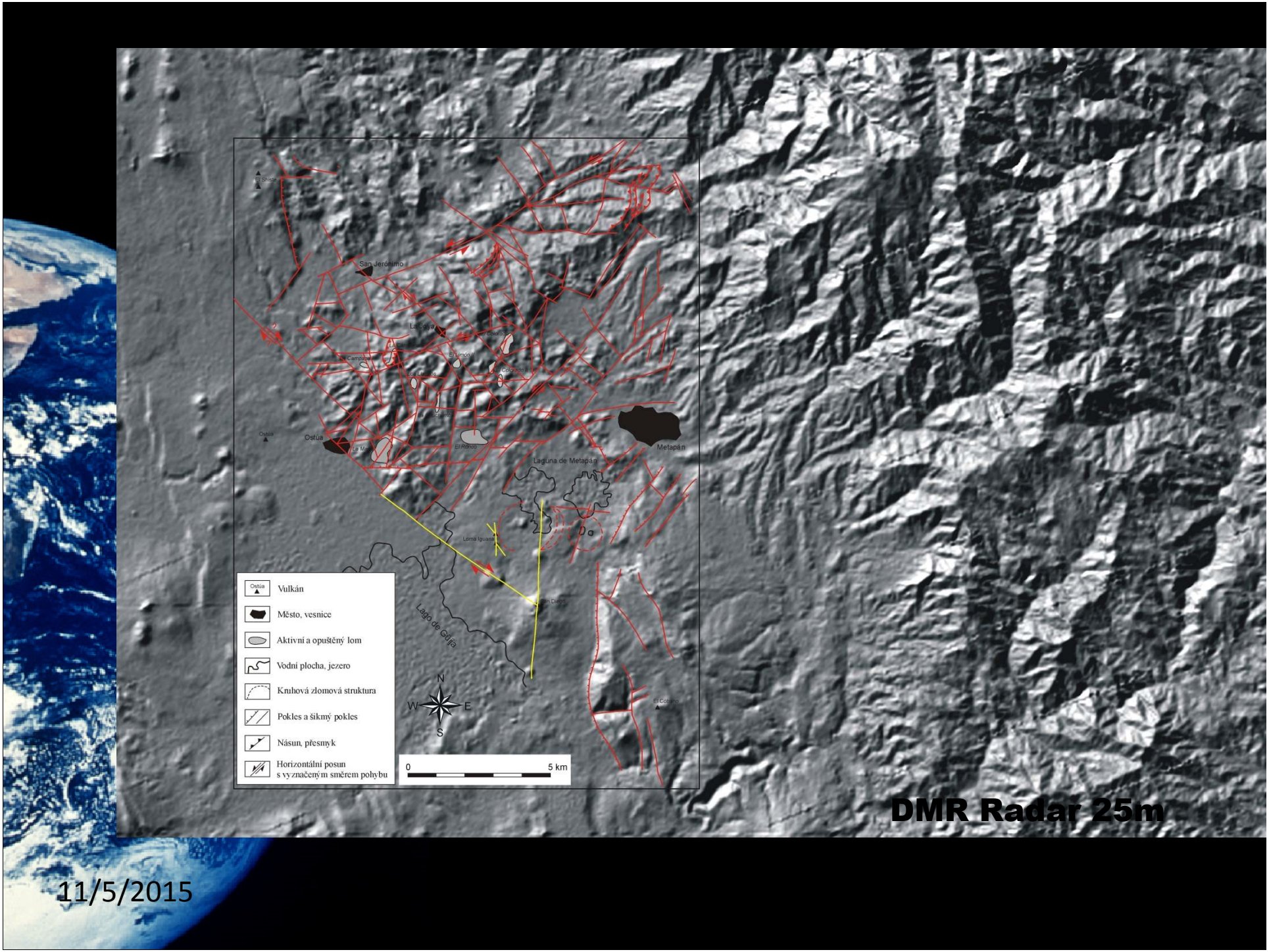

Viewer #1 : landsat_tm5_iran.img (:Band_7)(:Band_5)(:Band_3)
File Utility View AOI Raster Help
Landsat TM 753

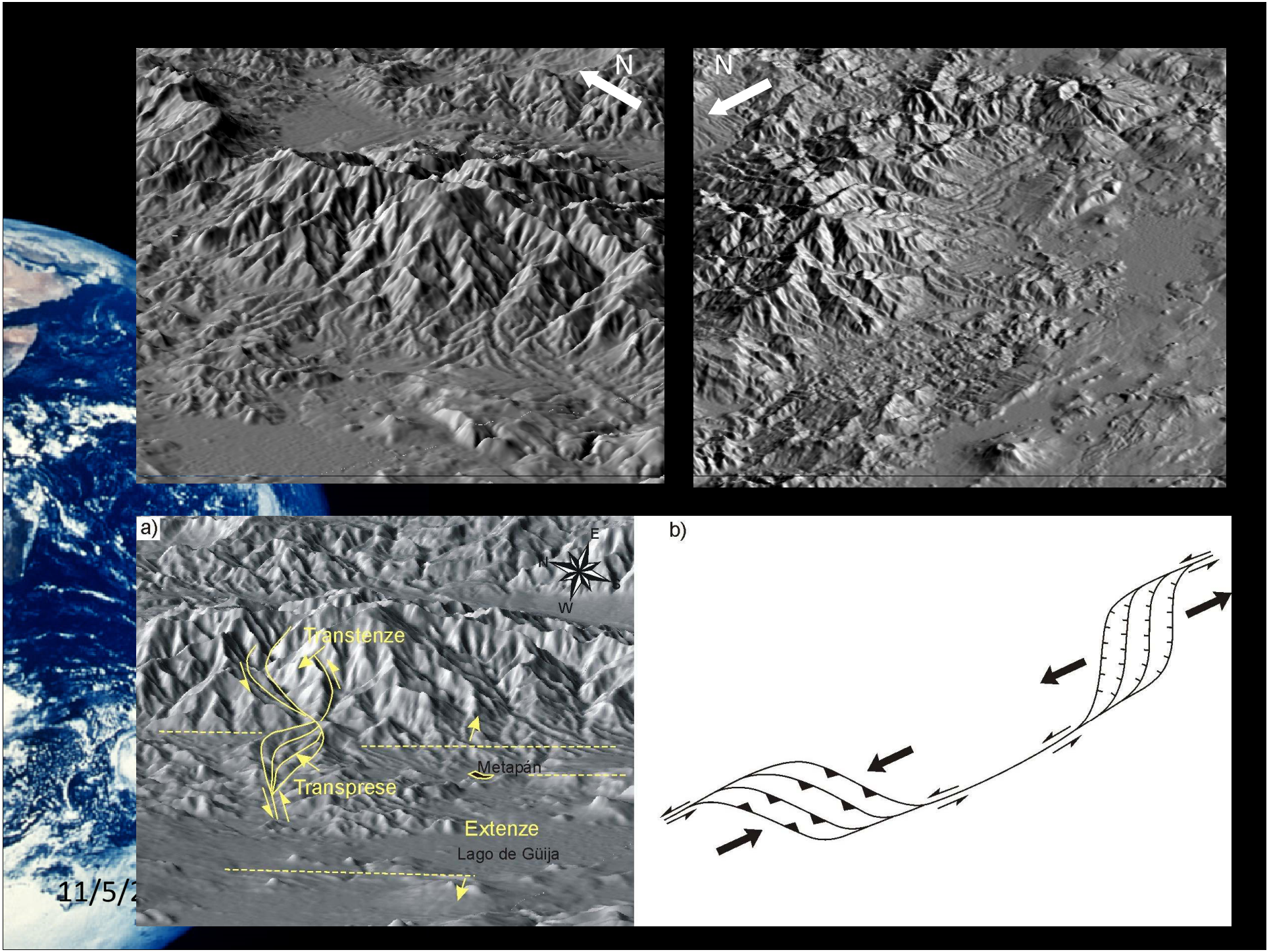

Viewer #1 : iran_gyps5-7.img (:Layer_1)
File Utility View AOI Raster Help
Landsat TM 5-7

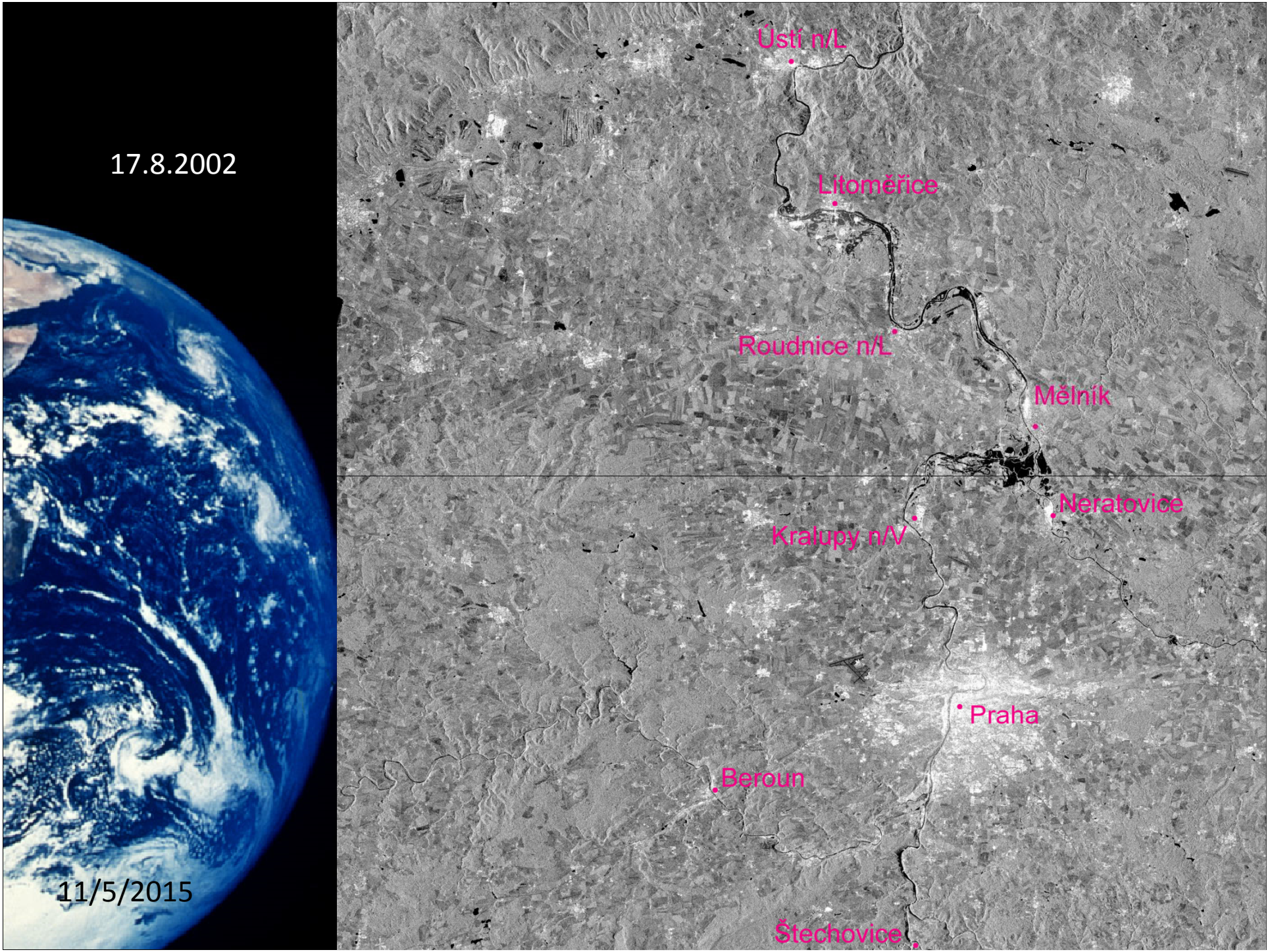

11/5/2015


90°
0 300
KM
N
TRIPLE
JUNCTION
NOAM
Cayman Trough
11/5/
DMR Radar 90m

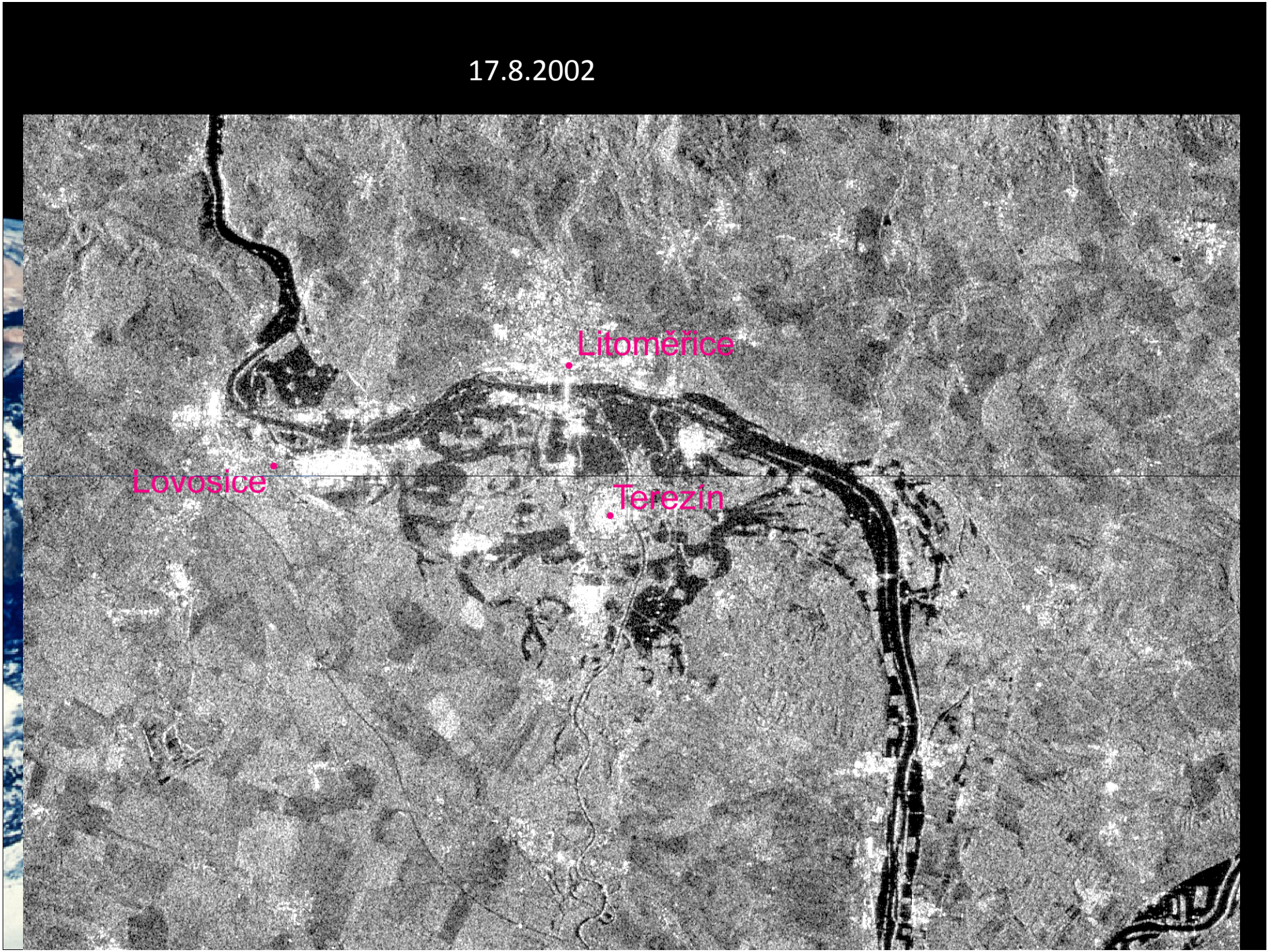

Zlom Motagua
Zlom Jocotán
Graben Ipala
Metapán
Jezero Güija
Median Trough
11/5/2015
DMR Radar 90m

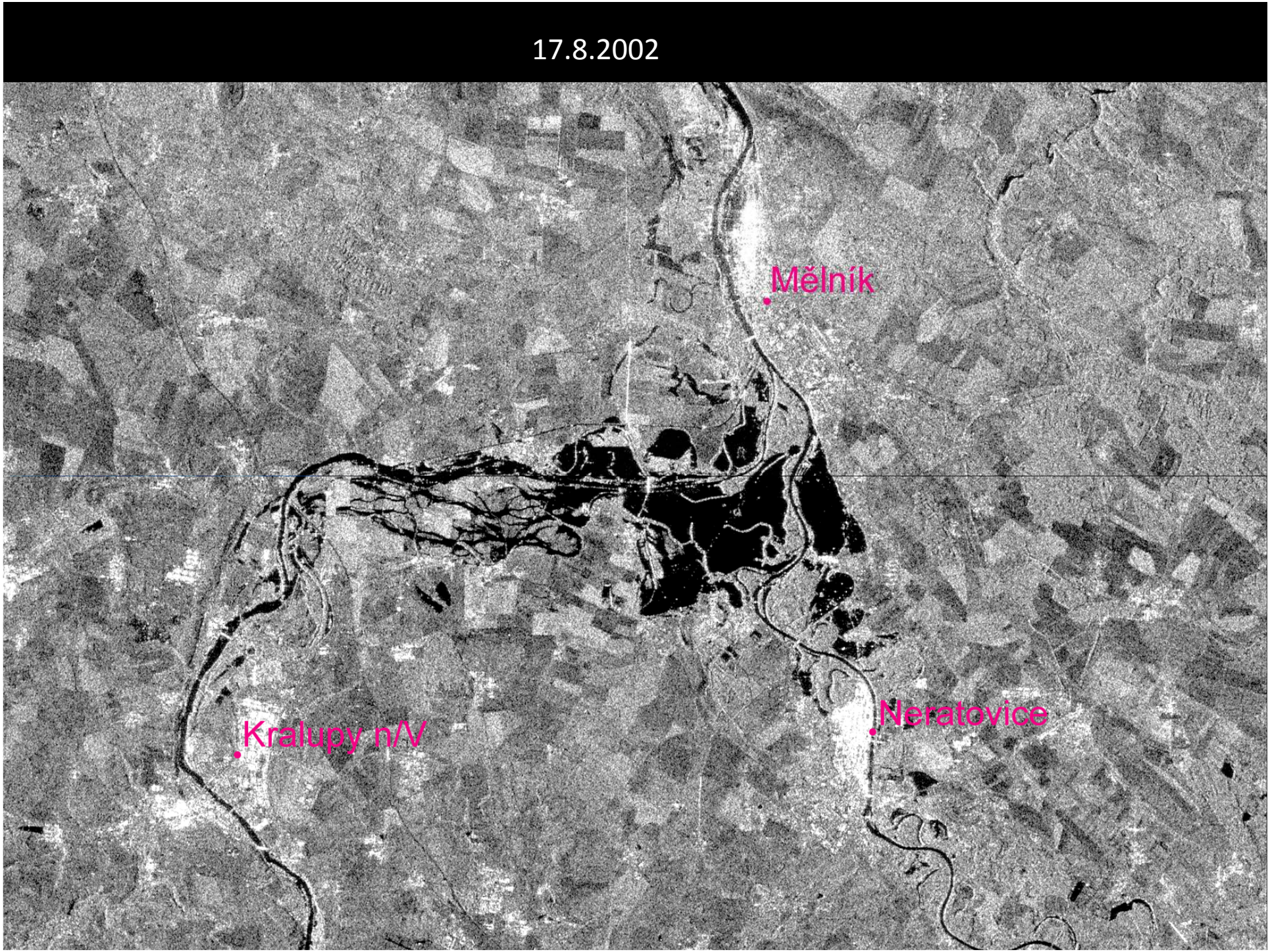

San Jerónimo
Ostúa
Metapán
Laguna de Metapán
Lago de Güija
Vulkán
Město, vesnice
Aktivní a opuštěný lom
Vodní plocha, jezero
Kruhová zlomová struktura
Pokles a šikmý pokles
Násun, přesmyk
Horizontální posun
s vyznačeným směrem pohybu
N
W
E
S
0
5 km
DMR Radar 25m
11/5/2015


N
N
a)
E
N
W
Transtenze
Metapán
Transprese
Extenze
Lago de Güija
b)


17.8.2002
11/5/2015
Ústí n/L
Litoměřice
Roudnice n/L
Mělník
Neratovice
Kralupy n/V
Praha
Beroun
Štechovice

17.8.2002




17.8.2002
Mělník
Kralupy n/V
Neratovice