

P and S velocity anomalies in the upper mantle beneath Europe and Asia from tomographic inversion of ISC data

Digital version of the model and tool for visualization

Internet: www.ivan-art.com/science/REGIONAL/vis_regional.zip

European part corresponds to paper

Koulakov I., M.K. Kaban, M. Tesauro, and S. Cloetingh, 2009, P and S velocity anomalies in the upper mantle beneath Europe from tomographic inversion of ISC data, Geophys. J. Int. 179, 1, p. 345-366. doi: 10.1111/j.1365-246X.2009.04279.x

Asian model is submitted to JGR in August 2010 as:

Koulakov, I., High-frequency P and S velocity anomalies in the upper mantle beneath Asia from inversion of worldwide travel time data

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1. Structure of files:

The tool is aimed at visualization of the results of regional tomographic inversion in horizontal and vertical sections. The presented version contains the files for visualization of two models:

P and S velocity anomalies in the upper mantle beneath Europe (Koulakov et al., 2009);
High frequency P and S velocity anomalies down to 900 km depth beneath Asia (Koulakov, 2010, submitted to JGR)

The root folder `VIS_REGIONAL` initially contains the following folders and files:

1. `PROG` : folder with programs. In the presented version it contains only one program `vis_hor_ver` for visualization of the model in horizontal and vertical sections. The main program “`vis_hor_ver.f90`” is written in *fortran-90* and compiled under *Windows OS*.
2. `DATA` : folder with data for different models. In the presented version it contains two model “`EUROPE__`” and “`ASIA_ALL`” (the name should consist of 8 characters).
3. `model` : file which contains the name of the model to proceed.

Each of these folders contains the following files:

1. `MOD_3D_1.dat` and `MOD_3D_2.dat`: files which contain the model of P and S velocity anomalies, respectively, in a regular grid. It can be used by anyone to produce files suitable for other visualization tools. The fragment of the program for reading these files in *fortran* is presented below.

```
open(3,file='../DATA/'//re//'/MOD_3D_'//ps//'.dat')
read(3,*) fmod1,fmod2,dfmod ! longitude: min,max,step
read(3,*) tmod1,tmod2,dtmod ! latitude: min,max,step
read(3,*) zmod1,zmod2,dzmod ! depth: min,max,step
nfmod=(fmod2-fmod1)/dfmod+1
ntmod=(tmod2-tmod1)/dtmod+1
nzmod=(zmod2-zmod1)/dzmod+1
allocate(dvmod(nfmod,ntmod,nzmod))
do izmod=1,nzmod
  do itmod=1,ntmod
    read(3,*) (dvmod(ifmod,itmod,izmod),ifmod=1,nfmod)
  end do
end do
close(3)
```

2. `SET.DAT`: files which contains visualization parameters for horizontal and vertical sections.

`/DATA/EUROPE__ /SET.DAT`

```
blue_red.scl      scale for velocity anomalies
-5 5              diapason for velocity anomalies, %
***** Parameters of horizontal slices *****
1000 750          Size of the image in pixels
5 5              Ticks on the axes
10              Number of depth levels
10 25 50 100 150 200 300 400 500 700
-5. 40. 0.15      fil,fi2,dfi: longitude
30. 55. 0.15      tet1,tet2,dtet: latitude
***** Parameters of vertical sections *****
0 300            Size of the image in pixels (if xpix=0 vert/hor scale is 1/1)
200 100          Ticks on the axes
10              dx
0 700 10         zmin, zmax, dz
200             dsmark
100             distance from profile for earthquakes
2 1             horizontal section and PS to show the location of profiles
-0.5 0.6         dfi,dtet: shift for marks
12             Number of profiles
```

-2.58	46.00	25.23	41.30	Fia,teta,fib,tetb: ends of the profiles
4.53	35.51	16.86	51.61	
8.06	38.18	26.76	51.11	
8.96	36.47	27.30	49.18	
13.83	36.20	27.91	49.31	
18.32	34.97	29.47	48.89	
23.33	32.03	30.92	48.89	
14.38	36.47	12.14	54.32	
3.94	49.79	18.00	36.65	
6.58	49.08	38.68	36.57	
29.95	30.23	12.61	54.13	
6.11	53.36	9.30	43.21	

3. [coastal_line.bln](#) and [polit_bound.bln](#): files which contain the coastal lines and political boundaries in the study area.

4. [sources.dat](#) is the file which contains all the sources in the study area which can be shown in vertical sections.

2. Steps for visualization (example for the EUROPE model):

Note: this version of the software is suitable for *Windows OS* only.

1. Copy and unzip the file [vis_regional.zip](#) to any location of your computer.
2. Check if file `/model.dat` contains the correct name of the model ([EUROPE__](#) in our case).
3. Open file `/DATA/EUROPE__ /SET.DAT` and define the necessary parameters.
The most important are following:
 - a. Number of horizontal levels and their depths (lines 6, 7)
 - b. Depth interval and grid spacing for vertical sections (lines 13, 14)
 - c. Limits of the map and grid spacing for visualization (lines 8, 9)
 - d. Number of vertical sections and coordinates of their ends (lines 19 and following to the end of the file)
 - e. Size of bitmap pictures (PNG format) in pixels for horizontal and vertical sections (lines 4 and 11, respectively). For vertical section, if `x_pix=0`, the width of the picture will be computed according to the height and ratio 1/1 of the section.
4. Run the file `/PROG/vis_hor_ver/vis_hor_ver.exe`.

Successful running of the program will result at producing the following files and folders:

1. Folder `/PICS/EUROPE__` which contains the PNG picture of the resulting horizontal and vertical sections. It includes the following files:
 - a. [hor_dv_AB.png](#) (**A** is 1 or 2 depending of P or S model; **B** is number of depth section) horizontal sections of P and S models in different depths.
 - b. [ver_dv_AB.png](#) (**A** is 1 or 2 depending of P or S model; **B** is number of profile) vertical sections of P and S models including distribution of earthquakes.
 - c. [hor_profilesAB.png](#) (**A** is 1 or 2 depending of P or S model; **B** is number of depth section, defined in `SET.DAT`, line 17) locations of the profiles superimposed with one selected horizontal section.
2. Folder `/DATA/EUROPE__ /GRIDS` which contains the files which are suitable for visualization in Surfer Golden Software. One can use a SRF file in www.ivan-art.com/science/EUROPE/srf_template.zip as a template to create own SRF images of

horizontal and vertical sections using these grid and data files. Some of these files are listed below:

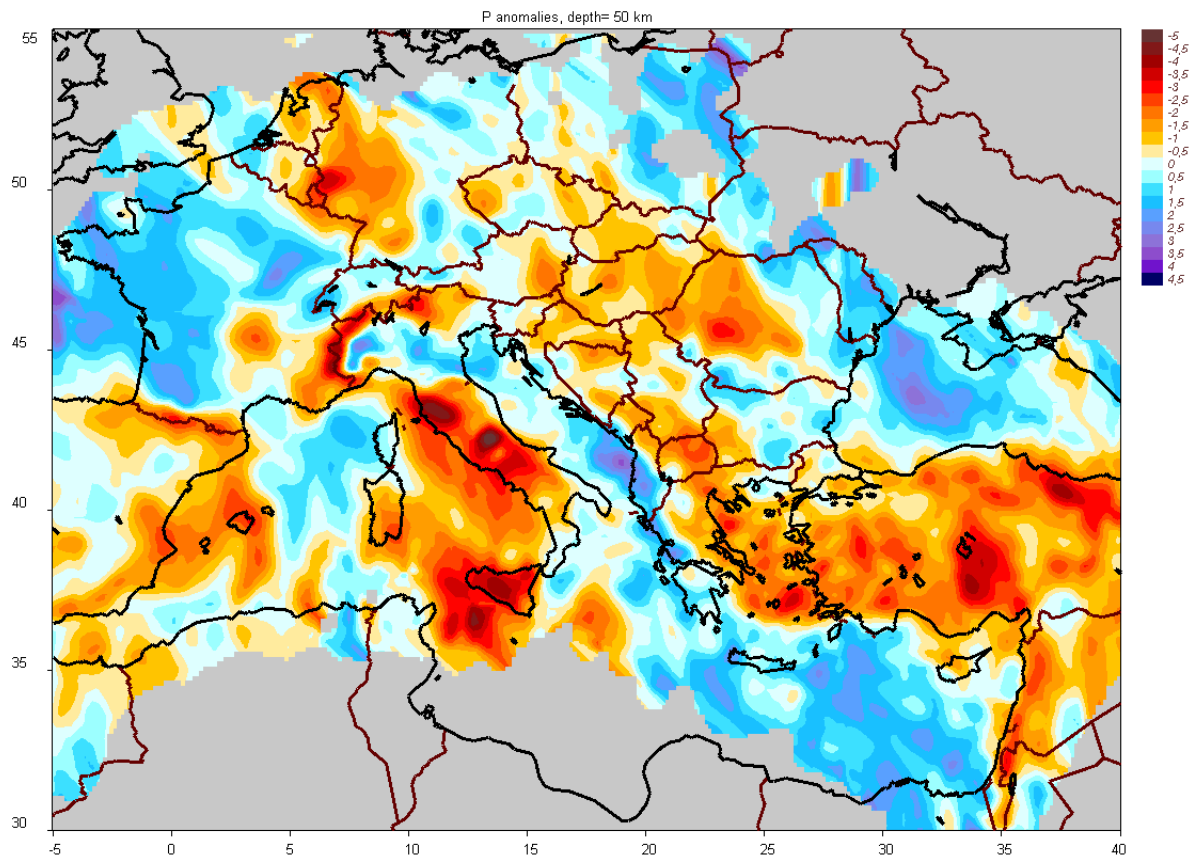
- a. `dv_AB.grd` (**A** is 1 or 2 depending of P or S model; **B** is number of depth section) horizontal sections of P and S models in different depths.
- b. `ver_AB.grd` (**A** is 1 or 2 depending of P or S model; **B** is number of profile) vertical sections of P and S models.
- c. `srce_B.dat` (**B** is number of vertical section) sources along the vertical section.
- d. `mark_B.blm` and `mark_B.dat` (**B** is number of vertical section) locations of the profiles in map view.

3. Examples of pictures for the EUROPE model:

All these examples can be found at:

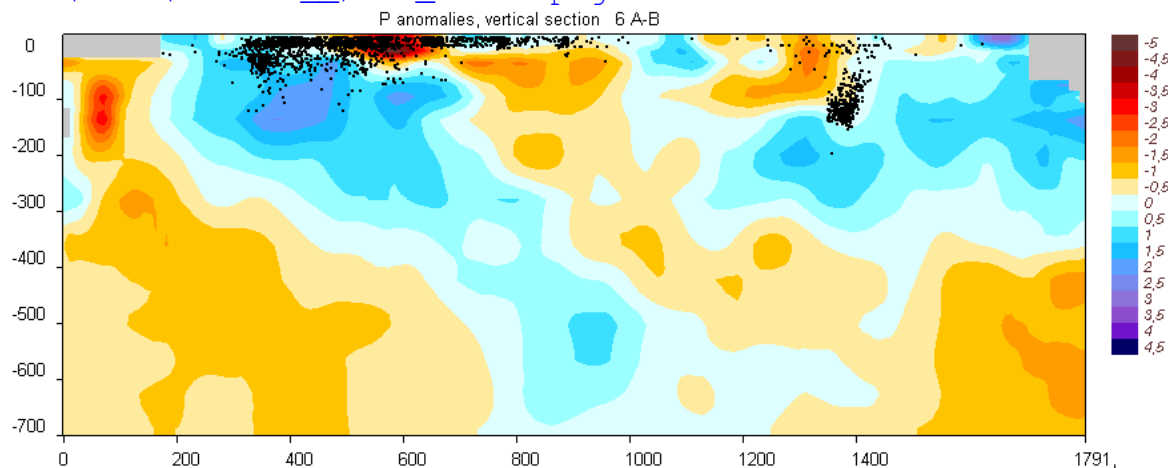
www.ivan-art.com/science/REGIONAL/png_pictures_europe.zip

1. Horizontal section of P velocity anomalies at 50 km depth,
file: `/PICS/EUROPE___/hor_dv1 3.png`.



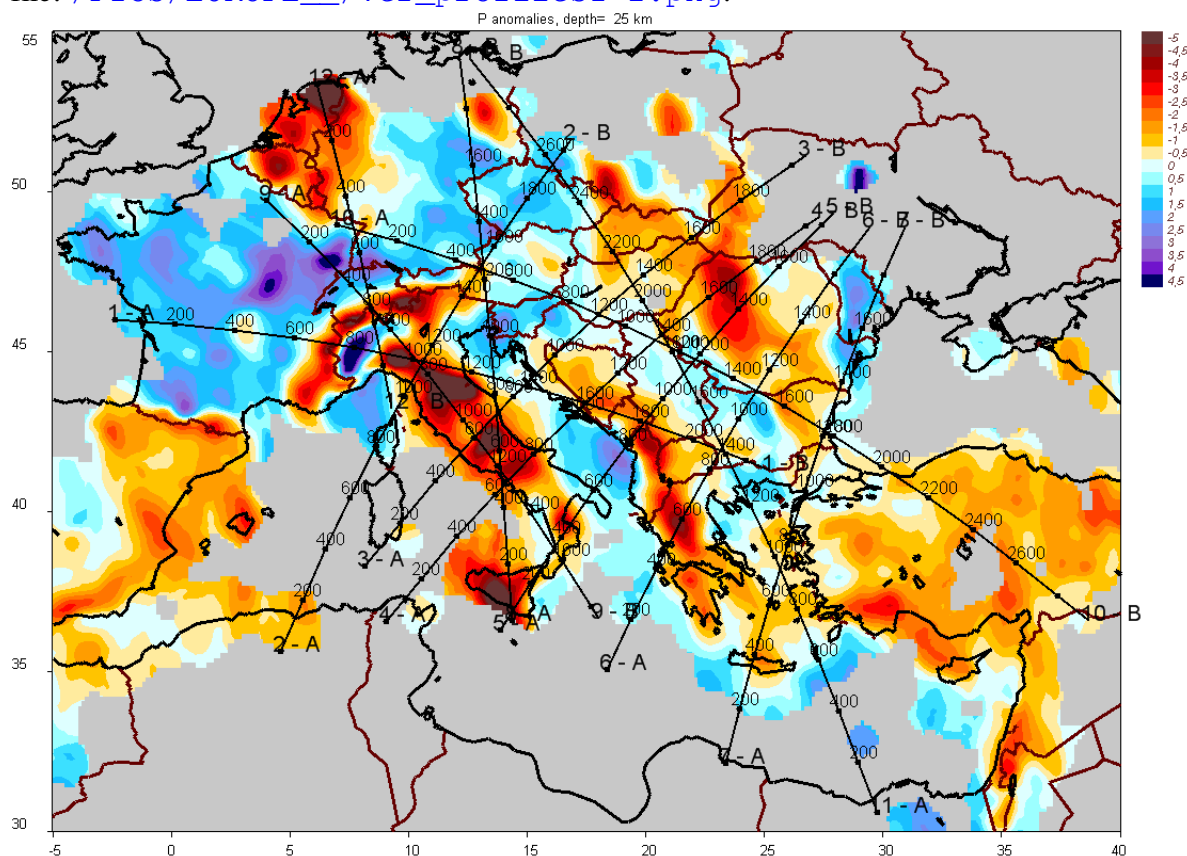
file: /PICS/EUROPE__/_ver_dv1 2.png.

file: /PICS/EUROPE__/_ver_dv1 2.png.



file: /PICS/EUROPE___/ver_profiles1 2.png.

file: /PICS/EUROPE___/ver_profiles1 2.png.

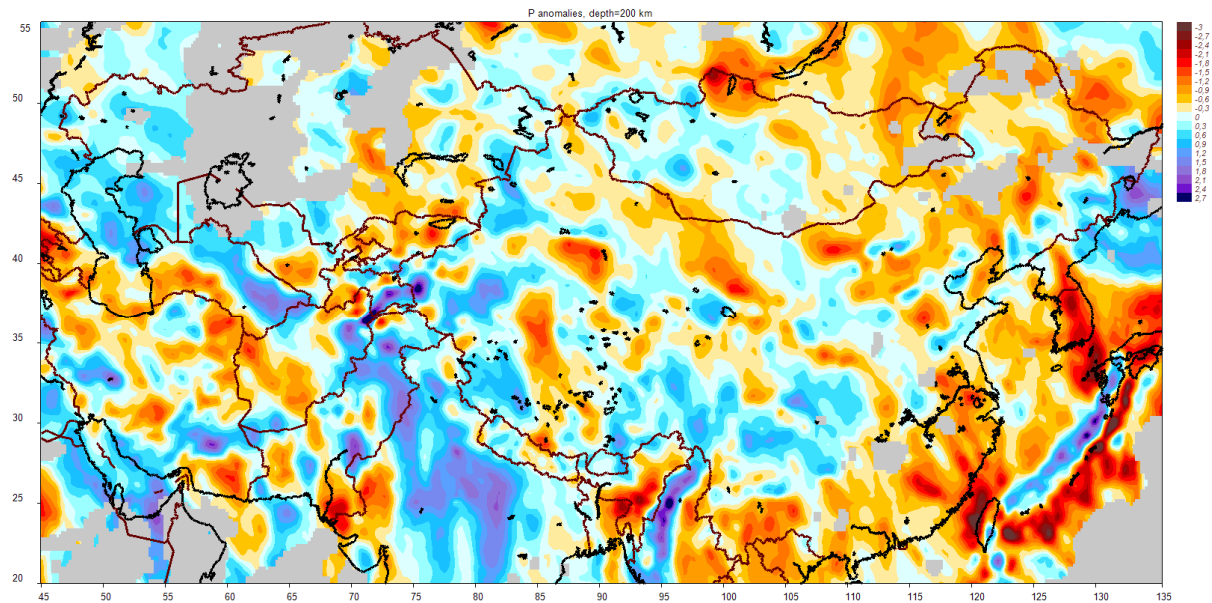


4. Examples of pictures for the ASIA model:

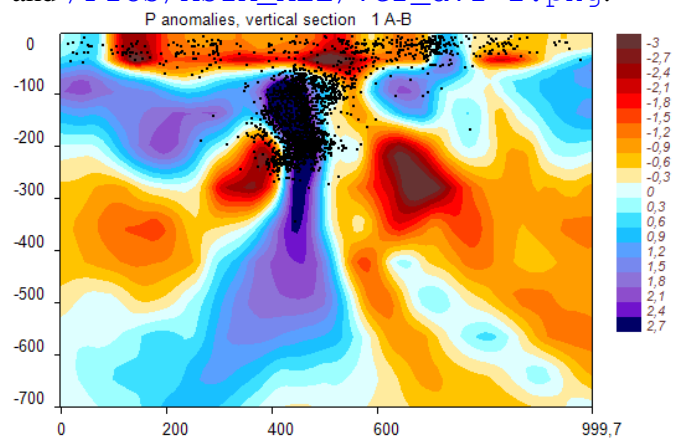
All these examples can be found at:

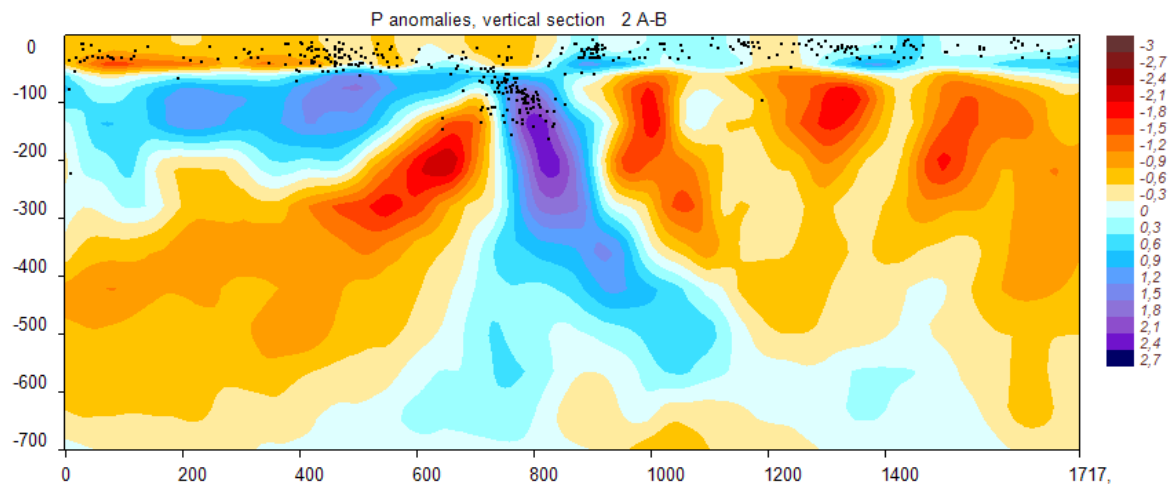
www.ivan-art.com/science/REGIONAL/png_pictures_asia.zip

1. Horizontal section of P velocity anomalies at 200 km depth,
file: `/PICS/ASIA_ALL/hor_dv1 4.png`.

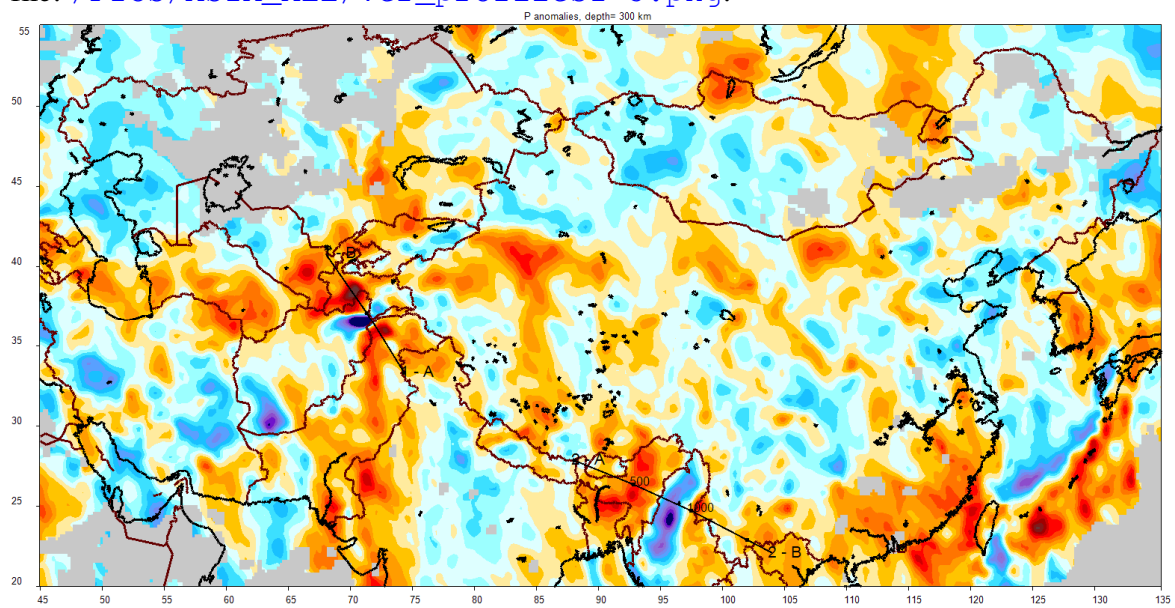


2. Vertical sections 1 and 2 of P velocity anomalies,
`/PICS/ASIA_ALL/ver_dv1 1.png`.
and `/PICS/ASIA_ALL/ver_dv1 2.png`.





3. Locations of the profiles superimposed with P velocity anomalies at 25 km depth
 file: [/PICS/ASIA_ALL/ver_profiles1 5.png](#).



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