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Seismotomographic structure of the central zone of Kamchatka suprasubduction complex according to the dense seismological networks data

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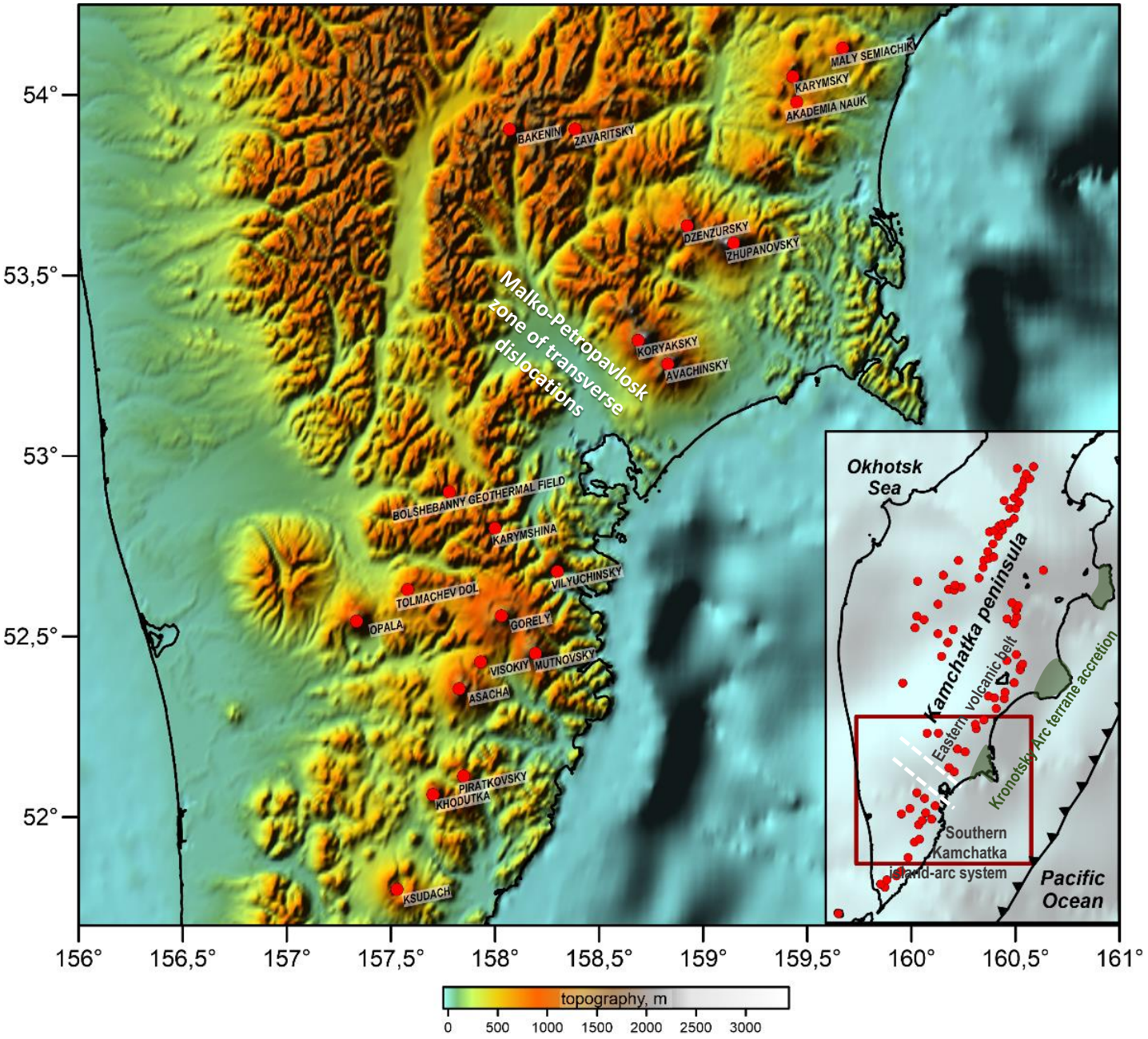
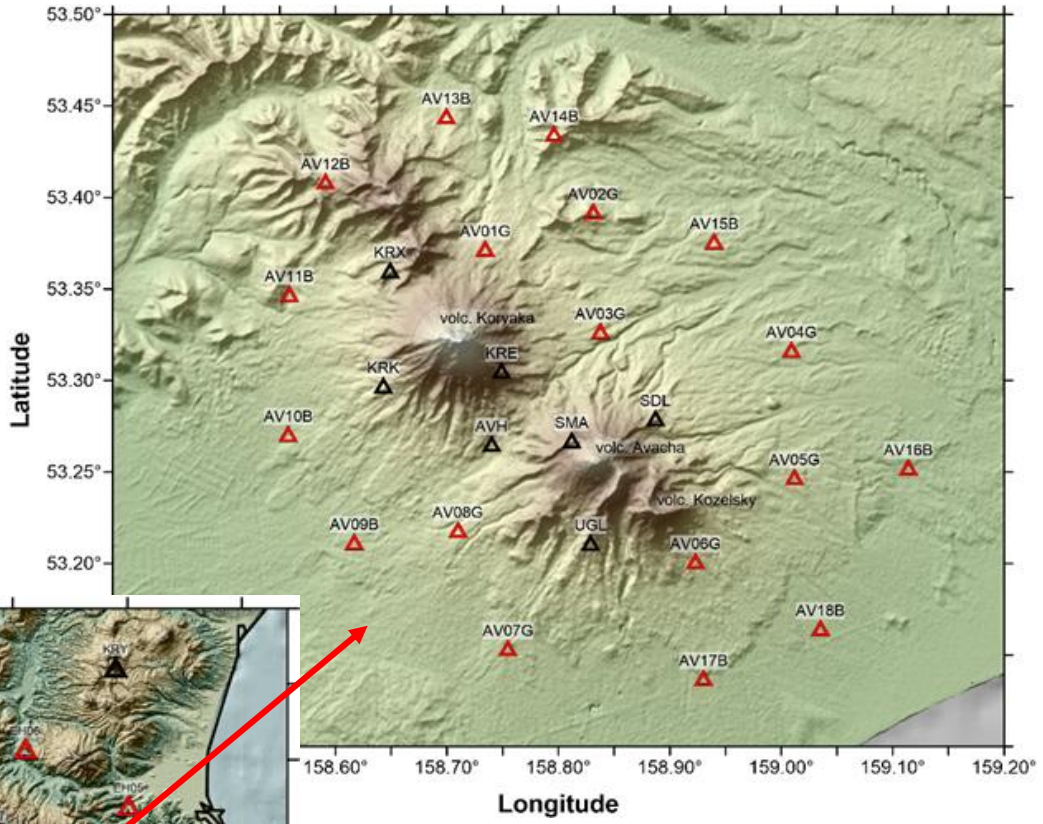
Location and relief of the Kamchatka investigated region



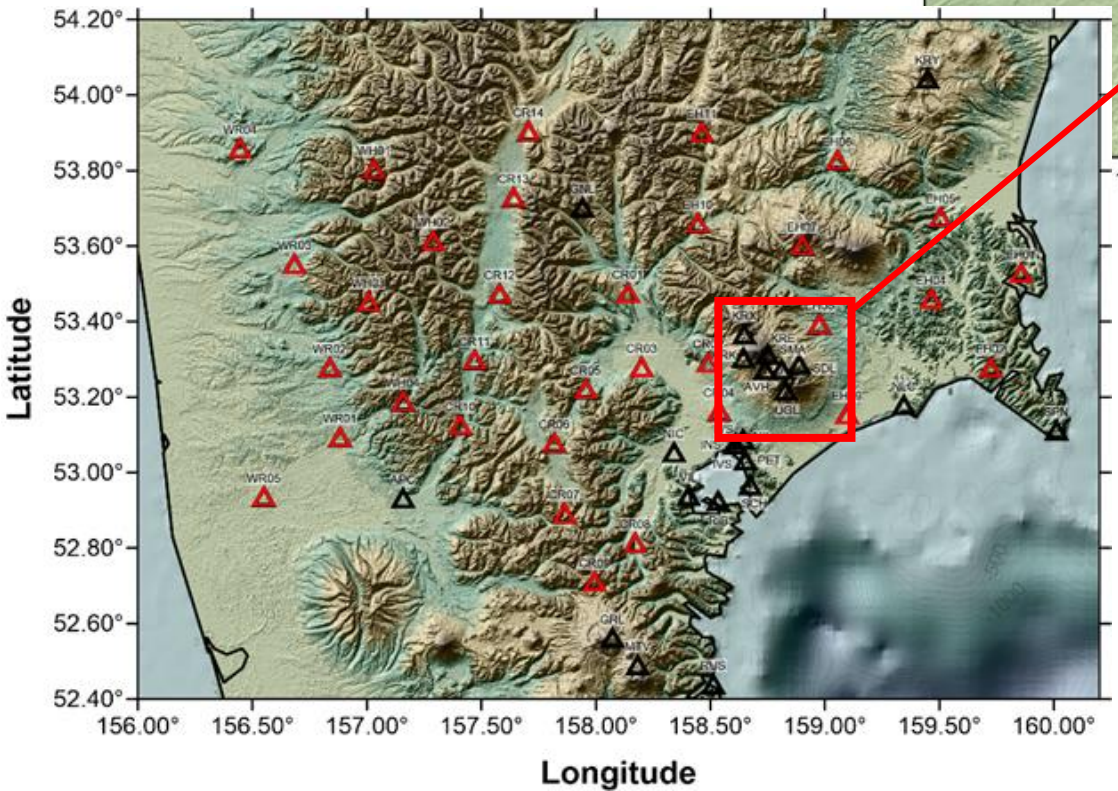
Station arrangement in the temporary networks, the data of which were used in the tomographic inversion

18 temporary stations on the Avacha volcano system (2018-2019) and 33 temporary stations in the central zone of Kamchatka (2019-2020).

2018-2019



2019-2020

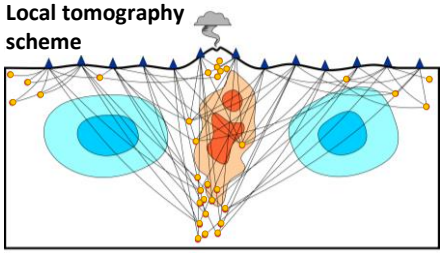


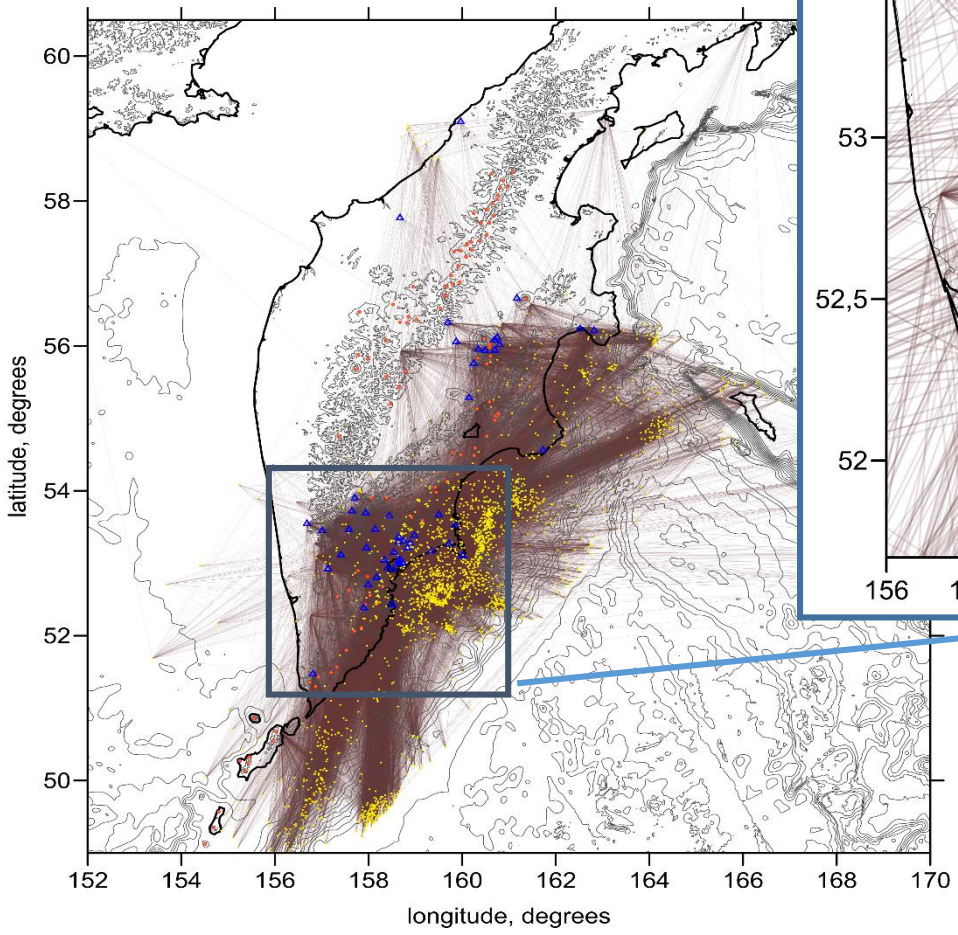
The installation of a temporary network in the central zone was carried out with the support of RSF #20-17-00075 and Megagrant # 14.W03.31.0033 of the Ministry of Education and Science of Russia.

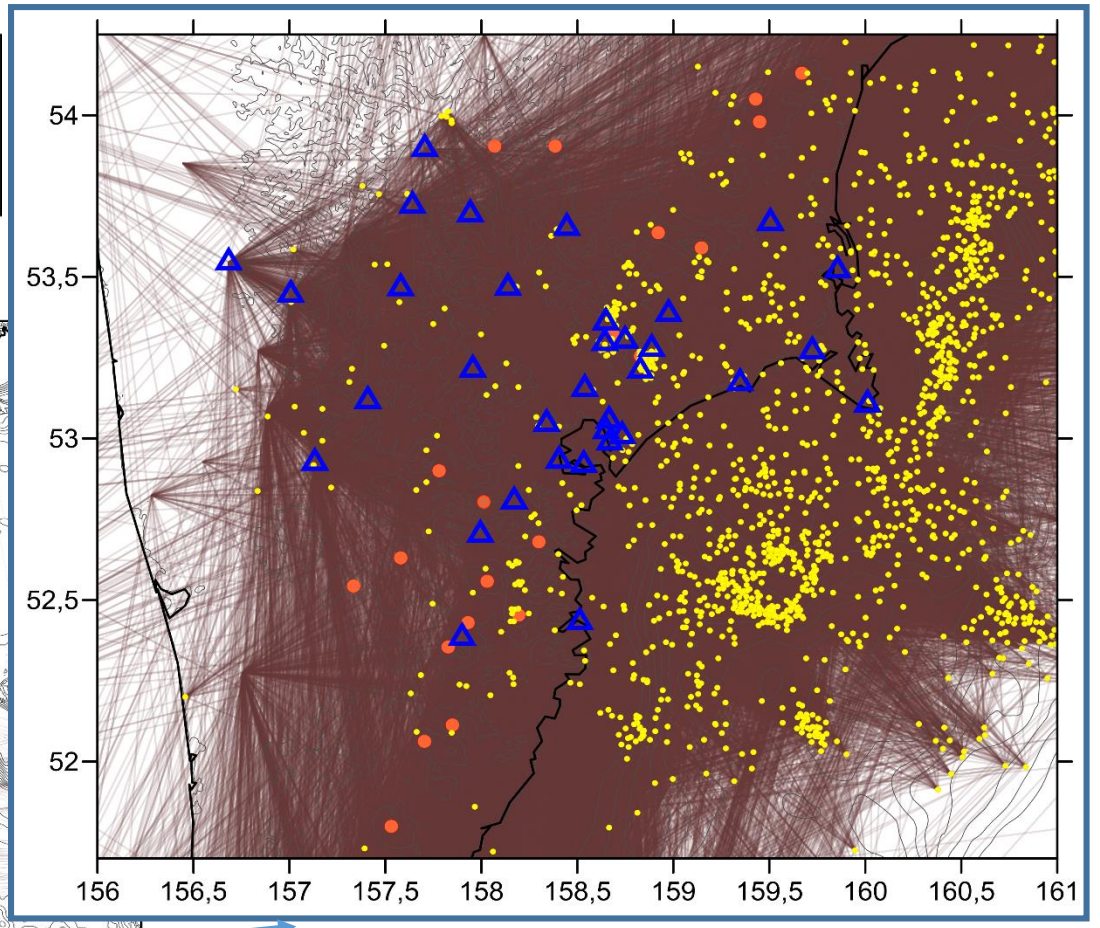
The stations of temporary networks are marked with red triangles, and the permanent stations of the Kamchatka branch of the FRC GS RAS are marked with black triangles.

Data set for tomographic modeling

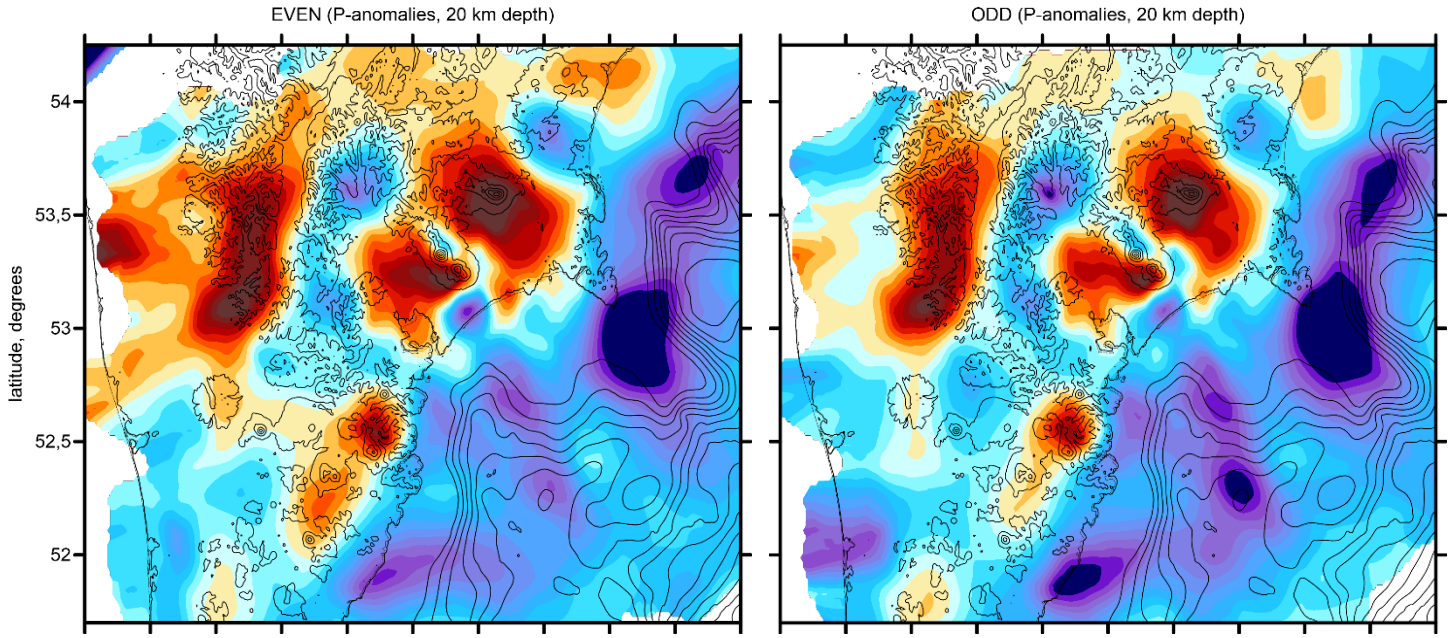
The model was constructed using the LOTOS algorithm (Koulakov, 2009) based on the data of 2687 local earthquakes of 2018-2020, recorded by 134 stations.







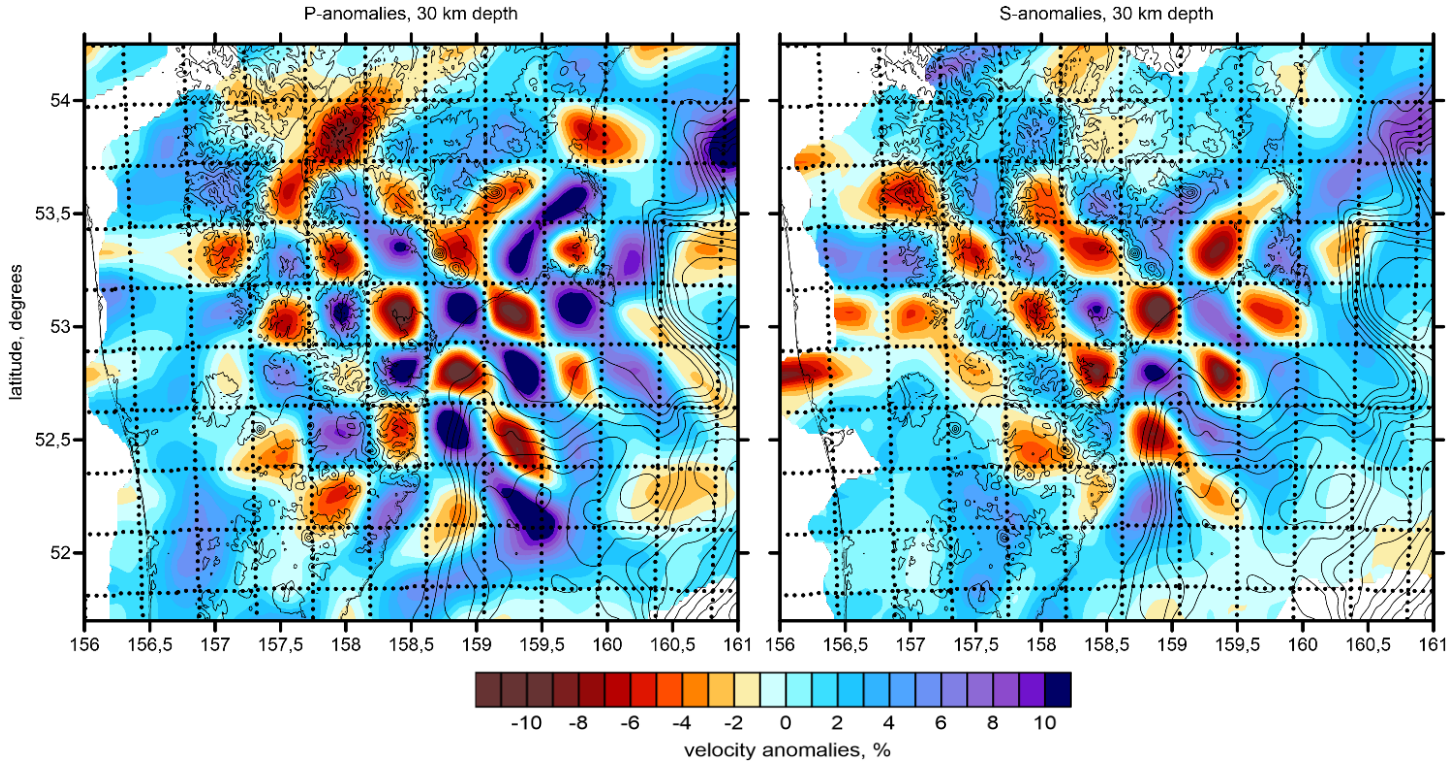
The tomographic inversion used 59088 travel times of P waves and 34697 of S waves.
On this figure shows: the distribution of stations (by blue triangles), earthquakes (by yellow dots), rays (brown lines); orange dots show volcanoes and geothermal systems of Kamchatka, gray contours - relief.



Test with EVEN and ODD numbers of the source real data

showed a low noise level in the received data

Example for P-data at a depth of 20 km.



Checkerboard synthetic test

to check the resolution of the original data system and therefore the tomography results

The test with alternating anomalies of +/-7% with a characteristic size of 30x30 km at a depth of 30 km.

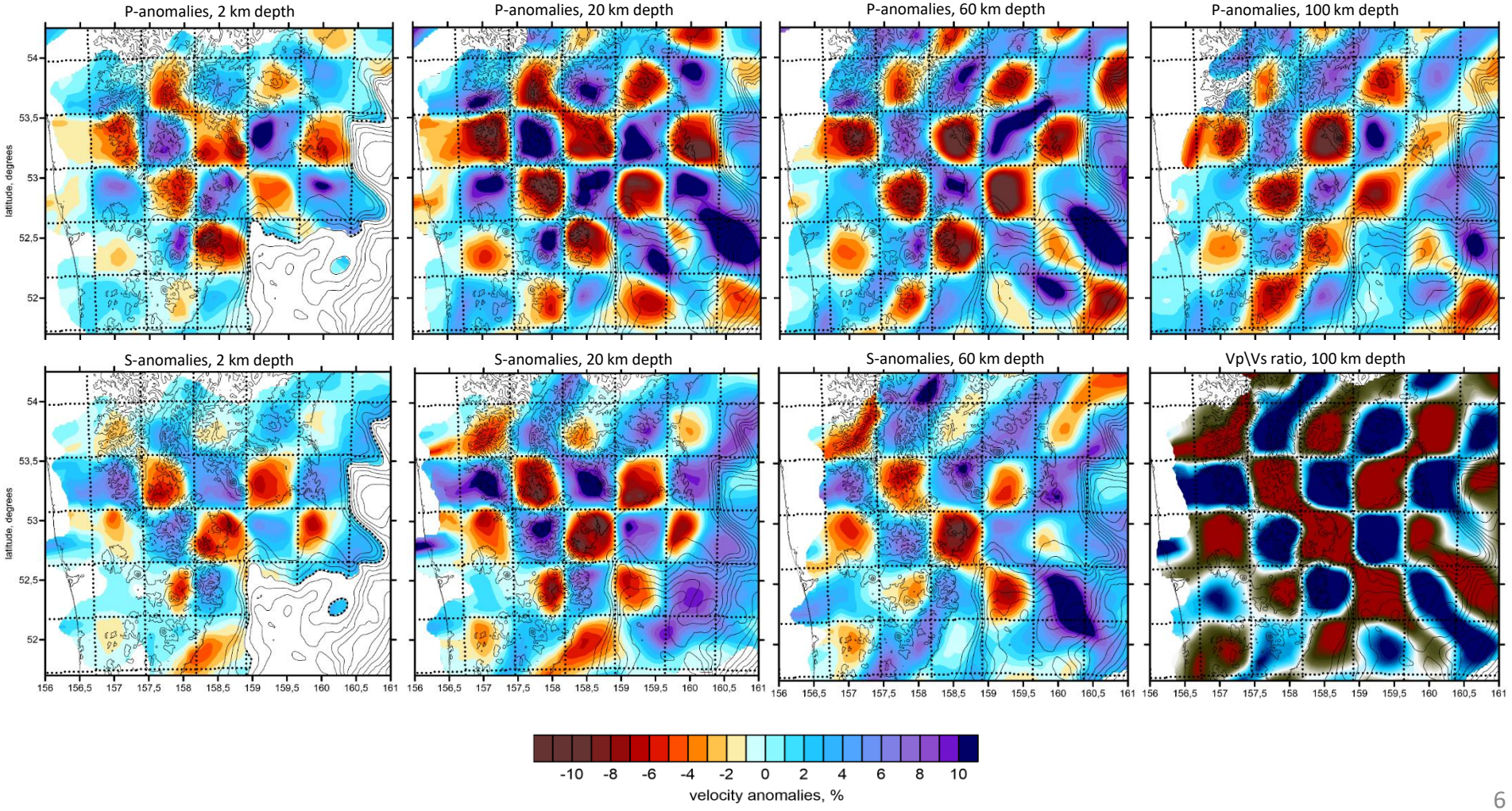
Dotted lines indicate the contours of the synthetic anomalies.

Checkerboard synthetic test

with a characteristic anomaly size of 50x50 km

The selected horizontal sections of P and S synthetic anomalies models over the entire depth of the study area (2, 20, 60, and 100 km) are presented. In the lower right corner the horizontal section of Vp/Vs ratio synthetic model at a depth of 100 km is presented.

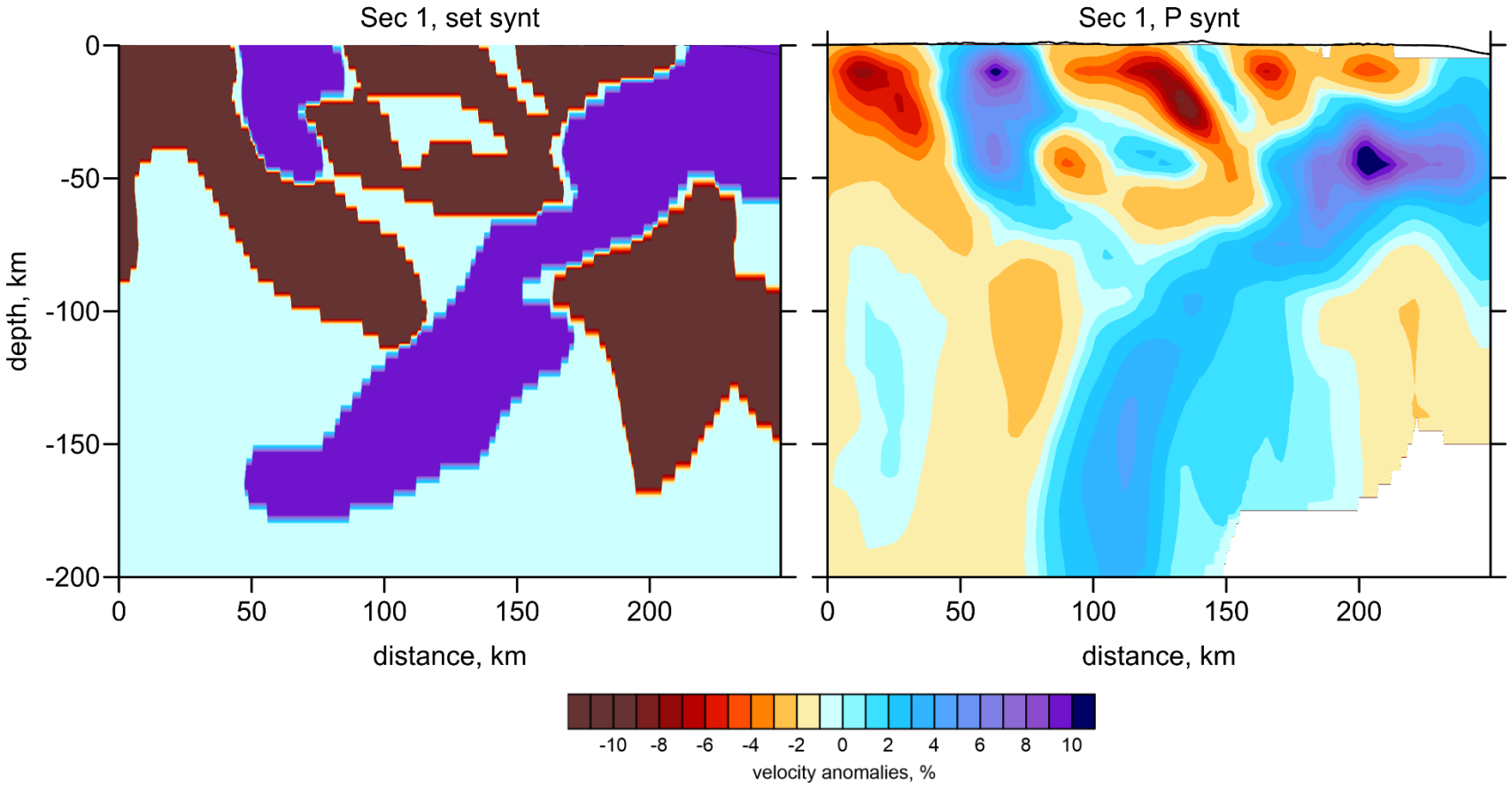
The test with alternating anomalies of +/-7 %. Dotted lines indicate the contours of the synthetic anomalies.



Synthetic test with free-shaped anomalies

example in the vertical projection: the shapes of the anomalies were set similarly to those observed in Sec 1 of the obtained P-wave velocity anomaly model (shown on the next slide)

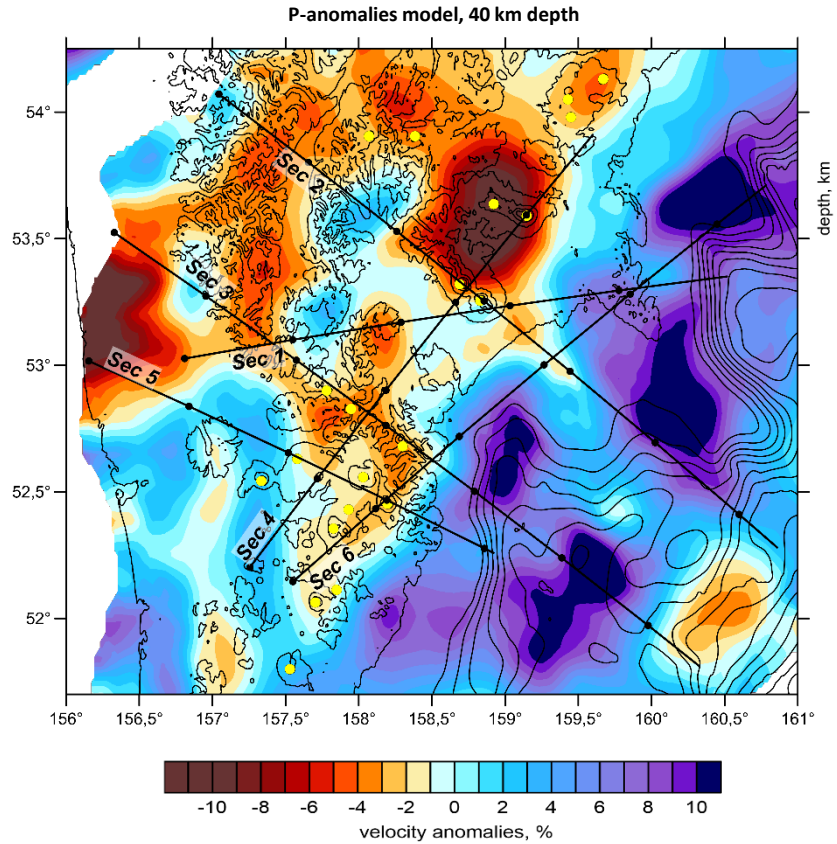
(the test with realistic characteristics demonstrates a satisfactory recovery of a complex superposition of anomaly boundaries)

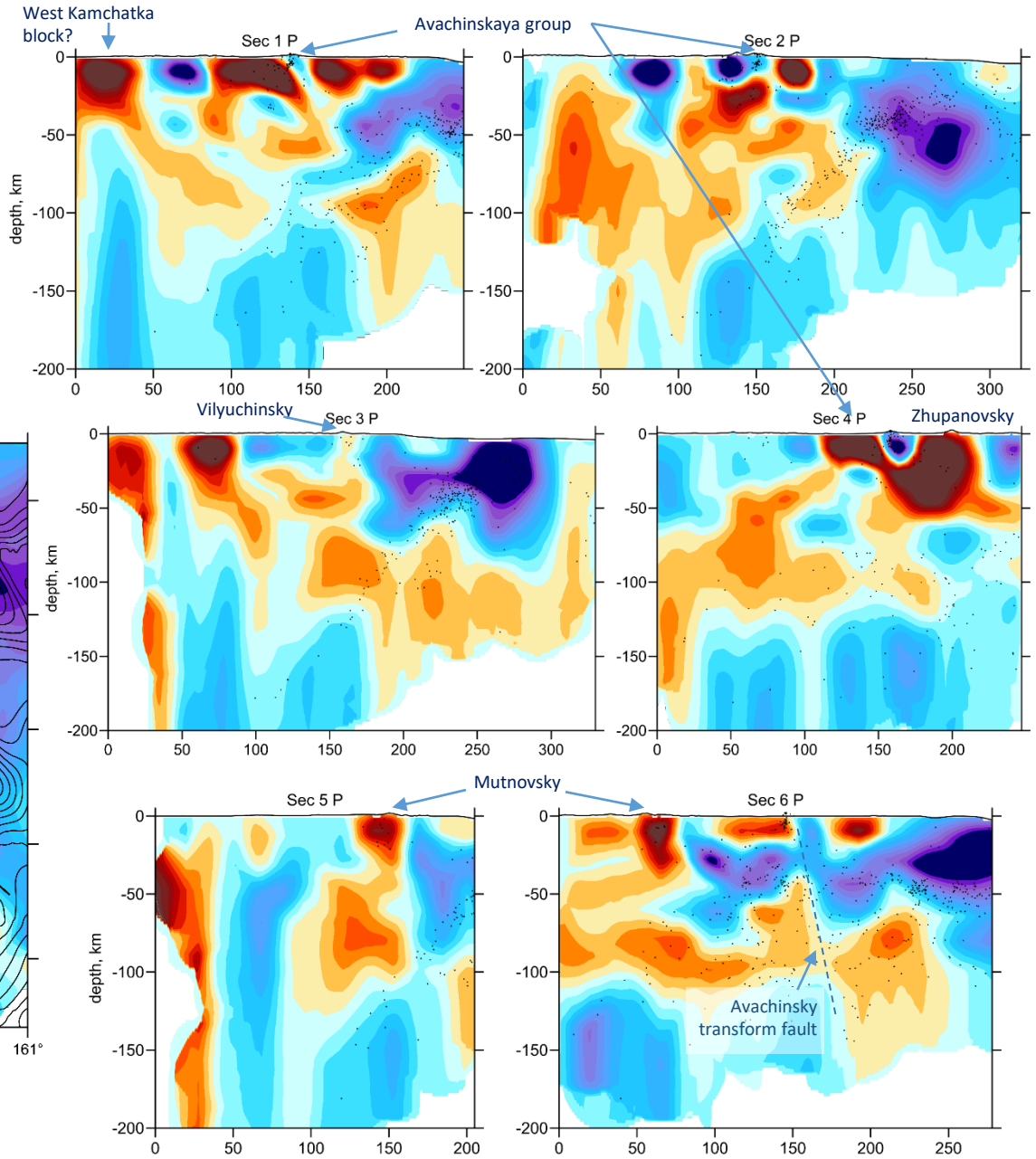


The resulting model of P-wave velocity anomalies

On the horizontal section (depth 40 km), the black lines show the location of the profiles, yellow dots – volcanic edifices and hydrothermal systems.

The black dots on the vertical sections show the distribution of earthquake hypocenters within 50 km from the profile plane.

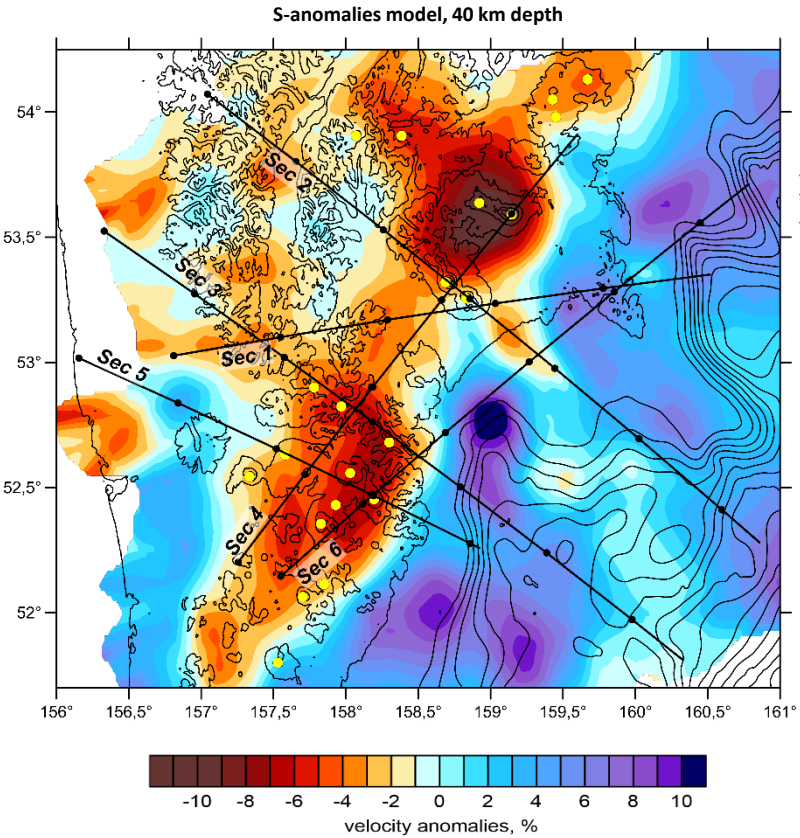


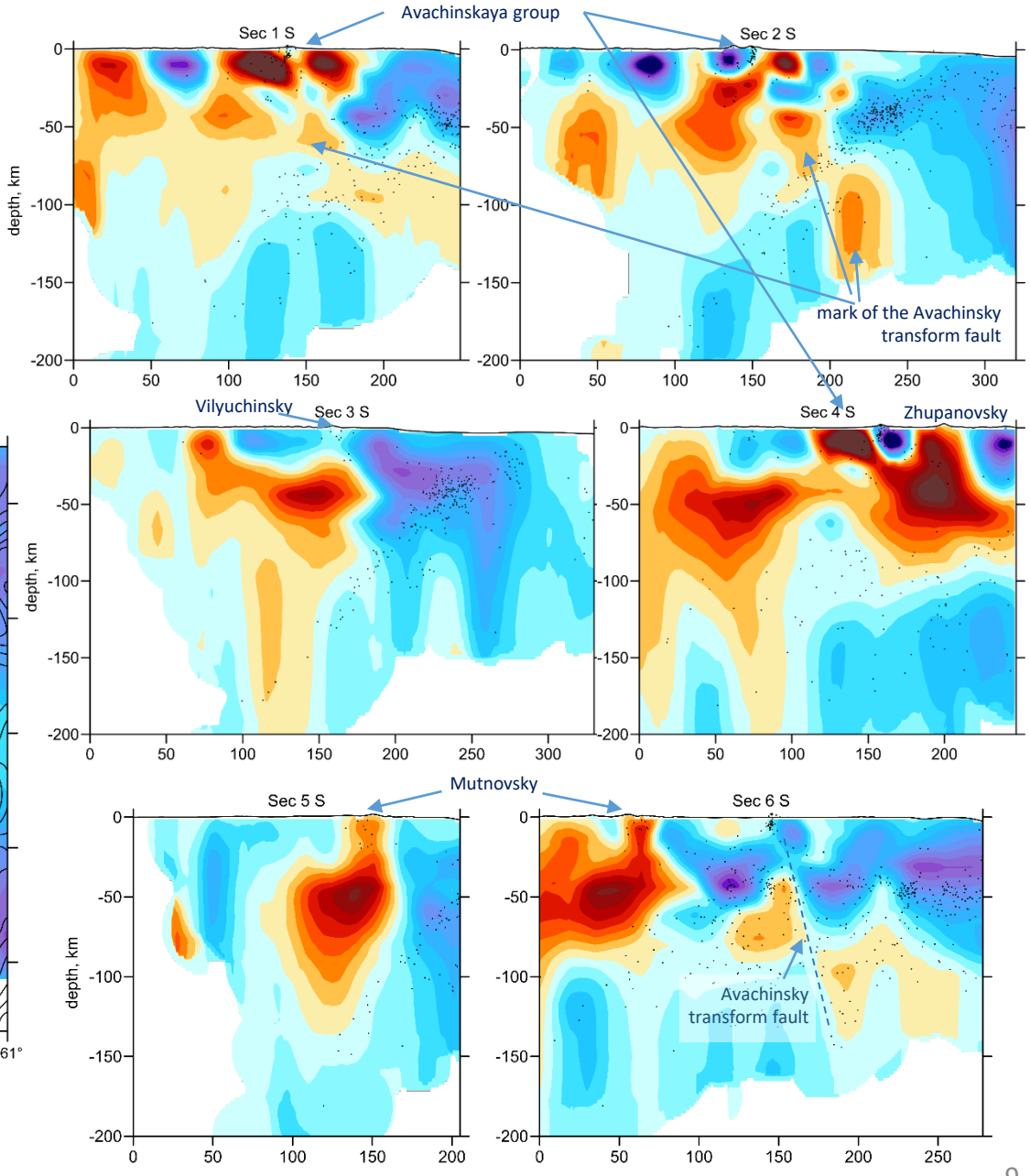


The resulting model of S-wave velocity anomalies

On the horizontal section (depth 40 km), the black lines show the location of the profiles, yellow dots – volcanic edifices and hydrothermal systems.

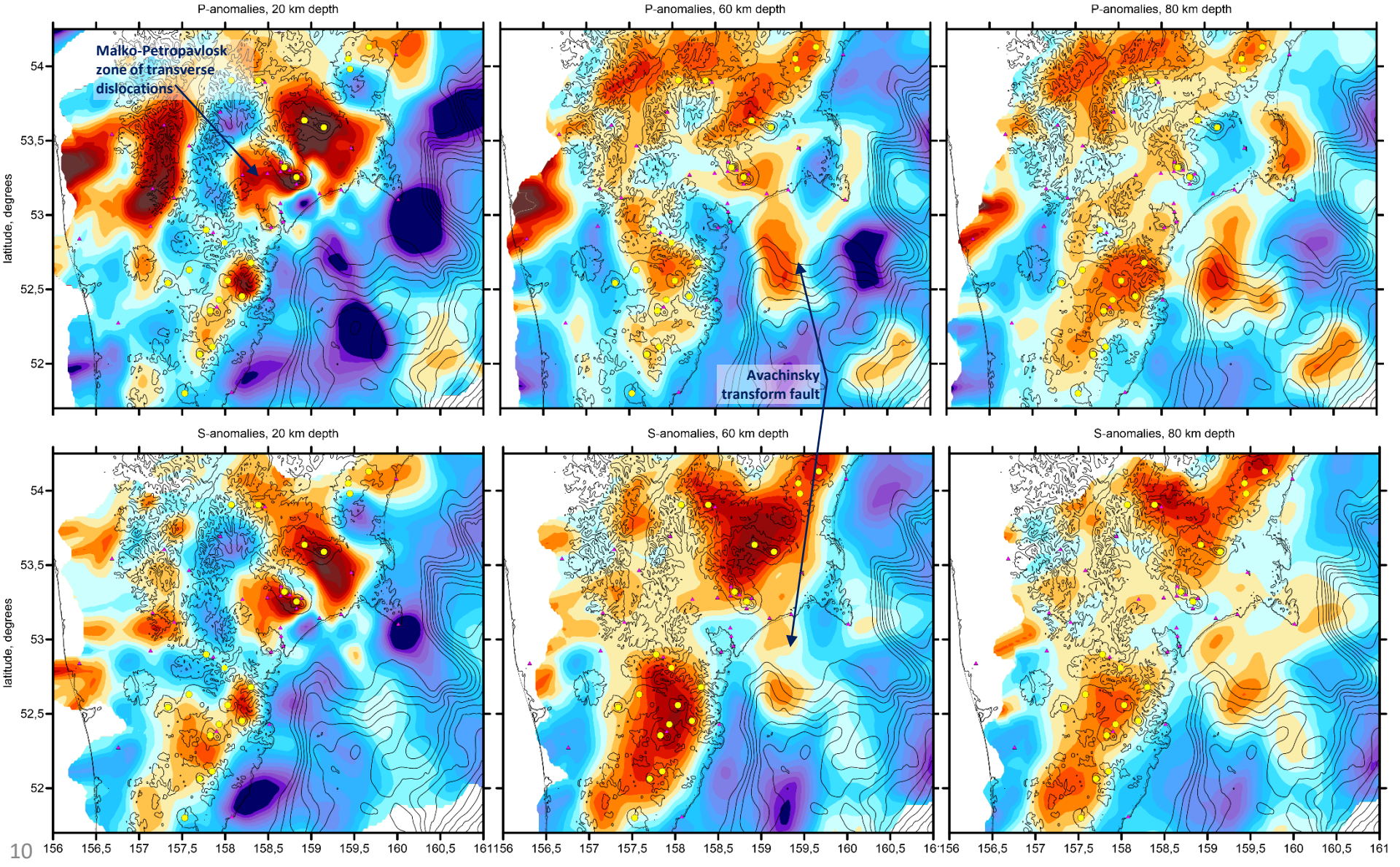
The black dots on the vertical sections show the distribution of earthquake sources within 50 km from the profile plane.





The resulting model of velocity anomalies in the central zone of Kamchatka

Horizontal sections are presented at depths of 20, 60, and 80 km;
yellow dots indicate the location of volcanoes;
purple triangles represent seismic stations whose data are used in this study.



Summary

The resolution of the new model makes it possible to trace the zones of fluid and melt release from the slab, their migration in the mantle wedge and crust, and makes it possible to assess their role in feeding the magmatic systems of the Eastern Volcanic Belt and Southern Kamchatka.

Volcanoes of the Avachinskaya group have a common magma plumbing system at a depth more than 50 km, which could be traced from the slab.

The Vilyuchinsky volcano feds through an intermediate large magma chamber located at a depth of 30-55 km, which is probably also related to the feeding of the Karymshina caldera and related Bolshebanny geothermal field located to the west. This large chamber fed from a conduit originated on the slab at more than 70 km depth.

The feeding system of the Gorely and Mutnovsky volcanoes is traced to the slab at depths of more than 100 km.

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Thank you for your attention!