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The crustal structure of South Eastern Europe in the new European Plate reference model

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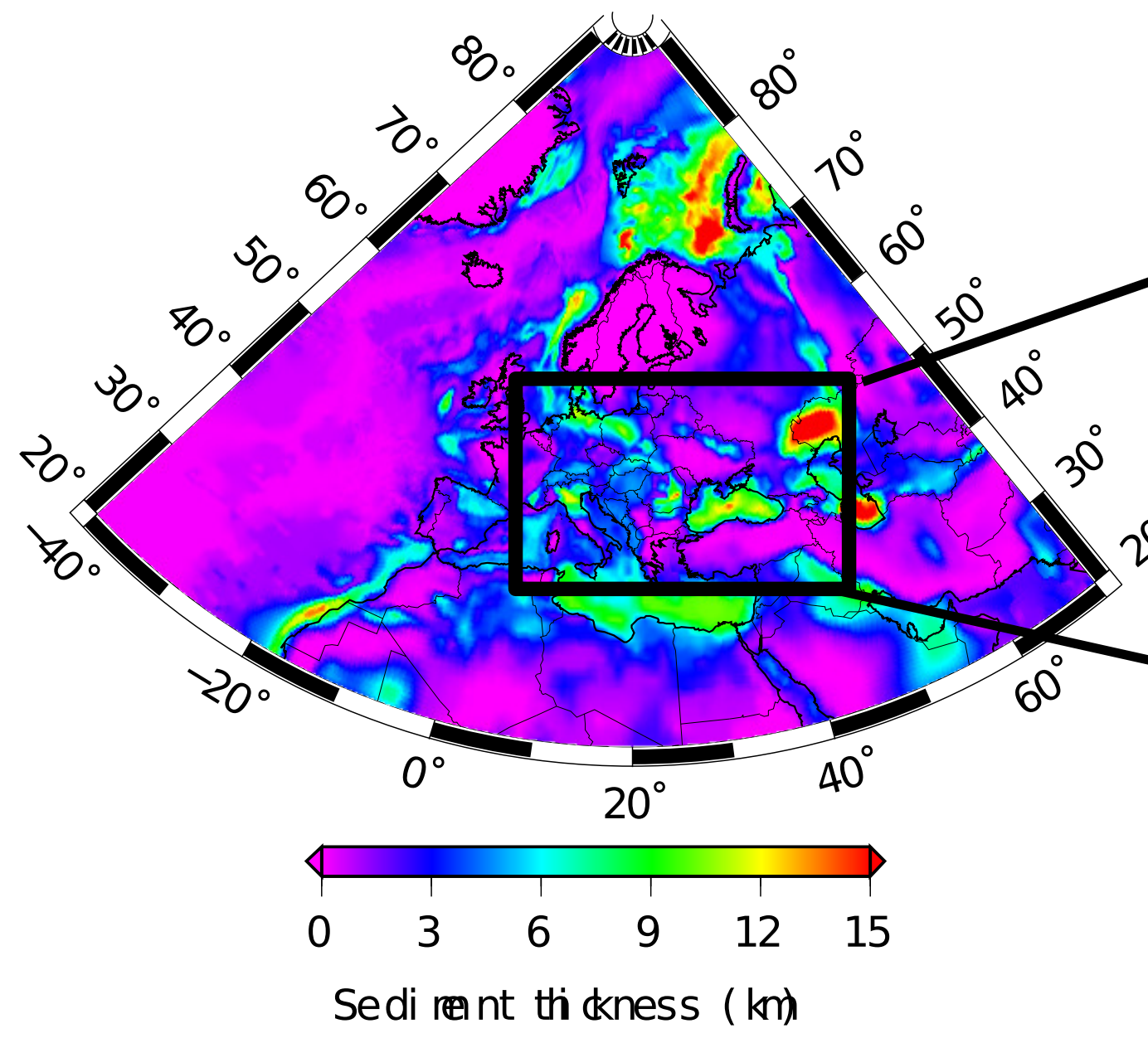
INTRODUCTION

The new European Plate crustal model (EPcrust) represents a continental-scale, a priori, compilation of current knowledge on the structure of the upper layers of the earth, designed as a large-scale reference for further seismological studies.
Here we specifically review some of the contributions used, and test and compare the model in detail for the Eastern Alps region, Carpathians- Pannonian region comprising orogene, platform and basin structures (Hungary, Romania), Black Sea, Balkan area (Bul- garia, Greece and Turkey) and the western margin of the East European Platform (Ukraina).

EUROPEAN PLATE REFERENCE MODEL (Molinari & Morelli, 2009)

New a priori model of the European plate, EPcrust, is based on a new, comprehensive compilation of currently available information from diverse sources, ranging from seismic prospection to receiver functions studies.
Most original information refers to P-wave speed, from which we derive S-wave speed and density from scaling relations (Brocher, 2005).
The model covers the whole European plate from North Africa to the North Pole (20°N- 90°N) and from the Mid-Atlantic Ridge to the Urals (40°W-70°E).
The parameterisation represents the crust in three layers (sediments, upper crust and lower crust), and describes the geometry and the seismologically relevant parameters with a resolution of 0.1° x 0.1° on a geographical latitude-longitude grid (target structural resolu- tion is ~100 km). For each grid point and layer a single set of parameters (seismic velocities Vp, Vs and density) and relative error bars, are specified.
We include in EPcrust a new contribution from some selected seismic profiles in the Easter Alps region.



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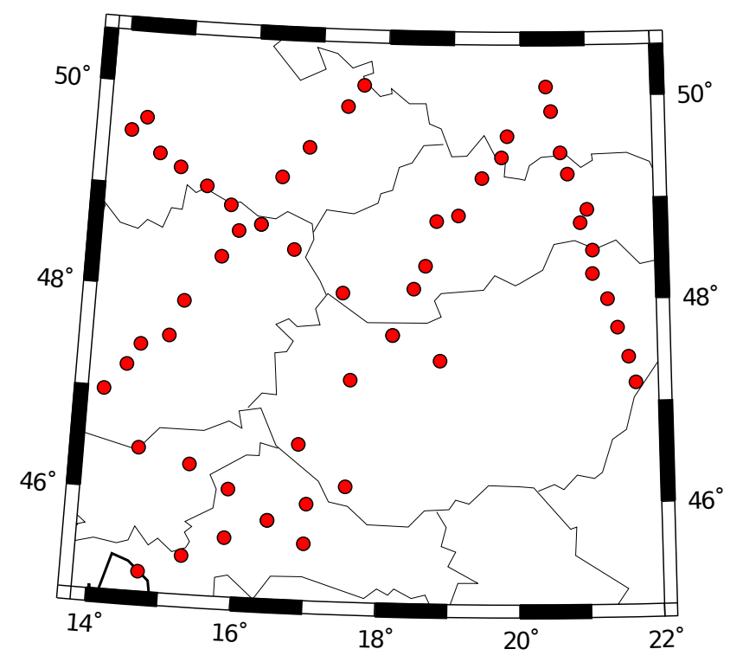
Sediment thickness in the whole region of the Eocrust model.

Moho depth in the central-eastern part of the EPcrust model

NEW LOCAL EAST ALPS CRUSTAL MODEL

To include data from seismic profiles, we first sample the line at discrete points. We then create a 'local' model using geostatistical tools and the same parameterisation as the global EPcrust model. Finally, we include the 'local' areal model into the global one, weighting it according to resulting variances.

We use the ordinary kriging method (implemented in S-GeMS, The Stanford Geostatistical Modeling Software) to assemble the local model. Ordinary kriging is well suited to obtain the best linear estimate of the parameters in each grid points. The tool provide also a variance matrix for each parameter that is used to weight each grid point of the local model during its integration in EPcrust.



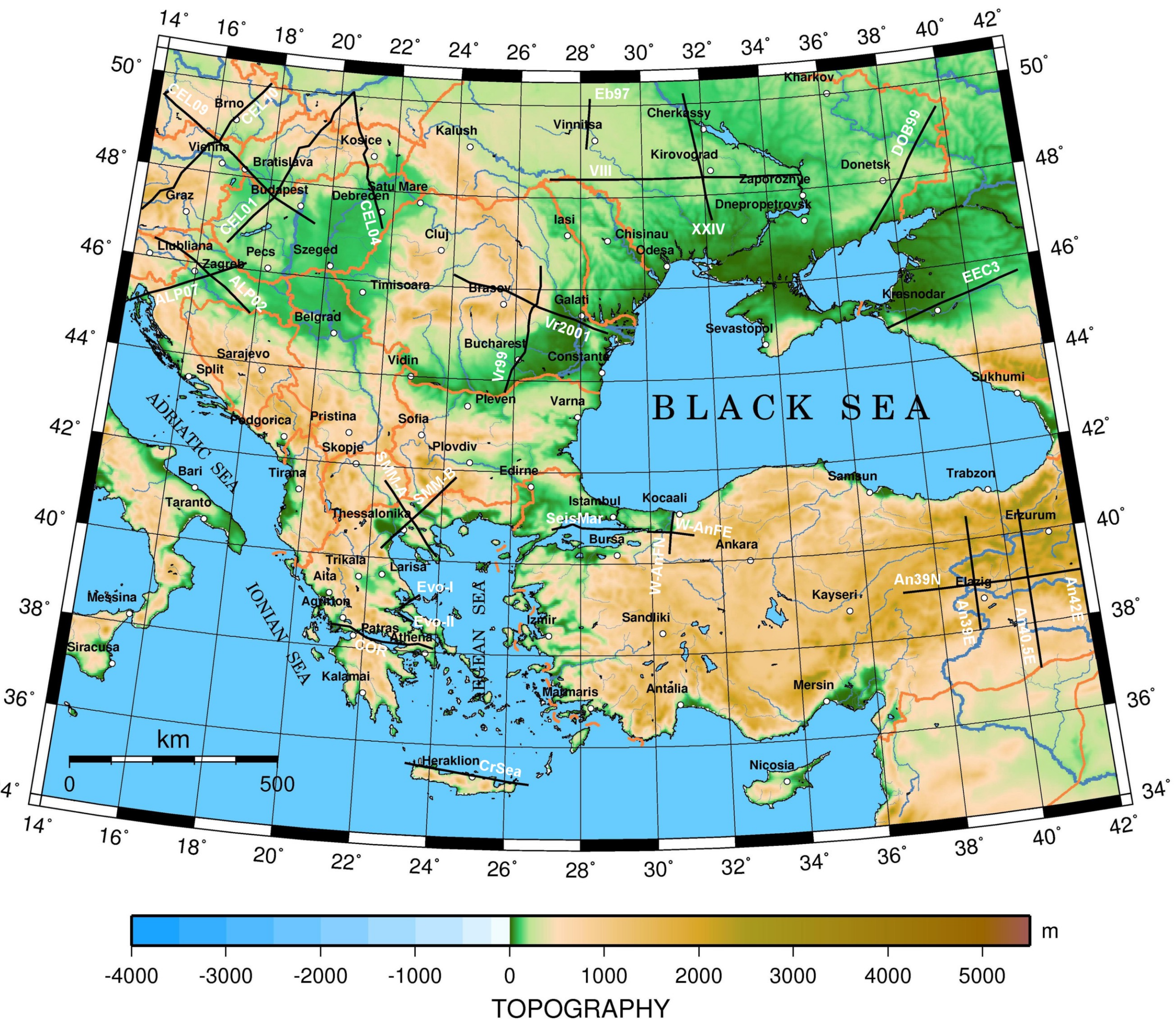
Seismic lines used to create the local model:
ALP02. ALP07 CEI01 CEI04 CEL09 CEO 10

Sediment depth, upper crust depth, Moho depth of the local model.

P-wave spped in the upper (left) and lower (rigth) crust.5655

SEISMIC PROFILES

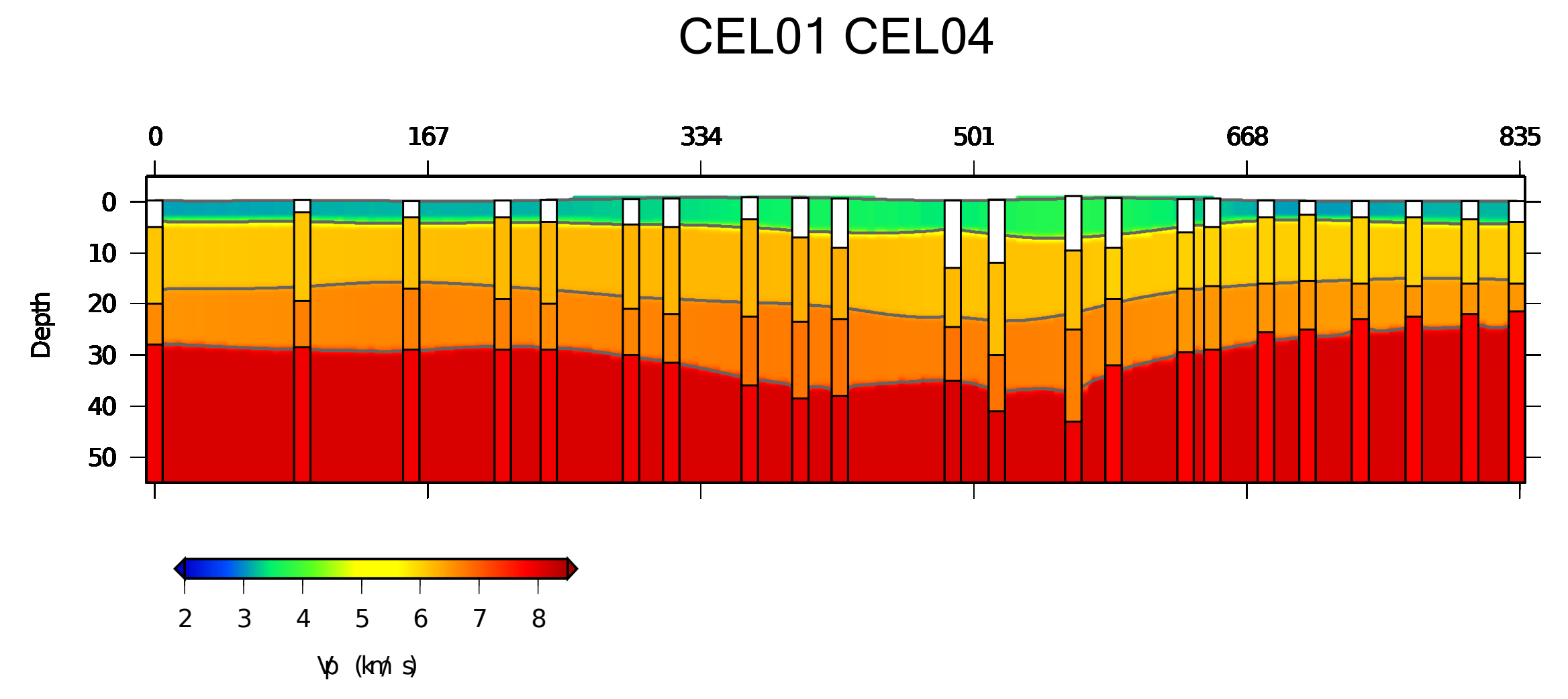
We collect informations about the crustal structure from local compilations and individual studies mostly deriving from analysis of active source experiments.
26 seismic lines were selected from the published papers. For each seismic line some 1D models was extracted either on location of shotpoints or at distances spaced between 50-100 km along the line. In those points were delimited the three major layers: sediments, upper and lower crust by interfaces from the top of upper and lower crust and Moho. A mean Vp for each major layer was computed as a weigthed mean of velocities of the secundary layers.These 1D models are reported as a column on the dispayed crustal sections.

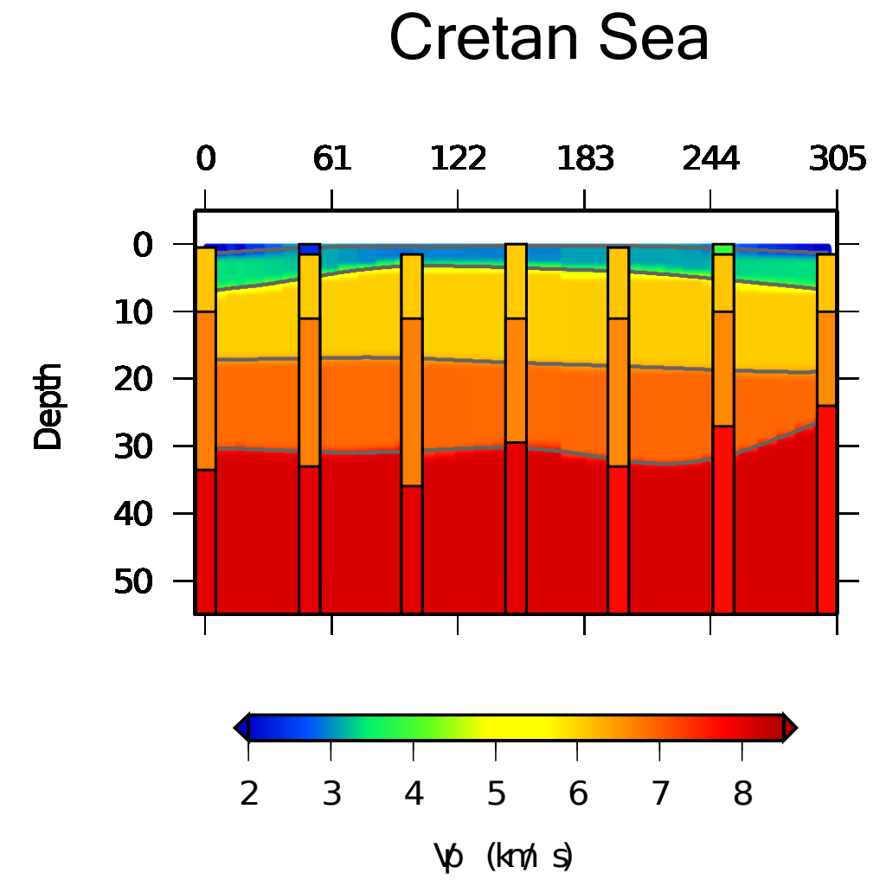


Geographic map of the SE Europe with location of the seismic lines (black) used for creating and testing of model.

LEGEND

ALP02-	Behm et al. (2006)
ALP07-	Sumanovac et al.(2009)
CEL01-	Sroda et al.(2006), Guterh and Grad, (2006), Guterh et al. (2003)
CEL04-	Sroda et al.(2006), Guterh and Grad, (2006), Guterh et al. (2003)
CEL09-	Ruzek et al.(2007), Hrubcova et al.(2005)
CEL10-	Grad et al.(2009), Hrubcova and Sroda (2009)
Eb97-	Thybo et al. (2003)
VIII-	Grad et al.(2006), Grad and Tripolsky (1995)
XXIV-	Grad et al.(2006), Grad and Tripolsky (1995)
DOB99-	DOBREfraction'99 Working Group (2003)
EEC3-	Kostyucenco et al.(2004)
VR99-	Hauser et al.(2001)
VR2001-	Hauser et al.(2007)
SMM-A-	Papazacos (1998)
SMM-B-	Papazacos (1998)
Evo-I-	Makris et al(2001)
Evo-II-	Makris et al(2001)
COR-	Zelt et al.(2005)
CrSea-	Makris et al. (2006)
SeisMar-	Becen at al.(2009)
W-AnFN-	Karahan et al.(2001)
W-AnFE-	Karahan et al.(2001)
An42E-	Angus et al. (2006)
An39E-	Angus et al. (2006)
An40.5E-	Angus et al. (2006)
An39N-	Angus et al. (2006)

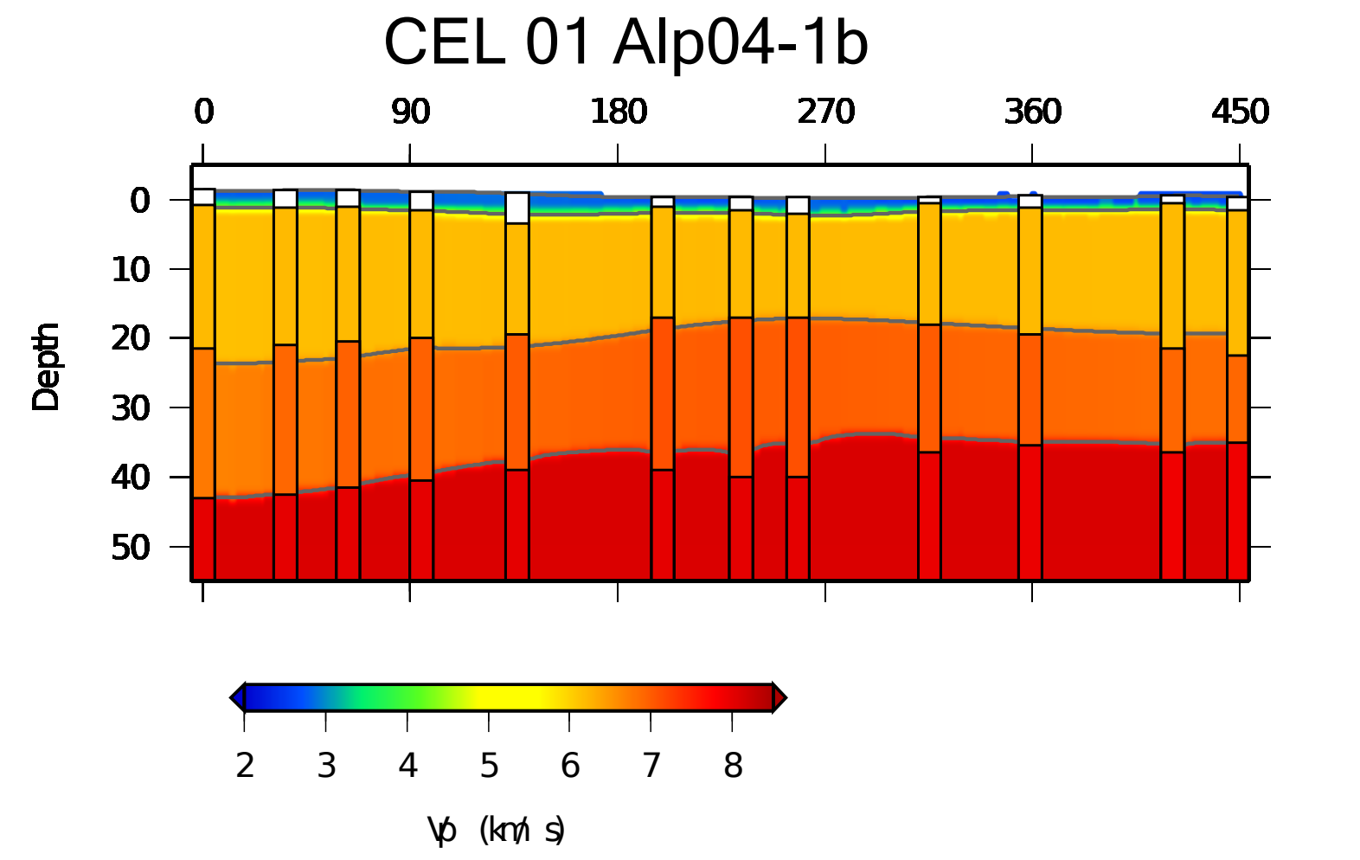


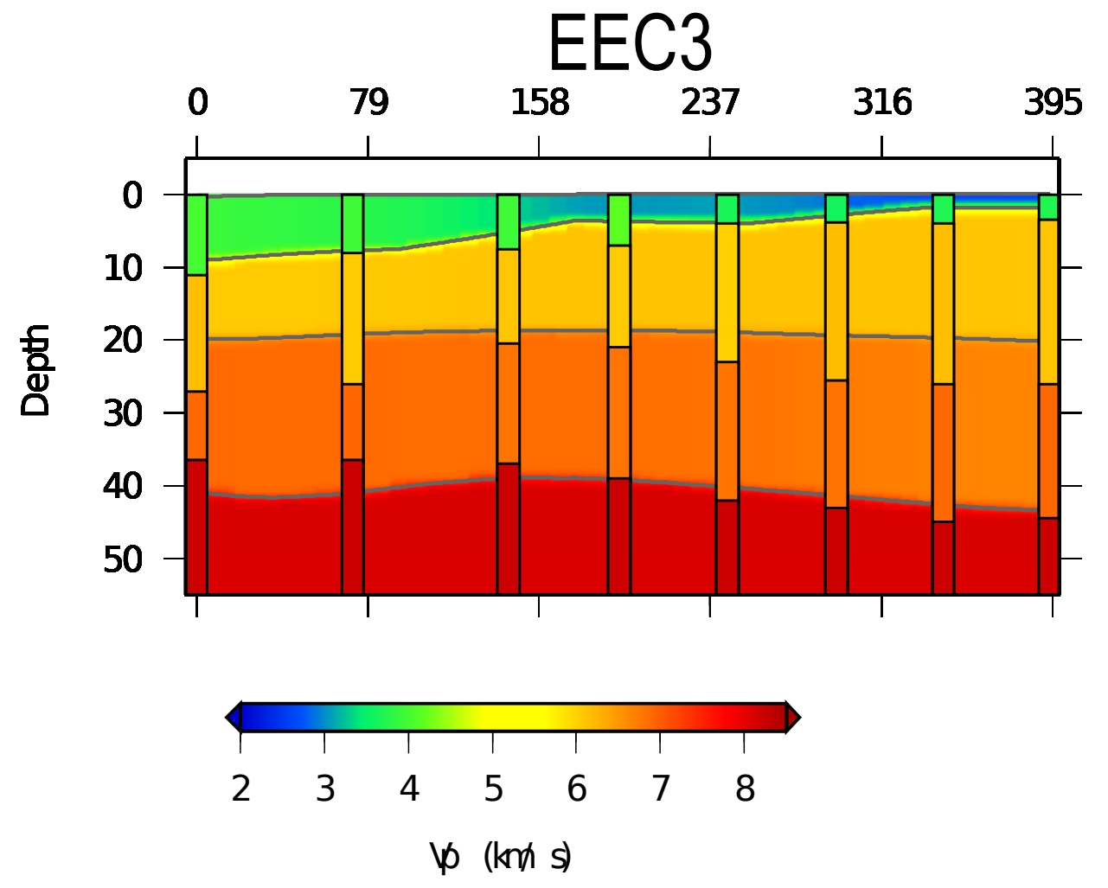


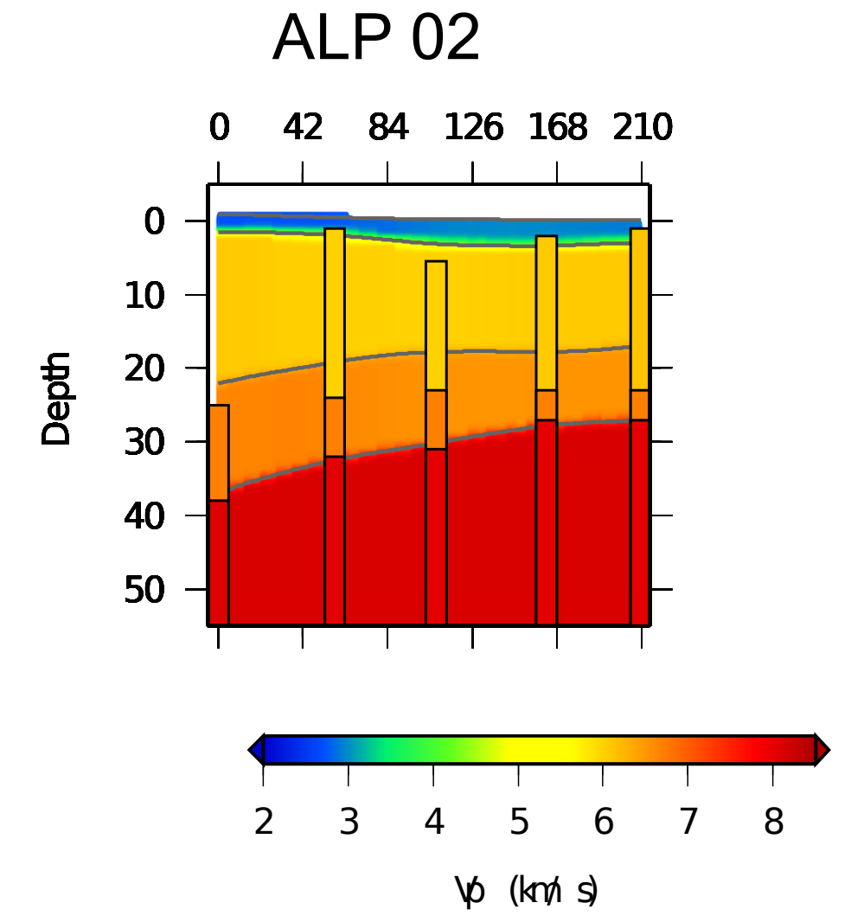
COMPARISON: EPCRUST vs. PROFILES

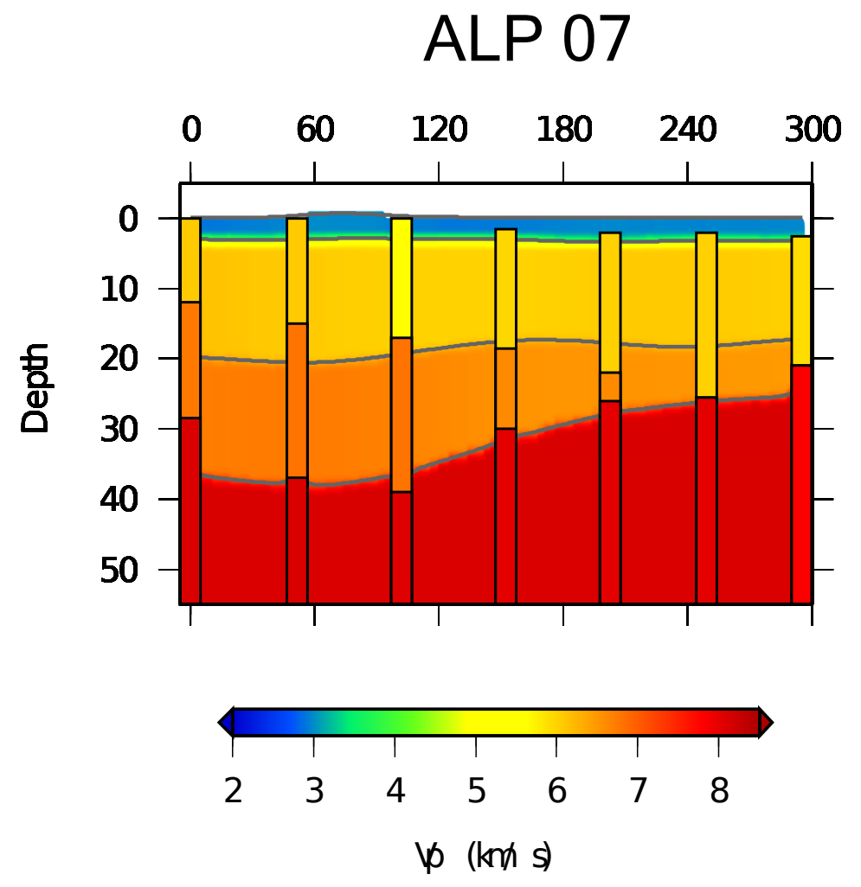
EPcrust, by being the result of integration of different data and pre-existing models, cannot honor precisely the seismic profiles taken from literature. Nonetheless, it is able to fit them quite well.
We compare profiles cut from EPcrust (cristalline basement upper crust basement, Moho surfaces and P-wave velocity) along profiles in the SE Europe, with the seismic line collected from the literature.
In each of the following picture, we plot EPcrust in the background, and the seismic line properties (sampled at discrete points).

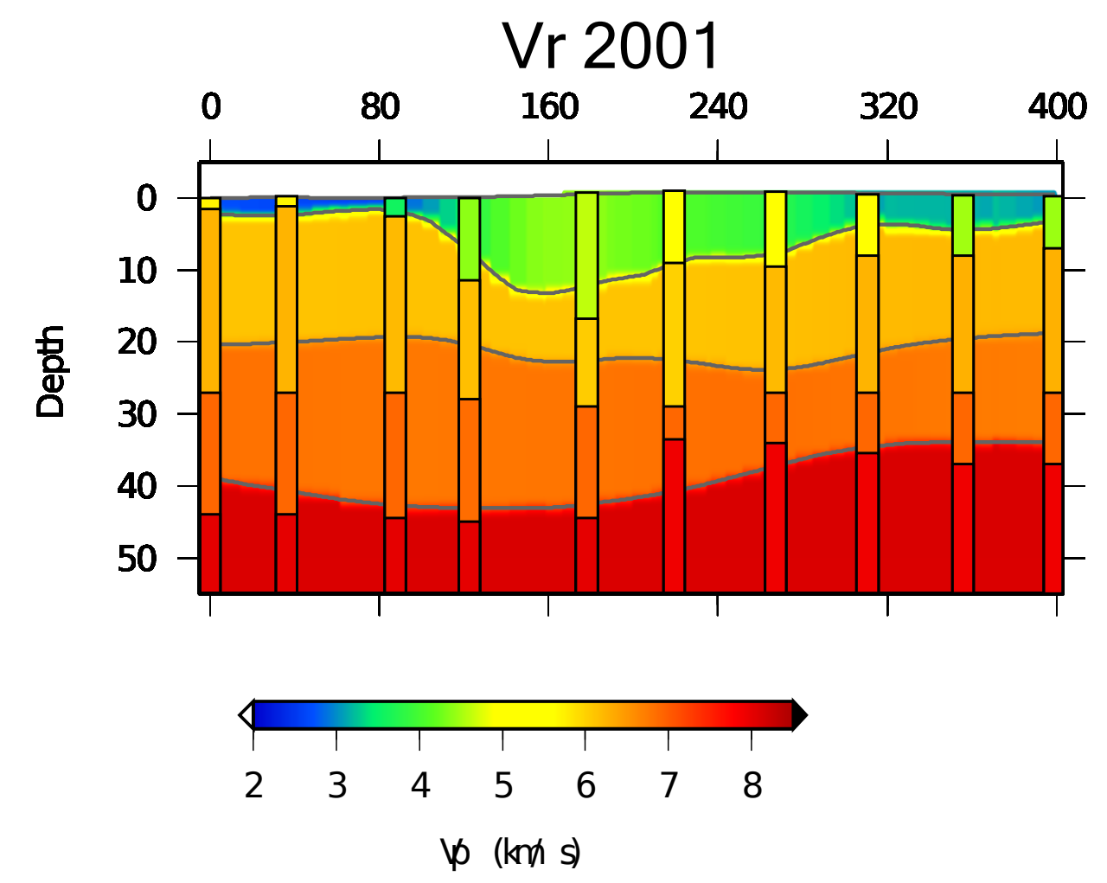
In most of the comparison the EPcrust model is in good agreement with the data: differences for the deoths of the interfaces are in a range of 2 km, and for the velocity structure in a range of 0.2 km/s.
Where agreement is poor, we need to make some correction of the reference model, but for these cases we need a larger density of crustal data..

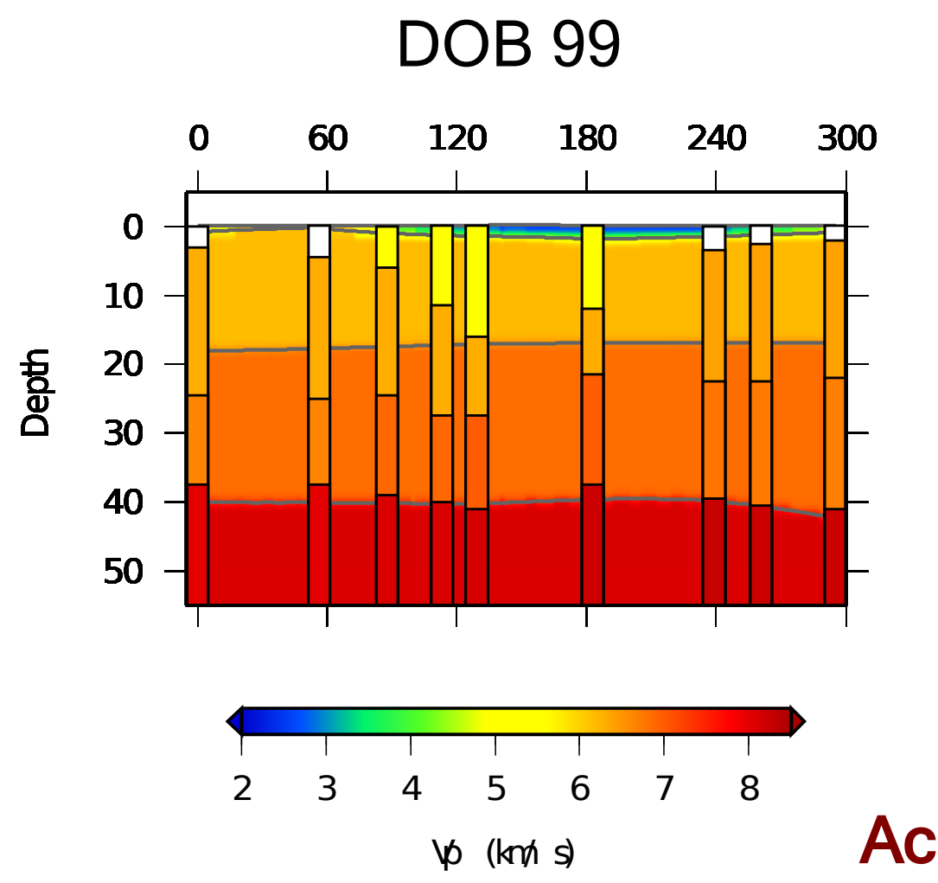












CONCLUSIONS

This study compared the EPcrust model with local data provided by seismic active source experiments in different areas from SE Europe. Based on the seismic line data the EPcrust were rectified in the Easter Alpine area. Unfortunately seismic experiments are uneven distributed across of area with a higher density towards the Central Europe and a poor and lack coverage for the southern part. On the selected lines some 1D crustal models were sampled as a reference term for the EPcrust model. Most of data have shown a good agreement of EPcrust with local data. A enhancement of model is possible where agreement is low but it involves more and accessible crustal data. A future work could be done in such of regions if there are available data.

Acknowledgements

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