Towards realistic testing with RTM, FWI

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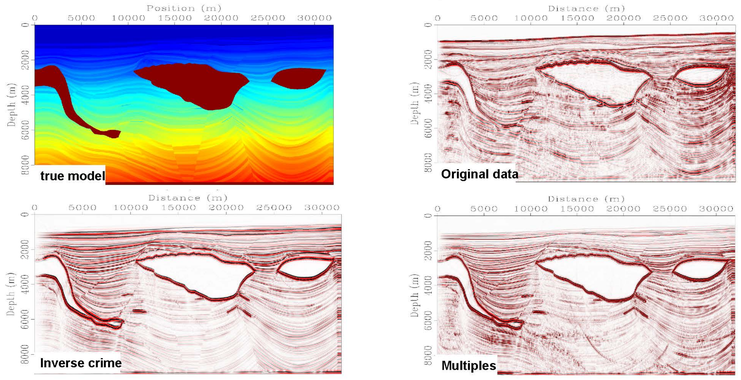
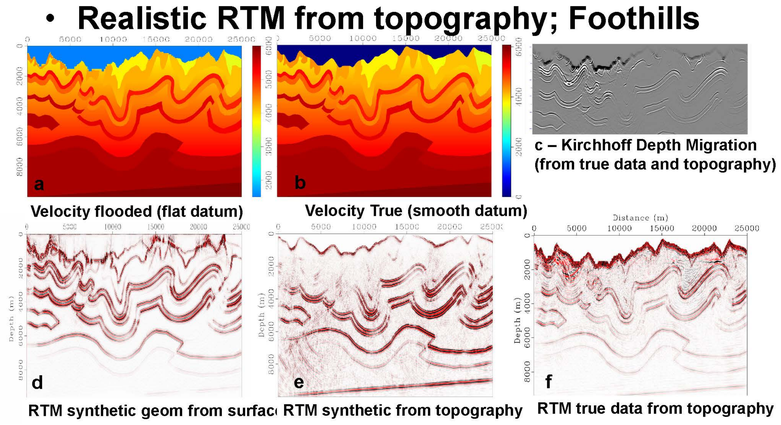
- **Realistic RTM tests Salt, beyond inverse crime**



Towards realistic testing is a project devoted to increase the reliability of seismic tests (modelling, migration, FWI and processing) by creating High Performance Computing tools with the functionality to work in large real data sets. They can read data from SEGY files for example. This allows us to work with external data and avoid the inverse crime pitfalls.

In addition, with these tools we can create synthetic tests matching original data and set upper-end quality control baselines. For example, in the figure, we see an RTM from original data, which we can compare with the inverse crime result where we predicted data without multiples. Or we can create models with multiples and alternative techniques and see the effect of multiples.

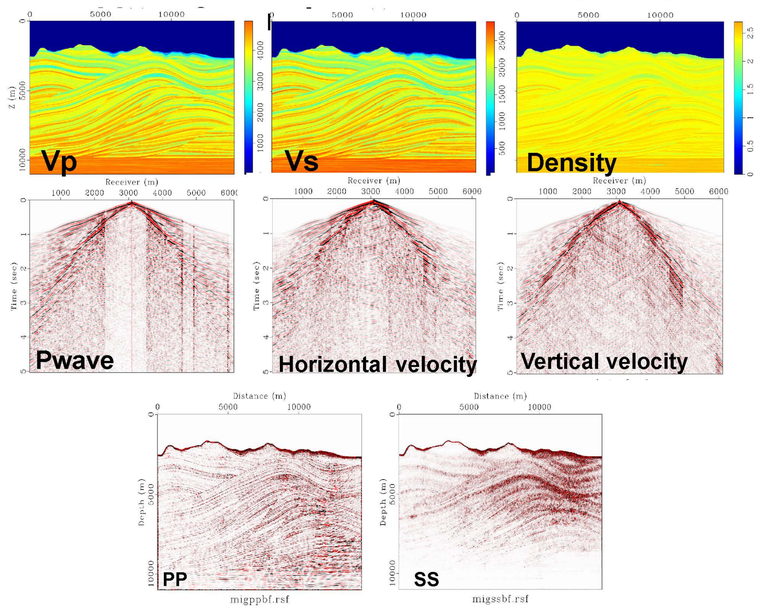
- **Realistic RTM from topography; Foothills**



The figure above illustrates different degrees of realism as we go from inverse crime with flat datum to realistic modeling from topography to no-inverse crime by working from original data.

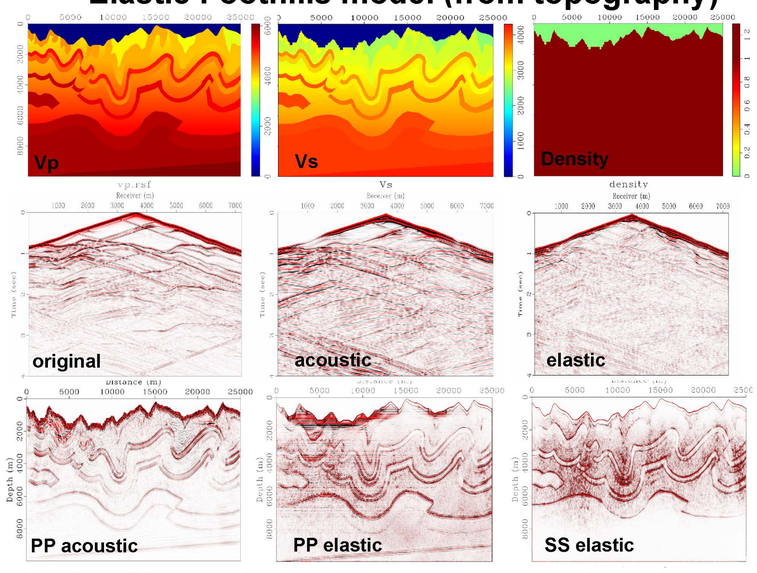
a) flooded topography (flat datum), b) real topography, c) Kirchhoff depth migration from real topography and original data, d) RTM from synthetic data on top of the flooded velocity, e) RTM from synthetic data modelled from the true topographic terrain, and f) RTM from true topography using original data. d) and e) are inverse crime scenarios, c) and f) are not.

- **SEAM 2 Elastic modeling from Topography**

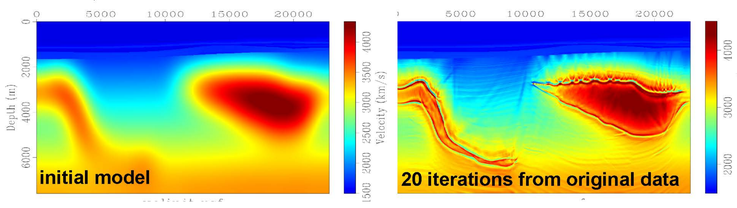


This project includes to model near-surface realistic noise with finite difference algorithms. For example, here we see data modeled from topography, which honour the boundary conditions and produces the Rayleigh and scatter waves. This near-surface noise can be used to realistically evaluate RTM and FWI. We see below RTM results for PP and SS from noisy data.

- **Elastic Foothills model (from topography)**

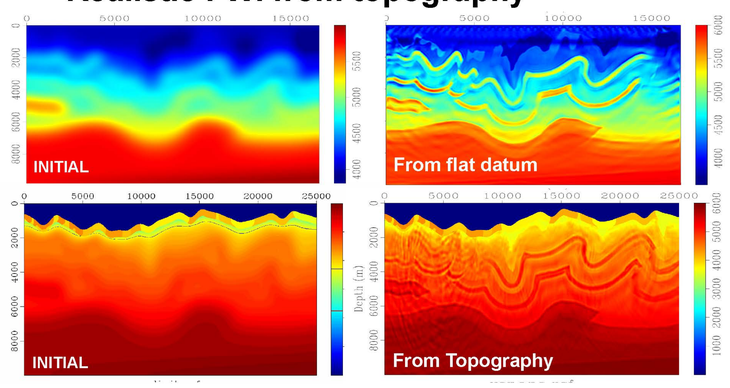


In the Figure above, we see a comparison between acoustic and elastic modelling and RTM, in all cases from topography. The elastic migration includes near surface noise, but the acoustic does not. .



Salt models are quite challenging because of difficult convergence but also because of their size. This Pluto FWI tests from 670 shots represents a problem 530 times larger than Marmousi (model size and data size)

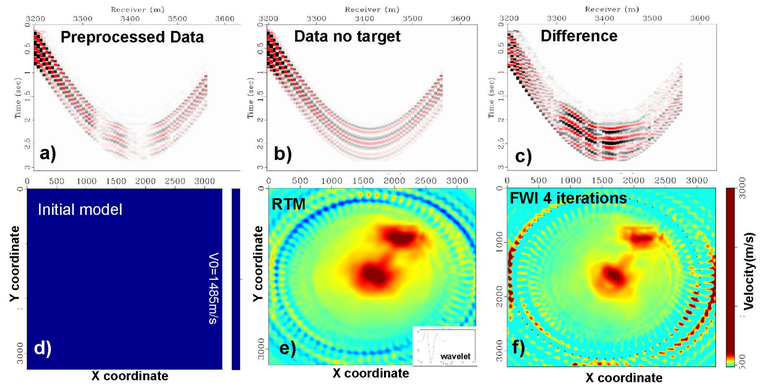
- **Realistic FWI from topography**



Here we emphasize the difference between unrealistic vs realistic tests. The result in the top cannot be matched in real data because moving the data to a flat datum would distort the data too much. The example below, on the other hand, is data created from topography and therefore includes the complexities of near surface modeling.

Physical model data, using inverse crime to understand

In this example, we work first with matching synthetic data to understand the problem a) Original shot from physical model after mute, b) true wavelet. c) fake velocity model, d) shot from fake numerical model e) Ricker wavelet, f) FWI from synthetic (inverse crime).



All real physical model: a) Original shot after mute, b) Original shot without target. c) Difference, d) Initial model, e) RTM from difference, f) real data FWI (from difference)

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