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A recipe for consistent 3D management of velocity data and time-depth conversion using Vel-IO 3D

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3D geological model production and related basin analyses need large and consistent seismic dataset and hopefully well logs to support correlation and calibration; the workflow and tools used to manage and integrate different type of data control the soundness of the final 3D model.
Even though seismic interpretation is a basic early step in such workflow, the most critical step to obtain a comprehensive 3D model useful for further analyses is represented by the construction of an effective 3D velocity model and a well constrained time-depth conversion.
We present a complex workflow that includes comprehensive management of large seismic dataset and velocity data, the construction of a 3D instantaneous multilayer-cake velocity model, the time-depth conversion of highly heterogeneous geological framework, including both depositional and structural complexities.
The core of the workflow is the construction of the 3D velocity model using Vel-IO 3D tool (Maesano and D'Ambrogi, 2017; https://github.com/framae80/Vel-IO$_3$D) that is composed by the following three scripts, written in Python 2.7.11 under ArcGIS ArcPy environment:
i) the 3D instantaneous velocity model builder creates a preliminary 3D instantaneous velocity model using key horizons in time domain and velocity data obtained from the analysis of well and pseudo-well logs. The script applies spatial interpolation to the velocity parameters and calculates the value of depth of each point on each horizon bounding the layer-cake velocity model.
ii) the velocity model optimizer improves the consistency of the velocity model by adding new velocity data indirectly derived from measured depths, thus reducing the geometrical uncertainties in the areas located far from the original velocity data.
iii) the time-depth converter runs the time-depth conversion of any object located inside the 3D velocity model
The Vel-IO 3D tool allows one to create 3D geological models consistent with the primary geological constraints (e.g. depth of the markers on wells).
The workflow and Vel-IO 3D tool have been developed and tested for the construction of the 3D geological model of a [U+FB02]at region, 5700 km2 in area, located in the central part of the Po Plain (Northern Italy) in the frame of the European funded Project GeoMol.
The study area was covered by a dense dataset of seismic lines (ca. 12000 km) and exploration wells (130 drilling), mainly deriving from oil and gas exploration activities. The interpretation of the seismic dataset leads to the construction of a 3D model in time domain that has been depth converted using Vel-IO 3D, with a 4 layer-cake 3D instantaneous velocity model.
The resulting final 3D geological model, composed of 15 horizons and 150 faults, has been used for basin analysis at regional scale, for geothermal assessment, and for the update of the seismotectonic knowledge of the Po Plain.
The Vel-IO 3D has been further used for the depth conversion of the accretionary prism of the Calabrian subduction (Southern Italy) and for a basin scale analysis of the Po Plain Plio-Pleistocene evolution.

Maesano F.E. and D'Ambrogi C., (2017), Computers and Geosciences, doi: 10.1016/j.cageo.2016.11.013
Vel-IO 3D is available at: https://github.com/framae80/Vel-IO$_3$D