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The influence of velocity gradients choice in deep alluvial basin seismic site response

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(A) INTRODUCTION

The distribution of shear-wave velocities in depth is a key parameter to evaluate amplification effects.

The shallow subsoil, very important for strong motion related studies, has often a well defined velocity structure, inferred from different geophysical surveys. However when the engineering bedrock (*Vs*=800*m/s*) reaches high depths, the velocity structures are extrapolated, commonly with linear gradients.

The choice of a linear gradient represents a simplified approach, and is the most common case treated in literature. A more realistic choice could be represented by velocity gradients which follow exponential functions. (Kaufman, 1953).

The type of velocity gradient is crucial for seismic site characterization.

(B) METHOD

In this study we collect the velocity gradients obtained for different alluvial basins (see references in Figure 1). All of these authors follow the base equations used to obtain the distribution of shear-wave velocity (*vs*) in depth (*z*):

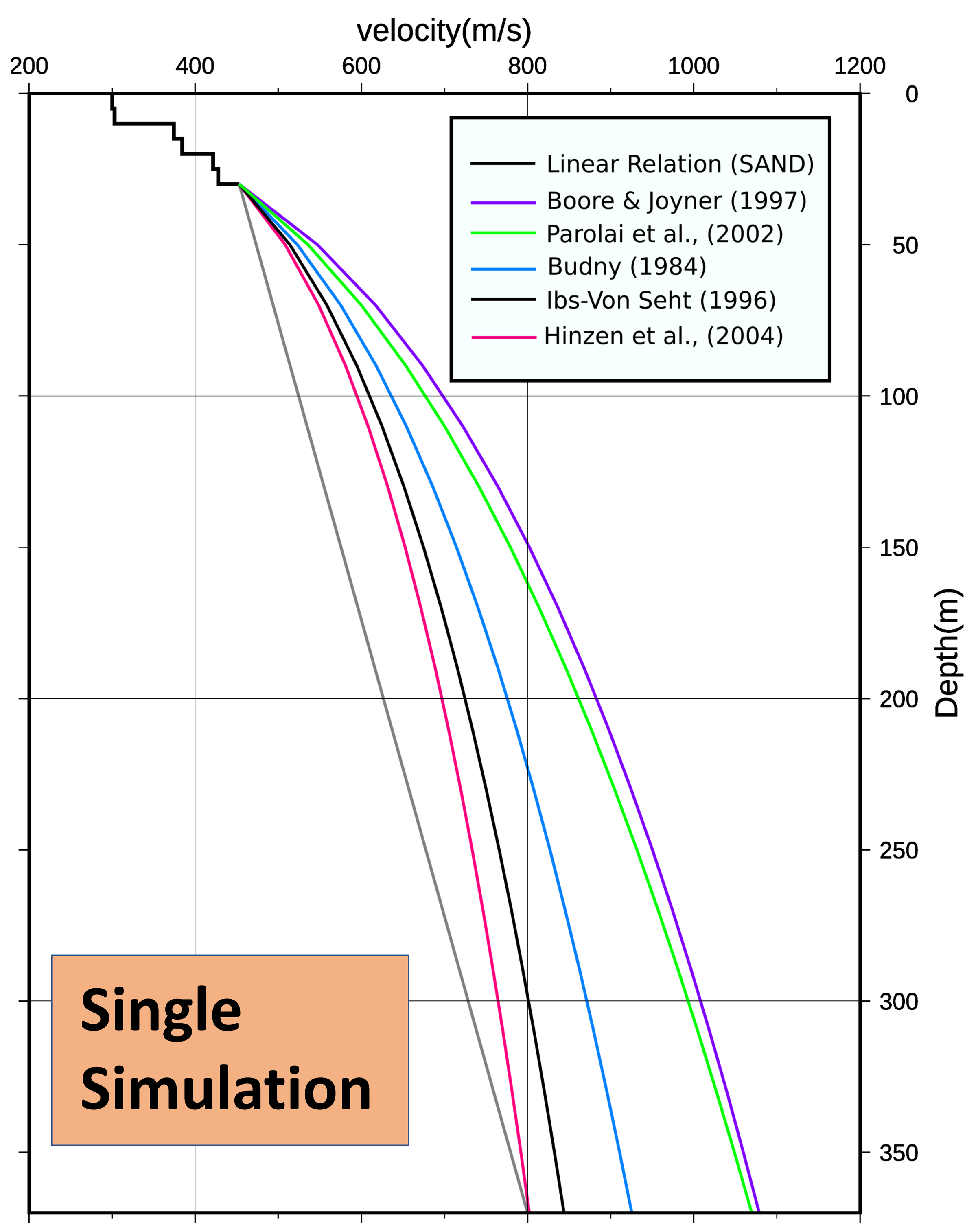
$$vs(z)=v_0(1+z)^x$$

- v_0 : surface shear-wave velocity
- x: dependence of velocity in depth. $x \in]0,1[$, which holds for each $z \geq 0$

We perform simulations for each type of gradients (including the linear one) using STRATA program, performing site response analysis in the frequency domain using time domain input option (the accelerogram of Friuli Earthquake, 6/5/1976, Mw: 6.5).

(C) PRELIMINARY RESULTS

Figure 1



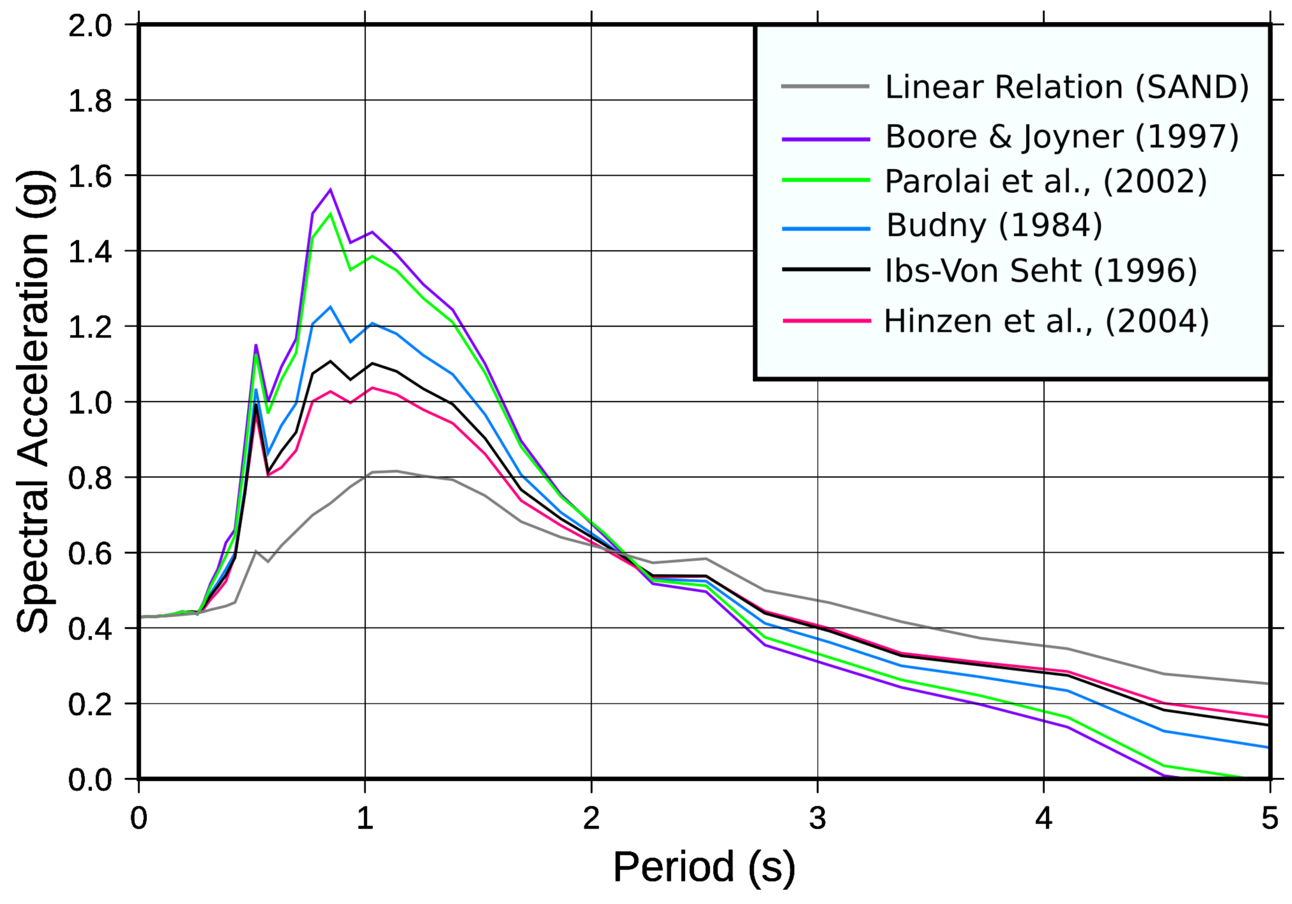


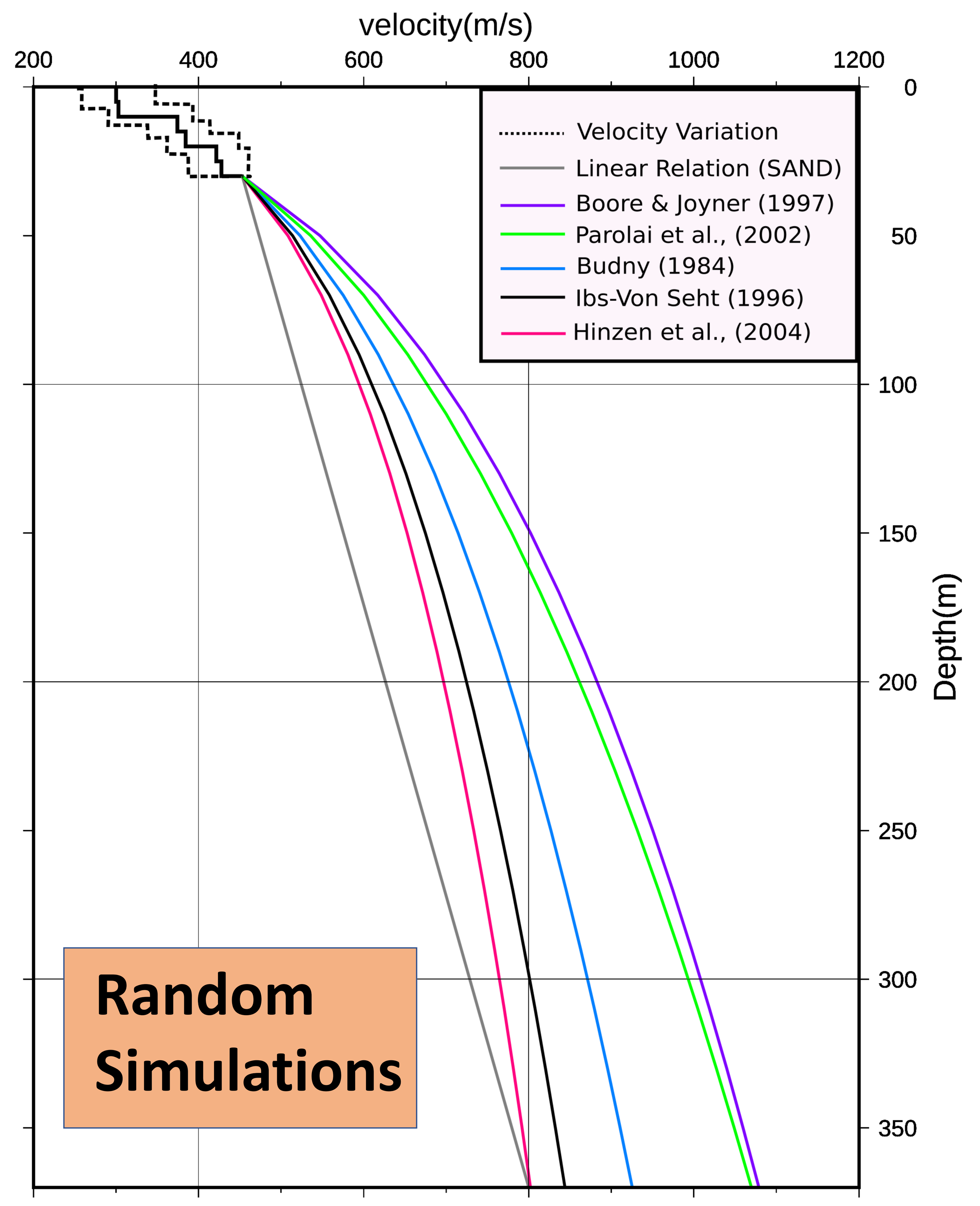
Figure 1. For the upper 30 meters of the subsoil we consider a mean shear-wave profile typical of a sand deposit. Below the 30 meters we consider different type of exponential gradients found in literature and the linear gradient. The linear gradient is built assuming a seismic bedrock reaching a depth of 370 m; the acceleration spectra obtained for each velocity gradient are also shown.

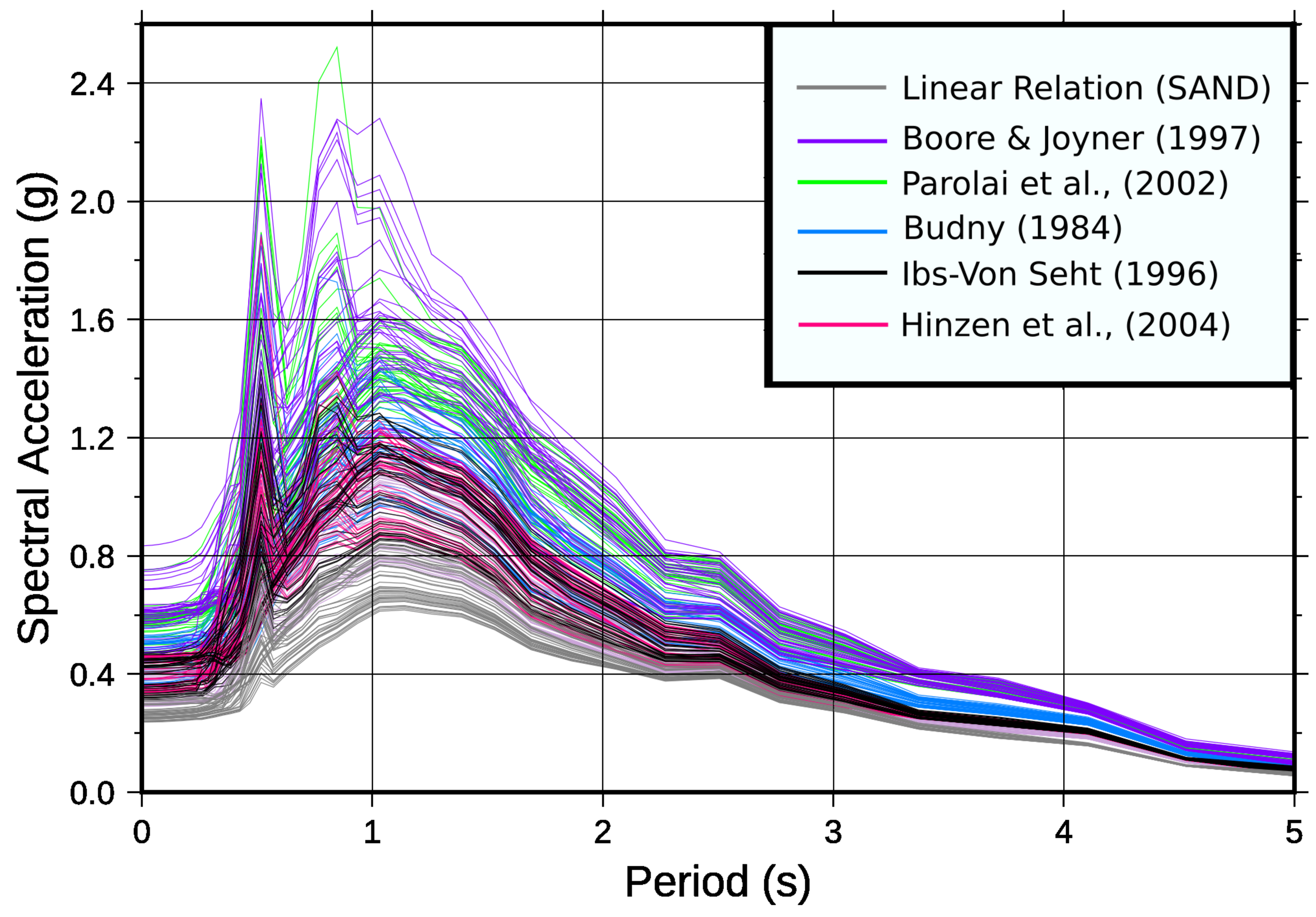
Figure 2. Probabilistic analysis with Monte Carlo method. We consider a population of 50 random velocity profiles and we plot the response spectrum of each realization.

There are differences for the maximum values of spectral acceleration (ξ=5%); in particular the simplified approach of the linear gradient underestimates the acceleration.

In general, **the choice of velocity gradient is of paramount importance for ground response analysis and, consequently, for seismic hazard assessment** (Cascone et al., 2020)

Figure 2





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