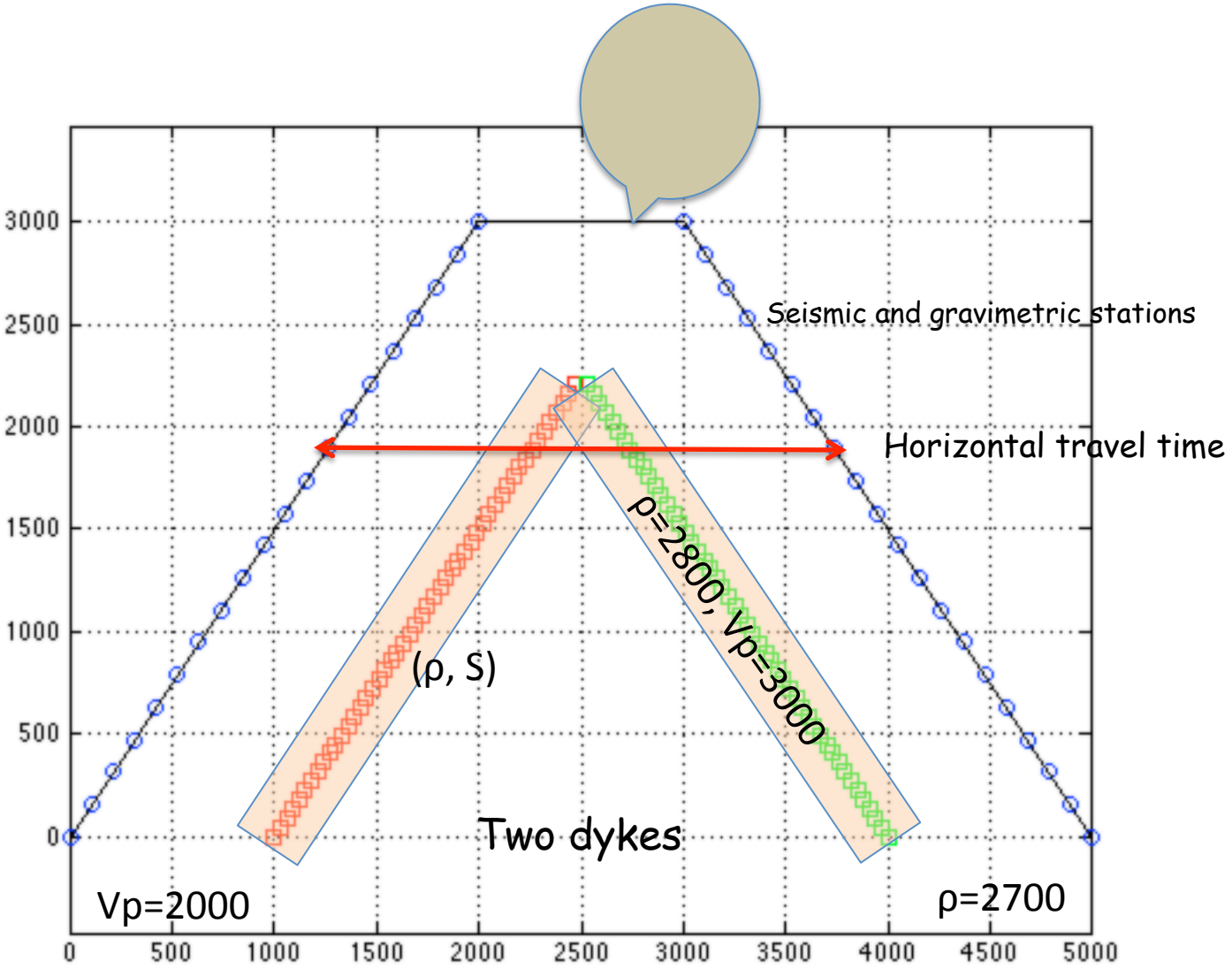
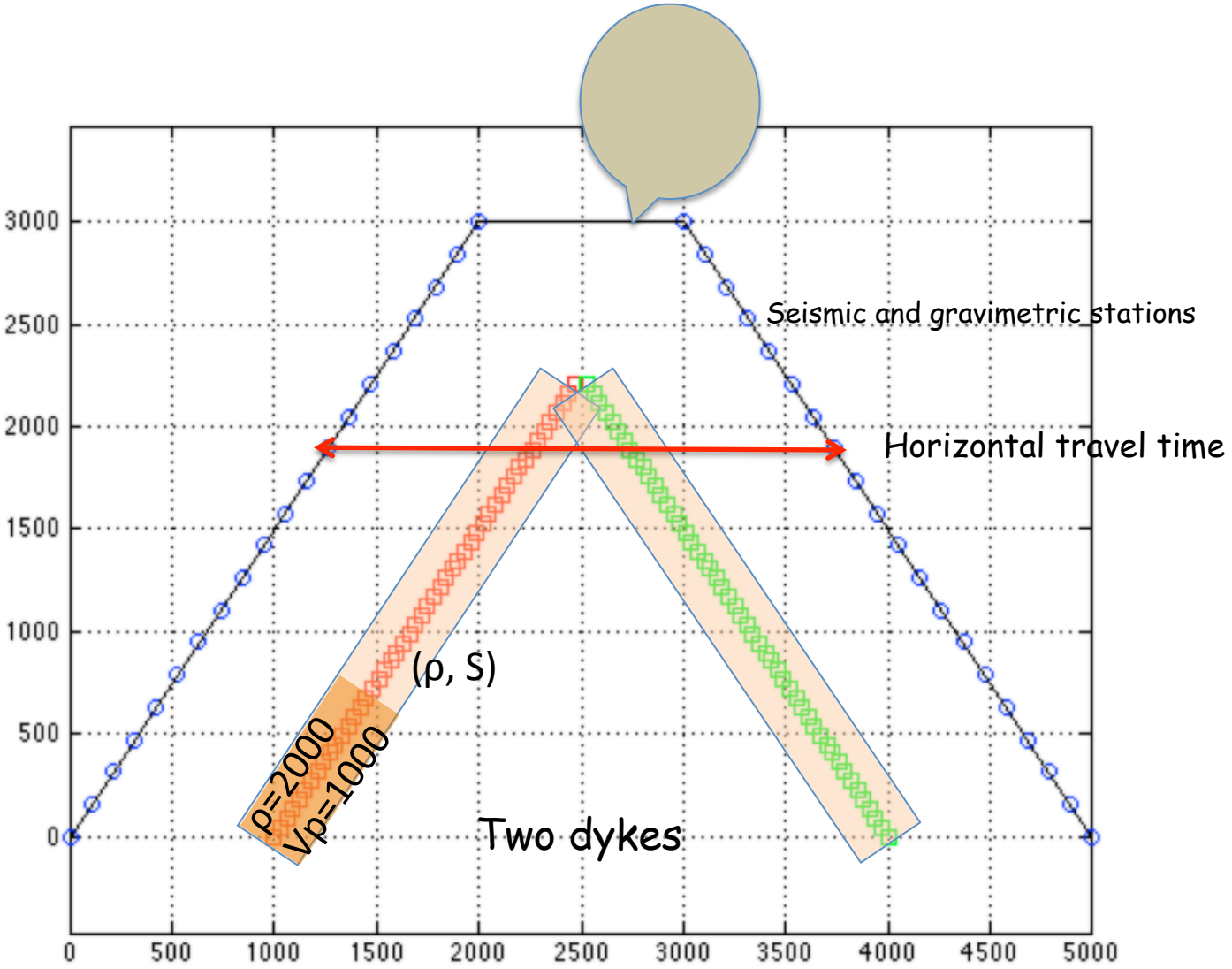
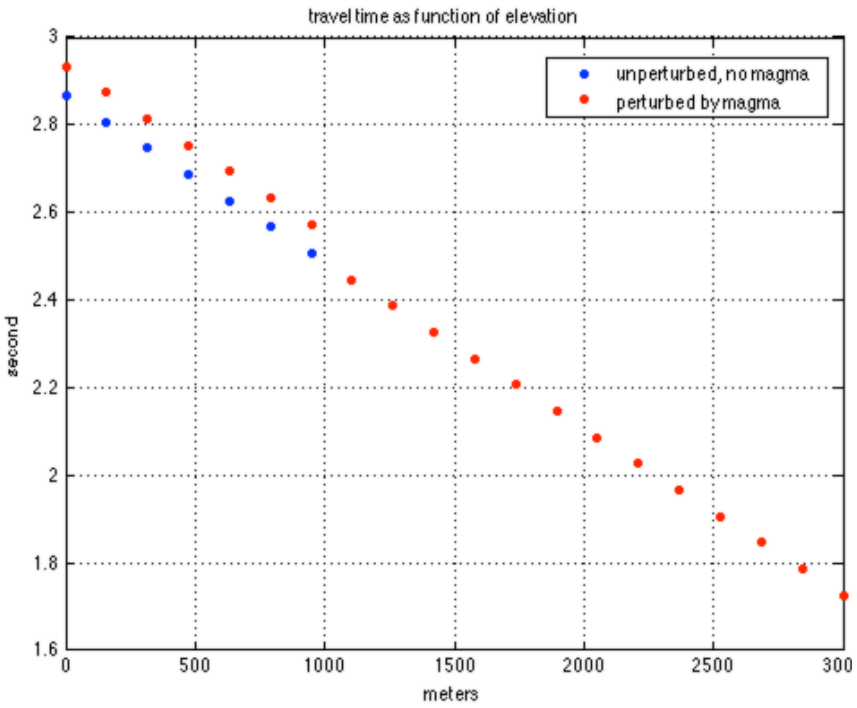
A joint inversion: seismic and gravity on a volcano (active…)

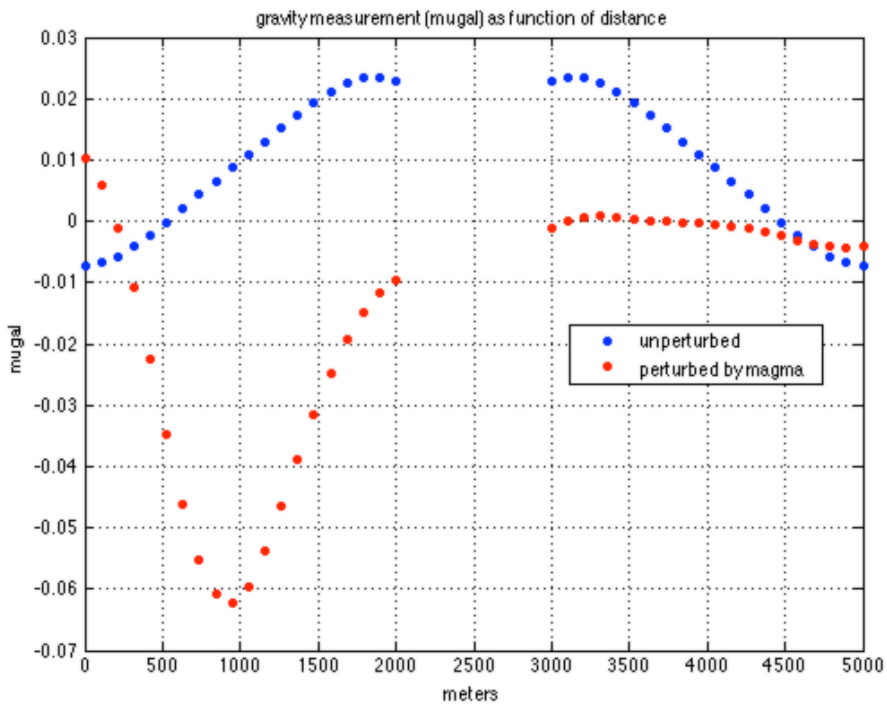


A joint inversion: seismic and gravity on a volcano (active…)



Joint inversion: an experiment





How to solve ?

$$\underbrace{\left\| G.m - d \right\|^2_{\mathbf{C}d}}_{\text{data}} + \underbrace{\left\| m - m_{prior} \right\|^2_{\mathbf{C}_m}}_{\text{model}} + \underbrace{\left\| S - f(\rho) \right\|^2_{\mathbf{C}_\rho}}_{\text{coupling}}$$

Assume a linear coupling between ρ and S:

$$\left\| G.m - d \right\|^2_{\mathbf{C}d} + \left\| m - m_{prior} \right\|^2_{\mathbf{C}_m}$$

Joint inversion: an experiment

$$\vec{d} = \mathbf{G}\,\vec{m}$$

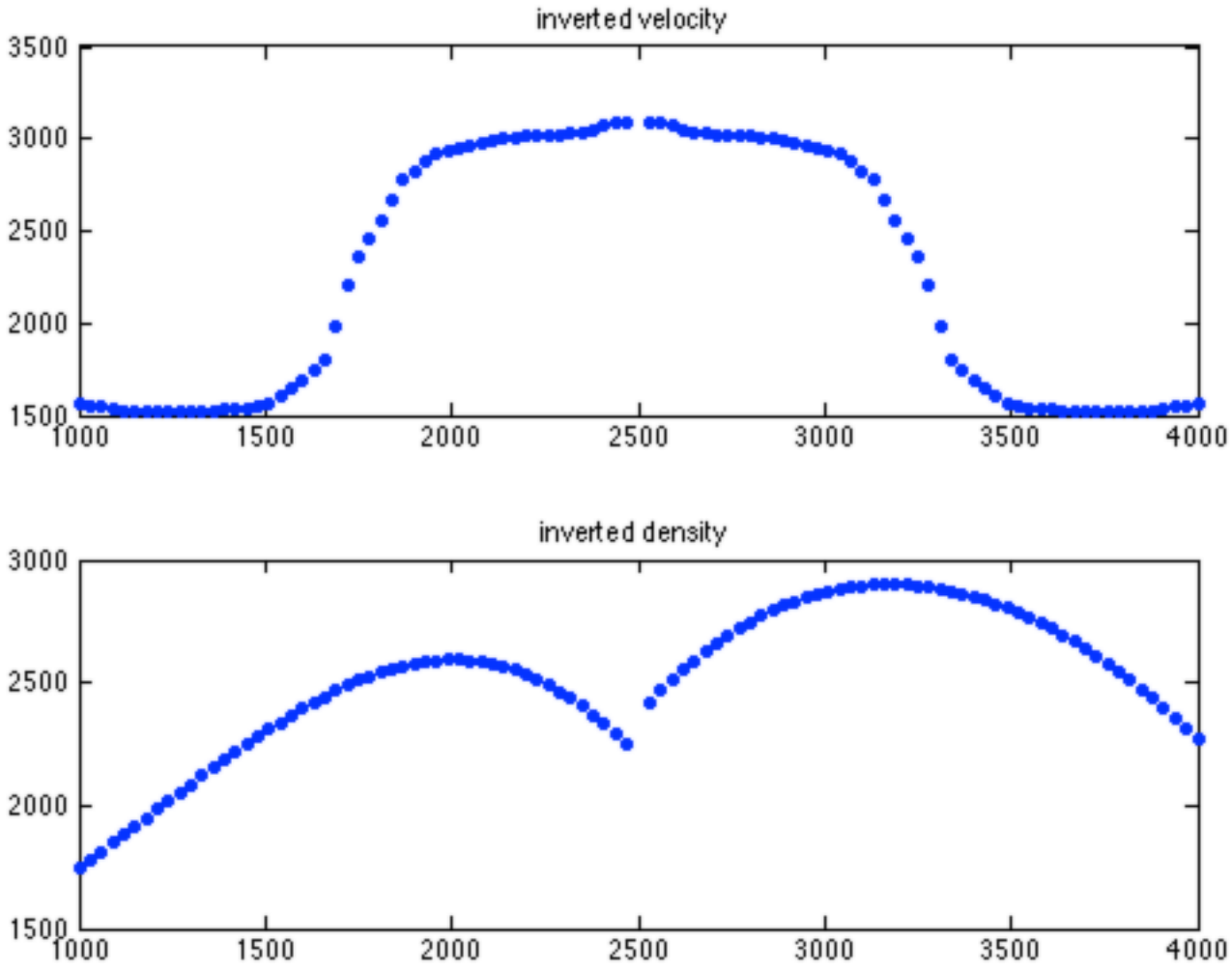
$$d = \begin{bmatrix} \text{ns} \times \textit{travel times} \\ \text{ns} \times \textit{gravity left slope} \\ \text{ns} \times \textit{gravity right slope} \end{bmatrix} \quad G = \begin{bmatrix} \dfrac{dT_{ravelTime}}{dS_{lowness}} & 0 \\ 0 & \dfrac{dG_{ravity}}{d\rho_{ensity}} \end{bmatrix} \quad m = \begin{bmatrix} \text{np} \times \textit{slowness dyke 1} \\ \text{np} \times \textit{slowness dyke 2} \\ \text{np} \times \textit{density dyke 1} \\ \text{np} \times \textit{density dyke 2} \end{bmatrix}$$

$$C_d = \begin{bmatrix} \sigma_t & 0 & 0 \\ 0 & \sigma_g & 0 \\ 0 & 0 & \sigma_g \end{bmatrix} \qquad C_m = \begin{bmatrix} \sigma_{S_{dyke1}} & 0 & coupling & 0 \\ 0 & \sigma_{S_{dyke2}} & 0 & 0 \\ coupling & 0 & \sigma_{\rho_{dyke1}} & coupling \\ 0 & coupling & 0 & \sigma_{\rho_{dyke2}} \end{bmatrix}$$

$$\hat{m} = m_{prior} + (\mathbf{G}^{\mathbf{T}}\mathbf{C}_{\mathbf{d}}^{\mathbf{-1}}\mathbf{G} + \mathbf{C}_{\mathbf{m}}^{\mathbf{-1}})^{\mathbf{-1}}\mathbf{G}^{\mathbf{T}}\mathbf{C}_{\mathbf{d}}^{\mathbf{-1}}\left(d - G.m_{prior}\right)$$

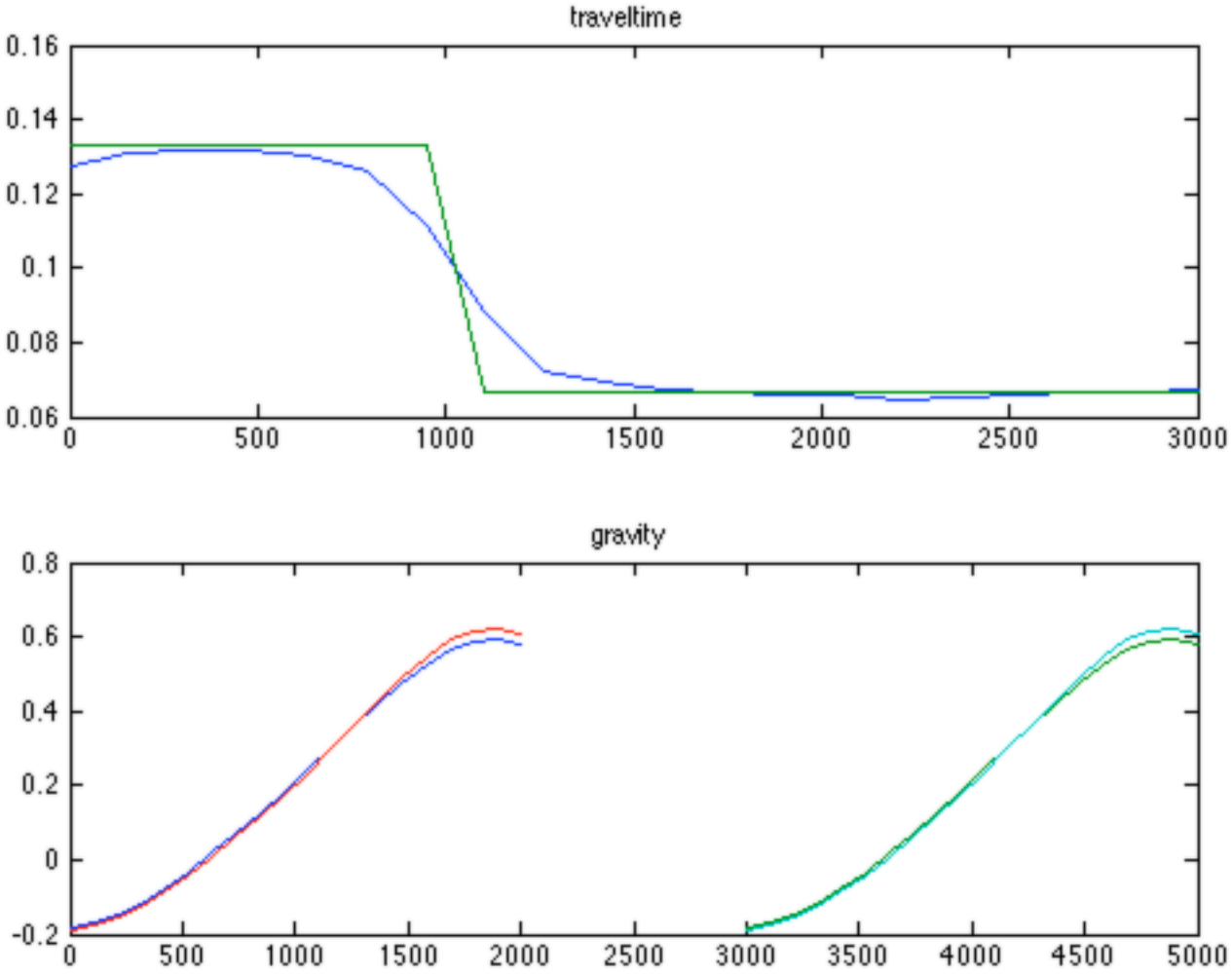
Joint inversion: an experiment

Independent inversion, no coupling

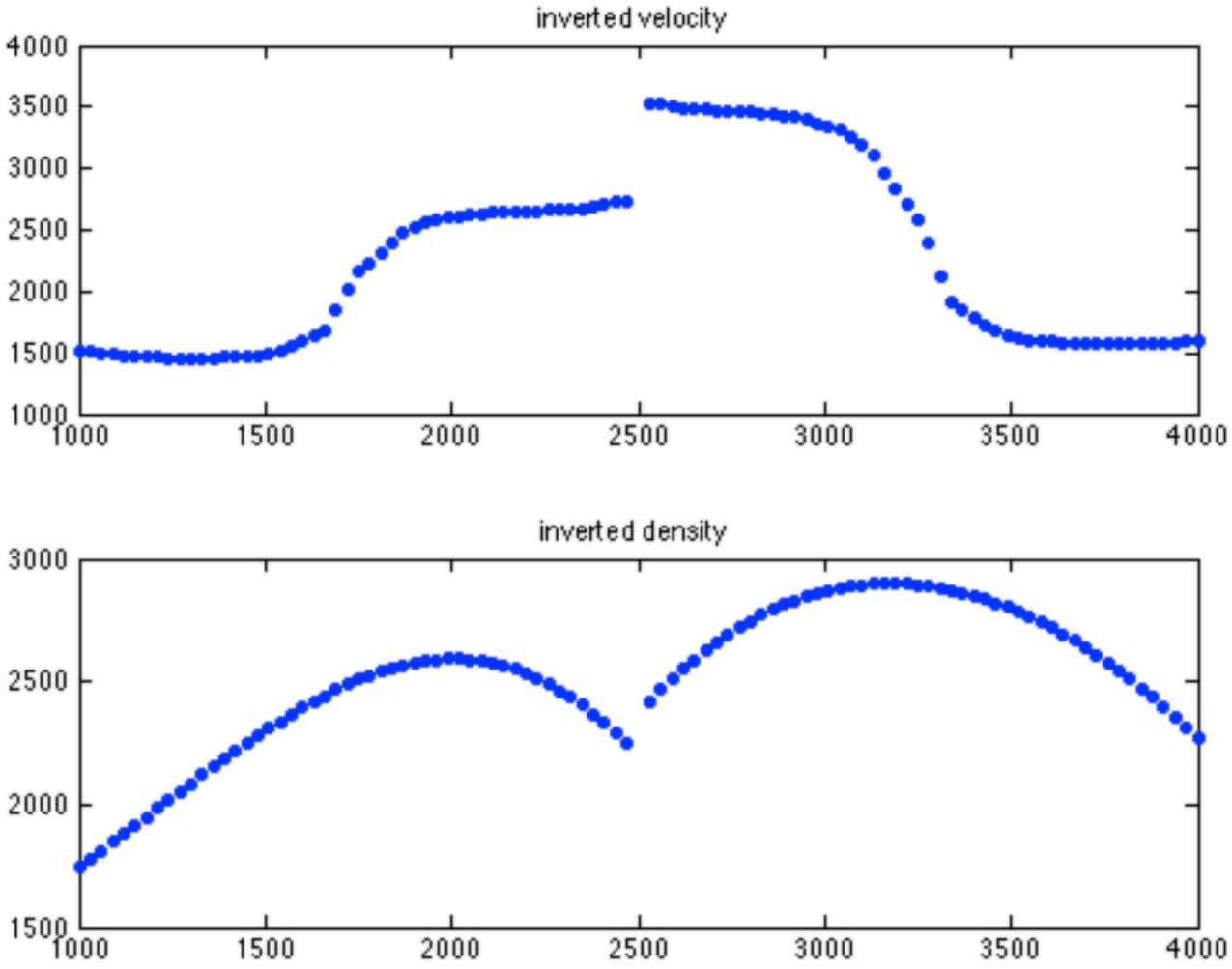


Joint inversion: an experiment

Independent inversion, no coupling



Joint inversion: data fitting



Joint inversion: data fitting