4. Model validation tests

4.1. Comparison with two-dimensional model results

The 3D model has been tested against the 2D model of Slingerland et al. (1994). The 3D model represents a continuous plate with 131 by 74 cells, with a mesh-size of 10 km and a 50 m tall sediment load of width 100 km in the middle of the plate, spanning the breadth of the plate (see Fig. 4).

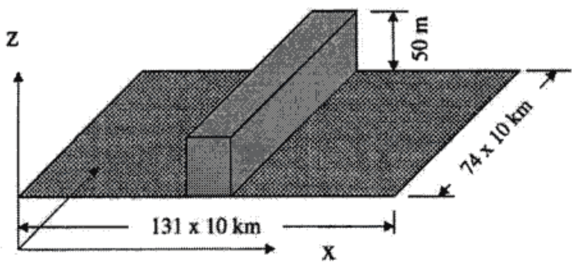

Fig. 4. 3D setting of 2D test case.

For a continuous plate with a load of finite width, ΔL, an analytic solution was derived by using Green's function (Slingerland et al., 1994). The deflection $w(x)$ is specified by two equations. One is applicable underneath the rectangular load, and the other applies to regions beyond the load.

Underneath the load:

$$w(x) = -\frac{K}{2}\left[2 - 2e^{-\lambda\Delta L/2}\cos\left(\frac{\lambda\Delta L}{2}\right)\right], \tag{9}$$

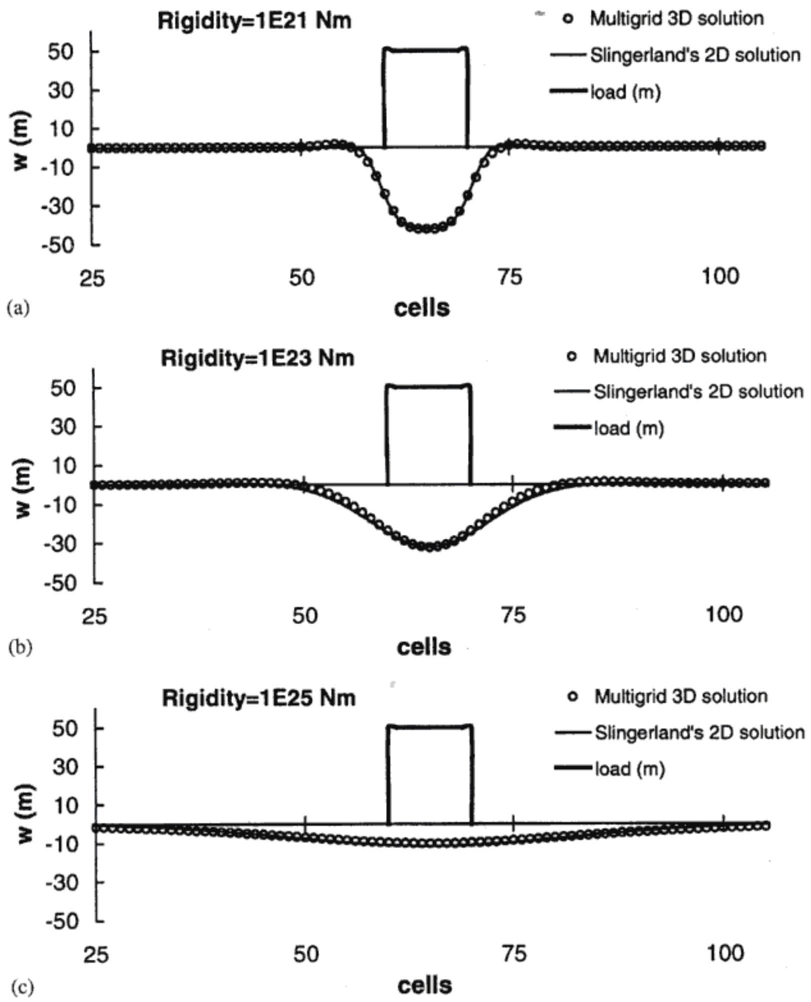

Fig. 5. Deflection curves calculated by Slingerland's 2D model and present 3D multi-grid solution. Elastic thickness Te: (a) 5.4 km, (b) 25.2 km, (c) 117.1 km.

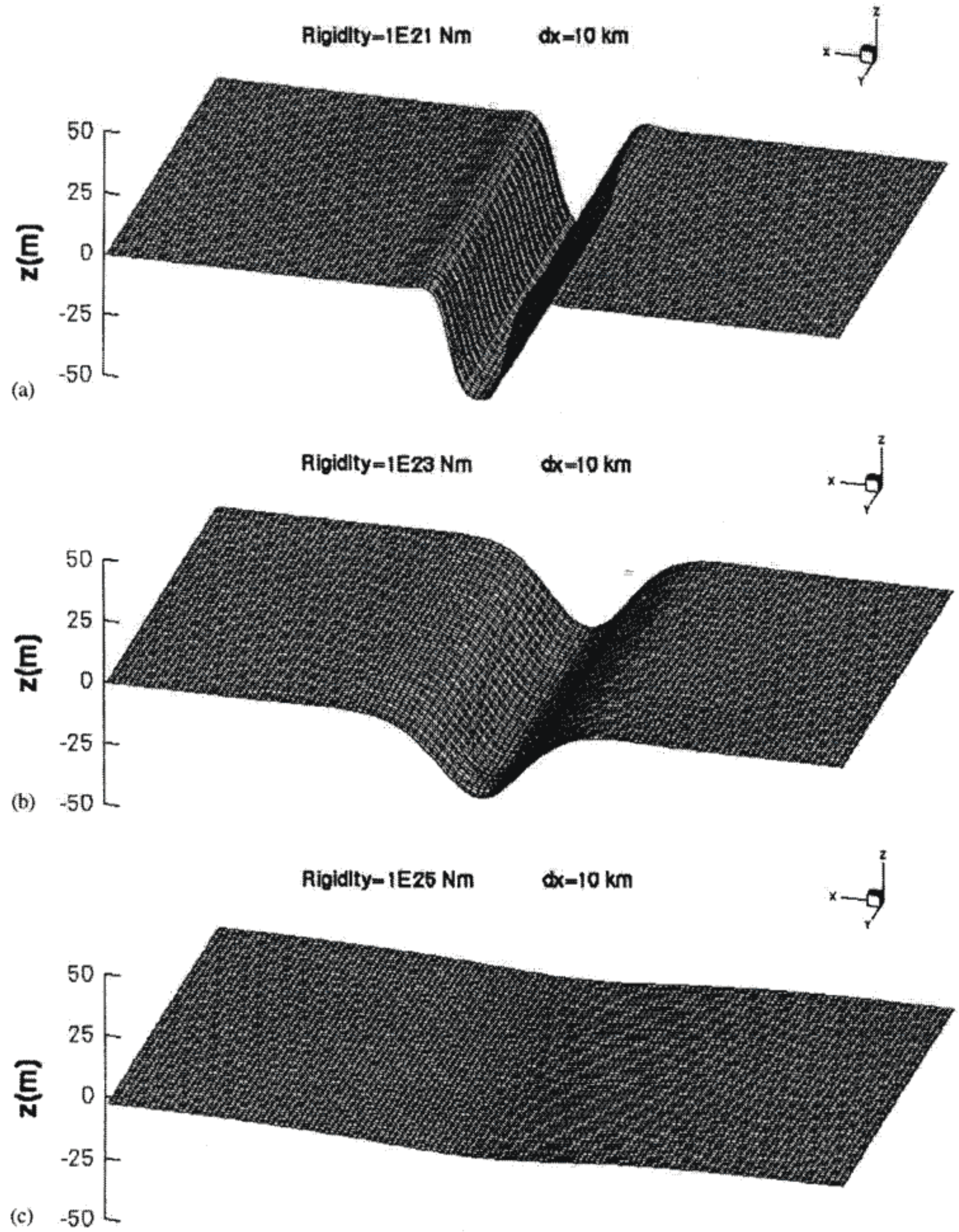

Fig. 6. Plate deflection under indefinite line-load (100 km × 50 m) by present 3D model. Elastic thickness Te: (a) 5.4 km, (b) 25.2 km, (c) 117.1 km.

Beyond the load:

$$w(x) = -\frac{K}{2}\left[e^{-\lambda\Delta L(c+\Delta L/2)}\cos(\lambda\Delta Lc) - e^{-\lambda\Delta L(c-\Delta L/2)}\cos(\lambda\Delta Lc)\right], \qquad (10)$$

where $K = \rho_{crust} - \rho_{air}/\rho_m - \rho_{air}$; $\lambda = [(\rho_m - \rho_{air})g/4D]^{1/4}$; ΔL is the width of load; c is the distance between the centre of the load and the current position.

In this 2D calculation the plate is represented by 131 units, each unit 10 km wide. The load is also divided into 10 load elements with uniform width of 10 km and 50 m high, e.g. $h_{load} = 50$ m. The density of the load, ρ_{load}, is 2200 kg/m^3. The results are shown in Fig. 5 in comparison with 3D solutions.

The flexural deflection results calculated by the present three-dimensional model are shown in Fig. 6.