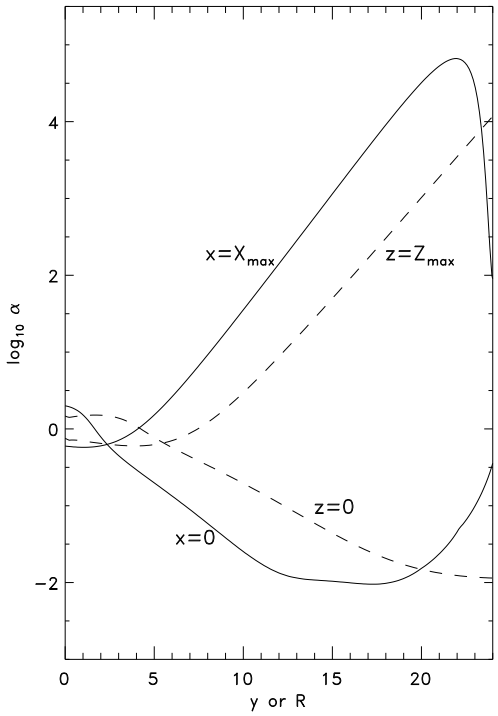

Fig. 10. Decadic logarithm of the ratio between the magnetic and gas pressures in the final state under constant gravity condition. The two solid lines give α values along the lines $x = 0$ and $x = X_{\max} = 15$ for the Cartesian model and the dashed lines give α along $z = 0$ and $z = Z_{\max} = 15$ in the axisymmetric case.

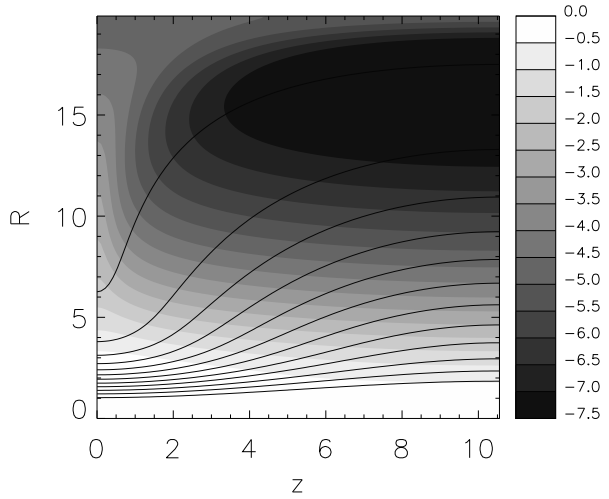

Fig. 11. Distribution of the volume density and magnetic field lines in the axisymmetric final equilibrium state in a non-uniform radial gravitational field with $s = 4$. In order to facilitate comparison with Figure 6 in which $H = 2$, distance is measured in units of $H/2$. Field lines (solid curves) were chosen so that they have the same magnetic strength in the initial state as those displayed in Figure 6.

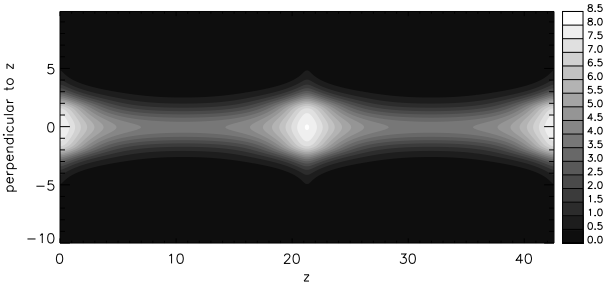

Fig. 12. Column density map for the final axisymmetric state along a line of sight perpendicular to the axis of symmetry (z-axis). We used $\alpha = 1$, $s = 4$ and $\lambda_z = 21.3$. The units of density and length are $\rho_0(0)$ and $H/2$, respectively. Note that the scale is linear.

that obtained in axisymmetric models with constant gravity but similar to that found in Cartesian models with uniform gravity.

5. DISCUSSION AND CONCLUSIONS

The Parker instability dictates that longitudinal magnetic field lines that give some support against gravity are always unstable to undular perturbations. It has long been realized that the Parker instability, which is interesting in itself, may play a significant role in understanding the formation of massive clouds in the interstellar medium, probably aided by thermal and gravitational instabilities (Mouschovias et al. 2009). The Parker instability can also play a role in the evolution of filamentary structure, such as filamentary clouds, at least at the early stages of the instability. While the properties of the final states are well documented for Cartesian models (e.g., M74; Basu, Mouschovias, & Paleologou 1997; Kim et al. 2001), it was unclear how they depend on the adopted geometry. In order to fill this gap, our primary goal was to investigate the nonlinear outcome of such an instability in an axisymmetric model where the initial equilibrium configuration consists of a infinite cylinder in the presence of a longitudinal magnetic field. We quantified the level of buoyancy of the magnetic field and drainage of the gas to promote density enhancements, as compared to the Cartesian models, which are currently being used to study the formation of substructure in the interstellar medium. We focused on understanding the physics of the Parker instability in filaments, rather than on making detailed comparisons with ob-