Discussion

We were able to replicate the chaotic behaviour displayed by the model of Hastings and Powell. Indeed, the Poincaré sections (fig. 4 (a, c)) plotted (x,y) coordinates of points of the phase plots that theoretically coincided with the plane in the "handle" of the teacup-shaped diagrams. The Poincaré sections being almost unidimensional, we considered, as explained in the original paper, a single variable within our Poincaré maps (fig. 4 (b, d)). The slopes of these latter graphs denoted chaos, as specified by Hastings and Powell. The effect of initial conditions on the diverging trajectories of the model (fig. 2), its unending cycles (fig. 1), and the existence of the bifurcation diagrams (fig. 3) were also indicators of chaos.

Explain differences of fig. 1

Explain differences of fig. 2

Explain differences of fig. 3

We believe that our mixed results in attempting to replicate fig. 4 came from the algorithm we used to identify the points that coincided with the plane. We indeed specified a tolerance value (epsilon), which defined a region under and above the plane. The region was also defined by manually chosen values of x and y, which allowed us to target the "handles" of the phase plots. We kept the points that were inside the region and plotted them as needed in order to form our Poincaré sections and maps. Although we were able to precisely replicate the Poincaré sections for b_1 = 3.0 (fig. 4 (a)) and 6.0 (fig. 4 (c)), the Poincaré maps need some refinement. For b_1 = 3.0 (fig. 4 (b)), it lacked some points of the phase plots and included others that were closed yet non-coincident with the plane. For b_1 = 6.0 (fig. 4 (d)), the discrepancy was more obvious, and might be due to the more chaotic behaviour of the system under this parameter, observed for instance from the larger width of its "handle" (compare axis intervals of fig. 4 (a, c)). We are still working on improving our algorithms to adequately replicate Hastings and Powell's Poincaré maps.