**S1 Eq** To account for the difference in variability between the correlation coefficients of each pair of orbits, we also computed the following standardised distance $\delta_{std,M_k}$ between $GCM(M_k)$ and $\overline{GCM}_M$ where $\sigma(i,j)$ is the standard deviation of the correlation coefficients of the pair of orbits $(i,\, j)$ under $H_0$. We built the test by computing $\eta$ the number of times the standardised distance between $GCM_G$ and $\overline{GCM}_M$ is smaller or equal to the distance $\delta_{std,M_k}$. The $p$-value [50] is defined by $\hat{p} = (\eta+1)/(K+1)$. The larger the $p$-value, the less evidence against $H_0$.

$$\delta_{std,M_k} = \sqrt{\sum_{i=1}^{11} \sum_{j=i+1}^{11} \left( \frac{\overline{GCM}_M(i,j) - GCM(M_k)(i,j)}{\sigma(i,j)} \right)^2} \qquad (1)$$