This directory contains the code for one particular sensitivity analysis of the planets simulation:

Name: subsequent mutations

Description: In the standard model, the feedbacks are fixed at the beginning and not subsequently altered. It is possible, however, that significant changes to planetary climate systems could take place at times between 0 and 3 billion years, as argued by Ford Doolittle. Such changes could have occurred on Earth at the time that plants colonised the land and the first forests spread out across the land. Another example step-change, according to the ‘giant-impact hypothesis’, arose as a result of the impact of a small planet (‘Theia’ in the literature on the subject) with the Earth, which led to the creation of the Moon. The possession of the Moon may have had (although some argue otherwise) a stabilising effect on Earth’s climate after the event.

One-off mutations to the climate system were implemented by adding a random number of mutation events, each one occurring at a random time with the 3 billion years. Each mutation event was of a random type, out of 4 possible types. The first type is a step change to *f* of the same value, for all values of *T*. The second type is the addition of a negatively or positively sloping line crossing the y-axis at *Tmid* (adding to *f* at *Tmin*, the opposite at *Tmax*, and adding nothing at *Tmid*). The third type is the addition (or subtraction, depending on a random number) of a pyramid-type function which increases (decreases) linearly from zero at *Tmin* and *Tmax* to a maximum (minimum) of at *Tmid*. The fourth and final type is the addition of a Gaussian function of maximum amplitude , centred randomly anywhere within the habitable range and standard deviation ('width') equal to one-tenth of the habitable range.

The following files were altered in order to implement this sensitivity analysis:

planets\_ODE.m

ts\_slave.m

plot\_history.m

The following files were created in order to implement this sensitivity analysis:

determine\_mutations.m

update\_mut\_effects.m

plot\_current\_feedbacks.m