Referee 1

Many thanks for the constructive suggestions. Our responses are in red text below.

The paper describes PLASIM-GENIE a new intermediate-complexity Atmosphere- Ocean Earth System Model, designed for simulations of millenium+ length. The new model is well suited for studies of long-term climate change, its simulation of present-day climate is acceptable, its formulation is mostly described well, and I recommend publication subject to the following changes being made.

1. It's not 100% clear whether or not this model has a carbon cycle, and what aspects of this are turned on or off. The model is described as an AOGCM (suggesting no C-cycle), but section 2.1 and others do allude to the simulation of different carbon pools on land, which is slightly confusing. I presume there is some sort of diagnostic C-cycle which does not affect atmospheric CO2, but does affect vegetation. However GENIE- 1 does contain a fully interactive C-cycle. The abstract, introduction, section 2.1 and other sections have to be clearer about which parts of the C-cycle are on or off. Any flexibility in the C-cycle (ie: being run in a diagnostic mode to simulation terrestrial pools but without affecting the ocean and atmosphere) should be noted, as potential users of this AOGCM would be interested in this.

As suggested, we have added flexibility to the run the terrestrial carbon cycle in diagnostic mode. If parameter nbiome is set to 2, the calculation of land surface characteristics depends only upon the initialised vegetation state (e.g. from an existing spin-up), but the vegetation is allowed to dynamically evolve.

"ENTS can be run in a diagnostic mode (setting parameter *nbiome*=2), simulating terrestrial carbon pools without affecting the climate state."

We have now clarified in the abstract and introduction that the coupling is only to the physical components of the GENIE framework. Additionally we have added explanatory text in section 2.1:

"We note that although ENTS is formulated in terms of carbon densities, we have not coupled PLASIM-ENTS to the GENIE-1 carbon cycle; this extension is straightforward in principle and will be addressed in future work."

2. What is the difference between PLASIM-GENIE and OSU-Vic? Is the UVic ocean component a frictional geostrophic model like GENIE? OSU-UVic is also downloadable, so potential users of PLASIM-GENIE should know the differences between the two.

We have clarified with the additional text in section 4.1.1:

"The most significant difference between PLASIM-GENIE and USOVic is the differing complexity of the ocean models; USO-Vic incorporates the more

complex primitive-equation Modular Ocean Model (MOM) version 2.2 (Pacanowski 1995) at a horizontal resolution of 1.8° x 3.6°. The primitive equations include momentum advection terms neglected in our system."

3. The following parameterisations in section 2.1 need to be clarified/described in more detail (a sentence or two on each will do): -"shortwave and longwave radiative transport"; this is a very confusing term and in particular needs clarifying -"interactive clouds"; are these based on relative humidity? -"diffusive transport"; I guess this is some sort of hyperdiffusion? -how many visible and IR bands are there in PLASIM's radiation scheme?

We have now expanded the description of parameterisations in section 2.1:

"PLASIM (Fraedrich 2012) is a reduced complexity AGCM, with the 3D primitive equation atmosphere model PUMA at its core (Fraedrich et al 2005). PLASIM is described in detail in Lunkeit et al (2007) and references therein. We summarise briefly here. The atmospheric dynamics are solved using the spectral transform method, formulated for temperature, log surface pressure, divergence and vorticity. The short wave radiation scheme separates solar radiation into two bands, $\lambda<0.75\mu m$ (with cloud scattering, ozone absorption and Rayleigh scattering) and $\lambda>0.75\mu m$ (with cloud scattering, cloud absorption and water vapour absorption). The long wave radiation scheme uses the broad band emissivity method, with the (greenhouse gas) effect of water vapour, carbon dioxide and ozone included in the calculation of emissivity. Ozone concentration is prescribed with an analytic spatio-temporal distribution. Cloud emissivity is calculated from the cloud liquid water content. Fractional cloud cover is diagnosed from relative humidity (stratiform clouds) and from the convective precipitation rate (convective clouds). Other parameterised processes include large-scale precipitation, moist convection (both cumulus and shallow), dry convection, boundary layer heat fluxes, vertical diffusion (to represent unresolved turbulent exchange) and horizontal diffusion (applied to selectively dampen short wavelengths in spectral space)."

4. Section 3.2: Radiation and convection seem to account for a very large percent- age of the CPU load: potential users might want to replace the radiative scheme with something that is quicker- but also more general and flexible, e.g. a simpler semi-grey scheme (e.g. one LW band emits from the surface, one from the atmosphere depend- ing on some simplified optical depth). Could the authors add a sentence on how easy this might be to do (from the point of view increasing this model's potential user base)

We have added text in section 3:

"We note that the modular structure of PLASIM means that replacing the radiation scheme with, for example, a computationally fast semi-grey scheme (Frierson et al 2006) would be relatively straightforward. An efficient convective adjustment scheme (Betts and Miller 1986) is already available as an alternative to the default moisture budget scheme (Kuo 1965, 1974)."

5. Section 3.3: Why does conversion from PE to KE necessarily cause an energy imbalance? This should be explained in detail- or at the very least a citation to other work that clearly explains why the imbalance happens should be included.

We have added explanatory text in section 3.3:

"We note that the PLASIM atmosphere does not precisely conserve energy, as illustrated by Hoskins and Simmons (1975) for a similar dry dynamical core. The largest effect in PLASIM comes from the conversion from potential to kinetic energy. This conversion cannot be formulated in a conservative manner in the semi-spectral scheme since it involves triple products while the (Gaussian) grid only allows for the conservation of quadratic quantities."

6. Figures 2,3,4: it is very hard to see what the differences between model and reanalysis are without difference plots. Contours plots of differences between PLASIM-GENIE and reanalysis need to be made for these three figures so readers can see what and where they are for themselves.

Difference plots have been added to Figures 2, 3, and 4.

7. Suggestion: the simulation of aridity seems pretty good- the authors might want to state the simulation of aridity in the abstract so potential users who are interested in model/observations comparisons are more likely to investigate the rest of the paper.

Text added to abstract:

"The simulated climate is presented considering (i) global fields of seasonal surface air temperature, precipitation, wind, solar and thermal radiation, with comparisons to reanalysis data; (ii) vegetation carbon, soil moisture and aridity index; (iii) sea surface temperature, salinity and the meridional Atlantic and Pacific streamfunctions. Considering its resolution PLASIM-GENIE reproduces the main features of the climate system well and demonstrates usefulness for a wide range of applications."