We thank Dale Allen for engaging in the discussion. His comments are insightful and we hope that our responses will help to stimulate future discussion on what are fundamental questions for the parametrisation of lightning. We specifically address the points below.

Well written paper
I have three questions:
How would the ice-flux parameterization compare to a similarly formulated mass-flux parameterization? It should be better, but how much better?

RESPONSE. We explored the question whilst developing the parametrisation. To give a quantitative response we have found the correlation of mass flux at 440hPa against LIS using the same approach as in Fig. 2 with cloud ice flux at 440hPa. The mass flux-only variable has a correlation with LIS of 0.51 over land and 0.23 over ocean. In relation to the third question, it would seem that the cloud ice flux variable has made clear improvements over land but has not made similar improvements over the ocean.

Would the CTH scheme perform better if marine flashes were assumed to have the same power dependence as continental flashes, albeit with a smaller constant in front.

RESPONSE. We have not attempted to alter the existing parametrisation since justification for the ocean power was given in the original Price and Rind (1992) article on CTH. However, the effects of such a change would be to amplify higher flashrate estimates over oceans and dampen low flashrates. Given the incorrect focus of the parametrisation along the ITCZ we believe the higher power could only have a negative impact on the ability to estimate flash rates.

Any thoughts as to why separate land/ocean parameterizations are needed even with ice-flux?

RESPONSE. The mixed-phase microphysics and dynamics of oceanic deep convection are still a topic of research which makes it difficult for models to fully represent this. Even if we were sure of the representation of deep convection over the oceans then this parametrisation still does not represent all aspects of the non-inductive charging mechanism as the features required are still in development in large-scale models. It is clear, for example that the downward flux of graupel is important for the production of lightning; Deierling et al. (2008) found that including graupel provided an improvement. However, graupel is not a variable available in ERA-Interim. It may be that graupel is not present in sufficient quantities in the charging zone in deep oceanic convection.

One final hypothesis that the authors put forward is that of differing lightning characteristics over the ocean such as in the energy, power or duration of flashes. Recent research using a variety of data types has demonstrated different characters between land and ocean flashes such that

ocean flashes are more energetic, powerful or longer (Hutchins et al., 2013, Said et al., 2013, Petersen and Chuntao, 2013, Beirle et al., 2014). If this is the case then using the charging theory alone may not fully explain the variance in flash frequency density. The characteristics of lightning may also hold important information regarding the variance in emissions from lightning. We have decided to include this hypothesis in the discussion in the hope it will encourage future work on lightning parametrisations to include ideas about such characteristics.