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Interactive comment on "Sustainable use of renewable resources in a stylized social-ecological network model under heterogeneous resource distribution" *by* W. Barfuss et al.

Anonymous Referee #2

Received and published: 11 November 2016

Dear Editors,

General comments:

I think this manuscript presents a very important step forward in the analysis of social-ecological networks by considering explicitly resource heterogeneity. I endorse all comments made by Referee #1, and will provide observations on topics not covered in said previous review. In general the paper is very well written and results are clearly presented. Finally, I also will recommend inviting the authors to carry out a major revision.

Specific comments:

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Discussion paper

In page 3 the idea of a Poisson process driving the social update times is presented, with parameter tau being the mean and std. dev. of the associated exponential distribution of said times. According to this distribution, tau can get values in the positive real line. This means that network rewirings can happen on a continuous time line. Meanwhile, rewirings can imply an update in the strategy such that a harvest rate for a given agent can change immediately. This implies suddenly updating the -Ei*si term in the differential equation for stocks (Eq. 3, pg. 4). While nothing is said about the numerical method used for solving these equations (and that needs to be provided) I will assume you are using some form of Runge-Kutta method (perhaps simply 1st. order Euler). Depending on the software package utilized, you need to set the desired accuracy to the method and the algorithm should adapt the Time Step accordingly, or you set the Time Step by hand according to some criteria (which should be made explicit). In any discrete-time numerical approximation method, interrupting an integration step with a sudden update to the equation (as discussed above) can be tricky. If you didn't develop the integration method yourselves, many out-of-the-box numerical packages will silently update your equation only at the beginning of the next integration step (and NOT exactly at ti) when the update is required to happen at a social update time ti that is not an exact multiple of the method's selected Time Step (with the latter coincidence bearing a theoretical probability of zero !). This is a common phenomena (an error) that might or might not alter your numerical results. What is for granted is that this could become a numerical artifact that artificially synchronizes your emergent system's behavior to the solver's Time Step, and that could be a problem, because sometimes you are not in control of this TIme Step, or simply did not pay attention to it. E.g. if the Time Step is in the order of magnitude of the average tau value, you can get noticeably biased behaviors. Please provide all required information to understand how your simulation code deals with these equation updates (called "time-event detection and handling" in the domain of continuous systems simulation). Also provide details for the numerical method adopted, its parameters (e.g. accuracy and/or Time Step), software used, etc.

In page 6, you state that the model will always converge to a consensus for the given set up. It is well known (see the bibliography on e.g. agent-based opinion dynamics http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0139572) that the initial configuration of states can dramatically change the final state of the system (e.g. full consensus vs. full polarization) Your inital conditions for si are drawn from an uniform distribution between 0 and si_max. This is one very particular case where the overall system's average si(0) equals si_max/2. I believe that it is necessary to rule out the possibility that your conclusions are only applicable to this case. I.e. I suggest to test your system by sweeping a reasonable range of values for the overall system's mean si(0) other than si_max/2.

In page 7, the name of 2.3 should be "Model parameterization and simulation protocol" as the system is not modeled here but is only parameterized, together with making experimentation decisions like the number of runs.

In page 8, when talking about critical values for phi and tau, it gives the impression that the observations made apply for all possible cases, regardless of the heterogeneity sigma (lines 5 to 15). It is obvious that this is not the case, as you elaborate on the impact of sigma in 3.2 Please make it more explicit what scenario lines 5 to 15 apply to (perhaps for sigma=0.01 in Fig. 3 ?)

Interactive comment on Earth Syst. Dynam. Discuss., doi:10.5194/esd-2016-15, 2016.