Project Global Warming

Model Validation:

Perform model validation to ensure that the "right" model is built. Here is some of scenarios that you can use to validate the model

1. "Business-as-Usual 1" scenario: Run the model for 23 years using the given values of parameters which are estimated from historical data and observe the change in Carbon/CO_2 in the atmosphere in 2035 (assuming that 2012 is Year 0 in your simulation). According to 2014 BP Energy Outlook, the growth in CO_2 emissions will rise by 29%. Does your simulated result reflect this projection? Do you have to make any adjustments of the parameter values if the BP projection is believed to be accurate?

2. "Business-as-Usual 2" scenario: Run the model for 200 years using the given values of parameters (or the adjusted ones from part 1 above) and observe the change in the temperature in 200 years from now. Does it make sense? Discuss.

3. "Zero Combustion Emission Growth-Zero Deforestation" scenario: Run the model for 200 years using zero deforestation flux and zero combustion emission growth rate ($egr = 0\%$, instead of 3%). Does your result make any sense? Discuss.

4. "Low Combustion Emission -Zero Deforestation" scenario: Run the model for 200 years using zero deforestation flux and zero combustion emission growth ($egr = 0\%$) and low combustion emission. That is, in addition to setting deforestation flux and egr to 0, set the initial combustion emission $f_c(0)$ to a low value (e.g. 0.5 Gt-year). Does your result make any sense? Discuss.

Scenario Analysis:

Use the well-validated model to perform scenario analysis to investigate:

1. The effects of increasing (e.g. doubling) and decreasing (e.g. 30%, 50%, 70% etc.) the rate of deforestation or fossil fuel combustion or both on the temperature change. Try the following scenarios:
   - Double the deforestation rate, keeping $egr = 3\%$ and $f_c(0) = 5$ Gt-C
   - Double egr, keeping deforestation flux = 1.15 Gt-C/year and $f_c(0) = 5$ Gt-C
   - Double both the deforestation rate and egr, keeping $f_c(0) = 5$ Gt-C
   - Reduce the deforestation rate/increase reforestation rate (set deforestation flux = 50%, 0%, -10%, -20%, -50% of the current value), keeping $egr = 3\%$ and $f_c(0) = 5$ Gt-C
   - Reduce egr (to 2%, 1%, 0%, -1%, -2%, -3%), keeping the deforestation flux at 1.15 GT-C & $f_c(0) = 5$ Gt-C

   From the above analysis, if you have limited resources and have to focus on either reducing deforestation/increasing reforestation or reducing combustion emission (but not both), which one would you do? Which should be given a higher priority?

2. The effects of various policies to reduce the emissions of CO_2 into the atmosphere (such as those which are being currently discussed or agreed upon) on the change in temperature. For example,
   - Obama-Xi agreement: Reduce emission rate by 26-28% by 2030
   - The UN agreement: Zero emission by 2100
   - Do some research or design your own policies here. Add, if any, whatever you deem fit..