Climate Dynamics El Nino model assignment

Due April 19 2011. Instructions online.

1. (Theory question) Derive the complex dispersion relation for the delayed action oscillator model considered in the Lecture notes. By using the following substitutions:

$$
\begin{aligned}
b &\equiv \varepsilon exp(c\tau)/\tau > 0 \\
z &\equiv (c - \sigma)\tau
\end{aligned}
$$

   write these in a particularly simple form involving only ε and z. After further (obvious) manipulation use the matlab zero finding facility (or any method you desire) to find solutions as a function of ε. This is a potentially challenging exercise and full marks will be given for good partial attempts.

2. (Model question) In the gui choose solutions with the stochastic forcing set to zero and the coupling strength at 1.5. How does the period of the oscillation vary with shallow water speed? By varying the coupling strength study the effect of the shallow water speed on the model stability.

3. (Model question) Repeat question 2 but study the effect of the western boundary reflection coefficient. Are these relations consistent with the dispersion relations derived and displayed in the lecture notes. Provide a convincing argument for your belief.

4. (Model question) By varying the stochastic forcing and the coupling strength derive some conclusions about when a self-sustaining oscillation is possible in this model. Hint: the input of stochastic forcing acts as an energy source for the system. Compare the solutions critically with those of the observed variability shown in the lecture notes.

5. (Model question) What effect does the eastern boundary have on solutions?