HW#3 (Lectures 6) Due September 22, 2010

1. The annual evaporation (E) equation that Budyko considered (similar to Eq. (1) in Choudhury 1999) is given by,

$$\frac{E}{P} = \Phi(\phi) = \left[\phi \tanh(1/\phi)\left(1 - \cosh\phi + \sinh\phi\right)\right]^{1/2} \tag{1}$$

   E is annual evaporation, P is annual precipitation, and R_n is the annual net radiation, and $\phi = R_n / PL_e$ (Eq. (6.3)). Plot a graph of E/P (y-axis) vs. R_n / P (x-axis) for values of R_n / P ranging from 0 to 4. Interpret the plot in physical terms for asymptotic conditions, $R_n / P \to 0$, and $R_n / P \to \infty\,(>>1)$.

2. Eq. (6.4) (Lecture 6) gives a different expression for *E/P* than given in Eq. (1). Show numerically that these two expressions give very similar results. Explain your computations.

3. Derive Eq. (11) in Choudhury (1999). It follows, as he noted, that $\langle E \rangle \le \langle E \rangle'$. Assume that variances of P and R_n increase as the scale (size) increases from a plot to river basins. Show (numerically or analytically) that for a given P and R_n, E calculated from Eq. (6.4) (Lecture 6) decreases as α decreases. Explain how the two sets of results furnish a basis for Choudhury's hypothesis that E for river basins has a smaller α than for field plots.