

Problem Set 5: MAE 127

due Friday, May 13, 2005

1. Temperatures in the Southern Ocean are reported to have risen in the last few decades. The data file `deltaT.mat` (available from the course web site and from the UCSD server) contains three variables: “deltaT” indicates the difference between temperatures measured historically from ships and temperatures measured in the 1990s; “decade” indicates the decade when shipboard observations were collected; “sigma” indicates the one standard deviation uncertainty in the temperature change estimates.

(a) Fit a constant and linear slope to the data, using a weighted least-squares fit. Estimate the uncertainty in your fit.

(b) Using only the data from the 1950s through 1990s, repeat your fit.

(c) On the basis of the results from (a) and (b), what would you predict total ocean warming relative to the 1990s to be in 2100? What are the uncertainties in your estimate?

2. Using the same data as in question 1, now consider the “goodness of fit” using the χ^2 criteria.

(a) Estimate χ^2 for the fits in (a) and (b). On the basis of the χ^2 criteria which is a better fit?

(b) Some people have suggested that temperature variability might be cyclical, with a 60 year time scale. To evaluate this, fit the full records (1930s-1990s) to a constant, linear trend, plus a cosine and sine with 60 year periodicity. On the basis of the χ^2 criteria, does adding additional parameters measurably improve your fit? Please comment on the results.

3. Again using the same data as in question 1, consider how well you could fit a constant, linear trend, and 500 year cycle to the data. Use a singular value decomposition to check whether the matrix inversion is likely to be stable. If you have doubts about the results, you might consider what the uncertainties in your fit imply for extrapolations for future ΔT .