ATMOS 5500/6500, Fall 2019
Numerical Weather Prediction
Dr. Zhaoxia Pu

Lab Assignment III: Perform a simple Cressman analysis

Assigned on Monday, September 16, 2019
Due on Monday, September 23, 2019

Objectives:
1) Get familiar with data analysis procedure; 2) Practice on data analysis with a simple Cressman analysis scheme

Instructions for Cressman scheme and a sample code

A sample MATLAB program has been provided to you for you to start with. This program illustrates how a Cressman analysis scheme performs with different observation densities in the presence of observation errors. The scheme is given by

$$X_a(j) = X_b(j) + \frac{\sum_{i=1}^{n} w(i,j)(y(i) - X_b(i))}{\sum_{i=1}^{n} w(i,j)}, \qquad (1)$$

where $w(i,j)$ is a weighting function, which equals one if the grid point j is collocated with observational point i and is a decreasing function of the distance, with $w(i,j)$ =0 for $d_{i,j} > R$, where R is a user-defined constant, known as the radius of influence and d_{ij} is a measure of the distance between point i and j . Two different weighting functions are coded:

- Square

$$w(i,j) = \max(0, \frac{R^2 - d_{i,j}^2}{R^2 + d_{i,j}^2}) \ ; \qquad (2)$$

- Exponential

$$w(i,j) = e^{-d_{i,j}^2/2R^2} \ . \qquad (3)$$

The program is set up to have a sine wave as the truth and a background equal to half the truth-value at every point. Before running the program the user must set the following variables at the top of the program:

n_pts	Number of grid points;
obs_position	Grid points at which there are observations;
obs_sign	Position of observation in observation vector which user wants to have the incorrect sign (i.e., 1 for 1st observation, 2 for 2nd, etc.).
obs_big	Position of the observation in observational vector which user wants to have the wrong value.

As the program runs the user is asked to input the radius of influence R and the choice of weighting function w.

Lab Problems:

1. Use the sample code to perform Cressman analysis with different weighting functions and different R.
2. Change the observational positions, then, play with the code to see how the density and position of the observations would affect the analysis results.
3. Change the observation errors and test the sensitivity of observational errors to analysis results.
4. Make an iterative analysis cycle, perform analysis and compare results with the case, which uses the single set up of R.

Lab Report:

Based on your experiments, write a report to summarize your results (minimum 2 pages of text, 12pt Times New Roman; doubled space). You can attach figures to support your conclusion. Please hand in your lab report, figures and programs at beginning of the class on due day. I might ask some of you to send your program electronically after you hand in the report.

Policy:

Lab assignment should finish independently. Although group work and discussion are encouraged, e*ach student must write report by self*.