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**Applied Numerical Weather Prediction Due: 13 April 2022**

**Data Assimilation**

**(8.1)** Utilize your weather forecast model from Activity#4 (using **periodic** boundary conditions, p. 103) and predict the zonal wind at a future time under the conditions…





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{for +1000 km ≤ x ≤ +2000 km, 0.0 m s-1 otherwise}

where ***A***, ***k***, and ***ω*** are equal to 5 m s-1, π /(1x106 m), and 3.14x10-5 s-1, respectively, as ***x*** varies from 2000 km to +2000 km using 1001 grid points, with dt=60 seconds, with *forward-in-time differencing* and *centered-in-space differencing*. Note that the analytic expression for the zonal wind component applies **only at the initial time** (*t* = *t0* = 0) and applies only for the weather stations located at grid points numbered 1, 111, 235, 374, 427, 589, 633, 787, 852, 987, and 1001. You must use a data assimilation scheme to create the initial conditions at the 1001 grid points given the “observations” at the 11 locations given above.

Create the initial conditions using inverse distance squared weighting as the means of interpolating the observed zonal wind component values to the 1001 grid point locations. Run your forecast model out to a 9-hour forecast and plot the zonal wind component forecast by the model at the 3-, 6-, and 9-h forecasts. Include on each of the plots the actual (analytic) solution at the 3-, 6-, and 9-h forecasts.

[q8.1.1] Compute the absolute error at each of the grid points and the mean absolute error (average of the absolute error) for the initial time and the three forecast times. Does the mean absolute error indicate that the forecasts are getting worse with time? If so, what might be the causes of worsening forecasts?

Create the initial conditions using linear interpolation as the means of interpolating the 11 observed zonal wind component values to the 1001 grid point locations. Run your forecast model out to a 9-hour forecast and plot the zonal wind component forecast by the model at the 3-, 6-, and 9-h forecasts. Include on each of the plots the actual (analytic) solution at the 3-, 6-, and 9-h forecasts.

[q8.1.2] Compute the absolute error at each of the grid points and the mean absolute error (average of the absolute error) for the initial time and the three forecast times. How do the mean absolute errors using linear interpolation compare to those using inverse distance weighting squared? Is the 9-h forecast of one data assimilation method worse than the other? If so, how might you explain the differences in performance of the 9-h forecast?