**Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Activity#4**

**Applied Numerical Weather Prediction Due: 14 February 2022**

**Discretization of Simplified Governing Equations (cont.)**

**(5.1)** Create a weather forecast model that will predict the zonal wind at a future time under the conditions…



$$u\left(x, t\_{0}\right)=2.0 m s^{-1}, 80 km \leq x \leq 100 km; 0.0 m s^{-1}, otherwise$$

where ***c*** is equal to 15 m s-1 as ***x*** varies from  to +700 km using a horizontal grid spacing (Δx) of 1 km and a time step (Δt) of 30 s, with *forward-in-time* and *backward-in-space* differencing schemes. Note that the analytic function for “*u*” is to be applied **only at the initial time** (*t* = *t0* = 0). Integrate the model out through 15000 seconds and plot the exact (analytic) and numerical zonal wind component at the two forecast times t = 900 and 15000 seconds.

[q5.1.1] If we define the Courant number as $μ=c\frac{Δt}{Δx}$ , what is the Courant number for the given conditions in Problem (5.1) and what can you say about the stability of our problem given the results of Fig. 4.6 found in D&VK?

[q5.1.2] Create two similar plots for the conditions given in Problem (5.1), except with the translation speed (***c***) increased to 35 m s-1. What, if any, challenges and/or difficulties are encountered with the new condition on the translation speed?

**(5.2)** Based on what you know about numerical stability applied to the [q5.1.2] example, how might you adjust your time step (Δt) so that you can make your computer weather forecast model march further into the time integration without having problems?

[q5.2.1] Create two similar plots for the conditions given in [q5.1.2], except with the time step (Δt) decreased to 10 s. What is the Courant number for these new conditions?

[q5.2.2] How do the numerical solutions of all three experiments {Problem (5.1), [q5.1.2], and [q5.2.1]} handle the shape, amplitude, and translation of the exact (analytic) solution?