4.3 Sensitivity of the waves included in spectral coupling

The attention was directed to the tuning the parameters for spectral relaxation especially in choosing the wavenumbers band for blending the fields. This band is placed in between K0 and K1, the namelist parameters based on the resolutions of the coupling and coupled model. When total wavenumer is smaller than K0, alpha function takes value 1, and when is bigger than K1 takes value 0. It was found out that the lowest parameter should be equal with the wavenumber of the largest disturbance that can enter into the limited domain during the coupling interval, meanwhile the upper one should be nearly to the wavenumber of the smallest disturbance. The most suitable values being around wavenumbers 2 for K0 and 10 for K1.

4.4 Tests for tuning the alpha function

We proceeded in this point to find the most suitable parameter alpha function for the spectral coupling scheme. This function is a function depending on different wavenumbers chosen between K0 and K1 interval. The first tests with the same functions of Davies flow-relaxation scheme like in ALADIN, did not bring any improvements in solution in our case. So that the tuning continued with searching different shapes for the alpha function.

The sudden appearence of the cyclone into the limited domain can be explained by the strong influence of the large scale infomation provided to the LAM at the spectral coupling times. The LAM is forced at a certain fixed time, the coupling time to couple its spectral fields with the large scale ones. The model itself will suffer a shock by the large scales introduction and the dynamical evolution of the LAM is seriously affected. This behaviour brings the idea to minimaze the forcing by a smoother introduction of the large scale information into the limited domain which permits a more realistic evolution of the cyclone inside the LAM.

The approach was to treat alpha function dependent on time which allowed a very gentle entering of large-scale spectral information into domain. This is done in such a way that in the beginning of the coupling interval the alpha function is kept equal to zero and after some time it is starting to grow until it reaches its final shape, while in the next coupling time being reset to zero again . Alpha function was multiplied by a beta function, which has the value zero until a relative threshold is reached, then it grows linearly until the value one at the end of the coupling interval (Figure 3a). The equation used in the proposed method is very similar with the operational coupling equation:

Xc(m,n)=alpha(m,n)*Xls(m,n) + [1-alpha(m,n)]*X(m,n), where alpha is a linear function which changes smoothly from 1 to 0, m, n are wavenumbers, where Xls is the large scale field, and Xc the resulted blended field. It was proposed that:

alpha (m,n,t)=alpha(m,n)*beta(t)

Evolution of alpha function during a coupling time interval is very important in this point. Observing that the cyclone enters into limited domain after half time of the first coupling interval, the beta function was built (Figure 3b center) that at the first part of the coupling time interval is kept constant at the zero value in order to obtain a nonaffected solution of the LAM. After the relative threshold (TSTARTSC) is reached, the function is growing to the maximum value at the end of the coupling time interval, being reset to zero at the next coupling time.

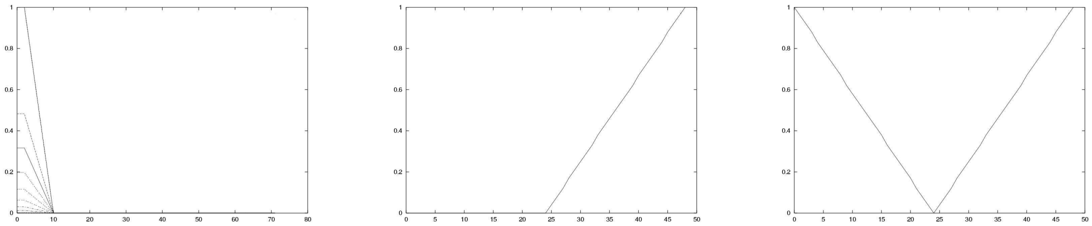

Figure 3: (a) Alpha function for relaxation function of wavenumbers (x-axis) at different time steps (left) maximum at the coupling time, (b) Beta function of time for one coupling interval of 6h (center), (c) Beta function of time symmetric for one coupling interval of 6h (right)

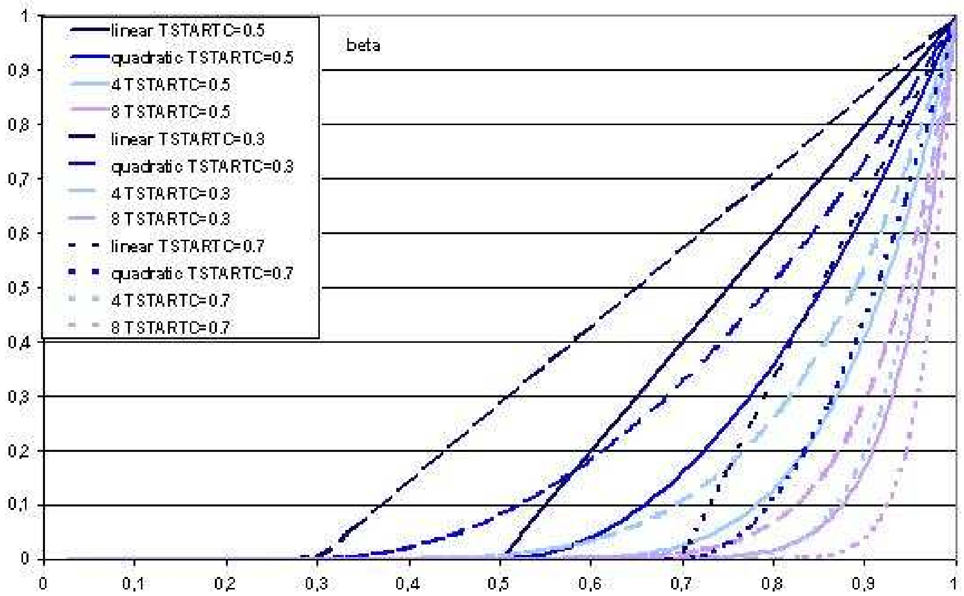

Figure 4: Beta function shown for different threshold TSTARTSC values and different exponents. Curves of the same type correspond to the same coupling interval and curves of the same colour corresponds to the same exponent of beta function.

With other words exactly at the coupling time the LAM receives full large scales, with the next time step the small scales provided by LAM are predominant and after the relative threshold is touched, small scales are mixed with large scales information by decreasing the percent of the first and decreasing the percent of the latest.

Further experiments countinued being proposed a symmetric shape of the beta function during a coupling time interval (Figure 3c right). Interesting to see is if this does not lead to a degradation of the forecast. But the experimental results showed a corrupted evolution of the cyclone which seems to oscillate inside the domain. So that the idea of using beta function symmetric is far to be considered as positive result. By using a constant function at the beginning followed by a linear smoothly growing shape of beta function for temporal relaxation in the second part seems to be the most suitable for this coupling scheme.