Large scale flow patterns in July 2002 surrounding Florida as diagnosed from EOF analysis.

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An empirical orthogonal function (EOF) analysis of the stream function has been performed on the NCEP/NCAR reanalysis data for the July 2002 period. The global stream function for each day was truncated to the region between 7.5-42.5˚N and 62.5-100˚W at each pressure level for the 4 synoptic times on all 31 days of July 2002 (124 separate analyses). The monthly mean stream function was subtracted off of the NCAR/NCEP reanalysis data, and the EOF analysis was performed on the time deviations from this mean flow.

The mean stream function pattern at 150 hPa is shows in the top left panel of the Figure1.

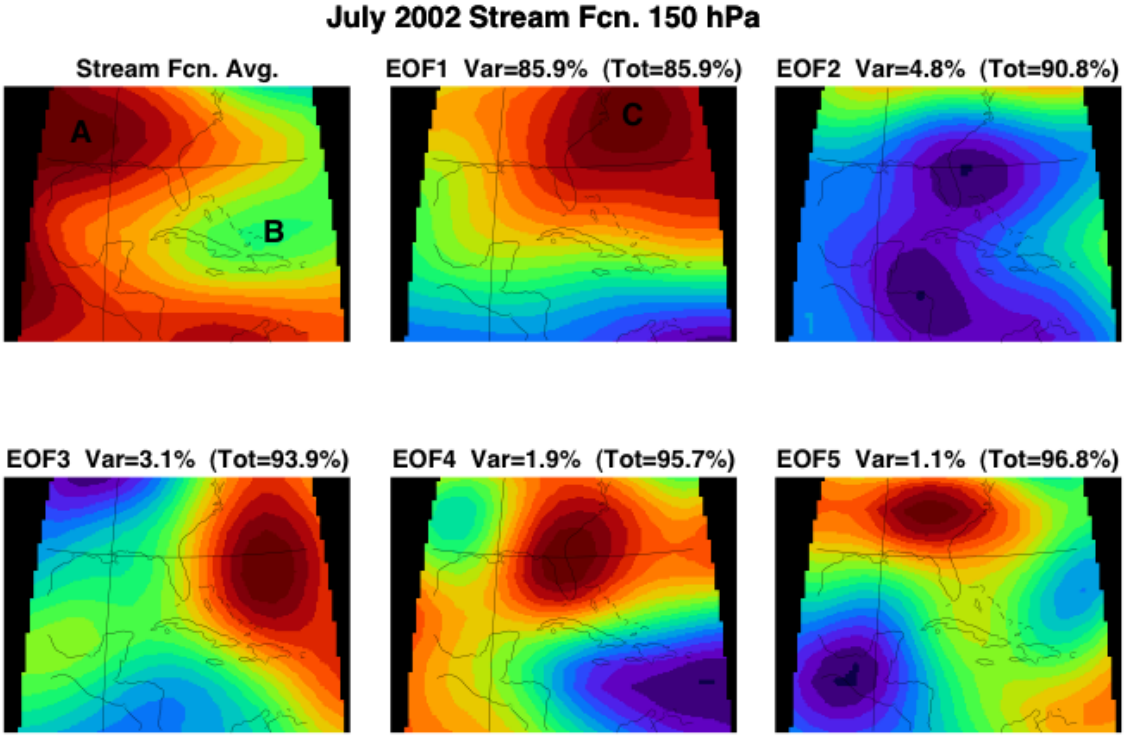


Figure 1. Stream lines on the 150 hPa for July 2002 (top left panel) and the first five Empirical Orthogonal Functions (EOFs) for this same surface.

The July 2002 mean flow in the upper troposphere was dominated by a large-scale anti-cyclonic flow that was centered over the U. S. Midwest (denoted by the A in Figure 1), with an anti-cyclone to the SE of Florida (denoted by a B). This pattern carried air from the north, across the Florida peninsula from the NE into the Gulf. The first EOF of the 150 hPa flow explains 85.9% of the variance. In its negative phase, the flow over Florida is from the NW, while in its positive phase, the flow is from the NE. The second EOF is dominated by a low centered over Florida. The third EOF is characterized by a strong anticylone east of Florida over the Atlantic. Both the first and third EOF show clear evidence of diurnal cycles in the 150 hPa flow. EOF-1 is maximum at 0Z, and a minimum at 12.

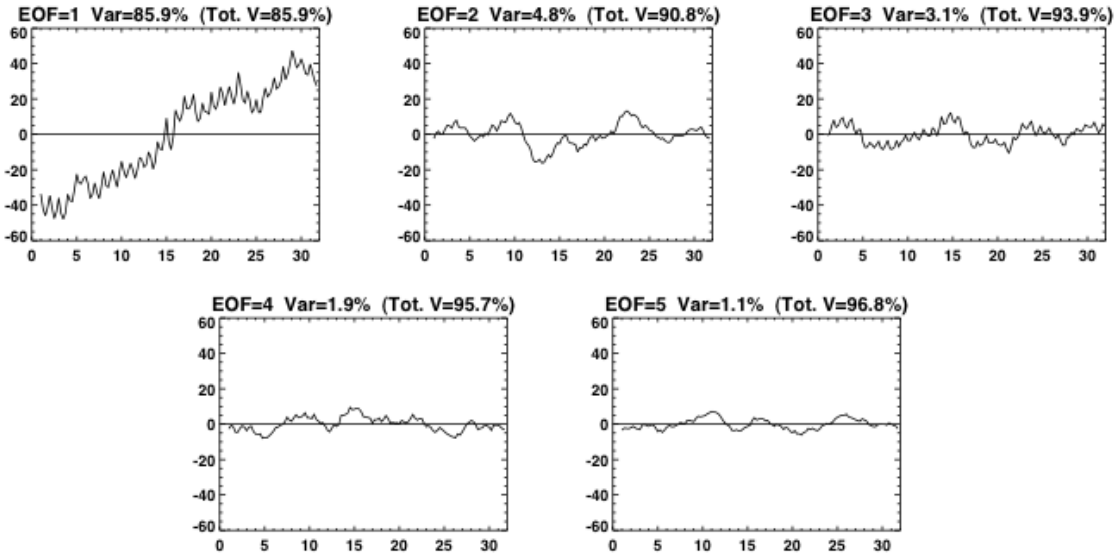
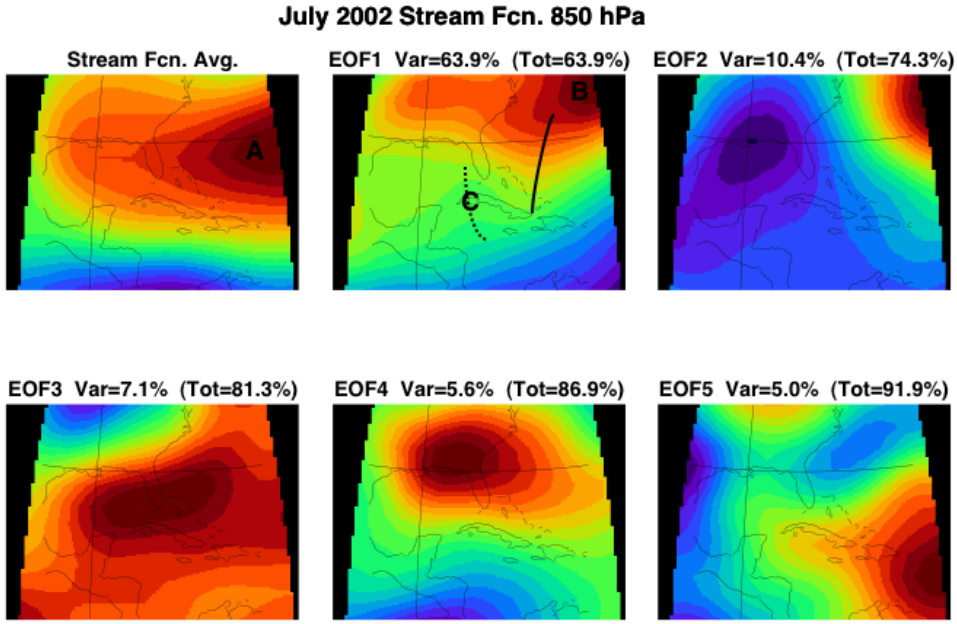


Figure 2. EOF coefficients for the first 5 eigenfunctions as a function of day of the month. The variance explained by each eigenfunction is indicated in the panel title with the total cumulative variance explained in brackets.

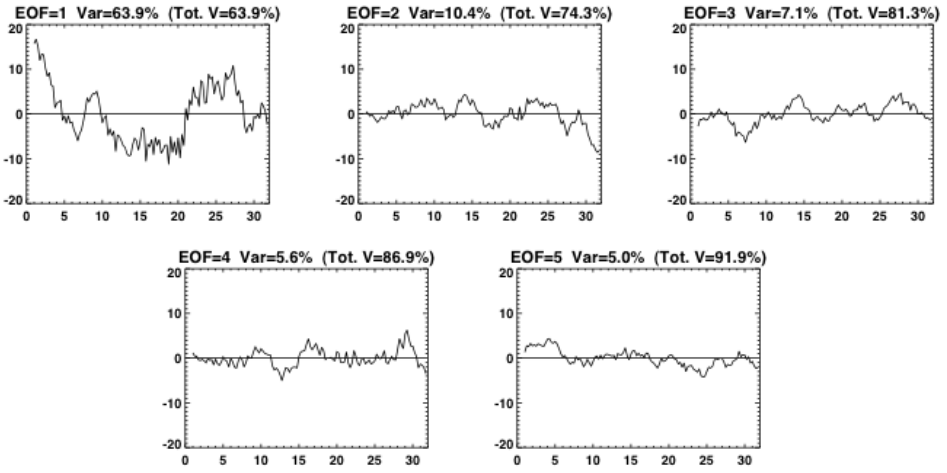
Figure 2 displays the EOF coefficients (recall that the stream function for each day is a product of these coefficients times the EOF functions shown in Figure 1). Over the course of the month, the first EOF switches from a negative phase to a positive phase. This implies a switch from NNW flow to an NNE flow over the course of the month with the strengthening anti-cyclone to the NE of Florida (denoted by the C in Figure 1).

The flow at 850 hPa was markedly different from the 150 hPa flow. Figure 3 displays the mean stream function at 850 hPa and the first five EOF patterns for July 2002.



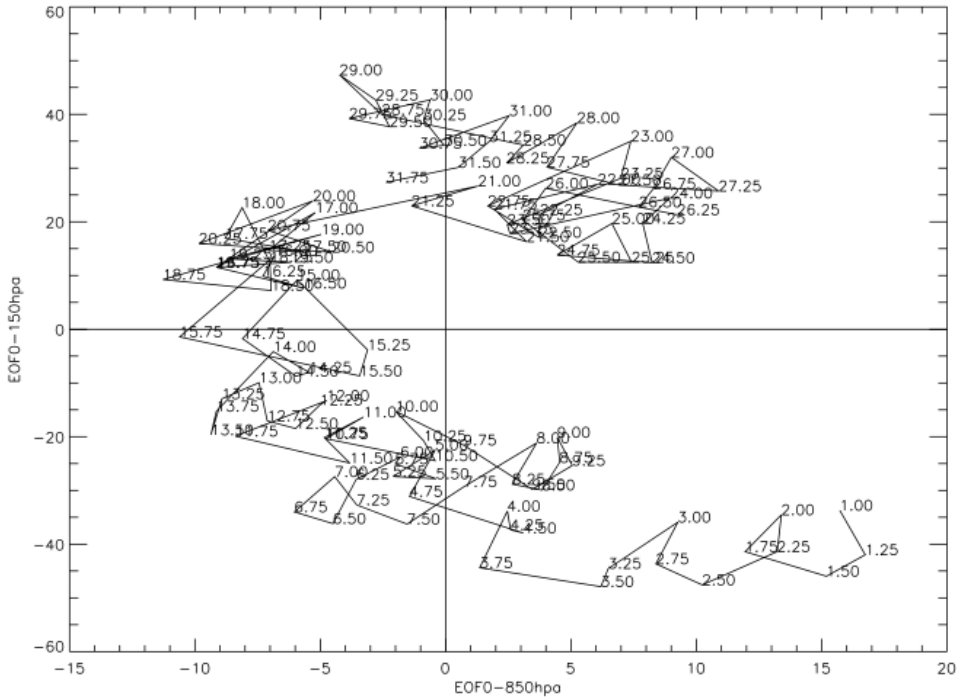
The 850 hPa flow is dominated by the anti-cyclone to the east of Florida (denoted by the letter A). This first eigenfunction explains 63.9% of the variance in the flow field. The variance in the Florida region is controlled by the anti-cyclone to the NE of Florida (denoted by B). A ridge extends southward from this anti-cyclone (solid line) with a trough immediately to the west of Florida (denoted by C and the dashed line). In the positive phase of this EOF-1, the ESE flow across the Florida Penninsula is strengthened, while in the negative phase, this flow is weakened.

The EOF coefficients for the 850 hPa are displayed in Figure 4. Again, the variability of the flow is dominated by the first EOF, with significant contributions from the next 4 EOFs.



During the first 5 days of July, the high to the NE of Florida is relatively strong, weakens by the 6th, redevelops on the 9th, and then remains in a weakened state from July 10-21. The Bermuda high intensifies from July 21-28, but again weakens during the last few days of the month.

The coefficients at 850 hPa and 150 hPa are plotted against one another in Figure 5 to show the evolution of the flow over the course of the month. The month begins with strong ESE flow at 850 mb, with NNW flow at 150 hPa (bottom right quadrant of Figure 5). Over the course of the month, the flow at 150 hPa steadily shifts to the NNE, while the Bermuda high weakens. In the latter part of the month, the flow is dominated by strong ESE flow at lower altitudes (with the exception of the last few days of the month), and NNE winds at upper altitudes. As with the EOFs at 150 hPa, the 850 hPa EOFs also display diurnal variations.


EOF0−150hpa
EOF0−850hpa
60
40
20
0
−20
−40
−60
−15
−10
−5
0
5
10
15
20