The Florida Current: Mean Jet Structure and Variability from HF Radar Observations in a Stream Coordinate Frame

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APPENDIX

Conversion from the Geographical to Stream Coordinate Frame

To convert from geographical to stream coordinates, one must define: (1) the new origin - taken here as the jet core; (2) the jet core's downstream direction; and (3) the cross-stream distance of each measurement from the defined origin. Once these three variables have been determined, the data can be shifted and rotated to the new stream coordinate system.

The Florida Current has a nearly meridional orientation, and its meanders in the HF radar domain are restricted by the channel width. Therefore it can be reasonably assumed that the core of the Florida Current can be identified at one grid point in longitude (x) for each monotonic step in latitude (y), from the south ($y = 1$) to the north ($y = N$). This method then works iteratively; for each row from $y = 1$ to $y = N$, the core is defined at a point along x. The conversion steps are outlined for a map of velocity vectors at one time step (*Figure 4*):

1) *Identify the jet core* $x_0(y)$

The jet core is defined as the ridge of maximum velocity (white circles in *Figure 4*). For each latitude (y), the velocity profile $V(x) = \sqrt{u(x)^2+v(x)^2}$ is smoothed in longitude by a running 5-point boxcar filter, and the maximum velocity $\hat{V}(x_0)$ is identified as the core x_0. This produces a set of core locations $x_0(y)$. This jet core profile $x_0(y)$ is smoothed using a 1-D spline fit to reduce discontinuities.

2) *Determine the core's downstream direction* $\theta(y)$

The core's downstream direction is computed from the average direction of the velocity vector at the core ± 3 grid points in x. This produces a set of downstream angles $\theta(y)$ for the set of core locations $x_0(y)$.

3) *At each core location* $x_0(y)$*, identify the grid points on the map that lay along a line perpendicular to the core downstream direction* $\theta(y)$

For each core location, identify the set of grid points (x, y) that lay along a line nearly perpendicular to the core's downstream orientation $\theta(y)$ (not perfectly perpendicular since we are restricted to equally spaced points on a Cartesian grid). *Figure 4a* displays the core locations and their associated grid points that lay along the perpendicular line.

4) *For each perpendicular grid point, calculate its distance from the core, and rotate its u-component* (*v-component*) *into a cross-stream (downstream) orientation*

Compute the cross-stream distance *r* (in km) from each perpendicular grid point to its respective core location $x_0(y)$. The new 'stream' grid point is a function of cross-stream distance and assigned the core location's latitude (y_c). Rotate the vectors based on the downstream orientation $\theta(y)$:

$$u_s(r, y_c) = u(x, y) \cdot sin\big(\theta(y)\big) - v(x, y) \cdot cos(\theta(y)) \quad (1)$$

$$v_s(r, y_c) = u(x, y) \cdot cos\big(\theta(y)\big) + v(x, y) \cdot sin(\theta(y)) \quad (2)$$

5) *Re-grid data from the geographical grid (x, y) to the stream coordinate grid (r, y_c)*

Bin the grid points according to their cross-stream distance *r* from the core, and their assigned along-stream location, which is the latitude of their assigned core location (y_c). Thus, the latitude is retained for the core grid points, while a grid point perpendicular to the core grid point may have any original latitude or longitude (*Figure 4*). Finally, the data is interpolated onto a uniform grid of 1 km spacing.

Note this method does not assign every grid point on the map to a core location, as can be seen in *Figure 4b*. This is because not every grid point lays along a line perpendicular to a core location. After converting to the new coordinate system, the data is quality controlled; again, any data points that exceed 3 standard deviations (STD) from a running 5-day mean are removed, and grid points with less than 30% coverage are thrown away.

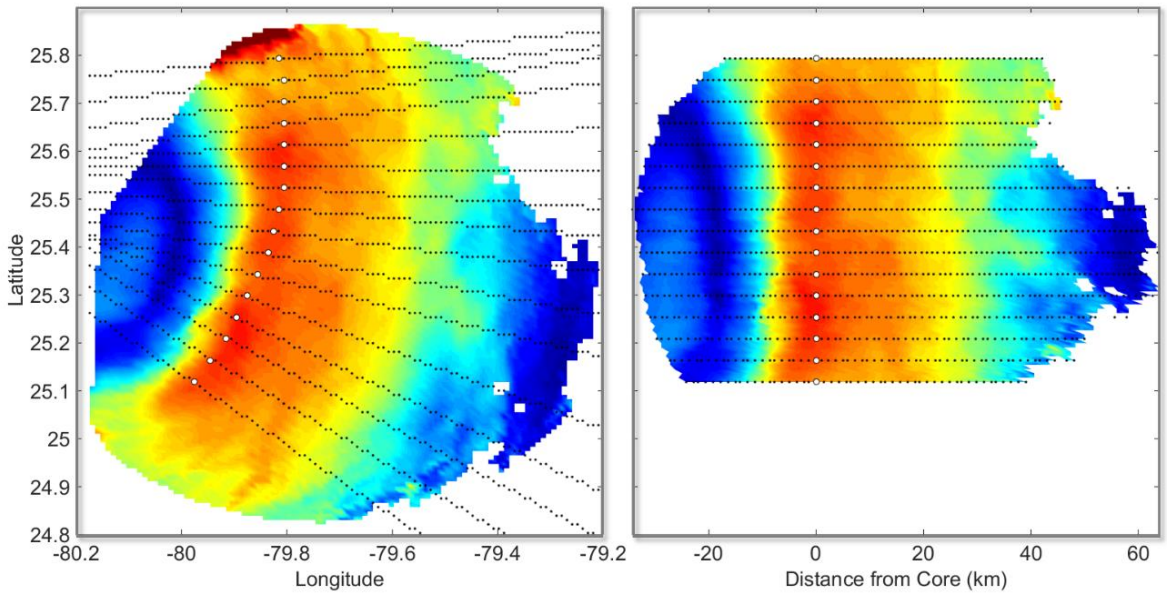

Figure A1. Real-data schematic showing stream coordinate conversion, plotted at half resolution. (a) Geographical coordinate frame (white circles denote the identified core grid points; black dots denote grid points associated with each core point). (b) Stream coordinate frame, the same grid points have been binned relative to distance from core. Note in this new frame the *y*-axis signifies the latitude of the core grid point only, while the black grid points may have any original latitude as seen in *(a).*