ESTIMATES OF NEAR-SURFACE COASTAL CURRENTS FROM ALONG-TRACK ALTIMETER DATA: *A CASE STUDY IN THE SOUTH ATLANTIC BIGHT*

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Study area: South Atlantic Bight (SAB)

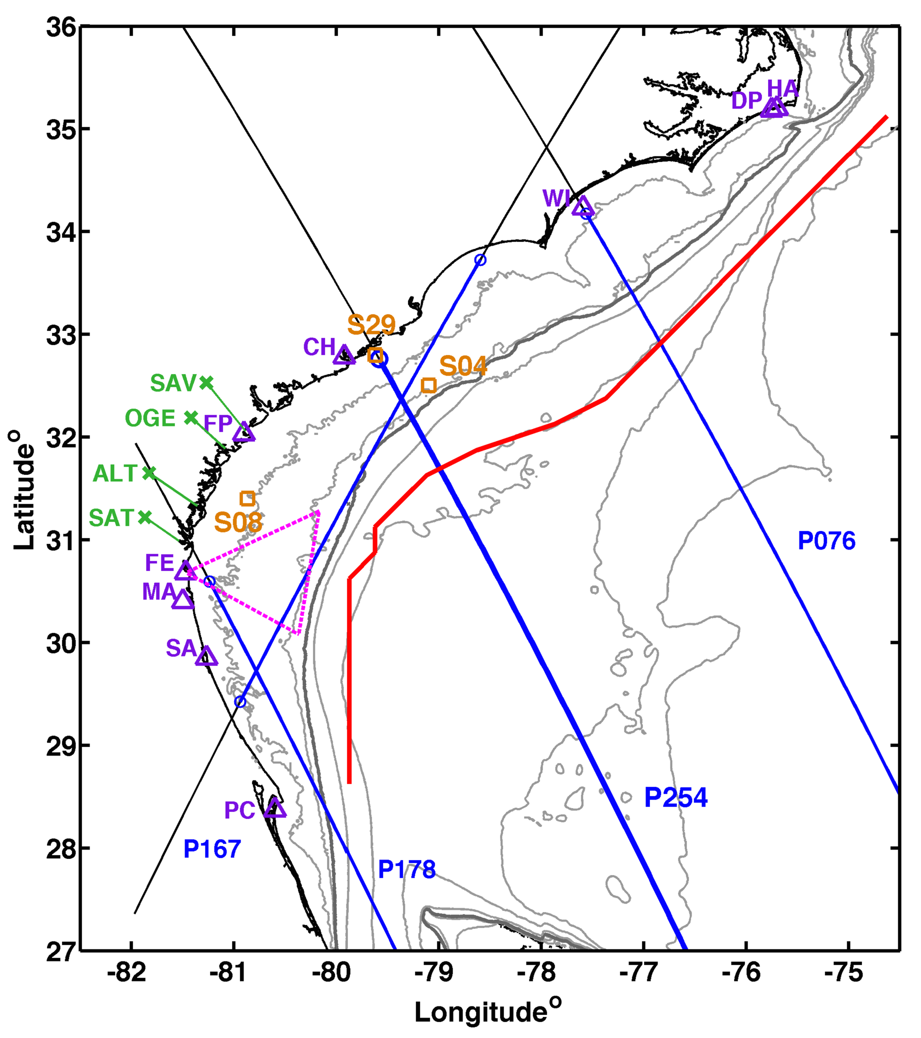


Figure 1. Altimetry satellite tracks (blue), moorings (brown), tidal gauges (purple), major rivers (green) and HF radar spatial coverage (magenta) on the SAB. The long-term mean Gulf-stream position is shown as thick red line. Also shown are bathymetry contours (gray) in 20, 40, 50 (thick), 200, 600, 1000, 3000m. In the present study, we focused on ground track P254 and two crossovers. Less than ***25%*** of the data is missing at the distance larger than ***15km*** from the coast, the correlation between TG and altimeter data are higher than ***0.8***.

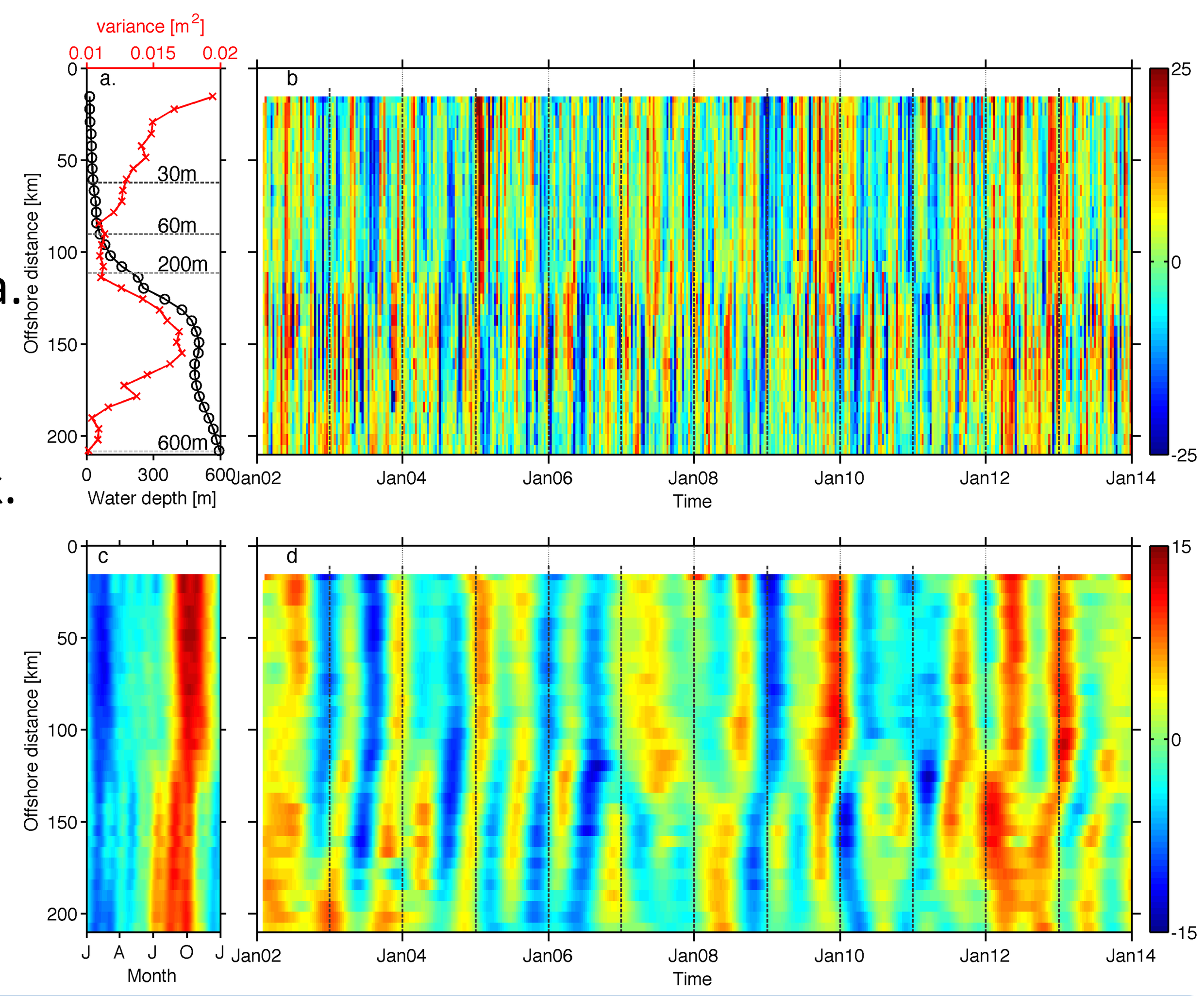


Figure 2. 14 years of Sea Level Anomalies (SLA) along the ground track P254 using J1 and J2 data. SLA variance (a; red) increases towards the coast and the shelf break. (b) SLA residue after the removal of the low-frequency component of SLA, which is the sum of seasonal cycles (c) and interannual variation (d).

Geostrophic velocity anomalies

Figure 3. Surface geostrophic velocity anomalies (a) estimated from the slope of along-track SLA (red) and low-frequency component (blue) using 12-point linear regression within 50 m isobath. Monthly averaged velocity anomalies (b) reveal a poleward flow during summer and equatorward flow during spring and autumn, and are comparable with ADCP (green) and HF radar (brown) measurements.

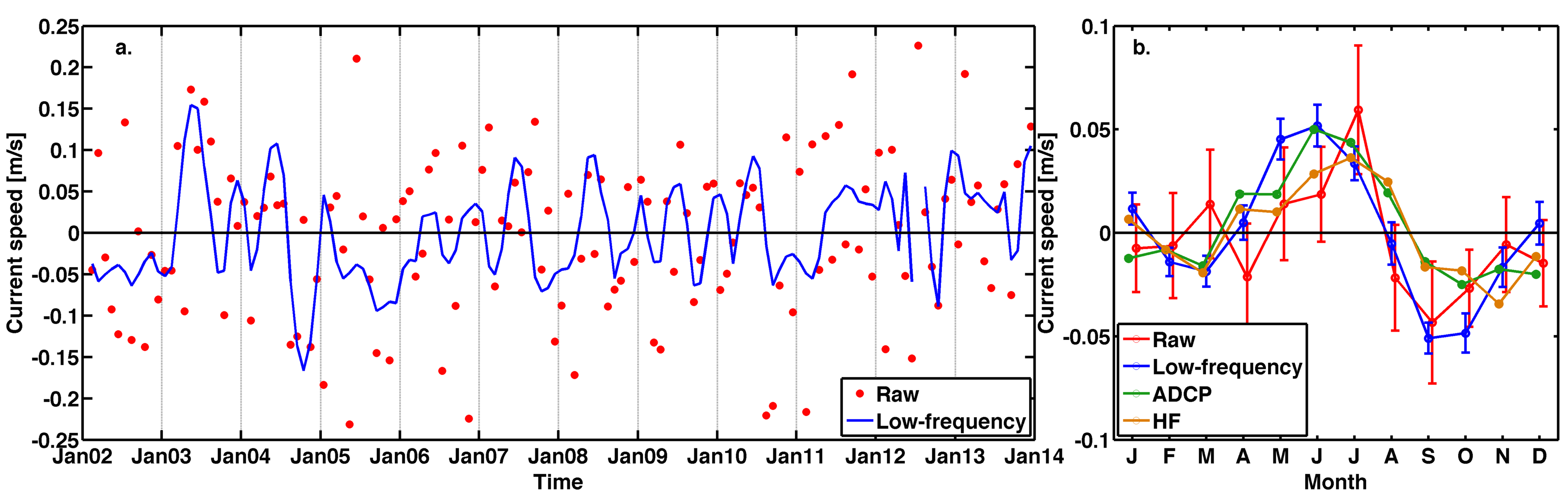
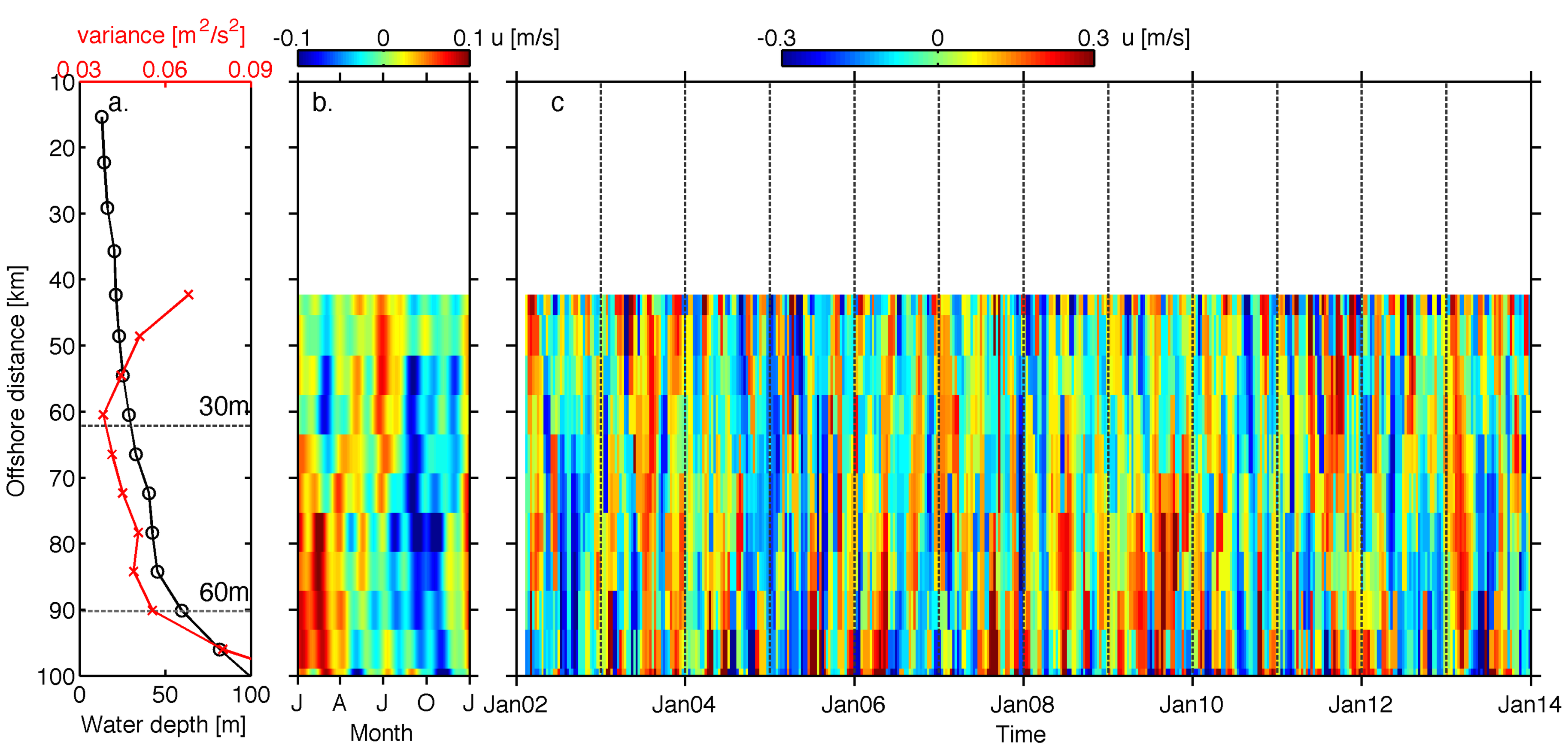


Figure 4. Geostrophic velocity anomalies spatial variation using 7-point linear regression. (a) Velocity variation (red) increases towards the coast and the shelf break. (b) velocity anomalies seasonal cycles and residues (c) after the removal of seasonal cycles.



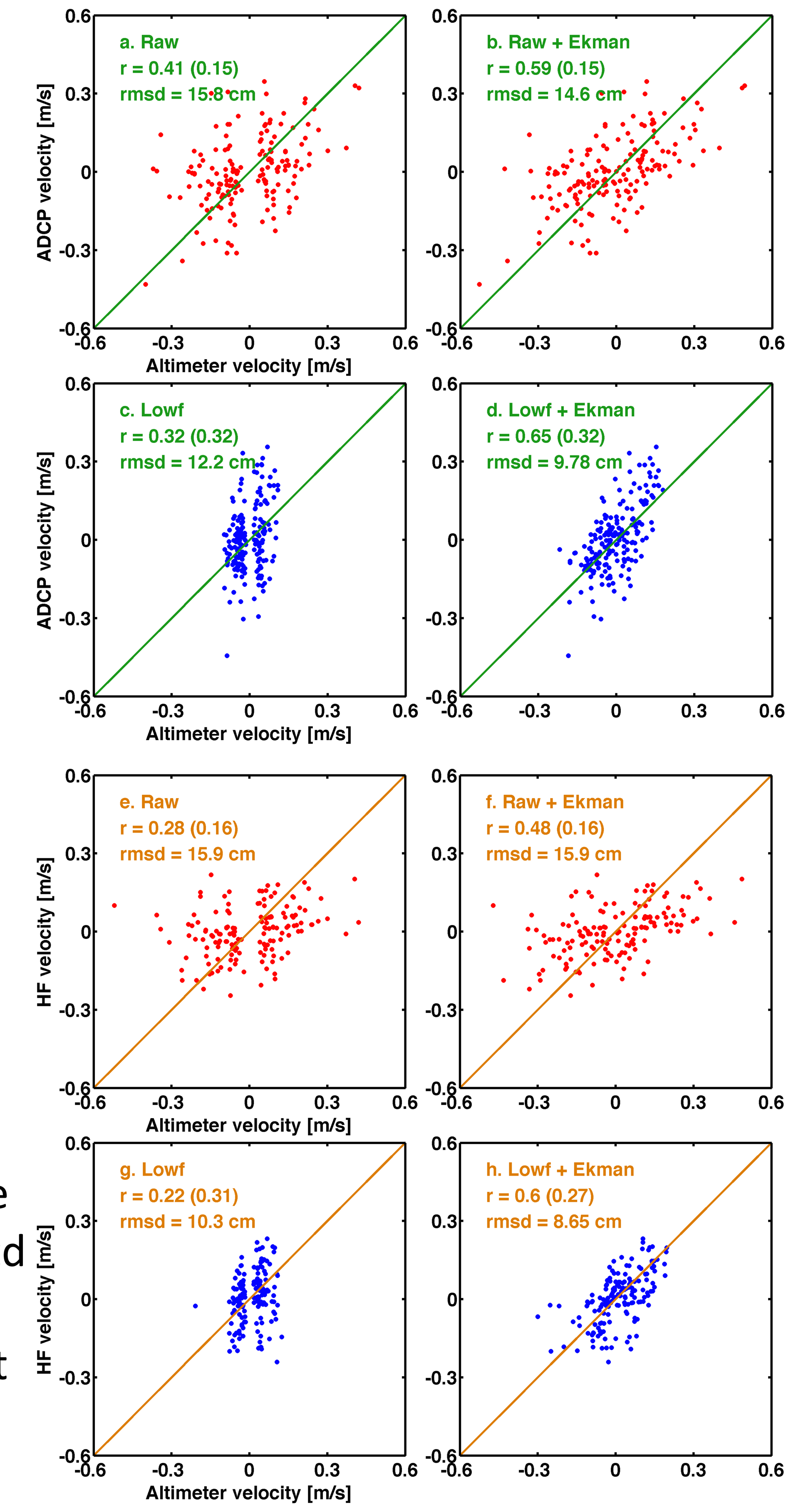
Validations with independent current measurements

ADCPs (2005 – 2012; a-d):

- Combination of two ADCPs time series (by matching the variance)
- Used the hourly data at 2 m then passed a 40-h Low-pass filter (LPF)
- Subsampled at Altimeter-time and removed the temporal mean (≈ 0.03 m poleward)

HF radar (2008 – 2013; e-h):

- Averaged between 20 m – 40 m isobath then passed a 40-h LPF
- Subsampled at Altimeter-time and removed the temporal mean (≈ 0.02 m poleward)

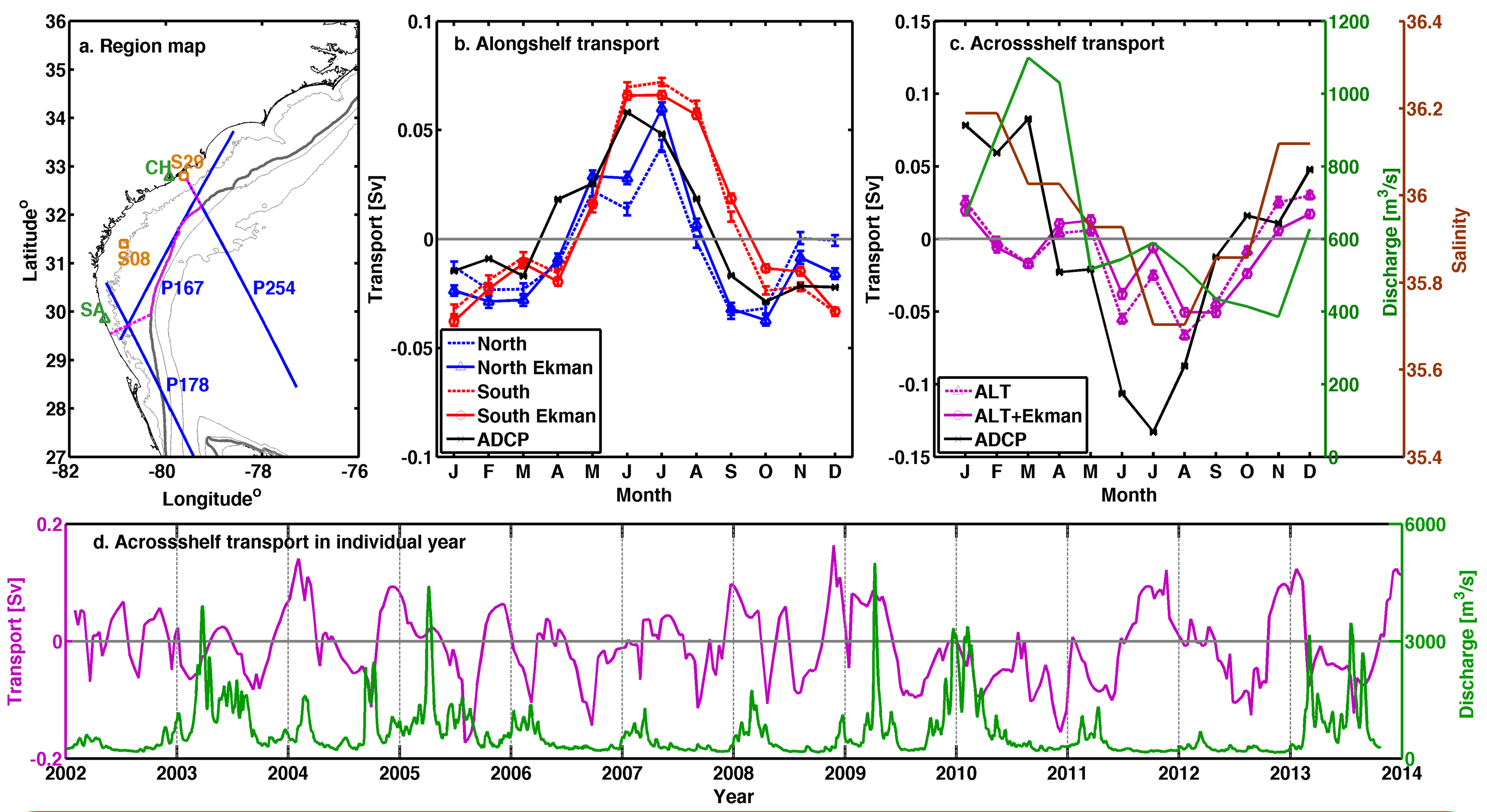


Findings (Figure 5.):

- Adding the Ekman component increases the correlation, decreases the rms difference, collapse the comparison to 1:1 line
- Rms difference is comparable to std of velocity anomaly time series
- Low-frequency + Ekman is the best way to represent the 'true' near-surface velocity

Applications: Estimate the cross-shelf transport

Figure 6. Unique geometry of ground tracks in SAB provides two crossovers (a). The divergence of the along-shelf transport at two crossovers (b, North-blue; South-red) is used to estimate the cross-shelf transport (c, d), which is then compared with the river discharge (c, d) and the offshore salinity (c).



What we understand so far:

1. Along-shelf currents:
   - Altimeter-derived velocities are comparable with independent current measurements
   - Wind (Ekman component) is important in the SAB
2. Cross-shelf transports:
   - Maximum offshore transport occurs during the summer time, driving the offshore low salinity.
   - The concurrence of offshore transport and high river discharge might play an important role in determining the physical and biological characteristics in the SAB.

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