Atmospheric Drivers of Oceanic North Swells in the Eastern Caribbean

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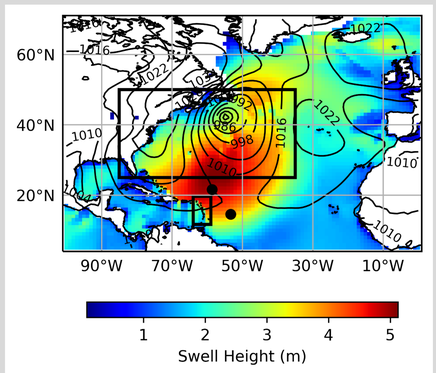
I. Introduction

- Wintertime North Atlantic storms generate swells that impact the entire basin, including north swells in the Eastern Caribbean.
- Large coastal waves result.
- Good surfing but ecosystem and infrastructure damage.
- Analysis: NDJFMA 1979-2019

Figure 1. North coast of Barbados.

II. Study Area



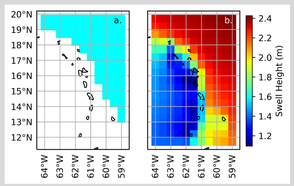


Figure 2 . Atmospheric pressure and ocean swell for March 20, 2008 swell event.

Figure 3. Eastern Caribbean

III. Average Atmosphere and Ocean

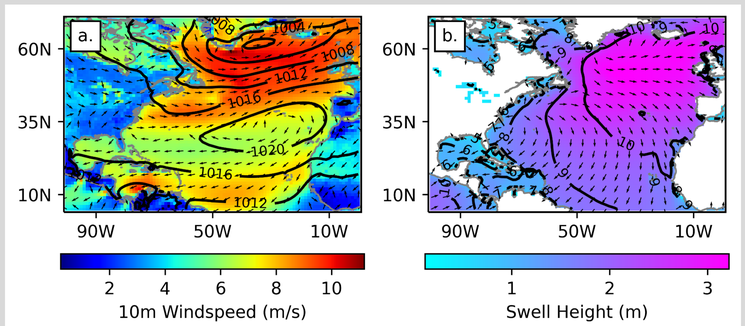


Figure 4. NDJFMA seasonal average sea level pressure, surface wind speed, and wind direction. Also, swell period, height, and direction.

- Slower easterly-northeasterly wind in E. Caribbean.
- Smaller and northeasterly swell in E. Caribbean.

IV. North Swell ID and Characteristics

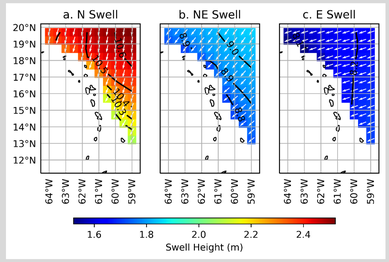


Figure 5. Average swell conditions for three EOF/cluster patterns.

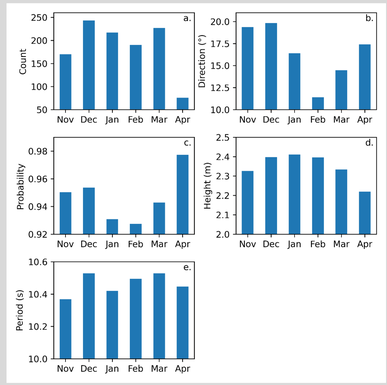


Figure 6. Monthly North Swell Characteristics.

- EOF-cluster analysis generates 3 clusters.
- N. swell strongest and most frequent in mid-winter.

V. North Swell Composite Anomalies

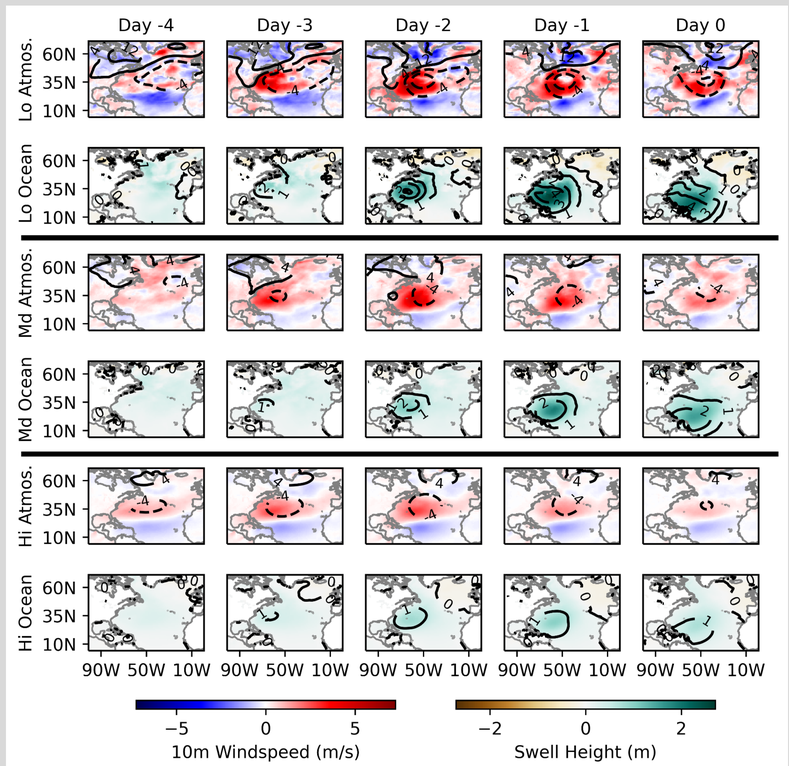


Figure 7. Atmosphere and ocean swell anomaly composites for low, medium, and high probability north swell events. Day 0 is the swell day in the Eastern Caribbean.

- Swells strongest day -1, 0 and for low probability events.
- Deepest low pressure and strongest wind day -3, -2, -1.

VI. Tracks of Swell-Causing Storms

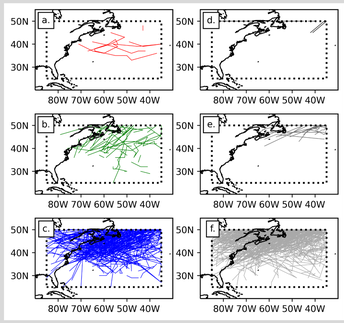


Figure 8. All storm tracks.

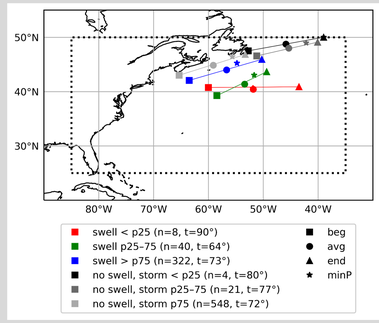


Figure 9. Average storm tracks.

- Largest swells: storms further southeast, with zonal trajectory and slower track speed.

VII. Occasional High Pressure Swells

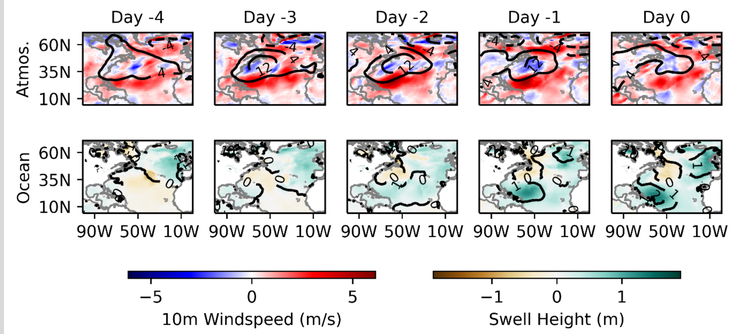


Figure 10. Atmosphere and ocean swell anomaly composites for high pressure induced, medium probability north swell events (10 events).

- Swells with westward high pressure day -3, -2, -1.

VII. Summary

- North swells: 16% of winter days.
- Represent largest swell conditions.
- Strongest swells in mid-winter.
- Strongest storm winds 1-3 days prior to swell.
- Biggest north swells produced by slow, southerly, zonal storms.
- High pressure occasionally induces north swells.

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