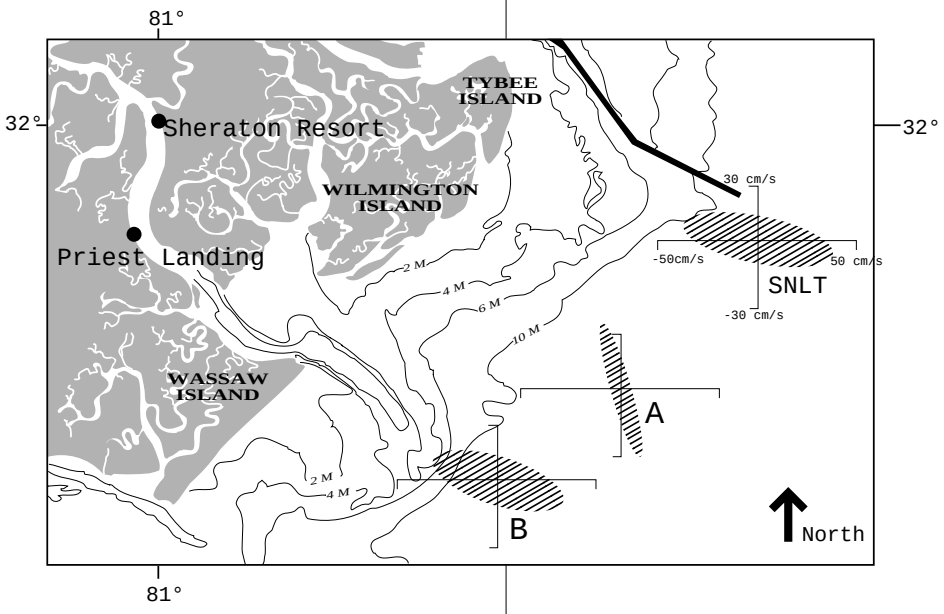
Climatology & Oceanography of the Georgia Coast

INTRODUCTION

This brochure suummarizes climatological and oceanographical data for the coastal region ofGeorgia, generally off Tybee and Wassaw Islands, the proposed site of sailing competition during the 1996 Summer Olympics. Brief data summarizes are provided in graphical form for seasonal air and water temperature, mean surface wind speed and direction, and monthly variations in wind intensity. Additional information on approximate tidal current speed anddirection and bathymetry are provided as are data on expected surface salinity variations in the region.

The information provided in this brochure is taken from studies conducted during the past twenty-five years by the Skidaway Institute of Oceanography, a unit of the University System of Georgia.



BATHYMETRY

The oceanic region off Tybee and Wassaw Islands is typical of the shallow and broad continental shelf of the southeastern U.S. The width of the shelf off Georgia is 100 km. The depth at the offshore edge of the shelf is about 50 m. The Gulf Stream flows at the shelf edge, but it has negligible impact off Tybee Island.

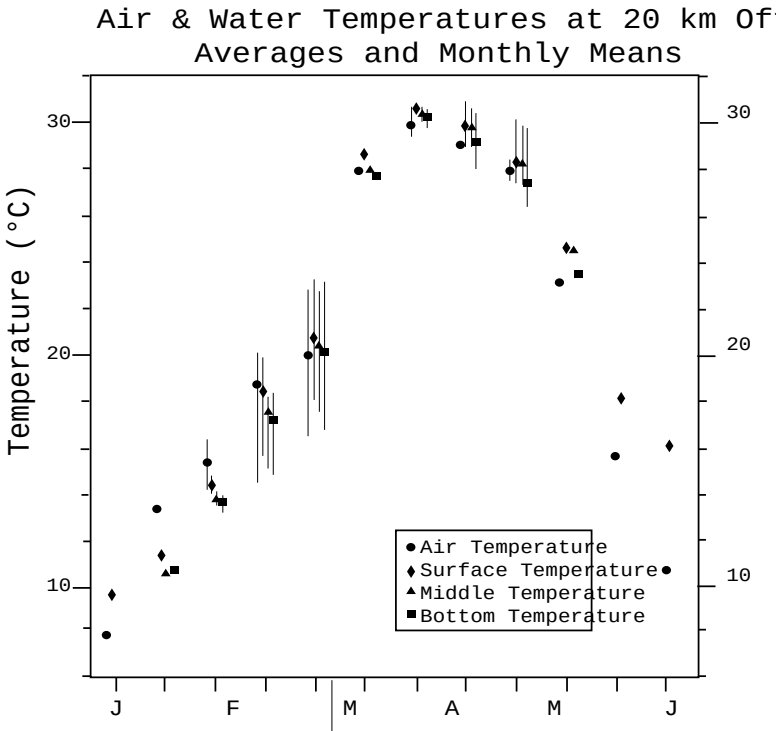
Within the region of interest maximum depths are about 15-20m. The bottom substrate is mostly coarse to fine sand from the beach to offshore.

CLIMATOLOGY

Climatology of the ocean region is subtropical, and monthly mean air and ocean temperatures rarely fall below 10°C. The annual cycle of air and water temperatures 20 km off the coast of Tybee Island varies about 20°C over the annual cycles. Water depth is only 15 m deep at this distance offshore, therefore, monthly mean air temperatures are quite similar to ocean temperatures because of the relatively small thermal capacity of such shallow water

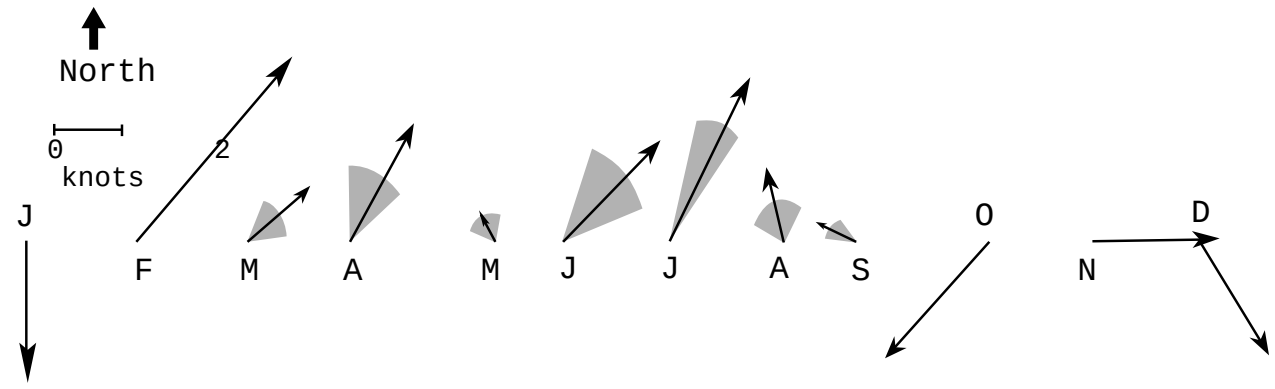
The monthly mean wind vectors (direction toward which wind blows) 20 km off the coast of Tybee Island show a fairly consistant mean wind direction toward the northeast over the months from February through July (small mean wind magnitudes are an effect of the averaging process). The actual strength from day to day can be much greater than a monthly averages. Beginning in August, there is a transition period afterwhich the mean winds blow toward the southwest in October.

The strength of the wind off this coastal region varies significantly during the year. The months from May until September have relatively light winds under 10 m/s. During autumn and continuing through winter, winds above 10 m/s can occur 30 per cent of the time. Winds over the land and in the estuaries are usually lighter than winds encountered in the open ocean.



Comparison of winds at the Savannah Municipal Airport with winds over the ocean 20 km off Tybee Island, GA. Numbers in parentheses are standard deviations.

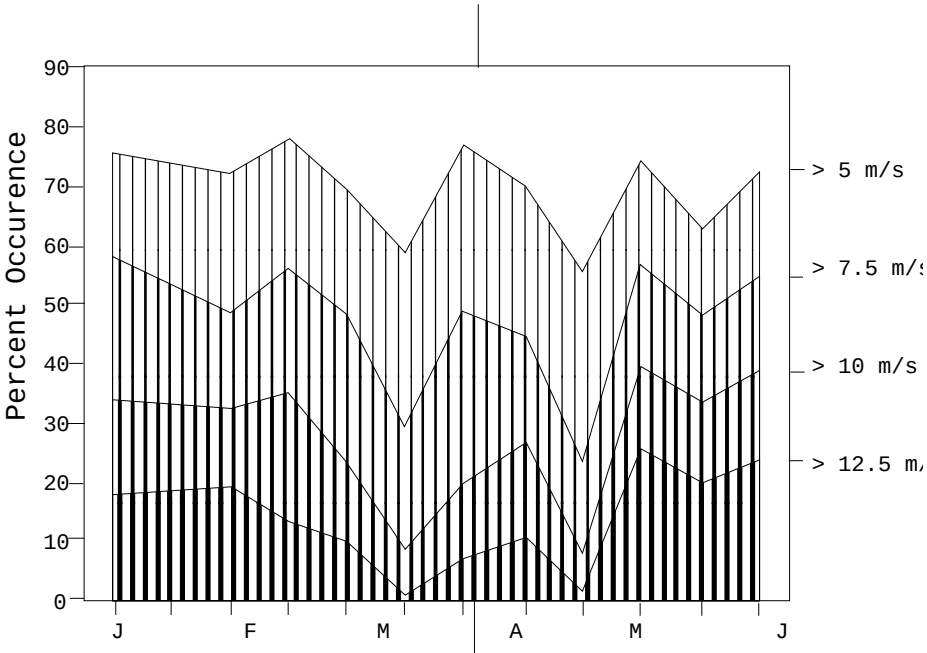
	Land Wind	Ocean Wind
Cross-coast component (m/s)	0.5 (1.5)	<0.03 (3)
Up-coast component (m/s)	1.0 (1.5)	3.0 (4)
Mean speed (m/s)	1.5	3.0
Mean direction (deg true)	65	45



Monthly mean wind vectors approximately 15km off Tybee Island, GA. When monthly means are available for more than one year, a qualitative impression of direction variations is indicated by the fan-shaped zone surrounding the mean vector.

TIDES

The largest tidal range south of Cape Cod occurs off Savannah where the average range is 2 meters. Spring tides which occur at new and full moon have ranges of about 2.5 meters. The intervening neap tides which occur at half moon have ranges of about 1.7 m.



Monthly variations in intensity of wind speed. Shaded areas represent percentage of monthly wind speeds greater than 5. 7.5, 10 and 12.5 m/s respectively.

Tidal currents generally reach 0.3 to 0.5 m/s off Tybee Island. However, in the channels between islands and shoal areas attached to the inlets, currents can be much stronger. The vectors of tidal motion near the surface trace ellipses over a 12 hr 25 min period. The ellipses (shown in the bathymetry diagram) are generally oriented perpendicular to the depth gradient. The vectors change direction in a clockwise manner. Since local bathymetry is variable, the orientation of the ellipses relative to the compass is also variable. The major axes of tidal currents typically point toward inlet mouths within distances of 15 km. Since tidal excursions are only 5 km, the inlets appear to exert a zone of influence on tidal motion on the order of 3 times the tidal excursion.

In contrast to conditions in the rivers and tidal creeks, there is no slack water in the tidal currents offshore between flood and ebb tide. Rather the currents flow weakly along the coast.

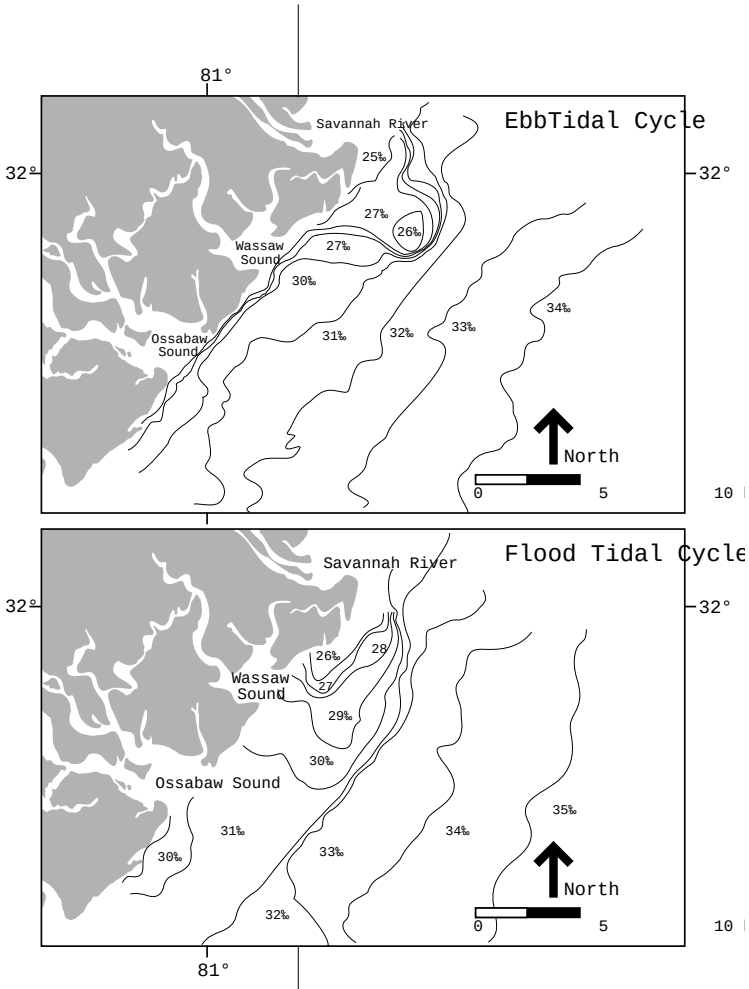
Neap and spring tides affect the strength of tidal currents. Within 10 km of the coast, maximum neap flood and ebb tidal currents are typically 0.1 m/s and increase to 0.2 m/s 20 km offshore. During spring tides, these currents reach nearly 0.3 m/s 10 km offshore and 0.5 m/s 20 km offshore.

SALINITY

Salinity off the Georgia coast just south of the Savannah River varies seasonally in response to variations in freshwater discharge by the river. During the time of competition (i.e., August) the offshore salinity structure can only be guessed at but would probably not be too different than that shown in the surface salinity diagram presented.

The Savannah River is one of the largest rivers in the southeastern US that discharges freshwater to the continental shelf. Tidal and wind mixing of the River's discharge creates a band or plume of low salinity water next to the coast. This plume is rarely found more than 10 - 15 km off Tybee and generally flows southward along Tybee Island, It can sometimes be found off Wassaw Island to the south when wind conditions are favorable. The low salinity band can effect the direction and strength of ocean currents.

The position of the Savannah River plume can change dramatically between high and low tide. Near the end of ebb tide, the plume is displaced offshore and usually to the south unless winds blow strong from the southwest. As flood tide ends, the plume is bent shoreward and is usuallly found squeezed nect to Tybee Island. Of course, stronger than normal wind conditions can alter the configuration of the plume.



WIND-DRIVEN CURRENTS

The upcoast or down-coast component of the currents in shallow coastal waters are generally governed by the upcoast or down-coast wind component. This means that the diagram of monthly mean winds can be used to indicate the direction of wind drift as long as the location of interest is outside the zone of impact of the Savannah River plume. The wind drift is consistantly up-coast offshore of the plume during the months from February to September. However, during months of October and November, the wind-driven currents are down-coast in correspondance with the wind direction during that season.

The correspondance of the up-coast currents to wind is altered near the coast. There, the ocean currents are influenced by the band of low-salinity water found adjacent to the coast. The drift currents under light wind conditions (effects of tidal currents removed) flow southward inside what oceangraphers call a coastal frontal zone. The width of this zone corresponds to the width of the low-salinity band of water fed by the Savannah River and other rivers along the coast. Inside the coastal front, the salinity of ocean waters change in both a horizontal and vertical direction. On average, the salinity increases in the offshore direction and as depth within the water column increases.

The magnitude of the salinity gradients, both horizontally and vertically, depend on wind velocity. When winds are upcoast, the corresponding upcoast current

near the surface has a small offshore component which carries some of the low salinity water adjacent to the coast offshore. If one observes surface salinty at a point about 10 km off Tybee, the upcoast wind causes the salinity to decrease. This has the effect of increasing the width of the coastal front as well as increasing the difference in salinity between surface and bottom waters within the coastal front.

If the wind reverses to downcoast, the salinity conditions and the width of the front can change rather drastically. The corresponding downcoast surface current has a small component toward the coast which carries water of higher salinity (and higher density) into the coastal front. The higher density surface water easily mixes away the vertical gradient of salinity while increasing the horizontal gradient by squeezing the low salinity coastal waters against the coast. Thus, the width of the coastal front is relatively small during downcoast winds.

Downcoast winds prevail during autumn months beginning in October (see diagram above). However, the prevailing upcoast winds in spring and summer can change at anytime to downcoast. As long as the wind fluctuations last about one day or longer, the changes in the coastal waters discussed above can occur within a matter of 6 to 12 hours.

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