The Gulf Stream Experiment
Passive Microwave Measurements of Sea Surface Salinity

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The potential for global monitoring of sea surface salinity from space has been recognized for some time (Swift and McIntosh, 1983; Lerner and Hollinger, 1977) and may soon come to fruition with the selection of the Aquarius mission by NASA's Earth System Science Pathfinder (ESSP) program (Koblinsky, et al, 2001; Le Vine, et al, 2001). Passive microwave sensors at L-band (1.4 GHz) operating from aircraft have demonstrated that salinity can be measured with sufficient accuracy (1 psu) to be scientifically meaningful in coastal waters (Le Vine et al, 1998; Miller et al, 1998). Measuring salinity globally over the open oceans presents additional issues largely because of the much greater accuracy (~ 0.2 psu) required for global maps to be scientifically viable (SSIWG, 2000). Research has been conducted at the Goddard Space Flight Center and is continuing to address these issues and to develop the potential for remote sensing of sea surface salinity from space.

As part of this research, a series of measurements called, The Gulf Stream Experiment, were conducted during the summer of 1999 to address issues of passive microwave remote sensing of salinity in the open ocean. The measurements consisted of airborne microwave instruments supported by ships and drifters for surface truth. The study area was a 200 km by 100 km rectangle about 250 km east of Delaware Bay between the continental shelf waters and north wall of the Gulf Stream.

The primary passive instruments were the ESTAR radiometer (L-band, H-pol) and the SLFMR radiometer (L-band, V-pol). Additional instruments on the aircraft included a C-band radiometer (ACMR), an ocean wave scatterometer (ROWS) and an infrared radiometer (for surface temperature). These instruments were mounted on the NASA P-3 Orion aircraft. Sea surface measurements consisted of thermosalinographs on the R/V Cape Henlopen and the M/V Oleander (Figure 1), and data from salinity and temperature sensors on three surface drifters deployed from the R/V Cape Henlopen.

The primary experiment period was August 26-September 2, 1999. During this period the salinity field within the study area consisted of a gradient on the order of 2-3 psu in the vicinity of the shelf break and a warm-core ring with a gradient of 1-2 psu. Detailed maps were made with the airborne sensors on August 28 and 29 and on September 2 flights were made over the surface drifters to look for effects due to a change in surface roughness resulting from the passage of Hurricane Dennis.

Results show a good agreement between the microwave measurements and ship measurements of salinity (Figure 2). Salinity retrieved on August 29 from the ESTAR

brightness temperature maps corresponds well with the features of the salinity field measured by the ship and drifters (Figure 3).

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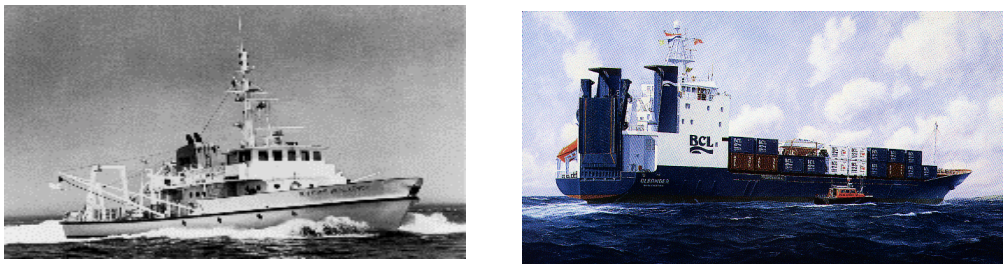

Figure 1: The R/V Cape Henlopen (left) and M/V Oleander (right)

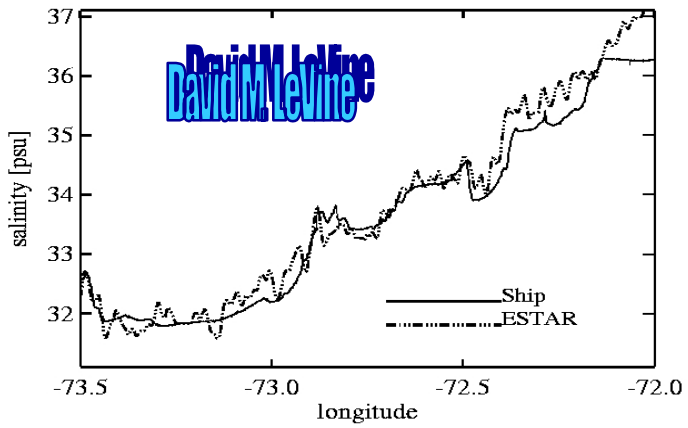

Figure 2: Comparison of salinity derived from ESTAR observations and measurements with the theromosalinograph aboard the R/V Cape Henlopen (29 Aug 1999)

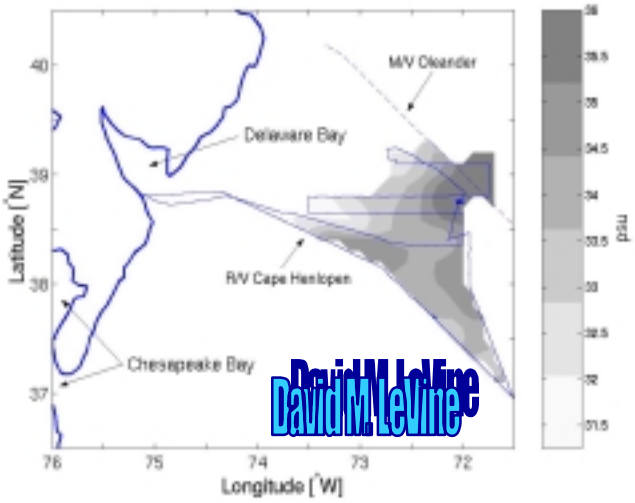

Figure 3: Salinity field derived from measurements by the R/V Cape Henlopen and M/V Oleander showing the ship track and study area. The study area was about 250 km east of Delaware Bay between the continental shelf waters and north wall of the Gulf Stream.