Precision Ocean Salinity Measurements using the Passive Active L/S-band Aircraft Instrument

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Abstract- **Ocean salinity measurements using the Passive Active L/S-band instrument flying on the NCAR C-130 aircraft were made in July 2002 near Monterey, CA. When the radiometer data were corrected for the SST using the Klein and Swift salinity model and surface roughness effects using the L-band scatterometer, the retrieved salinity measurements had an RMS difference of 0.2-0.3 psu when compared with the R/V Point Sur ship measured salinity data.**

keywords - sea surface salinity, microwave radiometers

I. INTRODUCTION*

A set of ocean salinity measurements has been made in support of the new Earth System Science Pathfinder (ESSP) Aquarius mission to measure global sea surface salinity (SSS). The goal of these measurements was to further develop techniques for the accurate measurement of the ocean surface brightness temperature and then use this data to retrieve SSS. This requires a very stable and sensitive radiometric measurement and correction for the perturbing effects due to the ocean surface roughness, sea surface temperature (SST) and the reflected galactic emission.

II. MEASUREMENTS

The measurements were made using the Passive Active L/S-band (PALS) instrument [1] flying on the NCAR C-130 aircraft. The PALS instrument was mounted at a 45° angle facing out the rear door of the C-130 aircraft, which was opened during the flights. The flights were made between 14-19 July 2002 over the Pacific Ocean near Monterey California and were coordinated with the Navy research vessel R/V Point Sur that was continuously measuring the sea surface salinity and temperature. The track of the R/V Pt. Sur is shown in Fig. 1, with the three measurement lines: 67, 70/73 and 77. All measurements were done after sunset to avoid solar interference

The L-band brightness temperature variations associated with salinity changes are small, e.g. a salinity change of 0.2 psu (practical salinity units or parts per thousand) results in a brightness temperature change of ~0.1 K, in this cool (12-14 C) ocean water. Therefore, it is necessary to have a very stable radiometer for these measurements. In the 2002 measurements, the PALS radiometer had stability better than 0.1 K

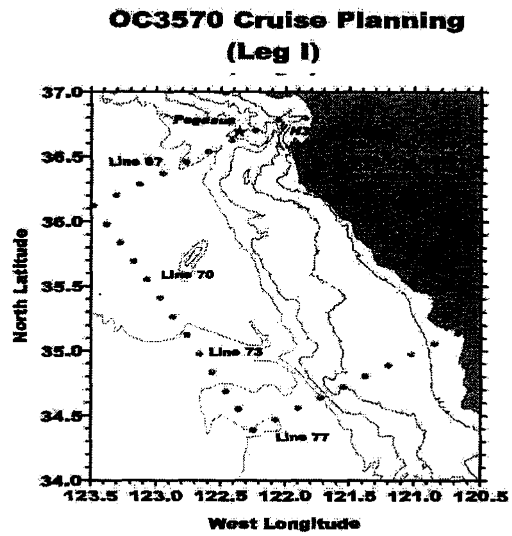

Fig. 1. July 2002 Monterey measurement lines and R/V Pt. Sur ship track.

over the measurement lines. This was achieved by using a Dicke radiometer, with a three position switching sequence, and noise diodes for calibration [1]. It was also necessary to temperature control the front-end radiometer components to ±0.1 C as explained in [2]. The radiometers were calibrated periodically with ambient and liquid nitrogen coax loads at the radiometer coax inputs. These calibrations also verified the stability of the instrument to ±0.1 K. The absolute calibration offset was adjusted to be in agreement with the Klein and Swift salinity model [3]. As explained in [1], the L-band scatterometer was operated about 10% of the time between the radiometer measurements. Only the L-band measurements will be discussed in this paper because about 50% of the S-band data were corrupted due to radio frequency interference (RFI).

III. DATA ANALYSIS

It is necessary to correct the measured data for the small changes in the aircraft roll and pitch. During the flights, small roll and pitch (±5 degree) maneuvers were used to determine these corrections. These corrections were then applied to the radiometer and scatterometer data. During a measurement line, the aircraft roll and pitch were stable within ±1 degree, so only small corrections were necessary.

The SST was measured by the IR sensors on the C-130 aircraft and by the R/V Pt. Sur. There was good agreement,

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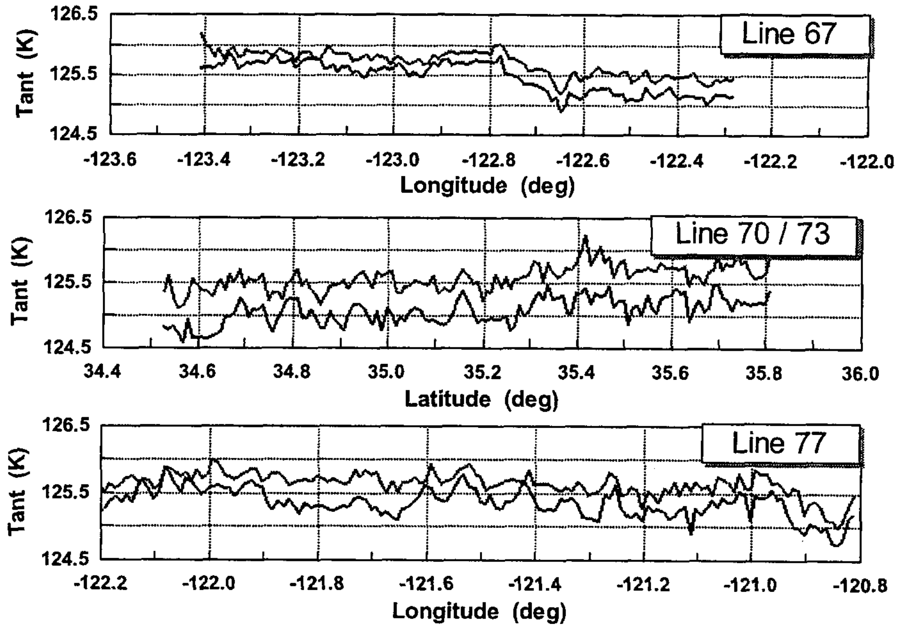

Fig. 3. Radiometer Vertical (V) (red) and Horizontal (H) (blue) position plots after corrections for surface roughness and SST variations. The H data (lower blue curves) has a bias of 50 K added to display the data on the same plot. Note the similarities in the V and H data. Adjusting the H bias, the minimum RMS difference between V and H is 0.2 K.

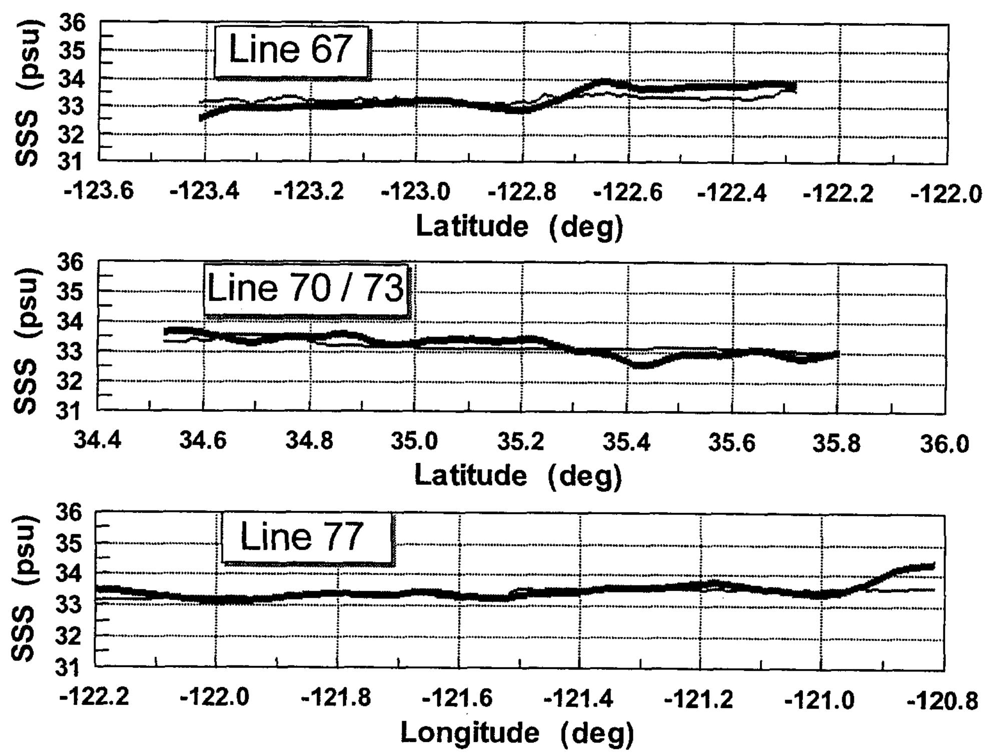

Fig. 4. Retrieved SSS data (thick red) compared to measured SSS (thin green) from the R/V Pt. Sur ship. The RMS difference between the retrieved SSS and the ship SSS is 0.29 psu for Line 67, 0.24 psu for Line 70/73 and 0.11 psu for Line 77.