

Passive Active L/S-Band Microwave Aircraft Sensor for Ocean Salinity Measurement

F. K. Li,

W. J. Wilson,

S. Yueh,

S. Dinardo

Jet Propulsion Laboratory

and

Caltech

S. Howden

University of Maryland

July 27, 2000

Introduction

- Sea Surface Salinity is key ocean geophysical parameter that is “missing” from spaceborne remote sensing measurements of global ocean
 - deep and tropical ocean circulation
- Feasibility of sea surface salinity remote sensing
 - Klein and Swift (78), Swift and McIntosh (83), Ellison et al. (98)
 - Airborne proof-of-concept experiments
 - Blume et al. ‘78, Lagerloef et al. ‘95, Miller et al. ‘98, LeVine et al. ‘98
- Ocean Microwave emissivity depends on
 - surface dielectric constant (related to sea surface salinity)
 - surface roughness
 - sea surface temperature
 - others? (e.g. foam)

Introduction (cont'd)

- At L-Band (1.4GHz), Ellison et al.
 - $\Delta T_b \sim 0.8^\circ\text{K}$ per PSU ($>20^\circ\text{C}$)
 - $\Delta T_b \sim 0.4^\circ\text{K}$ per PSU (5°C)
 - to achieve 0.1 to 0.2 PSU accuracy required for global ocean studies
 - require $\sim 0.1^\circ\text{K}$ ΔT accuracy
- To determine effects of surface roughness
 - use of active radar sensor with near simultaneous measurements at frequencies close to radiometers
- Additional evaluation of benefit
 - dual polarization (V,H)
 - dual frequencies (L/S-Band)
- Motivation to develop a high accuracy, active/passive L/S-Band airborne instrument



L and S-Band Aircraft Radiometer Characteristics

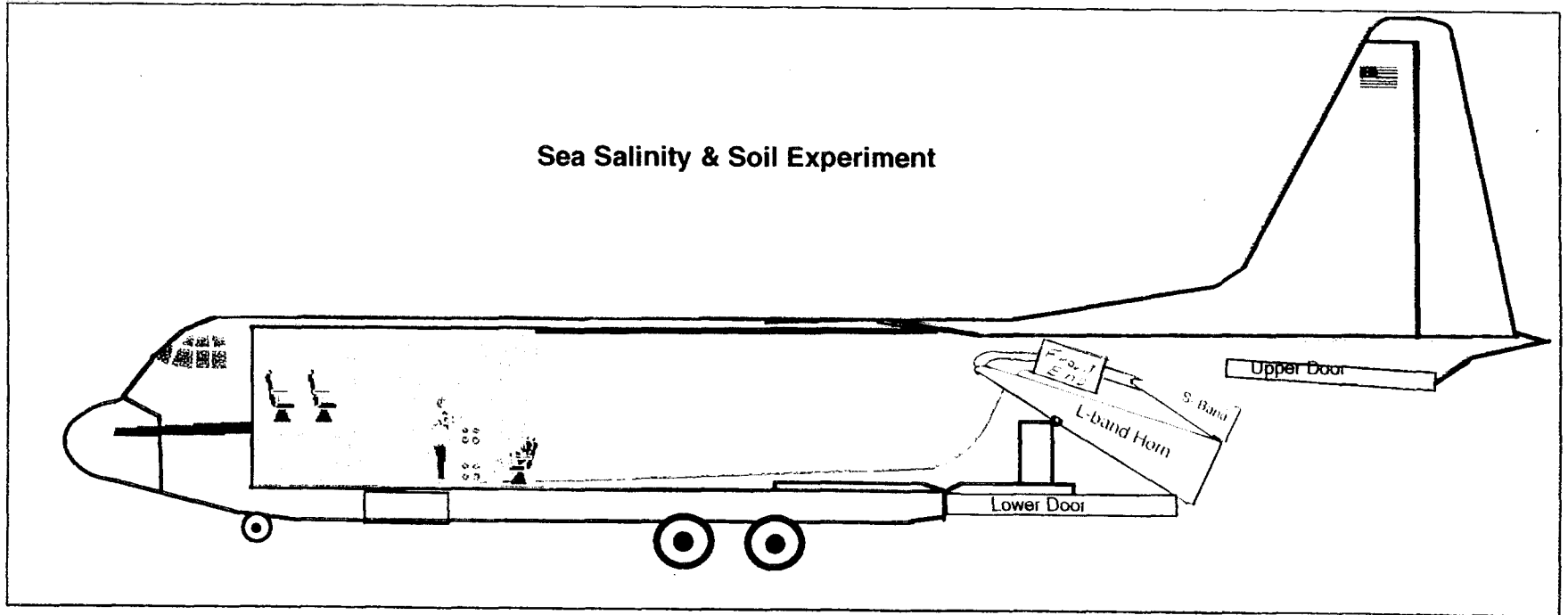
Frequencies	1.41 and 2.69 GHz
Antenna Beam Efficiency	> 90%
Polarization	Horizontal & Vertical
Beam Incidence Angle	38°
Spatial Resolution (@ 1.2 km)	0.7 km
Dicke Switch Rate	80 Hz
RMS Noise per Footprint	0.15 K
Absolute Calibration Accuracy	1.0 K
Calibration Stability	0.1 K



L and S-Band Aircraft Radar Characteristics

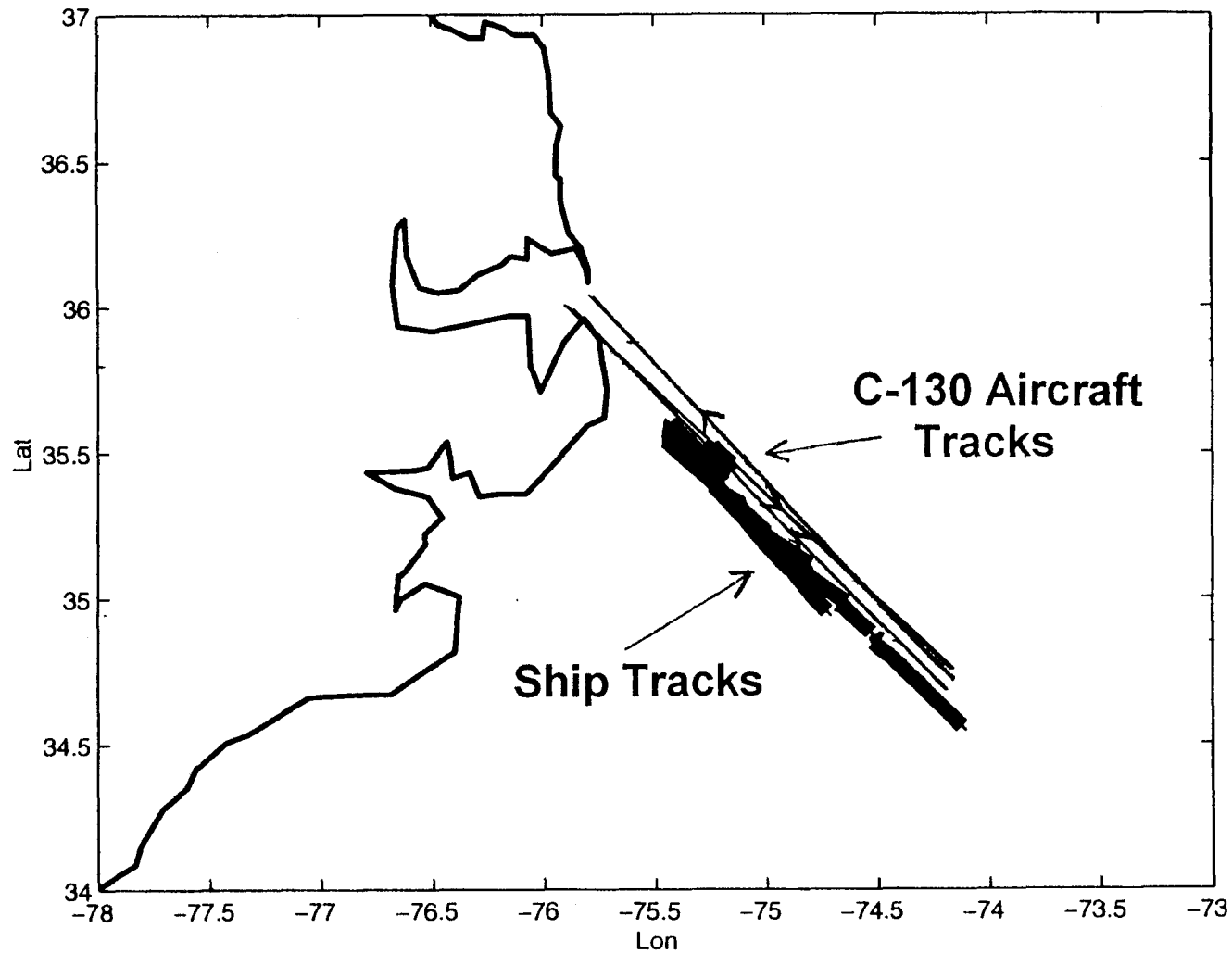
Frequencies	1.26 and 3.15 GHz
Polarization	HH, VH, VV
Beam Incidence Angle	38°
Spatial Resolution (@ 1.2 km)	0.7 km
Transmit Power and Duty cycle	5 Watts and 8%
Pulse Repetition Rate (PRF)	2.8 kHz
Signal to Noise Ratio per pixel	> 15 dB
Sensitivity	0.2 dB
Calibration Stability	0.1 dB

Sea Salinity & Soil Experiment





Cape Hatteras Ship and C-130 Tracks Over Gulf Stream on July 18, 1999





OCEAN SALINITY AIRCRAFT INSTRUMENT

Summary of PALS July 1999 Ocean Measurements

- **Over the Gulf Stream, large changes in the brightness temperature, ~ 3 K, were measured on all runs due to the large changes in the Salinity of ~ 5 PSU. There was good agreement with the TSG data from the Cape Hatteras.**
- **In the open ocean, a small change in the brightness temperature of ~ -0.2 K was measured on July 18th, which is consistent with the TSG data of a 0.4 PSU increase from the M/V Oleander**
- **Some problems with the ocean measurements**
 - **Near continuous RFI at S-band, minimum on Sunday, 18 July, No significant problem at L-band**
 - **Sun glint is a concern, and observations must be planned to minimize the effects**



OCEAN SALINITY AIRCRAFT INSTRUMENT

- JPL has built a dual polarized microwave L and S-band active and passive aircraft instrument for precision ocean salinity measurements
- This will be the first instrument of this kind to provide accurate active and passive measurements at L and S-bands
- Will provide data to improve existing radiative transfer and backscatter models of ocean surfaces
- Will develop improved algorithms for salinity for testing in models and validation of future space instruments