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Environmental Modeling Center
Ocean Modeling Branch

TECHNICAL NOTE[1]

A NEURAL NETWORK-BASED FORWARD MODEL FOR DIRECT ASSIMILATION OF SSM/I BRIGHTNESS TEMPERATURES

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LIST OF ABBREVIATIONS

BT:	brightness temperature
C:	degrees Celsius
CC:	correlation coefficient
FM:	forward model, the same as GMF
FXX:	SSM/I instrument number XX
GHz:	10^9 cycles/second
GMF:	geophysical model function, the same as FM
H:	horizontal polarization
K:	degrees Kelvin
***L*:**	columnar liquid water
LIMA:	European oceanic weather ship
MIKE:	European oceanic weather ship
NCEP:	National Centers for Environmental Prediction
NDBC:	National Data Buoy Center
NN:	neural network
NRL:	Naval Research Laboratory
OMBNN3:	Ocean Modeling Branch Neural Network number 3 - SSM/I retrieval algorithm
OWS:	oceanic weather ship
PB:	physically-based
P&K	Petty and Katsaros (1992, 1994) - see References
SD:	standard deviation
SSM/I:	Special Sensor Microwave / Imager
SST:	sea surface temperature
TAO:	tropical atmosphere ocean
TOGA:	tropical ocean global atmosphere
V:	vertical polarization
***V*:**	columnar water vapor

1. INTRODUCTION

This report contains a description of a new neural network (NN) SSM/I forward model (FM) or geophysical model function (GMF) which generates SSM/I brightness temperatures (BTs) at five frequencies, 19GHz(V and H), 22GHz (V), and 37GHz(V and H) given the wind speed (*W* in m/s), columnar water vapor (*V* in mm), columnar liquid water (*L* in mm), and *SST* (in °C). This OMBFM1 (Ocean Modeling Branch Forward Model number 1) has been developed to be used for direct assimilation of SSM/I BTs into NCEP atmospheric forecast models.

There are two different approaches to developing GMF, a physically-based (PB) approach and an empirical approach. PB approaches use radiative transfer equations and various physical models to describe the air/sea interface and to derive the relationship between satellite BTs and atmospheric and oceanic parameters such as columnar liquid water, columnar water vapor, surface wind speed, and SST. Empirical FM derives relations between BTs and atmospheric and oceanic parameters from empirical data (e.g., collocation of satellite and buoy and/or radiosonde observations). Because PB approaches usually rely heavily on empirical parametrizations, using data similar to those used in the empirical approaches, the difference between PB and empirical approaches is not so great. For example, a SSM/I FM developed by Petty (1990) and Petty and Katsaros (1992, 1994) (P&K FM) uses only for the parametrization of atmospheric effects over 16,000 radiosonde/SSM/I matchups. As a result, PB FMs contain many empirical parameters. OMBFM1 which is a completely empirical FM contains approximately the same number of parameters (which correspond to the NN weights and biases). Several physically based GMFs for SSM/I BTs have been developed. Among them are P&K FM and Wentz (1992) FM. At the best of our knowledge, OMBFM1 is the first empirical FM for the SSM/I.

The purpose of this technical note is to document the development and validation of OMBFM1. In the Section 2, the architecture of the new GMF OMBFM1 is described. Section 3 describes the data sets which are used and the preprocessing of these data. Section 4 describes the training process. In Section 5 we perform detailed validation of the OMBFM1 using various criteria and matchups from different SSM/I instruments. Section 6 presents a sensitivity and error