

AD-A192 299

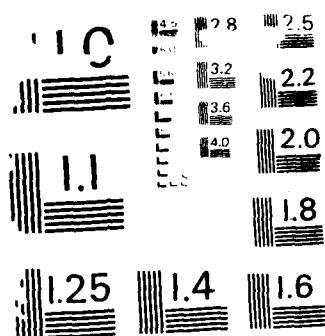
VALIDATE ALGORITHMS FOR THE DETERMINATION OF RAINFALL
RATES FROM SSH/I MI. (U) WISCONSIN UNIV-MADISON SPACE
SCIENCE AND ENGINEERING CENTER.. J P ROBERTS 22 FEB 88
N00014-86-K-2001 F/G 4/1

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RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963



SPACE SCIENCE AND ENGINEERING CENTER

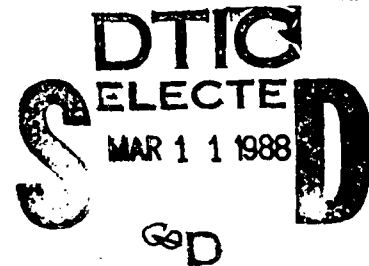
UNIVERSITY of WISCONSIN - MADISON
1225 West Dayton Street
Madison, Wisconsin 53706

TIC FILE COPY

22 February 1988

AD-A192 299

Dr. James Hollinger, Code 83-11
Naval Research Laboratory
4555 Overlook Ave., S.W.
Washington, DC 20375-5000



Dear Dr. Hollinger:

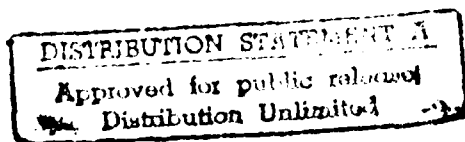
In compliance with the bi-monthly reporting requirements of Contract N00014-86K2001, entitled "Validate Algorithms for the Determination of Rainfall Rates from SSM/I Microwave Satellite Imagery", enclosed is a progress report for the months of December, 1987 and January, 1988.

If you have any questions or desire further information, please contact me at (608)262-0985. Thank you for your consideration.

Sincerely,

John P. Roberts
Assistant Director

cc: Robert C. Lo, Code 7781-2 (1)
Administrative Contracting Officer, ONRRR (1)
Director, NRL (6)
Defense Technical Information Center, Code S47031 (12)
Spangler, Financial Officer (1)
Carpenter, Contracting Officer (1)
Vitense
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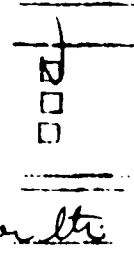
Progress Report for December 1987 / January 1988

During the past two months, our research activities have included (a) updating our catalog of rain cases observed by the SSM/I coincident with radar coverage from our primary or secondary sites, (b) ordering SSM/I, radar, and raingage data for the aforementioned cases, (c) processing the gage-calibrated United Kindom radar data and merging this data with SSM/I observations to create statistics files, (d) developing software for deriving gage calibration coefficients to be used with uncalibrated radars, (e) writing routines for applying BMDP scatterplot and step-wise multiple linear regression software to the SSM/I-ground truth statistics files, and (f) adapting the NCAR SCD plotting package for the contouring of data fields and the production of other high-quality graphics. In addition, software for creating vertical integrals of volume-scan radar data has been nearly completed. Codes are also under development (with the cooperation of Dr. Gene Poe of NRL) for constructing antenna pattern-matching filters.

We are continuing our collaboration with Dr. Chris Kummerow and his colleagues at the Severe Storms Branch of NASA/Goddard Space Flight Center. By this cooperative effort we hope to expedite the radiative transfer modeling necessary for the analysis of SSM/I-ground truth data sets and improve the current rain rate algorithm.

Validation Data

From the primary validation site at Marshall, CO., we have collected and begun to process radar and raingage data for the first seven rain events identified by our weather analysts. Including secondary validation sites, our catalog now contains over 240 radar-observed rain events at midlatitudes in the United States



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that coincide with SSM/I overpasses.

We have received radar data from 5 cases at the primary validation site at Patrick AFB (Cape Canaveral), FL., and have identified over 90 rain cases in the subtropics with coincident SSM/I and radar/raingage coverage.

To date, our weather analysts have identified 108 moderate- or heavy-rain cases covered by at least one of the British Meteorological Office's radars in the United Kingdom. Our initial algorithm validation will incorporate data from these radars since they are pre-calibrated using raingage data. We have processed two SSM/I August (1987) overpasses for which we have also processed the corresponding U.K. radar data, and we have just received data from 5 more overpasses which occurred during that month. Several more U.K. overpasses will be ordered shortly.

Acquisition of data from the Canadian radars and raingages is under way. A total of 246 rain cases within range of at least one of the 5 Canadian validation sites have been identified.

In total, over 700 significant rain cases coinciding with both SSM/I overpass and coverage by the primary or secondary radars have been identified. As of January 15, 1988, we have received approximately 90% of all radar data, 30% of all raingage data, and 10% of the SSM/I data ordered since November 1, 1987.

Validation Software

The software module for deriving radar calibration factors from raingage totals is almost complete. This is essentially the last piece of software required for the validation of the current rain retrieval algorithm.

Some modification of existing software may be required if volume-scan radar data is to be utilized in the validation. Under development are codes to calculate

vertical integrals of radar rain rate over the 625 km² validation areas. Either vertically-integrated radar or CAPPI's may correlate better with surface totals (as measured by gages) than the more standard PPI scans, because the altitude and breadth of the radar target in PPI scans constantly increases with range. Vertically-integrated or CAPPI radar data provide a measure of rain rate which is less range-dependent. In the near future we plan to compare the various radar products against raingage totals in order to determine the best product for validation.

Control code for accessing the scatterplot and step-wise multiple linear regression routines of the BMDP statistical software package have been written and tested.

Preliminary Validation Results:

Since the radar calibration module is yet to be completed, we have concentrated on the validation of the current rain rate algorithm using gage-calibrated PPI radar data from the United Kingdom. Unfortunately we have only just received the SSM/I data (due to delayed shipment) corresponding to the majority of U.K. rain cases identified. However, we have already processed two SSM/I overpasses during August which correspond to significant rain events observed by the U.K. radars. From these two overpasses 289 validation areas (each covering 625 km²) were identified, with 227 areas located completely over land and 62 areas over water. Although the number of validation areas so far identified does not constitute a statistically significant data set for validation, the addition of the SSM/I data just received should provide meaningful statistics for the midlatitude summer zone.

Future Plans and Goals:

Over the next two months, highest priority will be given to the completion and testing of the radar calibration software and the compilation of SSM/I-ground truth statistics for the United Kingdom. The software required to create vertical integrals of volume-scan radar data will be completed concurrent with the development of the radar calibration software. We expect that the large volume of data from each radar volume-scan will require optical disk storage for standard format files, since the amount of hard disk space on the our VAX-751 system is limited, and magnetic tape storage is impractical and costly.

December 1987-January 1988
Progress Period

DESCRIPTION OF EFFORT: Validate Algorithms for Determination of Rainfall Rates from SSM/I Microwave Satellite Imagery

FUNDS ALLOCATED:	\$289,998.00
FUNDS ON CONTRACT:	360,643.00
\$ AMT THIS VOUCHER:	13,076.64
CUMULATIVE \$ AMT VOUCHERS SUBMITTED:	287,684.95
BALANCE:	2,313.05
COST THRU TECHNICAL REPORT PERIOD NOT VOUCHERED:	\$ 28,361.09

s1550p3

**PUBLIC VOUCHER FOR PURCHASES AND
SERVICES OTHER THAN PERSONAL**

U.S. DEPARTMENT, BUREAU, OR ESTABLISHMENT AND LOCATION Disbursing Officer (7) Naval Research Laboratory 4555 Overlook Avenue, SW Washington, DC 20375-5000 ATTN: Code 1332	DATE VOUCHER PREPARED December 9, 1987	VOUCHER NUMBER 4-X097-24
	CONTRACT NUMBER AND DATE N00014-86-K-2001	PAID BY
	REQUISITION NUMBER AND DATE	
VIA: ONR		DATE INVOICE RECEIVED
PAYEE'S NAME AND ADDRESS Board of Regents of the University of Wisconsin System ATTN: Director of Research Administration—Financial 442 A. W. Peterson Office Building 750 University Avenue Madison, Wisconsin 53706		DISCOUNT TERMS
		PAYEE'S ACCOUNT NUMBER

SHIPPED FROM	TO	WEIGHT	GOVERNMENT B/L NUMBER
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NUMBER AND DATE OF ORDER	DATE OF DELIVERY OR SERVICE	ARTICLES OR SERVICES (Enter description, item number of contract or Federal supply schedule and other information deemed necessary)	QUANTITY	UNIT PRICE		AMOUNT (1)
				COST	PER	
	11/1/87 to 11/30/87	For detail, see SF 1035, Continuation Sheet, total amount claimed transferred from page 1 of SF 1035. cc: Dr. James A. Weinman Gwendolyn V. Taylor John P. Roberts Marie Spangler				\$13,076.64

(Use continuation sheet(s) if necessary)		(Payee must NOT use the space below)		TOTAL	\$13,076.64
PAYMENT: ☐ COMPLETE ☒ PARTIAL ☐ FINAL ☐ PROGRESS ☐ ADVANCE	APPROVED FOR	EXCHANGE RATE	DIFFERENCES		
	Provisional	= \$ Payment subject to later = \$1.00			
	BY:	audit			
	Gwendolyn V. Taylor				
	TITLE Procurement Assistant Offc. of Naval Research		Amount verified, correct for		
					(Signature or initials)

Pursuant to authority vested in me, I certify that this voucher is correct and proper for payment.

(Date) (Authorized Certifying Officer) (Title)

ACCOUNTING CLASSIFICATION (Appropriation symbol must be shown other classification optional)

CHECK NUMBER ON TREASURER OF THE UNITED STATES		CHECK NUMBER ON (Name of bank)	
CASH	DATE	PAYEE	
\$			

PAID BY \$	PER TITLE	TH: pw
	* When stated in foreign currency, insert name of currency. * If the ability to certify and authority to approve are combined in one person, one signature only is necessary, other wise the approving officer will sign in the space provided, over his official title. * When a voucher is received in the name of a company or corporation, the name of the person writing the company or corporate name, as well as the capacity in which he signs, must appear. For example John Doe Company, per John Smith, Secretary, or Treasurer, as the case may be.	

Standard Form No. 1035 7 GAO 5000 1035-108-01		PUBLIC VOUCHER FOR PURCHASES AND SERVICES OTHER THAN PERSONAL			VOUCHER NO. 4-X097-24	
					SCHEDULE NO.	
		CONTINUATION SHEET			SHEET NO. 1	
U.S. DEPARTMENT, BUREAU, OR ESTABLISHMENT Dept. of NAVY						
NUMBER AND DATE OF ORDER	DATE OF DELIVERY OR SERVICE	ARTICLES OR SERVICES <i>(Enter description, item number of contract or Federal supply schedule, and other information deemed necessary)</i>	QUAN- TITY	UNIT PRICE		AMOUNT
				COST	PER	
		Contract No.: N00014-86-K-2001				
		Target/Estimated Costs				\$ 289,998.00
		Target/Fixed Fee				-0-
		Total Contract Value				<u>\$ 289,998.00</u>
		<u>Analysis of Claimed Current and Cumulative Costs and Fee Earned</u>				
				Amount For Current Period Billed		Cumulative Amt. From Inception To Date of This Billing
		<u>Major Cost Elements:</u>				
		Salaries and Wages	\$	-0-		\$ 34,122.94
		Fringe Benefits		-0-		1,841.24
		Materials & Supplies		-0-		-0-
		Equipment		-0-		13,647.20
		Travel		-0-		-0-
		Other		9,152.05		150,729.61
		Tuition Remission		-0-		7,094.68
		Total	\$	9,152.05		\$207,435.67
		Overhead - 43% of MTDC		3,924.59		80,249.28
		Total Amounts Claimed		<u>\$13,076.64</u>		<u>\$287,684.95</u>

END

DATE

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