Working Agreement
between
ASTER Team Member
Dr. Thomas J. Schmugge
USDA/ARS Hydrology Laboratory
And
EOS AM Project
Goddard Space Flight Center
For a Scientific Investigation related to the EOS
Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)

Approved by:

Thomas Schmugge 1/16/96
Thomas Schmugge
ASTER Team Member
USDA/ARS Hydrology

Piers Sellers
EOS AM Project Scientist
GSFC

Walter J. Rawls 1/17/96
Dr. Walter Rawls
Research Leader
USDA/ARS Hydrology

C. J. Scolese
EOS-AM Project Manager
GSFC

Mike Ruff
Acting Director, Natural Resource Institute
BARC

D. Harris
Associate Director of ESDIS
GSFC

Concurred by:

A.B. Kahle
U.S. ASTER Science Team Leader
JPL

D. Nichols
ASTER Science Project Manager
JPL

Working Agreement

between

ASTER Team Member

Dr. Thomas J. Schmugge

Hydrology Laboratory
Natural Resource Institute
Beltsville Agricultural Research Center
Agricultural Research Service
U.S. Department of Agriculture
Beltsville, Maryland 20705

And

EOS AM Project
Goddard Space Flight Center
Greenbelt, Maryland 20771

For a Scientific Investigation related to the EOS
Advanced Spaceborne Thermal Emission and
Reflection Radiometer (ASTER)

Revised 11 January 1996

1.0 Introduction

1.1 Purpose

This Working Agreement defines the execution/operations phase (C/D) responsibilities and milestones for Thomas Schmugge, Science Team Member for the Advanced Spaceborne Thermal Emission and Reflection Radiometer experiment of the Earth Observing System(EOS) AM Project. This work includes, but is not limited to, doing research in support of the EOS Science Plan, and developing and maintaining software to produce special science data products from the observations produced by the ASTER instrument.

1.2 Key Assumptions

In order to accomplish the key objectives outlined below, we have a few specific data needs. We will require repetitive images over the test sites especially after a rain, to follow the dry down process. These data should be the surface radiances corrected for any atmospheric effects. We expect that the VNIR and TIR images will be coregistered so that they can be merged with data from other sources. These will include, but are not limited to, micrometeorlogical and surface vegetation observations, components of the radiation balance and soil moisture estimates made from spaceborne microwave sensors such as ESTAR or SAR.

1.3 Applicable Documents

Execution Phase Project Plan for the Earth observing System (EOS) (GSFC 170-01-01)

EOS Science Plan (In development)

ASTER Team Member Algorithm Software Development Guidelines (JPL D-11418)

ASTER Team Leader Experiment Implementation Plan (JPL D-11200) (Preliminary)

EOS Project Calibration Management Plan (GSFC 420-03-01)

ASTER End-to-End Data System Concept Document (JPL D-11199)

1.4 Management Relationship

Although this Working Agreement is between Dr. Thomas Schmugge, ASTER Science Team Member, and the NASA Goddard Space Flight Center, Dr. Schmugge's activities described in

this Agreement will performed under the leadership and technical oversight of the U.S. ASTER Science Team Leader, Dr. Anne B. Kahle of the Jet Propulsion Laboratory.

2.0 Team Member Responsibilities

Team Member responsibilities include: 1) the conduct of scientific research in the area of land surface climatology which requires accurate estimates of land surface temperature from ASTER and MODIS; and 2) the development of an algorithm for a special science data product related to the estimation of land surface fluxes from ASTER data.

2.1 Science Objectives

The broad purpose of this investigation is to perform research leading to or supporting long-term observations from the ASTER that will contribute to improved understanding of the global processes occurring on or near Earth's surface and in the atmosphere, especially surface-atmosphere interactions. A fundamental and specific objective of this investigation is the development and evaluation of methods for using ASTER surface temperature data for determining the energy fluxes at the land-atmosphere interface. Estimates of the fluxes based on these methods will be archived in data sets for general scientific use. These data sets will contribute to the construction of interdisciplinary science products. Dr. Thomas Schmugge will carry out scientific investigations leading to the publication of results in proceedings of scientific meetings and refereed journals.

2.2 Task Descriptions

1. Dr. Schmugge will review his investigation objectives, performance requirements, and required science measurements in relation to the performance characteristics of the ASTER instrument, and will update/revise these factors as appropriate.

2. Dr. Schmugge will develop algorithms for using ASTER surface temperature data to estimate components of the surface energy balance especially, evapotranspiration (ET). This parameter has been classified as a special data product. To achieve the objective the following sub-tasks have been identified:.

- 2a The study of the variations in surface emissivity over the 8 - 12 micron range for an agricultural/vegetated scene. The spectral variation of emissivity over this band for bare soils may provide a method for understanding the mixed pixel problem.

- 2b The study of the possible band combinations which do the best job of correcting for atmospheric effects. Correction for both emissivity and atmospheric effects is required since it is necessary to know surface temperatures to better than 1 C for evapotranspiration estimation. These approaches may be better since they correct for the effects of the actual atmosphere observed by the sensor.

- 2c The study the loss of information by degrading the spatial resolution from 90m to 1 km

for the heterogeneous scenes as observed by ASTER and by the appropriate channels of MODIS.

- 2d Participate in field experiments, both domestic and international, to acquire the data necessary to address the above problems and for the development and validation of the flux algorithms..

3. Dr. Schmugge will serve as a co-chairman of the Ecology and Land Surface Climatology Working Group and as a member of the atmospheric corrections and the temperature emissivity separation working groups.

2.3 Science Computing Facilities

The plan for the overall structure of Dr. Schmugge's SCF is a network of UNIX workstations, PC's and peripherals, connected to a LAN with a gateway connection to Internet via a T1 (1Mb) line. Currently the SCF includes one IBM RS/6000 workstation, multiple PC's and peripherals. The SCF is managed by a part- time system administrator/programmer through internal ARS support. Current software packages include PCI (EASI/PACE) for image processing, IDL for general data analysis, SPANS for GIS analysis, and S-Plus for statistical analysis. The facility is expected to evolve to include upgrades of the RS/6000 workstation and associated software. Dr. Schmugge will provide detailed information to the Team leader to be incorporated into an ASTER-wide SCF plan as necessary.

2.4 Project Meetings and Reviews

Dr. Schmugge will support an annual meeting, if required by the Team Leader and/or the EOS AM Project, to discuss progress and plans and resolve issues associated with scientific research, science algorithm development, data processing resource requirements, the SCF's, and other matters associated with this working agreement.

Dr. Schmugge will participate in the EOSDIS development by reviewing designs or attending design reviews as deemed necessary by the U.S. ASTER Team Leader. Dr. Schmugge will participate in the algorithm peer reviews conducted by the EOS Program, at the request of the AM Project Scientist and the U.S. ASTER Team Leader.

Dr. Schmugge or a representative will attend and actively participate in the ASTER Science Team meetings which will be held at a minimum of 2 times per year, with at least one meeting per year held in Japan. Foreign trips will require the approval of the U.S. Department of Agriculture/ Agricultural Research Service.

2.5 Reporting

Dr. Schmugge will:

- Submit quarterly technical progress reports to both the EOS AM Project and the U.S.

ASTER Science Team Leader. These reports will include:

- Progress since the last quarterly report;
- Activities planned for the next quarter;
- 12 month schedule;
- Issues and concerns.

- Submit a NASA 533 Financial Report (or its equivalent) to the ASTER Instrument Manager on a quarterly basis. Reporting will separate Science and SCF activities.

- Provide contributions to the ASTER Interim and Final Science Reports.

- Present the results of ASTER-related research at scientific meetings both domestic and international and in refereed scientific journals. NASA/EOS will be acknowledged as the data source, and a copy of each will be provided to EOS Project Science Office.

2.6 Special Requirements

Dr. Schmugge will ensure that a citation identifying the NASA EOS Program is contained in each publication resulting from work either fully or partially supported by funding provided by this working agreement.

Dr. Schmugge will ensure that all special data products, produced with funding support from this agreement, are delivered to the EOSDIS, along with appropriate documentation and metadata.

3.0 Period of Performance

The period of performance for this agreement is from January 1, 1995 through December 31, 2001.

4.0 Schedule (Milestones)

Define test sites	1/1/95	1/1/00
Prepare Field Instrumentation	1/1/95	1/1/99
Perform Field Meas.	1/1/95	1/1/01
Select candidate Flux Algorithm	1/1/95	1/1/97
Evaluate selected Algorithm		
Pre-Launch	1/1/97	7/1/98
Post-Launch	7/1/98	1/1/01

5.0 Allotment of funds

The Goddard Space flight Center (GSFC) will provide funding as shown in Table 1. The funding shown is consistent with : 1) the working agreement and other provisions of this agreement; 2) The best current estimates of the funds available to GSFC to conduct the EOS missions. If circumstances change, the terms of this agreement may be revised with the approval of both parties.

Table 1.
Research Funding ($K)

FISCAL Year	Science Funds	SCF Funds	Total
1995	70	10	80
1996	70	10	80
1997	75	10	85
1998	80	10	90
1999	90	30	120
2000	100	20	120
2001	100	10	110
2002	100	20	120
2003	100	10	110
2004	50	5	55

~~Mike~~ Michelle Adding Coor

Agricultural Research Service
Research Management Information System
ARS Project Documentation System
416/417 Submission for Review
01/25/96

Project Number: 1270-13660-005-08R
Accession Number: 0400216
Mode Code: 1270-10-00

Attention NPL Team:
ADA: Jan van Schilfgaarde
Leader: David A. Farrell
Member(s): Dale A. Bucks C. Richard Amerman vice Range

Approval is requested for the following ARS Action:
NEW

The proposed changes to the following items have been requested by:
1270-10-00 BELTSVILLE AREA
NATURAL RESOURCES INSTITUTE
HYDROLOGY LABORATORY

SUBMITTED

__ Approved

__ Disapproved

Comment: New Reimb w/ Nasa Upcoming

Signatures:

Area Director: _____ Date: 1/29/96

PAO: _____ Date: / /

Area Budget Off: _____ Date: / /

Agricultural Research Service
Research Management Information System
ARS Project Documentation System
01/23/96

Executive Summary Sheet

For ARS Project No. 1270-13660-005-08R
Accession Number 0400216
Mode Code 1270-10-00

Reimbursable

Award Date: 02/01/96

THE USE OF SATELLTE REMOTELY SENSED DATA FOR LAND SURFACE FLUX DERMINATION

BELTSVILLE AREA
NATURAL RESOURCES INSTITUTE
HYDROLOGY LABORATORY

Project Start Date: 02/01/96 Termination Date: 01/31/01

Proposed Official Funding Levels:

Net to Location:	FY 96($+	0)
Received Total All FY's:	($+	0)

****** Official Strategic Plan Codes ******

1.3.1.1	30%
6.6.2.1	70%

Reason Project was Initiated: Budget Increase

Remarks:
New Reimbursable with NASA.

APPROVED:

Area Director: on / / by
Assoc Depty Admin: on / / by

Created: on 01/04/96 By B85
Last Modified: on 01/23/96 By

********** UNOFFICIAL PROJECT **********

Form AD-416 *****UNOFFICIAL PROJECT*****

1. Accession: 0400216 | 2-4. Agency ID: ARS 1270-10-00 | 5. Project Number: 1270-13660-005-08R | 6. Status: N=NEW

7. Title: THE USE OF SATELLTE REMOTELY SENSED DATA FOR LAND SURFACE FLUX DERMINATION

8. Performing Organization: 0000 6562 AGRICULTURAL RESEARCH SERVICE
BELTSVILLE
MARYLAND 20705 05

12. SY Time/Investigator/Series/Grade SCHMUGGE THOMAS J — SY Total: .00 — General Physical Science GS 15

16. Research Location on Campus: NO — Total Net to Loc: (+ $0)

17-1. Project Type: R=Reimbursable — 17-2. B=OTHER — FY: 96

21. Facilities: B = FEDERALLY LEASED — Agreement No.:

22. Regional Project Number: — A: - - B: - -

24. OBJECTIVES:
Determine the utility of using the Multispectral data to be acquired by the ASTER insturment on NASA's Earth Observing System to estimate the evapotranspiration flux/water use form agricultural fields. Define an algorithm or approach for making these estimates from the EOS data.

25. APPROACH:
Prior to the launch of the satellite in 1998, ground and remotely sensed data acquired during a number of field experimens covering a range of agricultural conditions will be analyzed to evaluate candalate algorithms for making flux estimates. After launch the selected algorithms will be evaluated with satellite data over a limited number of test sites, mostly ARS Research Watersheds.

27. KEYWORDS:
REMOTE SENSING SURFACE TEMPERTURE EVAPOTRANSPIRATION WATER USE

	Recommended			Approved		Concurred	
Signature		A/D	Date	Signature		A/D	Date
RL:	WALTER J RAWLS	A	01/19/96	NPL1:			00/00/00
LD:	MICHAEL D RUFF	A	01/23/96	NPL2:			00/00/00
ABFO:			00/00/00	NPL3:			00/00/00
AD:			00/00/00	BPMS:			00/00/00
PAO:			00/00/00	ADA:			00/00/00

28. Award Date: 02/01/96 | 29. Start Date: 02/01/96 | 30. Termination Date: 01/31/01 | Duration: (months) 060

NPL Team: ADA: Jan van Schilfgaarde Leader: David A. Farrell

Form AD-417 Document Printed 01/25/96 *****UNOFFICIAL PROJECT*****

1. Accession:	2-4. Mode Code:	5. Project Number:	Date Last Modified:
0400216	ARS 1270-10-00	1270-13660-005-08R	01/23/96

			Proposed Net to Loc
STP(s)	1.3.1.1	Hydrological Processes	30% (+)
	6.6.2.1	Information Processing Technologies	70% (+)
		Total Proposed Net to Loc:	(+ $0)

32.	Basic Research:	30%	(+ 0)
33.	Applied Research:	50%	(+ 0)
34.	Development Effort:	20%	(+ 0)
		Total Proposed Net to Loc:	(+ $0)

	Prime Commodity	Codes Activity	Research Problem Area Code	Field of Science Code	Prime %	Proposed Net to Loc
36.	0200	4300	105	2120	50	(+)
37.	0200	4300	105	2421	50	(+)
				Total Proposed Net to Loc:		(+ $0)

SubClass.	Codes	Description	%	Proposed Net to Loc
Commodity	0200	WATER	100	0
		Total Proposed Net to Loc:		$0
Activity	4399	RESOURCE DEV, CONS, MGMT	100	0
		Total Proposed Net to Loc:		$0
Special	FBP5	ENVIRON & NATURL RESOURCE	100	0
Special	SA+3	SUSTAINABLE AGRI + 3	100	0
Special	W2D	EVAPORATION TRANSPIRATION	50	0
Special	W2G	WATER IN SOILS	50	0
Special	W7B	DATA ACQUISITION-WATER	50	0

NPL Team: ADA: Jan van Schilfgaarde Leader: David A. Farrell

* Note: Rounding may cause minor differences in calculated value compared to the proposed Net to Location.

1/25/96

AUTHORIZATION TO APPLY FOR AND USE FUNDS FROM OUTSIDE SOURCES

Modecode/Log Number: 1270-10-00 10360 Status: New
Location / Management Unit Name:
NATURAL RESOURCES INSTITUTE
HYDROLOGY LABORATORY

Contact: SCHMUGGE THOMAS J Type: Principal Investigator
Series: General Physical Science GS 15 Telephone: (301)504-7490

Purpose of Funds: Research > 25,000
Type of Agreement: Reimbursable

Remarks:

Source of Funds: Type: Other Federal
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

IPSC: Never Waived

Do you or any full-time resident of your household have any activity or financial interest (dealings) with the Cooperating Organization? NO

Start Date: 02/01/96 End Date: 01/31/01 Duration: 60 (months)

Prior Proposed: $	500,000
Proposed Amount:	0
Total Proposed:	500,000

How are funds to be used? ARS FTE: 1.00

Category 1&4 Salaries:	0	Supplies:	0	Equipment:	0
Other Federal Salaries:	0	Travel:	0	RSA:	0
Other Costs:	0				

Value of Owned or Controlled ARS Buildings & Land Utilized: 0

AREA ETHICS ADVISOR ONLY:
Confirmation and determination of 'dealings' question responded by SY.
No Dealings, No Conflict

	Recommended		Approved	Concurred
Signature		A/D Date	Signature	A/D Date
RL:	WALTER J RAWLS	A 01/19/96	NPL1:	
LD:	MICHAEL D RUFF	A 01/23/96	NPL2:	
ABFO:			NPL3:	
AD:			BPMS:	
PAO:			ADA:	

Form ARS-425 (5/94)

***** UNOFFICIAL *****

1/25/96

AUTHORIZATION TO APPLY FOR AND USE FUNDS FROM OUTSIDE SOURCES

Modecode/Log Number: 1270-10-00 10360 Status: New

Title of Proposal:
THE USE OF SATELLTE REMOTELY SENSED DATA FOR LAND SURFACE FLUX DERMINATION

Project Number:
1270-13660-005-08R
Accession: 0400216

Type of Work to be Completed:
Research on the development and validation for algorithms/approaches for estimating components of land surface energy balance using remotely sensed thermal infrared data.

Work to be Performed: In-house and Extramural
Extramural Agreement Type: General Cooperative Agreement

Principal Performing Organization:
PENNSYLVANIA STATE UNIVERSITY
PENNSYLVANIA PA 16202

Extramural Amount: $ 100,000

If part or all of funds will be used for extramural research, give reason:
The group of Penn State University has a long history of research on the use of thermal infrared data and have performed cooperative research with us for several years.

Title of In-house Project:
REMOTE SENSING FOR HYDROLOGY

Project Number:
1270-13660-005-00D
Accession: 0148190

Is the proposed research directly related to the in-house project of SY? YES

Sub Commodity Codes from In-house:
0200 WATER
0320 WATERSHEDS

STP Codes from In-house:
1.3.1.1 Hydrological Processes
6.6.2.1 Information Processing Technologies

Describe the deliverables that the Agency will provide the funding organization:
An algorithm or approach for using remote sensed thermal infrared for determining components of the surface energy balance.

Will this research require more FTE than currently available to SY/MU? NO
Number of FTE needed: .0

AREA DIRECTOR ONLY:
Will the Area Director agree to provide the FTE if project is funded? YES
Does the SY/MU have the needed expertise/facilities/time to conduct the proposed research? YES

Is the proposed funding level and duration adequate to provide the deliverables described above? YES