RECORD OF ENVIRONMENTAL CONSIDERATION

PROJECT NAME: SMAP-VEX'08

A. Description and location of proposed action:

The Soil Moisture Active-Passive – Validation Experiment 2008 (SMAP-VEX'08) NASA P-3B mission will test and validate two new NASA L-band radiometers and re-fly a GPS reflectometer. Following the instrument validation and test phase, the P-3B will participate in a multiplatform, mixed altitude soil moisture mapping experiment coordinated by the United States Department of Agriculture (USDA). SMAP-VEX'08 is part of the overall Soil Moisture Active and Passive (SMAP) mission Phase A activities designed to test soil moisture instrument retrieval algorithms for L-Band Radiometers in preparation for the SMAP satellite mission.

Date and/or Duration of project: September 2008 and October 2008

2. It has been determined that the above action (choose one)

_____ a. Is adequately covered in an existing EA or EIS.
   Title: ___________________________________________________________
   Date: ___________________________________________________________

XX b. Qualifies for Categorical Exclusion and has no special circumstances which would suggest a need for an Environmental Assessment.
   Categorical Exclusion: 4.2.1 a (2)
   (NASA, NPR 8580.1, Chapter 4)

_____ c. Is exempt from NEPA requirements under the provisions of:
   __________________________________________________________________

_____ d. Has no significant environmental impacts as indicated by the results of an environmental checklist and/or detailed environmental analysis. (Attach checklist or analysis as applicable)

_____ e. Will require the preparation of an Environmental Assessment.

_____ f. Will require the preparation of an Environmental Impact Statement.

NEPA Program Manager, Code 250 9/11/08

Project Manager, Code 840 9/11/08
### NEPA Environmental Checklist (R&D Projects)

**Project Name:** SMAP-VEX’08  
**Date:** September 02, 2008  
**Project Contact:** John Valliant  
**Building Number and Location:** D-1, room N220  
**Phone Number:** 757-824-1422  
**Project Start Date:** September 2008

**Description of Project:** See attached sheet

### Environmental Impacts:

“Yes” responses may require the project to prepare an Environmental Assessment or conduct additional studies.

#### A. Geologic:
- Greater than 10% change in topography or ground surface relief features? Yes [ ] Maybe [ ] No [ X ]
- Any increase in wind or water erosion of soils, either on or off site? Yes [ ] Maybe [ ] No [ X ]
- Changes in deposition, situation, or erosion that may modify the wetlands or bay? Yes [ ] Maybe [ ] No [ X ]

*Explain all “yes” and “maybe” answers:*

#### B. Air:
- Substantial air emissions or deterioration of ambient air quality? Yes [ ] Maybe [ ] No [ X ]
- The creation of objectionable odors? Yes [ ] Maybe [ ] No [ X ]
- Alteration of air movement, moisture, temperature, or any changes in climate, either locally or regionally? Yes [ ] Maybe [ ] No [ X ]

*Explain all “yes” and “maybe” answers:*

#### C. Water:
- Disturbance of groundwater? Yes [ ] Maybe [ ] No [ X ]
- Greater than 10% changes in absorption rates, drainage patterns, or the rate and amount of surface runoff? Yes [ ] Maybe [ ] No [ X ]
- Alter the course or flow of floodwaters? Yes [ ] Maybe [ ] No [ X ]
- Alteration of the direction or rate of ground water? Yes [ ] Maybe [ ] No [ X ]
- Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations? Yes [ ] Maybe [ ] No [ X ]
- Activities resulting in changes of greater than 10% of Center total potable water use (maximum 820,000 gallons/month)? Yes [ ] Maybe [ ] No [ X ]
- Any construction or other activity in a floodplain or wetland? Yes [ ] Maybe [ ] No [ X ]

*Explain all “yes” and “maybe” answers:*

#### D. Cultural Resources:
- Is the project located in an historic district or affects an existing landmark? Yes [ ] Maybe [ ] No [ X ]
- Will the project alter a building that is 50 years or older? Yes [ ] Maybe [ ] No [ X ]
- Is the project located in an area of suspected archaeological resources? Yes [ ] Maybe [ ] No [ X ]

*Explain all “yes” and “maybe” answers:*

#### E. Biological Resources:
- Construction/grading/filling within or adjacent to designated wetlands? Yes [ ] Maybe [ ] No [ X ]
- Reduction of the numbers of any rare, or endangered species? Yes [ ] Maybe [ ] No [ X ]
- Construction/grading/filling within open space or grasslands areas? Yes [ ] Maybe [ ] No [ X ]
- Introduction of new species or plants into an area, or impacts the normal replenishment of existing species? Yes [ ] Maybe [ ] No [ X ]
- Proposed construction activities in piping plover habitat? Yes [ ] Maybe [ ] No [ X ]
- Proposed construction activities within 600 feet of an eagle’s nest? Yes [ ] Maybe [ ] No [ X ]
- Propose new landscaping or modify existing landscaping? Yes [ ] Maybe [ ] No [ X ]

*Explain all “yes” and “maybe” answers:*

#### F. Noise:
- A noise increase greater than 10% from an existing operation? Yes [ ] Maybe [ ] No [ X ]
- Exposure of people to severe noise levels (above 80 dBA)? Yes [X] Maybe [ ] No [ ]
- Increase existing CNEL noise contours surrounding the airfield Yes [ ] Maybe [ ] No [ X ]
G. Land Use:

a. Substantial alteration of the present or planned land use? Yes [ ] Maybe [ ] No [ X ]
b. Activities resulting in changes of greater than 10% of Center energy consumption (1,800,000 KWH of Main Base energy, 2,175,000 KWH of launch area energy, or 4,250,000 KWH of total energy)? Yes [ ] Maybe [ ] No [ X ]
c. Activities resulting in a change in total employment levels greater than 10% (more than 95 people)? Yes [ ] Maybe [ ] No [ X ]

H. Health and Safety:

a. Generation of ionizing or non-ionizing radiation? Yes [ ] Maybe [ ] No [ X ]
b. Generate any air emissions? Yes [X] Maybe [ ] No [ ]
c. Use of pesticides, including insecticides, herbicides, fungicides or rodenticides? Yes [ ] Maybe [ ] No [ X ]
d. Confined space entry? Yes [ ] Maybe [ ] No [ X ]
e. Risk of exposure to asbestos or lead containing materials? Yes [ ] Maybe [ ] No [ X ]

B. Transportation/Circulation:

a. Generation of substantial vehicle trips (over 620 per day)? Yes [ ] Maybe [ ] No [ X ]
b. Affect existing parking facilities or demand for new parking? Yes [ ] Maybe [ ] No [ X ]
c. Substantial impact upon existing transportation systems? Yes [ ] Maybe [ ] No [ X ]
d. Increase in traffic hazards to motor vehicles, bicyclists, or pedestrians? Yes [ ] Maybe [ ] No [ X ]

I. Services:

a. Affect or result in need for new or altered government-provided fire protection services? Yes [ ] Maybe [ ] No [ X ]
b. Affect or result in need for new or altered government-provided security services? Yes [ ] Maybe [ ] No [ X ]

J. Environmental Justice:

a. Does the project have the potential to disproportionately affect low-income populations or minority populations? Yes [ ] Maybe [ ] No [ X ]

Explain all “yes” and “maybe” answers:

Explain all “yes” and “maybe” answers: Noise will be generated by aircraft; crew is required to wear hearing protection.

Hazards of Electromagnetic Radiation to Ordnance (HERO) and Hazards of Electromagnetic Radiation to Personnel (HERP) calculations were performed for MAPIR and DBSAR transmitters. MAPIR is a passive electronic system and poses no hazard to the aircraft and/or crew. GPSRS has no transmitters. All instruments will be operated in accordance with the flight project’s safety plan.

The aircraft will carry standard K-bottles of nitrogen. The Safety Engineering Note (SEN) includes the calculations associated with a nitrogen gas leak that could occur in NASA 426 P-3B. Complete diffusion of one K-bottle of nitrogen has little effect on the cabin air composition (very slight reduction of the oxygen concentration). At no point will the release of one bottle of gaseous nitrogen even begin to create a hazardous environment, with the complete diffusion of the nitrogen gas. In addition, the air in NASA 426 is refreshed/replaced approximately every three minutes while in flight. The crew shall take caution regarding inadvertent leaks of gaseous nitrogen when in flight if the cabin air exchange/pressurization system becomes inoperable, or when on the ground and in the vicinity of a K-bottle which experiences a sudden and massive nitrogen gas leak.

Exhaust emissions from aircraft will be minor and transient.
OVERVIEW OF THE SMAP-VEX’08 MISSION

1.1 INTRODUCTION:

The Soil Moisture Active-Passive – Validation Experiment 2008 (SMAP-VEX’08) mission will test and validate two new NASA L-band radiometers and re-fly a Global Positioning System (GPS) reflectometer. Following the instrument validation and test phase, the Wallops Flight Facility (WFF) P-3B aircraft will participate in a multiplatform, mixed altitude soil moisture mapping experiment coordinated by the United States Department of Agriculture (USDA). SMAP-VEX’08 is part of the overall SMAP mission Phase A activities designed to test soil moisture instrument retrieval algorithms for L-Band Radiometers in preparation for the SMAP satellite mission.

The WFF P-3B SMAP-VEX’08 flights will first fly each of two L-Band radiometers in a separate test phase to validate instrument operations and data collection. During the initial test phase the instruments teams will also be investigating possible radio frequency interference (RFI) emissions from ground based sites within their receive bandwidth. Following the initial instrument test flights the P-3B will fly in concert with a NASA G-3 and Twin Otter aircrafts over agricultural test sites on Maryland’s Eastern Shore. For the multiplatform soil moisture study a total of five instruments and at least one satellite will be collecting data for the experiment to compare with in-situ ground data collected at the test sites. The three instruments being flown aboard the WFF P-3B are as follows:

- Marshall Airborne Polarimetric Imaging Radiometer (MAPIR) - Dr. Charles Laymon, NASA Marshall Space Flight Center (MSFC)
- Digital Beam Forming Synthetic Aperture Radiometer (DBSAR) – Mr. Rafael Rincon, NASA Goddard Space Flight Center (GSFC)
- GPS Remote Sensing Instrument (GPSRS) – Dr. Michael Grant, NASA Langley Research Center (LRC)

MAPIR is a new aircraft based L-band radiometer that observes emissions in the 1401-1425 MHz passband. Designed and built by the MSFC, it can operate in several modes that facilitate mapping larger regions and can effectively simulate the SMAP radiometer configuration while doing this. The MAPIR antenna is a planar phased array that can electronically steer two independent beams that feed four ultra stable radiometers. The radiating element of the antenna subsystem is a dual-polarized, probe-fed patch antenna comprised of 80 individual “smart” patches. The antenna has a main lobe beamwidth of ~15° at boresight and first sidelobe level of less than -30 dB achieved by a Taylor Amplitude Taper. Each antenna element has a phase shifting network associated with each polarization to point the beam at a given scan angle up to +/- 45° from boresight. Each RF pathway results from any combination of four independent beam steering angles. Thus, the system is capable of simultaneous measurements of horizontal and vertical polarizations or a single polarization at two different look angles.

The DBSAR instrument is an airborne radar developed at GSFC that combines electronic beam steering and digital beam-forming to allow the implementation of different scanning techniques. DBSAR is utilizing the same antenna as was flown on the P-3B for the RadSTAR-A test flights in 2006 and 2007. The DBSAR test flights are part of the RadSTAR initiative intended to develop the
technology that will enable a combined radar/radiometer system that jointly uses a single, dual frequency antenna with cross-track scanning capabilities, but no moving parts. The technology will enable single aperture measurements of important Earth Science Enterprise climate applications such as ocean salinity, soil moisture, sea ice, and surface water among others.

The GPSRS uses GPS radio-navigation signals that strongly reflect from (liquid) water and, to a lesser extent, from land surfaces. The strength of the land-reflected signal is a function of both surface roughness and dielectric constant. The airborne GPSRS is used to simultaneously acquire both the direct-from-satellite and surface-reflected signals. Surface-reflected signals emanate from elliptically shaped areas of constant transmission path delay which yields a power vs. delay map of the surface.

WFF will supply the P-3B aircraft, aircraft support, and project management. This project plan scope covers the WFF managed mission, which is scheduled for September-October 2008. The scheduled mission dates are as follows:

- One one-half to one hour Engineering Check Flight DBSAR – week of September 1, 2008
- Two to three- one to two hour program test flights DBSAR – week of September 8, 2008
- One one-half to one hour Engineering Check Flight MAPIR – week of September 22, 2008
- Two to three- one to two hour program test flights MAPIR – week of September 22, 2008
- Approximately 20-30 hours mission SMAP-VEX’08 flights to be coordinated with field program – October 1-14, 2008.

All flights are to be flown in Visual Flight Rule (VFR) conditions. The potential for weather or mechanical related mission delays is possible.

1.2 OBJECTIVES

The overall WFF objective for the SMAP-VEX’08 mission is to fly three instruments over predetermined flight lines over the Delmarva Peninsula and nearby Mid-Atlantic test sites. All test and program flights will based from NASA WFF.

The DBSAR program has two minimum goals:
- Goal 1 - Collect data over a mixed background of land and ocean during flight lines that cross the Delmarva Peninsula or other targets previously flown. This goal will validate the ability to successfully record data from the instrument.
- Goal 2 - Display the backscatter cross-section data in a map format from a flight that crosses the Delmarva Peninsula or other targets. This goal will validate the ability to calibrate and display the radar backscatter cross-section measurements.

The minimum goal/success criteria for the MAPIR program is as follows:
- Gain familiarity with aircraft integration process and operations,
- Acquire brightness temperature data at 40° in staring mode at different resolutions over varied land cover types at varied soil moisture conditions, and
- Detect, acquire & archive spectral characteristics of RFI.
The GPSRS system is flying as a piggy-back instrument and will collect data during DBSAR and MAPIR allotted flights. Therefore, no success criteria or flight planning will be completed for GPSRS.

1.3 MISSION DESCRIPTION

Both instrument test flights and science program flights are planned for SMAP-VEX’08. The DBSAR test flights will utilize one or two of four predetermined flight lines within locations over the Virginia Eastern Shore; the Chesapeake Bay; Williamsburg, Virginia; and Durham, North Carolina. Test flight altitudes will be 2, 4, and 8 kilometers (km). Currently, 6-8 test flight hours are planned for DBSAR.

MAPIR test flights will utilize up to three predetermined flight lines over the Delmarva Peninsula region. Test flight altitudes will also be 2, 4, and 8 km with 6-8 test flight hours planned, basing from WFF.

The region selected for the SMAP-VEX’08 program flights is a mixed agriculture and forest site located about 1 hour east of Washington, DC on the Eastern Shore (of the Chesapeake Bay). Flight lines will cover portions of Maryland and Delaware. The general location is shown in Figure 1. This region is located on the Delmarva Peninsula and land cover is mixed agriculture (58%) and forest (33%). Summer crops are primarily corn and soybeans. The daily plan for the program flights is shown below. Currently, 20-30 flight hours are planned for program flights. The number of flights to be flown will be determined while the program is underway in coordination with the USDA.

Daily Flight Plan:

- Deploy to target area of interest in northern Delmarva Peninsula as required to meet science and technology objectives.
- Flight lines shall be approximately 90 km long and identified in advance by end coordinates.
- Ascend to 2000 m and conduct at least one pass along two prescribed adjacent flight lines separated by 2000 m.
- Ascend to 4000 m and conduct at least one pass along prescribed flight line (directional preference unknown at this time).
- Ascend to 8000 m and conduct one pass along prescribed flight line.
- On specified days, additional passes at each altitude may be required. These shall be specified prior to takeoff.
- Return to base via a northern or southern loop enabling radio frequency interference (RFI) surveillance during descent.
- Where RFI is detected, additional flights at alternative altitudes may be specified.

One Engineering Check Flight will be flown for both DBSAR and MAPIR prior to the mission. Approval to proceed from Engineering Check Flight to operations will be based on acceptable aircraft performance and secure instrumentation modules upon landing. No pre-mission or post-mission instrument calibration/test flights are planned. All instrument calibrations will be completed during the science flights.
1.3 ANALYSIS

Hazards of Electromagnetic Radiation to Ordnance (HERO) and Hazards of Electromagnetic Radiation to Personnel (HERP) calculations were performed for the MAPIR and DBSAR transmitters. MAPIR is a passive electronic system and poses no hazard to the aircraft and/or crew. The GPSRS has no transmitters. All instruments will be operated in accordance with the flight project’s safety plan.

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Exhaust from the P-3B aircraft will be minor and transient. To mitigate noise impacts, the project crew will wear hearing protection in accordance with the project’s safety plan.

1.4 CONCLUSIONS

WFF’s support of the SMAP-VEX’08 mission has been evaluated in accordance with NEPA through the attached NEPA Environmental Checklist for Research and Development Projects. The impacts from the SMAP-VEX’08 mission are not considered substantial but are likely to be minor and transient.

1.5 POINTS OF CONTACT:

<table>
<thead>
<tr>
<th>Project Team Members</th>
<th>Position/Expertise</th>
<th>Phone #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Charles Laymon</td>
<td>Principal Investigator</td>
<td>256.961.7885</td>
</tr>
<tr>
<td>Rafael Rincon</td>
<td>Principal Investigator</td>
<td>301-614-5725</td>
</tr>
<tr>
<td>John Valliant</td>
<td>Project Manager</td>
<td>757 824-1422</td>
</tr>
<tr>
<td>Michael Singer</td>
<td>Pilot-in Command</td>
<td>757-824-1919</td>
</tr>
<tr>
<td>Shane Dover</td>
<td>Pilot/Aviation Safety Officer</td>
<td>757-824-2419</td>
</tr>
<tr>
<td>George Postell</td>
<td>Pilot</td>
<td>757-8241529</td>
</tr>
<tr>
<td>Mike Cropper</td>
<td>AETD Configuration Manager</td>
<td>757 824-2140</td>
</tr>
<tr>
<td>James Hoffman</td>
<td>Ground Safety Representative</td>
<td>757 824-1130</td>
</tr>
</tbody>
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