RECORD OF ENVIRONMENTAL CONSIDERATION

PROJECT NAME: Tropical Composition, Cloud, and Climate Coupling (TC-4)
FR#: 78301

1. Description and location of proposed action: The NASA DC-8 will serve as one of the airborne science platforms for TC-4. Upload of the aircraft will take place at McClellan Airpark in Sacramento, CA. During deployment, the aircraft will be based out of the Juan Santamaria International Airport, San Jose, Costa Rica. The field deployment takes place July 13 to August 10, 2007. A total of 126 flight hours have been allocated for the mission, which includes 1 engineering check flight, 2 project check flights, and 2 transit flights (to and from Costa Rico). A maximum of 12 flights will be flown during the deployment, with a nominal flight length of 8 hours.

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 Date

_____ _____
Project Manager, Code 840 Date

NEPA Environmental Checklist (R&D Projects)

Project Name: Tropical Composition, Cloud, and Climate Coupling (TC-4) **Date:** May 14, 2007
Project Contact: Dave Easmunt **Project Start Date:** July 11, 2007
Building Number and Location: D-1, room 219 **Phone Number:** 757-824-1376
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:

a. Greater than 10% change in topography or ground surface relief features? Yes [ ] Maybe [ ] No [X]
b. Any increase in wind or water erosion of soils, either on or off site? Yes [ ] Maybe [ ] No [X]
c. 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:

a. Substantial air emissions or deterioration of ambient air quality? Yes [ ] Maybe [ ] No [X]
b. The creation of objectionable odors? Yes [ ] Maybe [ ] No [X]
c. 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:

a. Disturbance of groundwater? Yes [ ] Maybe [ ] No [X]
b. Greater than 10% changes in absorption rates, drainage patterns, or the rate and amount of surface runoff? Yes [ ] Maybe [ ] No [X]
c. Alter the course or flow of floodwaters? Yes [ ] Maybe [ ] No [X]
d. Alteration of the direction or rate of ground water? Yes [ ] Maybe [ ] No [X]
e. 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]
f. Activities resulting in changes of greater than 10% of Center total potable water use (maximum 820,000 gallons/month)? Yes [ ] Maybe [ ] No [X]
g. Any construction or other activity in a floodplain or wetland? Yes [ ] Maybe [ ] No [X]

Explain all "yes" and "maybe" answers: _____

D. Cultural Resources:

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

Explain all "yes" and "maybe" answers: _____

E. Biological Resources:

a. Construction/grading/filling within or adjacent to designated wetlands? Yes [ ] Maybe [ ] No [X]
b. Reduction of the numbers of any rare, or endangered species? Yes [ ] Maybe [ ] No [X]
c. Construction/grading/filling within open space or grasslands areas? Yes [ ] Maybe [ ] No [X]
d. Introduction of new species or plants into an area, or impacts the normal replenishment of existing species? Yes [ ] Maybe [ ] No [X]
e. Proposed construction activities in piping plover habitat? Yes [ ] Maybe [ ] No [X]
f. Proposed construction activities within 600 feet of an eagle's nest? Yes [ ] Maybe [ ] No [X]
g. Propose new landscaping or modify existing landscaping? Yes [ ] Maybe [ ] No [X]

Explain all "yes" and "maybe" answers: _____

F. Noise:

a. A noise increase greater than 10% from an existing operation? Yes [ ] Maybe [ ] No [X]
b. Exposure of people to severe noise levels (above 80 dBA)? Yes [X] Maybe [ ] No [ ]
c. Increase existing CNEL noise contours surrounding the airfield Yes [ ] Maybe [ ] No [X]
Explain all "yes" and "maybe" answers: Only at take-off and landing. Hearing protection required on airfield.

G. Land Use:

a. Substantial alteration of the present or planned land use? Yes [ ] Maybe [ ] No [X]
b. Increase in the rate of use of any natural resource? Yes [ ] Maybe [ ] No [X]
c. 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]
d. Activities resulting in a change in total employment levels greater than 10% (more than 95 people)? Yes [ ] Maybe [ ] No [X]
Explain all "yes" and "maybe" answers: _____

H. Health and Safety:

a. Generation of ionizing or non-ionizing radiation? Yes [X] Maybe [ ] No [ ]
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]
f. Result in the exposure or disturbance of contaminated soil or ground water? Yes [ ] Maybe [ ] No [X]
g. Generate industrial wastewater or storm water discharge? Yes [ ] Maybe [ ] No [X]
h. Use of Class I ozone-depleting substances (CFC's, TCA, halons)? Yes [ ] Maybe [ ] No [X]
i. Acquisition, use, or storage of any toxic or hazardous substance? Yes [X] Maybe [ ] No [X]
j. Generation of medical (biohazard), hazardous, toxic, or radiological wastes? Yes [ ] Maybe [ ] No [X]
k. Use, disturbance, or disposal of PCBs? Yes [ ] Maybe [ ] No [X]
l. Use of toxic gas? Yes [ ] Maybe [ ] No [X]
Explain all "yes" or "maybe" answers: Air emissions from DC-8 will be minor and transient. Earth pointing lasers and radioactive sources will be present, however all operations will be conducted in accordance with the approved TC-4Safety Plan. (see below).

I. 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]
Explain all "yes" and "maybe" answers: _____

J. 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]
Explain all "yes" and "maybe" answers: _____

K. 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: _____

OVERVIEW OF THE
NASA TROPICAL COMPOSITION, CLOUD AND CLIMATE COUPLING (TC-4) CAMPAIGN

1.1 INTRODUCTION

The Project Plan covers only the portion of the NASA Tropical Composition, Cloud and Climate Coupling (TC-4) mission associated with DC-8 operations and the required Mission Management function provided by NASA Wallops Flight Facility.

The NASA DC-8 will serve as one of the airborne science platforms for TC-4. Upload of the aircraft will take place at McClellan Airpark in Sacramento, CA. During deployment, the aircraft will be based out of the Juan Santamaria International Airport, San Jose, Costa Rica. The field deployment takes place July 13 to August 10, 2007. A total of 126 flight hours have been allocated for the mission, which includes 1 engineering check flight, 2 project check flights, and 2 transit flights (to and from Costa Rico). A maximum of 12 flights will be flown during the deployment, with a nominal flight length of 8hours.

The tropical tropopause transition layer (TTL) is one of the most mysterious regions of the atmosphere and is of critical importance to the Earth's climate and atmospheric chemistry. Changes in water vapor in the stratosphere and upper troposphere can play an important role in modulating the climate since water is the most powerful greenhouse gas in the atmosphere. The aircraft will carry 24 different instruments that will measure cloud microphysical properties, aerosol properties, atmospheric compounds, and other important atmospheric characteristics of the TTL. One of the instruments will release dropsondes from the aircraft. Day to day operations and flight plans will be dictated by location of convections, forecasts from various models, and satellite data and satellite overpass. The majority of the flights will be conducted over the ocean and will focus around the evolution of associated mesoscale convective systems. There will be two ground radar systems. One will be located in Panama with the other located at the airport in San Jose, Costa Rica. The primary target region will be the Gulf of Panama and the surrounding waters where deep convection is know to occur frequently in the month of July.

1.2 OBJECTIVES

The main scientific objectives of TC-4 are to:

- validate space-based measurements of geophysical parameters, particularly those known to possess strong variations on small spatial scales (e.g. water, cirrus) in a meaningful fashion;
- improve the understanding of the processes that convective intensity and aerosol properties affect cirrus anvil properties;
- address and evaluate the cloud structure, ice crystal size distributions, ice water content, ice crystal single-scattering properties, radiative fluxes, relative humidity and wind velocities during the evolution of cirrus anvils;

- explore the formation, maintenance, and distribution of thin cirrus in the Tropical Tropopause layer, and what is the influence of thin cirrus on radiative heating and cooling;
- gain a better understanding of the physical mechanisms that control (and cause) long-term changes in the humidity of the upper troposphere: in the tropics and subtropics;
- observe the chemical fates of short-lived compounds transported from the tropical boundary layer into the Tropical Tropopause layer;
- determine the chemical nature and outflow from the convective region of the Western Pacific, and the mechanisms that control the ozone below and within the Tropical Tropopause Transition layer; and
- gain a better understanding of the mechanisms that maintain the humidity of the stratosphere.

1.3 SCHEDULE

The Principal Investigators (PIs) for the TC-4 campaign are Dr. Michael Kurylo (NASA HQ), Dr. Hal Maring (NASA HQ), and Dr. Jim Crawford (NASA Langley Research Center). The University of North Dakota will supply the DC-8 maintenance and aircrew supporting a 126 flight hour campaign. NASA's Wallops Flight Facility (WFF) will supply safety and project management.

During TC-4, NASA N436NA (DC-8) will be based at San Jose, Costa Rica. Instrument upload and check flights will be conducted at McClellan Air Park, CA. Below is a break down of the mission schedule:

Table 1. Flight Schedule

Flight	Location	Date	Duration
ECF	McClellan Air Park	27 June '07	2hr
PCF #1	McClellan Air Park	28 June '07	2hr
PCF #2	McClellan Air Park	30 June '07	4hr
PCF #3	McClellan Air Park	2 July '07	8 hr
Transit to Costa Rica	McClellan Air Park	13 July '07	6hr
Mission Flights	San Jose, Costa Rica	16 July – 08 August '07	~ 11 flights, ~ 8 to 10hr each
Transit to California	McClellan Air Park	11 August '07	6.5hr

1.4 ENVIRONMENTAL CHECKLIST SUMMARY

The TC-4 mission contains two items identified in the environmental checklist that require further explanation. They are discussed below:

1.4.1 Lasers

There are 36 lasers employed in this campaign. All except those in the DIAL, DLH, and LASE experiments are completely enclosed in their respective instruments. Laser Nominal Ocular Hazard Distances (NOHDs) are compiled in Table 2 for the exposed laser systems onboard the DC-8 aircraft for this mission. NOHDs are in effect only when the lasers are exposed and operated during maintenance or calibration. DIAL, DLH, and LASE are also described separately below.

Table 2. Experiments with lasers transmitting outside the aircraft

Experiment	Principal Investigator	Laser Type	Class	Wavelength (nm)	Nadir NOHD	Zenith NOHD
DIAL	Ed Browell, NASA LaRC	Nd:YAG Dye	IV	290[1]	70m	70m
		Nd:YAG Dye	IV	300[1]	70m	70m
		Nd:YAG Dye	IV	532[2]	4.37km	N/A
		Nd:YAG Dye	IV	600[2]	N/A	8.74km
		Nd:YAG Dye	IV	1064[3]	1.92km	1.92km
DLH	Glenn Diskin, NASA LaRC	Visible Diode	II	635	N/A	N/A
		InGaAsP Diode	IIIb	1400	120 cm	N/A
LASE	Ed Browell, NASA LaRC	He-Ne Diode	II-IIIb	532[4]	N/A	N/A
		Pulsed Ti:Sapphire	IV	815[1,2,3]	9.7km	9.7km
		Nd:YAG	IV	1064[4]	N/A	N/A

[1] ATC facilities will be notified of the dates and times of the airborne operations prior to operating within their respective areas. Operations within any restricted areas will be pre-coordinated. The aircraft pilot must confirm visually and with the DC-8 aircraft tracking system that there are no other aircraft at risk of crossing the DC-8 flight path. Pilots or laser operators can terminate laser operations to maintain safety. The DIAL and LASE systems will not be permitted to operate in high traffic areas.

[2] Same as Note 1 above with the following exception: below 29,000ft agl, the laser will be tuned such that it is always eye safe at 1km (3280ft agl).

[3] Same as Note 1 above with the following exception: below 10,000ft agl, the laser will be shut down.

[4] Beam terminated within laser curtain with no possibility that non-participating personnel can be exposed. Personnel inside curtain wear laser goggles.

1.4.1.1 LASE

The LASE is a tunable laser system that contains three Lasers: (1) a neodymium-doped yttrium aluminium garnet (Nd:YAG) Class IV pump laser operating at 1064 nanometers (nm) and 532 nm, (2) a titanium-sapphire (Ti:sapphire) Class IV power oscillator operating at selected wavelengths in the 813-818 nm region, and (3) a gallium- aluminum-arsenate (GaAIAs) Class III laser diode operating at selected wavelengths in the 813-818 nm region.

The maximum Nominal Ocular Hazard Distance (NOHD) for the nadir and zenith beams at 815 nm is 9.7 kilometers (km) (31,824 feet). When the aircraft is operated at lower altitudes, the laser beams will be adjusted to ensure the beam is below the maximum permissible exposure (MPE) at ground level. Additional mandatory safety precautions are specified in Table 2. The LASE Lidar will be operated under NASA Langley's Safety Permit # NIR-367.

1.4.1.2 DIAL

The Differential Absorption Lidar (DIAL) contains several Class IV Nd:YAG Dye systems and transmits from both the nadir and zenith position on the aircraft. The maximum NOHD for the zenith beam is 8.74 km (28,674 feet) (when operated at 600 nm) and 4.37 km (14,337 feet) for the nadir beam (at 532 nm). When the aircraft is operated at lower altitudes, the laser beams will be adjusted to ensure the beam is below the MPE at ground level. Additional mandatory safety precautions are specified in Table 2.

1.4.1.3 DHL

The Diode Laser Hygrometer (DLH) contains Class II and Class IIIb lasers that transmit from the window port at FS410L to a retroflector located on the #1 engine nacelle. The maximum laser NOHD is 120 centimeters (4 feet). Protective eyewear is required at closer distances. The risk to personnel on the ground is minimal, as one would have to place him/herself directly in line with the beam, within 120 centimeters of the beam source, which is approximately 14 feet above the ground.

1.4.2 Radioactive Sources

1.4.2.1 LARGE - Krypton-85 (Kr–85) Radioactive Source

The LARGE instrument employs a Krypton-85 source, a Model 3077 2 milliCurie (mCi) Kr-85 aerosol neutralizer, manufactured by TSI, serial number 2606. The Kr-85 source is small enough that even if a person breathed in the entire quantity they would not exceed federal limits on radiation exposure. In accordance with Chapter 10 of the Code of Federal Regulations, Part 31.5 (10 CFR 31.5), a general license has been issued by the Nuclear Regulatory Commission (NRC) for the use or possession of Kr-85 radioactive sources. The source is maintained under NASA control with all affixed labels, warnings and instructions.

1.4.2.2 CIMS – Polonium-210

The CIMS instrument uses three separate 5mCi sources sealed in gold foil. The Polonium-210 ion source is a custom made anti-static device and is designed for use on compressed air lines in clean rooms. The type of radiation emitted by the Polonium is alpha particles which do not penetrate an inch of air at atmospheric pressure and are effectively shielded by a piece of notebook paper. Thus the source is well protected by its aluminum casing.
The California Institute of Technology holds the license for the state of California. Costa Rican licensing and procedures will be followed while in the field.

1.5 Conclusions

WFF's support of the TC-4 experiments has been evaluated in accordance with NEPA through the attached NEPA Environmental Checklist for R&D Projects. The impacts from the TC-4 experiments are not considered substantial but are likely to be minor and transient.

Points of Contact:

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