National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

October 12, 2004

Reply to Attn of: Science Mission Directorate

MEMORANDUM FOR THE RECORD

FROM: Associate Administrator for Science

SUBJECT: Orbiting Carbon Observatory (OCO) Environmental Assessment

The proposed OCO mission has been reviewed in accordance with the Routine Payload criteria established in the "Final Environmental Assessment of NASA Routine Payloads on Expendable Launch Vehicles from Cape Canaveral Air Force Station Florida and Vandenberg Air Force Base California" dated June 2002, and Finding of No Significant Impact (FONSI) dated June 18, 2002. After considering the enclosed Environmental Evaluation and Routine Payload Checklist for the OCO Project, I am designating the OCO mission as a NASA Routine Payload. As a NASA routine payload, the OCO mission is within the definitions established by the Environmental Assessment and FONSI. The OCO mission will have no significant impact, individually or cumulatively, on the quality of the human environment.

A. V. Diaz

Enclosure

cc:
Sun-Earth System Division/Dr. Cleave
Mission & Systems Management Division/Mr. Ianson
Office of the General Counsel/Mr. Stewart
Environmental Management Division/Mr. Kumor
JPL/1610/Mr. Wilcox
JPL/3800/Mr. Chudasama

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JPL

July 1, 2004

Environmental Evaluation and Recommendation for NASA Routine Payload Categorization of the Orbiting Carbon Observatory (OCO) Project

The proposed OCO mission has been reviewed in accordance with the Routine Payload criteria established by the *"Final Environmental Assessment of NASA Routine Payloads on Expendable Launch Vehicles from Cape Canaveral Air Force Station Florida and Vandenberg Air Force Base California,"* dated June 2002 and Finding of No Significant Impact (FONSI) dated June 18, 2002. This review shows that the OCO mission meets all of the Routine Payload Criteria and therefore it is recommended that OCO be designated a NASA Routine Payload. Supporting mission description and Routine Payload Checklist documentation are attached.

Virma Mowrey   7-22-04
V.S. Mowrey, Supervisor   Date
Launch Approval Planning Group

Concurrence:

J. Phillips for   7-22-2004
R. E. Wilcox, Manager   Date
Cross-Program Launch Approval Engineering

Concurrence:

B. Chudasama   7/22/2004
Bharat Chudasama   Date
OCO Project Manager

Description of Proposed Mission:
Orbiting Carbon Observatory (OCO), a NASA Earth System Science Pathfinder (ESSP) small-satellite program mission, would provide global measurements of atmospheric carbon dioxide needed to describe the geographic distribution and variability of carbon dioxide sources and sinks. After mission launch in 2007, OCO would regularly generate and release precise global maps of carbon dioxide (CO_2) in the Earth's atmosphere. Scientists would analyze OCO data to improve our understanding of the natural processes and human activities that regulate the distribution of CO_2 in the atmosphere. This improved understanding would enable more reliable forecasts of future changes in the abundance and distribution of CO_2 in the atmosphere and the effect that these changes may have on the Earth's climate. The OCO spacecraft would be launched in October 2007 on-board a Standard Taurus expendable launch vehicle from Vandenberg Air Force Base (VAFB), California. The end of the baseline mission would be October 2009.

The OCO Mission was proposed in response to a NASA Announcement of Opportunity for the Earth System Science Pathfinder (ESSP) Program in 2002. The ESSP Program is a component of the Earth Science Enterprise (ESE) that addresses unique, specific, highly-focused mission requirements in Earth science research. The ESSP program is an innovative approach for addressing global change research by providing periodic "Windows of Opportunity" to accommodate new scientific priorities and infuse new scientific participation into the Earth Science Enterprise. The ESSP program is characterized by relatively low to moderate cost, small to medium sized missions that are capable of being built, tested and launched in a short time interval. These missions are capable of supporting a variety of scientific objectives related to earth science, including the atmosphere, oceans, land surface, polar ice regions and solid earth. OCO was selected in December 2001 as the tenth ESSP Mission. The mission selection was based on the OCO Concept Study Report dated July 2001.

The mission is low risk with high reliability because it incorporates proven technologies, which require no additional development. OCO is a single instrument consisting of three high resolution grating spectrometers that fly on a dedicated spacecraft. The instrument, developed by Hamilton Sundstrand Sensor Systems, would acquire the most precise measurements of atmospheric CO_2 ever made from space. The spacecraft, developed by Orbital Sciences Corporation, is based upon the LeoStar-2 design. The same LeoStar-2 design was used on the successful SORCE and GALEX Earth orbiting missions.

The OCO orbit path would be carefully designed to meet the needs of the experiment. To best measure the spatial variation of global CO_2 abundance, OCO measurements would cover as much of the Earth's surface as possible. OCO would fly near the Earth's poles ensuring that observations would cover most of the Earth's surface at least once every sixteen days. In addition, OCO measurements must record changes in CO_2 abundance over annual seasonal cycles. The abundance of CO_2 in the atmosphere varies relative to seasons, but also varies relative to the time of day. Thus, the acquisition of CO_2 abundance at different times of day could adversely impact accurate measures of seasonal changes. To ensure that the mission data reflect representative measures of seasonal and longer term changes in CO_2 abundance, OCO would always acquire measurements at the same time of day. The spacecraft would fly a Sun synchronous orbit that makes observations in the early afternoon, at about 1:15 PM. Acquisition of spectroscopic measurements of CO_2 in reflected bright sunlight that is typical at that time of day would generate the best possible instrument signal. In addition, the effect of clouds and the variation of near surface CO_2 abundance are minimal in the early afternoon.

The OCO would fly in loose formation with a series of other Earth orbiting satellites known as the Earth Observing System Afternoon Constellation, or the A-train. This coordinated flight formation would enable researchers to correlate OCO data with data acquired by other instruments on Earth observing spacecraft. In particular, Earth scientists could compare OCO data with nearly simultaneous measurements acquired by the Atmospheric Infrared Sounder (AIRS) instrument onboard NASA's Aqua spacecraft.

Statement of Purpose and Need:

Carbon Dioxide (CO_2) is a critical component of the Earth's atmosphere. However, since the beginning of the industrial age the concentration of CO_2 has increased by about 25%. Current research indicates that continuing increases in atmospheric CO_2 may modify the environment in a variety of ways. These changes may impact ocean currents, the jet stream and rain patterns. CO_2 can enter the atmosphere from a variety of sources. Some sources are natural and others are from human activity. Other natural processes, called sinks, remove CO_2 from the atmosphere. The complete process of CO_2 exchange is known as the carbon cycle. To better understand the carbon cycle, the U. S. Department of Energy tracks and monitors CO_2 emissions from a global network of ground-based sites. However, the number of measurement devices in the current ground-based CO_2 network is not sufficiently large enough to resolve the spatial distribution of CO_2 sources and sinks over the Earth's surface. Using a space-based platform, OCO would collect a far greater number of high resolution measurements, which in turn, would provide the distribution of CO_2 over the entire globe. Scientists could analyze OCO data to improve our understanding of the natural processes and human activities that regulate the distribution of CO_2 in the atmosphere. This enhanced understanding could improve life on earth by enabling more reliable forecasts of future changes in the abundance and distribution of CO_2 in the atmosphere and the effect these changes may have on the Earth's climate.

Improving life on planet Earth is foremost in NASA's Vision, and the central work of NASA's Earth Science Enterprise (ESE) and includes research and technology development that answers the fundamental question "How is the Earth system changing, and what are the consequences for life on Earth?". NASA's ESSP Program, a component of ESE, oversees experimental space missions that enhance mankind's understanding of the scientific processes that govern our home planet. OCO, a NASA ESSP small satellite program mission, would help in answering the fundamental question by providing high resolution measurements, which when combined with data from the available ground-based network, would provide scientists with the information they need to better understand the processes that regulate atmospheric CO_2 and its role in the carbon cycle.

NASA Routine Payload Checklist (1 of 2)

PROJECT NAME: OCO DATE OF LAUNCH: October 1, 2007

PROJECT CONTACT: Bharat Chudasama PHONE NUMBER: 818-354-5338 MAILSTOP: T1722

PROJECT START DATE: December 2001 PROJECT LOCATION: JPL

PROJECT DESCRIPTION: **The Orbiting Carbon Observatory (OCO), an Earth System Science Pathfinder (ESSP) Program mission, would be an Earth orbiting mission which would measure global atmospheric carbon dioxide needed to describe the geographic distribution and variability of carbon dioxide sources and sinks. A two-year mission, OCO would complete global CO_2 mapping every 16 days.**

	YES	NO
A. SAMPLE RETURN:	YES	NO
1. Would the candidate mission return a sample from an extraterrestrial body?		X
B. RADIOACTIVE SOURCES:	YES	NO
1. Would the candidate spacecraft carry radioactive materials?		X
2. If Yes, would the amount of radioactive sources require launch approval at the NASA Associate Administrator level or higher according to NPG 8715.3 (NASA Safety Manual)?		
Provide a copy of the Radioactive Materials Report as per NPG 8715.3 Section 5.8.3.		
C. LAUNCH AND LAUNCH VEHICLES:	YES	NO
1. Would the candidate spacecraft be launched using a launch vehicle/launch complex combination other than those indicated in Table 1 below?		X
2. Would the proposed mission cause the annual launch rate for a particular launch vehicle to exceed the launch rate approved or permitted for the affected launch site?		X
Comments:		
D. FACILITIES:	YES	NO
1. Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities?		X
2. If Yes, has the facility to be modified been listed as eligible or listed as historically significant?		
Provide a brief description of the construction or modification required:		
E. HEALTH AND SAFETY:	YES	NO
1. Would the candidate spacecraft utilize any hazardous propellants, batteries, ordnance, radio frequency transmitter power, or other subsystem components in quantities or levels exceeding the Envelope Payload characteristics (EPCs) in Table 2 below?		X
2. Would the candidate spacecraft utilize any potentially hazardous material as part of a flight system whose type or amount precludes acquisition of the necessary permits prior to its use or is not included within the definition of the Envelope Payload (EP)?		X
3. Would the candidate mission release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space?		X
4. Would launch of the candidate spacecraft suggest the potential for any substantial impact on public health and safety?		X
5. Would the candidate spacecraft utilize a laser system that does not meet the requirements for safe operation (ANSI Z136.1-2000 and ANSI Z136.6-2000)? For Class III-B and IV laser operations, provide a copy of the hazard evaluation and written safety precautions (NPG 8715.3).		X
6. Would the candidate spacecraft contain pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health?		X
Comments:		

continued on next page

NASA Routine Payload Checklist (2 of 2)

PROJECT NAME:	**OCO**	DATE OF LAUNCH:	October 1, 2007
PROJECT CONTACT:	Bharat Chudasama	PHONE NUMBER:	818-354-5338 MAILSTOP: T1722
PROJECT START DATE:	December 2001	PROJECT LOCATION:	JPL

PROJECT DESCRIPTION: **The Orbiting Carbon Observatory (OCO), an Earth System Science Pathfinder (ESSP) Prograi mission, would be an Earth orbiting mission which would measure global atmospheric carbo dioxide needed to describe the geographic distribution and variability of carbon dioxide sources and sinks. A two-year mission, OCO would complete global CO_2 mapping every 16 days.**

F. OTHER ENVIRONMENTAL ISSUES:	YES	NO
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?		X
2. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues?		X
Comments:		

Table 1: Launch Vehicles and Launch Pads

Launch Vehicle	Eastern Range (CCAFS Launch Complexes)	Western Range (VAFB Space Launch Complexes)
Atlas IIA & AS	LC-36	SLC-3
Atlas IIIA & B	LC-36	SLC-3
Atlas V Family	LC-41	SLC-3
Delta II Family	LC-17	SLC-2
Delta III	LC-17	N/A
Delta IV Family	LC-37	SLC-6
Athena I & II	LC-46 or -20	California Spaceport
Taurus	LC-46 0r -20	SLC-576E
Titan II	N/A	SLC-4W
Pegasus XL	CCAFS skidstrip KSC SLF	VAFB airfield

Table 2: Summary of Envelope Spacecraft Subsystems and Envelope Payload Characteristics (EPC)

Structure	**Unlimited:** aluminum, magnesium, carbon resin composites, and titanium **Limited:** beryllium [50 kg (110 lb)]
Propulsion	Mono- and bipropellant fuel; 1000 kg (2200 lb) (hydrazine); 1000 kg (2200 lb) (monomethyhydrazine) Bipropellant oxidizer; 1200 kg (2640 lb) (nitrogen tetroxide) Ion-electric fuel; 500 kg (1100 lb) (Xenon) SRM; 600 kg (1320 lb) (AP)-based solid propellant
Communications	Various 10-100 W (RF) transmitters
Power	Solar cells; 150 A-Hr (Ni-H_2) battery; 300 A-Hr (LiSOC) battery; 150 A-Hr (NiCd) battery
Science instruments	10 kW radar ANSI safe lasers (Section 4.1.2.1.3)
Other	Class C EEDs for mechanical systems deployment Radioisotopes limited to quantities that are approved for launch by NASA Nuclear Flight Safety Assurance Manager Propulsion system exhaust and inert gas venting