

# OCEANSAT-2: Announcement of Opportunity

## 1.0 DESCRIPTION OF THE OPPORTUNITY

### 1.1 Overview of the Objectives

The Indian Space Research Organization (ISRO), Department of Space (DOS), Government of India, announces an opportunity to carry out scientific research for the utilization of Oceansat-2 data. Oceansat-2 is ISRO's second in the series of IRS satellites dedicated for ocean research. It will provide continuity to the services and applications of the Oceansat-1 Ocean Colour Monitor (OCM) data along with additional data from a Ku-band pencil beam Scatterometer and Radio Occultation Sounder for the Atmosphere (ROSA) sensors. Oceansat-2 is scheduled to be launched during third quarter of 2008 onboard Polar Satellite Launch Vehicle (PSLV) from Sriharikota, India.

Oceansat-2 will carry three sensors onboard, viz., Ocean Colour Monitor (OCM-2), Ku-band pencil beam Scatterometer and an Italian payload called Radio Occultation Sounder for the Atmosphere (ROSA). Data from these payloads are meant for addressing various research areas, primarily in oceanographic and atmospheric science. The data from the satellite is likely to be made available to the global scientific community after necessary post-launch sensor characterization, which is expected to be completed within 6 months from the launch.

This Announcement of Opportunity (AO) is open to global scientific community for submitting research proposals towards utilization of data from Indian Payloads i.e., OCM-2 and Scatterometer in the following broad categories:

- Development of retrieval algorithms and Cal/Val experiments
- Application of ocean colour and Scatterometer data for oceanographic and atmospheric research
- Synergistic studies using multi-sensor data to understand processes
- Techniques development for assimilation of derived geo-physical parameters in numerical models

It should be noted that this AO does not fund the 'projects', but only ensures that the selected Principal Investigators (PI) are provided with relevant, limited data sets at no cost.

### 1.2 Who can submit a Proposal?

Proposals could be submitted by individuals or a group of scientists, academicians and research scholars belonging to recognised institutions, universities, government and non-government organisations. The proposals must be forwarded through the Head of the Institution, with appropriate assurance for providing necessary facilities for carrying out the AO projects.

## 2.0 OVERVIEW OF OCEANSAT- 2 MISSION

Oceansat-2 will be a three axis body stabilized spacecraft to be placed into a near circular sun-synchronous orbit, at an altitude of 720 Km, with an equatorial crossing time of around 1200 hrs. The

orbital period is 99.31 minutes and the repetevity cycle is 2 days. The main structure is made up of Aluminium honeycomb - CFRP composite cylinder with vertical and horizontal decks for sub-system mounting. Three deployment mechanisms are included - solar panel auto-deployment after separation from the launcher, OCM hold down-release-tilt mechanism and SCAT antenna hold-down-release mechanism. Thermal control system is designed for 12 noon local time and uses both passive and active control elements. The power system is configured with solar array of same size as IRS-P6/P5 with Silicon cells to generate 1360 W at EOL. Two 24 AH Ni-Cd batteries will provide eclipse and peak load support. All the sub-systems are supplied with two raw buses of 28-42 V and DC-DC converters are used to derive required voltage lines. A centralized Bus Management Unit (BMU) designed with MAR31750 microprocessor provides the functions of AOCs, Sensor processing, Telemetry and Command, auto-temperature control and PSK demodulation of the TTC uplink carrier. Earth sensors, Digital sun sensors, tri-axial magnetometers, Four- $\pi$  steradian sun sensors and gyroscope based inertial reference unit will provide the platform attitude and rate measurements. The control actuators consist of 4 nos. of 5 NMS, 0.1NM torque reaction wheels mounted in Tetrahedral orientation, two magnetic torquer coils and monopropellant Hydrazine thrusters. An 8-channel SPS system will provide both position and velocity, improving the overall orbit determination accuracy.

The payload data handling system is configured to transmit OCM and Scatterometer data on a single carrier with QPSK modulation at 42.45 Mbps rate. The OCM data will be transmitted on I-channel and SCAT / ROSA data will be transmitted on Q-channel. An indigenous on-board Solid State Recorder of 64 Gbits capacity is used to record the onboard processed data. The Payload telemetry data transmission system is configured using SSPAs and conventional X-band antenna.

## 2.1 Ocean Colour Monitor (OCM-2)

OCM-2 is a solid-state camera operating in push broom scanning mode, using linear array Charge Coupled Devices (CCDs) as detectors. This camera has eight narrow spectral bands operating in visible and near infrared (NIR) bands (402-885 nm). Since the ocean observation is planned at the local time of equator crossing time of 1200 hrs noon, the camera can be tilted up to  $\pm 20^\circ$  in the along track direction to avoid sun glint. The specifications and performance parameters of OCM are given in **Annexure 1**.

OCM data will be available in two spatial resolutions: Local Area Coverage (LAC) of 360 m and Global Area Coverage (GAC) of 4 km. While LAC data will be available either through direct broadcast and/or "selective recording", Global Area Coverage (GAC) data will be recorded onboard Solid State Recorder (SSR) and played back at the primary ground reception station at National Remote Sensing Agency (NRSA) at Hyderabad, India. In order to meet the objective of covering oceans around Indian region, Real Time LAC data will be routinely received at the NRSA primary ground station. The area of coverage of the primary reception station is shown in the figure at **Annexure 2**. Obtaining complete global coverage in GAC mode will take 4 days (6 days in worst case). Hence, on-board recording of LAC data (where there is no Ground station) will be on a restricted basis since both LAC and GAC cannot be recorded simultaneously.

Direct reception of LAC data by interested agencies can be made through their X-band receiving stations by entering into a commercial agreement with Antrix Corporation, India (commercial wing of ISRO). However, this is not under the purview of this Announcement.

Since OCM-2 is designed to provide one of the highest spatial resolutions among the contemporary ocean colour sensors with unique regional and global coverage, it is expected to provide ample opportunities/ application potential, for both scientific and commercial uses.

## 2.2 Scatterometer

The prime objective of this payload is the retrieval of the near surface wind vectors over the ocean surface. The scatterometer system has a 1-m parabolic dish antenna and a dual feed assembly to generate two pencil beams and is scanned at a rate of 20.5 rpm to cover the entire swath. The inner beam makes an incidence angle of  $48.90^\circ$  and the outer beam makes an incidence angle of  $57.60^\circ$  on the ground. It covers a continuous swath of 1400 km for inner beam and 1840 km for outer beam respectively. The inner and outer beams are configured in horizontal and vertical polarization respectively for both transmit and receive modes. Brief specifications of the Scatterometer and view geometry are provided in **Annexure 3**.

## 3.0 DATA AVAILABILITY

Data will be made available to the Principal Investigators (PIs) after the commissioning phase, which is expected to be around 6 months after launch. The data sets required for executing the AO projects would be provided at no cost after evaluation. The term 'data' refers to the data products produced at the data processing facility at NRSA and distributed as listed in **Annexure 4**. All the GAC products from OCM-2 and products 2B, 3W and 3S from Scatterometer will be hosted on the NRSA website as soon as the data is received at the primary reception station. Additional data required by the PIs such as LAC data from OCM-2 and Level 2A product from Scatterometer will be supplied within 15 days of its reception.

## 4.0 EVALUATION OF PROPOSALS

With the overall Oceansat-2 mission objectives briefly summarised in Section 1.0, this Announcement of Opportunity (AO) for potential Principal Investigators is aimed towards stimulating newer research in oceanography and atmospheric research; identifying necessary support for calibration and validation of Oceansat-2 payloads; and for encouraging development of specific techniques for operational use of the data on a regional/ global basis. Towards this, the proposals received in response to this AO will be evaluated considering primarily the scientific/ technical merits. The principal elements considered in selecting the proposals, among other things, would be:

- The overall, scientific or technical merit of the proposal, uniqueness and innovative methods, approaches or concepts planned to be demonstrated.
- Potential for contributing to applications by making synergistic use of scatterometer and ocean colour data.

- The competence and relevant experience of the PIs and/or co-investigators for achieving the proposed objectives.

It is generally not envisaged to select multiple projects addressing the same geographical area or applications or multiple proposals from the same institution.

## **5.0 SPECIFIC AREAS OF INTEREST**

### **5.1 Ocean Colour Monitor-2 (OCM-2)**

Proposals are invited in the following areas of interest for utilisation of OCM data:

- Algorithm development for atmospheric correction of OCM data
- Regional bio-optical algorithm development with special emphasis in case-II waters
- Inversion techniques to derive inherent optical properties using OCM data
- Validation of OCM derived geophysical parameters
- Inter-sensor data comparison and data merging
- Ocean primary productivity modeling
- Assimilation of ocean-colour data in eco-system models
- Models for quantitative estimation of suspended sediments
- Bio-geochemical cycle of Carbon and Nitrogen
- Algal bloom detection
- River plumes and coastal productivity
- Climate change and ocean colour
- Synergistic use of ocean colour and scatterometer winds
- Characterization of absorbing aerosols over oceans
- Innovative technique development for ocean colour feature extraction
- Ocean colour and sustainable fisheries management
- Impact of agricultural practices on coastal water productivity
- Aerosol characterization and transport over oceans

### **5.2 Scatterometer**

Proposals are invited in the following areas of interest for utilisation of Scatterometer data:

- Validation of wind vectors
- Monsoon Onset
- Tropical cyclone tracking
- Short and Medium range weather prediction
- Rain estimation over oceanic region
- Ocean state forecast: wave, circulation
- Forecasting ocean surface wind vector
- Air-sea interactions
- Ocean process studies: MLD studies
- Ocean surface wind stress and its impact

- Ocean surface pressure fields
- Climate change studies
- Land applications: Land cover, Agriculture
- Sea ice cover

The above-mentioned topics are only indicative and PIs are free to suggest other potential topics of direct relevance. The proposals can also be a combination of several of those areas mentioned in the topics of interest under OCM and Scatterometer. It may also happen that only a portion of the proposal is accepted, in which case, the PI will be given the opportunity to accept or decline such partial acceptance.

## **6.0 GUIDELINES FOR PROPOSAL PREPARATION**

The potential PI should submit the proposal in a format described in the following sections. The format for the cover page is given in **Annexure 5**. The format for the detailed proposal is given in **Annexure 6**.

**The format for proposal includes a Declaration to be signed by the Principal Investigator and Head of the Institution.**

### **6.1 Instructions for Submission of Proposal**

Proposals should be limited to around 10 pages in length on standard A4 size paper, typed double-spaced and in the prescribed format. Two copies of the proposal prepared in the formats given in **Annexure 5** and **Annexure 6** should be mailed to:

Dr. Abhijit Sarkar,  
Project Director, OCEANSAT-2 Utilisation Project  
Meteorology and Oceanography Group, Bopal Campus  
Space Applications Centre, Ambawadi Vistar P.O.  
Ahmedabad-380 015, India.  
Telephone: +91 - 79 - 2691 6102; +91 - 2717 - 23 5482  
Fax: +91 - 79 - 2691 6078; +91 - 2717 - 23 5431  
E-mail: abhijit\_sarkar@sac.isro.gov.in ; sarkar.abhi@gmail.com

### **6.2 Description of the Proposal**

The main part of the proposal should contain a summary (briefing the objectives, methodology, deliverables of the project and the time schedule), followed by a detailed description of the objectives and the scientific rationale being addressed. The data requirement and the analysis methods should be highlighted. The methodology or approach to be followed and the expected results of the project must be presented. Targeted schedule for various stages of the project must be indicated including the completion date. Criteria for assessing the success of the project should be projected. The data requirements, particularly that calls for large quantum of data, should be justified.

### 6.2.1 *Project Duration*

It is expected that the project will be completed within 3 years. Projects will be evaluated and short listed by September 2008. PIs are expected to present the preliminary results in a workshop to be conducted around end 2009.

### 6.2.2 *Data Requirements*

As described in section 6.2, the proposal should identify OCM and/or Scatterometer data for the study. The National Remote Sensing Agency (NRSA) Data Centre situated at Hyderabad, India will make the Scatterometer global recorded data available to the PIs. OCM LAC data will be made available by this centre only for such of those areas, which are covered under its radio visibility circle (Refer figure for the area of coverage from the primary ground reception station). For those areas falling outside the Hyderabad visibility circle, specific arrangements will be made to record limited OCM-2 LAC data on onboard recorder and made available to the PIs on post-facto basis as explained in section 2.1.

Only limited data sets fulfilling the project requirement will be supplied. The project should clearly indicate the type of data product (refer Annexure 3 for available data products), geographical area and period of coverage, and quantum of data. All approved PIs are encouraged to download the data products which are hosted on the website and the additional data products required will be supplied directly to the PIs within 15 days of its reception.

### 6.2.3 *Personnel*

The project may involve joint efforts involving many individuals from the concerned institution(s). However, only one PI will be recognised. Other participants could be designated as "Co-Investigators". PI/Co-Investigator shall provide Curriculum Vitae referring to educational qualifications, the work carried out in the related areas and list of recent publications. The PI is responsible for ensuring timely completion of the project. The assurance of necessary administrative and financial support to PI and Co-Investigators from Head of the Institution(s) is a must.

### 6.2.4 *Facilities and Equipment*

Describe available computer facilities, image analysis and other equipment in the home institution or in sister concerns and is accessible for the project.

### 6.2.5 *Project Evaluation*

It is proposed that a workshop will be conducted at the end of every year for the purpose of reviewing the progress of the AO projects and sharing the results with international scientific community. PIs of each project are expected to attend these workshops.

**7.0 TERMS AND CONDITIONS**

- ISRO reserves the right to revoke in part or in whole its support for a project at any time without assigning any reason.
- The data sets provided must be used only for the purpose specified in the proposal. The project personnel do not have the right to copy, lease or loan the satellite data without the prior permission of ISRO/DOS. Ownership and copyright of the data lies with ISRO. Also, this data is supplied free of cost purely for scientific research and it should not be used for any commercial and operational applications. Commercial use is defined as that involving the sale or resale of data, as well as data derived therefrom, for more than the cost of reproduction. Operational use is defined as routine real-time or near-real-time use of the data as well as the data derived therefrom.
- The user will make available to the scientific community the salient results of the AO projects through publication in appropriate journals or other established channels. Acknowledgement of ISRO support must be made in all reports and publications arising out of the AO projects. Copies of all publications resulting from these research projects must be submitted to ISRO to the address mentioned under paragraph 6.1. ISRO reserves the right to use the published results in its reports and publications with due reference to the publication. If the reports or publications are copyrighted, ISRO will have a royalty-free right under the copyright to reproduce, distribute, and use the copyrighted works for their purposes.
- Any print of the data/ products supplied by ISRO should carry the mark '© reserved ISRO' mark in legible letters.
- The PI is required to submit six-monthly progress reports during the duration of the project. A detailed report is to be submitted during the mid-term and final reviews in soft copy form.
- The PI must maintain an inventory of data products received/ obtained under the AO project(s) and the data products must be deposited with the home institution after the end of the project.

**The declaration contained in the proposal format must be signed by the PI and Head of the Institution (Annexure 7). Otherwise the proposal will not be considered valid and is liable to be rejected.**

**8.0 SCHEDULE**

**Deadline for submission of proposals : June 30, 2008**

**Notification of evaluation results to Principal Investigators : September 30, 2008**

**Annexure - 1****Specifications of Oceansat-2 OCM**

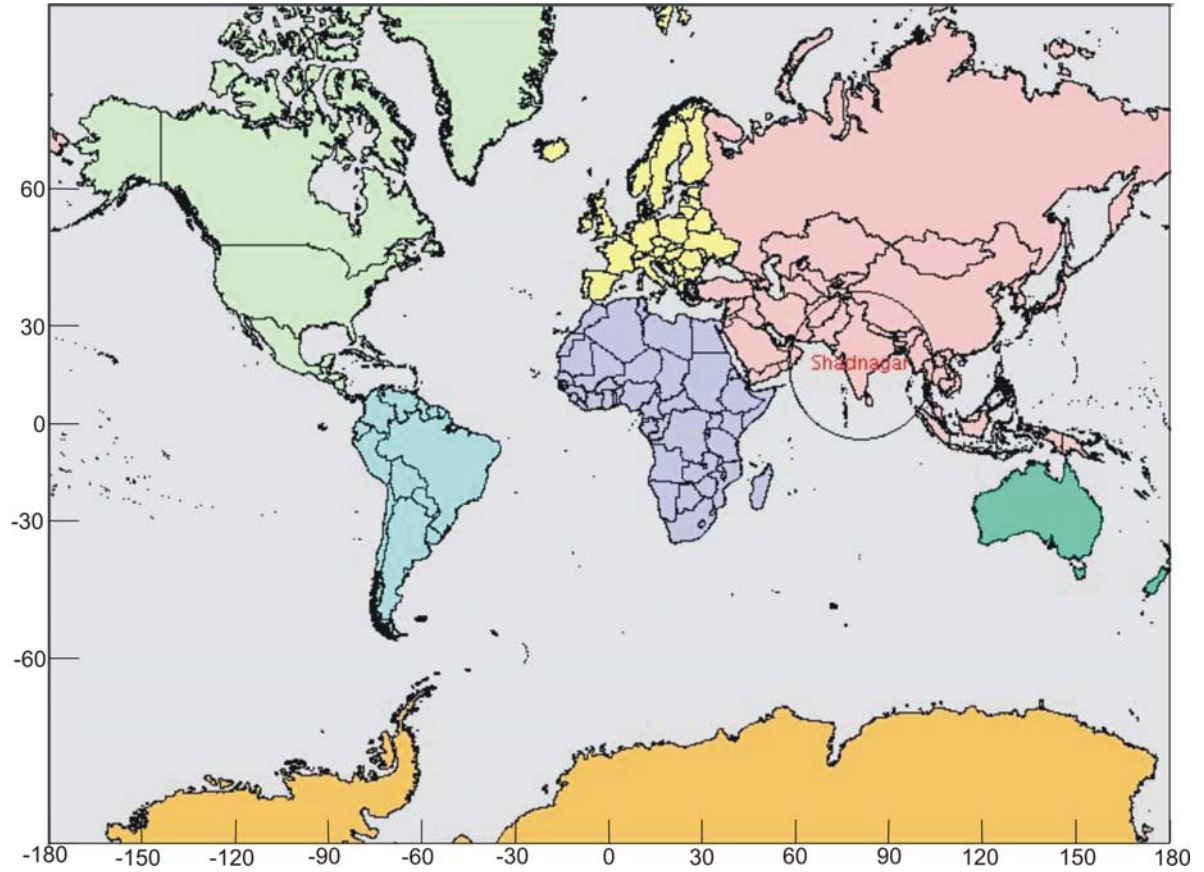
1. Ground Resolution (m)
  - LAC : 360 (across-track); 236 (along-track)
  - GAC : Approximately 4 km
2. Swath (km) : 1420
3.
 

Instrument Spectral Bands	Wavelength Range (nm)	SNR @ Ref Radiance	Nominal reference radiance of Sea (mW/ cm <sup>2</sup> / sr/ μm)	Saturation radiance (mW/ cm <sup>2</sup> / sr/ μm)
C1	402-422	356	9.1	70.2
C2	433-453	386	8.4	36.5
C3	480-500	380	6.6	29.6
C4	500-520	324	5.6	25.8
C5	545-565	311	4.6	21.2
C6	610-630	240	2.5	16.0
C7	725-755	286	1.6	1.9
C8	845-885	141	1.1	14.3
4. MTF (at Nyquist) >0.26
5. Quantisation 12 bits
6. Along track steering ±20°  
(To avoid sun glint)
7. Data rate (Mbps) 20.8



**Annexure - 2**

**Figure showing the visibility circle of the Primary Reception Centre at National Remote Sensing Agency (NRSA) at Hyderabad, India.**



**Annexure - 3****Specifications of Oceansat-2 Scatterometer**

	<b>Inner Beam</b>	<b>Outer Beam</b>
Altitude	720 km	
Frequency	13.515 GHz	
Scanning rate	20.5 rpm	
Look Angle	42.66°	49.33°
Incidence Angle	48.9°	57.6°
Swath	1400 km	1840 km
One way 3dB Beam Width (Az x El)	1.47° x 1.67°	1.47° x 1.67°
One way 3dB foot Print	26 km X 46 km	31 km X 65 km
Polarisation	HH	VV
Wind Speed range & accuracy	4-24 m/s with accuracy of 2 m/s (rms)	
Wind Direction	0-360° (20° rms)	
Wind vector cell size	50 km x 50 km	

**Annexure - 4****Data products from OCM and Scatterometer****Standard LAC data products of OCM (360 m resolution):**

- Level 1B LAC : Radiance product
- Level 1C LAC : Geo-referenced (Radiometrically and geometrically corrected) product
- Level 2C LAC : Geometrically corrected geo-physical parameters
  - Chlorophyll concentration product
  - Total Suspended Matter concentration product
  - Aerosol optical depth at 865 nm
  - Diffuse attenuation coefficient ( $K_d$ -490 nm)

**Standard GAC data products of OCM (approximately 4 km resolution):**

- Level 1B GAC : Strip based/ Scene based Radiance product
- Level 2B GAC : Geo-physical parameters
  - Chlorophyll concentration product
  - Total suspended matter concentration product
  - Aerosol optical depth at 865nm
  - Diffuse attenuation coefficient ( $K_d$ -490 nm)
- Level 3 GAC : Binned products
  - Weekly
  - Monthly
  - Yearly

**Standard products from Scatterometer:**

- Level 2A : Sigma-0 product in swath grid with 50 km spacing
- Level 2B : Wind vector in swath grid with 50 km spacing
- Level 3W : Global wind vector with grid spacing of 0.5°
- Level 3S : Global sigma-0 product with grid spacing of 0.5°

**Annexure - 5**

**Cover Page of the Proposal**

**Title of the Proposal**

**Name and Designation of PI**

**Telephone, Fax and E-mail Address**

**Name of Institution with full Address**

**Signature of PI with Date**

**Signature of Head of Institution**

**Announcement of Opportunity (AO) proposal  
submitted to Indian Space Research Organization (ISRO) on**

**Annexure - 6**

**Format of the Proposal**

1. Title of the Proposal:
2. Name of the Principal Investigator:  
Institution;  
Telephone:  
Fax:  
E-mail:  
Mailing Address:
3. Summary of the proposed work
4. Details on the preliminary work done/background experience, if any
5. List of Publications in the related field
6. Description of the project
  - Theme
  - Objectives
  - Study area (latitude/ longitude)
  - Type of data products required (season(s), periodicity and number)
  - Methodology
  - Schedule
  - Expected results and its possible uses
7. Name of Co-investigator(s) in the AO project (please include bio-data of all Investigators)
8. Available facilities and equipment at your institution

**Annexure -7**

**Format for Declaration**

**Declaration**

We have carefully read the terms and conditions of Oceansat-2 AO programme and agree to abide by them.

It is certified that if the AO proposal is accepted and supported by the Indian Space Research Organisation (ISRO), the facilities as identified in the proposal and administrative support available at our institution and needed to execute the project will be extended to the Principal Investigator and other Co-investigators.

We certify that the data products provided would be used only for the intended AO project.

It is agreed that data products will be returned to ISRO in case the AO project does not progress / complete as scheduled.

Signature of PI with Name and Designation

Signature of Head of Institution with Name and Designation

Date:

Seal of Head of Institution

### List of Abbreviations

AO	-	Announcement of Opportunity
AOCS	-	Attitude and Orbit Control System
CFRP	-	Carbon Fiber Reinforced Plastic
DOS	-	Department of Space
EOL	-	End of Life
GAC	-	Global Area Coverage
IRS	-	Indian Remote sensing Satellite
ISRO	-	Indian Space Research Organization
LAC	-	Local Area Coverage
MLD	-	Mixed Layer Depth
NRSA	-	National Remote Sensing Agency
OCM	-	Ocean Colour Monitor
PI	-	Principal Investigators
PSK	-	Phase Shift Keying
PSLV	-	Polar Satellite Launch Vehicle
QPSK	-	Quadri Phase Shift Keying
ROSA	-	Radio Occultation Sounder for the Atmosphere
SCAT	-	Scatterometer
SPS	-	Satellite Positioning System
SSPA	-	Solid State Power Amplifier
SSR	-	Solid State Recorder
TTC	-	Telemetry, Tracking and Command