

**Centre for Atmospheric & Oceanic Sciences  
Indian Institute of Science  
Bengaluru, India**

**SUPPLY OF EDDY COVARIANCE SYSTEM FOR FLUX  
MEASUREMENT IN ATMOSPHERIC BOUNDARY LAYER**

**Enquiry No.: CAOS/NOBLE/01/ Dated 28.08.2016**

Quotation is invited for the supply of a complete Eddy Covariance (EC) system for measuring the fluxes of momentum, sensible and latent heats using an open path hygrometer/gas analyzer, a 3D sonic anemometer, a fast response temperature sensor along with slow response wind speed and direction sensor, air temperature and humidity sensor, tipping bucket rain gauge, heat flux sensor, net radiometer, barometric pressure sensor, soil temperature and soil moisture sensor, as per the details given below.

**The last date for receiving the bids : 20 September 2016**

**1. Minimum System Specifications**

**A. Open path gas Analyzer/ IR Hygrometer**

No	Description	Requirement/Specification
1.	Measurement range for water vapor	0 – 30 g m <sup>-3</sup>
2.	Absolute accuracy	0.1 g m <sup>-3</sup>
3.	Sampling frequency	User settable, maximum not less than 20 Hz.
4.	Measurement precision at 20 Hz	0.05 g m <sup>-3</sup>

**B. 3-axis Sonic Anemometer: 02 Nos**

No	Description	Requirement/Specification
1.	Outputs required	3 components of wind velocity and sonic temperature
2.	Measurement range of wind speed	0-45 m/s
3.	Data output rate	Selectable, up to 50 Hz
4.	Data out put format	Serial, baud rate upto 38400 bps
5.	Accuracy of wind speed	1% rms or 0.1 m/s whichever is higher
6.	Resolution	0.01 m/s
7.	Accuracy of Sonic temperature	0.1 deg. C

### C. Fast response temperature sensor

No	Description	Requirement/Specification
1.	Sensor type	Resistance thermometer/thermocouple
2.	Measurement range of temperature	-10° to +50°C
3.	Frequency response	20 Hz
4.	Data out put format	Analogue or digital

### Operating conditions of the instruments listed above & cable lengths

1.	Working temperature range	-10° to +50 °C
2.	Working environment	Land, rainy/moist and semi-arid areas
3.	Input power	DC and 220-240 V AC, 50 Hz
4.	Cable length from sensor to data logger	Adequate length required for a 32 meters tower

### D. Data Acquisition System including communication and interface

It is desirable that data can be acquired through a PC as well as by an independent data logger without being attached to a PC. The interface unit to synchronize data acquisition from IR hygrometer, sonic anemometer and temperature sensor. It could be either an integral part of the system or a separate unit. The module to directly store data from the three sensors specified above and along with storage device of minimum 16 GB capacity and 2-4 analogue data (voltage) inputs is required. The module to accept standard USB or SD cards for data storage.

**Support software** for programming the module via a PC, sensor/input interfacing, data archival management and computation of eddy fluxes.

### Additional specifications for the data acquisition system

No	Description	Requirement/Specification
1	Maximum sampling frequency	Not less than 50 Hz
2.	Working temperature range	-10° to +60 °C
3.	Input power	DC and 220-240 V AC, 50 Hz
4.	Housing	IP65
5.	Computer interface	Windows OS through USB port
6.	Data storage	Capacity 16 GB or more. Options for storing both raw data, processed data & retrieve them in standard formats (NETCDF/HDF/GrADS and ASCII)

## **E. Other Meteorological Sensors**

### **(a) Wind Speed and Direction sensors: 03 Nos**

**Range: 0-100 m/s (224 mph), 0- 360°**

**Accuracy: Wind Speed:  $\pm 0.3$  m/s (0.6 mph) or 1% of reading; Wind Direction:  $\pm 3^\circ$**

### **(b) Air Temperature and Relative Humidity sensors: 03 Nos**

**RELATIVE HUMIDITY: Measuring Range: 0-100 %RH; Accuracy at 23°C:  $\pm 1\%$ RH,**

**Stability: Better than  $\pm 1\%$ RH per year; Response Time: 10 seconds**

**TEMPERATURE: Calibrated Measuring Range: -50 to 50°C ; Response Time: 10 seconds**

**Accuracy at 23°C:  $\pm 0.3^\circ\text{C}$  /optional  $\pm 0.1^\circ\text{C}$**

### **(c) Tipping Bucket Rain Gauge: 01 No**

**Resolution: 0.1 mm per tip ; Accuracy: 2% up to 25 mm/hr 3% up to 50 mm/hr**

### **(d) Heat Flux sensors: 02 Nos**

### **(e) Soil Temperature sensors: 04 Nos**

### **(f) Soil Moisture Sensors: 04 Nos**

### **(g) Net Radiometer: 01 No**

### **(h) Barometric pressure sensor: 01 No**

**Pressure Range: 500-1100 hPa; Operating Temperature: -40 to +60°C; Long Term**

**Stability: 0.2% FS per year**

## **Additional specifications for the meteorological sensors**

**Cable length: Should provide adequate cable length sufficient for installation in a 32 meters tal boundary layer tower.**

**Mounting Hardware: Should provide mounting hardware required to mount all sensors listed in A to E sections.**

## **F. Calibration kit and spare parts**

All tools/attachments needed for carrying out calibration of the instruments to be quoted and supplied along with the main items. A document explaining the calibration procedure to be provided.

### **2. APPLICATION SOFTWARE**

- i. Options for accessing and storing raw data at the highest output frequency for each sensor. Provisions for reprocessing archived data.
- ii. Display data in graphical format when connected to a PC.
- iii. Output data in standard met formats (netcdf, HDF, binary, etc.) and ASCII format
- iv. Data quality flags.
- v. Provision for monitoring the health of the equipment at regular intervals & display on the screen when connected to a PC.
- vi. Provision for upgradation of the system software including the retrieval algorithm free of charge as and when become available.

### **3. DOCUMENTATION**

- i. Hard and soft copies of the documents including manuals for operation, servicing and maintenance of each sub system.
- ii. Literature on the validation procedure, retrieval algorithms along with the empirical constants used.

### **4. SYTEM INSTALLATION**

The system will be installed by us. All needed technical information to be provided.

### **5. WARRANTY AND MAINTENANCE**

The manufacturer should indicate the warranty period clearly. For extended warranty, please specify the cost separately.

### **6. QUALIFYING CRITERIA FOR VENDORS**

During the last 2 years the manufacturer should have supplied at least two such system which is operational and functional. List of installations in the tropical region along with the name and e-mail id of the contact person(s) to be provided.

## **7. COMPLIANCE / NON-COMPLIANCE STATEMENT**

Along with the quotation, vendor to submit a detailed item-wise compliance / non-compliance statement referring the specifications given in this document. The compliance statement shall be supported by original brochure(s) of the equipment or published literature from the manufacturer.

## **8. DELIVERY SCHEDULE**

- i. Delivery terms and timescales should be clearly indicated.
- ii. Place of delivery – CIF Bangalore. The equipment should be duly insured from the supplier warehouse to Institute warehouse.
- iii. The taxes/duty applicable to be indicated separately. If required, IISc will provide ED/CD exemption certificate.

## **9. PRICE PROPOSAL**

The bidder shall submit two sealed covers containing technical bid and price bid. The price bid should give detailed price proposal item-wise for each & every equipment & services. Technical bid should contain an exact copy of the price bid without revealing the price details. The list of deliverables is at Annexure-I.

## **10. PAYMENT TERMS & CONDITIONS**

To be specified clearly. Normally, the payment is after satisfactory supply of material and installation for local suppliers.

## **11. ADDRESS FOR CORRESPONDANCE**

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