सत्यमेव जयते

इलेक्ट्रॉनिकी एवं
सूचना प्रौद्योगिकी मंत्रालय
MINISTRY OF
**ELECTRONICS AND
INFORMATION TECHNOLOGY**

MAKE IN INDIA

SAMEER

Passion for performance

ATMOSPHERIC INSTRUMENTATION @ SAMEER

In-House R&D Activities

Society for Applied Microwave Electronics Engineering & Research
Ministry of Electronics & Information Technology Government of India

www.sameer.gov.in

Overview

Introduction

Radar based Atmospheric Remote Sensing Systems

Radiosonde Systems

Passive Atmospheric Remote Sensing Systems

IT based Atmospheric Data Processing Solutions

Radar Based Installations


SODAR
1996

Wind Profiler
Radar@ Pune
2001


Ionosonde
2013

ST Radar
@ Gauhati
2018


Ka Band
Cloud Radar
2021

MMWR
Radiometer 2024

Introduction:
Journey of Atmospheric Instrumentation @SAMEER

Origins and Mission:

The Society of Applied Microwave Electronics Engineering & Research (SAMEER), an autonomous laboratory under the Ministry of Electronics & Information Technology (MeitY), Government of India, was established in 1977 as the Special Microwave Products Unit (SMPU) at the Tata Institute of Fundamental Research (TIFR), Mumbai. SAMEER has since evolved into a leading centre for research and development in microwave and electromagnetic engineering technologies with a strong focus on atmospheric instrumentation.

Core Technology Areas:

Recognizing the importance of high-resolution atmospheric measurements across time and space, SAMEER has built extensive expertise in acoustic- and radio-wave–based instrumentation. Its work spans four major technology domains: Radar-Based Atmospheric Remote Sensing Systems, Radiosonde and Sounding Systems, Passive Remote Sensing Instruments, and IT-Based Atmospheric Data Processing Solutions.

- **Radar-Based Remote Sensing:** Development of indigenous UHF/VHF wind profilers, the MST radar at Gadanki (1990), ST radar for measurements up to 20 km, 400 MHz RASS systems, and Ka-band cloud radars for cloud and rainfall studies.
- **Radiosonde and Sounding Systems:** Indigenous digital Radiosonde and Ozonesonde technologies transferred to IMD, and the first Indian ionosondes operational at Dibrugarh and Prayagraj.
- **Acoustic Systems:** Phased-array Doppler SODARs and portable SODARs, deployed at research and industrial sites including BARC, VSSC, NPCIL, and NARL.
- **Passive Remote Sensing:** Millimetre-wave radiometers measuring temperature and humidity profiles up to 10 km, with successful deployment at IMD Guwahati.
- **IT and Data Processing Solutions:** Real-time GPS-based precipitable water estimation, automatic chart digitization, and synoptic/pilotsonde data processing tools.

Applications and Impact: SAMEER's technologies are operational across India at IMD centres, research institutes, and strategic organizations, supporting atmospheric science, environmental monitoring, and weather forecasting. These indigenous systems reduce dependence on costly imports and enable continuous, high-resolution atmospheric observations.

Conclusion: Over the past four decades, SAMEER has steadily advanced indigenous atmospheric instrumentation, supporting national agencies and research institutions. Its contributions continue to enhance India's capabilities in weather and climate research while strengthening national self-reliance.

MST RADAR

INTRODUCTION

A state of the art atmospheric radar system called Mesospheric Stratospheric Tropospheric [MST] radar MST Radar has been designed, developed and installed at Gadanki village, near Tirupati. This radar, which is considered second largest in the world, is capable of detecting and measuring wind velocities, wind shear and other atmospheric turbulences upto a height of 100 kms into the sky. The radar was commissioned in 1993 and since then it is fully operational. Scientists from all over the country primarily use the radar for atmospheric research. The Indian MST radar is a highly sensitive pulse coded, coherent VHF phased array radar operating at 53 MHz with an average power aperture product of 7 x 108 Wm2 . Various aspects of the turbulence characteristics and wind fields in the middle atmosphere with resolutions of the order of a few tens of meters in height and a few tens of second in time may be studied using this radar

Applications

Research tool in the Investigation of

- Prevailing Winds
- Waves (including gravity waves) turbulence
- Atmospheric Stability
- Mesoscale meteorology
- Input data for weather forcasting

Installation

National Atmospheric Research Laboratory (NARL), Gadanki, Tirupati

Specifications	
Frequency	53 MHz
Average Power Aperture Product	7 X 103 Wm2 (4.8 X 106 Wm2 in ST mode)
Peak Power	2.5 MW (180kW in ST mode)
Maximum Duty Ratio	2.5%
Number of Yagi Antennas	1024 (256 in ST mode)
Beam Width	3° (4.6° in ST mode)
Number of Beams for Automatic Scanning	7
Pulse Width	1 to 32 µS coded (1 µS baud)
Pulse Repetition Frequency	62.5 Hz – 8 kHz (in binary steps)
Maximum number of range bins	256
Number of Coherent Integrations	4 to 512 (in binary steps)
Maximum number of FFT points	512
Radar Controller	PC/AT featuring prog. experiment
Computer System	32 bit super mini with vector accelerator (Masscomp- MC5600

PHASED ARRAY DOPPLER SODAR

Project Overview:

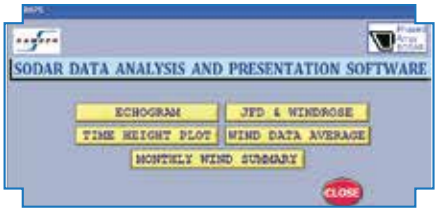
Acoustic Radar or SODAR (Sound Detection and Ranging) is an instrument used for Atmospheric Boundary Layer Studies and Environmental Applications. This system transmits train of acoustic pulses into the atmosphere and receives the back scattered acoustic echoes. The intensity of these echoes depends on the temperature inhomogeneity in the atmospheric layers. In a mono static SODAR system, the three-dimensional wind information can be obtained by transmitting consecutive pulses in the vertical and two orthogonal directions tilted slightly from the vertical. The SODAR developed by SAMEER makes use of phased array antenna for generating the multiple beams. Phased array technology provides the capability to electronically steer the sound beam in any direction. A portable SODAR system operated with solar panel and battery developed for easily deployable and remote operation applications.

Applications:

- Environmental Impact Studies
- Prediction of Toxic Chemical Spills
- Inversion Detection
- Sea Land Breeze Studies
- Meteorology
- Aeronautical Services
- Research in Atmospheric dynamics
- Environmental Monitoring
- Wind Energy site evaluation

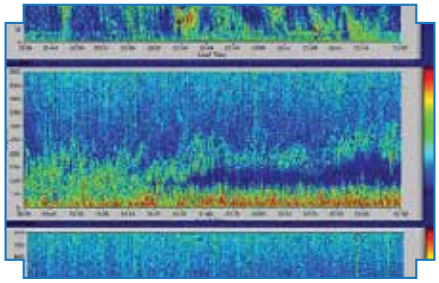
Specifications	
Operating Frequency	1.7 to 2.5 kHz, (Selectable)
Acoustic Power	100 W
Averaging Time	1-60 min
Wind Speed	0-35 m/s
Wind Direction	0-360 Deg
Wind Speed Accuracy	0.1 m/s
Max Range	600 m @ 40dBA 1km in favourable condition
Data Products	Echogram, Wind Components, Wind rose, Total Height Plot, JFD, Stability Class, Mixing Heigh

Deployed Sytems

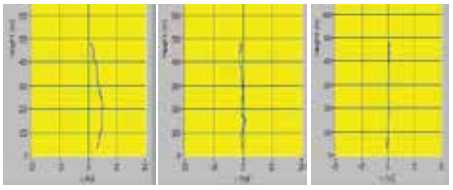


Offline SODAR Software GUI

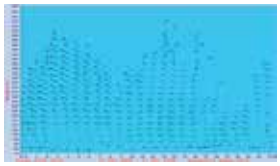
Online SODAR Software GUI



Echogram

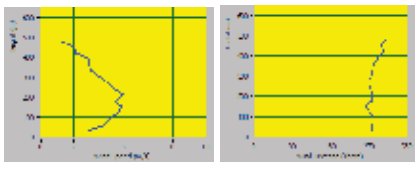


Zonal Meridianal Vertical



Time Height Plot

Wind Rose



Wind Speed Wind Direction

WIND AND TEMPERATURE PROFILER

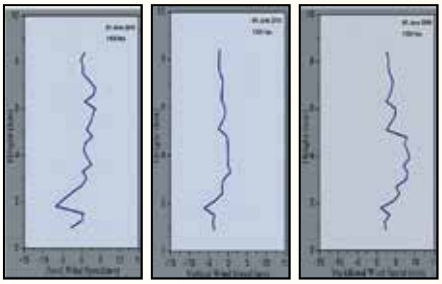
Project Overview:

Wind and temperature profiler provides vertical profiles of horizontal winds in the troposphere and also gives temperature profile information upto 3 km. Wind profiler system as designed is a ground based clear air coherent Doppler Radar. It transmits a suitably designed coded RF Pulsed waveform at UHF frequencies. It also employs pulse coding technique to improve the vertical range. Back scatter echoes are obtained from troposphere and analyzed to get wind information using FFT techniques. Wind profiler measurements are carried in three orthogonal directions using three independent beams. Power of order of 16 kW peak is radiated through a coaxial collinear antenna having effective aperture area of the order 80 sq.m.

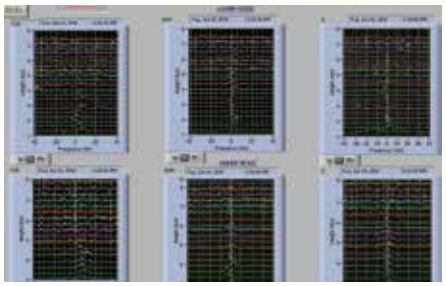
RASS attachment for temperature profiling

For this an FMCW acoustic sweep is transmitted to ensure the Bragg matching condition at all ranges. A suitable modification in the receiver hardware is implemented in order to get RASS (Radio Acoustic sounding System) echoes corresponding to the sound velocity.

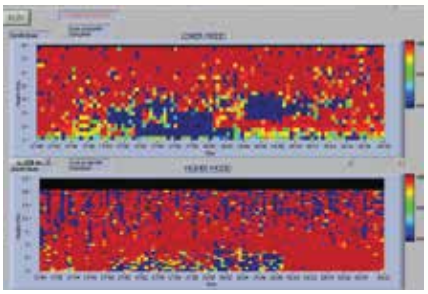
Specifications	
Frequency	404.37 MHz.
Peak power	16 kW
Pulse width	2 gs (un coded), 16 gs (coded)
Duty ratio	Fixed coaxial- collinear dipole
Antenna type	phased array
Antenna gain	32 dB
Antenna side lobe	40 dB down in horizontal dir
3 dB beam width	5 deg
Pulse repetition period	60 us (LHM) , 160 gs (HHM)
Min. height for wind	1 km (500 m possible)
Max. height for wind	15 km
Min. height for Temperature	1 km
Max. height for Temperature	3 km
Height resolution	300 m
Max. Doppler frequency	64 Hz (variable)
No. of FFT points	user selectable (128 to 1024), 256 (typical)
No of coherent integrations	User selectable (76 typical)
No. of incoherent integrations	User selectable (10 typical)
Acoustic exciter system	Bragg compatible



Zonal Wind Speed | Meridianal Wind Speed | Vertical Wind Speed



Normal Power Spectra



Vertical Beam Intensity plot

SOFTWARE:

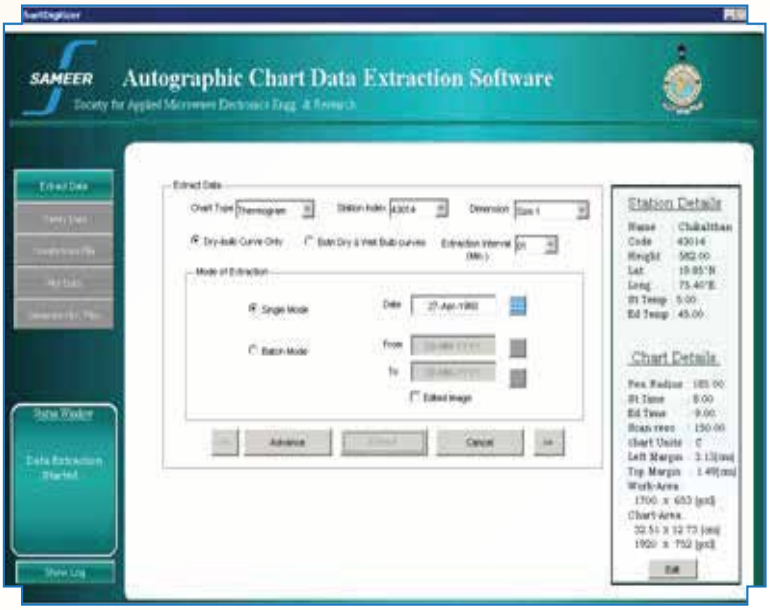
It offers an operational software. It includes data processing and display of Power Spectra, IJVW Components, Wind Speed and Direction, Data Table, Intensity Plot and 24 hours time height cross section plots.

WP/RASS Software GUI

Coaxial-Collinear Antenna

Coaxial-Collinear Antenna

AUTOGRAPHIC CHART DATA EXTRACTION SOFTWARE (ACDES)

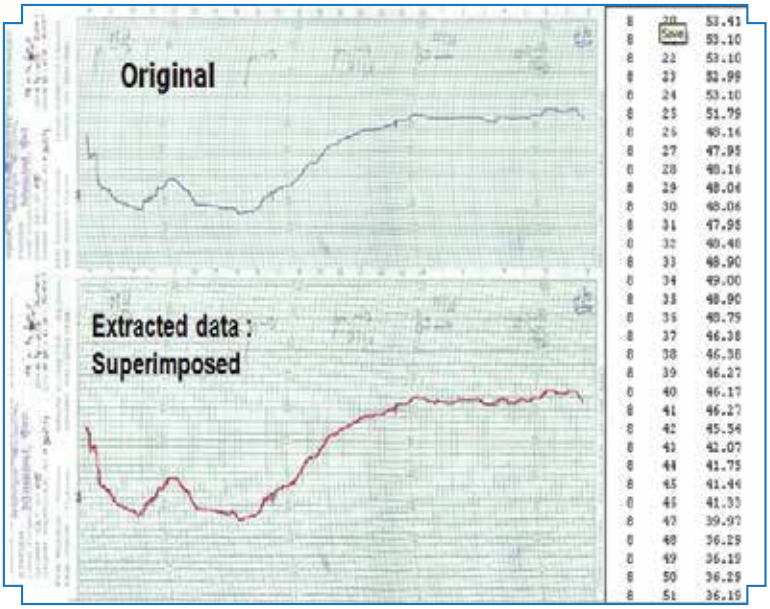


System Overview:

- SAMEER has developed ACDES to extract meteorological data from scanned autographic charts.
- The extracted data is quality checked and verified for correctness before archiving
- The ACDE software is developed using MATLAB® image processing and data Filtering algorithms.

Software Features:

- High speed, Temporal Resolution and Accuracy of Extracted Values
- Built-in QA/QC and Graphical verification of the extracted data
- Addressed issues like tilt in charts, hand written text, missing axes, differing sizes and formats etc.
- Minimal User Inputs for automatic extraction of the Graphs
- Single and Batch Mode Operations
- Generation of daily & monthly tabulated values for archival at NDC



Tangible Benefits:

- Digital storage of the High temporal resolution data for easy access
- Studying fast changing site specific weather phenomenon
- High temporal resolution data of Surface Pressure, Temperature and Humidity will be of immense help to the scientific community in making medium, long range forecasting and climatological studies .

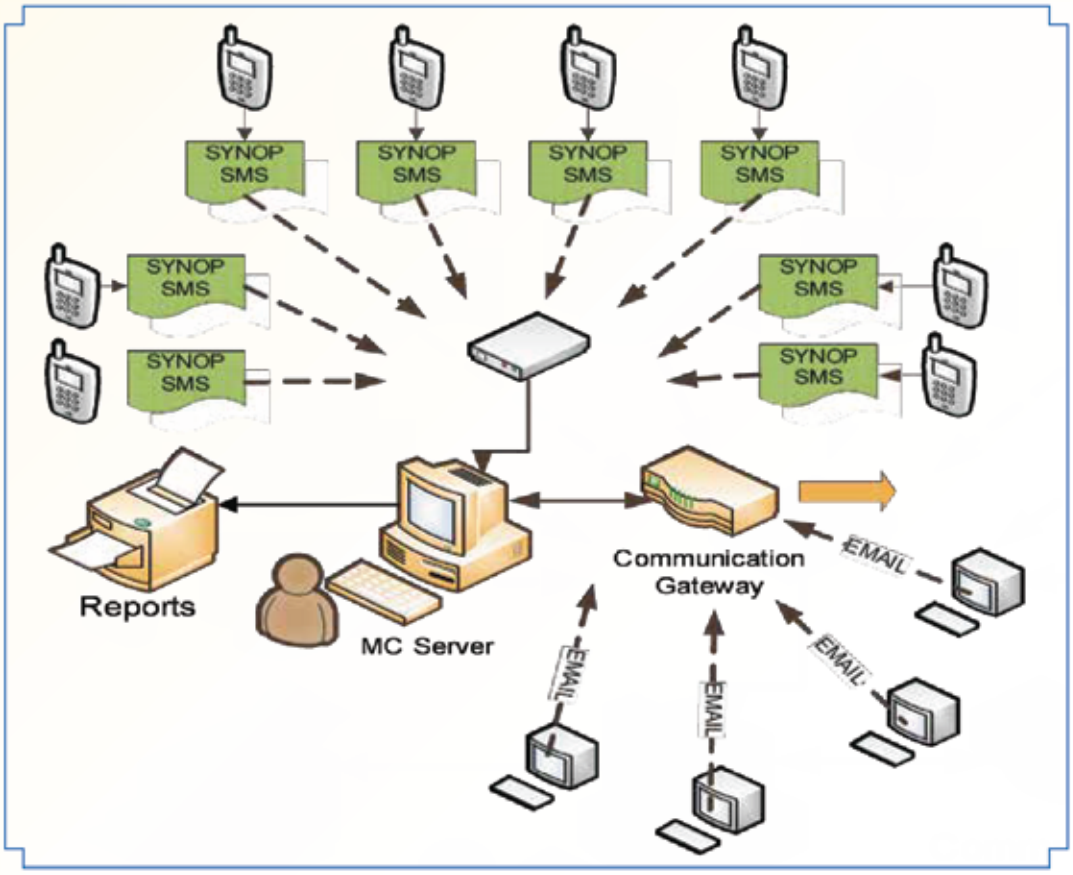
Portability:

- The current system is tailor made for Extraction of IMDs autographic weather charts like thermogram, hygrogram etc. This software can be easily modified to suit other similar applications.

AUTOMATION OF SURFACE OBSERVATORIES

System Overview:

- Surface Meteorological Data Collection at Synoptic hours on HHDL / PC
- Automatic Processing of Synoptic data with quality checks to generate synoptic message
- Instant Transmission of Synoptic message to Regional Met Center (RMC) through SMS / Email
- Server at all RMCs to automatically collect, check and process Synoptic Messages in near real time
- Automatic Transmission of quality Checked Synoptic messages on GTS
- Automatic Generation of Meteorological Reports at RMC



Hand Held Data Logger:

- Sleek, Rugged Enclosure Adhering to IP-65 standard
- User Friendly Interface to input surface met data with built in quality checks
- Automatic generation and Transmission of Synoptic message
- Provision to store one year observation data in HHDL

Tangible Benefits:

- Instant availability of quality checked Surface meteorological data for weather forecasting
- Significant saving in the man-hours and stationary due to elimination of manual work
- Availability of Latest data at NDC for research and commercial usages.

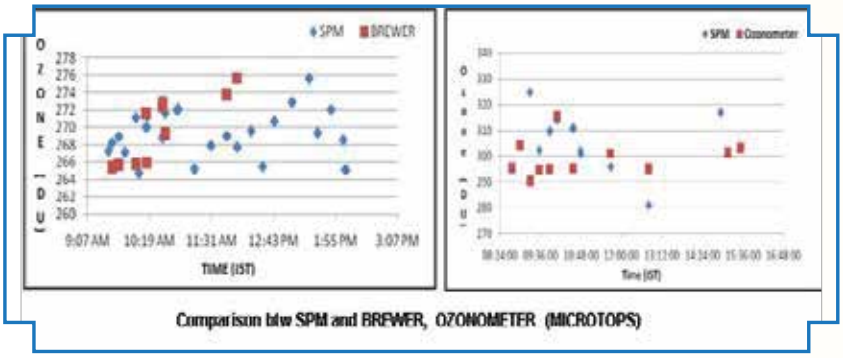
MULTI-CHANNEL HAND HELD SUN PHOTOMETER

Project Overview:

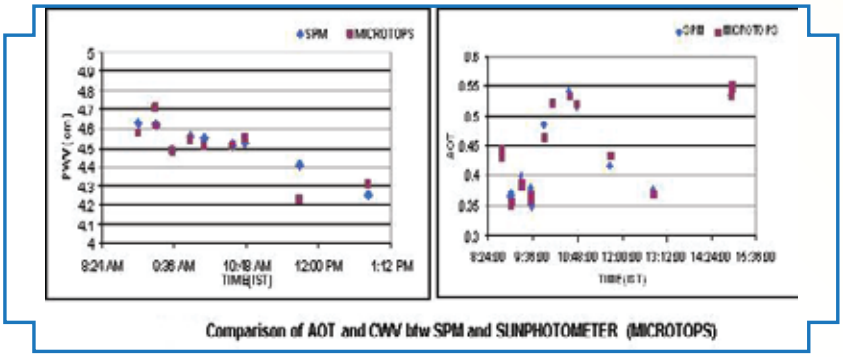
- Sun-photometry is a passive remote sensing technique used to measure properties of aerosols and important trace gases in the atmosphere.
- SAMEER has developed a five channel, handheld Sun photometer which measures columnar amounts of Aerosol, Water Vapour and Ozone above observation site.
- Sensor Calibration: The sensors extraterrestrial constants at each wavelength were derived using Langley calibration technique.

Silent Features:

- Sleek, Rugged Enclosure Adhering to IP-65 standard Operates on alkaline AA battery pack
- Low cost, durability, and long-term optical stability.
- A built-in pressure transducer automatically measures atmospheric pressure.
- Optional Global Positioning System (GPS) receiver for geographic coordinates of the observation site
- The instrument can record up to 9000 scans of the raw and processed data.
- Rechargeable Batteries and USB charging
- PC and Printer interface through USB port.



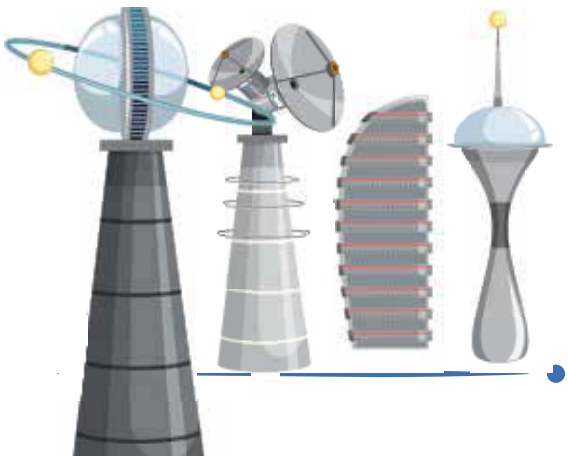
Comparison btw SPM and BREWER, OZONOMETER (MICROTOPS)



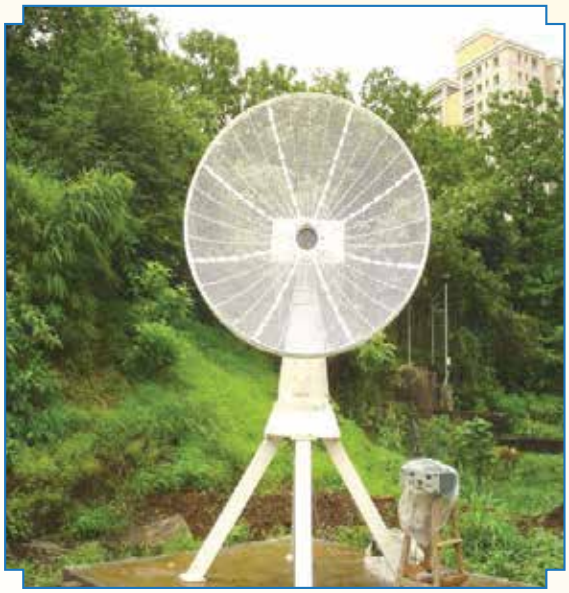
Comparison of AOT and CWV btw SPM and SUNPHOTOMETER (MICROTOPS)

Applications:

- Input to Weather Forecasting models, air quality forecasting and for climate studies
- Pollution and Environmental monitoring.
- Photobiology, Scientific and educational studies.
- Irradiance based calibration of imaging sensors.



RADIO THEODOLITE AT 1680 MHZ

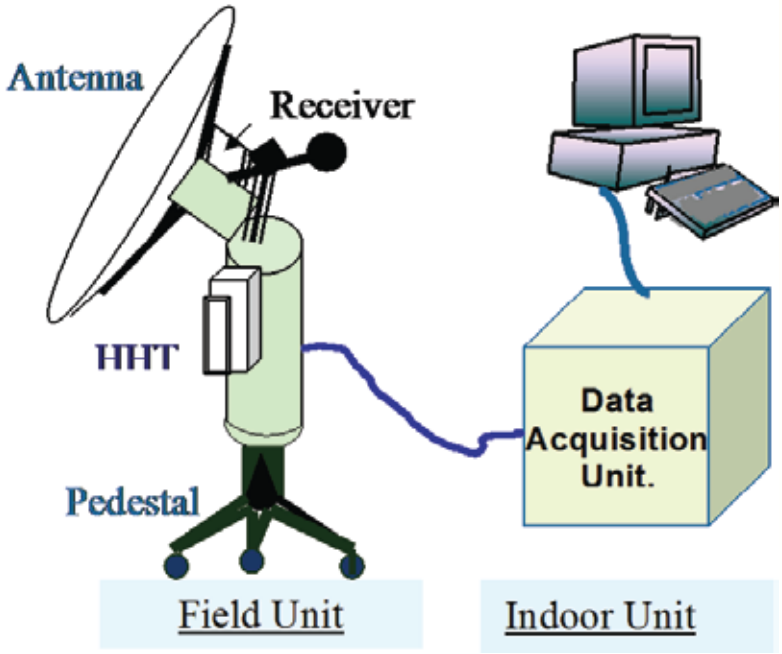


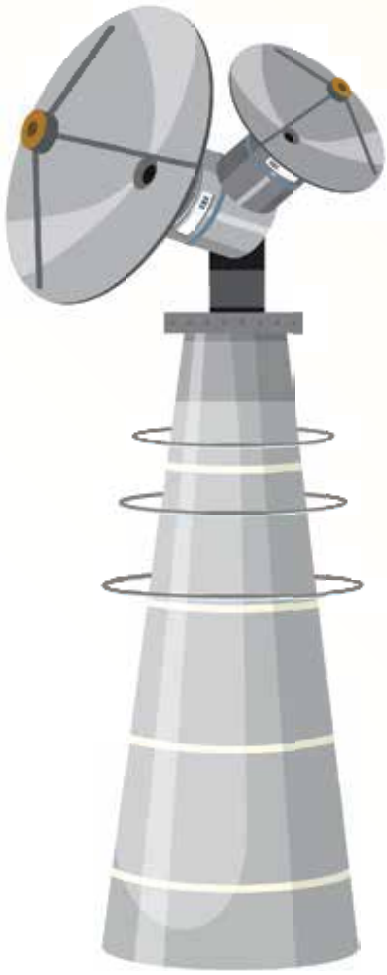
Project Overview:

Regular Monitoring of the upper atmosphere is done by sending a balloon with atmospheric sensors and a UHF transmitter. This unit is called the 'Radiosonde'. The Radiosonde signals are received by 6 Radiosonde and the balloon is also tracked by Radio-Theodolites.The units also track the balloon accurately. The Radio theodolite computes wind velocity and the parameter profile from the received data. This data is useful for prediction.

Features:

- Automatic Tracking of the Balloon position.
- Automatic Frequency tracking
- Automatic Computation of Atmospheric Parameters





Specifications	
Operating frequency	1680 MHz
Tracking principle	Mono-pulse Tracking
Antenna type	Offset feed parabolic dish
Angular Coverage	Azimuth 360° (Contin) Elevation –5 ° to 90°
Tracking speed	20 °/sec, for Az & El
Tracking Accuracy	0. 1° (both in Az & El)
Receiver Frequency range	1680±20 MHz
Sensitivity	-110 dBm
Dynamic range	90 dB

DIGITAL IONOSONDE (RADAR)

Project Overview:

The Ionosonde is a 'stand-alone' system which uses radar technique to probe the Ionosphere.

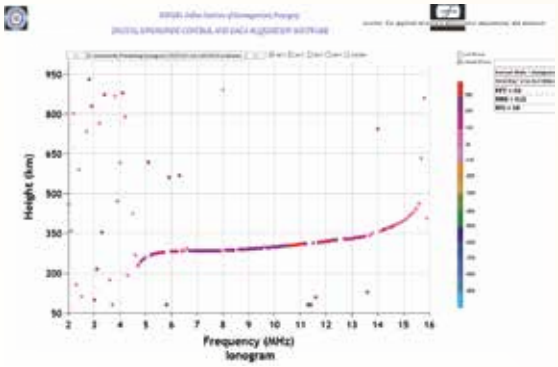
SAMEER has indigenously developed Digital Ionosonde, which exploits advanced techniques for signal analysis such as pulse coding, pulse compression, coherent integration etc. with reduced transmitting power of the RF Signal

Features:

- Height Range: Up to 1020 km with Range Resolution of 5 km
- Frequency Range: From 1 to 20 MHz digitally synthesized, with step size of 50 KHz.
- Noise Suppression: Coherent pulse averaging and FFT techniques used to improve signal to noise ratio.
- Operational Check: Facility is provided to carry out simulations for calibration and validation of the system.
- PC Based Control: Proposed System will be PC controls and provides highly flexible setup and control with storage
- Flexibility of The System: Can be operated in Multiple Modes
- Field Programmable Firmware: System is provided with Field Programmable Firmware.

Applications:

- The Ionosonde is a 'stand-alone' system which uses radar technique to probe the Ionosphere. Physics of ionosphere Studies
- Ionosphere forecasting.
- Meteor observations and related studies,
- Investigation of the Ionospheric Layers and their temporal and spatial variation
- Determination of ionospheric Characteristics
- Polar Cap Studies
- Equatorial and High Latitude Electro jet Studies



Specifications	
Transmitter Antenna	Double Delta (NS -EW)
Polarization	Right hand Circular
Transmit Frequency	1 – 20 MHz with 100 kHz steps
Peak Power	~ 1 KW
Transmitting signal	8 /16/32 bit Bi-phase code
Receiver Antenna	Magnetic Loop Turn-style
Receiver Channels	8
Maximum Range	1020 Km
Range Resolution	~5 Km
Signal Processing	DDC, CIC Filter Decoding Coherent integration, FFT

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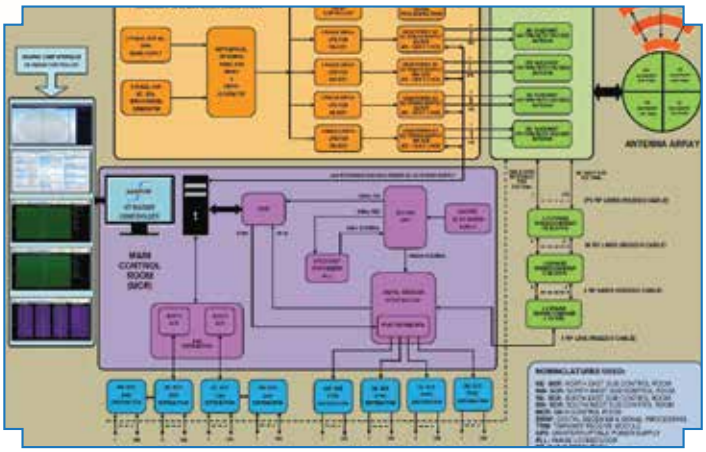
STRATOSPHERE TROPOSPHERE RADAR

INTRODUCTION

ST Radar is clear air weather radar operating at 212.5 MHz, has been established at Gauhati University Campus (26.140N, 91.730E, 50 mts above MSL) by SAMEER, Mumbai. It is the world's first system with cutting edge indigenous technology in 200 MHz band with open configuration (Antennas, T/R Modules and Cables placed in the open field) wherein active phased array concept has been used. It is a coherent pulsed Doppler radar operating in Doppler Beam Swinging (DBS) mode. It consists of 576 antenna elements arranged in a circle with square grid. Each antenna is connected with its own Transmit-Receive Module (T/R Module) to generate high quality wind data (wind speed and its direction) with high spatial and temporal resolution on continuous basis. This data when fed to weather numerical models or similar numerical models would lead to forecasting and nowcasting of atmospheric phenomena in north east region will be helpful to various sectors such as meteorology, agriculture & civil aviation, disaster management etc. The Radar will be utilised extensively by universities/research laboratories in North-East region of India and will train manpower in the area of atmospheric science and RF technology.

SYSTEM DESCRIPTION

The block diagram of ST radar shows the various sub-systems of the radar and how they are interconnected. System works on 3 phase 415V AC 50 Hz electric supply. Then electric supply is connected to four UPSs which in turn are connected to 12 numbers of high power AC-DC supplies (48 V DC) placed in four Sub-Control Rooms. 48 V DC supply is routed from these control rooms to antenna array to power 576 T/R modules. Mains supply is also carried to fifth Sub-Control Room known as Master Control Room (MCR) where it connects to the fifth UPS. Its output gives supply to radar controller, radar display unit, digital receiver & exciter sub-system and digital receiver interface (DRI) unit.



SYNC and CAN signals are distributed from MCR to four Sub-Control Rooms and then to Antenna Array to feed each of 576 T/R Module units. CAN provides connectivity between Radar Controller and 576 T/R Module Controllers (TRMC) sitting in each T/R Module. The radar parameters are downloaded to each TRMC by Radar Controller over the CAN interface. Each TRMC has an FPGA which generates all the control signals for that T/R Module. The SYNC Signal is generated by FPGA in the Digital Receiver. Sync Signal is like an IPP with a width of 1µs and variable PRF. TRMC signal generation starts after sync signal. SYNC signals are differential signals and routed to each T/R Module separately.

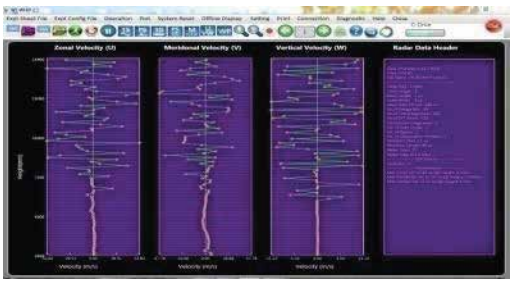
System clock is 10 MHz OCXO which is used as reference source. It locks 212.5 MHz PLL which is amplified and fed to 576 T/R Modules through chain of power divider/combiner network placed in the Antenna Array field. During reception, signals are combined coming out of the receive section of T/R Module through the same set of power dividers/combiners and fed to digital receiver through DRI unit for further processing. The digital receiver generates I and Q signals at base band level and the same is decoded, in case of coded transmission, coherently integrated and spectral estimation is done using FFT techniques in real time to estimate the three spectral parameters viz., received power, Doppler and spectral width. The data is displayed on a high end graphical work station. Graphical Display of wind data is shown in standard display formats. The Radar controller is the interface between operator and the Radar. It generates the operating parameters of the wind profiler, selects the beam positions and sets the Radar for collecting the data in different operating parameters

ST RADAR SUBSSYSTEMS

- Antenna Array and RF and Control Feeder Network
- Transmit/Receive Modules and its Local Controller
- Digital Receiver
- Signal Processing
- Radar Controller
- Power Supply, CAN & SYNC Signal Distribution

TYPICAL APPLICATIONS

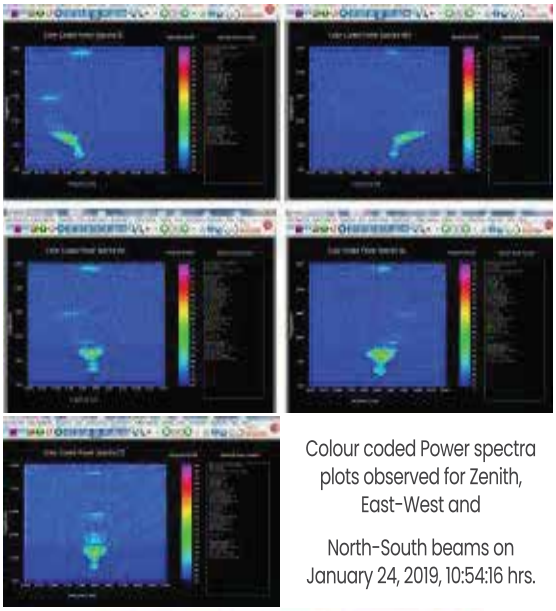
- Meteorology
- Input for Weather Prediction
- Disaster Management
- Civil Aviation
- Ionospheric Studies, Atmospheric Research
- Study of Precipitating Clouds



UVW Components of Wind

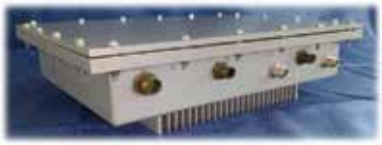
STRATOSPHERE TROPOSPHERE RADAR

Specifications	
Type of system	576 element Active Phased Array with T/R Modules
Frequency	212.5 MHz
Bandwidth	4MHz
Antenna element	Four element Yagi-Uda antenna
Antenna element gain	7.9 dBi
Height Coverage	500 m to 20 kms (Depending upon C_n^2)
Range gates	256 (programmable)
Modes of operation	DBS
Height Resolution	~ 75m to 300m (Programmable)
Antenna Area	572 m^2 (Aperture Diameter 27m)
Effective Aperture	522 m^2
Array Beam width	~3.2^0 nominal
Antenna Array gain	34.5 dBi nominal
Off- zenith angle	0^0 to 20^0 in steps of 1^0 (Programmable)
Azimuth angle	0^0 to 360^0 in steps of 1^0 (Programmable)
Pulse width	0.5 to 64 µs
Modulation	Binary phase shift keying(BPSK) coded compression
Code	Complimentary code/Barker code
Baud	0.5 to 4 µs
Pulse repetition frequency (PRF)	250Hz to 5KHz
TRM peak power	400 W (Typical per element)
Total peak power	230.4 kW
Duty ratio	Up to 10% (Max)
Peak power × Effective Aperture product (PAP) ~	1.2 × 108 Wm2
Receiver Noise Figure	3.0 dB



Colour coded Power spectra plots observed for Zenith, East-West and

North-South beams on January 24, 2019, 10:54:16 hrs.

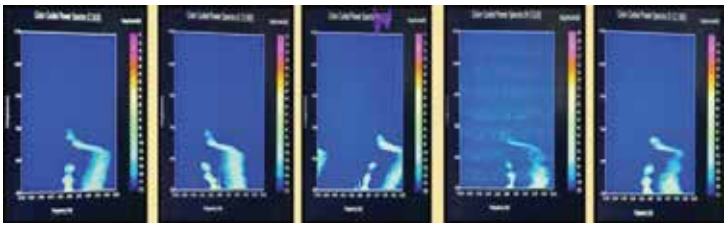


TRANSMIT/RECEIVE (T/R) MODULE

ANTENNA ARRAY

ANTENNA ARRAY

Normal Power Spectra observed during clear air condition for East-West And North-South beams On June 4, 2018, 15:33:52 Hrs



Colour coded Power spectra observed during rain for Zenith, East-West and North-South beams on June 14, 2018, 07:15:30 hrs.

T/R Module Power Supply & CAN/SYNC Distribution Rack

DIGITAL RECEIVER AND RADAR CONTROLLER

1:4 Way

1:9 Way

DEVELOPMENT OF KA-BAND POLARIMETRIC SCANNING DOPPLER RADAR DOPPLER CLOUD PROFILING

Project Overview:

Cloud is an important constituent of earth's water cycle. It is well known fact that clouds modify earth's energy budget and play an important role in affecting Earth's climatic. Therefore, study of Cloud variability in time and space is very important. Ka-band Cloud Radar is one such system developed for the first time in India, which provides data for study and observation of cloud fields and its evolution in time and space. This Cloud Radar system working at 35.6 GHz operates in azimuth and elevation scanning modes. It provides three dimensional detailed view of clouds spanning hemi- sphere of radius about 20 kms over the radar site by continuously recording the returned Intensity, Doppler (velocity) and Doppler width at each range gates.

About System

It is a trailer mounted system which can be transported using a puller to any location. The complete Radar system is mounted upon Scissor Lift Platform and Radar Controller PC is mounted inside the cabin for Data Processing. Diesel Generator and UPS has been provided to facilitate Radar operation and observation at any remote location also. User friendly GUI can be accessed by user to setup configuration for operating radar and online and offline plots for the data obtained can be seen with display software.

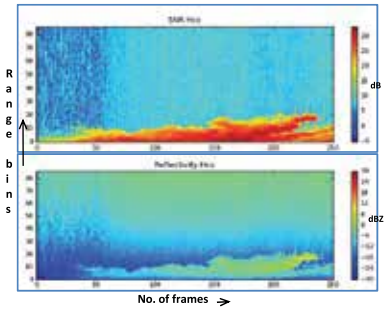
Operation

Some of the preliminary results of data obtained by Ka-band scanning polarimetric cloud radar is also shown. It is Reflectivity and SNR plots for Hco channel data acquired during moderate rain event in July 2019. Operational parameters FFT=256, NICI40, IPP-225us, Baud = 0.75usec, Coded-barker 13 bit were used. The system is also equipped with Internal and External Calibration facility.

Data Products/ Preliminary results

Following are the data products;

a. Reflectivity
b. SNR
c. Doppler velocity
d. Spectrum width
e. Correlation coefficient
f. Differential reflectivity
g. Linear De-Polarization Ratio
h. Specific Differential Phase
i. Time series data



Specifications	
Frequency	~ 35.6 GHz (⊠ = 8.42mm)
Radar Configuration	Scanning Mode and Stationary Mode
Transmit polarization	Single H, V and Alternating H or V
Receive polarization	Simultaneous H and V
Receiver noise figure	≤ 6.0 dB
Range resolution	37.5-75-150 meters (selectable)
Vertical/Radial Range Coverage	0.3 km to 15 kms / 25 Kms
Temporal Resolution	~ 1 sec
Velocity resolution	0.1 m/s
Max. Unambiguous radial velocity	± 10.77 m/s
Max. sensitivity at 10 km vertical height	-35 dBZ, 1.0 sec averaging, 150m range resolution
Scanning	Az: 00 to 3600; El: -900 to 900
Scan rate	Azimuth 0-6 rpm / elevation 0-1 rpm; accuracy ± 0.1deg
Products	SNR, Z, V, Width, ZDR, LDR, KDP,PhiDP, RhoHV
Archive Data Format	Net-CDF

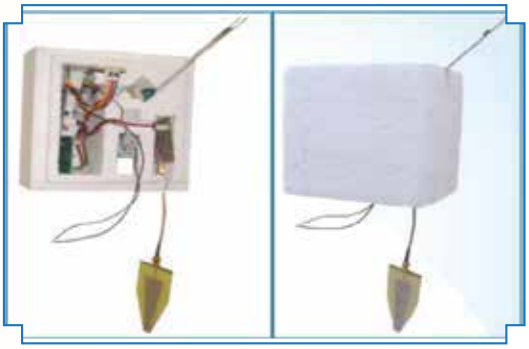
User Applications

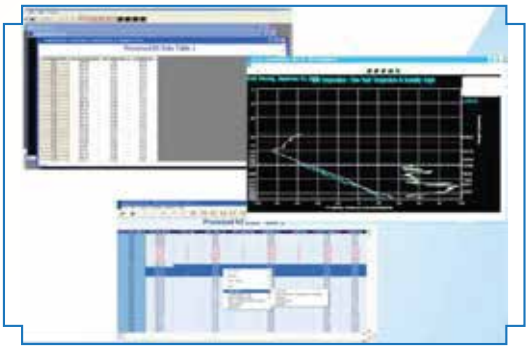
- Meteorology /Atmospheric Research
- Civil aviation
- Defence
- Space Applications
- Input for weather prediction
- Cloud microphysical studies etc.

System Description

- Parabolic Dish Antenna (D-1.8m, Gain-51dB)
- Solid state Transmitter with 2.2K W peak Power
- Ultra Stable Exciter sub-system
- High Dynamic Range Receiver
- BITE (Built-in-test equipment) sub-system
- FPGA based Digital Receiver
- Power Distribution Units
- DC Power Supply
- Radar Controller PC
- Antenna Drive and Pedestal unit for scanning
- Chiller for cooling of system
- Compressor & Dry Air Unit
- UPS and Diesel Generator for Power Supply
- Scissor lift for lifting up the system during operation

GPS DIGITAL RADIOSONDE





Project Overview:

SAMEER has successfully developed and demonstrated the GPS Radiosonde at 1680 MHz

SAMEER has transferred the GPS Radiosonde technology to India Meteorological Department (IMD) for use in their Upper Air Data Network

Tangible Benefits

- High resolution upper air data is an important input to Numerical Weather Forecast and air pollution models
- Graphical View of the profile data is useful for interpretation of the atmosphere's vertical thermodynamics and kinematics
- Local severe storm, aviation, and marine forecasts
- Weather and climate change research
- Ground truth for satellite and remote sensing instrument data

DRS Features:

- Light weight balloon payload (<250 grams)
- Operates on two high power lithium AA cells
- Compatible with different sensor packages
- Uses pre-calibrated sensor package hence no ground calibration required
- On board GPS receiver for wind estimation
- Pressure computation from GPS heights, making pressure sensor optional
- Fully software controlled ground system
- Real time Data acquisition and Processing software with Graphical User Interface, graphical and tabular displays of data
- Generation of detailed flight report and WMO TEMP Message

Specifications	
Frequency	404.37 MHz.
Peak power	16 kW
Pulse width	2 gs (un coded), 16 gs (coded)
Duty ratio	Fixed coaxial- collinear dipole
Antenna type	phased array
Antenna gain	32 dB
Antenna side lobe	40 dB down in horizontal dir
3 dB beam width	5 deg
Pulse repetition period	60 us (LHM) , 160 gs (HHM)
Min. height for wind	1 km (500 m possible)
Max. height for wind	15 km
Min. height for Temperature	1 km
Max. height for Temperature	3 km
Height resolution	300 m
Max. Doppler frequency	64 Hz (variable)
No. of FFT points	user selectable (128 to 1024), 256 (typical)
No of coherent integrations	User selectable (76 typical)
No. of incoherent integrations	User selectable (10 typical)
Acoustic exciter system	Bragg compatible

DEVELOPMENT OF LOW COST GPS PILOT BALLOON SYSTEM

Project Overview:

SAMEER has successfully developed and demonstrated the GPS PILOT Balloon at both 1680 and 403 MHz

SAMEER has in the process of transferring the GPS PILOT Balloon technology to India Meteorological Department (IMD) for use in their Upper Air Data Network .GPS PILOT Balloon is primary source to collect Upper air wind observations using balloon ascents all over world.

The transmitter chip is a 1680/403MHz Frequency Shift Keying (FSK) system that transmits GPS data to the ground based system for wind measurement.

The Ground System consists of an Indoor Receiver (common for both 1680/403 MHz) and an Outdoor Unit (Antenna System).

Data Acquisition & Transmitter Board:

The Data Acquisition Board acquires and integrates data from GPS Receiver module and provides the data frame which are transmitted to the ground station at a baud rate of 2400 bps. It takes data from position data from GPS receiver on UART port. Monopole antenna is used to transmit the data from the transmitter, which radiates at 1680 / 403 MHz

GPS Pilot Balloon Configuration:

- Data Integrator Board (DIB)
- Transmitter (168/403 MHz)
- GPS Receiver Module
- Battery Pack (Duracell alkaline)

GPS Pilot Balloon Features:

- Light weight balloon payload (<150 grams)
- Operates on alkaline AA battery pack
- On board GPS receiver for wind estimation
- Fully software controlled ground system
- Real time Data acquisition and Processing software with Graphical User Interface, graphical and tabular displays

Tangible Benefits:

- High resolution upper air wind data is an important input to Numerical Weather Forecast and air pollution models
- Used in issuing alerts and warning for aviation
- Weather and climate change research
- Ground truth for satellite and remote sensing instrument data

Specifications	
Frequency range	1680/403MHz +/- 3 MHz
Modulation	GFSK
Frequency Deviation	+/- 50 KHz
Frequency Step	1 MHz
Output Power	+22 dBm +/- 1dB at antenna input
Antenna Gain	3 dBi
Antenna Type	Monopole Antenna
Supply Voltage	+5V
Current	110 mA+/-30mA @+5V
Operating Temperature	- 10o C to +50o C

LIGHTNING DETECTION NETWORK

Project Overview:

- Lighting Detection network system detects the cloud to Ground lighting.
- Indigenous LDN in North India will help in understanding the Lightning climatology and it's linkage with climate change.
- LDN system gives the Accurate location of lighting with the accuracy in several meters.
- Total 6 nodes are required to cover North East area of India
- Base line of each node is 100-200 Kms

Salient Features:

- Eight Lightning Detection nodes in North East region of India
- Cloud to Ground Lighting detection.
- VLF receiver at 1-30 KHz
- FPGA based data acquisition system .
- GPS time stamping for accurate location finding
- Single board computer based node controlling software for data decimation to server on Ethernet.
- Data collection from all the nodes on the Processing server.
- Sophisticated software for the lighting data visualization.

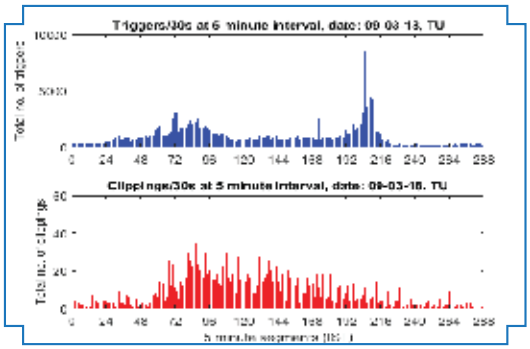
Applications:

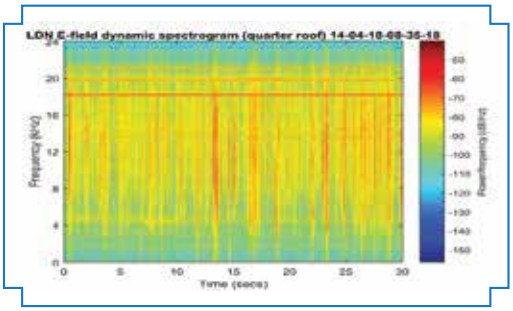
- Early warning alters to companies and people
- Storm location & storm Intensity Identification
- Microburst Prediction
- Aviation
- Meteor observations and related studies

End Users:

- Indian Meteorological Department
- Local Authorities for data distribution
- Tripura University

Specifications	
Lightning Type	Cloud to ground(flashes & strokes)
Time Synchronization	GPS receiver with few tens of nanoseconds accuracy.
Network Detection Efficiency	>80% (for C-C)
Location Accuracy	<1KM for CG
Nominal Baseline Between Sensors	~100 –200KM
VLF Band	1- 30KHz
Remote monitoring	Remote monitoring of nodes and central station.
Communication interface	TCP/IP or Dedicated communication lines
Data @nodes	Data buffering at Node stations In case of communication failure to central location.





SMART OBSERVATORY SYSTEM

Project Overview:

SAMEER has successfully developed a digital data logging system which can log various phenomena like temperature, humidity, rainfall, etc.

The data logger is an electronic device that is used to store data over time, commonly known as data logging. This includes data acquisition device such as serial communication system which uses a Single-board computer as a real time data recording system. In this project raspberry-pi is used as computer to perform this recording and to display real time output on LCD screen. The data of all parameters will be saved in SD card and pen drive. Hence data records will be maintained in a readable file. This data logging system is requires only 5V DC, data logger accept number of sensor inputs, sampling and saving the data at a predetermined frequency.

Data Acquisition:

In real time measurement the System will be enclosed in the Stevenson Screen. The RTD produces a low-level voltage signal and it gives to signal conditioning card where amplification & processing of the signal is done. RTD interface card is used to transfer this signal to raspberry pi using RS 232.

The SOS system can also capable of interfacing mechanical sensors such as temperature, humidity & rainfall. The sensors are mechanical and deflect output on PCB plate. PCB plate will give electrical signal to raspberry pi. The Hair Hydrograph is an instrument used for recording continuously the relative humidity of the atmosphere. Thermograph is an instrument used for recording temperature of the air continuously with respect to time. Self Recording Rain Gauge is an instrument used for recording rainfall.

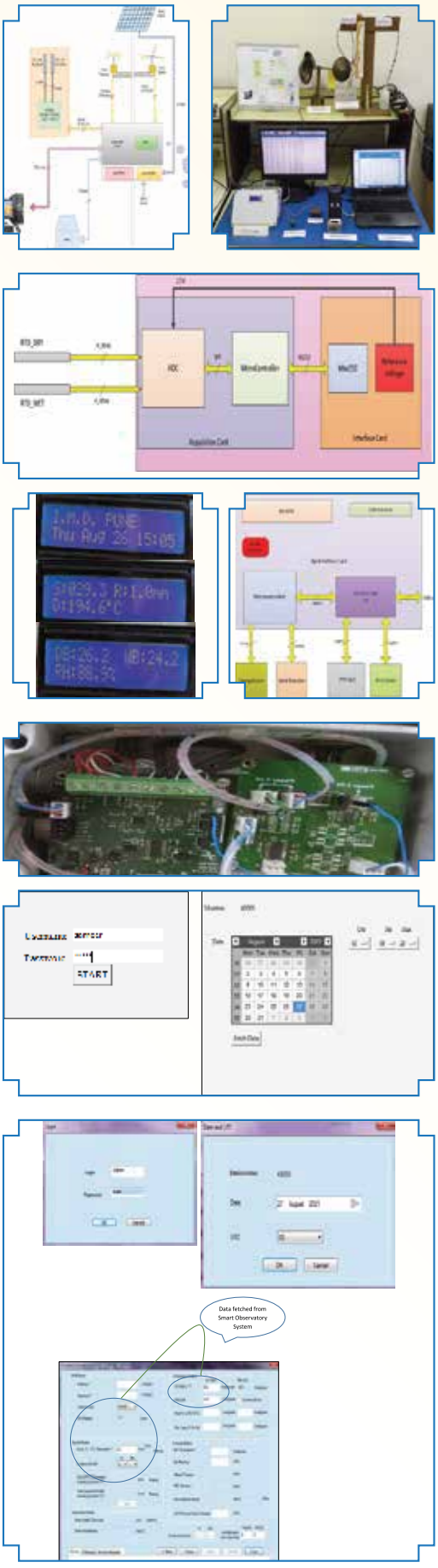
SOS Configuration:

Single-board computer | PT-100 RTDs | Wind and Rain Sensor

Tangible Benefits:

- High resolution temperature data
- High resolution wind speed and wind direction data
- Continuous acquisition and recording of Dry Bulb & Wet Bulb Temperature, WS + WD & Rainfall in SD card and USB drive
- Display of acquired data @ 1min
- Accurate, Consistent & Reliable data quality in all Weather Conditions
- Embedded & PC based software for archival , processing & display of senor data

Specifications	
Class B RTD	-200°C to +600°C
AD7124-4/ AD7124-8	24 Bit
ADuC814	8 Bit
R-Pi Module	3 B
Operating Temperature	- 10o C to +50o C
Data Archival Rate	Per min
Data Output Port	Ethernet
Data Archival capacity	3 months
Wind data	Speed/Direction
Supply Voltage	+5V
Current	1A @+5V



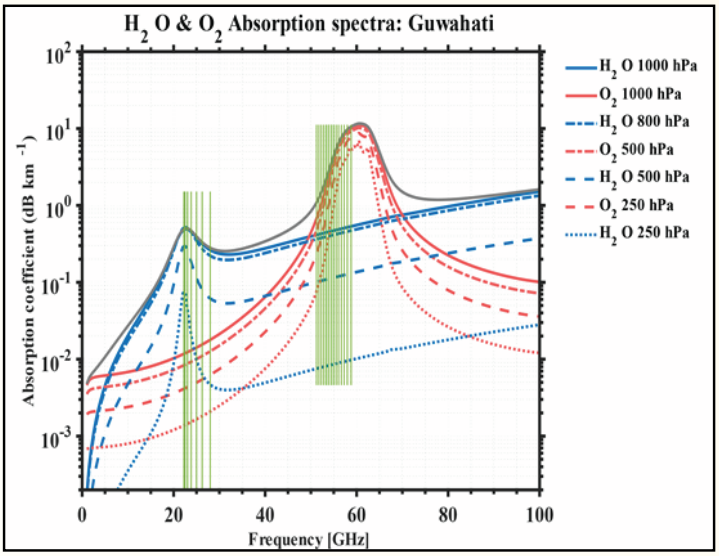
MMW RADIOMETER FOR CLIMATE STUDIES

SYSTEM DESCRIPTION

The radiometer system is essentially a very low noise passive receiver with ultra-high sensi vity that receives very low level of atmospheric radia on at two-milli meter wave frequency bands i.e., the K-band spanning 20 - 30 GHz and the V-band across 50 - 60 GHz. Atmospheric radia on at the Kband is due to the water vapor absorp on, while the V-band radia on is due to theoxygen absorp on intended to derive atmospheric temperature and humidity profiles 10 km or higher.

System Specification

System Parameters	Specifications
Humidity	K Band (22-30 GHz) Frequency Agilent 8 Calibrated channels
Temperature	V Band (50-60 GHz) Frequency Agilent 14 Calibrated Channels
Brightness Temperature Range	0-400 K
Temperature Profile Range	-90 to +50°C
Height Coverage	Up-to 10 km
Range Resolution 100m to 2 km Above 2 km	 100 m 200---400 m
Humidity Profile Range	0-100 %
Retrieval Algorithm	Machine Learning /Neural Network Based
Derived Products	Dew point Temp SkewT – log P Diagram
Scanning	Azimuth and Elevation



Water Vapor and Oxygen absorption Spectra

RADIOMETER SOFTWARE FEATURES

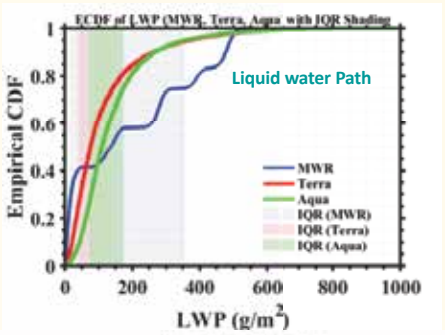
This software provides real time data acquisition and control for different radiometer sub-systems like elevation & azimuth positioning , LO synthesizer, blower operations etc.

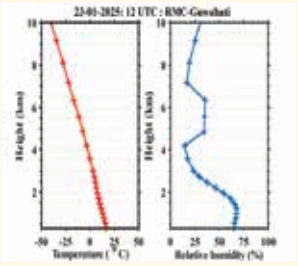
It generates Brightness Temperature (TB) data as per the operational parameters entered by the user. Based on TB values real time temperature and humidity profiles are derived using machine learning.

Applications:

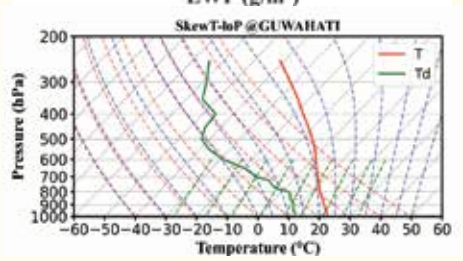
- Meteorology
- Aviation
- Defense
- Atmospheric Research

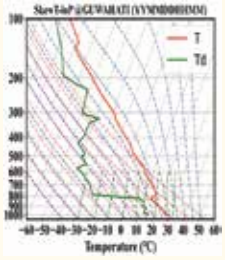
Data Product



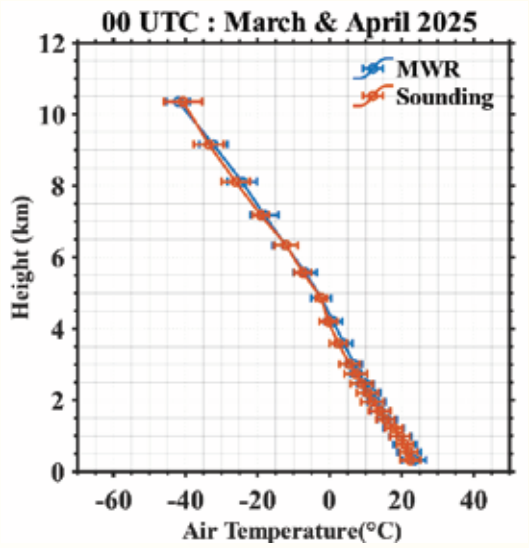


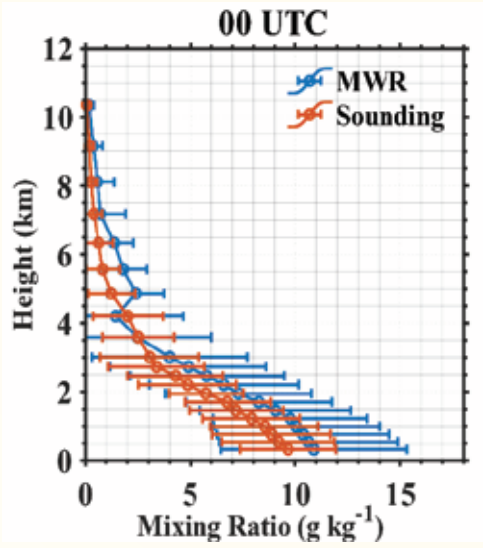
T & RH Profiles



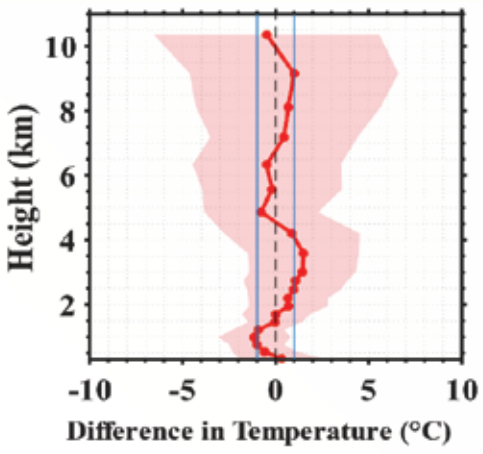


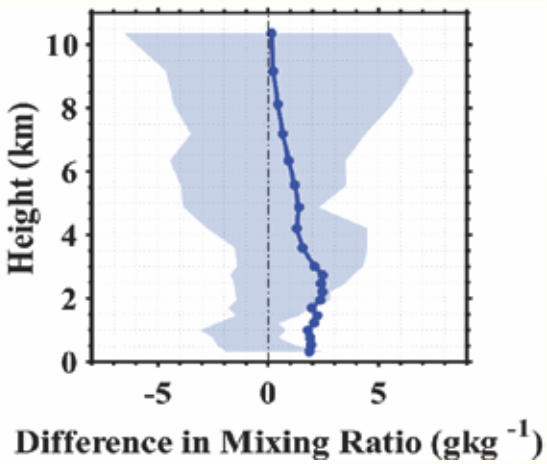
Skew T-LogP diagram





Radiometer data Validation





SODAR INSTALLATIONS

Sodar Sites

MST Radar Installation @ Gadanki 1989

SODAR Installation @SAMEER 2022

Radiometer Installation @ Guwahati 2025

Cloud Radar Installation @ SAMEER Kharghar 2018

Ionosonde Installation @ Prayagraj 2024

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