Status of Indian Radiosonde and future plans for improving the quality of upper air radiosonde data.

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INDIA METEOROLOGICAL DEPARTMENT

Workshop

on

"Reference Upper-Air Observations for the GCOS: Potential Technologies and Networks"

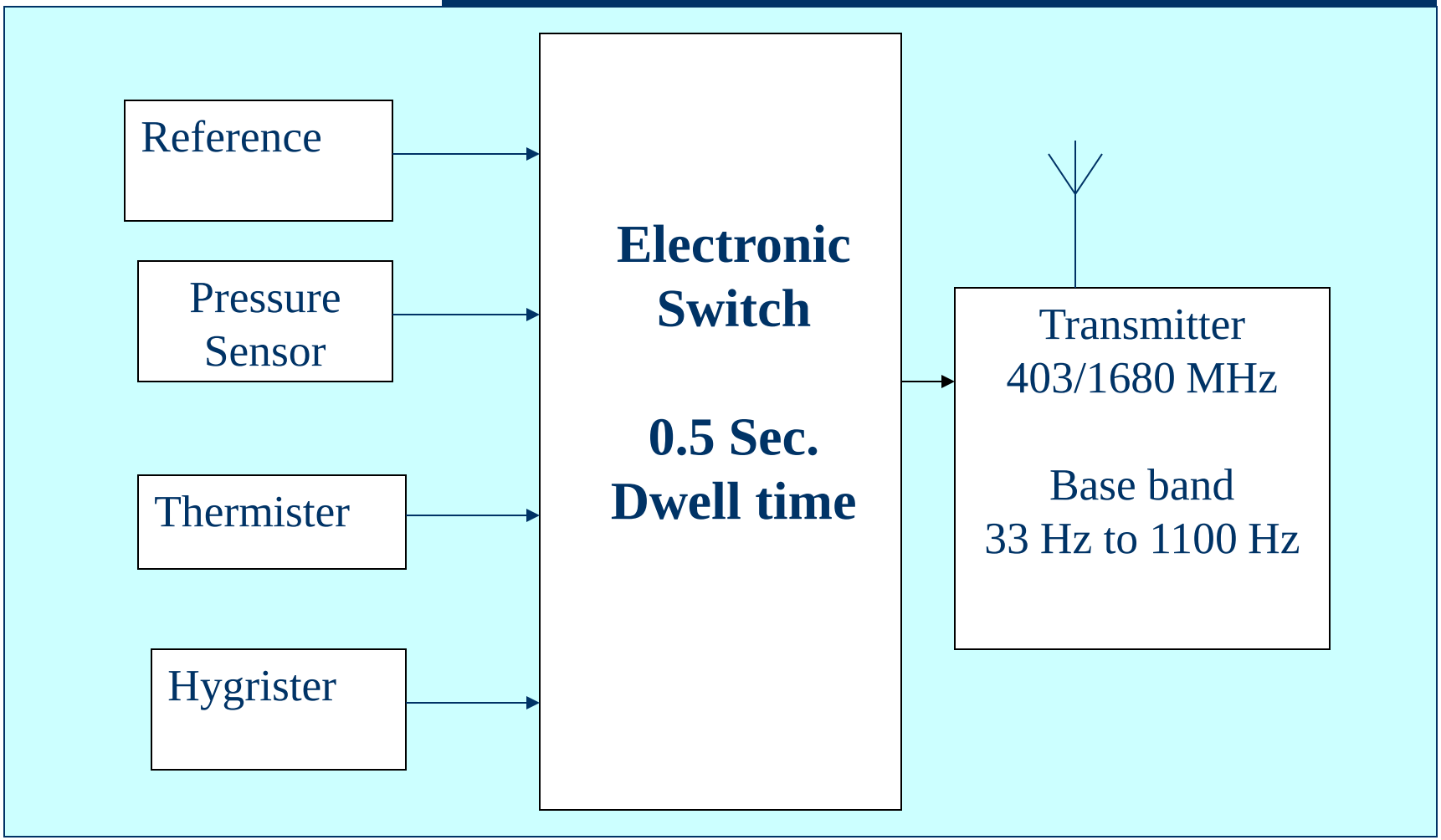
Seattle, USA.

22-24 May, 2006

Background

- Long history of RS/RW observations in India.
- IMD Manufactures its own radiosondes, sensors and hydrogen gas for IMD MK-III, MK-IV radiosonde ascents.
- Initially computation was being done manually, then upgraded to semi-automatic using PC in 1989-90.
- Introduction of MK-IV radiosonde developed indigenously.
- Converted to fully automatic system starting from June 2003 deployed at 33 locations by March 2005.

MK-IV Radiosonde



Features of IMD MK-IV Radiosonde

Higher resolution of data.

One data set available every 2 seconds.

Fully automatic data acquisition possible with electronic switching between sensors.

Real time processing of data possible due to automatic ingest.

Better quality checks.

Features of Auto computation software for IMD MK-IV

Menu Driven with graphical user interface.

Real time data display during balloon ascents.

Generation of various messages and graphs as per WMO format.

Strict quality checks incorporated in software.

Comparison with previous data sets easier due to facilities in the software.

High resolution data available to user.

Modernisation

- Radiosonde of IMD using sensors of 1970-80
- Pressure sensor is Mechanical bellows type. Hence has limited accuracy and reliability.
- Requirement of weather community more stringent.
- Need felt for change of sensors to those with latest technology.
- Multi pronged efforts to improvise.
- Stress on indigenous approach for self reliance.

Impact due to introduction of IMD MK-IV

Assessment done using ECMWF analysis available on website.

Standard deviation of height(Observed-First Guess) at 100 hpa used for analysis.

Analysis indicates that error is decreasing after the induction of MK-IV in the observational network.

Majority of the stations have shown downwards trend in errors.

Few stations have not shown improvement. Reason is being investigated.

Impact due to introduction of IMD MK-IV

12 UTC

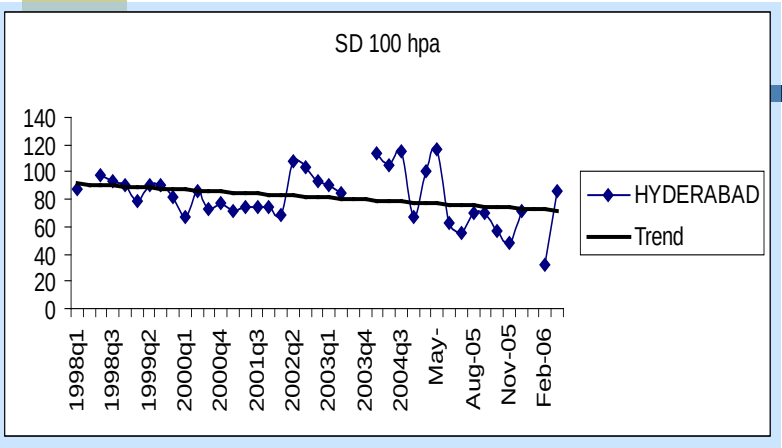
Station	SD before MK-IV	SD After MK-IV
Jodhpur	108	86 (Oct. 03 to March 06)
Lucknow	103	94 (Oct. 03 to March 06)
Nagpur	90	82 (Dec. 03 to March 06)
New Delhi	70	94 (June 03 to March 06)
Kolkata	88	84 (Feb. 04 to March 06)
Mumbai	93	87 (Oct. 03 to March 06)
Chennai	91	86 (Jan. 04 to March 06)

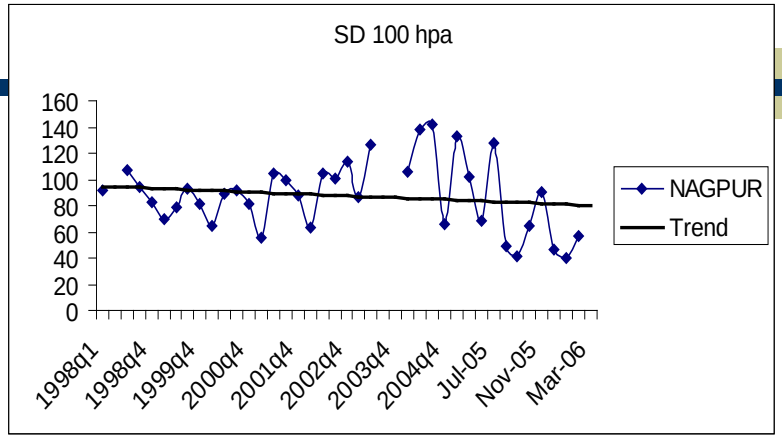
Impact due to introduction of IMD MK-IV

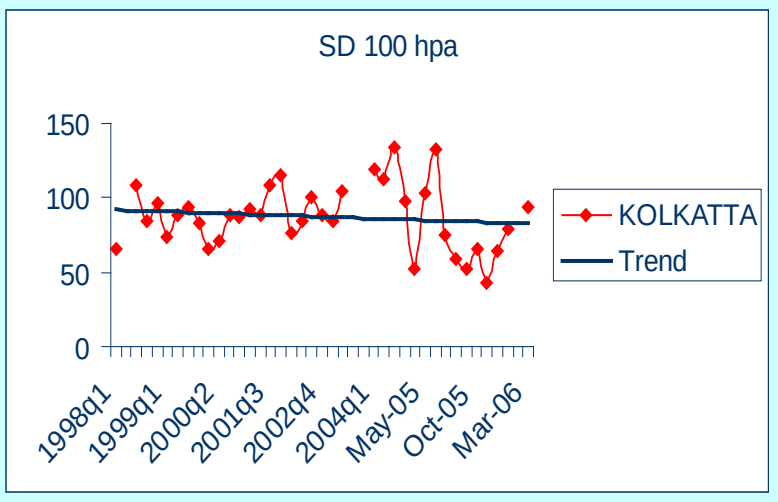
00 UTC

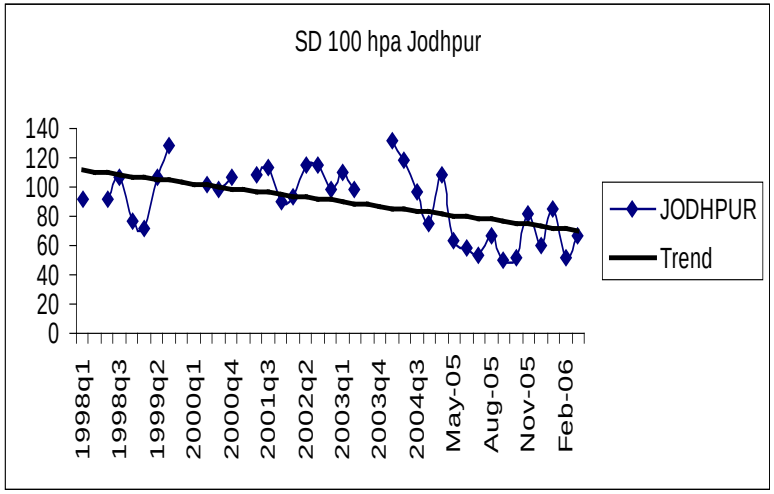
Station	SD before MK-IV	SD After MK-IV
Agartala	90	70 (Feb. 05 to March 06)
Bhopal	88	83 (March 04 to March 06)
Hyderabad	84	77 (Sept.03 to March 06)
Chennai	86	80 (Jan. 04 to March 06)
Karaikal	77	74 (Jan. 04 to March 06)
Lucknow	98	94 (Oct. 03 to March 06)
Mumbai	96	91 (Oct. 03 to March 06)

SD 100 hpa (00 UTC ascents)









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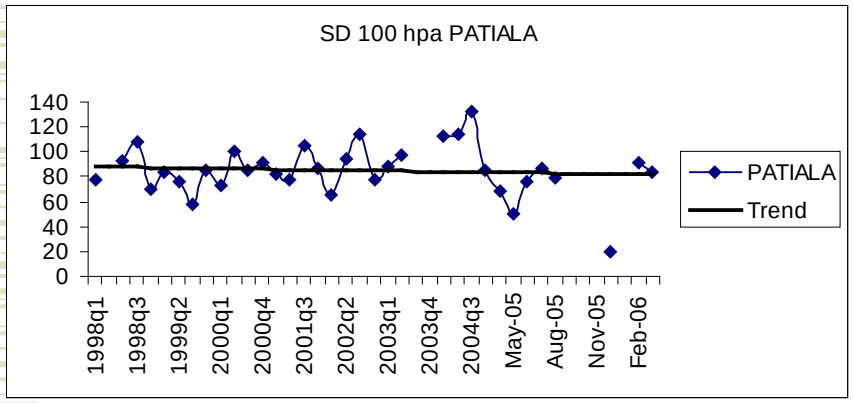
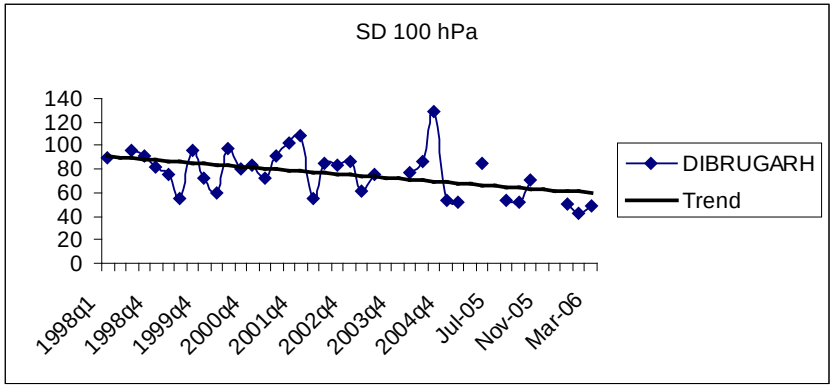
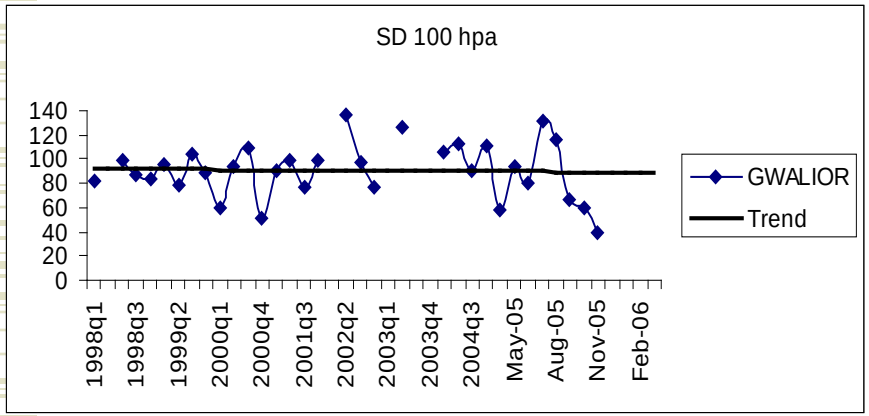
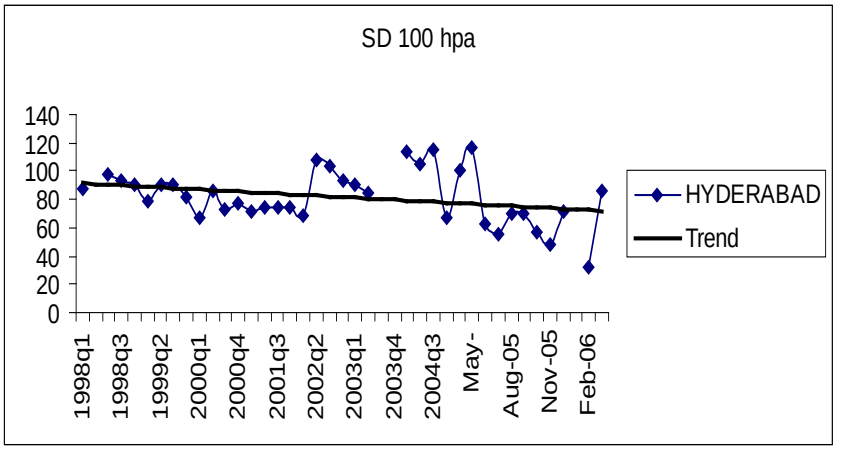
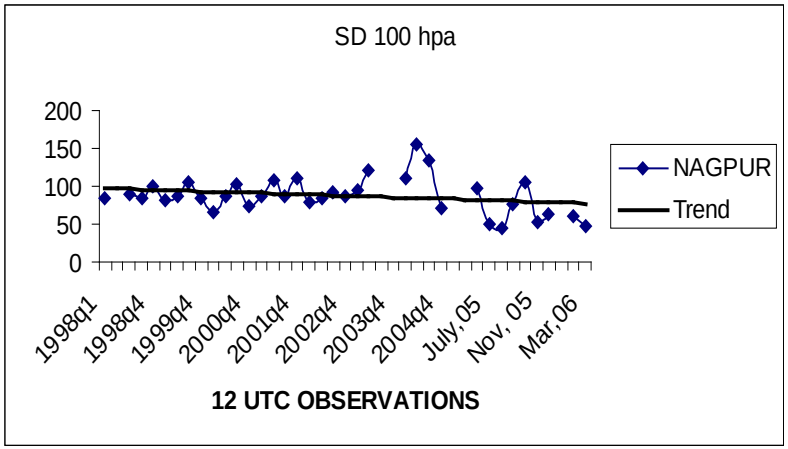


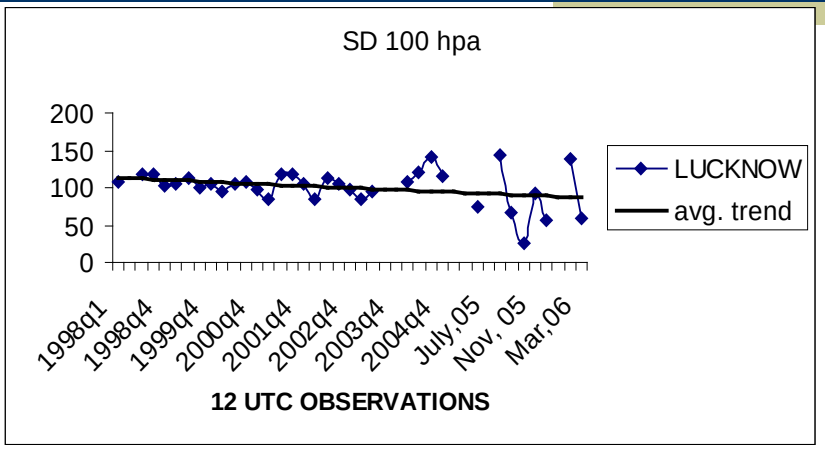


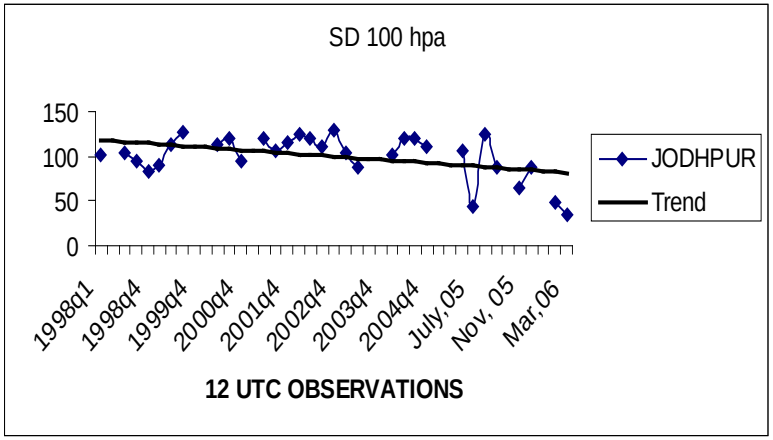


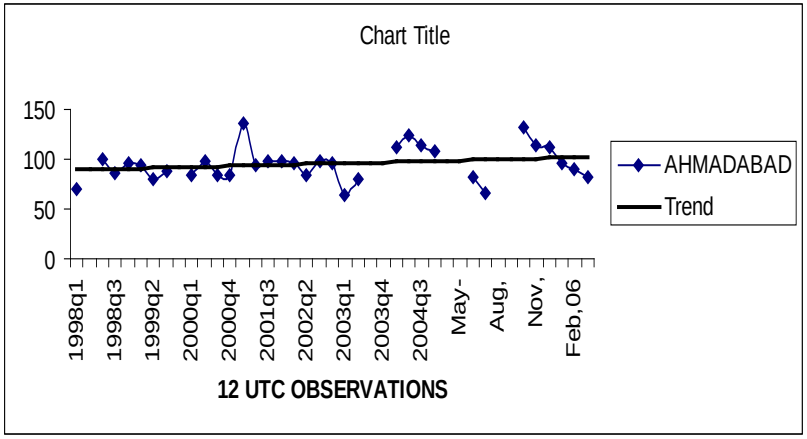


SD at 100 hpa (12 UTC ascents)









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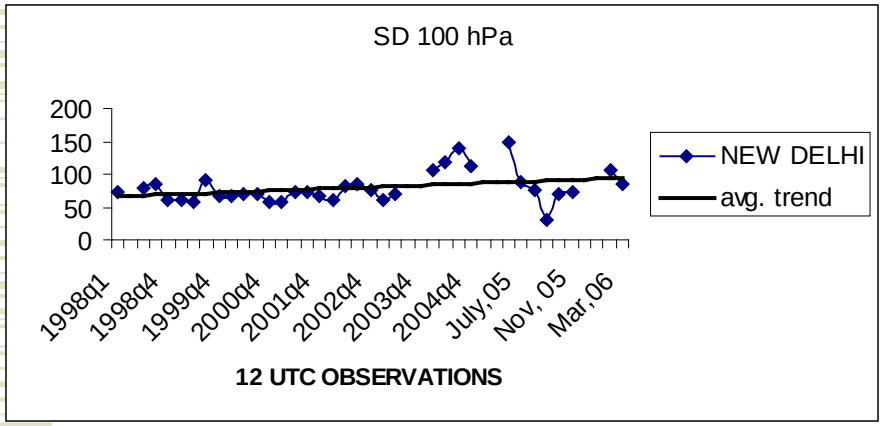
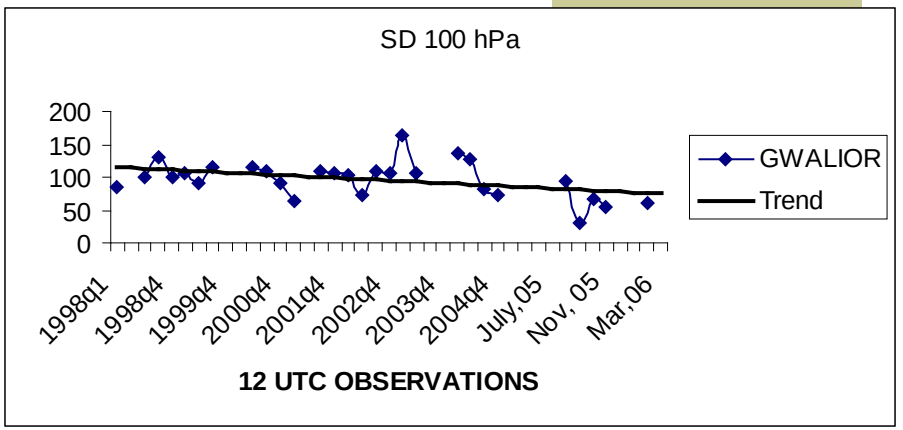
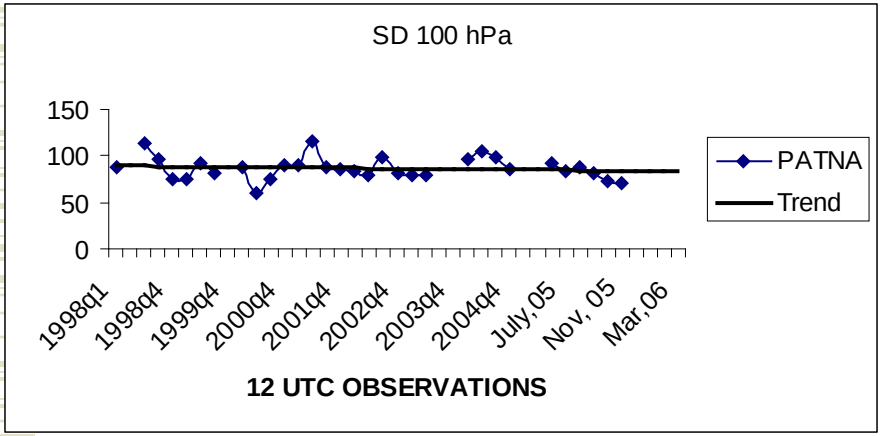
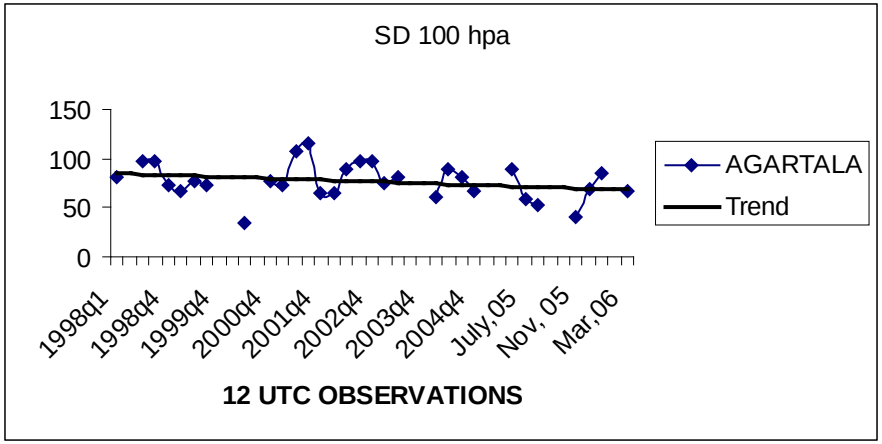








Quality assessment after implementation of MK-IV

- Data compared using monthly monitoring reports (MMR) generated by ECMWF.
- Shows gradual reduction of errors in majority of stations.
- Indicative of improvement due to implementation of fully automatic system in the network.
- Investigation required at locations not showing improvement.
- Stabilization of performance in the network approaching with time.

Modified IMD-IV radiosonde with solid state pressure sensor.

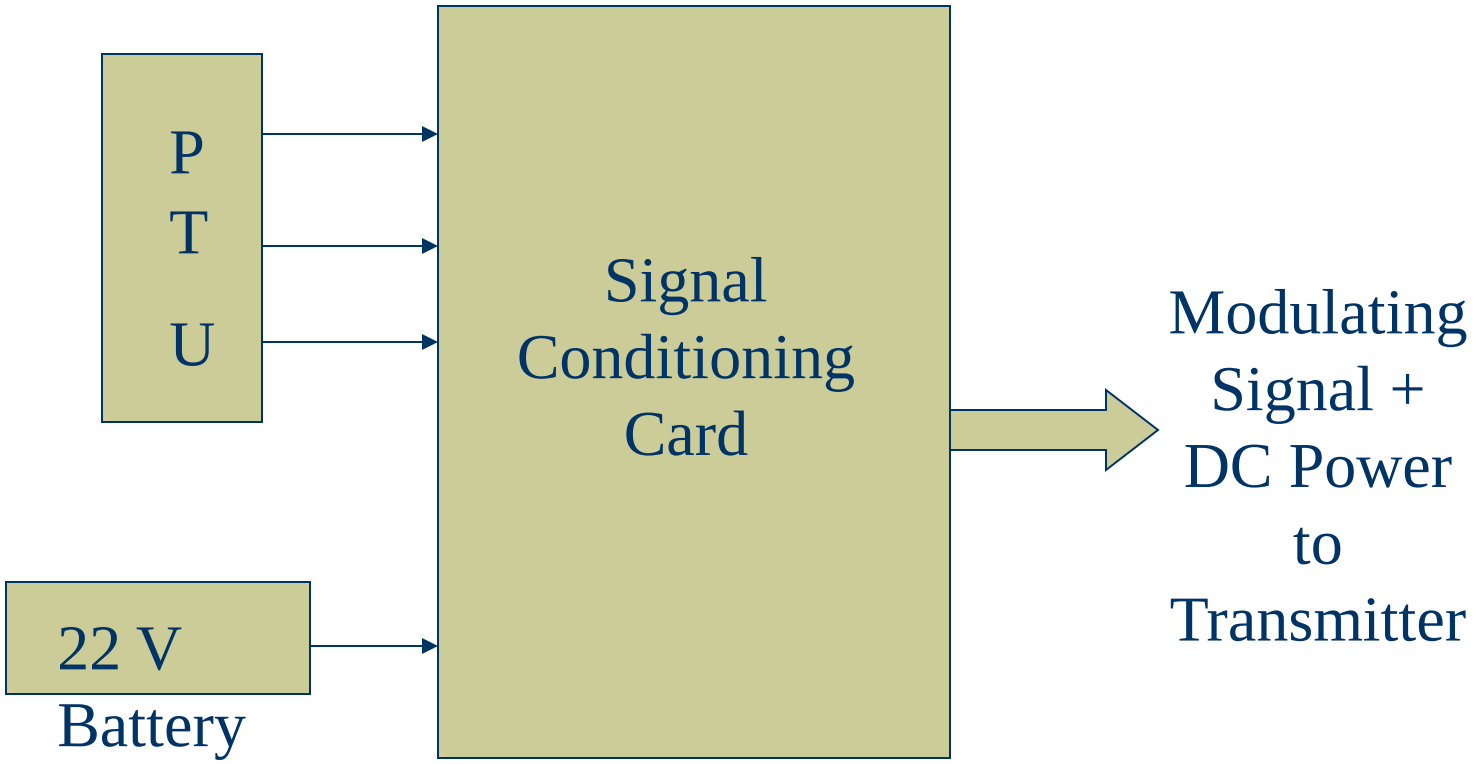
- Conventional bellows type of pressure sensor to be replaced by solid state pressure sensor.
- Increased reliability, accuracy.
- Ease of use for operator resulting in less human errors leading to quality data.
- Reduced operating costs.
- Prototype test ascents successful.
- Design finalization implementation stage reached.

Solid State Pressure Sensor

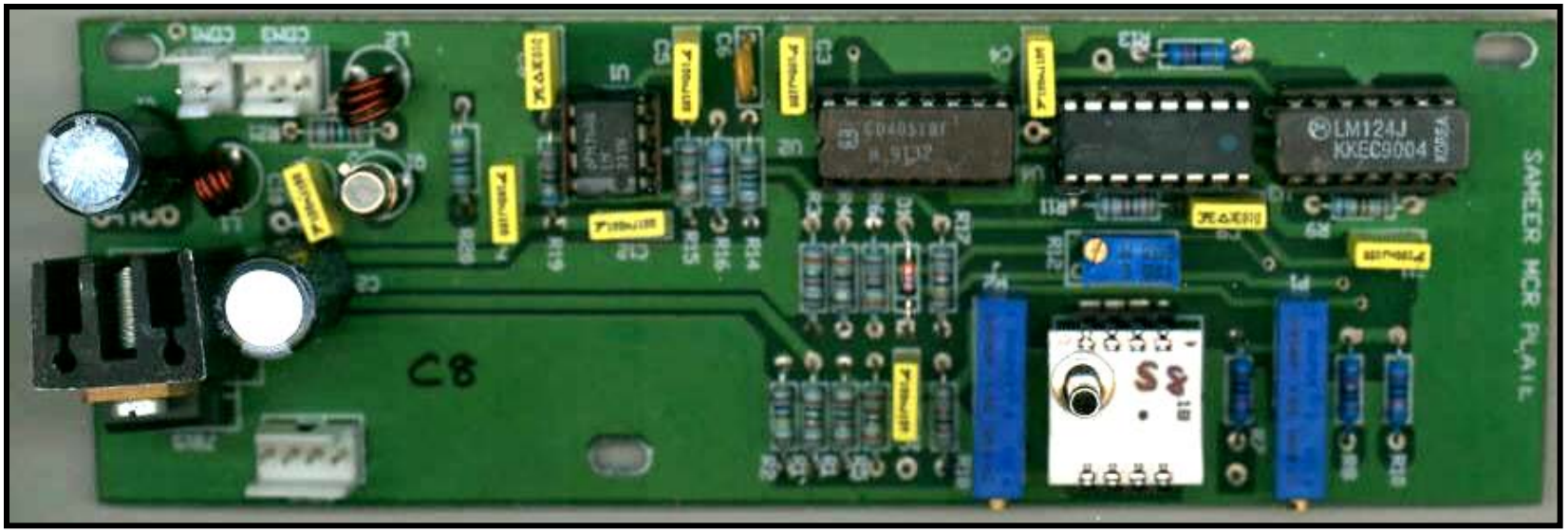
Characteristics of the Solid State Pressure Sensor

Pressure range	1020 hPa to 5 hPa
Operating Temperature	-40°C to +55°C
Weight	3.3 grams
Supply Voltage	4.75 V to 5.25 V
Current Consumption	10 mA
Linearity	-2.5 to +2.5 % FS

Modified MK – IV Radiosonde



Radiosonde module with Solid state pressure sensor (Mk-IV)



Signal conditioning card with solid state pressure sensor

It is basically an analog sonde.

This will be the radiosonde before implementing digital radiosonde.

All commercial components used to keep production cost economical.

No change in ground system except modification of the processing software.

Standard level data of the flights taken at Ayanagar with Modified MK – IV radiosonde

Pressure (hPa)	Height (gpm) on 22nd March, 06	Height (gpm) on 23rd March, 06
1000	72	72
925	850	925
850	1573	1658
700	3191	3277
500	5842	5885
400	7500	7557

Standard level data of the flights taken at Ayanagar with Modified MK – IV radiosonde

Pressure (hPa)	Height (gpm) on 22nd March, 06	Height (gpm) on 23rd March, 06
300	9536	9606
250	10775	10844
200	12244	12304
150	14053	14084
100	16474	16469
70	18540	18572

Results of Test ascents taken at Delhi with modified MK –IV radiosonde

Date	Ht.of 100 hPa (In gpm)	Temp. Deg C
21st March, 2006	16664 m	-67.9°C
22nd March, 2006	16474 m	-77.1°C
23rd March, 2006	16469 m	-77.8 °C
24th March, 2006	16336 m	-71.0 °C

Results of Test ascents taken with modified MK -IV

Inferences:

Design viable, worked successfully till balloon burst.

Accuracy near to goal but requires calibration equipment up-gradation at IMD

More ascents planned in July with final version of module.

Implementation in last quarter of 2006 at select stations.

Ascents taken with Sippican MK-II radiosonde

- About forty ascents have been taken at Delhi with sippican MK- II radiosonde and IMD's existing universal radiotheodolite.
- Ascents taken from 15th December 05 to 5th January 06.
- Results compared with data obtained from IMD MK – IV radiosonde.
- Data obtained from MK- IV is comparable with data obtained using Sippican MK- II radiosonde.

Comparison of 100 hPa height taken with Sippican MK – II and IMD MK - IV

Date	00 UTC MK- II (Sippican)	06 UTC MK – IV (IMD)	12 UTC MK – II (Sippican)
26 Dec., 05	16411		16380
27 Dec., 05	16377	16341	16355
28 Dec., 05	16342	16273	16327
29 Dec., 05	16287	16278	16296
30 Dec., 05	16297	16346	16308

Developmental Projects for radiosondes

- Indigenous Digital Radiosonde is being developed under and MOU with M/S Semiconductor Complex Ltd.
- MEMS based sensors for Pressure, Temperature and Humidity.
- ASIC being developed for signal conditioning in digital radiosonde.
- Prototype sensors have been tested. Results are encouraging. Further improvements in progress.
- Monolithic Microwave Integrated Circuit based transmitter at 1680 MHz also being developed indigenously.

Target Specifications of the proposed IMD Digital Radiosonde

Pressure Sensor :

Range	1100 mbar to 3 mbar
Resolution	0.2 mbar
Accuracy	0.2 mbar
Linearity	0.4 % of FSO
Hysteresis	0.3 % of FSO

Target Specifications of the proposed IMD Digital Radiosonde

Temperature Sensor :

Range	- 90°C to + 55 °C
Resolution	0.1 °C
Accuracy	0.2 °C
Response Time	< 1 Sec.

Target Specifications of the proposed IMD Digital Radiosonde

Relative Humidity Sensor :

Range	5 % RH to 100 % RH
Resolution	1% RH
Accuracy	3% RH
Response Time	3 Sec. To 10 sec.

Target Specifications of the proposed IMD Digital Radiosonde

Readout ASIC :

* 8 Input Ports
* 14 bit serial output data

THANKS