



Agency for Meteorology, Climatology, and Geophysics of  
the Republic of Indonesia



# AUTOMATION OF OBSERVING NETWORK IN BMKG

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Damianus Tri Heryanto, Untung Merdijanto

ICAWS-2017

International Conference on Automatic Weather Stations  
24 – 26 October 2017, Offenbach am Main, Germany

- Introduction
- Automation Roadmap
- Implementation
- Data flow
- Parallel Observation
- Challenges
- Conclusion

- BMKG surface observing network:
  - 120 meteorological stations,
  - 21 climatological stations/posts,
  - 3 Global Atmosphere Watch (GAW),
  - 285 Automatic Weather Station (AWS),
  - 44 Automated Weather Observing System (AWOS),
  - 402 Automatic Rain Gauges (ARG),
  - 44 Radiosonde stations,
  - 40 weather radar, and
  - 3 Wind Profiler Radar (WPR)



- EEC : 20
- Gematronik : 14
- Baron : 5
- Vaisala : 1

- Total : 285 locations



# Automatic Rain Gauge (ARG) Network

- Total : 402 locations





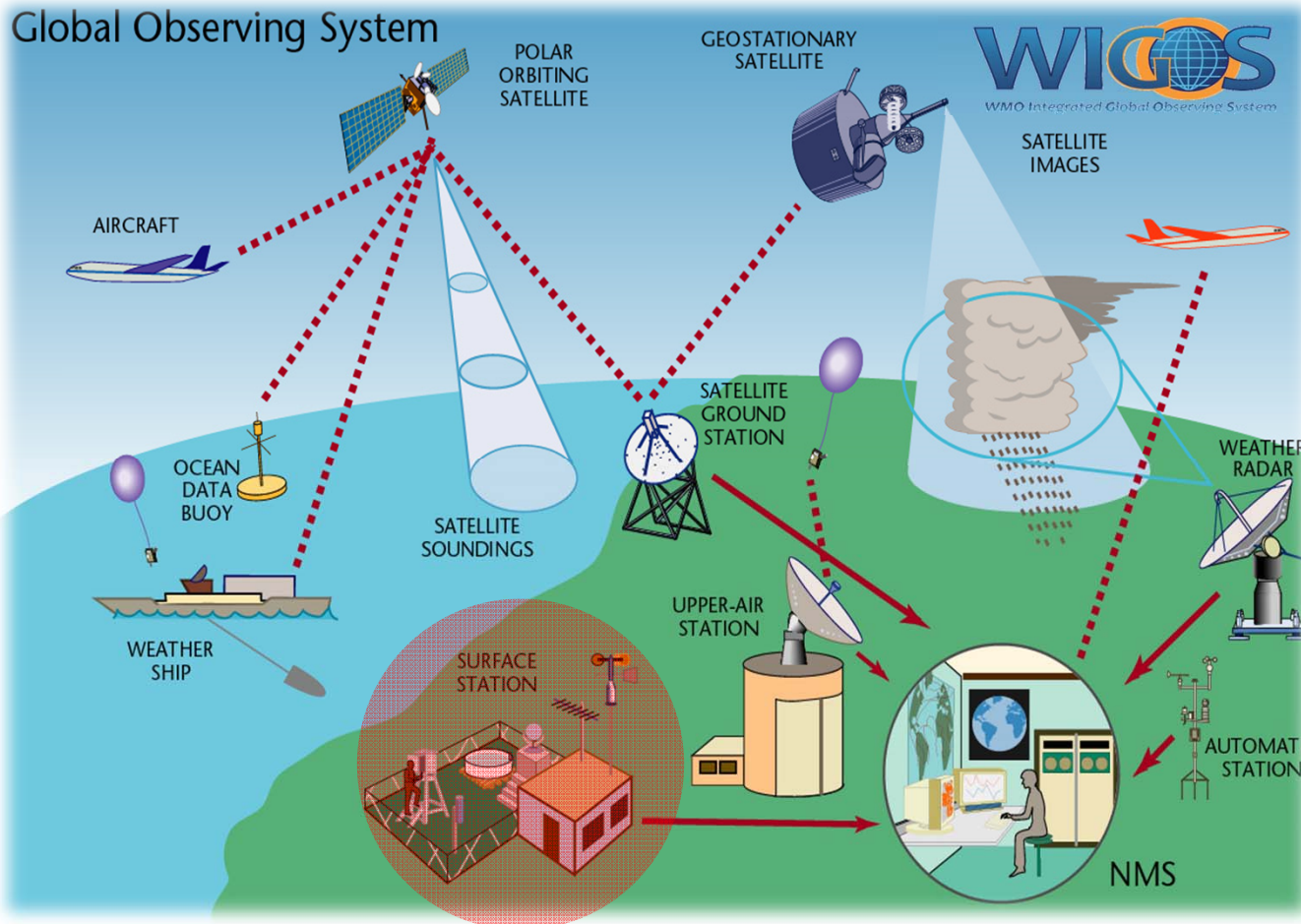


- Meteorological Station : 120
- Climatological Station : 21
- Geophysical Station : 31

# Why Automation?

- The needs for the observing network automation:
  - Minamata Convention on Mercury 2013
  - ICAO Technical Instruction for the Safe Transport of Dangerous Goods by Air
  - WIGOS Pre-Operational Phase 2016 – 2019.
  - BMKG roadmap on the automation of observing network 2014 – 2019





1. AUTOMATION
2. METADATA (OSCAR)
3. COMM. NETWORK
4. HPC DAN STORAGE (STR II)
5. SOP
6. CAPACITY BUILDING

# Automation Roadmap

FUNDING	STATION	YEAR					GRAND TOTAL
		2015	2016	2017	2018	2019	
APBN*	BASIC	5	25	5			35
	NON-BASIC				7	45	52
	CLIMATOLOGY			21			21
STR-1**	BASIC	25					25
	NON-BASIC	8					8
<b>Total</b>		<b>38</b>	<b>25</b>	<b>26</b>	<b>7</b>	<b>45</b>	<b>141</b>

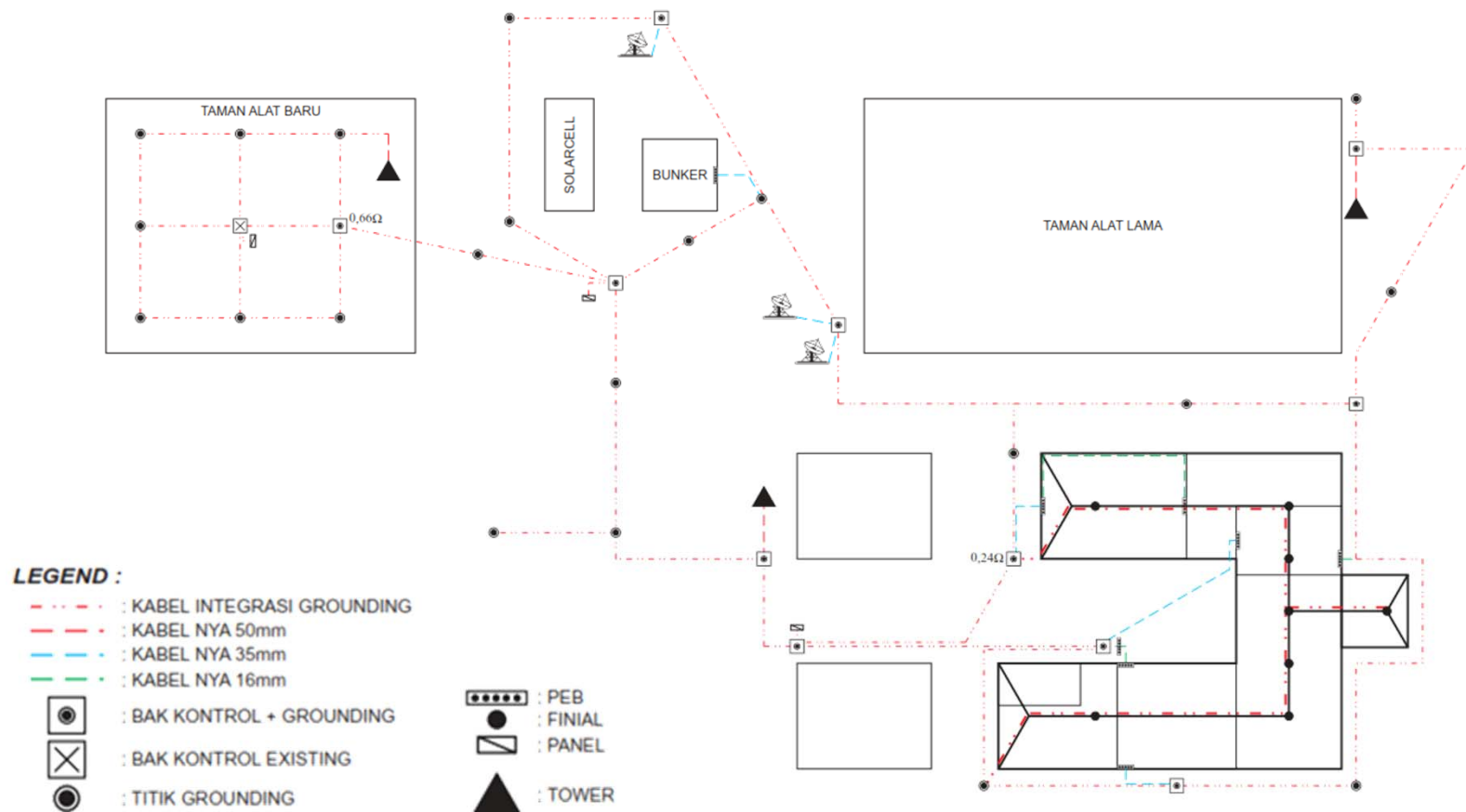
\* State Budget

\*\* Strengthening project in collaboration with Meteo France International (MFI)

# Implementation

- Provision of integrated grounding system and surge protector.
- Rearrangement of met garden, e.g: ground levelling; cable ducting set up, sensors siting and exposure;
- Equipment replacement from manual/conventional to electronic/digital.
- Provision of supporting facilities such as UPS, solar panels, and generator sets
- Reconfiguring communication network.
- Adjustment of data format and metadata.
- Designing client interface and monitoring application.
- Parallel observation.

Maumere Station, East Nusa Tenggara, Indonesia





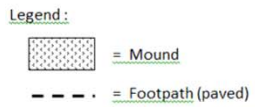
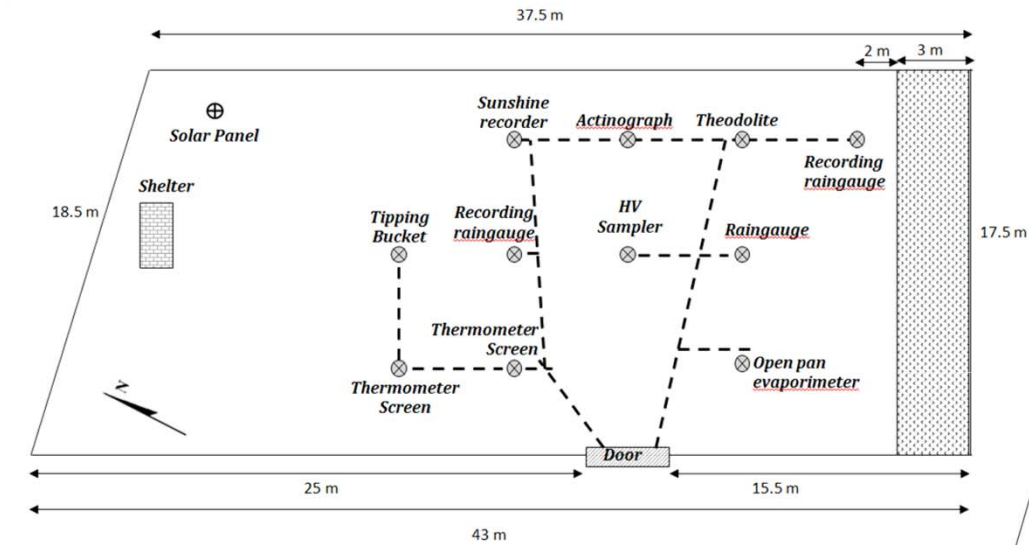
# Met Garden Rearrangement (1)

13

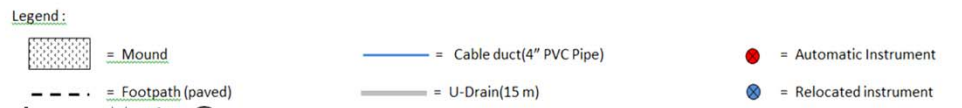
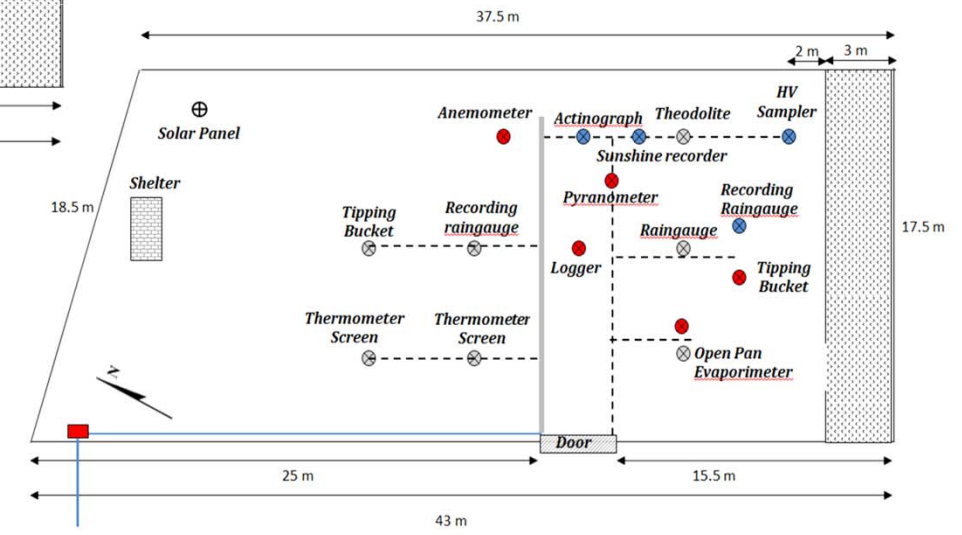


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← Before



After →





- Kualanamu Station, North Sumatera, Indonesia



**Before (2015)**



**After (2016)**

# Datalogger

- Supply voltage 10 – 24 V with power consumption 0.5 - 0.7 W
- The Datalogger equipped with an LCD display, 13 input, 6 output, and configurable virtual channel with an easily adjustable measuring interval for single values per channel.
- The Compact Flash Card ( CF Card) data memory provide a data storage buffer for 1 year.
- The Datalogger also provides mobile and wireless data transfer via CF card, with cable via interface RS232 or optional via GSM modem, telephone modem, radio modem, or RS485.

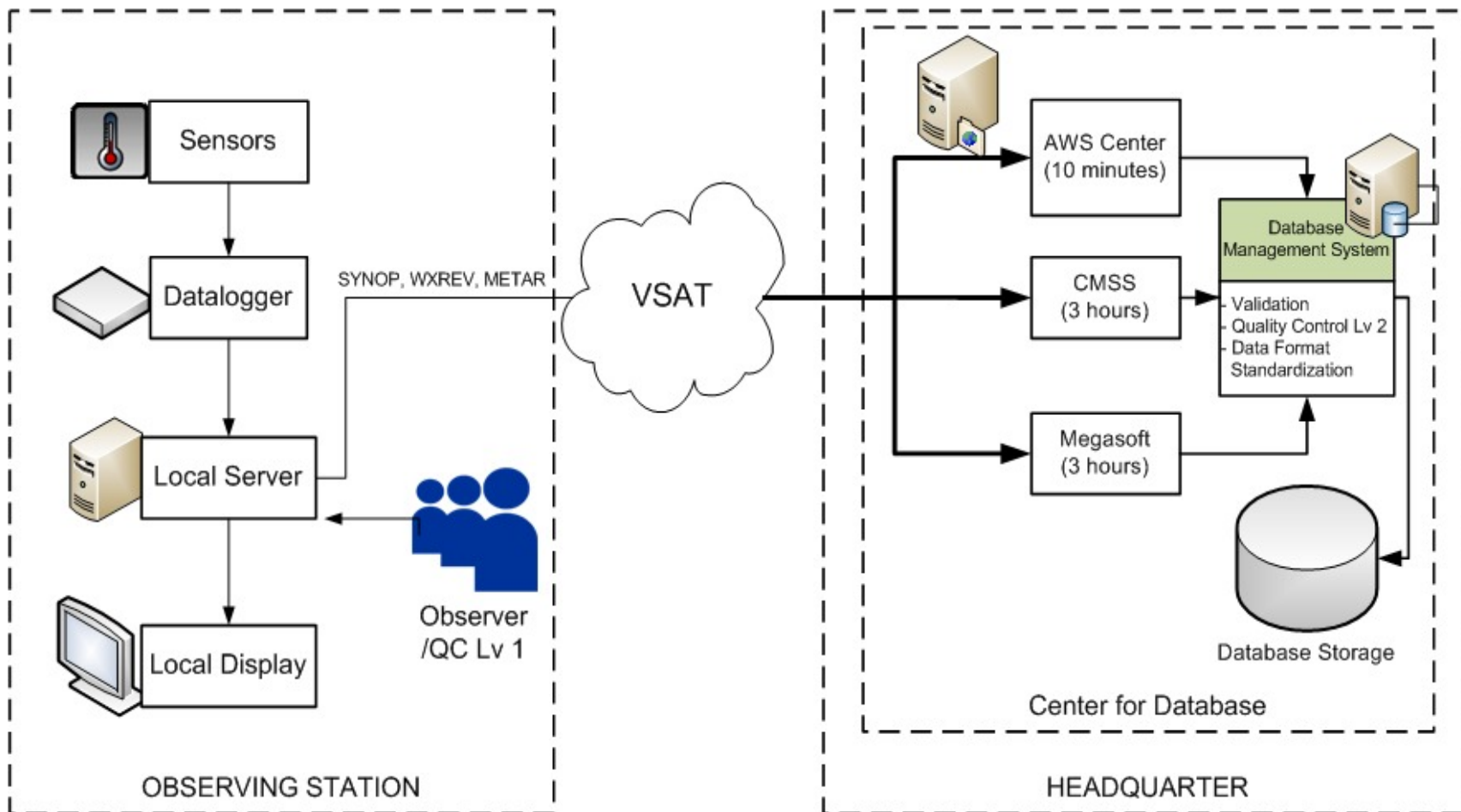
# Sensors Specification

17

No	Parameter	Sensor	Accuracy	Range	Resolution
1	Wind Speed	Ultrasonic	$\pm 0.2$ m/s	0 – 75 m/s	0.1 m/s
2	Wind Direction	Ultrasonic	$< 2^\circ$	0 - 359.9 $^\circ$	0.1 $^\circ$
3	Temperature	Pt100 RTD Class F0		-40 s/d +85 $^\circ\text{C}$	$\pm 0.1$ $^\circ\text{C}$
4	Relative Humidity	Capacitive thin film	$\pm 1,5\%$ RH for 0 - 90%RH	0 – 100%	
5	Atmospheric Pressure	Silicone Capacitive	+ 0.15 hPa	500 - 1100 hpa	0.1 hPa
6	Rainfall	Tipping bucket	2%		0.2 mm
7	Solar Radiation	Silicon photodiode	100m V/W/m2	0 - 2.000W/m2	0.4 – 1.1 $\mu\text{m}$
8	Evaporation	Open pan			
	a. Water level	Pressure difference	0.4 mm	0 - 200 mm	
	b. Water temperature	Thermistor	$\pm 0.03^\circ\text{C}$	-50 - +70 $^\circ\text{C}$	
	c. Wind speed	Cup	+ 0.5 m/s	0.4 - 55 m/s	$\leq 0.1$ m/s

# Data flow


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**BADAN METEOROLOGI KLIMATOLOGI DAN GEOFISIKA**  
STASIUN METEOROLOGI BUDIARTO CURUG

Jumat, 08 September 2017  
15:45:19 WIB

08:45:19 UTC

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Nomor Stasiun : **96739**  
ID WMO : **WIRR**

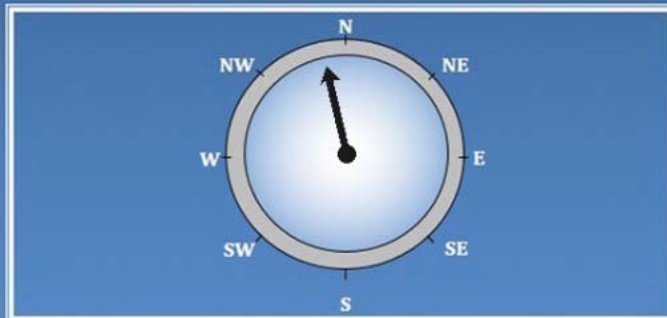
## REAL TIME DATA

Lintang : **-6.287800 °**  
Bujur : **106.564000 °**  
Ketinggian DPL : **46.0 meter**

Suhu Udara (T)	: <b>32.0</b>	°C
Suhu Titik Embun (Td)	: <b>21.6</b>	°C
Kelembaban (RH)	: <b>54</b>	%
Curah Hujan (RRR)	: <b>0.0</b>	mm


  

Tekanan Udara (P)	
Stasiun	Landasan
QFE : <b>1002.9 mb</b>	QFE : <b>1003.1 mb</b>
QFF : <b>1008.0 mb</b>	QNH : <b>1008.6 mb</b>



Arah Angin (ddd)	: <b>347</b>	°
Kecepatan Angin (ff)	: <b>2.0</b>	Knot
Penguapan Udara	: <b>2.6</b>	mm
Radiasi Matahari	: <b>712</b>	W/m <sup>2</sup>






**BADAN METEOROLOGI, KLIMATOLOGI DAN GEOFISIKA**  
STASIUN METEOROLOGI BUDIARTO CURUG, KAMPUS STPI BANDARA BUDIARTO CURUG

Friday, 08 September 2017

08:45:57 UTC

<b>DIGITALISASI PC's</b>	<table border="1"> <tr><td>LOCALHOST</td><td>172.50.90.6</td></tr> <tr><td>DISPLAY</td><td>192.168.1.127</td></tr> <tr><td>TROPOS</td><td>/dev/ttyUSB0</td></tr> </table>	LOCALHOST	172.50.90.6	DISPLAY	192.168.1.127	TROPOS	/dev/ttyUSB0	<b>STATION INFORMATION</b>	<table border="1"> <tr><td>WMO NUMBER</td><td>96739</td></tr> <tr><td>ICAO CODE</td><td>WIRR</td></tr> <tr><td>AWS CENTER</td><td>STA5062</td></tr> <tr><td>LATITUDE</td><td>-6.287800</td></tr> <tr><td>LONGITUDE</td><td>106.564000</td></tr> <tr><td>ALTITUDE</td><td>46.0</td></tr> <tr><td>TIMEZONE</td><td>WIB</td></tr> <tr><td>QFE HEIGHT</td><td>2.00</td></tr> <tr><td>QNH HEIGHT</td><td>46.00</td></tr> </table>	WMO NUMBER	96739	ICAO CODE	WIRR	AWS CENTER	STA5062	LATITUDE	-6.287800	LONGITUDE	106.564000	ALTITUDE	46.0	TIMEZONE	WIB	QFE HEIGHT	2.00	QNH HEIGHT	46.00	<b>WIND VIEW</b>		<b>PRESSURE GROUP</b>	<table border="1"> <thead> <tr> <th colspan="2">MET GARDEN</th> <th colspan="2">RUNWAY</th> </tr> </thead> <tbody> <tr><td>QFE</td><td>1002.9</td><td>QFE</td><td>1003.1</td></tr> <tr><td>QFF</td><td>1008.0</td><td>QNH</td><td>1008.6</td></tr> <tr><td colspan="4" style="text-align: center;">PRESSURE CHANGE</td></tr> <tr><td>06:00-09:00</td><td></td><td></td><td>-1.3</td></tr> <tr><td>00:00-24:00</td><td></td><td></td><td>3.8</td></tr> <tr><td colspan="4" style="text-align: center;">PRESSURE CHANGE IDENTIFIER</td></tr> <tr><td>06:00-09:00</td><td></td><td></td><td>7</td></tr> <tr><td>00:00-24:00</td><td></td><td></td><td>8</td></tr> <tr><td colspan="4" style="text-align: center;">PRESSURE</td></tr> <tr><td></td><td>MIN</td><td>AVG</td><td>MAX</td></tr> <tr><td>08:30-08:40</td><td>1002.5</td><td>1002.6</td><td>1002.6</td></tr> <tr><td>00:00-24:00</td><td>1002.5</td><td></td><td>1007.1</td></tr> <tr><td colspan="4" style="text-align: center;">BAROMETER IDENTIFIER (aP)</td></tr> <tr><td></td><td></td><td></td><td>2</td></tr> </tbody> </table>	MET GARDEN		RUNWAY		QFE	1002.9	QFE	1003.1	QFF	1008.0	QNH	1008.6	PRESSURE CHANGE				06:00-09:00			-1.3	00:00-24:00			3.8	PRESSURE CHANGE IDENTIFIER				06:00-09:00			7	00:00-24:00			8	PRESSURE					MIN	AVG	MAX	08:30-08:40	1002.5	1002.6	1002.6	00:00-24:00	1002.5		1007.1	BAROMETER IDENTIFIER (aP)							2	<b>TEMPERATURE GROUP</b>	<table border="1"> <tr><td colspan="4" style="text-align: center;">DEW POINT</td></tr> <tr><td></td><td></td><td></td><td>21.6</td></tr> <tr><td colspan="4" style="text-align: center;">WET BULB</td></tr> <tr><td></td><td></td><td></td><td>22.4</td></tr> <tr><td colspan="4" style="text-align: center;">TEMPERATURE</td></tr> <tr><td></td><td>MIN</td><td>AVG</td><td>MAX</td></tr> <tr><td>08:30-08:40</td><td>32.0</td><td>32.2</td><td>32.3</td></tr> <tr><td>00:00-24:00</td><td>22.9</td><td></td><td>32.7</td></tr> <tr><td>12:00-12:00</td><td>28.4</td><td></td><td>32.7</td></tr> <tr><td colspan="4" style="text-align: center;">HUMIDITY</td></tr> <tr><td></td><td>MIN</td><td>AVG</td><td>MAX</td></tr> <tr><td>08:30-08:40</td><td></td><td>54</td><td></td></tr> <tr><td>00:00-24:00</td><td>42</td><td></td><td>90</td></tr> <tr><td colspan="4" style="text-align: center;">DEW POINT</td></tr> <tr><td></td><td></td><td>AVG</td><td></td></tr> <tr><td>08:30-08:40</td><td></td><td>21.7</td><td></td></tr> <tr><td colspan="4" style="text-align: center;">THERMOMETER IDENTIFIER (aT)</td></tr> <tr><td></td><td></td><td></td><td>0</td></tr> <tr><td colspan="4" style="text-align: center;">HUMIDITY IDENTIFIER (aU)</td></tr> <tr><td></td><td></td><td></td><td>2</td></tr> </table>	DEW POINT							21.6	WET BULB							22.4	TEMPERATURE					MIN	AVG	MAX	08:30-08:40	32.0	32.2	32.3	00:00-24:00	22.9		32.7	12:00-12:00	28.4		32.7	HUMIDITY					MIN	AVG	MAX	08:30-08:40		54		00:00-24:00	42		90	DEW POINT						AVG		08:30-08:40		21.7		THERMOMETER IDENTIFIER (aT)							0	HUMIDITY IDENTIFIER (aU)							2
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# Parallel Observation

22

- WMO/TD No. 1378 : minimum 2 years parallel observation is preferable.
- Director General of BMKG's Instruction No: IKB.02/II/2014 Year 2014 : 4 years parallel observation



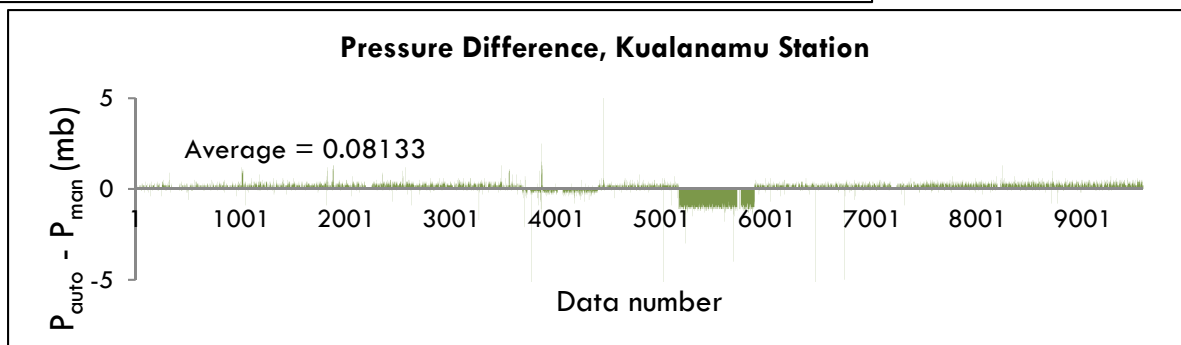
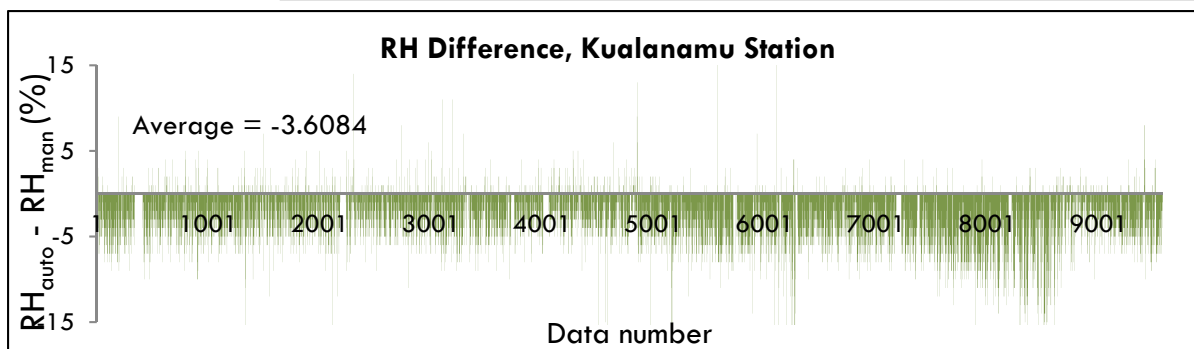
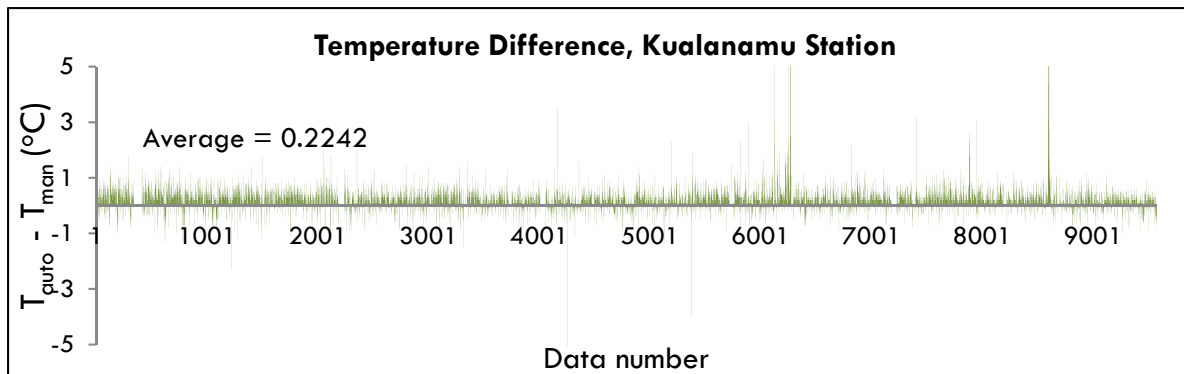
← Evaporation



Temp. & RH →

ICAWS-2017, Offenbach am Main Germany

# Parallel Measurement



- Capacity building capabilities on maintenance human resources.
- Financial limitation.
- Traceability maintenance
- Electricity
- Communication



# Conclusion

- 63 stations have been automated
- 22 stations automation are in progress till the end of 2017
- Parallel observations have being conducted on 30 locations





THANK YOU

