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THE PROCEEDING

Grha ITS, December 21-22, 2010

2nd APTECS 2010

International Seminar on Applied Technology, Science, and Arts

Telkom Indonesia

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Naharadia Prakarsa

IPTEK
The Journal for Technology and Science

LPPM - ITS

PROCEEDING

2nd INTERNATIONAL SEMINAR ON APPLIED TECHNOLOGY, SCIENCE AND ARTS - APTECS 2010

THEME

EMPOWERING CREATIVITY THROUGH SCIENCE AND TECHNOLOGY TO ENHANCE NATIONS COMPETITIVENESS

GRAHA SEPULUH NOPEMBER, 21-22 December 2010

Organized by :
Institute of Research and Public Services (LPPM)
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
2010

2nd INTERNATIONAL SEMINAR ON APPLIED TECHNOLOGY, SCIENCE, AND ARTS (APTECS 2010)

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OPENING SPEECH OF THE RECTOR OF ITS

Assalamu'alaikum Wr.Wb. Good Morning Ladies and Gentlemen, Let me, first, praise the Almighty God for the blessings and mercies that have made all we have today possible.

Distinguished guests, esteemed presenters and participants, I would like to extend the warmest welcome to all of you attending the 2nd ***Internasional Seminar on Applied Technology, Science and Arts*** **(APTECS)**. I would like to express my profound gratitude to Prof. KISHIDA Satoru for his willingness to join this seminar and to deliver his outstanding lecture on the Prospect of High-Tech Superconducting Oxides and their Surface Analysis Superconductivity, Surface Analysis, and Oxide as the Creative Industry for the Future. This speech would be very contributing to all attending this seminar.

Acknowledgement must also be given to all the attending plenary sessions, the Ministry of Marine Affairs and Fisheries Republic of Indonesia, Dr. Ir. H Fadel Muhammad Al-Haddar; the Chief Executive Officer, Mr. Dahlan Iskan; and Prof. Wayan Dibya who are willing to spend some of their time that I know they are quite compact in schedule**.** Thank you for featuring very inspiring experience and insightful notions that would be very contributing to all attending this seminar to build high comprehensive and up to date prior knowledge. Allow me to express my heartfelt gratitude to many sponsors for their generous financial support.

APTECS is an annual seminar hosted by the Institut Teknologi Sepuluh Nopember (ITS) as the forum of academic sharing focusing on various issues in science, technology and arts. As one of the reputable institutions in Indonesia, it is undeniable that active contributions of ITS would be one of the important considerations to deal with the Asean China Free Trade Agreement (ACFTA) that has been launched since the 1st January 2010. At the same time ceasing International competitions would become one of the agenda that must be done by enhancing as well as empowering the national competitiveness in all aspects including engineering, economy, social, and many others. In fact, regarless of the subsequently and surely diminished natural resources, people today need to be able to find brilliant ways to determine success in economy for the future of this beloved country, Indonesia. Dear Audience, the main point of my speech is that this country would take the global challenge only if we are able to develop dynamic cultures and traditions as a nation. And, ITS, in the Golden year anniversary, would become the leading institution to enliven the competition through the development of science, technology, and not to mention cultures and arts.

Now, dear audience, the seminar is all yours. I hope everyone will find the seminar inspiring and enriching, through presentations and discussions on empowering creativity through science and technology to enhance nation competitiveness. Finally, I wish to see you again in the coming 3rd APTECS seminar, December 2011. I wish great happiness, good health, and much success to each of you. Thank you.

Surabaya, 21 Desember 2010
Rector of ITS

Prof. Priyo Suprobo

OPENING SPEECH OF THE CHIEF OF INSTITUTE OF RESEARCH AND PUBLIC SERVICES

First of all, let us praise God whose blessings have enabled us to band together here in the 2nd International APTECS seminar that, this year, is hosted particularly to commemorate the golden year anniversary of the Institut Teknologi Sepuluh Nopember. It is a pleasure for LPPM to welcome you all the professional researchers either from abroad or all over Indonesia. This is the forum where we can meet colleagues from various specialty areas to develop knowledge, technology, and arts that would, of course, contribute to the lives of the mankind

In the attempt to foster the development of science and technology, basic and applied researches, and industrial researches as well are all the major activities need to be conducted to enhance industrial productivity and competitiveness and to advance our nations unchallenged supremacy; therefore, unless there were any publications and disseminations of research findings and discoveries, researches with high sophisticated findings and contributions would have completely no meaning.

In this global era, without ability to cope with advanced technology and to develop the creativity and innovation, industries would not be able to take part into rigorous competitions. For this reason, then APTECS raises the topic of "***Empowering Creativity through Science and Technology to Enhance Nations Competitiveness".***

APTECS is forwarded to be one of the forums for researchers to disseminate and further discuss the results of researches; furthermore, this forum is promoted to enrich creative and innovative ideas that would be worth considering for further researches. Intensive communication as well as discussions in APTECS would continue the process of advancing science, technology, and arts as well. Moreover, further attempt of this form is to promote the implementation of the research finding to give positive contributions for our beloved country.

All researches and their findings are aimed to keep up and further develop our noble cultural values, arts, and human civilization so that, as a member of world societies, our nation would be much dignified among other nations on earth. By hosting this seminar LPPM-ITS is not only to gain the advancement of the science and technology throughout all the findings offered in this forum but at the same time, to encourage and to enhance the arts and cultural values of this country that would fruitfully signify our existence as a nation.

This academic forum meets annually at the end of the year, and next year we would welcome you to see us again in the 3rd APTECS International Seminar that would offer more laborious topics.

On behalf of LPPM-ITSI would like to express my deepest gratitude to all presenters and participants, and I wish a productive and inspiring seminar.

Surabaya, 21 Desember 2010

Prof. Ir. I Nyoman Sutantra MSc.PhD
The Chief of LPPM-ITS

OPENING SPEECH OF THE COMMITTEE CHAIRMAN

Rector of ITS,
Dr. Ir. H. Fadel Muhammad, Minister of the Ministry of Marine Affairs and Fisheries Ministry
Prof. KISHIDA Satoru from Tottory University Japan
Prof. Wayan Dibya fron Indonesian Arts Institute, Denpasar Bali
Mr. Dahlan Iskan, the Chief Executive Officer of PLN
Distinguished Presenters, all participants, and Colleagues

Assalamualaikum, Wr. Wb.

I am both honored and delighted to welcome you here in this remarkable conference hosted by Institut Teknologi Sepuluh Nopember (ITS) Surabaya in corporation with the Research Institute and Public Services (LPPM) ITS. The conference today takes the topic of "Empowering Creativity through Science and Technology to Enhance Nations Competitiveness".

On behalf of the committee, I would like to thank Prof. Priyo Suprobo, the Rector of ITS, whose full support has enabled all of this possible; Prof. I Nyoman Sutantra, M.Sc, PhD., the head of LPPM who has kept encouraging us in accomplishing all good preparation to welcome you here today until tomorrow; and the support of the board of committee of the golden year anniversary, whose financially support this event. Also, all the sponsors who keep rendering and make today's conference be more easily carried out.

Ladies and Gentlemen,

The interest of the international scientific community is clear, sharing enormous inspiring notions, research findings and innovations. This Conference has attracted 150 domestic and overseas presenters, it means that within two days we will hear 150 oral presentations. The subjects range from descriptions of recent technology, science both natural and social, and arts. So, it is marvelous, isn't it? Only in two days 150 brilliant ideas would have been disseminated and enriched our inventory of knowledge; furthermore, these 150 fresh and prolific ideas will enable this beloved country ready to face the challenge of ACFTA.

Ladies and Gentlemen,

In the middle of us, here we have four notable speakers who would overcome our desire for inputing the latest knowledge delivered in their presentations in the plenary sessions. Therefore, I would like to express my sincere gratitute and warm welcome to Prof. KISHIDA Satoru who comes far away from Tuttori University, Japan; I also feel grateful for the coming of important figures: our Minister, Dr. Ir. H Fadel Muhammad Al-Haddar; Prof. Wayan Dibya from Denpasar-Bali, and Mr. Dahlan Iskan who has been so popular among us, people of Surabaya.

Ladies and gentlemen,
Today's conference is born due to a hard work of all committee and staffs who have spent their time working day by day arranging every detail of the event, so allow me to congratulate their very keen and perfect job that makes me standing up here welcoming all the distinguished guests.

Last but not least, I would like to ask you all an apology for all incovenience that you might find prior, during, or after the conference; we are all just an ordinary man that won't be able to avoid making mistakes. Thank you and have extraordinarily inspiring seminar.

Wassalamu'alaikum Wr.Wb,

General Chairman of 2nd APTECS 2010
Dr. Bambang Sampurno

ACKNOWLEDGEMENTS

Special gratitude is extended to all of the followings:

RECTOR OF INSTITUT TEKNOLOGI SEPULUH NOPEMBER

INSTITUTE OF RESEARCH AND PUBLIC SERVICES – ITS

THE JOURNAL OF IPTEK ITS

MINISTRY OF MARINE AFFAIR AND FISHERIES

TOTTORI UNIVERSITY, JAPAN

PERUSAHAN LISTRIK NEGARA (PLN)

PT. TELEKOMUNIKASI INDONESIA, TBK

PT. TRUBA JAYA ENGINEERING

PT. NAHARADIA PRAKASA

HOUSE OF BEAUTY CLINIQUE

ELEKTRO BUDOYO – ITS

SMKN IX SURABAYA

for never ending supports that have made the 2nd APTECS 2010 held successfully

SCHEDULE
INTERNATIONAL SEMINAR ON APPLIED TECHNOLOGY, SCIENCE, AND ARTS
2nd APTECS 2010

Monday, 20 December 2010

Time	Activities
19.00 - 22.00	Welcome dinner for overseas participants, officially attended by the mayor, Ir. Tri Rismaharini, MT

Day I: Tuesday 21 December 2010

Time	Activities						
06.45 - 07.30	Registration						
07.30 - 07.40	Indonesian Traditional Musical Instruments- Elektro Budoyo : Ayak Talu						
07.40 - 07.50	Traditional Dancing : Jejer Gandrung Banyuwangi - SMKN 9 Surabaya						
07.50 - 08.00	Welcome to 2nd APTECS : Dr. Bambang Sampurno						
08.00 - 08.05	Ladrang APTECS : Elektro Budoyo						
08.05 - 08.15	Colossal Dancing Remo : Elektro Budoyo						
08.15 - 08.25	Speech from The Chief of Research and Public Services - ITS : Prof. I.N Sutantra						
08.25 - 08.30	Opening Term - Rector ITS : Prof. Priyo Suprobo						
11.30 - 12.30	Theme I : The prospect of High - Superconducting Oxides and Their Surface Analysis Superconductivity, Surface Analysis, and Oxide and The Creative for The Future: by Prof. KISHIDA Satoru – Tottori University, Japan Theme II : Central Roles of The Electricity to Enhance the Quality of Nation Competitiveness: by Mr. Dahlan Iskan – PLN Moderator: Prof. Imam Robandi						
	Break for Lunch and Pray						
	A	B	C	D	E	F	G
12.30 - 12.47	Eng-21	Art-1	Eng-65	Eng-87	Sci-1	Eng-51	Eng-105
12.47 - 13.04	Eng-22	Art-2	Eng-66	Eng-88	Sci-2	Eng-52	Eng-106
13.04 - 13.21	Eng-23	Art-3	Eng-67	Eng-89	Sci-3	Eng-53	Eng-107
13.21 - 13.38	Eng-24	Art-4	Eng-68	Eng-90	Sci-4	Eng-54	Eng-108
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15.30 - 15.47	Eng-30	Gen-6	Eng-74	Eng-96	Gen-9	Eng-60	Eng-114
15.47 - 16.04	Eng-31	Gen-7	Eng-75	Eng-97	Gen-4	Eng-61	Eng-115
16.04 - 16.21	Eng-32	Gen-8	Eng-76	Eng-98	Gen-5	Eng-62	Eng-116

NOTE :

A : Room Argopuro 1
B : Room Argopuro 2
C : Room Kawi
D : Room Lawu
E : Room Semeru 1
F : Room Semeru 2
G : Room Utama

Day II: Wednesday, 22 December 2010

Time	Activities						
06.45 - 08.00	Registration						
08.00 - 08.10	Indonesian Traditional Musical Instrument- Elektro Budoyo : Ojo dipleroki & Kelinciku Ucul						
08.10 - 08.20	Traditional Dancing Pendet - TPKH ITS						
08.20 - 08.30	Indonesian Traditional Musical Instrument - Elektro Budoyo : Ketawang						
08.30 - 10.30	Keynote Speaker III and IV Panel : Theme III: Resilience of National Arts and Culture to Enhance Nation Competitiveness: By Prof. Wayan Dibia – Indonesian Arts Institute, Bali Theme IV : Empowering Marine Resources to Enhance Nation Competitiveness: Dr. Ir. H Fadel Muhammad Al-Haddar – Ministry of Marine Affairs and Fisheries Moderator: Prof. I Ketut Aria Pria Utama						
	A	B	C	D	E	F	G
10.30 - 10.47	Eng-1	Eng-9	Eng-17	Eng-46	Eng-39	Eng-78	Eng-33
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12.58 - 13.45	Break for Lunch and pray						
13.45- 14.00	Closing Ceremony and Awarding Certificate						
14.00 - 14.30	Preparation for City Tour (Cancelled)						
14.30 - 17.30	City Tour (Cancelled)						
17.00 - ...	See you on 3rd APTECS						

NOTE :

A : Room Argopuro 1
B : Room Argopuro 2
C : Room Kawi
D : Room Lawu
E : Room Semeru 1
F : Room Semeru 2
G : Room Utama

Moderator Day I

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B	Room : Argopuro II	B: Prof. Ir. Happy Ratna Sumartinah, M.Sc., Ph.D.
C	Room : Kawi	C: Prof. Dr. Ir. Mauridhi Hery Purnomo, M.Eng.
D	Room : Lawu	D: Prof. Ir. Gamantyo Hendrantono, M.Eng., Ph.D.
E	Room : Semeru 1	E: Prof. Dr. R. Y. Perry Burhan, M.Sc.
F	Room : Semeru 2	F: Prof. Dr. Ir. Suprapto, M.Sc.
G	Room : Utama	G: Dr. Maria Anityasari,ST.,ME.

Moderator Day II

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B	Room : Argopuro II	BDr. Ir. A. A. Masroeri, M.Eng.
C	Room : Kawi	C: Prof. Ir. Sutardi, M.Eng., Ph.D.
D	Room : Lawu	D: Prof. Ir. Djauhar Manfaat, M.Sc., Ph.D.
E	Room : Semeru 1	E: Prof. Dr. Ir. Adi Soeprijanto, M.T.
F	Room : Semeru 2	F: Prof. Dr. Ir. Dra. Danawati Hari Prajitno, SE,M.Pd.
G	Room : Utama	G: Dr. Ir. Ria Asih Soemitro, M.Eng., DEA.

Rules of Paper Presentation

1. The allotted time for presentation and question-answer session is 15 minutes for each presenter

2. To keep prompt presentation, bell would ring three times to remind the presenter's available time for presentation. It rings every eight minutes of the allotted time, ten minutes, and the last 15 minutes.

3. It is mandatory that the presenter promptly uses the time allotted.

4. The timekeeper would also strictly watch the time allotted to each presenter.

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Hydrometeorological Data Collection and Processing

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Abstract— **Hydrometeorological data are important for many fields and applications involving movement and distribution of water which include hydrological modelling, design of hydraulic structures, flood prediction, navigation and water management. The activity of collecting, processing and analyzing hydrometeorological data attracts hydrologist, meteorologist, and other scientist which deal with water and its circulation. The hydrometeorological observations were carried out daily using the UNESCO-IHE roof weather station, Delft, the Netherlands for a period of 8 Days from 17th April to 24th April 2007. Two main types of instruments used are single reading (such as rain gauge and counting anemometer) and continuous reading (such as the thermograph and data logger). Data from continuous recording instruments only could be obtained on the last day of observation periods. These observations summarise the final results obtained after processing of raw data of temperature, rainfall, relative humidity, sunshine duration (n/N), solar radiation and wind speed. Then, compare them with the past weather on April in the Netherlands (from the literature). From the result analysis, it can be summarized that Potential Evapotranspiration (PET) calculation by Penman-Monteith method has showed the same trendline with PET Makkink. The observations period was relatively dry compared with the past weather in April. The max temperature of 24.80C and radiation of 789.89 W/m2 respectively were comparatively higher than temperature and radiation of the past weather. The rise of temperature and solar radiation can be a first estimation of climate change indication.**

Keywords—**hydrometeorological data, collection and processing, climate change indication**

1.1. Background

Hydrometeorology is a branch of meteorology that deals with problems involving the hydrologic cycle, the water budget, and the rainfall statistics of storms. The boundaries of hydrometeorology are not clear-cut, and the problems of the hydrometeorologist overlap with those of the climatologist, the hydrologist, the cloud physicist, and the weather forecaster.

Hydrometeorological data are important for many fields and applications involving movement and distribution of water which include hydrological modelling, design of hydraulic structures, flood prediction, navigation and water management. The hydrometeorological observations were carried out daily using the UNESCO-IHE roof weather station, Delft, the Netherlands for a period of 8 Days from 17th April to 24th April 2007. Data from continuous recording instruments only could be obtained on the last day of observation periods.

These observations summarize the final results obtained after processing of raw data of temperature, rainfall, relative humidity, sunshine duration(n/N), solar radiation and wind speed.

1.2. The Objectives

The objectives of this research are to collect, process and analyze the hydrometeorological data and use them to estimate Potential Evapotranspiration (PET).

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II. REFERENCES

2.1. Related Definitions

Hydrology (UNESCO, 1964 in De Laat, 2006) is the science which deals with terrestrial waters, their occurence, circulation and distribution on our planet, their physical and chemical properties and their interaction with the physical and biological environment, including the effect on them of the activity of man.

It follows that hydrology is restricted to be terrestrial occurence of water, excluding oceanography and meteorology. Hydrology studies the flow of water over land, in rivers and lakes, but also through soil, plant and the atmosphere.

Some definitions on hydrometeorolgical data are presented below (De Laat, 2006):

Temperature (T*)*. For a proper observation of temperature, the thermometer must measure the air temperature only, hence the energy should be supplied by convection (air current) and not by radiation, condensation or conduction.

Relative Humidity (RH). Evaporation is very sensitive to the humidity of the air and it ceases completely when the air becomes saturated with water vapour ($RH=e_d/e_s=1$), provided the temperatures remains the same. More accurate measurements on RH are obtain with a psychrometer, consists of two thermometers, one with its bulb wrapped in wet muslin and one dry.

Solar Radiation. The latent heat of vaporization, L, required for the transfer of water into vapour is, directly or indirectly, provided by energy from the sun. Therefore, solar radiation is the most dominant factor determining the evaporation rate. Net radiation estimates can be obtained from observed hours of

sunshine using empirical formulae. A simple instrument to measure the number of hours of sunshine is the Campbell-Stokes type of sunshine recorder.

Climate Change refers to any change in climate over time whether due to natural variability or as a result of human activity. This differs from the usage in the Framework Convention on Climate Change where climate change refers to a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climatevariability observed over comparable time periods (Bolin, 1995).

1.3. Evapotranspirasi Potensial (PET)

In practice, PET is calculated by several methods. In this research, the methods used were limited by the methods commonly used in hydrology studies (De Laat, 2006) as follows:

1.3.1. PET Kombinasi Penman-Monteith

$$ET_{P-M} = \frac{\frac{C\ sR_N + c_p \rho_a (e_a - e_d)/r_a}{L}}{s + \gamma(1 + \frac{r_c}{r_a})} \quad (1)$$

where:

C = constant to convert units fromi kg/m^2 s to mm/day (C =86400)

L = latent heat of vaporization (L = 2.45*10^6)

s = slope of the temperature-saturation vapour pressure curve = $\frac{409 e_s}{(T_a + 237.3)^2}$

R_N = net radiation at the earth's surface (W/m^2) = $(1-r)R_s - R_{nL}$

c_p = specific heat of air at constant pressure (=1004 J/kg/K)

ρ_a = density of air(=1.207 kg/m^3 at sea level)

e_a = or e_s = saturation vapour pressure for the air temperature at 2 m height in kPa = $0.6108 e^{\frac{17.27 T_a}{T_a + 237.3}}$

e_d = actual vapour pressure of the air at 2 m height in kPa = $e_s - \gamma (T_{dry} - T_{wet})$

T_{dry} = dry bulb temperature

T_{wet} = wet bulb temperature

RH = relative humidity (%)

r_a = aerodynamic resistance, is a function of the wind speed = $\frac{245}{0.5U_2 + 0.5}$

γ = psychrometric constant (γ= 0.067 kPa/^{0}C at sea level)

Global radiation data R_s are more often available, but if they are not, the R_s data can be estimated from solar radiation from outer atmosphere, R_A radiation which can be written as:

$$R_s = (0.25 + 0.5\frac{n}{N})R_A \quad (2)$$

where:

n/N = actual hours of sunshine (hours) / possible hours of sunshine (hours)

1.3.2. PET dengan basis Radiasi : Metode Makkink

De Laat, 2006, stated that the evapotranspiration flux of a grass crop, amply supplied with water, is largely governed by the available radiation energy. The equation of Makkink is based on global radiation and temperature data only which can be written as:

$$ET_{Makkink} = C_M \frac{s}{s+\gamma} \frac{R_s}{L} \quad (3)$$

where:

C_M = Makkink constant = 0.65 = is presently used as the standard method to estimate PET of grass by Royal Meteorological Institute of the Netherlands.

III. METHODOLOGY AND INSTRUMENTS

The methodology used in this research was based on the formulation of research objectives, literature reviews, concept and knowledge during the MSc course. In general, it was started with literature review, followed by data preparation and analysis and ended with report writing.

The activities during the research are performed in Figure 1.

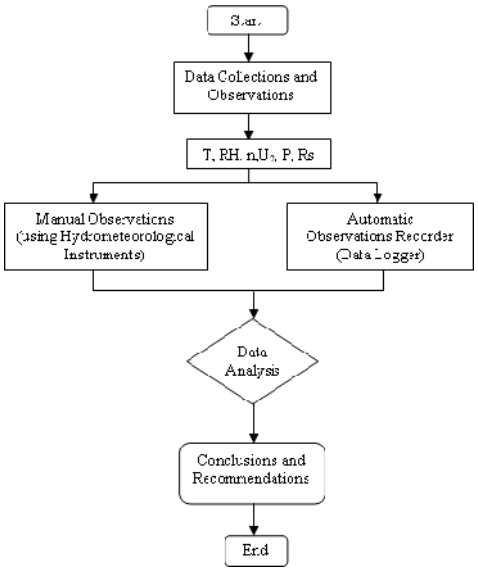

Figure 1. Flowchart of the Methodology

Two main types of instruments used for meteorological data collection at UNESCO-IHE roof weather station are Single Reading (such as Rain gauge and counting anemometer) and continuous reading (such as the hygrograph and data logger).
The following measurements were recorded :

Temperature

The minimum and maximum temperatures for each day were obtained from the Max-Min Thermometers (Figure 2.a) which taken immediately after opening the Stephenson shelter and then were reset for the following day readings. The actual temperatures were obtained from the dry-wet bulb thermometer (Figure 2.b). These readings were then compared with those recorded by thermal hydrograph (Figure 2.c) and data logger.

Relative Humidity

Two methods were used for computation of Daily Relative humidity. By using *temperature method*, the dry and wet bulb temperatures were recorded and red again after 10 minutes. The readings were used to compute the relative humidity, Saturation pressure (e_a) and dew point (actual) vapour pressure of the air (e_d).

Twet and Tdry refers to average temperature readings from wet and dry bulb thermometer respectively (for 10 minutes interval). In the Sling Psychrometer method (Figure 2.d) readings of wet and dry bulb thermometer were taken after slinging the thermometers for a period of two minutes. The temperature difference between the wet and dry bulb was used to determine the relative humidity from the slider. Other humidity readings were obtained from thermograph chart and data logger.

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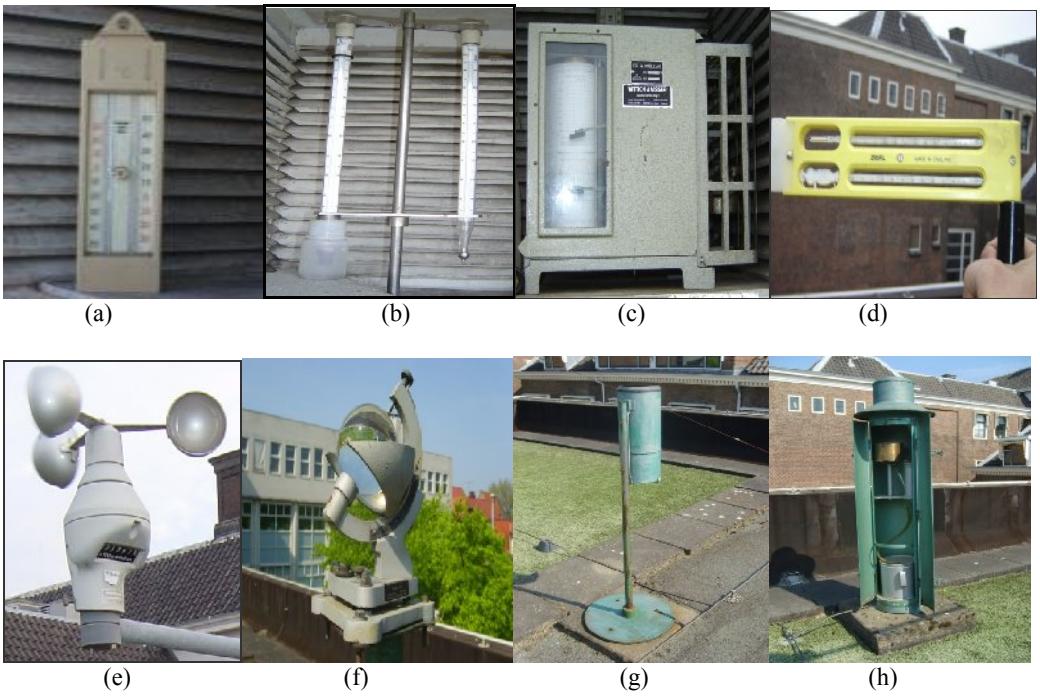


(a) (b) (c) (d)

(e) (f) (g) (h)

Figure 2. The Instruments used in the observations :

a) Min-Max Thermometer
b) Dry and Wet Bulb Thermometer
c) Thermal Hydrograph (Thermograph)
d) Sling Psychrometer
e) Anemometer
f) Campbel-Stokes Sun Shines Recorder
g) Totalizing Rain Gauge
h) Pluviograph

Wind Speed

The actual wind speed was determined from Anemometer (Figure 2.e) as the average over 10 minutes. The following formula was used:

$$U = (U_2 - U_1) \times \frac{100}{Time} \quad (4)$$

where U_1 and U_2 are first and second wind speed readings recorded from anemometer respectively under the time considered.

Radiation

Direct Sunshine duration measurements were recorded daily from Campbel-Stokes sunshine recorder (Figure 2.f). The sunshine registration strips were replaced everyday. The amount of cloud cover was also estimated and recorded with description of the clouds condition.

Precipitation

Totalising rain gauge (Figure 2.g), rainfall recorder (pluviograph) (Figure 2.h) and data logger were used to record amount of rainfall every morning. The chart in the rainfall recorder was changed with a new one and the clock wound everyday.

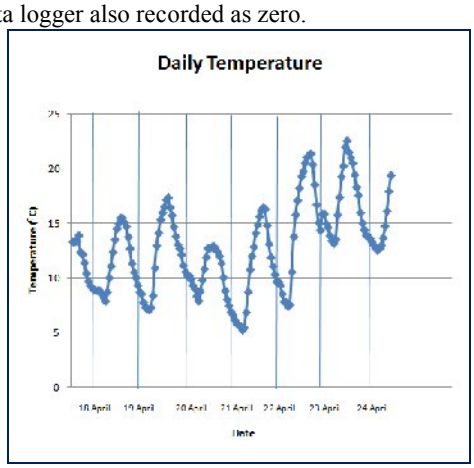
Data Logger

Recorded data at 1 hour interval, were downloaded from data logger for the period of measurement (8 Days). The data includes downwards solar radiation R_s (Wm^{-2}), wind speed U_2 (ms^{-1}), temperatures T (^0C), relative humidity RH (%), and rainfall P (mm) . The data was then used for computations of daily precipitation and daily mean values of wind speed, solar radiation, air temperature and relative humidity.

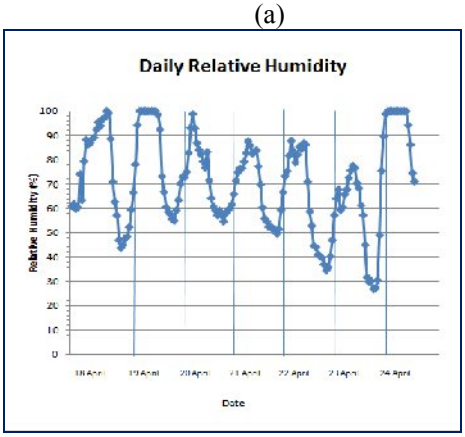
IV. Results and Discussions

1.4. Continous Reading Results (Data Logger)

Continous reading results can be seen from Figure 3 below. The results obtained consist of daily temperature, daily RH, daily wind speed and daily Rs. At the time of observations there was no rain and the data logger also recorded as zero.



(a)



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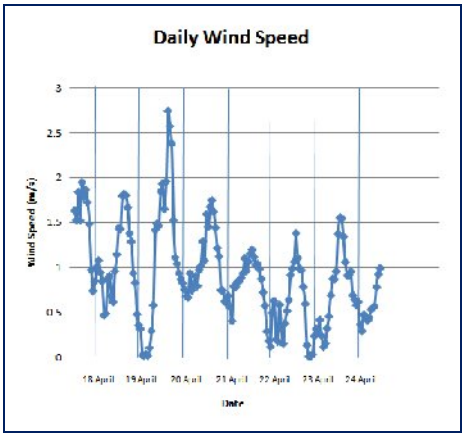
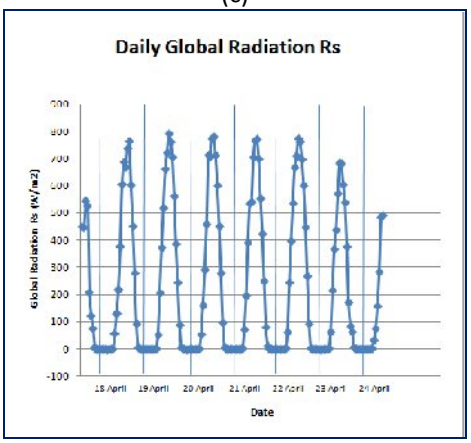


(c)



(d)

Figure 3.Graphs of the Hydrometeorological Data from Data Logger for a Period of 17-24 April 2007

From the graphs above, it can be concluded the range for each parameter. For temperature, the value ranged from (5.23 to 22.54)^{0}C; where as for RH ranged from (26.9 to 100)%; while for wind speed ranged from (0.02 to 2.74) m/s and for Rs ranged (-2.5 to 789.89) W/m^2.

4.2. Single Reading Results

Single reading results consist of temperature, relative humidity, wind speed, precipitation, sunshine duration and cloud cover using some manual instruments.

4.2.1. Temperature

Table 1 compares the results of temperature measurements from thermometer, thermograph and data logger. The recording of thermograph stopped before noon in 24th April so that there is no record (NA refers to Not Available).

Table 1. Temperature Measurements

Temperature									
With the Min-Max thermometer							Thermograph		Data Logger
Date	Morning			Afternoon			Morning	Afternoon	Daily Average
	T_{min} ^0C	T_{max} ^0C	T_a ^0C	T_{min} ^0C	T_{max} ^0C	Ta ^0C	Ta ^0C	Ta ^0C	Ta ^0C
17-Apr-07	-2	NA			24	13	NA	18	11.9
18-Apr-07	3	24.8	10	-5	15	15	6.8	11	11.4
19-Apr-07	4	12	11.2	-1	17	12	6	13.5	12.1
20-Apr-07	3	18	7.4	2	12	13	7	8.9	10.6
21-Apr-07	5	13	6.8	5	13	12	4	10	10.4
22-Apr-07	NA	NA	NA	NA	NA	NA	6	14.5	14.4
23-Apr-07	4	15	15	-4	23	22	11.9	18.5	17.1
24-Apr-07	-3	24	13.2	-4	21	20	11	NA	14.3
Average	**2**	**17.8**	**10.6**	**-1.2**	**17.9**	**15**	**7.5**	**13.5**	**12.8**

1.4.1. Relative Humidity

Table.2 shows the value of relative humidity using the Temperature Method and Sling Psychrometer Method, Thermograph and Data Logger respectively. From this table it can be seen that the four measurements gave different values.

Tabel 2. Relative Humidity Measurements

		Relative Humidity		
Date	Temperature	Sling Psychrometer	Thermograph	Data Logger
17-Apr-07	82.8	30.0	40.0	72.1
18-Apr-07	89.3	44.5	73.8	75.6
19-Apr-07	96.4	62.8	77.5	79.7
20-Apr-07	91.1	50.8	71.3	71.3
21-Apr-07	91.5	59.3	72.5	68.3
22-Apr-07	NA	NA	72.5	61.0
23-Apr-07	91.1	56.8	68.8	58.9
24-Apr-07	94.3	69.3	66.3	94.7
Average	90.9	53.3	67.8	72.7

The trend of the four methods are seemingly the same. It can be seen clearly at Figure 4. It shows that almost all methods follow the same path. The highest trendline refers to measurement from Min-Max thermometer and the lowest one is Sling Psychrometer. Because of there were not available values from measurements of Min-Max thermometer and Sling Psychrometer, the nodes are not connected by lines. However, if they are available, it should be noted that the values of RH are expected exist and followed the trendline of two other methods (Thermograph and Data Logger).

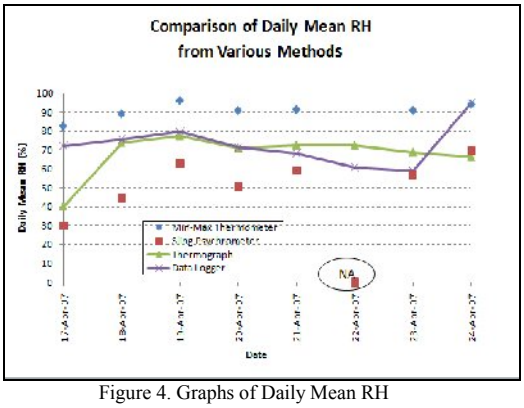


Figure 4. Graphs of Daily Mean RH

1.4.2. Wind Speed

Wind speed averaged around 1m/s for the entire week as indicated in Table 3. The range of the 10'minute average wind speed was from (0.5 to 0.8) m/s in the morning and (0.5 to 2.2) m/s in the afternoon. The 24 hour average was between (0.5 to 1.2) m/s.

Table 3. The Observed Values of Wind Speed

Wind Speed				
Date	U_2 Morning 10' Average (m/s)	U_2 Afternoon 10' Average (m/s)	U_2 24 hours Average (m/s)	Data logger Daily Average (m/s)
17-Apr-07		1.8		1.5
18-Apr-07	0.8	1	1..	1.1
19-Apr-07	0.5	2.2	0.9	1.1
20-Apr-07	0.7	2	1.2	1.1
21-Apr-07	0.5	1.2	1	0.8
22-Apr-07	NA	NA	NA	NA
23-Apr-07	0.5	0.8	0.5	0.7
24-Apr-07	0.7	0.5	0.7	0.6
Average	**0.6**	**1.4**	**0.9**	**1.0**

1.4.3. Global Radiation Rs

Table 4 shows the observations of sunshine duration and cloud cover. The range of sunshine duration is between 4 and 7 hours which is small compared to the maximum value of Netherlands in April of 13.8 hours (Heijboer, 2002). The Rs values are the values obtained from data logger which represent the daily mean Rs for a period of 17 to 24 April 2007. In general, the week was sunny with a little clouds.

Table 4. The Observations of Sunshine duration and Cloud covers

Date	Sunshine Duration (Hours)	Cloud (%)	Rs (W/m^2)	Cloud Condition
17-Apr-07		70	237.5	Cloudy, a bit sunny with wind
18-Apr-07	4.00	10	236.0	Quite clear sky, very small clouds in some places
19-Apr-07	5.50	10	252.7	Clear sky, sunny
20-Apr-07	5.00	10	252.9	Sunny, little clouds
21-Apr-07	6.75	30	249.4	Little cloudy
22-Apr-07	NA	NA	260.4	NA
23-Apr-07	4.50	20	202.2	Sunny, little clouds
24-Apr-07	1.50	0	108.8	No clouds, sunny
Average	**4.54**		**225.0**	

1.5. Potential Evapotranspiration

The results for Potential Evapotranspiration (PET), which were calculated by using Penman-Monteith and Makkink methods for manual and data logger readings can be described clearly in Figure 5. From the figure, it is indicated that PET Penman-Monteith and PET Makkink for data logger are higher than manual. Nevertheless, PET Penman-Monteith and PET Makkink for two different measurements have identified the same trendline (the PET values fall almost in the same range). It can be concluded that Makkink method quite good in calculating PET (as a first and quick estimation), especially if there are only radiation and temperature data available.

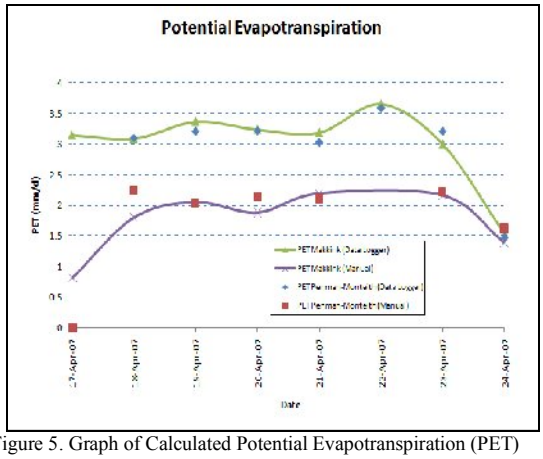


Figure 5. Graph of Calculated Potential Evapotranspiration (PET)

1.6. Comparison with the Past Weather of the Netherlands

Table 5 indicates the past weather conditions for the Netherlands. From the observations data that we have obtained before, we can make some comparisons between parameters as follows :

(a) For the temperature data, the recorded temperatures are comparatively higher than the past weather of April temperature.

(b) For relative humidity, the sling psychrometer gives smaller value of relative humidity compared to the other instruments. The values from the data logger are also different from the other values because there are daily averages including the daily fluctuations during the 24 hours. Where as the values from other instruments reflect the situation at the measuring moment. The RH from temperature method has slightly correspond to the past weather of April RH.

(c) For wind speed, the observation data are much lower than the April average of past weather, based on the fact that there were almost no wind during the period.

(d) For solar radiation, the observation values are higher than the past recorded value of the Netherlands. This can be explained by the act that April 2007 was dry and sunny with little clouds.

Table 5. Past Weather Conditions for the Netherlands

Parameter	Unit	Past Weather Values	Remarks for April
Temperature (T_{max})	°C	12.5 - 13.5	Monthly Max
Temperature (T_{min})	°C	3.5 - 4.5	Monthly Min
Rainfall (P)	mm	40 - 45	Monthly Average
Wind speed (U_2)	m/s	5 - 5.5	Monthly Average
Relative Humidity (RH)	%	82.5 - 85	Monthly Average
Radiation (Rs)	W/m^2	153 - 160	Monthly Average

V. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

This paper demonstrates the collection, processing and analysing hydrometeorological data that are used for calculating PET and weather comparison. Based on the completed tasks, the following conclusions are drawn:

a) There are some manual instruments (such as thermometer, thermograph, ect) that can be used to collect hydrometeorological data and can be compared with automatic data recorder (data logger).
b) The use of the instruments should follow the instructions and be done rigorously.
c) For the computation of evapotranspiration, it is recommended to use Penman-Monteith method because it has considered many parameters which gives more accurate results. In practical, makink method is used when there is no many data available because it only considers solar radiation and temperature.
d) The observation period was relatively dry compared with the past weather in April. The rise of temperature and solar radiation can be a first estimation of climate change indication.

5.2. Recommendations

a) It is recommended to be more familiar with the manual observations so that the data obtained can be accurate as possible.
b) More complete data on vegetation, land use and soil type in detail would be very beneficial in calculating potential and actual evapotranspiration.
c) Additional studies about hydrometeorological data for long term periods is recommended to be carried out together with a more extensive data collection and measurements.

I would like to thank to Dr. Raymond Venneker for his support and assistance and also all my friends (Amarech Fikre, Kamaliza Josine, Segule A. Segule and Thirubalasingham Barathithasan) for their cooperation and support during the observations.

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