American Research Foundation



ISSN 2476-017X

شَبَكَةُ المؤتمَرَاتِ العَرَبِيَةِ

http://arab.kmshare.net/

Available online at http://proceedings.sriweb.org/akn/

AASRC-ARF JOINT INTERNATIONAL ACADEMIC CONGRESS ON POLITICS, ENGINEERING, SOCIOLOGY, INFORMATION, HEALTH & MEDICAL, EDUCATION AND COMMUNICATION

25-26 October, 2017

Istanbul Aydın University, Istanbul

المؤتمر الاكاديمي الدولي الثامن عشر – في رحاب جامعة اسطنبول ايدن | 25 – 26 اكتوبر 2017

اسطنبول – تركيا

Forecasting of Air Stability Depending on the Potential Temperature

Osama T. Al-Taai,^a Zainab S. Muhammad^b

^{a, b} DAS— Department of Atmospheric Sciences, Collage of Science, University of Al-Mustansiriyah,

Baghdad, Iraq

^a <u>aus_tar77@yahoo.com</u>,^b <u>redsun57@yahoo.com</u>

Abstract. The Stability is one of the most important subject that have an effect on weather conditions where when the atmosphere is stable, the surface of the earth cools, especially during the clear nights and when the atmosphere is unstable, the surface is heated. The aim of this research is to classify the clouds according to the atmospheric stability and the accompanying air conditions and determine the type of clouds formed in the case of stability and instability. Data were taken by temperature, dew point, atmospheric pressure and height from satellites recorded by the European Centre for Medium-Range Weather Forecasts (ECMWF) for height (32-26509.7) meter the levels of pressure (1000-20) mb, the choice of the characteristic day (15/1, 16/2, 17/3, 15/4, 15/5, 15/6, 15/7, 15/8, 15/9, 15/10, 15/11, 15/12) of the month of 2015 for the Baghdad station to obtain the largest possible number and variety of clouds and their use in the calculation of cloud cover and weather stability in terms of calculation daily change, monthly and seasonally variation of temperature and dew point, calculation of cloud cover with height, potential temperature, and atmospheric stability. The temperature change, dew point, cloud base and height were determined, and then the thickness, type and classification of the cloud were calculated. The potential temperature was also calculated with height to determine the type of air stability, as well as the calculation of atmospheric stability with the height of the cloud base and under the cloud base where the atmosphere is stable, unstable or neutral.

Keywords: Cloud cover, Forecasting, Stability, Potential temperature, Baghdad.

ؤتمرات العرَبيَّة

http://arab.kmshare.net/

American Research Foundation



ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/

1 INTRODUCTION

Clouds is a phenomenon of condensation occurring water vapor in the sky, and rely on posed in the amount of moisture and the degree of stability of the air from the wind and blowing air classroom, The types of clouds are (Abd, H. F., 1997):

- Stratus clouds class which is that when it is formed low air progressing with Stratus any form compact layers between them, cover large areas of the sky, they are horizontal proliferation rather than vertical format, usually found in the air stable, and are formed when the rush of warm air currents above the air low temperature cold, divided into two types, such as the withdrawal of Nimbo and medium clouds, and the clouds are low caste thickness was sometimes accompanied by light rain occurs when you see them in the sky.
- Cumulus clouds famous cumulus clouds presence in the air cases is stable, and that is formed by air disturbances and the influence of wind speed and severity, and named Cumulus as they pile up on top of each other on a vertical form differs from the type of class that runs horizontally, and when gathering clouds and accumulate in very large quantities This indicates the presence of rain and snow cold and sometimes, cumulus clouds cannot see the sky through which they covered entirely, but this is expected to be rainy weather with the wind when you see the clouds class and snowfall as winter months.

Can be defined Stability is a situation where the air expulsion cooler than the surrounding air at the same pressure (altitude). It will decrease air antenna expulsion.

Often stability associated with hurricanes when they are removed convection currents that make the air is reduced to give a dry, sunny conditions and instability is the case where the expulsion of air is warmer than the air surrounding it at the same pressure (altitude). Parcel of air buoyant. Will Rises air expulsion antenna, and at moisture condensation cumulus clouds will consist (associated with thunderstorms). The air parcels can be forced to rise due to divergence aloft, for example. Parcels of warm air which rise through the lower atmosphere cool adiabatically. The rate and maintenance of any vertical uplift depend upon the temperature-density balance between the rising parcel and the surrounding air. But there are situations in which air parcels will spontaneously rise or sink. The general topic heading for the set of processes that govern this spontaneous motion is "instability".

Stability is the state in which an air parcel finds itself colder than the air surrounding it at the same pressure (elevation). The air parcel will spontaneously sink. Stability is often linked with anticyclones when any convection currents are suppressed by sinking air to give dry, sunny conditions. Instability is the state in which an air parcel finds itself warmer than the air surrounding it at the same pressure (elevation). The air parcel is buoyant. It will spontaneously rise. (If moisture is condensing, the resulting cloud will be cumulus, cumulus congestus or cumulonimbus (associated with thunderstorms)).

The air parcel is an important and useful conceptual device in atmospheric sciences. Can make a parcel by gathering together a usually unspecified amount of air and pretend the air is surrounded by an invisible boundary that insulates the parcel air from its surrounding environment. The parcel boundary, however, is flexible, permitting the air inside to expand or contract as conditions dictate (Samson, et al., 2010). When rising moist air cools through expansion, it will eventually reach its dew point. At this point condensation of vapor into drops of water occurs, and latent heat is released. The release of heat through condensation warms the air, thus, temperature drops less rapidly in rising moist air than in rising dry air. When gases are heated they expand, becoming less dense and lighter in weight. They are buoyed upward by surrounding denser gases the reason that warm air rises. Thus the warmer parcel will continue to rise. Under such conditions, the atmosphere is said to be unstable. In converse, a stable atmosphere exists when a rising parcel of air reaches a height, where through expansion, it becomes cooler than surrounding air at that altitude and sinks back to its former position. The lower atmosphere at night is usually always stable; whereas, during the daytime it is usually unstable.

مرًات العرَبْ

http://arab.kmshare.net/

American Research Foundation



ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/

This is especially true if the weather is fair with mostly clear skies. Stable or unstable air conditions can develop under cloudy skies, but their degree of development is usually less. Can also conclude that cooling from below promotes stability, while heating from below promotes instability (Schroeder, et al., 1970).

2 THE STUDY AREA

The work was carried out with the daily temperature, dew point, pressure, and high data from the (ECMWF), specifically the model <u>E</u>CMWF <u>R</u>e <u>A</u>nalyses (ERA-Interim) (Dee, 2011). The city of Baghdad was chosen for this work located at the latitude 32.14° N and longitude 44.14° E and at a height of 31.7 m in central Iraq as shown in Fig. 1. (Jubouri, et al., 2010). Iraq determines the site's astronomer and Geographical in Systems of compression surface and upper influential type the weather and climate of Iraq's weather phenomena associated with it. The thunderstorm phenomena familiar occurrence. It is produced by small-term storm clouds with large vertical extensions Produced by clouds with vertical extensions accompanied Lightning and thunder accordingly often strong winds with the falling rain sometimes accompanied falling hail (Carpal, 1989). We cannot be called a thunderstorm as a thunderstorm unless the sound of thunder which hears an international agreement on it (Bidawid, 2003).



Fig. 1. Baghdad station (Google, 2017).

3 EXPERIMENT WORK

3.1 The Atmospheric stability

The resistance of the atmosphere to vertical motion. We said that stable air tends to resist vertical air movement. If a horizontally moving parcel of air is lifted or forced to rise, as over a mountain, that parcel will tend to settle back to its original level. It is heavier than the air around it; therefore, it will sink back, if possible, to the level from which it originated. If the atmosphere is unstable, any parcel of air that is lifted will tend to rise like a hot air balloon. If the atmosphere is neutral; that is, the actual temperature lapse rate equals the dry adiabatic lapse rate, a parcel of air cools, its relative humidity increases. If the parcel cools enough, 100-percent relative humidity, or its dew point, will be reached at that point clouds form (Schroeder, et al., 1970). Stephen Schneider summed up the main characteristics of the ten races of clouds through the below Table 1:

American Research Foundation



شَبَكَةَ المُؤْتَمَرَاتِ العَرَبِيَّةِ http://arab.kmshare.net/

ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/

Cloud Type	Symbol	High cloud base (km)	Temp. cloud base (⁰ C)	Thick. (km)	Case of water in the clouds	Rising air speed (m/sec)
Cirrus	Ci	5-10	-30,-70	0.5-2	Ice	0.1-0.3
Cirrostratus	Cs	5-10	-25,-40	1-2	Ice	0.1-0.3
Cirrocumulus	Cc	5-12	-25,-40	0.1-0.3	Liquid or mixed	0.3-1
Altostratus	As	3-8	-10,-30	1-3	Ice or mixed	0.1-0.3
Altocumulus	Ac	2-8	-10,-30	0.1-1	Liquid or mixed	0.3-1
Nimbostratus	Ns	0.5-2	-10,-20	2-10	Ice or mixed	0.3-1
Stratus	St	0-2	-10,-20	0.1-0.5	Liquid	0-0.3
Stratocumulus	Sc	0-2	-10,-20	0.1-2	Liquid or mixed	0.1-1
Cumulus	Cu	1-4	-5,25	0.5-4	Liquid	0.3-3
Cumulonimbus	Cb	1-4	-5,25	2-20	Mixed	3-30

Table 1. The main characteristics of the ten races clouds (Stephen, 1996).

The temperature equals the dew point. This is Lifting Condensation Level (LCL). That's the level at which condensation can be achieved by lifting. LCL has another name as well, "cloud base". When reached cloud base, so what happens next? We're finally saturated (Samson, et al., 2010). When determining the high base cloud at the point of convergence between the curved temperature parcel and curved temperature dew point and symbolized by the symbol z_b and determine the temperature of the top cloud at divergence point curve temperature curve dew point temperature and symbolized by the symbol z_t can be find the thickness of the cloud equation (Rogers, 1984):

$$\Delta z_c = z_t - z_b \tag{1}$$

3.2 The Potential Temperature (Theta)

The potential temperature (theta) is the temperature that a sample of air would have if it were brought dry adiabatically to a pressure of 1000 mb. Potential temperature is commonly expressed in kelvins. (Whiteman, 2000; Ackerman, et al., 2013).

$$\theta = T \left(\frac{1000}{p}\right)^{286}$$
⁽²⁾

 θ : Potential temperature in °C.

T: Temperature in °C.

P: pressure in mb.

Thus, whether the parcel has an upward, downward, or no acceleration depends on how the environmental potential temperature changes with height (Ahrens, 2012).

Global Proceedings Repository

American Research Foundation



شَبَكة المؤتمرَاتِ العَرَبِيَّةِ http://arab.kmshare.net/

ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/

$$\frac{d\theta}{dz} > 0 \text{ Stable} \quad -$$
$$\frac{d\theta}{dz} < 0 \text{ Unstable}$$
$$\frac{d\theta}{dz} = 0 \text{ Neutral} \quad -$$

(3)

4 RESULTS AND DISCUSSION

4.1 Calculation the thickness and height of the clouds in Baghdad station

While determining the height of the convergence points and the spacing between the curve of the vertical change of temperature and the curve of the dew temperature change in the Fig. 2. The thickness of the clouds that were deposited above Baghdad station was calculated for the study days of each month and the monthly rates and the seasonally rates for the year 2015 and also were classified according to their height and thickness. The appeared type of the clouds in the Baghdad station is due to the wind movement. The uneven heating of the surface of the earth causes the pressure to be degraded. A movement of wind from the high pressure zone to the low pressure zone is called the general wind. In the Baghdad station, the clouds Sc, of clouds St, and Cb clouds of accumulated marshes that accompany the unstable atmosphere. As well as the Cu clouds that accompany the stable atmosphere, the as clouds and the Ns clouds that accompanies the stable atmosphere and the clouds Ci that accompany the stable atmosphere. The city of Baghdad is characterized by a climate of semi-desert with little and fluctuating rain. In the months of January, February, October and November and the absence of clouds in the months of April, June, July, August.



Fig. 2. The curve of the vertical change for the real temperature, the vertical change curve of the dew point temperature, the area of convergence between the two axes with the height of the monthly average in Baghdad station for year 2015.

Global Proceedings Repository American Research Foundation



ات العَرَبِيَّةِ http://arab.kmshare.net/

ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/



Followed Fig. 2.

American Research Foundation



http://arab.kmshare.net/



ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/



Followed Fig. 2.

4.2 Calculating the atmospheric stability depending on the potential temperature

Note through the Fig. 3. The higher the increase the less the pressure and the potential temperature increases with the increase in the height, the relationship between the potential temperature and the height of a positive relationship and its relation with pressure is inverse relationship, where the potential temperature was calculated from the Equation (2) depending on the temperature and pressure of the cloud, the stability state is calculated from the potential temperature change with the elevation of the cloud base and under the cloud base of Equation (3) to determine the stability state of the atmosphere under the cloud base and compare it with the cloud base to confirm the atmospheric stability of the cloud. Where the cloud is stable, the air temperature is slowly decreasing with altitude or may increase with altitude and when the cloud is unstable any air temperature decreases rapidly with altitude and when the cloud and under the base of the clouds where most of the clouds in all the stations at the base of the cloud and under the base of the cloud, where Iraq lies within the subtropical regions. The climate of the subtropical regions is characterized by a warm summer to hot and cold to moderate winter with rare frosts.

Global Proceedings Repository American Research Foundation



http://arab.kmshare.net/

ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/

Baghdad statio	n data		January			
Pressure base (mb) 975		350	Average January			
High base (m)	209.5	8307.7	30000			
The temperature of the base (°C)	13.0005	-36.2268				
Dew point the base (°C)	3.3999	-3507.46	- 200			
Pressure top (mb)	875	200	20000			
High top (m)	986.1	11946.95	(j)			
The temperature of the top (°C)	7.3966	-55.6894				
Dew point the top (°C)	-6.3488	-69.1180	± - 600 Å			
Thickness	776.6	3639.25				
Cloud type	Sc	Ci	5000 Temperature (C) Dev point (C) Dev point (C) Dev point (C) 1000 -200 -100 0 100 200 300 400 500			
Cloud classification	Low	High	Pressure under the base (mb) 1000 400			
dθ/dz	0.0004	0.0046	$d\theta/dz$ under the base -0.0004 0.0041			
Stability state	stable	stable	Stability state under the base unstable Stable			
Baghdad statio	n data		February			
Pressure base (mb)	925	300	Average February			
High base (m)	573.5	9343.55	30000			
The temperature of the base (°C)	11.5207	-43.6193	25000			
Dew point the base (°C)	-0.4163	-54.7299				
Pressure top (mb)	875	250	20000			
High top (m)	986.1	10561.3				
The temperature of the top ($^{\circ}C$)	8.1293	-49.6949				
Dew point the top(°C)	-4.7671	-62.0713				
Thickness	412.6	1217.75	5000 Temperature (C) - 800			
			Bew point (C) Potential temperature (C)			
Cloud type	St	Cs				
			-200 -100 0 100 200 300 400 500			
Cloud classification	Low	High	Pressure under the base (mb) 950 350			
dθ/dz	.00180	.00470	$d\theta/dz$ under the base .00140 0.0044			
Stability state	stable	stable	Stability state under the base stable Stable			
Baghdad stat	on data	300	March			
High base (m)	9343 55		Average March			
The temperature of the base (°C)	-42 6303					
Dew point the base (°C)	-54 0902		25000 - 200			
Pressure ton (mb)	-54.0502		20000			
High top (m)	11220.7		Ê 400 Ê			
The temperature of the top (°C)	-53.4189		Ĕ, 15000			
Dew point the top $(\)$	-65 5276		표 · · · · · · · · · · · · · · · · · · ·			
Thickness	-03	77 15				
Thickness		//.15	5000			
Cloud type	Cs		-200 -100 0 100 200 300 400 500			
Cloud classification	F	Jigh	Pressure under the base (mb) 350			
dθ/dz	0.0046		$d\theta/dz$ under the base (110) 550			
Stability state	stable		Stability state under the base stable			

Fig. 3. The report for the monthly average for thickness, height, type and classification of the clouds and the status of the weather stability of the base of the cloud and under the cloud base in Baghdad station for year 2015.

American Research Foundation



ISSN 2476-017X

ARF

Available online at http://proceedings.sriweb.org/akn/



Followed Fig. 3.

American Research Foundation



http://arab.kmshare.net/

وتمرات العرَبيَّةِ

ARF

Available online at http://proceedings.sriweb.org/akn/



Followed Fig. 3.

Global Proceedings Repository American Research Foundation



ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/

ARF

Pressure base (mb)800400Average OccureHigh base (m)1864 657381 834093Dew point the base (°C)4308834093Pressure top (mb)550125High top (m)4948 4514985.7The temperature of the top (°C)-61.866Dew point the top (°C)-18.9328The temperature of the top (°C)-18.9328Cloud typeCuCiCloud classificationLowHigh base (m)200.5Stability statestableStability state-30.027The temperature of the top (°C)10.547Pressure top (mb)850Pressure top (mb)850Pressure top (mb)850Pressure top (mb)3639.25Cloud classificationLowHigh base (m)200.5Pressure top (mb)850Pressure top (mb)850Bigh base (m)200.5Pressure top (mb)850Pressure top (mb)850Cloud classificationLowHigh base (m)200.5Cloud classificationLowHigh base (m)200.5Cloud classificationLowHigh base (m)200.5Cloud classificationLowHigh base (m)200.5Cloud classificationLowHigh base (m)0.0035Cloud classification1900High base (m)900High base (m)900High base (m)900High base	Baghdad statio	n data		October			
High base (m)1864.657381.8Image: constraint of the base (°C)15.4657381.8The temperature of the base (°C)4.308-34.09631000Pressure top (mb)5501251000Dew point the top (°C)-6.1866-64.80691000Dew point the top (°C)-6.1866-64.80691000Dew point the top (°C)-6.1866-64.80691000Cloud typeCuCi1000Cloud typeCuCi1000Cloud typeCuCi1000Cloud typeCuCi1000Baphdad station datatop 1753350Pressure base (mb)9753357The temperature of the base (°C)17.7524-33.6324Dew point the top (°C)10.133639.25The temperature of the base (°C)-1.6797Pressure top (mb)850200High base (m)209.5Cloud tassificationLowHigh base (m)0.0035Dew point the top (°C)-1.6797The temperature of the base (°C)-1.6797Cloud typeScCloud tassificationLowHigh base (mb)209.5Dew point the top (°C)-1.6797The temperature of the base (°C)-1.6797Cloud tassificationLowHigh base (mb)209.5Dew point the top (°C)-1.6797Cloud tassificationLowHigh base (mb)200.35Dew point the top (°C)-1.6797 <td>Pressure base (mb)</td> <td colspan="2">800 400</td> <td colspan="3">Average October</td>	Pressure base (mb)	800 400		Average October			
The temperature of the base $(^{\circ}C)$ 15.4695 -23.0173 Deep point the base $(^{\circ}C)$ 4.308 -34.0963 Pressure top (mb) 550 -125 High top (m) 4948.45 14985.7 The temperature of the top $(^{\circ}C)$ -6.1866 -64.8069 Dew point the top $(^{\circ}C)$ -18.9328 -78.1526 Thickness 3083.8 76039 Cloud classification Low High d0/dz under the base (mb) 825 450 d0/dz 0.002 0.0029 Stability state stable stable Stable Stable 0.0023 0.0028 Stability state 0.002 0.0029 Baghdad station data Vortuge 0.0025 0.0028 Baghdad station data Vortuge 0.0025 0.0028 High base (m) 209.5 8307.7 High base (m) 209.5 8307.7 Dew point the top $(^{\circ}C)$ 10.547 -56.1995 Dew point the top $(^{\circ}C)$ 10.547 -56.1995 The temperature of the base $(^{\circ}C)$ 8.8453 -45.8461 Pressure top (mb) 850 200 High top (m) 1210.8 11946.95 The temperature of the base $(^{\circ}C)$ 1.6.757 - 68.1995 Thickness 1001.3 3639.25 Cloud classification data Vortuge 0.0035 0.0035 Stability state under the base (mb) 900 High top (m) 209.5 The temperature of the base $(^{\circ}C)$ 1.6.757 - 68.1999 Thickness 1001.3 3639.25 Cloud type Sc Ci $(^{\circ}C)$ 1.7578 + $^{\circ}C$ Ci $^{\circ}C$ $^{\circ$	High base (m)	1864.65	7381.8	30000	1200		
Dev point the base (°C)4.3088-3.40963Pressure top (mb)550125The temperature of the top (°C)-6.1866-6.48069Dev point the top (°C)-18.9328-78.1526Thickness3083.87603.9Cloud typeCuCiCloud classificationLowHigh db/dz0.0020.00299Stability statestablestablestablestablestablestablestablecloud classificationLowPressure base (mb)975350350The temperature of the top (°C)1210.8The temperature of the top (°C)1001.33639.25CiThe temperature of the top (°C)1001.3Cloud classificationLowHigh base (m)200.5Cloud classificationLowHigh base (m)200.55The temperature of the top (°C)Cloud classificationLowHigh base (m)200.55The temperature of the top (°C)Cloud classificationLowHigh base (m)200.55Dev point the base (°C)4.6172Pressure top (mb)900High base (m)200.55Dev point the base (°C)4.6172Pressure top (mb)900High base (m)900High base (m)900High base (m)900<	The temperature of the base (°C)	15.4695	-23.0173	25000	- 1000		
Pressure top (mb) 550 125 High top (m) 4948.45 14985.75 The temperature of the top (°C) -18.9328 -78.1526 Thickness 3083.8 7603.9 Cloud type Cu Ci Persure under the base (mb) 8.025 0.0002 Stability state stable stable stable 0.025 0.0002 Stability state stable stable 0.025 0.0002 Stability state 0.025 8.307.7 The temperature of the base (°C) 17.7524 -33.6324 Dew point the base (°C) 18.512 - 33.6324 Dew point the base (°C) 10.547 -56.095 The temperature of the base (°C) 10.547 -56.095 Dew point the top (°C) 10.547 -56.095 The temperature of the base (°C) 10.547 -56.095 Dew point the top (°C) 10.547 -56.095 The temperature of the base (°C) 8.4453 at-45.8461 Pressure under the base (mb) 0.000 0.0002 Stability state stable stable 0.0003 0.0003 Stability state stable 0.0013 363.925 Cloud type Sc Ci 0.0002 0.0002 Stability state stable 0.0013 363.925 Cloud type Sc Ci 0.0003 0.0035 Stability state stable 0.0013 363.925 Cloud type Sc Ci 0.0001 0.000 0.0002 Stability state 0.0013 363.925 Cloud type Sc Ci 0.0002 0.0002 Stability state 0.0013 363.925 Cloud type Sc Ci 0.0002 0.0002 Stability state 0.0032 0.0035 Stability state 0.0032 0.0035 Stability state 0.0013 0.0035 Stability state 0.0001 0.0001 High base (°C) $0.4.002$ 0.0001 High base (°C) $0.24.027$ 0.0001 High base (°C) 0.0001 0.0001 Stability state under the base (°C) 0.0001 0.0001 High base (°C) 0.0001 0.0001 High b	Dew point the base (°C)	4.3088	-34.0963				
High top (m) 4948.45 14985.7 The temperature of the top ($^{\circ}C_{\circ}$ -18.9328 -78.1526 Thickness 3083.8 7603.9 Cloud type Cu Ci Ci Pressure under the base (mb) 825 450 d0/dz 0.002 0.0029 d0/dz under the base 0.0023 0.0028 stabile Baghdad station data Volume 1210.8 11946.95 The temperature of the base ($^{\circ}C_{\circ}$ 17.7524 -33.6324 Dew point the base ($^{\circ}C_{\circ}$ 16.6397 -68.1999 Thickness 1001.3 3639.25 Cloud type Sc Ci Ci Pressure under the base (mb) 1000 4000 d0/dz under the base (mb) 209.5 The temperature of the base ($^{\circ}C_{\circ}$ 16.797 -68.1999 Thickness 1001.3 3639.25 Cloud type Sc Ci Pressure under the base (mb) 1000 4000 d0/dz under the base (mb) 209.5 The temperature of the base ($^{\circ}C_{\circ}$ 14.727 Pressure top (mb) 900 High top (m) 209.5 The temperature of the base ($^{\circ}C_{\circ}$ 14.712 Pressure top (mb) 900 High top (m) 209.5 The temperature of the top ($^{\circ}C_{\circ}$ 14.302 Thickness 570.3 Cloud type Sc Ci Ci Dew point the top ($^{\circ}C_{\circ}$ 14.302 Thickness 570.3 Cloud type Sc Ci Diversite the base (mb) 1000 4000 d0/dz under the base (mb) 0007 High top (m) 779.8 The temperature of the top ($^{\circ}C_{\circ}$ 14.302 Thickness 570.3 Cloud type St Ci Diversite the base (mb) 1000 0.0032 Stability state stable 570.3 Cloud classification Low Base 570.3 Cloud classifica	Pressure top (mb)	550	125	20000	- 800		
The temperature of the top $(^{\circ}\mathbb{C})$ -18.9328 -78.1526 Thickness 308.8 760.9 Cloud type Cu Ci Ci Pressure under the base (mb) 825 450 d $^{\circ}$ /d	High top (m)	4948.45	14985.7	Ê	- 600 (fil		
Dew point the top $(^{\circ}C)$ -18.9328 -78.1526 Thickness 3083.8 7603.9 Cloud type Cu Ci $^{\circ}$ Ci $^{\circ}$	The temperature of the top (°C)	-6.1866	-64.8069	편 15000	an a		
Thickness 3083.8 7603.9 1000 1000 1000 1000 1000 1000 Cloud typeCuCi 1000 100 1000 1000 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 100023 10003 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000	Dew point the top ($^{\circ}C$)	-18.9328	-78.1526	± 10000	- 400 ž		
Cloud typeCuCi $u = 1$ $u =$	Thickness	3083.8	7603.9		200		
Cloud typeCuCiPressure under the baseNotemberCloud classificationLowHigh stablePressure under the base0.0023 450 0.0023Stability statestablestableStability state under the base0.0023 450 0.0023Baghdad station dataNovemberNovemberPressure base (mb)975350 8307.7NovemberThe temperature of the base (°C)17.7524-33.6324 950NovemberPressure top (mb)850200 10.547-56.095 36392Pressure under the baseNovemberDew point the top (°C)-1.6797-68.1999 3639.25Pressure under the base1000400 40/dzCloud typeScCiPressure under the base0.00070.0028 3tableBaghdad station dataLowHigh 0.0035Pressure under the base0.00070.0028 3tableCloud classificationLowHigh 0.0035Pressure under the base0.00070.0028 3tableBaghdad station data209.5 12.2815 Dew point the top (°C)12.2815 12.2815 0.0003Pressure top (mb)900 112.2815 12.2815 Dew point the top (°C)8.205 4.302 17.779.8The temperature of the base (°C)4.20172 9.00900 900 High base (m)779.8 779.8The temperature of the top (°C)8.2055 9.205 10 wpoint the top (°C)8.2055 9.2055900 900 900 116 temperature of the top (°C)1000 900 900 116 temperature of the top (°C)1000 900 10				5000 — Pew point (c)		
Cloud typeCuCi $\frac{1}{20}$ </td <td></td> <td></td> <td></td> <td>Potential te</td> <td>mperature (C)</td>				Potential te	mperature (C)		
Cloud classification $d\theta/dz$ Low 0.002 High 0.002 Pressure under the base (mb) $d\theta/dz$ under the base $table$ 825 0.0028 450 0.0028 Stability statestablestablestablestablestablestablestableBaghdad station975 $1000000000000000000000000000000000000$	Cloud type	Cu	Ci	-200 -100 0 100 200 300	400 500		
$ \begin{array}{c c c c c c } Cloud classification & Low & High \\ d/dz & 0.002 & 0.0029 & d/dz under the base (mb) & 825 & 450 \\ 0.0023 & stable & stable & stable & stable & stable \\ \hline \\ $							
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Cloud classification	Low	High	Pressure under the base (mb) 825	450		
Stability state5.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0025.0	da/dz	0.002	0.0029	$d\theta/dz$ under the base (110) 023	3 0.0028		
Stability stateStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStableStable <td>Stability state</td> <td>otoblo</td> <td>stable</td> <td>Stability state under the base stable</td> <td>stable</td>	Stability state	otoblo	stable	Stability state under the base stable	stable		
Bagindad station dataNovemberPressure base (mb)209.5350High base (m)209.58307.7350Average NovemberThe temperature of the base ($^{\circ}$ C)8.8453-45.8461	Stability state	stable	stable	Stability state under the base stable	e stable		
Fileskue base (init)9735.50High base (init)209.58307.7The temperature of the base (°C)17.7524-33.6324Dew point the base (°C)8.8453-45.8461Pressure top (mb)850200.5High top (m)1210.811946.95The temperature of the top (°C)-1.6797-68.1999Thickness1001.33639.25Cloud typeScCiCloud typeBaghdad station dataPressure under the base (mb)1000400Baghdad station dataDecemberThicknessThe temperature of the top (°C)12.2815Dew point the base (°C)12.2815DecemberThe temperature of the top (°C)The temperature of the top (°C)209.5The temperature of the top (°C)12.2815Dew point the top (°C)4.6172Pressure top (mb)900High base (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)8.2055Dew point the top (°C)8.2055Dew point the top (°C)8.2055Dew point the top (°C)9.000High top (m)779.8Cloud classificationLowCloud tassificationLowOld/dz0.0031Odi/dz0.0031BableStableStableStableBableStable	Bagndad statio	n data 075	250	November			
The temperature of the base $(^{\circ}C)$ 17.7524 -33.6324 Dew point the base $(^{\circ}C)$ 17.7524 -33.6324 Dew point the base $(^{\circ}C)$ 17.8524 -45.8461 Pressure top (mb) 850 200 High top (m) 1210.8 11946.95 Dew point the top $(^{\circ}C)$ 10.547 -56.095 Dew point the top $(^{\circ}C)$ 10.547 -56.095 Dew point the top $(^{\circ}C)$ 10.547 -56.095 Cloud type Sc Ci Cloud type Sc Ci Bagbdad station data Pressure under the base (mb) 1000 400 d0/dz under the base (mb) 1000 40/d Stability state under the base Stable	High base (m)	209.5	8307 7	30000 Average November	1200		
The temperature of the base ($^{\circ}$ C) 8.8453 445.8461 Pressure top (mb) 850 200 High top (m) 1210.8 11946.95 Dew point the top ($^{\circ}$ C) 10.547 -56.095 Dew point the top ($^{\circ}$ C) -1.6797 -68.1999 Thickness 1001.3 3639.25 Cloud type Sc Ci Cloud classification Low High dθ/dz 0.0035 0.0035 Stability state stable stable Pressure under the base (mb) 1000 400 0.0007 0.0032 Stability state of the base ($^{\circ}$ C) 12.2815 Dew point the base ($^{\circ}$ C) 4.6172 Pressure top (mb) 900 High top (m) 779.8 The temperature of the top ($^{\circ}$ C) 4.302 Thickness 570.3 Cloud type St Cloud classification Low High 0.0031 Cloud type St Cloud classification Low Stable Sta	The temperature of the base (%)	17 7524	33 6324				
Pressure top (mb) 850 200 High top (m) 1210.8 11946.95 Dew point the top (°C) 10.547 -56.095 Dew point the top (°C) -1.6797 -68.1999 Thickness 1001.3 3639.25 Cloud type Sc Ci Cloud type Sc Ci Baghdad station data Construction Low High odd/dz under the base (mb) 1000 400 d0/dz under the base (mb) 1000 400 d0/dz under the base (mb) 1000 400 d0/dz under the base (mb) 0.0007 0.0032 Stability state under the base (mb) 0.0001 Stability state under the base (mb) 0.0001	Demonstrative of the base (C)	0.0452	-55.0524	25000	- 1000		
Pressure top (mb)850200High top (m)1210.811946.95The temperature of the top (°C)-1.6797-56.095Dew point the top (°C)-1.6797-68.1999Thickness1001.33639.25Cloud typeScCiCloud classificationLowHigh dθ/dzdθ/dz0.00350.0035Stability statestablePressure under the base (mb)10004000.00070.0032Stability state975High base (m)209.512.2815Dew point the top (°C)4.6172Pressure top (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)4.302Thickness570.3Cloud classificationLowdθ/dz0.0031Kloud classificationLowdθ/dz0.0031Stability stateStability state under the base (mb)00.0031040/dz00.0031040/dz00.0031040/dz00.0031040/dz the base0100000.0031040/dz the base0100000.0031040/dz the base040/dz00.0031040/dz00.0031040/dz00.0031	Dew point the base (-C)	8.8455	-45.8401	20000	- 800		
The temperature of the top ($^{\circ}C$) 10.547 -56.095 Dew point the top ($^{\circ}C$) 10.547 -56.095 Thickness 1001.3 3639.25 Cloud type Sc Ci Cloud type Sc Ci Cloud classification Low High dθ/dz 0.0035 0.0035 Stability state stable stable stable Pressure under the base (mb) 1000 400 dθ/dz under the base 0.0007 0.0032 Stability state ($^{\circ}C$) 12.2815 Dew point the base ($^{\circ}C$) 4.6172 Pressure top (mb) 900 High top (m) 777.88 The temperature of the top ($^{\circ}C$) 8.2055 Dew point the top ($^{\circ}C$) 4.302 Thickness 570.3 Cloud type St Cloud classification Low Atting the base (here the base here the base (here the base here here here here here here here he	Pressure top (mb)	850	200	2000	600 Ê		
The temperature of the top (°C) -1.6797 -68.1999 Thickness 1001.3 3639.25 Cloud type Sc Ci $\frac{1000}{200} -\frac{1000}{100} \frac{1000}{200} \frac{1000}{20} \frac{1000}{20}$	The temperature of the ten	1210.8	56.005	Ĕ, 15000	i ooo		
Dew point the top (°C) -1.6797 -68.1999 Thickness 1001.3 3639.25 Cloud type Sc Ci Cloud classification Low High $d\theta/dz$ 0.0035 0.0035 0.0035 Stability state stable stable stable θ/dz under the base (mb) 1000 400 $d\theta/dz$ under the base (mb) 1000 400 $d\theta/dz$ 0.0035 0.0035 0.0035 Stability state under the base (mb) 1000 400 $d\theta/dz$ under the base (mb) 1000 $d\theta/dz$ under the b	The temperature of the top (-L)	10.547	-56.095	E E E E E E E E E E E E E E E E E E E	- 400 se		
Thickness1001.3 3639.25 Cloud typeScCiTemperature (C) Desploit (C)Cloud classification $d\theta/dz$ Low 0.0035 High $stable$ Pressure under the base (mb)1000 0.0032 400 0.0035 Stability stateStablestablePressure under the base 0.0007 0.0032 0.0032 $stableBaghdad station dataDecemberPressure base (mb)975112.28150.0035112.28150.0070.00320.0070.0032The temperature of the base (°C)12.281512.28150.00710000.0070.0032The temperature of the base (°C)4.617212.28150.00510000.00070.00010.0070.0007The temperature of the top (°C)8.205510000.00010.00010.00010.0001Cloud typeStThe temperature of the top (°C)8.20550.00330.00310.000310.00010.0001Cloud typeStStPressure under the base (mb)0.00310.0001Cloud typeStStability state0.000310.0001$	Dew point the top (~L)	-1.6/9/	-68.1999		- 200		
Cloud typeScCiCloud classification $d\theta/dz$ Low 0.0035 High 0.0035 Pressure under the base $d\theta/dz$ under the base1000 0.0007 400 0.0032 Baghdad station db/dzPressure under the base $d\theta/dz$ under the base 0.0007 0.00032 0.0032 $stableBaghdad stationHigh base (m)975209.5DecemberPressure base (mb)High base (m)975209.50.000712.28150.00070.0007Dew point the base (°C)4.617290000.000710.28150.000710.000The temperature of the base (°C)4.617290000.000710.00000.000710.00000000000000000000000000000000000$	Thickness	1001.3	3639.25	5000 Temperatur	e (C)		
Cloud typeScCiCloud classificationLowHigh 0.0035Pressure under the base (mb)1000400 $d\theta/dz$ stablestablestablestablestableBaghdad station dataPressure under the base0.00070.0032Pressure base (mb)975DecemberPressure base (mb)97512.2815Dew point the base (°C)12.2815 4.6172 Dew point the base (°C)4.6172Pressure top (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)8.2055Dew point the top (°C)8.2055Dew point the top (°C)8.2055Cloud typeStCloud typeStCloud classificationLowdlodz0.0031dlodz0.0031dlodz0.0031Stability statestable				— Potential ter	mperature (C)		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Cloud type	Sc	Ci		100 500		
Cloud classificationLowHigh High odd/dzPressure under the base (mb)1000400 $d\theta/dz$ 0.00350.0035 $d\theta/dz$ under the base0.00070.0032Stability statestablestablestableStability state under the basestablestableBaghdad station dataDecemberPressure base (mb)975High base (m)209.5Average DecemberThe temperature of the base (°C)4.6172Pressure top (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)-4.302Thickness570.3Cloud typeStCloud typeStCloud classificationLowd θ/dz 0.0031d θ/dz 0.0031Stability statestableStability stateStability state				-200 -100 0 100 200 300	400 500		
dθ/dz0.00350.0035dθ/dz under the base0.00070.0032Stability statestablestableStability state under the basestablestableBaghdad station dataDecemberPressure base (mb)975High base (m)209.5The temperature of the base (°C)4.6172Pressure top (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)4.302Thickness570.3Cloud typeStCloud typeStCloud classificationLow dθ/dzCloud classificationLow stability stateStability statePressure under the base (mb) dθ/dz under the baseStability stateStability state	Cloud classification	Low	High	Pressure under the base (mb) 1000	400		
Stability statestablestableStability state under the basestablestablestableBaghdad station dataDecemberPressure base (mb)975High base (m)209.5The temperature of the base (°C)12.2815Dew point the base (°C)4.6172Pressure top (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)-4.302Thickness570.3Cloud typeStCloud typeStCloud classificationLowd θ/dz 0.0031Stability stateStability stateStability statestableStability stateStability state	$d\theta/dz$	0.0035	0.0035	$d\theta/dz$ under the base 0.000	7 0.0032		
Baghdad station dataDecemberPressure base (mb)975High base (m)209.5The temperature of the base (°C)12.2815Dew point the base (°C)4.6172Pressure top (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)-4.302Thickness570.3Cloud typeStCloud typeStCloud classificationLowdθ/dz0.0031Stability statestableStability statestable	Stability state	stable	stable	Stability state under the base stable	e stable		
Pressure base (mb)9/5High base (m)209.5The temperature of the base (°C)12.2815Dew point the base (°C)4.6172Pressure top (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)4.302Thickness570.3Cloud typeStCloud classificationLowdθ/dz0.0031Stability statestableStability statestable	Baghdad statio	n data	75	December			
The temperature of the base ($^{\circ}C$) 12.2815 Dew point the base ($^{\circ}C$) 4.6172 Pressure top (mb) 900 High top (m) 779.8 The temperature of the top ($^{\circ}C$) 8.2055 Dew point the top ($^{\circ}C$) 4.302 Thickness 570.3 Cloud type St Cloud type St Cloud classification Low dθ/dz 0.0031 Stability state stable Stability state under the base (mb) 1000 dθ/dz 0.0001	High base (m)	9/5		Average December	0		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	The temperature of the base (%)	12 2815					
Dew point the base $(1)^{1/2}$ Pressure top (mb)900High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)-4.302Thickness570.3Cloud typeStCloud classificationLowd θ/dz 0.0031Stability stateStability stateStability statestable	Dew point the base (°C)	4 6172		25000	- 200		
High top (m)779.8High top (m)779.8The temperature of the top (°C)8.2055Dew point the top (°C)-4.302Thickness570.3Cloud typeStCloud typeStCloud classificationLow dθ/dzOutputPressure under the base (mb)Might dp/dz0.0031Stability stateStability stateStability stateStability state	Pressure top (mb)	900					
Intermetative of the top ($^{\circ}$ C)8.2055Dew point the top ($^{\circ}$ C)-4.302Thickness570.3Cloud typeStCloud classificationLowd θ/dz 0.0031Stability stateStability stateStability stateStability state	High top (m)	77	9.8	20000	- 400 2		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	The temperature of the top ($^{\circ}$ C) 8 20'		2055	E 15000	e		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dew point the top (°C)	_4	302		Less u		
Cloud type St Cloud classification Low Pressure under the base (mb) 1000 $d\theta/dz$ 0.0031 $d\theta/dz$ under the base 0.0001 Stability state stable Stability state under the base Stability	Thickness	57	20.3	10000	- 000 E		
Cloud type St $\begin{array}{c c} & & \\ & \\ & \\ Cloud classification \\ & \\ & \\ & \\ & \\ & \\ & \\ & \\ & \\ & \\ $	Thereiss	57	0.5				
Cloud typeStCloud classificationLow $d\theta/dz$ 0.0031 $d\theta/dz$ 0.0031Stability statestability stateStability stateStability state				5000 - Comparison of Compariso	2)		
$0 \rightarrow -200$ 1000 1000 200 100 200 300 400 500 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 1000 <td colspan="2">Cloud type</td> <td>St</td> <td></td> <td>iperature (C)</td>	Cloud type		St		iperature (C)		
Cloud classificationLowPressure under the base (mb)1000 $d\theta/dz$ 0.0031 $d\theta/dz$ under the base0.0001Stability statestableStability state under the baseStable				-200 -100 0 100 200 300	400 500		
Cloud classificationLowPressure under the base (mb)1000 $d\theta/dz$ 0.0031 $d\theta/dz$ under the base0.0001Stability statestableStability state under the baseStable	Cloud alassift	Ŧ		Descente under the base (b)	1000		
Stability state stable Stability state under the base Stable		LOW 0.0031		$d\theta/dz$ under the base	1000		
	Stability state	0.0031 stable		Stability state under the base	Stable		

Followed Fig. 3.

American Research Foundation

وْتَمَرَّاتِ الْعُرَبِيَّةِ

http://arab.kmshare.net/



ISSN 2476-017X

Available online at http://proceedings.sriweb.org/akn/

5 CONCLUSIONS

The following conclusions were reached:

- 1. The largest number of clouds occurred in the months of January, February, October, November, and season winter, and the disappearance of clouds in the months of April, June, July, and August.
- 2. It was found that the high clouds were stable base and stable under the base, medium and low clouds stable base stable and unstable under the base.
- 3. When the air is humid, the stability helps to form fog at the surface or low clouds St near the surface of the earth.
- 4. If the air is dry, the stability helps to concentrate the sand and dust in the layers near the surface of the earth, which helps to reduce horizontal visibility.
- 5. When the air is wet, the instability helps to form the cumulus clouds and the accumulated pile, and therefore the occurrence of thunderstorms and the occurrence of precipitation in the form of showers and may be accompanied by cold sometimes.
- 6. If the air is dry, the currents of the air of instability cause the occurrence of air bumps in addition to it helps to raise sand and dust according to the nature of the earth.

References

Abd, H. F., (1997). *Repeat wind and its relationship to cloud cover*. Journal of Applied Department of Geography (Arabic).

Ackerman, S. A., and A Knox J., (2013). *Meteorology*. Jones and Bartlett Publishers, pp. 608.

- Ahrens, C. D., (2012). *Meteorology Today: An Introduction to Weather, Climate, and the Environment.* Cen gage Learning, pp. 640.
- Bidawid, J.M.T., (2003). *Thunderstorms in the western plateau Iraq*. Journal of the Faculty of Arts, Vol. 64.
- Carpal, A. R., (1989). Repetition thunderstorms in Iraq's. Basra University Magazine, Vol. 2.
- Dee D. P., (2011). The ERA-Interim reanalysis: configuration and performance of the data assimilation system. Q. J. R. Meteorology Soc. Vol.137, (pp. 553–597).
- Google maps, (2017). Baghdad station map.

https://www.google.com/maps/d/viewer?mid=12GkRVtOqKbeWV6KOIM1Z4NqeYcs&hl=en&l 1=33.35938787677278%2C44.42868942382813&z=12

- Jubouri, M., behind Hakeem, and Abdul-Jabbar, S. A., (2010). *Experiences in the process of monitoring, analysis and forecasting of air*. Jafar Metropolitan modern art print, Iraq, Baghdad, Mutanabi Street, Naaman Adhami Complex, pp. 304.
- Rogers, R.R., (1984). *The physics of clouds*. Translate by Mohiuddin Abbas, and Rashid Hammoud al-Naimi, Al-Mustansiriya University Press, Baghdad.

Samson, J.P., and Ahrens C. D., (2010). Extreme Weather and Climate. Cen gage Learning, pp. 528.

Schroeder, M. J., and Buck, C. C., (1970). Fire weather: a guide for application of meteorological information to forest fire control operations.

Stephen S., (1996). Encyclopedia of Climate and Weather. Oxford University.

Whiteman C. D., (2000). *Mountain Meteorology: Fundamentals and Applications*. Oxford University Press, pp. 376