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NUMERICAL APPLICATIONS TO WEATHER PREDICTION USING FINITE DIFFRENCE SCHEME IN ABUJA-NIGERIA

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Abstract: **In this Research, some problems associated with numerical weather prediction are discussed. we have been able to simulate some finite difference schemes to predict weather trends of Abuja. By analyzing the results from these schemes, it has shown that the best scheme in the finite difference method that gives a close accurate weather forecast is the trapezoidal scheme when comparing with sunshine, Rainfall, and windspeed. We use the trapezoidal scheme to stimulate the numerical weather data obtained from the federal Airports Authority. Finally using Matlab (2021a) to acquire subsequent numerical tendency.**

Keywords: **Rainfall, Weather Prediction, Forecasting, Numerical, Finite Difference, Windspeed.**

1. INTRODUCTION

Weather forecasting is one of the most complicated and exceedingly important problems of modern science. Despite evident progress in the few decades and transition from manual forecasting methods to numerical ones, there are still some specific problems that are being solved either by manual methods or methods based on direct man-computer interaction. An ever increasing need in more detailed information on the actual meteorological conditions and problems related to the use of manual labour are responsible from intensive development of numerical weather prediction (NWP).

A number of experience in mathematical modelling based on the achievements in the development of theoretical principles of dynamic meteorology and computational mathematics has been gained in recent decades. It is this experience that enables us today to create powerful systems for assimilation meteorological and oceanographic data with high spatial-temporal resolution, to develop high-quality efficient technologies of NWP and to do investigate on mathematical modelling of climate. And it all started a long time ago.

The roots of numerical weather prediction can be traced back to the work of Vilhelm Bjerknes, a Norwegian physicist who had been called the father of modern meteorology. In 1904, he published a paper suggesting that it would be possible to forecast the weather by solving a system of nonlinear partial differential equations.

A British mathematician Lewis Fry Richardson spent three years developing Bjerknes's techniques and procedures to solve these equations. Armed with no more than a slide rule and a table of logarithms, and working among the World War I battlefields of France where he was a member of an ambulance unit, Richardson computed a prediction for the change in pressure at a single point over a six-hour period. The calculation took him six weeks, and the prediction turned out to be completely unrealistic, but his efforts provided a glimpse into the future of weather forecasting (Le Roux, 2008).

2. CONCEPTUAL FRAMEWORK

The Conceptual framework of the weather forecast is to enhance the accuracy in weather prediction. An ideal forecasting system would incorporate user-end information. In recent years, the meteorological community has begun to realize that

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while general improvements to the physical characteristics of weather forecasting systems are becoming asymptotically limited, the improvement from the user end still has potential. The weather forecasting system should include user interaction because user needs may change with different weather. A study was conducted on the conceptual forecasting system that included a dynamic, user-oriented interactive component. This research took advantage of the recently implemented.

3. LITERATURE REVIEW

Because the output of forecast models based on atmospheric dynamics requires corrections near ground level, Model Output Statistics (MOS) were developed in the 1970s and 1980s for individual *forecast points* (locations). The MOS apply statistical techniques to post-process the output of dynamical models with the most recent surface observations and the forecast point's climatology. This technique can be correct for model resolution as well as model biases. Even with the increasing power of supercomputers, the forecast skill of numerical weather models only extends to about two weeks into the future, since the density and quality of observations together with the chaotic nature of the partial differential equations used to calculate the forecast introduce errors which double every five days. The use of model ensemble forecasts since the 1990s helps to define the uncertainty of forecast and extend weather forecasting further into the future than otherwise possible.Until the end of the 19th century, weather prediction was entirely subjective and based on empirical rules, with only limited understanding of the physical mechanisms behind weather processes. In 1901 Cleveland Abbe, founder of the United States Weather Bureau, proposed that the atmosphere is governed by the same principles of thermodynamics and hydrodynamics that were studied in the previous century. In 1904, VilhelmBjerknes derived a two-step procedure for model-based weather forecasting. First, a *diagnostic step* is used to process data to generate initial conditions, which are then advanced in time by a *prognostic step* that solves the initial value problem. He also identified seven variables that defined the state of the atmosphere at a given point: pressure, temperature, density, humidity, and the three components of the flow velocity vector. Bjerknes (1904) pointed out that equations based on mass continuity, conservation of momentum, the first and secondlaws of thermodynamics, and the ideal gas law could be used to estimate the state of the atmosphere in the future through numerical methods. With the exception of the second law of thermodynamics, these equations form the basis of the primitive equations used in present-day weather models.

4. MATERIAL AND METHOD

In this Research we shall be studying the use of finite difference methods especially the various schemes deduced by this method which include; the Euler Schemes, backward schemes, Matsuno Schemes etc. in generating weather parameters, therefore we shall evaluate the advection equations to simulate the schemes using previous known weather parameters and data set from Federal Airports Authority of Nigeria (FAAN), Abuja and data set deduced using the finite difference schemes.

ADVECTION EQUATIONS

The advection equation is the major model used in this weather prediction meanwhile other schemes were derived based on their stability, conditional stability and neutrality as it affect the weather trends in a local station. Many of the important ideas can be illustrated by reference to the advection equation which we write in the form

$$\frac{\partial u}{\partial t} + c\frac{\partial u}{\partial x} = 0 \qquad (2)$$

where c is a constant. We divide the (x, t) −plane into a series of discrete points $(i\Delta x, n\Delta t)$ and denote the approximate solution for u at this point by u_i^n. The possible finite-difference scheme for the equation is

$$\frac{u_i^{n+1} - u_i^n}{\Delta t} + c\frac{u_i^n - u_{i-1}^n}{\Delta x} = 0 \qquad (3)$$

We may rewrite (3) as

$$u_i^{n+1} = (1-\mu)u_i^n + \mu u_{i-1}^n, \qquad (4)$$

where $\mu = c\Delta t/\Delta x$. The advection equation Eq. (2) has a possible finite-difference scheme given by Eq. (3) and hence an analytic solution of the advection equation in the form of a single harmonic is

$$u(x,t) = Re[U(t)e^{ikx}] \qquad (5)$$

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Here $U(t)$ is the wave amplitude and k the wavenumber. Substituting this result into Eq. (2) gives

$$\frac{dU}{dt} + ikcU = 0, \qquad (6)$$

which has the solution

$$U(t) = U(0)e^{-ikct}, \qquad (7)$$

$U(0)$ which is the initial amplitude. Hence

$$u(x,t) = Re\left[U(0)e^{-ik(x-ct)}\right] \qquad (8)$$

as expected. The solution is finally expressed in Eq. (8).

However, in the von Neumann method we looked for an analogous solution of the finite-difference equation Eq. (4) which after substituting $u_j^n = Re\left[U^{(n)}e^{ikj\Delta x}\right]$, this reduces the entire scheme to the amplitude equation;

$$U^{(n+1)} = \lambda U^{(n)} \qquad (9)$$

which properly defines the amplification factor $|\lambda|$ and hence we can now study the behavior of the amplitude $U^{(n)}$ as n increases, the stability of the scheme and the frequency of the stability is given by;

$$p = \omega\Delta t \qquad (10)$$

$$\Delta t \leq \frac{1}{|\omega|} \qquad (11)$$

where p is the stability of the scheme, λ is the wavelength ω is the frequency and Δt the time interval and $\omega = 1,2,\dots,n$.

For Euler Scheme

$$\lambda = 1 + ip, \quad |\lambda| = (1+p^2)^{\frac{1}{2}}. \qquad (12)$$

at $p = 1$, we have

$$\lambda = 1 + i$$

This scheme is unstable$|\lambda| > 1$ for any $p > 0$

For Backward Scheme

$$\lambda = \frac{\left(1+\frac{1}{4}ip\right)}{(1+p^2)}, \quad |\lambda| = (1+p^2)^{-\frac{1}{2}} \qquad (13)$$

at $p = 1$, we have

$$\lambda = 0.5 + 0.125i$$

This scheme is stable

For Trapezoidal Scheme

$$\lambda = \frac{\left(1+\frac{1}{4}p^2+ip\right)}{\left(1+\frac{1}{4}p^2\right)}, \quad |\lambda| = 1. \qquad (14)$$

at $p = 1$, we have

$$\lambda = 1 + i/1.25$$

This scheme is always neutral.

For Matsuno Scheme

$$\lambda = 1 - p^2 + ip, \ |\lambda| = (1 - p^2 + p^4)^{\frac{1}{2}} \qquad (15)$$

at $p = 1$, we have

$$\lambda = i$$

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This scheme is stable, if $|p| \leq 1$.

For Heun Scheme

$$\lambda = 1 - \tfrac{1}{2}p^2 + ip, \ |\lambda| = \left(1 + \tfrac{1}{4}p^4\right)^{\frac{1}{2}}. \quad (16)$$

at $p = 1$, we have

$$\lambda = 0.5 + i$$

This is always $>$ 1 so that the Heun scheme is always unstable.

However, we select the real part minus the product of the imaginary part of the deduced wavelength with itself for the resultant solution of

$$U^{(n+1)} = \lambda U^{(n)}$$

as

$$U^{(n+1)} = Re\left[\lambda U^{(n)}\right]. \quad (17)$$

NUMERICAL SOLUTIONS

Summary of Weather Data Set From Federal Airport Authority of Nigeria, Abuja Station

Table 1: Dataset from the Federal Airport Authority of Nigeria for Abuja Station

Annual Climatological Summary **Year: 2021**

Station: ABUJA, NG **Elev: 343.1ft. Lat: 09.15ºN Lon: 07.00ºE**

STATION NUMBER	STATION NAME	ELEV	LAT	LONG	DATE	RelHum	TMAX	TMIN	RAINFALL	SUNSHINE HRS	WIND SPEED	WIND DIRECTION
65125	Abuja	343.1	09.15'N	07.00'E	201501	43	35.5	19.3	0	7.3	2.9	N
65125	Abuja	343.1	09.15'N	07.00'E	201502	50	37.4	23.2	0.6	7.5	3.7	NE
65125	Abuja	343.1	09.15'N	07.00'E	201503	62	37.7	25	7.5	8.2	3.5	NE
65125	Abuja	343.1	09.15'N	07.00'E	201504	62	36.6	25.7	74.2	7.5	5	E
65125	Abuja	343.1	09.15'N	07.00'E	201505	76	35.8	24.6	109.2	7.4	4.9	SW
65125	Abuja	343.1	09.15'N	07.00'E	201506	81	30.2	23.2	267.2	7.5	4.7	S
65125	Abuja	343.1	09.15'N	07.00'E	201507	86	28.7	22.3	314.8	4.5	3.7	SW
65125	Abuja	343.1	09.15'N	07.00'E	201508	87	28.7	22.5	278.3	5.2	4.2	NW
65125	Abuja	343.1	09.15'N	07.00'E	201509	83	29.5	22.2	258.4	5.2	4.1	W
65125	Abuja	343.1	09.15'N	07.00'E	201510	78	30	21.8	238.2	6.8	3.3	NW
65125	Abuja	343.1	09.15'N	07.00'E	201511	64	33.7	21.6	Trace	9.2	3	E
65125	Abuja	343.1	09.15'N	07.00'E	201512	36	35	17.2	0	8.8	3.2	NE

Source: FAAN

Solution of Sunshine Hours Prediction Using Finite Difference Scheme

Using Eq. (17) and sunshine hours value from Table 1 for the first month, we compute the predicted values for the different schemes.

$$U^{(n+1)} = Re\left[\lambda U^{(n)}\right]$$

For Heun Scheme

where $\lambda = 0.5 + i$ and $U^{(n)} = 7.3$ for sunshine hours

then

$$U^{(n+1)} = Re[7.3(0.5 + i)] = Re[3.65 + 7.3i] = 3.65 - 1 = 2.65$$

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For Matsuno Scheme

where $\lambda = i$ and $U^{(n)} = 7.3$ for sunshine hours

then

$$U^{(n+1)} = Re[7.3(i)] = Re[7.3i] = 0$$

For Trapezoidal Scheme

where $\lambda = 1 + i/1.25$ and $U^{(n)} = 7.3$ for sunshine hours

then

$$U^{(n+1)} = Re[7.3(1 + i/1.25)] = 7.66 - 1 = 6.66$$

For Backward Scheme

where $\lambda = 0.5 + 0.125i$ and $U^{(n)} = 7.3$ for sunshine hours

then

$$U^{(n+1)} = Re[7.3(0.5 + 0.125i)] = 4.6 - 1 = 3.6$$

For Euler Scheme

where $\lambda = 1 + i$ and $U^{(n)} = 7.3$ for sunshine hours

then

$$U^{(n+1)} = Re[7.3(1 + i)] = 7.3 - 1 = 6.3$$

The results of predicted sunshine hours for all the 12 months of the year are shown in Table 2

Table 2: Sunshine Hours 2022 (SHRs 2022)

Months	Wavelength λ					Amplitude $U^{(n)}$	Schemes $U^{(n+1)}$(SHRs 2022)				
ω	Heun	Matsuno	Trapezoidal	Backward	Euler	Sunshine 2021	Heun	Matsuno	**Trapezoidal**	Backward	Euler
1	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	7.3	2.65	0	**6.66**	3.6	6.3
2	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	7.5	2.75	0	**6.86**	3.7	6.5
3	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	8.2	3.1	0	**7.56**	4.08	7.2
4	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	7.5	2.75	0	**6.86**	3.7	6.5
5	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	7.4	2.7	0	**6.76**	3.68	6.4
6	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	7.5	2.75	0	**6.86**	3.7	6.5
7	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	4.5	1.25	0	**3.86**	2.2	3.5
8	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	5.2	1.6	0	**4.56**	2.58	4.2
9	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	5.2	1.6	0	**4.56**	2.58	4.2
10	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	6.8	2.4	0	**6.16**	3.38	5.8
11	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	9.2	3.6	0	**8.56**	4.58	8.2
12	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	8.8	3.4	0	**8.16**	4.38	7.8

From the above table, the selection of the scheme to represent the model forecasting for the sunshine hours for 2022 is based on the trend of the scheme whose result is closest to the previous year i.e. 2021 and hence among all five schemes in the table it is very obvious that aside Euler's (Forward) Scheme which is the second closest, the Trapezoidal Scheme is the closest to the given sunshine hours in 20. Hence we use the Sunshine Hours predicted using the Trapezoidal Scheme.

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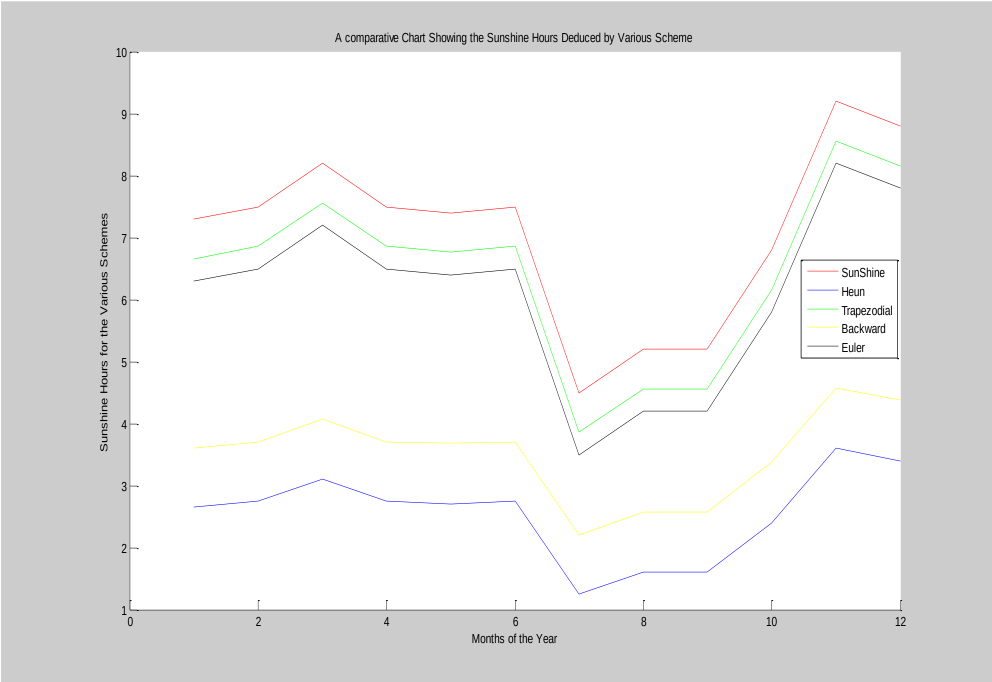

Figure 1: A Comparative Chart Showing the Sunshine Hours Deduced by Various Schemes in one year

Observing our choice Trapezoidal Scheme from Figure 1 above it is obviously showing that the sunshine hours between January and May will be relatively high and will begin to decrease from June and start to rise again around September and falls again in December.

Solution of Wind Speed Prediction Using Finite Difference Scheme

Using equation (17) and wind speed value from Table 1 for the third month, we compute the predicted values for the different schemes.

$$U^{(n+1)} = Re[\lambda U^{(n)}]$$

For Heun Scheme

where $\lambda = 0.5 + i$ and $U^{(n)} = 3.5$ for wind speed

then

$$U^{(n+1)} = Re[3.5(0.5 + i)] = Re[1.75 + 3.5i] = 1.75 - 1 = 0.75$$

For Matsuno Scheme

where $\lambda = i$ and $U^{(n)} = 3.5$ for wind speed

then

$$U^{(n+1)} = Re[3.5(i)] = Re[3.5i] = 0$$

For Trapezoidal Scheme

where $\lambda = 1 + i/1.25$ and $U^{(n)} = 3.5$ for wind speed

then

$$U^{(n+1)} = Re[3.5(1 + i/1.25)] = 3.86 - 1 = 2.86$$

For Backward Scheme

where $\lambda = 0.5 + 0.125i$ and $U^{(n)} = 3.5$ for wind speed

then

$$U^{(n+1)} = Re[3.5(0.5 + 0.125i)] = 2.7 - 1 = 1.7$$

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For Euler Scheme

where $\lambda = 1 + i$ and $U^{(n)} = 7.3$ for wind speed

then

$$U^{(n+1)} = Re[3.5(1 + i)] = 3.5 - 1 = 2.5$$

The results of predicted wind speed for all the 12 months of the year are shown in Table 3

Table 3: Wind Speed 2022 (WS 2022)

Months	Wavelength λ					Amplitude $U^{(n)}$	Schemes $U^{(n+1)}$(WS 2016)				
ω	Heun	Matsuno	Trapezoidal	Backward	Euler	Wind Speed'15	Heun	Matsuno	**Trapezoidal**	Backward	Euler
1	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	2.9	0.45	0	**2.26**	1.4	1.9
2	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	3.7	0.85	0	**3.06**	1.8	2.7
3	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	3.5	0.75	0	**2.86**	1.7	2.5
4	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	5	1.5	0	**4.36**	2.48	4
5	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	4.9	1.45	0	**4.26**	2.4	3.9
6	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	4.7	1.35	0	**4.06**	2.3	3.7
7	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	3.7	0.85	0	**3.06**	1.8	2.7
8	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	4.2	1.1	0	**3.56**	2.08	3.2
9	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	4.1	1.05	0	**3.46**	2	3.1
10	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	3.3	0.65	0	**2.66**	1.49	2.3
11	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	3	0.5	0	**2.36**	1.48	2
12	$0.5 + i$	i	$1 + i/1.25$	$0.5 + 0.125i$	$1 + i$	3.2	0.6	0	**2.56**	1.58	2.2

From the above table, the selection of the scheme to represent the model forecasting for the Wind Speed for 2022 is based on the trend of the scheme whose result is closest to the previous year i.e. 2021 and hence among all five schemes in the table it is very obvious that aside Euler's (Forward) Scheme which is the second most closest, the Trapezoidal Scheme is the most closest to the given Wind Speed in 2021. Hence we use the Wind Speed predicted using the Trapezoidal Scheme.

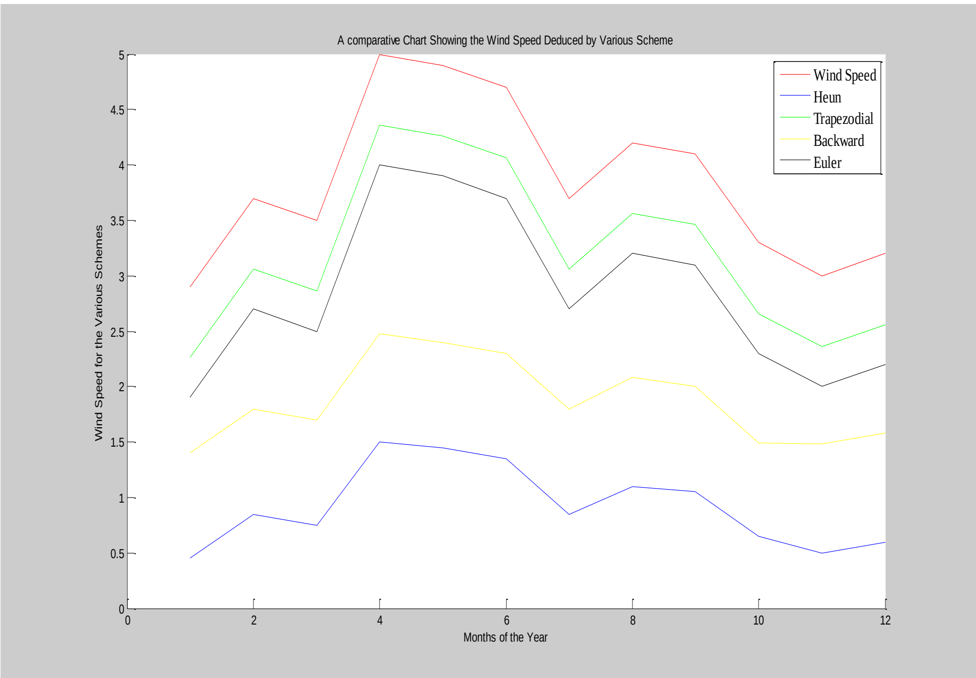

Figure 2: A Comparative Chart Showing the Wind Speed Deduced by Various Schemes in one year

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Observing our choice Trapezoidal Scheme from Figure 2 above it is obviously showing that the wind speed will increase from January to May and will begin to decrease from June and start to rise again around September and falls again in November.

The results of predicted rainfall for all the 12 months of the year are shown in Table 4

Table 4: RainFall 2022 (RF 2022)

Months	Wavelength λ					Amplitude $U^{(n)}$	Schemes $U^{(n+1)}$(RF 2016)				
ω	Heun	Matsuno	Trapezoidal	Backward	Euler	Rain Fall '15	Heun	Matsuno	**Trapezoidal**	Backward	Euler
1	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	0	-1	0	**-0.64**	-0.02	-1
2	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	0.6	-0.7	0	**-0.04**	0.28	-0.4
3	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	7.5	2.75	0	**6.86**	3.7	6.5
4	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	74.2	36.1	0	**73.56**	37	73.2
5	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	109.2	53.6	0	**108.56**	54.58	108.2
6	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	267.2	132.6	0	**266.56**	133.58	266.2
7	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	314.8	156.4	0	**314.16**	157.38	313.8
8	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	278.3	138.15	0	**277.66**	139	277.2
9	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	258.4	128.2	0	**257.76**	129	257.4
10	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	238.2	118.1	0	**237.56**	119	237.2
11	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	Trace	Trace	Trace	**Trace**	Trace	Trace
12	$0.5+i$	i	$1+i/1.25$	$0.5+0.125i$	$1+i$	0	-1	0	**-0.64**	-0.02	-1

From the above table, the selection of the scheme to represent the model forecasting for the Rain Fall for 2022 is based on the trend of the scheme whose result is closest to the previous year i.e. 2021 and hence among all five schemes in the table it is very obvious that aside Euler's (Forward) Scheme which is the second most closest, the Trapezoidal Scheme is the most closest to the given Rain Fall in 2021. Hence we use the Rain Fall predicted using the Trapezoidal Scheme.

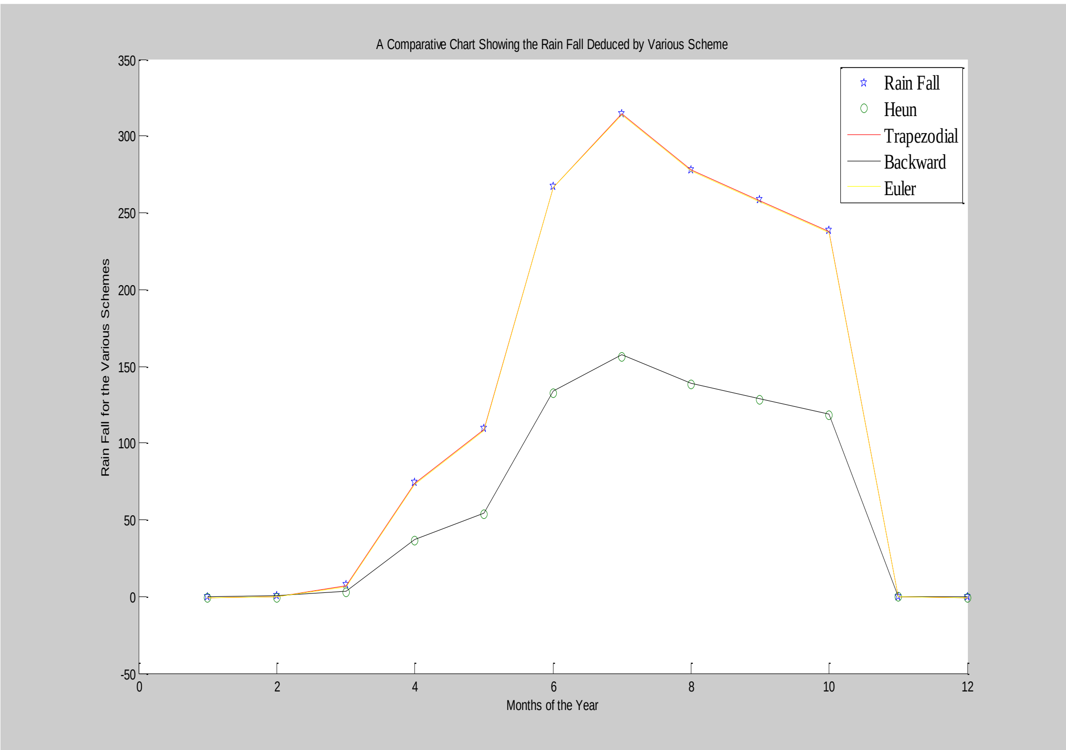

Figure 3: A Comparative Chart Showing the Rain Fall Deduced by Various Schemes in one year

Observing our choice Trapezoidal Scheme from Figure 3 above it is obviously showing that the rain fall will start around late February and be very high in June till around October then will begin to reduce and dry season will set in from November.

Summary of Predicted Weather Data Set From Compatible Finite Difference Scheme

Table 4: Compatible FDM Numerical Weather Prediction Year: 2022

Station: ABUJA, NG **Elev: 343.1ft. Lat: 09.15ºN Lon: 07.00ºE**

STATION NUMBER	STATION NAME	ELEV	LAT	LONG	DATE	RelHum	TMAX	TMIN	RAINFALL	SUNSHINE HRS	WIND SPEED	WIND DIRECTION
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201601	**42.36**	**34.86**	**18.66**	**-0.64**	**6.66**	**2.26**	NE
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201602	**49.36**	**36.76**	**22.56**	**-0.04**	**6.86**	**3.06**	N
65125	**Abuja**	**343.1**	**09.15' N**	**09.24'W**	201603	**61.36**	**37.06**	**24.36**	**6.86**	**7.56**	**2.86**	NW
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201604	**61.36**	**35.96**	**25.06**	**73.56**	**6.86**	**4.36**	NE
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201605	**75.36**	**35.16**	**23.96**	**108.56**	**6.76**	**4.26**	NE
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201606	**80.36**	**29.57**	**22.56**	**266.56**	**6.86**	**4.06**	N
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201607	**85.36**	**28.06**	**21.66**	**314.16**	**3.86**	**3.06**	NE
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201608	**86.36**	**28.06**	**21.86**	**277.66**	**4.56**	**3.56**	NW
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201609	**82.36**	**28.86**	**21.56**	**257.76**	**4.56**	**3.46**	W
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201610	**77.36**	**29.36**	**21.16**	**237.56**	**6.16**	**2.66**	E
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201611	**63.36**	**33.06**	**20.96**	**Trace**	**8.56**	**2.36**	W
65125	**Abuja**	**343.1**	**09.15'N**	**09.24'W**	201612	**35.36**	**34.36**	**16.56**	**-0.64**	**8.16**	**2.56**	NE

Table 4 shows the values of the predicted weather data values obtained by using the trapezoidal scheme. This compared favourably with the real weather data values collected from Federal Airport Authority of Nigeria (FAAN) Abuja Station shown on Table 1.

5. CONCLUSION

Weather prediction for a particular station is mostly accurate in the advent of recursive use of previous predictions or measurement. This research has unveiled that studying the weather trends helps in predicting future weather attenuation using numerical solutions deduced by finite difference method. The finite difference method has been used to deduce compatible models for automated attenuation of various parameters involved in the weather formation with the use of MATLAB(2021) in predicting future weather trends. The derivation of the models based on the finite difference method gives a high level of significance. In conclusion, the weather prediction for a station was flexibly obtained accurately prior to the use of previous determined or forecasted data and a compatible C-grid staggered finite difference method.

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