Meteorological variables and forecasting: Review

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Abstract—Meteorology is the science that deals with the atmosphere and its movement. Meteorological variables observations and forecasting are made for a variety of reasons. There are different applications for different timescale and space scales for averaging, station density and resolution of phenomena. In this paper the review of different techniques used for meteorological variables and it's forecasting.

Keywords—Meteorology.

I. INTRODUCTION

Meteorology is a branch of the atmospheric sciences which includes atmospheric chemistry and atmospheric physics, with a major focus on weather forecasting. Meteorology focuses on the atmospheric variables (e.g., temperature, Lightening, humidity, etc.) related to weather forecasting and current or near-future conditions.

Major theoretical and technological advancements occurred in the twentieth century [1]. The development of radar (1935) coupled with increasing upper-air observations from weather balloons and aviation led Carl-Gustav Rossby (1937) to introduce methods for analyzing the upper-level atmospheric wave structures that now bear his name. Based on earlier mathematical atmospheric modeling efforts, John von Newmann and his colleagues in 1950 produced the first computer-generated weather forecasts (Moran, 2006). Weather satellites (1960), Doppler radar (1990), and other technological innovations have continued to shape our understanding and forecasting of atmospheric processes [1]. The meteorological paramete rs (pressure, temperature relative humidity) used to calculate radio refractivity for Minna were provided by Center for Basic Space center (CBSS) [2].

II. SCALES IN ATMOSPHERIC PROCESSES

Atmospheric processes play important roles in shaping the Earth's energy and water cycles Weather phenomena are analyzed at a variety of scales of motion. There are four scales of motion that will be focused on largest to smallest land area.

- The global scale
- synoptic scale
- Mesoscale
- Microscale.

A. The global scale:

Global scale meteorology is the study of weather patterns related to the transport of heat from the tropics to the poles. It includes events that impact large areas of the global and last for weeks and even months at a time. Features such as the polar jet stream can be found just about any time somewhere. The polar jet stream is an example of a global scale phenomenon. Its influence circles the globe and influences the polar and middle latitudes with varying extent throughout the year. Another example of a global scale phenomenon is the position of subtropical highs. The position and strength of subtropical highs can influence weather across the globe.

B. synoptic scale:

The next scale is the synoptic scale. Synoptic scale meteorology predicts atmospheric changes at scales up to 1000 km and 105 sec (28 days), in time and space. Phenomena on the synoptic scale can span over 1000s of kilometers and last for many days. Mid-latitude cyclones, hurricanes, and fronts are examples of synoptic weather events. A weather forecaster looks closely at the global scale and synoptic scale when making weather forecasts beyond 1 day out.

C. The mesoscale:

It is the next scale. Mesoscale meteorology is the study of atmospheric phenomena that has horizontal scales ranging from 1 km to 1000 km and a vertical scale that starts at the Earth's surface and includes the atmospheric boundary layer, troposphere, tropopause, and the lower section of the stratosphere. Mesoscale timescales last from less than a day to weeks. These weather phenomena typically last from an hour to a day and influence 10s to 100s of kilometers of distance. Examples of mesoscale weather events include thunderstorms (especially complexes of thunderstorms such as MCCs and squall lines), differential heating boundaries (i.e. sea breeze), and mesolows. A weather forecaster will integrate an increasing amount of mesoscale analyses into their forecasting technique when making short term forecasts such as over the next several hours to 1 day.

D. **Microscale:**

This is a last scale of motion. In the microscale meteorology is the study of atmospheric phenomena on a scale of about 1 kilometer (0.62 mi) or less. Individual thunderstorms, clouds, and local turbulence caused by buildings and other obstacles (such as individual hills) are modeled on this scale.

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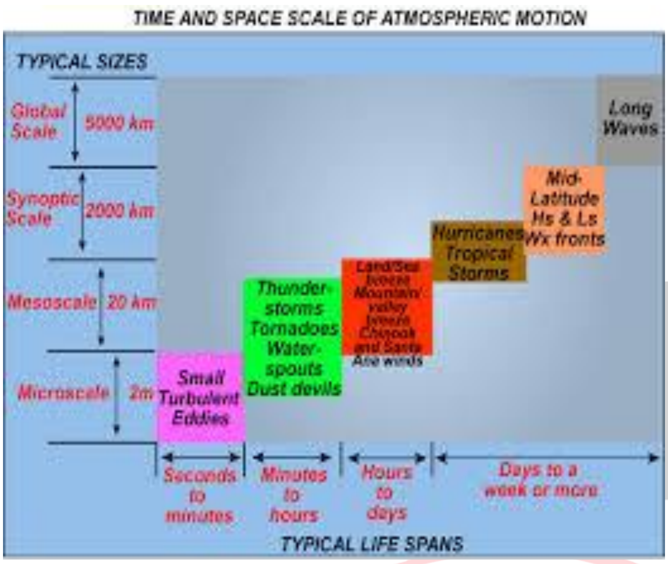
These events occur typically from minutes up to an hour and cover small distances such as less than 10 kilometers. Examples of microscale phenomena include tornadoes, rainbows, convective updrafts, and downdrafts. This scale is important since it is the scale most experienced with the eyes in-person. These are the weather events that are witnessed when going outside.



III. Trends in Annual Mean of Meteorological Parameters –

Data on temperature from 2002 to 2009 shows an overall increasing trend with a minimum of 19.7 ° C recorded in 2002 and a maximum of 23.3 ° C during 2010. The coefficient of correlation of temperature and time is 0.50 implying that temperature has a significant positive relationship with time. Therefore a temperature change has to be taken as a significant parameter in determining the agriculture outputs in future. The variations in temperature are rather smooth with time as can be seen from the figure, except during 2002- 2003 and 2009-2010 where a steep increase was observed. The NOAA Climatological Data Centre also has identified 2010 as the warmest of all the years since 2000 globally.

A. *Trend in Relative Humidity:*

Relative Humidity records from Tabuk between 2002 and 2011 shows a decreasing trend with the highest value of 39.48 % recorded in 2002 and minimum value of 33.63 % in 2010. RH also exhibits a slow variability with time. The coefficient of correlation also shows a negative value (-0.64) indicating that there is a decrease in RH with time.

B. *Trend in Evapo Transpiration:*

Trend in Rainfall Statistical record of rainfall in Tabuk region shows an increasing trend with time with a positive correlation coefficient of 0.43. The annual mean rainfall shows a peak in the year 2010 with an average of 44.4 mm followed by the year 2006 with 26.6 mm. Extreme rainfall (24 hour) was observed during 2010 (38.8 mm), followed by 22.2 mm and 8 mm in 2 days in 2009.

IV. Changes in Weather

•Expected increase in temperatures

: Geographical location already places the country in heat surplus zone of earth.

•Expected changes in precipitation patterns:

One most imminent threat from climate change is altered monsoon intensity in the Indo-

•Potential impacts on natural resources: The increases in temperature and late / intensive monsoon rains will:

– Further enhance the ongoing process of land degradation.

- Cause increasing glacier out- falls and enhances landslides.
- Further increase siltation loads downstream.
- Bring changes in species patterns (fast growing species are expected to take over and will affect the native biodiversity).
- Cause shift in special boundaries (shifts of conifers and alpine species towards higher altitude are expected).[3]

V. Conclusion

This paper presented a review on Meteorological variables and forecasting under different time-scales. Common meteorological parameters measured at most weather stations include maximum, minimum, and average temperature, maximum relative humidity, and wind speed. There are four scales of Atmospheric Processes and two Trends in Annual Mean of Meteorological Parameters Each of the parameters depends upon the remaining parameters, and the underlying relationships are highly complex, nonlinear, and have spatial and temporal variations.

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