

# A study based on Role of Cloud Computing in Climate Forecasting

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## ABSTRACT

Cloud computing help us to improve the ability of delivery, data storage, and propagation through various applications or platforms, allowing flexible cooperation and statistics used by the scientists'. This paper reviews about basic cloud computing terminology and defines regional climate forecast modeling based on clouds. An outline for weather forecasting system based on a real-time cloud that could be set up in Mauritius will be proposed. The Gulf MetOcean System for forecast provides an example of using cloud computing resources that is regionally diverse to overcome infrastructure challenges and limits. All the teams of Met Office are busy in conducting today's happenings and the main focus of Lab on creating modules for services that have to be conducted tomorrow. To discuss about the high processing speed of big data using cloud computing Climate Engine outlined briefly. To create virtual computing cluster for the CESM simulations on the AWS EC2, Star Cluster is used. Demonstration of the technologies of Cloud Computing like optimization techniques or MapReduce to analyze weather data or simulate temperature distributions. Although rare severe weather is present, CloudCast defines cloud platforms named as pay-as-yougo to remove devoted computing road and rail network.

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## 1. Introduction

Now Days, cloud computing has an important role in the day to day life of engineers and scientists, along with the rising capabilities of digital devices, workstations and mobile phones. Cloud computing help us to improve the ability of delivery, data storage, and propagation through various applications or platforms, allowing flexible cooperation and statistics used by the scientists'. Now in routine life, it helps the prevalent accessibility or auditory circulation and captured data, like streaming movies or music available from saleable vendors. The resources of the cloud computing provide as the spine to numerous web-based applications or the web pages or the web sites that the public is generally used, as well as data distribution systems that distribute climate information or key weather forecast or severe warm weather. This paper reviews about basic cloud computing terminology and defines regional **climate forecast** modeling based on clouds. Its very interesting for the cloud computing world and engineers to access data and how they serve data and models and they communicate in the innovative way, scrutinize and use the services of cloud platform. Resource sharing as well as distributed computing of models and scientific results that has to be shared are very common concepts these days in the field of science. Now we can easily do this by using remote repositories code. For share files and store files we use cloud storage system and can also communicate in groups by using one platform that is shared by all.[1]

This article defines an urgent computing problem that is the method for simulation based upon **ensemble** with metocean events forecasting. The method tells the developed data-flow construction conceptual basis for the ensemble forecasting based upon simulation. The architecture of data processing based on ensemble implementing the environment of cloud computing CLAVIRE which can extend provisioning and scheduling of main computing resources was developed by it. At last the part of St. Petersburg "a flood preventing

software" was the solution for Baltic Sea water level forecasting for ensemble. UC-task an extreme metocean events simulated by ensemble comprehensively supported by this approach. The techniques based upon ensemble are also relying with data-intensive tasks. Cloud computing environment with the extended UC scheduling modules used by this developed architecture. [2]

With the arrival of global warming and other weather disorders, numerous countries are facing severe climate surroundings like tsunami which lead to life loss and damage of property at high pace. Forecasting these surroundings with old forecast methods are not capable because these systems are capable of predicting over hours and also require large regions. However, some forecasting systems are also available that are capable of localized sensors with facilities of **cloud computing** that can work for small regions and also has real time utility. These systems uses various techniques like regression analysis, time series, Fuzzy logic, and neural networks. Recently, Mauritius has also faced major problems due to drastic flash floods which could not be predicted with the conventional weather forecasting system in place in the country. The author in this paper first discussed about climatic profile in Mauritius, the existing weather forecasting systems as well as the recent issues that Mauritius has faced due to dramatic climatic conditions that could not be predicted on time. A detailed analysis of the techniques used in real-time cloud based weather forecasting systems will then be made and eventually a weather forecasting system based upon real-time cloud framework that could be set up in Mauritius will be proposed. [3]

In another review the author projected RPS Group, PLC, ASA which had a contract to develop an forecasting system named Meteorological and Oceanographic (MetOcean) operational system. After passing all the stages of development like designing and testing phase, it was implemented in Dubai that is its own town. But the systems reliability was challenged

by the network problems and infrastructure lacking, so it was unable to make automated predictions in routine. Then a big decision was taken to shift all of its challenges to the cloud. Mainly the Web services of Amazon, which is responsible for the many high capability operations of computing all over the globe. The process of implementing cloud at place of system makes many benefits like cost-deductive implementation and testing of updates, rapid development and co ordinations in parallel behavior. The infrastructure of Amazon have continually upgraded and reduced the initial runtime from 5h to 2h in 2013. A forecast system named as Gulf MetOcean gives an example of cloud computing resources of utilize regional diverse for diminish limits of infrastructure where scientific computing is unavailable and high performance is also a challenge. Then it realizes its actual mission of being scalable and efficient global MetOcean forecasting system and to provide cost-effective and valuable option for meeting user requirements all over globe such as MetOcean forecasting. [4]

According to the authors a Lab named "Met Office Informatics" placed at the United Kingdom's as a new group for the National Weather Service. In this group scientists, designers and engineers all are expert in the field of software are collaborated. The main objective of this lab is to make data of environmental science useful which it gets through the experiments and inventions so that they can get working prototypes from concepts as early as possible. Its operations are also linked with the Met Offices operational and research teams. All the teams of Met Office are busy in conducting today's happenings and the main focus of Lab on creating modules for services that have to conduct tomorrow. For achieving these goals they use new technologies of cloud computing. Lab gets its first success in project that is used for the visualization of 4D web browsers for numerical weather forecast data of high resolution. [5]

In next article the author said "A big amount of data is being generated by Numerical weather forecast system." This article considered that there are 2 use cases available in which the techniques of cloud computing can use:

- The routine propagation of output data that is being modeled in a well-timed manner;
- The prerequisite of a large investigate facts.

There is a center called European Center for Medium-Range Weather Forecasts(ECMWF), which is both a 24/7 services provider and also a institute for research and it is an intergovernmental organization. It proposed a data in context with which above discussion pretends. [6]

This article proposed another way that is simulated climate model applied on cloud computing environment that is available commercially. The team test the reliability and performance by implementing various models like CESM(Community Earth System Model), model developed by NCAR (National Center for Atmospheric Research) in the United states called flagship climate model, AWS(Amazon web service) EC2 which is a environment for cloud computing provided by Amazon.com. To develop virtual computing cluster for the CESM simulations on the AWS EC2 it uses the Star Cluster. The time spent on the AWS EC2 virtual cluster by CESM simulation is compared with the time spent on the local computing cluster that is dedicated local and has high performance powers with InfiniBand connections almost for

one year. The CESM technique is very useful and efficient because of AWS EC2 virtual cluster CPU cores about 64 cores. At a spatial resolution of 1.9° latitude by 2.5° longitude the standard configuration of CESM has increased from 16 to 64 cores and reduces the running time of wall clock by 50% and with the linear scaling. But the communication latency becomes major problem in this. Past 64 cores, it prevails over the benefit of distributed computing and the speed of parallel processing becomes constant.[7]

Another article specifies that the scarcity of durable interpretations, mainly in context to assorted atmosphere or ground, may obstruct including weather information at suitable spatial parameters for scientific and administrative research. To solve the problems of scientists and land managers and to enhance early warning systems and empowering the scientific knowledge many products like climate and remote sensing systems had developed. But this type of data is almost not approachable for the users of the broader sector and hence required big data for computational purposes. Along with these many other platforms like Google Earth Engine, Google's parallel cloud computing platform are also used for visualize, share, download, process or manipulate weather and remote sensing real time information. To overcome all the above computational barriers a new web based application is going to use that is called Climate Engine (<http://ClimateEngine.org>). It has the capabilities of processing of big data at very high speed using cloud computing. There are various examples to show the applications of Climate Engine like ecology and agriculture, famine fire, etc are the types of weather research. On demand parallel cloud computing has created vast abilities for remote sensing and climate forecasting and which can be further used for natural resource monitoring and understanding procedure. [8]

This article illustrates an inventive data study for climate using Cloud Computing; It involves two terms that is Data science services of system as well as application software's for the study of extreme events of climate. This paper uses technologies of cloud computing like optimization techniques or MapReduce for examine climate data or for temperature distribution simulations. It discussed two main cases: In he first case main focus is on temperature forecast through the historical data of London, Singapore and Sydney, so that they can compare the original past trend and forecasted data. In the second case it analyze numerical data by using 5 step MapReduce and visualizations by 8 step process. The main reson of doing so is to check temperature distributions of the United States at the time of polar vertex that is before after and during the process, along with the experience during or after the floods in United kingdom. The technique of optimization is used to improve the performance that causes 100 nodes within Cloud and Non-Cloud. Performances are also check without optimization. And with optimization performance lies within 20% to 30% upto 60 nodes in cloud. [9]

Another review paper discovers that although large regions forecast is possible after few hours these days but they cannot use much in severe climate. The author presents new term that is **CloudCast** here. This is an application that is used forecast weather on the short term basis and can also access users present location. Although rare severe weather is present, **CloudCast** defines cloud platforms named as pay-as-yougo to remove devoted computing infrastructure. It has 2

parts: 1) A framework that is used to maintain a link between radars and resources of cloud, and 2) To generate short term climate forecast accurately it use Nowcasting algorithm. This study is related with the CloudCast's design, hence it need specific staging criteria of cloud. As a result it achieves sufficient throughput in the serial transfer but in the parallel transfers it has problem for the real time mobile casting. This article also talks about the accuracy of the forecasting and depict accuracy of 10 minutes in coming days. At last CloudCast executes successfully on campus radar and it was live and a fifteen minute Nowcast was delivered on a client's mobile in less than two minutes following the start of the data sampling. [10]

## 2. Conclusion

This review paper is for the readers to be aware of various aspects of Role of cloud computing in Climate Forecasting. A detailed analysis of the techniques used in real-time cloud

based weather forecasting systems. Resource sharing as well as distributed computing of models and scientific results that has to be shared are very common concepts these days in the field of science. Now we can easily do this by using remote repositories code. For share files and store files we use cloud storage system and can also communicate in groups by using one platform that is shared by all. However, some forecasting systems are also available that are capable of localized sensors with facilities of **cloud computing** that can work for small regions and also has real time utility. On demand parallel cloud computing has created vast abilities for remote sensing and climate forecasting and which can be further used for natural resource monitoring and understanding procedure. Simulated climate model applied on cloud computing environment that is available commercially and it prevails over the benefit of distributed computing and the speed of parallel processing becomes constant.

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