

Geographical information system in meteorology environmental sciences essay

[Environment](#), [Ecology](#)



Despite a batch of attempts by scientists in specifying what geographical information system (GIS) is, definitions still vary and sometimes can add to confusion. Many definitions can be referred to in this essay but we will restrict ourselves to two definitions. The first 1 is by Longly et Al, A (2004) who define GIS by mentioning to it as the survey `` of the cardinal issues originating from the creative activity, managing, storage and usage of geographic information " (p. 3) . The 2nd definition is by Heywood (2006) who defines GIS as a `` system for capturing, hive awaying, look intoing, incorporating, pull stringsing, analysing and exposing informations which are spatially referenced to the Earth " (p. 9) .

In his of import book, Mirror Worlds, Gelernter (1992) argues that `` we are populating in a universe where the existent and the digital universes are meeting " and that `` you will look into a computing machine screen and see world. Some portion of your world- the town you live in, the company you work for, your school system, the metropolis hospital- will hang at that place in a crisp coloring material image, abstract but recognizable, traveling subtly in a 1000 topographic points " (p. 1) . The rise of smart systems is seting more information at our fingertips. Our nomadic phones, loaded with a assortment of applications, can draw all of this information together to state us where precisely we are and how far we are from a nice cup of java. We can book a vacation and acquire day-to-day updates of the conditions conditions at our finish. Of class, there are wider and arguably more of import utilizations of smart systems beyond these strictly superficial applications.

The usage of geographical information systems (GIS) has been at the really head of Gelernter 's (1992) vision of the 'mirror universe ' . As a affair of fact the usage of such systems stems from the inflow of computing machines into America during the sixtiess. Harmonizing to Chapman and Thornes (2003) these early systems were used to, `` supply a simplified position of the existent universe by exposing digital particular information as dynamic electronic maps " (p. 314) . They go on to reason that GIS has now, `` evolved into a powerful direction tool used for capturing, patterning, analyzing and exposing spacial informations " (p. 314) . Here we see a clear illustration of the digital and the existent universes clashing with potentially illimitable third applications for the information gathered.

This essay we will see the usage of GIS specifically in the field of weather forecasting. In this regard the first subdivision will supply a brief debut to some of the issues here and besides show a conceptual model that will function to steer the subsequent research. The 2nd subdivision will see the existent application of GIS in weather forecasting, pulling on specific illustrations of its usage. How is the information collected and how is it used? What are some of the possible chances and challenges that it presents? These are merely some of the inquiries that this subdivision will trust to reply. The concluding subdivision will be a decision that will try to pull the statements together.

Section 1: Gilbert and Meteorology

Planet Earth is experiencingA of all time altering climatic events which are doing, about every twenty-four hours, the headlines of the intelligence

requiring, therefore, more surveys and research. Although the survey of conditions and climate is indispensable because exposing climatic information and information is of an affair of involvement for the populace for different grounds, it is even more of import for meteorologists as it constitutes a really important beginning of information for their field.

Tveit et al (2008) argue that the public demand for information on assorted climatological, meteoric, hydrological and environmental issues requires, `` multifacet, cross-discipline information or cognition so that quantitative methodological analysis and tools are necessary to pull out, analyse, form and measure the needed information " (p. 6) . They go on to reason that in this context, GIS has emerged as a powerful tool due to the fact that it makes it possible to, `` combine all necessary processes for visual image, integrating, flexible combination and storage of information for different information sets " (p. 6) . Thorne (2005) observes that over the past decennary, the usage of GIS has experienced an rush in involvement due to the falling monetary values of consumer GIS merchandises, faster calculating treating power and the rise of the cyberspace. This has resulted in, `` a set of fast real-time bespoke solutions and visual images for many national meteoric services and terminal users " (p. 1) .

However, Van der Wel (2008) argues, the usage of GIS in weather forecasting is being held back for a figure of grounds. He observes that, `` the credence of commercial GIS tools beyond climatology is still a cumbersome procedure, partially caused by the defects underlying the information theoretical account and partially by the deficiency of cognition of applicable

GIS methods " (p. 11) . Another possible account is put forward by Petrosyan (2001) , who posits that meteorologists are, `` more concerned with the inquiry why phenomena happen and less with the part where they go on " (p. 26) . This begs the inquiry of merely how GIS is being utilised in this field.

Chapman and Thornes (2003) argue that the usage of GIS in weather forecasting allows for spacial variables to be compared with other variables, ensuing in datasets that can potentially profit a whole host of different maps. They observe that, `` climatological and meteoric phenomena are of course spatially variable and therefore GIS represent a utile solution to the direction of huge spacial clime datasets for a broad figure of applications " (p. 314) . Thornes (2005) subsequently expands on this, by saying that, `` GIS methods allow the elaborate analysis of spacial forms of assorted atmospheric parametric quantities, supplying an in deepness expression into the regularities and variableness of conditions and clime over clip and infinite " (p. 1) . Chapman and Thornes (2003) argue that GIS serves a double intent in weather forecasting. These are the derivation of informations and the subsequent customization of informations in third applications. Figure 1 shows their conceptual theoretical account of this double function.

Figure 1: Conceptual Model of the Dual Role of GIS in Meteorology

(beginning: Chapman and Thornes, 2003: 314)

The balance of this essay will utilize this conceptual theoretical account as a model for the argument into the utilizations of GIS in weather forecasting. This essay will concentrate chiefly on the customization portion of the theoretical account, as it is here that we see the existent application of the informations to existent life state of affairss.

Section 2: Uses of GIS in Meteorology

Chapman and Thornes ' (2003) theoretical account shows that the first function of GIS in weather forecasting is derivation. This chiefly concerns itself with how the information is collected. Although this essay trades chiefly on the 2nd conceptual function of GIS, it is deserving sing the first briefly.

2. 1: Derivation of Spatial Climate Data

Chapman and Thornes (2003) observe that there are three chief signifiers of the derivation of spacial clime informations. These are: distant detection ; baseline climatologies ; and climate insertion. Therefore, it would be deserving sing these three subjects individually.

2. 1. 1: Distant Feeling

Chapman and Thornes (2003) province that GIS and remote feeling are really similar subjects. In world, they are so similar that it is difficult to separate or find where one ends and where the other Begins. However, the chief differentiation is that distant detection, `` enables the acquisition of large-scale comprehensive datasets where as GIS provides a agency to expose and analyze the information " (p. 315) .

2. 1. 2: Baseline Climatologies

Chapman and Thornes (2003) observe that climate information is frequently displayed in a GIS in a assortment of different ways. They argue that because climate information is normally a point beginning, one of the chief challenges in weather forecasting is how to project this information across a wider spatial sphere. They provide that the extrapolation of climate information, `` has enabled good estimations of a country 's baseline climatology without the demand for extended archive of conditions records " (p. 316) .

2. 1. 3: Climate Interpolation

Chapman and Thornes (2003) argue that, `` when covering with more spatially comprehensive climate datasets, the issue is not the illation of 'first estimate ' baseline climatology, but alternatively the insertion of point station information across the landscape by geostatistical techniques " (p. 317) .

The above has outlined the methods by which spatial climate datasets are gathered. These datasets can so be compared in a GIS, along with information gathered from other beginnings. The ensuing information can be tailored to run into the demands of a assortment of third applications. The undermentioned subdivision of this essay will see some of these applications.

2. 2: Application of Spatial Climate Data

Once information has been collected, it is of import that it can be put to good usage in a assortment of ways. As already stated, the possible application of informations collected by GIS is illimitable but this essay will see some of the major applications.

2. 2. 1: Agribusiness

Agribusiness is possibly the biggest donee of the usage of GIS in weather forecasting. The usage of such systems allows for husbandmans to break predict and understand the conditions and how this could impact on their harvest outputs. There are infinite illustrations of this in operation and this essay shall now show a few.

Madeline and Beltrando (2005) analyze how spacial interpolation-based function of spring hoars has helped Champagne manufacturers in northern France. The vineries in this part are highly sensitive to extreme frost events that sometimes occur in spring. In 2003, 50 % of the Champagne vineries were destroyed by a terrible hoar. The merchandise of these vineries is highly of import to the economic well-being of this part of France and so it of import to hold in topographic point a dependable prediction system that can foretell minimal temperatures. Madeline and Beltrando (2005) usage GIS to set up relationships between the minimal temperatures in certain vineries and the assorted other geographic and topological factors that cause fluctuation in temperature. They province that the usage of GIS allowed them to, `` construct a map of the norm estimated minimal temperatures across the whole vinery country which can be used by vino agriculturists to

place frost sensitive countries " (p. 54) . This should decrease the opportunity of future hoar harm to this economically of import harvest.

Another survey conducted by Menkir et Al (2000) used GIS spacial climatic informations of 114 sites in sub-Saharan Africa to see distinguishable zone where corn would turn best. They found that corn would react best in forest-transition savannas, Northern Guinea savannas, Sudan savannas and mid height parts. This information is potentially really utile for nutrient policy contrivers.

2. 2. 2: Ecology

Chapman and Thornes (2003) observe that, `` in much the same manner as possible harvest distribution can be modelled utilizing GIS based agroclimatic theoretical accounts, ecological diverseness can be modelled with regard to spacial clime datasets " (p. 320) . There are several noteworthy illustrations of this. Rodhouse (2010) uses GIS informations to analyze how the altering oceanenvironmentis impacting on cephalopod populations. Waluda and Rodhouse (2005) usage GIS informations to research the impact of angling on the population of the Jumbo winging calamari. This essay would propose that the usage of GIS in this sphere is likely to increase in approaching old ages as the argument around planetary heating and how it could be impacting on species becomes of all time more pressure.

2. 2. 3: Forestry

GIS can function multiple intents in forestry. Like in agribusiness and ecology, it can be used to place different clime zones or to foretell the output

of a peculiar country. However, GIS has been put to some advanced usage in this field. For illustration, Hantzschel et al (2005) usage GIS to gauge radiation balances, temperature and evapotranspiration degrees in different types of flora. One of their most interesting decisions, sing the subject of this essay, is that changeless betterments in engineering will take to better consequences in the hereafter and increase the importance of GIS in the hereafter. They province that, `` the lasting betterment in declaration and quality of the digital surface informations allows an improved simulation of the existent land surface and the associated feedback between topography, land usage variableness and meteoric measures and will increase the importance of GIS-based theoretical account consequences in the close hereafter " (p. 41) .

Pew and Larsen (2001) used GIS to analyze the spacial and temporal form of wildfires caused by worlds on Vancouver Island. They argue that being able to accurately foretell where and when wildfires are most common is, `` a first measure in cut downing their effects " (p. 1) .

2. 2. 4: Weather Forecasting

Chapman and Thornes (2003) argue that GIS has become, `` a cardinal direction constituent in conditions processing systems leting instantaneous plotting, insertion and life of conditions informations across any isobaric degree of the ambiance " (p. 322) . For illustration, Kumar et al (1998) show that through the usage of distant detection signatures, GIS can be used to alarm specific locations of the way of a tropical cyclone. This is a potentially life salvaging application of GIS. Chapman and Thornes (2003)

observe that GIS, `` partly automates prediction by easing velocity and throughput of conditions informations in real-time every bit good as supplying support for traditional conditions treating undertakings such as contouring and superposition " (p. 320) .

2. 2. 5: Conveyance

GIS is peculiarly utile for conveyance contrivers as it can be used to help in be aftering for winter route care. Thornes et Al (2005) used GIS to analyze a stretch of route in Poland to foretell route temperatures at certain times of twelvemonth. Better apprehension of route temperatures can assist transport contrivers know when to stock up on grit and when they should be directing out gritting trucks. The manner Britain land to a arrest in February 2010 should function as a timely reminder that this is still non an exact scientific discipline. Hopefully the betterments in GIS that Hantzschel et Al (2005) reference in their survey should take to more acurate anticipations in the hereafter.

2. 2. 6: Climate Change

It could be argued that all the applications of GIS presented in this essay have some bearing on clime alteration. Chapman and Thornes (2003) argue that GIS has become, `` a visual image tool for the end product of clime theoretical accounts such as general circulation theoretical accounts used to foretell the planetary impacts of hypothesise clime alteration scenarios " (p. 325) . It is likely that as engineering improves and smart systems are able to interact with each other in more productive and effectual ways, GIS will go

on to play a critical function in supplying information that charts the impacts of planetary heating.

Section 3: Concluding Remarks

The debut to this essay quoted the work of Gelernter (1992) who argued that the existent and the practical universe were traveling of all time closer together. This essay would reason that GIS represents the realisation of this vision in many ways. The usage of GIS in the field of weather forecasting are basically illimitable and will undoubtedly better as calculating treating power grows greater and telecommunications improve. A recent particular study in The Economist (2010) looked at the rise of smart systems. These systems are bring forthing immense sums of informations that we are merely merely understanding what to make with. The study notes that, `` smart systems may be humankind 's best hope for covering with its pressing environmental jobs " (p. 4) . Smart systems can be used to do power grids, transit webs and H2O distribution systems more efficient. GIS will play a cardinal function in assisting to use the informations produced by smart systems and guaranting that it is put to the best possible usage.

This essay would reason that GIS will go on in the development that Chapman and Thornes (2003) referred to earlier in this essay. However, it is the belief of this essay that we are merely get downing to see the possible applications and utilizations of GIS in the field of weather forecasting. This essay has merely touched on a few countries where it is being utilized at the minute. As terminal users in the assorted subjects learn to tackle the power of the information that is at their disposal, GIS will go on to play a polar

function in how we understand the universe. Thorne (2005) remarks that, `` the hereafter for the usage of GIS by atmospheric scientists is bright but increased coaction between the GIS and atmospheric communities is limited by information substructures that do n't easy interoperate " (p. three) . This essay would reason that it is merely a affair of clip before differences between these information substructures are resolved and the true potency of GIS can be unleashed.