CLIMATE GENERATIONS

By Pierre LOTY, October 2011

Abstract

The issue of climate change is now shaping the future of societies. The type of development needed is determined by reliable data on climate likely to direct action aiming at long term protection of our climate and environment. The purpose of this paper is to construct the concept of climate generation, based on the demographic concept of generation. The idea springs from the similarity between intensity and schedule in demographic and whether events. Construction of climate generation will supply climate science with rich, powerful indicators likely to provide fine-tuned longitudinal and cross-sectional climatic cohort analysis. In demographic studies, it is common to guess the future behavior of present generations using information on past and present generations. Similarly, it will be possible to project future climate trends based on current and previous climatic behavior.

Keywords: climate change, climate generation, intensity, schedule, projection

Introduction

Much has been written concerning climate and climate change. According to the United States Environmental Protection Agency Glossary of Climate Change Terms, "climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer)." The changing climate may reflect a variation in average weather conditions. It could also be the result of extreme whether events distributed around an unchanged average.

Much is still needed in order to determine the real cause behind changing weather. Studies so far tend to "attribute climate change to anthropogenic causes"[1]. In other words, statistical evidence shows with high confidence that

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[1] Rosenzweig, C., G. Casassa, D.J. Karoly, A. Imeson, C. Liu, A. Menzel, S. Rawlins, T.L. Root, B. Seguin, P. Tryjanowski, 2007: Assessment of observed changes and responses in natural and managed systems. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 79-131. (p. 83)

climate change is related to human activities[2]. Nevertheless purely demographic concepts could also add details to our understanding of the causes of climate change. For instance, the demographic concept *generation* is considered in this article from a climatic perspective. In demography, a generation or cohort is defined as a “group of individuals (within some population definition) who experience the same event within the same time interval” (Ryder, N., *The cohort as a concept in the study of social change*, presented at the 1959 annual meeting of the American Sociological Association). The present study will conceptualize the notion climate generation in an effort to view climate as a resilient phenomenon perpetuating itself over the years.

1. The concept climate generation

Simply put, a climate generation is a set of climates under observation within the same time period. For instance, if climates in Chad and Cameroon were studied since the same starting date, we would consider the two climates as belonging to the same generation. Climates could give birth to still other climates. To illustrate, if a noteworthy variation in average weather is noticed in Yaoundé (Cameroon), then the Yaoundé climate will be termed ‘child’ of the general climate (or parent climate) in Cameroon. The birth date of this climate is the date when substantial change in weather has been recorded for the first time. Climates born the same date are of the same generation. Therefore, climates could be grouped according to dates of first data recording, in a longitudinal perspective. The number of new climates observed within a particular climate range is counted as the parity of that climate. Since the birth of a new climate means climate is changing, definition of climate generations and climate parity makes it possible to define the correlated notions of climate change schedule (CCS) and climate change intensity (CCI).

2. Climate Change Intensity

In demographic analysis, the *intensity* of a demographic event within a cohort life time is an indication of how frequently this event happens within the

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[2] “Statistically significant regional warming trends over the last 50 and 30 years are found in many regions of the globe” (Spagnoli et al., 2002; Karoly and Wu, 2005; Karoly and Stott, 2006; Knutson et al., 2006; Zhang et al., 2006; Trenberth et al., 2007, Figure 3.9)

cohort's lifetime[3]. Here, the demographic event defining the cohort must be different of the demographic event related to the intensity. If the climate generation is defined by the birth date or date of first data recording for the particular climates forming the generation, the climate change intensity is defined relative to birth dates of new climates observed within the parent climate. As a result, birth dates considered for purposes of defining the CCI are posterior to the birth date used as origin of the generation.

An important assumption when defining the intensity of an event is the notion of lifetime of the cohort under consideration. There should be a period of time wherein the event occurs more frequently succeeded by a time period when the occurrence of the event is considered negligible, thus making it possible to sum up retrospectively the frequency of occurrence for the entire period.

Moreover, the period 100 years is usually used in climate science as reference time. In this line of reasoning it could be postulated that a climate's lifetime is 100 years. For the purpose of this study, it has been admitted that the birth date of a climate is the time when observation of that climate starts. In the same vein, the death of a climate should be the time when studies about that climate are deemed completed. After 100 years, all weather events in the region are deemed to belong to a new round of observations. It is suggested that after 100 years, enough weather variation would be observed in the particular region to override the older climate henceforth replaced by the birth of new climate generations. Granted, the general stability of climate means weather variations are constrained within definite bounds. Yet, this is in line with the idea of climate reproduction: parent climates give birth to climates resembling them, but original enough to be termed new climates, albeit in the same climate family.

Under these basic assumptions, it is possible to compute the intensity of climate births (or climate variability in climate science terminology) within a climate generation in a longitudinal perspective.

Let us assume that 10 climates are being observed in a tropical area starting from a common origin-date. Any significant weather variation observed

[3] According to Francis Gendreau, the intensity of a demographic phenomenon is the average number of events experienced by an individual of the cohort. (Francis Gendreau, 1993, La population de l'Afrique – The population of Africa, KHARTALA – CEPED, p. 196).

subsequently will be termed climate child of the particular climate where the variation was recorded. After 100 years, a summary of the frequency of new climate occurrences will yield climate change intensity. The following chart describes the climate generation model.

Figure 1. Climate generation model

	Climate 1	**Climate 2**	● ● ●	**Climate 10**
Year	**0**	**0**		**0**
Event	Climate Child 1.1	-		Climate Child 10.1
Year	**10**	**10**		**10**
Event	Climate Child 1.2	Climate Child 2.1		-
	20	**20**		**20**
	-	-		-
	30	**30**		**30**
	-	-		-
	●●●	●●●		●●●
Year	**90**	**90**		**90**
Event	Climate Child 1.3	Climate Child 2.2		Climate Child 10.2
	100	**100**		**100**

Within this model, it is possible to compute CCI for the particular climate generation being observed as the average number of new climates being observed within a set time range. This indicator yields a measure of climate change within a century. For instance, computations could give 0.4 new climates per climate unit. This vivid depiction of how frequently climate is changing is a net result yielded by demographic analysis applied to climate change science.

At this stage of the study, it is quite possible to compare climate change intensity for different regions. In other words, it is possible to know areas where climate is changing more rapidly. Also, it is possible to compare the intensity of climate change within the 19^{th} century climate generation to the level of climate variability in the 20^{th} century climate generation. In a nutshell, elegant comparisons would be possible over space and time using demographic native indicators such as intensity or schedule.

3. Climate Change schedule (CCS)

In demography, the schedule of events within a given generation is an indication of when events happen within the life time of the cohort[4]. Similarly, the CCS within a climate generation is a reflection of the time when climate change happened within the life time of the climate cohort. For instance, a CCS of 70 years within the 20th century climate generation would mean that climate variability in the 20th century typically occurred in the year 1970.

If it is possible to get a simple and neat indicator of how much climate change occurred and when the change typically happened, then analysis of the causes of climate change would be greatly enhanced. As an illustration, it would be possible to correlate factors like anthropogenic activity in 1970 with the surge of climate variability around that time as suggested by the CCS. In other words, climate change intensity and climate change schedule gives more insight and flexibility in the understanding of the causes behind climate change.

The power of such indicators in deciphering trends nestled in climate change should not be underestimated. Indeed, demographic analysis is adept at tracing out complex causal chains. Even better than statistical analysis (mainly used in climate change science), demographic analysis usually goes far enough in bringing out the meaning behind complex data.

4. Cross-sectional analysis of climate change

An important result of climate generation conceptualization is the ability to project future climate trends based on past and present climate behavior. In cross-sectional demographic analysis, events are neatly summarized for many cohorts within the same period. For instance, births occurring to all women in a country in 2011 would be summarized to get a transversal rate describing the average number of births per woman that year.

Moreover, cross-sectional rates as indicators of intensity have still another meaning. The rate of birth occurrence in 2011 computed among all age groups yields the standard number of children a woman belonging to a hypothetical

[4] In other words, the schedule of a demographic phenomenon is the age-specific distribution of events during the life time of the cohort. (Roland Pressat, 1983, L'analyse démographique – The demographic analysis, Presses universitaires de France, p. 11).

generation would have if every year she went through the age specific birth rates experienced by women of the respective age groups in 2011[5].

In climate change parlance, it means the possibility to project climate variability in the future. One basic assumption is necessary in this regard: the stability of demographic trends. In other words, it should be assumed that the behavior between different generations of women would not change much over time. Applied to climate change, the assumption means all climate generations are in the same range of weather variations. This is easily obtainable if climates involved belong to the same climatic region. For instance, all climates belonging to the tropical region are expected to fall within definite weather-related bounds. Consequently, weather variability, or new climate generations behavior, is relatively stable.

With the previous assumption, it is possible to compute the transversal rate of climate change for a given period. Tracing out all climate variations within parent climates in the tropical region within a given period would yield the average weather variation of the period. Because new variations are construed as new climate generations, it is possible to infer that the average weather variation of the period is the weather variability we would have for a given parent climate if it went through the various variability rates experienced by climates of various age groups in the tropical area within the period studied.

Conclusion

It is almost certain that climate is changing. Therefore, it is no exaggeration to suggest the idea of new climate generations. Even more importantly, this characterization could yield fine-tuned indicators likely to provide specific information about the causal chain underlying climate change. Already, it is possible, with due conceptualization of the notion climate generation, to compute climate change intensity and climate change schedule, as smart indicators able to capture profound measures of climate change variability. With such interesting prospects, it surely is necessary to apply this theory on various climate databases to test its robustness.

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[5] According to the United States Population Reference Bureau, the standard indicator of the number of live births per woman for a given period (known as the Total Fertility Rate), “measures the fertility of an imaginary group of women who pass through their fictitious reproductive lives subject to the rates of childbearing experienced by real women in a given year”. (Joseph A. McFalls Jr., 2007, Population: A Lively Introduction, Population Bulletin, Vol. 62, No. 1.)

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2. Joseph A. McFalls Jr., 2007, Population: A Lively Introduction, Population Bulletin, Vol. 62, No. 1.

3. Spagnoli et al., 2002; Karoly and Wu, 2005; Karoly and Stott, 2006; Knutson et al., 2006; Zhang et al., 2006; Trenberth et al., 2007, Figure 3.9

4. Francis Gendreau, 1993, La population de l'Afrique – The population of Africa, KHARTALA – CEPED, 464 p.

5. Roland Pressat, 1983, L'analyse démographique – The demographic analysis, Presses universitaires de France, 295 p.