China and Its Climate: The Impacts on Culture

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Using the Science of Weather in Business and Public Policy

January 24, 2005

All nations of the earth, both world powers and developing countries, and all peoples across the globe have to cope with the demands of the climate in which they find themselves. China is no exception. In fact, China has had to deal with a broad range of climates, from deserts to tropics. According to M. Glantz (2003), climate can be viewed from three different perspectives: "climate as a constraint to social and economic development; climate as a resource to be fully exploited to society's advantage; and climate as a hazard that can spawn other hazards and disasters" (p. 43). The climate of China can easily be seen from each of these perspectives. Using the climate as a resource, China developed early as a cultural civilization agriculturally, technologically, and artistically. More recently, Chinese culture has not developed as quickly as other nations in the world even though many may argue that China had a head start. One argument for China's slow development is from the perspective of seeing climate as a hazard; many parts of China were plagued and continue to be affected by natural disasters. On the other hand, this slowing of development may partly be due to the idea that some of the climates of China have been a constraint on the nation's cultural development. In the future, global warming's impact on the Chinese climate may prove to show climate as a resource.

First, the interrelationship of climate and culture in China throughout history will be examined as to whether or not the Chinese have used climate to the advantage or to the disadvantage of their society. Comparisons of different climate regions as well as different cultures demonstrate the strong, positive relationship of climate and culture. However, studying the natural disasters that have influenced the cultures of different regions show that climate and culture can also form a negative relationship. Additionally,

predictions can be made as to the effect of climate change on the cultures of China. Finally, although some can argue that other factors, such as genetics or education, play a much larger role in the development of culture, the relationship of climate and culture in China can no longer be ignored. In other words, China's climate has played a crucial role in the development of Chinese culture and will continue to influence China's progress as a nation as the climate changes.

At first glance, Chinese culture seems to be monolithic despite the diversity of the climate. After all, one rarely if ever hears of Chinese minorities or Chinese sub-cultures. However, contrary to first appearances, Chinese culture is diverse with many different cultural regions and people groups, including Han Chinese, the Mongols, the Li, the Tibetans, and Uygurs, as well as numerous other fragmented ethnic people groups. Despite this diversity, some truth exists in the assertion of the cultural uniformity of China. For example, of the approximately 1.3 billion people who live in China (*General information*, n.d.), the majority speak Mandarin Chinese. Nevertheless, diversity is illustrated by the fact that at least 130 other languages are spoken in China (Diamond, 1999). This diversity in Chinese culture is due in part to the climate variations found in the nation.

As shown in figure 1, China is divided into 22 provinces (excluding Taiwan), 5 autonomous regions, 4 municipalities, and 2 special administrative regions, or SAR's (*General information*, n.d.). However, when discussing climate, these divisions serve little purpose since China has a range of climate conditions providing significant differences in temperature, humidity, and precipitation. The temperatures range from

Fig. 1) Provided by P.B. Ebrey, University of Washington

tropical to frigid, and sixty percent of the rainfall occurs in the three summer months (*About China: Climate*, 2002). Therefore, here China will be divided into six climate regions: northern China, northwestern desert regions, southwestern mountainous China, central temperate China, , southern tropics, and coastal China. Here climate refers to "average meterological conditions" over a relatively long period of time and a "wide range of spatial and temporal scales" (Glantz, 2003, p. 17).

Even the most uneducated realize that climate affects certain obvious aspects of culture, such as dress. For example, the Tibetans in the high mountains wear Tibetan robes and boots for warmth while some women in rural, tropical China wear much less clothing (*China through a lens*, n.d.). The varying climate conditions also provide the

right environment for high-quality agriculture, forestry, and animal husbandry. (*About China: Climate*, 2002). However, while examining the varying climates of the regions, much more surprising correspondences with the cultures of these regions are found.

In general, China's climate is dominated by dry seasons and wet monsoons (*Climate of China*, 2004). Most of China lies in the northern temperate zone, but because of the influence of monsoons that cause a northwestern cold, dry wind in winter and a southwestern warm, moist wind in summer, China experiences a 40C temperature difference (All temperatures in this paper are recorded in Celsius.) between the north and south. The huge influence that monsoons exert over China have led some climatologists to call a large temperature difference in seasons, a wet summer, and a dry winter "a Chinese type of climate." (*Country guides: China*, 2003, para. 11). China's diverse climate is illustrated by the fact that China has areas with four distinct seasons as well as tropical rain forests and deserts (*China's Climate*, 1997).

The strong monsoons from the north, of course, profoundly affect northern China, which include Inner Mongolia and the provinces of Hebei, Heilongjiang, Jilin, and Laoning. Much of this area is better known as Manchuria. In general, northern China is colder and drier than other regions (Diamond, 1999). In fact, the domination of the monsoons cause the region's winters to be 5 to 18 degrees colder than other locations at the same latitude (*General information*, n.d.). The coldest temperatures in China can be found in the northern stretches of the Heilongjiang province, which has virtually no summer. In fact, temperatures in far northern China commonly touch -40C. Beijing itself can have temperatures as cold as -20C. However, in the short summer, which corresponds to the region's rainy season, temperatures can reach 38C with severe humidity.

Nonetheless, most of northern China does experience four distinct seasons with a milder spring and autumn (*China travel tour guide*, 2003).

The climate of northern China has, of course, influenced the development of culture. First, northern China developed a drought-resistant species of millet in the ancient history of its agriculture while southern China was developing mostly rice (Diamond, 1999). Obviously climate affects plant domestication and agriculture since different species of plant and animal life thrive in different climates. Additionally, because of the harsh winters, many tourists never venture to this region. Many of the areas with the harshest conditions are sparsely populated. These two factors may be reasons why the region still boasts some of the country's most unspoiled natural forests and grasslands. The more southern part of this region, which includes Beijing, has much milder temperatures and has become a center for Chinese cultural development. For example, this is the region of the northern section of the Great Wall (Neville-Hadley, 2003).

Northwestern China, which mostly encompasses the large province of Xingjiang, is home to China's desert regions. This region understandably experiences extreme temperatures. The summers are hot and dry with high temperatures around 47C. Annual preciptation averages less than 10 centimeters. However, the winter in northwestern China can be as cold as the rest of northern China with temperatures at least -10C (*China through a lens*, n.d.).

Some of the deserts in northwestern China and in Mongolia were former grasslands. Some of the present grasslands in and near northwestern China have recently been showing signs of desertification mostly because of overgrazing in the last century

(Chuluun and Ojima, 2002). In fact, deserts now make up 27% of China's land, more than its farmland. Plus, the desertification is now increasing by 2,460 square km annually (*China through a lens*, n.d.). Such climate variations have caused and will continue to cause short-term seasonal movements of people as well as long-term migrations from arid and semi-arid lands (Chuluun and Ojima, 2002). This problem as well as other problems related to climate change are discussed later.

Culturally, northwestern China is home to several of the Silk Roads, which ran from the Middle East to China (Neville-Hadley, 2003). Geographically, the desert would prove to be an easier passage than the mountains to the south. Climatically, traveling at night in the summer would be easier than traveling in the strong winds and harsh weather conditions common in the mountains of Tibet and China.

Central China includes many of the river valleys and the provinces of Shangdong, Henan, Hunan, Hubei, Jiangxi, and others. This region lies around the Yangtze River, which is generally considered to divide the nation into north and south (*Climate of China*, 2004). This region has a longer but much more humid summer than northern China. However, its winters can be almost just as cold, but generally central China is much wetter than northern China anytime of year with an average precipitation of 76 centimeters per year (*China travel tour guide*, 2003). Generally, however, central China is considered to be the country's most temperate region with four clearly defined seasons (*Climate of China*, 2004).

History has already proven that climate dramatically influenced the development of culture in central China. In the Hunan Province, the beginning of settlements along the Yangtze River correspond to weaker summer monsoons since the region had to develop a

more organized society in order to develop irrigation systems (Yasuda, 2004). In the Shaanxi Province, diet and health changes occurred in the fifth millennium BP. The climate became much colder, which led to increased anemia and decreased adult stature (Pechenkina, 2002) as well as a southward migration. However, during the relatively recent recorded history of China, this central region has remained temperate and, therefore, became China's "cradle of civilization." China was unified rather early mostly because of the geographical conditions of long rivers and rolling hills in central China (Diamond, 1999). The region served as home to many of China's dynasties as well as the religious founder Confucius. Central China also encompasses Shanghai, which is China's wealthiest city (Neville-Hadley, 2003), no doubt partly because of the temperate climate, which offers superior conditions for developing culturally, economically, and socially.

While two-thirds of China has mountains or rolling hills, southwestern China, which includes Tibet and the province of Qinghai is extremely mountainous. In fact, southwestern China has some of the highest peaks in the world. If one considers Tibet one of China's autonomous regions as China does, then China can claim to share Mount Qomolangma, also known as Mount Everest, with Nepal (*China's geography*, n.d.). Because of these mountains, southwestern China's climate varies dramatically from much of the rest of China since it has vertical seasonal zones (*Climate of China*, 2004). Southwestern China's climate is also influenced by monsoons blowing up from the Indian Ocean. Moreover, the most mountainous areas of this region experience an extremely harsh climate. Its long winter begins in October and lasts until May. Not surprisingly, Mount Qomolangma's annual mean temperature is -29C (*China's Climate*, 1997). The

summer is warm but has intense sunlight radiation and strong winds. The summer also is the region's rainy season.

Understandably, some parts of this region are outright uninhabitable. However, the region does boast a few large cities, such as Lhasa, which is the former home of the famous Dalai Lama. Part of the rich culture of Tibet is due to the geography of the land with its high mountain peaks. However, the rest, especially the sparse population, is partly because of the harsh climate (Neville-Hadley, 2003). Many of the people who do live in this region depend upon the tourism from the famous high peaks.

Much of southern China, including Yunnan Province, Sichuan Province, and Hainan Island, could be described as tropical. The summer is typhoon season with temperatures around thirty-eight degrees. Moreover, the winter in southern China is fairly short, lasting only about three months and with much milder temperatures than the rest of China's winters. Hainan Island does not even experience a true winter (*China travel tour guide*, 2003). Additionally, the annual mean temperature in the Xisha Islands is about 26 degrees Celsius, the highest in China (*China's Climate*, 1997).

Southern China is the nation's producer of tropical fruits as well as other tropical products, such as medicines. Without the favorable climate with its warm temperatures, such a livelihood would not be possible. Moreover, since China as a communist country tries to be as self-sufficient as possible, having tropical products available has proved to be significant in recent history. However, a great deal of this region still remains rural with little development.

China is also home to a large number of rivers as well as a fairly long coastline. These regions, which include the provinces of Jiangsu, Zhejiang, and Fujian, have a

slightly different climate. Of course, Jiangsu's more northern location causes a lower annual mean temperature than Fujian, which is more tropical. Although best discussed within the different regions already mentioned, a few added notes must be made for this unique climate region. The coastal regions can experience heavier rainfall than other areas because of typhoons that develop in the South China Sea and move northeast along the coast. The typhoons are generally worse along the southern coast, which experiences the most severe winds and heaviest rainfall. China's typhoons are most common in July through October. Large potions of the coast, such as Hong Kong, can experience rainfall throughout the entire year (*Country guides: China*, 2003).

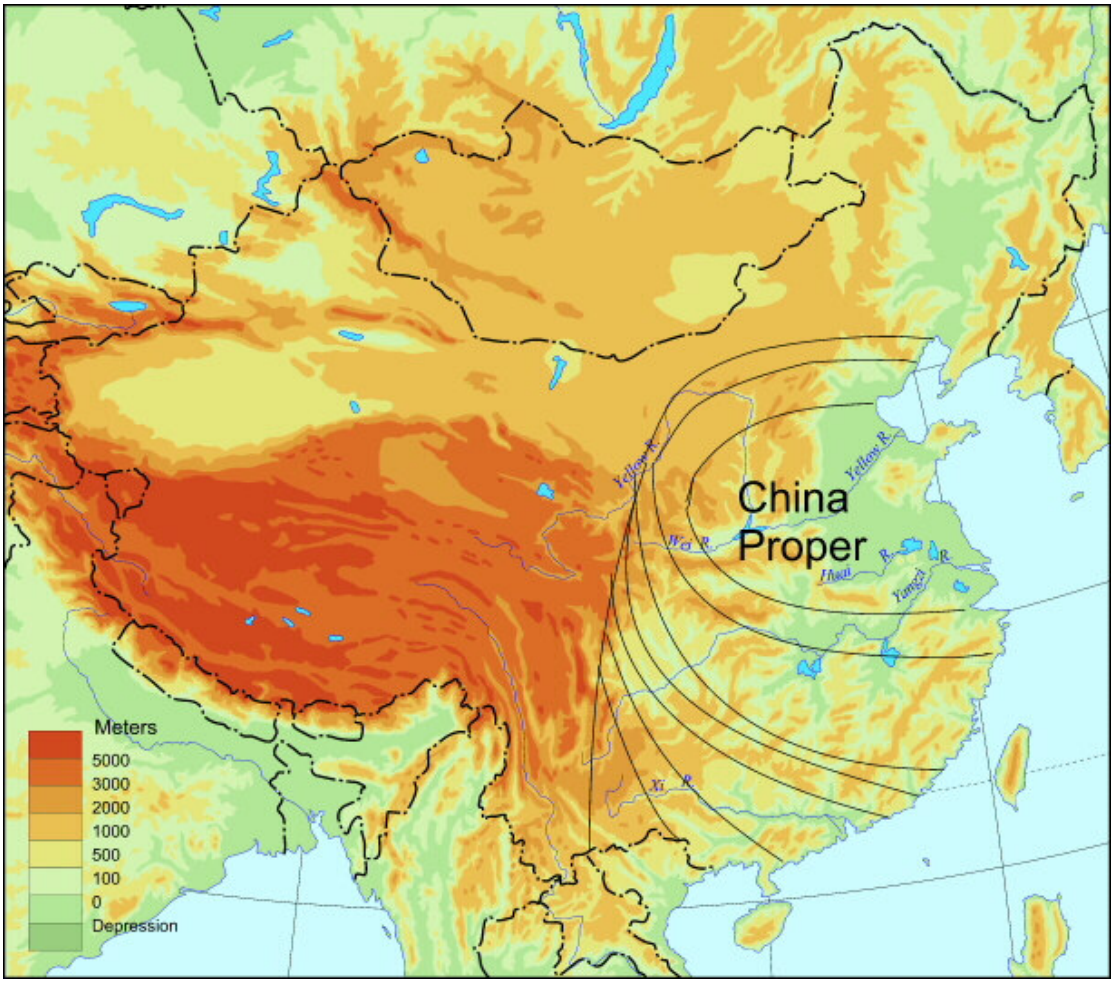

Fig. 2) Provided by P.B. Ebrey, University of Washington

The extreme climates of China have had a profound influence on the development of Chinese culture. As shown in figure 2, China is often divided into China Proper and Outer China. China Proper encompasses the eastern and central regions of the country. After examining the variety of climates in China, one may notice that these areas are the most temperate regions of the country. They contain four distinct seasons as well as abundant rainfall (Ebrey, n.d.). Therefore, these regions would have been most productive for agriculture purposes and most comfortable for living.

The climate has even affected the appearances of the people who reside in the different regions of China. The genetic differences that cause these variations in appearance can be traced back to the different climate conditions. Northern China, which generally has colder temperatures and less precipitation, is home to people who are "taller, heavier, paler, with more pointed noses, and with smaller eyes that appear more 'slanted'" when compared to the South Chinese (Diamond, 1999, p. 323). Although these genetic differences do not directly relate to the area's culture, the North Chinese and the South Chinese also have distinctly different ways of life, economically, agriculturally, and socially. These differences in culture as well as the differences in appearance are, therefore, two factors of the same root cause: differing climates.

Moreover, evidence suggests that much of modern China's culture began in northern China and spread to southern China. For example, Sino-Tibetan speakers moved south, which is shown through the historical records of the spread of Chinese language families. The Chinese writing system, bronze technology, and state formation based on the organization of the Zhou Dynasty of North China also moved from north to south (Diamond, 1999). Because of the dominant movement of culture, many northern Chinese

still feel culturally superior to southern Chinese in addition to non-Chinese peoples. Moreover, a historical study has shown a steady movement of people moved southward from less favorable climatic regions into the more favorable regions (Chang, 1946). While many plausible theories exist to explain the southward movement of culture, one reasonable and even likely explanation is that perhaps northern Chinese took their culture with them as they migrated to warmer areas for agricultural purposes or simply greater comfort. Northern Chinese may also have moved south to conquer the southern peoples and then imposed their culture on the conquered. After all, southern China had many advantages over the north, including a warmer, wetter climate.

One important aspect of culture that has been markedly influenced by China's climate is the food in different regions of the country. For example, Tibetans eat tsampa, which is a roasted highland barley flour, as their staple food since the Chinese staple of rice cannot be easily grown in the harsh climate of the western mountains. Meanwhile, many southern Chinese often can still be seen chewing betel nuts, which are tropical nuts that can act as a mild stimulant. Most of the central Chinese eat a more well-recognized diet with meat, rice, noodles, and vegetables, partly because of their more temperate climate (*China through a lens*, n.d.). The variations in China's climate even affect such a mundane but integral part of Chinese food culture as tea drinking. Because of variations in climate, different regions grow different kinds of tea as well as use different techniques for brewing the tea. Green tea is grown in the provinces of Zhejiang, Anhui, and Jiangsu. Black tea was developed in Hunan, Yunnan, and Sichuan. Wulong tea is made along the southeastern coast, and jasmine tea was developed in northern China. However, the most prolific area of tea production is in central China along the Yangtze River (*China's tea*

culture, 2000). This interrelationship of culture and climate is just one more example of how climate can affect even the smallest parts of life.

Most importantly, China's diverse climate, which includes tropical, temperate, and desert conditions, offered many advantages over other early civilizations. China began producing domesticated food at about the same time as the early civilizations of the Middle East. The ranges in climate, however, allowed China to produce a greater diversity of foods and domesticated animals as well as a broader range of possibilities for developing technologies since tropical climates would not need the same tools and technologies as desert climates. Some of the technologies that early China contributed to the world are cast iron, the compass, gunpowder, paper, and printing. Most importantly, the major portion of the early civilizations in China had more precipitation than the Fertile Crescent's environment, which would prove beneficial for China's agricultural development (Diamond, 1999).

However, in recent history, China has not developed as far as the above advantages would have one believe. The southward movement of culture in China has also raised the common question: Why have cooler, more temperate climates seemed to produce more advanced civilization more quickly? However, this question is beyond the scope of this paper. Instead, another question will be raised: Why did China not develop as quickly as countries with a less diverse climate and less unification? In other words, why has China not developed as quickly as countries in the western hemisphere?

A multitude of theories exists to answer this question. However, many of these theories do not draw from the interrelationship of climate and culture. One possible hypothesis would draw on the perspective of seeing climate as a hazard. After all, China

has suffered many severe weather events with negative repercussions. In the Qinghai Province, the prehistoric Qijia Culture was influenced by frequent flooding and violent earthquakes (Yang 2003). In more recent years, extreme meteorological events (EMEs), a term borrowed from Glantz (2003), have continued to impact China. From the year 1900 to the year 2000, China had seven severe weather events listed among the top global weather, water, and climate events of the century: the Huang He and Yangtze River flood of 1931, typhoons of 1912 and 1922, and droughts of 1907, 1928-1930, 1936, and 1941-1942 (Smullen, 1999).

In 1931, between July and August, heavy monsoon rains caused the Huang He and Yangtze rivers to overflow. Flooding covered about 34,000 square miles of land. Entire communities, agriculture, and farmland were washed away, showing climate as a definite hazard to Chinese culture. The Yangtze River, also known as the Chang Jiang, has flooded several times since 1900. The flood waters of 1998 also swamped about 1500 oil wells (Yangtze flood, 1998), which severely affected the livelihood and economic development of the region. In 1995, the Chinese government finally reported that 85,000 had died in floods along the Yangtze River (World's worst, 2005). Moreover, several major cities are located along the Yangtze River; therefore, a large number of people as well as their culture are affected when major flooding occurs. In more severe climate events demonstrating climate as a hazard to culture, the Chinese coastline has been targeted by some major typhoons in 1912, 1922, 1959, and 1960, killing more than 113,000 people (*Lists of wars and disasters*, 2005).

More recently, in 2004, the central regions of China experienced widespread flooding. Considerable damage to housing and infrastructures was seen throughout the

south, central, and eastern provinces of China. Over 1,100 were killed, 1.3 million were left homeless, and 140 million people were affected. Property damage was also extensive in the Hunan Province; more than 72,000 homes collapsed, and another 173,000 were damaged. Crops were severely affected, with more than 350,000 hectares being washed away or damaged. In the Yunnan province, 8,000 homes were completely damaged, and 64,000 hectares of crop were lost (Anderson, 2004), a severe loss for an economy that depends on agriculture.

In contrast to typhoons and floods, the climate in China also produces major droughts. One of the more devastating was in 1907 when an estimated 24 million people died. Over the years of 1928 to 1941, an estimated 11 million died because of major droughts (*Lists of wars and disasters*, 2005). China has also been threatened by droughts more recently, which will be discussed later. Obviously, while Chinese climate has favored some in providing a temperate climate for agriculture, undoubtedly drought forces a regression of the progress of Chinese culture through loss of life, property, and the opportunity to make a living.

In a report from the China Ministry of Civil Affairs, more than 170 million people were reported as being affected by floods, droughts, landslides, typhoons, and earthquakes in China in 2004. The economic losses for China were estimated to exceed 10.9 billion US dollars ("Natural disasters claim," 2004). The losses in 2003 were even higher, totaling 22.8 billion US dollars ("Natural disasters cost," 2003). In addition to flooding, landslides, and earthquakes, China suffered from a severe drought and twelve sandstorms that affected about half of China (*Report on the state*, 2003). Obviously, in

China, the people affected by these disasters can see climate as both a hazard to life and property and an economic and social constraint.

Evidently, EMEs affect China nearly every year. Records reveal that deaths and property damage have been quite significant. As China continues to grow in population and development, economic losses most likely will become much greater, posing a threat to Chinese culture. Moreover, the growth and development in the central, northern, and western regions have been adversely affected by the climate conditions, and the regular occurrence of major natural disasters have been a threat to the culture in these regions.

However, some may legitimately argue that natural disasters are a common enough occurrence and are hazards to all countries, not merely the developing nations. The United States has had its share of natural disasters over the last century and even in the last year, but such natural disasters have posed no significant threat to the culture in these areas even if the disasters have had economic and societal effects. Therefore, another theory for why China has not developed as significantly in the last century as countries in the Western hemisphere must be proposed. Diamond (1999) suggests that China's decline began in the fifteenth century when the ruler in power decided to stop all shipping and oceangoing fleets, yet this theory has little to do with climate. An alternate climate-related theory is that China's climate is so diverse that it became difficult to take advantage of what all the different climates had to offer. This theory holds some weight since most of the developed part of China is in China Proper (Ebrey, n.d.), which has a temperate climate. China Proper begins to drop off into Outer China where other climates begin, such as the desert and mountainous regions (See Figure 2). China has noticed this problem and is currently seeking to reverse the underdevelopment of other regions. In

2000, China began a develop-the-west program for both the desert and mountain regions. They are implementing construction and industrial projects to develop these areas (*China through a lens*, n.d.). However, such action is not being taken in the southern regions. Looking into this problem also raises the age-old but still inadequately answered question of why tropical climates cannot seem to develop culturally as quickly as temperate climates. This question, while interesting, is quite beyond the limits of this paper.

Finally, the crisis of global warming raises the question of how this climate change will affect the culture of China. China, once again, may choose to view climate as a constraint that limits any cultural development to the already developed China Proper because of its temperate climate. China could act from the idea that climate is a hazard and suffer beneath the threat of EMEs. On the other hand, China could begin to use climate as a resource for the benefit of its society and cultures. This perspective would be the most beneficial and is certainly quite plausible. In other words, climate change could positively impact Chinese development and help them to emerge as a new world power in the 21st century.

First, the approaching challenge of climate change must be explained. Projected anthropogenic global climate change is largely due to the increase in concentration of greenhouse gases (GHG) in the atmosphere. Gases such as carbon dioxide (CO2), methane, and water vapor all contribute to what has been termed the "greenhouse effect", or the warming of the earth's atmosphere as GHGs trap some of earth's outgoing longwave radiation. Enhancement of the greenhouse effect may cause future climate change due to the anthropogenic increase in GHG concentration. Major sources of this increase in concentration of GHGs since the late 18th century are the industrialization of

nations and the processes that industrialized nations use to provide food and energy to their people, such as the combustion of fossil fuels and the burning of biomass. Shown in Figure 3 are two NCAR climate model runs comparing the natural and anthropogenic contributions to global warming over the last century. Clearly, a dependence on anthropogenic effects is shown to agree with observed warming on a global scale.

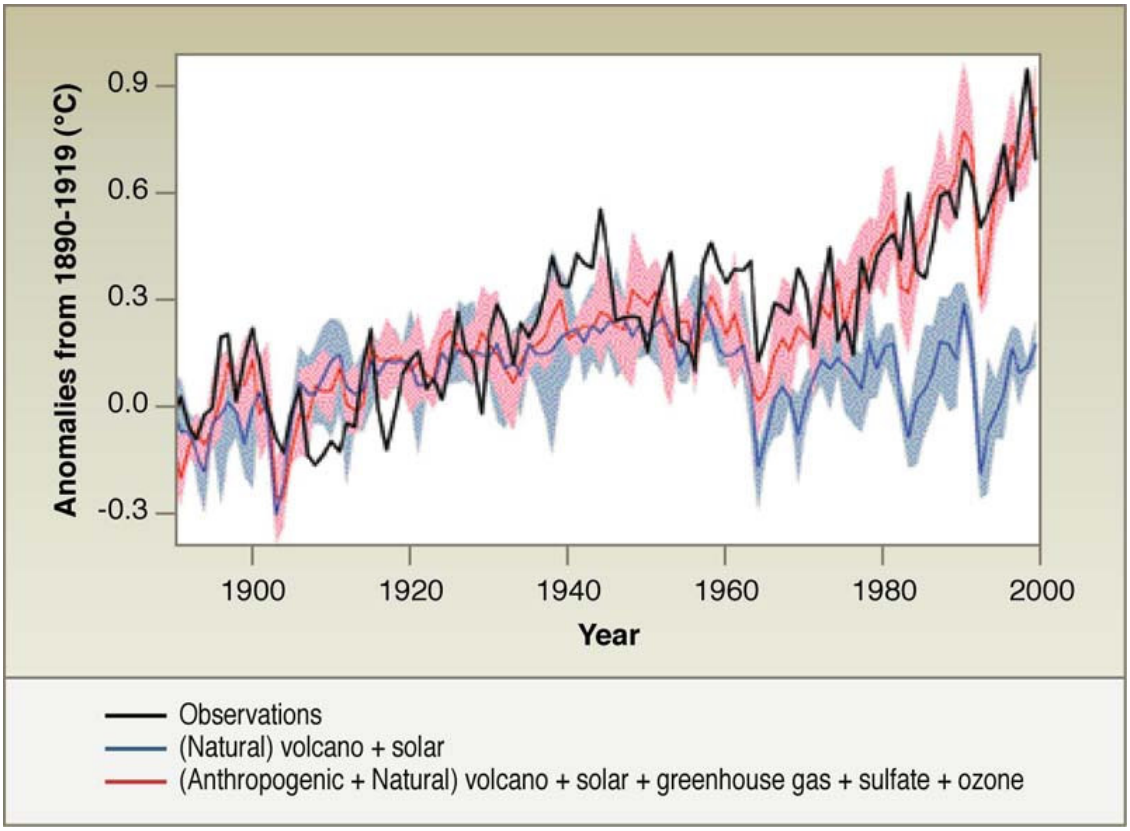

Fig. 3) Provided by Dr. David Karoly, University of Oklahoma (class presentation)

As the climate continues to warm, there are many questions as to the precise regional and global effects. Likely results of warming will include an increase in evaporation leading to longer and more severe droughts; an increase in convection leading to more unpredictable and more intense but less frequent rainstorms, leading to flooding and inconsistent river levels; partial or complete melting of ice sheets and glaciers, and a thermal expansion of the oceans, both contributing to a rise in global sea

levels; and a longer growing season in the high latitudes. The most questionable effects are the role of clouds (Will an increase in evaporation rate lead to an increase in global cloud cover, and therefore an increase in global albedo, mitigating the warming trend?); the role of aerosols generated from dust storms and fires, which act to reflect incoming solar radiation; and the impact of the warming on tropical cyclone frequency and intensity and longer term events such as monsoons and El Nino.

Global climate change will impact different regions of the world in different ways, depending on local topography, land use, and many other factors. Due to its vast physical size and geographic diversity, climate change will affect China in many different ways. Of the six regions in China previously mentioned (northern China, western mountainous China, central temperate China, northwestern desert regions, southern tropics, and coastal eastern China), each of them possess future scenarios up for debate. The following data table shows projected temperature and precipitation changes for four of those regions under IS92a projected GHG emission scenarios, using an ensemble of model output.

Table 1) Projected Temperature (deg C) and Precipitation changes (%)

	2020s			**2050s**			**2080s**		
	Annual	Winter	Summer	Annual	Winter	Summer	Annual	Winter	Summer
Temperature									
Asia Average	1.58	1.71	1.45	3.14	3.43	2.87	4.61	5.07	4.23
Boreal	2.17	2.66	1.71	4.32	5.52	3.29	6.24	8.04	4.82
Arid	1.61	1.56	1.77	3.18	2.81	3.55	4.83	4.41	5.34
Temperate	1.49	1.74	1.23	2.86	3.26	2.48	4.34	5.11	3.67
Tropical	1.36	1.62	1.13	2.69	3.25	2.19	3.84	4.52	3.20
Precipitation									
Asia Average	3.6	5.6	2.4	7.1	10.9	4.1	11.3	18.0	5.5
Boreal	6.1	11.1	2.6	12.8	23.8	5.1	20.7	39.5	7.7
Arid	1.3	3.0	-2.1	1.3	6.9	-2.3	-1.3	6.9	-4.0
Temperate	3.9	4.2	3.7	7.9	13.3	5.4	10.9	20.1	7.8
Tropical	2.9	2.7	2.5	6.8	-2.1	6.6	11.9	5.3	7.9

Source: (IPCC, 2001)

The following paragraphs will present a few of the ways climate change may impact these regions of China, primarily as presented in the Intergovernmental Panel on Climate Change's (IPCC) 2001 assessment report. This report has a mixed thesis: overall, climate change is expected to positively impact Chinese agriculture in the form of increased global CO2 levels, enhancing the photosynthetic process, but negative effects will also be felt due to increasing average temperature, greater risk for severe drought, flood conditions, and soil degradation (IPCC, 2001). In addition, coastal urban areas will be impacted negatively by rising sea levels, and inland river valleys might suffer from a decrease in frequency and intensity of rainfall. As one can see, there remains much uncertainty as to the exact consequences of climate change in China and the impact on its culture. As a developing nation, China has a greater than average risk of becoming challenged by the stresses of global warming but also a greater opportunity for growth if they choose to wisely exploit global warming and act to adapt to the new realities of the changing climate. If China accepts the responsibility and develops the foresight to prepare and adapt for climate change, they stand to emerge as a major world power by the end of the 21st century. Recent technological developments such as the establishment of a space program imply that China is already working to advance itself in world standing.

The availability of fresh water is already a problem in China. Much of temperate China depends on the seasonal nature of the monsoon rains every summer. This seasonality of rainfall is already helping to producing a shortage of 28.8 million cubic meters of fresh water daily across China (Smil, 1996). Temperate regions, including river plains, are among the most vulnerable to climate change. In river valleys, which depend upon storage reservoirs during the dry seasons, even more stress will be applied to this

already delicately balancing system. Droughts in 1972, 1978, and 1997 have been recorded as the most serious and extensive in China's recent history (IPCC, 2001). As previously mentioned, a large number of severe floods also have occurred recently in China, predominately over the middle and lower basins of the Yangtze, Huanghe, Huaihe, and Haihe Rivers. (IPCC, 2001) Further climate change will add to the uncertainty that already exists in timing the monsoon rains. Developing a better understanding of the monsoon-dominated climate and better forecast models will allow farmers and water resource managers to better prepare for scenarios of the changing Chinese monsoon climate.

Rice is a staple of Chinese nourishment, and is grown most extensively in the temperate regions, requiring a specialized and sensitive climate in which to flourish. These sensitive areas must remain irrigated, and are therefore highly sensitive to potential river fluctuations. Since rice is one of China's major food sources, this could inflict constraints on the further growth of this rapidly developing nation and modifications to its culinary heritage and culture. During the 1990s, rice production and productivity in Asia grew at a much slower rate than did population (IPCC, 2001). The decline in per capita rice productions has been attributed to water scarcity, indiscriminate and inefficient use of fertilizers and pesticides and the reliance on a narrower genetic material base, impacting variability and resilience (IPCC, 2001). Projected shifts in rainfall with a potential alteration of the monsoon would add to the issue of water scarcity. An intensive cropping system is used to increase rice yield per acre per year, resulting in two to three crops per year (IPCC, 2001). Such aggressive land use policies will likely combine with global warming to provide added stress to the land and to the agricultural stability of

China. Moisture stress from prolonged dry spells or thermal stress resulting from heat-wave conditions will also significantly affect the agricultural productivity (IPCC, 2001). As table 2 shows below, the benefit of increased concentrations of atmospheric CO2 on the rice harvest is severely diminished as warming increases. Therefore, with the advent of climate change and global warming, rice yield in China is expected to decline (IPCC, 2001). Any realized threat of decline in rice productivity will threaten the livelihood of China and its 1.3 billion inhabitants. Possible solutions would be to breed heat-resistant crop varieties by utilizing genetic resources that may be better adapted to warmer and drier conditions (IPCC, 2001).

Model Used and Ambient CO2 levels (current 2005 level ~360ppm)	Table 2) Percent Change in Mean Potential Rice Yield in Asia resulting from Surface Air Temperature Increment of:			
	0C	+1C	+2C	+4C
ORYZA1 Model, 340ppm	0.00	-7.25	-14.18	-31.00
***, 510ppm	23.31	12.29	5.60	-15.66
***, 680ppm	36.39	26.42	16.76	-6.99
SIMRIW Model, 340ppm	0.00	-4.58	-9.81	-26.15
***, 510ppm	12.99	7.81	1.89	-16.58
***, 680ppm	23.92	18.23	11.74	-8.54

Source: (IPCC, 2001)

Unlike the lower latitudes which will be affected by changes in monsoon rainfall and increased chance of drought, in the northern latitudes, climate change should be beneficial to China, by increasing the growing season. In general, areas in the mid- and high latitudes will experience increases in crop yield, whereas yields in areas in the lower latitudes generally will decrease (IPCC, 2001). Indeed, climate change should be advantageous to wheat yield in northeast China (IPCC, 2001). While global warming should play a positive role for agriculture in boreal China with the growing season likely to expand by 1-1.5 months by 2100, studies on projected impacts of climate change

suggest that northeast China may be deprived of the largely pristine conifer forests and its habitat, and broad-leaved forests in east China may shift northward by approximately 3 degrees of latitude (IPCC, 2001).

Northwestern and western China, due to lower annual rainfall rates, are at risk for an increase in desertification. Because soil moisture is likely to decline in this region due to increases in the evaporation rate, the least-dry land types are expected to become semi-arid, and semi-arid land is expected to become arid (IPCC, 2001). The major impact of climate change in arid and semi-arid Asia is likely to be an acute shortage of water resources associated with significant increases in surface air temperature (IPCC, 2001). If populations continue to expand in this region, it will only make the problem of water scarcity worse. The idea of rainfall harvesting in addition to traditional dry farming practices would likely help augment the scarce water resources of this part of China (IPCC, 2001). This of course would in turn affect the local culture and farming techniques that have developed over the centuries and millennia.

Human encroachment in the barely inhabitable mountainous regions of southwestern China has reduced vegetation cover, which has increased soil moisture evaporation, erosion, and siltation in ground water (IPCC, 2001). This is a good example of a form of climate change that does not involve increased emissions of GHGs. By attempting to inhabit these marginally survivable areas, either by free will or due to lack of other more easily inhabitable areas, people are causing these regions to become even less habitable. The government's recent attempt to further populate these areas could prove to be disastrous for the future habitability of these delicate regions.

A sign that climate change is already occurring in China is the fact that almost 67% of the glaciers in the Himalayan mountain range have retreated in the past decade (IPCC, 2001). This has likely caused a short-term increase in river flow downstream, but if farmers in river valleys begin to depend on this flow rate, they will eventually be forced to adjust their irrigation practices when glaciers begin to melt entirely.

In tropical southeast China, agricultural production is sensitive not only to temperature increases and changes in the nature and characteristics of monsoons, but also coastal effects (IPCC, 2001). While inland areas could suffer from scarcity of fresh water and higher air temperatures, coastal China - especially deltaic coasts - will also have to contend with rising sea levels and uncertainty regarding the tracks and intensities of future tropical cyclones. Low-lying muddy coastlines associated with large deltas form a significant resource and support large human populations. In China, such low-lying deltas cover about 4,000km - 22% of the total coastline (IPCC, 2001). Major delta areas of China will be subjected to stresses associated with sea-level rise, saltwater intrusion, siltation and land loss. Low-lying coastal cities will be at the forefront of impacts, including Shanghai, Tianjin, and Guangzhou. (IPCC, 2001) This is where climate change could perhaps most effect the Chinese way of life.

Second-order effects of climate change will also impact Chinese cities. China's rapid economic growth, industrialization, and urbanization - accompanied by inadequate infrastructure investment and management capacity - have contributed to widespread problems of water scarcity throughout the country (IPCC, 2001). Of the 640 major cities in china, more than 300 face water shortages; 100 face severe scarcities (IPCC, 2001). Heat stroke will also become an increasing obstacle to the well-being of Chinese citizens.

A remarkable increase in the number of heatstroke patients and mortality was observed when maximum daily temperatures in Nanjing exceeded 36C for 17 days during July 1988 (IPCC, 2001). Moreover, large cities modify their own surrounding climate in a process known as the urban heat island. Pavement and buildings are more efficient at absorbing incoming solar radiation than the vegetation of the countryside. Therefore, cities heat up quicker throughout the day than neighboring rural areas, creating in effect a "heat island" in which temperatures can be several degrees celsius greater in the cities than in surrounding areas. Also, with a rise in surface temperature and changes in rainfall patterns, the distribution of infectious disease-carrying vectors such as mosquito species may change (IPCC, 2001). Malaria remains a major problem for tropical areas of China. An estimated 25-40% of urban inhabitants in developing countries today live in impoverished slums and squatter settlements, with little or no access to water, sanitation or refuse collection (IPCC, 2001). The process of rapid urbanization and industrialization in several Asian megacities has also in itself placed enormous stress on urban infrastructure, human well-being, cultural integrity, and socioeconomic arrangements. (IPCC, 2001) The fact remains that the "ecological footprint" of these cities is huge and continues to grow. As farmers in rural areas struggle to deal with the effects of climate change on their livelihood, migration to the large cities will undoubtedly continue, further compounding this problem.

Economic concerns are also a primary motivator when preparations for climate change are considered. There is a need, particularly in Asia, for increased recognition by the financial sector that climate change could affect its future (IPCC, 2001). Although global gross domestic product has increased by a factor of three since 1960, the number

of weather-related disasters has increased four-fold, evidence of more people putting themselves at more risk (IPCC, 2001). Therefore, climate change can be considered an opportunity as well as a threat for the insurance industry because an increase in risks and perceived risks implies more business opportunities. Energy demand for heating, cooling, and agriculture activities will also be influenced by climate change (IPCC, 2001). Energy companies and energy traders stand to make significant profit if they decide to take advantage of the opportunities global warming will present. However, some energy sources, like hydroelectricity will suffer from climate change.

Socially, ensuring food security may remain an unaccomplished dream for many Asian countries unless appropriate strategies are put in place to ensure environmental and ecological protections and conservation of natural resources. (IPCC, 2001) Asian economic growth has failed to alleviate poverty for a large share of Asian people to date (IPCC, 2001). Achieving economic and industrial growth in China that is sustainable, both ecologically and economically viable over the long term, would require more than just cleaner, more efficient industrial processes; it demands a reorientation toward becoming less material-intensive and attempting to contribute toward protecting our environment and ecosystem (IPCC, 2001).

Since China's main source of energy are its vast coalfields, it will be hard for Chinese policymakers to put self-imposed limits on GHG emissions. Doing so would mean denying a cheap source of energy to its people, and risk falling behind in relation to other nations in the development process. If Chinese scientists and engineers were to take steps to anticipate climate change and begin to develop cleaner, more efficient use of coal, including sequestration techniques, the resulting reduction in GHG emissions would

help to mitigate future warming and therefore benefit future Chinese (and world) society. However, since China is listed as a "non-annex 1" nation in the Kyoto protocol, and therefore not subject to mandatory emission reductions by international law, the immediate reasons why China would opt to divert its resources toward developing new and cleaner technologies are not clear. Therefore, China will likely continue to emit increasingly large fractions of the world's total GHG emissions as they take advantage of a cheap energy source in their desire to develop and expand in world stature. The most likely actions China will take regarding climate change and global warming will be one of adaptation rather than mitigation. Some adaptive measures, however, may have their own detrimental impacts. Sea walls and levees, for example, once broken can create catastrophic floods far worse than the natural occurring ones they were designed to prevent. The IPCC recommends that "the principle of sustainable development must guide all future development strategies" (IPCC, 2001). All things being equal, the most promising policy options are those for which benefits accrue even if no climate change takes place (IPCC, 2001). Such policy options include:

- Breeding of new crop varieties and species (heat and salt tolerant, low-water use);
- Maintenance of seed banks;
- Drought management;
- Promotion of efficiency of irrigation and water use;
- Trans-national cooperation to promote sustainable water resources management and flood risk management;
- Rehabilitation of degraded forests and watersheds;
- Further focused research to expand our understanding of the climate-ecosystem-social system interactions. (IPCC, 2001)

The specific paths that China will take toward or away from this principle remain to be seen.

The security and sustainability of the region is highly dependent on future trends of such extreme events and preparedness for them. (IPCC, 2001) However there remains great uncertainty in projections of potentially disastrous changes in tropical cyclones, monsoons, and El Nino. (IPCC, 2001) If climate change becomes truly disastrous, competition over the world's fresh water, arable land, and energy resources could provoke either cooperation or conflict. Wars have already begun to be fought over oil and water rights around the globe, and as these resources become even more precious, such conflicts will likely increase unless cooperation and agreement on a fundamental level is reached. China will not be exempt from these pressures, and the potential exists for vast social and geopolitical change throughout the next century through both new alliances and new enemies.

In conclusion, both climate and climate change have drastic impacts on the culture of the specific regions, whether the regions be in China or elsewhere. In the distant past, China used its climate as a resource to develop an advanced civilization far in advance of cultures in the West. More recently, China's climate may have been viewed as a hazard by its people as they were threatened by natural disasters. Additionally, China has been unable to use its climate adequately to keep up with the effects of the Industrial Revolution in the West. In fact, because of China's diverse climate, some climate regions such as the northwestern deserts and southwestern mountains could be seen as a constraint on further progress of Chinese culture. With the advent of climate change,

China can once again choose how to view its climate. The nation has the potential to choose wisely and exploit climate change to gain world power. However, the future consequences of any action taken today are a mystery to policy makers. The risks may prove to be great for any proactive action to be taken. Instead, leaders may choose to view climate as a future hazard. Nonetheless, they must accept that climate has and will continue to affect their society and their culture. While climate decisions and their consequences on future Chinese society and culture remain to be seen, these decisions will have to be made soon as the effects of climate change are already beginning to impact the nation and peoples of China.

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