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Knowing the Weather:

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If human affairs go amiss down here below, then the response of Heaven Above will be as swift as [that of] a shadow or an echo. How can one say that this has not been checked by examination?
Kangxi Emperor, 1678¹

Many societies, seeking a measure of influence over the vagaries of the sky, invested their rulers or shamans with the title “rain king” or “rain queen” and charged them with ceremonial duties of vast significance not only for upholding the physical well-being and prosperity of the tribe but also for maintaining the proper relationships between heaven and Earth.

James Rodger Fleming, 2010²

Knowing the Weather

The weather is never “just” the weather. Instead, it is experienced through historically constructed knowledge of it. The idea that the sky contains, transcends, and instils signs and meanings has, as James Fleming records, formed the source of inspiration for myths, religions, and poetry for thousands of years.³ The term “meteorology,” literally the “knowledge of meteors,” continues to inspire a sense of that original wonder and awe that is felt when we stare at the body of the sky. Descartes opens his treatise Les Météores with the statement that “we naturally feel more wonder for those things above us, than for the things at our own level.”⁴ The environmental historian Vladimir Jankovic notes that the “term *meteoros* referred to things suspended, elevated or raised up, possibly even sublime, noble and magnificent. [...] Other derivatives suggested suspense, doubt, excitement and, in some cases, even mental trouble, wild imagination or false hopes.”⁵ The term reveals how closely and holistically astronomical events have historically been associated with terrestrial phenomena. What happened in heaven was believed to have a reciprocal relationship to events that occurred on earth. Humans had an intermediary political function in this relationship. As the physical geographer Mike Hulme writes, “experiences of extreme weather [...] have long been interpreted by individuals and cultures as signifiers of divine blessing or judgement.”⁶

Astrometeorological traditions in both the “West” and the “East” were for that reason often rooted in a divine authority

1 Kangxi Emperor, quoted in Mark Elvin, The Retreat of the Elephants: An Environmental History of China (New Haven and London: Yale University Press, 2004), 415–416.

2 James Rodger Fleming, Fixing the Sky: The Checkered History of Weather and Climate Control (New York and Chichester: Columbia University Press, 2010), 3.

3 Ibid.

4 René Descartes, quoted in Philip Fisher, Wonder, the Rainbow, and the Aesthetics of Rare Experiences (Cambridge, MA: Harvard University Press, 1998), 44.

5 Vladimir Jankovic, “The End of Classical Meteorology,” in The History of Meteoritics and Key Meteorite Collections: Fireballs, Falls and Finds, ed. Gerald Joseph Home McCall, A. J. Bowden and Richard John Howarth (London: Geological Society, 2006), 91–92.

6 Mike Hulme, Why We Disagree about Climate Change: Understanding Controversy, Inaction and Opportunity (Cambridge: Cambridge University Press, 2009), 13.

which would reward good behaviour with “good” weather, while immoral conduct was punished with “bad” weather. Cambridge scholar Liba Taub notes that discussions “about whether the gods play a role in causing meteorological phenomena recur in both Greek and Latin texts.”⁷ Mark Elvin similarly remarks how the early Chinese dynasties related and attributed the nature of the weather, the richness of the harvest, and the occurrence of natural disasters to the behaviour of the “God Above” [*Shangdi*] and ancestral spirits.⁸ The weather also conveyed knowledge of future events. Heavy storms have, for example, historically been translated as signs of providence that change was “in the air” or that disasters were looming.

Weather signs and other meteorological phenomena would long continue to fascinate natural philosophies on the nature of weather phenomena. However, the arrival of the Enlightenment and modern enquiries, and research on the chemistry of gases marked the definitive end of meteorology as a science of messages and meteors, and the start of a scientific paradigm that understood the sky as constituted by physical-chemical constituents. Jankovic writes that “[r]ain, thunder and wind became the phenomena of atmosphere, all made up of their own stuff and with their own dynamics, heat properties and chemical attributes.”⁹ The authority through which the weather was understood thus shifted from the realm of the gods to the rational domain of man. The withdrawal of knowledge as myth was, in short, replaced by knowledge as a measure of (rational) man. The weather increasingly became imagined as a set of numbers, something that could be calculated, a challenging equation perhaps, but one that nevertheless harboured the promise that its secrets could become known to man. The rise of supercomputers, the latest episode in the attempt to replace the knowledge of the gods with that of man, has brought modern science to the farthest edges in its exploration of that possibility. These super machines, with deified names such as *Titan* and *Atlas*, assemble and process historically unprecedented amounts of data in an attempt to reveal the hidden coding of the weather. At the heart of this very long tradition of enquiries into the behaviour of the skies remains the pursuit of knowledge about the weather.

The politics of weather knowledge might have changed in the transition from God to Reason but they certainly have not

⁷ Liba Taub, *Ancient Meteorology* (London and New York: Routledge, 2003), 10.

⁸ Elvin, *The Retreat of the Elephants*, 95–100.

⁹ Jankovic, “The End of Classical Meteorology,” 97.

withdrawn, and questions of governance remain the principal motivation for advancing technological attempts at weather forecasting. Weather has a direct effect on the politics on the ground: from agriculture to urban planning, from dikes to tourism, from clothing to disaster management. The weather matters, and knowledge of it has a direct bearing on politics. Bad weather, the World Bank estimates, costs the global economy \$150 billion per year.¹⁰ This awareness is perhaps nowhere as great as in China, which hosts the world's fastest supercomputer and where discussions of the possibility of changing the behaviour and trajectory of the weather have led to actual weather modification experiments.

This paper will historically analyze how the relationship between the politics and knowledge of weather has unfolded in the Chinese context. The first section looks at the phenomenological ways in which the weather was conceptualized in ancient China. By looking at the experience of weather knowledge in China, I demonstrate how the weather was never just the weather; instead, it conveyed a message of political relevance. Humans were not considered the passive recipients of weather phenomena. Their moral behaviour rather functioned as a harmonious, balancing mediation between heaven and earth. The second section of this paper looks at the relationship between knowledge of the weather and governance in a more contemporary context. I focus my attention on advances in supercomputing to analyze how the political need to know the weather has given rise to the emergence of simulation technologies that provide for the possibility of changing it. Knowledge of the weather is also here driven by the importance of political balance on earth. However, the possibility of balance is in modern times no longer determined by divine intervention of heaven, or the moral behaviour of man. Knowledge of the weather to allow for such a possibility is instead produced and facilitated by technology.

Balance, Weather, and the Heavens

The weather commonly refers to a specific state or a condition of the atmosphere. Unlike the *longue durée* of the climate, the weather is marked by irregularities and intensities.¹¹ The inherent temporal quality and fickle nature of the weather

¹⁰ World Bank, "Damages from Extreme Weather Mount as Climate Warms," 18 November 2013, www.worldbank.org/en/news/press-release/2013/11/18/damages-extreme-weather-mount-climate-warms.

¹¹ Paul N. Edwards, [A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming](#) (Cambridge, MA: MIT Press, 2010), xiv.

continue to remain visible in its French name, *temps*, which refers to both time and the weather.¹² The environmental anthropologist Tim Ingold links the weather to the ancient Greek deity *Kairos*,¹³ the God of the occasion, the opportune moment, or “the right time.” For this reason *Kairos* was often depicted in sculptures as balancing on the edge of a razor. *Kairos* refers to an indeterminate and fleeting instance, a time that needs seizing and which contains the seeds for an alternative course of history. The weather, however, also revolves around continuity and balance. Ingold writes that “there is a pattern to the weather, but it is one that is continually woven in the multiple rhythmic alterations of the environment—of days and night, sun and moon, winds and tides, vegetative growth and decay, and the comings and goings of migratory animals.”¹⁴ The idea of the weather as being something continuous on the one hand while on the other irregular and rupturing is, of course, not a Greek invention. The idea of “balanced weather” is in fact a recurrent theme in a great number of different meteorological traditions.

The Chinese word for the weather, 天气 (*tianqi*), conveys similar themes of balance and imbalance, of continuity and change.¹⁵ The compound literally translates as “heavenly air” and is often contrasted with earthy (*di*) and human (*ren*) forms of air. Together the elements constitute the so-called three foundational powers (*sancai*) responsible for bringing order to the cosmos. The character for “air” (气 or *qi*) in traditional Chinese thought refers to a spirit or energy that provides for the possibility of life. The sinologists Zhang and Rose define *qi* as constituting the ancient Chinese “worldview that asserts the whole world came from nothing to something, from chaos to order.”¹⁶ Its historical etymology is said to depict the image of three ethereal clouds (☰) held together by a rising vapour.¹⁷ The ancient Chinese saw *qi*, similar to the pre-Socratic conceptualization of air, as something which pervaded all things in the cosmos.¹⁸ However, *qi* contrasted with ancient Greek naturalism in that it was thought to be neither inherently atomistic nor oscillating. It was nevertheless seen to constitute material existence and came later, via Daoism, to be identified with the act of bodily breathing and nourishment.¹⁹

Qi operates on the basis of mediation, as humans play an active part in balancing *qi* between earth and heaven. Daoism

12 See also: Michel Serres and Bruno Latour, Conversations on Science, Culture, and Time (Ann Arbor: University of Michigan Press, 1995).

13 Tim Ingold, “Lines and the Weather,” in Vital Beauty: Reclaiming Aesthetics in the Tangle of Technology and Nature, ed. J. Brouwer, A. Mulder and L. Spuybroek (Rotterdam: V2 Publishing, 2012), 17, original emphasis.

14 *Ibid.*, 18, original emphasis.

15 There does exist a small number of publications exclusively focused on the concept of *qi* in the English language. Readers might be interested in Zhang Hu Yuan and Ken Rose, A Brief History of Qi (Brookline, MA: Paradigm Publications, 2001).

16 *Ibid.*, vi.

17 David Macauley writes that the traditional character for air, 氣, “represented sun and fire, which together produce steam, whose appearance as air was portrayed as squiggly lines of vapor.” David Macauley, Elemental Philosophy: Earth, Air, Fire, and Water as Environmental Ideas (Albany, NY: SUNY Press), 61.

18 In a discussion on the influential early Qing philosopher Wang Fuzhi, the scholar JeeLoo Liu writes that “*qi* exists from the beginning of the universe and is in constant movement and transformation.” JeeLoo Liu, “Wang Fuzhi’s Philosophy of Principle (*Li*) Inherent in *Qi*,” in Dao Companion to Neo-Confucian Philosophy, ed. John Makeham (Dordrecht, Heidelberg and New York: Springer Science, 2010), 358. Dainian Zhang writes elsewhere that *qi* “is both what really exists and what has the ability to become. [...] *Qi* is the life principle but is also the stuff of inanimate objects. As a philosophical category *qi* originally referred

describes how, through meditative breathing, one can achieve higher levels of spiritual insight.²⁰ Confucianism instead prescribes that greater moral rectitude helps towards a more balanced, harmonious relationship between heaven and earth.²¹ In both cases, the weather was a force that could be altered through human behaviour, or, in the words of the American sociologist Peter Berger, “[e]verything ‘here below’ has its analogue ‘up above’.”²² Climatic imbalances in the form of natural catastrophes (e.g. earthquakes, droughts, floods, etc.) were considered to be the result of moral dissipation. Bad weather was never merely just “bad weather”; instead it was seen as a message from heaven. In China, heaven-sent disasters (*tianzai*) portended the end of rulers and even dynasties that had lost their heavenly granted mandate (*tianming*) to rule. Omens of aerial imbalance between the “Three Powers” did not, however, inevitably result in social-political collapse on earth. The weather thereby constituted an almost *de facto* channel between the ruler and heaven. The fate of rulers and dynasties could be resuscitated and the balance between heaven and earth restored if calamities were effectively predicted and prevented through amended moral-social behaviour.

The relationship between social conduct and the weather led to the discovery of an “empirically *observable* correlation between morals and rainfall.”²³ The famous sinologist Joseph Needham provides an empirically rich account of the historical development of weather records and predictive meteorological modelling in pre-modern China.²⁴ A “moral meteorology”²⁵ became increasingly relevant during the territorial expansion of the last Chinese dynasty, as “accurate information about the weather was strategic and crucial to political stability.”²⁶ Similarly, Elvin describes how Qing rulers (1644–1911) effectively linked good local governance to the weather.²⁷ The Yongzheng Emperor, for example, noted that “the level of the harvest will correspond to the level of the governor-general and the governor.”²⁸ Good weather would thus provide legitimacy to imperial governance. It enhanced economic activity and transcended heavenly approval, as much functionally as metaphorically.

The arrival of modern meteorological knowledge and instruments dispersed by Jesuit missionaries in the seventeenth and eighteenth centuries changed the enterprise of weather

to the existence of whatever is of a nature to change.” Dainian Zhang, Key Concepts in Chinese Philosophy (New Haven and Beijing: Yale University and Foreign Language Press, 2002), 45, original emphasis.

¹⁹ See also David W. Pankenier, Astrology and Cosmology in Early China: Conforming Earth to Heaven (Cambridge: Cambridge University Press, 2013), and Joseph Needham, Science and Civilisation in China, Vol. 3: Mathematics and the Sciences of the Heavens and the Earth (Cambridge: Cambridge University Press, 2008 [1954]).

²⁰ See, for instance, Antony R. Berger, Dark Nature in Classic Chinese Thought (Victoria: University of Victoria Press, 1999).

²¹ See Mary Evelyn Tucker and John Berthrong, eds., Confucianism and Ecology: The Interrelation of Heaven, Earth, and Humans (Cambridge, MA: Harvard University Press, 1998).

²² Quoted in Pankenier, Astrology and Cosmology in Early China, 232.

²³ Elvin, The Retreat of the Elephants, 414, original emphasis.

²⁴ Needham, Science and Civilisation in China.

²⁵ The term appears in Elvin, The Retreat of the Elephants and Mark Elvin, “Who Was Responsible for the Weather? Moral Meteorology in Late Imperial China,” Osiris 2, no. 13 (1998): 213–237.

²⁶ Andrea Janku, “Heaven-Sent Disasters in Late Imperial China: The Scope of the State and Beyond,” in Natural Disasters, Cultural Responses: Case Studies Toward a Global Environmental History, ed. Christof Mauch and Christian Pfister (Lanham, MD and Plymouth: Lexington Books, 2009), 240

forecasting in China, and would gradually transform the Chinese cosmological relationship to the weather. Mathematics, for instance, came to play a more dominant role in predicting droughts, floods, and other meteorological phenomena. The new astronomic science, imported at a time in which Europe itself was going through a revolutionary secularization of knowledge, replaced traditional Islamic knowledge of astronomy in the Qing Court. This change heralded an early first step in a long process towards the secularization of the weather.

Over the centuries, the weather came to be seen as something rational and calculable. It did continue, however, to perform an important function in the divine governance of populations. Shapiro notes, for example, how Mao's onslaught on nature caused much critique among scholars.²⁹ Stories of balance and order between nature and humans resurfaced during the disastrous years of the Great Leap Forward (1958–1961), and came to challenge Mao's authority in a similar way as floods and droughts had done to China's earlier dynastic rulers. For example, the catastrophic 1976 Tangshan Earthquake, the most lethal of the twentieth century, was by locals similarly seen as a sign from heaven. The event was politically exploited by anti-Maoist factions to deepen the imminent fall of the already ailing Chairman. In Heaven Cracks, Earth Shakes, James Palmer notes that the earthquake was seen as "a direct challenge to the Mandate of Heaven, a blow struck at the very heart of the government's legitimacy."³⁰

The relationship between cosmology and ecological politics continues to play a role in questions of governance. "Weather events, especially extreme ones," Hulme writes, "remain enshrined as 'acts of God'."³¹ Online discussions on the Sichuan earthquake of 2008 were, for example, swift in evoking the old portents of a Mandate of Heaven. China's political elites were quick to use the Mandate discourse to "demonstrate wisdom, virtue and caring for the welfare of their people."³² However, the potent mythology that lies hidden in perceptions of the weather is not the only force through which the weather challenges the legitimacy of terrestrial authorities. The fact that about 80 percent of all disasters are directly tied to weather events suggests that knowledge of the weather remains of great functional importance for governance.³³ This has become particularly evident when considering that environmental

²⁷ Elvin, The Retreat of the Elephants.

²⁸ Elvin, The Retreat of the Elephants, 425.

²⁹ Judith Shapiro, Mao's War Against Nature: Politics and the Environment in Revolutionary China (Cambridge: Cambridge University Press, 2001).

³⁰ James Palmer, Heaven Cracks, Earth Shakes: The Tangshan Earthquake and the Death of Mao's China (New York: Basic Books, 2012), 197.

³¹ Hulme, Why We Disagree about Climate Change, 156.

³² Florian Schneider and Yih-Jye Hwang, "The Sichuan Earthquake and the Heavenly Mandate: Legitimizing Chinese Rule through Disaster Discourse," Journal of Contemporary China 23, no. 88 (2014): 641.

³³ Havidan Rodriguez, Walter Diaz, Jennifer M. Santos, and Benigno E. Aguirre, "Communicating Risk and Uncertainty: Science, Technology, and Disasters at the Crossroads," in Handbook of Disaster Research, ed. Havidan Rodriguez, Enrico L. Quarantelli and Russell R. Dynes (New York: Springer, 2007), 476–488.

disasters seem increasingly to have anthropogenic origins. The onslaught on the environment has had severe social-economic repercussions and political implications, especially in China. Official Chinese estimates suggest that \$69 billion is lost annually due to natural disasters.³⁴ The vast majority of those losses are the said result of “wild” weather. As a consequence, the environment has surpassed land expropriation as the main motivation for the more than 180,000 popular protests that take place across the country each year.³⁵ Indeed, as Shapiro notes, “China’s handling of its environmental crisis has become of critical importance to the country’s stability and the legitimacy of the government.”³⁶

These factors of social and economic unbalancing have led the Chinese government to take a greater strategic interest in the weather. Today the language of weather knowledge is expressed computationally. The fact that China currently hosts the world’s fastest supercomputer is illustrative of the political importance the state attaches to knowledge of the weather. The remainder of this paper engages with the ways computation has historically affected weather knowledge. Indeed, computational knowledge is increasingly giving rise to the possibility of an anthropogenic shaping of the weather; the balance between heaven and earth has thereby become a matter of technology.

Balance, Weather and the Supercomputer

The rise of supercomputers after WWII for the first time enabled the possibility of “foreknowledge of the weather,”³⁷ and computerized meteorological information came to be used in agriculture, car manufacturing, commercial aviation, and air pollution monitoring. Graphic Earth System Models, which consider chemical, physical, biological, and, increasingly, anthropogenic processes, quickly took over earlier numerical traditions of climate modelling and weather forecasting that had been more local in focus. The change marked a fundamental shift from empirical research to the actual representational modelling of the weather. The history of computerized weather forecasting and that of computing in general are, according to computer engineers, “very tightly coupled.”³⁸ The process of understanding and forecasting the non-linear and capricious trajectory of the weather involves such immense amounts of

34 Reuters, “Costs of Natural Disasters in China Surge to \$69 Billion,” Reuters.com, 24 February 2014, uk.reuters.com/article/2014/02/24/us-china-disasters-idUKBREA1N0JW20140224.

35 Elizabeth Economy, “China Wakes Up to Its Environmental Catastrophe,” Bloomberg Business, 13 March 2014, www.businessweek.com/articles/2014-03-13/china-wakes-up-to-its-environmental-catastrophe.

36 Judith Shapiro, China’s Environmental Challenges (Cambridge: Polity Press, 2012), 9.

37 Frederik Nebeker, Calculating the Weather: Meteorology in the 20th Century (San Diego: Academic Press, 1995), 135.

38 Lloyd Treinish, quoted in Samuel Greengard, “Weathering a New Era of Big Data,” Communications of the ACM 57, no. 9 (2014): 13.

data processing that “[n]o field other than nuclear weapons research and high-energy physics have ever demanded so much calculating capability.”³⁹ The compound noun “super-computer” tellingly refers to a machine from “above”; such devices are given mythological names such as *Raijin* (Japanese god of thunder), *Titan*, *Vulcan* (Roman god of fire), *Atlas* (Greek titan of astronomy), and *Jaguar* (Mayan god), and are designed to discover the meta-language that captures the *kairotic* nature of the weather.⁴⁰

The complexity of the climate means, however, that it is not technologically possible to reflect a perfect mirror image of the future course of the weather. The complexity is of such an order of magnitude that old ideas about the harmonious and balanced nature of the weather have been thrown out the window. Mastery of knowledge that would perfectly predict the weather has, in other words, been accepted as unattainable. Rather, as the historian Paul Edwards explains, the reality is that supercomputers work towards a series of models that provide possible future trajectories of the weather.⁴¹ Weather forecasting has thus become a “probabilistic science,” which means that weather models or simulations do not mirror but attempt to visually *represent* the future course of the weather. Policy decisions on actions concerning the weather are made on the basis of a large series of models derived from data averages; this means that the models are “world-building.” Such models do not “merely represent, but in a social and semiotic sense [*construct*], the global atmosphere.”⁴² They are, in other words, the “instruments by which scientists and other policymakers construct and articulate competing visions not only of today’s world, but also of what they hope, and fear, for tomorrow’s.”⁴³ It is only through such simulation technologies that the weather (and by extension the climate) is made imaginable and representable. But simulations do not function without bias: their status as representation means that they embody certain meanings and thereby come to serve a particular function. They allow for the planning and execution of different (and competing) mitigation and adaption strategies.

In China, the gap between simulation and “world-building” has been narrowed unlike anywhere else. The development of the Chinese government’s latest supercomputer, the Tianhe-2, marks a revolution in the world of supercomputing. The machine,

39 Edwards, [A Vast Machine](#), 173.

40 The idea of God as supercomputer was raised by the mathematical physicist Frank J. Tipler, in [The Physics of Immortality: Modern Cosmology, God and the Resurrection of the Dead](#) (London: Pan Books, 1996).

41 Edwards, [A Vast Machine](#).

42 Paul N. Edwards, “Representing the Global Atmosphere,” in [Changing the Atmosphere: Expert Knowledge and Environmental Governance](#), ed. Clark A. Miller and Paul N. Edwards (London: MIT Press, 2001), 65, original emphasis.

43 Miller and Edwards, introduction to [Changing the Atmosphere: Expert Knowledge and Environmental Governance](#), 18.

44 “China’s Tianhe-2 Remains ‘Fastest’ Supercomputer,” [China Daily](#), 19 November 2013, www.chinadaily.com.cn/bizchina/2013-11/19/content_17114803.htm.

45 Xue-Feng Yuan, quoted in Mimi Lau, “China’s World-beating Supercomputer Fails to Impress Some Potential Clients,” [South China Morning Post](#), 30 June 2014, www.scmp.com/news/china/article/1543226/chinas-world-beating-supercomputer-fails-impress-some-potential-clients.

whose name aptly translates as “Heavenly River Two” (from 天河, or “Milky Way”), is at the time of writing the world’s fastest processor.⁴⁴ The director of the National Supercomputing Centre in Guangzhou argues that “the machine takes one second to finish what 1.3 billion personal computers would need 1,000 years to complete.”⁴⁵ Besides numerous other functions, Tianhe-2 is intended to be used to simulate atmospheric conditions⁴⁶ and monitor the dense layers of smog that dangerously pollute the atmosphere of many Chinese cities.⁴⁷

The pursuit of greater processing powers has already inspired the Chinese government to invest in research on the next generation of supercomputers.⁴⁸ Plans for a series of so-called “exascale” supercomputers are underway in China. They would be the first generation of machines powerful enough to simulate human brain activity.⁴⁹ The processing power of these new machines, roughly thirty times more powerful than Tianhe-2, will be able to conduct one million trillion calculations (10^{18}) per second and thereby lead the way to more sophisticated algorithms and higher weather model resolutions. Higher resolution and more advanced data-simulation modelling would help in turn to increase the reliability of medium- and long-term predictions and enhance the ability to adequately foresee extreme weather conditions in the near future. The temporality of climatological predictions through exascale modelling could, according to research, be lengthened to decades and even centuries.⁵⁰ Theoretically, these simulations would therefore both help to mitigate immediate disasters and adapt to medium- and long-term changes in the weather.

Representational weather technologies not only passively monitor weather conditions but also contain the seeds for the active manipulation of existing weather compositions and developments. The relationship between computer simulation and actual environmental engineering has also become particularly relevant in research into “weather modification” and “geoengineering.”⁵¹ Output from climate simulators is thereby used to assess the potential impacts of hypothetical attempts to actively engineer the weather and the climate without actually leaving the virtual world of computer models.

China currently hosts the world’s largest weather modification programme (*rengong yingxiang tianqi bangongshi*), which actively uses supercomputers.⁵² The programme, launched in

46 Xiangke Liao, Liquan Xiao, Canqun Yang and Yutong Lu, “MilkyWay-2 Supercomputer: System and Application,” Frontiers of Computer Science 8, no. 3 (2014): 345–356.

47 “China’s Supercomputer Technology Used to Monitor Smog,” Xinhua, 12 September 2013, news.xinhuanet.com/english/china/2013-12/09/c_132952877.htm.

48 See, for example, Bob Davis, “China’s Not-So-Super Computers,” The Wall Street Journal, 23 March 2012, online.wsj.com/articles/SB10001424052702303812904577298062429510918.

49 See, among other accounts, James L. McClelland, “Is a Machine Realization of Truly Human-Like Intelligence Achievable?” Cognitive Computation 1, no. 1 (2009): 17–21, and Henry Markram, “The Human Brain Project,” Scientific American 306, no. 6 (June 2012): 50–55.

50 See, for instance, Dawn Levy, “Exascale Supercomputing Advances Climate Research,” Scientific Discovery through Advanced Computing 16 (2010): 20–31.

51 See, for example, H. Schmidt, K. Alterskjær, D. Bou Karam, O. Boucher, A. Jones, J. E. Kristjánsson, U. Niemeier, M. Schulz, A. Aaheim, F. Benduhn, M. Lawrence and C. Timmreck, “Solar Irradiance Reduction to Counteract Radiative Forcing from a Quadrupling of CO₂: Climate Responses Simulated by Four Earth System Models,” Earth System Dynamics 3 (2012): 63–78.

52 Mark Williams, “Weather Engineering in China,” Technology Review, 25 March 2008, www.technologyreview.com/news/409794/weather-engineering-in-china.

2007 and supervised by the China Meteorological Administration (CMA, *zhongguo qixiang ju*), employs some 47,700 part-time and full-time workers from around the country.⁵³ It boasts a fleet of over fifty aircrafts, approximately 7,000 rocket launchers and 7,000 anti-aircraft guns for cloud-seeding purposes.⁵⁴ The legal framework surrounding weather modification in China reveals the explicit underlying economic motivations for weather knowledge. The 2002 law on the “Regulations on Administration of Weather Modification” (*rengong yingxiang tianqi guanli tiaoli*) reads, for example, that weather modification is intended “to mitigate or avert meteorological disasters and properly exploit climatic resources.”⁵⁵ The head of the CMA stated that the organization’s “goal is to reduce [economic] losses caused by weather disasters from three percent of GDP last year to one percent by the end of the period.”⁵⁶ Recently, the CMA proudly stated that its weather modification programme conducted “[s]ome 560,000 manipulations of the weather [...] since 2002, [releasing] 489.7 billion tons of rain and [saving] about 66 billion yuan (USD 10.4 billion) in economic losses.”⁵⁷

Computer-generated weather simulations inform and affect the very real world of policy-making and politics on the ground.⁵⁸ Knowledge of the weather can also be used to actively change the aerial composition of the weather itself. The weather continues, in other words, to be a means of governance. However, whereas the non-moderns prayed and behaved morally to enable a balanced relation to the weather, we moderns are attempting to subordinate the *kairos* of the weather through the technological means of computerized representation.

Conclusion

Knowledge of future weather is today linked to advances in computational technology. Ideas of balance and harmony, constitutive of older imaginaries of the weather, have not become redundant, but reappear as conditions fashioned by machines. Simulations thus create a weather that is *almost* (but never quite) as “real” as the weather. This discrepancy leaves room open for the possibility of weather alteration. It offers the opportunity for politics to imagine and even create alternative, and competing, weather paths.

The Chinese government has thus far been primarily

53 Zheng Xin, “Better Tech to Boost Weather Manipulation,” *China Daily*, 23 May 2012, www.chinadaily.com.cn/china/2012-05/23/content_15360828.htm.

54 Zhao Huanxin and Bao Wanxian, “Demand Rising for Weather Modification,” *China Daily*, 3 April 2010, www.chinadaily.com.cn/china/2010-03/04/content_9534044.htm.

55 State Council, Article 3 of the “Regulations on Administration of Weather Modification,” *Executive Meeting of the State Council*, 1 May 2002, www.cma.gov.cn/en/LegalSystem/LawsAndRegulations/201203/t20120320_166791.html.

56 Quoted in Tuo Yannan, “Cloud Seeding Set to Cover a Wider Area,” *China Daily*, 3 May 2012, www.chinadaily.com.cn/china/2012-03/05/content_14752259.htm.

57 Xin, “Better Tech to Boost Weather Manipulation.”

58 See also Nick Srnicek, “Representing Complexity: The Material Construction of World Politics” (PhD diss., London School of Economics, 2013).

interested in using weather knowledge to achieve greater economic growth. However, growing public discontent over the consequences of extreme weather conditions has forced it to consider the consequences of that economic emphasis. This means, to paraphrase Peter Berger's earlier-quoted dictum that "everything 'up above' has its analogue 'here below'." A "balanced" weather stimulates, in other words, economic growth as much as it provides for the health of society. The weather therefore continues to be of great relevance for upholding political legitimacy. But while the weather language of the gods had been informed by morality, it now seems increasingly to be the computational language of machines that has come to occupy the question of how we "know the weather."