

## ARTICLE

# *Transboundary Implications of China's Weather Modification Programme*

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### Abstract

In recent years, China has expanded its national weather modification programme to exploit climatic resources and adapt to climate change. The unprecedented scale of China's weather modification programmes has raised concerns over potential environmental impacts, including transboundary impacts. This article analyzes the domestic governance of weather modification in China and the extent to which this legal framework satisfies China's obligations under customary international law to minimize risks of significant transboundary harm. We find that existing arrangements do not satisfy procedural obligations under customary international law; nor do they adequately address the risks of environmental impacts associated with the increased use of weather modification. Procedures for transboundary environmental impact assessment (EIA) and engagement with regional neighbours are needed for China to comply with international law and promote stability in the region.

**Keywords:** Weather modification, Atmospheric water, Cloud seeding, Climate change adaptation, Transboundary impacts, Chinese law

## 1. INTRODUCTION

China is implementing a large-scale programme of cloud seeding, which has attracted media attention worldwide.<sup>1</sup> In 2022, China experienced the most severe summer

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<sup>1</sup> 'China Deploys Rain-Seeding Drones to End Drought in Sichuan', *Bloomberg*, 26 Aug. 2022, available at: <https://www.bloomberg.com/news/articles/2022-08-26/china-deploys-rain-seeding-drones-to-end-drought-in-sichuan>; Z. Hui, 'At Least 10 Chinese Provinces Use Cloud-Seeding to Combat Heat

heatwaves since records began in 1961. Daytime temperatures were above 35°C, lasting for over two months.<sup>2</sup> The associated drought affected transportation, industry, food, and hydro-electricity production for close to one billion people across 17 provinces.<sup>3</sup> In response to these crippling drought conditions, China imposed tight water-consumption restrictions and deployed aircraft and drones to seed clouds to enhance rainfall.<sup>4</sup>

Weather modification by cloud seeding involves injecting particles – such as dry ice, silver iodide or salts – into certain types of cloud to enhance precipitation or suppress hail.<sup>5</sup> Depending on local geographical and meteorological conditions, cloud seeding operations can be air-based, with particles delivered via aircraft or drones, or ground-based using generators, canons or rocket launchers.<sup>6</sup> Developed by American scientists after the Second World War, weather modification techniques focused initially on mitigating extreme weather events and increasing rainfall for agriculture.<sup>7</sup> In recent years, cloud seeding has become a ‘long-term water resources management tool’<sup>8</sup> around the world, to alleviate water shortages and enhance hydro-electricity production.<sup>9</sup> Some states, including China, also use weather modification to mitigate hailstorms, although the scientific evidence for hail suppression remains inconclusive.<sup>10</sup>

Weather modification has been researched for over 50 years in China and other countries, yet its environmental impacts remain understudied and poorly understood.<sup>11</sup> While weather modification techniques have obvious benefits, they also pose risks of adverse impacts.<sup>12</sup> Altered precipitation patterns can affect plant and animal

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Wave; ‘No Effect’ on Climate Change, Ecosystem’, *Global Times*, 26 Aug. 2022, available at: <https://www.globaltimes.cn/page/202208/1273964.shtml>; Reuters, ‘China Deploys Cloud-Seeding Planes and Cuts Electricity Use as Record Heatwave Takes Toll’, *The Guardian*, 17 Aug. 2022, available at: <https://www.theguardian.com/world/2022/aug/18/china-deploys-cloud-seeding-planes-and-cuts-electricity-use-as-record-heatwave-takes-toll>.

<sup>2</sup> S. Mallapaty, ‘China’s Extreme Weather Challenges Scientists Trying to Study It’ (2022) 609(7929) *Nature*, p. 888.

<sup>3</sup> D. Wong & H. Huang, ‘China’s Record Heatwave, Worst Drought in Decades’, *South China Morning Post*, 31 Aug. 2022, available at: <https://bit.ly/3AZUR3F>.

<sup>4</sup> E.T. Yeh, ‘Sky River: Promethean Dreams of Optimising the Atmosphere’ (2022) 7(2) *Made in China Journal*, pp. 96–101, at 96. See also S. Deng et al., ‘China Is Seeding Clouds to Replenish Its Shrinking Yangtze River’, *CNN*, 18 Aug. 2022, available at: <https://edition.cnn.com/2022/08/17/asia/china-heat-drought-climate-yangtze-intl/index.html>.

<sup>5</sup> See generally V.J. Schaefer, ‘The Early History of Weather Modification’ (1968) 49(4) *Bulletin of the American Meteorological Society*, pp. 337–42.

<sup>6</sup> X. Guo et al., ‘Advances in Cloud Physics and Weather Modification in China’ (2015) 32 *Advances in Atmospheric Sciences*, pp. 230–49, at 238.

<sup>7</sup> See, e.g., V.C. Ball, ‘Shaping the Law of Weather Control’ (1949) 58 *The Yale Law Journal*, pp. 213–44, at 240.

<sup>8</sup> WMO Expert Team on Weather Modification Research, ‘Report of the Expert Team on Weather Modification Meeting’, 2015, p. 5, available at: <https://community.wmo.int/en/wwrp-wx-mod>.

<sup>9</sup> A.I. Flossmann et al., ‘Peer Review Report on Global Precipitation Enhancement Activities’, WWRP-2018-1, WMO, 2018, pp. 1–5, available at: <https://library.wmo.int/records/item/42100-peer-review-report-on-global-precipitation-enhancement-activities>.

<sup>10</sup> World Meteorological Organization (WMO), *Statement on Weather Modification* (WMO, 2015), p. 3, available at: <https://community.wmo.int/en/activity-areas/wwrp/wwrp-working-groups/wwrp-expert-team-weather-modification>.

<sup>11</sup> Flossmann et al., n. 9 above, p. 16.

<sup>12</sup> WMO, n. 10 above, p. 2.

communities, land structure, and hydrology.<sup>13</sup> In addition to the direct risks of weather modification, unsuccessful cloud seeding operations can increase the impacts of droughts, floods and other weather disasters, for example, by increasing hail or reducing precipitation.<sup>14</sup>

The risk profile of weather modification differs depending on the scale and type of seeding agent deployed. Some studies suggest that silver iodide could have accumulative properties, with risks of persistence in the food chain and impacts on biological diversity.<sup>15</sup> The United States (US) Weather Modification Association considers the annual dispersal of three tonnes of silver iodide in Canada and the US to be environmentally safe.<sup>16</sup> However, the World Meteorological Organization (WMO) Statement on Weather Modification recommends that ‘any plans to use either a massive quantity of such a product or a different seeding agent should be accompanied with a preliminary evaluation of its potential effects on both environment and human health’.<sup>17</sup> The WMO is a United Nations (UN) agency, which facilitates information exchange on weather modification. The WMO Statement on Weather Modification articulates authoritative but non-binding guidelines for conducting weather modification projects.<sup>18</sup>

There are concerns, both within and beyond China, about the negative impacts of weather modification at the scale of China’s expanding programme.<sup>19</sup> Weather modification activities could affect the regional distribution of rainfall, potentially depriving downwind areas of their natural precipitation.<sup>20</sup> In some cases, weather modification could also increase rainfall: studies demonstrate that seeding agents such as silver iodide can seed clouds and thus *enhance* rainfall up to 200 kilometres (km) from the target area.<sup>21</sup> Therefore, there is a clear risk of ‘extra-area effects’ on ecosystems and communities beyond the target area, including ‘the possibility of creating severe

<sup>13</sup> C.F. Cooper & W.C. Jolly, *Ecological Effects of Weather Modification: A Problem Analysis* (University of Michigan, Department of Resource Planning and Conservation 1969), pp. 120–2.

<sup>14</sup> WMO, n. 10 above, p. 6. See also, W.R. Cotton & R.A. Pielke, *Human Impacts on Weather and Climate* (Cambridge University Press, 2007), p. 250.

<sup>15</sup> C. Fajardo et al., ‘Potential Risk of Acute Toxicity Induced by AgI Cloud Seeding on Soil and Freshwater Biota’ (2016) 133 *Ecotoxicology and Environmental Safety*, pp. 433–41.

<sup>16</sup> See generally Weather Modification Association (WMA), ‘Position Statement on the Environmental Impact of Using Silver Iodide as a Cloud Seeding Agent’, July 2009, available at: <https://weathermod.org/wp-content/uploads/2018/03/EnvironmentalImpact.pdf>.

<sup>17</sup> WMO, n. 10 above, p. 12.

<sup>18</sup> World Meteorological Congress & WMO (eds), *Fifteenth World Meteorological Congress, Geneva, 7–25 May 2007: Abridged Final Report with Resolutions* (WMO, 2007), p. 54, available at: [https://library.wmo.int/doc\\_num.php?explnum\\_id=5225](https://library.wmo.int/doc_num.php?explnum_id=5225); WMO, ‘Strategic Plan for the Implementation of WMO’s World Weather Research Programme (WWRP): 2009–2017’ (WMO, 2009), pp. 49–50, available at: [https://library.wmo.int/doc\\_num.php?explnum\\_id=5758](https://library.wmo.int/doc_num.php?explnum_id=5758) (WMO Strategic Plan).

<sup>19</sup> See, e.g., S. Pathak, ‘Adding Artificial Rain to the Sino-Indian Conundrum’, *Asia Times*, 10 Apr. 2018, available at: <https://asiatimes.com/2018/04/adding-artificial-rain-sino-indian-conundrum>. See also D. Jayaram & K. Bhattacharjee, ‘China’s Geoengineering Push Dangerous for the Region’, *The Sunday Guardian Live*, 19 Dec. 2020, available at: <https://www.sundayguardianlive.com/news/chinas-geoengineering-push-dangerous-region>.

<sup>20</sup> R. List, ‘Weather Modification: A Scenario for the Future’ (2004) 85(1) *Bulletin of the American Meteorological Society*, pp. 51–64, at 57.

<sup>21</sup> T.P. DeFelice et al., ‘Extra Area Effects of Cloud Seeding: An Updated Assessment’ (2014) 135–136 *Atmospheric Research*, pp. 193–203.

weather or floods' or 'increasing rainfall in one local region at the expense of rainfall in a neighbouring local region'.<sup>22</sup> Within China, this issue arose in the 2000s when local governments in provinces such as Henan, Guanxi and Shaanxi accused each other of stealing precipitation (or 'cloud theft').<sup>23</sup>

Of perhaps more importance are concerns that weather modification activities could have detrimental impacts across national borders.<sup>24</sup> Controversy over potential transboundary impacts of weather modification has persisted since the 1960s,<sup>25</sup> and these concerns continue to feed geopolitical tensions.<sup>26</sup> It is not the purpose of this article to assess whether any of China's weather modification activities have in fact caused, or are likely to cause, significant transboundary harm. A claimant state would face major challenges in litigating a claim based on actual harm because of the difficulties in establishing a causal link between a specific weather modification activity and any alleged transboundary harm.<sup>27</sup> It may be possible, however, to demonstrate that the increased risk makes harm 'likely'. With the present state of science, it remains extremely difficult to demonstrate that weather modification activities cause transboundary impacts (for example, disruption of regional climate systems, changes in transboundary watercourses). Yet, in accordance with the precautionary approach recognized under international law,<sup>28</sup> these uncertainties should not be used as reasons for postponing measures to prevent serious impacts from occurring.

A prominent example of these concerns is the ongoing tension between India and China over China's 'Sky River' weather modification project on the Tibetan Plateau.<sup>29</sup> Since 2016, Tsinghua University, Qinghai University, and the

<sup>22</sup> Cotton & Pielke, n. 14 above, p. 250.

<sup>23</sup> S. Chien, D. Hong & P. Lin, 'Ideological and Volume Politics behind Cloud Water Resource Governance: Weather Modification in China' (2017) 85 *Geoforum*, pp. 225–33, at 232.

<sup>24</sup> See generally L.L. Roslycky, 'Weather Modification Operations with Transboundary Effects: The Technology, the Activities and the Rules' (2003) 16 *Hague Yearbook of International Law*, pp. 3–40.

<sup>25</sup> See, e.g., R.J. Davis, 'The United States and Mexico: Weather Technology, Water Resources and International Law' (1972) 16(4) *Natural Resources Journal*, pp. 530–44, at 543.

<sup>26</sup> See, e.g., Pathak, n. 19 above; ToI Staff, 'Iranian General Blames Water Woes on Israeli "Cloud Theft"', *The Times of Israel*, 2 July 2018, available at: <https://www.timesofisrael.com/iranian-general-blames-water-woes-on-israeli-cloud-theft>.

<sup>27</sup> T. Majzoub et al., "'Cloud Busters': Reflections on the Right to Water in Clouds and a Search for International Law Rules' (2008) 20(3) *Colorado Journal of International Environmental Law and Policy*, pp. 321–66, at 337–43.

<sup>28</sup> As explained in Section 3 below, all states are obliged under the no-harm rule of customary international law to adopt a precautionary approach where there is scientific uncertainty concerning risks of significant transboundary harm. While the precise framing differs across contexts, the most widely accepted formulation of the precautionary principle provides that '[w]here there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation': Rio Declaration on Environment and Development, adopted by the UN Conference on Environment and Development, Rio de Janeiro (Brazil), 3–14 June 1992, UN Doc. A/CONF.151/26/Rev.1 (Vol. I), 14 June 1992, available at: [https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A\\_CONF.151\\_26\\_Vol.I\\_Declaration.pdf](https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_CONF.151_26_Vol.I_Declaration.pdf) (Rio Declaration).

<sup>29</sup> C.L. Geros, 'Drinking the Winds: Monsoon as Atmospheric Spring' (2021) 7(1) *GeoHumanities*, pp. 65–88, at 81–2. See also S. Chen, 'China Needs More Water: So It's Building a Rain-Making Network Three Times the Size of Spain', *South China Morning Post*, 26 Mar. 2018, available at: <https://www.scmp.com/>

meteorological bureau of Qinghai province have been working on the Sky River Project (*Tianhe* in Mandarin),<sup>30</sup> in collaboration with a military contractor, the Aerospace Science and Technology Corporation.<sup>31</sup> The project is expected to transfer up to 5 billion cubic metres of water annually from the Yangtze river, to feed the inland river systems further north, including the Yellow river basin.<sup>32</sup> The Chinese Meteorological Administration (CMA) has already installed more than 500 ground-based generators to seed clouds over the Qinghai-Tibetan Plateau.<sup>33</sup> The generators are activated by satellites that monitor and forecast meteorological conditions,<sup>34</sup> with further support announced in September 2022.<sup>35</sup> This experiment is intended to be scaled up to tens of thousands of generators, covering an area of up to 1.6 million km<sup>2</sup>.<sup>36</sup> However, because of the controversial nature of the project, information on the Sky River project is scarce.<sup>37</sup>

There are doubts that the scale of the Sky River project is feasible,<sup>38</sup> but more pressing are concerns that enhancing precipitation over the Himalayas for the benefit of China may deprive India of beneficial rainwater.<sup>39</sup> The project has been planned with little transparency or cooperation with neighbouring countries in South and Southeast Asia, especially India.<sup>40</sup> These factors contribute to discomfort over what is perceived by some to be the militarization of the Chinese weather modification programme.<sup>41</sup>

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[news/china/society/article/2138866/china-needs-more-water-so-its-building-rain-making-network-three](https://news/china/society/article/2138866/china-needs-more-water-so-its-building-rain-making-network-three); this newspaper article was the first source to make information on the Sky River project available to an English-speaking audience.

<sup>30</sup> G. Wang et al., ‘Study on Sky Rivers: Concept, Theory, and Implications’ (2018) 21 *Journal of Hydro-environment Research*, pp. 109–17, at 110.

<sup>31</sup> Geros, n. 29 above, p. 81.

<sup>32</sup> Q. Zhang & Q. Gu, ‘Sustainability Analysis of Cross-Regional Drinking Water Project in North and South China Take West Route of the South-to-North Water Diversion and the Tianhe Project’ (2019) *IOP Conference Series: Earth and Environmental Science*, pp. 1–6, at 2.

<sup>33</sup> *Ibid.*

<sup>34</sup> G. Wang et al., ‘The Sky River Project’, International Association for Hydro-Environment Engineering and Research, 2017, pp. 120–22, at 122, available at: <https://henry.baw.de/server/api/core/bitstreams/a01e5e16-fb25-4155-a778-99245374f7e9/content>. See also E.M. Hunchuck, M. Ferrari & J. Cheng, ‘Prologue to the Sky River’, *The Avery Review*, June 2021, available at: <https://www.averyreview.com/issues/53/prologue-to-the-sky-river>.

<sup>35</sup> CMA, ‘The China Meteorological Administration Deploys and Promotes the Capacity Building of Weather Modification in Southwest China’, 22 Sept. 2022, available at: [http://www.cma.gov.cn/2011xwxz/2011xqxww/2011xqxyw/202209/t20220901\\_5065542.html?from=singlemessage&fbclid=IwAR1b5RSZFWz6PJDPW9jIO-Wwm2wooh13ReL5DB\\_MiQFMpXdq28GAL6y1-Q](http://www.cma.gov.cn/2011xwxz/2011xqxww/2011xqxyw/202209/t20220901_5065542.html?from=singlemessage&fbclid=IwAR1b5RSZFWz6PJDPW9jIO-Wwm2wooh13ReL5DB_MiQFMpXdq28GAL6y1-Q) (in Chinese).

<sup>36</sup> Chen, n. 29 above.

<sup>37</sup> Yeh, n. 4 above, pp. 99–100.

<sup>38</sup> See generally T.J. Xuan & W. Jiawen, ‘Qinghai-Tibet Artificial Rainfall Project “Delusional,” Experts Say’, *Caixin Global*, 27 Nov. 2018, available at: <https://www.caixinglobal.com/2018-11-27/qinghai-tibet-artificial-rainfall-project-delusional-experts-say-101352671.html>.

<sup>39</sup> Pathak, n. 19 above; A. Jash, ‘China’s Practice of Weather Modification: Implications for India’, *Centre for Land Warfare Studies Issue Brief*, Mar. 2020, available at: [https://www.claws.in/static/IB-125\\_Chinas-Practice-of-Weather-Modification.pdf](https://www.claws.in/static/IB-125_Chinas-Practice-of-Weather-Modification.pdf).

<sup>40</sup> *Ibid.*

<sup>41</sup> ‘China’s “Weather Modification System” Raises Alarm in Assam’, *The Times of India*, 29 Mar. 2018, available at: <https://timesofindia.indiatimes.com/city/guwahati/chinas-weather-modification-system-raises-alarm-in-assam/articleshow/63527223.cms>.

The rapid upscaling of China's capacity to intervene in atmospheric processes underscores the need for robust laws to assess and mitigate environmental impacts across provincial and international borders. The WMO notes that 'legal aspects may be particularly important when weather modification activities are performed in the proximity of borders between different countries'.<sup>42</sup> This article investigates these issues. It examines the way in which China currently governs its weather modification programme, with a particular focus on whether its current assessment and monitoring requirements satisfy customary international law obligations to avoid transboundary harm. We show that detailed laws are in place to address the safety of weather modification operations, but that limited consideration has been given to the risks of transboundary environmental impacts. The analysis is based on a review of available literature, combined with doctrinal analysis of officially translated Chinese laws, as well as policies and plans translated using translation software.<sup>43</sup>

The analysis proceeds in six parts. Following this introduction, Section 2 outlines the development and features of China's weather modification programme. Section 3 considers China's international law obligations, with a particular focus on obligations to assess and prevent transboundary impacts under international customary law. Section 4 then evaluates whether the domestic regime governing weather modification activities meets China's international obligations to India and other neighbouring countries. Section 5 discusses the kinds of mechanism needed to ensure that China's weather modification laws comply with international requirements. We conclude in Section 6 that stronger safeguards are needed to address the environmental, social, and economic risks associated with weather modification, both within China and across national borders.

## 2. CHINA'S WEATHER MODIFICATION PROGRAMME

China is the largest investor in weather modification deployment globally.<sup>44</sup> Since 2014, governments at all levels in China have invested 13.267 billion yuan (CNY) (or close to US\$ 2 billion) in weather modification activities, including about US\$ 400 million originating from the central government.<sup>45</sup> These activities have covered more than one third of China's total land area.<sup>46</sup> Atmospheric water resources are unevenly distributed across the country, with the south generally having more atmospheric water than the north, leading to varying cloud seeding potential in different regions.<sup>47</sup> Cloud seeding demand also varies depending on seasons, with most regions facing water scarcity

<sup>42</sup> WMO, n. 10 above, p. 12.

<sup>43</sup> Translations were conducted by the authors from Mandarin to English using Google Translate. Wherever the meaning was unclear, Baidu Translate (the Chinese search engine) was used to complement or refine the first result.

<sup>44</sup> WMO Expert Team on Weather Modification Research, n. 8 above, p. 5.

<sup>45</sup> CMA, 'National Weather Modification Development Plan 2021–25' (2021) (in Chinese) (2021–25 WMDP), para. I(1)(1) (translated by the authors from Chinese to English).

<sup>46</sup> *Ibid.*

<sup>47</sup> L. An et al., 'Regional Characteristics and Exploitation Potential of Atmospheric Water Resources in China' (2022) 42(5) *International Journal of Climatology*, pp. 3225–45, at 3227.

in spring and summer, and a few regions facing limitations in autumn and winter.<sup>48</sup> While the number of research programmes is small,<sup>49</sup> most weather modification activities are conducted on an operational basis, using cloud seeding techniques for precipitation enhancement and hail suppression.<sup>50</sup> Both cloud seeding applications involve the dispersal of silver iodide, although dry ice and liquid nitrogen can also be used to enhance precipitation.<sup>51</sup>

Weather modification is a manifestation of China's attempts to harness atmospheric water resources to ensure economic stability, alongside commitments to 'fix the air' by addressing atmospheric pollution.<sup>52</sup> The 2022 drought is the latest of many meteorological disasters in China, and the use of weather modification to mitigate heatwaves is only one application of the Chinese programme. Over the past two decades, China has deployed cloud seeding principally to increase freshwater resources and mitigate the impacts of hailstorms on weather-dependent sectors such as agriculture.<sup>53</sup>

The possibility of weather modification was first championed by Mao Zedong in 1956, with a research programme entitled 'Prior Research on Cloud and Precipitation Physics and Artificial Rain'.<sup>54</sup> The first weather modification experiments were conducted in 1958 in northern and western China.<sup>55</sup> China's extensive research on weather modification continued for over 40 years, before operational planning commenced with the establishment of the National Coordination Committee of Weather Modification<sup>56</sup> and the first Weather Modification Development Plan (1996–2010).<sup>57</sup> The 2012 State Council's 'Comments on Further Strengthening Weather Modification' (known as Document No. 44) provided the legal basis for the next Weather Modification Development Plan (WMDP) 2014–20.<sup>58</sup>

The size, rapid up-scaling and breadth of weather modification in China is unprecedented.<sup>59</sup> As in other countries,<sup>60</sup> China uses weather modification to secure water

<sup>48</sup> M. Kong et al., 'A Nationwide Analysis of Water Scarcity and Cloud Seeding Demand Levels from Analyzing Water Utilization Data, Agricultural Drought Maps, and Local Conditions in China Mainland' (2021) 8(6) *Earth and Space Science*, pp. 1–18, at 14.

<sup>49</sup> See, e.g., Chinese Randomized Precipitation Enhancement Experiment (CRPEEX): A.M. Abshaev et al., 'Rain Enhancement through Cloud Seeding', in M. Qadar et al. (eds), *Unconventional Water Resources* (Springer, 2022), pp. 21–50, at 44.

<sup>50</sup> Guo et al., n. 6 above, p. 237.

<sup>51</sup> *Ibid.*, p. 237–9.

<sup>52</sup> M. Nieuwenhuis, 'The Governing of the Air: A Case Study of the Chinese Experience' (2016) 15(1) *Borderland*, pp. 1–23, at 11.

<sup>53</sup> Chien, Hong & Lin, n. 23 above, p. 229.

<sup>54</sup> *Ibid.*, p. 228.

<sup>55</sup> Guo et al., n. 6 above, p. 231.

<sup>56</sup> WMO Expert Team on Weather Modification Research, n. 8 above, p. 8.

<sup>57</sup> Chien, Hong & Lin, n. 23 above, p. 228.

<sup>58</sup> State Council of the People's Republic of China, 'Comments on Further Strengthening Weather Modification', Document No. 44, 30 Aug. 2012, available at: [http://www.gov.cn/zwqk/2012-08/30/content\\_2213785.htm](http://www.gov.cn/zwqk/2012-08/30/content_2213785.htm) (in Chinese).

<sup>59</sup> See generally, Chien, Hong & Lin, n. 23 above; Chen, n. 29 above; J. Watts, 'China Plans Rapid Expansion of "Weather Modification" Efforts,' *The Guardian*, 4 Dec. 2020, available at: <https://www.theguardian.com/world/2020/dec/03/china-vows-to-boost-weather-modification-capabilities>.

<sup>60</sup> At least 50 countries are currently undertaking weather modification research, development, and deployment: WMO Expert Team on Weather Modification Research, n. 8 above, p. 3.

resources for freshwater consumption and hydro-electric production, especially along the Yangtze river in Yunnan and Sichuan provinces.<sup>61</sup> Weather modification, employed for both precipitation enhancement and hail suppression, is also used to increase food production and ensure food security, notably in the province of Jilin and the Yellow river plain.<sup>62</sup>

Beyond these conventional applications, the technology has also been used for ecological restoration. For example, weather modification for precipitation enhancement has been conducted in the Sanjiangyuan National Nature Reserve in the province of Qinghai, to restore the headwaters of the Yangtze, Yellow and Mekong rivers.<sup>63</sup> The 2014–20 WMDP promotes weather modification as a tool to restore vulnerable ecological areas – such as rivers, lakes, glaciers and wetlands – which have been affected by climate change, desertification, and biodiversity loss.<sup>64</sup> It also claims that weather modification operations have increased the surface of lakes and grassland coverage in the Tibetan plateau, thus creating a ‘green ecological barrier’, which preserves those areas from economic development.<sup>65</sup> The Plan also promotes weather modification as a means to lower air temperatures during heatwaves, and lower surface water temperatures in lakes to control the proliferation of bacteria.<sup>66</sup>

Cloud seeding can also improve air quality,<sup>67</sup> as increased rainfall ‘washes out’ harmful pollution from the air.<sup>68</sup> As part of its ‘blue skying’ campaign,<sup>69</sup> China uses weather modification to control sandstorms, reduce haze, and manage the health risks of air pollution. Weather modification has also been used to secure fair weather for important national events.<sup>70</sup> The 2008 Olympic Games is the best-known example of the government’s assertion of control over atmospheric resources for public

<sup>61</sup> Chien, Hong & Lin, n. 23 above, p. 228.

<sup>62</sup> Ibid.

<sup>63</sup> Ibid., pp. 229–30.

<sup>64</sup> National Development, Reform Commission & CMA, ‘National Weather Modification Development Plan 2014–20’, 2014, para. 6(1) (in Chinese) (2014–20 WMDP) (translated by the authors from Chinese to English).

<sup>65</sup> Ibid., para. 6(1). It is worth noting that some non-governmental organizations, like the International Campaign for Tibet, argue that the Chinese government’s claims of promoting ‘ecological restoration’ are inconsistent with the construction of infrastructure in Tibet – such as roads, railways, dams, mining projects, and the bottled water industry – which have significant environmental impacts in the region; see, e.g., International Campaign for Tibet, ‘China’s Claims in New White Paper about Protecting Tibet’s Environment Are Contradicted by Increased Production of Bottled Water from Shrinking Tibetan Glaciers, More Dams’, 8 Aug. 2018, available at: <https://savetibet.org/chinas-claims-in-new-white-paper-about-protecting-tibets-environment-are-contradicted-by-increased-production-of-bottled-water-from-shrinking-tibetan-glaciers-more-dams>; ETC Group, ‘China’s Plan to Seed Himalayan Clouds Is Geoengineering: Unintentional or Otherwise’, 8 Nov. 2018, available at: <https://www.etcgroup.org/content/chinas-plan-engineer-himalayan-clouds-geoengineering-unintentional-or-otherwise?language=en>.

<sup>66</sup> 2014–20 WMDP, n. 64 above, para. 6(1).

<sup>67</sup> Chien, Hong & Lin, n. 23 above, p. 230.

<sup>68</sup> Flossmann et al., n. 9 above, p. 6.

<sup>69</sup> S.-S. Chien, ‘Blueskying’, *Society and Space*, 9 Apr. 2019, available at: <https://www.societyandspace.org/articles/blueskying>.

<sup>70</sup> Chien, Hong & Lin, n. 23 above, pp. 229–31.

amenity.<sup>71</sup> In response to the International Olympic Committee's threats to postpone the event because of the high level of air pollution,<sup>72</sup> officials triggered rainfall to clean the air and prevent the heavy rainfalls forecast over Beijing.<sup>73</sup> China's use of weather modification for mega-events is only a minor aspect of the national weather modification programme,<sup>74</sup> despite it being mentioned frequently in the literature.<sup>75</sup> However, this demonstrates that China uses weather modification not only to adapt to climate change impacts, as is common in other countries, but to exert control over atmospheric resources, extending its influence beyond its territorial resources such as minerals and surface water.<sup>76</sup> Regardless of the purposes for which weather modification activities are conducted, there are risks associated with their deployment on such a large scale (for example, potential disruption of the hydrological cycle with effects on people and the environment).

The 2014–20 WMDP was issued to ensure the smooth development of weather modification technologies and bolster the management of weather modification.<sup>77</sup> While it provides a general summary of the potential environmental impacts of weather modification, the Plan nonetheless considers it beneficial for the country's sustainable development. The Plan integrates weather modification in the framework of 'ecological civilization', which broadly equates with the concept of 'sustainable development'.<sup>78</sup> The 2014–20 WMDP identifies the main organizational challenges for weather modification, encompassing cross-regional operations, science-based decision making, security, and responsibility.<sup>79</sup> These challenges are especially pertinent in the context of multi-level and large-scale operations. The WMDP divides the country into six administrative regions – Northeast, Northwest, North, Central, Southwest and Southeast – as part of its commitment to strengthen 'responsibility, information

<sup>71</sup> J. Qiu & D. Cressey, 'Taming the Sky: Is It Really Possible to Stop Rain, Invoke Lightning from the Heavens or Otherwise Manipulate the Weather?' Jane Qiu and Daniel Cressey Report on the Once-Scorned Notion of Weather Modification' (2008) 453(7198) *Nature*, pp. 970–5, at 972–3.

<sup>72</sup> E. Stewart, 'IOC Praises Efforts to Reduce Air Pollution in Beijing', *The Guardian*, 7 Aug. 2008, available at: <https://www.theguardian.com/world/2008/aug/07/china.olympics2008>.

<sup>73</sup> M.W. Pontin, 'Weather Engineering in China', *MIT Technology Review*, 25 Mar. 2008, available at: <https://www.technologyreview.com/2008/03/25/270084/weather-engineering-in-china>.

<sup>74</sup> K. Edney & J. Symons, 'China and the Blunt Temptations of Geo-Engineering: The Role of Solar Radiation Management in China's Strategic Response to Climate Change' (2014) 27(3) *The Pacific Review*, pp. 307–32, at 320.

<sup>75</sup> See, e.g., S. Joronen, M. Oksanen & T. Vuorisalo, 'Towards Weather Ethics: From Chance to Choice with Weather Modification' (2011) 14(1) *Ethics, Policy & Environment*, pp. 55–67, at 55; E.C. Smit, 'Geoengineering: Issues of Accountability in International Law' (2015) 15(2) *Nevada Law Journal*, pp. 1060–89, at 1073; K. Brent, J. McGee & J. McDonald, 'The Governance of Geoengineering: An Emerging Challenge for International and Domestic Legal Systems' (2015) 24(1) *Journal of Law, Information and Science*, pp. 1–33, at 8.

<sup>76</sup> See generally J. Chen & J. Cui, 'Property Rights Arrangement in Emerging Natural Resources: A Case Study of China's Nationalization of Wind and Sunlight' (2013) 27(1) *Columbia Journal of Asian Law*, pp. 81–127; Nieuwenhuis, n. 52 above; Chien, Hong & Lin, n. 23 above.

<sup>77</sup> See generally 2014–20 WMDP, n. 64 above.

<sup>78</sup> *Ibid.*, para. 6. For a discussion of the Chinese ecological civilization see, generally, B. Boer, R. Cantley-Smith & T. Qin, 'Introduction to the Special Issue on Ecological Civilization and Environmental Governance' (2020) 4(2) *Chinese Journal of Environmental Law*, pp. 121–9.

<sup>79</sup> 2014–20 WMDP, n. 64 above, para. 1(2).

sharing, and coordination' between state, province, city, and county levels.<sup>80</sup> Weather modification activities are conducted in all regions for different purposes, which include food, water, and 'ecological' security.<sup>81</sup> In each region, one city is identified as the centre of operations and its meteorological bureau is responsible for coordinating cloud seeding operations at the regional level.<sup>82</sup>

On completion of the 2014–20 WMDP, the Office of the State Council published its 'Opinions on Promoting the High-Quality Development of Weather Modification'.<sup>83</sup> This document provided the foundation for the 2021–25 WMDP, and committed to strengthen research, innovation, and operational capacity for weather modification.<sup>84</sup> Between 2014 and 2020, weather modification activities for precipitation enhancement covered an area of 2.83 million km<sup>2</sup>, with an estimated 79.2 billion tons of annual increase in rainfall and snowfall (or about 15% of the annual national water consumption).<sup>85</sup> Weather modification coverage is expected to double by 2025 under the 2021–25 WMDP to cover over 5.5 million km<sup>2</sup> for rainfall/snowfall enhancement, and 580,000 km<sup>2</sup> for hail suppression.<sup>86</sup> In total, these programmes will cover an area that is 150% larger than that of India.

Like the earlier Plans, the 2021–25 WMDP emphasizes the importance of weather modification for ecological restoration. This is in line with the Overall Plan for National Major Ecosystem Protection and Restoration Major Projects (2021–2035), which identifies key ecological areas, including the Qinghai-Tibet Plateau, and the Yellow and Yangtze rivers.<sup>87</sup> The 2021–25 WMDP encourages snow enhancement projects in the Himalayas to combat the retreat of the glaciers as a consequence of climate change.<sup>88</sup> The new WMDP also encourages the automation of weather modification delivery methods, especially the use of unmanned aerial vehicles (drones) and artificial intelligence.<sup>89</sup>

Prominent scientists, such as Bruintjes, question China's unsubstantiated claims concerning the effectiveness of its weather modification activities.<sup>90</sup> Studies

<sup>80</sup> *Ibid.*, para. 3(1).

<sup>81</sup> For a discussion of the weather modification administrative division see W. Gasser, 'Let It Rain: Weather Modification in Europe, USA and with a Special Focus on China' (Masters' thesis, Technische Universität München (Germany), Mar. 2016), pp. 31–5.

<sup>82</sup> *Ibid.*, p. 78.

<sup>83</sup> Office of the State Council, 'Opinions of the General Office of the State Council on Promoting the High-quality Development of Weather Modification Work', 2 Dec. 2020, available at: [http://www.gov.cn/zhengce/content/2020-12/02/content\\_5566429.htm](http://www.gov.cn/zhengce/content/2020-12/02/content_5566429.htm) (in Chinese).

<sup>84</sup> *Ibid.*

<sup>85</sup> 2021–25 WMDP, n. 45 above, para. I(1)(4).

<sup>86</sup> *Ibid.*, para. II(3). See also State Council, 'China to Forge Ahead with Weather Modification Service', 2 Dec. 2020, available at: [http://english.www.gov.cn/policies/latestreleases/202012/02/content\\_WS5fc76218c6d0f7257694125e.html](http://english.www.gov.cn/policies/latestreleases/202012/02/content_WS5fc76218c6d0f7257694125e.html).

<sup>87</sup> 2021–25 WMDP, n. 45 above, para. IV(1)(2).

<sup>88</sup> *Ibid.*, para. I(2).

<sup>89</sup> *Ibid.*, para. IV(2)(2–3).

<sup>90</sup> R. Bruintjes, cited in B. Walker & O. Boyd, 'China's Geoengineering Plans Dismissed as "Fantasy"', *China Dialogue*, 11 Apr. 2013, available at: <https://chinadialogue.net/en/climate/5891-china-s-geoengineering-plans-dismissed-as-fantasy>; Xuan & Jiawen, n. 38, above; L. Pike, 'China's Scientific Community Confronts "Rogue Science"', *The Wire Science*, 19 Dec. 2018, available at: <https://science.thewire.in/external-affairs/world/chinas-scientific-community-confronts-rogue-science>.

demonstrate that weather modification by cloud seeding is efficient only in the presence of clouds, and that operations conducted as an emergency response in times of drought are largely unsuccessful.<sup>91</sup> Regardless of its effectiveness, the deployment of cloud seeding as an emergency response to the 2022 drought is the latest evidence of China's commitment to upscaling its national weather modification programme. The scale of its plans raises questions regarding the adequate management of environmental risks and associated socio-economic impacts.

### 3. CHINA'S OBLIGATIONS UNDER INTERNATIONAL LAW

This section introduces the international law applicable to weather modification activities. We explain why the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD Convention)<sup>92</sup> is of limited use in providing safeguards for the peaceful use of weather modification, before focusing on the no-harm rule as the only rule of international law that imposes legal limits on China's weather modification programme.

#### 3.1. *The ENMOD Convention*

The 1977 ENMOD Convention is the primary international instrument of direct relevance to weather modification.<sup>93</sup> It prohibits state parties from 'engag[ing] in military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party'.<sup>94</sup> China acceded to the Convention in 2005.<sup>95</sup> However, the treaty establishes obligations concerning weather modification only for military or hostile purposes, while encouraging the use of weather modification for peaceful purposes, such as water management.<sup>96</sup> Article III(2) of the ENMOD Convention provides: 'The States Parties to this Convention undertake to facilitate, and have the right to participate in, the fullest possible exchange of scientific and technological information on the use of environmental modification techniques for peaceful purposes'.<sup>97</sup> Apart from a broad commitment to facilitate exchange of scientific and technological information, the ENMOD Convention does not impose legal limits on China's use of weather modification for peaceful purposes.

<sup>91</sup> Flossmann et al., n. 9 above, p. 78.

<sup>92</sup> New York, NY (US), 10 Dec. 1976, in force 5 Oct. 1978, available at: [https://treaties.un.org/doc/Treaties/1978/10/19781005%2000-39%20AM/Ch\\_XXVI\\_01p.pdf](https://treaties.un.org/doc/Treaties/1978/10/19781005%2000-39%20AM/Ch_XXVI_01p.pdf).

<sup>93</sup> *Ibid.*, Art. I.

<sup>94</sup> *Ibid.*, Art. I(1).

<sup>95</sup> See, e.g., *United Nations Treaty Collection*, available at: [https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&cmdsg\\_no=XXVI-1&chapter=26&clang=\\_en](https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&cmdsg_no=XXVI-1&chapter=26&clang=_en).

<sup>96</sup> ENMOD Convention, n. 92 above, Art. III(1). For a detailed analysis see J. McGee et al., 'International Governance of Solar Radiation Management: Does the ENMOD Convention Deserve a Closer Look?' (2020) 14(4) *Carbon & Climate Law Review*, pp. 294–305, pp 297–9.

<sup>97</sup> ENMOD Convention, n. 92 above, Art III(2).

For the Convention to apply, the hostile intent of a state needs to be demonstrated. While the term ‘hostile’ is not defined in the text or in the *travaux préparatoires*, the context in which the Convention was negotiated is crucial for understanding its scope. The ENMOD Convention originated with the 1974 Conference of the Committee on Disarmament.<sup>98</sup> The Preamble states that state parties were guided by ‘the cause of halting the arms race, and of bringing about general and complete disarmament under strict and effective international control, and of saving mankind from the danger of using new means of warfare’.<sup>99</sup> As confirmed during the first review conference, the ENMOD Convention is a multilateral disarmament convention, intended to prevent the development and use of technology for environmental – including meteorological – warfare.<sup>100</sup> It was not intended as an environmental agreement to manage (transboundary) environmental impacts. Initially intended to apply to situations of armed conflict, Bodle argues that ‘[a]pplying the ENMOD Convention in peacetime on the basis of a subjectively determined “hostile” use would erode this distinction and introduce a grey area between the two areas of law’.<sup>101</sup> It is important, therefore, to distinguish between risks of transboundary harm from weather modification and the hostile use of these technologies. Conflating the two does not accurately reflect the scope and purpose of this Convention, and there is no state practice or decision of international courts or tribunals to support such an interpretation.

We acknowledge concerns regarding the potential future militarization of the Chinese weather modification programme. However, as long as China continues to conduct its weather modification programme for peaceful purposes, it does so in compliance with the ENMOD Convention. While the provisions of this Convention may become relevant in future, China’s present execution of its weather modification programme falls outside the scope of the Convention.

### 3.2. *The No-Harm Rule*

The ‘no-harm rule’ is a fundamental principle of customary international environmental law. Originating from the *Trail Smelter* arbitration (1938–1941),<sup>102</sup> the no-harm rule imposes a due diligence obligation on states to prevent activities within their jurisdiction and control that cause significant transboundary harm to the territory of other states and areas beyond national jurisdiction.<sup>103</sup> The no-harm rule has been affirmed in

<sup>98</sup> UN General Assembly, ‘Report of the Conference of the Committee on Disarmament’, 1976, UN Doc. A/31/27.

<sup>99</sup> ENMOD Convention, n. 92 above, Preamble.

<sup>100</sup> ‘Final Document of the First Review Conference of the Parties to the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques’ (1984), ENMOD/CONF.1/13/1, available at: <https://s3.amazonaws.com/unoda-web/documents/library/conf/ENMOD-CONF-1-13-1.PDF>.

<sup>101</sup> R. Bodle, ‘Geoengineering and International Law: The Search for Common Legal Ground’ (2013) 46 *Tulsa Law Review*, pp. 305–22, at 312.

<sup>102</sup> *Trail Smelter (United States v. Canada)*, Awards, 16 Apr. 1938 and 11 Mar. 1941, *Reports of International Arbitral Awards*, Vol. III, pp. 1905–82, at 1965.

<sup>103</sup> The ICJ has affirmed that the no-harm rule applies also to areas beyond national jurisdiction in *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, 8 July 1996, *ICJ Reports* (1996), pp. 226–67,

multiple decisions by international courts and tribunals.<sup>104</sup> It has also been re-articulated in Principle 21 of the Stockholm Declaration,<sup>105</sup> Principle 2 of the Rio Declaration,<sup>106</sup> and in numerous multilateral environmental agreements.<sup>107</sup> As a principle of customary international law, the no-harm rule is legally binding on all states and can be enforced through international litigation. Examples of situations in which states have invoked this rule include transboundary air pollution from smelters<sup>108</sup> and aerial herbicide spraying,<sup>109</sup> pollution of shared waterways,<sup>110</sup> and the alteration of river flows.<sup>111</sup>

The no-harm rule imposes substantive and procedural obligations on states for activities that pose a risk of ‘significant’ transboundary harm.<sup>112</sup> There is no objective definition of this threshold,<sup>113</sup> but the International Law Commission (ILC) suggests that ‘significant’ means ‘something more than “detectable” but need not be at the level of “serious” or “substantial”’.<sup>114</sup> As noted above, there is concern that China’s weather modification activities could cause severe weather conditions hundreds of kilometres beyond the target area, and may either deprive neighbouring states of rainfall or cause flooding. Such risks are not trivial and would be likely to satisfy the Commission’s threshold.

The no-harm rule is generally interpreted as providing states with a substantive ‘due diligence’ obligation, in that states must use ‘all means at their disposal’ to avoid significant transboundary harm occurring, but are not required to prevent it

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at 241–2. The ICJ affirmed the due diligence nature of this obligation in *Pulp Mills on the River Uruguay (Argentina v. Uruguay)*, Judgment, 20 Apr. 2010, *ICJ Reports* (2010), pp. 14–107, at 55–6.

<sup>104</sup> See, e.g., *Corfu Channel (United Kingdom v. Albania)*, Merits, 9 Apr. 1949, *ICJ Reports* (1949), pp. 4–169, at 22; *Lake Lanoux Arbitration (France v. Spain)*, Award, 16 Nov. 1957, 24 *International Law Reports* (1957), pp. 101–42, at 129; *Gabčikovo/Nagymaros Project (Hungary v. Slovakia)*, Judgment, 25 Sept. 1997, *ICJ Reports* (1997), pp. 7–84, at 41.

<sup>105</sup> Declaration of the UN Conference on the Human Environment, adopted by the UN Conference on the Human Environment, Stockholm (Sweden), 5–16 June 1972, UN Doc. A/CONF/48/14/Rev.1, available at: <http://www.un-documents.net/aconf48-14r1.pdf>.

<sup>106</sup> Rio Declaration, n. 28 above.

<sup>107</sup> See, e.g., United Nations Convention on the Law of the Sea (UNCLOS), Montego Bay (Jamaica), 10 Dec. 1982, in force 16 Nov. 1994, Arts 192–194(2), available at: [https://www.un.org/depts/los/convention\\_agreements/texts/unclos/unclos\\_e.pdf](https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf); Convention on Biological Diversity, Rio de Janeiro (Brazil), 5 June 1992, in force 29 Dec. 1993, Art. 3, available at: <https://www.cbd.int/doc/legal/cbd-en.pdf>; United Nations Framework Convention on Climate Change, Rio de Janeiro (Brazil), 9 May 1992, in force 21 Mar. 1994, Preamble, available at: <https://unfccc.int/resource/docs/convkp/conveng.pdf>; Vienna Convention for the Protection of the Ozone Layer, Vienna (Austria), 22 Mar. 1985, in force 22 Sept. 1988, preamble, available at: <https://ozone.unep.org/treaties/vienna-convention>.

<sup>108</sup> *Trail Smelter*, n. 102 above.

<sup>109</sup> See, e.g., *Case concerning Aerial Herbicide Spraying (Ecuador v. Colombia)*, Memorial of Ecuador Vol. I, 28 Apr. 2009, ICJ General List No. 138, p. 273 (*Aerial Herbicide Spraying*).

<sup>110</sup> *Pulp Mills*, n. 103 above.

<sup>111</sup> *Lake Lanoux*, n. 104 above.

<sup>112</sup> For a detailed discussion, see K.A. Brent, ‘The Certain Activities Case: What Implications for the No-Harm Rule?’ (2017) 20(1) *Asia Pacific Journal of Environmental Law*, pp. 28–56.

<sup>113</sup> *Ibid.*, p. 53.

<sup>114</sup> International Law Commission (ILC), ‘Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, with Commentaries’ (2001) vol II, Part 2, *Yearbook of the International Law Commission*, pp. 148–70, at 152.

absolutely.<sup>115</sup> The standard of care required to discharge this obligation depends on the activity in question. The care must be ‘appropriate and proportional to the degree of risk of transboundary harm’,<sup>116</sup> with riskier activities attracting a higher standard of care. There are no international law cases involving weather modification that specify the type of action that is necessary, but the International Court of Justice (ICJ) has noted that risks of environmental harm are often irreversible and therefore warrant a more stringent standard of care.<sup>117</sup> The ILC Draft Articles on Prevention of Transboundary Harm also suggest that the size and location of an activity, special climate conditions, and materials used should also be considered in determining the standard of care.<sup>118</sup> The size of China’s weather modification programme and its proximity to national borders would probably justify a high standard of care. The submission by Colombia in the *Aerial Spraying* judgment provides examples of the types of action that might be required, such as ensuring the use of the most up-to-date technology and methods, ensuring environmental monitoring, ongoing scientific review of the programme, and independent auditing of the programme.<sup>119</sup>

To satisfy their due diligence obligation under the no-harm rule, states must also take appropriate regulatory and administrative action to address the risk of transboundary harm.<sup>120</sup> The ICJ made clear in its 2010 *Pulp Mills* judgment that this entails the adoption and vigilant enforcement of appropriate rules and measures under domestic law.<sup>121</sup> Those rules should adopt or give effect to a precautionary approach, in that states cannot use scientific uncertainty regarding the precise nature of risks as an excuse to ignore their obligations under customary international law.<sup>122</sup> Adopting a precautionary approach is especially relevant for activities like weather modification, where there might be ‘plausible indications’ of potential transboundary risks but uncertainty concerning their scope or nature.<sup>123</sup> In such situations, Boyle suggests that the precautionary approach may indeed ‘reduce the standard of proof required in order to

<sup>115</sup> *Pulp Mills*, n. 103 above, pp. 55–6; see also ILC, *ibid.*, pp. 153–5; B. Mayer, ‘Obligations of Conduct in the International Law on Climate Change: A Defence’ (2018) 27(2) *Review of European, Comparative & International Environmental Law*, pp. 130–40, at 133–4; A. Boyle, ‘Transboundary Air Pollution: A Tale of Two Paradigms’, in S. Jayakumar et al. (eds), *Transboundary Pollution: Evolving Issues of International Law and Policy* (Edward Elgar, 2015), pp. 233–60, at 237.

<sup>116</sup> *Responsibilities and Obligations of States with respect to Activities in the Area*, Advisory Opinion, International Tribunal for the Law of the Sea (ITLOS), Case No. 17, 1 Feb. 2011, pp. 14–78, at 43 (*Activities in the Area*). While this case involved rules under UNCLOS (n. 107 above), the comments of ITLOS on the nature of due diligence obligations apply also to customary international law.

<sup>117</sup> *Pulp Mills*, n. 103 above, pp. 76–7; *Gabčíkovo/Nagymaros Project*, n. 104 above, p. 77. See also K. Schmalenbach, ‘States Responsibly and Liability for Transboundary Environmental Harm’, in P. Gailhofer et al. (eds), *Corporate Liability for Transboundary Environmental Harm: An International and Transnational Perspective* (Springer, 2023), pp. 43–84, at 57.

<sup>118</sup> ILC, n. 114 above, p. 154.

<sup>119</sup> *Aerial Herbicide Spraying*, n. 109 above, pp. 376–7.

<sup>120</sup> *Pulp Mills*, n. 103 above, p. 79; *South China Sea Arbitration (Philippines v. China)*, Awards, 12 July 2016, Permanent Court of Arbitration, Case No. 2013-9, pp. 375–6; ILC, n. 114 above, p. 154.

<sup>121</sup> *Pulp Mills*, n. 103 above, p. 79.

<sup>122</sup> *Activities in the Area*, n. 116 above, pp. 46–7. See also Boyle, n. 115 above, pp. 243–5.

<sup>123</sup> *Activities in the Area*, n. 116 above, p. 46.

establish that an activity poses a risk of harm'.<sup>124</sup> In other words, the precautionary principle implies that states still have obligations under the no-harm rule where there is a risk of serious or irreversible transboundary harm, but there is uncertainty as to its precise nature or magnitude.

If triggered, the no-harm rule also imposes procedural obligations on states: namely, the duty to conduct a transboundary environmental impact assessment (EIA),<sup>125</sup> the duty to cooperate, and a duty to notify and consult with potentially affected states.<sup>126</sup> In its *Pulp Mills* judgment, the ICJ affirmed the duty to conduct a transboundary EIA as a principle of customary international law in its own right, as well as a necessary component of due diligence.<sup>127</sup> Customary international law does not dictate the precise content and scope of a transboundary EIA, but the ICJ has noted that it should reflect the 'nature and magnitude of the proposed development and its likely adverse impact on the environment'.<sup>128</sup>

Several international organizations have recommended that states conduct weather modification activities in line with the no-harm rule and have further clarified what states should do to satisfy their international legal obligations. In 1980, the United Nations Environmental Programme (UNEP) developed the Provisions on the Cooperation of States in Weather Modification.<sup>129</sup> These provisions explicitly extend general principles of international law, including the no-harm rule, to weather modification activities, stating that 'weather modification activities should be conducted in a manner designed to ensure that they do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction'.<sup>130</sup> They recommend that states assess the environmental consequences of weather modification activities 'which are likely to have an effect on areas outside of their national jurisdiction' and 'make the results of such assessments available to all concerned States'.<sup>131</sup> They also recognize that states have obligations of cooperation, consultation, notification and exchange of information concerning weather modification activities that present transboundary risks.<sup>132</sup> The UNEP Provisions recommend that states gather and record information on weather modification to make it available to the WMO,<sup>133</sup> and invite states to 'encourage and facilitate international cooperation' through bilateral, regional or multilateral agreements.<sup>134</sup>

<sup>124</sup> Boyle, n. 115 above, pp. 244.

<sup>125</sup> *Activities in the Area*, n. 116 above, pp. 64–5.

<sup>126</sup> *Certain Activities Carried Out by Nicaragua in the Border Area (Costa Rica v. Nicaragua) and Construction of a Road in Costa Rica along the San Juan River (Nicaragua v. Costa Rica)*, Judgment, 16 Dec. 2015, *ICJ Reports* (2015), pp. 6–81, at 45 (*Nicaragua/Costa Rica*).

<sup>127</sup> *Activities in the Area*, n. 116 above, p. 72.

<sup>128</sup> *Pulp Mills*, n. 103 above, p. 73.

<sup>129</sup> UNEP Governing Council, 'Provisions for Co-operation between States in Weather Modification', 29 Apr. 1980, Decision 8/7/A.

<sup>130</sup> *Ibid.*, para. 1(f).

<sup>131</sup> *Ibid.*, para. 1(e).

<sup>132</sup> *Ibid.*, para. 1(b)–(d).

<sup>133</sup> *Ibid.*, para. 1(c).

<sup>134</sup> *Ibid.*, para. 1(h).

In 2018, the ILC finalized its Draft Guidelines on the Protection of the Atmosphere, which provide that ‘intentional large-scale modification of the atmosphere should be conducted with prudence and caution, subject to any applicable rules of international law’.<sup>135</sup> This further suggests that states should comply with the no-harm rule when conducting large-scale weather modification activities. Therefore, to satisfy its obligations, China would need to conduct transboundary EIAs of weather modification activities, as well as notify and consult with neighbouring states that may be adversely affected by these activities.

#### 4. THE DOMESTIC LEGAL FRAMEWORK FOR WEATHER MODIFICATION IN CHINA

This section examines the domestic legal regime governing weather modification in China. An understanding of this framework is necessary to evaluate China’s compliance with international customary law, particularly the obligation to prevent transboundary harm (further discussed in Section 5).

##### 4.1. *Institutional Arrangements*

China’s current framework focuses on the beneficial impacts of weather modification for local communities and ecosystems. The Meteorology Law 1999 lays the legal foundation for Chinese weather modification projects and policies in its Chapter V ‘Prevention of Meteorological Disasters’.<sup>136</sup> The law defines weather modification as:

efforts aimed at rain or snow enhancement, hail suppression, rain suppression, fog dispersal, frost prevention by exerting, under appropriate conditions, artificial influence on local atmospheric, physical and chemical processes through scientific and technological means, in order to avert or mitigate meteorological disasters and rationally exploit climatic resources.<sup>137</sup>

This definition extends beyond the mere avoidance of weather disasters to the exploitation of climatic resources. The Regulations on Meteorological Services 1994, which the Meteorology Law replaced, defined climatic resources as ‘climate conditions such as solar, thermal, hydraulic and wind energy which can be used in human economic activities’.<sup>138</sup> However, the current Meteorology Law does not define ‘climatic resources’. While the reasons behind this omission are unclear, Chen and Cui explain that ‘[o]ne reason might have been to preserve the flexibility to expand the scope of the definition whenever technological advances facilitate the exploitation of new forms of climate resources’, including the exploitation of atmospheric water via weather

<sup>135</sup> ILC, ‘Draft Guidelines on the Protection of the Atmosphere, with Commentaries’ (2021) Vol II, Part 2, *Yearbook of the International Law Commission*, pp. 13–51, at 31.

<sup>136</sup> Meteorology Law of the People’s Republic of China, 31 Oct.1999, in force 1 Jan. 2000, available at: [http://www.china.org.cn/environment/2007-08/27/content\\_1034467.htm](http://www.china.org.cn/environment/2007-08/27/content_1034467.htm) (official English translation).

<sup>137</sup> *Ibid.*, Art. 41(5).

<sup>138</sup> Regulations on Meteorological Services, issued by the State Council, 18 Aug. 1994, ineffective 1 Jan. 2000 (in Chinese) (cited in Chen & Cui, n. 76 above, pp. 87–8).

modification.<sup>139</sup> The lack of definition may give the law a wider scope, but it also creates uncertainty regarding the type of activity to which the Law might apply.

Under Article 30 of the Meteorology Law, governments at all levels are authorized to plan and organize weather modification.<sup>140</sup> It also provides competent meteorological departments with authority to administer, guide and arrange weather modification operations.<sup>141</sup> At the national level, the CMA Department of Emergency Response, Disaster Mitigation and Public Services coordinates weather modification activities, supervises the work of local meteorological departments, and organizes research through nine meteorological institutes.<sup>142</sup> Article 30 also outlines the obligations that bodies engaging in weather modification activities must satisfy: these include having appropriate qualifications, using specified equipment, and following any operational rules.<sup>143</sup> Under Article 39, violations of Article 30 requirements incur sanctions ranging from injunctions and disciplinary warnings to fines of up to CN¥ 100,000 (or about US\$ 20,000).<sup>144</sup> Compensation is payable if weather modification conducted in breach of Article 30 causes loss to others.<sup>145</sup> However, the Law does not create compensation mechanisms for loss caused by weather modification activities conducted in compliance with Article 30. It is also unclear whether such compensation could be paid to foreign nationals – or neighbouring countries – adversely affected by the activities.

The State Council adopted the Regulations on Administration of Weather Modification in 2002 ‘for the purpose of strengthening the administration of weather modification, and preparing against and mitigating meteorological disasters’.<sup>146</sup> The regulations recognize that weather modification plans prepared by local meteorological departments and approved by governments are for ‘public welfare’ and expenses included in governments’ budgets.<sup>147</sup> Under the regulations, local governments are responsible for organizing experts to evaluate the effects of weather modification.<sup>148</sup> The regulations also require the exchange of information between relevant departments, including meteorological stations and departments in charge of agriculture, water conservancy, and forestry.<sup>149</sup> However, nothing in the law or the

<sup>139</sup> Ibid.

<sup>140</sup> Meteorology Law, n. 136 above, Art. 30.

<sup>141</sup> Ibid.

<sup>142</sup> ‘Meteorological bureaus are established in 31 provinces, autonomous regions and municipalities (excluding meteorological services at Hong Kong, Macao, and Taiwan), 14 meteorological bureaus at sub-provincial cities (including 4 cities which have been specifically designated in the state development plan), 318 meteorological bureaus at prefecture level and 2,300 bureaus (stations) at county level’: ‘China Meteorological Administration’, *China Meteorological News Press*, 31 July 2008, available at: [http://www.cma.gov.cn/en/aboutcma/introduction/201203/t20120319\\_166488.html](http://www.cma.gov.cn/en/aboutcma/introduction/201203/t20120319_166488.html).

<sup>143</sup> Meteorology Law, n. 136 above, Art. 30.

<sup>144</sup> Ibid., Art. 39. The authors are unaware of any sanction given under Art. 39.

<sup>145</sup> Ibid.

<sup>146</sup> Regulations on Administration of Weather Modification, issued by the State Council, 19 Mar. 2002, in force 1 May 2002, Art. 1, available at: <https://faolex.fao.org/docs/pdf/chn137408E.pdf> (official English translation).

<sup>147</sup> Ibid., Art. 5.

<sup>148</sup> Ibid., Art. 7.

<sup>149</sup> Ibid., Art. 13.

regulations provides for exchange of information with foreign counterparts regarding activities conducted in the proximity of international borders.

Most responsibilities lie with the meteorological departments. The meteorological departments of provinces, autonomous regions, or municipalities (that is, at the subnational level) have the authority to determine the most suitable sites for weather modification operations,<sup>150</sup> define qualification requirements,<sup>151</sup> and organize training and examination of personnel engaged in weather modification.<sup>152</sup> As at 2014, close to 48,000 people were employed in weather modification activities<sup>153</sup> and thus required training under the regulations.<sup>154</sup> In addition, the meteorological departments at or above county (local) levels are responsible for ensuring the safety of operations, including through public notification of weather modification operations.<sup>155</sup> As Gasser explains:

The national, regional and provincial levels are mainly responsible for the implementation of weather modification projects involving aircraft operations, the city, county and station level on the other hand, are responsible for the execution of ground operations with rockets and cannons.<sup>156</sup>

Regional Weather Modification Centres coordinate weather modification at the regional level.<sup>157</sup> The CMA established the Weather Modification Centre in 2007,<sup>158</sup> but it was only officially launched by the Communist Party's Central Committee and the State Council in 2021.<sup>159</sup> The CMA Weather Modification Centre coordinates weather modification operations across the six weather modification regions (for example, cross-regional operations) and participates in the development of national weather modification plans and guidelines.<sup>160</sup> For instance, the Weather Modification Centre has developed a system of real-time communication – the National Air-Ground Communication System – which allows for the rapid exchange of information in air-based weather modification operations.<sup>161</sup> Despite these technological advances,

<sup>150</sup> Ibid., Art. 8.

<sup>151</sup> Ibid., Art. 9.

<sup>152</sup> Ibid., Art. 10.

<sup>153</sup> 2014–20 WMDP, n. 64 above, para. I(1).

<sup>154</sup> See, e.g., Regulations, n. 146 above, Art. 12.

<sup>155</sup> 'Where weather modification operations are to be implemented, the local competent meteorological department shall, on the basis of the actual situations, make a public announcement in advance and notify the local public security organ to ensure safety and security': *ibid.*

<sup>156</sup> Gasser, n. 81 above, p. 37.

<sup>157</sup> 2014–20 WMDP, n. 64 above, para. V(1)(1).

<sup>158</sup> CMA, '60-Years Weather Modification in China', 13 Sept. 2018, available at: [http://www.cma.gov.cn/en2014/news/Features/201809/t20180913\\_477849.html](http://www.cma.gov.cn/en2014/news/Features/201809/t20180913_477849.html).

<sup>159</sup> See also, CMA, 'China Meteorological Administration Weather Modification Center Officially Launched', 2021, available at: [http://www.cma.gov.cn/2011xwzx/2011xqxxw/2011xqxyw/202112/t20211221\\_589354.html](http://www.cma.gov.cn/2011xwzx/2011xqxxw/2011xqxyw/202112/t20211221_589354.html) (in Chinese).

<sup>160</sup> 2021–25 WMDP, n. 45 above, para. IV(5)(2). See also CMA, 'Weather Modification Center of China Meteorological Administration', available at: [http://www.cma.gov.cn/zfxgk/gknr/jgyzn/jgsz/zsdw/202008/t20200805\\_4629772.html](http://www.cma.gov.cn/zfxgk/gknr/jgyzn/jgsz/zsdw/202008/t20200805_4629772.html) (in Chinese).

<sup>161</sup> See generally D. Li et al., 'FACT: An Air-Ground Communication Framework for Seeding Quality Control of Aircraft' (2022) 41(2) *Computer Systems Science and Engineering*, pp. 539–55.

information on weather modification activities is not systematically made accessible to other states or the WMO.

The regulations also stipulate safety standards for equipment. They require that weather modification equipment, including rockets and rocket launchers, be manufactured according to national technical standards and requirements.<sup>162</sup> These materials must be transported and stored in accordance with laws related to the administration of weaponry and explosives,<sup>163</sup> and must be verified annually.<sup>164</sup> It is an offence to use equipment that fails to meet these safety standards,<sup>165</sup> and individuals and organizations responsible for causing serious accidents in violation of the regulations may be held civilly or criminally liable.<sup>166</sup>

Despite this extensive framework governing the administrative and safety aspects of weather modification, the regulations do not provide for impact assessment of weather modification operations. Instead, this falls within the scope of China's general environmental legislation.

#### 4.2. *Environmental Impact Assessment of Weather Modification*

The Law on Environmental Impact Assessment of the People's Republic of China 2002 (EIA Law) (amended in 2016 and 2018) requires relevant departments at all levels to prepare EIAs for both plans and construction projects.<sup>167</sup> While 'plans' and 'construction projects' are not defined, weather modification activities fall within the scope of the EIA Law in so far as they require the construction of delivery apparatus, such as installation of ground generators. The 2014–20 WMDP required EIAs for specific weather modification projects ('construction projects'), in recognition that increased rainfall would 'provide ecological water for larger areas through natural water system and water conservancy facilities' but would also 'directly affect local ecosystems'.<sup>168</sup> No separate EIA was needed for the Weather Modification Development Plans, as Article 18 of the EIA Law prevents the duplication of EIA requirements.<sup>169</sup>

All construction projects must undergo some form of assessment, but different requirements apply depending on the likelihood of a project causing significant impacts.<sup>170</sup> Article 16 of the EIA Law provides that '[i]f the environmental impacts may be significant, [the construction entities] shall work out a report of environmental impacts so as to include an all-round appraisal of the environmental

<sup>162</sup> Regulations, n. 146 above, Art. 15.

<sup>163</sup> *Ibid.*, Art. 16.

<sup>164</sup> *Ibid.*, Art. 17.

<sup>165</sup> *Ibid.*, Art. 18.

<sup>166</sup> *Ibid.*, Arts 19, 20.

<sup>167</sup> Law on Environmental Impact Assessment of the People's Republic of China, 28 Oct. 2002, amended 29 Dec. 2018 (EIA Law), available at: [https://english.mee.gov.cn/Resources/laws/environmental\\_laws/202012/t20201204\\_811509.shtml](https://english.mee.gov.cn/Resources/laws/environmental_laws/202012/t20201204_811509.shtml) (official English translation), and [https://www.commissiemer.nl/docs/os/sea/legislation/china\\_s\\_ea\\_legislation\\_03.pdf](https://www.commissiemer.nl/docs/os/sea/legislation/china_s_ea_legislation_03.pdf) (unofficial English translation).

<sup>168</sup> 2014–20 WMDP, n. 64 above, para. I(2).

<sup>169</sup> EIA Law, n. 167 above, Art. 18.

<sup>170</sup> X. He, 'In the Name of Legitimacy and Efficiency: Evaluating China's Legal Reform on EIA' (2020) 32(3) *Journal of Environmental Law*, pp. 441–69, at 450.

impacts'.<sup>171</sup> Accordingly, the competent meteorological bureau in each of China's six weather modification regions was required to prepare comprehensive environmental impact statements (EIS) for their weather modification construction projects. The EIS must contain an environmental baseline study, an evaluation of the potential environmental impacts and protection measures, a cost-benefit analysis, suggestions for environmental monitoring, and an overall assessment of whether a project should proceed.<sup>172</sup> In recent years, China has consolidated its EIA system to remedy deficiencies.<sup>173</sup> However, the multiplicity of amendments and technical guidelines has rendered the system complex, fragmented, and unpredictable. Issues of local government accountability, enforcement, and public participation remain.<sup>174</sup>

The EIA legislation makes access to information and public participation mandatory, unless the state deems the project to be confidential.<sup>175</sup> Some regions have already conducted and published EISs for their weather modification projects.<sup>176</sup> In most cases, the proponent is required to solicit comments from both experts and the public, and to specify which comments have been considered when finalizing the EIS.<sup>177</sup> However, the EIS for the Southwest region, in which the Sky River project is located, is confidential and not publicly available.

While the Chinese central government has progressively formalized public participation in environmental decision making,<sup>178</sup> local authorities have been able to select their preferred participation mechanisms (such as expert meetings or solicitations of opinion).<sup>179</sup> Some local officials have carried out participation processes formalistically.<sup>180</sup> Questionnaires are the main method of public participation, rather than public hearings or meetings. This technique has significant drawbacks.<sup>181</sup>

<sup>171</sup> EIA Law, n. 167 above, Art. 16.

<sup>172</sup> *Ibid.*, Art. 17.

<sup>173</sup> Y. Yang, 'Reformed Environmental Impact Assessment in China: An Evaluation of Its Effectiveness' (2020) 11(10) *Journal of Environmental Protection*, pp. 889–908, at 889–90.

<sup>174</sup> *He*, n. 170 above, p. 459.

<sup>175</sup> EIA Law, n. 167 above, Art. 21.

<sup>176</sup> E.g., the EIA of the Southeastern weather modification project was announced in 2017, available at: [http://gd.cma.gov.cn/zfxgk/tzgg\\_91206/202011/t20201102\\_2334794.html](http://gd.cma.gov.cn/zfxgk/tzgg_91206/202011/t20201102_2334794.html) (in Chinese).

<sup>177</sup> EIA Law, n. 167 above, Art. 21.

<sup>178</sup> See, e.g., State Environmental Protection Administration, 'Provisional Measures for Public Participation in Environmental Impact Assessment' (2006), available at: <https://www.chinalawtranslate.com/en/enviroparticipation> (unofficial translation); Ministry of Ecology and Environment, 'Measures for Public Participation in Environmental Impact Assessment', 16 Oct. 2018, available at: [https://asiasociety.org/sites/default/files/inline-files/\\_2018\\_MEE\\_Measures%20for%20Public%20Participation%20in%20Environmental%20Impact%20Assessment\\_E\\_0.pdf](https://asiasociety.org/sites/default/files/inline-files/_2018_MEE_Measures%20for%20Public%20Participation%20in%20Environmental%20Impact%20Assessment_E_0.pdf) (unofficial translation). For a review of participation requirements see, e.g., J. Wu et al., 'Environmental Impact Assessment', in J. Wu & I.S. Chang (eds), *Environmental Management in China: Policies and Institutions* (Springer, 2020), pp. 35–62, at 49.

<sup>179</sup> M. Beach, B. Bleish & S. Yang, 'The Role of Public Participation in Ecological Impact Assessment (EcIA) and Environmental Impact Assessment (EIA) in China' (2006) 8 *China Environment Series*, pp. 3–27, at 4–5.

<sup>180</sup> T. Johnson, 'Public Participation in China's EIA Process and the Regulation of Environmental Disputes' (2020) 81 *Environmental Impact Assessment Review*, pp. 1–7, at 3.

<sup>181</sup> J. Wu et al., 'Strategic Environmental Assessment Implementation in China: Five-Year Review and Prospects' (2011) 31(1) *Environmental Impact Assessment Review*, pp. 77–84, at 80.

Pre-defined questions can be complex, selected participants are not always representative of affected communities, and the acceptance or rejection of comments is often poorly justified.<sup>182</sup> Accordingly, commentators have suggested that China's efforts to increase participation in EIA has been ineffective in practice.<sup>183</sup>

The agency responsible for assessing impacts also varies with the size of the proposed project. Under the EIA Law, an EIS must be examined and approved by 'the competent administrative department in charge of environmental protection'.<sup>184</sup> Reforms have devolved approval powers to provincial and county-level environmental protection bureaus to streamline EIA procedures and improve efficiency.<sup>185</sup> However, the national Ministry of Ecology and Environment remains responsible for reviewing and approving the EIS for construction projects 'that include different provinces, autonomous regions or municipalities directly under the Central Government'.<sup>186</sup> This is notably the case for regional weather modification projects that are cross-boundary in nature. Nevertheless, the EIA Law does not require consideration of potential transboundary impacts.

The Chinese EIA framework does not require or provide for participation by the public located outside China. However, this omission is not unique to the Chinese context, and unsurprising given that there is no regional framework for cooperation on EIA in Asia.<sup>187</sup> Boyle suggests that denying equal access to information, participation, and effective remedies to people affected extraterritorially could amount to a human rights violation.<sup>188</sup> However, there is no such requirement under international customary law, which requires 'state' participation, rather than public participation.<sup>189</sup>

The Northwestern region is the largest weather modification region, covering an area of about 3.53 million km<sup>2</sup>.<sup>190</sup> Its EIS was the first to be published in 2016,<sup>191</sup> providing insights into some of the limitations of EIA approaches in the context of weather

<sup>182</sup> X. Yao, J. He & C. Bao, 'Public Participation Modes in China's Environmental Impact Assessment Process: An Analytical Framework Based on Participation Extent and Conflict Level' (2020) 84 *Environmental Impact Assessment Review*, pp. 1–12, at 8.

<sup>183</sup> D. Brombal, A. Moriggi & A. Marcomini, 'Evaluating Public Participation in Chinese EIA: An Integrated Public Participation Index and Its Application to the Case of the New Beijing Airport' (2017) 62 *Environmental Impact Assessment Review*, pp. 49–60, at 58–9; J. Wu et al., 'Study on the Practice of Public Participation in Environmental Impact Assessment by Environmental Non-Governmental Organizations in China' (2017) 74(C) *Renewable and Sustainable Energy Reviews*, pp. 186–200, at 195–6.

<sup>184</sup> EIA Law, n. 167 above, Art. 22.

<sup>185</sup> He, n. 170 above, pp. 447–9.

<sup>186</sup> EIA Law, n. 167 above, Art. 23.

<sup>187</sup> A. Ogihara, M. Shimaoka & H. Roppongi, 'Potentialities for a Regional Public Participation Framework in Asia: An Environmental Assessment Perspective' (2016) 52 *Land Use Policy*, pp. 535–42, at 535.

<sup>188</sup> Boyle, n. 115 above, pp. 252–3.

<sup>189</sup> S. Marsden, 'Public Participation in Transboundary Environmental Impact Assessment: Closing the Gap between International and Public Law?', in B. Jessup & K. Rubenstein (eds), *Environmental Discourses in Public and International Law* (Cambridge University Press 2012), pp. 238–60, at 246.

<sup>190</sup> 2014–20 WMDP, n. 64 above, para. III(2)(2).

<sup>191</sup> The Northwestern region comprises the provinces of Gansu, Shaanxi, Qinghai, Ningxia, Xinjiang, and four cities of Inner Mongolia (Alxa League, Bayannaer City, Wuhai City, Ordos City): Beijing Municipal Research Institute of Environmental Protection & Chinese Academy of Meteorological Sciences, 'Environmental Impact Report of Construction Projects for Weather Modification in Northwest China', 2016 (Northwestern EIA), available at: <https://www.mee.gov.cn/ywgz/hjxpxj/>

modification. The Northwestern EIS considered pollution resulting from the construction phase of the project (2016–2019), focusing on dust, noise, water pollution, and solid waste.<sup>192</sup> It concluded that these would not have significant environmental impacts after appropriate mitigation actions.<sup>193</sup> The EIS also addressed the environmental impacts of the weather modification operations themselves,<sup>194</sup> stating that operations were expected to use 208 kilograms of silver iodide each year.<sup>195</sup> The assessors noted the low toxicity of silver iodide and concluded that the operations would not have significant environmental impact because the potential concentrations were far below the National Standard for Drinking Water Health Standards ( $\leq 0.05$  mg/L (milligrams per litre)).<sup>196</sup> However, the EIS did not consider the overall amount of silver iodide used countrywide because EIA procedures in China (as in many countries) focus on the direct impacts of a proposed activity, and do not require consideration of indirect or cumulative impacts and interactions.<sup>197</sup>

The Northwestern EIS completed two stages of public participation. Following online publicity and onsite public notices, the CMA solicited public opinion through a questionnaire (rather than a public hearing). According to the EIS, 96.8% of those contacted responded to the questionnaire.<sup>198</sup> No one expressed opposition to the proposed project,<sup>199</sup> although 62.8% of participants responded that they had only a slight understanding of weather modification.<sup>200</sup> This experience reflects a limitation of the EIS process in China: that participation procedures can be (and often are) designed to comply with minimum legal requirements, rather than facilitate meaningful public consultation.<sup>201</sup> Indeed, ‘top-down’ participation mechanisms, such as questionnaires, are often conducted *after* decisions are reached, casting serious doubt on their influence in decision making.<sup>202</sup> This approach to EIA is also consistent with what has been referred to as ‘authoritarian environmentalism’, where ‘[p]ublic participation is limited to a narrow cadre of scientific and technocratic elites while others are expected to participate only in state-led mobilisation for the purposes of implementation’.<sup>203</sup>

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[jxsh/hjyxpj/xmslqk/201609/W020160909514890214465.pdf](https://www.xinhuanet.com/jxsh/hjyxpj/xmslqk/201609/W020160909514890214465.pdf) (translated by the authors from Chinese to English).

<sup>192</sup> Ibid., para. 4(3).

<sup>193</sup> Ibid., para. 13(1).

<sup>194</sup> Ibid., para. 4(4).

<sup>195</sup> Ibid., para. 3(4)(3).

<sup>196</sup> Ibid., para. 8(4).

<sup>197</sup> Y. Wang, R.K. Morgan & M. Cashmore, ‘Environmental Impact Assessment of Projects in the People’s Republic of China: New Law, Old Problems’ (2003) 23(5) *Environmental Impact Assessment Review*, pp. 543–79, at 558–9.

<sup>198</sup> Northwestern EIA, n. 191 above, para. 17(8).

<sup>199</sup> Ibid.

<sup>200</sup> Ibid., para. 17(6)(2)(2).

<sup>201</sup> C.S.F. Chi, J. Xu & L. Xue, ‘Public Participation in Environmental Impact Assessment for Public Projects: A Case of Non-Participation’ (2014) 57(9) *Journal of Environmental Planning and Management*, pp. 1422–40, at 1424.

<sup>202</sup> Johnson, n. 180 above, p. 1.

<sup>203</sup> B. Gilley, ‘Authoritarian Environmentalism and China’s Response to Climate Change’ (2012) 21(2) *Environmental Politics*, pp. 287–307, at 288.

The Northwestern EIS acknowledged that rain enhancement operations would have impacts on surface water but concluded that the impacts on nearby nature reserves would be positive.<sup>204</sup> These nature reserves constitute natural habitat for species protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)<sup>205</sup> and bilateral agreements on migratory birds;<sup>206</sup> thus, supporting the ecological health of these areas is consistent with international obligations.

The Northwestern EIS did address the issue of potential extra-area effects. It recognized that weather modification would be likely to increase overall precipitation over non-target areas by 1%, equivalent to approximately 60 billion tons of water, without changing its temporal and spatial distribution.<sup>207</sup> Concerning the risks of impacts beyond China's borders, the EIS explained that, because weather systems essentially move from west to east across China, the expected increase in rainfall would mostly affect the Chinese territory.<sup>208</sup> The Northwestern EIA process did not require or include any consultation or cooperation with adjacent countries, nor with countries along the Mekong-Lancang river, which originates in the Northwest region (Qinghai). To comply with due diligence obligations, China's EIA processes need to incorporate a more thorough consideration of transboundary impacts, including through enhanced transparency and granting neighbouring countries access to relevant information.

The lack of transboundary EIA requirements and consultation with potentially affected states under Chinese domestic law is concerning, given the scale of current weather modification projects and their proximity to neighbouring states. Moreover, this gap has not been filled by any 'extraordinary' processes of consultation with neighbours, such as India. This raises questions about China's compliance with its due diligence obligations under customary international law.

#### 4.3. *Ownership of Atmospheric Resources*

China has developed a robust legal framework to govern the safety aspects of weather modification, but questions remain about its ability to address the governance and ownership of atmospheric water. Under the Constitution, the central government owns natural resources, including water resources.<sup>209</sup> China's Water Law 2002

<sup>204</sup> Northwestern EIA, n. 191 above, para. 5(4)(2)(2).

<sup>205</sup> Washington, DC (US), 3 Mar. 1973, in force 7 Jan. 1975, available at: <http://www.cites.org/eng/disc/text.php>.

<sup>206</sup> See, e.g., Agreement between the Government of Japan and the Government of the People's Republic of China on Protection of Migratory Birds and Natural Habitats Thereof, Beijing (China), 3 Mar. 1981, in force 8 June 1981, available at: <http://extwprlegs1.fao.org/docs/pdf/bi-140191.pdf> (in Chinese); Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment, Canberra (Australia), 20 Oct. 1986, in force 1 Sept. 1988, available at: <http://www.austlii.edu.au/au/other/dfat/treaties/ATS/1988/22.html>.

<sup>207</sup> Northwestern EIA, n. 191 above, para. 8(3)(3).

<sup>208</sup> *Ibid.*

<sup>209</sup> 'All mineral resources, waters, forests, mountains, grasslands, unreclaimed land, beaches and other natural resources are owned by the state': Constitution of the People's Republic of China, 4 Dec. 1982, Art. 9, available at: [http://www.npc.gov.cn/zgrdw/englishnpc/Constitution/node\\_2825.htm](http://www.npc.gov.cn/zgrdw/englishnpc/Constitution/node_2825.htm) (official English translation).

confirms that ‘water resources are owned by the State’,<sup>210</sup> but the Water Law explicitly applies to surface water and groundwater and does not clarify the legal status of atmospheric water. The Meteorology Law delegates the management of climatic resources, including atmospheric water, to lower levels of government.<sup>211</sup>

In line with the Meteorology Law, several provinces have asserted state ownership of climatic resources. In 2012, the Northeastern province of Heilongjiang became the first to pass Regulations on Climate Resources Survey and Protection, recognizing state ownership over climatic resources.<sup>212</sup> The regulations define climatic resources as ‘wind energy, solar energy, precipitation and any component of the atmosphere that is capable of being used by human activities’.<sup>213</sup> Shanxi, Guangxi, Guizhou, and Tibet have all passed similar regulations.<sup>214</sup> While several Chinese commentators have criticized the constitutionality of these provincial regulations, Chen and Cui argue that the nationalization of climatic resources is consistent with Chinese law.<sup>215</sup> Chen also argues that, even though state property is often used as a means to expand governmental control over resources, it is also an optimal property regime for emerging natural resources, such as atmospheric water.<sup>216</sup> It facilitates future transition in utilization patterns and creates room for flexibility in the face of scientific uncertainty.<sup>217</sup>

Chien, Hong and Lin suggest a tension between the provisions of the Water Law and the Meteorology Law which could result in jurisdictional conflicts between the central and local governments.<sup>218</sup> They argue that the ownership of water resulting from weather modification activities in the Henan and Hubei provinces, which affect catchment areas that supply the Greater Beijing region, is uncertain.<sup>219</sup> It is unclear whether these provinces exclusively own the water or if they are under an obligation to share with cities in other provinces, including Beijing. The Regulations on Administration of Weather Modification 2002 contain provisions intended to avoid disputes between local governments over so-called ‘cloud theft’. They establish specific procedures for weather modification operations implemented across the boundaries of provinces, autonomous regions or municipalities, requiring relevant governments to consult with neighbouring areas over cross-boundary decision making.<sup>220</sup> Where governments cannot agree, the

<sup>210</sup> Water Law of the People’s Republic of China, 21 Jan. 1988, revised 29 Aug. 2002, Art. 3, available at: <http://www.asianlii.org/cn/legis/cen/laws/wlotprocme508> (unofficial English translation).

<sup>211</sup> Meteorology Law, n. 136 above, Art. 33.

<sup>212</sup> Heilongjiang Province Regulations on Climate Resources Survey and Protection (promulgated by the Standing Committee of Heilongjiang People’s Congress, 14 June 2012) Art. 7 (cited in Chen & Cui, n. 76 above, p. 83).

<sup>213</sup> Heilongjiang Regulations, Art. 2 (cited in Chen & Cui, *ibid.*).

<sup>214</sup> Chen & Cui, *ibid.*, p. 89.

<sup>215</sup> *Ibid.*, p. 102.

<sup>216</sup> J. Chen, ‘Optimal Property Rights for Emerging Natural Resources: A Case Study on Owning Atmospheric Moisture’ (2013) 50(1) *University of Michigan Journal of Law Reform*, pp. 47–105, at 53.

<sup>217</sup> *Ibid.*

<sup>218</sup> Chien, Hong & Lin, n. 23 above, p. 232.

<sup>219</sup> *Ibid.*

<sup>220</sup> Regulations, n. 146 above, Art. 14.

CMA is empowered to decide.<sup>221</sup> However, there are no provisions in the regulations or elsewhere under Chinese law that require consultation with neighbouring states that might be affected by China's weather modification activities.

## 5. ENHANCING CHINESE WEATHER MODIFICATION LAW TO ADDRESS TRANSBOUNDARY EFFECTS

Concerns over the Chinese weather modification programme are taking place against a backdrop of diplomatic and military tensions over the disputed Himalayan border, known as the Line of Actual Control. It extends over 3,500 km between India and China. The tensions escalated in June 2020, with confrontations in the Galwan valley, resulting in the loss of military personnel on both sides.<sup>222</sup> These tensions had already affected hydrological data sharing in 2017. China failed to share data on the Brahmaputra river following a stand-off in the Doklam region, which compromised India's flood control and disaster management capacity.<sup>223</sup> Adding to controversies relating to China's construction of dams upstream of transboundary rivers,<sup>224</sup> China's use of weather modification to control water resources in the Himalayas is challenging water security in the region.<sup>225</sup>

There are also growing concerns over the potential militarization of China's weather modification programme.<sup>226</sup> The prospect of weather modification being used for military purposes prompted the development of the ENMOD Convention,<sup>227</sup> to which China is a party. The geopolitical implications of the Chinese weather modification programme suggest that international mechanisms may be needed to improve state cooperation and regulate large-scale weather modification. Such an approach was suggested by the ILC in its report on protection of the atmosphere.<sup>228</sup>

<sup>221</sup> Ibid.

<sup>222</sup> A. Sharma, 'Galwan Valley Clash Unmasks China's Geopolitical Intent and India's Delusion with China', *The Times of India*, 26 Sept. 2020, available at: <https://timesofindia.indiatimes.com/blogs/voices/galwan-valley-clash-unmasks-chinas-geopolitical-intent-and-indias-delusion-with-china>.

<sup>223</sup> D. Jayaram, 'Mutual Mistrust Should Give Way to Water Cooperation between India and China', *Climate Diplomacy*, 14 Mar. 2018, available at: <https://climate-diplomacy.org/magazine/cooperation/mutual-mistrust-should-give-way-water-cooperation-between-india-and-china>.

<sup>224</sup> 'China's Dam-Building over Brahmaputra Risks Water War with India', *The Economic Times*, 24 Jan. 2021, available at: <https://economictimes.indiatimes.com/news/defence/chinas-dam-building-over-brahmaputra-risks-water-war-with-india/articleshow/80432810.cms?from=mdr>.

<sup>225</sup> A. Roy, "'Weather War': A Latest Addition to the Sino-India Conundrum?", *Observer Research Foundation*, 22 Aug. 2018, available at: <https://www.orfonline.org/expert-speak/43534-weather-war-a-latest-addition-to-the-sino-india-conundrum>; J. Griffiths, 'China to Expand Weather Modification Program to Cover Area Larger than India', *CNN*, 4 Dec. 2020, available at: <https://www.cnn.com/2020/12/03/asia/china-weather-modification-cloud-seeding-intl-hnk/index.html>; S. Chaudhary, 'China Threatens India with a Weather Modification System that Can Cover 1.5 Times the Area of Entire India', *The Eurasian Times*, 5 Dec. 2020, available at: <https://eurasianimes.com/china-threatens-india-with-a-weather-modification-system-than-is-1-5-times-larger-than-india>.

<sup>226</sup> D. Jayaram, 'Without Attention, Geoengineering Could Upend Foreign Policy', *Wilson Center*, 30 Sept. 2020, available at: <https://www.wilsoncenter.org/article/without-attention-geoengineering-could-upend-foreign-policy>.

<sup>227</sup> ENMOD Convention, n. 92 above.

<sup>228</sup> ILC, 'Third Report on the Protection of the Atmosphere', 25 Feb. 2016, UN Doc. A/CN.4/692.

China has contributed actively to international initiatives on meteorological sciences.<sup>229</sup> This demonstrates a level of commitment to cooperation with the international scientific community. However, given the large scale of China's weather modification activities and the proximity to state borders in which some activities are being conducted, scientific cooperation alone cannot satisfy China's obligations under the no-harm rule.<sup>230</sup> As noted above, China also has an obligation to adopt appropriate rules and measures at the domestic level to prevent transboundary harm.<sup>231</sup> However, China's domestic laws for weather modification do not currently fulfil the procedural obligations required under the no-harm rule relating to impact assessment, consultation, and notification. Rather than conducting transboundary EIAs, notification and consultation on an ad hoc basis, China should develop mechanisms under its domestic law to ensure routine practice and adherence by weather modification operators.

If China fails to implement such measures, there are limited options available to neighbouring states under international law. As noted in Section 3, breaches of the no-harm rule have been the subject of international litigation, the most recent example being the *Certain Activities and Construction of a Road* cases between Costa Rica and Nicaragua.<sup>232</sup> In order for such a claim to proceed, however, China would need to consent to have it brought before an international court or tribunal. Alternatively, neighbouring states in Southeast Asia could seek to negotiate a new regional or multilateral agreement with China and each other. Such an agreement could facilitate consultation with countries likely to be affected by weather modification,<sup>233</sup> but the likelihood of such an agreement seems low. China has been reluctant to join international agreements regulating the management of transboundary rivers.<sup>234</sup> It has entered into regional agreements to facilitate transboundary cooperation over shared water resources with some of its neighbours, such as Russia.<sup>235</sup> However, the practice of transboundary EIA in China is still in its infancy. At the minimum, setting up an information-sharing platform could ensure greater transparency in the conduct of weather modification activities. As Knowles and Skidmore argue, '[a]s China invests substantial funding into programs that are likely to cause ripple effects across multiple

<sup>229</sup> CMA, 'Multilateral Cooperation', 9 Sept. 2018, available at: [http://www.cma.gov.cn/en2014/international/features/201409/t20140919\\_261798.html](http://www.cma.gov.cn/en2014/international/features/201409/t20140919_261798.html).

<sup>230</sup> See Section 3 above.

<sup>231</sup> *Pulp Mills*, n. 103 above, p. 69.

<sup>232</sup> *Nicaragua/Costa Rica*, n. 126 above.

<sup>233</sup> E.B. Weiss, 'Principles for International Agreement' (1977) 9(6) *Futures*, pp. 490–501, at 495.

<sup>234</sup> China is not party to the Convention on the Law of the Non-Navigational Uses of International Watercourses (New York, NY (US), 21 May 1997, in force 17 Aug. 2014, available at: [https://legal.un.org/ilc/texts/instruments/english/conventions/8\\_3\\_1997.pdf](https://legal.un.org/ilc/texts/instruments/english/conventions/8_3_1997.pdf)), nor to the Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin (Chiang Rai (Thailand), 5 Apr. 1995, available at: <https://www.mrcmekong.org/assets/Publications/policies/agreement-Apr95.pdf>).

<sup>235</sup> See generally J. Ke & Q. Gao, 'Only One Mekong: Developing Transboundary EIA Procedures of Mekong River Basin' (2012) 30(3) *Pace Environmental Law Review*, pp. 950–1004; N.S. Castillo & Y. Bian, 'China's Obligation to Conduct Transboundary Environmental Impact Assessment (TEIA) in Utilizing Its Shared Water Resources' (2014) 55(1) *Natural Resources Journal*, pp. 105–25.

economies, both transparency and quality analysis are in the interests of the global community'.<sup>236</sup>

Another potential forum for cooperation is the WMO. This organization has long played a leading role in facilitating information exchange on weather modification through joint research projects,<sup>237</sup> international training and dialogue,<sup>238</sup> and the creation of a voluntary reporting mechanism.<sup>239</sup> The WMO terminated its reporting system in 2007 and instead established the Expert Team on Weather Modification Research to keep relevant research under review, provide advice and assistance to states on scientific experiments, and develop guidelines on the status of weather modification.<sup>240</sup> China participates in meetings of the Expert Team, contributes to its trust fund, and organizes WMO training on weather modification.<sup>241</sup> Until 2001, China also regularly reported its weather modification activities to the WMO Register on National Weather Modification Projects. Given the limitations of China's domestic arrangements and regional agreements, other states (including states in the region) could use the WMO forum to formalize cooperation. Re-establishing the voluntary reporting mechanism is one option, although a mandatory reporting mechanism would be more effective in avoiding the risk of transboundary effects.<sup>242</sup>

## 6. CONCLUSION

A growing number of states are using weather modification as a climate adaptation measure,<sup>243</sup> but the scale of China's weather modification programme is unprecedented. The scale of the Sky River project is significant in its own right, and some critics have suggested that China's weather modification programme could provide the infrastructure needed for more controversial global solar radiation management (SRM), such as stratospheric aerosol injection.<sup>244</sup> It is currently unlikely that China would deploy SRM unilaterally,<sup>245</sup> but its weather modification programme does demonstrate the

<sup>236</sup> S. Knowles & M. Skidmore, 'Using Weather Modification to Subdue Severe Weather', in M. Skidmore (ed.), *Handbook on the Economics of Disasters* (Edward Elgar, 2022), pp. 389–99, at 397.

<sup>237</sup> See, e.g., P.W. Summers, 'The WMO Precipitation Enhancement Project (PEP): Progress to Date and Present Status' (1980) 12(1) *The Journal of Weather Modification*, pp. 70–83.

<sup>238</sup> WMO, 'WMO Conference on Weather Modification Discusses Research, Environment', *WMO News*, 11 Oct. 2011, available at: <https://public.wmo.int/en/media/news/wmo-conference-weather-modification-discusses-research-environment>.

<sup>239</sup> WMO, 'Register on National Weather Modification Projects', available at: [https://library.wmo.int/index.php?lvl=notice\\_display&id=8188#.YGPTYB1xXUo](https://library.wmo.int/index.php?lvl=notice_display&id=8188#.YGPTYB1xXUo).

<sup>240</sup> World Meteorological Congress & WMO, n. 18 above, p. 54; WMO Strategic Plan, n. 18 above, pp. 49–50. See also WMO, 'WWRP Expert Team on Weather Modification', available at: <https://community.wmo.int/en/activity-areas/wwrp/wwrp-working-groups/wwrp-expert-team-weather-modification>.

<sup>241</sup> WMO Expert Team on Weather Modification Research, n. 8 above, p. 3.

<sup>242</sup> Roslycky, n. 24 above, p. 21.

<sup>243</sup> Flossmann et al., n. 9 above, p. 1.

<sup>244</sup> ETC Group, n. 65 above.

<sup>245</sup> Edney & Symons, n. 74 above, p. 320. See also Z. Liu & Y. Chen, 'Impacts, Risks, and Governance of Climate Engineering' (2015) 6(3–4) *Advances in Climate Change Research*, pp. 197–201, at 200; W. Weng & Y. Chen, 'A Chinese Perspective on Solar Geoengineering', in J.J. Blackstock & S. Low (eds), *Geoengineering Our Climate? Ethics, Politics, and Governance* (Routledge, 2018), pp. 155–8.

country's willingness and capability to undertake large-scale atmospheric intervention projects.<sup>246</sup> China is involved in SRM research, but Chinese scientists contend that China will not proceed with SRM deployment until international collaboration mechanisms are in place.<sup>247</sup> Weather modification and SRM are often distinguished on the basis that weather modification is intended to modify weather events at the local scale, whereas SRM typically contemplates intervention in the climate system at the global scale.<sup>248</sup> The line is blurred for regional programmes,<sup>249</sup> and the magnitude of the Chinese weather modification programme raises questions concerning the value of such distinction.<sup>250</sup> In this article we have argued that China should apply greater caution in respect of large-scale weather modification.

The Chinese government has developed a strong legal framework to govern the safety aspects of weather modification, showcasing the government's purported control over atmospheric resources. However, the governance of weather modification in China does not fully address potential environmental impacts associated with the scale of its programme, especially the risk of transboundary impacts. For China to comply with international customary law, a revision of its domestic legal framework is needed to reflect both the substantive and procedural obligations imposed under the no-harm principle.

Firstly, China should strengthen its legal framework to perform greater 'due diligence' in preventing its national weather modification programme from causing significant transboundary harm, and give effect to a precautionary approach. This is especially important for projects such as the Sky River project, which take place close to the boundary with neighbouring states. Secondly, China should adopt and enforce appropriate procedural measures to address the risk of transboundary harm. China could create clear processes for conducting transboundary EIA under the existing domestic framework. This would include assessment and monitoring of impacts on regional rainfall distribution and transboundary watercourses. China would

<sup>246</sup> J.C. Moore et al., 'Will China Be the First to Initiate Climate Engineering?' (2016) 4(12) *Earth's Future*, pp. 588–95, at 592; B. Bluemling, R.E. Kim & F. Biermann, 'Seeding the Clouds to Reach the Sky: Will China's Weather Modification Practices Support the Legitimization of Climate Engineering?' (2019) 49(1) *Ambio*, pp. 365–73, at 366.

<sup>247</sup> H. Lushan, 'Has "Geoengineering" Arrived in China?', *China Dialogue*, 9 Nov. 2020, available at: <https://chinadialogue.net/en/climate/how-to-supervise-geoengineering>; S. Moore & F. Eyck, 'China Doesn't Want a Geoengineering Disaster', *Foreign Policy*, 21 Feb. 2023, available at: <https://foreignpolicy.com/2023/02/21/china-geoengineering-rules-climate-change>.

<sup>248</sup> UK House of Commons, Science and Technology Committee, 'The Regulation of Geoengineering: Fifth Report of Session 2009–10', 18 Mar. 2010, pp. 15–6, available at: <https://publications.parliament.uk/pa/cm200910/cmselect/cmsctech/221/221.pdf>; O. Edenhofer et al. (eds), 'IPCC Expert Meeting on Geoengineering: Meeting Report', Lima (Peru), 20–22 June 2011, p. 45; National Research Council Committee on Geoengineering Climate, *Climate Intervention: Reflecting Sunlight to Cool Earth* (National Academies Press, 2015), p. 201, available at: [http://www.nap.edu/catalog.php?record\\_id=18988](http://www.nap.edu/catalog.php?record_id=18988).

<sup>249</sup> E.A. Parson, 'Climate Engineering in Global Climate Governance: Implications for Participation and Linkage' (2014) 3(1) *Transnational Environmental Law*, pp. 89–110, at 102; P. Williamson & R. Bodle, *Update on Climate Geoengineering in relation to the Convention on Biological Diversity: Potential Impacts and Regulatory Framework*, Technical Series No. 84 (Secretariat of the Convention on Biological Diversity, 2016), p. 129.

<sup>250</sup> Edney & Symons, n. 74 above, pp. 316–7.

also need be more proactive in fulfilling its duty to cooperate with, notify, and consult with potentially affected states, starting with greater transparency in sharing assessment and monitoring results. Such measures could address the environmental and socio-economic risks associated with weather modification, both within and across national borders, and reduce regional geopolitical tensions.

A multilateral regional instrument could address deficiencies in China's domestic governance of large-scale atmospheric interventions. Such an instrument could encourage notification and consultation with potentially affected countries and assessment of transboundary risks. It could also establish a mechanism for information sharing on weather and climate intervention research and development. In the absence of such an agreement, however, the WMO has an important role to play in strengthening international cooperation and information exchange. In the meantime, China will need to revise its domestic framework to align with principles of customary international law, potentially setting an example for other states to follow.