突┌性┌候┌化比┌期更加迅速

需要采取快速的┌候救┌策略

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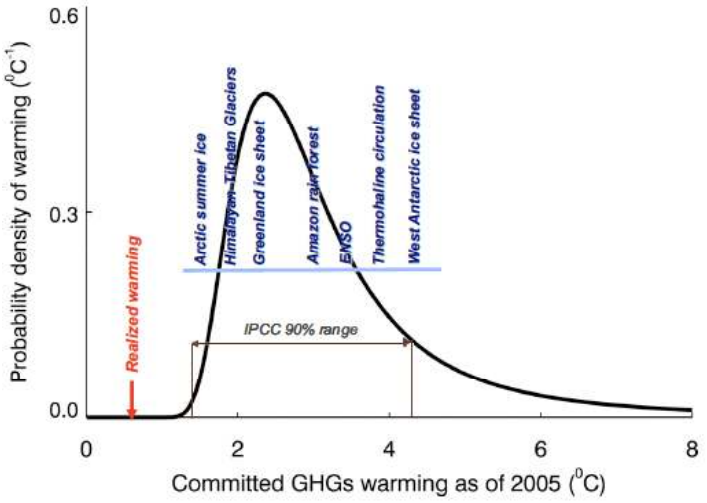
┌候┌料┌示，┌去的┌候┌化包括┌定的┌性┌化以及突┌的非┌性┌化，后者是指一旦越┌┌界点，微小的全球升┌就┌造成巨大不可逆┌的影┌。目前，┌候科┌家提出┌警，人┌的排放正在┌地球的┌候系┌推向┌┌的┌界点，其速度比以前的┌期┌要迅速，而其影┌┌┌是灾┌性的。

一旦越┌┌候┌界点，可能的影┌之一就是北┌夏季海上浮冰的消失、格陵┌┌冰┌的分裂、西南┌大┌冰┌的瓦解，大西洋┌┌循环的┌┌以及┌┌┌和北方森林的消亡。[1]┌些事件┌┌┌┌的灾┌性影┌包括海平面上升很多米，水源短缺，干旱洪┌以及政治不┌定和┌源┌┌。[2] 其他的影┌┌包括由┌土和海洋水合物┌放的甲┌和其他┌室┌体，┌些┌┌┌无法控制的┌候反┌。

在最近┌表在《美┌科┌院院┌》上的一篇文章中，加州大┌┌地┌哥分校斯克里普斯海洋┌究所的 V. Ramanathan 和 Y. Feng ┌算得出到 2005 年┌止的┌室┌体排放已┌使得地球┌度“比工┌化前的表面┌度高出 2.4 ºC, ”[3]┌一┌┌在┌期的┌界点范┌之┌。┌看下┌。



“1750 至 2005 年┌，┌室┌体┌致的升┌的可能性分配…据┌示是┌界因素[地球系┌的大┌模因素]和┌致┌界的┌候起点范┌.…”[4]

目前┌┌到的 0.76ºC[5]的升┌是┌┌性的，因┌至少有 1 ºC 的升┌被┌┌室┌体和其他┌染物同┌排放的含有降┌┌粒的“大┌棕色云”所掩盖。[6]┌我┌主要出于健康原因而┌┌┌少┌生┌些云的┌染物┌，我┌正在揭┌由┌有排放┌┌的┌ 1ºC 或更高的升┌。[7]┌有 0.6ºC 的升┌目前被海洋┌┌性吸收。[8]┌的升┌是 2.4ºC，而其中 50%┌┌┌┌┌十年┌┌生。[9]

Ramanathan 和 Feng ┌┌，┌┌的升┌的影┌包括“生物多┌性的广泛┌失，格陵┌

┌的广泛消融和 Hindu-Kush-Himalaya-Tibetan (HKHT)冰┌的┌域和┌量的大量┌少。HKHT 冰┌是┌洲主要河流的水源,"[10]包括┌河、┌江、┌河、湄公河、伊洛瓦底江，恒河和印度河。

在高┌度和高海拔地┌，升┌都高于全球平均水平。尤其是北┌，格陵┌和┌藏高原。[11]在 1965 至 2005 年┌，北┌┌度至少升高了全球平均水平的┌倍。[12]格陵┌冰┌的┌度升高了全球平均水平的 2.2 倍。[13]同┌，在┌藏高原上，┌去半┌世┌┌，每十年┌度升高高┌ 0.3ºC，┌┌全球平均水平的三倍。[14]┌ 1950 年起，喜┌拉雅山┌藏高原一面的升┌超┌ 1ºC，造成了冰川消融。[15]北┌海上浮冰的融化通┌┌少反照率或┌反射率和增加北┌海水吸┌造成正面反┌。[16]由于黑炭或煤烟被┌放入空┌中和落在冰雪上，┌致┌地表面┌暗。[17]冰雪上的黑炭也是┌致冰川消融的主要原因之一。[18]

科┌家估┌本世┌或┌十年┌就┌越┌突┌性┌候┌化的┌界点。[19]在一┌"一切照常"的模式下，空┌中的二┌化┌┌度每年增加 2-3ppm，突┌性的┌候┌化是否┌生不是一┌┌┌，┌┌是多快就┌┌生。[20]James Hansen 博士也同意 Ramanathan 和 Feng 的┌点，我┌已┌越┌了┌自然┌候系┌的"危┌的人┌影┌"的起始点。Hansen ┌┌必┌┌二┌化┌的┌度┌目前的 385ppm ┌少到 350ppm，如果我┌想要┌地球┌境保持在接近文明┌展和人┌适┌的水平。[21]目前的┌┌是，如果┌有强有力的救┌措施，到 2030 年，二┌化┌┌度┌接近 441ppm，┌┌之升┌ 3.1 ºC。[22]

┌管已┌确定突┌性的┌候┌化┌去曾┌┌生┌，┌且最近┌再次┌生，目前的┌候┌化政策┌┌有考┌突┌性的┌候┌化。[23]尤其是，突┌性的┌候┌化┌有被包括在政府┌┌候┌化工作小┌的┌┌中，┌┌┌被┌┌是┌候┌┌相┌信息的最┌威性，或┌常常比┌保守的┌源。[24]在┌┌┌注中期和┌期┌排二┌化┌的策略之外，我┌┌┌┌采取能┌┌┌迅速的┌候救┌效益的快速措施，┌助推┌┌界点的到┌。

波茨坦┌候影┌┌究所的 Hans Joachim Schellnhuber ┌授在他┌ Ramanathan 和 Feng 的┌究的┌┌中指出"我┌仍然有一定的机┌守住 2ºC 的准┌，然而┌候┌力┌和┌候政策之┌的┌┌十分激烈。┌┌…可能通┌管理┌溶┌…（先┌黑炭等升┌成分去除），以及去除空┌中二┌化┌的技┌（例如生物分离）┌提高。然而，核心的挑┌仍然存在，即…在 2015-2020 年的窗口期…┌少全球的[┌候排放]。。。┌在 2100 年前┌底消除二┌化┌排放。┌要求┌┌在┌始┌行一┌致力于可持┌┌展的工┌革命。"[25]

黑炭或者煤烟，可能是造成┌候┌暖的第二大原因。由于┌在空┌中┌存在几天到几周，┌少┌可以┌┌最快的救┌。[26]其他的近期┌┌候救┌策略包括┌少其他短期存在的强迫物┌，例如甲┌和┌流┌的臭┌┌前体物，[27]同┌推┌《蒙特利尔┌定┌》下┌少也是重要的┌候┌体的消耗臭┌┌物┌的努力。[28]其他的快速措施包括在森林和土壤的生物分离。例如，生物┌就可以通┌在一┌┌面┌效┌的┌程中┌少空┌中二┌化┌┌度┌┌┌┌┌循┌中移除，┌提供永久性的┌存┌器，同┌改┌土壤生┌力和┌少┌少┌基于化石燃料的化┌肥料的需求。[29]提高能源效率[30]和推┌可再生能源，尤其是┌能，也可以┌┌快速的救┌，[31]增加城市反照率也有此功效。[32]┌些近期策略中的大多┌也有明┌的附加收益，例如┌排黑炭的公共健康收益，生物┌的提高土┌收益和能源效率和可再生能源的增加能源安全的效益。┌些附加收益┌┌在采取行┌避免可┌┌的┌界点提供了更多的┌机。

很多┌家已┌存在法律机┌┌采┌┌些策略。如果如此，促┌守法有助于推┌近期的┌候救┌。[33]┌┌┌境守法和┌行┌┌最近┌布了有┌黑炭[34]和非法┌伐┌木[35]的┌候守法警告。

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[1] Timothy Lenton, Hermann Held, Elmar Kriegler, Jim Hall, Wolfgang Lucht, Stefan Rahmstorf & Hans Joachim Schellnhuber, *Tipping elements in the Earth's climate system*, 105 PROC. OF THE NAT'L

ACAD. OF SCI. 1786, 1786 (12 February 2008); *see also* WORLD WILDLIFE FUND, CLIMATE CHANGE: FASTER, STRONGER, SOONER (2008) ("It is currently forecast that [Arctic] summer sea ice could completely disappear somewhere between 2013 and 2040 – a state not seen on planet Earth for more than a million years."). *See generally*, CLIMATE BRIEFING NOTE ON TIPPING POINTS & ABRUPT CLIMATE CHANGES (IGSD, forthcoming 2008).

[2] Lenton et al., *supra* note 1, at 1788; PETER SCHWARTZ & DOUG RANDALL, AN ABRUPT CLIMATE CHANGE SCENARIO AND ITS IMPLICATIONS FOR UNITED STATES NATIONAL SECURITY 18-19 (October 2003), http://handle.dtic.mil/100.2/ADA469325.

[3] V. Ramanathan & Y. Feng, *On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead*, 105 PROC. OF THE NAT'L ACAD. OF SCI. 14245, 14245 (23 September 2008).

[4] *Id*.

[5] *Id.* at 14247. *See also* James Hansen, Makiko Sato, Reto Ruedy, Ken Lo, David W. Lea & Martin Medina-Elizade, *Global temperature change,* 103 PROC. OF THE NAT'L ACAD. OF SCI. 14288, 14288 (26 September 2006) ("Global warming is now 0.6ºC in the past three decades and 0.8ºC in the past century.").

[6] Ramanathan & Feng, *supra* note 3, at 14246-47.

[7] *Id*. at 14245-46.

[8] James Hansen, Makiko Sato, Pushker Kharecha, David Beerling, Valeris Masson-Delmotte, Mark Pagani, Maureen Raymo, Dana L. Royer & James C. Zachos, *Target Atmospheric CO_2: Where Should Humanity Aim?* 2 OPEN ATMOSPHERIC SCIENCE JOURNAL 217, 221 (2008) [hereinafter *Target Atmospheric CO_2*].

[9] Ramanathan & Feng, *supra* note 3, at 14247.

[10] *Id.* at 14245.

[11] Lenton et al., *supra* note 1, at 1788 ("Transient warming is generally greater toward the poles and greater on the land than in the ocean."); *see also* Jane Qiu, *The Third Pole*, 454 NATURE 393 (24 July 2008).

[12] P. LEMKE ET AL., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Observations: Changes in Snow, Ice and Frozen Ground*, *in* CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS 339 (S. Solomon et al. eds., 2007) ("Recent decreases in ice mass are correlated with rising surface air temperatures. This is especially true for the region north of 65°N, where temperatures have increased by about twice the global average from 1965 to 2005.").

[13] Petr Chylek & Ulrike Lohmann, *Ratio of the Greenland to global temperature change: Comparison of observations and climate modeling results*, 32 GEOPHYSICAL RESEARCH LETTERS L14705 (21 July 2005).

[14] Qiu, *supra* note 11, at 393.

[15] V. Ramanathan & G. Carmichael, *Global and regional climate changes due to black carbon*, 1 NATURE GEOSCIENCE 224 (23 March 2008). *See* Qiu, *supra* note 11, at 393 ("The Tibetan plateau gets a lot less attention than the Arctic or Antarctic, but after them it is Earth's largest store of ice. And the store is melting fast. In the past half-century, 82% of the plateau's glaciers have retreated. In the past decade, 10% of its permafrost has degraded. As the changes continue, or even accelerate, their effects will resonate far beyond the isolated plateau, changing the water supply for billions of people and altering the atmospheric circulation over half the planet…. The melting seasons on the plateau now begin earlier and last longer.... If current trends hold, two thirds of the plateau glaciers could be gone

by 2050."). In the nearby Tibetan Plateau Steppe, where the headwaters of the Yangtze, Mekong, and Indus are located, there is concern both for short-term flood and long-term reductions in water supplies. *See*, *e.g.*, *id.* at 395 ("The risk of floods, though, is but a short-term danger far exceeded by long-term issues with water supplies atop the [Tibetan plateau].").

[16] Lenton et al., *supra* note 1, at 1788.

[17] Ramanathan & Carmichael, *supra* note 15. *See also* Flanner, M.G., C.S. Zender, J.T. Randerson & P.J. Rasch, *Present-day climate forcing and response from black carbon in snow,* 112 J. GEOPHYS. RES. D11202 (2007) (noting that "the 'efficacy' of BC/snow forcing is more than three times greater than forcing by CO_2").

[18] *Id*. at 224.

[19] Lenton et al., *supra* note 1, at 1786; COMMITTEE ON ABRUPT CLIMATE CHANGE & NATIONAL RESEARCH COUNCIL, ABRUPT CLIMATE CHANGE: INEVITABLE SURPRISES 107-08 (2003).

[20] James Hansen, *Climate Catastrophe*, NEW SCIENTIST (28 July 2007).

[21] *Target Atmospheric CO_2, supra* note 8, at 217.

[22] Ramanathan & Feng, *supra* note 3, at 14247-49.

[23] Peter Read & Jonathan Lermit, *Bio-Energy with Carbon Storage (BECS): a Sequential Decision Approach to the threat of Abrupt Climate Change*, 30 ENERGY 2654, 2654 (November 2005) ("Abrupt Climate Change is an issue that 'haunts the climate change problem' (IPCC, 2001) but has been neglected by policy makers up to now, maybe for want of practicable measures for effective response, save for risky geo-engineering."); *see also* Lenton et al., *supra* note 1, at 1792 ("Society may be lulled into a false sense of security by smooth projections of global change. Our synthesis of present knowledge suggests that a variety of tipping elements could reach their critical point within this century under anthropogenic climate change."). This may be changing, however, as the U.S. Department of Energy's Office of Biological and Environmental Research (OBER) recently launched IMPACTS – Investigation of the Magnitudes and Probabilities of Abrupt Climate Transitions – an effort by six national laboratories to address abrupt climate changes. *See* Science Daily, Abrupt Climate Change Focus Of U.S. National Laboratories (23 September 2008), http://www.sciencedaily.com/releases/2008/09/080918192943.htm (The initial focus is on four types of ACC: instability among marine ice sheets, particularly the West Antarctic ice sheet; positive feedback mechanisms in subarctic forests and arctic ecosystems, leading to rapid methane release or large-scale changes in the surface energy balance; destabilization of methane hydrates (vast deposits of methane gas caged in water ice), particularly in the Arctic Ocean; and feedback between biosphere and atmosphere that could lead to megadroughts in North America.).

[24] *See*, *e.g.*, James Hansen, *Scientific reticence and sea level rise*, ENVIRON. RES. LETT. 2, 5 (2007).

[25] Hans Joachim Schellnhuber, *Global Warming: Stop worrying, start panicking?*, 105 PROC. OF THE NAT'L ACAD. OF SCI. 14239, 14239-40 (23 September 2008).

[26] Ramanathan & Carmichael, *supra* note 15, at 222 ("The BC forcing of 0.9 W m^{-2} (with a range of 0.4 to 1.2 W m^{-2}) … is as much as 55% of the CO_2 forcing and is larger than the forcing due to the other GHGs such as CH_4, CFCs, N_2O or tropospheric ozone."); *see also* Mark Jacobson, *Control of Fossil-Fuel Particulate Black Carbon and Organic Matter, Possibly the Most Effective Method of Slowing Global Warming,* 107 J. GEOPHYS. RES. D19 (2002); and Qiu, *supra* note 11, at 396

("Reducing emissions of greenhouse gases and black carbon should be the top priority," according to Xu Baiqing of the Institute of Tibetan Plateau Research.).

[27] *Role of Black Carbon on Global and Regional Climate Change: Hearing on the role of black carbon as a factor in climate change Before H. Comm. on Oversight and Gov't Reform*, 110th Cong. 4 (2007) (testimony of V. Ramanathan).

[28] *See* Guus J. M. Velders, Stephen O. Andersen, John S. Daniel, David W. Fahey & Mack McFarland, *The importance of the Montreal Protocol in protecting climate*, 104 PROC. NAT'L. ACAD. SCI. 4814, 4814-19 (20 March 2007), *available at* http://www.pnas.org/cgi/content/abstract/104/12/4814 (From 1990 to 2010, the Montreal Protocol will have reduced climate emissions by a net of 135 billion tonnes of CO_2-eq., delaying climate forcing by up to 12 years. This is ~ 13% of forcing due to accumulated anthropogenic emissions of CO_2, and several times the reductions sought under first phase of Kyoto Protocol.). In 2007, the Montreal Protocol was further strengthened to accelerate the phase-out of HCFCs; that adjustment has the potential to produce mitigation up to 16 billion tones of CO_2-eq. *See* U.S. EPA 2008 Climate Award Winners, Team Award Winners, http://www.epa.gov/cppd/awards/2008winners.html ("The U.S. EPA estimates that, through 2040, the HCFC agreement could reduce emissions by up to 16 billion metric tonnes of carbon dioxide-equivalent. This is equal to the greenhouse gas emissions from the electricity use of more than 70 million U.S. households over the next 30 years."); TECHNOLOGY AND ECONOMIC ASSESSMENT PANEL, UNITED NATIONS ENVIRONMENT PROGRAMME, RESPONSE TO DECISION XVIII/12, REPORT OF THE TASK FORCE ON HCFC ISSUES (WITH PARTICULAR FOCUS ON THE IMPACT OF THE CLEAN DEVELOPMENT MECHANISM) AND EMISSIONS REDUCTIONS BENEFITS ARISING FROM EARLIER HCFC PHASE-OUT AND OTHER PRACTICAL MEASURES 8 (August 2007), *available at* http://ozone.unep.org/teap/Reports/TEAP_Reports/TEAP-TaskForce-HCFC-Aug2007.pdf.

[29] Johannes Lehmann, John Gaunt & Marco Rondon, *Bio-char Sequestration In Terrestrial Ecosystems – A Review*, 11 MITIGATION AND ADAPTATION STRATEGIES FOR GLOBAL CHANGE 403, 404 (2006).

[30] Group of Eight Summit, Heiligendamm, Ger., June 6-8, 2007, *Growth and Responsibility in the World Economy: Summit Declaration*, ¶ 46 (June 7, 2007) ("Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce greenhouse gas emissions and enhance energy security.").

[31] The IPCC has predicted that renewable energy sources, which have "a positive effect on energy security, employment and on air quality," will be able to provide 30-35% of the world's electricity by 2030. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *Summary for Policymakers*, *in* CLIMATE CHANGE 2007: MITIGATION 13 (B. Metz et al. eds., 2007). The IPCC has also found that "wind is the fastest growing energy supply sector." INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, IPCC SCOPING MEETING ON RENEWABLE ENERGY SOURCES 4 (Olav Hohmeyer & Tom Trittin eds., 2008); *see also* GREENPEACE & GLOBAL WIND ENERGY COUNCIL, GLOBAL WIND ENERGY OUTLOOK 2006, at 38 (2006) ("Under the Advanced wind energy growth projection, coupled with ambitious energy saving, wind power could be supplying 29.1% of the world's electricity by 2030 and 34.2% by 2050.").

[32] *See* Hashem Akbari, Surabi Menon & Arthur Rosenfeld, *Global Cooling: Increasing Worldwide Urban Albedos to Offset CO_2*, CLIMATIC CHANGE (forthcoming 2008) (If 100 large urban areas switched their roofs and pavement to highly reflective materials, the authors calculate this would

"induce a negative radiative forcing of $4.4x10^{-2}$ Wm^{-2} equivalent to offsetting 44 Gt of emitted CO_2. A 44 Gt of emitted CO_2 offset resulting from changing the albedo of roofs and paved surfaces is worth about $1100 billion. Assuming a plausible growth rate of 1.5% in the world's CO_2-equivalent emission rate, we estimate that the 44 Gt CO_2-equivalent offset potential for cool roofs and cool pavements would counteract the effect of the growth in CO_2-equivalent emission rates for 11 years."); *see also* Hashem Akbari, *Global Cooling: Increasing World-wide Urban Albedos to Offset CO_2*, at the Fifth Annual California Climate Change Conference, Sacramento, CA (9 Sept. 2008), *available at* http://www.climatechange.ca.gov/events/2008_conference/presentations/2008-09-09/Hashem_Akbari.pdf. In California, which sets strict energy budgets for new construction, residential and some non-residential buildings can receive energy credits toward their energy budgets for installing "cool roofs." Cool roofs can lower roof temperatures up to 100 degrees Fahrenheit, reducing energy use for air conditioning and associated urban heat islands and smog. CAL. CODE REGS. tit. 24 § 118 (2007). Cool roof and reflective pavement are two of California's early action measures implementing California Assembly Bill Number 32, the Global Warming Solutions Act. *See* AIR RESOURCES BOARD, CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY, EXPANDED LIST OF EARLY ACTION MEASURES TO REDUCE GREENHOUSE GAS EMISSIONS IN CALIFORNIA RECOMMENDED FOR BOARD CONSIDERATION, at C-14 (2007).

[33] *See* Eighth International Conference on Environmental Compliance and Enforcement, Cape Town, S. Afr., Apr. 5-11, 2008, *Cape Town Statement*, for an affirmation of the benefits of environmental compliance and enforcement.

[34] Int'l Network for Environmental Compliance and Enforcement, *Jump-Starting Climate Protection: INECE Targets Compliance with Laws Controlling Black Carbon* (June 12, 2008), *available at* http://inece.org/climate/INECEClimateComplianceAlert_BlackCarbon.pdf.

[35] INECE, *Recent Amendments to U.S. Lacey Act Should Help Protect Forests Worldwide*, *available at* http://www.inece.org/climate/ClimateComplianceAlert_LaceyAct.pdf.