

# Hiroshima's Disaster, Climate Crisis, and the Future of the Resilient City 広島の災害、気候危機と回復力のある都市（「レジリエント・シティー」）の未来

Andrew DeWit



Hiroshima City's unprecedented extreme rain and multiple landslides of August 20 took over 70 lives and wrecked several districts. The disaster was big enough to stay in the international news cycle for a few days, in spite

of a summer rife with epidemic Ebola as well as worsening economic, environmental, geopolitical and other crises. This article argues that Hiroshima merits a great deal more sustained attention, indeed that it should be deliberately made a turning point in studying climate change and urban resilience. Surveys of the disaster sites, together with other evidence, suggest that Hiroshima's calamity offers multiple warnings about the impacts of accelerating climate change. This has led to a significant flow of human, fiscal and material resources, within Japan, that could be matched and coordinated with urban-resilience programmes in the US and elsewhere.

Hiroshima's status as the icon of the nuclear age is also important. The city's tragedies afford an historic opportunity to broaden and internationalize ongoing American initiatives to develop new metrics for measuring the dynamic reality of climate threats and adapting with green infrastructure and other means. This disruptive effort is crucial in a world dominated by status-quo interests and likely to spend USD 78 trillion on infrastructure over the years to 2025.<sup>1</sup> Much of that money may be wasted and countless lives put at risk because urban infrastructure decisions are largely based on the predictable past. As Marshall Shepherd, Director of the University of Georgia's Atmospheric Sciences Program and 2013 President of the American Meteorological Society argued on Aug 13, after reviewing the compelling data on intense-rainfall events in the US, civil engineers and hydrologists continue to rely on the past as a guide for

storm water engineering.<sup>2</sup> The reality is that we inhabit a rapidly urbanizing world whose city planners and infrastructure are evidently unprepared for intensifying climate extremes. We lack the collaborative global agency dedicated to fostering cutting-edge climate science and placing it at the forefront of decision-making on critical infrastructures. Thus Hiroshima could and should become a locus of collaboration on building urban resilience in the face of an accelerating collective threat.

### Japan's "Torrential Rains of August, 2014"

Since July 30 of this year, all regions of Japan have experienced floods, slides and other disasters from unusually intense rains, and much of the country has seen record-breaking rainfalls. By August 22, the number and scale of rainfall, flood and slide events had already become so exceptional that the Japanese Meteorological Agency (JMA) officially named the phenomena and their period the "Torrential Rains of August, 2014."<sup>3</sup> On August 26, the persistence and extent of extremes saw the JMA announce an emergency meeting of the Extreme Weather Analysis Deliberation Committee, expediting it to take place on September 3.<sup>4</sup>

Against the larger backdrop of climate change, the JMA currently believes the proximate cause of much of the extreme weather to be a weak summertime Pacific high-pressure ridge and an unusual meandering westerly flow in the archipelago's north. This pattern is said to have led to a stalled front into which warm and moist air streamed in from the Pacific to the south.<sup>5</sup> Record-setting rainfalls include 237.75 centimeters (94 inches) over 30 days in Kochi Prefecture's Kami City, fully 6.3 times the norm.<sup>6</sup> The extent of overcast skies may also be without postwar precedent. As of August 31, cumulative hours of sunshine for the month were slated to be the lowest - or tied for lowest with 1980 - since record-keeping for the region

began in 1890 in much of northern Kyushu (Fukuoka, Kumamoto, Oita, Nagasaki, and Saga Prefectures), the Chugoku region (Hiroshima, Okayama, Shimane, Tottori, and Yamaguchi Prefectures) and Shikoku (Ehime, Kagawa and Kochi Prefectures).<sup>7</sup>

### The Disasters in Hiroshima

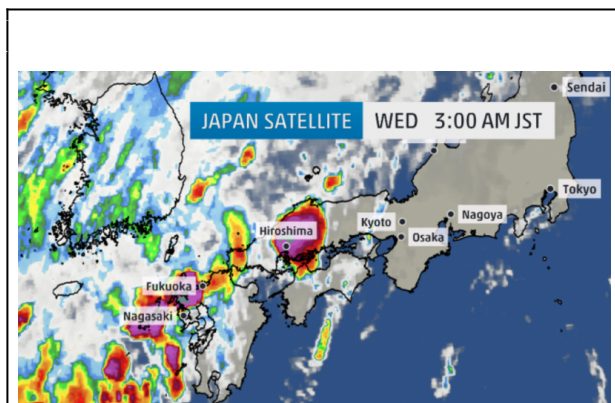
Hiroshima City (population: 1.18 million) and its environs were among the regions hit particularly hard by rain from the start of August. Japan's excellent climate monitoring system provides a detailed empirical record of what took place. Prominent among the observation hardware are the JMA's 1,300 Automated Meteorological Data Acquisition System (AMeDAS) monitors. They are separated at intervals of roughly 17 kilometers, and provide a steady stream of precise information, in real time via dedicated communications lines, on precipitation, temperature, humidity and other details.<sup>8</sup> There is an AMeDAS facility in Hiroshima's Miiri district, one of the focal points of the multiple landslides, and its data figure prominently below. The AMeDAS network is of course supplemented by monitoring facilities managed by other agencies and levels of government, in addition to Japan's weather satellite network, all of which provide essential details.<sup>9</sup>

The Miiri district and its AMeDAS station are in Hiroshima's 353.35 square km Asakita Ward, one of Hiroshima City's 7 wards (population: 146,328). Together with the 117.21 square km Asaminami Ward (population: 241,251), these wards are large and heavily residential areas dominated by houses and condominiums in the city's northern reaches. Both wards encompass numerous densely wooded mountains several hundred meters in height.

The AMeDAS data show that Asakita Ward's Miiri district enjoyed sunny skies in late July. But then the weather turned decidedly gloomy and wet. By mid-month, Miiri's monitor

recorded only four days with three or more hours of sunshine, and fully 8 days where there was no sunshine at all. The weather then took a further turn, from unpleasant to dangerous, as warm and moist air flowing up from the southern Pacific Ocean ran into the stalled low-pressure system over western Japan. Experts suggest a “back-building” phenomenon saw thunderstorms generated one after another, along a roughly 100-kilometer line of cumulonimbus clouds.<sup>10</sup> On the evening of August 16, the JMA warned that mudslides were a threat throughout the prefecture due to soil saturation in many areas caused by heavy rains from 2 typhoons (numbers 11 and 12) in early August as well as the other days of drizzle and the continuing bouts of intense rain from the train of storms.<sup>11</sup> The city was spared catastrophe on the 16th and the following few days. But disaster hit in the early morning hours of August 20, after unprecedentedly intense rain fell in the city. The weeks of rain, often concentrated in bursts of severe torrents, brought devastating landslides to many neighbourhoods on or near the numerous hillsides in Asaminami and Asakita wards.

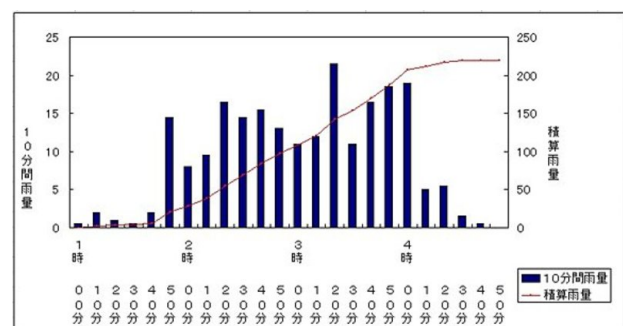
other urban centres (Fukuoka and Nagasaki) in Western Japan. At ground level, the JMA AMeDAS monitor in Miiri had recorded 25.4 centimeters of rainfall from the start of August through to the evening of the 19th, much more than its 14.31 centimeter historical average for the entire month.<sup>12</sup> Rolling thunder and driving rain that began around 10:00 PM on the night of the 19<sup>th</sup> suddenly tapered off, to the great relief of area residents. But after most went to bed, the storms resumed with an even greater vengeance. The data are seen in the accompanying chart produced by Japanese meteorologist Yoshida Tomomi, and derived from the Miiri monitor’s data. It shows that fully 22.4 centimeters fell from 1:50 AM to 4:40 AM of the 20<sup>th</sup>, the largest amount that has ever fallen in a one-day period since monitoring began at the Miiri station.<sup>13</sup> The left-hand side of Yoshida’s chart measures rainfall in 10-minute intervals, in gradations of 5 millimeters, and the right-hand-side the cumulative rainfall, in gradations of 50 millimeters. The X-axis is time, beginning at 1:00 A.M. and ending at 4:50 A.M. The tallest blue bar shows that the peak intensity arrived at 3:20 A.M., when a deluge of well over 20 millimeters poured down in just those 10 minutes.<sup>14</sup>



Satellite image of thunderstorms and intense rain (purple) just before landslides on August 20

A satellite image taken at 3:00 A.M. on the 20<sup>th</sup> shows the intensity of the storms and rain (in purple) at that moment in Hiroshima as well as

That same night, a Hiroshima Prefectural rain gauge elsewhere in Asakita Ward recorded a rainfall intensity of 13.0 centimeters per hour by 3:50 A.M., reaching a three-hour total of 21.75 centimeters by 4:30 A.M. The city as a whole saw an unprecedented total for the day of 27.5 centimeters.<sup>15</sup>







Millimeters of rainfall in Asakita Ward Miiri district, August 20 from 1:00 AM to 4:00 A.M., in 10-minute intervals

Landslides in Hiroshima’s Asakita Ward  
One of the slides that struck Miire

The landslides began at about 3:20 A.M., and unfolded with an atypical ferocity and in at least 50 places over an area roughly 11 kilometres long and just under 3 kilometers wide.<sup>16</sup> These events were big and fast. One landslide that struck the Miiri district was surveyed by the Japanese Erosion Control Academic Association’s specialists. Their preliminary results suggest that a 3000 cubic meter, 3-meter-high wall of trees, soil and rocks roared down from the 339 meter-tall Takamatsu Mountain at about 40 kilometers per hour.<sup>17</sup>

The worst hit district was Asaminami Ward’s Yagi district, where over half of the dead or still missing were concentrated. It was struck by

many slides that originated from areas with a particularly high density of large rocks.<sup>18</sup> A survey undertaken by Professor Suga Yuzo of the Hiroshima Institute of Technology indicates that one of the slides that ripped into Yagi started roughly a kilometer away when the roughly 2 meter thick surface soil tore loose from midway up 586.4 meter-high Abusan mountain. The enormous mass of material, including boulders of several tons, then raced down the underlying granite’s 20–28 degree steep slopes. Incredibly, parts of this slide may have momentarily reached speeds of as much as 144 kilometers per hour. It devastated an area of just under 34,000 square meters.<sup>19</sup>

Landslides per se are not without precedent in Hiroshima City, as well as Hiroshima Prefecture as a whole. June 29 of 1999 saw over 31 fatalities from rain-driven multiple landslides in the city, including 6 dead in the wards hit this year.<sup>20</sup> Japan’s Ministry of Land, Infrastructure and Transport (MLIT) lists 525,307 areas - well over 30,000 of them in Hiroshima alone - that are at risk of landslides nationwide.<sup>21</sup> This large number of potentially unstable areas is due to Japan’s mix of a very mountainous topography and volcanic soils, one of the features it shares with Korea. Considerable effort is made to shore up hillsides in order to prevent their collapse, especially because postwar growth saw cities and other infrastructure spread out into danger zones. Even so, the number of events is clearly climbing. MLIT studies indicate that the decade 2004 to 2013 saw an average of 1178 landslides per year. This was a striking jump over the average of 839 during the decade of 1994 to 2003, and 771 from 1984 to 1993.<sup>22</sup>

Moreover, the evidence continues to accumulate that August’s extreme weather made the geology of this disaster exceptional in a way that has startled Japanese specialists, leading them to warn of the implications for the entire country. For example, surveys undertaken on August 20<sup>th</sup> to the 22<sup>nd</sup> by

Hiroshima University Professor Kaibori Masahiro, an erosion control specialist, suggests there was another unusual and disturbing aspect to the disaster. Kaibori's examination of damage to the Yagi district turned up little evidence of rounded weathered granite but a great deal of large (several tens of centimeters) and angular sedimentary rock and other comparatively hard volcanic (rhyolite) rock. This finding is important. Landslides in Japan most often involve the surface soil of weathered granite becoming saturated by rain and then sliding down a slope. Sedimentary and volcanic rocks are generally not implicated in landslides, particularly because the former's sharp edges and resistance to saturation make it difficult to get them flowing. Kaibori suspects that the sheer intensity of the area's rainfall overwhelmed these properties. He warns that extreme rain appears capable of producing slides regardless of the underlying geology, meaning a disaster such as Hiroshima's is possible anywhere in the country.<sup>23</sup>

As of August 30, thousands of volunteers as well as nearly 3400 police, firefighters and military personnel had found 72 dead amidst the wreckage. They continue the grim task of looking for bodies, with 2 still missing over a week after the disaster.<sup>24</sup> Their efforts were often hampered by continuing rains that brought the work to a halt for several hours at a time, due to the grave risk of new slides and "secondary disasters."<sup>25</sup> By August 28, for example, Miiri's total rainfall for the previous 30 days had climbed to a cumulative 53.35 centimeters, 3.76 times the historic norm, and the JMA was forecasting more rain to come.<sup>26</sup> The extent of the disaster was reflected, shortly in its wake, in the 1,685 people in emergency shelters and the city's evacuation orders and warnings to a total of 164,108 of its 1.17 million residents.<sup>27</sup>



Several of the slides that struck the Yagi district

Rescue work in Hiroshima

The Japanese military at work

### No Denialism Here

For the experts who advise Japan's MLIT and other agencies, the principal driver for the mounting number of landslides is the



increasing frequency of intense-rain events, due to climate change. The intensity of the recent rain in Hiroshima is clearly part of this pattern, and should have been what Americans like to call a “teachable moment.” Yet the English-language coverage of the Hiroshima disasters has yet to mention the connection to climate change. Perhaps this reticence reflects the Anglosphere’s deeply polarized politics concerning whether climate change is indeed occurring. The lamentable state of affairs sees even (what used to be) the quality press cover climate-related disasters without mentioning climate change or citing arguments aimed at minimizing the impact.<sup>28</sup>

Fortunately, the Japanese media operate in an environment in which most adults understand that climate change is underway. Hence, the August 21 Mainichi Shimbun,<sup>29</sup> a centrist publication, ran an interview with disaster-prevention expert Yadabe Ryouichi,<sup>30</sup> a professor at Ehime University. Ehime is across the Inland Sea (Setou Naikai) from Hiroshima, the two prefectural capitals being just 67 kilometers apart. The Mainichi’s article centred on what to do in the face of such disasters, but Yadabe prefaced his advice by noting that increasingly intense rainfall events are a global phenomenon and thus one should not be surprised to see them occurring in Hiroshima. Unlike most press coverage in Anglo-America, the Mainichi did not search for a denialist in order to “balance” Yadabe’s remarks.

Similar matter-of-factness was seen in the August 23 Sankei Shimbun, a quite openly right-wing newspaper. In an article on the large proportion of over-65 elderly among the victims, the newspaper cited Kansai University Professor Ozawa Mamoru. Ozawa pointed out that the elderly are not only less physically prepared to flee, but also mentally less ready to recognize the need. He suggested this is because they lack experience of these extreme climate-linked events. In other words, just like so many urban planners and businesses, they

often mistakenly base their decisions on a past whose lessons lead to misjudging the present threat.<sup>31</sup>

And as fate would have it, Hiroshima’s disaster hit and unfolded a day before Nagasaki University professor of water engineering, Tada Akihide, gave the keynote talk - “The Influence of Climate Change and the Coming Relationship Between Water and People” - at an August 21 “Water Symposium” held in Nagasaki City.<sup>32</sup> This symposium is an annual event, having been initiated in 1996 by the Water Engineering Committee of the Japan Society of Civil Engineers.<sup>33</sup> The symposia are held in a different prefecture every year, and this year’s event saw attendance by 440 representatives of governments, the private sector, academics and others.

Professor Tada noted that bouts of intense rain of 10 centimeters or more per hour have been recorded 9 times in Nagasaki Prefecture between 2002 and 2010, nearly double the 5 times recorded in the decade between 1992 and 2001.

#### Continual Learning From Hiroshima

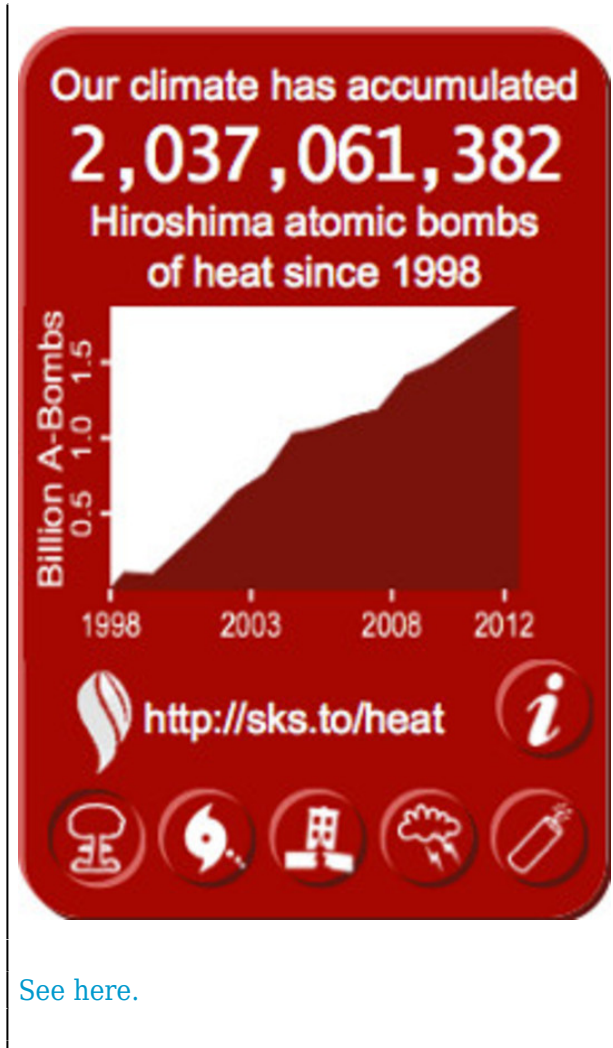
Hiroshima is of course the icon of the nuclear age, as is Nagasaki. References to rain in the context of the two cities generally mean the “black rain” of radioactive fallout mixed with carbon residues from fires that consumed the cities.<sup>34</sup> In Hiroshima, the radioactive rain began to fall about twenty minutes to a half hour after the approximately 8:15 A.M. nuclear blast on August 6, 1945. It had a devastating impact on human health, one that was completely denied at the time and covered up for years by US occupation censors.



Less well known is the 26 kiloton (of TNT equivalent) Hiroshima atomic bomb's use as a unit for measuring the planet's heat imbalance due to the activity of greenhouse gases emitted by humans. The climate scientists who cooperate on the blog "Skeptical Science" determined in their research that this warming is 250 trillion Joules per second. As they point out, the figure is difficult for anyone to grasp, particularly lay persons - such as the present writer - without a strong background in science. So they quantified the number in terms of Hiroshima bombs (and other more familiar phenomena), finding that it is equivalent to four Hiroshima bombs per second. They also designed a widget that shows the accumulated number of "Hiroshima atomic bombs of heat" since 1998 a number that is well over 2 billion.

This calamitous history, and its enduring

relevance, potentially opens a door to greatly expanded US-Japan scientific and technical cooperation on climate change that might save many more lives than were lost in Hiroshima's past and present tragedies. Though the Japanese are well informed about climate change, like everyone else they are unsure about its scale, the speed at which it is accelerating, and precisely what to do about it. There are simply too many new data streaming in from satellite and ground-based observations. For example, NASA and University of California, Irvine, researchers revealed on May 12 of this year that melt in part of the West Antarctic Ice Sheet is "in an irreversible state of decline," an incontrovertible tipping point that jolted the attentive public.<sup>35</sup> Shortly afterwards, a summary of data from NASA's GRACE satellites, which measure the planet's gravitational differences, provided truly shocking revelations on the reduction of groundwater flows.<sup>36</sup> There is very recent hard evidence that water vapor (which accelerates climate forcing) is increasing in the upper troposphere.<sup>37</sup> There is also good reason to believe that methane releases are accelerating, some of it from fracking, but much due to pronounced Arctic-region heating ("Arctic Amplification") and what it is doing to the tundra and beneath the shallow seas.<sup>38</sup> Along with these disturbing findings come indications that the polar vortex is indeed out of control, and that the so-called Rossby waves driving extreme weather have been accelerating since 2000.<sup>39</sup> These research results are not part of the draft IPCC synthesis report that was leaked to the media on August 26, a draft that used the word "risk" 351 times in 127 pages. Even so, the draft also noted that "currently observed impact might already be considered dangerous," and warned of further extreme weather as well as conflict, refugee crises, constraints on food production, and other grave challenges.<sup>40</sup>



risks are grave and require quick action. A culture of conservatism reigns among scientists, leading them to be very cautious in publishing their findings. This conservatism, as it relates to climate scientists, was described in detail by Oreskes and several other expert colleagues in a February 2013 paper in *Global Environmental Change*, titled “Climate change prediction: Erring on the side of least drama?”<sup>41</sup> The authors interviewed scientists and found that a range of factors restrain them from making bold predictions even when there is considerable evidence. These factors include concerns about the loss of credibility as well as the kind of public criticism experienced by several prominent climate scientists (particularly Michael Mann). They also reviewed past climate predictions and measured them against available outcomes. They determined that climate scientists have not been given to the “alarmism” frequently referred to in the blogosphere and even the mainstream media. In fact, they found quite the reverse. They determined that scientists are biased “toward cautious estimates, where we define caution as erring on the side of less rather than more alarming predictions. We call this tendency ‘erring on the side of least drama (ESLD).’” They also warn that this bias “needs to be appreciated because it could prevent the full recognition, articulation, and acknowledgment of dramatic natural phenomena that may, in fact, be occurring. After all, some phenomena in nature are dramatic. If the drama arises primarily from social, political, or economic impacts, then it is crucial that the associated risk be understood fully, and not discounted.”

Distracted by other crises as well as - to be blunt - cash from vested interests, many democratic governments have a poor capacity to respond to climate change. Naomi Oreskes and Eric Conway illustrated this weakness in their short 2014 book *The Collapse of Western Civilization: A View From the Future*, in which they reviewed the successes of the “carbon combustion complex” and speculated it would continue to trump science in the democratic countries, suggesting that it might lead to their downfall.

In their book, Oreskes and Conway also point to the practices of the scientific community as a further factor inhibiting the recognition that

This evidence of accelerating climate change and the factors inhibiting responses is the backdrop to what took place in Hiroshima. The Japanese themselves are hamstrung by ESLD. This can be seen, for example, in the over-reliance on IPCC scenarios in the white papers of the MLIT, the Ministry of the Environment, and other agencies and institutions charged



with climate-related planning for urban and other infrastructures. This likely reflects ESLD at work in Japanese scientific circles as well as the difficulty of coordinating initiatives among Japan's quite siloed central government agencies. Even Japan's plethora of "smart city" programmes lack a critical engagement with the multiplicity of dynamic variables driving climate change and its extreme weather.

### **SERDP's Research Programme on Climate Change**

Fortunately, there is an irony at work in our collective favour. Since democratic governance in the US has largely gone AWOL in the face of climate change, the military have been left to measure its implications for their runways, piers, and other infrastructure. In particular, the US Department of Defense agency Strategic Environmental Research and Development Program (SERDP), co-managed by the US Department of Energy as well as the Environmental Protection Agency, is tasked with getting the best real-time information on climate change - particularly its manifestation in weather - and what it means for infrastructure. These are not people with guns or Dr Strangelove types seeking to build more lethal weapons. Moreover, they do their work via contracts with academic experts and others who apply for grants, an approach that affords academe an opportunity to get past the ESLD problem. SERDP's November 7, 2013 FY 2015 Statement of Need in the Resource Conservation and Climate Change (RC) program area focuses on "adapting to changes in the hydrologic cycle under non-stationary climate conditions." This phrase may seem jargonistic, but "non-stationary climate conditions" refers to conditions in which variations in rainfall and such related phenomena as snowfall and groundwater flows are outside of the range of historic patterns. The rainfall extremes in Hiroshima may or may not be deemed "non-stationary," depending on the degree to which JMA and other research

find them deviating from past patterns. SERDP's investigations may indeed be aided, directly or indirectly, by forthcoming Japanese work. This is because the SERDP specifically point to the need to examine rainfall patterns and their influence from climate change "for geographic regions and applications of interest of the Department of Defense (DOD)." That potentially means just about everywhere, including Japan, because the US has over 7500 military bases or other facilities in much of the world.

Moreover, another area of concern for the SERDP is studying the frameworks for responding to increasingly intense climate change events. In their words "these frameworks should (A) facilitate the phasing in of adaptive responses, including, for example, the ability to incorporate the use of green infrastructure, to account for the pace of change and the time horizon over which decisions must operate and (B) enable an evaluation of projected and realized robustness against a range of plausible climate change futures." That means the SERDP is committed to finding out how to use green infrastructure, such as natural barriers rather than concrete seawalls, and other means to cope with climate challenges. They also want to understand the kinds of climate extremes that may be experienced, region by region, over the ensuing decades, and how to build up resilience against those potentially non-linear threats. In addition, they note that the Department of Defense is keen to avoid overcommitting resources as well as undertaking "maladaptive responses." In other words, they are also developing cost-benefit calculations that incorporate dynamism, something that is not yet being done anywhere else. In light of what we saw at Hiroshima, and see almost daily around the world, it is difficult to overstate the importance of the SERDP research programme.

With US military permanent installations almost everywhere in the world, the ambit of

this study is potentially very large. Its content also overlaps very much with the climate-related concerns of urban communities like Hiroshima. This is because its applications of interest include “water treatment, storm water, and sewer systems; roof design; flooding, drainage, and soil erosion implications affecting infrastructure: flood zone delineation and management, and water supply quantity and quality issues.” The SERDP also makes it clear that the “users of the intended research outcomes include but are not limited to: military installations; government agencies; service supply chains, real estate, insurance and contracting industries; and private developers.”

The sophistication of the SERDP’s study is thus potentially much more timely and practical than the IPCC’s work, which is hampered by being a few years out of date as soon as it is released. The IPCC draft synthesis, bold as it is in its warnings, is almost certain to be greatly watered down by the time of its official release on November 2. And IPCC reports suffer from the additional handicap of offering little advice on what is likely to happen in local areas. The SERDP effort seems also more sophisticated than the “Risky Business” study released by Michael Bloomberg, Hank Paulson and others on June 24, 2014.<sup>42</sup> The study is extremely important for informing business and governments about their regional risk of extreme events, especially potentially fatal combinations of high heat and humidity. But it is confined to the United States and lacks engagement with dynamic feedback effects and other variables noted above. It is also impaired by its overriding concern to be bipartisan, and thus has no policy recommendations for the phenomena it does describe. By contrast, the SERDP effort is aimed to “advance fundamental science considerations,” meaning it draws on the full range of data in the real world. It is also very policy-relevant. The SERDP authors of the Statement of Need expect that the research results “will be transitioned to practice” quite

soon upon completion because of the increasing demand for clear-eyed adaptation studies.<sup>43</sup>

### Making Hiroshima a Milestone

Returning to the disaster that hit Hiroshima, it is difficult to exaggerate the significance of SERDP’s initiative. It should become the benchmark approach for researching what is already happening and what may be coming as well as how to adapt to it cost-effectively.

One reason this benchmarking is an urgent imperative is that Japan’s fiscal flows are already being hit by climate change, with poor coordination among governments. Examples of this abound. An August 29 NHK broadcast highlighted, for example, the case of Atsugi City (population: 224,426) in Kanagawa Prefecture and 40.5 km southeast of Tokyo. (Atsugi City is, as it happens, is quite close to the US Naval Air Facility Atsugi.) Over the past five years, the city has thrice been inundated with rains that exceeded the 5.1 centimeter/hour perceived as the maximum when its sewerage was put in place. Last April, for instance, a storm with rainfall of 6.5 centimeters per hour delivered significant damage to the city’s waterworks. The central government recently undertook a survey to determine the system’s inadequacies and what might be done. It turns out that increasing the capacity of the system to handle floods and storm runoff would mean widening the drainage pipes in place. But that alone would not only be costly; it would also require shifting gas lines and other infrastructures close to the currently inadequate water pipes. Inter-governmental fiscal rules in Japan see the central government fund 50% of the cost of local governments’ sewerage-installation expenses. But the prospect of paying for upgrading such infrastructure nationwide already has the MLIT arguing that “budgets are limited and we’d like local governments to use them efficiently.”<sup>44</sup> In short, a classic example

of buck-passing.

At the same time, the MLIT (and other ministries) was quick to seize upon the Hiroshima slides in order to lobby for an increase in its own budget. As of August 28, the MLIT made it clear that it would be seeking a 16% increase in its allocation for the coming 2015 fiscal year, raising it to a total YEN 6.687 trillion.<sup>45</sup> The MLIT proposes devoting YEN 293.2 of that amount to landslides and flood-control prevention. The requested increase in these two areas, if secured in the fiscal process that starts in the fall, would represent a 23% increase on the initial 2014 budget's amounts.<sup>46</sup> YEN 94.3 billion of that is dedicated to measures against landslides. The MLIT's plans for the money include erosion-control dams, surveys of areas with soft ground, and YEN 11.9 billion on a special warning system to send alerts to residents' smart phones in the event of extreme danger.<sup>47</sup> These anti-landslide and flood-control measures may or may not be useful, but their YEN 67 billion increase certainly pales in comparison to MLIT's request for a total increase in the year of over YEN 1 trillion. Given Japan's well-known history of pork barrel public works, as well as the above-noted lack of engagement on climate threats, it seems legitimate to ask if expenditures are being properly prioritized. Surely some money can and should be found for a SERDP-style study.

Another potential benefit from linking Hiroshima with the American initiative would be for the Americans themselves. The Obama Administration has tried to start a nationwide initiative on local resilience, including creating a 26-members State, Local and Tribal Leaders Task Force on Climate Preparedness and Resilience as well as getting a fiscal appropriation of USD 1 billion for a "Climate Resilience Fund."<sup>48</sup> More recently, US Senator Patty Murray, chairwoman of the US Senate Budget Committee, released an August 1 memo on climate change, budget costs, military

bases, and other items. Her memo detailed four ways in which rising temperatures and sea levels as well as increasingly extreme natural disasters would "worsen the fiscal outlook." She pointed out that the US federal government "has spent three times more on disaster relief in the past decade," compared to the previous one. She also sought to underline the scope of the threats by noting that they included civilian infrastructure as well as military bases, obviously emphasizing the threat to national defence in order to gain as much traction on the issue as possible. She also emphasized that the costs of climate change would continue to increase, straining already tight budgets as well as forcing the diversion of funds from other priority areas.<sup>49</sup>

What happened in Hiroshima not only illustrates the significance of what Obama and Murray, along with countless others, are trying to do. It also offers the opportunity to broaden the SERDP initiative. There are potentially significant synergies possible from Japanese and American cooperation on researching the actual speed and scale of climate change, across a variety of regions, and building new metrics for calculating cost-effective means of adaptation (which can, of course, simultaneously include mitigation). This is hardly a controversial proposal, as there is already an extensive background of Japanese and US cooperation on climate change in other spheres. One example is the US and Japanese space agencies' (NASA and JAXA) collaboration on the new (operational from May 29, 2014) Global Precipitation Measurement Core Observatory satellite to measure rain and snow.<sup>50</sup>

A broader initiative, through building on the SERDP work, would have the advantage of putting the proper experts in an interdisciplinary context where they are less inhibited by ESLD. Precisely how to institutionalize that US-Japan cooperation in this flurry of post-disaster fiscal politics and



other goings-on is not immediately evident. But Hiroshima University has a number of high-quality research centres and is closely linked to others within Japanese academe and civil society. Moreover, the Japan Society of Civil Engineers will celebrate the centenary of its founding on September 27 of this year, followed by a succession of events through the fall on sustainability, disaster management and other themes.<sup>51</sup> American climate scientists and other experts might be well-advised to visit and network, and help turn this tragedy into a turning point. Getting collaboration going between the two countries, focused on this immensely important initiative, could then be broadened further. It would be productive to include regional partners, such as South Korea which has similar topography to Japan's and whose damage by landslides alone has increased from 231 hectares (ha) in the 1980s to 341 ha in the 1990s and to 713 ha in the 2000s.<sup>52</sup> The studies are also surely of interest to such city and climate-change focused international organizations as the C40 as well as the Rockefeller Foundation 100 Resilient Cities programme.<sup>53</sup>

As noted in the introduction, this deliberate effort to learn again from Hiroshima seems especially crucial in a world dominated by status-quo interests and likely to spend USD 78 trillion on infrastructure over the years to 2025. Much of that money may be squandered and countless lives put at risk because urban infrastructure decisions continue to be based on a past climate that is gone.

**Andrew DeWit** is Professor in Rikkyo University's School of Policy Studies and a coordinator of The Asia-Pacific Journal. His recent publications include "Climate Change and the Military Role in Humanitarian Assistance and Disaster Response," in Paul Bacon and Christopher Hobson (eds) *Human Security and Japan's Triple Disaster* (Routledge, 2014), "Japan's renewable power prospects," in Jeff Kingston (ed) *Critical Issues*

*in Contemporary Japan* (Routledge 2013), and (with Kaneko Masaru and Iida Tetsunari) "Fukushima and the Political Economy of Power Policy in Japan" in Jeff Kingston (ed) *Natural Disaster and Nuclear Crisis in Japan: Response and Recovery after Japan's 3/11* (Routledge, 2012). He is lead researcher for a five-year (2010-2015) Japanese-Government funded project on the political economy of the Feed-in Tariff.

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### Notes

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<sup>2</sup> Marshall Shepherd, "Recent Urban Floods: A simple equation," Weather Underground News and Blogs, August 13, 2014.

<sup>3</sup> See (in Japanese) “Japanese Meteorological Agency calls it the ‘Torrential Rains of August, 2014,’ NHK News, August 22. See also the Japanese Meteorological Agency press release (in Japanese) “Concerning official naming of torrential rains from July 30 of 2014,” Japanese Meteorological Agency, August 22, 2014.

<sup>4</sup> See (in Japanese) “Concerning the emergency meeting of the Extreme Weather Analysis Deliberation Committee: Analysis of the causes of August 2014 unseasonable weather,” JMA, August 26, 2014.

<sup>5</sup> See (in Japanese) “Extreme Weather: A succession of record-breaking torrential rains, centred on Western Japan,” Mainichi Shimbun, August 22, 2014.

<sup>6</sup> See (in Japanese) “Continuing rains already 3.6 times annual average,” Mainichi Shimbun, August 27, 2014.

<sup>7</sup> See (in Japanese) Sakakibara Junko “The unseasonable August is headed towards historic lows in sunshine,” Tenki.jp, August 31, 2014.

<sup>8</sup> The relevant details are described in “Observations,” Japan Meteorological Agency, nd.

<sup>9</sup> The satellite network is slated for expansion via the scheduled October 7, 2014, launch of Himawari 8. The satellite will see satellite photo intervals cut from every 30 minutes to every 10 minutes and the number of cloud-imaging types increased from 5 to 16. See (in Japanese) “Mitsubishi Electric completes work on Himawari 8 with liftoff scheduled for October,” Sankei Shimbun, August 23, 2014.

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<sup>11</sup> Japan Meteorological Agency (JMA), (in Japanese) “Please be cautious of landslide

threat in Hiroshima Prefecture through late evening of the 16<sup>th</sup>,” JMA Hiroshima Station Release, August 16, 2014 (8:12 P.M.).

<sup>12</sup> The historical (1981-2010) data for the Miiri AMeDAS station are available (in Japanese) [here](#).

<sup>13</sup> See (in Japanese) “Bulletin on global extreme weather events, with Hiroshima’s ‘torrential rains’”.

<sup>14</sup> See (in Japanese), “Persistent rains from typhoons, an August almost without sunshine, and then the shock from saturated ground and guerilla rain,” Sankei Shimbun, August 23, 2014.

<sup>15</sup> See (in Japanese) “Hiroshima hit by more than an average month’s worth of rain in three hours,” Asahi Shimbun, August 20, 2014.

<sup>16</sup> See (in Japanese) “The dead in Hiroshima total 49; multiple, simultaneous landslides in 50 locations,” Asahi Shimbun, August 23, 2014.

<sup>17</sup> See (in Japanese) “Specialist survey suggests mudflow momentarily reached speed of 144 kilometers per hour,” Mainichi Shimbun, August 26, 2014.

<sup>18</sup> See (in Japanese) “Damage to Yagi district in the Hiroshima disaster from massive rocks that fell from area dense in them,” Nikkei Shimbun, August 31, 2014.

<sup>19</sup> See (in Japanese) “Nagasaki Institute of Technology Professor’s survey indicates mudflow speed may have been 144 kilometers per hours, leaving not time to flee,” Sankei Shimbun, August 25, 2014.

<sup>20</sup> Toru Hanai, “Landslides hit Japan’s Hiroshima, killing at least 36,” Reuters, August 20, 2014.

<sup>21</sup> The number is as of November 30, 2013. See pp. 32-3 of (in Japanese) “Deliberation

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<sup>22</sup> See (in Japanese) “Landslides have increased by 50% over the past 20 years due to global warming and the frequency of heavy rain,” Asahi Shimbun, November 16, 2013. See also (in Japanese) “Land Protection and Erosion Control,” MLIT, November 19, 2013.

<sup>23</sup> See (in Japanese) “Even hard sedimentary rocks slide: Unprecedentedly intense rain overwhelmed geological strength,” Sankei Shimbun, August 23, 2014.

<sup>24</sup> See (in Japanese) “The search for 2 still missing in Hiroshima slides continues,” NHK News, August 30, 2014.

<sup>25</sup> Takashi Nakamura and Tomoyuki Hamahata, “Rescuers vigilant for secondary disaster signs,” The Japan News, August 24, 2014.

<sup>26</sup> The precipitation, sunshine and temperature data, from August 28, and by intervals of previous 10 days, 20 days, 30 days, 60 days, and 90 days, and for all AMeDAS stations, is available [here](#).

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<sup>28</sup> One example is the New York Times coverage discussed by Joe Romm, “The Brutally Dishonest Attacks On Showtime’s Landmark Series On Climate Change,” Climate Progress, April 9, 2014.

<sup>29</sup> See (in Japanese) “An interview with Ehime University Professor Yadabe Ryouichi on how to prepare for landslides,” Mainichi Shimbun, August 21, 2014.

<sup>30</sup> Professor Yadabe’s profile is [here](#).

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<sup>33</sup> *The Society* will have the centenary celebration of its founding on September 27, 2014.

<sup>34</sup> See “Black Rain,” Hiroshima Peace Media Center, nd.

<sup>35</sup> See Carol Rasmussen, “West Antarctic Glacier Loss Appears Unstoppable,” NASA News, May 12, 2014.

<sup>36</sup> Carol Rasmussen, “Parched West is using up underground water,” NASA Climate Change News, July 24, 2014.

<sup>37</sup> Climate forcing refers to the amount of energy we receive from the sun and the amount of energy radiated back into space, a product in turn of the amount of greenhouse gases. “Global warming amplifier: Rising water vapor in upper troposphere to intensify climate change,” Science Daily, July 28, 2014.

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<sup>40</sup> “Global warming is already here and could be irreversible, UN panel says,” The Guardian, August 26, 2014.

<sup>41</sup> Keynyn Bryssea, Naomi Oreskes, Jessica O’Reilly, Michael Oppenheimer “Climate change prediction: Erring on the side of least



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<sup>42</sup> The "Risky Business" website is [here](#).

<sup>43</sup> Strategic Environmental Research and Development Program (SERDP), "FY 2015 Statement of Need, Resource Conservation and climate change [RC] program area: ["adapting to changes in the hydrologic cycle under non-stationary climate conditions,"](#) SON Number: RCSON-15-02, November 7, 2013.

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<sup>45</sup> See (in Japanese) ["Disaster prevention stressed in MLIT YEN 6.6 trillion budget request,"](#) Yomiuri Shimbun, August 28, 2014.

<sup>46</sup> See (in Japanese) ["Landslide and flood-control measures to YEN 290 billion in MLIT budget request,"](#) Nikkei Shimbun, August 28, 2014.

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<sup>51</sup> The details are available in English [here](#).

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<sup>53</sup> See [here](#).