MONTHLY NEWSLETTER
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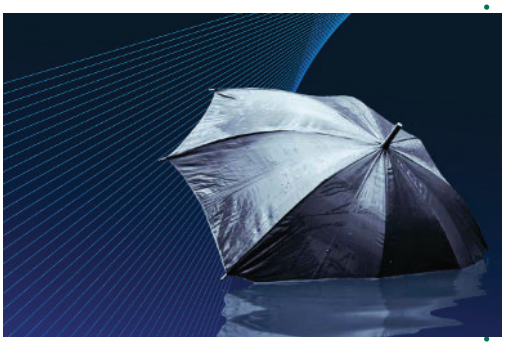
Woods Hole Research Center

WHRC contributes hazard analysis to landmark McKinsey report on socioeconomic impacts of changing climate

Dr. Philip B. Duffy
President & Executive Director

We can't stop climate change without leadership from the private sector, and this month saw a landmark example of that: the release of important new research on near- to medium-term (10-30 years) risks from climate change by the McKinsey Global Institute (MGI), the business and economics research arm of global management consulting firm McKinsey & Co. For its reports, MGI seeks the advice of academic advisors and industry experts to inform its research. Woods Hole Research Center scientists joined a number of leading institutions and thought leaders in MGI's working group on climate risk. We also produced much of the climate science analysis in the report.



The simple fact of the leading management consulting firm highlighting near-term physical climate risks (from extreme heat, drought, etc.) is major news, and the work shows how a stable climate is foundational to human prosperity. Illustrating the severity of 10- to 30-year risks is a powerful means to motivate action on adaptation and decarbonization.

An important difference between this work and previous efforts is that this work does not attempt to make a comprehensive estimate the effects of climate change on global GDP. (In my view there is no meaningful way to do that.) Rather, this analysis takes a bottom-up approach, focusing mainly on specific aspects of climate change in specific regions and exploring their socioeconomic ramifications more fully. For example, the study looks at extreme heat in India and its effects on labor productivity, national GDP, and human mortality. Another case study examines how threats to Florida real estate from sea level rise might affect property values, insurance premiums, state property tax revenues, and more.

These "knock-on effects" are precisely what make it impossible at present to estimate the total economic costs of climate change—the effects are simply too pervasive and interconnected.

Where do we go from here?

MCKINSEY *continued on next page*

McKinsey Report: Climate risk must be part of corporate, government decision-making

A new report from the McKinsey Global Institute (MGI) finds that physical climate risks are present and growing, suggesting leaders must take climate hazard assessment into account and consider adaptation measures. WHRC scientists produced much of the analyses of physical climate hazards for the report, which finds that absent adaptation and mitigation, their under-recognized "non-linear" characteristics could lead to large-scale socioeconomic effects[1].

The report, *Climate risk and response: Physical hazards and socioeconomic impacts*, assesses the socioeconomic risk from "acute" hazards, such as floods or hurricanes, as well as from "chronic" hazards, which are long-term shifts in climate parameters like temperature. To focus on the time horizon of decisions being made today, the report looks at two periods: between now and 2030, and from 2030 to 2050.

Among the report's key findings:

- **Climate change impacts are felt today and are likely to grow, intensify, and multiply.** This will have direct effects on socioeconomic systems in five areas: livability and workability, food systems, physical assets, infrastructure services, and natural capital.

REPORT *continued on next page*

MCKINSEY *continued from front*

First, WHRC hopes to continue producing physical climate hazard analyses for MGI's research on the socioeconomic consequences of climate change.

Second, our ongoing work with Wellington Management and the California Public Employees Retirement System (CalPERS) will grow with the announcement later this month of a major new partner.

Finally, we are seeking new opportunities to apply our risk assessment capabilities. A well-functioning insurance industry, for example, would be very helpful in managing climate risks, and WHRC can help to bring that about by providing granular assessments of risk that incorporate climate science. Cities and towns, including those here on Cape Cod, are on the front lines of climate change, yet lack the resources to cope. The same applies to national governments in the developing world. Our risk modeling capabilities can help.

WHRC's risk assessment work is organized around the foundational objective of maximizing public benefit through transparency and easy access to information. In contrast to a growing industry of for-profit providers of risk information, we are choosing to forego opportunities to monetize access to our data, on the belief that wide availability of top-quality climate risk information is an important public good. Another element of our approach, which further distinguishes us from private-sector providers, is that our methods will be published in the peer-reviewed literature. This gives consumers of risk information confidence in the soundness of our work and distinguishes it from low-quality alternatives (which do exist in the market but can be difficult to recognize). Publication of our methods also allows others to build and improve upon them, which isn't possible when methods are closely guarded trade secrets.

This approach of putting public good ahead of our own financial gain is, of course, exactly in line with WHRC's long-standing mission and culture and is enthusiastically supported by our staff and board of directors. We're depending on our donors to support it too, because this approach relies on philanthropic support to obtain societal benefit from our risk assessment capabilities. Initial indications are very encouraging, and we're excited about the potential to do more.

Thanks as always for your interest and support.

REPORT *continued from front*

- **The socioeconomic impacts of climate change will likely be non-linear as system thresholds are breached and have knock-on effects. Societies and systems most at risk are ones already close to physical and biological thresholds.** In Ho Chi Minh City, for example, direct infrastructure asset damage from a 100-year flood could rise from about $200-$300 million today to $500 million to $1 billion in 2050, while knock-on costs to the economy could rise from $100- $400 million to $1.5-$8.5 billion.
- **The global socioeconomic impacts of climate change could be substantial as a changing climate affects human, physical, and natural capital.** The number of people living in areas with a non-zero chance of lethal heat waves would rise from essentially zero today to between 700 million and 1.2 billion by 2050. The mild Mediterranean climate is expected to grow hotter and drier—by 2050, the climate in the French port city of Marseille could more closely resemble that of Algiers today—which could disrupt key sectors such as tourism and agriculture.
- **Decision-makers will need to better understand physical climate risk, while accelerating adaptation and mitigation.** Policy makers and business leaders will need to translate climate science insights into potential physical and financial damages, through systematic risk management and robust modelling recognizing the limitations of past data. Preparations for adaptation—whether seawalls, cooling shelters, or drought-resistant crops—will need collective attention, particularly about where to invest versus retreat. Science tells us that the only way to reduce long-term climate risk is through decarbonization at scale.

The report's release drew international media attention, with coverage in the *Financial Times*, *Wall Street Journal*, and CNBC, among many others.

"Many climate science reports focus on averages and the end of the century, but this report from the McKinsey Global Institute, leveraging climate hazard data from WHRC, shows how our societies and economies could cross critical thresholds and face new vulnerabilities over less time than the duration of a typical mortgage. What emerges is a framework for using the insights of climate science," said Dr. Spencer Glendon, Senior Fellow at WHRC and director of its research for the report. "This report makes clear that physical risk needs to be integral to decision-making the way financial and cyber risk now are. Fortunately, climate models perform vastly better than financial or economic ones. Decision-makers need to start using them."

[1]MGI estimates inherent physical risk, absent adaptation and mitigation, to dimension the magnitude of the challenge and highlight the case for action. Climate science makes extensive use of scenarios ranging from lower (Representative Concentration Pathway 2.6) to higher (RCP 8.5) CO_2 concentrations. MGI chose to focus on RCP 8.5, because the higher-emission scenario it portrays enables us to assess physical risk in the absence of further decarbonization.

Study: Rapidly warming Arctic-Boreal Zone demands more space-based monitoring

The Arctic-Boreal Zone (ABZ) is warming faster than elsewhere on Earth, threatening northern residents, economies and ecosystems, yet our current satellite formulation is inadequate for systematic monitoring and for improving process-based and large-scale understanding its integrated components. That's according to a new study by a team of 41 scientists published in the American Geophysical Union's Reviews of Geophysics. Researchers say an enhanced knowledge of the ABZ, which includes the cryosphere, biosphere, hydrosphere, and atmosphere, is necessary to provide more accurate predictions of future changes and to develop better-informed climate adaptation and mitigation strategies.

"Satellites, such as the Landsat program, are essential for being able to monitor the rapidly changing Arctic-Boreal Zone. Several of these programs now have decades of consistent observations, which has allowed us to track critical ABZ properties during the initial decades of climate warming," said WHRC scientist Dr. Brendan Rogers, a co-author of the study.

Among the study's recommendations:

- Protecting existing remote sensing and developing new technology for observing sea and land ice, oceans, snow, permafrost, vegetation, wet-lands, fire, short-lived pollutants, greenhouse gases, clouds, and albedo (reflectivity);
- The development of a comprehensive and robust suborbital (i.e., aircraft) portion of an ABZ observing network, which can act to fill some temporal gaps in satellite coverage, can provide detail unobtainable from space, and is necessary for validation and interpretation of satellite data;
- The continuation, enhancement, and/or creation of long-term, multi-satellite, climate-quality, and self-consistent data records of ABZ components, such as surface temperature, energy fluxes, vegetation properties, and sea ice extent and volume, for improved quantitative determination of ABZ trends;
- That Earth scientists work in parallel with policy and other decision-support organizations and stakeholders to formulate strategies that pursue innovative, informed, and practical uses for Earth science data in science-based decision-making (e.g., the development of tools that support mitigation and adaptation strategies).

"Sustained multi-national government support for the expansion and continuity of Earth observing satellite networks is critical. In addition, we need ongoing support for analysis and interpretation of data collected by satellites," said WHRC scientist Dr. Jennifer Watts, a co-author of the study.

WHRC recently launched the Arctic Carbon Monitoring and Prediction System, using on-the-ground observa-tions and satellite remote sensing data to gain new understanding on how quickly permafrost regions are changing and what that means for global warming. The effort includes partners at the Harvard Kennedy School's Belfer Center for Science and International Affairs and start-up funding from the Gordon and Betty Moore Foundation.

To support WHRC's Arctic Carbon campaign to help deliver the funding necessary to support this critical climate research, donate through WHRC.org and select Arctic Research and Policy as your designation, or contact Beth Brazil at 508-444-1549 or bbrazil@whrc.org.

Satellite image courtesy of the Copernicus Sentinel-2 mission - 2017.

Fires in southern Amazon could double in warming climate

Manmade climate change will double the area burned by fires in the southern Amazon and push fire into protected areas. However, avoiding new deforestation can have an equally massive impact, cutting total net fire emissions in half and helping prevent fires from escaping into protected areas and indigenous lands. That's according to research published in the journal Science Advances that included scientists from Woods Hole Research Center and our partners at IPAM Amazônia.

Results from an ecosystem-fire model suggest that Amazon fire regimes will intensify under both low- and high- greenhouse gas emission scenarios in the coming decades. Projections show that by 2050, up to 16% of the region's forests could be burned at least once, emitting up to 17.0 petagrams (Pg) of CO_2 equivalent into the atmosphere.

The good news is that the simulations also show that avoiding new deforestation could reduce net emissions by 38% under a low global emissions scenario (RCP2.6) and 56% under a high global emissions scenario (RCP8.5D). Preventing repeated burning could also promote faster forest recovery of carbon stocks, given that 26% of the areas burned, did so more than once.

"What this paper shows is that the actions we take now, both in fossil fuel emissions and in forest protection, will reverberate for generations to come. We can't deforest the Amazon and expect trees to regrow the same way in a changed climate. Today and tomorrow's hotter and drier conditions mean that many historically forested areas will face new challenges to protect themselves against wildfires," said Dr. Paulo Brando, WHRC scientist and lead author of the study.

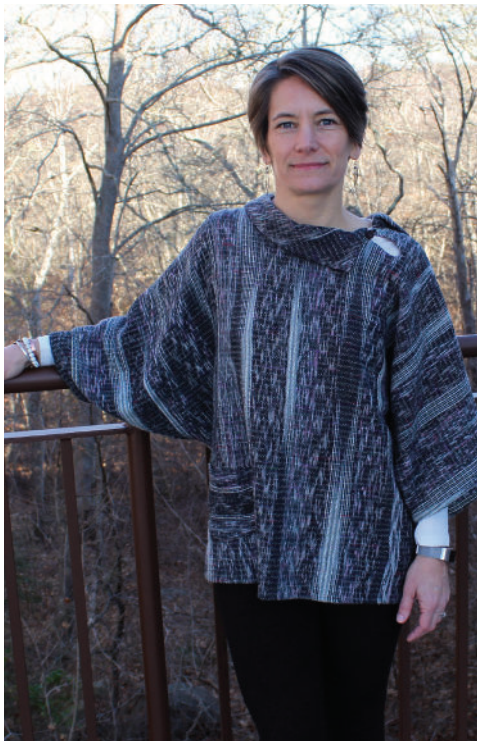
Even protected areas are projected to burn more frequently and intensely. While moist conditions currently prevent fires from spreading in the forest understory, those areas are projected to become more vulnerable to fire as severe droughts become more common.

"This study illustrates the urgency of our recently launched Amazon fundraising initiative (Fighting climate change by ending tropical deforestation). Any viable solution to global climate change requires that Amazon forests remain intact so they can continue to sequester carbon. But 2019 saw the worst deforestation and fires in a decade, making it more difficult to guarantee their future. With additional support, WHRC and IPAM are poised to harness science and collaborative policy innovation to save these forests," said Dr. Michael Coe, WHRC scientist and a co-author of the study.

When donating through WHRC.org, you can make a contribution specifically to the WHRC/IPAM Amazon Fund.

NASA Earth Observatory images by Joshua Stevens, using Landsat data from the U.S. Geological Survey.

Heather Goldstone joins WHRC to lead communications team



WHRC is welcoming Heather Goldstone, a Ph.D.-credentialed scientist and an award-winning journalist, as Chief Communications Officer.

Dr. Goldstone's work has focused on introducing audiences to the excitement of discovery and the importance of science in our daily lives. She served as science correspondent for WCAI and WGBH Radio, hosting *Living Lab Radio*. Goldstone holds a Ph.D. in ocean science from M.I.T. and Woods Hole Oceanographic Institution. Her reporting on science and the environment has appeared on NPR, *PBS News Hour*, *The Takeaway*, and PRI's *The World*. In 2014, she was recognized with WGBH's Margret and Hans Rey/Curious George Producer award.

"Heather combines enormous talent for communications with deep expertise in climate change and top-notch credentials in earth science," WHRC President Dr. Philip Duffy said. "I am excited about her ability to help us reach new and bigger audiences as we seek to increase our impact and visibility."

Dr. Goldstone will lead WHRC's communications team, overseeing media outreach, social media, and WHRC's monthly newsletter and twice-yearly Canopy magazine. David McGlinchey, who had overseen communications, will become Chief of External Affairs, leading WHRC's partnerships and government relations.

"Climate science has been a central theme of my reporting over the past decade. I am excited to put all of my energy into finding innovative ways to continue delivering WHRC's important science into the hands of those who can drive climate action," Dr. Goldstone said.

In the news : highlights

Humans must adapt to climate change destruction. *Financial Times* quotes John Holdren. January 21

More shippers and shipping companies promise to avoid Arctic routes. CBC (Canada) features Greg Fiske. January 13

Paulo Brando was quoted in several articles on Friday's "Gathering Firestorm" publication:

> **The Amazon is a key buffer against climate change. A new study warns wildfires could decimate it**. CNN.com. January 10
>
> **The Amazon stores tons of carbon. Climate change-fueled wildfires could ruin that**. *Popular Science*. January 10
>
> **Area of Amazon affected by wildfires projected to grow by 2050**. *New Scientist*. January 10

The Role of Climate Change in the Australian Wildfires. Niskanen Center blog by Zach Zobel and Niskanen's Joseph Majkut. January 10

The biggest climate questions for a new decade. *E&E News* quotes Jennifer Francis on climate and the polar vortex. Also published at Scientific American. January 3

Martha's Vineyard in 2040: A test case for the Green New Deal. *Martha's Vineyard Times* op-ed quotes Phil Duffy's December talk at the Martha's Vineyard Commission. January 2

Altmetric Top 100, a list of the most-discussed research papers of the year based on online activity, ranks the **climate emergency sign-on letter** in the journal Bioscience, led by WHRC Board Chair Bill Moomaw among others, as number four for 2019.

A look back at APR's coverage of climate change in 2019. *Alabama Political Reporter* quotes Jennifer Francis on climate and heat waves. December 31

We're spending our children's inheritance. *Vancouver Times Colonist* op-ed quotes Jennifer Francis. December 22

Top scientists warn of an Amazon 'tipping point'. *Washington Post* quotes Thomas Lovejoy, Sue Natali, and Paulo Brando. December 20

Reporting on climate change from Cape Cod, where sea levels could put everything at risk. *USA Today* op-ed by WCAI/Report for America reporter Eve Zuckoff references WHRC's wind turbine and solar panels. December 19

Help Nature Help Itself, Let Forests and Fields Stand Strong. *Vineyard Gazette* op-ed by David Foster, director of the Harvard Forest at Harvard University, cites Phil Duffy's recent presentation to the Martha's Vineyard Commission. December 19

Woods Hole Undergraduate Internship Program Aimed at Diversity in Science. NOAA blog mentions WHRC's participation in the PEP program, which is now seeking 2020 applicants. December 19

Foster Brown had two op-ed columns in *Jornal A Gazeta* (Rio Branco, Acre, Brazil): **Does Amazon deforestation affect rainfall? Yes. The most important question: How much?** (November 29), and **To think about development in the Amazon we need to talk about climate** (November 19).

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At the American Meteorological Society's 100th Annual Meeting in Boston, WHRC President Phil Duffy spoke on a panel titled *The Future of Financial Weather and Climate Risk Management*. The panel also included Boston Environment Commissioner Carl Spector and Wellington Director of Climate Research Chris Goolgasian.

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