**Arctic Answers Knowledge Pyramid**

*“Arctic Meltdown and Unruly Tropical Storms: Are They Connected?”*

*by J. A. Francis*

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**Arctic Answers Briefs** answer questions about Arctic environmental change that are framed for policy makers. Each Brief concisely conveys the state of the science. The **Knowledge Pyramid** of the state of the science and knowledge is presented below with the Arctic Answers Brief at the apex, built upon layers of references of increasingly more technical information: summaries, synthesis papers, and the building blocks of detailed basic research and technical academic studies.

**Key References:  *Selected references that provide state-of-the-art synthesis information needed to answer policy-relevant questions about rapid Arctic change.***

Duan, L., L. Cao, and K. Caldeira. 2019. Estimating contributions of sea ice and land snow to climate feedback. *Journal of Geophysical Research: Atmospheres* 124:199-208. <https://doi.org/10.1029/2018JD029093>.

Greene, C.H., J.A. Francis, and B.C. Monger. 2013. Superstorm Sandy: A series of unfortunate events? *Oceanography* 26 (1):8–9. <http://dx.doi.org/10.5670/oceanog.2013.11>.

Knutson, T. R., M.V. Chung, G. Vecchi, J. Sun, T.-L. Hsieh, and A.J.P. Smith. 2021. ScienceBrief Review: Climate change is probably increasing the intensity of tropical cyclones. In: *Critical Issues in Climate Change Science,* eds. C. Le Quéré, P. Liss, and P. Forster. <https://doi.org/10.5281/zenodo.4570334>.

Kossin, J.P. 2018. A global slowdown of tropical-cyclone translation speed. *Nature* 558:104–107. <https://doi.org/10.1038/s41586-018-0158-3>.

Mann, M.E., S. Rahmstorf, K. Kornhuber, B.A. Steinman, S.K. Miller, and D. Coumou. 2017. Influence of anthropogenic climate change on planetary wave resonance and extreme weather events. *Nature Scientific Reports* 7*.* <https://doi:10.1038/srep45242>.

Voosen, P. 2021. Arctic ice loss not a big culprit in harsh winters. *Science* 372 (6543):668-669.<https://doi:10.1126/science.372.6543.668>.

Woolings, T., D. Barriopedro, J. Methven, S.-W. Son, O. Martius, B. Harvey, J. Sillmann, A.R. Lupo, and S. Seneviratne. 2018. Blocking and its response to climate change. *Current Climate Change Reports* 4:287-300. <https://doi.org/10.1007/s40641-018-0108-z>.

**Summaries:  *Accessible summaries of main findings, critical questions, and societal importance.***

Harvey, C. 2021. Hurricanes Are Hitting Maximum Strength Closer to Land. *Scientific American*, E&E News, Natural Disasters, 29 January 2021. <https://www.scientificamerican.com/article/hurricanes-are-hitting-maximum-strength-closer-to-land/>.

# Knutson, T.R., M.V. Chung, G. Vecchi, J. Sun, T.-L. Hsieh, and A.J.P. Smith. 2021. Climate change is probably increasing the intensity of tropical cyclones. *ScienceBrief Review* 26 March 2021. <https://news.sciencebrief.org/cyclones-ar2021/>.

**Syntheses: *Resources for a comprehensive understanding of the issue and how different concepts interrelate.***

Overland, J.E., T. J. Ballinger, J. Cohen, J.A. Francis, E. Hanna, R. Jaiser, B.-M. Kim, S.-J. Kim, J. Ukita, and T. Vihma. 2021. *Environmental Research Letters* 16:043002. <https://doi.org/10.1088/1748-9326/abdb5d>.

**Building Blocks: *Technical studies with details and foundational information about individual concepts.***

Coumou, D., J. Lehmann, and J. Beckmann. 2015. The weakening summer circulation in the Northern Hemisphere mid-latitudes. *Science* 348 (6232):324–327. <https://doi:10.1126/science.1261768>.

Tachibana, Y., K.K. Komatsu, V.A. Alexeev et al. 2019. Warm hole in Pacific Arctic sea ice cover forced mid-latitude Northern Hemisphere cooling during winter 2017–18. *Scientific Reports* 9:5567. <https://doi.org/10.1038/s41598-019-41682-4>.