Cold, hot or dry: Persistent weather extremes associated with decreased storm activity

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A decrease in storm activity over large parts of the US, Europe, Russia, and China is found to influence weather extremes—cold ones in winter, hot or dry ones in summer. This is now shown in a study by scientists from the Potsdam Institute for Climate Impact Research. The observed changes in storm activity are likely related to changes in other atmospheric dynamics like the jet stream—strong westerly winds

circling the Northern hemisphere high up in the sky.

"Less or less severe storms in the mid-latitudes, this at first sight seems to be good news - but unfortunately it isn't," says lead-author Jascha Lehmann. "These storms have a moderating effect on land temperatures as they bring maritime air from the oceans to the continents and a lack of them can thus favor extreme temperatures."

In the Northern Hemisphere mid-latitudes, much of the day-to-day weather variability is determined by the storm track regions located over the Atlantic and Pacific oceans. Here, weather systems, including storms, are generated and travel eastwards to the continents. In winter, storms bring air from the relatively warm oceans to the continents and thus have a warming effect. In summer, the effect reverses with winds bringing relatively cool and moist air from the sea. The authors show that a lack of such weather systems can thus favor more persistent heat and drought events in summer, and cold spells in winter.

"This summer a severe drought in China's northern bread basket region Liaoning threatened crop yields, while California has been experiencing a prolonged drought for no less than three consecutive years," says Lehmann. Comprehensive analysis of satellite weather data shows that these are indeed regions where significant reductions in storm activity are detected during the rainy season. In summer, storm activity calmed down over as much as 80 percent of the land area in the mid-latitudes. In winter the changes are more patchy, yet pronounced reductions are found over eastern US and large parts of Europe and Asia. This includes regions like New York and Chicago which suffered from record-breaking cold temperatures in recent winters.

These detected changes in mid-latitude storm tracks are likely linked to changes in the jet stream and planetary waves in the atmosphere. Such dynamical changes favor certain types of weather situations in some

regions and others elsewhere. "Regional changes are mostly due to natural variability but on top of that we see this pronounced overall weakening in summer storm activity," says co-author Dim Coumou, "This is also something projected by climate models under future emission scenarios. However, the data so far is not sufficient to say whether the storm activity changes are caused by climate change - this has to be investigated further."

Although average summer storm activity decreases, the most intense winter storms are projected to increase in frequency under continued global warming. This could have severe implications for heavy rainfall events. Also, the most intense hurricanes and typhoons in the tropics are likely to increase under future warming because they're driven by rising ocean surface temperatures. In the Northern mid-latitudes, the main driver is the temperature difference between the warm equator and the cold Arctic; a difference that is shrinking because man-made warming is over-proportionate in the Arctic.

"Altogether our study highlights how sensitive regional weather conditions are to any changes in large-scale atmosphere dynamics," says Coumou. "This can have serious impacts for people on the ground."

More information: Lehmann, J., Coumou, D. (2015): The influence of mid-latitude storm tracks on hot, cold, dry and wet extremes. *Scientific Reports*. DOI: 10.1038/srep17491

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