identical states of a chaotic system to exponentially diverge. As such, it typically sets the horizon of predictability.

“This is really very good,” Holger Kantz, a chaos theorist at the Max Planck Institute for the Physics of Complex Systems in Dresden, Germany, said of the eight-Lyapunov-time prediction. “The machine-learning technique is almost as good as knowing the truth, so to say.”

The algorithm knows nothing about the Kuramoto-Sivashinsky equation itself; it only sees data recorded about the evolving solution to the equation. This makes the machine-learning approach powerful; in many cases, the equations describing a chaotic system aren’t known, crippling dynamicists’ efforts to model and predict them. Ott and company’s results suggest you don’t need the equations — only data. “This paper suggests that one day we might be able perhaps to predict weather by machine-learning algorithms and not by sophisticated models of the atmosphere,” Kantz said.

Besides weather forecasting, experts say the machine-learning technique could help with monitoring cardiac arrhythmias for signs of impending heart attacks and monitoring neuronal firing patterns in the brain for signs of neuron spikes. More speculatively, it might also help with predicting rogue waves, which endanger ships, and possibly even earthquakes.

Ott particularly hopes the new tools will prove useful for giving advance warning of solar storms, like the one that erupted across 35,000 miles of the sun’s surface in 1859. That magnetic outburst created aurora borealis visible all around the Earth and blew out some telegraph systems, while generating enough voltage to allow other lines to operate with their power switched off. If such a solar storm lashed the planet unexpectedly today, experts say it would severely damage Earth’s electronic infrastructure. “If you knew the storm was coming, you could just turn off the power and turn it back on later,” Ott said.