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A period-halving bifurcation emerges in Arctic Sea Surface Temperature

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Global climatic patterns on earth are subjected to a periodic forcing from the annual solar cycle. Due to the tilted axis that Earth presents to the Sun, summer is warmer than winter in most areas of the globe within their respective hemispheres. Beside the annual cycle, more minor variations in monthly temperatures do exist and include earlier or later extrema, or change in amplitude, but no factor has seemed to challenge the well-behaved seasonality in globally recorded climate history. This seasonality is deeply embedded with all aspects of life and human activity on Earth: ecosystems, biological reproduction, opportunity for sustenance and behavior, the spread of infectious diseases, economies and lifestyles entirely rest on this pillar of annually cyclical temperatures. Arctic climate is under intense scrutiny due to its crucial role in the geodynamics of Earth, and the recent perception of its instability. A 4D visualization and analysis of the National Oceanographic and Atmospheric Administration (NOAA) Optimum Interpolation Sea Surface Temperature V2 dataset from 1982 to August 2020 shows that two areas in the Arctic have recently started to exhibit a small peak in winter temperature, in addition to the larger peak seen in the summer. The phenomenon has no equivalent in the recent spatiotemporal climate records. Among several explanations for this phenomenon, one is that the entrained dynamics of sea surface temperature has undergone a period-halving bifurcation. Sea Surface Temperatures reflect the behavior of an open system with multiple driving factors that affect their spatiotemporal organization, notably, the amount of sunlight received. The annual forcing from sun exposure is obviously very strong in lands that barely see any light in the winter months and that remain fully illuminated in the summer. Countering this strong disposition, the period halving is suggestive of a nonlinear phase transition in Arctic Climate and calls for continuing scrutiny and efforts toward theoretical modeling.

Keywords: Climate, phase transition, bifurcation, nonlinear theory, complexity