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A New Theory of Scale Selection: What Determines the Avalanche Scale?

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A novel theory to describe the formation of shear flow patterns and avalanches by radially propagating heat flux waves is presented. A model for heat avalanche dynamics is extended to include a finite delay time between the instantaneous heat flux and the mean flux, based on an analogy between heat avalanche dynamics and traffic flow dynamics. The response time introduced here is an analogue of the drivers'response time in traffic dynamics. The microscopic foundation for the time delay is the time for mixing the phase space density. The inclusion of the finite response time changes the model equation for avalanche dynamics from Burgers equation to a nonlinear telegraph equation. Based on the telegraph equation, the formation of heat flux jams is predicted. The growth rate and typical interval of jams are calculated. The connection of the jam interval to the typical step size of the shear flow staircase is discussed. The separation between shear flow layers is calculated and constitutes the effective outer scale of the avalanche distribution.

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