Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02488, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02488
EGU General Assembly 2008

Generalized Reynolds numbers and points of contact between intermittent turbulence and Self Organized Criticality

S. C. Chapman(1), G. Rowlands(1), N. W. Watkins(2)
(1)CFSA, Physics Dept., Univ. of Warwick, UK, (2) Natural Complexity, BAS, UK

Self Organised Criticality (SOC) has received considerable attention in the context of bursty, intermittent plasma transport and energy release in for example solar flares and the earth's magnetotail. This phenomemology can also either be characterized as, or be coexistent with, intermittent turbulence. Here we elucidate a key similarity, and difference, between turbulence, and SOC. In fluid turbulence a single control parameter, the Reynolds number R_E, which is a function of macroscopic system variables is sufficient to quantify the transition from ordered (laminar) to disordered (turbulent) flow. We suggest that a wider class of systems has this property including SOC. These systems can all be driven into a state with defining characteristics: they have many degrees of freedom (d.o.f.); are driven, dissipating and out of equilibrium; are on average in a steady state; and show scaling over a large dynamic range. The Reynolds number expresses the number of d.o.f., or energy carrying modes in the system. For avalanche models exhibiting SOC, d.o.f. refer to avalanche sizes and the Reynolds number R_A that we identify is simply the well known ratio of the driving rate to system dissipation rate. The SOC slowly driven interaction dominated limit is reached by taking R_A to zero; we show this maximizes the number of d.o.f. in the opposite sense to fluid turbulence. This result clarifies the much debated relationship between turbulence and SOC. An important corollary is that, in sufficiently large bandwidth systems, SOC-like behaviour can persist in conditions of finite drive (finite R_A) and we quantify how the observed scaling range varies with R_A if a system is in SOC. This provides an accessible observable that can distinguish SOC and turbulence.