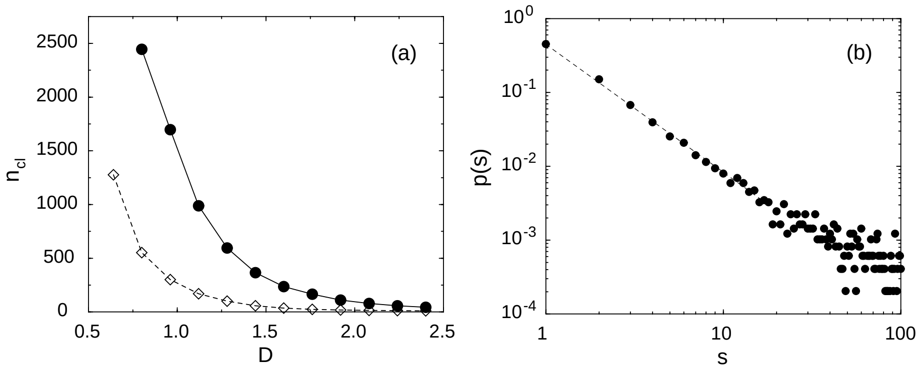

Fig. 4. – Statistics of coherent space-time clusters: (a) average number of clusters n_{cl} *vs.* coupling strength D for $\sigma = 0.28$ (empty diamonds) and $\sigma = 0.40$ (solid circles). (b) Cluster size distribution for $D = 0.10$ and $\sigma = 0.49$, the dashed line corresponds to a power law fitting with $\alpha = 1.73$. The dynamical evolution used to generate these was measured every 0.5 time units.

displayed by model (1). Figure 4a shows the number n_{cl} of coherent space-time clusters, averaged over all non-decaying realizations out of 100, for increasing values of the coupling and two fixed values of the noise strength. The figure shows that there is no sharp transition between the regimes of complex spiral dynamics (large number of clusters, fig. 1a) and spiral meandering (small number of clusters, fig. 1b), although n_{cl} decreases two orders of magnitude in a small range of D values. The number of clusters increases in any case with increasing noise level, as could be expected. This, however, does not imply an increase in the irregularity of the structures.

The distribution of coherent space-time cluster sizes has been used in the past to characterize the spatiotemporal behaviour of excitable media. It has been observed that such a distribution scales with a power law, in the form $p(s) \propto s^{-\alpha}$, where $p(s)$ is the distribution function and s the space-time size of the clusters. The exponent α has been identified to be approximately between 2 and 3 for noise-induced structures [2, 23]. Here we perform such an analysis for noise-induced complex dynamics (fig. 1a). The result is shown in fig. 4b, for parameters D and σ that ensure a large number of clusters (around 5000 in all cases examined) and thus good statistics. The measured distribution shown in fig. 4b obeys a power law (spanning 1.5 decades in s) with an exponent $\alpha \approx 1.75 \pm 0.05$, which is observed to depend neither on the coupling strength nor on the noise intensity, as long as these parameters ensure a turbulent-like state.

In conclusion, external spatiotemporal noise has been observed to induce spiral breakup and complex spiral dynamics in a simple spatially extended model of excitable media with local FitzHugh-Nagumo–like dynamics. This structured dynamical state resembles closely the spatiotemporal chaotic behavior observed in deterministic models with modified FitzHugh-Nagumo dynamics. This effect can be ultimately related to the parametric character of the noise, which makes the stochastic influence to depend on the local state of the system: noise only acts in those sites that are excited (*i.e.*, where the activator variable is non-zero). A non-parametric (additive) noise would arouse fluctuations both in the excited and in the non-excited regions, and hence it would not simply break the spiral up, but sweep it away and generate completely irregular, noisy dynamics. On the contrary, the noise-induced regimes reported here exhibit a certain degree of regularity, which can be quantitatively characterised by the number of space-time clusters. A large number of clusters corresponds to complex