Modelling the Spread of Parasitoid Wasps from Point Release

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Parasitoid wasps are critical for biological pest control and are increasingly being used in agriculture to protect crops via release. However, due to their small size (often less than 1 mm), movement and long-distance dispersal of these wasps have long been poorly understood and likely underestimated. Recent data collected by Kristensen *et al.* [1] on the wind-borne dispersal pattern of *E. hayati* (0.7 mm long) provides a new and significant opportunity to develop a detailed, multi-scale model for the initial spread of small invasive insects and the dispersal of wind- or water-borne organisms in general.

In this talk I will present a new model for parasitoid wasp dispersal from point release. The model is derived from underlying stochastic processes and, as a special case of the Fokker-Planck equation, is fully deterministic. The Python implementation of this model is general enough to be extended to other systems (e.g. plankton dispersal), and is capable of running month long simulations on the scale of 150 km^2 while maintaining a resolution of 25x25 m - all within a minute on a common workstation. Speed is an essential component of our model because it permits fitting parameters to data using a Bayesian framework. Evaluation of the model in comparison with multi-scale, first-release data suggests the critical role of non-linear air flow for dispersal further than 1 km [2].

References

[1] N. P. Kristensen, P. J. De Barro, and N. A. Schellhorn (2013). *The initial dispersal and spread of an intentional invader at three spatial scales*, PLOS ONE, Public Library of Science, 8(5): e62407.

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