

Signalling mechanisms that improve robustness in fruit fly embryo patterning

Abstract: Morphogens are secreted molecules that influence the development of cells in embryonic tissue. Patterns of gene expression or signalling immediately downstream of many morphogens such as the bone morphogenetic protein (BMP) and decapentaplegic (Dpp) are highly reproducible and robust to perturbations. This is perhaps surprising in view of experimentally determined low concentration (approximately picomolar) range of Dpp, tight receptor binding and very slow kinetic rates, all of which should favor large fluctuations in signalling.

To shed light on this issue, we developed a stochastic model of Dpp signalling in *Drosophila melanogaster* and used the model to quantify the extent to which stochastic fluctuations would lead to errors in spatial patterning. This was done both with and without a surface-associated BMP-binding protein (SBP), which is an auxiliary protein that plays no direct role in signalling. By analyzing this model over a wide range of parameter values, we find that such SBPs are likely to play an important role in the reliability of morphogen patterning.