INTRODUCTION

During metazoan embryonic development morphogen gradients are one method used to provide naive tissues with positional information. Morphogen gradients determine pattern production by inducing target genes and the corresponding downstream developmental programs at specific concentrations.

Drosophila embryogenesis has been used as model system to understand the establishment and effects of morphogen gradients. During Drosophila embryogenesis the formation of morphogen gradients define both the anterior-posterior and dorso-ventral axis, providing the basis of hierarchical gene expression networks which are vital for the segmentation of the embryo and specification of cell fates.

Maternal mRNAs are deposited into the Drosophila oocyte before fertilisation and localised as seen in Fig1. Following translation and diffusion of the protein products high anterior to low posterior gradients of bicoid and hunchback are formed, with opposing gradients of nanos and caudal (Fig 1). These morphogens define broad domains of zygotic gene expression which set up segmentation in the embryo.

Despite the extensive research on the establishment of the Bicoid and Nanos gradients and their downstream effects on Hunchback and Caudal translation, the system has not been modelled stochastically.

We aim to

ESTABLISHMENT OF THE BIOCID GRADIENT

The gradient of Bicoid in the early Drosophila Embryo is generally believed to be established by the diffusion of the bicoid protein following translation of maternal mRNA which is deposited at the anterior pole of the embryo. There is however much controversy about the exact mechanisms involved.

We have used the existing models proposed in Grimm et al., 2011 and more recent experimental data to build multiple models of the formation of the Bicoid gradient up to cycle 14 of Drosophila embryogenesis.

Properties of Bicoid - diffusion coefficient and degradation rate

Increasing translation rate

Bicoid mRNA diffusion

Optimum model

NANOS

CAUDAL and HUNCHBACK

Hunchback zygotic transcription