Modelling temperature spread

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Introduction

- The spread of wildfire is notoriously hard to predict because there are so many influencing factors.
- Last month a fire broke out near Fort McMurray in Canada, causing billions of dollars worth of damage.
- Multiple factors contributed to the rapid fire growth, including the unusually dry winter and high temperatures.

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Figure: *Fire at Fort McMurray*

Method

Our model

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$$

- We took as a starting point the heat equation in one spatial dimension.
- Then we added on a term (the Fisher equation) that describes the growth and spread of heat.
- However, this gave rise to the problem that our equation was now non-linear.

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- We then decided to implement a discretized model using a semi-explicit method.
- The linear part of our function was implicitly discretized and the non-linear part was explicitly discretized.

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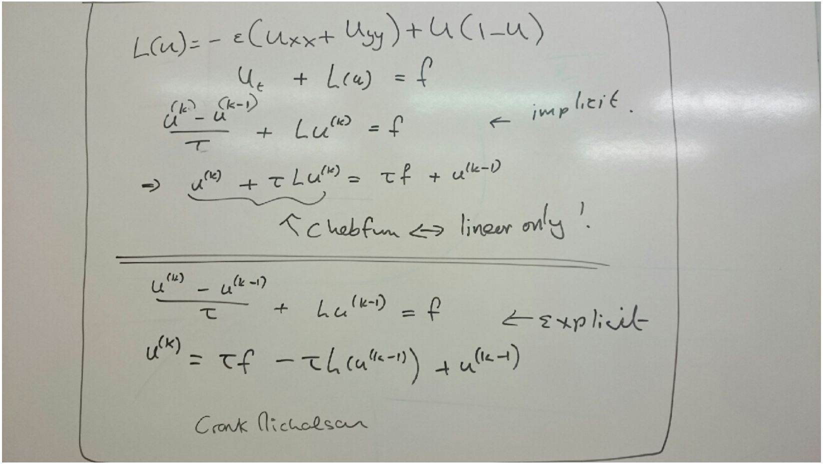

Figure: *Discretized equation*

2D Model

Our new 2D model

$$\frac{\partial u}{\partial t} = \varepsilon \nabla^2 u + \vec{w} \cdot \nabla u + u(1-u) \qquad on[0,1]^2 \times [0, T].$$

- We extended the model to a 2-D version.
- We also added in a variable to model the effect of wind speed.
- We were unhappy with Dirichlet boundary conditions as the solution at the edge was unrealistic.
- As a result we imposed Neumann boundary conditions.

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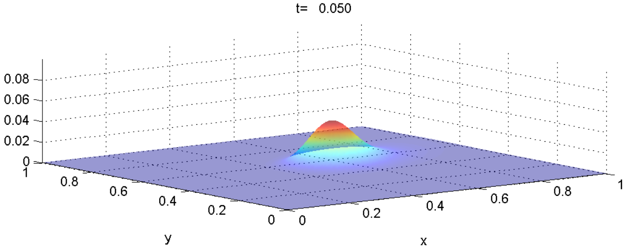
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0.08
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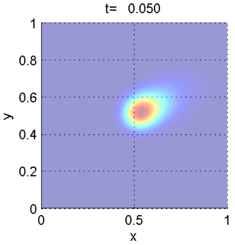
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- We would have liked a more precise representation to show the growth of the fire.
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