Simulation used to Generate Alerts within an Australian Bushfire Early Warning System

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Background

- Existing technology and data sets
  - Fire behaviour models
  - Fuel data
  - Forecast weather
  - Alert systems
  - **Also** UWA Bushfire Simulation System (Mk2)

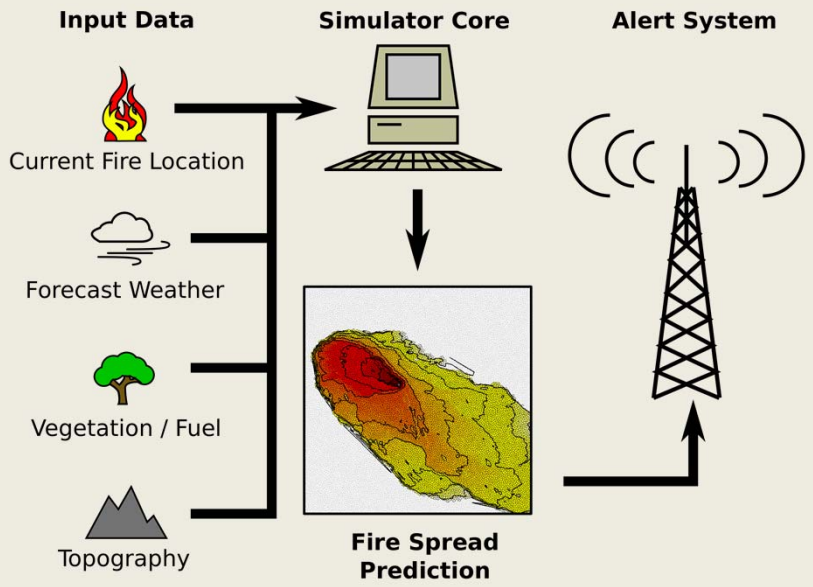
    Mk1 version developed as Bushfire CRC project

this will make **rapid fire spread prediction** and **early warning** possible

Goal

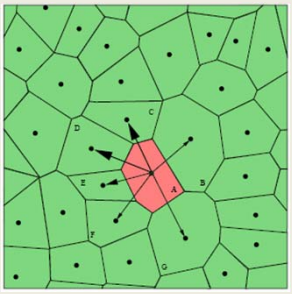
- To simulate bushfires in real time and rapidly communicate spread predictions via email, SMS and web enabled mobile phone
- Requires *fire spread simulation core* to generate fast, automatic, detailed spread prediction maps, also to simulate fires in **extreme** conditions

System Overview



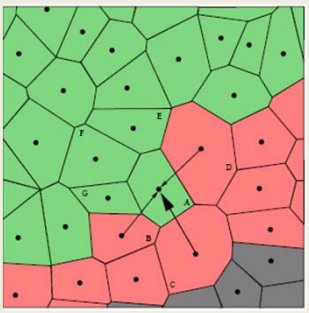
Fire Spread by Propagation Delay

- Each patch has approximately 6 neighbours
- When patch ignited rate of spread calculated from fuel type, moisture, wind speed and direction
- Distance and direction to each neighbour determines *time* of ignition of neighbour from current patch

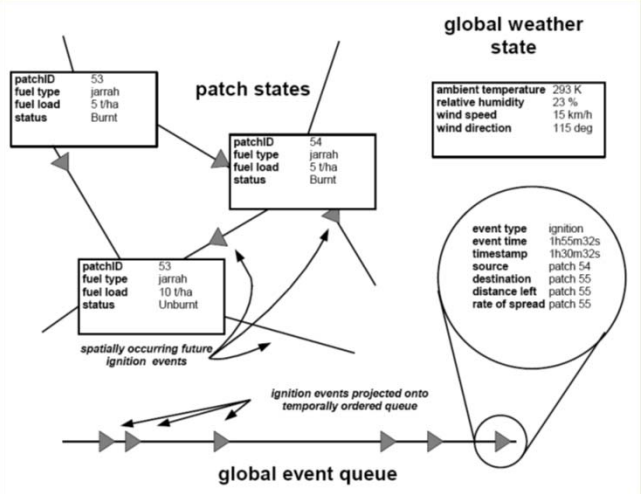


Spread Over Landscape

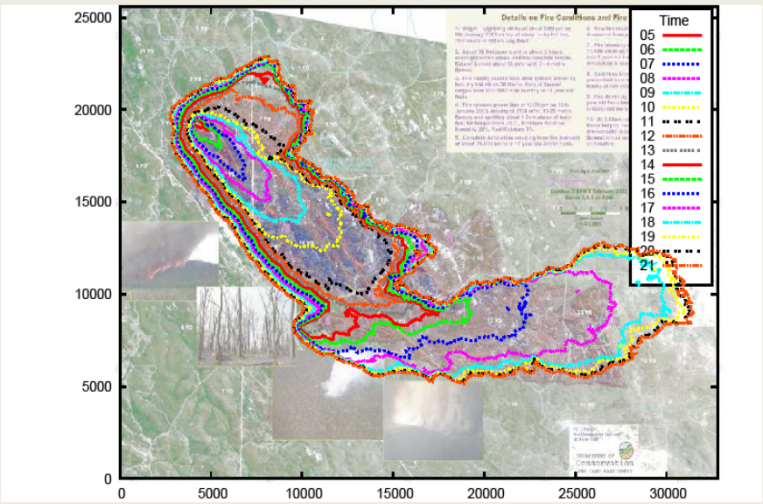
- Each patch in one of three states: unburnt, burning or burnt
- Ignition changes the state of *unburnt* patches to *burning*
- When patch ignited, ignition of each of its unburnt neighbours is *scheduled*
- Burnt cells cannot be re-ignited



Discrete Event Simulation



Output : Spread Prediction Map



Performance

- Fast simulation permits:
  - New predictions as soon as fire-line position or weather forecast updated
  - Fire managers to run “what if” simulations to explore alternate weather conditions and different interventions
- Current simulations 10km x 10km at 100m resolution (~7000 cells) in ~30s
- Time scales with area burnt and spatial resolution

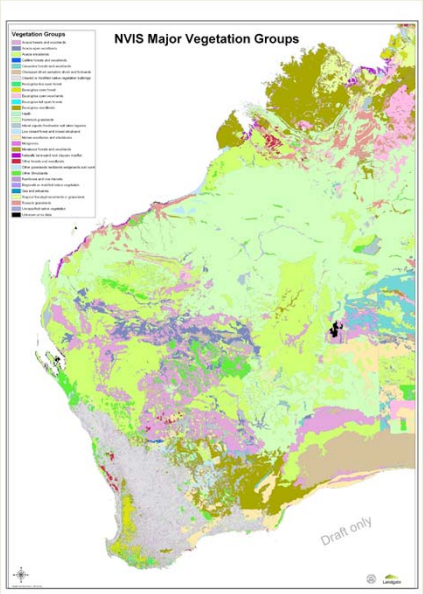
Rapid simulation permits:

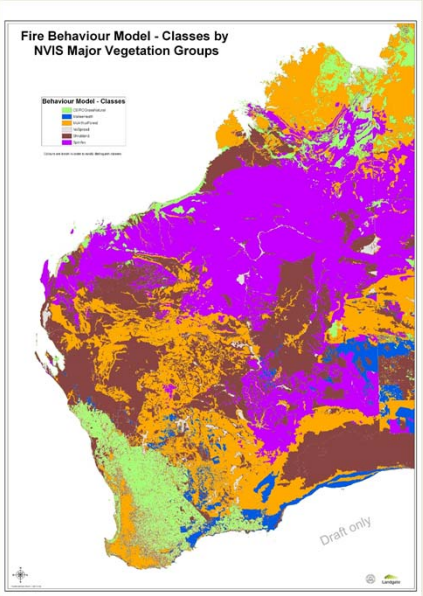
- Risk map generation based on multiple simulations using variant weather drawn from probabilistic weather model
- User-adjustable “what if” weather scenarios
  - Stronger winds
  - Timing of wind direction changes e.g. passage of front
- Additional outputs
  - Fire intensity
  - Spotting danger and expected distances

Challenges

- Forecast weather
- Accuracy of fuel mapping
- Fire spread models in extreme conditions
- Accurate data on current fire location
- Validation of simulation technology

West Australian Vegetation





Fire Behaviour Models

- Existing Fire Behaviour Models used to predict rates of fire spread from cell to cell based on weather and fuel inputs
- Selection of appropriate FBM based on vegetation type
- Choice may be constrained by input data availability
  - E.g. Project Vesta fuel hazard score maps
- Problem : FBMs may under-predict rates of spread in **extreme** conditions
  - Companion ARC project with FESA and Landgate uses remote sensing and historical fire data to address this

Validation

- Validation is necessary to:
  - test simulation algorithm
  - improve Fire Behaviour Models
  - increase confidence in simulator results

  Validate by simulating as many historical fires as possible where good data is available
  - Challenge : sourcing high quality data from previous ***extreme*** fires
- Validate with "live" data during fire season

Bushfire Early Warning Project

- Partners :
  - School of Computer Science and Software Engineering, UWA : fire spread simulator
  - Landgate : database and server development and management, remote sensing, GIS
  - FESA : fire fighting end user, expertise and experience in fire spread prediction and fire management
- Digital Regions Initiative Project, Dept. of Broadband, Communications and the Digital Economy