Victoria Fire Weather Climatology Dataset

Sarah Harris[1], Tim Brown[1,2], Graham Mills[1], Domagoj Podnar[2], Hauss Reinbold[2] and Matt Fearon[2]

[1]School of Earth Atmosphere and Environment, Monash University

[2]Climate, Ecosystem and Fire Applications, Desert Research Institute

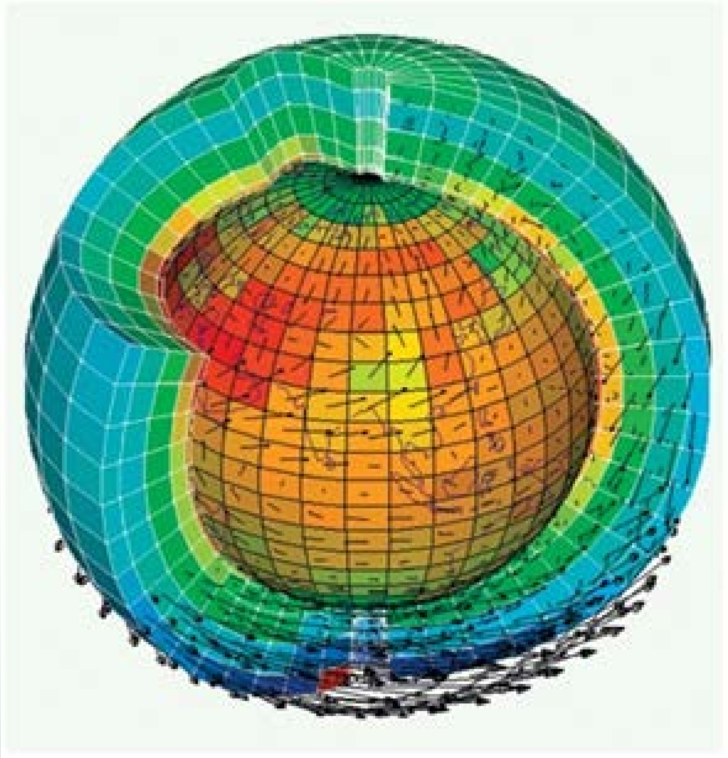
Outline

- Background
- Development of the dataset
- Evaluation and meteorological case studies
- Fire weather climatology and application
- Next steps and conclusion

Rationale and background

- Weather and climate play a major role in the extent and severity of bushfires
- Fire agencies use past weather to :
  - Run fire behaviour models to determine areas of greatest risk and where the most effective fuel hazard reduction burns should take place
  - Construct scenarios that can be used in their longer term strategic management plans
- Spatially and temporally homogenous data have not been previously available
- DELWP commissioned a project to create:
  - A high resolution spatially and temporally complete record of temperature, relative humidity, wind speed, wind direction along with drought and fire indices.
  - Extending back as far as possible
  - Hourly
  - Highest feasible spatial resolution
  - Fire behaviour model – Phoenix compatible
  - Both meteorologically and climatologically realistic

Regional modelling approach and background



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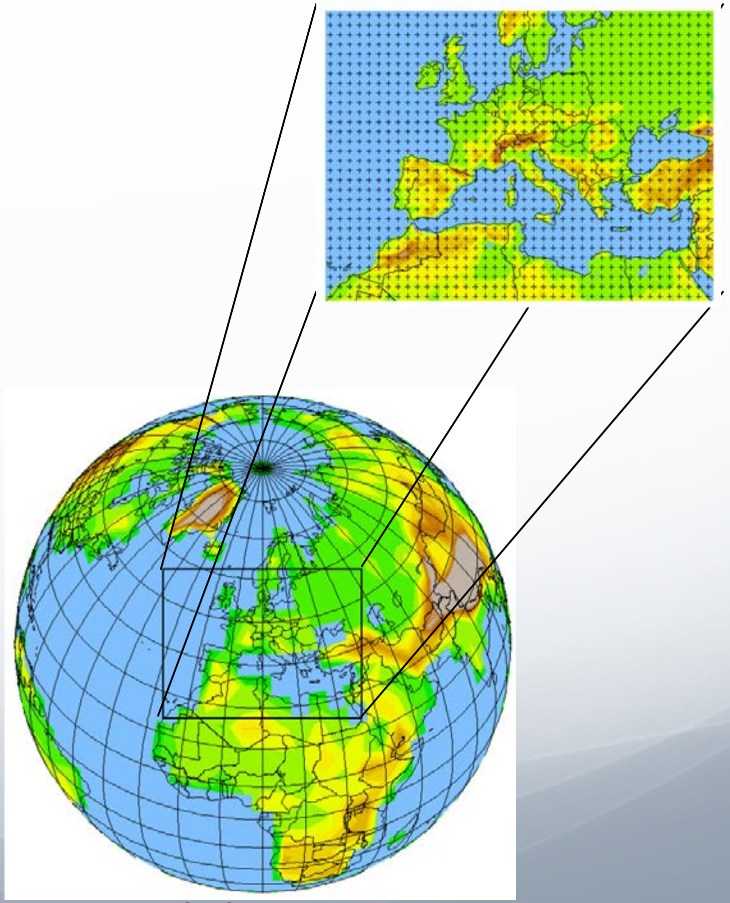
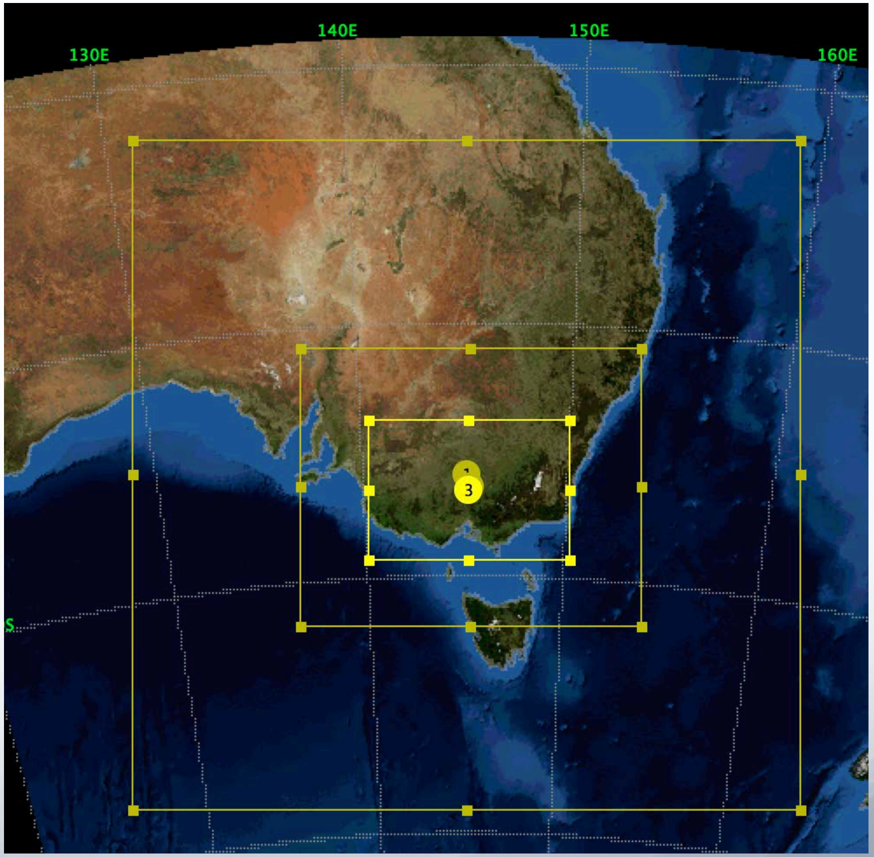


Source: Linda O. Mearns, NCAR

Model configuration

- WRF (V3.5.1)
- 36, 12,
  and 4 km grids
- Initial state and lateral boundary conditions from reanalyses data
- 14 day integration period
- Bias Correction – Quantile Mapping (resolves diurnal, seasonal and spatial variations)



The Dataset

- 4 x 4 km grid
- January 1972- December 2012
- Surface Hourly – Temperature, Relative Humidity, Wind Speed, Wind Direction, Forest Fire Danger Index and precipitation
- Surface Daily – Drought Factor, Keetch Byram Drought Index
- Upper air level data – 32 levels

Evaluation

- Initial emphasis on configuration testing
  - Parameterisation
- Subjective evaluation by meteorological expert
- Statistical fit against observations – trends, biases, spikes
- Case studies and climatology

Case Studies

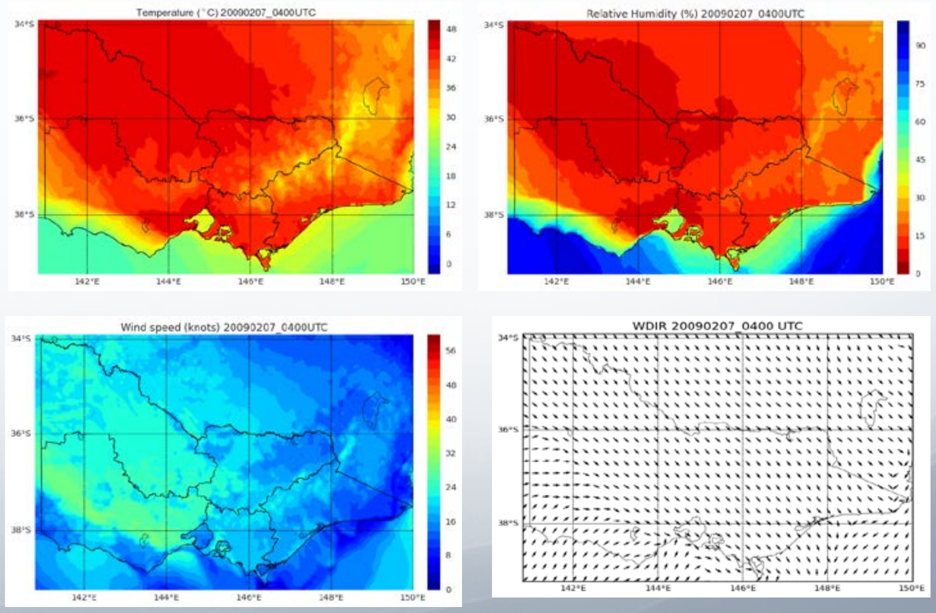
13 fire weather case studies:

Western District Fires 1977, Ash Wed and preceding dust storm 1983, Bemm River 1988, Strathbogie 1990, Berringa 1995, Dandenong Ranges 1997, Linton 1998, King Is Smoke 2001, Canberra 2003, Alpine breakout 2003, Brisbane Ranges 2006, Black Saturday 2009

6 mesoscale meteorology case studies:

- Strong southwesterly wind surges through the northwest (mallee) areas of Victoria
- A persistent strong foehn-like wind maximum over the coast east of Cape Otway
- Excellent simulations of the Winchelsea Convergence (Mills and Morgan (2006)
- Wind fluctuations over western Victoria associated with cellular convection in the planetary boundary layer
- Southerly wind surges through the Kilmore Gap
- Complex circulation features associate with interacting topographically-induced and land-sea temperature contrast induced circulations.

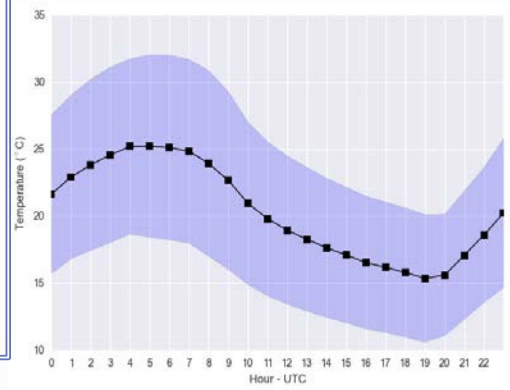
Black Saturday - 7th February 2009

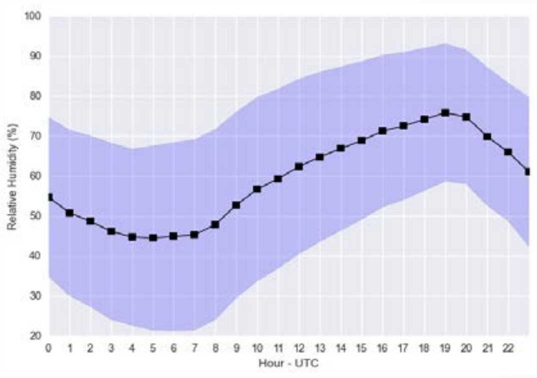


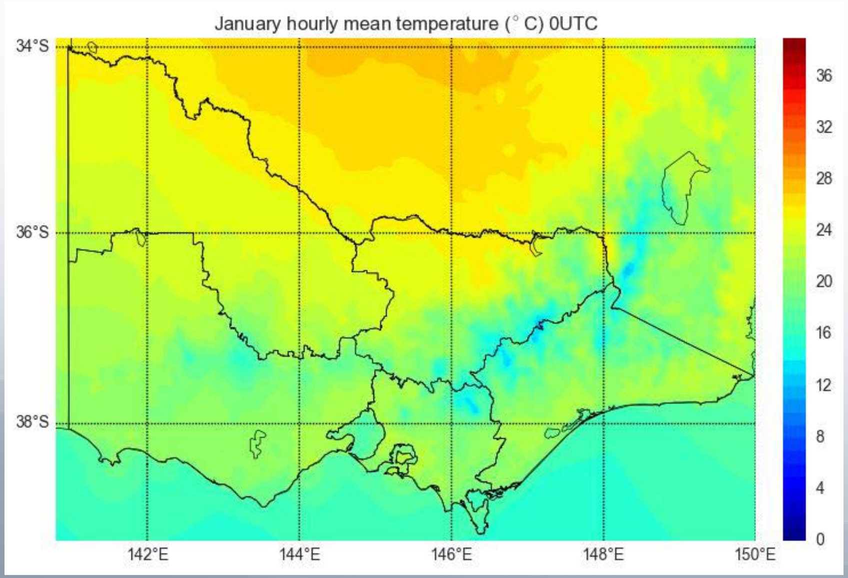
Diurnal cycle

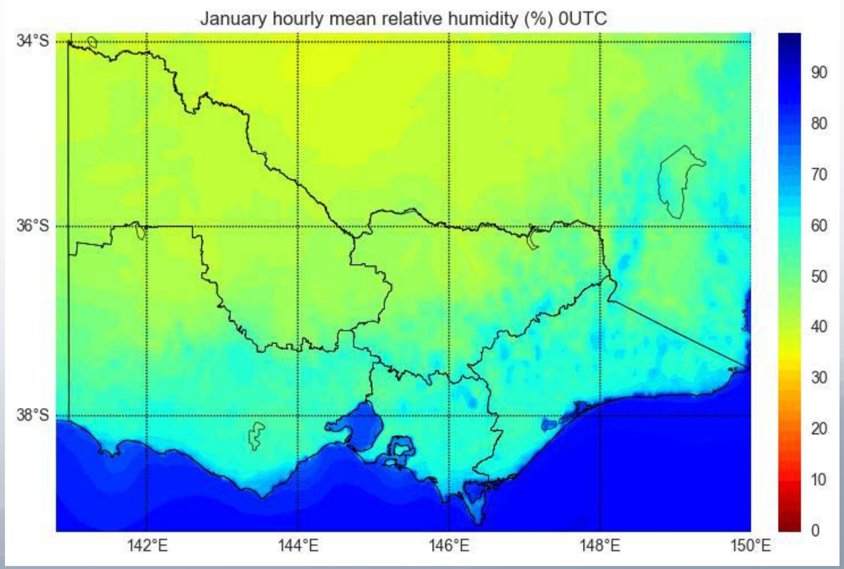
Identify:

- Peaks and duration of peaks
- Shoulder and overnight
- Spatial variability
- Trends



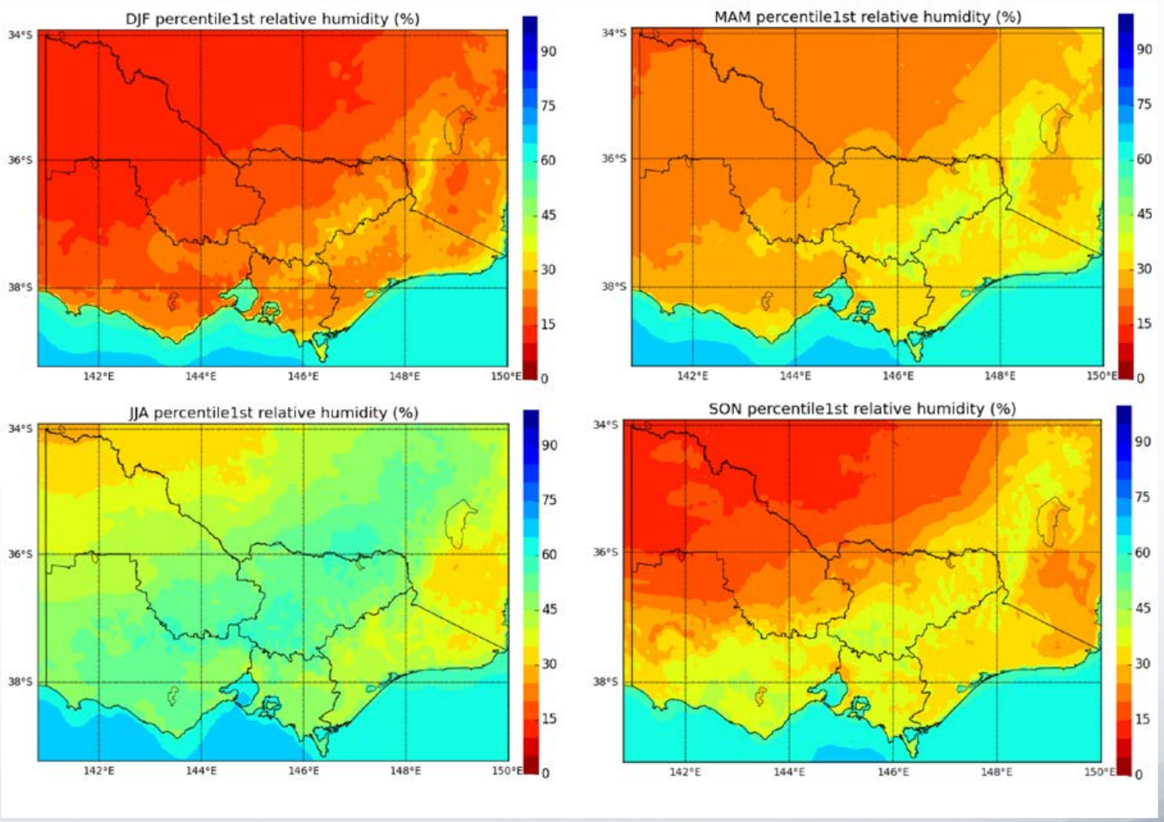






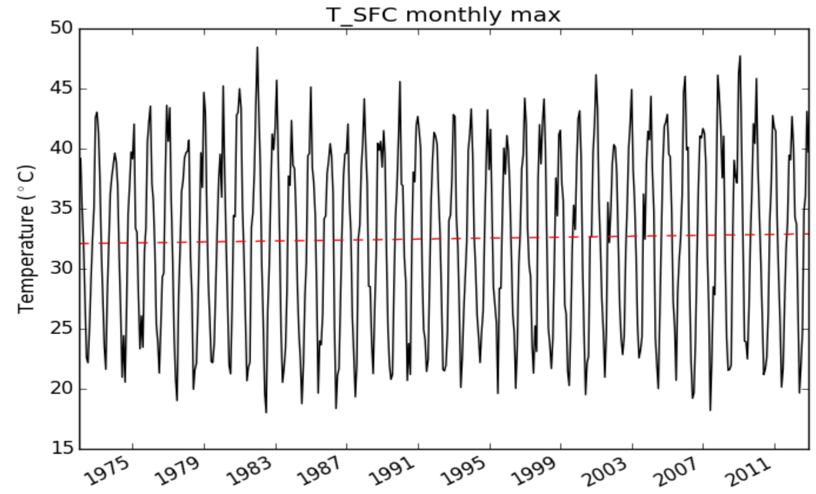
Seasonal variability

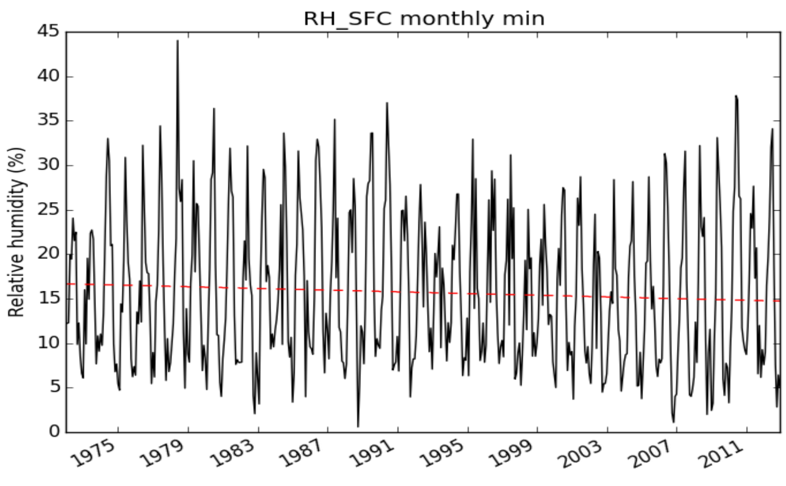
- What are the differences spatially between seasons?
- Identify where and when parts of the state are commonly available for prescribed burning and also extremes or scenarios that highlight dangerous fire weather could occur.
- Trends - how have the seasons changed over time?
- Small scale features that cannot be found from an observing network



Interannual variability

- Analyse variability for Victoria, at a given latitude and longitude or focus on differences between fire regions
- Identify trends and anomalies for each variable

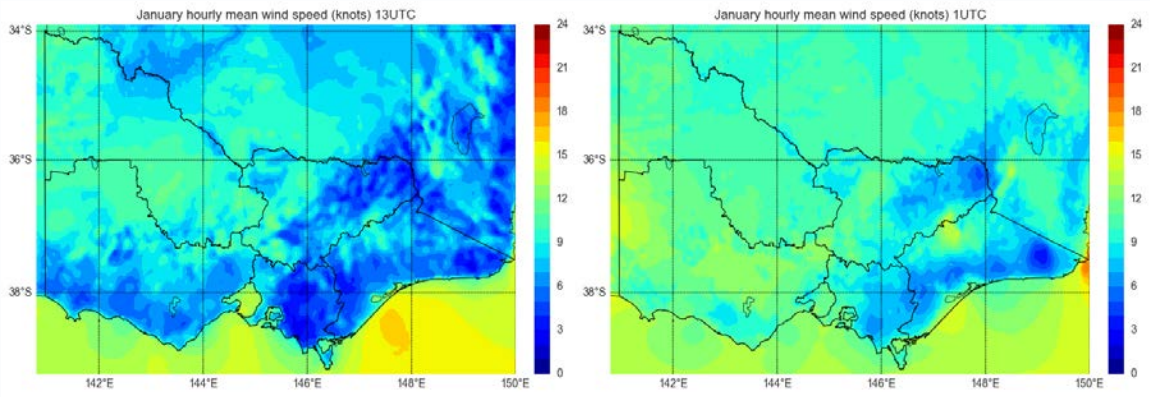




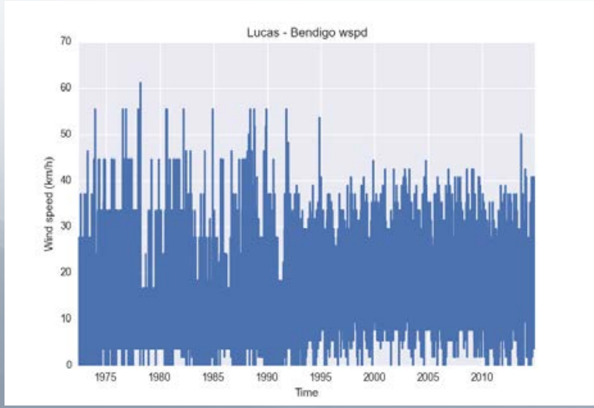
Wind speed

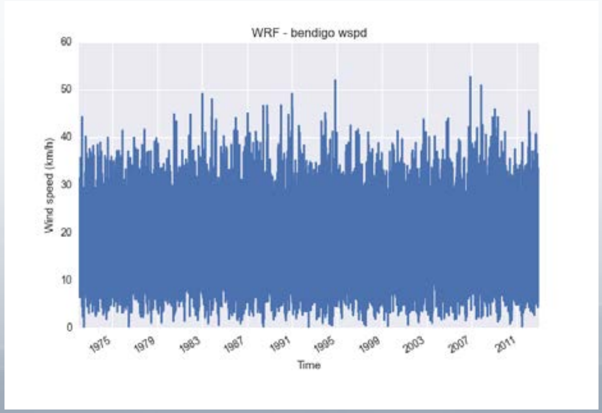
Identify local climatological features - wind surges, down bursts, wind fluctuations.

Diurnal differences



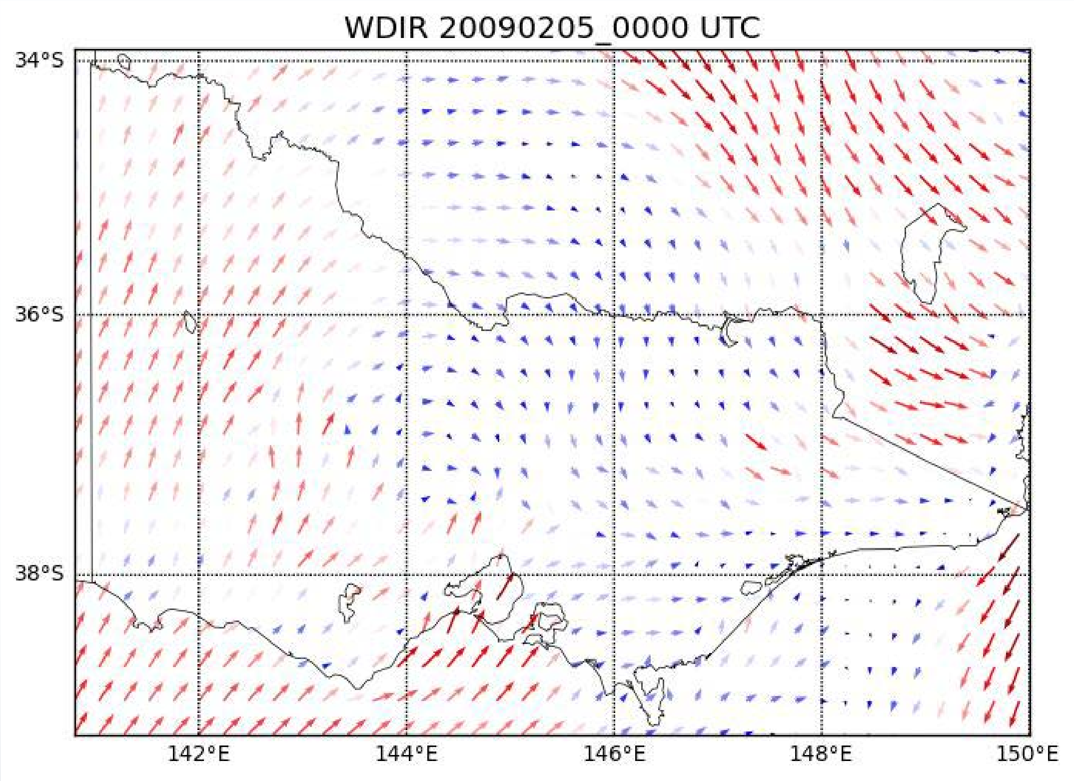
Consistency issues resolved



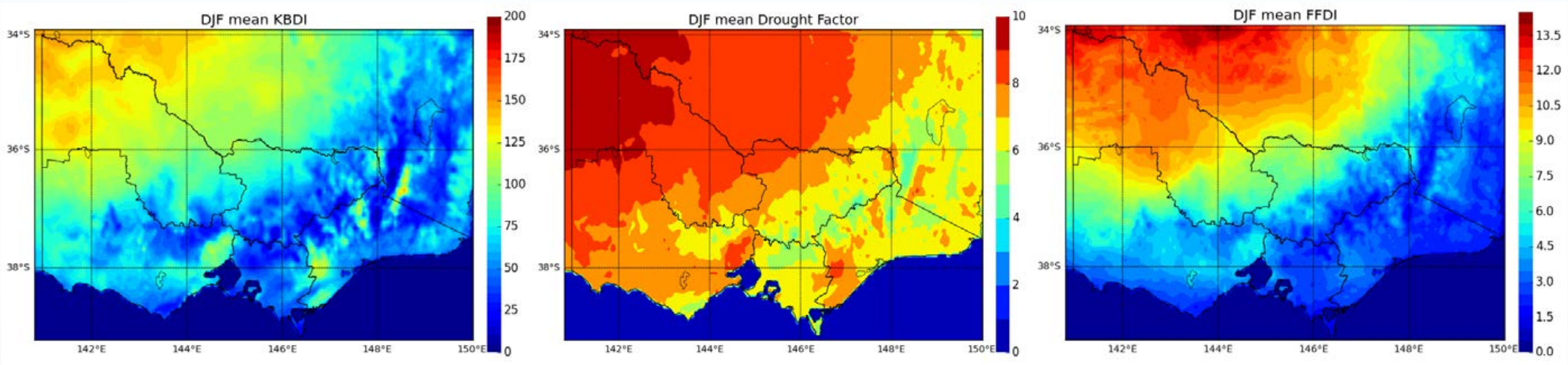


Wind direction

- Document most common wind directions and strengths before and after wind change
- Create a climatology of wind change strength and distribution

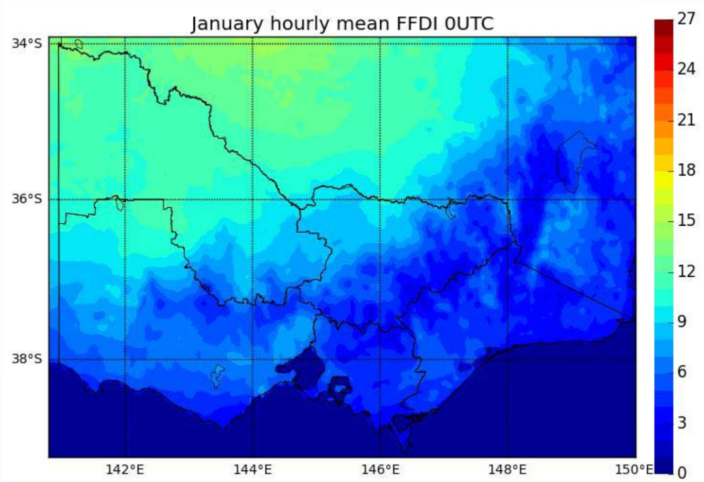


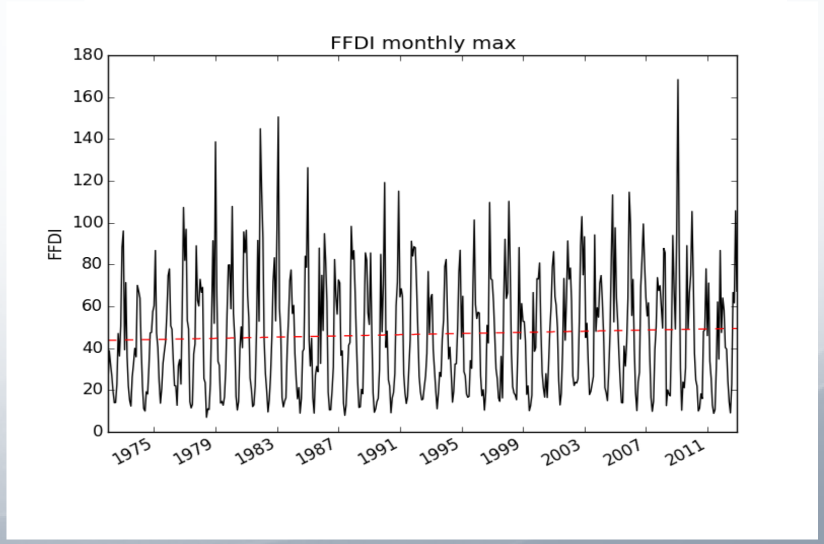
Fire and drought indices



FFDI

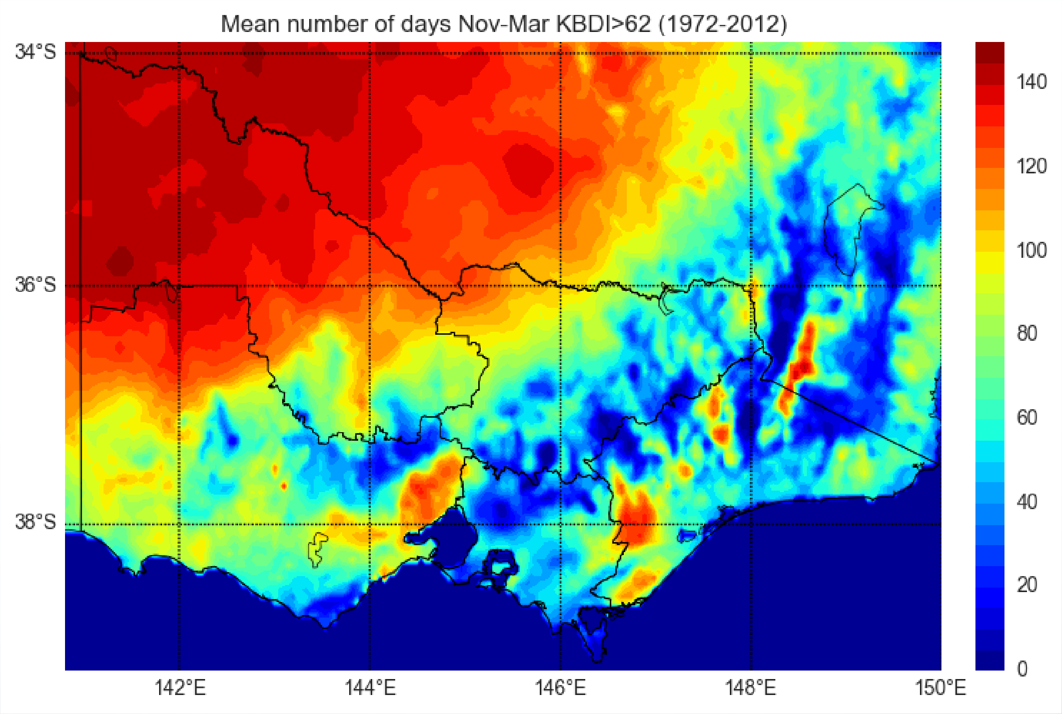
- Diurnal cycles
- Seasonal and inter annual variability
- Peaks
- Duration
- Trends
- Anomalies
- Comparisons to fire activity (separated by prescribed fire and bushfires)





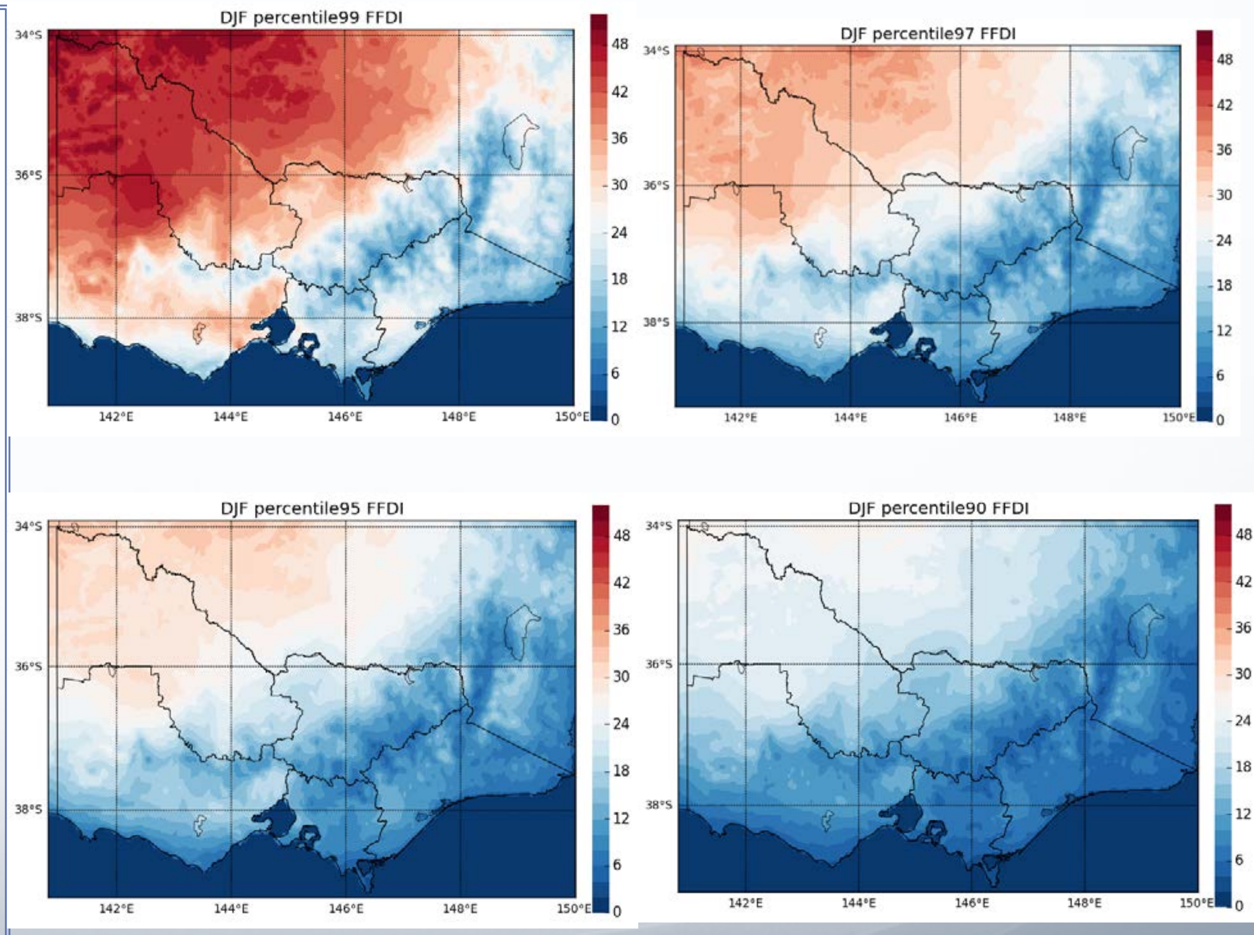
Thresholds

- Single variable thresholds
- Thresholds for multiple variables
- Occurrences daily and hourly

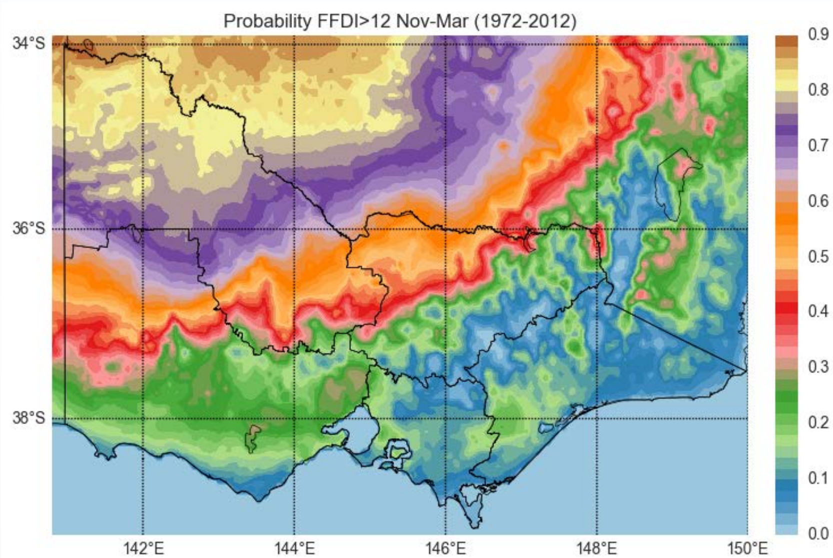


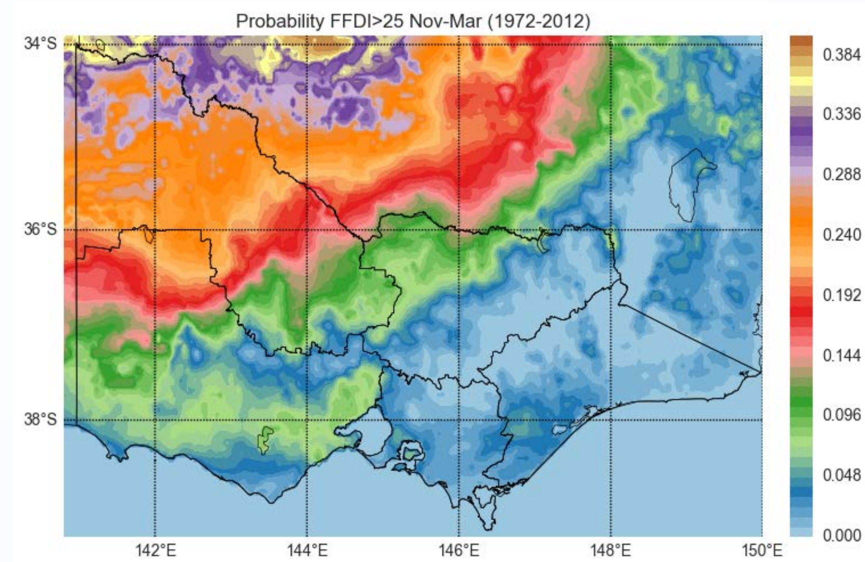
Developing scenarios

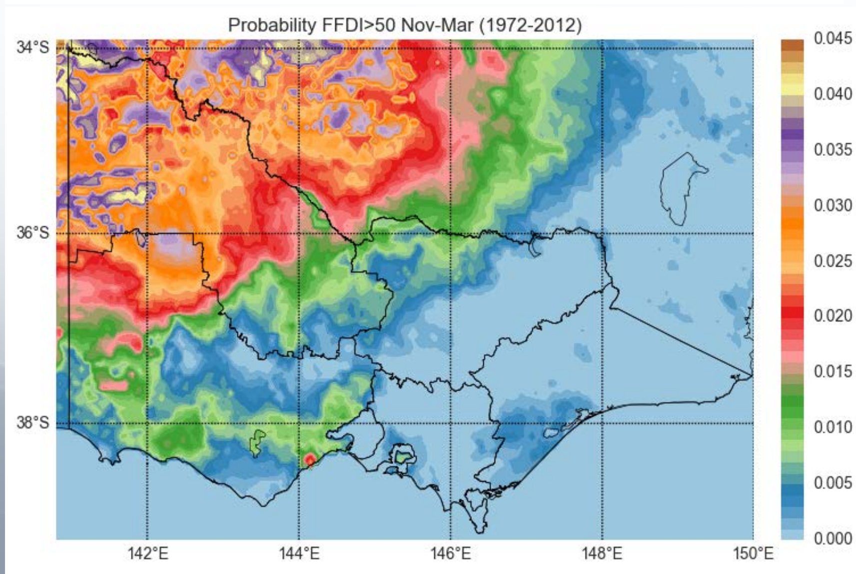
- Determine a range of scenarios based on past weather to identify areas of greatest risk and where fuel hazard reduction burning will be most effective.
- Develop scenarios during active ‘campaign’ fire to determine likely weather conditions for remaining fire season

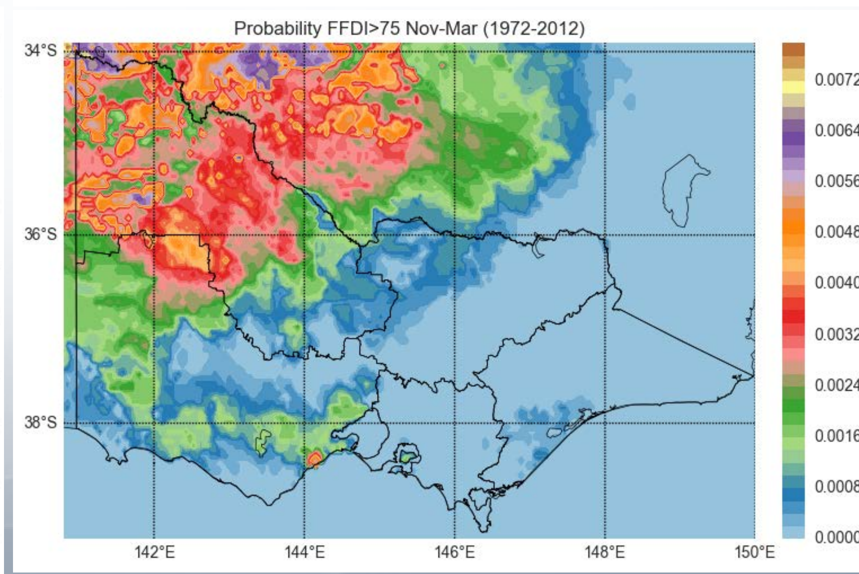


Return interval and probability analysis



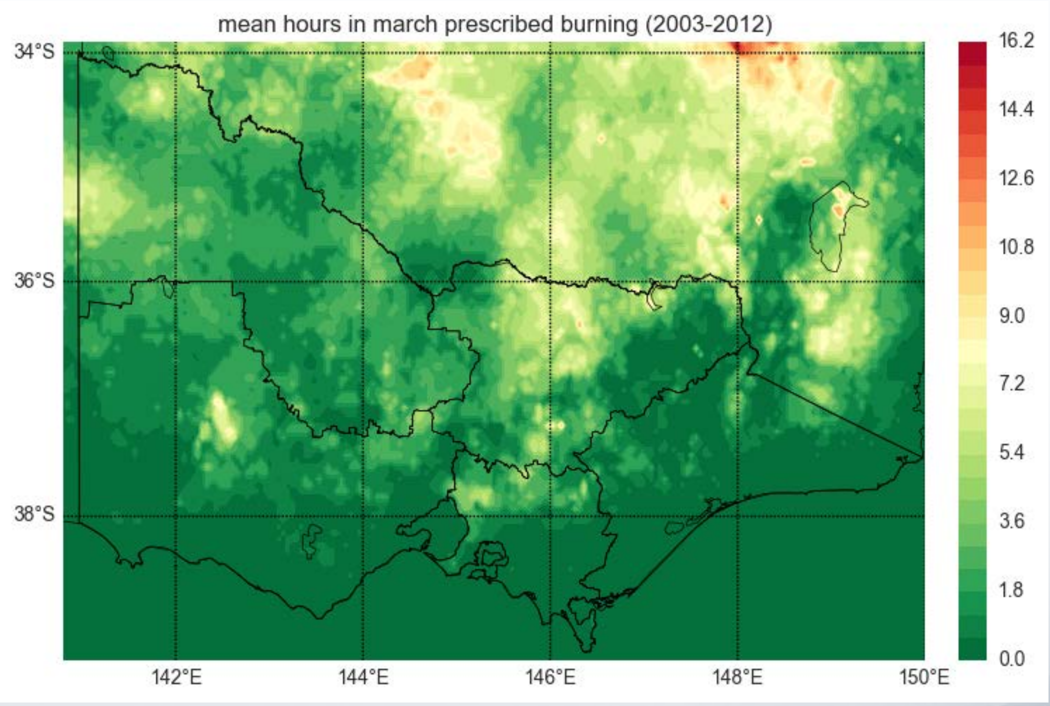






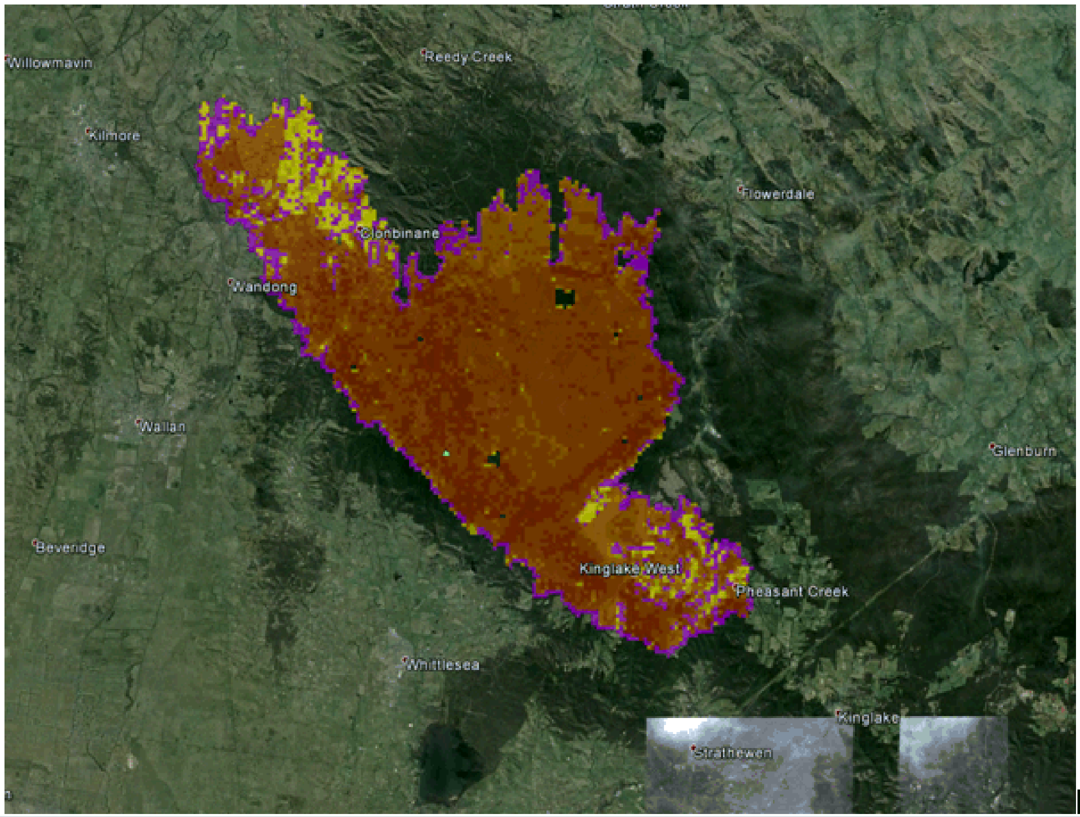
Prescribed Burning Conditions

- Vary thresholds based on prescribed burning prescriptions for different vegetation types and determine the number of hours available per month
- Identify optimal burn windows spatially and temporally
- Examine changes over time
- Assess whether burn targets are feasible (based on past weather conditions)



Temp<30ºC, RH 35<70%, WSPD<10.8 km/h, FFDI<8

Fire behaviour models - Phoenix



Courtesy of Andy Ackland (DELWP)

Next Steps

- Further evaluation of the dataset
- Characterising fire weather of Victoria
- Relationships between fire activity and fire weather
- Optimal prescribed burning windows
- Use dataset as baseline for climate change studies

Conclusion

- A 41-year spatially and temporally homogenous 4 km gridded data set has been created for Victoria
- *This dataset will provi*de *information to drive bushfire risk analysis to inform strategic planning around where to focus fuel management as well as bushfire response and suppression strategies* (end user statement)
- The opportunities for further research and applications in fire management are immense (upper air level data)
- Not just for fire related research
- This dataset could be created for other states

sarah.harris@monash.edu