Ngarkat, South Australia, fire and smoke
Key Topics:

- fire [2]
- modelling [3]
- propagation [4]

Fire spread prediction across fuel types [5]
This research tested two established reliable physics-based models—the Fire Dynamics Simulator and FIRESTAR3D—to simulate bushfire scenarios in three broad areas: sub-canopy wind flow, firebrand transport, and propagation of grass and forest fires. The team has made significant inroads into providing usable outputs as well as understanding various aspects of bushfire behaviour. This project was established to create a capability and capacity in Australia to conduct research and understand physical-based wildfire modelling approaches. There are several international groups developing these models, and it is imperative that Australia can interact and work alongside these researchers to translate the findings to the Australian context.

Project: detail Notabs

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Description

It is crucial for emergency and disaster management organisations to predict of the rate of spread and intensity of bushfires for operational planning, community warnings and the deployment of their resources.

In this project, the research team tested two established reliable physics-based models: Fire Dynamics Simulator (FDS) and FIRESTAR3D to simulate bushfire scenarios in three broad areas:

(1) sub-canopy wind flow,

(2) firebrand transport, and

(3) propagation of grass and forest fires.

The team made significant inroads into providing usable outputs as well understanding various aspects of bushfire behaviour.

This project was also established to create a capability and capacity in Australia to conduct research and understand physical-based wildfire modelling approaches. There are several international groups developing these models, and it is imperative that Australia can interact and work alongside these researchers to translate the findings to the Australian context. Overall, this project has obtained greater insight into bushfire physics and outcomes are now being utilised to parameterise various phenomena for operational models.

Read the final report here. [42]

Related News

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[43]

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[44]

21 MAY 2020

New online - May 2020

COMMUNICATION, EMERGENCY MANAGEMENT

[45]

21 APR 2020

New online - April 2020

COMMUNICATION, EMERGENCY MANAGEMENT

[46]

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New online - February 2020

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[47]

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EMERGENCY MANAGEMENT, FIRE

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[52]

15 NOV 2018

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EARTHQUAKE, MODELLING

[53]

22 OCT 2018

New online – October 2018

[54]

18 SEP 2018

Conference papers available online

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[55]

08 FEB 2017

New online - February 2017

[56]

14 SEP 2016

New online - September 2016

[57]

10 DEC 2014

Newsletter - Fire spread prediction

FIRE, FIRE IMPACTS

[58]

25 AUG 2014

Fire in France

[59]

Publications

Year	Type	Citation
2023	Journal Article	Innocent, J. [60], Sutherland, D. [10], Khan, N. [15] & Moinuddin, K. [6] **Physics-based simulations of grassfire propagation on sloped terrain at field scale: flame dynamics, mode of fire propag**
2023	Journal Article	Sutherland, D. [10], Rashid, M. [14], Hilton, J. [66] & Moinuddin, K. [6] **Implementation of spatially-varying wind adjustment factor for wildfire simulations** [67]. *Environmental Modelling & Software*
2023	Journal Article	Khan, N. [15], Sutherland, D. [10] & Moinuddin, K. [6] **Simulated behaviour of wildland fire spreading through idealised heterogeneous fuels** [72]. *International Journal of Wildland Fire* (2023). doi:
2023	Journal Article	Hassan, A. [77], Accary, G. [78], Sutherland, D. [10] & Moinuddin, K. [6] **Physics-based modelling of junction fires: Parametric study** [79]. *International Journal of Wildland Fire* (2023). at <https://ww
2023	Journal Article	Innocent, J. [60], Sutherland, D. [10], Khan, N. [15] & Moinuddin, K. [6] **Physics-based simulations of grassfire propagation on sloped terrain at field scale: motivations, model reliability, rate of**
2022	Journal Article	Wadhwani, R. [40], Sutherland, D. [10], Ooi, A. [89] & Moinuddin, K. [6] **Firebrand transport from a novel firebrand generator: numerical simulation of laboratory experiments** [90]. *International Jo*
2022	Journal Article	Wadhwani, R. [40] *et al.* **A review of firebrand studies on generation and transport** [95]. *Fire Safety Journal* **134,** (2022). DOI [96] Google Scholar [97] BibTeX [98] EndNote XML [99]
2022	Journal Article	Wickramasinghe, A. [36], Khan, N. [15] & Moinuddin, K. [6] **Determining firebrand generation rate using physics-based modelling from experimental studies through inverse analysis** [100]. *Fire*
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2021	Report	Rashid, M. [14] & Moinuddin, K. [6] **Studying leaf area density based wind adjustment factor in Spark** [117]. (Bushfire and Natural Hazards CRC, 2021). Google Scholar [118] BibTeX [119] EndNote
2021	Report	Khan, N. [15], Wickramasinghe, A. [36], Rashid, M. [14] & Moinuddin, K. [6] **Fire spread across different fuel types: research and utilisation – final project report** [42]. (Bushfire and Natural Hazard
2020	Journal Article	Accary, G. [78] *et al.* **Physics-Based Simulations of Flow and Fire Development Downstream of a Canopy** [124]. *Atmosphere* **11,** (2020). DOI [125] Google Scholar [126] BibTeX [127] EndNote XM
2020	Report	Khan, N. [15], Sutherland, D. [10] & Moinuddin, K. [6] **Recirculation regions downstream of a canopy on a hill** [129]. (Bushfire & Natural Hazards CRC, 2020). Google Scholar [130] BibTeX [131] En
2020	Report	Rashid, M. [14], Sutherland, D. [10] & Moinuddin, K. [6] **Fire spread prediction across fuel types: annual report 2018-19** [133]. (Bushfire and Natural Hazards CRC, 2020). Google Scholar [134] BibT
2020	Report	Khan, N. [15], Sutherland, D. [10] & Moinuddin, K. [6] **Simulation of flows through canopies with varying atmospheric stability** [137]. (Bushfire and Natural Hazards CRC, 2020). Google Scholar [13
2020	Report	Moinuddin, K. [6], Khan, T. [141] & Sutherland, D. [10] **Effect of relative humidity on grassfire propagation** [142]. (Bushfire and Natural Hazards CRC, 2020). Google Scholar [143] BibTeX [144] Endl
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2020	Report	Rashid, M. [14], Hilton, J. [66], Khan, N. [15], Sutherland, D. [10] & Moinuddin, K. [6] **A report on WRF software development (preliminary)** [150]. (Bushfire & Natural Hazards CRC, 2020). Google Sch
2019	Conference Paper	Parker, J. [154] & Allen, A. [155] **Utilisation of fire spread simulators to assess power network fire risk** [156]. *AFAC19 powered by INTERSCHUTZ - Bushfire and Natural Hazards CRC Research F*
2019	Conference Paper	Moinuddin, K. [6] & Sutherland, D. [10] **Simulations of radiation heat flux on a structure from a fire in an idealised shrubland** [161]. *Bushfire and Natural Hazards CRC Research Day AFAC19* (201
2019	Journal Article	Sutherland, D. [10], Sharples, J. J. [110] & Moinuddin, K. [6] **The effect of ignition protocol on grassfire development** [165]. *International Journal of Wildland Fire* **29,** 70-80 (2019). DOI [166] Google
2019	Journal Article	Moinuddin, K. [6] & Sutherland, D. [10] **Modelling of tree fires and fires transitioning from the forest floor to the canopy with a physics-based model** [170]. *Mathematics and Computers in Simula*
2019	Journal Article	Khan, N. [15], Sutherland, D. [10], Wadhwani, R. [40] & Moinuddin, K. [6] **Physics-Based Simulation of Heat Load on Structures for Improving Construction Standards for Bushfire Prone Areas**
2019	Report	Khan, N. [15], Sutherland, D. [10], Philip, J. [13], Ooi, A. [8] & Moinuddin, K. [6] **A preliminary report on simulation of flows through canopies with varying atmospheric stability** [180]. (Bushfire an
2018	Conference Paper	Sutherland, D. [10], Wadhwani, R. [40], Philip, J. [13], Ooi, A. [8] & Moinuddin, K. [6] **Simulations of the effect of canopy density profile on sub-canopy wind speed profiles** [184]. *AFAC18* (Bushfir
2018	Conference Paper	Bates, J. [188] **Research proceedings from the 2018 Bushfire and Natural Hazards CRC and AFAC Conference** [189]. *Bushfire and Natural Hazards CRC & AFAC annual conference 2017* (Bushfir
2018	Conference Paper	George, N. [193], Philip, J. [13] & Ooi, A. [8] **Direct Numerical Simulation of Confined Wall Plumes** [194]. *21st Australasian Fluid Mechanics Conference* (2018). at <https://people.eng.unimelb.edu.au
2018	Journal Article	Moinuddin, K. [6], Sutherland, D. [10] & Mell, W. [111] **Simulation study of grass fire using a physics-based model: striving towards numerical rigour and the effect of grass height on the rate**
2018	Report	Moinuddin, K. [6], Roy, S. Singha [41], Sutherland, D. [10] & Khan, N. [15] **Improvements to wind field generation in physics-based models to reduce spin-up time and to account for terrain, hea**
2018	Report	Sutherland, D. [10], Wadhwani, R. [40], Philip, J. [13], Ooi, A. [8] & Moinuddin, K. [6] **Simulations of the effect of canopy density profile on sub-canopy wind speed profiles** [208]. (Bushfire and Nat
2018	Report	Sutherland, D. [10], Philip, J. [13], Ooi, A. [8] & Moinuddin, K. [6] **Literature review: modelling and simulation of flow over tree canopies** [211]. (Bushfire and Natural Hazards CRC, 2018). Google Sc
2017	Conference Paper	Sutherland, D. [10], Moinuddin, K. [6] & Ooi, A. [8] **Large-eddy simulation of neutral atmospheric surface layer flow over heterogeneous tree canopies** [215]. *AFAC17* (Bushfire and Natural Hazar
2017	Conference Paper	Rumsewicz, M. [219] **Research proceedings from the 2017 Bushfire and Natural Hazards CRC and AFAC Conference** [220]. *Bushfire and Natural Hazards CRC & AFAC annual conference 2017* (B
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2017	Journal Article	Wadhwani, R. [40], Sutherland, D. [10], Moinuddin, K. [6] & Joseph, P. [229] **Kinetics of pyrolysis of litter materials from pine and eucalyptus forests** [230]. *Journal of Thermal Analysis and Calorim*
2017	Report	Moinuddin, K. [6] & Sutherland, D. [10] **Numerical modelling of fires on forest floor and canopy fires** [235]. (Bushfire and Natural Hazards CRC, 2017). Google Scholar [236] BibTeX [237] EndNote
2016	Journal Article	MacDonald, M. [239], Chan, L. [240], Chung, D. [241], Hutchins, N. [242] & Ooi, A. [8] **Turbulent flow over transitionally rough surfaces with varying roughness densities** [243]. *Journal of Fluid Dy*
2016	Report	Moinuddin, K. [6], Sutherland, D. [10] & Thorpe, G. [12] **Fire spread prediction across fuel types: Annual project report 2015-2016** [248]. (Bushfire and Natural Hazards CRC, 2016). Google Scholar
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2015	Report	Thorpe, G. [12] **Fire spread prediction across fuel types: Annual project report 2014-2015** [256]. (Bushfire and Natural Hazards CRC, 2015). Google Scholar [257] BibTeX [258] EndNote XML [259]
2015	Report	Thorpe, G. [12] **Fire Spread Across Fuel Types Annual Report 2014** [260]. (2015). Google Scholar [261] BibTeX [262] EndNote XML [263]

Presentations & Resources

DATE [264]	TITLE [265]	DOWNLOAD	KEY TOPICS
21 Mar 2014	Fire spread prediction across fuel types [266]	1.49 MB	[267] (2), [3], prescribed burning [268]
08 Sep 2014	Next generation models for predicting the behaviour of bushfires [269]	1.12 MB	[270] (2), [3]
27 Oct 2014	Next generation models for predicting the behaviour of bushfires [271]		fire [2], modelling [3]
04 Dec 2014	Challenges in physics based bushfire modelling [272]	885.16 KB	[273] (2), fire severity [274], modelling [3]
22 Mar 2016	Severe and High Impact Weather - cluster overview [275]	0 bytes	[276] (2), [3], scenario analysis [277]
24 Oct 2016	Fire spread across fuel types [278]	3.44 MB	[279] (2), [280], fuel reduction [281], modelling [3]
25 Oct 2016	Next generation fire modelling [282]	1.35 MB	[283] (2), [280], fire severity [274], fire weather [284]
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07 Sep 2017	Mapping the efficacy of an Australian fuel reduction burn using Fuels3D point clouds [291]	1.6 MB	[292] (2), [281], modelling [3], prescribed burning
31 Oct 2017	Fire spread across fuel types [293]	1.1 MB	[294] (2), [295], modelling [3]
18 Sep 2018	Simulations of the effect of canopy density profile on sub-canopy wind speed profiles [296]	1.08 MB	[297] (2), [281]
23 Nov 2018	Fire spread prediction across fuel types by physics-based modelling [298]	2.02 MB	[299] (2), [280], fuel reduction [281]
27 Aug 2019	Simulation Of Heat Fluxes On A Structure From A Fire In An Idealised Shrubland [300]	495.46 KB	[301] (2), [302], fire [2]
17 Oct 2019	Fire Spread Across Fuel Types [303]	3.21 MB	[304] (2), [284], fuel reduction [281]

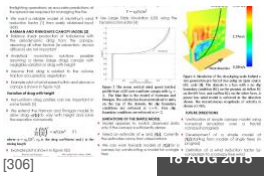
Posters

[305]

Next generation models for predicting the behaviour of bushfires: Challenges and prospects

[305]

Bushfires occur on a scale that may be measured in kilometers. However, a challenge faced in developing next...



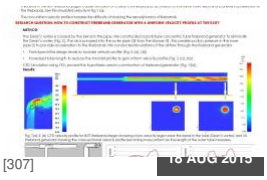
[306]

Flow Prediction Through Canopies

[306]

FIRE WEATHER [284], MODELLING [3]

A simple model of flow through a tree canopy and comparison with large-eddy simulations.



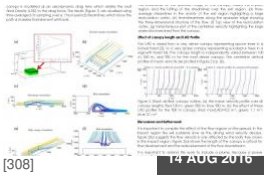
[307]

Refinement and Validation of Firebrand Transport Sub Model for a Physics Based Bushfire Prediction Model: Design of a Firebrand Generator

[307]

FIRE [2], MODELLING [3]

Firebrands are burning pieces of, for example, bark, leaf litter, and twigs. Firebrands can be transported by...



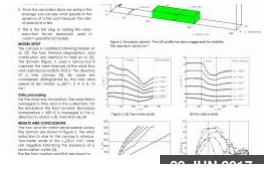
[308]

Simulations of sub-canopy winds

[308]

FIRE SEVERITY [274], REMOTE SENSING [309]

Operational fire models rely on wind reduction factors to relate the standard meteorological measured or...



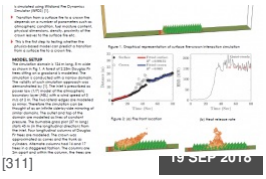
[310] 29 JUN 2017

Simulated rate-of-spread of a grassfire propagating under a tree canopy

[310]

FIRE [2], MODELLING [3]

Simulations of a fire entering, propagating under and leaving a tree canopy are conducted using FDS [1], a...



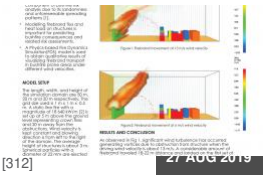
[311] 19 SEP 2018

Physics-based modelling of fires transitioning from the forest floor to the canopy

[311]

FIRE [2], MODELLING [3]

Can a physics-based model predict a transition from a surface fire to a crown fire?



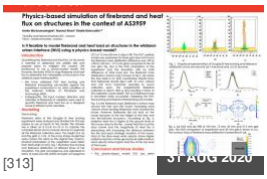
[312] 27 AUG 2019

Potential of modelling firebrand load on structure in Wildland Urban Interface

[312]

FIRE DECISION MAKING [302], IMPACTS [280]

Is it feasible to model firebrand load on structure using a physics-based model in WUI?



[313] 31 AUG 2020

Physics-based simulation of firebrand and heat flux on structures in the context of AS3959

[313]

FIRE [2]

Key findings: Validation of firebrand model in fire dynamic simulator with tree burning experimental data,...

[314] 31 AUG 2020

Dynamic wind reduction factor in predicting fire rate of spread

[314]

FUEL REDUCTION [281]

Key findings: Dynamic wind reduction factors have considerable effects on forest fires where variable canopy...

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Effectiveness of resources to supress bushfire: aerial and ground based [315]

EMERGENCY MANAGEMENT CAPABILITY [316]

Dr Matt Plucinski
CSIRO [317]

[317]

Through the flames - quantitative analysis of strategic and tactical wildfire suppression [318]

BUSHFIRE PREDICTIVE SERVICES [319]

Dr Greg Penney
Edith Cowan University [320]

[320]

Mapping bushfire hazard and impacts [321]

BUSHFIRE PREDICTIVE SERVICES [319]

A/Prof Marta Yebra
Australian National University [322]

[322]

Fire surveillance and hazard mapping [323]

BUSHFIRE PREDICTIVE SERVICES [319]

Prof Simon Jones
RMIT University [324]

[324]

Improved predictions of severe weather to reduce community impact [325]

SEVERE AND HIGH IMPACT WEATHER [326]

Dr Jeff Kepert
Bureau of Meteorology [327]

[327]

Optimisation of fuel reduction burning regimes [328]

PRESCRIBED BURNING AND CATCHMENT MANAGEMENT [329]

A/Prof Tina Bell
University of Sydney [330]

[330]

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