

Wild City - Climate Change in southwest Western Australia and implications for urban forest management

Dr. Jatin Kala

Lecturer in Atmospheric Science, Murdoch University

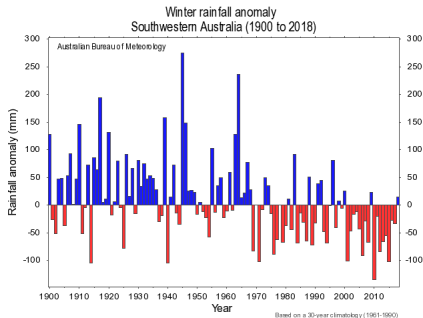
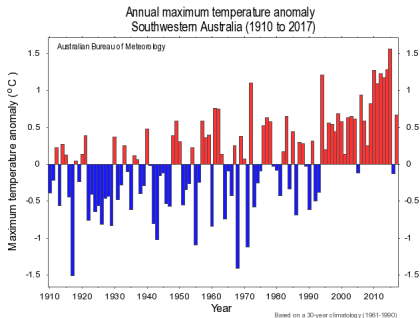
(J.Kala@murdoch.edu.au)

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Talk Outline

- ▶ Research on regional climate modelling for southwest WA
- ▶ Research focussing on the Urban Heat Island (UHI) effect
- ▶ Some ideas for potential research collaborations

The southwest is getting warmer and dryer



<http://www.bom.gov.au/climate/change>

My Research

- ▶ I use regional atmospheric modeling systems to answer questions such as:
 - ▶ How will the climate of southwest WA change in the future?
 - ▶ What are the implications for viticulture and cereal crops?
 - ▶ How will fire weather change in the future?
 - ▶ The Urban heat island effect
 - ▶ What is the Urban Heat Island of Perth?
 - ▶ Can models simulate the UHI of Melbourne?, if so, what would happen if we painted all roofs white?

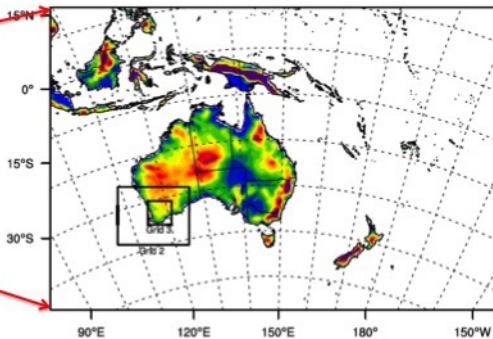
How? - Regional Climate Models

**Global Climate Model (GCM) or
re-analysis**



150 to 250 km

Regional Climate Model (RCM)



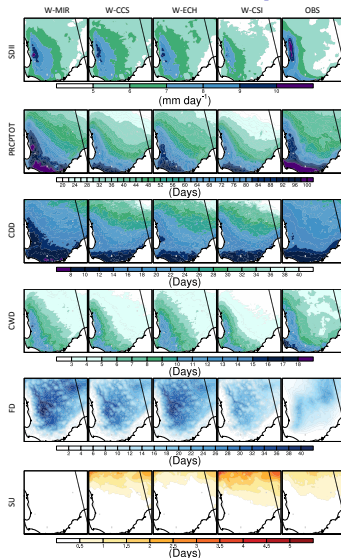
50 to 5 km

How? - Regional Climate Models

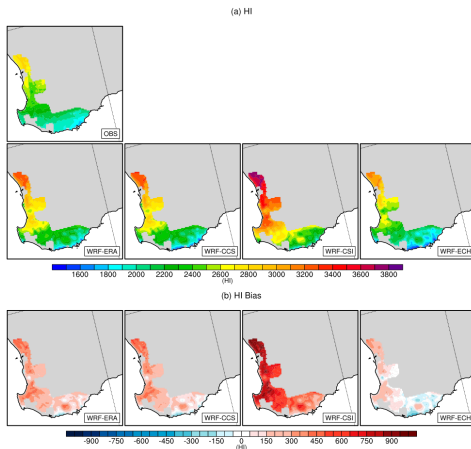


- Use of high-performance computing, 100's of TB of data

Climate indices relevant to cereal crops

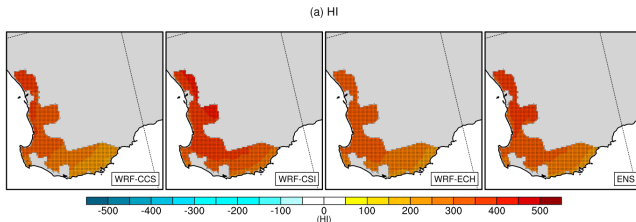


Climate indices relevant to viticulture - Huglin Index



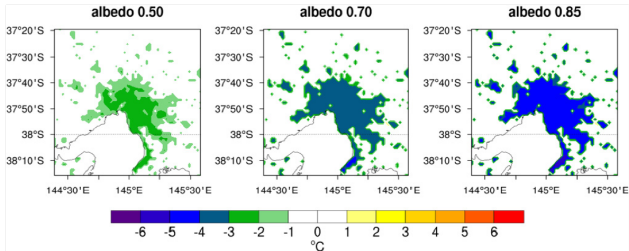
Firth, Kala, Lyons, Andrys (2017), *Journal of Applied Meteorology and Climatology*, 56, 2113-2138

Climate indices relevant to viticulture - Huglin Index



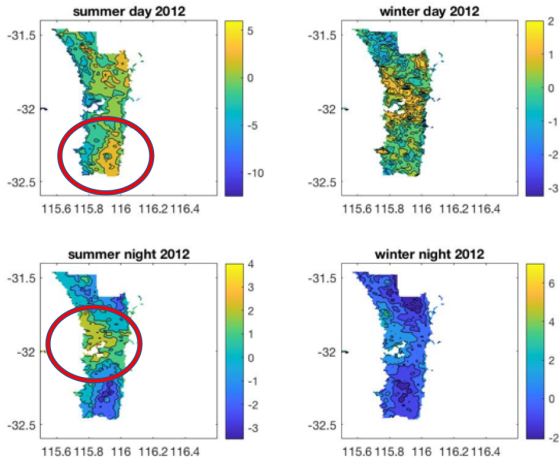
Firth, Kala, Lyons, Andrys (2017), *Journal of Applied Meteorology and Climatology*, 56, 2113-2138

The Urban Heat Island of Melbourne - what if we painted all roofs white?



Imran, Kala, Ng, Muthukumaran (2018), *Climate Dynamics*, 50, 2553-2586
 Imran, Kala, Ng, Muthukumaran (2018), *Journal of Cleaner Production*, 197, 393-405

The Urban Heat Island of Perth derived from MODIS land surface temperature



Results from T. Wangmo Masters project

Potential Research Projects

- ▶ High resolution (1 to 10 km) regional atmospheric modeling
 - ▶ e.g., What is the projected future urban/suburban sprawl for Perth, and how is that likely to affect weather and climate?

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 - ▶ e.g., What is the measured cooling benefit of different types of urban forests? Micro-climatic observational study - What tree species are most suitable for urban forests?
- ▶ Even better - combining both!
 - ▶ Observational field campaigns which inform model development, and modeling which informs field campaign design

References

- ▶ H.M. Imran, J. Kala, A.W.M. Ng, S. Muthukumaran (2018) Effectiveness of green and cool roofs in mitigating urban heat island effects during a heatwave event in the city of Melbourne in southeast Australia, **Journal of Cleaner Production**, 197, 393-405, doi:10.1016/j.jclepro.2018.06.179
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- ▶ Firth, R., J. Kala, T. Lyons, and J. Andrys (2017) An analysis of regional climate simulations for Western Australia's wine regions – Model evaluation and future climate projections. **Journal of Applied Meteorology and Climatology**, 56, 2113-2138, doi:10.1175/JAMC-D-16-0333.1
- ▶ Andrys, J., J. Kala, T. J. Lyons (2017) Regional climate projections of mean and extreme climate for the southwest of Western Australia (1970–1999 compared to 2030–2059). **Climate Dynamics**, 48, 1723–1747, doi:10.1007/s00382-016-3169-5
- ▶ Andrys, J., T. J. Lyons and J. Kala (2016) Evaluation of a WRF Ensemble using GCM Boundary Conditions to Quantify Mean and Extreme Climate for the Southwest of Western Australia (1970-1999). **International Journal of Climatology**, 36, 4406-4424, doi:10.1002/joc.4641
- ▶ Andrys, J., Lyons, T. J., and Kala, J. (2015) Multi-decadal Evaluation of WRF Downscaling Capabilities Over Western Australia in Simulating Rain- fall and Temperature Extremes. **Journal of Applied Meteorology and Climatology**, 54, 370-394, doi:10.1175/JAMC-D-14-0212.1
- ▶ Kala, J., Andrys, J., Lyons, T. J., Foster, I. J., Evans, B. J. (2015) Sensitivity of WRF to driving data and physics options on a seasonal time-scale for the southwest of Western Australia. **Climate Dynamics**, 44, 633-659, doi:10.1007/s00382-014-2160-2

Questions?