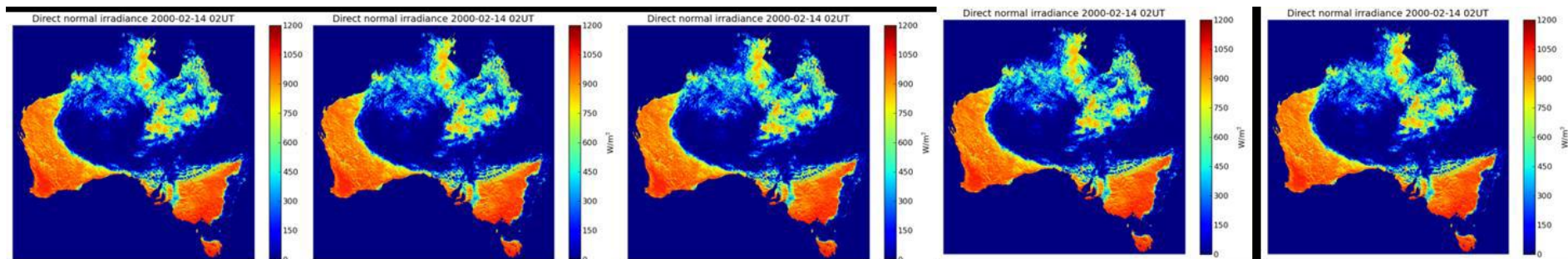




# Investigating the effects of a changing climate on siting of renewables

Dr Merlinde Kay



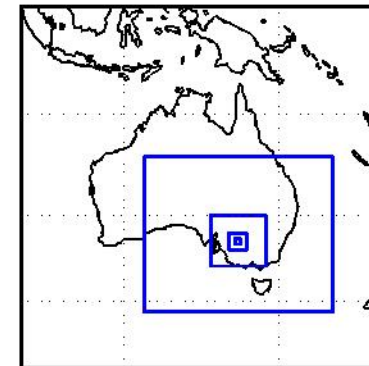
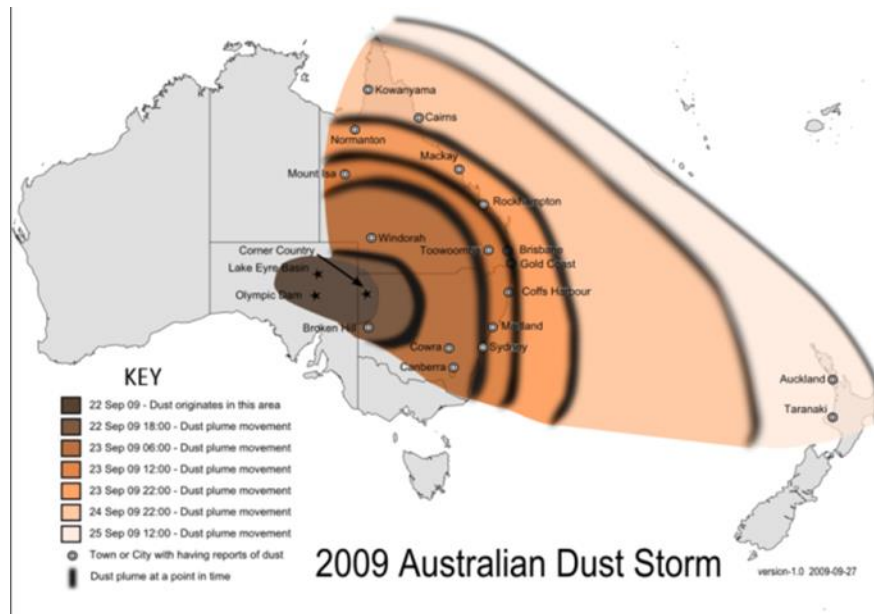
# Energy Meteorology

- **Energy Forecasting investigates how climate and weather influence the energy sector. My research group uses the connection between energy and meteorology to develop models that lead to promotion of cost-effective and sustainable weather and climate risk management strategies for the Energy industry**
  - Resource assessment
  - Siting and planning
  - Forecasting and optimisation
  - Assist in technology design
  - Building optimisation



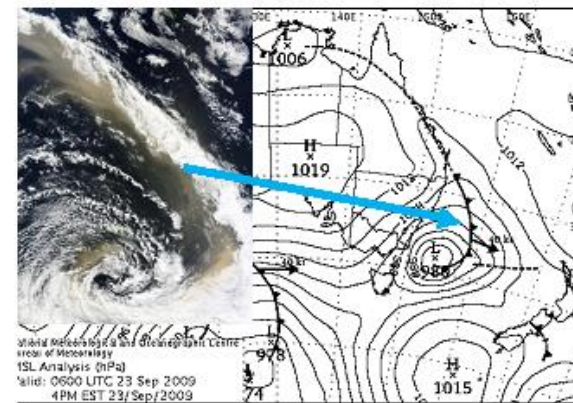
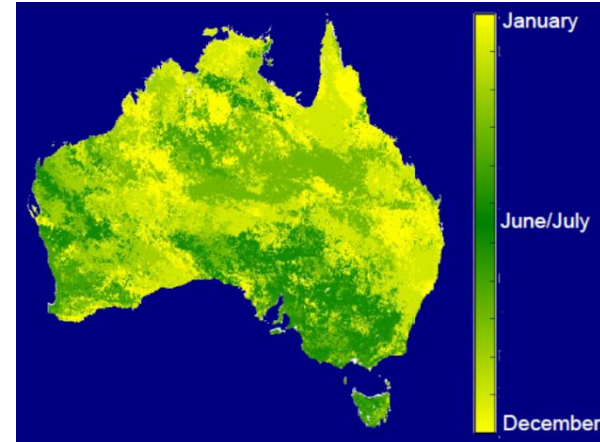
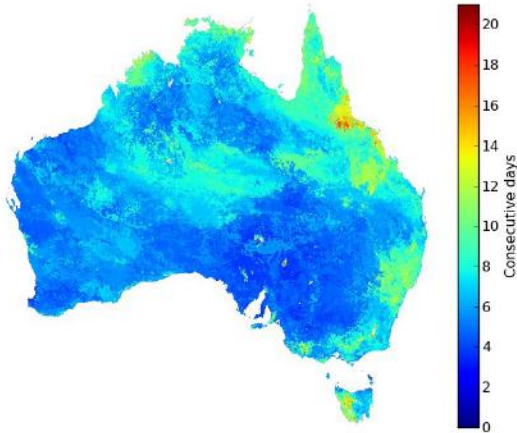
# Ongoing Projects at UNSW

- Utilising weather models for building energy management optimisation
- Wind forecasting and assessment
- Hybrid forecasting and optimisation of battery storage
- Distributed Forecasting
- Aerosol modelling/forecasting for CST

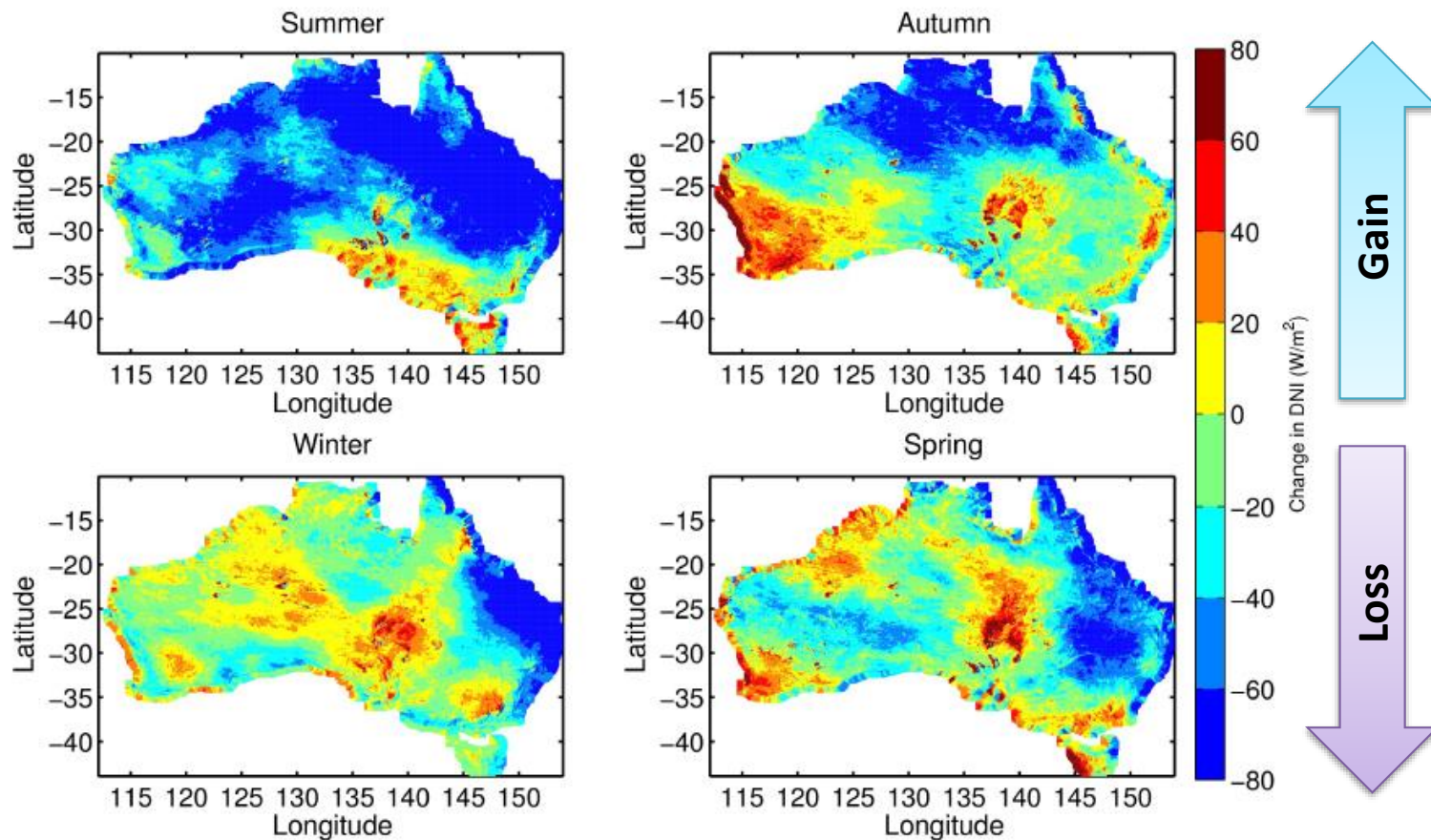


# Characterising Variability

- Analysing weather data and insolation
  - Identifying weather patterns that correlate to periods of high and low power production
  - Predictability of these weather events at appropriate levels of aggregation



# Total change in DNI from 1990-2012



# Where should new wind and solar energy sites be located to avoid climate and financial risk?

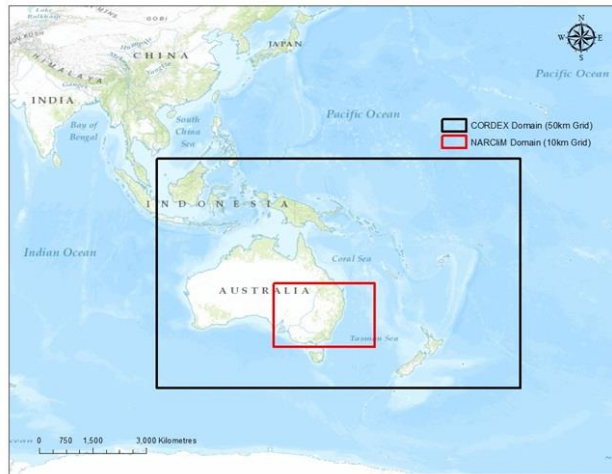
- *The aim of this project is to minimise the risk in investing in potential wind and solar energy sites.*
- How will climate change affect the choice of future renewable sites?
- Where would investments be most or least risky? Can we identify sites that will remain optimal and economically viable in 20 years' time as weather and climate change?



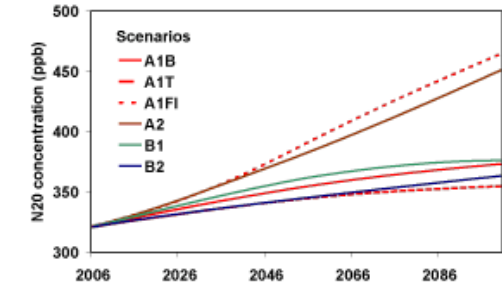
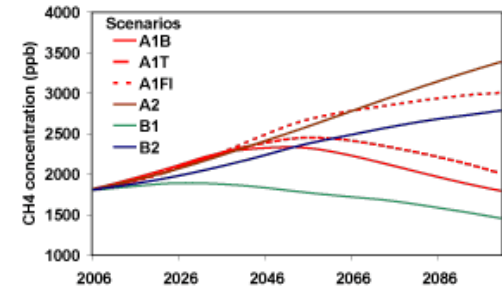
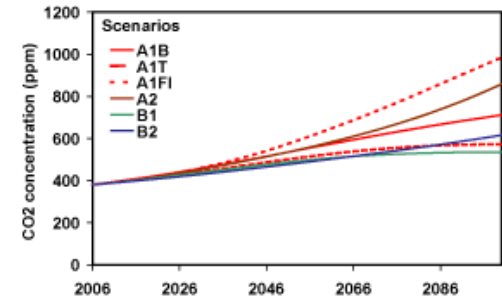
A/Prof Jason Evans, Dr Abhnil Prasad and Prof Andy Pitman

# Regional Climate Projections

- We use a regional climate ensemble and separately downscale four global climate models (MIROC3.2-medres, ECHAM5, CCCMA3.1, and CSIRO-Mk3.0) using the Weather Forecasting and Research (WRF) modeling system version 3.3.



- This created a 12-member ensemble for three time periods:
  - present (1990–2009),
  - near future (2020–2039),
  - far future (2060–2079). All future simulations used the SRES A2 emissions scenario.



Skamarock, W.C., Klemp, J.B., Dudhia, J., Gill, D.O., Barker, D.M., Wang, W., Powers, J.G., 2008. A description of the advanced research WRF version 2. NCAR Technical Note. NCAR/ TN-475+STR, 123 pp.

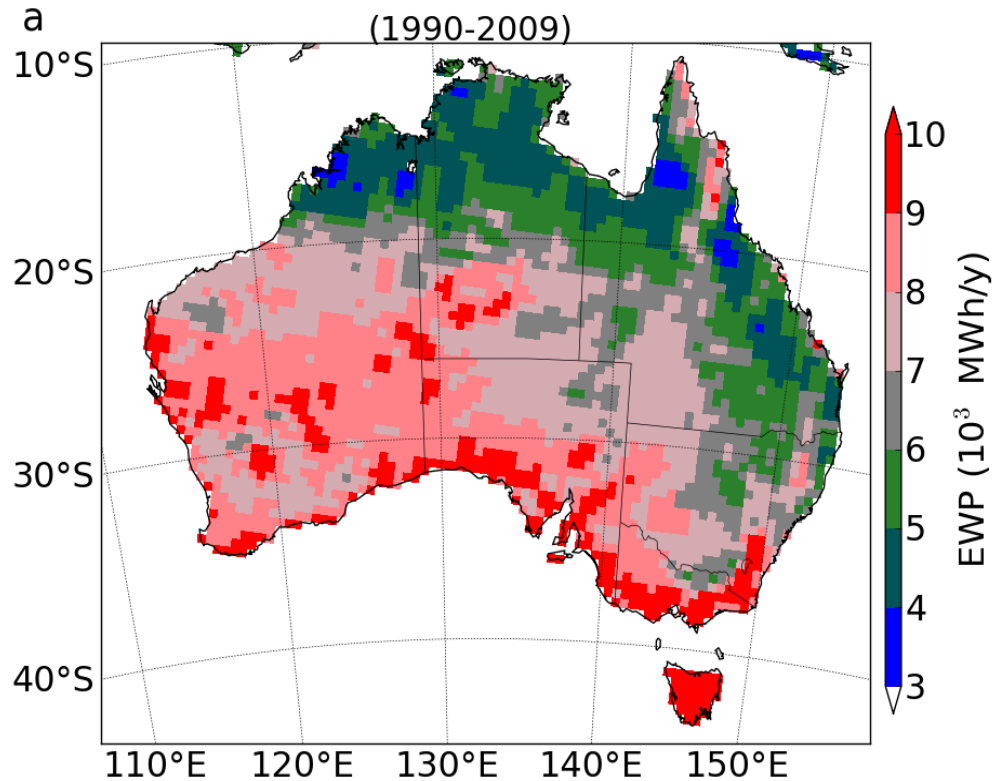
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Olson, R., Evans, J., Di Luca, A., Argüeso, D., 2016. The NARCLIM project: model agreement and significance of climate projections. Climate Research 69, 219–227. doi:10.3354/cr01403

Nakicenovic N, Swart R (eds) (2000) special report on emissions scenarios: a special report of Working Group III of the Intergovernmental Panel on Climate Change. Cambridge University Press. Cambridge

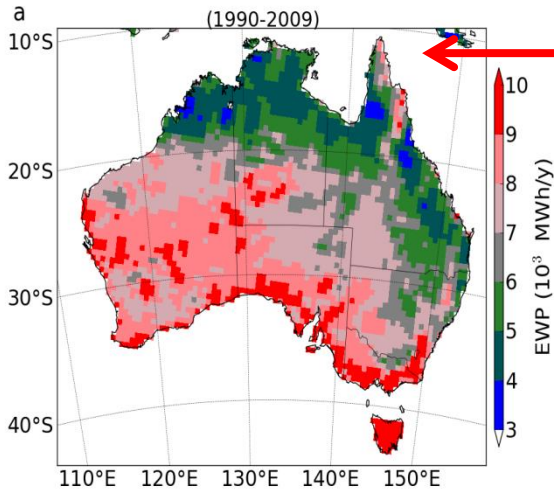
# Extractable Wind Power (EWP)

- The amount of power that can be extracted from wind turbines – 80m hub height



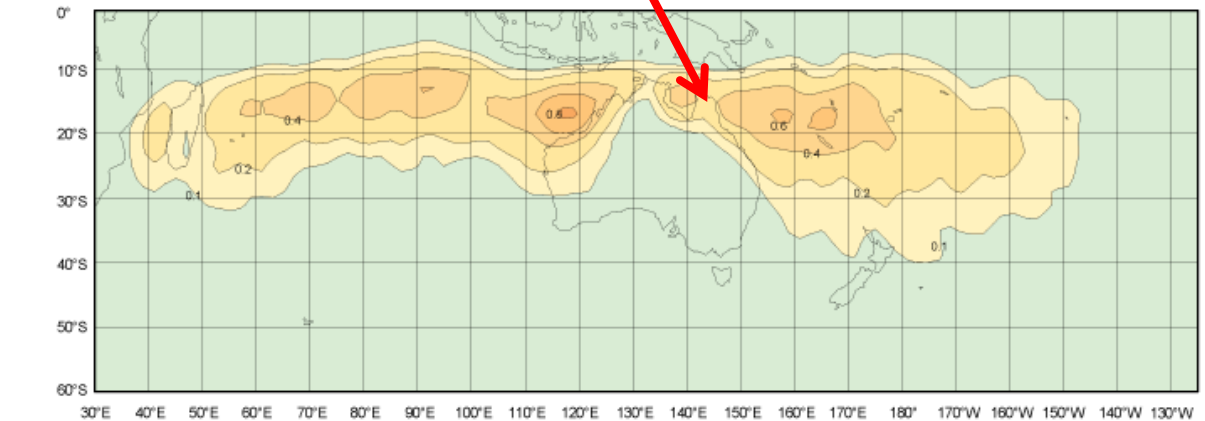


# Extractable Wind Power (EWP)



Average annual number of tropical cyclones

Australian Government  
Bureau of Meteorology



Number of tropical cyclones

0.1 0.2 0.4 0.6 0.8 1.0

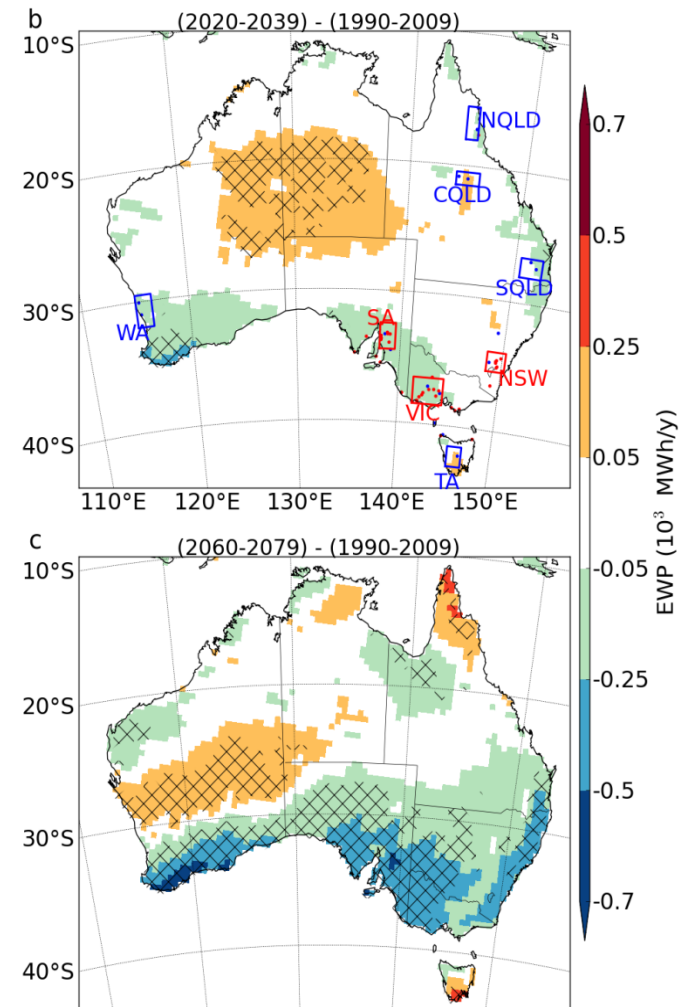
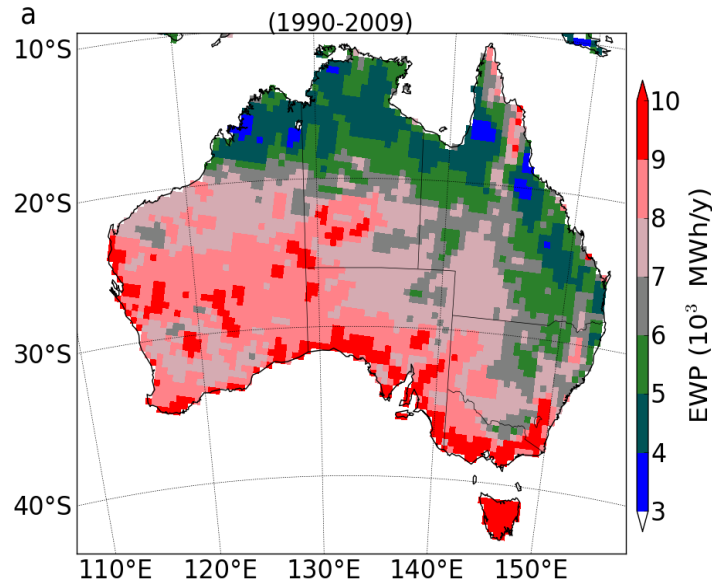


Based on a 2 x 2 degree resolution gridded analysis using 36 years of data (1969/70 to 2005/06 tropical cyclone seasons).

© Commonwealth of Australia, 2008

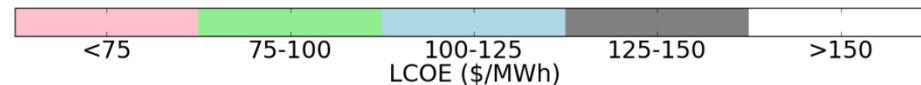
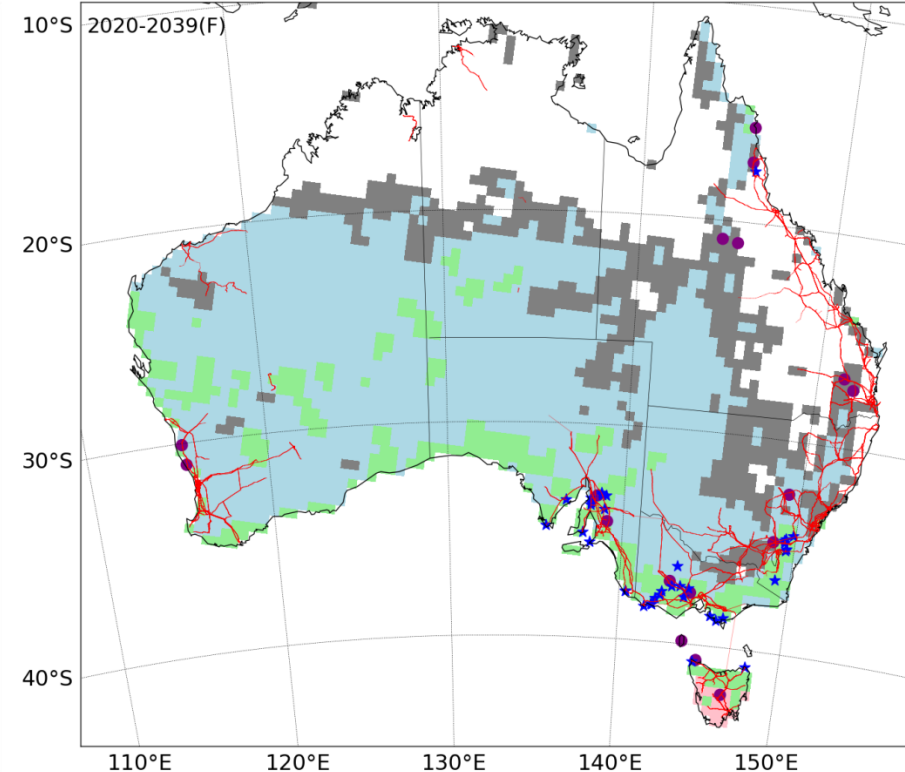
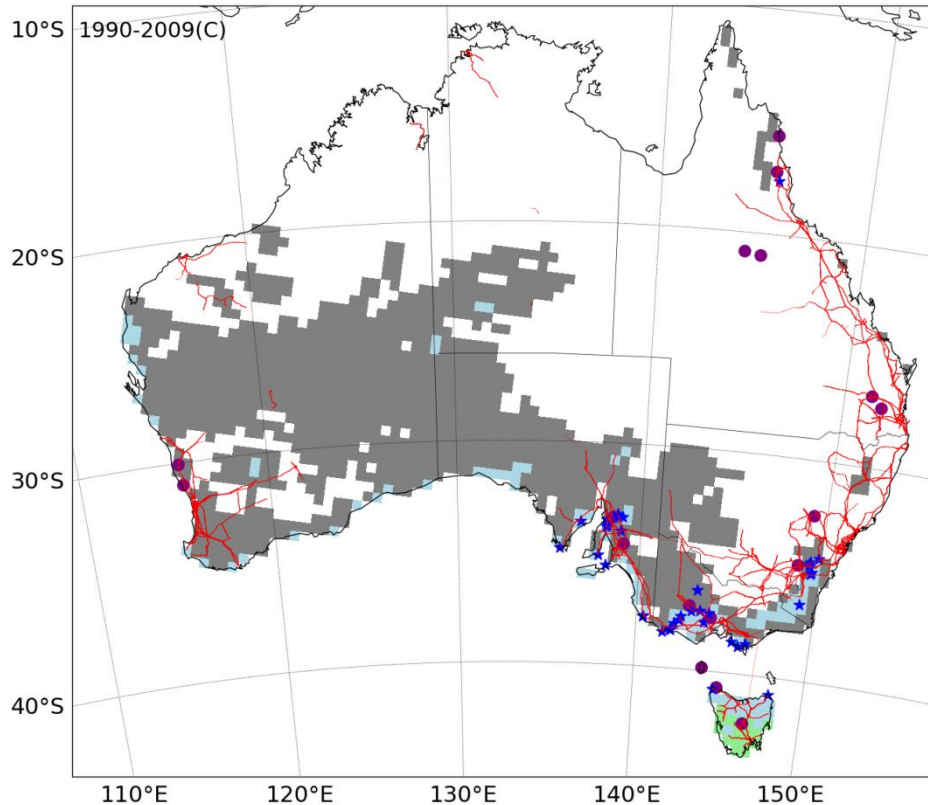
# Extractable Wind Power (EWP)

- The amount of power that can be extracted from wind turbines – 80m hub height



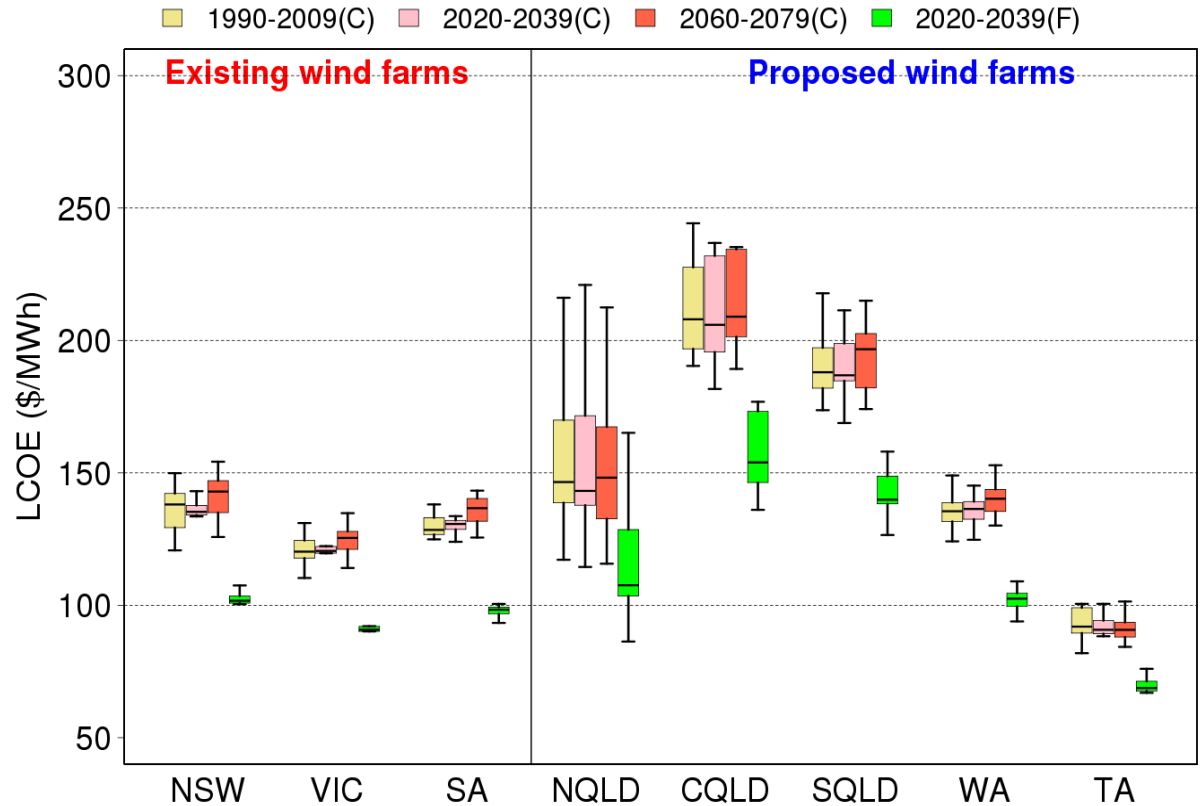
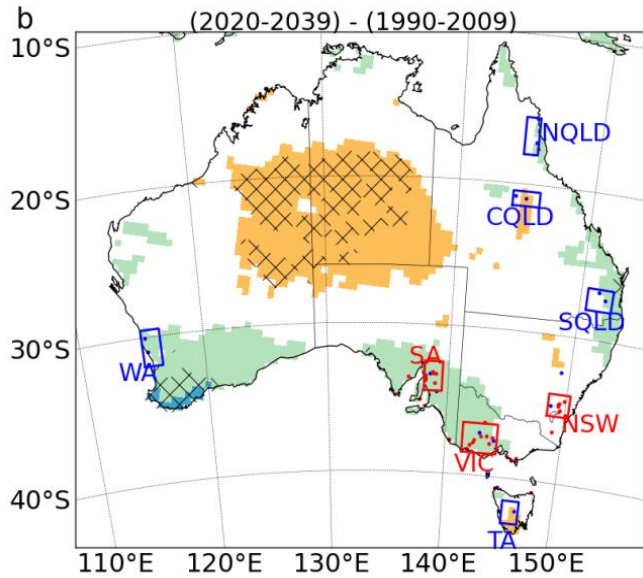
# Levelised Cost of Electricity (LCOE)

- Minimum cost at which a generator must sell the produced electricity in order to break even\*



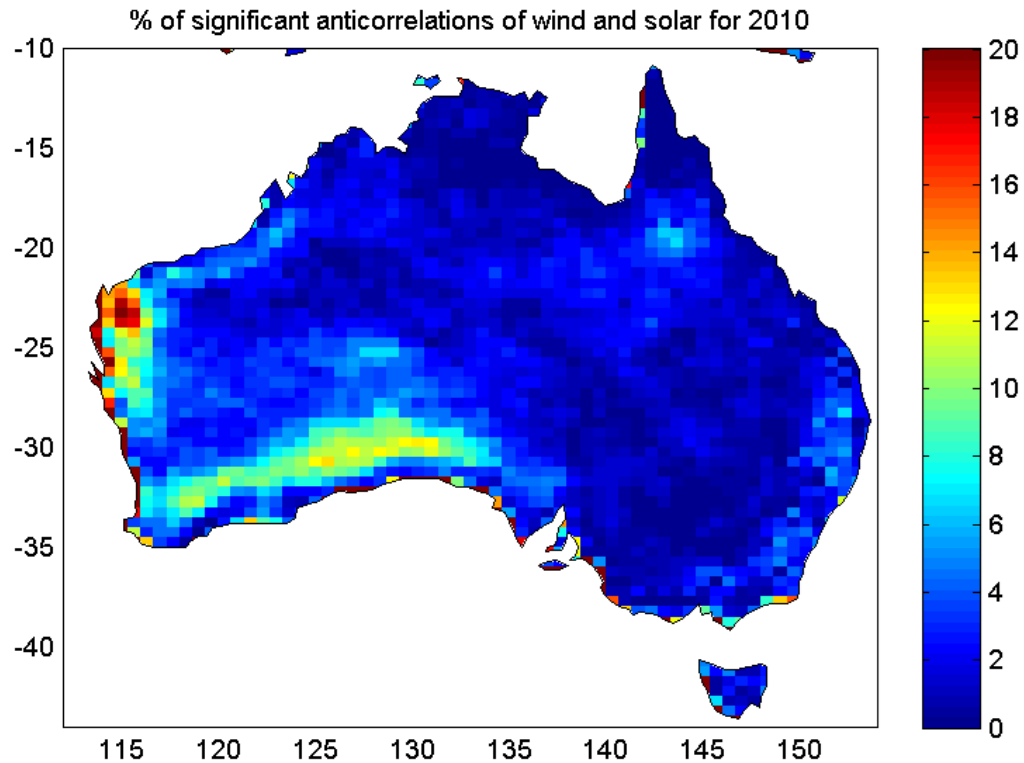
\* The calculation of LCOE and the assumptions used are based on the Aus Energy Technology Assessment Reports [<https://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/aeta/AETA-Update-Dec-13.pdf>, [https://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/aeta/australian\\_energy\\_technology\\_assessment.pdf](https://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/aeta/australian_energy_technology_assessment.pdf)]

# Comparison between Existing and proposed sites



# Future Projections

- Future generation traces for solar



**Thank You**