

CLOUDS & CLEAR SKY

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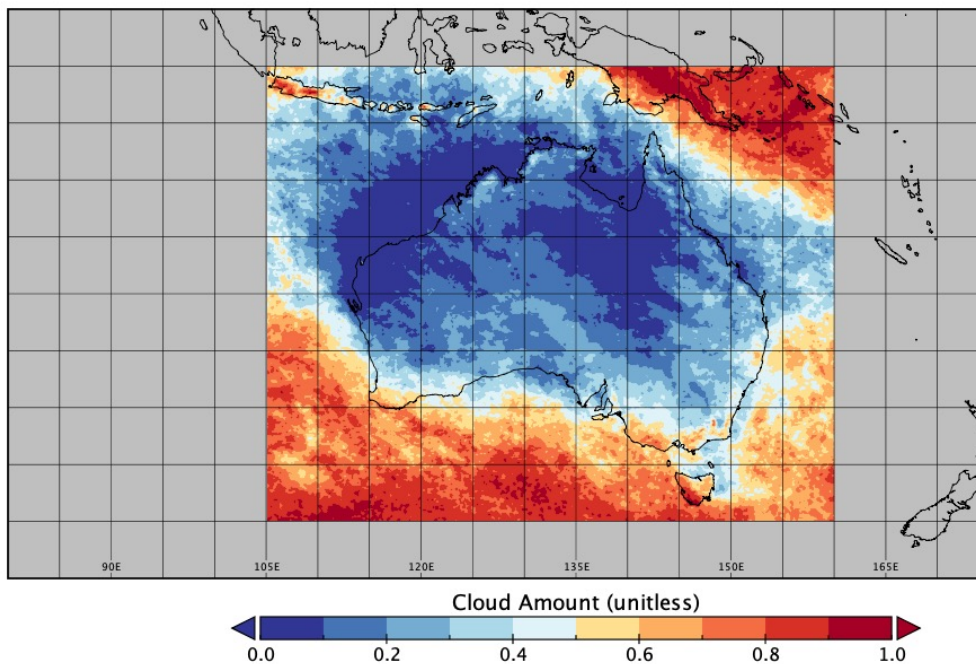
PATMOS-x AVHRR data set

- 40-year data set (1979 to 2018)
 - 0.1° resolution
 - Available 4 times/day (early morning, mid-morning, mid-afternoon, early evening)
 - Latitude: 5°S to 45°S; Longitude: 105°E to 160°E
- Sourced from University of Wisconsin, Madison, WI, USA
- Official Climate Data Record (CDR)
- Data record has performed well under comparisons with other existing cloud data sets and validation undertaken against CALIOP/CALIPSO data.

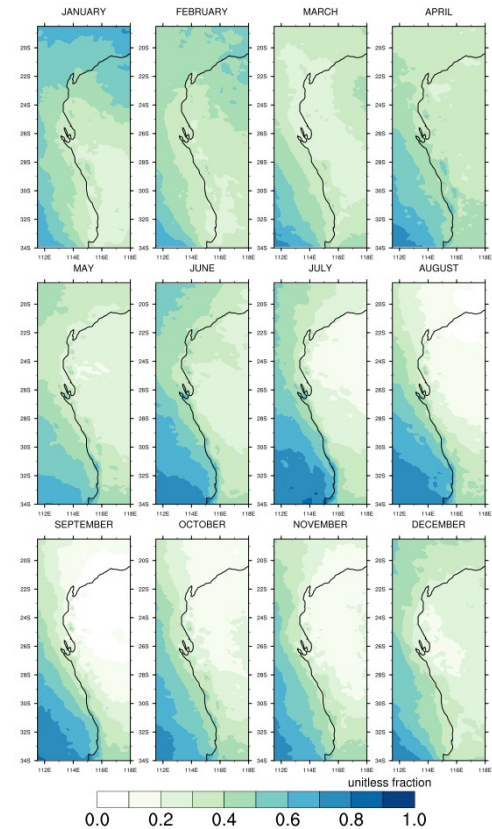
Cloud Amount (CA)

- Imagery and Plots used to highlight monthly, annual and decadal analysis.

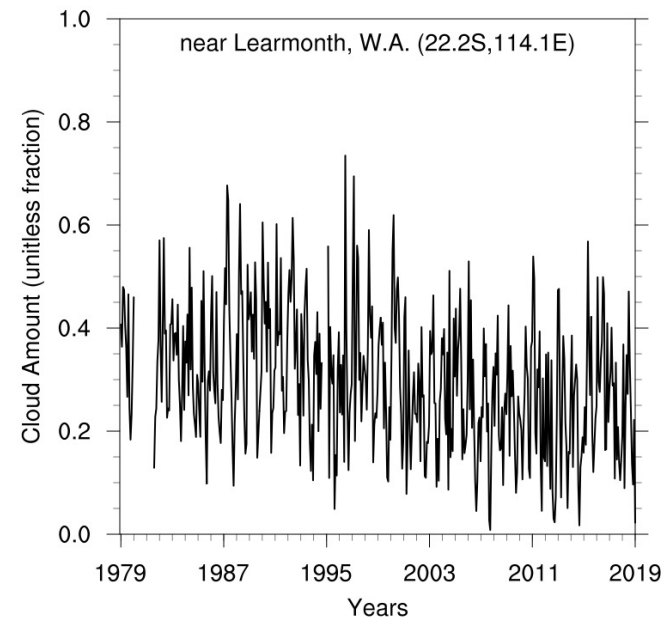
Mid-afternoon Cloud Amount in September 2018



Average CA Over Western Australian Sub-region - AM (2009 to 2018)



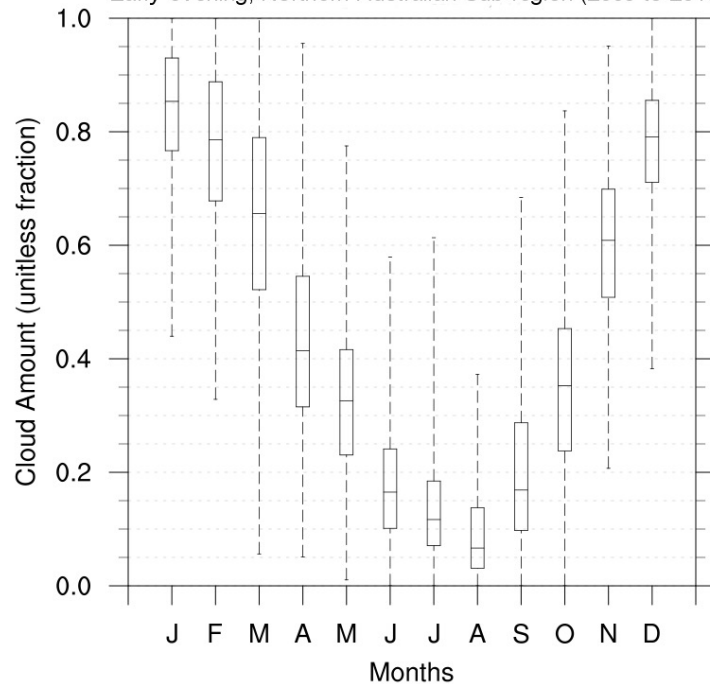
40 years of Mid-afternoon Cloud Amount (1979 to 2018)



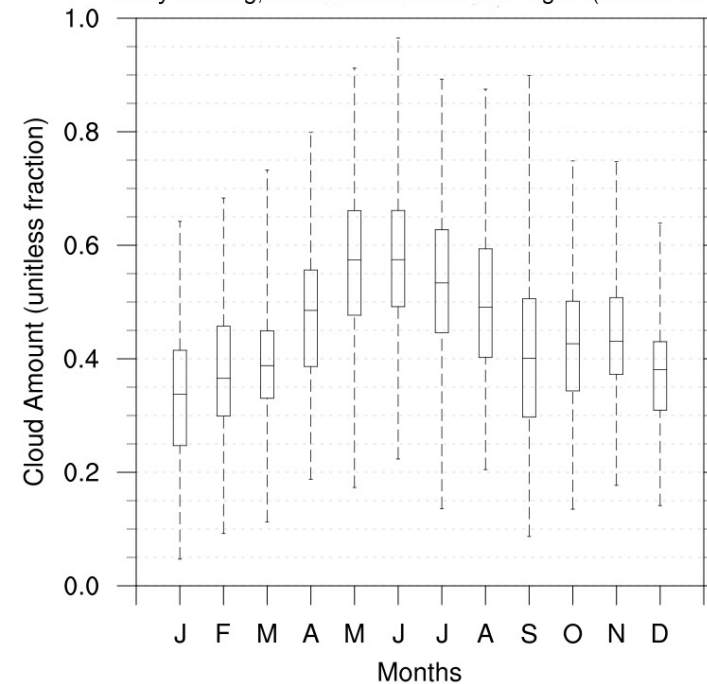
Cloud Amount (CA) statistics

- Minimum, Quartile 1 (25%), Median, Quartile 3 (75%), Maximum

Monthly Box and Whisker Plot of CA Over Land
- Early evening, Northern Australian Sub-region (2009 to 2018)

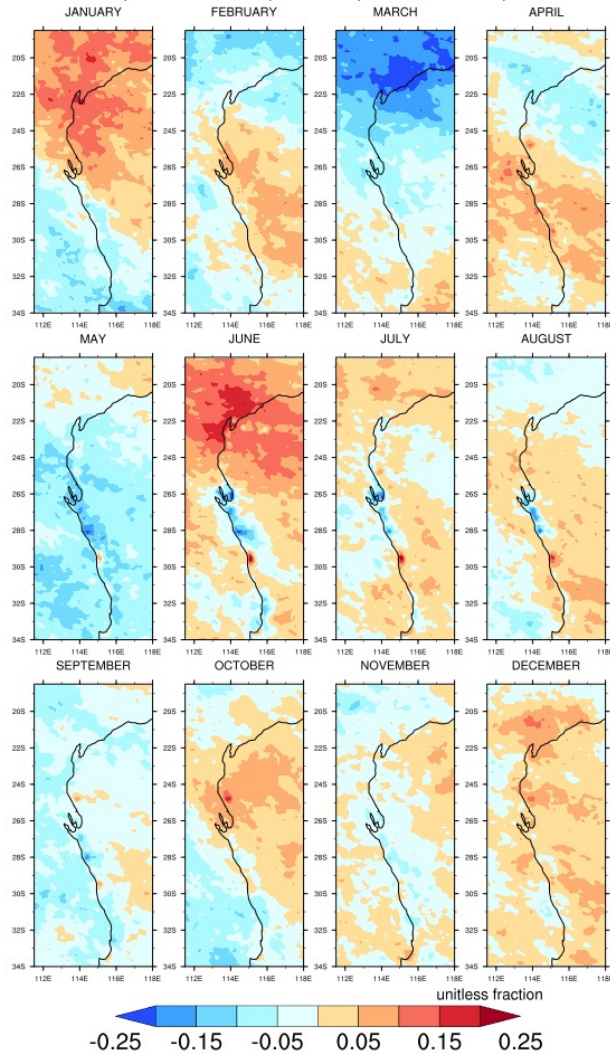


Monthly Box and Whisker Plot of CA Over Land
- Early evening, Southern Australian Sub-region (2009 to 2018)

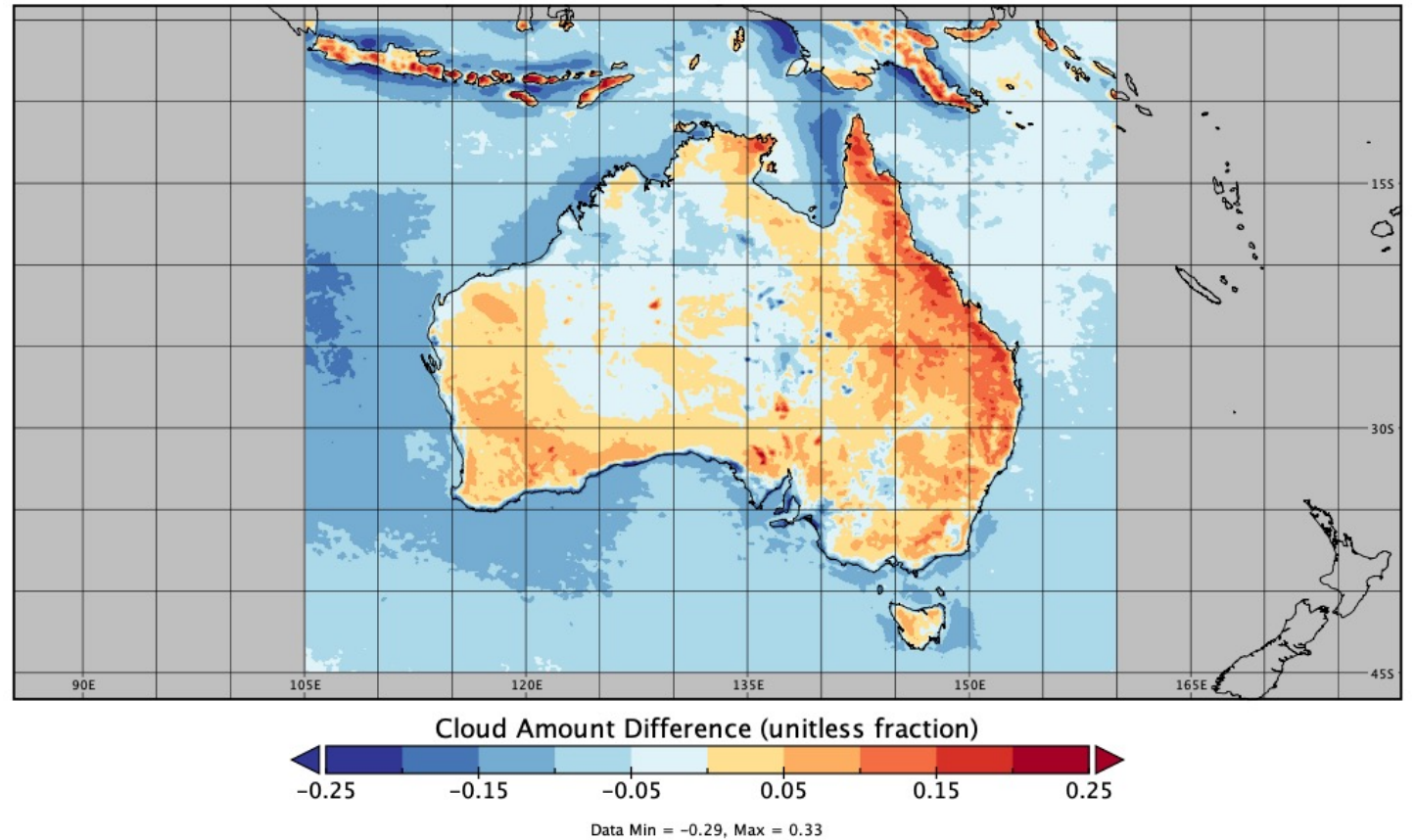


Cloud Amount (CA) change

Difference between Decades: Early morning Decadal Average CA
 - (2009 to 2018) minus (1999 to 2008)



Difference in Decadal (2009 to 2018) Average Cloud Amount
 Mid-afternoon Cloud Amount minus mid-morning Cloud Amount



Clear sky site and multi-site analysis in benefit of optical communication

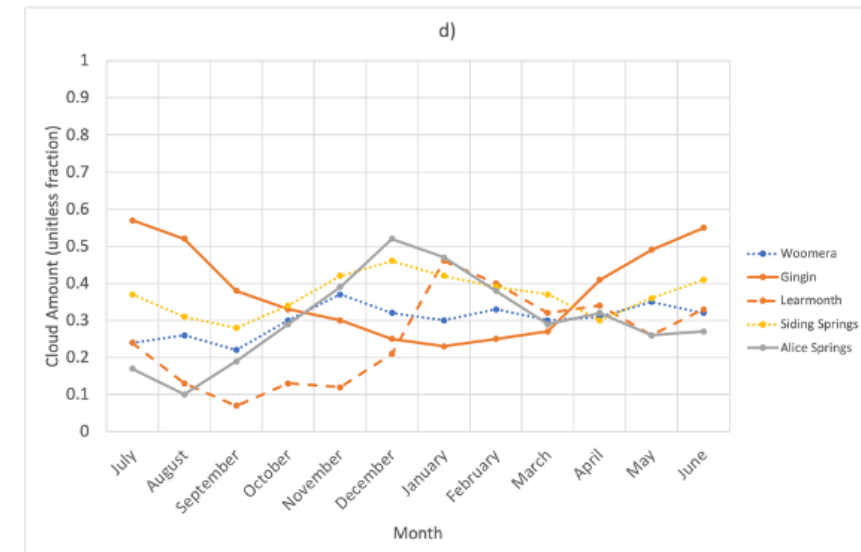
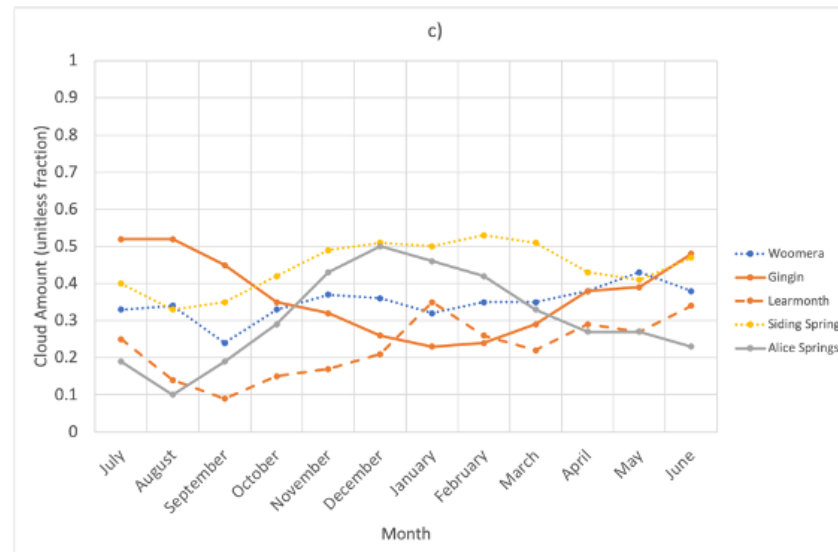
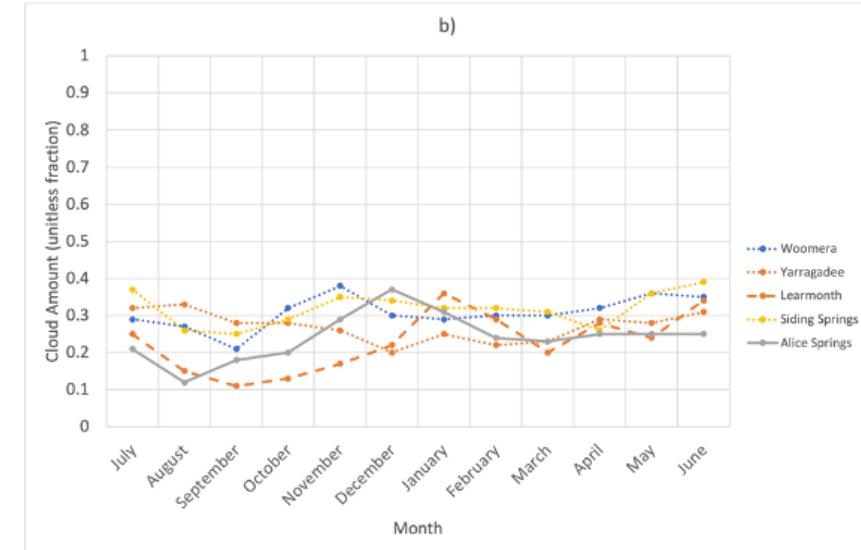
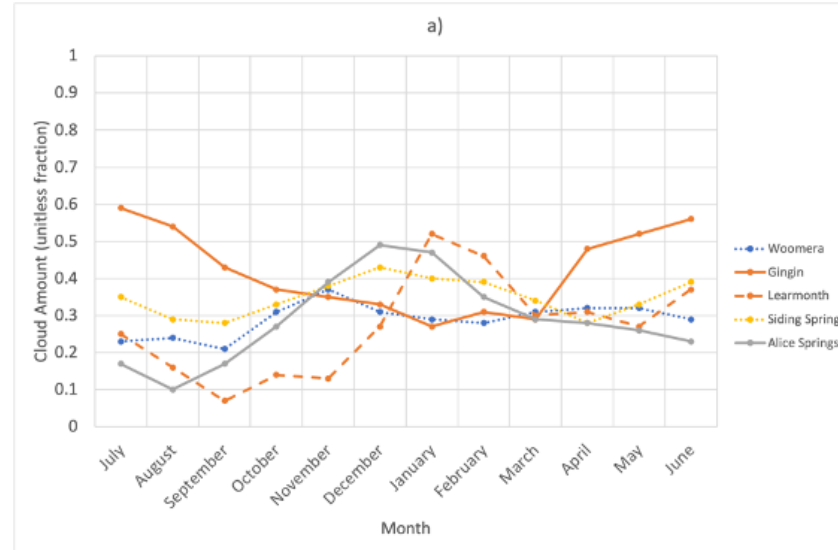
- Evaluate the clear sky availability for specified sites between 2009 and 2018.
- Evaluate the minimum number of sites that would ensure at least 90%-95% clear sky opportunity across Australia.

Cloud Amount (CA) statistics of Australian sites

- Monthly data between 2009 and 2018 analysed using 5x5-pixel data squares at ten separate locations across Australia.
- Data analysed according to region; a) South Australian sites, b) Western Australian sites, c) Australian Capital Territory and New South Wales sites and d) Northern Territory sites
- And also at four different times during a 24-hour time period; a) Early morning, b) Mid-morning, c) Mid-afternoon and d) Early evening.
- Long term trends assessed across 40 years of data at each location
- Locations with the least amount of cloud in each region and time period were then compared.

Site analysis

- Lowest regional cloud amount time series of decadal means from monthly data.
- Means calculated from data between 2009 and 2018 using 5x5-pixel data squares at separate locations across Australia.
- Data displayed according to time of day; a) Early morning, b) Mid-morning, c) Mid-afternoon and d) Early evening.
- Plots organised to highlight the transition across Southern Hemisphere summer months.

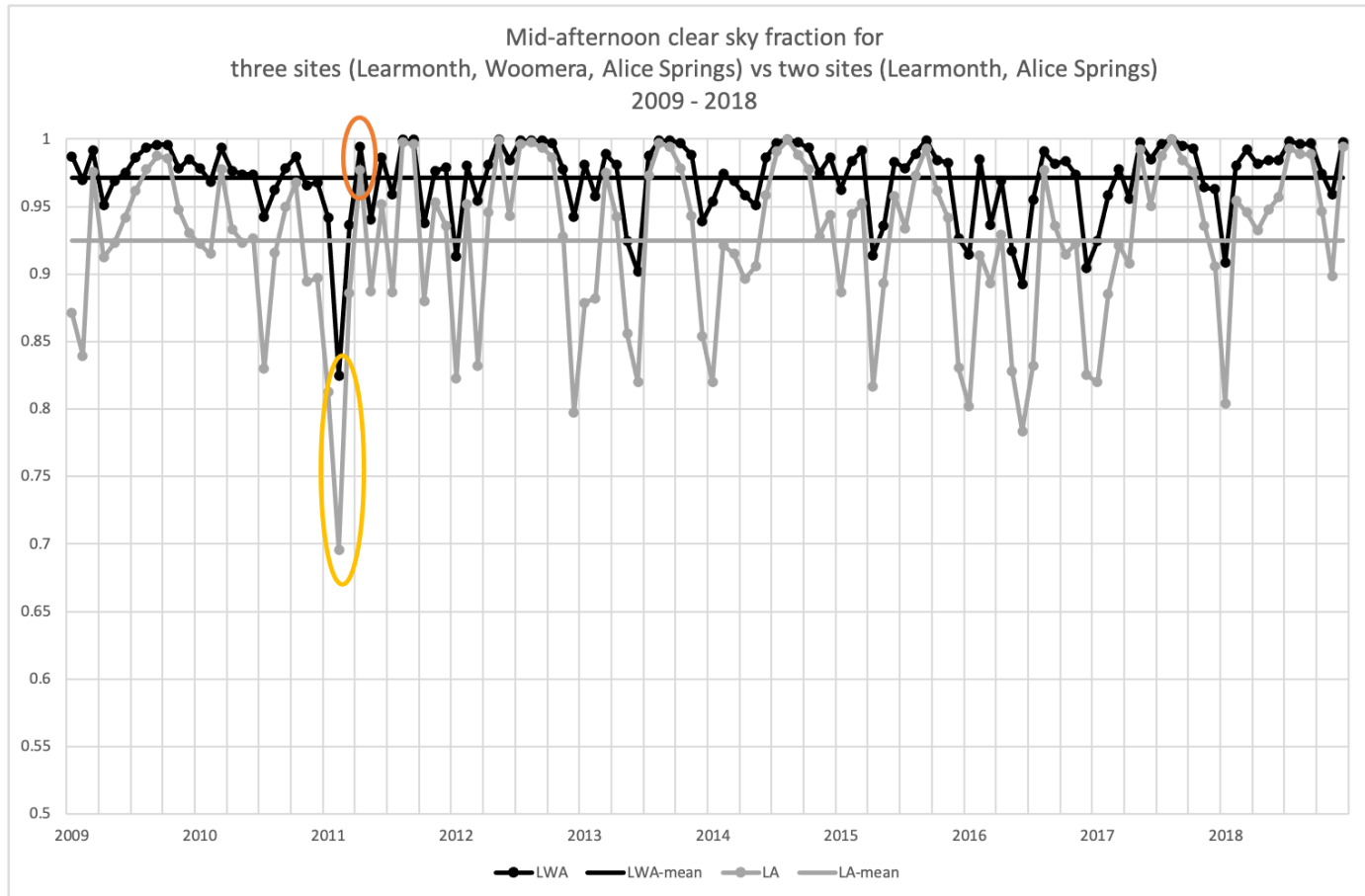


Clear sky fraction calculation of multiple sites

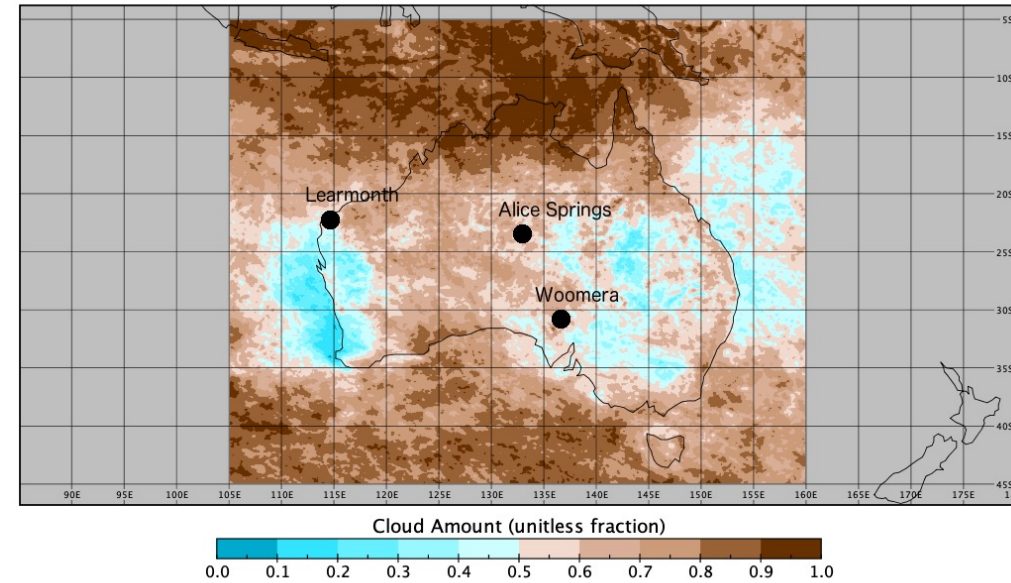
- Cloud amount averages from 5x5-pixel data squares around each location are calculated for each month
- Cloud amount fractions from two locations are multiplied together
-> Probability of two independent events occurring together (A and B cloudy).
- Subtract from 1 to get the clear sky alternatives (A clear, B clear or A and B clear)
- Example: Location A, Location B, Location C
 - 2-site analysis -> $\text{clear sky}_2 = 1 - (CA_A * CA_B)$
 - 3-site analysis -> $\text{clear sky}_3 = 1 - (CA_A * CA_B * CA_C)$

Comparison with imagery

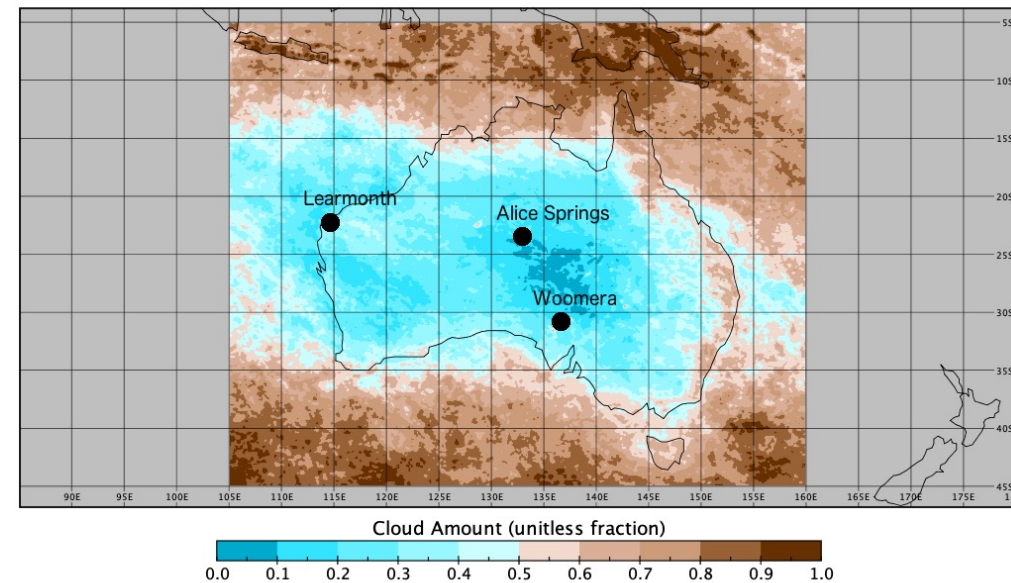
- February and April, 2011



Mid-afternoon Cloud Amount - FEBRUARY 2011

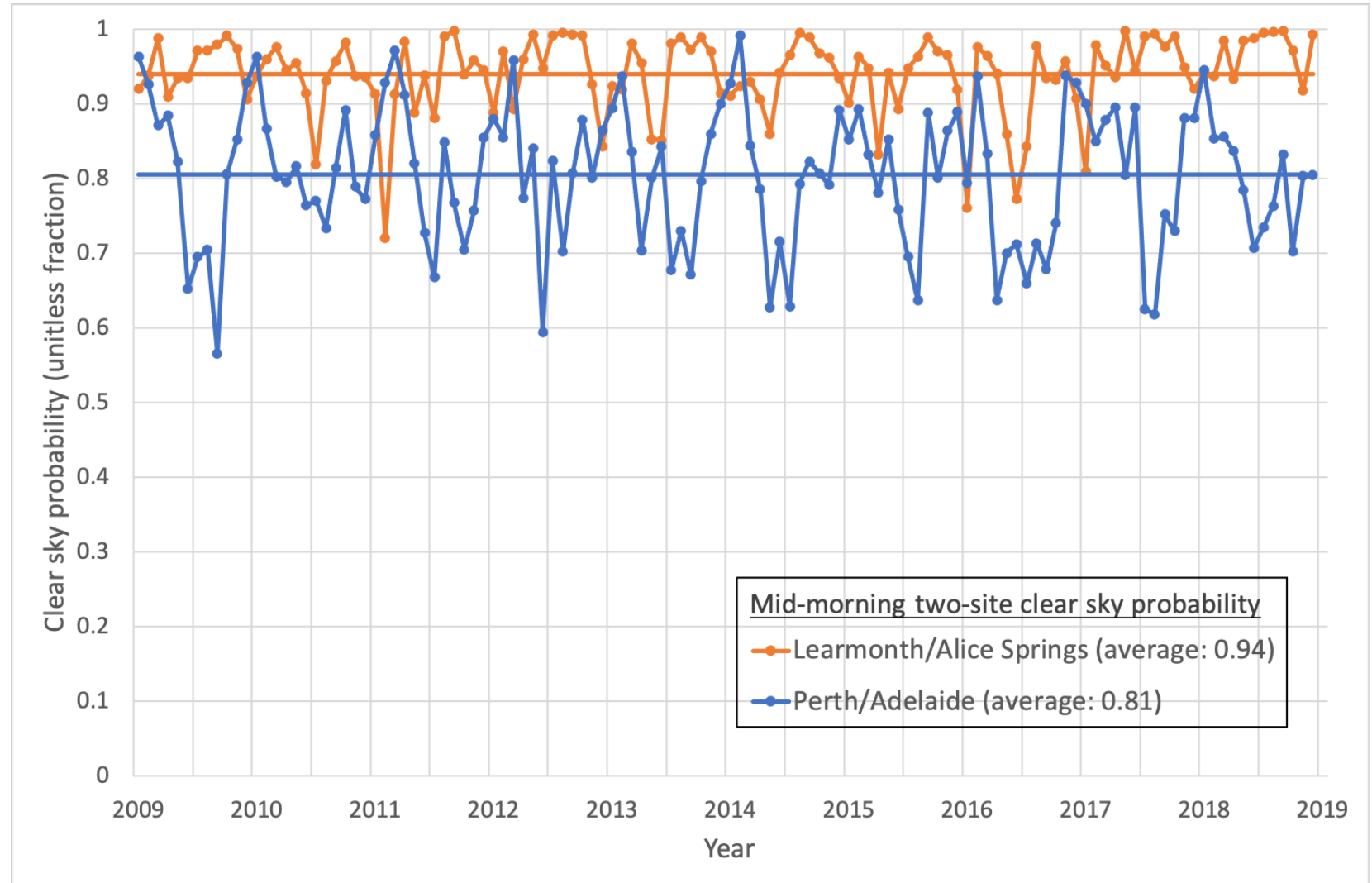


Mid-afternoon Cloud Amount - APRIL 2011



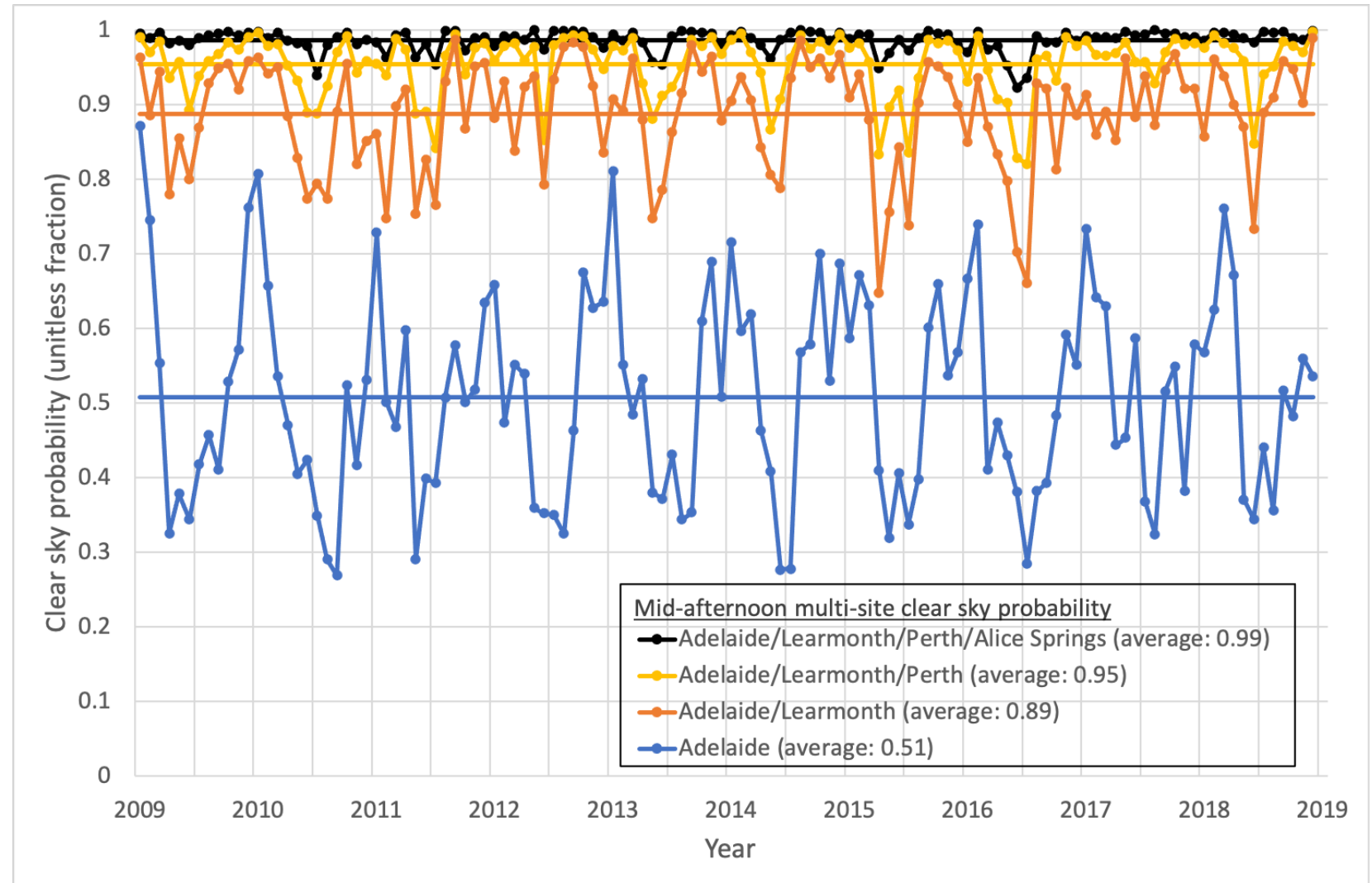
Multi-site analysis

- 6 single sites across Australia (chosen for low cloud levels) to be assessed in multi-site networks.
- Fifteen 2-site networks analysed.
- Most achieved a clear sky probability > 0.85 but less than half were > 0.90 .



Multi-site analysis

- Twenty 3-site networks were analysed.
- All 3-site networks had a clear sky probability > 0.90 with a high % > 0.95 .
- Preferred networks contain spatially distant, low correlated sites with low cloud levels.



NCI

- The 40-year Australian archive of PATMOS-x AVHRR is also in the process of being listed as a netCDF4 database on the NCI that will be available for testing with regional cloud numerical models.
- WAMSI funded