Detection of the Occurrence and Impacts of the Nauru Island Effect

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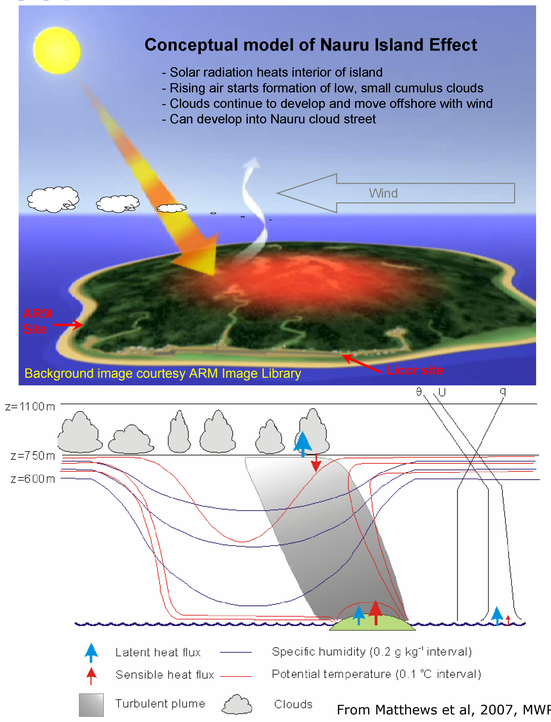
Introduction:

Nauru99 showed that Nauru island had sporadic impact on the ARM measurements located on the leeward side of the island. The Nauru Island Effect Study was used to develop the methodology to detect its occurrence. A Licor pyranometer system was deployed in Sept 2005 at the airport to use in island effect detection.

1. Conceptual model and schematic of Nauru Island Effect



From Matthews et al, 2007, MWR.

2. Nauru Island Effect Detection

Detection using revised McFarlane et al. (2005) methodology. Island Effect is occurring if:

1) Wind is from across island (direction 60-200°), average 30 minutes up to time of interest

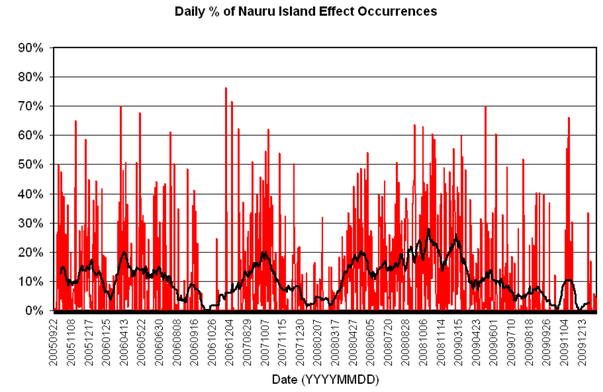
2) Air temperature > 302K at time of interest

3) One hour average SW correlation between Licor and Nauru ARM site <0.8, 60-minute correlation centered on time of interest

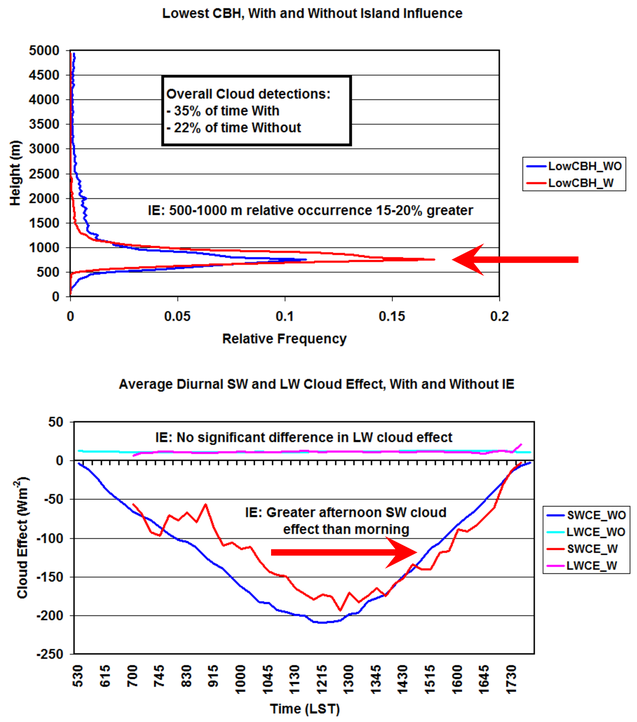
4) 60-minute Standard Deviation (centered on time of interest) in downwelling SW at least 10% greater at Nauru ARM site than at the Licor site

3. Frequency of the occurrence of the Nauru Island Effect

Sept 2005 – Jan 2010 daylight percent of occurrence (red) of an island influence at the Nauru ARM site, and 30-day running mean (black). Average: 11%



4. Island Effect increases low level cloud frequency by 15-20%, shifts SW cloud effect toward afternoon.

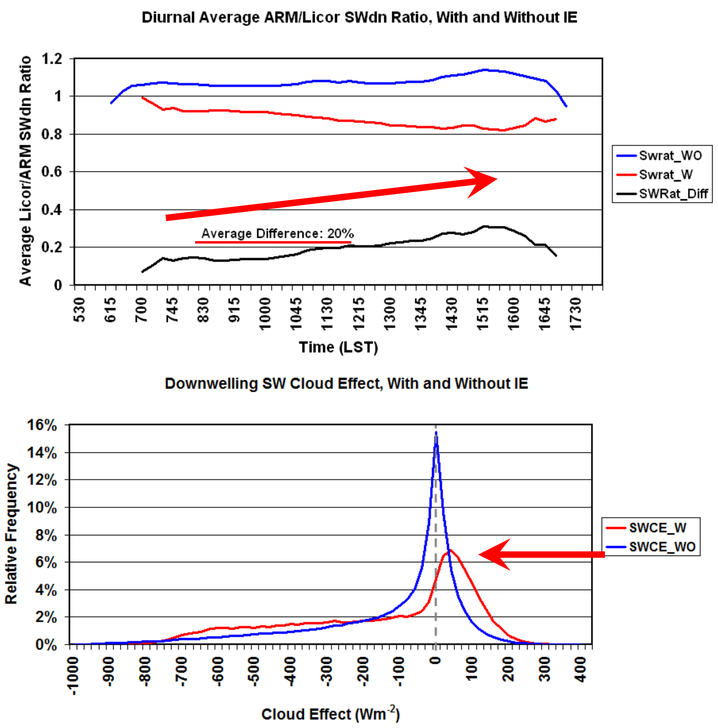


Aggregate lowest cloud base height relative frequency with height (top) and average diurnal SW and LW downwelling cloud effect (bottom).

CONCLUSIONS:

The Nauru Island Effect (IE) occurred on average 11% of the time during the study period. The IE increased the frequency of lowest cloud base height by 15-20%, and decreased the downwelling SW by an average of 20%. Fractional sky cover is primarily between 10-60% during IE periods (not shown), which in turn produces more frequent positive cloud effect occurrences. There was no significant impact on downwelling LW.

5. Magnitude of IE-driven decrease in SW increases from 10-30% across the day (Avg 20%) and produces more frequent positive cloud effect.



Average Diurnal ratio of ARM/Licor SWdn (top) and relative frequency of downwelling SW cloud effect (bottom) using 1-minute data.

References:

Matthews, S., J. M. Hacker, J. Cole, J. Hare, C. N. Long, and R. M. Reynolds, (2007): Modification of the atmospheric boundary layer by a small island: observations from Nauru, MWR, Vol. 135, No. 3, pages 891–905.

McFarlane, S. A., C. N. Long, and D. M. Flynn, (2005): Impact of Island-Induced Clouds on Surface Measurements: Analysis of the ARM Nauru Island Effect Study Data, JAM, 44, 1045–1065.