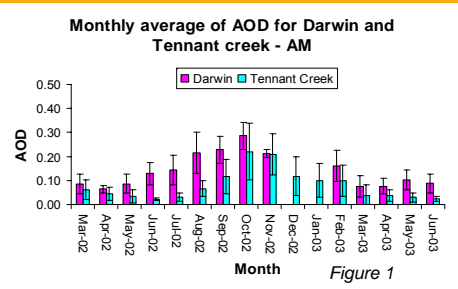


The effects of biomass burning on the atmosphere in the Northern Territory

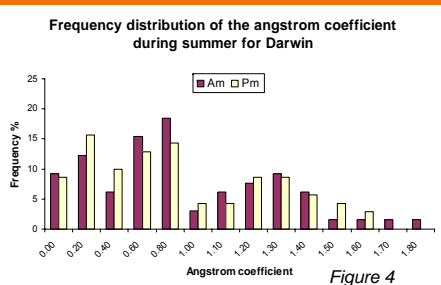
Christopher Reyes, Elizabeth Henderson, Majed Radhi, Zahra Bouya, Michael Box, Gail Box

For six weeks, two undergraduate students studied the effects of biomass burning on the top end atmosphere. Chris's project focused on the ozone variation within a day. Elizabeth's project focused on finding trends in the aerosol optical depth and the Angstrom coefficient. This poster displays a few of the results they found during their research.

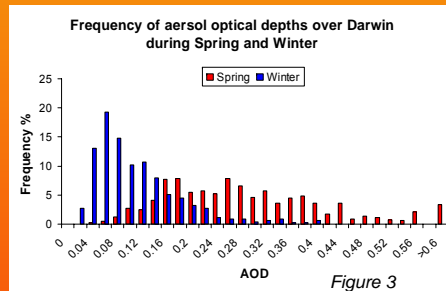
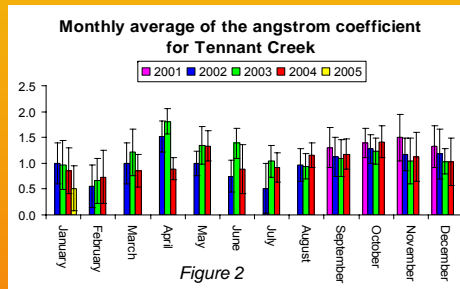
Using monthly averages of aerosol optical depth (AOD) from BOM and ARM the annual cycles of the AOD and the Angstrom coefficient were found for the Tennant Creek and Darwin sites. As figure 1 displays, over Tennant Creek there is a yearly cycle with the highest AOD between September and December with lows occurring in June and July. Tennant Creek seems to have a biannual cycle of the Angstrom coefficient, with highs in April and October (figure 2). Darwin has a much dirtier atmosphere, with the AOD being consistently higher than that of Tennant Creek (figure 1). Darwin also has a yearly cycle of AOD, with highs between August and November, with lows in March, April and May. No relationship could be found for Darwin's Angstrom coefficient.



Some interesting trends were discovered when the frequencies of AOD and Angstrom coefficient were plotted by season. Although Darwin is classified as having a fire season during Winter and Spring, the aerosol optical depths show that the air above Darwin is relatively clean during winter, and dramatically changes in springtime (figure 3).



Although minute-by-minute data were analysed for Tennant Creek, unfortunately no significant results were obtained due to significant time constraints. This work is continuing with Majed Radhi for Wagga Wagga data for his Ph.D.



When looking at the frequencies of the Angstrom coefficient, an interesting trend was found in summer. Darwin obviously has two distinct sources of aerosol, of different sizes. This is shown by the two peaks in figure 4, one where the Angstrom coefficient is less than 1.0, and the other well above. This could be due to the coastal setting of Darwin.

Ozone has an annual cycle so this project was aimed at looking at correlations between the data and the meteorological parameters. Two datasets were used, the first was retrieved from the World Ozone and Ultraviolet Radiation Data Center (WOUDC), which gave the daily ozone representing the total thickness of the ozone column in Dobson Units (DU). The ozone time series are derived from 5 years (2000-2004) of WOUDC data. The second dataset was derived from ARM spectral measurements, which gave both morning and afternoon values, using Eigenvalue analysis to infer the total ozone column over Darwin during March 2002 to June 2003.

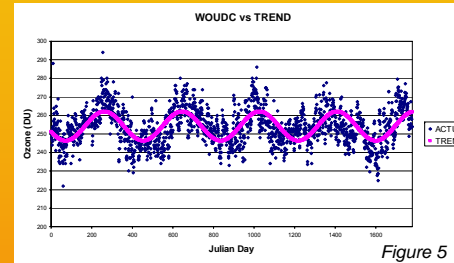
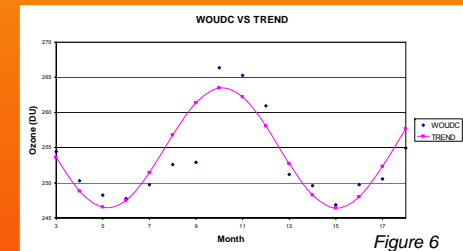


Figure 5 shows the WOUDC data, over the five years, and the annual cycle. There's a clear relationship, but the scope of this project was to determine the correlations between data (minus the trend) and the meteorological parameters. The figure shows that during the biomass seasons (peaks in the trend) there is (on some days) a significant difference between the data and the trend, which suggests that the biomass burning is contributing to the increased ozone production. The correlation between the difference and the temperature is $\rho = 0.37$ and $\rho = 0.47$, morning and afternoon respectively, which suggests that the complex afternoon meteorology plays a more dominate role in the overall ozone production. The wind speed and direction also exhibited this similar correlation.

The monthly trend (figure 6) was subtracted out of the WOUDC data to look at the correlations with temperature, wind speed and direction, during the biomass season of 2002 (May – November). The temperature correlated at $\rho = 0.58$ and $\rho = 0.60$, morning and afternoon respectively. Wind speed correlated strongly with $\rho = 0.77$ and $\rho = 0.51$, morning and afternoon respectively. Wind direction didn't correlate well in the morning but had a $\rho = 0.42$ in the afternoon. This suggests that the meteorological parameters have a significant impact on the ozone production.

The ARM data showed a strong annual trend, which was subsequently subtracted out of the data. The differences in the morning and afternoon were then correlated, $\rho = 0.65$ during the biomass season, which suggest that the data may be influenced by not only the local meteorology but the smoke received from the biomass burning.

The bushfire data was used to 'correlate' with the ARM data. Throughout the year (March '02 – June '03) there were many recorded fires, but many of them were either too far to have any effect or the wind wasn't blowing in the right direction. But there were 5 groups of days which were of a close proximity (under 1000kms) and the winds were in the favorable direction. Of the five days, the 14th, 16th and 20th of October give the best indication of the impact biomass burning has in ozone production. A total of 17658.08kms² of fire affected area was detected on the 13th of August at an average distance of 672.68kms and bearing of 216°37'17". The synoptic charts indicated that the winds were blowing in from the S-SW direction. The morning and afternoon differences are 10.88DU, 18.68DU and 10.09DU on the 14th, 16th and 20th respectively. Although this is a simple analysis, it gives good reason to assume that the ozone readings were affected by the biomass burning on the 13th.



The correlation between the monthly morning and afternoon averages, derived from the ARM measurements, shows a positive relationship, $\rho = 0.85$, which is expected. But when taking a closer look at the daily values of morning and afternoon during the biomass burning season, the correlation decreases to $\rho = 0.59$, which suggests that the daily variation of the biomass burning and the complex meteorology play a larger role. The data was correlated with the temperature, $\rho = 0.32$ and $\rho = 0.47$, morning and afternoon respectively, with wind speed and direction, and all suggest that the afternoon meteorology dominate the overall ozone production.