“In the Lord we trust…. all others must provide data!”

anonymous
- Seasonal pattern is discernable in sub-μm data, contrasting the total fraction.
- Annual mean aerosol scattering of PM10 fraction is 6x higher than PM1 fraction.
- For the PM1 fraction, Summer months (DJF) have the least variation in aerosol light scattering (2 – 4 Mm⁻¹) – highest wind speeds; mainly from south (marine organic particles & predominantly sea salt particles?)
- Late Autumn - Winter months (MJJA) are dominated by urban particles; also evident in ω and å
Single Scattering Albedo ($\omega_0$): Continental vs Marine fraction

- Continental = $^{222}$Rn > 1200 mBeq/m$^3$  
  Marine = $^{222}$Rn < 350 mBeq/m$^3$
- Both Continental & Marine albedo fractions display an annual cycle
- Continental annual mean $\omega_0 \sim 0.92$ compared to $\sim 0.99$ for marine
- Marine fraction – generally, most of seasonal variation is in the $5^{th}$ – $25^{th}$ percentile of data compared to $5^{th}$ – $95^{th}$ percentile of Continental fraction
- From May – Sep, Continental albedo fraction contains Urban signal & instances of Biomass burning (resulting in higher amounts of absorbing aerosols)
- Complex to decipher when considering $\omega_0$ alone – deal with frontal systems as well as incidences of inversion trapping of pollutants
Smaller Å indicative of large particles & bigger Å indicate smaller particle sizes

Strong evidence of a seasonal pattern in data set

Smaller particles dominate in late autumn - winter months (AMJJ when mean Å > 0) & larger particles in summer season (NDJFM) when mean Å ≤ 0 (mainly sea-salt dominance)

Strongest seasonal pattern observed in the 75th - 95th percentile data
Aerosol optical properties as f(x) of Carbon monoxide distribution

- CO is a good indicator of anthropogenic influence(s): at CPT baseline CO ranges from 40 – 70 ppb
- Both absorption and scattering follows similar increases with increasing [CO]
- For the sub-μm data – sudden increase in absorption & scattering as CO increase above 70 ppb
Changes in albedo is very sensitive to variations in CO

- For CO < 50 ppb, albedo corresponds to ~0.97 – 1.0 (particles of mostly of reflective nature)
- For CO < 130 ppb, albedo ~0.93 – 0.83 (darker particles more absorptive in nature)
- 3 albedo “ranges” representing (1) clean, marine air (2) mixed urban / continental / biomass (3) urban combustion & biomass burning

Backscatter fraction is another indicator of particle size: ratio of $\sigma_{bsp_G}/\sigma_{sp_G}$

As CO increases above baseline, smaller particle sizes become more prominent
Changes in Ångström exp is also very sensitive & abrupt when [CO] changes to polluted conditions

For CO > 50 ppb, very clear shift from larger particle sizes to smaller sizes

At CPT [CO] < 50 ppb ≈ â ≤ 0 and [CO] >100 ppb ≈ â =1

Particle size remain fairly constant on [CO] ~100 - 400 ppb; SSA indicate increase in absorptive nature over the same range

For the sub10μm data, median â ≈1 associated with a SSA of 0.76 – 0.86
Sub-μm scattering fraction increases on [CO] ~20-100 ppb then levels off at 0.4.
Sub-μm absorption fraction decreases from 0.85 – 0.45 in 70+ ppb [CO] range.
Comparison of CPT with 3 marine stations (brw=Barrow, Alaska; wsa=Sable island, Nova Scotia; thd=Trinidad head, California).
As Rsp increases (more scattering due to sub-um particles) angstrom exponent (10um, red/green wavelength pair) also increases.
Summary & Conclusions

- Observed aerosol climatology largely driven by summer – winter wind regimes

- Large range of albedo ($\omega_0$) values for CPT: e.g. continental winter-time total fraction varies between 0.70 – 0.97

- Ångström exp annual cycle clearly reflects the dominance of large, sea salt aerosols in summer months and smaller, combustion related aerosols in winter

- At [CO] above 100 ppb, small particles play a significant role in defining CPT albedo & Ångström exponents

- Complimentary trace gas data (e.g. CO & $^{222}$Rn) useful tool in characterizing overall aerosol climatology at Cape Point
THANK YOU

ANY QUESTIONS?