# A overview of published VOCALS studies on gas composition and aerosol along 20S

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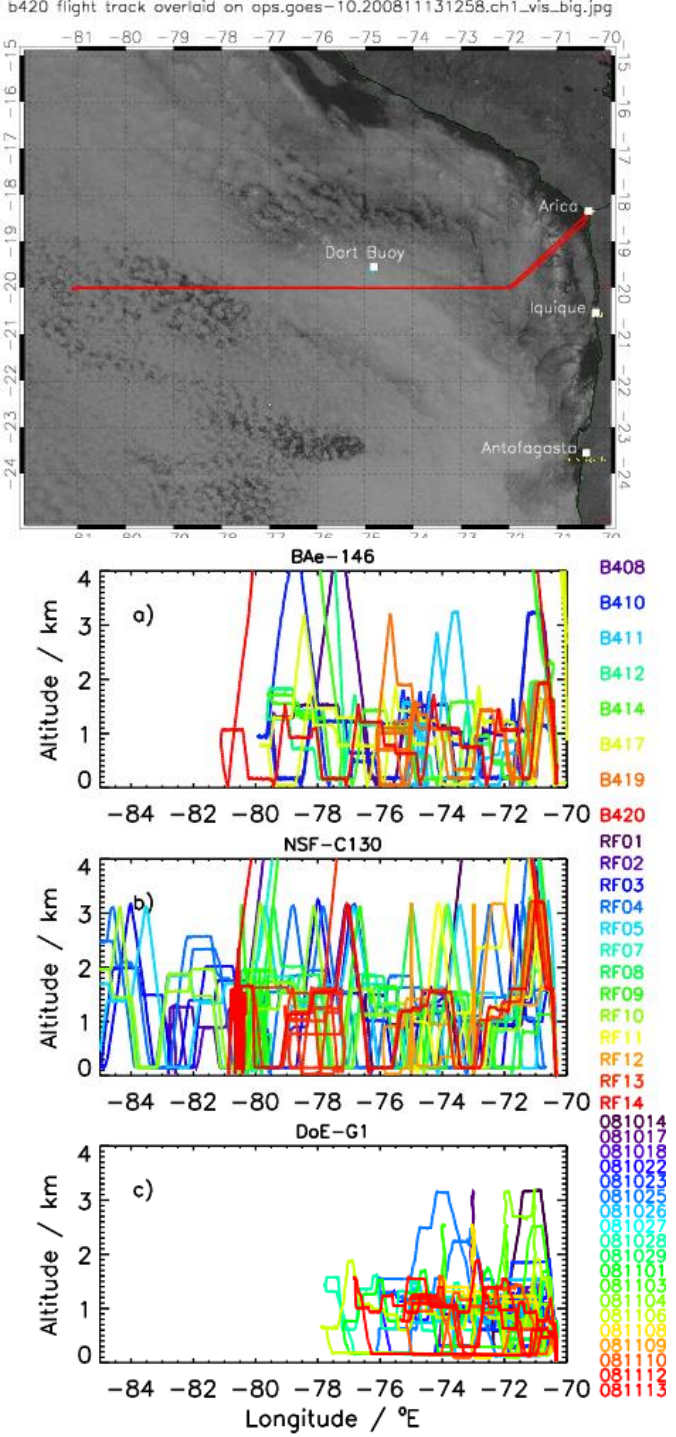
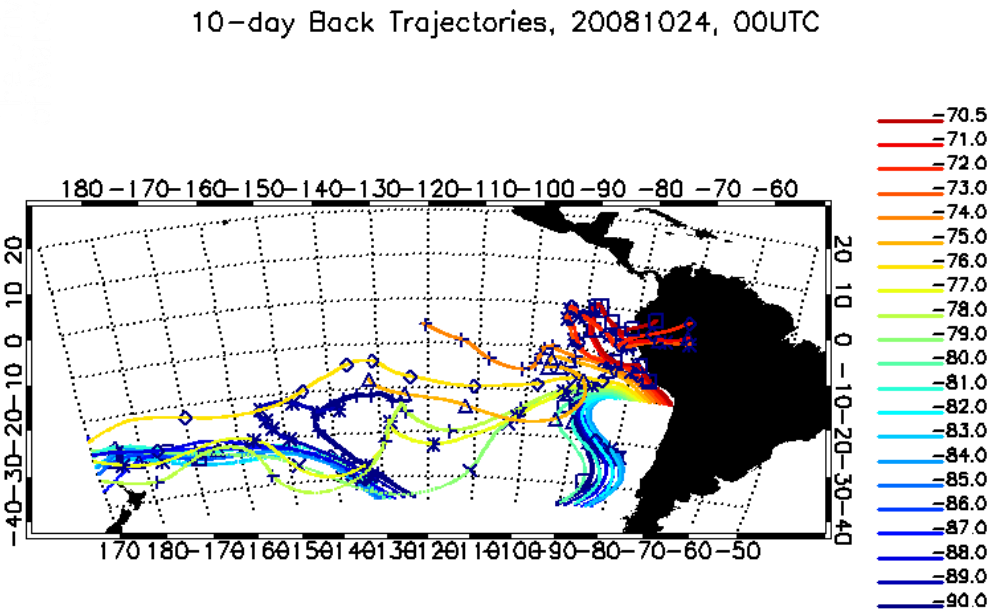
# 20-South Rationale

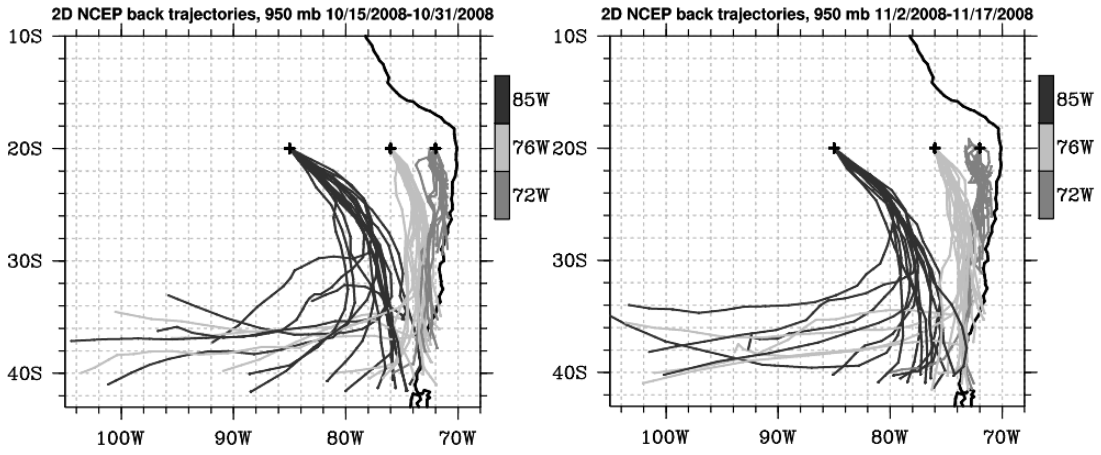
- Statistically representative cloud, thermodynamic and composition dataset in support of modelling.
- UK BAe-146, US DoE-G1, US NSF-C130 and Ron Brown used.
- 35 flights = 230 hours sampling time.
- 70 - 90 W, from 0-7 km, over 24 days.
- Composition statistics as a function of longitude interpreted for airmass history.
- *Allen et al, 2010, ACPD, in press*
- *Links to Bretherton et al., 2010, ACP*

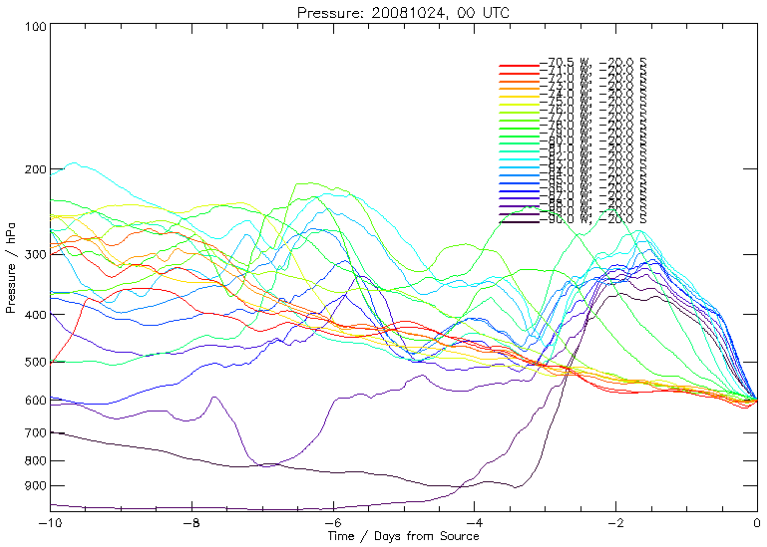


# Back Trajectory Analysis

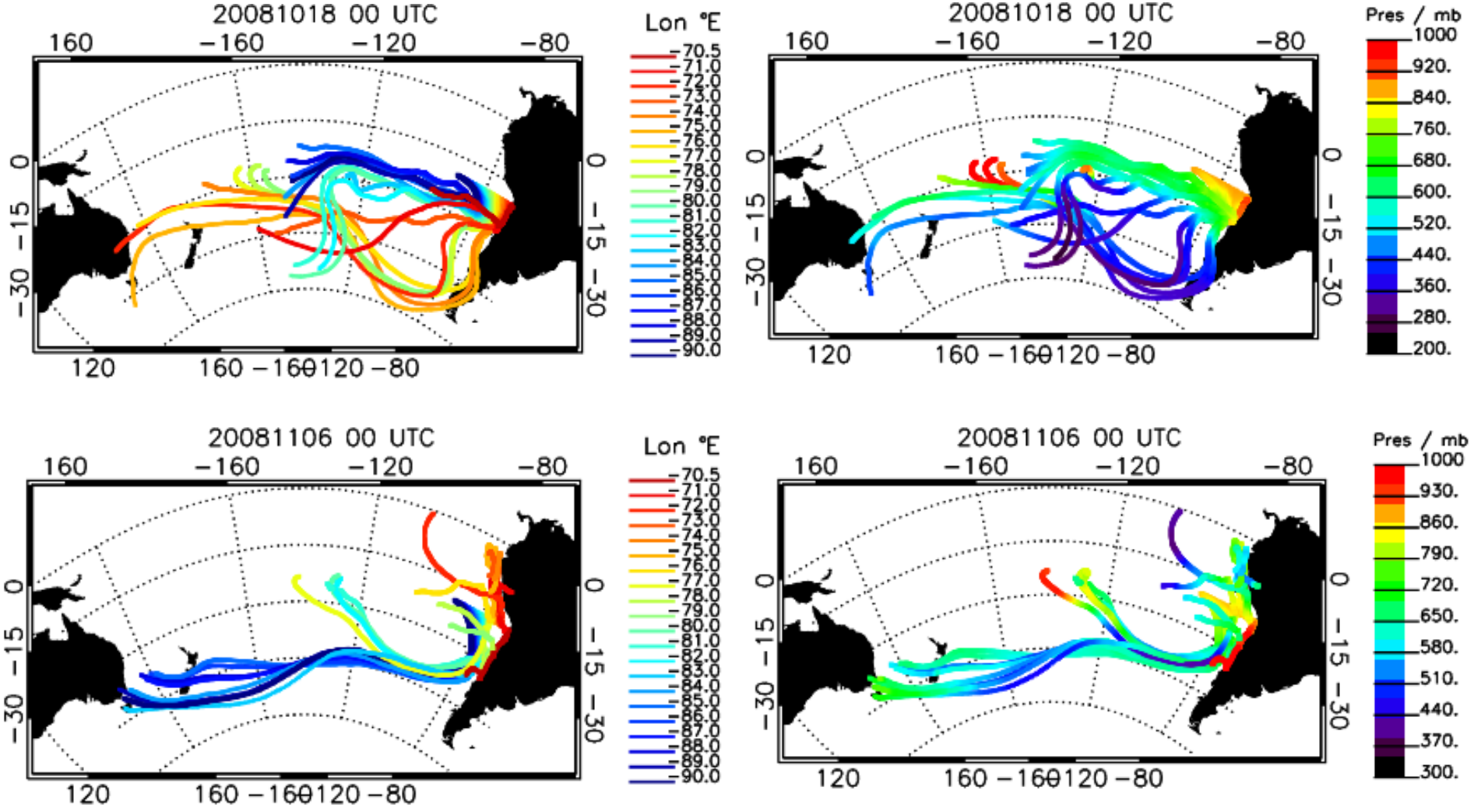



- BL trajectories show lack of variability and more south-north direction than FT
- FT has a gradient in source origin Continental PBL sources near the coast
- Descended long-range remote sources west of 75 W.
- Uplift to UT may have frozen in some pollution signatures and removed others



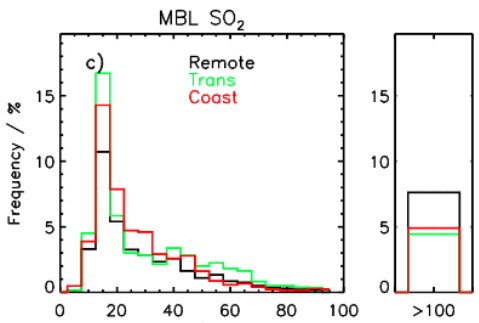



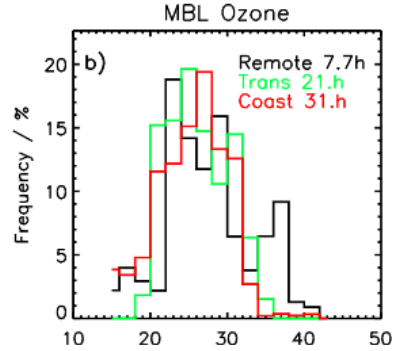
# Back trajectories - FT

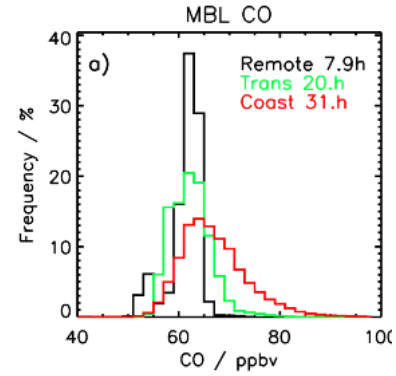


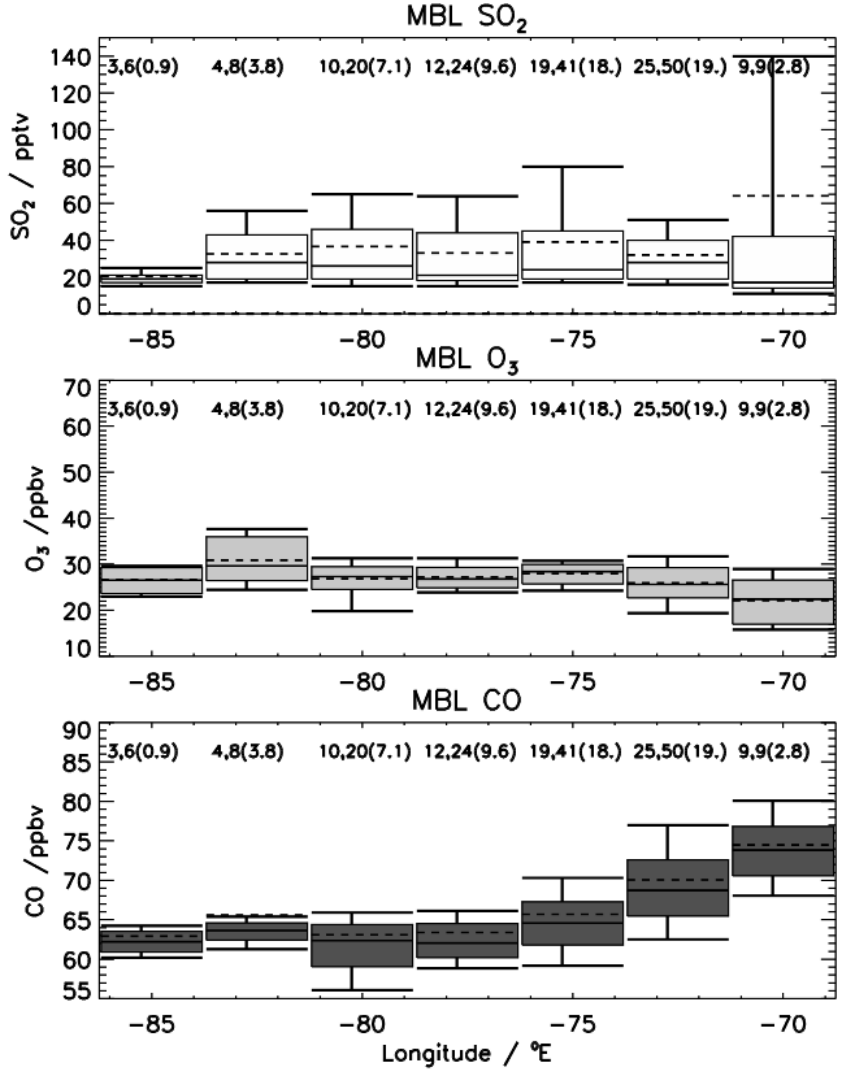
# Coastal Gradients – MBL (Allen et al 2011)

- CO decreases with distance offshore – reduced reach of combustion-affected airmasses
- SO2 shows episodic enhancement near-shore. Note long tail.
- Ozone essentially flat, note bimodal in remote zone



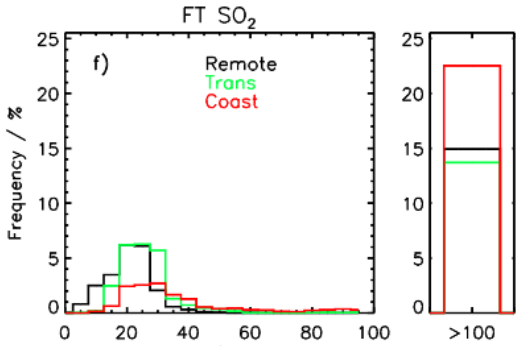



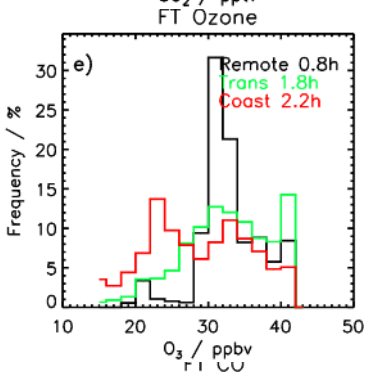



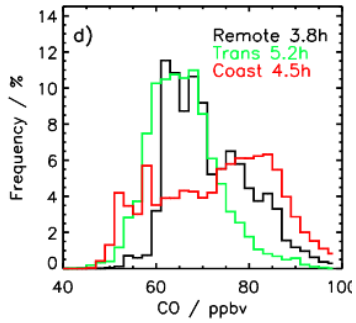



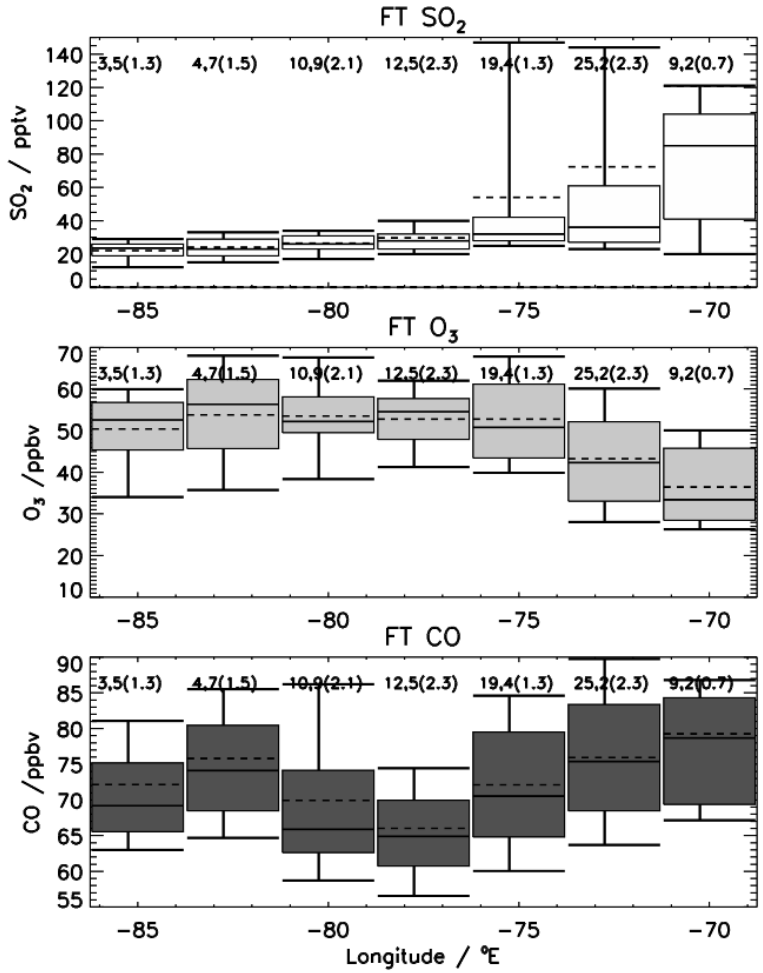
# Coastal gradients - FT

- Weak gradient in CO
- Strong gradient in SO2 with episodic nature
- Increasing gradient in ozone – note bimodal distribution in CO and O3.

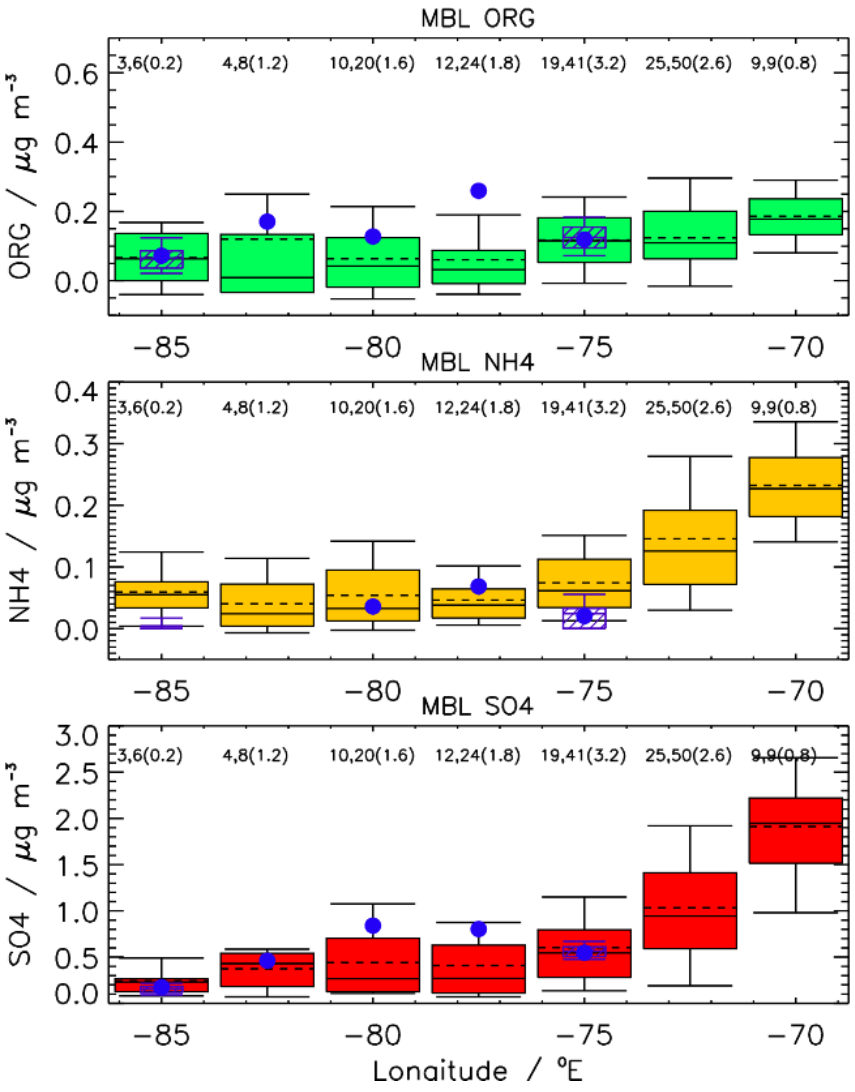


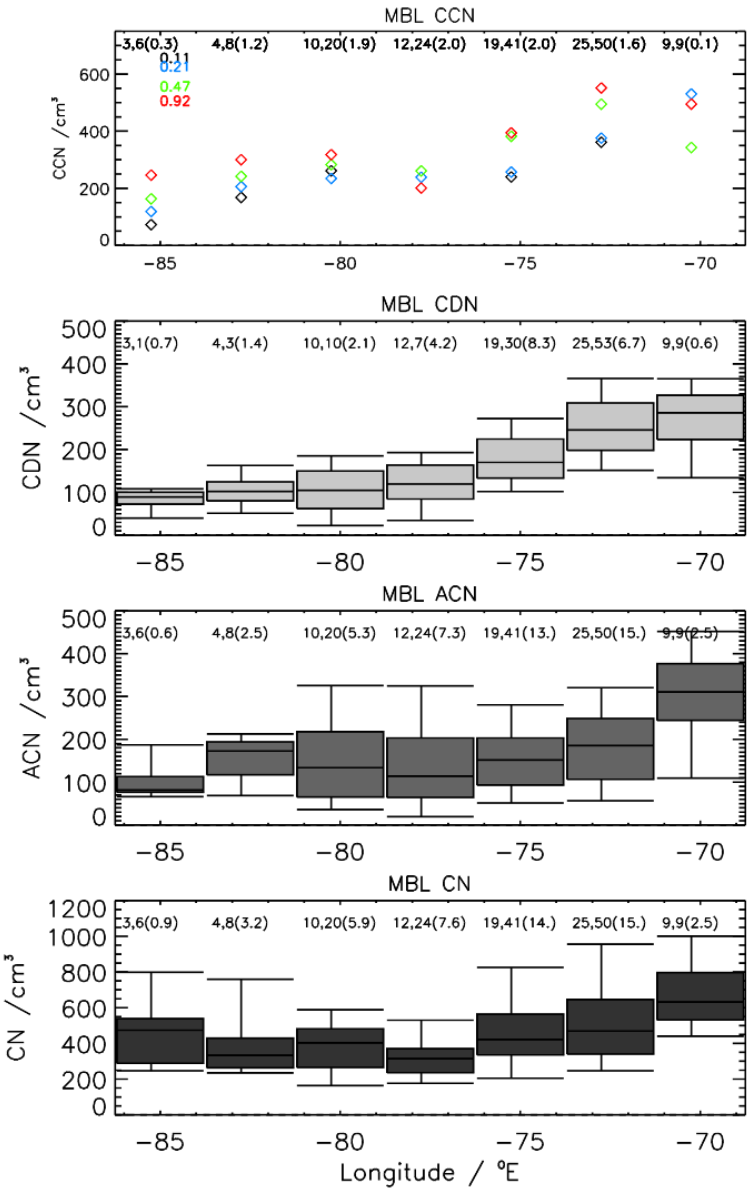



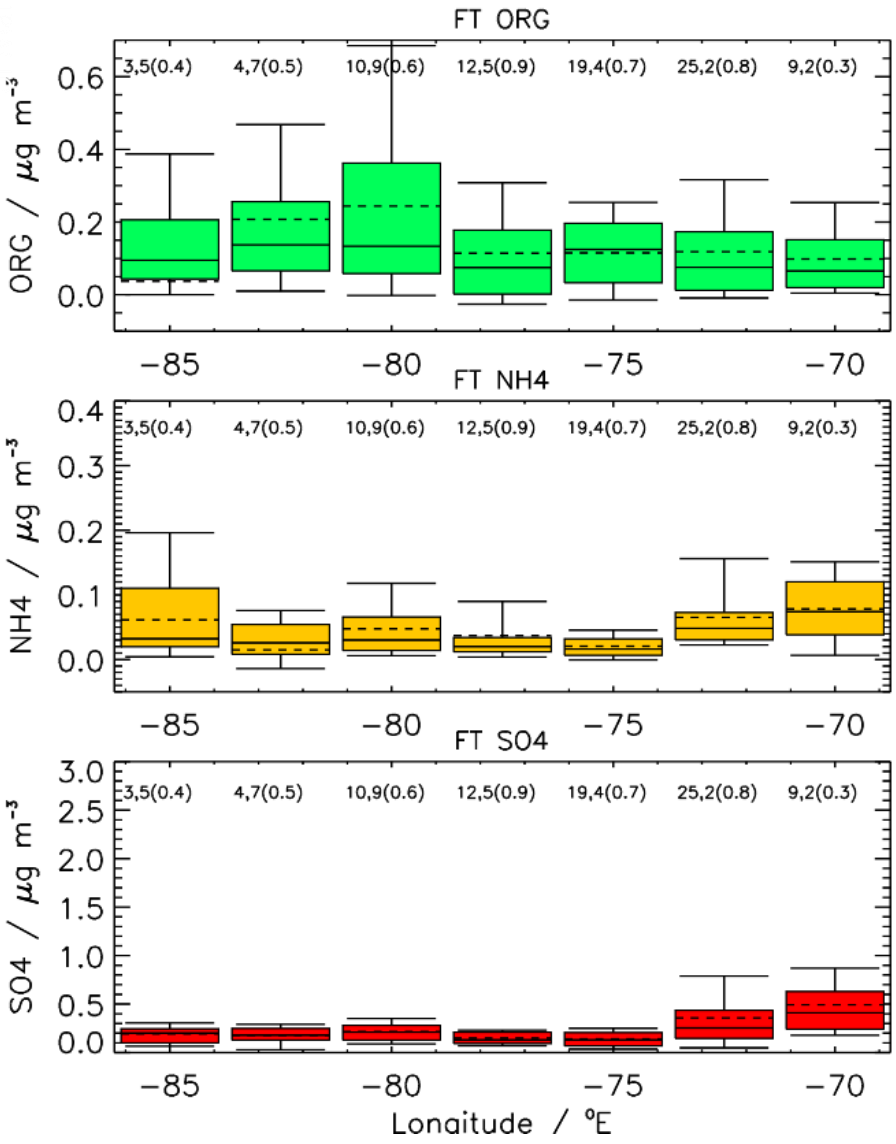



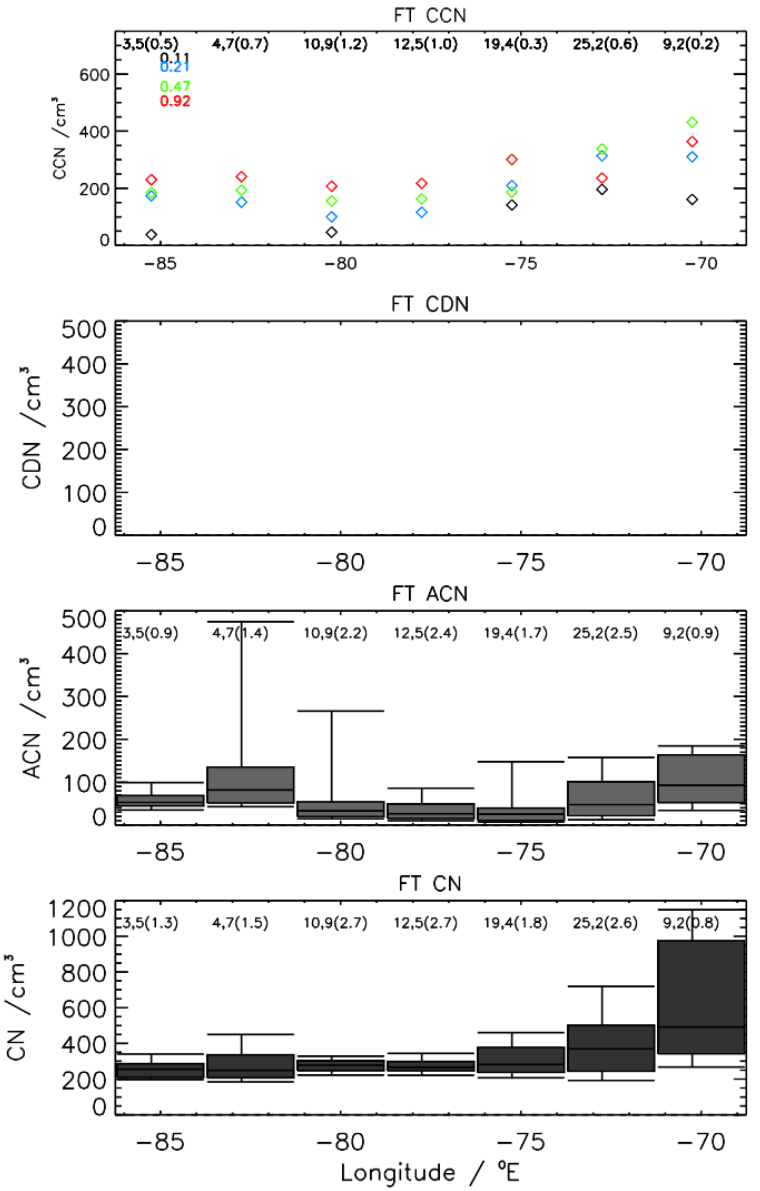
# MBL Aerosol composition and clouds



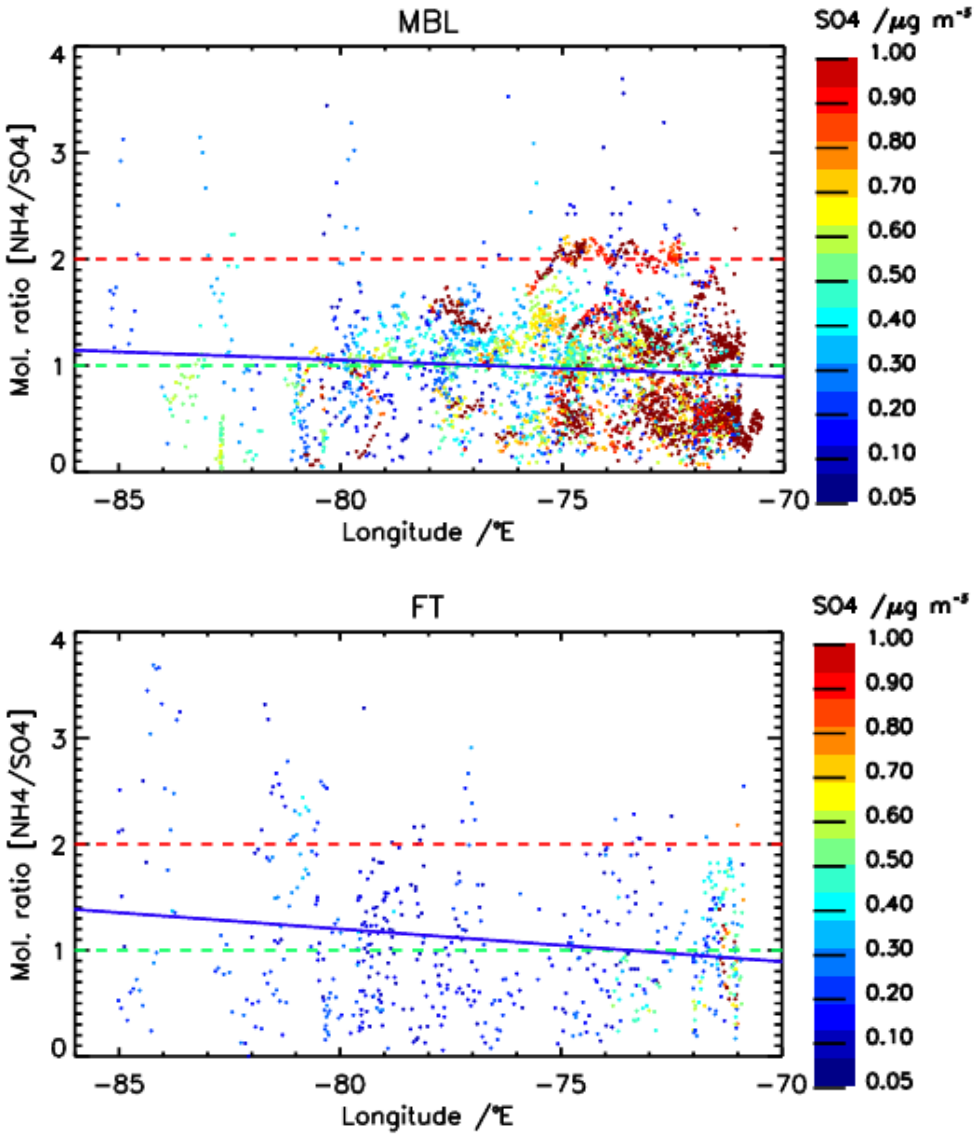



# FT Aerosol and clouds

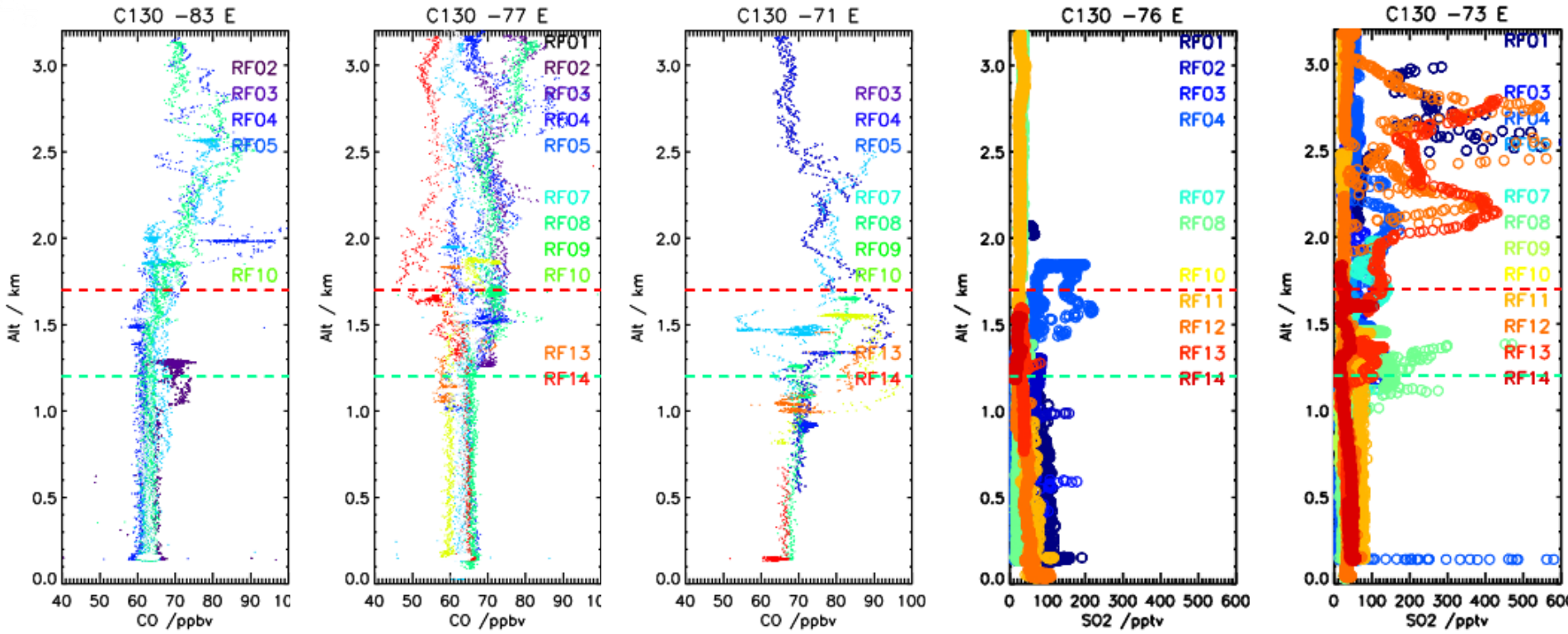


# Aerosol acidity

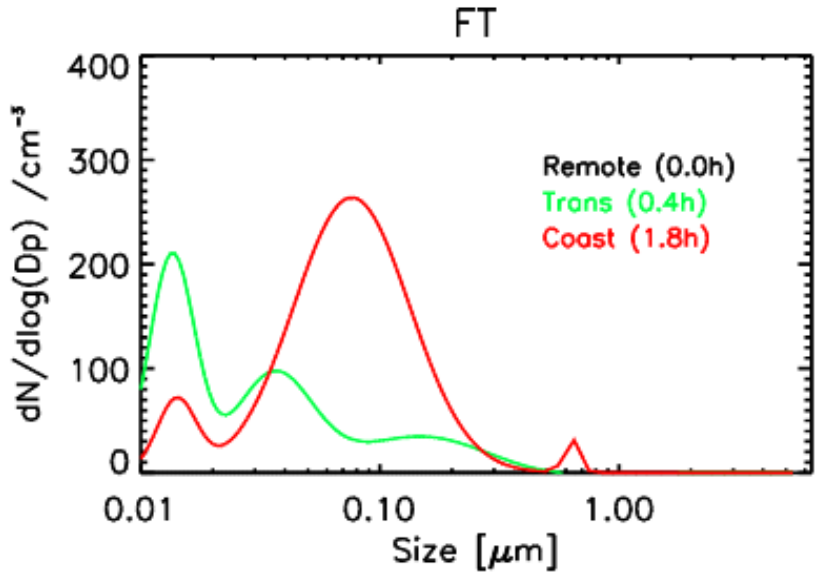


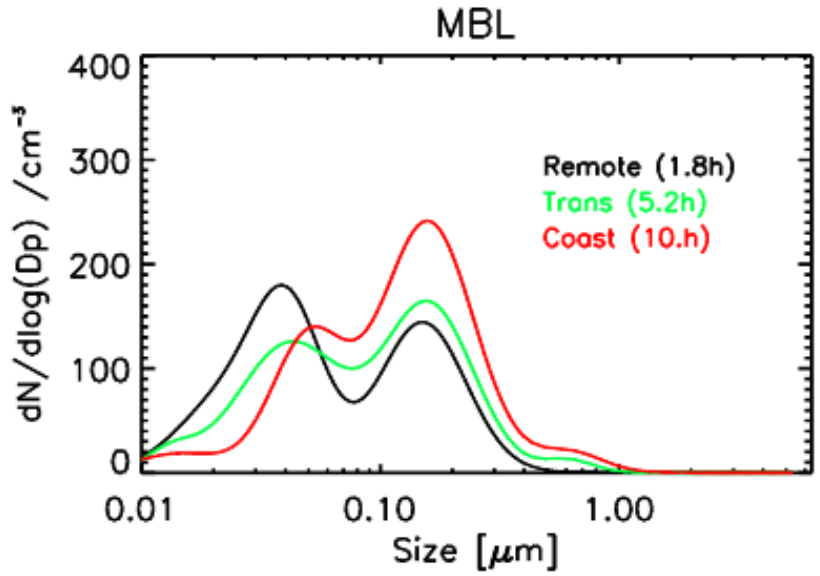
# Variability and mixing

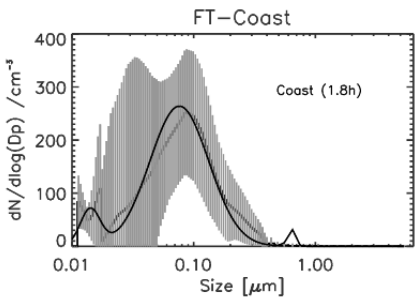


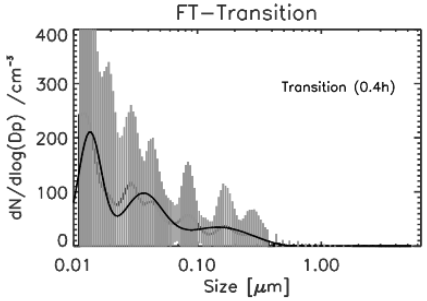

- MBL well mixed
- Often enhancements in the FT – discrete layers.
- Evidence of entrainment and mixing in the cloud layer

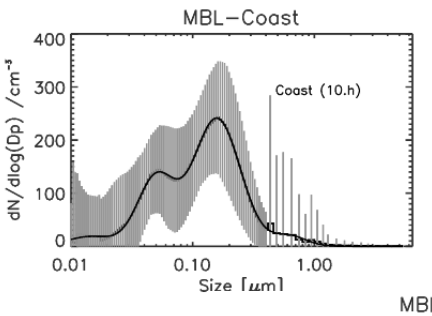
# Aerosol size distributions

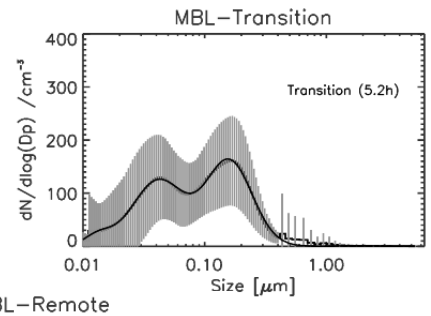


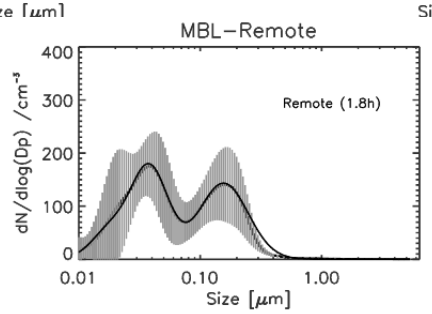



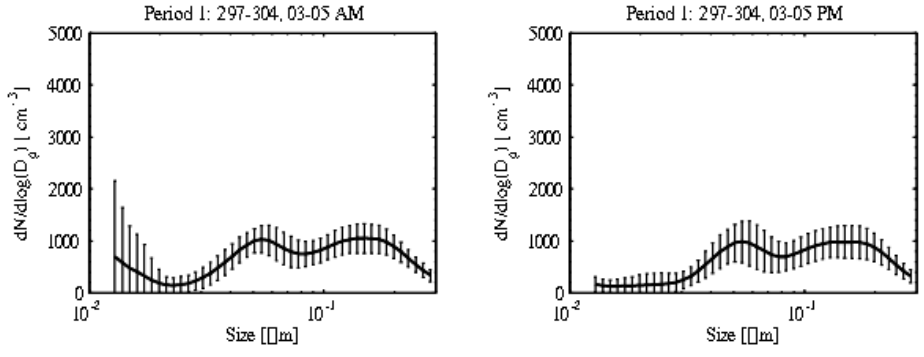



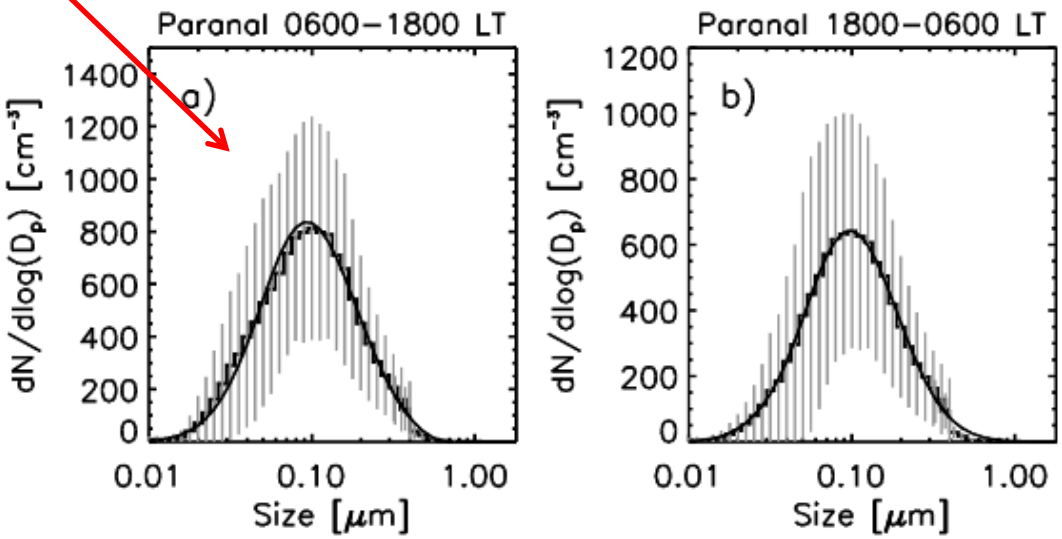




Dominant 100-110 nm mode. Occasional evidence of recent growth (cloud depletion)

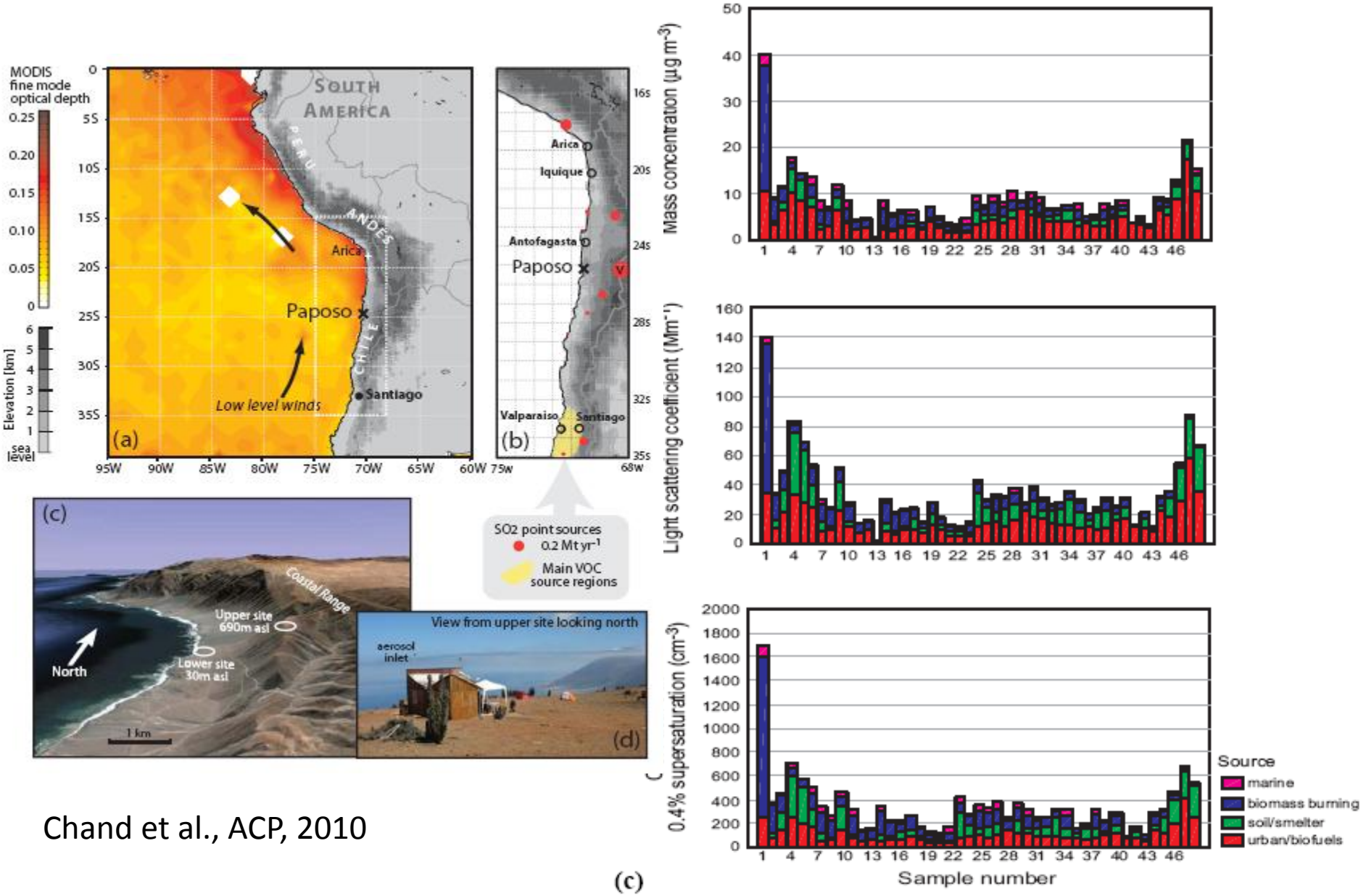
# Size distributions from coastal sites

- Little variability at Paranal (2690 masl)
- High variability at Paposo (690 masl), especially in growth modes (40 nm)



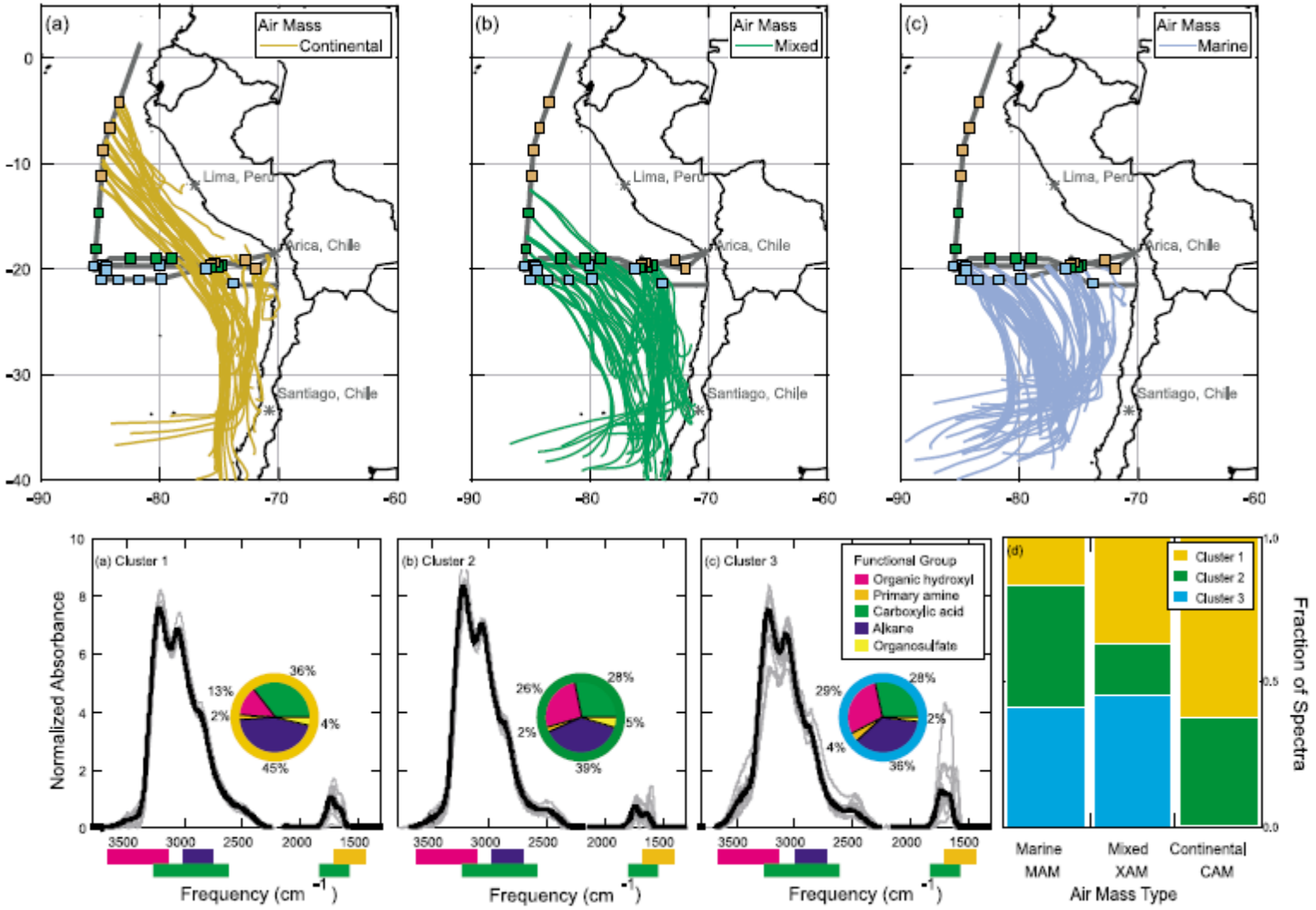



# Source attribution at the coast




Chand et al., ACP, 2010

# Aerosol chemical characterisation offshore




Hawkins et al., JGR, 2009

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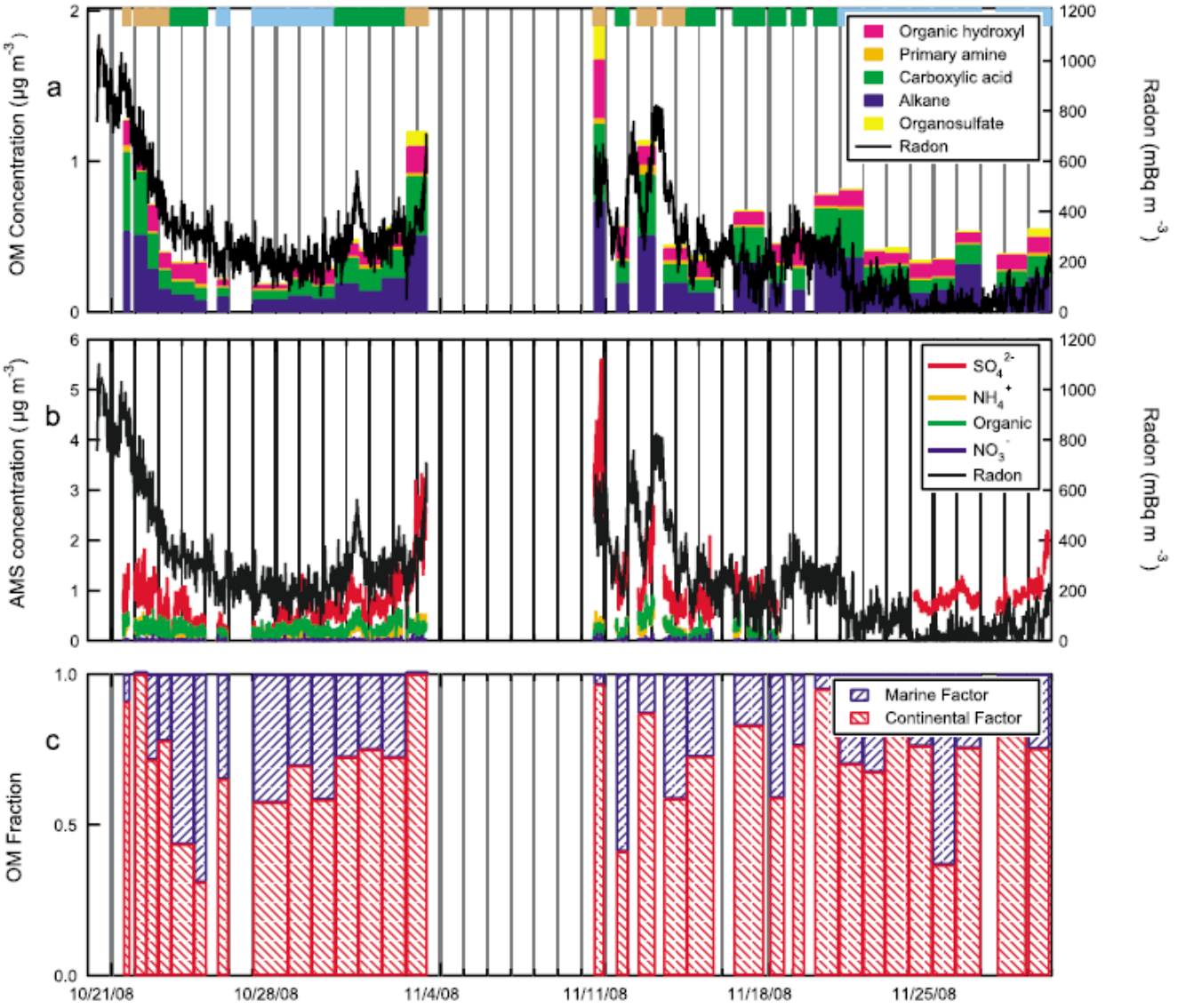


Hawkins et al., JGR, 2009

# Summary of VOCALS Chemical characterisation findings published to date

• Significant zonal gradients in mean MBL sub-micron aerosol particle size and composition, CO, O3 and SO2 – associated with similar gradients in CDN

• FT is often more polluted than the MBL in the mean but highly variable – complex interleaving of air masses from diverse source

• Points to entrainment being an important process – Tony Clarke

• Coastal measurements indicate that whilst urban/biofiel sources dominate the contribution to aerosol mass, biomass burning are an important contribution to CCN

• Shipborne measurements indicate the majority of the organic matter in aerosol are anthropogenic in nature, with some primary marine contribution