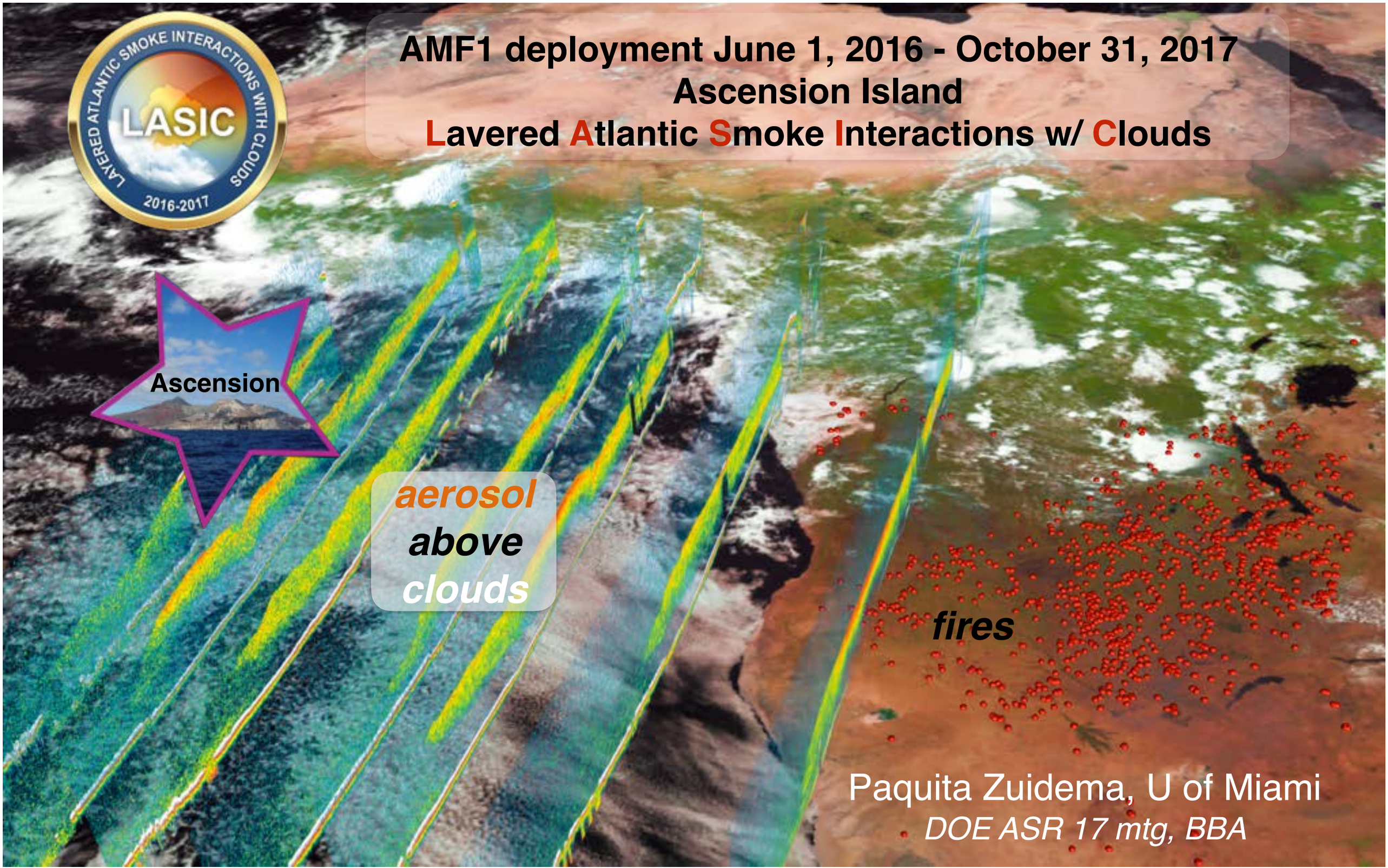
LASIC is interrogating the absorbing-aerosols-above-low-cloud regime: climatically-important, unprecedented data



August 13
rBC>1700 ng m^{-3}

objectives
- improve knowledge of BBA properties
- characterize aerosol-cloud vertical structure
- understand cloud adjustments to BBA

DOE AMF1 deployment
Layered Atlantic Smoke Interactions Campaign (LASIC)
June 1, 2016 - October 31, 2017

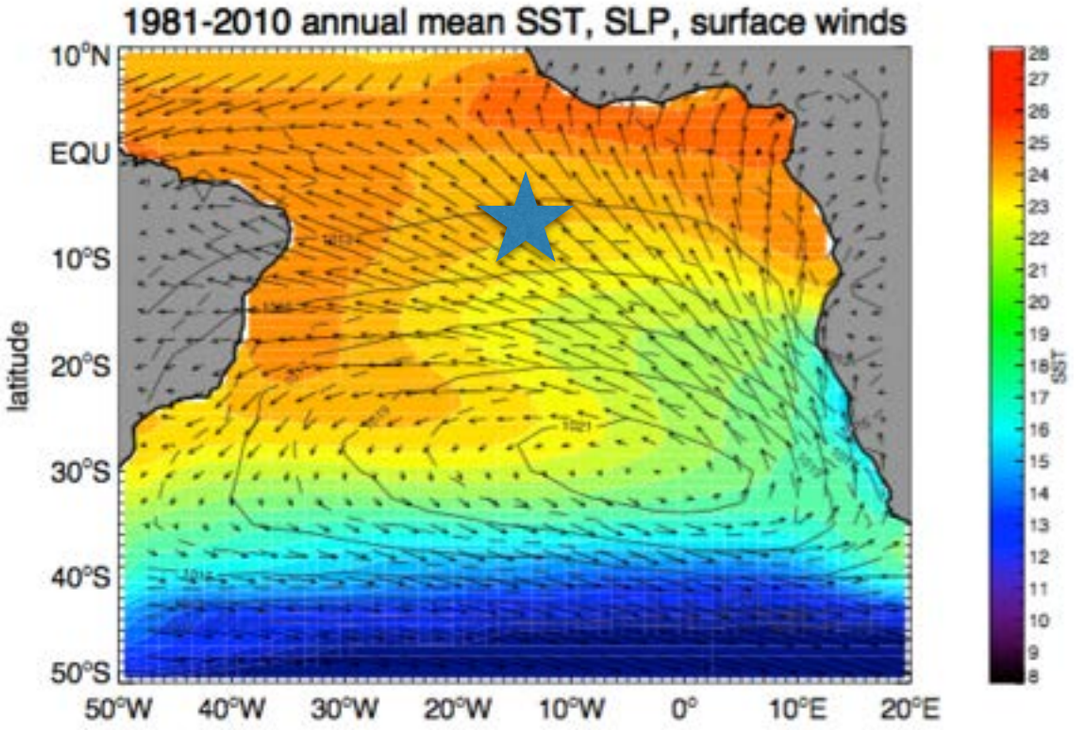
aerosol: ***sizes (UHSAS,SMPS), hygroscopicity (HTDMA), cloud nucleation activity (CCN,CPC,CPC2), carbon mass (SP2), scattering&absorption (PSAP, neph, aeth, humidigraph)***

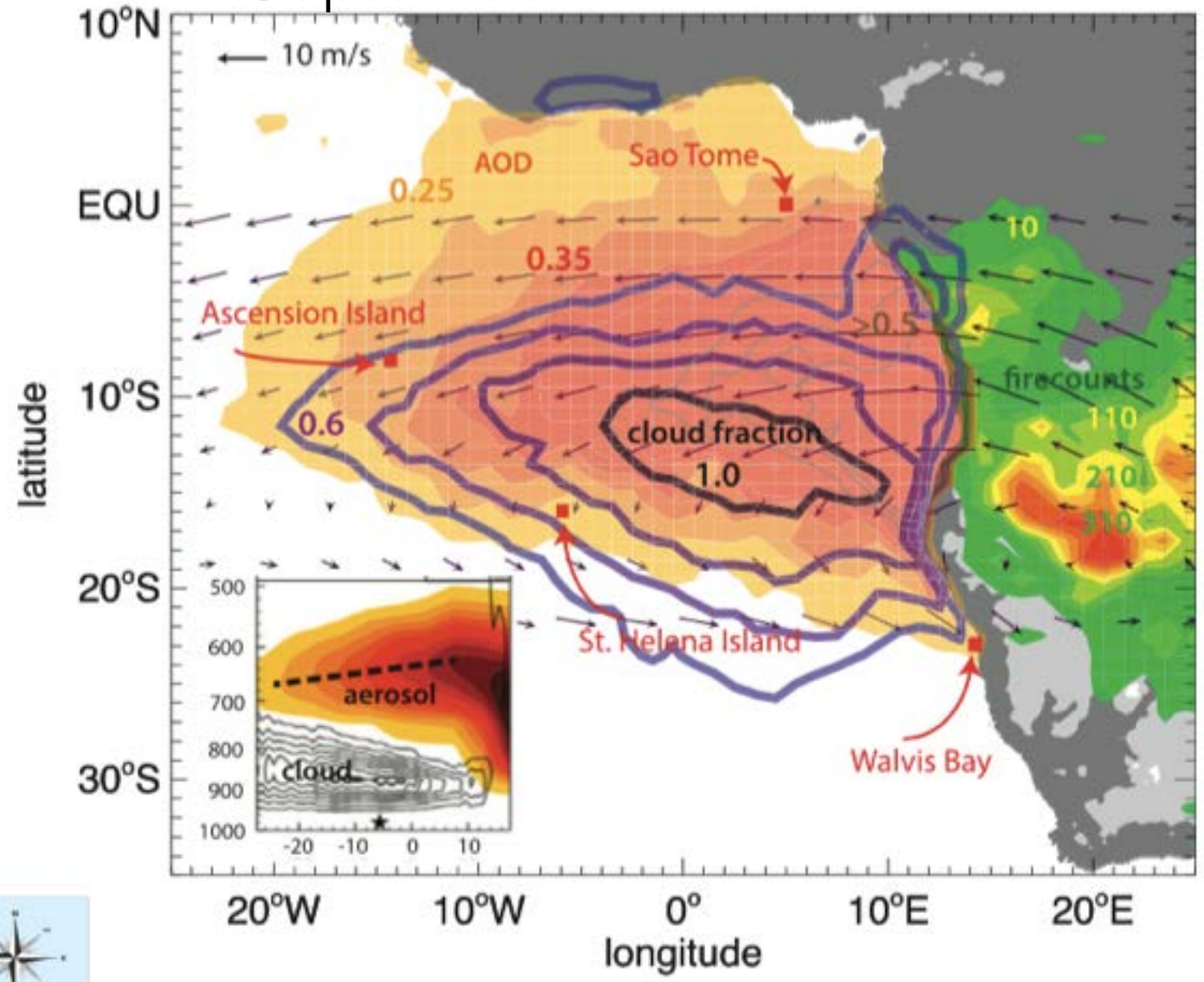
vertical structure: ***aerosol, cloud, precipitation (micro pulse lidar, ceilometer, 35 & 90 GHz zenith and scanning radars), thermodynamics & dynamics (radiosondes, 4-8x/daily, radar wind profiler)***

passive remote sensing: ***aerosol (MFRSR,sun photometer), cloud (AERI, MWR), radiation (SASHE, SASZE, NFOV)***

08 26 2016

background

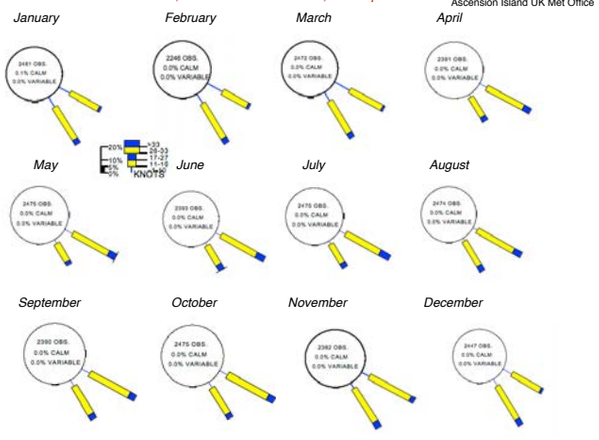




UK Met Office* monthly-mean surface wind roses, 2005-2014

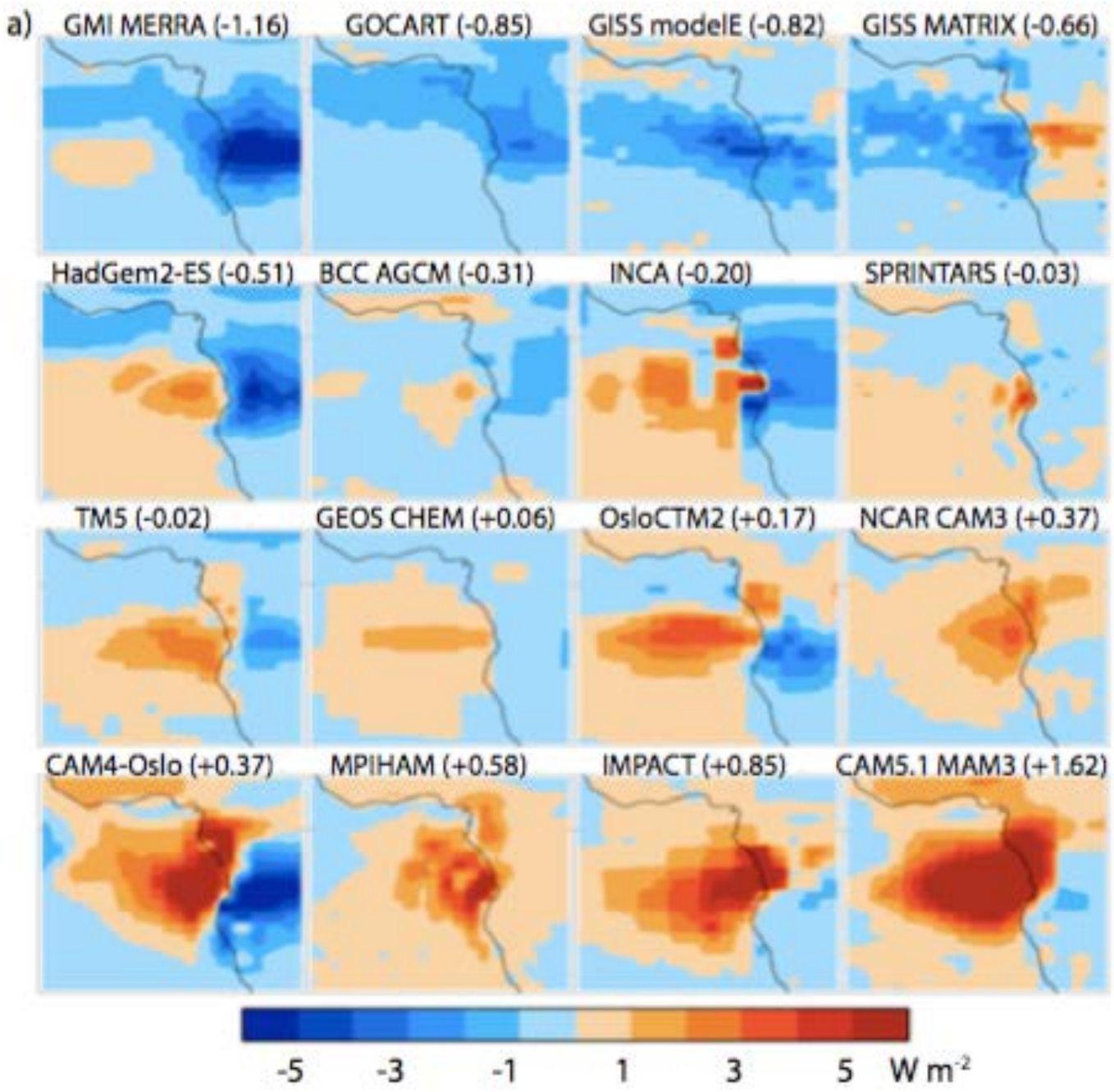
winds consistent, SSE December-March, ESE April-October

*Simon Fox, Ascension Island UK Met Office

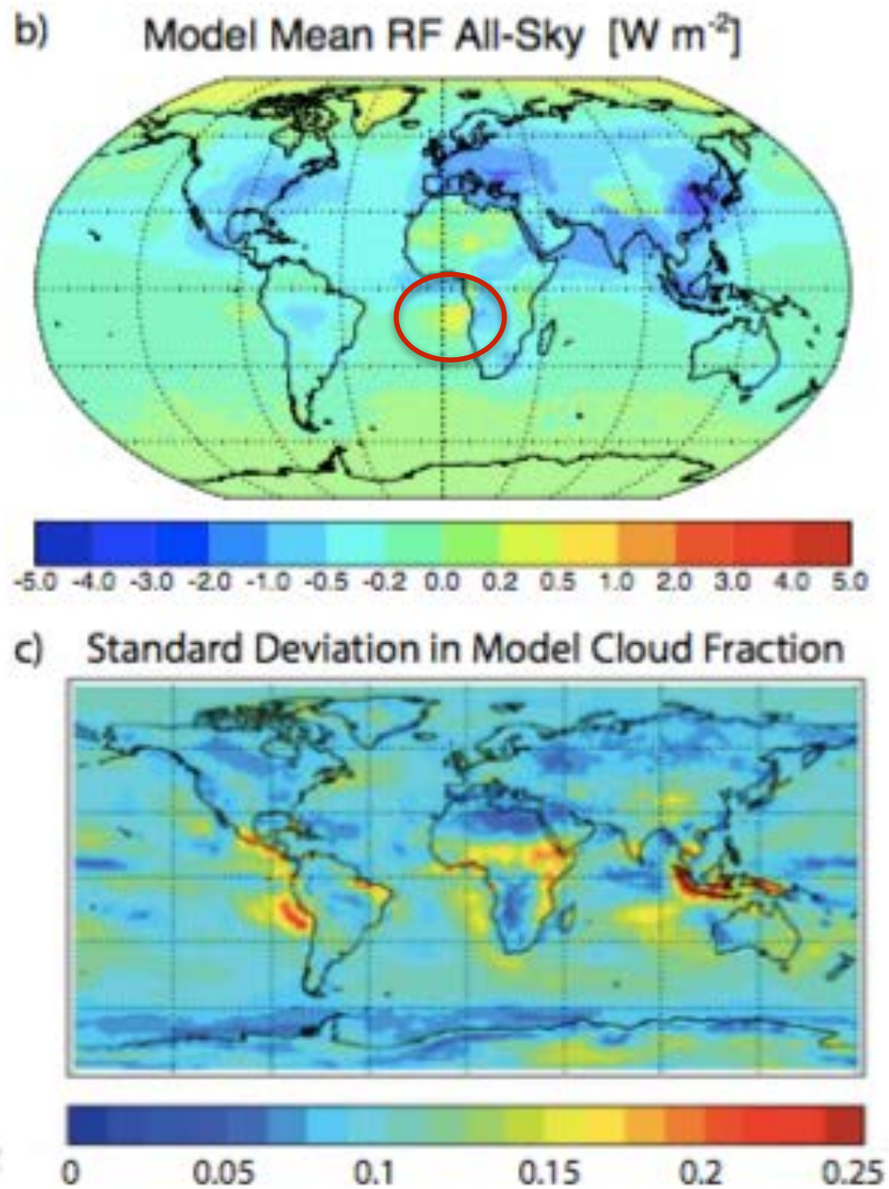


global aerosol models highlight southeast Atlantic direct radiative warming, but estimates vary significantly

individual model set-ups



AEROCOM model assessment
- fixed aerosol radiative properties

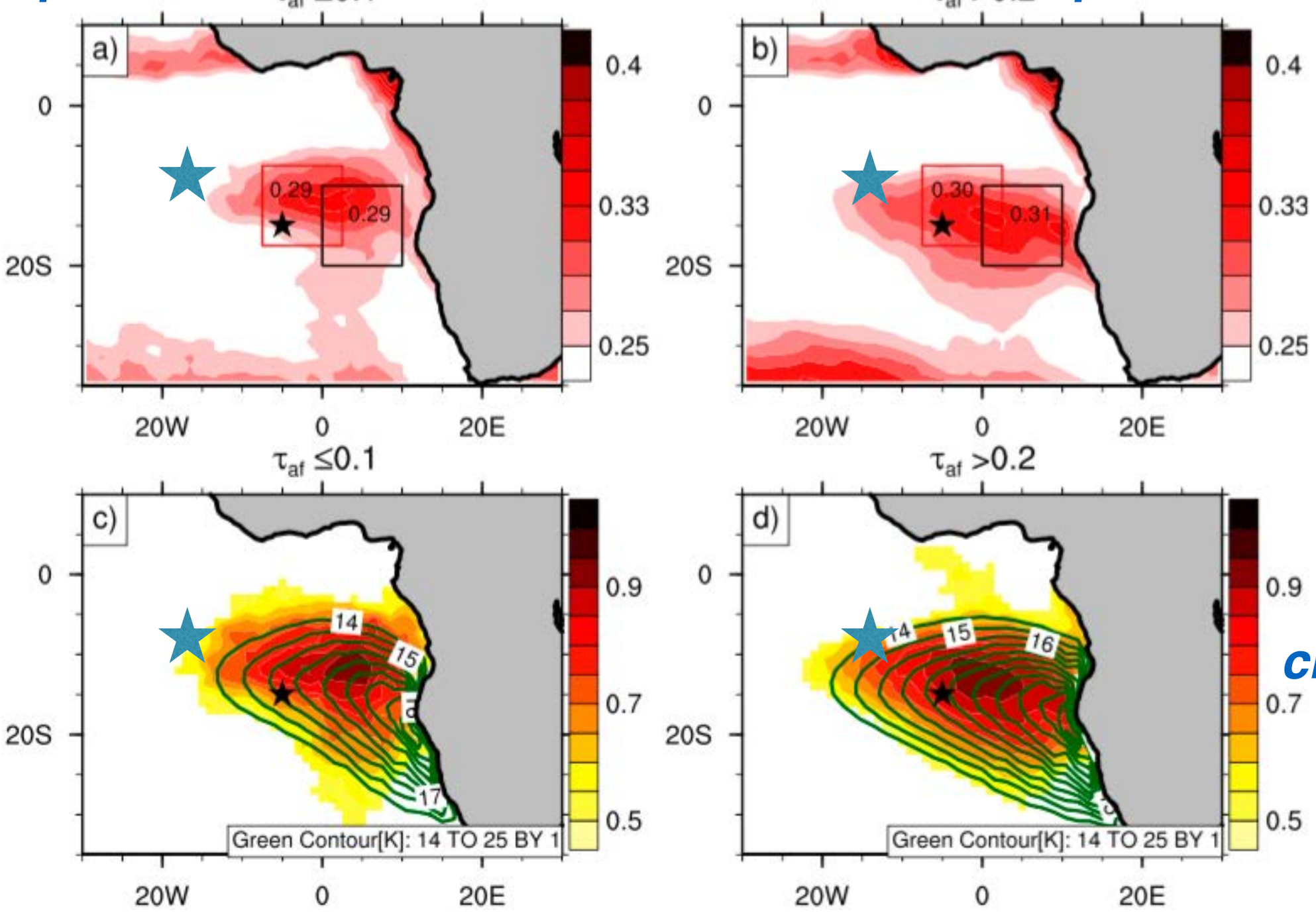


adapted from Stier et al., 2013

highly sensitive to SSA value

also conceivable semi-direct radiative effect may exceed direct radiative effect

pristine $\tau_{af} \leq 0.1$ $\tau_{af} > 0.2$ ***polluted***



CERES all-sky albedo

MODIS cloud fraction, ERA-I LTS

Adebiyi et al., 2015 JCLIM

pre-deployment thinking: most aerosol, cloud in September

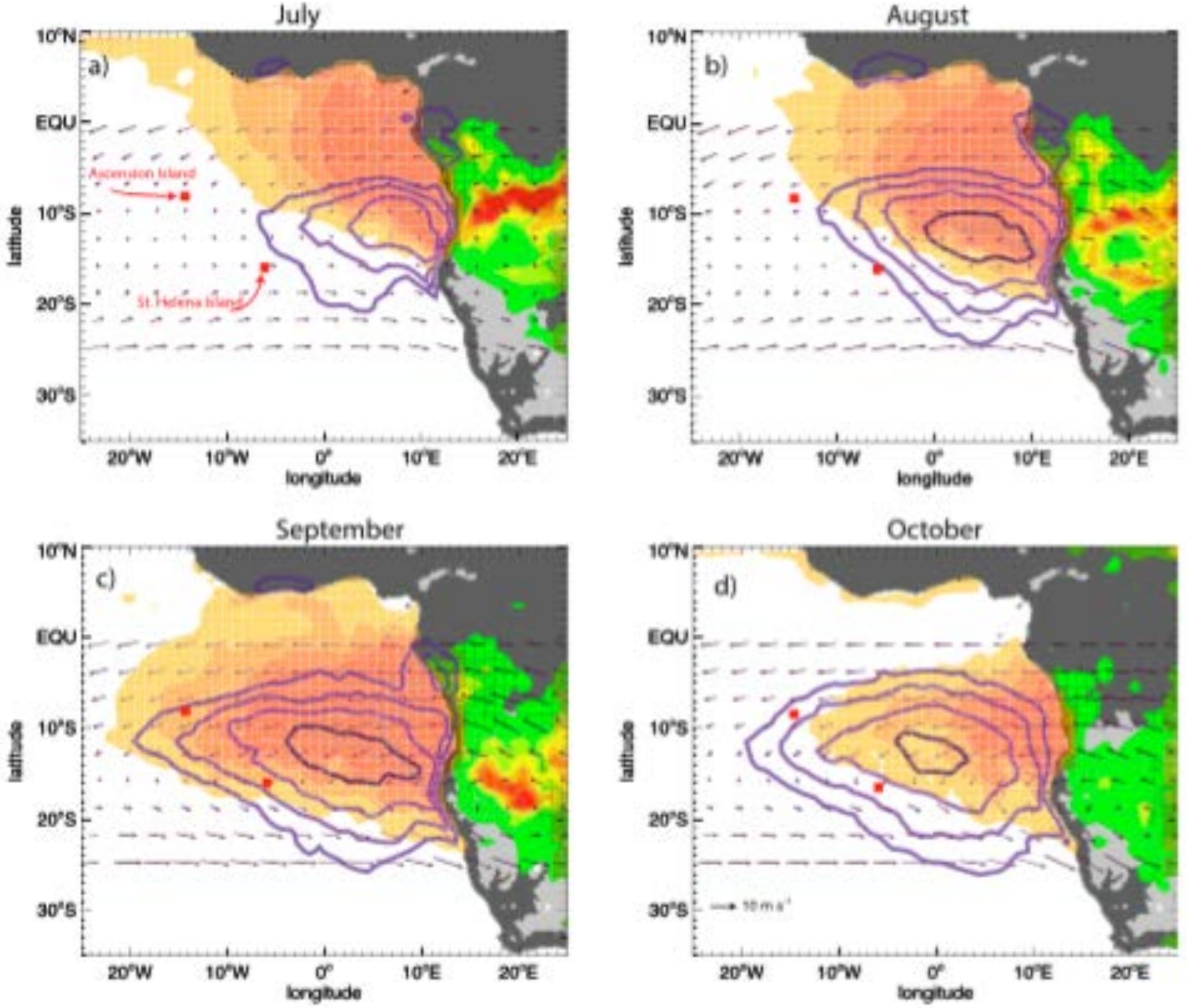
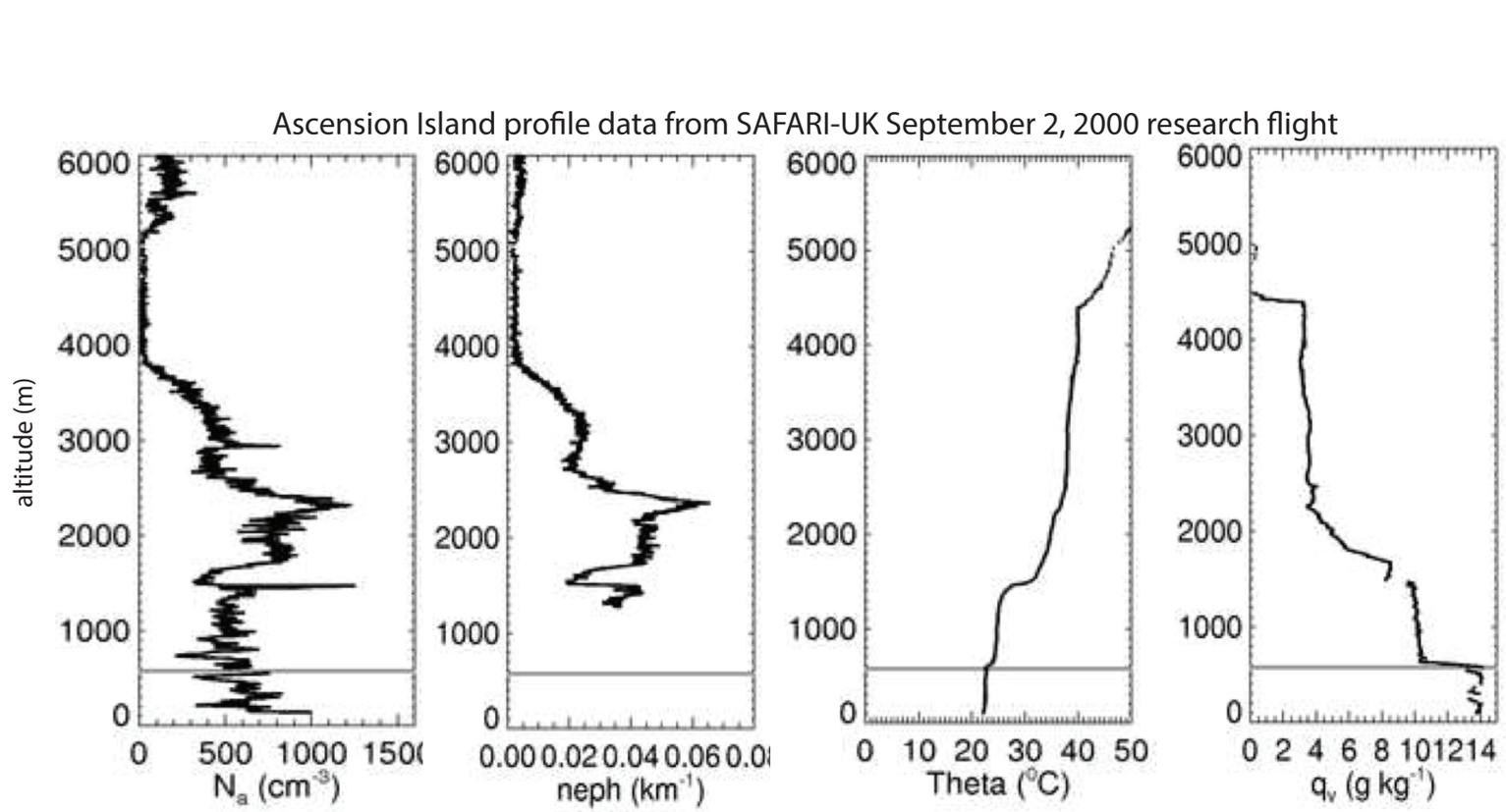


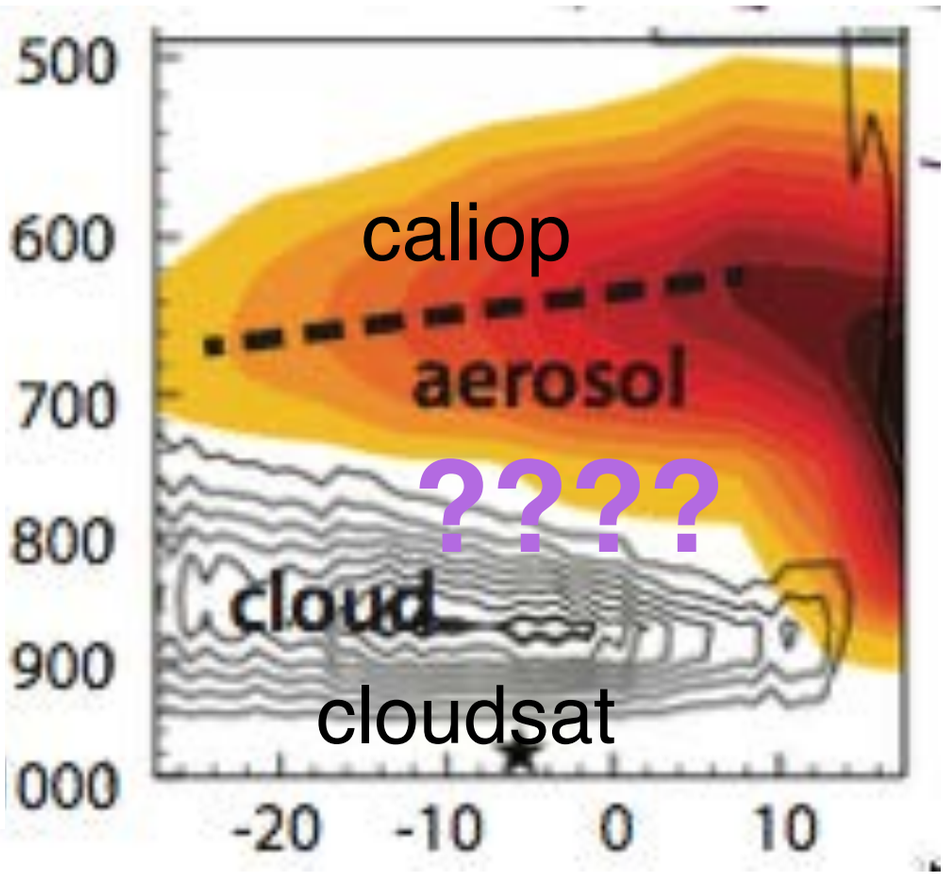
FIG. 5. (a) July, (b) August, (c) September, and (d) October MODIS mean 2002–12 cloud fraction (blue to black contours, 0.6–1.0 increments of 0.1), fine-mode aerosol optical depth (yellow-red shading indicates 0.25–0.45 in increments of 0.05 and very light black contour lines indicate 0.5–0.7 in increments of 0.1), fire pixel counts (green–red shading, 10–510 in increments of 50), and ERA-Interim 2002–12 monthly-mean 600-hPa winds. Red squares indicate Ascension Island and St. Helena Island.

Adebiyi et al., 2015 JCLIM

pre-deployment thinking:

only one known documentation of aerosol mixing down to surface. how often does this happen?

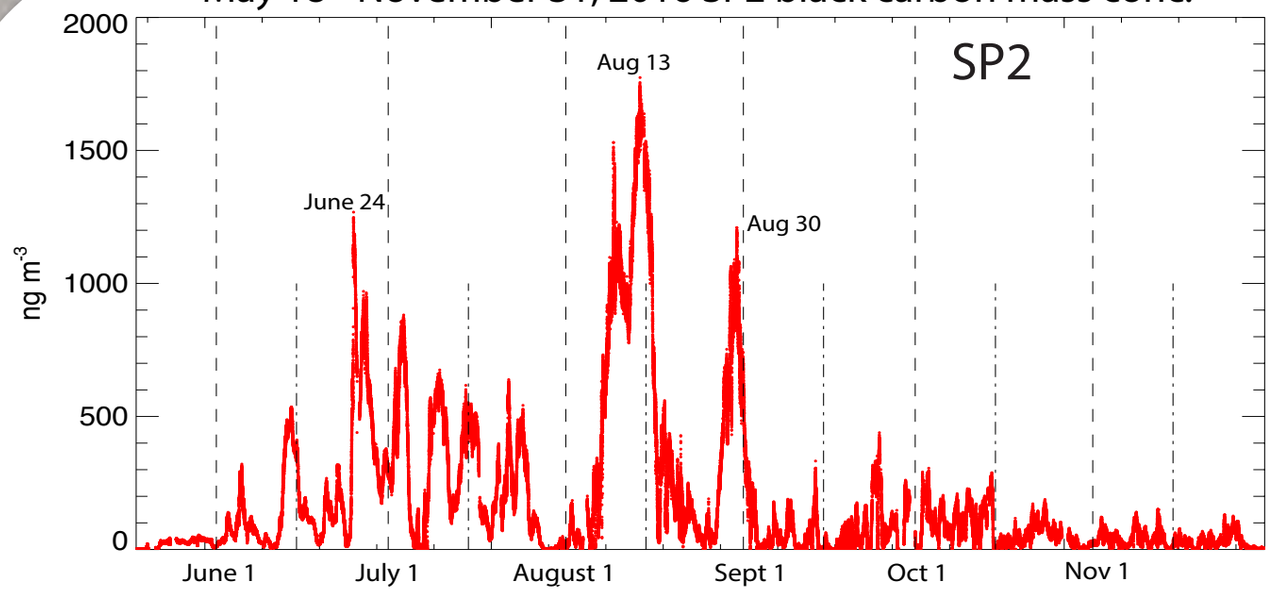




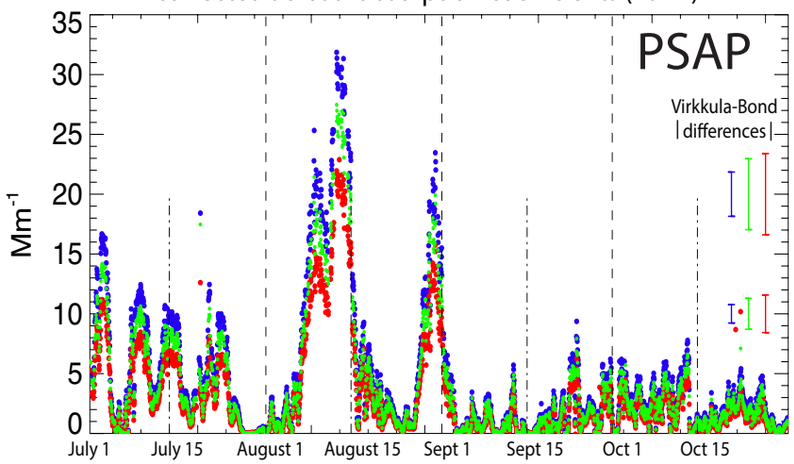
answer:often

August 13
rBC>1700 ng m^{-3}

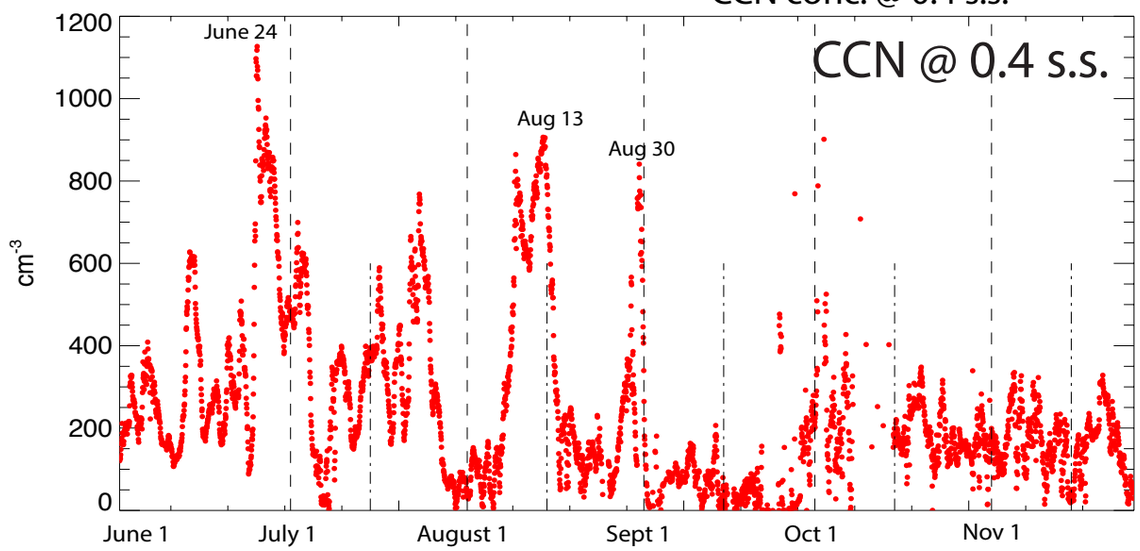
May 18 - November 31, 2016 SP2 black carbon mass conc.



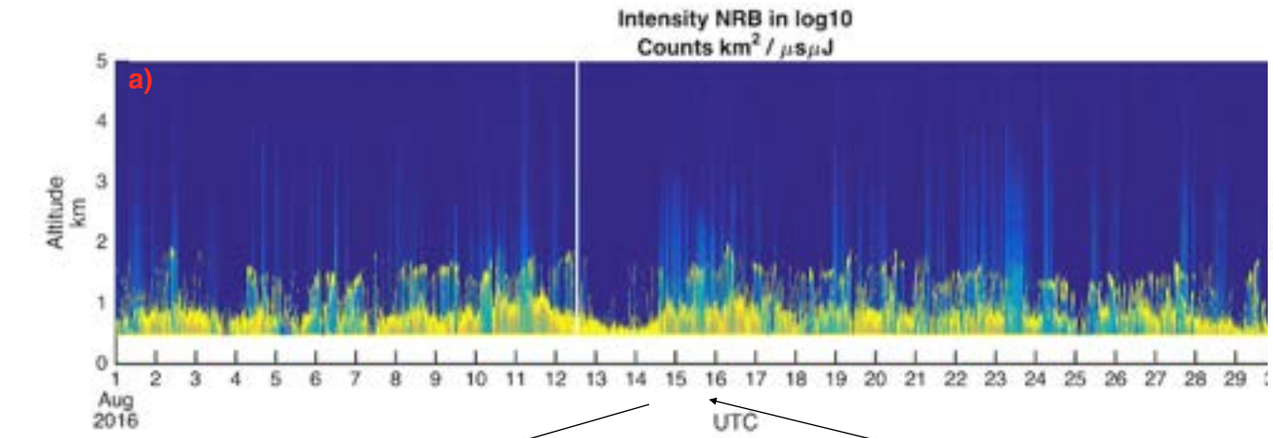
corrected aerosol absorption coefficients (PSAP)

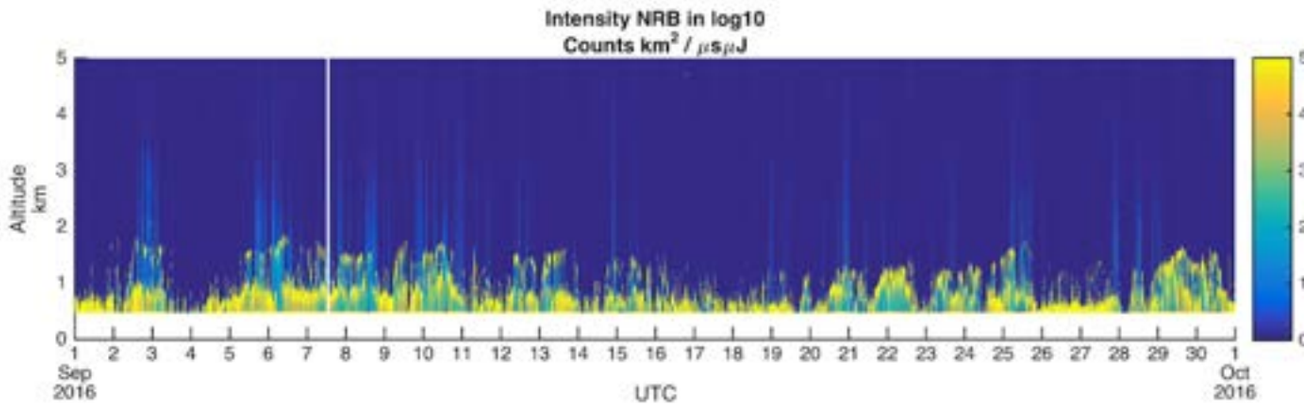


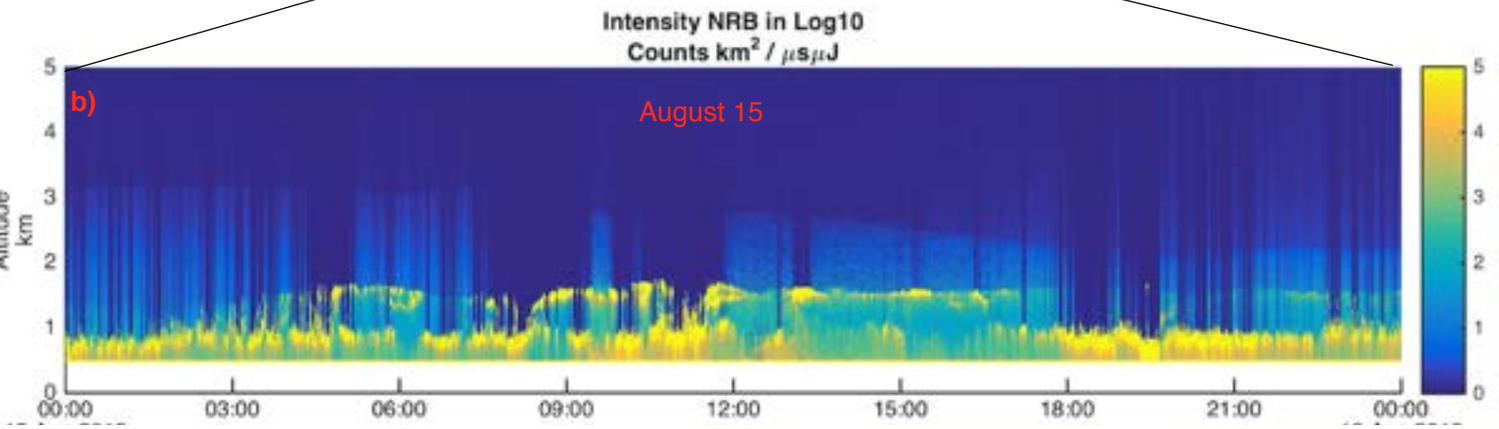
CCN conc. @ 0.4 s.s.

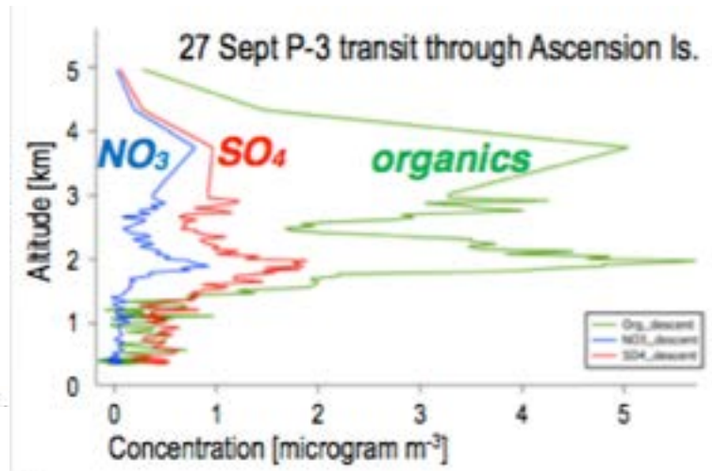


most mixing to surface in August, little in cloudy September
information on free-tropospheric aerosol in September still a challenge

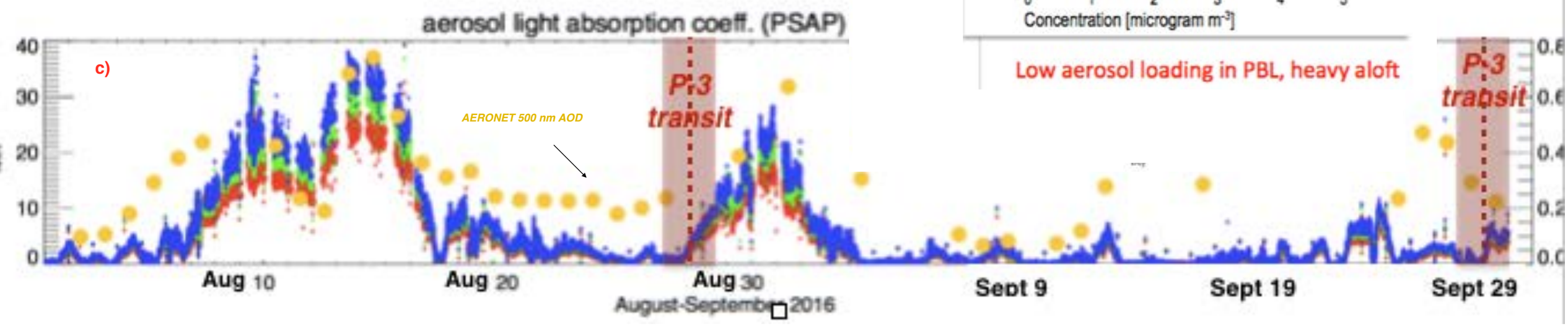




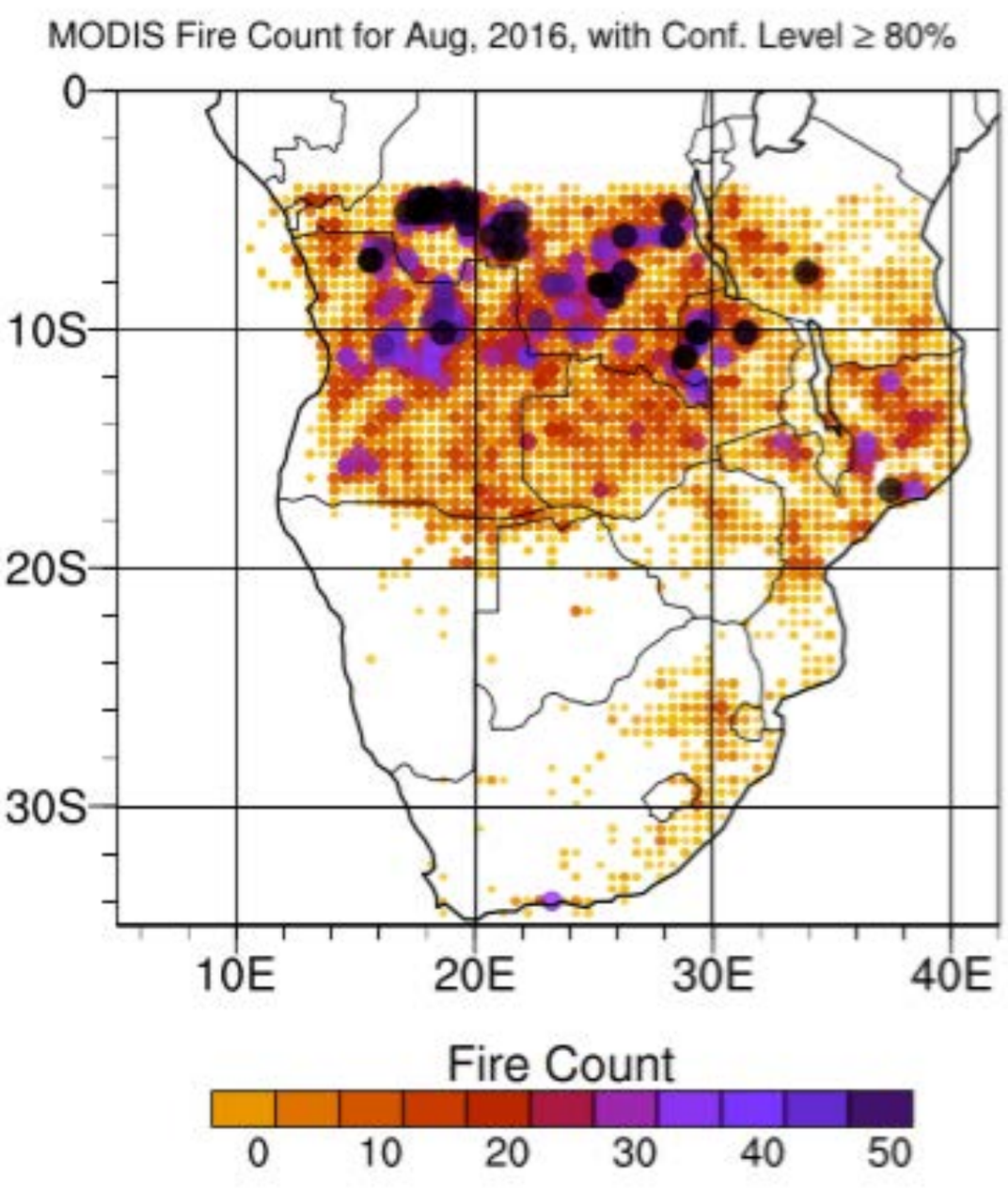


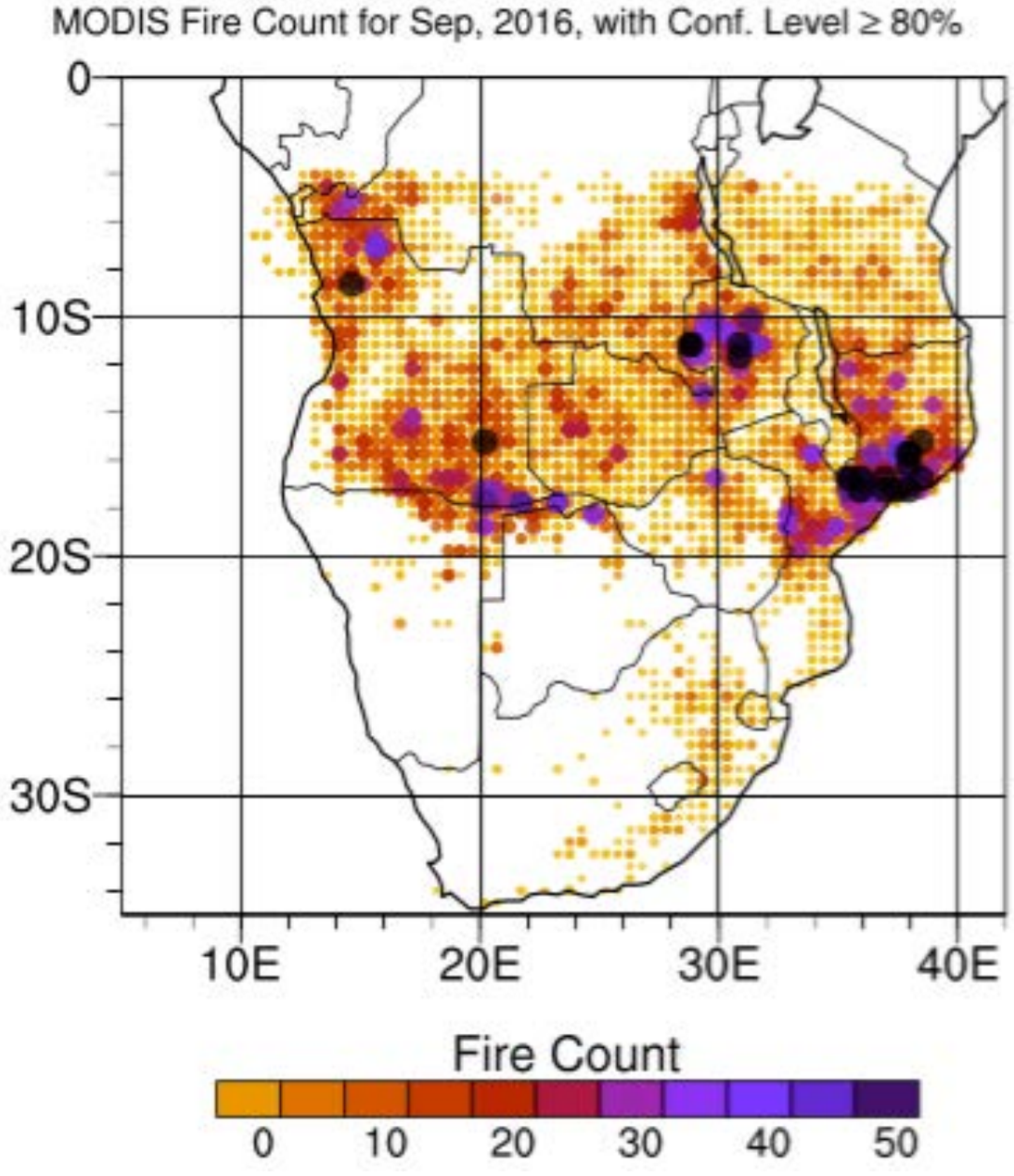


U Hawaii



significant shift in fire spatial distribution between August to September (2016)

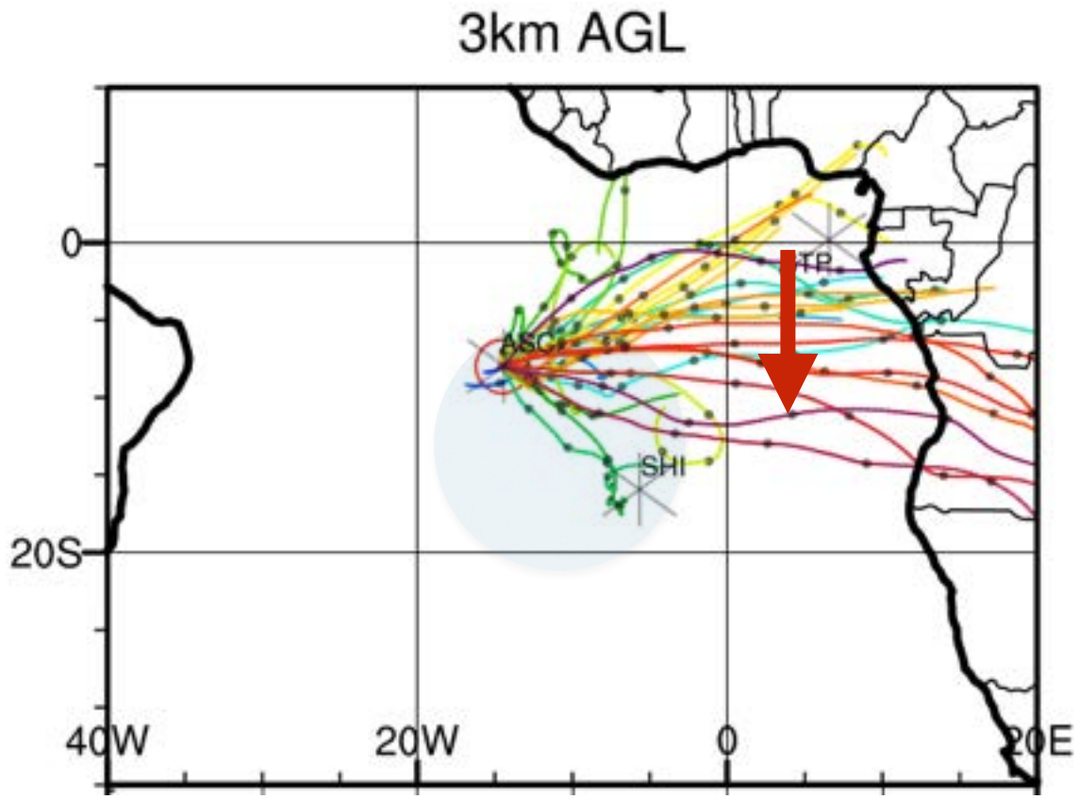


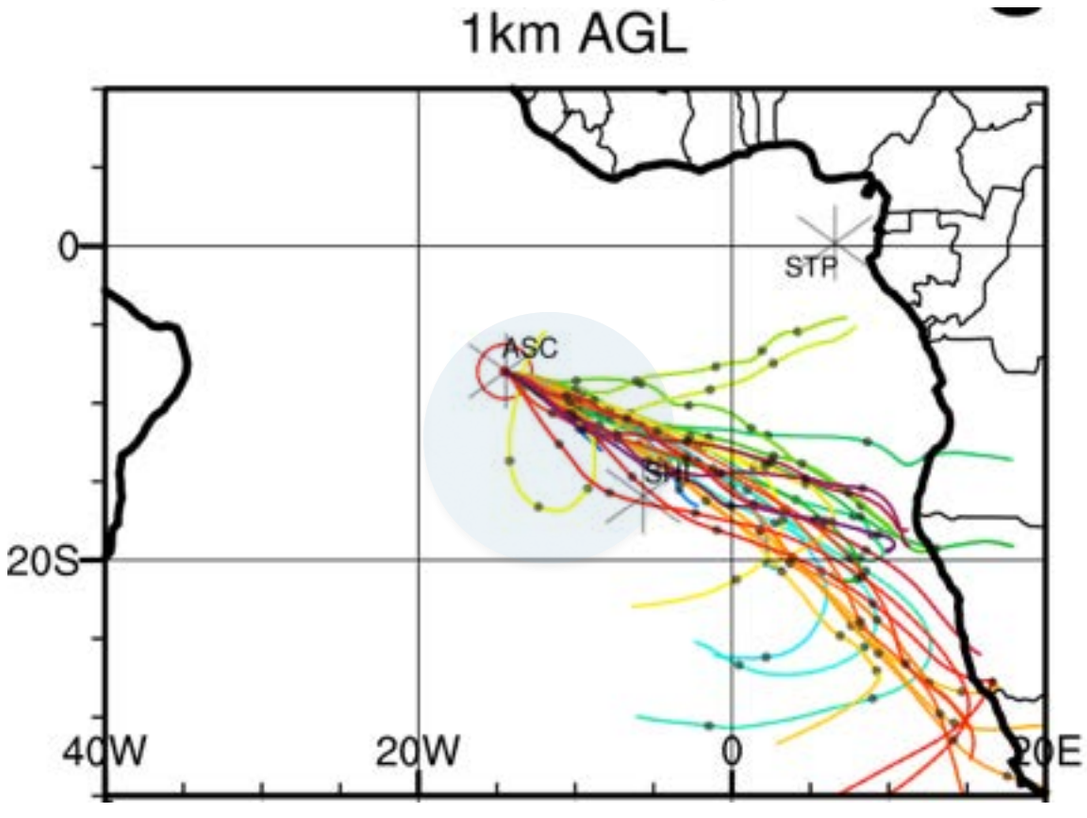


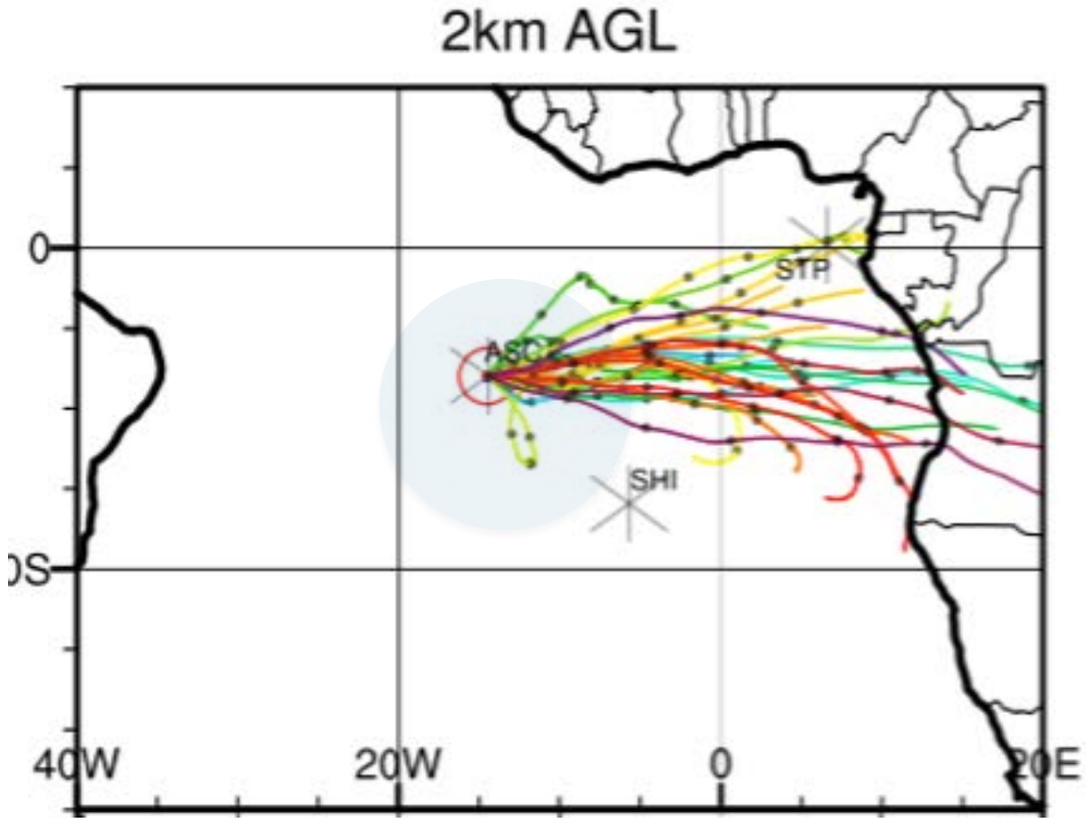
A. Adebiyi; details in Adebiyi and Zuidema, 2016, QJRMS

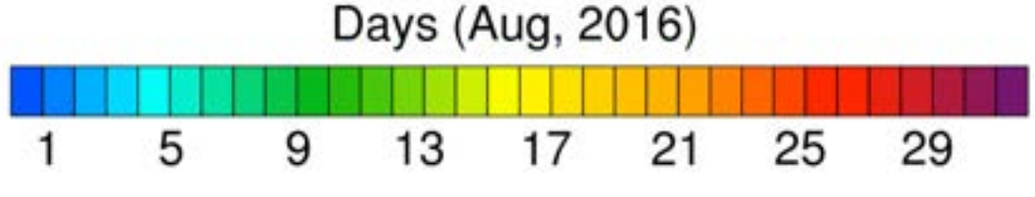
6-day HYSPLIT back trajectories from Ascension show:

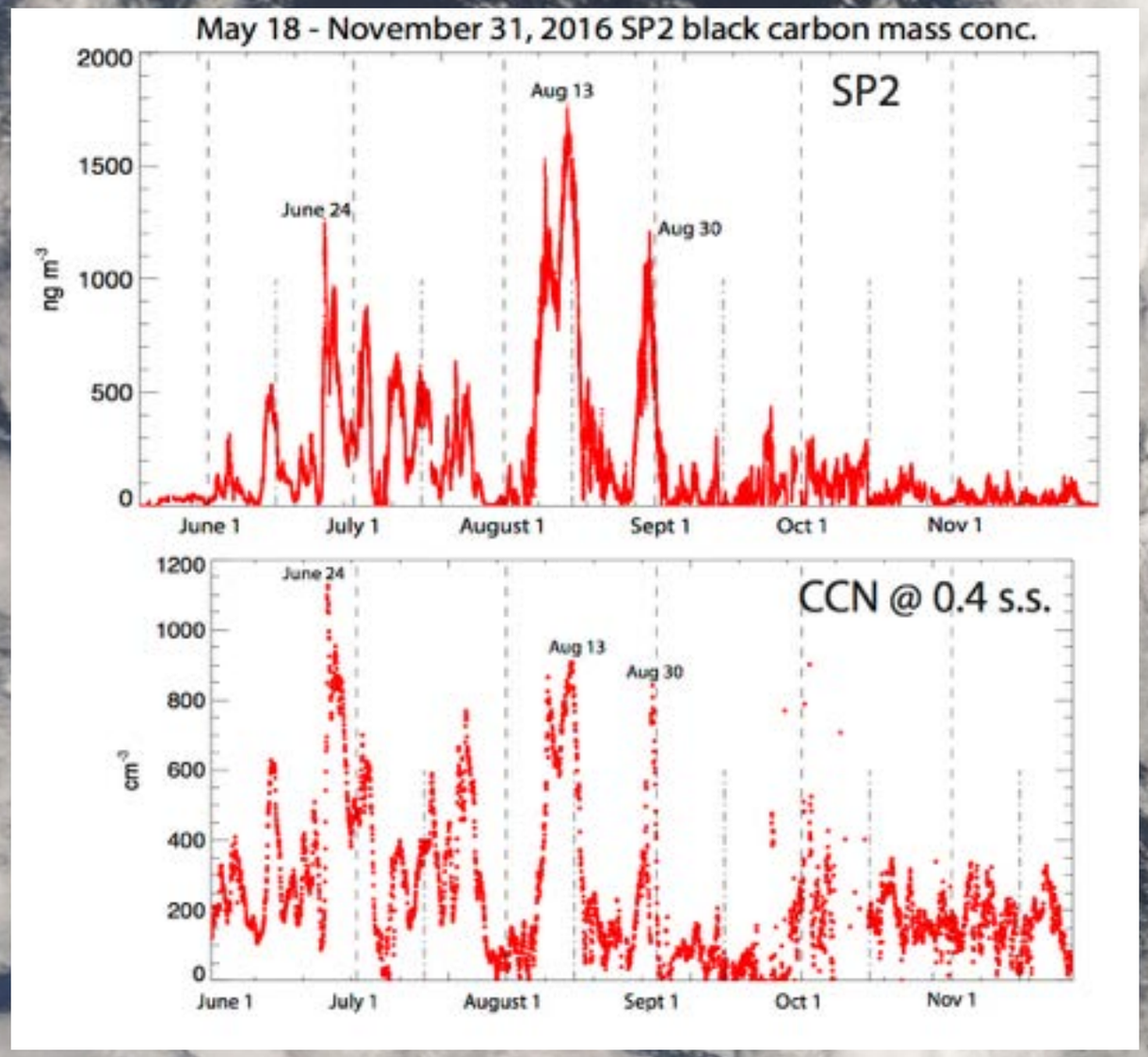
- North to South progression in 3km back trajectories during August
- local recirculation at 1-3 km in mid-August











August 13
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objectives

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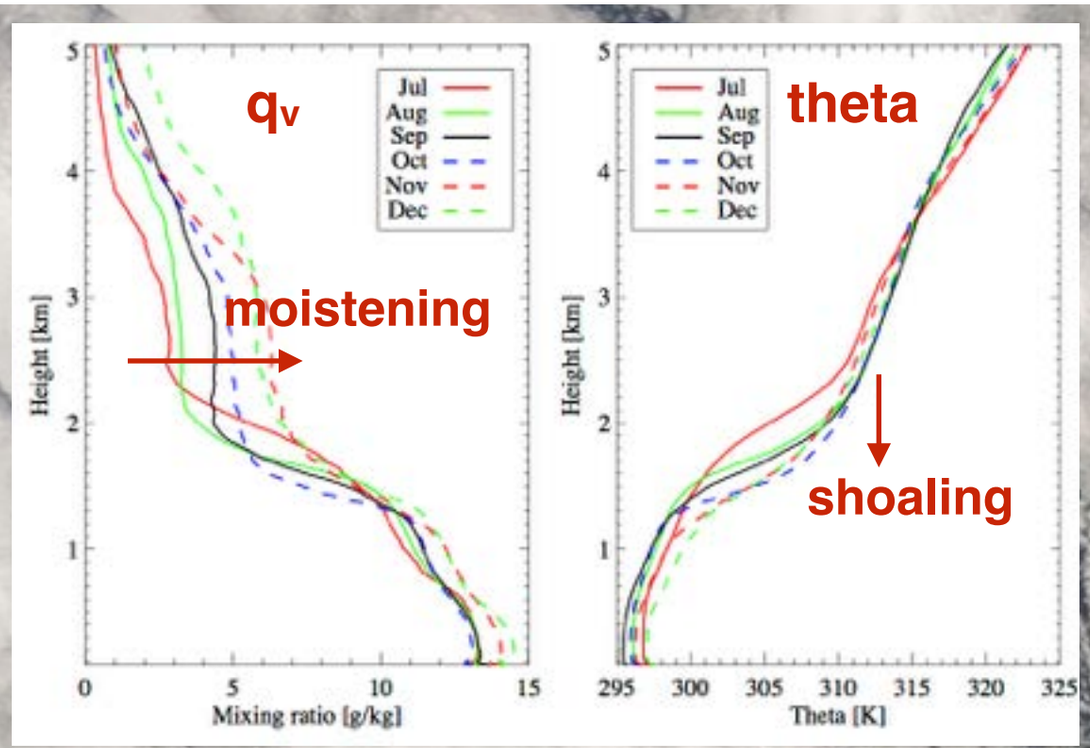
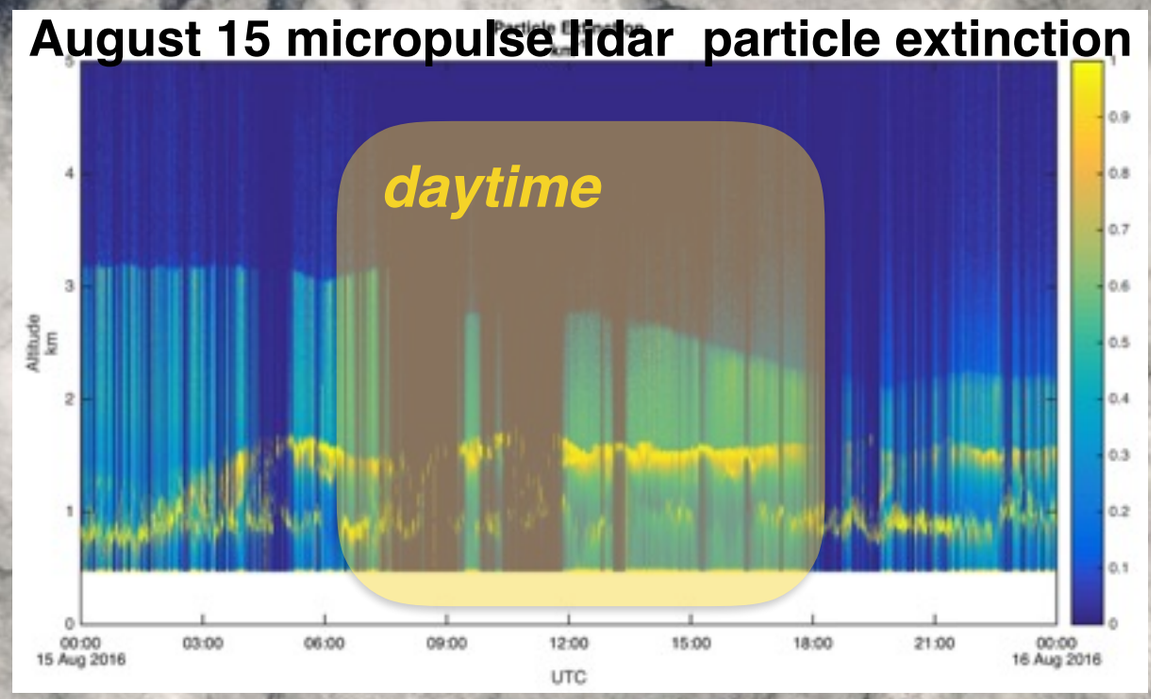


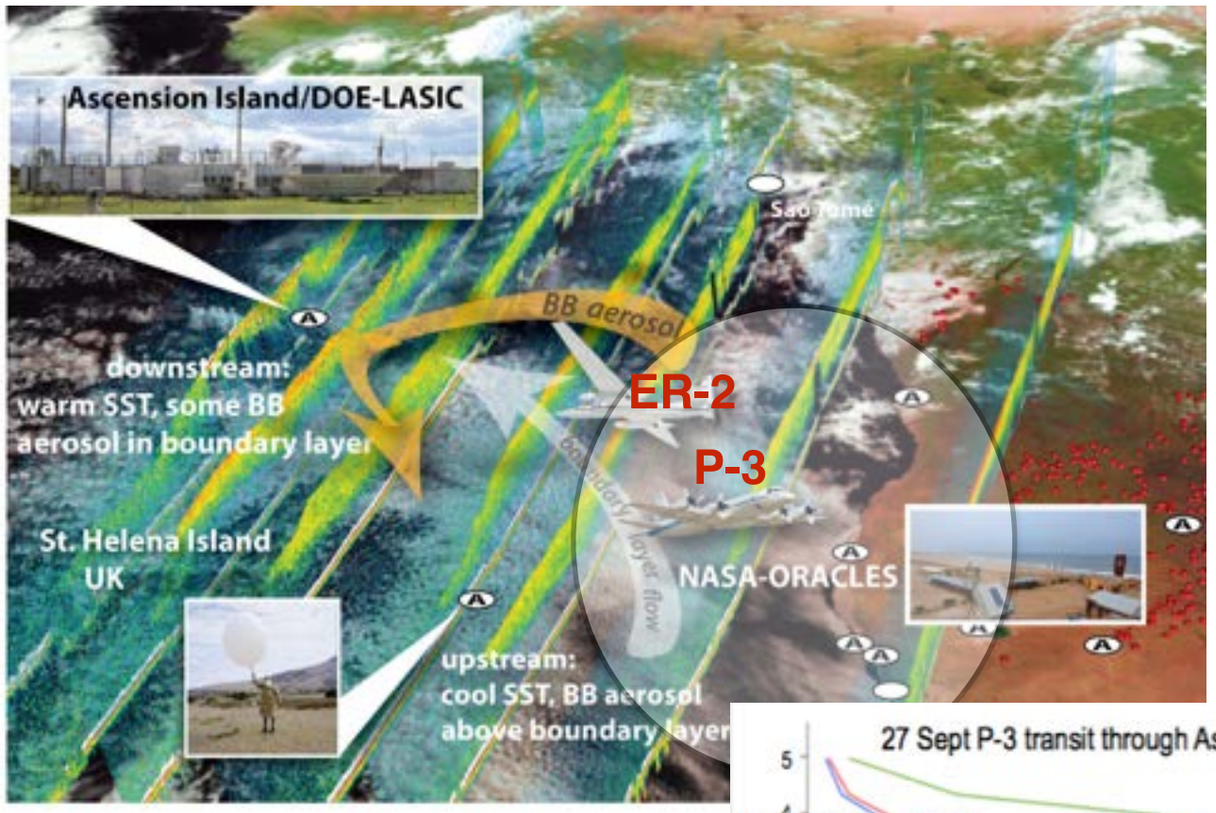
August 15 micropulse lidar particle extinction

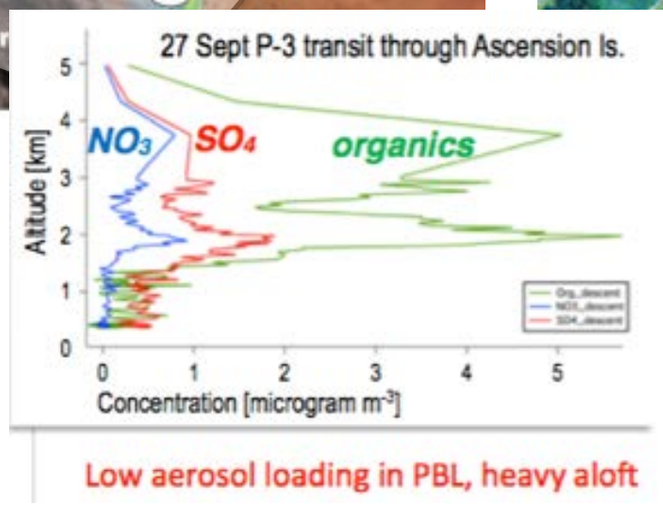


complementary aircraft measurements

September, 2016: NASA

based at Walvis Bay, Namibia





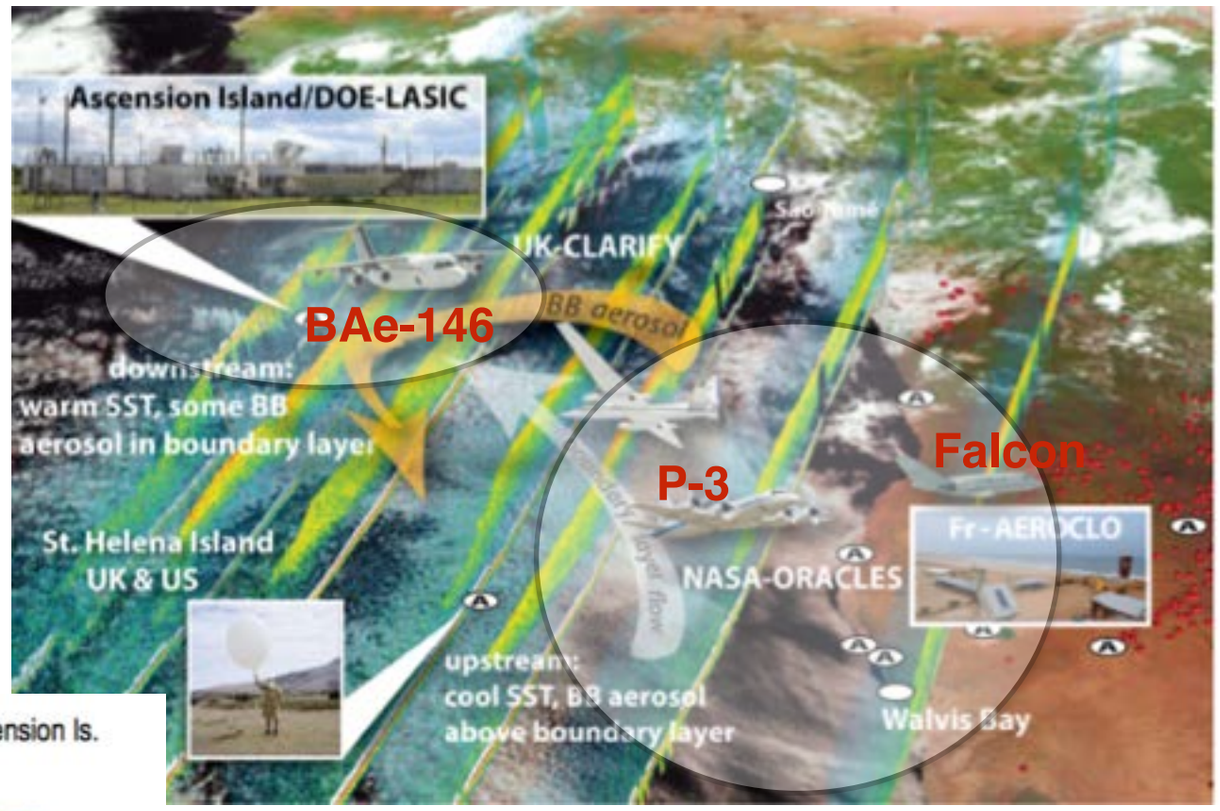
Low aerosol loading in PBL, heavy aloft

August-September, 2017: UK

based at Ascension

August-Sept 2017: NASA, French

plan to base at Walvis Bay, Namibia



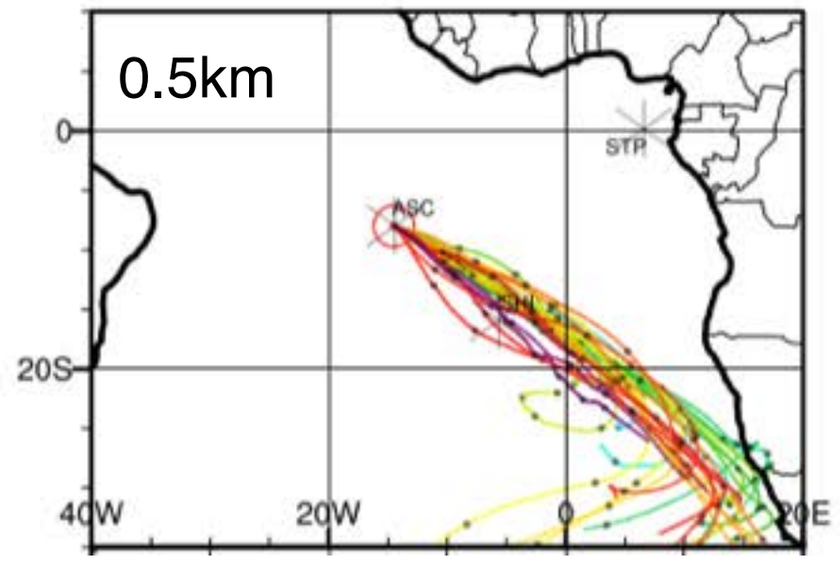
how can the DOE ASR/ARM community contribute?

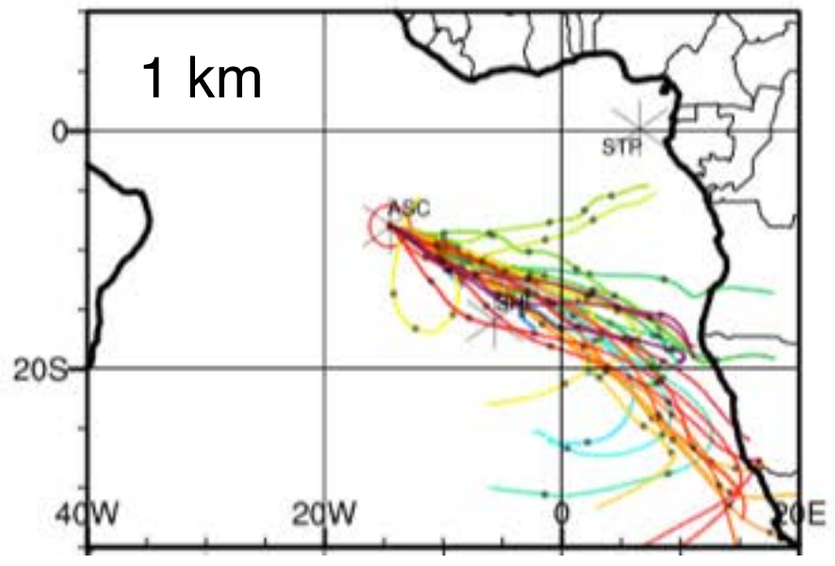
- what is the best-estimate SSA? can we explain it?
- does the SSA evolve with time?
- how well can we describe the relative aerosol-cloud vertical structure, and how do models compare?
- how do we best set up process model studies using the ARM data?

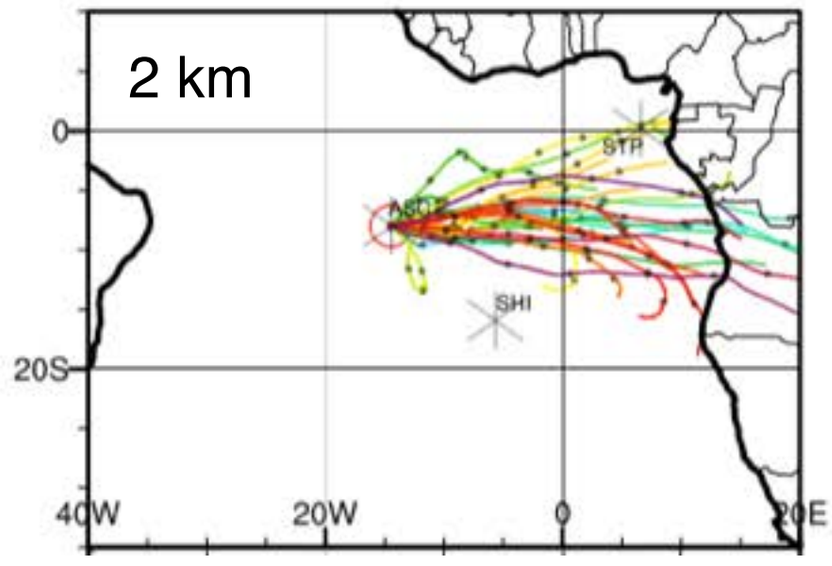
- extra slides

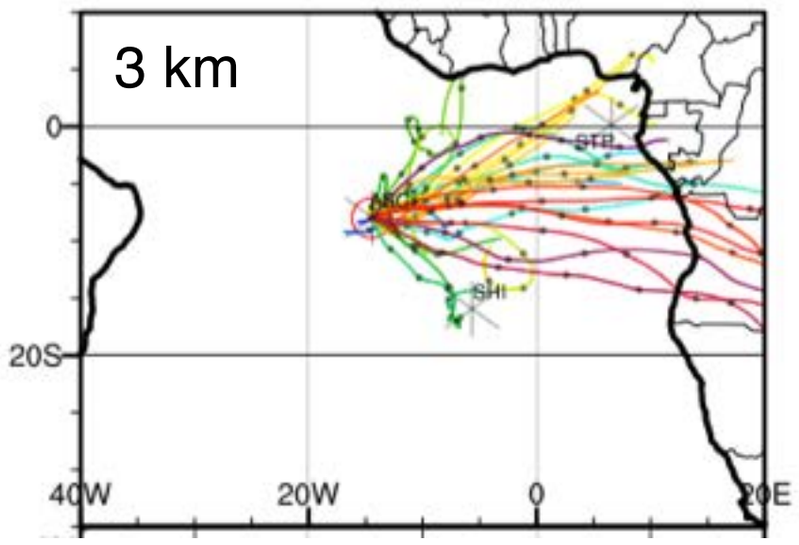
where is the smoke coming from?

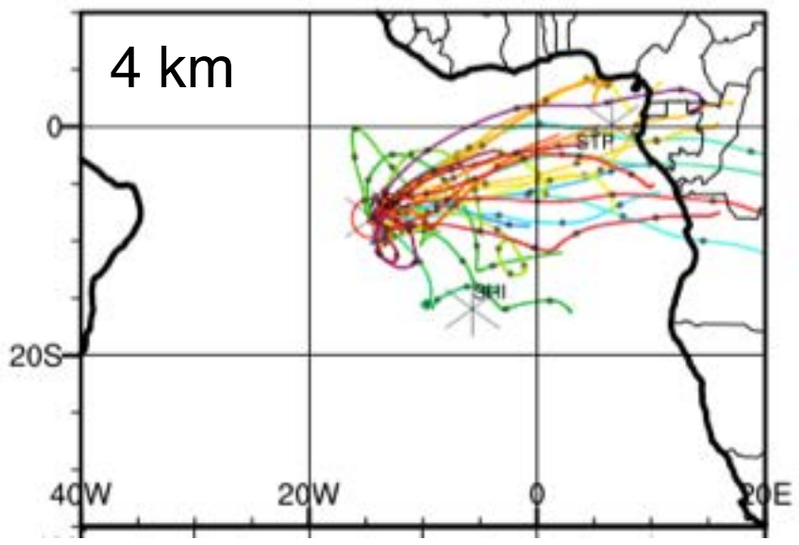
6-day HYSPLIT back trajectories from Ascension

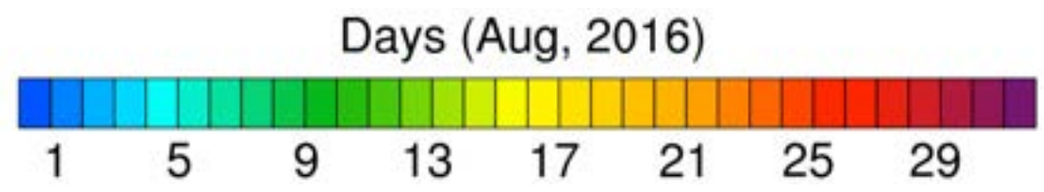












does the diurnal cycle hold clues?