Assessing the Link Between Aerosol Mixing State, Structure and Composition and their Optical Properties: Ascension Island as a Testbed for the South-East Atlantic Aerosol

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DOE-ASR Meeting, June 24, 2020

Proposal Goals and investigational approach:

- Explore how differences in bulk aerosol optical properties measured by in-situ instruments are linked with aerosol single particle properties and how LASIC, CLARIFY and ORACLES are linked and representative of the SEA domain.

Characterizing aerosol regime/sources from CLARIFY and ORACLES using in-situ, filters, trajectory → Linking airborne aerosol regime/sources with LASIC ground-based data

- Assess trends in BB single particle characteristics and optical properties during the burning season.

Explore trends in BB composition and optical properties (including MAC) in ORACLES&CLARIFY → Investigate which of the processes are relevant to explain the trends in LASIC

- Investigate whether we can perform closure of BB optical properties and trends between our single particle and process understanding and the in-situ optical bulk measurements.

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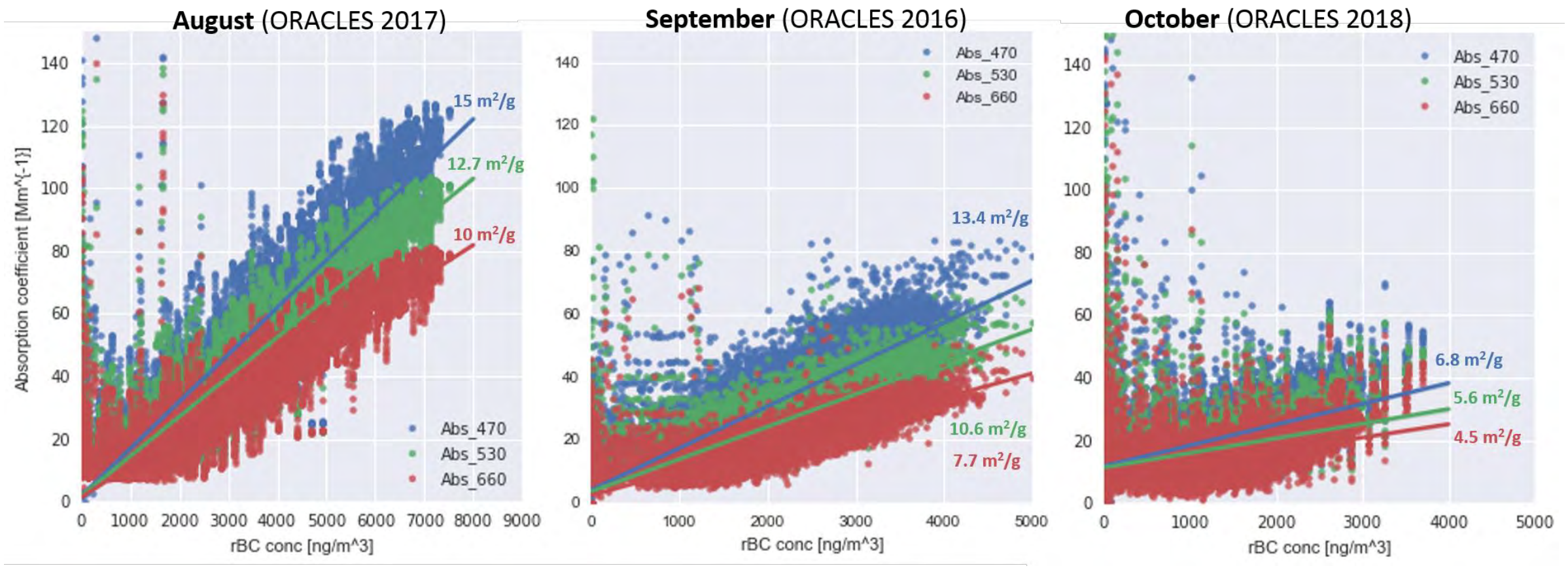
ORACLES, CLARIFY and LASIC MAC trends:



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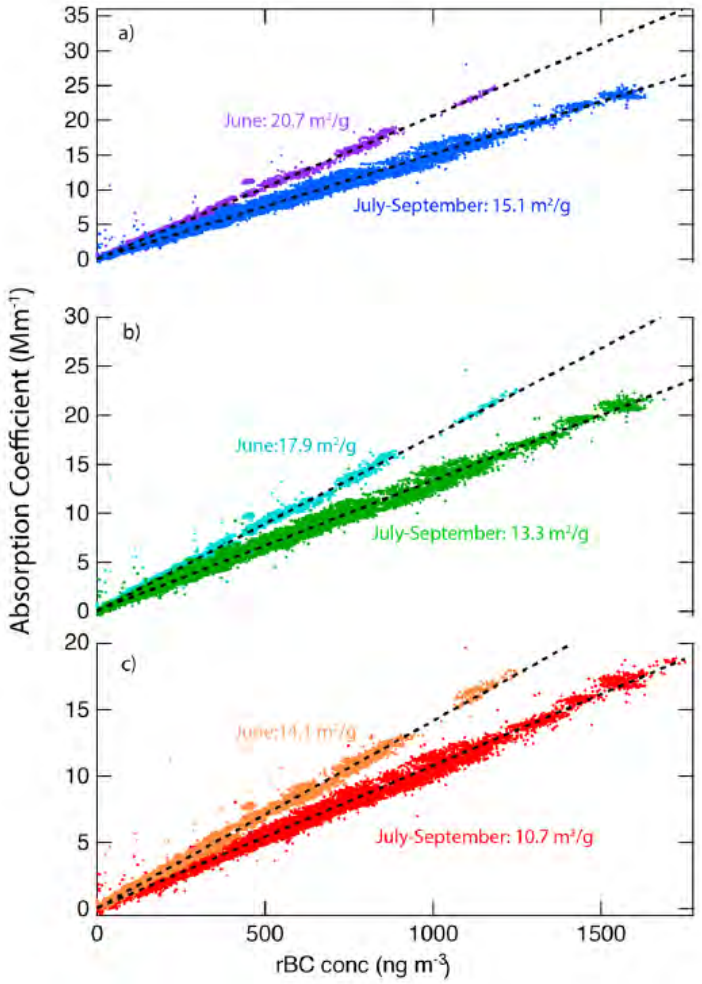
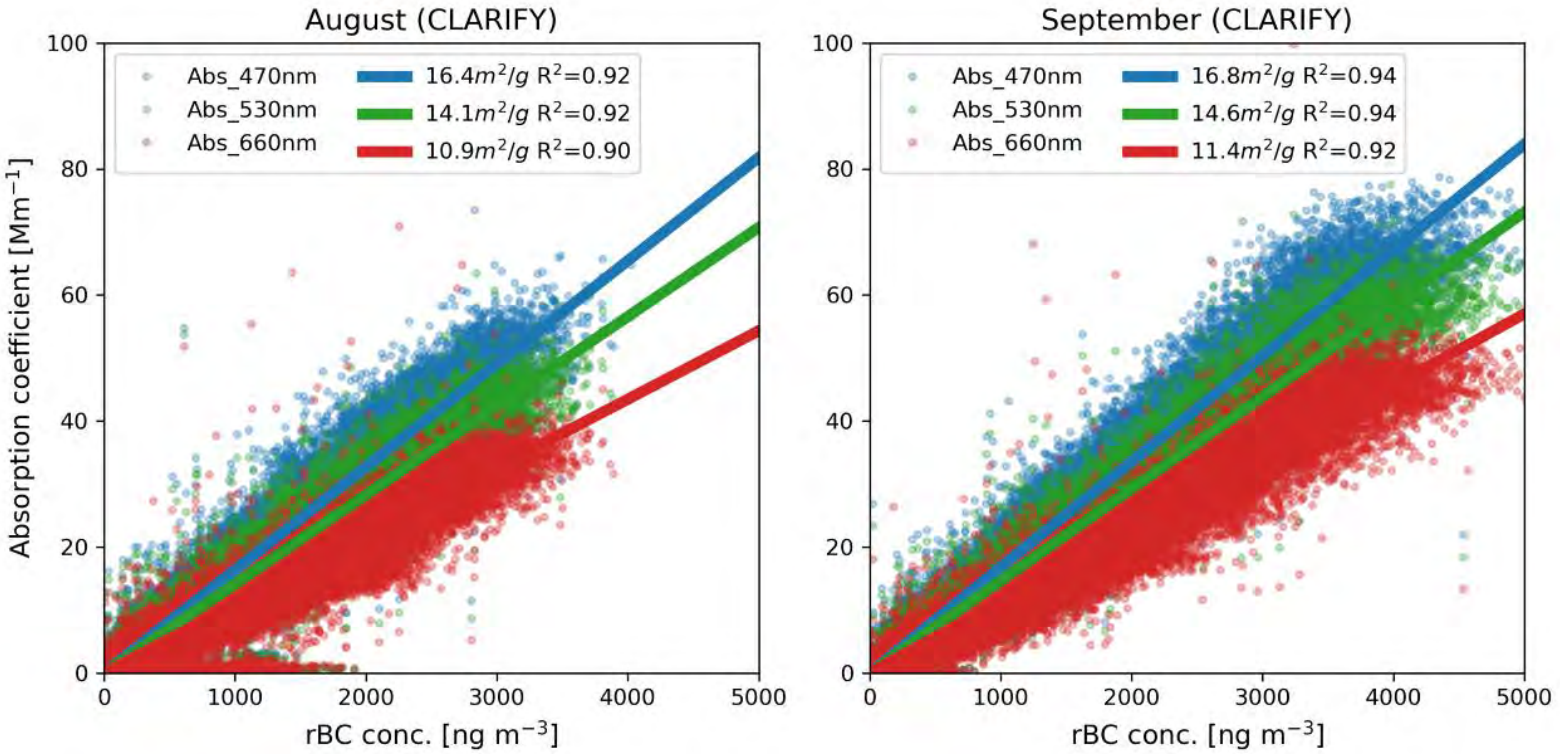
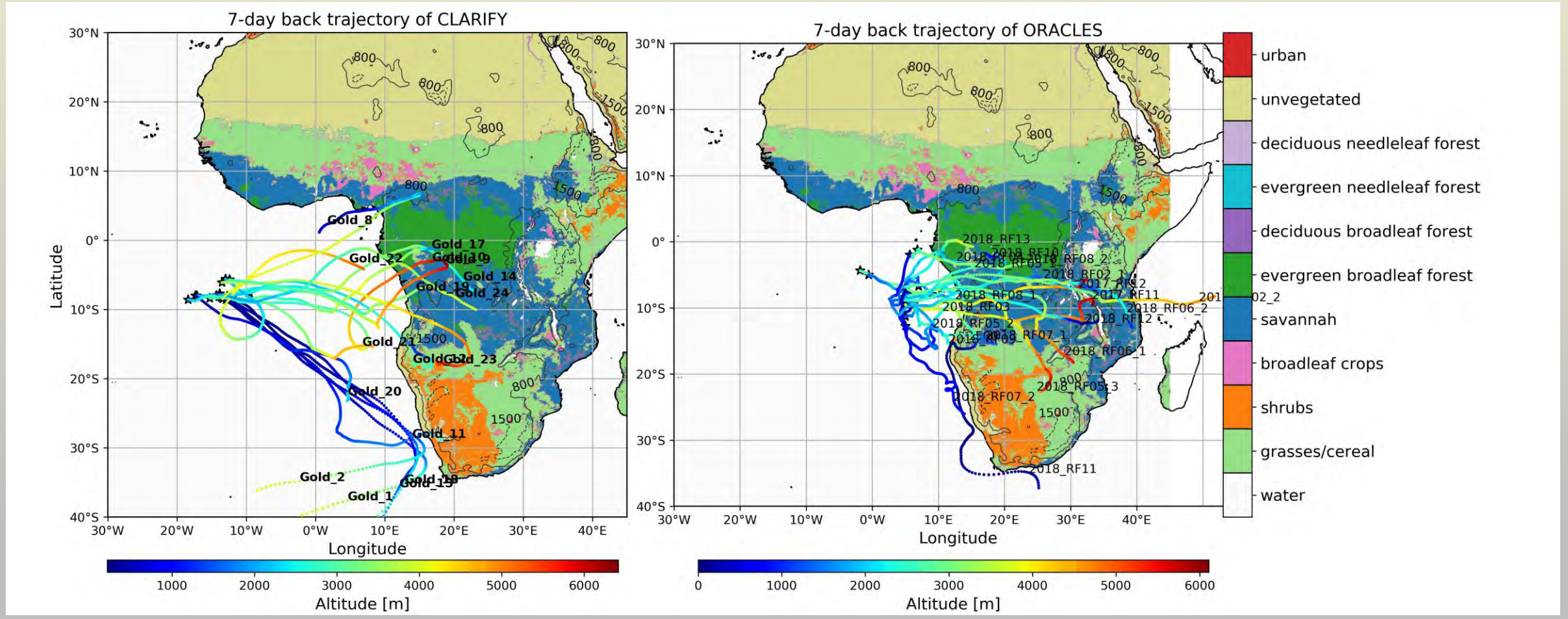


Zuidema et al., GRL, 2018



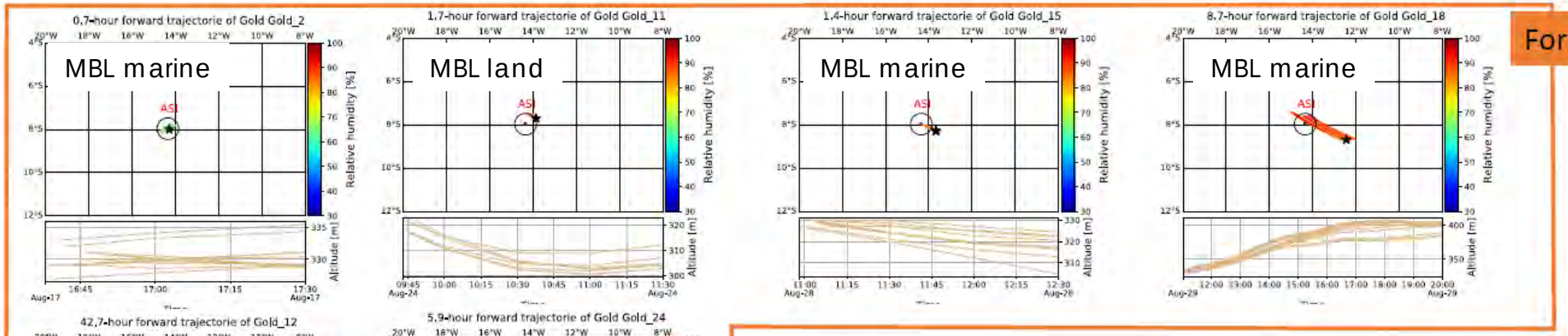
- ORACLES and CLARIFY show MAC decreasing with BB season with relatively similar magnitudes; CLARIFY shows higher MAC values with no obvious trend/slight increase?

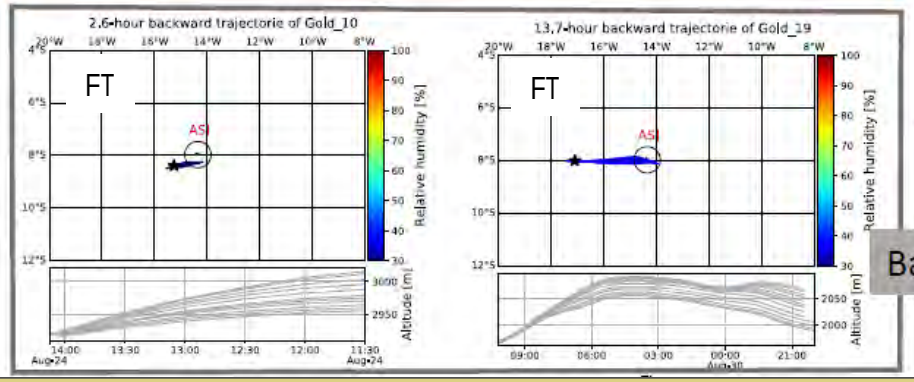
Spatial location and land-type sources of Filter samples:



Selecting linked cases:

From CLARIFY

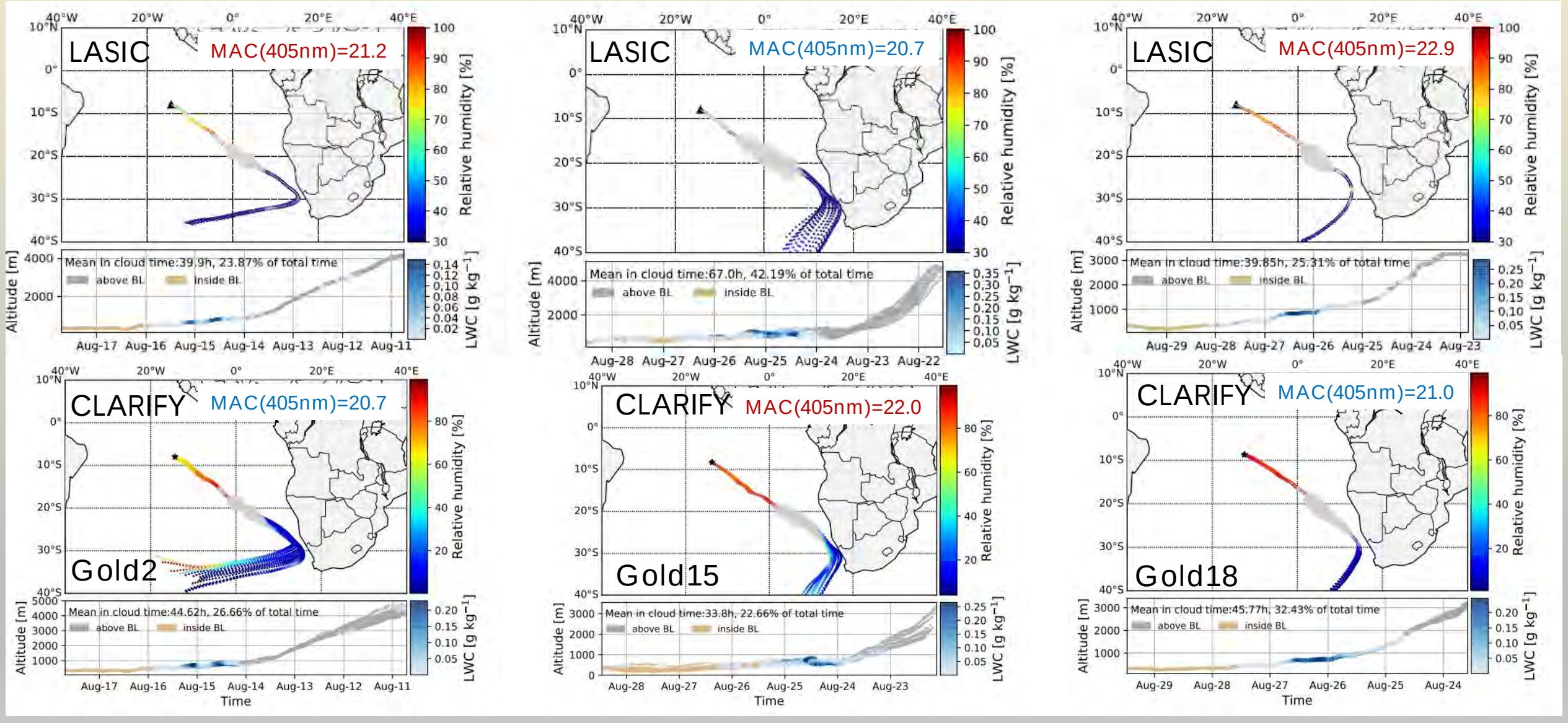




Only CLARIFY had matched cases for filter times

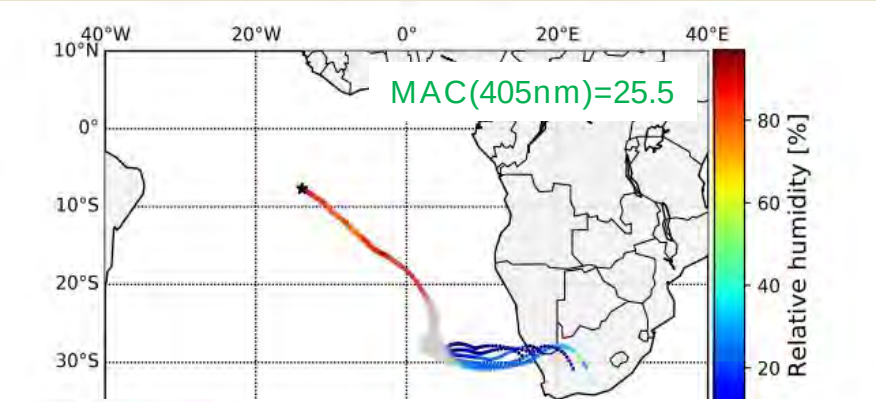
- 6 samples link LASIC observation by its forward trajectory, 2 samples are connected with backward trajectory.
- Time of airmass reaching LASIC region (the circle in the plot, centered at ASI, with 0.5° radius) is ranging from 42.7 to 0.7 hours
- Most of the linked forward trajectories are inside MBL (brown color). The back trajectories of those samples show they are **originated from marine source**.
- Backward trajectory linked samples are in free-troposphere.

Effect of cloud processing in MBL samples:

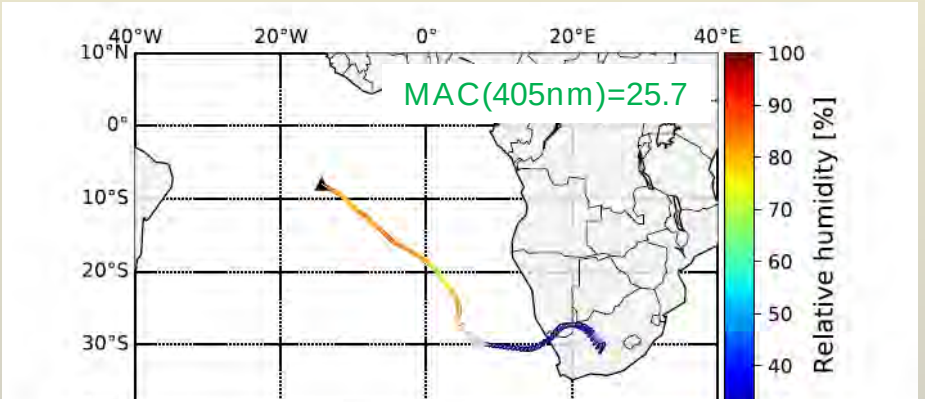


MAC and composition for MBL sample from land:

CLARIFY



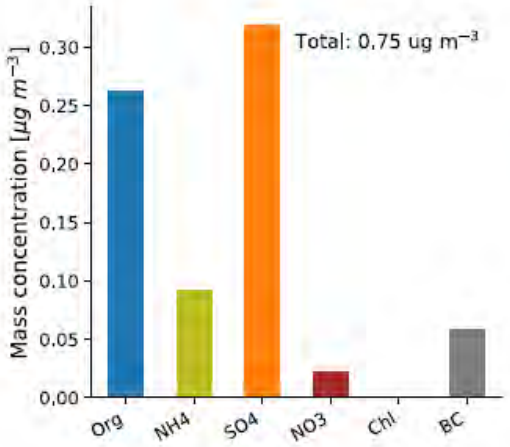
LASIC

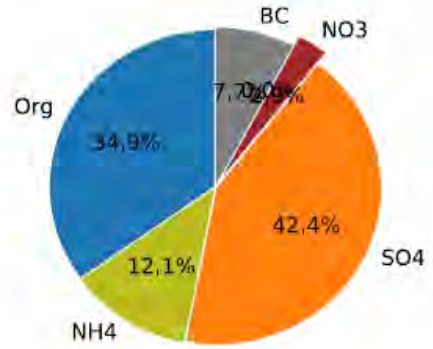


Category 2: (Gold 11)

CLARIFY

Gold 11 AMS

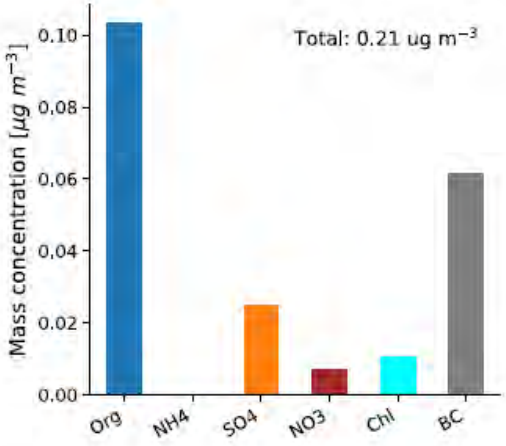


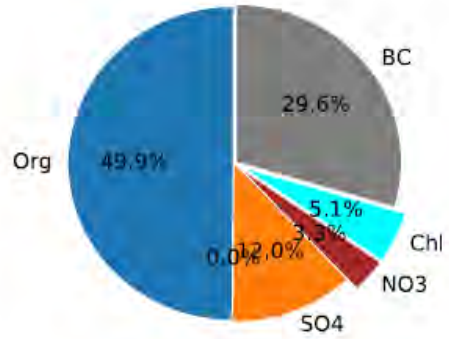


After 1.7-hour

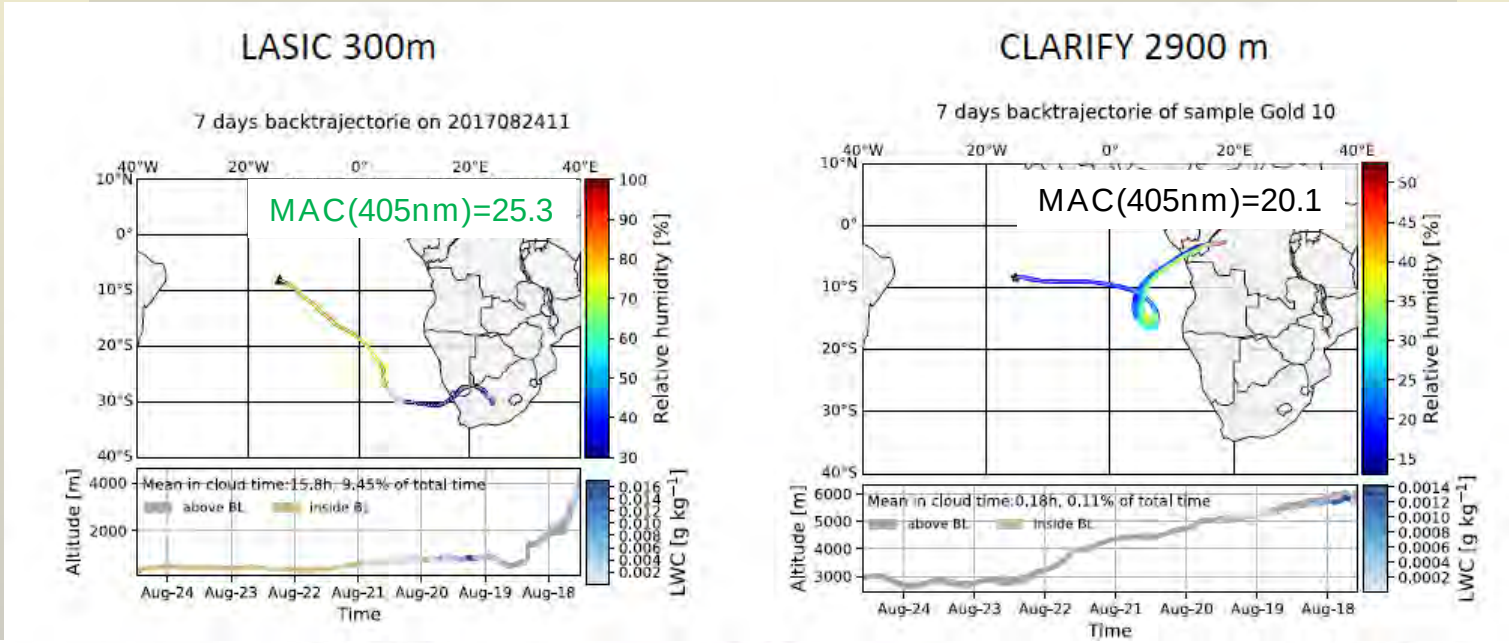
LASIC

LASIC AMS





Free Troposphere and Ground sample comparison:

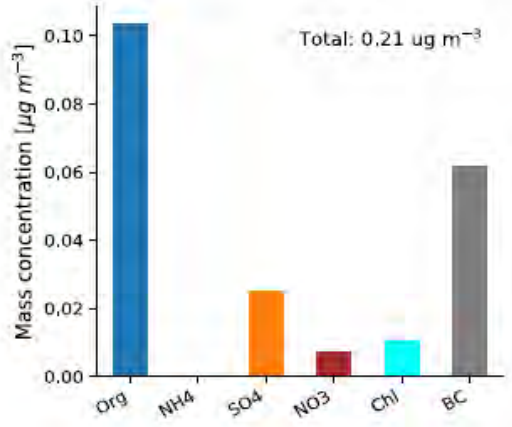


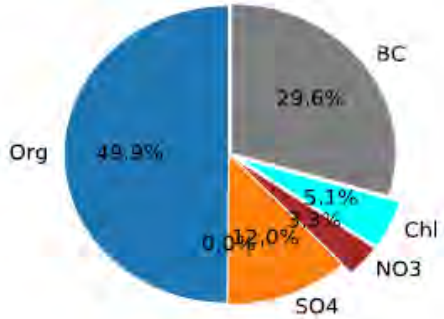
Gold10

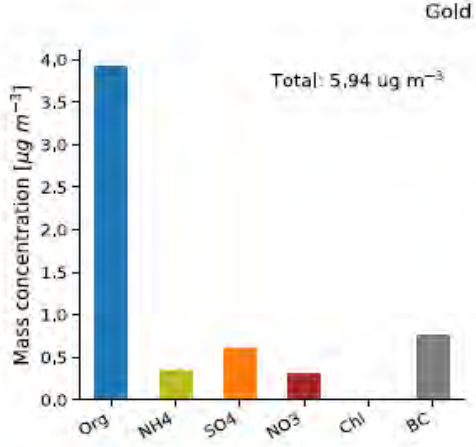
Ground

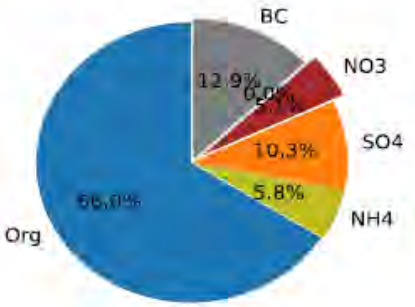
2.6-hour

2900 m









MAC, filter composition and sources:

Filter name	Source-Traj CLARIFY	Source-Traj LASIC	MAC CLARIFY	MAC LASIC	Particle types
Gold2	marine	marine	20.7	21.2	
Gold15	marine	marine	22	20.7	chloride
Gold18	marine	marine	21	22.9	calcium chloride
Gold11	Shrubs	Shrubs	25.5	25.7	calcium+Na+NaCl
Gold12	Shrubs/grasses	Shrubs/grasses	22.6	-	
Gold24	Savannah	marine	20.1	-	BC+Na+K salts
Gold10	Savannah	Shrubs	20.1	25.3	BC+Na salts
Gold19	Savannah	marine	18.8	21.7	Minerals+Si(dust)

Preliminary results summary

- When comparing cases, we need to take into account not just trajectory source but also the time spent in the MBL and cloud processing along the trajectory and just before sampling.

- From the few matching cases we found in the MBL, LASIC MAC will increase compared to CLARIFY if no cloud processing occurred just before sampling and will decrease if cloud processing occurred.

- AMS ground composition for LASIC is much lower in total mass for all compared samples with CLARIFY (whether in MBL or FT), with higher percentage of BC and lower percentage of Organic material when compared with CLARIFY AMS.

- Calcium and Na salts seem to be related to higher MAC (with Shrubs sources); Marine sources have the second highest MAC in the investigated group and mineral type has the lowest.