



EarthCARE 2026 Science and Validation workshop

8–12 June 2026 | Rhodes House | Oxford, UK

Validation of the ATLID L2 Aerosol Classification with Airborne Lidar Observations in the Tropical Atlantic

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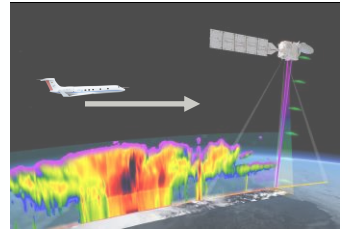
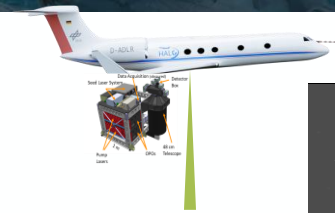


EarthCARE underflights with HALO aircraft



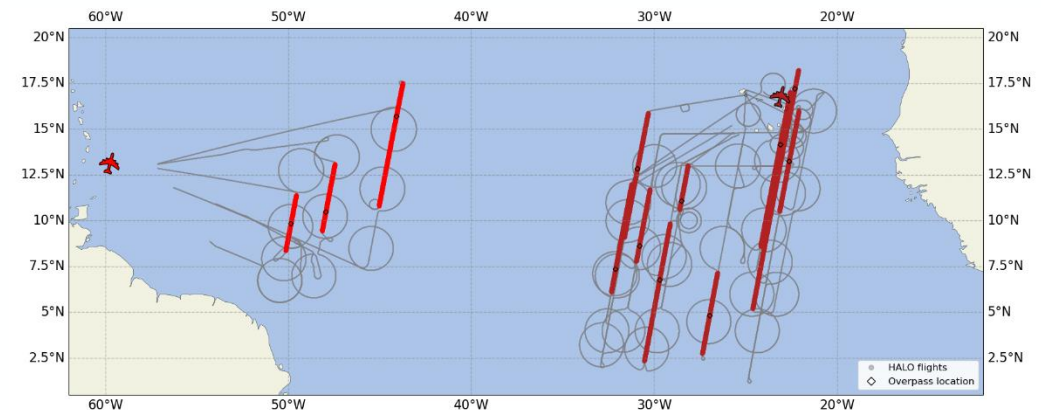
- Observations with high spectral resolution lidar WALES

- molecular / particle backscatter (532/1064nm)
- particle depolarization, particle extinction, lidar ratio (532nm)



- Coordinated underflights during the field campaign PERCUSION (Groß et al., 2026, AMT, accepted)

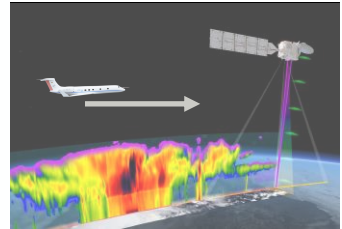
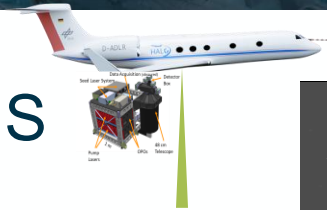
- 12 underflights in the tropical Atlantic (8,300km flight track)
- Strong collocation of ATLID/WALES data



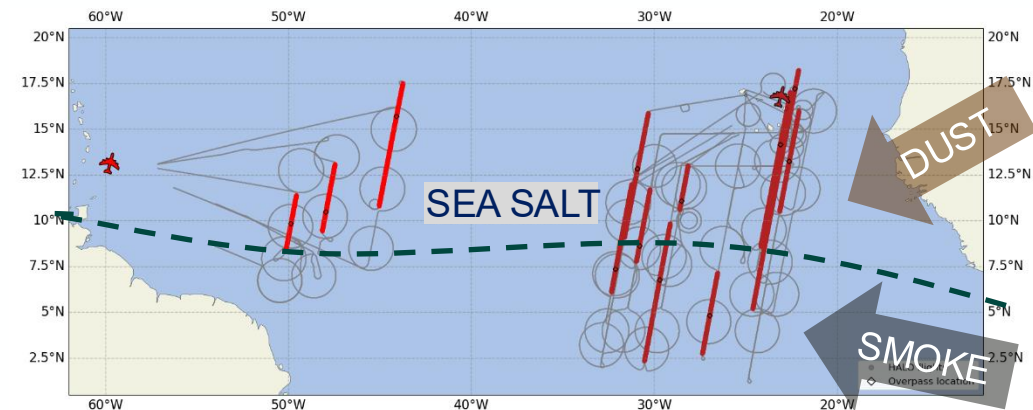
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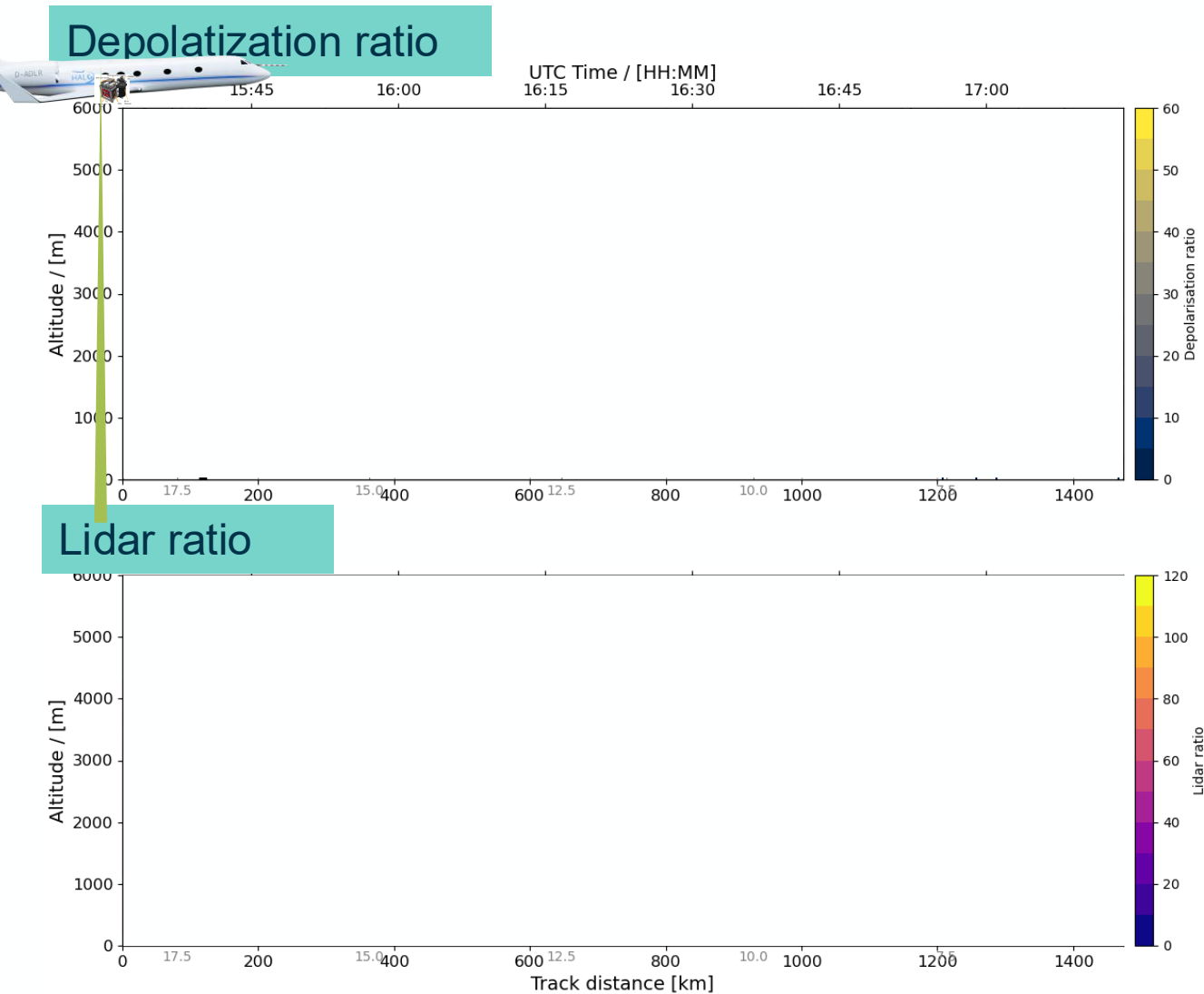
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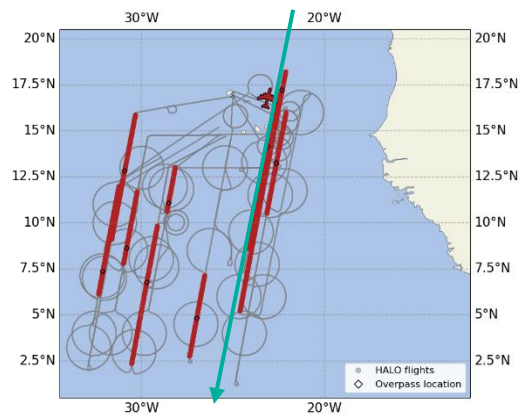
- Coordinated underflights during the field campaign PERCUSION (Groß et al., 2026, AMT, accepted)
 - 12 underflights in the tropical Atlantic (8,300km flight track)
 - Strong collocation of ATLID/WALES data
 - Goal to capture various aerosol conditions
- **Opportunity for validation of ATLID's aerosol classification (from ATL-TC)**



Cross sections for an example research flight

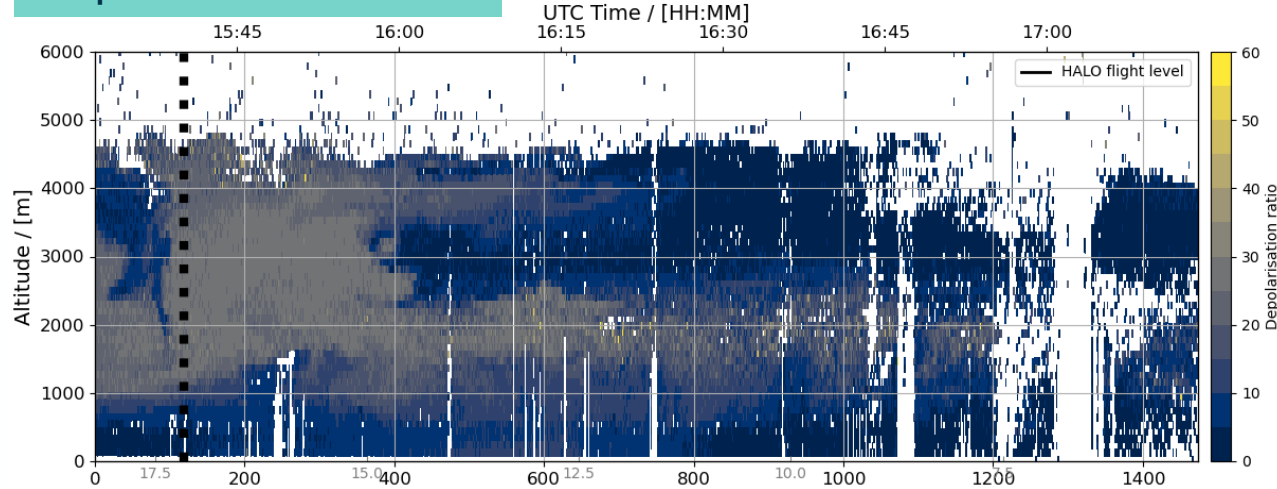


HALO research flight (13 Aug. 2024)

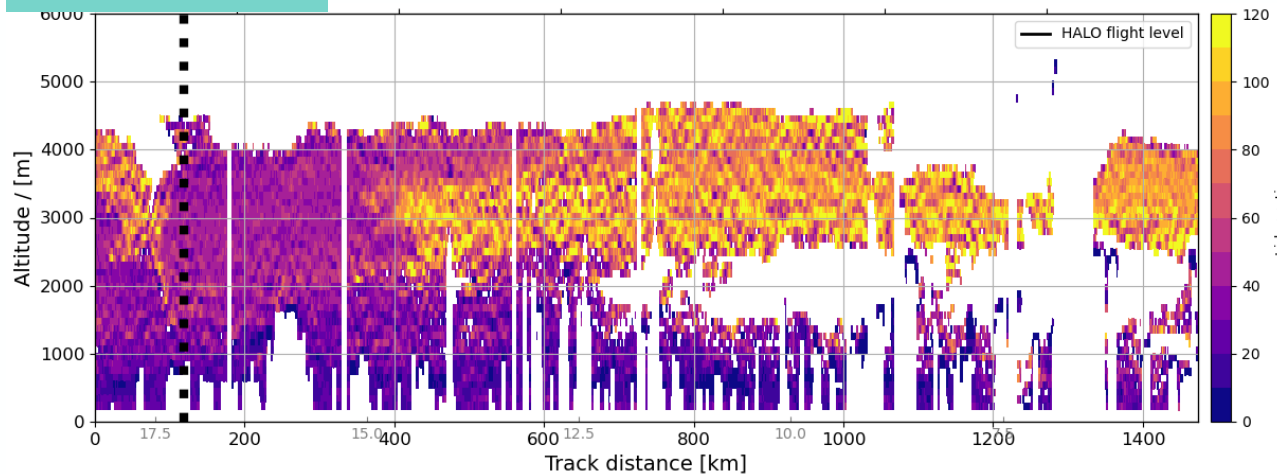


Cross sections for an example research flight

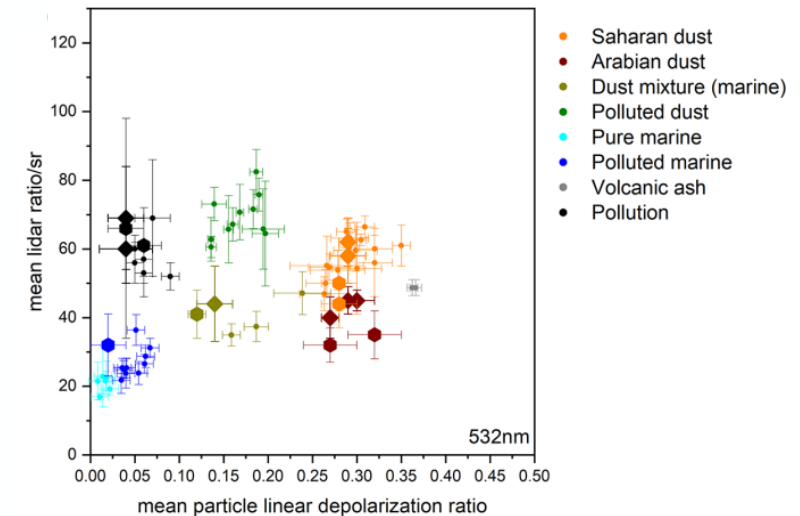
Depolarization ratio



Lidar ratio



Depol-Lidar ratio correlation space



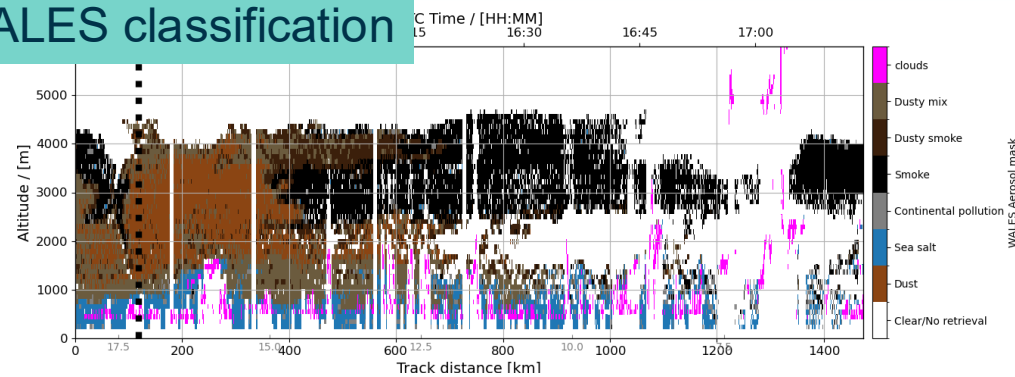
Adopted from Groß et al., 2025

- Data clusters according to different aerosol types
- Aerosol classification and re-projection to cross section

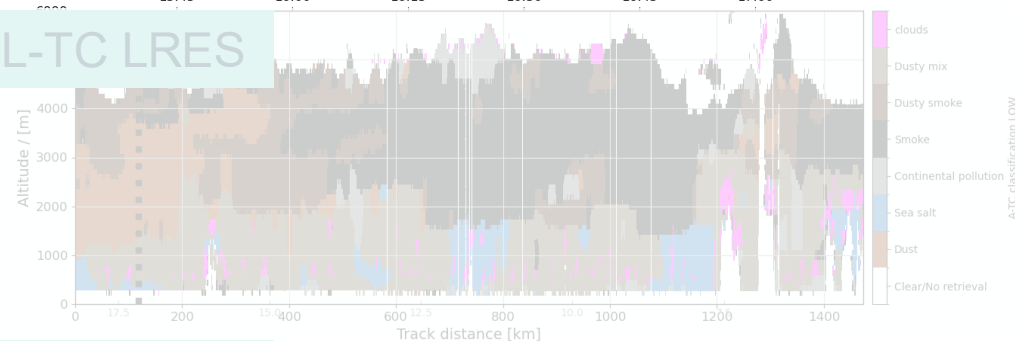
Aerosol classification comparison WALES/ATL-TC



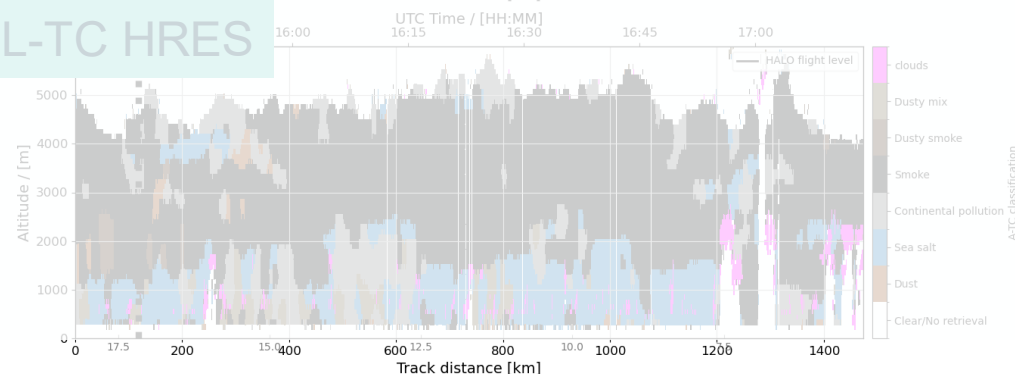
WALES classification



ATL-TC LRES



ATL-TC HRES



➤ 3 distinct aerosol regimes observed by WALES:

➤ mineral dust

➤ Smoke

➤ Sea salt

➤ Good representation of these distributions in ATL-TC LRES (particularly dust and smoke)

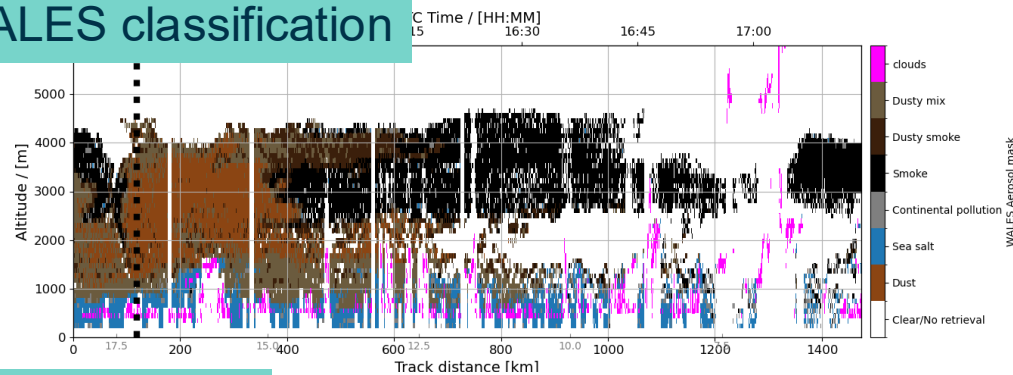
➤ ATL-TC HRES: strong presence of smoke, but more realistic sea salt representation near surface

Baseline BA, Frame: 01473E

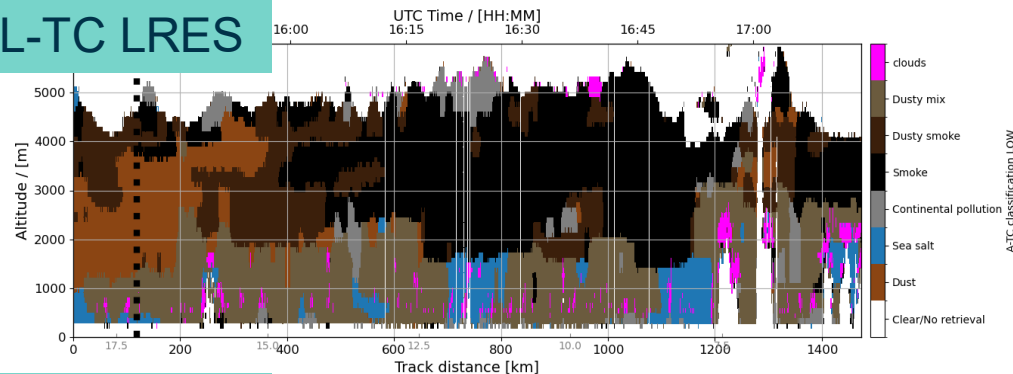
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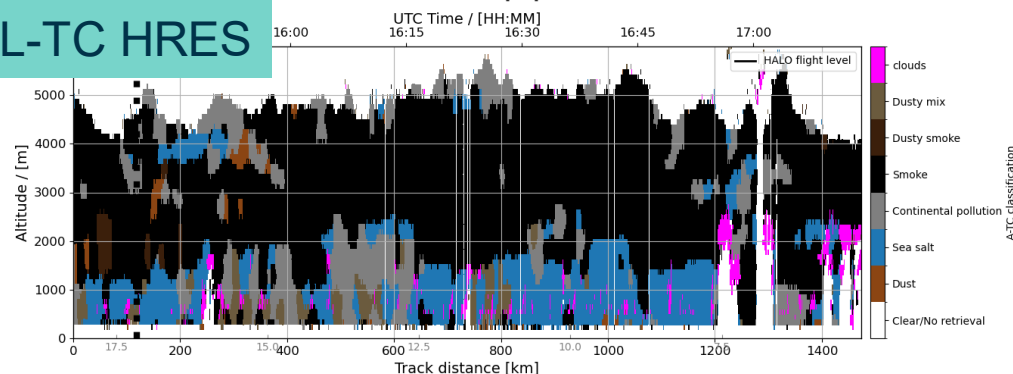
WALES classification



ATL-TC LRES



ATL-TC HRES



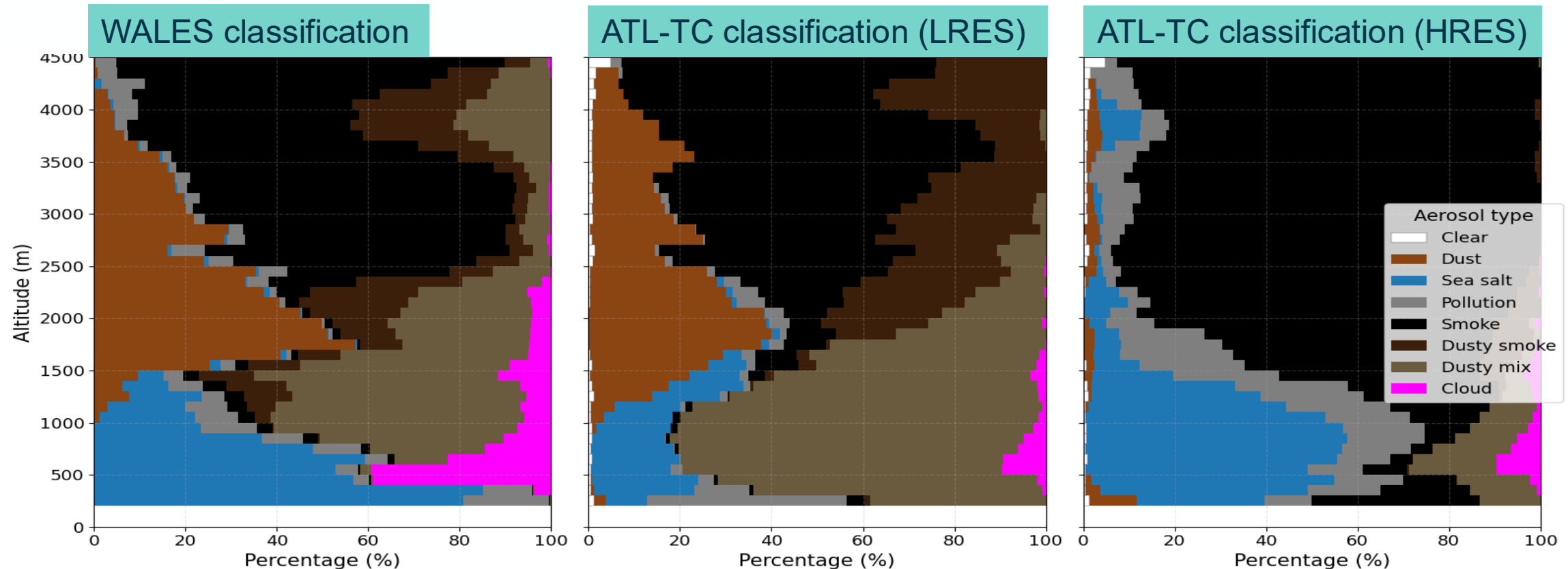
- 3 distinct aerosol regimes observed by WALES:
 - mineral dust
 - Smoke
 - Sea salt
- Good representation of these distributions in ATL-TC LRES (particularly dust and smoke)
- ATL-TC HRES: strong presence of smoke, but more realistic sea salt representation near surface

Baseline BA, Frame: 01473E

Aerosol classification for the example flight



Aerosol type contribution per altitude bin

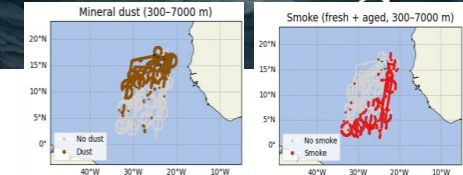


- **Smoke** (2.5-5km) and **Dust/Dusty smoke** (1.5-5 km): improved representation by ATL-TC LRES
- **Sea salt** (0-1.5km): best representation by ATL-TC HRES

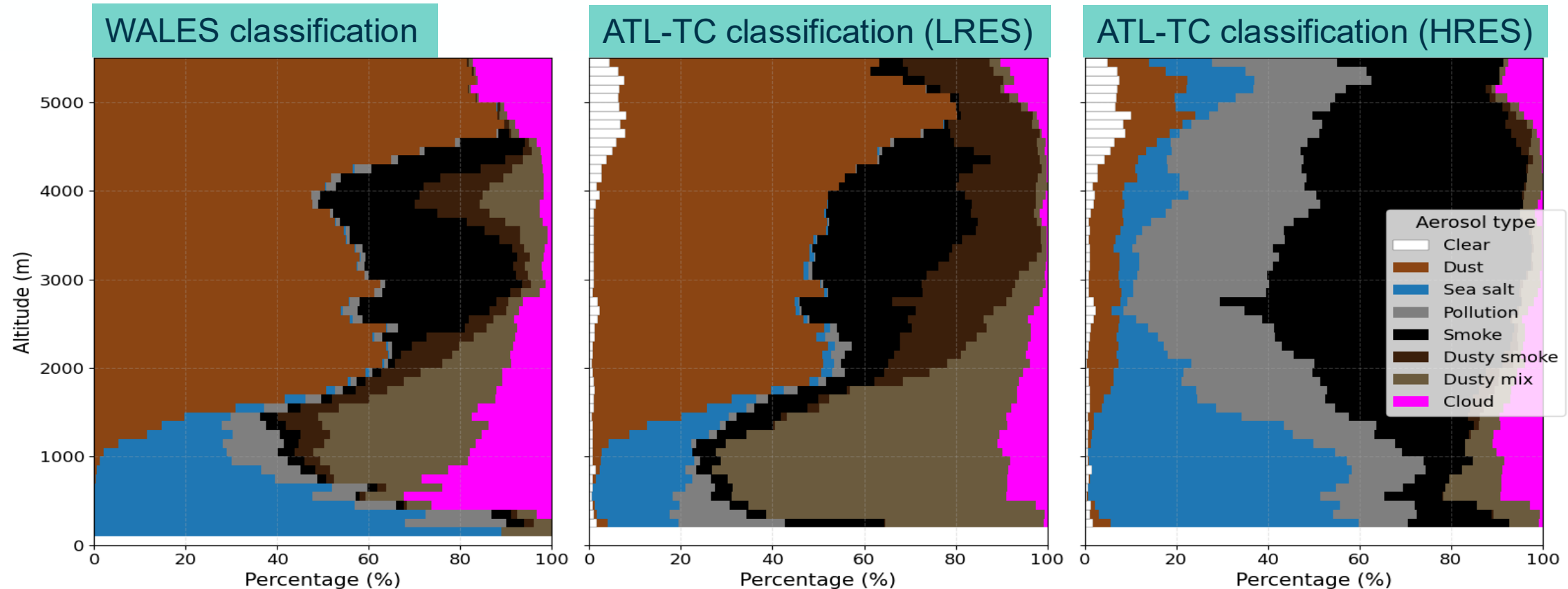
Aerosol classification for PERCUSION



Statistical comparison for 12 PERCUSION flights



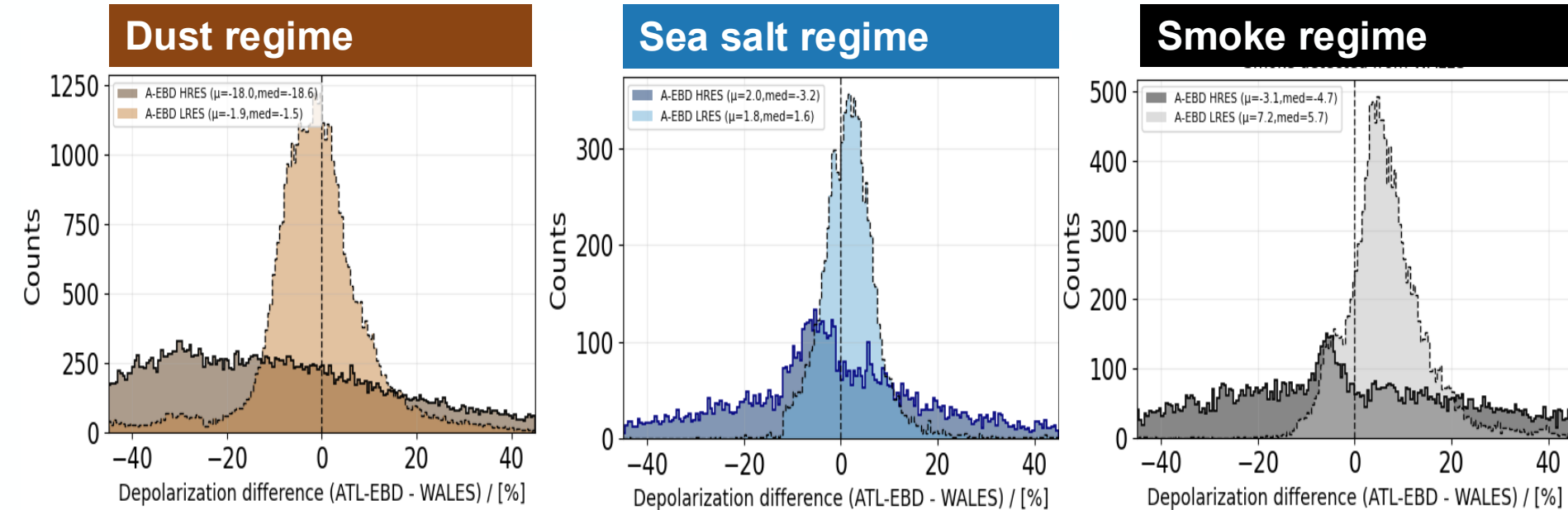
**Baseline: BA,
E-Frames**



- Large data set analysis confirms impressions
- Can the different aerosol types be explained by changed depol/lidar ratio in ATL-EBD?

ATL-EBD - WALES depol. differences for distinct aerosol regimes

*Baseline: BA,
E-Frames*



Overall strong agreement in depolarization between WALES and A-EBD LRES

→ **Comparable, sharp distributions (A-EBD LRES – WALES)**

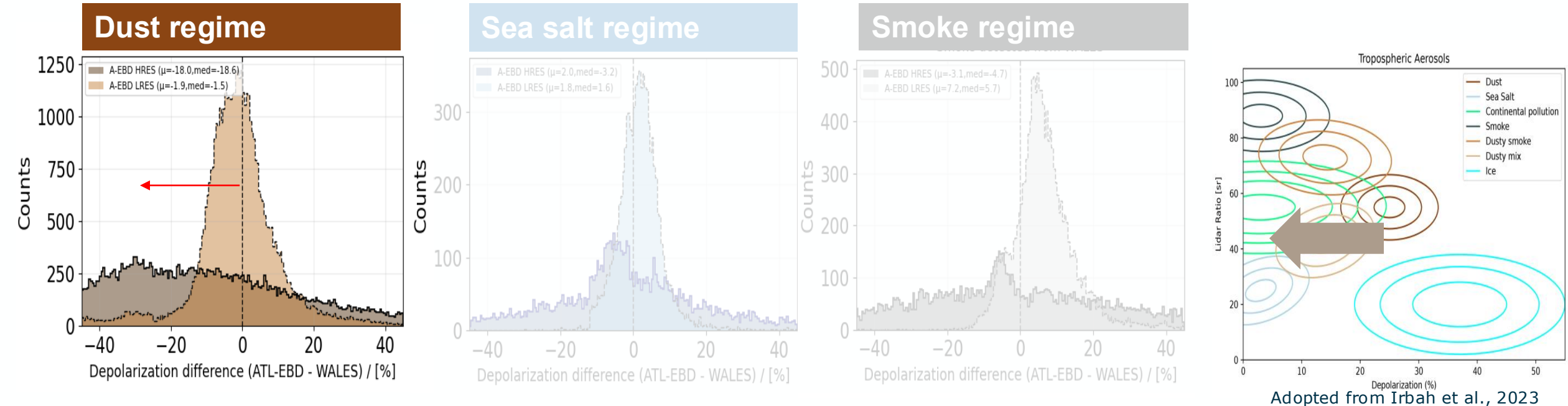
→ **Flat distributions for (A-EBD HRES – WALES)**

Depolarization study for A-EBD LRES/HRes



ATL-EBD - WALES depol. differences for distinct aerosol regimes

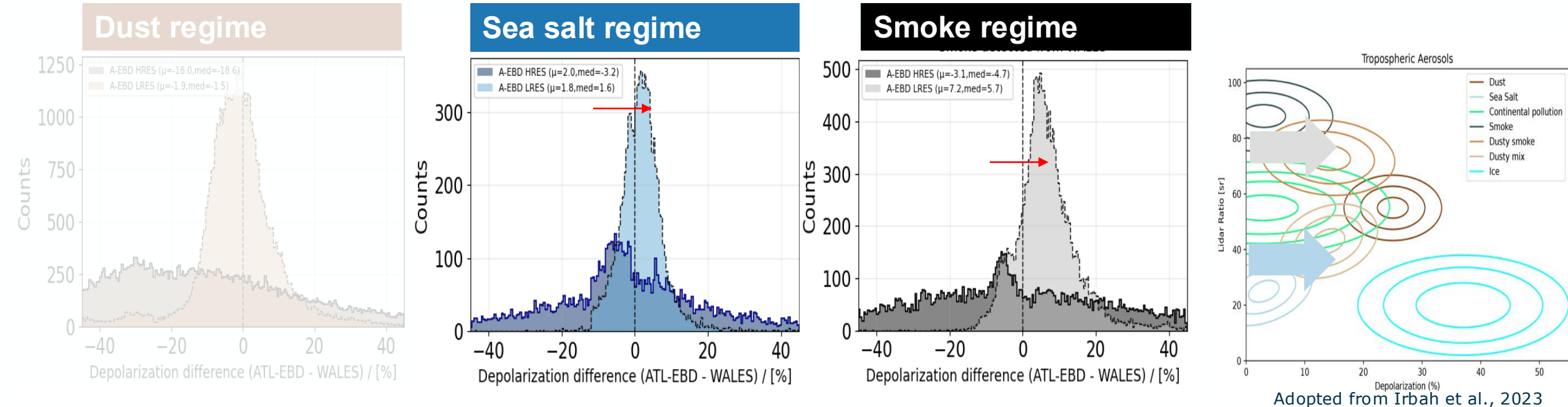
**Baseline: BA,
E-Frames**



- **Dust regime** (strong depol):
 - Broader and shifted distributions: depol in LRES lower than for HRES → less smoke

ATL-EBD - WALES depol. differences for distinct aerosol regimes

**Baseline: BA,
E-Frames**

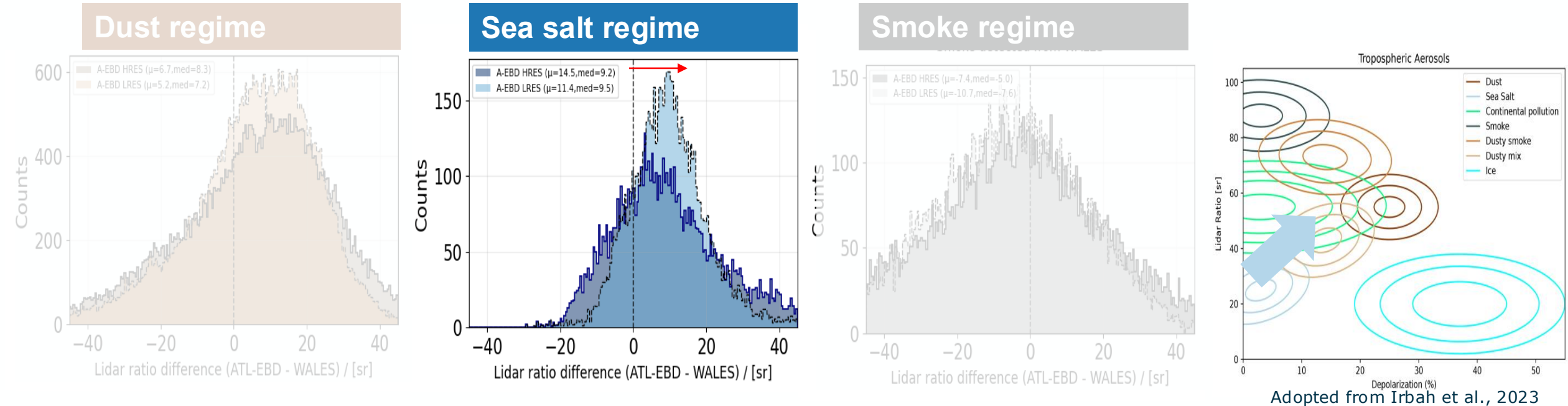


- **Sea salt regime & Smoke regime (low depol.):**
 - LRES slightly shifted towards positive values
 - less pure sea salt in LRES
 - less pure smoke and more dusty smoke in HRES

Lidar ratio study for A-EBD LRES/HRES

ATL-EBD - WALES lidar ratio differences for distinct aerosol regimes

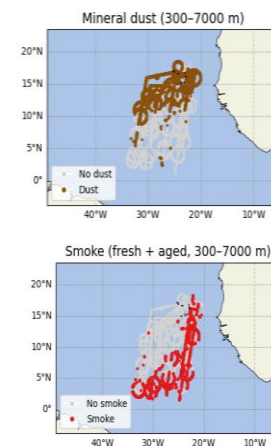
**Baseline: BA,
E-Frames**



➤ **Sea salt regime:** slightly increased lidar ratio + depol. → more dusty mix/pollution in HRES

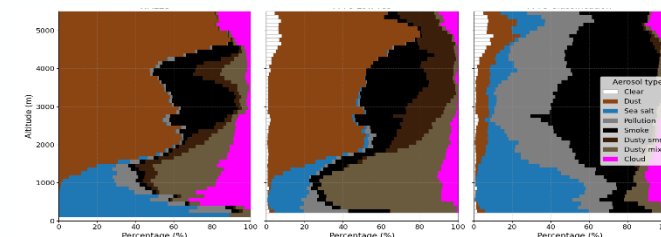
Airborne HSRL observations during PERCUSION field campaign

- 12 EarthCARE underflights in the tropical underflight
- Observations cover wide range of aerosol conditions (smoke, dust, sea salt)



Validation of the aerosol classification from A-TC

- Investigation of classification at different resolutions:
 - LRes: good representation of dust and smoke, too less sea salt
 - HRes: more realistic sea salt, but too smoky
- Analysis of depol./lidar ratio of A-EBD at different resolutions:
 - Observed shifts are in line with changed classifications



Outlook

- Inclusion of extratropical flights + recent Baseline
- Validation of aerosol layer properties

