



PACE Microphysical Aerosol Properties from Polarimetry (PACE-MAPP)



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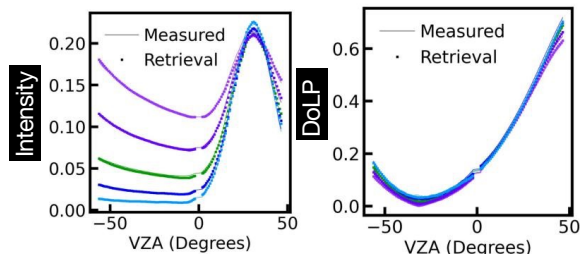
Why PACE-MAPP?

- ❖ Aerosol absorption is a key climate geophysical variable (GV) that polarimeters can quantify
- ❖ Polarimetry is vital to understanding the impacts of aerosols and clouds on weather and climate
- ❖ Incredible advances in aerosol, ocean, and cloud remote sensing using polarimetry are possible using machine learning (Stamnes et al., 2018; Gao et al., 2021; Stamnes et al., 2023)

Airborne PACE-like data (RSP)

- ❖ Aerosol Cloud Meteorology Interactions Over the Western Atlantic Experiment (ACTIVATE)
 - Research Scanning Polarimeter (RSP)

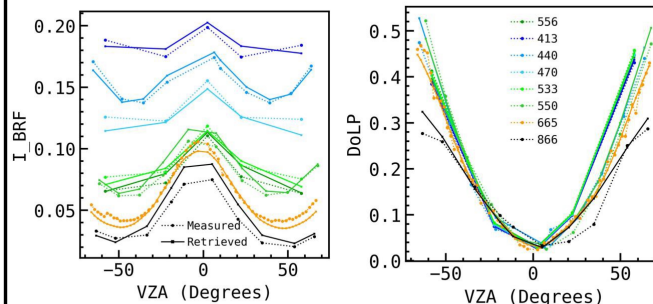
ACTIVATE 2022/05/17 RSP



- ❖ MAPP uses neural networks to become 1000x faster (7 channels from 410-2264 nm are simulated at all viewing angles)

What is PACE-MAPP?

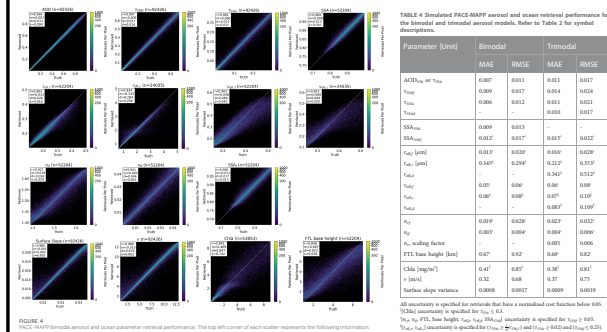
Equatorial Atlantic Ocean: 20240410T160650.L1C.V2.5km.nc



Polarimeters like SPEXone and HARP2 measure light not only at multiple wavelengths, but also measure both the intensity and polarization at multiple angles

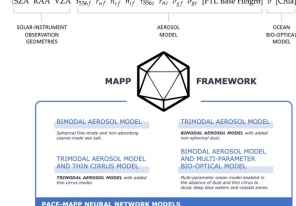
- ❖ The PACE-MAPP retrieval algorithm uses optimal estimation, a coupled atmosphere-ocean vector radiative transfer model, neural networks, and inherent optical property lookup tables for the Earth's aerosol, cloud, and uncoated/coated hydrosol particles (Chemyakin et al., 2021; 2023; 2024)
- ❖ Goal: to retrieve accurate aerosol optical and microphysical properties and ocean properties using optimal estimation
- ❖ Only planned operational algorithm for both polarimeters and OCI on PACE

PACE-MAPP performance



- PACE-MAPP is expected to retrieve total aerosol optical depth at 556 nm (AOD_{556}) within ± 0.017 , fine-mode AOD_{556} within ± 0.024 , and fine-mode single-scattering albedo (SSA_{556f}) within ± 0.022
- Uncertainties expressed as 1σ

ISCA RAA VZA τ_{556} τ_{440} τ_{410} τ_{380} τ_{350} τ_{320} τ_{290} τ_{260} τ_{230} τ_{200} τ_{170} τ_{140} τ_{110} τ_{80} τ_{50} τ_{30} τ_{10} τ_{0} τ_{-10} τ_{-30} τ_{-50} τ_{-70} τ_{-90} τ_{-110} τ_{-140} τ_{-170} τ_{-200} τ_{-230} τ_{-260} τ_{-290} τ_{-320} τ_{-350} τ_{-380} τ_{-410} τ_{-440} τ_{-556} τ_{-556f} τ_{-556b} τ_{-556c} τ_{-556d} τ_{-556e} τ_{-556f} τ_{-556g} τ_{-556h} τ_{-556i} τ_{-556j} τ_{-556k} τ_{-556l} τ_{-556m} τ_{-556n} τ_{-556o} τ_{-556p} τ_{-556q} τ_{-556r} τ_{-556s} τ_{-556t} τ_{-556u} τ_{-556v} τ_{-556w} τ_{-556x} τ_{-556y} τ_{-556z} τ_{-556aa} τ_{-556ab} τ_{-556ac} τ_{-556ad} τ_{-556ae} τ_{-556af} τ_{-556ag} τ_{-556ah} τ_{-556ai} τ_{-556aj} τ_{-556ak} τ_{-556al} τ_{-556am} τ_{-556an} τ_{-556ao} τ_{-556ap} τ_{-556aq} τ_{-556ar} τ_{-556as} τ_{-556at} τ_{-556au} τ_{-556av} τ_{-556aw} τ_{-556ax} τ_{-556ay} τ_{-556az} τ_{-556ba} τ_{-556bb} τ_{-556bc} τ_{-556bd} τ_{-556be} τ_{-556bf} τ_{-556bg} τ_{-556bh} τ_{-556bi} τ_{-556bj} τ_{-556bk} τ_{-556bl} τ_{-556bm} 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- PACE-MAPP is a fully adaptable, 100% Python framework that supports different retrieval parameters, processing pipelines, and neural network forward models via a simple config file
- Supports bimodal and trimodal aerosol models
- Tested using synthetic PACE data and airborne RSP polarimeter data
- Support for PACE Level-1C (L1C) data
- Combined SPEXone + HARP2 retrieval speed using 11 channels and all available viewing zenith angles: ~5 sec/core

References

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