Particulate optical properties in the Mediterranean and Black seas through CALIPSO spaceborne lidar measurements

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The Rationale
Ocean subsurface particle distributions have been successfully derived using CALIOP (Cloud-Aerosol Lidar with orthogonal Polarization) lidar measurements on the CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) satellite. Assessing the oceanic surface layer’s optical properties through CALIOP is one of the reasons of the extension of the CALIOP mission for another 3 years (2018-2020).

The Objective
is the evaluation of the potential CALIOP ocean products at regional scale. Mediterranean and Black seas have been considered as study cases. Multi-sensor L3 Ocean Color (OC) product (MODIS-AQUA and NPP-VIIRS data) provided by the Copernicus Marine Environment Monitoring Systems (CMEMS) were used as reference.

Methods

CHL, BBP and γ comparison
According to different ‘trophic regimes’ [5], MED is divided in four bioregions: West Med (1), East Med (2), Tyrrenhian Sea (3), Adriatic Sea (4).

Distribution of CHL, bbw, and γ along the CALIOP groundtracks (a, b and c panels, respectively) obtained from CMEMS computation and from eq (3), respectively.

- γ and CHL: significant correlation for Adriatic Sea, low correlation for the other bioregions
- γ and bbw: high correlation for BS and Adriatic Sea (2,80), significant correlation for West Med, low signal and correlation in no bloom regions (2 and 3)

Annual Cycles
Different trophic and optical regimes in MED and BS
Similar phytoplankton biomass annual cycle • summer minima • wintertime maxima Different particulate (bbw) annual cycle • BS: semi-annual cycle • MED: summertime maxima Sub-surface γ annual cycle • BS: semi-annual cycle • good agreement with bbw • MED: summer max - winter max • agreement with CHL

What’s next
- Full mission (2006 – 2017) analysis of CALIOP depolarization ratio δ and sub-surface integrated backscatter γ in MED and BS
- Analysis of ADM-AEOLUS measurements to estimate the sub-surface signal contribution

Day vs Night
Day and night data provide similar coverage and correlation consistent with day-night analysis.

Annual cycle:
BS: day-night difference is due to spatial sampling
MED: day-night difference > 30% between May and September (real signal?)

Conclusions
- Particulate optical properties in the Mediterranean and Black seas were estimated through CALIPSO spaceborne lidar measurements
- Depolarization ratio δ well compares with the sub-surface backscatter γ observations
- Sub-surface backscatter γ presents good correlation with the backscattering as derived by OC in optically complex waters (coastal and/or dominated by terrigenous load)
- Sub-surface integrated backscatter γ demonstrated to be as efficient as CO parameters for the phytoplankton dynamics at seasonal and basin scales

References