European Geosciences Union
General Assembly 2016
Vienna | Austria | 17–22 April 2016
EGU.eu

TROPOS

Closure between ice-nucleating particle and ice crystal number concentrations in ice clouds embedded in Saharan dust

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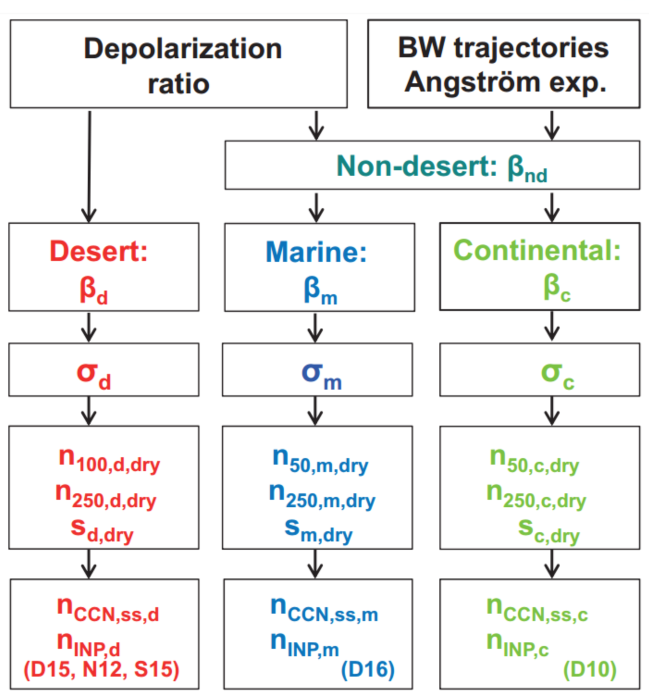
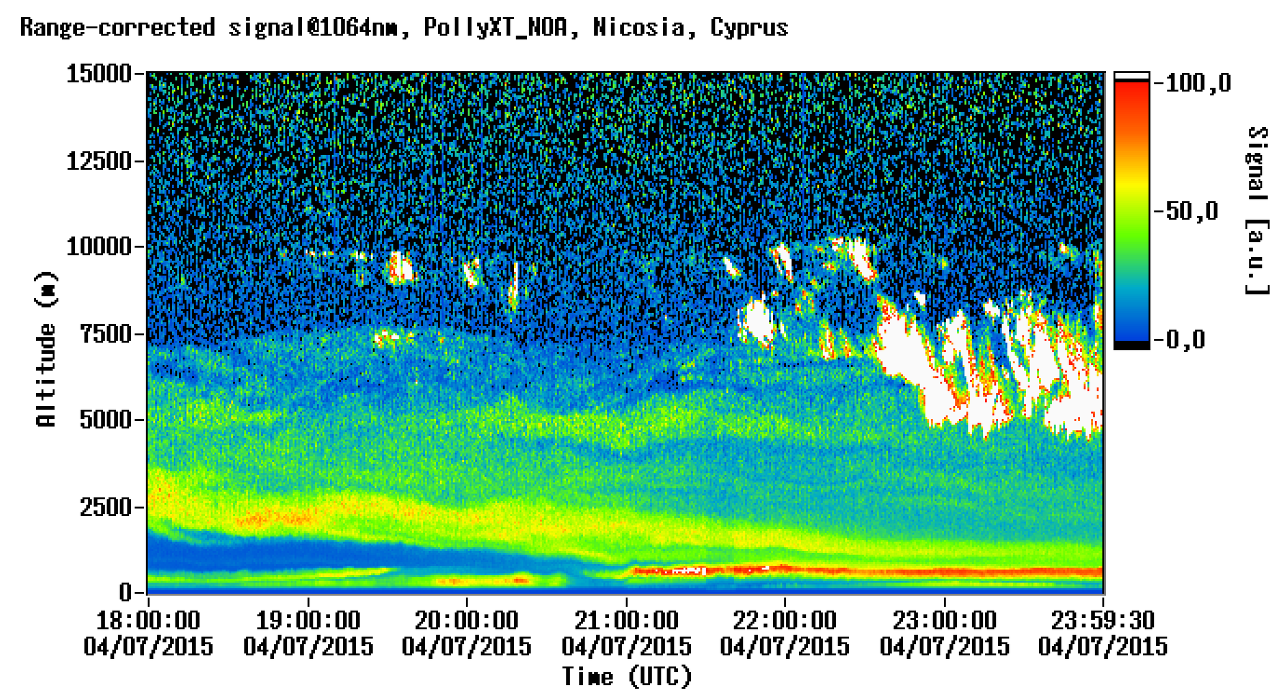
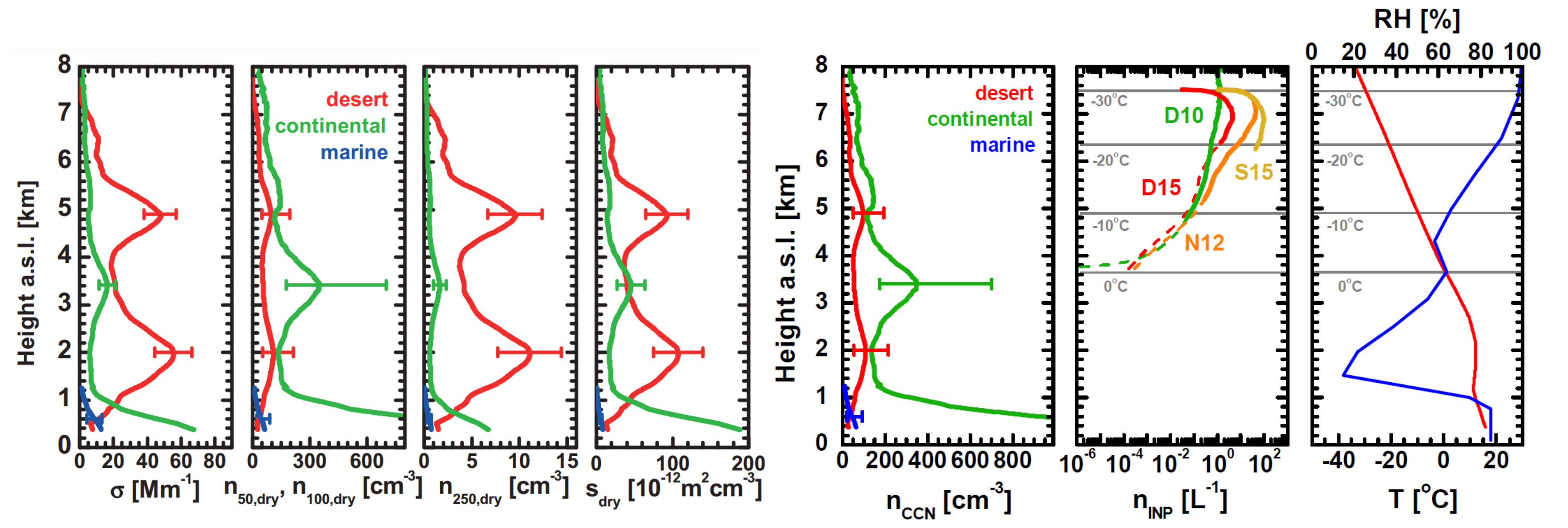
Lidar observations during the BACCHUS Cyprus 2015 campaign

A comprehensive study on the potential of polarization lidar to provide vertical profiles of CCN-relevant particle and INP number concentrations has been developed (see references 1,2 below). Of key importance is the separation of the basic aerosol types (desert, continental, marine) by means of the polarization lidar technique. Based on an in-depth correlation study applied to long-term and field campaign AERONET observations, it is has been demonstrated that a solid way exists from the particle extinction coefficients, as measurable with lidar, to the basic aerosol parameters from which the n_{CCN} and n_{INP} profiles can be estimated . We apply the method to lidar observation of dust outbreaks crossing Cyprus during the BACCHUS spring 2015 campaign in Cyprus.

Methodology



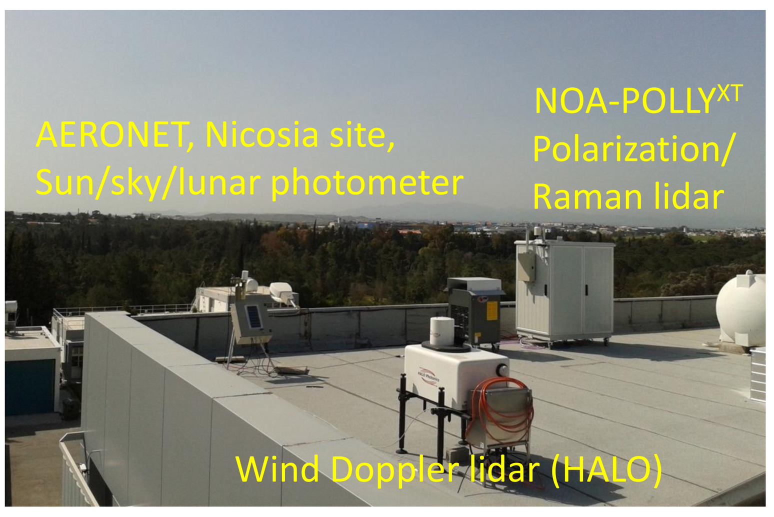


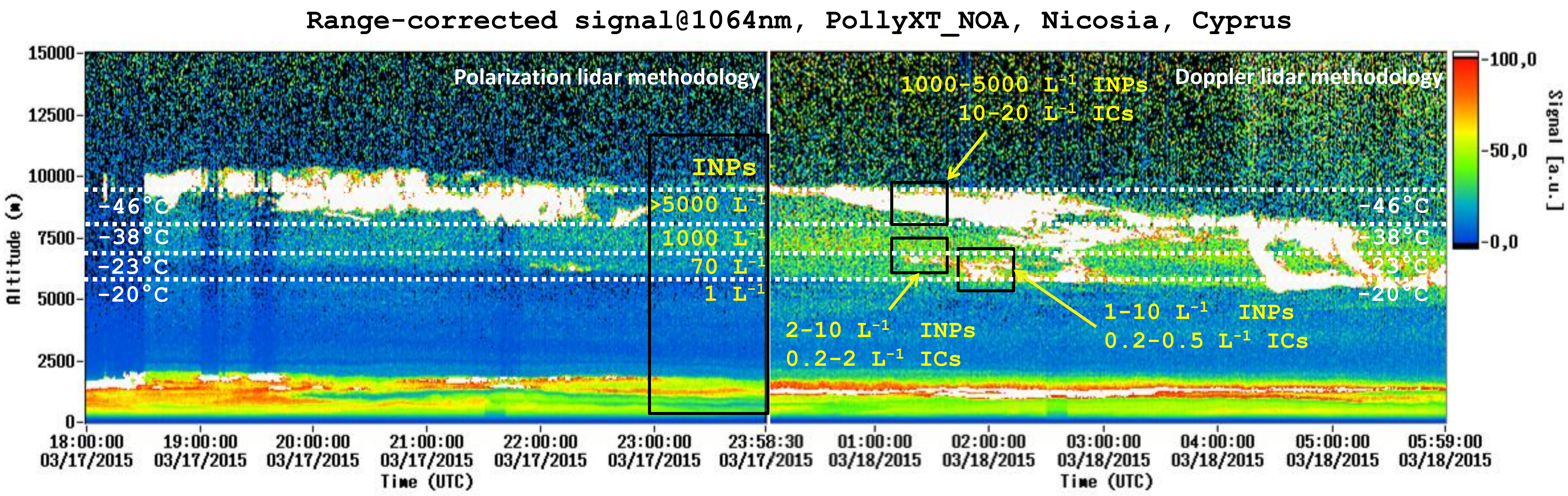


Height profiles of the 532 nm aerosol extinction coefficient σ and derived profiles of particle number concentrations $n_{50,dry}$ (dry radius >50nm, marine, continental) and $n_{100,dry}$ (dry radius >100nm, desert), of the large particle fraction in terms of $n_{250,dry}$ (dry radius >250nm), and surface area concentration s_{dry}, separately for all three aerosol types.

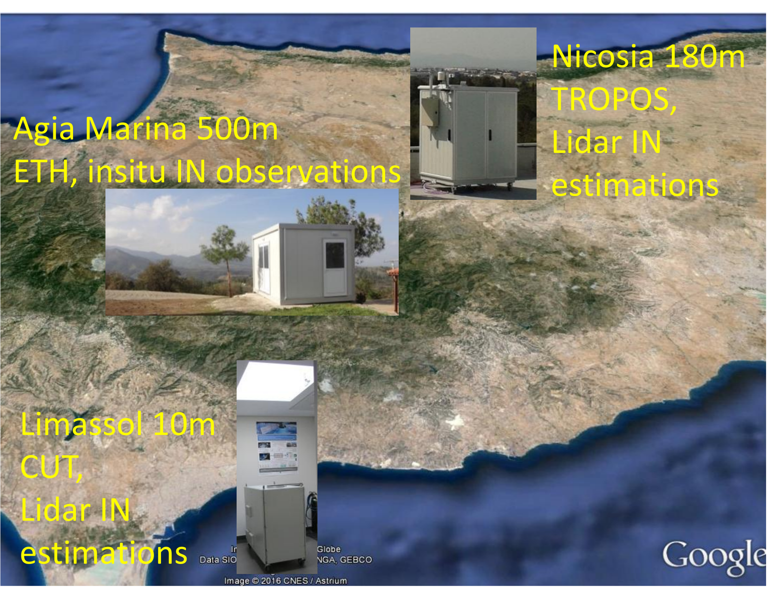
(Left) Particle number concentration n_{CCN} for a supersaturation of 0.15%. (Center) Ice-nucleating particle number concentration n_{INP}, computed with the parameterization schemes after DeMott et al. (2010) , DeMott et al. (2015) , Niemand et al. (2012) , and Steinke et al. (2015). (Right) GDAS temperature and relative-humidity profiles for Limassol.

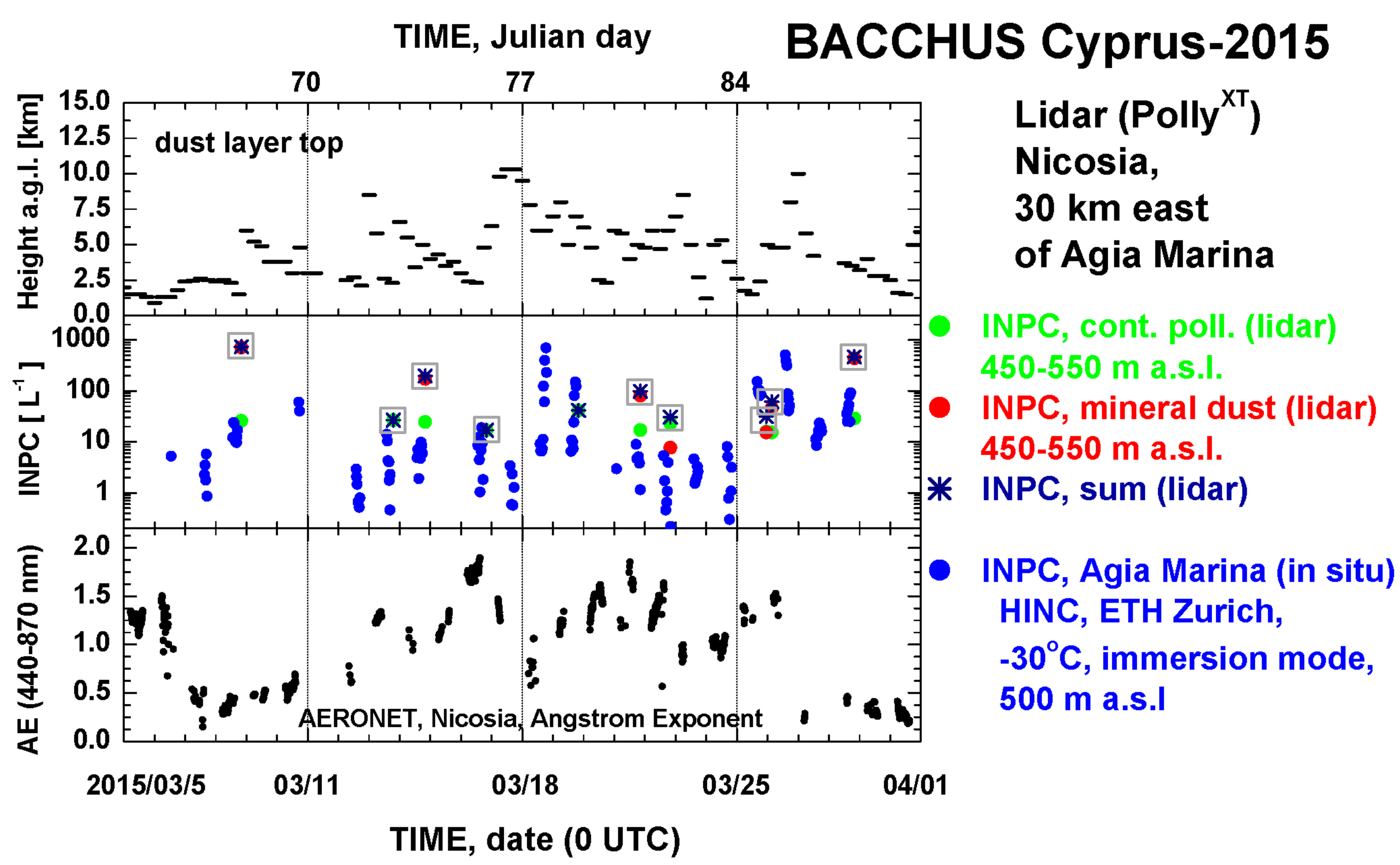
Closure





In situ vs Lidar





Uncertainties

Typical uncertainties in the lidar-derived particle optical properties (for 532 nm wavelength), in the retrieved microphysical particle properties, and the estimated cloud-relevant quantities

Parameter		Relative uncertainty
Backscatter coefficient	β_p	5-10%
Backscatter coefficient (desert dust)	β_d	10-15%
Backscatter coefficient (continental)	β_c	10-20%
Backscatter coefficient (marine)	β_m	20% (PBL)
Extinction coefficient (desert dust)	σ_d	15-25%
Extinction coefficient (continental)	σ_c	20-30%
Extinction coefficient (marine)	σ_m	25% (PBL)
Number concentrations (dry radius >50 nm)	$n_{50,i,dry}$	Factor of 1.5-2
Number concentrations (dry radius >100 nm)	$n_{100,i,dry}$	Factor of 1.5-2
Number concentrations (dry radius >250 nm)	$n_{250,i,dry}$	30-50%
Surface area concentration	$s_{i,dry}$	30-50%
Number concentration (CCN reservoir)	$n_{CCN,ss,i}$	Factor of 2–3
INP number concentration	$n_{INP,i}$	Factor of 3–10

References

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2. Mamouri, R. E. and Ansmann, A.: Potential of polarization lidar to provide profiles of CCN- and INP-relevant aerosol parameters, Atmos. Chem. Phys. Discuss., 15, 34149-34204, doi:10.5194/acpd-15-34149-2015, 2015.

BEYOND CRADLE BACCHUS

Acknowledgements

This work is funded by EU FP7-ENV-2013 programme "impact of Biogenic vs. Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding" (BACCHUS), project no. 603445.
The BEYOND project has received funding from the European Union's FP7-REGPOT-2012-2013-1 programme under grant agreement No 316210
The GEO-CRADLE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 690133
ERATOSTHENES Research Center of the Department of Civil Engineering & Geomatics at the Cyprus University of Technology for the support (http://www.cut.ac.cy/).
We are grateful to AERONET for high-quality sun/sky photometer measurements in Cyprus, Morocco, Cape Verde, and Barbados.