

Effect of aerosol vertical distribution on the transfer of solar radiation through the atmosphere

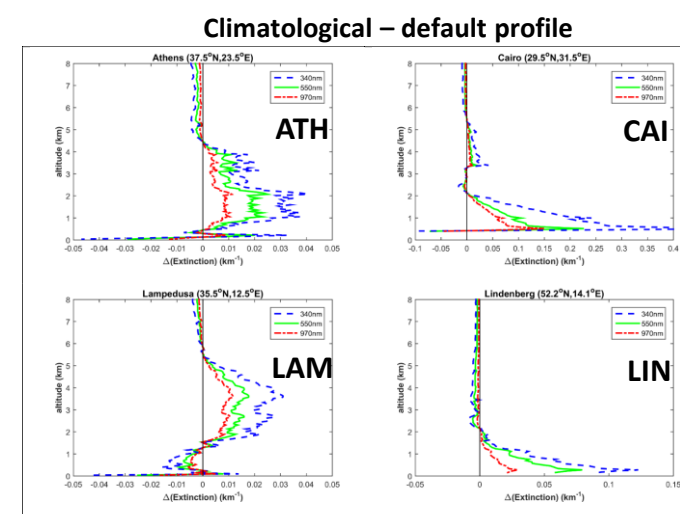
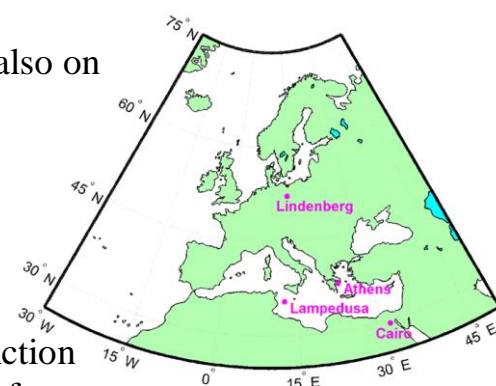
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Introduction & methodology

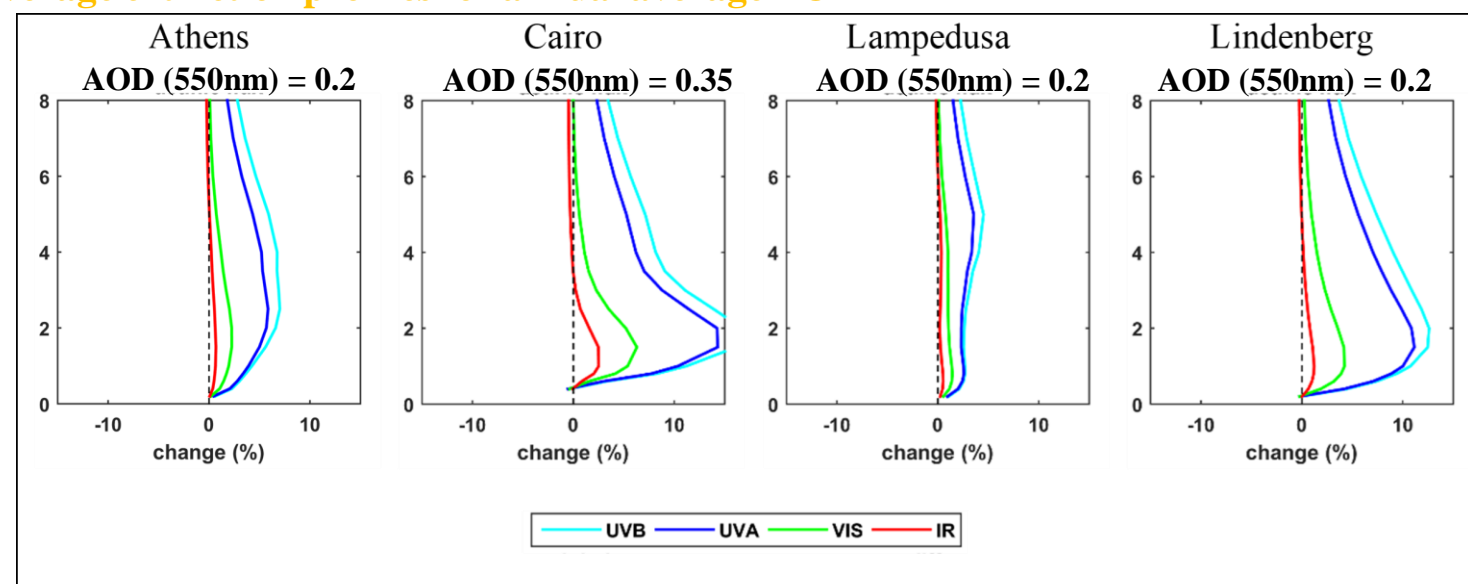
- Radiative effects of aerosols depend on their physical and optical properties, but also on their distribution in the atmosphere.
- Default profiles are commonly used in modelling studies instead of real or climatological profiles.
- Simulations were performed using the Shettle (1989) climatological aerosol extinction profile, and the seasonally and annually averaged extinction profiles for each site from LIVAS (Amiridis et al., 2015).



- Seasonal and annual AOD, Angstrom, SSA, asymmetry factor
- Downwelling and upwelling irradiances, heating rates, and the actinic flux were simulated from 0 to 8 km.
- Four locations with quite different aerosol characteristics

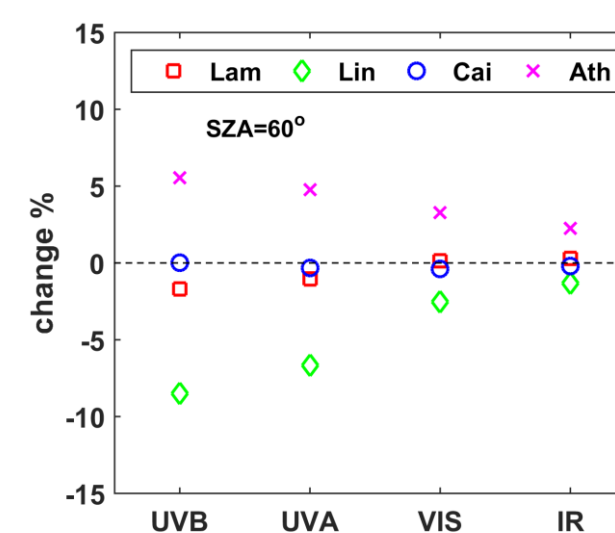
Results

Average extinction profiles for annual average AOD

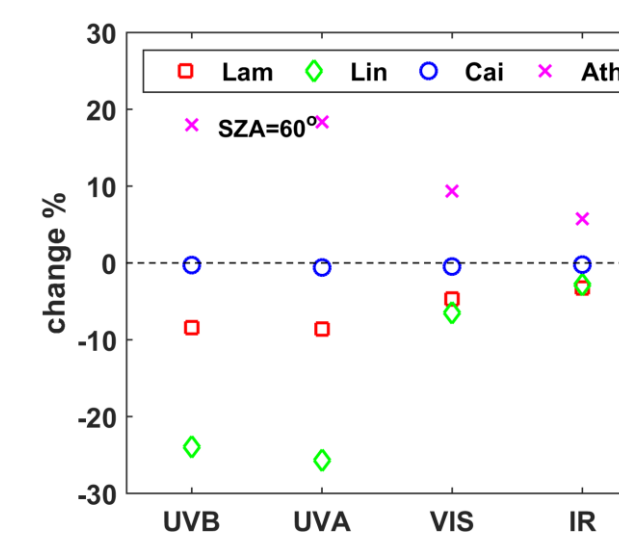


Using annually averaged extinction profiles instead of climatological: Differences up to 15% for actinic flux in UV. At the surface differences were smaller than 2%

Profiles for extremely high AOD (AOD at 550 nm ~ 1.0 – 1.2)



Extremely high AOD: Differences up to 10% at the surface for global UV



Extremely high AOD: Differences up to 30% at the Top of Atmosphere for upwelling UV

Conclusions

- Larger differences in the atmosphere (~10 – 15% for UV) and very small differences at the surface and TOA (<5% for UV) for climatological AOD (0.2 – 0.4)
- For very high aerosol load differences are much larger and are also significant at the surface and at the TOA
- Larger differences in UV and smaller differences in VIS and IR

References

1. Amiridis et al., : LIVAS: a 3-D multi-wavelength aerosol/cloud database based on CALIPSO and EARLINET, Atmos. Chem. Phys., 15, 7127–7153, <https://doi.org/10.5194/acp-15-7127-2015>, 2015.
2. Shettle, E.P. Models of aerosols, clouds and precipitation for atmospheric propagation studies, in Atmospheric Propagation in the UV, Visible, ir and mm-Region and Related System Aspects. Agard Conf. Proc. 1989. Available online: https://www.researchgate.net/publication/234312286_Models_of_aerosols_clouds_and_precipitation_for_atmospheric_propagation_studies

Acknowledgements

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