# Evaporation of sunscreen films: how the UV protection properties change.

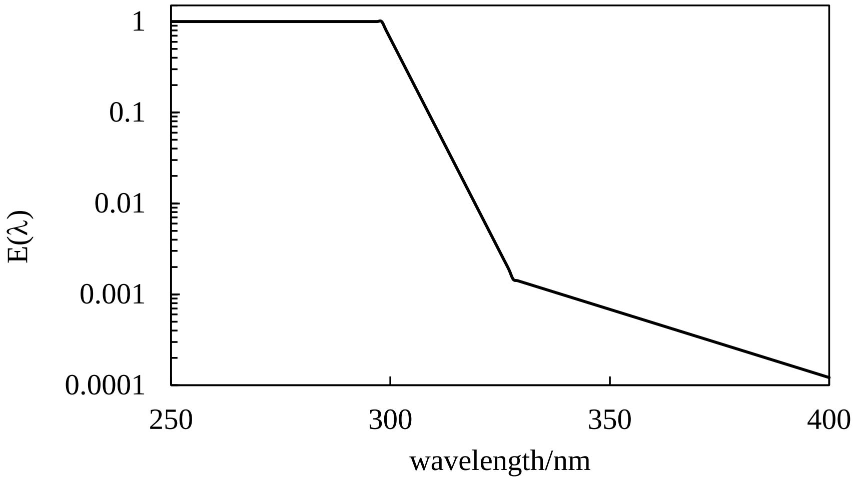
Bernard P. Binks[a], Jonathan Brown, Paul D.I. Fletcher[a]*, Andrew J. Johnson[a], Ioannis Marinopoulos[a], Jonathan M. Crowther[b] and Michael A. Thompson[c]

[o]*Department of Chemistry, University of Hull, Hull HU6 7RX, UK*
[b] *GSK Consumer Healthcare (UK) Ltd., 980 Great West Road, Brentford, Middlesex, TW8 9GS, UK*
[c]*GSK Consumer Healthcare, STF 1N-45, PO Box 13398, 20 TW Alexander Drive, Research Triangle Park, North Carolina, 27709-3398, USA*

*Corresponding author. Email: P.D.Fletcher@hull.ac.uk

## Supporting Information

Figure S1. Reference erythema action spectrum E(λ) (upper plot) and spectral irradiance of terrestrial sunlight S(λ) corresponding to midday midsummer sunlight for latitude 40$^{o}$N, solar zenith angle 20$^{o}$ and ozone layer thickness equal to 0.305 cm. (From: B.L. Diffey and J. Robson, *J. Soc. Cosmet. Chem.*, 1989, **40**, 127-133.)



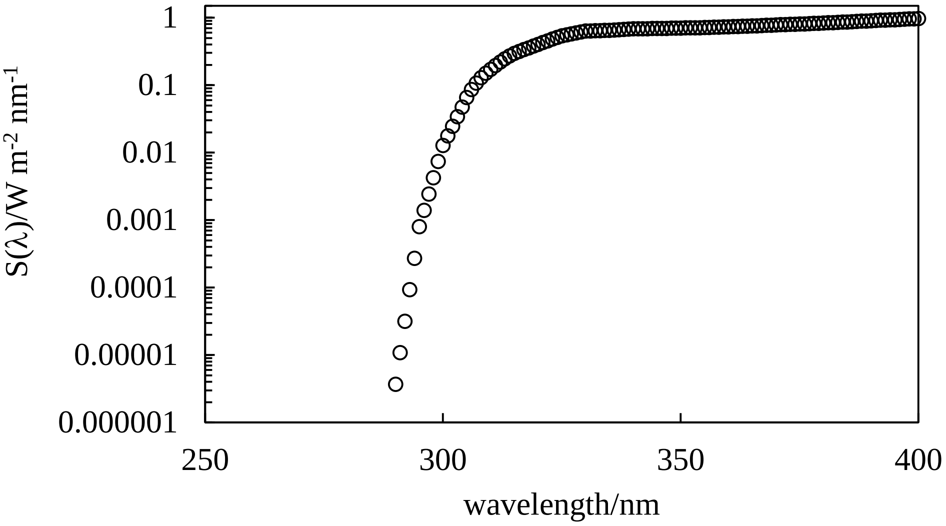
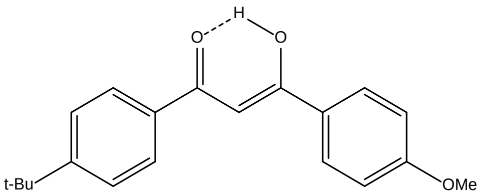
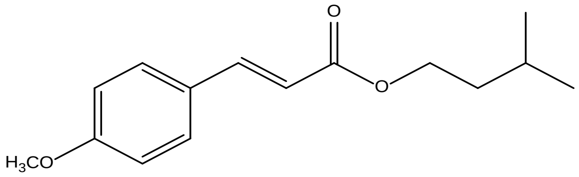


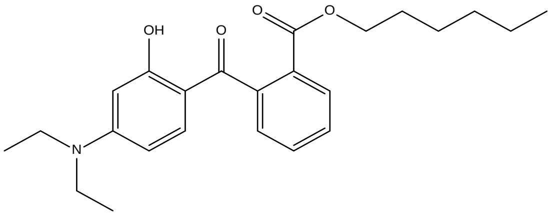
Figure S2. Molecular structures of the UV filters.



4-*tert*-butyl-4’-methoxy dibenzoyl methane (enol form), also known as avobenzone (AVB)



*Iso*-pentyl *p*-methoxycinnamate (MC)



Diethylamino hydroxybenzoyl hexyl benzoate (DHHB)

Figure S3. Spectra of the UV filters in PG.

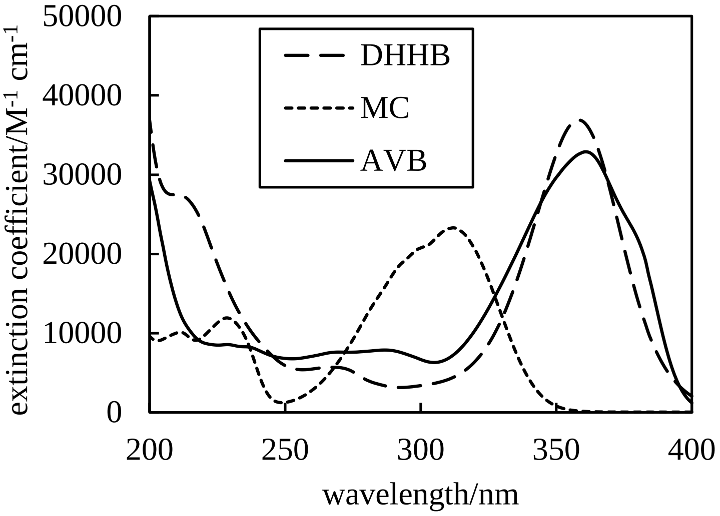


Figure S4. Evolution of film mass, total film area and average film thickness with evaporation time for a film of pure PG spread on quartz.

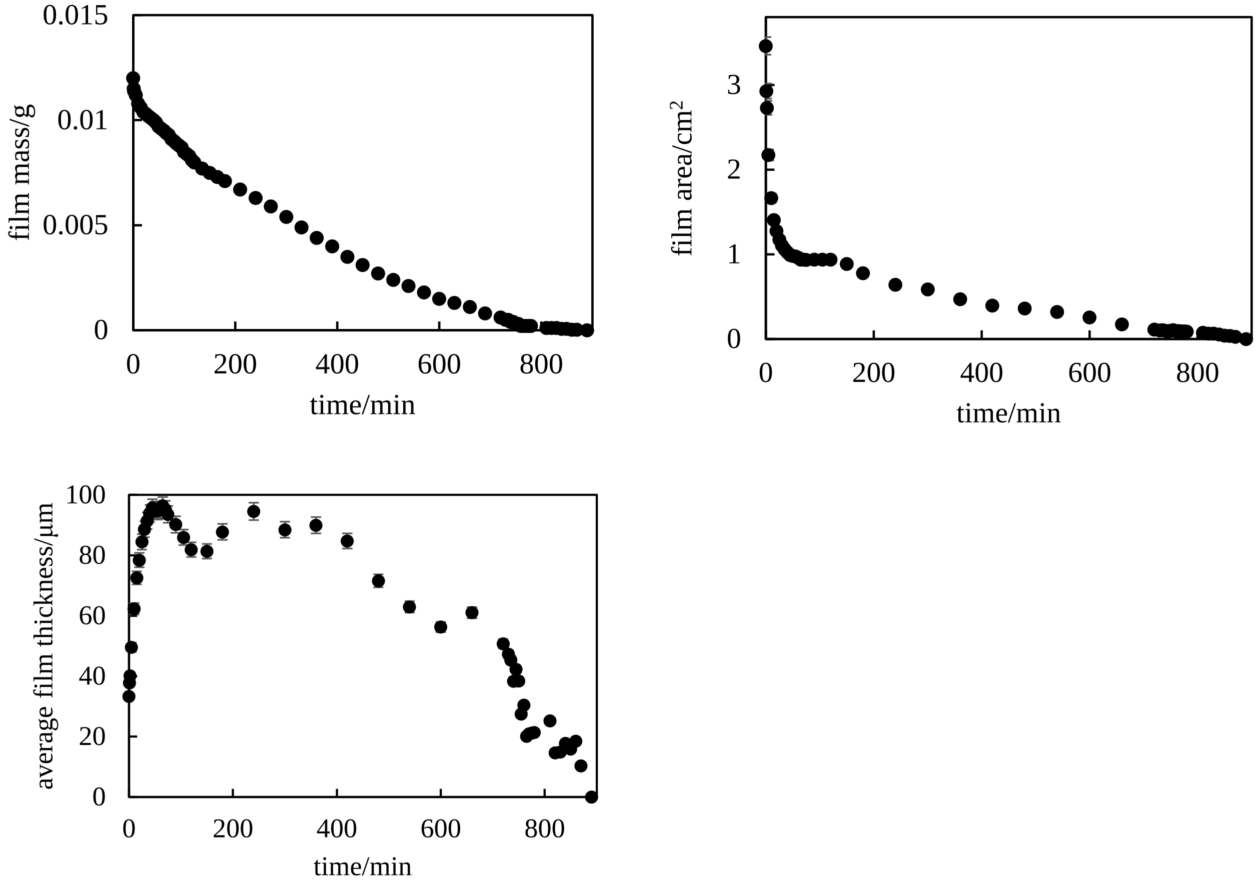


Figure S5. Overall appearance and representative optical micrograph of the film residue following 690 minutes of evaporation of 8 mM AVB in PG on a quartz plate. The film region in the micrograph corresponds to the centre of the illuminated area indicated by the red rectangle.

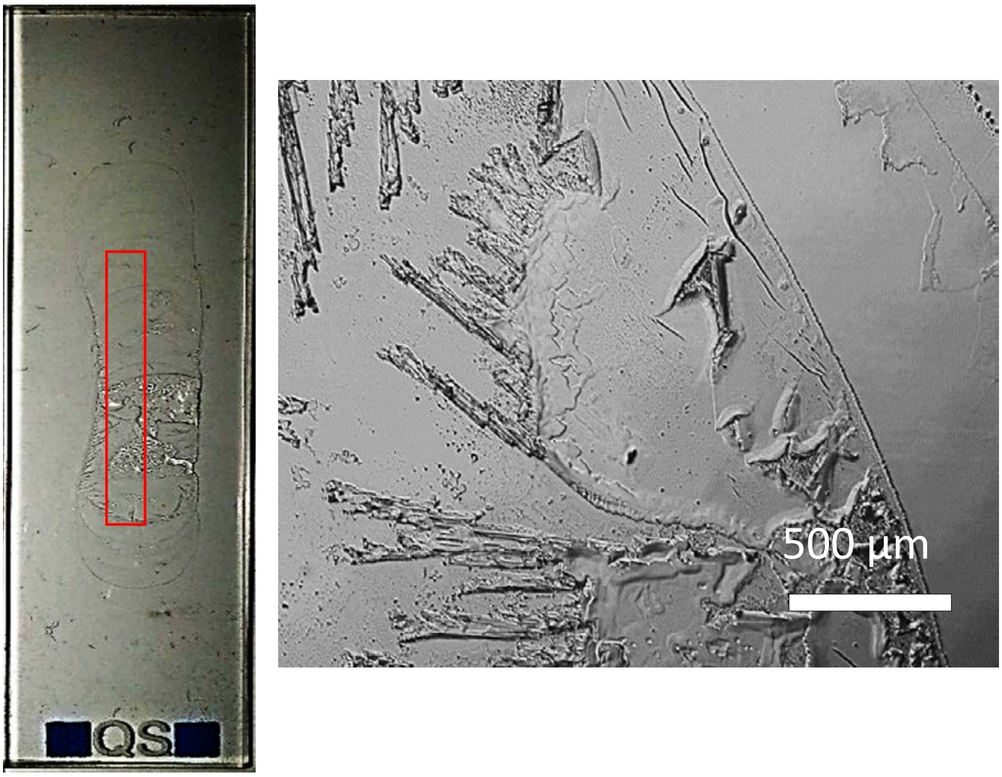


Figure S6. Variation of film mass, area and average thickness during evaporation of a film of 8 mM AVB in decane spread on quartz. The fraction of illuminated area covered by film ($A_f$) was equal to 1 throughout the evaporation. The dashed lines indicate the point at which AVB precipitates.

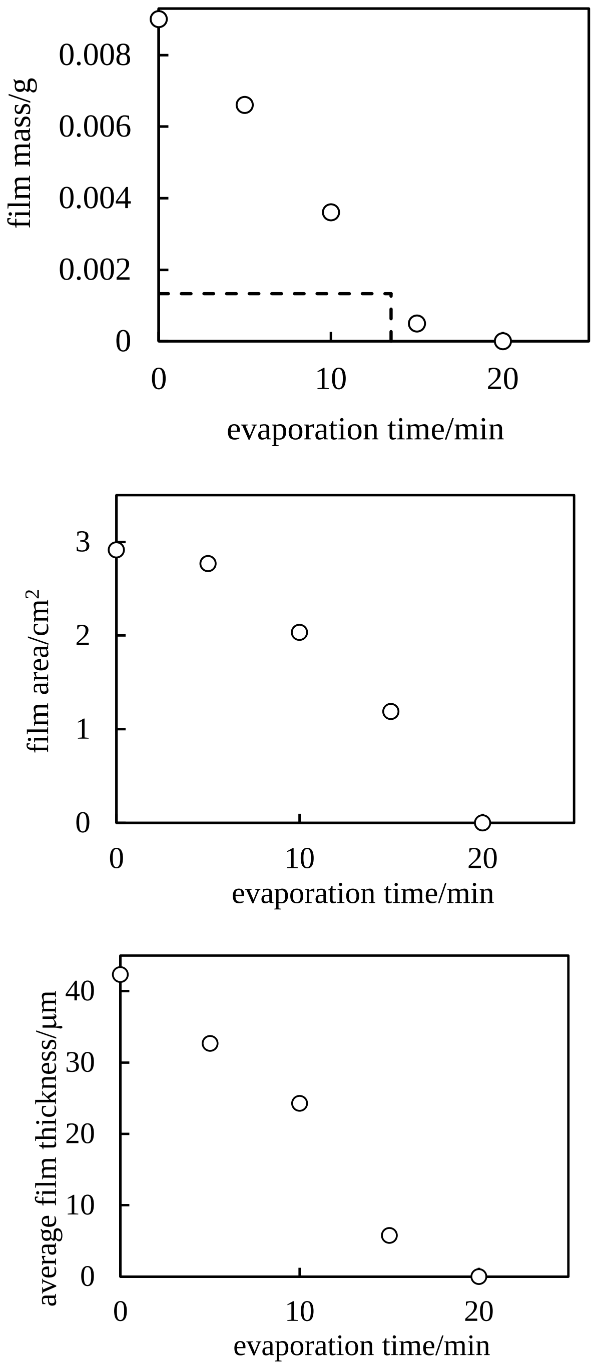


Figure S7. Upper: Spectra (versus air reference) of film of 8 mM AVB in decane spread on quartz at the start and end of complete evaporation. Lower: optical micrograph of the film residue within the illuminated area after 20 minutes evaporation.