

Study Questions

What can a 4-year high resolution time series of multi-spectral b_{bp} tell us about the temporal variability in the spectral slope γ ? Does the choice of wavelength matter? What can we deduce about the particle size distribution (PSD)? How does absorption affect b_{bp} measurements?

Methodology

- Surface measurements every 15 min at BOUSSOLE Buoy in NW Mediterranean
- Particulate backscattering b_{bp} at 4 λ (442,488,550,620 nm) from 2008-2011
- Four estimates of spectral slope γ determined using 4 different pairs of wavelengths
- Seasons determined from surface chlorophyll and mixed layer depth.

Seasonal Variations in γ

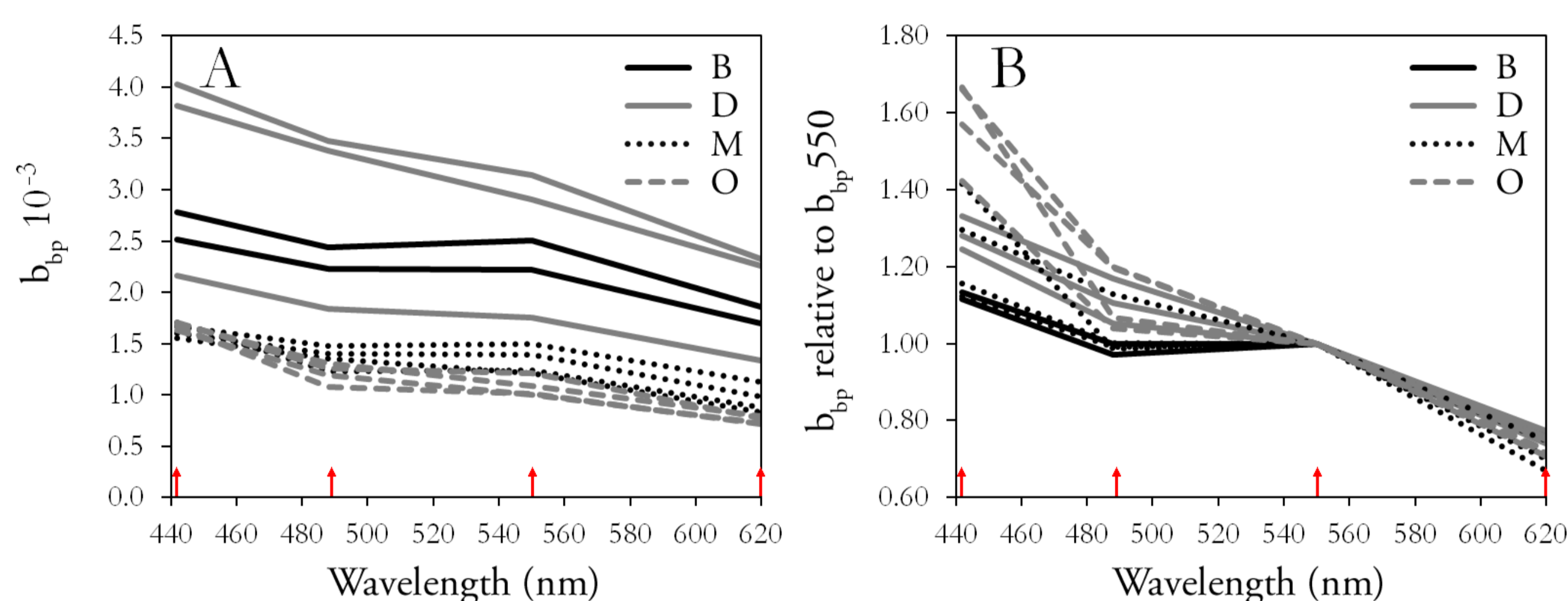


Fig. 1. Mean seasonal backscattering spectra (A) and spectra normalised to b_{bp550} (B) (seasons shown as B: bloom; D: decline; M: mixing; O: oligotrophy). Individual measurement wavelengths are shown as red arrows.

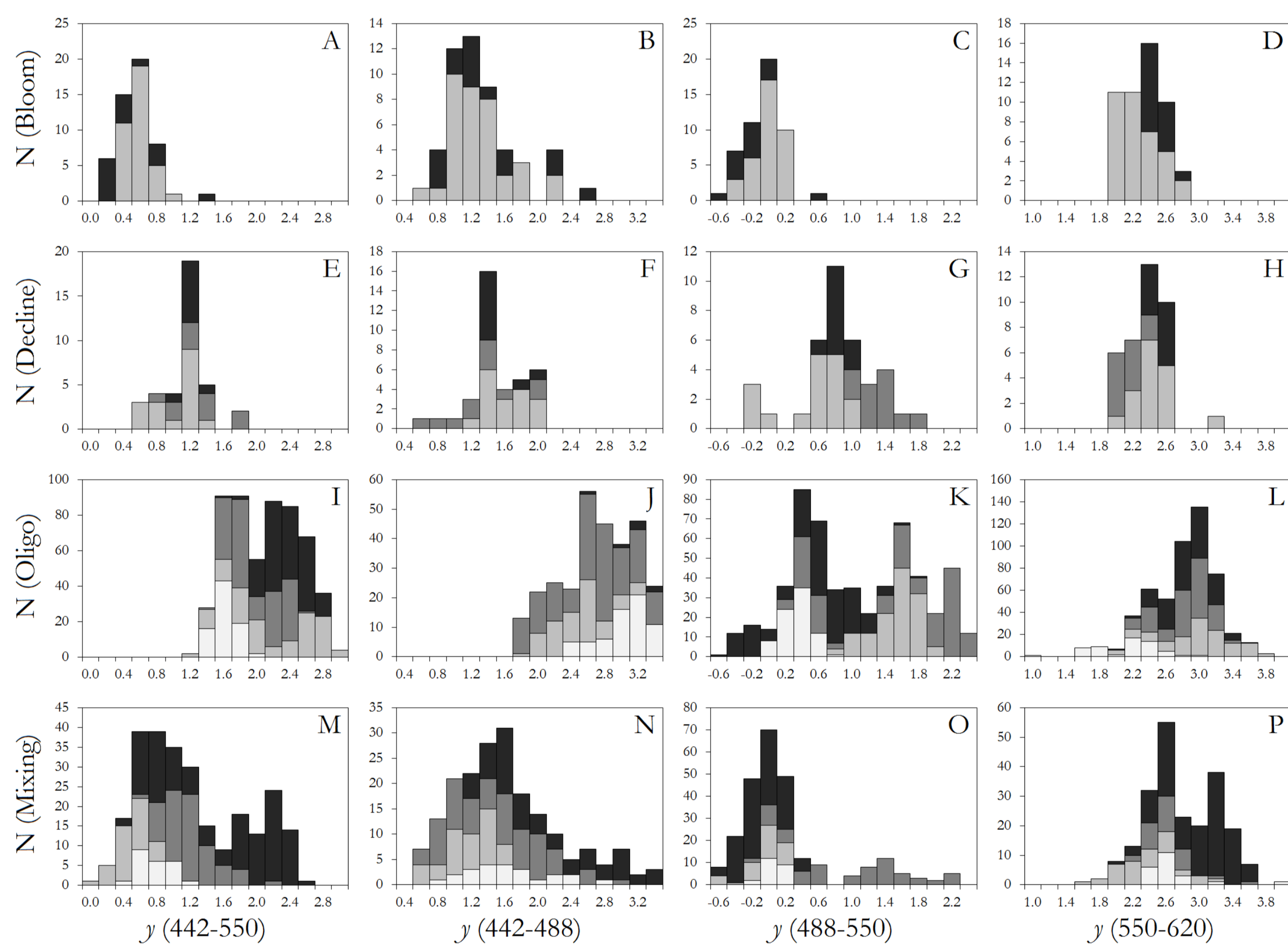


Fig. 2. Histograms of the frequency of distribution of mean daily γ for each estimate and each season. Shades indicate year from light (2008) to dark (2011).

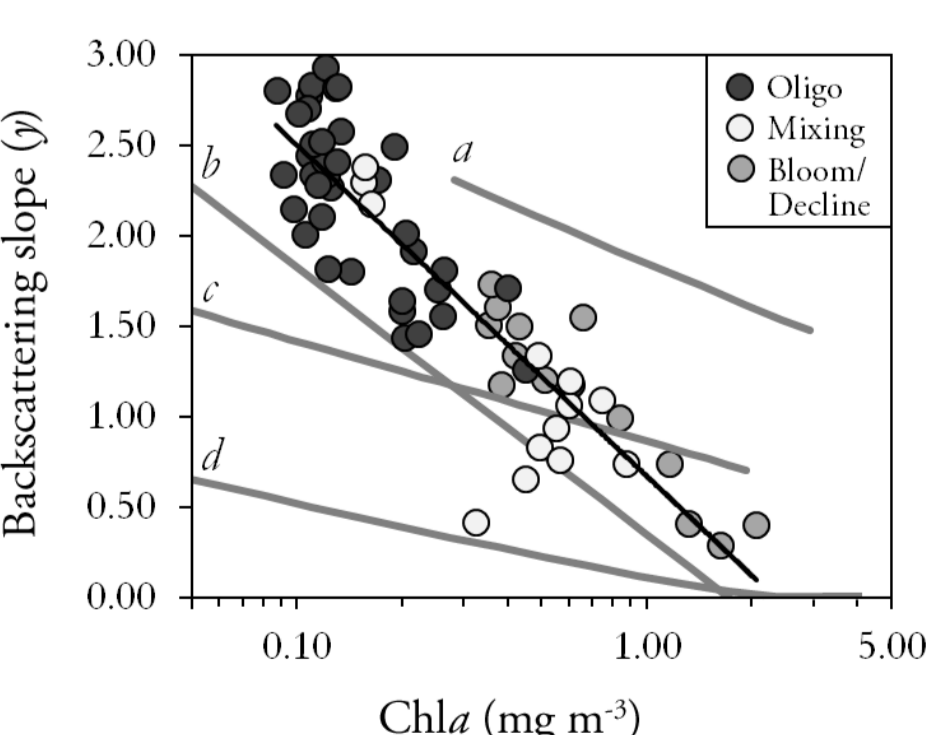


Fig. 3. γ (442-550) vs Chl a .

1. Seasonal dependence of b_{bp} with greater values during bloom proliferation and decline.
2. Evidence of depression in slope around 442-488 nm probably due to phytoplankton absorption.
3. Depression leads to differences in estimates of γ depending on wavelengths considered.
4. γ (442-550) shows most appropriate range in values, seasonal variations and relationship to chl.

Diel Cycles of γ

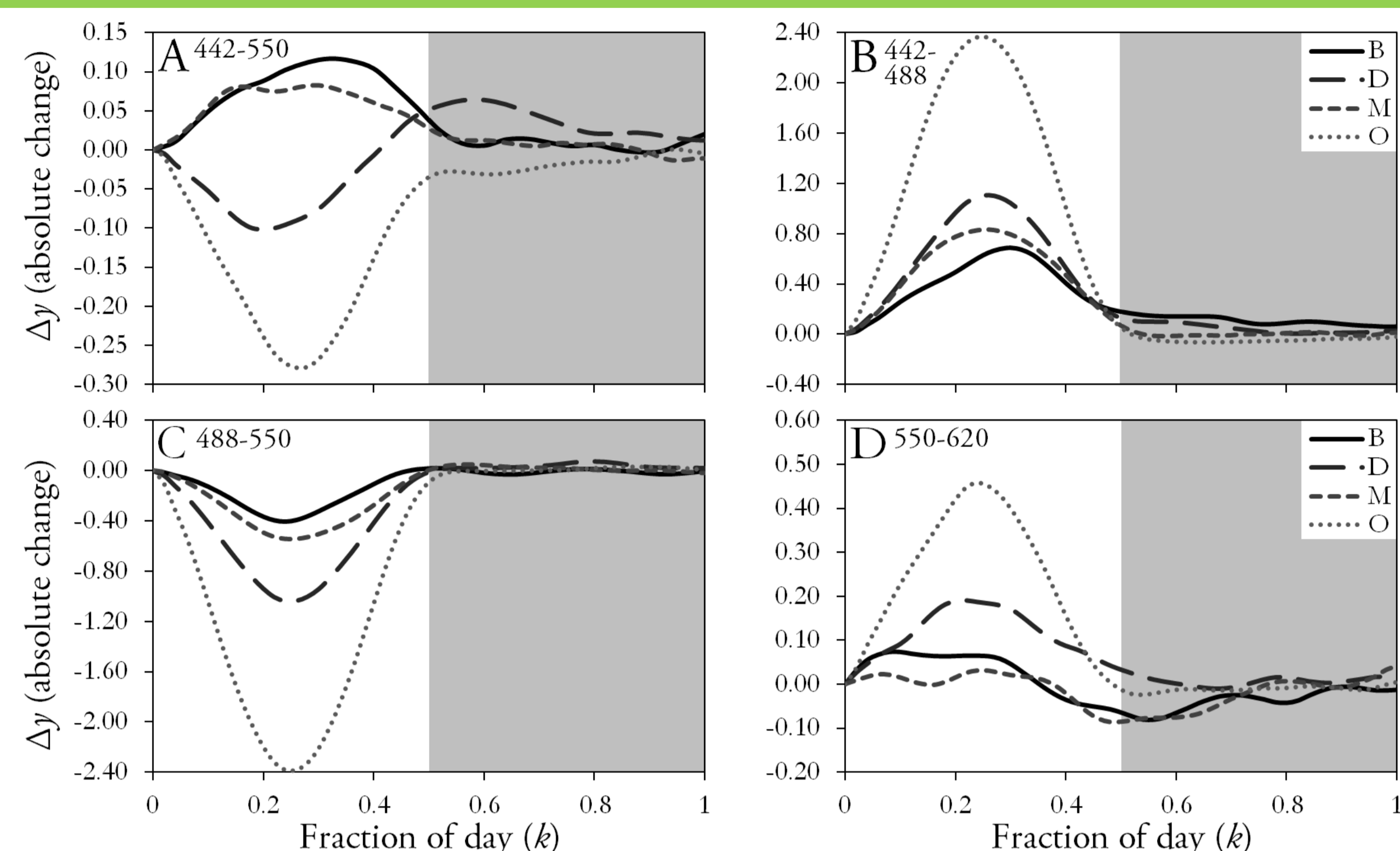


Fig. 4. Mean seasonal diel cycles of the four estimates of γ .

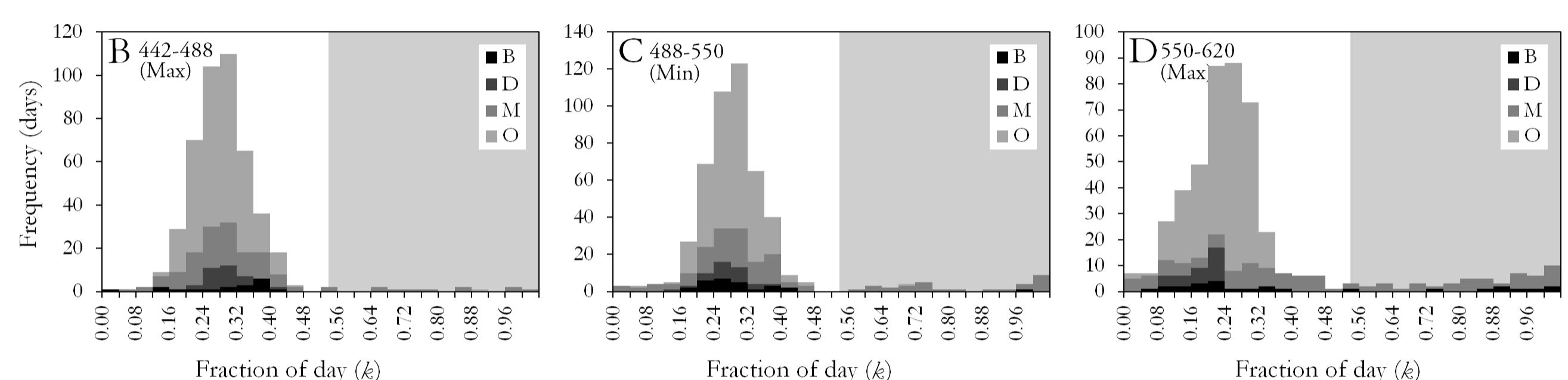


Fig. 5. Histogram of the timing of the daily γ min or max (depending of sign of Fig. 3 variations) for three estimates of γ showing number of days for each 0.04 bin of k .

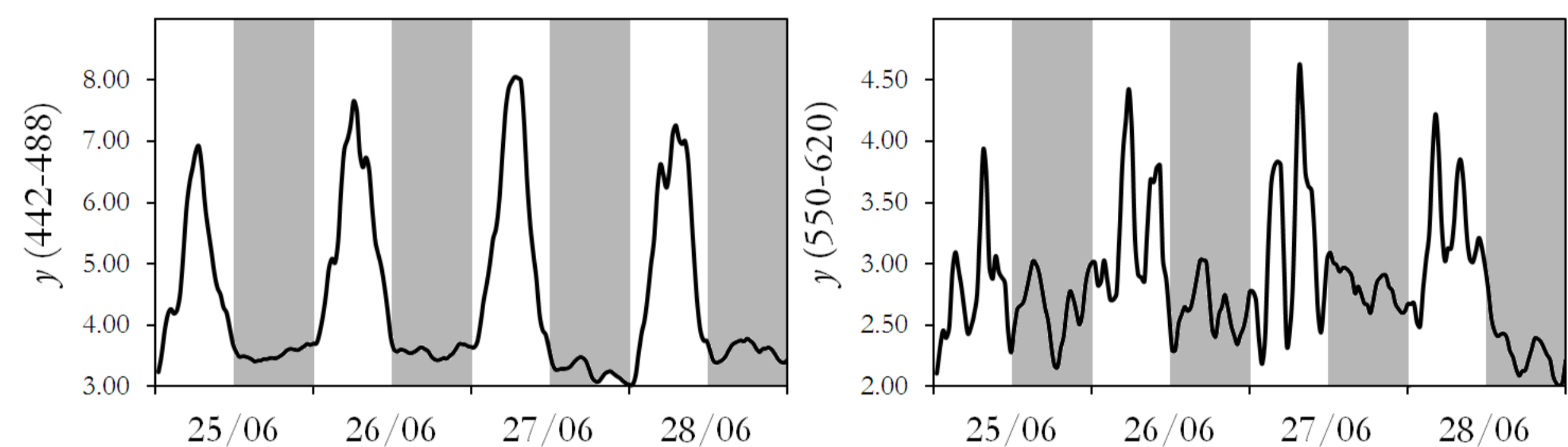


Fig. 6. Examples of diel cycles of γ between 25-28 June 2011.

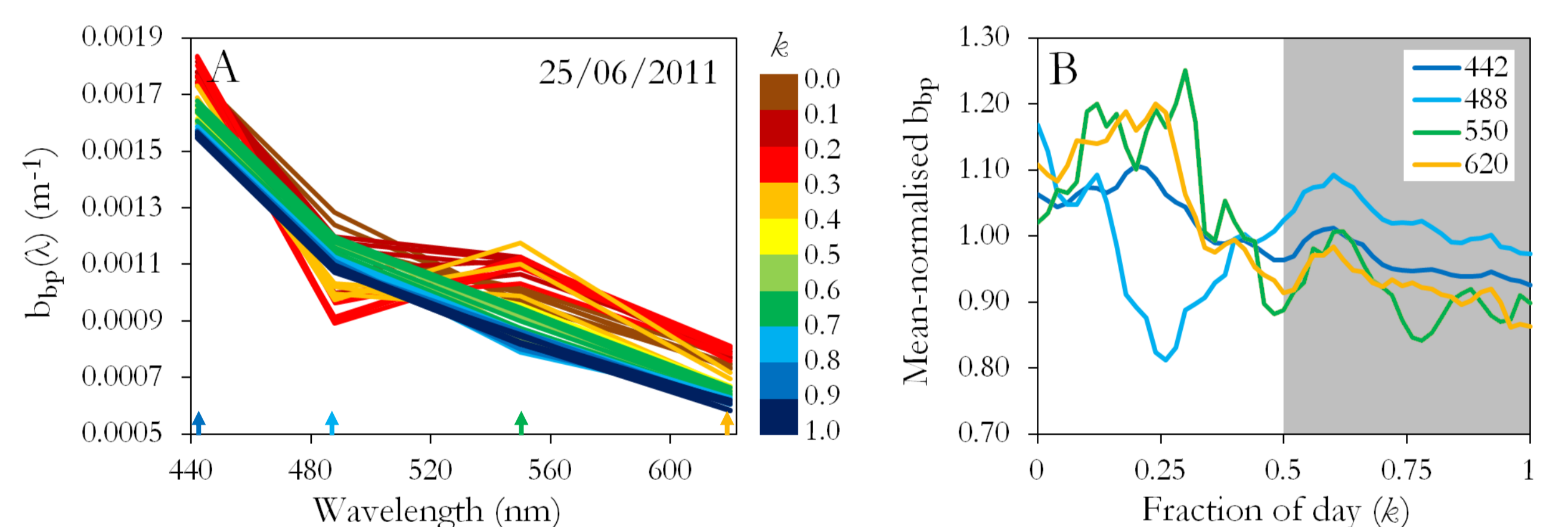


Fig. 7. b_{bp} spectra on 25 June 2011 (A) and mean-normalised diel cycles of $b_{bp}(\lambda)$ (B).

1. Strong diurnal cycles observed for all estimates of γ and for all seasons.
2. Timing of diel maxima/minima shows little intra-seasonal variability.
3. The amplitude of the cycle is greatest for wavelengths around a_{ph} depression, γ (442-488) & γ (488-550), with unimodal diel variations.
4. Unaffected by absorption, γ (550-620) could be used to infer PSD.
5. Individual diel cycles reveal periods of cell division (e.g. two day⁻¹) and growth.

Conclusions

These results represent the first comprehensive characterisations of the diel cycles of the b_{bp} spectral slope and highlight the need to consider the wavelengths used, particularly at the diel scale. Multi-spectral b_{bp} observations could be used to infer absorption as well as particulate size distribution. Consideration of temporal scales is paramount with γ (442-550) best for seasonal analyses but hard to interpret on diel scales.

Further Questions

Could remotely sensed b_{bp} estimates at select wavelengths be used to derive a_{ph} ?

What additional insights could be provided by hyperspectral instruments?

How do these measurements compare to other oceanic provinces?

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