UNIVERSITY OF LIVERPOOL

Proudman Oceanographic Laboratory
NATURAL ENVIRONMENT RESEARCH COUNCIL

Internal waves and slope mixing in the Faroe-Shetland Channel

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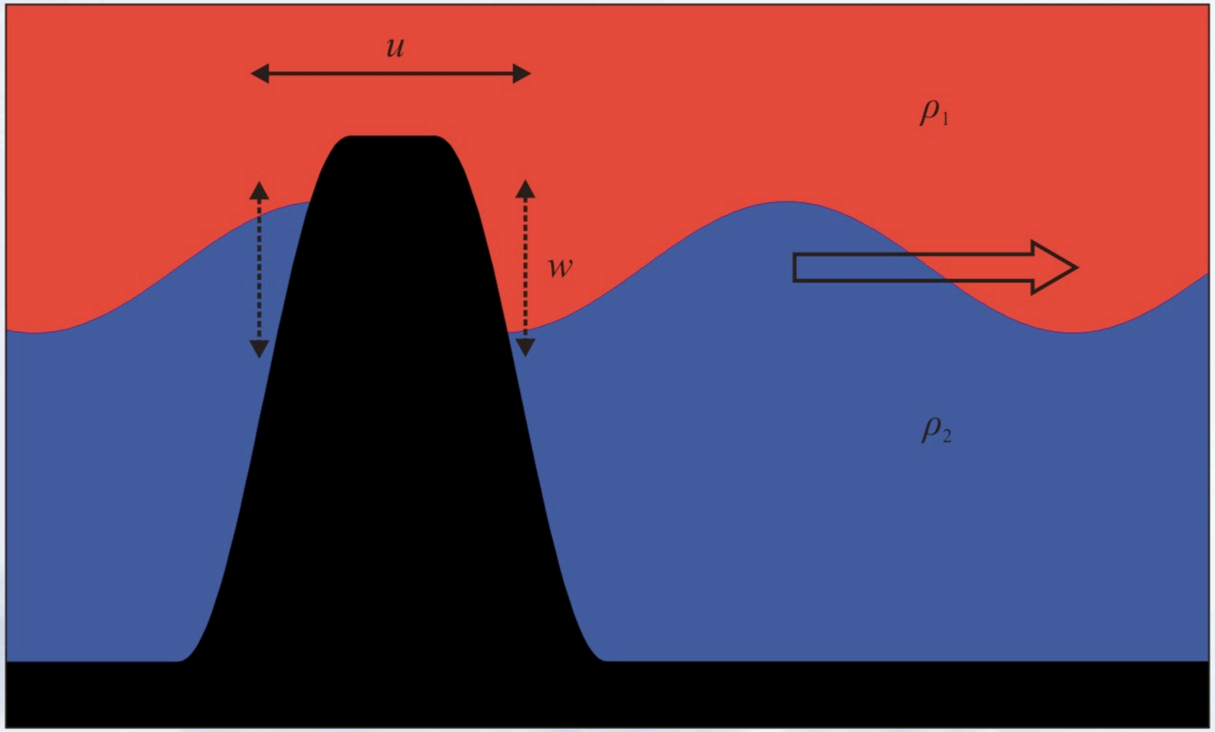
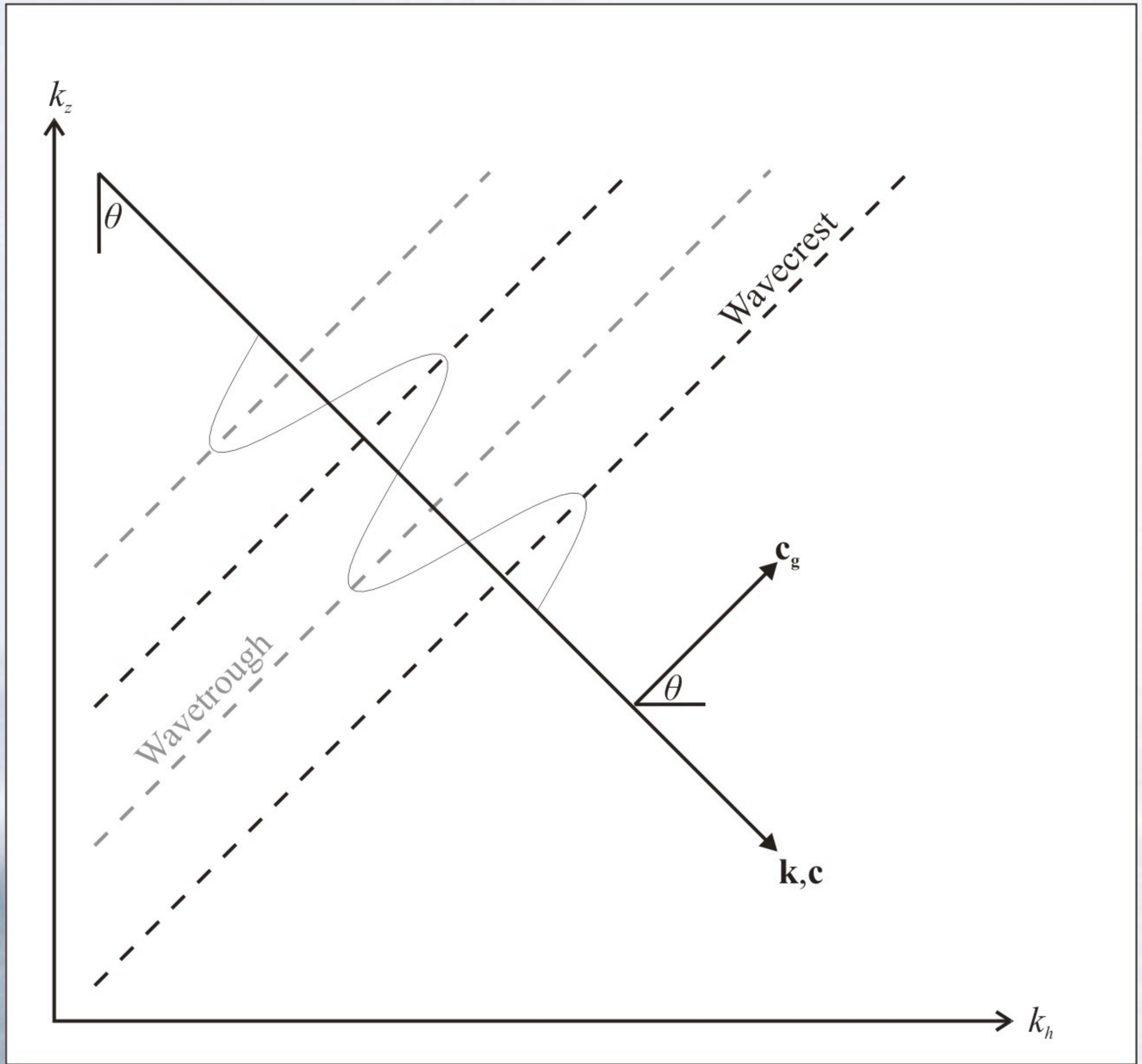
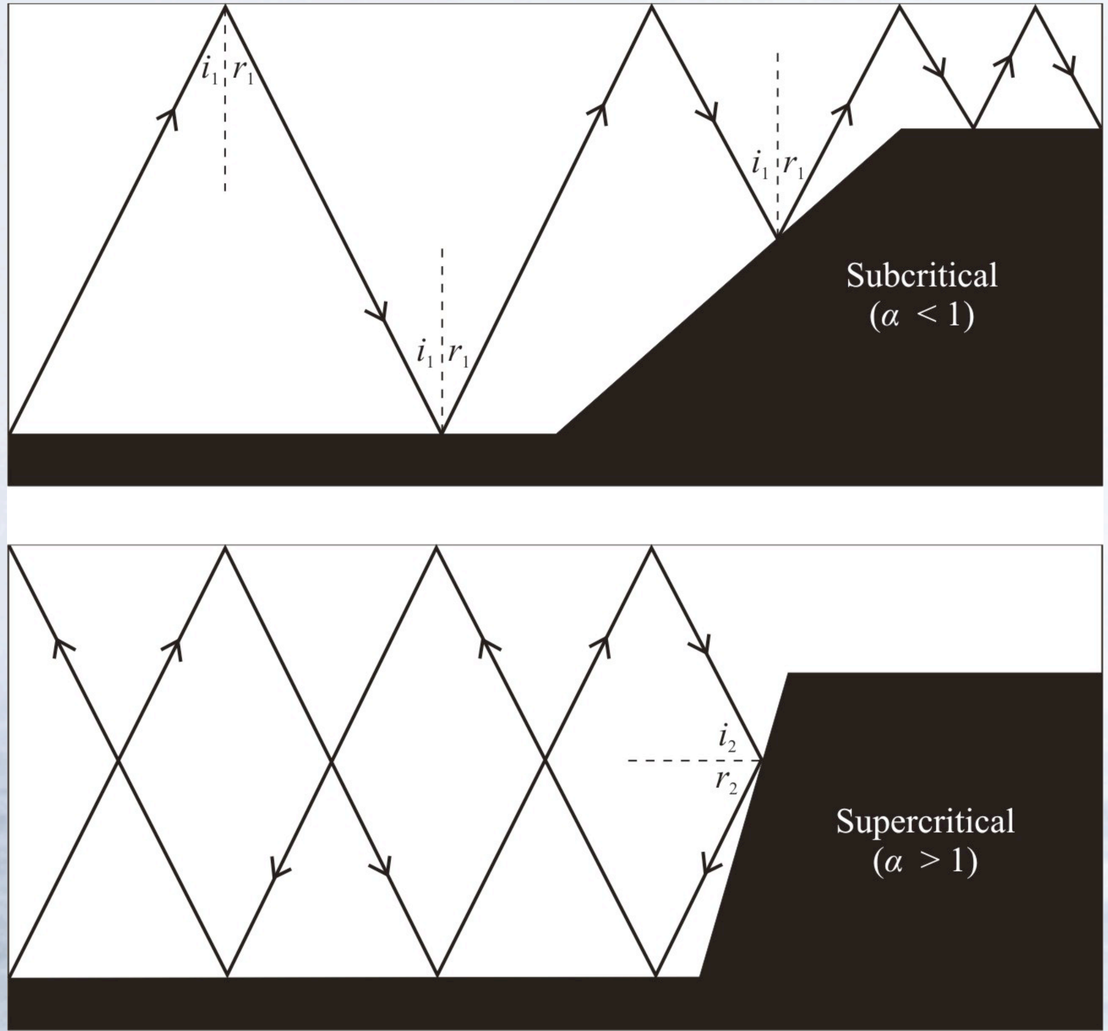
Internal waves



Internal waves



Internal wave reflection



$$s_{wave} = \left(\frac{\omega^2 - f^2}{N^2 - \omega^2} \right)^{1/2}$$

$$s_{topog} = \frac{dh}{dx}$$

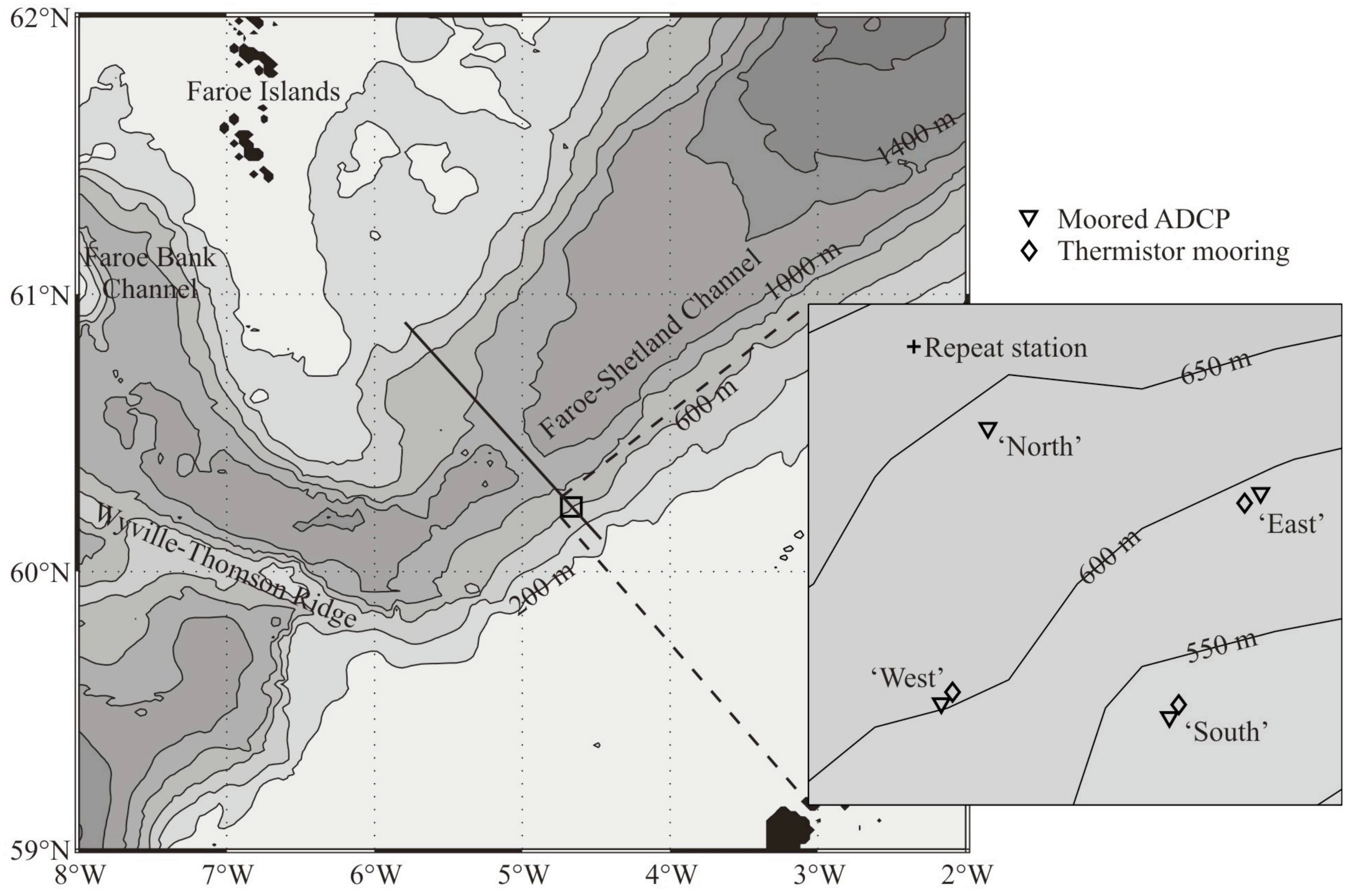
$$\alpha = \frac{s_{topog}}{s_{wave}}$$

$\alpha < 1 \rightarrow$ subcritical

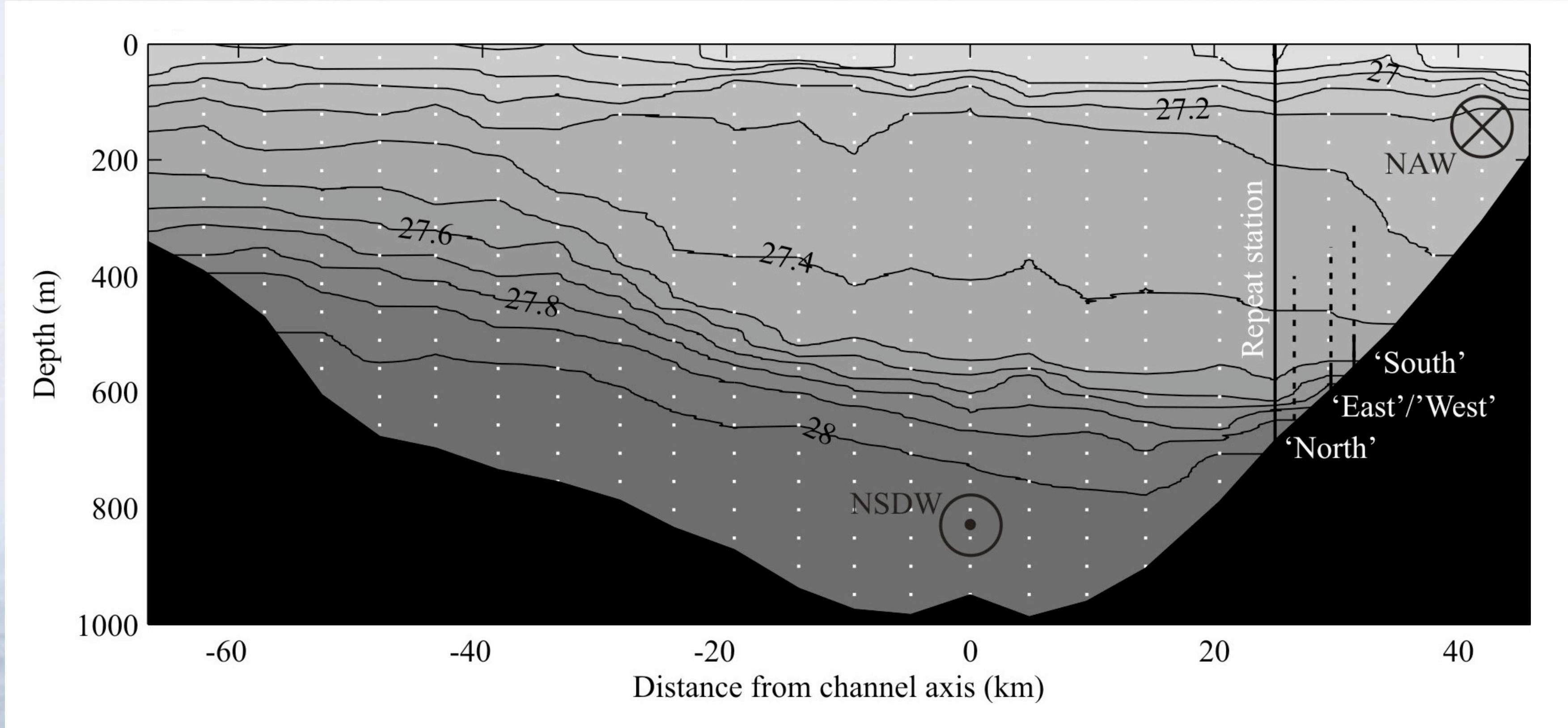
$\alpha = 1 \rightarrow$ critical

$\alpha > 1 \rightarrow$ supercritical

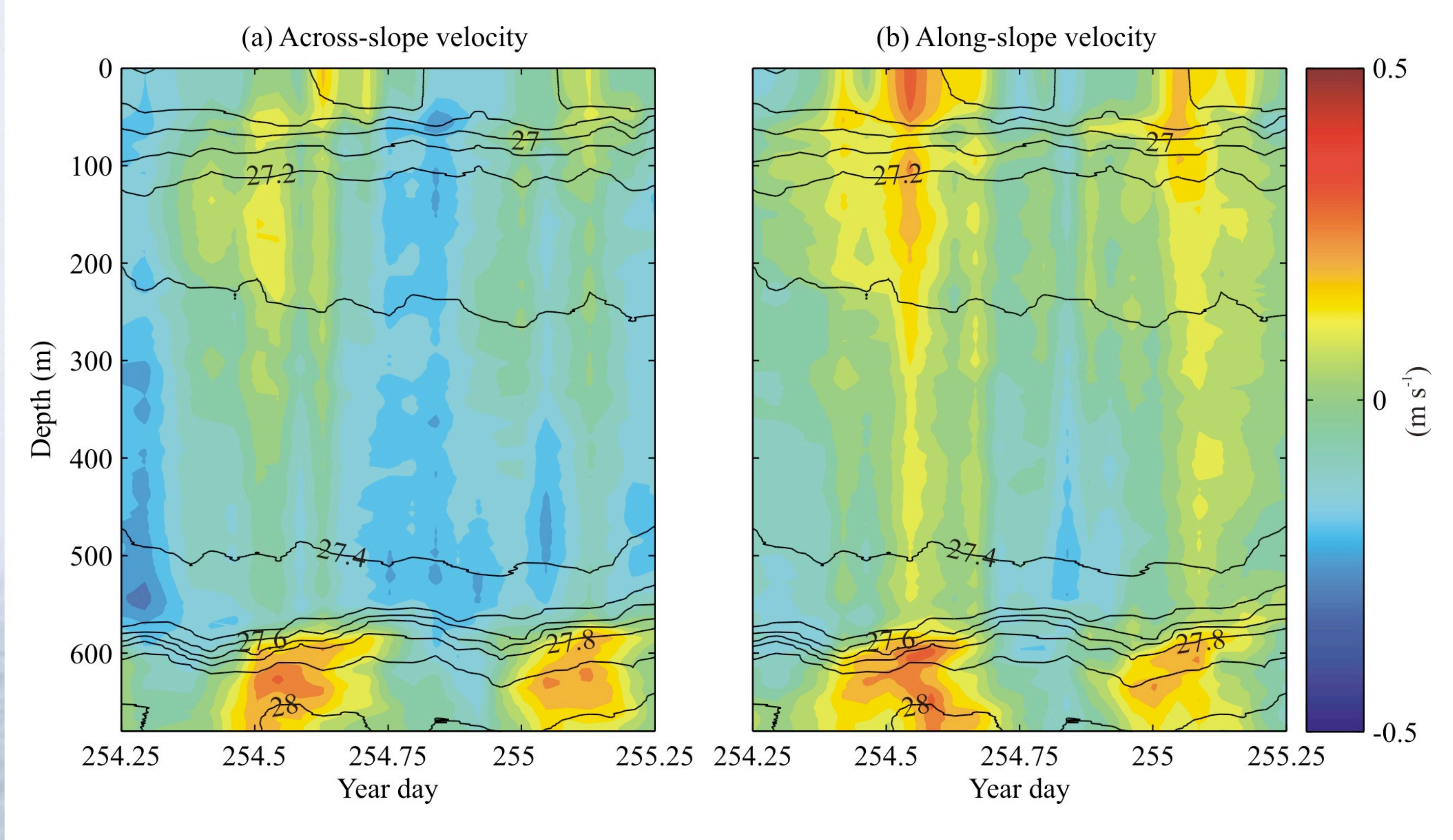
Faroe-Shetland Channel



Faroe-Shetland Channel



Internal Tide



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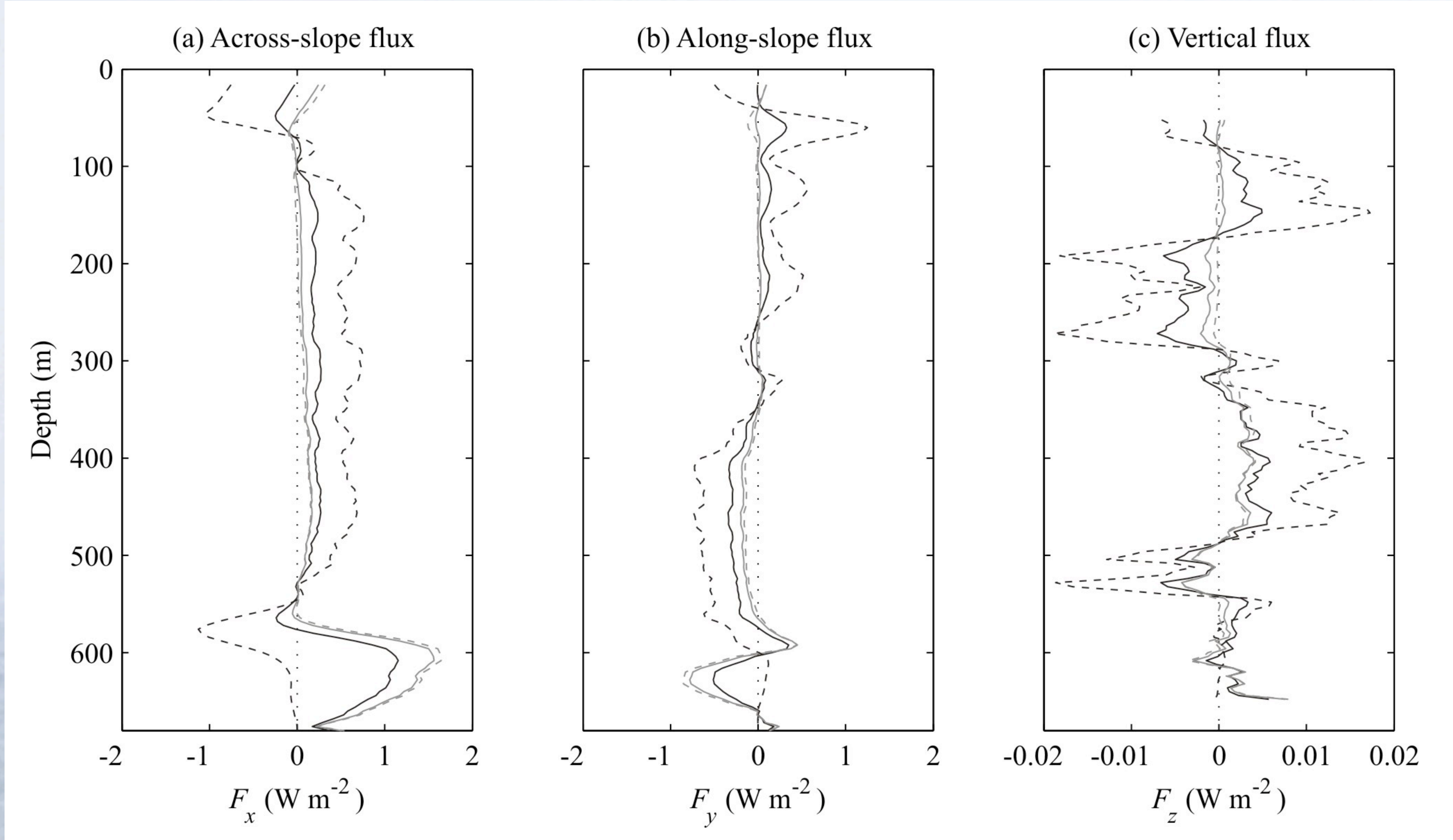
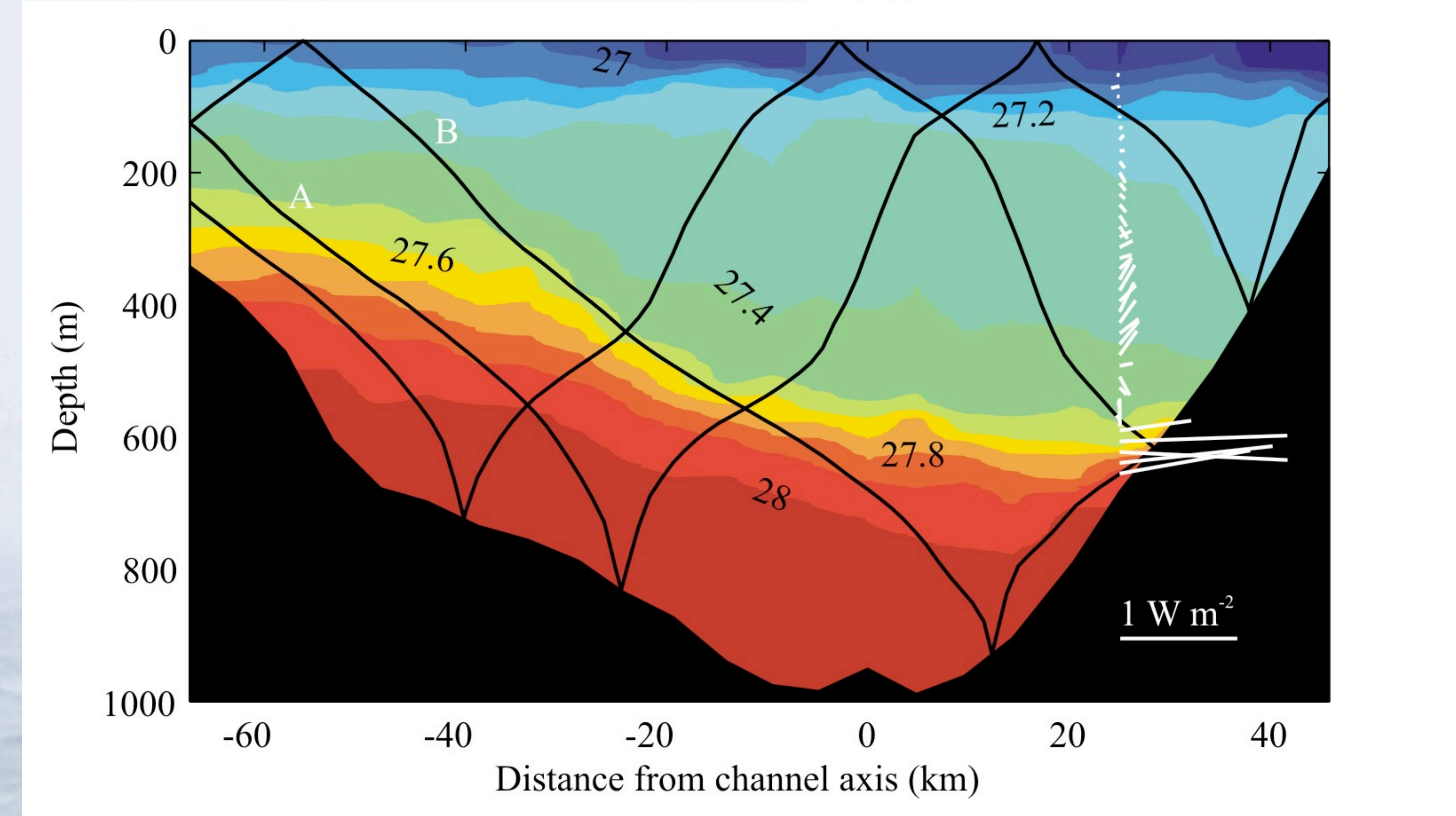
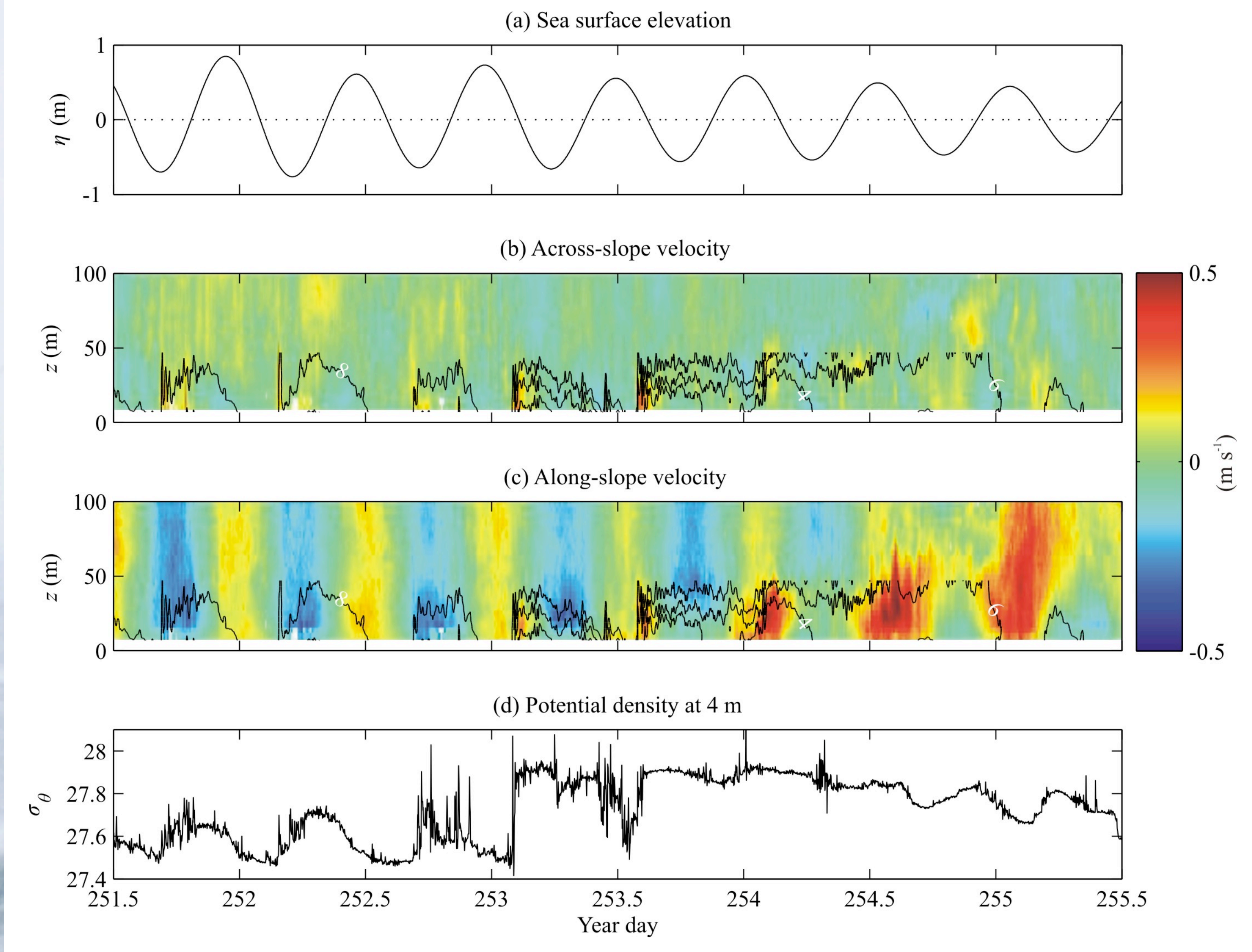


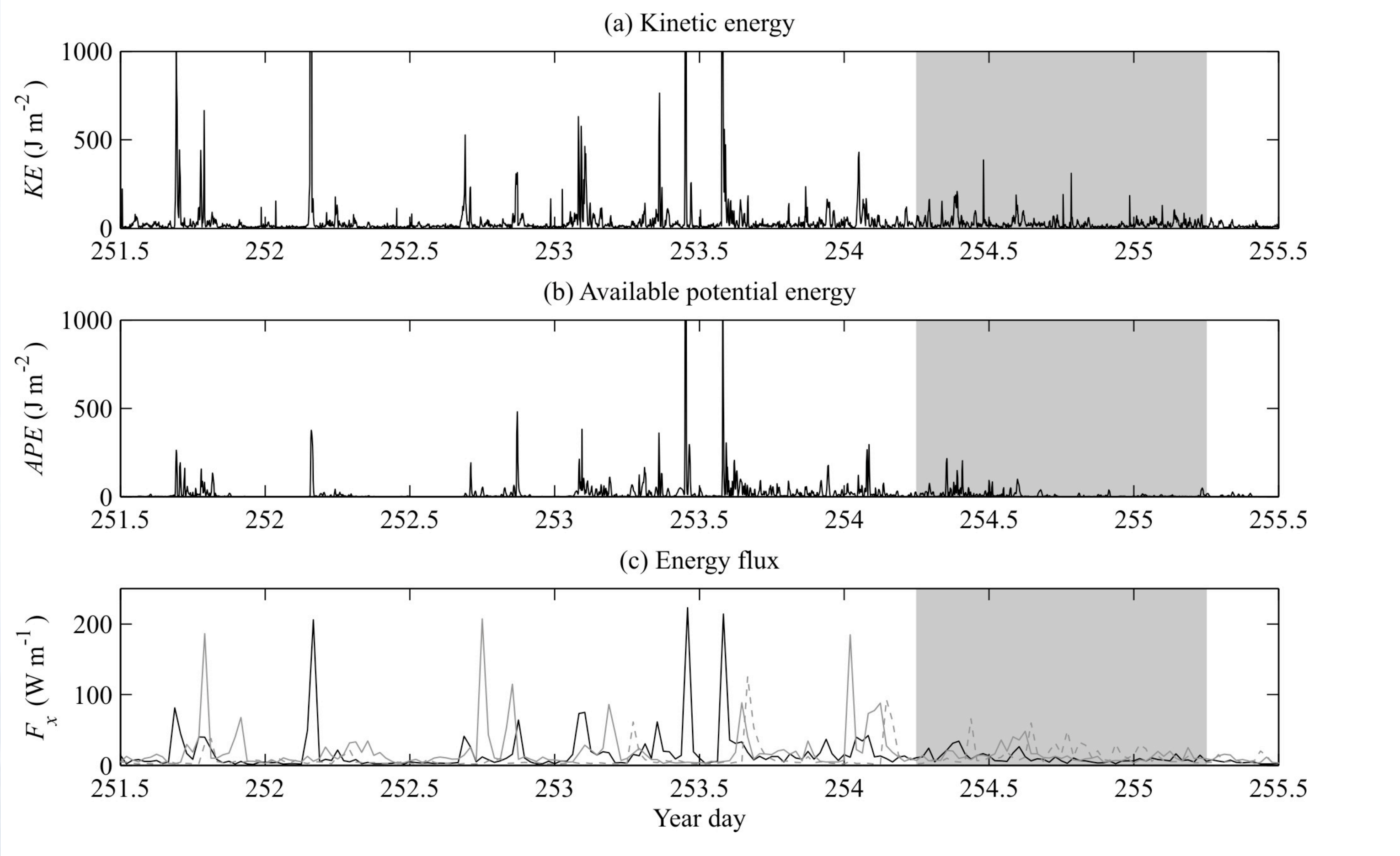
Internal Tide



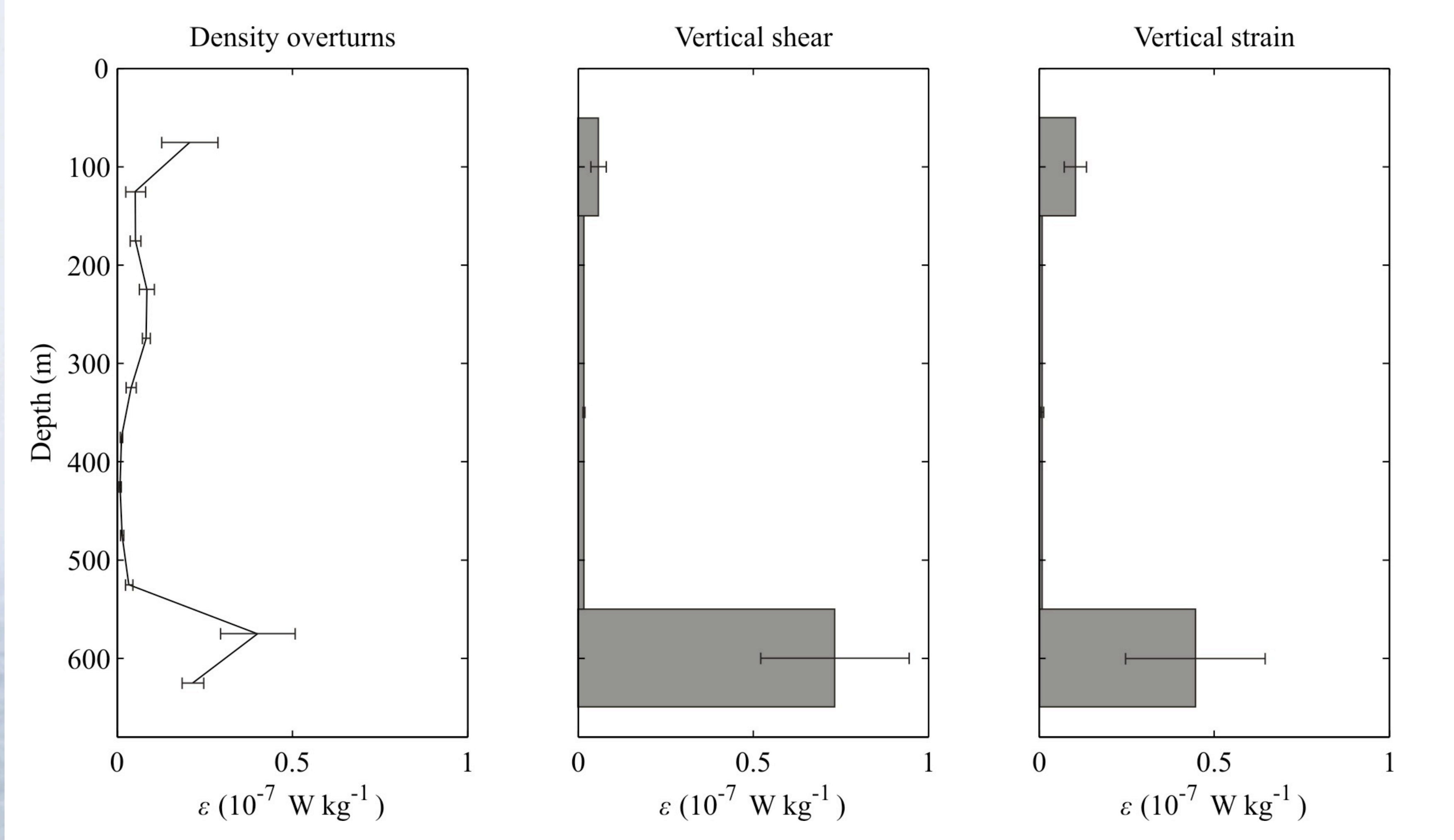
Near-bed, non-linear internal waves



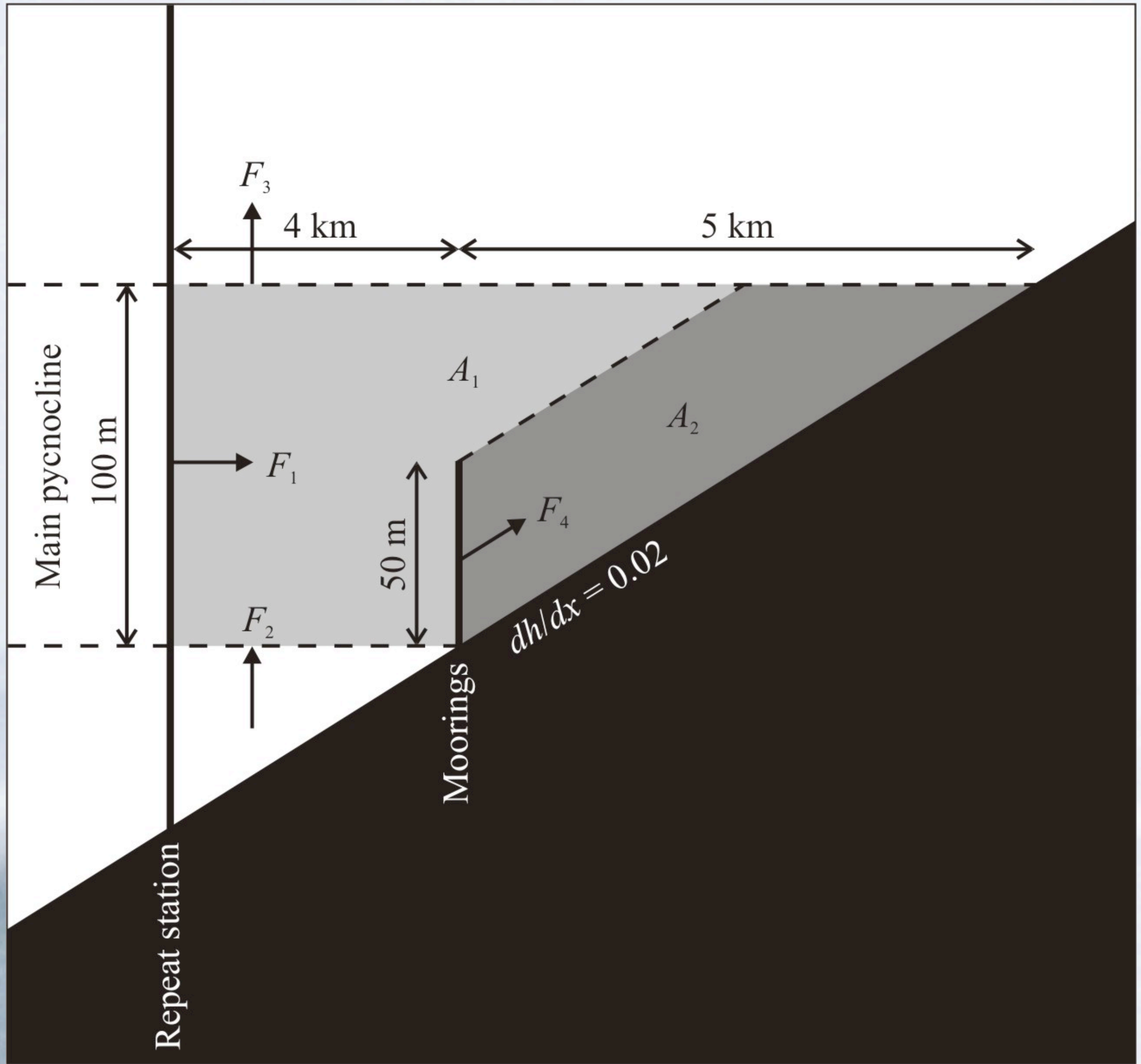
Near-bed, non-linear internal waves



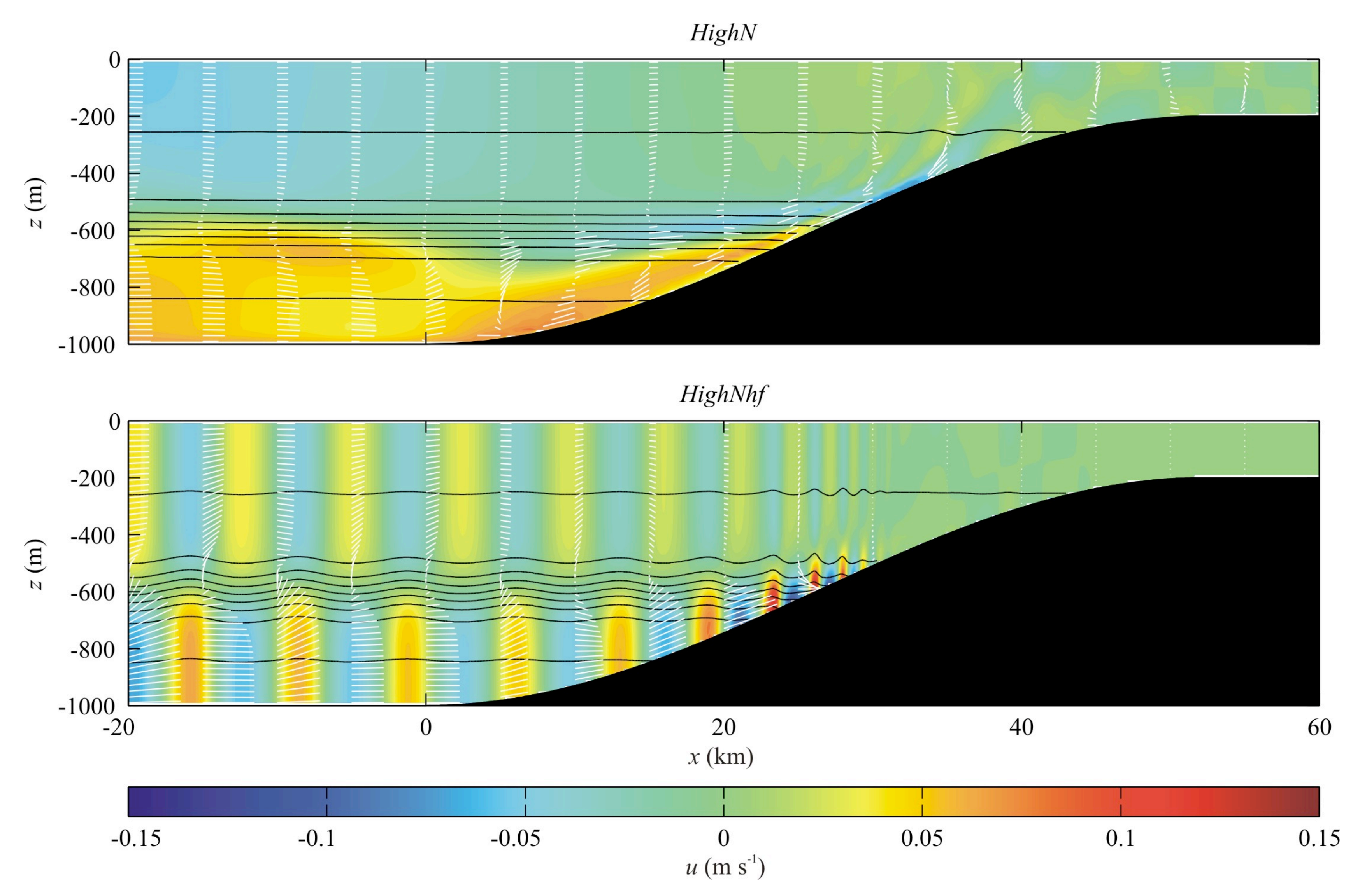
TKE dissipation rate



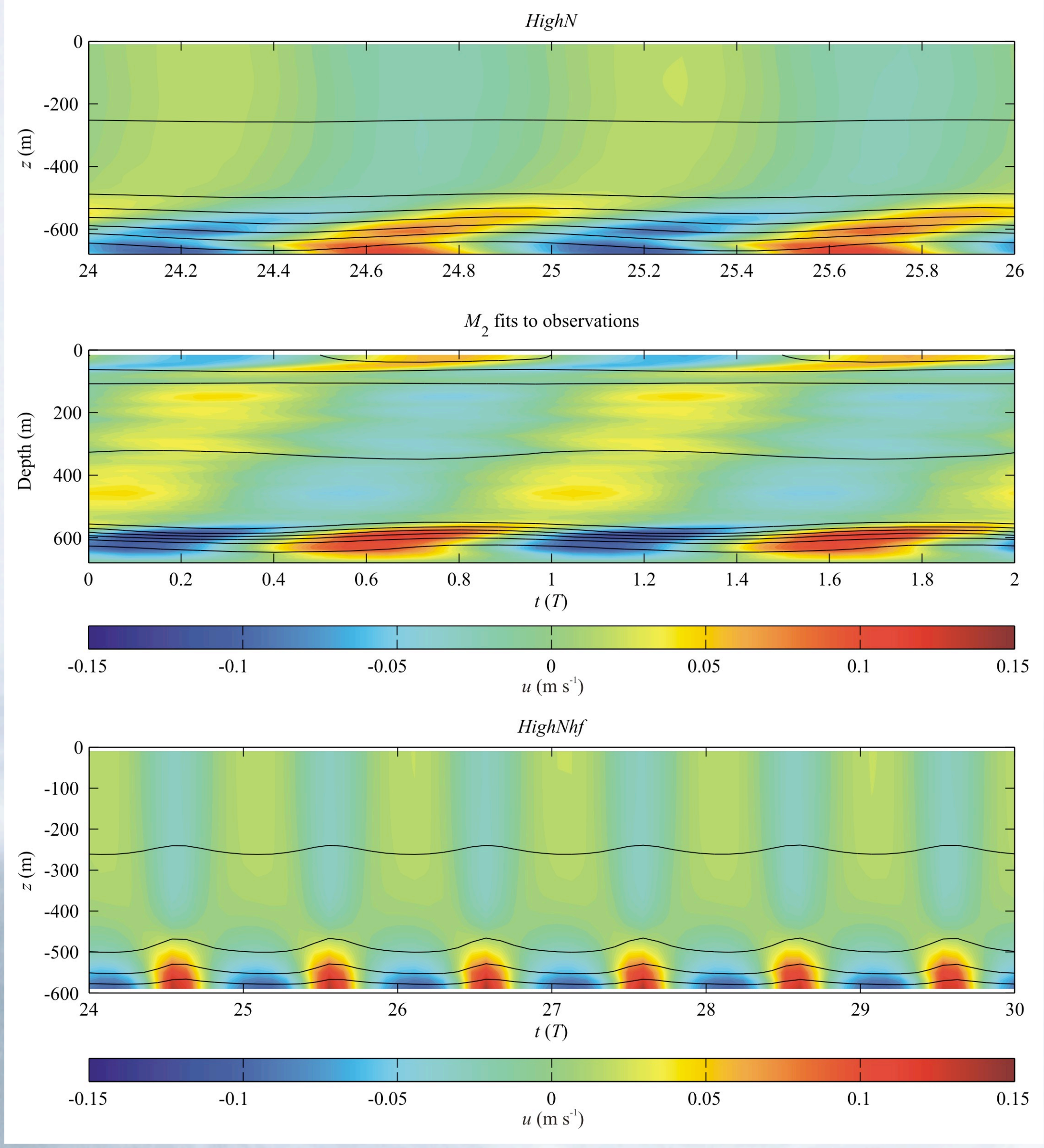
Internal wave energy dissipation



Numerical model



Numerical model



Conclusions

- Mixing on the slope enhanced above background levels ($\varepsilon = 5 \times 10^{-8}$ W kg^{-1} → $\kappa_\rho = 2 \times 10^{-4}$ m^2 s^{-1})
- Can be accounted for by internal wave energy fluxes
  - Internal tides, 150 W m^{-2} (100 W m^{-2} in pycnocline)
  - Near-bed, non-linear internal waves, up to 200 W m^{-2}
- Up to 68% of incident internal tide energy reflected
- Modal structure maintained upon reflection → cannot be explained simply by critical slope theory
- Non-linear internal waves must dissipate or break locally because near-bed $N < \omega$ further up the slope
- Up-slope of the intersection with pycnocline, internal wave energy cannot progress onto the shelf

Slope mixing processes