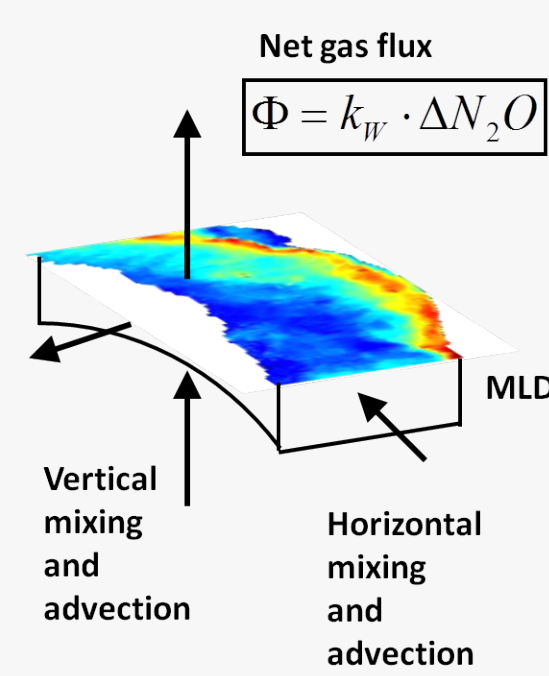


Multidiurnal warm layer and inhibited gas exchange in the Peruvian upwelling regime

T. Fischer, A. Kock, D.L. Arévalo-Martínez, M. Dengler, P. Brandt, H.W. Bange

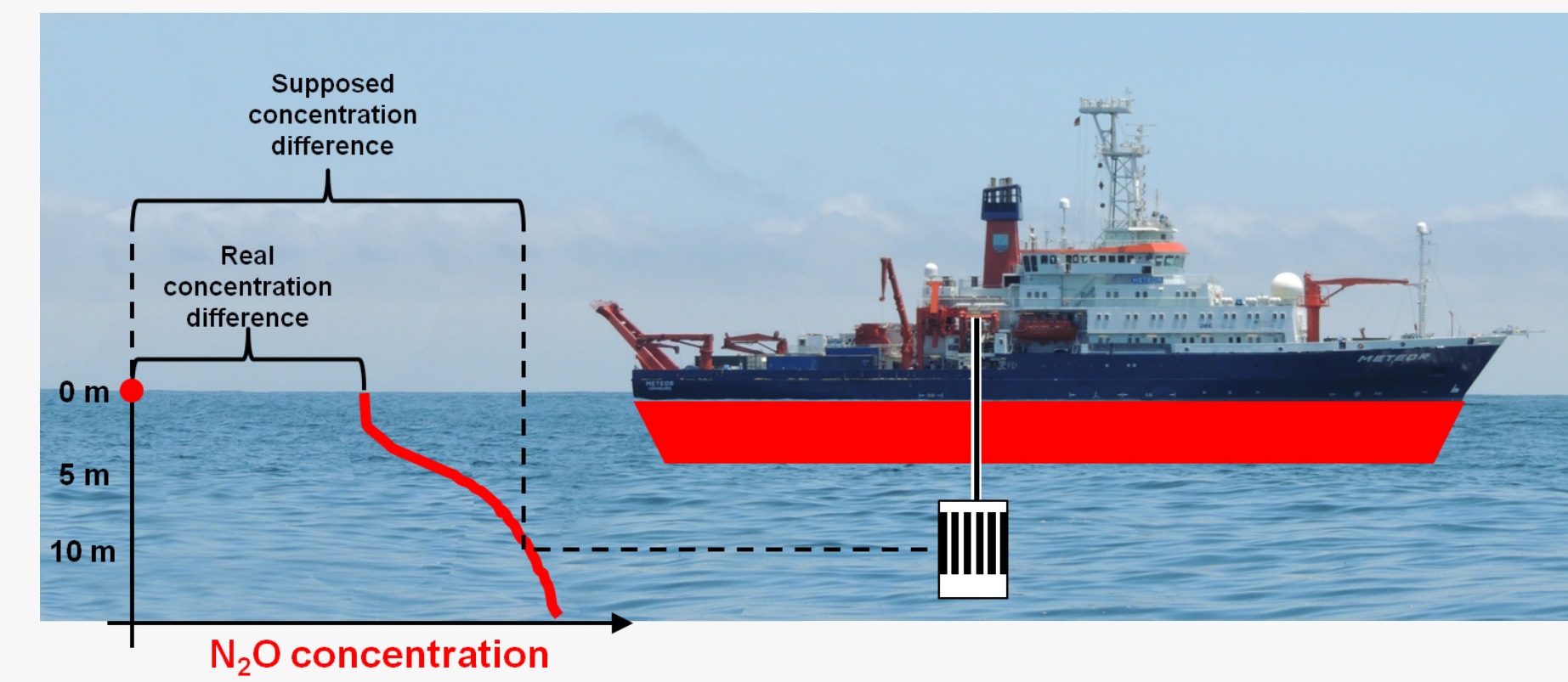
Measuring nitrous oxide (N₂O) in the top 10 meters of the Peruvian upwelling

Motivation



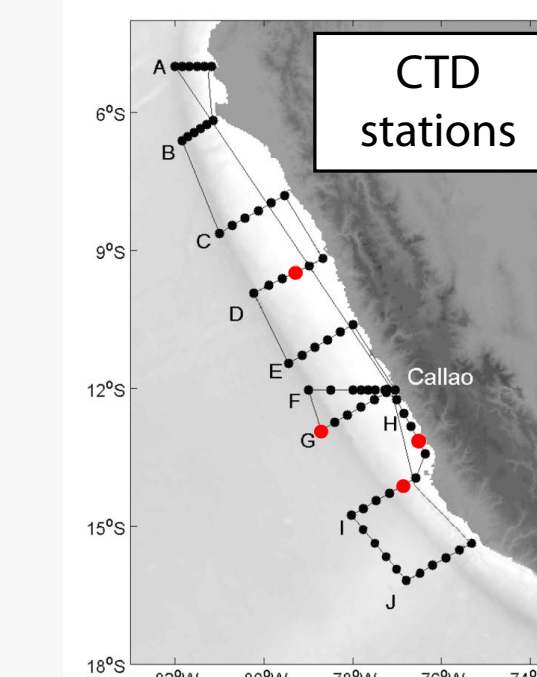
In the Mauritanian upwelling regime, N₂O supply from below is too low to explain the measured N₂O emissions. (Kock et al., 2012)

Do we estimate gas emissions from adequate concentrations?

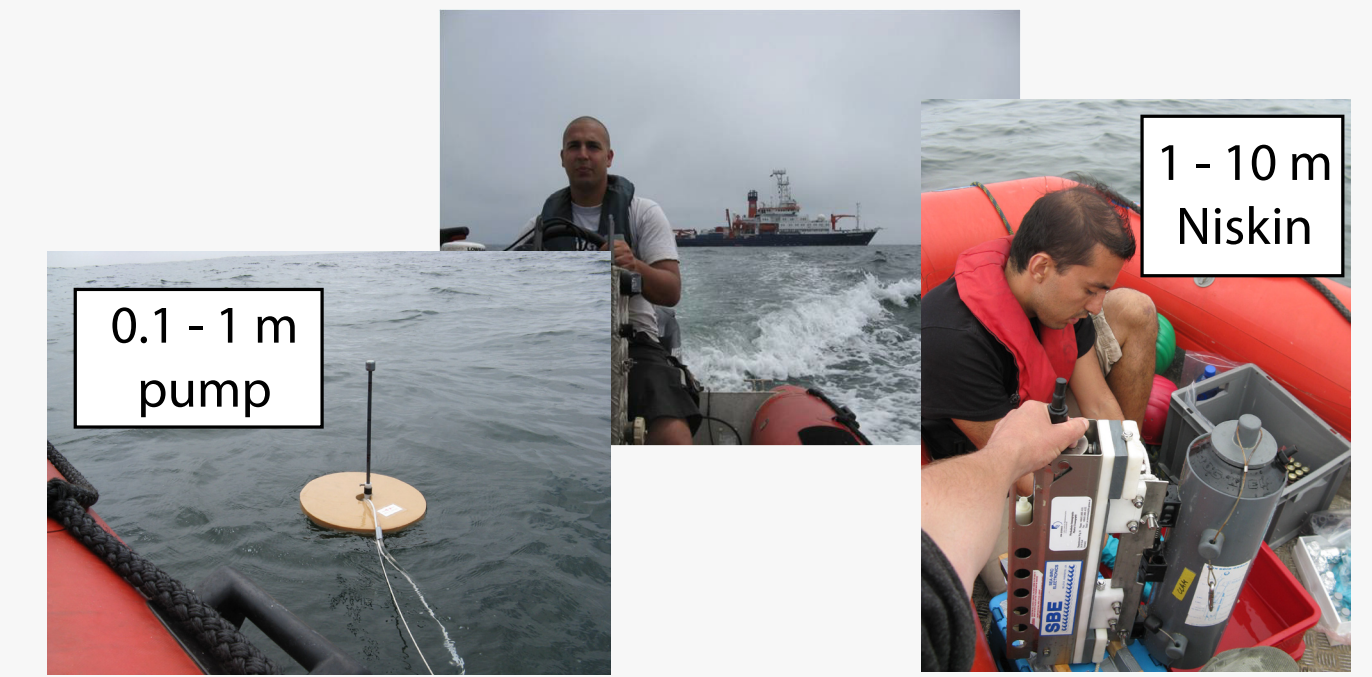


N₂O measurements during Meteor cruise M91 in December 2012

Ship based profiles

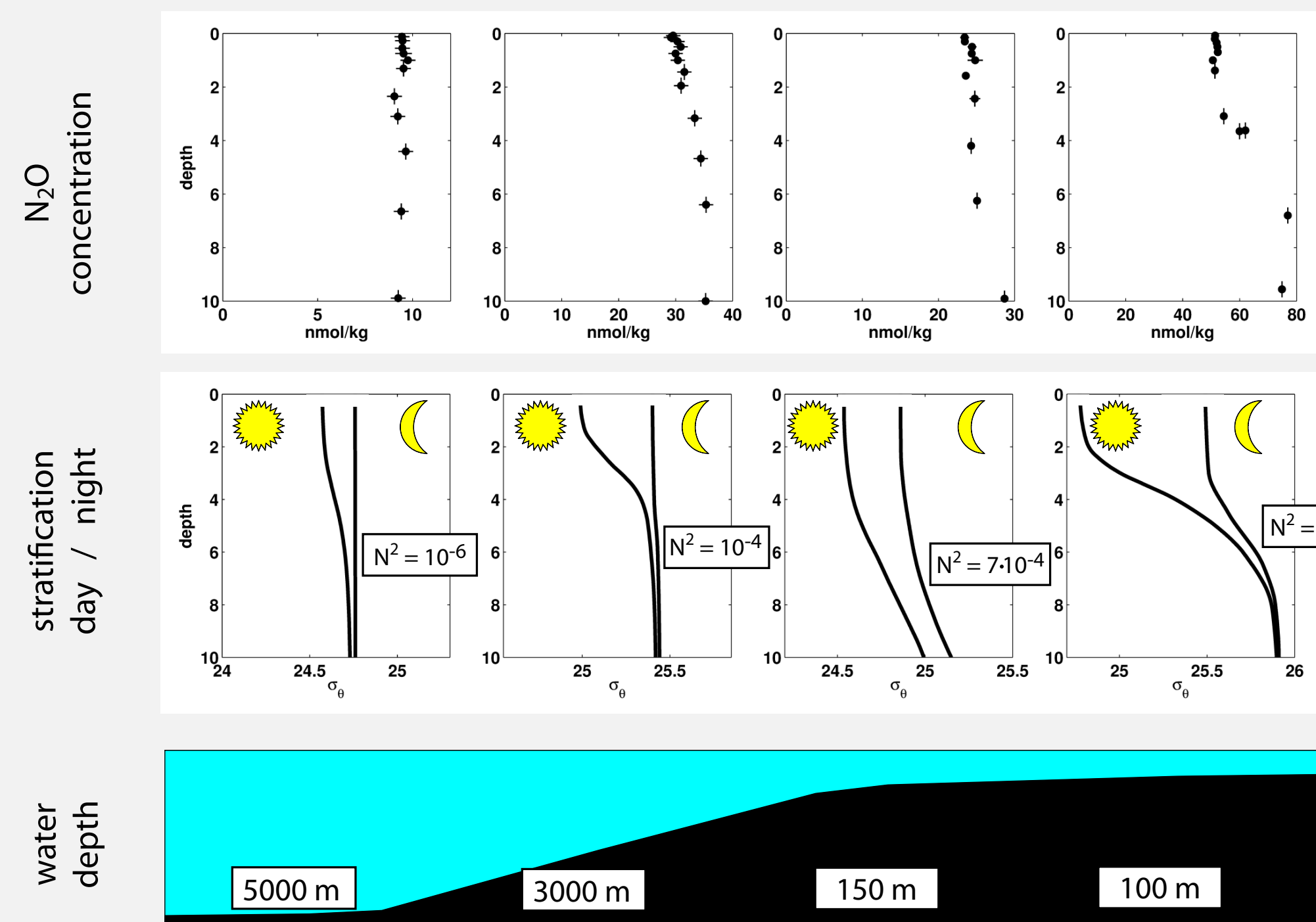


Shallow sampling away from ship's influence

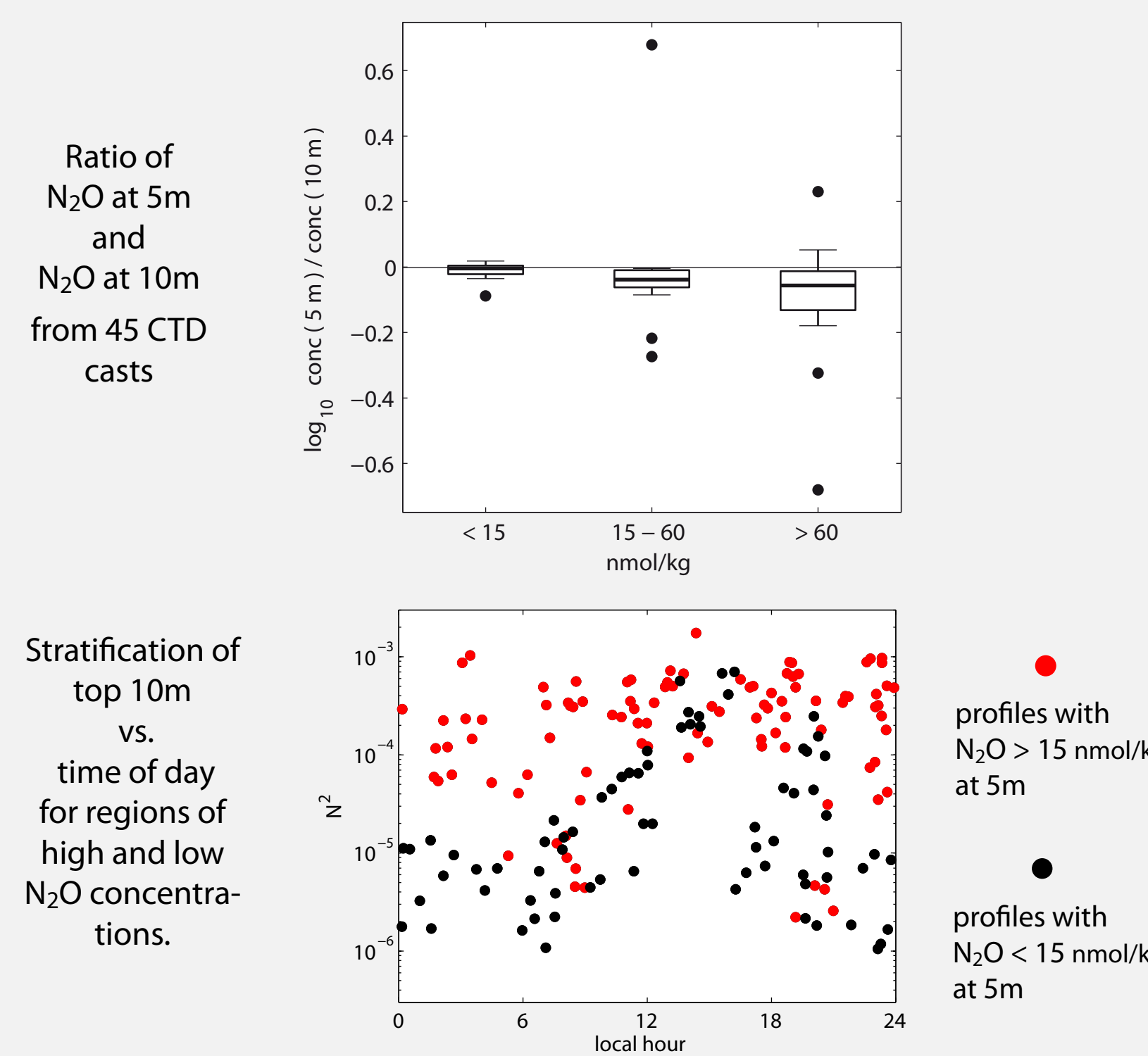


Vertical N₂O gradients exist and are associated with a shallow stratified layer

Vertical concentration gradients in top layer exist and vary regionally. Shape of concentration profiles resembles density profiles at night.



Stronger N₂O gradients are associated with higher N₂O concentrations and night time stratification

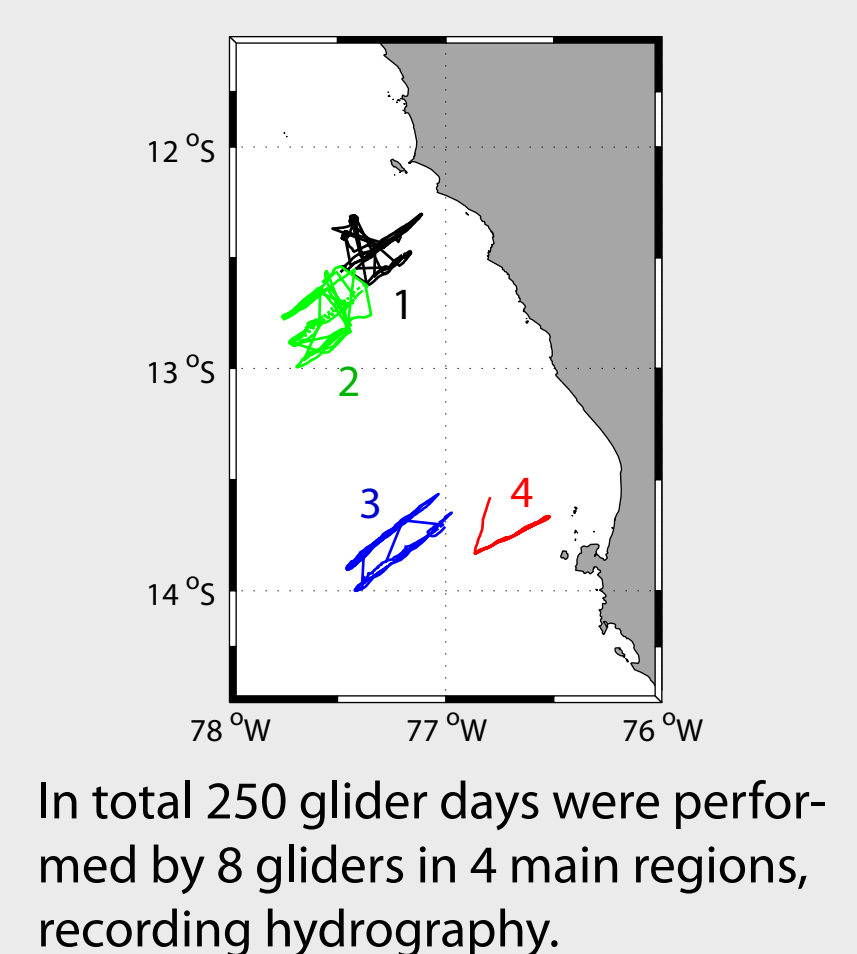


Hypothesis:

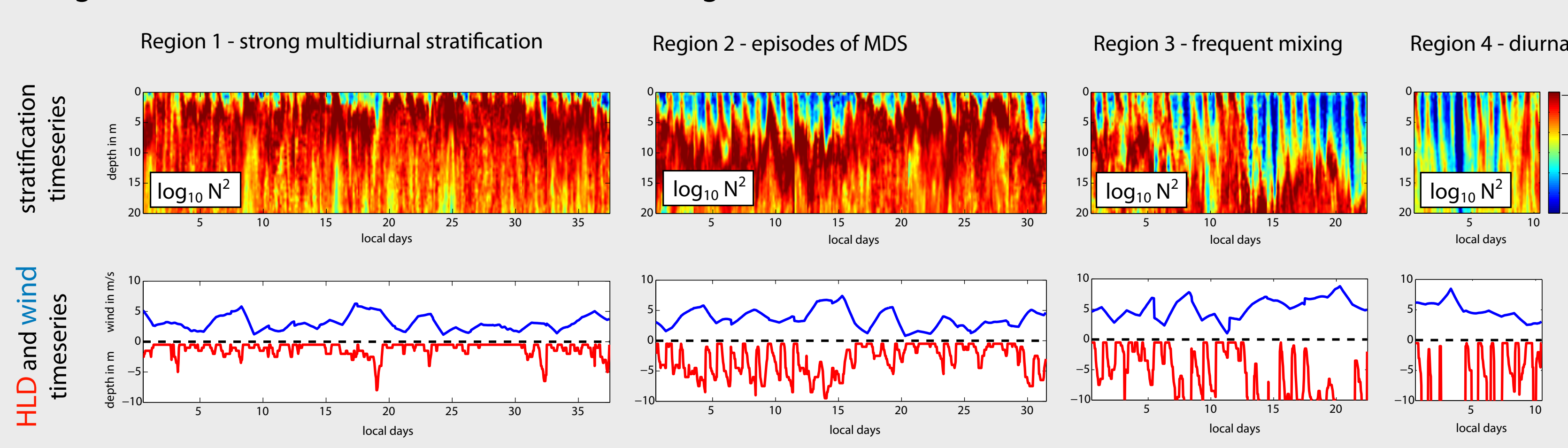
Mixing is inhibited in a shallow stratified layer that is not eroded over one or more nights. The subsequent isolation of the surface layer (the 'multidiurnal warm layer') from deeper layers, and the continuing out-gassing cause surface depletion.

Existence of multidiurnal shallow stratification is verified by glider surveys

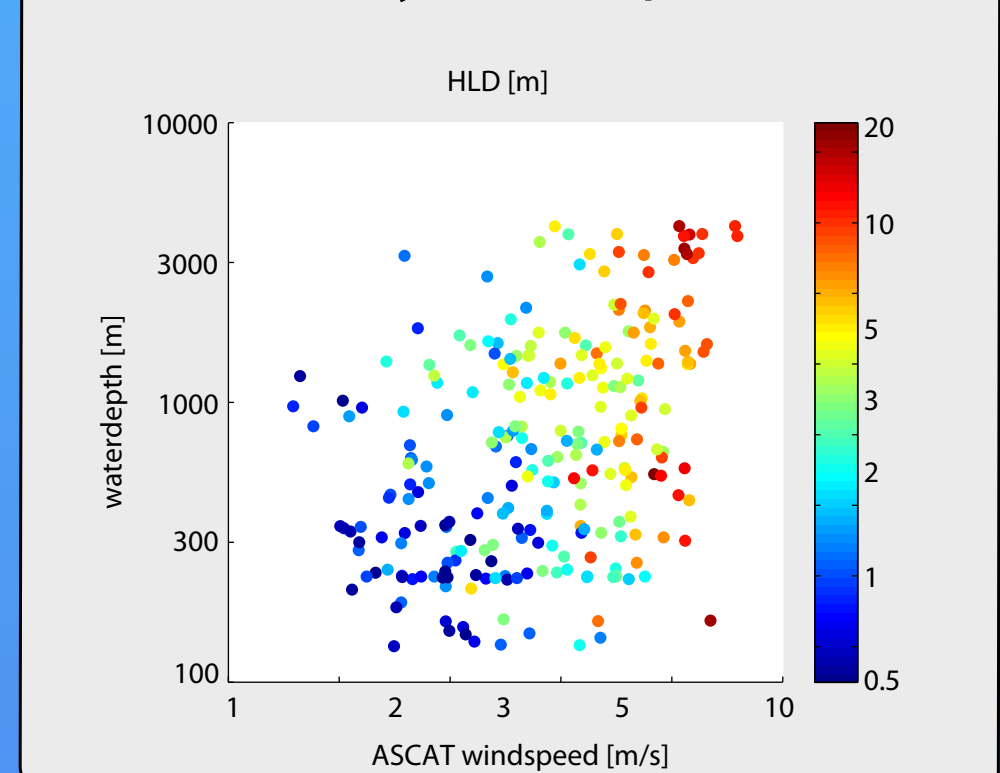
Glider fleet in Jan/Feb 2013



4 regional stratification timeseries with different grades of multidiurnal stratification

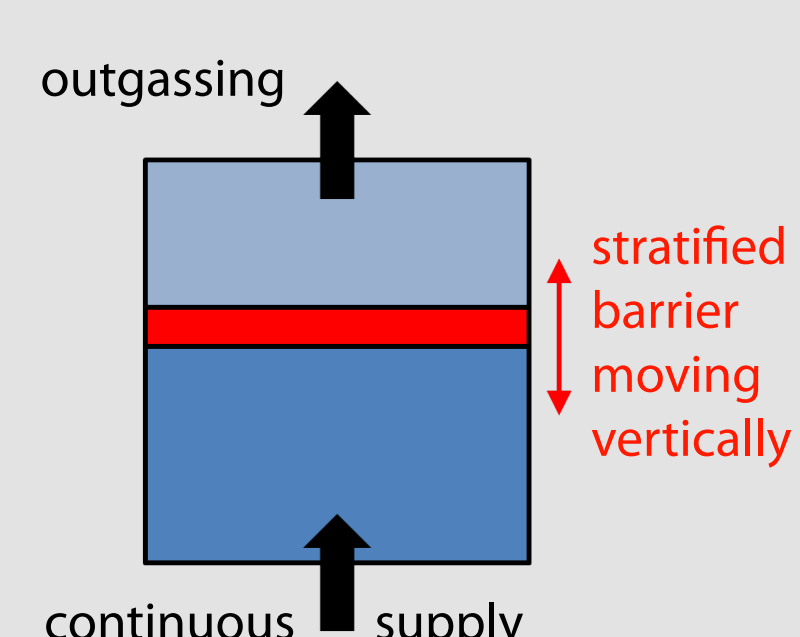


Depth of homogeneous surface layer (HLD) is mainly determined by wind speed



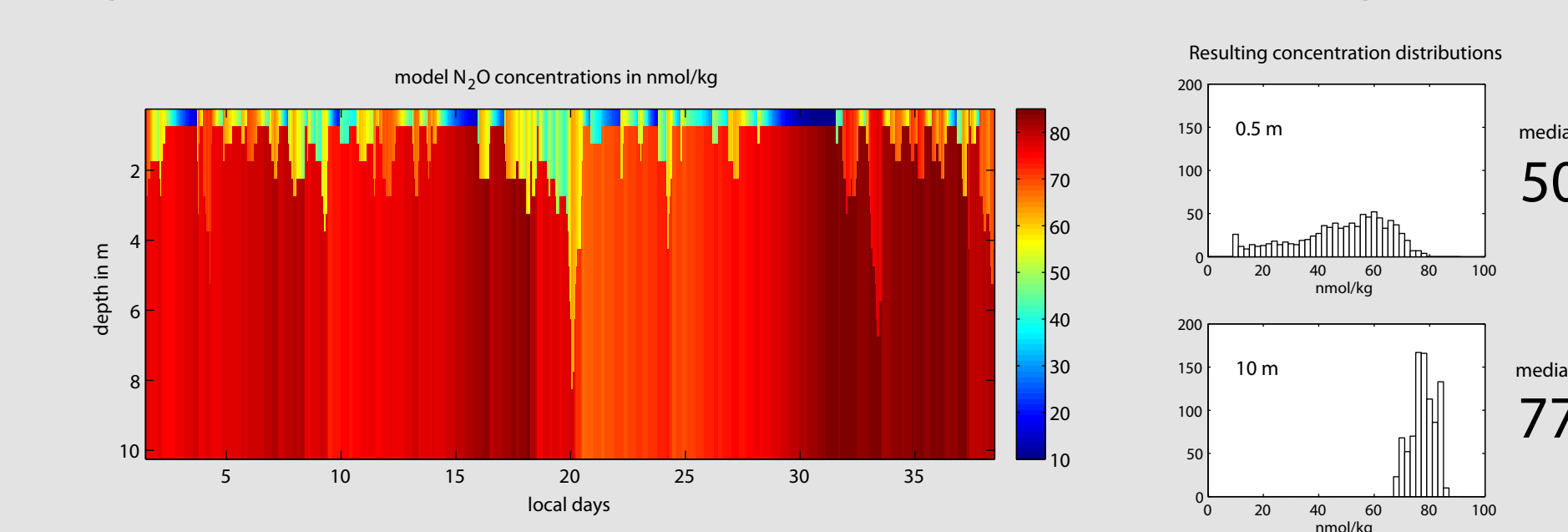
A 1-D model constrained by glider timeseries can reproduce the N₂O gradients

Simple 1-D two layer model



Exchange across the stratified barrier layer is only via entrainment. For the vertical movement of the barrier the observed HLD timeseries are used.

Region 1 - multidiurnal stratification causes distinct gradient



Region 3 - diurnal stratification not sufficient for strong gradient

