Internal Wave Imprints on Temperature Fluctuations as Revealed by Rapid-Sampling Deep Profiling Floats

Zhiyuan Gao[1,2], Zhaohui Chen*[1,2], Xiaodong Huang[1,2], Zhenhua Xu[2,3], Haiyuan Yang[1,2], Zhongsheng Zhao[1,2], Chong Ren[2], Lixin Wu[1,2]

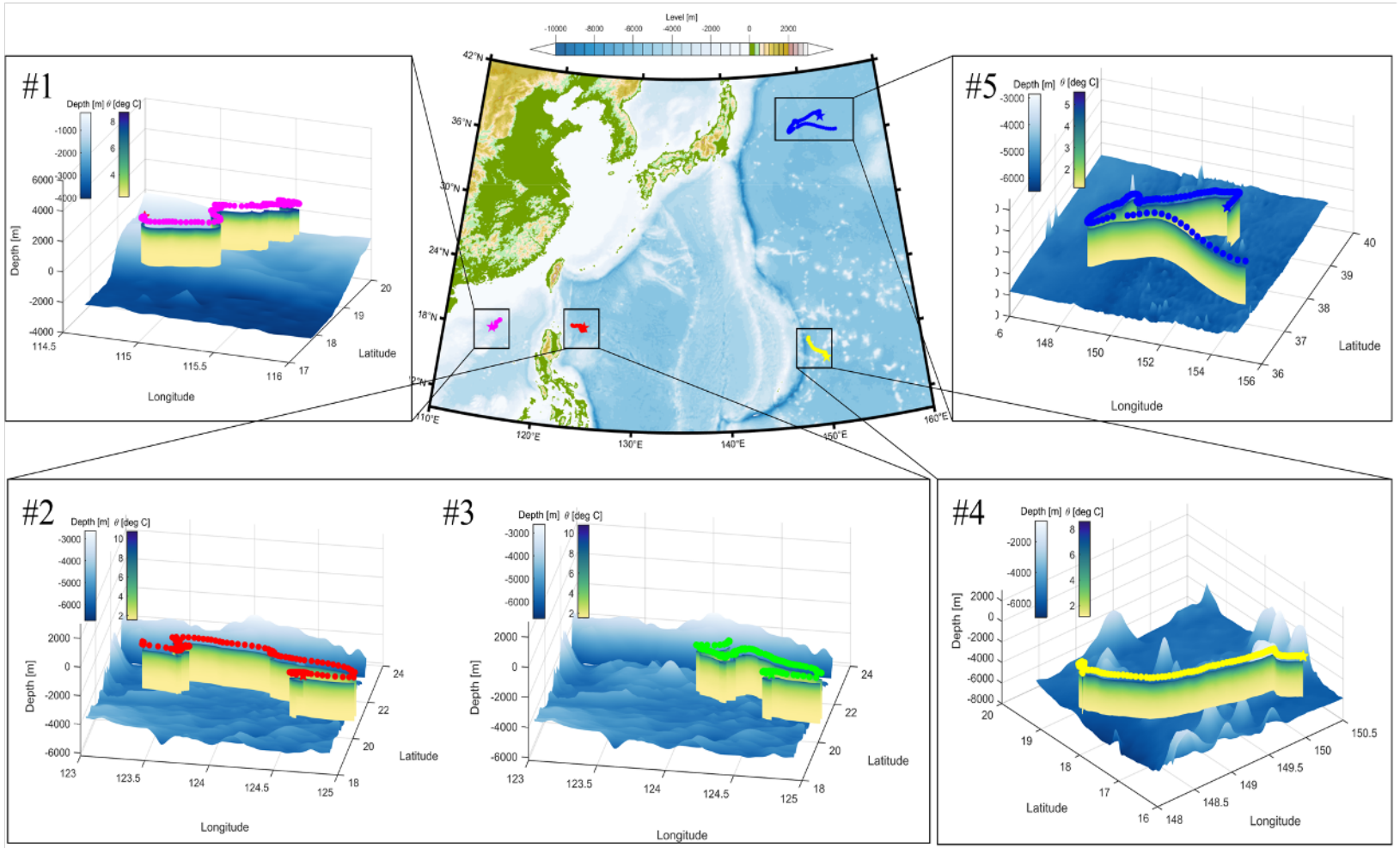
[1]Key Laboratory of Physical Oceanography, Ocean University of China, Qingdao, China

[2] Pilot National Laboratory for Marine Science and Technology (Qingdao), Qingdao, China

[3] Key Laboratory of Ocean Circulation and Waves, Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

* *Corresponding author*: Zhaohui Chen chenzhaohui@ouc.edu.cn

Data and Methods



- ✓ 5 deep floats deployed in the northeastern South China Sea (SCS), Philippine Basin (PB), Mariana Arc (MA), and Kuroshio Extension (KE)
- ✓ Fast-sampling model (~1 day).

Fig. 1 Trajectories of 5 deep floats

Data and Methods

$$T(z,t) = T_0(z) + \sum_{j=SD,D,f} \left(H_j(z) cos(\sigma_j t - g_j(z)) \right)$$

$$T(z,t) = T_0(z) + \sum_{j=SD,D,f} \left(a_j(z) cos(\sigma_j t) + b_j(z) sin(\sigma_j t) \right)$$

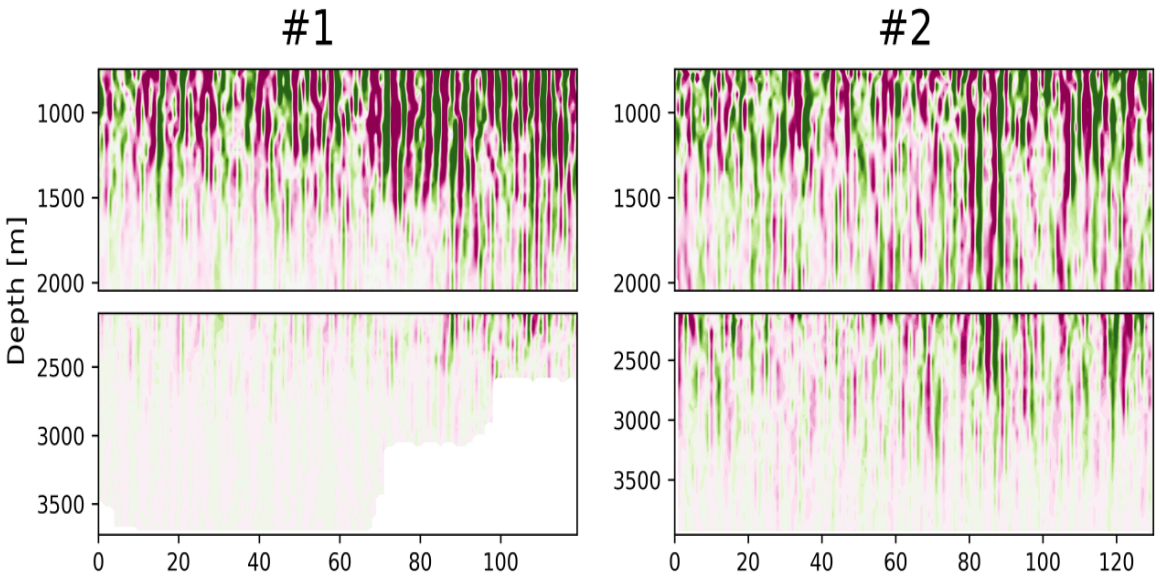


Fig. 2 Profile-to-profile variability of temperature

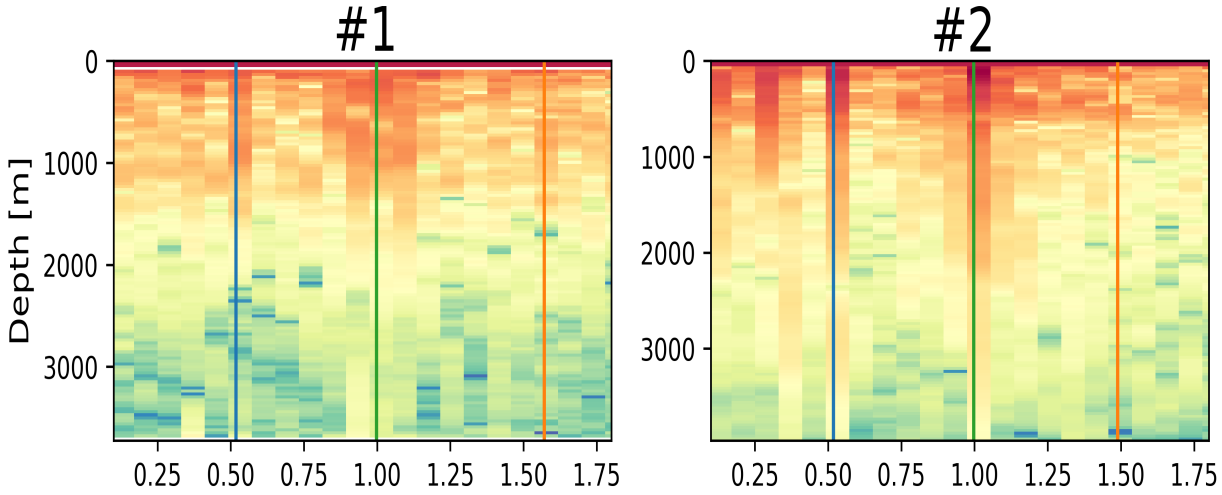


Fig. 3 Amplitude of temperature fluctuations within the period band 0.1-1.8 days

Internal waves imprints on temperatures and vertical displacement

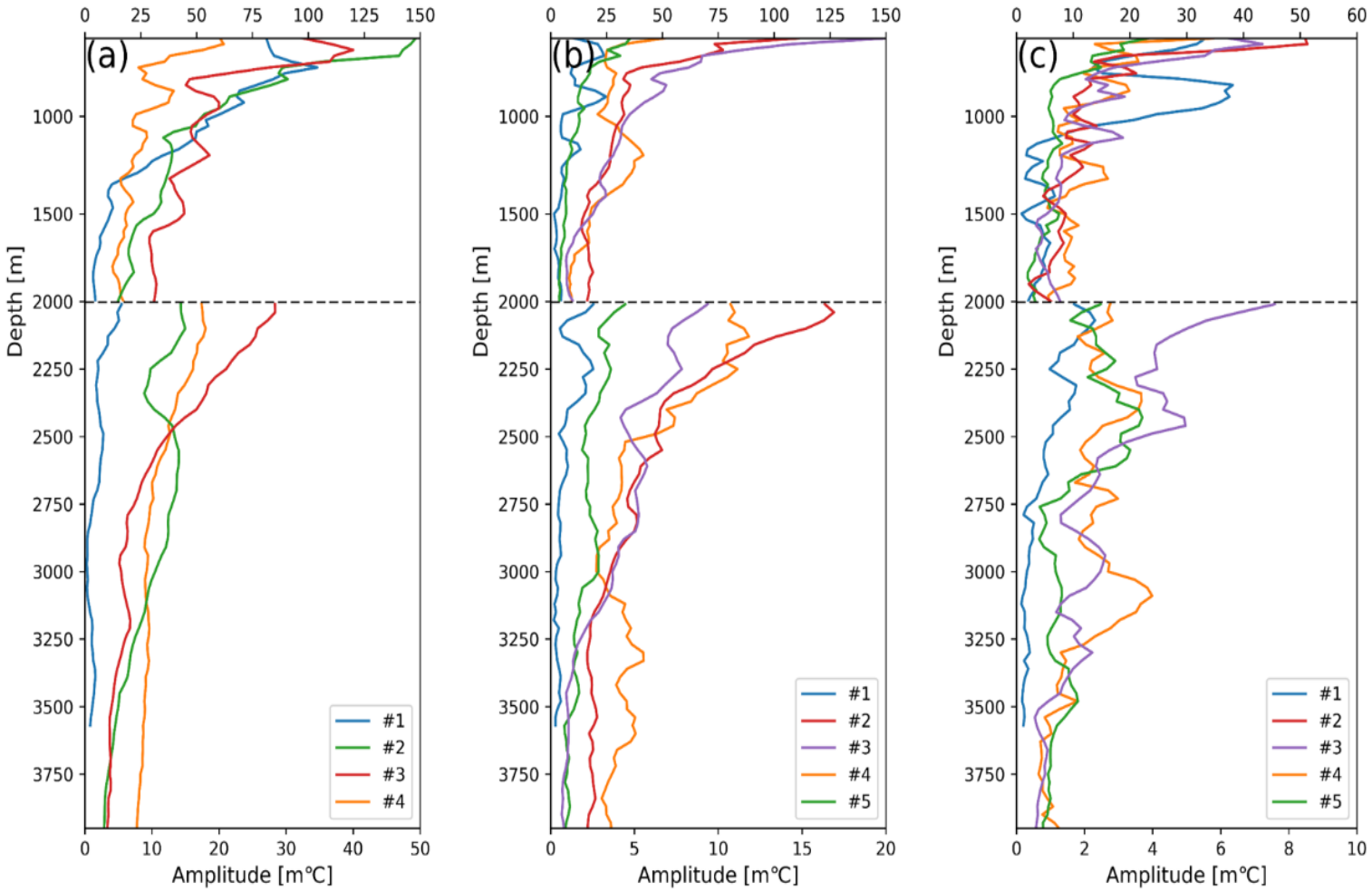


Fig. 4 The mean temperature fluctuating amplitudes derived from five deep profiling floats at (a) diurnal, (b) semidiurnal, and (c) near-inertial frequencies.

- ✓ The temperature fluctuating amplitudes derived from floats #2, #3, and #4 are large in the deep ocean.
- ✓ The amplitudes are very close between floats #2 and #3, but more prominent for float #4 whose maximum fluctuating amplitude.

Internal waves imprints on temperatures and vertical displacement

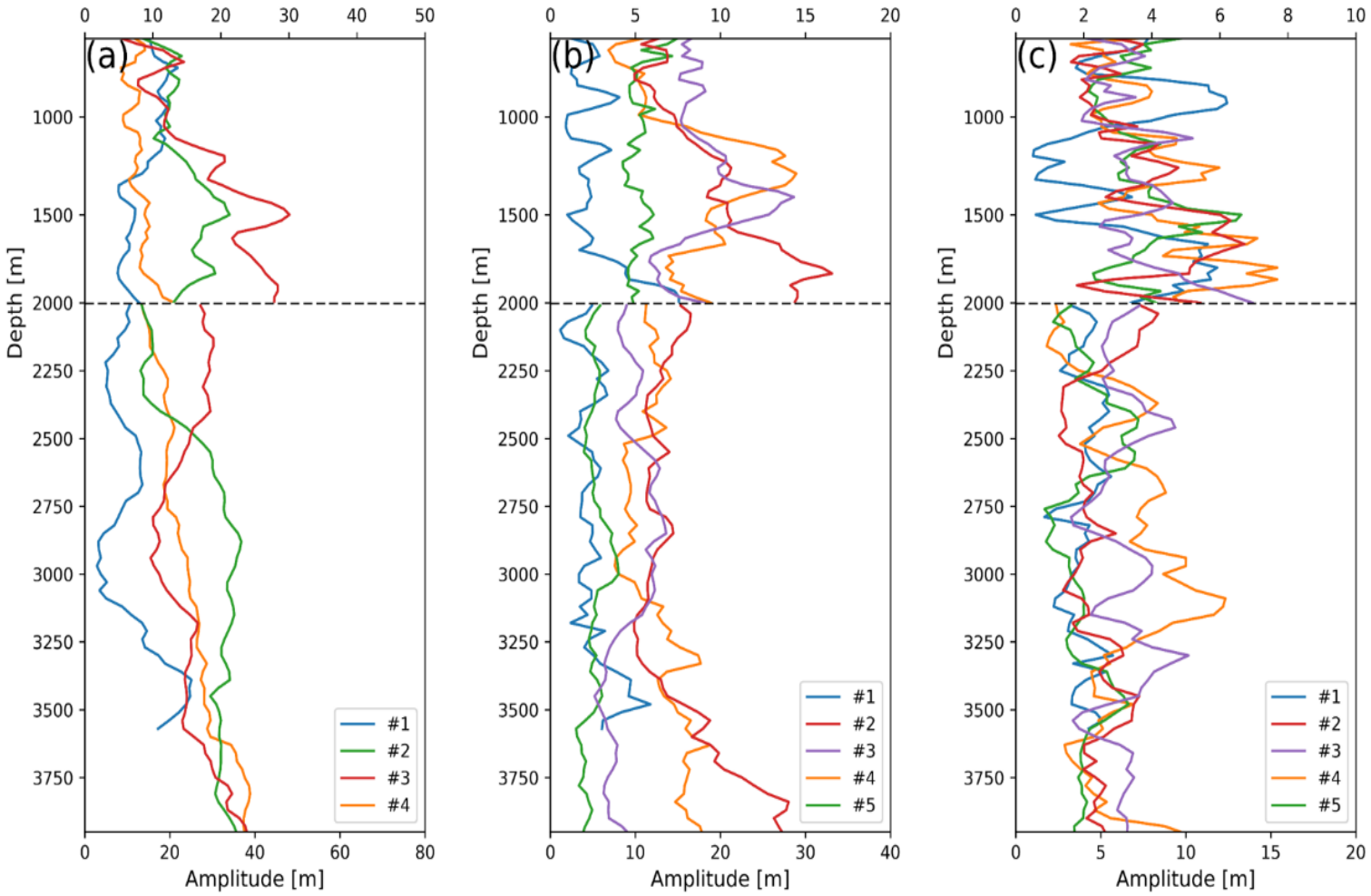


Fig. 5 As in figure 4, but for vertical displacements.

- ✓ The vertical displacement increases prominently below 2000m due to weak stratification in the deep ocean .
- ✓ The significant vertical displacement reflects stronger internal tides generation in the MA .

Conclusions

- ✓ Internal waves are found to have considerable imprints on temperature fluctuations using rapid-sampling deep profiling floats.
- ✓ The temperature fluctuations can reach 7 m°C at 4000 m, posing challenges to assess the real deep ocean warming rate.
- ✓ The internal waves induced temperature fluctuations in the deep ocean are generally larger in the Philippine Basin and Mariana Arc.