Data assimilation sensitivity experiments in the East Auckland Current region

Rafael Santana[1,2]; Helen Macdonald[1]; Joanne O'Callaghan[1]; Sutara Suanda[2,3]; and Sarah Wakes[2]

[1]National Institute of Water and Atmospheric Research (NIWA); [2]University of Otago; [3]University of North Carolina Wilmington

rafael.santana@niwa.co.nz

Introduction

- Analysis of in-situ and remote sensing observations document strong mesoscale variability in the **East Auckland Current (EAuC)** region (Santana et al. 2021).
- **Goal:** Assess the impact of surface and subsurface data assimilation (DA) into a model of the EAuC (Fig. 1a).

Methods

- **ROMS** has **2 km** of horizontal resolution and 30 sigma levels. The model was forced on the surface by JRA55do and at the lateral boundaries by HYCOM-NCODA.
- **4D-Var** was used to assimilate AVISO SSH, AVHRR SST, subsurface temperature, salinity, and velocities from moorings M3, M4 and M5 (**Fig. 1b**).
- 3 experiments starting on 1st of May 2015 (same initial condition) were performed to evaluate the observations' impacts:
  - No DA (**Free run**);
  - Assimilation surface fields (**ASF**);
  - Assimilation surface and mooring data (**ASFUVTS**).
- Model results were compared to daily averaged observations.

Results

Fig. 1:

- Free run shows similar mean results for SSH and temperature field. A small cold bias (0.5ºC) was simulated in the upper water column.

Fig. 2:

- Assimilation of surface fields was responsible for reduction of SSH rmsd by improving the representation of the mesoscale field.
- Assimilation of subsurface data reduced SSH rmsd near the moorings but slightly increased errors in the southern region.

Fig. 3:

- Free run had small temperature difference in comparison to observations.
- ASF increased cold bias from mid-Oct 2015 onwards. Strong uplift of the 10ºC and 6ºC isoterms was observed in mid-Feb and mid-Apr, respectively.
- Assimilation of in situ data prevents the growth of cold bias.

Fig 4:

- ASF run increased temperature rmsd in comparison to the Free run but improved velocity complex correlation by at least 3 fold.
- Assimilation of in situ data (ASFUVTS) was important to correct temperature errors generated by the assimilation of surface fields only.
- ASFUVTS doubled complex correlation with velocities.

Summary

- Free run well represented mean SSH and temperature fields but misplace mesoscale eddies on a daily basis.
- ASF reduced SSH rmsd relative to Free run as surface assimilation improved representation of the mesoscale field.
- Assimilation of mooring data reduced temperature errors by half and increased velocity representation by 2 fold.

For more: **rafacsantana.github.io**

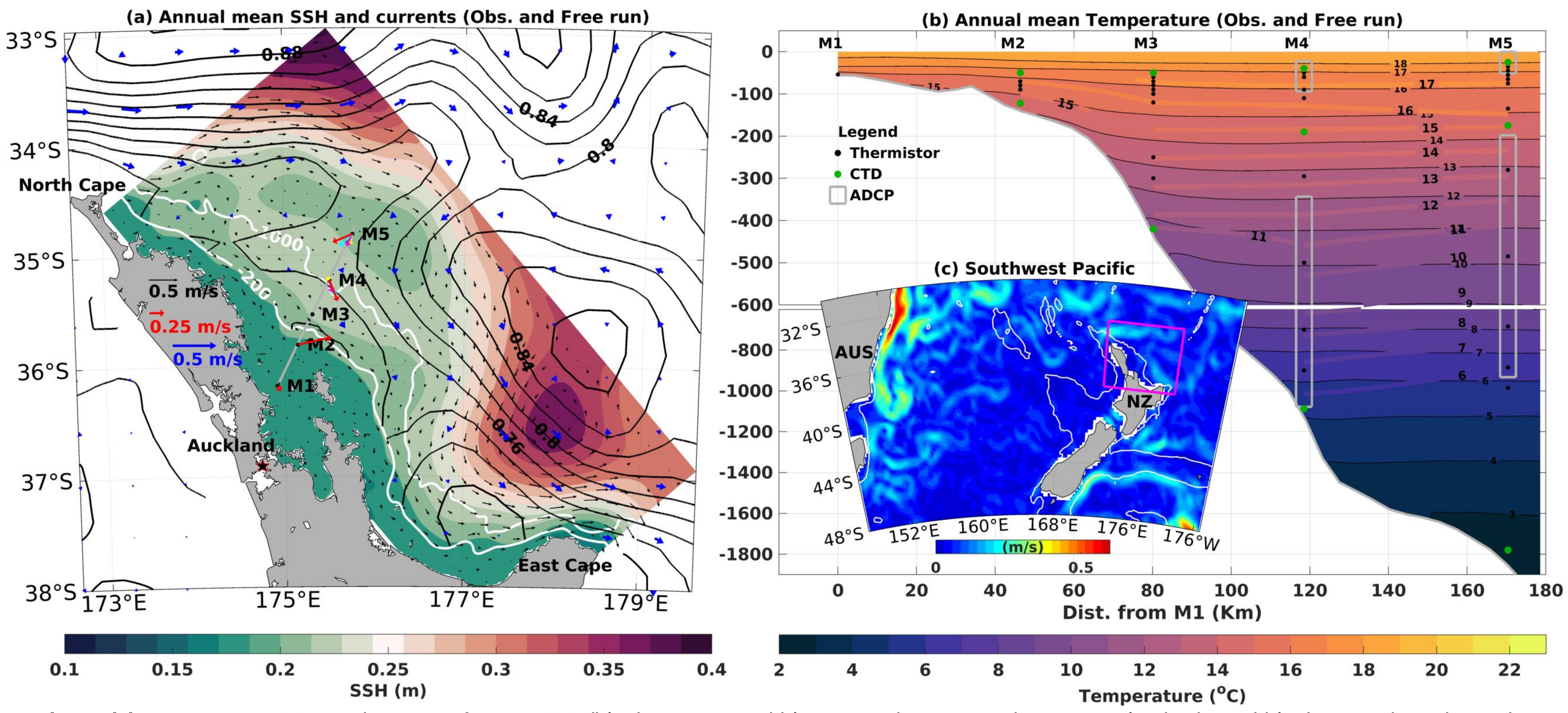

Fig. 1: (a) 1-year mean SSH and currents from AVISO (black contour and blue arrows), Free run (green-purple shade and black arrows), and mooring (coloured arrows). **(b)** 1-year mean temperature from Free run (shade) and moorings (coloured lines). **(c)** Study area relative to Southwestern Pacific Ocean

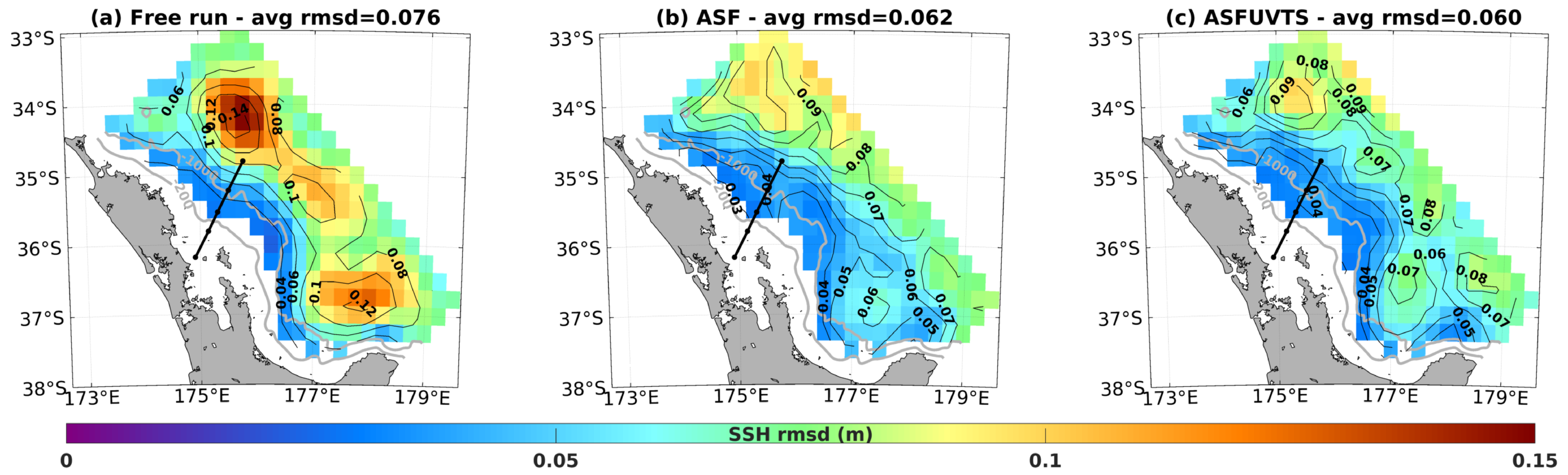

Fig. 2: Maps of SSH rmsd between model and AVISO from **(a)** Free run **(b)** ASF, and **(c)** ASFUVTS.

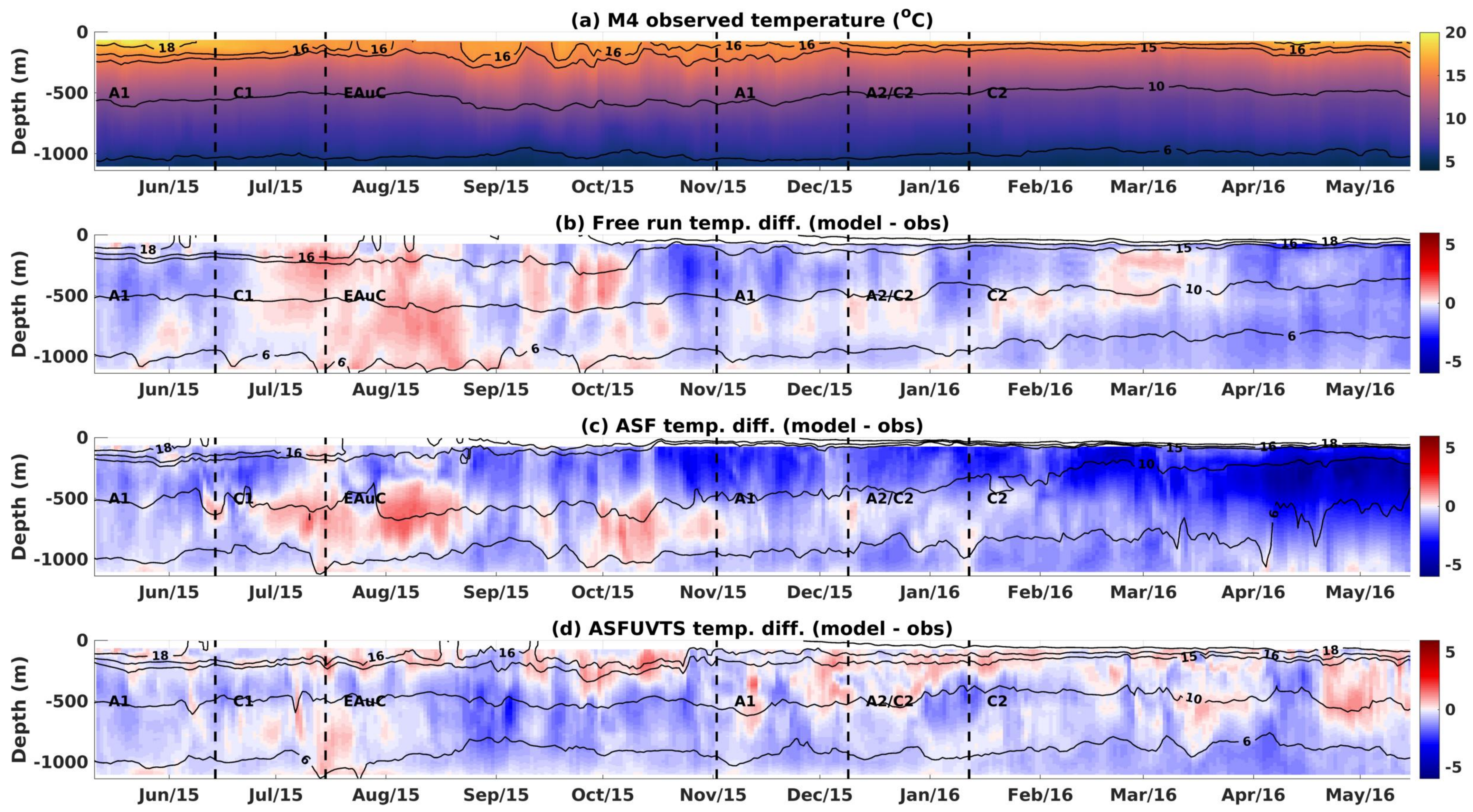

Fig. 3: Time series of temperature profile at M4 from observations **(a)** and temperature difference between model and observations from **(b)** Free run, **(c)** ASF run, and **(d)** ASFUVTS run, and their corresponding temperature timeseries as black contours. The dashed black lines represent 6 mesoscale events identified in Santana et al. (2021).

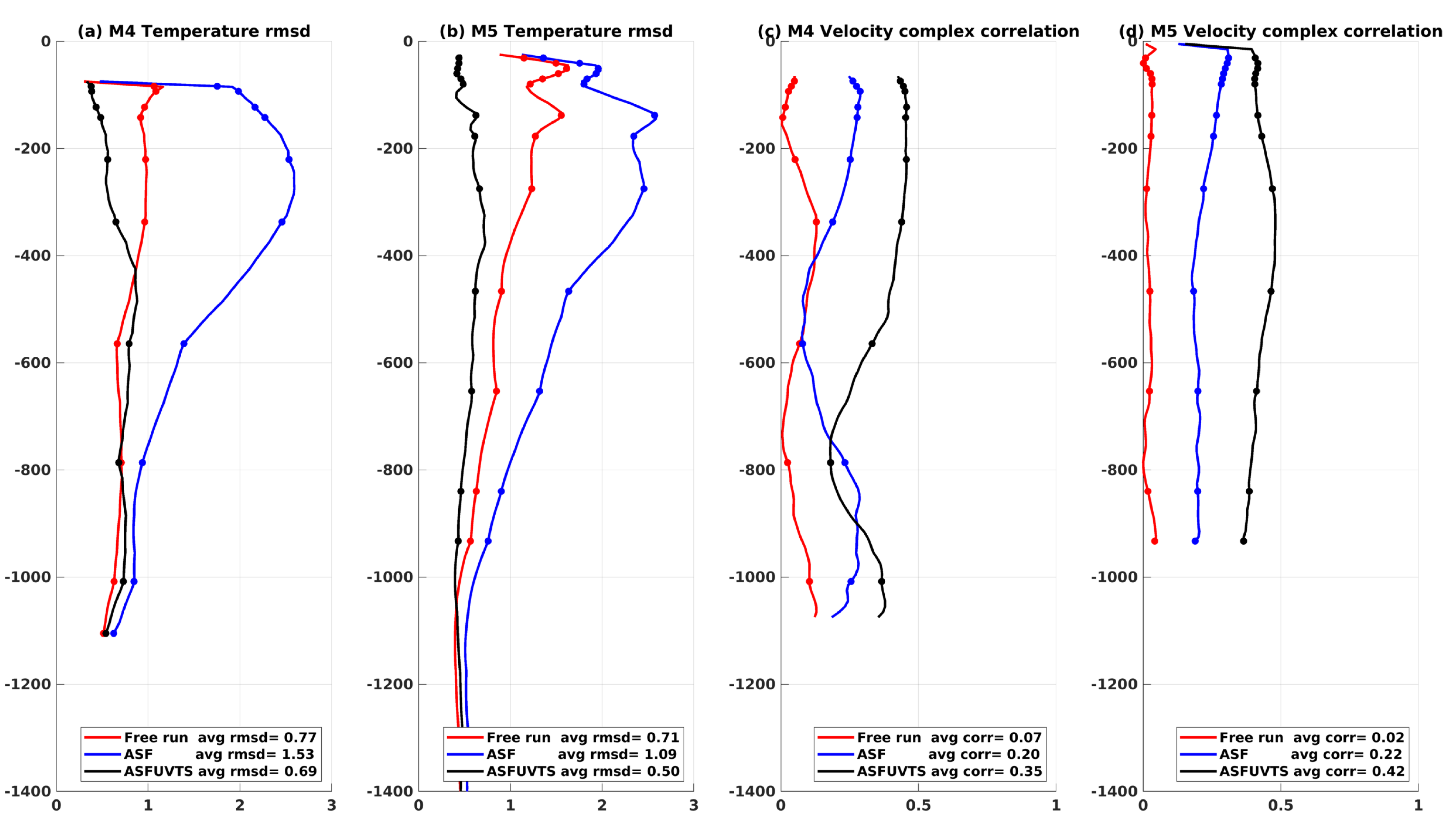

Fig. 4: Profiles of temperature rmsd at M4 **(a)** and M5 **(b)**, and velocity complex correlation at M4 **(c)** and M5 **(d)** from Free run (red), ASF run (blue), and ASFUVTS (black). The dots represent median depth of temperature sensors.