

Particle ('debris') tracking at possible crash sites of MH370

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Abstract

Malaysia Airlines flight MH370, with 239 passengers on board, was scheduled to fly from the Malaysian capital, Kuala Lumpur, to Beijing in China on Saturday 8 March 2014. It disappeared from civilian radar screens about an hour into the scheduled six-hour flight. Initially the search region was in the south China Sea, but on 24 March, it was revealed that satellite data from Inmarsat indicated that the plane flew along the southern search corridor and the flight "ended in the southern Indian Ocean". Initially the search area was in the Southern Ocean sector of the Indian Ocean (86–90° E 44–46° S). Further analysis of the Inmarsat data indicated the flight might have crashed ~1000 km to the north of the Southern Ocean site (94–98° E 27–34° S). Subsequently, the search site was moved farther north to the vicinity of the Wallaby Plateau (103–104° E 20–21° S). There was a huge demand by the media on how oceanography could help with the search, and the modelling group at the University of Western Australia performed particle tracking, forward and backward in time, to examine the surface currents in the region and the dispersal pattern of any possible debris. We used the flow fields from the HYCOM global ocean model as input to a particle tracking model, which was able to simulate both forward and backward in time. The results of simulations (undertaken in near-real time during the search period) indicated that the oceanographic conditions varied considerably between the different locations, and at the location on the Wallaby Plateau the circulation was dominated by a large sub-mesoscale eddy for several weeks.

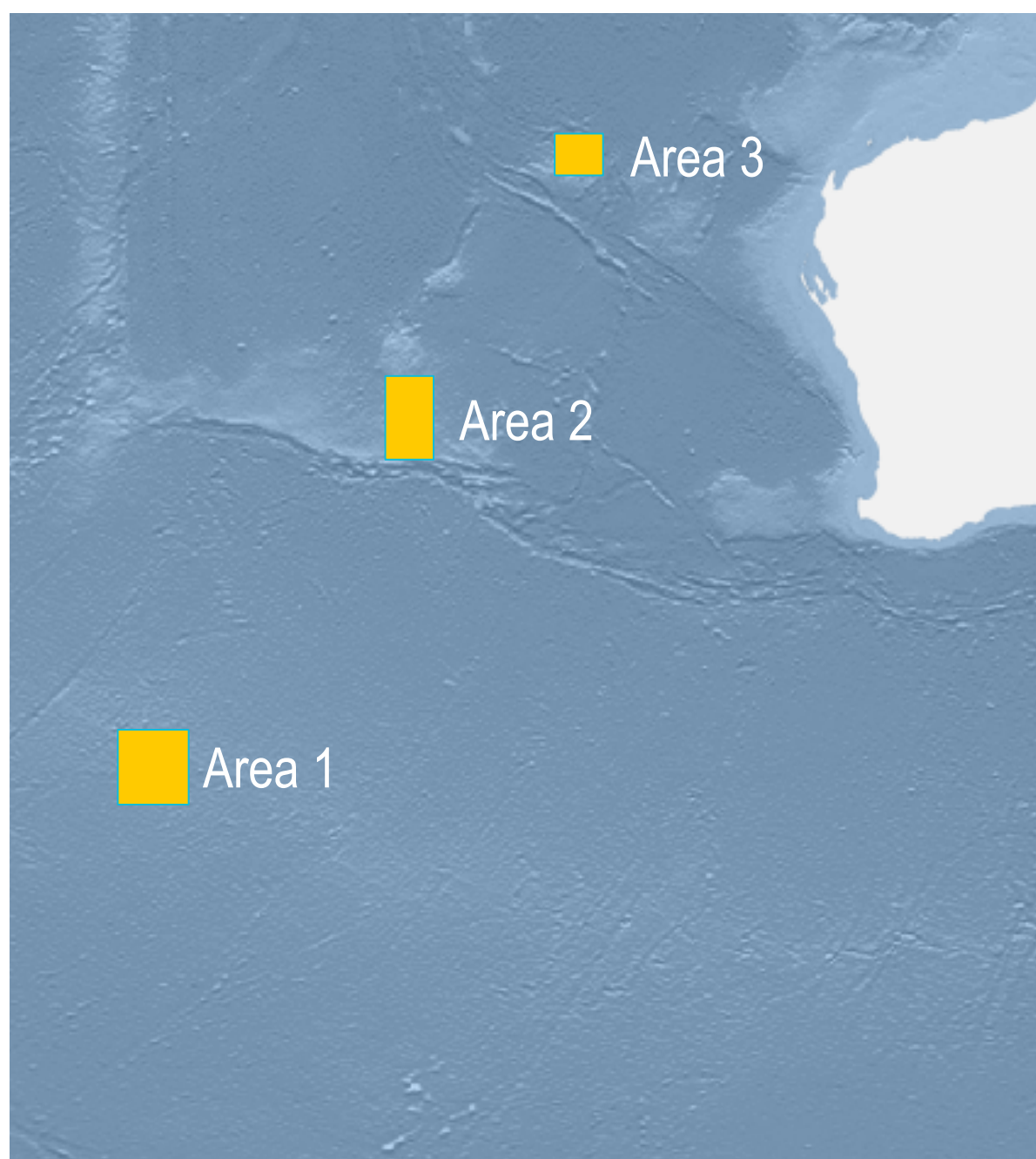


Figure 1: The 3 main search areas. The initial search area was in the Southern Ocean (area 1) then moved to the region of Broken Ridge and Guldren Draak Seamount (area 2), followed by the Wallaby Plateau (area 3). The search is now concentrated in area 2.

Debris-tracking model

Particle dispersion modelling was performed using the particle-tracking tool ICHTHYOP-3.2 (<http://www.previmer.org>). Surface velocity fields were extracted from the global HYbrid Coordinate Ocean Model (HyCOM) with 1/12° reanalysis outputs at daily intervals (<http://hycom.org>). We chose the fourth-order Runge-Kutta numerical scheme in ICHTHYOP-3.2 to simulate Lagrangian advection of individual particles. The numerical time step was set to 180 s and particle trajectory position outputs were set to 6-hour intervals. Both forward and backward particle tracking runs were made for the 3 different search areas.

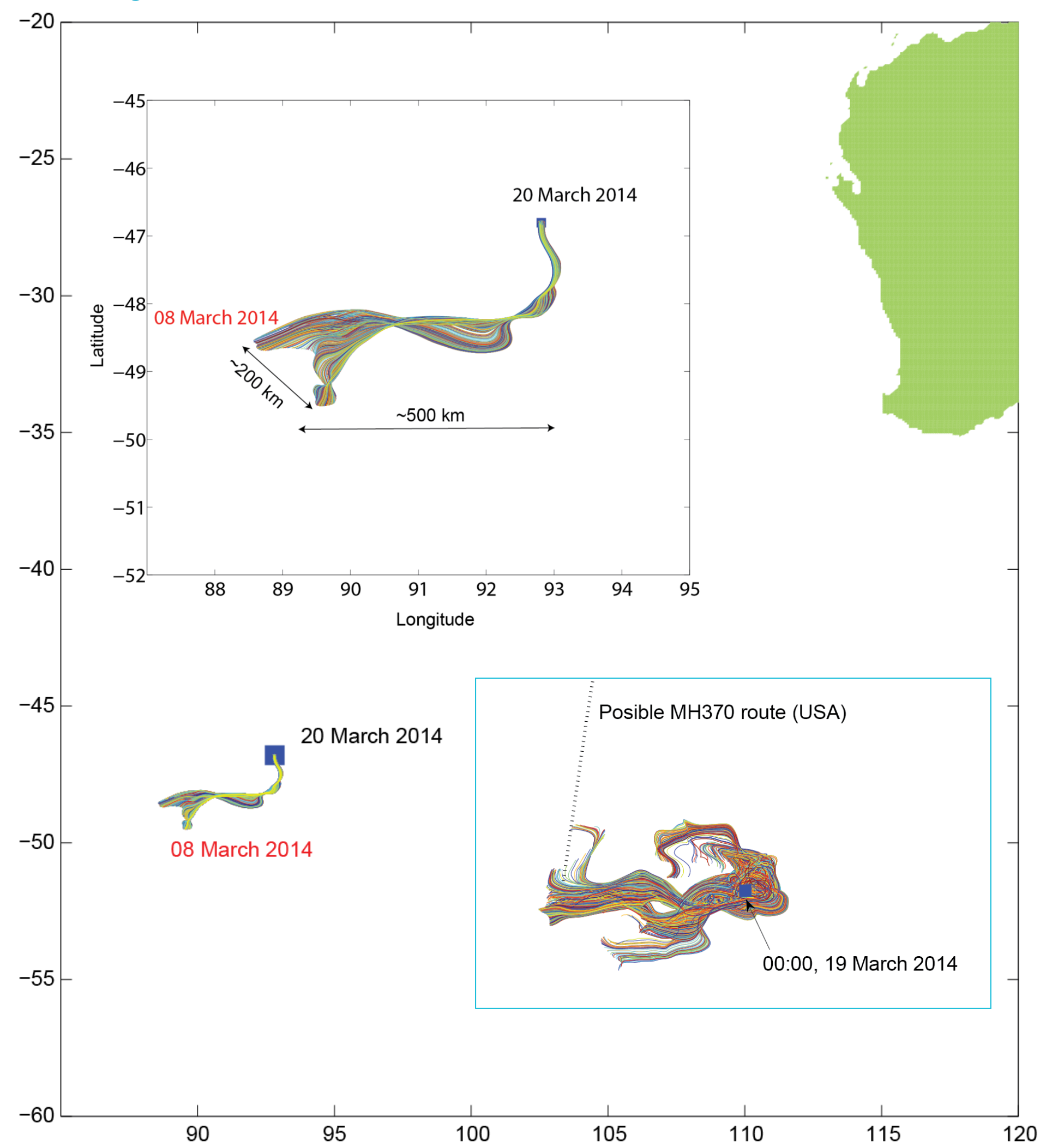


Figure 2: Backward particle tracking for area 1.

Longer-term tracking

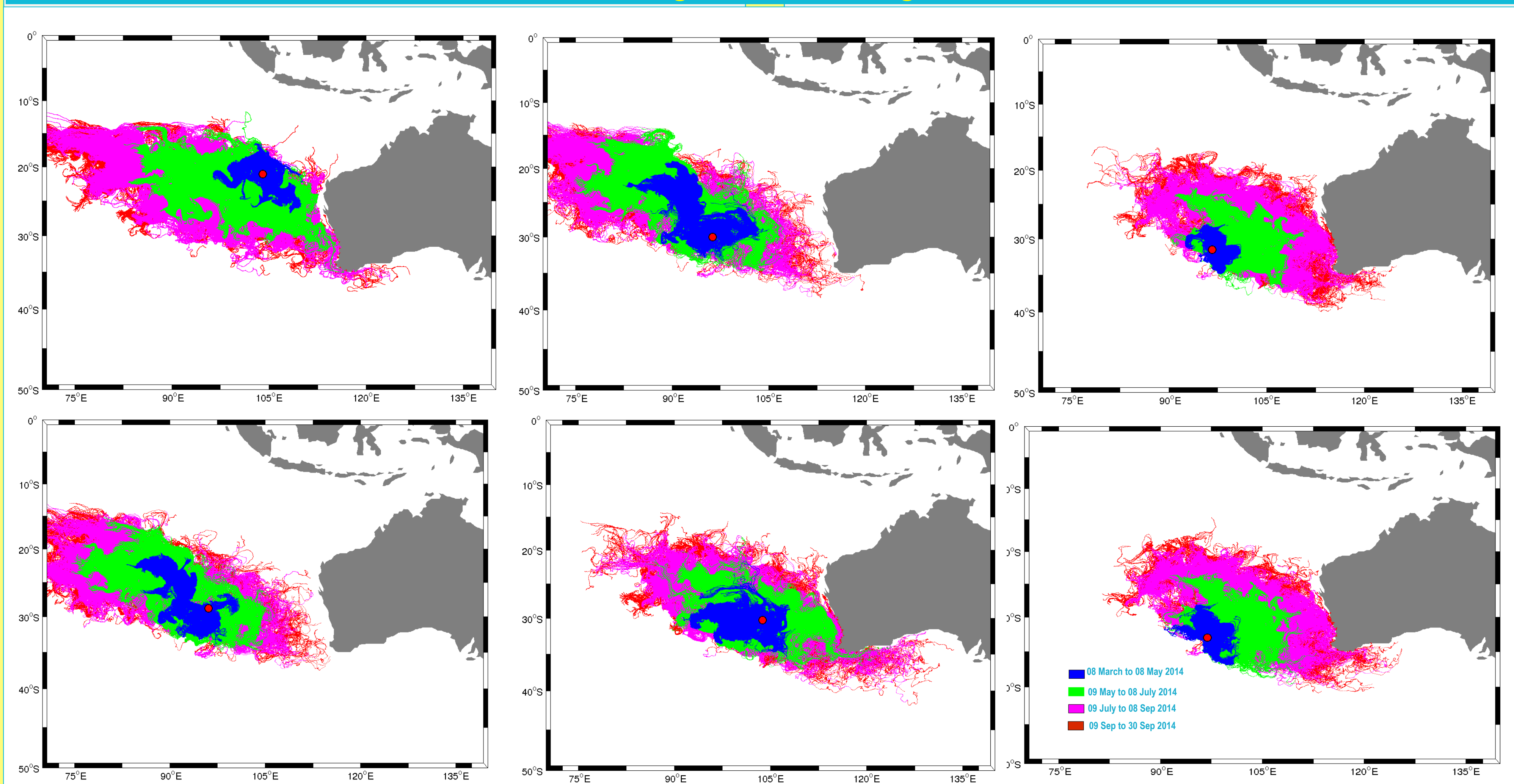


Figure 3: Results of longer-term particle tracking from 8 March 2014 to 30 September 2014. Colours represent every 2 months.

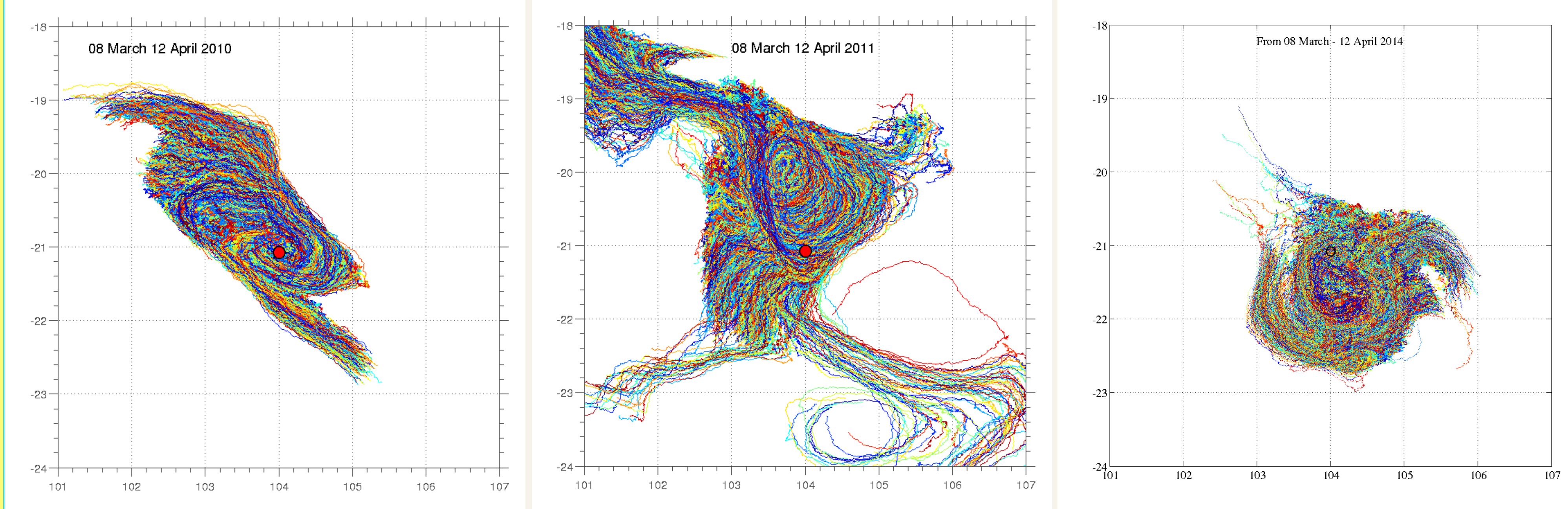


Figure 4: Interannual variation in particle tracks for area 3: 2010, 2011 and 2014.

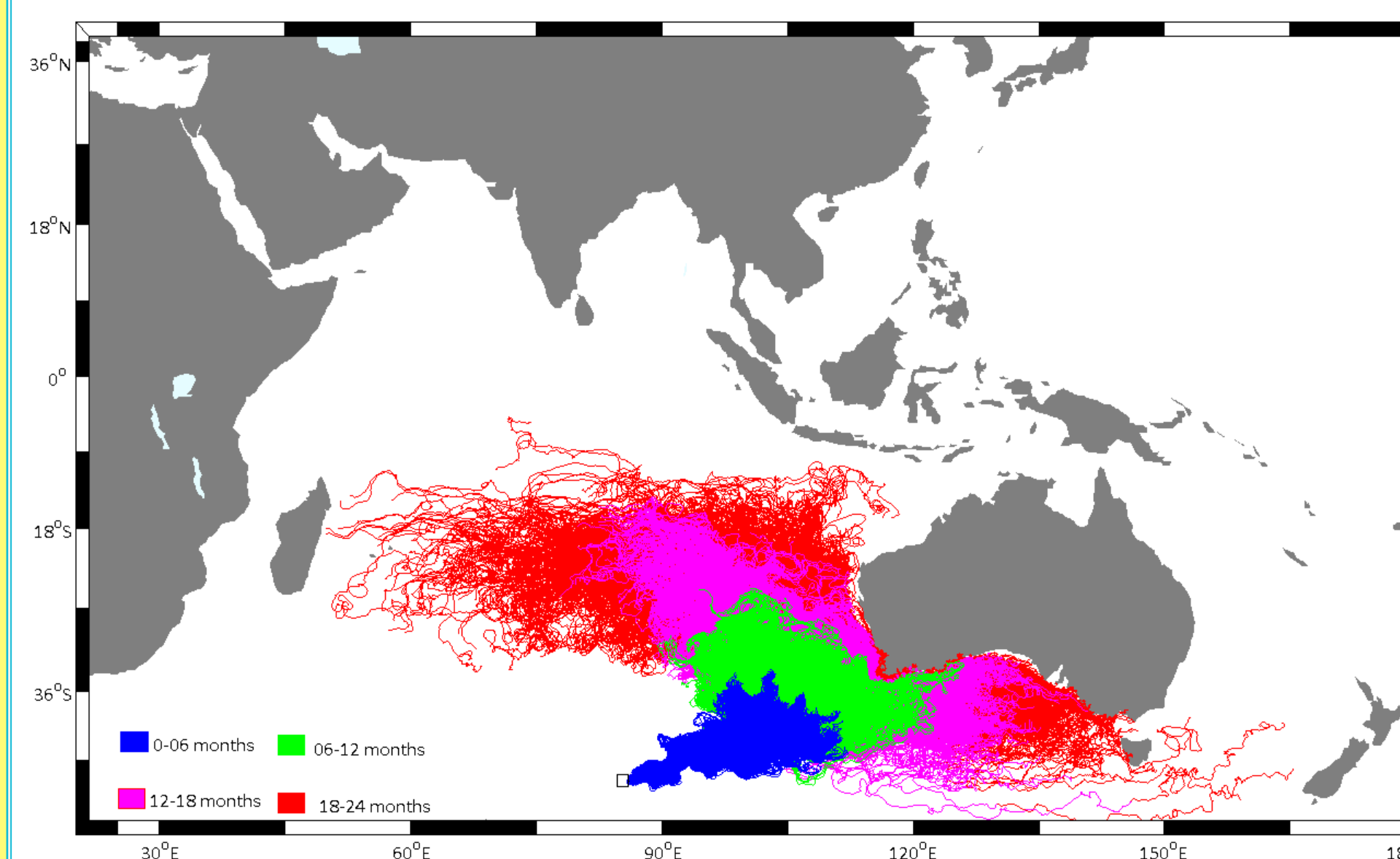


Figure 5: Results of longer-term particle tracking over 2 years from 8 March 2010 to 30 September 2014. Colours represent every 6 months.

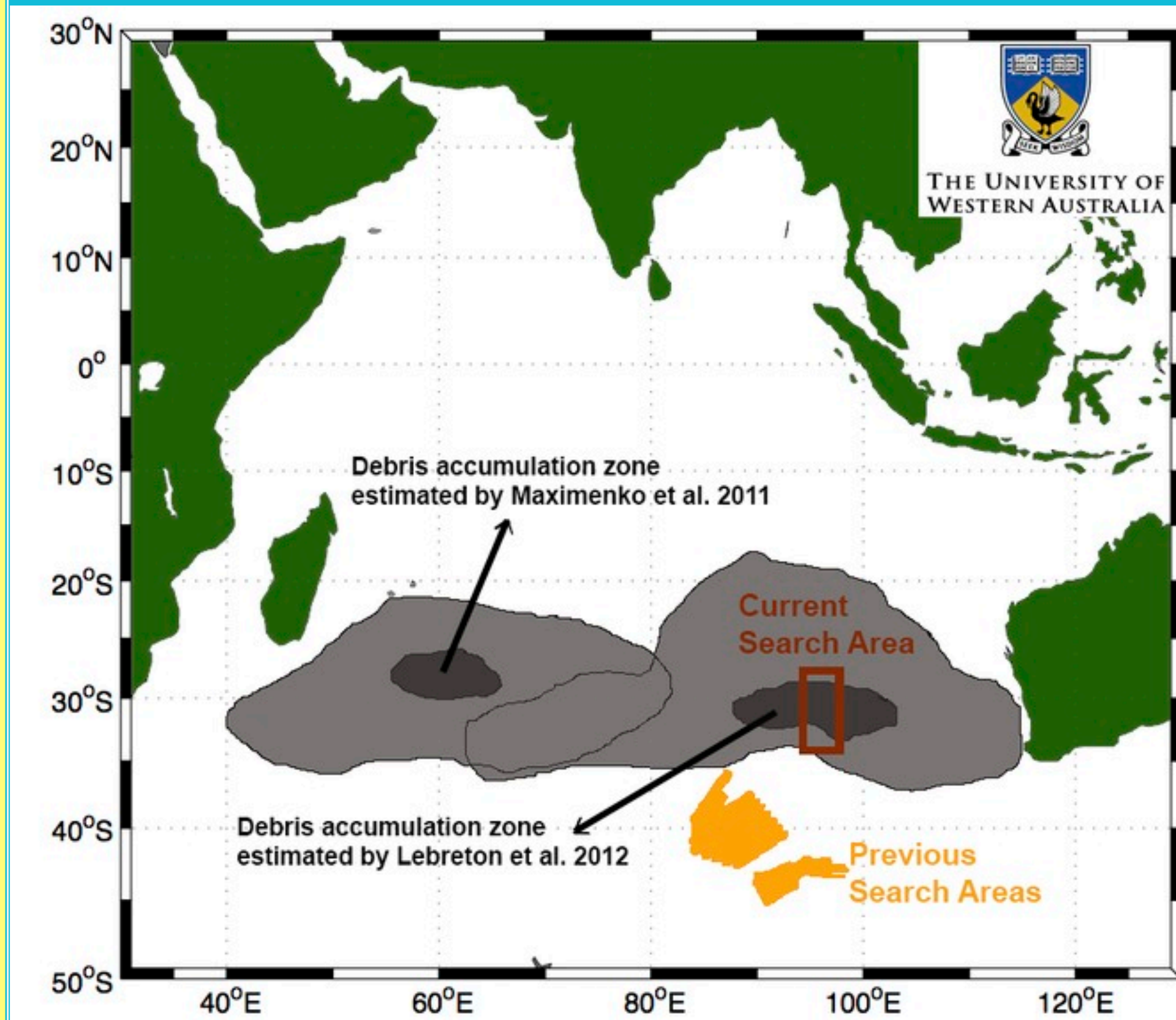


Figure 6: Current search area is within the Indian Ocean 'garbage patch' (<https://theconversation.com/the-difficulty-of-searching-for-mh370-in-a-giant-rubbish-patch-25083>).

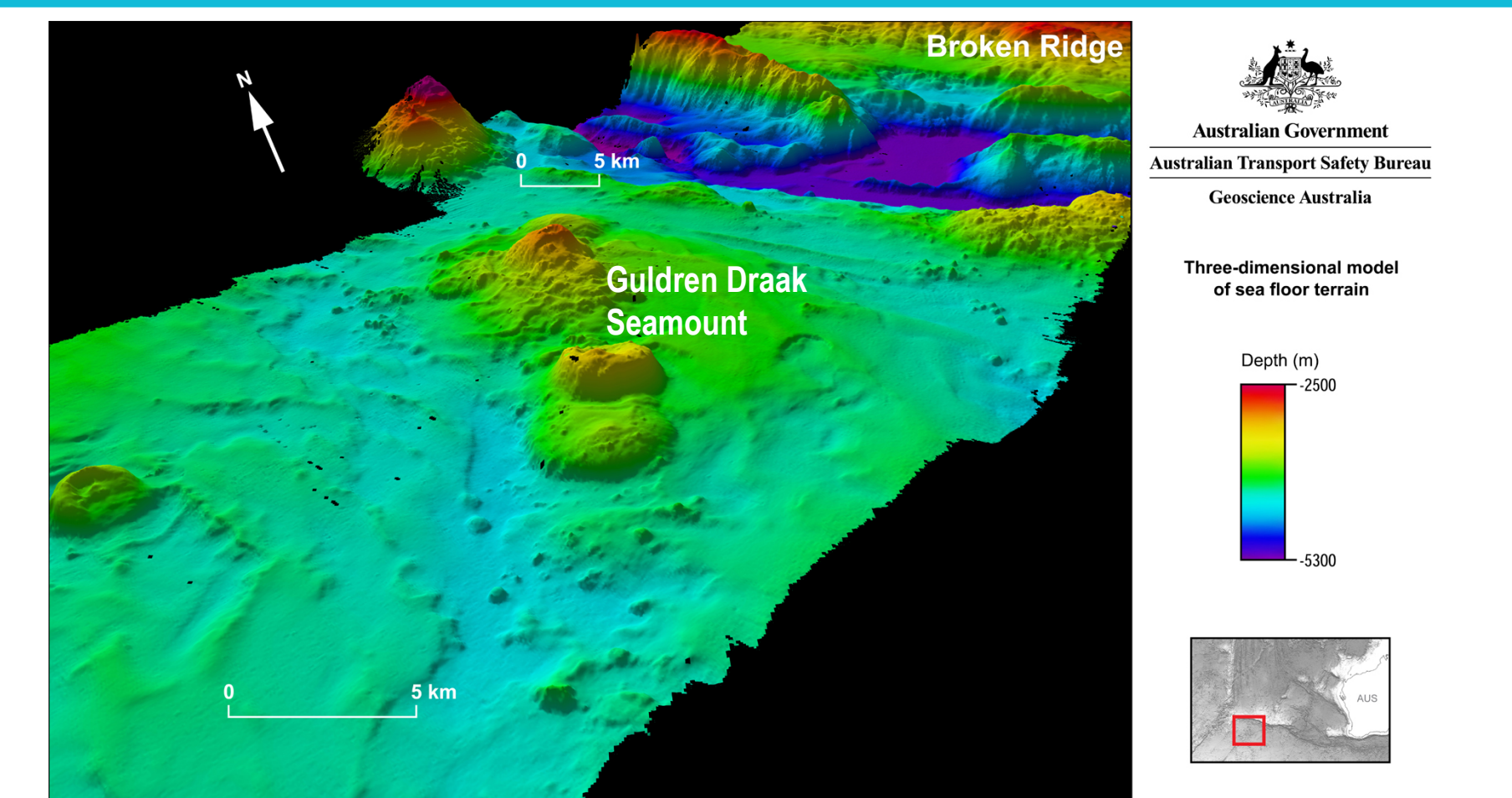


Figure 7: Updated topography of area 2 from <http://www.atsb.gov.au/media/5155208/>.



Figure 8: Forward tracking from different locations: area 2.

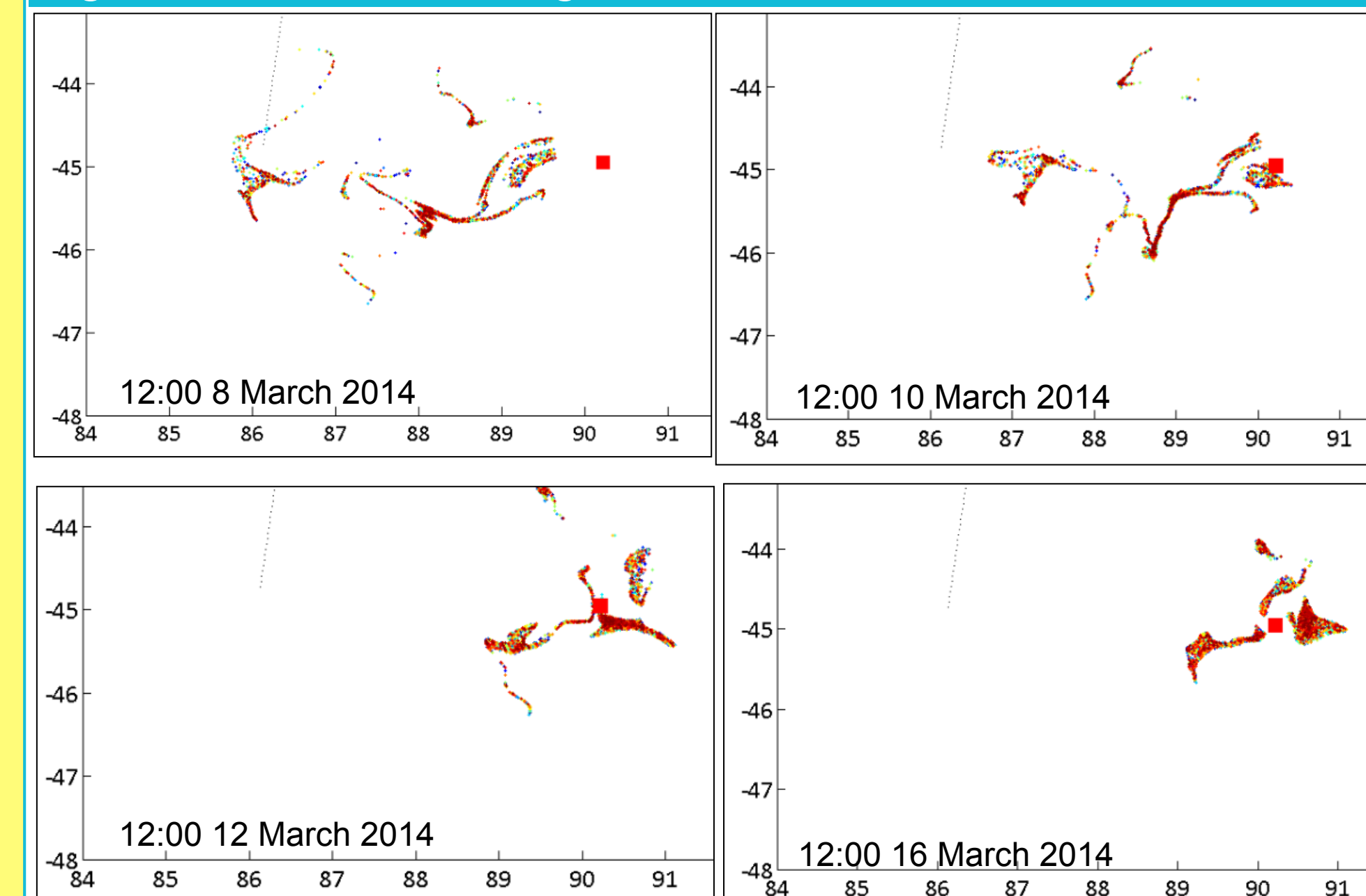


Figure 9: Backward particle tracking for area 1 to connect 'debris' identified from Chinese satellite and MH370 flight path.