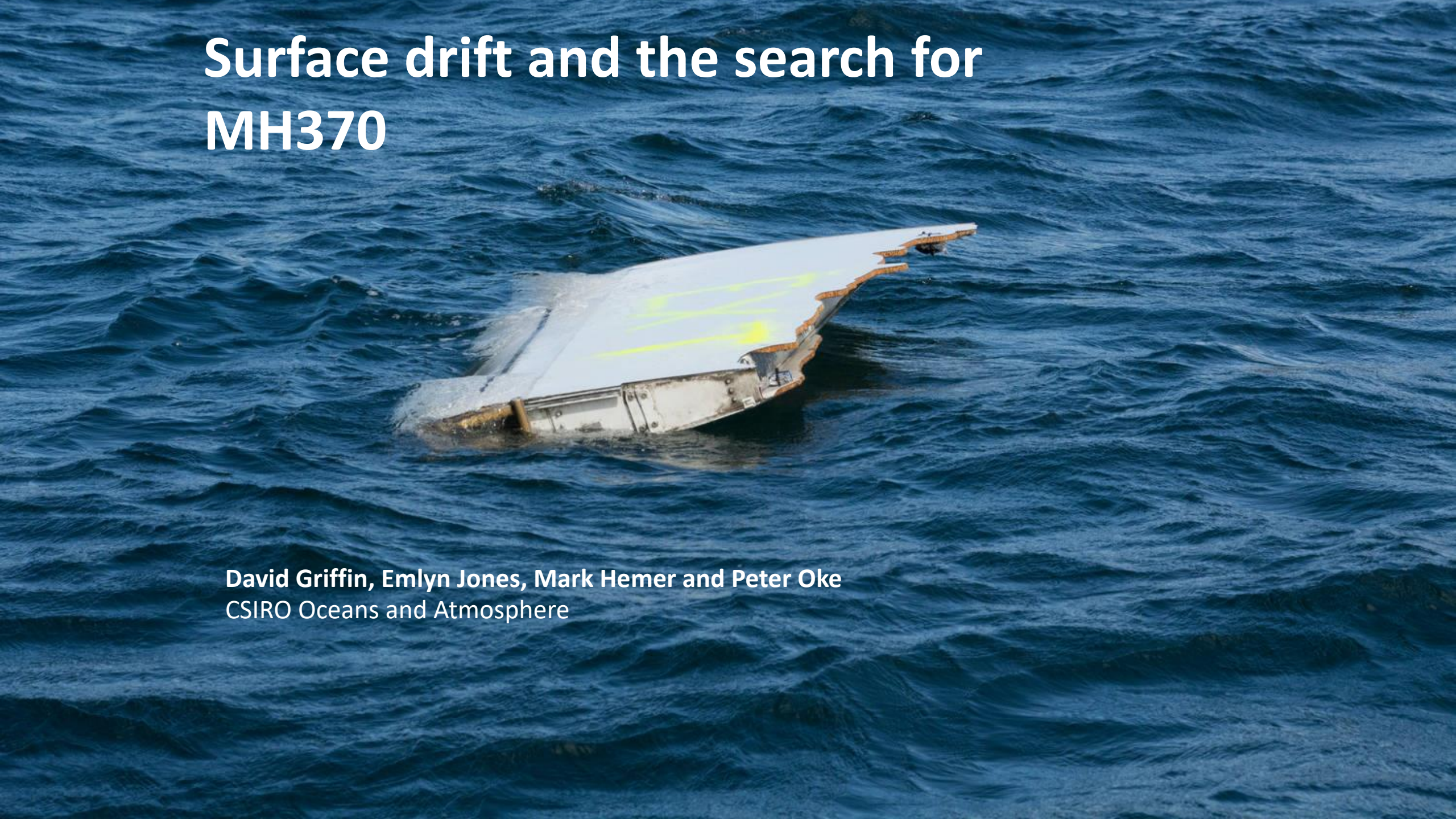
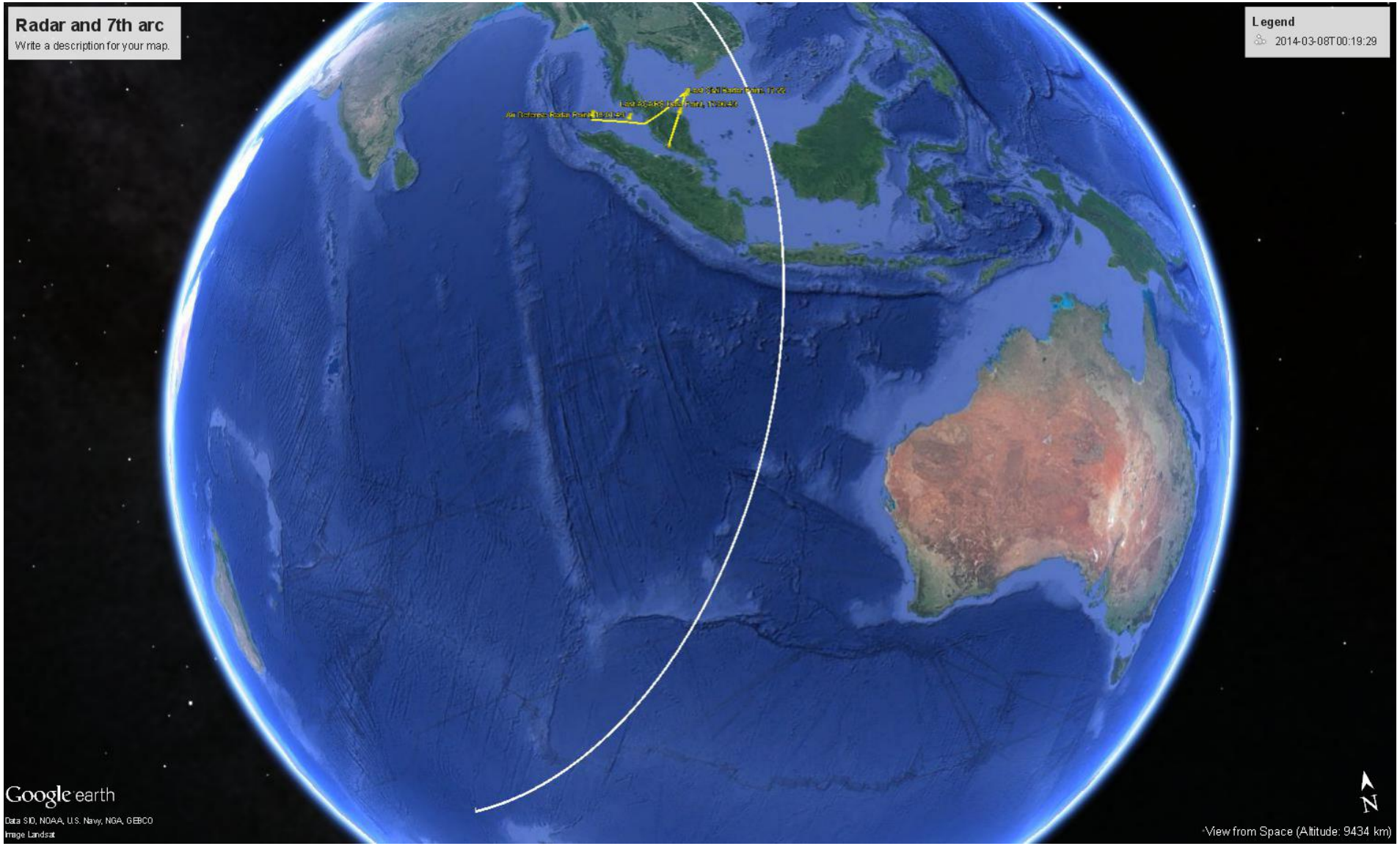
Surface drift and the search for MH370



David Griffin, Emlyn Jones, Mark Hemer and Peter Oke
CSIRO Oceans and Atmosphere

The most tragic aviation incident of all time.

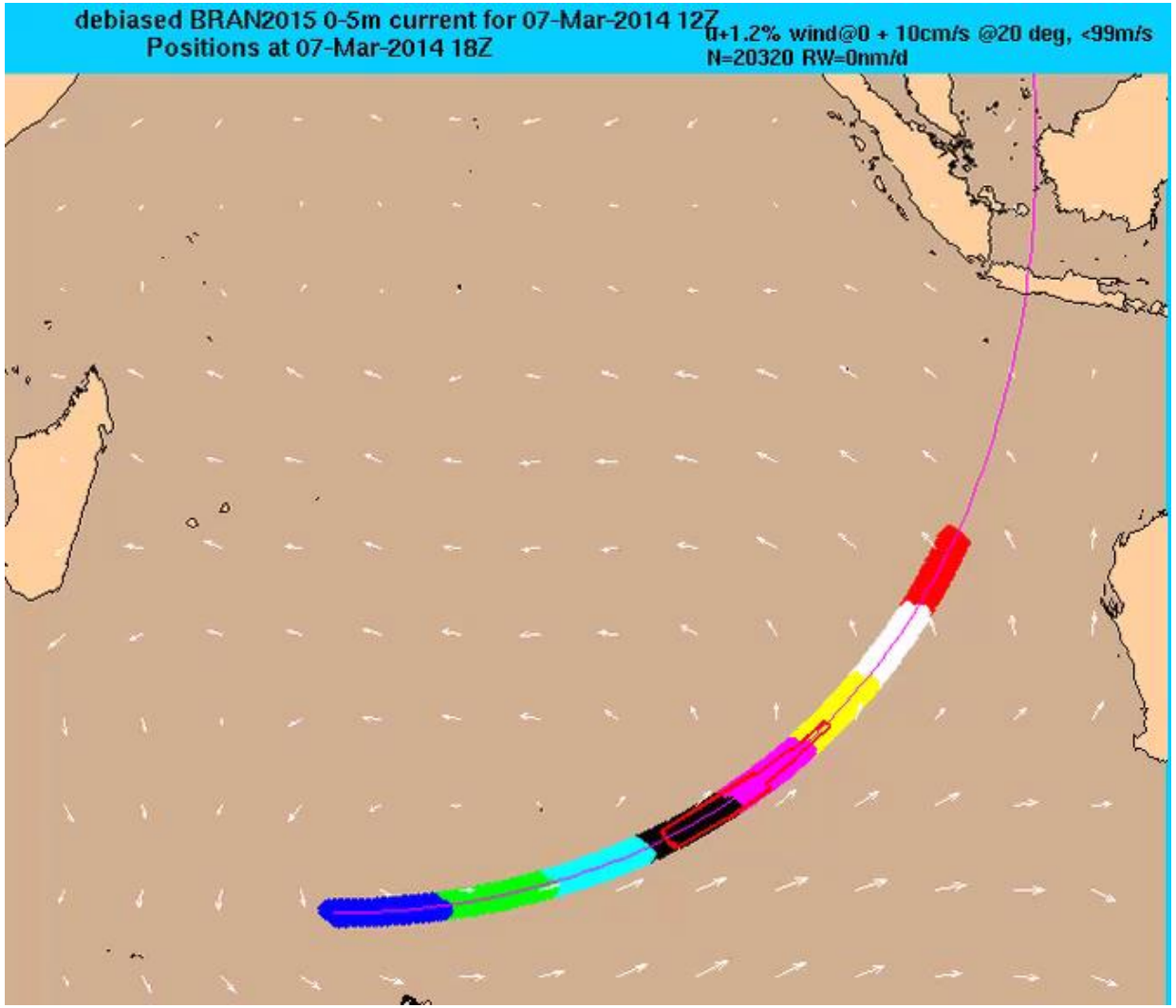
- March 2014, Malaysian Airlines flight MH370 disappeared
- Inmarsat call log metadata: it flew 7h into the southern Indian Ocean
- Ping delay and Doppler define the '7th arc' of possible impact points
- March-May 2014: Aerial searching found nothing
- 2015-2016: Towed side-scan sonar 39-36S
- July 2015: flaperon on Reunion Island (22S 55E)
- Dec 2015-Aug 2016 more pieces on African beaches
- Pressure to resume search
- Jan-June 2018. AUV side-scan 36S-25S (Ocean Infinity)
- 2019: Mystery remains, deeper than ever.
- Where should the next search be? (Were our drift simulations flawed?)


Radar and 7th arc
Write a description for your map.
Legend
2014-03-08T00:19:29
Google earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
N
View from Space (Altitude: 9434 km)

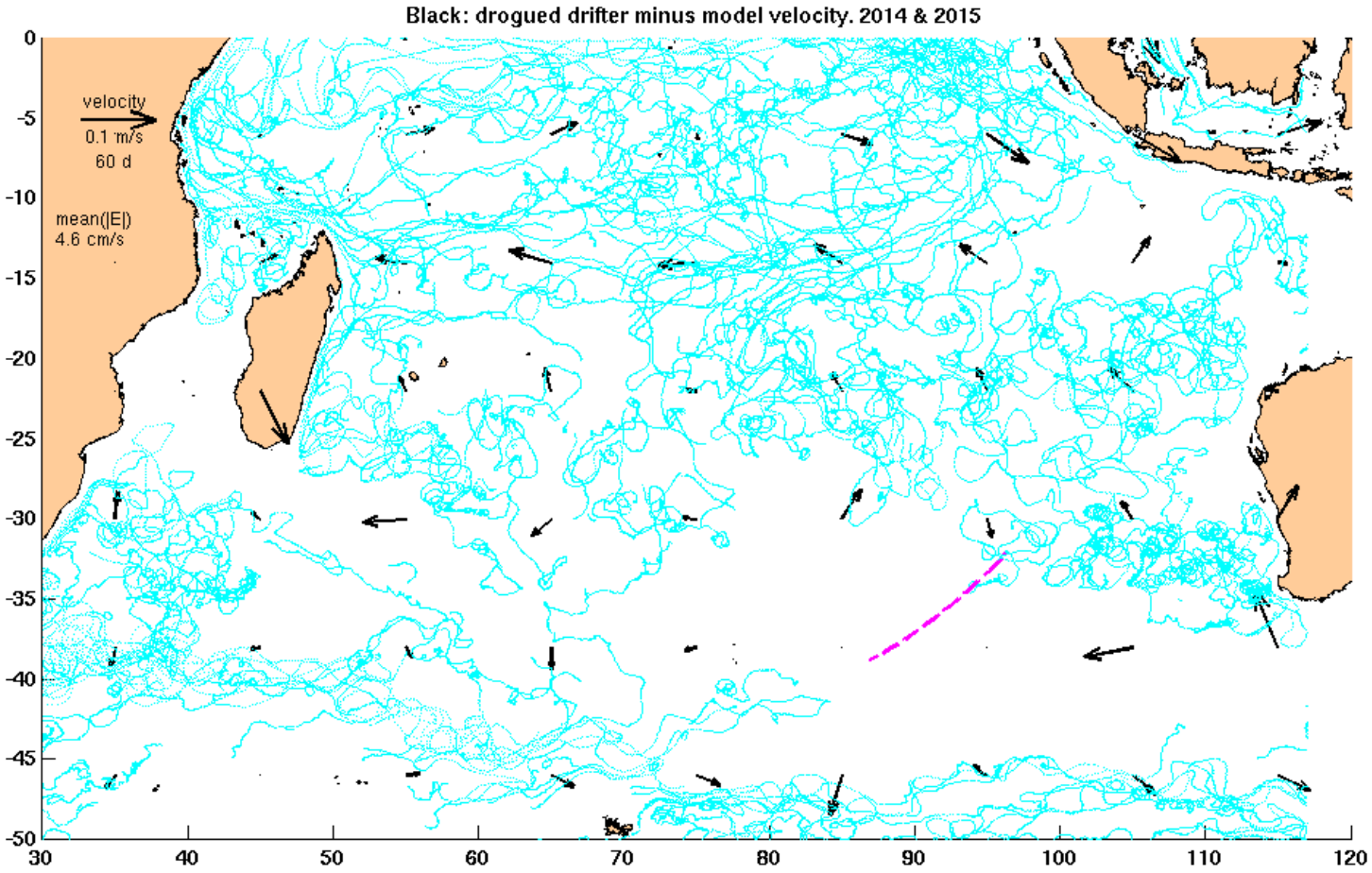
2014 surface search. 40 days.
Many ships and aircraft. Nothing found.

B777 flaperon, 29 July 2015. First ‘proof’ of crash. 508d at sea. 4000km from 7th arc search area.

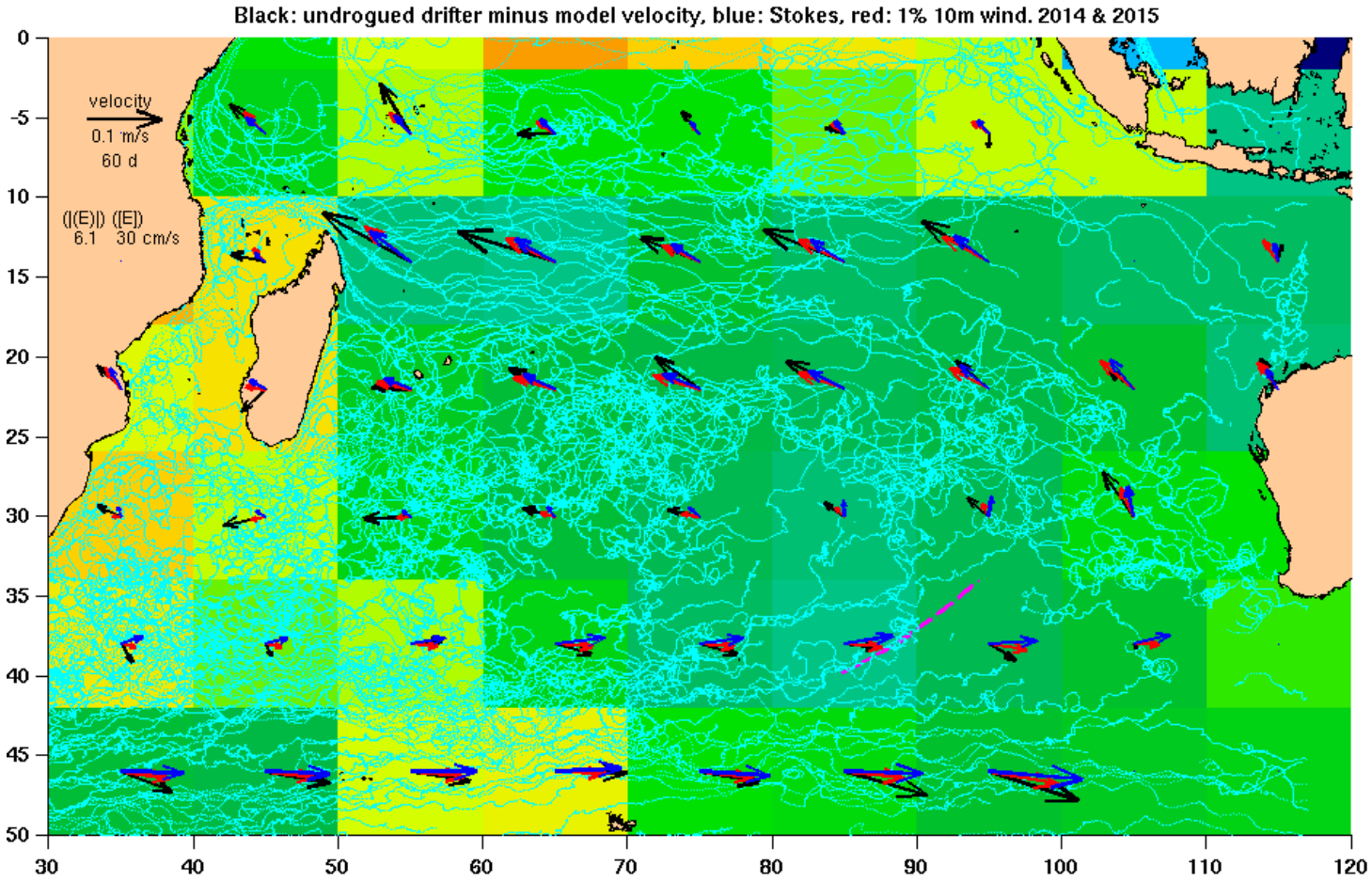
Flaperon trajectories from a wide range of potential crash locations



Australia's 'Bluelink' model has 5m layers and no Stokes Drift. Velocity at 12m agrees with (drogued) GDP buoys.

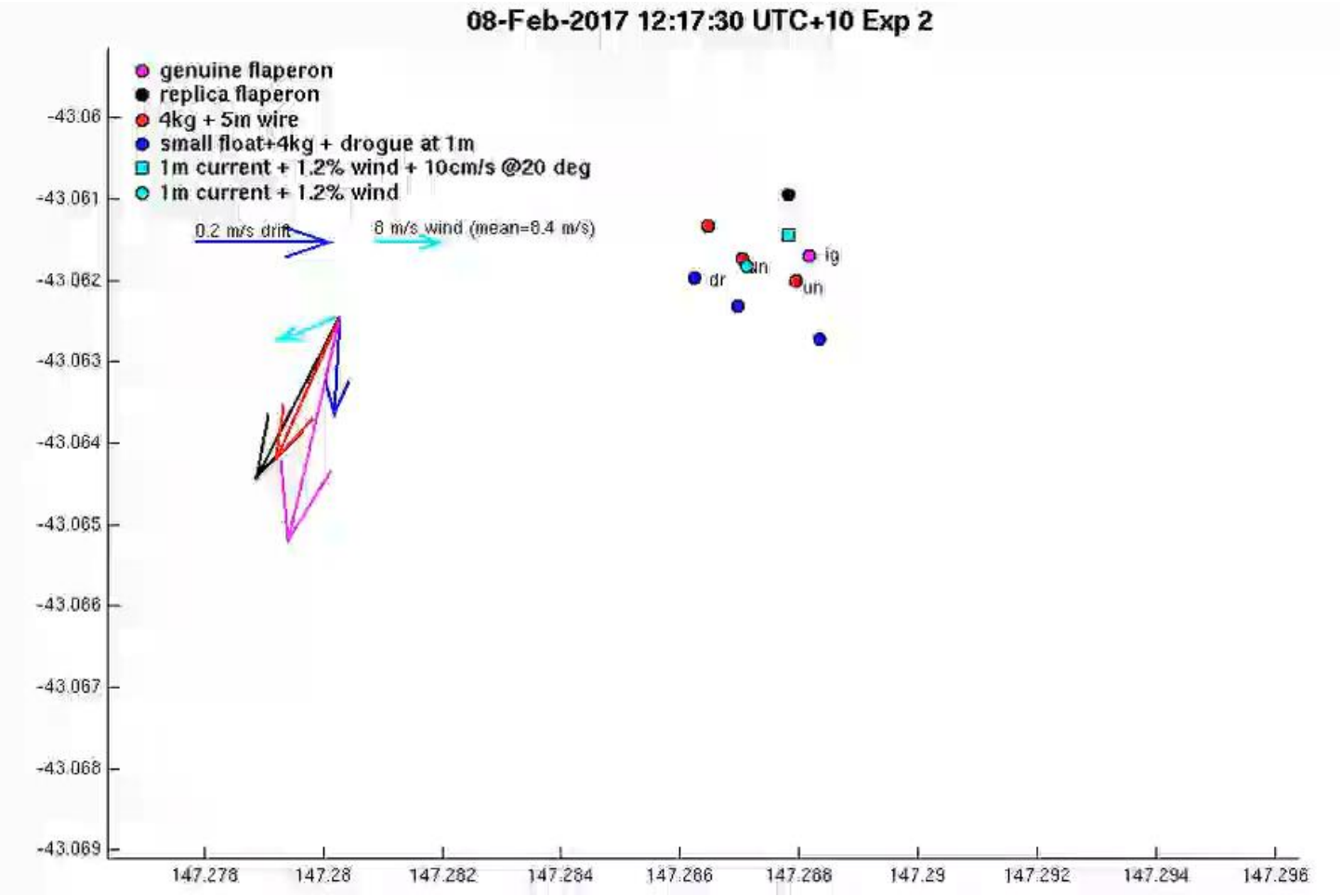


Add Stokes Drift (=1.2% wind) for undrogued buoys (and aircraft debris).



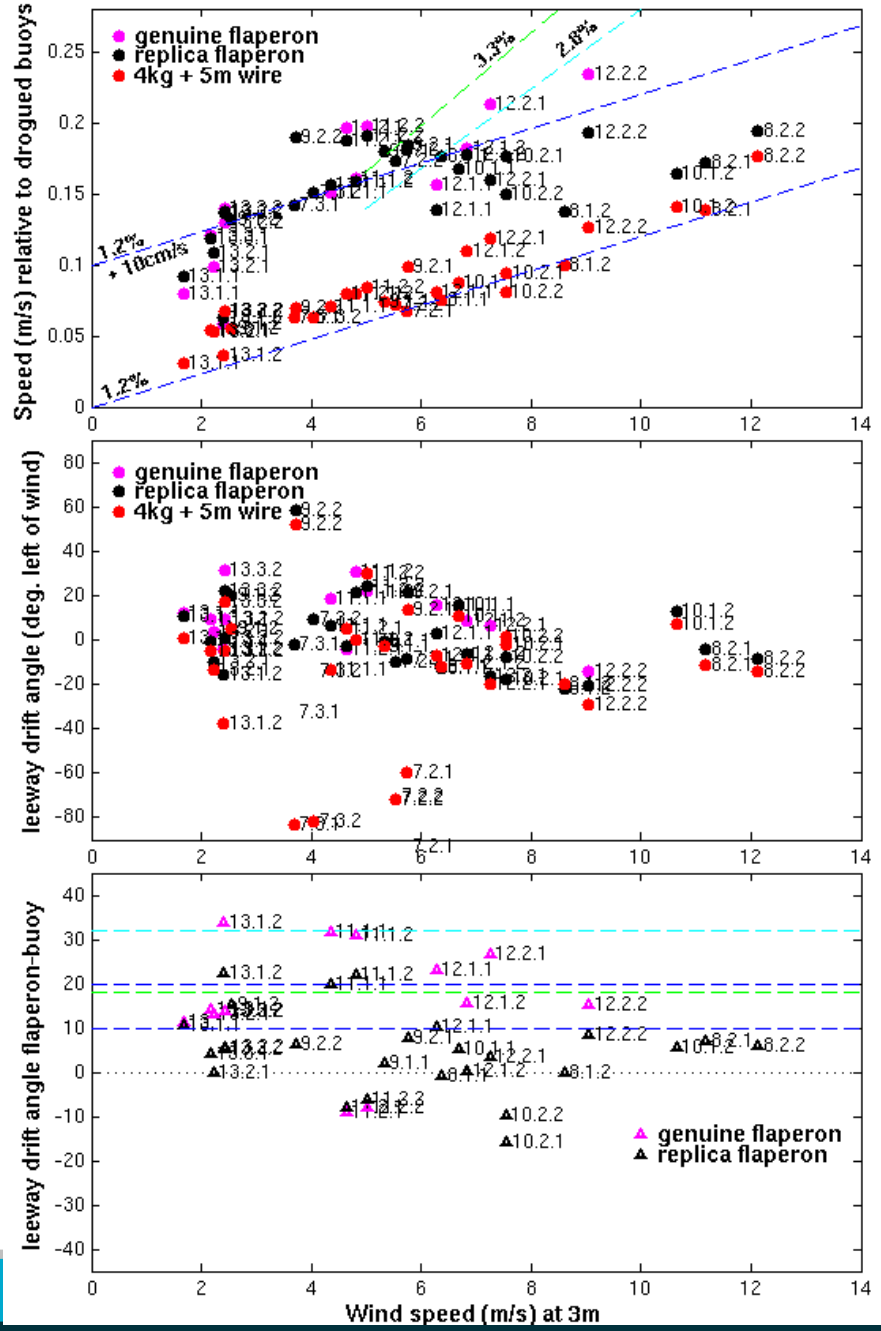
Does a flaperon drift like a GDP buoy?

15 expts: no, it goes faster. e.g. 8 Feb 2017:

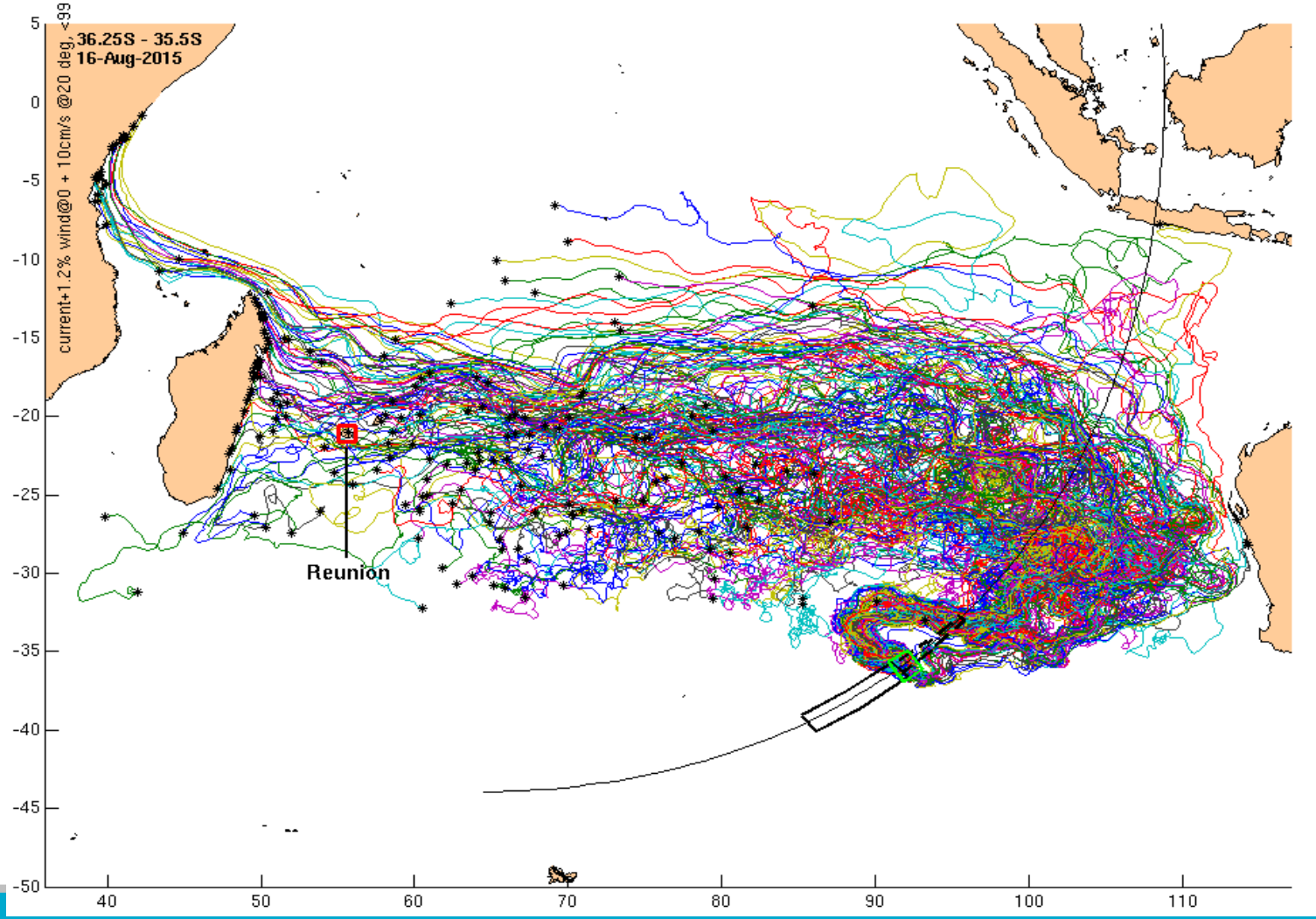


Flaperon ‘windage’ is actually Stokes Drift + 10cm/s @ 20° left of wind.

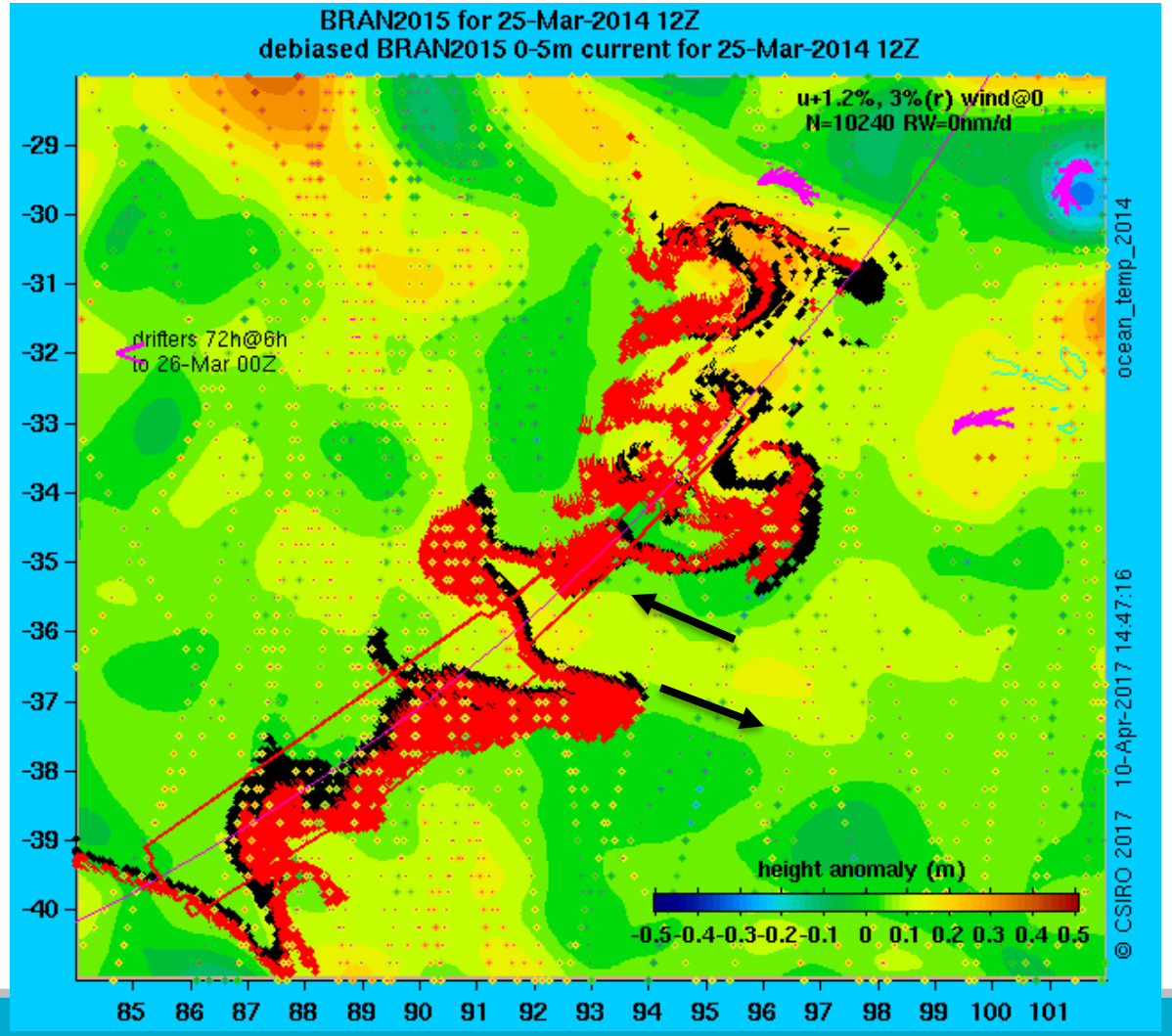
Left? Flaperon is asymmetric. Small waves impart momentum. Pengam (2016) predicted angle but higher speed.



Initial NW drift from near 35°S prevents WA landfall



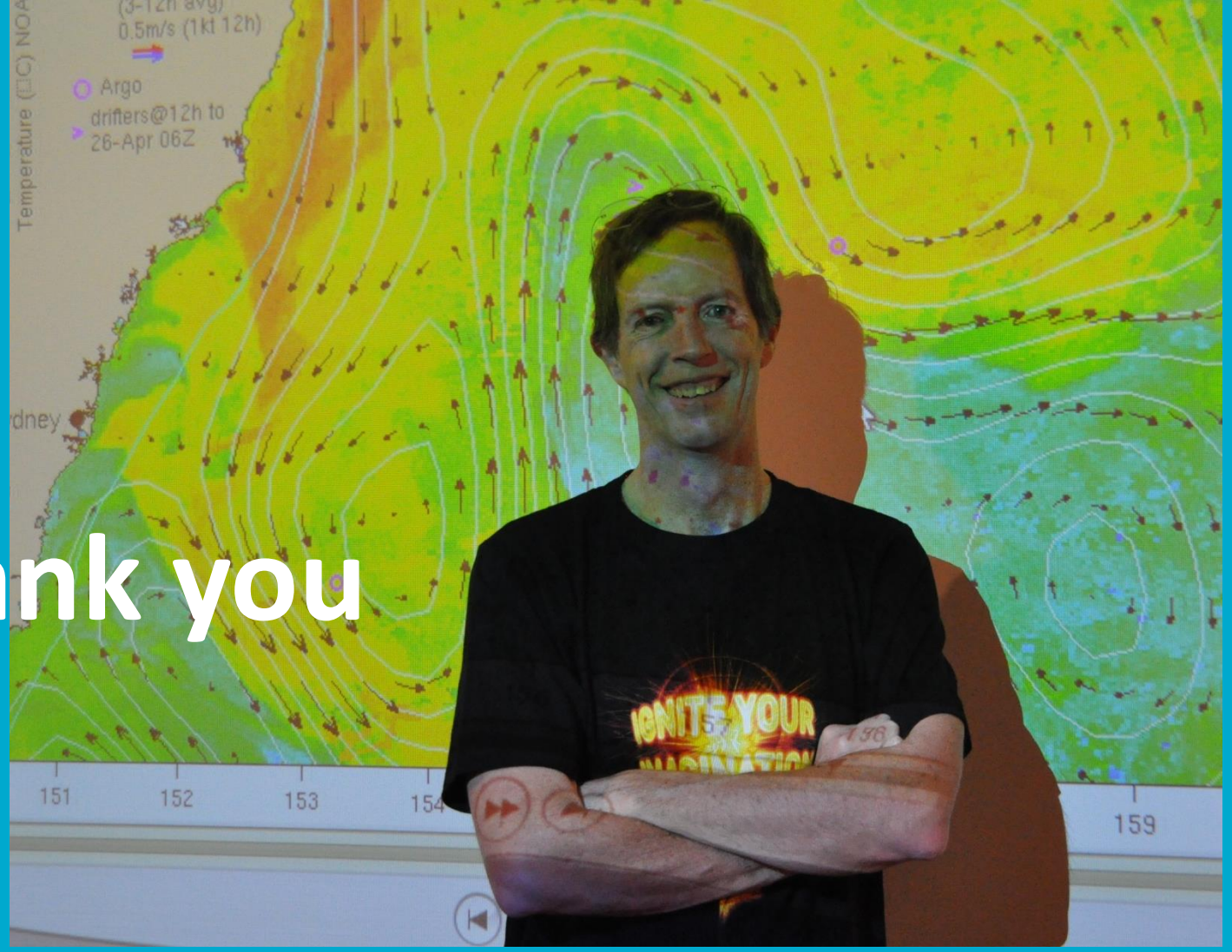
Ridge of high sea level observed by altimetry. Geostrophic flow to west near 35°S in March 2014



Where could it be?

- It ‘should’ have been found. But it wasn’t.
- Impact must have been somewhere along the 7th arc – but how close?
- Many debris items in Madagascar, Mauritius.. - but what about Kenya and Tanzania? Blaine Gibson did not go there. Only Australia was systematically searched.
- The next of kin, and many onlookers, want this solved.
- This work has been exhausting, profoundly disappointing but very rewarding.
- Ocean Infinity are open to continuing the search – but where?

Thank you



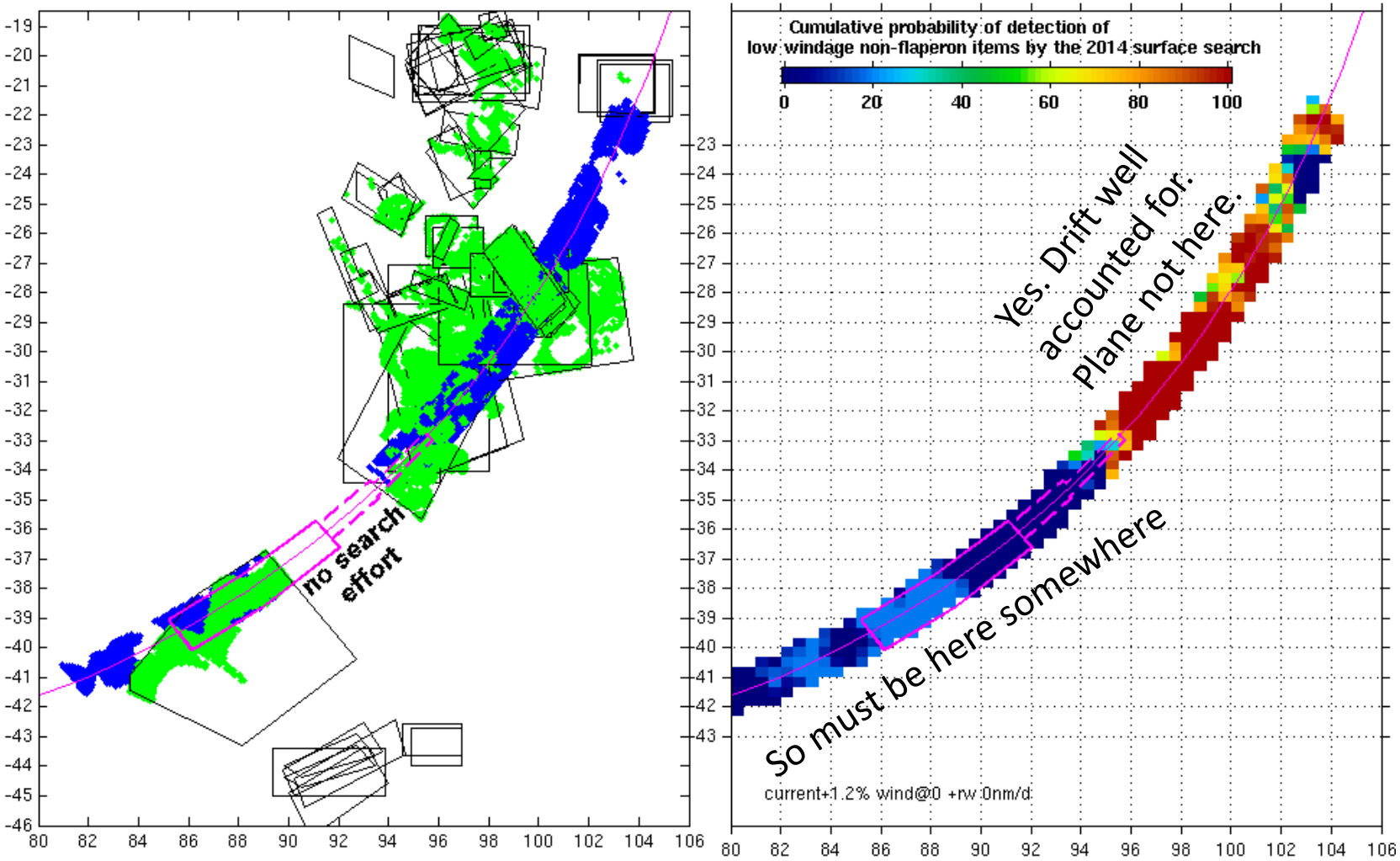
CSIRO and Bureau of Meteorology colleagues

NOAA for 10 drifters

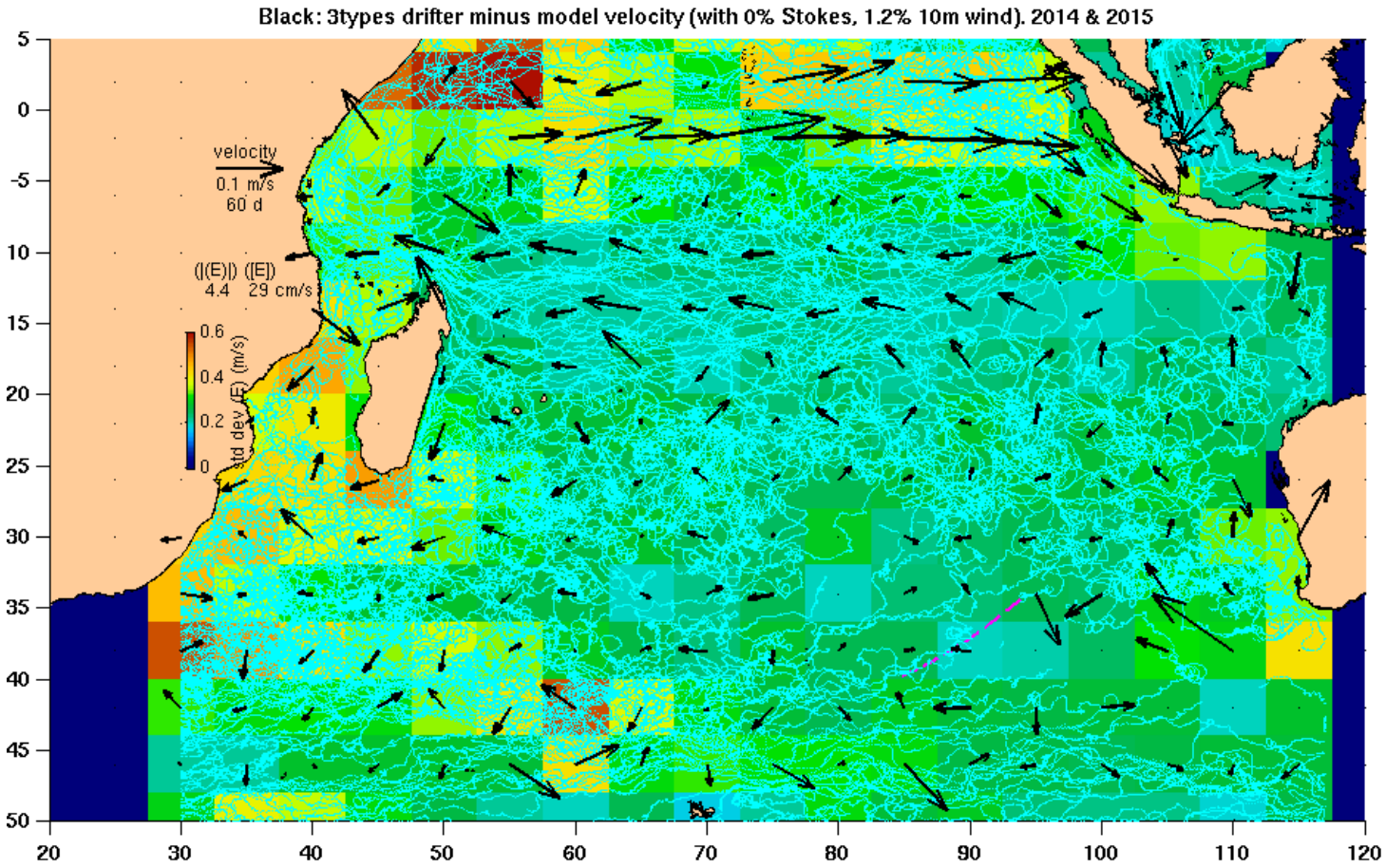
This work was funded by ATSB

DAVID.GRIFFIN@CSIRO.AU WWW.MARINE.CSIRO.AU/~GRIFFIN
www.csiro.au

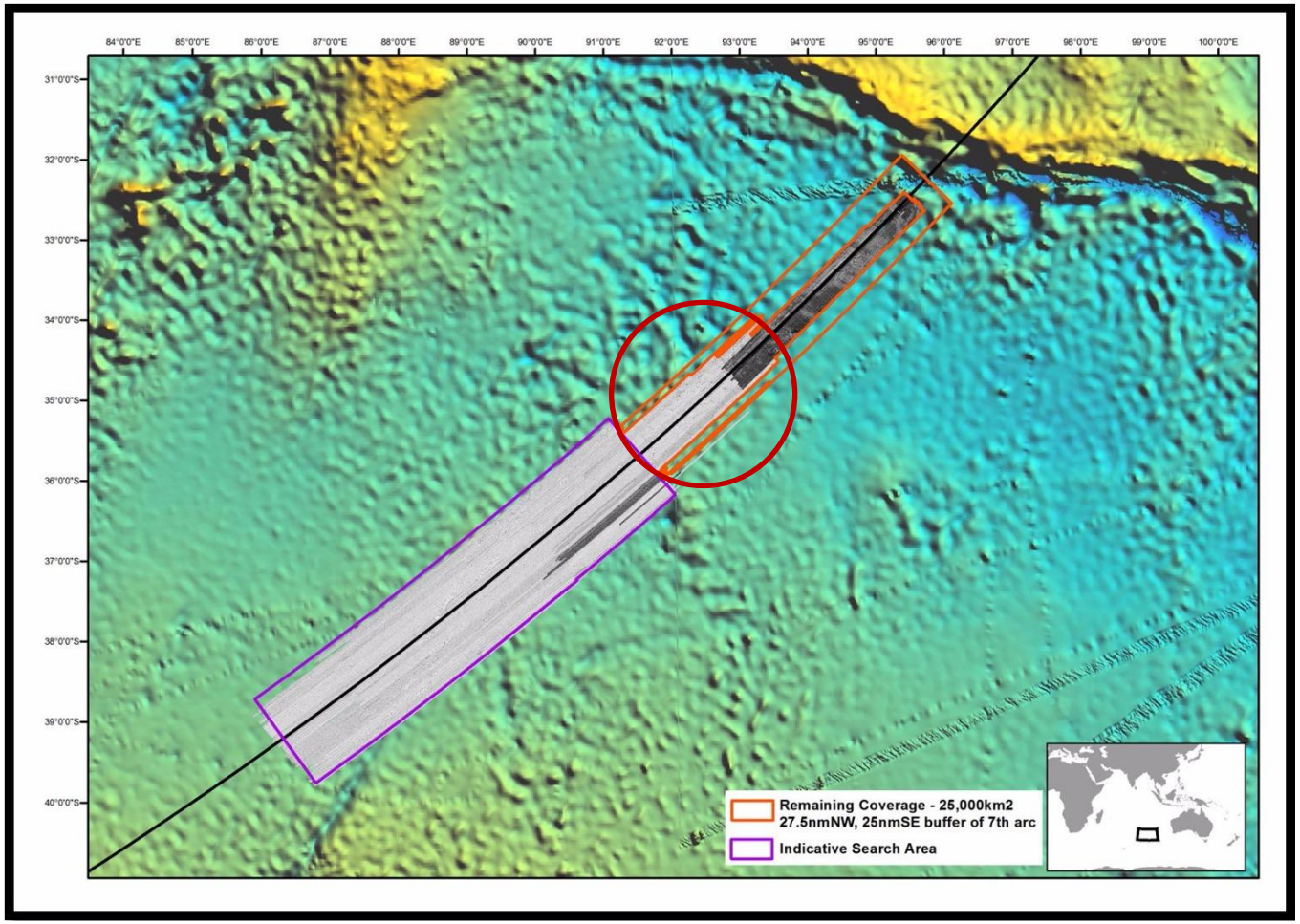
Did the surface search have a chance?



Remaining model bias is small, and removed (where believable) for doing trajectories



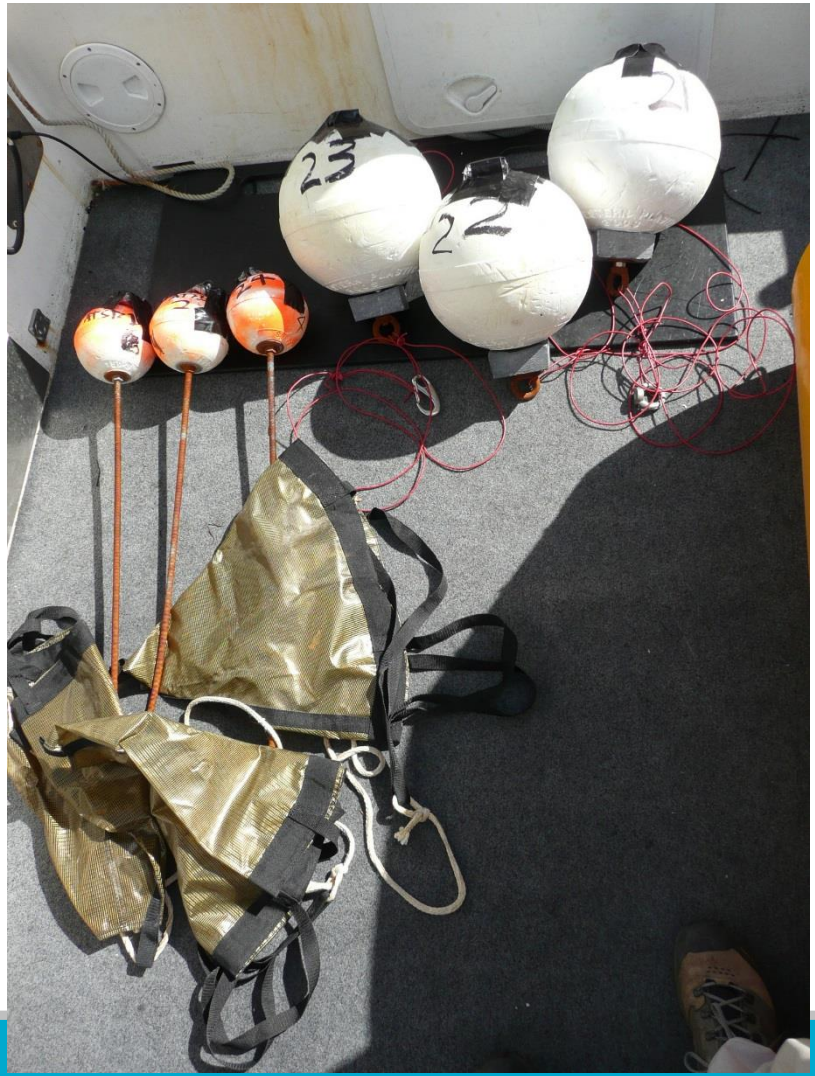
35°S has been searched, but not quite wide enough.



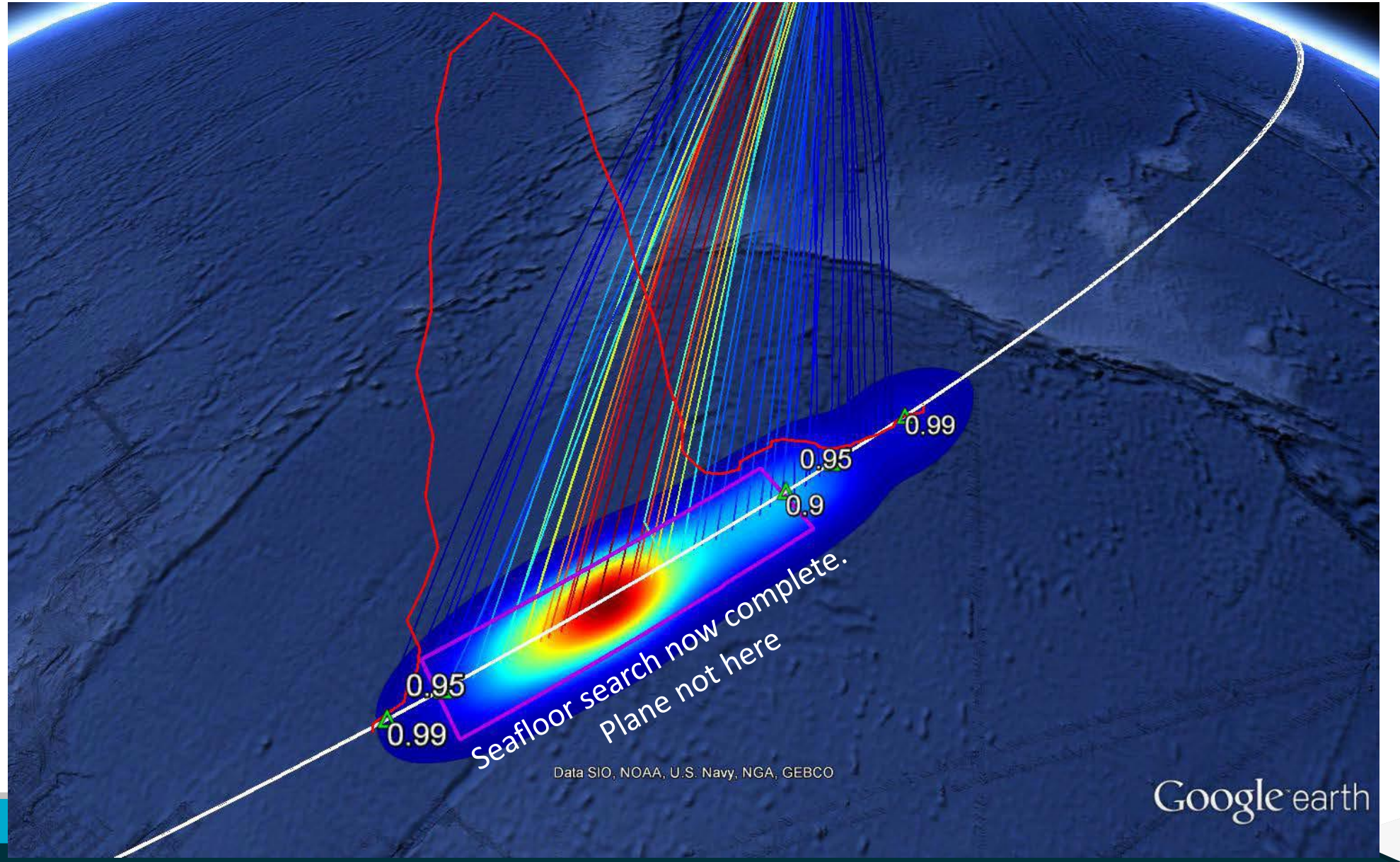
2) Upside down:

15kt pitched it over. Then yaws.

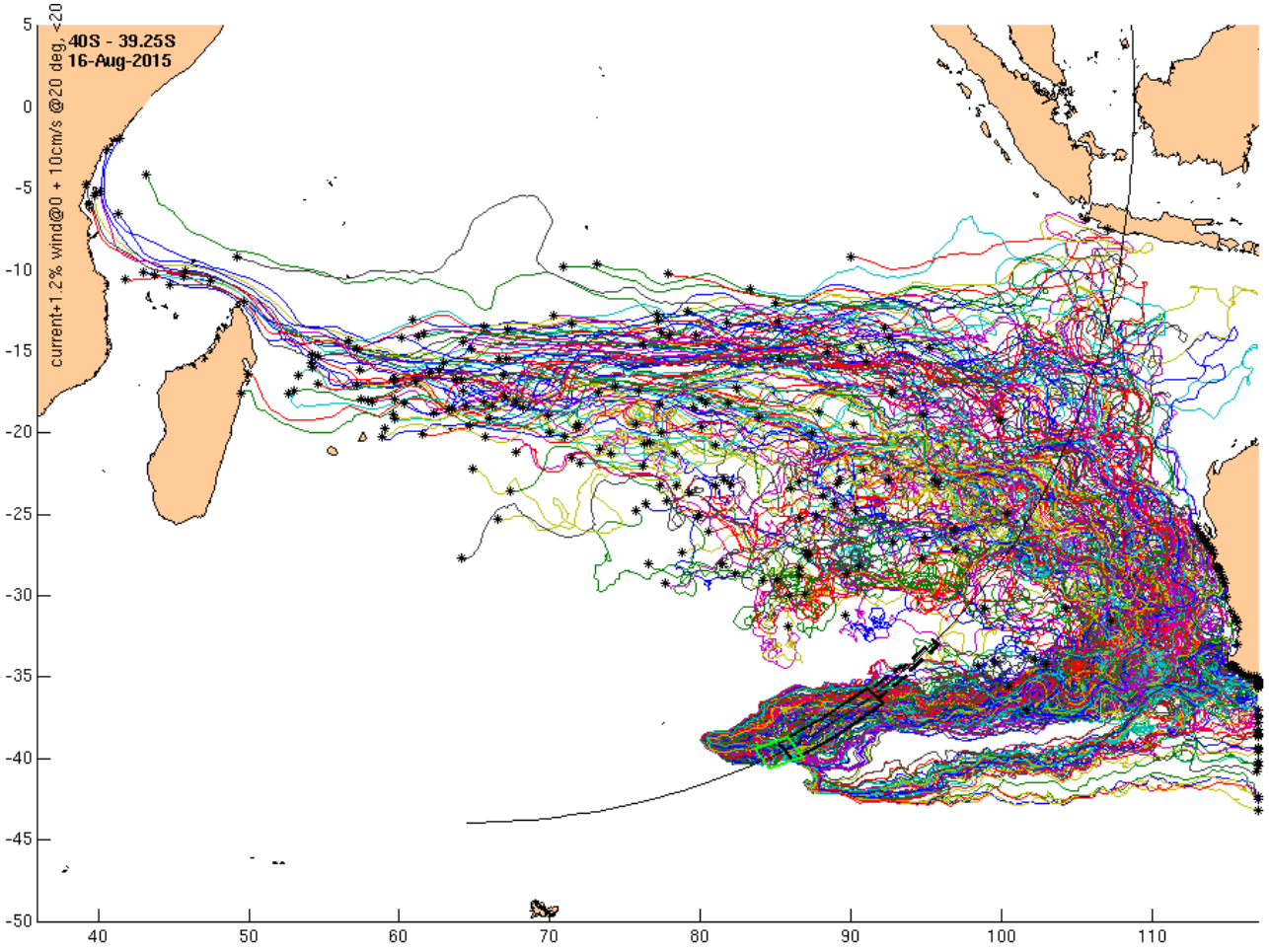
Reference buoys: with drogues to measure current, undrogued to replicate GLD drifters.

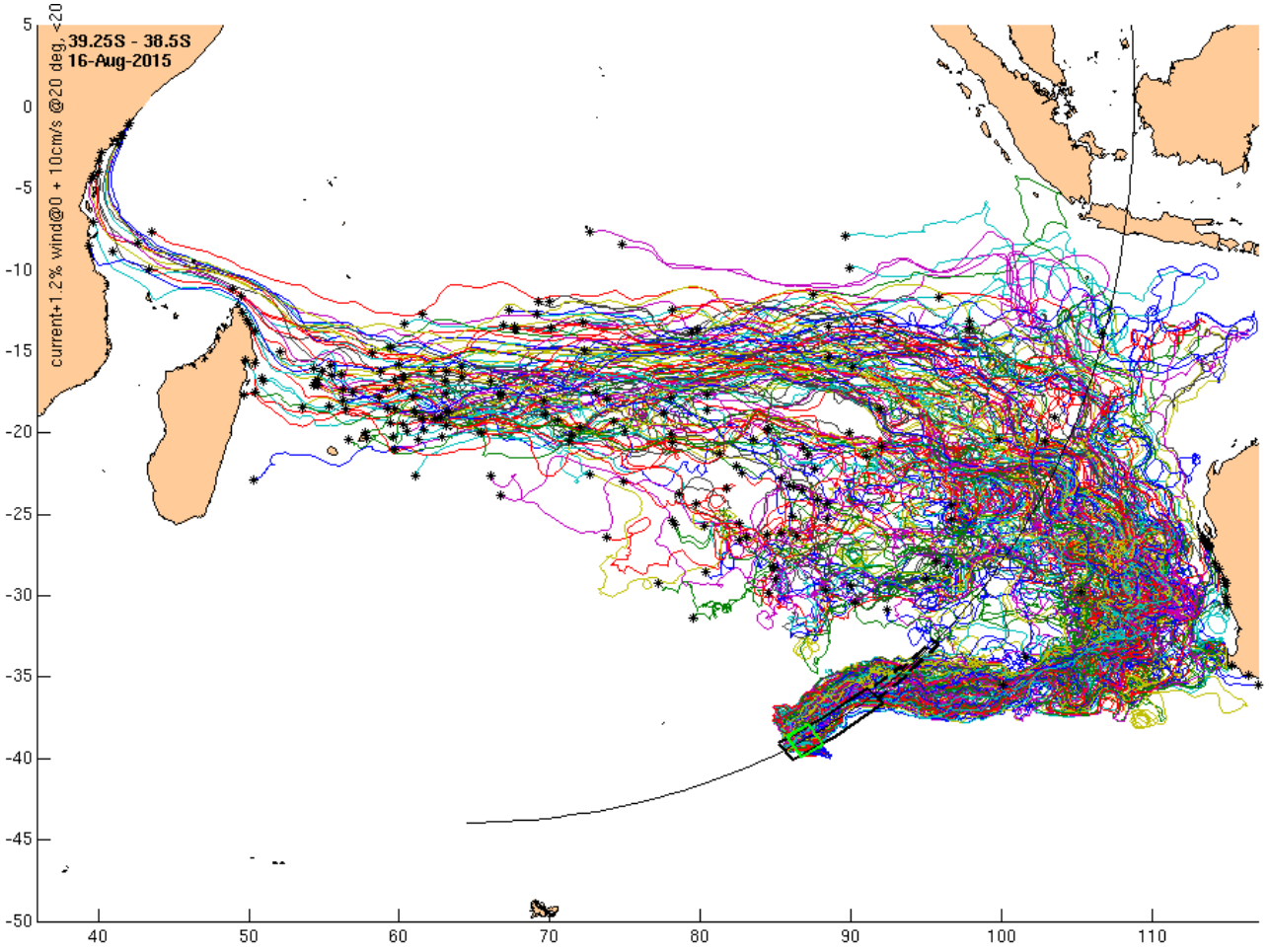


DST Group analysed all feasible flight paths



Southern splashpoints: Australia was a much more likely destination than La Reunion or Africa




39.25S - 38.5S
16-Aug-2015
current+1.2% wind@0 + 10cm/s @20 deg, <20
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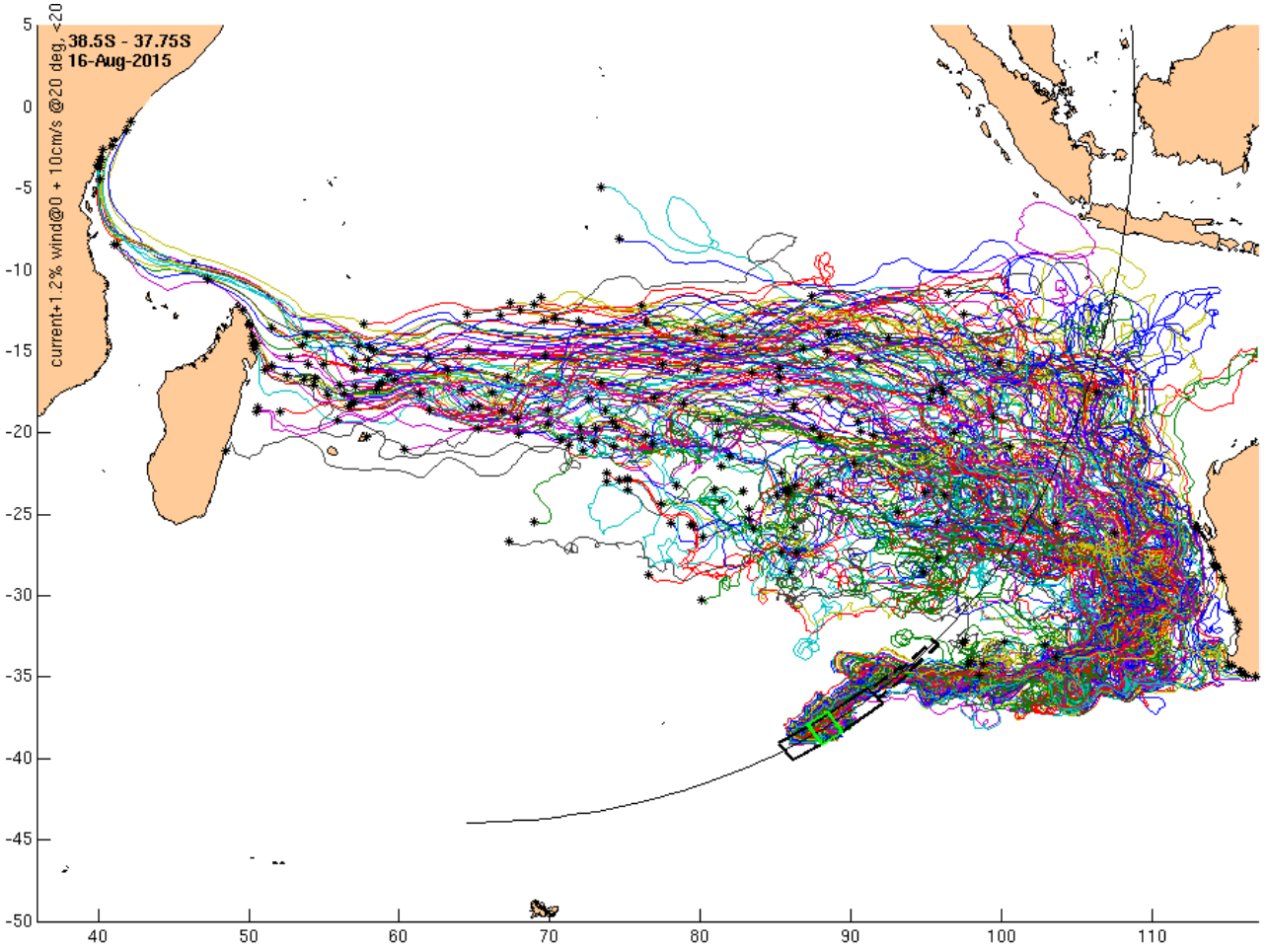
38.5S - 37.75S
16-Aug-2015
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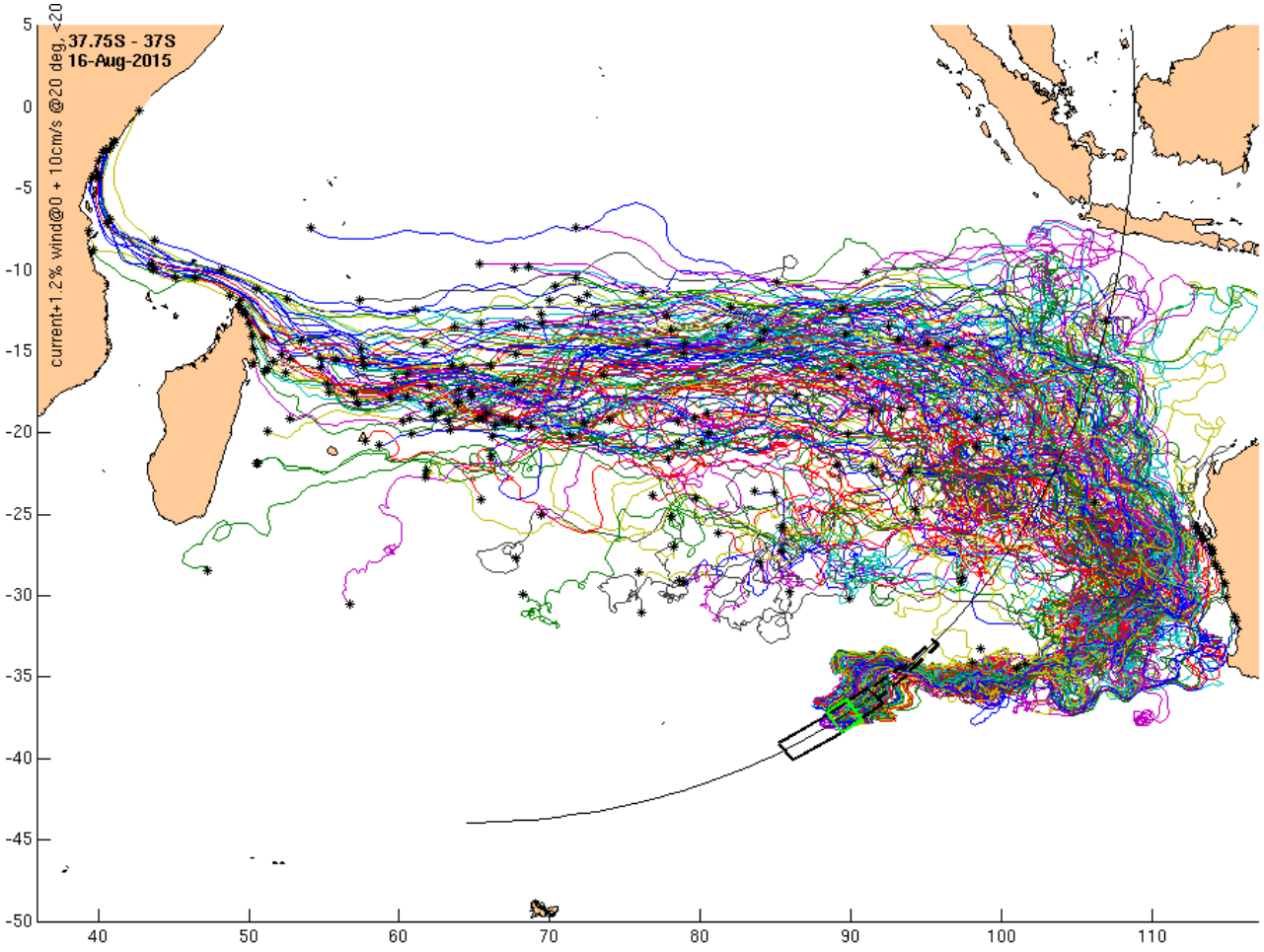
37.75S - 37S
16-Aug-2015
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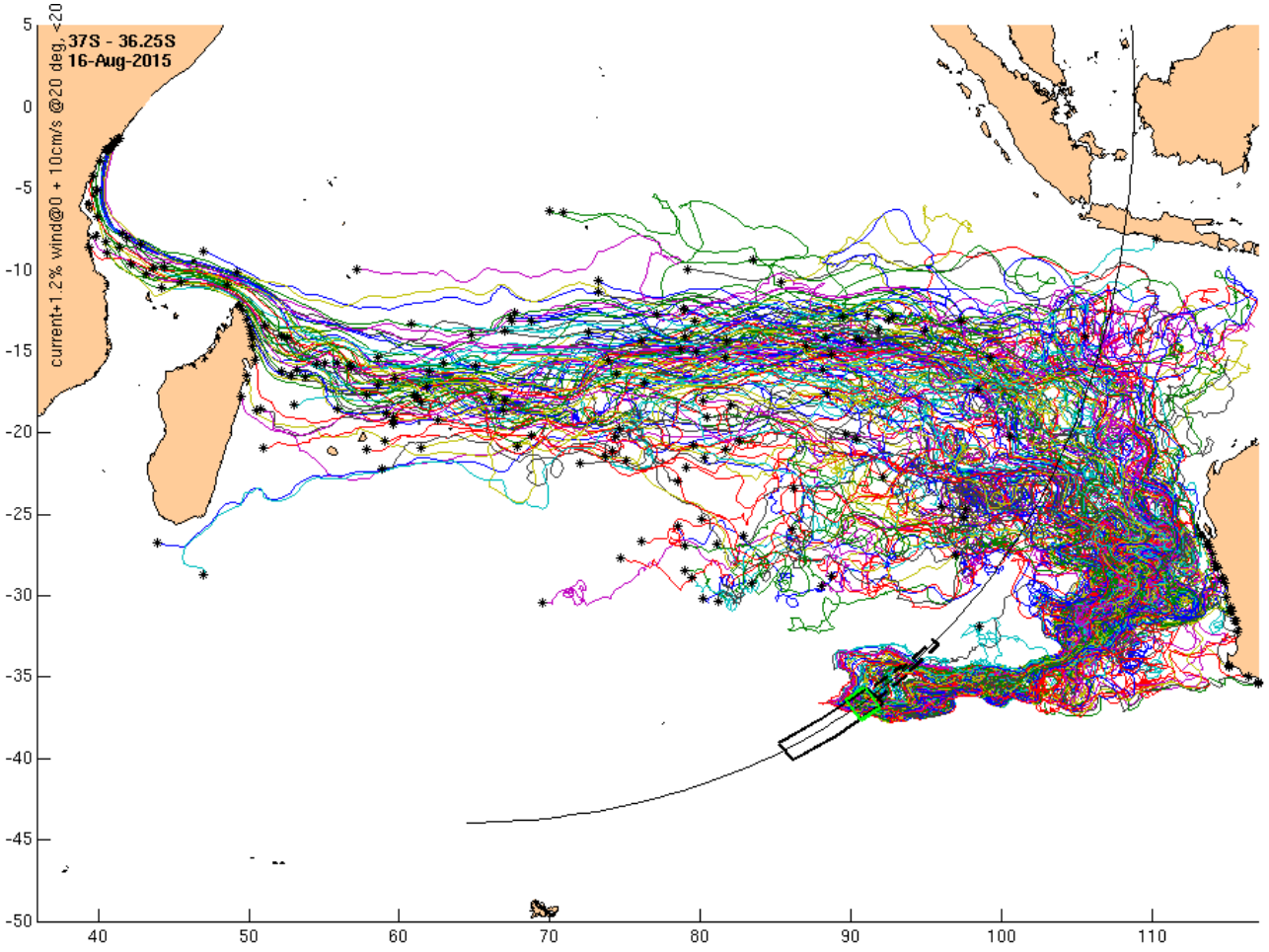
37S - 36.25S
16-Aug-2015
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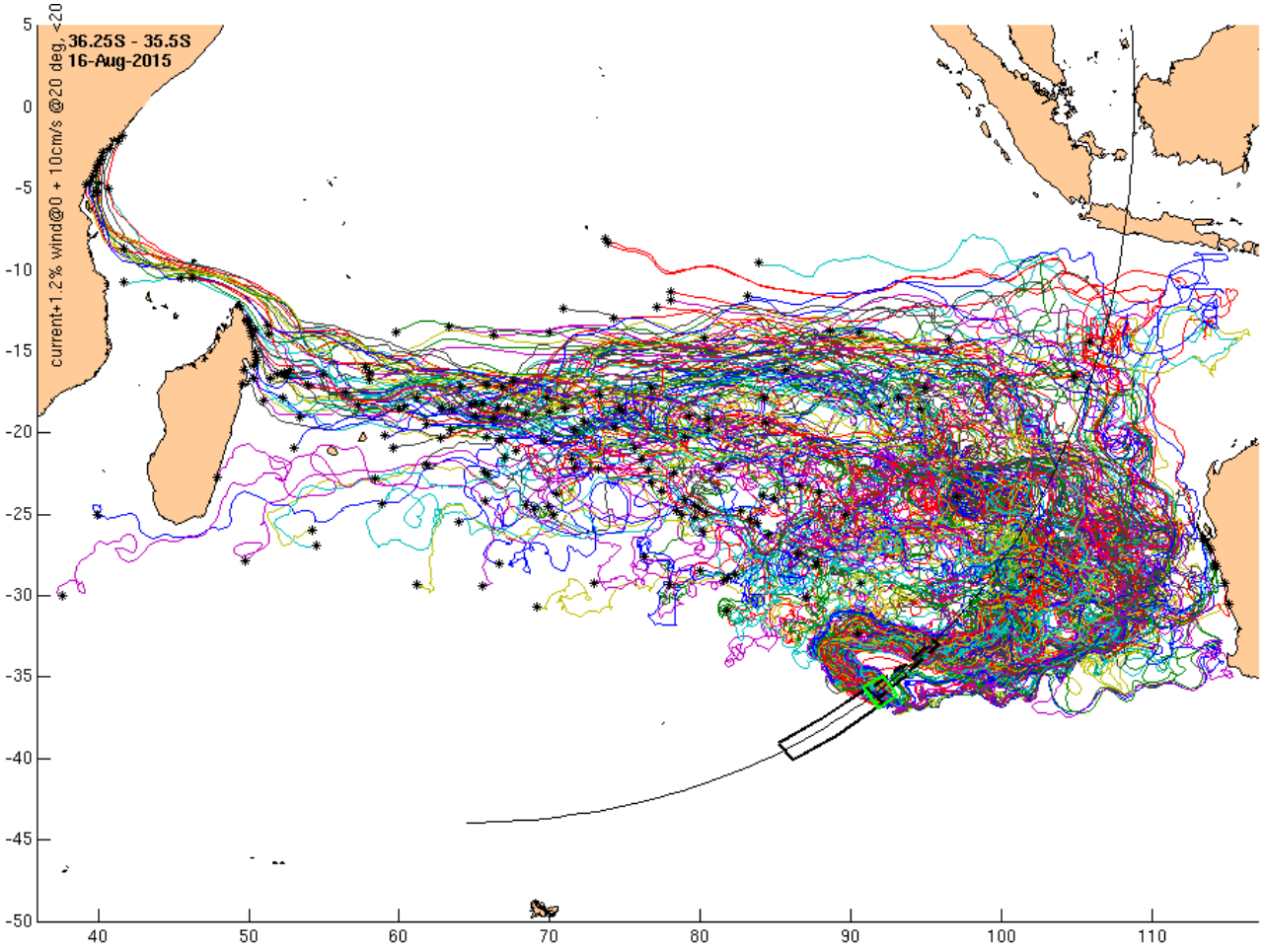
36.25S - 35.5S
16-Aug-2015
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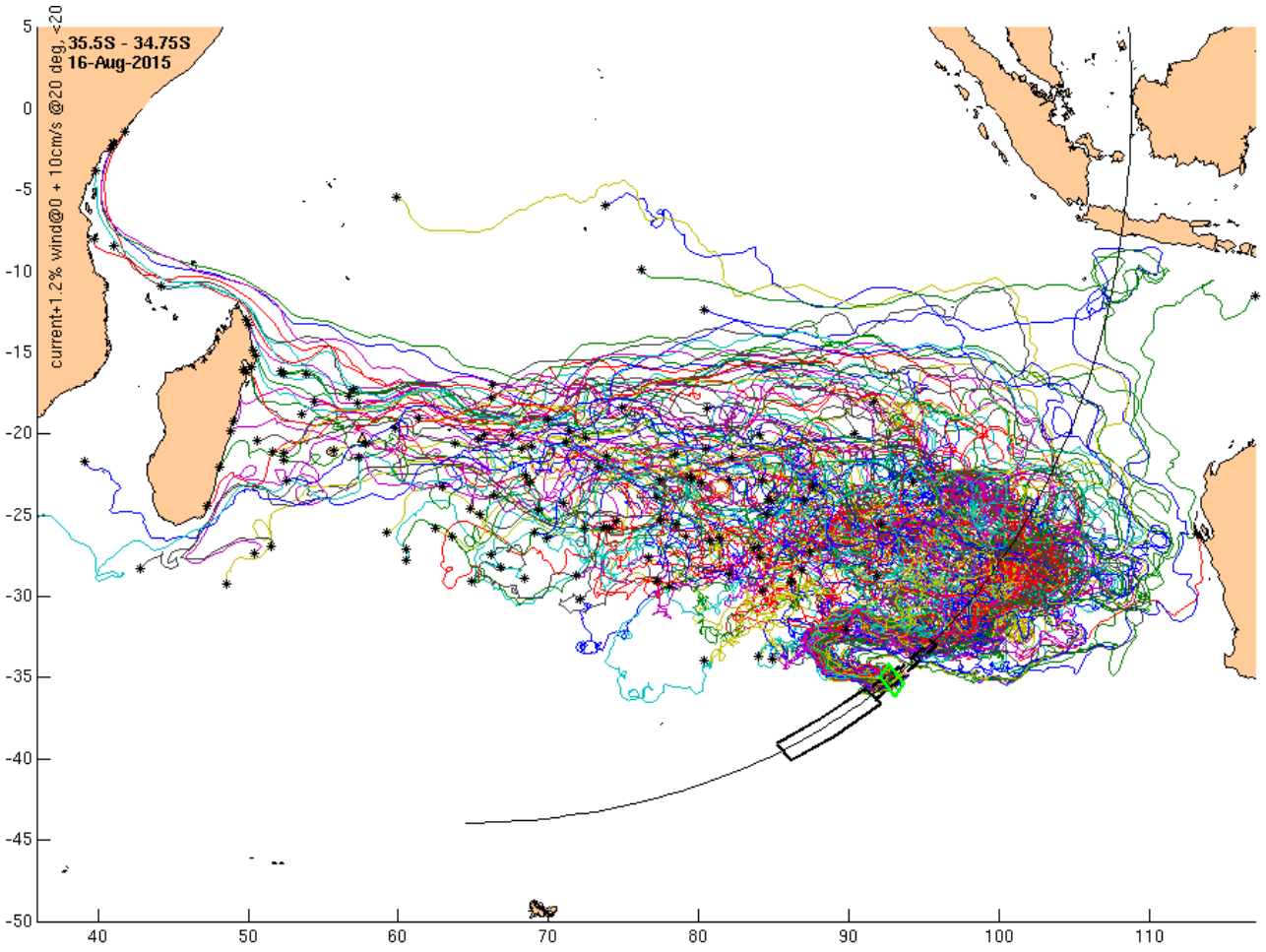
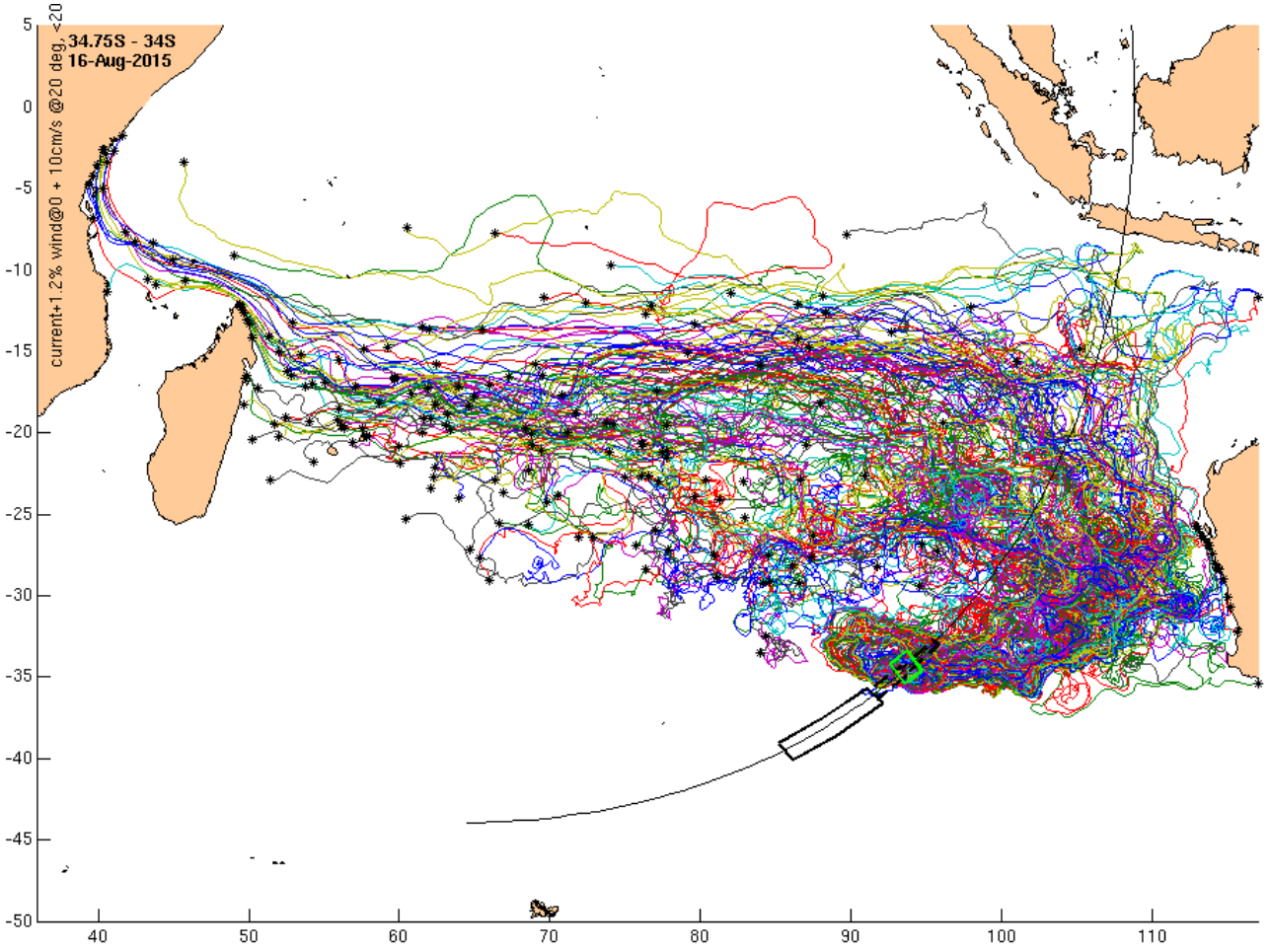
35S: No trajectories to Aust. Plenty to La Reunion.




34.75S - 34S
16-Aug-2015
current+1.2% wind@0 + 10cm/s @20 deg, <20
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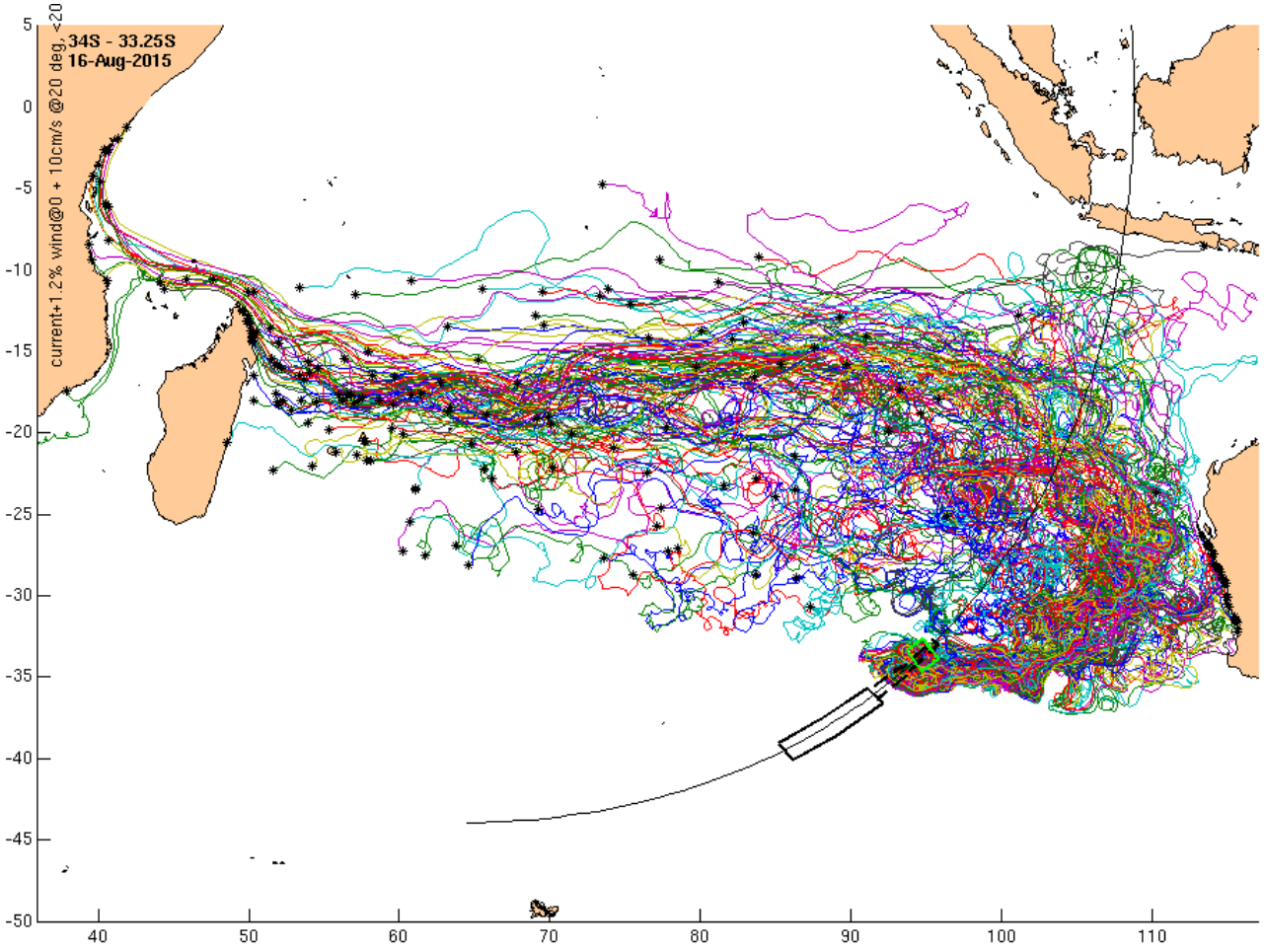
34S - 33.25S
16-Aug-2015
current+1.2% wind@0 + 10cm/s @20 deg, <20
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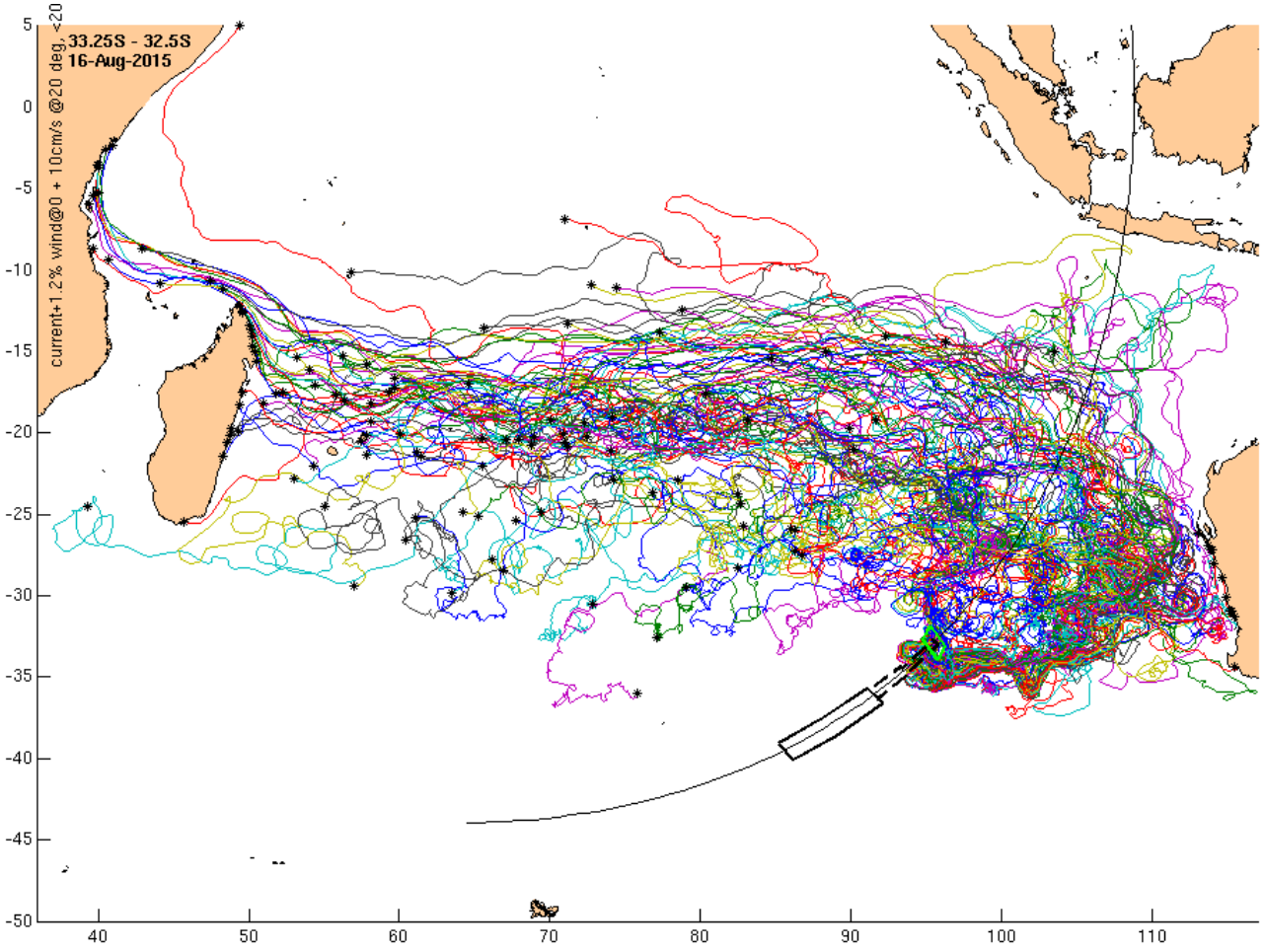
33.25S - 32.5S
16-Aug-2015
current+1.2% wind@0 + 10cm/s @20 deg, <20
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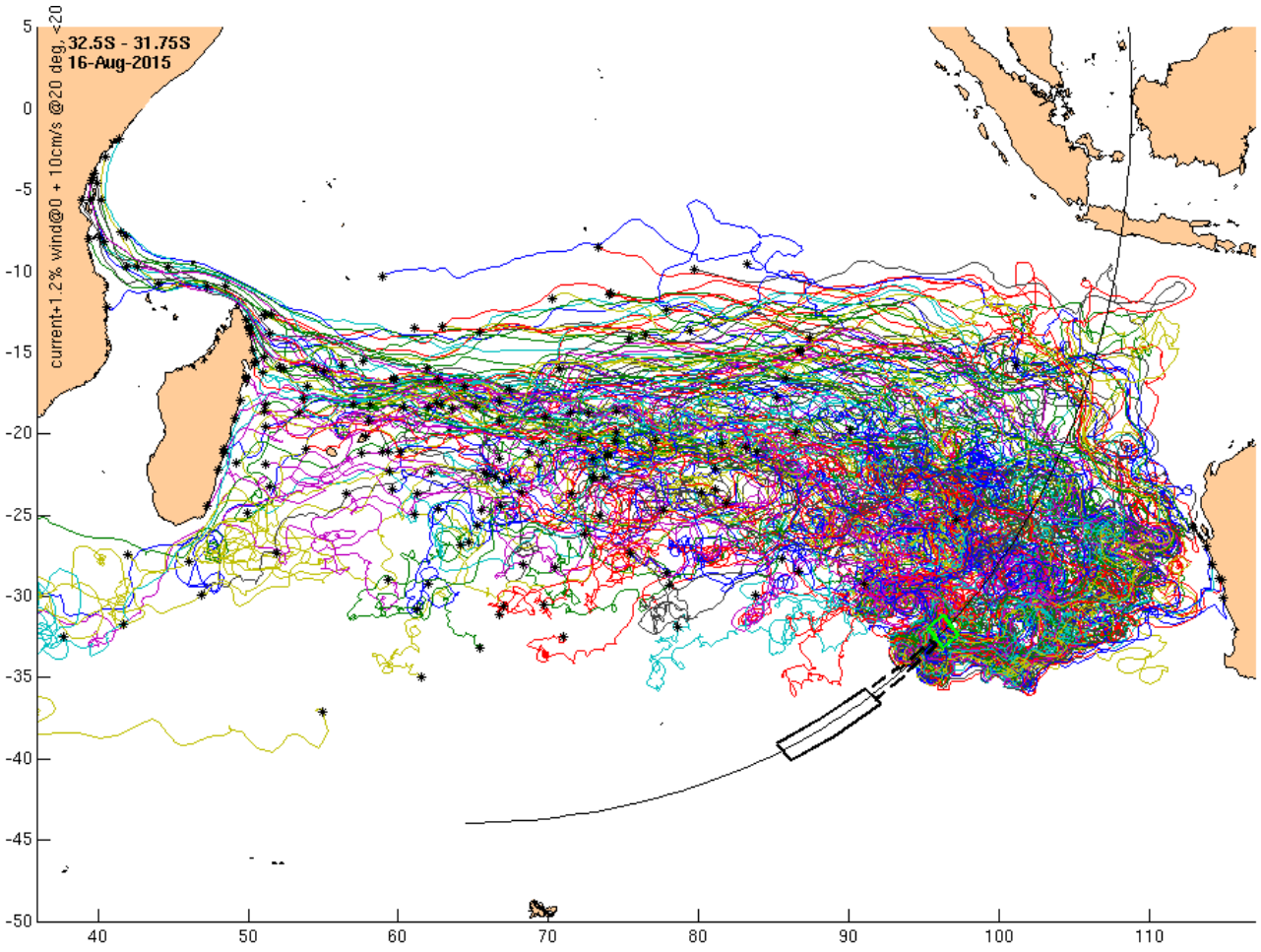
32.5S - 31.75S
16-Aug-2015
current+1.2% wind@0 + 10cm/s @20 deg, <20
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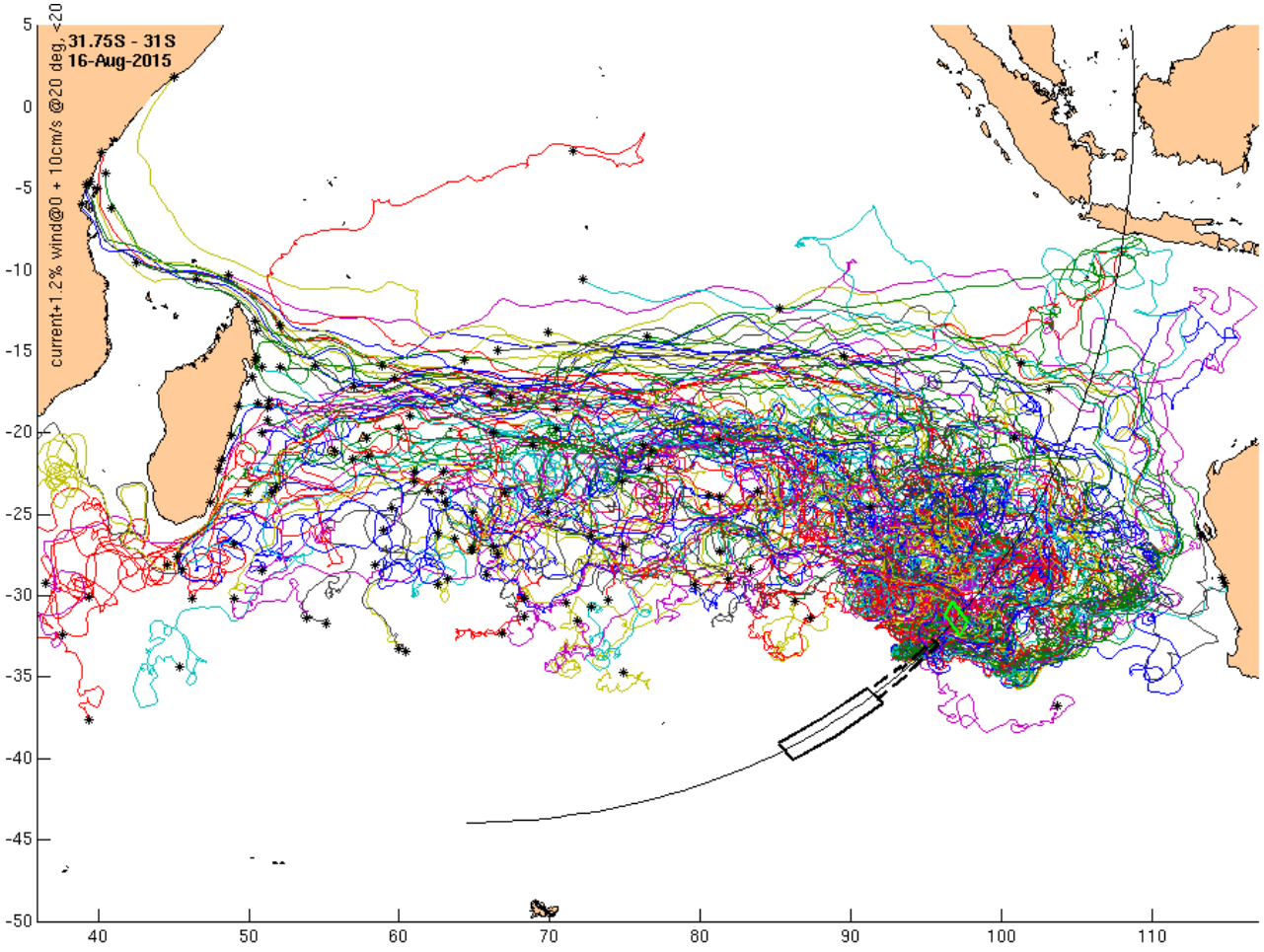
31.75S - 31S
16-Aug-2015
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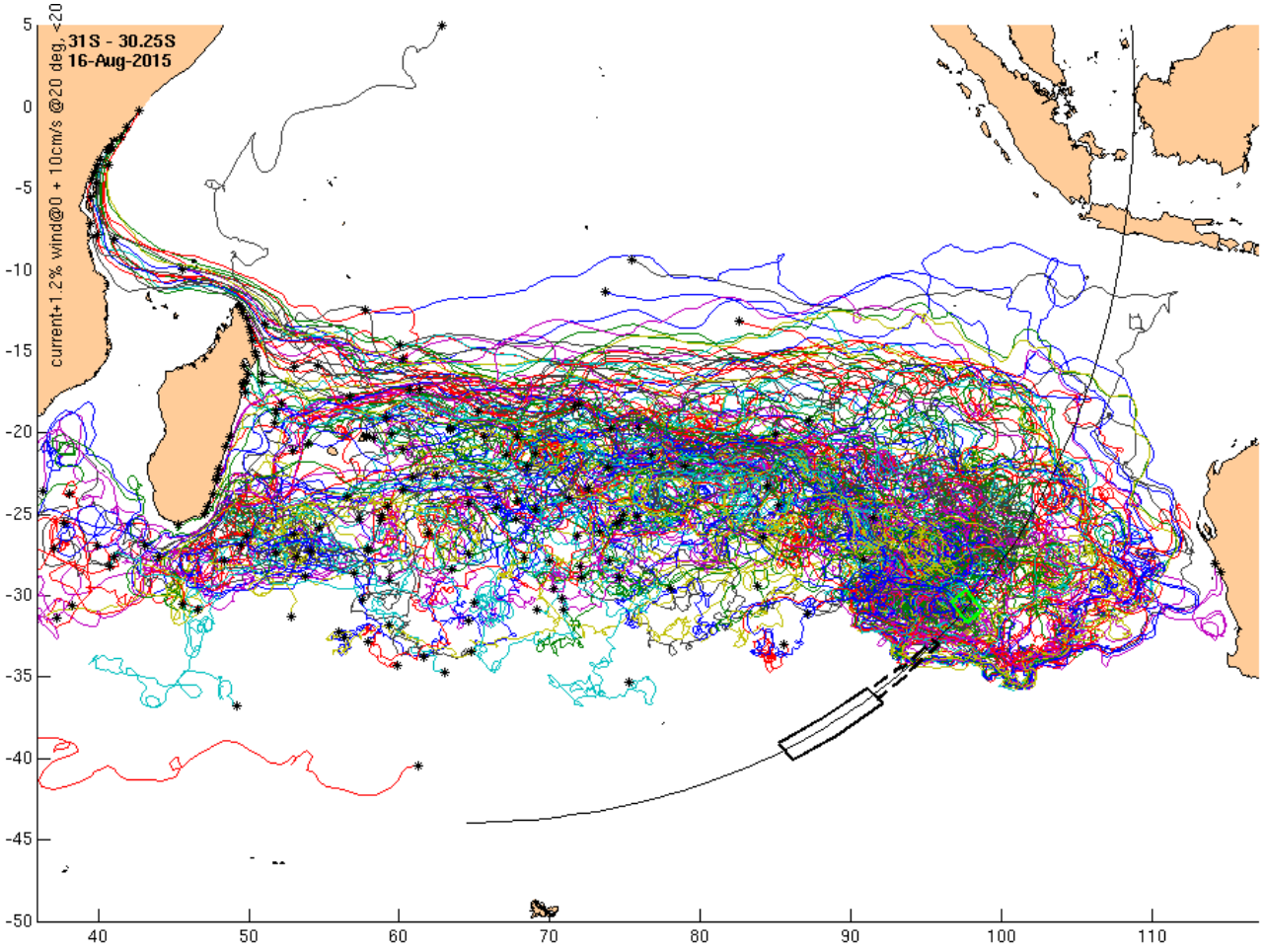
31S - 30.25S
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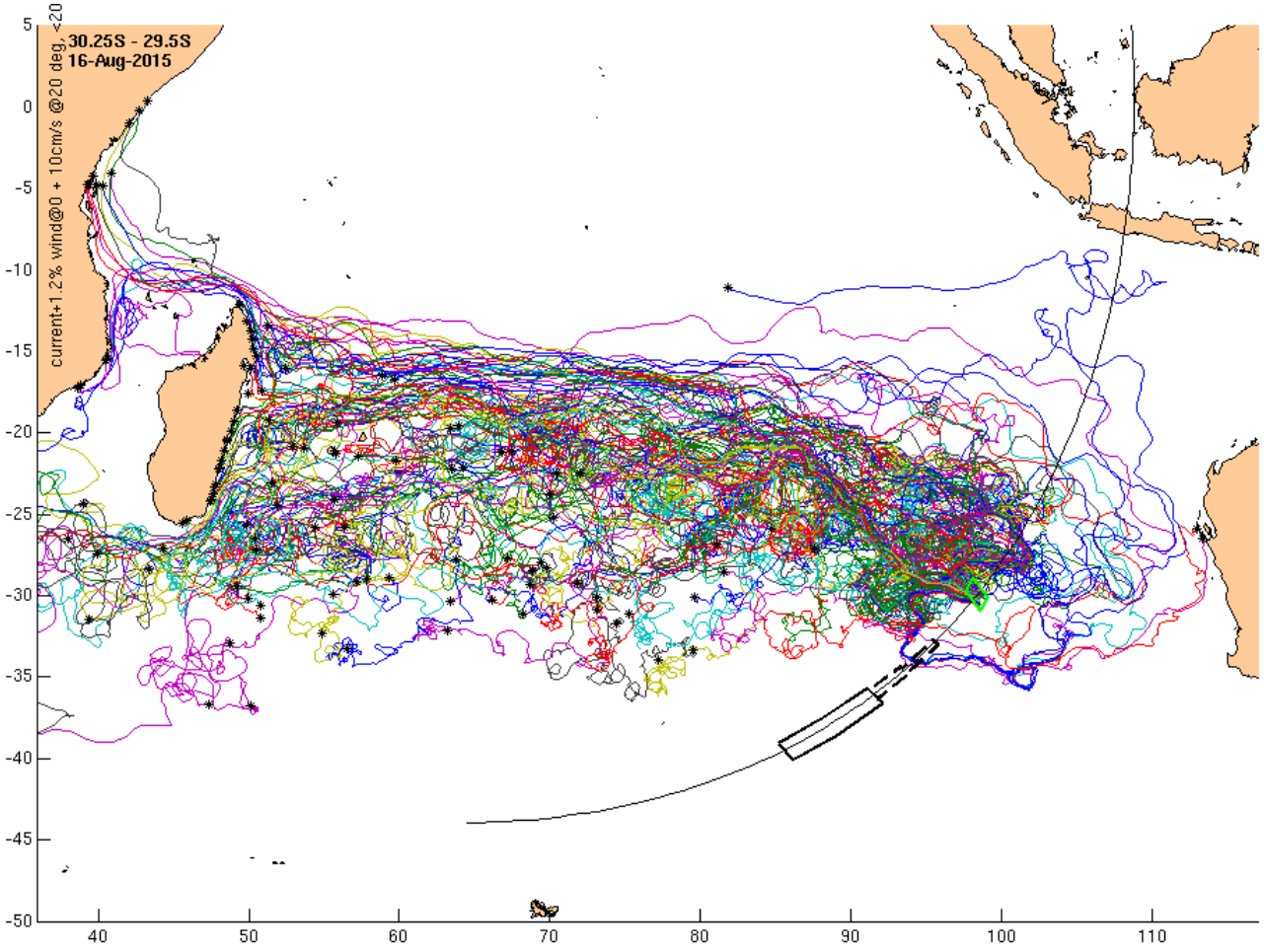
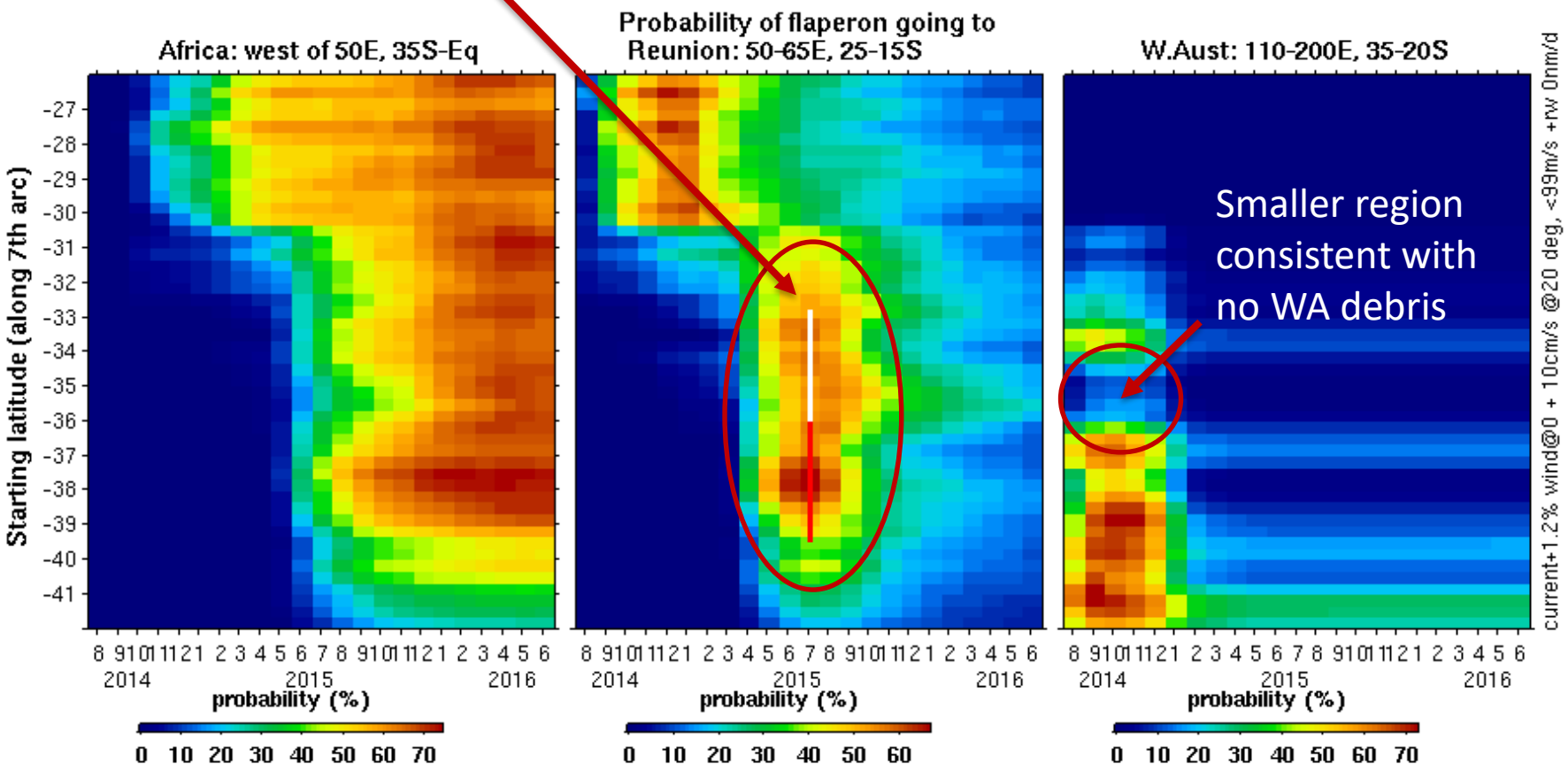
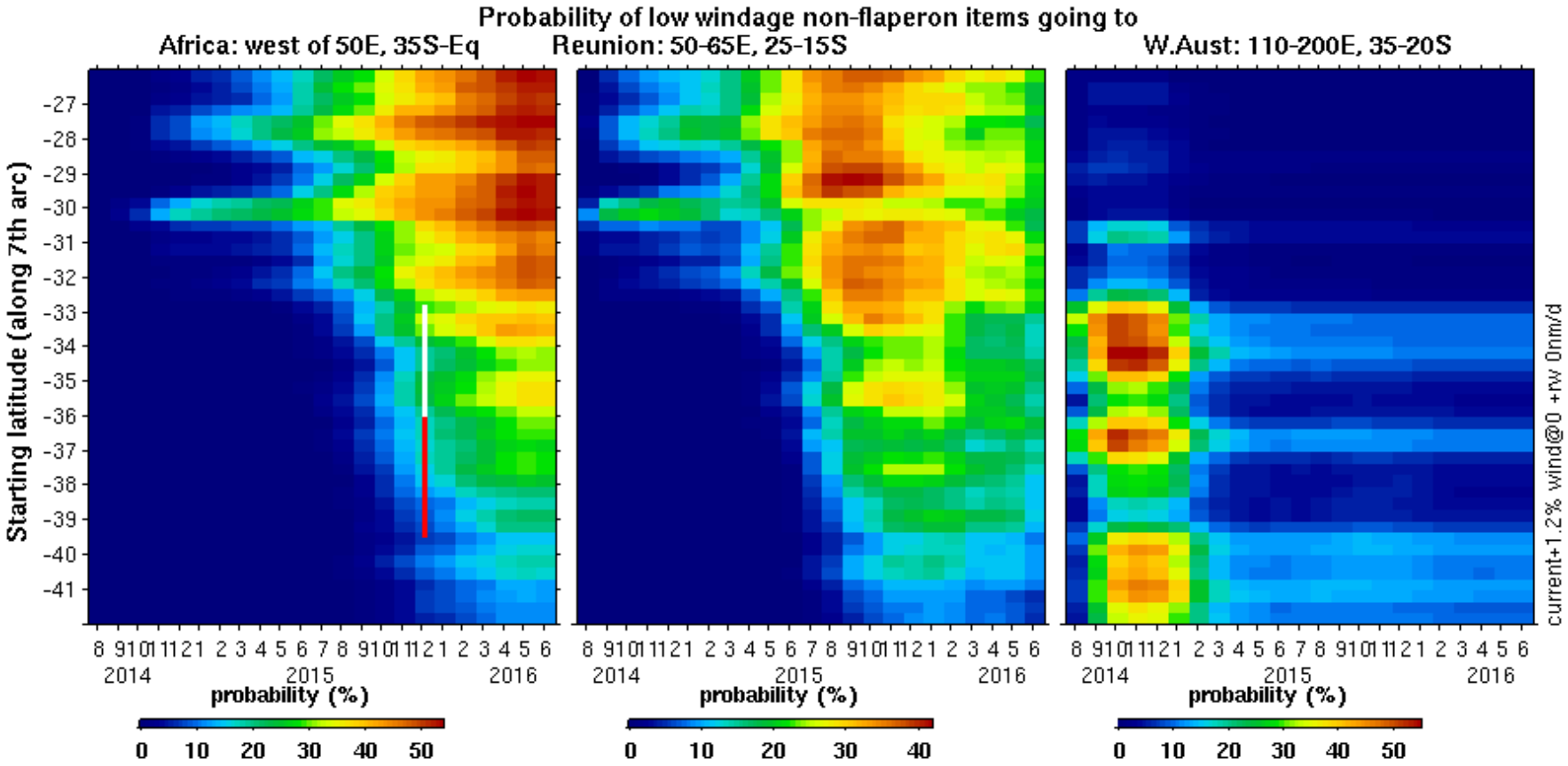
Northern splashpoints: arrival at Africa more likely than La Reunion, and before Aug 2015.



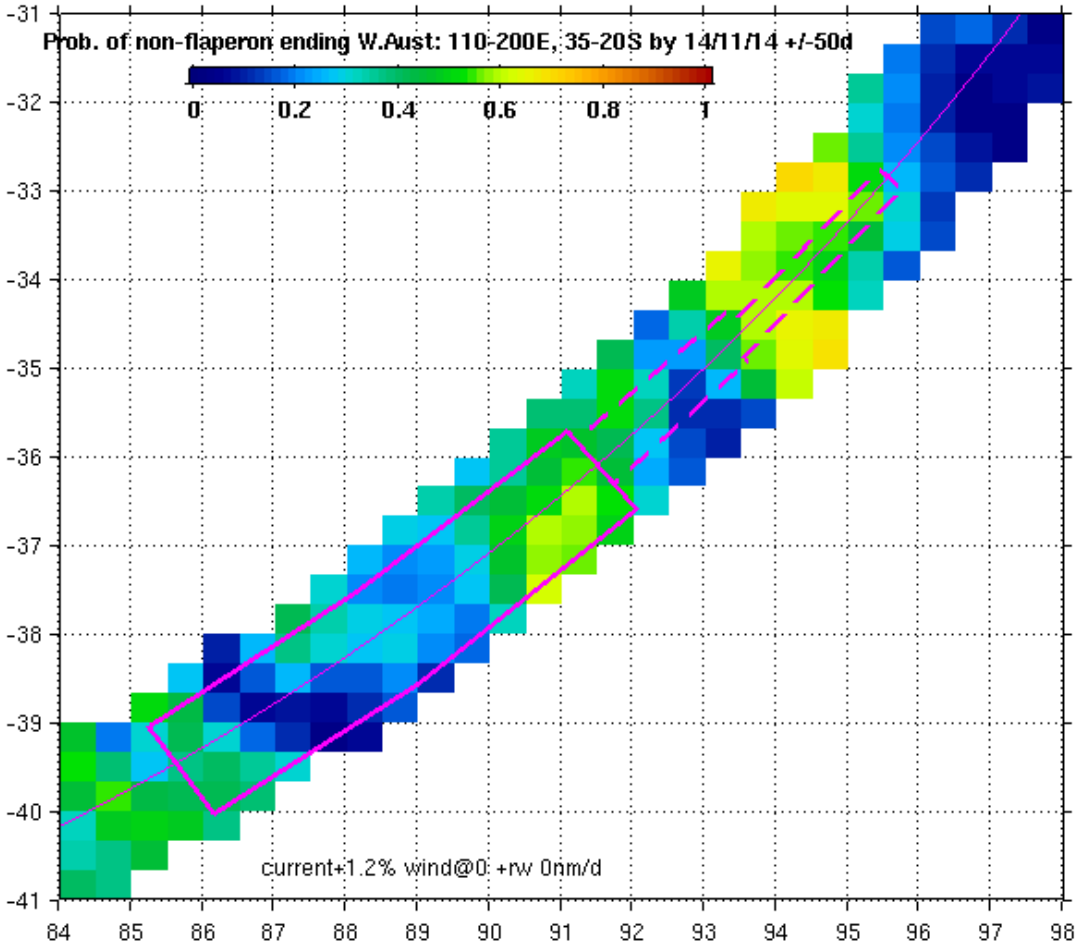
Mid 2015 is flaperon's most likely arrival time at Reunion. But doesn't say where crash occurred.



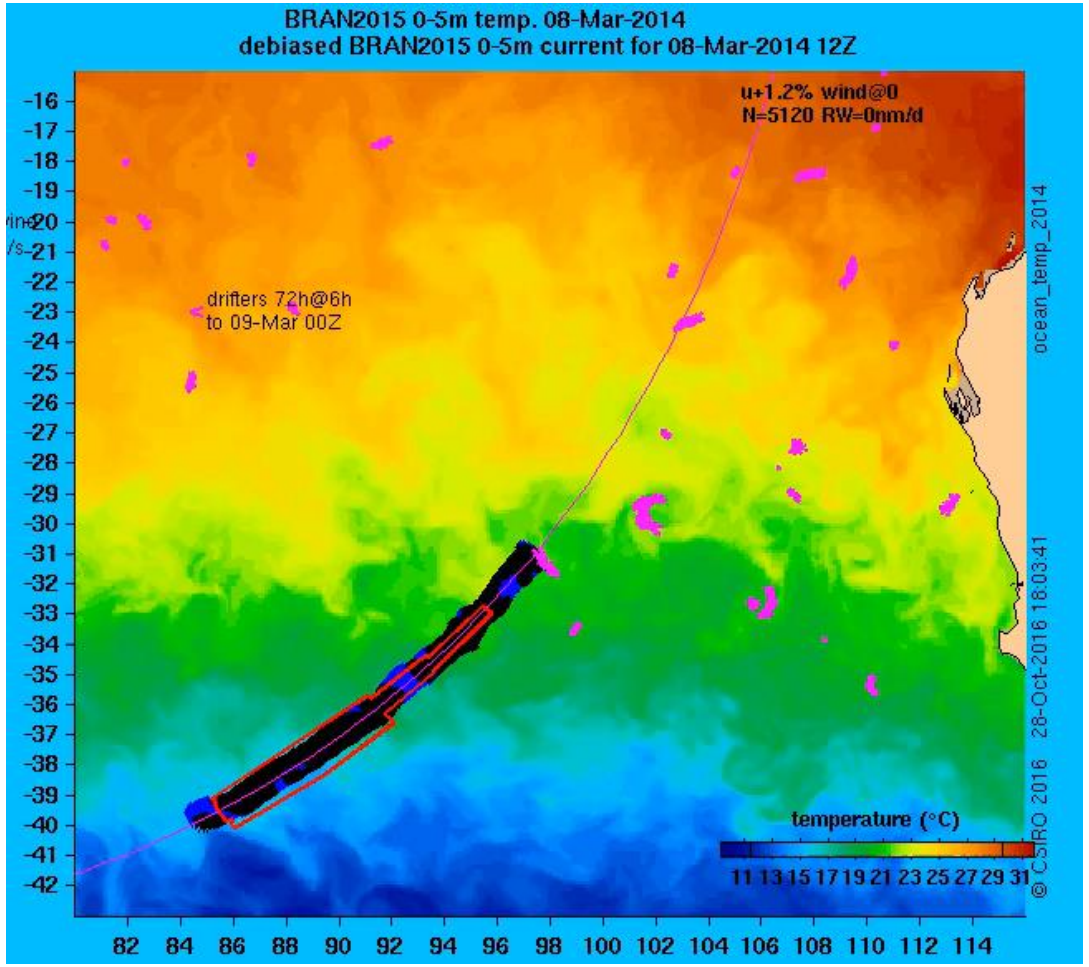
Non-flaperon items: Dec 2015 onwards



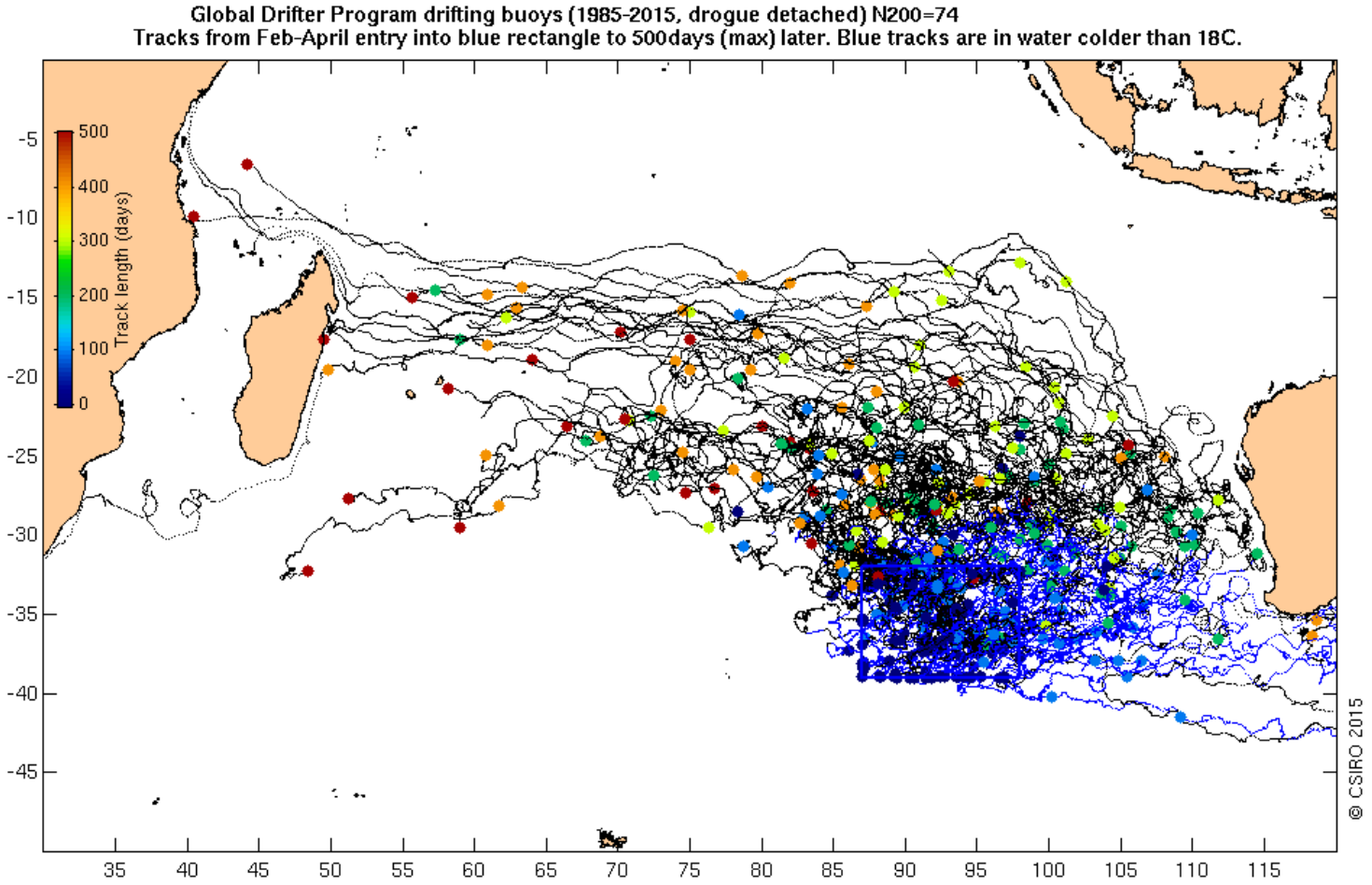
Non-arrival of debris at Aust is very informative



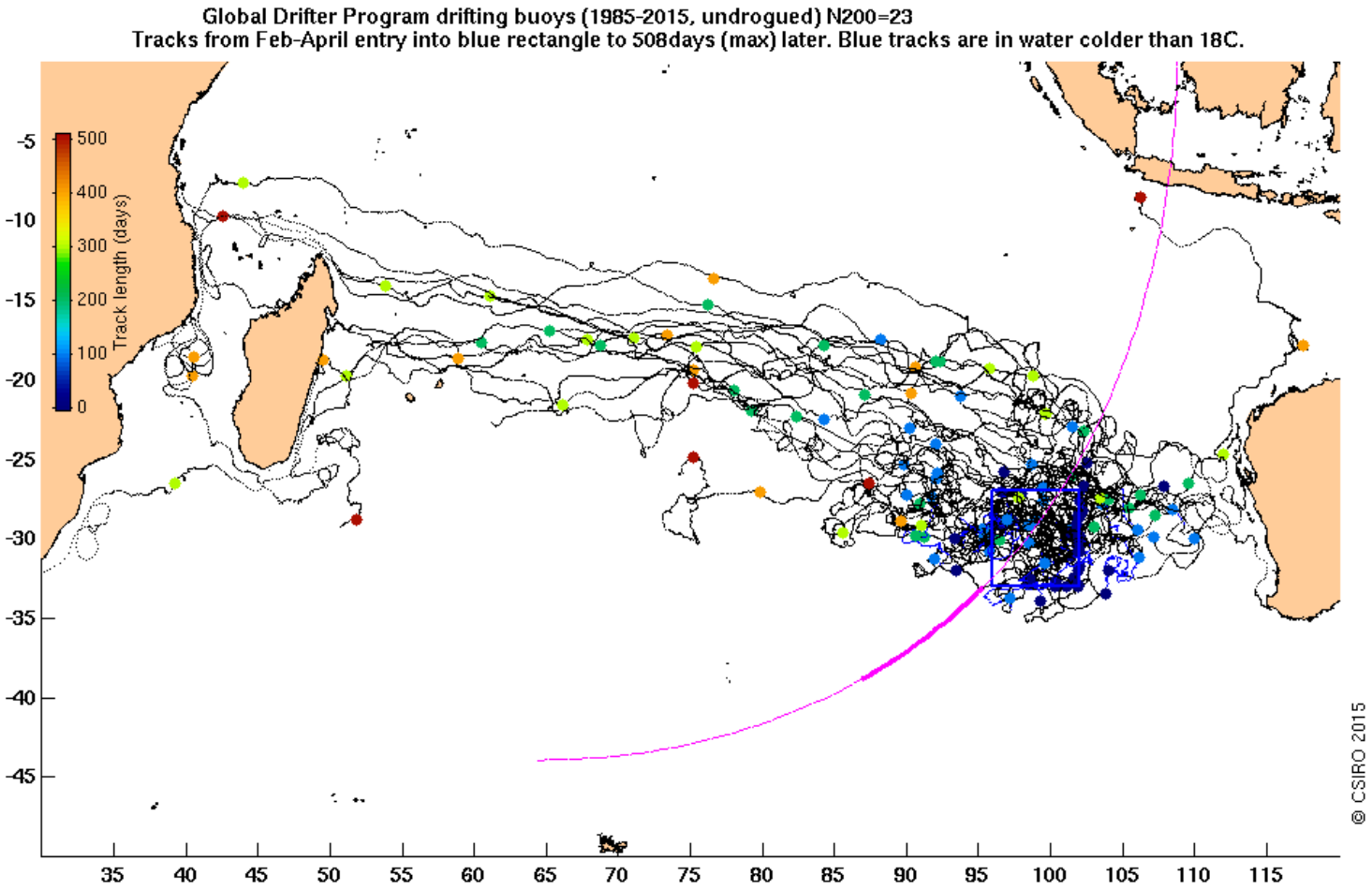
Can the model really simulate all those eddies?
Yes, thanks to satellites. Proof: watch the drifters.



Undrogued drifters take 500d to get to La Reunion from near the search area



But much less from farther north



Drifters south of the search area go east.