SURFACE CURRENT WORKING GROUP

Surface Current – Working Group

At the inaugural FOO meeting in July 2015, a number of priority areas emerged that would benefit from further dialogue to ensure effective, ongoing communications and cooperation.

Working groups were formed for the two highest priorities

One being the surface current Working Group which first convened in Feb 2016

Has convened every 6 to 8 weeks since then

Membership

The group participants have consisted of attendees from the FOO 2015 meeting that had a particular interest in this area.

Initially determined to keep the group a manageable size and consisting of a mixture of data providers, specialists and end users.

‘Current’ Members

- AIMS
- AMSA
- RPS APASA
- Bureau of Met
- CSIRO
- Defence
- Shell
- UTAS/IMOS
- UWA

What is a ‘surface current’??

No standard definition – a ‘surface current’ can mean different things for different people.
Modellers: layer thickness of 10cm through to 10m.
Observationalists: measured velocities at depths from 1cm through to 15m

US has a standard 1m layer – developed through time and user requirements

Important from Search and Rescue as well as pollution and other user perspectives

Recommendation and position statement

Depth Averaging

Near-surface shear can be significant so the FOO recommends that the term ‘surface’ be phased out in preference for a terminology that is more explicit about vertical averaging.

1m vertical averaging is the layer most applicable to SAR so when developing future models the recommendation is that an estimate of the 1m average is provided (in addition to the native grid).

Currently Australia’s operational model has a surface layer 5m thick so the un-modelled shear needs to be added – either by the provider or the user (but not both!).

Recommendation and position statement

Time Averaging

Modelled and observed velocities are always an average over a period of time.
3h in the case of Australia's OceanMAPS system

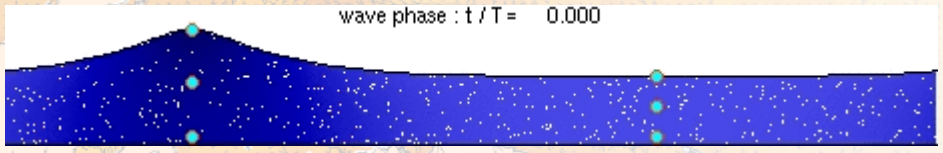
However operational users typically require an estimate at shorter intervals than that so the effect of

- Tide
- Inertial oscillations and
- Atmospherically-forced motions

are represented.

FOO recommends that operational forecasts be available at hourly intervals with tides included

Stokes Drift



Items drifting in the surface 1m are influenced by Stokes Drift, which can be several cm/s and thus relatively important.

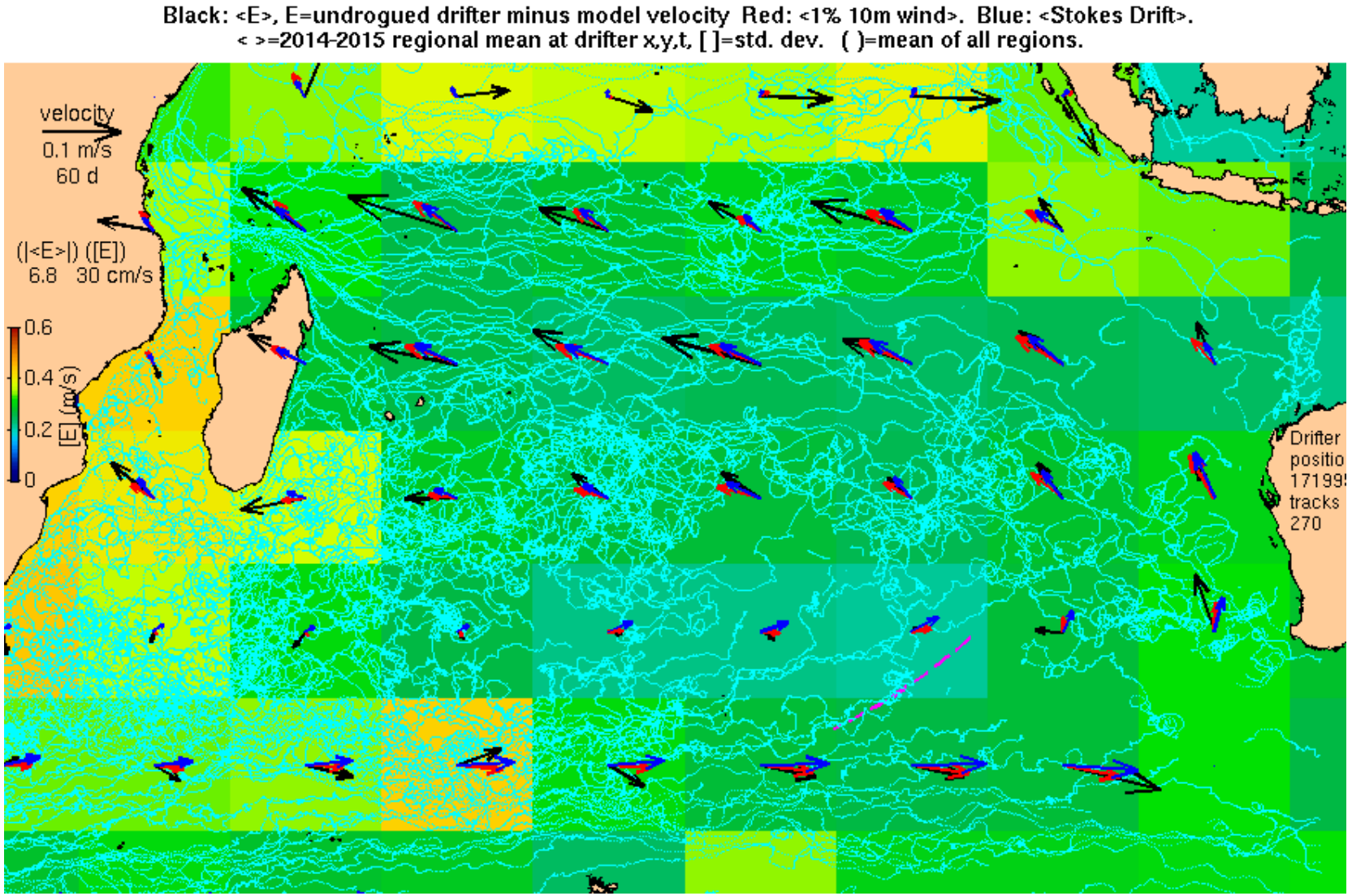
Stokes Drift is mostly due to short-period waves , so don't try to estimate it from Hsig, Tsig, Dsig.

Ideally, estimate it from the full directional wave spectrum (WW3 does this for you), and include this as a forcing term in the hydrodynamic model (via the Stokes-Coriolis term) so the 'anti-Stokes' response is included.

Otherwise, add about 1.2% of the wind velocity.

In either case, be aware that adding an empirical 'windage' (or Leeway) drift may have accounted for Stokes unless it was intentionally isolated.

BRAN compared with undrogued drifters.



BRAN - DRIFTER

1% 10m WIND

STOKES DRIFT

Mean error ≈ mean Stokes Drift ≈ 1.2% mean wind

Measurements

It is very difficult to measure the velocity of the surface 1m.

HF radars sense a surface-weighted average of the top 5-8m.

Drogued drifters of the SVP design measure the 5-15m average.
Un-drogued SVP drifters have some windage.

ADCPs suffer side-lobe interference (so can't see surface velocity).
Downward suffer blanking at sfc. Side-looking ADCPs an option.

SLDMBs are drogued drifters designed to measure the 1m average.

Verification

Primarily based on ad hoc studies related to events

- Montara
- MH370

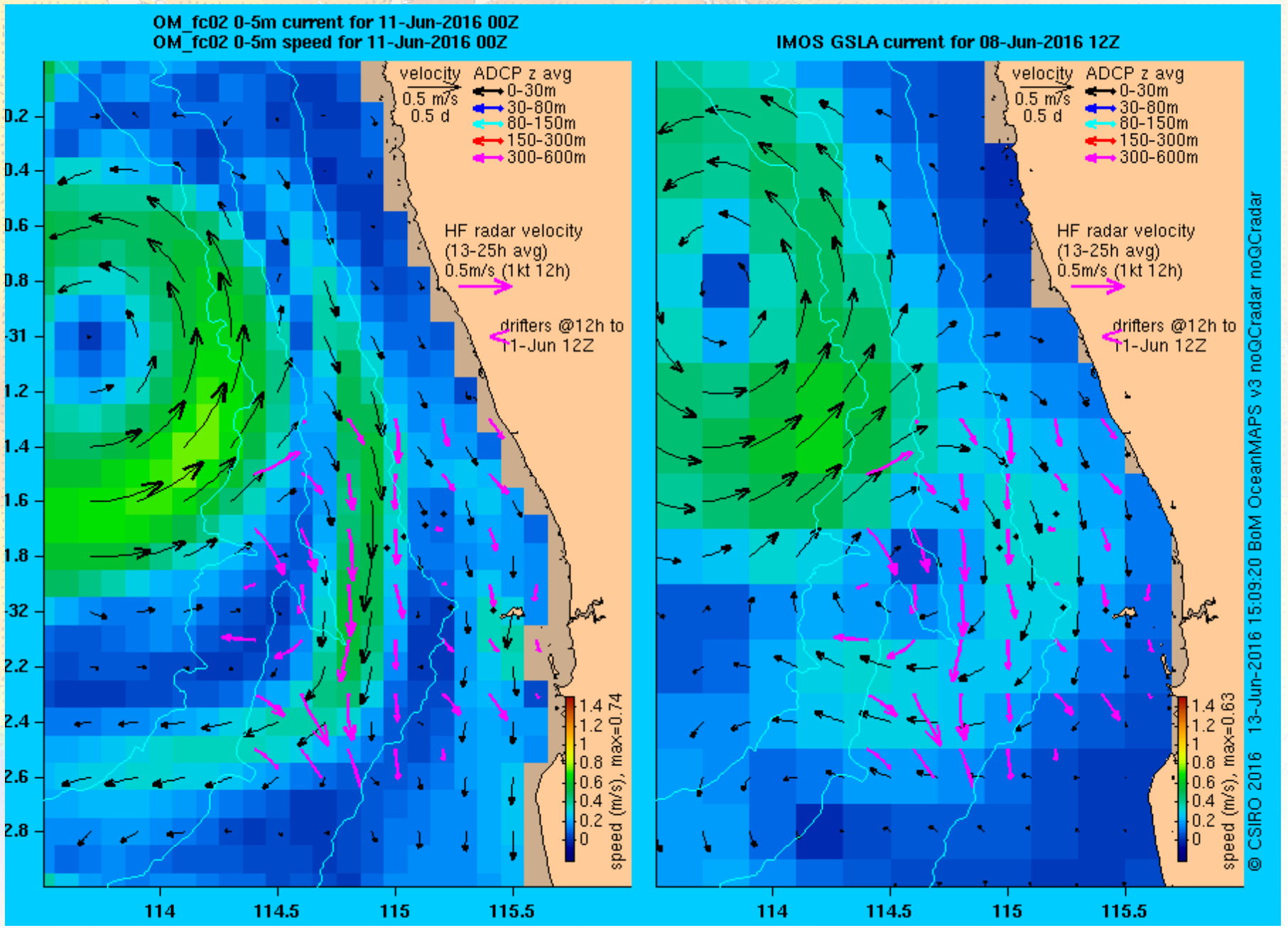
Systematic/routine quantitative verification of forecast products is not widespread

- Preliminary discussions regarding this are underway (see following slides)
- Skill metrics should be refined to enable standard comparisons between forecasts

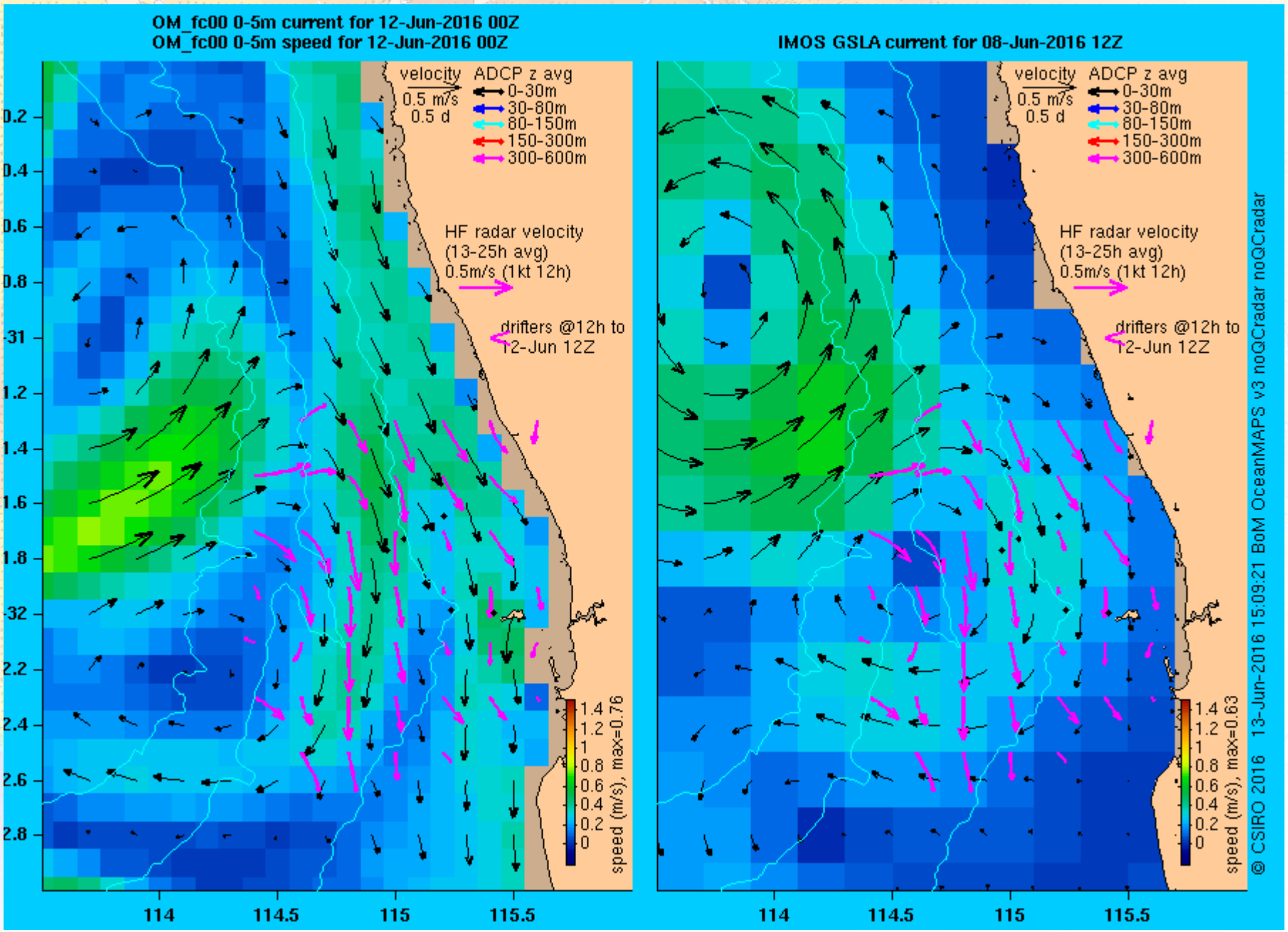
Routine qualitative comparisons with HF radars (next slide) and drifters exist

Issues/constraints to achieving a reliable verification

- Observation coverage/sample size
- Observation errors (depths, biases)
- Model products (averaging, sub-grid scales)
- Consistent measures (model-based, product based)
- Standardisation (international US-Coastguard, Europe)

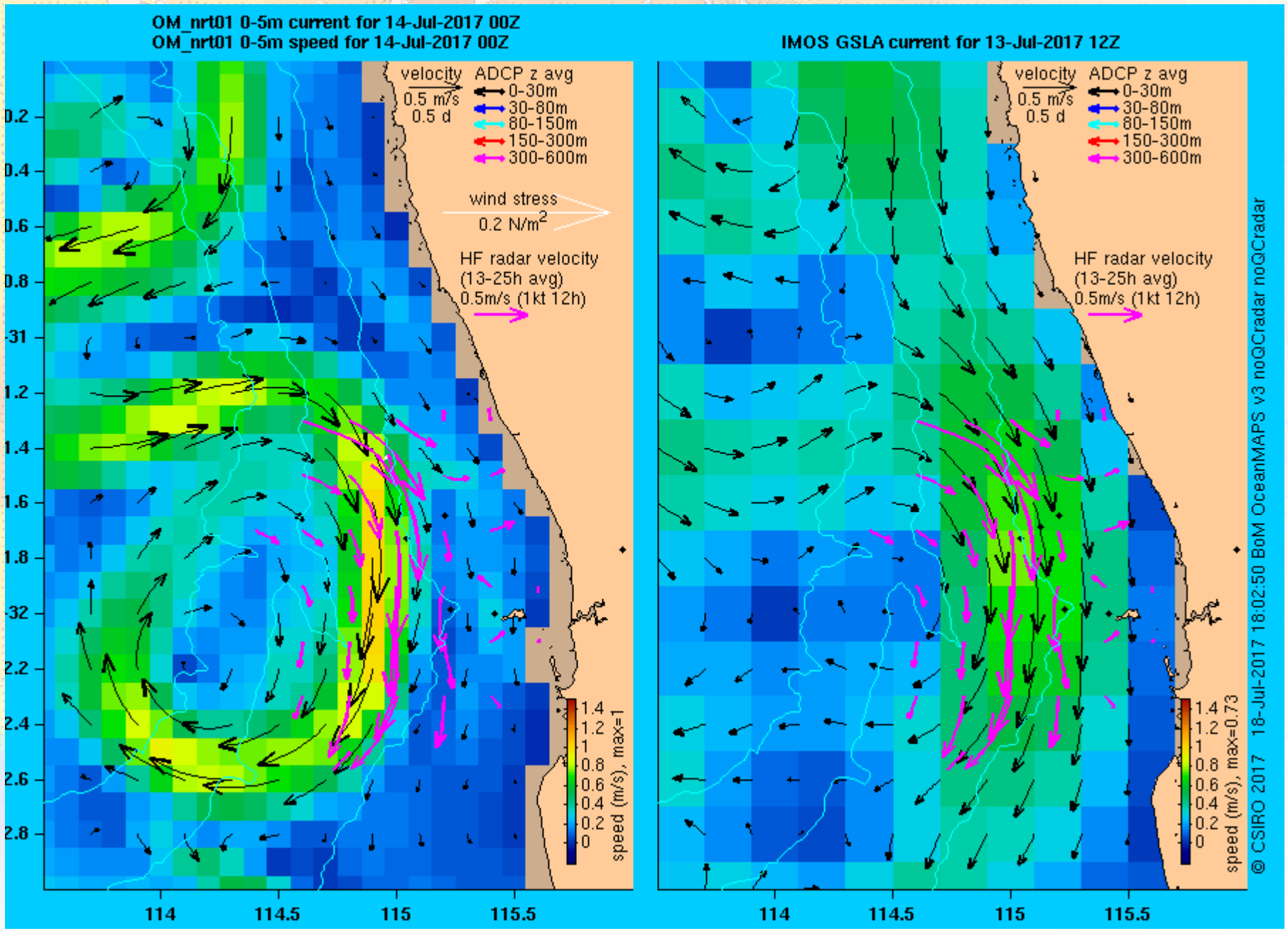


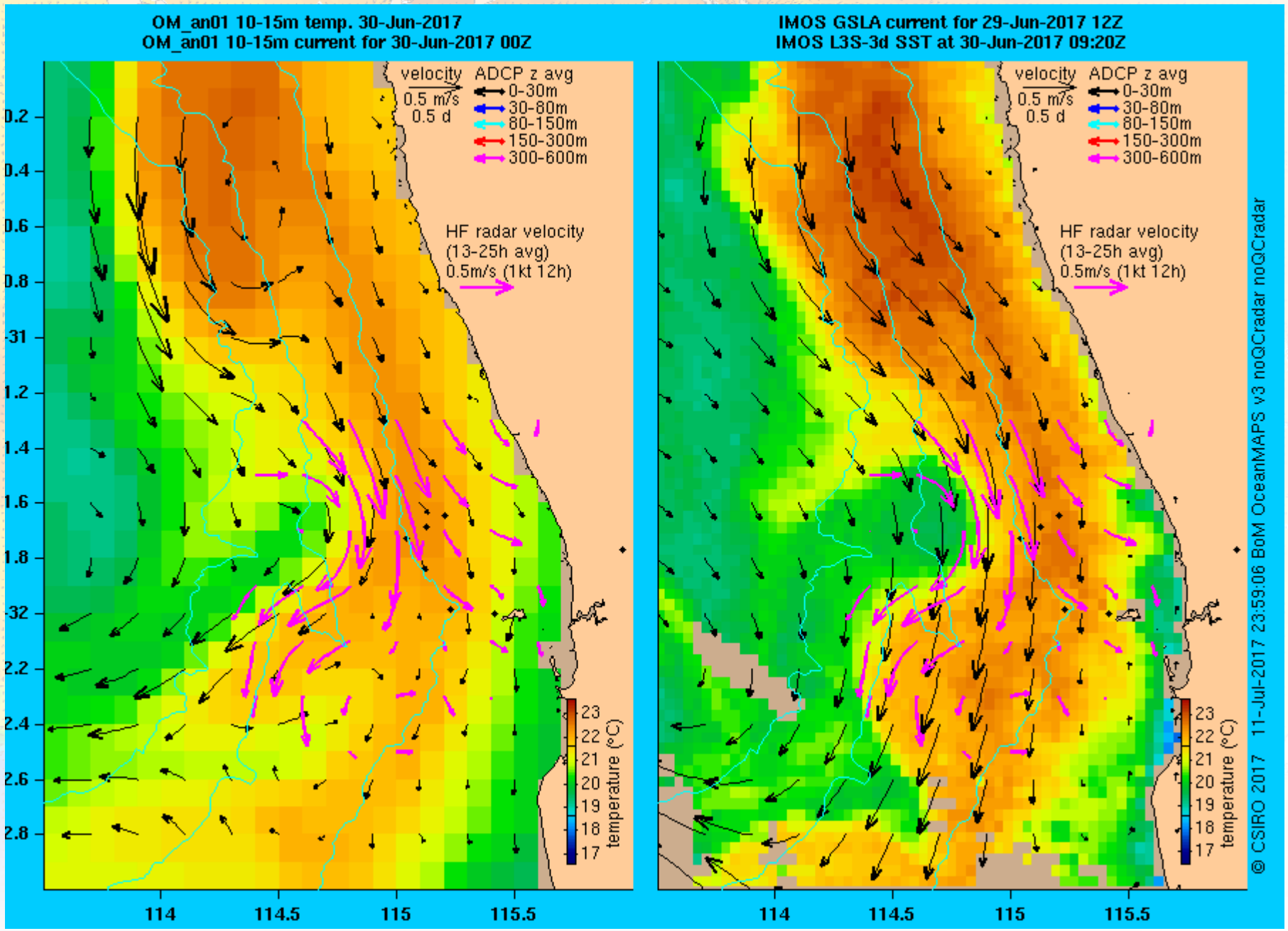
11 June 2016 **OceanMAPSv3** **IMOS GSLA**



12 June 2016 **OceanMAPSv3** **IMOS GSLA**

Geostrophic velocity from altimeter sea level for 24-Jun-2017 including mean dynamic height relative to 2000m.




OM_an01 10-15m temp. 30-Jun-2017
OM_an01 10-15m current for 30-Jun-2017 00Z
velocity
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0-30m
30-80m
80-150m
150-300m
300-600m
HF radar velocity
(13-25h avg)
0.5m/s (1kt 12h)
temperature (°C)
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114
114.5
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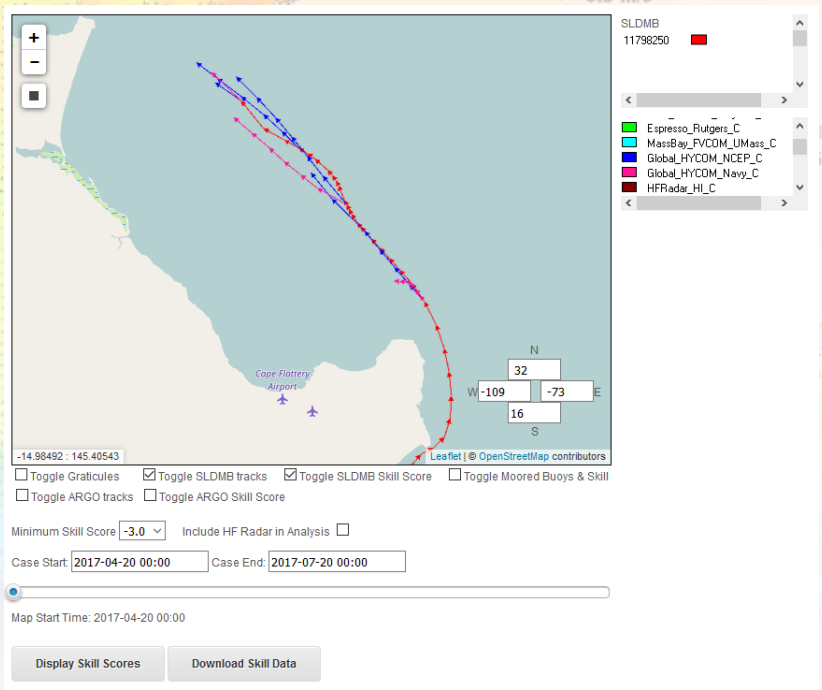
IMOS GSLA current for 29-Jun-2017 12Z
IMOS L3S-3d SST at 30-Jun-2017 09:20Z
© CSIRO 2017 11-Jul-2017 23:59:06 BoM OceanMAPS v3 noQCradar noQCradar

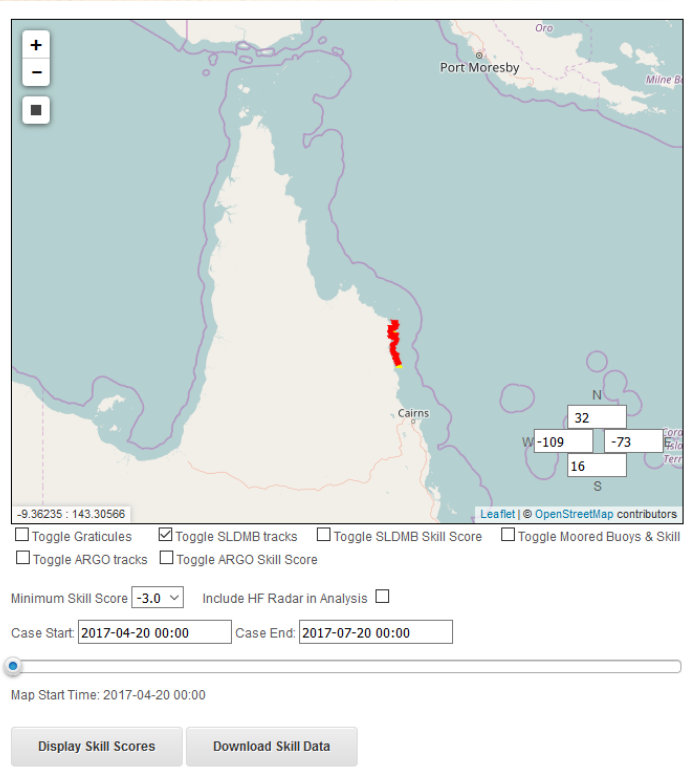
Verification of Surface Currents

- The US Coast Guard (USCG) recognised the need for verification of surface currents throughout SAR incidents

- SLDMB drifters are now routinely deployed during SAR incidents to ground truth the model forecast surface currents

- A system recently developed by the USCG with RPS automatically runs model comparisons every 6 hours for deployed SLDMBs to verify model forecast current reliability





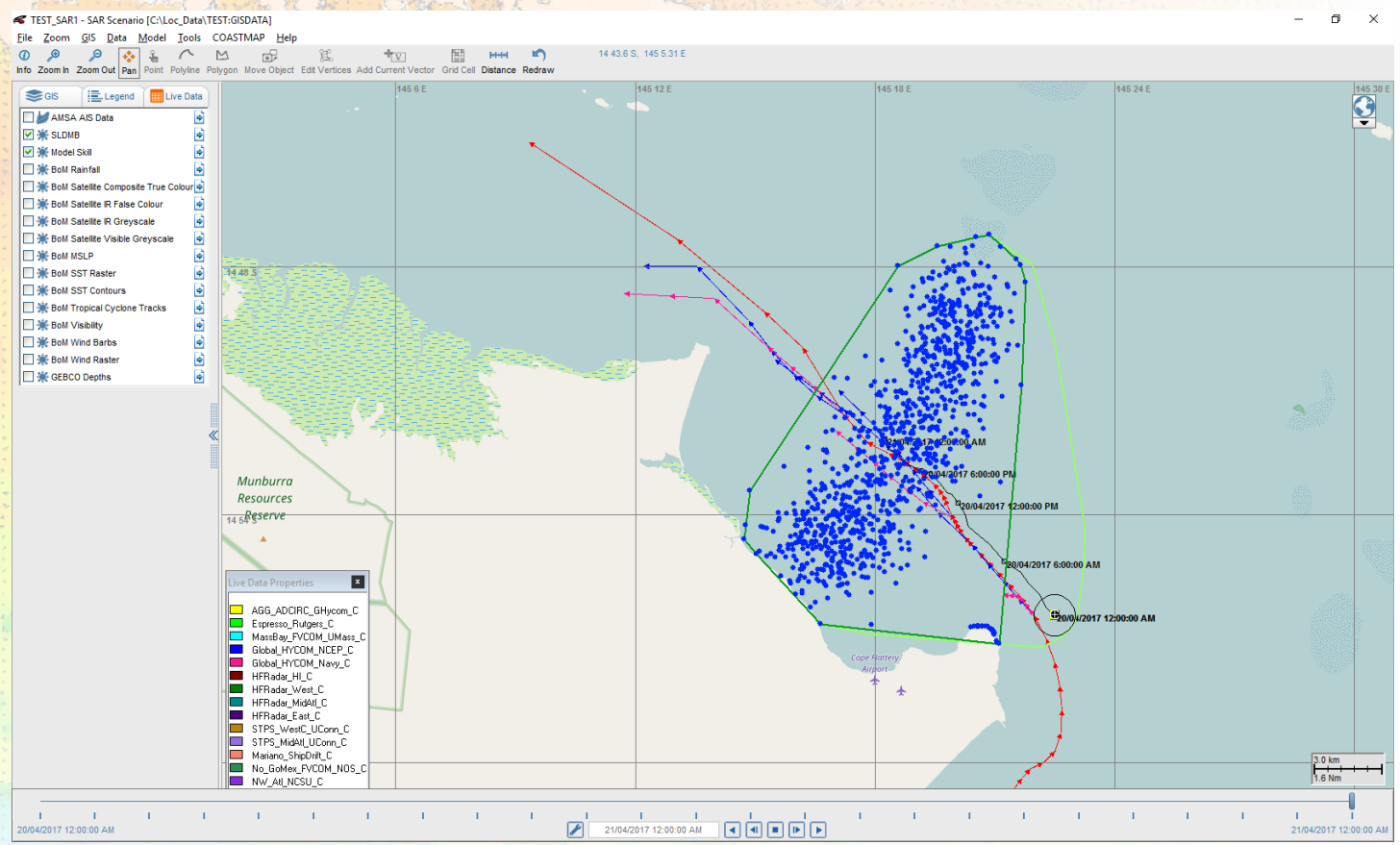
Zoom out (upper) and Zoom in (lower left) SLDMB Skill Score on RPS EDS dashboard.

Images show the northward track of an SLDMB (red), and subsequent model trajectories (blue and pink) off the coast of North Queensland.

Verification of Surface Currents

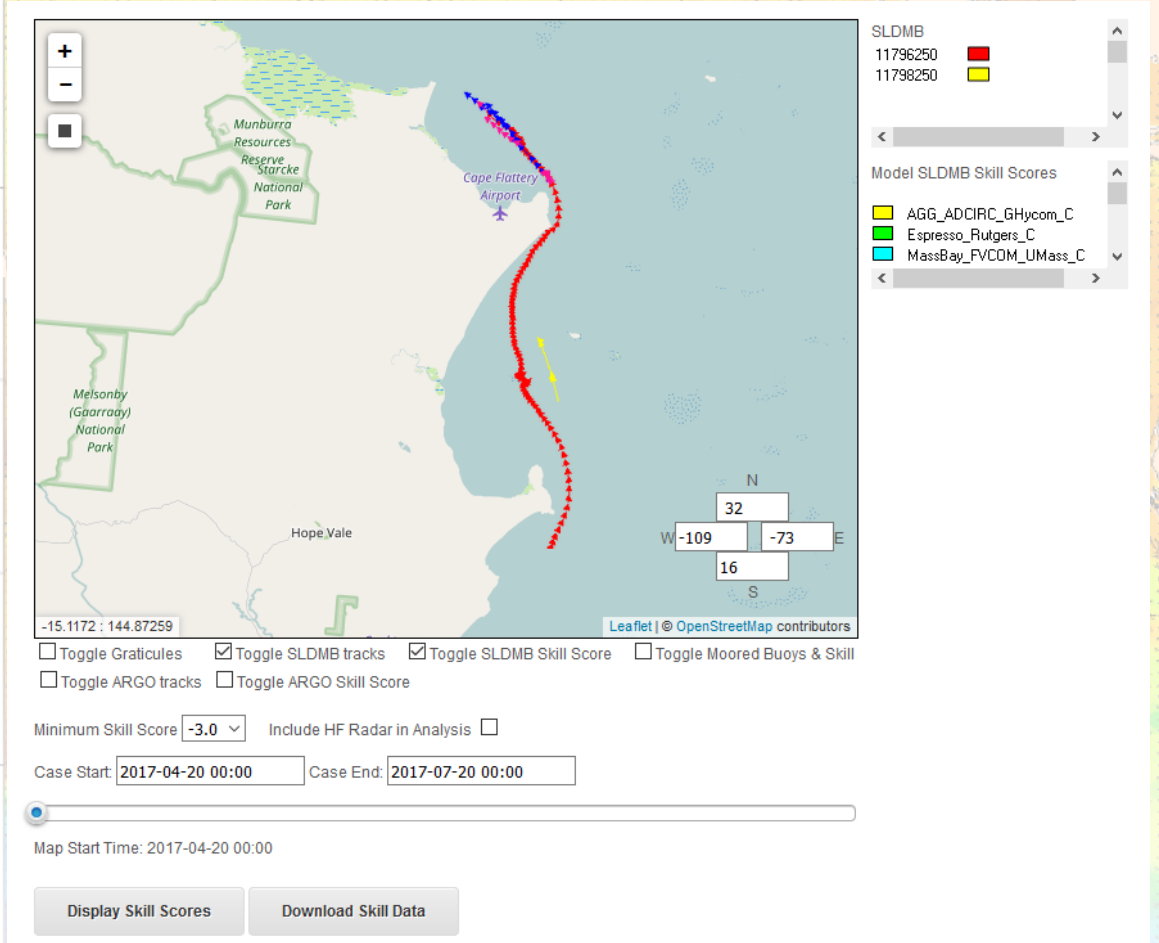
- The Skill Score system can be used in incidents (i.e. SAR), or as a research tool to develop statistical estimates of model performance

- Live SLDMB tracks and the Skill Score can assist the SAR operator in the selection of the most applicable forecast surface current dataset during an incident (i.e BLUElink, HYCOM NCEP, HYCOM Navy or FOAM)



Visualisation of SLDMB track (Red line) travelling northwards, model forecast of SLDMB track from Skill Score (Blue and Pink lines), and SARMAP search area (blue dots within green polygon)

Verification of Surface Currents



Dashboard view showing SLDMB track (Red and Yellow) and model forecast tracks (blue and pink) near Cooktown, QLD

- SLDMB comparison statistics can be provided for an area for individual SAR cases, or over a longer term period.

-Statistics are provided for all of the ocean models that are present in the Area of Interest (AOI)

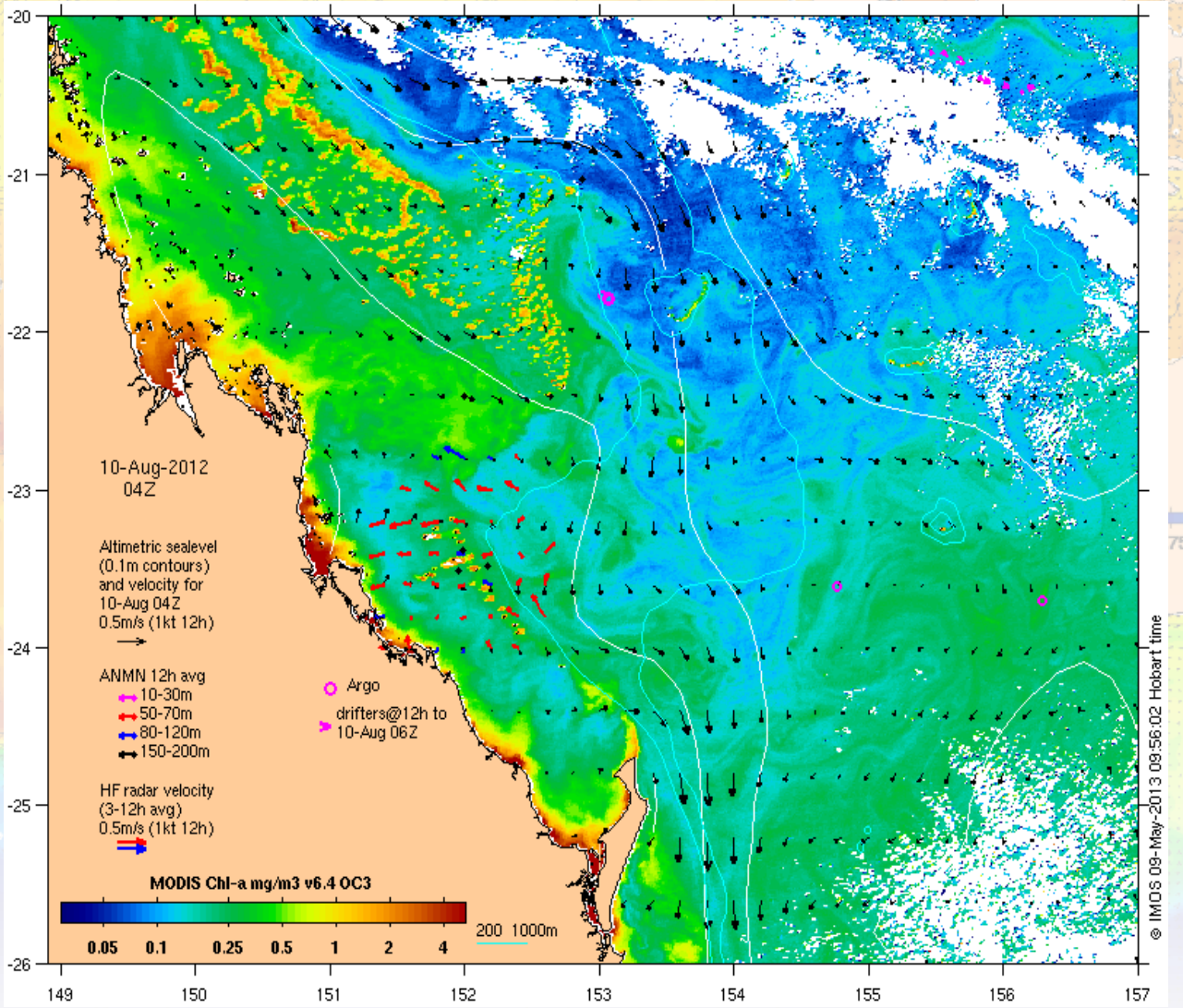
Average skill scores in AOI (16.00,-109.00 to 32.00, -73.00).

Model	6 Month						Case					
	SLDMB			Moored			SLDMB			Moored		
	Skill Score	Num Buoys	Num Obs.	Skill Score	Num Buoys	Num Obs.	Skill Score	Num Buoys	Num Obs.	Skill Score	Num Buoys	Num Obs.
AGG_ADCIRC_GHycom_C	-0.1058	31	285	-0.4403	9	3363	-0.1782	24	211	-0.4686	4	2189
Global_HYCOM_Navy_C	-0.0682	38	594	-0.3721	10	4239	-0.0343	27	460	-0.4624	5	2767
Global_HYCOM_NCEP_C	-0.1108	38	565	-0.4176	10	3569	-0.1252	27	432	-0.4714	5	2285
HFRadar_East_C	-0.0558	9	66	0	0	0	-0.0558	9	66	0	0	0
Mariano_ShipDrift_C	-0.4716	32	348	-0.1936	10	4347	-0.4573	22	241	-0.2271	5	2869
No_GoMex_FVCOM_NOS_C	-0.0169	21	292	0	0	0	0.0093	17	233	0	0	0
NoAtl_HYCOM_NCEP_C	-0.9848	13	112	-0.3576	6	940	0	0	0	0	0	0
NW_Atl_NCSU_C	-0.0172	38	430	-0.271	10	1275	0.0023	26	327	-0.3032	5	867

Skill Scores Computed From ARGO Floats (16.00, -109.00 to 32.00, -73.00)
2017-04-20 00:00 - 2017-07-20 00:00 .

Model	Average Skill Score	Standard Deviation	Number Simulations
HYCOM_GLOBAL_ADCIRC_CURRENTS	-0.32	1.13	18
HYCOM_GLOBAL_currents	-0.34	0.99	38
HYCOM_Global_Navy_currents	-0.25	0.94	46
MARIANO_currents	0.15	0.29	37
NW_ATL_CURRENTS	0.1	0.56	31

IMOS Oceancurrent



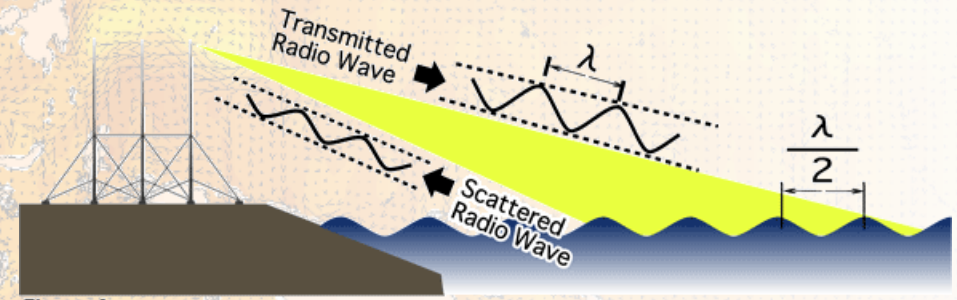
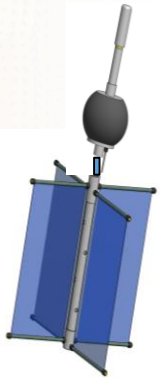
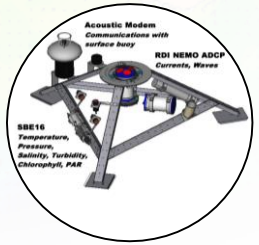


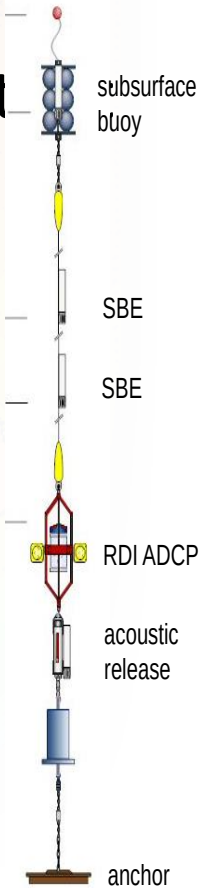
Figure 1



This product provides a daily archive of ocean observations t feature surface or near surface currents derived from:

- Satellite Altimetry
- Ocean Surface Radar (red)
- In situ moorings
- SVP drifters



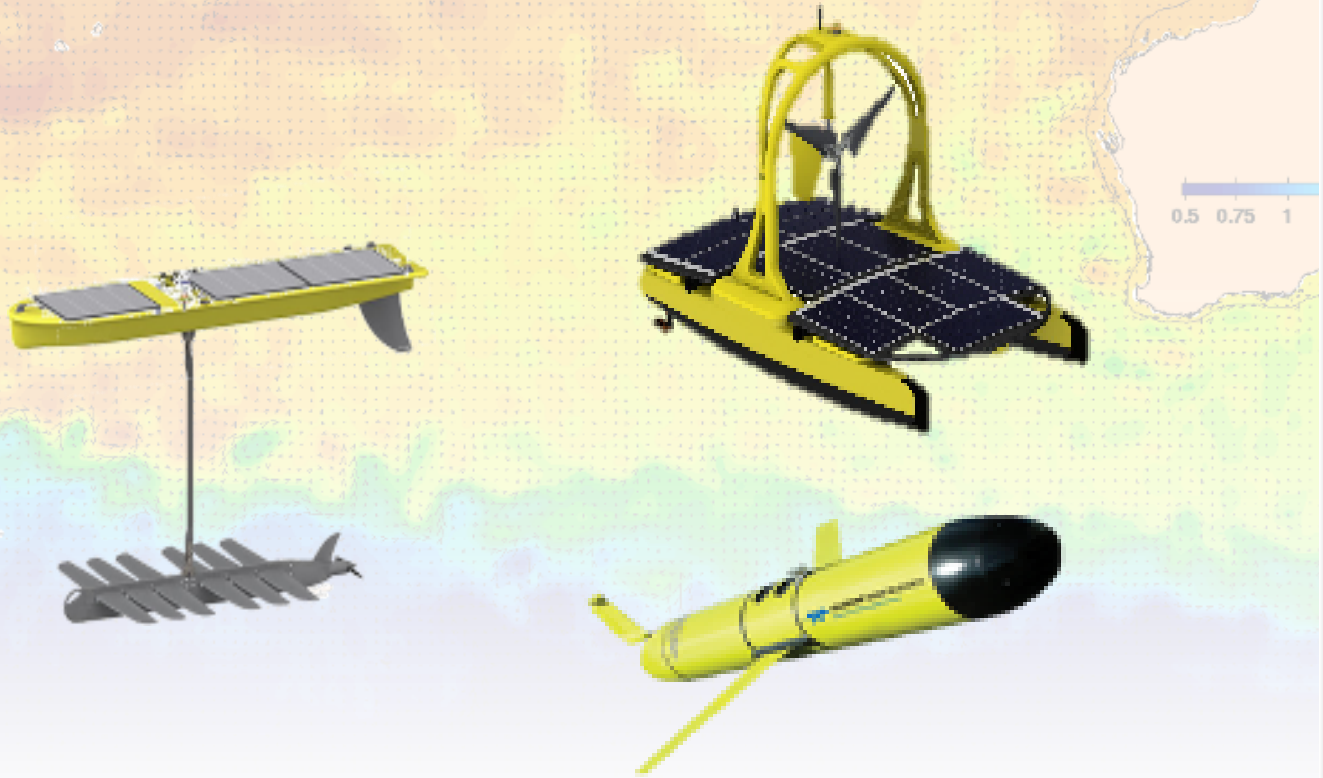


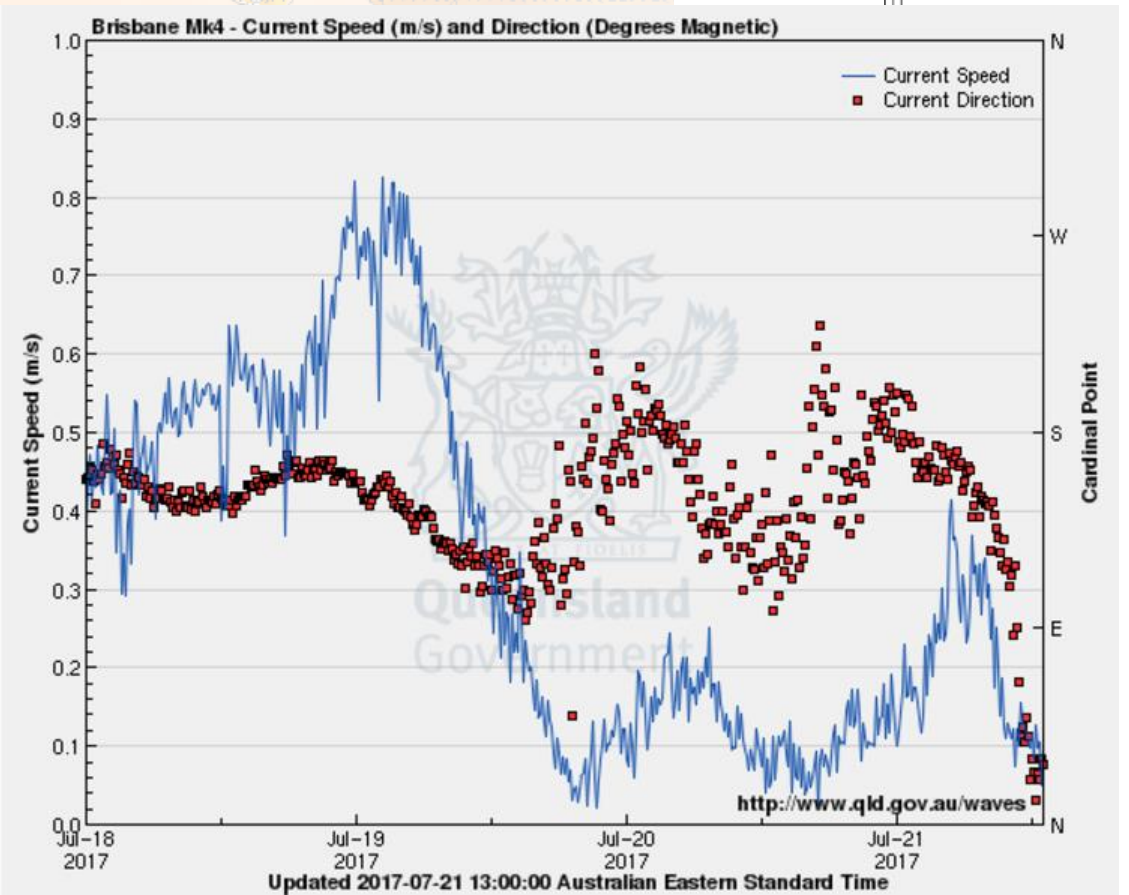
http://oceancurrent.imos.org.au/

Surface current from new platforms

New platforms are now available for surface current measurements using doppler velocity loggers or profilers

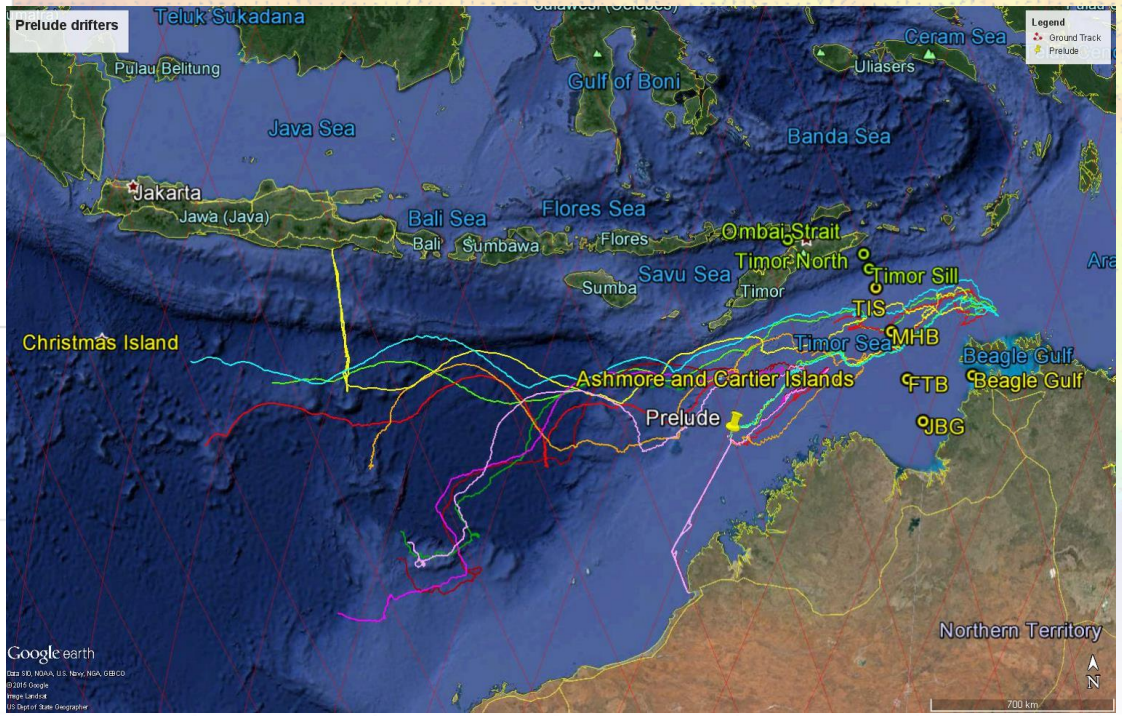
- Coastal arrays of waverider buoys that measure surface currents
- ASVs like the waveglider or Global C-Cat

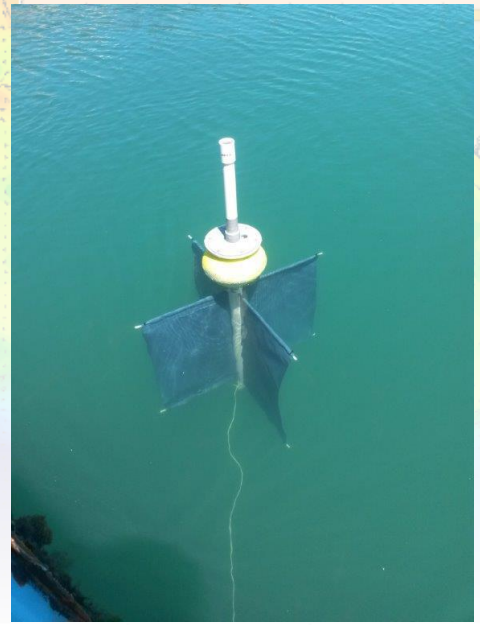




Satellite tracked drifter

- Partner with an Australian company Myriota to develop multiple sensor datastreams at a disruptive price point
- Utilises satellite transmission at AIS network frequencies
- Bespoke design to measure the surface current (1m) in deep or shallow regions
- Can be tethered to be inexpensive near real time buoys

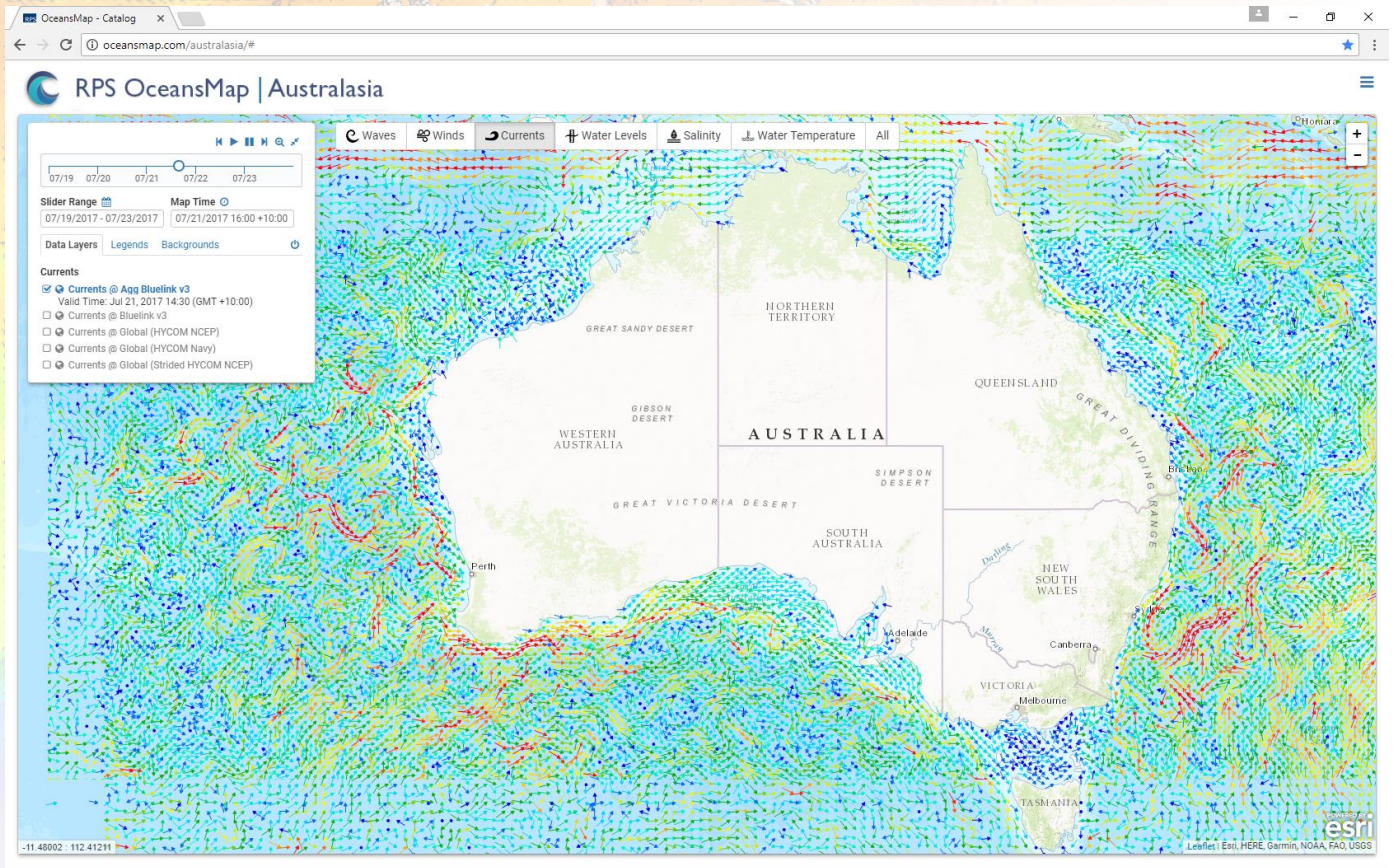




Operational Use of Surface Current Forecasts

Surface current forecasts are used for a wide range of operational uses including:

- Oil and chemical spill forecasting
- Maritime search and rescue
- Predicting the path of lost drifting objects
- Oil and Gas industry daily operations
- Optimal ship routing
- Sailing and recreational boating
- Backtracking to determine incident locations
- Ports and Harbour Actions



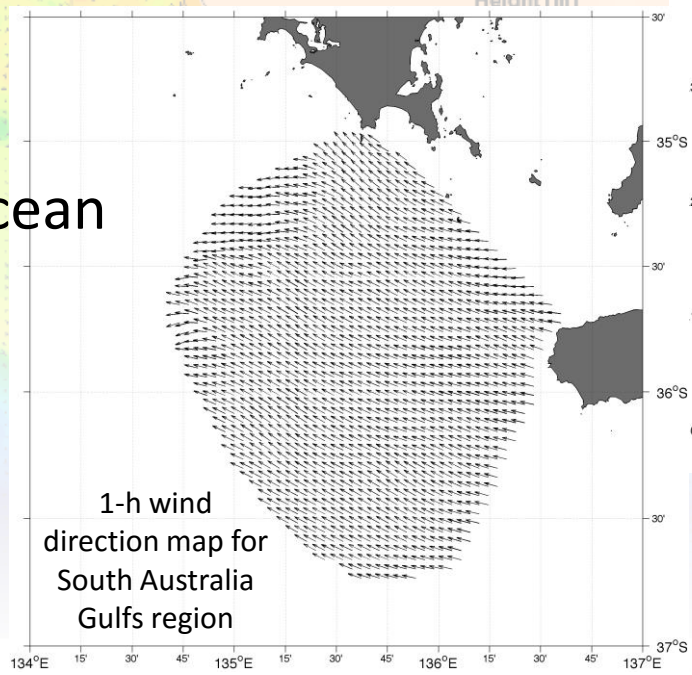
Online portal for viewing metocean forecast model data

High-Frequency (HF) radars

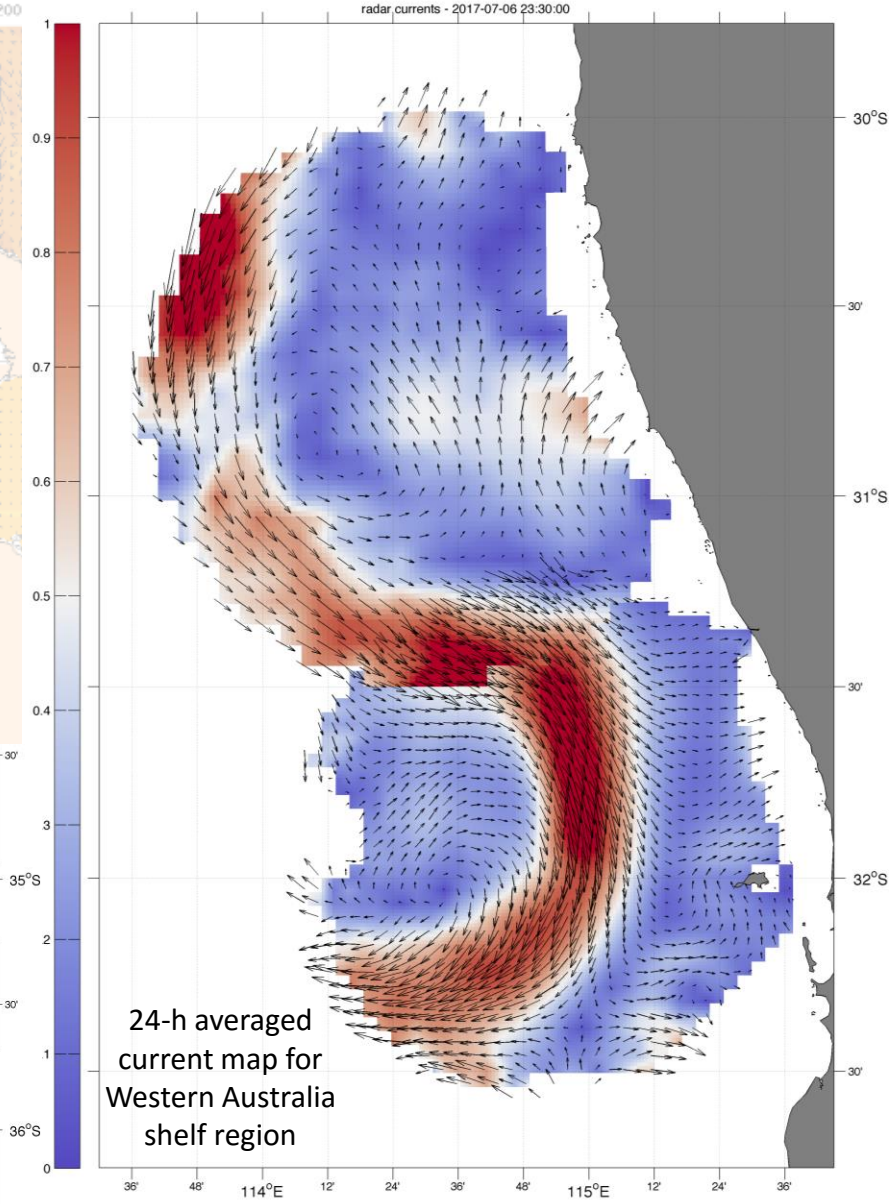
Near-surface (2-4 m depth) maps of ocean currents and surface winds up to 200 km offshore, averaged over 1-h time interval at a 1.5-6 km spatial resolution

Capable of resolving:

- Sub-tidal - tidal frequency bands
- Inertial oscillations
- Sub-mesoscale and mesoscale ocean features
- Available in near real-time



1-h wind direction map for South Australia Gulfs region

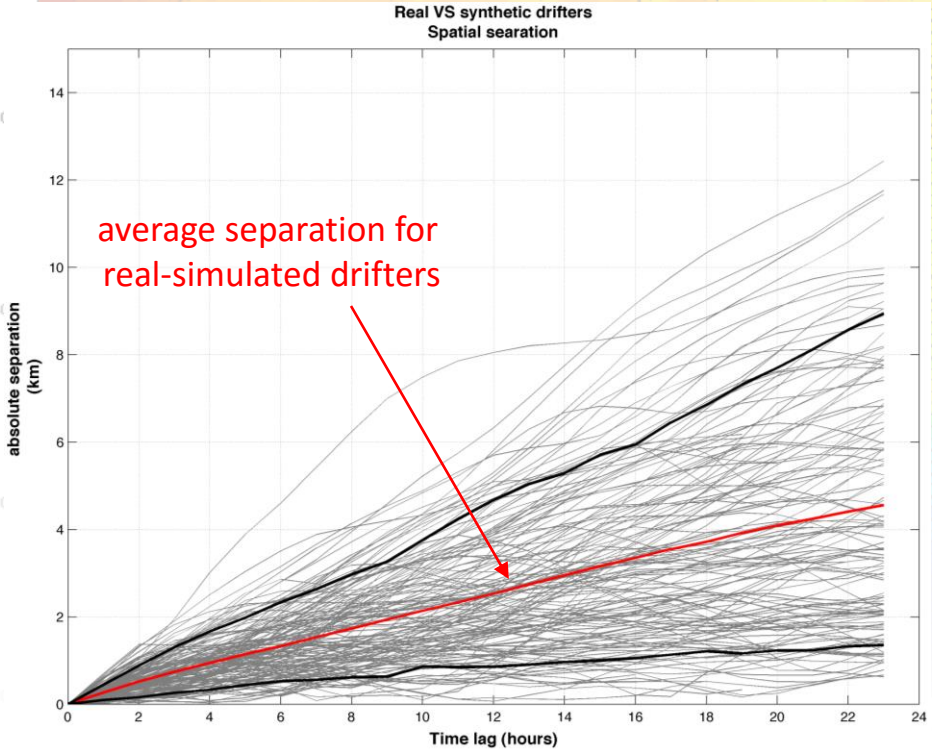


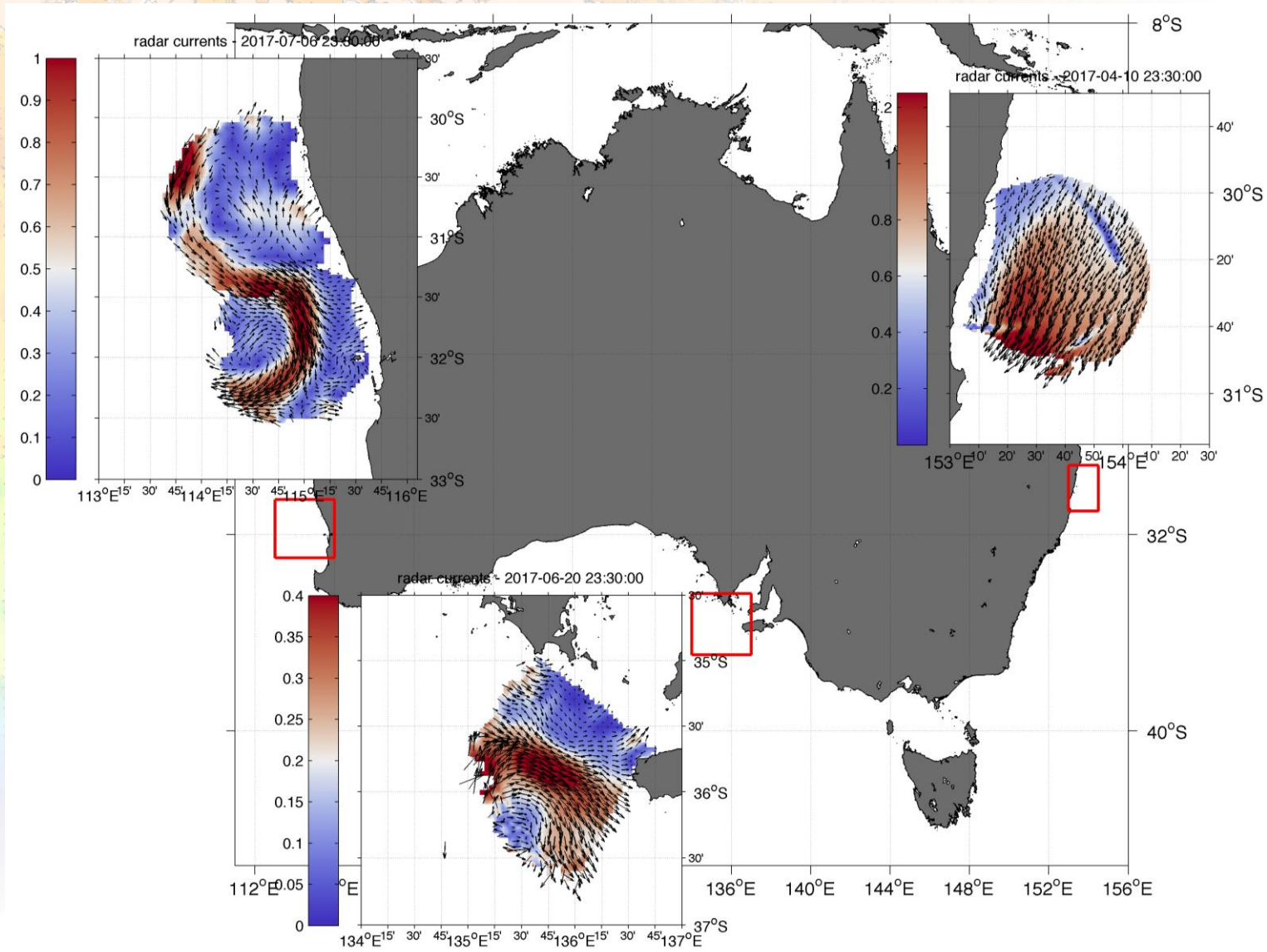
24-h averaged current map for Western Australia shelf region

High-Frequency (HF) radars

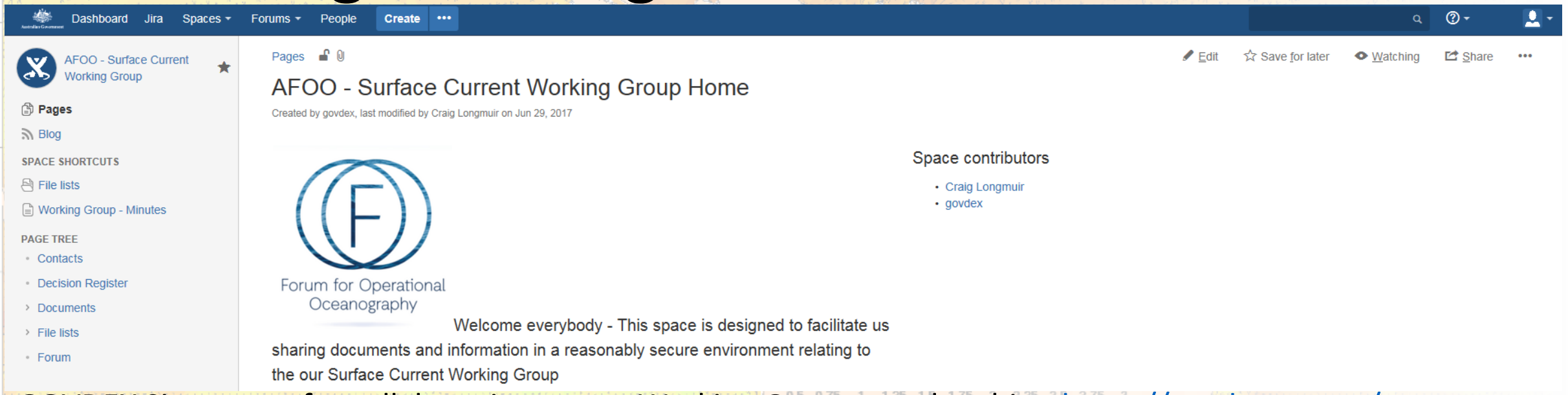
4 HF radar nodes across Australia, managed by the Australian Coastal Radar Network (ACORN) facility based at UWA

Designed originally for scientific research but with potential for operational purposes (e.g., search-and-rescue)





Networking – Sharing Information



GOVDEX Site set-up for collaboration across Working Group membership - https://govdex.gov.au/

Uses Confluence – Team Collaboration Software
Assist in facilitation of information sharing and discussion

Australian Government hosted secure website - No costs

- Minutes
- Forum Preparation
- Future sharing of documents – Resource Receptacle

Where to?

Just beginning to get moving with some Projects

Continue Collaboration?

Continue information sharing?

Are we meeting the group's needs?

Make-up of Group – right mix of interested people?

Size of group – contract/stabilise/expand?

Frequency of meetings – maintain momentum and meet every 6 weeks or so?


COLLABORATE
WITH PEOPLE
YOU CAN
LEARN FROM
Pharrell Williams