Validation of the GlobCurrent surface current products in Australia

M. Cancet[1], D. Griffin[2], M. Cahill[2], B. Chapron[3], J. Johannessen[4], C. Donlon[5]
[1]NOVELTIS, France – [2]CSIRO, Australia – [3]IFREMER, France – [4]NERSC, Norway – [5]ESA/ESTEC, The Netherlands
Corresponding author: mathilde.cancet@noveltis.fr

Introduction

The **surface ocean current products** (GlobCurrent, OSCAR, AVISO, CTOH…) are generally mainly **based on the geostrophic and the Ekman contributions** derived from altimetry and wind observations, respectively. However, the **ocean tides are often one of the main contributors to the ocean currents on the shelves**. Ignoring this contribution in the total surface currents can lead to errors of several cm/s in the surface current estimates, in some regions.

The **East Australian Current** (EAC), a **strong geostrophic structure** that flows southward along the Australian eastern coast, and the **wide range of tidal regimes** ranging from macro-tidal to micro-tidal that characterizes the **Australian continental shelf** both provide **ideal conditions to thoroughly test the GlobCurrent surface current products**. In addition, for more than 10 years Australia has been maintaining a network of about 50 **ADCP instruments** all around the country, principally through its government-supported Integrated Marine Observing System (IMOS). Finally, a large number of **drifting buoys** have been launched in the EAC region for more than 15 years and the observations are made available by NOAA/AOML.

This poster presents an **assessment of the GlobCurrent products** against IMOS current meter data and drifting buoys observations in Australia. The consistency between the GlobCurrent products and the in situ observations was evaluated on the EAC geostrophic structure, **close to the coast and offshore**.

Datasets

GlobCurrent products (v3.0)

- Geostrophic currents: 1/4°grid, daily but intrinsic temporal resolution is 15-20 days (optimal interpolation)
- Ekman currents at 15-m depth: 1/4°grid, 3-hourly
- Total surface currents at 15-m depth = geostrophic + Ekman (1/4°, 3-hourly maps)

→ Some temporal filtering is necessary to compare in situ data with GlobCurrent maps.

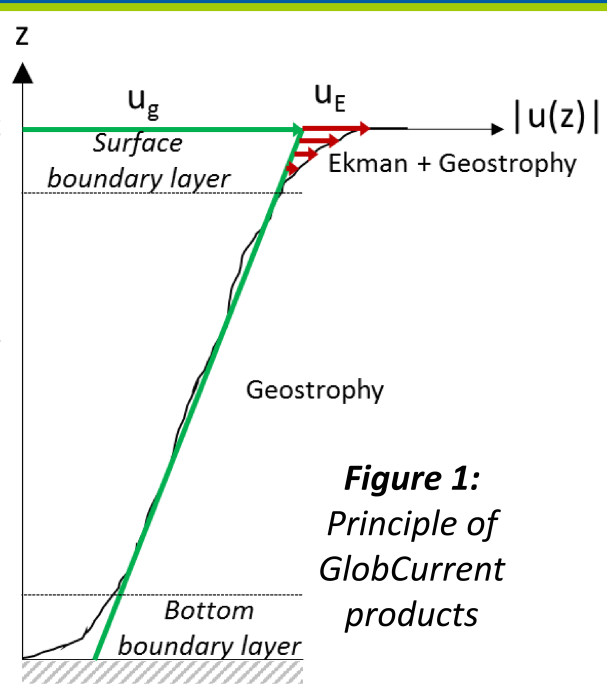


Figure 1: Principle of GlobCurrent products

ADCP data from IMOS

- Selection of 4 stations in the East Australian Current (EAC) region
- 5-10 minute sampling
- Measurements at several depths

Drifting buoys data from NOAA/AOML

- 15-m depth velocities derived from buoys trajectories
- 6-hour sampling

Both ADCP and drifting buoy data contain all the ocean dynamics: geostrophic currents, Ekman currents, tidal currents, etc…

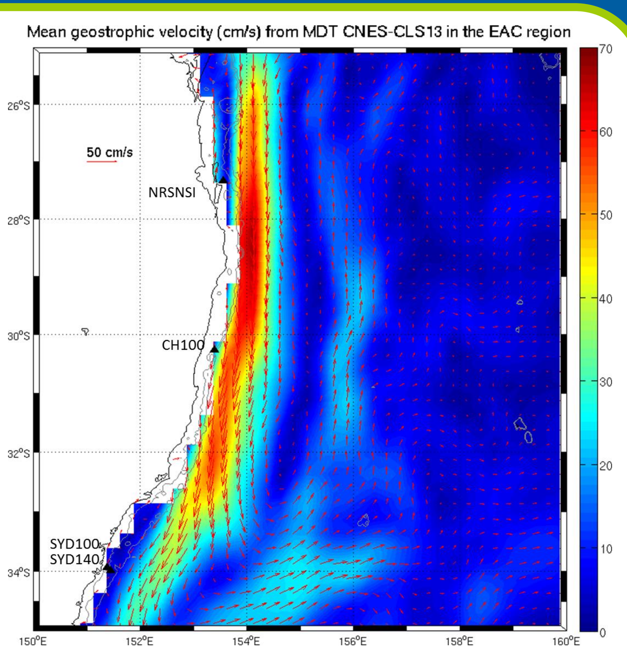


Figure 2: Mean geostrophic velocities derived from the CNES-CLS13 MDT off New South Wales (EAC in red) and ADCP stations.

Assessment in the East Australian Current region

Comparison with ADCP data

30-day low-pass filter applied to ADCP and GlobCurrent data

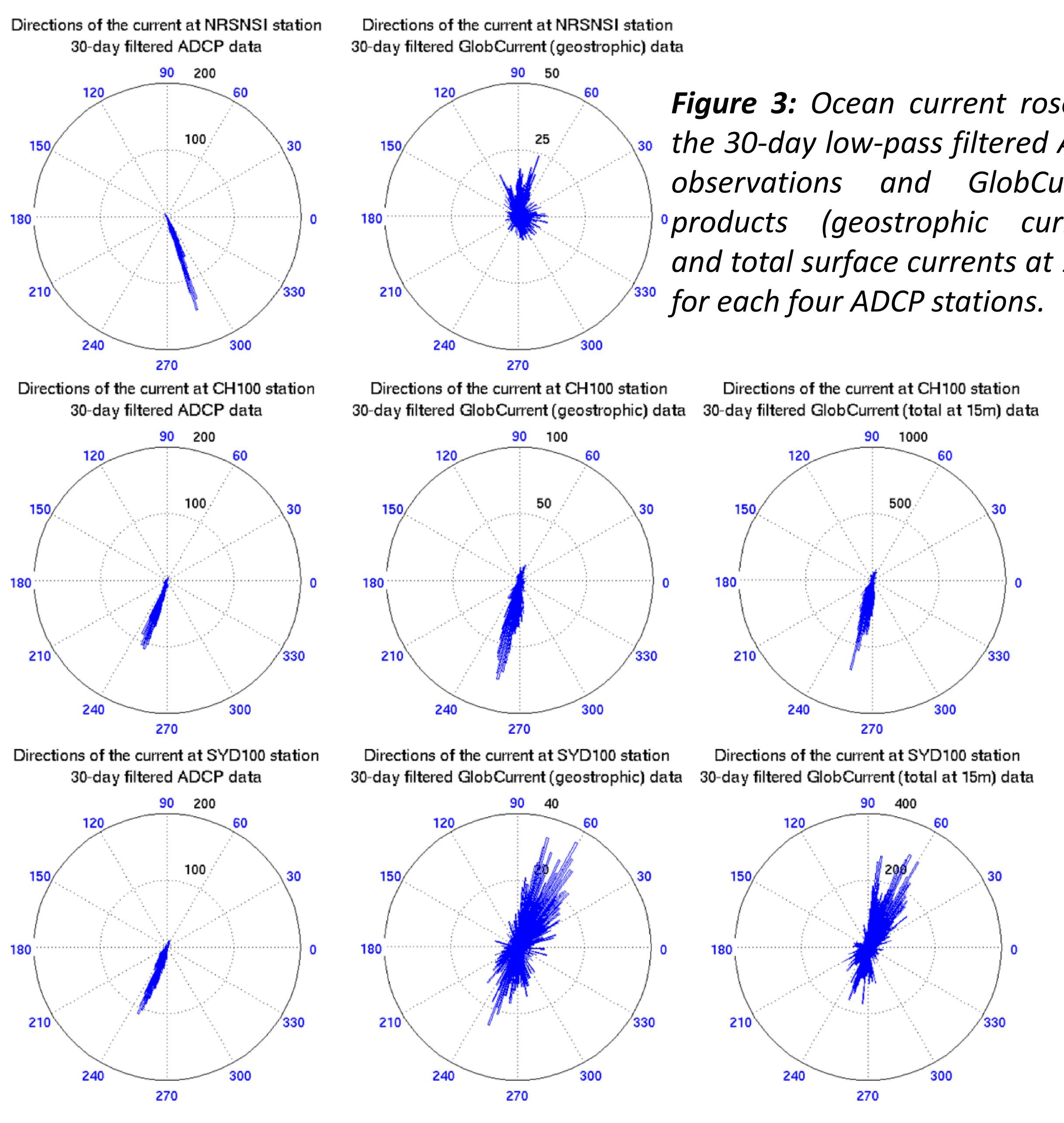


Figure 3: Ocean current roses of the 30-day low-pass filtered ADCP observations and GlobCurrent products (geostrophic currents and total surface currents at 15m) for each four ADCP stations.

→ The main current directions are consistent only at the Coffs Harbour (CH100) station. At the other stations, the mean geostrophic currents derived from the CNES-CLS13 MDT and used as basis for GlobCurrent show unexpected coastal counter-currents.

→ The resolution of the MDT in this region is not sufficient to compute accurate currents near the coast.

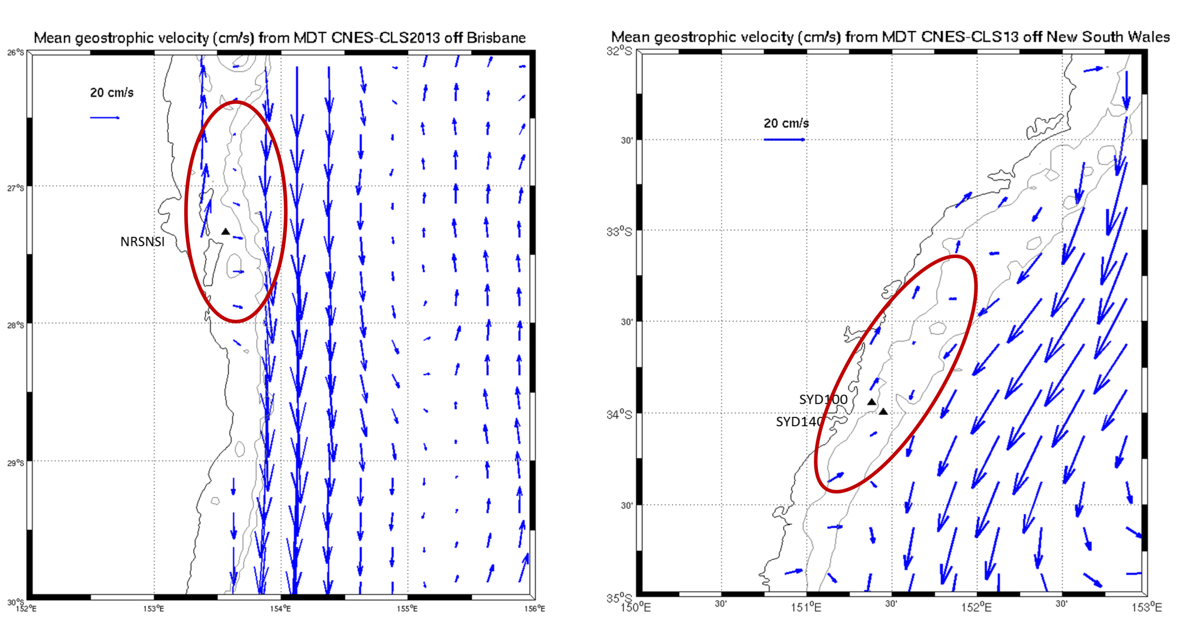


Figure 4: Mean geostrophic velocities from the CNES-CLS13 MDT off Brisbane (left) and off Sydney (right). Black triangles show the ADCP stations. The light-gray lines show the 100-m and 200-m isobaths.

Comparison with drifting buoy data:

Selection of four drifting buoys flowing along the New South Wales coast.

→ The large eddy structures are globally well represented in the GlobCurrent total current products, even if they generally lack energy (Fig. 5).

→ Close to the coast the GlobCurrent products are either not defined (1/4° grid) or not consistent with the in situ data (as expected). The ADCP and drifter data are in good agreement.

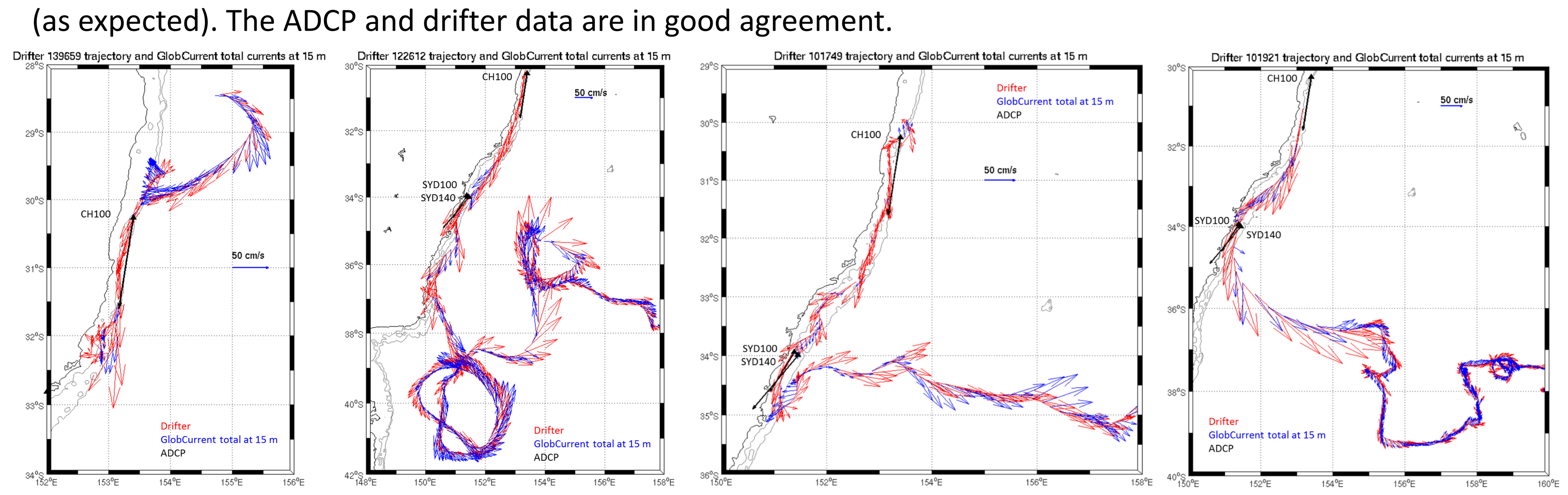


Figure 5: Drifters trajectories and velocities (in red) and velocities of the GlobCurrent total currents at 15 m at the drifters positions (in blue). The ADCP velocities at the closest positions of the drifters are also shown (in black).

Launch of pseudo-drifters: Monitoring of the trajectories of pseudo-drifters launched at real positions of drifter 101921 and advected by the GlobCurrent maps. Comparison between GlobCurrent geostrophic and total currents.

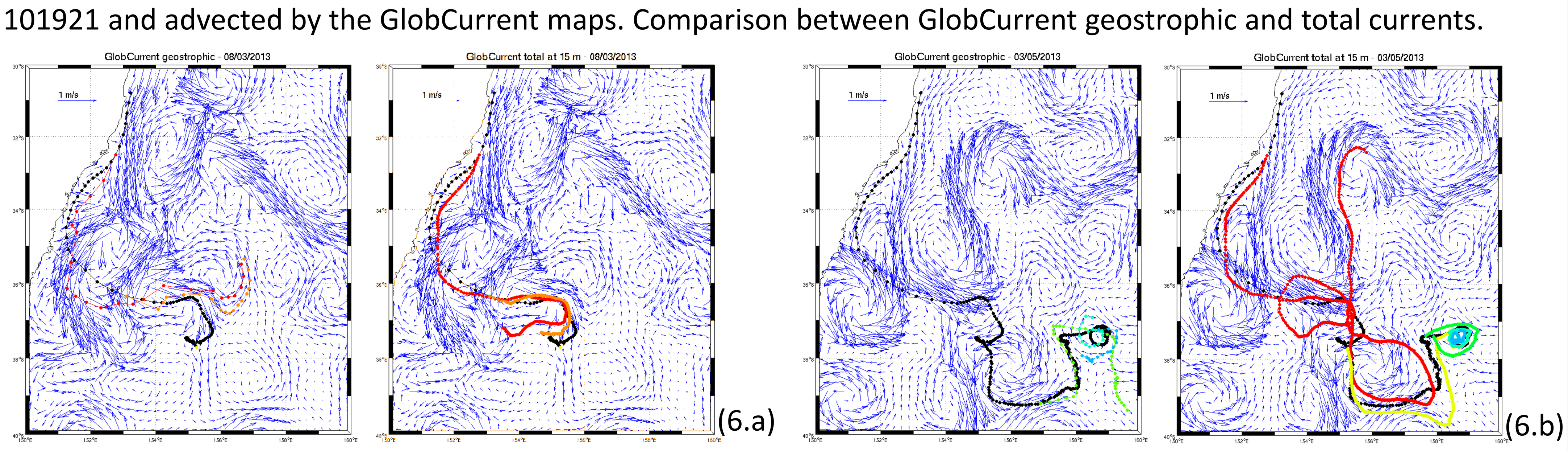


Figure 6: Snapshots ((a) and (b)) of trajectories over the time of pseudo-drifters (in colors) advected by the fields of GlobCurrent total surface currents at 15 m (right plot) or GlobCurrent geostrophic currents (left plot). The positions of the real drifter are in black. The GlobCurrent velocity fields used to advect the pseudo-drifters are shown with blue arrows.

Skill scores of the GlobCurrent products:

The skill score (s) is computed following the methodology proposed by Liu and Weisberg, 2011 and Liu et al, 2014. It is based on the estimate of c, the cumulative Lagrangian separation distance (d) divided by the cumulative length of the observed trajectory (l).

$$\begin{cases} s = 1 - c & (c \leq 1) \\ s = 0 & (c > 1) \end{cases} \qquad c = \frac{\sum_{i=1}^{N} d_i}{\sum_{k=1}^{M} l_k}$$

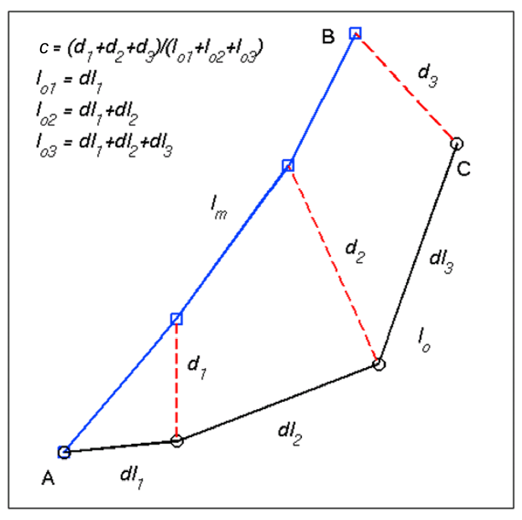
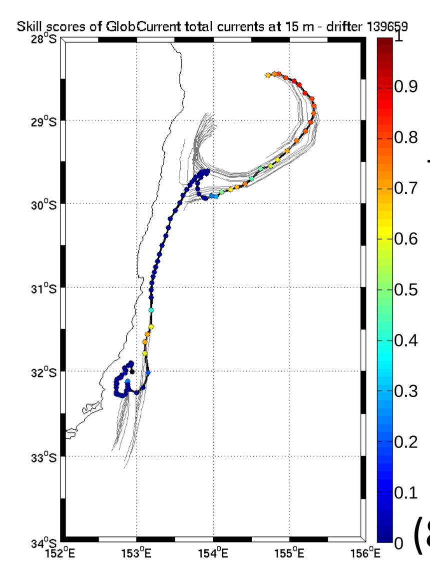


Figure 7: Diagram of skill score principle as proposed by Liu et al. Adapted from Liu and Weisberg, 2011.

The skill scores of the GlobCurrent products were estimated after 3 days of advection of the pseudo-drifters by the GlobCurrent fields.

On large oceanic structures, the GlobCurrent products show high skill scores. The skill scores are lower near the coast and on small patterns.



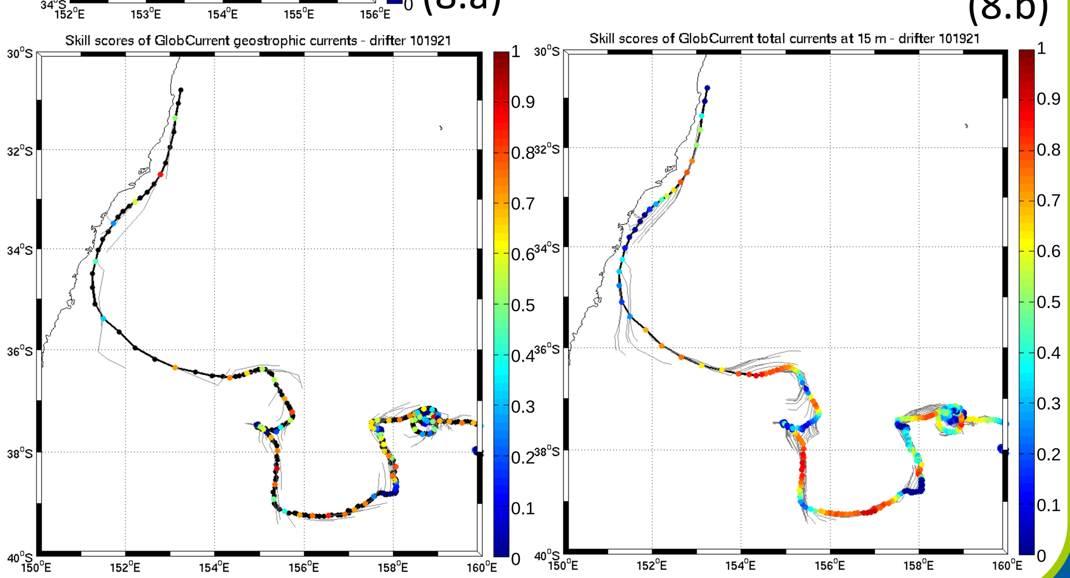


Figure 8: Skill scores (in colors) after 3 days of advection with the GobCurrent fields, for two different drifting buoys ((a) and (b)). The black dotted line shows the positions of the real drifter. The light gray lines show the positions of the pseudo-drifters launched at each position of the real drifter after 3 days of advection by the GlobCurrent maps.

CONCLUSIONS

By construction, the **GlobCurrent products are not designed for coastal applications**. The comparison to ADCP coastal data shows that **the resolution of the MDT** - used to derive the mean geostrophic currents used as mean for GlobCurrent products – **is too coarse at the coast** and generates artefact patterns.

The comparison to drifting buoy data shows the **good consistency of GlobCurrent total currents on large structures offshore**. On smaller patterns (< 100 km), the performance of the GlobCurrent fields is limited.

This work will be published in Cancet et al, 2017, submitted to RSE.