Coastal flow propagation off south Portugal

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Introduction

- Off south Portugal, the coastal circulation is often reported based on satellite sea surface temperature (SST) in spring and summer due to strong water temperature contrast.
- Equatorward flows, associated with coastal upwelling, are described to develop near Cape São Vicente and to progress eastward advecting cold water; poleward flows develop at east and progress westwards advecting warm water (Fig. 1).
- In the present work, the propagation of coastal flows is characterized based on a high frequency radar (HFR) time series of surface current velocities from February 2016 to October 2020.

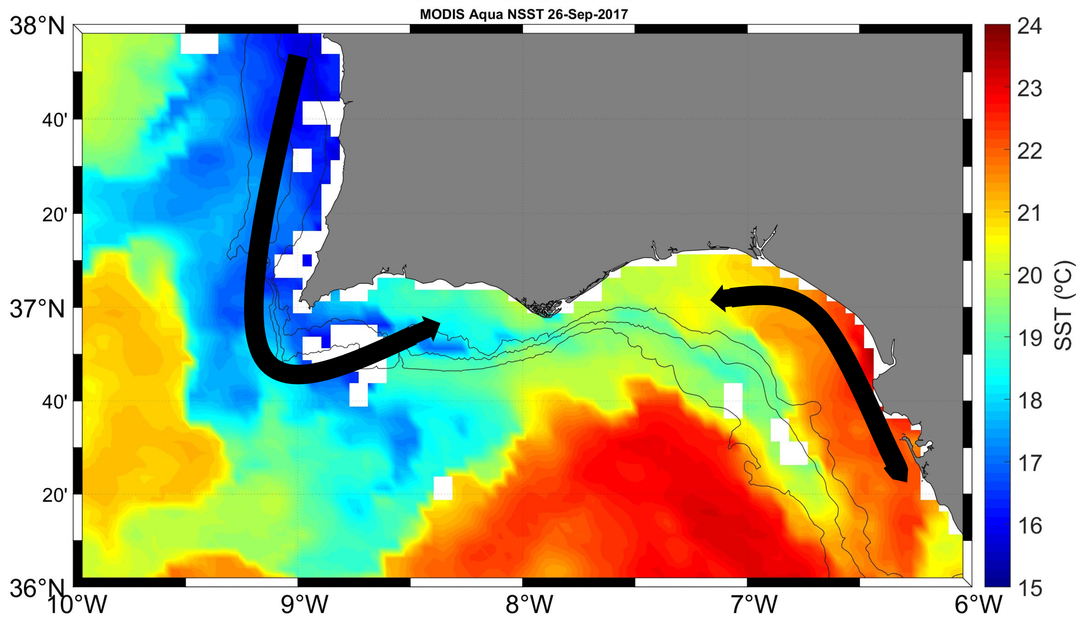

Fig. 1. Example of strong SST contrast in south Portugal observed by satellite.

Identification of propagation events

- Alongshore velocities extracted at 7 locations along the coast were selected: W1, W2, W3 on the western shelf; CSM at Cape Santa Maria; and E1, E2, E3 on the eastern shelf (Fig. 2).
- Concomitant flow reversals within a 7-day period at 3 groups of triplets with adjacent locations were identified (W1, W2, W3: Western shelf; W3, CSM, E1: CSM region; E1, E2, E3: Eastern shelf);
- To discard small oscillations in flow direction, a reversal event was retained when the alongshore flow was ≥ 0.05 m.s-1 before and after the reversal and when the (reversed) flow direction remained constant for 36 h, at least.
- Propagation events were defined as sequential flow reversals (from one alongshore direction to the other) having a realistic propagation speed (≤ 0.2 m.s-1).

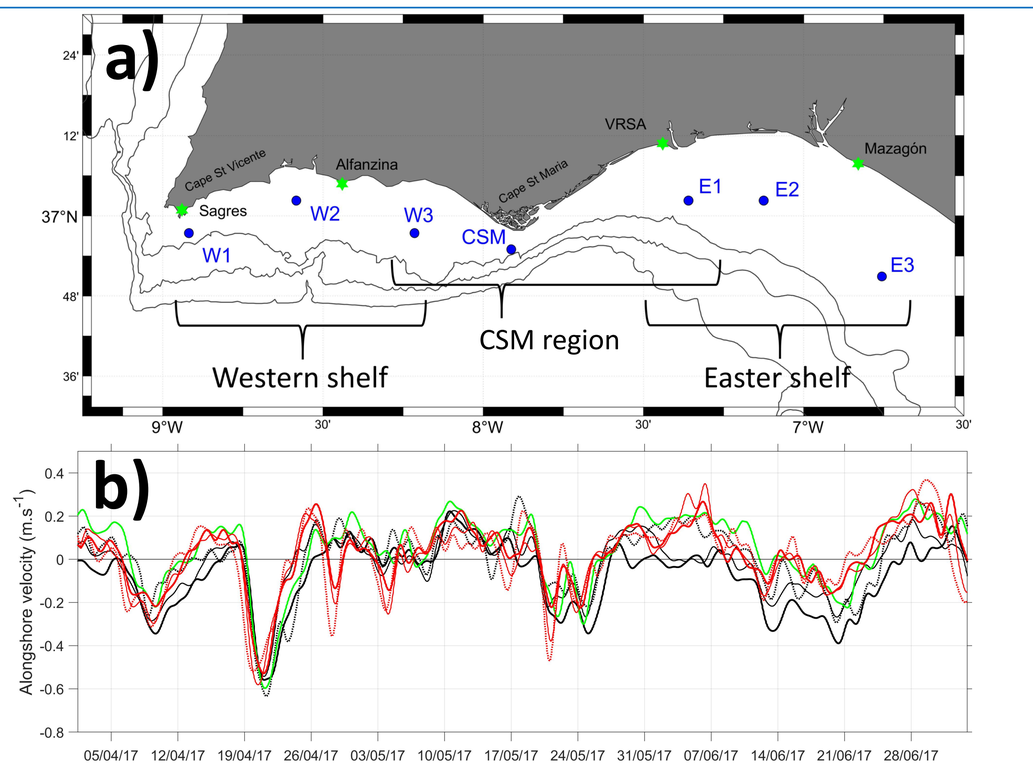

Fig. 2 (a) Locations (blue dots) used to extract the alongshore component, positions of the HFR antennas (green dots) and the groups of triplets (western shelf, CSM region, eastern shelf). (b) Example of the alongshore velocities extracted at the selected locations.

Results

- Between 20 and 38 concomitant flow reversal at each region of triplets were detected (Table 1).
- Propagation events were rarely observed:
  - Western shelf (W1, W2, W3): no propagation
  - Eastern shelf (E1, E2, E3): two propagation events, one for both poleward and equatorward flows.
  - CSM region (W3, CSM, E1): one propagation event of a poleward flow.

Table 1. Number of concomitant reversals registered at each region of triplets.

	Western Shelf	CSM region	Eastern Shelf
Equatorward	30	22	38
Poleward	30	20	32

Discussion

- Since the signal of the current reversal **does not propagate along the coast** the assessment of the coastal circulation based on SST only must be done carefully.
- In the example in Fig. 3, waters in the vicinity of CSM experienced a significant warming but currents at this region were always equatorward (Fig. 3 black box).
- This observation suggests that heat may not be advected from east, contradicting the classical view of currents propagating along the coast.

Conclusions

- Coastal currents along the South Portuguese coast develop concurrently at the eastern and western shelves.
- Since propagation was also absent in CSM region, no propagation between shelves exist.
- The classical view (based on SST) that equatorward (poleward) flows propagate from west to east (east to west) is challenged.

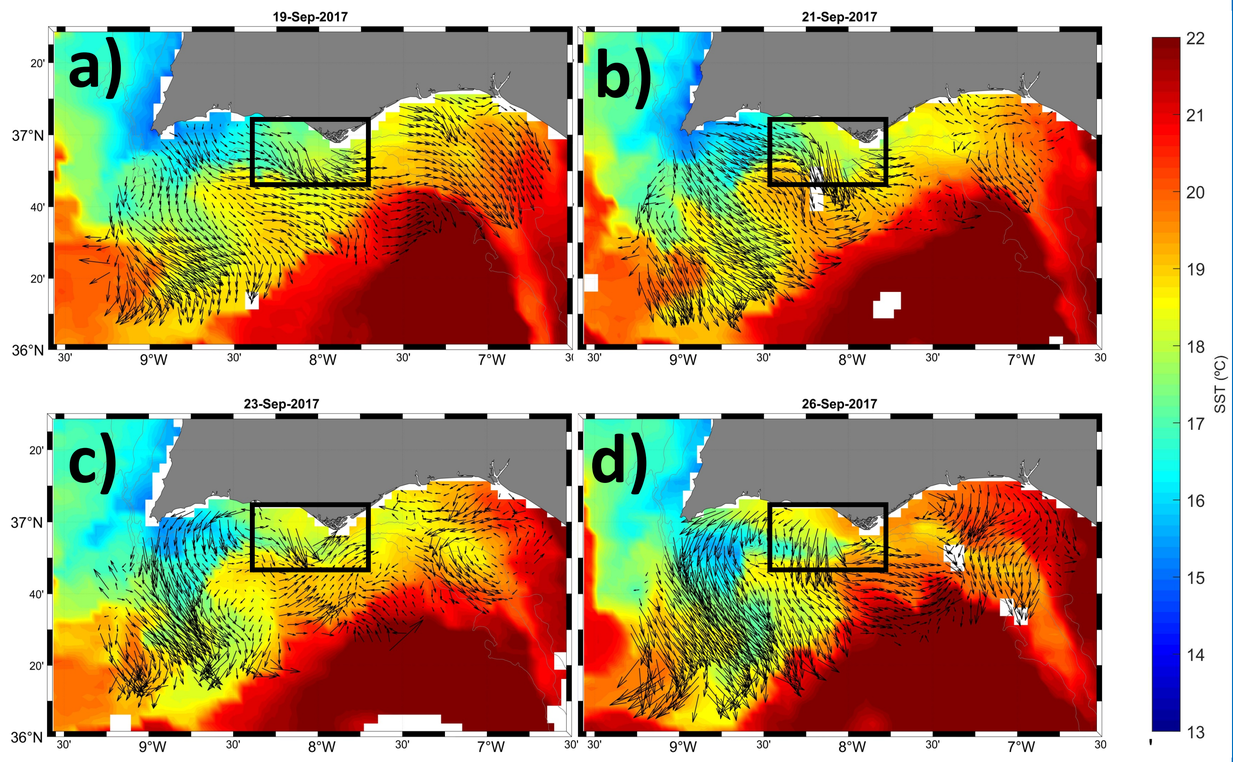

Fig. 3 Sea surface temperature and hourly measurements of filtered HFR surface currents for the period of 19-26 September 2017.

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