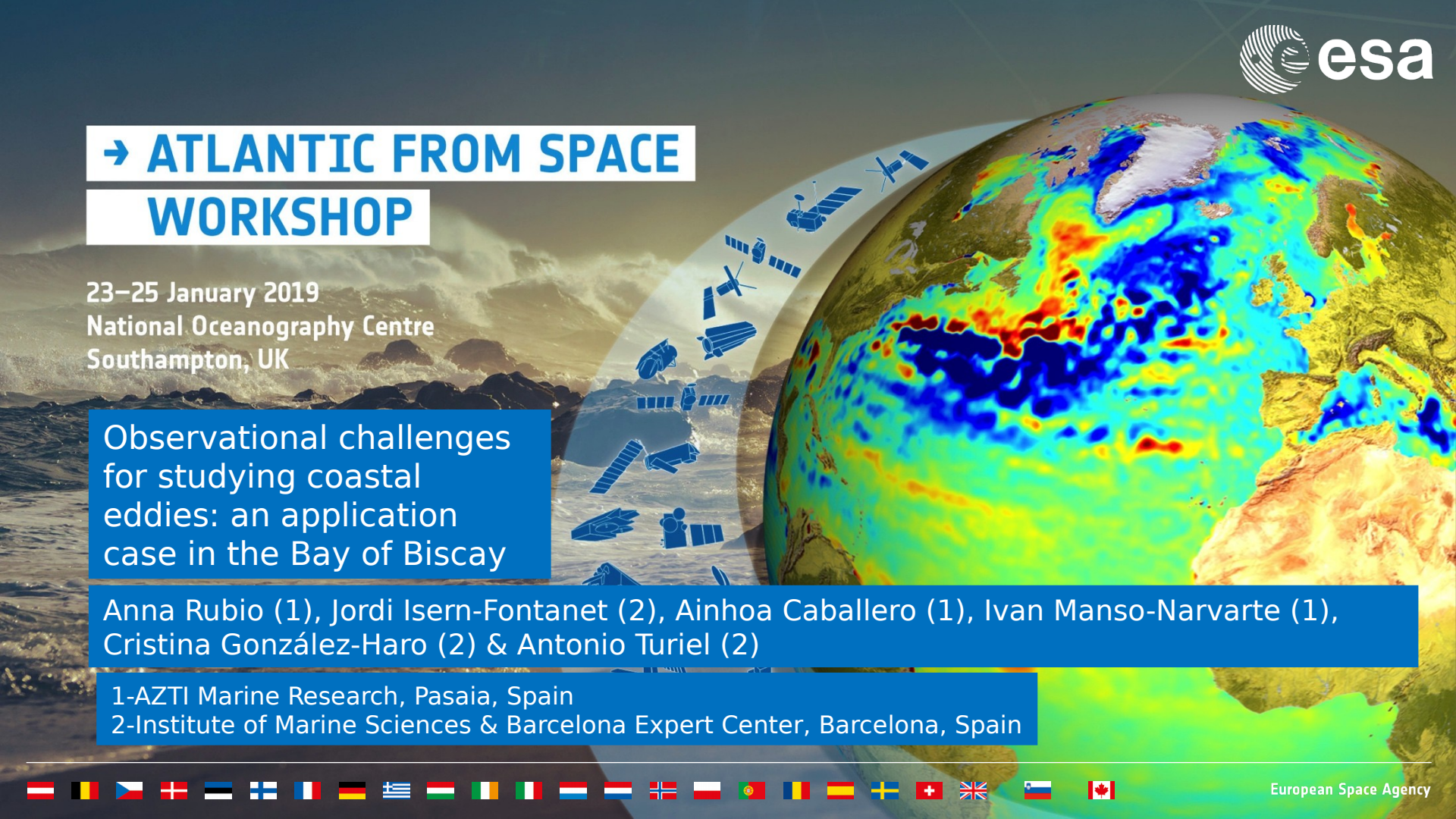

→ ATLANTIC FROM SPACE WORKSHOP

23–25 January 2019
National Oceanography Centre
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Observational challenges for studying coastal eddies: an application case in the Bay of Biscay

Anna Rubio (1), Jordi Isern-Fontanet (2), Ainhoa Caballero (1), Ivan Manso-Narvarte (1), Cristina González-Haro (2) & Antonio Turiel (2)

1-AZTI Marine Research, Pasaia, Spain
2-Institute of Marine Sciences & Barcelona Expert Center, Barcelona, Spain

Observational challenges for studying coastal eddies: an application case in the Bay of Biscay

OUTLINE

1- OBSERVATION OF COASTAL SURFACE CURRENTS BY **LAND-BASED HF RADARS**

2- OBSERVATION OF **COASTAL EDDIES IN THE SE BAY OF BISCAY**

3- NEW APPROACHES FOR THE STUDY OF COASTAL EDDIES:

- HIGH-RESOLUTION SURFACE CURRENTS USING SURFACE QUASI-GEOSTROPHIC (SQG) APPROXIMATION

4- CONCLUSIONS AND FUTURE WORK

LAND-BASED HF RADARS

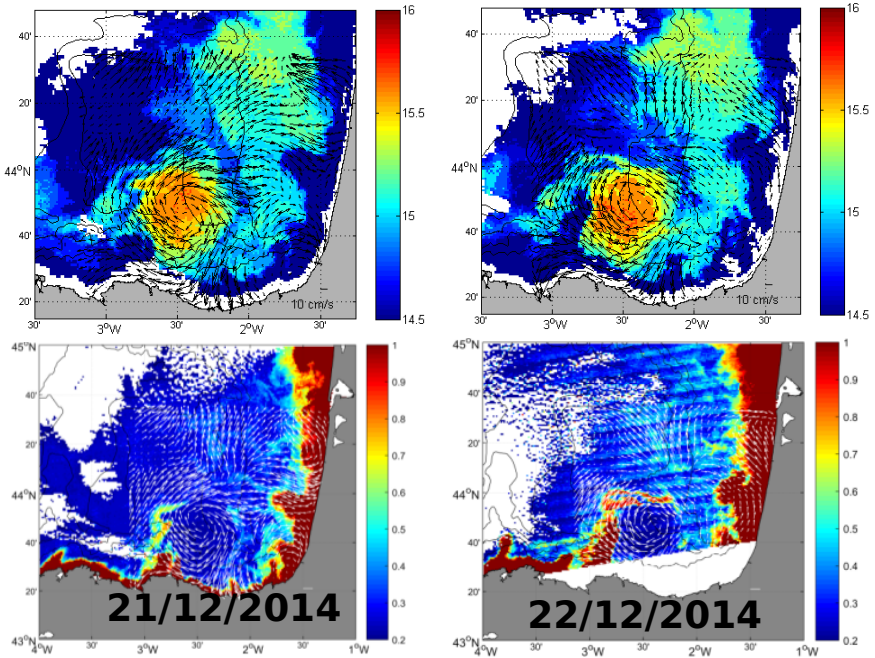
- Measure total surface currents
- The temporal and time scales resolved depend mainly on the operation frequency and available bandwidth

Typical scales	SE Bay of Biscay
Temp. resol. **10min – 3 hours**	**1 hour**
Range resol. **100 m – 12 km**	**5 km**
Max. range **200-300 km**	**150 km** (Good data)
Integration depth **10 cm - 3 m**	**1-3 m**

Rubio et al., 2017 Front. Mar. Sci. 4:8. doi: 10.3389/fmars.2017.00008

COASTAL EDDIES IN THE SE BAY OF BISCAY

EDDIES OBSERVED BY HF RADAR AND SATELLITE IR & VISIBLE



Rubio et al., 2018 RSE doi:10.1016/j.rse.2017.10.037

- Case study of an eddy monitored by remote sensing and HFR during 20 days
- Similar anticyclonic eddies were observed between November and March in other years (recurrent feature in SE BoB)
- Rubio et al. discussed on the effects of the eddies in the cross-shelf export of coastal waters.

Surface Quasi Geostrophy (SQG)

- For a non-divergent flow it is possible to define a stream-function such that

$$\vec{v}(\vec{x}) = \vec{e}_z \times \nabla\psi(\vec{x})$$

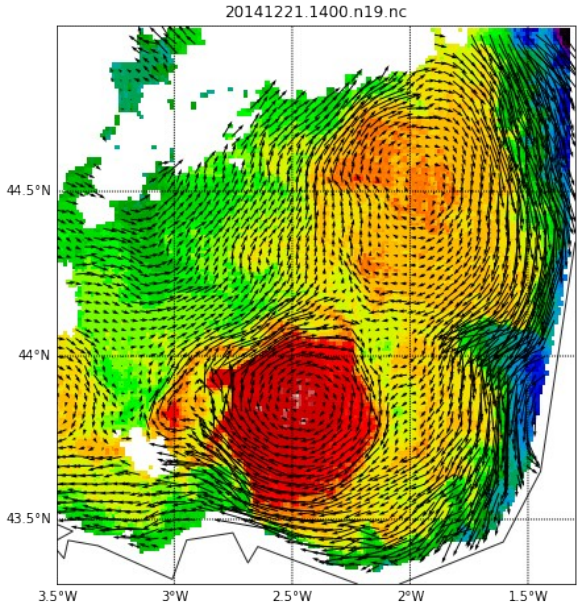
- The reconstruction of surface currents from SST is possible through the SQG approximation, if the environmental conditions are appropriate

$$\hat{\psi}(\vec{k}) \propto k^{-1}\hat{T}_b(\vec{k})$$

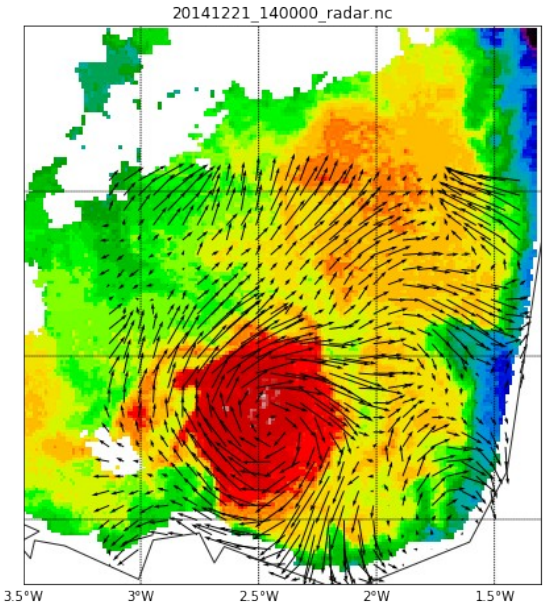
Lapeyre & Klein JPO 2006, Lacasce & Mahadevant JMR 2006, Isern-Fontanet et al. GRL 2006

December 21 2014 14:00

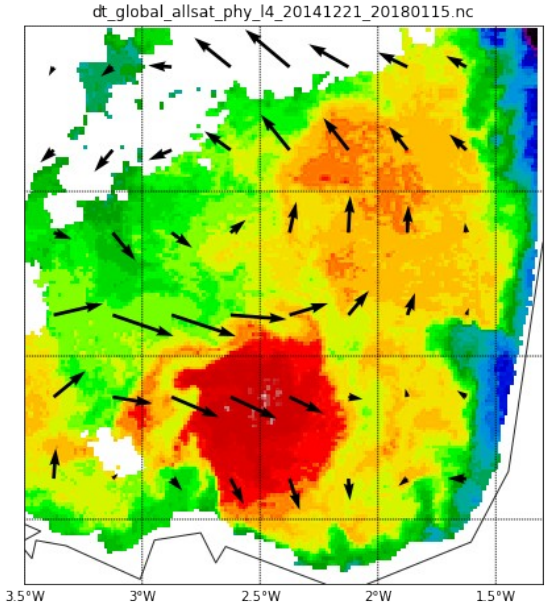
SQG



HF Radar

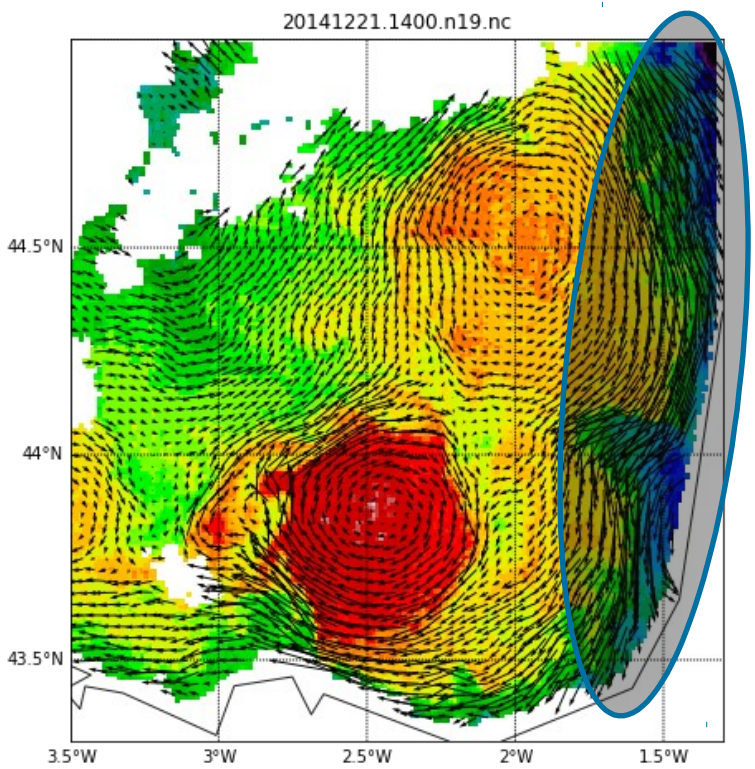


Altimetry



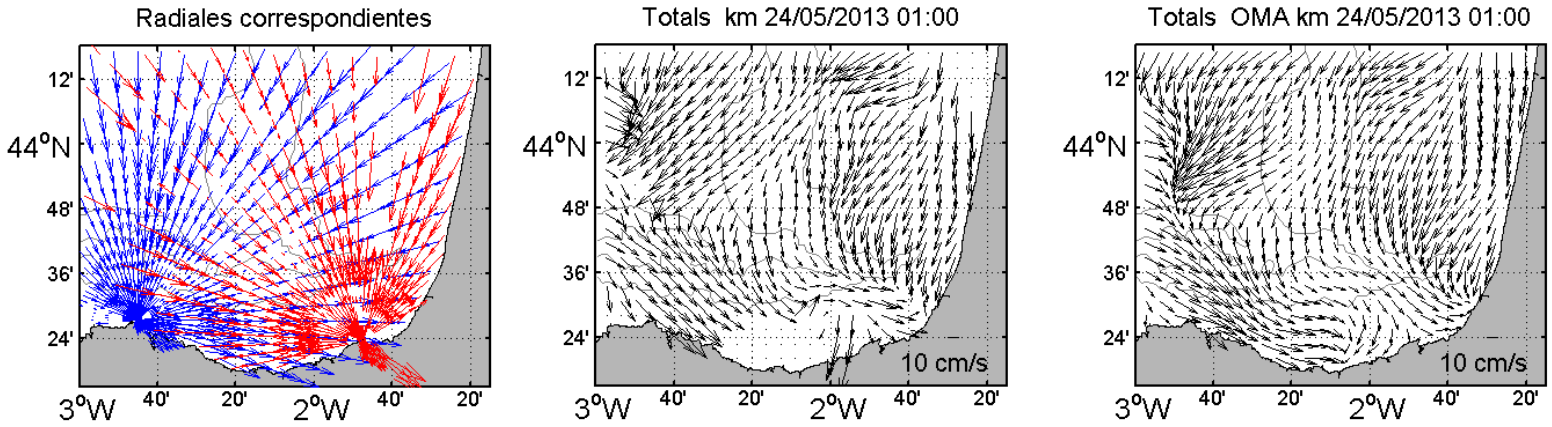
Limitations of SST + SQG

- SST patterns have to be correlated to subsurface potential vorticity patterns
- Phase shifts are typically introduced by:
  - Mixed Layer dynamics (e.g. Isern-Fontanet et al. JGR 2008, JPO 2014)
  - Salinty contribution (e.g. Isern-Fontanet et al. GRL 2017)
- Geostrophic currents: no-wind, no-tides, ...



Limitations of HF radars

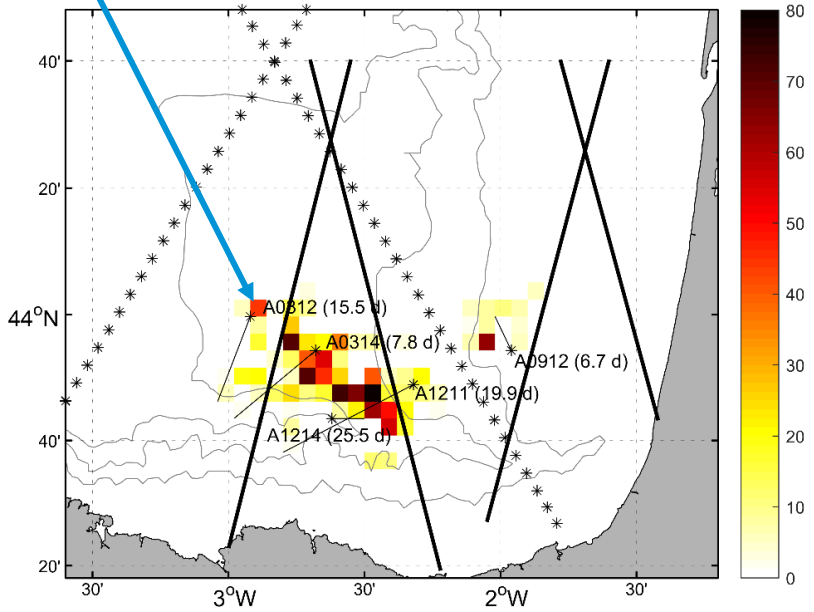
EXAMPLE OF HF RADAR CURRENTS IN THE SE BAY OF BISCAY



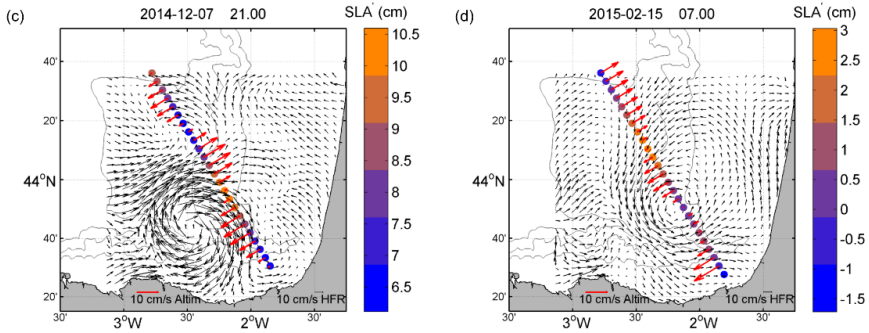
Limitations of altimetry

TRACKS OF JASON3 (DOTTED) AND SENTINEL 3/4 (for 2018)

Spatial distribution of the number of anticyclone cores (2011-2014)



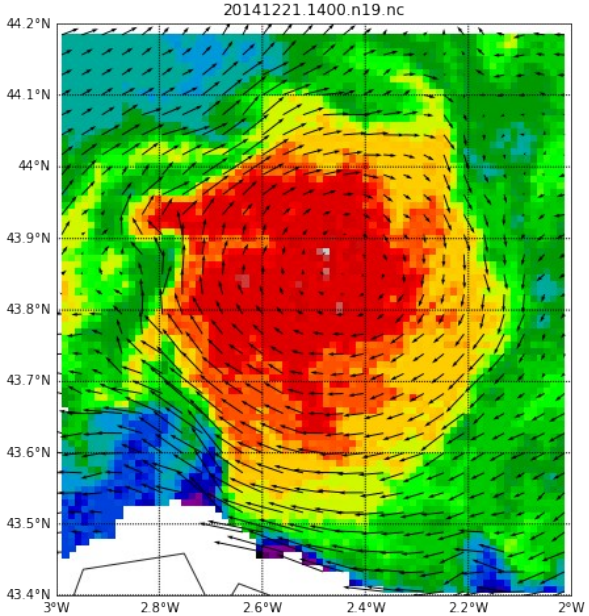
HF radar + along-track SLA (Jason3)

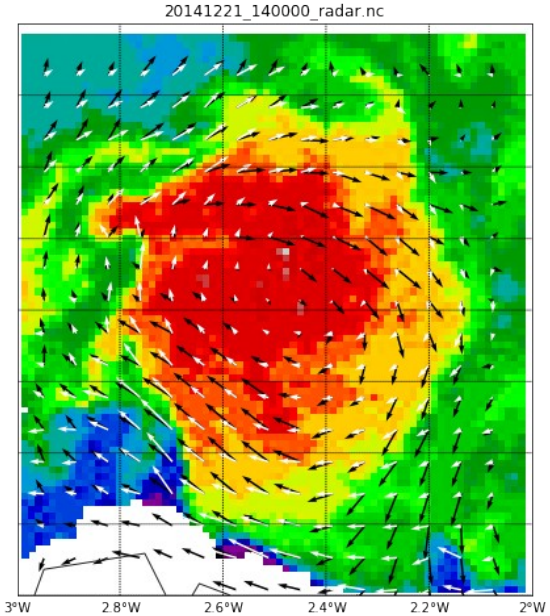


Manso-Narvarte, et al. 2018. Oc.Sci. doi:10.5194/os-2018-33.

Revisit period: Sentinel 3A: 23days
Jason 3: 10days

December 21 2014 14:00





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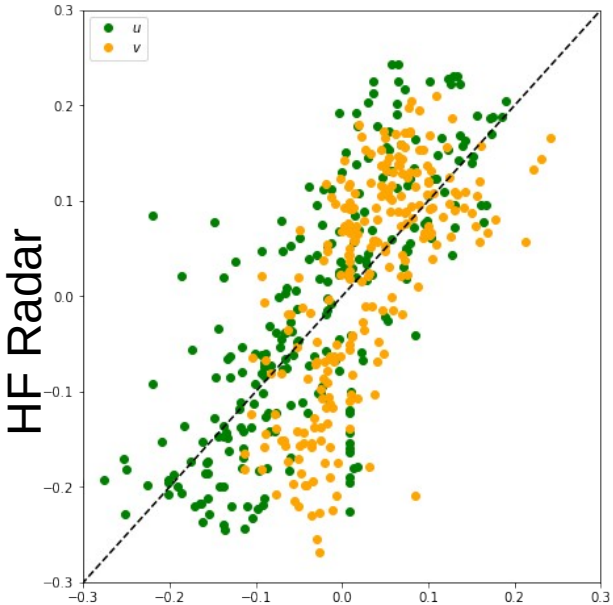

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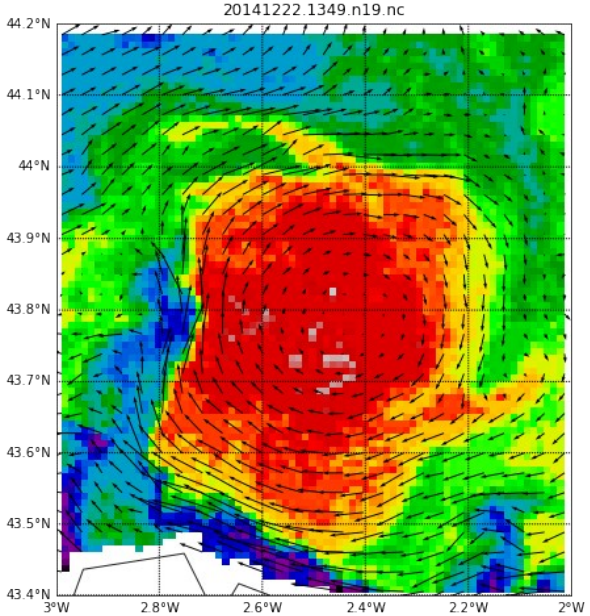

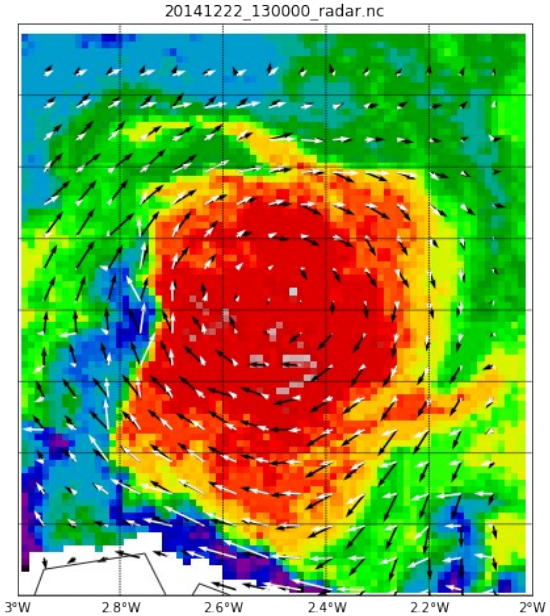

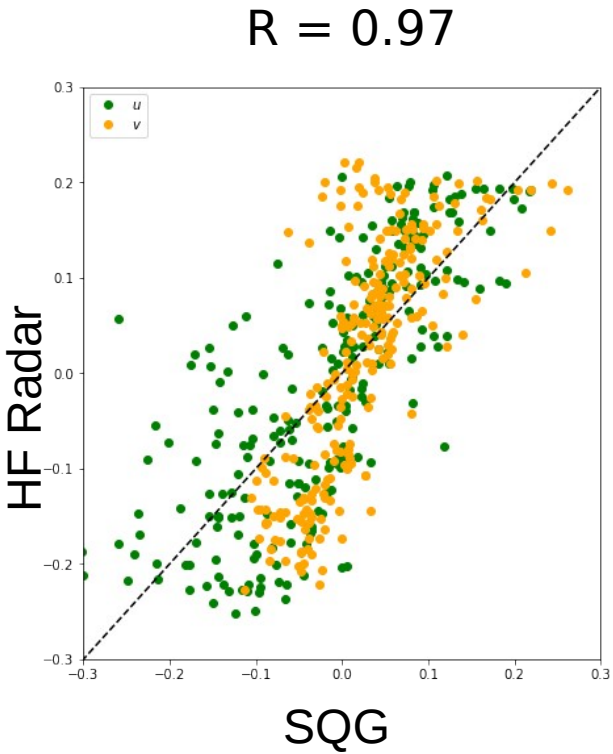

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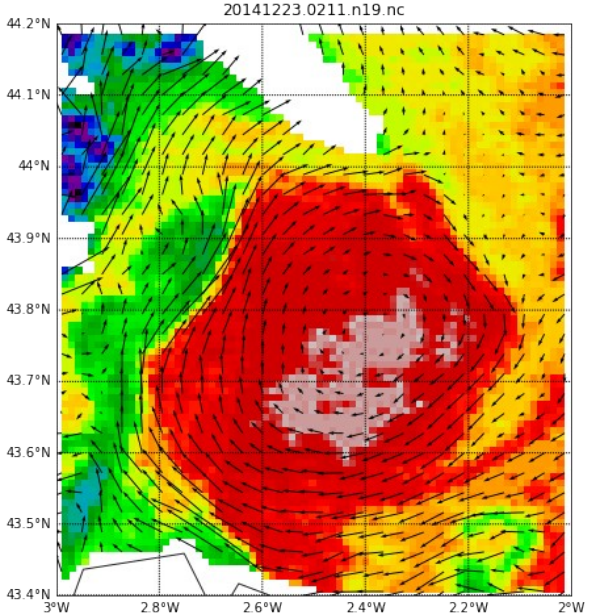

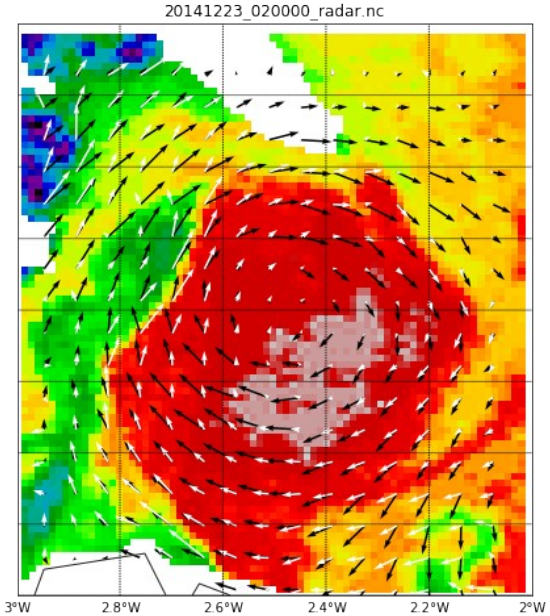

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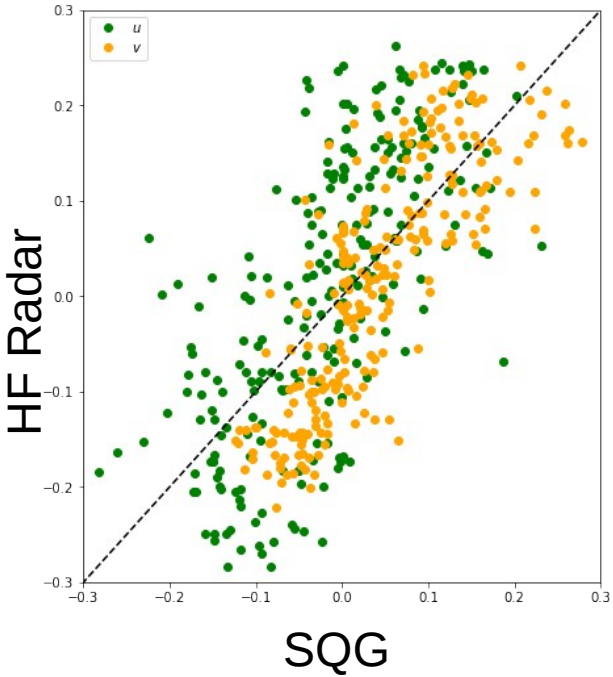
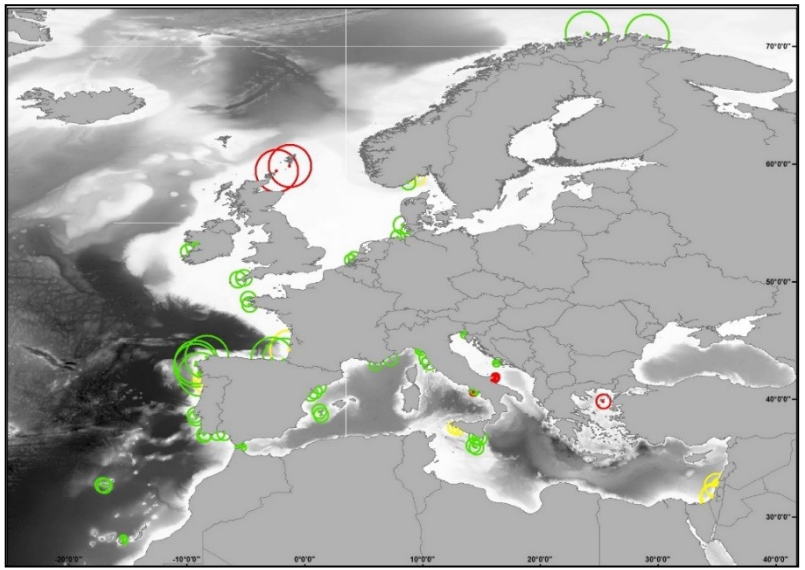


FUTURE WORK

- Merge SST-based information with HF radar
  - e.g. SST-phase + HFR spectra (Isern-Fontanet et al. JPO 2014, González-Haro et al. JGR 2014)
  - Others: low resolution SST (AMSR2) or L-band SSS

- Extend the reconstruction of coastal currents along the whole Atlantic coast
  - Improve gaps in HF radars
  - Retrieve currents in areas not covered by HF Radar



From: Present and future of the European HF radar network: outcomes of the INCREASE project.Rubio et al. 2018. The 4th Orca meeting. Okinawa (Japan).

CONCLUSIONS

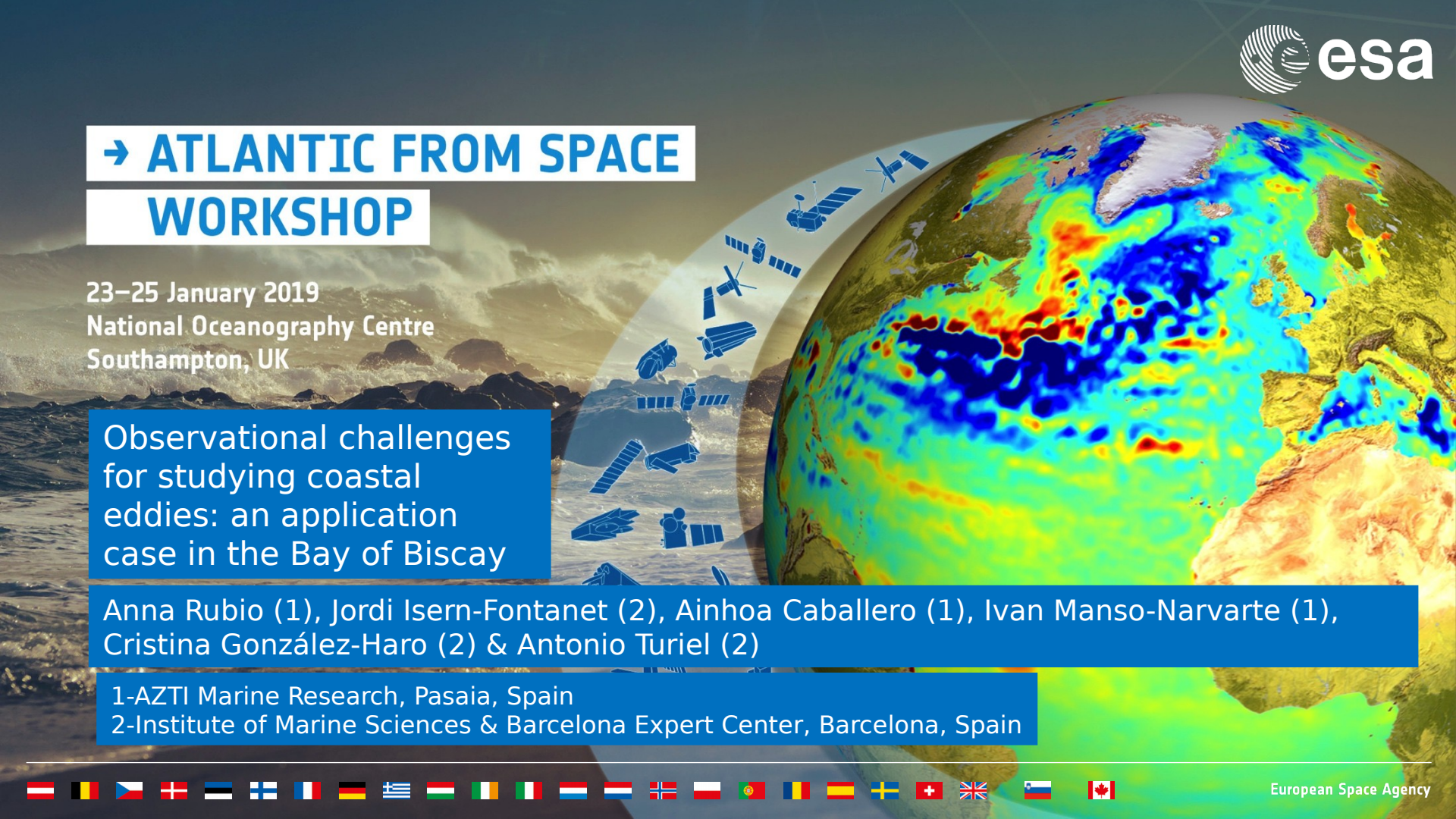
- Observed recurrent coastal eddies by a land-based HF radar in the SE Bay of Biscay play a significant role in the export of coastal waters towards the open ocean (Rubio et al. 2018).

- Their observation using satellite measurements and radar HF is possible but limited by the discontinuous coverage and/or resolution of the data.

- **The SQG approximation on visible and satellite IR data allows to retrieve the 3D dynamics of eddies** (under appropriate environmental and dynamical conditions).

CONCLUSIONS

- These eddies could play a very significant role in the transport of water masses in the Atlantic. In the absence of an extensive HF radar network along the basin coast, **the combined use of HF radars and remote sensing maps to extract dynamic information on these coastal processes emerges as a promising approach.**



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