# Surface currents in the Mercator Océan global and regional systems: validation against observations, use for application and feasible improvements.

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Ocean Forecasters

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# OUTLINE

- **Mercator operational systems**

- **Overview of calibration and validation**

- **Use of current estimates and forecasts: some relevant applications**

- **Improving operational current estimates using bias correction**

# Systems

# MERCATOR systems

**Based on the <span style="color:red">NEMO</span> ocean modeling platform and the <span style="color:red">SAM2</span> data assimilation system (Variables assimilated: SLA, SST, in-situ T/S profiles). Biogeochemical model based on <span style="color:red">PISCES</span>**

**Atmospheric forcing: <span style="color:red">ECMWF</span>**

- **Operational systems**
  - ¼° global model (PSY3)
  - 1/12° Atlantic model (PSY2)
  - 1/12° global model (PSY4)
  - 1/36° North East Atlantic model (IBI36, tides, no assim., also operated by Puertos del Estado for MyOcean)
  - 1° global biogeochemical coupled system (BIOMER1V1)
  - 2° and 1° global model (PSY2G, for climatic applications)
- **Other systems**
  - ¼° global model for reanalyses (GLORYS, 1992-2009)  (DRAKKAR)
  - 1/12° and 1/36° Mediterranean models (MED12, MED36)

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# Mercator Océan and the operational oceanography framework

- Mercator operational systems contribute to the Global and IBI component of MyOcean and the Marine Core Service

- Mercator operational systems have a high degree of integration in the MyOcean System

- Mercator Océan is contributing to GODAE Ocean View, a framework for discussing/planing actions concerning the global ocean observing system, operational systems intercomparison, R&D activities etc….

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# VALIDATION

# Near-real time validation of currents (1/2)
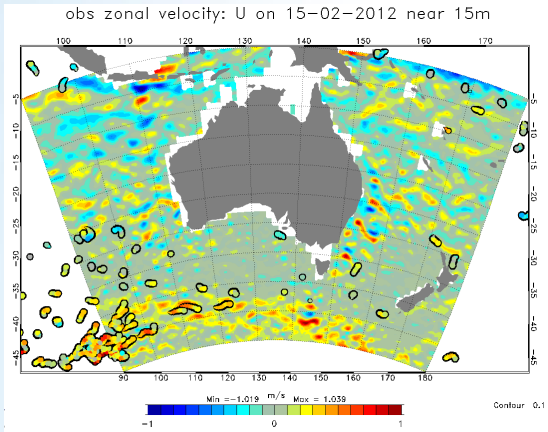
- **Comparisons to:**
  - CORIOLIS Drifters

    (GTS drifters → Météo-France (CMM) → CORIOLIS)
  - surface currents deduced from altimetry and wind (SURCOUF, CLS)

- **Limitations**
  - Limited number of drifters, drogue loss problem (despite control), what do really measure the drifters (slip, windage, current depth)?
  - SURCOUF is not an independent product because of assimilation of SLA in model, estimates are not provided in coastal areas, and less accurate close to the equator
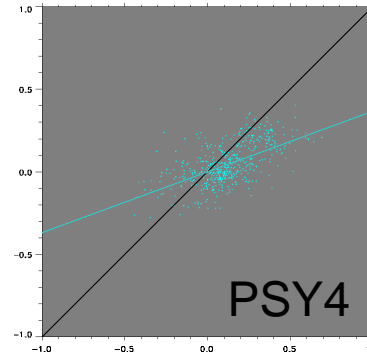
# Near-real time validation of currents (2/2)
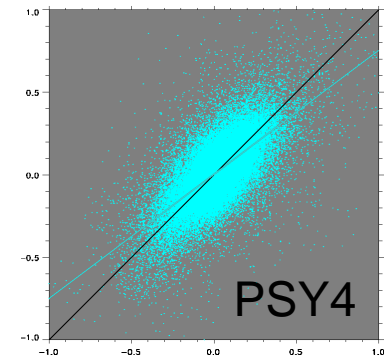
- **Weekly validation**



Drifters/SURCOUF
surf. Zonal vel.
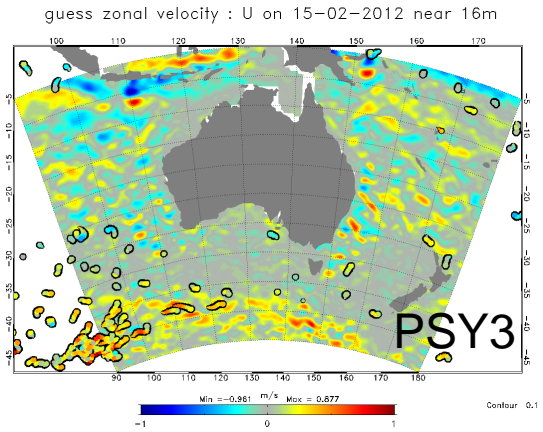
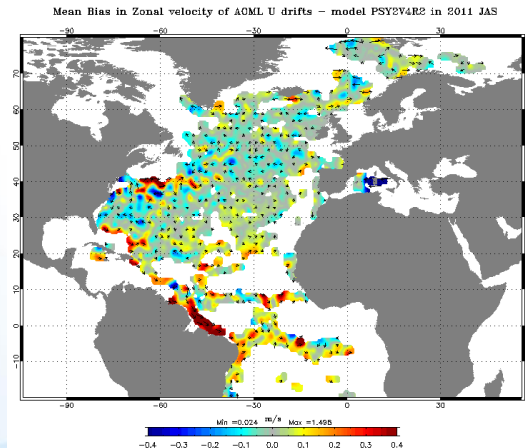Drifters/model
surf. Zonal vel.
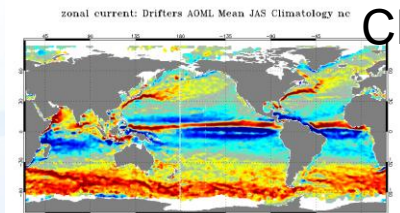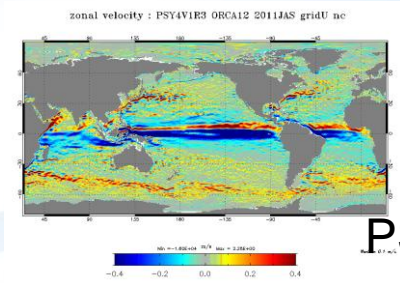
Drifters/model
surf. Zonal vel.

SURCOUF/model
surf. Zonal vel.

- **Quarterly validation: eg, AMJ 2011 mean bias**



Mean bias of
Surf. zonal velocity
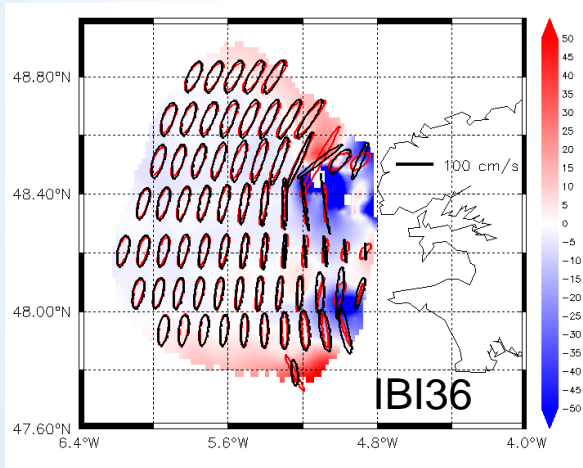(drifters – model)

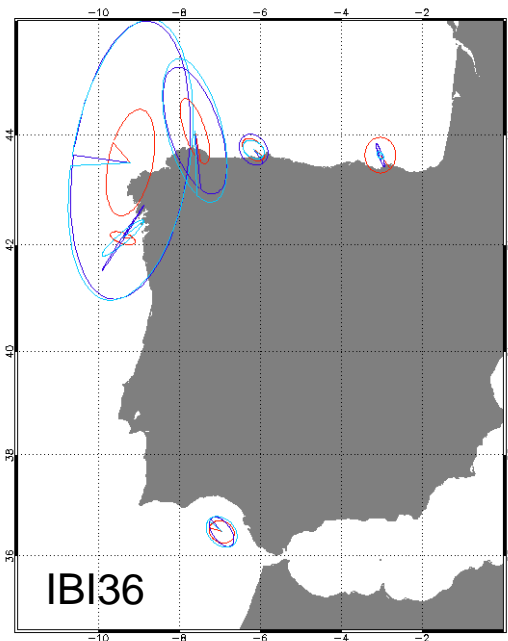Comparisons to
AOML drifters
climatology

# Delayed time validation of currents

- **Comparisons to:**
  - Current-meters from fixed stations
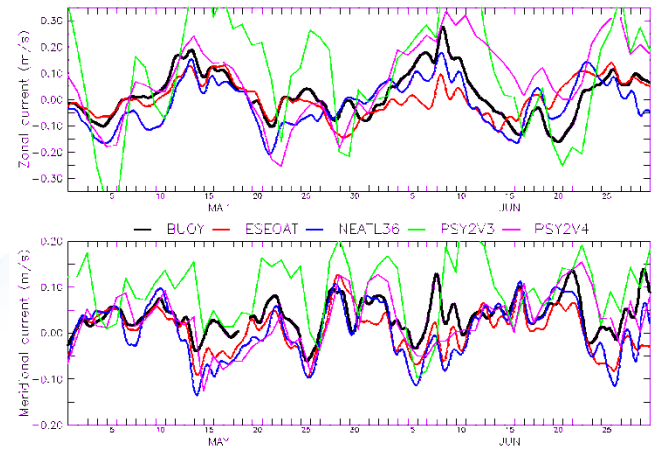  - ADCP
  - HF radar
  - Other products …



M2 amplitude in Iroise Sea
Tidal ellipses and difference
(SHOM HF radar and model)



M2 tidal ellipses
(in-situ measurements and models)
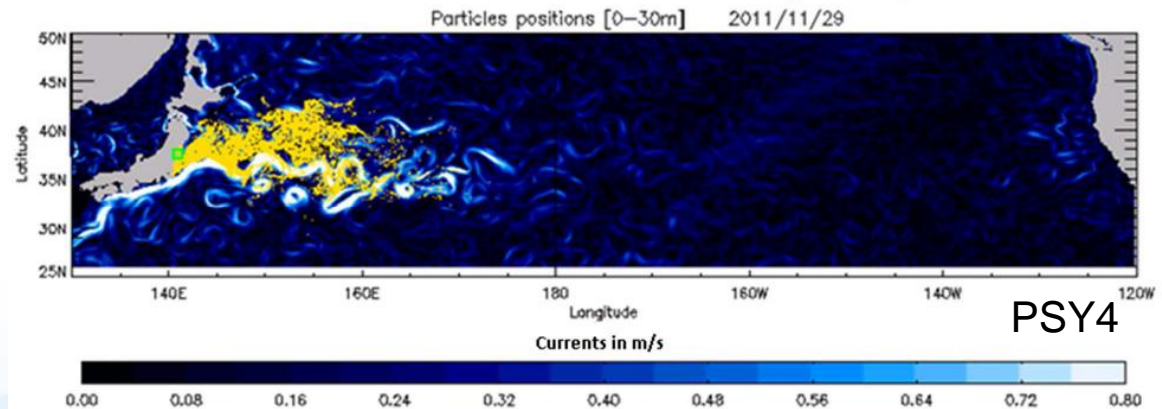
IBI36 / PSY2v3 / PSY2v4 / ESEOAT



Residual velocities at
Estaca de Bares buoy
(in-situ and models)

# APPLICATIONS

# Drift applications

- **Background ocean currents for Météo-France drift modelling operational applications with MOTHY**
  - E.g.: assistance for refining reverse drift computations in the case of AF447 wreckage (need for assimilation of reliable velocity observations)

- **Estimation of the dispersion of large pollutions at ocean basins scale (ariane tool)**
  - E.g.: estimate of Fukushima effluents dispersion (ARIANE tool)

**Real time estimate of Fukushima effluent dispersion, MONTHLY SCALE**

Particles positions [0-30m]     2011/11/29

PSY4

Currents in m/s

0.00   0.08   0.16   0.24   0.32   0.40   0.48   0.56   0.64   0.72   0.80

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# Use of MERCATOR surface currents in the ECMWF forecasting system (J. Bidlot, ECMWF)

**Impact study of using MERCATOR surface currents in the ECMWF**

forecasting system

**=> Surface currents**

can have a beneficial impact of the quality of ocean wave analysis and forecasts.



Wave height bias with respect to ENVISAT and Jason 2 (model - alt)
IFS/WAM T1279 dcwv first guess 2011-07-01 - 2011-08-31
reference, NO surface currents (0001)
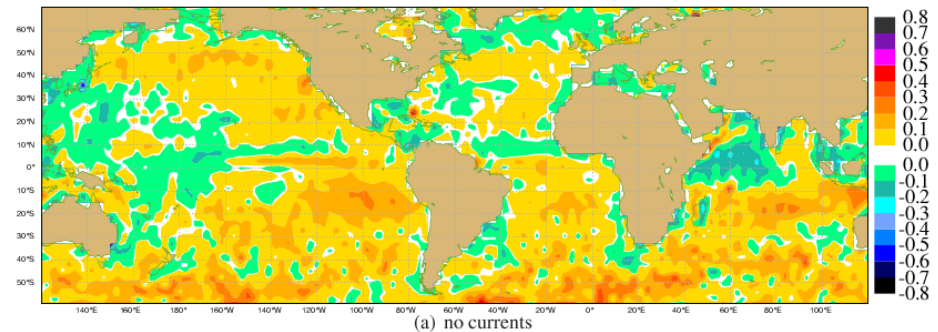
(a) no currents

Wave height bias with respect to ENVISAT and Jason 2 (model - alt)
IFS/WAM T1279 dcwv first guess 2011-07-01 - 2011-08-31
with surface currents (fk11)

(b) with currents

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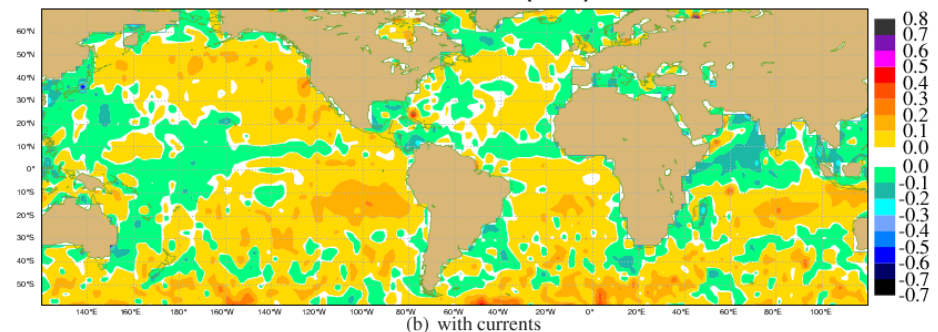
# BIAS CORRECTION

# Bias correction based on assimilation approach (E. Greiner, CLS) (1/2)

- **Objective: set up a method to correct large scale bias of velocity fields in analysis and forecasts ocean systems.**

- **Method**
  - Apply a quality control on the observations (drifters, corrected by M.H. Rio, CLS)
    - Correction of the slip (0.07% of the wind speed)
    - Correction of the windage (up to 3% of the wind speed in the case of drogue loss)
    - Estimation of the error
  - Variational analysis
    - Use 48h averaged model currents at 15m depth

- **Not yet applied to forecasting systems**

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# Assimilation of velocity: bias correction (E. Greiner, CLS) (2/2)

- **Ex: in the Medit. Sea**
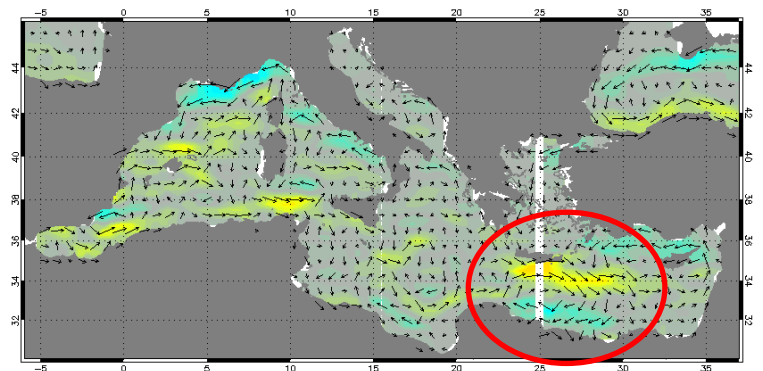  - Circulation strengthened in the south of Crete, inversed in the north of Egypt

Without correction



U guess 2008{01,02,03}*
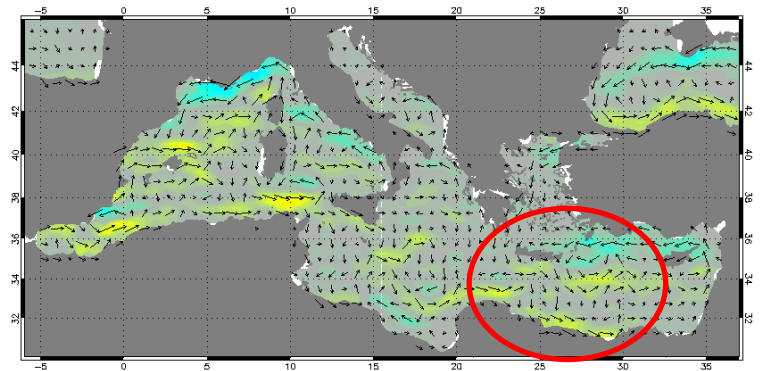
With correction



U ana 2008{01,02,03}*

# SUMMARY

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- **Operational oceanography supports upper ocean applications and provide ocean current for different users:**
  - Security: oil spill, contaminations, accidents
  - Shipping, entertaining/sport activities
  - Others… climate, defence…

- **Mercator Ocean provides daily estimates and forecasts of 3D ocean currents, at different scales: global eddy-permitting to regional submesoscale, including tidal and high frequency upper ocean dynamics.**

- **Available ocean current observations (derived from satellite altimetry, and drifting buoys) are used in near-real time to validate the operational products.**

- **In R&D and delayed cal/val mode, a larger set of ocean currents observations is used (ADCP, mooring data, HF radar, deep currents from floats etc….)**

- **Mercator Ocean is implementing assimilation-based techniques to improve current estimates, using available observations, and trying to limit the impact of their errors.**

- **Every new observations dataset provided in real-time will be highly considered for operational oceanography. We need:**
  - RT delivery operational (daily)
  - Quality control, error < 5 cm/s
  - Adapted to forecasting space scale

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