

Ocean surface currents: some
aspects of model control, validation
and operational applications in the
marine industry

Fabrice Bonjean
(fabrice.bonjean@sat-ocean.com)

SAT-OCEAN

OSCAR Near realtime x
www.oscar.noaa.gov

National Oceanic and Atmospheric Administration

OSCAR Ocean Surface Current Analyses - Real time

Home Project Overview Data Display & Download Validation General Interest

Near-realtime global ocean surface currents derived from satellite altimeter and scatterometer data

5-Day Interval Surface Current, February 25, 2012 → 1.0 meter/sec
Latest realtime data

New Updates!

- * High resolution 1/3 degree data available, for all plot types, with expanded latitudinal extent
- * Validation graphics comparing OSCAR with [moored buoys](#) and [global drifters](#)
- [Global Dataset for Display and download at 1 degree and 1/3 degree resolution](#)
- [Peer-reviewed scientific publications using OSCAR data](#)
- [OSCAR data available through OPeNDAP/DODS](#)

Pilot project for a NOAA/NESDIS
Operational Surface Current Processing and Data Center
[National Ocean Partnership Program \(NOPP\)](#)

Home | [Project Overview](#) | [Data Display & Download](#) | [Validation](#) | [General Interest](#)

OSCAR Project Office
Earth and Space Research

[webmast.oscar@noaa.gov](#)
[Credits](#) | [Disclaimer](#) | [Privacy Policy](#)

www.sat-ocean.com

The screenshot shows the homepage of SAT-OCEAN. The browser window title is "Home - SAT-OCEAN - Chromium". The address bar shows "www.sat-ocean.com". The website has a dark blue header with the SAT-OCEAN logo and a navigation menu with links for Home, Services, About us, References, Contact, and Customer Area (with a lock icon). Below the header is a section titled "OPERATIONAL APPLICATIONS :" with five sub-sections: SHIP ROUTING (with a ship icon and image of a ship), ON SITE FORECAST (with a weather icon and image of an offshore rig), METEOCEAN STUDIES (with a bar chart icon and image of a satellite), RENEWABLE ENERGIES (with a wind turbine icon and image of wind turbines), and SEISMIC SURVEY (with a seismic icon and image of a ship at sea). Below this is a paragraph of text: "SAT-OCEAN provides weather and oceanographic services to the marine industry. Our exclusive metocean solutions based on environmental satellite data are designed to forecast and hindcast ocean currents, wind and waves anywhere in the world. Our customers take advantage of proven and efficient forecast services to secure their operations at sea, improve performance or save time. They also benefit from our historical studies for operations planning, design or risk assessment. Oil and gas, drilling, shipping, towing, seismic or renewable energy related players have been calling on our expertise for over 10 years." At the bottom, there are logos for TOTAL, Shell, Transocean, and another logo with a 'W'. To the right is a "Customer Area" button with a "CONNEXION" sub-button.

Home - SAT-OCEAN - Chromium

Home - SAT-OCEAN

www.sat-ocean.com

SAT-OCEAN

Home Services About us References Contact Customer Area

OPERATIONAL APPLICATIONS :

- SHIP ROUTING**
- ON SITE FORECAST**
- METEOCEAN STUDIES**
- RENEWABLE ENERGIES**
- SEISMIC SURVEY**

SAT-OCEAN provides weather and oceanographic services to the marine industry. Our exclusive metocean solutions based on environmental satellite data are designed to forecast and hindcast ocean currents, wind and waves anywhere in the world. Our customers take advantage of proven and efficient forecast services to secure their operations at sea, improve performance or save time. They also benefit from our historical studies for operations planning, design or risk assessment. Oil and gas, drilling, shipping, towing, seismic or renewable energy related players have been calling on our expertise for over 10 years.

TOTAL **Shell** **Transocean** **W**

Customer Area

CONNEXION

OPERATIONAL APPLICATIONS



Surface currents:
real-time and
forecast

Speed gains, time and fuel savings

Towing (rig/FPSO mobilization, moves, new builds), heavy lifters, tankers or container-carriers...

OPERATIONAL APPLICATIONS

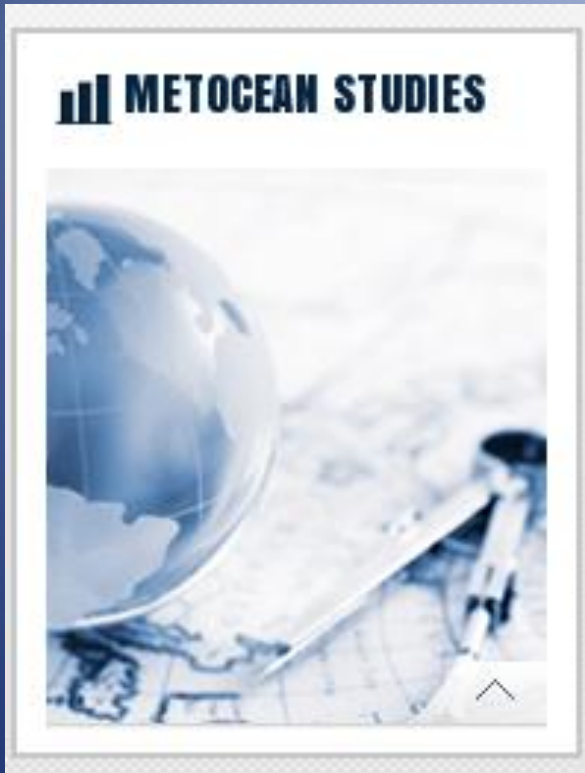


Surface currents:
real-time and
forecast

24/7 metocean forecast services worldwide.
Real-time reports include 2D or 3D current, wind and wave forecasts.
Operators and contractors assess their risk and optimize operations in
real time.

Drill-ship, FPSO, rig, barge , oil-spill monitoring

OPERATIONAL APPLICATIONS



Surface currents:
hindcast

Historical statistical studies (hindcast) of ocean currents.

2D or 3D current based on the most recent 2 to 10 year environmental variability.

Operators and contractors gain a thorough understanding of metocean conditions on site.

Operations planning: riser & rig design, field development studies,
pipe laying, ocean current data mining

for renewable energy related operations (site selection).

OPERATIONAL APPLICATIONS



Surface currents:
hindcast

Ocean surveys around the world dedicated to the assessment of energy production potential using the **ocean currents and hydrokinetic devices**.

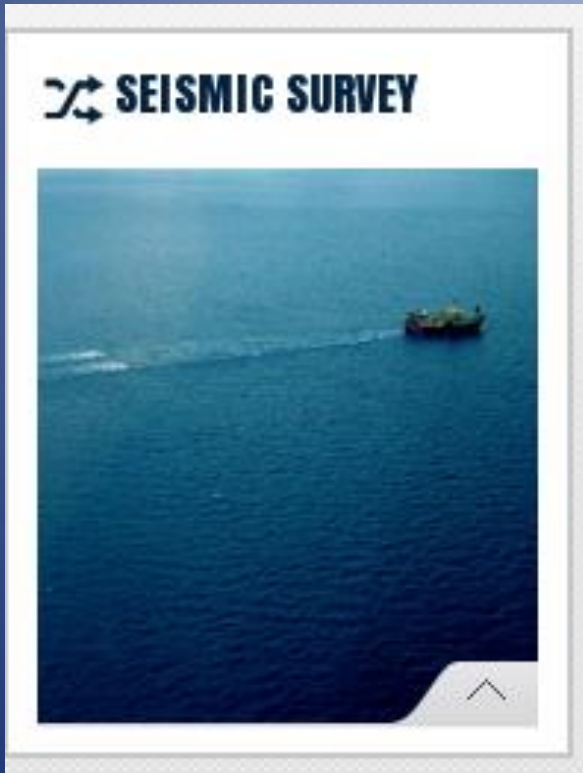
Detailed reports down to 1/64th of a degree resolution.

“Big picture” (through maps and animations) of the presence of strong and steady horizontal currents.

Customers get the capability of forecasting potential business earnings in the future, and anticipating engineering requirements, from site locations to worst case scenario events.

Points of major interest are selected that provide the best spots in terms of current strength, steadiness, distance to coast, bathymetry, and any other constraint required.

OPERATIONAL APPLICATIONS



Surface currents:
real-time and
forecast

Very high resolution ocean currents required (down to 1/64th of a degree).

High level real-time forecast service dedicated to offshore seismic surveys optimization.

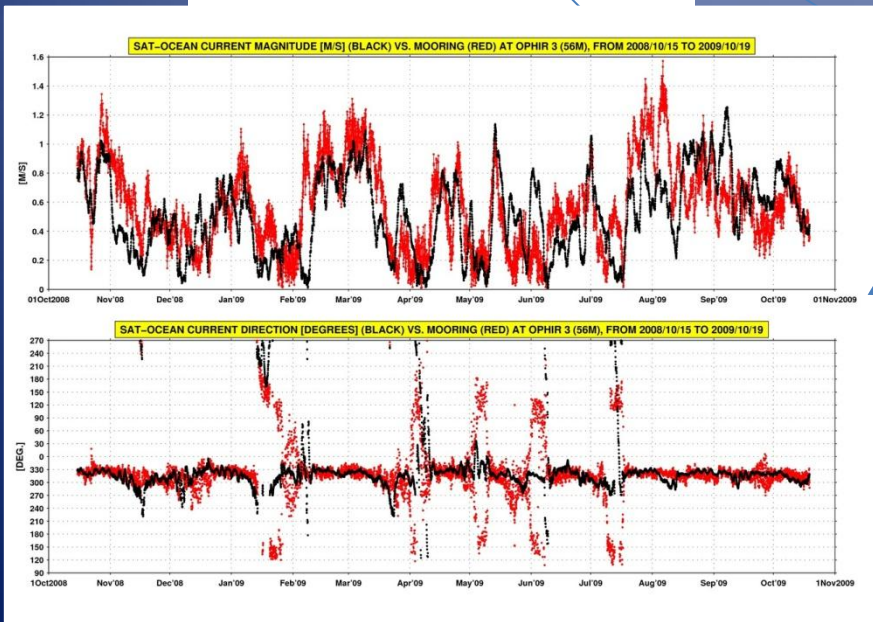
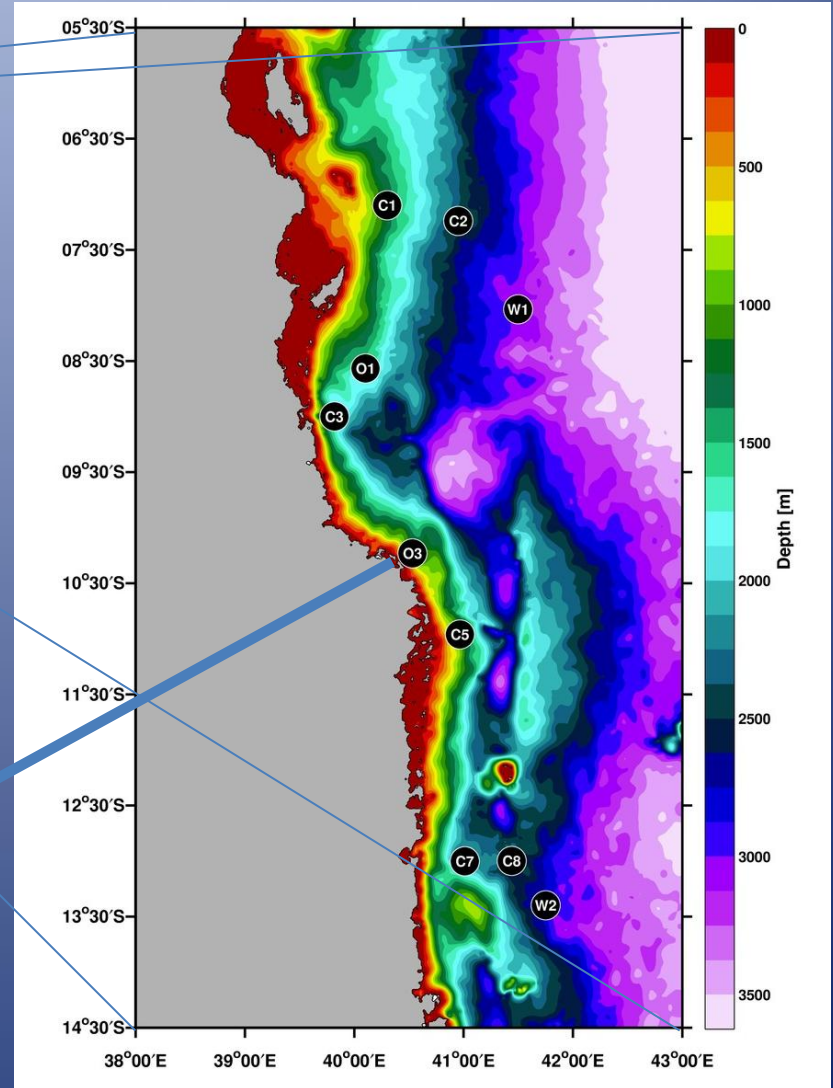
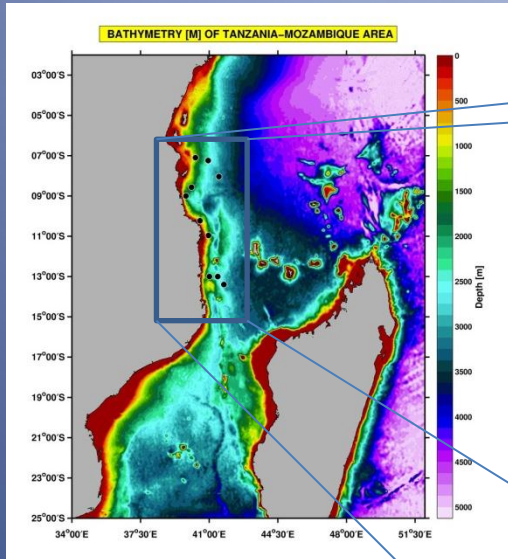
Provide streamer depth ocean current and feather forecast.

Operators calibrate their racetrack strategy on current forecast trend, optimize their infill, anticipating currents and consequent feather, reduce time filling “holes”, secure close-passes

PRODUCT VALIDATION

- Often O&G operators build an in-situ database over a specific target area and time period.
- Most often: mooring data at their location of interest, or shipboard ADCP data
- Data available after hindcast dataset delivery.
- Sometimes competition between providers.
- Comparisons to observations are also carried out in real-time

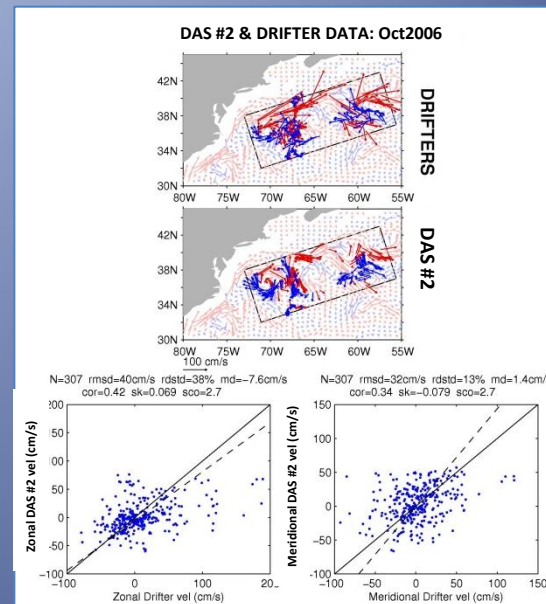
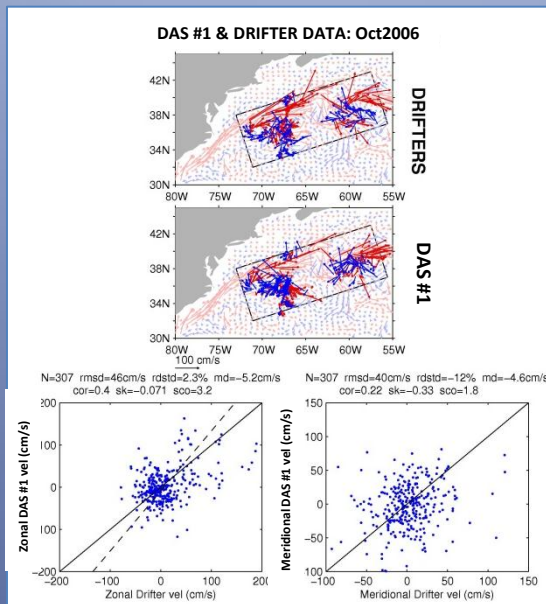
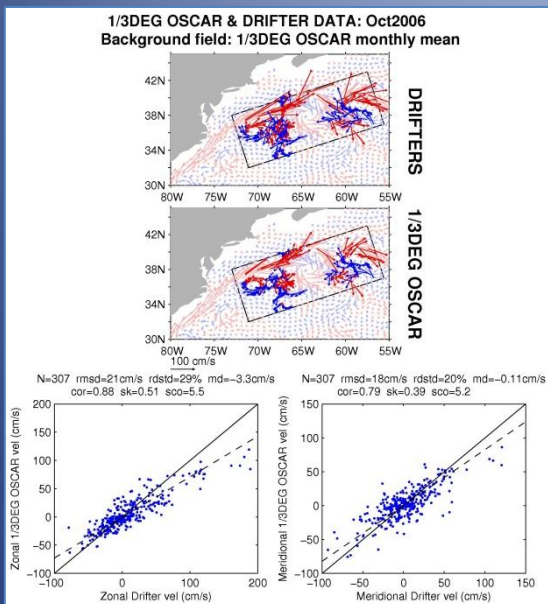
PRODUCT VALIDATION EXAMPLE: JIP/TAMOMS



PRODUCT VALIDATION

- Pointwise validations (mooring time series)
 - Rms of difference, direction difference, correlation, spectrum comparison analysis, etc...
 - Distribution comparison analysis: joint speed & direction occurrence distribution, marginal distributions, speed cumulative distribution, Q-Q plots, etc...
 - Amplitude maximum, extreme value distribution, etc...
- Along-ship track real-time comparisons (mostly with shipboard ADCP data during seismic survey)
- Drifting buoys
- Next?

PRODUCT VALIDATION



•GS area •Oct.05-Dec.06 •Drifters •N=3583 •ΔT=1 day	RMSD (cm/s)		RDSTD (%)		MD (cm/s)		COR		SKILL		SCORE (max=10, min=0)	
	U	V	U	V	U	V	U	V	U	V	U	V
	OSCAR 1/3°	22	21	22	19	-4.4	-1.7	0.83	0.78	0.44	0.37	5.4
OSCAR 1°	26	23	44	46	-3.6	-2.1	0.77	0.73	0.34	0.29	4.1	3.8
SURCOUF	21	20	18	16	-3.2	-1.0	0.84	0.79	0.46	0.39	5.7	5.4
DAS #1	38	37	-2	-4	-2.4	-3.8	0.52	0.39	0.04	-0.1	3.8	2.9
DAS #2	36	33	48	45	-2.4	-1.8	0.36	0.25	0.08	-0.0	2.5	2.1
DAS #3	37	33	81	87	1.6	-1.6	0.28	0.07	0.06	0.0	1.9	1.4
DAS #4	37	33	87	92	-2.2	-2.5	0.35	0.13	0.07	0.0	1.9	1.5
DAS #5	38	32	88	89	0.52	-1.7	0.23	0.2	0.05	0.02	1.7	1.6

•EQPAC area •Oct.05-Dec.06 •Drifters •N=11859 •ΔT=1 day	RMSD (cm/s)		RDSTD (%)		MD (cm/s)		COR		SKILL		SCORE (max=10, min=0)	
	U	V	U	V	U	V	U	V	U	V	U	V
	OSCAR 1/3°	18	16	23	42	3.8	0.0	0.87	0.56	0.5	0.17	5.7
OSCAR 1°	19	16	24	51	3.1	0.27	0.87	0.57	0.49	0.18	5.6	3.1
SURCOUF	19	17	20	46	1.0	0.77	0.85	0.47	0.48	0.12	5.7	2.8
DAS #1	24	22	11	-4	6.8	-0.4	0.77	0.42	0.34	-0.1	5.4	3.1
DAS #2	25	23	-8	-2.4	2.6	0.87	0.79	0.34	0.32	-0.16	5.5	2.8
DAS #3	27	19	19	60	9.9	0.9	0.74	0.25	0.27	0.02	4.6	2
DAS #4	24	19	37	62	0.54	0.13	0.77	0.26	0.35	0.03	4.4	2
DAS #5	28	19	54	60	1.9	-0.3	0.66	0.33	0.23	0.05	3.3	2.2

(DAS = GCM-based Data Assimilation System)

(GODAE – Bonjean et al, 2008)

MODEL CONSTRAINT

- Reasonable idea to constrain models using diagnostics current fields
- Geostrophic velocity: only global field directly related to surface currents and monitored in DT and NRT (from alongtrack AVISO). However not always the preeminent dynamics/diagnostics field that characterizes the total surface currents variations.
- SST

Conclusion

Suggestions (for discussion)

- Total surface current velocity (tides, Stokes drift, inertial motion, etc...), (characteristic depth)
- Needs:
 - “Pure” observational database of total current
 - Best estimate of velocity field (merging, diagnostic model etc...)
- Assessment of the EO-based product usefulness
Rmsd, correlation to , but also speed/direction distribution, extreme speed values, ...