

Norwegian Meteorological Institute

Marine forecasting and research at MET Norway - Bergen

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Overview

Forecasting trajectories and waves Observations Autonomous platforms Possible collaboration

Norwegian Oil Fields



Oil drift service at MET

Spill trajectory forecast within 30 minutes at real events 24/7
Forcing data from ocean, atmosphere and wave models
Most important users: NOFO and Kystverket
Research&Development

·Staff of 400 (90 scientist) – 50 in Bergen (8 scientist)



National reponsibilities of MET Norway

Provide forecast of the transport and fate of oil in case of a spill/accident



Provide forecast of the transport of objects (person-in-water, life raft, boats, containers...) to support search and rescue operations





30 minute response time, at any time - operated by forecasters on duty



Norwegian Clean Seas Association for Operating Companies



Input from general forecast models



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Nesting of models







Wave models





Stokes drift, up to 1 m/s





Probability forecasting



Ocean models (ROMS) Arctic20 + Nordic4 + NorKyst800



NorKyst800



Daily mean speed at 3 m depth: 2013-02-27

Simulating drift of a large number of particles (Lagrangian elements)



Trajectory models at MET Norway

Downwind leeway

-90

OD3D (oil)

- Martinsen et al., 1994: The operational oil drift system at DNMI. Technical Report No. 125, Norwegian Meteorological Institute, Oslo, Norway, 52 pp.
- Wettre et al., 2001: Development of a 3-dimensional oil drift model at DNMI. Research Rep. No. 133, Norwegian Meteorological Institute, Oslo, Norway, 50 pp.
- Leeway (objects, persons and small boats)
 - Allen, A. A. and J. V. Plourde, Review of leeway: Field experiments and implementation. USCG RD center technical report CG-D-08-99. (1999)
 - cm/s Breivik . and A. A. Allen, An operational search and rescue model for the Norwegian Sea and the North Sea. J. Mar. Sys., 69, 99-113 (2008) doi:10.1016/j.jmarsys.2007.02.010
- ShipDrift (larger ships)





Crosswind leeway [cm/s]

Leeway speed [cm/s] and divergence at 10 m/s wind with error ellipses



Leeway speed [cm/s] and divergence at 10 m/s wind with error ellipses



Leeway speed [cm/s] and divergence at 10 m/s wind with error ellipses



Leeway speed [cm/s] and divergence at 10 m/s wind with error ellipses



Jibing probability: 4% per hour



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Purpose specific modules

OpenDrift - summary of features

- A new modular open source framework for lagrangian particle tracking
 Written in Python solely, using only standard libraries
 - clean code, following PEP8 style conventions
- · No installation necessary, platform independent
- · Good performance, due to economical use of disk/network access
- · Robust for operational use (priority list of input data)
- · Simple to implement and improve models/modules
 - may focus on the physical/chemical/biological processes
- Can use input data (wind/waves/currents...) from any file format (including online/remote), in any map projection
 - no need to preprocess input data
 - users may run model locally without needing to download current/wind/waves
- · May run forwards and backwards in time
 - e.g.: «which ship did release the oil?»

Avoid preprocessing of input data











through remote Thredds servers



OpenOil 2010-03-23 06:00 to 2010-03-31 14:00 (800 steps)

Leeway simulation with «Life raft»



GlobOilRisk – initialisation from remote sensing







Holey Sock, 15 m

iSphere and CODE drifters 2010-2014





Foto: Benn Ståle Johnsen

Hva er dette?

Arne Johnsen fra Svolvær fant denne «bøya» duppende i sjøen ved Risvær. Nå vil han gjerne vite hva det er!

Tweet 0

Q +1 < 0

Gullik Maas Pedersen

E-post

Skriv ut

Tips en venn

f Anbefal

0



Foto: Benn Ståle Johnsen

Mysteriet oppklart

Bøyen som Arne Johnsen fant utenfor Rivær er en del av et forskningsprisjekt,



Drift «model»

v = model_current + stokesdrift + a*wind



4

NOFO experiment June 2015: drifters



Modelled with wind drift only



2.25°E 2.3°E 2.35°E 2.4°E 2.45°E 2.55°E 2.55°E 2.6°E 2.65°E 2.7°E 2.75°E 2.8°E 2.85°E 2.9°E 2.95°E 3.9°E 3.05°E 3.1°E 3.15°E 3.2°E 3.25°E 3.3°E

Modelled with currents and wind drift



Using NorKyst800 and Arome

50 hour simulation

Testing GlobCurrent input



http://tds0.ifremer.fr/thredds/dodsC/CLS-L4-CUREUL_HS-ALT_SUM-V01.0_FULL_TIME_SERIE

Testing GlobCurrent input



http://www.github.com/knutfrode/opendrift

5) https://github.com/knu	utfrode/opendrift	▼ C'	♀ hovedredningssentra	alen → ☆ 🖻 🛡
This repository Search		Pull requests Issues Gist		🖍 +- 📓
knutfrode / open	drift		O Unwatch → 6	★ Star 5 % Fork
Open source framework f	or ocean trajectory modelling	— Edit		
T 133 commits	₽ 2 branches	🛇 0 releases	碗 1 contributor	<> Code
				() Issues (7
Branch: master - opendrift / +			:=	א Pull requests 0
Also environment variables (wind, current etc) are now also recorded			III Wiki	
knutfrode authored 7 days	ago	lates	st commit 69e290ff48 🔂	
Configobj	Added module six for python 2	Added module six for python 2-3 compatibility of configobj		-∳⊷ Pulse <u>III</u> Graphs
doc	Minor update of UML diagram.		8 months ago	
elements	Fixed exported datatype of netCDF flag attributes. Cleaned code accor		. 2 months ago	
export	Also environment variables (w	Also environment variables (wind, current etc) are now also recorded \ldots		C Settings
models	Also environment variables (w	Also environment variables (wind, current etc) are now also recorded		
readers	Updated seed_point() function to take vector of lon/lat paris as inpu		12 days ago	HTTPS clone URL
scripts	Plotting function for readers may now show one of the variables. Util		22 days ago	You can clone with HTTPS, SSH, or Subversion. [®]
test_landmask	Made LagrangianArray an Abs	Made LagrangianArray an Abstract Base Class 2 years		
.gitignore	Ignoring .pyc files	Ignoring .pyc files		Download ZIP
README.md	Update README.md	Update README.md		
example.py	Also environment variables (w	Also environment variables (wind, current etc) are now also recorded		
example_backandforth.py	Status now follows CF conver	Status now follows CF convention on flags in netCDF export. Status co		
example_fake.py	Introduced configobj for user (Introduced configobj for user (and web interface) configuration. Star		
example_import.py	Modified names of functions w	Modified names of functions which return number of elements to be mor 18		
example_leeway.py	First leeway commit. Running	First leeway commit. Running with fake values a n		
example macondo pv	Status now follows CF conver	Status now follows CF convention on flags in netCDF export. Status co		

The Offshore Sensing SailBuoy

- · GPS tracking and two way Iridium communication
- Navigates to GPS way points with 1-2 knots speed
- · Measures waves, T, S, Oxygen
- www.sailbuoy.no
- www.deep-c.org











Wave measurements at Ekofisk -November 2015



Controlled Meteorological Balloons



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Comparison of CMET and WRF Profiles





Troll Antarctica 2012



Antarctic Balloon Campaign 2013

Longest Polar Flight of a Controlled Meteorological Balloon - Launched from Aboa Station (13-01-18)

Participants: Lars Hole, Paul Voss, Tjarda Roberts, Timo Vihma, Aurora Stenmark, Lingyi Wu, Mika Kalakoski, Petri Heinonen, FINNARP Team





Possible student projects

- GUI for OpenDrift (python)
- Oil/Ice module for OpenDrift (python)
- Analysis tools for SailBuoy or CMET Balloons (python/matlab)
- Statistical tools capacity building projects in Vietnam or Myanmar (R/python/matlab)
- Contact: Irh@met.no