Definitions of surface currents for integrating observations and modeling

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Definition from GOOS-OOPC

World Climate Research Programme (WCRP)

Global Climate Observing System (GCOS)

Global Ocean Observing System (GOOS)

The **GOOS** Physics and Climate expert panel:
The **O**cean **O**bservations **P**hysics and **C**limate panel, **OOPC**

is responsible for the Physics Essential Ocean Variables (**EOVs**), and is the lead in delivering to the Climate theme for the Oceans domain, in consultation with other GOOS panels.

EOV specification sheet at www.ioc-goos-oopc/obs/ecv.php

(Surface current is also an Essential Climate Variable for the Oceans)

OOPC specification sheet

www.goosocean.org

The surface ocean general circulation is responsible for significant **surface transport of heat, salt, passive tracers and ocean pollutants**. On basin scales, surface currents and their variations are a major player in climate to weather fluctuations. **Parameterized wind stress and heat flux depend upon the speed of the near-surface wind relative to the moving ocean surface**, which can be significantly affected at large scales by surface currents such as the western boundary currents and Antarctic Circumpolar Current, and at smaller scales by mesoscale variability. **Convergences/divergences, spiralling eddies, and filaments all contribute to vertical motions and mass exchange**. Surface currents impact **the steepness of surface waves**, and are thus important for **generating accurate marine sea state forecasts**. Because of their significance in advecting passive particles, knowledge of surface currents is also important for applications such as **oil spill and marine debris response**, search and **rescue operations**, and **ship routing**. Currents, particularly tidal currents, can also modify **storm surge impacts and sea level changes**.

OOPC specification sheet

www.goosocean.org

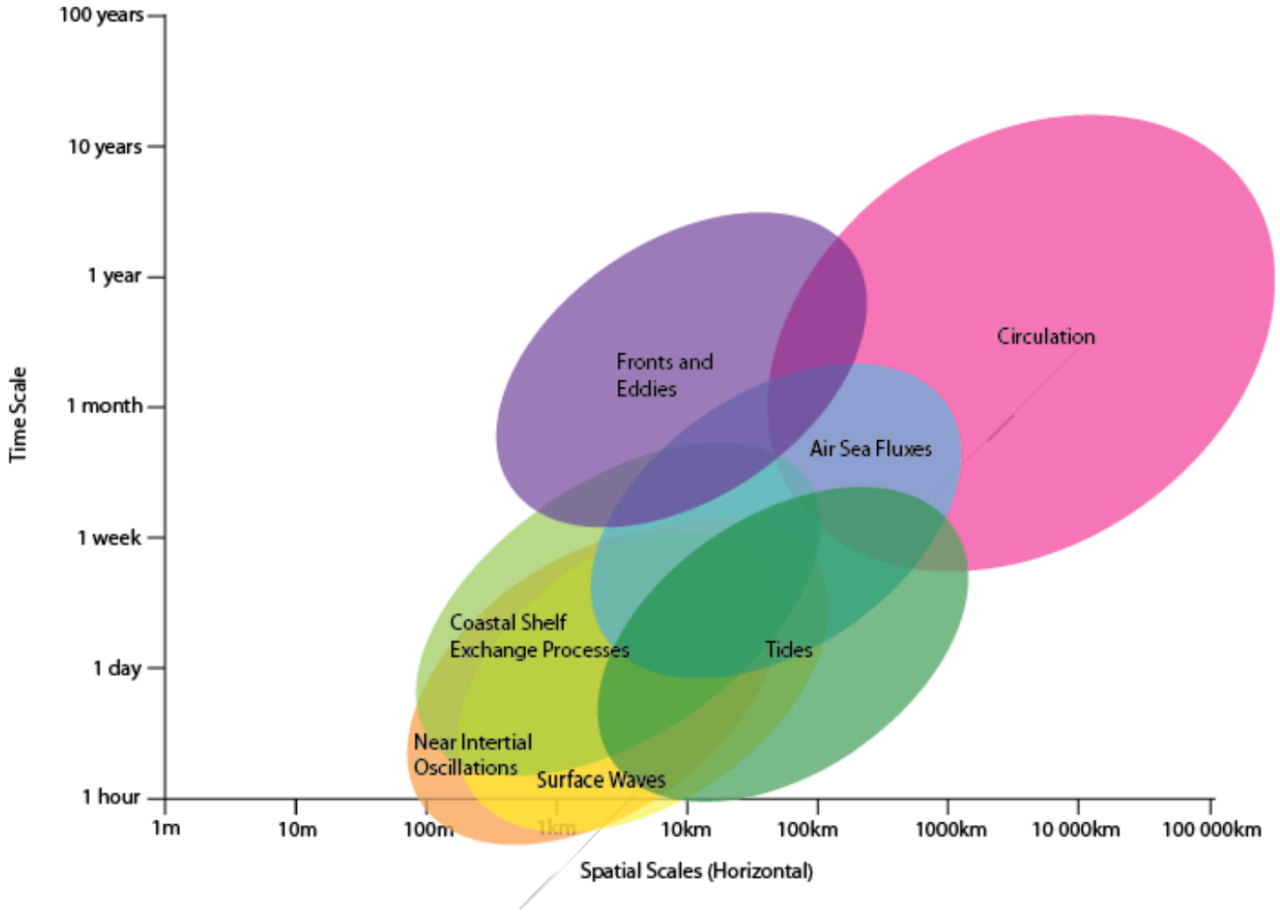


Figure 1: Scales of phenomena[6] addressed, with indications of the magnitude of the signal to capture.

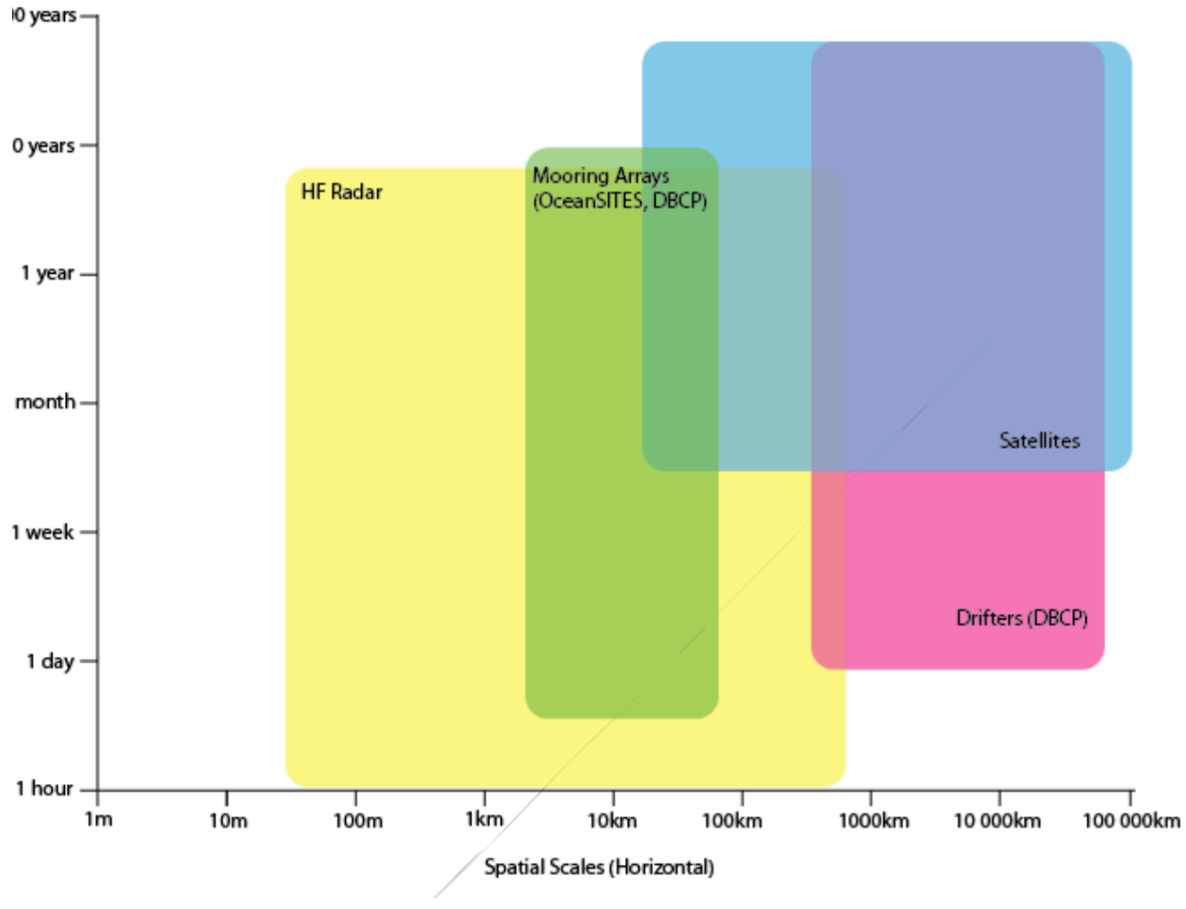


Figure 2. The well resolved observation scales of the component networks .

OOPC specification sheet

www.goosocean.org

Variable Information	
Name of Variable (ECV and/or EOV)	Surface Current
Sub-Variables[1]	Near surface velocity at stated depth, surface geostrophic velocity, near-surface Ekman currents, tidal currents, Lagrangian drift, Stokes velocity, surface speed
Derived Variables [2]	Mass transport, horizontal heat and fresh-water fluxes, surface stress, kinetic energy and kinetic energy flux, upper-ocean turbulent mixing, surface turbulent heat and fresh-water/salt fluxes, air-sea fluxes, advection of oceanic properties (biogeochemical tracers, pollutants, debris, etc.), particle dispersion, larval drift, wave forecasts, Ekman velocities, Stokes drift.
Supporting Variables [3]	Sub-surface temperature and salinity, sea surface height, waves, ocean vector winds
Contact/Lead Expert(s) [4]	OOPC Expert team: GlobCurrent (www.globcurrent.org)

[1] Sub-variables are components of the EOV/ECV that may be measured, derived variables of other EOV/ECVs, or inferred from other elements of the observing system.
[2] Derived Variables are quantities or indicators calculated from the EOV or ECV
[3] Supporting variables are other EOV/ECVs, or other measurements from the observing system, that may be needed to deliver the EOV
[4] Contact experts should include experts or teams for platforms and for products

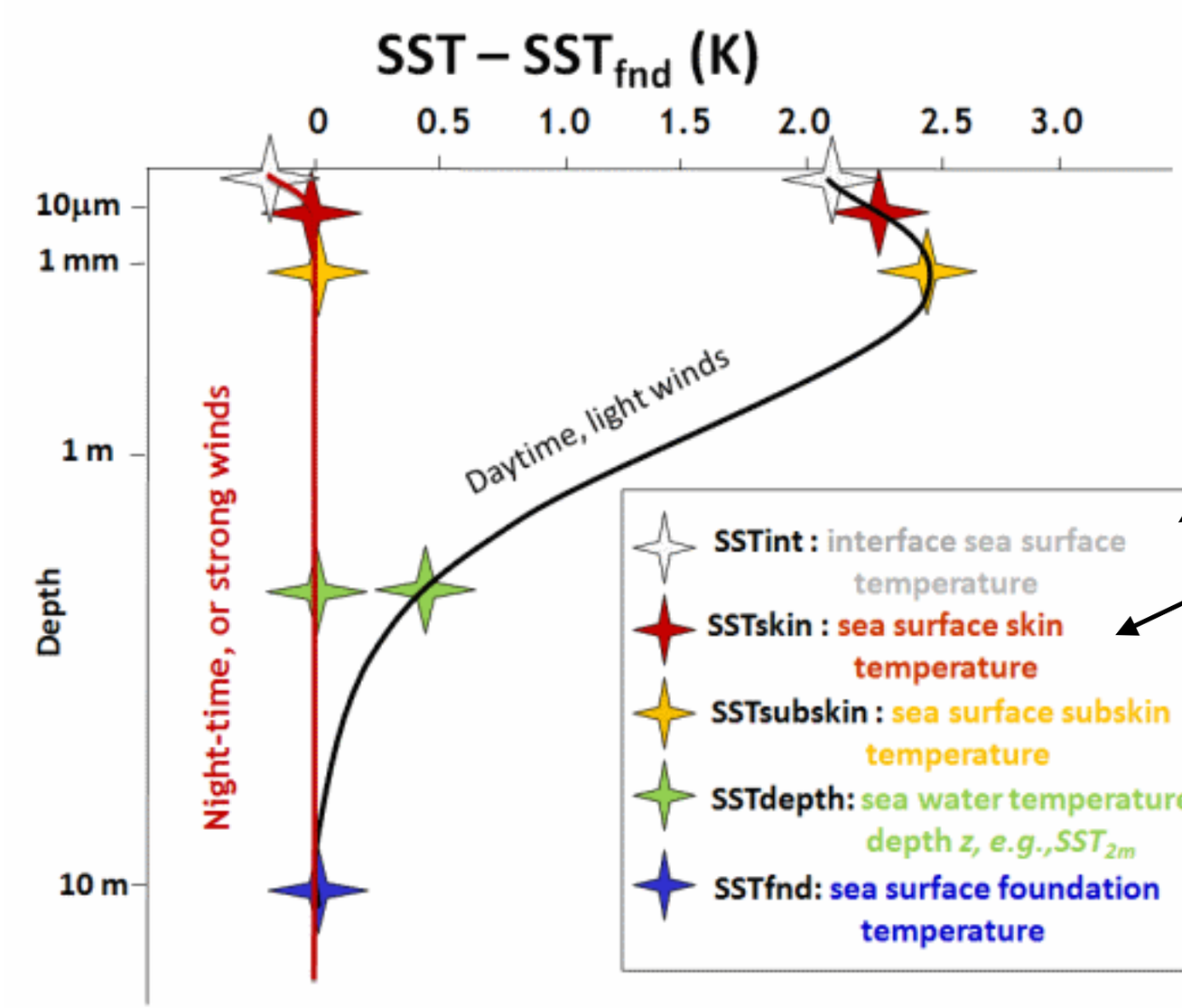
Definition from IOC-GOOS-OOPC

EOV specification sheet at www.ioc-goos-oopc/obs/ecv.php

ECV	Product(?)	Frequency	Resolution	Required Measurement Accuracy	Stability per decade
Surface Currents	Surface geostrophic Currents	Hourly to weekly	30 km	5 cm/s	Not specified
Sea Surface Temperature	Sea Surface Temperature	Hourly to weekly	1-100 km	0.1 K over 100 km scales	< 0.03 K over 100 km scales

Should we come up with our own definition?

Example from the Group for High Resolution SST (GHRSST)
https://www.ghrsst.org/



hypothetical, can't be measured, no practical use

10-20 µm : Infrared radiometer

Infrared radiometer

many in-situ instruments including drifters

Definitions from the workshop registration survey

“Please provide your definition of ocean surface currents and/or the type of ocean surface currents used in your research. (Examples: 15-m depth velocity from Lagrangian surface drifters at 6-hour resolution, daily-averaged velocity of ocean model top layer, etc.)”

28 answers! Thank you!

Definitions from the workshop registration survey

The various definitions given by registrants can be organized according to :

1. temporal scales
2. vertical scales
3. processes
4. observation or modeling platforms

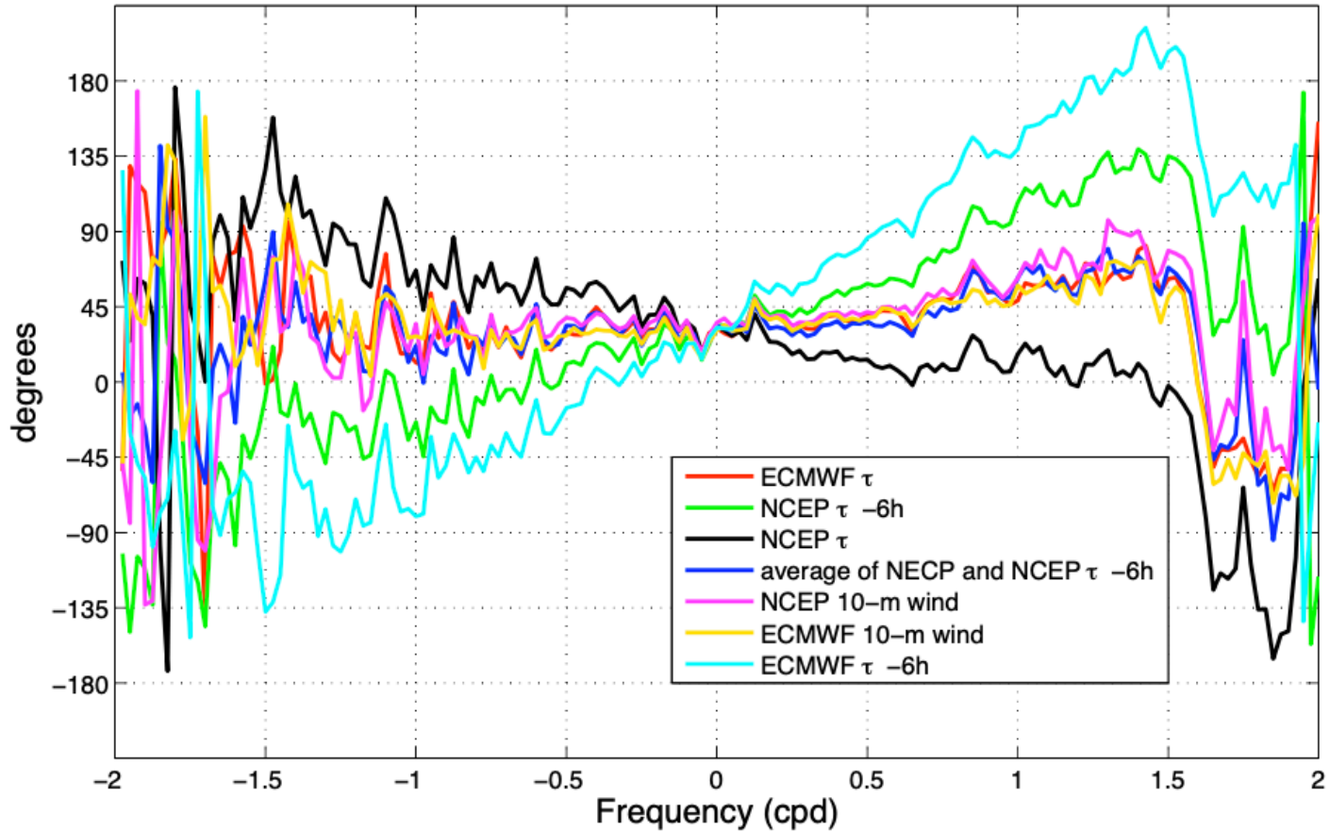
What about horizontal scales?

1. Temporal scales

- 10 min,
- hourly,
- 6-hourly,
- daily

Temporal scales: surface drifters example

Drifter locations are interpolated at 6 h intervals, at times t= 00:00, 06:00, 12:00, and 18:00 GMT, using 10 data points, the total of the 5 nearest points in time both before and after t, regardless of the nature of the data (GPS or Argos).
Drifter horizontal velocities are calculated at 6 h intervals by central differences.



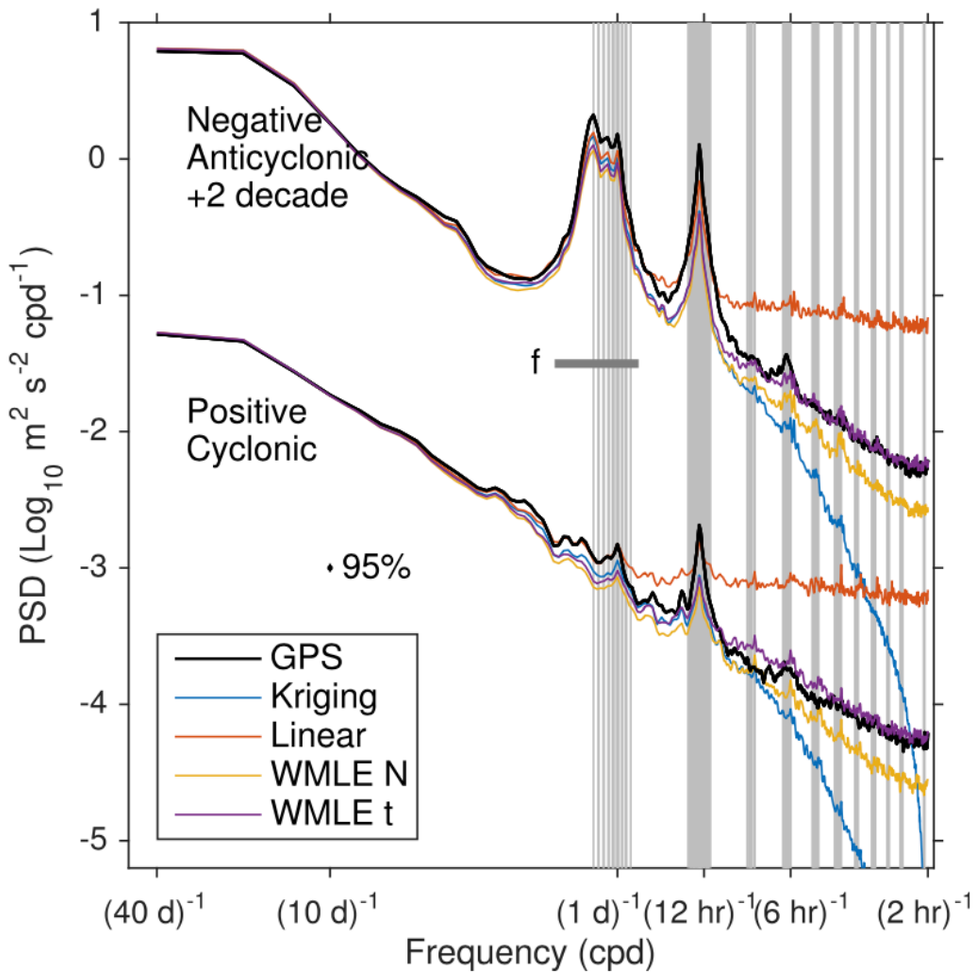
Elipot and Gille (2009a)

Temporal scales: surface drifters example

The hourly drifter dataset contains estimates of position and velocity using fixed number of data points (4), hence a variable length window (both for Argos tracked and GPS tracked drifters)

One consequence is for uncertainty (noise level)

Elipot et al. (2016)



2. Vertical scales (depth)

- Infinitesimal (~0 m),
- surface (0 m),
- average over 1 m
- 1 m
- upper meters
- 1-10 m
- 15 m
- 12-18 m
- 10-30 m
- 0-50 m

3. Processes

- Geostrophic
- from SSH
- Ocean-atmosphere moving boundary
- Lagrangian mean

- Ekman transport velocity
- Velocity involved in air-sea fluxes (heat and momentum)
- Ocean velocity used to define atmospheric stress
- Mixed-layer velocity

4. Platforms …

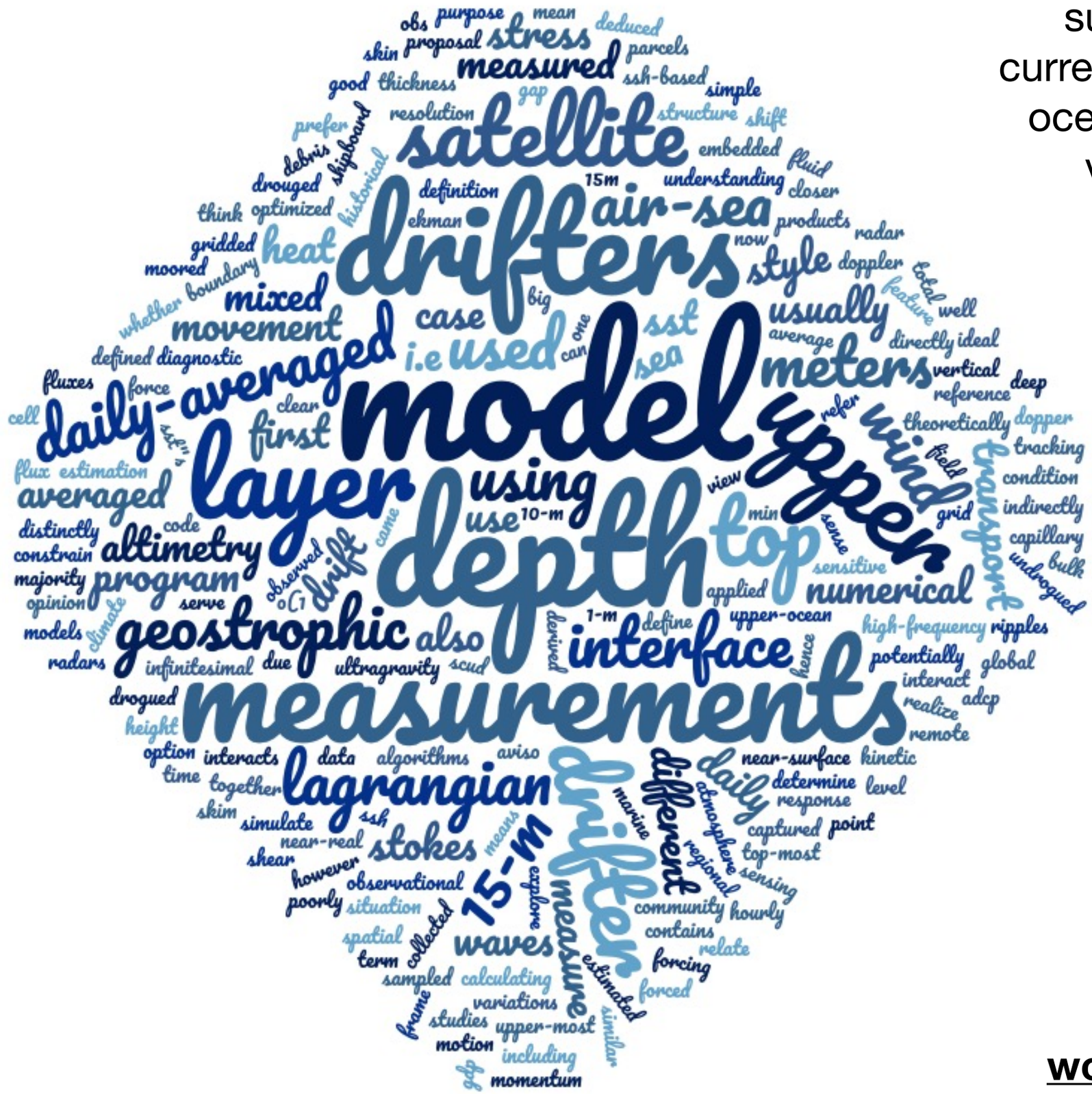
- from satellite altimetry
- gridded altimetry products
- GDP drogued and undrogued drifters, CODE drifters
- High frequency radar (using Doppler effect)
- remote sensing (other than altimetry)

… and Models

- top layer
- first model depth
- ocean model top interface
- upper most grid cell

What about density coordinate models?

Word Cloud



subtracted:
current(s), surface, ocean, velocity, velocities

wordclouds.com