Describing geophysical turbulence with a Schrödinger-Coriolis equation in velocity space

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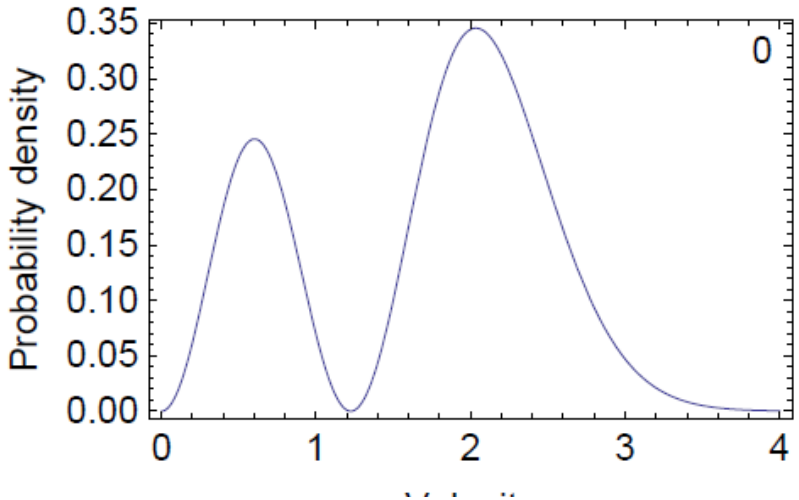
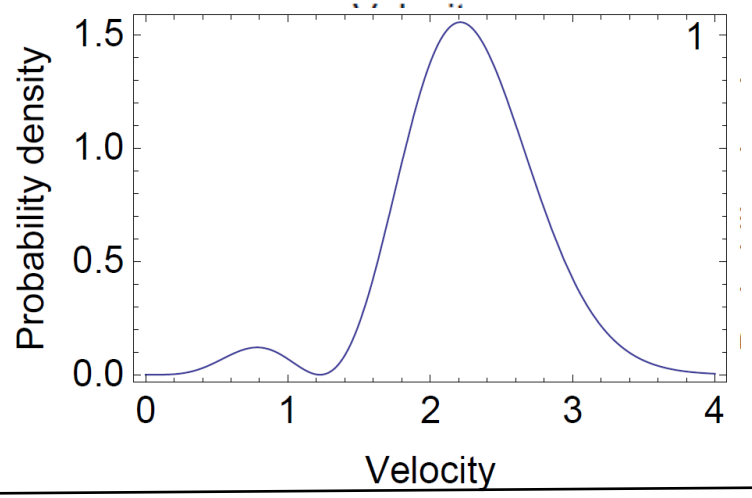
Objective : Predictions of the scale-relativity (SR) approach for a turbulent fluid in rotation.

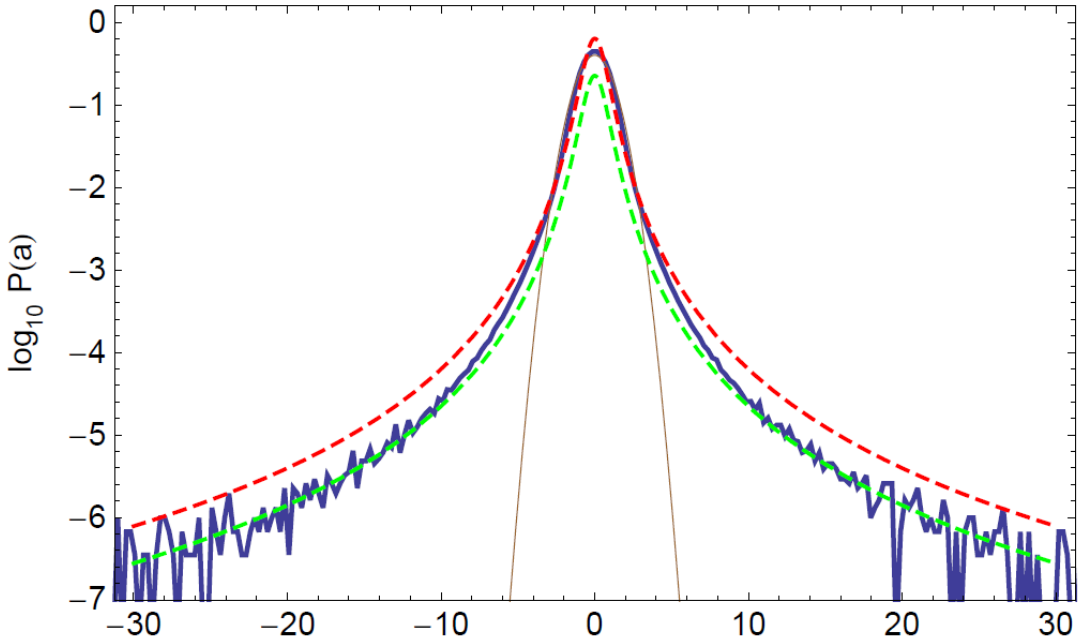
Main features:

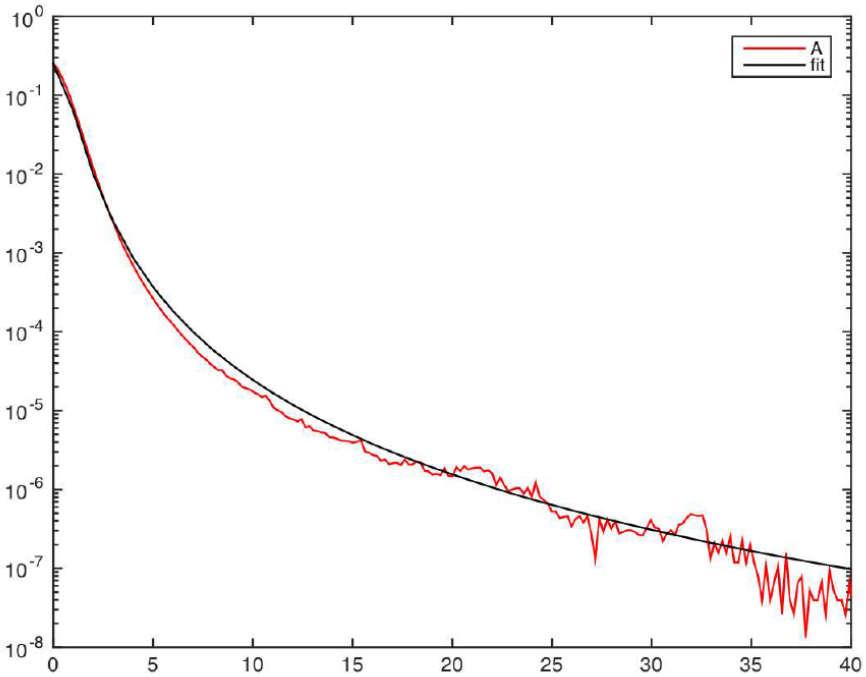
- In SR, time derivative of the governing Navier-Stokes equation in usual x-space can be transformed into a Schrödinger –like equation in velocity space with an external vectorial field to account for the rotation, together with a local Velocity Harmonic Oscillator (VHO) potential in v-space.
- The coefficients of this VHO are given by second order x-derivatives of the pressure.
- We can then give formulae for the velocity and acceleration Probability Distribution Functions (PDF).
- Using a simple model of anisotropic harmonic oscillator, we compare our predictions with relevant data from oceanic drifters velocity measurements. We find a good agreement of the predicted acceleration PDF with that observed from drifters.

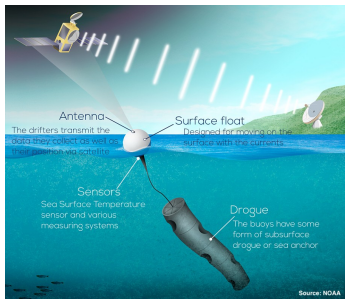
$$\left(\mathcal{D}_v \nabla_v - \frac{1}{2}\, i\, K_v(v)\right)^2 \psi_v + i\mathcal{D}_v \frac{\partial \psi_v}{\partial t} - \frac{1}{2}\,\widetilde{\Phi}_v(v)\,\psi_v = 0$$


Probability density
0
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
1
2
3
4


Probability density
1
1.5
1.0
0.5
0.0
0
1
2
3
4
Velocity


log10 P(a)
0
−1
−2
−3
−4
−5
−6
−7
−30
−20
−10
0
10
20
30


A
fit
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
10^-6
10^-7
10^-8
0
5
10
15
20
25
30
35
40


Antenna
The drifters transmit the data they collect as well as their position via satellite
Surface float
Designed for moving on the surface with the currents
Sensors
Sea Surface Temperature sensor and various measuring systems
Drogue
The buoys have some form of subsurface drogue or sea anchor
Source: NOAA