LES Modelling of the Impact of the Topography on Large-scale Exchange Flow in the Strait of Gibraltar
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Detecting coherent turbulent structures
Billows of primary shear instabilities are detected for positive values of Q-parameter, second invariant of velocity gradient:

\[ Q = -\frac{1}{2} \frac{\partial u}{\partial x_2} \frac{\partial v}{\partial x_1} \]

In outflowing conditions, patches of \( Q > Q_{crit} \) appear west of Camarinal Sill at the shear interface and are characterized by a roll-up of salinity. They are advected westward by the Mediterranean outflow.

Detection of Hydraulic Jump
Flow critical point:

\[ F = \frac{v}{c} \geq 1 \]

Interface discontinuity:

\[ \Delta u = -u_1 \frac{\partial H}{\partial x_2} \Delta b_2 \]

\[ \Delta u_0 = -u_1 \frac{\partial H}{\partial x_2} b_2 \]

Acceleration of surface and bottom layers:

\[ \frac{\partial u}{\partial t} + \frac{\partial u}{\partial x_1} u_1 + \frac{\partial u}{\partial x_2} u_2 = -\frac{\partial H}{\partial x_2} b_1 \]

\[ \frac{\partial u}{\partial t} + \frac{\partial u}{\partial x_1} u_1 + \frac{\partial u}{\partial x_2} u_2 = -\frac{\partial H}{\partial x_2} b_2 \]

Detection of hydraulic jumps and shear instabilities for several tidal regimes.

Hydraulic Jump Variability
LES of hydraulic control of large-scale circulation at Camarinal Sill.

In September-October 2020, the field campaign GEPETO aims at making direct observations of hydraulic jumps, coherent mixing structures and ISWs.