The domain is a unit square. Free slip boundary conditions are prescribed on all sides. The resolution is fixed to 64x64 $Q_1 \times P_0$ elements. The flow is isoviscous and the buyancy force is given by

$$f_x = 0 \tag{1}$$
$$f_y = \rho\alpha T(x,y) \tag{2}$$

with

$$T(x,y) = \cos(kx)\delta(y-y_0)$$

where $k = 2\pi/\lambda$ and λ is a wavelength, and y_0 represents the location of the buoyancy.

One can prove [?] and refs. therein that there is an analytic solution of the surface stress σ_{zz}:

$$\frac{\sigma_{yy}}{\rho\alpha g} = \frac{\cos(kx)}{\sinh^2(k)}\left[k(1-y_0)\sinh(k)\cosh(ky_0) - k\sinh(k(1-y_0)) + \sinh(k)\sinh(ky_0)\right]$$

We set $\lambda = 1$ and explore $y_0 = \frac{63}{64}, \frac{62}{64}, \frac{59}{64}$. Zhong et al. report for measurements at $x = 0$:

Method	$y_0 = 63/64$	$y_0 = 62/64$	$y_0 = 59/64$
Analytic solution	0.995476	0.983053	0.912506
Pressure smoothing	1.15974	1.06498	0.911109
CBF	0.994236	0.982116	0.912157

We are then interested in numerically computing this quantity:

$$\sigma_{yy} = -p + 2\eta\dot{\epsilon}_{yy}$$

and we start with the trivial measurement in the middle of the elements forming the top row of the mesh.

[redacted]

features

- $Q_1 \times P_0$ element
- incompressible flow
- mixed formulation
- isothermal
- isoviscous
- analytical solution
- pressure smoothing
- consistent boundary flux