4.1. Topografski valovi - Uvod

Fenomenologija:

- dugoperiodične ($T >> 2\pi/f$), slobodne oscilacije
- u priobalnom području gdje je $h = h(x)$
- generirani vjetrom, prigušuje ih trenje
- male denivelacije
- rotacijska gibanja u unutrašnjosti fluida
- opažaju se kao obrat struja

Dinamika:

$$\frac{d}{dt}\left(\frac{\eta + f}{D}\right) = 0$$

- plitko → *squeezing* → $\eta < 0$
- duboko → *stretching* → $\eta > 0$

4.2. Model ravne obale i eksponencijalnog profila dna

<u>Modeliranje:</u>

Pretpostavke:

- homogeni fluid
- nelinearni članovi $\ll$
- hidrostatičnost

linearizirane jednadžbe za plitki fluid

- dugoperiodičnost (∂/∂t << f)
- širina šelfa << L_R

$$\frac{\partial(Du)}{\partial x}+\frac{\partial(Dv)}{\partial y}+\cancel{\frac{\partial\zeta}{\partial t}}=0$$

$$u=\frac{1}{D}\frac{\partial\Psi}{\partial y}\ , \qquad v=-\frac{1}{D}\frac{\partial\Psi}{\partial x} \qquad\qquad D\vec{v}=\vec{\nabla}\Psi\times\vec{k}$$

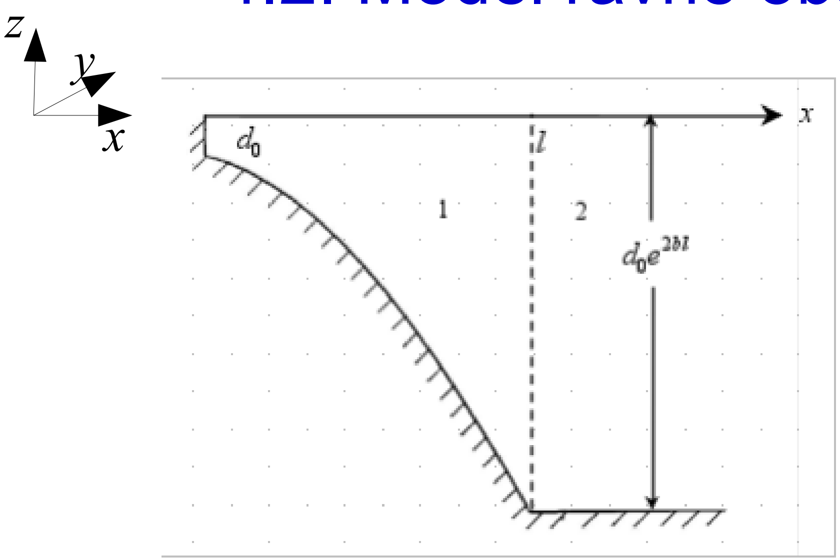
<u>Jednadžba vrtložnosti</u>

$$\boxed{\frac{\partial}{\partial t}\left[\frac{\partial}{\partial x}\left(\frac{1}{D}\frac{\partial\Psi}{\partial x}\right)+\frac{\partial}{\partial y}\left(\frac{1}{D}\frac{\partial\Psi}{\partial y}\right)\right]+f\left[\frac{\partial}{\partial y}\left(\frac{1}{D}\right)\frac{\partial\Psi}{\partial x}-\frac{\partial}{\partial x}\left(\frac{1}{D}\right)\frac{\partial\Psi}{\partial y}\right]=0}$$

- pretpostavimo rješenje:

$$\Psi(x,y,t)=\Phi(x)e^{i(\gamma y-\omega t)}\ , \qquad v_\varphi=\omega/\gamma$$

4.2. Model ravne obale i eksponencijalnog profila dna



$$D(x) = \begin{cases} d_0 e^{2bx}, & 0 \le x \le l \\ d_0 e^{2bl}, & x > l \end{cases}$$

Područje 1:

$$\boxed{\Phi'' - 2b\Phi' - \left(\frac{2b\gamma}{\sigma} + \gamma^2\right)\Phi = 0}$$

$$\boxed{\Phi_1(x) = ce^{(b+im)x} + de^{(b-im)x}}$$

$$\boxed{k_1 = b + \underbrace{\sqrt{b^2 + \frac{2b\gamma}{\sigma} + \gamma^2}}_{-m^2}} \qquad \boxed{k_2 = b - \sqrt{b^2 + \frac{2b\gamma}{\sigma} + \gamma^2}}$$

$$m^2 + b^2 + \gamma^2 = -2bf\frac{\gamma}{\omega} \qquad \left\{\sigma = \frac{\omega}{f}\right\}$$

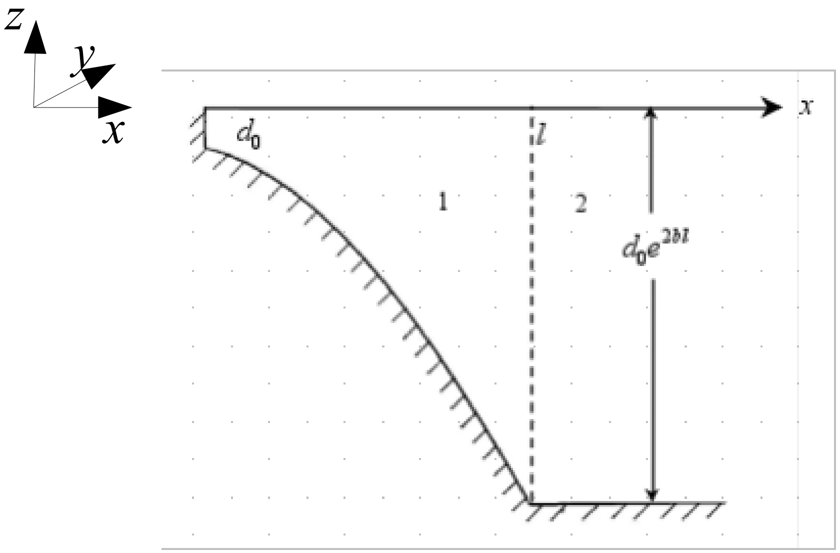
$$\omega = \frac{-2bf\gamma}{m^2 + b^2 + \gamma^2}$$

R.U.: $\vec{v} \cdot \vec{n} = 0$

$$\boxed{\Phi_1(x) = Ae^{bx}\sin mx \qquad 0 \le x \le l}$$

$$v_\varphi = \frac{\omega}{\gamma} < 0$$

4.2. Model ravne obale i eksponencijalnog profila dna



$$D(x) = \begin{cases} d_0 e^{2bx}, & 0 \le x \le l \\ d_0 e^{2bl}, & x > l \end{cases}$$

Područje 2:

$$\Phi'' - \gamma^2 \Phi = 0$$

$$\Phi_2(x) = c e^{\gamma x} + d e^{-\gamma x}$$

R.U.: $\Phi_2(x \to \infty) = 0$

$$\Phi_2(x) = B e^{-|\gamma| x} \qquad x > l$$

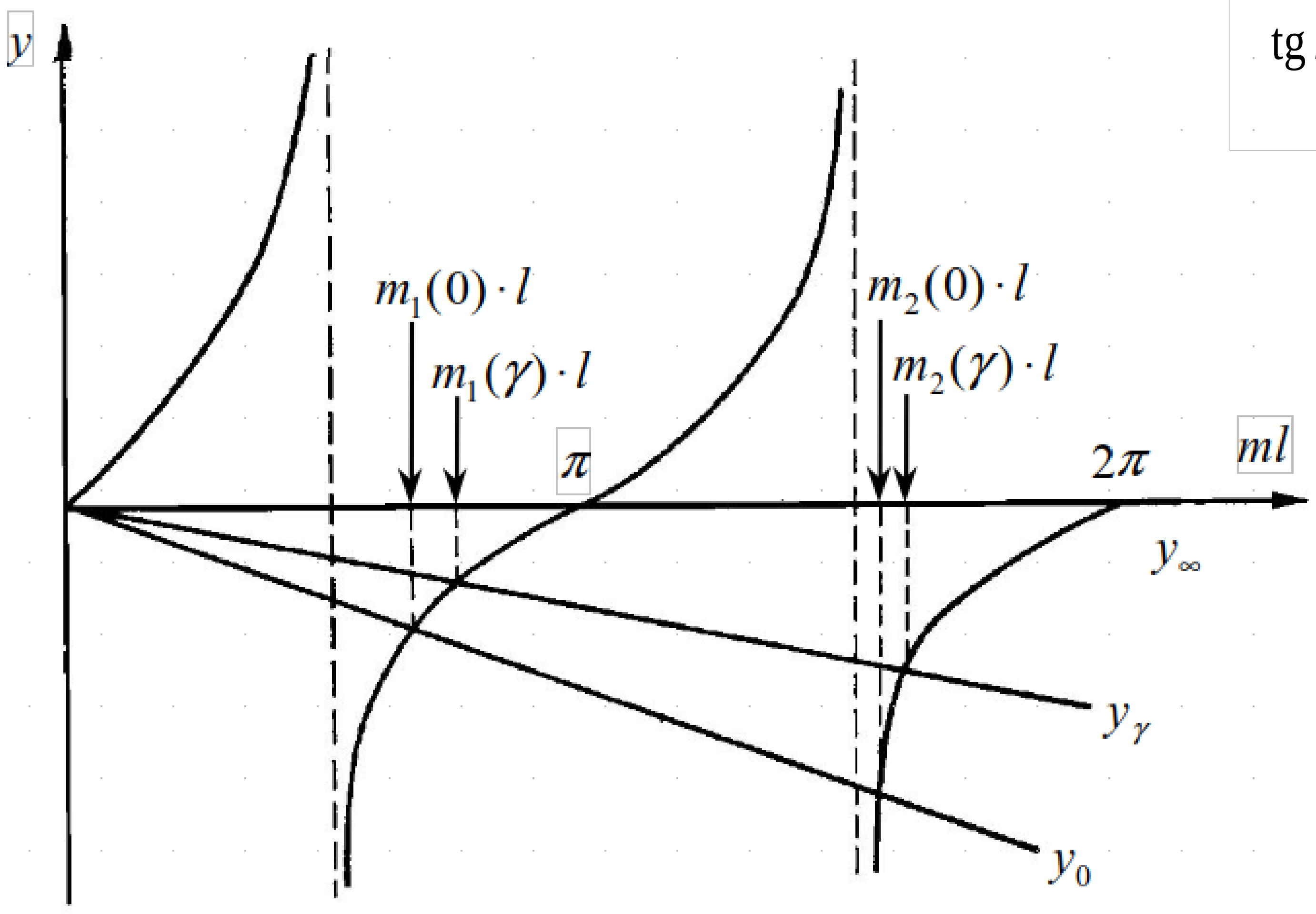
Granica 1-2:

$$u_1 = u_2 , \qquad x = l$$

$$\zeta_1 = \zeta_2 , \qquad x = l$$

$$\operatorname{tg} ml = -\frac{m}{|\gamma| + b}$$

4.2. Model ravne obale i eksponencijalnog profila dna

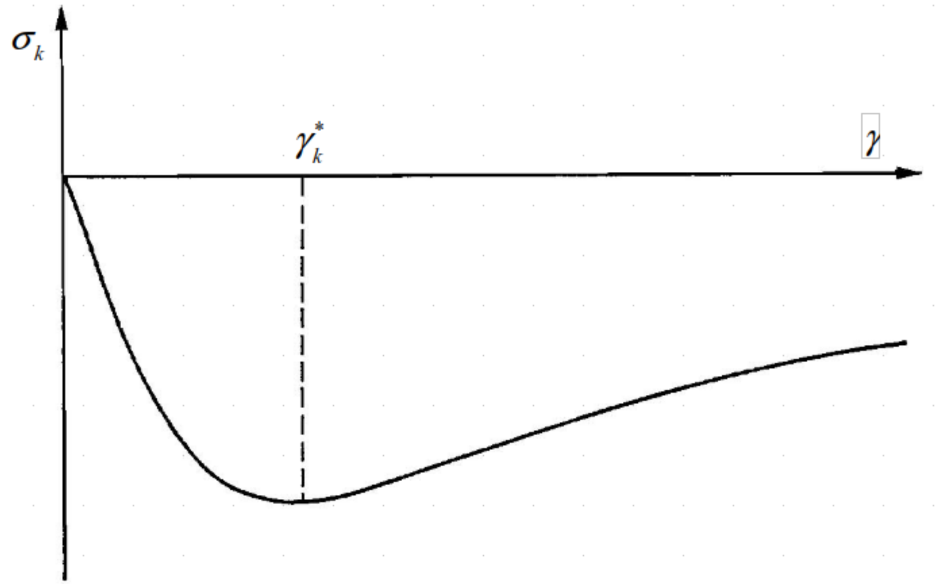


$$\operatorname{tg} ml = -\frac{m}{|\gamma| + b}$$

4.2. Model ravne obale i eksponencijalnog profila dna

$$\omega = \frac{-2bf\gamma}{m^2 + b^2 + \gamma^2}$$

$$\sigma = \frac{\omega}{f}$$



Dugi valovi:

$$v_\varphi \cong -\frac{2bf}{m_k^2 + b^2}$$

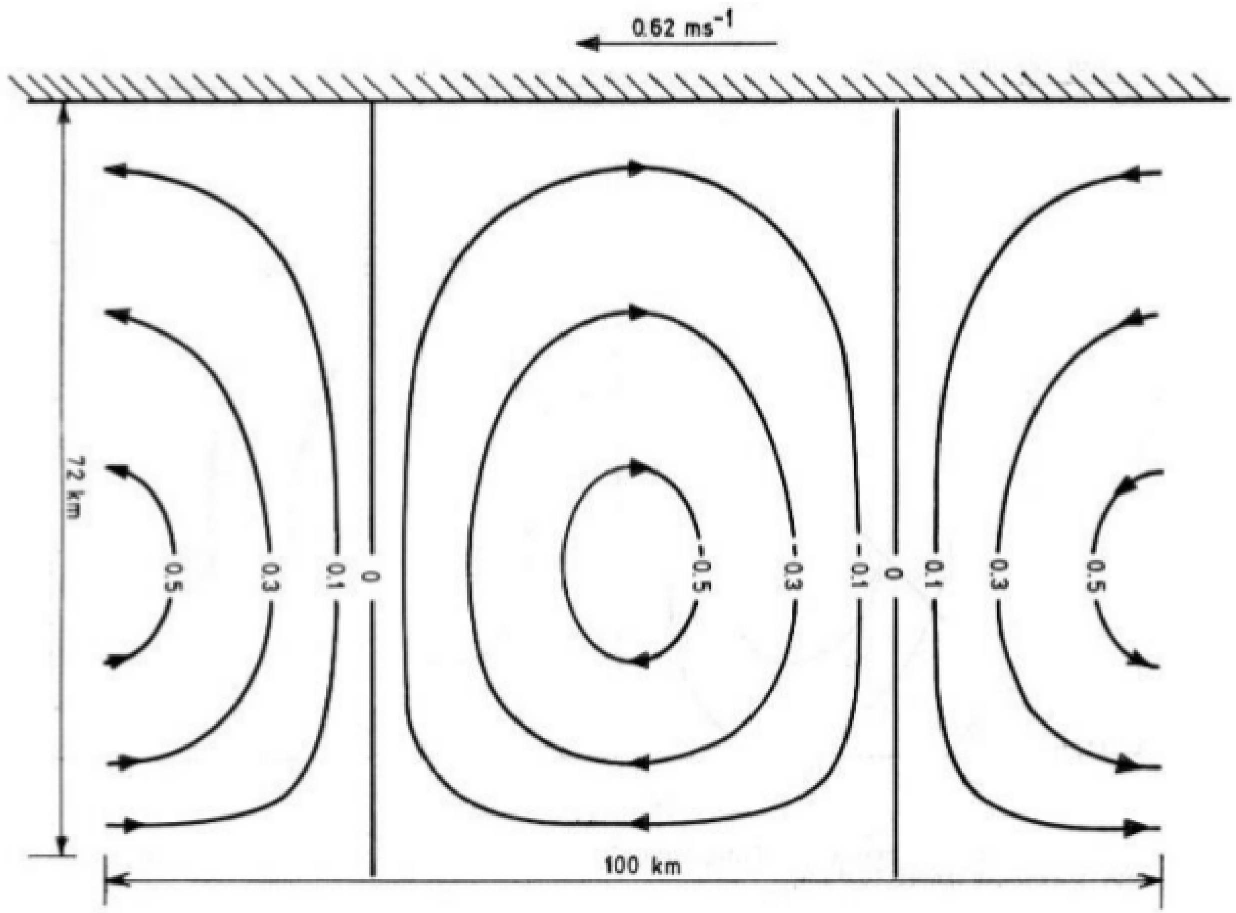
$$v_g = v_\varphi$$

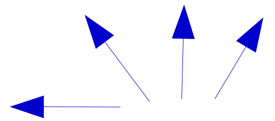
Kratki valovi:

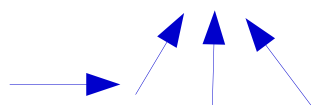
$$v_\varphi \cong -\frac{2bf}{\gamma^2}$$

$$v_g \cong -v_\varphi$$

4.2. Model ravne obale i eksponencijalnog profila dna







<u>Primjer:</u> kratki valovi, 1. mod, u t = 0

$$m_k(\gamma) = m_k(\infty), \quad m_k l = k\pi$$

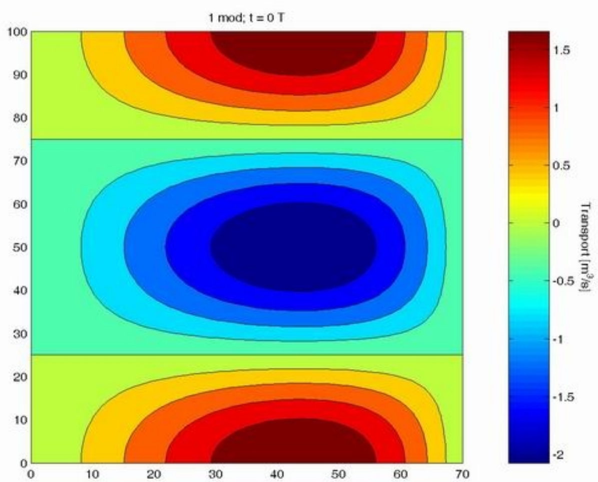
$$\mathcal{Re}\{\psi_1(x,y,t=0)\} = A\,e^{bx}\ \sin\frac{\pi}{l}x\ \cos\gamma y \qquad 0 \le x \le l\,,$$

$$\Phi_1(x) = Ae^{bx}\sin mx$$

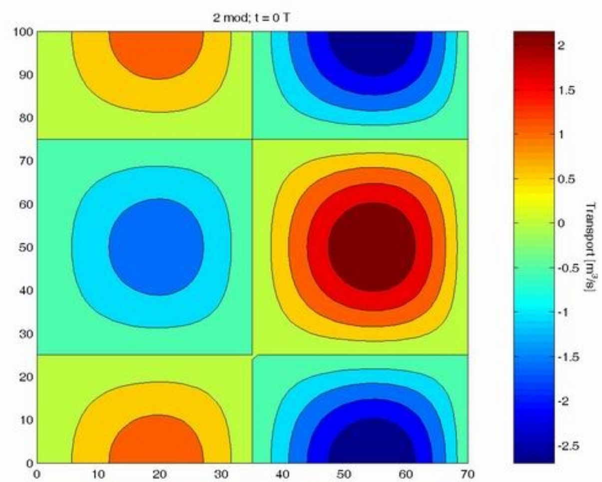
4.2. Model ravne obale i eksponencijalnog profila dna

strujna funkcija u času t = 0

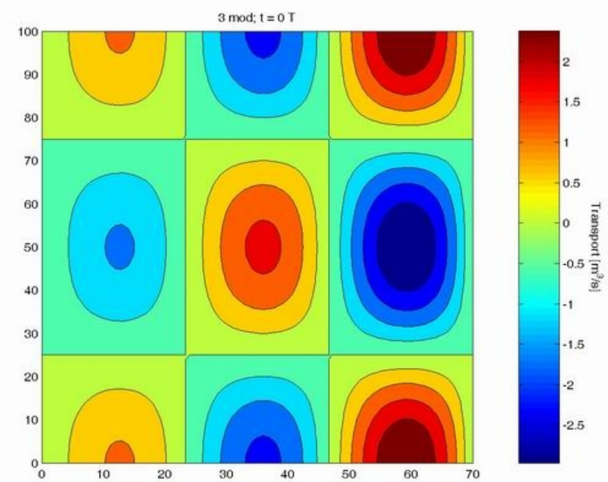
1. mod



2. mod



3. mod



4.2. Model ravne obale i eksponencijalnog profila dna

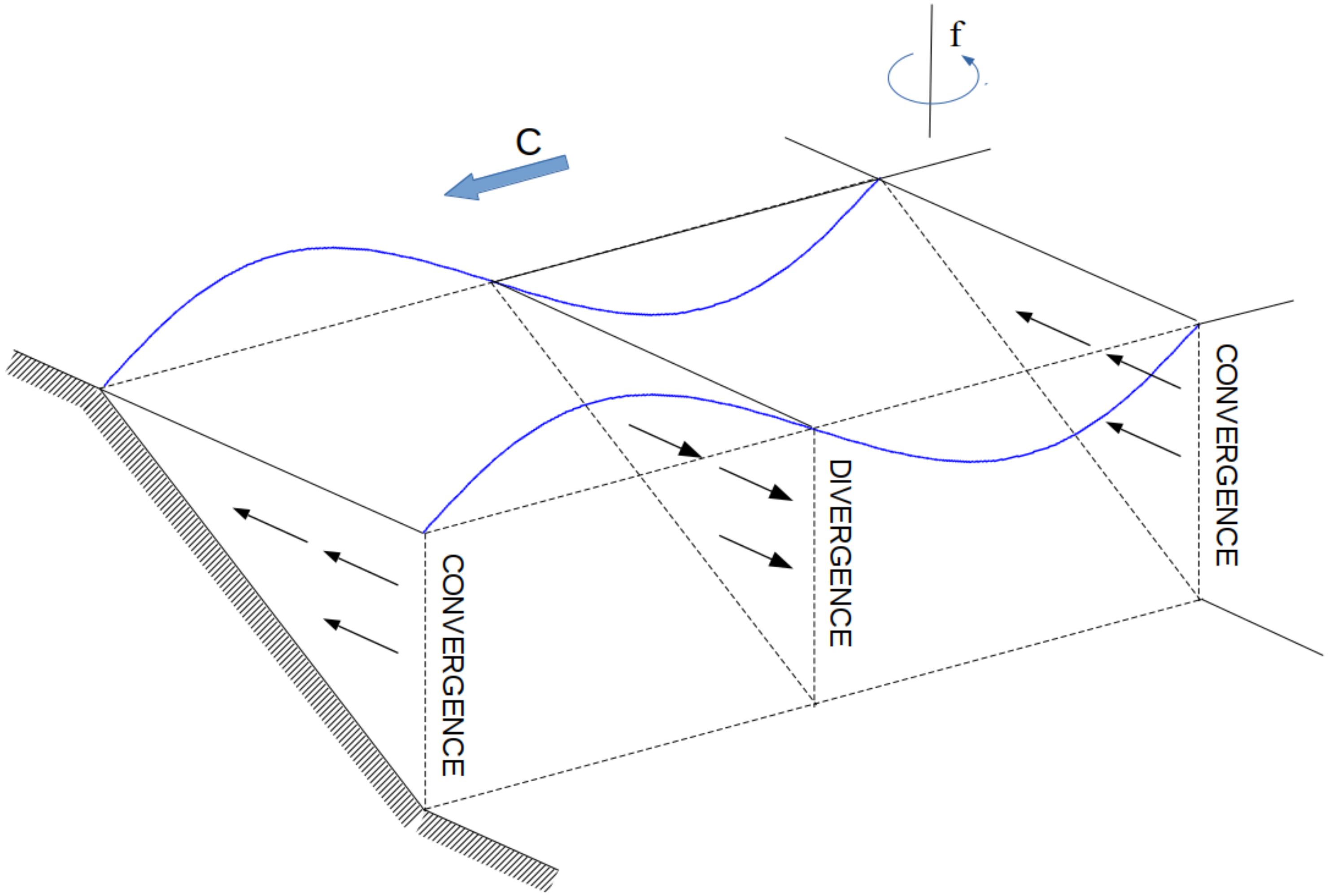
Mala internet škola oceanografije: http://skola.gfz.hr

http://skola.gfz.hr/matlab_primjeri/topo_e_1.gif

http://skola.gfz.hr/matlab_primjeri/topo_e_2.gif

http://skola.gfz.hr/matlab_primjeri/topo_e_3.gif

Topografski valovi - propagacija



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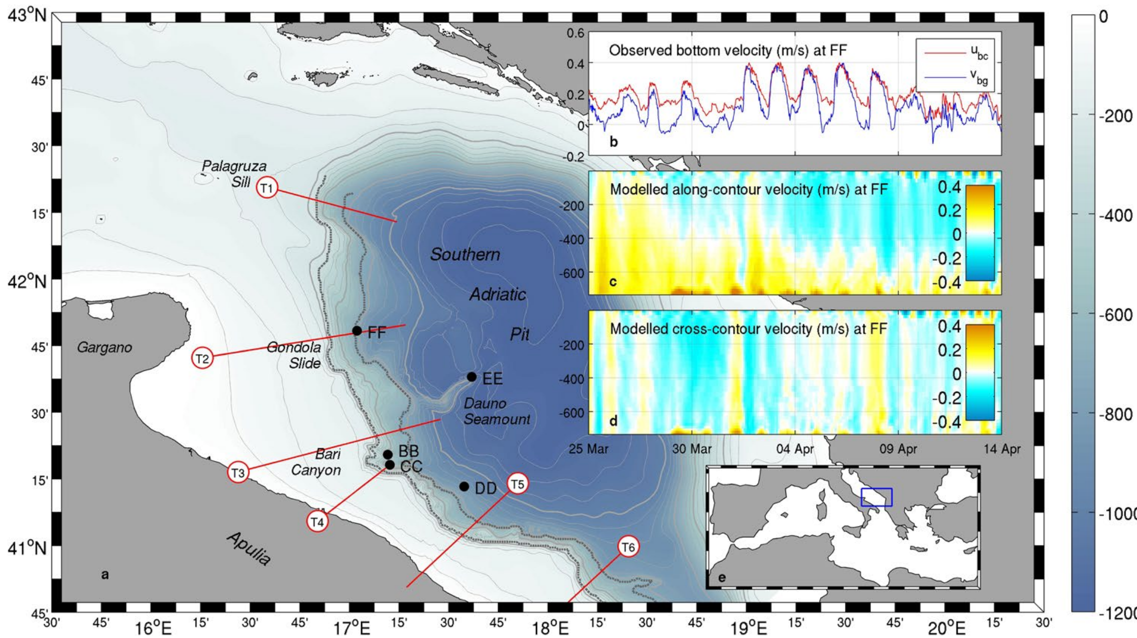
(2018)

25/03 – 15/04/2012



Period: 2 - 4 d
Valna duljina: 35 – 87 m

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