Modelação hidrodinâmica

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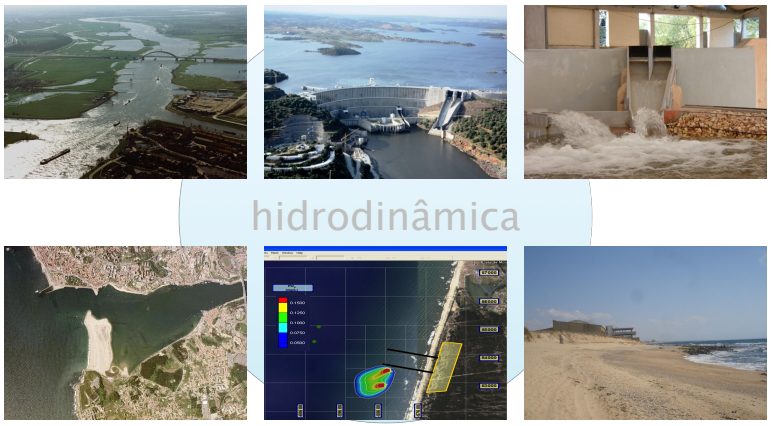
- introdução
- aplicações
- formulação matemática
- *software*
- gpu – quais as potencialidades?

introdução

hidrodinâmica

introdução

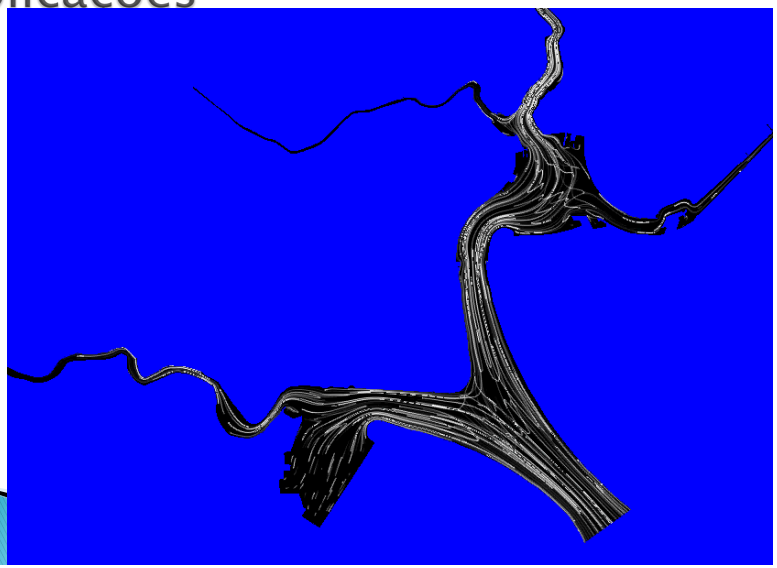


introdução

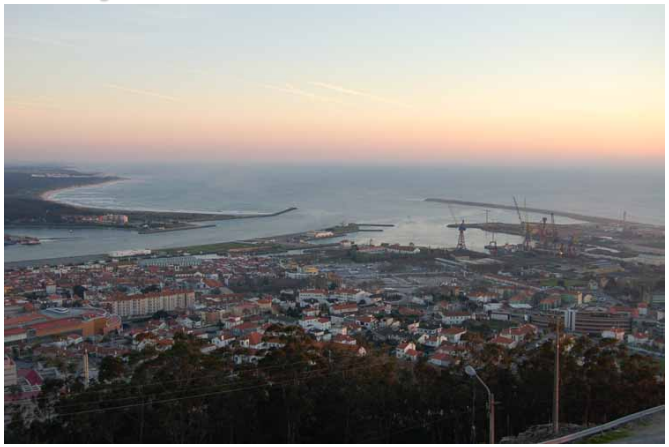
aplicações

Marina Bay
Singapura

aplicacões

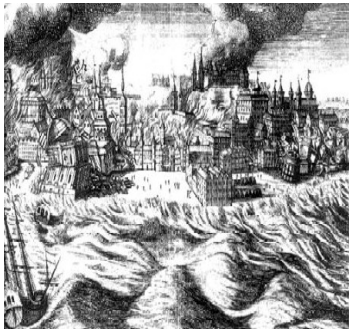


aplicações

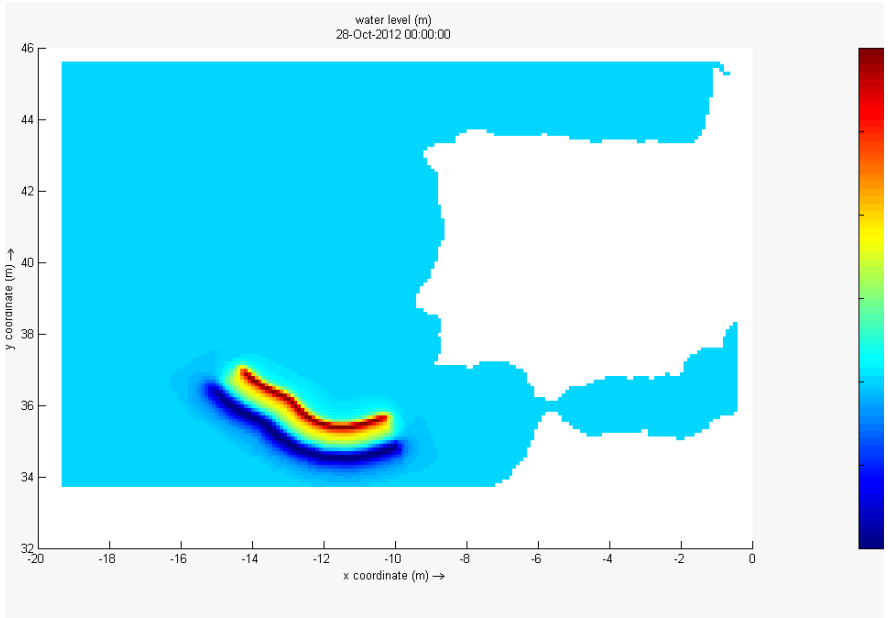


Estuário do rio Lima

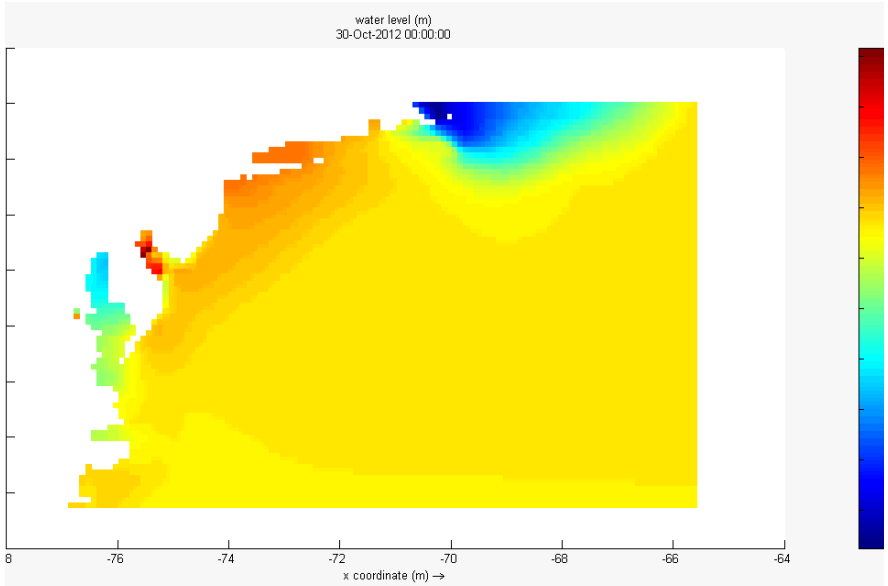
aplicações



Terramoto seguido de tsunami
Lisboa, 1755



aplicações



formulação matemática

1 – conservação de massa

2 – conservação de quantidade de movimento

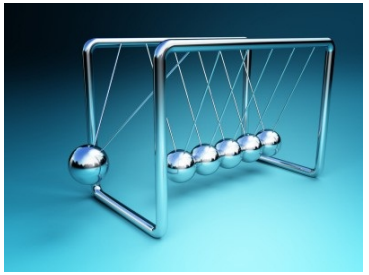
3 – transporte de calor

4 – transporte de sal

5 – transporte de escalares turbulência

6 – transporte de escalares qualidade da água

7 – transporte de sedimentos



formulação matemática

CM

$$\frac{\partial \eta}{\partial t}+\frac{\partial[(h+\eta)U]}{\partial x}+\frac{\partial[(h+\eta)V]}{\partial y}=0$$

CQM –XX

$$\frac{\partial U}{\partial t}+U\frac{\partial U}{\partial x}+V\frac{\partial U}{\partial y}=fV-g\frac{\partial \eta}{\partial x}-\frac{g}{\rho}\frac{\partial \rho}{\partial x}\frac{h+\eta}{2}+$$
$$+\frac{\rho_a k W_v^2\cos\varphi}{h+\eta}-\frac{gn^2U\sqrt{U^2+V^2}}{(h+\eta)^{4/3}}+\frac{\varepsilon}{\rho}\left(\frac{\partial^2U}{\partial x^2}+\frac{\partial^2U}{\partial y^2}\right)$$

CQM –YY

$$\frac{\partial V}{\partial t}+U\frac{\partial V}{\partial x}+V\frac{\partial V}{\partial y}=-fU-g\frac{\partial \eta}{\partial y}-\frac{g}{\rho}\frac{\partial \rho}{\partial y}\frac{h+\eta}{2}+$$
$$+\frac{\rho_a k W_v^2 sen\varphi}{h+\eta}-\frac{gn^2V\sqrt{U^2+V^2}}{(h+\eta)^{4/3}}+\frac{\varepsilon}{\rho}\left(\frac{\partial^2V}{\partial x^2}+\frac{\partial^2V}{\partial y^2}\right)$$

TM

$$\frac{dc}{dt}+U\frac{dc}{dx}+V\frac{dc}{dy}-\frac{d}{dx}Dx\frac{dc}{dx}-\frac{d}{dy}Dy\frac{dc}{dy}-\sigma+R(c)=0$$

formulação matemática

CM

$$\frac{\partial \eta}{\partial t}+\frac{\partial}{\partial x}(uD)+\frac{\partial}{\partial y}(vD)+\frac{\partial w}{\partial \sigma}=0$$

CQM–XX

$$\frac{\partial}{\partial t}(uD)+\frac{\partial(uuD)}{\partial x}+\frac{\partial(vuD)}{\partial y}+\frac{\partial}{\partial \sigma}(wu)-fvD=-DP_1+\frac{\partial}{\partial \sigma}\left(\frac{K_M}{D}\frac{\partial u}{\partial \sigma}\right)+DF_1$$

CQM–YY

$$\frac{\partial}{\partial t}(vD)+\frac{\partial(uvD)}{\partial x}+\frac{\partial(vvD)}{\partial y}+\frac{\partial}{\partial \sigma}(wv)+fuD=-DP_2+\frac{\partial}{\partial \sigma}\left(\frac{K_M}{D}\frac{\partial v}{\partial \sigma}\right)+DF_2$$

T Calor

$$\frac{\partial}{\partial t}(\Theta D)+\frac{\partial(u\Theta D)}{\partial x}+\frac{\partial(v\Theta D)}{\partial y}+\frac{\partial}{\partial \sigma}(w\Theta)=\frac{\partial}{\partial \sigma}\left(\frac{K_H}{D}\frac{\partial \Theta}{\partial \sigma}\right)+DF_\Theta$$

T Sal

$$\frac{\partial}{\partial t}(SD)+\frac{\partial(uSD)}{\partial x}+\frac{\partial(vSD)}{\partial y}+\frac{\partial}{\partial \sigma}(wS)=\frac{\partial}{\partial \sigma}\left(\frac{K_H}{D}\frac{\partial S}{\partial \sigma}\right)+DF_S$$

Modelo Turbulência – q^2

$$\frac{\partial}{\partial t}(q^2D)+\frac{\partial(uq^2D)}{\partial x}+\frac{\partial(vq^2D)}{\partial y}+\frac{\partial}{\partial \sigma}(wq^2)=\frac{\partial}{\partial \sigma}\left(\frac{K_q}{D}\frac{\partial q^2}{\partial \sigma}\right)+\frac{2K_M}{D}\left[\left(\frac{\partial u}{\partial \sigma}\right)^2+\left(\frac{\partial v}{\partial \sigma}\right)^2\right]+$$
$$+2K_H\frac{g}{\rho}\frac{\partial \rho}{\partial \sigma}-2\frac{q^3D}{B_1 l}+DF_q$$

Modelo Turbulência – q^2l

$$\frac{\partial}{\partial t}(q^2lD)+\frac{\partial(uq^2lD)}{\partial x}+\frac{\partial(vq^2lD)}{\partial y}+\frac{\partial}{\partial \sigma}(wq^2l)=\frac{\partial}{\partial \sigma}\left(\frac{K_q}{D}\frac{\partial(q^2l)}{\partial \sigma}\right)+$$
$$K_M E_1\frac{l}{D}\left[\left(\frac{\partial u}{\partial \sigma}\right)^2+\left(\frac{\partial v}{\partial \sigma}\right)^2\right]+K_H E_3 l\frac{g}{\rho}\frac{\partial \rho}{\partial \sigma}-\frac{q^3D}{B_1}\left[1+E_2\left(\frac{l}{\kappa L}\right)^2\right]+DF_l$$

software

- Telemac
- Autores: Electricité de France; BundesAnstalt für Wasserbau (BAW, Germany) ; Centre d'Etudes Techniques Maritimes et Fluviales (CETMEF, France); aresbury Laboratory (United Kingdom); Electricité de France R&D (EDF, France); HR Wallingford (United Kingdom); Sogreah (now in Artelia group, France)
- Idade: 19 anos
- Linguagem: Fortran 95
- SO: Unix, Linux, Windows

software

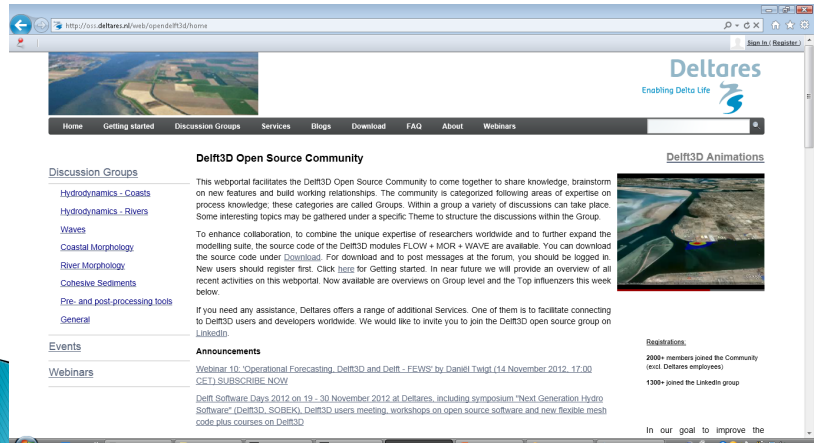
- Telemac

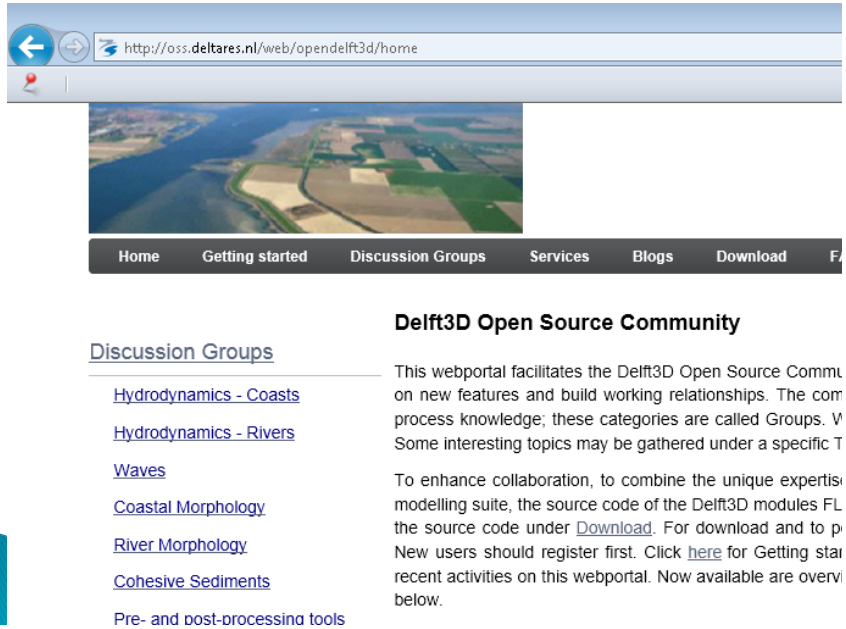
software

- Delft3d
- Autores: Deltares (Holanda)
- Idade: 30 anos
- Linguagem: Fortran 90
- SO: Unix, Linux, Windows

software

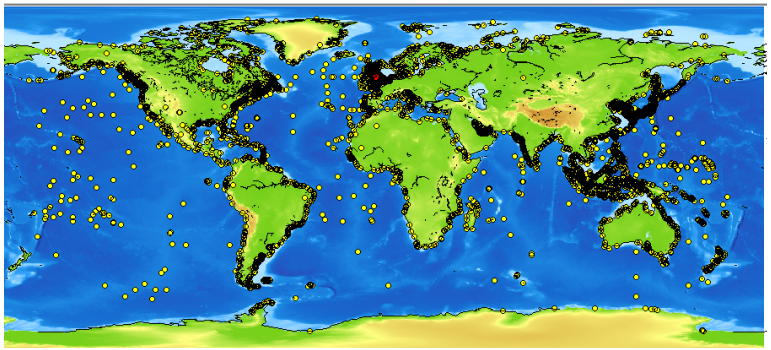
- Delft3d





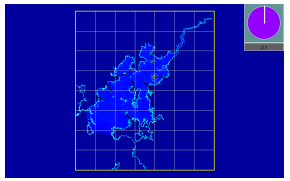
software

- Implementação de modelos

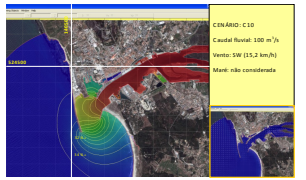


software

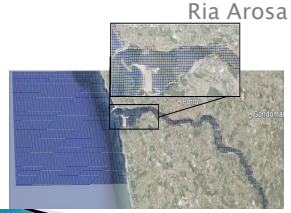
- Implementação de modelos



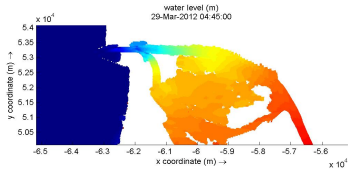
Ria Arosa



Estuário rio Lima



Estuário rio Douro



Estuário rio Mondego

software

- processamento paralelo

Delft3d

Telemac

- Decomposição do domínio
- MPI

software

- processamento paralelo

Telemac

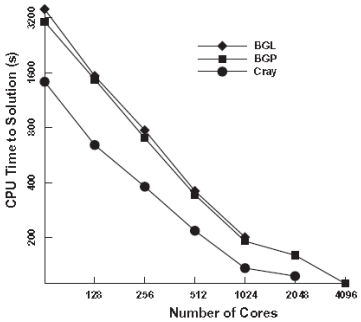


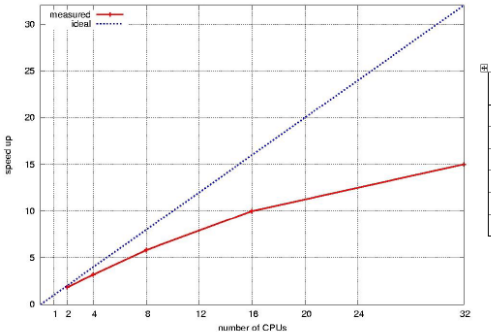
Fig. 2. TELEMAC 2D performance for a 2 million element mesh.

C. Moulinec et al. / Computers & Fluids 51 (2011) 30–34

software

- processamento paralelo

Delft3d

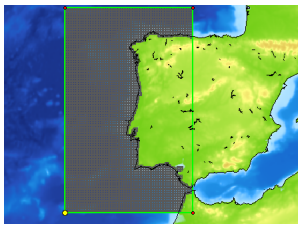


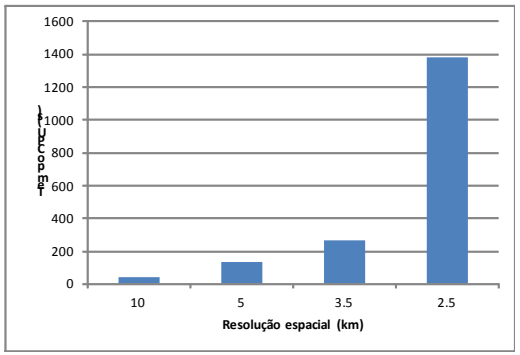
Jagers, B. / 4th PRACE International Seminar "HPC driving innovation in Europe" Bologna, 16-17 april 2012

software

- processamento

Delft3d





gpu – quais as potencialidades?

gpu – quais as potencialidades?

- previsões hidrodinâmicas
- sistemas de suporte à decisão:
  - conjuntos de simulações em condições de incerteza
  - problemas de otimização envolvendo estruturas hidráulicas

gpu – quais as potencialidades?

- Principais tarefas a desenvolver:
  - instalação do software (DEC+DI)
  - pesquisa e análise de trabalhos anteriores (DEC+DI)
  - dados de base para criação de modelos (DEC)
  - simulação de exemplos e avaliação de desempenho (DI)
  - redação de relatório/artigo com metodologias e resultados (DEC+DI)

Questões?

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