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Drukken en draaien

Basisfysica, Coriolis en zoet-zoutinteracties (PPT)

Mosselman, Erik

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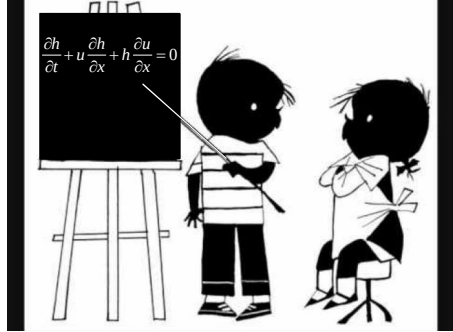



Drukken en draaien

Basisfysica, Coriolis en zoet-zoutinteracties

Erik Mosselman
WMCN-kennisdag
Water Management Centre of the Netherlands
Lelystad, 11 oktober 2016

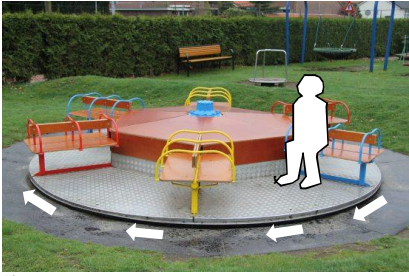
Basisfysica






Coriolis

Ooit Coriolis-krachten gevoeld?











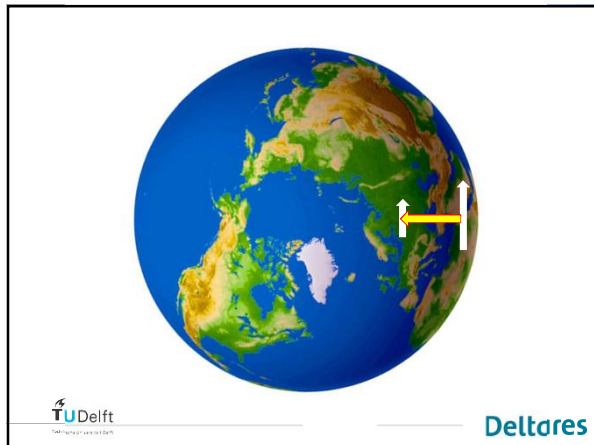
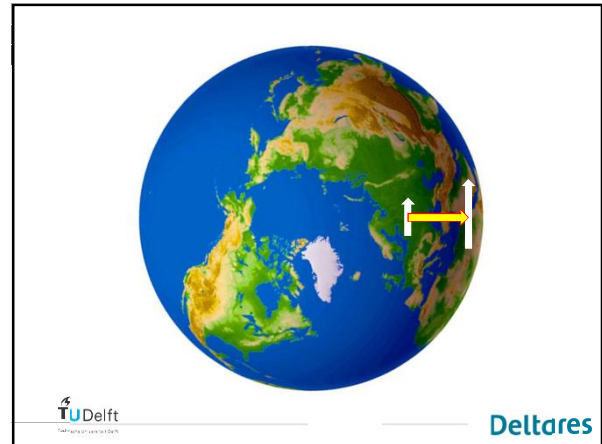








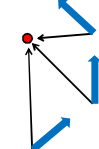
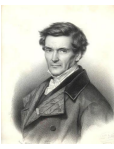




Coriolis

Coriolis-krachten

- Afwijking naar rechts op het noordelijk halfrond: draaiing tegen de wijzers van de klok

Gustave-Gaspard Coriolis

- Afwijking naar links op het zuidelijk halfrond

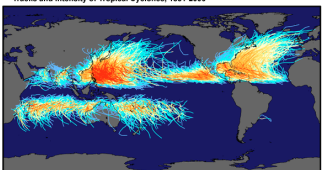
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Coriolis

Coriolis-krachten

- Zeestromingen en luchtstromingen
- Noodzakelijk ingrediënt voor orkanen
- Middagssessie over orkanen door Femke Davids
- Waar op de wereld zijn orkanen het sterkst?



Tracks and Intensity of Tropical Cyclones, 1981-2006

Saffir-Simpson Hurricane Intensity Scale

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Basisprincipes van waterbeweging

Basisprincipes:

- Wet van Behoud van Massa (continuïteit)
- Wet van Behoud van Impuls (Tweede Wet van Newton)



Antoine Lavoisier

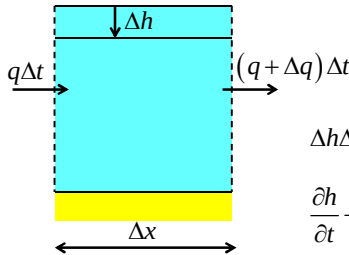


Isaac Newton

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Continuïteit



$$\Delta h \Delta x + \Delta q \Delta t = 0$$

$$\frac{\partial h}{\partial t} + \frac{\partial q}{\partial x} = 0$$

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Continuïteit

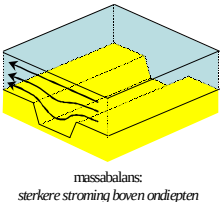
$$\frac{\partial h}{\partial t} + \frac{\partial q}{\partial x} = 0$$

Stationaire stroming: $\partial \dots / \partial t = 0$

$$\frac{\partial q}{\partial x} = 0$$

$q = \text{constant}$

$hu = \text{constant}$



massabalans:
sterkere stroming boven ondiepten

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Tweede Wet van Newton

$$F = ma$$

Per eenheid van massa:

$$\frac{F}{m} = \frac{Du}{Dt}$$

Werking van verschillende krachten:

$$\frac{Du}{Dt} = \frac{\Sigma F}{m}$$

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Tweede Wet van Newton

$$\frac{Du}{Dt} = \frac{\Sigma F}{m} = \frac{\Sigma F}{\rho V}$$

Welke krachten werken er op een watervolume?

- Zwaartekracht (via drukgradiënt) $\frac{F_{druk}}{m} = -g \frac{\partial z_w}{\partial x} = +gi$
- Stromingsweerstand (bodempwrijving, vegetatie, overlaten) $\frac{F_{resist}}{m} = -\frac{\tau_b}{\rho h}$
- Wind $\frac{F_{wind}}{m} = +\frac{\tau_{wind}}{\rho h}$

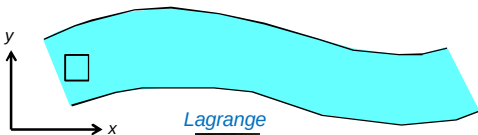
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Tweede Wet van Newton

$$\frac{Du}{Dt} + g \frac{\partial z_w}{\partial x} + \frac{\tau_b}{\rho h} - \frac{\tau_{wind}}{\rho h} = 0$$

Meebewegen of stilstaan: Euler versus Lagrange



Lagrange



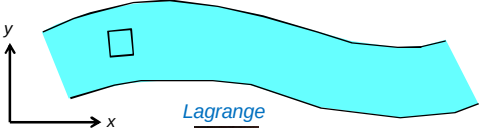
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Tweede Wet van Newton

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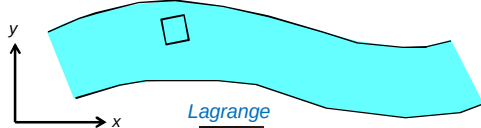



Deltares

Tweede Wet van Newton

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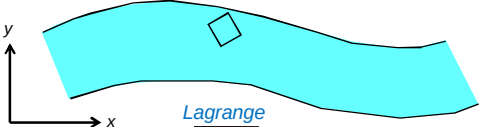



Deltares

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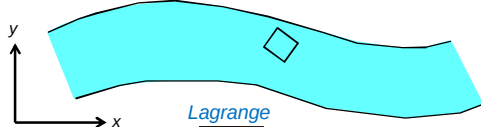



Deltares

Tweede Wet van Newton

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Meebewegen of stilstaan: Euler versus Lagrange



Lagrange

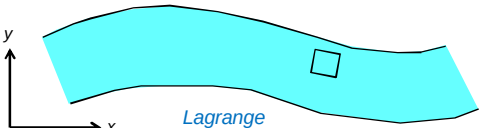



Deltares

Tweede Wet van Newton

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Meebewegen of stilstaan: Euler versus Lagrange



Lagrange

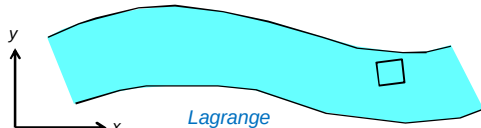



Deltares

Tweede Wet van Newton

$$\frac{Du}{Dt} + g \frac{\partial z_w}{\partial x} + \frac{\tau_b}{\rho h} - \frac{\tau_{wind}}{\rho h} = 0$$

Meebewegen of stilstaan: Euler versus Lagrange

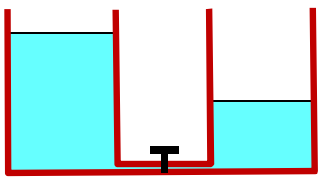


Lagrange




Deltares

Drukverschillen

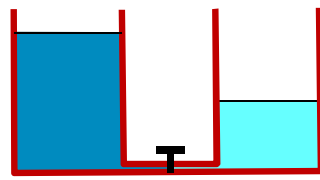


- Wat gebeurt er als je de kraan open draait?
- Wat is de eindsituatie?

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Drukverschillen

zout $\rho = 1025 \text{ kg/m}^3$ zoet $\rho = 1000 \text{ kg/m}^3$

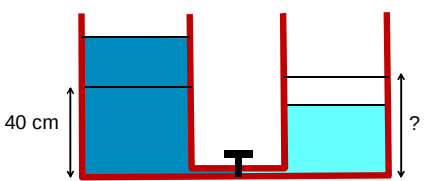


- Wat gebeurt er als je de kraan open draait?
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Drukverschillen

zout $\rho = 1025 \text{ kg/m}^3$ zoet $\rho = 1000 \text{ kg/m}^3$



40 cm ?

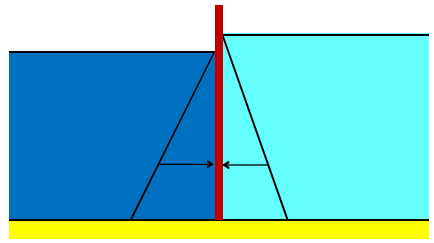
$$p = \rho_{\text{links}} g H_{\text{links}} = \rho_{\text{rechts}} g H_{\text{rechts}}$$

$$H_{\text{rechts}} = 1,025 H_{\text{links}} = 41 \text{ cm}$$

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Drukverschillen

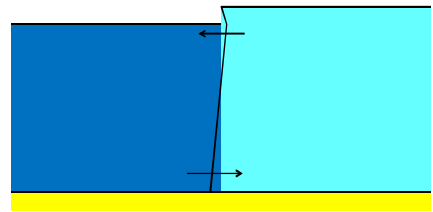
zout zoet



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Drukverschillen

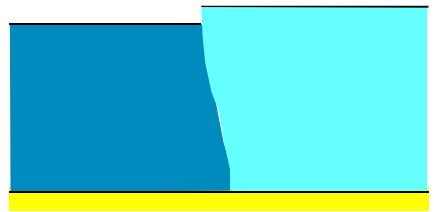
zout zoet



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Drukverschillen

zout zoet



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