Continuity of incompressible, free surface flows

Engineering Fluid Mechanics

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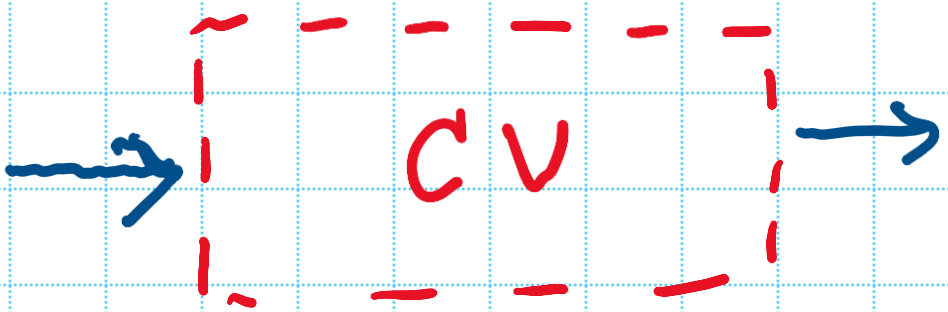
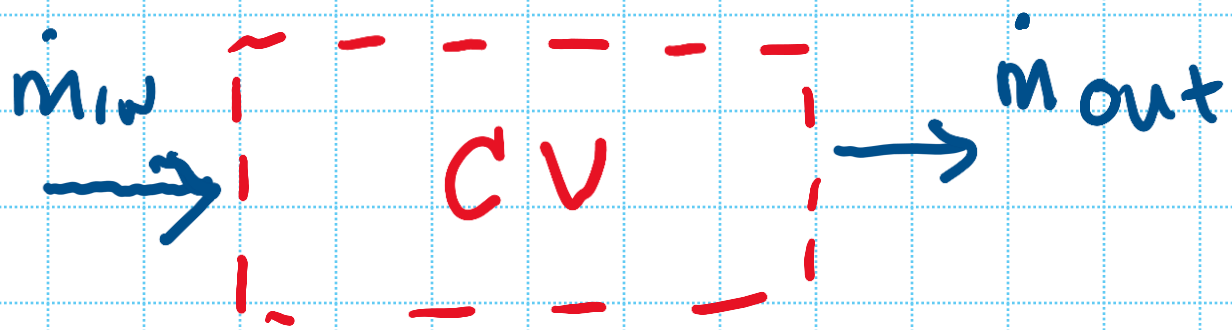
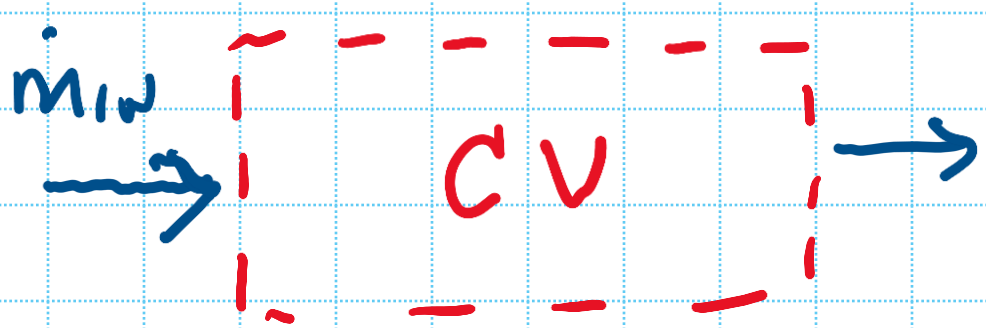
Application of **1D continuity** to steady, incompressible, free surface flows



Application of 1D continuity to **steady**, incompressible, free surface flows



Application of 1D continuity to **steady**, incompressible, free surface flows



$$\dot{m}_{out} - \dot{m}_{IN} = 0$$

$$\dot{m}_{out} = \dot{m}_{IN}$$

$$\rho \cdot V \cdot A = \dot{m}$$

$$\frac{M}{L^3} \cdot \frac{L}{t} \cdot L^2 = \frac{M}{t}$$

$$\frac{d}{dt}\int_{CV} \rho \, d\forall + \int_{CS} \rho \, (\vec{V}_r \cdot \vec{n}) \, dA = 0$$

Change of mass in CV over time

Net mass flux out of CV

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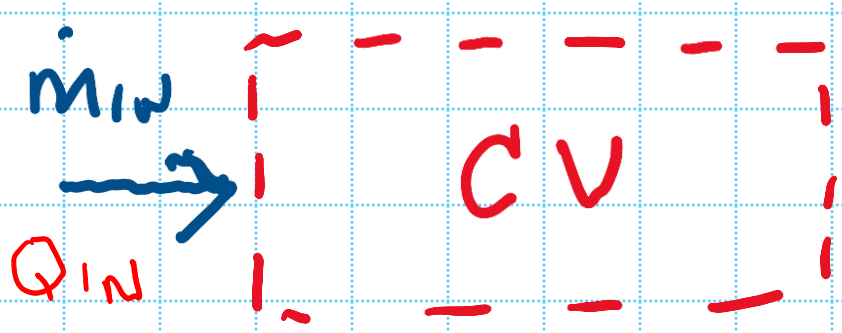


$\dot{m}_{out}$
Q_{out}

$\dot{m} = \rho Q$

$\dot{m}_{IN} = \rho_{IN} Q_{IN}$

$\dot{m}_{out} = \rho_{out} Q_{out}$

$\dot{m}_{IN} = \dot{m}_{out}$

$\rho_{IN} = \rho_{out}$

$\rho_{IN} Q_{IN} = \rho_{out} Q_{out}$

$Q_{IN} = Q_{out}$

Application of 1D continuity to **steady**, **incompressible**, free surface flows

$$\cancel{\frac{\partial \rho}{\partial t}} + \vec{\nabla}(\rho \vec{V}) = 0$$

GENERAL

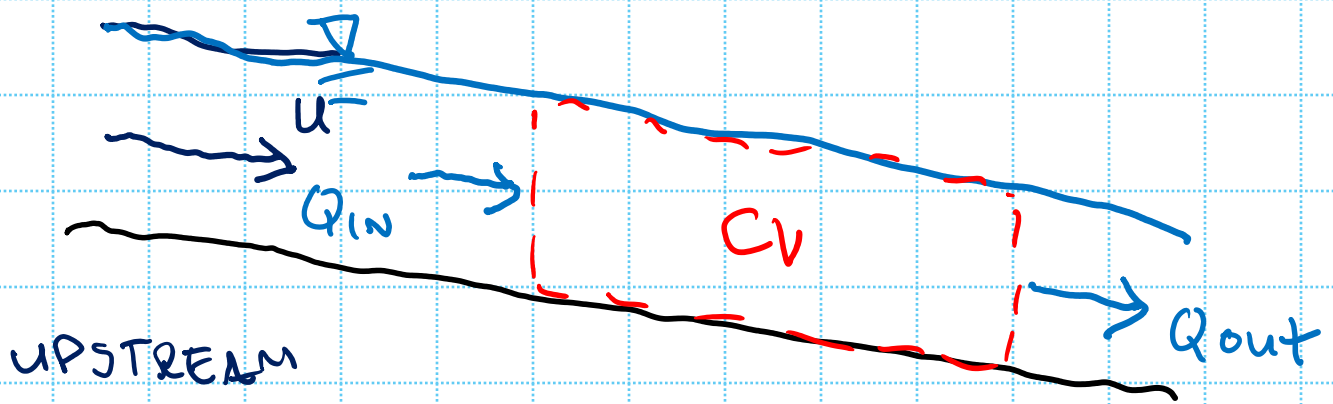
$$\vec{\nabla}(\rho \vec{V}) = 0$$

STEADY

$$\vec{\nabla} \vec{V} = 0$$

INCOMPRESSIBLE

Application of 1D continuity to steady, incompressible, **free surface flows**



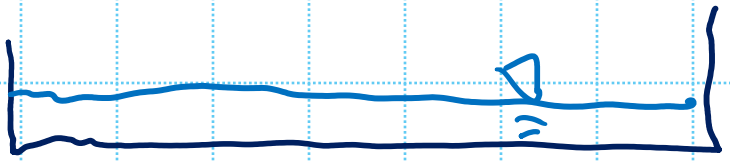
$Q_{IN} = Q_{out}$

$Q = A \cdot V_{avg}$

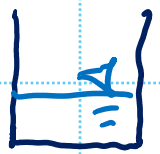
$A_{IN} V_{IN} = A_{out} V_{out}$

$A_{IN} > A_{out}$

$V_{IN} < V_{out}$



A IN - BIG



A_{out} - SMALL

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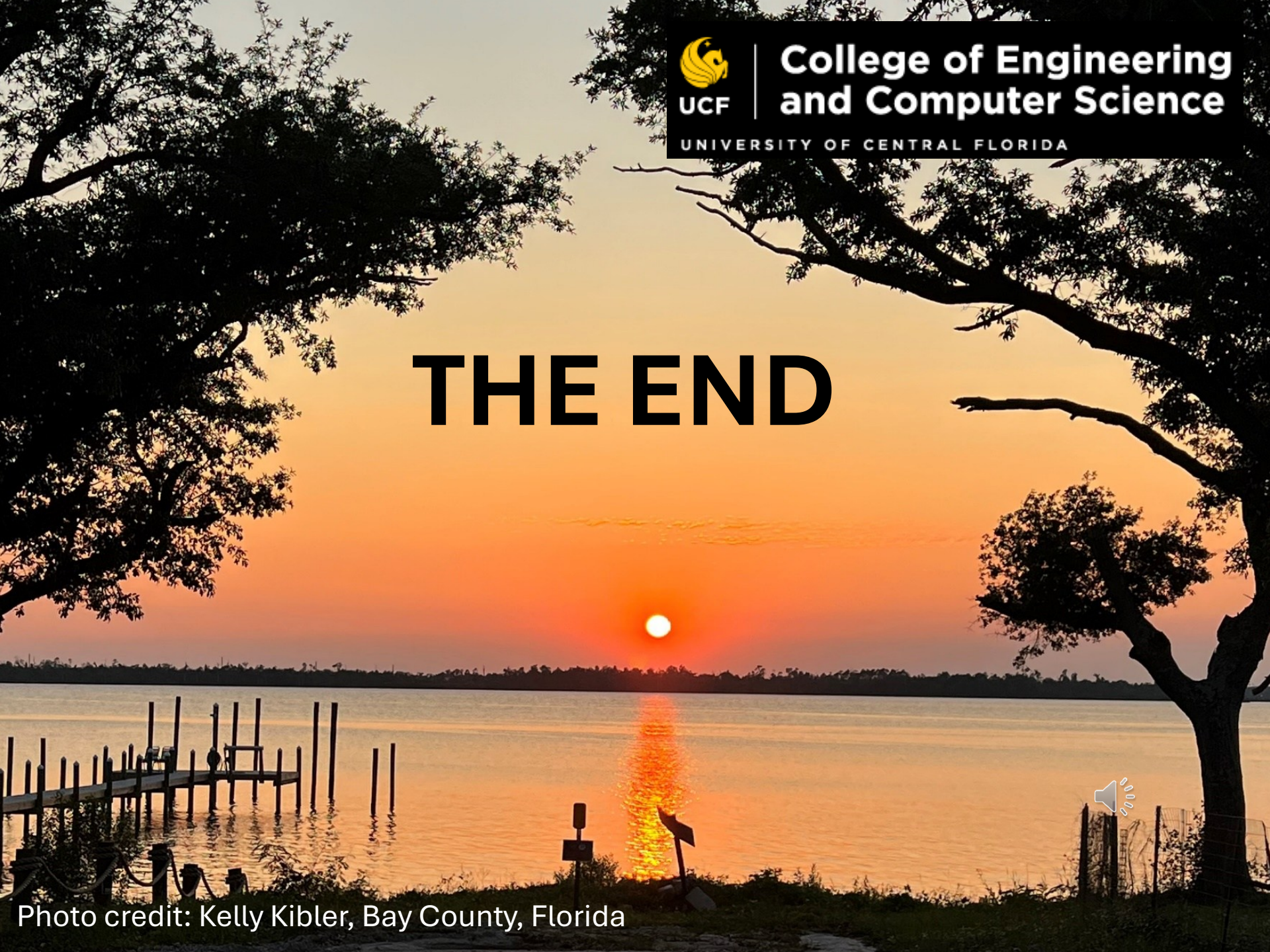
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THE END
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