

# **SELFE: Semi-implicit Eulerian-Lagrangian Finite Element**

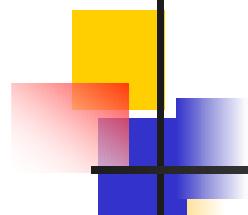
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**ELCIRC User Group Meeting**

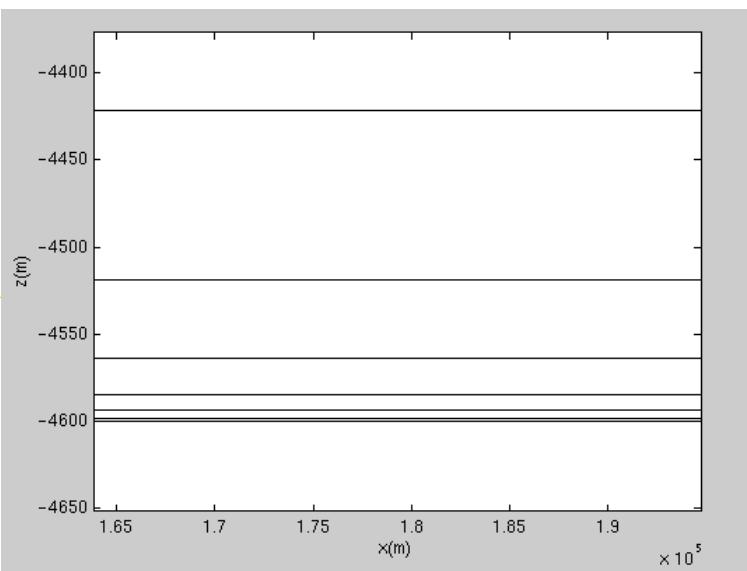
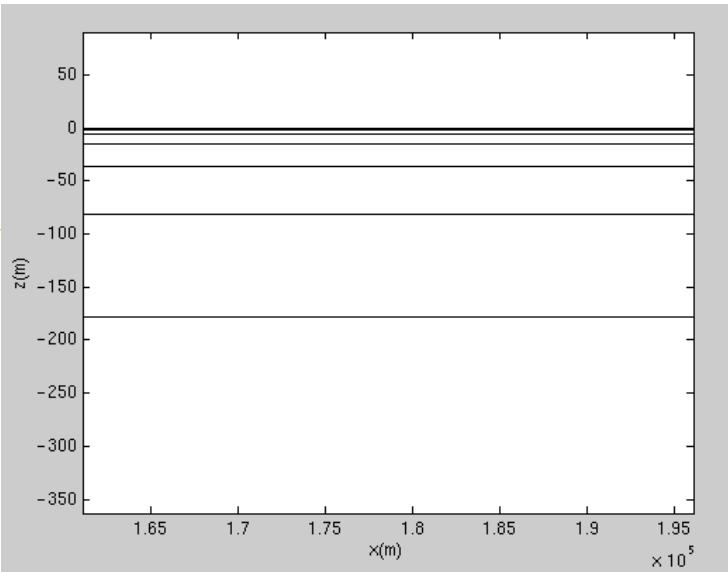
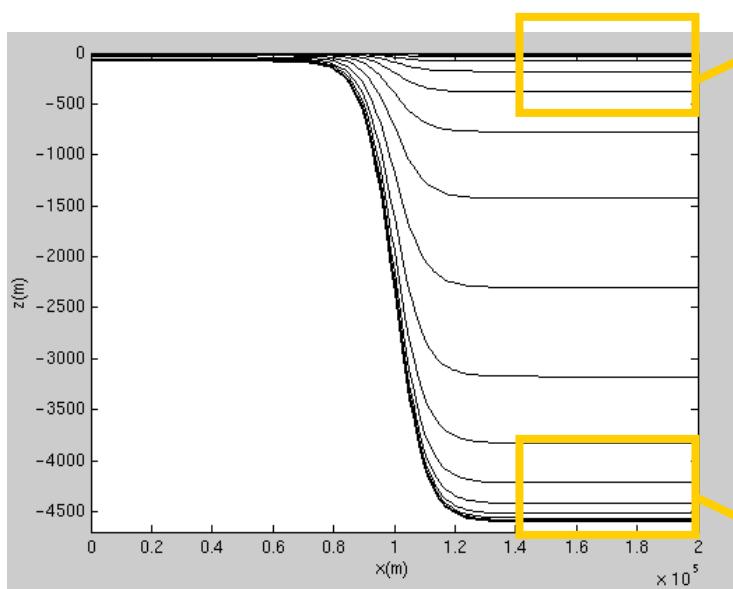


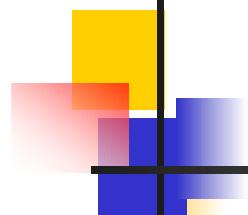
# Comparison

Model name	<b>ELCIRC</b>	<b>SELFE</b>
Numerical method	Semi-implicit FD/FV	Semi-implicit FE/FV
Shape function (barotropic)	Constant	Linear
Advection	ELM	ELM with optional sub-division of grids
CFL restriction	No	No
Horizontal grid	Orthogonal unstructured	Unstructured
Vertical grid	$z$ -coordinate	$\sigma$ -coordinate
Volume conservation	Numerically exact	Numerically not exact
Baroclinicity	FD with trapezoidal integration	Hybrid method with 4 <sup>th</sup> - or 6 <sup>th</sup> order integration
o.b.c. for elevation	Empirical	Natural
Transport eq	<ul style="list-style-type: none"> <li>■ FD</li> <li>■ FCT (in progress)</li> </ul>	<ul style="list-style-type: none"> <li>■ FE</li> <li>■ FCT (in progress)</li> </ul>

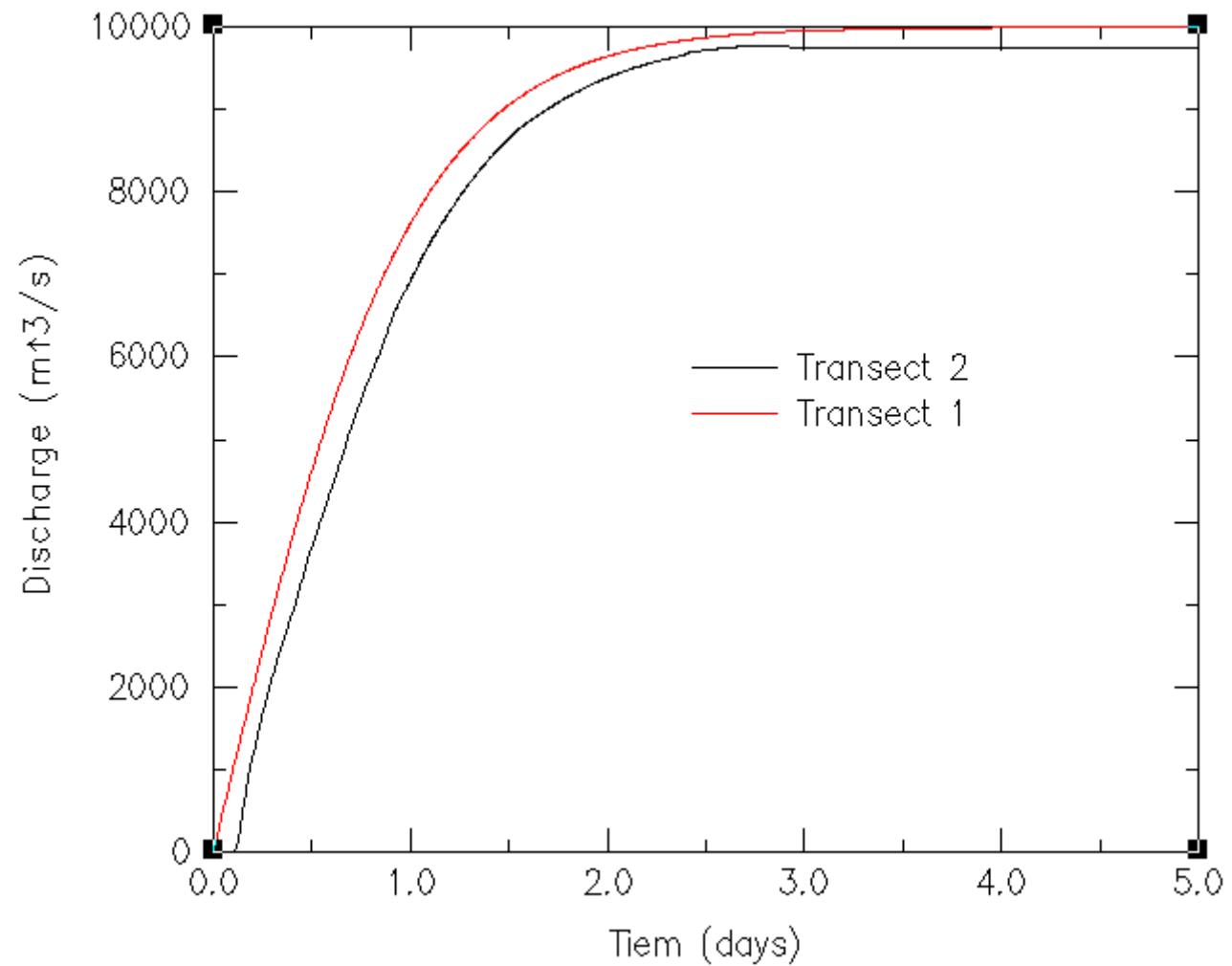
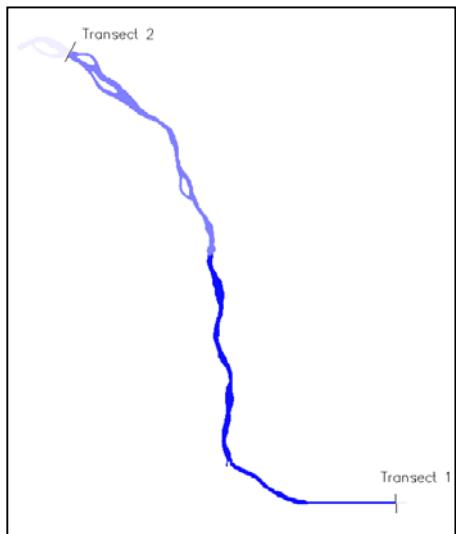


# S-coordinates (Song & Haidvogel 1994)





# Volume conservation test



Error:

SELFE: ~2.5%

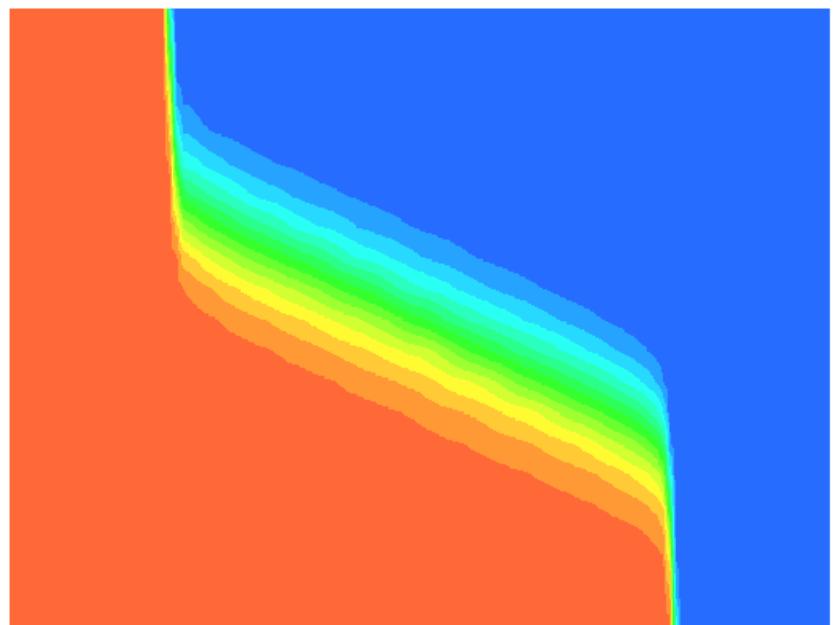
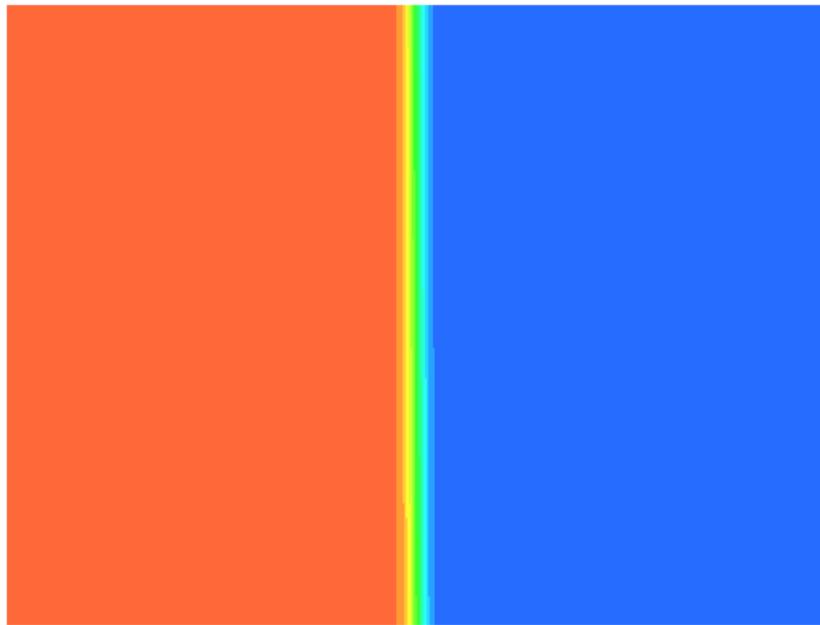
ELCIRC: <1%

# Adjustment under gravity

$t=0\text{hr}$

$k-k_l$

$t=12\text{hr}$



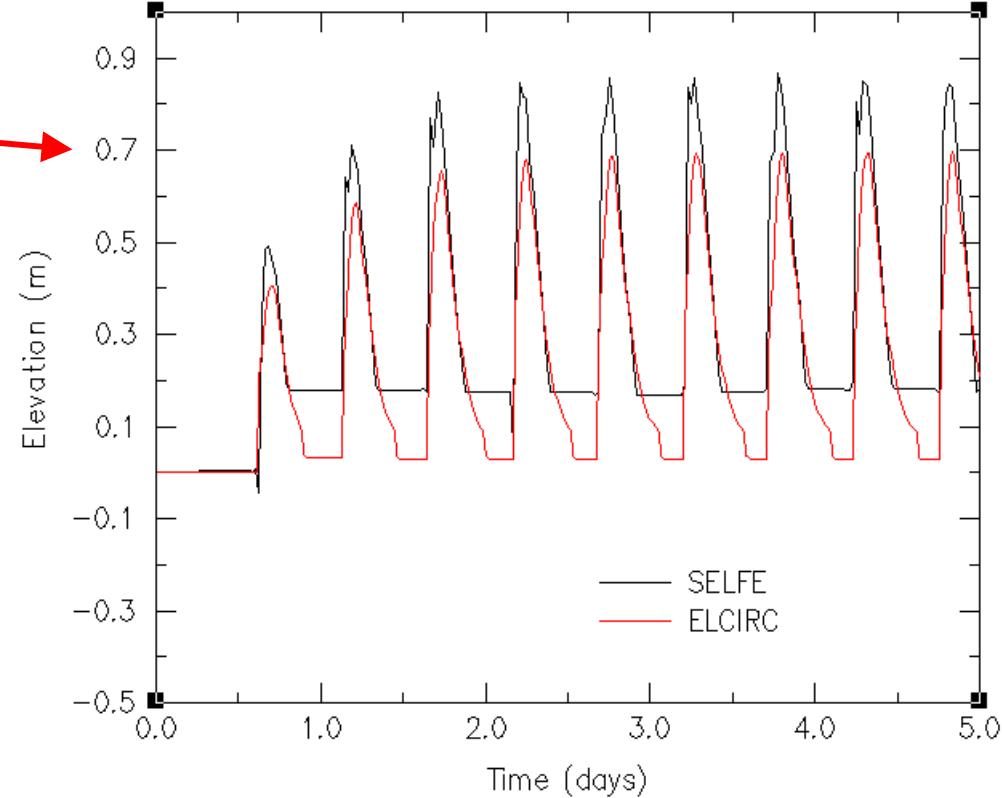
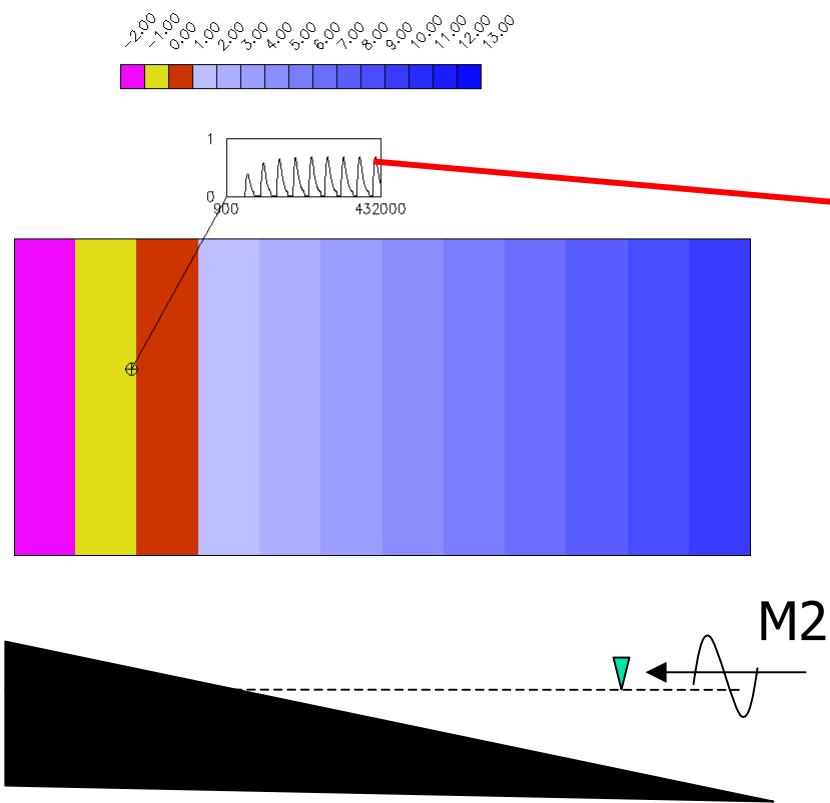
Internal wave speed:

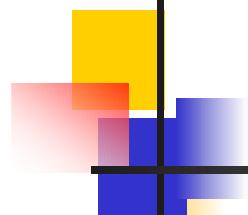
SELFE: 92% (linear) or 93% (quadratic);

ELCIRC: 82% (best result: 88% with 4x resolution)

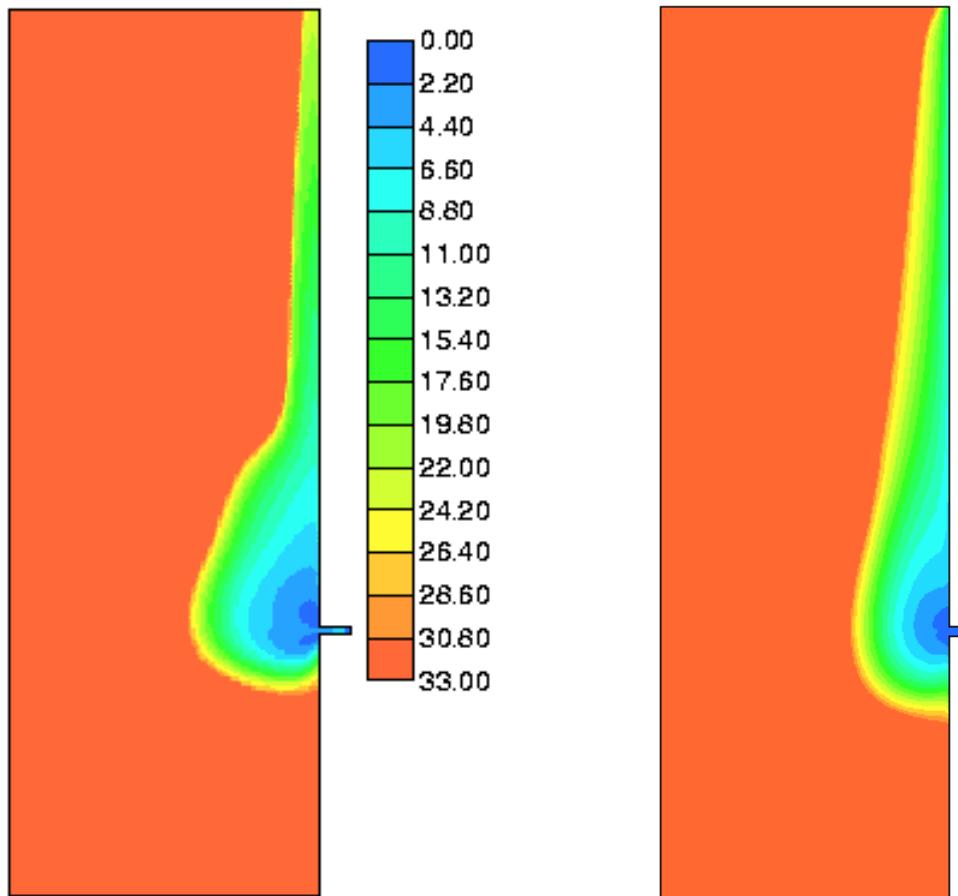
ROMS: 90-94%

# Wetting and drying



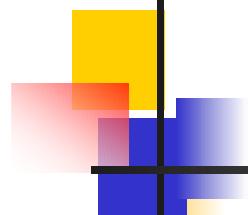


# Plume test



ELCIRC

SELFE (preliminary)



# List of things to do and discussions

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- \*A  $\sigma$ -coordinates version of ELCIRC
- \* An alternative, non-ELM, scalar transport algorithm, to seek strict mass conservation and to reduce numerical diffusion.
- \* SELFE
- Non-hydrstatic ELCIRC
- Version control
- Organization of web site

# 3D community ocean models

	ADCIRC <sup>1</sup>	POM <sup>2</sup> /ROMS <sup>3</sup>	FVCOM <sup>4</sup>	QUODDY <sup>5</sup>	UnTRIM <sup>6</sup> / ELCIRC
Wetting and drying	2D only	No	Yes	No	Yes
Horizontal grid	Unstr.	Stru.	Unstr.	Unstr.	Unstr.
Vertical representation	$\sigma$ -coord	$\sigma$ -coord	$\sigma$ -coord	$\sigma$ -coord	$z$ -coord
Numerical algorithm	FE	FD	FV	FE	FD/FV
Continuity wave or primitive equations	GWCE	PE	PE	GWCE	PE
Mode splitting	Yes	Yes	Yes	Yes	No
Advection treatment	Eul	Eul	Eul	Eul	ELM

1. Advanced Circulation, Luettich *et al.* (Univ. of UNC, Waterway Experiment Station of Army Corp of Engineers):
2. Princeton Ocean Model (POM) (Mellor and Blumberg)
3. Regional Ocean Modeling System, Haidvogel *et al.* (Rutgers Univ.)
4. Finite Volume Community Ocean Model, C. Chen (University of Massachusetts)
5. QUODDY, Lynch *et al.* (Dartmouth College)
6. Unstructured Tidal River Inter-tidal Mudflat, Casulli (Univ. of Trento, Italy)