GETM

A General Estuarine Transport Model

Hans Burchard\textsuperscript{1}, Karsten Bolding\textsuperscript{2}, Jean-Marie Beckers\textsuperscript{3}, Manuel Ruiz Villarreal\textsuperscript{4}, Emil Stanev\textsuperscript{5}

\textsuperscript{1}hans.burchard@io-warnemuende.de, \textsuperscript{2}karsten@bolding-burchard.com, \textsuperscript{3}jm.beckers@ug.ac.be, \textsuperscript{4}manuel@gotm.net, \textsuperscript{5}e.stanev@icbm.de

\textsuperscript{1}Institut für Ostseeforschung Warnemünde
\textsuperscript{2}Bolding & Burchard Hydrodynamics, Asperup, Denmark
\textsuperscript{3}University of Liège, Belgium,
\textsuperscript{4}Spanish Institute of Oceanography, A Coruña,
\textsuperscript{5}ICBM, Universität Oldenburg
Coastal modelling challenges I

- **Drying and flooding algorithm** for simulation of Wadden Sea areas.
- **Bottom-fitted coordinates** for better representing near-bed currents.
- **Surface-fitted coordinates** for fine near-surface resolution at high tidal range.
- **General vertical coordinates** for better fitting the model grid to internal structures.
Coastal model challenges II

- **Flexible horizontal coordinates** for better representing complex bathymetry and higher resolutions of specific regions without nesting.
- **Monotone high-order advection schemes** for better representing fronts and stratification.
- **Higher order turbulence models** for good representation of vertical mixing.
## Why a new 3D model?

The following table lists various 3D models along with their characteristics:

<table>
<thead>
<tr>
<th>Model</th>
<th>Vertical discretisation</th>
<th>Horizontal discretisation</th>
<th>Barotropic time-stepping</th>
<th>High-order turbulence closures</th>
<th>Drying/Flooding</th>
<th>Public Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOM-4</td>
<td>z</td>
<td>CU</td>
<td>MSP</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>POM</td>
<td>s</td>
<td>CU</td>
<td>MSP</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>ROMS</td>
<td>s</td>
<td>CU</td>
<td>MSP</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>POL3DB</td>
<td>s</td>
<td>CA</td>
<td>MSP</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>GHER-M</td>
<td>2 - σ</td>
<td>CA</td>
<td>MSP</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>COHERENS</td>
<td>σ</td>
<td>CA</td>
<td>MSP</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>TRIM-3D</td>
<td>z</td>
<td>CA</td>
<td>IMP</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>MIKE-3</td>
<td>z</td>
<td>CA</td>
<td>ADI</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TELEMAC-3D</td>
<td>σ</td>
<td>FE</td>
<td>IMP</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>ECOM</td>
<td>s</td>
<td>CU</td>
<td>IMP</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>MOHID</td>
<td>s</td>
<td>CA</td>
<td>ADI</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>GETM</td>
<td>s</td>
<td>CU</td>
<td>MSP</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

The table indicates which models support various discretisation and time-stepping methods, as well as whether they are available in the public domain.
GOTM is a one-dimensional numerical model developed and supported by a core team of ocean modellers. GOTM aims at simulating accurately vertical exchange processes in the marine environment where mixing is known to play a key role. GOTM is freely available under the GPL (Gnu Public License).

The interested user can download the source code, a set of test cases (Papa, November, Flex,...) and a comprehensive report.

You are warmly invited to join the GOTM mailing list and send any comments/questions to the GOTM team or become a GOTM contributor. The GOTM developers are grateful to their sponsors.
North Frisian Wadden Sea

Burchard and Bolding [2002]
East Frisian Wadden Sea

VERTICALLY INTEGRATED VELOCITY

Stanev et al. [2003]
Tidal Elbe I

Topography data provided by BAW Hamburg
Tidal Elbe II

Suspended particulate matter concentration

Burchard et al. [2003]

Conclusions, literature

- GETM is one of the very few Public Domain models designed for small scale coastal and estuarine applications.
- The study of coastal and estuarine dynamics is a challenge for Physical Oceanographers.
- An OGCM with high resolution does not converge to a coastal or estuarine model.