A qualitative assessment of climate change impacts on the stability of small tidal inlets via schematised numerical modelling

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Publication date
2014

Document Version
Final published version

Citation (APA)

Important note
To cite this publication, please use the final published version (if applicable).
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Are Inlet Initial Model results agree SLR Reduction of littoral drift Inlet Series of strategic Nature Representative sites: Type 1 Inlet Inlet Enhancement of littoral drift Enhancement (SLR)) SLR When

Model Results:
- Inlet locally, cross-sectionally stable, F=233 (consistent with Bruun criteria)
- Model results agree with Jarrett 1976 AP relationship and Escollifer curve

<table>
<thead>
<tr>
<th>Present condition simulation (PS)</th>
<th>Climate Change simulations (GS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Varying MSL (i.e. SLR), wave, riverflow, in-isolation (G1) and in combination (G2).</td>
<td>- SLR (by 2100): 1m</td>
</tr>
<tr>
<td>+ SLR (by 2100): 1m</td>
<td>+ Hs, H and R vary (from PS values)</td>
</tr>
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<td>- Simulation duration: same as PS</td>
<td>- Basin infilling included in SLR simulations</td>
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</tbody>
</table>

Nature of Changes:
- SLR reduces slightly but in the range (5-100) m.
- Riverflow (up +10%) or SLR alone can have significant impact on inlet stability (r changes significantly from good (>150) to fair (100-150) or fair to poor (50-100) class).
- Changes in riverflow (±40%), Hs(±8%) or SLR alone have insignificant impact on inlet stability (r always > 150). Inlet in "good Bruun classification."
- Enhancement of littoral drift by (Hs+8%, H+10% or Hs, H+10%) can result r in values from 150 to 50 (but not below 50).
- Scenarios with SLR or higher riverflow (R) generally increases r.
- SLR of 1m results in significant mean coastline recession (up to ~120m).
- Other CC driven changes in system forcing do not result in significant coastline recession/propagation.
- Coastline variability (spatial) is maximum when it becomes more southerly (as of ~100m).

- Inlet does not change type in all tested CC scenarios, implying that even under the most extreme projected CC driven variations in forcing, Inlet type will not change its general behavior.

Methods:
- Series of strategic idealised model applications, using Delft3D.
- Schematised inlet/forcing conditions representing 3 main inlet morphodynamic characteristics.

Type 1: Permanently open, locationally stable inlet
Type 2: Permanently open, alongshore migrating inlet
Type 3: Seasonally/Intermittently open, locationally stable inlet

Representative sites: Type 1 – Negombo lagoon; Type 2 – Kalutara lagoon; Type 3 – Maha Oya river (Southwest coast of Sri Lanka).

Model Results:
- Inlet stability indicator: F=P/Mtot (Bruun, 1978: Mtot=annual littoral drift (m³/year), P= tidal prism (m³))

<table>
<thead>
<tr>
<th>F=P/Mtot</th>
<th>&gt; 150</th>
<th>100 – 150</th>
<th>50 – 100</th>
<th>20 – 50</th>
<th>&lt; 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bruun Classifications</td>
<td>Good</td>
<td>Fair</td>
<td>Fair to poor</td>
<td>Poor</td>
<td>Unstable</td>
</tr>
</tbody>
</table>

Type 1: Stable Inlet
1. Present Simulation
- Inlet migrates 460m Southward (in one year), r=16 (consistent with Bruun criteria, unstable inlet)
- Model results agree with Jarrett 1976 AP relationship and Escollifer curve

Type 2: Migrating inlet
1. Present Simulation
- Inlet completely closes when riverflow is small (after 31days), r=2 (consistent with Bruun criteria, unstable inlet).

Type 3: Intermittently Closing Inlet
1. Present Simulation
- Inlet changes in closure type, r increases to >200.
- Model results agree with Jarrett 1976 AP relationship

3. Conclusions
- Type 1 Inlet does not change its behavior significantly due to any CC driven variations in system forcing (i.e. inlet does not change type). Inlet always closes, r always <20 in unstable Bruun category.
- However, under individual CC forcing scenarios, the inlet response varies.