EstSim Pilot Testing: Performance Evaluation of Prototype Simulator

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Aim of pilot testing

- Build on development work by evaluating performance
- Evaluate usability of simulator code

Consideration of:

- Generic versus specific estuaries
- Interpretation of results
- Range of applicability

Pilot testing considerations

Driven by management questions:

- Emergent properties of an estuary
- Sensitivities of an estuary to change
- Constraints on the evolution of the estuary
- Evaluating quantitative model performance

Thames

- Started with generic funnel-shaped estuary
- Initial experiments to validate and produce specific set up
  - Slight change to “marsh” logic statement
  - Addition of encroachment term
- Range of scenarios
  - Barrage, dredging, reclamation, realignment, accelerated sea level rise

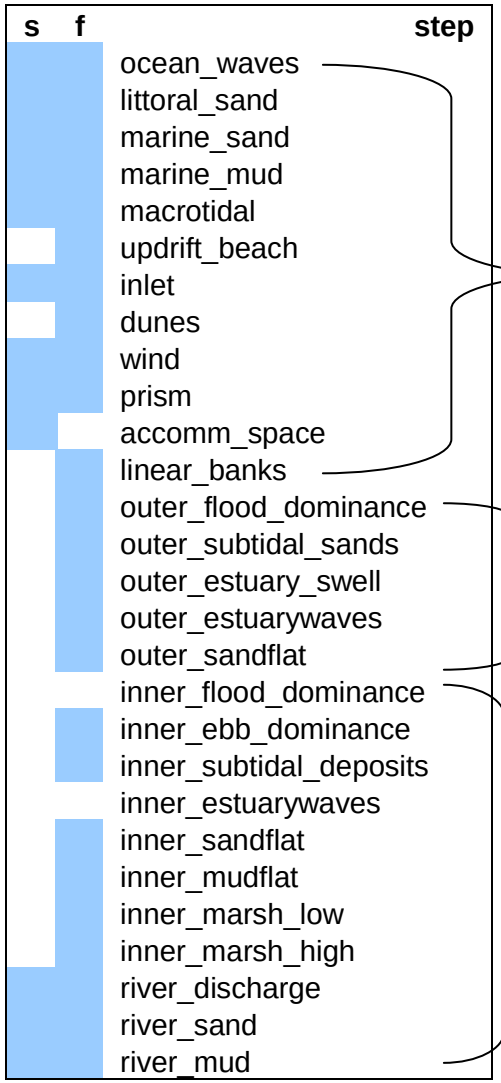
Thames Estuary – generic setup

Evolution from start to finish

1	2	3	4	5	6	7	8	9	10	11	12	13	step
1	1	1	1	1	1	1	1	1	1	1	1	1	ocean_waves
1	1	1	1	1	1	1	1	1	1	1	1	1	littoral_sand
1	1	1	1	1	1	1	1	1	1	1	1	1	marine_sand
1	1	1	1	1	1	1	1	1	1	1	1	1	marine_mud
1	1	1	1	1	1	1	1	1	1	1	1	1	macrotidal
0	0	0	1	1	1	1	1	1	1	1	1	1	updrift_beach
1	1	1	1	1	1	1	1	1	1	1	1	1	inlet
0	0	0	0	0	0	0	0	1	1	1	1	1	dunes
1	1	1	1	1	1	1	1	1	1	1	1	1	wind
1	1	1	1	1	1	1	1	1	1	1	1	1	prism
1	1	1	1	1	1	1	0	0	0	0	0	0	accomm_space
0	0	0	1	1	1	1	1	1	1	1	1	1	linear_banks
0	1	1	1	1	1	1	1	1	1	1	1	1	outer_flood_dominance
0	0	0	0	0	0	1	1	1	1	1	1	1	outer_subtidal_sands
0	1	1	1	1	1	1	1	1	1	1	1	1	outer_estuary_swell
0	1	1	1	1	1	1	1	1	1	1	1	1	outer_estuarywaves
0	0	0	1	1	1	1	1	1	1	1	1	1	outer_sandflat
0	1	1	1	1	1	1	1	0	0	0	0	0	inner_flood_dominance
0	0	0	0	0	0	0	0	0	0	1	1	1	inner_ebb_dominance
0	0	0	1	1	1	1	1	1	1	1	1	1	inner_subtidal_deposits
0	0	1	1	0	0	0	0	0	0	0	0	0	inner_estuarywaves
0	0	0	0	0	0	1	1	1	1	1	1	1	inner_sandflat
0	0	0	1	1	1	1	1	1	1	1	1	1	inner_mudflat
0	0	0	0	0	0	0	0	0	0	0	0	1	inner_marsh_low
0	0	0	0	0	0	0	0	0	1	1	1	1	inner_marsh_high
1	1	1	1	1	1	1	1	1	1	1	1	1	river_discharge
1	1	1	1	1	1	1	1	1	1	1	1	1	river_sand
1	1	1	1	1	1	1	1	1	1	1	1	1	river_mud

Set of 28 features present during simulation

Thames Estuary – generic setup



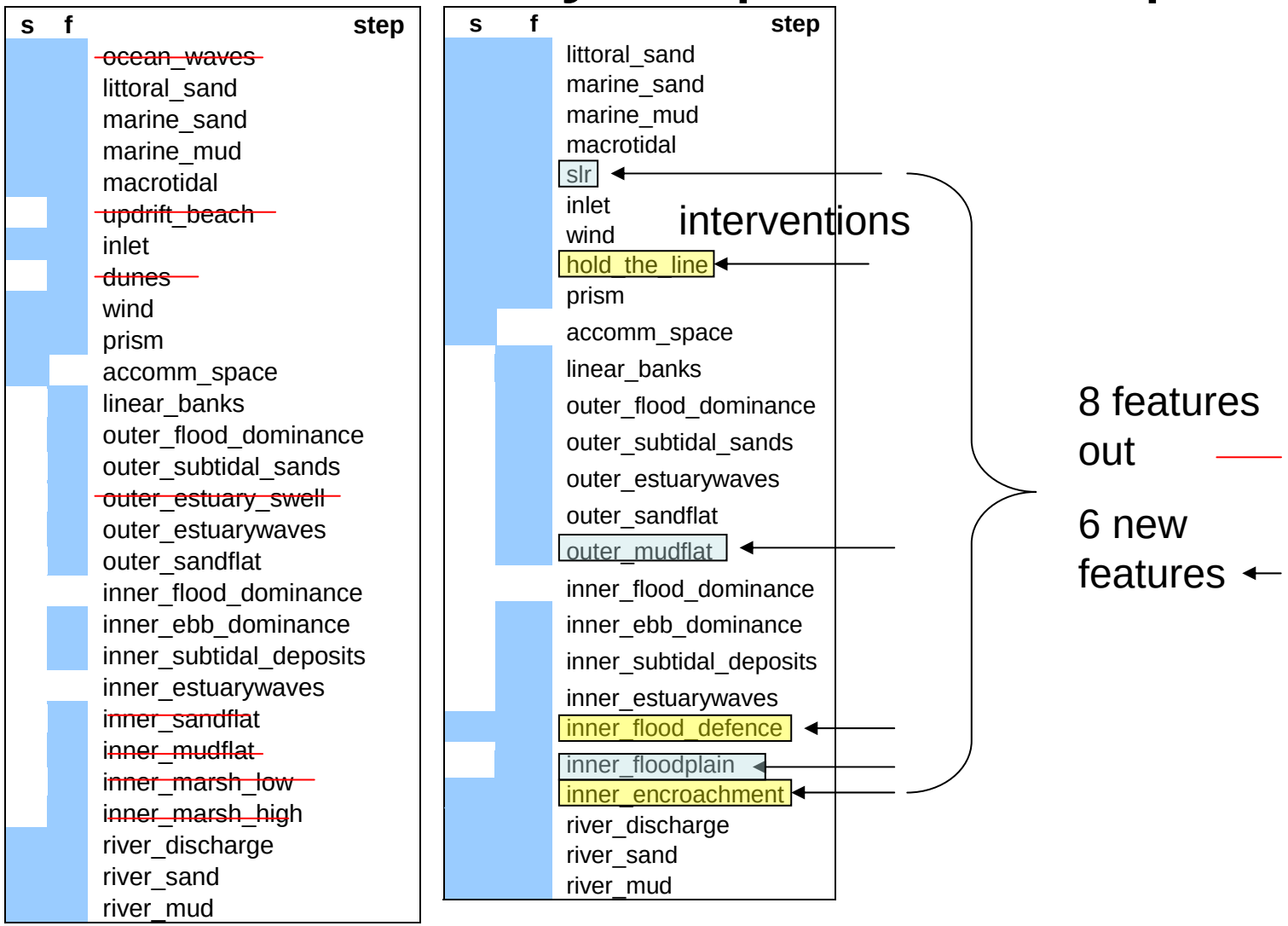
Show only **s**tart and **f**inish steps

Coastal estuary features

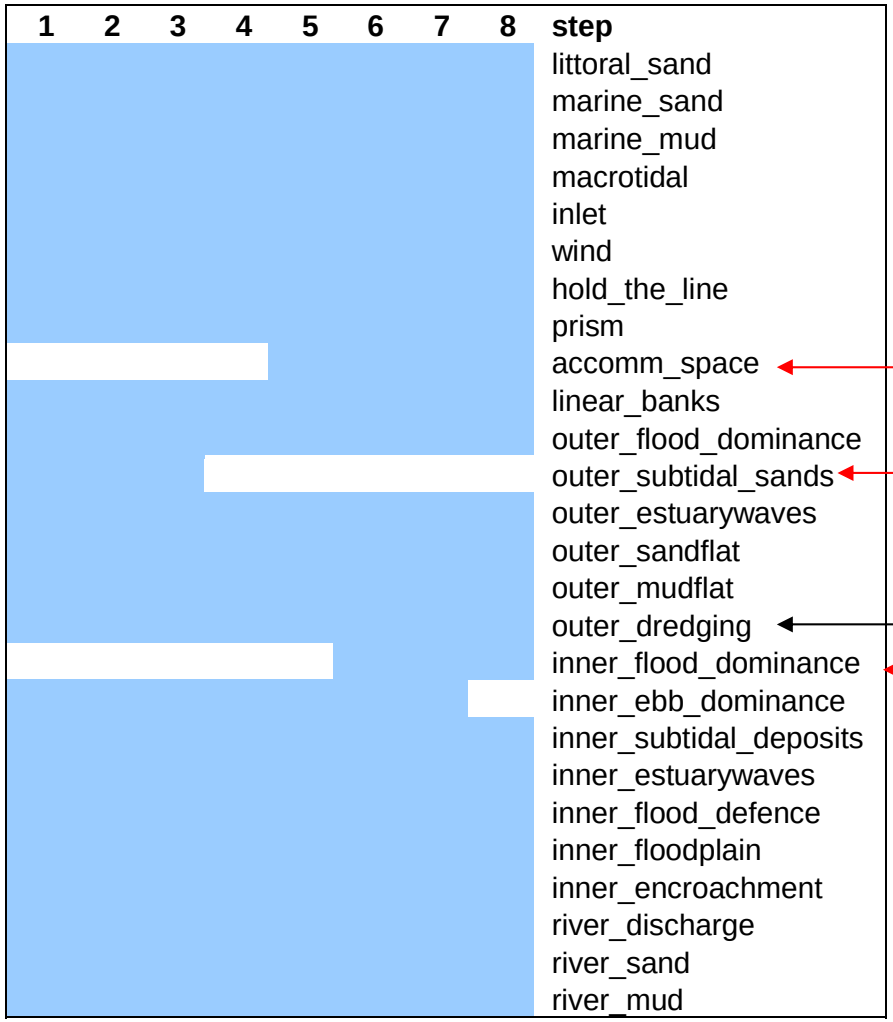
Outer estuary features

Inner estuary features

Thames Estuary – specific setup



Thames – outer dredging



n.b. Accelerated sea level rise = off

Off then on

On then off

Intervention

Off then on

Present version of simulator does not determine significance of change

Range of interventions

Interventions	
Seawall	Presence of sea wall
Groynes	Presence of groynes - affects longshore drift
sea level rise	Presence of sea level rise
Hold the line	Management option to maintain current flood defences
Realign	Management option to remove flood defence
Inner flood defence/Outer flood defence	Management option to remove flood Defence in the inner/outer estuary
Inner Dredging/Outer dredging	Presence of dredging (deepening) in the inner/outer estuary
Barrage	Presence of a barrage which reduces tidal range in the inlet

- Interventions apply everywhere
  - Can be refined

Thames pilot testing

- Examined reclamation and realignment of inner flood defences
- Realignment
  - Inner flood plain and inner encroachment turned off
  - Inner marsh (high and low) develops
  - Outer estuary not affected

Teign

- Started with generic spit-enclosed estuary
- Initial experiments to validate and produce specific set up
  - An illustrative function for inner reed beds;
  - An updrift seawall; and,
  - No marine mud supply.

Teign

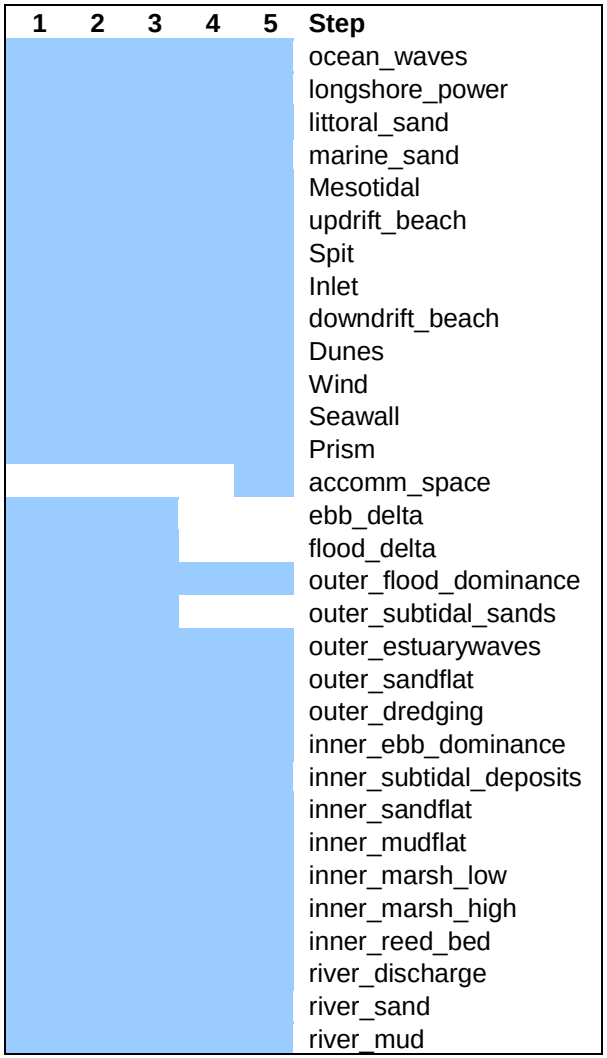
- Reed beds form in the inner estuary as observed
- Absence of marine mud prevents outer-mud-flats from forming
  - In line with observed morphology of the estuary
- But….outer flood dominance
  - estuary is strongly ebb dominant

- Definition of estuary (inner and outer)
  - No obvious “inner” and “outer” sections
  - Outer estuary is only a very short section between the narrow mouth and Shaldon Bridge about 1km up-estuary
  - A matter of interpretation

Scenarios tested

- Flood defences
- Realignment
- Dredging
- Groynes (on coast)

Simulation of outer dredging



increased accommodation space

loss of ebb and flood deltas

loss of outer subtidal sands

inner estuary unaffected

Interpretation of dredging

- Definition of inner and outer estuary
  - Complicates the interpretation
- Dredging in inner estuary
  - No affect on outer estuary, down drift beach, accommodation space and flood and ebb deltas
- Inner subtidal deposits are removed
  - Inner mud flats, marshes and reed beds remain
  - Lack of sensitivity to scale of intervention

EstSim simulator - Conclusions (1)

- Easy to use and quick to run
- Can be used readily to explore generic estuary behaviour
- Can be set up for specific estuaries
  - Requires good knowledge of estuary gemorphology and processes
  - Requires initial testing with “data” on estuary
- Can be used to evaluate general direction of change

EstSim simulator - Conclusions (2)

- In present form cannot capture scale of change
  - E.g. large vs minor
- Partial ability to capture sensitivities
- Can be used to help develop conceptual models and as an educational tool
- Interpretation is key (i.e. “on”/”off”) and context important