

# The Systems Approach

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# Overview

- What is
  - A Systems Approach?
  - Behavioural / Qualitative Modelling?
- System Definition / Mapping
  - (Behavioural Statements Objective)



# What is a Systems Approach?

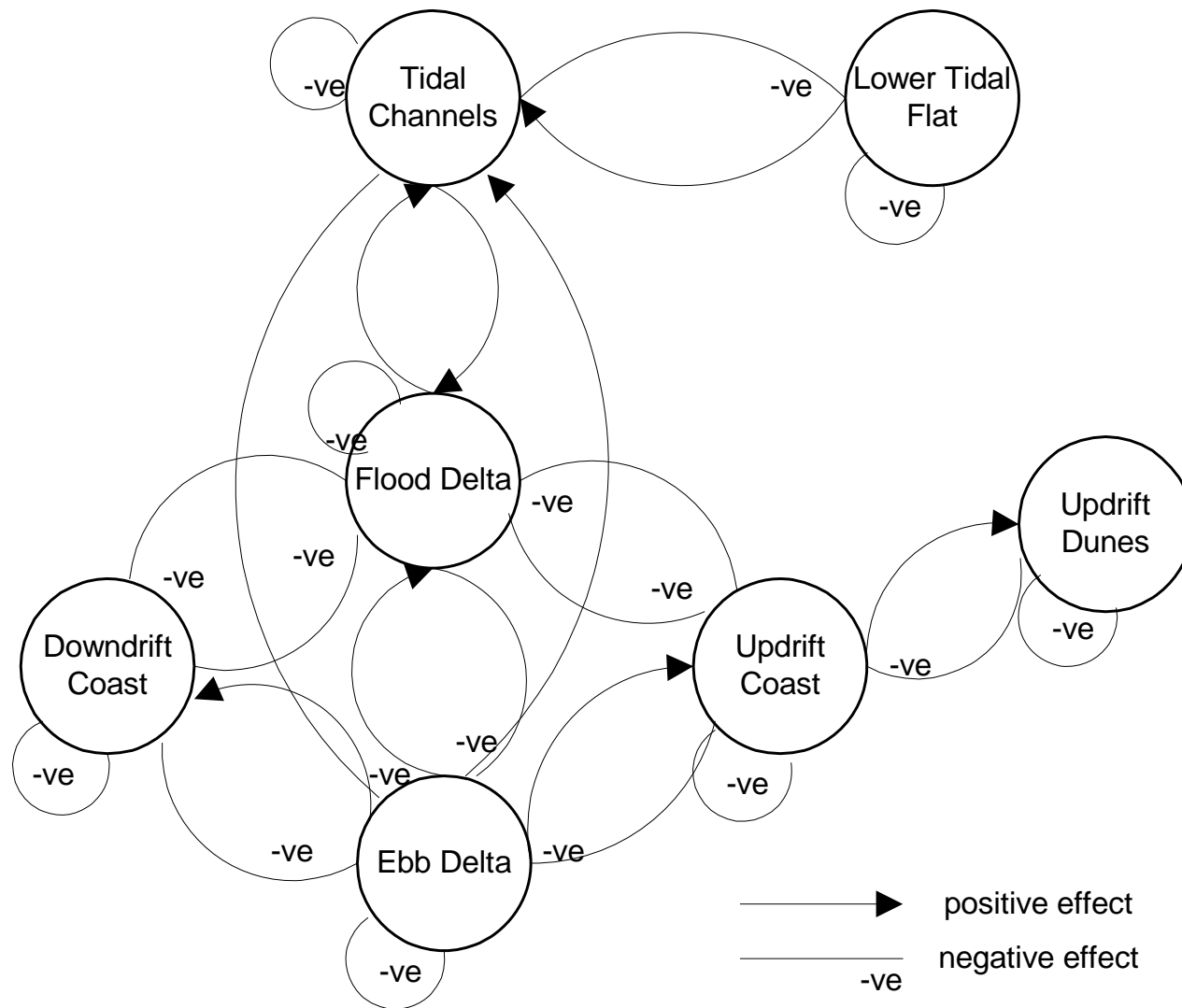
- *Defining* individual components that make up a given environment and characterising how these components interact;
- *In order to* explain how different elements interact and respond to change



# Systems Diagrams

- Means of capturing key attributes of a systems
- Flowchart representation of a system
- Dependant on underlying knowledge of processes





Signed graph representation for the impacts of sea-level rise on an inlet or lagoon entrance (Capobianco et al., 1999)



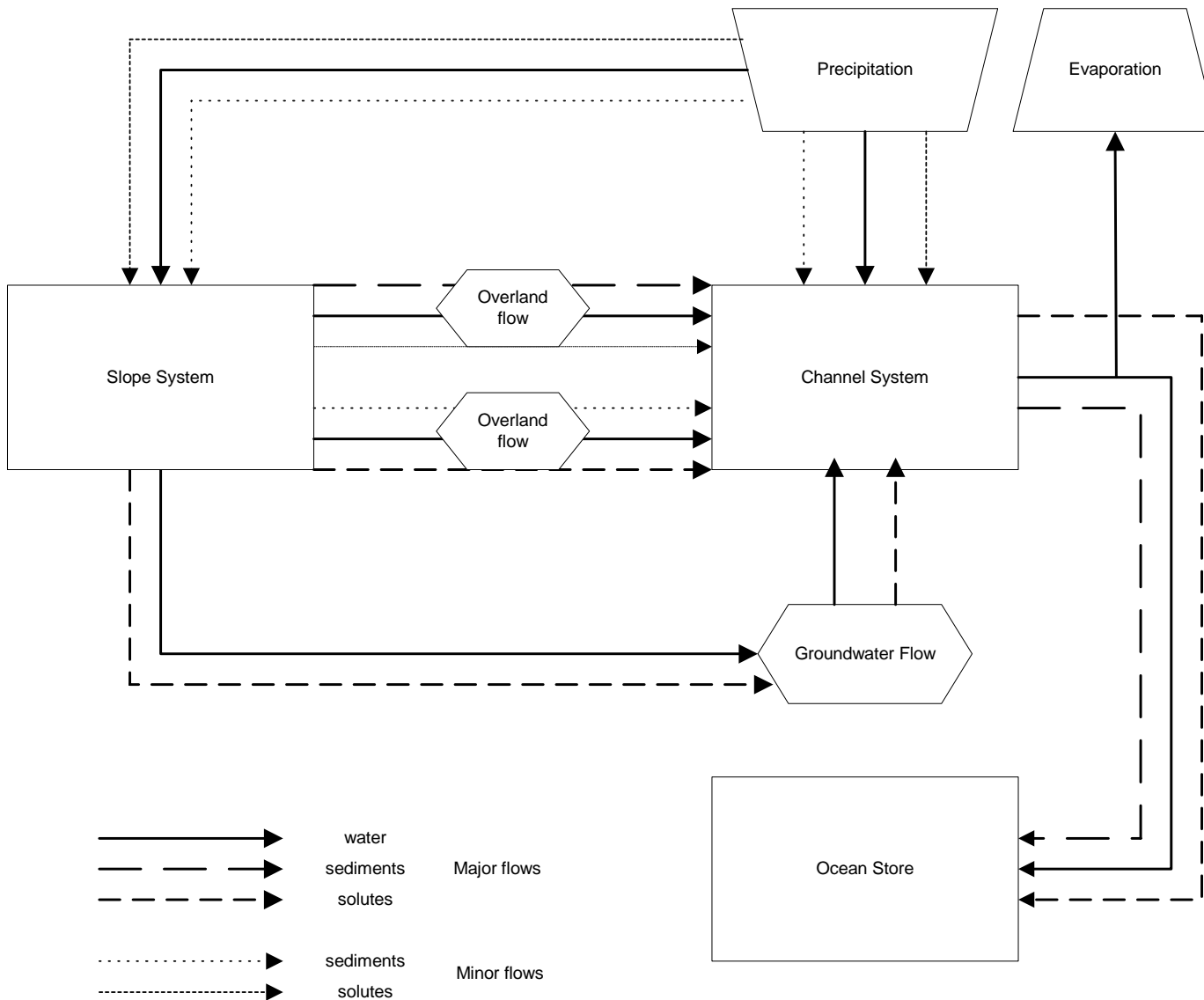


Diagram showing the pathways through the catchment basin system (White *et al.*, 1984)



# Levels of System Abstraction

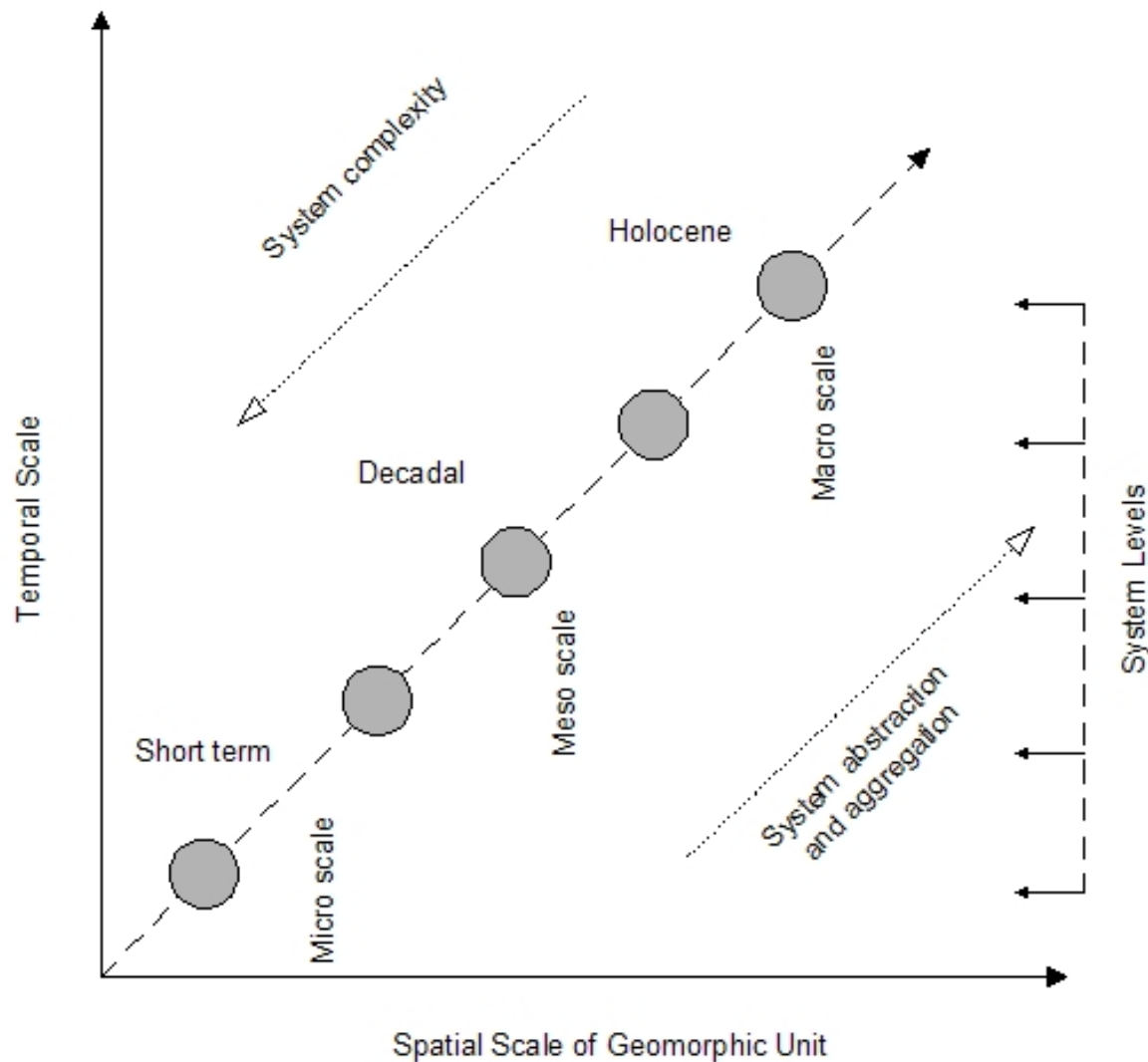
- Representation of every element / interaction of a system on one diagram
  - Too complex;
  - Inhibit understanding of whole system;
- Abstraction required
  - Separating system out into layers



# System Abstraction







Micro: Geomorphological Features;  
 Meso: Geomorphological unit;  
 Macro: Regional Land Mass

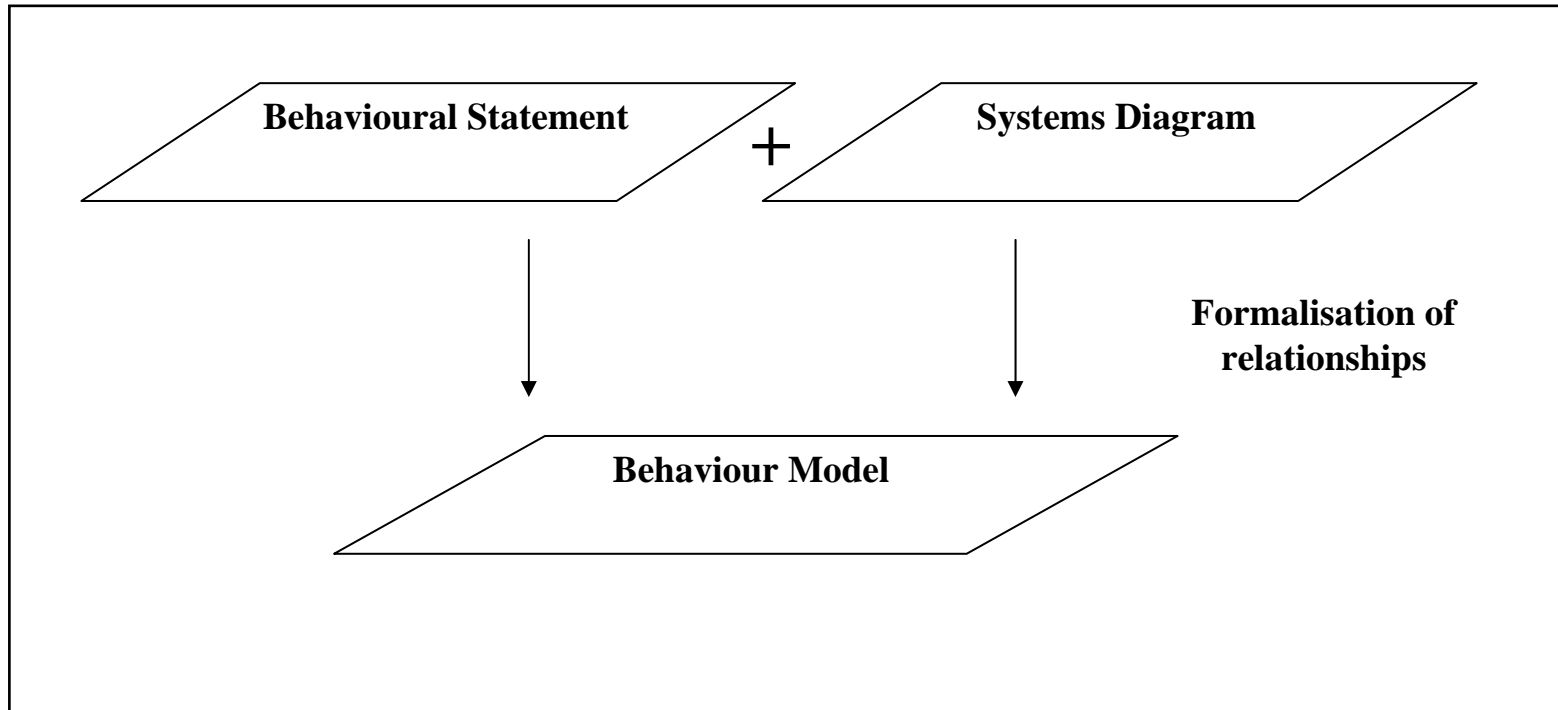


# Behavioural or Qualitative Modelling

- Extension of basic systems approach;
- Aims:
  - Capture systems definition within simple model to predict behaviour;
  - Does not need to represent underlying physical processes;
- Systems approach highlights presence of interactions, behavioural approach develops interaction as a relationship (response)
- Mapping estuarine system components first stage in developing behavioural model



# The Systems Approach and Behavioural Models



# Estuarine System Definition and Mapping

**Estuary Classification**

**Review Systems Approach  
and Develop Protocol**

**Mapping System Components  
(Behavioural Descriptions /  
Systems Diagrams)**



# Estuary Typology

- Identify range of UK:
  - Behavioural estuary types;
  - geomorphological elements present within each.
- Futurecoast (Dyer, 2002) classification amended and simplified:
  - Working typology for UK estuaries



# Estuary Typology

Type	Origin	Behavioural Type	Spits <sup>1</sup>	Barrier Beach	Dune	Delta	Linear Banks <sup>2</sup>	Channels <sup>3</sup>	Rock Platform	Sand Flats	Mud Flats	Salt Marsh	Cliff	Flood Plain <sup>4</sup>	Drainage Basin
1	Glacial valley	Fjord	X					X	X	X			X		X
2		Fjord	0/1/2					X	X	X	X	X		X	X
3	Drowned river valley	Ria	0/1/2					X	X		X	X	X		X
4		Spit enclosed	/1/2		X	E/F		X/N		X	X	X	X	X	X
5		Funnel shaped	X		X	E/F		X		X	X	X		X	X
6	Marine/fluvial	Embayment			X		X	X		X	X	X		X	
7	Drowned coastal plain	Tidal inlet	0/1/	X	X	E/F		X		X	X	X		X	

## Notes:

1 Spits: 0/1/2 refers to number of spits; E/F refers to ebb/flood deltas; N refers to no low water channel; X indicates a significant presence.

2 Linear Banks: considered as alternative form of delta.

3 Channels: refers to presence of ebb/flood channels associated with deltas or an estuary subtidal channel.

4 Flood Plain: refers to presence of accommodation space on estuary hinterland.



# Estuary Typology

- Rule base applied to:
  - EMPHASYS database
  - Futurecoast database
  - JNCC inventory.
- Classification of UK Estuaries
- Identification of estuary types and geomorphic elements in UK estuaries



# Levels of Abstraction

- Estuary Type:
  - Fjord, Fjard, Ria, Spit Enclosed, Funnel Shaped, Embayment, Tidal Inlet
- Geomorphic Elements:
  - Cliff, Barrier Beach, Dunes, Delta, Rock Platform, Channel, Mudflat, Sandflat, Saltmarsh, Drainage Basin.



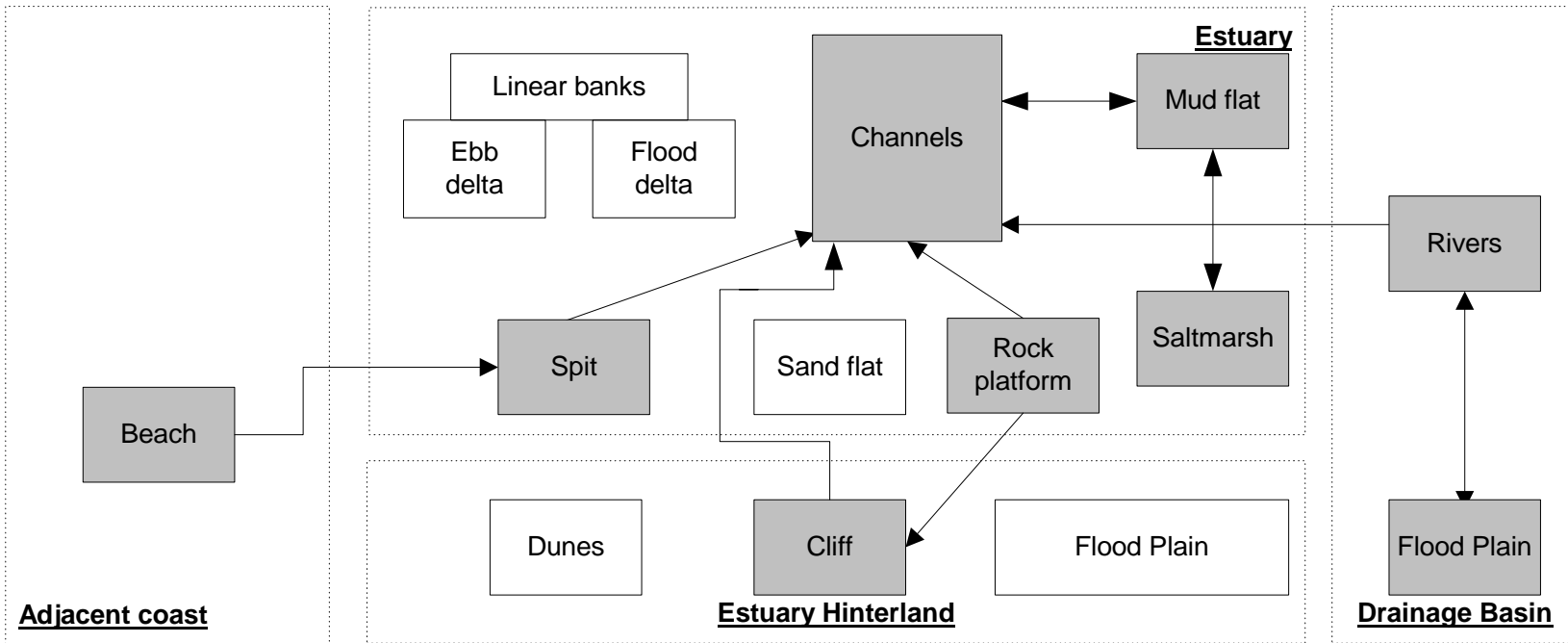


# Behavioural Statements Protocol

- Definition of Geomorphic Feature;
- Function
- General Behaviour;
- General Form;
- Formation and Evolution;
- Forcing Factors;
- Evolutionary Constraints;
- Behavioural Timescales;
- Interactions with other Geomorphic Elements



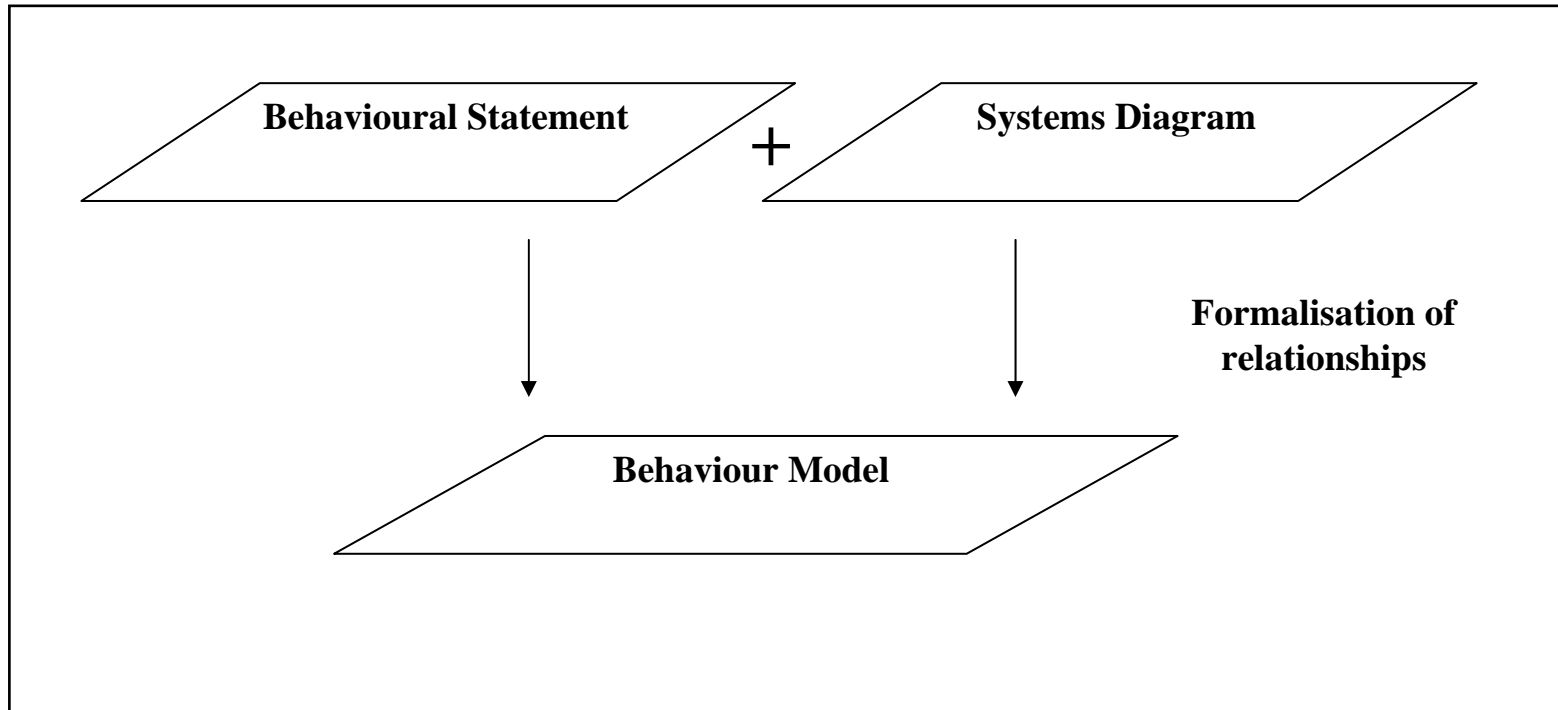
# Systems Diagrams



## Systems Diagram for a generic 'Ria'



# The Systems Approach and Behavioural Models





# Estuary Typology: Rule Base

Type	Behavioural Type	Rule
1	Fjord	Glacial origin, exposed rock platform set within steep-sided relief and with no significant mud or sand flats
2	Fjard	Glacial origin, low lying relief, with significant area of sand or mud flats
3	Ria	Drowned river valley in origin, with exposed rock platform and no linear banks
4	Spit enclosed	Drowned river valley in origin, with one or more spits and not an embayment
5	Funnel shaped	Drowned river valley in origin, with linear banks or no ebb/flood delta and not an embayment.
6	Embayment	River or marine in origin (i.e. not glacial), with multiple tidal rivers meeting at or near mouth and a bay width/length ratio <sup>1</sup> of 1 or greater, and no exposed rock platform <sup>2</sup>
7	Tidal inlet	Drowned coastal plain in origin, with barrier beaches or spits

## Rules to Identify Estuary Type Using the UK Estuaries Database

