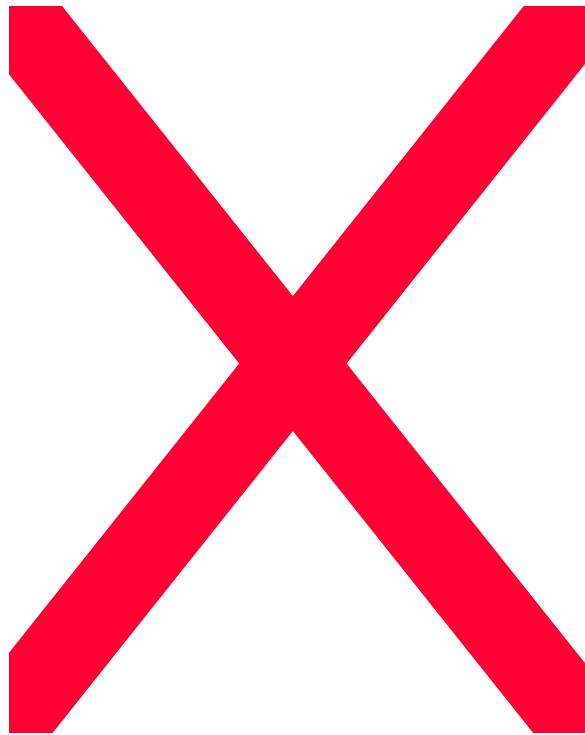


WAVE-CURRENT FORECAST SYSTEM FOR THE MOUTH OF THE FRASER RIVER

James Stronach, Lillian Zarembo
Hay & Company Consultants

May Wong, Laurie Neil, Neil McLennan
Environment Canada – Meteorological Service
of Canada, Pacific & Yukon Region



Outline of talk

- Winds
- Numerical model of currents:
Georgia/Fuca, and forecast area
- Strait of Georgia wave model
- Forecast area wave model (with wave
current interaction)
- Forecast operations
- Future tasks

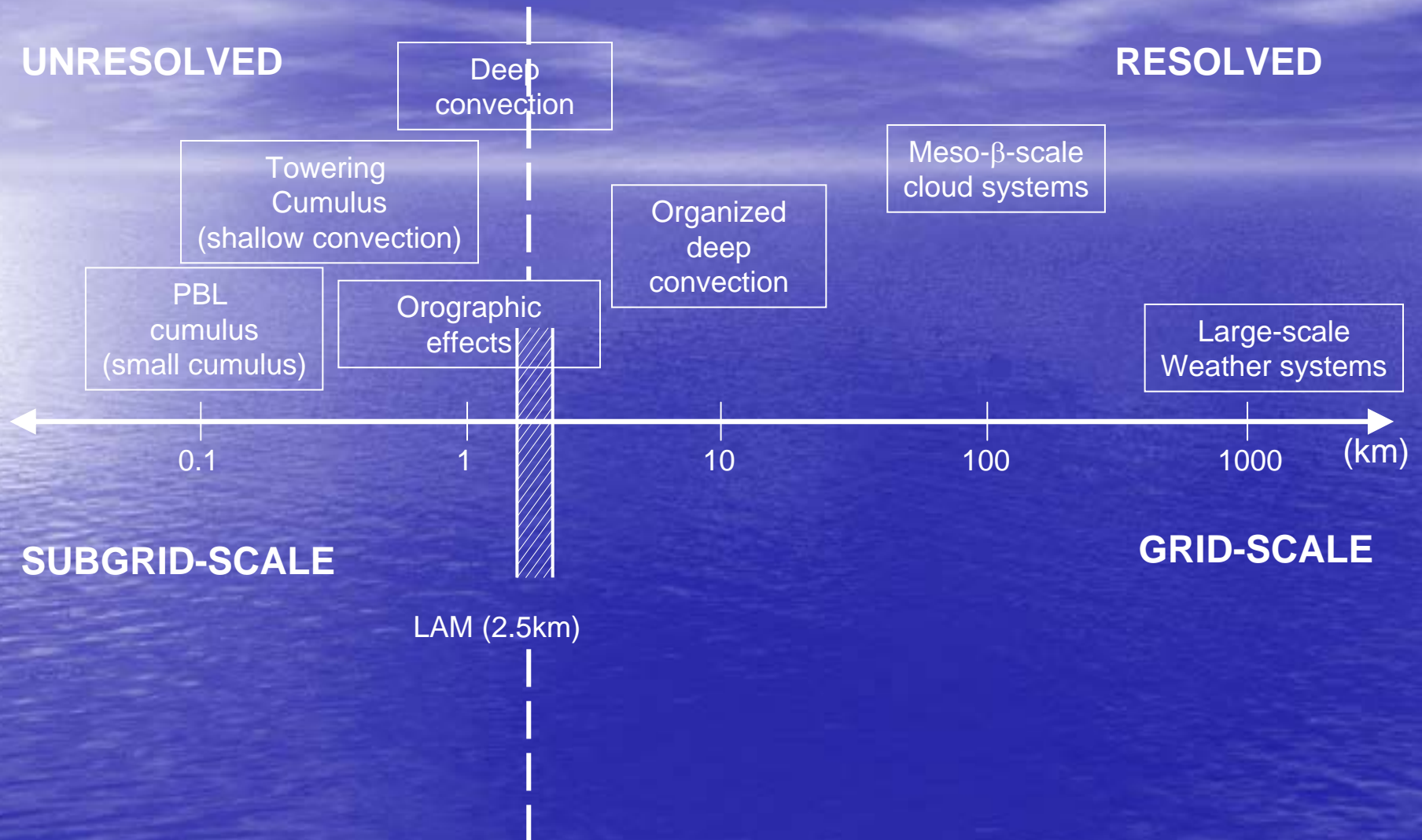
Winds for the forecast system

- GEM-LAM for forecasts
- Coastal stations & buoys for hindcast
- Also weather information (clouds, air temp, relative humidity) for temperature modelling

GEM LAM description

- GEM : Global Environmental Multi-Scale
- LAM : Limited Area Model (BC Coast)
- Forecasts out to 36 hours

Atmospheric Events



- Processes that occur below the grid scale have to be parameterized.
- Parameterization has to be compatible with model dynamics and grid spacing

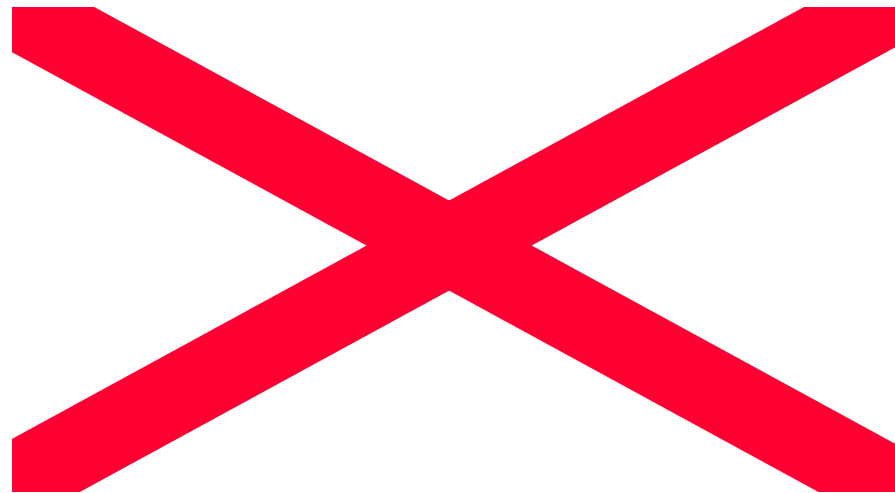
Sub-grid scale Orographic Process

- Reduce wind speed when flow strikes mountainous terrain
 - Gravity wave drag
 - Emulates breaking of mountain waves
 - Only affects flow at relatively high levels
 - Flow Blocking
 - Affects flow at low levels in mountains
 - Restricts flow over the barrier
 - Results in displacement of precipitation patterns upstream of mountains
 - Removes warm temperature bias

model specifics at 2.5km

- Horizontal resolution
 - Grid spacing 2.5 km
 - “Resolution” about 3-6 Δx
- Non-hydrostatic
 - Vertical accelerations
- Vertical hybrid coordinates
 - Terrain following at low levels
 - Terrain damped out above tunable level
- Precipitation schemes
 - less parameterization required

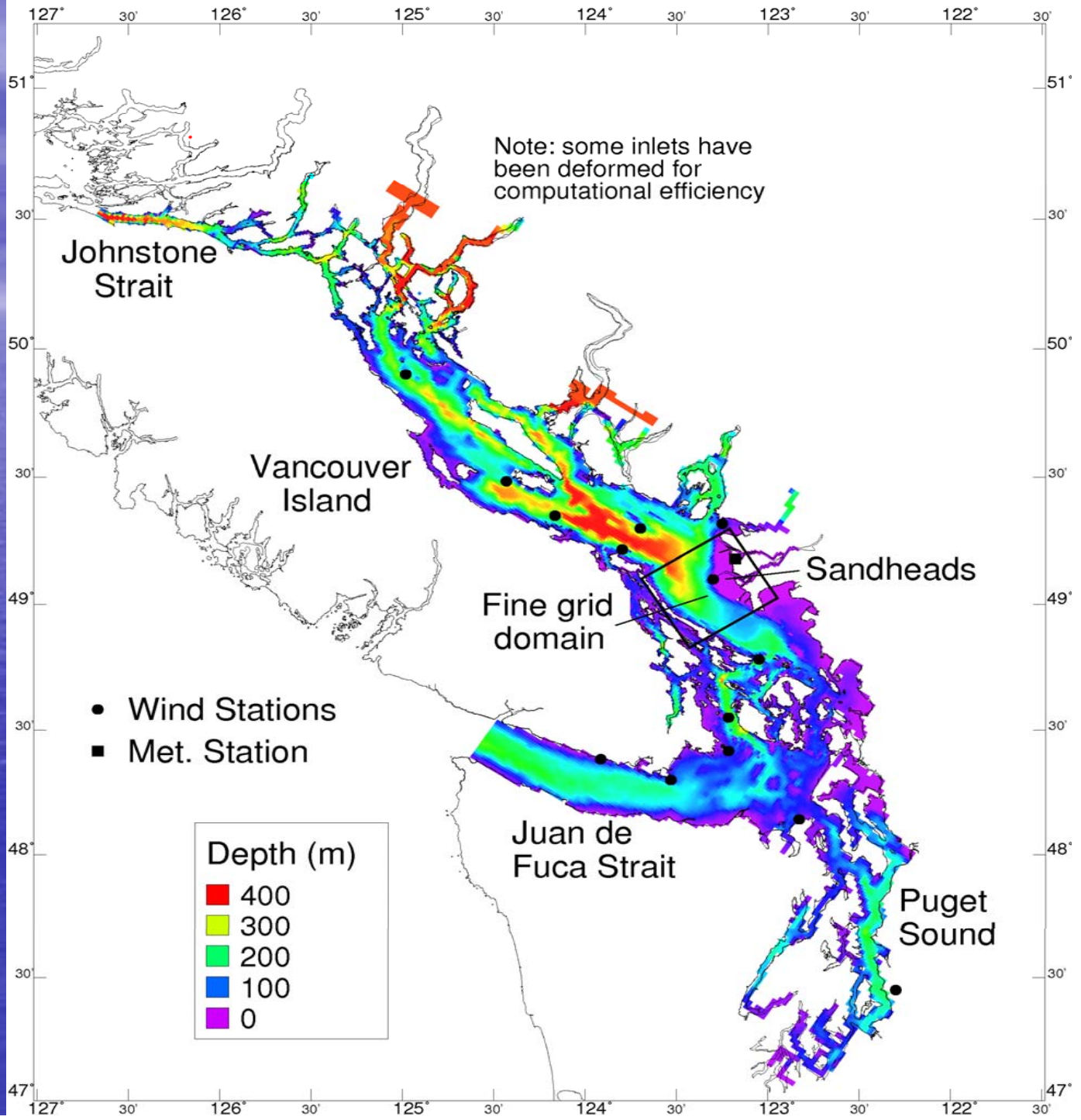
Forecast and Observed Wind Fields



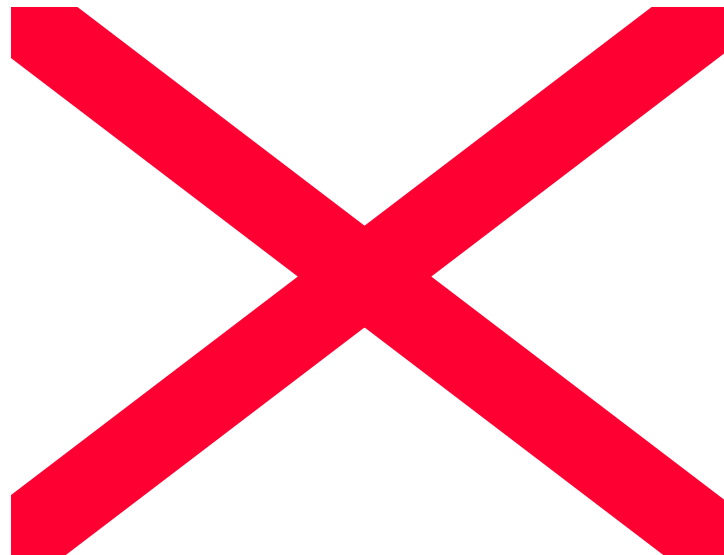
Hydrodynamic Modelling

- H3D: in-house numerical model
- Developed from GF8, used operationally in Gulf of St. Lawrence
- Two resolutions: 1000 m for Georgia / Fuca, 200 m for forecast area
- Temperature and salinity fields
- Sediment too, for validation

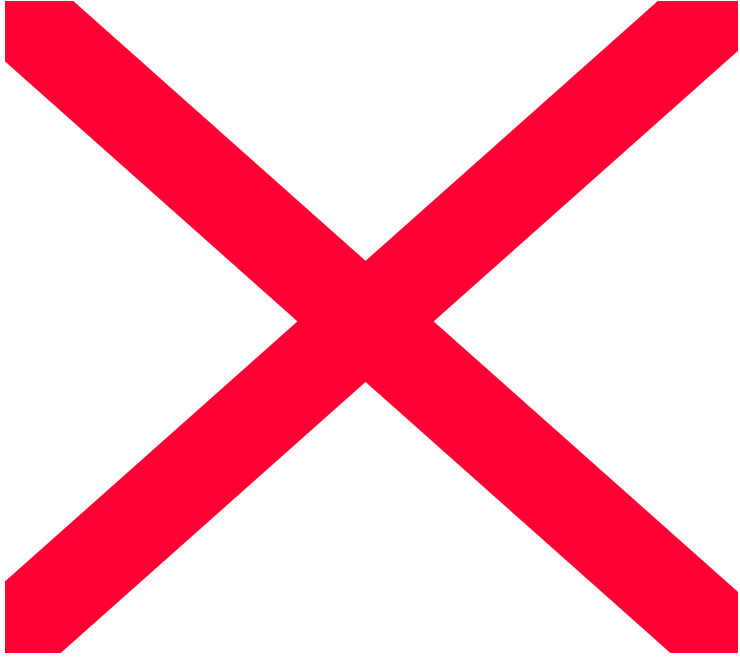
Location map



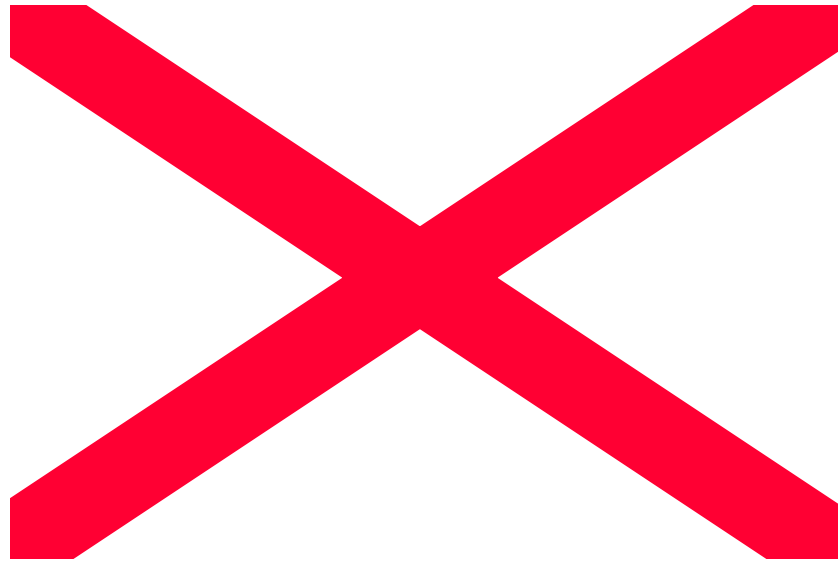
Circulation modelling – H3D

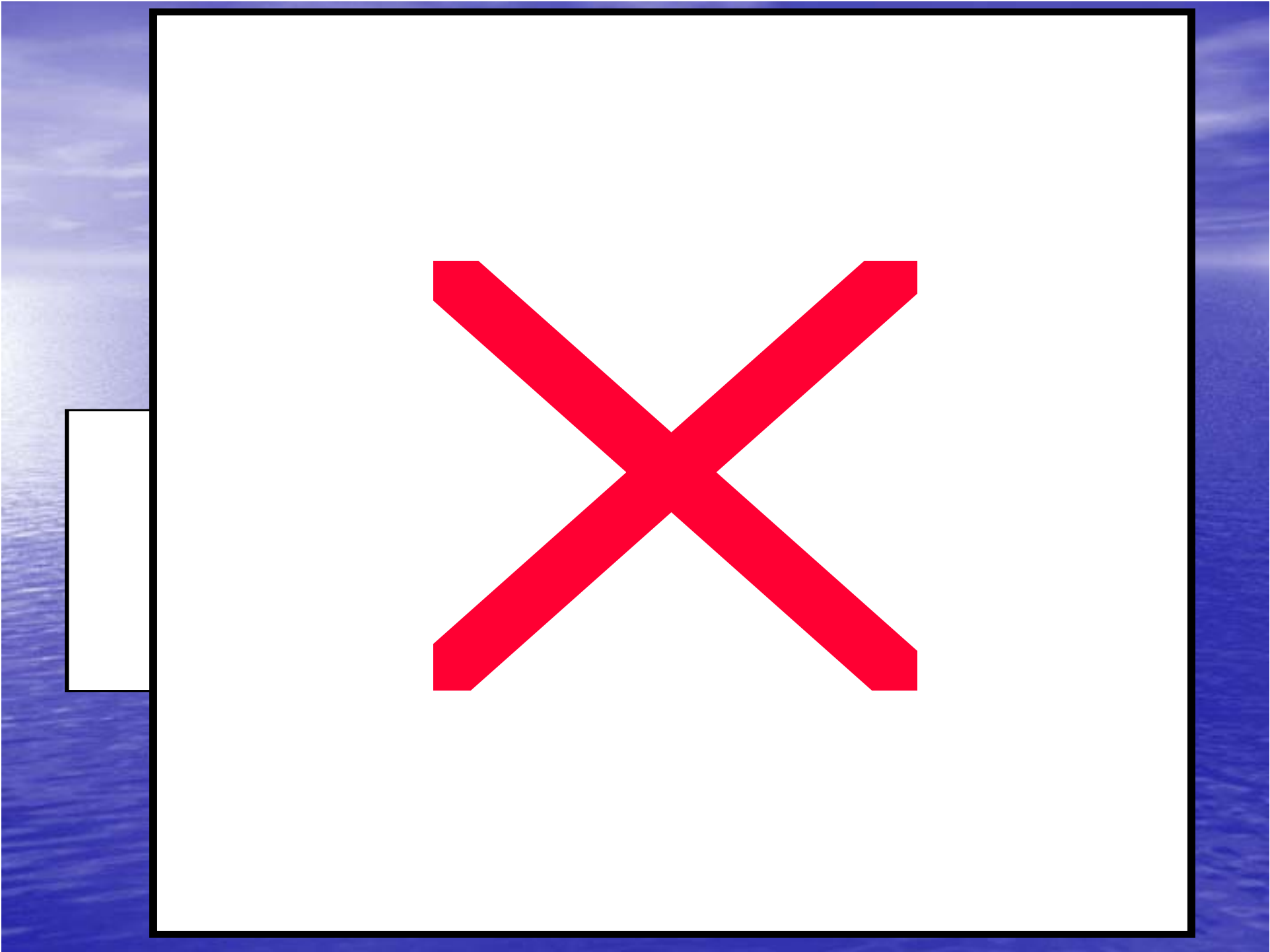


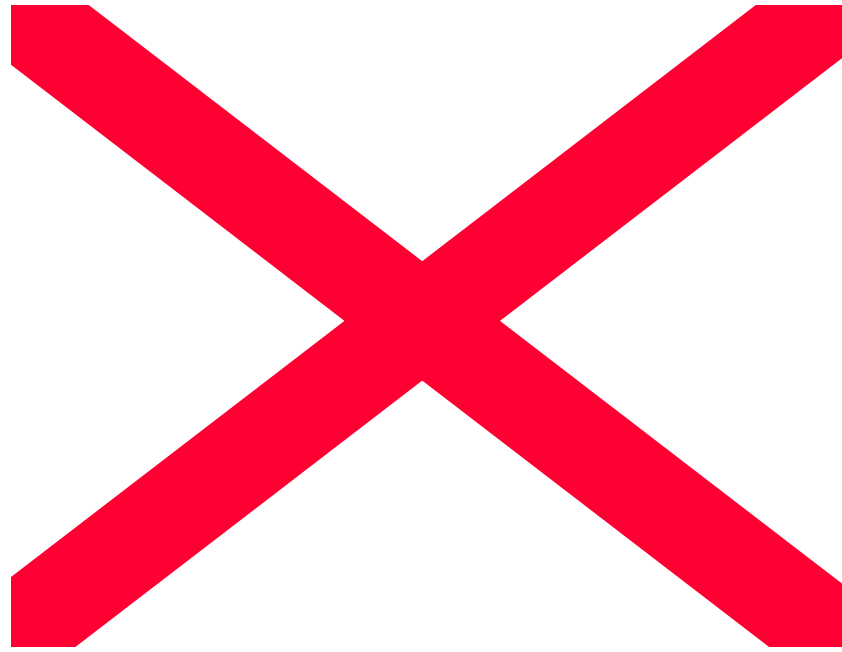
77



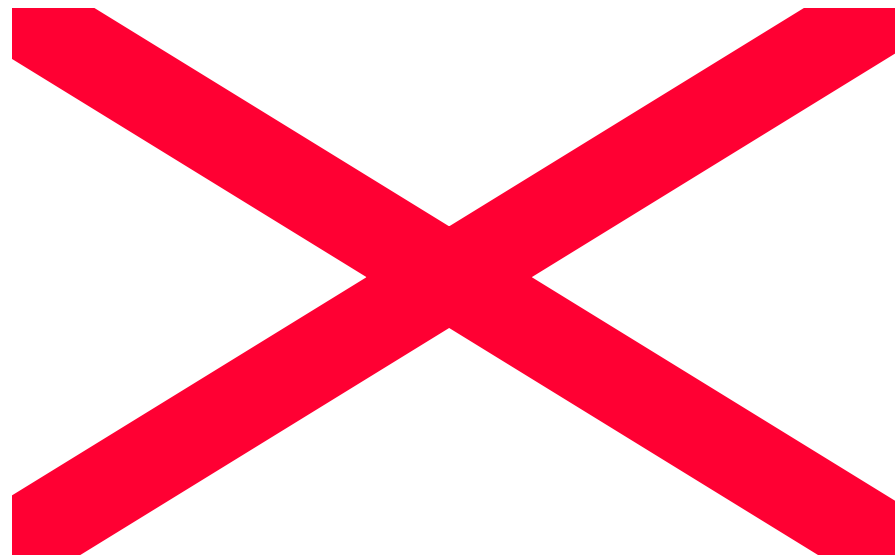
Nested H3D models

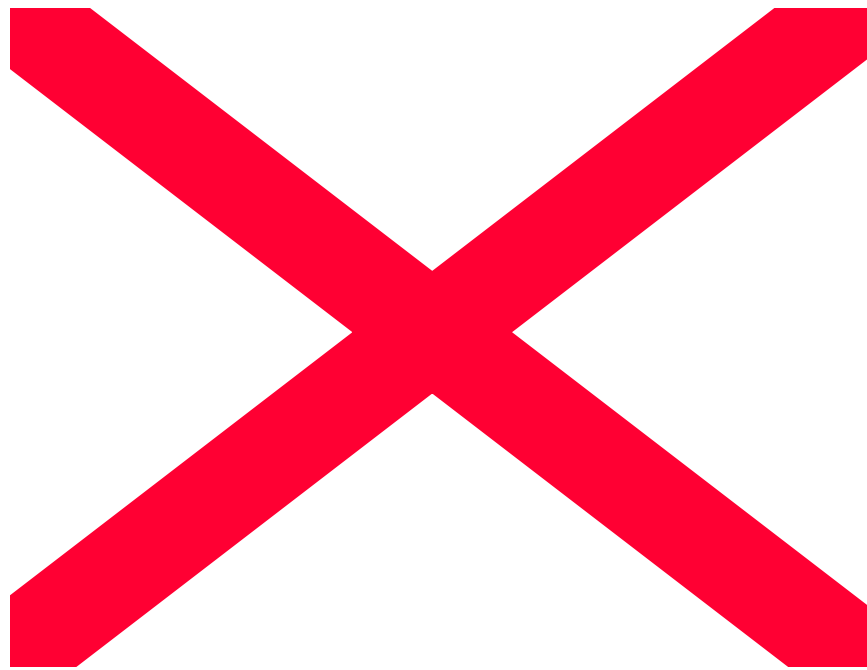




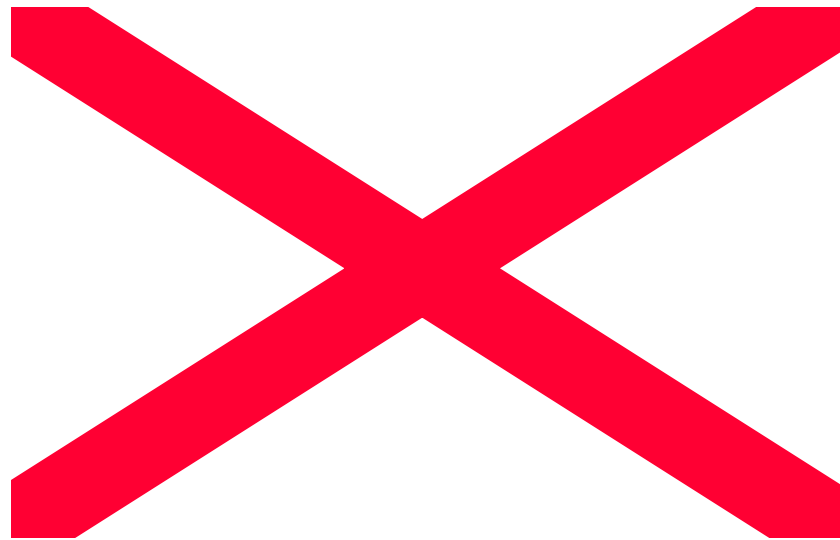


Donelan wave model

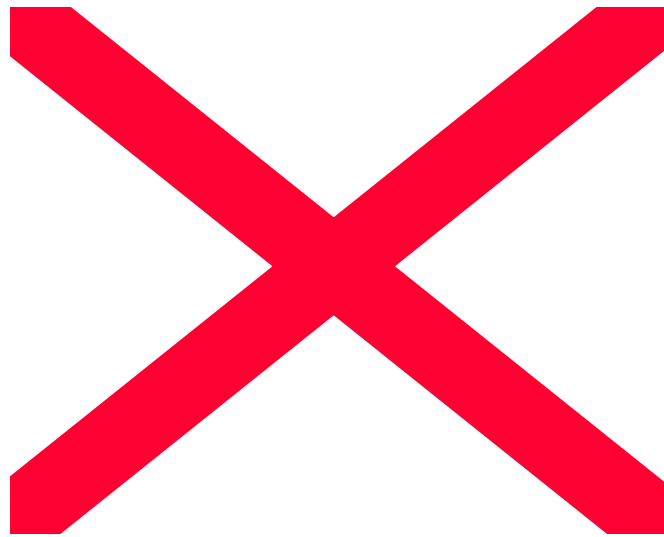




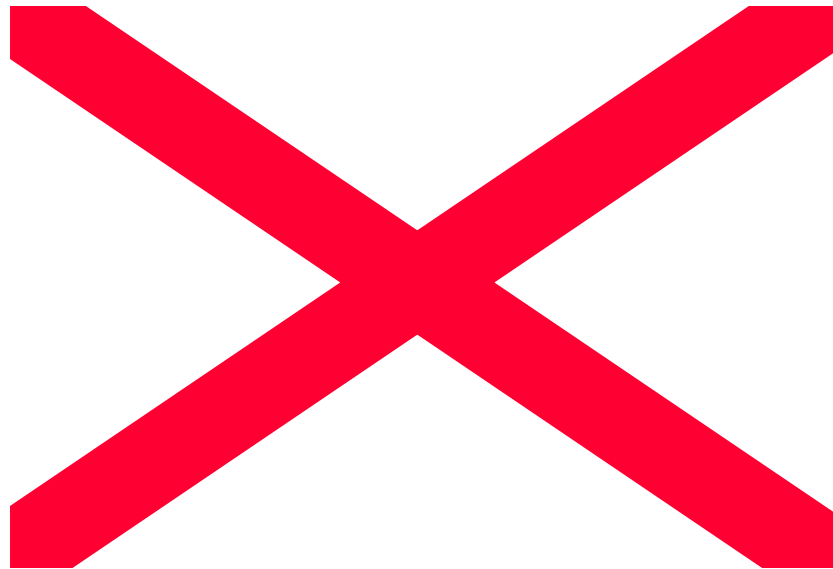
Donelan wave model validation



Swan wave model

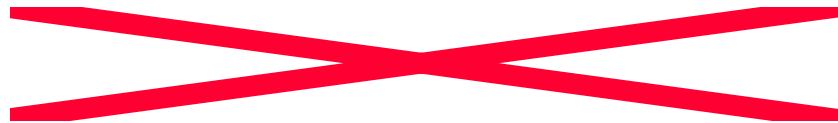


SWAN wave model validation



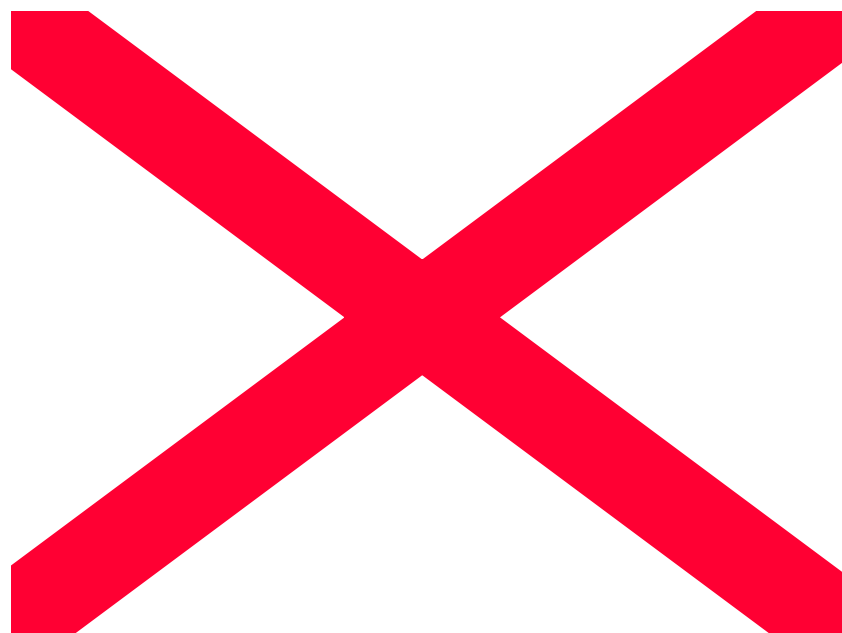
Wave-current interaction

- $\sigma^2 = gk \tanh(kh)$
- $\eta = \sigma + k \cdot U$
- action balance equation

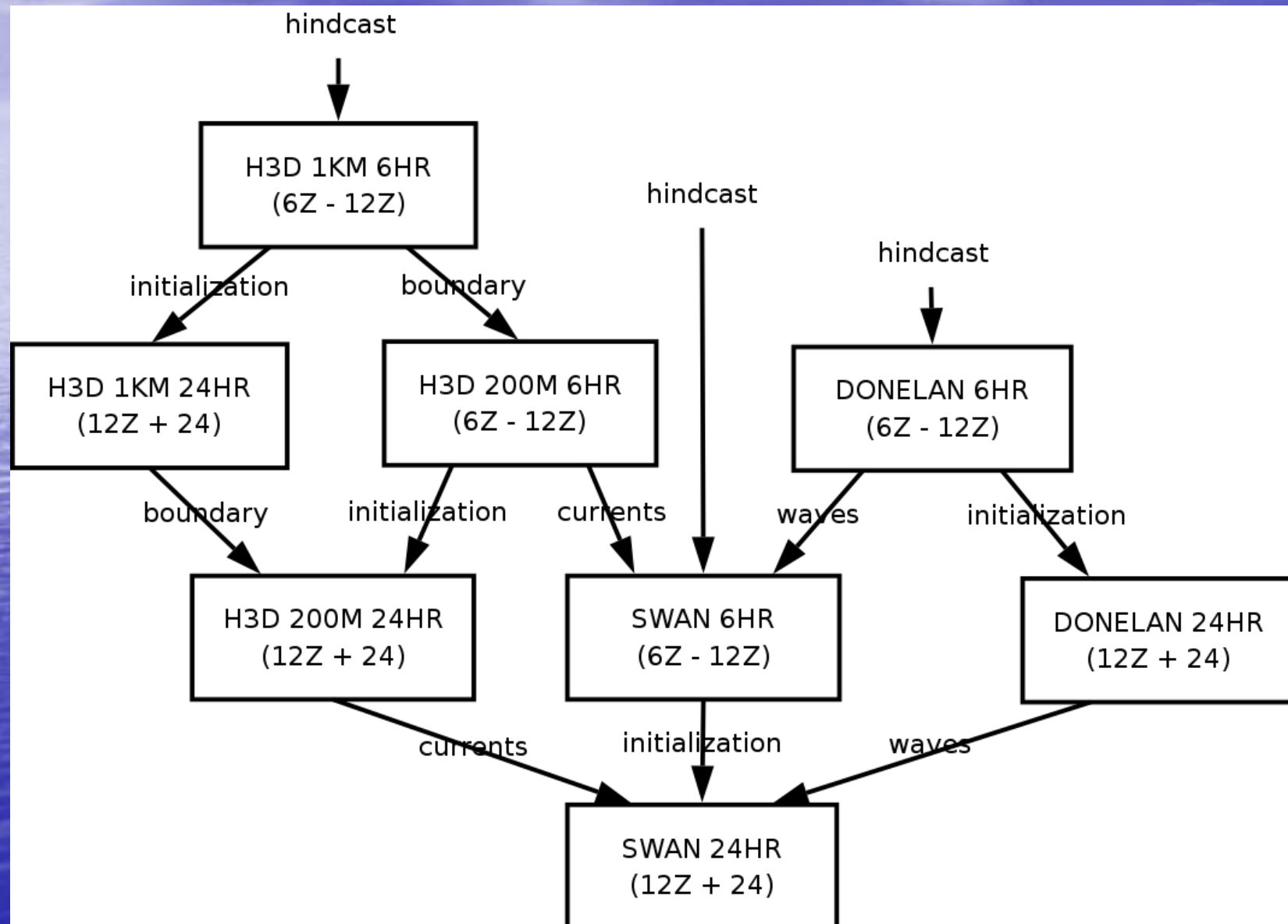


Wave-Current Interaction

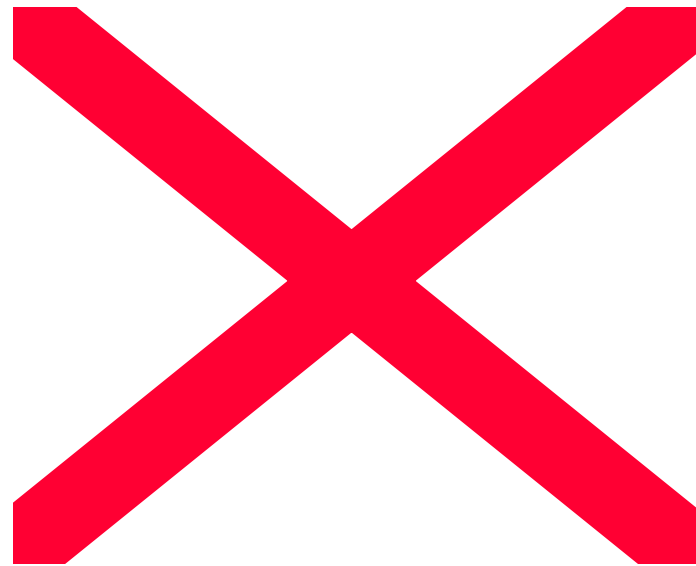




Model framework



Forecast output



Status

- Delivered spring 2006
- Currently being tested
- Project also includes setting up a video system at Sand Heads, and acquisition of validation data
- Not yet in operational use

WAVE-CURRENT FORECAST SYSTEM FOR THE MOUTH OF THE FRASER RIVER

Dr. James Stronach
jstronach@hayco.com