~~Scale- and Process-Jumps in a Multimodel Project on Hurricane Impacts at the Seabed~~

Time and Event Statistics, Related to Seabed Hazards

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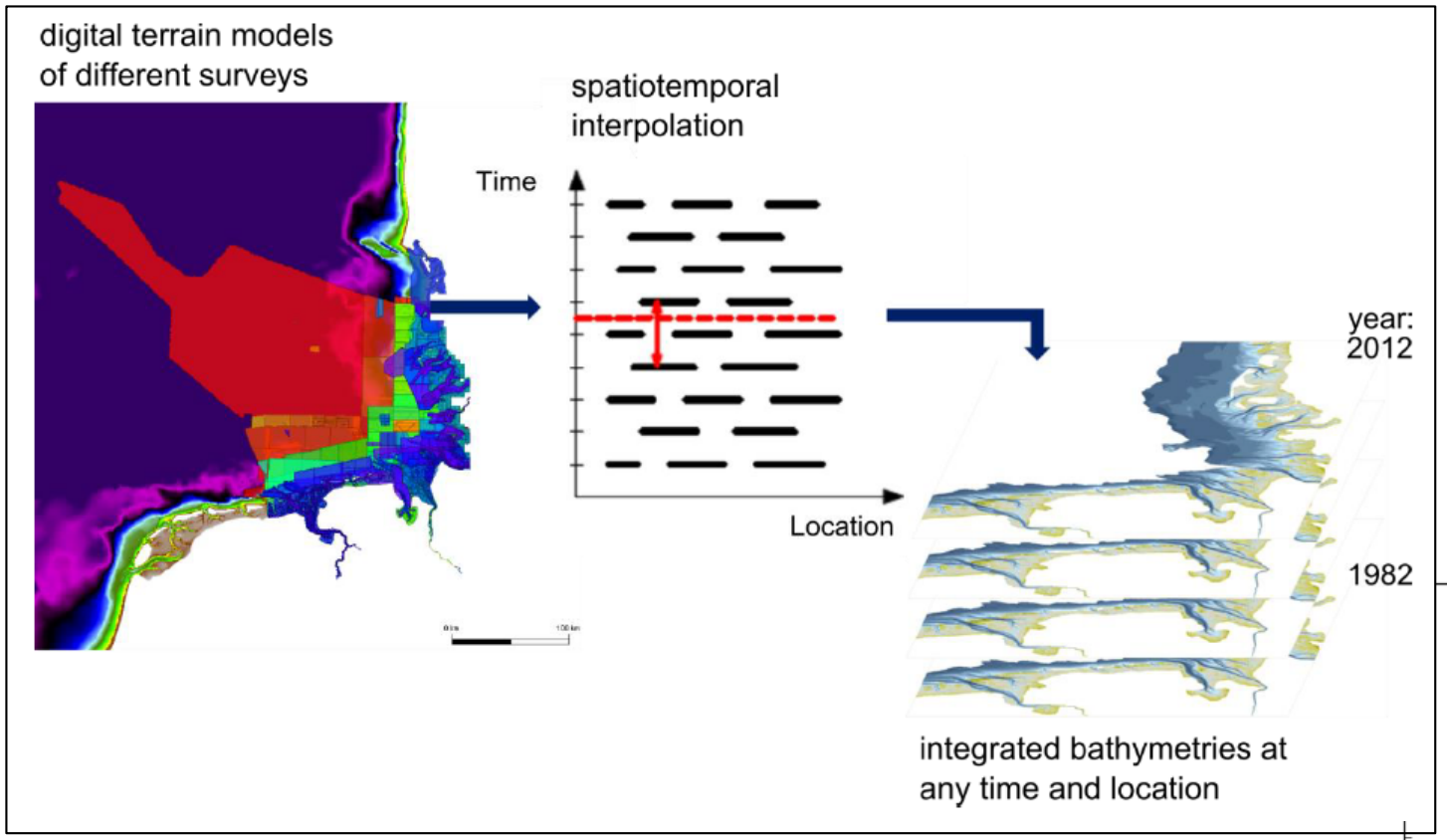
Time scales and Hazards

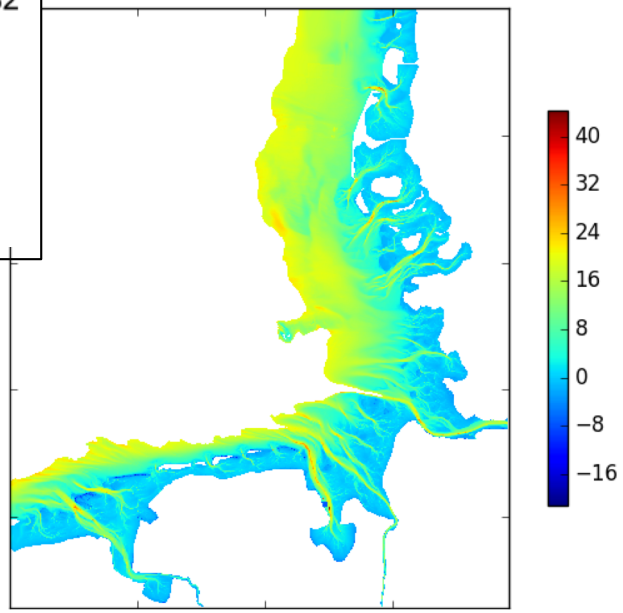
- Seabed change statistics – compare with Julio Hoffimann Mendes' LIDAR model-tank stratigraphies
- Object (UXO) migration around cables, platforms – extreme event return-times method

Seabed Change and Return Times



Data Integration methods (BSH Hamburg)

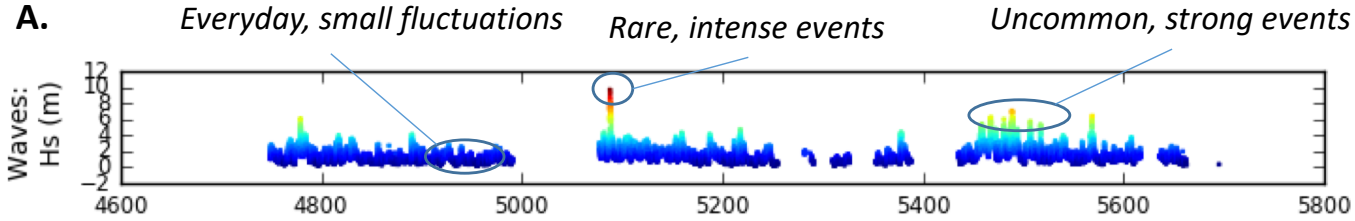
Location of the region



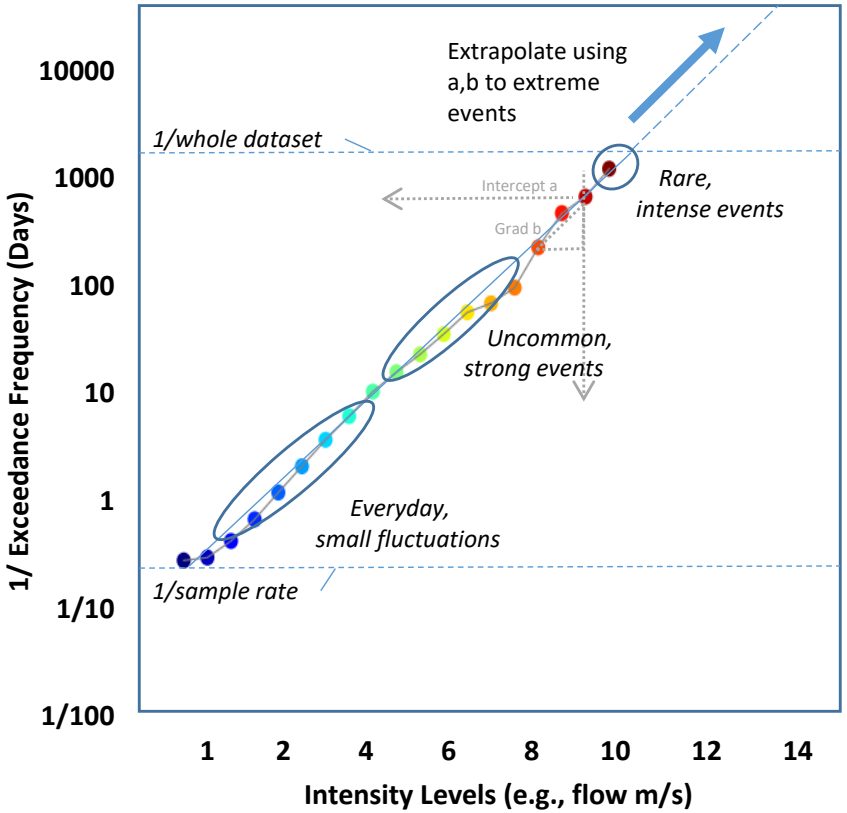
And general bathymetry

Exceedances and Return Periods

A.



B.



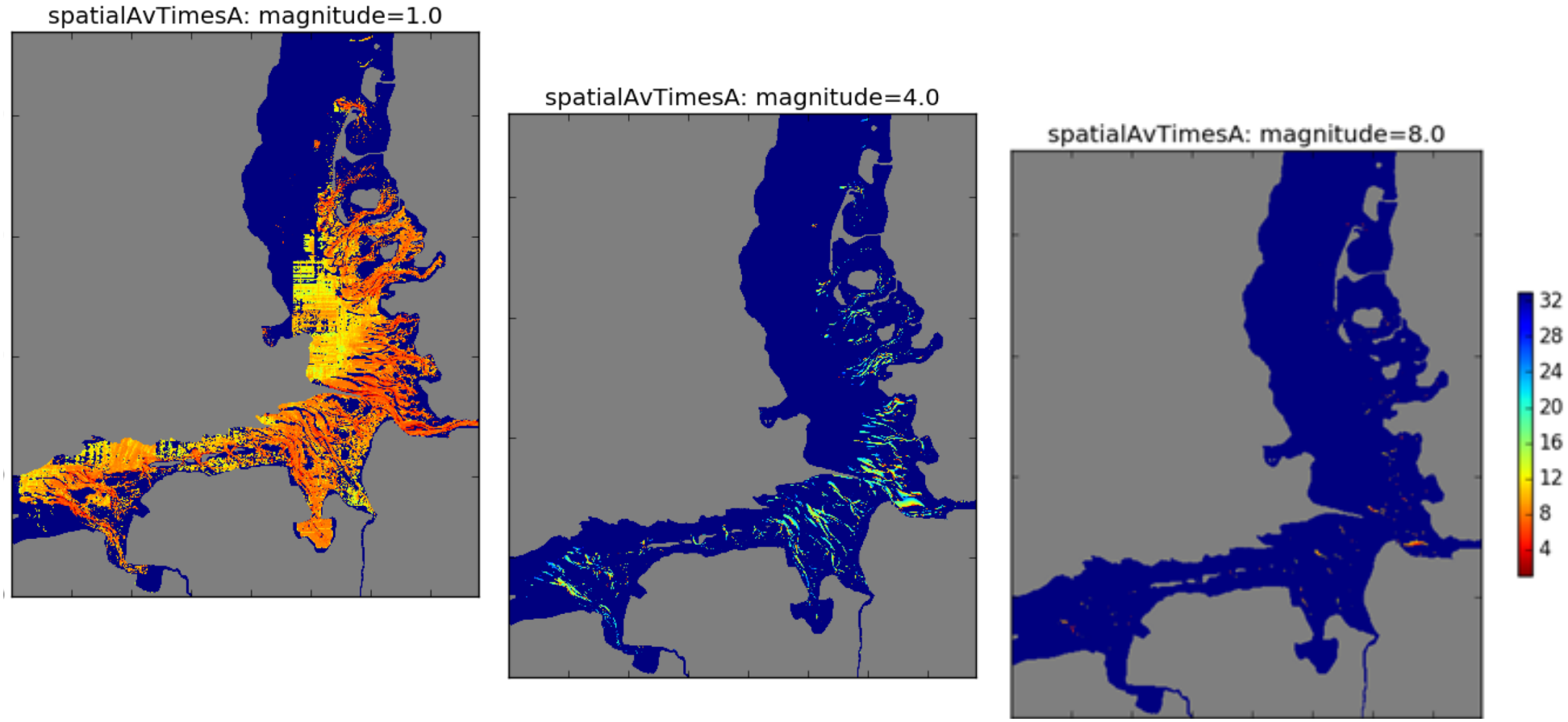
- Rank the data by event intensity exceedance
- Many processes in nature have an exponential or power-law intensity-frequency relationship
- They plot approximately linear on log-linear or log-log scales
- Exploit that to predict extreme event frequencies

C.

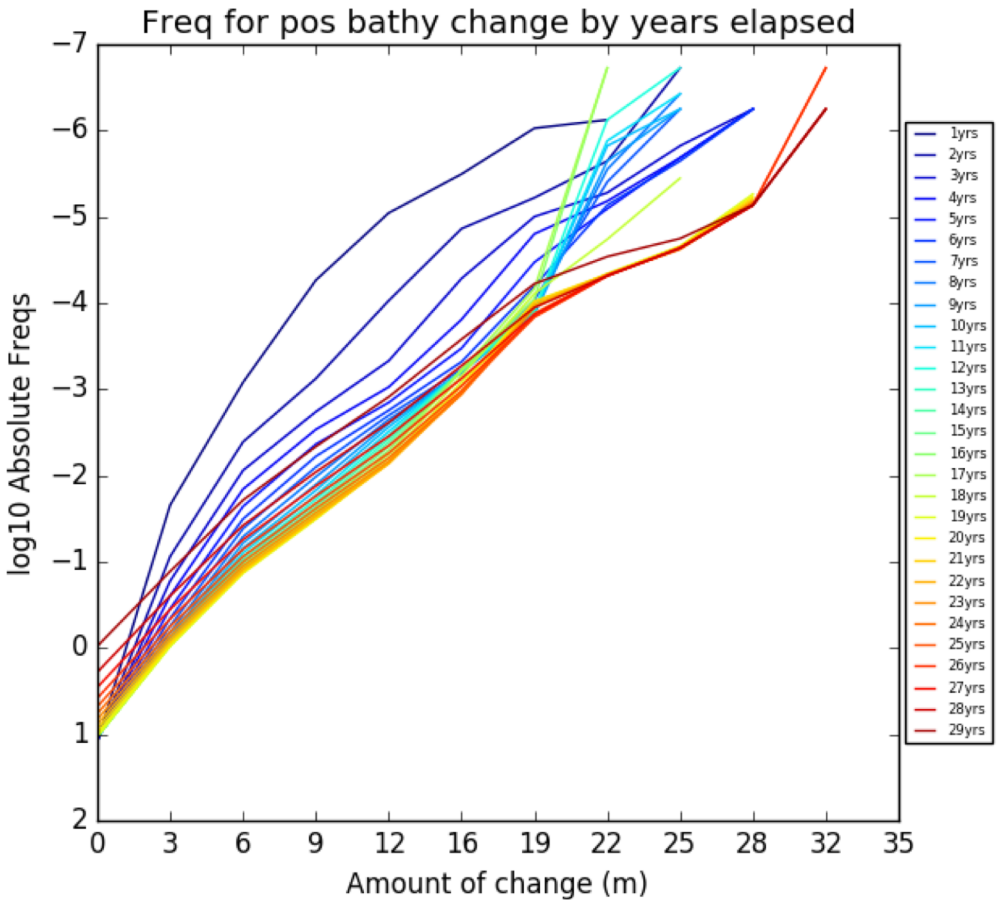
$$Tr = {N * dT}/{Pe}$$

Tr – Return Time
N - Number samples
dT – Sampling interval
Pe – Frequency of exceedance

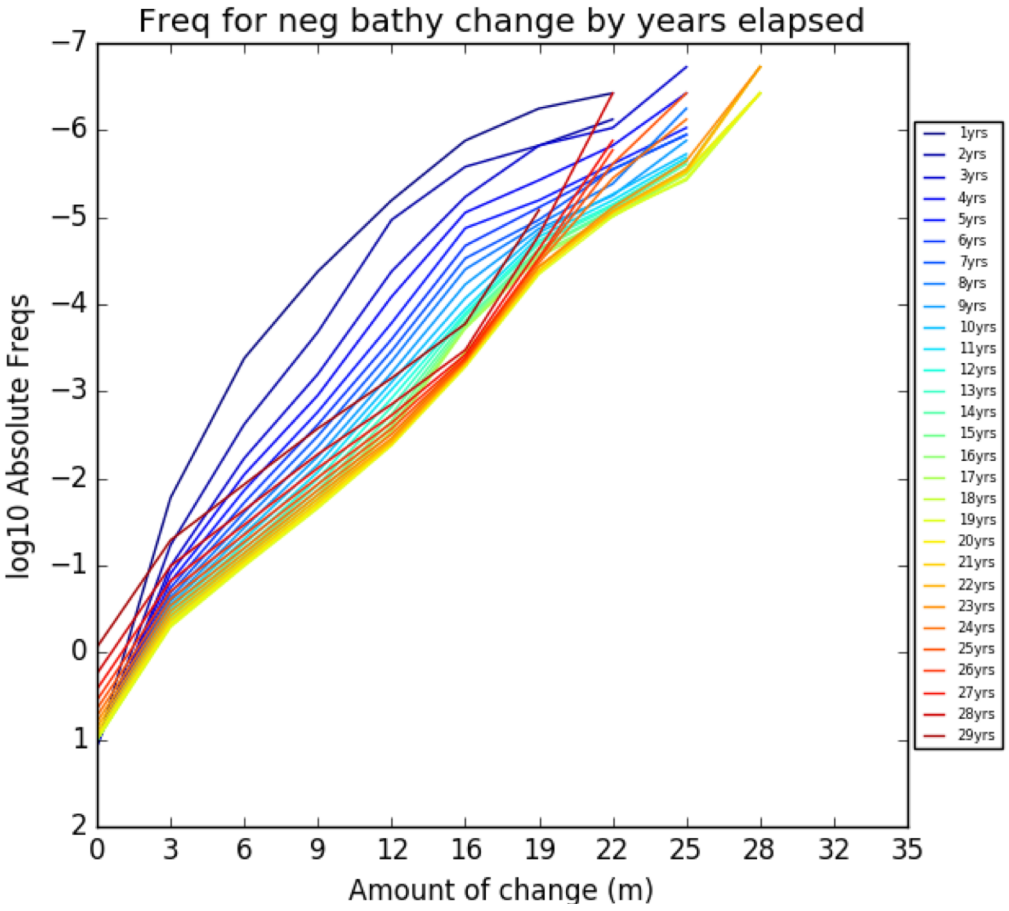
Bathymetry Statistics

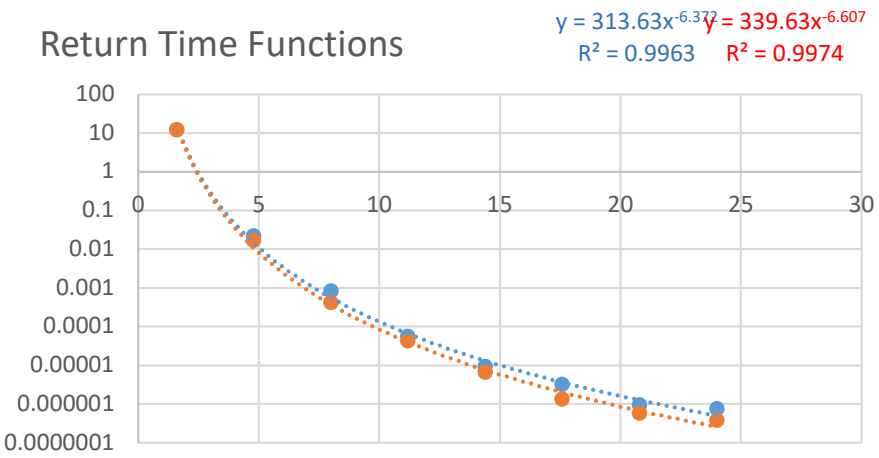


A selection from mappings of the spatially resolved exceedance Return Period data (colour units, years; magnitudes in metres burial). These figures are based on, and may have limitations from the BSH repeat hydrographic surveys.



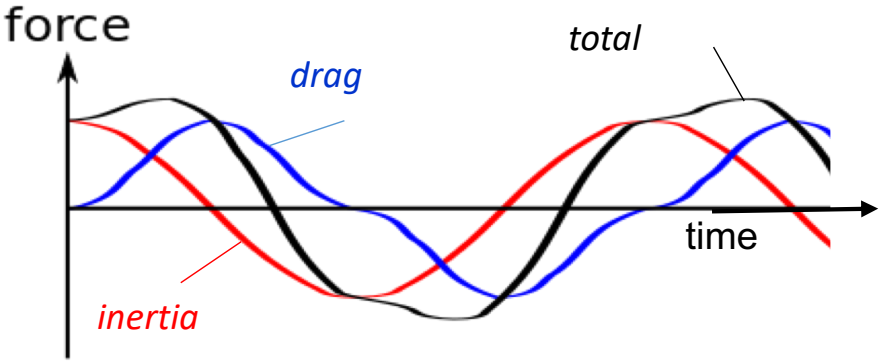
Exceedance statistics,
Elevation changes (+ve & -ve)
as the area evolved through 29yrs





Object Migration Timings

Movement/Migration Simulations



Morisson formulation (Wikipedia 2018)

- Drag force (fluid relative movement)

$$F_D = {}^{\rho_w}/_2 \, C_D \, A_{obj} \, |U_{fl} - V_{obj}|(U_{fl} - V_{obj})$$

- Added mass (hydrodynamic inertia)

$$F_I = \rho_w \, C_A \, V_{obj} \, (\dot{U}_{fl} - \dot{V}_{obj})$$

- Froude-Krylov (wave-pressure field)

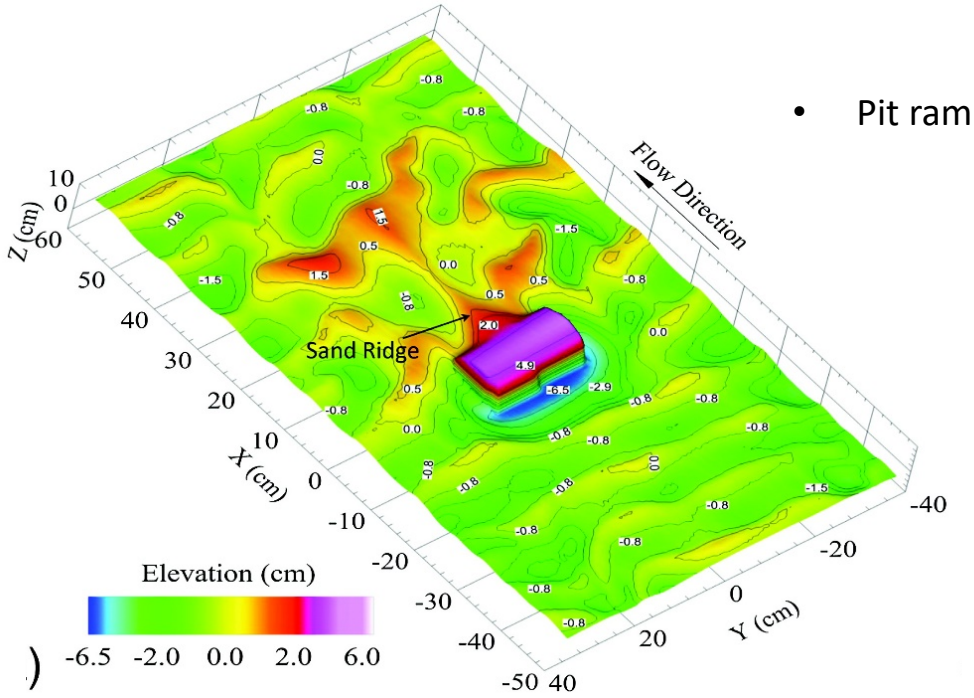
$$F_{FK} = \rho_w \, V_{obj} \, (\dot{U}_{fl}),$$

- Buoyancy and Lift
- Friction and/or rolling resistances from bed contact

$$F_{F\&R} = C_{F\&R} \, F_{normal} \, ,$$

- Pit ramp incline

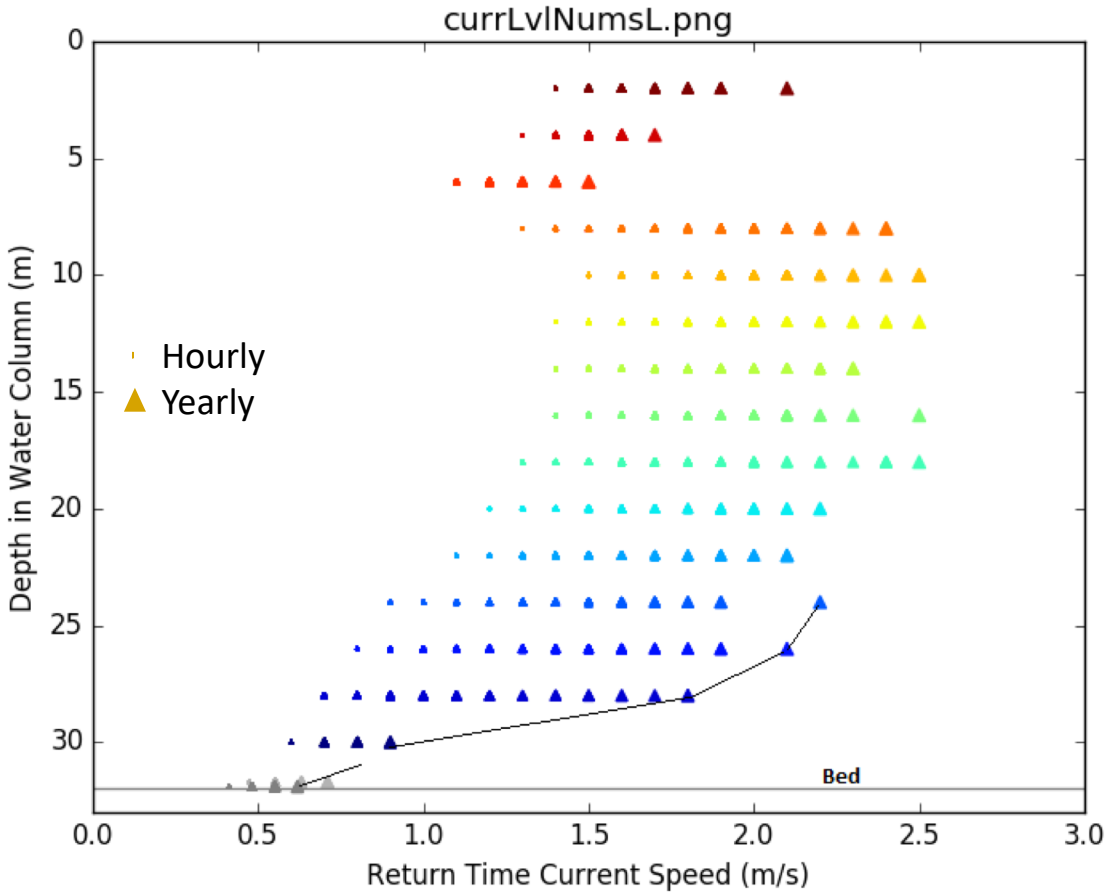
$$F_{ramp} = F_{normal} \, sin(\theta_{slope})$$



Cataño-Lopera et al. (2013)

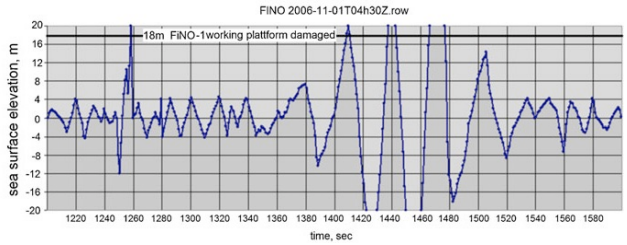
Platform data, return periods, extreme events

Return Time analysis of flows at Fino1



Note strong slowing of bottom currents at bottom

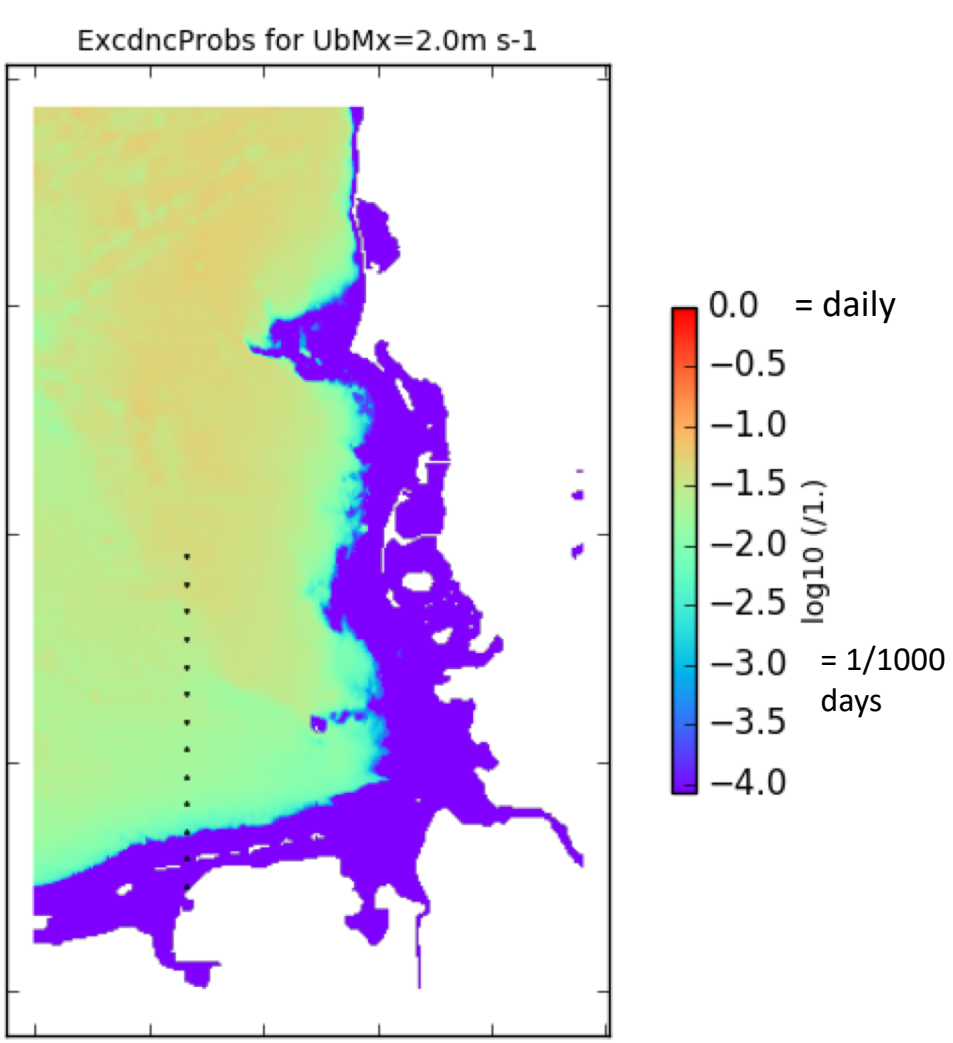
An extreme event (storm Britta, 2006)



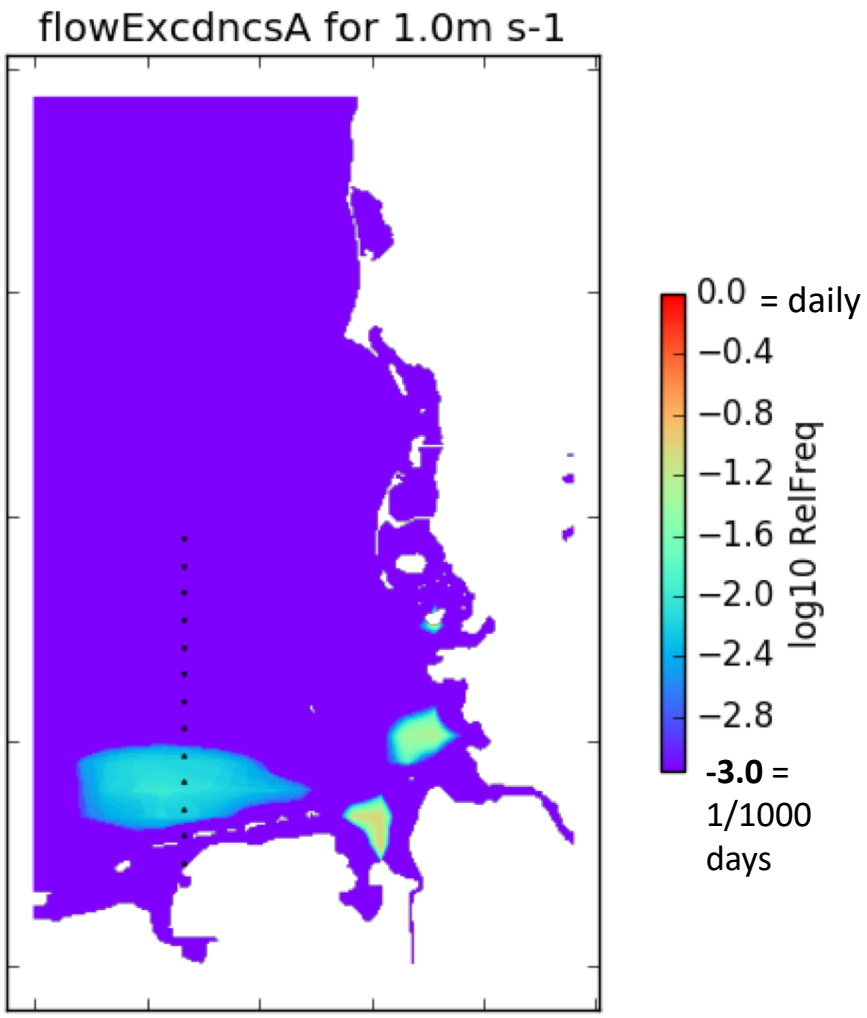
Pleskachevsky Lehner & Rosenthal 2012

Exceedance statistics on near-bottom flows

Wave-induced

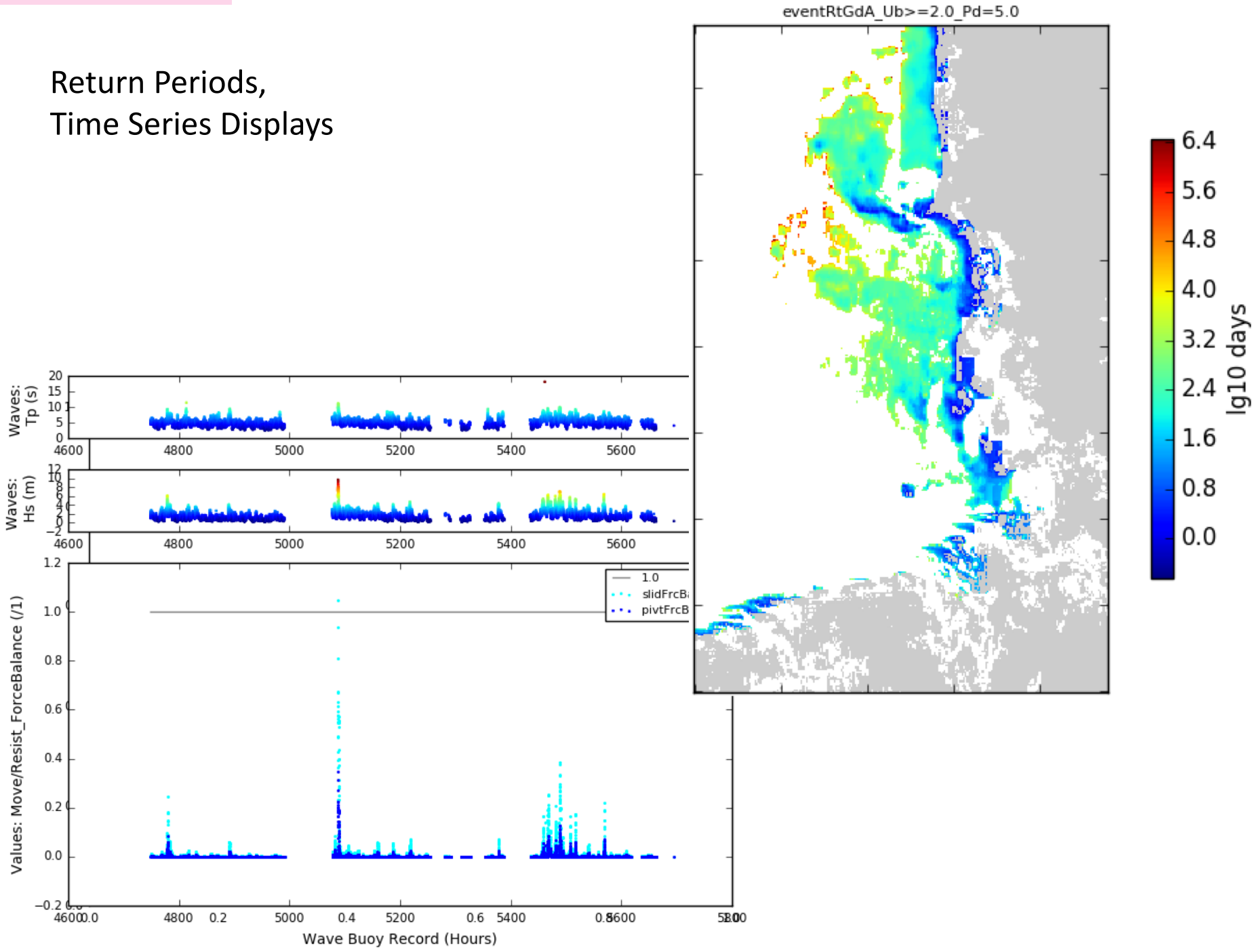


Current

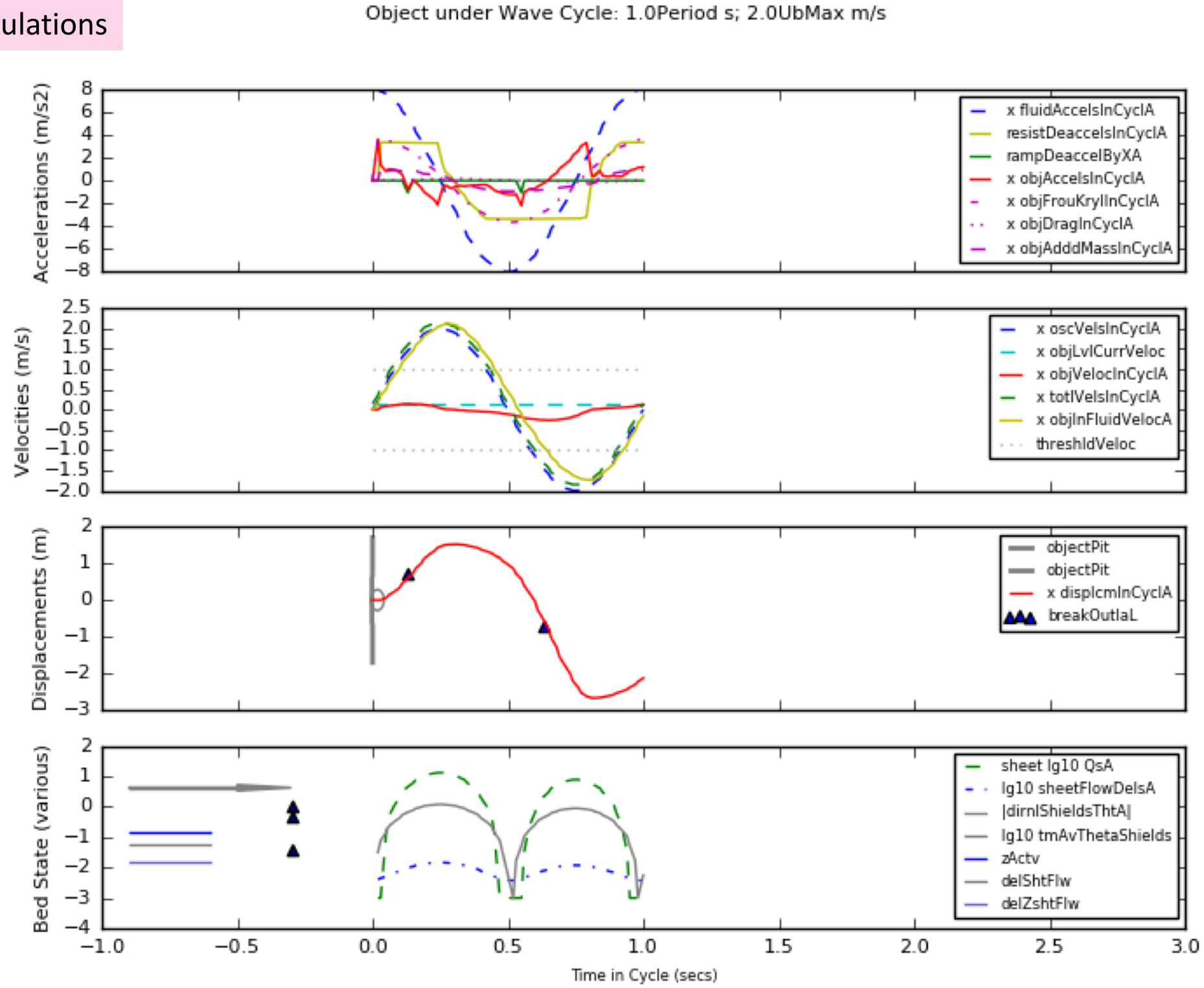


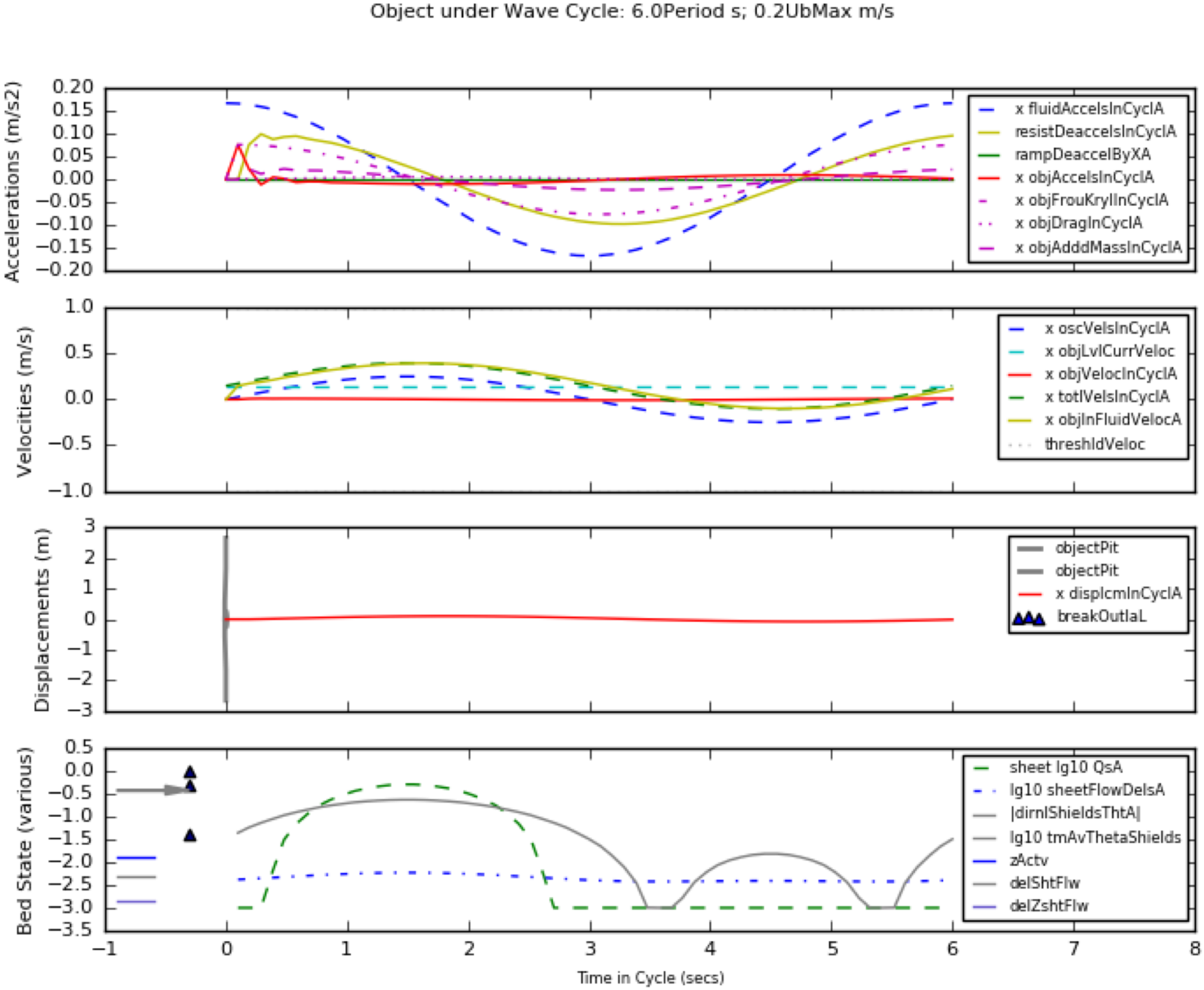
Modeling Options

Return Periods,
Time Series Displays



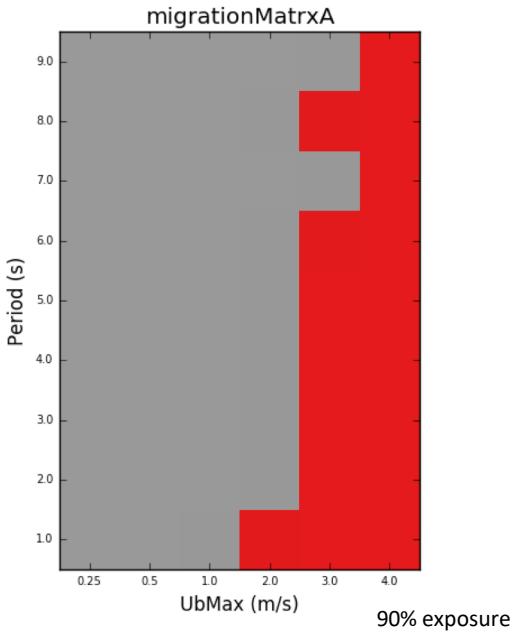
Simulations



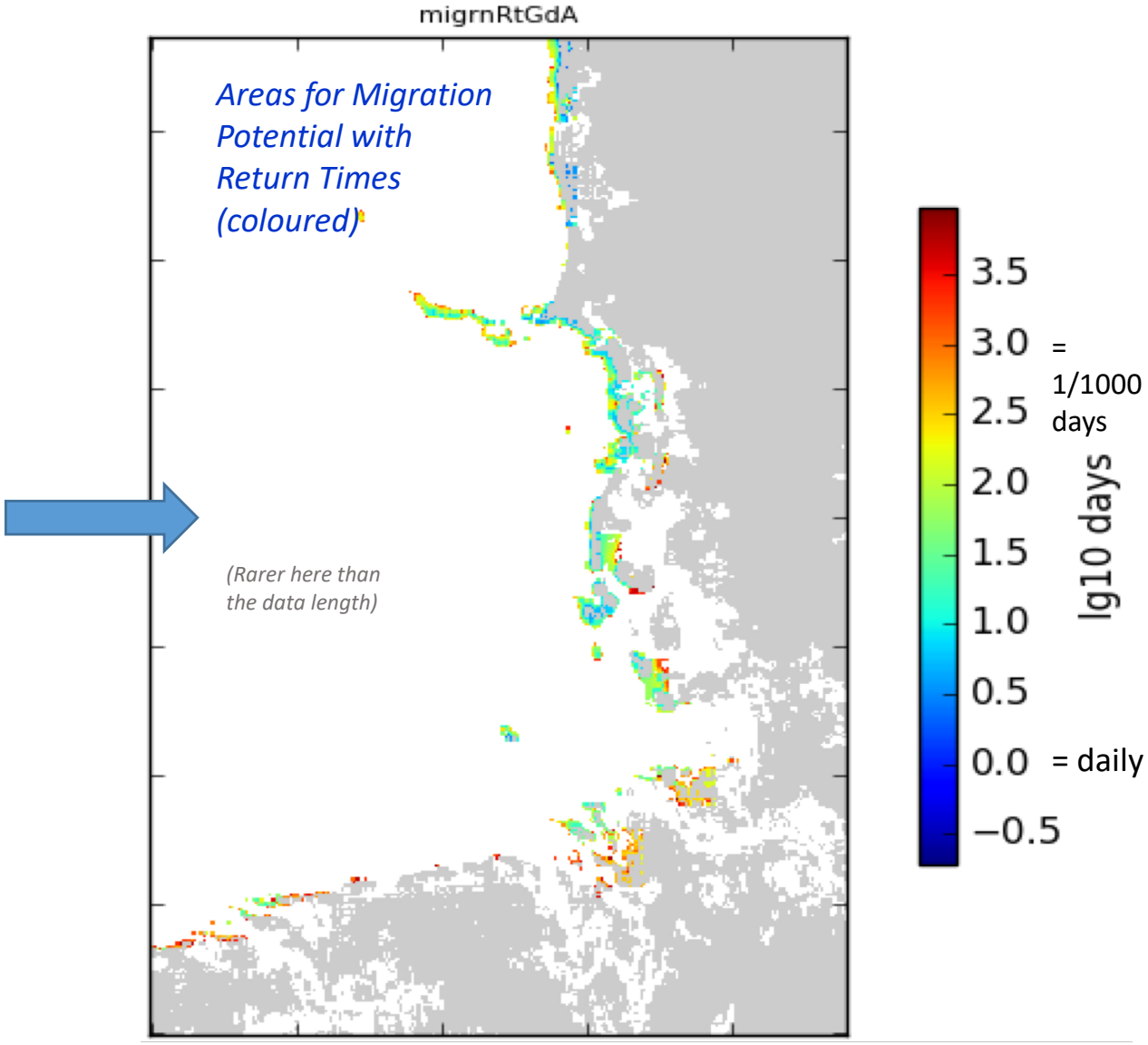

Object under Wave Cycle: 6.0Period s; 0.2UbMax m/s
Accelerations (m/s2)
x fluidAccelsInCyclA
resistDeaccelsInCyclA
rampDeaccelByXA
x objAccelsInCyclA
x objFrouKrylInCyclA
x objDragInCyclA
x objAdddMassInCyclA
Velocities (m/s)
x oscVelsInCyclA
x objLvlCurrVeloc
x objVelocInCyclA
x totlVelsInCyclA
x objInFluidVelocA
threshldVeloc
Displacements (m)
objectPit
objectPit
x displcmInCyclA
breakOutIaL
Bed State (various)
sheet lg10 QsA
lg10 sheetFlowDelsA
|dirnlShieldsThtA|
lg10 tmAvThetaShields
zActv
delShtFlw
delZshtFlw
Time in Cycle (secs)

Object Migration-Potential Statistics

Yes/No Matrix for Migration out of Pit



90% exposure



Validation modules

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The End