APPENDIX B. SWASH AND MATLAB SCRIPTS

A1 SWASH SCRIPTS

Wave propagation. Shallow flume
(s1_2shallir.sws)

```
$***********HEADING**********************************
$
PROJECT  '1 shall ir2'   '1i2'
$ Zeebrugge Storm 1: Propagation of a spectrum wave over a shallow flat area
$
$**********MODEL INPUT********************************
$
MODE DYN ONED
COORD CART
$
CGRID REG 0. 0. 0. 560 0. 933 0
VERT 3
$
INPGRID  BOTTOM 0. 0. 0. 1 0 560 0.
READINP BOTTOM 1 's1_shallir.bot' 1 0 FREE
$
INIT ZERO
BOU SHAP JON 3.3 SIG MEAN DSPR DEGREES
BOU SIDE W BTYPE WEAK ADDBOUNDWAVE CON SPECT 3.045 6.88 90 0 30 MIN
BOU SIDE E BTYPE SOMM
$
SPON E 300
$
BREAK
DISCRET UPW MOM
NONHYD
$
$*************OUTPUT REQUESTS ************************
$
QUANT HRMS DUR 30 MIN
QUANT SETUP DUR 30 MIN
$
GROUP 'GAUGE' 1 1 1 1
TABLE 'GAUGE' NOHEAD 's1_2shallir0.tbl' TSEC WATL OUTPUT 000200.500 0.5 SEC
GROUP 'GAUGE1' 250 250 1 1
TABLE 'GAUGE1' NOHEAD 's1_2shallir150.tbl' TSEC WATL OUTPUT 000200.500 0.5 SEC
GROUP 'GAUGE2' 500 500 1 1
TABLE 'GAUGE2' NOHEAD 's1_2shallir300.tbl' TSEC WATL OUTPUT 000200.500 0.5 SEC
GROUP 'GAUGE3' 375 375 1 1
TABLE 'GAUGE3' NOHEAD 's1_2shallir225.tbl' TSEC WATL OUTPUT 000200.500 0.5 SEC
$
GROUP'GAUGE5' 1 933 1 1
TABLE 'GAUGE5' NOHEAD 's1_2shallir_hrms.tbl' XP HRMS BOTL
TABLE 'GAUGE5' NOHEAD 's1_2shallir_setup.tbl' DIST BOTL SETUP
```

```
TABLE 'GAUGE5' NOHEAD 's1_2shallir_watl.tbl' DIST WATL
$
TEST 1,0
COMPUTE 000000.000 0.03 SEC 004500.000
STOP
```

Impermeable smooth dike
(s3_2dikeir.sws)

```
$***********HEADING**********************************
$
PROJECT  '3 2 dike spect'   '32d'
$
$ Zeebrugge Storm 3: Propagation of a spectrum wave on a dike scenario – V2
$
$**********MODEL INPUT*******************************
$
MODE DYN ONED
COORD CART
$
CGRID REG 0. 0. 0. 346 0. 692 0
VERT 1
$
INPGRID  BOTTOM REG 0. 0. 0. 346 0 1 0.
READINP BOTTOM 1 's3_2dikeir.bot' 1 0 FREE
$
INIT ZERO
BOU SHAP JON 3.3 SIG MEAN DSPR DEGREES
BOU SIDE W BTYPE WEAK ADDBOUNDWAVE CON SPECT 3.47 8.41 90 0 2 HR
BOU SIDE E BTYPE SOMM
$
VISC 0
FRIC 0.01
$
BREAK
DISCRET UPW UMOM H MINM
DISCRET UPW WMOM H MINM
TIMEI 0.02 0.3
NONHYD
$
$*************OUTPUT REQUESTS ************************
$
QUANT HRMS DUR 30 MIN
QUANT SETUP DUR 30 MIN
$
GROUP 'GAUGE' 1 1 1 1
TABLE 'GAUGE' NOHEAD 's3_dikeir0.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05 SEC
GROUP 'GAUGE1' 207 207 1 1
TABLE 'GAUGE1' NOHEAD 's3_dikeir103.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05 SEC
GROUP 'GAUGE2' 233 233 1 1
TABLE 'GAUGE2' NOHEAD 's3_dikeir116.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05 SEC
GROUP 'GAUGE4' 261 261 1 1
TABLE 'GAUGE4' NOHEAD 's3_dikeir130.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05 SEC
GROUP 'GAUGE3' 271 271 1 1
TABLE 'GAUGE3' NOHEAD 's3_dikeir135.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05 SEC
```

```
GROUP 'GAUGE5' 281 281 1 1
TABLE 'GAUGE5' NOHEAD 's3_dikeir140.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05 SEC
GROUP 'GAUGE6' 293 293 1 1
TABLE 'GAUGE6' NOHEAD 's3_dikeir146.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05 SEC
$
GROUP'GAUGE8' 1 692 1 1
TABLE 'GAUGE8' NOHEAD 's3_dikeir_hrms.tbl' XP HRMS BOTL
TABLE 'GAUGE8' NOHEAD 's3_dikeir_setup.tbl' DIST BOTL SETUP
TABLE 'GAUGE8' NOHEAD 's3_dikeir_watl.tbl' DIST WATL
$
TEST 1,0
COMPUTE 000000.000 0.005 SEC 022000.500
STOP
```

Rubble mound breakwater (impermeable core)
(s1_Bimpcoreir.sws)

```
$***********HEADING**********************************
$
PROJECT  '1 impcoreir B'   '1cB'
$
$ Zeebrugge Storm 1: Propagation of a spectrum wave on an imperm core breakwater scenario - BETA
$
$**********MODEL INPUT*******************************
$
MODE DYN ONED
COORD CART
$
CGRID REG 0. 0. 0. 346 0. 692 0
VERT 1
$
INPGRID  BOTTOM REG 0. 0. 0. 346 0 1 0.
READINP BOTTOM 1 's1_5impcore.bot' 1 0 FREE
$
INPGRID POROS REG 0. 0. 0. 346 0 1 0
READINP POROS 1 's1_impcoreir.n' 1 0 FREE
$
INPGRID PSIZE 0. 0. 0. 346 0 1 0
READINP PSIZE 1 'coreir.psz' 1 0 FREE
$
INPGRID HSTRUCTURE 0. 0. 0. 346 0 1 0
READINP HSTRUCTURE 1. 's1_5impcore.hst' 1 0 FREE
$
INIT ZERO
BOU SHAP JON 3.3 SIG MEAN DSPR DEGREES
BOU SIDE W BTYPE WEAK ADDBOUNDWAVE CON SPECT 3.04 6.88 90 0 2 HR
$
FRIC 0.01
VISC 0
PORO 1 1 1000 1.8
$
BREAK
DISCRET UPW UMOM H MINM
DISCRET UPW WMOM H MINM
TIMEI 0.02 0.3
```

```
NONHYD
$
$*************OUTPUT REQUESTS ***********************
$
QUANT HRMS DUR 30 MIN
QUANT SETUP DUR 30 MIN
$
GROUP 'GAUGE' 1 1 1 1
TABLE 'GAUGE' NOHEAD 's1_impcoreir0.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05 SEC
GROUP 'GAUGE1' 207 207 1 1
TABLE 'GAUGE1' NOHEAD 's1_impcoreir103.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05
SEC
GROUP 'GAUGE2' 233 233 1 1
TABLE 'GAUGE2' NOHEAD 's1_impcoreir116.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05
SEC
GROUP 'GAUGE4' 261 261 1 1
TABLE 'GAUGE4' NOHEAD 's1_impcoreir130.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05
SEC
GROUP 'GAUGE3' 271 271 1 1
TABLE 'GAUGE3' NOHEAD 's1_impcoreir135.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05
SEC
GROUP 'GAUGE5' 281 281 1 1
TABLE 'GAUGE5' NOHEAD 's1_impcoreir140.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05
SEC
GROUP 'GAUGE7' 293 293 1 1
TABLE 'GAUGE7' NOHEAD 's1_impcoreir146.tbl' TSEC WATL DISCH OUTPUT 002000.500 0.05
SEC
$
GROUP'GAUGE6' 1 692 1 1
TABLE 'GAUGE6' NOHEAD 's1_impcoreir_hrms.tbl' XP HRMS BOTL
TABLE 'GAUGE6' NOHEAD 's1_impcoreir_setup.tbl' DIST BOTL SETUP
TABLE 'GAUGE6' NOHEAD 's1_impcoreir_watl.tbl' DIST WATL
$
TEST 1,0
COMPUTE 000000.000 0.005 SEC 022000.500
STOP
```

A2 MATLAB SCRIPTS

<u>Spectral wave analysis</u>

Script sent by Victor and corrected according to the error found.

```
function [Hm0,Tp,Tm01,Tm_10,Hrms]=spectral_analysis6(t,W,p)
%Function that builds the wave spectrum from a wave record (water
elevation)
%and give some output parameters.
%
% Input parameters
% t = time series input
```

```
% W = Water elevation series input
%
%The output parameters are the significant wave height and the mean
wave
%period.

%At: time interval between the results written on the table!
At=t(2)-t(1);
%Sampling frequency
fr=1/At;

%Length of the water elevation record
n=length(W);
%number of periodograms
%p=10;
%p=5;
%W is divided into 20 samples/periodograms 18000/20=900
samples/periodogram
%W is divided into 10 periodograms 18000/10=1800 samples/peridogram
%W is divided into 5 periodograms 18000/5=3600 samples/periodogram
%Very long records needed!!! 90 min for 10 periodograms or 45 for 5.

%Periodogram samples
x=[];
for i=1:p
   x(:,i)=W((1+(i-1)*n/p):((n/p)*i));
end

%Next power of 2 greater or equal to length of the sample vector to
%calculate fft. FFT needs a length power of 2 to be efficient. For a
%shorter record, zeros will be added to reach this value.
nfft=2^(nextpow2(length(x(:,1))));
% Calculate the number of unique points
NumUniquePts = ceil((nfft+1)/2); % o nfft/2+1

Pxx=[];
for i=1:p
%PSD
fftW=fft(x(:,i),nfft);
fftW=fftW(1:NumUniquePts);
Pxx(:,i)=(abs(fftW)/(n/p)).^2.*2;
%Pxx(:,i)=(abs(fftW)/(n/p)).^2;
%There was an error in this last line, the proper
%result is reached multiplying by 2
end
%Right Scaling with the time duration of each periodogram
Pxx=Pxx*(At*n/p);

%Average periodograms to build a smoother spectrum
mW=sum(Pxx,2)/p;

%Frequency vector
% Evenly spaced frequency vector with NumUniquePts points.
f = (0:NumUniquePts-1)*fr/nfft;
%f = (1:NumUniquePts)*fr/nfft;
%Wave period vector for the plot
%ft=1./f;
```

```
%Wave frequency spectral density plot
figure(2)
plot(f,mW)
xlabel('Frequency (Hz)')
ylabel('Power Spectral Density (m^2/Hz)')
title('Power wave Spectrum at x=0 of flume')

%Wave Spectral density plot with wave period
%figure(3)
%plot(ft,mW);
%xlabel('Wave period (s)')
%ylabel('Power Spectral Density')
%title('Power wave Spectrum at x= of flume')

%Computation of some wave parameters.
%To do that 2 integrals must be numerically computed. Since the
%analytical function is unknown and the available data is a set of
points
%(theorically equidistant), a Newton-Cotes quadrature will be used.
%As the spectrum graph is built using linear interpolation, a
composite
%trapezoidal rule will be used for numerical integration.

%Spectrum function E(f)=mW
%total number of points
m=length(mW);
%number of subintervals
m=m-1;
%length of the subinterval
Ax=(f(m+1)-f(1))/m;

%Integral I1 m0=int{E(f)df} I1
s=0;
for i=2:m
    s=s+mW(i); %sum(2,m) f(xi)
end
m0=0.5*Ax*(mW(1)+2*s +mW(m+1));

%Integral I2 m1=int{f*E(f)df} I2
s=0;
%f=f*E(f)=f*mW
for i=2:m
    s=s+f(i)*mW(i);
end
m1=0.5*Ax*(f(1)*mW(1)+2*s+f(m+1)*mW(m+1));

%Integral I3 m2=int{f^2*E(f)df} I3
s=0;
for i=2:m
    s=s+(f(i))^2*mW(i);
end
m2=0.5*Ax*((f(1))^2*mW(1)+2*s+(f(m+1))^2*mW(m+1));

%Integral I4 m_1=int{f^(-1)*E(f)df} I4
s=0;
for i=3:m
```

```
    s=s+mW(i)/f(i);
end
m_1=0.5*Ax*(1/f(2)*mW(2)+2*s+1/f(m+1)*mW(m+1));
%Note: f(1)=0 and so it is expluded. The integral is not fully
computed.
%There is a mistake there!

%Spectrum analysis output
%Significant wave height
%Hm0=4*sqrt(int{E(f)df})
Hm0=4*sqrt(m0)
%Mean spectral wave period
%Tm01=(int{E(f)df}/(f*int{E(f)df}))
Tm01=m0/m1
%Peak wave period
[M,i]=max(mW);
fm=f(i);
Tp=1/fm
%Mean zero-crossing period
T0=sqrt(m0/m2)
%Mean spectral wave period Tm-1,0 with a higher weight of the longer
waves
Tm_10=m_1/m0
%Remember that one point has been ommited to compute Tm_10. I am not
sure
%if it does not affect the result!
%Root Mean Square Wave height
Hrms=sqrt(2)/2*Hm0
```