

Quantum Mechanics in Modern Physics

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Abstract 2YHUUHFHQWHDUVPXFKSURJUHVKDVEHH QDFKLHYHGLQ WKH ILHOGV RI QXPHULFDO PRGHOLQJ VKRUHOLQH SURFHVVHV ZDYHV FXUUHQWVZDYHVDQGFUHQW+RZHYHUWKHUHDUHVWLOOVRPHSUREOHPV LQWKHH[LVWLQJPRGHOVWROLQNWKHRQWKHILUVV WKHK\GURG\QDPLFVRI ZDYHVDQGFUHQWVVDQGVHFRQGO\WKHVHGLPHQW WUDQVSRUWSURFHVVHV DQGGXHWRWKHYDULDELQWLVWLPVSDFDQGLQW HUDFWRQRDQGWKH VLPXOWDQHRXVDFWLRQRIZDYHFUHQWQHDUWKH VKRUH7KLVSDSHULVWKH HVWDEOLVKPHQWRIDQXPHULFDOPRGHOLQJWRIRUHF DVVWKHVHGLPHQW WUDQVSRUW IURPGHYHORSPHQW VFHQDULRV RI KDUERU VWUXFWXUH ,W LV HVWDEOLVKHGRQWKHEDVLRIDQXPHULFDOPXOD WLRQRIDZDWHU VHGLPHQWPRGHOLDD'PRGHOLVLDVHWRIFRGHVFDF OFXODWLRQ 0,.(+,VRIWZDUH7KLVLVWRH[DPLQHWKHHIHFWRWKH VHGLPHQW WUDQVSRUW GULYHUV IROORZLQJ WKH GRPLQDQW LQFLGHQW ZDYH LQ WKH GLUHFWRQRWSDVVLQSWKDUERUZRUNXQGHUHLIHH UHQWYDULDQWVSODQQLQJ VWXGLHVWRILQGWKHWKQFLFDODQGHFRQRPLFOLP LWDWLRQVWRWKHVHGLPHQW WUDQVSRUWDQGSURWHFWLRQRWKHDKDUERUVWUXF WXUHRSWLPXPVROXWLRQ

Keywords 2ZHOO FXUUHQW UDGLDWLRQ VWUHVV VHGLPHQW PHVK 0,.(

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257VWUXFWXUHVDFQEHVHWXSE\WKHQDWXUDOFR QVWUXFWLRQRI RQHRUVHYHUDOGLNHVRUMHWWLHV\$ZURQJFDOFX ODWLRQLQWKH GHVLJQRISRUVVWUXFWXUHVDFQOHDGWRSUREOH PVRISHQHWUDWLRQRI ORQJZDYHVIRORZHG\IRUPDWLRQRIFXUUHQWVL QWKHEDVLDQSV DUHVXOWODUJHDPXQVVRIVHGLPHQWVPD\EHWU DQVSRUWHGVLOWXS DFFXPXODWHG IRU WKH KDUERU EDVLQ 7KLV SURFHVV UHVXOWV IURP WKH VHGLPHQW PRYHPHQW LQVKRUH DUHDV LQ IDFW FRQVLGHUDEOH DPRXQW RI VDQG DQG QRQRKHVLYH VXVSHQGHHG VHGLPHQW DUH WUDQVSRUWHG E\ WKH DFWLRQ RI ZDYHV DQG FXUUHQWV :KHQ WKH

ZDYHVUHDQFKWKHFRDQVWQGEUHDNRQWKHEHDFK WKH\JHQHUDWH FRDQVWDO FXUUHQWV WKDW LQWUDFW ZLWK WKH ZDYHV LQFLGHQW WR WUDQVSRUW VHGLPHQW >@ :DYHV DUH HVVHQWLDQO PRYHPHQWV RI VHGLPHQWV LQ WKH QHUVKRUH GXULQJ WKH EUHDNLQJ WKH ZDYH HQUJ\ IURP LV GLVSHOOHG DQG WUDQVIRUPHG PDLQO\ WXUEXOHQFH WKDWSXWVPRYLQJ\HGLPHQWVZKLFKDUHWUDQV SRUWHG\FXUUHQWV LW SURGXFW DQGRU WKRVH GXH WR WLGHV DQG ZLQGV >@ >@ 6HYHUDO DXWKRUV DJUHH RQ WKH LPSRUWDQFH RI WKH DFWLYLW\ RI LQWUDFWLRQV EHWZHHQ VHGLPHQW DQG ZDWHU ZKLFK DFWLYDWH LQ VZDVK]RQH DQG LW LV WKH SODFH IRU H[FKDQJH DQG VHGLPHQW WUDQVSRUWDWLRQ>@>@7KHUHIRUHLVWLVSRUW DQWWRIRUHFVWVWKH GHYHORSPHQW RI VHGLPHQW PRYHPHQW LQFOXGLQJ WKH GHWHFWLRQ

0.0LKRXELLVD3URIHVVRUDW\DERUDWRU\0RELOL]DWLRQD QG9DOXDWLRQRI :DWHU5HVVRXUFH\095RI+LJK1DWLRQD06FKRROIRU+\GUDXOL F(16+ 32 %R[%OLGD \$OJHULDSKRQH ID[HPDLOPLKNDP#HQVKG] +\DKPDQLLD3K\WVXGHQW\DERUDWRU\0RELOL]DWLRQD QG9DOXDWLRQRI :DWHU5HVVRXUFH\095RI+LJK1DWLRQD06FKRROIRU+\GUDXOL F(16+ 32 %R[%OLGD \$OJHULDSKRQH ID[HPDLOKGDKPDQL#HQVKG] DQGORFDOL]DWLRQRIDUHDVRIHURVLRQDQGGHSRV LWLRQDWRUQHDU

WKHVKRUHVIRFRDQVWDOVWUXFWXUHVDUUDQJHP HQWVDQGGKDUERUEDVLQ ,W LV TXLWH FOHDU WKDW FHUWDLQ FRDQVWDO FDKQJH LV OLQNHG WR DQWKURSRJHQLF DFWLRQ VXFK DV FRQGXFWLQJ RI WKH H[LVWLQJ HQLQHULQJ\WUXFWXUHVZLWKRXWWDNLQJLQ WRDFFRXQW\WKHPDULQH \V\WHP DQG LQWUDFWLRQV ZLWK WKH GLIHHUHQW WKH IDFWRUV OLVWHG DERYH 7KLVVWXGLVGHYHORSLQJIRUHFVWVWKHVHGL PHQWPRYHPHQW IURPSODQQLQJVFHQDULRVKDUERUEDVLRQWKH\$ OJHULDQFRDQVWV,W LV EDVHG RQ D VHW RI QXPHULFDO VLPXODWLRQV ZLWK D\GUR VHGLPHQWU\PRGHOLQDELGLPHQVLRQDOPRGHOL VLRQFRPSXWHU FRGHV0,.(+,6RIWZDUH,W\VFRQVLVWLQJRIIRXUPRG

XOHV LQFOXGLQJ WZR SHUIHFWO\ FRPSOHPHQWDU\
PRGXOHV FRQFHUQLQJ
K\GURG\QDPLFVDQGWKHVWXG\DUHDRIVKRDOLQJ0,
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RQWKH
FXUUHQWSDWVWHUQVZLWK0.(+'DQGFQDEHLQWHJU
DWHGLQWR D PRGXOH ZKLFK
FDOFXODWHVQRQFRKHVLYH VVSHQGHG
VHGLPHQW WUDQVSRUWZLWK0,(67

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A. Model of Wave Agitation

3UHGLFWLRQ PRGHOV ZDYHV DUH JHQHUDOO\
EDVHG RQ WKH
HTXDWLRQIRUHQHUJZKHUHWKHHQHJ\GHQVLW\I
URPWKHZDYH
(VT
WKHIXQFWLRQSDXOVDWLRQDQGWKHZDYHGLUHFV
LRQYDULHV
VORZO\ZLWKVSDFH\DQGWKHWPSRUDOYDULDEO
H
,Q WKH SUHVHQFH RI WKH FXUUHQW LW LV PRUH
SHUWLQHQW WR VLPXODWH WKH GHQVLW\ RI ZDYH
DFWLRQ IV T LQVWHDG RI WKH
HQHUJ\GHQVLW\RIWKHZDYH'HQVLW\RIZDYHDFWLR
QLVGHILQHG

$$1 \left[\frac{WZT}{V} \right]$$

7KHUHODWLYHIUHTXHQF\RIWKHZDYHLVHTXDOW
R

$$\sqrt{\quad} V \text{ JNWDQKNG ZN8}$$

8QGHU VWHDG\ FRQGLWLRQV LH ZKHQ WKH
FXUUHQW DQG ZDYH
SDUDPHWHUVDUHLQYDULDQWRYHUWLPVHODWL
YHWRWKHWPVFDORHRI WKH ZDYH SHULRG WKH
HTXDWLRQ IRU WKH FRQVHUYDWLRQ RI WKH
ZDYHLVH[SUHVHGE\

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F₁F_TDUH DUHDVFRPSRQHQRWRIJURXSYPHORFLW\GLU
HFWRQWKH WHUP 6 LV WKH VSULQJ IXQFWLRQ
YDULHV ,W UHSUHVHQWV WKH FRPELQHG HIIHFW
RI WKH JHQHUDWLRQ DQG GLVVLSDWLRQ RI ZDYH
DFWLRQILVWKHGHQVLW\ZDYHDFWLRQ
0,(306 LV D OLQHDU PRGHO RI UHIUDFWLRQ DQG
GLIUDFWLRQ EDVHG XSRQ D SDUDEROLF
DSSUR[LPDWLRQ RI WKH

$$\square C_g \square I ZI \quad C^g \quad C$$

7KHJUHDWQHVVRIJURXSYPHORFLW\&JLVH[SUHV
HGE\

$$- - \frac{C_g^w V_k}{V L Q K^{k d}} ; V_k$$

Z J N
WKNGLVWKHGLVSHUVLRQUHODWLRQVKLS(TXDWL
RQFDQ

B. Sediment Transport Model

7KH SURSRVHG PRGHO UHOLHV RQ WKH
IRUPXODWLRQ RI WKH 6HGLPHQW 7UDQVSRUW
3URJUDP EDVHG RQ D WZRGPHQVLRQDO DSSURDFK
WR FRPSXWLQJ KRUL]RQWDO+ LQ ZKLFK WKH
VHGLPHQW WUDQVSRUW UDWH LV FDOFXODWHG
LQ WKH GLUHFWRU RI WKH
PHDQFXUUHQWZLWKDUHVXOWLQJWUDQVYHUVHF
RPSRQHQRWRIERWWRP VORSH
7KH DYHUDJH YHUWLFDO SURILOHV DUH
FDOFXODWHG E\ LQWHJUDWLRQ
WKHVWUHVVRWXUEXOHQWUWLFWLRQ

$$\bar{w} UQ \left[\frac{w}{w} \right] \quad w8$$

7KH WRWDO UDWH RI WUDQVSRUW RI
QRQFRKHVLYH VHGLPHQWV T_w LV
FDOFXODWHGE\DGGLQJUDWHRIVHGLPHQWUWUDQV
SRUWT_vVVSHQVLRQ
ORDGDQGEHGORDGT_E

$$\langle T_w \langle T_v \rangle T_B \rangle$$

(DFK UDWH LV FDOFXODWHG VHSUDUWHO\
%UDFNHWV LQGLFDWH WKDW VVFK UDWHV DUH
DYHUDJHG GXULQJ WKH SHULRG RI WKH ZDYH 7KH
WUDQVSRUWUWUDWH T_E LV FDOFXODWHG DFFRUGLQJ
WR WKH GLPHQVLRQHV
QXPEHU)E\UHODWLRQJVKHDULQJWUHVVLQWKHER
WWRP

$$8' \quad) \quad V J'$$

ZKHUHVLVWKHUHODWLYHGHQVLW\RIWKHVHGLPH
QWJDFFHODUDWLRQ
RIJUDYLW\GLDPHWHURIWKHJUDLQVLJH8
LVLQVWDQWDQHRXV
YHORFLW\VKHDULQJQVVRFLDWHGZLWKWKHVNLQI
ULFWLRQ7KHUWHRI WUDQVSRUW RI WKH
VHGLPHQW VVSHQGHG T_v LQVWDQWDQHRXV LV
FDOFXODWHGE\

$$qG_s^3 d u z t c z t dzG$$

ZKHUHWLVWKHWLPHGGHSWKRIZDWHUFYROXPHFR
QFHQWUDWLRQ RI VVSHQGHG VHGLPHQW X
YHORFLW\ RI WKH FRPELQG IORZ RI
FXUUHQWVWDQGDZDZD
7KHLQVWDQWDQHRXVFRQFHQWUDWLRQRIWKHVH
GLPHQWVXVSHQGHG

$$\frac{wc}{w} \frac{w}{w} \frac{wc}{w} \frac{wc}{w} \frac{wc}{w} \frac{wc}{w} \frac{wc}{w}$$

C. Study of Harbour Facility

7KHSURMHFWLVH[WHQGLQJRIWKHVKHWHULQ.K
HPLVWLILVKLQJ
KDUERULWLVORFDWHGNPIURPWKHSURYLQFHRI7LS
D]DDQGLW
KDLVLUHFHQW\HUVYHU\DFWLYHLQWKHILVKHUL
HVVHFWRU,QRUGHU
WRPHHWRQFHUQVRIWKHUJLRQDQH[WHQVLRQV
WXG\WKHVKHWHU
.KHPLVWLILVKLQJLQWKHILVKLQJKDUERUZDVLQW
LDWHG
7KHGHVLJQLVSRWHFWHGE\WZRMHWWLHVDPDL
QQRUWKHDVWIRU D GLVWDQFH RI P DQG WKH
ZHVW VLGH RI P ZLWK D SDVVZRUG LQSW VLGH
IDFLQJ ZHVW \$OO DORQJ WKH FRDVLWOLQH RI
.KHPLVWLLVGHYHORSQJQVVRFLDWHGZLWKWKHVNLQI
HGVKDSHDOPRVW

NPLQOHQJWKZKLFKUXQVIURPWKHPRXWKRIWZRPV
DOOHU
ZDGLV)LJ



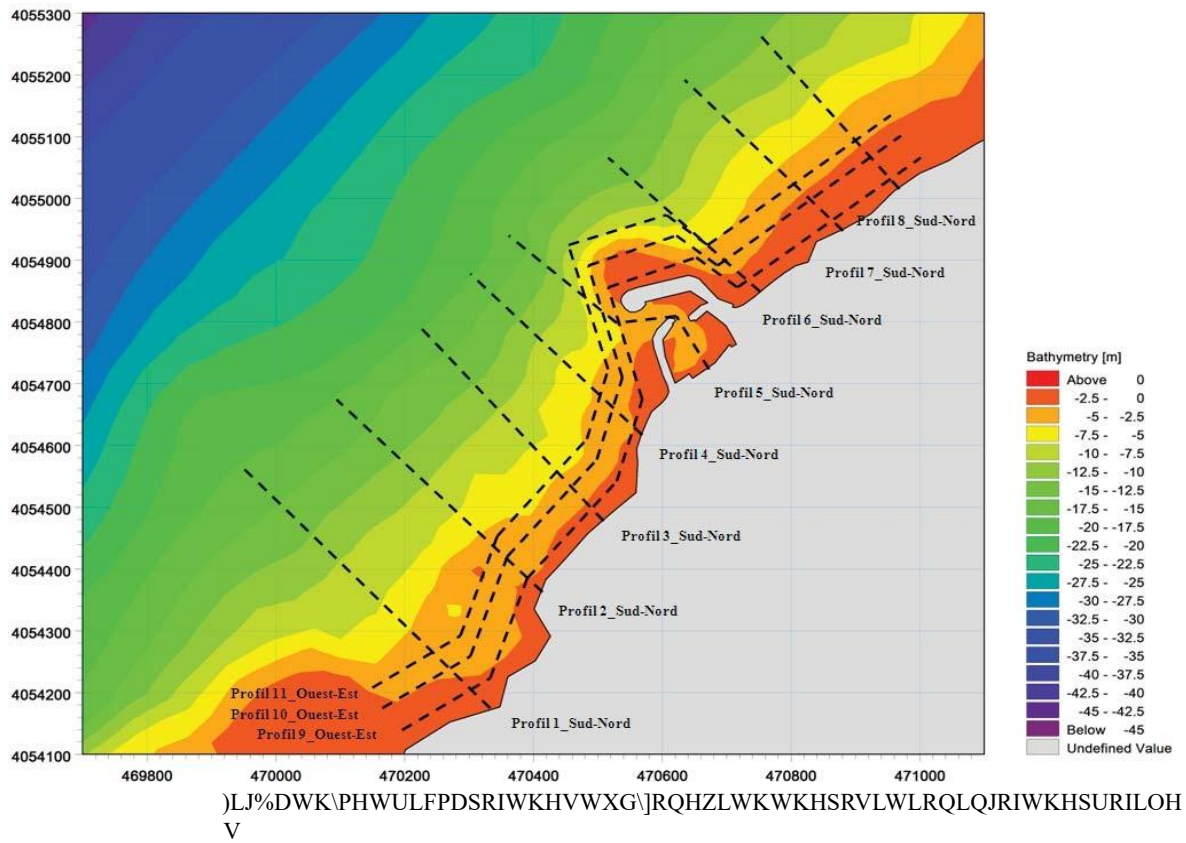
)LJ*HRJUDSKLFDORFDWLRQSRUW.KHPLVWL6FDOH

)RU FRPSDULQJ WKH UHVXOWV RI WKH VWXGLHV
RI WKH UHGXFHG
PRGHZHKDYHXVHGWKHFRGHFDQFXODWLRQV,.(
WRVWXG\ YDULRXV DOWHUQDQWLYHV IRU WKH
LPSOHPHQWDWLRQ LQVWHDG MHWWLHV RI
WKHKDUERUZRUN

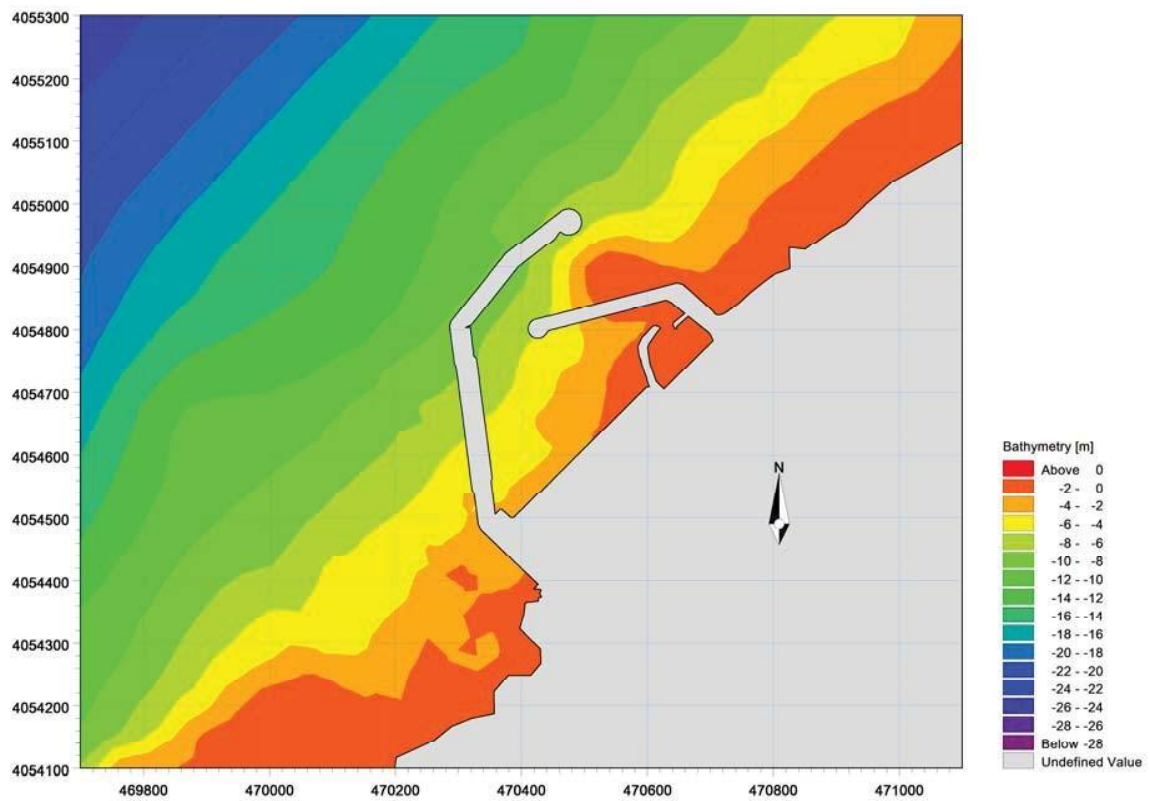
,Q RUGHU WR DQDO\JH WKH HYROXWLRQ RI WKH
ILHOG RI UDGLDWLRQ VWUHVHV DQG VHGLPHQW
IORZ WKH VWXG\ DUHD KDV EHHQ GLYLGHG LQWR
WR HLJKW SURLOHV LQ ORQJLWXGLQDO DQG
WKUHH LQ WUDQVYHUVDQ)LJ

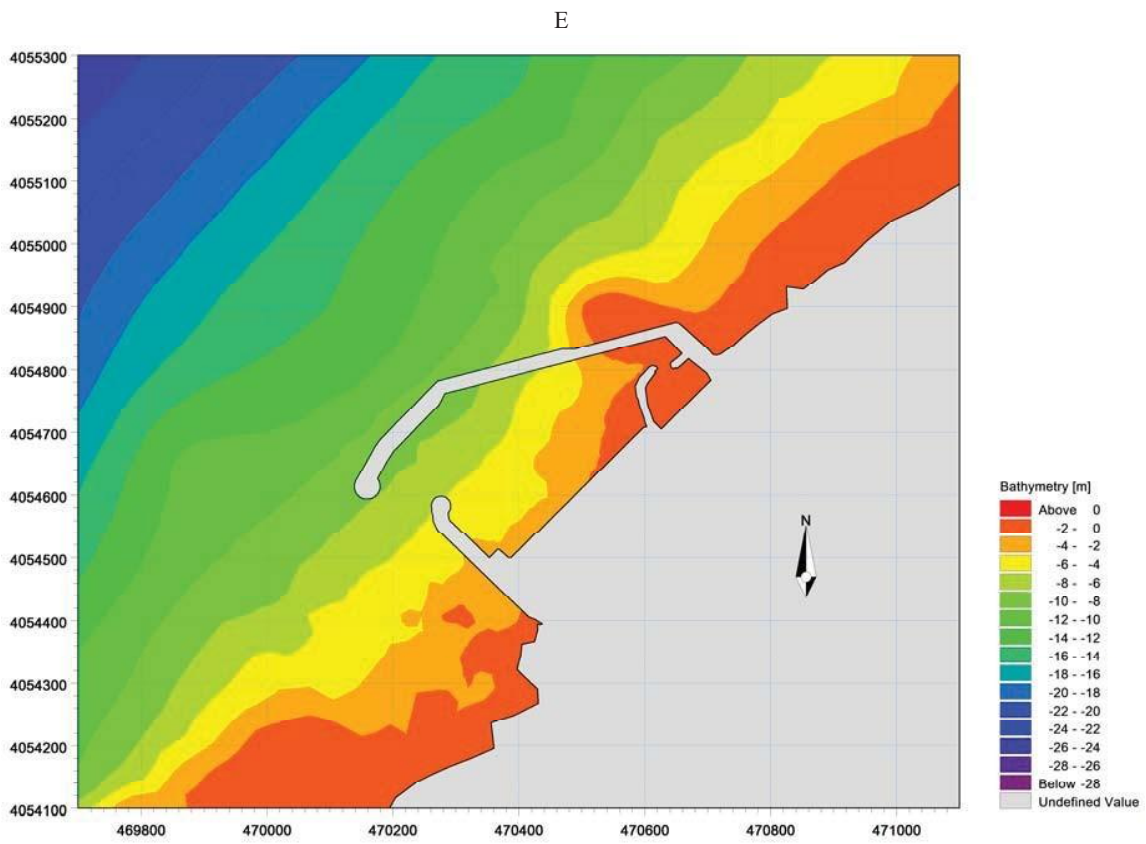
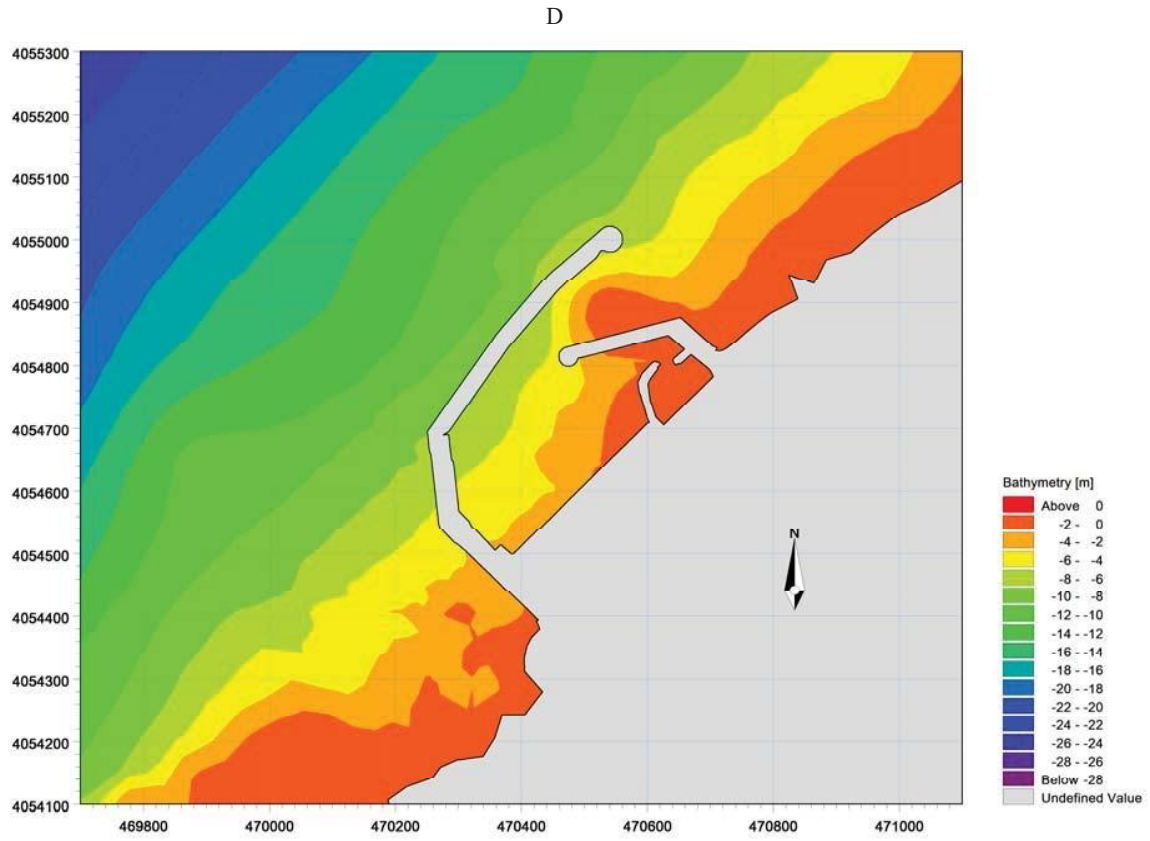
\$QDO\LV RI WKH EDWK\PHWULF FKDUW
UHYHDOV DQ LUUHJXODU
PRUSKRORJLQWKHIDY\EHWZHHQWKHFRDVLWOLQH
DQGWKHGHSWK
FRQRXUPOLQLPXPDOWLWXGHVDYHUDJHPD[LPPXP
DOXHV FRUHVSRQGWRRPP

,WVKRXOGEHQRWGHGKDWDFRUGLQJWRWKHVX
UYH\UHVXOWVZLWK
WKHODQFHWKHSUHVHQFHFRIDURFN\DUHDZKLFKH[
WHQGVIURPWKH
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WUDOSDUWRIWKH
VLWHZKHUHDVLQ:HVWSDUW\WKHODWWHUHDFK
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)LJ'LDJUDPRIWKHYDULRXVKDUERUGHYHORSHPHQWDOWHUQDWLYHVDSOWHUQDWLYHESOWHU
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D. Validation Testing

)RU JHQHUDWLQJ WKH VLPXODWLRQ ZH KDYH
DGRSWHG IRXU
FODVVHVRIWKHPRVWUHTXHQWDQGPRVWLPSRUW
DQWZDYHVWKHLU HIIHFW LV SUHGRPLQDQW
7KHVH ZDYHV UHVXOW IURP VKLS REVHUYDWLRQV
IURP WR E\ WKH 8QLWHG 6WDWHV 1DYDO
:HDWKHU&RPPDQG

7R YHUL\ WKH UHOLDELWLW\ RI QXPHULFDO
FRPSXWLQJ FRGHV
0,,(DFRPSDUDWLYHVWXG\ZDVPDGHEDVHGWHVWVF
DUULHG

RXW7KHZDYHIOXPHLVPORQJPZLGHZLWKDGHSWKRI
P,WLVILWWHGZLWKDUDQGRPJHQHUDWRUZDYHV*H
QHUDWLRQ ZDYHV REWDLQHG E\ XVLQJ D
FRPSXWHU DVVRFLDWHG ZLWK D UHFRUGLQJ WDSH
LQ QDWXUH DQG ZDYH FRQYHUWHG LQWR WUDLQV
RI ZDYHV -216:\$ WSH (DFK WHVW LV SHUIRUPHG
ZLWK D ZDYH
SURJUHVVLYHO\LQFUHDV\QJLQFUHPHQWV

SEHDULQJRIWKHZDYHVLVFKDUDFWHULJHGE\VLQJ
LILFDQWZDYH KHLJKW SLDU+V DQG ZDYH SHULRG7s
7KH UHFRPPHQGHG
GXUDWLRQIRUHDFKWHVWLVPLQXWHVPRGHQZKLF
KFRUUHVSRQGV
WRDVHFVWRUPQDWXUHGXUDWLRQRIWKHHQGXU
DQFHVHULHVLV KRUV LQ WKH PRGHO
FRUUHVSRQGLQJ WR D SHULRG RI KRUV VWRUP
DW WKH VLWH 7KH GLVWULEXWLRQ VKRZV WKDW
SHOLWHV DOO
VDPHOVKDVORZFRQFHQWUDWLRQVWKLVIUDFWL
RQWKHVHOHYHOVYDU\ EHWZHHQ DQG 7KLV ORZ
SHUFHQWDJH LQGLFDWHV WKDW WKH VHGLPHQWV
IURP WKH \$UHD DUH LQ SHUSHWXDO UHZRUNLQJ ,Q
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7KH ZDYH SURSDJDWLRQ LV UHIOHFWHG LQ WKH
DSSURDFK WR WKH VKRUH E\ D PRGLLFDWLRQ RI
WKHVH FKDUDFWHULVWLFV LH GHFUHDVHG ZDYH
KHLJKW DQG GHYLDWLRQ RI WKH DQJOH RI
LQFLGHQFH UHVXOWV
IURPWKHSKHQRPHQRRIUHIUDFWLRQIXPHULFDOP
RGHOLQJZDV
XVHGWRH[DPLQHWKHLQLWLDOFRQGLWLRQRIWKH
VLWHDQGLKJOLJKW
WKHK\GURG\QDPLFIDFWRUVWKDWUHEHKLQGV
QGHQFURDFKPHQW
RIWKHH[LVWLQJDKDUERUGHYHORSHPHQW)LJ
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FRPSDUDEOH5LJKWO\WKHPD[LXPUIHODWLYHHUUR
UEHWZHHQWKH YDOXHV REWDLQHG LQ ERWK
WHVWV GRHV QRW H[FHHG HLJKW SHUFHQW
FRQILUPLQJ WKH UHOLDELWLW\ DQG FRQVLVWHQF\
RI FDOFXODWLRQ
UHVXOWVREWDLQGHUHIUDFWLYHVLPXODWLRQ
7KH VHW RI YDOXHV RI FRPSDUDWLYH
SDUDPHWHUV LV VKRZQ LQ 7DEOHV,,DQG,,,

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,W LV DSSDUHQW WKDW WKH ZDYH GLUHFWLRQ □ 1 DUH WKH PRVW IDYRUDEOH IRU WKH IRUPDWLRQ RI ORQJVKRUH FXUUHQWV WKXV SURYLGLQJ D GULYLQJ IRUFH IRU VHGLPHQW WUDQVSRUW LQ WKH GLUHFWLRQ RI WKH RYHUORRNLQJ LQFLGHQW ZDYHV LQ WKH GLUHFWLRQ

IURPZHVVWRHDVWRYHUWKHSDVVWRWKHKDUERU HQWUDQFH

7R VHDFUK IRU D PHFKDQLVP WR ILJKW DJDLQVW WKH VDQG HQFURDFKPHQW RI WKH KDUERU EDVLQ SKHQRPHQW LW LV SDUDPRXQW WR DFW GLUHFWO\ RQ WKH GLUHFWLRQ RI ORQJVKRUH FXUUHQWV JHQHUDWHG E\ WKH LQFLGHQW VZHOO IROORZLQJ WKH GLUHFWLRQ PHQWLRQHG DERYH)RU WKLW ZH SURSRVH WR H[DPLQH WKUHH VWUXFWXUDO YDULDQWV DPHG DW PLWLJDWLQJ WKH HIIHFWRU RI WKH

HIIHFWRIWKHPD[LXPDORQJVKRUHF\XUUHQWVVRQW KHSDVVDQGWKH KDUERUEDVLQ]LJ

Characteristics of Alternative 1 (a): 0DLQ MHWW\ P VHFRQGDU\ MHWW\ P PDLQ MHWW\ RULHQWDWLRQ □ DQG GLUHFWLRQVHFRQGDU\MHWW\□

Characteristics of Alternative 2 (b): 0DLQ MHWW\ P VHFRQGDU\ MHWW\ P PDLQ MHWW\ RULHQWDWLRQ □ DQG GLUHFWLRQVHFRQGDU\MHWW\□

Characteristics of Alternative 3(c): 0DLQ MHWW\ P VHFRQGDU\ MHWW\ P PDLQ MHWW\ RULHQWDWLRQ □ DQG GLUHFWLRQVHFRQGDU\MHWW\□

7KHFRGH0,(67FDQGHWHUPLQHWKHVHGLPHQWIO X[EDVHG RQVHGLPHQWRORJLFDQGDWDIURPWKHVLWHDQGD OORZVSURYLGHVDQ RSWLPDO VROXWLRQ IRU WKH FRQVWUXFWLRQ RI WKH DOWHUQDWLYHV VWXGLHG

5HO\QJ RQ WKH K\GURG\QDPLF DQG VHGLPHQWRORJLFDQ GDWD IURPWKHVWXG\VLWHWKUHHDOWHUQDWLYHVZHU HVXJJHVWHGWRH[WHQG WKHH[LVLWQJSRUWMHWLHVFRQVWLWXWLQJWK HEDVLQRIWKHQHZSRUW ,WLVHYLGHQWWDWORQJVKRUHF\XUUHQWVUHS UHVHQWVKHDELOLW\WR SXW PRYLQJ QRQFRKHVLYH VHGLPHQW SDUWLFOHV RQ WKH ZDYH DFWLRQV

,WLVDSURSULDWHO\QRWHGWKDWIRUZDYHPRV WXQIDYRUDEOHLV GLUHFWLRQ□IRIZDYHVWKHDOWHUQDWLYHWZRK DVUHODWLYHO\OHVV DIIHFWHGE\WKHVHGLPHQWIOX[RILVWORFDWLRQD WWKHSDVVDQGWKH KDUERUEDVLQ

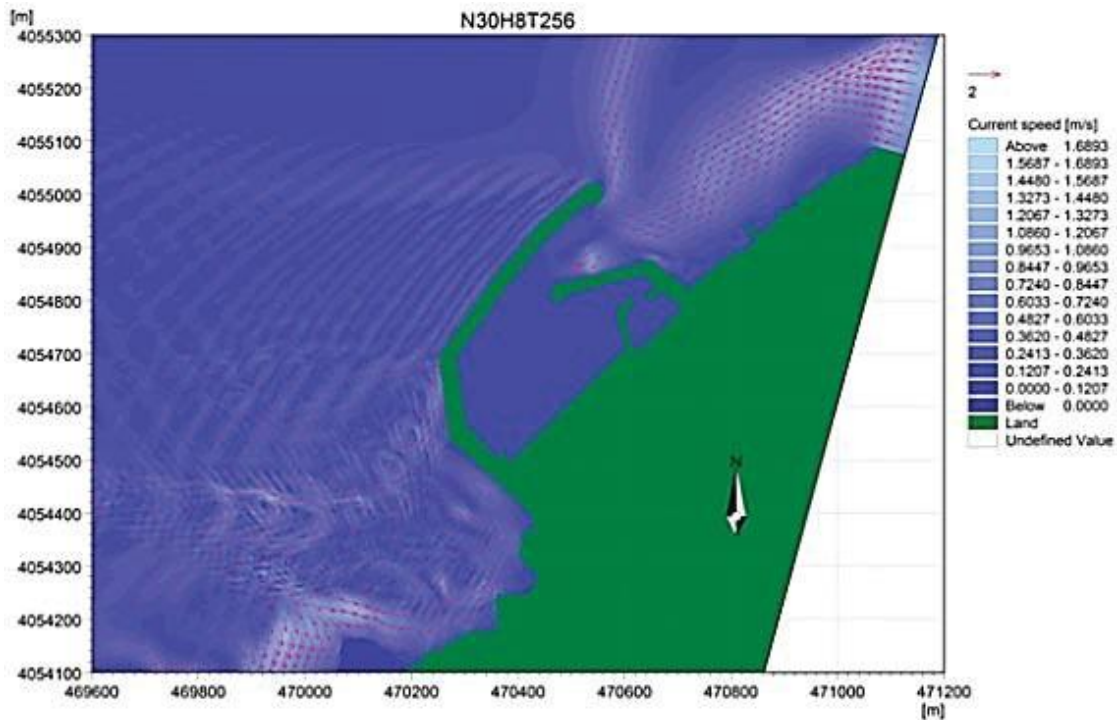
7KH HYROXWLRQ RI VHGLPHQWU\ IORZ LV QRUWKHDVW ZLWK DQ DYHUDJHVSHFLILFUDWHHTXDOWRP\HDS\$FFRUGLQ JWR WKH SURILOHV RI VHGLPHQW IOX[GHSHQGLQJ RQ WKH FXPQDWLYH GLVWDQFHRIWKH:HVW&RDVWRWKH(DVW/RFDOL]DWLRQDWSURILOH 1^RDQGHKDYHHVWLPDWHGWKHPD[DYHUDJHPLQ IOX[VHGLPHQWUHVSHFWLYHO\7KHIROORZLQJHGL

PHQWGLVFKDUJH PD[LPDO HTXDO P \HDU WKDW
VKRZ VLJQLLFDQW
VHGLPHQWIOX[LQWKHYLFLQLW\RIIVKRUH
7R RWKHU GLUHFWLRQV RI ZDYHV HQXPHUDWHG
DERYH WKH VHGLPHQWV IOX[LQGXFHG E\
ORQJVKRUH FXUUHQWV SURGXFHV QR
HIIHFWRWKHKDUERU)LJ
)RUGLUHFWLRQ □1 WKHIORZRFFXUULQJDW WKH
H[LW RI WKH
FKDQQHORIWKHKDUERULVWREHFRQVWLWXWHGD
VVHULRXVKLQGHUVWR
WKHWUDQVLWVKRUHOLQHIXQFWLRQLQJRIWKHSR
UW
,Q YLHZ RI PLWLJDWLQJ WKH LPSDFW RI WKH
FRDVWDO VWUHDPV
IRUWK(VWGLUHFWLRQWRZDUGVDWWKHHQWU\RI
WKHSDVVSODFHRI
FRQFHQWUDWLRQRIDGLDWLRQVWUHVHVIDYRU
LQJWUDQVSRUWDWLRQDQG
GHSRVLWLRQRIWKHVHGLPHQWV
)FRQVLGHUHGLWXVHIXOWRSURYLGHDEUHDNZ
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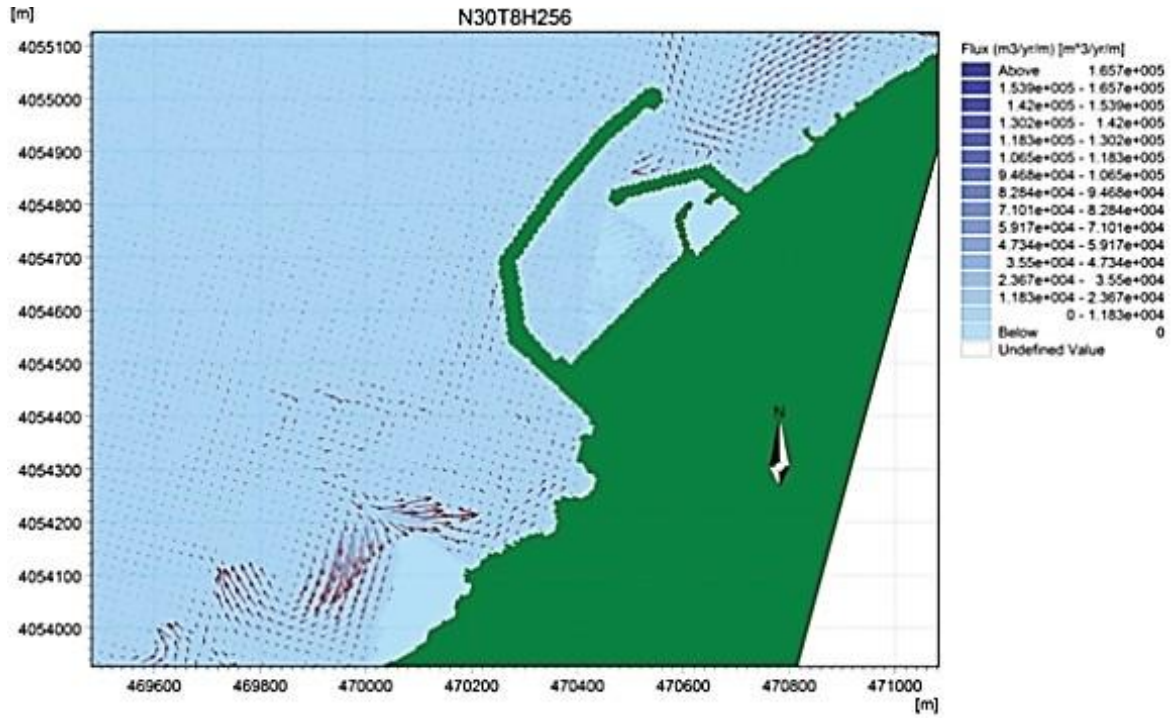
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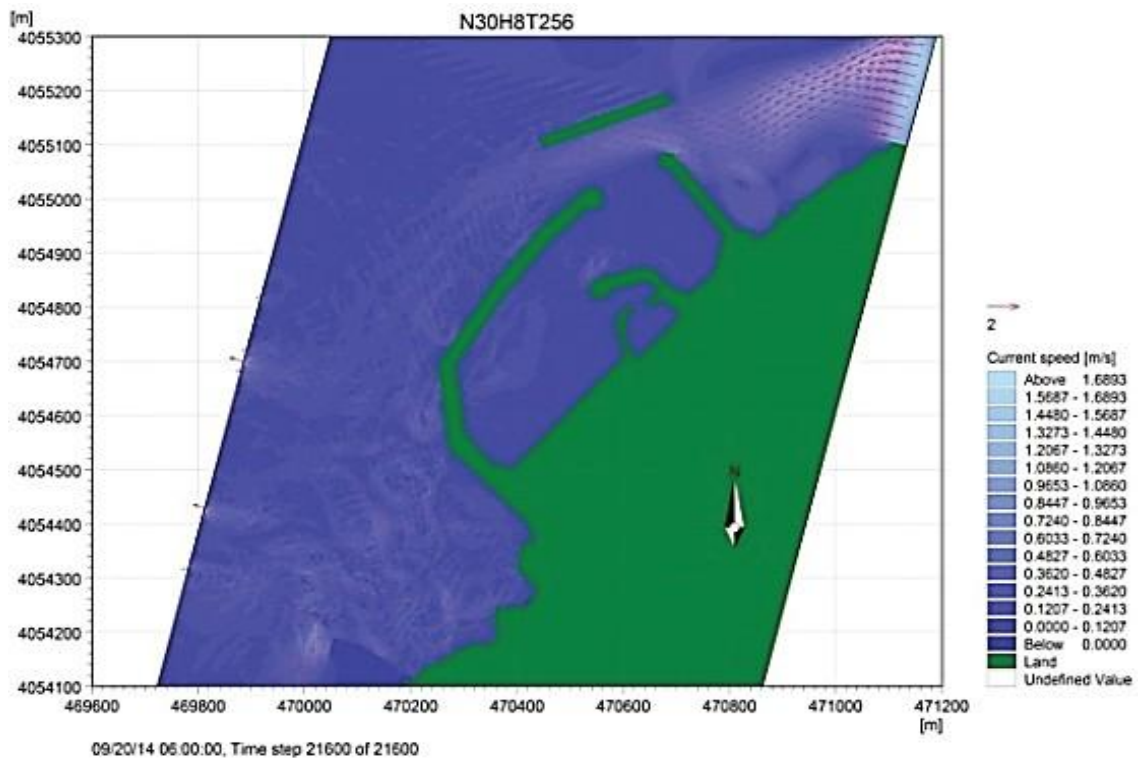


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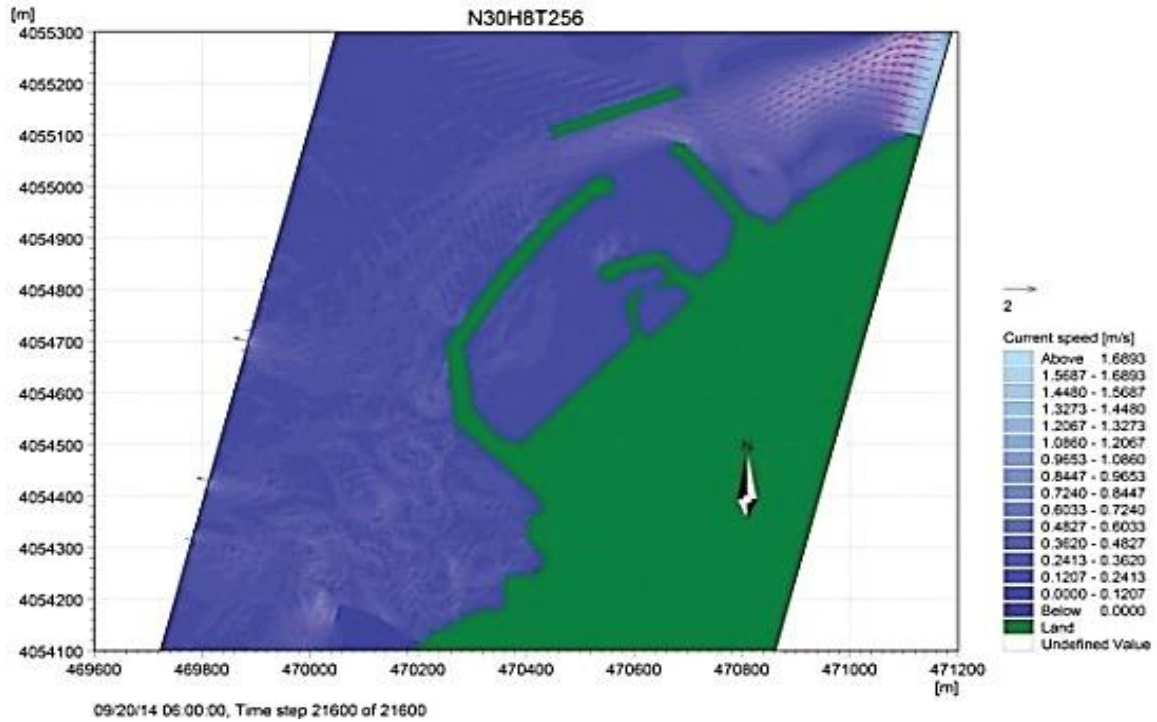


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