EUROPEAN COMMISSION
DIRECTORATE GENERAL JRC
JOINT RESEARCH CENTRE
Institute for the Protection and Security of the Citizen
Global Security and Crisis Management Unit
CriTech

Wednesday, 03 March 2010

Tsunami Chile 27 February 2010

Part 3: Estimation of Coastal inundation

Generals

The objective of Tsunami simulations changes with the time elapsed from the time of the event (see Appendix A – type of Tsunami calculations). While the initial calculations, performed automatically few minutes after the event, had the objective the identification of the coastal section affected by the Tsunami, the objective now is to identify more precisely which are the cities and villages that could have been inundated by the Tsunami waves. The presence of the Tsunami waves on-shore could have amplified the impact of the earthquake and thus these could be the most damaged areas; this information could help in prioritizing the relief efforts.

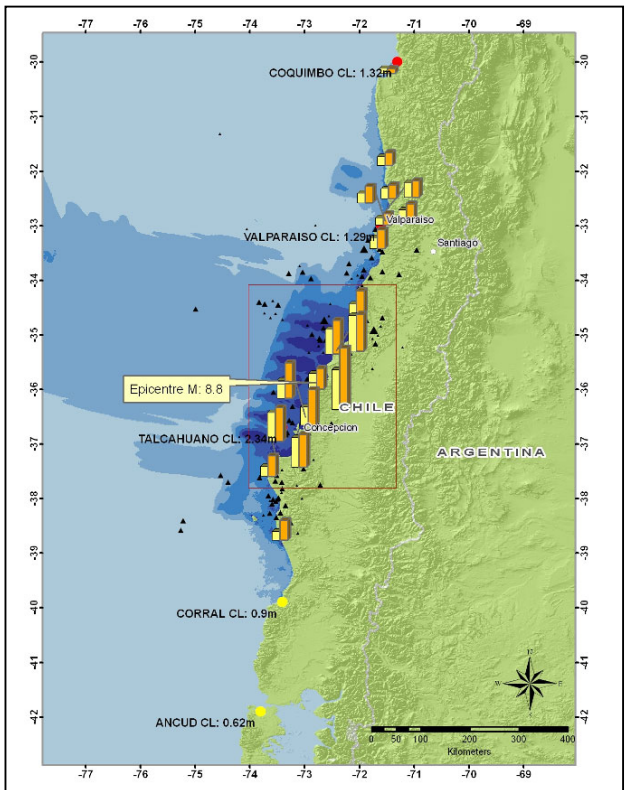


Figure 1 Finite fault model - Crust deformation and tsunami wave height with indication of possible inundated locations

At the moment the exact locations of the inundated areas are unknown or partially known. The knowledge of the water height off-shore is not sufficient to judge the possibility of inundation. In some cases high water level on the shore connected with steep shore prevents the possibility of damage on the coast.

Inundation calculations require very high resolution data for bathymetry and topography (as shown in previous events like Samoa 2009) which is not available for Chile. It is impossible to calculate precisely the exact inundation extent; nevertheless a preliminary indication of the potential inundated locations is possible. Early Warning calculations were performed using JRC-SWAN model while for these more detailed calculations the JRC model *HyFlux2* has been used.

The identified locations have also been compared with GIS extracted flat areas and with the available information present in media reports. The picture above shows the locations with an indication of the confirmation or not by media reports.

Coastal Inundation simulations

The calculations have been performed using **SRTM30 PLUS Global topography (v 5.0)**[1] for the bathymetry/topography, while for the crust deformation the Finite Fault Model solution has been adopted[2] Fig. 1 shows the initial deformation, which was applied on the initial water surface levels as well as on the bathymetry/topography, assuring at instant 0 the conservation of the total mass of liquid on each control volume of the space domain.

Cascade simulations have been set-up in order to simulate coastal inundation. In the present report the calculations listed in Table 1 are shown. For all the simulations the calculation time is of 3 hour.

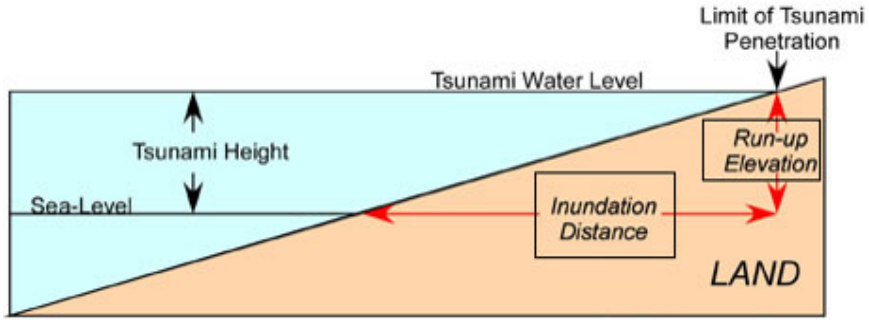
Calculation	Grid size	Latmin	Latmax	LonMin	LonMax
Coarse-dx.1800 (1 min)	1800	-40	-30	-80	-67.71
Coarse-dx.900 (0.5 min)	900	-42	-30	-81	-69
coarse-dx.300-sexta_quinta	300	-34.1	-30	-76	-70
coarse-dx.300-octava_septima	300	-37.7	-34	-74.5	-71.7
coarse-dx.300-novena	300	-40	-37.7	-76	-73
coarse-dx.300-robinson_crusoe	300	-34	-33	-81	-78

Table 1 - Simulations

Some of the relevant maps produced by the simulations are listed in Table 2.

	Max. water elevation (maps)	Run-up elevation (m)	Inundation distance (m)
Gray light	<0.2	<0.3	<30
Green	0.2 – 0.4	0.3 – 0.6	30 – 60
Yellow	0.4 – 0.8	0.6 – 1.2	60 – 120
Orange	0.8 – 1.6	1.2 - 2.4	120 – 240
Red	1.6 – 3.2	2.4 – 4.8	240 – 480
Magenta dark	>3.2	>4.8	>480

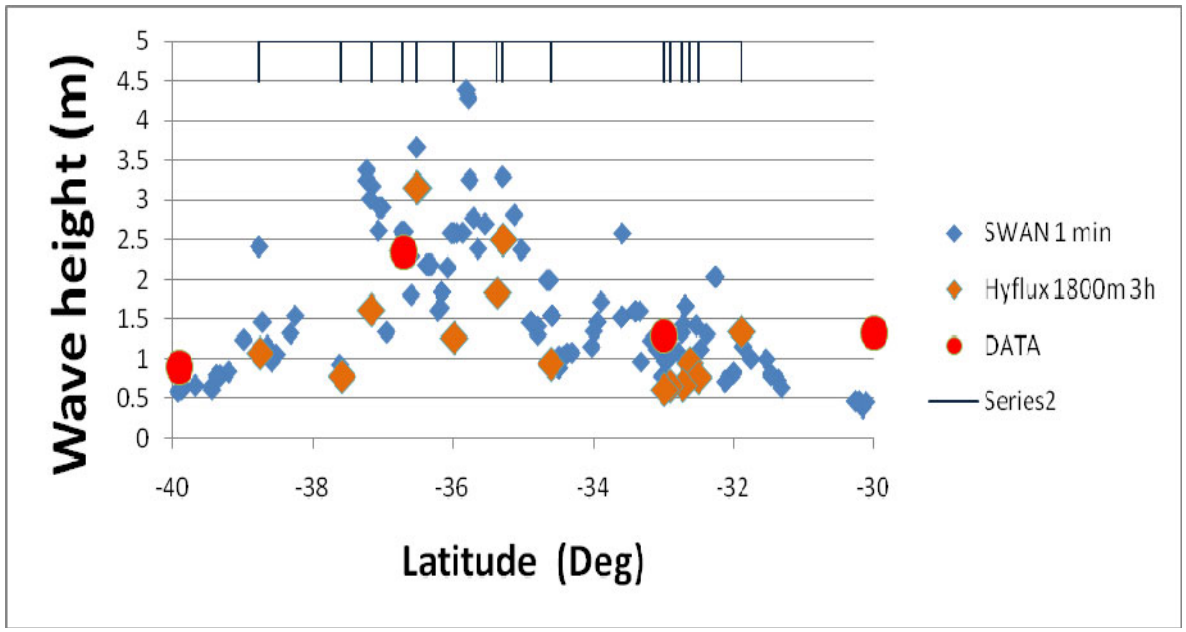
Table 2 - Maps produced by coastal simulations, see figure below for the definition of quantities



[1] http://topex.ucsd.edu/WWW_html/srtm30_plus.html

[2] http://earthquake.usgs.gov/earthquakes/eqinthenews/2010/us2010tfan/finite_fault.php

The figure below represents the distribution of wave heights along the latitude. The red dots are measured data, the blue diamonds are locations evaluated with the JRC-SWAN code (the model used for early warning calculations), the orange diamonds are the locations evaluated with the Hyflux code. The lines above indicate the locations considered inundated.



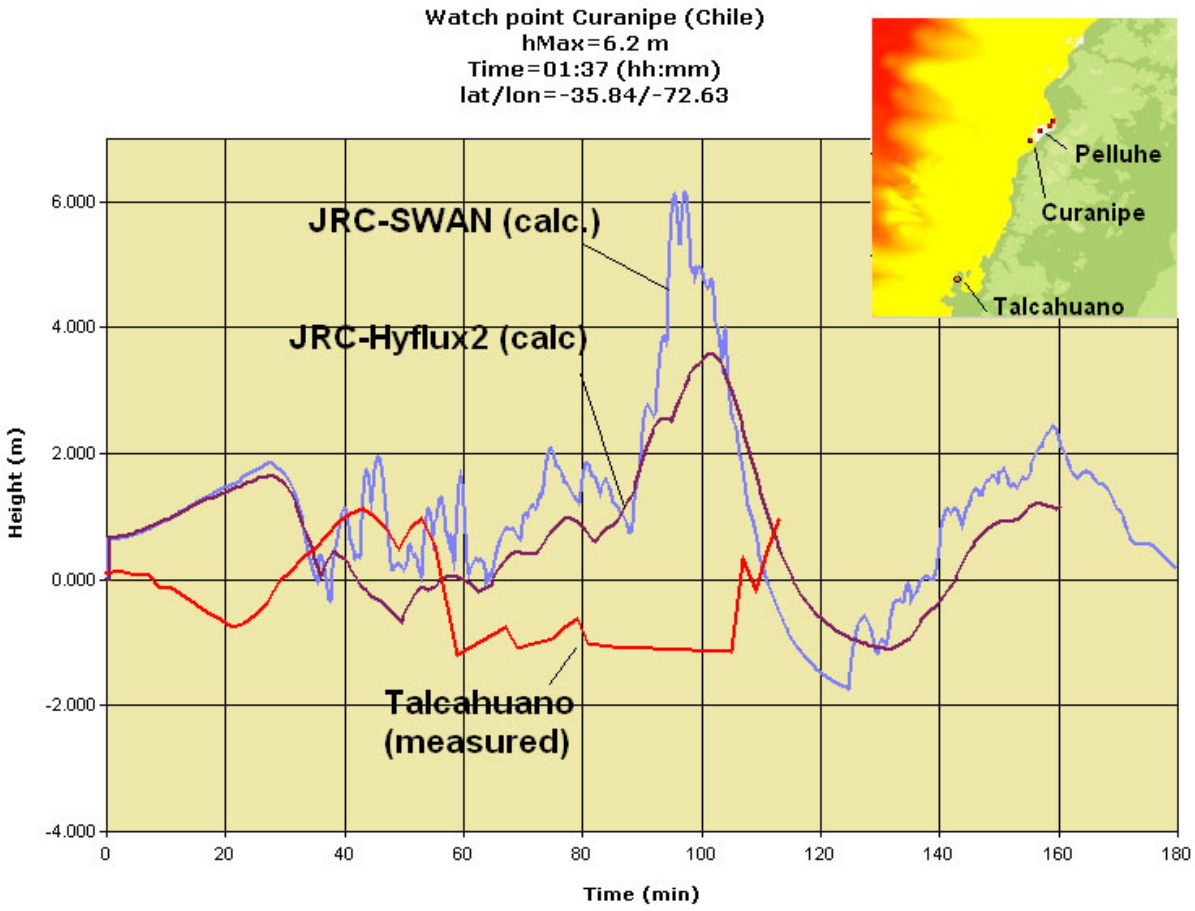
Within all these locations we have identified the table below which represents 16 locations in which the calculations indicated potential inundation, ordered by approaching wave height. Of these 5 have been confirmed by reading media reports. In the next days more information will be available and it will be possible to confirm other locations or add or remove locations.

The locations indicated do not mean an exact point but indicate an area around which inundation could be found. In the table the values ontained with SWAN are also reported; in general these values are higher than the ones obtained with Hyflux2, as it can beseen also by the plot above, but the general trend is conserved among the two codes.

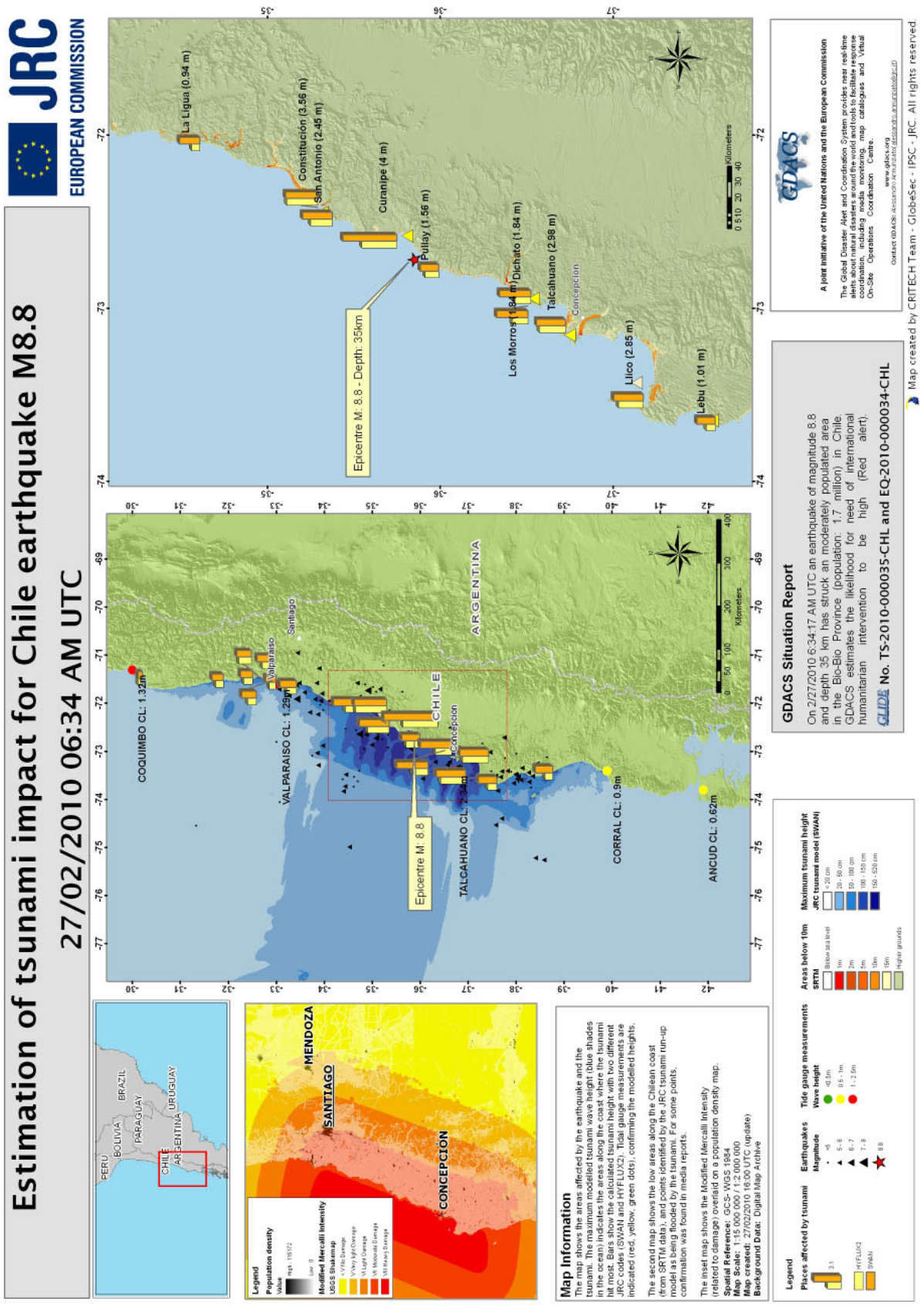
Location	Latitude	Longitude	Wave Height (m) (SWAN)	Time Max (hh:mm)	Inundation confirmed
Curanipe	-35.7493	-72.61455	4.00(6.2)	01:41	CONFIRMED
Constitución	-35.2917	-72.4199	3.56(3.7)	01:03	CONFIRMED
Talcahuano	-36.7251	-73.1037	2.98 (3.3)	02:09	CONFIRMED
Llico	-37.1751	-73.5373	2.85 (3.4)	01:55	NOT-CONFIRMED
San Antonio	-35.3751	-72.4866	2.45 (3.4)	01:19	CONFIRMED
Los Morros	-36.5084	-72.987	1.84(3.6)	00:38	CONFIRMED
Dichato	-36.5251	-72.9369	1.84(3.6)	00:38	CONFIRMED
Pullay	-35.9917	-72.7868	1.56 (2.1)	01:30	CONFIRMED
La Greda	-32.7251	-71.5193	1.46 (1.7)	00:44	NOT-CONFIRMED
La Laguna	-32.6251	-71.4526	1.41 (2.0)	00:41	NOT-CONFIRMED
Algarrobo	-33.3277	-71.6731	1.10 (1.9)	01:31	NOT-CONFIRMED
Papudo	-32.5085	-71.4693	1.02 (1.4)	02:36	NOT-CONFIRMED
Lebu	-37.5917	-73.6708	1.01 (2.1)	00:41	CONFIRMED
Concón	-32.9084	-71.536	0.97 (1.7)	00:20	NOT-CONFIRMED
La Ligua	-34.6084	-72.053	0.94 (2.3)	00:05	NOT-CONFIRMED
Puerto Saavedra	-38.7584	-73.4539	0.87 (2.0)	02:32	NOT-CONFIRMED
Conchalí	-31.8918	-71.536	0.85 (1.3)	02:32	NOT-CONFIRMED
Valparaíso	-32.9918	-71.5693	0.77 (1.2)	00:40	NOT-CONFIRMED
Tongoy	-30.2108	-71.48982	0.53 (0.5)	02:38	NOT-CONFIRMED

In the following sections a more detailed analysis of each of the 16 locations is indicated. The locations are ordered by Administrative Entities.

The figure below reports the behavior of the wave in the location which was mostly affected, which is the one between -35.88 and -35.75 that includes the locations of Curanipe and Pelluhe and other small villages. It is interesting to note that, although the fault was very close to the coast and even included part of the coast, the main wave that caused most damage occurred after 1.5 h from the earthquake. Both JRC-SWAN and Hyflux show a very similar trend with a second large wave at this time. This is also confirmed by one measurement that was not very close to this location but that shows a second wave at about 100 min and then the measurement is broken.

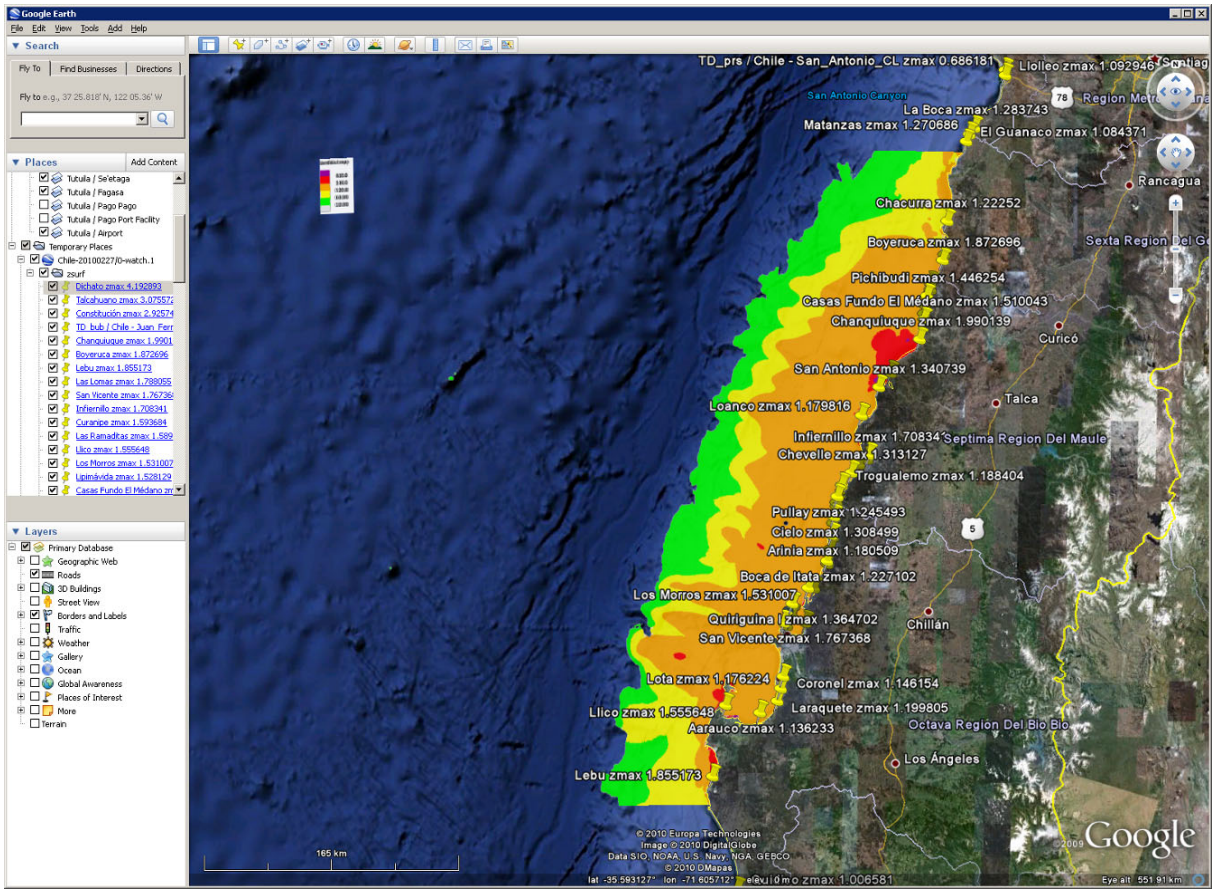

Watch point Curanipe (Chile)
hMax=6.2 m
Time=01:37 (hh:mm)
lat/lon=-35.84/-72.63
Pelluhe
Curanipe
Talcahuano
JRC-SWAN (calc.)
JRC-Hyflux2 (calc)
Talcahuano
(measured)
Height (m)
Time (min)
6.000
4.000
2.000
0.000
-2.000
-4.000
0
20
40
60
80
100
120
140
160
180

Overall Map


Estimation of tsunami impact for Chile earthquake M8.8
27/02/2010 06:34 AM UTC
JRC
EUROPEAN COMMISSION
PERU
BOLIVIA
BRAZIL
PARAGUAY
CHILE
ARGENTINA
URUGUAY
MENDOZA
SANTIAGO
CONCEPCION
ARGENTINA
CHILE
Valparaiso
Santiago
Concepcion
COQUIMBO CL: 1.32m
VALPARAISO CL: 1.29m
TALCAHUANO CL: 2.34m
CORRAL CL: 0.9m
ANCUD CL: 0.62m
Epicentre M 8.8
Epicentre M: 8.8 - Depth: 35km
La Ligua (0.94 m)
Constitución (3.56 m)
San Antonio (2.45 m)
Curanipe (4 m)
Pullay (1.56 m)
Los Morros (1.84 m)
Dichato (1.84 m)
Talcahuano (2.98 m)
Concepción
Lirco (2.85 m)
Lebu (1.01 m)
Kilometers
Legend
Population density
Modified Mercalli Intensity
USGS Shakemap
Legend
Places affected by tsunami
Earthquakes
Magnitude
Tide gauge measurements
Wave height
HYFLUX2
SWAN
Areas below 10m
SRTM
Maximum tsunami height
JRC tsunami model (SWAN)
Map Information
The map shows the areas affected by the earthquake and the tsunami. The maximum modelled tsunami wave height (blue shades in the ocean) indicates the areas along the coast where the tsunami hit most. Bars show the calculated tsunami height with two different JRC codes (SWAN and HYFLUX2). Tidal gauge measurements are indicated (red, yellow, green dots), confirming the modelled heights.
The second map shows the low areas along the Chilean coast (from SRTM data), and points identified by the JRC tsunami run-up model as being flooded by the tsunami. For some points, confirmation was found in media reports.
The inset map shows the Modified Mercalli Intensity (related to damage) overlaid on a population density map.
Spatial Reference: GCS- WGS 1984
Map Scale: 1:15 000 000 / 1:2 000 000
Map created: 27/02/2010 16:00 UTC (update)
Background Data: Digital Map Archive
GDACS Situation Report
On 2/27/2010 6:34:17 AM UTC an earthquake of magnitude 8.8 and depth 35 km has struck an moderately populated area in the Bio-Bio Province (population: 1.7 million) in Chile. GDACS estimates the likelihood for need of international humanitarian intervention to be high (Red alert).
GLIDE No. TS-2010-000035-CHL and EQ-2010-000034-CHL
GDACS
A joint initiative of the United Nations and the European Commission
The Global Disaster Alert and Coordination System provides near real-time alerts about natural disasters around the world and tools to facilitate response coordination, including web-based information, map catalogues and Virtual On-Site Operations Coordination Centre.
www.gdacs.org
Contact GDACS: alessandro.annunziato@jrc.ec.europa.eu
Map created by CRITECH Team - GlobeSec - IPSC - JRC. All rights reserved.

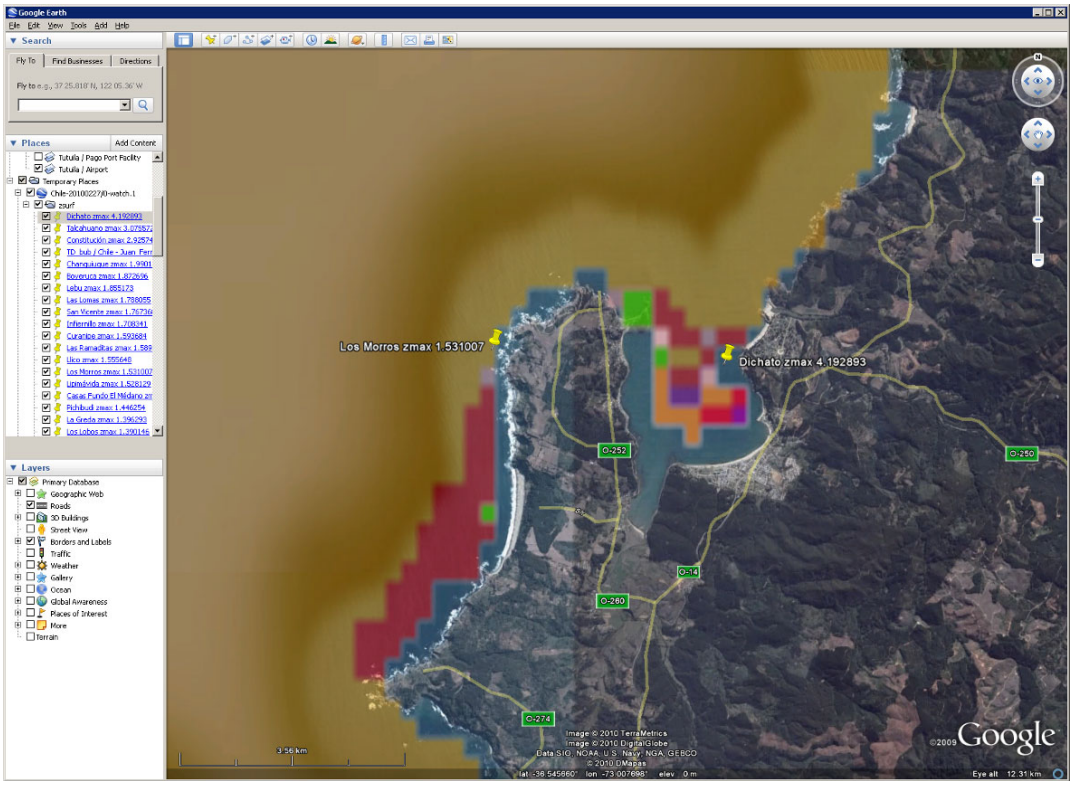
Septima, Octava Region

- Dichato
- Talcahuano
- Costitution
- Lebu
- Pelluhe, Curanipe

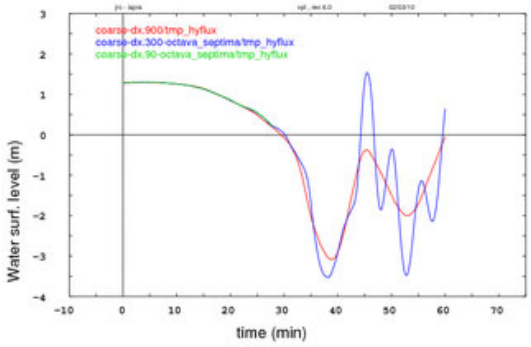


Dichato

http://guanabee.com/2010/03/terremoto-dichato-chile/



Los Morros zmax 1.531007

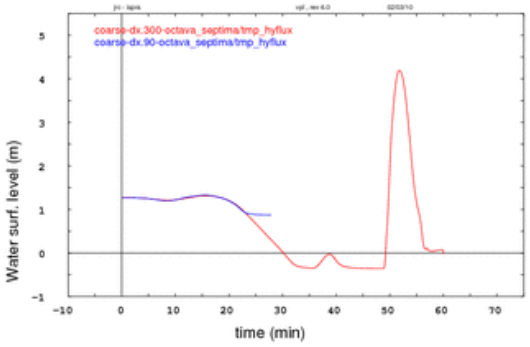


maxZ = 1.531007 maxV = 1.255701

watch Los Morros id=11049 lat=-36.53091 long=-72.98135 distPlace=1228.303

Directions: To here - From here

Dichato zmax 4.192893

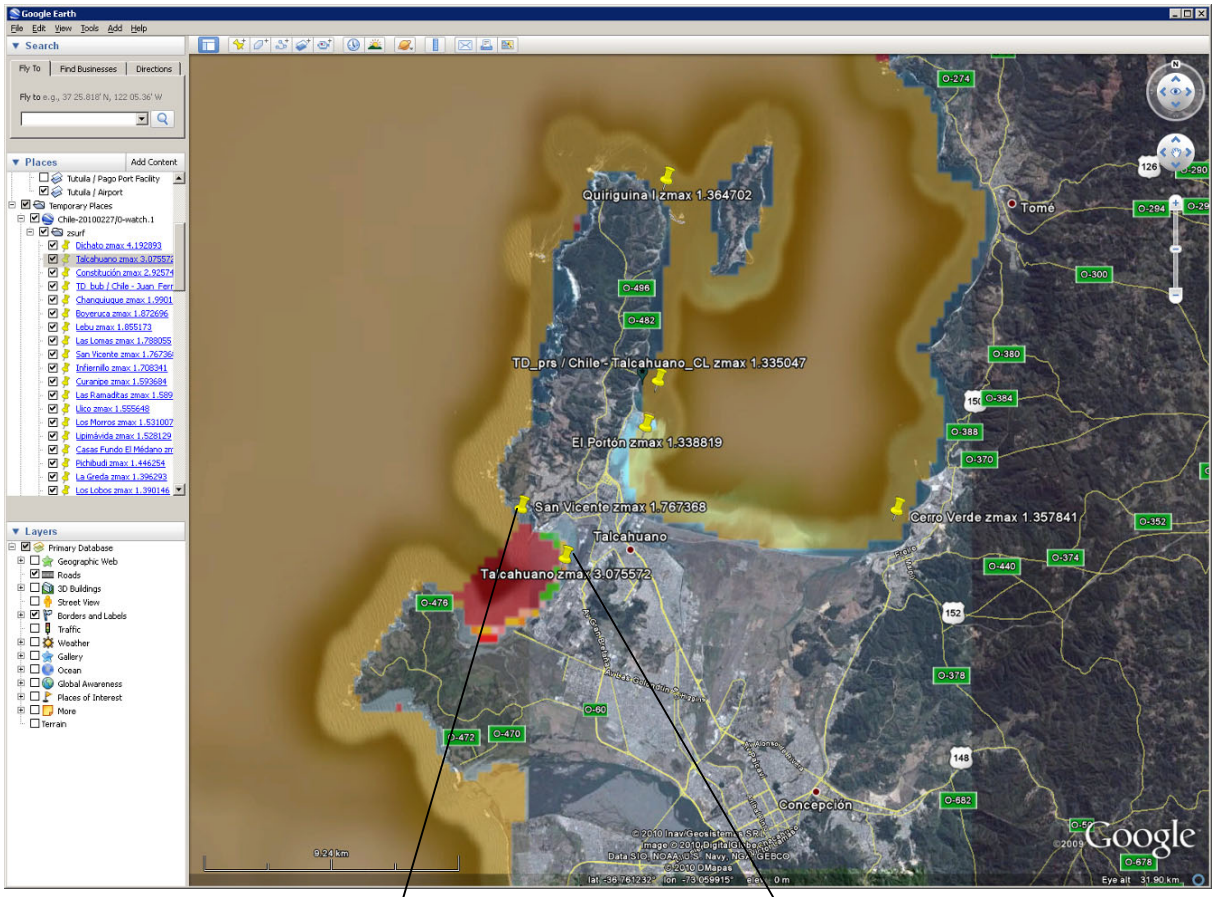


maxZ = 4.192893 maxV = 2.853117

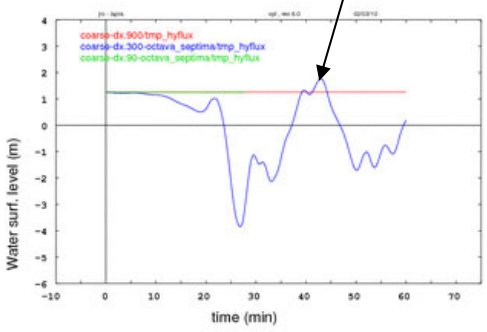
watch Dichato id=11050 lat=-36.53306 long=-72.94035 distPlace=1877.044

Directions: To here - From here

Talcahuano



San Vicente zmax 1.767368

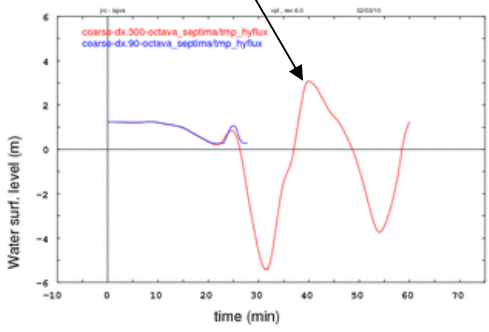


maxZ = 1.767368 maxV = 2.123955

watch San Vicente id=36302 lat=-36.72646 long=-73.15044 distPlace=1875.675

Directions: To here - From here

Talcahuano zmax 3.075572

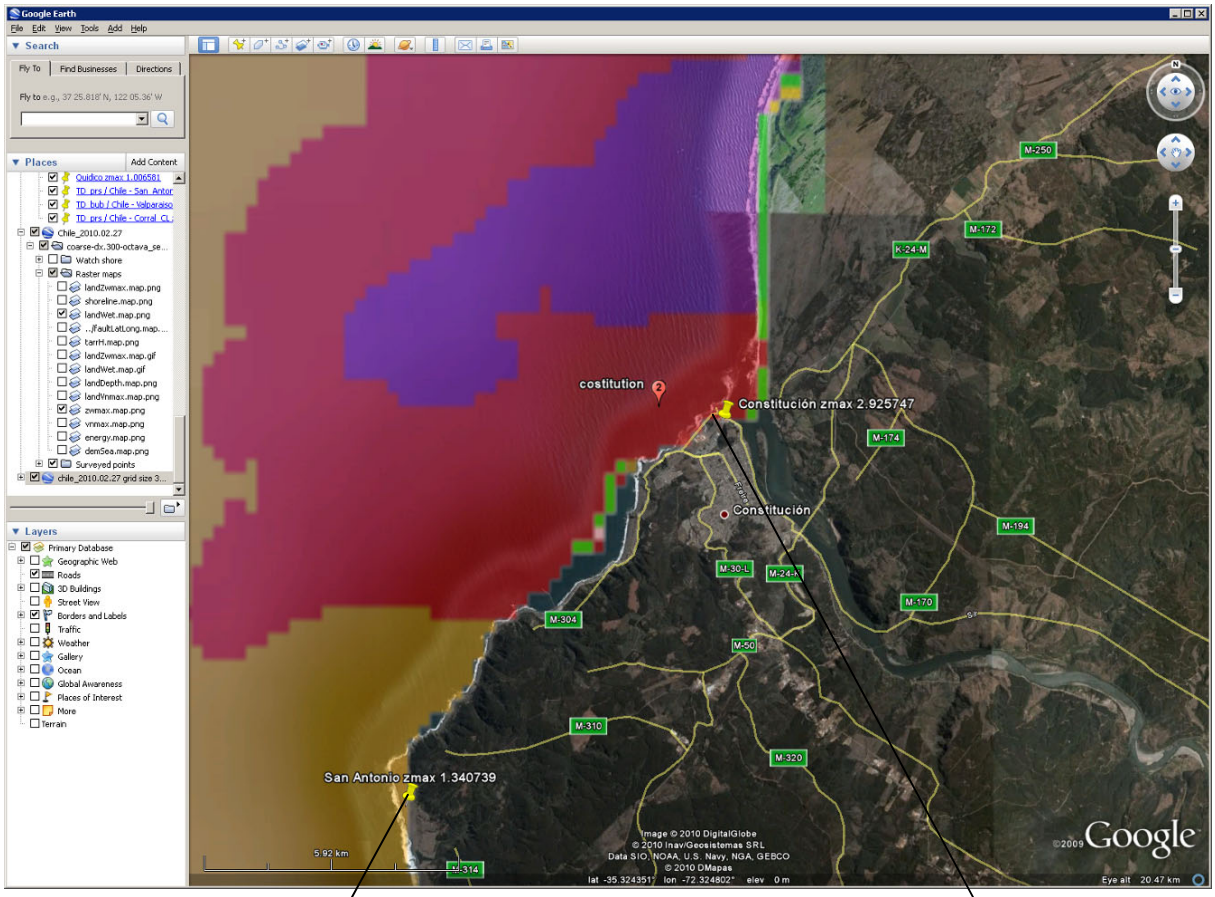


maxZ = 3.075572 maxV = 0.855032

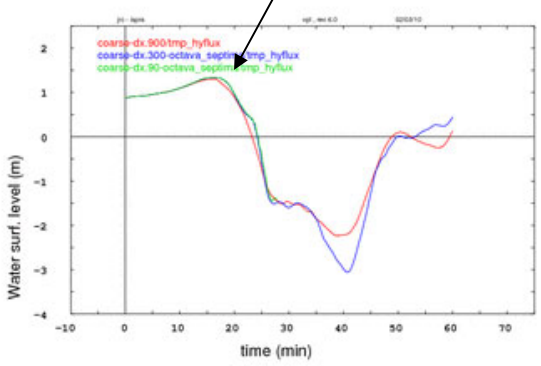
watch Talcahuano id=1215 lat=-36.74269 long=-73.13264 distPlace=481.906

Directions: To here - From here

Costitution



San Antonio zmax 1.340739

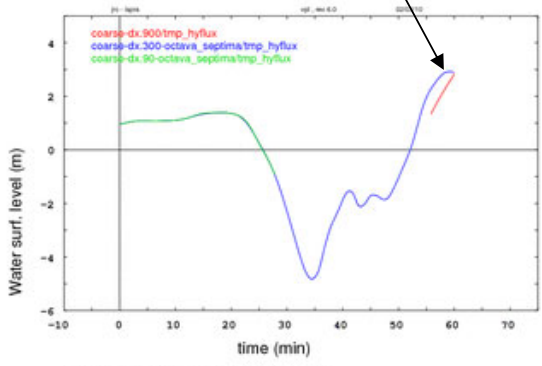


maxZ = 1.340739 maxV = 0.384881

watch San Antonio id=35867 lat=-35.39994 long=-72.49516 distPlace=50.406

Directions: To here - From here

Constitución zmax 2.925747

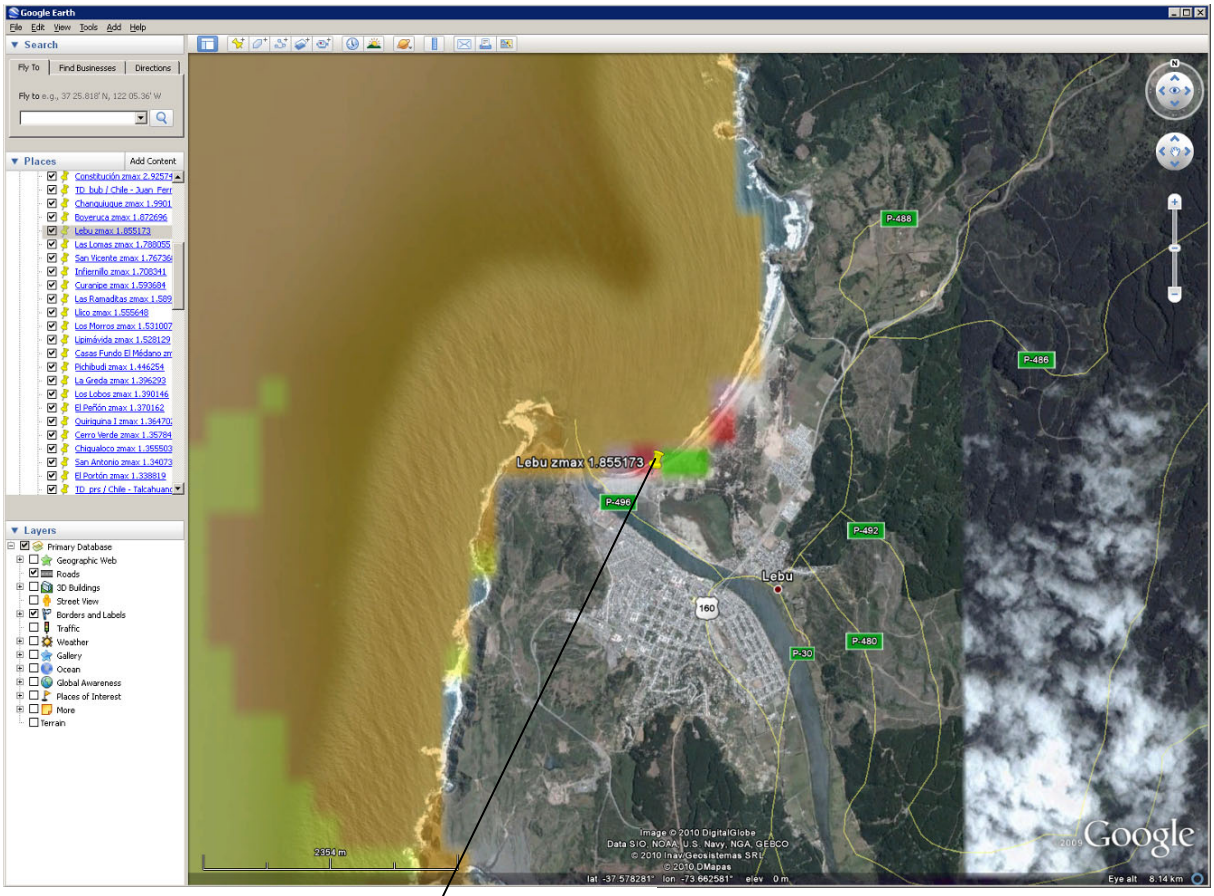


maxZ = 2.925747 maxV = 0.412496

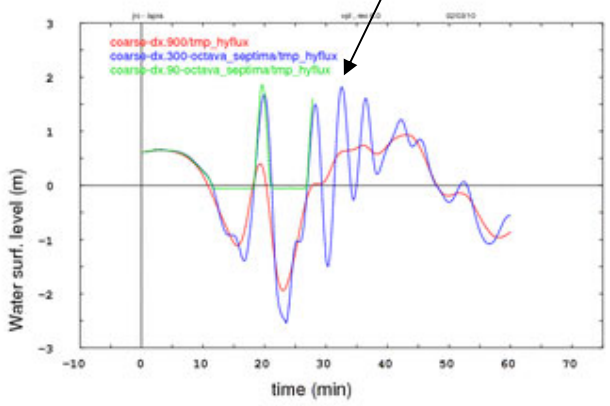
watch Constituci n id=4347 lat=-35.32022 long=-72.41463 distPlace=489.572

Directions: To here - From here

Lebu



Lebu zmax 1.855173



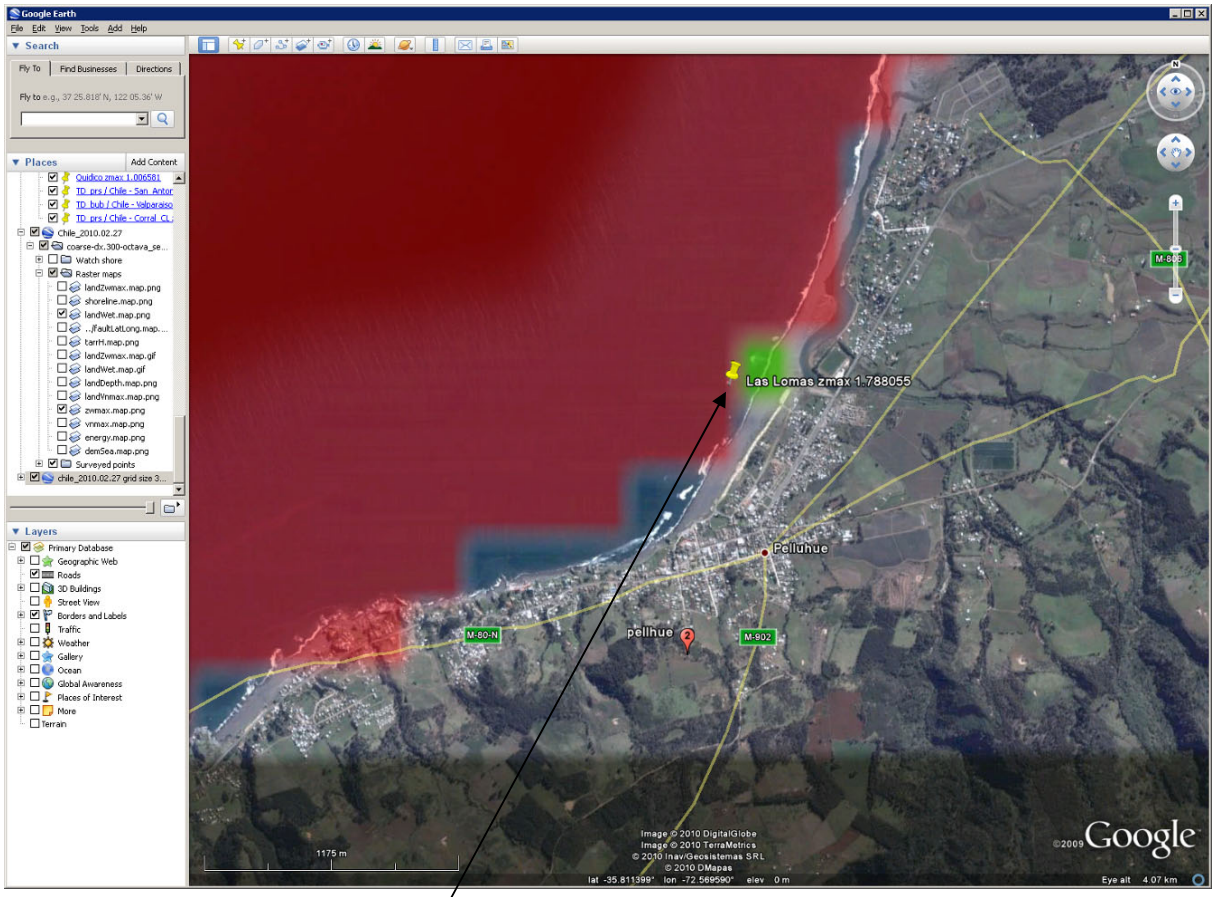
maxZ = 1.855173 maxV = 1.354474

watch Lebu id=11055 lat=-37.59681 long=-73.65621 distPlace=1326.291

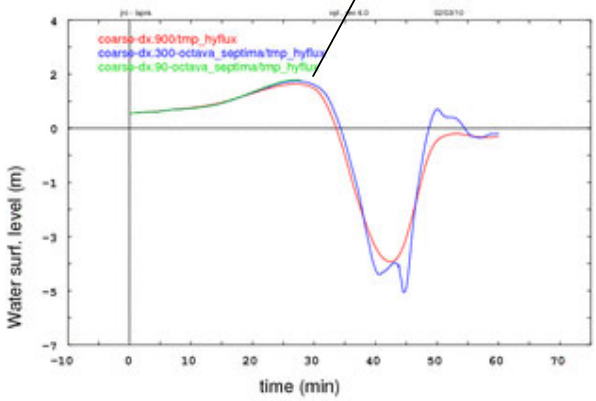
Directions: To here - From here

Pelluhe, Curanipe

http://newsbizarre.com/2010/02/resort-town-of-pelluhue-destroyed-by.html



Las Lomas zmax 1.788055

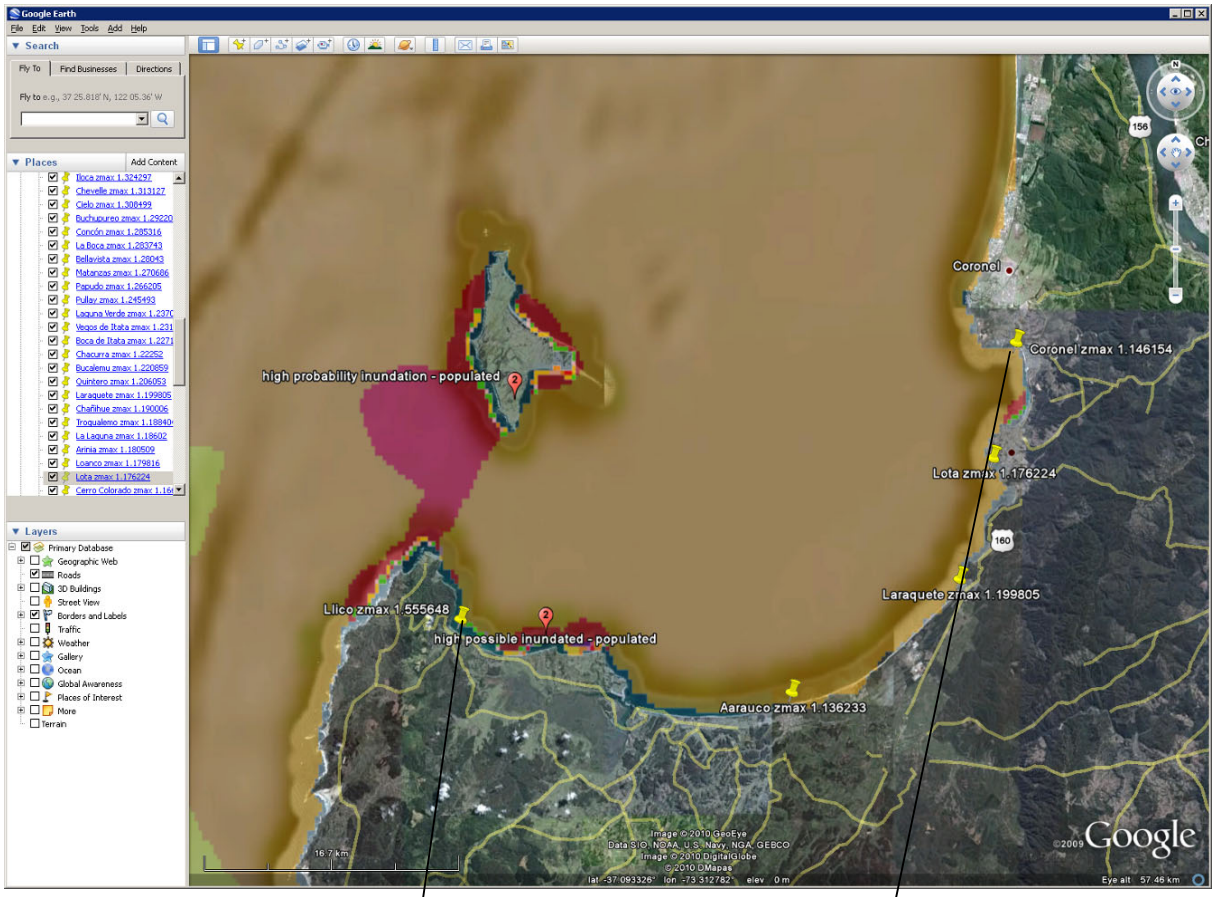


maxZ = 1.788055 maxV = 1.135263

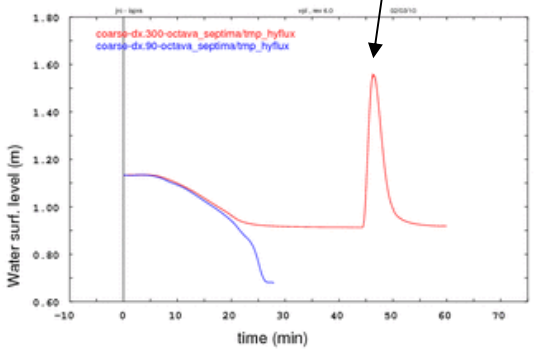
watch Las Lomas id=11042 lat=-35.80755 long=-72.57544 distPlace=178.624

Directions: To here - From here

Llico



Llico zmax 1.555648

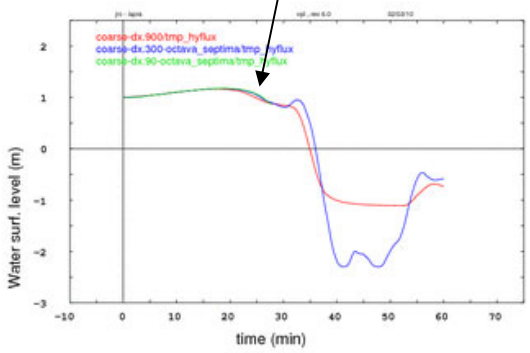


maxZ = 1.555648 maxV = 0.509741

watch Llico id=36262 lat=-37.19323 long=-73.56166 distPlace=874.19

Directions: To here - From here

Lota zmax 1.176224



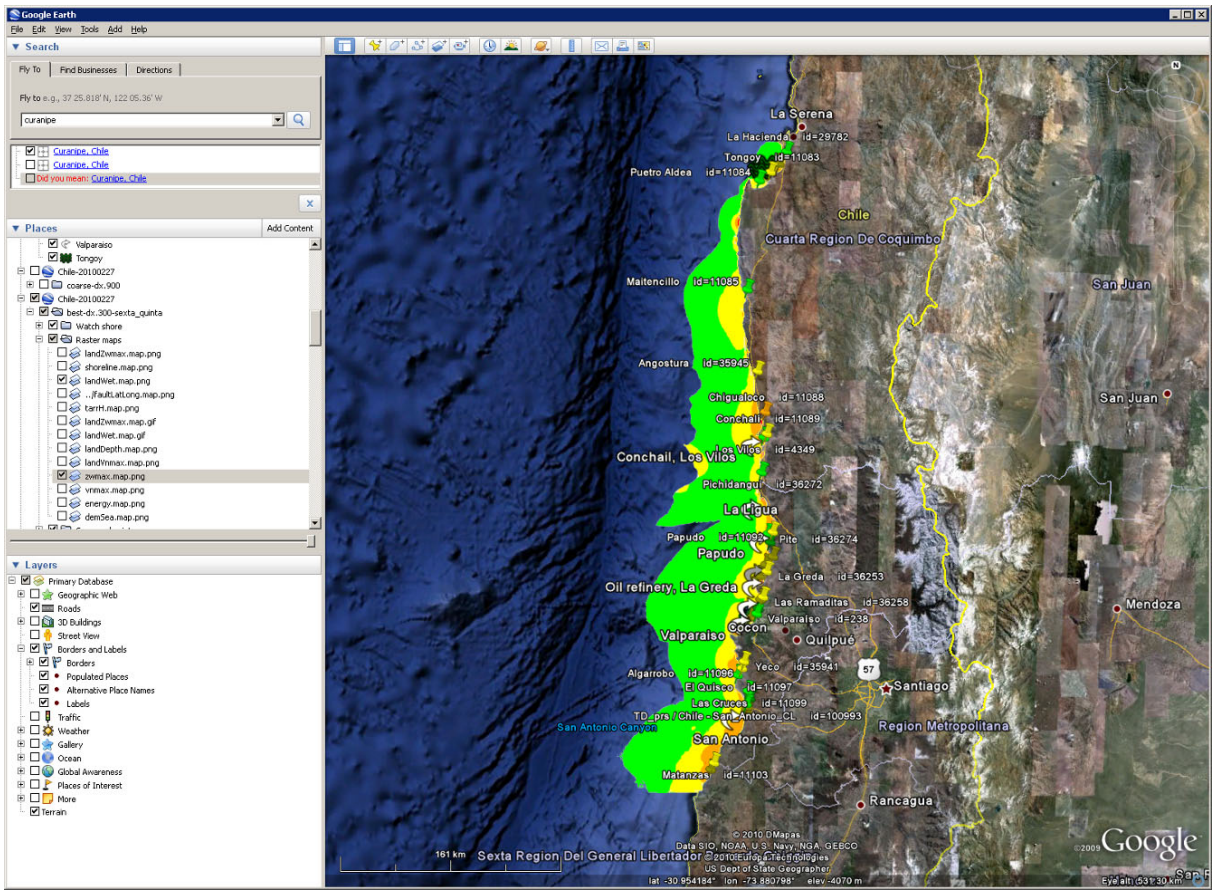
maxZ = 1.176224 maxV = 1.391981

watch Lota id=1217 lat=-37.09811 long=-73.17107 distPlace=1374.278

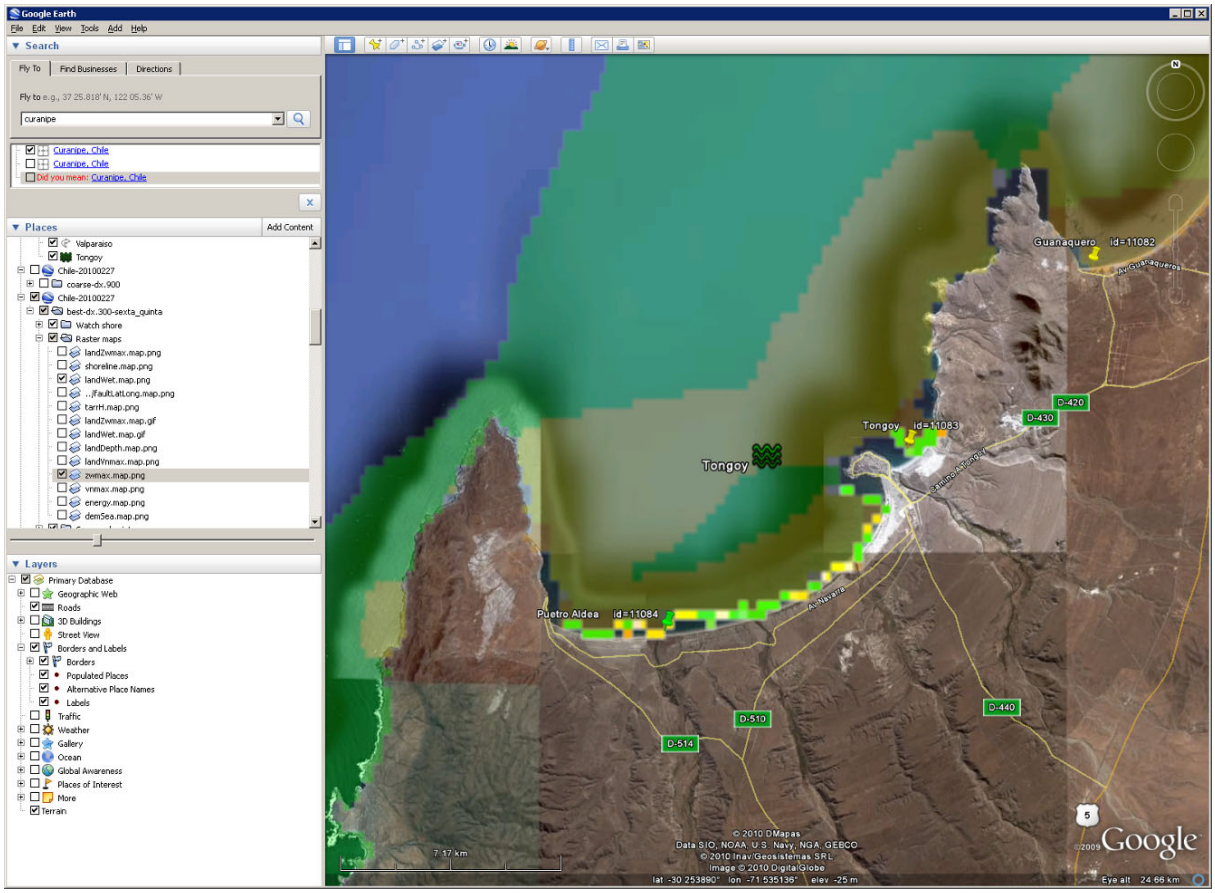
Directions: To here - From here

Sexta Quinta Region

- Tongoy
- Concon
- La Greda
- Papudo
- Conchail, Los Vilo
- La Ligua
- La Laguna
- San Antonio
- Valparaiso
- Alcarroco



Tongoy


Google Earth
File Edit View Tools Add Help
Search
Fly To
Find Businesses
Directions
curanipe
Curanipe, Chile
Curanipe, Chile
Did you mean: Curanipe, Chile
Places
Add Content
Valparaiso
Tongoy
Chile-20100227
coarse-dx.900
Chile-20100227
best-dx.300-sexta_quinta
Watch shore
Raster maps
land2wmax.map.png
shoreline.map.png
landWet.map.png
../FaultLatLong.map.png
tarrH.map.png
land2wmax.map.gif
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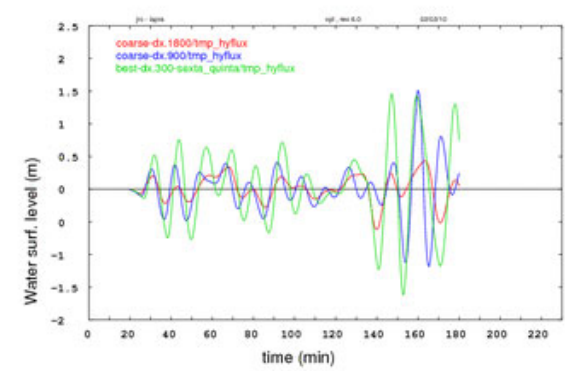
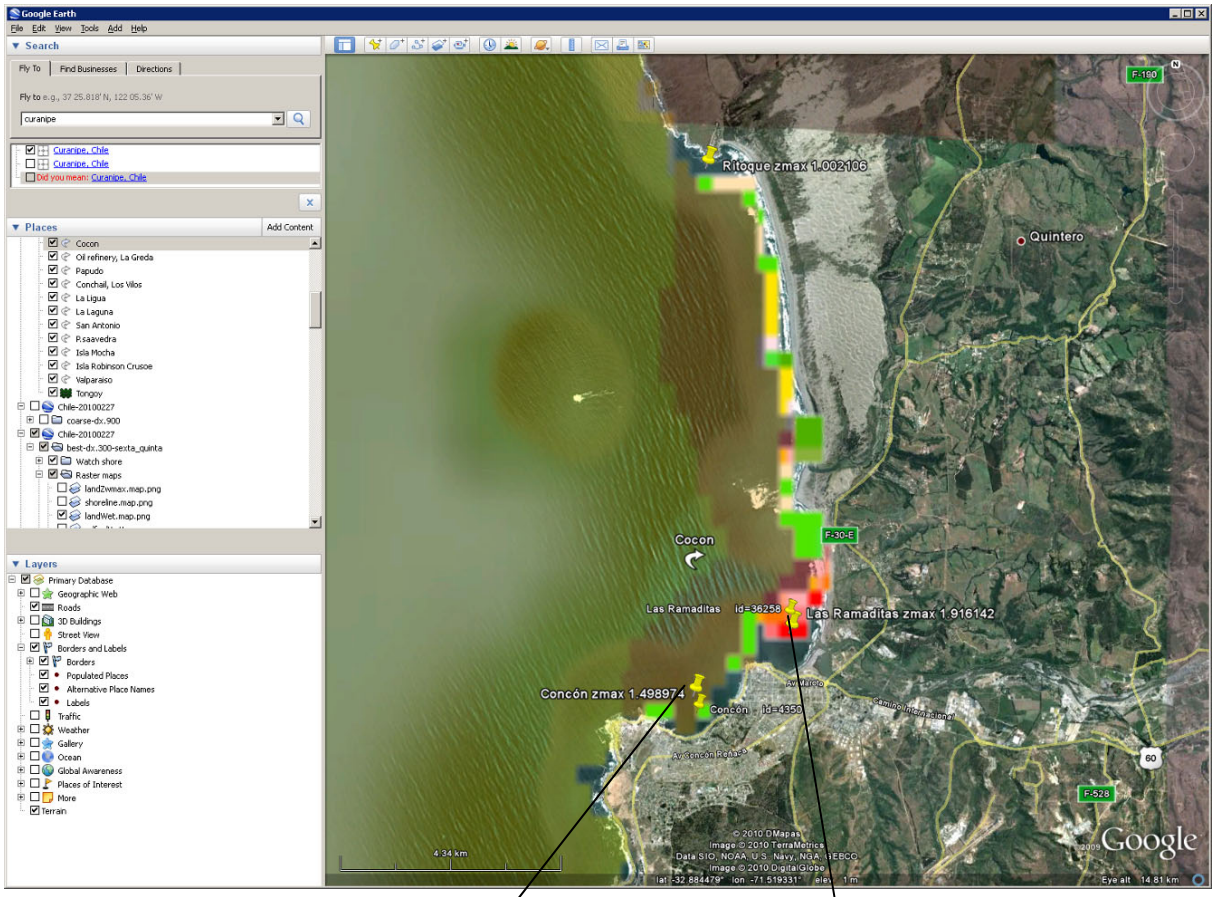
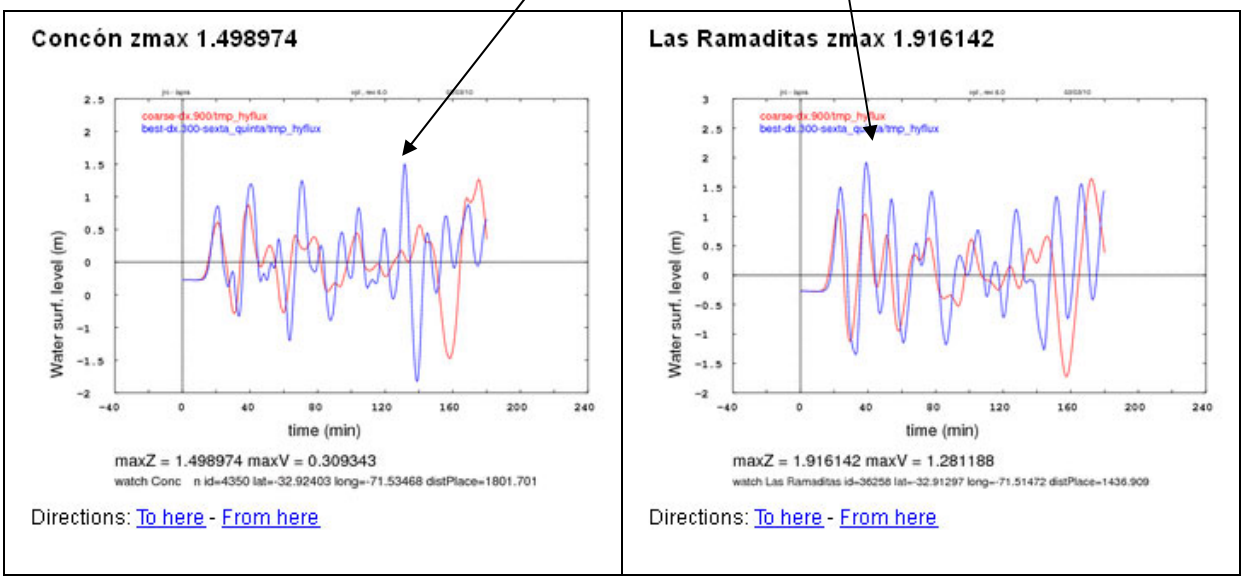
landDepth.map.png
land1wmax.map.png
zwmax.map.png
vmax.map.png
energy.map.png
demSea.map.png
Layers
Primary Database
Geographic Web
Roads
3D Buildings
Street View
Borders and Labels
Borders
Populated Places
Alternative Place Names
Labels
Traffic
Weather
Gallery
Ocean
Global Awareness
Places of Interest
More
Terrain
Guanaquero id=11082
Tongoy id=11083
Tongoy
Puetro Aldea id=11084
D-420
D-430
D-440
D-510
D-514
5
© 2010 DMapas
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2010 Inav/Geosistemas SRL
Image © 2010 DigitalGlobe
Google
Eye alt 24.66 km

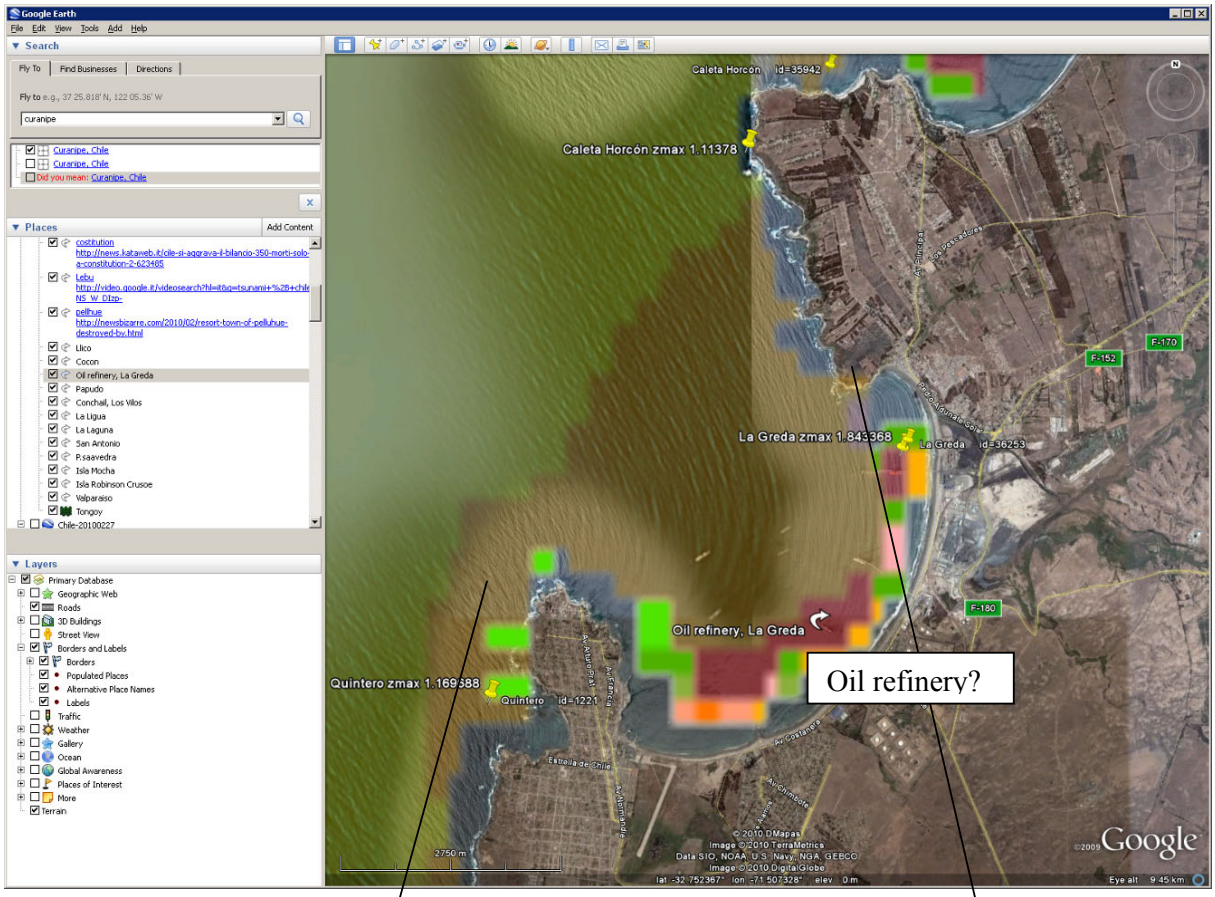

Tongoy zmax 1.508889
coarse-dx.1800/tmp_hyflux
coarse-dx.900/tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.508889 maxV = 1.401204
watch Tongoy id=11083 lat=-30.25218 long=-71.49382 distPlace=15.914
Directions: To here - From here

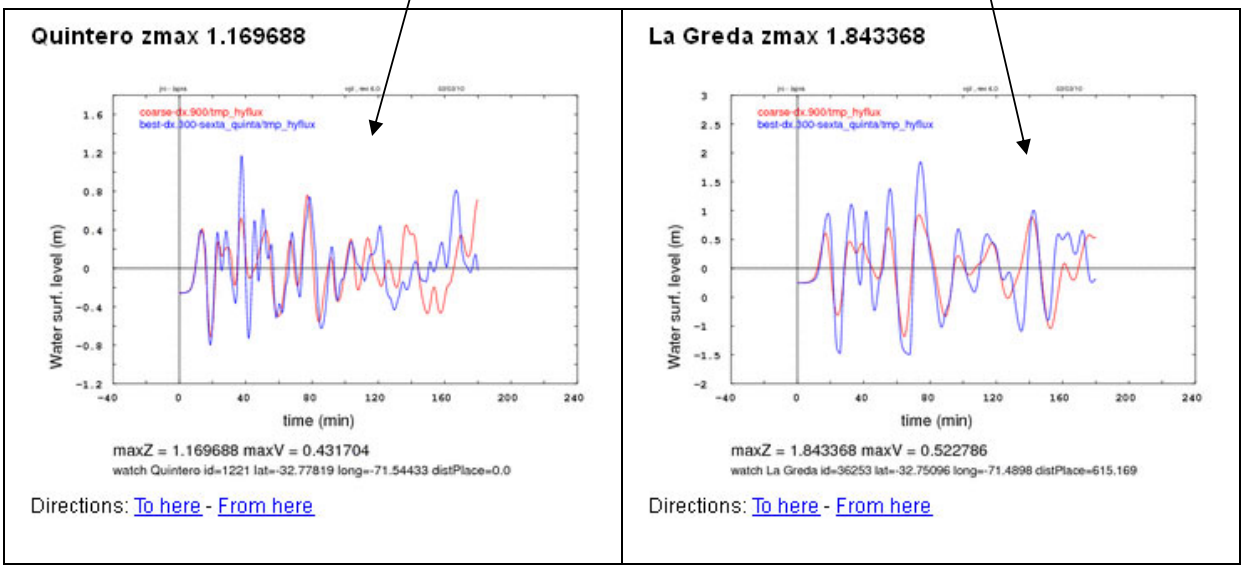
Concon


Google Earth
Ritoque zmax 1.002106
Quintero
Cocon
Las Ramaditas Id=36258
Las Ramaditas zmax 1.916142
Concón zmax 1.498974
Concón Id=4350
Google

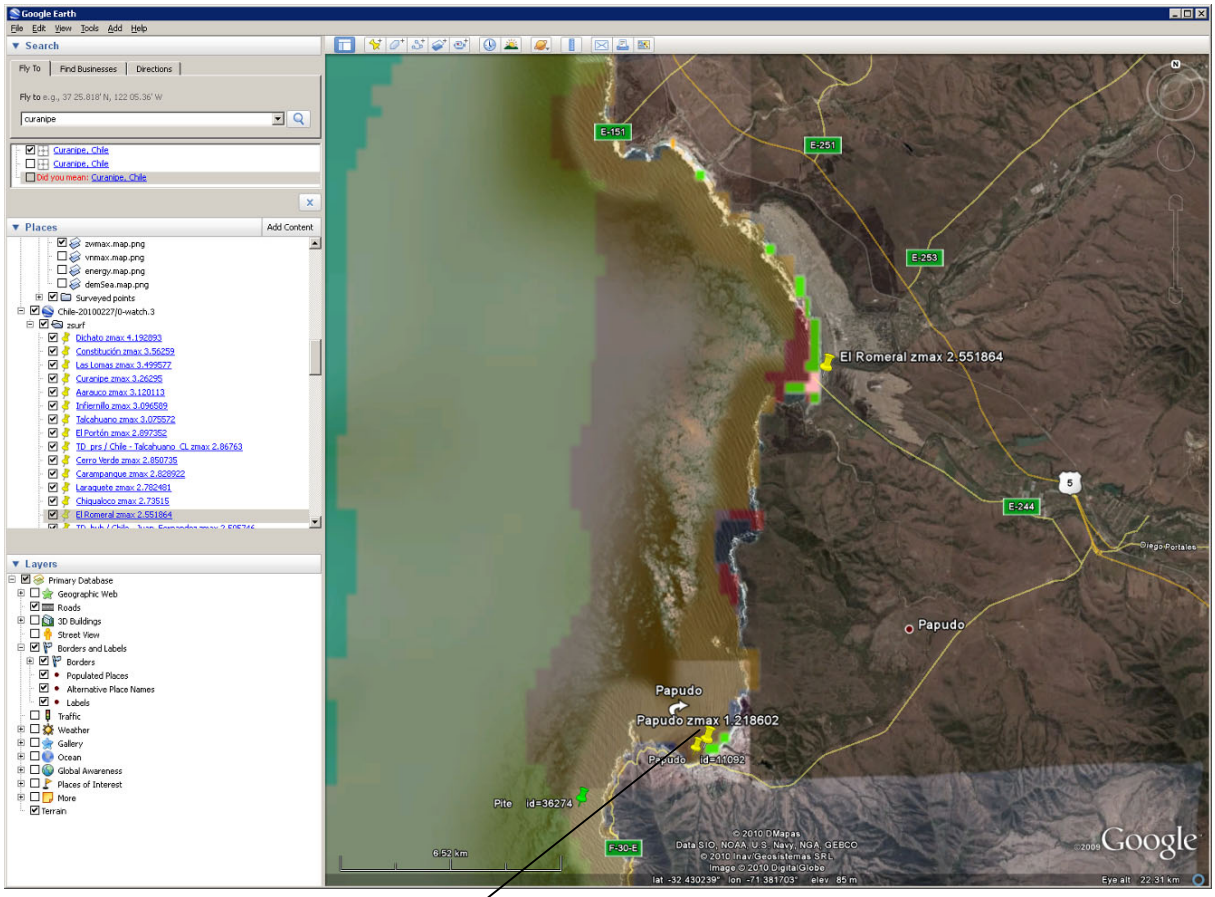

Concón zmax 1.498974
coarse-dx.900/tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.498974 maxV = 0.309343
watch Conc n id=4350 lat=-32.92403 long=-71.53468 distPlace=1801.701
Directions: To here - From here
Las Ramaditas zmax 1.916142
coarse-dx.900/tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.916142 maxV = 1.281188
watch Las Ramaditas id=36258 lat=-32.91297 long=-71.51472 distPlace=1436.909
Directions: To here - From here

La Greda, Oil refinery





Papudo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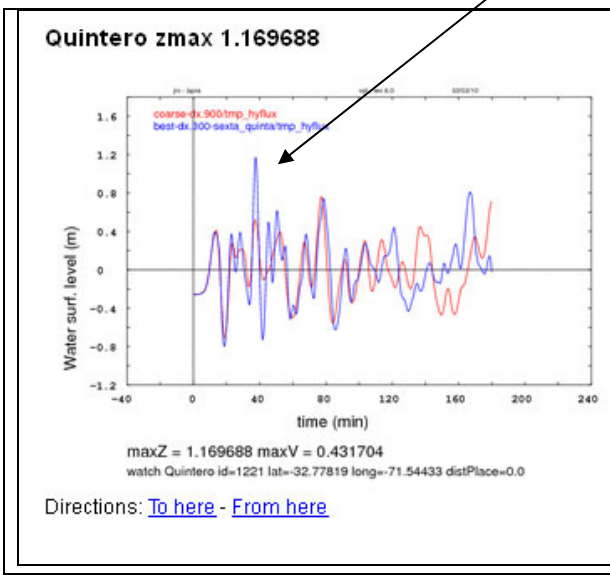
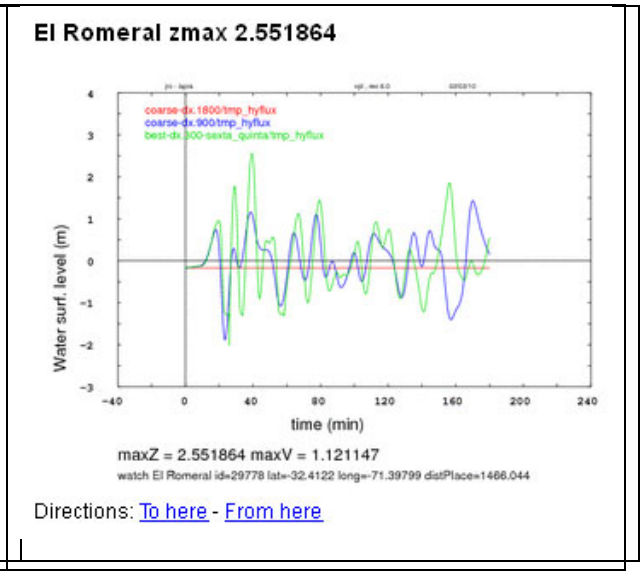
Surveyed points
Chile-20100227/0-watch.3
zsurf
Dichato zmax 4.192893
Constitución zmax 3.56259
Las Lomas zmax 3.499577
Curanipe zmax 3.26295
Aarauco zmax 3.120113
Infiernillo zmax 3.096589
Talcahuano zmax 3.075572
El Portón zmax 2.897352
TG_prs / Chile - Talcahuano_CL zmax 2.86763
Cerro Verde zmax 2.850735
Carampangue zmax 2.828922
Laraquete zmax 2.782481
Chigualoco zmax 2.73515
El Romeral zmax 2.551864
Layers
Primary Database
Geographic Web
Roads
3D Buildings
Street View
Borders and Labels
Borders
Populated Places
Alternative Place Names
Labels
Traffic
Weather
Gallery
Ocean
Global Awareness
Places of Interest
More
Terrain
E-151
E-251
E-253
El Romeral zmax 2.551864
E-244
5
Diego Portales
Papudo
Papudo
Papudo zmax 1.218602
Papudo id=11092
Pite id=36274
F-30-E
6.52 km
© 2010 DMapas
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2010 Inav/Geosistemas SRL
Image © 2010 DigitalGlobe
lat -32.430239° lon -71.381703° elev 85 m
Eye alt 22.31 km
Google


Quintero zmax 1.169688
coarse-dx.900/tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.169688 maxV = 0.431704
watch Quintero id=1221 lat=-32.77819 long=-71.54433 distPlace=0.0
Directions: To here - From here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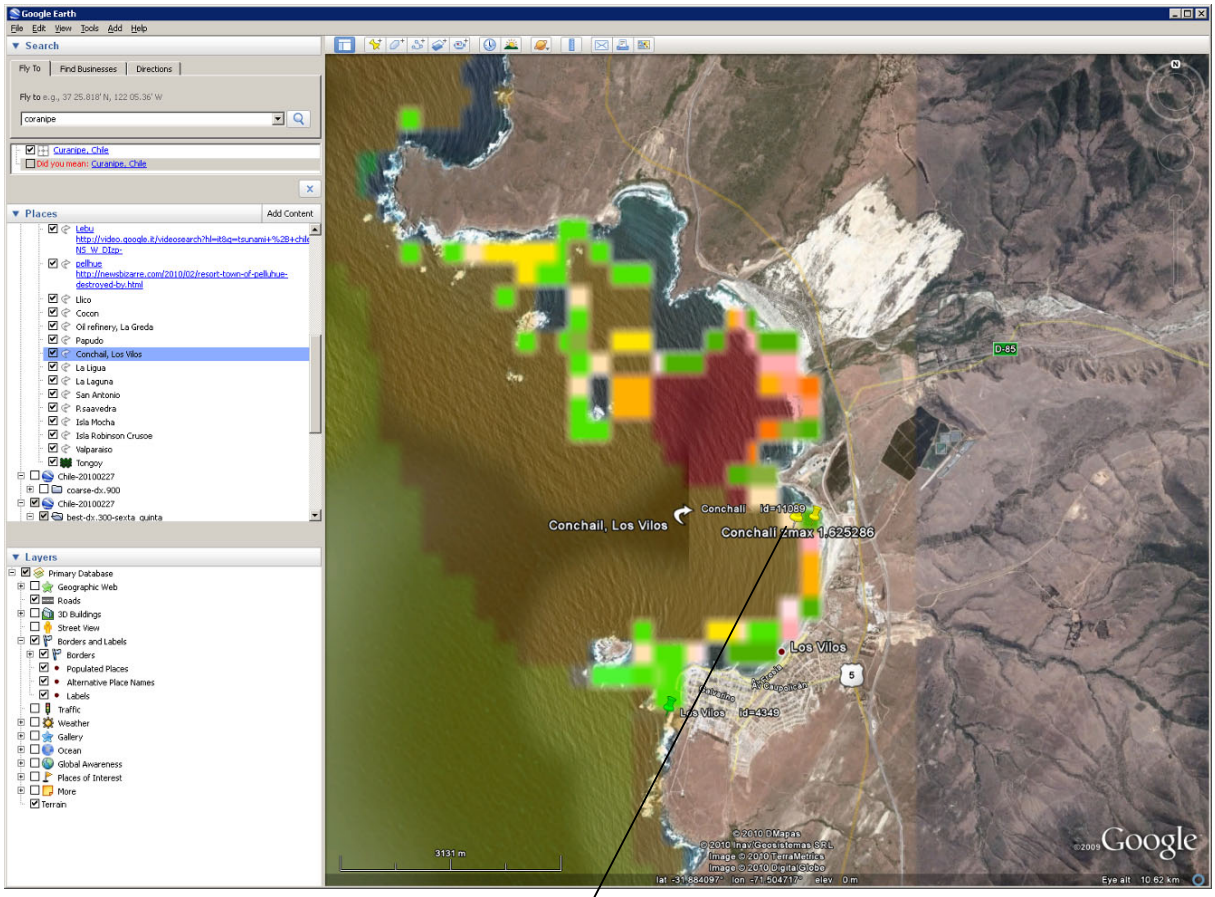
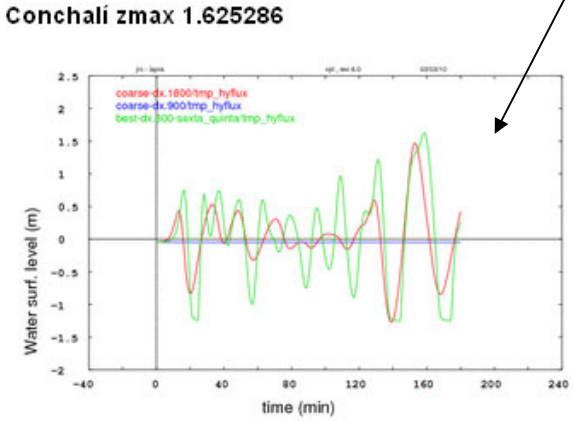
coarse-dx.1800/tmp_hyflux
coarse-dx.900/tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 2.551864 maxV = 1.121147
watch El Romeral id=29778 lat=-32.4122 long=-71.39799 distPlace=1466.044
Directions: To here - From here

Conchail, Los Vilos



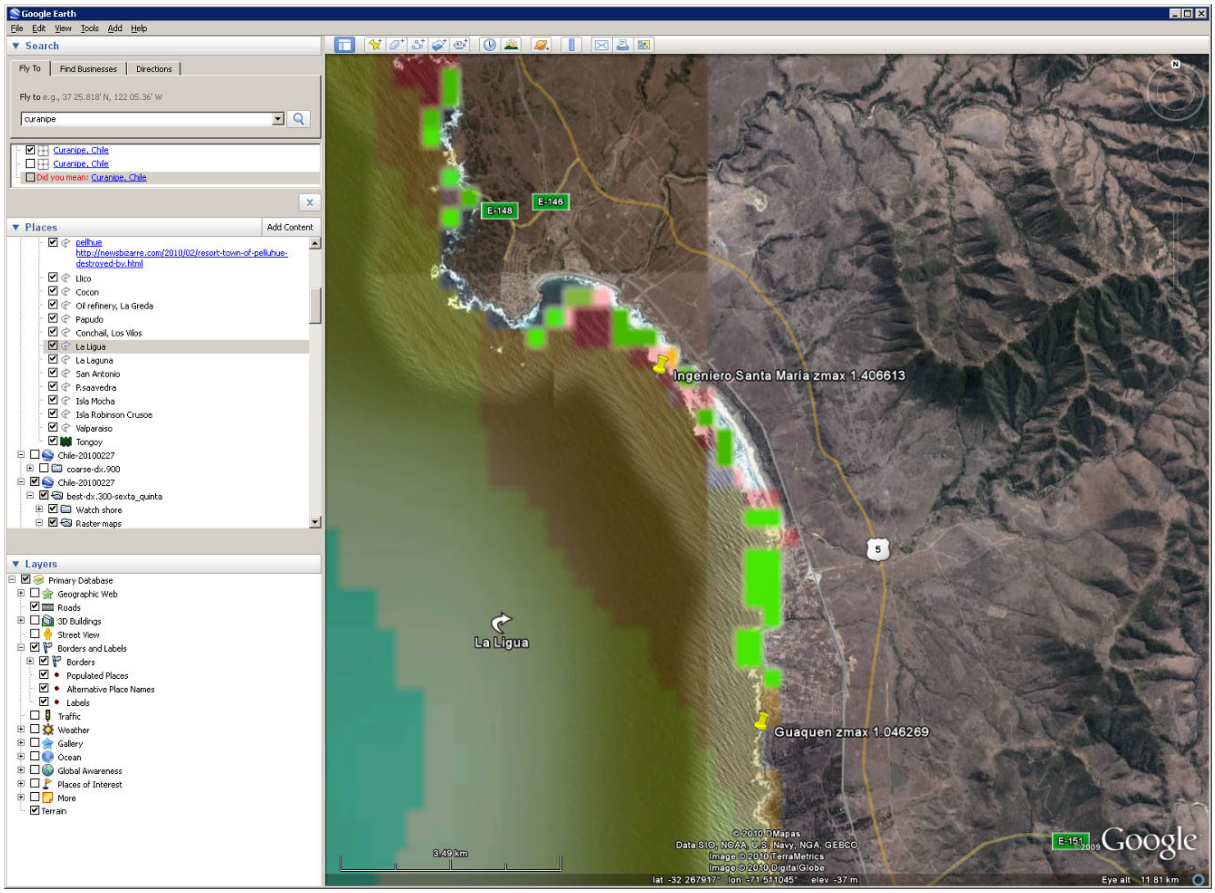


maxZ = 1.625286 maxV = 0.475273

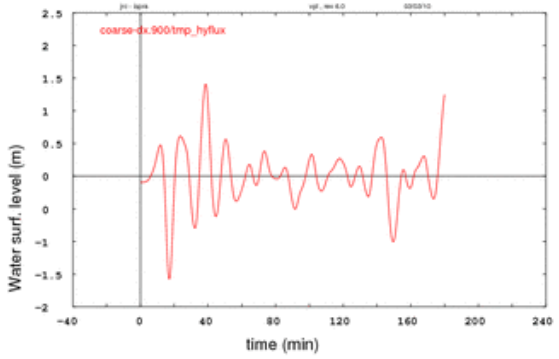
watch Conchal id=11089 lat=-31.88568 long=-71.50096 distPlace=1028.732

Directions: To here - From here

La Ligua



Ingeniero Santa María zmax 1.406613

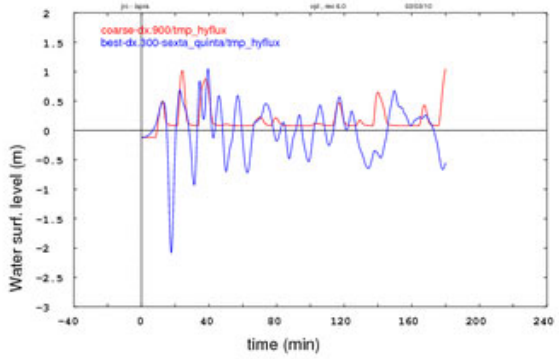


maxZ = 1.406613 maxV = 0.395378

watch Ingeniero Santa Mar a id=35944 lat=-32.25161 long=-71.4925 distPlace=3171.641

Directions: To here - From here

Guaquen zmax 1.046269

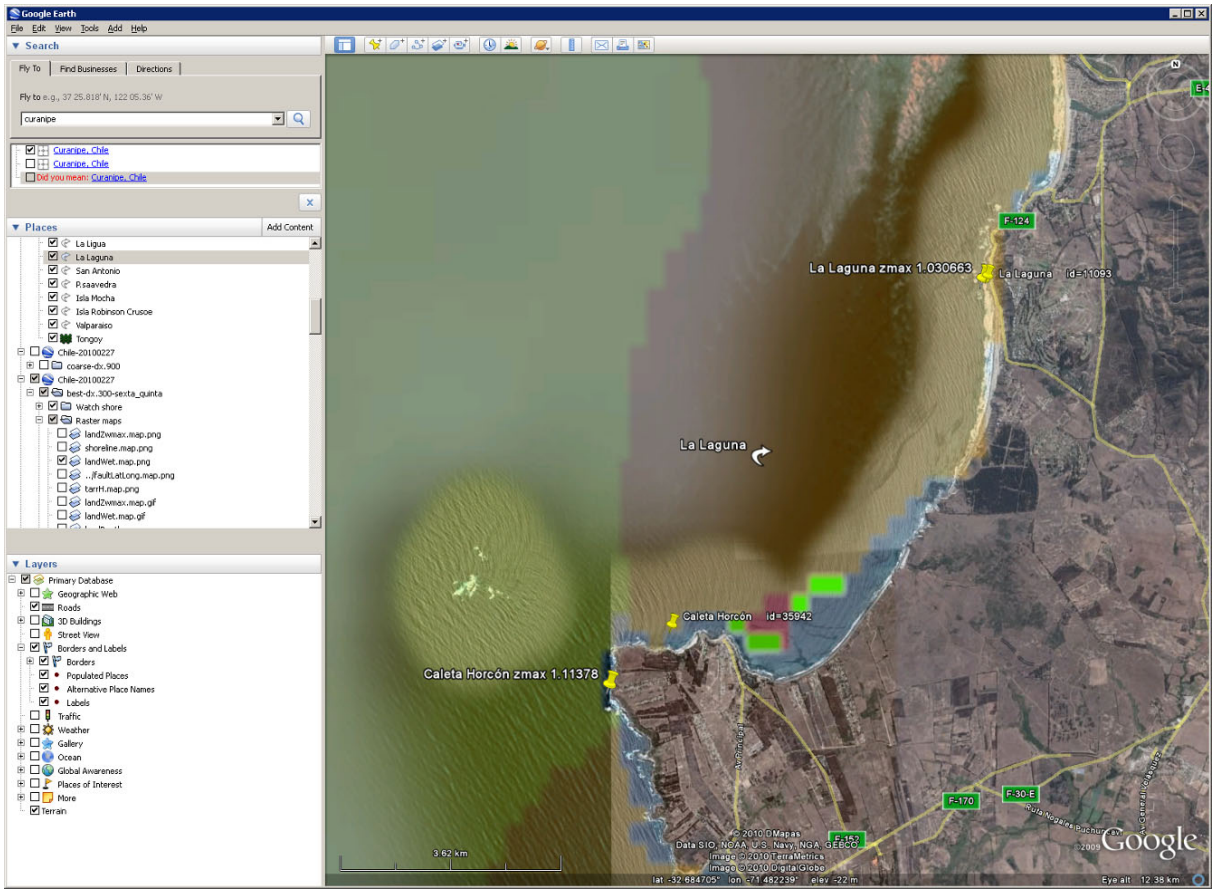


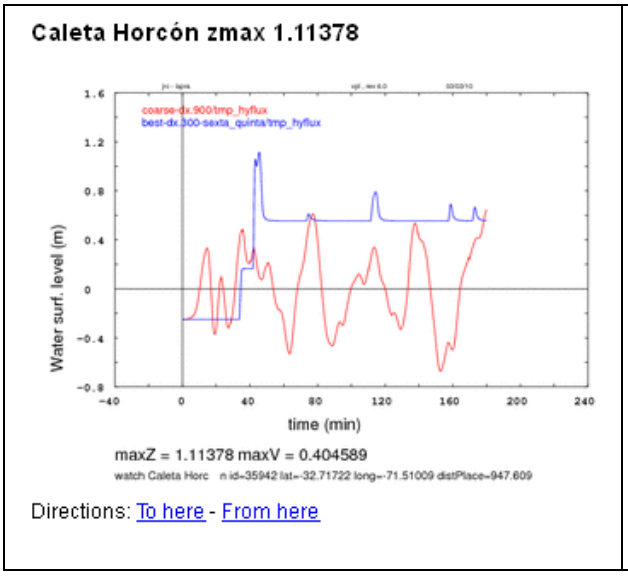
maxZ = 1.046269 maxV = 0.314704

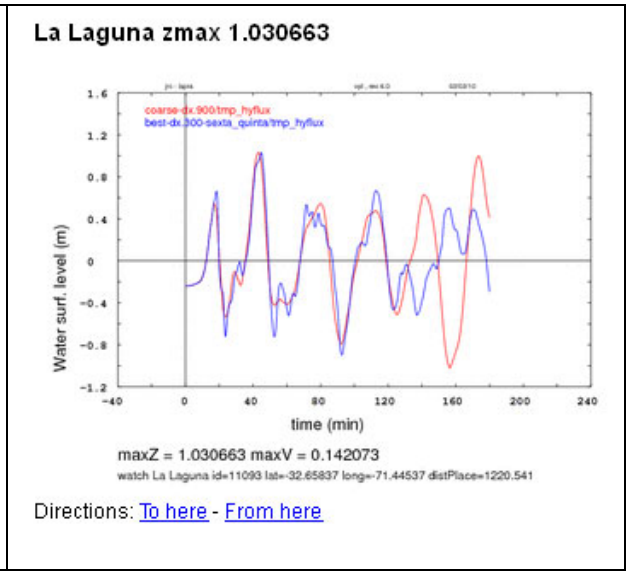
watch Guaquen id=11091 lat=-32.30101 long=-71.47604 distPlace=2212.321

Directions: To here - From here

La Laguna


Google Earth
File Edit View Tools Add Help
Search
Fly To
Find Businesses
Directions
curanipe
Curanipe, Chile
Curanipe, Chile
Did you mean: Curanipe, Chile
Places
Add Content
La Ligua
La Laguna
San Antonio
Isla Mocha
Isla Robinson Crusoe
Valparaiso
Tongoy
Chile-20100227
coarse-dx.900
Chile-20100227
best-dx.300-sexta_quinta
Watch shore
Raster maps
land2wmax.map.png
shoreline.map.png
landWet.map.png
../FaultLatLong.map.png
terrH.map.png
land2wmax.map.gif
landWet.map.gif
Layers
Primary Database
Geographic Web
Roads
3D Buildings
Street View
Borders and Labels
Borders
Populated Places
Alternative Place Names
Labels
Traffic
Weather
Gallery
Ocean
Global Awareness
Places of Interest
More
Terrain
La Laguna zmax 1.030663
La Laguna id=11093
La Laguna
Caleta Horcón id=35942
Caleta Horcón zmax 1.11378
F-124
F-170
F-30-E
F-150
3.62 km
© 2010 DMapas
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2010 TerraMetrics
Image © 2010 DigitalGlobe
Google
Eye alt 12.38 km


Caleta Horcón zmax 1.11378
coarse-dx.900/tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.11378 maxV = 0.404589
watch Caleta Horc n id=35942 lat=-32.71722 long=-71.51009 distPlace=947.609
Directions: To here - From here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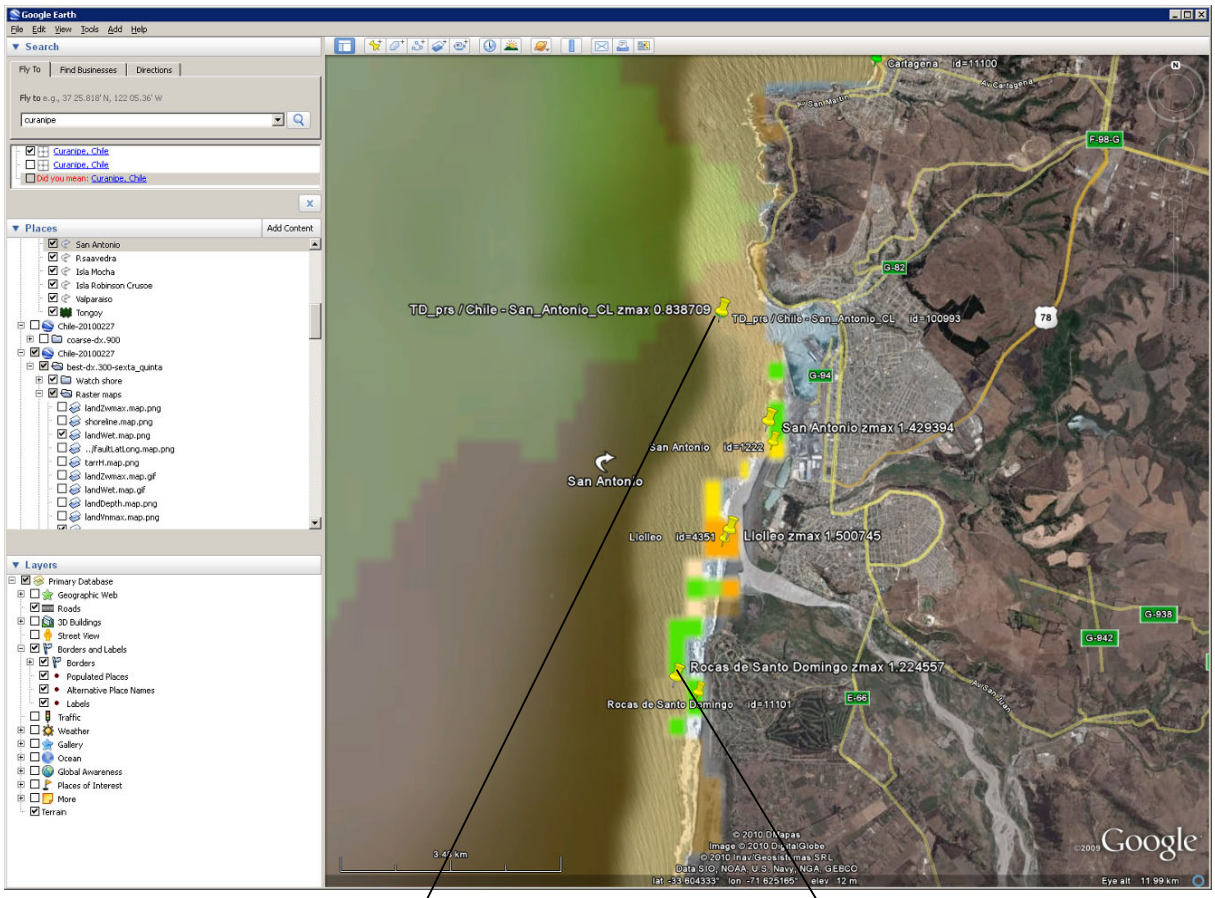
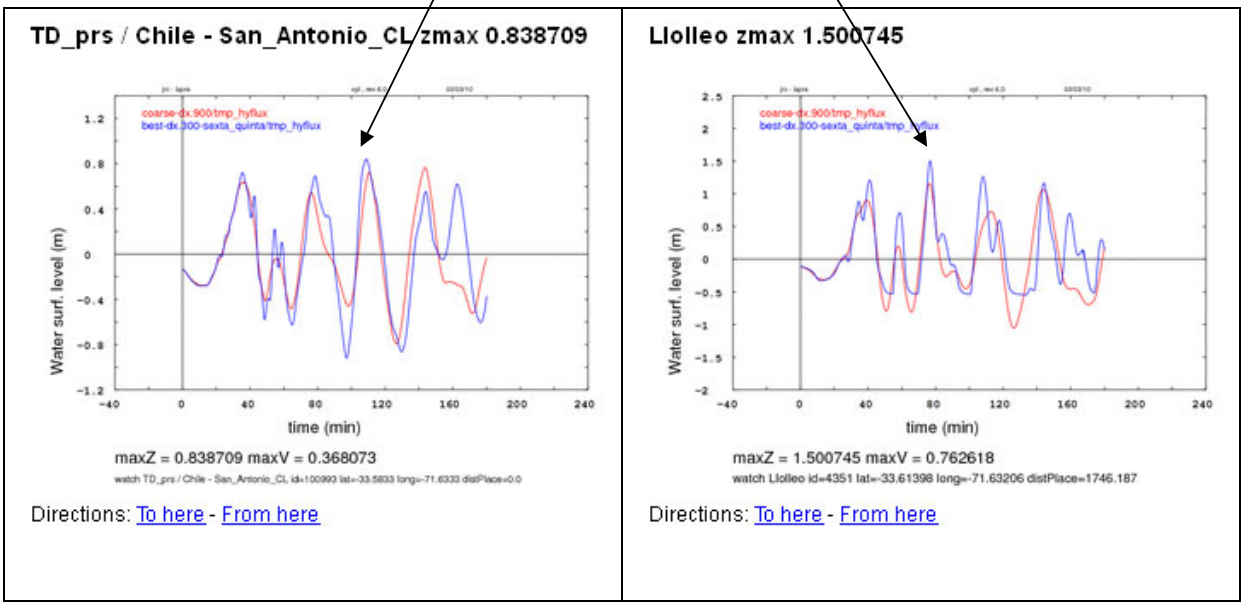
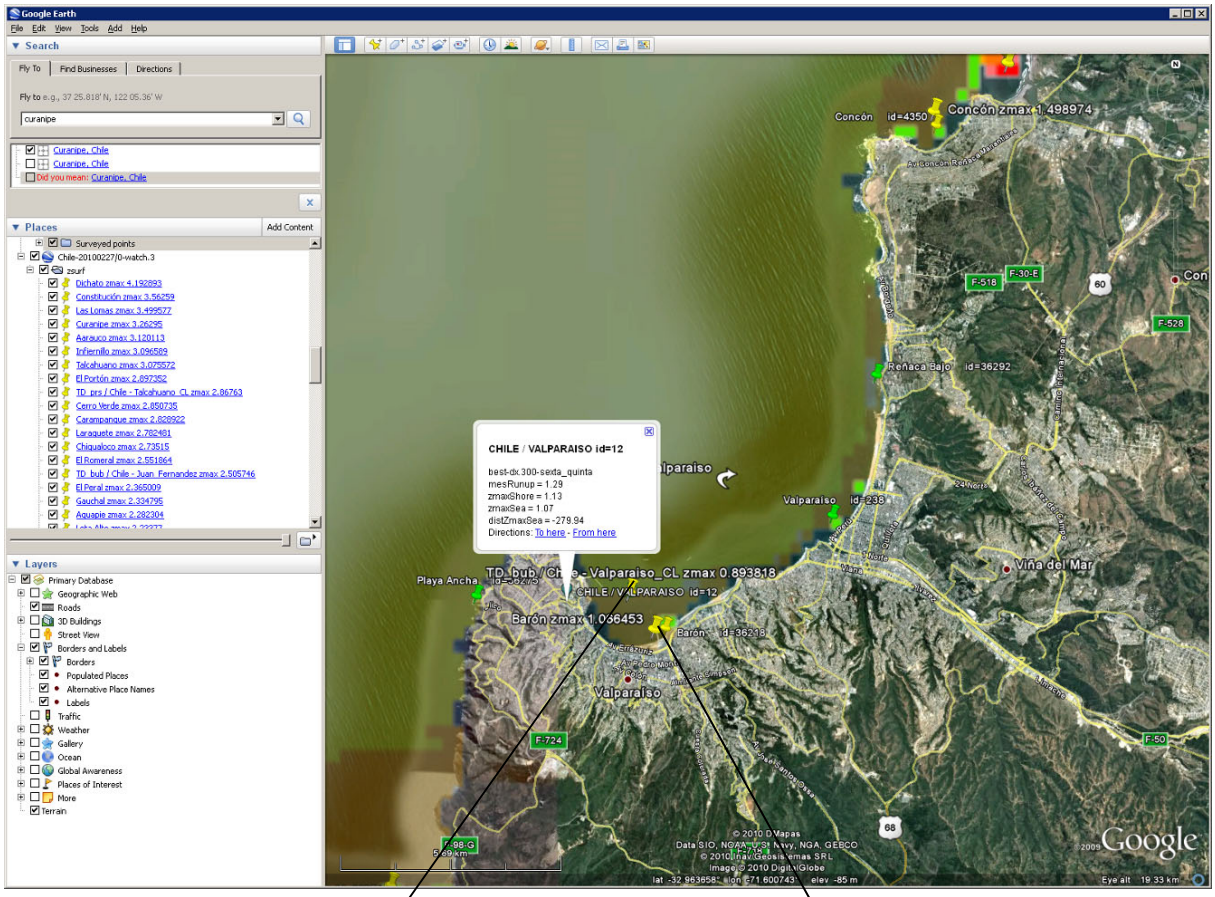
coarse-dx.900/tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.030663 maxV = 0.142073
watch La Laguna id=11093 lat=-32.65837 long=-71.44537 distPlace=1220.541
Directions: To here - From here

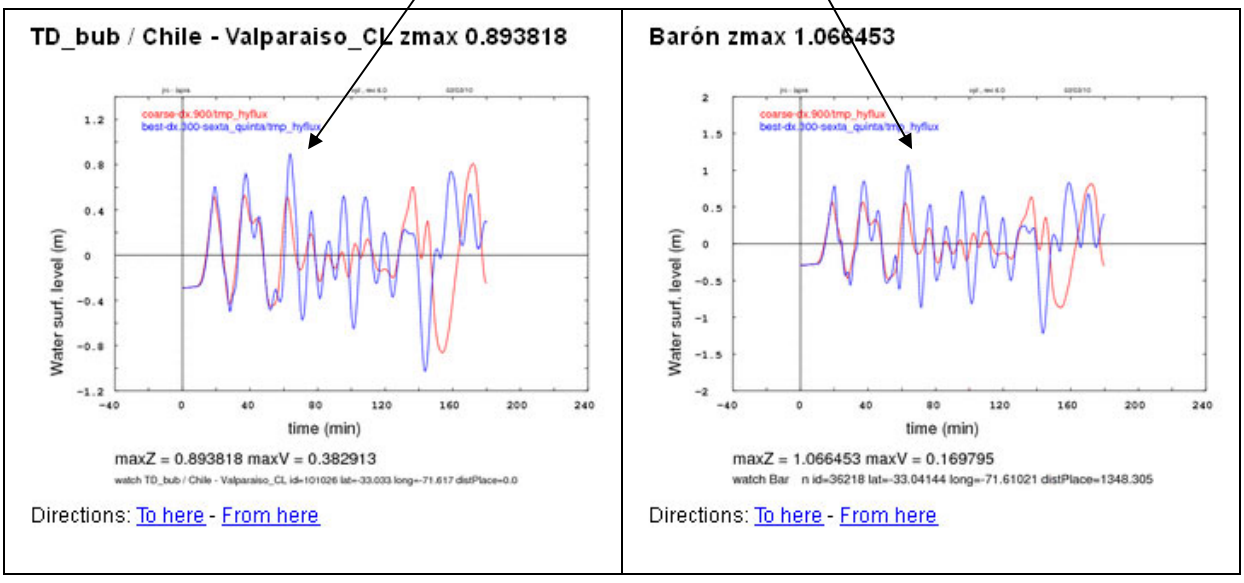
San Antonio


Google Earth
TD_prs / Chile - San_Antonio_CL zmax 0.838709
San Antonio zmax 1.429394
Llolleo zmax 1.500745
Rocas de Santo Domingo zmax 1.224557
San Antonio
Llolleo id=4351
Rocas de Santo Domingo id=11101
Cartagena id=11100
TD_prs / Chile - San_Antonio_CL id=100993
Google

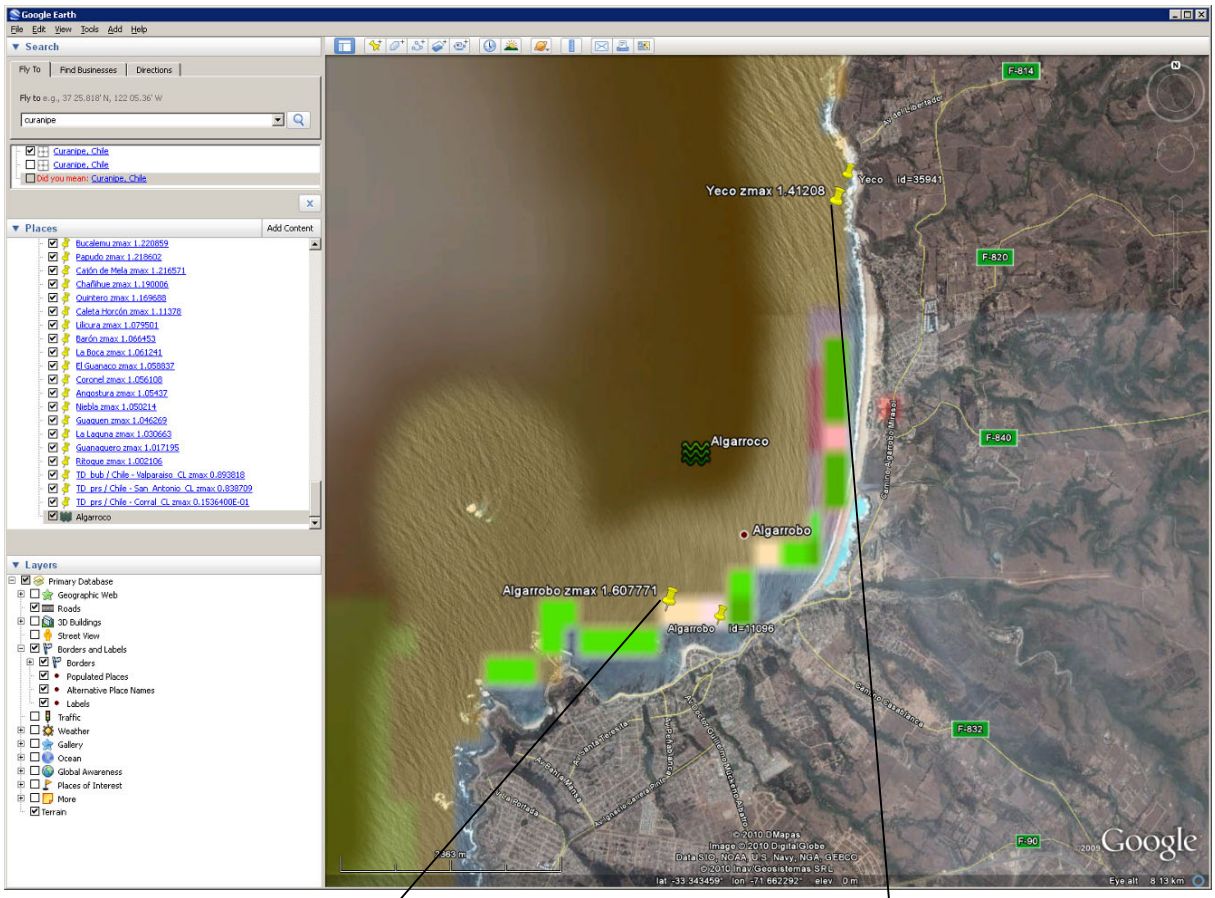

TD_prs / Chile - San_Antonio_CL zmax 0.838709
coarse-dx.900/tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 0.838709 maxV = 0.368073
Directions: To here - From here
Llolleo zmax 1.500745
coarse-dx.900/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.500745 maxV = 0.762618
watch Llolleo id=4351 lat=-33.61398 long=-71.63206 distPlace=1746.187
Directions: To here - From here

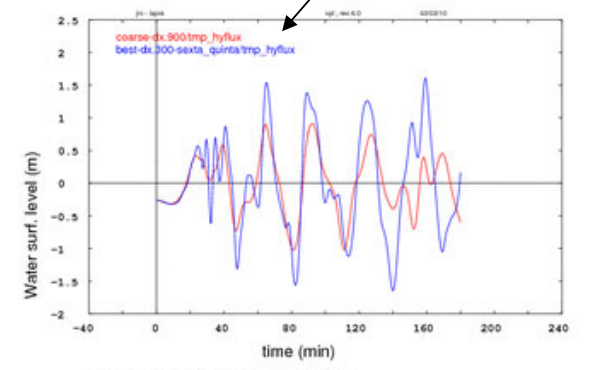
Valparaiso


Google Earth
Concón id=4350
Concón zmax 1.498974
Reñaca Bajo id=36292
CHILE / VALPARAISO id=12
best-dx.300-sexta_quinta
mesRunup = 1.29
zmaxShore = 1.13
zmaxSea = 1.07
distZmaxSea = -279.94
Directions: To here - From here
Valparaiso id=238
Viña del Mar
TD_bub / Chile - Valparaiso_CL zmax 0.893818
CHILE / VALPARAISO id=12
Playa Ancha
Barón zmax 1.066453
Barón id=36218
Valparaiso
F-518
F-30-E
F-528
F-724
F-50
68
Google


TD_bub / Chile - Valparaiso_CL zmax 0.893818
coarse-dx.900.tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 0.893818 maxV = 0.382913
watch TD_bub / Chile - Valparaiso_CL id=101026 lat=-33.033 long=-71.617 distPlace=0.0
Directions: To here - From here
Barón zmax 1.066453
coarse-dx.900.tmp_hyflux
best-dx.300-sexta_quinta/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.066453 maxV = 0.169795
watch Bar n id=36218 lat=-33.04144 long=-71.61021 distPlace=1348.305
Directions: To here - From here

Algarroco

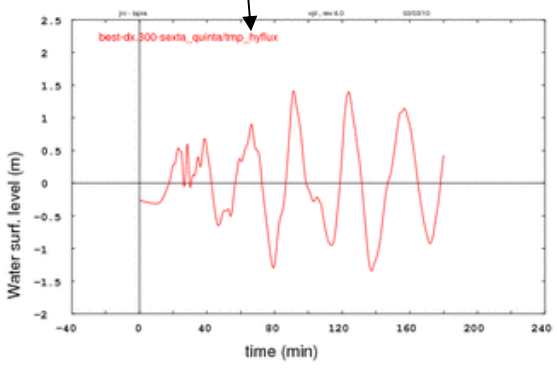




maxZ = 1.607771 maxV = 0.602611

watch Algarrobo id=11096 lat=-33.35679 long=-71.67388 distPlace=1271.041

Directions: To here - From here



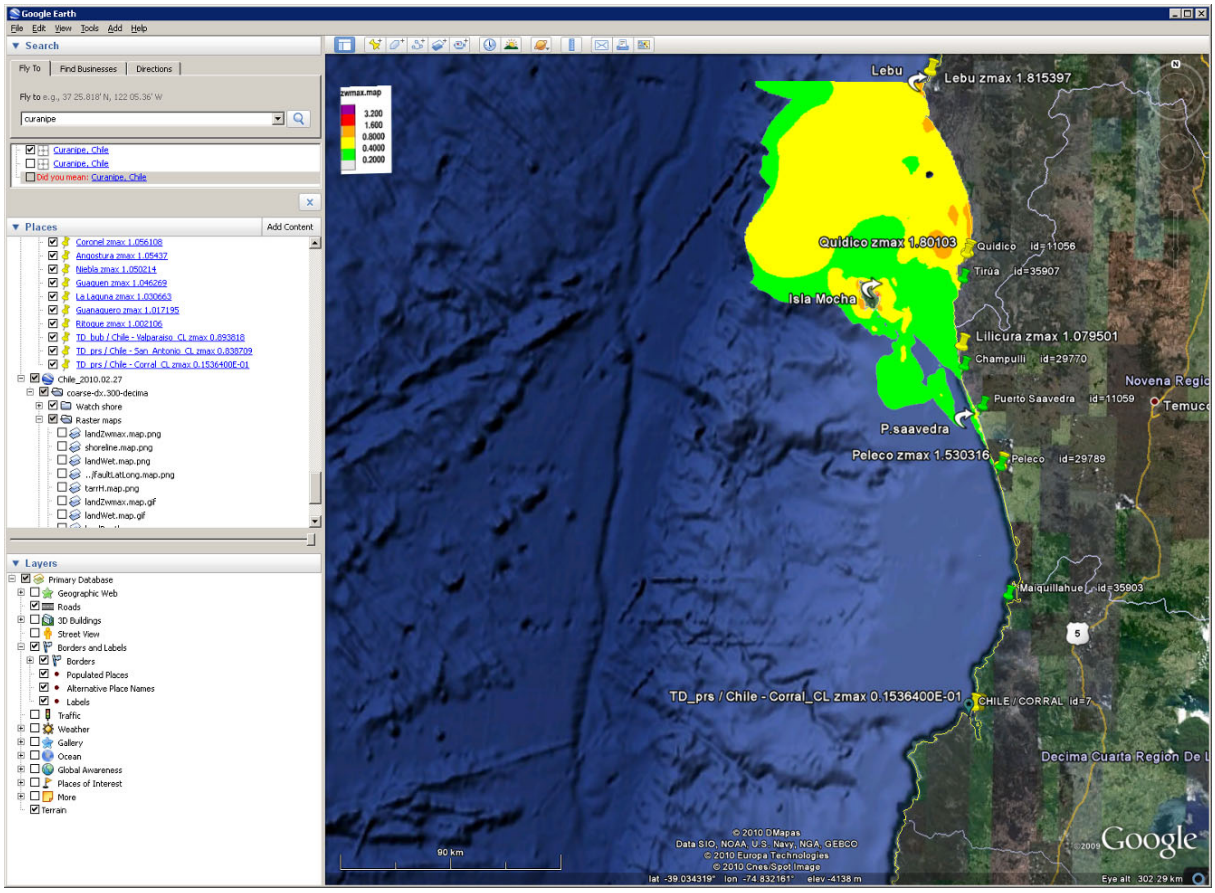
maxZ = 1.41208 maxV = 0.140158

watch Yeco id=35941 lat=-33.31866 long=-71.65474 distPlace=2004.92

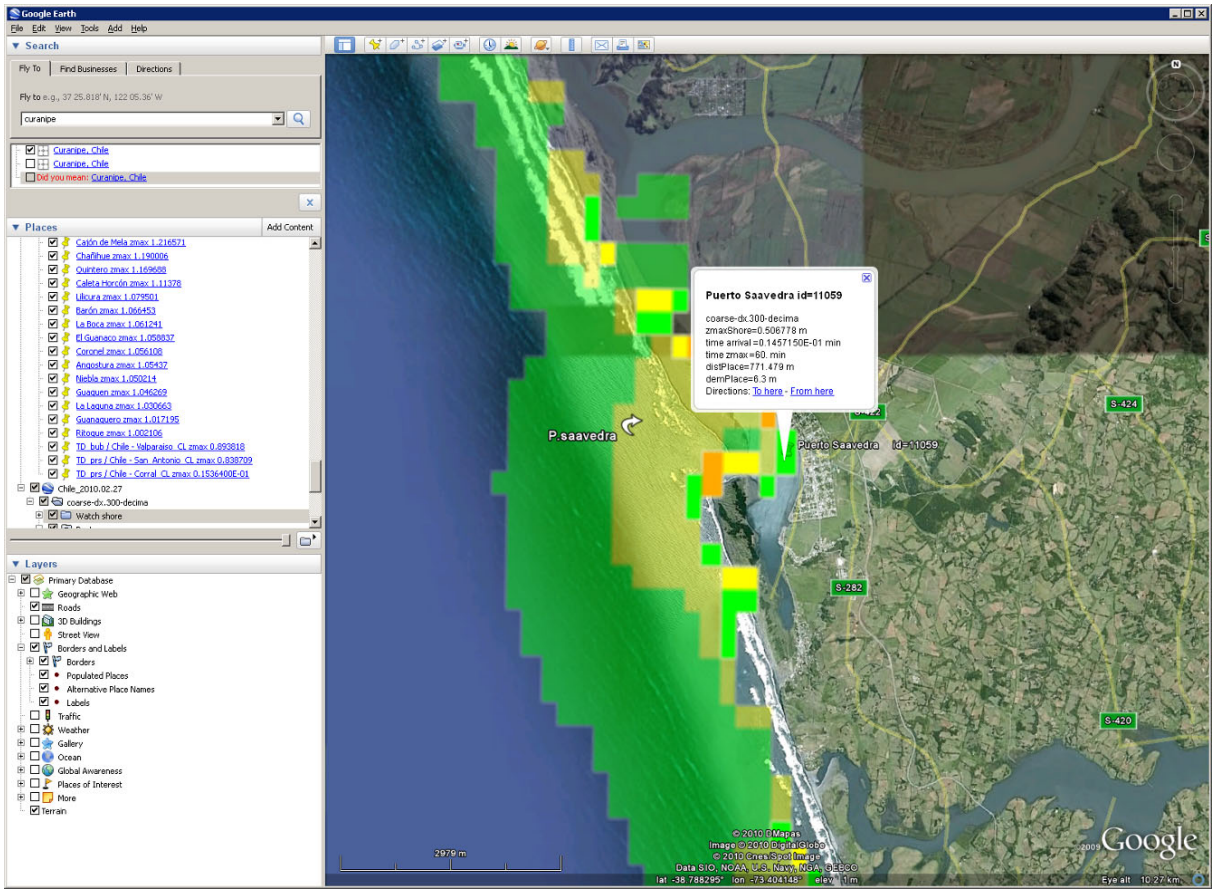
Directions: To here - From here

Novena Region

- P.ssavedra
- Isla Mocha
- Isla Robinson Crusoe

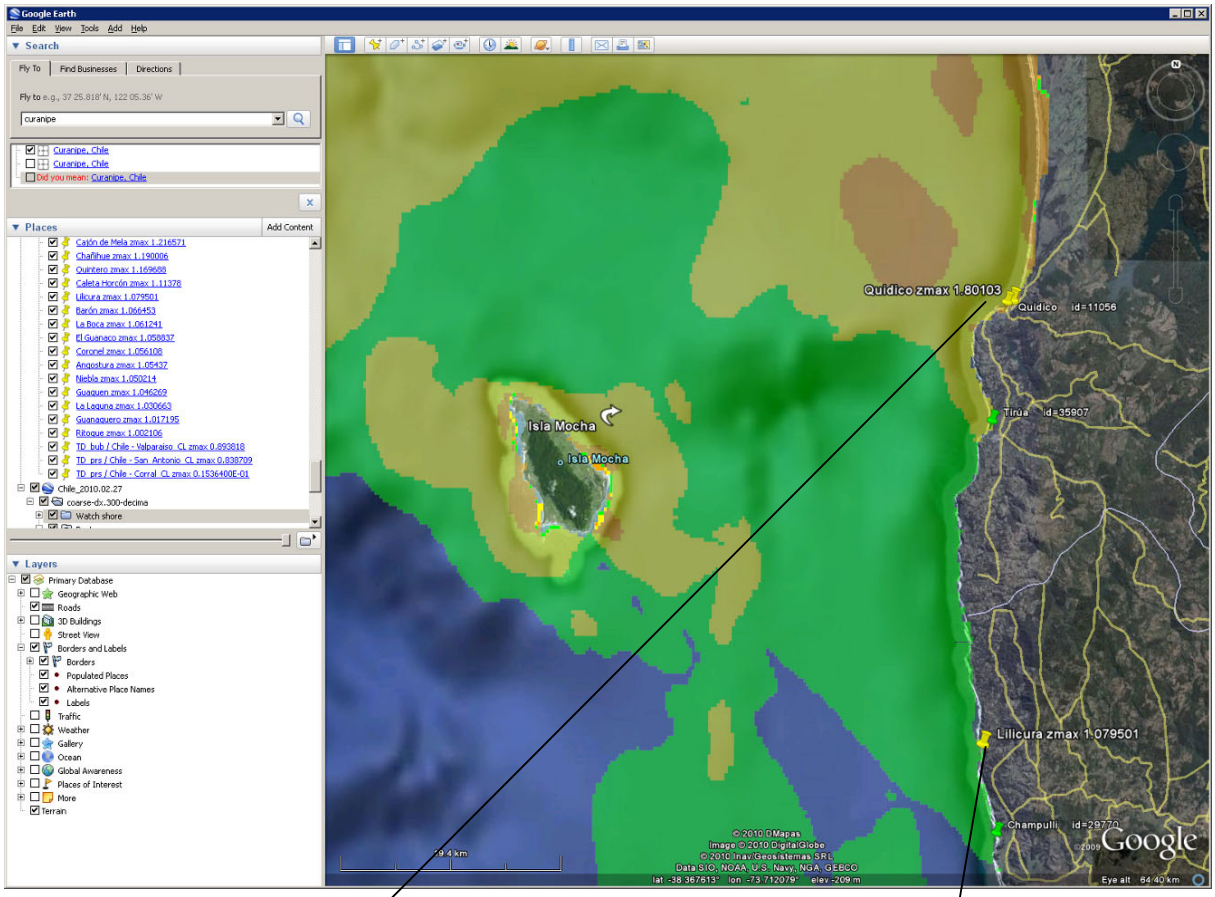


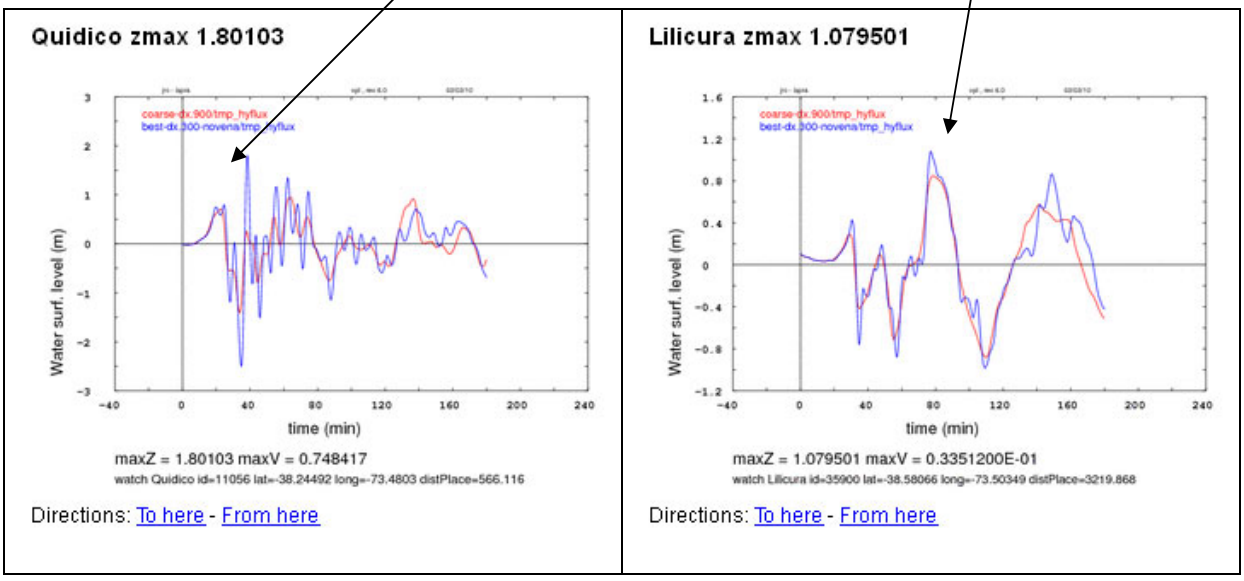
P.ssavedra



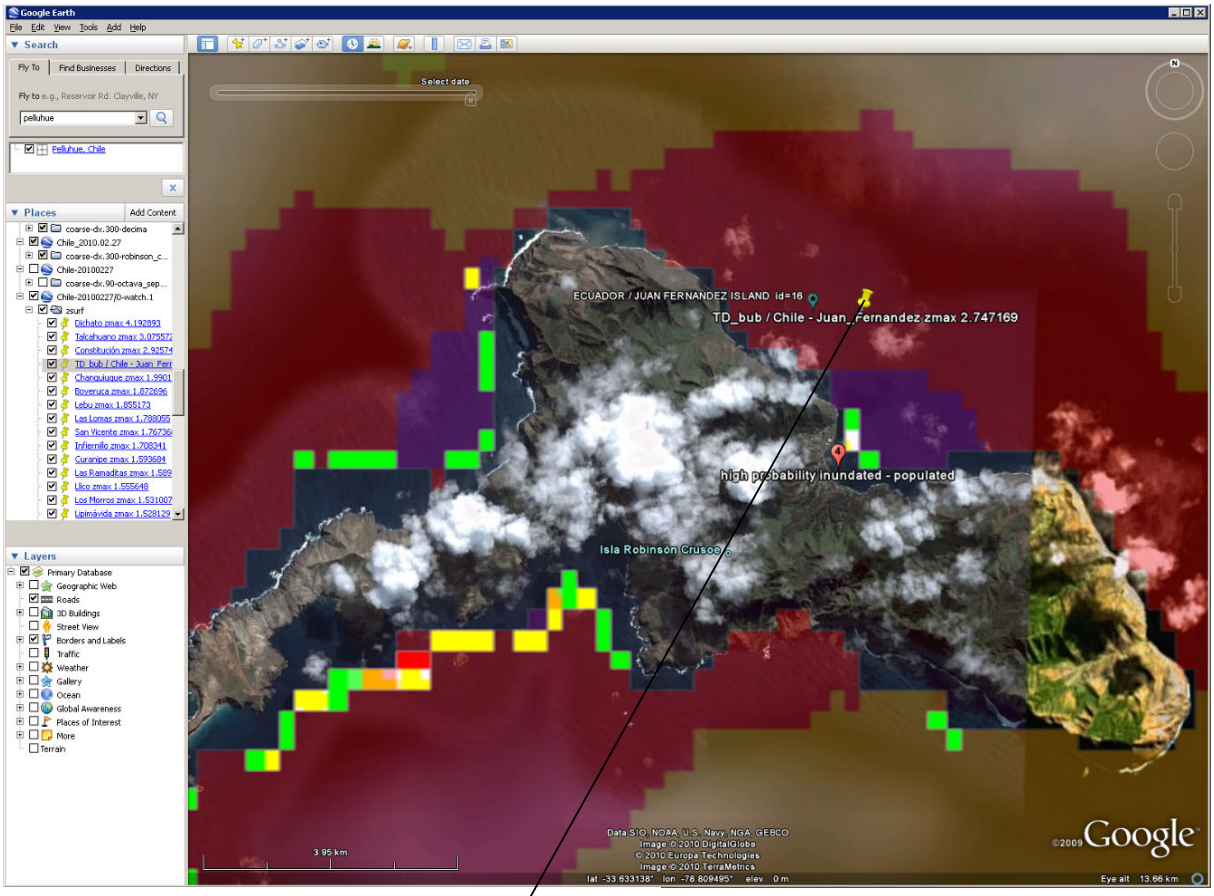
No water surface graphs are available, but populate area could be effected by inundation

Isla Mocha

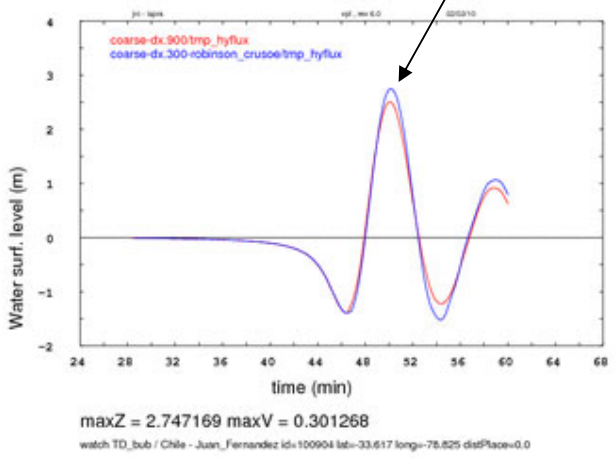

Quidico zmax 1.80103
Quidico id=11056
Tirua id=35907
Isla Mocha
Isla Mocha
Lilicura zmax 1.079501
Champulli id=29770
Google


Quidico zmax 1.80103
coarse-dx.900/tmp_hyflux
best-dx.300-novena/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.80103 maxV = 0.748417
watch Quidico id=11056 lat=-38.24492 long=-73.4803 distPlace=566.116
Directions: To here - From here
Lilicura zmax 1.079501
coarse-dx.900/tmp_hyflux
best-dx.300-novena/tmp_hyflux
Water surf. level (m)
time (min)
maxZ = 1.079501 maxV = 0.3351200E-01
watch Lilicura id=35900 lat=-38.58066 long=-73.50349 distPlace=3219.868
Directions: To here - From here

Isla Robinson Crusoe



TD_bub / Chile - Juan_Fernandez zmax 2.747169



maxZ = 2.747169 maxV = 0.301268

watch TD_bub / Chile - Juan_Fernandez id=100904 lat=-33.617 long=-78.825 distPlace=0.0

Directions: To here - From here

Appendix A – Types of Tsunami calculations

Several types of calculations and each of them has its own merit and needs.

- **Near-real time calculations**
  - These are performed very quickly after an event and can only use the information available 15-20 min after the event. The fault mechanism is not very well known (conservative assumptions must be done) and the position or the depth is not precise at the beginning.
  - The nodalisation is rather coarse (cell size between 2 and 8 km) to shorten the calculation time.
  - The objective of these calculation is the identification of the affected locations without pretending to exactly predict the height in all the locations.
- **Grid scenario calculations**
  - These are performed before an event for all likely tsunami scenarios. General assumptions on the fault mechanism must be done (conservative).
  - The nodalisation is rather coarse (cell size between 2 and 8 km) to shorten the calculation time a limit the data volume.
  - The objective of these calculation is the same as the near real-time calculations, but with even faster response times: calculations are not performed but alert systems can look up the scenario results in a database.
- **Post event calculations**
  - They are performed one or two days after an event when more information is available on the fault mechanism.
  - The nodalisation becomes more detailed (cell size between 200 and 900m) in order to accurately estimate the results.
  - The objective is to identify more precisely the locations and try to estimate the run-up height and the potential damage in the various coastal areas. In case an impact assessment is requested, inundation calculations are performed. In this case it is necessary to increase the detail level by reducing the cell size, i.e. down to 10-20m. The results are affected by the precision of the available topography and bathymetry, buildings, infrastructures, etc.
- **Risk assessment and risk management calculations**
  - These are performed before an event and are based on historical events.
  - These calculations are aimed at preparing evacuation plans in case of tsunami. They are very much site specific and in general it is necessary to perform very detailed calculations reducing the cell size down to 5-20m. Correspondingly also the bathymetry has to be specified with extreme detail which is not available worldwide.

The GDACS system is triggering ***near-real time calculations***, which provide the appropriate information for its alerting functions..