Tsunami observations in New Caledonia (2015-2016)

International Tsunami Workshop: Recent tsunamis in the Pacific (2007-2016) - Improving tsunami response

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Outline

- Sources of observations
- Dec 8 2016 Tsunami, Solomon Islands
- Dec 17 2016 Tsunami, PNG
- Sep 18 2015 Tsunami, Chile (and comparison with 1960 tsunami).
- « Northern Window » : vulnerability to North Pacific tsunami.
- Infragravity versus small tsunami
Rationale for « small tsunami » observations.

• Small tsunamis are still tsunamis, and observations can be used to validate models.

• A comprehensive modeling effort will start in 2017 to establish hazard maps and evacuation areas for the entire territory of New Caledonia.
New Caledonia Tide gauge network
Maintained by SHOM
Nouméa tide gauges and pressure sensors
Bottom pressure sensors in Poindimié During Chile Tsunami 2015

2 RBR DUO, 1Hz sampling:
-12m depth outside the barrier reef
-1m depth in front of the beach
Dec 8 2016 SI Tsunami

December 08 2016 tsunami

local time
Dec 8 2016 SI Tsunami

Hienghene, 7:11 am (local time)
Dec 17 2016 PNG Tsunami
Dec 17 2016 PNG Tsunami

December 17 2016 tsunami

- Hienghene
- Quinne
- Lifou
- Uitoe pressure sensor
- Numbo

Observation sites Dec 17 2016
2015 Chile tsunami
2015 Chile tsunami
2015 Chile tsunami

PTWC : 0.16m/0.12m; Observed 0.07m at coast, 0.01m offshore
2015 Chile tsunami

PTWC 25cm/12 cm; Noumea/Chaleix : 4.2 cm; Noumea/Numbo : 1.5 cm
Paper record of 1960 tsunami recorded at the Noumea/Chaleix tide gauge
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<tbody>
<tr>
<td></td>
<td>Model</td>
<td>Obs</td>
<td>Model</td>
</tr>
<tr>
<td>Hienghene</td>
<td>0.08</td>
<td>0.04</td>
<td>0.22</td>
</tr>
<tr>
<td>Ouinne</td>
<td>0.05</td>
<td>0.05</td>
<td>0.13</td>
</tr>
<tr>
<td>Lifou</td>
<td>0.05</td>
<td>0.10</td>
<td>0.18</td>
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<tr>
<td>Mare</td>
<td>N/A</td>
<td>N/A</td>
<td>0.14</td>
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<tr>
<td>Uitoe (reef outside Noumea)</td>
<td>0.07</td>
<td>0.01</td>
<td>0.04</td>
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<tr>
<td>Poindimié (offshore)</td>
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<td>N/A</td>
<td>N/A</td>
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<tr>
<td>Poindimié (coast)</td>
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<td>N/A</td>
<td>N/A</td>
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<tr>
<td>Numbo</td>
<td>0.06</td>
<td>noise</td>
<td>0.04</td>
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Significant land inundation has been reported in Ouvea (Loyalty Islands) in 1952.
Infragravity waves

• Generated at coastlines by wind generated waves.
• Periods ranging from 1 to 10s of minutes.
• Wide propagation range.
• mm to cm scales in the open ocean.
• Relevant to future wide-swath satellite altimetry mission
Infragravity waves in the deep ocean: An upward revision

J. Aucan¹ and F. Ardhuin²

Received 12 February 2013; revised 2 March 2013; accepted 5 March 2013.

IG waves (1-20 minutes) from 15s DART records.

Figure 2. Mean summer (winter) infragravity wave height in red (green) represented by the size of each circle.
Infragravity/small tsunami (10-60 minutes band)

Dec. 9 2016

Dec. 17 2016
Country response to Dec. 8 SI tsunami

Time (UTC/Local) | Event
--- | ---
17:39/4:39 | Earthquake
17:51/4:51 | PTWC message #1 received (received by email, **NO SMS, NO FAX received**), Magnitude 8
18:30/5:30 | Based on EQ location and Magnitude, Beach and « coastal zone » evacuation order is decided (before reception of PTWC message #2)
18:39/5:39 | PTWC message #2 received (received by email) Revised at 7.9, <0.3 m in NC
18:41/5:41 | Decision : Sirens sounded on East Coast and Loyalty Islands (before assessment of message #2). 51 out of 54 sirens worked properly.
18:54/5:54 | PTWC message #3 : Waves « much less than 0.3 m » for New Caledonia.
19:46/6:46 | PTWC message #4 : « Threat has passed »
19:50/6:50 | First wave observed at Hienghene tide gauge
20:04/7:04 | Waves are beginning to be seen by observers on the East Coast of the Mainland.
20:56/7:56 | MRCC is notified of a cruise ship at anchor ready to bring passengers to shore. Ship is ordered to wait until evacuation order is over, but proceeds anyway (arguing end of threat from message #4).
22:30/9:30 | End of alert.
Some Conclusions

• Tsunamis in 2015 and 2016 from different sources were observed at New Caledonia tide gauges and additional BPRs. (and this data is available for free !)

• Forecasts from PTWC had variable skills, due to complicated bathymetry.

• Country response was positively tested on Dec. 9 2016 (Solomon Islands). Biggest issue was the cruise ship.
SMART subsea cables in the ocean and earth observing system

- Telecom + science
- Cable repeaters host sensors
- Potential: 20,000 repeaters, 1 Gm, 50 km, 10-20 year refresh cycle
- Initially: bottom pressure, temperature and acceleration; supplement later

SMART cables will:
- Contribute to understanding of ocean dynamics and climate
- Improve knowledge of earthquakes and forecasting of tsunamis

SMART cables – first order addition to the ocean and earth observing system, with unique contributions that will strengthen and complement satellite and in-situ systems.

Societal benefits in adding sensors for climate and disaster monitoring

**Societal and environmental issues:**

- **Climate change** – ocean temperature and circulation – direct impact on societies
- **Sea level rise** – hazard for coastal states and cities
- **Disaster Warning** – tsunami and earthquake monitoring throughout ocean basins and coastal margins
Tsunami Detection Time at three bottom pressure recorders (2016)

Circles: Potential Epicenters of Tsunami Generating Earthquakes 120 km spacing

Color – time elapsed between an earthquake at the circle location and until the tsunami is detected at three bottom pressure sensors

Courtesy Dr. N. Becker PTWC
Tsunami Detection Time at three bottom pressure recorders (2016)

Circles: Potential Epicenters of Tsunami Generating Earthquakes 120 km spacing

Color – time elapsed between an earthquake at the circle location and until the tsunami is detected at three bottom pressure sensors

Add SMART 500 km spacing

Courtesy Dr. N. Becker PTWC