Earthquake details (automatic solutions):

Tsunami early warning within 5 minutes...

...and true size of large earthquakes within 10 minutes

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Anthony Lomax *ALomax Scientific, Mouans-Sartoux, France* Alberto Michelini

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Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy

1. Tsunami size, seafloor uplift and seismic moment

- 2. Tsunamigenic earthquakes: the $T_d \cdot T_0$, $T_d \cdot T_{50Ex}$ discriminant
- 3. M_{wpd} rapidly gives true size of large earthquakes
- 4. Examples: Tohoku 2011, Mentawai 2010
- 5. Conclusions

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Tsunami size depends on seafloor uplift





earthquake rupture

→ tsunami

Seafloor uplift not directly related to seismic moment



Seafloor uplift not directly related to seismic moment



Dominant period T_d and apparent duration T_0 , T_{50Ex}



 T_d – dominant period of early P-waves

 T_o – duration of high-frequency P-waves

 T_{50Ex} – early estimate if T_0 exceeds 50s

Dominant period T_d and apparent duration T_0 , T_{50Ex}









tsunami impact measures derived from: NOAA/WDC Historical Tsunami Database





tsunami amplitude measures derived from: NOAA/WDC Historical Tsunami Database

M_{wpd} – rapidly gives true size of large earthquakes





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+0min





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+1min





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+2min





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+3min





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+4min





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+5min





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+6min





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+7min





Real-time simulation: *M*_w9.1, Tohoku, Japan 2011 OT+8min











Real-time simulation: *M*_w7.8, Mentawai 2010



off-line simulation of Early-est realtime monitor - early-est.rm.ingv.it

OT+0min

1 Real-time simulation: *M*_w7.8, Mentawai 2010

OT+4min



Real-time simulation: *M*_w7.8, Mentawai 2010

OT+7min





Real-time simulation: Mw7.8, Mentawai 2010

OT+10min





-60°

-30

Tsunami early warning within 5 minutes

Conclusions

We present procedures using real-time seismogram data currently available for most parts of the world to:

1) Estimate within 5 min after an earthquake occurs the potential of the earthquake to generate a significant tsunami

- $T_d \cdot T_{50Ex}$ and $T_d \cdot T_0$ period-duration discriminants,
- give more and earlier information on tsunami impact than $M_w CMT$ or teleseismic T_0 ,
- possibly identifies directly the "tsunami" faulting potential of an earthquake.
- 2) Determine within 10 min after an earthquake occurs an accurate magnitude, M_{wpd} , giving the true size of very large earthquakes
 - extension of M_{wp} to full *P*-wave duration T_0 .

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3) Provide basic faulting parameters to aid in early tsunami forecast modeling

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Further information:

early-est.rm.ingv.it early-est.alomax.net

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Anthony Lomax

ALomax Scientific, Mouans-Sartoux, France - anthony@alomax.net

Alberto Michelini Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy alberto.michelini@ingv.it





Real-time: *M*_w9.1, Tohoku, Japan 2011 OT+15min





Real-time: *M*_w8.6, Sumatra 2012

OT+5min





Real-time: *M*_w8.6, Sumatra 2012

OT+10min

