

# 3<sup>rd</sup> IHO TIDAL AND WATER LEVEL WORKING GROUP MEETING

05 - 07 APRIL 2011, JEJU ISLAND, REPUBLIC OF KOREA



## TSUNAMI SIGNALS IN A SEA LEVEL REGISTER

TSUNAMI FEBRUARY 27<sup>th</sup>-2010

TSUNAMI MARCH 11<sup>th</sup>-2011

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SERVICIO HIDROGRÁFICO Y OCEANOGRÁFICO DE LA ARMADA DE CHILE

*Siempre queda mucho por hacer...*

# Lecture Overview

- Introduction
- Sea Level Registers
- Rate of Changes of Sea Level
- High and Low Frequency Time Series
- Tsunami Amplitudes

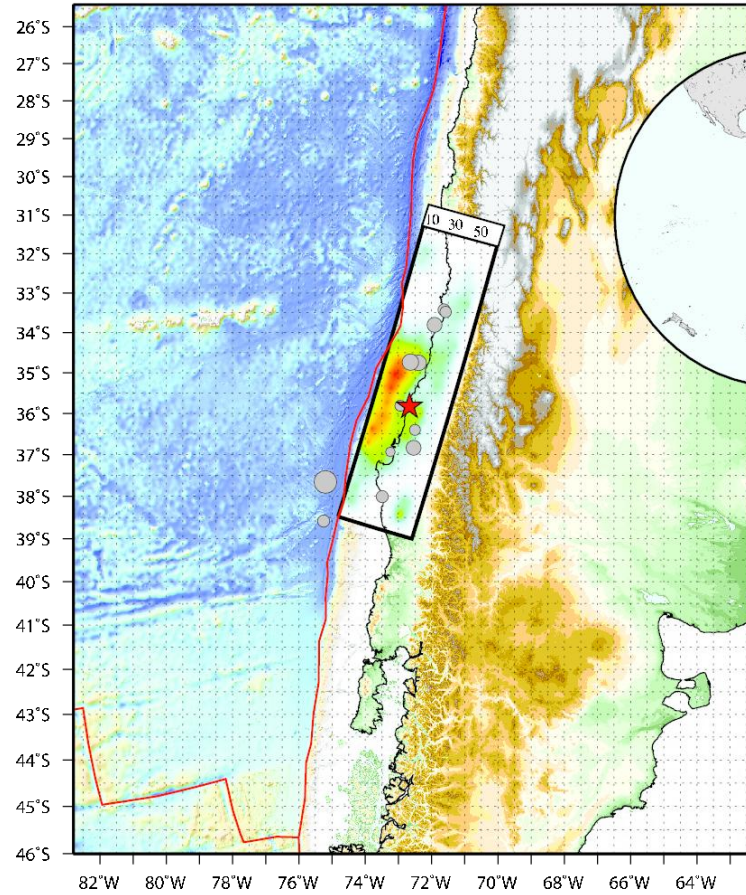
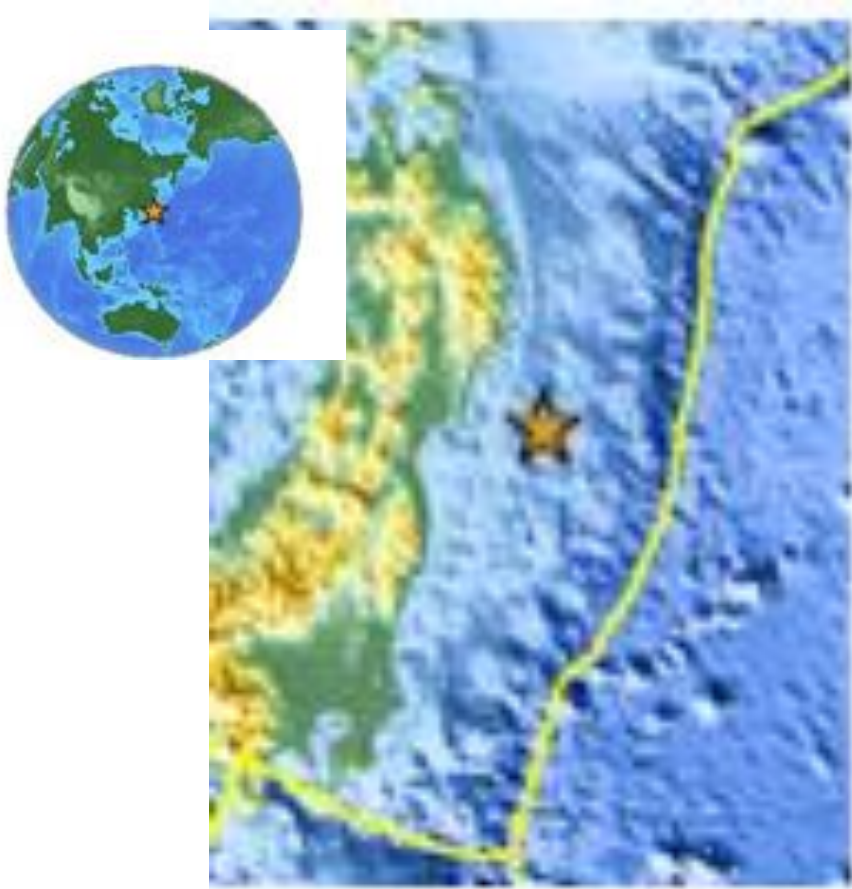


# Introduction

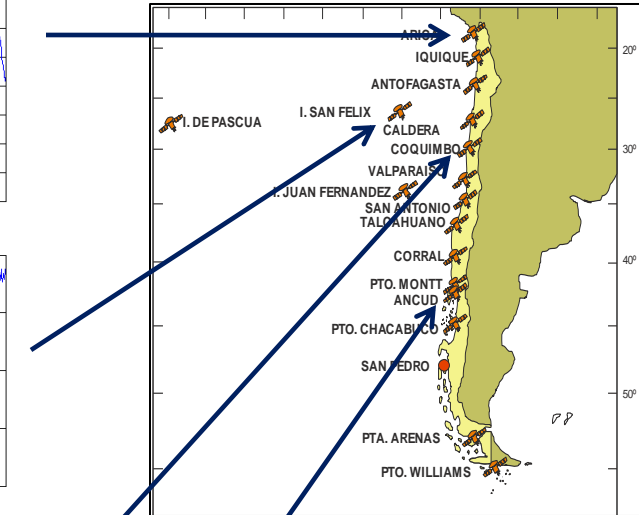
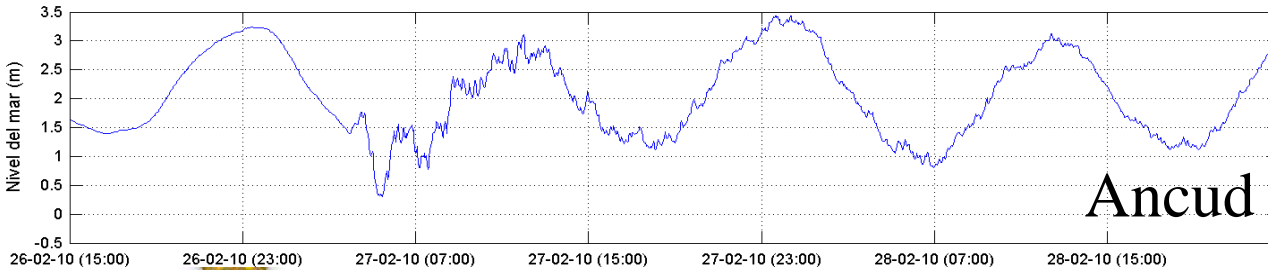
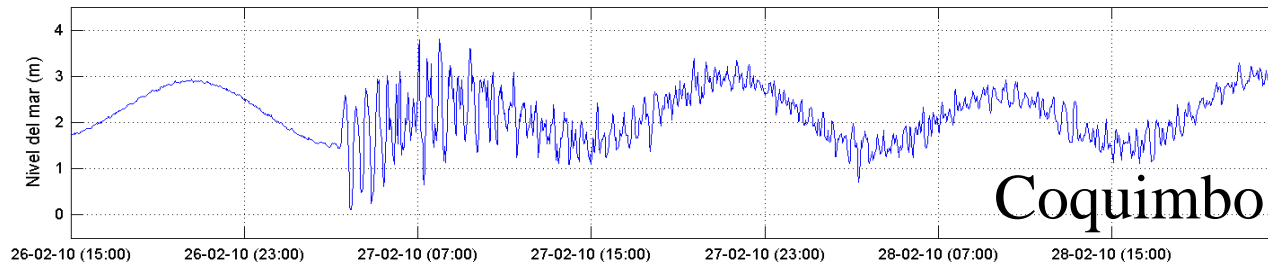
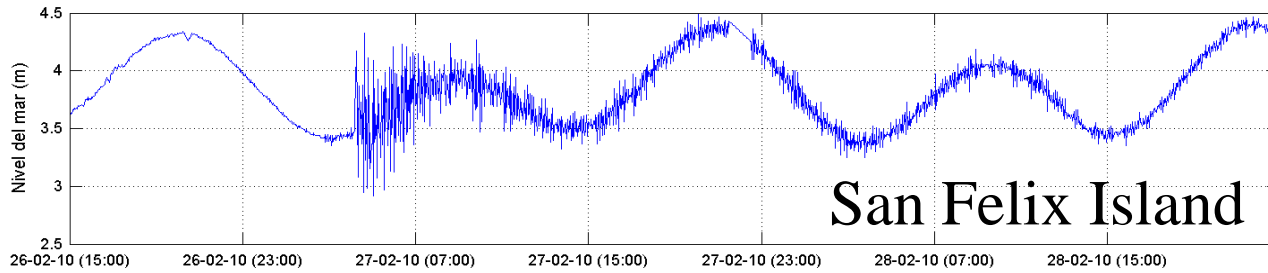
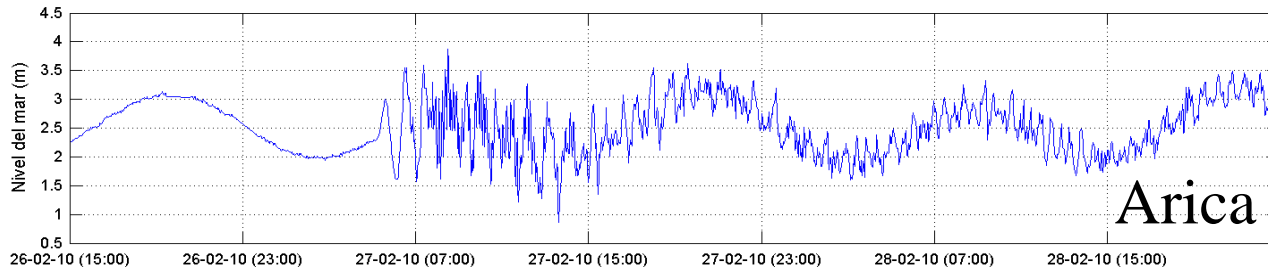
- At 3:34 local time, Feb 27<sup>th</sup> 2010, a devastating earthquake M 8.8 struck Chile
- At 14:46 local time, March 11<sup>th</sup>2011, a devastating earthquake M 9.0 struck Japan
- Both earthquakes also triggered tsunamis which crossed into the Pacific Ocean
- Historic world earthquake after 1900 listed by magnitude
  - 1960 05 22 Valdivia, Chile – M 9.5
  - 1964 03 28 Prince William Sound, Alaska – M 9.2
  - 2004 12 26 Sumatra – Andaman Island – M 9.1
  - 1952 11 04 Kamchatka – M 9.0
  - 2011 03 11 **Honshu, Japan** – M **9.0**
  - 2010 02 27 **Offshore Maule, Chile** – M **8.8**
- Sea level stations contribute strongly as tsunami detection systems with potential warning time from minutes to hours, depending on proximity of source location



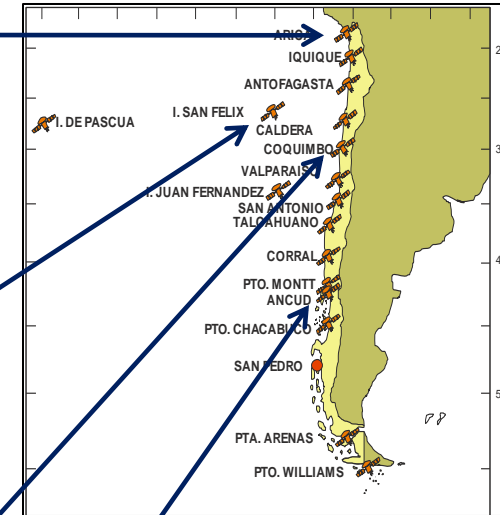
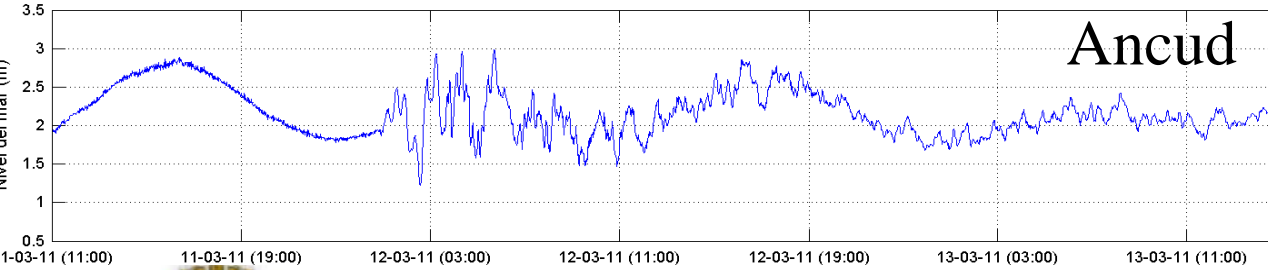
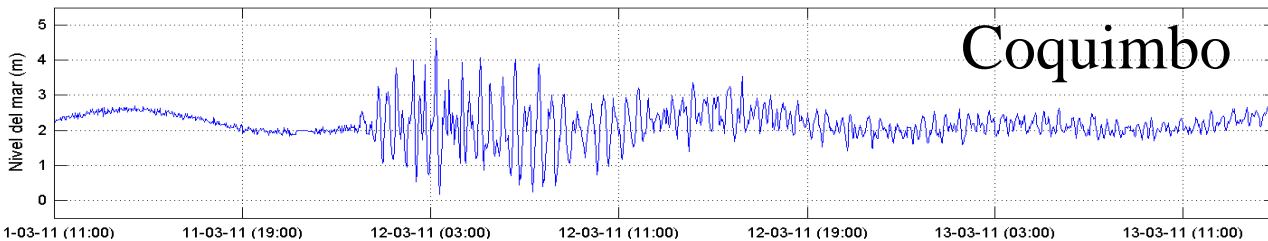
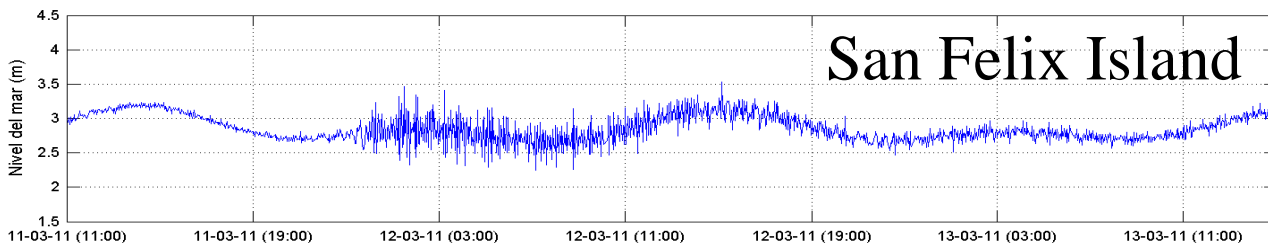
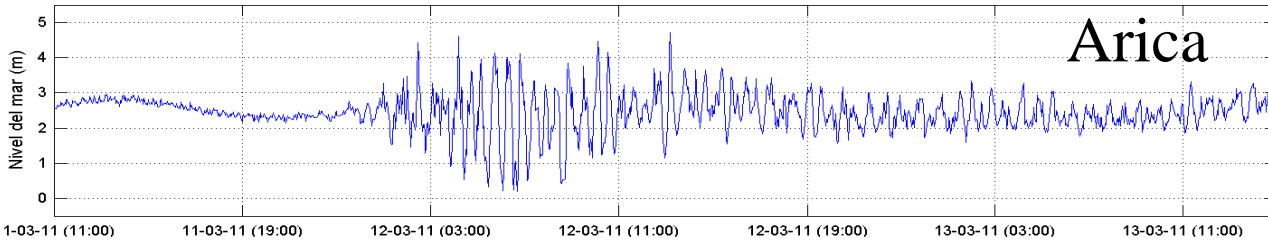
# Introduction



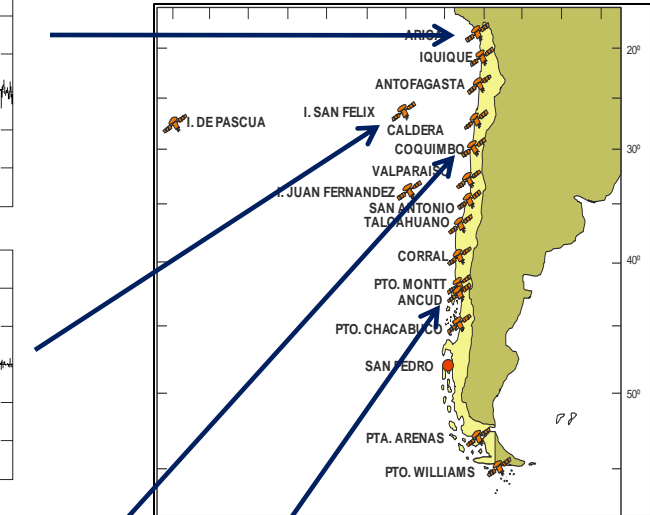
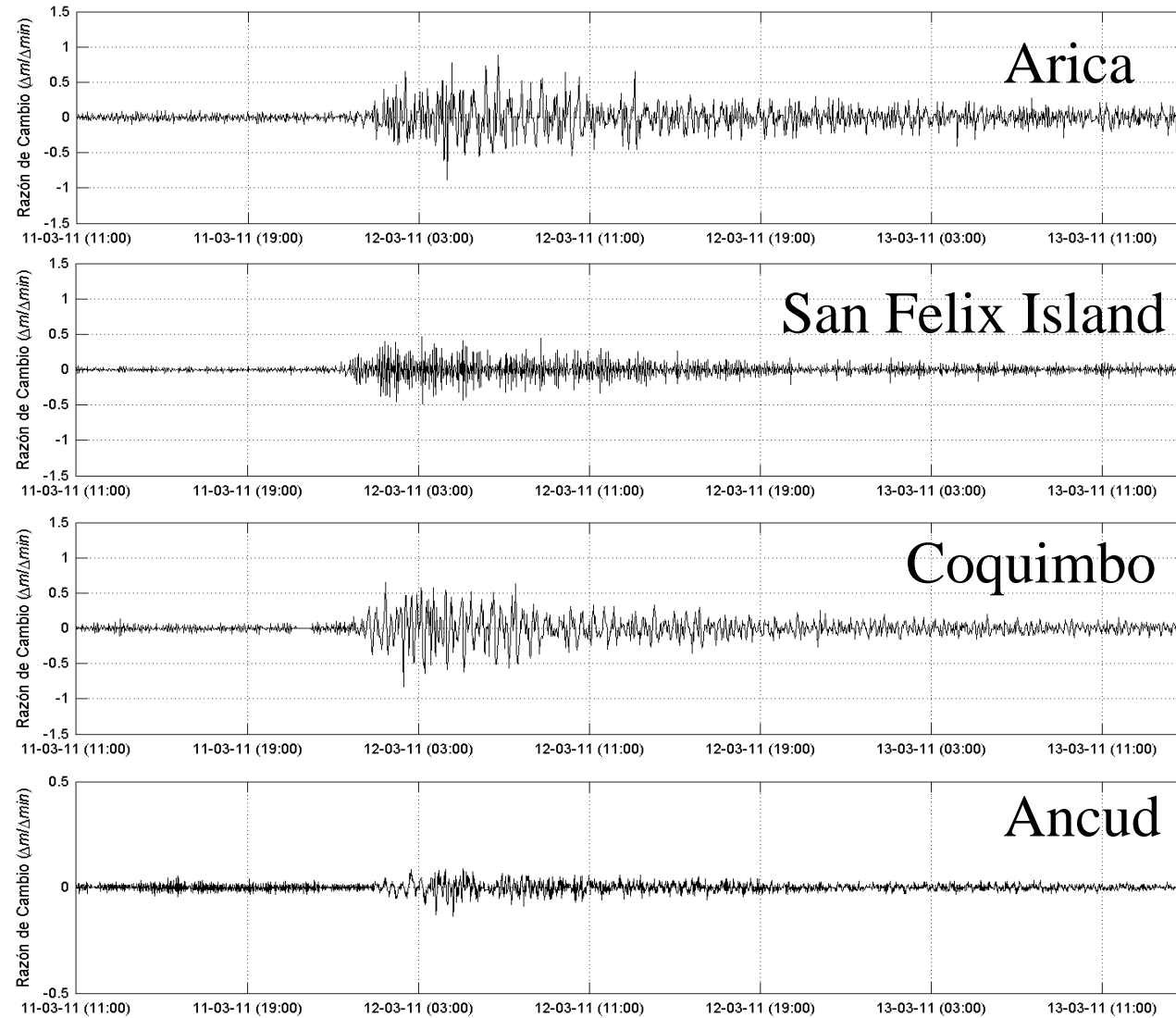
# Sea Level Register 26-28 Feb 2010



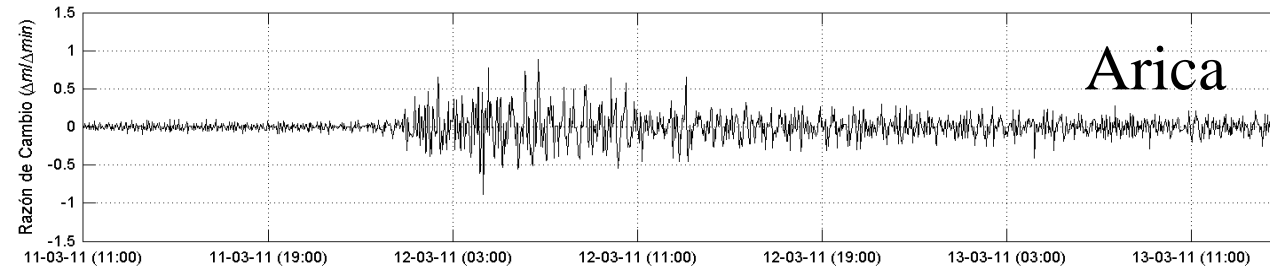
# Sea Level Register 11-13 March 2011



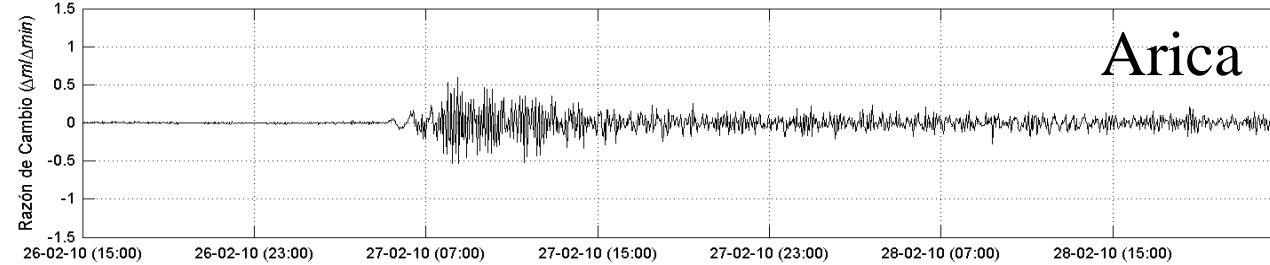
# Rate of Change 11-13 March 2011



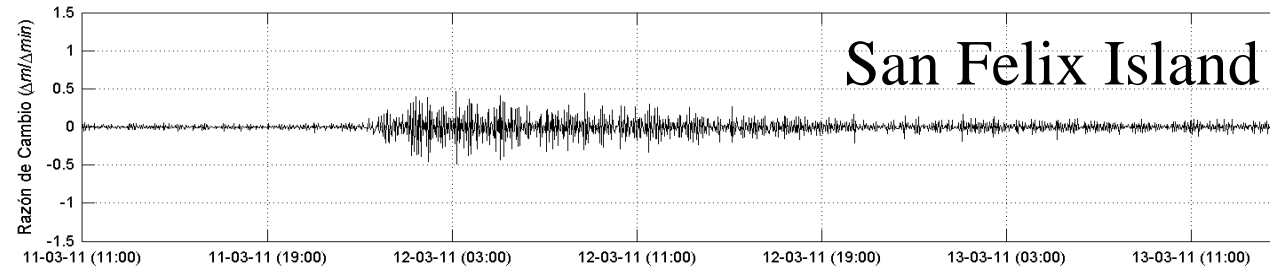
# Rate of Change Comparison



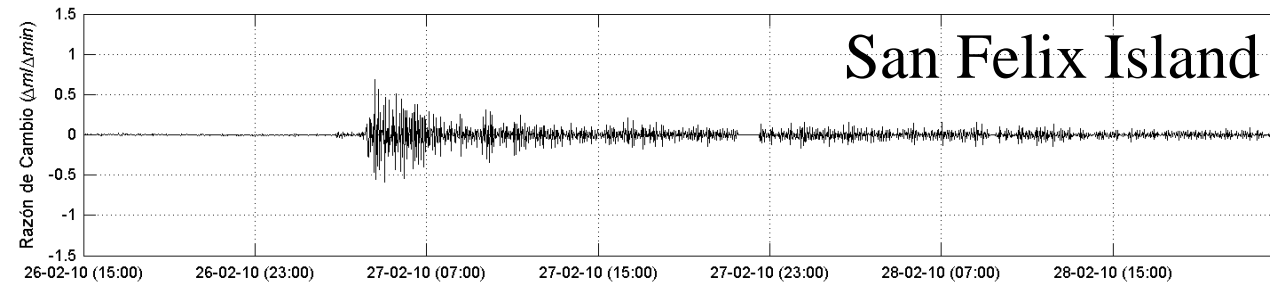
Mar 11 - 2011



Feb 27 - 2010



Mar 11 - 2011

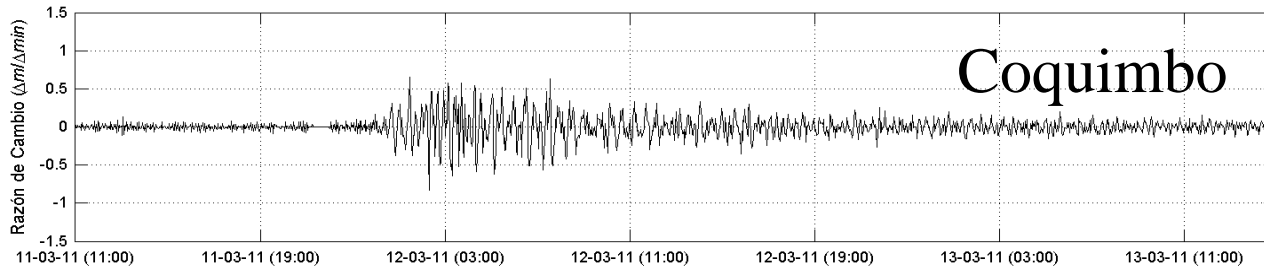


Feb 27 - 2010

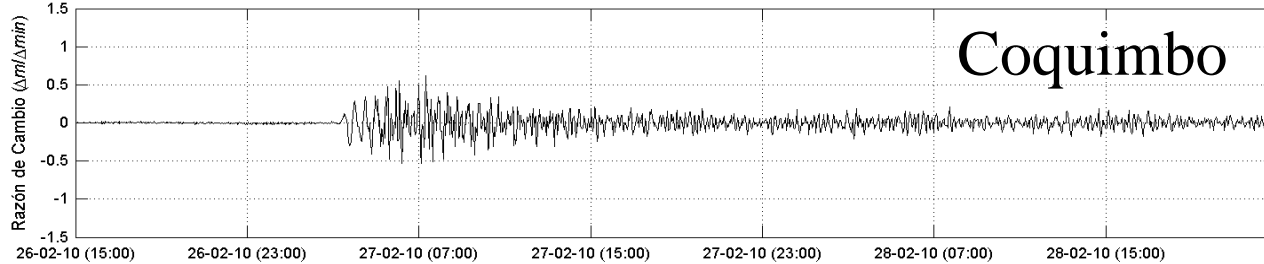




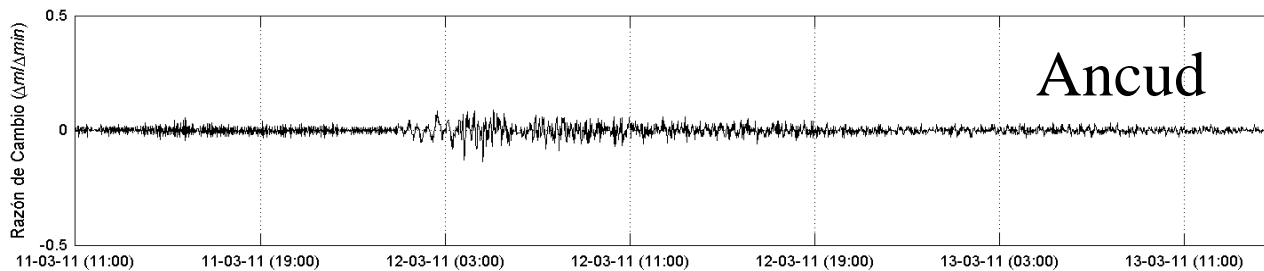
# Rate of Change Comparison



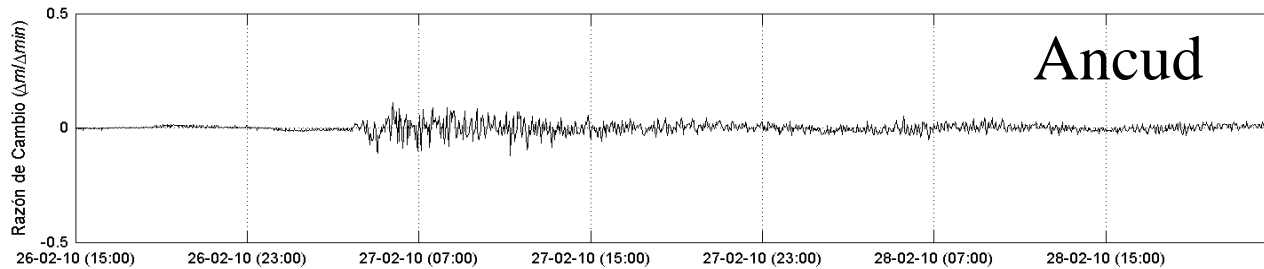
Mar 11 - 2011



Feb 27 - 2010



Mar 11 - 2011

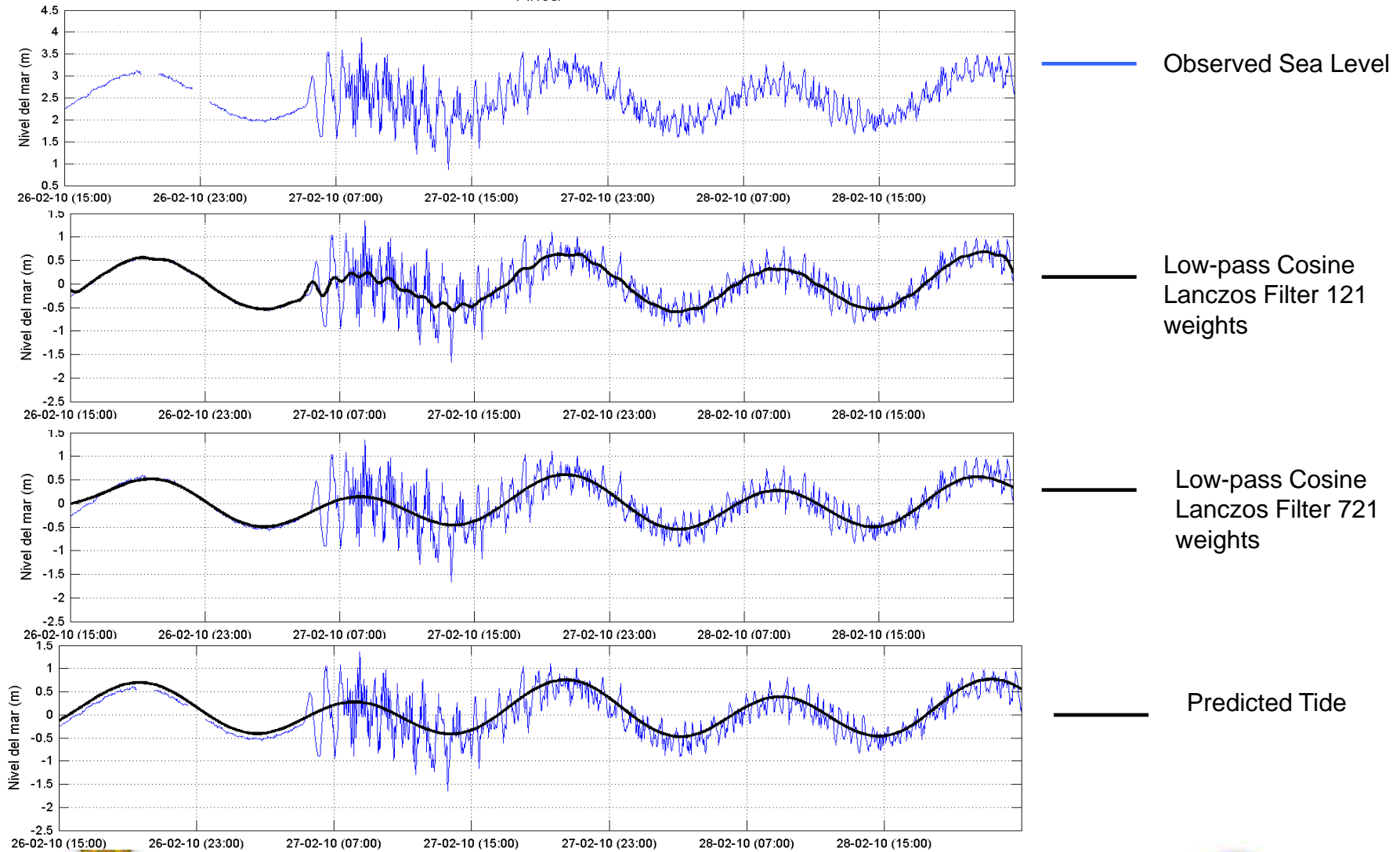


Feb 27 - 2010



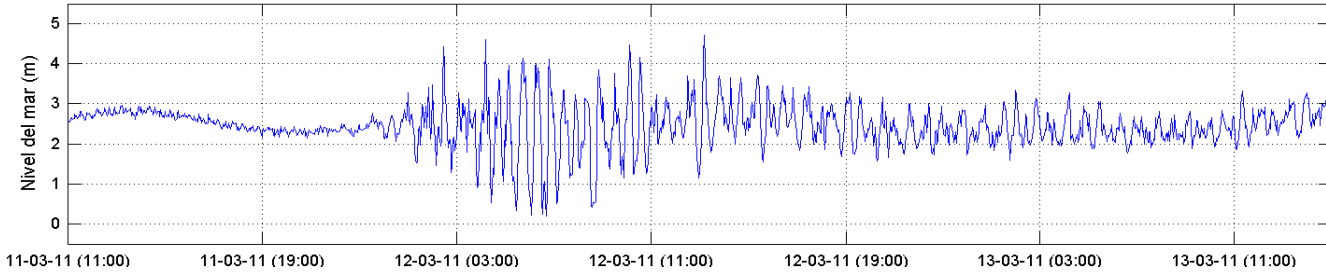
# High and Low Frequency Time Series

## Arica 26-28 Feb 2010

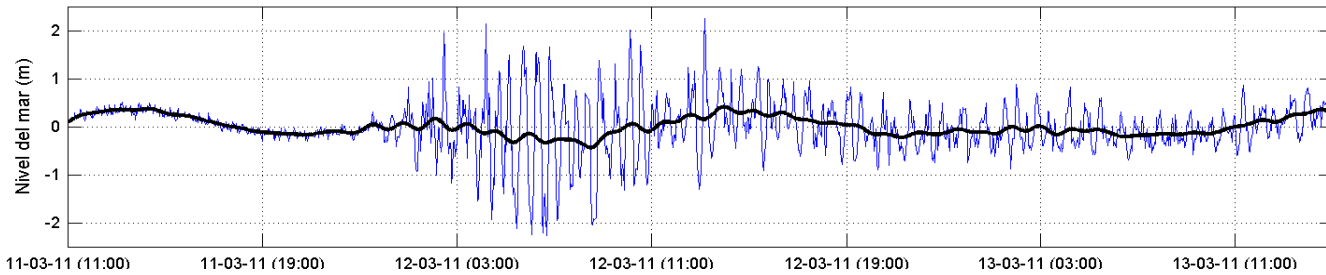


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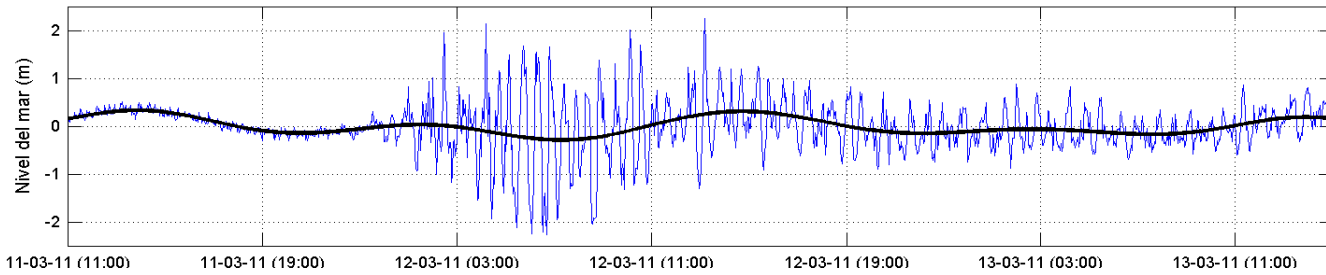
## Arica 11-13 March 2011



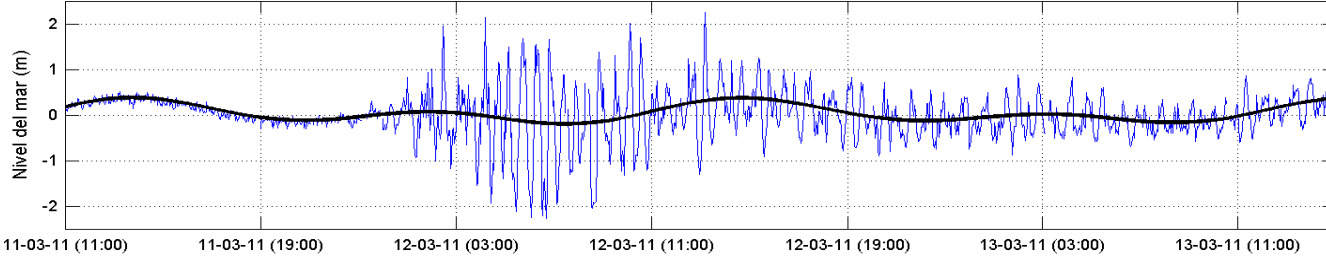
— Observed Sea Level



— Low-pass Cosine  
Lanczos Filter 121  
weights



— Low-pass Cosine  
Lanczos Filter 721  
weights

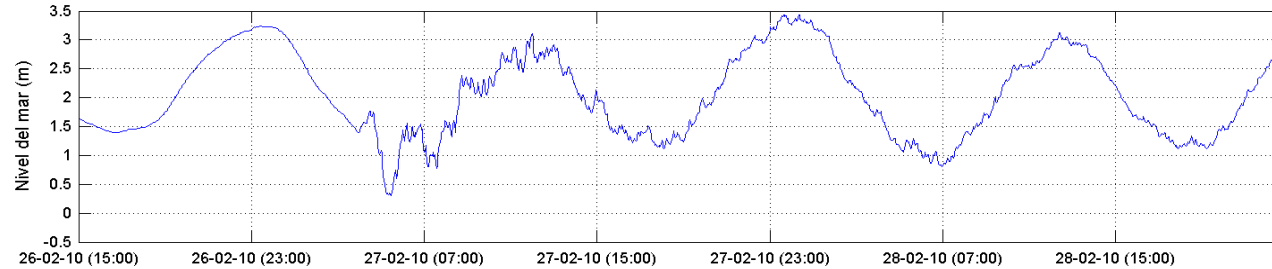


— Predicted Tide

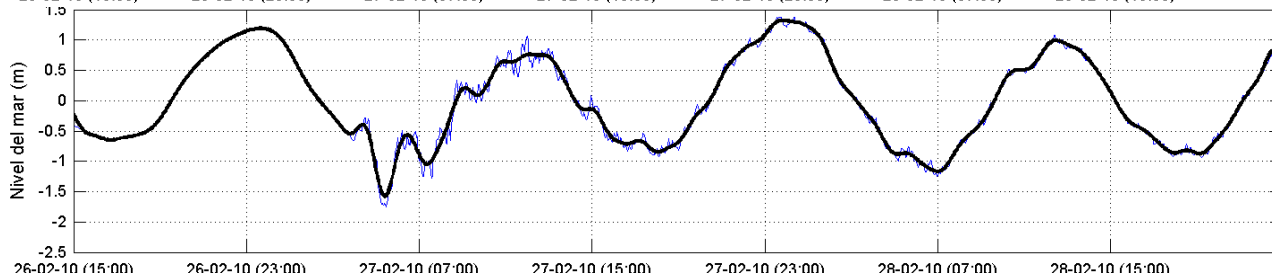


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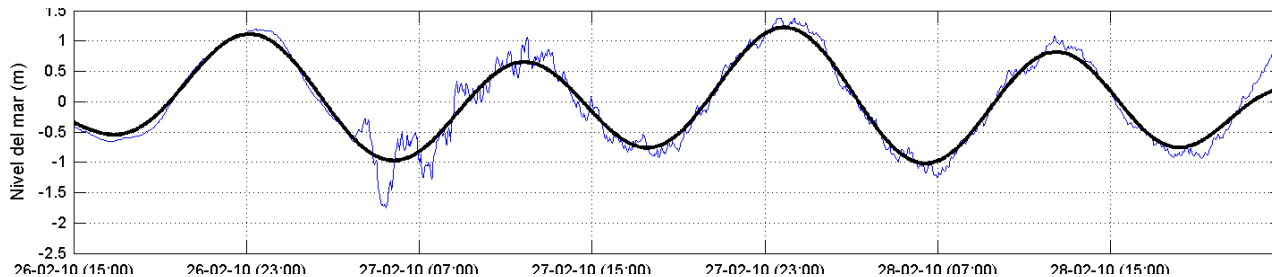
## Ancud 26-28 Feb 2010



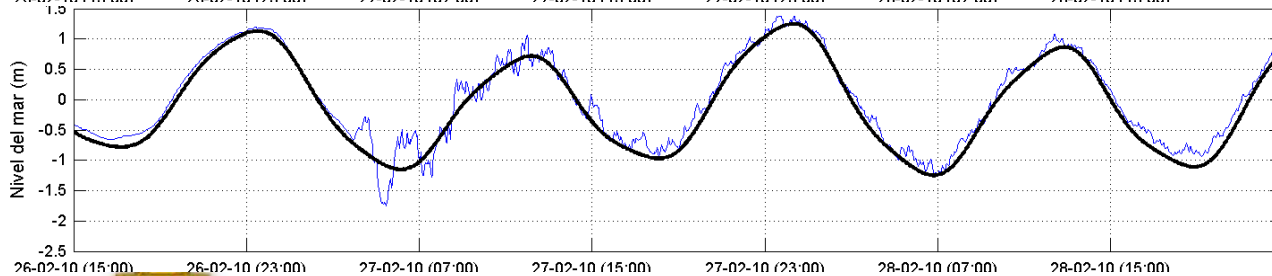
— Observed Sea Level



— Low-pass Cosine  
Lanczos Filter 121  
weights



— Low-pass Cosine  
Lanczos Filter 721  
weights

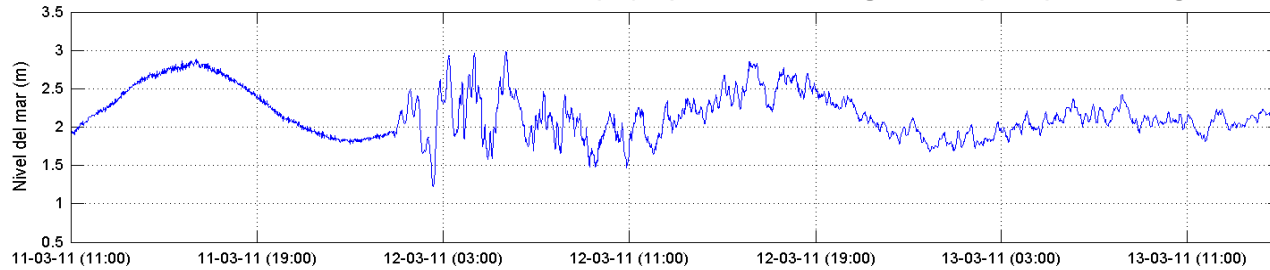


— Predicted Tide

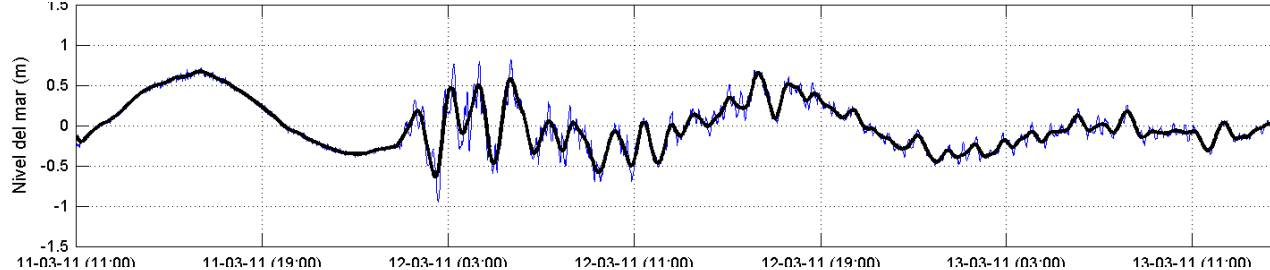


# High and Low Frequency Time Series

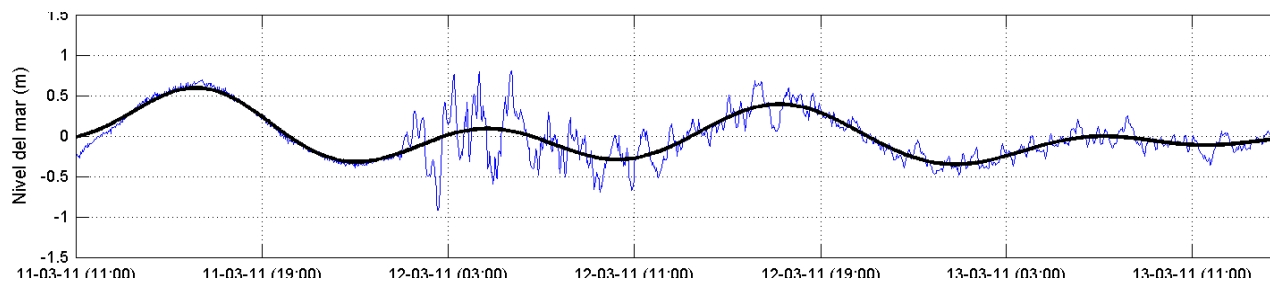
## Ancud 11-13 March 2011



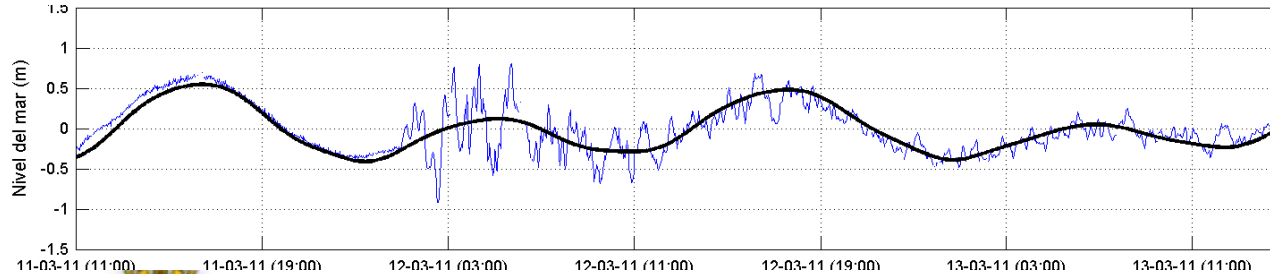
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— Low-pass Cosine  
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weights



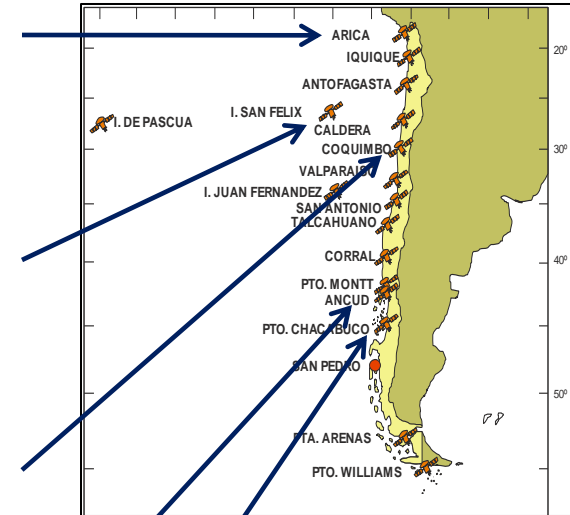
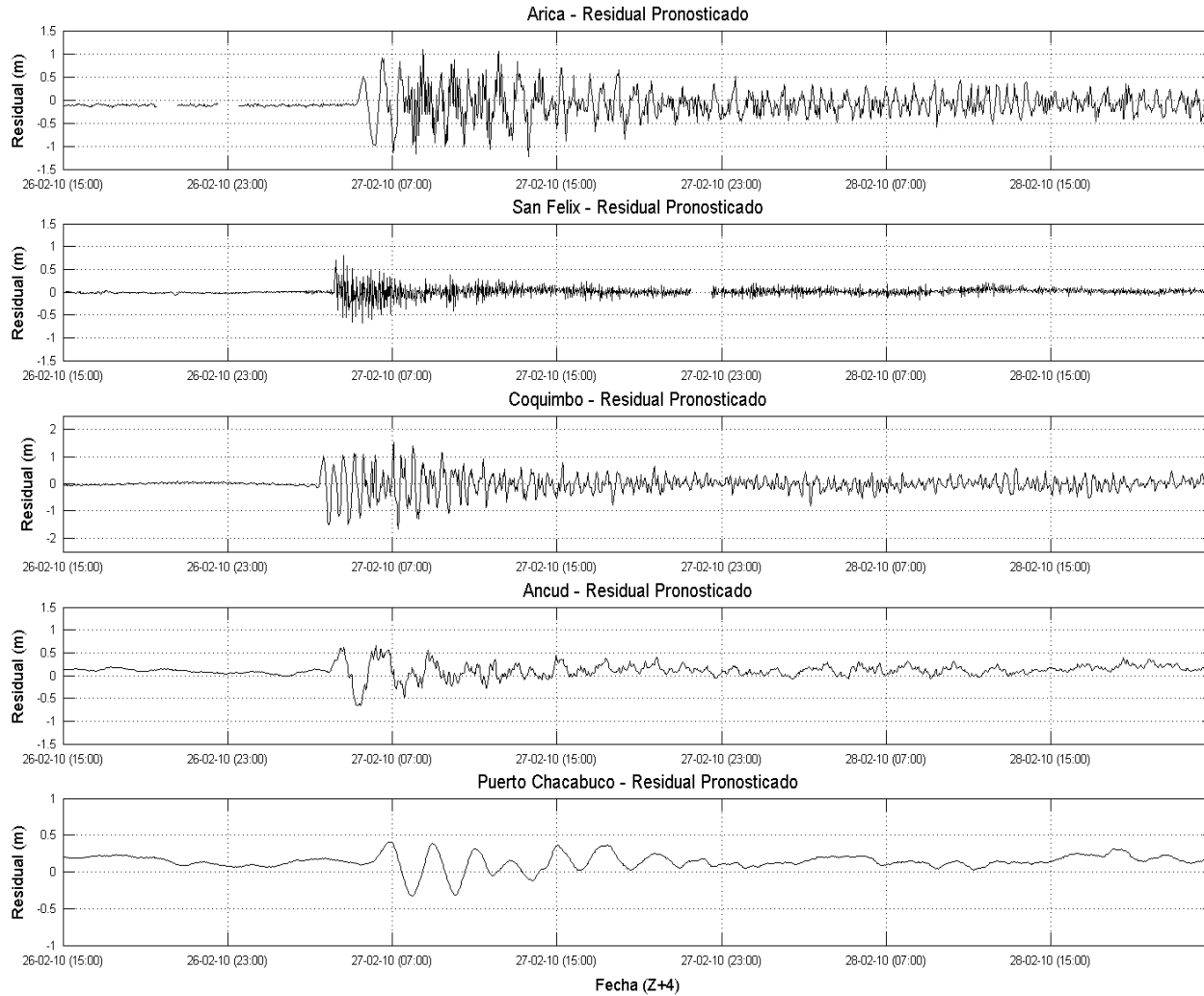
— Low-pass Cosine  
Lanczos Filter 721  
weights



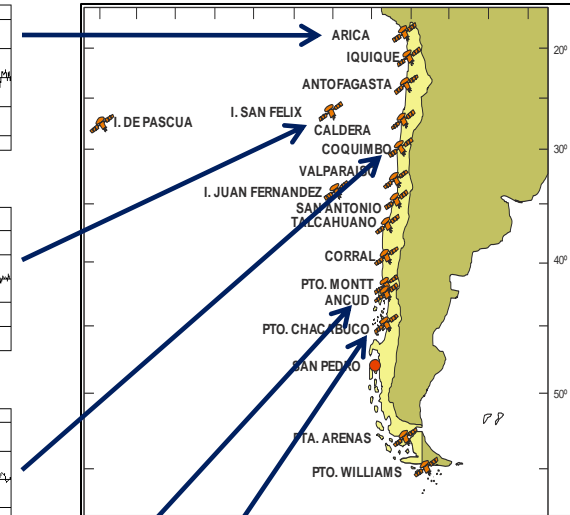
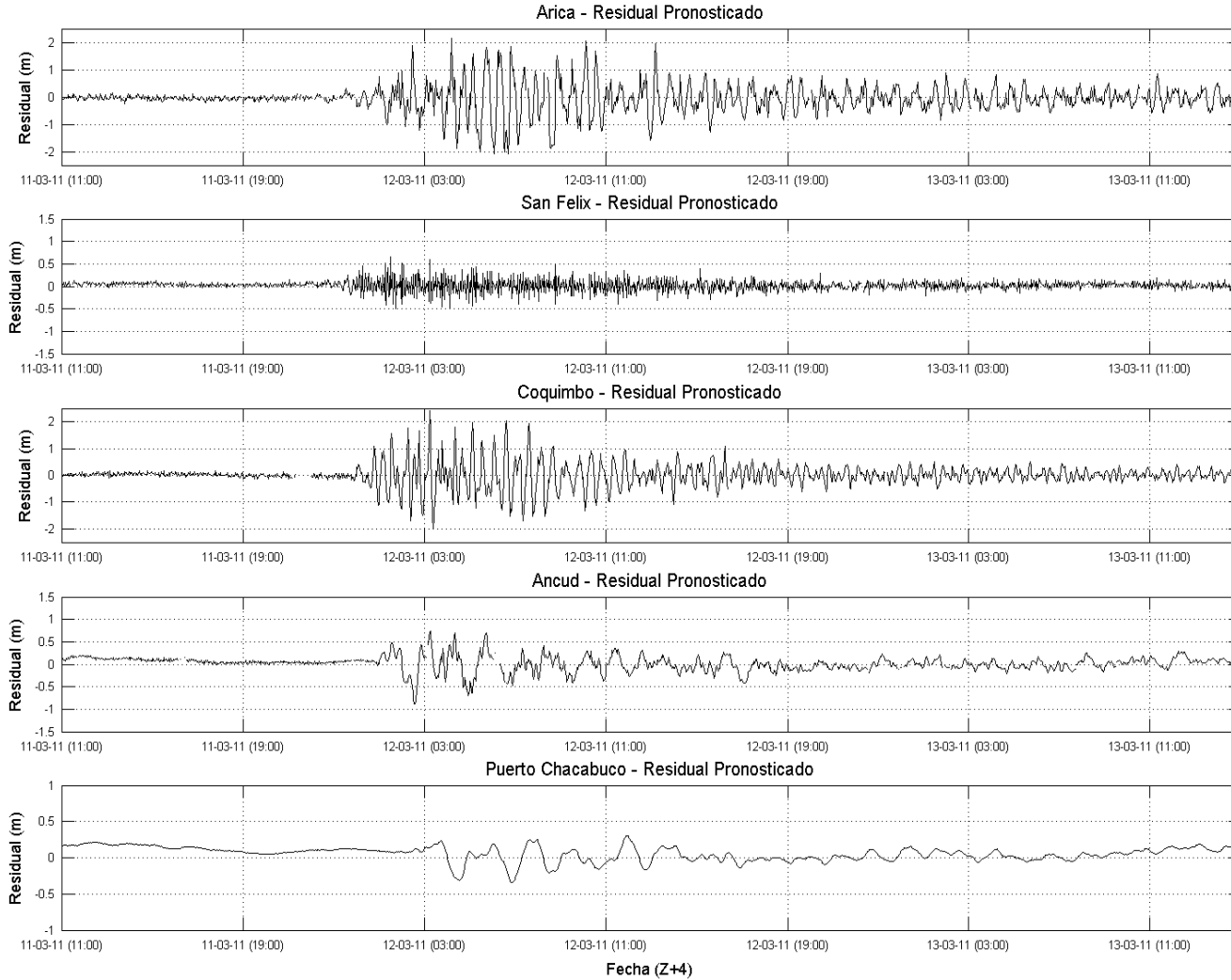
— Predicted Tide



# Tsunami amplitudes 26-28 Feb 2010



# Tsunami amplitudes 11-13 March 2011



# Amplitudes Maximum of the tsunami wave

Feb 27th 2010

March 11th 2011

Place	Amplitude Max. (m)		Amplitude Max. (m)	
	(+)	(-)	(+)	(-)
	<b>Prediction</b>			
Arica	1.09	1.23	2.16	2.09
San Felix	0.81	0.68	0.66	0.49
Coquimbo	1.53	1.65	2.41	2.02
Ancud	0.65	0.66	0.74	0.88
	<b>Cosine-Lanczos 721 weights</b>			
Arica	1.22	1.20	2.24	2.00
San Felix	0.81	0.65	0.63	0.51
Coquimbo	1.62	1.57	2.42	2.01
Ancud	0.55	0.78	0.74	0.89





THANKS

