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Departamento de Oceanografía Física

El rol de la simulación numérica en la resiliencia frente desastres naturales

Dr Markus Gross, Investigador Titular, CICESE

Contenido

- El GEM lab del Departamento de oceanografía física del CICESE
- Predicción del tiempo, su inicio y avances
- El clima y los desastres
- Predicción de medio plaza, sus retos y alances
- Predicción de alta resolución
  - ejemplo de vulcanos
  - predicción del lluvia
  - los incertidumbres
- Resiliencia frente Tsunamis, predicción de un impacto

Grupo GEM

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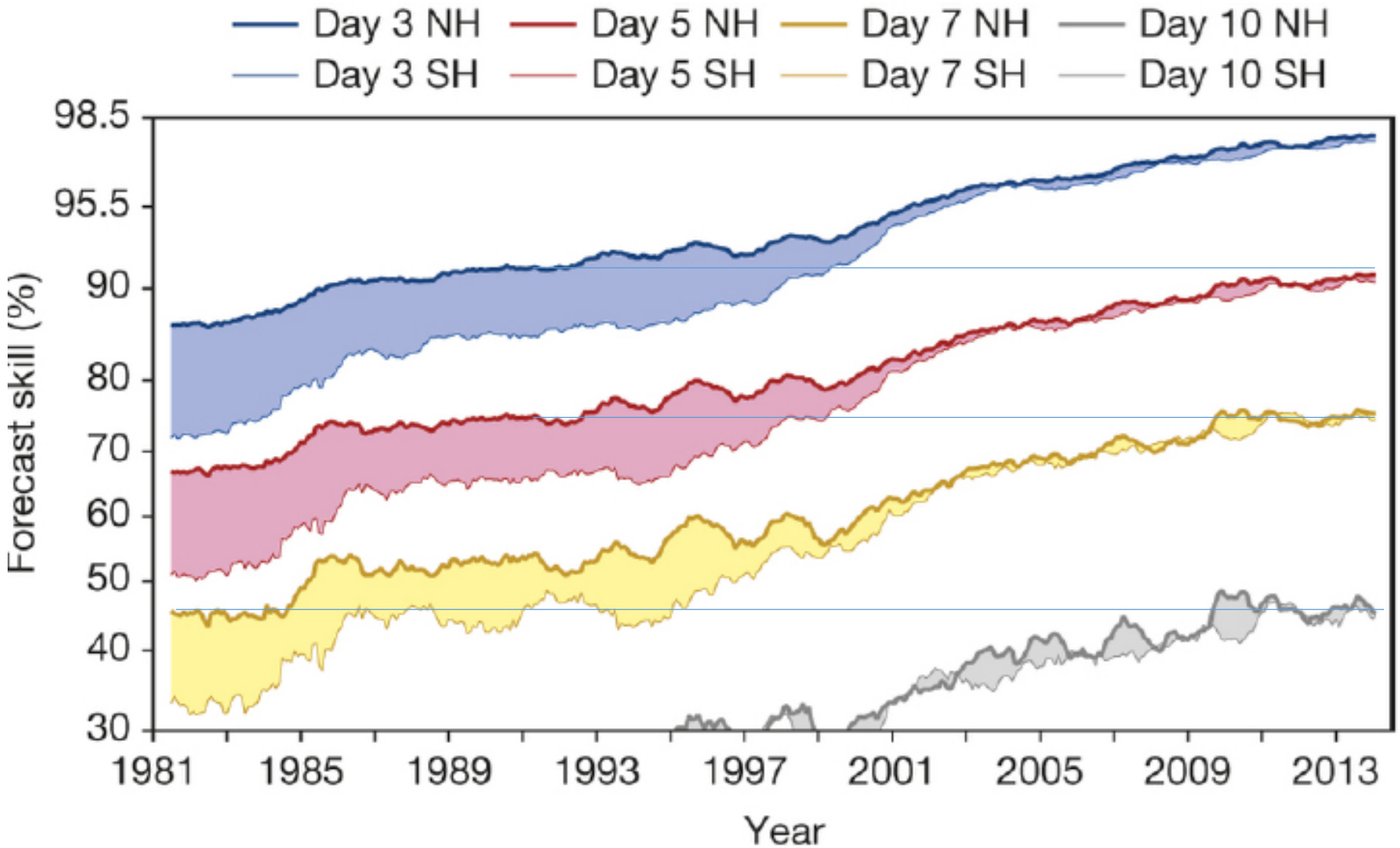
- Junto con la Dra Vanesa Magar
- Fundación en 2014
- 7-15 miembros (estudiantes, visitantes, técnicos y investigadores)
- investigación de flujos geofísicos, el tiempo, energías renovables y la costera
- mayoría del trabajo es teorético, sin embargo unas actividades recientes en campo parte del cemiOceano
- gem.cicese.mx

El inicio de predicción del tiempo

- The Times includes four short lines. The date: 1 August 1861.
- *General weather probable during next two days in the-*
  North–Moderate westerly wind; fine.
  West–Moderate south-westerly; fine.
  South–Fresh westerly; fine.
- That was it – the first published weather forecast, in 23 words.



Porcentaje de la habilidad del pronóstico para 3, 5, 7 y 10 días en el hemisferio norte y hemisferio sur (Bauer *et al.*, 2015)

el papel de las climatológicas y predicciones del largo plazo

- dice with bias
- still a dice!

Sin embargo

- Importante para
  - aseguro
  - generación de electricidad
  - recursos del agua
- Útil en el largo plazo!
- Probablemente equivocada algunas días

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Environmental Research Letters

CrossMark

LETTER

OPEN ACCESS

Skilful seasonal predictions for the European energy industry

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Keywords: seasonal prediction, nao, energy, predictability

Supplementary material for this article is available online

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http://www.independent.co.uk/news/uk/this-britain/weather-wars-at-the-met-office-is-it-going-to-be-a-barbecue-summer-thi

- In April 2009 the UK Met Office seasonal forecast leaked from a briefing to the energy sector to the public
- At the end of April 2009, its chief meteorologist at the time took the unusual step of calling a press conference to deliver good news after two gloomy summers. He explained that there was an 80 per cent chance of average or above-average temperatures.
- Initially it was though a success, the fact that there was “a chance” was communicated.
- Parts of the press went wild when he started talking about barbecues. July was then one of the wettest on record and people got angry. No talk about probabilities anymore ….

Why care when we get it “wrong”

- desensitization
- loss of funding
- panic
- no support when preventive action is required
- wrong weather forecasts will always feed climate sceptics!

HAPPY PHEW YEAR! 2017 weather forecast for Britain: January offers a chilly reception, but we're set for a BBQ summer

Find out the weather for each month of the year ahead

BY JIM DALE
30th December 2016, 12:51 am | Updated: 30th December 2016, 8:28 pm

https://www.thesun.co.uk/news/2499121/2017-weather-forecast-for-britain-january-offers-a-chilly-reception-but-were-set-for-a-bbq-summer/

THE past year has been damp squib in several ways, but a brighter 2017 is nearly here, say weather experts.
Summer is set to be a scorcher, but not before a big chill hits at the end of January.
Here Jim Dale, senior risk meteorologist of British Weather Services, predicts the rest of the year ahead.

February

February will bring snow and frost, as in Tetbury the same month in 2016

GET those thermals out — the country will feel like a fridge, if not the freezer, this month.
An airflow from Siberia is due to deliver a couple of snowy and frosty weather spells. It's enough to hit the front pages with traffic chaos and schools closures.

March

March will remain cold, with the occasional mild day

MARCH is normally a recovery month.
But don't be surprised if another wintry blast blows in and bites your backside just when you were thinking it was all over.
There will, however, be the occasional mild day to warm the cockles.

April

April will be dreary, as in London last spring

THIS is arguably the most diverse month in our calendar, capable of heatwaves, droughts, snow and hard frosts in equal measure.
This time around, bank on what it's famed for . . . showers! Plenty of them and possibly a tornado or two thrown in.
ill come just in time to deliver a near universal white Christmas. Cross your fingers very tight!

May

Showers will continue in May, as in overcast Malmesbury in 2016

NOW'S the time for some warmth.
But be warned, there's not going to be a major turnaround for a few weeks yet.
The month of May is also predicted to be pretty wet for some periods.
So expect a mixture of frontal systems and showers to dominate.

June

WOW, what a scorcher! There, I said it.
We are overdue a genuine heatwave and you know that when one late bus arrives it's often followed by two or three.
Sorry, Northerners, but the South will get the best weather first. Nothing new there.

More sunny days are on their way in July, like this one in Scotland in 2016

BY now the whole of the UK should be seeing higher temperatures than average.
There will be copious sunshine throughout all of July.
The odd week of wetter or thundery weather may strike here or there, but it will be more drought than deluge.

August

Temperatures continue to soar in August

BOOK your spot on the British beach.
The heatwave probably won't hit the heights of the summer of 1976. And we may not top the record UK temperature of 38.5C.
But if the probabilities are correct then you'll be needing sunblock. A lot of it.

September

In September heavy rain in may lead to floods, as it did on this section of highway near Stafford earlier this year

WE like September. It often delivers hot spells that make up for a ropy summer.
But this year could be a bit of a comedown following the expected heatwave.
Expect rain, lots of it. There may also be a risk of nationwide flooding.

October

Storms are in store for October, like this one in Bolton, Lancashire, last fall

RECENT autumns have proved mild, with warm temperatures at the beginning of the month.
But this may not be the case in 2017.
It is feared a rash of storms will rock the second half of the month.
So best be prepared for a washout October.

November

NOVEMBER is looking like being a pretty average month.
It will hopefully be mild like this year.
Expect the expected, with temperatures dropping and a mix of wet and milder days.
It should see a slow transition into winter.

December

December could bring a white Christmas (but hopefully not TOO white)

WE may not have got snow this Christmas.
But next December could well provide us with an early flutter or two.
With a little luck, the freeze will come just in time to deliver a near universal white Christmas. Cross your fingers very tight!

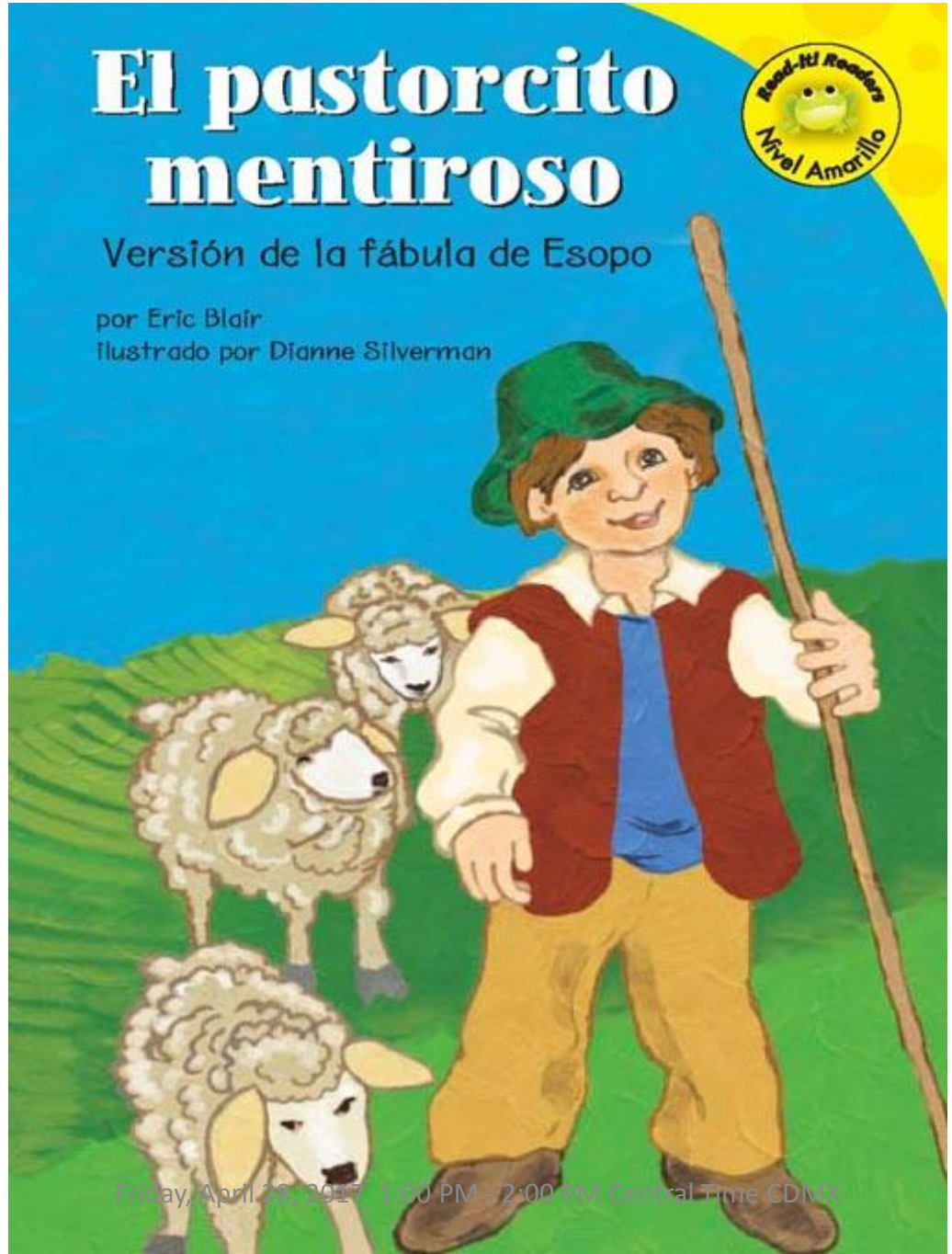

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Image: Mount Pinatubo erupts in the Philippines in 1991 (credit: AFP/Getty Images)

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- Prolonged disruption to aviation during the April - May 2010 eruption of Eyjafjallajökull, Iceland resulted in pressure to predict ash concentrations within the volcanic cloud for the purpose of considering allowing aircraft to fly in regions where ash concentrations were below an acceptable limit.
- Over the past few decades there have been a number of incidents where aircraft have flown into volcanic ash clouds resulting in damage to the aircraft and, in the most serious cases, loss of power to all engines

- Following the May 2010 erruption the forecasting centers have been heavily critizised for only releasing data on only approx. five levels of the atmosphere
- This was deemed not sufficient by some and some centeres even started to run their own dispersion models
- However, it was intentional to only release a few model levels to the public/decision makers, despite the model running with many more
- If the high vertical resolution of the model would be taken as a true representation and the ash would significantly reduce below 35000ft, say, some airlines may be tempted to fly at 30000ft anyway, as the model “clearly said it was safe”
- There is no reason to attribute this level of accuracy to a model result!

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Claramente nadie sería tan tonto….

http://www.telegraph.co.uk/travel/travelnews/7627992/Volcanic-ash-cloud-Virgin-boss-Branson-criticises-flight-ban-as-wrong-decision.html

- Volcanic ash cloud: Virgin boss Branson criticizes flight ban as 'wrong decision'

Virgin boss Sir Richard Branson Photo: PA

By Alastair Jamieson
10:38AM BST 24 Apr 2010

Follow 6,570 followers

The Virgin Atlantic boss said the airline lost about £50 million in six days and called for compensation for the industry.

Speaking in central London ahead of the Virgin London Marathon, Sir Richard said: "We've never asked for Government help in 25 years. We didn't even ask for Government help after 9/11. We took it on the chin.

"But I think on this occasion this was very much a Government decision to ground the planes and we would suggest that the Government should

- Ryanair's Michael O'Leary said at the time that "there was no ash cloud. It was mythical. It's become evident the airspace closure was completely unnecessary... none of us could see a bloody thing." He added: "Some idiot [...] spills coffee over the map of Europe and produces a big black cloud."
- Willie Walsh, the BA chief executive, described the closure as a "gross over-reaction to a very minor risk" and Virgin boss Richard Branson described the final set of closures as "beyond a joke". It is estimated the airlines lost about £2bn.

https://es.wikipedia.org/wiki/Vuelo_867_de_KLM

- El 15 de diciembre de 1989, el **vuelo 867 de KLM** en ruta al aeropuerto internacional de Anchorage, Alaska, desde el aeropuerto de Ámsterdam Schiphol, se encontraba en descenso hacia el aeropuerto de Anchorage cuando sus cuatro motores fallaron. El Boeing 747-400, con menos de seis meses de vida,[1] voló a través de una nube de ceniza volcánica procedente del Monte Redoubt,[2] que había erupcionado el día antes.
- En este caso la ceniza causó más de US$80 millones en daños al avión (siendo necesario reemplazar los cuatro motores), pero no hubo que lamentar ninguna víctima.

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Predicción numérica es clave

- A beses no se puede ver
- La mediciones requieren aviones
- El área es grande

Que mas podemos hacer con simulación numérica?

http://www.bbc.co.uk/science/earth/natural_disasters

Image: Pedestrians attempt to stay dry in Dhaka, Bangladesh, during flooding on 28 July 2009 (credit: AFP/Getty Images)

Image: A forest fire in Boise National Forest, Idaho, United States (credit: David R. Frazier Photolibrary, Inc./SPL)

Las predicciones determinísticas del corto plazo

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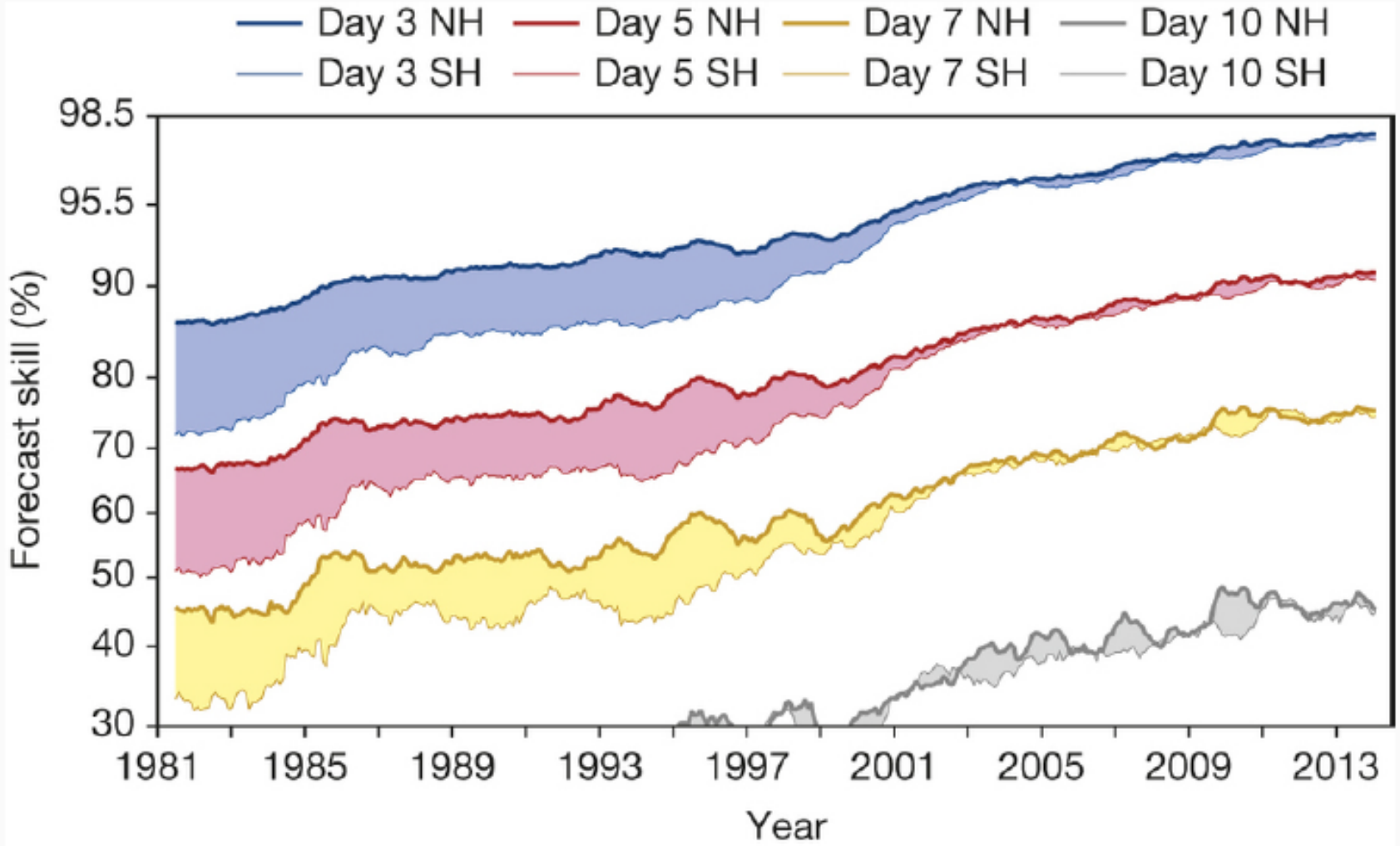
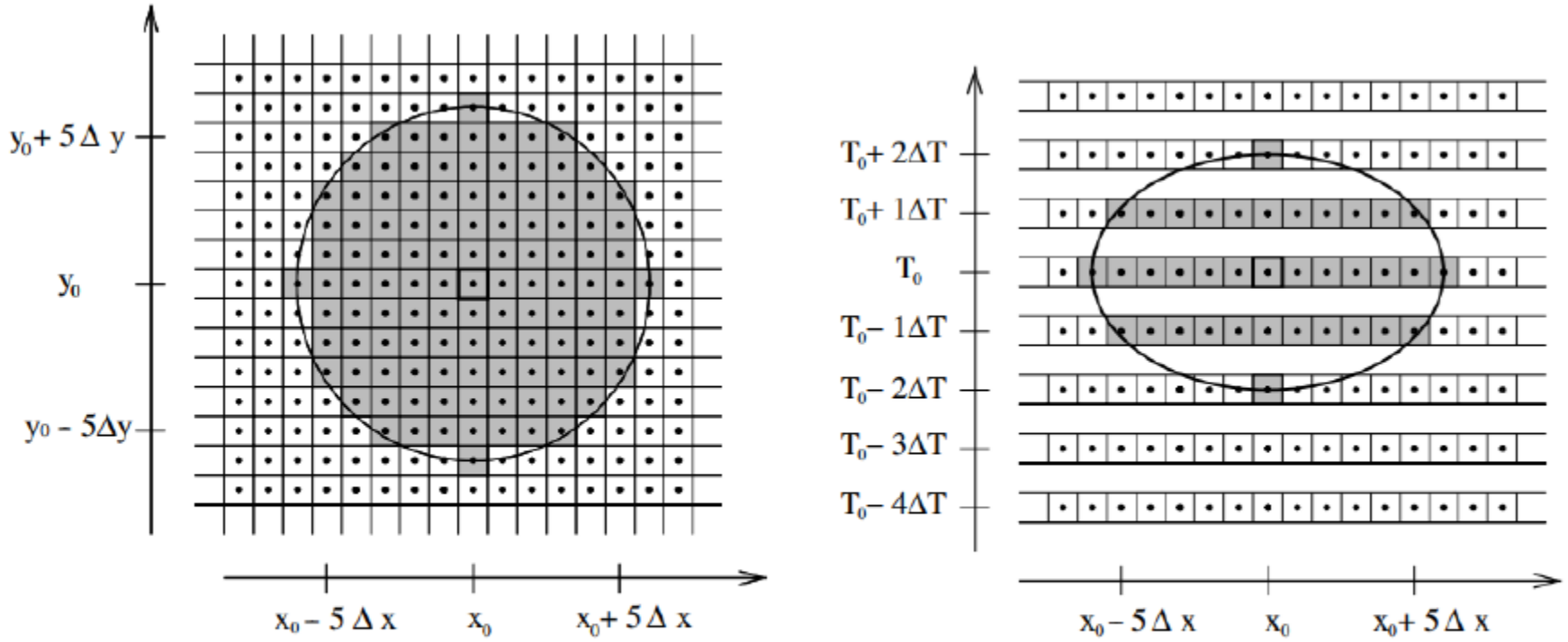


: Porcentaje de la habilidad del pronóstico para 3, 5, 7 y 10 días en el hemisferio norte y hemisferio sur (Bauer *et al.*, 2015)

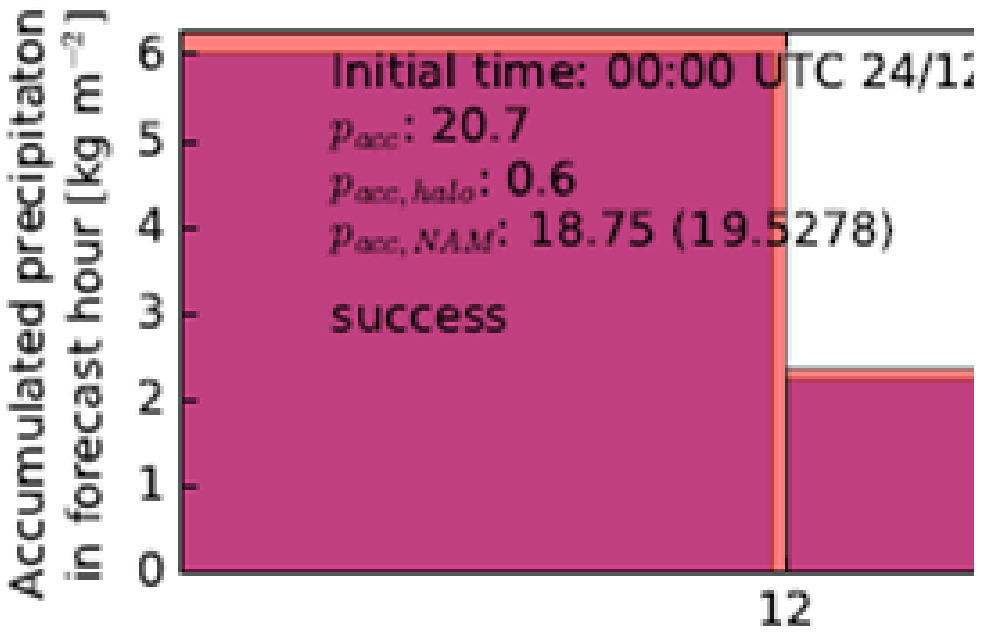
- sin embargo:
  - no son confiable en los puntos del malla
  - son una mejor representación del los procesos
  - pero no necesariamente del tiempo
  - dicen nada de los incertidumbres



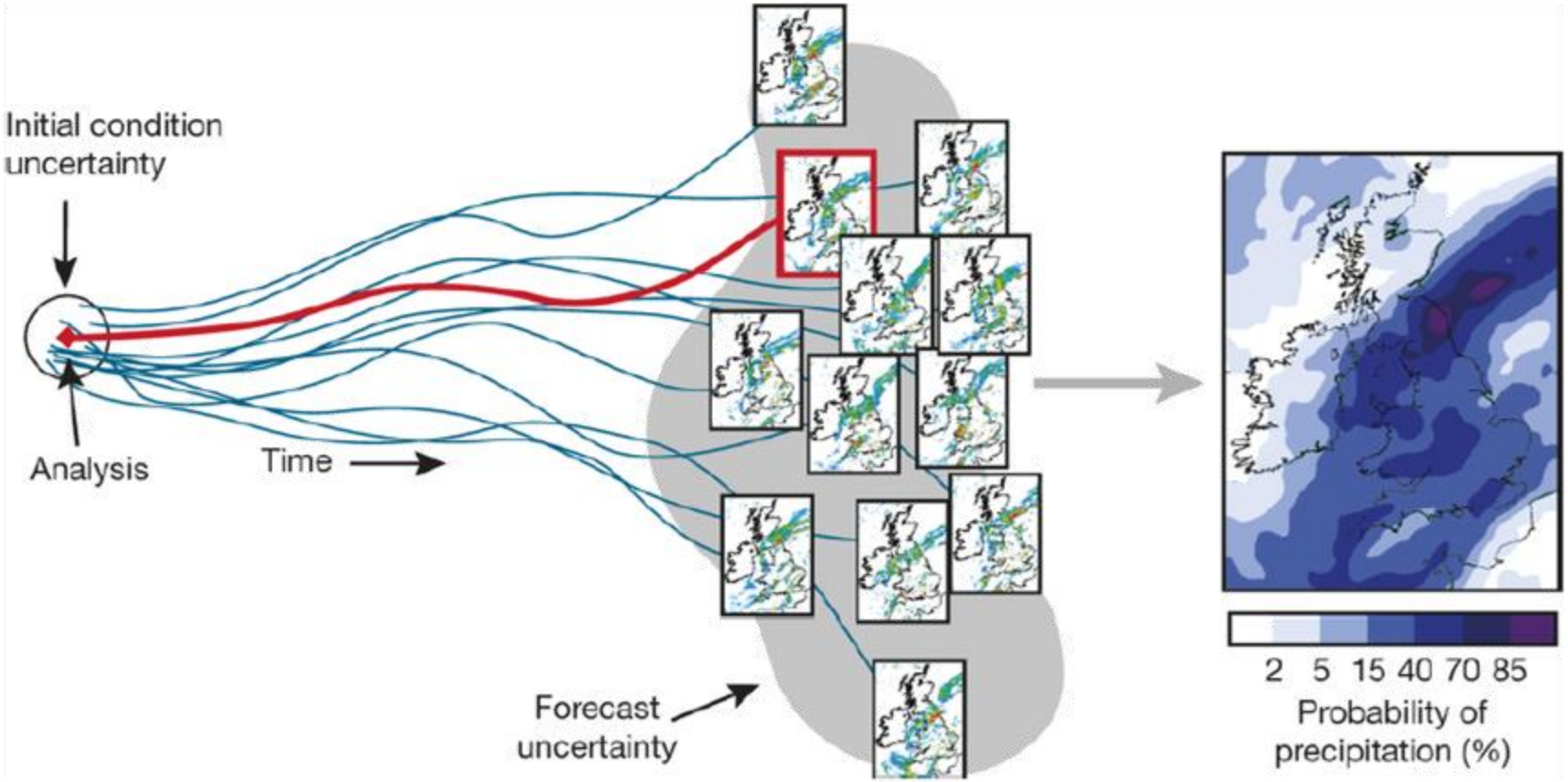
Esquema de espacio-temporal de una vecindad para el punto (x_o, y_o). Izquierda vecindad espacial en el plano (x, y).

Theis, Hense and Damrath, "Probabilistic precipitation forecast from a deterministic model: a pragmatic approach", Meteorol. Appl. 12, 257-268 (2005)

- Later we will see this figure again in its context. Here only note the predicted precipitation at a gridpoint and the average in the 9 cells in the proximity, in brackets.
- 5 km model
- 15x15km^2



introducer el componente aleatorio


Initial condition uncertainty
Analysis
Time
Forecast uncertainty
2 5 15 40 70 85
Probability of precipitation (%)

modelos locales de alta resolución

- porque la resolución?

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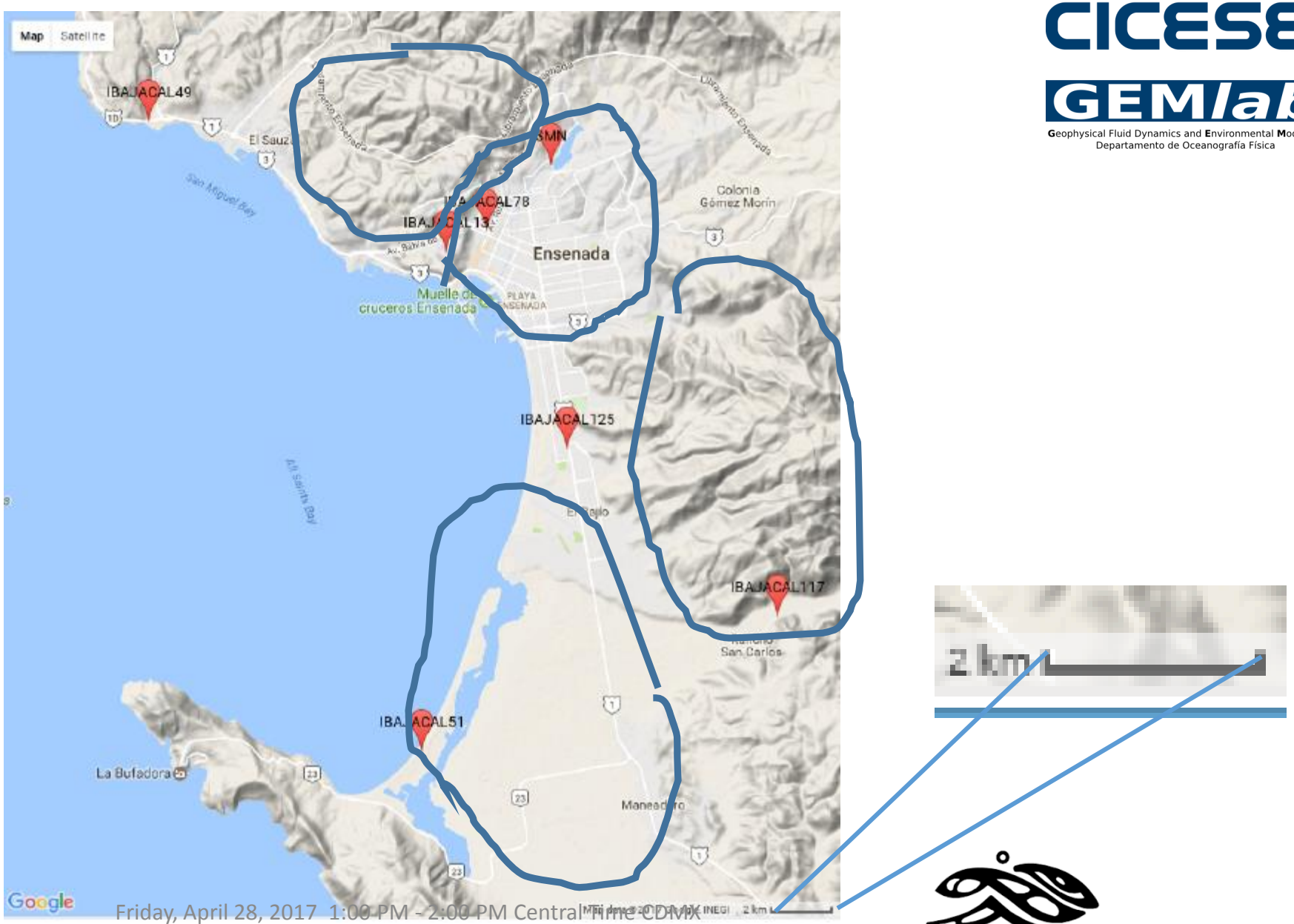
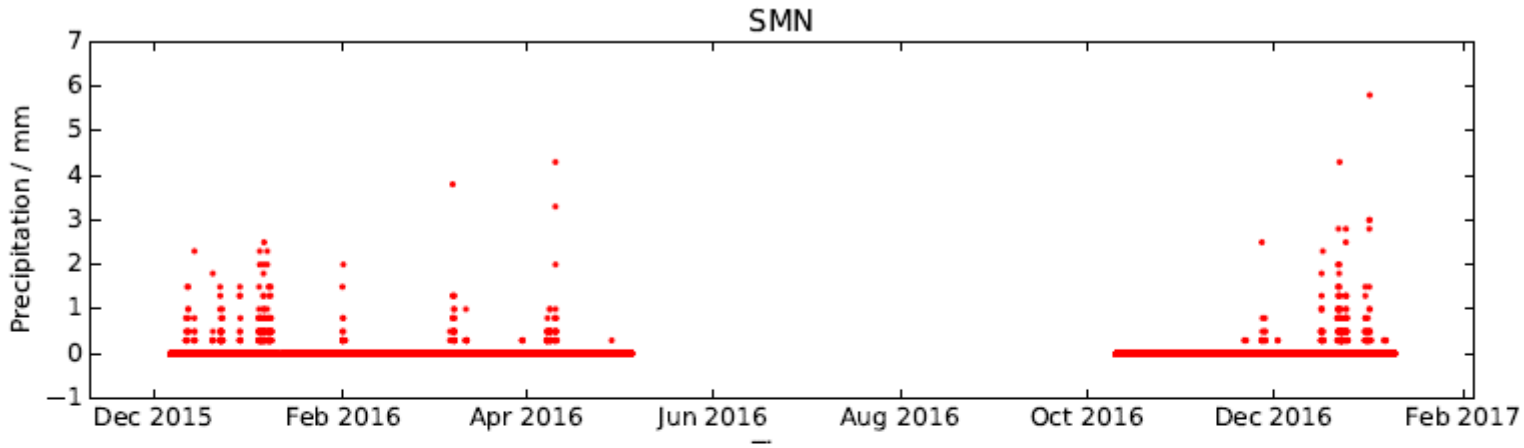
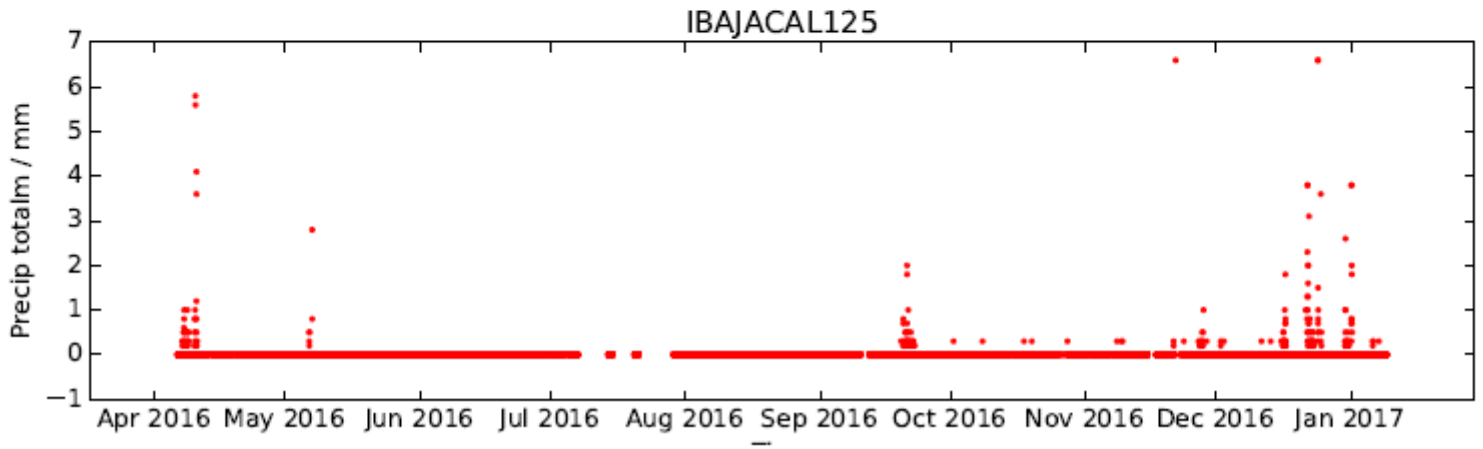




(a) SMN



(b) IBAJACAL125

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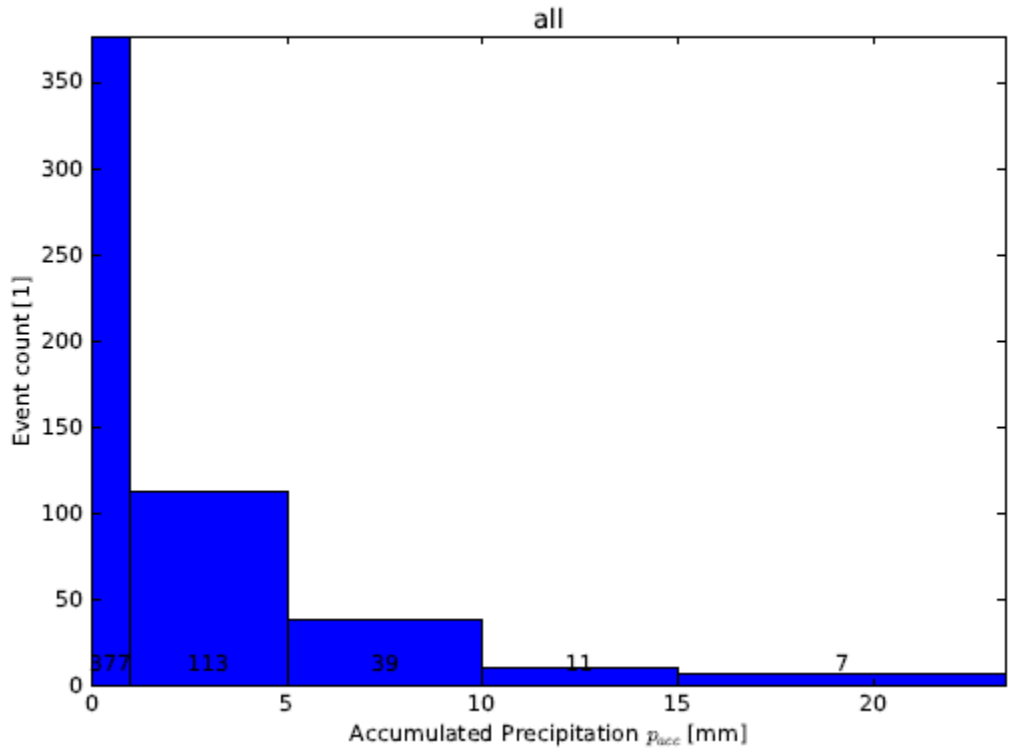

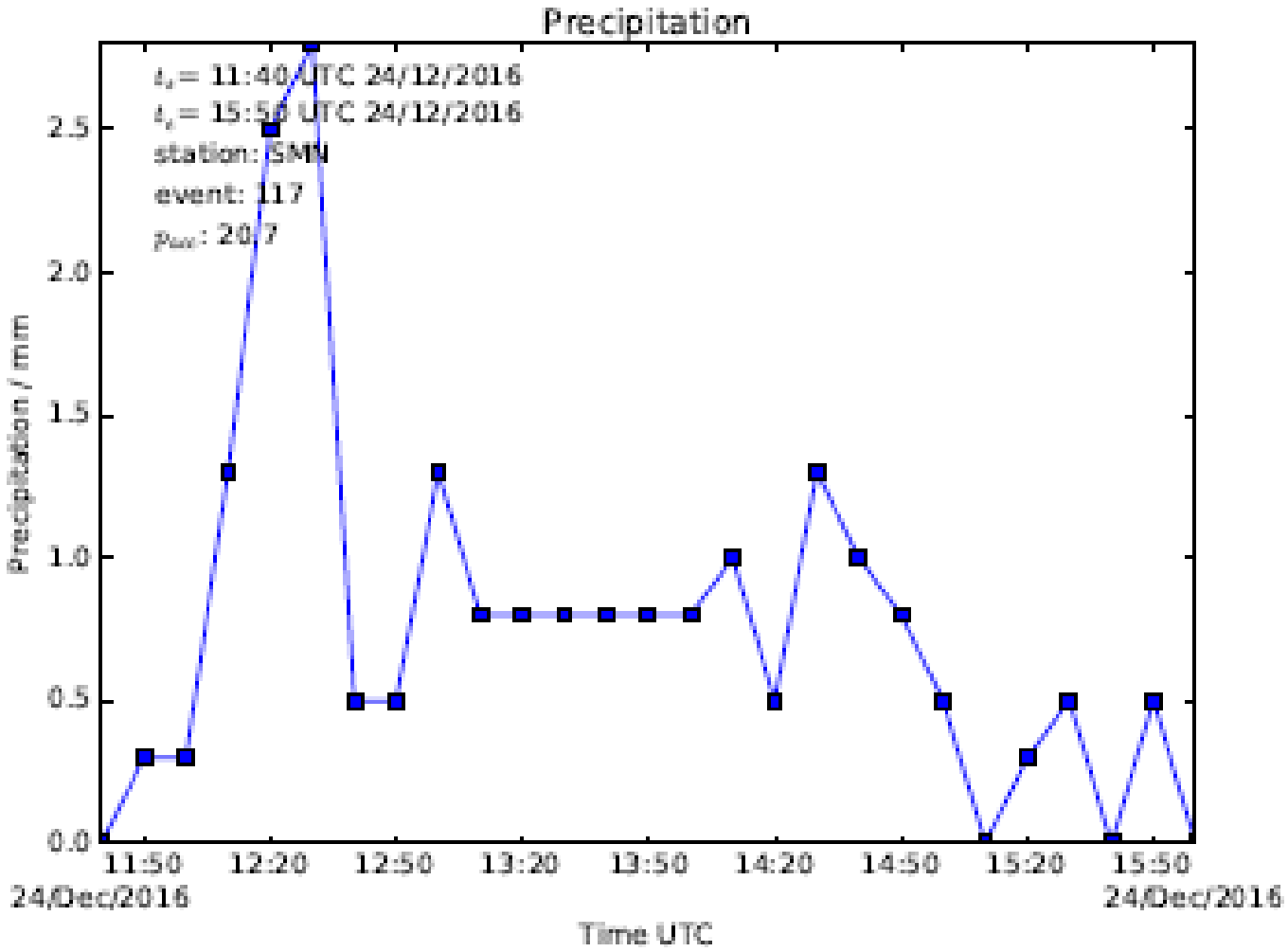
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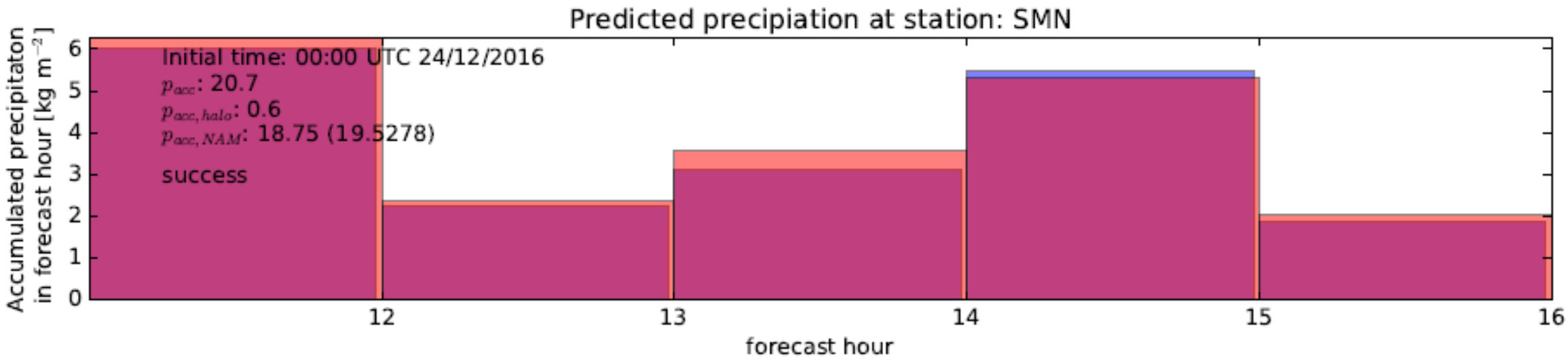

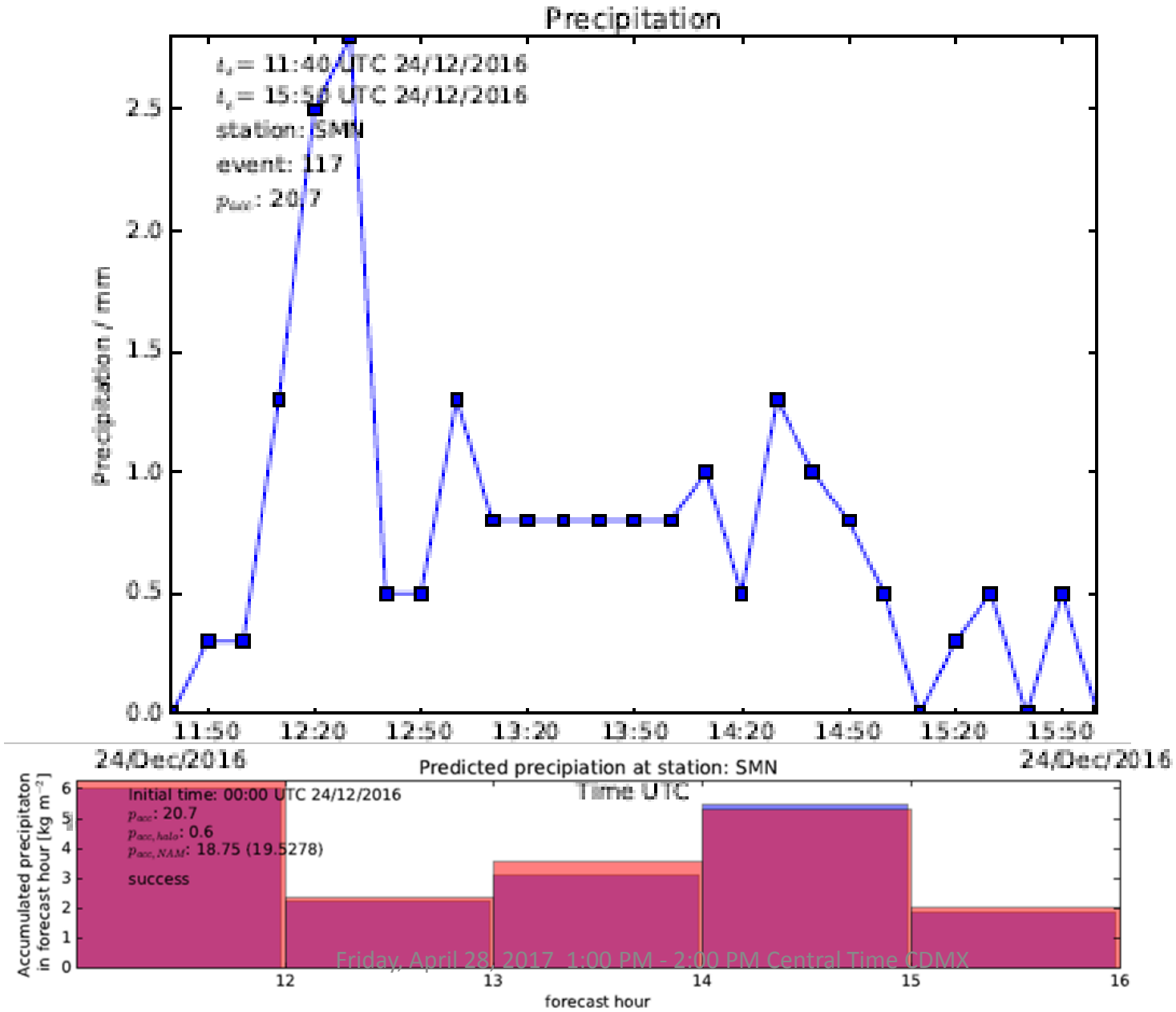

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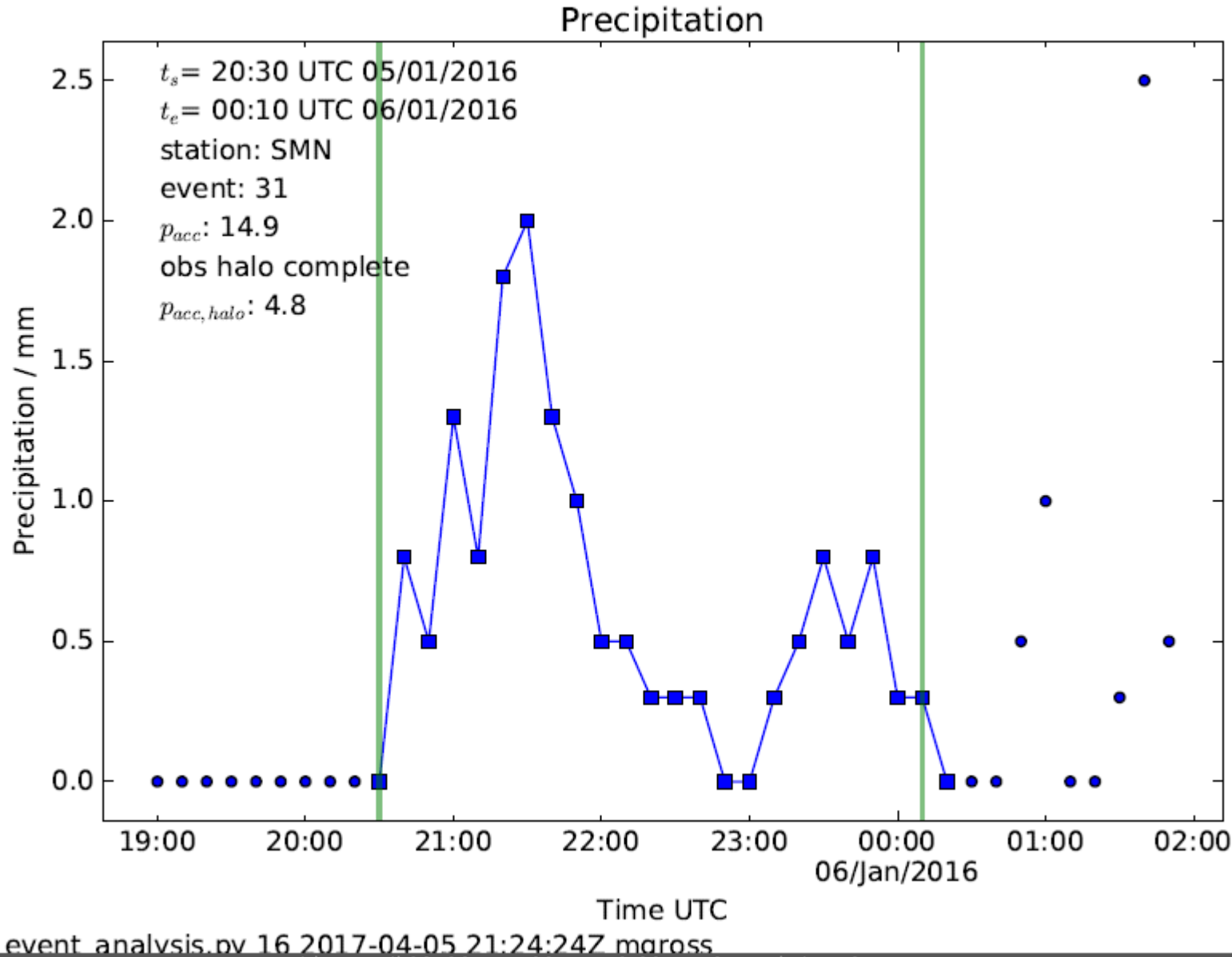
Friday, April 28, 2017 1:00 PM - 2:00 PM Central Time CDMX



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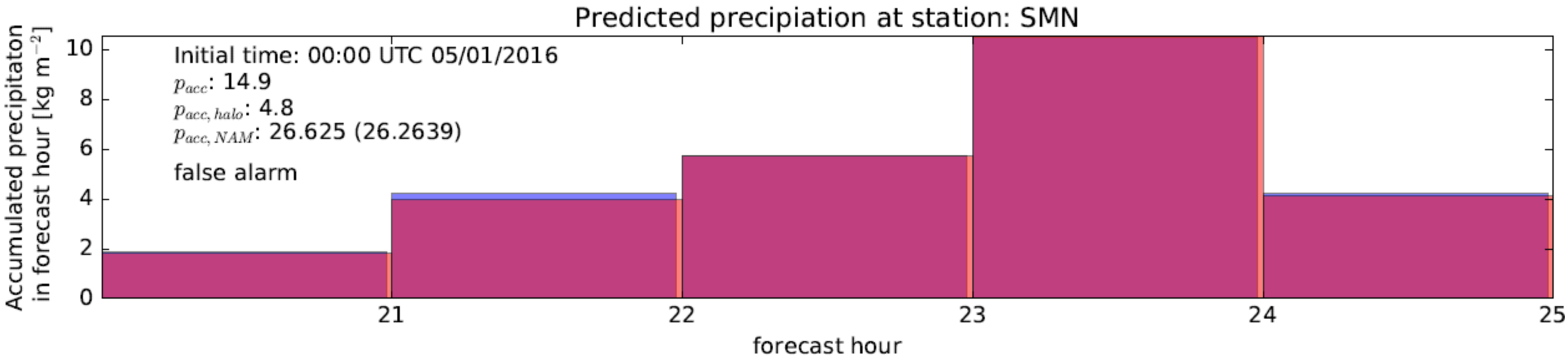

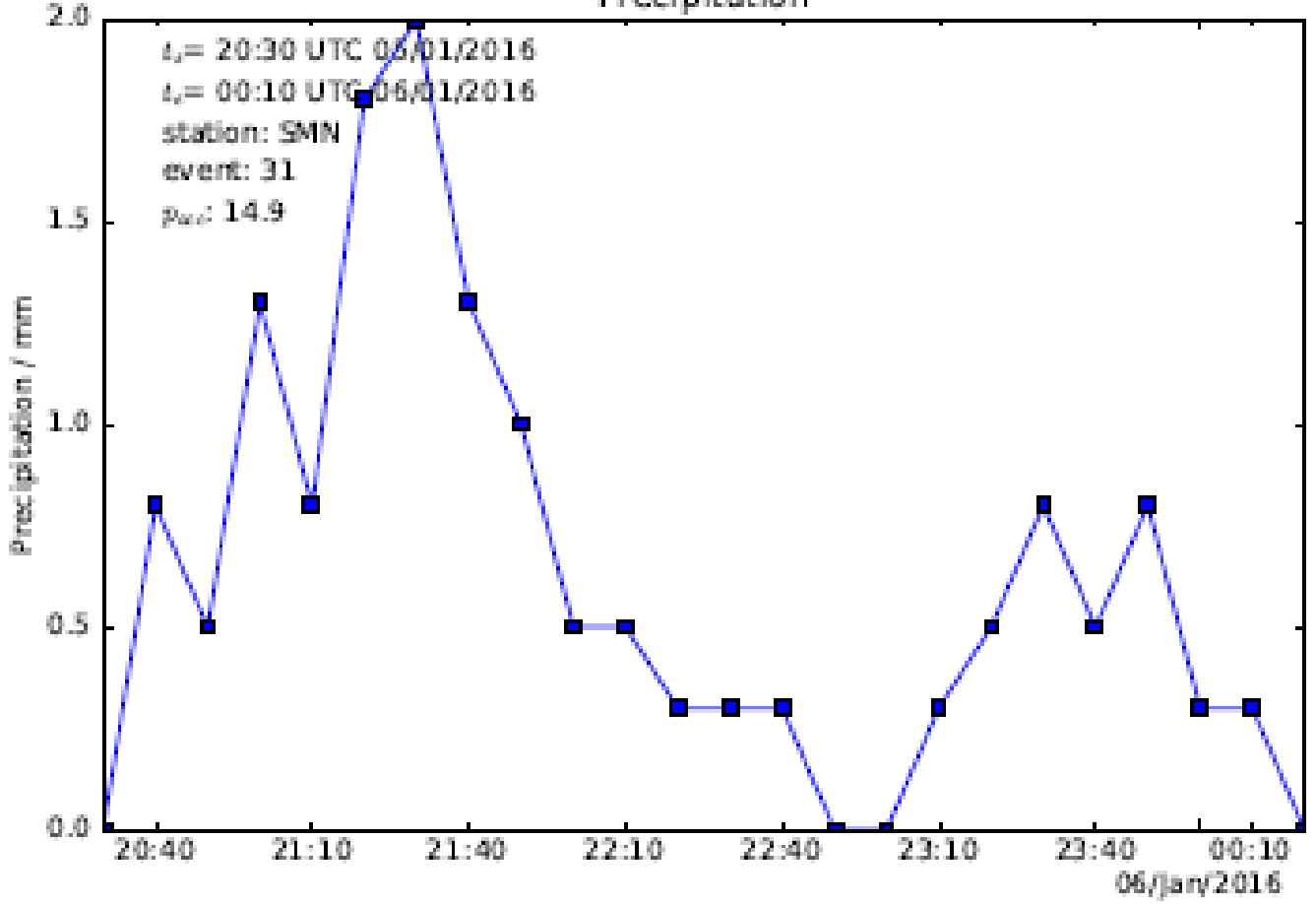

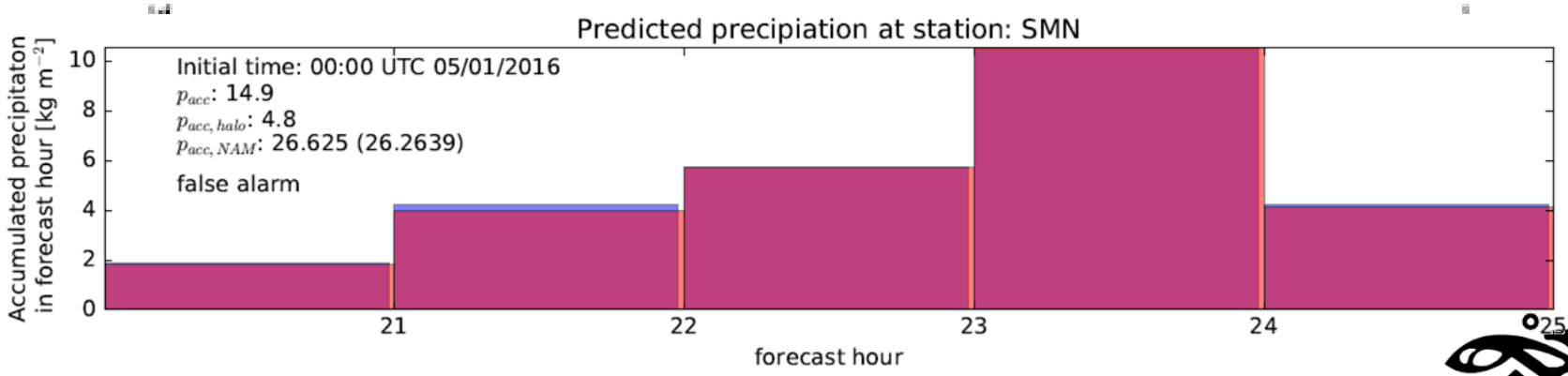

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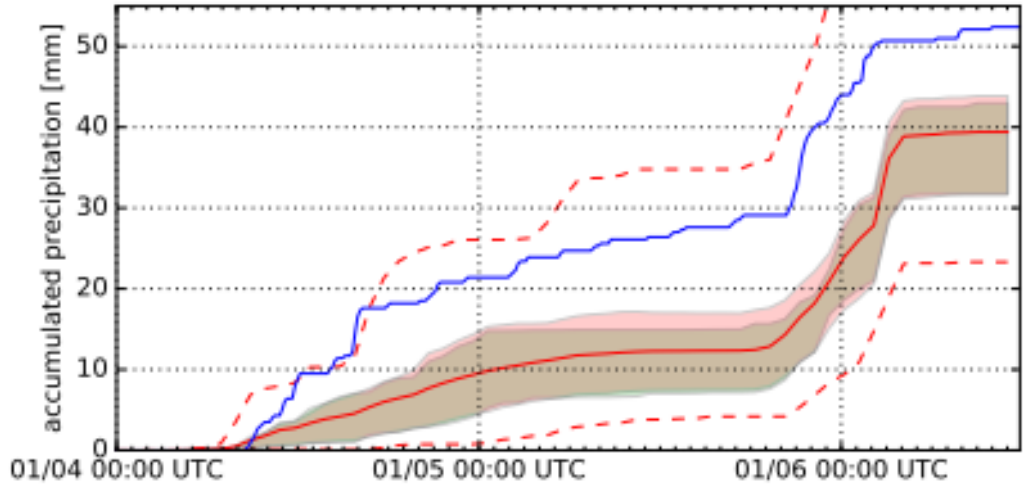
- missed 12
- success 3
- false alarm 4

- at times 22mm difference

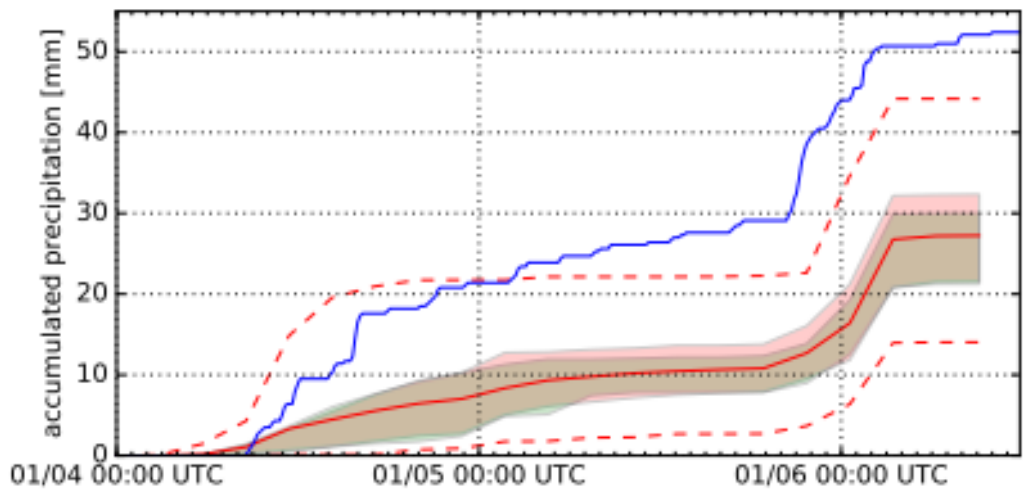
shows two things:

- success rate not good
- some may be for the wrong reason (right amount, wrong distribution in time)
- resolution certainly poor (often 9pt avg the “same” as point)

https://arxiv.org/pdf/1610.07676.pdf



(a) Subgrid enhanced



(b) Point ensemble

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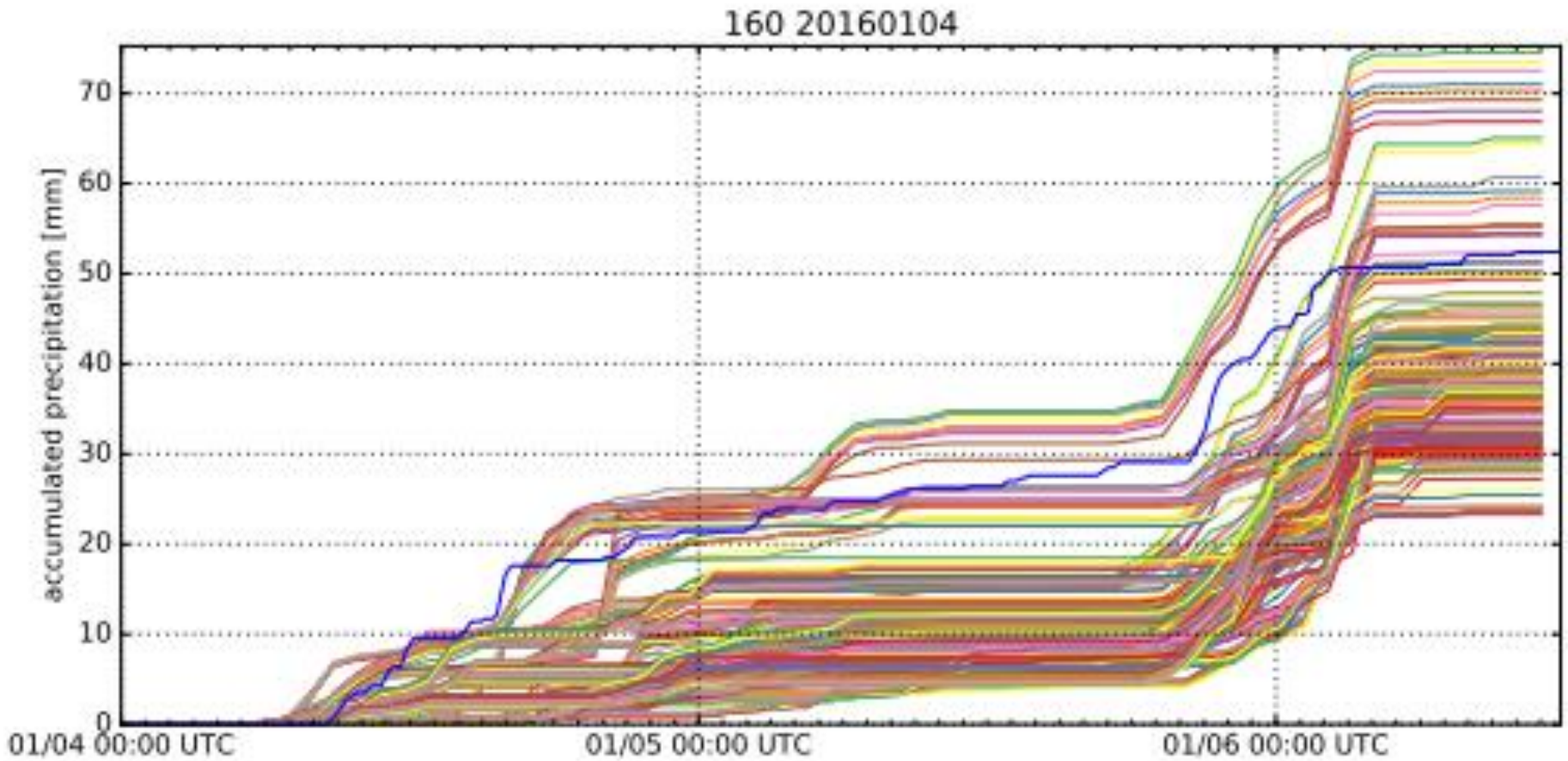
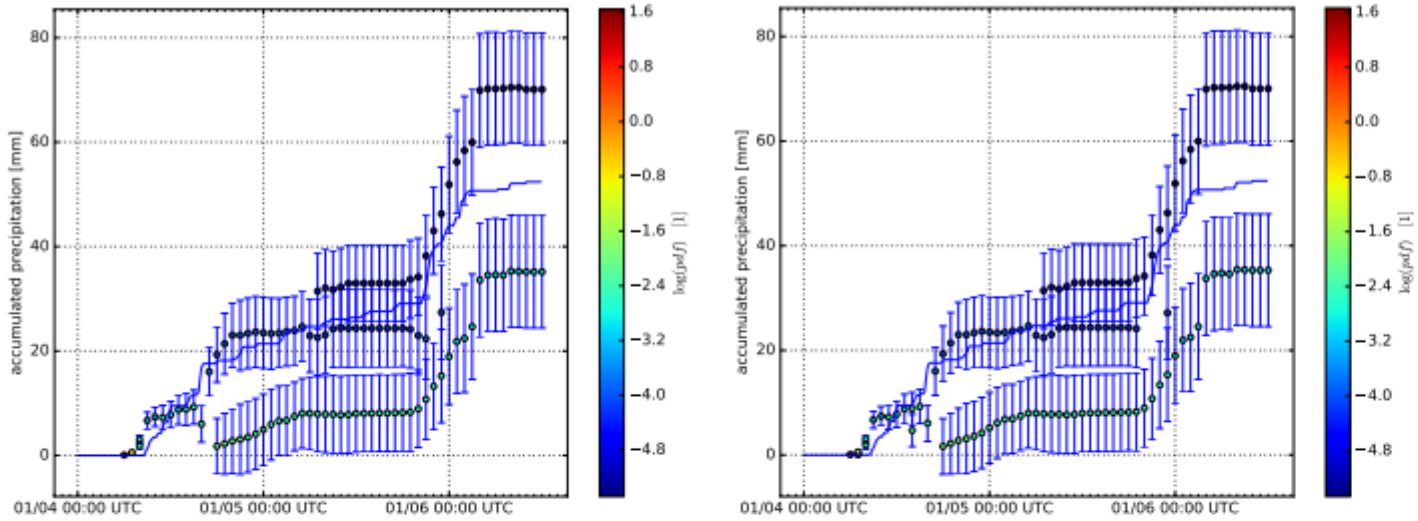
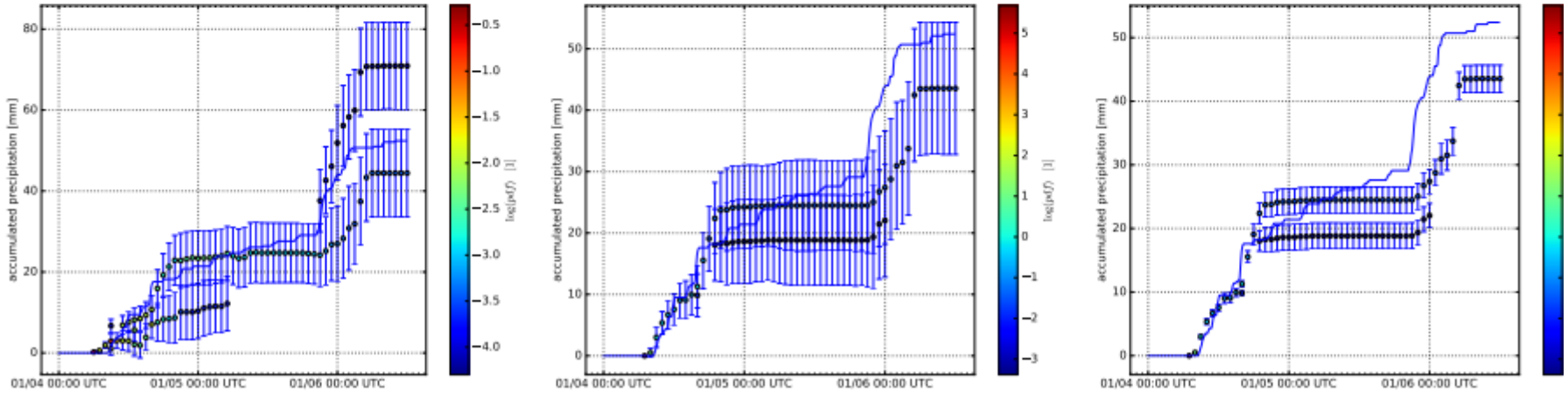




(a) $s_{thresh} = 5$ (b) $s_{thresh} = 10$



(c) $s_{thresh} = 15$ (d) $s_{thresh} = 20$ (e) $s_{thresh} = 20$

y que vamos a hacer con esto?

- información vital por los unidades de rescate
- tienen que saber cual son las incertidumbres
- mover gente y equipo implica un riesgo
- El riesgo de estar equivocado
- Esto no puede ser eliminado, sino minimizado

Contaminación costal después de un evento lluvioso

El tsunami model

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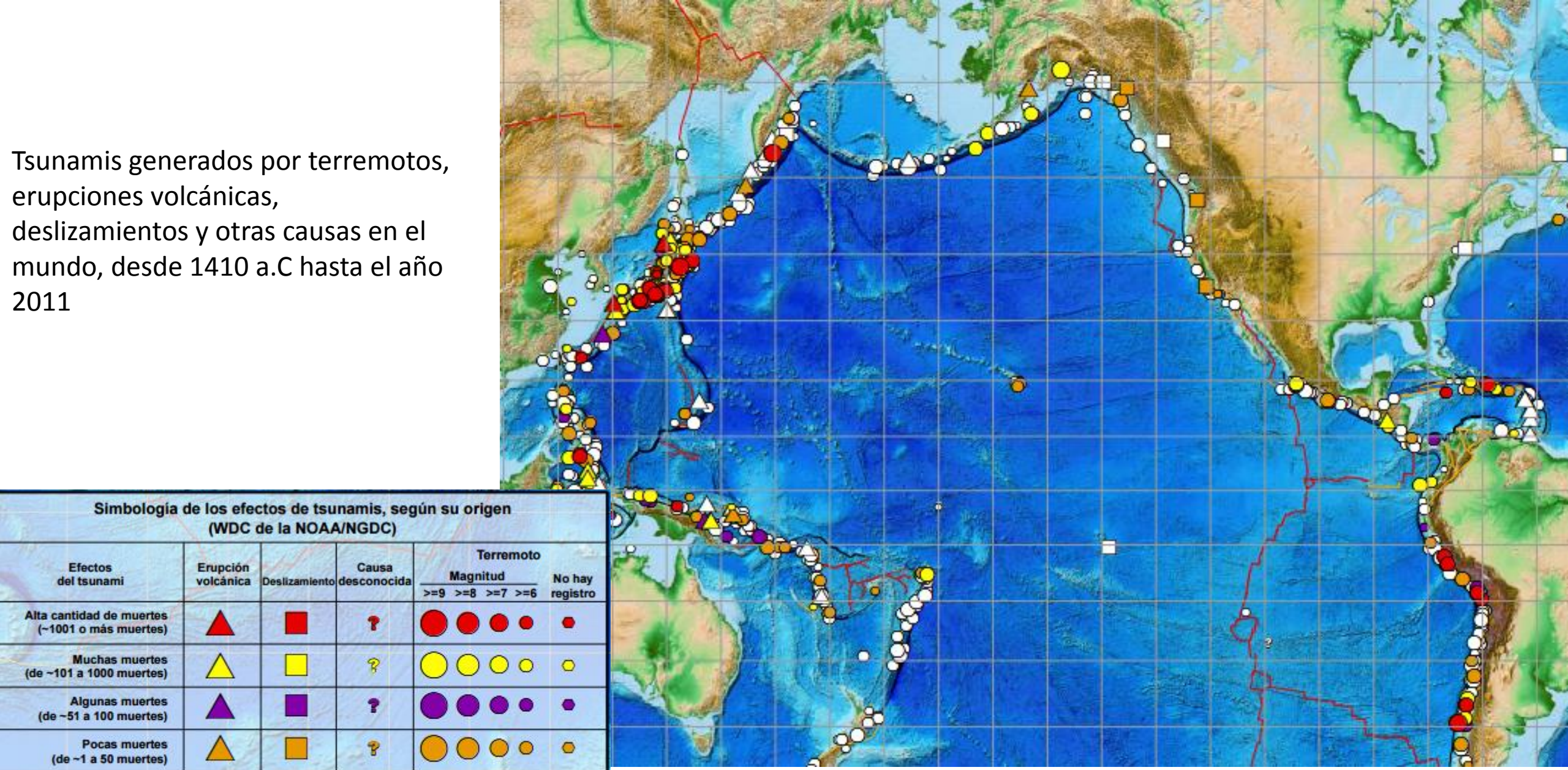
Tsunamis generados por terremotos, erupciones volcánicas, deslizamientos y otras causas en el mundo, desde 1410 a.C hasta el año 2011



Simbología de los efectos de tsunamis, según su origen (WDC de la NOAA/NGDC)

Efectos del tsunami	Erupción volcánica	Deslizamiento	Causa desconocida	Terremoto Magnitud >=9	>=8	>=7	>=6	No hay registro
Alta cantidad de muertes (~1001 o más muertes)	▲	■	?	●	●	●	●	●
Muchas muertes (de ~101 a 1000 muertes)	▲	■	?	●	●	●	●	●
Algunas muertes (de ~51 a 100 muertes)	▲	■	?	●	●	●	●	●
Pocas muertes (de ~1 a 50 muertes)	▲	■	?	●	●	●	●	●
Ninguna muerte	△	□	?	○	○	○	○	○

Límites de Placas

Divergente — Convergente — Transformante

Fuente: ITIC

- No se puede hacer predicciones de tsunamis
- Sin embargo podemos analizar sus impactos potenciales

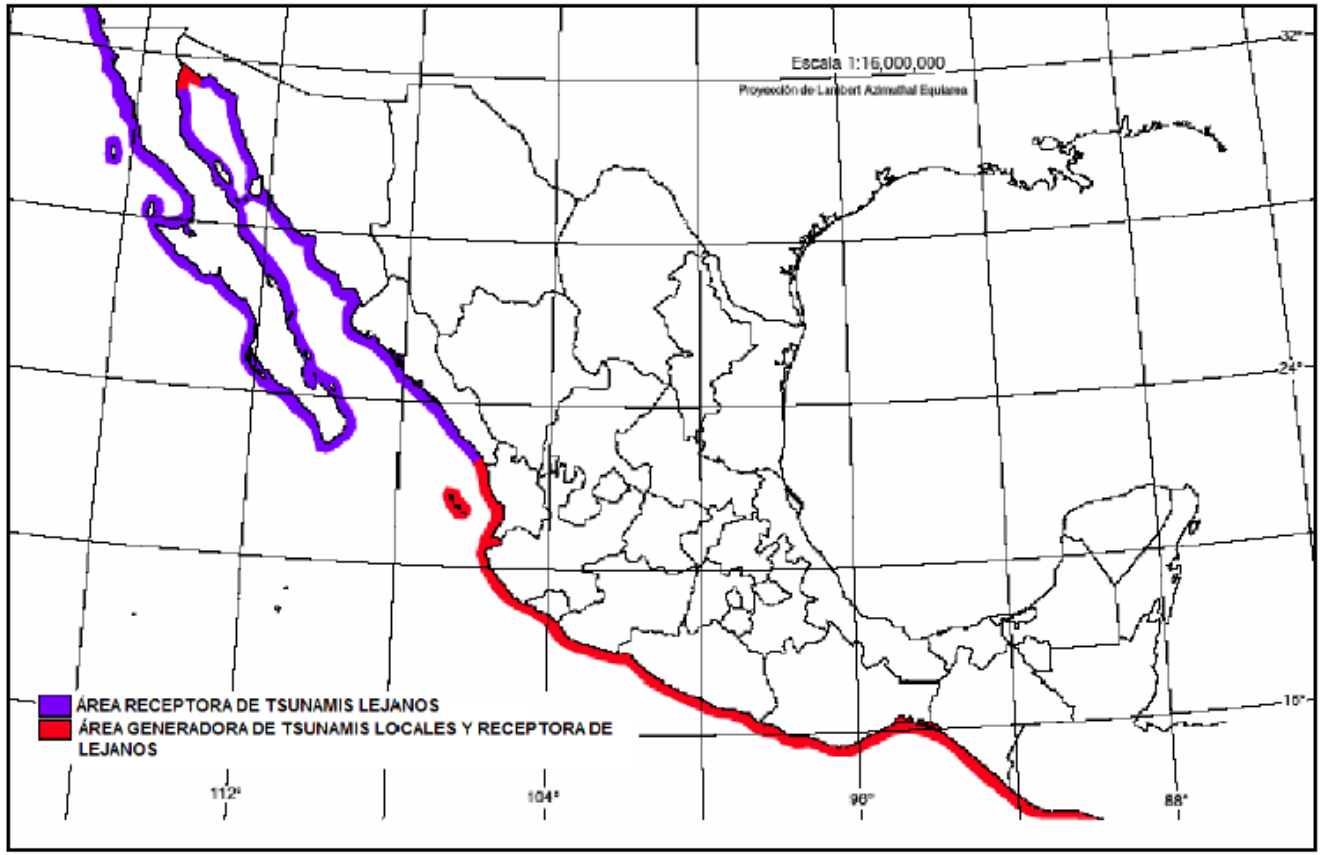
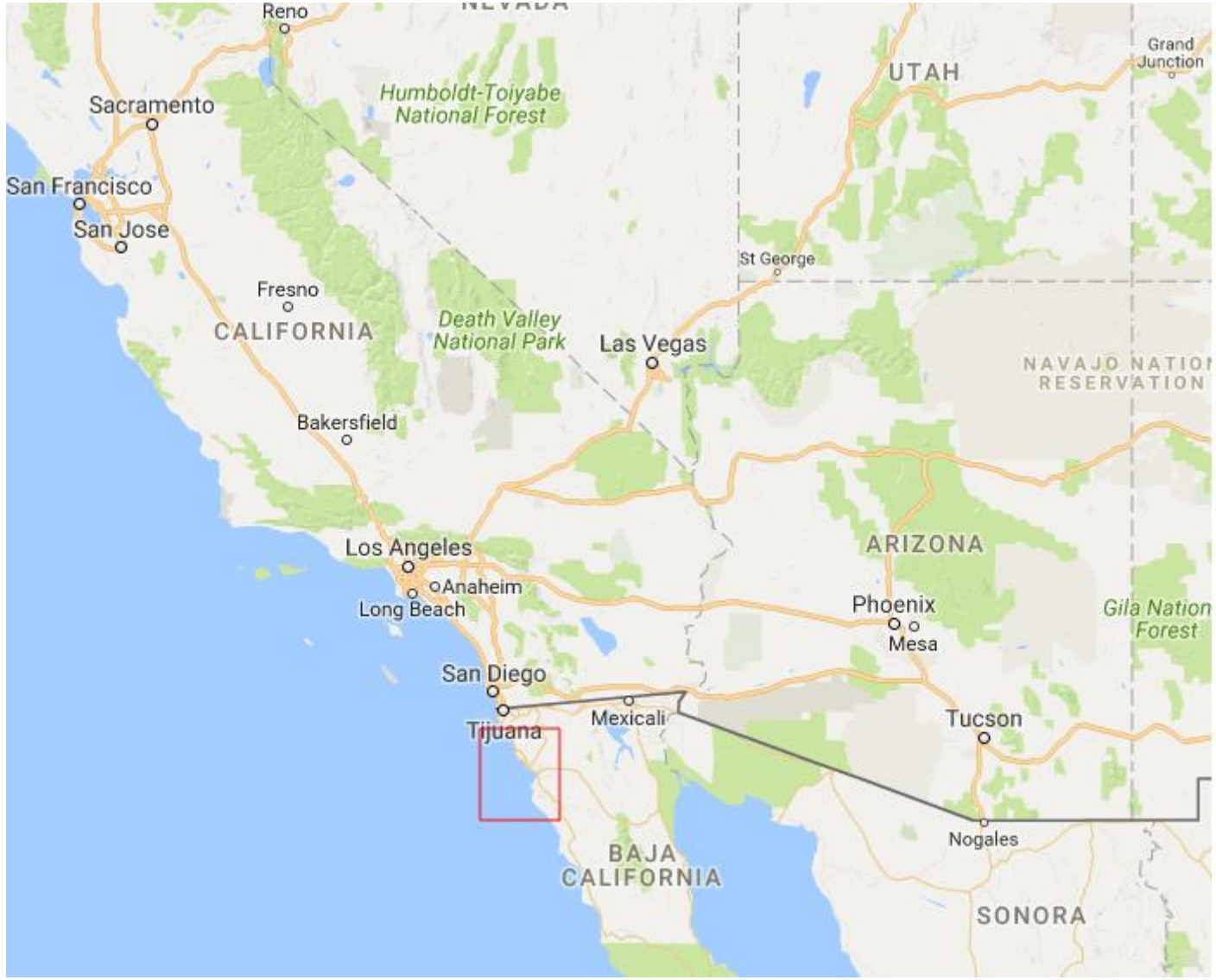


Figura 20.- Áreas receptoras y generadoras de Tsunamis. CENAPRED [8]

Fuente: **Atlas de Riesgos Naturales del Municipio de Ensenada 2012, Versión 30 Marzo 2012**
Universidad Autónoma de Baja California, Instituto de Investigaciones Oceanológicas

- delft3d
- 40 niveles verticales
- 1/60 y 1/296 grados resolución horizontal
- 0.1s y 0.01 segundos pasa de tiempo, non-hidrostático
- $\cosh^2$ condición de frontera con 8m amplitud
- impacto desde el oeste



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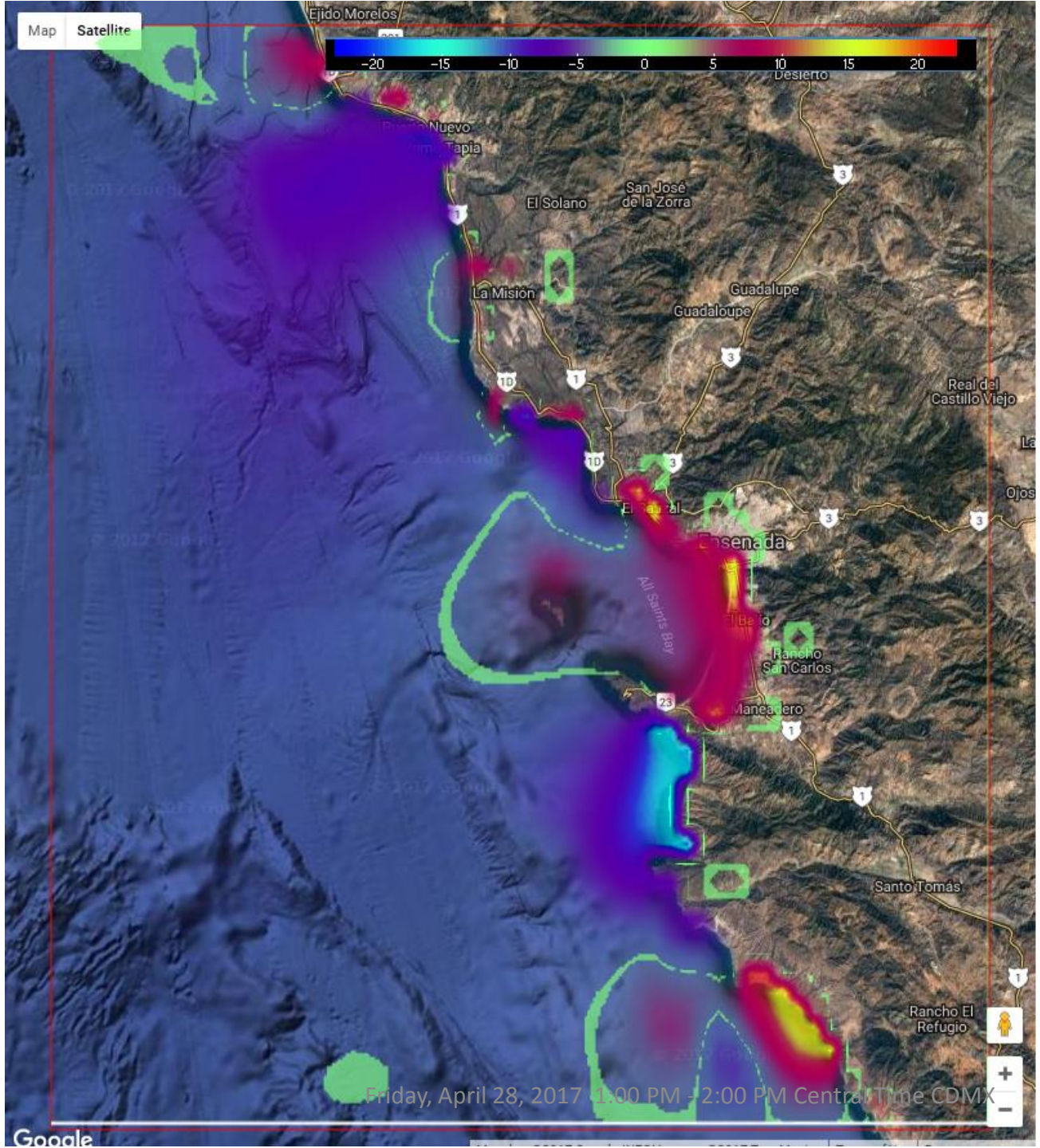


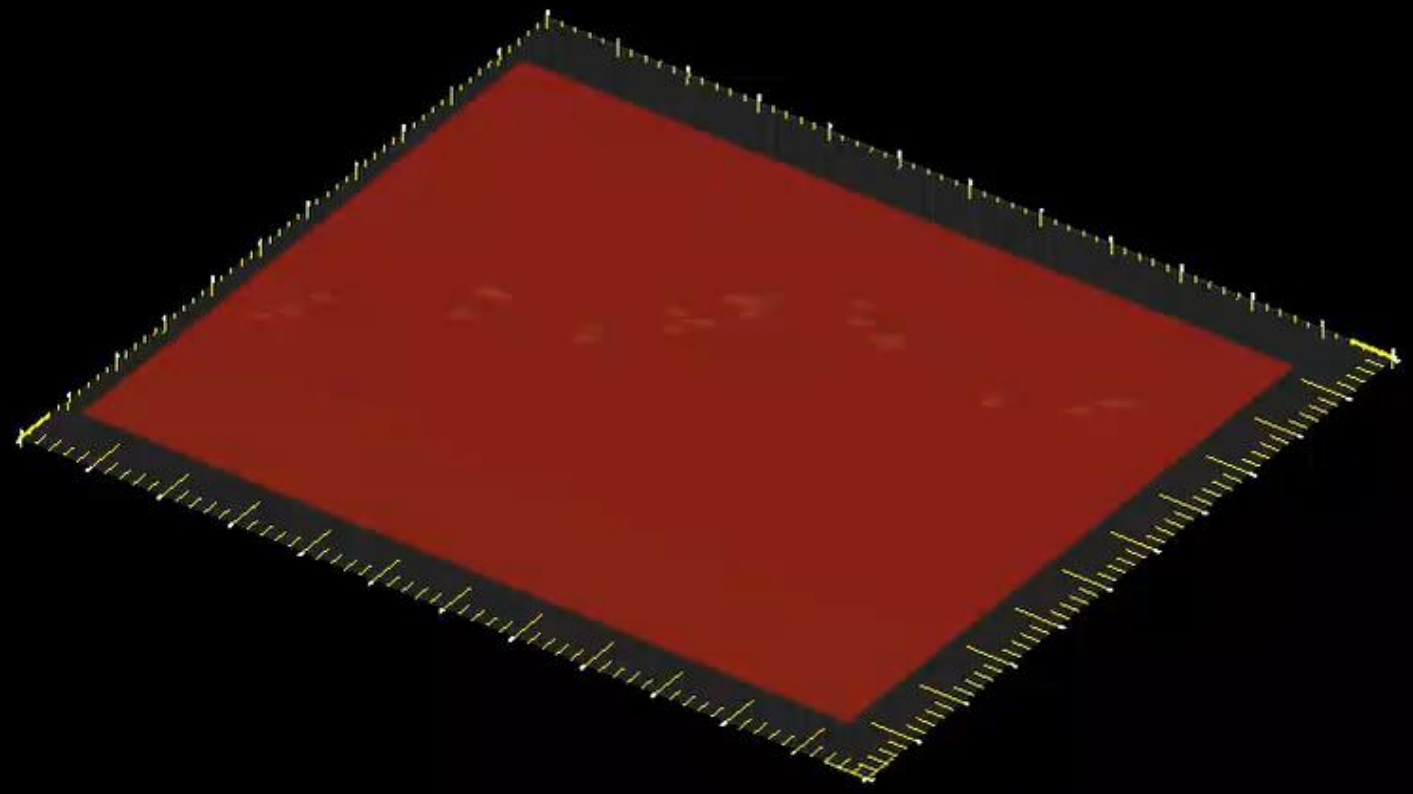
CICESE

GEMlab

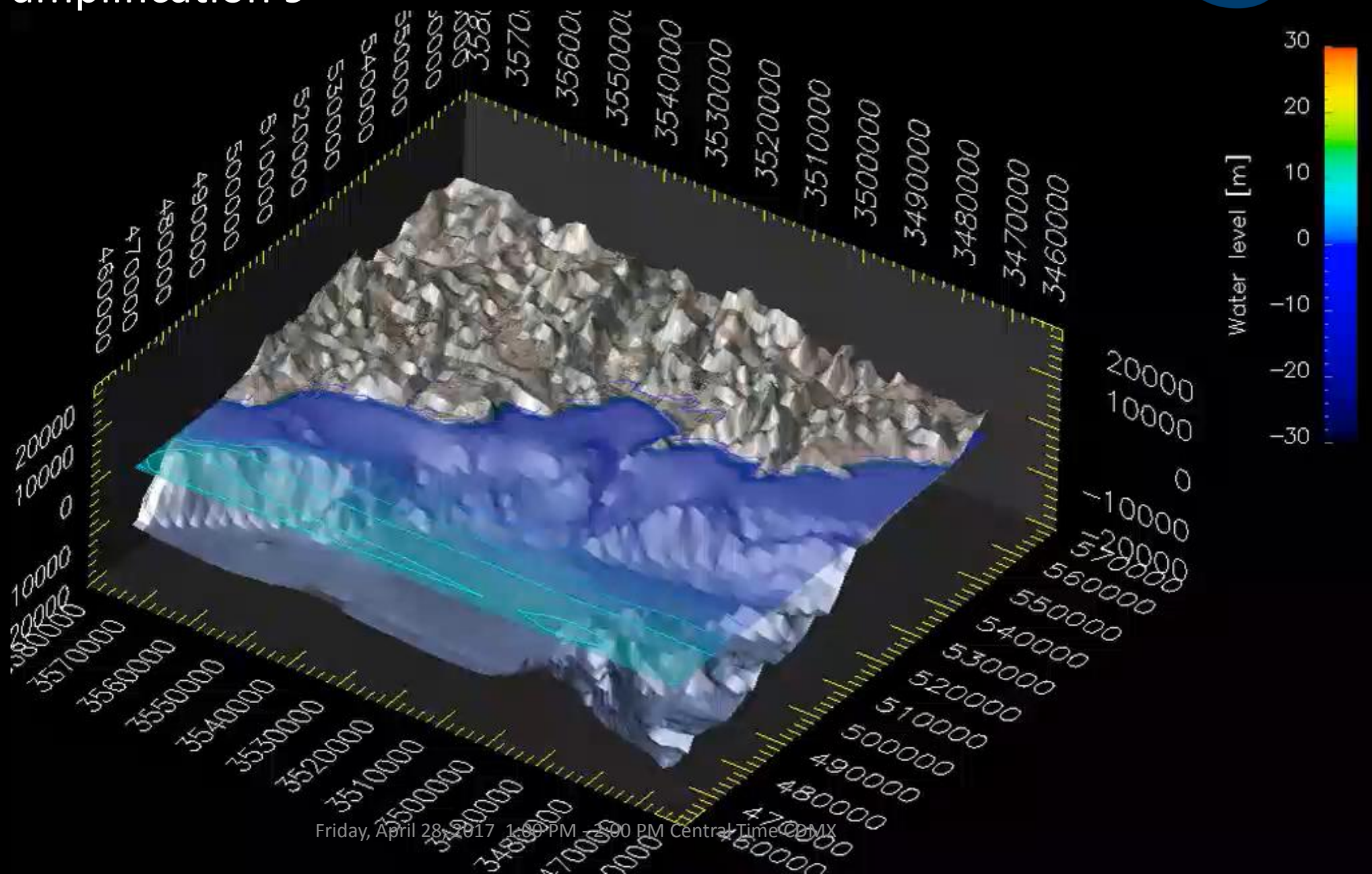
Geophysical Fluid Dynamics and Environmental Modelling
Departamento de Oceanografía Física

Friday, April 28, 2017 1:00 PM - 2:00 PM Central Time CDMX

- wave only, vertical amplification 800x
- http://gem.cicese.mx/index_php/webinario-ugm/?lang=es

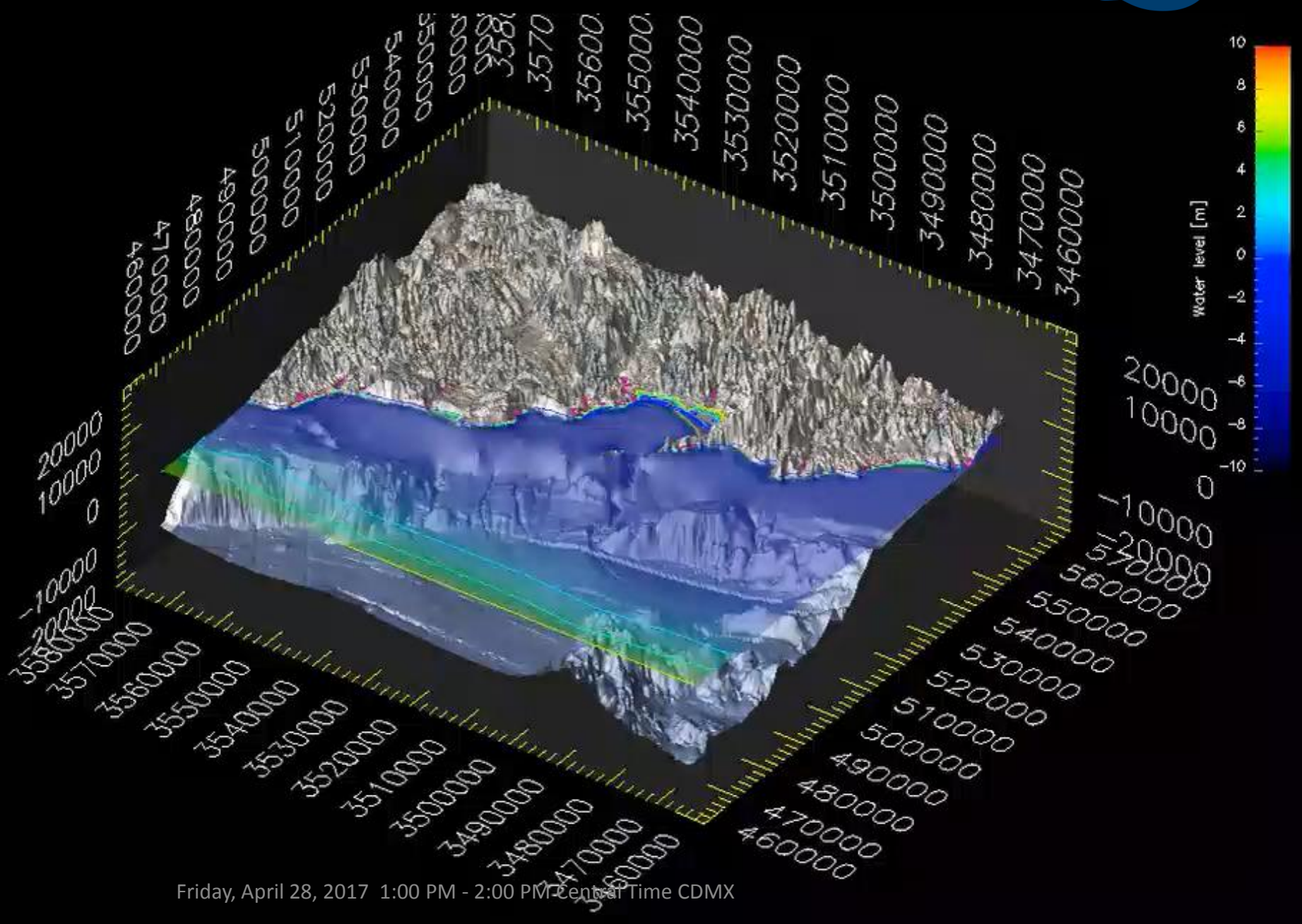


- vertical amplification 9

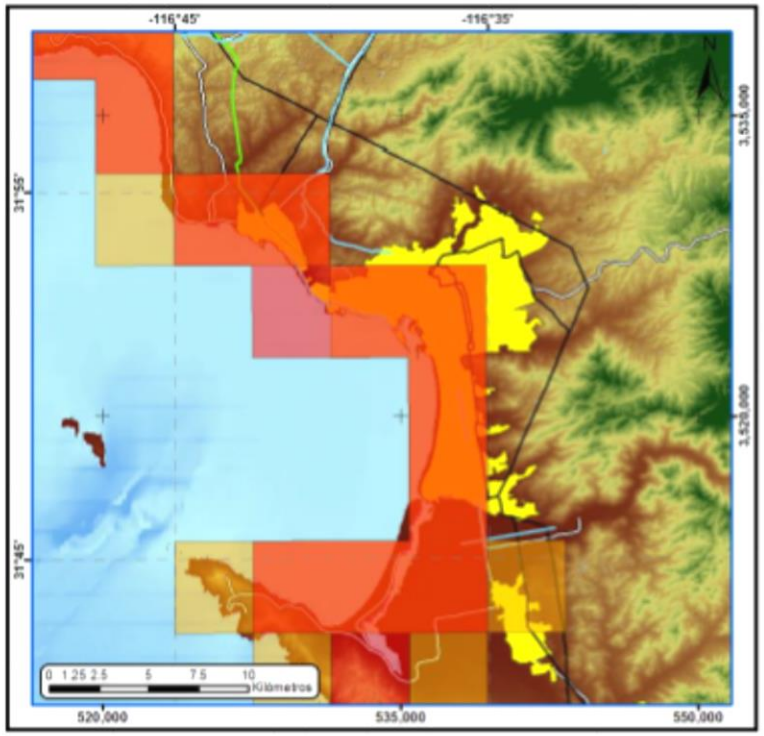


- closeup, vertical amplification 9

1/296 degree resolution




Water level [m]
10
8
6
4
2
0
-2
-4
-6
-8
-10



Simbología

- Acueducto
- Poliducto Pemex
- Líneas Eléctricas
- Carreteras Principales
- Mancha Urbana
- Delegaciones
- Poblaciones con mas de 2,500 hab.

Peligro Tsunami

- Medio
- Alto

Fuentes de información:
INEGI, SeMAR, Municipio Ensenada,SIDUE, SAGARPA, CONANP,
Center for Hazards and Risk Research (CHRR), Global Multi-Resolution Topography (GMRT), Columbia University, www.worlddim.org.

Sistema de Proyección: WGS 84, UTM Z11
Modelo Digital de Elevación y Batimétrico, 230 m de resolución (Izquierda).
Modelo Digital de Elevación 28 m y Batimétrico 235 m de resolución (Arriba).

Atlas de Riesgos Naturales del Municipio de Ensenada

C.P. ENRIQUE PELAYO TORRES
Presidente Municipal de Ensenada

C.P. JUAN PABLO VALENZUELA GARCÍA
Coordinador del Comité de Planeación para el Desarrollo Municipal

T.U.M. JULIO CÉSAR OBREGÓN ANGULO
Director de Protección Civil

Universidad Autónoma de Baja California

Instituto de Investigaciones Oceanológicas

Peligro Tsunami

15	Número de obra 102001tpp033196	Número de expediente PP/02011/AE/096

Fuente: **Atlas de Riesgos Naturales del Municipio de Ensenada 2012, Versión 30 Marzo 2012**
Universidad Autónoma de Baja California, Instituto de Investigaciones Oceanológicas

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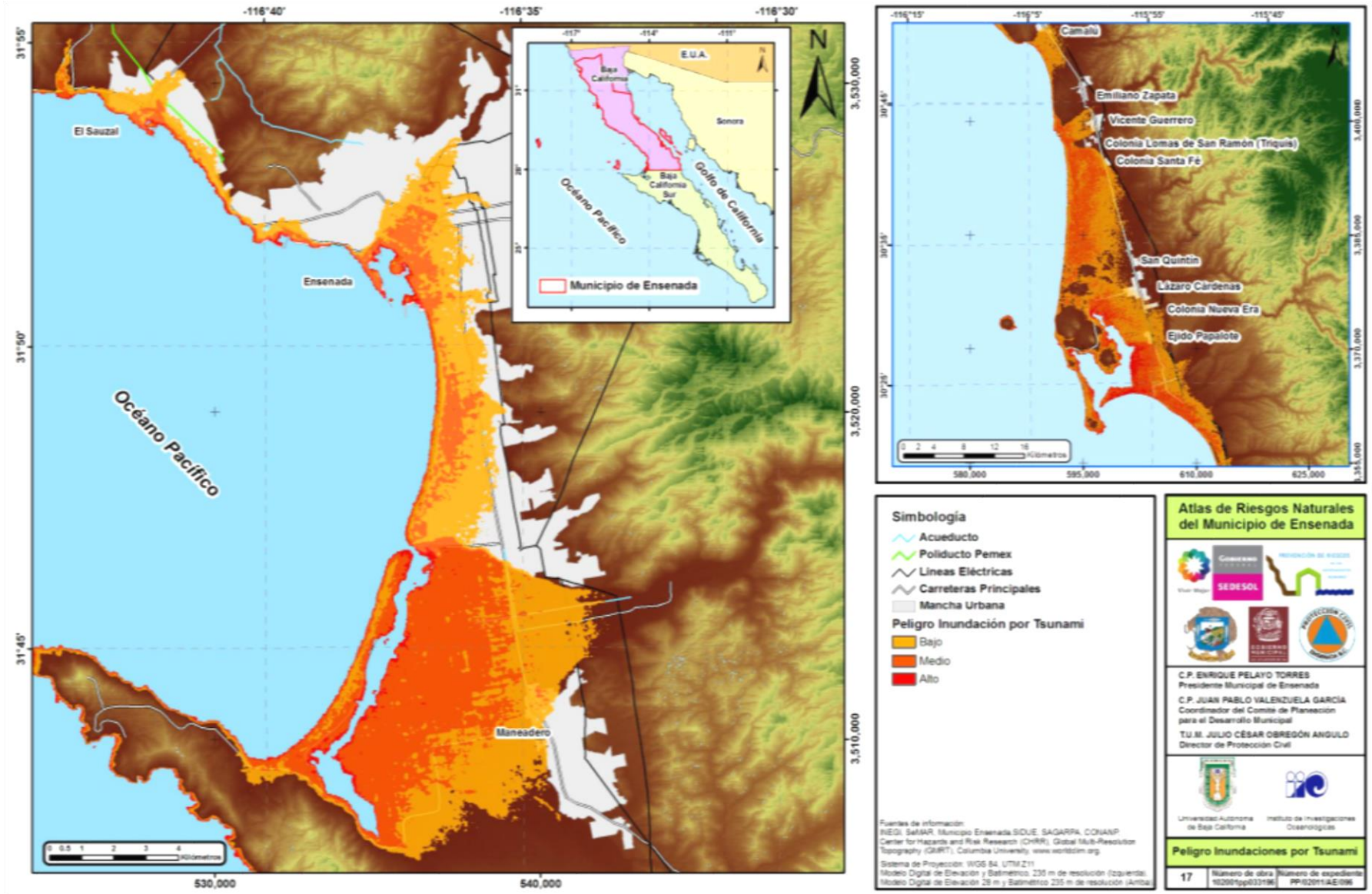

Fuente: **Atlas de Riesgos Naturales del Municipio de Ensenada 2012, Versión 30 Marzo 2012**
Universidad Autónoma de Baja California, Instituto de Investigaciones Oceanológicas

Gracias!

- Al CICESE
- en particular Dr Jonás de Basabe Delgado
- y Dr Julio Scheinbaum

- y a ustedes por su atención!

- gem.cicese.mx