

COCONet: Network: Plans and Status

2012 SIRGAS Meeting
Concepción, Chile - October 29-31, 2012

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with help from
John Braun, Karl Feaux, Jim Normandeau, and Barrett Friesen



COCONet

CONTINUOUSLY OPERATING CARIBBEAN
GPS OBSERVATIONAL NETWORK

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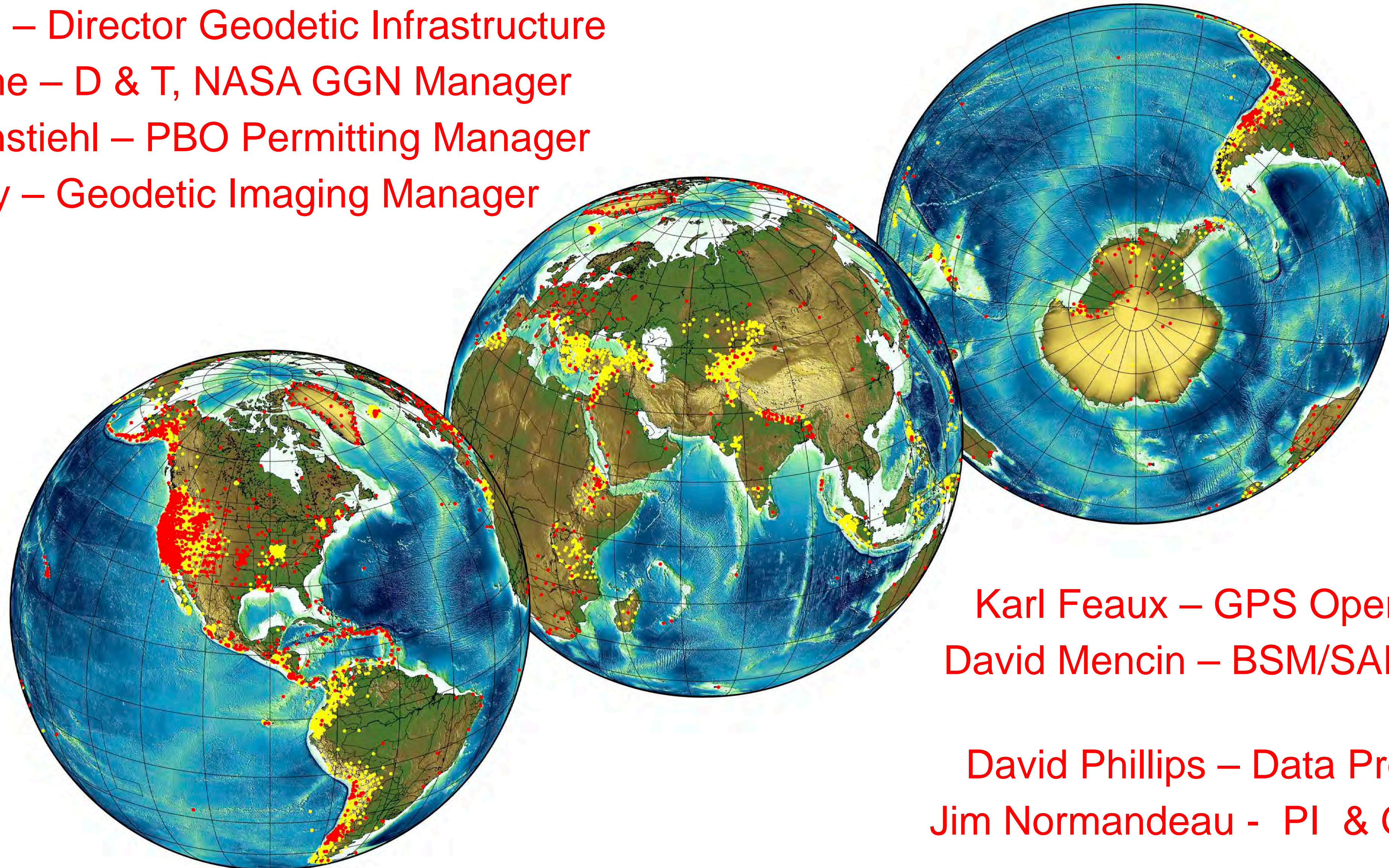
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Geodetic Infrastructure Program: PBO/SAFOD

Glen Mattioli – Director Geodetic Infrastructure
Freddy Blume – D & T, NASA GGN Manager
Kyle Bohnenstiehl – PBO Permitting Manager
Chris Crosby – Geodetic Imaging Manager



Karl Feaux – GPS Operations Manager
David Mencin – BSM/SAFOD Operations
Manager
David Phillips – Data Products Manager
Jim Normandeau - PI & Global Networks
Manager



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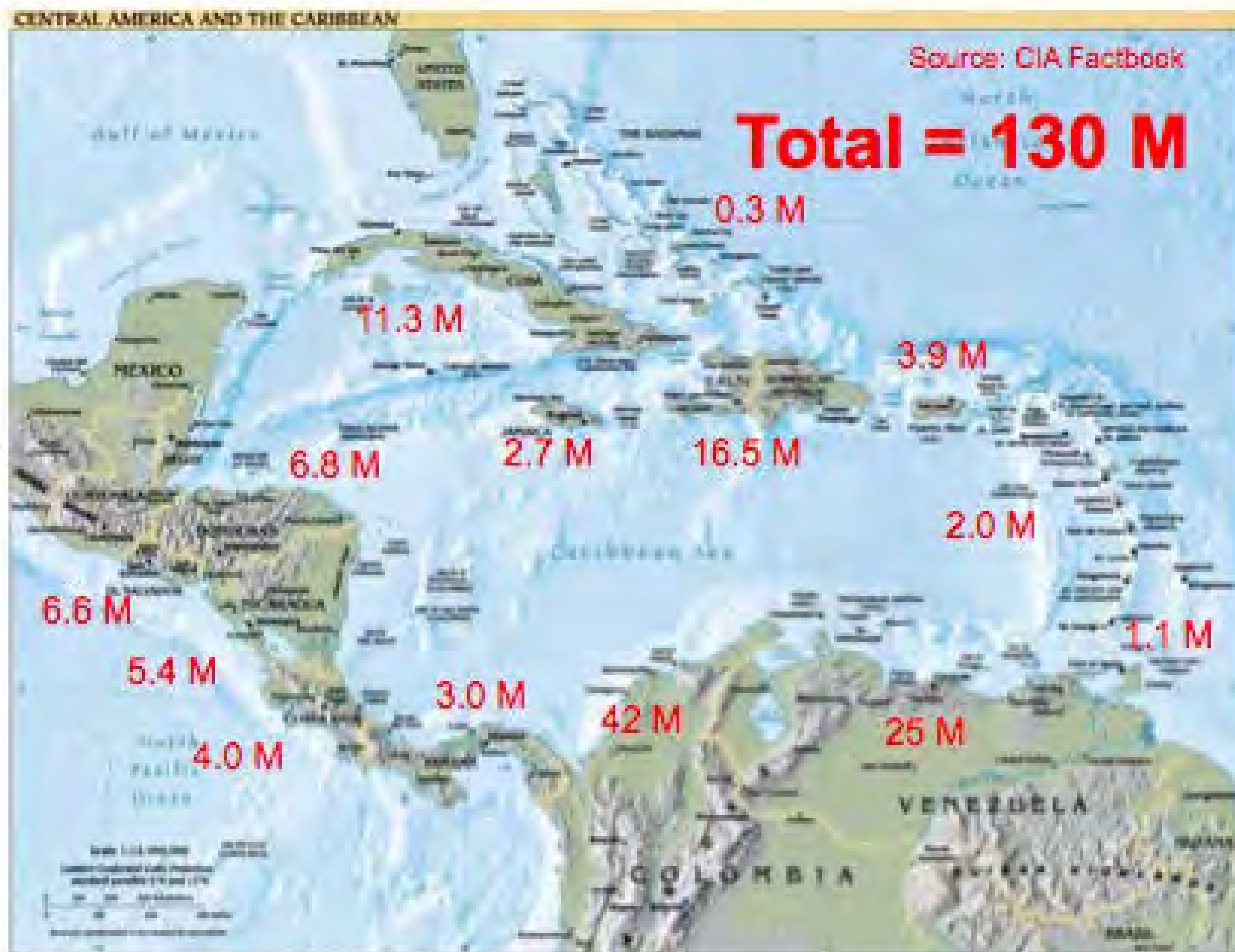
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COCONet: Hazards Motivation

Circum-Caribbean Population at Risk for Natural Hazards



A multidisciplinary research project focused on improving our understanding and ability to prepare for and predict natural hazards in the Caribbean, Central America, and Northern Andes - the Caribbean plate and its surrounding neighbors.

Earthquake hazards, tectonic deformation, climate change, severe weather

A 5-year, ~\$6M (US) project funded by the National Science Foundation both in response to the 2010 Haiti earthquake and an broader recognition of the vulnerability of the region to devastating hazards.

COCONet proposal Collaborative Research partners are UNAVCO, UCAR, Purdue University, and University of Puerto Rico Mayaguez

International research partners include BME-Haiti, INGEOMINAS (Mora), IPGP, SRC-UWI, Simon Bolivar Univ. (Perez), OVSICORI, INETER, UNAM, and many other institutions representing 31 circum-Caribbean countries.



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COCONet “Boundary Conditions”

- Focus on natural hazards and improving regional understanding of geodynamic and atmosphere-dynamic processes
- All raw data and data products must be shared, open, and available free-of-charge to users
- Synoptic-scale observations, which may be augmented with targeted, individual PI-driven projects
- Use data to enhance both technical and human capacity in region
- Develop strategic partnerships between US and local and regional institutions in 31 circum-Caribbean countries



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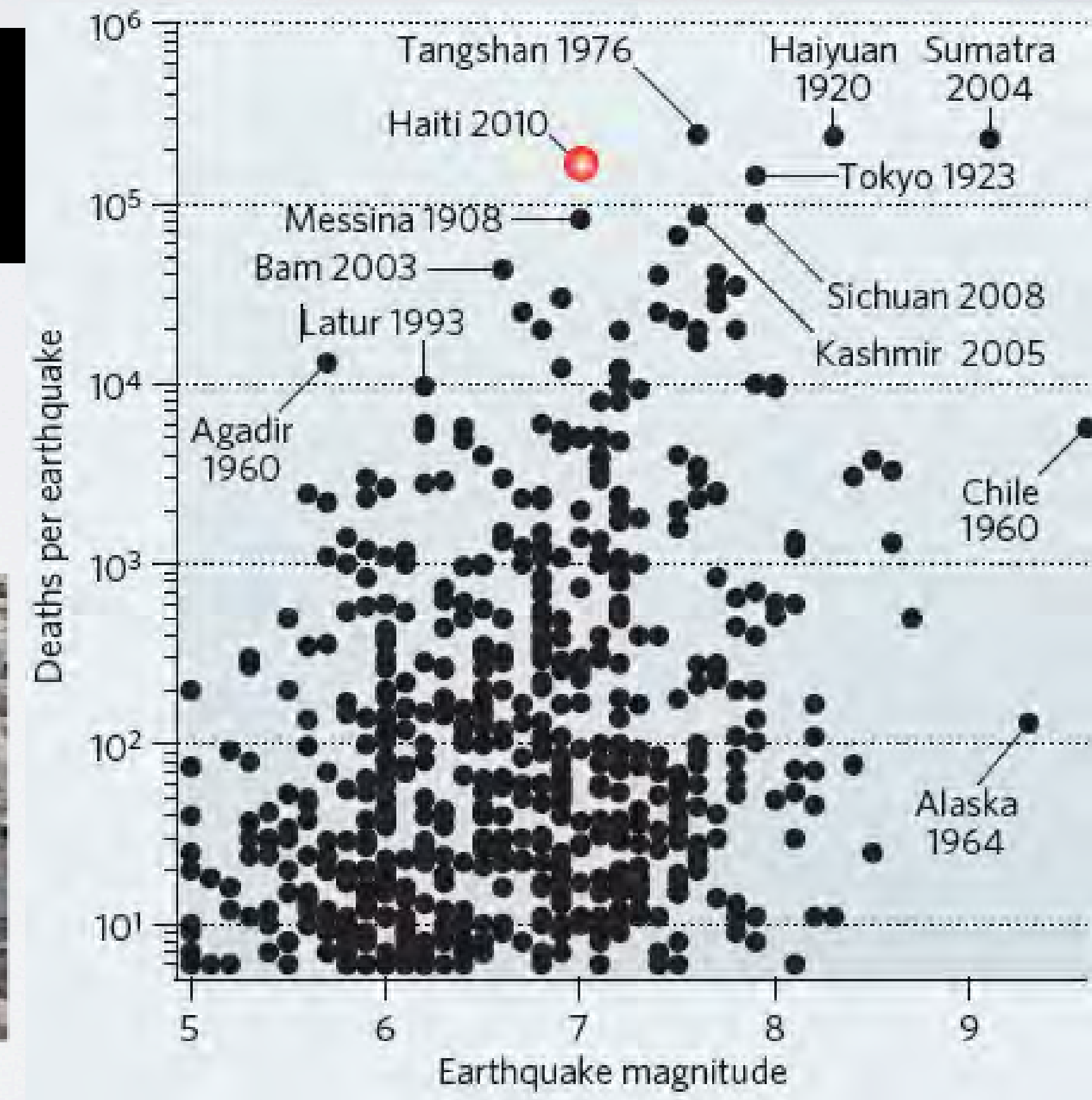
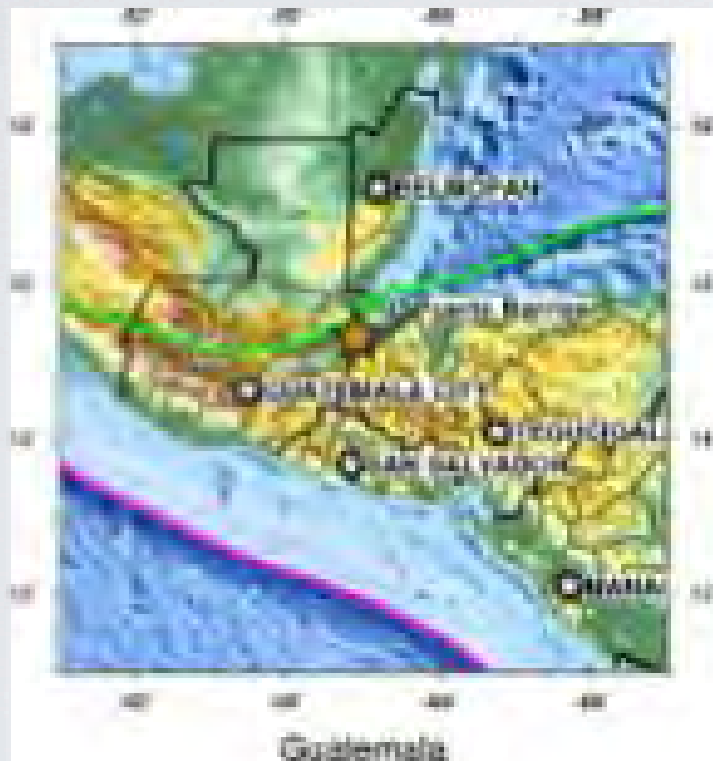
RECENT GEOHAZARDS

Some recent geophysical events and their impacts in the Caribbean region...

1976 Motagua EQ – 23,000 dead; 76,000 injured; 20% Guatemalans homeless

1995-2011 Soufriere Hills eruption: capital abandoned; 2/3s of island inhabitants flee

2010 Haiti EQ: 200,000-300,000 dead, 1.5 million homeless



From Bilham, Nature, 2010



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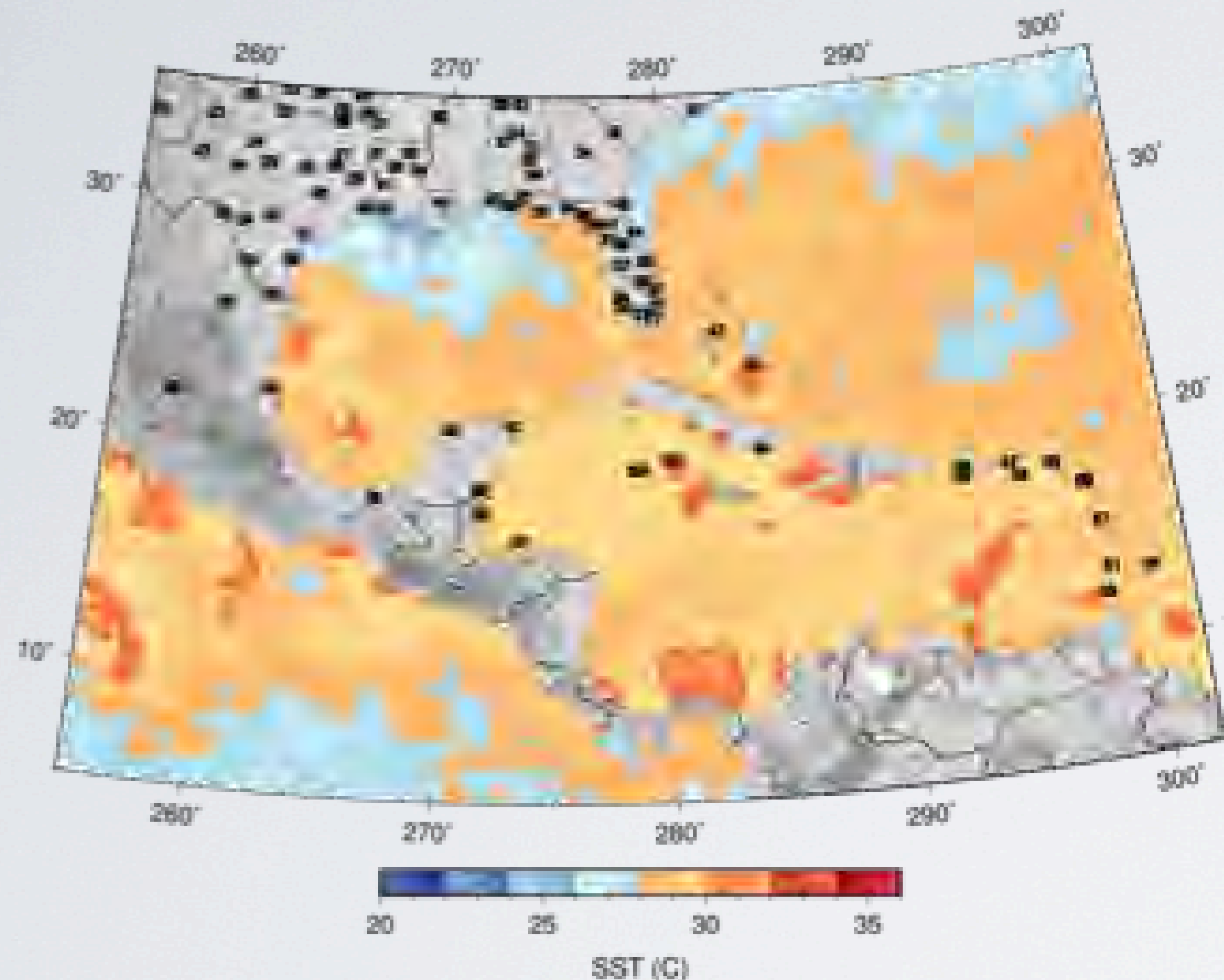
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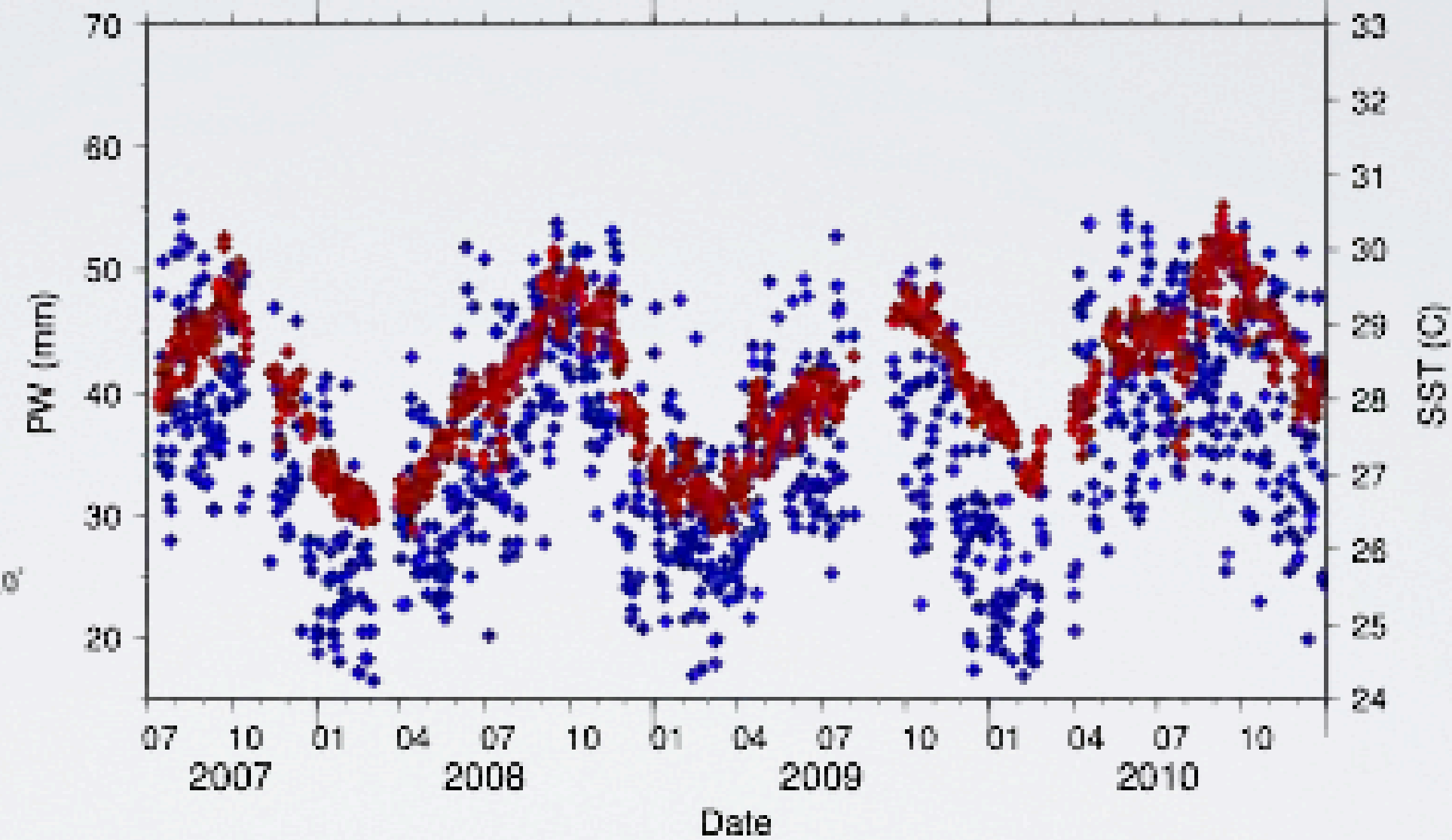


COCONet SCIENCE: MET & CLIMATE

Caribbean_SST_20080920



SVGB

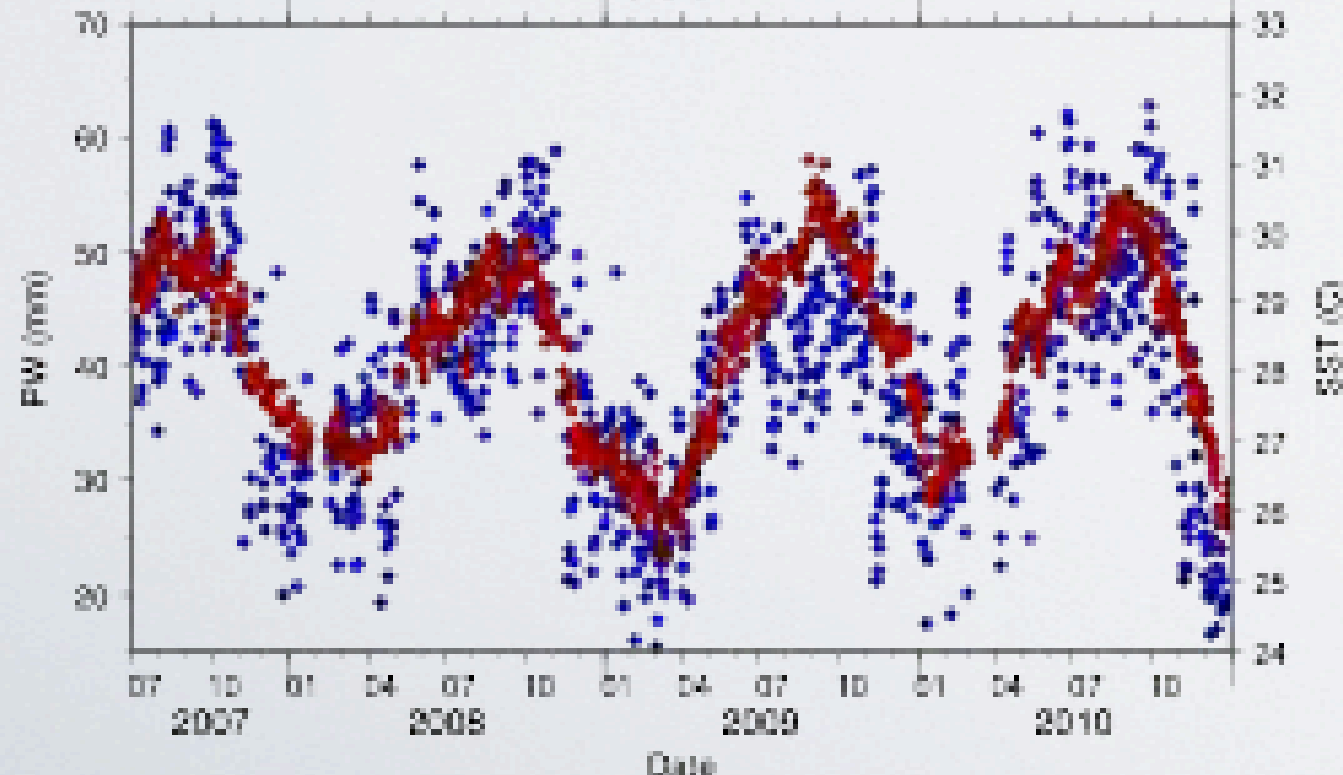


What are the physical mechanisms for the coupling between sea surface temperatures and atmospheric water vapor?

PW estimates from network show high correlation between SST and total column water vapor (not just surface humidity).

These results show the strong link between sea-surface temperature and atmospheric water vapor.

GCGT





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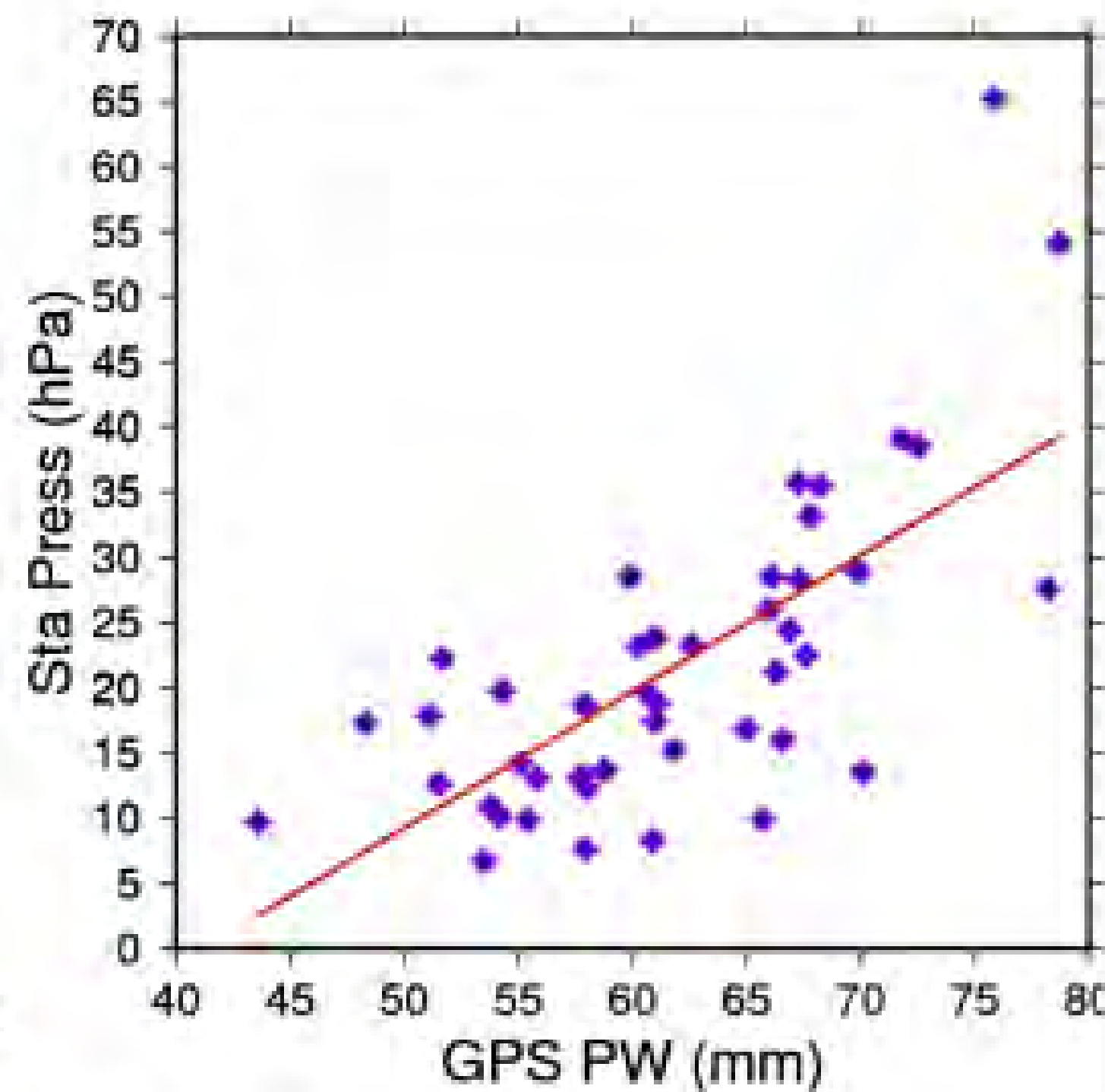
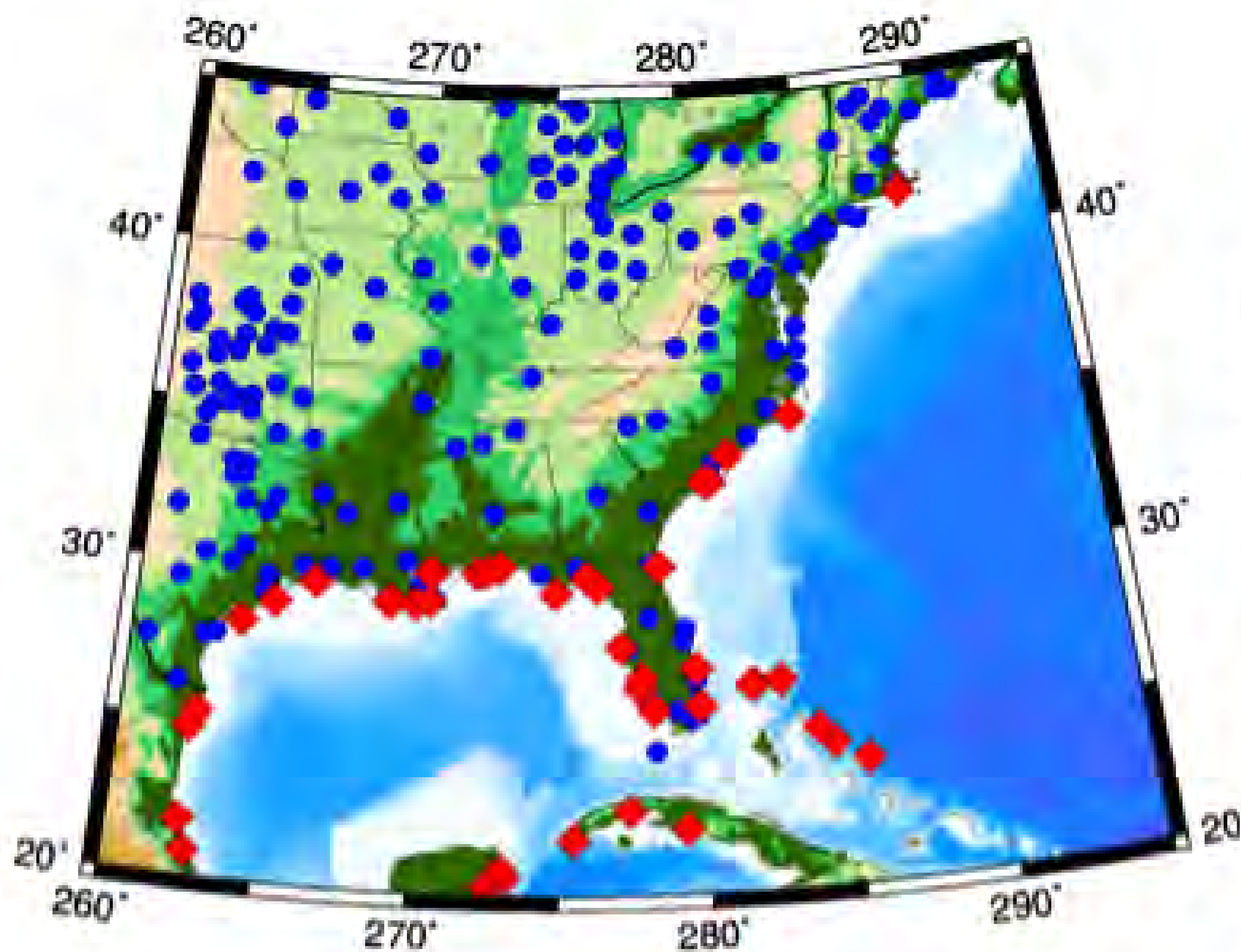


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COCONet SCIENCE: MET & CLIMATE



What is the impact of continuous estimates of PW on hurricane intensity forecasts?

The map on the left shows GPS stations (in blue), and locations of hurricane landfall. The scatterplot on the upper right shows the correlation between GPS PW and drop in surface pressure ($1013 - \text{Surf_Press}$) for stations within 200km of hurricane landfall.

The correlation between PW and surface pressure is -0.71. This high correlation is a positive sign that GPS PW can be used to improve intensity forecasts.



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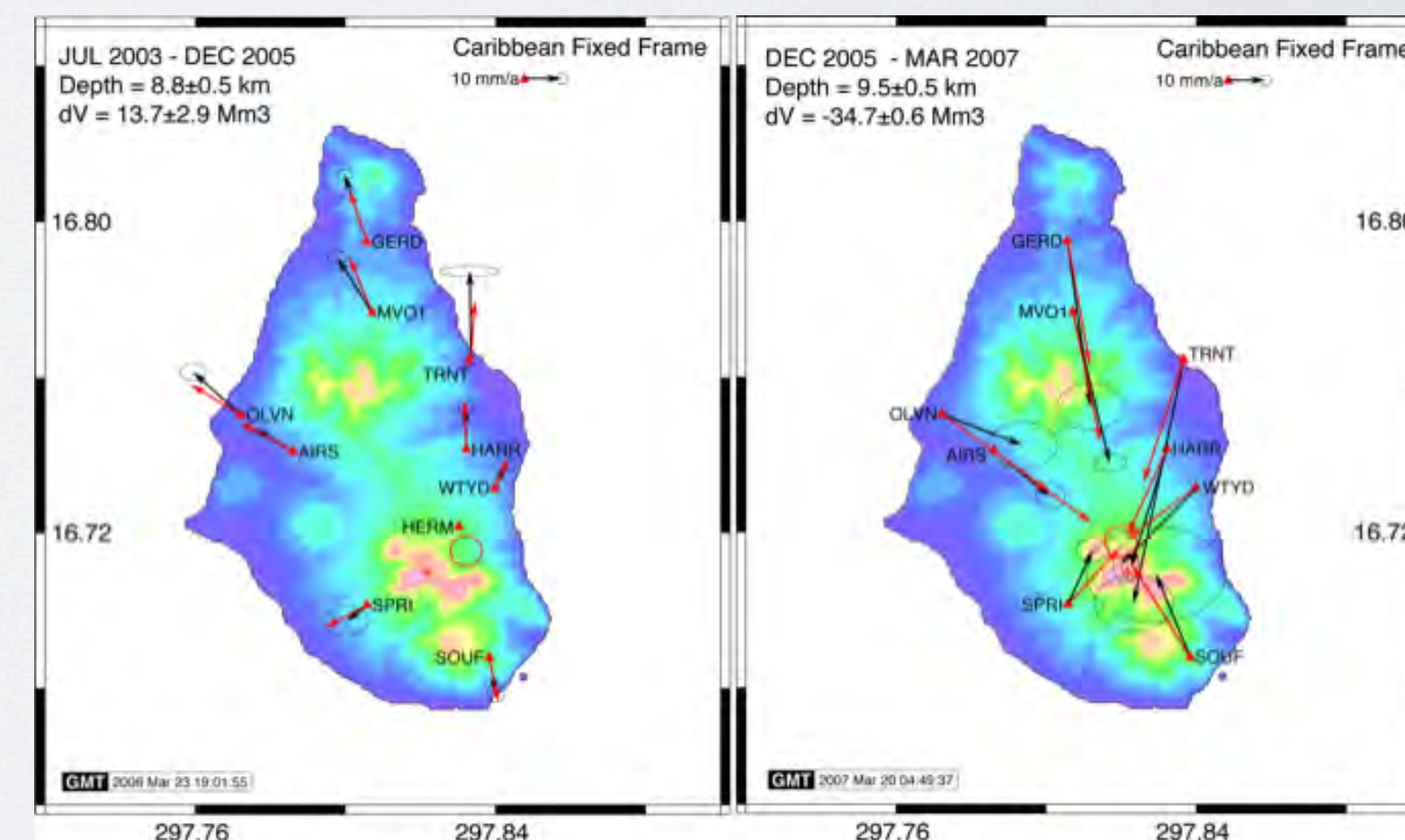
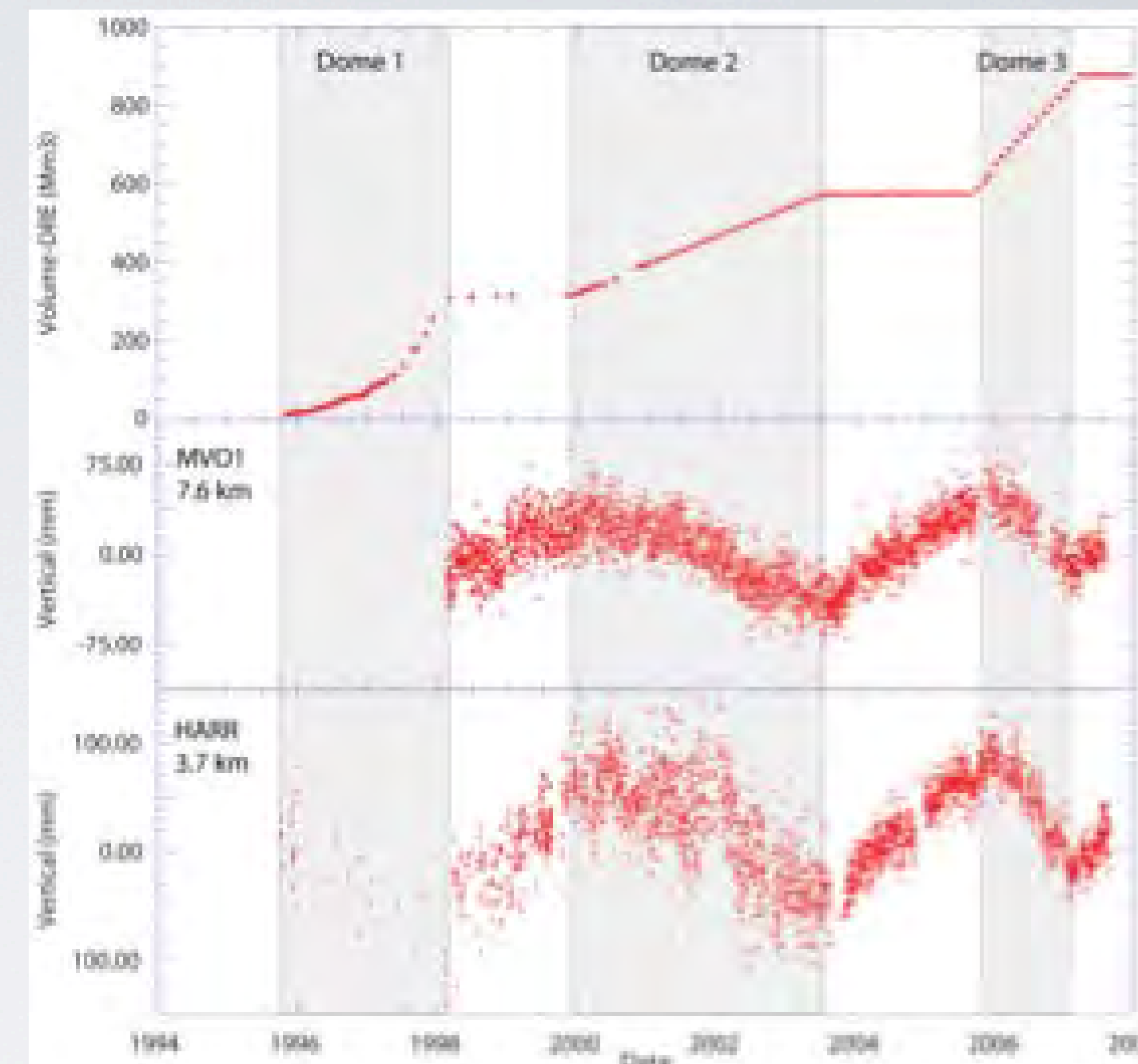
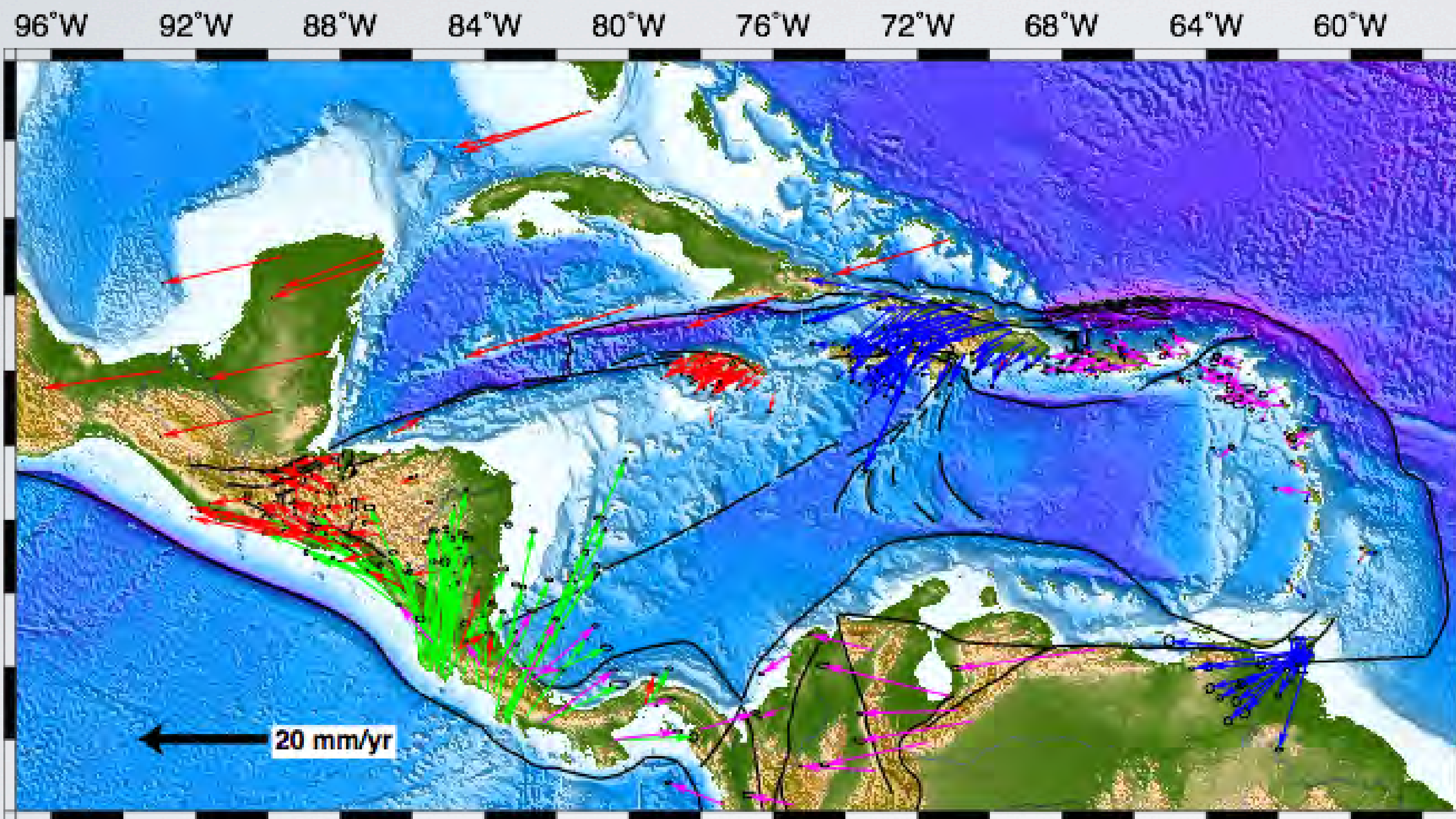


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COCONet SCIENCE: EARTHQUAKES & ERUPTIONS



Alvarado et al. (2010); DeMets & Wiggins-Grandison (2007); DeMets (unpub. 2011); Rodriguez et al. (2009)
 Turner et al. (2007); LaFemina et al. (2009)
 Calais et al. (2010); Weber et al. (2001)
 Jansma & Mattioli (2005); Turner et al. (2010); Mattioli (unpub. 2011); Trenkamp et al (2002)



Previous COCONet meetings

COCONet Siting Workshop
February 3-4, 2011: Puerto Rico

Preliminary Siting Plan Developed: 32 sites prioritized



3rd COCONet workshop:

Tulum, MX last week

80 participants helped to define regional data center requirements

COCONet Operator's Meeting
June 28-29, 2011: Trinidad

Final Siting Plan Developed: 50 New, 15 Refurbished, and 61+ Existing Stations





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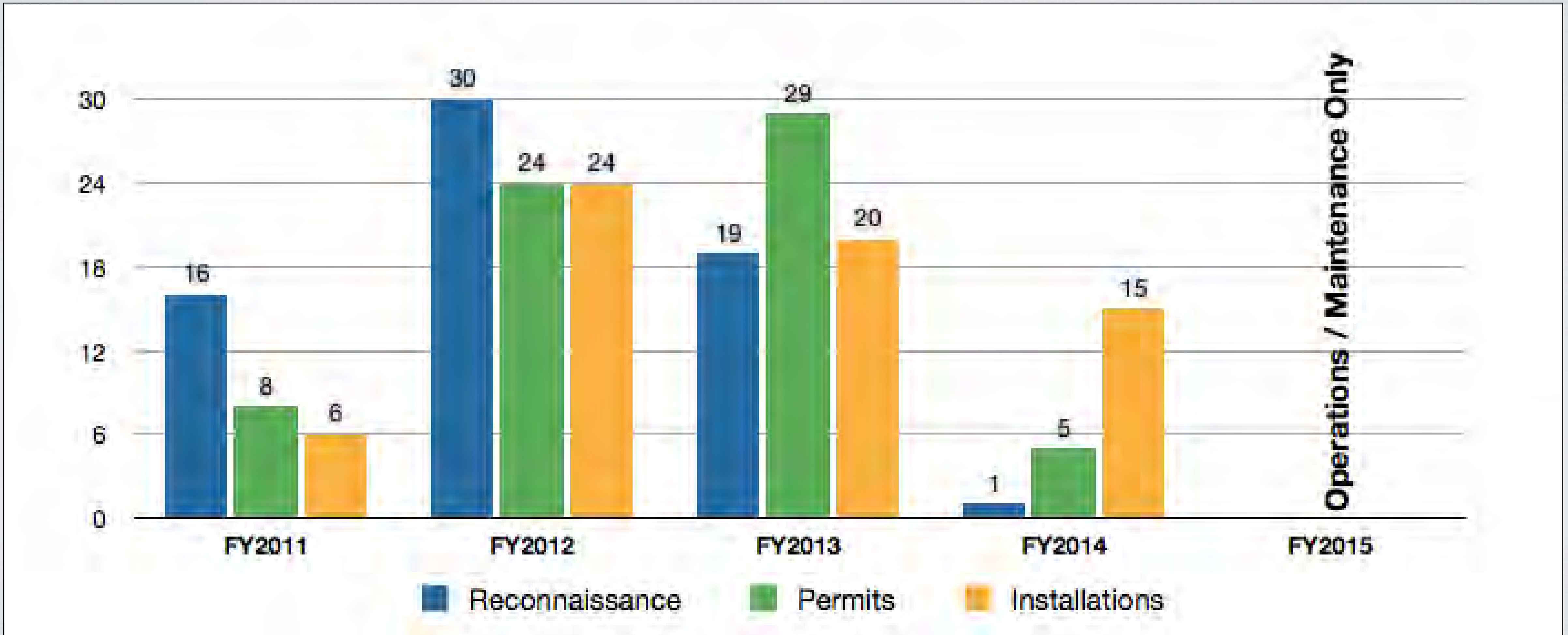
2011 Trinidad Siting Plan



- New Stations (50) ●
- Refurbished Stations (15) ●
- Existing Stations (61) ●

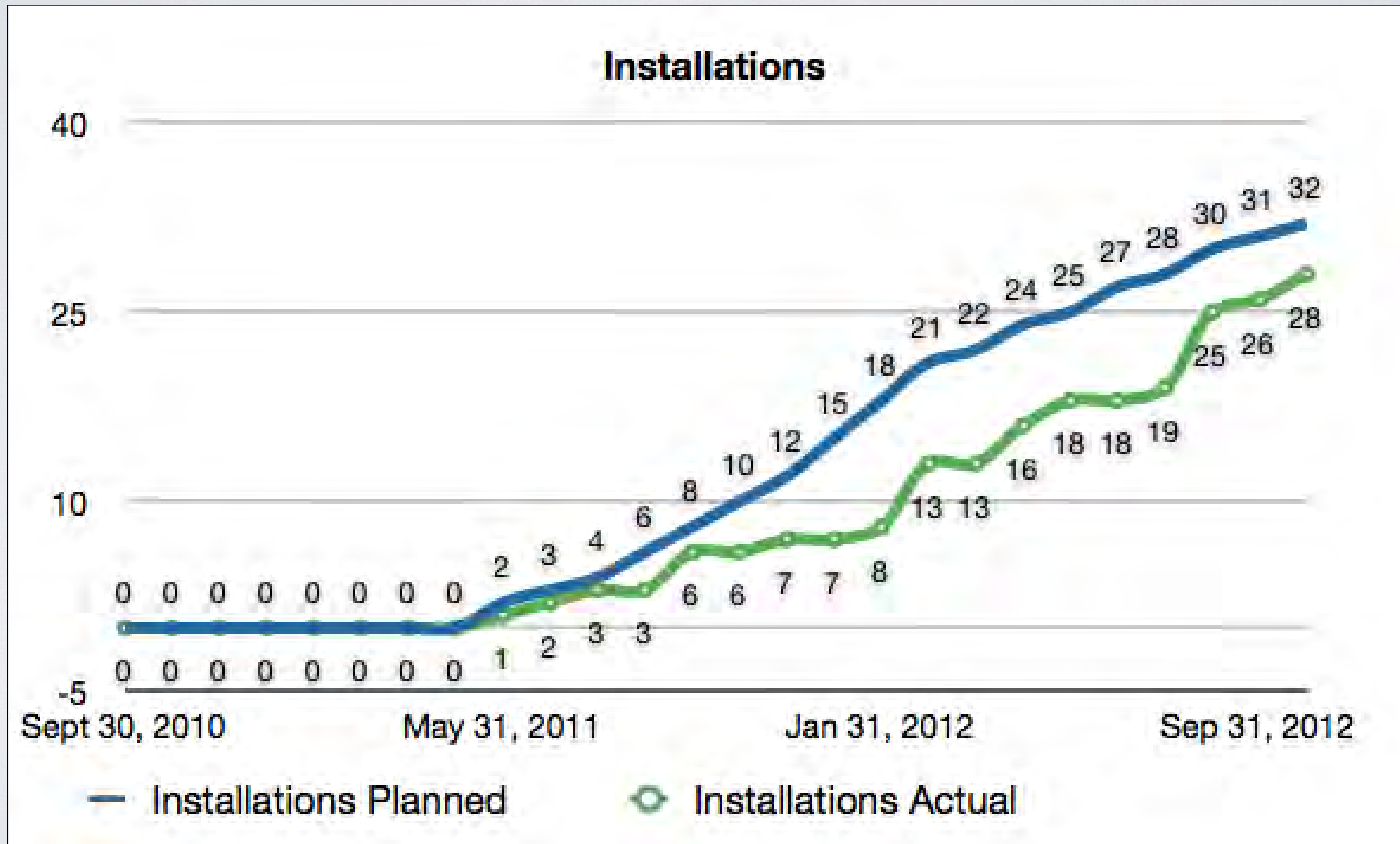


COCONet: Project baseline





COCONet: Construction





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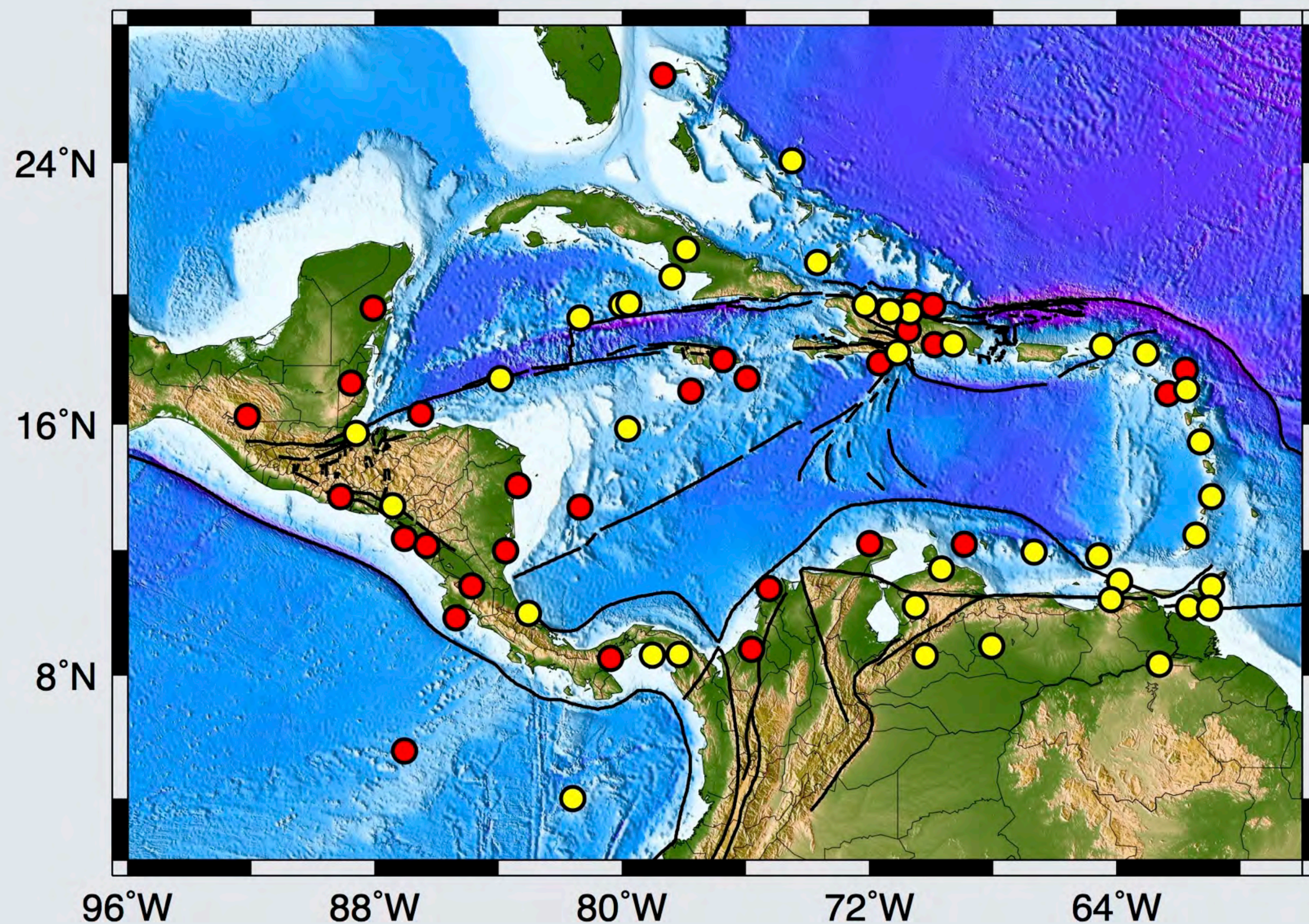


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COCONet Map: Current Installation Status



New Stations Planned: 46
Refurbished Planned: 21

New or Refurbished Stations Completed: 28 ●

Stations To Be Completed: 39 ●



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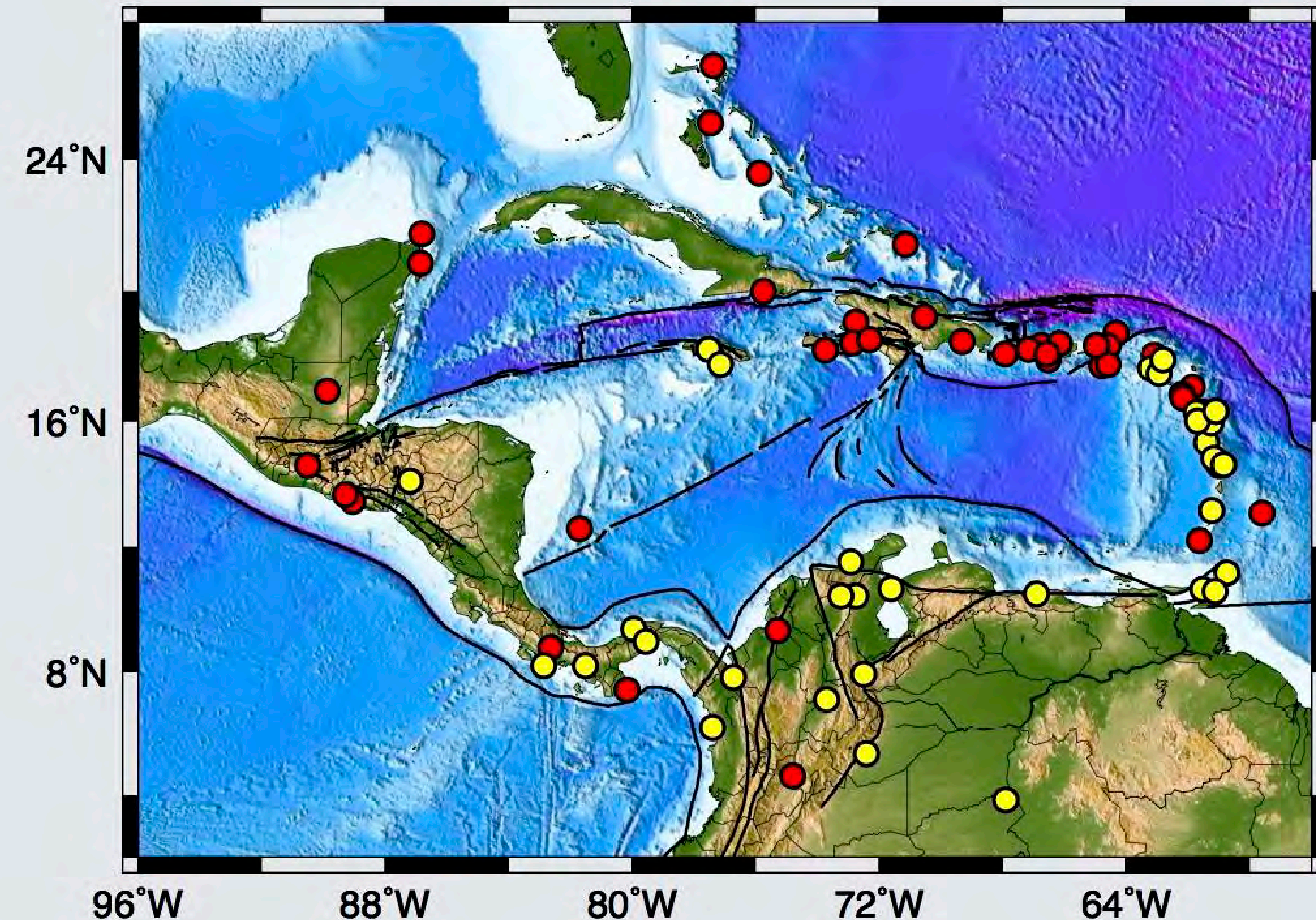


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COCONet Map: Existing Stations Status



Existing Stations Planned: 61
(From Trinidad) to 80

Existing Stations Delivering
Data to the COCONet
Archive: 45 ●

Existing Stations Not Yet
Delivering Data to the
COCONet Archive: 16-35 ●



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COCONet Supplement: Tide Gauge stations

- Proposal accepted by NSF in August, 2012
- Construction of 2 premium tide gauge stations
- including acoustic and pressure sensors,
GPS instruments located on the pier and
within 0.5 km of the pier
- Add GPS at two existing tide gauge
instruments in the sea level monitoring
network.
- Work with Tsunami warning and sea level
monitoring community to determine where the
stations are needed.



Photo Courtesy of PRSN



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COCO Net Stations Installed

ISCO (CN32): Cocos Island, Costa Rica



- Status: Installed
- Location: Cocos Island National Park
- Monument Type: Augured Short Braced
- Data Communications: Radio link to internet at park offices
- Partner Organizations: OVSICORI

CN15: Grand Bahama, The Bahamas



- Status: Installed
- Location: Freeport International Airport
- Monument Type: Short Drilled Braced
- Data Communications: Radio link to internet at airport offices
- Partner Organizations: Bahamas Department of Meteorology

CN40: Curacao



- Status: Installed
- Location: Meteorological Department Curacao Headquarters Building
- Monument Type: Short Drilled Braced
- Data Communications: Radio link to internet at Meteorological Department offices
- Partner Organizations: Meteorological Department Curacao



COCONet Stations Installed

QSEC: Costa Rica



- Status: Refurbishment complete
- Location: Existing monument QSEC
- Monument Type: Deep Drilled Braced
- Data Communications: Cellular modem
- Partner Organizations: OVISCORI

VERA: Costa Rica



- Status: Refurbishment complete
- Location: Existing monument VERA
- Monument Type: Deep Drilled Braced
- Data Communications: Cellular modem
- Partner Organizations: OVISCORI



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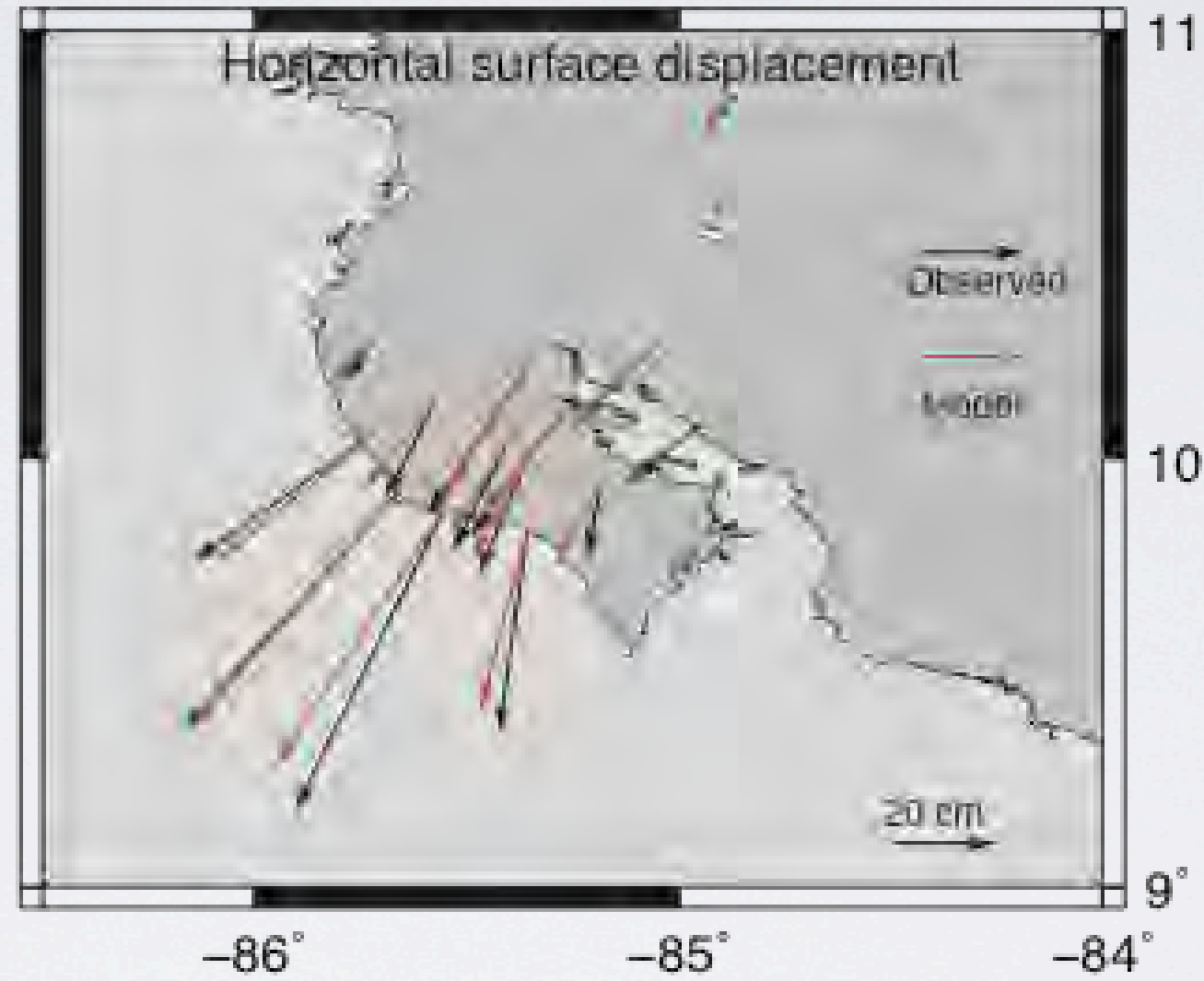
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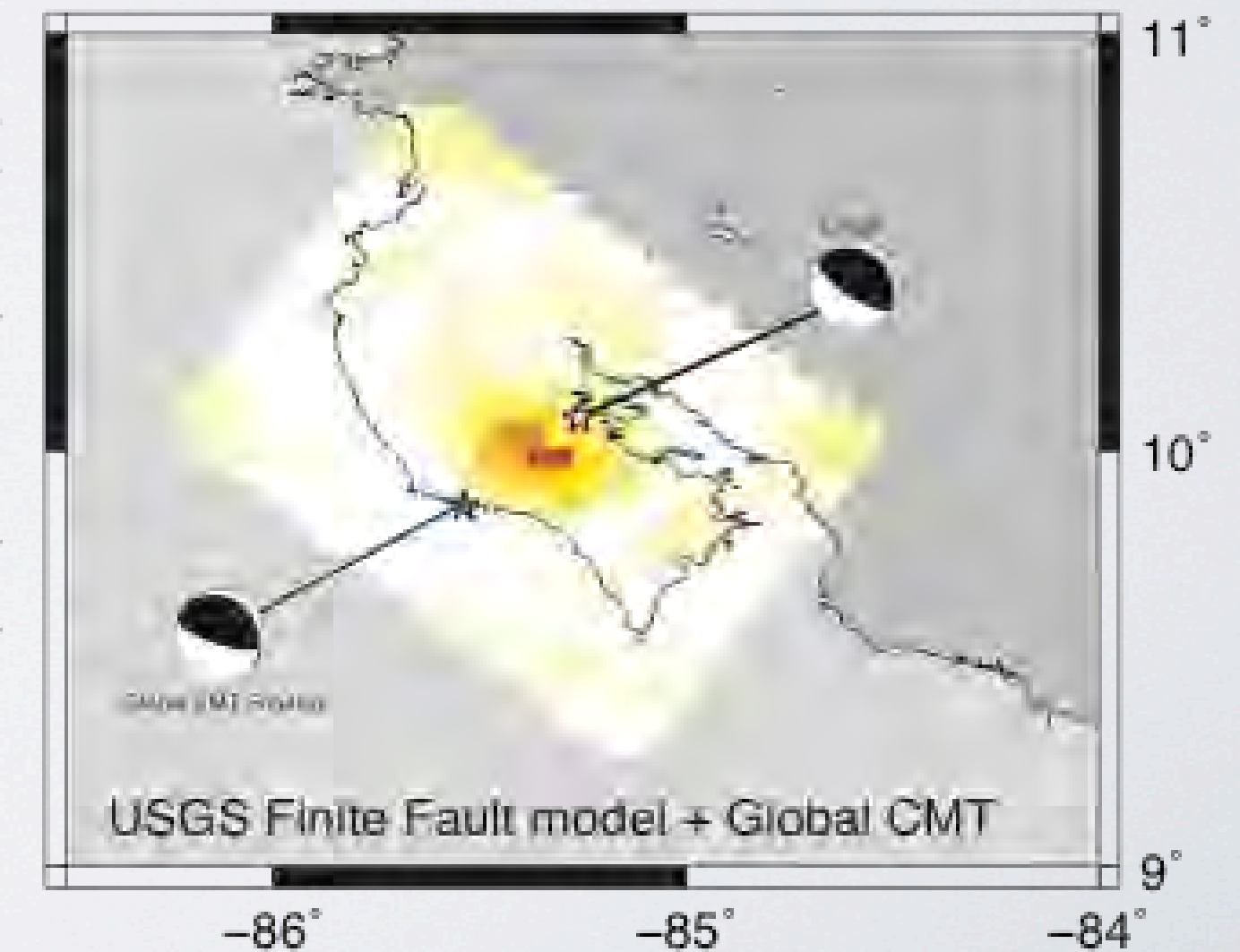
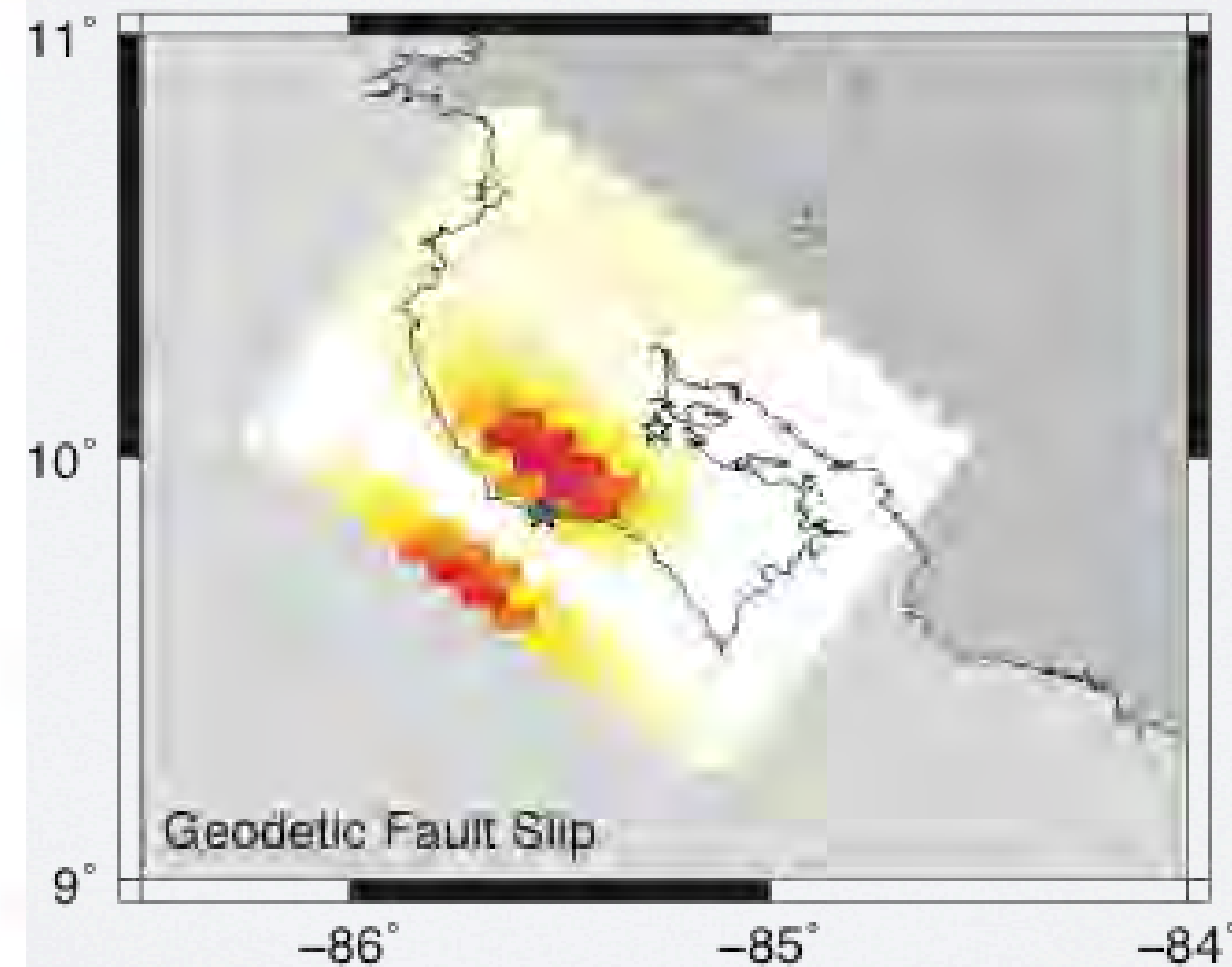
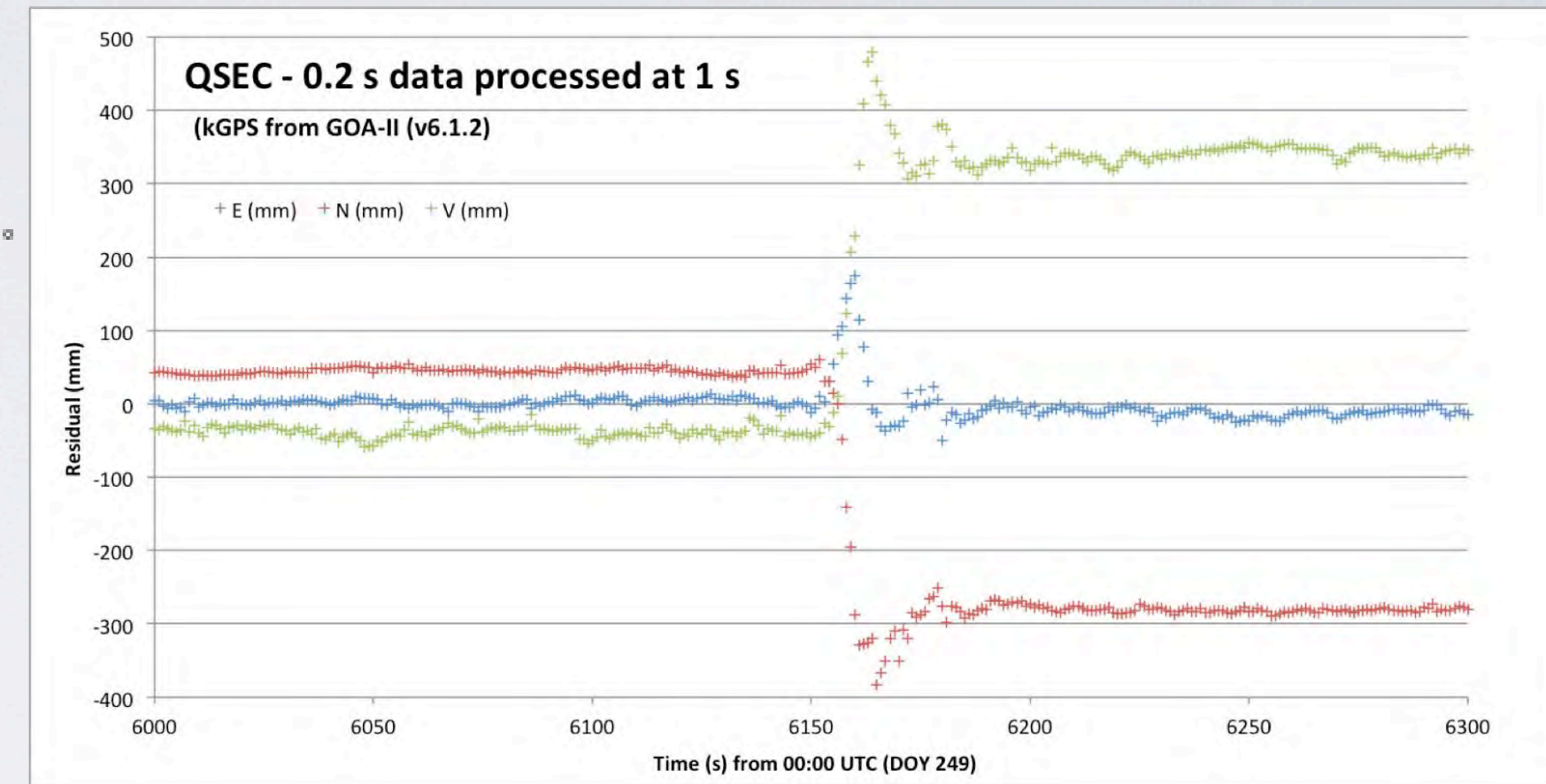
COCONet Science Highlights

Mw7.6 Nicoya Earthquake

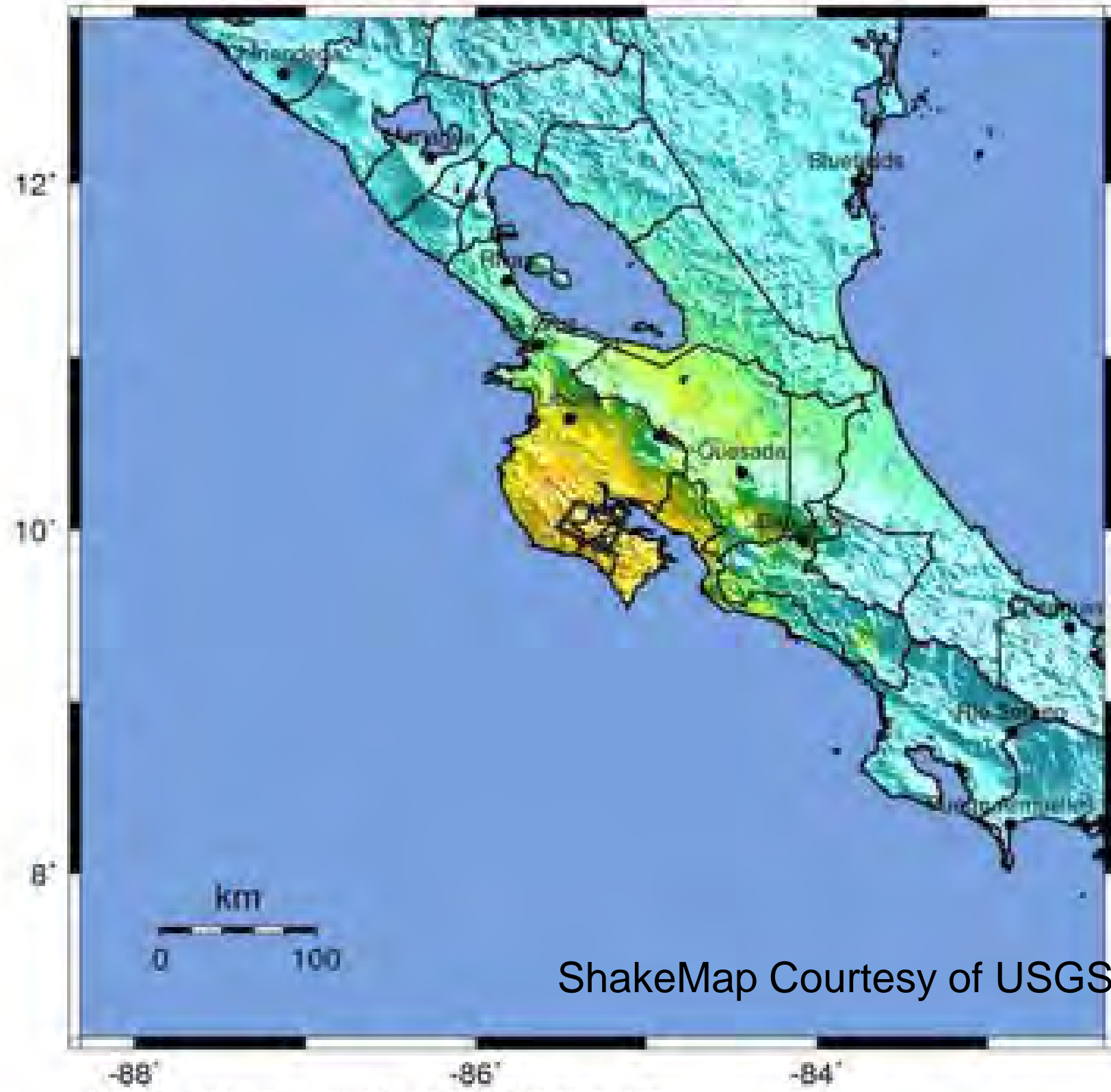
USF



Preliminary Results Not for Publications
September 5, 2012 M 7.6 Costa Rica Earthquake: Inversion of Geodetic Data for Fault Plane Slip



USGS ShakeMap : OFF THE COAST OF COSTA RICA
SEP 5 2012 02:42:07 PM GMT M 7.6 N10.00 W85.32 Depth: 40.1km ID:c000cfsd



ShakeMap Courtesy of USGS

Map Version 4 Processed Wed Sep 5, 2012 03:39:25 PM MDT

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	<0.02	0.1	1.4	4.7	9.8	20	41	88	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X

Scale based upon Worden et al. (2011)



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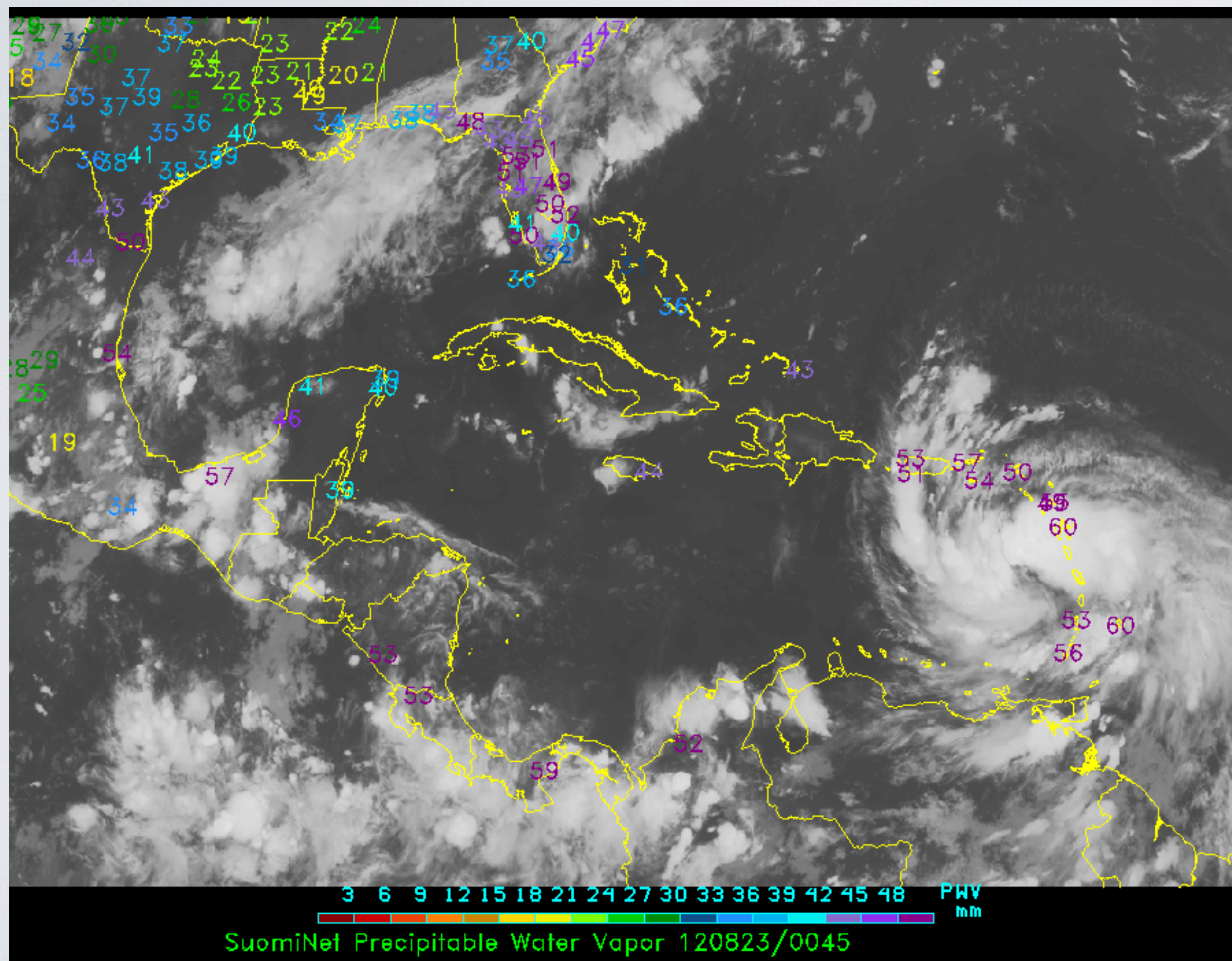


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COCONet Science Highlights Hurricane Isaac



COCONet stations will improve the forecasts of hurricane track and intensity using continuous observations of integrated water vapor.

COCONet stations are equipped with meteorological sensors and the data are analyzed to retrieve precipitable water vapor (PW).

The derived PW data are assimilated into the Weather Research and Forecasting (WRF) model to evaluate what impact they have on hurricane forecasts.

This movie (courtesy of Braun, et al., UCAR/COSMIC) shows the precipitable water vapor (in mm) along the path of Hurricane Isaac, utilizing some COCONet stations.



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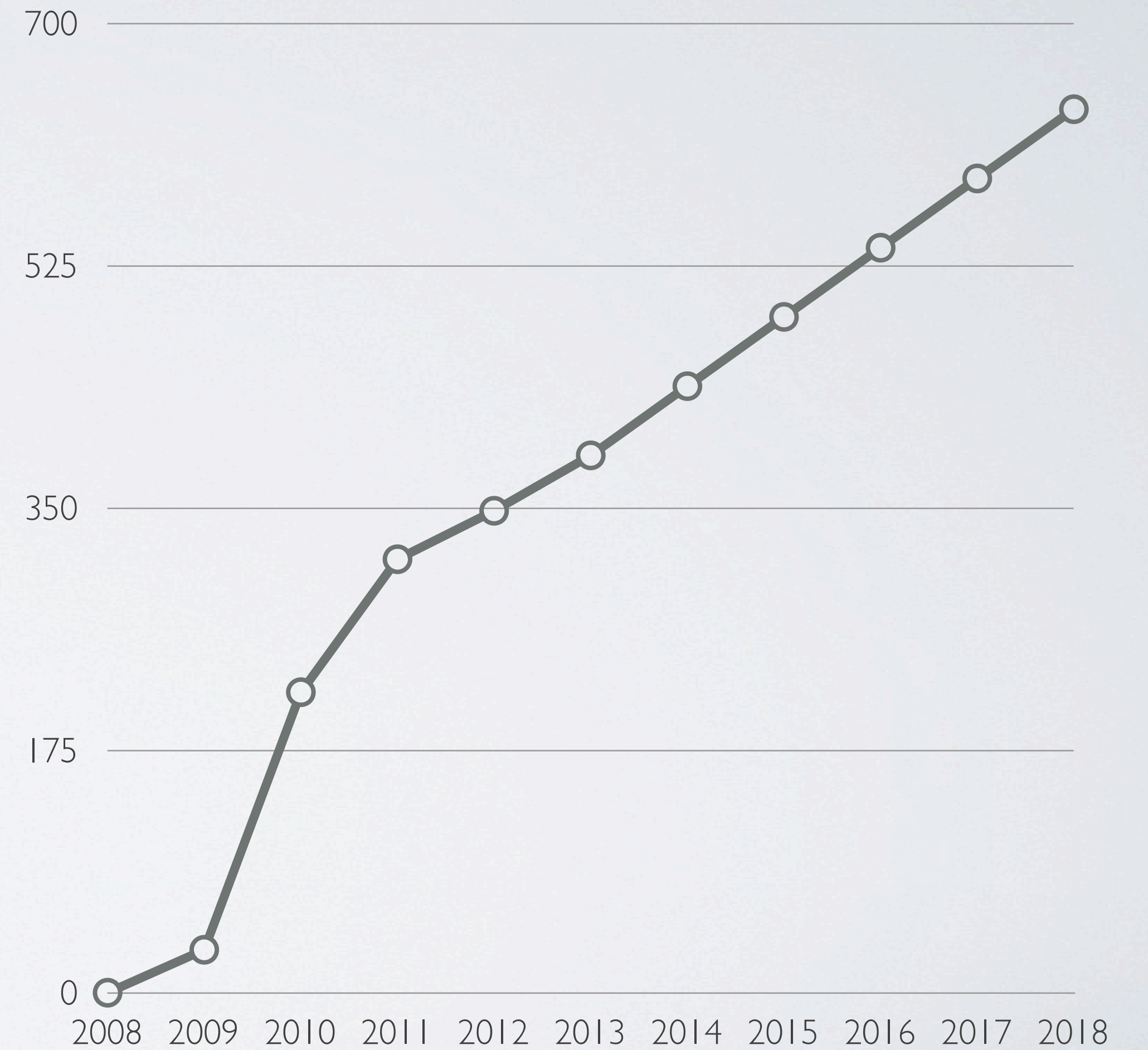
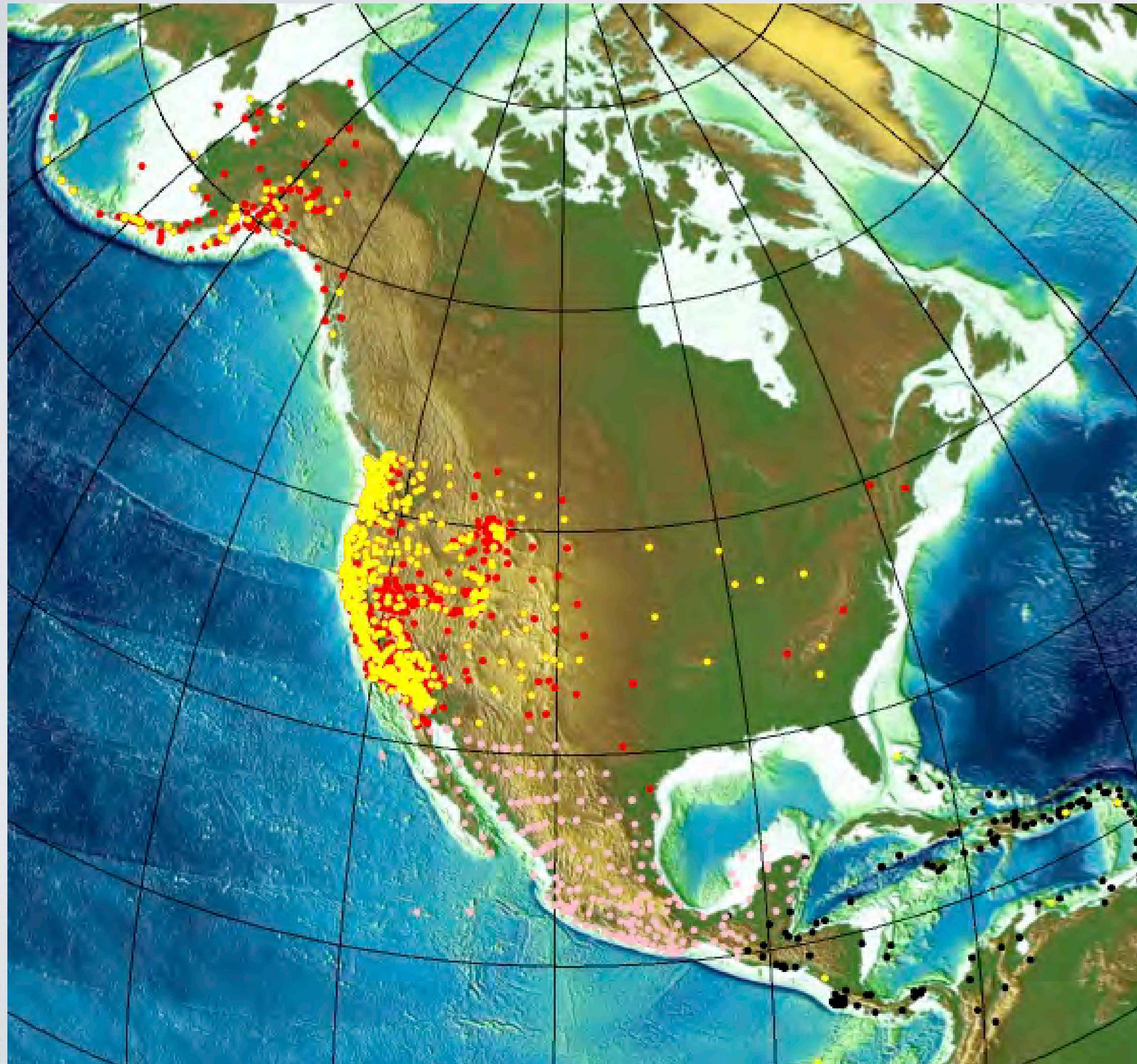
Difficult Stations



- Cuba
- Swan Island
- Malpelo Island



PBO: RT-GPS Upgrade Plan



PBO: RT-GPS Upgrade Plan

- 750+ Real-time stations
- 10 servers with 30-40 VMs
- Efficient load distribution
- Network Latency: 600 ms
- Network Completeness: 95%
- 1000+ Active Connections
- 1600 Mount Points
- Synchronized Databases
- Redundant Casters
- Positions and Archiving data
- Expansion capability to 1000 stations



*image is only representative



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Acknowledgments

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 Bob Wang

COCONet Partners

-  Puerto Rico Seismic Network
-  Universidad Autonoma de Santo Domingo, Dominican Republic
-  Dominican Republic Meterology Service
-  La Universidad del Zulia
-  Servicio Meteorologico Nacional (Mexico)
-  Instituto Nicaraguense de Estudios Territoriales
-  Intra-Americas Studies of Climate Processes
-  Jamaica Climate Service
-  The Pennsylvania State University
-  Caribbean Disaster Emergency Management Agency
-  State University Haiti
-  Colombian Institute for Hydrology, Meteorology and Environmental Studies
-  Instituto Geográfico de Venezuela Simón Bolívar
-  Fundación Venezolana de Investigaciones Sismológicas
-  Instituto Geográfico Nacional de El Salvador
-  University of Texas, Arlington
-  Camagüey Meteorological Center
-  Instituto Geográfico Nacional de Honduras
-  Autoridad del Canal de Panamá
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-  Centro de Investigaciones Sísmicas, Universidad de las Indias Occidentales
-  Institut de Physique du Globe de Paris
-  Montserrat Volcano Observatory
-  Universidad de Purdue, Estados Unidos
-  Universidad de Puerto Rico, Mayagüez
-  Meteorological Service of the Netherlands Antilles and Aruba
-  University of Arizona
-  University of Technology, Jamaica
-  Instituto Colombiano de Geología y Minería
-  Instituto Geográfico Nacional Ciudad de Guatemala
-  Universidad Nacional Autonoma de Honduras
-  University Corporation for Atmospheric Research (USA)
-  Universidad Nacional Autonoma de Mexico
-  National Oceanic and Atmospheric Administration, USA
-  United States Geological Survey
-  National Aeronautics and Space Administration, USA
-  National Science Foundation, USA
-  Departamento de Meteorología de Bahamas
-  Departamento de Meteorología de Curazao



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Thank You For Your Attention!

