Hazards and Risk @ SLR Network
A Preliminary Overview

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Overview

Background

- The ILRS is no more a global scientific experiment, it is a ***permanent*** measuring ***system***.
- As a system it should ***maximize*** the quantity, quality and timeliness of its ***outcome:*** NP data & results.
- And to ***optimize*** it's cost effectiveness.
- One way is by ***costs reduction***, both the short-term operating costs and the ***long term costs and losses***.

ILRS components

SLR Network

Human Factor

International Laser Ranging Service

Data/Analysis Centers

Communication Network

Basic Concepts

- **Hazard**: a situation that poses a level of threat to life, health, property, or environment.

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- **Vulnerability**: the extent to which changes could harm a system or be affected by the impact of a hazard
- **Risk**: the potential that an action or activity will lead to a loss or negative outcome.
- **Disaster**: when the Risk is realized.

Risk≈φ(Hazard * Vulnerability)

Basic Implementation Steps

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  The application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events.

Basic Implementation Steps

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  To identify the hazard's potential, origin, characteristics and behavior.

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- **Hazard prevention**: All steps which refers to the prevention of risks.

Basic Implementation Steps

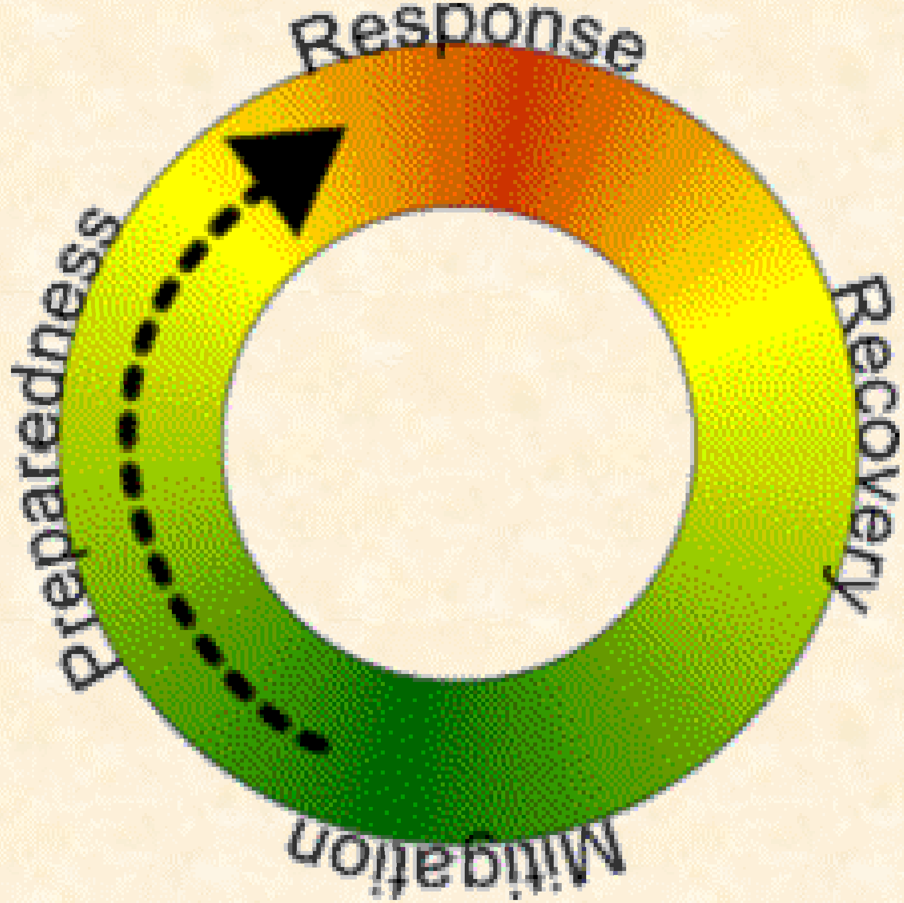
Mitigation=Prevention of Risks

- The ***most effective*** stage: the ***prevention*** of ***hazards development*** and/or ***risk reduction***.
- The ***more costly*** stage: ***disaster mitigation*****.**

If the hazards cannot be eliminated, the vulnerabilities shall be reduced.

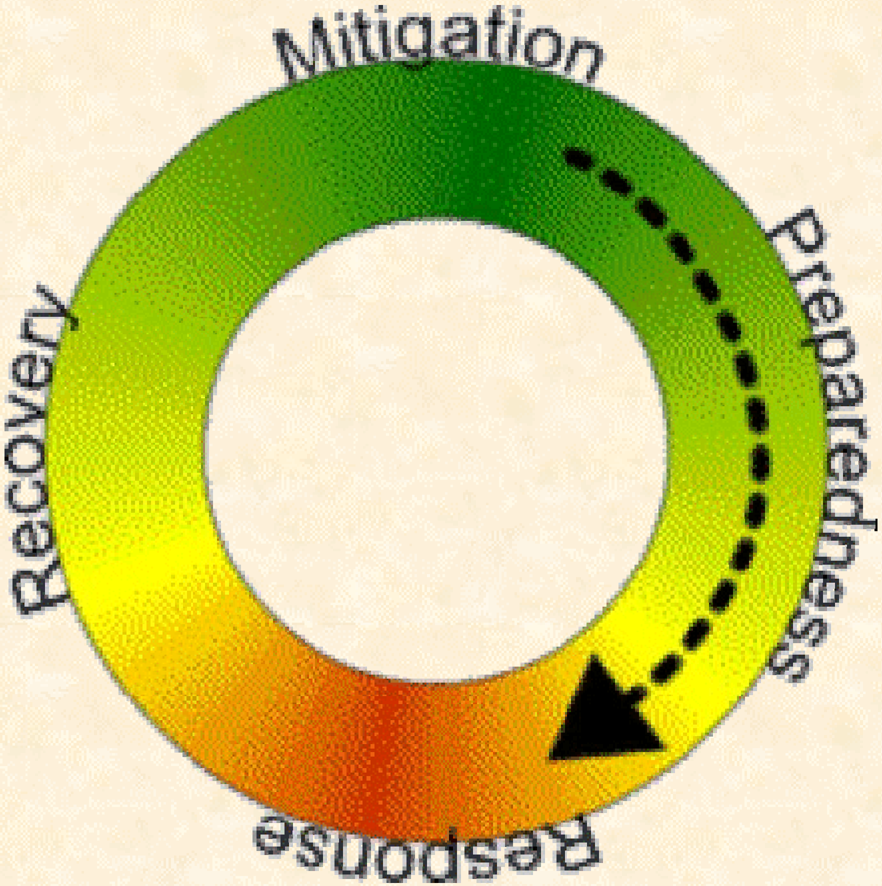
Emergency Management

- **Mitigation**
- **Preparedness**
- **Response**
- **Recovery**



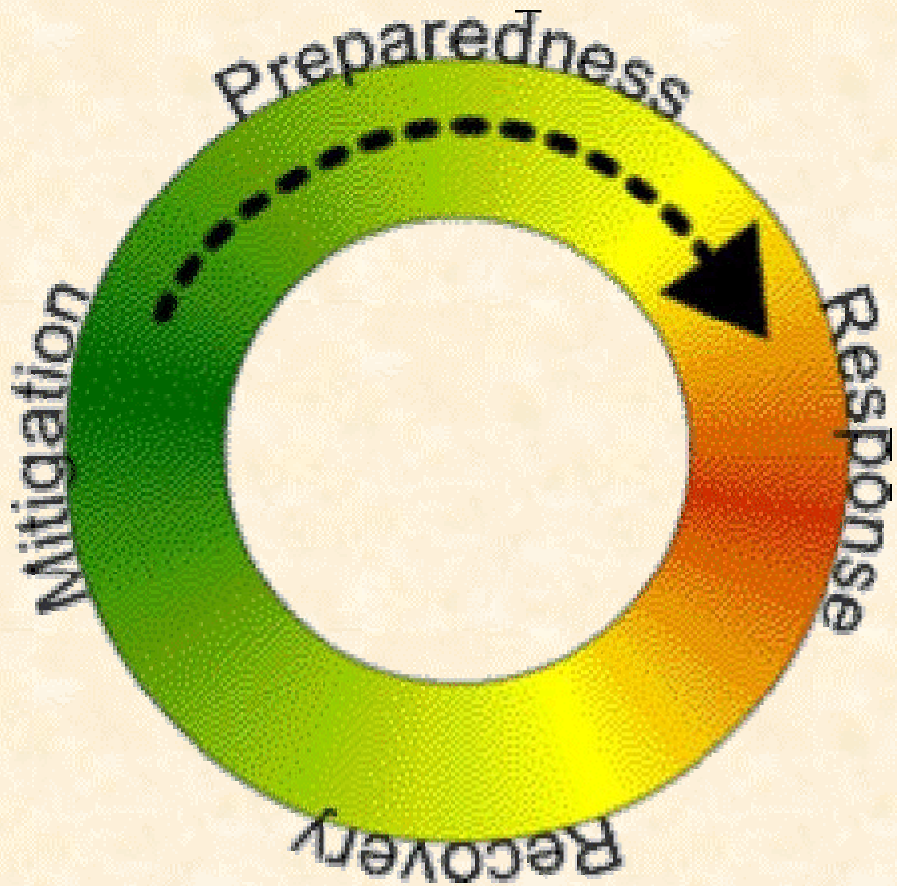
Emergency Management

- **Mitigation**
  - To prevent hazards from developing into disasters
  - To reduce the effects of disasters when they occur.
  - Focused on **long-term measures** for **reducing or eliminating risks.**



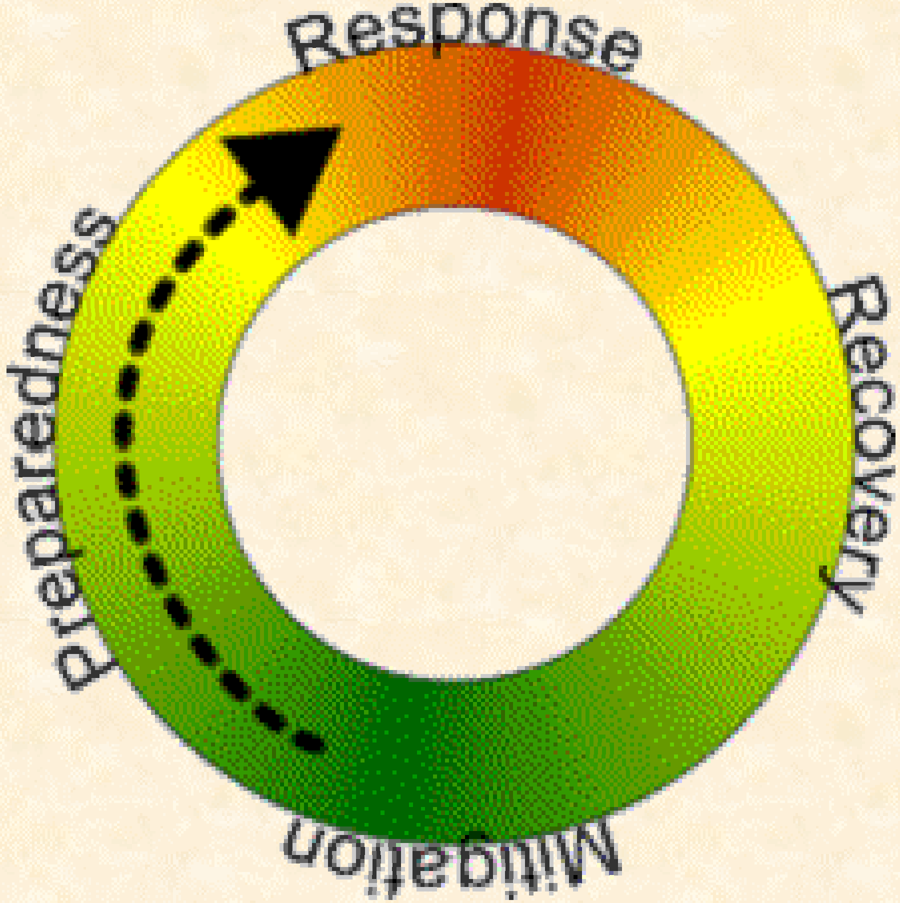
Emergency Management

- **Preparedness**
  - A **permanent cycle** of planning, organizing, training, to guarantee the coordination and capabilities to prevent, recover and mitigate the effects of natural and man-made disasters
    - communication plans
    - maintenance and training of emergency services
    - stockpiling of reserves



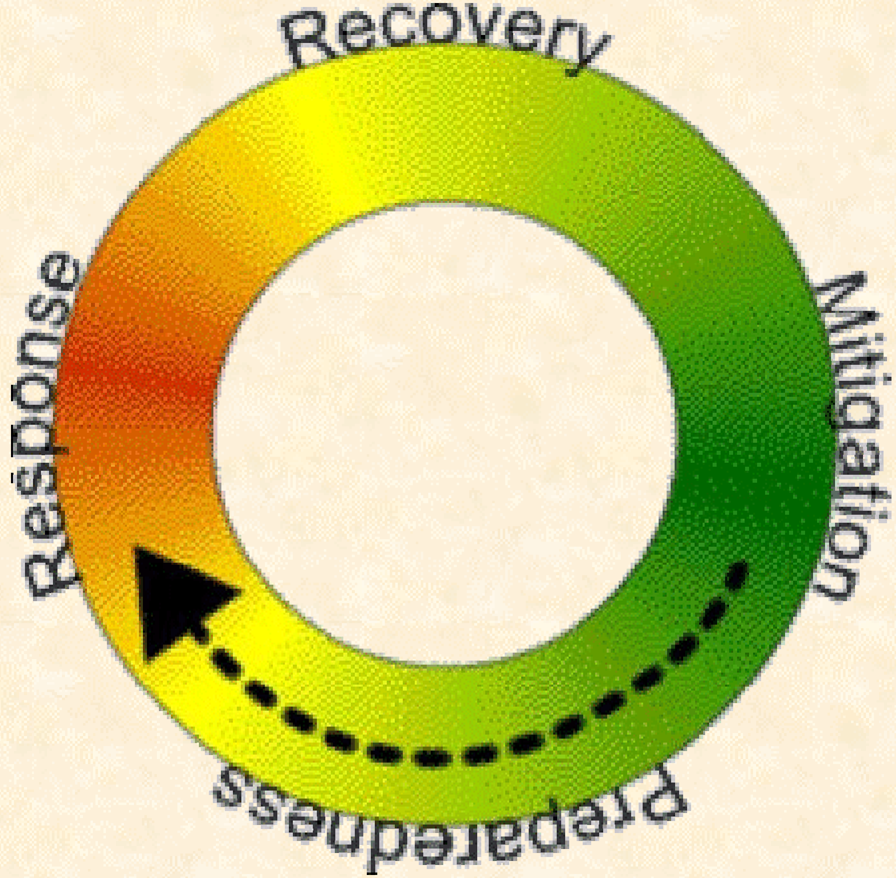
Emergency Management

- **Response**
  - The **mobilization** of the needed **emergency** services



Emergency Management

- **Recovery**
  - To **restore** the affected area, organization or system to **its previous state.**



Hazard Categories

- Geological
- Hydrological
- Climatic & Atmospheric
- Wildfire
- Antropogenic

Hazard Categories

- **Geological**

- **Earthquake**
- **Avalanche**
- **Lahar**
- **Sinkholes**
- **Volcanic eruption**

Hazard Categories

- **Hydrological**

- **Tsunami**
- **Flood**
- **Limnic eruption**
- **Whirlpool**
- **Maelstrom**
- **Seiche**

Hazard Categories

- Climatic & Atmospheric
  - Cyclonic storms
  - Lightning
  - Geomagnetic storm
  - Blizzard
  - Drought
  - Hailstorm
  - Heat wave
  - Ice storm
  - Tornado
  - Climate change

Hazard Categories

- Geological
- Hydrological
- Climatic & Atmospheric
- **Wildfire**

- **Natural Fires**
- **Arson**
- **Negligence**

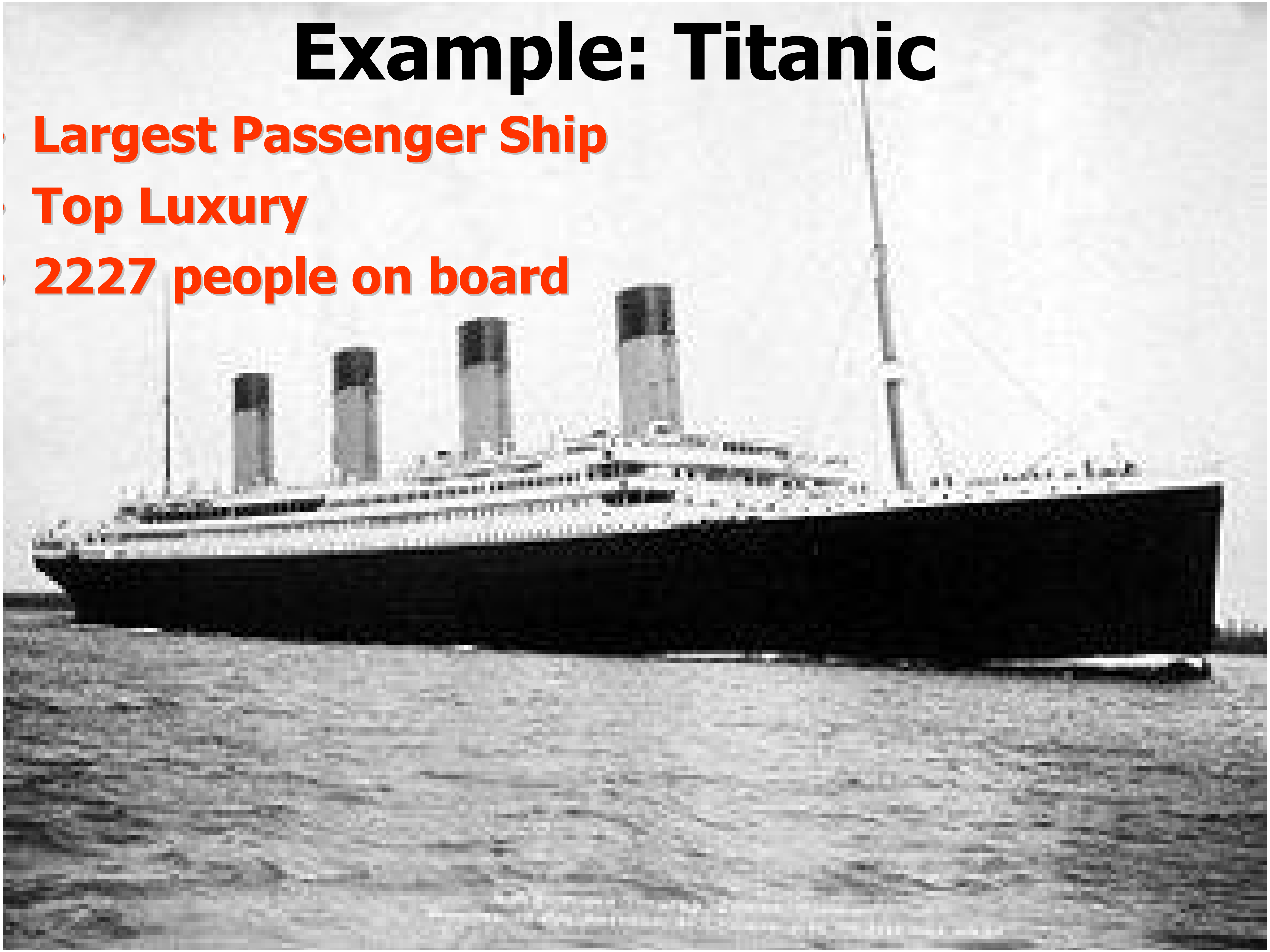
Hazard Categories

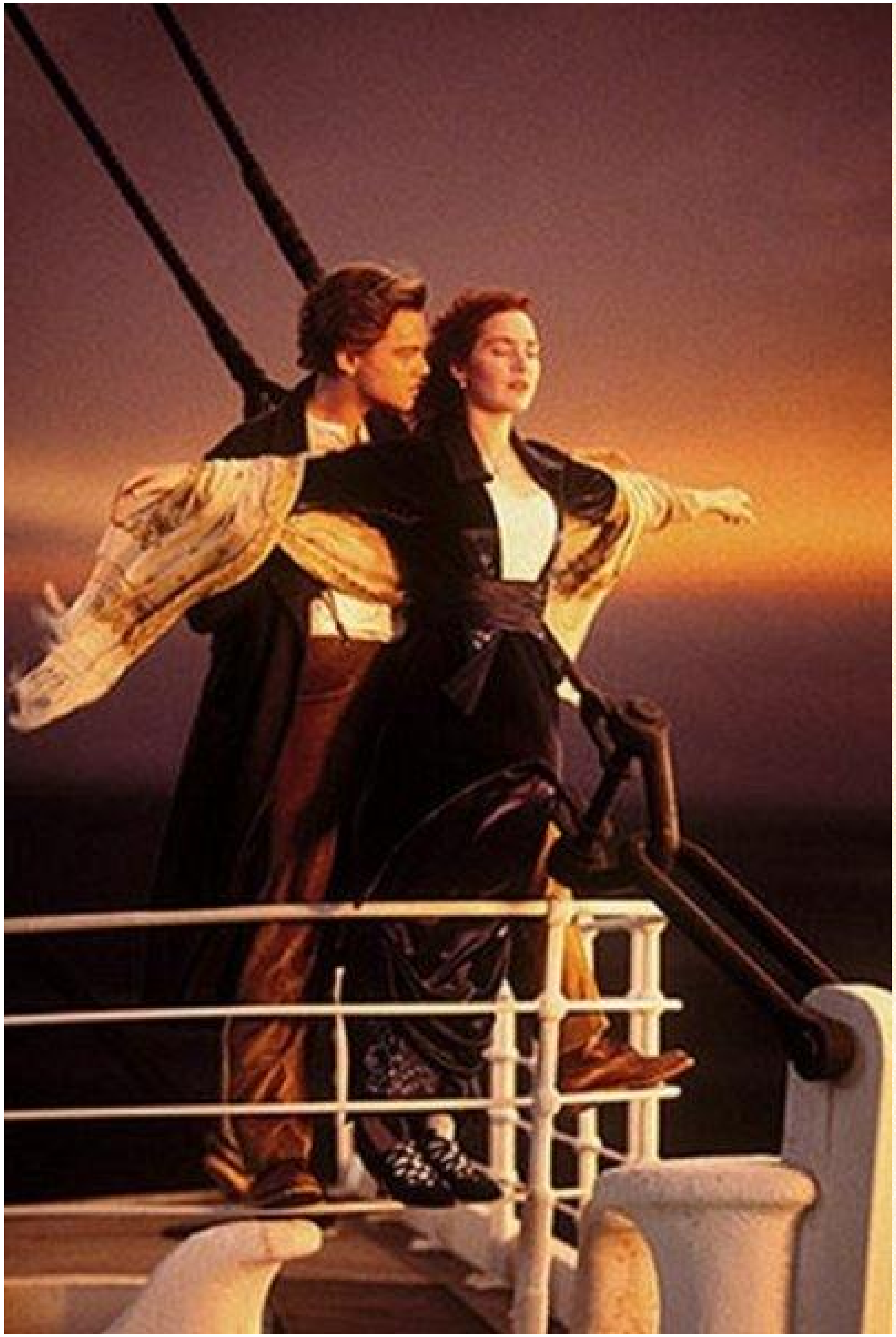
- Geological
- Hydrological
- Climatic & Atmospheri
- Wildfire
- **Antropogenic**

- **Crime**
- **Arson**
- **Terrorist incidents**
- **Rioting/War**
- **Power outages**
- **Communication outages**
- **Mixed Natural-Human**
- **Biological Hazards**

Example: Titanic

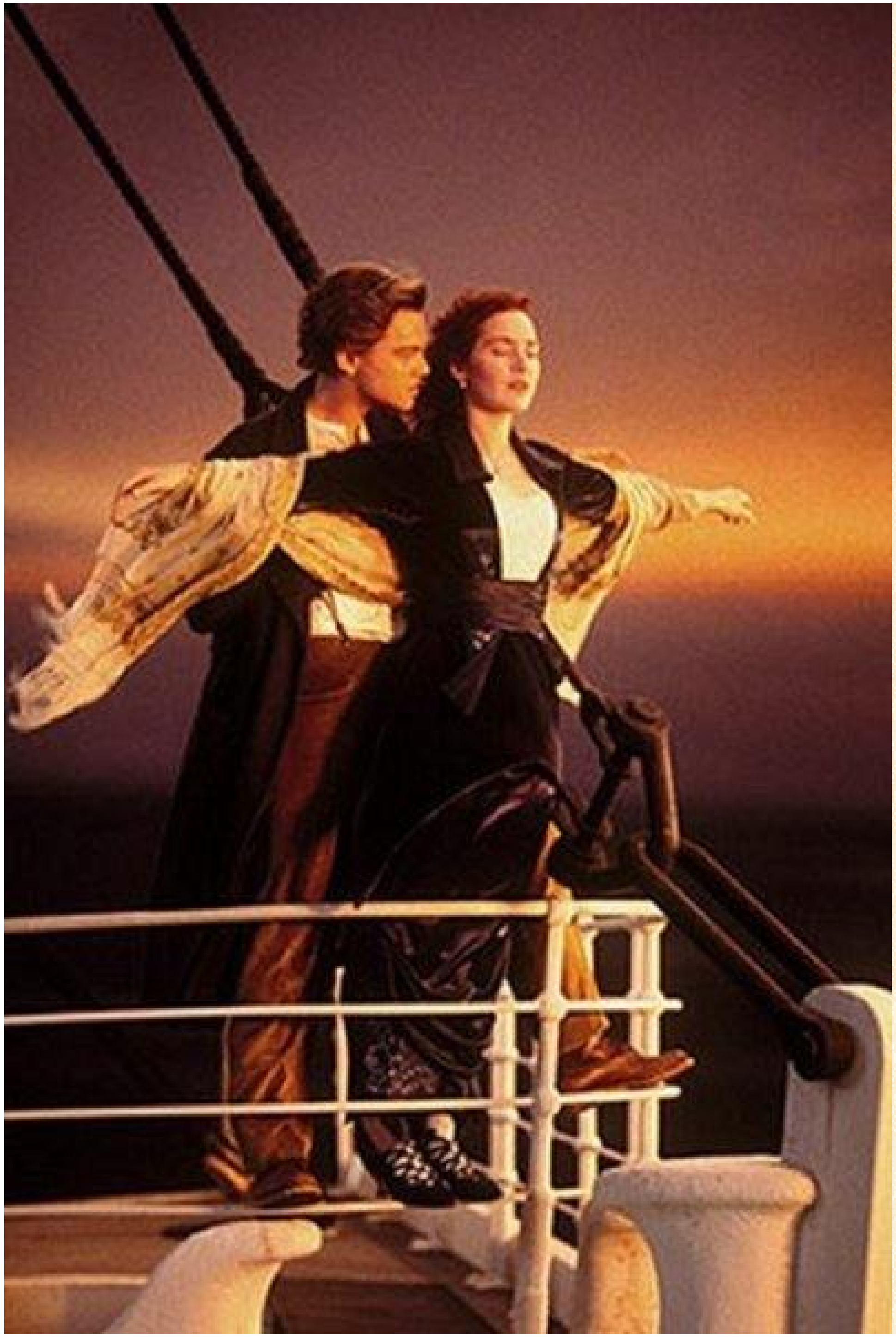
- Largest Passenger Ship
- Top Luxury
- 2227 people on board





Hazards

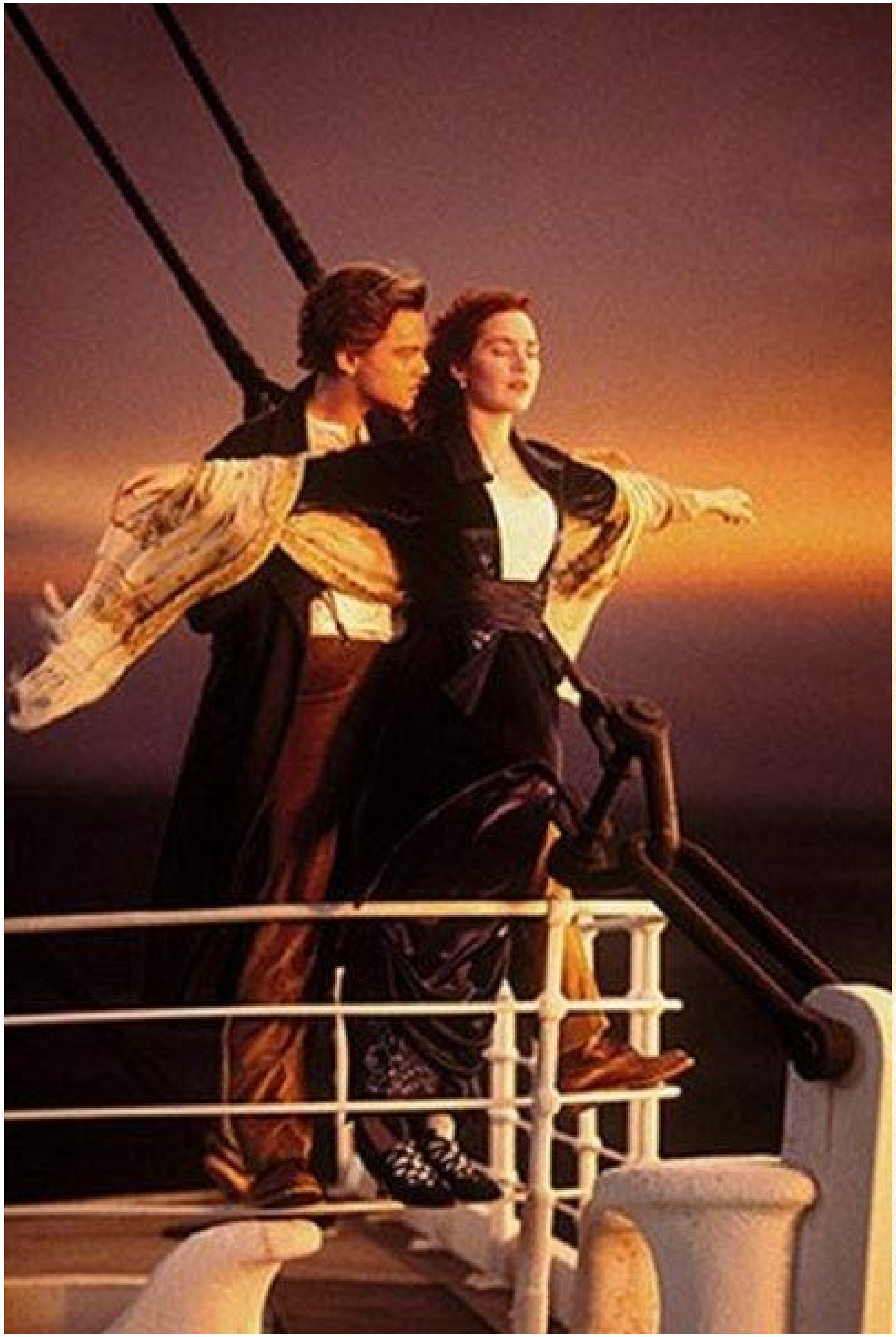
- Icebergs fields.
- Cold Seawater (<0°C).
- Darkness (new moon).



Vulnerabilities

- Outdated regulations.
- Insufficient lifeboats.
- Overconfidence on outdated/unproven design.
- High speed.
- Communication failures.
- Slow chain of command.
- No emergency drills.

- Leonardo di Caprio on board!



Risks

- Ship Damaged.
- Ship Sinking.
- Death in water by Drowning/Hypothermia.
- Delay in rescue.

- Another Titanic film, this time with Leonardo di Caprio.

Disaster

- Titanic lost.
- 1517 deaths.

- James Cameron's Oscar
- Cèline Dion, again...

Hazards @ SLR Network

Hazards @ SLR Network

- Human Factor
- Lifelines
- SLR stations
  - Buildings
  - Equipment
  - Operation

Human Factor

Personal Health Hazards:

- Irregular sleep patterns.
- Sit-down work in front of PC monitors.
- Unbalanced diet.
- Laser.

Main Hazard: Time

Human Factor

- Alla Massevitch
- Karel Hamal
- Werner Gurtner
- Wolfgang Seemueller
- Yang Fuming

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- Are we losing the **Historical Memory**?

Human Factor

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- Are we losing the **Historical Memory**?
- What is the SLR **Median Age**?
- It's growing?

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- How to implement the **Generational Flow**?
- How to improve the **Knowledge Transfer**?

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- What is the SLR **Median Age**?
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- How to implement the **Generational Flow**?
- How to improve the **Knowledge Transfer**?
- How to reduce the **Gender Imbalance**?

Lifelines Vulnerabilities & Risks

- **Lifelines:** Essentials infrastructures and supplies for the functioning of society or a system.
  - ◊ Power, Water, Oil & Gas utilities.
  - ◊ Telecommunications Networks (including Radio & TV).
  - ◊ Road, Rail, Airport and Port services.
  - ◊ Law & Order.

Lifelines Vulnerabilities & Risks

- **Power Supply.**
- **Communication Lines.**
- **Human Supplies.**
- **Catastrophe Sheltering.**
- **Catastrophe Security.**

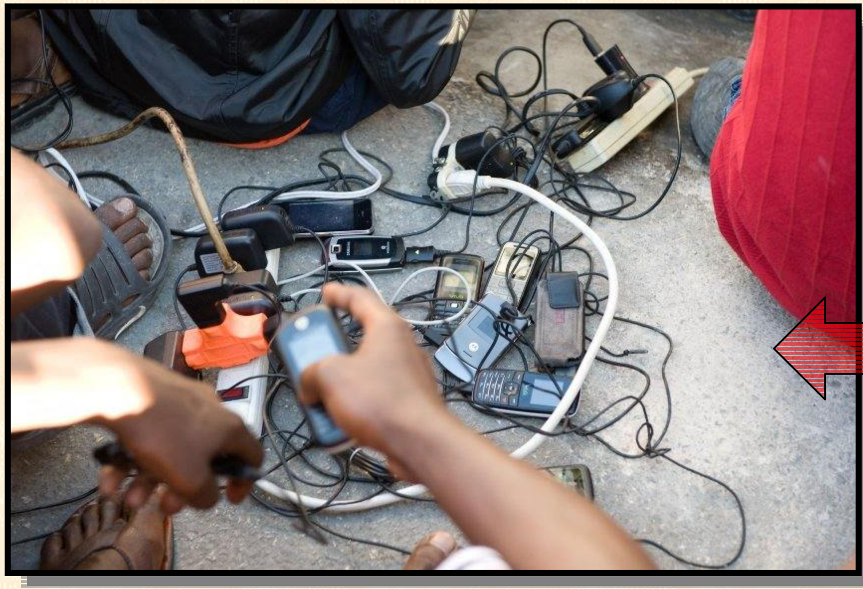
Lifelines Vulnerabilities & Risks

- **Power Supply.**

- Power plants.
  - Damage-Proof.
  - Fuel Reserves.
  - Distribution lines.
- Solar Cells & Windmills
  - Batteries.
  - Proper Mounting.
- Emergency Lights.
- Cellphone Charger.
- Cooling and Heating.

Lifelines Vulnerabilities & Risks

- **Power Supply.**



Port-au-Prince, Haiti 2010

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  - Distribution lines.
- Solar Cells & Windmills
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  - Proper Mounting.
- Emergency Lights.
- **Cellphone Charger.**
- Cooling and Heating.

Lifelines Vulnerabilities & Risks

- **Communications.**

- Phone lines
  - Sources (fixed, cell, Satellite)
  - Address Lists
- Internet.
  - Point-to-Point backup?
- Internal Communications
  - Contact List
  - Road Maps

Lifelines Vulnerabilities & Risks

- **Human Supplies.**
  - Food/Cooking.
  - Water.
  - Medical Supplies.
  - Storage & Processing.
  - Heating.

Lifelines Vulnerabilities & Risks

- **Sheltering.**

- Skeleton Crew.
  - Emergency planning.
- External Sheltering.
  - Refugees?

Lifelines Vulnerabilities & Risks

- **Security.**

- Physical Security.
  - Evacuation plans.
  - Storing non-essentials.
  - Theft/Looting.
  - Defensive Weapons.
- Fire/Flood Supplies.
  - Local water reserves.
  - Proper Equipment.
  - Contact Plans
  - Safe Storing place(s).

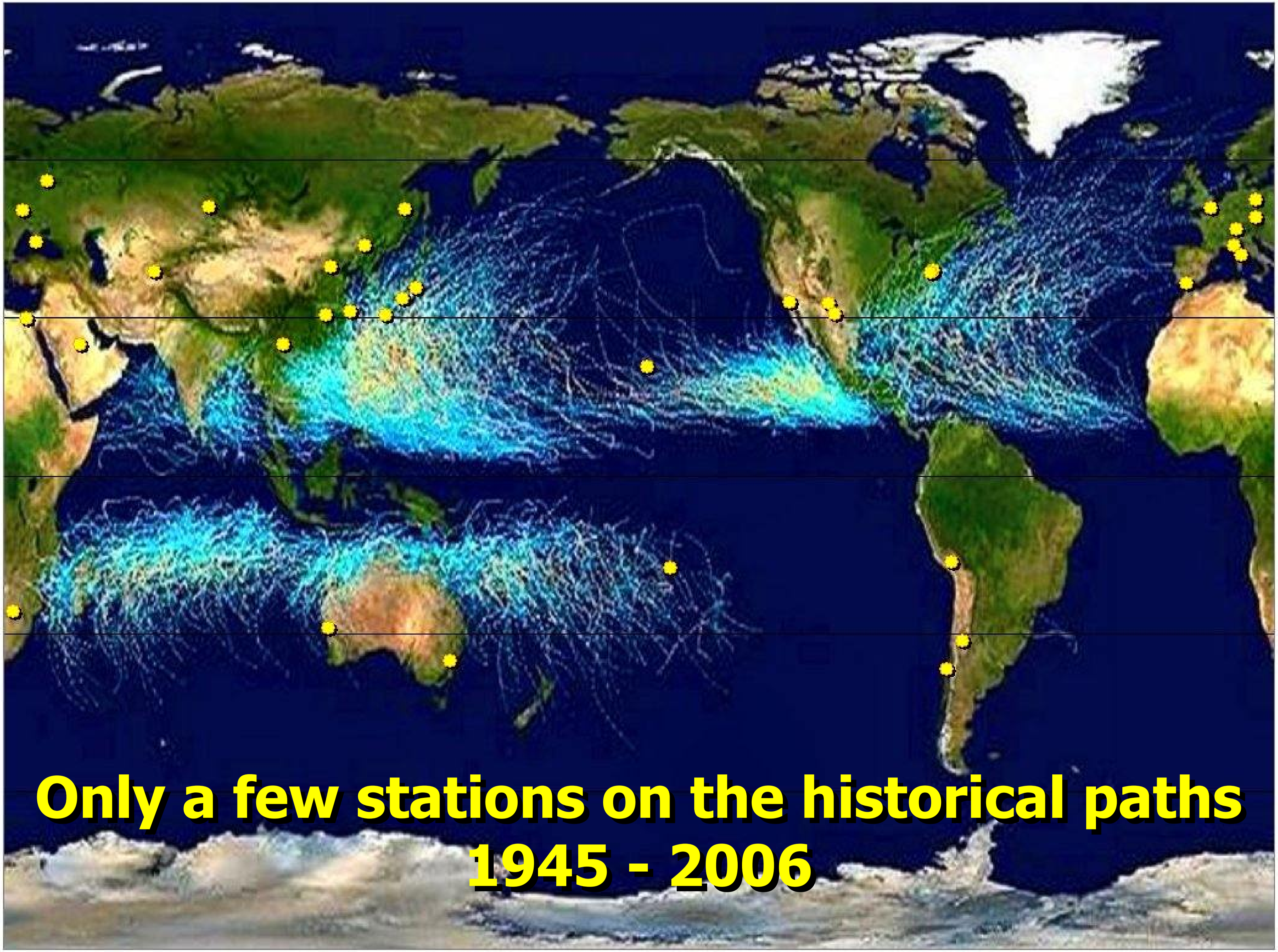
Hazards @ SLR Network

Hurricanes/Typhoons

- Seasonal Hazard.
- Localized areas.
- Path known in advance.
- Wind & water damages.
- Damage to power & comms lines.
- Few days overcast.

Hurricanes/Typhoons

- Important in localizing new stations.
- Hurricane proofing on the building design for the affected areas.
- Standard mitigation planning & procedures.


Only a few stations on the historical paths
1945 - 2006

Fires

Mt. Stromlo 2003

Fires

- Seasonal Hazard.
- What are the rules for local forest/land management?
- SLR Local vulnerabilities:
  - Water Supply.
  - Fuel deposits.
  - Compressed gasses.
  - Flammable/Toxic materials.

Fires

- Previous Coordination with the Firefighting Authority?
- Communication lines ready?
- Are countermeasures possible?
- There is an Evacuation Plan?
- Is everybody Trained?
- Insurance?


Fires
The Rockhouse Fire: McDonald, April 2011
Frank Cianciolo/McDonald Observatory

WHAT STARTS HERE CHANGES THE WORLD
THE UNIVERSITY OF TEXAS AT AUSTIN

Fire Prevention Services

Emergency 911 FPS 512-471-3511

Excellent Mitigation!

Home | About FPS | Contact Us | Fire Safety | Residence Halls | Off-Campus

McDonald Observatory Named Firewise Community

UT Fire Marshal Collaborates to Protect Valuable Research Facility

Back in November 2004, Fire Marshal Garland Waldrop made protecting the McDonald Observatory a top priority when he joined forces with The Texas State Fire Marshal's Office, Texas Forest Service, and Fort Davis Volunteer Fire Department to upgrade fire safety measures at The University of Texas at Austin's world-class astronomy facility. Now, only two years later, what Waldrop calls a "precedent-setting collaboration of state agencies" has provided McDonald Observatory with new firebreaks, equipment, and personnel, earning it national recognition as a Firewise Community.

McDonald Observatory, a leading center for astronomical research and public education, is located in the Davis Mountains of West Texas, on the highest road in the state. Because the observatory is situated approximately 6,800 feet above sea level and is surrounded by acres of brush and trees, it is at high risk for wild land fires; for this reason, The Texas State Fire Marshal's Office asked Waldrop to take part in an evaluation of the facility's fire safety in 2004.

Lightning

- Damage by induction on:
  - Equipment connected to phone lines.
  - on Meteo and GPS cables.

A high quality grounding and surge protectors are a good mitigation action.

Lightning can initiate forest fires.

Computing and Internet

Computing Hazards

Computers are fundamental:

- **Real time control.**
- **Data analysis.**
- **Information Exchange.**

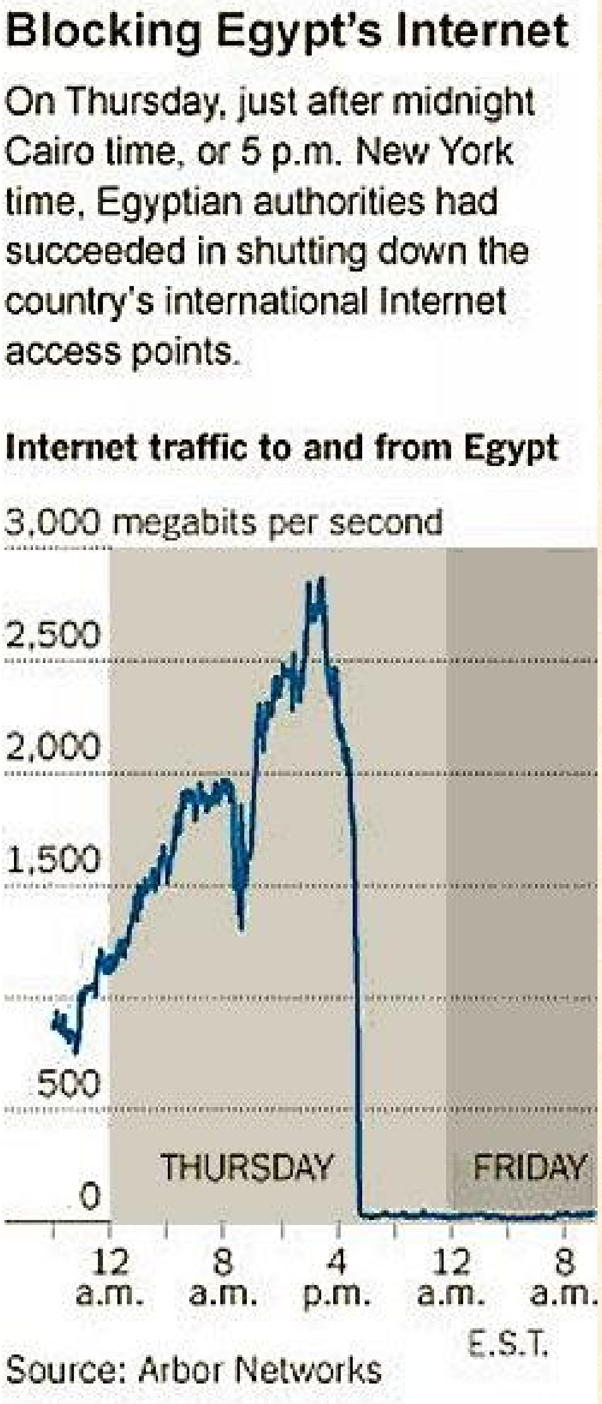
- **No PC, no Tracking!**

Computing Hazards

- **Local**
  - Virus/Hacking.
  - Old Technology, (lack of) spares.
  - UPS?
  - (Catastrophic) Failures.
  - Loss of software know-how.
  - Theft.

- **There is a <u>secured</u> software security copy on each SLR station?**

Hayastan Shakarian is accused of hacking through the cable that cut off Armenia's Internet



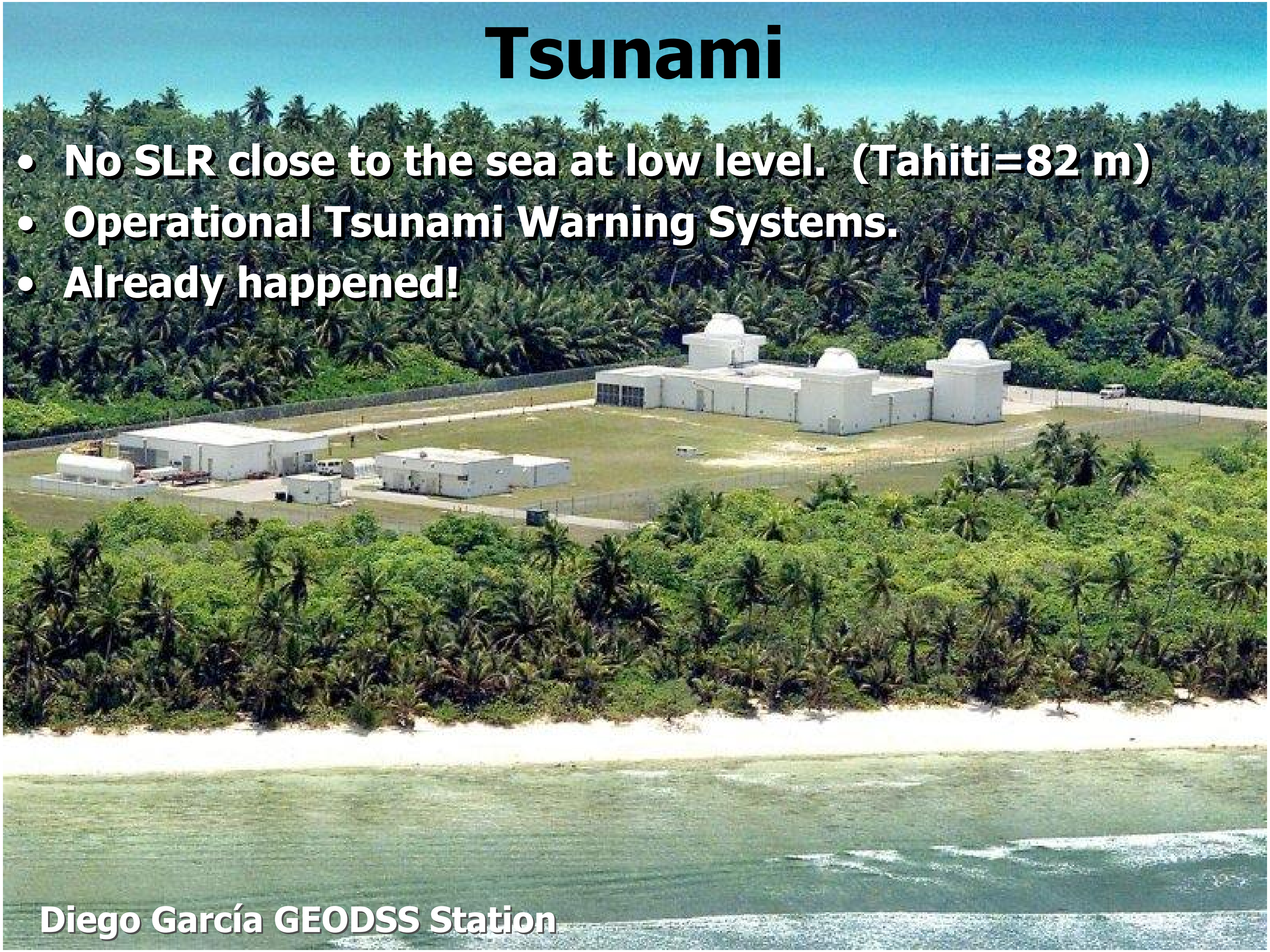
Internet Can Die

- **Local**
  - Government actions (Egypt)
  - Cyberattack (Estonia)
  - Local damage (Armenia)
  - Local disaster (Concepción)
- **Global**
  - Cyberwar.
  - Virus/Hacking.
  - Reduced capacity due to damage in lines.
  - Geomagnetic Storm.

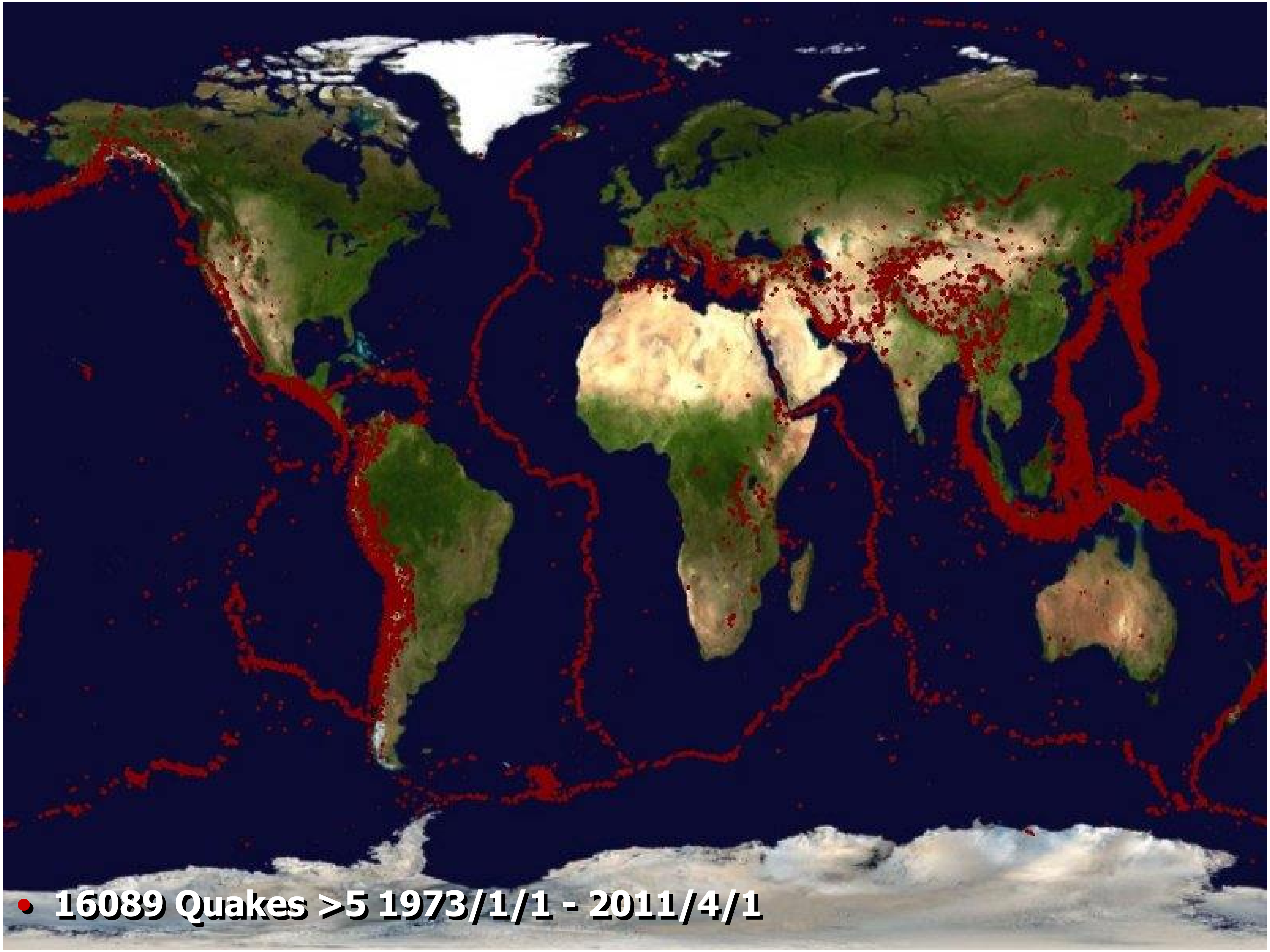
Earthquakes

Tsunami

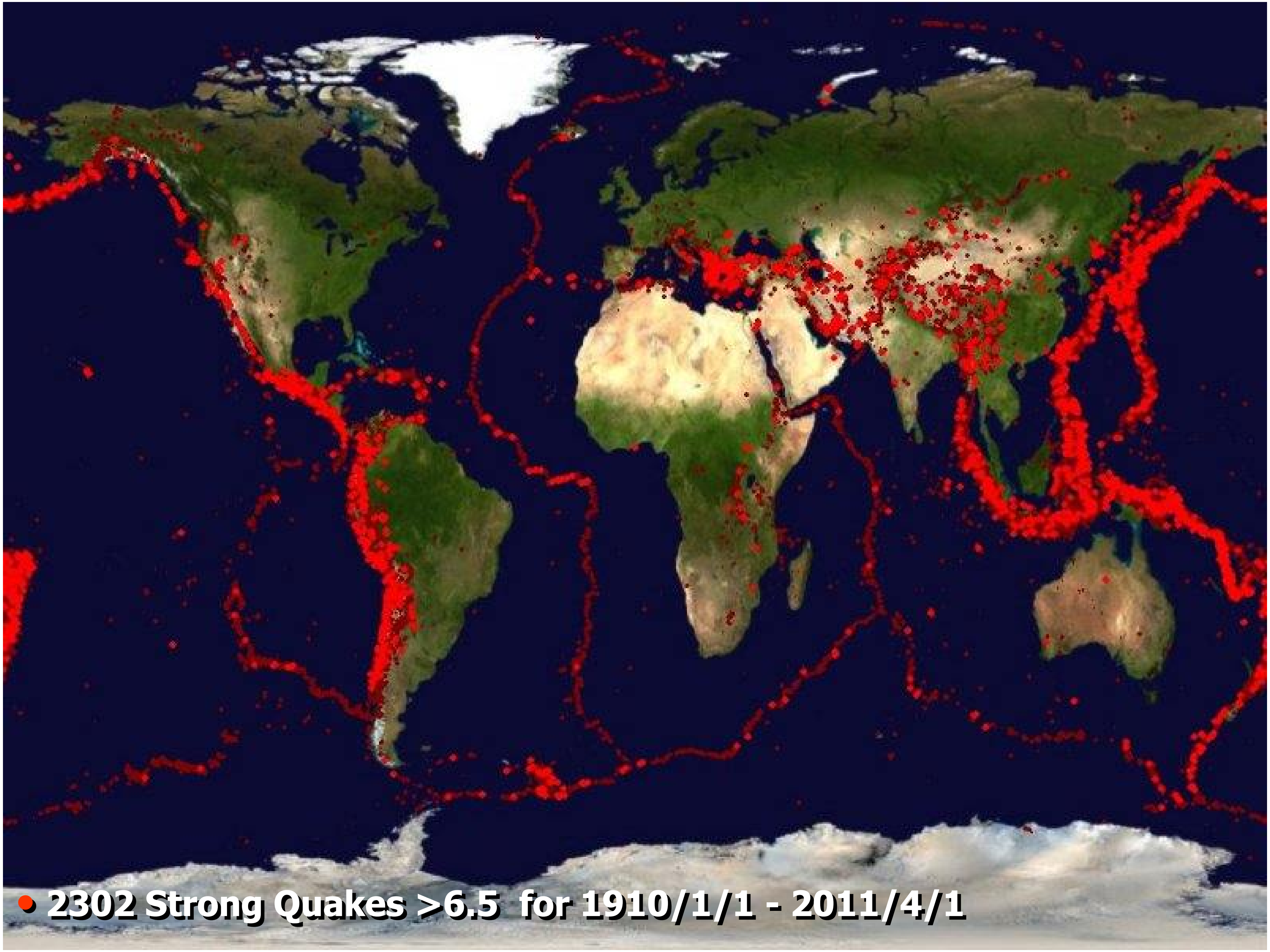
- No SLR close to the sea at low level. (Tahiti=82 m)
- Operational Tsunami Warning Systems.
- Already happened!

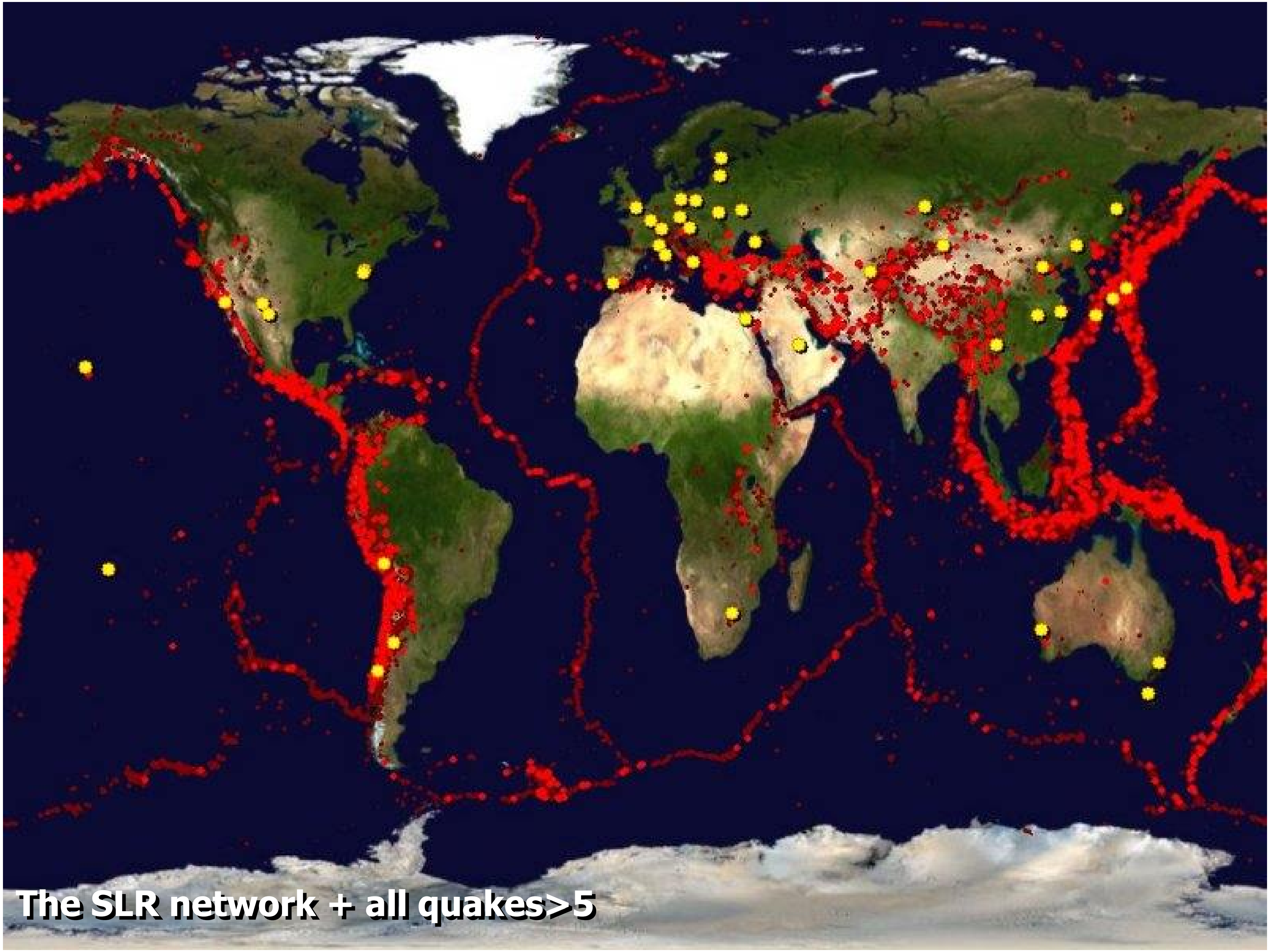


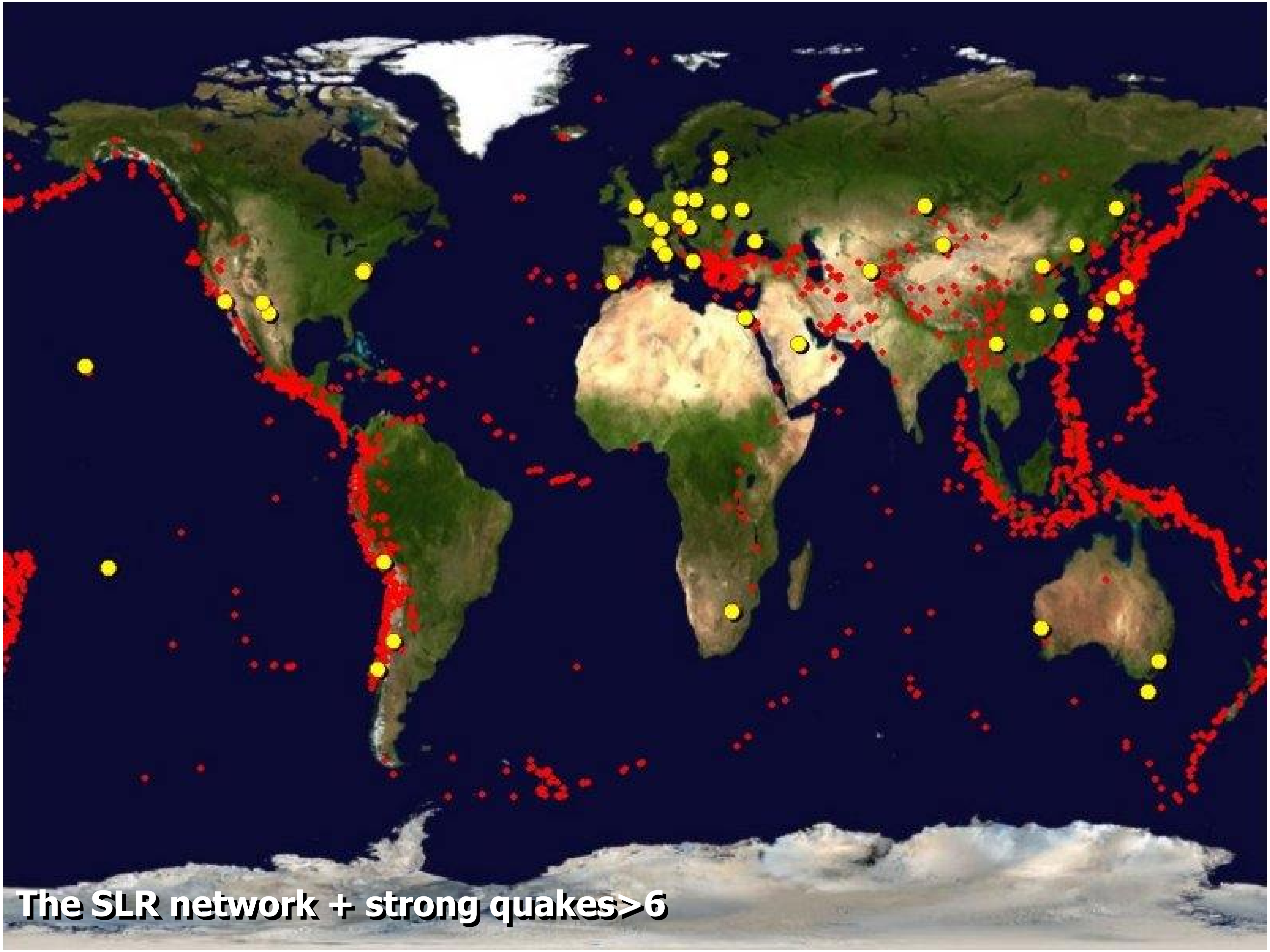
Diego García GEODSS Station



- **16089 Quakes >5 1973/1/1 - 2011/4/1**


• 2302 Strong Quakes >6.5 for 1910/1/1 - 2011/4/1

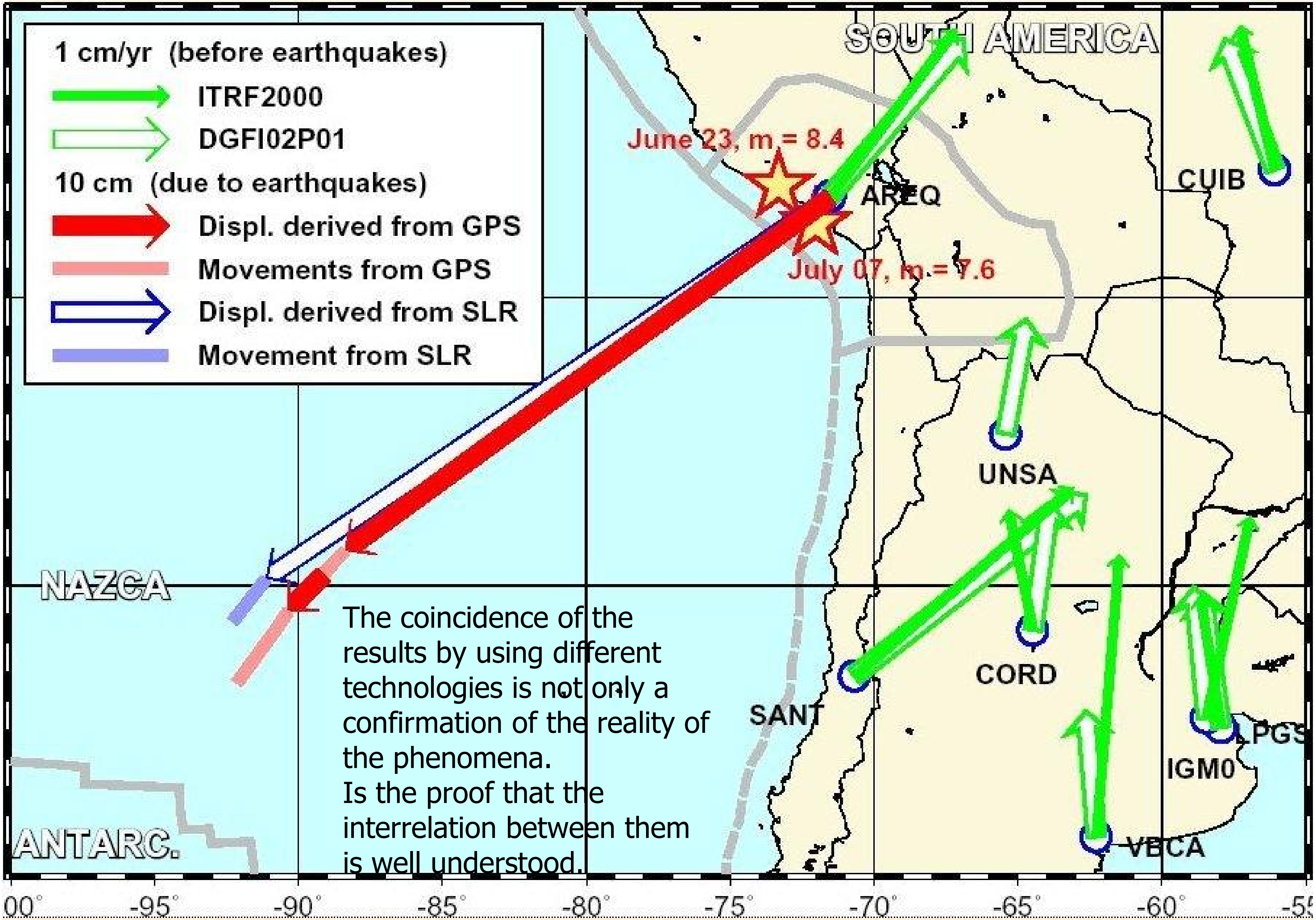

The SLR network + all quakes>5


The SLR network + strong quakes>6

Earthquake Hazard

- Earthquakes are not **ONLY** a Hazard.
- They are a chance for the SLR network to do state-of-the-art geophysics.
- Can we contribute?

YES!



The coincidence of the results by using different technologies is not only a confirmation of the reality of the phenomena.
Is the proof that the interrelation between them is well understood.

Earthquakes

- **Magnitude**: Is the measurement of the released earthquake energy in a $\log_{10}$ scale.

  Even using different measuring methodologies, it is a single value per earthquake.

- **Intensity**: Is the discreet classification of the local effects of the shaking in a *single point*.

  The intensity of a quake varies from point to point.

Earthquake Hazard

- **Seismic Microzoning**: Is the local evaluation of the seismic hazard by analyzing the response of the soil to the (expected) earthquakes.

It has:

- **Maximum Intensity/Acceleration** expected.
- **Recurrence Period** for the top expected value.
- (power spectra of the expected quakes - synthetic accelerograms-).

Earthquake Hazard

- Does each SLR station has its microzoning?
- Are the microzoning methodologies comparable?
- Are the stations ready for this hazard?

Earthquake Hazard

- **Analysis by proxy**:
- USGS Global quake Catalogue 1910-2011 for **2302** potentially destructive quakes >6.5m

for a given radius near the stations:

- Maximum Intensity ➡ Closest/Strongest quake
- Recurrence Period ➡ Number of strong quakes

Earthquake Hazard

The Hazard is understimated

- The local low-level seismic activity not included.
- On-site geological/geophysical properties not used.
- Long recurrence periods not apparent in the data.

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- A four level classification using the closest quake:

◊ Very low hazard	>1000 km.
◊ Low hazard	1000≈500 km.
◊ Medium hazard	500≈250 km.
◊ High (At risk) hazard	<250 km.

Very Low (>1000 Km)

Station	Long. Q	Lat. Q	m	Date	d Km.
Herstmonceux	13.100	46.300	6.5	9/15/1976 3:15	1064.6
Riga	26.670	45.840	7.0	5/30/1990 10:40	1247.3
Mendeleevo	34.300	44.300	6.8	9/11/1927 22:15	1319.2
Metsahovi	26.670	45.840	7.0	5/30/1990 10:40	1604.4
Mount Stromlo	159.000	-49.500	7.5	7/24/1924 4:55	1772.7
Greenbelt	-56.000	44.000	7.2	11/18/1929 20:32	1813.4
Stafford	-56.000	44.000	7.2	11/18/1929 20:32	1880.6
Tahiti	-171.180	-17.650	6.8	2/3/1980 11:58	2283.5

Herstmonceux: a 4.6m quake on 28/4/2007 at 52.7 km

Low (500~1000 Km)

Station	Long. Q	Lat. Q	m	Date	d Km.
Wuhan	115.300	35.200	6.8	7/31/1937 20:35	525.9
Grasse	13.100	46.200	6.5	9/11/1976 16:31	556.2
Golosiiv	26.800	45.800	7.3	11/10/1940 1:39	576.3
Shanghai	122.500	25.500	8.3	4/12/1910 0:22	635.0
Potsdam	13.270	46.360	6.5	5/6/1976 20:00	669.1
Borowiec	13.270	46.360	6.5	5/6/1976 20:00	712.6
Riyadh	52.800	28.400	7.1	4/10/1972 2:07	744.2
Hartebeesthoek	33.580	-21.320	7.0	2/22/2006 22:19	785.8
Apache Point	-112.120	28.160	6.6	1/4/2006 8:32	791.8
McDonald	-110.280	26.090	6.6	8/28/1995 10:46	796.7

Medium (250~500 Km)

Station	Long. Q	Lat. Q	m	Date	d Km.
Altay	78.850	49.990	7.1	7/23/1973 1:22	278.0
Helwan	29.600	32.200	6.7	9/12/1955 6:09	308.5
Wettzell	13.270	46.360	6.5	5/6/1976 20:00	310.8
Yarragadee	117.000	-31.600	7.4	10/14/1968 2:58	325.0
Maidanak	63.770	40.310	7.1	4/8/1976 2:40	326.5
Changchun	130.350	43.610	7.1	4/8/1999 13:10	394.6
Ajaccio	13.600	41.900	7.0	1/13/1915 6:52	399.9
Kom.-na-Amure	141.850	49.040	7.2	5/12/1990 4:50	409.2
Zimmerwald	13.100	46.300	6.5	9/15/1976 3:15	434.9
Lviv	26.670	45.840	7.0	5/30/1990 10:40	496.0

At Risk (<250 Km)

Station	Long. Q	Lat. Q	m	Date	d Km.
Arequipa	-71.500	-16.500	7.3	1/15/1958 19:14	3.9
Tanegashima	131.090	30.570	6.6	10/18/1996 10:50	7.3
Simosato	136.000	33.700	8.3	12/7/1944 4:36	14.8
San Juan	-68.500	-31.600	7.8	1/15/1944 23:49	15.5
Simeiz	34.300	44.300	6.8	9/11/1927 22:15	27.4
Katzively	34.300	44.300	6.8	9/11/1927 22:15	27.4
Concepcion	-73.370	-36.670	6.6	3/5/2010 11:47	36.2
Koganei	139.500	35.300	8.3	9/1/1923 2:59	45.6
Monument Peak	-115.840	33.010	6.7	11/24/1987 13:15	55.9
Kunming	102.700	24.200	7.7	1/4/1970 0:17	92.7
Haleakala Maui	-155.930	19.880	6.7	10/15/2006 17:07	97.9
Matera	15.370	40.910	6.5	11/23/1980 18:34	116.0
Beijing	117.980	39.570	7.5	7/27/1976 19:42	178.8
Graz	13.270	46.360	6.5	5/6/1976 20:00	186.8
San Fernando	-3.500	37.000	7.0	3/29/1954 6:17	248.3

Strongest Quake (<250 Km)

Station	Long. Q	Lat. Q	m	Date	d Km.
Arequipa	-72.200	-15.300	8.5	10/11/1939 14:51	149.9
Tanegashima	131.500	29.500	8.0	2/1/1916 7:36	126.3
Simosato	136.000	33.700	8.3	12/7/1944 4:36	14.8
San Juan	-68.500	-31.600	7.8	1/15/1944 23:49	15.5
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Katzively	34.300	44.300	6.8	9/11/1927 22:15	27.4
Concepcion	-72.900	-36.120	8.8	2/27/2010 6:34	81.1
Koganei	139.500	35.300	8.3	9/1/1923 2:59	45.6
Monument Peak	-116.440	34.200	7.3	6/28/1992 11:57	145.4
Kunming	102.700	24.200	7.7	1/4/1970 0:17	92.7
Haleakala Maui	-155.020	19.330	7.2	11/29/1975 14:47	200.2
Matera	15.400	41.100	6.5	7/23/1930 23:30	120.5
Beijing	115.100	37.500	7.6	3/22/1966 8:19	244.1
Graz	13.270	46.360	6.5	5/6/1976 20:00	186.8
San Fernando	-3.500	37.000	7.0	3/29/1954 6:17	248.3

Number of Quakes, At Risk

Station	0<250	250>500	0>500
Arequipa	13	21	34
Tanegashima	12	5	17
Simosato	16	37	53
San Juan	4	33	37
Simeiz	1	11	12
Katzively	1	11	12
Concepcion	18	18	36
Koganei	19	56	75
Monument Peak	10	2	12
Kunming	2	13	15
Haleakala Maui	4	0	4
Matera	2	15	17
Beijing	3	3	6
Graz	4	0	4
San Fernando	1	1	2

Number of Quakes, Medium

Station	0>500
Altay	4
Helwan	3
Wettzell	4
Yarragadee	1
Maidanak	28
Changchun	7
Ajaccio	1
Komsomolsk-na-Amure	5
Zimmerwald	4
Lviv	1

Combined History (<250 Km)

Station	Closest			Strongest			# Radius		
	m	Date	d Km.	m	Date	d Km.	0-250	250-500	0-500
Arequipa	7.3	1/15/1958	4	8.5	10/11/1939	150	13	21	34
Tanegashima	6.6	10/18/1996	7	8.0	2/1/1916	126	12	5	17
Simosato	8.3	12/7/1944	15	8.3	12/7/1944	15	16	37	53
San Juan	7.8	1/15/1944	16	7.8	1/15/1944	16	4	33	37
Simeiz	6.8	9/11/1927	27	6.8	9/11/1927	27	1	11	12
Katzively	6.8	9/11/1927	27	6.8	9/11/1927	27	1	11	12
Concepcion	6.6	3/5/2010	36	8.8	2/27/2010	81	18	18	36
Koganei	8.3	9/1/1923	46	8.3	9/1/1923	46	19	56	75
Monument Peak	6.7	11/24/1987	56	7.3	6/28/1992	145	10	2	12
Kunming	7.7	1/4/1970	93	7.7	1/4/1970	93	2	13	15
Haleakala Maui	6.7	10/15/2006	98	7.2	11/29/1975	200	4	0	4
Matera	6.5	11/23/1980	116	6.5	7/23/1930	121	2	15	17
Beijing	7.5	7/27/1976	179	7.6	3/22/1966	244	3	3	6
Graz	6.5	5/6/1976	187	6.5	5/6/1976	187	4	0	4
San Fernando	7.0	3/29/1954	248	7.0	3/29/1954	248	1	1	2

Combined History, At Risk

Station	Closest			Strongest			# Radius			% time
	m	Date	d Km.	m	Date	d Km.	0-250	250-500	0-500	2005-2010
Arequipa	7.3	1/15/1958	4	8.5	10/11/1939	150	13	21	34	1.21%
Tanegashima	6.6	10/18/1996	7	8.0	2/1/1916	126	12	5	17	0.52%
Simosato	8.3	12/7/1944	15	8.3	12/7/1944	15	16	37	53	1.13%
San Juan	7.8	1/15/1944	16	7.8	1/15/1944	16	4	33	37	6.49%
Simeiz	6.8	9/11/1927	27	6.8	9/11/1927	27	1	11	12	0.98%
Katzively	6.8	9/11/1927	27	6.8	9/11/1927	27	1	11	12	1.59%
Concepcion	6.6	3/5/2010	36	8.8	2/27/2010	81	18	18	36	3.27%
Koganei	8.3	9/1/1923	46	8.3	9/1/1923	46	19	56	75	1.10%
Monument Peak	6.7	11/24/1987	56	7.3	6/28/1992	145	10	2	12	3.29%
Kunming	7.7	1/4/1970	93	7.7	1/4/1970	93	2	13	15	0.18%
Haleakala Maui	6.7	10/15/2006	98	7.2	11/29/1975	200	4	0	4	1.65%
Matera	6.5	11/23/1980	116	6.5	7/23/1930	121	2	15	17	4.01%
Beijing	7.5	7/27/1976	179	7.6	3/22/1966	244	3	3	6	1.38%
Graz	6.5	5/6/1976	187	6.5	5/6/1976	187	4	0	4	5.98%
San Fernando	7.0	3/29/1954	248	7.0	3/29/1954	248	1	1	2	3.03%

35.8 % of data 2005-2010

Can we rank the stations?

Rank	Station	Points
1	Arequipa	21
1	Simosato	21
1	Koganei	21
2	Concepcion	24
2	San Juan	24
2	Tanegashima	24
3	Monument Peak	27
4	Beijing	30
5	Haleakala Maui	31
6	Kunming	33
6	Graz	34
7	Matera	39
8	Simeiz	45
8	Katzively	45
9	San Fernando	47

Data up to 1/April/2011

Can we rank the stations?

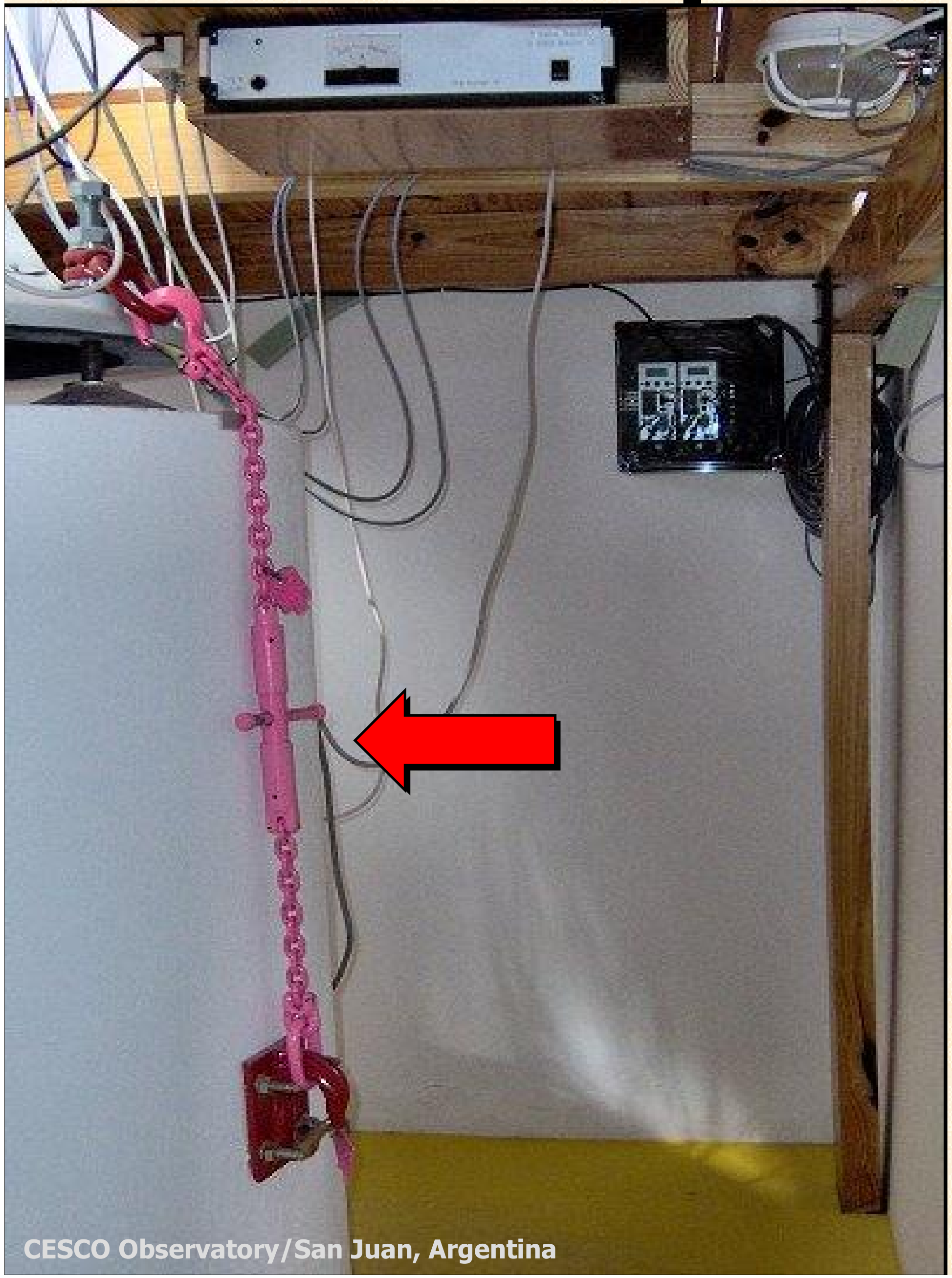
Rank	Station	Points
1	Arequipa	21
1	Simosato	21
2	Concepcion	22
2	Koganei	22
3	San Juan	24
4	Tanegashima	25
5	Monument Peak	27
6	Beijing	29
7	Haleakala Maui	32
7	Kunming	32
8	Graz	34
9	Matera	38
10	Simeiz	42
10	Katzively	42
11	San Fernando	44

Data up to 31/Dec/2009

Earthquake Hazard

- In the ILRS lifetime **several stations** will be **seriously affected** by earthquakes both in itself and by a regional/local disaster.
- The data generated by the SLR(+GPS) will be valuable for the full understanding of the Earthquake dynamics.
- **Good Mitigation** measures could reduce the damages and facilitate a fast return to operational status, **saving money, time** and maybe **lives**.
- Should be a predetermined operational police?

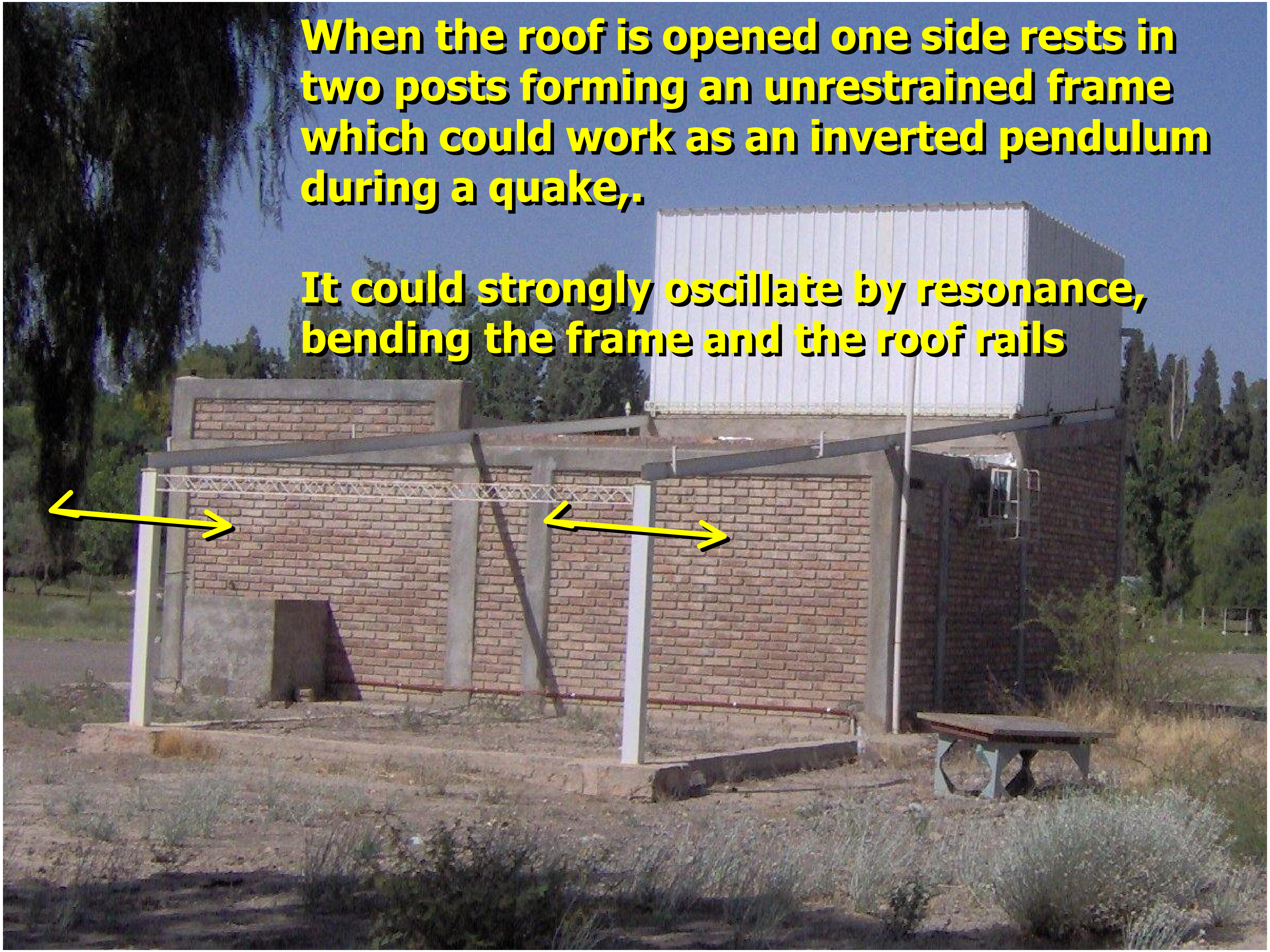
Earthquake Mitigation



- Are the building & mobile roof quake-ready?
- Are the Telescope, Laser & Optics secured?
- Have a manual roof closing option.
- Fix the racks to the walls.
- Secure the computers and other components.
- Protect ***everything*** from falling roof parts.
- Have a single, accessible power-off option.
- Train everyone!


Example: Improving the roof safety at San Juan
Security locks for the roof


Security
locks for
the roof


When the roof is opened one side rests in two posts forming an unrestrained frame which could work as an inverted pendulum during a quake,.
It could strongly oscillate by resonance, bending the frame and the roof rails


The solution: Reinforce the frame(s) with either iron rods, or steel cables under tension.

A predetermined operational police

- **Stop tracking until all back to normal.**
  - First priority: Fastest damage recovery.
  - Keeping the IGS station and other non-stop technologies operating.

A predetermined operational police

- **Stop tracking until all back to normal.**
  - First priority: Fastest damage recovery.
  - Keeping the IGS station and other non-stop technologies operating.

- **ASAP Tracking.**
  - An agreed reduced tracking program?
    - Pending new coordinates determination.
    - Limited by (man)power available.
    - Limited by available CPF's at the station.
  - Could be needed a two way non-internet data transfer link.

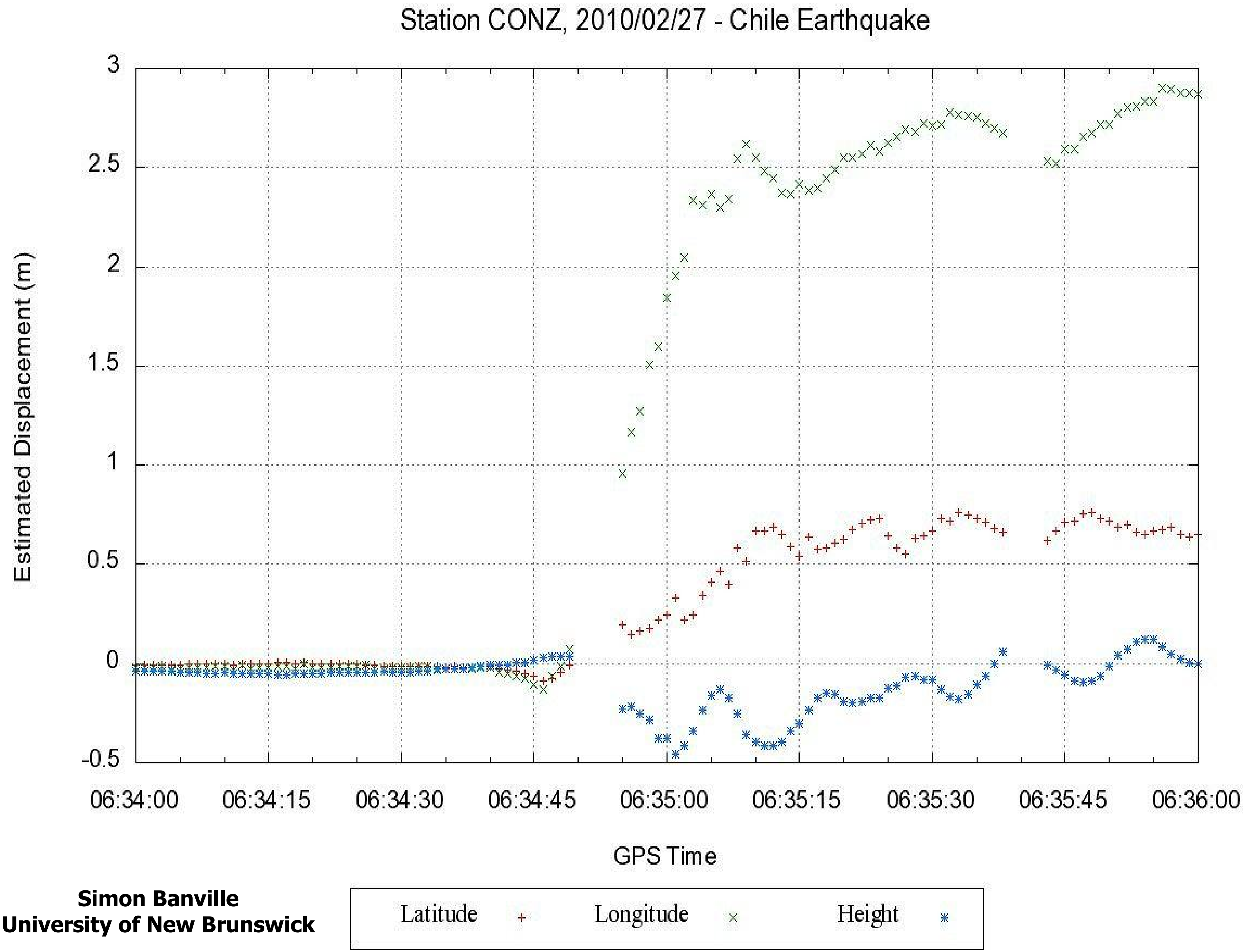
SLR<=>GPS, a perfect complement

- **Different time resolution scale.**
  - Day(s) for SLR.
  - Seconds for GPS.

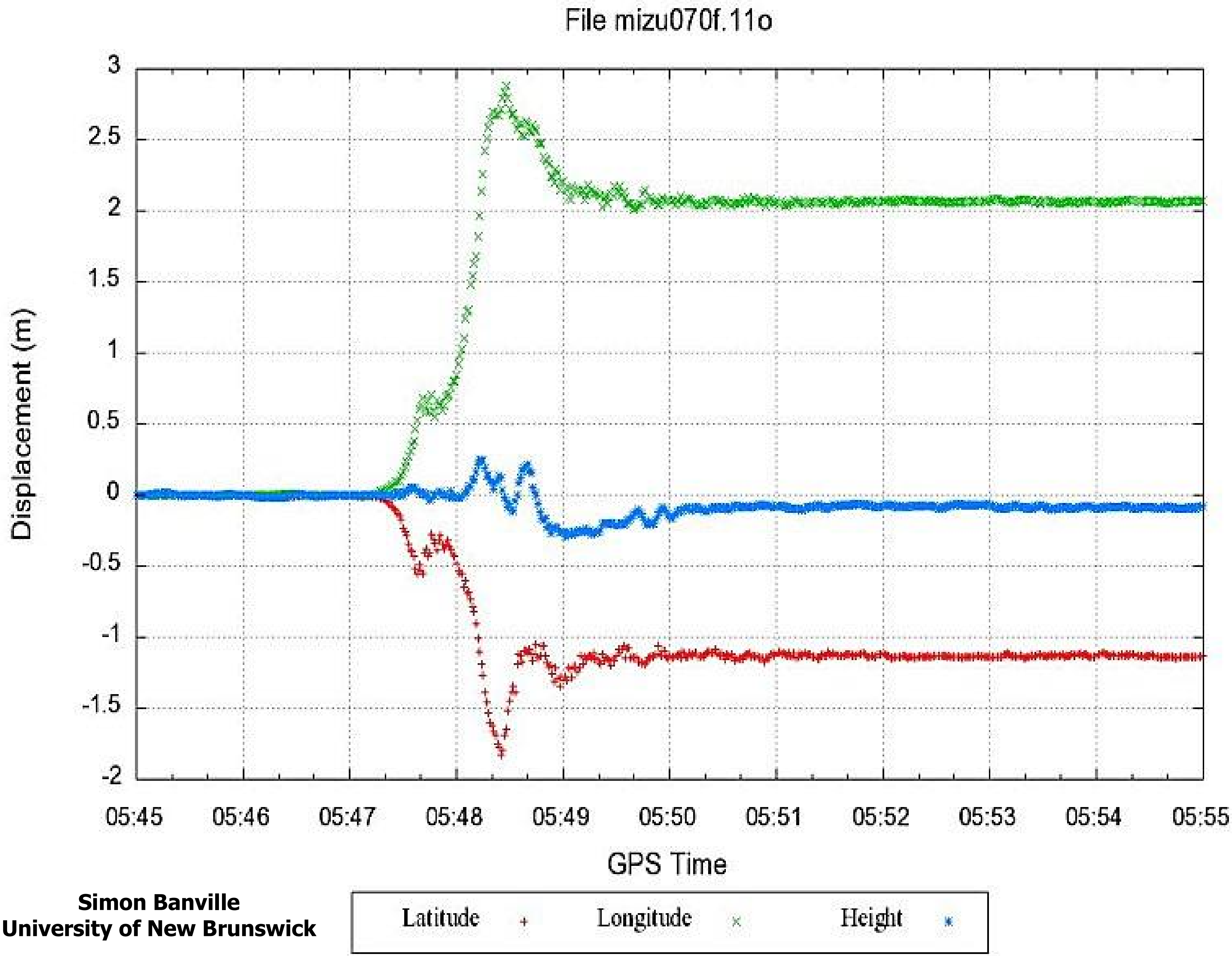
- **Regional densification.**
  - The regional GPS networks are denser.

- **Replacement/Repair costs.**
  - GPS receivers are cheaper with lower operational costs.

- **SLR with Less systematic errors, a primary global reference network.**



Simon Banville
University of New Brunswick



Simon Banville
University of New Brunswick

SLR without on-premises IGS-GPS

SLR Station	IGS GPS Station	Km	Other GPS Station	Km	Comment
IGS close					
Katzively	crao/Simeiz	3			
Lviv	sulp/Lviv	10			
Wuhan	wuhn/Wuhan	13			SLR moved
Non-IGS close					
San Juan	sant/Santiago	265	unsj/SIRGAS	5.8	future IGS
Apache Point	pie1/Pie Town	272	p027/UNAVCO	3.1	CORS
IGS Eliminated	/Out of service				
Koganei	kgni/Koganei	0.1	mtka/Mitaka	7.4	Broken
Tanegashima	gmsd/Natakane	0	aira/Aira	146	IGS/Out
No IGS close					
Stafford	nrl1/Washington	47			No CORS
Maidanak	kit3/Kitab	51			
Kom-na-Amure	khaj/Khabarovsk	271			
Helwan	ramo/Mitzpe Ramon	339			
Altay	nvsk/Novosibirsk	409			

Status April 30/2011

Can the SLR Network

Become a Hazard?

A legal Hazard?

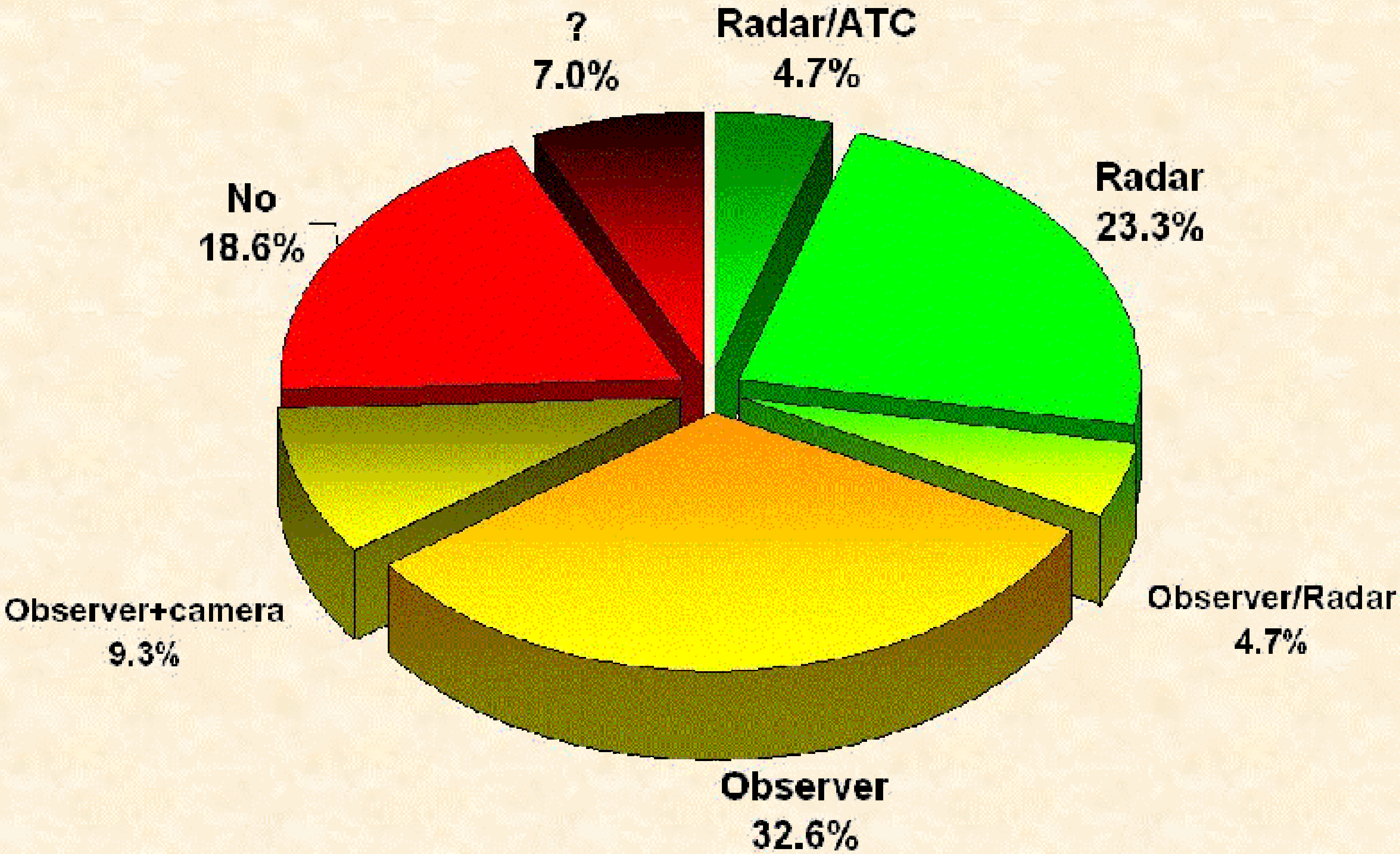
In-Sky laser safety

- Globally the number of **reported** aircraft incidents with laser *pointers* is **growing**.
- The usual answer are laws **restricting** the open air uses of lasers.
- Serious open air laser users:
  - **SLR**
  - **Lidar**
  - **Astronomical Adaptative Telescopes**
  - **Geodimeters**

Could be affected by non-comprehensive laws.
There is a copycat effect with these laws.

A legal Hazard?

In-Sky laser safety

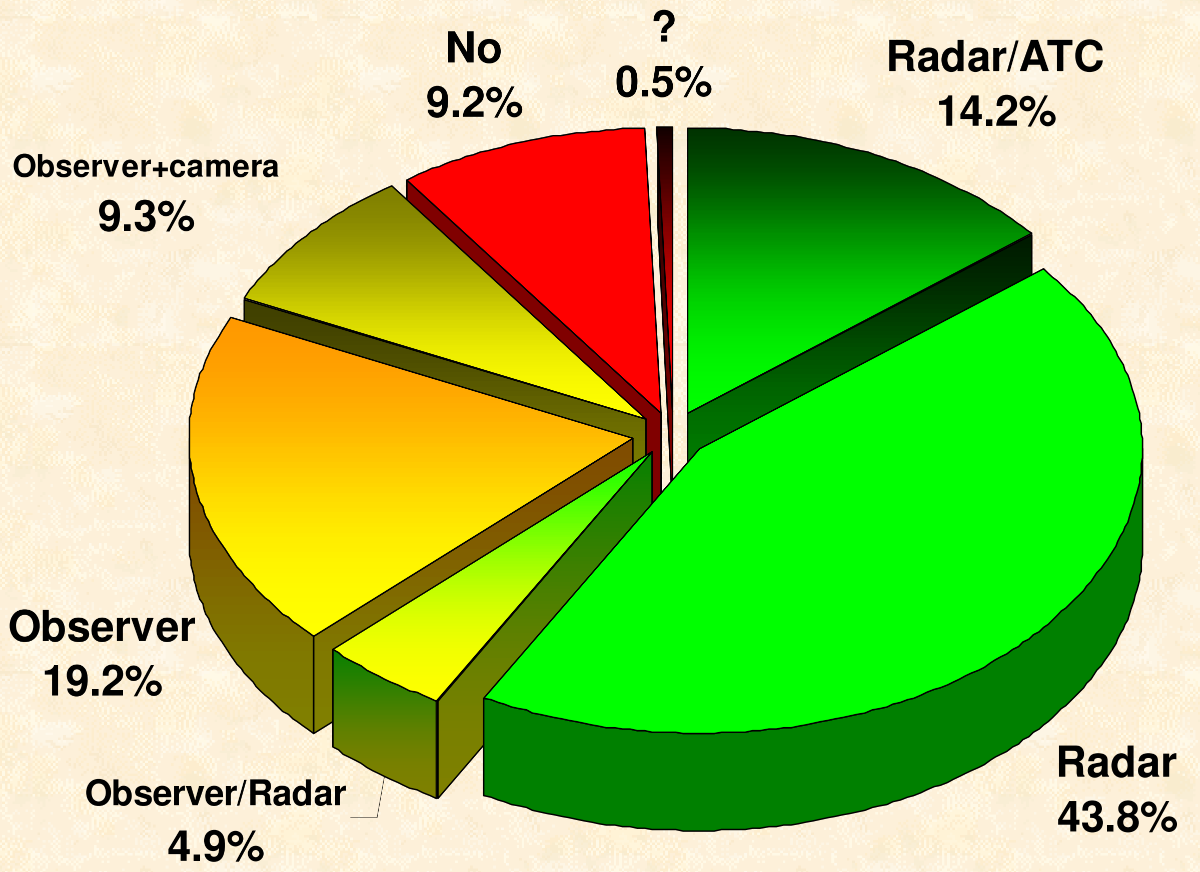


Taken from the current log files set

Airplane spotting method by Station

A legal Hazard?

In-Sky laser safety

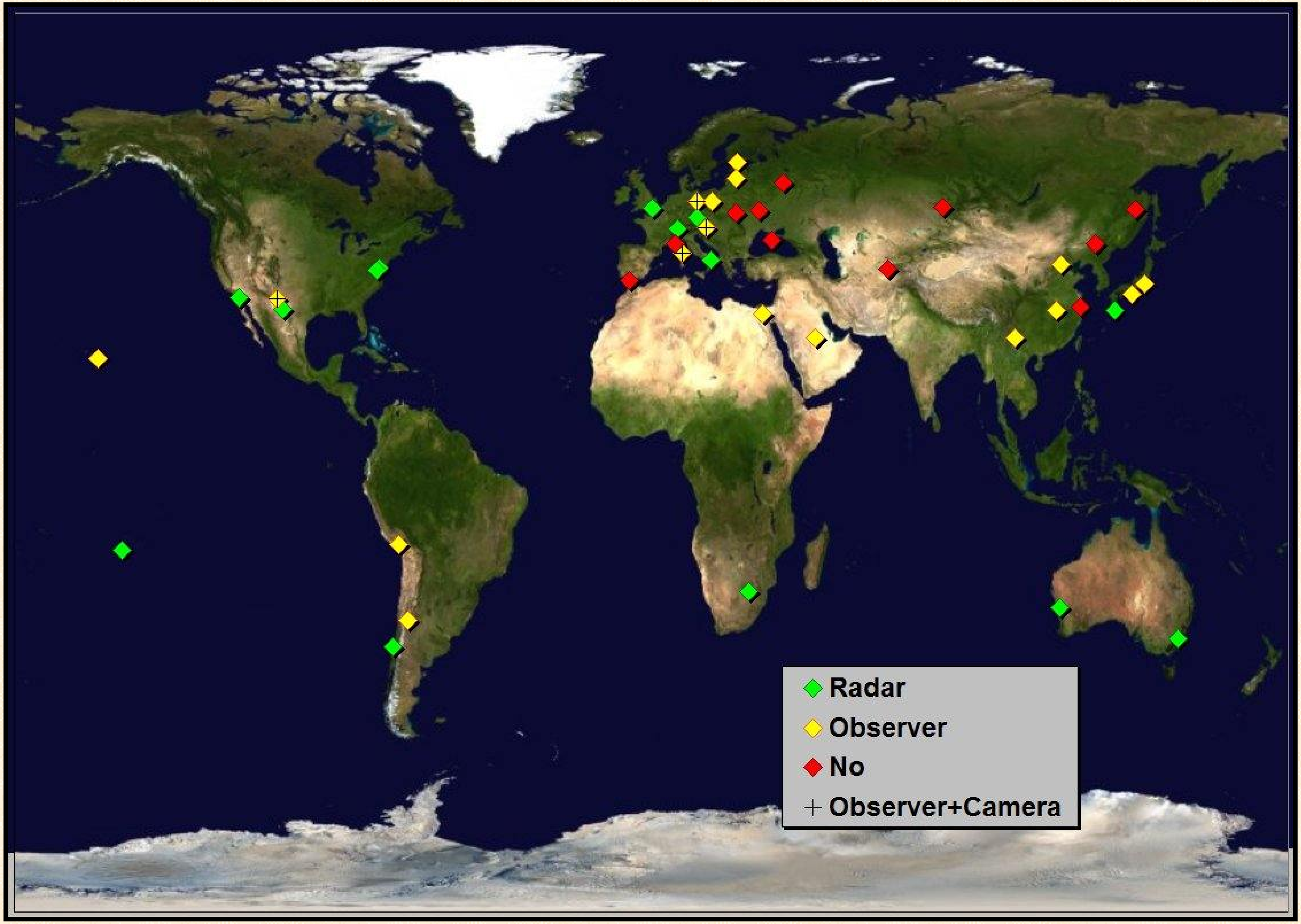


~90% of the SLR observing time using spotting

Taken from the current log files set

Airplane spotting method by Observing Time

A legal Hazard?



What to do?

Actions by the Stations/Agencies

- To carry out a full **Hazard Analysis** for the SLR stations.
- To **identify** the **Vulnerabilities** and rank them by impact importance.
- To implement and execute a **cost-effective Risk Management** program.
- The **regular** crew training in mitigation procedures.

Actions by the Stations/Agencies

- In particular at the **At Risk** Stations:
  - To support the local **Microzoning updating**.
  - To create and implement a **full** seismic mitigation program.
  - To guarantee the IGS units **operation** during a disaster.
  - To facilitate at/near the premises the **operation** of seismical instrumentation.

Actions by the ILRS

To recommend:

- The **inclusion** of Hazard/Risk analysis into the **design** of new stations.
- The **regular** Hazard/Risk analysis **updating** for the current stations.
- The **sharing** of experiences on Mitigation Procedures.
- To encourage the **conservation** of the ILRS Historical Memory.

Actions by the ILRS

To recommend:

- All SLR **should have** a **IGS station** operating on the premises.
- To **upgrade** the IGS stations to the **maximum sampling rate** possible, in particular at the At-Risk stations.
- That the IGS stations should be **operational during disasters**.

Actions by the ILRS

- **Creation of a "hot line" phone(s) Number(s) for:**
  - Centralized emergency communication.
  - Point-to-point two-way emergency data transfer.

- **Creation of a Centralized software/HDD image security bank.**
  - Off-line and Password protected.

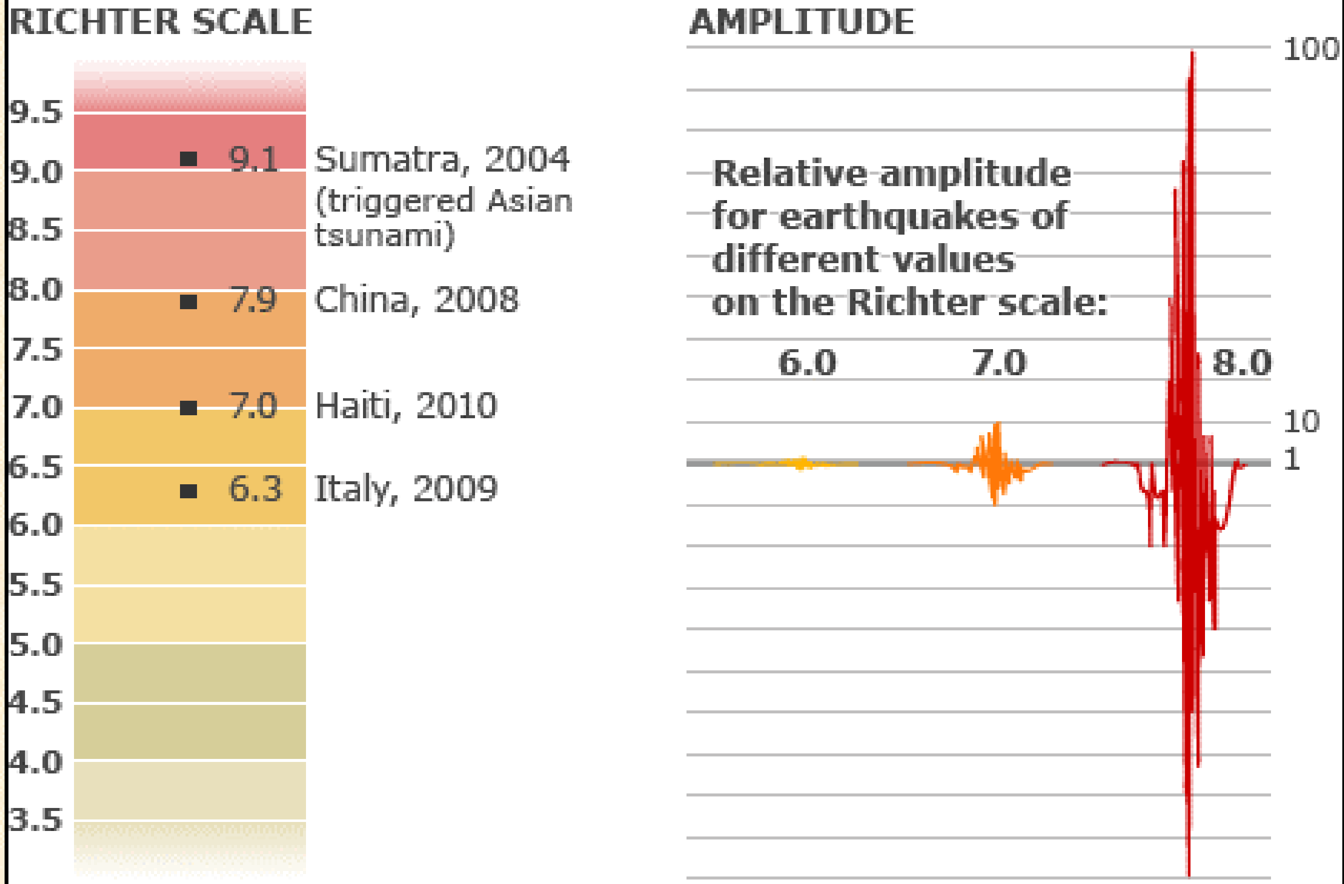
- **A two-way approach to In-Sky laser safety.**
  - Generalization of cost-effective technologies & solutions.
  - Should the close calls (if any) be reported?
  - Should be a participation in the legal process, together with other agencies, by giving the real facts?

Remember…

Scheiße Happens!

Measuring the size of earthquakes

The Richter Scale is the best known scale for measuring earthquakes, derived from a calculation (a logarithm) based on ground movement or amplitude. So an earthquake measuring 8.0 on the Richter scale is ten times bigger than one measuring 7.0, which is ten times bigger than a 6.0.



Source: British Geological Survey, US Geological Survey


Station CONZ
SIRGAS Analysis Centre at DGFI, 2010-10-29
2007
2008
2009
2010