



# Improving Data Access through Standards-based Metadata and Web Map Services

Access to Natural Hazards Data



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# Increasing Coastal Risks

- Coastal population increasing globally
  - As of 2003, 53% of the USA population lived on the coasts
  - Coastal population expected to increase by 10% by 2015
- Increasing risk and December 2004 Tsunami prompted study
  - *Tsunami Risk Reduction for the United States: A Framework for Action* (December 2005)
  - U.S. plan for developing tsunami-resilient communities and international coordination

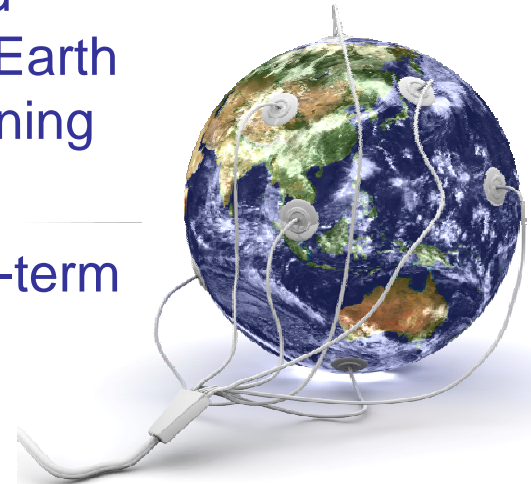
- Informed decision-making essential to minimize impact of natural disaster on communities

- Need for integrated, global data as a basis for informed decision-making is greater than



## The Global Earth Observation System of Systems

- GEO 2006 Disaster-related Task: Promote and facilitate free and unrestricted exchange of all Earth observation data relevant to tsunami early warning systems.
- Seeks to meet the need for timely, quality long-term global information
- Facilitates exchange of data and information
- Improves decision-makers' abilities to address pressing policy issues



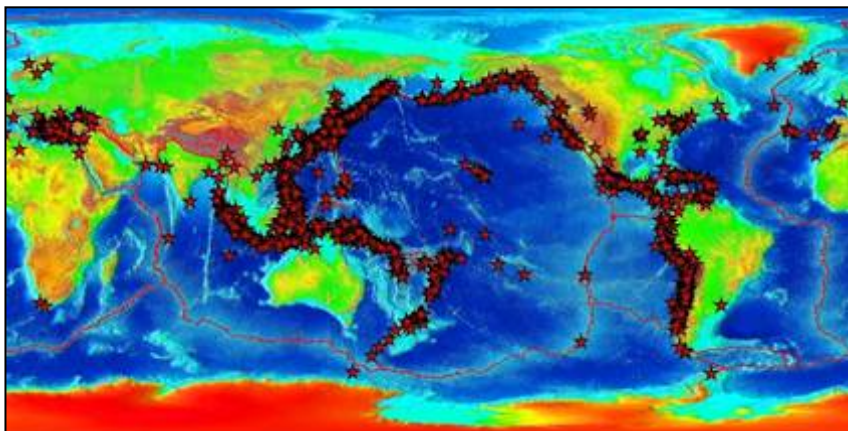
## The World Data Center System

- The WDC for Solid Earth Geophysics, Boulder has responsibility for global tsunami data and the ability to deliver integrated access to these data

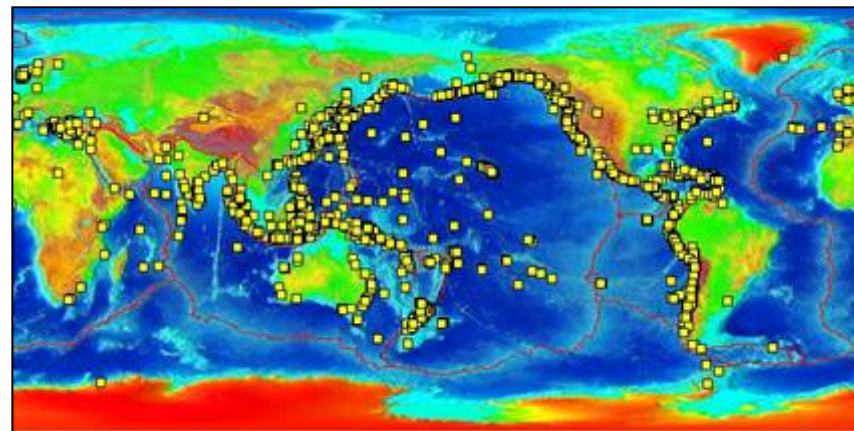


- Real-time data needs – Identifying danger and alerting at-risk areas
  - Seismic data for events of magnitude 6 and greater
  - Tsunameter data for deep-ocean verification (or cancellation) of event
  - Coastal water level data (stations registering tsunami arrival)
- Record of the past to prepare for the future
  - Past Tsunami Source Events (where, what, when, how big, how bad)
  - Tsunami Runup Locations (where, when, how high, what impact)
  - Imagery and descriptions of past damage – preserving visual record
- Data for forecast models to improve warnings and minimize damage
  - Deep-ocean bathymetry – tsunami travel times and propagation models
  - Local community preparedness – near-shore relief data for inundation models

WDC-SEG, Boulder  
Natural Hazards Data  
Contact: Paula Dunbar  
[Paula.Dunbar@noaa.gov](mailto:Paula.Dunbar@noaa.gov)



Events Generating Tsunamis

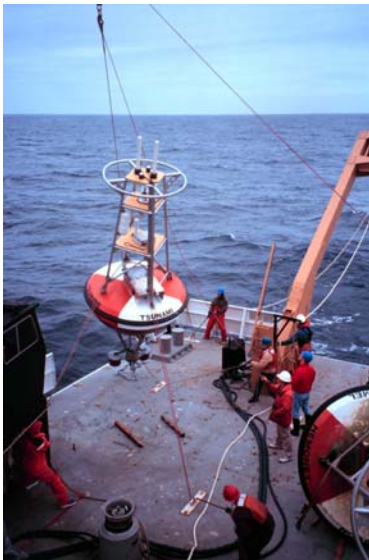


Tsunami Runup Locations



## Discuss data management for two tsunami-monitoring data streams

- Deep-ocean water level data from NOAA DART
- Coastal water level data from NOAA CO-OPS

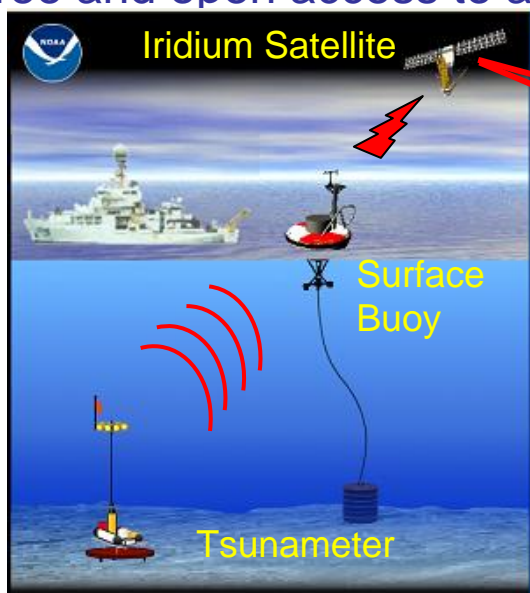
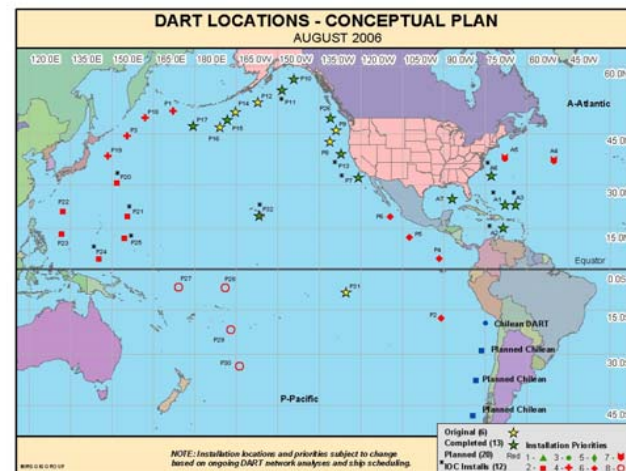


## Real-time Event Data

- 15-second averages sent to NDBC and to NOAA Message Gateway; then to Warning Centers

## Retrospective High Resolution Data

- Retrieve buoy every 2-5 years
- Event and full-resolution data sent to NGDC/WDC archive
- Free and open access to archive

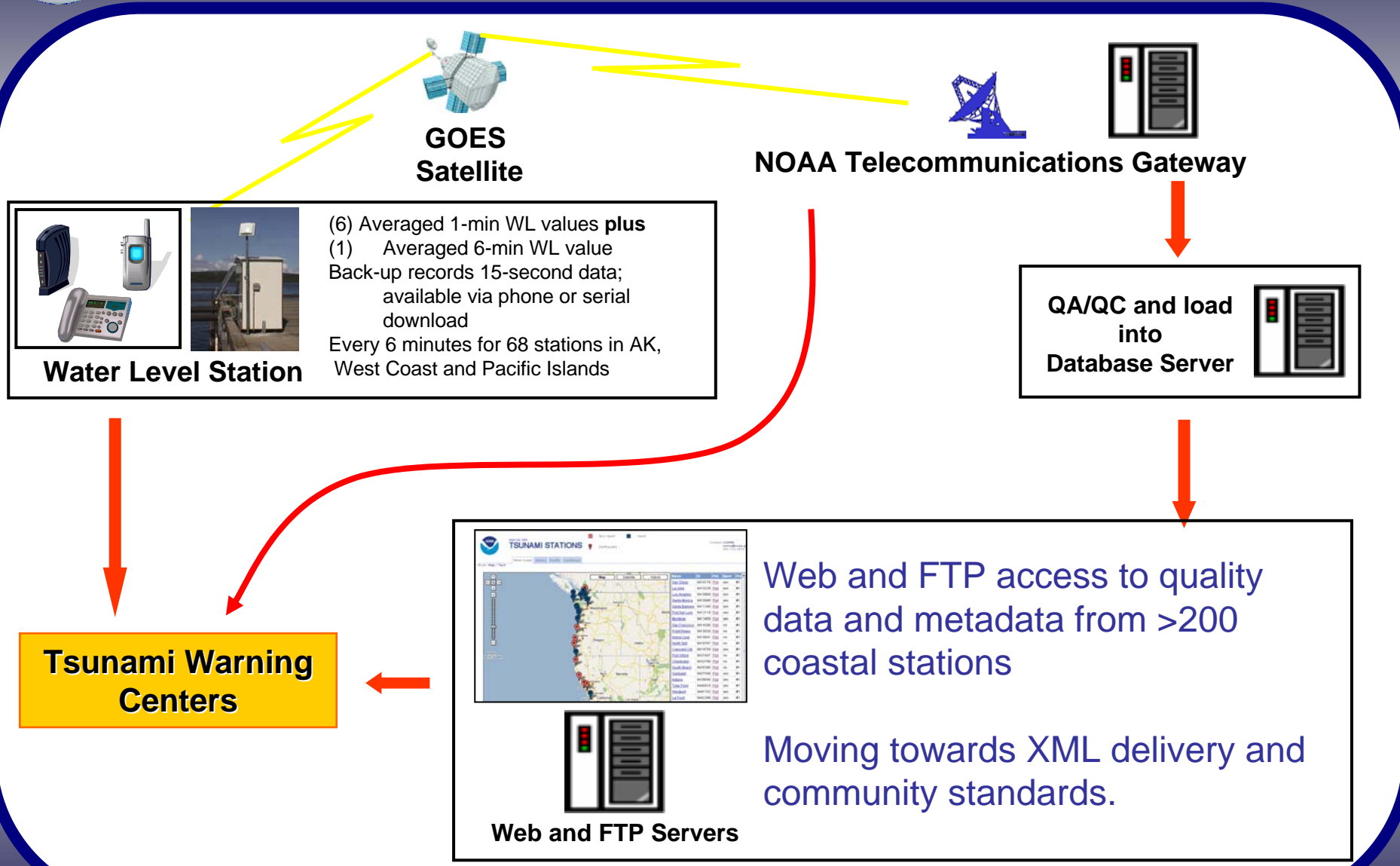



Red = real-time  
 Black = retrospective



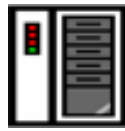


# NOAA Coastal Water Level Network


**Water Level Station**

(6) Averaged 1-min WL values **plus**  
 (1) Averaged 6-min WL value  
 Back-up records 15-second data;  
 available via phone or serial  
 download  
 Every 6 minutes for 68 stations in AK,  
 West Coast and Pacific Islands



**QA/QC and load  
into  
Database Server**

**Tsunami Warning  
Centers**



**Web and FTP Servers**

Web and FTP access to quality data and metadata from >200 coastal stations

Moving towards XML delivery and community standards.



# Data Delivery Strategies Employed



- Follow International Standards Organization (ISO) metadata standard
  - Open access to metadata
    - Spatially-enabled relational databases
    - XML native databases and files
    - Formatted text
    - Publish and maintain metadata in a variety of catalogs and clearinghouses
- Move towards XML & GML description of data
  - Utilize Geography Markup Language to describe geographic content
  - Work with scientific community for standard XML syntax defining data
- Archive accessible on-line or near-line (robotic tape system)
  - Spatially-enabled relational databases
  - Support Open Geospatial Consortium (OGC)
  - Multiple delivery formats
    - International and community standard XML / GML
    - Net-CDF
    - ASCII





# Metadata Standards



Metadata: A record of information capturing the basic characteristics of a data or information resource. It represents the who, what, when, where, why and how of data.

The major uses of metadata are:

- provide information about data holdings to catalogues and clearinghouses
- provide information to process and interpret data from an external source

**BPR Data for D171\_2003 20030501 to 20040501**

Metadata from the NOAA Metadata Manager and Repository (NMMR)

- Identification Information
- Data Quality Information
- Entry and Attribute Information
- Distribution Information
- Metadata Reference Information
- Platform and Mission Information
- Instrument Information

---

**Identification Information:**  
**Dataset Identifier:** D171\_2003  
**Citation:**  
**Citation Information:**  
**Originator:** DOC/NOAA  
**Originator:** DOC/NOAA  
**Publication Date:** 20060421  
**Title:** BPR Data for D171\_2003 20030501 to 20040501  
**Search:** Historic DART  
**Search:** Real-time DART  
**Description:**  
**Abstract:**  
As part of the U.S. National Tsunami Hazard Mitigation Program (NTHMP), the Deep Ocean Assessment and Reporting of Tsunamis (DART) Project is an ongoing effort to maintain and improve the capability for the early detection and real-time reporting of tsunamis in the open ocean. DART stations have been sited in regions with a history of generating destructive tsunamis to ensure early detection of tsunamis and to acquire data critical to real-time forecasts. DART systems consist of an anchored seafloor bottom pressure recorder (BPR) and a communication system for real-time transmission of acoustic data.

HTML

---

XML

```

<?xml version="1.0" encoding="ISO-8859-1" ?>
<metadata>
  <idinfo>
    <datasetid>gov.noaa.ngdc.dart_bpr:D171_2003</datasetid>
  </idinfo>
  <citation>
    <citeinfo>
      <origin>DOC/NOAA/OAR/PMEL > Pacific Marine Environmental Laboratory, OAR, NOAA, U.S. Department of Commerce</origin>
      <origin>DOC/NOAA/NWS/NDBC > National Data Buoy Center, National Weather Service, NOAA, U.S. Department of Commerce</origin>
      <pubdate>20060421</pubdate>
      <title>BPR Data for D171_2003 20030501 to 20040501</title>
      <onlink>http://www.ngdc.noaa.gov/seg/hazard/DARTData.shtml</onlink>
      <onlink>http://www.ndbc.noaa.gov/dart.shtml</onlink>
    </citeinfo>
    <CI_OnlineResource>
      <linkage>http://www.ngdc.noaa.gov/seg/hazard/DARTData.shtml</linkage>
      <protocol>http</protocol>
      <name>Historic DART/BPR Data On-line</name>
      <description>Data access to historic DART/BPR data obtained from PMEL and NDBC.</description>
      <function>005</function>
    </CI_OnlineResource>
    <CI_OnlineResource>
      <linkage>http://www.ndbc.noaa.gov/dart.shtml</linkage>
      <protocol>http</protocol>
      <name>Real-time DART Data On-line</name>
      <description>Access to real-time DART data at NDBC.</description>
      <function>005</function>
    </CI_OnlineResource>
  </citation>
  <descript>
    <abstract>As part of the U.S. National Tsunami Hazard Mitigation Program (NTHMP), the Deep Ocean Assessment and Reporting of Tsunamis (DART) Project is an ongoing effort to maintain and improve the capability for the early detection and real-time reporting of tsunamis in the open ocean. DART stations have been sited in regions with a history of generating destructive tsunamis to ensure early detection of tsunamis and to acquire data critical to real-time forecasts. DART systems consist of an anchored seafloor bottom pressure recorder (BPR) and a communication system for real-time transmission of acoustic data.
  </abstract>
  </descript>
</metadata>

```



# NOAA CO-OPS XML Data Schema



## XML Example for Tidal Constituents

### XML File Sample:

```
<xml version="1.0">
  <station>
    <name>crescent city, ca</name>
    <id>9419750</id>
    <latitude>41.745</latitude>
    <longitude>124.183</longitude>
    <mean_depth></mean_depth>
    <date_last_modified year="" month="" day="" hour="" minute="" second=""/>
    <constituent name="m2" amplitude="0.176" phase="211.0" speed="28.9841042"/>
    <constituent name="s2" amplitude="0.183" phase="231.7" speed="30.0000000"/>
```

### Repeatable for # of constituents

```
<comment="note that all constituent names are case insensitive"/>
  </station>
</xml>
```

- **OGC Web Map Service (WMS)**
  - allows client overlay of map images
  - display from multiple Web Map Services
- **Tsunami data available via WMS**
  - DART Tsunameter data
  - Global event data
  - Global runup data
  - Global bathymetry / elevation data
- **In progress**
  - Linking coastal water level data (NOAA and GLOSS)





# OGC Standards – Sharing Data Values



- OGC Web Feature Service (WFS)
  - Allows client to retrieve geospatial data encoded in Geography Markup Language (GML)
  - Retrieval from multiple Web Feature Services
- Coming soon: Tsunami data available via WFS
  - DART Tsunameter data
  - Global event data
  - Global runup data
  - Global coastal water level data
- Data stored in open databases
  - Integrate the deep-ocean and coastal water level databases

```

<?xml version="1.0" encoding="UTF-8" ?>
- <wfs:FeatureCollection xmlns:ngdc="http://www.ngdc.noaa.gov/ngdc" xmlns:gml="http://www.opengis.net/gml"
  xmlns:wfs="http://www.opengis.net/wfs" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.ngdc.noaa.gov/ngdc
  http://map1.ngdc.noaa.gov/wfsconnector/com.esri.wfs.Esrimap/nosa_f?
  request=describefeaturetype&service=WFS&version=1.0.0 http://www.opengis.net/wfs
  http://schemas.opengis.net/wfs/1.0.0/WFS-basic.xsd">
- <gml:boundedBy>
- <gml:Box srsName="EPSG:4326">
  <gml:coordinates>-180,-90 180,90</gml:coordinates>
</gml:Box>
</gml:boundedBy>
- <gml:featureMember>
- <ngdc:DART-73 fid="DART-73.20">
  <ngdc:nosa.nws_dart_tsqp.buoy_id>51407</ngdc:nosa.nws_dart_tsqp.buoy_id>
  <ngdc:nosa.nws_dart_tsqp.description>2.5-meter discus buoy-type 2</ngdc:nosa.nws_dart_tsqp.description>
  <ngdc:nosa.nws_dart_tsqp.latitude>19.62</ngdc:nosa.nws_dart_tsqp.latitude>
  <ngdc:nosa.nws_dart_tsqp.longitude>-156.51</ngdc:nosa.nws_dart_tsqp.longitude>
  <ngdc:nosa.nws_dart_tsqp.deploy_date>Deploy 28Jun05</ngdc:nosa.nws_dart_tsqp.deploy_date>
  <ngdc:nosa.nws_dart_tsqp.objectid>20</ngdc:nosa.nws_dart_tsqp.objectid>
  <ngdc:shape.area>0</ngdc:shape.area>
  <ngdc:shape.len>0</ngdc:shape.len>
- <ngdc:_shape_>
- <gml:MultiPoint srsName="EPSG:4326">
  - <gml:pointMember>
    - <gml:Point srsName="EPSG:4326">
      <gml:coordinates>-156.51,19.6199999994026</gml:coordinates>
    </gml:Point>
  </gml:pointMember>
  </gml:MultiPoint>
</ngdc:_shape_>
</ngdc:DART-73>
</gml:featureMember>
- <gml:featureMember>
- <ngdc:DART-73>
  <ngdc:nosa.nws_dart_tsqp.buoy_id>51407</ngdc:nosa.nws_dart_tsqp.buoy_id>
  <ngdc:nosa.nws_dart_tsqp.description>2.5-meter discus buoy-type 2</ngdc:nosa.nws_dart_tsqp.description>
  <ngdc:nosa.nws_dart_tsqp.latitude>19.62</ngdc:nosa.nws_dart_tsqp.latitude>
  <ngdc:nosa.nws_dart_tsqp.longitude>-156.51</ngdc:nosa.nws_dart_tsqp.longitude>
  <ngdc:nosa.nws_dart_tsqp.deploy_date>Deploy 28Jun05</ngdc:nosa.nws_dart_tsqp.deploy_date>
  <ngdc:nosa.nws_dart_tsqp.objectid>20</ngdc:nosa.nws_dart_tsqp.objectid>
  <ngdc:shape.area>0</ngdc:shape.area>
  <ngdc:shape.len>0</ngdc:shape.len>

```

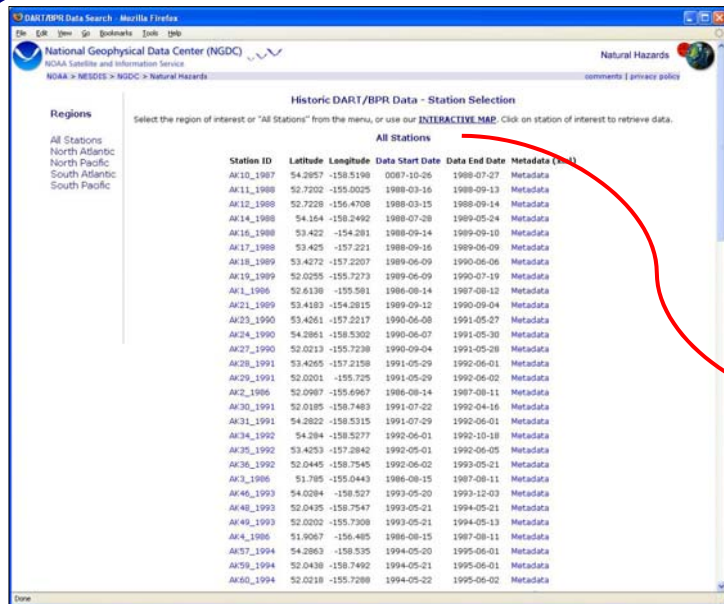
WFS

Parameter	Value in example
Server Name	http://map.ngdc.noaa.gov/wfsconnector/com.esri.wfs.Esrimap
Map Service Name	nosa_f (nosa feature server map)
Web Map Server Version	1.0.0
Request Type	getfeature
Layers to Display	DART-73 (Layer name and layer ID)
Bounding Box	-180,-90,180,90 (Lower Left, Upper Right)

WFS URL Specifications



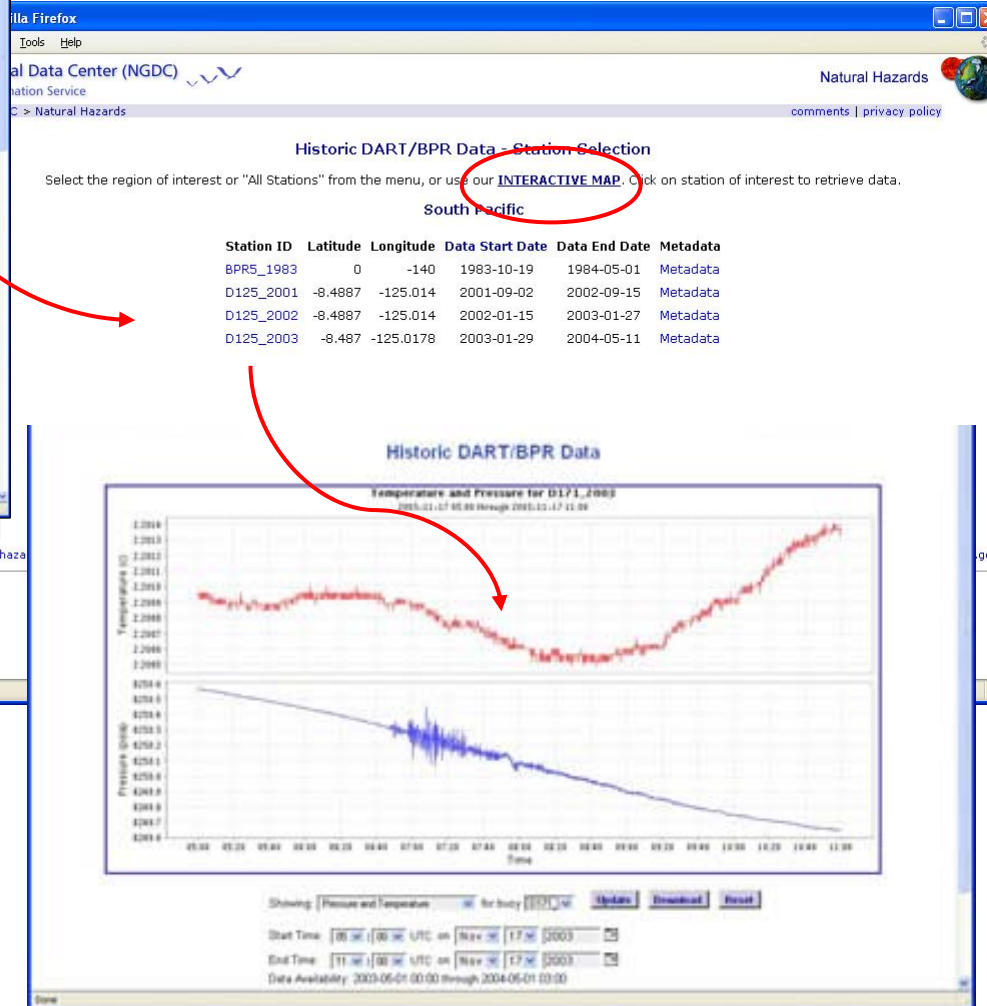
<http://www.ngdc.noaa.gov/seg/hazard/>



Historic DART/BPR Data - Station Selection

Select the region of interest or "All Stations" from the menu, or use our **INTERACTIVE MAP**. Click on station of interest to retrieve data.

Station ID	Latitude	Longitude	Data Start Date	Data End Date	Metadata
AK10_1987	54.2957	-158.5198	2007-10-26	1989-07-27	Metadata
AK11_1988	52.7202	-155.0025	1988-03-16	1989-09-13	Metadata
AK12_1988	52.7228	-156.4708	1988-03-15	1988-09-14	Metadata
AK14_1988	54.164	-158.2492	1988-07-28	1989-05-24	Metadata
AK16_1988	53.422	-154.281	1988-09-14	1989-09-10	Metadata
AK17_1988	53.425	-157.221	1988-09-16	1989-06-09	Metadata
AK18_1989	53.4272	-157.2207	1989-06-09	1990-06-06	Metadata
AK19_1989	52.0255	-155.7273	1989-06-09	1990-07-19	Metadata
AK1_1990	52.6138	-155.591	1988-08-14	1987-08-12	Metadata
AK21_1989	53.4183	-154.2815	1989-09-12	1990-09-04	Metadata
AK23_1990	53.4261	-157.2217	1990-06-08	1991-05-27	Metadata
AK24_1990	54.2861	-158.5302	1990-06-07	1991-05-30	Metadata
AK27_1990	52.0213	-155.7238	1990-09-04	1991-05-28	Metadata
AK28_1991	53.4265	-157.2158	1991-05-29	1992-06-01	Metadata
AK29_1991	52.0201	-155.725	1991-05-29	1992-06-02	Metadata
AK2_1986	52.0987	-155.6967	1986-08-14	1987-08-11	Metadata
AK30_1991	52.0185	-158.7483	1991-07-22	1992-04-16	Metadata
AK31_1991	54.2822	-158.5315	1991-07-29	1992-06-01	Metadata
AK34_1992	54.284	-158.5277	1992-06-01	1992-10-18	Metadata
AK35_1992	53.4253	-157.2842	1992-05-01	1992-06-05	Metadata
AK36_1992	52.0445	-158.7545	1992-06-02	1993-05-21	Metadata
AK3_1986	51.785	-155.0443	1986-08-15	1987-08-11	Metadata
AK46_1993	54.0284	-158.527	1993-05-20	1993-12-03	Metadata
AK48_1993	52.0435	-158.7547	1993-05-21	1994-05-21	Metadata
AK49_1993	52.0202	-155.7308	1993-05-21	1994-05-13	Metadata
AK4_1986	51.9067	-156.485	1986-08-15	1987-08-11	Metadata
AK57_1994	54.2863	-158.535	1994-05-20	1995-06-01	Metadata
AK59_1994	52.0438	-158.7492	1994-05-21	1995-06-01	Metadata
AK60_1994	52.0218	-155.7288	1994-05-22	1995-06-02	Metadata



Historic DART/BPR Data - Station Selection

Select the region of interest or "All Stations" from the menu, or use our **INTERACTIVE MAP**. Click on station of interest to retrieve data.

South Pacific

Station ID	Latitude	Longitude	Data Start Date	Data End Date	Metadata
BPRS_1983	0	-140	1983-10-19	1984-05-01	Metadata
D125_2001	-8.4887	-125.014	2001-09-02	2002-09-15	Metadata
D125_2002	-8.4887	-125.014	2002-01-15	2003-01-27	Metadata
D125_2003	-8.487	-125.0178	2003-01-29	2004-05-11	Metadata

Historic DART/BPR Data

Temperature and Pressure for D171\_2003  
2003-01-27 00:00 through 2003-03-17 00:00

Showing: Pressure and Temperature for buoy [D171] [v] [Update] [Download] [Print]

Start Time: [06:00] [UTC on] [Nov 17] [2003] [v]

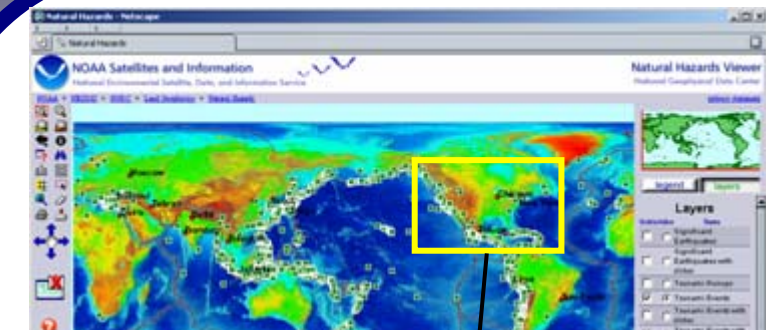
End Time: [11:00] [UTC on] [Nov 17] [2003] [v]

Data Availability: 2003-05-01 00:00 through 2004-05-01 00:00

- Locate Stations
  - Map or List
- View Metadata
  - Available for each bpr package
  - Text or xml standard formats
- Select, Plot, Subset, and Download Data
  - WMF implemented
  - WFS underway

## Web maps

- Operate off the same database
- Provide limited GIS capability
- Are linked to Photos, Additional Information, References



http://www.ngdc.noaa.gov - tsevent - Mozilla Firefox

**Tsunami Event**

Date			Tsunami Source			
Year	Mo	Dy	Location Name	Latitude	Longitude	Cause
1909	9	20	LOUISIANA: GRAND ISLE	29.233	-89.983	9

**Tsunami Runup**

Runup Location				Runup Measurements	Effects at Runup Location				
Country	Name	Latitude	Longitude	Per (Min)	1st	Deaths	Injuries	Damage	Houses
USA	GRAND ISLE, LA	29.373	-89.983						

**Comments for the Tsunami**

Erroneous runup. Actual event is a 15 foot storm surge from the Grand Isle, Louisiana. Found online at [http://www.ngdc.noaa.gov](#)


**References for the Tsunami**

ID	Author	Year	Citation
541	Lockridge, Patricia A., Lowell S. White, and James F. Lander	2002	Tsunamis and Tsunami-like Waves the International Journal of the Tsunami Society 120-144.
1804	Roth, David	2003	Louisiana Hurricane History: Early History. Louisiana. Found online at <a href="#">http://www.ngdc.noaa.gov</a>



National Geophysical Data Center (NGDC)

**Tsunami Damage to Railroad Facilities by 1964 Alaska Earthquake**




Earthquake of March 27, 1964, Gulf of Alaska. The tsunami caused much damage to the railroad facilities at Seward. Most of the Alaska Railroad dock was washed away by the waves. The railroad also lost two cranes and its water tower. Note also the fire-damaged oil storage tanks. Damage at Resurrection Bay totaled \$14.6 million dollars. Photo credit: NOAA/NGDC

[Download full resolution TIF image](#)

[Order Now](#)

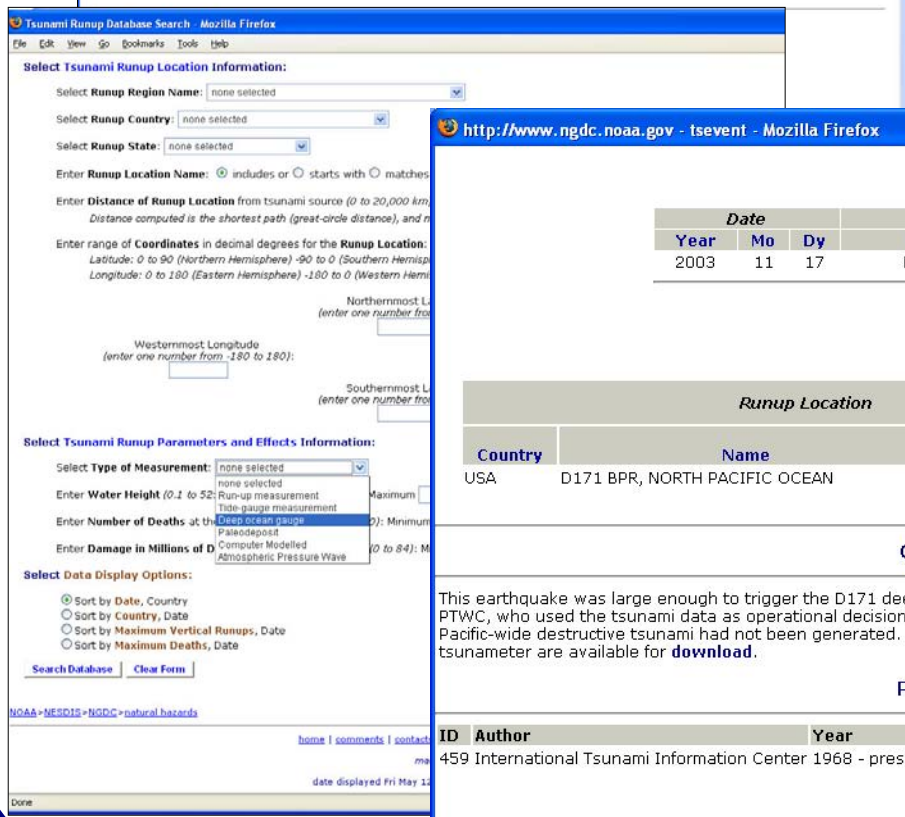
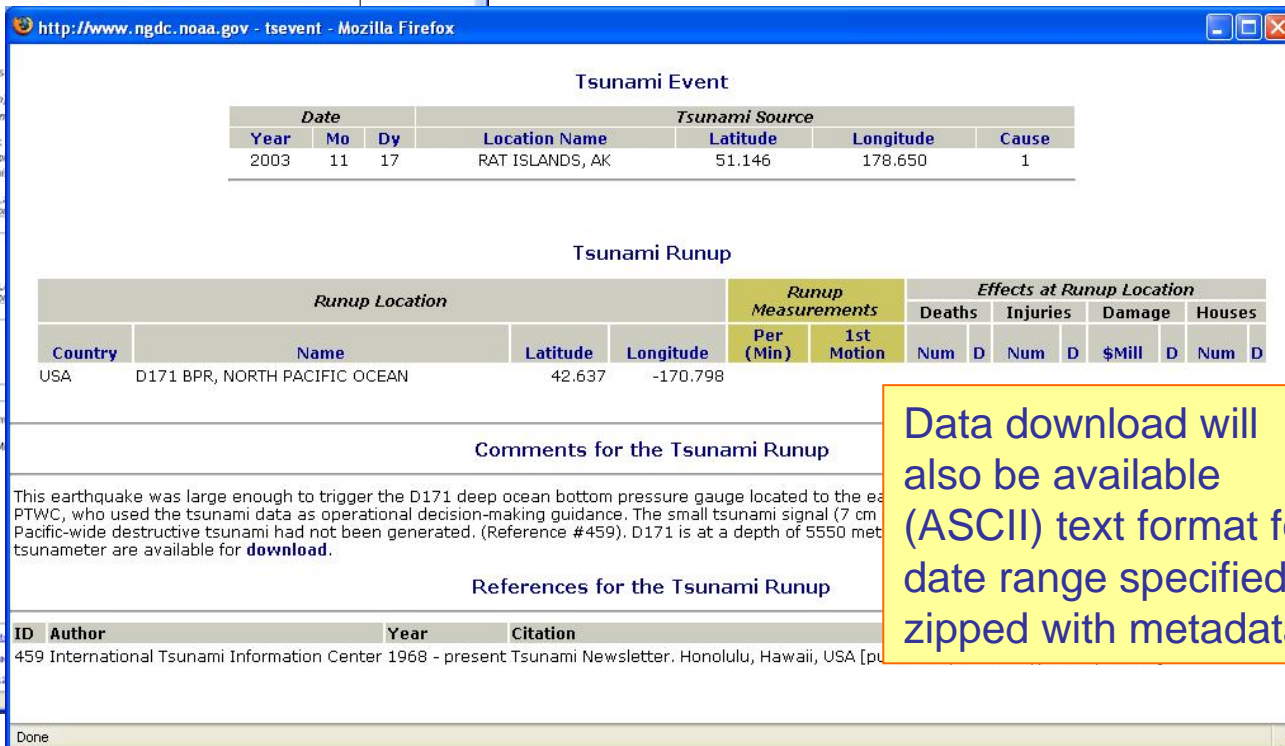
**Boat Beached by Tsunami, 1964 Alaska Earthquake**



Earthquake of March 27, 1964, Gulf of Alaska. This photo shows a beached fishing boat in the Seward area. The tsunami waves severely damaged many boats and washed them into the lagoon north of Seward and onto the tidal flats at the head of Resurrection Bay. Dock and harbor facilities were destroyed. A section of the waterfront about 1,000 m long, including the docks and the small boat harbor, slid into Resurrection Bay. Photo credit: University of Colorado

[Download full resolution TIF image](#)

## Linking retrospective global event data to observational data and imagery

Date			Tsunami Source			
Year	Mo	Dy	Location Name	Latitude	Longitude	Cause
2003	11	17	RAT ISLANDS, AK	51.146	178.650	1

Runup Location				Runup Measurements		Effects at Runup Location							
Country	Name	Latitude	Longitude	Per (Min)	1st Motion	Deaths	Injuries	Damage	Houses				
						Num	D	Num	D	\$Mill	D	Num	D
USA	D171 BPR, NORTH PACIFIC OCEAN	42.637	-170.798										

ID	Author	Year	Citation
459	International Tsunami Information Center	1968 - present	Tsunami Newsletter. Honolulu, Hawaii, USA [p...

Data download will also be available (ASCII) text format for date range specified – zipped with metadata





# Opportunities and Requirements



- Increasing need to look at “multi-hazard”
  - Need to describe and provide data for multidisciplinary use
  - Data need to be better described to aid non-expert users
- Advances in web access to databases and GIS technologies
  - Enable powerful search and display options
  - Enable integration of data - supporting GEOSS goals
- Improved collaboration on sea-level data exchange and archive
  - Closer community collaboration and exchange of data
  - Participate in data / metadata format discussion
- Continued improvement in global past event database
  - Partnerships with regional experts in Asia
  - Review, document sources, add content
- Rescue tsunami source material (catalogs)
  - Scan catalogs and provide PDF online
  - Entire document or
  - Abstract and citation if under copyright





# Summary



- **Global Science increasing demands**
  - High-quality multi-disciplinary data for decision making
  - Well-documented data in standard formats
- **Data Strategies Employed**
  - Follow International Standards Organization (ISO) metadata standard
  - Open access to metadata
    - Spatially-enabled relational databases
    - XML native databases and files
    - Publish and maintain metadata in a variety of catalogs and clearinghouses
  - Move towards GML & XML Community Standard description of data
    - Utilize Geography Markup Language to describe geographic content
    - Work with scientific community for standard XML syntax defining data
  - Archive accessible on-line or near-line (robotic tape system)
    - Spatially-enabled relational databases
    - Support Open Geospatial Consortium (OGC)
    - Multiple delivery formats

A topographic map of the Pacific Ocean region, showing the continental shelves and deep ocean trenches. The colors range from light blue (shallow) to dark blue (deep). The text "Thank you!" is overlaid in the center.

Thank you!



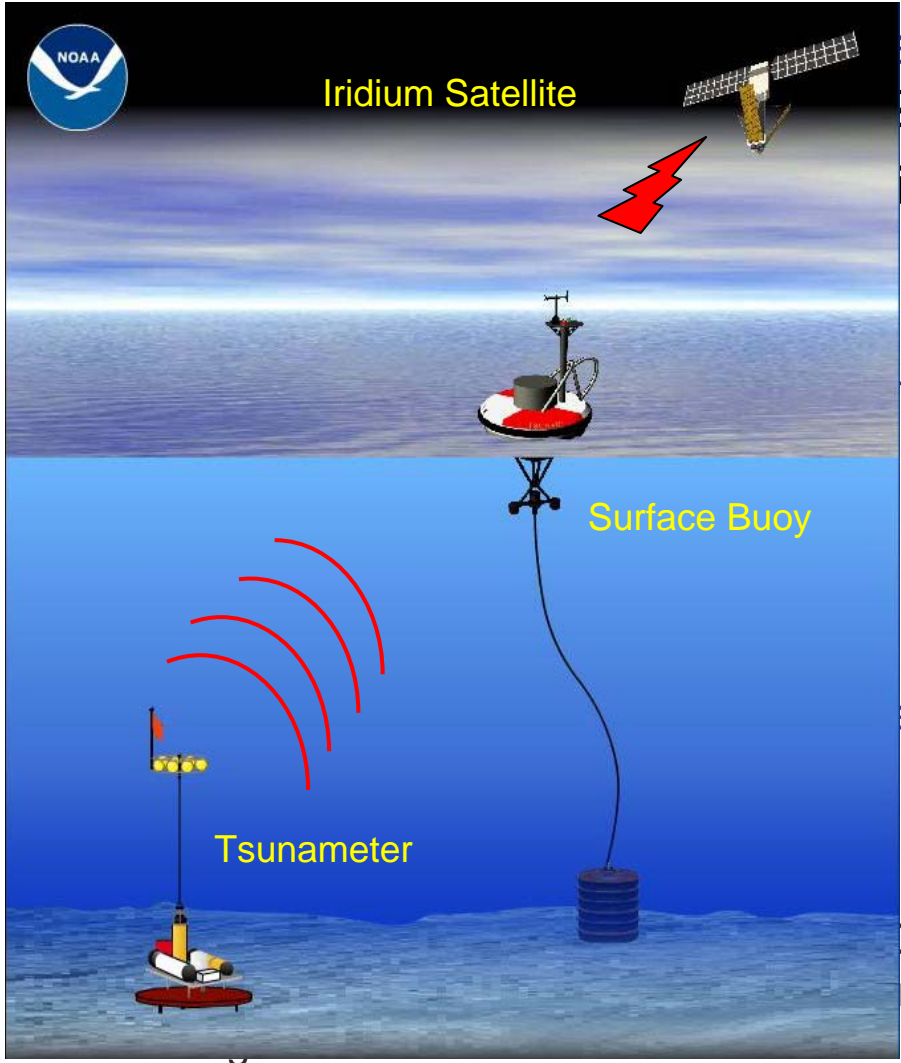
# XML GML



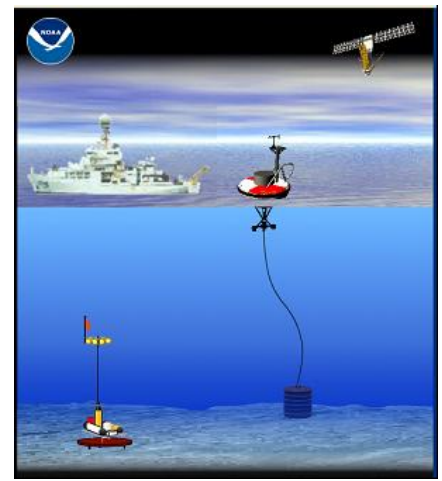
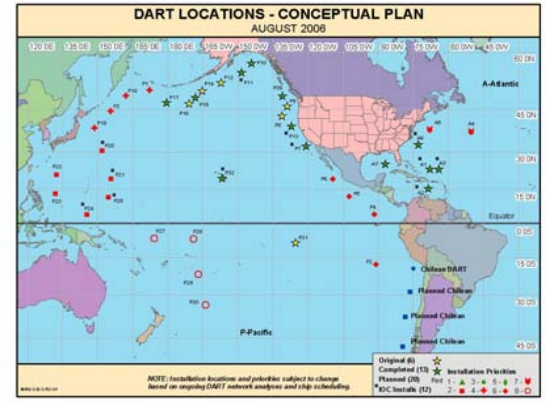
- XML is the rules governing markup of data
- Defined method of describing content, when used with a schema or dtd, enables others to read
- GML is XML “dialect” with well-defined rules and syntax
- GML enables developers to read and understand all documents following standard
- Analogy:
  - XML is the arabic alphabet
  - XML documents could be in French, German, or English and still be valid. Users need to know “dialect” to understand
  - GML is a dialect with well defined dictionary describing what each element means



# Tsunami Early Warning and Mitigation

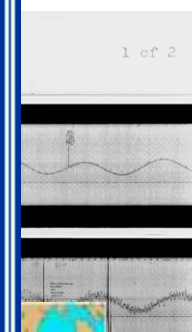
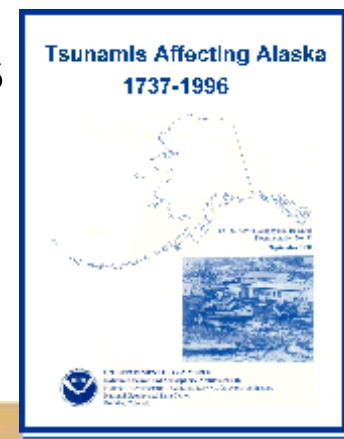
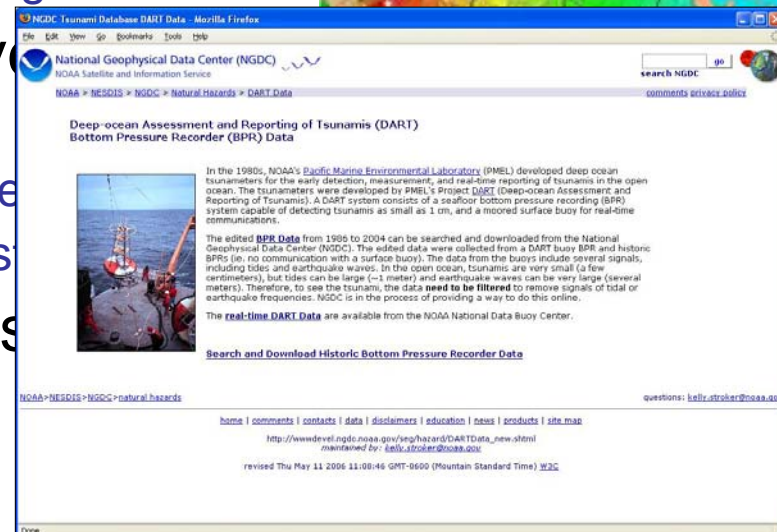


United States:  
 (2005)  
 Efficient  
 nation  
 and effective  
 on partnerships.  
 transfer  
 warning and  
 ional systems  
 Group on  
 Commission, World  
 for international





- Manage global database of historic events
  - Tsunami and significant earthquake and volcanic events databases 2000 BC to Present
- Manage archive of source documents
  - Tsunami, earthquake, volcanic eruption
- Manage archive of past event damage imagery
  - Prints, slides, digital imagery of damage
- Manage event-specific sea-level
  - Marigrams (paper)
  - Retrospective deep-ocean tsunameter
  - Selected Retrospective coastal tide s
- Manage bathymetry and near-s relief data
  - Modeling tsunami propagation
  - Modeling tsunami inundation

NGDC Tsunami Database DART Data - Mozilla Firefox

National Geophysical Data Center (NGDC)  
NOAA Satellite and Information Service

NOAA > NESDIS > NGDC > Natural Hazards > DART Data

Deep-ocean Assessment and Reporting of Tsunamis (DART)  
Bottom Pressure Recorder (BPR) Data

In the 1980s, NOAA's Pacific Marine Environmental Laboratory (PMEL) developed deep ocean tsunameters for the early detection, measurement, and real-time reporting of tsunamis in the open ocean. The tsunameters were developed by PMEL's Project DART (Deep-ocean Assessment and Reporting of Tsunamis). A DART system consists of a seafloor bottom pressure recording (BPR) system capable of detecting tsunamis as small as 1 cm, and a moored surface buoy for real-time communications.

The edited **BPR Data** from 1996 to 2004 can be searched and downloaded from the National Geophysical Data Center (NGDC). The edited data were collected from a DART buoy BPR and historic BPRs (ie, no communication with a surface buoy). The data from the buoys include several signals, including tides, and earthquake waves. In the open ocean, tsunamis are very small (a few centimeters), but tides can be large (~1 meter) and earthquake waves can be very large (several meters). Therefore, to see the tsunamis, the data **need to be filtered** to remove signals of tidal or earthquake frequencies. NGDC is in the process of providing a way to do this online.

The **real-time DART Data** are available from the NOAA National Data Buoy Center.

[Search and Download Historic Bottom Pressure Recorder Data](#)

NOAA > NESDIS > NGDC > natural hazards

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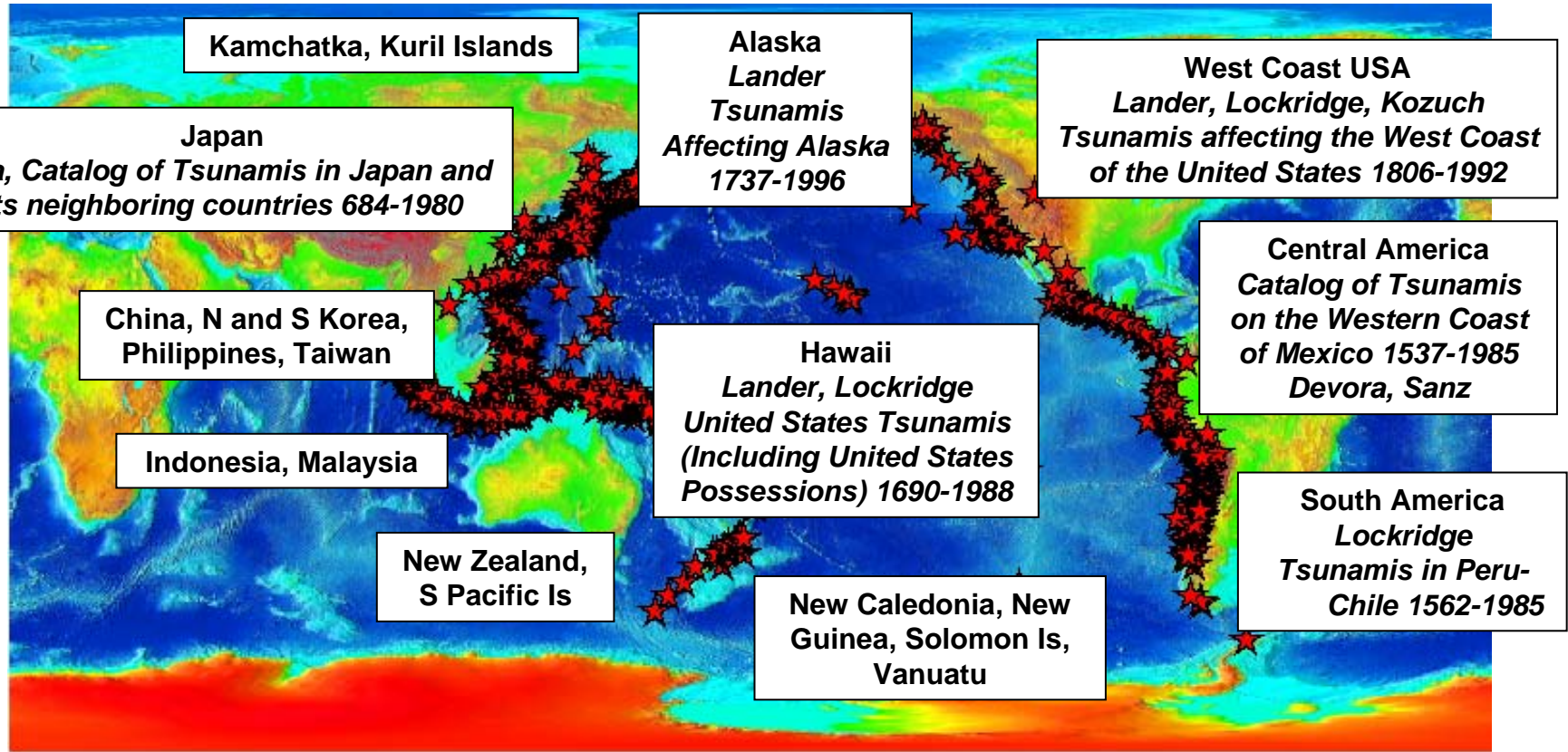
http://www.devel.ngdc.noaa.gov/seg/hazards/DARTData\_new.shtml  
maintained by: [bell.stroker@noaa.gov](mailto:bell.stroker@noaa.gov)

revised Thu May 11 2006 11:00:46 GMT-0600 (Mountain Standard Time) WDC



# Information from Many Source Catalogs

Some of the many tsunami catalogs used in the global compilation



Lander, Whiteside, Lockridge, 2003, Two Decades of Global Tsunamis 1982-2001  
Iida, 1967, Preliminary Catalogue of Tsunamis Occurring in the Pacific Ocean, 173-1967  
Soloviev and Go, 1984, A Catalogue of Tsunamis on the Eastern Shore of the Pacific Ocean 1513-1967  
Soloviev and Go, 1984, A Catalogue of Tsunamis on the Western Shore of the Pacific Ocean 173-1968  
Soloviev, Go, Kim, 1992, Catalog of Tsunamis in the Pacific 1969-1982