1st MEETING OF THE OHI TIDAL AND WATER LEVEL GROUP

30 MARCH - 01 APRIL 2009, NITEROI, BRAZIL

CHILEAN SEA LEVEL NETWORK

CURRENT STATE AND FUTURE PLANS

Juan Fierro C.

SERVICIO HIDROGRÁFICO Y OCEANOGRÁFICO DE LA ARMADA DE CHILE

Siempre queda mucho por hacer...

Lecture Overview

- Introduction
- Hardware Configuration of Sea Level Stations
- Data transmission
- Chilean Sea level stations in GLOSS
- Future Plans
- Conclusions

Introduction

Seal level data acquired by a tide gauge may be required in different ways, depending of the application.

- Real Time
- Near Real Time

Operational Products →
- Tsunami Warning System
- Storm Surge
- Marine Navigation & Safety

- Delayed Mode
- Fast Delivery

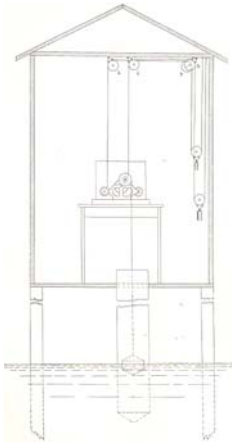
Scientific research →
- Long Term Changes in Sea Level
- Seasonal and Interannual changes
- Calibration of all operational satellites altimeters

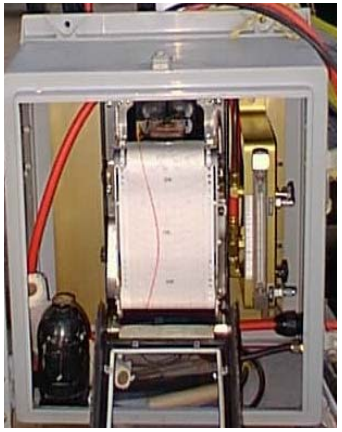
Global Ocean Hazards Warning and Mitigation System (GOHWMS) for coastal inundation

MARINE HAZARD	Tsunami	Storm surge	Extreme wind-forced waves	Long-term sea-level rise
Detection	**Sea-level observation system**			
Potential warning time	Minutes to hours, depending on proximity of source location	Hours to days, depending on climatic factors	Hours to days, depending on climatic factors	Decades to centennia
Action by Regional Warning Centre	Issuance of Watches, Advisories and Warnings to National Centres			No action
Action by National Warning Centre(s)	Immediate transmission of Advisories and Warnings to appropriate Local Authorities			No action

Chilean Sea Level Network
Hardware Upgrade process

1941 1970 1999 2009



dry purged recording tide gauge

Data collecting platforms

Mechanical devices | Digital equipments

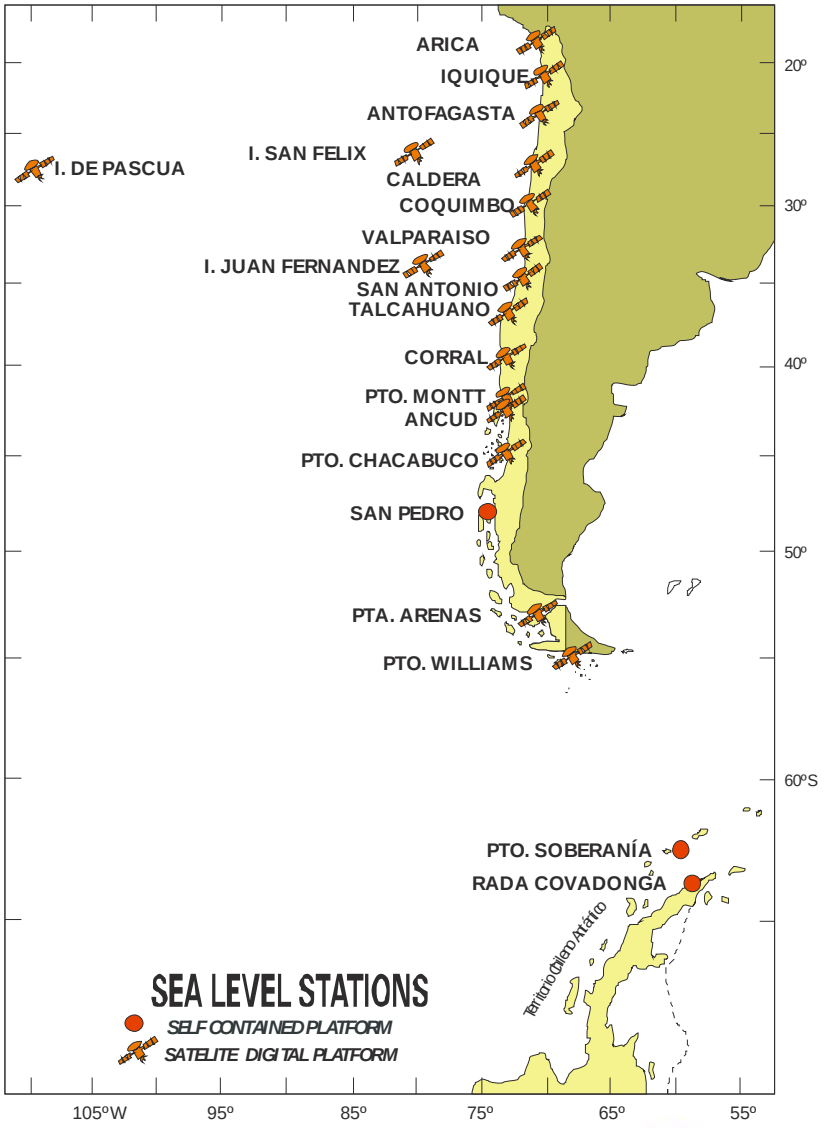
Chilean Sea Level Network

- **17 Stations with satellite transmission:**

  Sea Level : c/2min
  Water Temperature : c/1 hr
  Air Temperature : c/1 hr
  Atmospheric pressure : c/1 hr

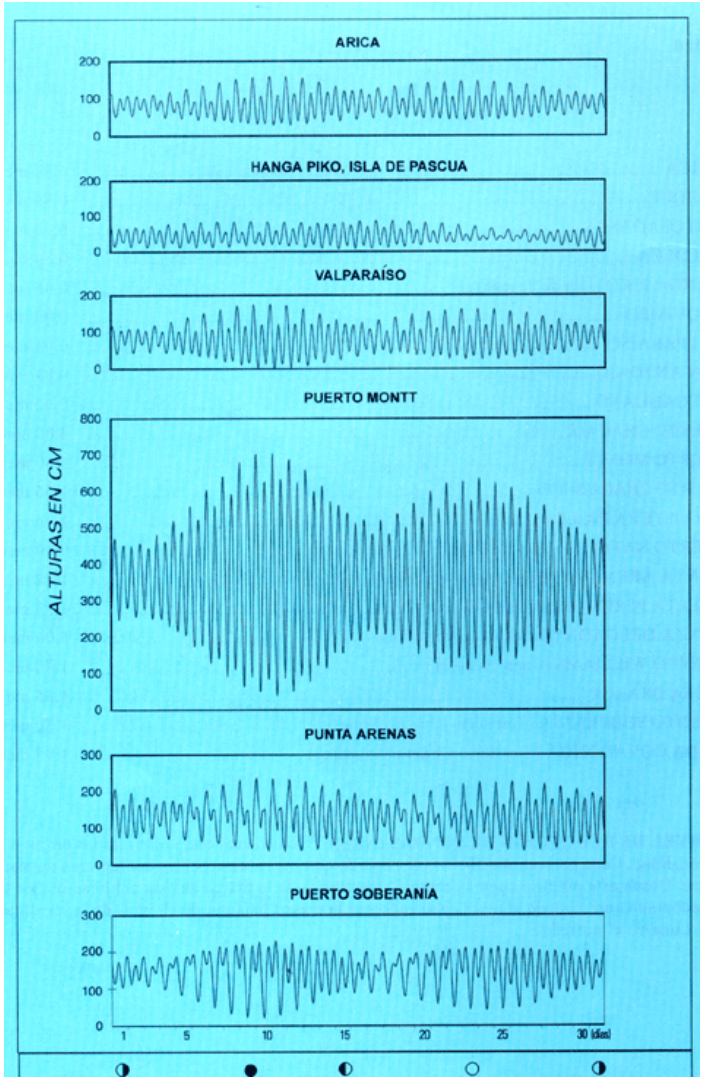
- **3 Self contained platforms:**

  San Pedro
  Pto. Soberanía
  Rada Covadonga



Chilean Sea Level Network

Station	Lat. °S	Long. °W	Installation Year
Arica	18° 29’	070° 19’	1950
Iquique	20° 13’	070° 10’	1958
Antofagasta	23° 39’	070° 25’	1945
I. San Félix	26° 16’	080° 07’	1984
Caldera	27° 04’	070° 50’	1950
I. De Pascua	27° 09’	109° 27’	1957
Coquimbo	29° 56’	071° 21’	1960
Valparaíso	33° 02’	071° 38’	1941
San Antonio	33° 35’	071° 38’	1985
I.R. Crusoe	33° 37’	078° 50’	1981
Talcahuano	36° 41’	073° 06’	1949
Corral	39° 52’	073° 26’	1961
Puerto Montt	41° 29’	072° 58’	1942
Ancud	41° 52’	073° 51’	1999
Pto. Chacabuco	45° 28’	072° 50’	1993
I.San Pedro	47° 43’	074° 54’	1995
Punta Arenas	53° 10’	070° 54’	1942
Puerto Williams	54° 56’	067° 37’	1964
Pto. Soberanía	62° 29’	059° 38’	1983
Rada Covadonga	63° 19’	057° 55’	2006



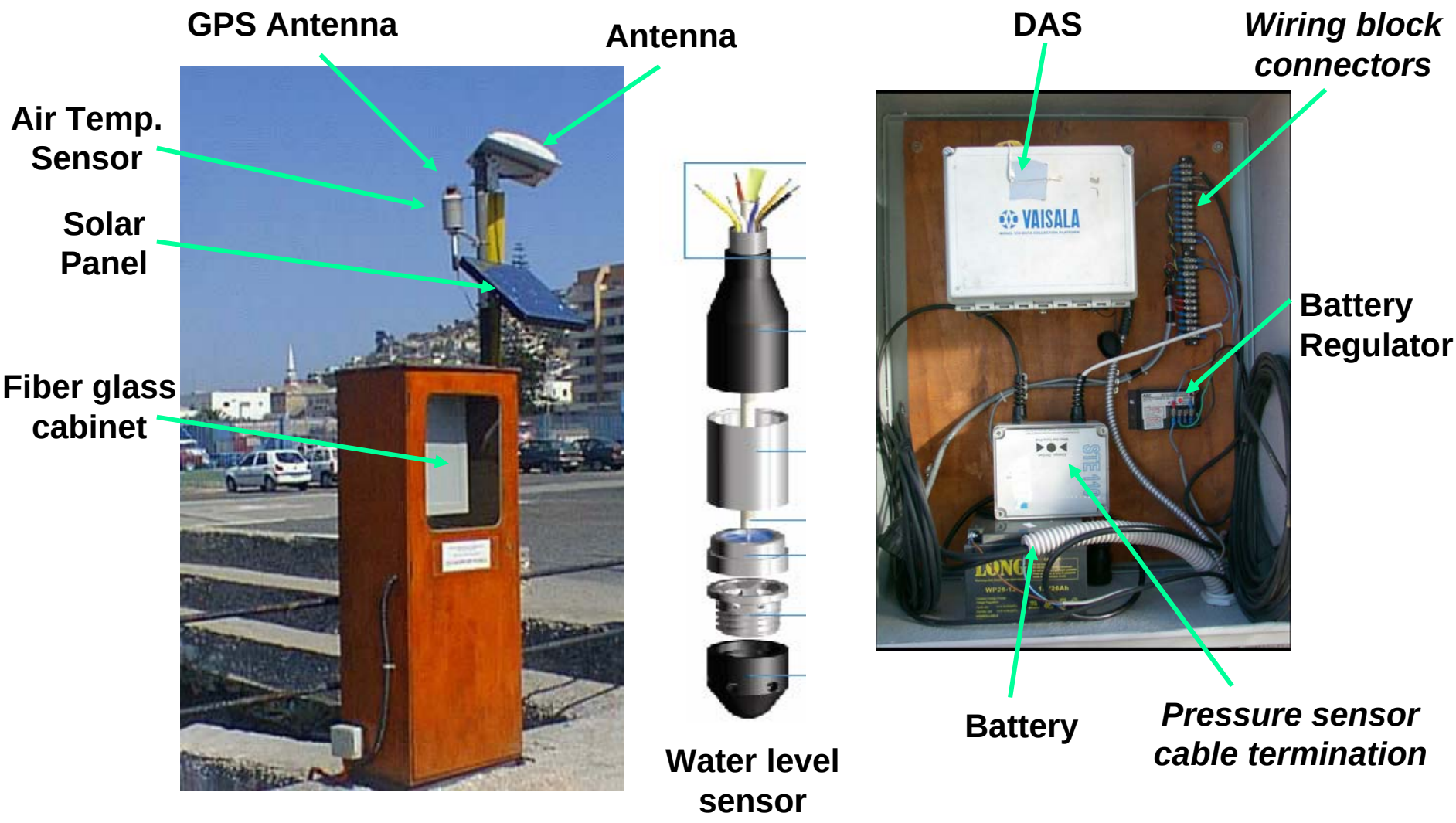
Last Quarter | New Moon | First Quarter | Full Moon | Last Quarter

Sea Level Stations
Hardware Configuration

Sea Level Station Configuration

Examples of Mounting

Sea Level Station - Standard Components



VAISALA DCP model 555C Issues

- From very Simple to very Complex
- From a single input to many inputs
  - Supports most sensors-industry wide
- From No Telemetry to any combination of Telemetry
  - Telephone Modem, Radio, Satellite, Cellular, Voice
- Multiple other options
  - Integrated display, Lid Alarm Switch, GPS (Integrated or external),.....

Satellite Systems: GOES-E, GOES-W (USA)

Main Characteristics

- Under responsibility of the National Oceanic and Atmospheric Administration (NOAA) through the National Environmental Satellite, Data, and Information Service (NESDIS).
- Require an GOES-certified transmitter.
- Each data collection platform located at the gauge is allocated fixed time slots during which 649 bytes of data can be transmitted to a satellite.
- 0 second/year with GPS option.
- Up to one time slot every five minutes can be allocated to each DCP.

Basic 555C Program Creation

NEW

Add SENSOR Definitions

Inputs to be measured

Add PROCESS Definitions

Interval
Statistics
Calculations
Conversions
Reformatting
Outputs

Save Program

Assemble Program

Convert program into executable form

Load Program into 555C

Pressure Transducer Sensor

DRUCK PTX1830

Specifications

- Operating Pressure Range : 1 to 900 psi (20 psi = 14.1 m)
- Accuracy : ± 0.1 % F.S.
- Operating Temperature Range : -20 to 60 ºC
- Full welded titanium construction
- Backed by 5 year corrosion warranty
- Vented polyurethane cable
- Cable Termination STE 110

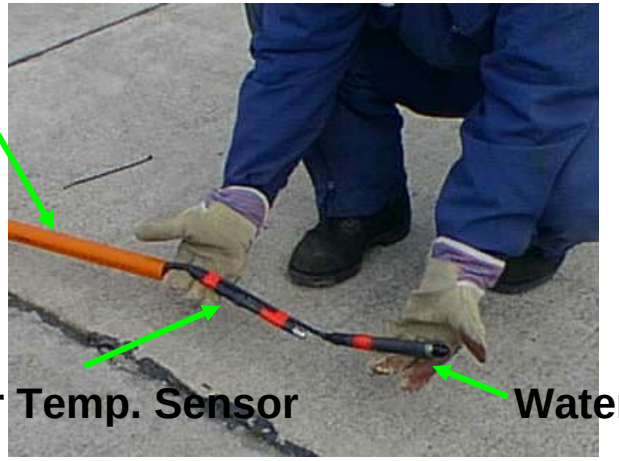
Silicon Sensing element within the all-titanium pressure module

Fixing submersible sensors

PVC Conduit 32 mm

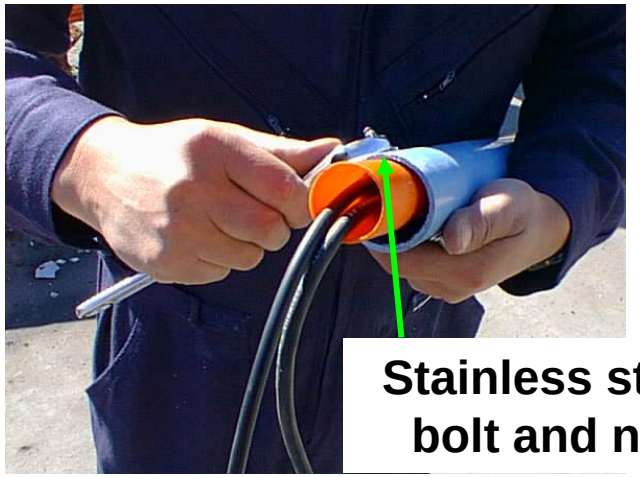
PVC Hydraulic 50 mm

Fiber glass tide staff



Water Temp. Sensor

Water Level Sensor



Stainless steel bolt and nut

Fixing submersible sensors

Bandit Stainless Steel
and Bandit strapping tool

Stainless Steel Clamps

Fixed to the Aquatrak
Sounding tube

Electric and Pneumatic Drill

Sea Level Stations with Self-contained platform

The sensor measures the hydrostatic pressure caused by the head of water above it. The influence of barometric pressure on the sensor is compensated for by applying air pressure to one side of the transducer through an air pipe.

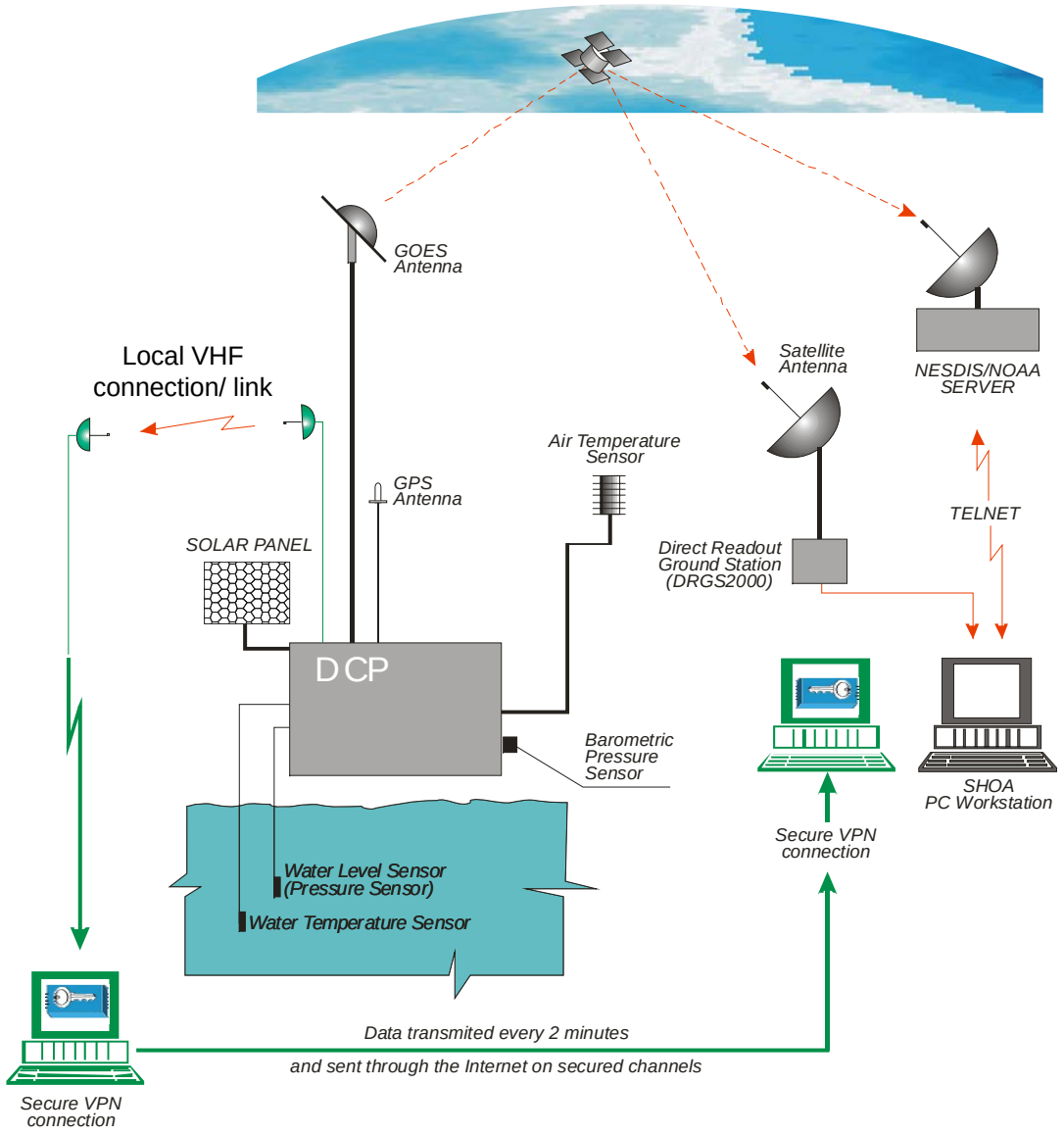
Stations operating with AANDERAA datalogger

Pto. Soberanía

Rada Covadonga

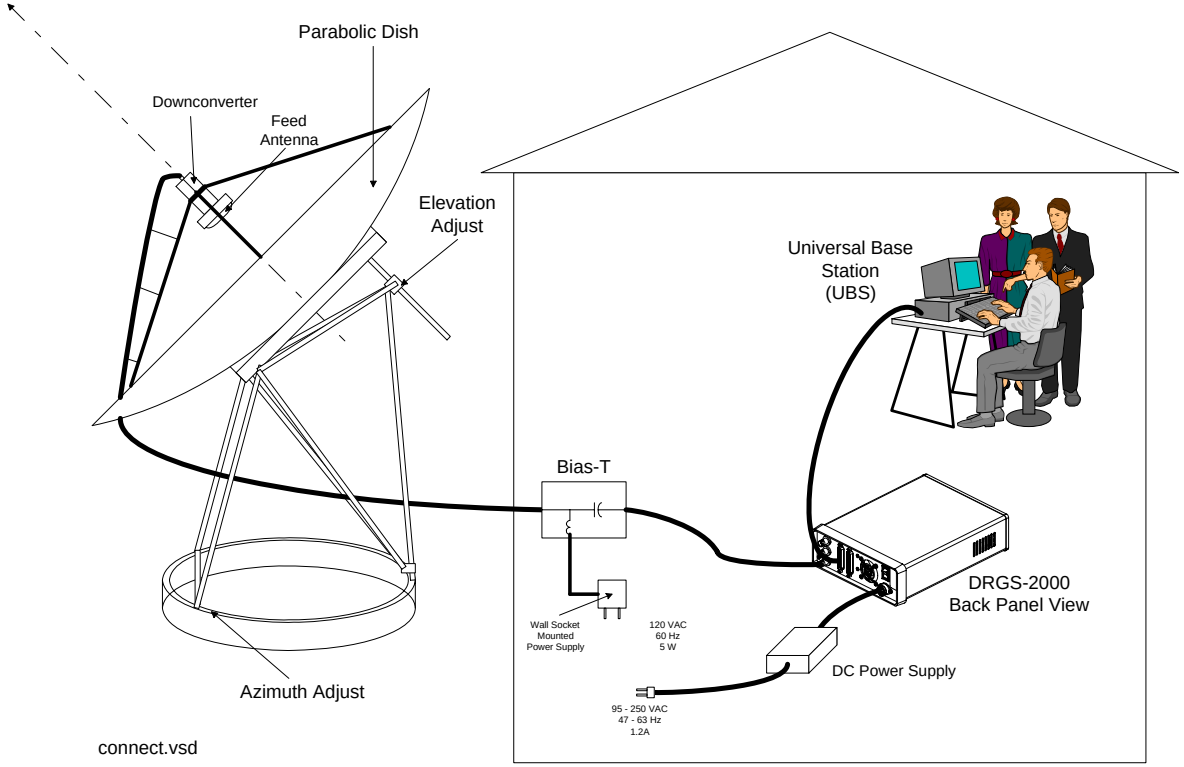
Data Transmission

Information flow across Chilean Sea Level network



Direct Readout Ground Station (DRGS)

Provides ability to directly receive data from GOES satellites without being dependent on secondary links



Data Format

GLOSS Station 174: Antofagasta (Chile)

Header Line added by NESDIS

Code Year J.day hhmmss F.Code Chann.

```
ADC020D203086042423G42-0NN047E9000201
1022 1020 1019 1019 1014 1017 1016 1016 1018 1017
1018 1020 1016 1017 1019 1013 1011 1011 1012 1016
1015 1014 1018 1018 1018 1019 1018 1017 1018 1020
17.0
19.3
19.4
1020.1
12.8
12.7
```

T^{o}_{a}

T^{o}_{w1}

T^{o}_{w2}

P^{o}_{atm}

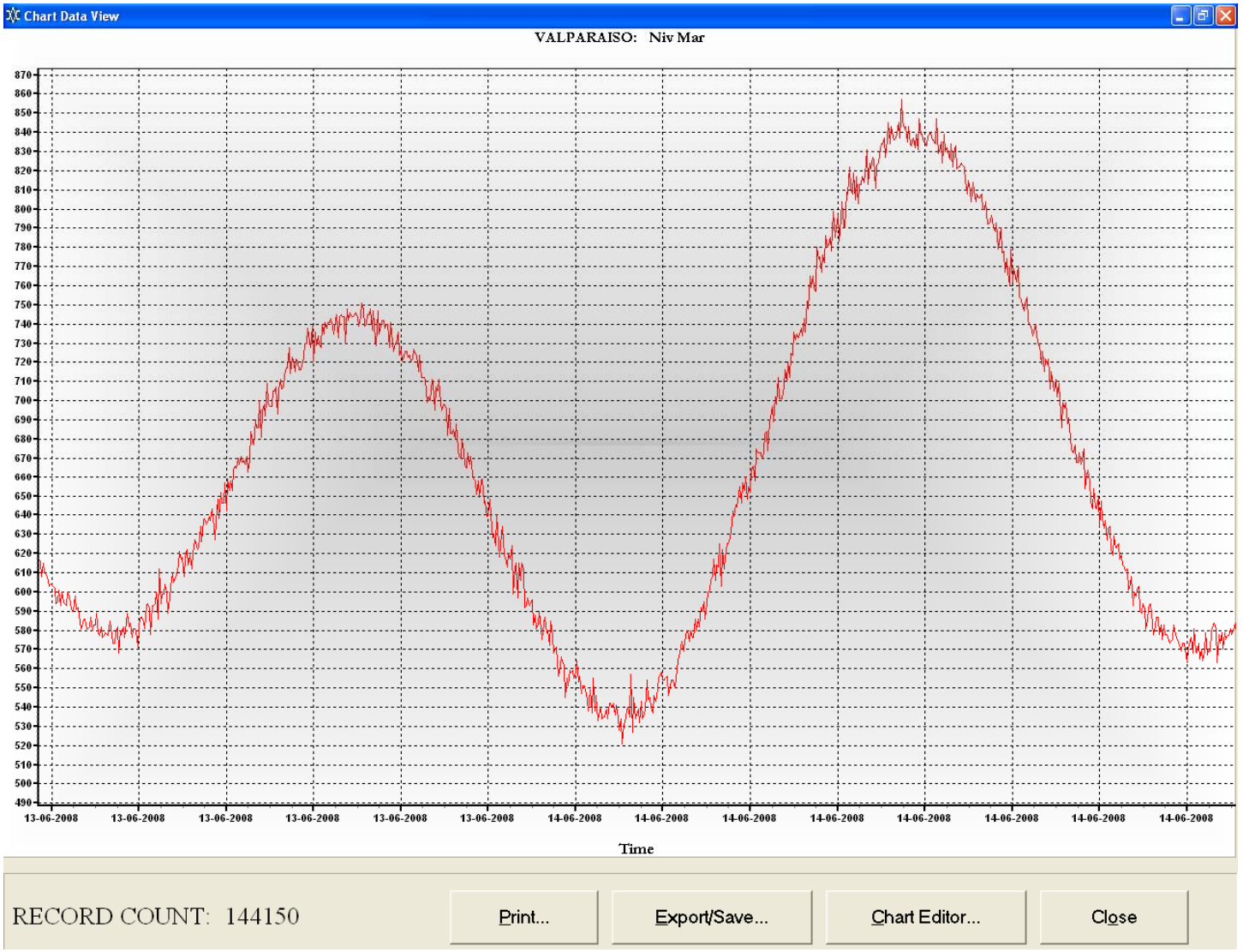
Volt

Sea Level 2 minutes average

UBS2000

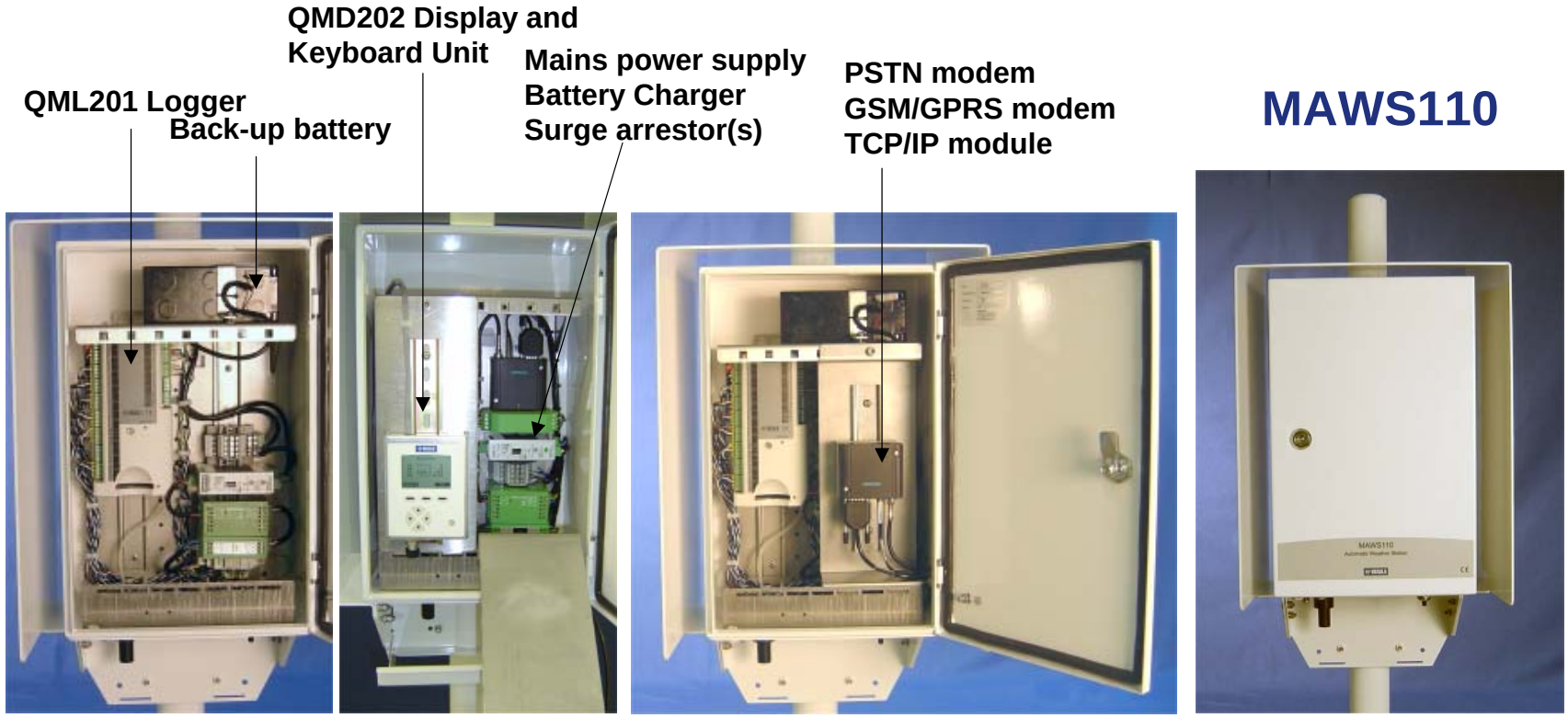
- Software developed by VAISALA
- Collect data from a large number of met and oce sensors
- Displays data in a variety of forms, including graphs, tables, wind roses, status, etc
- Ingests Data from
  - GOES Direct Readout Ground Station
  - Interrogated Radio
  - Telephone Modem

UBS2000 Screens



Future Plans

VAISALA HydroMet SYSTEM MAWS110
Medium Sized Systems



Submersible Water Level Sensor
PR-36XW/H

- **PR-36XW FOR MEASURING HYDROSTATIC LEVEL IN RIVERS, LAKES AND RESERVOIRS**
- **MEASURING RANGE 0 - 40 m (USER SETTABLE)**
- **PR-36XW/H WITH HASTELLOY DIAPHRAGM FOR SEA WATER APPLICATIONS**
- **SPECIFICATIONS:**

OUTPUT SIGNAL:	**4-20 mA, 2-WIRE**
ACCURACY:	**0.1 % of F.S.**
MATERIAL:	**STAINLESS STEEL, POLYURETHANE CABLE**

OPERATING TEMP. : - 40 ° ... +60° C

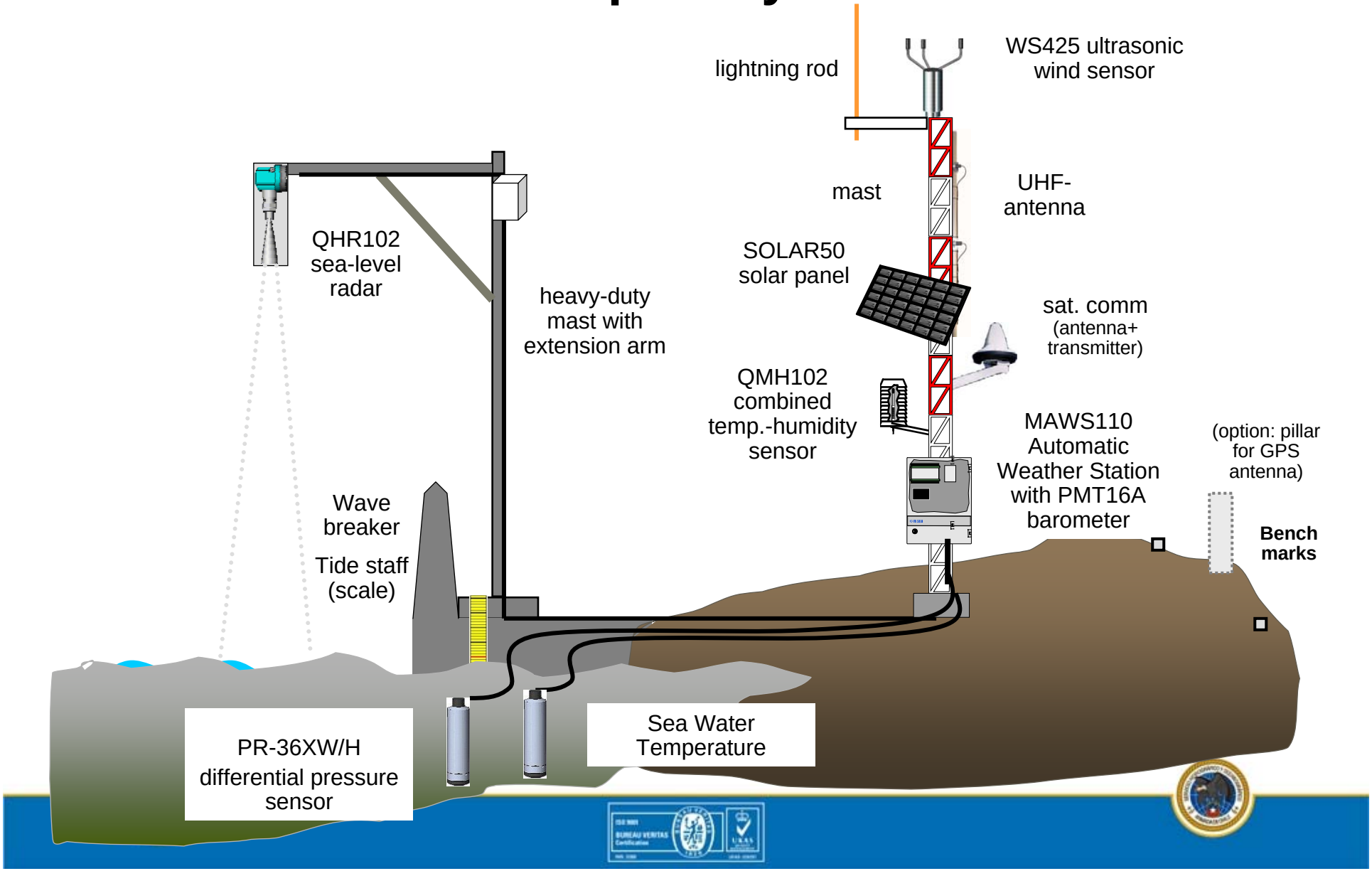
Radar Water Level Sensor QHR102

- **CONTACT FREE WATER LEVEL MEASUREMENTS (26 GHz TECHNOLOGY)**

  - **INSENSITIVE TO MUD, DRIFT WOOD, LEAVES, ETC**
  - **MINIMUM CONSTRUCTION WORK**
  - **INSENSITIVE TO FOG, AIR TEMPERATURE FLUCTUATION**

- **MEASURING RANGE 0 - 35 M**
- **ACCURACY: ± 3 MM**
- **OPERATING TEMP: - 20 TO +70° C**
- **LOW POWER CONSUMPTION**

Tide Station for Tsunami Monitoring
Example Layout



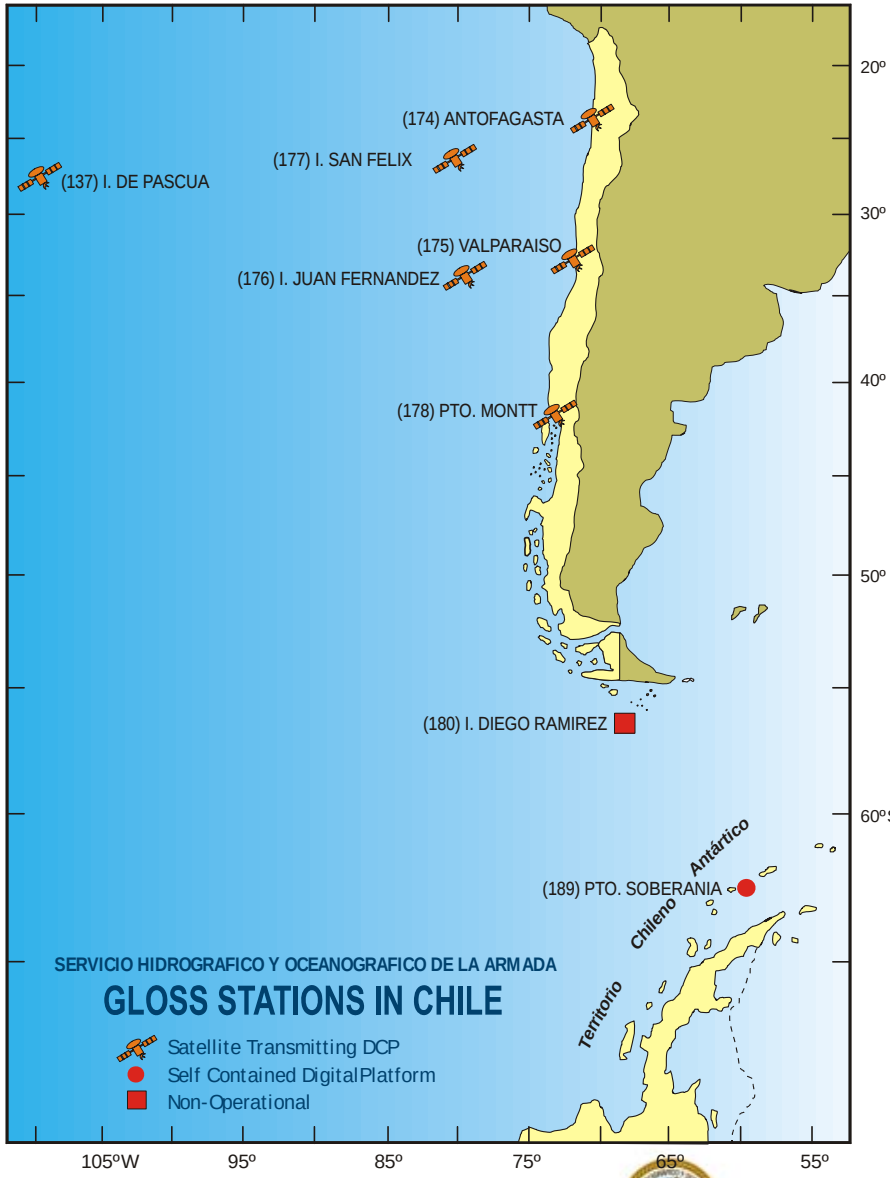
GLOSS STATIONS IN CHILE

GLOSS Stations in Chile

- The main component of GLOSS is the GLOSS Core Network which comprises 290 stations worldwide.

- Eight Chilean sea level stations have been considered in the GLOSS core network.

- I.Diego Ramírez station was discontinued in 1998 after being in operation for 10 years as part of the World Ocean Circulation Experiment (WOCE).



Data Streams to GLOSS Archiving Centres

- Chile contributes to GLOSS maintaining the following data streams to GLOSS archiving Centres:

Delayed Mode:

- Monthly Mean Sea Level to PSMSL
- Hourly Heights to PSMSL and UHSLC

Fast Delivery:

- GPS data collected in Valparaíso station (GLOSS 175) are sent to University of Ohio

Real Time:

- Data collected at all the Chilean stations are also being downloaded in near real-time by University of Hawaii Sea Level Center (UHSLC) and is made available on the Global Telecommunication System (GTS).

CONCLUSIONS

Conclusiones

- Chile has a national sea level network with a distribution according to the national operational requirements of the main ports and tsunami warning centres.

- The DCP has a flexible configuration with required autonomy while the componentes are easy to install and adaptable to different structures on the field.

- The data transmission systems allow to know timely the event of anomalous variations in the sea level, as a support to the decision making process in relation to the National Tsunami Warning System.

- Chile maintain an adequate sea level data streams to GLOSS centres for operational and scientific purposes.

- Many newer possibilities are being exploited or planned, i.e. redundancy in: DCP, data transmission system and sea level sensors. Multi-function platforms supporting Tsunami Warning Centres by increasing sampling and transmission rates (i.e., 1 min averages at 5 min transmission cycle using GOES system or less via GTS).

THANKS