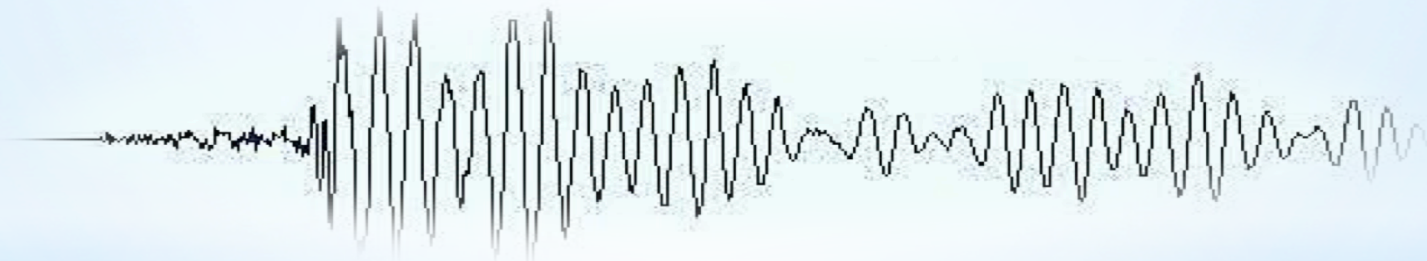


IRIS Metadata Workshop
'Managing Waveform Data and Related Metadata for Seismic Networks'
Kuwait, January 14-18, 2013

Moroccan Seismic Network: Overview



EL FELLAH Younes
Scientific Institute-University Mohammed V-Agdal, Rabat
Email: el.fellah.younes@gmail.com



Outline

- ⊕ **Scientific Institute, Mohamed V University, Rabat**

 - ⊕ Earth Physics Affiliation

- ⊕ **Seismicity of Morocco**

 - ⊕ A brief history of Earthquake monitoring in Morocco

 - ⊕ Current Equipment

 - ⊕ Support & Benefit

- ⊕ **Use of Data**

- ⊕ **Some activities**

Scientific Institute

The Scientific Institute of Rabat belongs to Mohamed V University:

- was created in 1920 and is composed by three departments:
 - Botany and Vegetal Ecology
 - Earth Sciences (including Earth physics, Geology and Geomorphology)
 - Zoology and Animal Ecology
- Is in charge of carrying out research activities related to flora, fauna and soil;
- the setting up of a systematic inventory of physical and biological environment;
- the creation of collections for a National Museum of Natural History;
- the reassembling of the necessary bibliographic elements for the setting up of a scientific library and the renovation and fitting of laboratories, observatories and station facilities required for its research.

Earth Physics Affiliation (EPA)

- managing the laboratory and seismic stations
- working on applied Physics, Instrumentation and Signal Processing
- **Seismic Waves and Earth Structure** (SWES) is the subordinated laboratory of the affiliation

- Axes of research

- Seismicity of Morocco and correlation between fault systems and seismic activity recorded, and seismic hazard assessment
- Seismic tomography and mapping of variations in the speed of seismic waves through the country, using receivers functions methods
- Seismic imaging and exploration of discontinuities and inhomogeneities in the crust.
- Geological anisotropy and determination of the quality factor of the seismic waves propagation

- The goals

- Installation and management of seismological stations
- Maintenance and data collection
- Creation of a seismic database for the country
- Seismic signal-processing according to themes or areas of research
- Production of scientific papers, articles, thesis, catalog of seismic events





Seismicity of Morocco

-seismicity was relatively moderate during the last century.

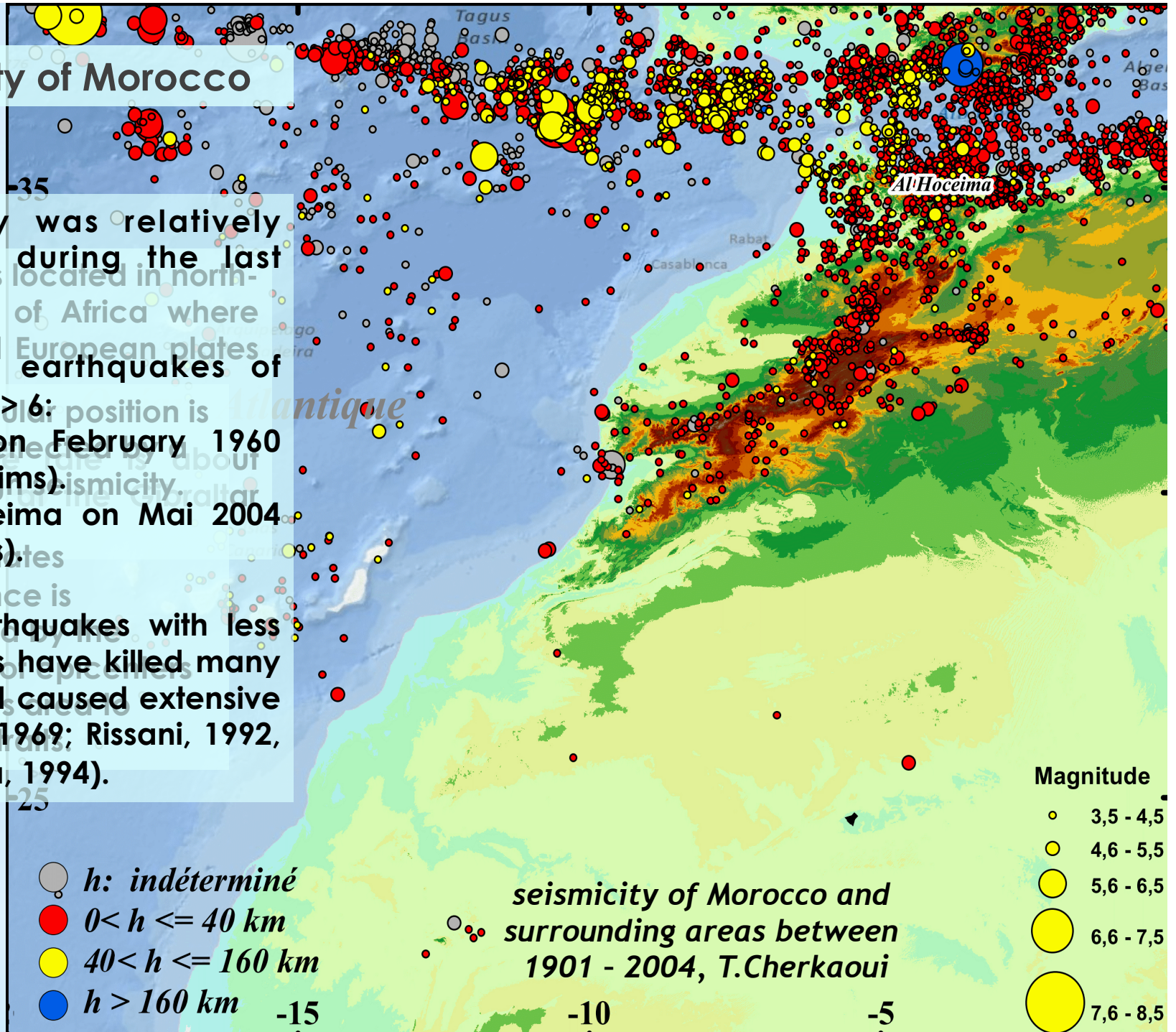
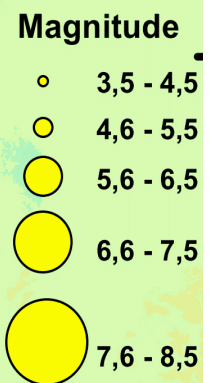
-Morocco is located in north-western tip of Africa where African and European plates collide.

-only two earthquakes of magnitude > 6 :
1- Agadir on February 1960 (12,000 victims).
2- Al Hoceima on Mai 2004 (629 victims).

-Other earthquakes with less magnitudes have killed many people and caused extensive damages (1969; Rissani, 1992, Al Hoceima, 1994).

-  h : indéterminé
-  $0 < h \leq 40$ km
-  $40 < h \leq 160$ km
-  $h > 160$ km

seismicity of Morocco and surrounding areas between 1901 - 2004, T.Cherkaoui



The epicenters are located in three regions

- **Atlas area:** seismic activity is mainly located in Middle Atlas and Central High Atlas. It is due in large part to the presence of a complex network of tectonic active faults, especially the great south High Atlas accident, which starts from Agadir and passes close to Figuig (epicenters can be violent like Agadir 1960).
- **Betic-Rif area:** The main seismicity is located in Andalucia (south Spain), Alboran Sea and northern Morocco. This seismic activity correspond to shallow earthquakes (depth < 40 km) and intermediate depth (40 - 160km).
- **Atlantic area:** here the two plates boundary is clearly distinguished. It's represented by the Azores - Gibraltar – Sicily seismic line . Earthquakes >7 can happen and hit Moroccan and Iberian Peninsula (1755 and 1969 events).

History of earthquake monitoring in Morocco

- In 1964, observations started with 4 stations (Rabat-Institut, Zaer, Averroes & Ifrane)
- In 1974, the network expanded to ten stations covering most of the country area.
- In 2005, a radical change had interested seismic stations in Morocco (Hardware, station number, numeric data, location ... etc)
- Since 2008, a total of 80 operational stations are permanently recording seismic activity in all territory.



Seismological observatories of the Institute scientific
(north part of Morocco)

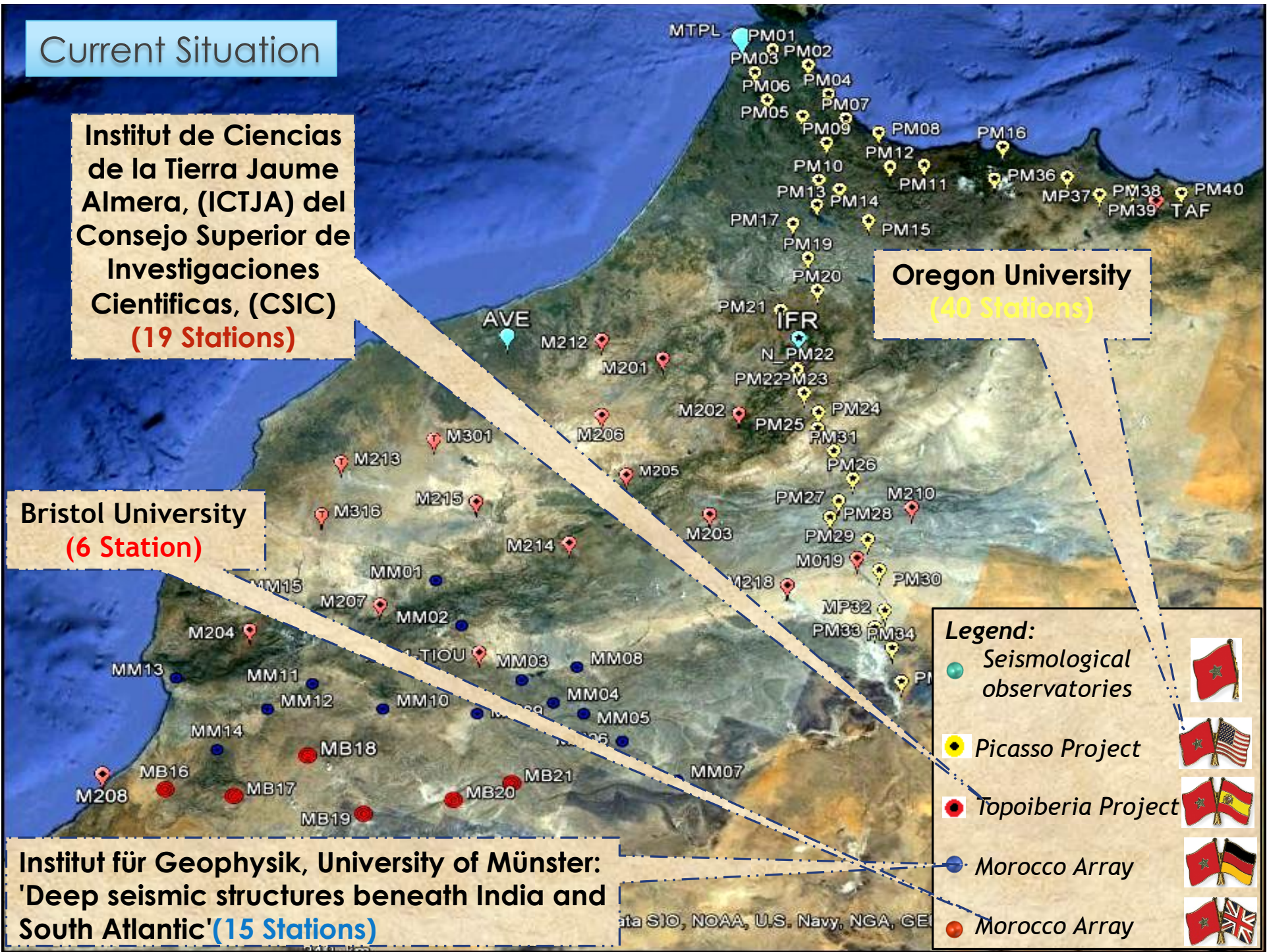
Current Situation

Institut de Ciències de la Terra Jaume Almera, (ICTJA) del Consejo Superior de Investigaciones Científicas, (CSIC)
(19 Stations)

Oregon University
(40 Stations)

Bristol University
(6 Station)

Institut für Geophysik, University of Münster:
'Deep seismic structures beneath India and South Atlantic'
(15 Stations)



Legend:

- Seismological observatories
- Picasso Project
- Topoiberia Project
- Morocco Array
- Morocco Array

Equipment

- Seismological observatories are built around broadband seismic stations.
- All equipment runs off of independent solar power except for Ifrane and Averroes.
- Seismic broadband equipment covers different types, we find:
 - Streckeisen STS-2 G3/Quanterra 330 Linear Phase Co
 - Nanometrics Trillium 120 Sec Response/Taurus Stand
 - Guralp CMG3T/Quanterra 330 Linear Phase Composite
 - Quanterra 330 Linear Phase Composite ,RT.130...



CMG-3T

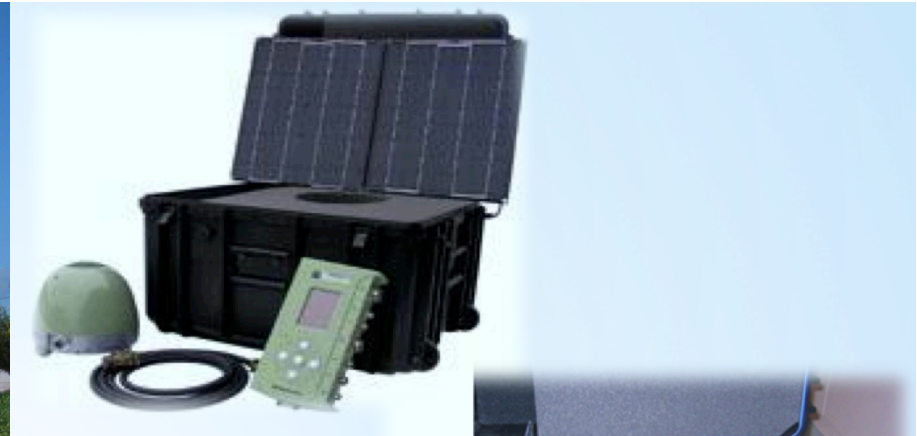
Streckeisen
STS-2



Nanometrics Taurus
dataloggers and
Trillium 120

Quanterra
Q330 Digitizer





Installation type from broadband seismic station

Support & Benefit

➤ **Capacity building:**

- Collaborations supports the geophysical PhD students in their thesis benefiting from training courses in the country or abroad.
- Sponsors Moroccan scientists for different annual workshops

➤ **Acquiring new knowledge and data:**

- The Moroccan seismic network make available data from observatories and from other sources to researchers/investigators, conducting the research as part of their training, academic studies or research. i.e. Moroccan seismic network data formed from various collaborations.

Support & Benefit

➤ **Sharing new technologies and techniques:**

- Provided equipment upgrades and spares of Seismometers
- Provided internet facility at Ifrane and Avveroes office for data streaming
- Provided computers for Ifrane and Avveroes stations which have played pivotal role in downloading, networking and data analysis

➤ **Building relationships between generation of geoscientists:**

- Moroccan scientists have collaborated with international scientists through annual workshops and research meetings

Use of Data

- Data from the observatories provide the underpinning for much of the science supported by collaboration network .
- Imaging earth's crust and mantle from analyses of the waves produced by many earthquakes at different depths, distances, and directions, as recorded by seismometers.
- Delineating active faults/source zones.
- Producing earthquake catalogues/bulletins
- Hazard assessment and risk mitigation through use of earthquake catalogues to determine the seismic hazard of a region.

Future Plans

- Real-time streaming Data from all stations (Seismic and GPS)
- Expand Seismic network to more stations, through Government funding and/or collaborative efforts.
- Introduce Accelerometers to network for strong motion data acquisition.
- Training in modern equipment, maintenance and Data analysis techniques
- Seismology staff to encourage young to get MSc's and PhD's (geophysics & Seismology)

Conclusion

- A collaborative investigations in seismology can give responses to geodynamic and tectonic
- A temporary network has supported Morocco Seismology and has formed the backbone of knowledge and support for local scientists
- it is demonstrated that development of permanent seismic network has really provided the much needed data and support for scientific capacity building

Thanks to :

- Incorporated Research Institutions for Seismology (IRIS)
<http://www.iris.edu>
- Kuwait Institute for scientific research (KISR)
<http://www.kisr.edu.kw/>
- Instituto de Ciencias de la Tierra Jauma Almera
<http://www.ictja.csic.es/>
- International Association of Seismology and Physics of the Earth's Interior
<http://www.iaspei.org/>
- Orfeus
<http://www.orfeus-eu.org/>
- International Federation of Digital Seismograph Networks
<http://www.fdsn.org/>

Thank you for your kind
attention

