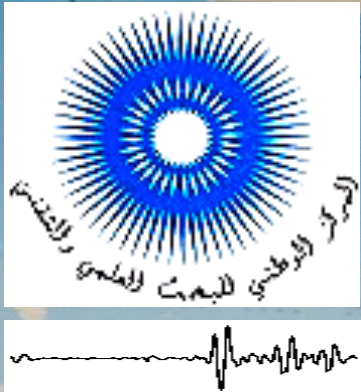


ROYAUME DU MAROC  
CENTRE NATIONAL POUR LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE  
(CNRST)

المعهد الوطني للبحوث العلمية والتقنية

INSTITUT NATIONAL DE GEOPHYSIQUE  
(ING)



# Transition from analog to digital seismic network in Morocco

Abdelilah Tahayt, Abdelouhed Birouk  
& ING-CNRST group, Morocco

European-Mediterranean Quatterra & Antelope Users Group Meeting  
March 22 - 24, 2010  
Institute of Geophysics, Prague

# Outlines

- Analog network
- International cooperation
- Fully Digital network
- Antelope use at ING-CNRST
- Perspectives on the future

# Summary of ING activities

## **National Institute of Geophysics :**

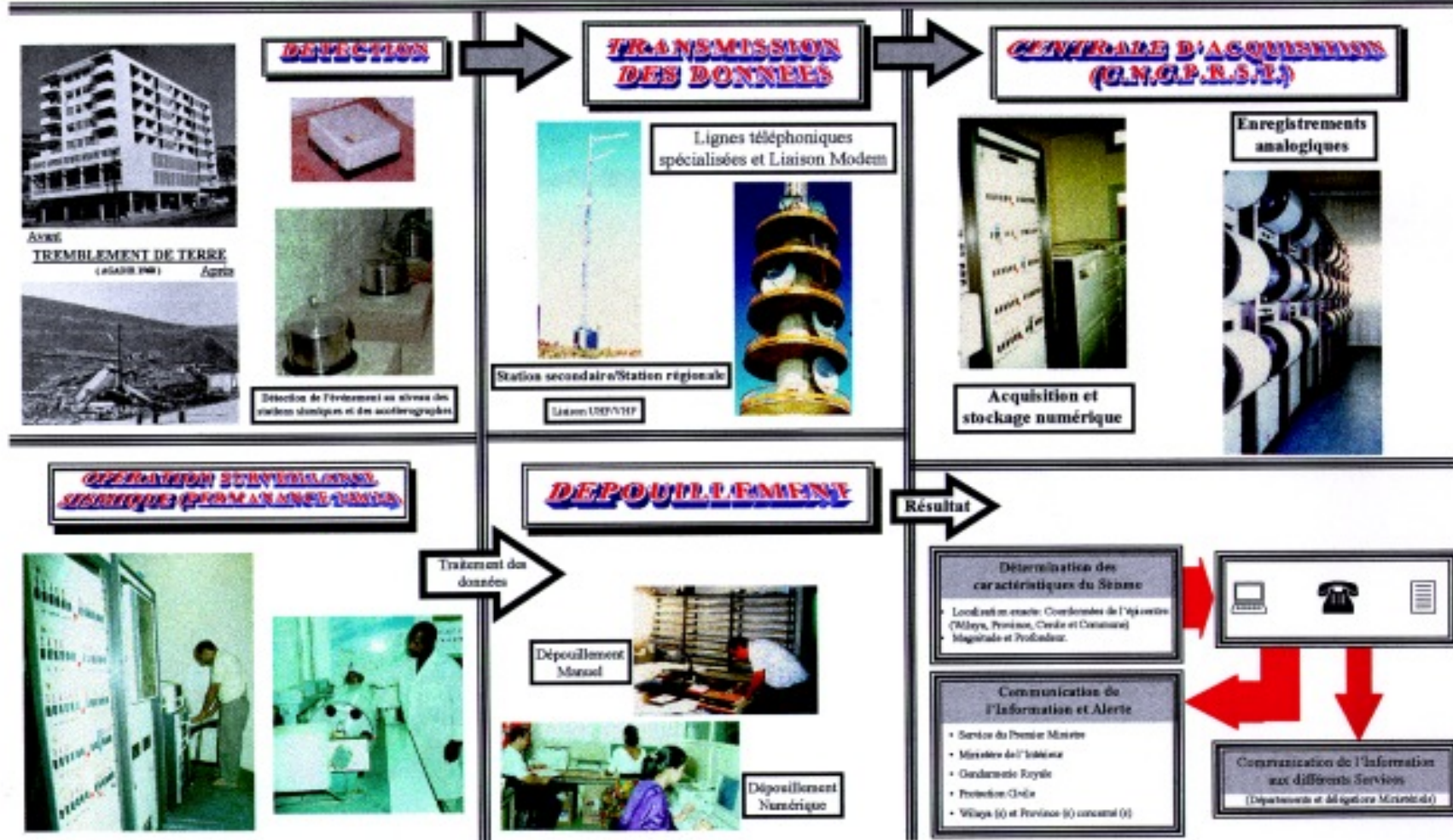
- **Installation, management and exploitation of the National Seismological Network**
- **Permanent (24/24, 7/7) national seismic monitoring and warning**
- **Seismic monitoring of large dams**
- **Site Seismic qualification of large buildings**
- **Seismic microzonation of urban areas**
- **International assistance in seismic networks installation**
- **Academic training**
- **International cooperation in seismic risk studies and monitoring (CEPRIS, CTBTO, MEDNET, PROHETEC, NEAREST,...)**



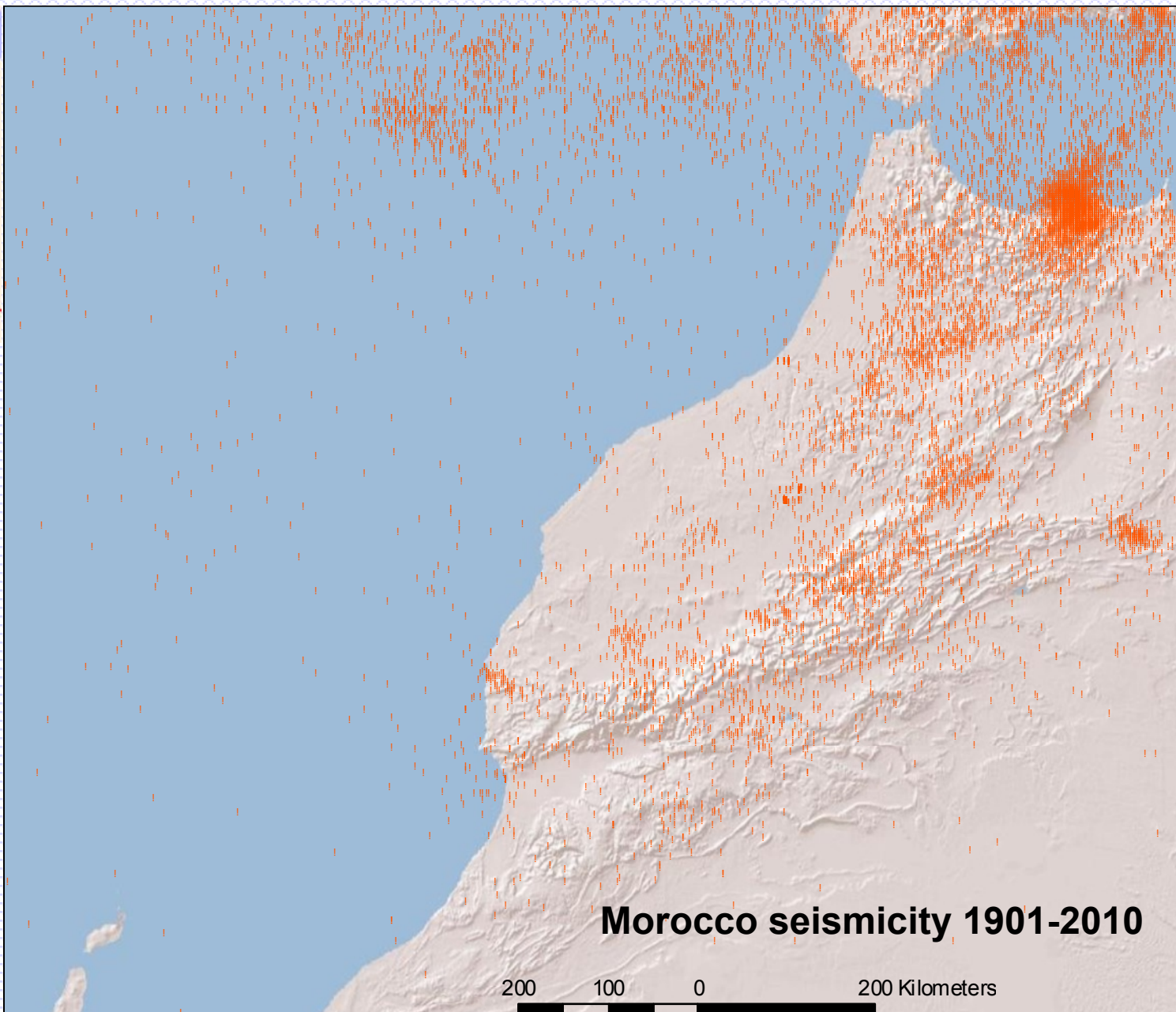
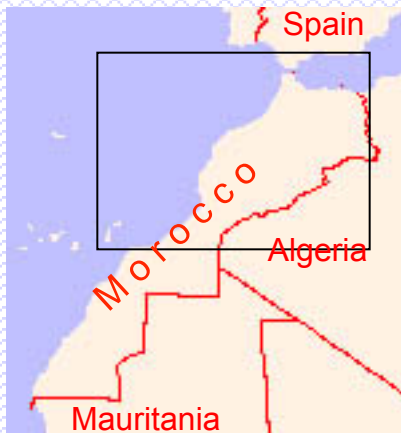
ROYAUME DU MAROC  
Centre National de Coordination  
et de Planification de la Recherche  
Scientifique et Technique  
(CNCPRST)

## SURVEILLANCE ET ALERTE SISMIQUE DU TERRITOIRE NATIONAL 24 HEURES / 24

Laboratoire de Géophysique  
LAG  
Tél: (212-7) 77-86-74  
Fax: (212-7) 77-86-78



Seismic warning sequence



**Morocco seismicity 1901-2010**

# SOME RESULTS

- Good warning system;
- Good knowledge of Moroccan active areas;
- Use of data to:
  - Compile new Seismic catalog;
  - Conduct Seismic hazard assessment studies
  - Support seismic building Code elaboration and its actualisation(RPS2000)

# Outlines

- Analog network
- International cooperation
- Fully Digital network
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- Perspectives on the future

# ANALOG TELEMETERED NETWORK

## Specifications

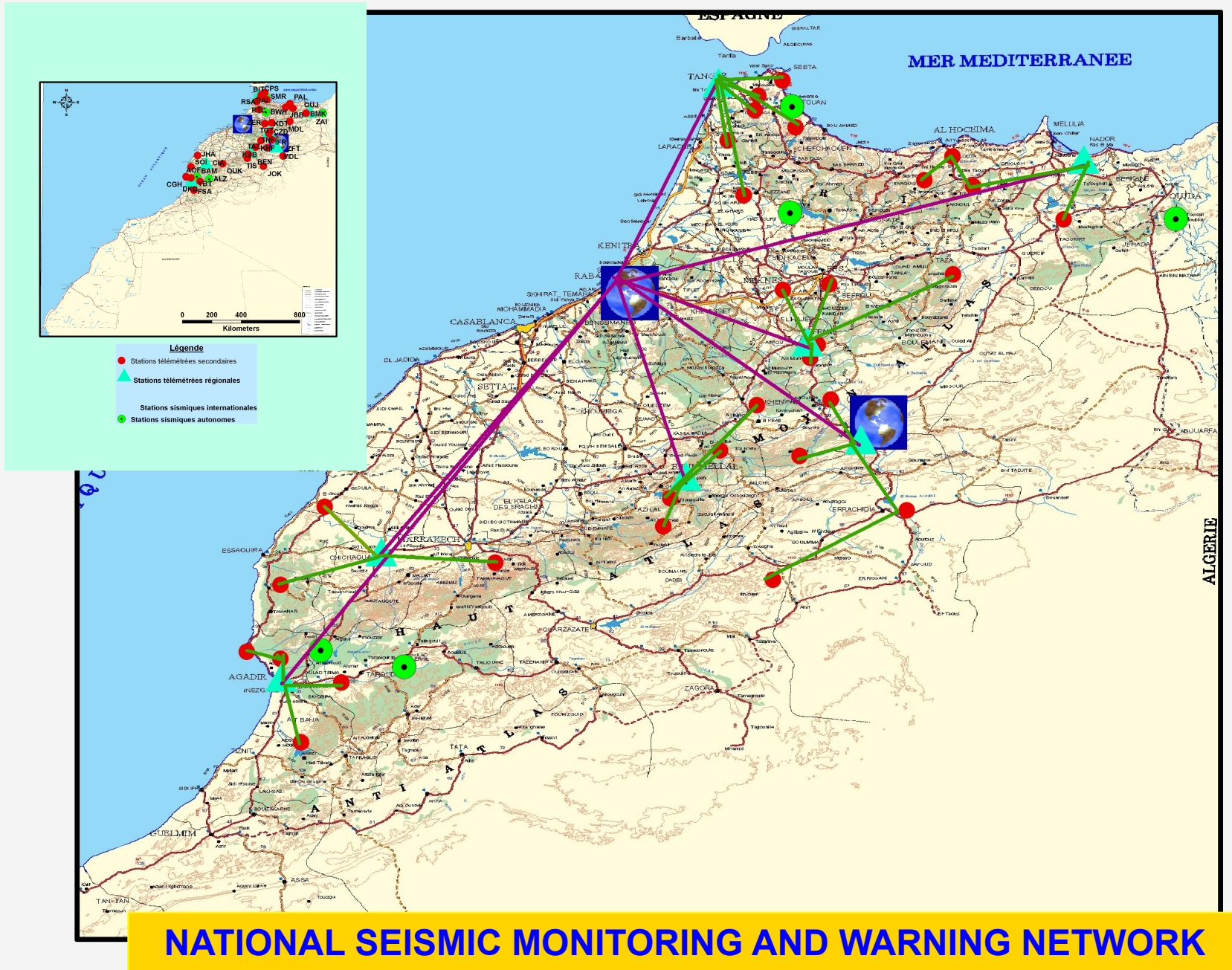
- Telemetry ,
- Real Time,
- Seismic network First generation (Analog + digitalization at the center)
- Coverage of the National Territory;
- 24h/24
- + 15 portable stations deployed in specific cases

## Composition

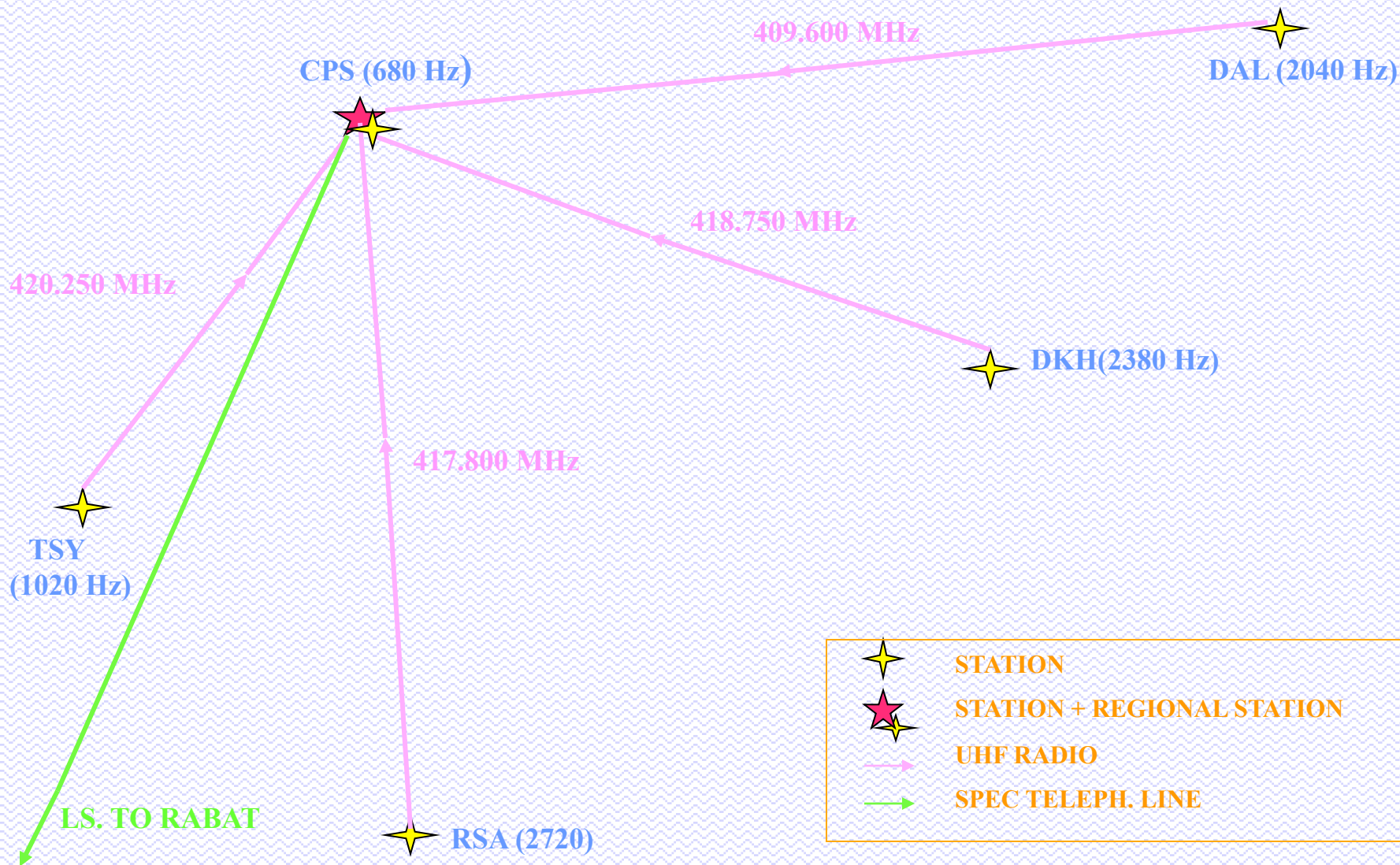
- 30 analog seismographs Short period distributed to 7 sub-networks;
- Acquisition Center (time synchronization, analog & digital recording)
- 32 paper Drums;
- Digital recording;
- Transmission : 28 UHF Links, 9 repeaters, 7 leased phone lines..



# Present day seismic stations distribution

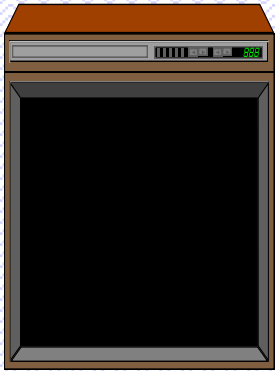


# Sub Network of Tangier



# ACQUISITION AND RECORDING AT THE CENTER

DEMULTIPLICOR  
DEMULATOR  
SYNC GPS HORLOGE



ACQUISITION PC



OFF LINE PROCESSING PC  
DIGITAL DETERMINATION



ETHERNET NETWORK

OFF LINE PROCESSING  
AND DATA ARCHIVING



SEMI-AUTOMATIC  
DETERMINATION



DATA OF AUTONOMOUS NETWORK AND  
ACCELEROGRAPHS

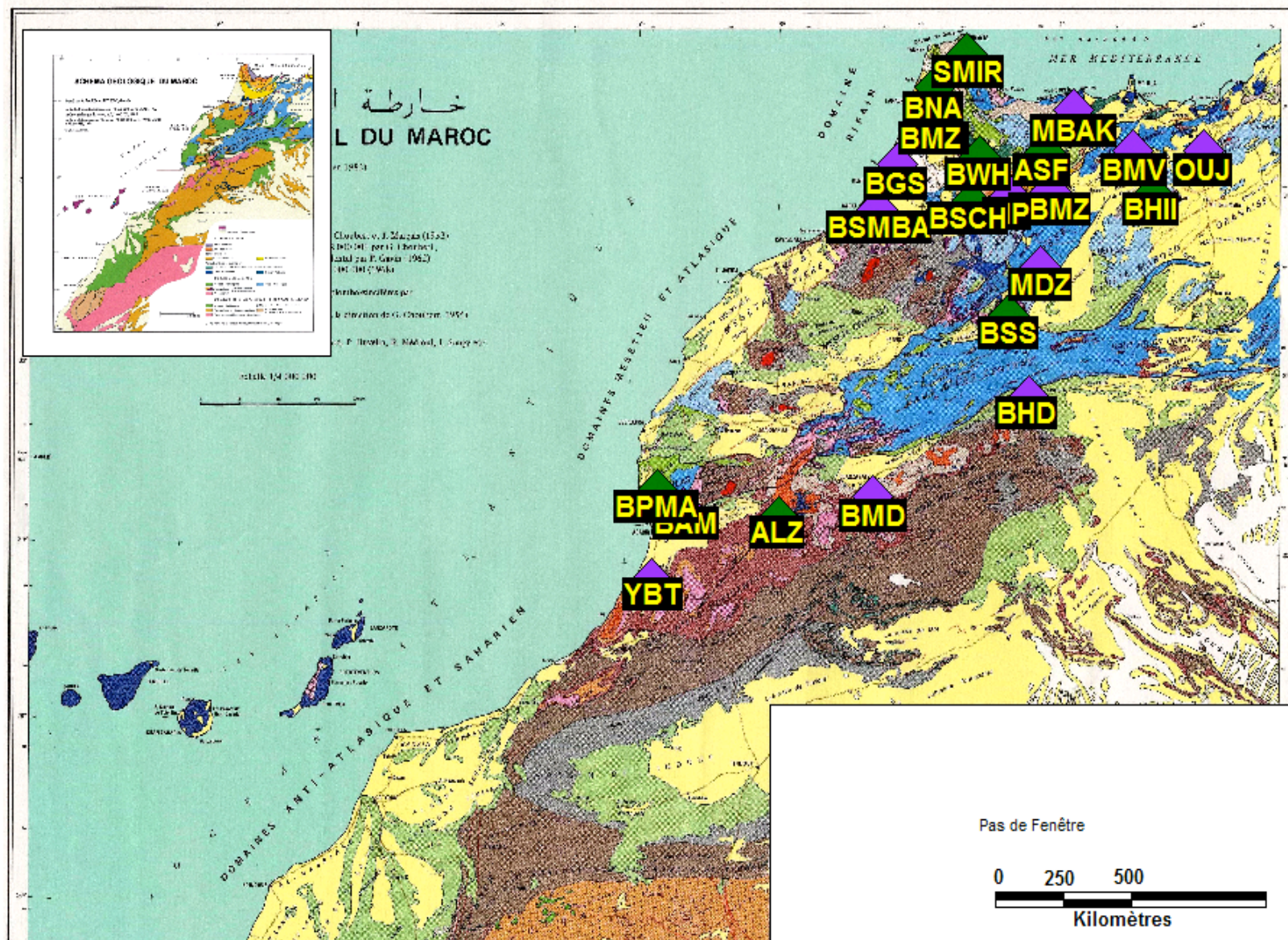


SPECIFIC LINE

ANALOG RECORDING



# Moroccan Strong Motion Network (About 50 accelerographs) & Seismic monitoring of large dams





## Seismic monitoring of large dams



# Outlines

- Analog network
- **International cooperation**
- Fully Digital network
- Antelope use at ING-CNRST
- Perspectives on the future

# MOROCCO BROADBAND STATIONS

## 1- MEDNET Station ( Mediterranean Very Broadband Seismographic Network)

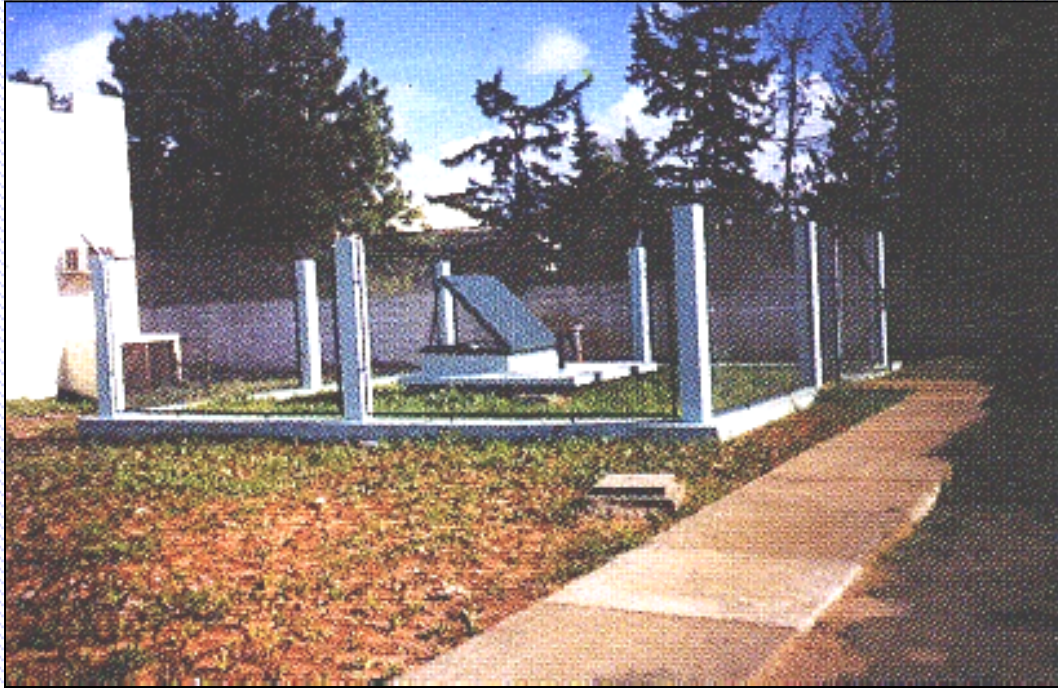
- VBB Very Broadband STS1, Quanterra 680, 24 bits resolution
- Seismicity & lithospheric Studies of the Mediterranean basin
- installed in Rabat, direct link to INGV ROME (by MODEM & INTERNET)

## 2- CTBTO Station (Comprehensive Nuclear-Test-Ban Treaty Organization)

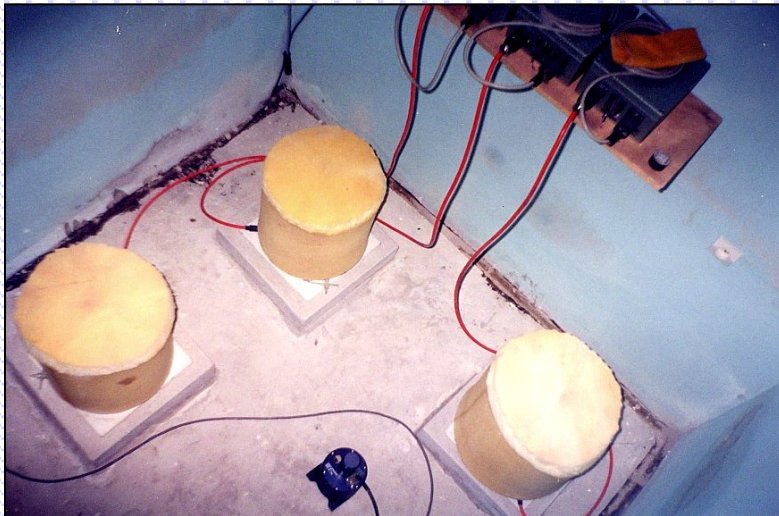
- BB: Broadband STS2, Europa 24 bits resolution
- IMS Auxiliary Station for nuclear explosions monitoring
- installed in Midelt, direct link to the IDC Vienna & CNRST via VSAT

## 3- Seismic array

- Morocco-USA Cooperation
- 9 Elements Array within 2 Km radius, 9 SP & 1 BB
- regional seismic activity monitoring
- south of Morocco, link to the USA & the CNRST by VSAT



# RABAT VBB MEDNET STATION



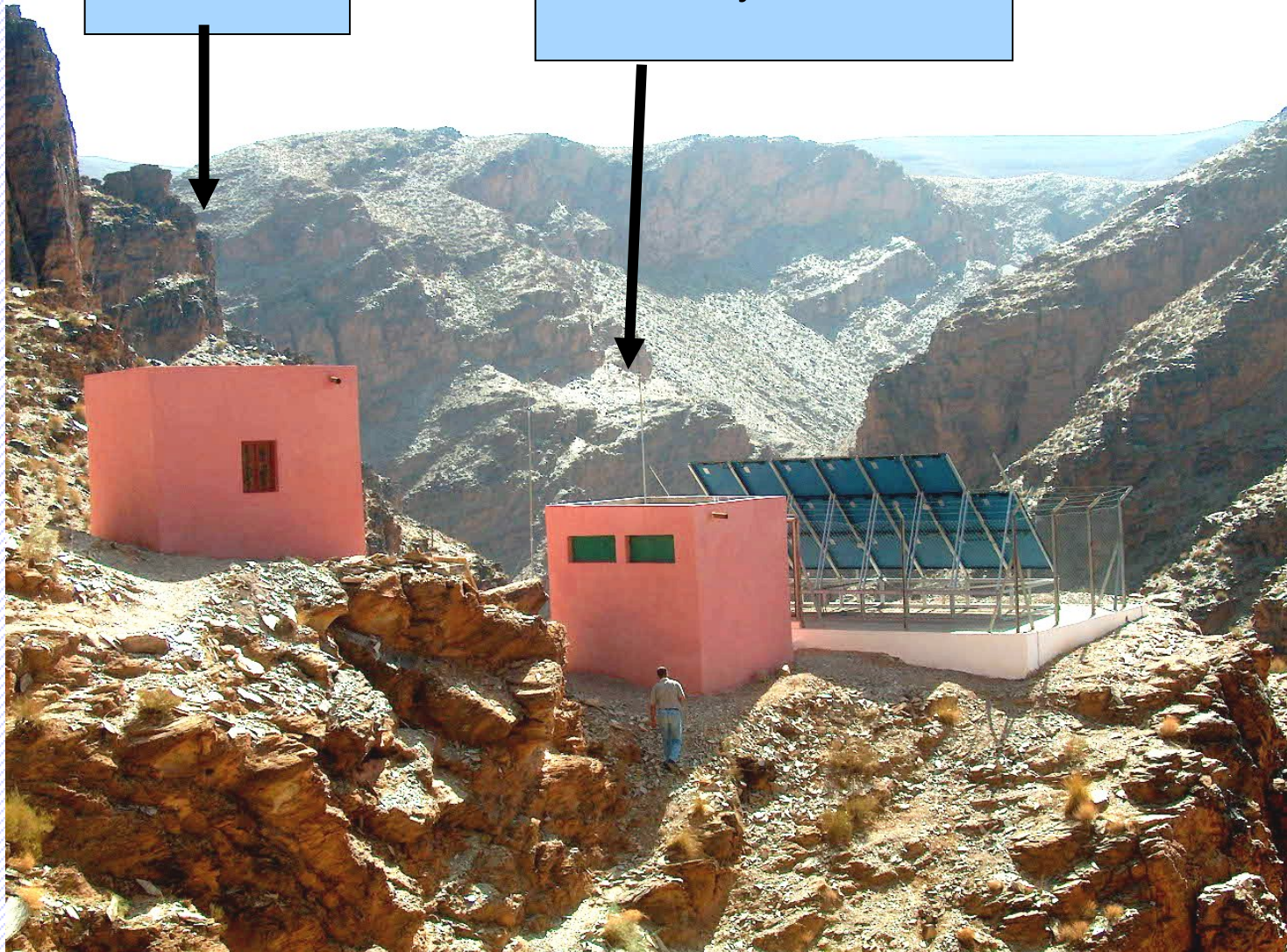


# MIDELT CTBTO STATION, SENSORS, DIGITIZER & VSAT MODEM



Guard Local

Power system Local



## IMS STATION Power Supply



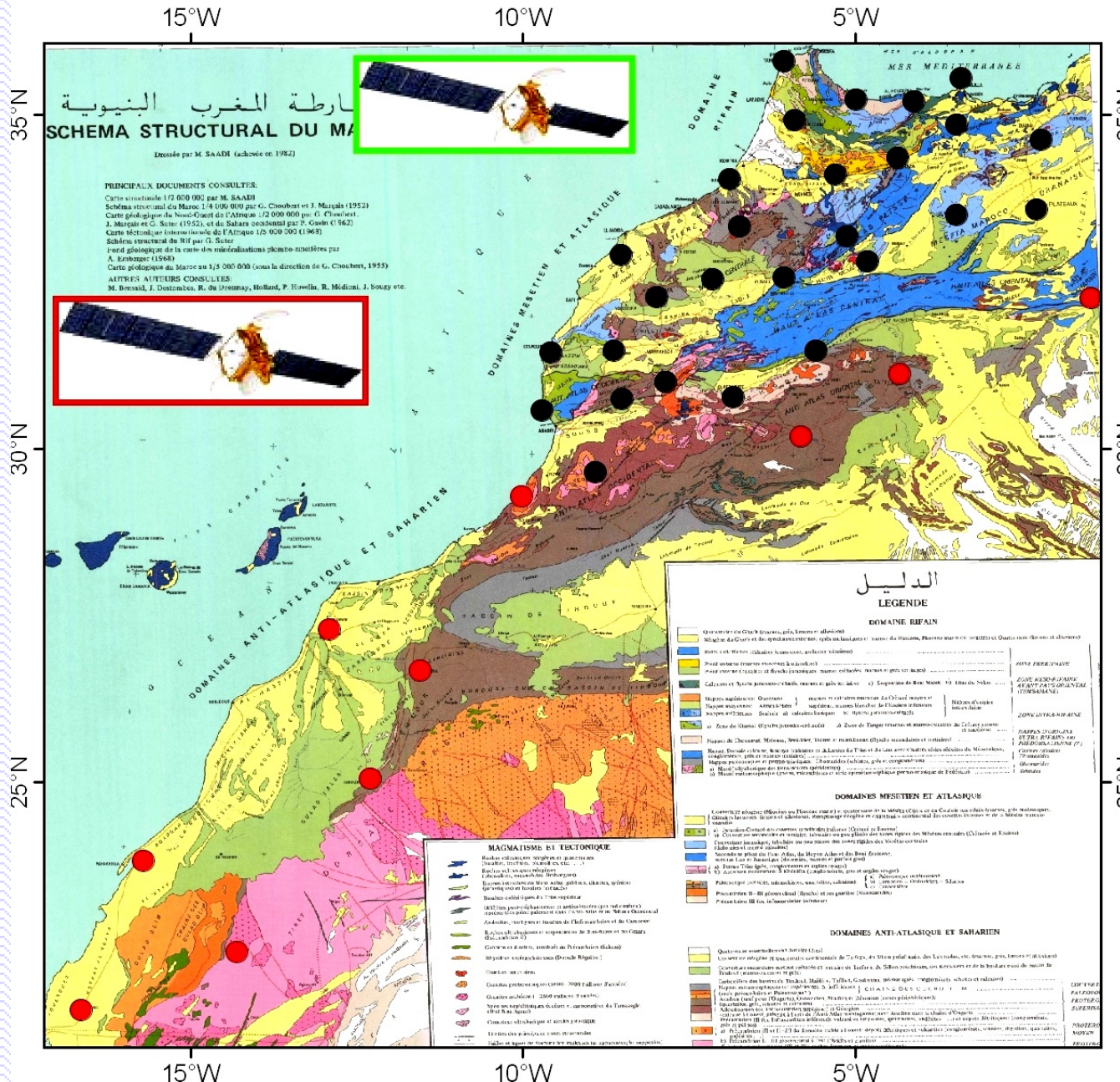
# Outlines

- Analog network
- International cooperation
- **Fully Digital Network**
- Antelope use at ING-CNRST
- Perspectives on the future

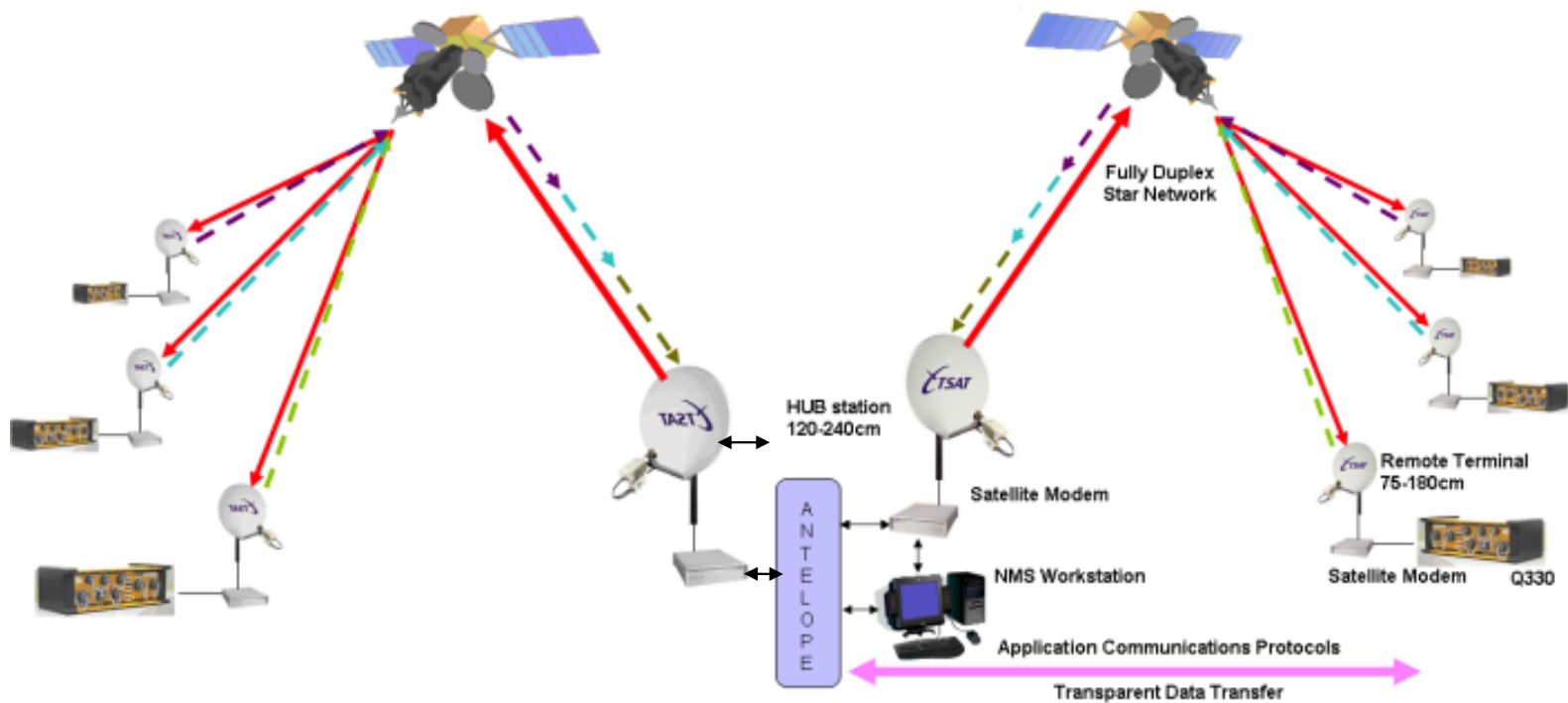
# Moroccan Seismic Network Upgrade

- **1st phase In progress :**
  - **20 BB stations;**
  - **11 SP stations;**
  - **VSAT facilities using 2 satellites & dual hub (seismic monitoring availability even in case of one satellite failure)**
  - **6-8 stations linked simultaneously by VSAT & VPN for redundancy purpose**
  - **8 stations equipped with STS-2 and Episensor**
  - **Data acquisition & processing system (antelope)**
  
- **Second Phase:**
  - **15 BB stations;**
  - **10 SP stations;**
  - **40 accelerographs;**
  - **15 Portable digital seismographs**

# Station distribution of the new telemetred seismic network (1st phase)



# Dual Hub reception, acquisition and processing system



# Present State of the VSAT Seismic Network

- Central, recording system operational since December 2008
- Since December 2008: **temporary** use of the best of the old seismic network stations ( 12) using UHF and leased line transmission, digitized at central recording system by two Q330, one VBB Station located at Rabat and 6 BB stations from the neighboring countries ( Portugal and Spain) by using Internet link.
- Since July 2009: Integration of 4 New VSAT stations ( OUK, RSA, CGR and CZD)
- At the End of February 2010: One new station ready for installation, 13 new sites yet prospected, permissions obtained and civil work underway.
- Between Mars and May, 14 sites will be prospected and the necessary permissions requested



# Moroccan Seismic Network Upgrade (Central recording System)



- 2 workstations Sun Ultra 45
- 1 Raid System;
- Dual Hub
- NMS server;
- 2 LCD screen 52' '

# OUKAIMIDEN (OUK) VSAT STATION



# New CGR Station Installation (SP)



## New CGR Station Installation (SP)



# Outlines

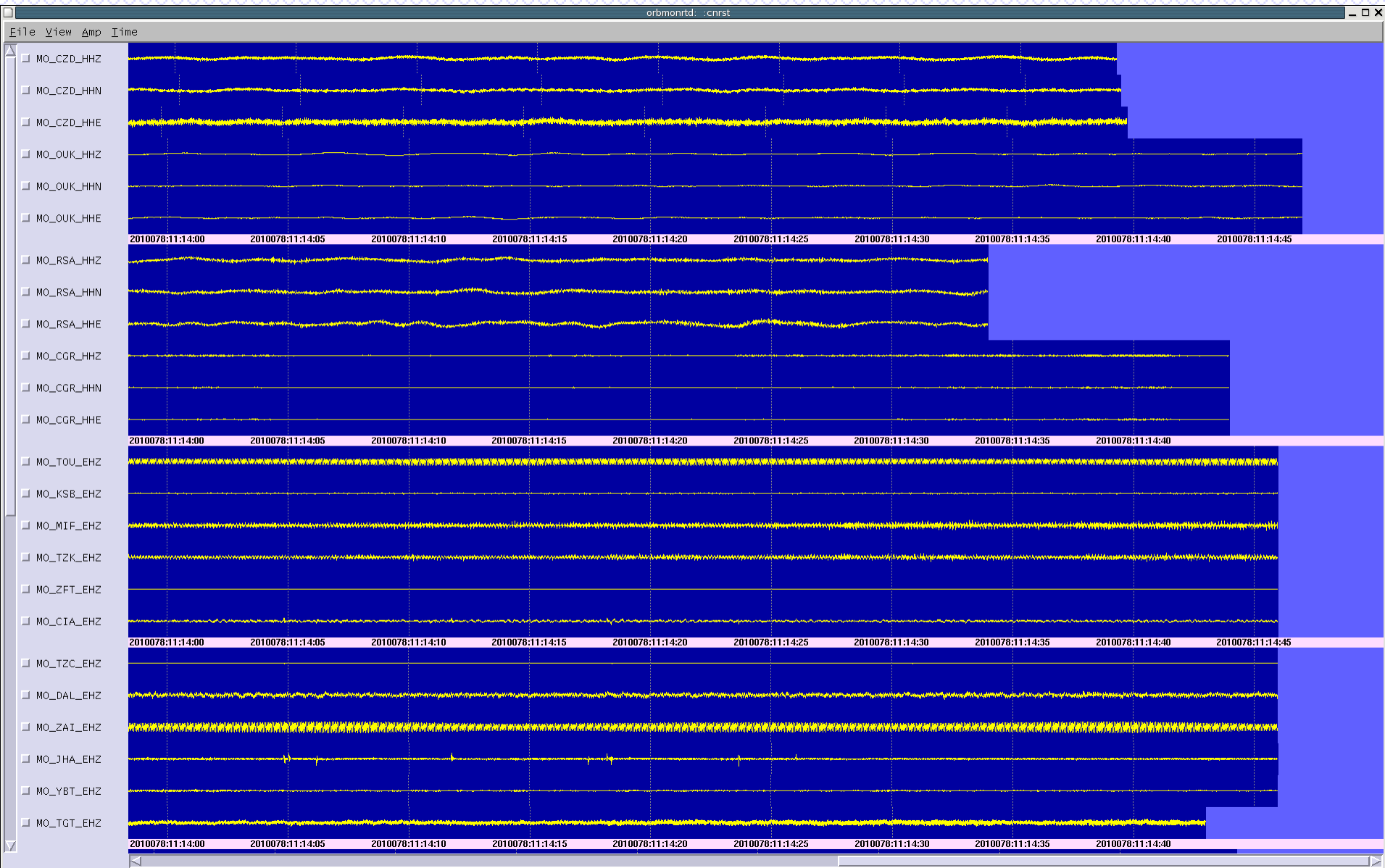
- Analog network
- International cooperation
- Fully Digital network
- **Antelope use at ING-CNRST**
- Perspectives on the future

# VSAT SEISMIC NETWORK CENTRAL RECORDING SYSTEM



# Data flow

## Digital & Analog used



# Antelope Real Time System

CNRST : Morocco Seismic Network

2010-078 10:58

File Edit View Refresh

Start System is up Load Average 1min 7.63 5min 7.85 15min 7.91 Cpu Usage (1 cpus) 585 processes Memory Usage ram swap 2048 Mb 1563 Mb Disk Usage root waveforms tmp Orb Ring Buffer Status :cnrst pkts/s 157 connections In 8.313 1000000 Out 380.926 1000000

Processing Tasks

Task	Pid	cpu	cpu	rss	rss	To Orb	From Orb	Latency
rtexec	10662	0.07	10.00	4.6	1000			
orbserver	10673	5.51	10.00	523.6	1000			
orbserver_lm	10678	0.03	10.00	108.8	1000			
orbserver_db	10680	0.00	10.00	3.1	1000			
dbidserv	10682	0.00	10.00	1.9	1000			
q3302orb	17296	0.63	10.00	10.6	1000	10.00	1000	500000
q12orb	10688	0.13	10.00	7.9	1000	10.00	1000	500000
gsn2orb	10690	0.00	10.00	2.5	1000			
geofon2orb	10695	0.03	10.00	39.1	1000			
ig2orb	12387	0.04	10.00	39.1	1000			
pm2orb	10699	0.02	10.00	27.1	1000			
orbimport	10701	0.01	10.00	2.4	1000	10.00	1000	500000
orb2db	10703	0.24	10.00	33.7	1000	10.00	1000	500000
orb2dbt	10705	0.00	10.00	7.4	1000	10.00	1000	500000
orb2dbt_auto	10707	0.00	10.00	4.3	1000	10.00	1000	500000
orbdetectP	10709	0.46	10.00	10.5	1000	10.00	1000	500000
orbdetectS	10711	0.23	10.00	4.4	1000	10.00	1000	500000
orbassoc	10713	0.18	10.00	61.7	1000	10.00	1000	500000
magnitudes	10715	0.05	10.00	39.6	1000	10.00	1000	500000
orbeqalert_em	28686	0.00	10.00	5.7	1000			

Cron Job Status patches daily\_bulletin datareport sysreport rtdbclean

Network Operation

processes ORB\_Clients ORB\_Sources ORB\_Data DB\_data Quanterra Event\_Map Grid\_local Grid\_regional

dlmon

dname	gp24	gp1	nr24	SLT	dlncy	runtm	tp	cme	bufr	nr24	dr	br24	bw24	mem	ade	cats	dlncy	lcq	cdfr	m0	m1	m2	temp	volt	amp	aamp	gps	gps	pll	lat	lon	elev
MN_RTC				09s	05s	18d00h29m17s					6.1k						18s	0.29s										3D	L	33.988	-6.857	58m
MO_CGR	0s	0s	0	14s	16s	10d06h18m41s	1.06	100%	0.0%	0	3.5k	36m	939k	0			00s	100%	-2us	20	20	20	28C	12.0V	82mA	7mA	3D	L	30.632	-9.882	120m	
MO_CZD	0s	0s	0	14s	12s	6d02h06m43s	0.98	100%	0.0%	0	5.9k	64m	1.4m	0			00s	100%	-2us	17	4	0	14C	12.2V	92mA	6mA	3D	L	33.032	-5.041	2443m	
MO_OUK	0s	0s	0	14s	21s	10d06h13m13s	1.02	100%	0.0%	0	4.2k	40m	940k	0			00s	100%	0us	7	-19	11	15C	12.2V	98mA	6mA	3D	L	31.207	-7.866	2824m	
MO_RSA	0s	0s	0	14s	06s	4d20h34m26s	1.00	100%	0.0%	0	5.7k	51m	1.1m	0			00s	100%	-2us	-6	33	-11	24C	12.0V	90mA	6mA	3D	L	34.884	-5.821	674m	
MO_RTC2	0s	0s	0	14s	02s	21h03m11s	1.00	100%	0.0%	1	18k	177m	10.0m	0			00s	100%	0us	20	20	20	23C	14.8V	71mA	6mA	3D	L	33.988	-6.857	111m	
MO_RTC3	0s	0s	0	14s	02s	13d15h28m19s	1.00	100%	0.0%	0	19k	187m	11m	0			00s	100%	0us	20	20	20	23C	13.9V	72mA	7mA	3D	L	33.988	-6.857	113m	

Antelope

Open System Solutions



# dbevents

The screenshot displays the dbevents software interface. The main window shows a world map with numerous grey circular markers representing seismic events. A legend in the bottom-left corner indicates the status and age of these events:

STATUS	LEGEND	AGE
○	- Unreviewed	- Within 1h
□	- Reviewed	- 1h to 6h

The right-hand panel contains a list of event data. The top part of the list shows a scrollable view of events with columns for time, magnitude, and station. The bottom part shows detailed metadata for a specific event:

```

2010074(03/15) 00:13:07 3.3ml
  lat = 33.7865, lon = -4.5573, depth = 12.6105
  orid = 15786, nass = 6, euid = 13469
  auth = 00_1 dbgM3, algorithm = dbseolocias
  latency = 39:24 minutes
2010074(03/15) 00:13:13 3.4ml
  lat = 32.9295, lon = -5.7497, depth = 31.8126
  orid = 15785, nass = 4, euid = 13469
  auth = 00_1 dbgM3, algorithm = dbseolocias
  latency = 2:00 minutes
2010074(03/15) 00:11:23
  lat = 35.8424, lon = -14.5181, depth = 0, 0000
  orid = 15785, nass = 4, euid = 13469
  auth = 00_1 dbg3, algorithm = dbseolociasp9
  latency = 2:47 minutes
    
```

The status bar at the bottom indicates: Status: Time: 2010078(03/19) 19:11:43 Gmt, 00:03:50 since last update, 09:40:57 since last event

# dbevents

dbevents / arts/r/system/ems/automatmo\_gui

File Maps Waveforms

Events Stations NextEvent PrevEvent NextMap QUIT

LEGEND

STATUS	AGE
○ - Unreviewed	■ - Within 1h
□ - Reviewed	■ - 1h to 6h

Status: Time: 2010078(03/19) 19:13:23 Gmt, 00:05:30 since last update, 09:42:37 since last event

2009343(12/09) 09:46:05	8 NEW
2009344(12/09) 17:24:39	6 AZOR
2009348(12/14) 02:50:12	11 SOUT
2009348(12/14) 06:41:20	8 NORT
2009349(12/15) 23:02:48	4 SOUT
2009351(12/17) 01:57:45	13 AZOR
2009351(12/17) 14:55:34	6.0mb
2009351(12/17) 20:01:37	6.9mb
2009352(12/18) 19:10:50	4.1ml
2009355(12/21) 02:45:15	5 NORT
2010003(01/03) 20:38:47	4.0ml
2010003(01/03) 22:36:33	6.3mb
2010010(01/10) 00:27:51	6.5mb
2010012(01/12) 21:53:26	7.3mb
2010015(01/15) 18:01:40	6.2mb
2010017(01/17) 09:18:20	6.2mb
2010020(01/20) 06:04:38	6.2mb
2010020(01/20) 11:03:06	6.2mb
2010021(01/21) 05:57:05	6.2mb
2010022(01/22) 00:46:45	6.2mb
2010023(01/23) 00:29:12	6.5mb
2010025(01/25) 22:52:25	6.2mb
2010027(01/27) 17:42:42	6.5mb
2010032(02/01) 22:34:10	6.5mb
2010035(02/04) 20:31:35	2.9ml
2010037(02/06) 06:20:49	3.0ml
2010037(02/06) 22:00:02	3.5ml
2010038(02/07) 03:20:14	4.0ml
2010038(02/07) 09:54:00	5.7mb
2010038(02/07) 17:09:39	3.5ml
2010038(02/07) 22:23:13	6.0mb
2010039(02/08) 19:06:45	6.1mb
2010040(02/09) 00:47:52	6.1mb
2010042(02/11) 21:55:37	6.1mb
2010044(02/13) 05:03:08	4.0ml
2010044(02/13) 20:52:18	4.9ml
2010045(02/14) 22:14:29	6.4mb
2010046(02/15) 21:55:58	6.4mb
2010049(02/18) 01:12:26	3.9ml
2010051(02/19) 00:13:11	4.1ml
2010051(02/20) 21:29:22	5.9mb
2010057(02/26) 04:42:28	6.6mb
2010058(02/27) 06:34:11	5.4mb
2010058(02/27) 08:11:55	6.4mb
2010058(02/27) 19:54:39	6.4mb
2010059(02/28) 11:25:44	6.5mb
2010060(03/01) 00:53:46	5.3ml
2010061(03/02) 22:59:47	4.6ml
2010063(03/04) 14:02:14	5.9mb
2010063(03/04) 22:39:09	6.7mb
2010064(03/05) 17:10:46	7.2mb
2010066(03/07) 15:51:13	3.3ml
2010067(03/08) 02:32:22	5.9mb
2010070(03/11) 06:21:41	6.7mb
2010073(03/14) 03:07:59	7.2mb
2010074(03/15) 00:13:07	5 MORO
2010074(03/15) 00:13:13	5 MORO
2010074(03/15) 00:13:07 3.3ml	5 MORO
lat = 33.7865, lon = -4.5573, depth = 12.6105	
orid = 15786, nass = 6, evid = 13469	
auth = %o_1 db%#3, algorithm = dbgenlocias	
latency = 39184 minutes	
2010074(03/15) 00:13:13 3.4ml	4 MORO
lat = 32.9295, lon = -5.7497, depth = 31.8126	
orid = 15785, nass = 4, evid = 13469	
auth = %o_1 db%#3, algorithm = dbgenlocias	
latency = 2100 minutes	
2010074(03/15) 00:11:23	4 AZOR
lat = 35.8424, lon = -14.5181, depth = 0.0000	
orid = 15785, nass = 4, evid = 13469	
auth = %o_1 db%#3, algorithm = dbgenlociasp9	
latency = 2147 minutes	
2010078(03/17) 04:30:25	4 AZOR
2010078(03/17) 16:49:48	4 AZOR
2010078(03/19) 09:30:45	6 LAKE

Internet Explorer

Corbeille

scn2

XPVCVKqcv

ino\_t4off

tatvfs=

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dupad64\_t

darr

mag

19:13

# dbevents

The screenshot displays the dbevents software interface. The main window is divided into a map area on the left and a data list on the right. The map shows a geographical region with several grey circles representing seismic events. A legend in the bottom-left corner explains the symbols and colors used for event status and age.

**LEGEND**

STATUS	AGE
○ - Unreviewed	■ - Within 1h
○ - Reviewed	■ - 1h to 6h

The data list on the right contains a table of seismic events with columns for ID, time, magnitude, and station. The event 2010038(02/07) 09:34:00 4.0ml is highlighted in green. Below the table, detailed parameters for this event are shown:

```

2010038(02/07) 09:34:00 4.0ml
lat = 34.8547, lon = -5.7379, depth = 28.3623
orid = 12675, nass = 10, euid = 10846
auth = $oa_1 dbgM13, algorithm = dbgenlocias
latency = 518 minutes
2010038(02/07) 09:33:56 4.0ml
lat = 34.9933, lon = -5.7022, depth = 0.5963
orid = 12674, nass = 5, euid = 10846
auth = $oa_1 dbgM13, algorithm = dbgenlocias
latency = 3112 minutes
2010038(02/07) 09:34:00 4.0ml
lat = 34.8547, lon = -5.7379, depth = 28.3623
orid = 12674, nass = 9, euid = 10846
auth = $oa_1 dbgM13, algorithm = dbgenlocias
latency = 3105 minutes
2010038(02/07) 09:34:03 4.4ml
lat = 35.0329, lon = -6.5693, depth = 21.2303
orid = 12670, nass = 4, euid = 10846
auth = $oa_1 dbgM13, algorithm = dbgenlocias
latency = 1556 minutes
2010038(02/07) 09:33:58 4.0ml
lat = 34.8476, lon = -5.7400, depth = 9.3179
orid = 12668, nass = 9, euid = 10846
auth = $oa_1 dbgM13, algorithm = dbgenlocias
    
```

The bottom status bar shows the current status: Status QAUG2010.ppt (03/19) 19:15:22 Gmt, 00:07:29 since last update, 09:44:36 since last event.

# Database & quality tests

This Computer

File Options  
 achanaux | affiliation | anetsta | arrival | assoc | calibration | changed | detection | dlsensor | emodel | event | gap | instrument | netmag | network | origerr | origin | predarr | ratechange | schanloc | sensor | sensormodel | site | sitechan | snetsta | specdisc | stage | stamag | wfdisc

mo network

net	netname	nettype	auth	ldate
II	(GSN) Global Seismograph Network (IRIS/IDA)	ww	SEED	11/22/2008 (327) 14:18:25.84350
IU	(GSN) Global Seismograph Network (IRIS/USGS)	ww	SEED	11/22/2008 (327) 14:25:09.61432
MN	MEDNET Project, Rome, Italy	ww	SEED	11/22/2008 (327) 14:25:39.96997
PM	IM	ww	SEED	11/22/2008 (327) 14:25:49.36553
MO	Morocco Seismic Network	lo	CNRST	11/22/2008 (325) 14:00:11.58201
IG	Spain Seismic Network	RE	SEED	1/01/2010 (001) 21:25:41.46439
WM	Western Mediterranean Seismic Network	WW	SEED	1/01/2010 (001) 21:25:47.75118

mo site

sta	ondate	offdate	lat	lon	elev	staname	statype
ASCN	1994274		-7.9327	-14.3601	0.1730	Butt Crater, Ascension Island	ss
CMLA	1996070		37.7637	-25.5243	0.4290	Cha de Macela, Sao Miguel Island, Azores	ss
MSKU	1999058		-1.6557	13.6116	0.3120	Masuku, Gabon	ss
PAB	1998014		39.5458	-4.3483	0.9250	San Pablo, Spain	ss
RCBR	1999060		-5.8275	-35.9014	0.4090	Riachuelo, Brazil	ss
RTC	2002203		33.9881	-6.8569	0.0500	Rabat, Morocco	ss
PESTR	2006001		38.8672	-7.5902	0.4100	Estremoz, Portugal	ss
PVAQ	2006357		37.4037	-7.7173	0.2000	Vaqueiros, Portugal	ss
TOU	2008325		34.9620	-3.7540	0.8000	Touzarine	ss
KSB	2008325		32.5760	-6.0390	0.8000	Ksiba	ss
TZK	2008325		34.0890	-4.1840	1.3000	Tazekka	ss
CZD	2008325	2009188	33.0330	-5.0430	1.0000	Col du Zad	ss
ZFT	2008325		32.0340	-4.3520	1.2000	Zeft	ss
CIA	2008325		31.5650	-8.7590	0.7000	Chichoua	ss
CEUT	2009115		35.8830	-5.3260	0.0330	Sebta Station	ss
SESP	2009118		38.1200	-2.5452	1.5280	Santiago de la Espada	ss
MIF	2009133		33.4090	-5.2290	2.0700	Michlifen	ss
AVE	2006180		33.2981	-7.4133	0.2300	ROA/UCH Station Averroes, Morocco, WM-Net	ss
IFR	2007180		33.5166	-5.1272	1.6300	ROA/UCH Station Ifrane, Morocco, WM-Net	ss
MELI	1999351	2004033	35.2899	-2.9392	0.0400	ROA/UCH/GEOPON Station Melilla, Spain, WM-Net	ss
MELI	2004033		35.2938	-2.9350	0.0050	ROA/UCH/GEOPON Station Melilla, Spain, WM-Net	ss
HORN	2009186		37.8466	-5.2582	0.2680	HORN	ss
CZD	2009189		33.0330	-5.0430	1.0000	Col du Zad	ss
OUK	2009189		31.2090	-7.8680	2.5000	Oukaimden	ss
RSA	2009253		34.8770	-5.8280	0.6500	Sar sar	ss
CGR	2009274		30.3630	-9.8880	0.2000	Cap Ghir	ss
PFVI	2008071		37.1328	-8.8268	0.1890	Vila Bispo station	ss
SACV	2000150		14.9702	-23.6085	0.3870	Santiago Island, Cape Verde	ss
SHEL	1995170		-15.9588	-5.7457	0.5370	Horse Pasture, St. Helena Island	ss
BFO	1996150		48.3319	8.3311	0.5890	Black Forest Observatory, Schiltach, Germany	ss
MBAR	1999265		-0.6019	30.7382	1.3900	Mbarara, Uganda	ss
DAL	2010064		35.9000	-5.4810	0.0200	Dalia	ss
YBT	2010064		29.8480	-9.4850	1.0200	Youssef Ben tachfine	ss
JHA	2010064		31.7360	-9.4540	1.5200	Jbel Lahdid	ss
ZAI	2010064		34.9700	-2.7460	1.0000	Zaio	ss
TZC	2010064		32.1480	-6.4900	1.2000	Tazerkount	ss
TGT	2010064		34.0700	-5.0550	0.8000	Tghat	ss

mo detection

srcid	sta	chan	time	state	filter	snr	ldate
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 8:58:39.59839	r	BW 0.8 4 3.0 4	6.9403	3/19/2010 (078) 8:59:08.02748
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 8:58:39.84839	t	BW 0.1 4 1.0 4	10.122	3/19/2010 (078) 8:59:18.01883
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:04:21.03839	r	BW 0.8 4 3.0 4	6.9342	3/19/2010 (078) 9:04:48.03931
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:04:21.28839	t	BW 0.1 4 1.0 4	7.5538	3/19/2010 (078) 9:04:58.02575
II_ASCN_BHZ_00/GENC	ASCN	BHZ_00	3/19/2010 (078) 9:04:55.26954	r	BW 0.8 4 3.0 4	5.6805	3/19/2010 (078) 9:05:25.91134
MO_TZK_EHZ/GENC	TZK	EHZ	3/19/2010 (078) 9:05:36.24839	r	BW 0.8 4 3.0 4	22.657	3/19/2010 (078) 9:05:58.03919
MO_MIF_EHZ/GENC	MIF	EHZ	3/19/2010 (078) 9:05:36.34839	t	BW 0.1 4 1.0 4	12.868	3/19/2010 (078) 9:06:08.03811
MO_CZD/MGENC/M100	CZD	MHZ	3/19/2010 (078) 9:05:15.26839	r	BW 0.8 4 3.0 4	6.8988	3/19/2010 (078) 9:06:48.03984
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:08:02.97839	r	BW 0.8 4 3.0 4	8.5572	3/19/2010 (078) 9:08:23.36198
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:08:03.80839	t	BW 0.1 4 1.0 4	11.163	3/19/2010 (078) 9:08:28.04563
MO_YBT_EHZ/GENC	YBT	EHZ	3/19/2010 (078) 9:12:43.55839	r	BW 0.8 4 3.0 4	5.8246	3/19/2010 (078) 9:13:08.02071
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:12:43.88839	t	BW 0.1 4 1.0 4	292.67	3/19/2010 (078) 9:13:08.02018
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:13:44.10839	r	BW 0.8 4 3.0 4	159.08	3/19/2010 (078) 9:13:18.04074
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:13:44.38839	t	BW 0.1 4 1.0 4	6.019	3/19/2010 (078) 9:14:08.01735
II_ASCN_BHZ_00/GENC	ASCN	BHZ_00	3/19/2010 (078) 9:17:16.61954	lp	BW 3.0 4 0 0	6.541	3/19/2010 (078) 9:17:38.01261
IG_CEUT_SHZ/SEED	CEUT	SHZ	3/19/2010 (078) 9:18:06.78000	lp	BW 3.0 4 0 0	10.028	3/19/2010 (078) 9:18:24.62956
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:18:28.05839	t	BW 0.1 4 1.0 4	5.6419	3/19/2010 (078) 9:19:08.03235
II_ASCN_BHZ_00/GENC	ASCN	BHZ_00	3/19/2010 (078) 9:18:57.11954	lp	BW 3.0 4 0 0	8.5651	3/19/2010 (078) 9:19:26.35958
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:29:01.29839	r	BW 0.8 4 3.0 4	6.0679	3/19/2010 (078) 9:29:28.01655
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:29:01.47839	t	BW 0.1 4 1.0 4	13.535	3/19/2010 (078) 9:29:38.02568
MO_ZFT_EHZ/GENC	ZFT	EHZ	3/19/2010 (078) 9:29:32.05839	r	BW 0.8 4 3.0 4	5.6788	3/19/2010 (078) 9:29:58.03375

Graph mo detection

detection | Subset: [ ]

Title: [ ]

X: time

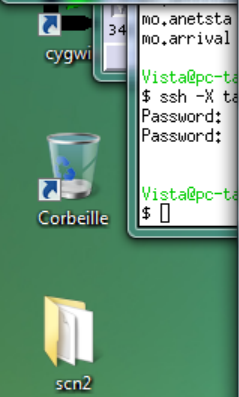
Y: snr

Plot Remove Clear Legend Postscript Done

# Moment tensor?

```
aspentwo: /export/home/tahayt/locate
User Commands          DBRMT(1)
NAME
  dbrmt - invert for regional moment tensor from a database
SYNOPSIS
  dbrmt [-v] [-p pfname] dbname orid
SUPPORT
  Contributed; NO BRTT support -- please contact author.
DESCRIPTION
  The dbrmt program computes a regional moment tensor for the
  origin specified on the command line. Much of the work is
  delegated to SAC and to Chuck Ammon's moment-tensor inver-
  sion code.
  dbrmt begins with a database which is assumed to contain:
  the origin time and parameters, picked arrivals for all sta-
  tions which are to be used, filled-in association informa-
  tion (e.g. delta, esaz) for the arrivals, correct coordi-
  nates for sites, and three-component waveforms. There must
  be a P-phase pick on the vertical channel of each station
  that will be used.
OPTIONS
  -p pfname
  Specify alternate name for the parameter file. Default
  is dbrmt.pf.
```

```
aspentwo: /export/home/tahayt/locate
Main Options  VT Options  VT Fonts
aspentwo% dbrmt
Usage: dbrmt [-v] [-p pfname] dbname orid
aspentwo% dbrmt /arts/rtsystem/db/mo 15876
2010-078 19:00:58 perl *fatal*: Can't find 'mijkennett' executable on path!
aspentwo% grep mijkennett /opt/antelope/4.11/bin/dbrmt
                eelog_notify( "Launching mijkennett to calculate moment-tensor elements\n" );
                $exp->spawn( "mijkennett" );
                $exp->expect( $mijkennett_timeout_sec, 'eof' );
@helpers = qw( sac mijkennett xtsynth gfconvert marktime tftn mtinv );
$mijkennett_timeout_sec = undef;
aspentwo% █
```



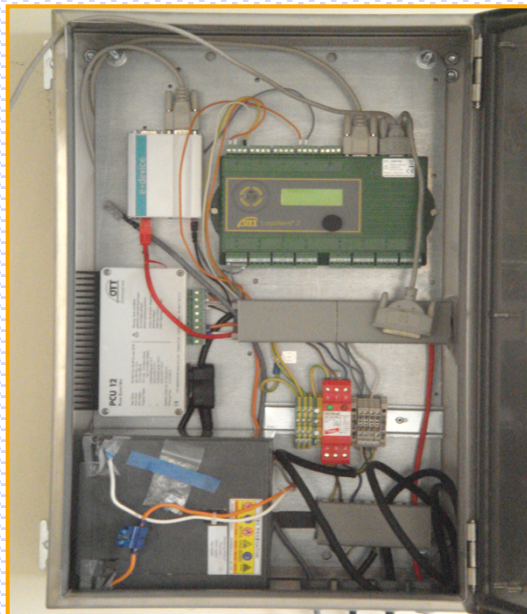
Windows taskbar and desktop icons including: cygwin, Vista@pc-ta, Corbeille, and scn2.

# Outlines

- Analog network
- International cooperation
- Fully Digital network
- Antelope use at ING-CNRST
- **Perspectives on the future**

- Merging all available data in the Antelope database (VSAT stations, Tide gages, Seismic Array, ...)
  - >> multidisciplinary studies
- Develop scripts combining GMT and Antelope
  - >> analysis and map generation
- NDC-CTBTO
  - >> global virtual network

# ING-CNRST CASABLANCA HARBOUR TIDE GAGE



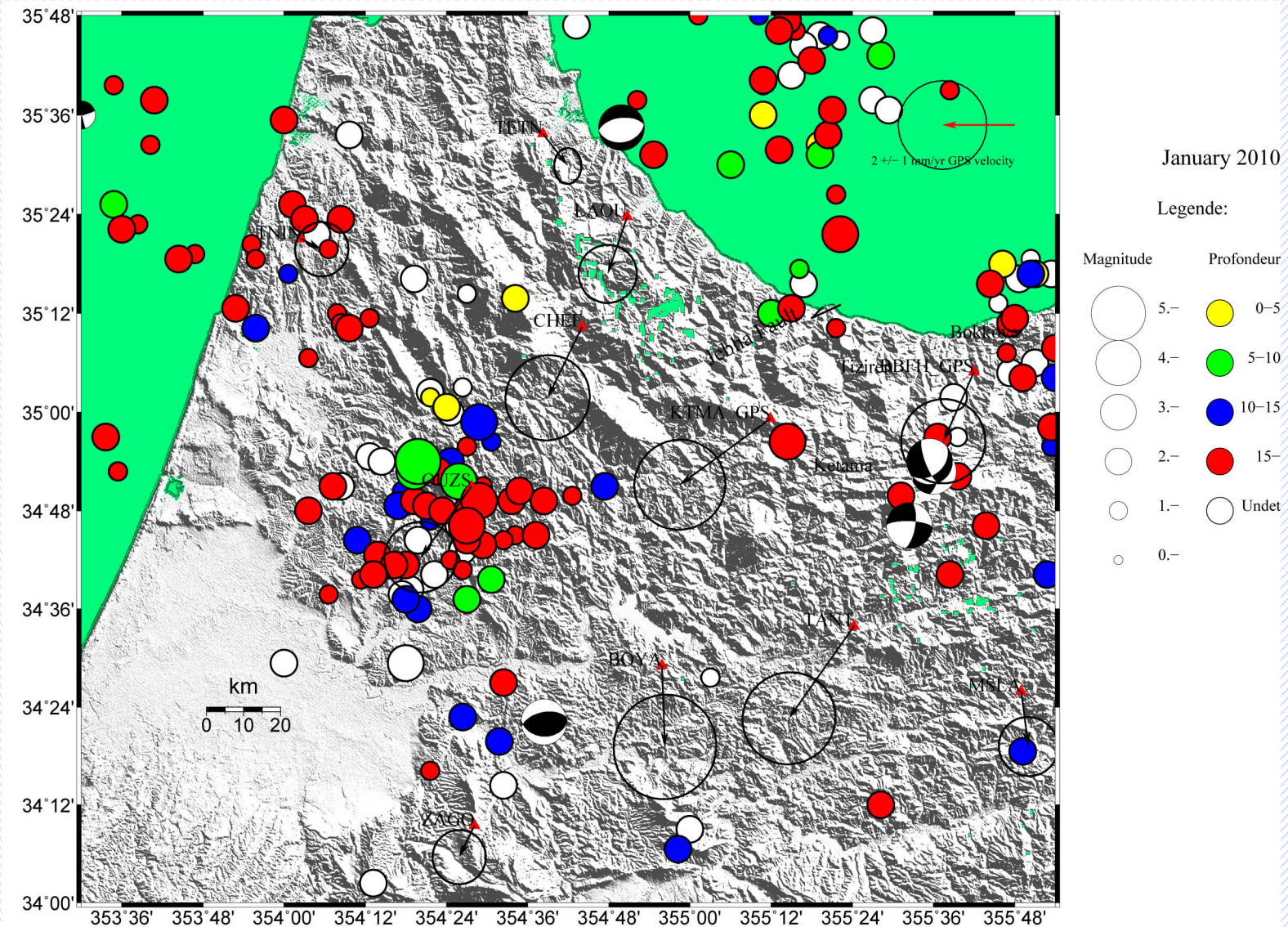


# Integration of tide gage data to Antelope database

- Cyclic reading of tide gage data (1s /2min)
- Integration of tide gage data in the Antelope database
- Real time display of the data
- Warning generation if sea level variation greater than an amount.

# HR-RT GPS

>> detect displacements in real time



*Thank you!*



*New building for ING, under construction*