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Early Warning System is needed for Earthquakes disaster mitigation in Syria
Case Study: Detecting and Monitoring the Active faulting zones along the Afro-Arabian-Syrian Rift System

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SUMMARY

It is known that many of the earthquakes that ever happened on our planet are located in active faults zones. So it is of most important to obtain detailed information on regional tectonic structures. The main approach of active faults survey at present is to use geological and geophysical methods, such as *in-situ* measuring, drilling and analysis of gravity and magnetic fields. However, because of the magnitude of the work, there are still many uncertainties that we cannot figure out by traditional approaches. Remote sensing has been brought forward for many years, and has applications in many hazard reduction domains, such as Earthquakes monitoring . Remote sensing technique has been thought as a good complementary tool to map active faults quickly at a large scale, because it can view a wide range of area at a time. Meanwhile, remote sensing images cover the spectrum from visible to microwave wavelengths of electromagnetic wave, which provides much useful information.

It is an effective method to identify active faults from different sources of remote sensing & compare the capability of some satellite sensors in active faults survey. It should discuss a few digital image processing approaches to be used for information enhancement and feature extraction related to faults.

- **Active Faults have some distinct features in satellite images.**
- **Usually, there are obvious straight lines, circular structures and other distinct patterns along the faults locations. Many works have been done to investigate active faults by using remote sensing images.**
- **Remotely sensed images Landsat MSS, TM or ETM+, SPOT XS/PAN are often used in active faults mapping.**

- **Images from those sensors have different spatial and spectral resolutions. We need to figure out which one is best suitable for our purpose.**
- **Moderate and high resolution satellite images can be the best choice, because in low resolution images, such as AVHRR with**
- **High resolution satellite (IKONOS, Quick -bird) images are very useful for precisely locating. Meanwhile, images with moderate resolution have the advantage of large scale survey.**
- **In some cases, high resolution DEM data was used with satellite images to produce 3-Dimensional representations of reality in identification of seismic faults .**
- **North West of Syria is part of one of the very active deformation belt on the Earth today. This area is located along the great rift System(Left-Lateral or African- Syrian rift System) .Those areas are tectonically active and cause time to time a lot of seismically events. This faulting zone system represent a unique structural feature in the Mediterranean area.**
- **Earthquake mitigation can be achieved with a better knowledge of a region's infra-and substructures. Basic topographic, geophysical, geological , digital elevation models(DEM) , digital terrain models (DTM) , and structural map can help to understand a region's vulnerability to seismic shocks.**

The Arabian plate is moving in a NNW direction, whereas the African plate is moving to the North. The left-lateral motion along the Dead Sea Fault Zone accommodates the difference in movement rate between both plates. Some 80 km to the North of AL-Ghab Graben both plates move into the Anatolian plate, which causes the latter to move to the West.

The analysis of TM Space Imagery and digital image processing of spectral data show that the lineaments along AL-Ghab Graben may be considered as linear Conjunctions accompanied with complex fracturing system. This complex is affected by distance stresses accompanied with intensive forces (Fig. 1).

Figure 1, Showing the area under study ,the young fault-controlled relief of AL-Ghab Graben area.

REMOTE SENSING APPLICATIONS

The AL-Ghab Graben is reflected in the intensity of neo-tectonics affecting it. Neo-tectonics is active, such as active faults. TM optical and radar data are used to image, for example, fault scarps and actively growing folds.
Visible and infrared imagery with moderate resolution is used to map lineaments, which are often surface expression of deep-seated fractures.
The Interpretation of Space Imagery TM shows that the surface expression of AL-Ghab Basin is flat plain with almost no topographic relief.
The plain is ~60 km long and ~15 km wide (Fig.2).
Faults would be expected along the western margin given a typical fault step-over arrangement for AL- Ghab Basin. To the south of AL-Ghab graben , between two strands of the Dead Sea Fault System (DSFS) is the Missyf Graben (Fig. 3).

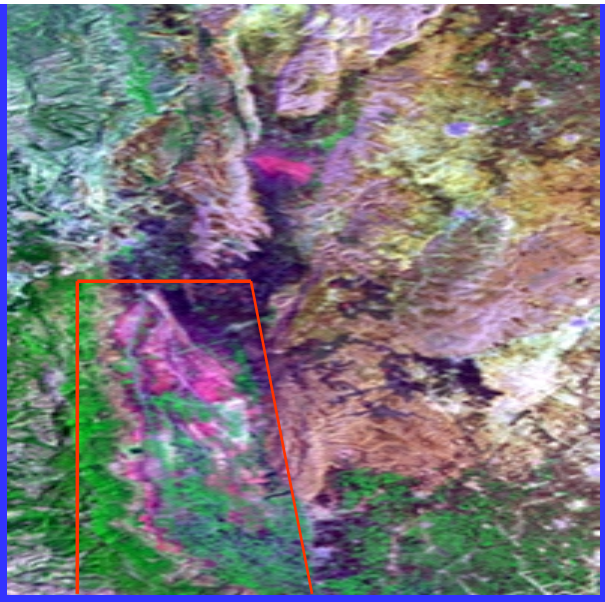

Figure 2,TM image (Colour composite) covers AL-Ghab Graben Complex

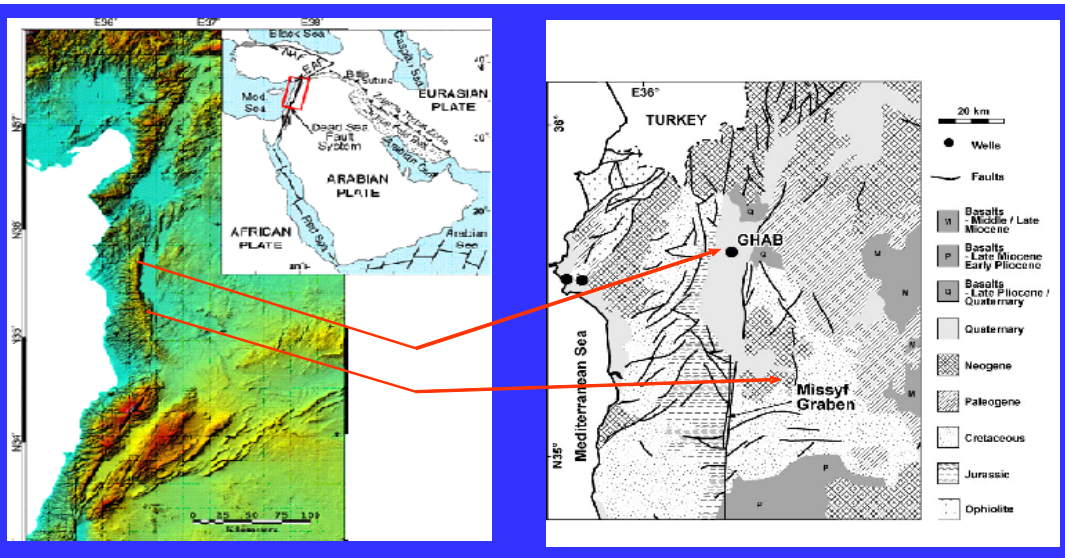

Figure 3 , Shows the AL-Ghab and Missyf Grabens and the Dead Sea Fault System (DSFS)

The Eastern fault strand can be traced northward at the surface along the eastern margin of AL- Ghab Basin before bifurcating to the north-northeast.. The basic

structure of AL-Ghab Basin is a fault-controlled double depocenter. The main depocenter is positioned beneath the southern portion of the surface plain, and slight northward migration of that depocenter with time is clear from the seismic data . Also apparent are a mid-basin ridge and a second smaller depocenter to the north.

The digital image processing of Radar imagery showing the presence of active and fresh faulting zones along the AL-Ghab Graben (Fig. 4). TM and SAR-DTM data, also showed a gradual color tone and interruptions of linear-ellipse shapes which reflecting the presence of discontinuity contours along the fault zone extension (fig.5). This features refer to abundance of surface morphological features indicate to Fresh Faults. Recent faulting is expressed as freshly exposed soil within the colluvial apron visible by its light tone color. These indicators had been proved by field checks.

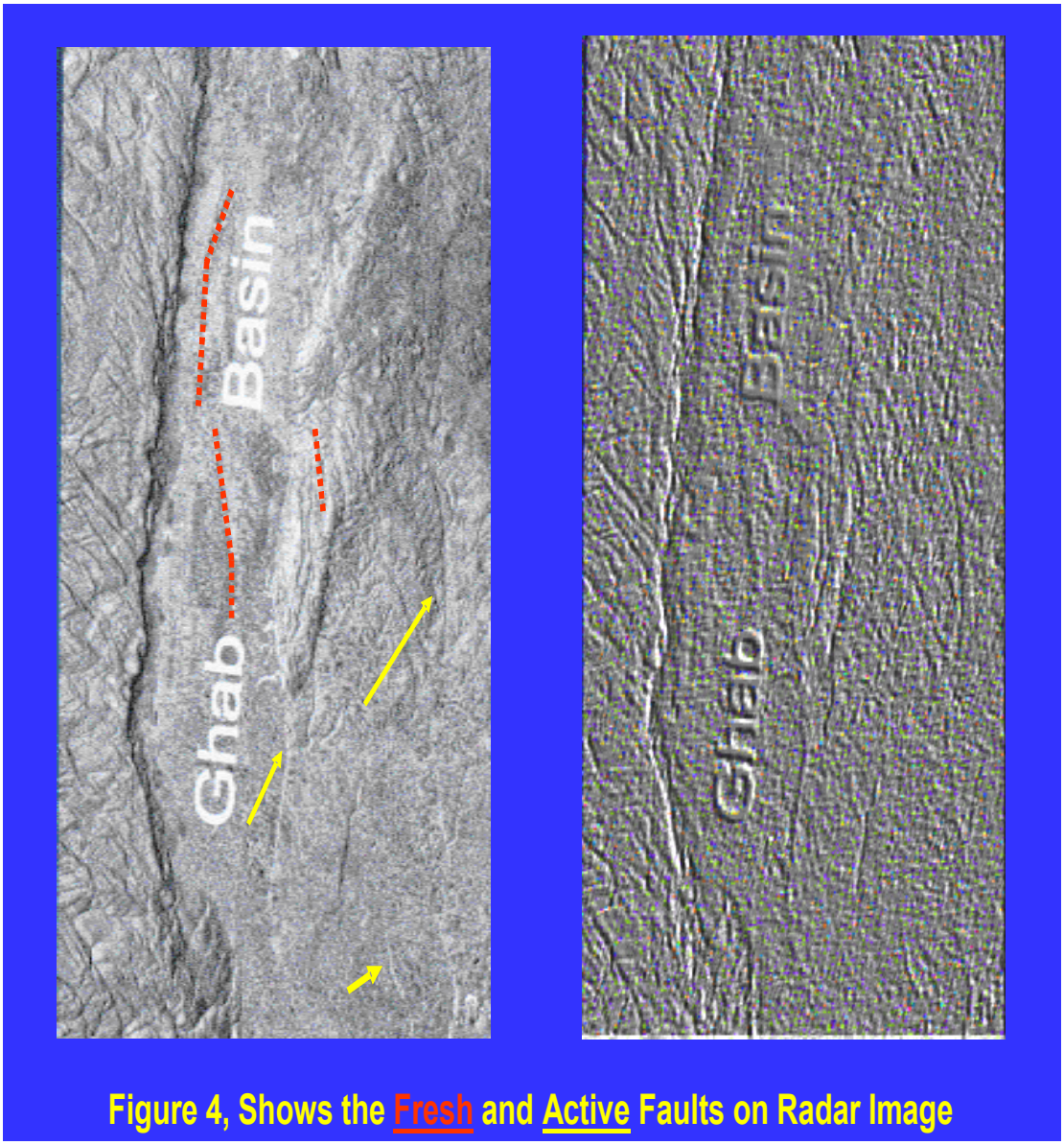

Figure 4, Shows the Fresh and Active Faults on Radar Image

The AL-Ghab graben appears capable of generating large earthquakes and it should be an essential element in any regional earthquake hazards Assessment .

CONCLUTIONS

1-The results are consistent with the observed surface faults that show a greater amount of relative motion on the eastern basin-bounding strike-slip fault.
2-Observations from AL- Ghab are echoed in theoretical models that show cross-basin oblique-slip faults accommodating initial basin opening, but most subsidence on the basin bounding faults.
3-Northward shifting depocenter, and the subsequent development of a second depocenter in AL- Ghab Basin, are due to increasing fresh faults overlap with time and step-over of the lateral motion from the eastern to the western faults.
4-The system formed, initially, as a result of the break up of the Arabian plate from the African plate since the mid-Cenozoic .
5-The tectonic evolution of Syria has been profoundly affected by movement on nearby Arabian plate boundaries.
6-This complex system in Lebanon and Syria has been the location of numerous large historical earthquakes ($M \geq 6.5$) .
7-The fault zone may still be active and capable of generating more destructive earthquakes in the future.