

FIG Working Week  
- Bridging the Gap Between Cultures  
Marrakech, Morocco  
May 18-22, 2011  
Under Patronage of His Majesty King Mohammed VI

## REGIONAL REFERENCE FRAMES: THE IAG PERSPECTIVE

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## CONTENT

1. *About the IAG*
2. *Objectives and organization of SC Regional Reference Frames*
3. *Regional incidence of activities*
4. *Global perspective*
5. *Summary*

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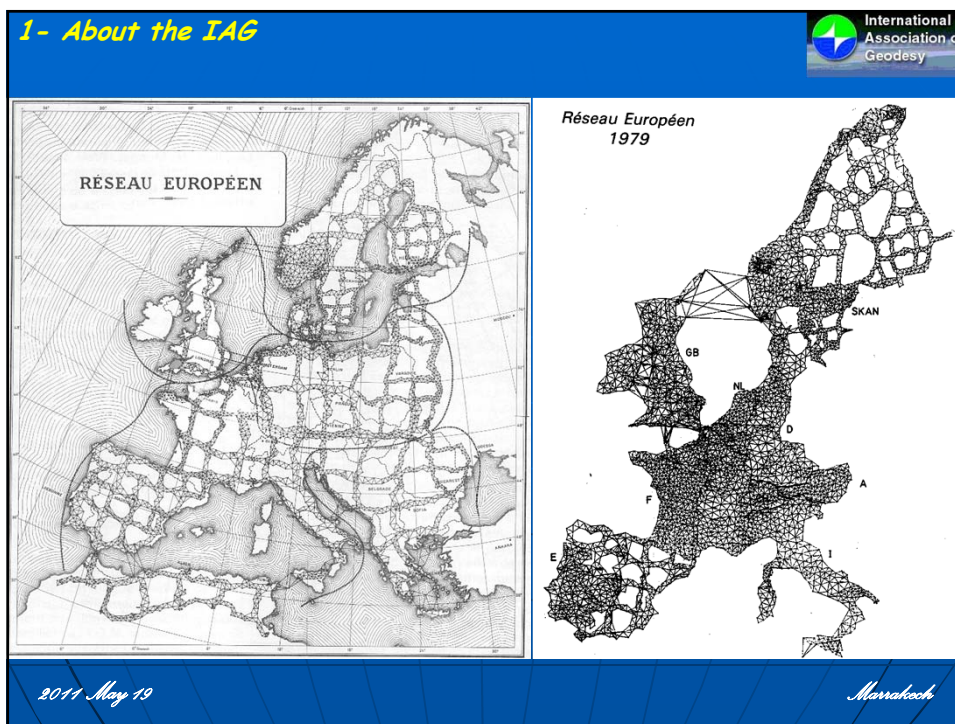
## CREATION OF THE IAG

- 1861: General Baeyer presented a report aiming at the cooperation of the central Europe states for the measurement of the Earth's shape and dimensions (*Mitteleuropäische Gradmessung*)
- 1864: 1<sup>st</sup> International Geodetic Conference at Berlin
- 1867: 2<sup>nd</sup> International Geodetic Conference (*Europäische Gradmessung*); Portugal and Spain join the organization
- 1885: end of General J.J. Baeyer's presidency
- 1887: creation of the International Association of Geodesy (*Internationale Erdmessung*) integrated by 20 states

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## THE IUGG



International Union of Geodesy and Geophysics  
Union Géodésique et Géophysique Internationale

- *Non-governmental scientific organization founded in 1919*
- *Member of the ICSU (International Council for Science)*
- *Integrates 8 Associations*

<i>IAG</i>	<i>Geodesy</i>
<i>IASPEI</i>	<i>Seismology and Physics of the Earth's Interior</i>
<i>IAVCEI</i>	<i>Volcanology and Chemistry of the Earth's Interior</i>
<i>IAGA</i>	<i>Geomagnetism and Aeronomy</i>
<i>IAMAS</i>	<i>Meteorology and Atmospheric Sciences</i>
<i>IAHS</i>	<i>Hydrological Sciences</i>
<i>IAPSO</i>	<i>Physival Sciences of the Oceans</i>
<i>IACS</i>	<i>Cryospheric Sciences</i>

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## IAG STRUCTURE

*Approved in Budapest, 2001 (IAG Scientific Assembly)*

*Ratified in Sapporo, 2003 (IUGG General Assembly)*

**Services**

**Commissions**

**Inter commission committees**

**IAG Projects**

**Communication and Outreach**

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## SERVICES

- **IERS** (*International Earth Rotation and Reference Systems Service*)
- **IGS** (*International GNSS Service*)
- **ILRS** (*International Laser Ranging Service*)
- **IVS** (*International VLBI Service for Geodesy and Astrometry*)
- **IGFS** (*International Gravity Field Service*)
- **IDS** (*International DORIS Service*)
- **BGI** (*International Gravimetric Bureau*)
- **IGES** (*International Geoid Service*)
- **ICET** (*International Centre for Earth Tides*)
- **PSMSL** (*Permanent Service for Mean Sea Level*)
- **BIPM** (*Bureau International des Poids et Mesures - time section*)
- **IBS** (*IAG Bibliographic Service*)

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## COMMISSIONS

- *Commission 1 Reference Frames*
- *Commission 2 Gravity Field*
- *Commission 3 Earth Rotation and Geodynamics*
- *Commission 4 Positioning and Applications*

## INTER COMMISSION COMMITTEES

- *Inter commission committee on Theory (ICCT)*
- *Inter commission committee on Geodetic Standards (ICGS)*
- *Inter commission committee on Planetary Geodesy (ICCPG)*

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## COMMISSION 1 – REFERENCE FRAMES SUBCOMMISSIONS

- SC1.1: Coordination of Space Techniques
- SC1.2: Global Reference Frames
- **SC1.3: Regional Reference Frames**
- SC1.4: Interaction of Celestial and Terrestrial Reference Frames

## INTER-COMMISSION STUDY GROUPS / WORKING GROUPS

- IC-SG 1: Theory, implementation and quality assessment of geodetic reference frames
- IC-SG 2: Precise orbit determination and reference frame definition
- IC-SG 3: Time series analysis
- IC-WG 1: Environment loading: modelling for reference frame and positioning applications

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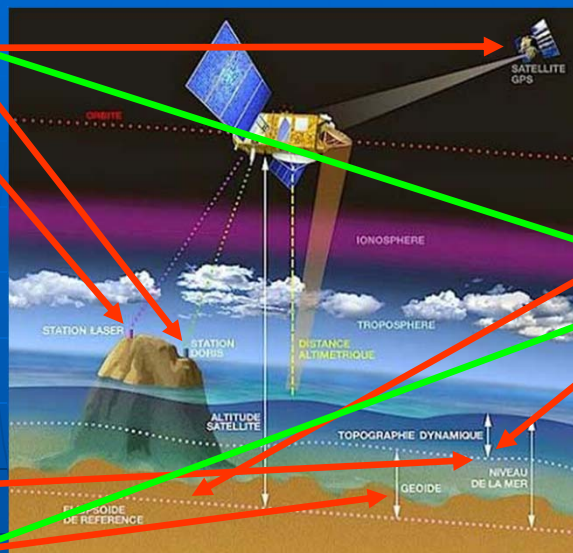
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Geodetic techniques

Earth rotation

Reference systems

Gravity field



(CNES/NASA)

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### 2- *Objectives and organization of SC 1.3*



## SUBCOMMISSION 1.3

### GENERAL PURPOSE

*SC1.3 Regional Reference Frames deals with the definitions and realizations of regional reference frames and their connection to the global International Terrestrial Reference Frame (ITRF)*

*Moreover, it offers a home for service-like activities addressing theoretical and technical key common issues of interest to regional organisations*

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## 2- Objectives and organization of SC 1.3



### SUBCOMMISSION 1.3

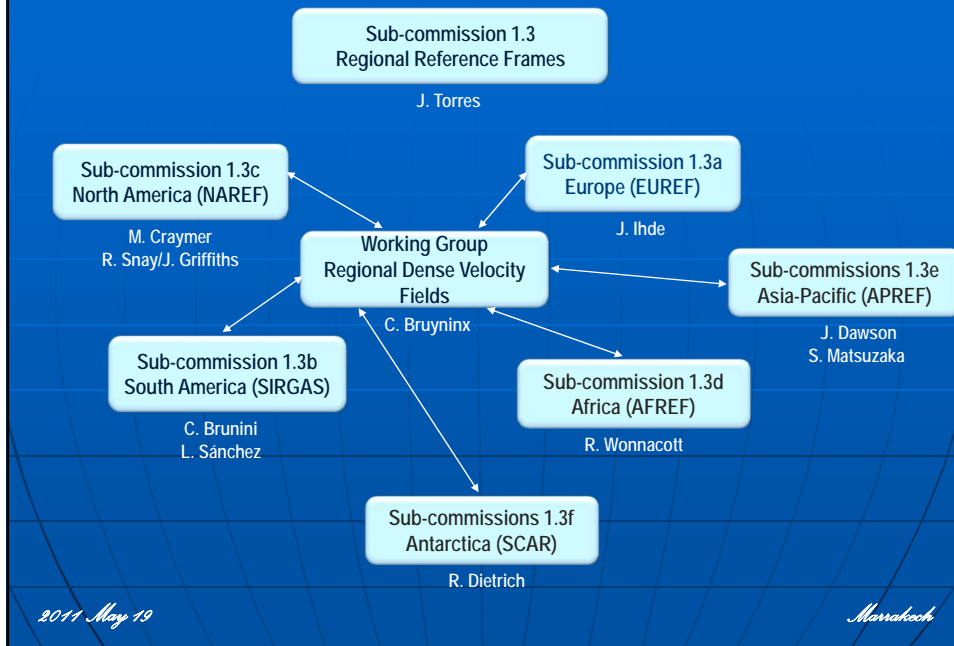
#### MAIN OBJECTIVES

- *Develop specifications for the definition and realization of regional reference frames, including the vertical component with special consideration of gravity data and other data.*
- *Coordinate activities of the regional sub-commissions focusing on exchange and share of competences and results.*
- *Develop and promote operation of GNSS permanent stations, in connection with IGS whenever appropriate, to be the basis for the long-term maintenance of regional reference frames.*
- *Promote the actions for the densification of regional velocity fields.*
- *Encourage and assist, within each regional sub-commission, countries to re-define and modernize their national geodetic systems, compatible with the ITRF.*

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## 2- Objectives and organization of SC 1.3



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2- Objectives and organization of SC 1.3



PARTICULAR ASPECTS

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2- Objectives and organization of SC 1.3



PARTICULAR ASPECTS

- EuroGeographics


EUREF




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2- Objectives and organization of SC 1.3



## PARTICULAR ASPECTS




**SIRGAS**

- Pan American Institute of Geography and History (PAIGH)


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2- Objectives and organization of SC 1.3



## PARTICULAR ASPECTS

- only 3 countries



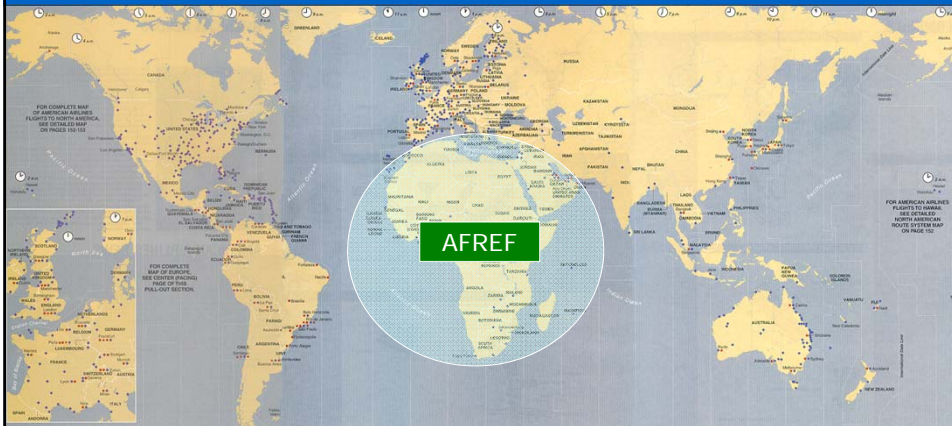
**NAREF**

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2- Objectives and organization of SC 1.3



PARTICULAR ASPECTS



- Regional Centre for Mapping of Resources for Development (RCMRD)

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2- Objectives and organization of SC 1.3



PARTICULAR ASPECTS

- 18th United Nations Regional Cartographic Conference (UNRCC)



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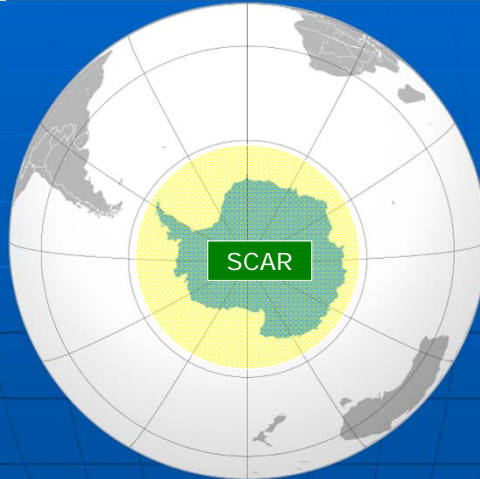
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## 2- Objectives and organization of SC 1.3



### PARTICULAR ASPECTS

- Group of Experts on Geodetic Infrastructure in Antarctica (GIANT)



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### 3- Regional incidence of activities



## EUREF

- Promotion of the **ETRS89** (European Terrestrial Reference System) and the **EVRS** (European Vertical Reference System)
- **244 GNSS stations of EPN** (European Permanent Network) operating by the end of 2010 (**59% GLONASS**)
- **49% of the stations broadcast real time data, with 3 broadcasters : BKG, ASI e ROB**

EUREF Permanent Tracking Network



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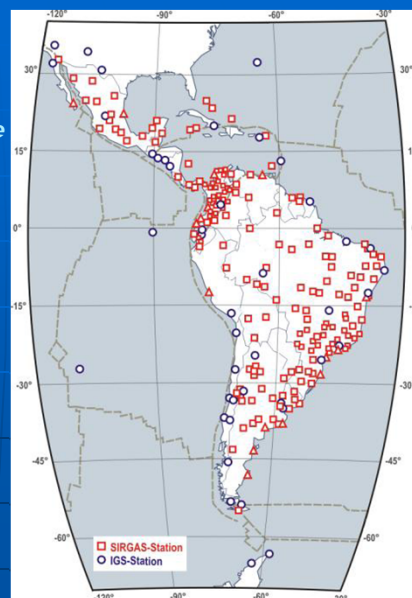
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### 3- Regional incidence of activities



## SIRGAS

- **Almost all** Central and South America countries **adopted** the reference system defined by SIRGAS
- The **SIRGAS-CON** (SIRGAS Continuously Operating Network) is composed by **270 stations (25% GLONASS)**
- Publication of a regional **velocity model (horizontal)** for coordinate update



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3- Regional incidence of activities



NAREF



- *New realization of NAD (North America Datum)*
- *Definition and maintenance of the relationships between the national and international reference systems*
- *Maintenance of the vertical datum for the management of the water system in the Great Lakes region*

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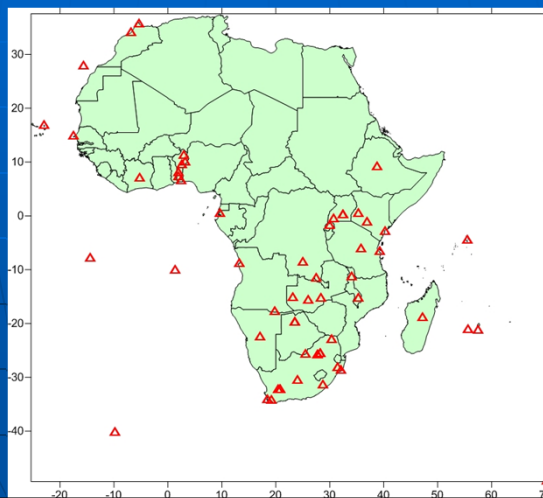
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3- Regional incidence of activities



AFREF

- *Big progress in the instalation of GNSS permanent stations*
- *Operational Data Center (since 2010) with an open policy: data from 45 GNSS permanent stations*



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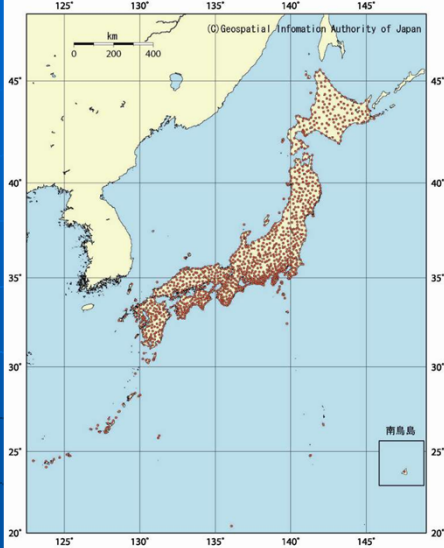
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**3- Regional incidence of activities**

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## APREF

- *Processing of GNSS observations in different analysis centers*
- *Improvement and extension of the GNSS network, as well as installation of VLBI stations*
- *Observation campaigns, including GNSS, VLBI and SLR, used also to determine velocities locally*



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**3- Regional incidence of activities**

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## SCAR

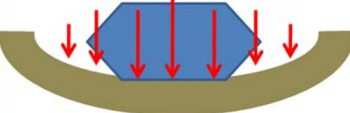
- *Regular analysis of GNSS stations data (non permanent)*
- *Active participation in the project POLENET (Polar Earth Observation Network), in the frame of the International Polar Year 2007/2008*

**Why do we need GPS stations in Antarctica ?**

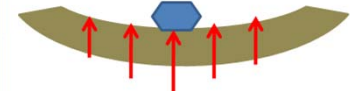


**ANTARCTICA CRUST** ↑↓ 15-30km

**ICE LOADING - 10 000 yr BP**



**ICE MELTING - Present**



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## CONTENT

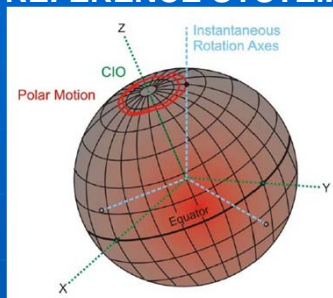
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### 4- Global perspective

## ITRS - INTERNATIONAL TERRESTRIAL REFERENCE SYSTEM



ADOPTED IN 1991 (VIENNA) BY THE IUGG

DEFINITION, REALIZATION AND PROMOTION BY  
THE IERS (successor of the BIH)

*(International Earth Rotation and Reference Systems Service)*

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#### 4- Global perspective

### ITRS

- *Origin at the Earth's centre of mass (considering the mass of the solid part, liquid part and atmosphere)*
- *Unit of length: meter (SI) consistent with TCG (Geocentric Coordinate Time)*
- *Orientation of axes consistent with the BIH definition at epoch 1984.0*
- *Non-rotation condition wrt horizontal tectonic motions*

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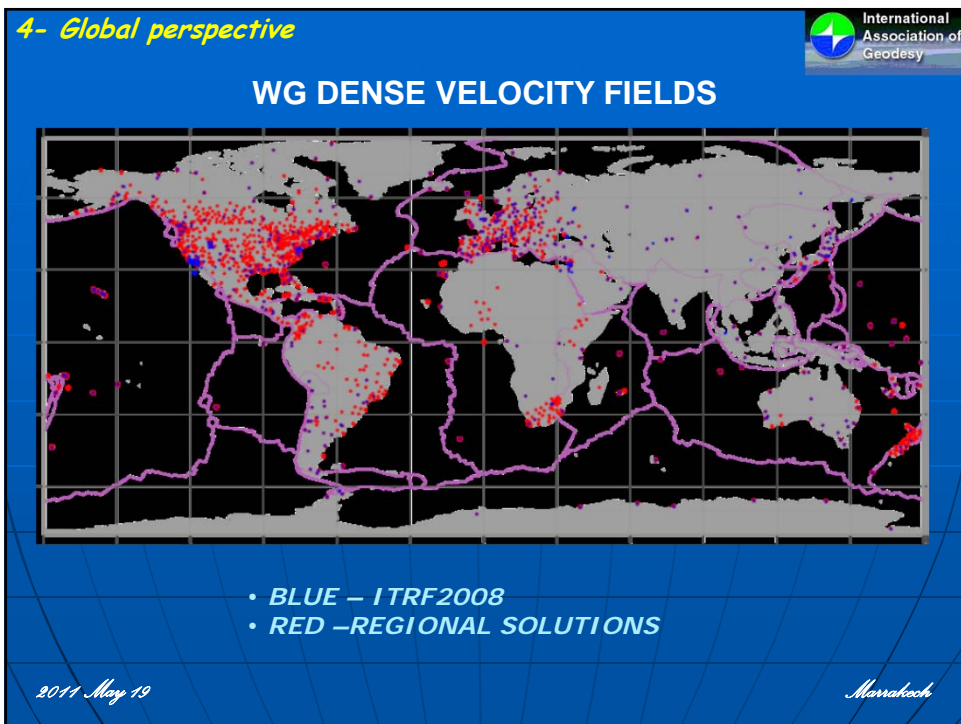
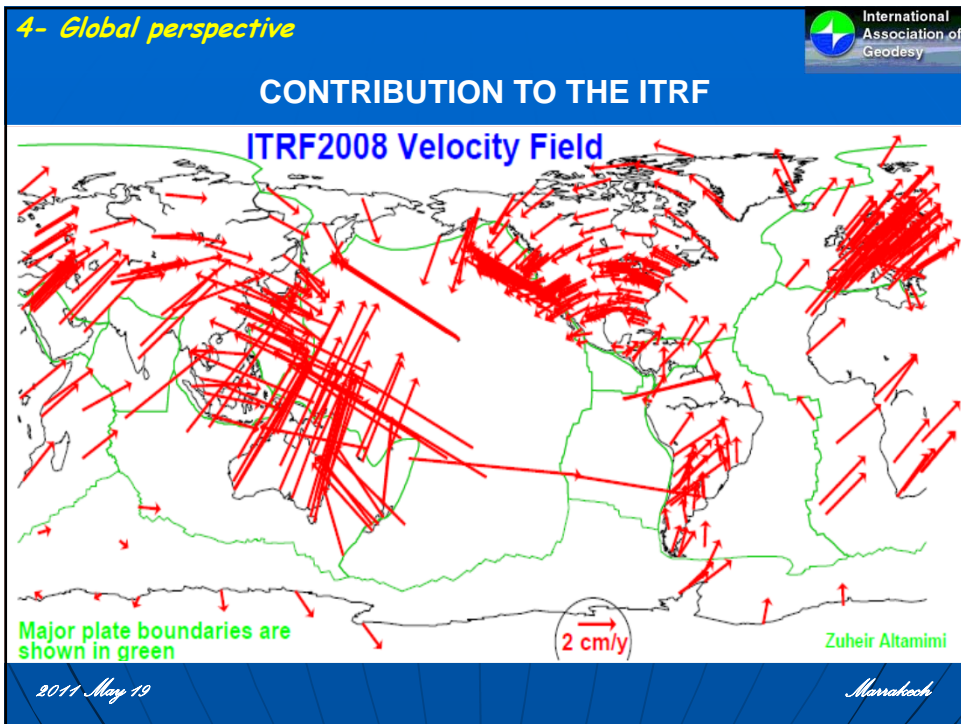
#### 4- Global perspective

### ITRF - INTERNATIONAL TERRESTRIAL REFERENCE FRAME

- *Set of geodetic references*
- *Coordinates estimation based on space geodetic techniques*
  - *VLBI (Very Long Baseline Interferometry)*
  - *SLR (Satellite Laser Ranging)*
  - *GPS (Global Positioning System)*
  - *DORIS (Doppler Orbitography Radiopositioning Integrated by Satellite)*

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4- *Global perspective*



**ACTIVE PARTICIPATION IN IAG EVENTS**

*Geodesy for Planet Earth, IAG Scientific Assembly 2009*

**SESSION 1:**

*Reference frames implementation for geoscience's applications:  
From local to global scales*

*IAG Commission 1 Symposium 2010*

*Reference Frames for Applications in Geosciences  
(REFAG2010)*

*Earth on the Edge: Science for a Sustainable Planet  
IUGG - IAG General Assembly 2011*

**Symposium G01:**

*Reference Frames from Regional to Global Scales*

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**SUMMARY**





*The close cooperation between research and  
governmental institutions is a key for the  
success of the projects*

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## SUMMARY

-  *The close cooperation between research and governmental institutions is a key for the success of the projects*
-  *There is much concern in organizing events in the educational area wrt "reference frames" topics*

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## SUMMARY

-  *The close cooperation between research and governmental institutions is a key for the success of the projects*
-  *There is much concern in organizing events in the educational area wrt "reference frames" topics*
-  *The organizational aspects play a more and more decisive role in the overall performance of the regional structures*

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## CONCLUSIONS

-  *The close cooperation between research and governmental institutions is a key for the success of the projects*
-  *There is much concern in organizing events in the educational area wrt "reference frames" topics*
-  *The organizational aspects play a more and more decisive role in the overall performance of the regional structures*
-  *The activities of the regional SC and the WG contribute to and benefit from the global perspective of the IAG*

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