

Contributos da Geodesia no mundo atual

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Geodesia

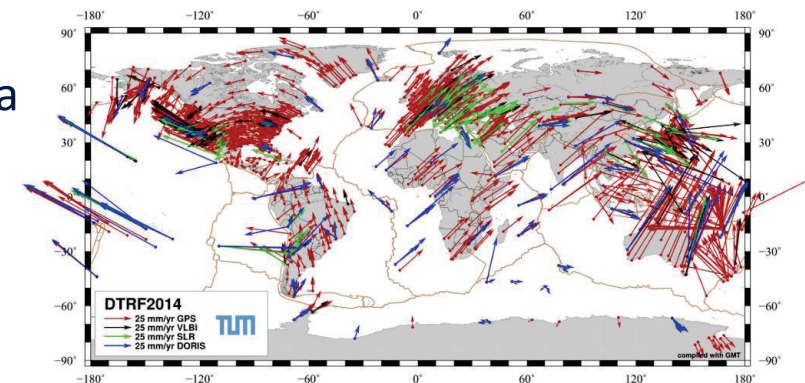
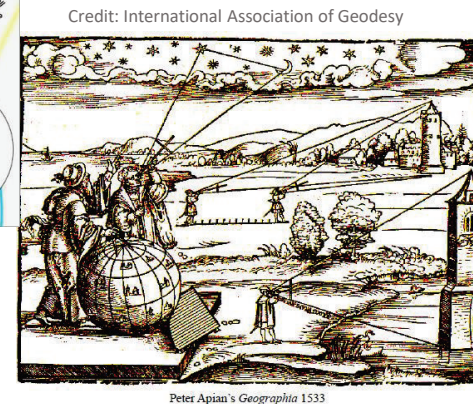
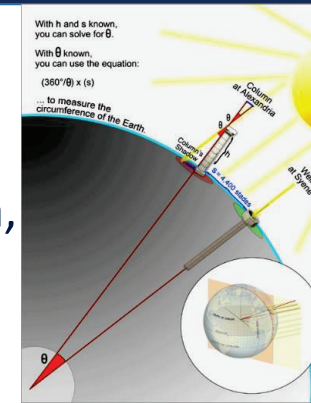
- Uma ciência muito antiga

- Uma das mais antigas Ciências da Terra. Estuda a forma, dimensões, rotação e campo gravitacional da Terra e determina posições de pontos/objetos sobre a superfície da Terra ou próximo

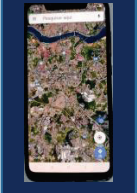
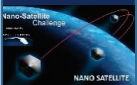
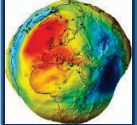
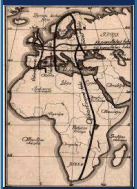
- Cada vez mais moderna

- A geodesia é particularmente relevante hoje em dia porque podemos medir movimentos com elevadíssima precisão - e tudo no planeta se move.

“Everything flows”



<https://www.dgfi.tum.de/en/research/reference-systems/determination-of-reference-frames/global-terrestrial-reference-frames/dtrf2014-en/>



A Geodesia: é o suporte para sabermos “onde”

- A Geodesia constitui um alicerce para apoio ao posicionamento, mapeamento e navegação
- A Geodesia estuda a forma, orientação e posições da Terra no passado e no presente e no futuro. A Geodesia permite saber:
 - **Onde** estão as coisas no presente
 - **Onde** estavam antes
 - **Quanto e para onde** se deslocam
- Toda a Geomática se apoia na Geodesia como estrutura de apoio aos levantamentos, mapeamento e navegação.

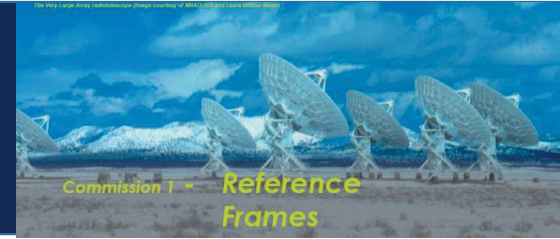
“Não podemos saber por onde vamos, se não soubermos onde estamos”

Mapeamento da superfície Terrestre

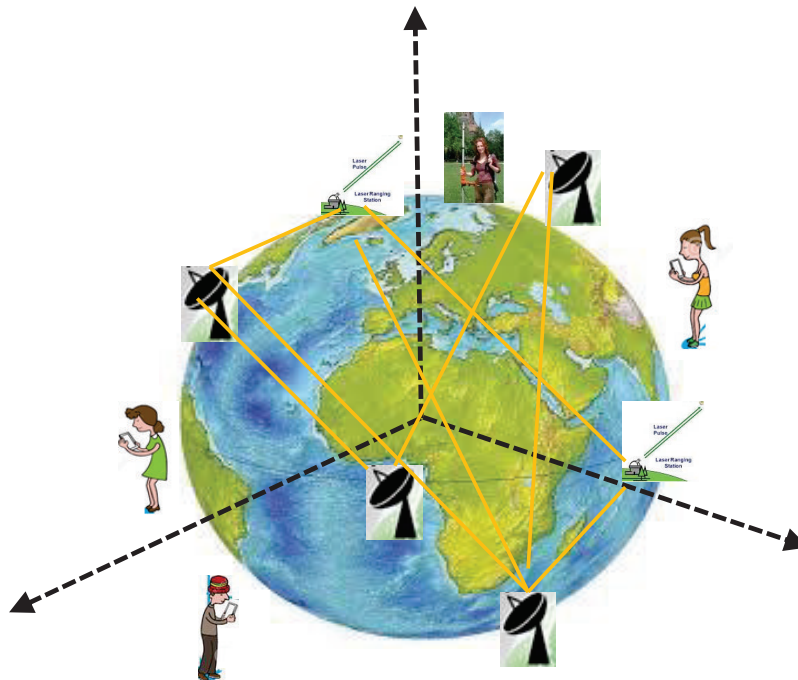
- O conhecimento da forma exata da Terra permite-nos construir mapas precisos para a sua representação.
- O conhecimento do campo gravitacional é também necessário porque a gravitação afeta quase tudo no nosso dia a dia. Da marcha dos relógios ao movimento de placas tectónicas, das marés dos oceanos à circulação atmosférica.
- O conhecimento do campo gravitacional da Terra permite-nos perceber melhor a dinâmica global do planeta.



Sistemas de referência



- Um dos objetivos da Geodesia é a determinação de posições na superfície terrestre
- Precisamos de um Sistema de Referência e de uma Superfície de Referência (TRS e Geóide)

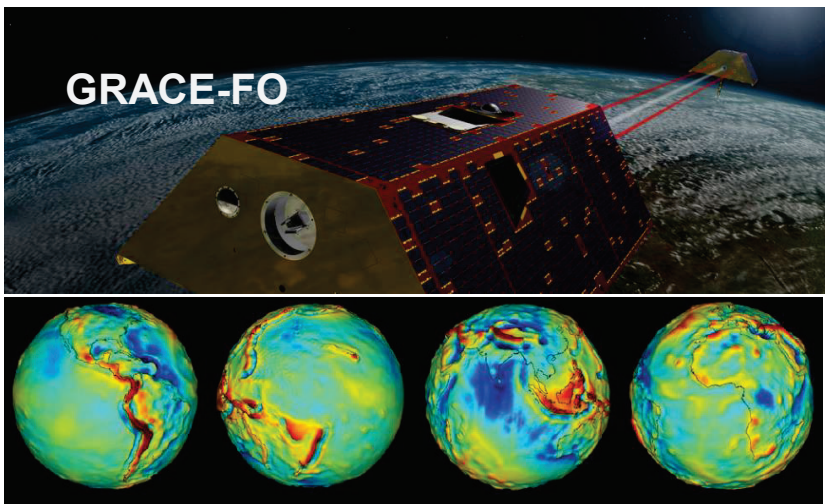


A generalização do uso dos sistemas **GNSS** à escala planetária, tem mostrado a importância de um Sistema de Referência, preciso e único, também nas aplicações usadas pelo cidadão comum (ex. navegação automóvel)

- Não podemos estimar pequenos movimentos sem definir posições precisas

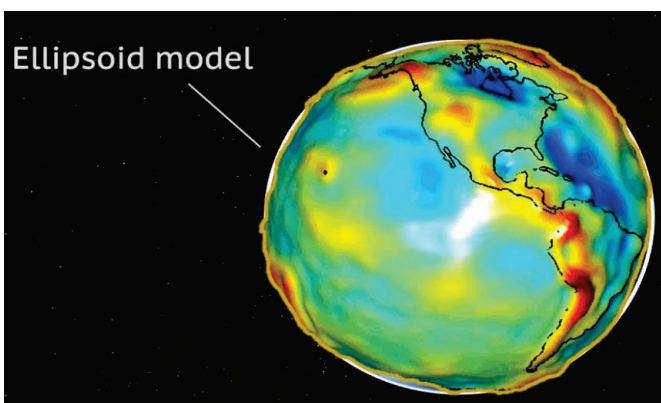
Superfícies de referência

GRACE-FO

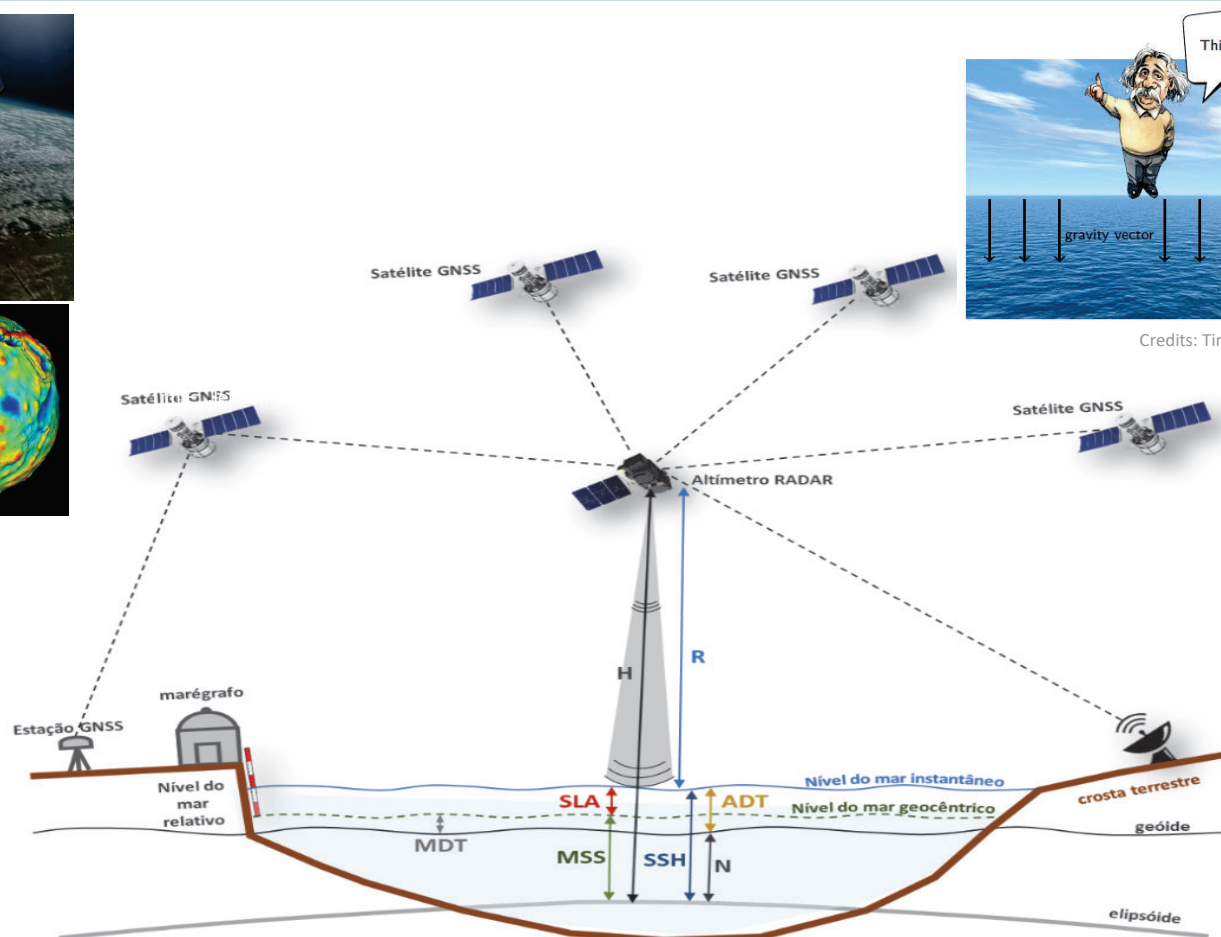


<https://gracefo.jpl.nasa.gov/resources/70/grace-fo-launch-press-kit/>

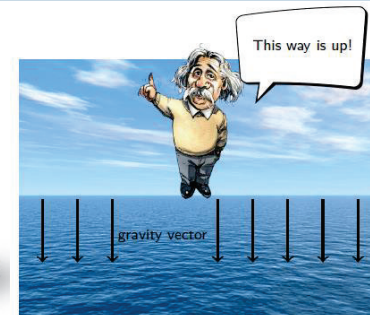
Ellipsoid model



https://www.ngs.noaa.gov/corbin/class_description/NGS_Datums_video_2c/NGS_Datums_video_2c.mp4

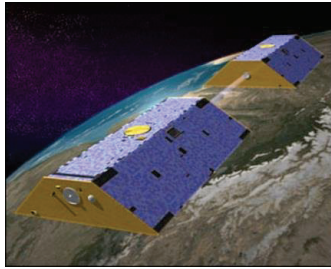


Credits: Clara Lázaro



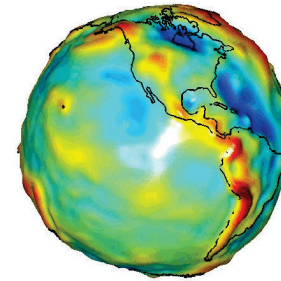
Credits: Tim E. Jensen

Gravimetry



GRACE/GOCE/Satellite Altimetry

Long Wavelengths
(≥ 250 km)

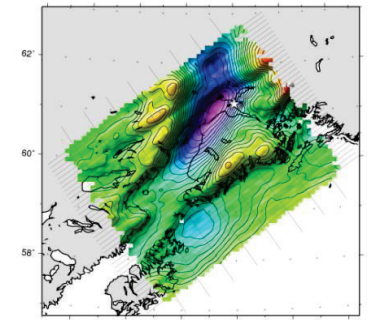


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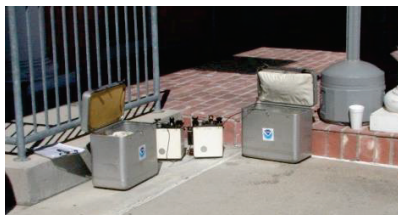


Airborne Measurement

Intermediate Wavelengths
(500 km to 20 km)

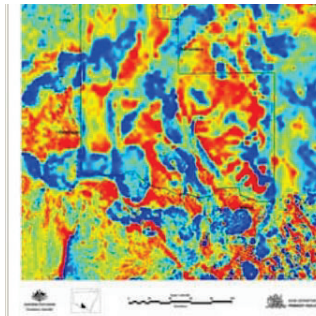


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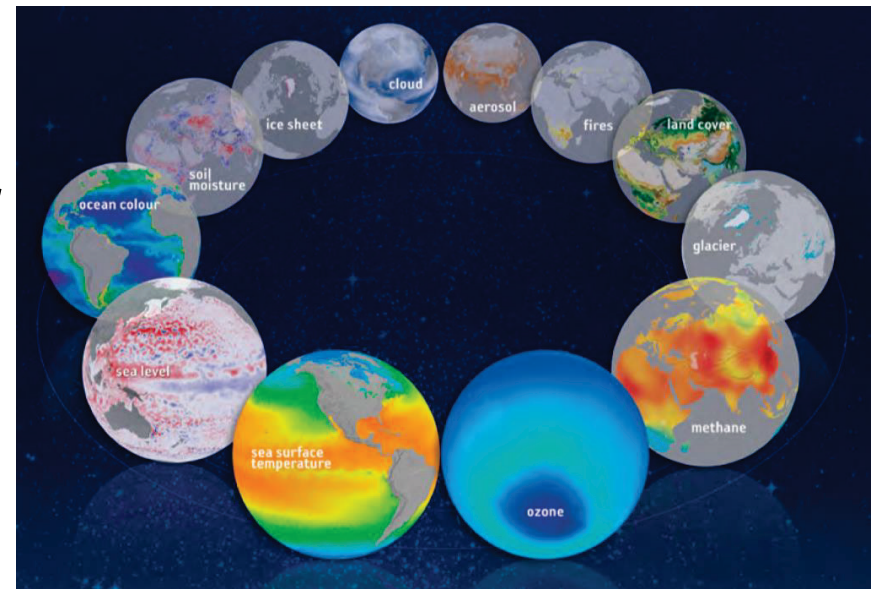


Surface Measurement

Short Wavelengths
(< 100 km)



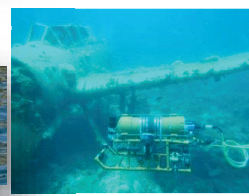
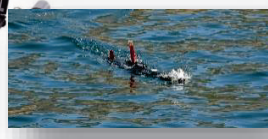
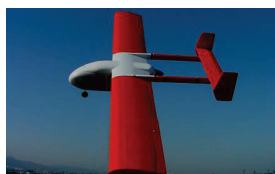
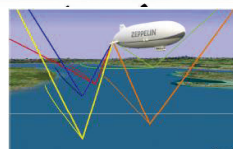
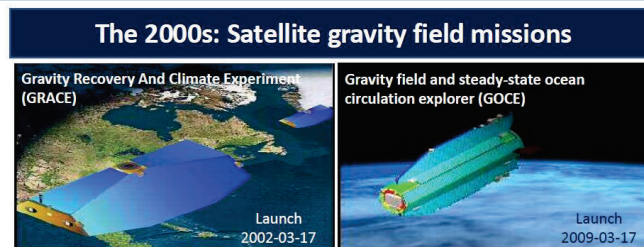
Credit: Youngman et al (NGS)



The top portion of the image features a blue and white illustration of a satellite in orbit around a stylized Earth. The text "Nano-Satellite Challenge" is written in a white, sans-serif font across the top. Below the satellite, the text "NANO SATELLITE" is displayed in a bold, white, sans-serif font. The bottom portion of the image shows a smartphone screen displaying a map application. The map shows a detailed view of a city area with green spaces and buildings. The smartphone is held in a hand, and the background is a solid dark blue.

Diferentes métodos plataformas e escalas de observação

Explorar sinergias entre dados espaciais, aéreos e *in-situ*



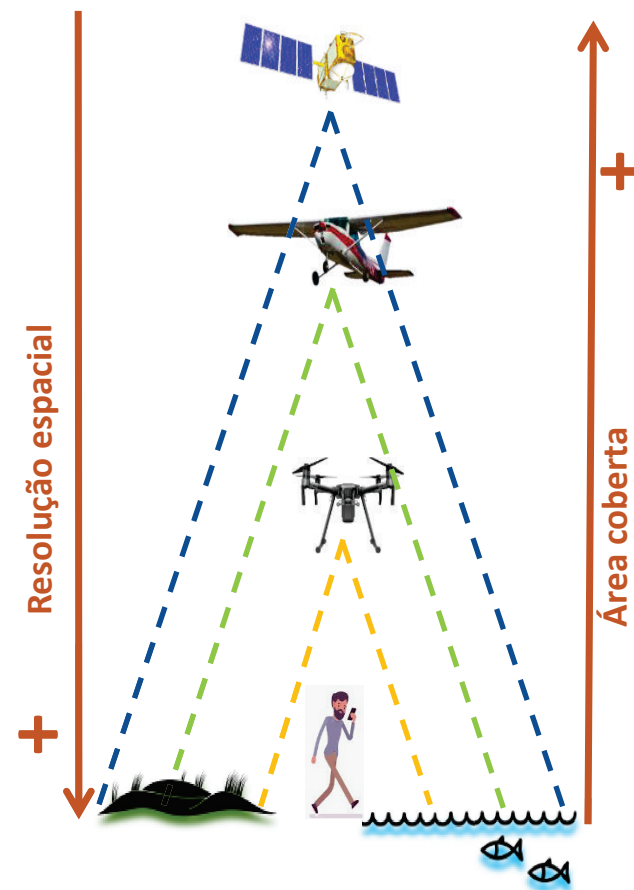
➤ **Satélite**

➤ **Aeronave**

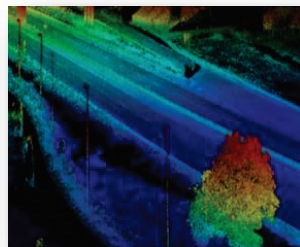
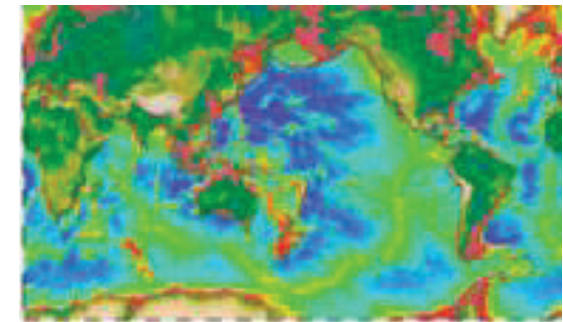
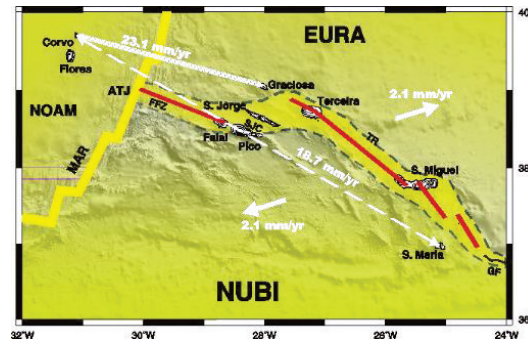
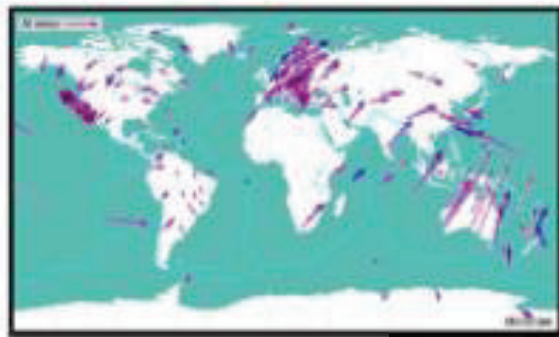
➤ **UAV**

➤ **Plataformas Terrestres**

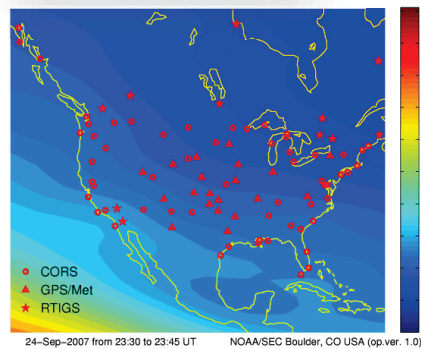
➤ **Plataformas Marítimas**



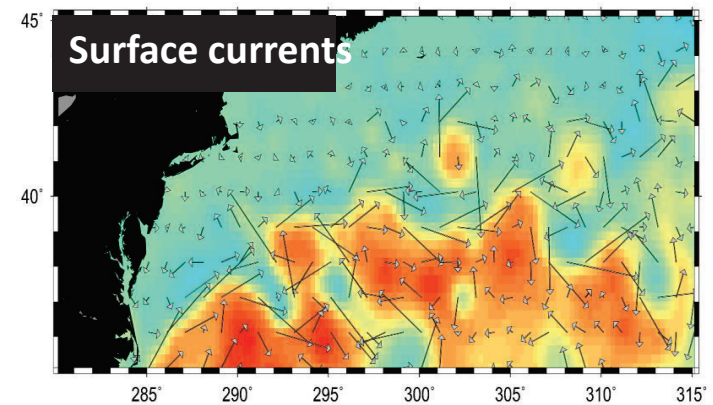
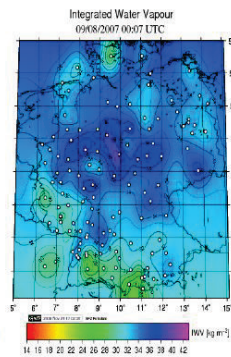
Muitos campos de aplicação no mundo actual



Total Electron Content Units $\times 10^{16} \text{ m}^{-2}$

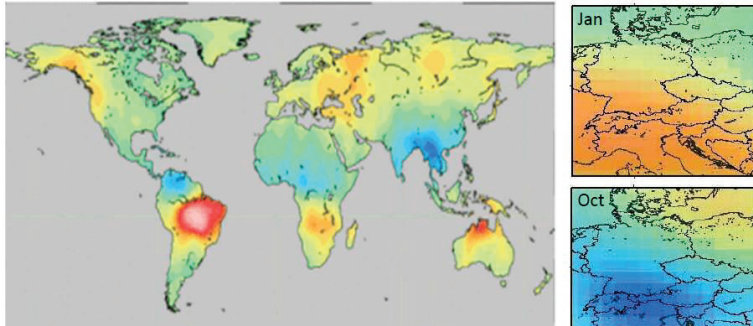


Water vapor information
in near-real time, operational
use in weather forecast

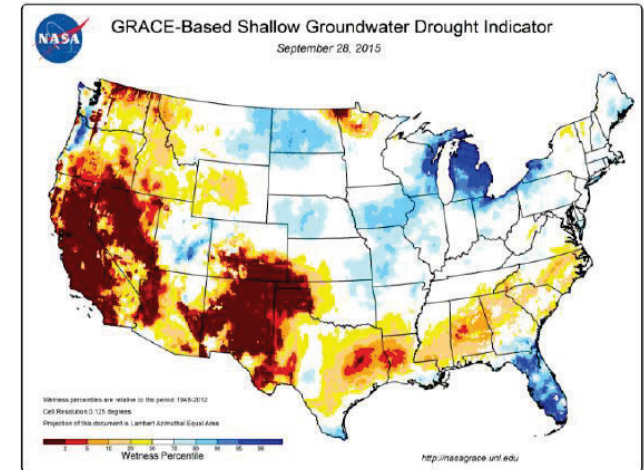
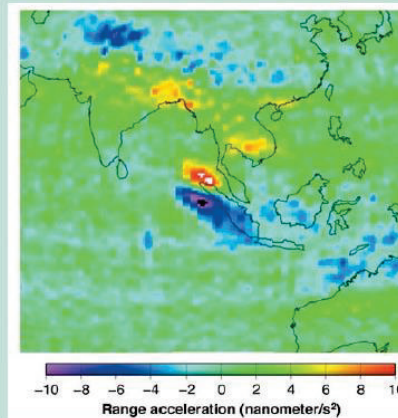


Muitos campos de aplicação no mundo actual

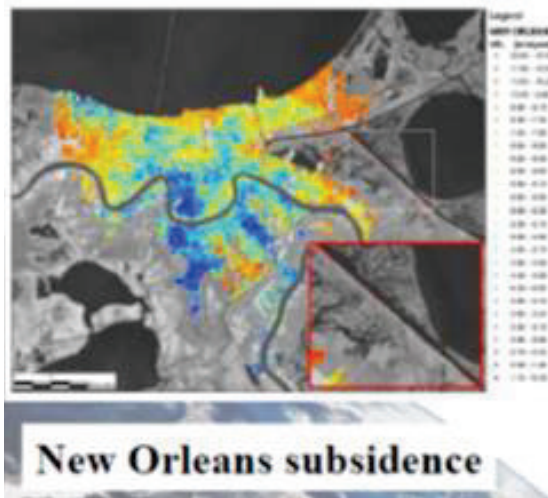
Results: Seasonal gravity changes generated by hydrological variations in the watersheds of the main river-systems



The effect of the Sumatra earthquake on gravity recovered from GRACE observations (NASA/JPL).

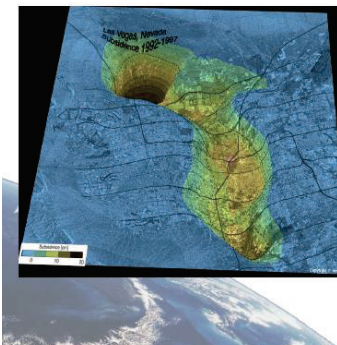


U.S. map, groundwater drought indicator
Image credit: NDMC

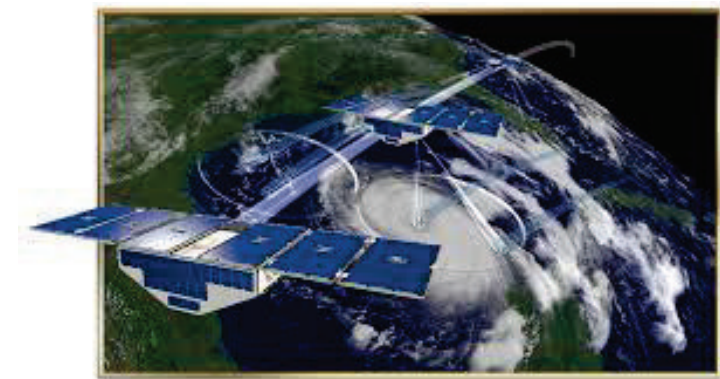
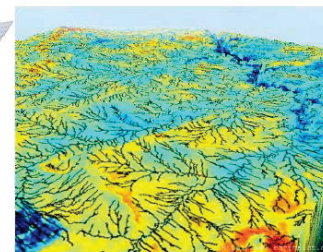


Credit: CSR- UTAustin

**Aquifer system deformation
(Las Vegas)**



Soil moisture



CYGNSS Satellite Constellation (<http://www.nasa.gov/cygnss/>)

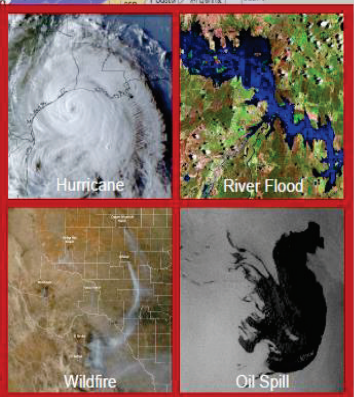
Muitos campos de aplicação no mundo actual

 **Center for Space Research**
The University of Texas at Austin

The UT Center for Space Research serves as a member of the Governor's Emergency Management Council and works in the State Operations Center with 32 state agencies and 8 federal agencies in response to major disasters.

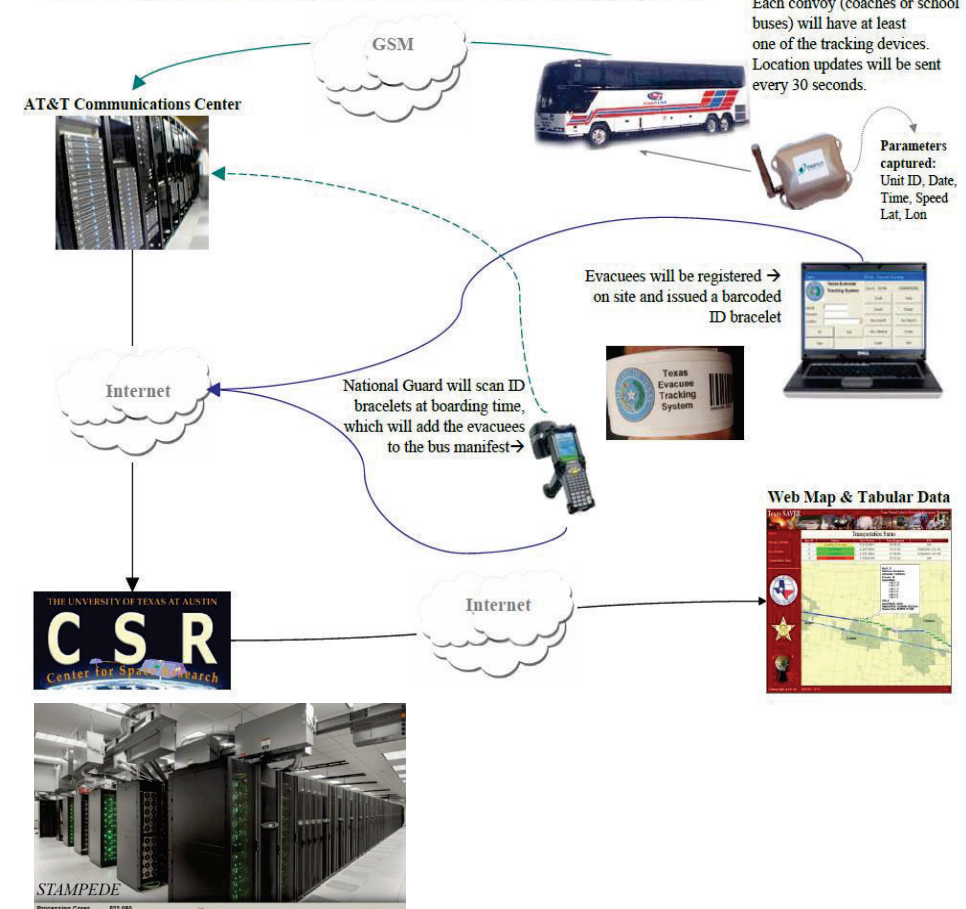
 SOC Command Cell, Governor's Conference Room

 Texas State Operations Center

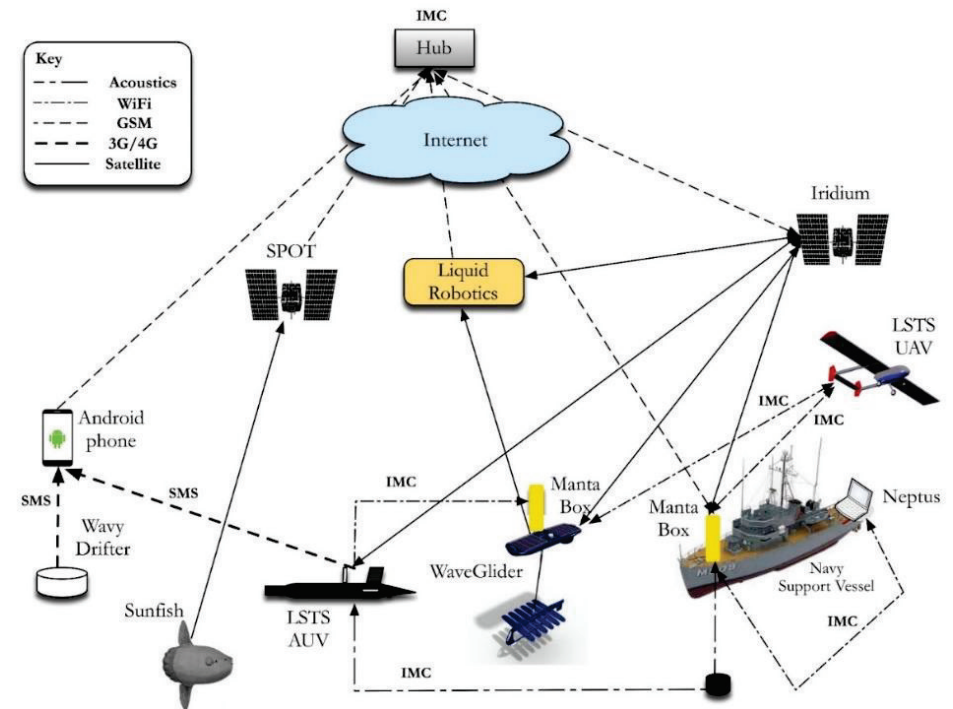
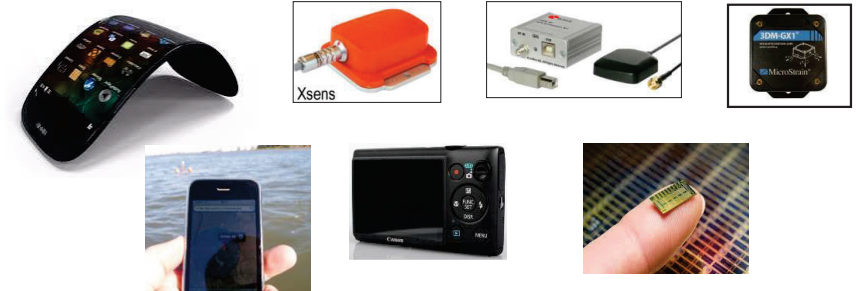
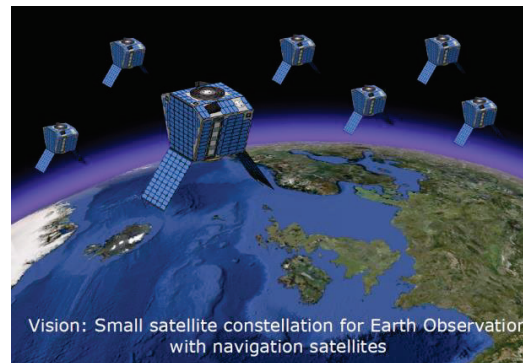
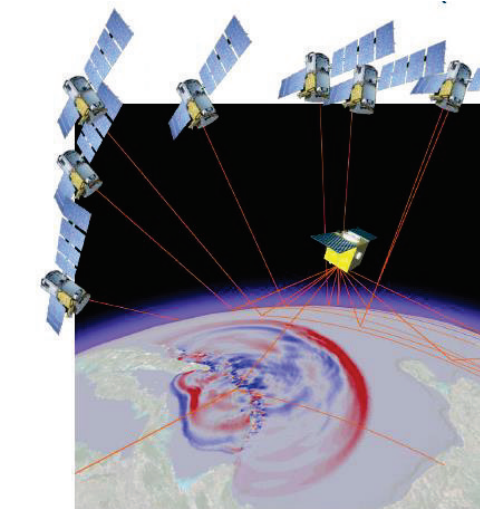
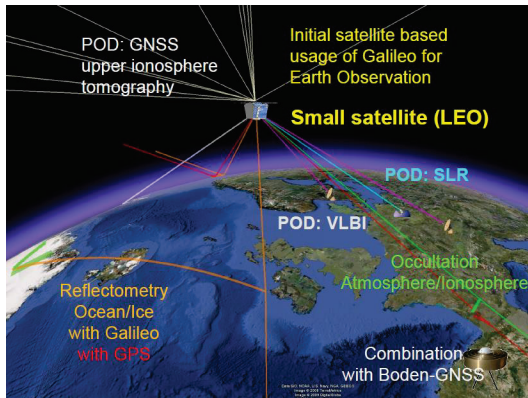


Credit: Gordon Wells (CSR- UTAustin)

Texas Special Needs Evacuation Tracking System

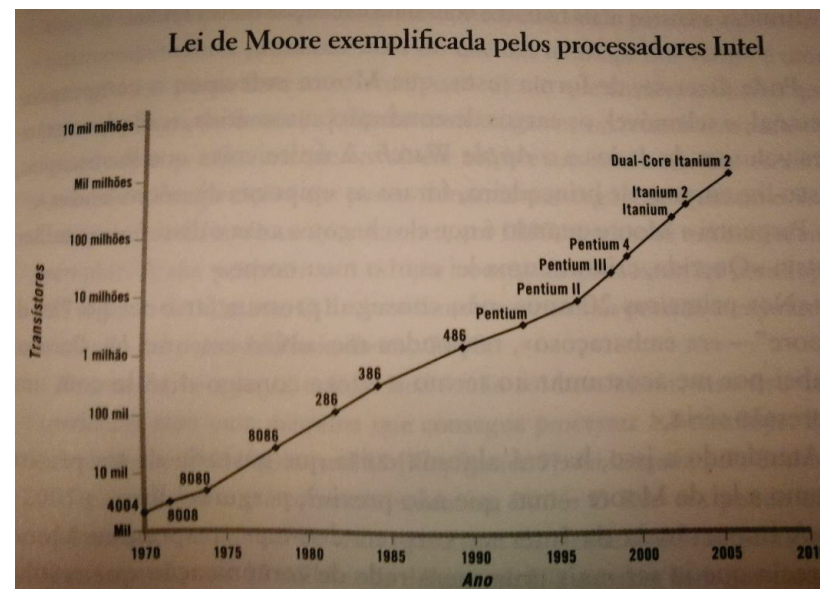
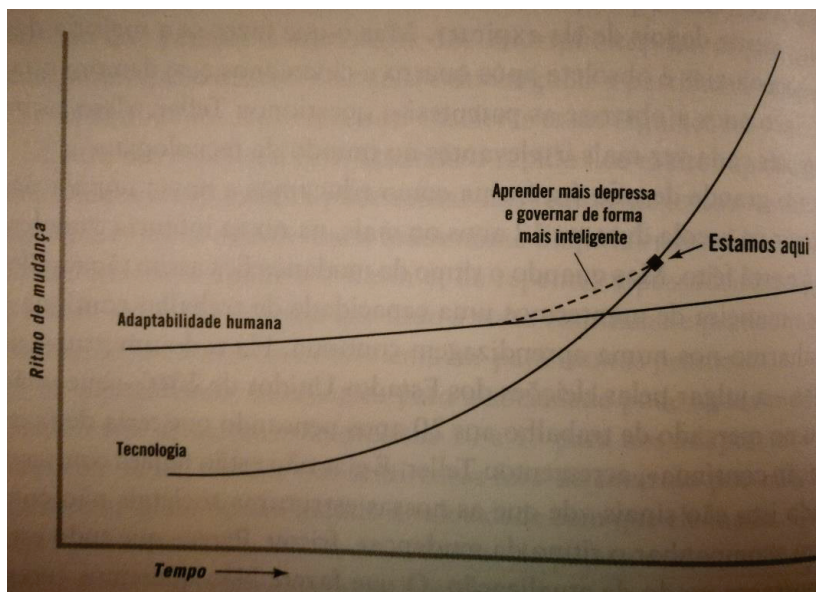


Integração de novos sensores e plataformas



Futuro

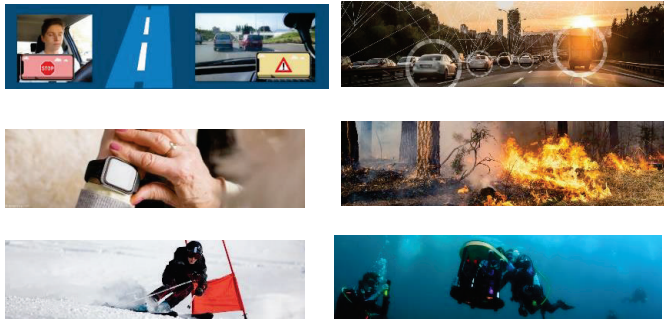
É difícil, ou mesmo impossível, prever o futuro da navegação por satélite da Detecção Remota e da Geodesia em geral.



Credit: Thomas Friedman – Obrigada pelo Atraso

Mudança de paradigma

- Na última década, os GNSS tornaram-se uma ferramenta global que fornece Posicionamento, Navegação e Tempo (PNT).
- Como a Internet, o GNSS é uma componente crítica da infra-estrutura de informação global.
- Há poucos anos, para se obter precisão topográfica era preciso usar um recetor geodésico.
- Hoje podemos obter a mesma precisão e desempenho diretamente com um smartphone.



A Geodesia do Futuro

A Geodesia é fundamental para percebermos as mudanças que ocorrem à escala planetária





How inappropriate to call this planet **EARTH** when it is quite clearly
OCEAN

Arthur C. Clarke