A new concept in satellite navigation

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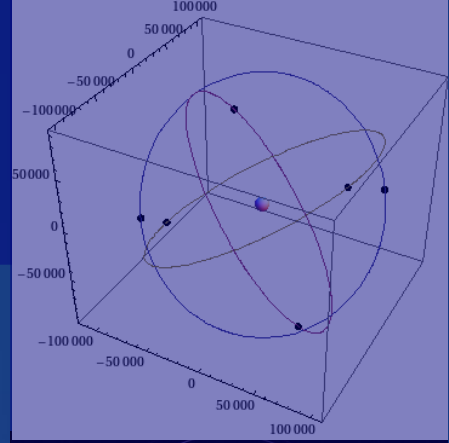
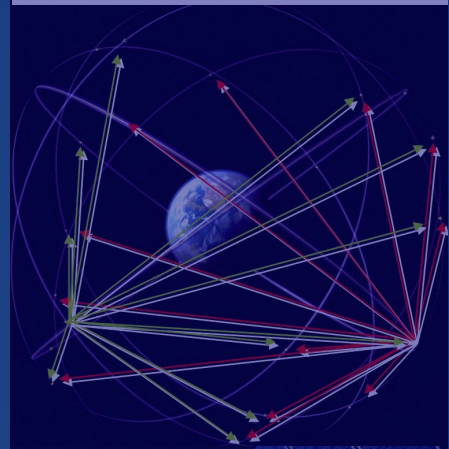




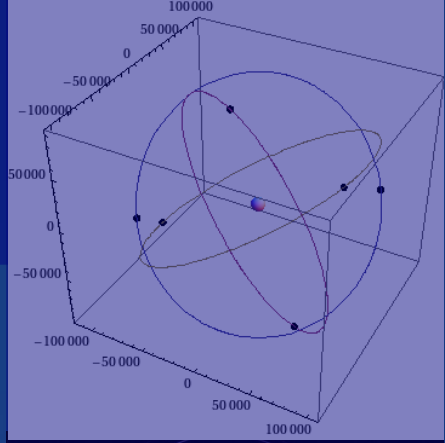
GNSS today

satellite tracking from Earth

position of satellites

receiver

position of the receiver

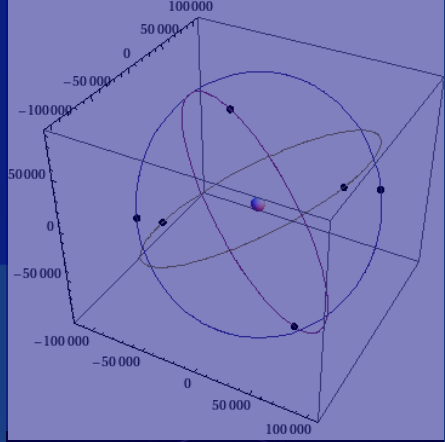


Earth tracking stations allow us to determine positions of the satellites.

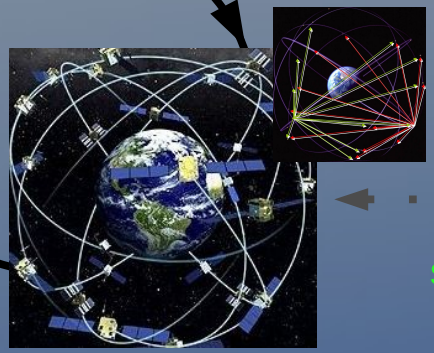
When a user of navigation receives a signal from the satellites, he can use positions of the satellites to determine his coordinates on Earth.

The accuracy of acquired coordinates depends on the accuracy of satellites' positions.

Relativistic GNSS



communication link between satellites



satellite tracking from Earth

satellite tracking from Earth is no longer required

position of satellites

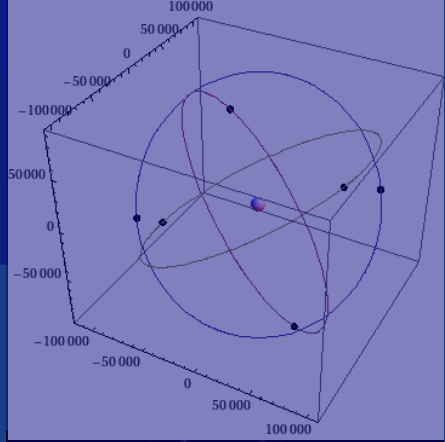
receiver

position of the receiver

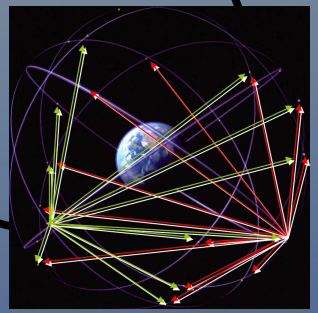
Because tracking stations are under influence of tectonic motion and tides, the positions can be determined only with limited accuracy.

If satellites communicated between one another, tracking stations would no longer be required, which would help us avoid some sources of positioning inaccuracy.

Relativistic GNSS



communication link between satellites



reduction of inter-satellite communication data

ABC – Autonomous Basis of Coordinates

position of satellites

receiver

position of the receiver

Univerza v Ljubljani, ESA Advanced Concepts Team (2009-2014)

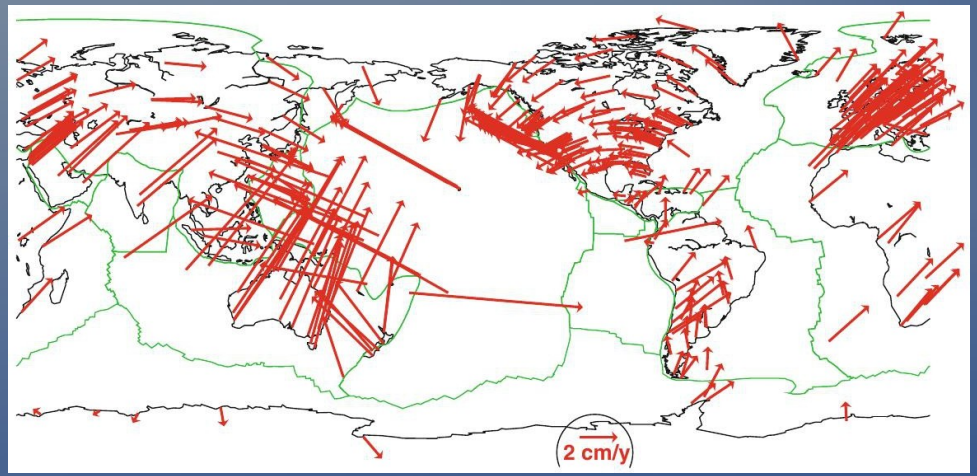
In this case, the theory of general relativity allows us to determine satellites' positions using inter-satellite communication.

An Autonomous Basis of Coordinates (ABC) can be established in this way, to form a foundation for an RGNSS – Relativistic Global Navigation System.

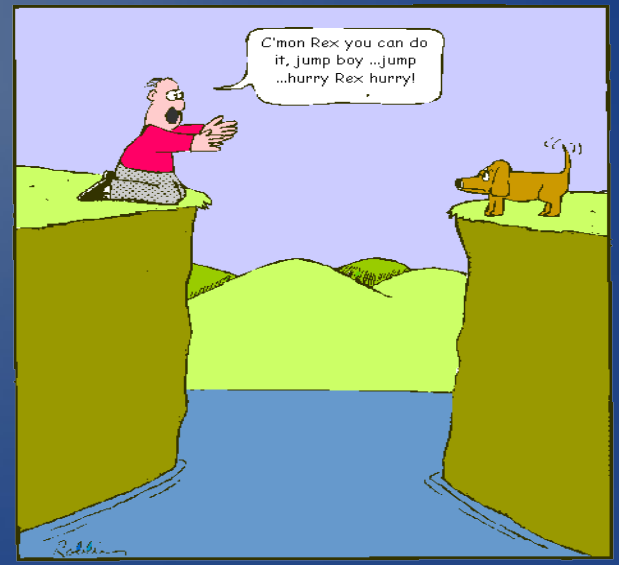
Positions acquired within RGNSS are determined with great accuracy, since no tracking stations on Earth are used in this process.

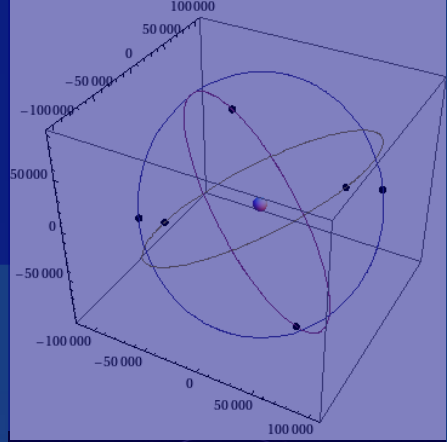
Advantages of RGNSS

routine measurements of tectonic plates motion

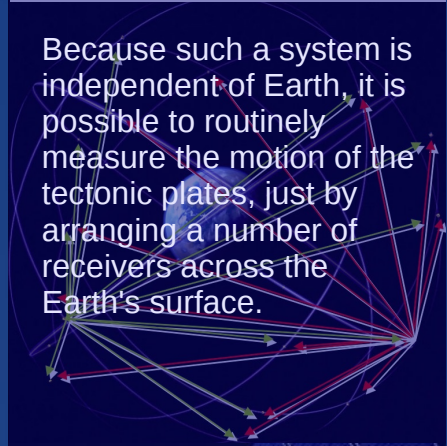


(Zuheir Altamimi, ITRF)

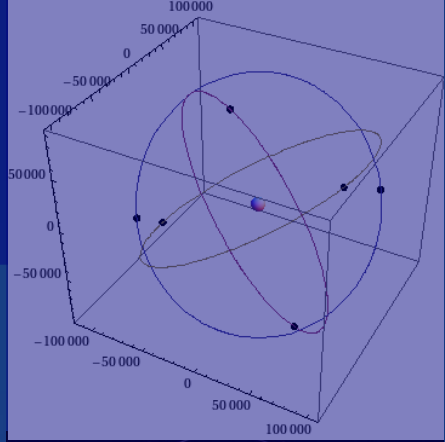




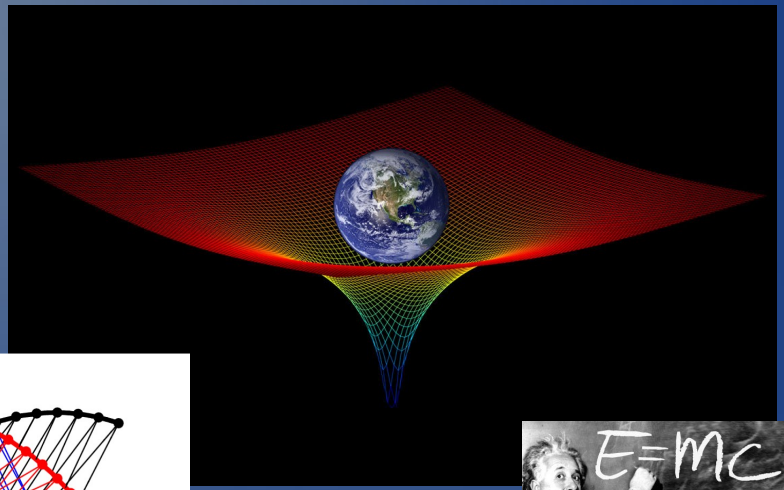
Because such a system is independent of Earth, it is possible to routinely measure the motion of the tectonic plates, just by arranging a number of receivers across the Earth's surface.

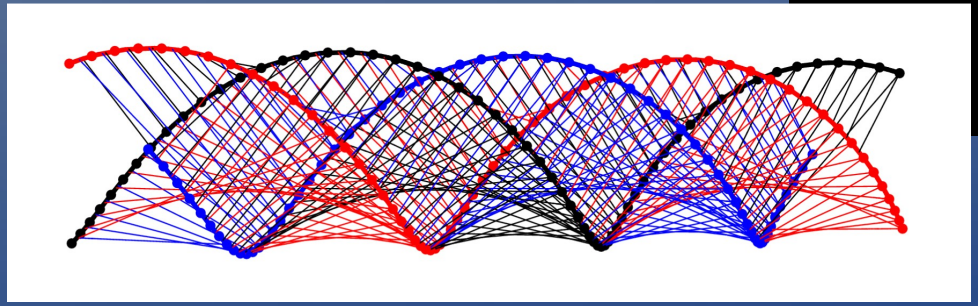


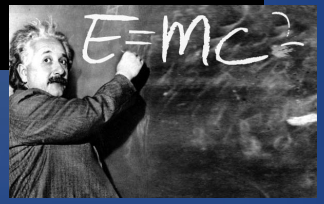
Advantages of RGNSS



measurements of space-time curvature around Earth





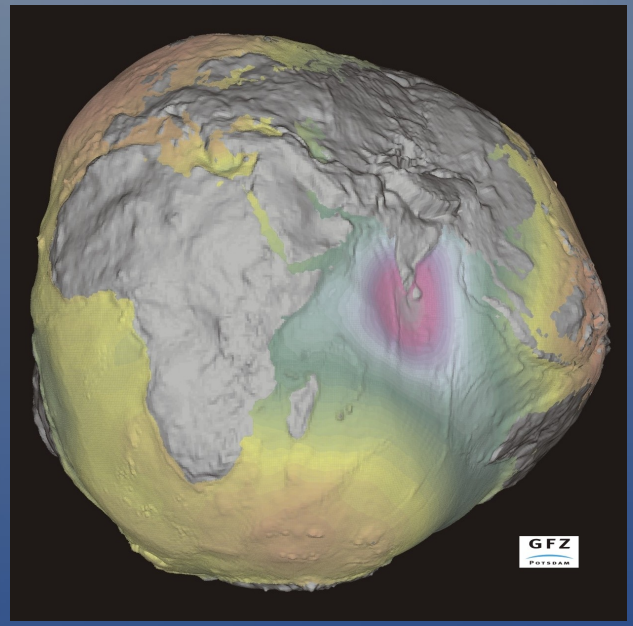


Satellites, that make the RGNSS, actually map the space-time around Earth.

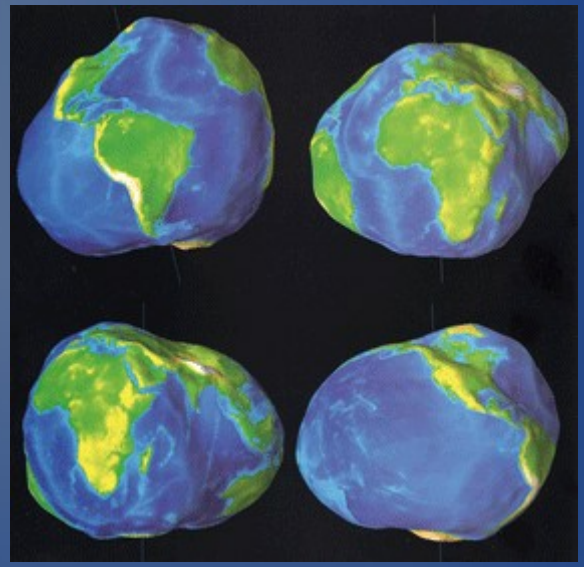
Because the ABC, and with it also the RGNSS, are based on the theory of general relativity, it is possible with this system to measure the space-time curvature arising from Earth and nearby celestial objects, such as the Moon, the Sun, Jupiter, and Venus.

Advantages of RGNSS

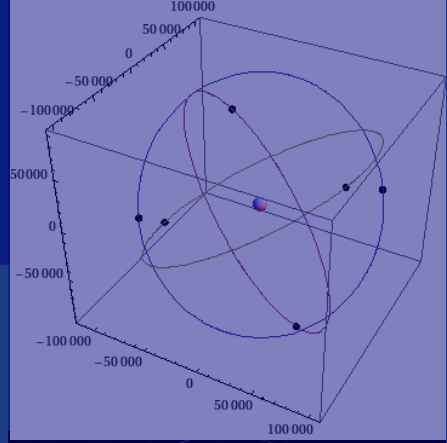
measurements of the shape of Earth



(GFZ, Potsdam)



(GEMOC ARC National Key Centre, Sydney)



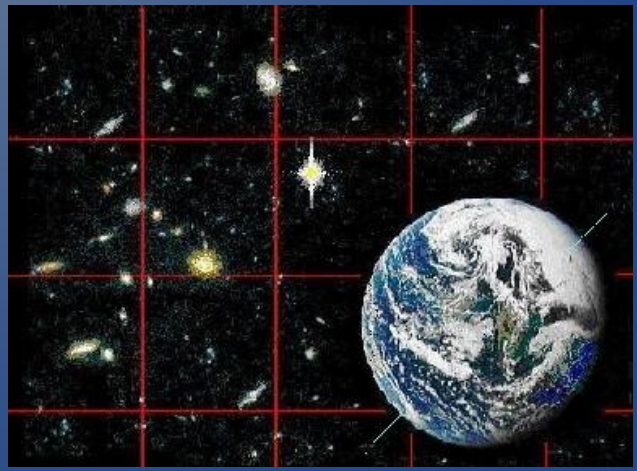
Due to great accuracy of and RGNSS, it is possible to use it for measuring the tiniest differences of the space-time curvature arising from non-spherical shape of Earth.

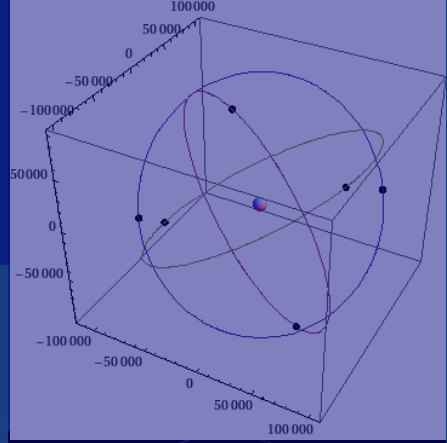
In this way, an RGNSS can contribute a share to the existing methods of measuring the shape of Earth.

Advantages of RGNSS

- Robustness
- Great accuracy
- Possibility to use the system as a clock with long term stability
- Tracking stations on Earth are no longer required

- Useful in science
  - geophysics
  - relativistic gravitation





Last, but not least, since the core of an RGNSS lies in the very well known motion of the satellites, such a system can be used as a clock with long term stability.