SPECTRE

[Service and Products for ionosphere EleCtronic content and TRoposphere over Europe]

An Operational distribution service of 2D TEC maps over Europe for natural hazard studies

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(1) NOVELTIS
(2) IPGP
(3) CETP
(4) ETHZ

SPECTRE objectives

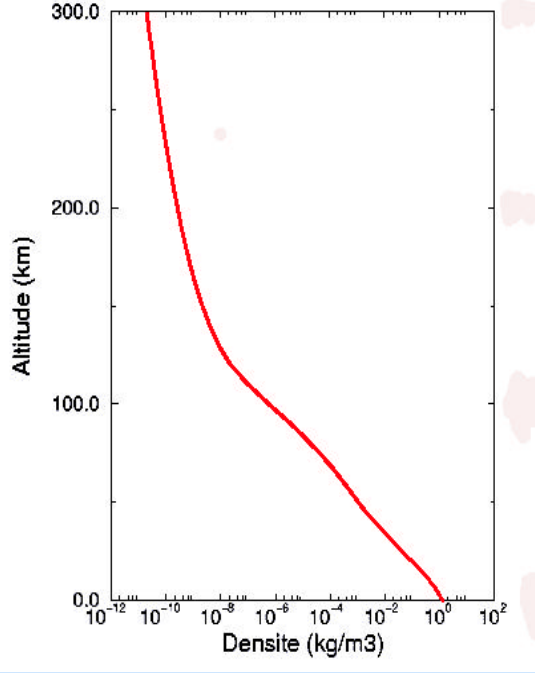
- **An operation distribution service of 2D TEC maps over Europe for Natural Hazard Studies**
  - **Benefit of ionosphere path delay corrections for remote sensing applications: mono-frequency GPS, SAR interferometry (study of slow deformations)**
  - **Measure ionospheric perturbations in response to solid earth motion**
    - **Acoustic coupling between solid Earth and the ionosphere**
    - **Atmospheric explosions: volcanoes, asteroids**

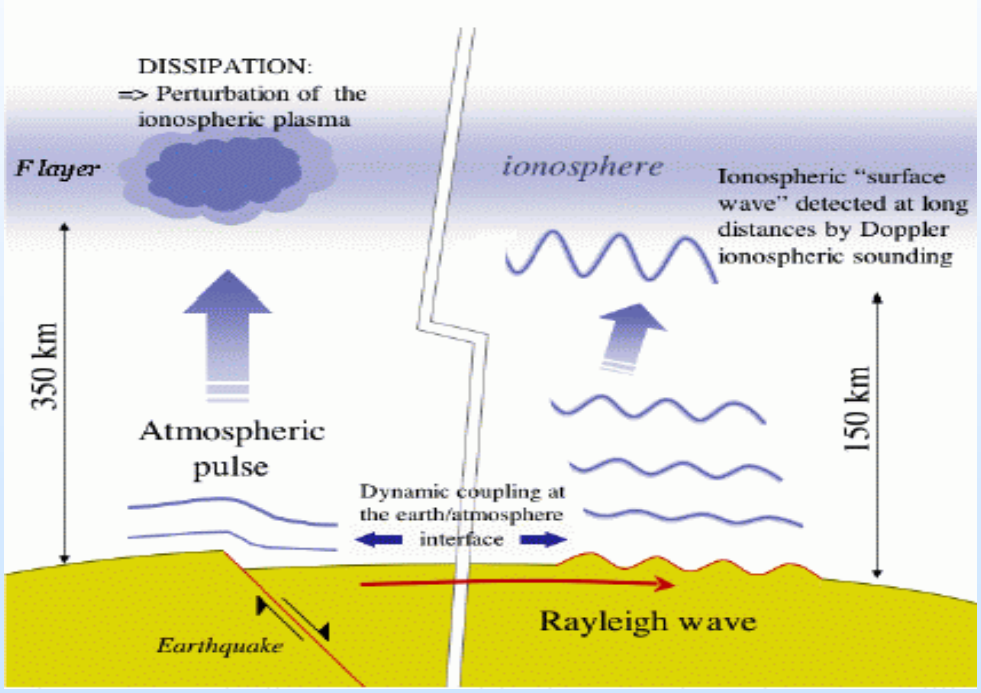
SPECTRE objectives

- **Seismic/atmospheric coupling**
  - Characterizing seismic wave field on large spatial scales
  - Remote sensing of volcanic activity
    - ⇒ Sparse seismometer distribution
  - Early warning of tsunami
  - Asteroid explosion
- **Funded by ESA, the French Ministry of Research and CNES**
  - NOVELTIS (SME)
  - IPGP (Institut de Physique du Globe de Paris)
  - CETP (Centre d'Etude des Environnements Terrestres et Planétaires)
  - ETHZ (Swiss Federal Institute of Technology of Zurich)

SPECTRE science

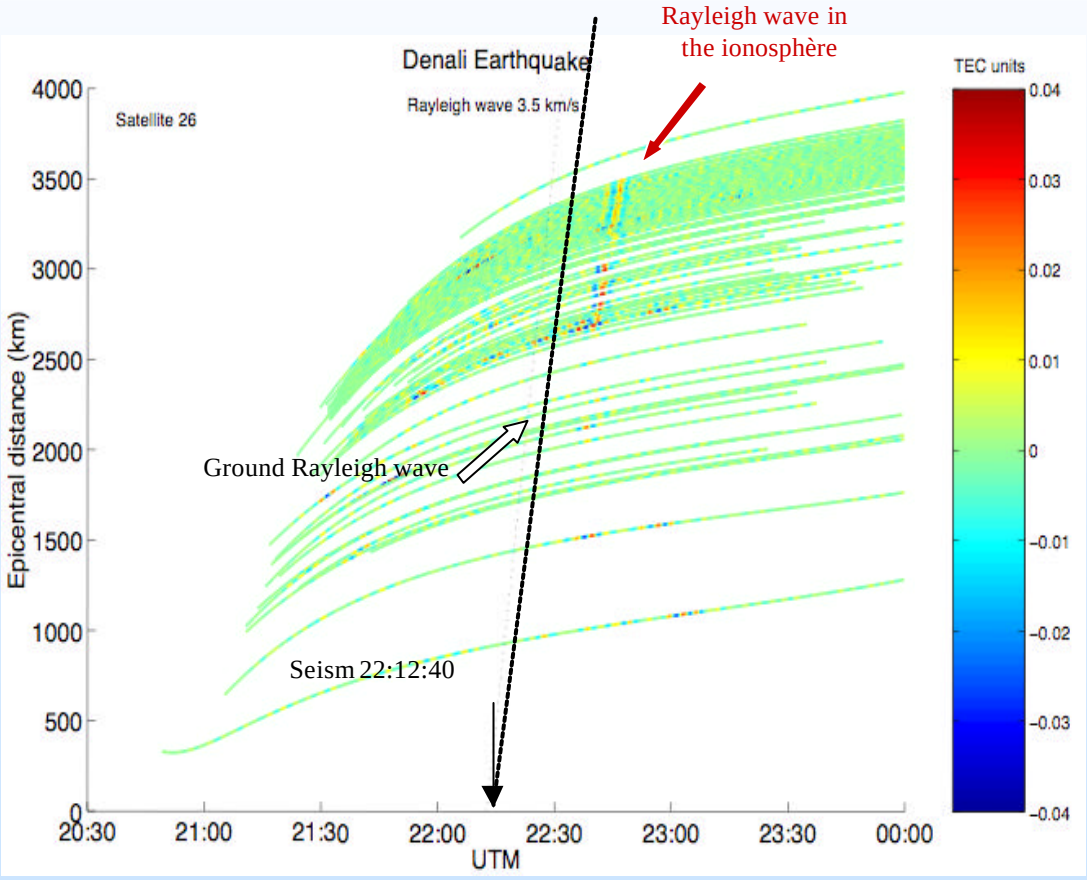
Wave propagation





Earthquakes

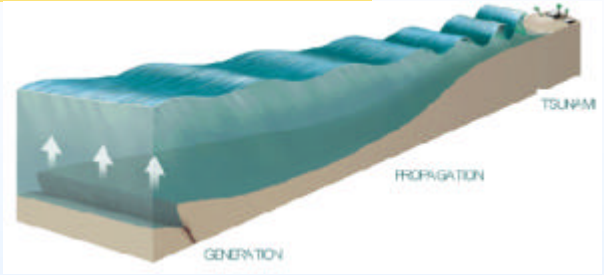
- TEC time series computation
- Typical variations TEC:10-100 TECU
- GPS resolution : 10-2 TECU
- High-pass filter (4.8 mHz)
  - ✦ suppression of long-wave signals
- Correction for Satellite and station inter-frequency biases.

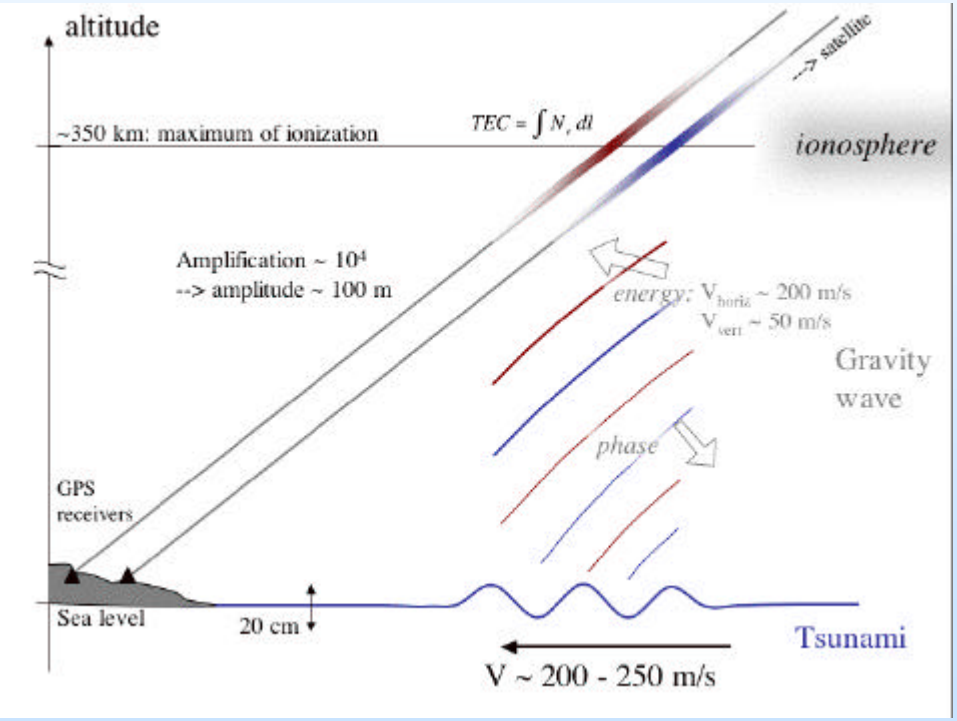


Tsunami (1/2)

- Origin : earthquakes, landslips
- Period between 10 min and 2 hours, λ > 500 km.
- Low energy losses
- Amplitude can reach 10 to 30 m near the coast.
- Difficult to detect in deep ocean because of small amplitude

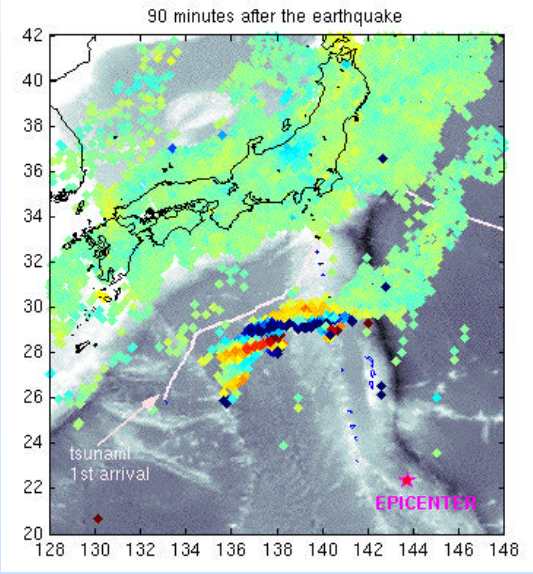
- Coupling tsunami wave/atmosphere
- Generation of gravity waves in the atmosphere.

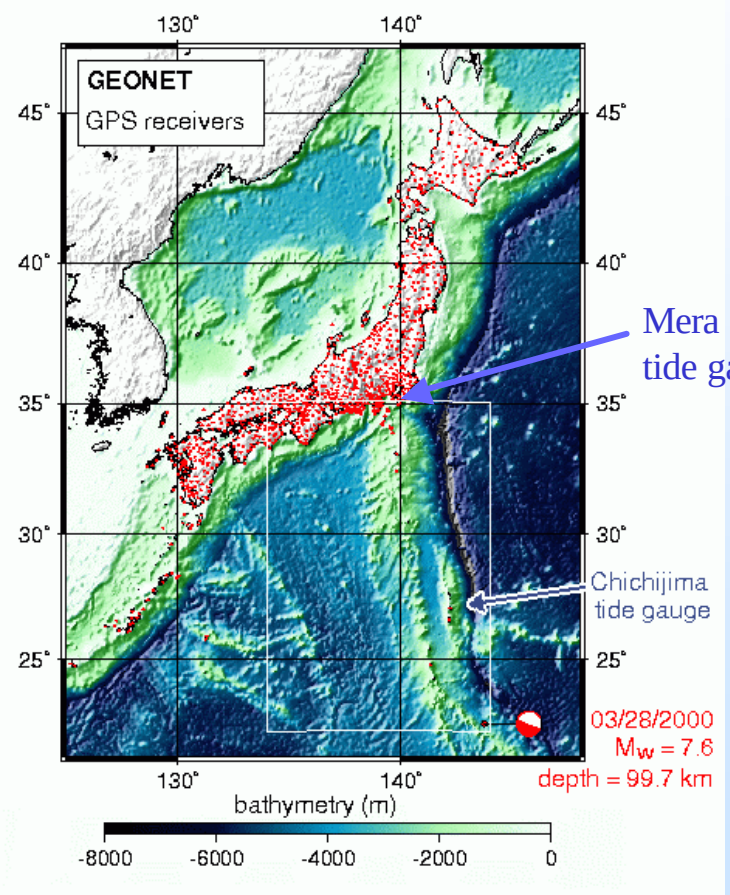




Tsunami (2/2)

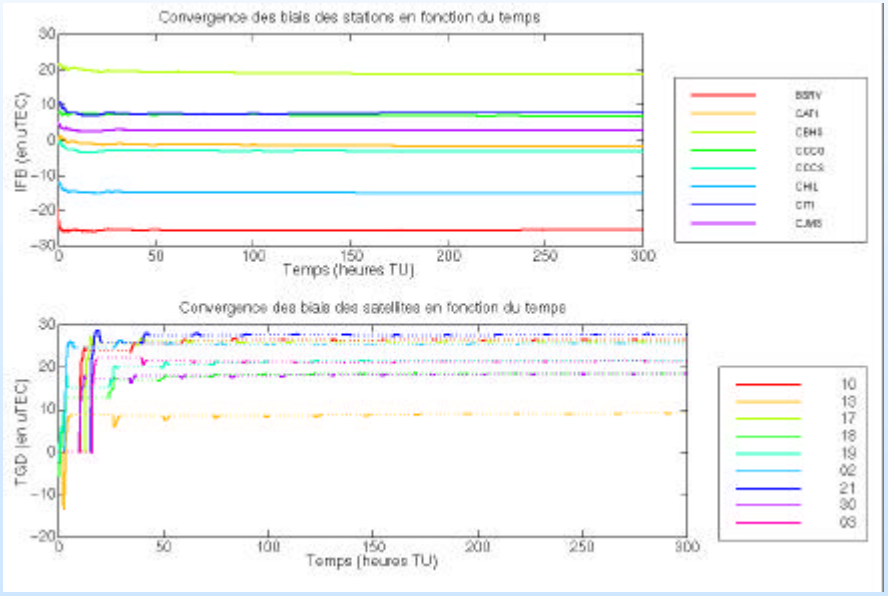
- Observed ionospheric signal (high-pass filter 0.1 mHz).
- Seism @ Volcano islands 11:01:00 UTC 28 march 2000, Japan
- Tsunami wave recorded @ Chichijima 12:05 and @ Mera 13:30





The method

- A Kalman filter estimates
  - Satellite TGDs & Ground Receivers IFBs
  - TEC at the node of a 2D grid
- Slant TEC satellite « receiver, corrected from TGDs & IFBs
- Vertical TEC derived from slant TEC
- 2D Maps computed from corrected vertical TEC



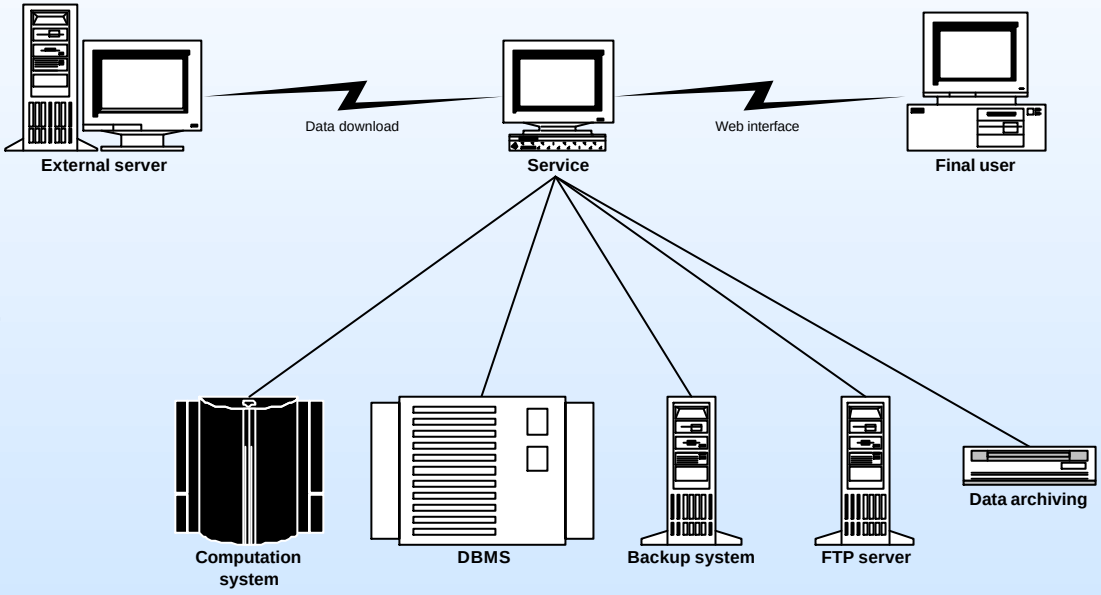
SPECTRE products

- **Products are:**
  - **Raw TEC data**
    - **GPS satellite TGDs**
    - **Ground Receivers IFBs**
    - **Slant TEC satellite « receiver, corrected from TGDs & IFBs**
  - **Processed TEC data**
    - **Vertical TEC @subiono point, corrected from TGDs & IFBs**
  - **2D TEC Maps**
  - **[3D TEC Maps (+tropospheric products)– IPGP/NOVELTIS PhD study started 2003/10/01]**

⇒ **All types of products: absolute and relative (time-filtered)**

SPECTRE Service

- 1.Computation unit dedicated to VTEC map production,
- 2. Database management system, storing the various products,
- 3. Backup system, implemented to save data and files regularly and to restore them in case of failure
- 4. Web interface to request data extraction
- 4. FTP server to make data available to service users,
- 5. Data archiving system to store oldest products.



SPECTRE Users (1/2)

U1: Organization or laboratories operating trans-horizon and trans-ionospheric radars.

U2: Organization or Laboratories performing inSAR remote sensing.

U3: Organization or Laboratories performing remote sensing seismology.

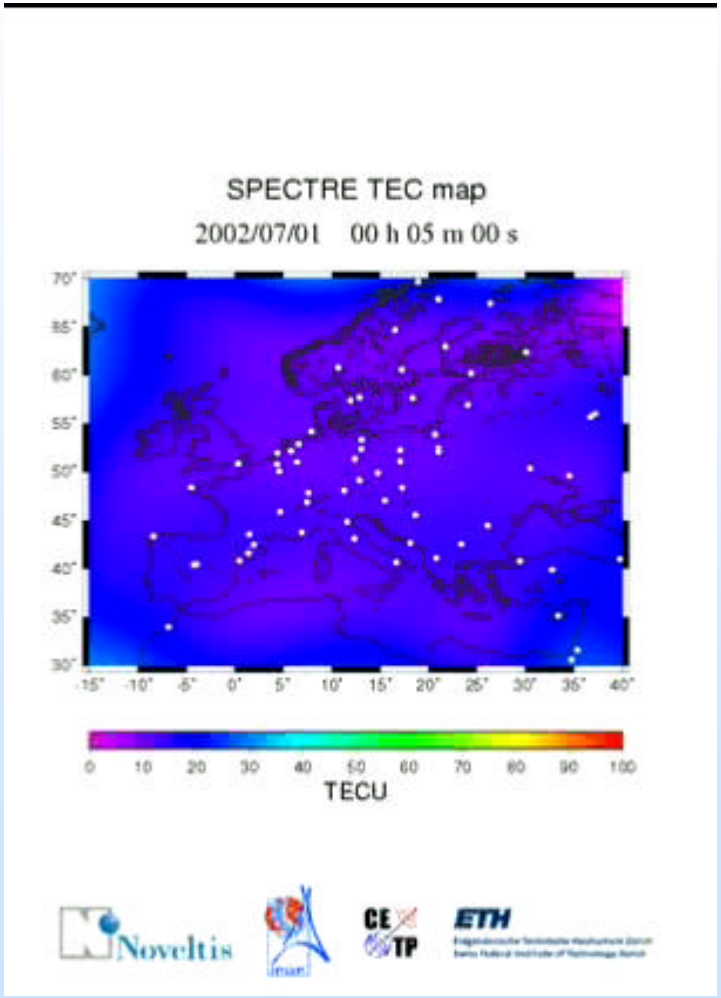
U4: Organization or laboratories performing Space Weather studies or studying ionospheric anomalies possibly related to earthquake.

U5: Organizations or Laboratories performing Geodesy research or services.

SPECTRE Users (2/2)

- **Private part: Products released freely to the SWEENET members during the ESA Pilot Project phase (2 years)**

- **Public part: general information on applications, illustrations.**



Project Status