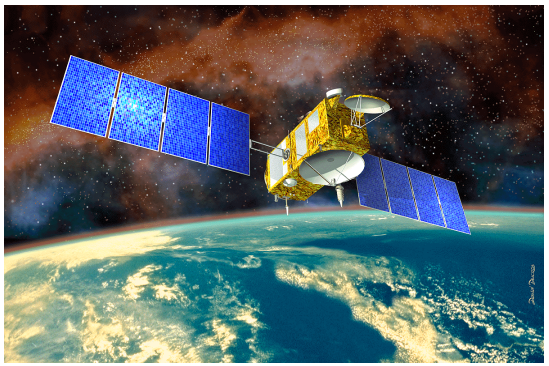


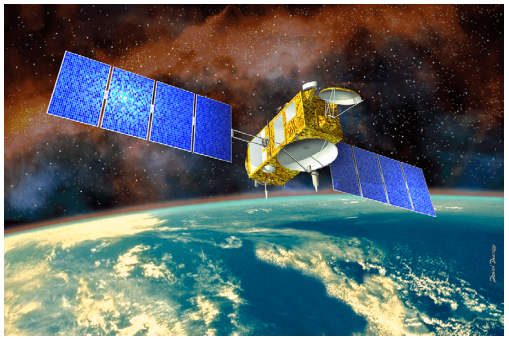
# DORIS system evolutions

Tavernier, G.; Granier J.P.

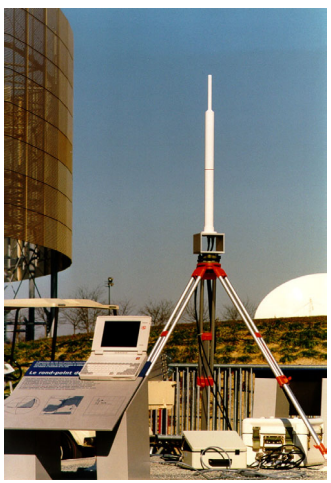
**D** OPPLER
**O** RBITOGRAPHY
and **R** ADIO-POSITIONING
**I** NTEGRATED
by **S** ATELLITE

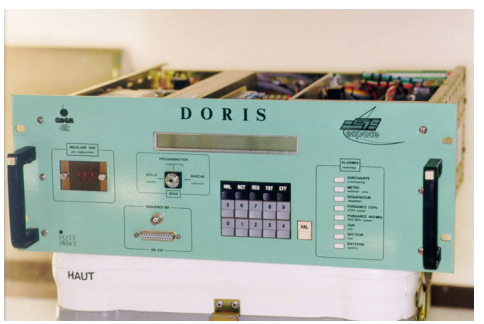
# Summary

- The DORIS system
- Orbitography network
  - monumentation
  - colocation
  - third generation beacons
- Satellites
  - second generation receiver: ENVISAT
  - miniaturized second generation receivers: JASON, SPOT 5
- SSALTO
- DORIS Pilot Experiment

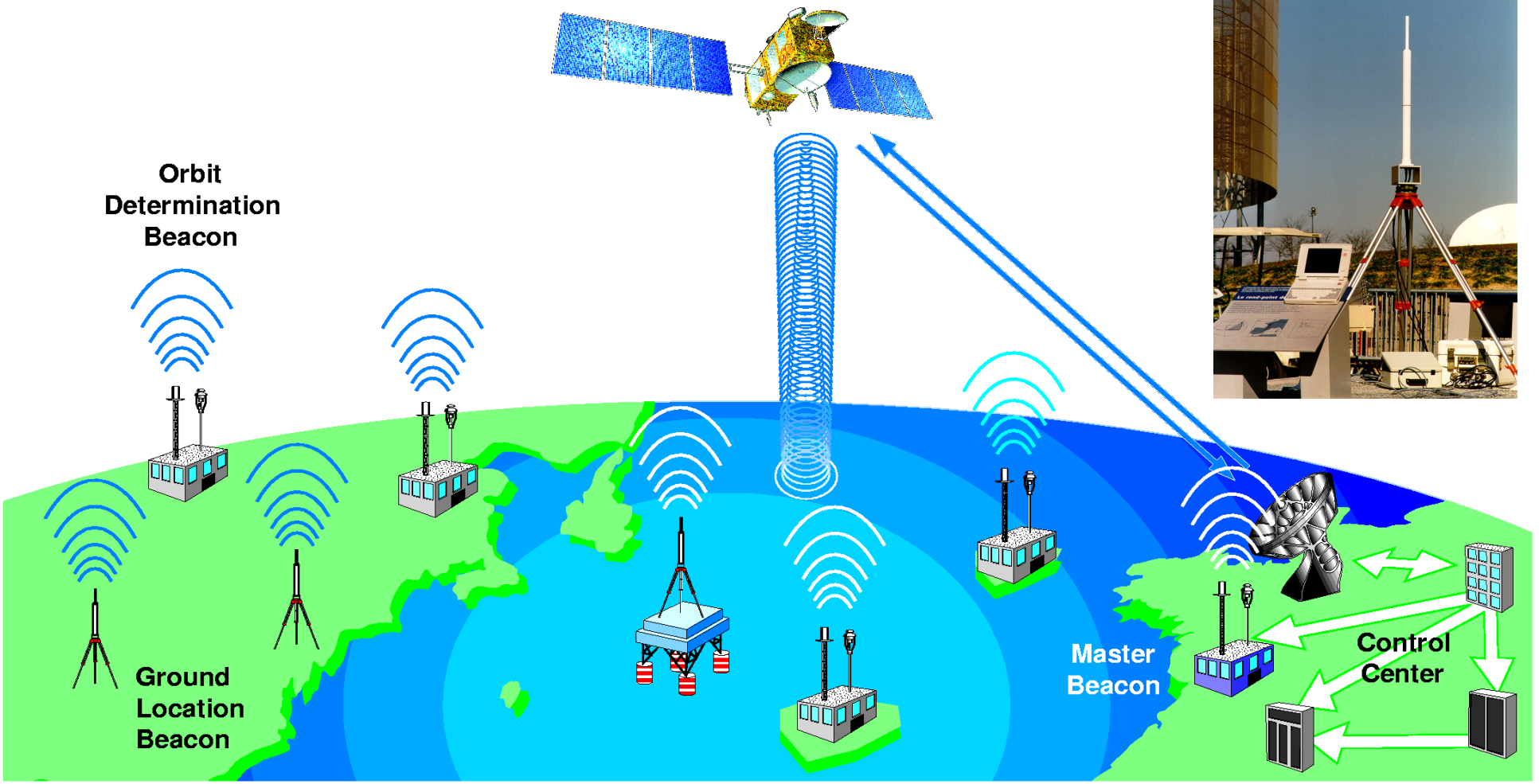


# THE DORIS SYSTEM





# DORIS SYSTEM



# The current orbitography network


- **SPOT coverage : 86 %**
- **TOPEX coverage : 96 %**

◆ **54 stations, 30 countries**

# Orbitography network

**The network's current evolutions aim at improving:**

- **The long term stability of the antennas**
  **(stations renovation action)**

- **The global coverage and colocations**
  **(a few more stations to fill in the remaining "holes"**
  **+ DORIS Pilot Experiment proposals)**

- **The equipment's reliability**
  **(deployment of third generation beacons)**

# DORIS Network
# Stations renovation action

- Amsterdam: concrete pillar (03/01)
- Kerguelen: concrete pillar (04/01)
- Kitab: concrete pillar (04/01)
- Ponta Delgada: rigid metal tower (08/01)
- Yellowknife: concrete pillar (10/01)
- Arequipa: concrete pillar (11/01)
- Noumea: iron pipe, concrete pillar (12/01)
- Chatham: rigid metal tower, concrete (11/01)
- Tristan Da Cunha: concrete pillar (01/02)
- Terre Adelie: concrete pillar, bedrock (03/02)
- Port Moresby: concrete pillar (03/02)

# Orbitography network: Upgrade of antennas monumentation

- **Current status: different kinds of antenna supports**
- **Reasons to undertake this upgrade**
  - Increase of precision of DORIS products
  - Evolution of the transmitters and receivers planned ⇒ evolution of antennas stability
  - ISGN requirements
- **Examples of antenna supports**
- **Host organization collaboration for the preliminary studies?**
- **Local network for stability observation?**

# Orbitography network: SYOWA

First installation

After strong wind

# Orbitography network: SYOWA new installation

# Collocations with other IERS techniques


- 3 other techniques (5 stations)
- 1 other technique (16 stations)
- 2 other techniques (12 stations)
- No colocation (21 stations)

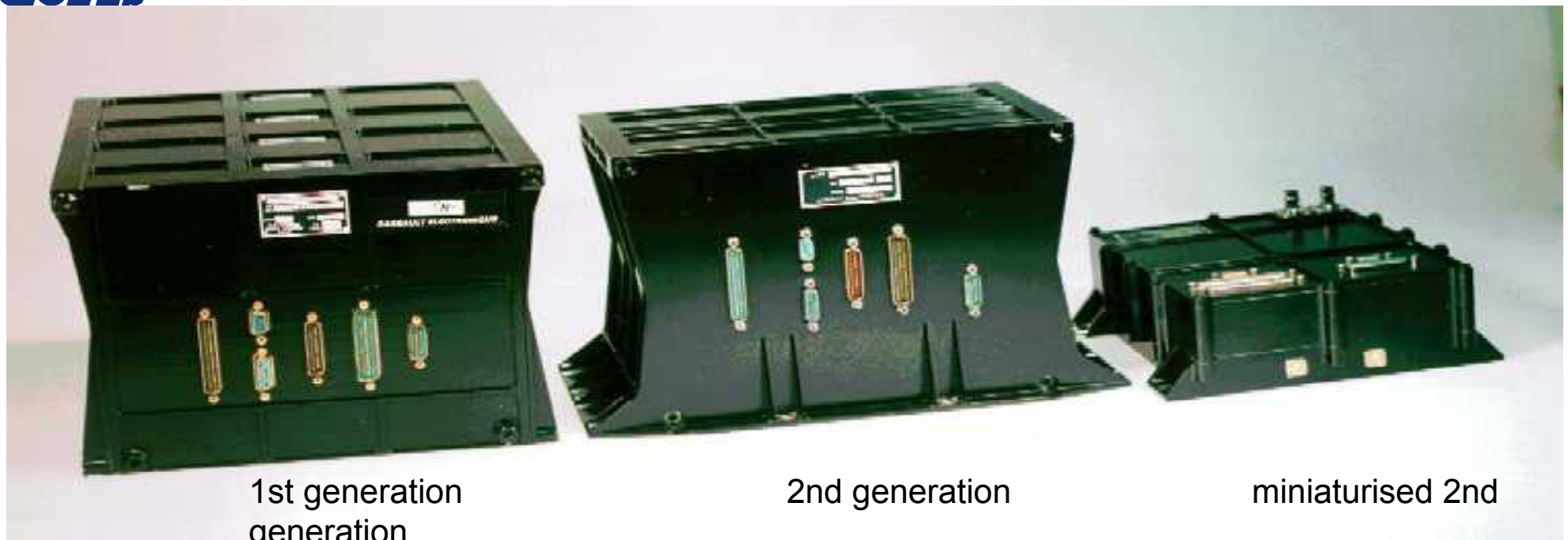
# Collocations with GLOSS tide gauges

- **16 DORIS stations are located less than 10 km away from a GLOSS tide gauge**
- **Geodetic connection available at 9 sites (bold names) out of 16**

# Orbitography network: Third generation beacons

- Main new features:
  - **Possible frequency shift, avoiding jamming by nearby stations**
  - **Increase of transmitted power**
  - **Modulated 2 GHz channel**
  - **Unambiguous internal International Atomic Time transmitted**
  - **Can be received even if the time has not been set**
  - **Possible remote control through a telephone line or Argos terminal**
- **Installation progress :**
  - **Toulouse Master beacon (December 2001)**
  - **Tristan Da Cunha (January 2002)**
  - **Kourou Master beacon, Mahe (soon)**

# DORIS RECEIVERS FAMILY



1st generation generation

2nd generation

miniaturised 2nd

| | 1st generation | 2nd generation | Miniaturized 2nd generation | Navigation receiver |
|---|---|---|---|---|
| Applications | SPOT2<br>SPOT3<br>TOPEX-POSEIDON<br>SPOT4 (DIODE) | ENVISAT | JASON<br>SPOT5 | On request |
| Characteristics | Bi frequency | Id. + dual channel + on board orbit | Id. + improved phase measurement | Mono-frequency |
| Mass | 18 kg | 11 kg | 6 kg | 4.5 kg |
| Volume | 20 l | 15 l | 6 l | 4 l |
| Power | 20 W | 26 W | 20 W | 12 W |

# Satellites

- Second generation receiver: ENVISAT
  - **Dual-chanel**
  - **on board orbit determination**
  - **improved accuracy**
- Miniaturized second generation receiver: Jason 1, SPOT 5
  - **phase measurement**
  - **Self-initialization (« lost in space »)**
  - **self-programming of the DORIS receiver**
  - **TAI time-tagging**

# Satellites: Jason 1

- Launched December 7, 2001 (Vandenberg, CA)
- DORIS On: December 8, 7:18 pm (Toulouse local time): Zero commands
- first measurements 15 ' after the setting ON: Toulouse (France) and Metsahovi (Finland). On Board orbit: a few km to a few m
- December 21: centimetric orbit
- December 25 to January 4: real-time orbit 9 to 16 cm radial (RMS)
- January 13: final orbit, at 1336 km above Earth. Jason-1 is before Topex/Poseidon by a little more than an minute

# Satellites: Jason 1

- surprising level of accuracy, exceeding that of Topex/Poseidon:
  - Comparison between Doris and GPS (TRSR) data over 7 days
  - using the same orbit computation software
  - 2 independent data sets of tracking measurements
  - fairly consistent results: RMS about 1.6 cm in the radial direction
  - **performance is improved by a factor of 2 wrt the initial specification**
  - much better than for T/P just 1.5 month after launch without any detailed tuning of any kind

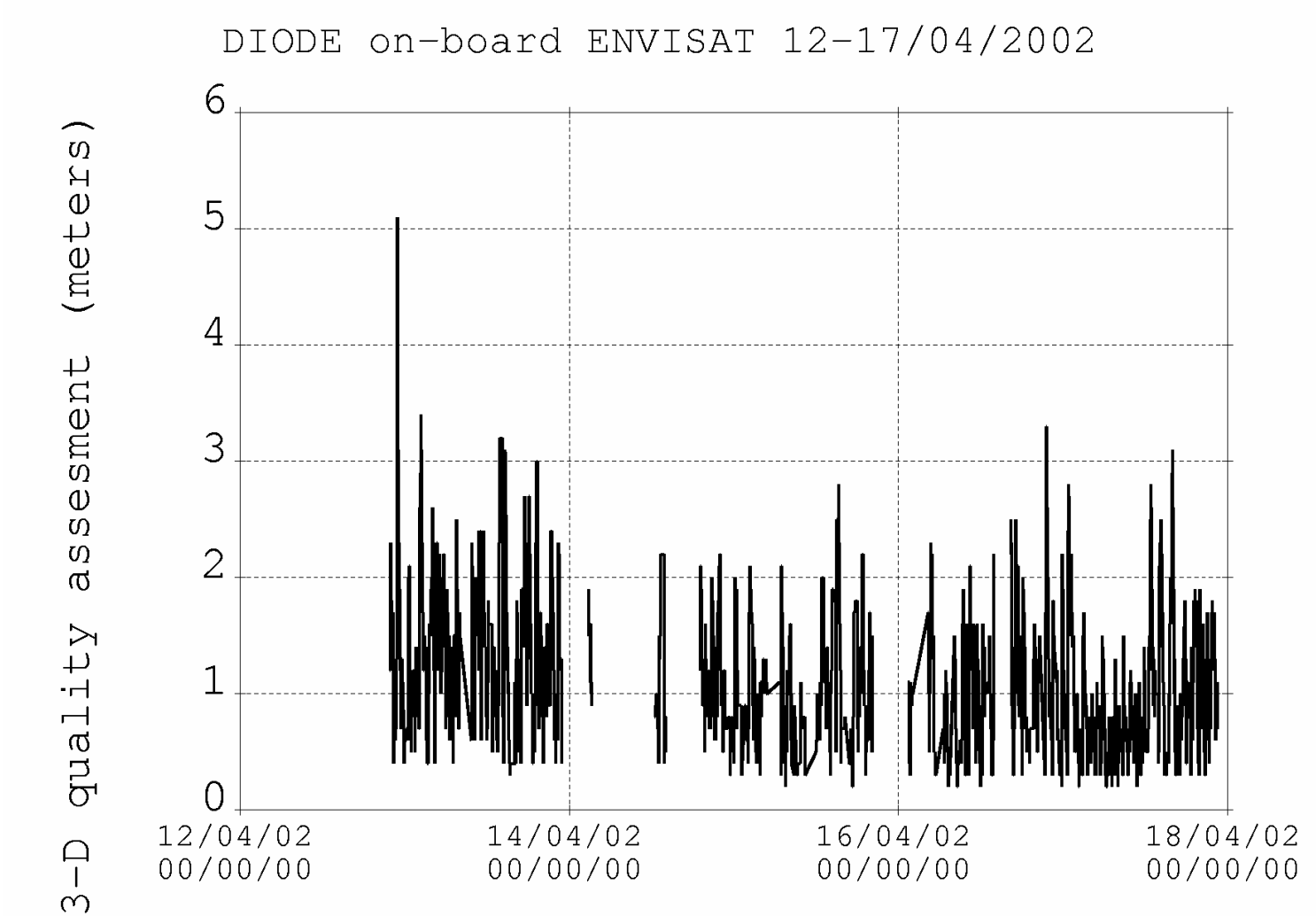
# Satellites: Jason 1

- For cycle 4, two orbits have been computed:
  - DORIS/LASER
  - TRSR (GPS)
  - Laser residual: 2.6 cm for the DORIS/LASER orbit
  - radial bias between the two orbits: 0.0 cm, with 1.1 cm RMS
- goal of determining the satellite's altitude with one-centimeter accuracy: the 1-cm challenge is about to be won!
- http://www.jason.oceanobs.com/html/portail/actu/actu_welcome_uk.php3

# Satellites: ENVISAT

- Launched March 1, 2002 (Kourou)
- DORIS On: March 14
- first SSALTO orbit: March 19 (March 16 data)
- April 4: 5 cms on the radial component (day-to-day overlaps )
- April 12: DIODE operating

# Satellites: ENVISAT



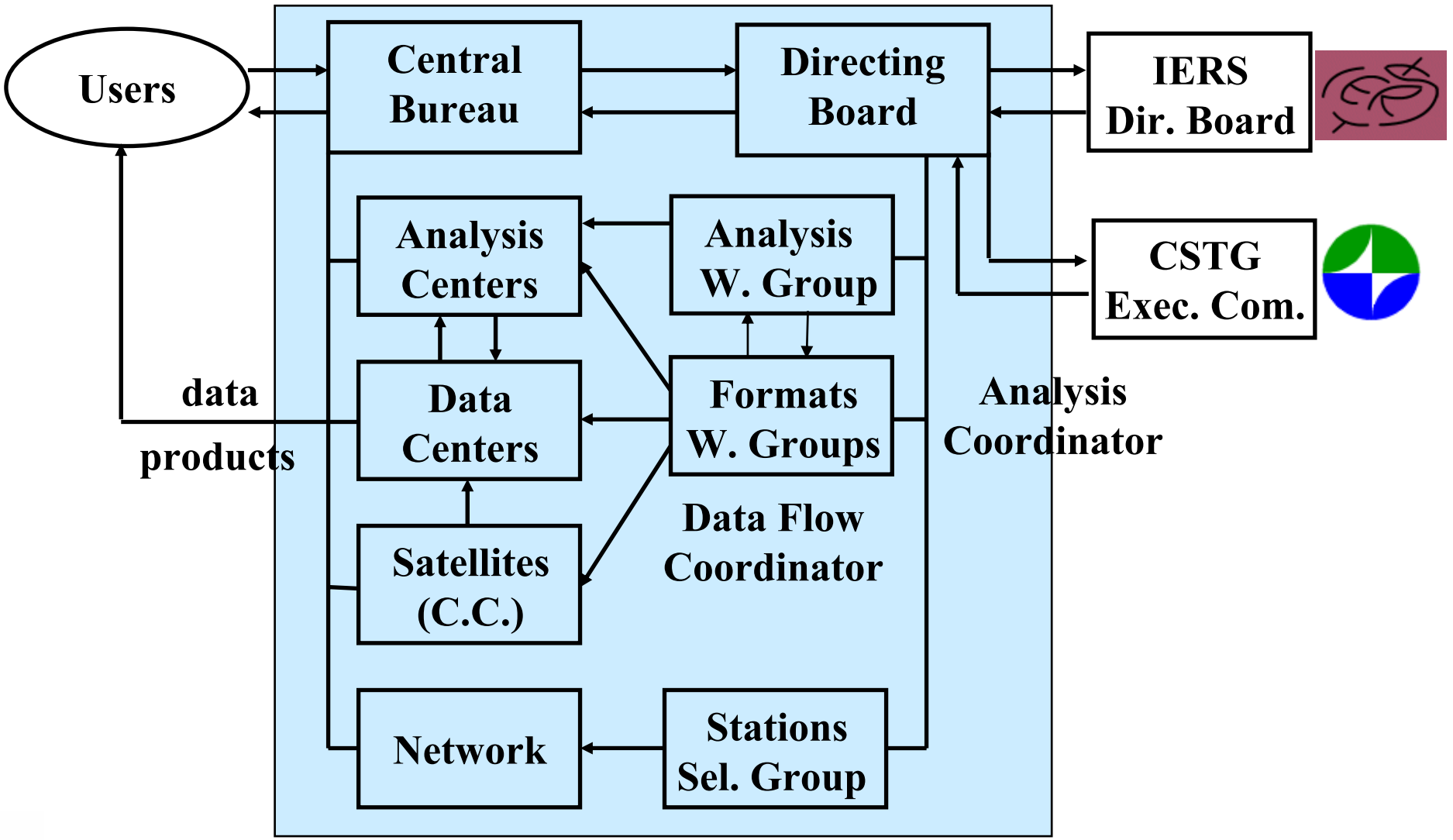
# Satellites: SPOT 5

- To be launched May 4, 2002 (Kourou)

# SSALTO: the new multi-missions orbitography and altimetry center

- Early and new instruments
  - **Early missions (SPOT 2 & 4, TOPEX/Poséïdon)**
  - **JASON (DORIS, GPS, Laser, altimeter, radiometer)**
  - **ENVISAT (DORIS, altimeter, radiometer)**
  - **SPOT 5 (DORIS)**
- Modular conception allowing new instruments to be easily integrated
- Centralize data archiving
- Includes public results interface and distribution
- Project including a deliverable control center for DORIS missions
- Location beacons → treatment included in the operational processing
  - allows better precision
  - same delay for results availability

# THE IDS STRUCTURE



# DORIS Pilot Experiment

- **Central Bureau:**
  - **CNES / CLS / IGN - France** **Gilles Tavernier**
    - http://ids.cls.fr


- **Data Centers:**
  - **NASA GSFC CDDIS - USA** **Carey Noll**
    - http://cddisa.gsfc.nasa.gov/cddis_welcome.html

  - **IGN** **Edouard Gaulué**
    - http://lareg.ensg.ign.fr/DORIS

# Analysis coordination

- **Martine Feissel  Paris Observatory and IGN  France**
- **2002 Analysis campain**
  - **Sets of station coordinates:**
    **L. Soudarin, J.-J. Valette, CLS and Z. Altamimi, IGN**
  - **Satellite orbits:**
    **H. Boomkamp, ESA**
  - **EOP time series**
  - **Geocenter time series**
- **http://lareg.ensg.ign.fr/IDS/**

# IDS Workshop

# Biarritz, France, June 13-14

- June 13 a.m.:
  - Session 1: DORIS Pilot Experiment - IDS
  - Session 2: Orbits and related products
- June 13 p.m.:
  - Session 3: DORIS analysis results
  - Session 4: IDS analysis campain
- June 14 a.m.: Analysis workshop
- June 14 p.m.: Network workshop
- http://www.cta-congres.com/BIARRITZ2002/twodori.html