

DORIS, present and future

**TAVERNIER, G.; GRANIER, J.P.; JAYLES, C.; SENGENES, P.
(CNES)**

ROZO, F. (COFRAMI)

SUMMARY

è System and Missions

è Satellites

- | 2G, 2GM receivers
- | DIODE navigator
- | future receivers

è Network

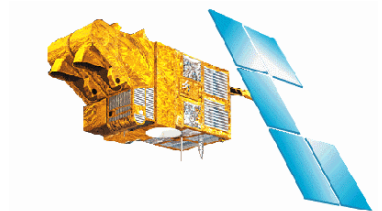
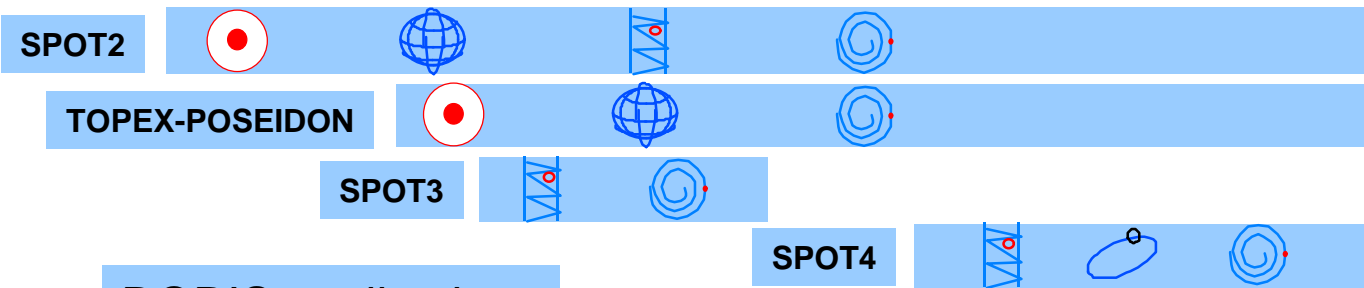
- | 3rd generation beacon
- | a new Master Beacon
- | New Time Beacons?

è DORIS ground segment







- | SSALTO

System and missions

90 91 92 93 94 95 96 97 98 99 2000 01 02 03 04 05 06 07



DORIS applications

-  Orbit determination
-  Gravity field
-  Earth rotation
-  Localization
-  On-board real time orbit
-  Time-tagging

December 7, 2001 **JASON1**     

March 1, 2002 **ENVISAT1**    

May 4, 2002 **SPOT5**    



CRYOSAT     

JASON2     

PLEIADES...

2G DORIS receiver: ENVISAT

è New routine measurement operation mode : Autonomous mode

- | DIODE directives for beacon signal acquisition
- | daily uploads no longer needed

è dual tracking ability : measurements $\simeq \times 2$

è increased instrument operational robustness:

- | more autonomous onboard software
- | radiation-hardened electronic parts : processor, mass memories

è Orbit determination: 2-3 cm radial rms

è improved DIODE accuracy

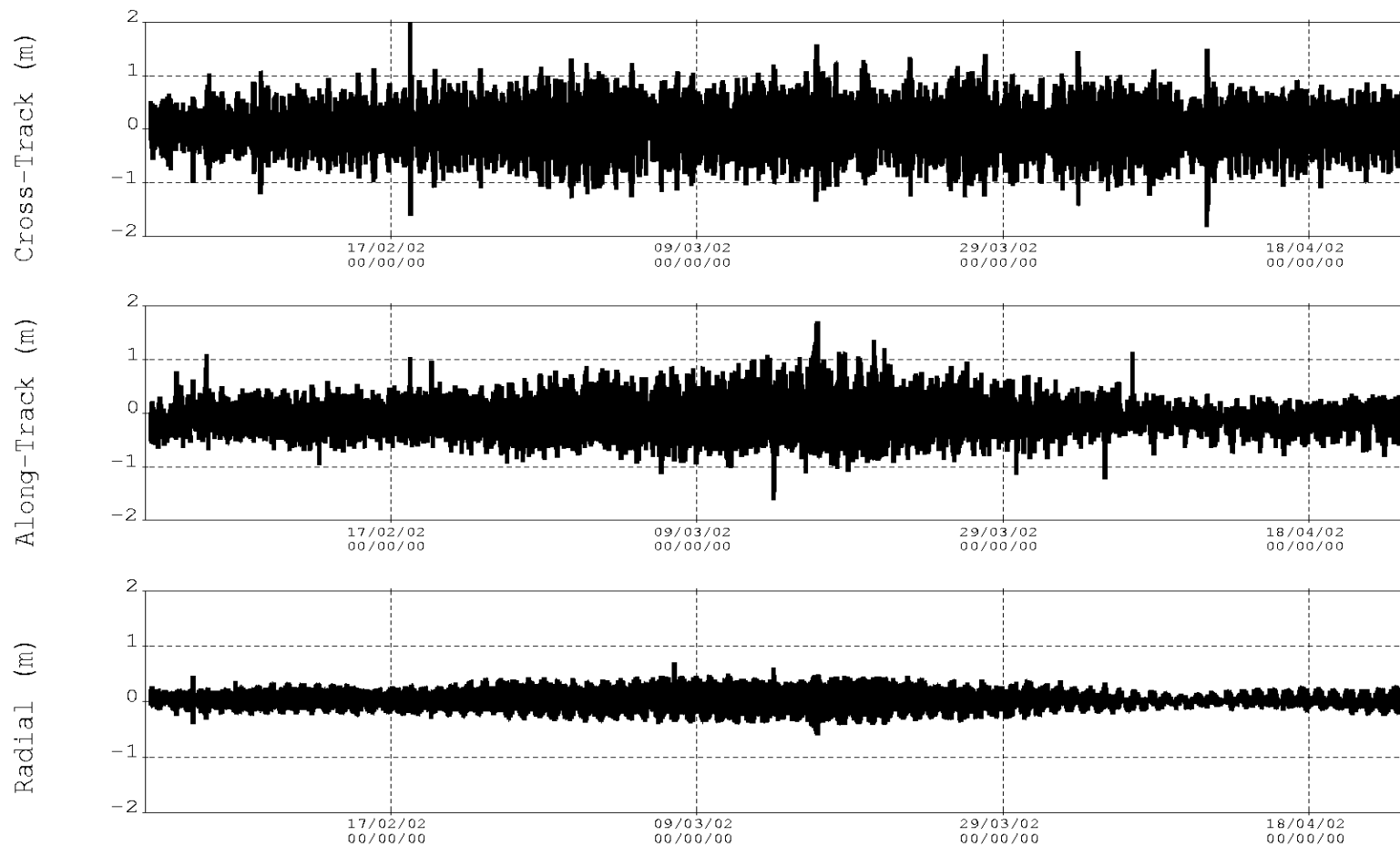
- | orbit estimation : \simeq 20-30 cm radial rms, 60 cm 3-D rms position accuracy
- | TAI estimation : \simeq 1-2 μ sec rms

2G miniaturized DORIS receiver

- è JASON1, SPOT5
- è New routine measurement operation mode : Autonomous mode
- è dual tracking ability : measurements \simeq x 2
- è increased instrument operational robustness
- è improved DIODE accuracy: 20 cm radial rms, 50 cm 3D rms
- è Specific
 - | Instrument and DIODE self-initialization: no ground commands
 - | Master Beacon broadcast: automatic update of onboard network description

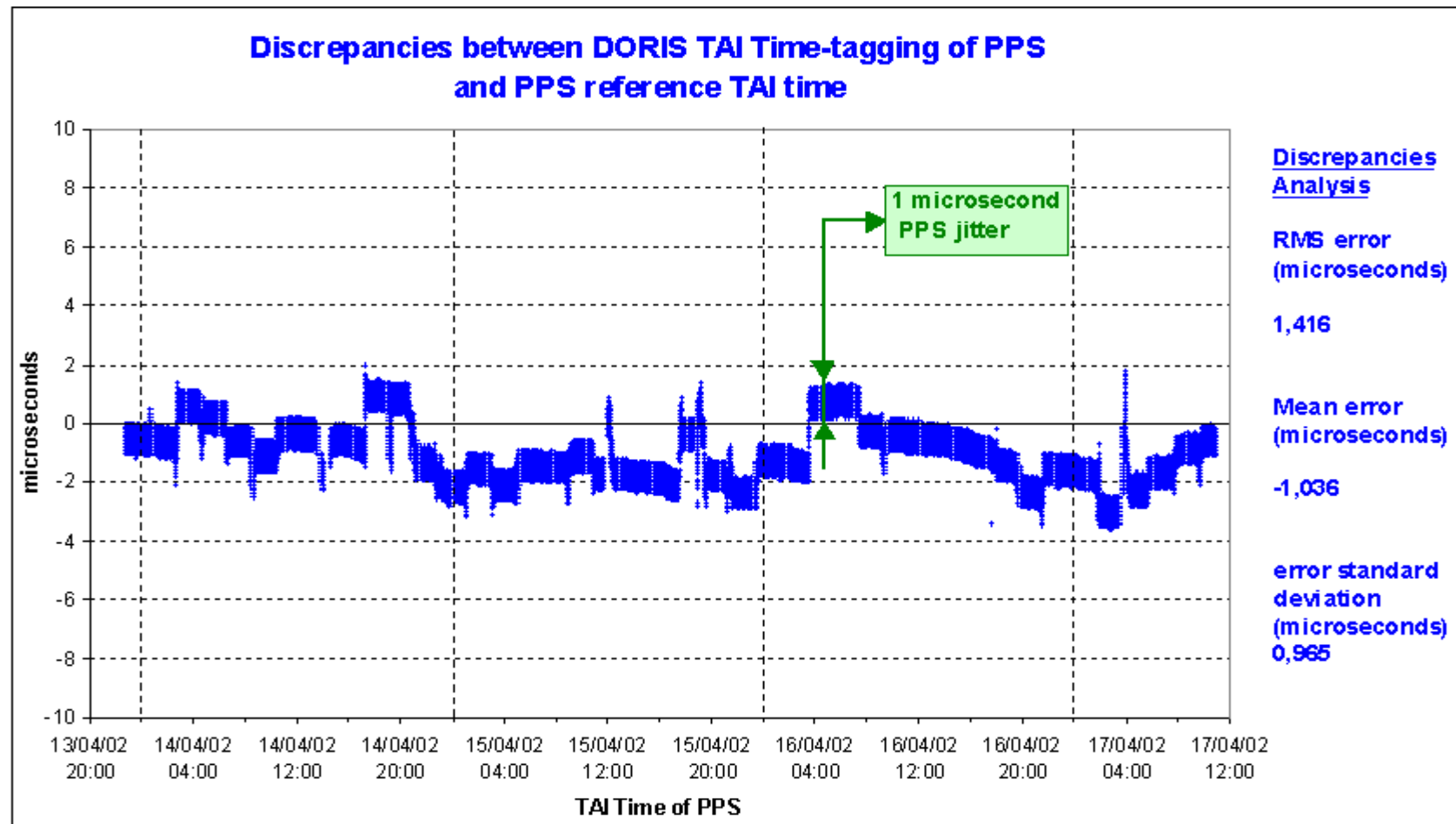
DIODE / JASON1 On-orbit Results

DIODE Jason1-POE



DIODE / JASON1

Time determination Results



CRYOSAT receiver

- è **2 channels**
- è **Same USO**
- è **New processor**
 - | Sparc ERC 32
 - | improved arithmetic (limiting factor for DIODE)
- è **Self-sufficient measurements**
 - | DIODE TAI dating (1.5 **ms** RMS) for raw measurements
 - | possible ground smoothing
- è **Spectral analysis (TBC)**
 - | beacon frequency search using FFT

Future 2GXX receivers

è 8 channels

- | based on DIODE directives for beacons signals acquisition

è New USO

- | 5 MHz: improved manufacture process, increased accuracy
- | less sensitive to radiation (factor 2 to 5 compared to previously used USO)

è Spectral analysis

- | beacon frequency search using FFT
- | more measurements during initialization
- | routine mode unchanged: DIODE directives for beacon signal acquisition
- | spectral analysis mode: new/unknown beacon (network, positioning)

è New processor

- | Sparc ERC 32
- | improved arithmetic (limiting factor for DIODE)

3G beacon : main new features

- è Frequency shift : ± 50 kHz / 2GHz ; ± 10 kHz / 400 MHz
- è Beacon modulation (beacon message and synchronization word) transmitted on both 400 MHz & 2 GHz signals
- è Broadcasting of current TAI date (LSB 10 seconds)
- è Improved monitoring of beacon operation status
- è restart mode : beacon switched ON without any time set
- è remote control connection (parameter programming through an external computer, a modem, ARGOS system)
- è can be easily upgraded into Time or Master Beacon: external 5MHz input, 1 Hz input and uploading transfer terminal connection

3G beacon : shifted frequencies

- è **New DORIS « flight software » (version 2.08) up-loaded on-board JASON1 (November 25, 2002)**
- è **Similar « flight software » update scheduled soon for ENVISAT and SPOT5 (2nd quarter 2003)**
- è **Shifted frequency tests in Toulouse (February 5, 2003):**
 - | **specific TC for JASON1 (measurements and navigation)**
 - | **4 passes over Toulouse: 10 a.m., 12 a.m., 2 p.m., 4 p.m.**
 - | **Doppler measurements OK**
 - | **Only a few Doppler collisions (2-3 measurements) with nearby stations:**
 - F **1st pass: Reykjavik**
 - F **2nd pass: Sptizberg**
 - F **3rd pass: Metsahovi**
 - | **DIODE OK: autonomous mode, orbit determination, quality indicator good**
 - | **possible measurements by ENVISAT (waiting mode)**
 - | **tests successful**

2GXX receivers & 3G beacon

è 3G beacon:

- | shifted frequencies
- | more stations in the same region

è 2GXX receiver:

- | 8 channels
- | measurements on all visible stations

è New dual channel receivers: feedback needed

- | system performance advance?
- | DORIS products improvement?

è Future receivers: which requirements?

A new Master Beacon

è Requirements

- | routine operation: 1 MB (48 hours max without MB)
- | DORIS/JASON1-SPOT5 auto-start: 2 different Time Beacons
- | broadcasts (time, network)
- | robustness

è Solution: 3rd Master Beacon

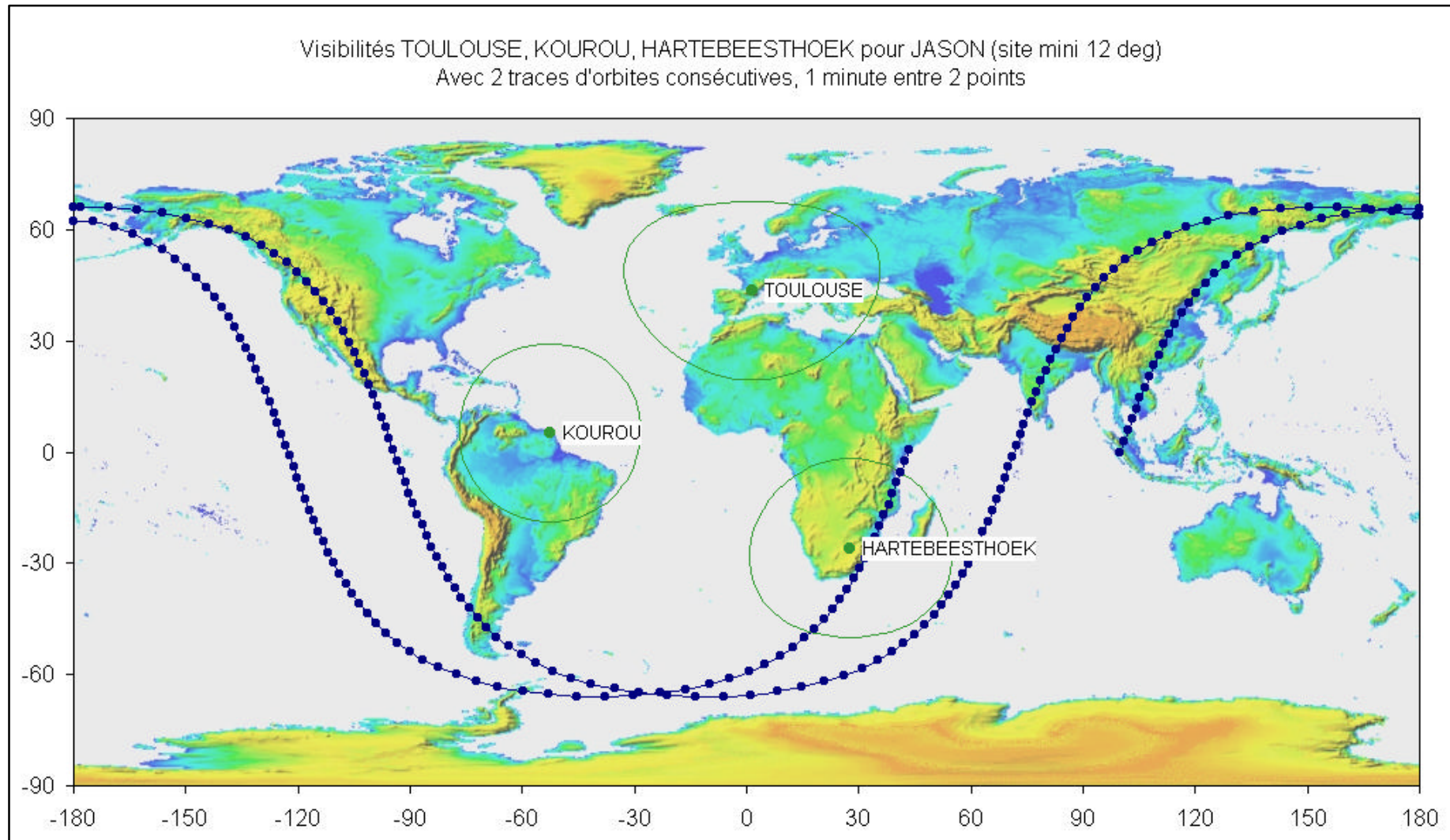
- | atomic clock: long-term stability + USO for short-term stability
- | increased MB coverage
- | permanent broadcast (power supply, radio-sounding, VLBI, Ariane TM)
- | reliable and accessible site (manpower and data link)

A new Master Beacon

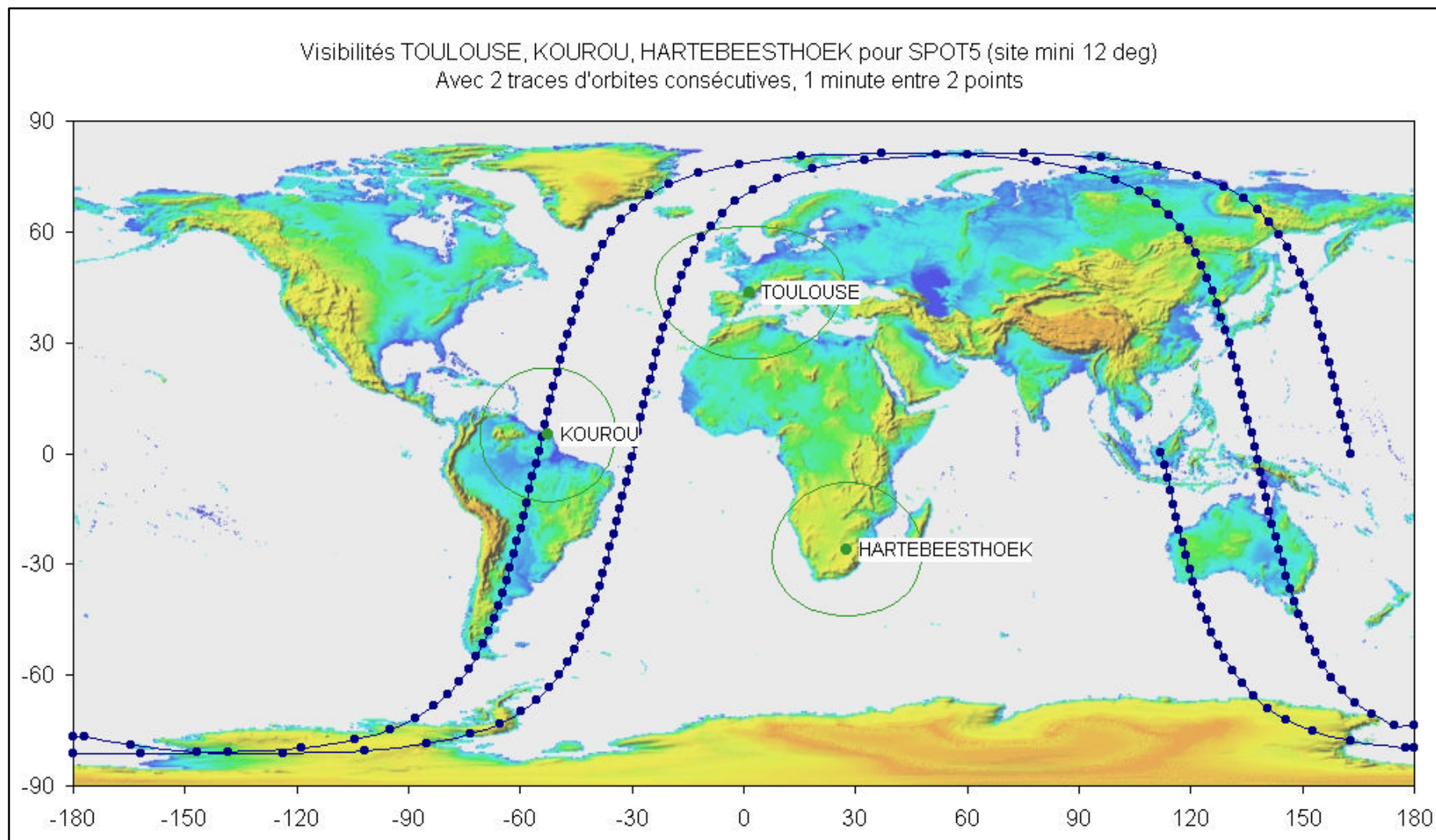
è Choice

- | **HBK (South Africa)**
- | **Cesium atomic clock + control**
- | **GPS receiver: TAI connection**
- | **equipment shared with Kourou (no redundancy, against Toulouse being redunded):**
 - F 3G beacon
 - F Transfer terminal
- | **data link : CNES dedicated line (2GHz station) or modem**
- | **installation : before the end of 2003**

A new Master Beacon



A new Master Beacon



New Time Beacons?

è Requirements

- | improved on-board USO monitoring (JASON1)
- | faster initialization

è Solution: new Time Beacons

- | atomic clock
- | TAI connection
 - F GPS receiver
 - F SSALTO processing in the future

è Proposals are welcome

SSALTO

the new multi-missions orbitography and altimetry center



è Early and new instruments and/or missions

- | Early missions (SPOT 2 & 4, TOPEX/Poseidon)
- | + JASON1 (DORIS, GPS, Laser, altimeter, radiometer)
- | + ENVISAT (DORIS, altimeter, radiometer)
- | + SPOT5 (DORIS)

è Data link with each satellite Ground segment

SSALTO

the new multi-missions orbitography and altimetry center



è SSALTO improved characteristics

- | modular conception allowing new instruments to be easily integrated
- | centralized data archiving
- | includes public results interface and distribution
- | beacons positionning is included in operational processing
- | capability to deliver a DORIS instrument Control Center for a « DORIS user » project => to be embedded in the Satellite Control Center