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Title: 20 years of evolution for the DORIS permanent network: from its initial deployment to its renovation
Authors: H. Fagard
Editor: P. Willis
Reviewer: G. Tavernier

Comments about the remarks that were not exactly followed, or deserve a comment:

General remarks:
In my mind, the paper is to long.

It has been shortened a bit, but not much as one of the reviewers said "Although the paper is somewhat lengthy, none of the information seems to be superfluous".

- how significant is the failure rate, do you have statistics on MTBF (Mean Time Between Failures)?

No

- Did you assess the impact of the local environment on failure rate?

No

There are many other reasons for stations unavailability: what about transport delays and hazards, custom and administrative proceedings, local problems such as power supply, communication difficulties, reaction delays...

Most of these parameters, which do have some influence on station unavailability, only contribute to make the replacement of a defective unit more difficult and longer. But the major and primary reason for station unavailability is equipment failures. If there were no failures, there would be no unavailability whatever the transport issues, customs delays, etc.

Chapter 10.4 The antenna stability evaluation might be removed:

The 5 other reviewers don't seem to think so.

Is this new evaluation really necessary? It has the same weakness as the previous one

No, it is much more detailed and less subjective.

and doesn't seem to be validated when looking for correlations with actually measured antenna eccentricity on some sites (see page 26).

See the end of section 10.4:
"But such an eccentricity check was carried out on too small a number of stations to be significant. Moreover, it should be noted that such a centring check only allows to survey the stability of the antenna reference point with respect to the mark at the base of the antenna. It doesn't allow detection of movement of the secondary support of the antenna (tower base or building), which can only be monitored through a footprint survey."

As mentioned in paragraph 7.1: "the actual stability of an antenna can only be properly assessed by surveying it at different epochs with respect to a stable reference mark" and reminded here: "The best way to actually assess the antenna stability would be to carry out stability surveys on a regular basis."

Yes but section 10.4 also says:
"Since this would require human and financial means well beyond those allocated to the maintenance of the DORIS network, other approaches had to be considered"

Page 1
Author : Hervé Fagard
As mentioned in the abstract and introduction, IGN has taken care of the deployment of the DORIS ground network and is also in charge of its operational maintenance. This major contribution to the DORIS system is achieved by a whole team. As far as I know Hervé Fagard usually deals with new sites

...and all existing ones

and it's hard to believe that the members of his team in charge of the operational maintenance of the network did not contribute to this very interesting paper.

Yes they did, providing: figures about the network operation rate in 2004 and 2005 (former figures are from Fagard & Orsoni 1998, 2000), figures about the distribution of the different kinds of failures, detailed information about the third generation beacons failures, interruptions of emissions due to VLBI campaigns and Ariane launches (all dealt with in section 9.2), and current equipment distribution (10.1).
As they have not written any part of this paper, nor reviewed it, is providing such material sufficient to qualify them as co-authors? What about people that have formerly contributed for years to the DORIS network installation and maintenance (Claude Boucher, René Picot, Gérard Imbert, Michel Lansman, Alain Gervaise, Alain Orsoni, Pierre Vergez)?

Page 2
Abstract
An intensive activity on account of a significant failure rate of the successive generations of equipment: see general remark

See reply to general remark

a very good coverage rate of the satellites orbits --> a very good coverage ratio of the satellites orbits.

"Rate" is correct, as confirmed by all other reviewers, most of them native English speakers.

Through a large number of well-distributed co-locations with the IGS, SLR and VLBI networks :
either IGS, ILRS and IVS or GPS, SLR and VLBI + general remark on abbreviations and contribution to the IERS frame --> and contribution to the IERS reference frame.

Page 3
Introduction
(…): what is the purpose of the DORIS system? What are its
main features? What are its components ? Which requirements and accuracy?

See new introductory paragraph + reference to Jayles et al.

Because of its experience in the field of the installation of geodetic networks -->
Because of its experience installating geodetic networks,

"installing" would be more correct than "installating"

it was estimated that the network should be made of approximately 50 stations, as evenly distributed as possible around the globe: this initial requirement only applied for TOPEX/POSEIDON launch in order to contribute to the gravity model improvement (the main error source for orbit determination at that time). Once the gravity model would have been improved, the network might have decreased.
As a matter of fact, the success and achievements of the TOPEX/POSEIDON led to new requirements. It was then decided to maintain this network and even to improved and increase it.

Several lines to say that the network required – and still requires – 50 stations. As some reviewers have complained about the paper being too long, I don't think adding such considerations is useful.

we will go in detail through the history --> we will scrutinize the history

According to my Robert & Collins, "to scrutinize" usually applies to documents. "detail", as suggested by another reviewer, was preferred.

with other space geodesy technique networks.--> with other space geodesy techniques networks.

No, "space geodesy technique" is a qualifier of "networks"

2.2 Selection of a host agency
After a site had been a priori selected --> After a site had been identified

Compromise between several revs.

with mains power supply available --> with main power supply available?

Seems OK for native English-speaking revs.

Page 5
as well as sending out of order equipment --> as well as sending back out of order equipment

see new wording, following other revs' comments

This negotiation stage generally took several months --> This negotiation stage generally lasted several months
took up to two or three years in succeeding --> went on two or three years before succeeding

see new wording, following other revs' comments

Page 6
3. Identification of the DORIS site and points
Therefore a more accurate name (Santa Cruz, i.e. the name of the island) was chosen when a new station was installed in March 2005, in order to avoid confusion with the first station installed at Sán Cristobal island, inaccurately named "Galapagos".
The example is rather unjudicious as the same name was given to at least 30 towns (1 in Argentina, 2 in Azores, 1 in Bolivia, 5 in Brazil, 2 in Canary Islands, 2 in Cuba, 1 in California, 1 in Chile, 3 in Mexico, 1 in Peru, 5 in Philippines, 1 in San Jose, 2 in Santo Domingo, 2 in Spain, 1 in Venezuela), 3 other islands (Brazil, California, Melanesia), 2 rivers (Argentina, Cuba), 2 mountains (California, Guatemala) and even one airport (India). Is Santa Cruz really more accurate?

Thanks for this interesting tour of the "Santa Cruz" places in the latin world, but there is only one "Santa Cruz" in the Galápagos archipelago so this new name is more accurate than that of a 11 island group.

Page 7
The very first station at Reykjavik, equipped with an Alcatel antenna, was "REYA": when?
After the Alcatel antenna was replaced with a Starec on the same tower, it was "REYB": when?

Not relevant here, we're dealing with a naming convention, not with the history of DORIS occupations at Reykjavik

There have been a few exceptions to these rules --> There are a few exceptions to these rules

A past tense was used, as the rule is now better followed

“Koke’e Park” --> “Kokee Park”?

“Koke’e” is the correct wording in the Hawaiian language

A weather station (figure 4) measuring temperature, pressure and humidity: which accuracy?

Information added for the three generations of met stations

5.2 Alcatel antenna layouts
a standard set of antenna supporting devices was sent --> a standard set of antenna supporting devices was usually sent to new sites

Useless detail, as all sites were “new” at that time.

Page 10
At a few sites where the antenna was installed on a roof, a clear sky view allowed to use only one tower section --> On a few sites where the antenna was installed on a roof, an open view allowed to use a single tower section

New wording is a compromise between several revs comments

a maximum of 14 units have been operating simultaneously in the network --> a maximum of 14 units were operated simultaneously in the network

New wording following a request from another rev.

6.1 Description of the second generation equipment
The new antenna model (Figure 11): Figure 11 only shows the bottom of the antenna. A picture of a whole antenna would be more appropriate

This is intentional. Such a close view allows to clearly see the assembly of the antenna on top of the pillar. There are plenty (even too many according to some reviewers) of “pictures of a whole antenna” in the paper.

Page 12
the internal one on the first generation beacons has been the cause of most failures --> the internal one on the first generation beacons was the cause of most failures

As there is no exact time reference in this sentence I think the use of the past perfect is more appropriate, which seems to be confirmed by no remark from native English-speaking reviewers on that point.

Very few such units have been deployed --> Very few such units were deployed

Past perfect: same remark as above

7 THE RENOVATION ERA
for the realisation of the IERS Terrestrial Reference System --> for the realisation of the IERS International Terrestrial Reference Frame

A Frame is the result of the realisation of a System, although it is of common use to (not quite rigorously) talk about "the realisation of the (ITR) Frame. IERS was removed as it is not necessary (source: Zuheir Altamimi).

Page 14
7.1 Network preliminary review
Such an evaluation --> This evaluation
A more refined stability assessment will be presented in chapter 10.4.: I think that the same restriction apply to this new assessment, thus limiting its interest.

I don't claim that the second assessment is perfect, but it is more refined and less subjective. As no other reviewer has questioned the interest of this assessment, it will be maintained in the paper.

Page 15
7.2.2 Design 1: concrete pillar

What about the use of bent connectors? Extra connections in the sometimes very corrosive open air can lead to contact problems, especially with "laboratory" connectors (not designed to be used outdoors). Due to constraints, the connectors might break, requiring the antenna to be replaced. These connectors turned to be the cause of some antennae failures requiring their replacement (1 confirmed, 3 under investigation)
According to lessons learnt, why not use a one meter lattice tower over the pillar:
- to avoid the use of a bent connector
- to minimize connections and corrosion opportunities
- to improve the "clear view"
- to minimize multi-path effects (reflexion on the ground)

See the updated sections 12.1 and 12.2.

Page 16
7.2.3 Design 2: self-supporting metal tower
One advantage of this kind of support is that it allows a direct cable connexion, avoiding the use of a bent connector

The drawbacks should also be addressed (more prone to corrosion), which would result in adding extra detail to an already lengthy paper.

Page 17

7.2.4 Design 3: antenna on a building
Using only one section of a 32 cm sided tower (figure 24), or a half-metre 17 cm sided one (figure 26) – which has the additional advantage of fitting on narrow concrete beams – guarantees an optimal rigidity of the support: are these two supports equivalent on the stability point of view?

The words "and equivalent" were added. Moreover, the answer is in the spreadsheet provided in the ESM.

7.4 The progress of the renovation
2 stations have been removed and not yet replaced --> 2 stations were removed

No, replacement is being considered (although at different locations) for both sites.

The renovation turned out to be much longer ... to a successful conclusion. This last paragraph is not very clear, is it really useful. "The renovation was a long and complex process, with sometimes more than one year for a renovation and more than 3 years for a new installation" would be clearer and more simple.

See new, shorter wording, taking another reviewer's comments into account.

8. THE IDS NETWORK AUGMENTATIONS --> "augmentations"? not very clear

Clear for all other 5 reviewers, most of whom are native English speakers

Page 19
with varied scientific objectives and for varied durations. --> with various scientific objectives and for varied durations.

Corrected, taking another reviewer's comments into account.

The following experiments have been carried out to date --> The following experiments were carried out to date

No, extended time period without accurate time reference → past perfect (native English-speaking reviewers OK)

on the Sorsdal glacier, Antarctica, by operating a DORIS station for about three months twice, during the austral summers 2002-2003 and 2003-2004. --> I think that it was a few weeks in December 2001- January 2002 (Sorsdal), January 2003 (Lambert) and January 2004 (Sorsdal). Possible reference: paper by Valette, Govind and Lemoine, same issue

This paper was not submitted

It was removed in January 2004 after producing little data, due to interference to the VLBI on one hand, and an equipment failure on the other hand: to be accurate, the

DORIS beacon was often turned off (almost every day) to avoid interference with the VLBI. The stand-by mode should have been used instead to keep the Ultra Stable Oscillator “warm”. Moreover, it was operated in shifted frequencies to avoid jamming with the nearby DORIS stations and at that time, Jason-1 was the only satellite able to perform measurements on such a station (today, SPOT-5 and ENVISAT could also perform such measurements).
Because of a failure of the second generation beacon shortly after its installation: as far as I know, strong winds (up to 200 km), a very dry climate and the nonconducting soil (lack of effective ground) produce high levels of static electricity in antennas, cables, leads, etc. and in many times it damaged electronic instruments connected to them on this site. People in Belgrano II noticed that when touching the PC terminal or Beacon, it produced a little electrostatic discharge between their finger and the beacon’s chassis.

Unnecessary details: some readers (including yourself) have complained about the paper being too long.

9. THE NETWORK MAINTENANCE
9.1 Maintenance running
Remark: SSALTO, the multi-missions orbitography and altimetry center is a facility devoted to the DORIS system and to altimetry missions control and processing. Located in CNES, Toulouse, France, it is in charge of □station network monitoring, science telemetry acquisition and pre-processing, □technological archiving, □precise orbit determination, □station precise positioning, DORIS integrity control. The network is monitored by the DORIS integrity team which associates operators, DORIS experts and the network maintenance team. Possible reference: paper by Jayles, Nhun Fat and Tourain, same issue (DORIS: SYSTEM DESCRIPTION AND CONTROL OF THE SIGNAL INTEGRITY).

These details are somewhat out of the scope of this paper. The short paragraph added at the beginning of the introduction leads the reader who wants additional information about the system’s other components to read Jayle’s paper.

An anomaly is detected by the DORIS control centre --> An anomaly is detected by the DORIS integrity team

The new name was added but “control centre” was retained as it was the name used for most of the 15-year operation of the DORIS system.

9.2 Maintenance statistics
The proportion of emitting beacons in the network averages to about 85 %, with lows at 80 % and highs reaching 95 %: to which time span do these figures refer?

Like the title of the paper suggests: unless specified differently, to the whole DORIS history.

Because of very long repairing delays and frequent shortages of spare units, a few

stations have remained down for several months before they could be replaced: long repairing delays and frequent shortages of spare units are not the only reason. Administrative and custom steps, transport delays and hazards

OK, added.

(beacons are available for months to be installed in Russia and we may still have several months to wait).

This (excess spare beacons WRT the network maintenance and renovation demand) is a very new situation, concerning only a very short time span WRT the whole DORIS history.

before they could be replaced --> before equipment could be replaced
This rate nevertheless allows the global coverage rate --> This rate nevertheless allows the global coverage ratio

"rate" is correct

This coverage rate --> This coverage ratio for high altitude satellites like TOPEX-Poseidon and Jason-1 (both at 1330 km altitude): 1330 km is high for a LEO satellite, but it is still a LEO (Low Earth Orbit) satellite. GPS (20000km) and geostationary satellites (36000 km) are much higher.

OK, wording was changed.

this model did not turn out to be more reliable than the first generation: some first generation beacons are now 20 years old and still working. Were they really not reliable (…)

This doesn't make the sentence "this [second generation] model did not turn out to be more reliable than the first generation" mistaken. I've said and I will stick to it: the second generation beacons were not more reliable than the first gen ones.

Page 23
10.4 The antenna stability evaluation
"in the frame of the definition of criteria for site quality aiming at identifying a set of core stations with accurate coordinates contributing to the ITRF (IDS 2004)":
- the IDS 2004 recommendation was "An IDS Working Group should define criteria for site quality (quality of equipment, reference point stability, reliability of power supply, quality of station coordinates time series...) in order to identify a set of reference stations with accurate coordinates contributing to ITRF. The Working Group will also maintain a list of stations (DORIS permanent network, IDS campaigns) that contribute to the IDS."

I don't see what is wrong in my sentence…

- The aim was to determine which station should contribute to ITRF and which should not and the quality of the antenna support is one criterium among other (see below).
- On the stability point of view, a revised evaluation similar to the preliminary review would be clearer and sufficient.

He who can do more can do less. The detailed figures (ID) which are the output of this assessment will be easier to combine with other criteria than a 4-possibility evaluation.

- Moreover, lessons learnt on some sites may modify part of your analysis.
“A stability study based on the statistical analysis of several years of DORIS weekly station coordinates”: this is not an antenna stability study. You are mixing basic elements related to the quality of the antenna support with an end-user product (weekly station coordinates) analysis, the quality of which depends on many other elements (masks, radio-frequency jamming, ionospheric scintilliation, site location and stability, operating rate and performance of the system...).

See modified text.

Global site quality assessment should include different distinctive aspects:
- antenna stability
- maintenance
- contribution to the DORIS system (geographical orbit covering, redundancy...)
- geodetic and tide gauges co-locations
- contribution to POD
- station coordinates times series
- statistical analysis of products

Some of these aspects have been addressed by IGN, others should be addressed by other people.

Page 24
Figure 31 shows the result of such an assessment, for the same network as on figure 16, but using this more detailed and less subjective approach: the new figure, with too many “values” (11 instead of 4) difficult to distinguish is rather confusing.

There are not 11 discrete values for ID, but a continuous range.

For instance, is MORA better or worse than KERB ?

The objective of this figure is not to allow a specific comparison between two stations with almost the same ID (such detailed information is available in the ESM), but to show a general picture of the network estimated stability, and above all its definite improvement over 6 years, which is clear when comparing figures 31 (now 29) and 32 (now 30).

As the new assessment has the same weakness as the previous (no stability surveys on a regular basis), was it worth the confusion?

Which confusion? No other reviewer was confused. The new approach is more rigorous, it takes more elements into account, but it doesn't claim to be perfect.

Page 26
D. Whole site / geological stability: little can be done as far as this criterion is concerned, other than choosing another site. For lack of detailed information, this was set to 2 for most stations, and the weight was set to 1, so that it would have little influence anyway on the result of the assessment: the site geological stability should be a very important criterion. Either it is too difficult to assess and it should be removed, or it has to be assessed. What is your position and what are your future plans?

It should be assessed, text was modified.

Figure 32 shows the antennas stability degree at the time of writing: same comment as figure 31 page 24.
An update of figure 16 would have been more convincing for me.

Same reply.

No correlation can be seen between the antenna stability index on one hand, and the actually measured antenna eccentricity at these sites: so was is really useful and is it worth keeping it.

The antenna eccentricities only refer to the ground mark, they don't take e.g. building movements into account, as clearly stated at the end of the paragraph.

Page 27
The third approach dealt with in (Le Bail submitted) assesses the actual antenna instability: I do not agree (see my comments on page 23).

OK, see modified text.

Page 29
11.3 Determination of a priori coordinates for the realisation of the IERS terrestrial reference frame --> for the realisation of the IERS International Terrestrial Reference Frame

Changed "Frame" to "System", and removed "IERS" (see reply to similar remark about section 7).

Page 30
11.4 Co-locations with other IERS techniques
Among these, some are 3 technique co-location sites--> Among these, some are 3 techniques co-location sites

No, "technique" is a qualifier of the noun "sites" (other examples: a three-star hotel, a four-storey building, etc.) (native English-speaking reviewers OK)

for which the inter-technique distance is less than 10 km: how was this value defined?

A limit has to be set. This round number allows to retain almost all potential co-location sites, while rejecting a few much longer distance ones (e.g. Goldstone, Kourou). See added information about co-locations.

projects for new stations in the Pacific Ocean (Tarawa, Kiritimati, and Adak): the Adak site would be nice but it might be difficult to find a suitable host agency

Why give additional detail for this project, not for the other ones?

Page 32
12. PLANNED EVOLUTIONS
12.1 Strengths and weaknesses of the DORIS network
Point 2: "It has practically the right number of stations to meet its primary objectives": strange statement. Is this point really "speaking" and useful?

5 other reviewers OK, so I'll leave it as is.

The PRARE network (Massmann et al. 1997), which initially aimed at achieving the same objectives at DORIS, has 10 stations operating: as far as I know, there are not so many PRARE stations still operating. Only 2? Please check

See ftp://ftp.gfz-potsdam.de/home/kg/PRARE/ERS2/PRARE2_INFO/WEEKLY_REPORTS/last_weekly_tracks.gif which shows that the network still comprises 10 stations, although only 2 were operating last week.

Points 3 (It makes the IERS network denser) and 4 (Unlike other IERS techniques) proceed from point 1. They should illustrate point 1 instead of appearing as specific strengths.

Point 4 has been merged with point 1 as suggested. But point 3 deserves being stressed by appearing as a separate item, as it is a major advantage of the DORIS network WRT similar networks.

to detect serial problems and take the necessary corrective actions --> to detect recurrent problems and undertake the necessary corrective actions.

New wording takes other another rev's comments into account.

Page 33
will remain impossible to fill for lack of islands --> will remain impossible to fill owing

to the lack of islands

All native English-speaking reviewers happy with "for lack of".

an additional station South of Japan: an alternative option in that area could be the Kouriles Islands

No, such a location would be too close to SAKB, and would not improve the coverage

The planned installation of a station at Tamanrasset (Algeria) would significantly improve the robustness while adding one more GPS (and maybe SLR) co-location.while adding one more GPS (and maybe SLR) co-location: currently no SLR station on this site.

This is why the word "maybe" was used…

Moreover, accurate simulations have shown that this is not a critical weakness and that a new station there would only slightly improve the network coverage and robustness.

OK, "significantly" was changed to "slightly"

there is a huge area between Metsähovi, Hartebeesthoek and Jiufeng where no such co-location is present:
although it is still interesting to add new SLR/DORIS co-locations, "huge area" might be a little exaggerated

A 5500 km radius (measured on the Earth's surface) circle fits between these three stations, covering an area of 90 million square km, i.e. about 1/6 of the Earth's surface. I do maintain the word "huge".

The main reason for DORIS data loss has essentially been the significant failure rate of the ground equipment: see general remark

OK, additional information was provided.

Page 34
12.2 Evolution plans and proposals
A new station should be installed at Rikitea (Polynesia), which will eventually replace the one at Rapa.
Moreover, new stations are in project at Tarawa and Kiritimati (Republic of Kiribati), Adak (Aleutian Islands), Tamanrasset (Algeria) and Riyad (Saudi Arabia). Figure 40 shows the location of these planned new stations: already mentioned in 12.1 Strengths and weaknesses of the DORIS network

True, but it does no harm to mention again, in a concise manner, all pending projects in the "evolution plans" section.

When starting the “renovation era” at the end of 1999, new accuracy requirements had to be assessed and taken into account and lessons learnt entailed corrective actions. More than 6 years later, what about the current requirements and lessons learnt on the occasion of this major renovation activity?
Possible issues:
- new design for the support (See my comments on page 15 7.2.2 Design 1: concrete pillar)
- use of “laboratory” bent connectors

OK, see updated section 12.2.

- multipath effects
- clear view constraint: 10 degrees might not be sufficient today as some new instruments are starting measurements with a 8 degrees elevation

No clear information nor updated specs from CNES on these topics at the time of writing, so I’m still sticking to the existing requirements, which have been taken into account while deploying and upgrading the network over two decades.

- way to check the clear view: which reference height?

No clear specs from CNES on this topic. A detailed question was asked to CNES in July 2005, no reply at the time this paper was written.

Use of a force-centred adaptator on the antenna supporting plate for an instrument to assess masks and to take “panoramic” pictures

Not really useful in this paper, would add extra unnecessary detail.

In spite of the overall good quality of the DORIS network and owing to the continuously improving scientific results achieved with it, a more prospective analysis would be very interesting here.

See updated section 12.2.

Page 35
Moreover, the massive deployment of third generation beacons gives us hope of a near 100 % operating rate: this might be a nice utopia. Even if the beacons tend to be more reliable, some failures will still happen and local environment and constraints will prevent from reaching this rate. A more realistic target should be 90% as a mean value and up to 95%.

See new wording.

By agreeing to criticize ourselves we allowed the network quality to progress significantly: the point is not to criticize. IGN did a great job deploying the network,

maintaining and improving it. The requirements were globally fulfilled... but these requirements constantly evolve (see my remark about TOPEX/POSEIDON in the introduction). What is important is to assess the requirements and to analyse lessons learnt in order to keep improving the network quality (availability, antennae stability...). This approach was requisite in 1999 and it still is today (don't use a past tense).

See new wording.

14. ACKNOWLEDGEMENTS
We also wish to thank the developers of the Generic Mapping Tools software (Wessel and Smith 1998), which was used to plot all maps in this paper, as well as for the continuous management of the network's evolutions: shouldn't this kind of statement be in the text rather than in the acknowledgements?

Doesn't it make sense to put an acknowledgement… in the acknowledgement section?

Page 36
References
Some DOIs are missing
URL could be indicated for non published references

OK, I added the DOIs I could find, and a couple of URLs

Page 40
Figure 1: caption Station upgrade or moving → caption Stations upgrade or moving

Text was changed, but following a native English-speaking reviewer's suggestion

Page 42
Figure 11: which station?

Insignificant here, as the objective of this picture is to show in detail the antenna and plate assembly

Page 45
Figures 20, 21 and 22: depending on the final size of the figures in the article, part of the text may be hard to read (font size).

It looks OK when printed on an A4 page, but will be checked with the editor at the final stage before publication

Page 46
Figure 25: it's hard to find the antenna in this picture.

This is why an red ellipse was drawn

The picture was apparently shot “from above”.
How high? Is the requirement for a clear view above 10 degrees fulfilled?

The purpose of this picture is to let the reader think that the antenna was placed randomly on the roof (which is not the case, as explained in the legend), not to discuss where the picture was taken from or how good the sky view is.

Page 48
Figure 30: pictures of SPOT-5 instead of SPOT-2 and Jason-1 instead of TOPEX/POSEIDON would be more up to date.

I agree, but SPOT-2 and Topex have operated much longer than SPOT-5 and Jason over the 15-year DORIS system history.

The “DORIS Control Center” should be split in two different component: the Satellite Control Center (antenna: one for each satellite) and SSALTO, the multi-missions orbitography and altimetry center.

OK but this is a recent evolution, considering the whole DORIS system history.

IGN/SIMB should be part of the DORIS integrity team (see my remark page 20). Exchanges between SSALTO and the DORIS integrity team are two-way and more Sophisticated

OK, but the current sketch is sufficient to make the reader understand the role of SIMB as an intermediary between the control centre and the host agencies.

Figure 31: the different colors and sizes might be difficult to distinguish in a black and white and possibly smaller picture in the final version of the article.
Figure 32: the different colors and sizes might be difficult to distinguish in a black and white and possibly smaller picture in the final version of the article.

The paper will be in colour, both in the printed and the electronic version. Moreover, see my reply above Re. these figures.

Figure 33: where is the 400MHz phase center of the Alcatel antenna?

Not important, as the actual positioning measurements are performed on the 2 GHz PC, whose position is shown here because of they are mentioned in the text (eccentricity to be taken into account when surveying, in case of an antenna tilt).
The figure was modified, and a table (with detailed information about all PC positions) added following another reviewer’s request.

Page 50
Figures 34 and 35: are they really useful?

They show the way both antennas are surveyed using GPS. Some reviewers seem to find them useful.

Figure 36: : the different colors might be difficult to distinguish in a black and white and picture.

The paper will be in colour.

The circles with sectors should be bigger.

OK, their size was slightly increased.