

Review: J. Geodesy Paper, 20 years of evolution for the DORIS permanent network: from its initial deployment to its renovation, by Herve Fagard.

Summary:

The paper is a thorough and comprehensive summary of the evolution and current state of the DORIS ground network. Because of its breadth and detail, this paper will serve as a general reference for a description of the DORIS network for many years, especially since DORIS is one of the four geodetic techniques that contribute to the ITRF and the IERS. The author is to be commended for assembling this major work.

Nonetheless, the paper is very long, and below I suggest some sections that might be abbreviated. The collocation table in the ESM (electronic supplementary material needs to be rechecked (see notes below). The abstract should be made more concise and descriptive of the content of the paper. The conclusion might include not only recommendations for the location of future stations, but also perspectives on how we can be assured the monumentation will remain stable given the need to maintain a stable ITRF (to within tenths of mm/year to assure stable measurements of sea level change) and measure geophysical phenomena (e.g. geocenter). Given his unique position, the author could offer observations on further improvements to the DORIS monumentation, and or the feasibility of densifying the network for use with the new multichannel spaceborne receivers. I recommend publication of the paper after the author tends to these issues and the points detailed below.

Detailed Commentary:

1. Abstract should be made more succinct, mentioning no of operational beacons, no of collocations, general purpose of paper.
2. Section 2.2: Not sure what is meant by equipment needing to be in room with “moderate temperature gradient “– perhaps what is meant with “moderate temperature variations.”
3. Section 2.2. By Vaisala receivers, are these on the radiosondes?
4. Section 3.0, Define DOMES number. Where do they come from?
5. If Section 4.0 is meant to be a summary of the network, and set the stage for the subsequent sections, it needs to cover (1) Evolution in positioning requirements (at inception vs. post 2000); (2) Evolution in beacons and antennae
6. Section 5.1, and later section (7.3, pp 17): Suggest other wording rather than ‘Integrated man-machine interface’, which sounds like a Borg implant. Also phrase “moderate temperature gradient” appears here as well.
7. The met package is briefly described (section 5.1) and it is said later improvements are made – however this description is weak. How accurately are

T, P, H measured in the various met system incarnations, and are the data reliable?

8. Section 5.2, first sentence is quite awkward. Suggest instead “IGN-F sent a stand set of antenna support devices in order to adapt to the different site layouts likely to be encountered.”
9. Section 5.2, page 10 top; which stations had the tower assembled in four sections?
10. Section 6, pp 11. “Yaragadee” is misspelled throughout paper; should be “Yarragadee”
11. Section 6.1 Specify stations affected by tilt and corrosion.
12. Section 6.1, pp11-12. As a matter of style, it might read better and be more concise if the bulleted points were written as narrative rather than as “bullets.”
13. Section 7. Don’t understand sentence “Such a policy has been applied until the end of the 90’s with no on-site intervention motivated....”
14. Top pp14, section 7; suggest use of active voice ... e.g. “IGN-F and CNES decided...” rather than “It was decided”.
15. Top pp 15, section 7.1, last sentence “The antenna centring turned out to be still within a few mm after more than ten years for several Altcatel...” Don’t understand this sentence. If the centering is within a few mm, is that not a good thing?
16. Section 7.2.1, would not routine analysis by analysis centers uncover antenna shifts of this sort?
17. Section 7.4. Suggest replacement second sentence “During this six year period, the following improvements IGN-F and the CNES made the following improvements to the network:”
18. Suggest replacement of last paragraph in section 7.4 with sentence “The progress of the renovation was affected by the need for detailed site survey and the elaboration of logistical details for new installations and renovations, with some projects requiring 3 years to complete.”
19. pp 19. The Antarctica campaigns were done on the Lambert and Sorsdal glaciers.
20. PP 20, section 9.2; maintenance statistics. A chart of the percent operational beacons vs. time would be extremely useful.

21. Suggest elimination of paragraph, pp 21, “Because of the shipment waiting period”
22. PP 21, as a matter of style, the bulleted information could be handled better in a narrative. Since 78% (a large) no of the maintenance requests involved time or frequency adjustment, some discourse on this might be appropriate since this appears to be a major factor in system reliability.
23. Bottom pp 21. Do we know what percentage of the time the Yellowknife and Syowa stations, and the Ascension and Libreville stations were shut down to avoid interference with VLBI or launch operations?
24. Paragraph on custom clearance formalities is unnecessary detail.
25. pp 22/23. Section 10.1/10.2. Perhaps this bullet information could be summarized in tables?
26. Section 11.3. Determination of a priori coordinates. This section is not necessary. It would be sufficient to say at the end of section 11.2 that A priori coordinates result from collocations/ties with other techniques, connections with previous DORIS beacons or GPS survey.
27. Section 11.4. This section needs to begin with the definition of what constitutes a collocation. Are sites that are several km apart truly collocated? While the section focuses on collocation with current geodetic techniques, if there is any information on ties between DORIS beacons and old Transit/Tranet/Doppler beacons this might be provided in the ESM. This is of historical but not inconsequential importance since the GEOSAT Transit/Tranet/Opnet stations have no direct tie to current SLR/DORIS/GPS reference frames. I also think the ESM or in a table, there should be a list of the currently known tie vectors and their associated uncertainties, and the dates of the last surveys (for the SLR/DORIS/VLBI ties, and even the Transit ties, if available). This would be **extremely** useful. The ESM material does not list the distances to the tidal collocations. Another column in the table, or a separate table would be useful.
28. Section 11.5. The internal DORIS ties should also be documented in the paper, probably in the ESM, along with the dates of the surveys establishing the ties, and the associated uncertainty. It should be mentioned that the benefit of such a tie vector is the ability to compute a better geodetic velocity from a longer time series.
29. Section 12.1, Is Gavdos also a station whose collocated GPS antenna could be made part of the IGS?
30. Section 12.2 could be subsumed into section 12.1 which would become a section 12.

31. In some places, paper refers to IGN-F, in others just IGN. Please pick one and be consistent.
32. Section 12 or conclusion. The “optimal” density of 50ish stations was designed with the idea of supporting POD on satellites with single channel receivers (Spot2, Topex). In a period where dual or seven channel receivers are the norm, is a densification of the network feasible? (Benefits better ITRF products, orbits done with reduce-dynamic techniques?)
33. Conclusion section. Last two paragraphs are a bit flat. Might mention that a new geodetic network conceived in the 1980’s now produces positioning on weekly basis at level of 10 – 15 mm, and contributes to success of altimetric missions. It is synergistic with other techniques, especially with SLR for POD applications. What are the biggest future challenges?
34. The figures in the paper show the DORIS tracking coverage in Mollweide or Hammer (or similar) whole world projection. The ESM might include current and projected coverage in polar projections (N and S Poles). This would be most interesting for polar altimetric missions (envisat, cryosat2).
35. Figure 33 shows the location of the 2 GHz phase center wrt. the antenna reference point. This (vertical) eccentricity for the two antennae should be documented in a table in the paper.
36. As a matter of stylistic preference, suggest “antennae” as the plural form rather than “antennas” throughout the paper.
37. Figure 29. An experiment was also carried out on the Lambert Glacier.
38. Figure 1 Replace “station upgrade or moving” with “station upgrade or move”
39. Commentary on ESM material: Collocation table:
 - A. GPS column four should be GNSS and “(IGS)” should be eliminated, perhaps with a note that at the time of this paper the collocations refer to GPS at present and not Glonass or Galileo.
 - B. Canberra-Orroral: SLR should be orange (former operating technique)
 - C. Goldstone was site of former fixed VLBI, and mobile SLR (which should be orange). Goldstone is also a VLBA station and data are used in VLBI solutions on an annual basis. For instance DSS 15 was scheduled for two experiments in 2005, and one was completed. It is true the productivity of the site as a VLBI station is not as great as many others, but an annual VLBI time series should exist.
 - D. Guam. GPS should be in green. Current GPS, unless GPS was not operating during time DORIS beacon was active.

- E. Huahine: SLR should be orange (former mobile SLR).
- F. Jiufeng/Wuhan: It is a site of a current GPS antenna. Suggest using “Jiufeng/Wuhan” as designation
- G. Monument Peak: Site of former mobile VLBI.
- H. Syowa: Listed as current VLBI station on IVS website.
- I. “Yaragadee” should be “Yarragadee”.
- J. Richmond: VLBI, SLR, GNSS should be orange. SLR at site was mobile (M).
- K. Collocation table should be on IDS website with links to site logs for other techniques.

40. Comment on Stability assessment ESM excel file.

- A. Measured “excentricity” should be “eccentricity”. What is the significance of this quantity?
- B. At the appropriate point in the text where the stability assessment is discussed there needs to be a table that summarizes the mean, standard deviation, and min/max values and which stations are min/max. The table should show this for (a) the start of the renovation; (b) status in march 2006, and it could be broken down in (b) by beacon and by antenna type.
- C. Suggest repeating line 3 (station names) just before final result (line 37) for readability.
- D. Perhaps a better name for “instability degree” would be “stability index” where like a golf score, the lower the better. The index is subjective, but since it is a primary tool for network assessment it needs to be documented.
- E. The stability index information should be placed on the IDS website attached to the station list and/or site log, and updated at regular intervals.

41. Commentary on Occupation Table:

- A. Suggest placing active stations in green; Closed non-operative stations in red (bold vs. plain text font does not quite make the distinction clearly enough).
- B. Perhaps Add comments about station incidents: i.e. FAIB, earthquake; AREA earthquake; GOLLA/GOMA, Landers earthquake; Ottawa station falling over; stations with corrosion problems, etc.
- C. A very useful table. Should be on the IDS website and updated on a regular basis with links to site logs.