



INSTITUT NATIONAL
DE L'INFORMATION
GÉOGRAPHIQUE
ET FORESTIÈRE

DORIS NETWORK 2022 STATUS REPORT

IDS Workshop, Venice, Oct 31 2022



Réunion Island, Indian Ocean

Jérôme Saunier, IGN France

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OVERALL PERFORMANCE REVIEW

Serving Space Altimetry and
Contributing to Geodesy

NETWORK GOALS AND ACHIEVEMENTS

Serving the space altimetry missions

Good coverage of ground stations for Precise Orbit Determination (POD)

Good data availability

Contributing to geodesy

Precise positioning of ground stations

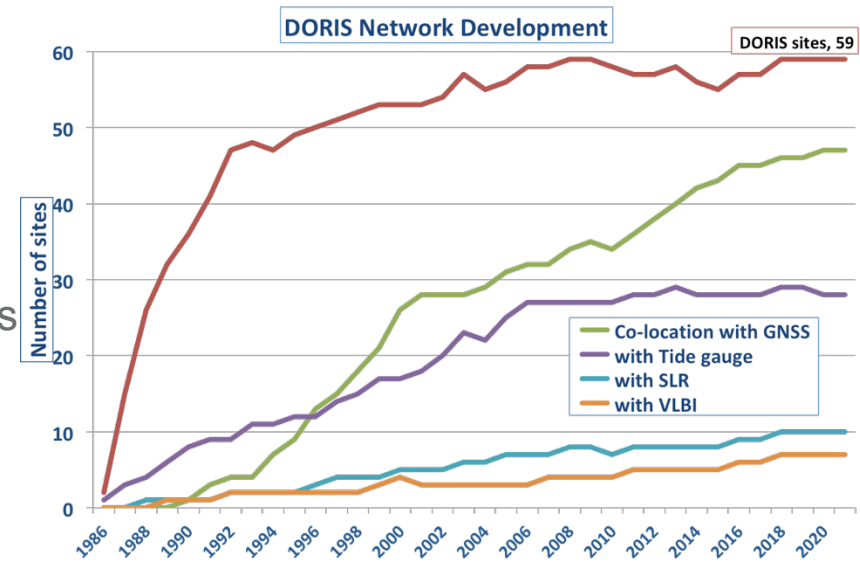
Co-location with other space geodetic techniques

Long time series

Network development

Between 55-60 stations over the past 20 years to maintain the required service for POD

Continuing effort to co-locate DORIS with other techniques



GEOGRAPHICAL COVERAGE

- 📍 Even distribution of the network stations
- 📍 Remaining coverage gaps in Southeast and Northwest Pacific, and Northern Australia



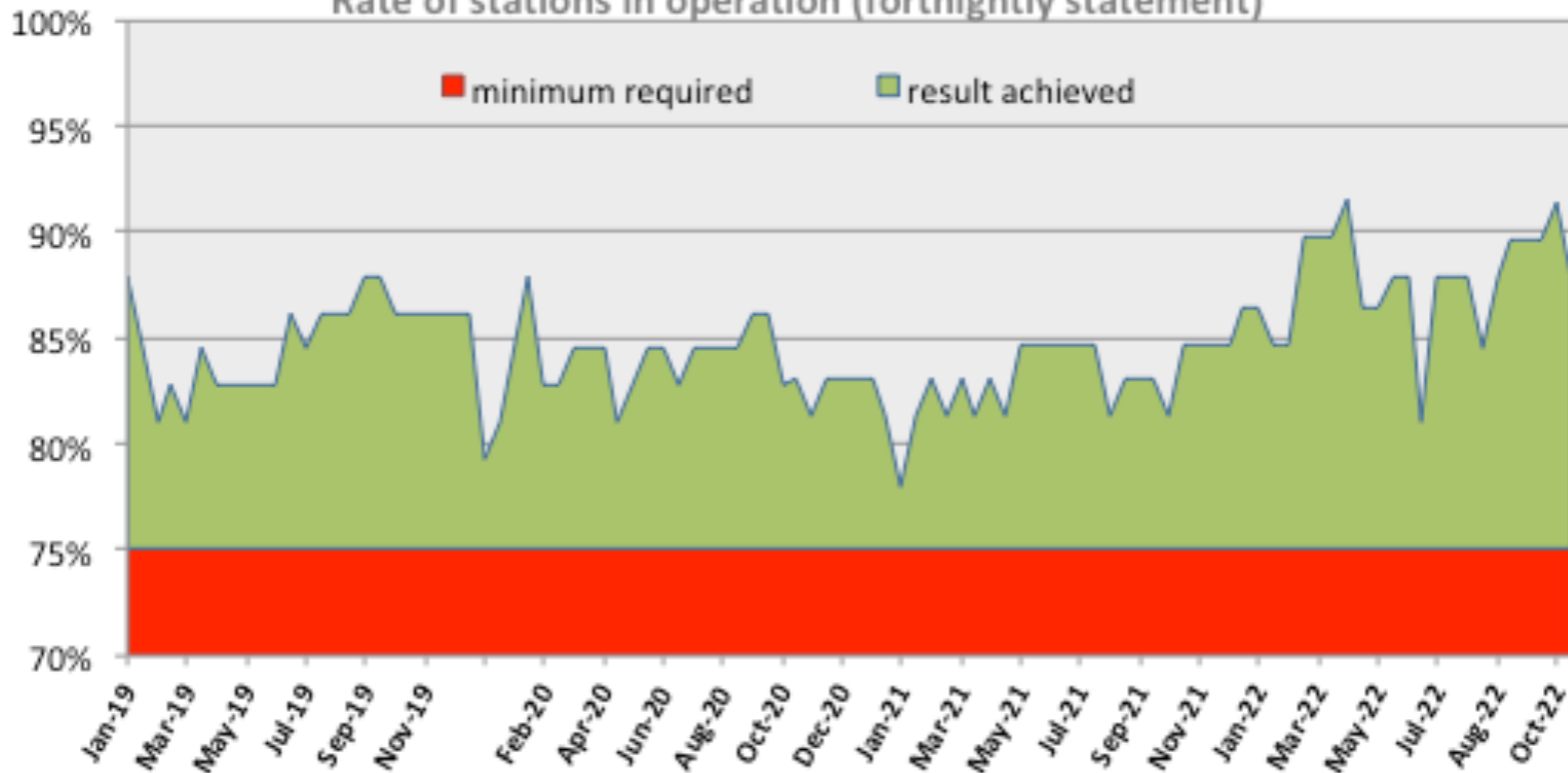
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NETWORK RELIABILITY

- 📍 Good rate of stations in operation: over 84% during the past four years
- 📍 Two difficulties over the period 2019-2022:
 - Wait for the start of the 4th generation beacon deployment in 2019
 - Covid-19 sanitary crisis in 2020-2021 blocking maintenance field operations

Network availability 2019-2022:

Rate of stations in operation (fortnightly statement)



CO-LOCATION WITH OTHER TECHNIQUES

📍 49 stations out of 58 co-located with at least one other IERS technique

📍 Systematic site surveys by IGN to contribute to the ITRF construction

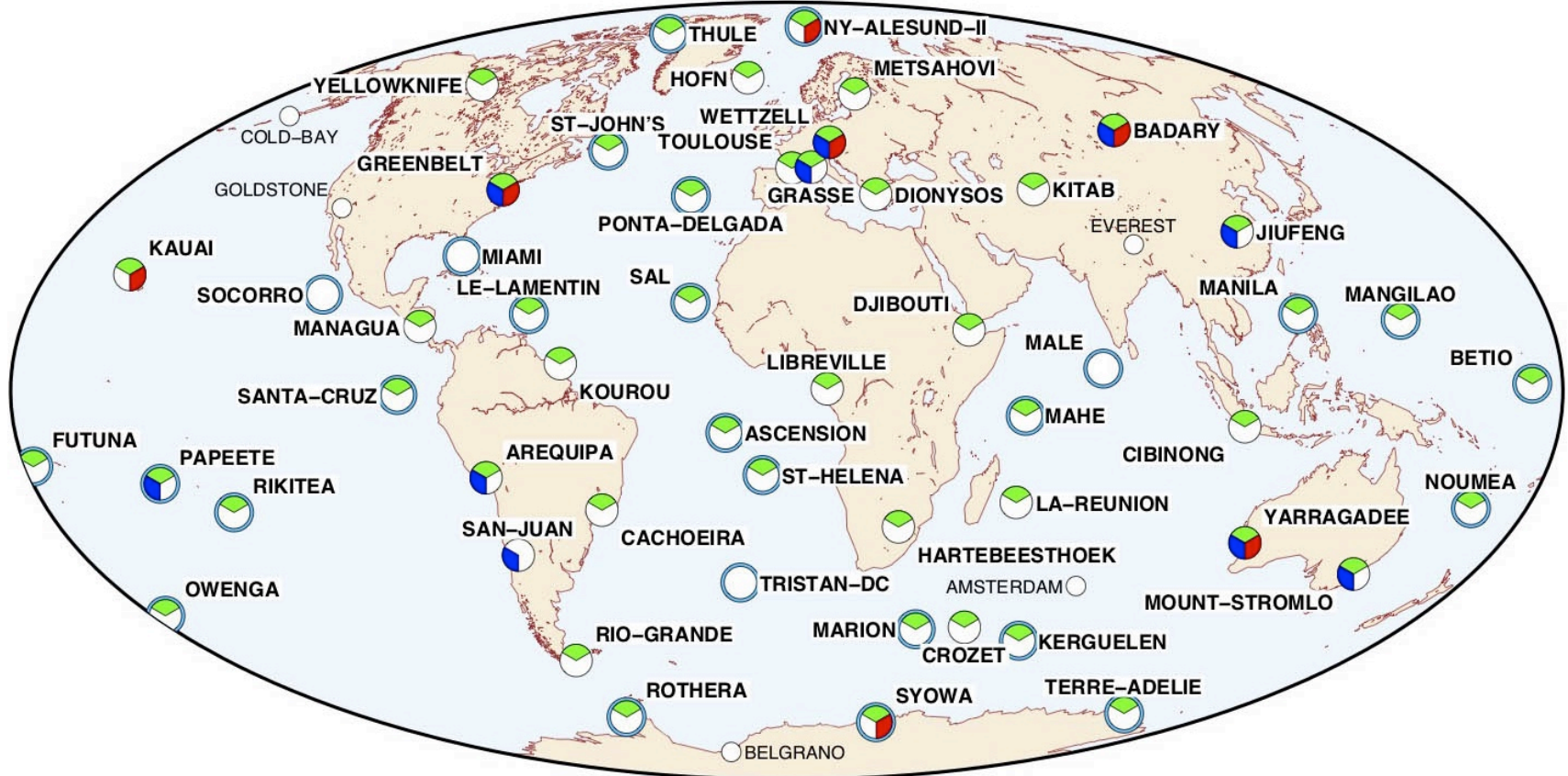
48 📍 GNSS (IGS)

10 📍 SLR

7 📍 VLBI


27 📍 Tide gauge

📍 No active co-location



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CONTRIBUTION TO ITRF2020

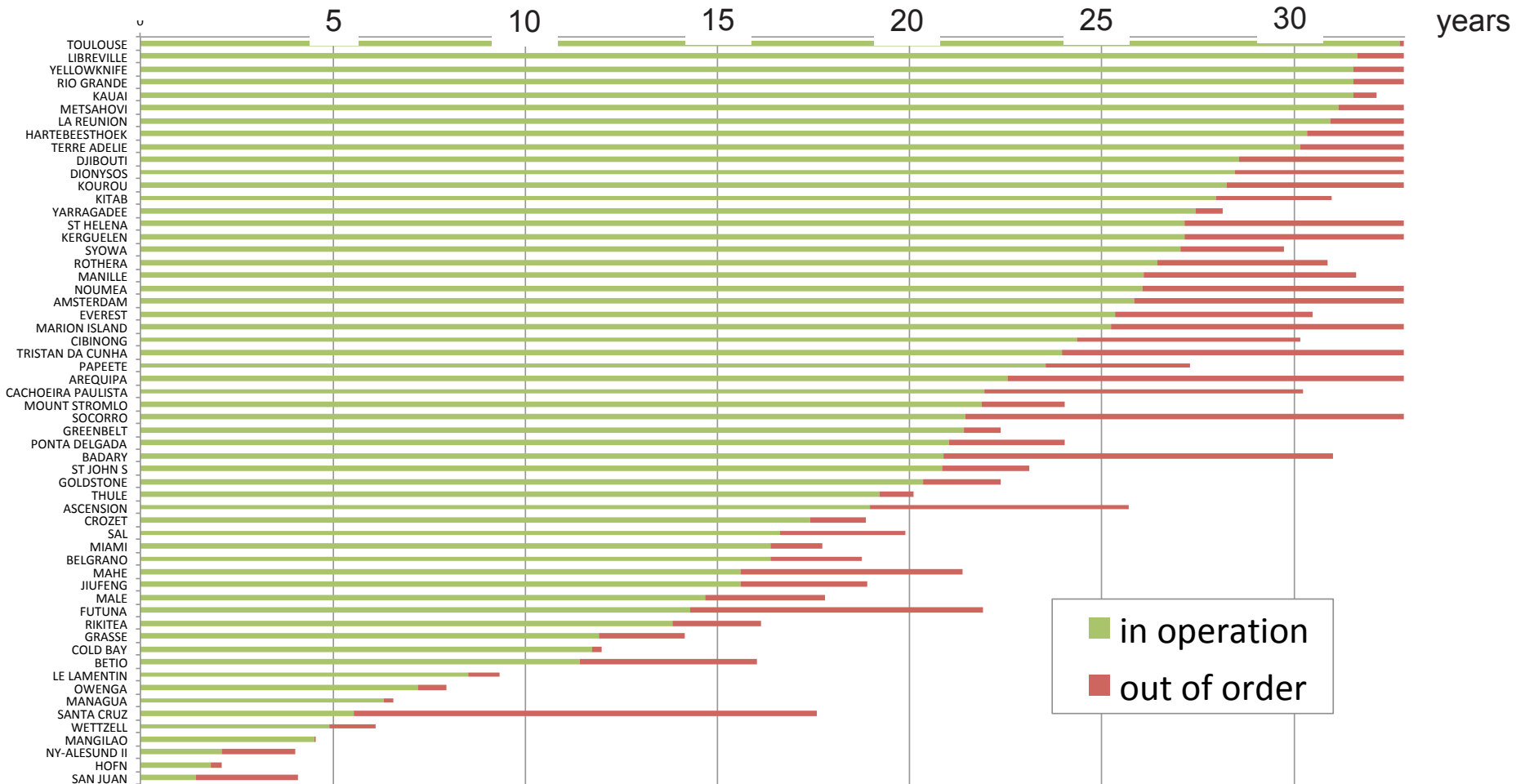
 Delivery of new Tie Vectors (SINEX files) to ITRS Center: 26 site surveys performed by IGN between 2013 and 2020 on the occasion of on-site operations for DORIS or REGINA (CNES/IGN Global GNSS Network)

N°	Site Ident (DOMES)	Site	Survey Date	GNSS	SLR	VLBI
1	10002	Grasse	2013	X	X	
2	41609	Cachoeira	2013	X		
3	97205	Le Lamentin	2013	X		
4	39901	Djibouti	2013	X		
5	22006	Manila	2014	X		
6	30313	Marion Island	2014	X		
7	31906	Ponta-Delgada	2014	X		
8	30302	HBK	2014	X		
9	23101	Cibinong	2015	X		
10	30602	Ascension	2015	X		
11	39601	Sal	2015	X		
12	41201	Managua	2016	X		
13	12334	Kitab	2016	X		
14	14201	Wetzell	2016	X		
15	92201	Papeete	2017	X		
16	41508	San Juan	2018	X	X	
17	66007	Rothera	2018	X		
18	82301	Mangilao	2018	X		
19	12602	Dionysos	2018	X		
20	40101	St-John's	2019	X		
21	91501	Terre Adélie	2019	X		
22	32809	Libreville	2019	X		
23	42005	Santa-Cruz	2019	X		
24	97401	La Réunion	2020	X		
25	10204	Höfn	2020	X		
26	10338	Ny-Alesund II	2020	X		X

LONG TIME SERIES

Half of the current network stations has more than 21y data availability

📍 Close monitoring and maintenance ensuring a large amount of data



MONUMENT STABILITY

Monumentation standardization

3 standard monuments complying with geodesy requirements

Distribution: Type I: 16 / Type II: 14 / Type III: 19 / substandard: 9

Appropriate foundations

Design, depth and size defined in accordance with the soil structure

Specifications applied to all new constructions since 2010

Stability assessment

Field measurements at the occasion of maintenance operation





NETWORK CURRENT STATUS

Last events and evolution

Outlook for the coming years

NETWORK EVENTS 2019

 Start of the 4th generation DORIS beacon deployment

2019	Station		Event
Jan.	GONC	Goldstone	Beacon replacement
	HEMB	St-Helena	Service interruption: beacon shelter rebuilding until May
Feb.	JIWC	Jiufeng	Beacon replacement
Mar.	ROXC	Rothera	Beacon replacement
	GR4B	Grasse	Beacon qualification 3G > 4G: invalid data until August 5th
May	KEVC	Kerguelen	Antenna replacement
Jun.	GRFB	Greenbelt	Beacon replacement
	STKC	St-John's	Antenna & Beacon replacement: 3G > 4G + site survey
Jul.	PDOC	Ponta-Delgada	Beacon replacement: 3G > 4G
	FUUB	Futuna	Beacon replacement
	SVAC	Ny-Alesund II	Beacon replacement
Sep.	SCRC	Santa-Cruz	Full equipment replacement - Restarting after 10y outage
Oct.	WEUC	Wetzell	Beacon replacement
Nov.	HEMB	St-Helena	Beacon replacement: 3G > 4G

NETWORK EVENTS 2020

📍 Several autonomous installation of the 4th generation beacon

📍 On-site operations in Europe and French territories

2020	Station		Event
Jan.	MALB	Malé	Reconnaissance with a view to renovate the station
Feb.	REUC	La Réunion	Major renovation (moved 70m south + equipment upgrade)
Mar.	MIAB	Miami	Beacon replacement: 3G > 4G
May	CRQC	Crozet	Antenna and Beacon replacement: 3G > 4G
Aug.	MSPB	Mount Stromlo	Beacon replacement: 3G > 4G
Sep.	TLSB	Toulouse	Beacon replacement: 3G > 4G
	HOFC	Höfn	New site in Iceland (replacing Reykjavik)
	GAVC	Gavdos	Reconnaissance with a view to installing new station
Dec.	AMVB	Amsterdam	Beacon replacement: 3G > 4G
	YASB	Yarragadee	Beacon replacement: 3G > 4G

NETWORK EVENTS 2021

 Continuation of the 4th generation beacon deployment

2021	Station		Event
Jan.	KEWC	Kerguelen	Beacon replacement: 3G > 4G
Feb.	GONC	Goldstone	Beacon replacement: 3G > 4G
Mar.	DIOB	Dionysos	Beacon replacement: 3G > 4G
April	KEXC	Kerguelen	Antenna replacement
	KIVC	Kitab	Beacon replacement
	ROZC	Rothera	Antenna and Beacon replacement: 3G > 4G
May	KEYC	Kerguelen	Antenna support modification
July	REVC	La Réunion	Antenna and Beacon replacement
Aug.	MEUB	Metsahovi	Beacon replacement: 3G > 4G
Sep.	MALC	Malé	Major renovation (moved + equipment upgrading)
Octt.	TRJB	Tristan Da C.	Beacon replacement: 3G > 4G
Nov.	MAIB	Mahé	Beacon replacement: 3G > 4G

NETWORK EVENTS 2022

 Shutdown of the Russian stations

 Resumption of field operations

2021	Station		Event
Jan.	CIDB	Cibinong	Beacon replacement: 3G > 4G
	KRWB	Kourou	Beacon replacement: 3G > 4G
April	HBMB	Hartebeesthoek	Beacon replacement: 3G > 4G
	BADB	Badary	Shutdown of the station following the Russo-Ukrainian War
	KRBB	Krasnoyarsk	Definitive shutdown and decommissioning
June	SJVC	San Juan	Antenna and Beacon replacement: 3G > 4G
July	SVBC	Ny-Alesund II	Antenna and Beacon replacement: 3G > 4G
	RIMB	Rikitea	Beacon replacement
Nov.	WEUC	Wetzell	Beacon replacement: 3G > 4G
	NOXC	Nouméa	Antenna and Beacon replacement: 3G > 4G
	OWFC	Owenga	Beacon replacement: 3G > 4G

NETWORK ONGOING DEVELOPMENTS

Gradual replacement of the equipment with new generation

4th generation beacon deployment (indoor equipment)

Starec C type antenna deployment (outdoor equipment)

Densification (10 additional stations)

Make the network more robust by adding stations in critical areas

Enhance the network contribution to various applications

Site renovation

Better meet the system requirements to improve the station performance

Connection between DORIS beacons and GNSS receivers

Clocks stability inter-comparison

About 30 sites concerned

Technical solution under progress at CNES

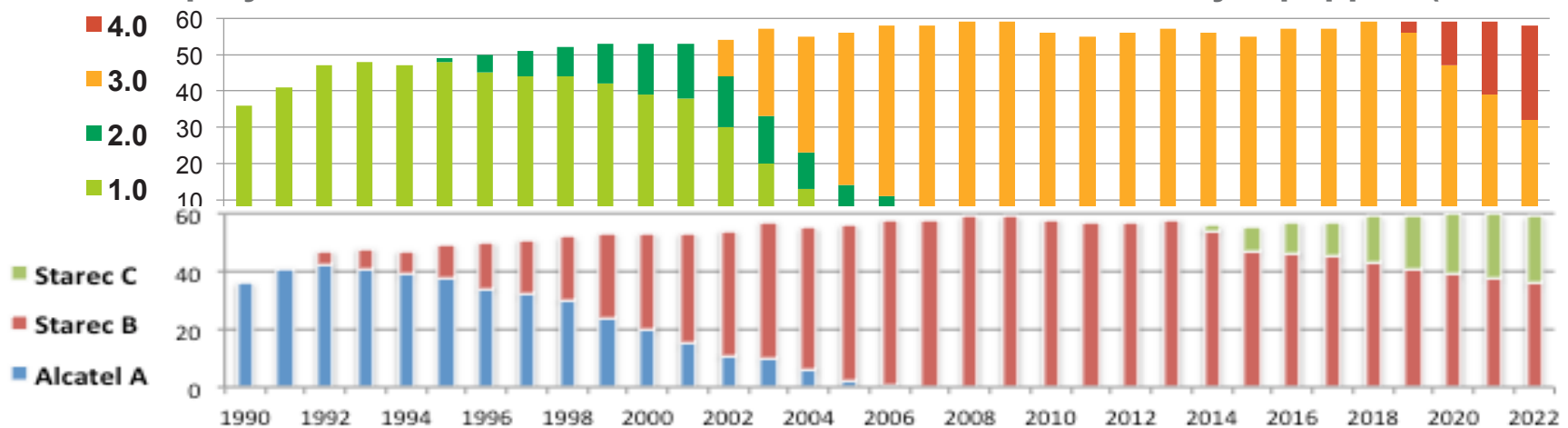
EQUIPMENT UPGRADING

Antenna “Starec C” deployment

- 📍 The standard uncertainty of the 2GHz phase center in the vertical direction was reduced to 2 mm from 5 mm (Saunier & Tourain, 2016)
- 📍 Deployment from 2014: 40% of the network stations already equipped (23 stations)

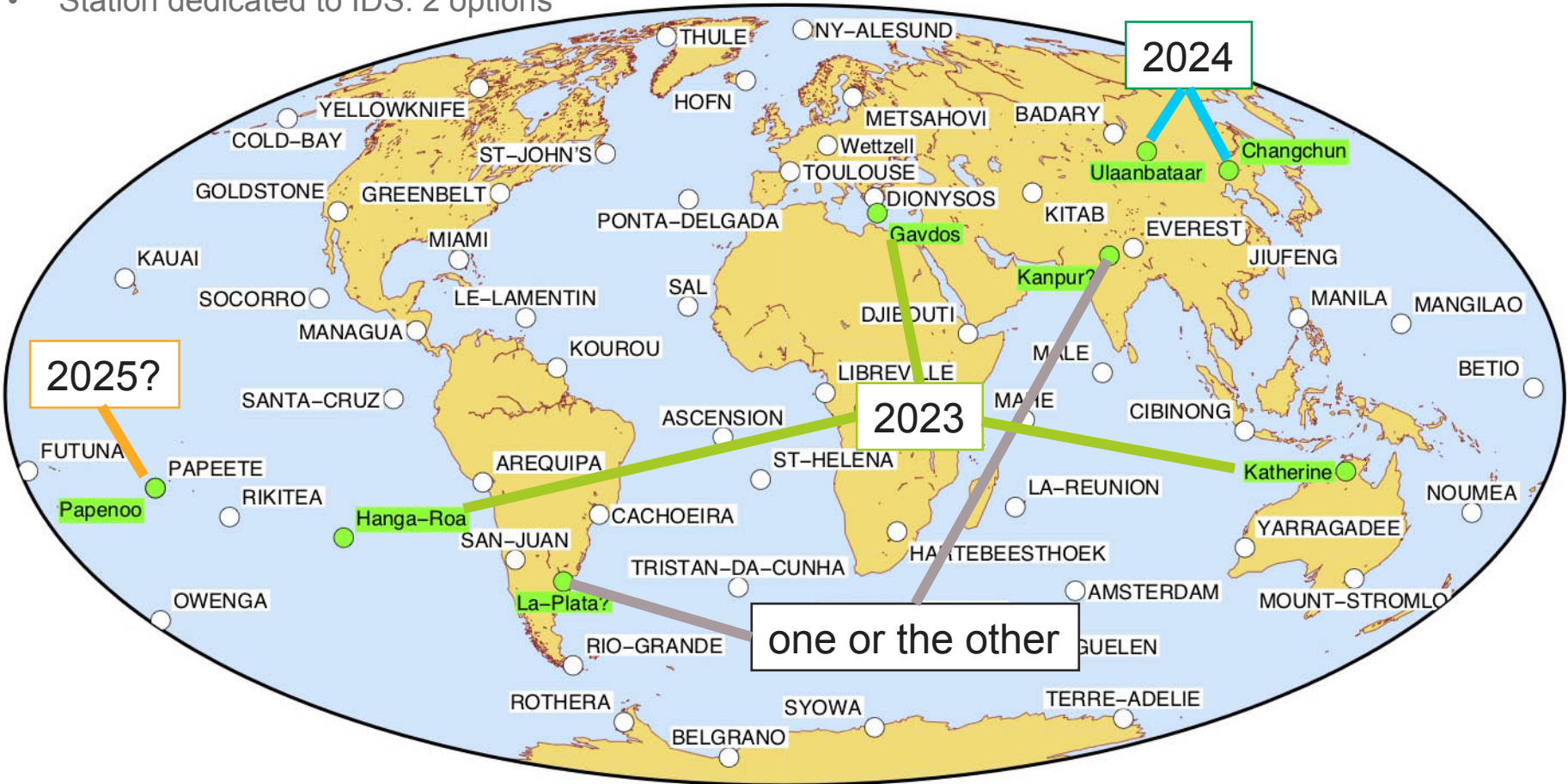
4th generation beacon “B4G” deployment

- 📍 Improving the network robustness: manufactured with up-to-date electronics
- 📍 Improving the stations performance: larger distance (50 m instead of only 15 m) between beacon and antenna, providing better options for antenna placement
- 📍 Deployment from 2019: 45% of the network stations already equipped (26 stations)



NETWORK DENSIFICATION

- Hanga-Roa (Chile): co-location GNSS
- Gavdos (Crete): co-location GNSS + tide gauge
- Katherine (Australia): co-location GNSS + VLBI
- Station dedicated to IDS: 2 options
- Ulaanbaatar (Mongolia): co-location GNSS
- Changchun (China): co-location GNSS + SLR
- Papenoo (French Polynesia): 4 techniques site



STATION RENOVATION > IMPROVING PERFORMANCE

Antenna re-location on the occasion of the B4G deployment

- 📍 2022: Everest (Nepal)
- 📍 2023: Rikitea (French Polynesia); Cachoeira-Paulista (Brazil)
- 📍 2024: Sal (Cape Verde)

Antenna re-location due to local constraints

- 📍 2024: Syowa (Antarctica); Le Lamentin (French West Indies);



B4G Beacon:
Cables 50 m long instead of 15 m

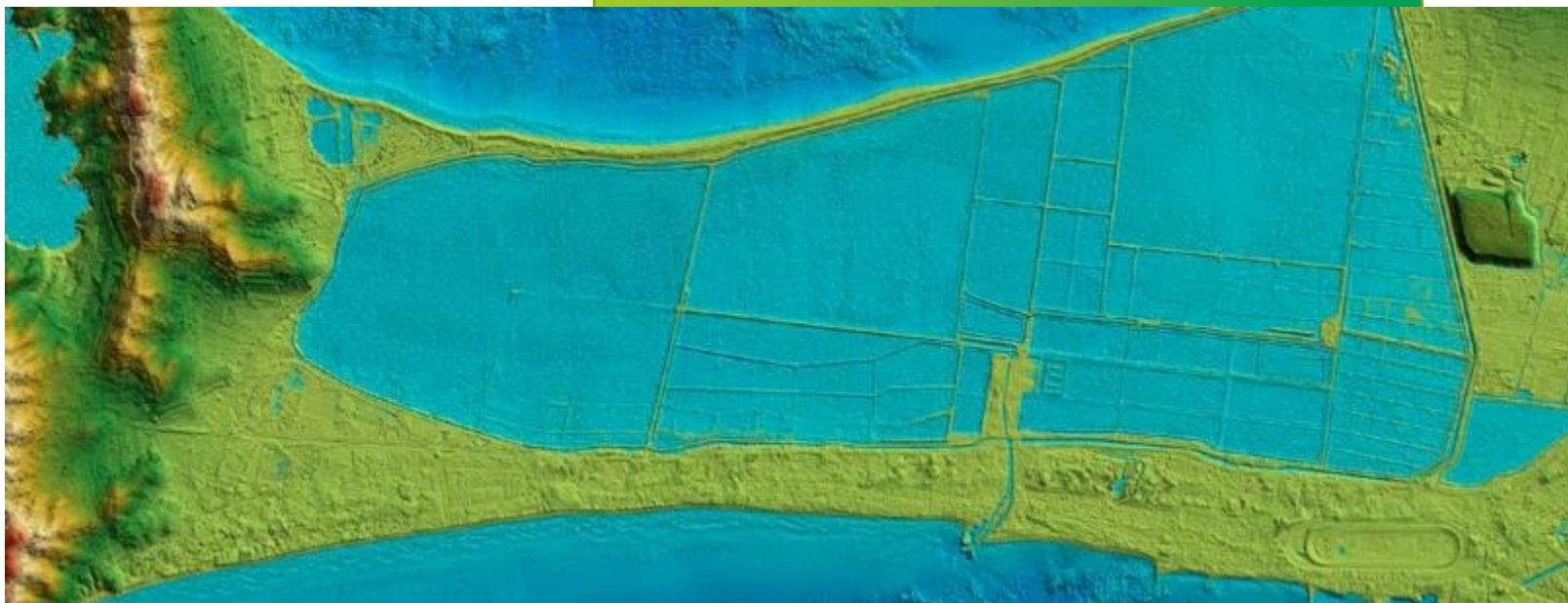




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