NETWORK 2006 REVIEW: EVOLUTION, MAINTENANCE AND COLOCATIONS

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Evolutions of the permanent network over six years

Since the start of the renovation action (early 2000):

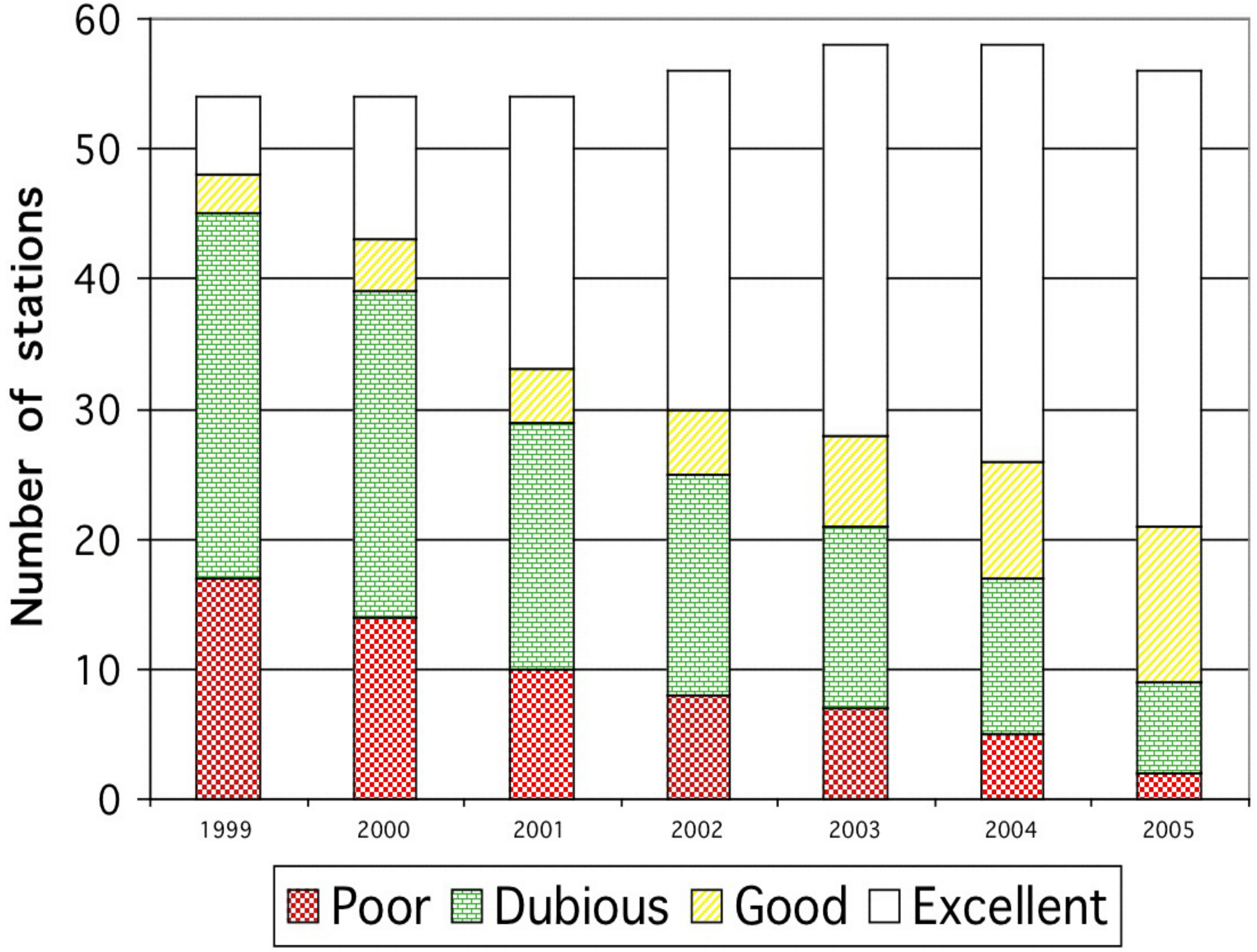
- **31 existing stations were renovated**
- **4 stations were added to the network: Mahe, Thule, Crozet, Belgrano**
- **8 stations were installed as a replacement for closed ones:**
  - » **Greenbelt (replacing Ottawa)**
  - » **Futuna (replacing Wallis)**
  - » **Sal (replacing Dakar)**
  - » **Jiufeng (replacing Purple Mountain)**
  - » **Male (replacing Colombo)**
  - » **Miami (replacing Richmond)**
  - » **Santa Cruz (replacing Galapagos)**
  - » **Monument Peak (replacing Goldstone)**
- **2 stations were removed and not yet replaced: Arlit and Guam**

Total: 43 new or renovated stations out of 56 (more than 3/4)

Permanent network renovation progress (1)

- The network renovation action was decided at the end of 1999
- It aimed at improving the long term stability of the antenna reference point
- In order to plan and monitor the renovation action, stations were classified using a somewhat subjective approach, into four categories (Excellent > Good > Dubious > Poor)
- Between 3 and 10 stations were renovated each year
- The whole process for a given station took between a few months and two years
- A couple of projects are still under way
- More than 80 % of the stations meet the new stability requirements (excellent or good)

Permanent network renovation progress (2)



Antenna support evolution example: Rio Grande (1)

Initial installation (1987):
Alcatel antenna, very loose guying

Antenna support evolution example: Rio Grande (2)

First upgrade (1995): Starec antenna, good quality guying, mm-level centring and verticality

Renovation (2001): deeply anchored concrete pillar, A4 stainless steel plate

Station quality assessment

- **Recommendation I-7 of the May 2004 IDS plenary meeting:**

  "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."

- **Criteria have been defined, and stations assessed accordingly by IGN, on the following aspects:**
  - Antenna stability
  - Co-locations

- **Other aspects could be assessed in a similar way: maintenance, time series, etc.**

- **Weighted combinations of the above assessments could be used to meet various network evaluation needs**

Antenna stability assessment

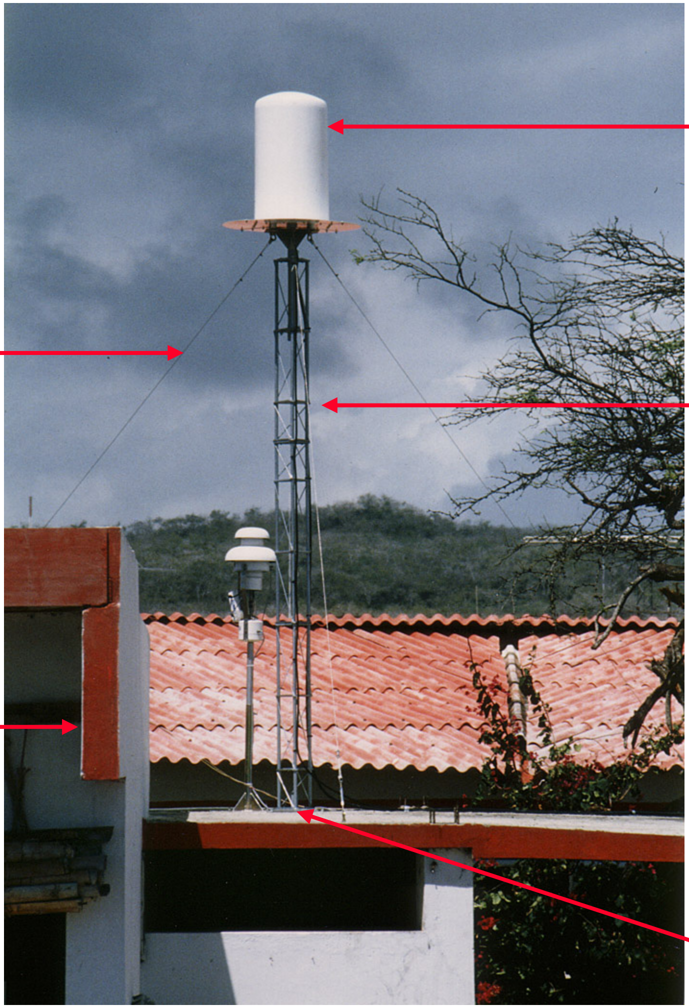
Principle:

- **Evaluate the stability of each element that is part of the antenna support**
- **The more elements between the antenna and the ground, the more potential instability sources**
- **Assign "instability points" to each element, depending on its characteristics**
- **Calculate a weighted total of the "instability points"**
  --> Instability Degree (ID) for each antenna
- **The lower ID, the more presumably stable the antenna**

Results:

- **All current and past DORIS occupations have been assessed**
- **Criteria are evaluated, and ID calculated using a spreadsheet**
- **ID ranged between 9 (best) and 44 (worst) before the renovation, 7 to 31 now**

Antenna stability assessment: what did we evaluate?



Antenna model: Starec / Alcatel

Guy-wires:
- How tight are they?
- Are they ideally arranged?

Tower: model & height

Building:
- What is it made of?
- How high is the antenna support above the ground?

Location of the support WRT the building's structure

Antenna stability assessment: examples

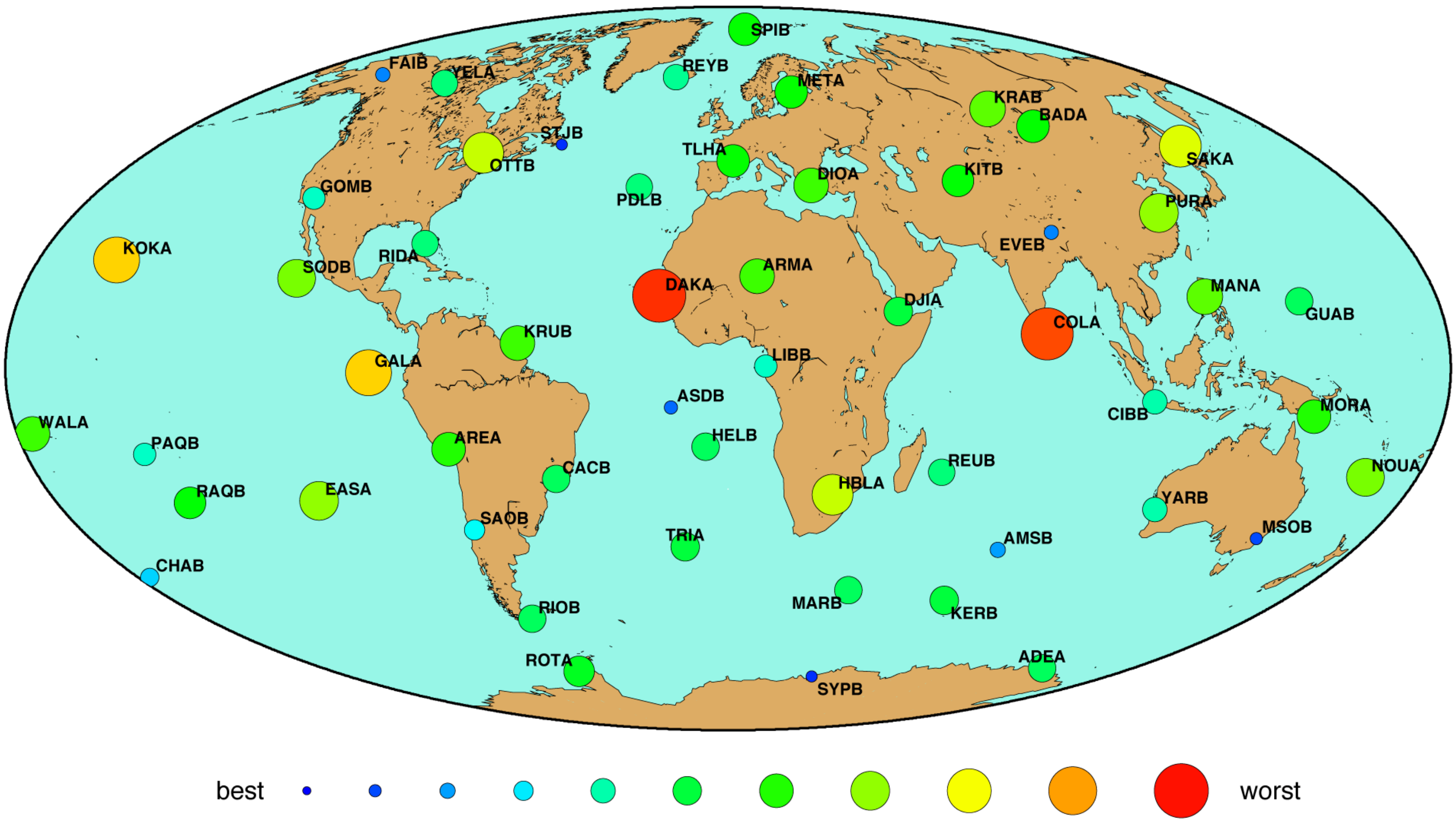
Considered element	Criteria	Weight	AREA	AREB	HELB	HEMB	SPIA	SPIB	SPJB	SYOB	SYPB	YELB	THUB	CADB
Antenna and supporting plate														
	Antenna	1	2	1	1	1	2	1	1	1	1	**1**	**1**	**1**
	Supporting plate	1	2	1	1	1	2	1	1	1	1	**1**	**1**	**1**
	Plate assembly	1	2	1	1	1	2	1	1	1	1	**1**	**1**	**1**
Primary support :														
Concrete pillar or metal pipe														
	Construction type	2		1							1	**1**		
	Ground hardness	1		2							2	**1**		
	Height	1		0							0	**0**		
Metal tower														
	Tower model	1	2		2	1	2	2	1	2			**1**	**2**
	Height (Leclerc tower)	1				2			2				**2**	
	Height (Normand tower)	3	2		2		2	2		6				**0**
	No guy-wires (Normand tower)	2												**0**
	Guying quality (Normand tower)	2	2		2		2	0		2				
Secondary support :														
Concrete block or pad on the ground														
	Construction type	2			2	2				2			**1**	
	Ground hardness	1			2	2				2			**2**	
Building														
	General structure	2	2				2	2	2					**2**
	Primary support location WRT structure	2	1				4	4	1					**1**
	Height of tower base above ground (m)	0,25	3				6	6	6					**5**
Whole site														
	Geological site stability	1	3	3	2	2	2	2	2	2	2	**2**	**2**	**2**
	Instability degree (ID) :		28	10	23	14	34	27	16	35	9	**8**	**12**	**14**

Initial installation

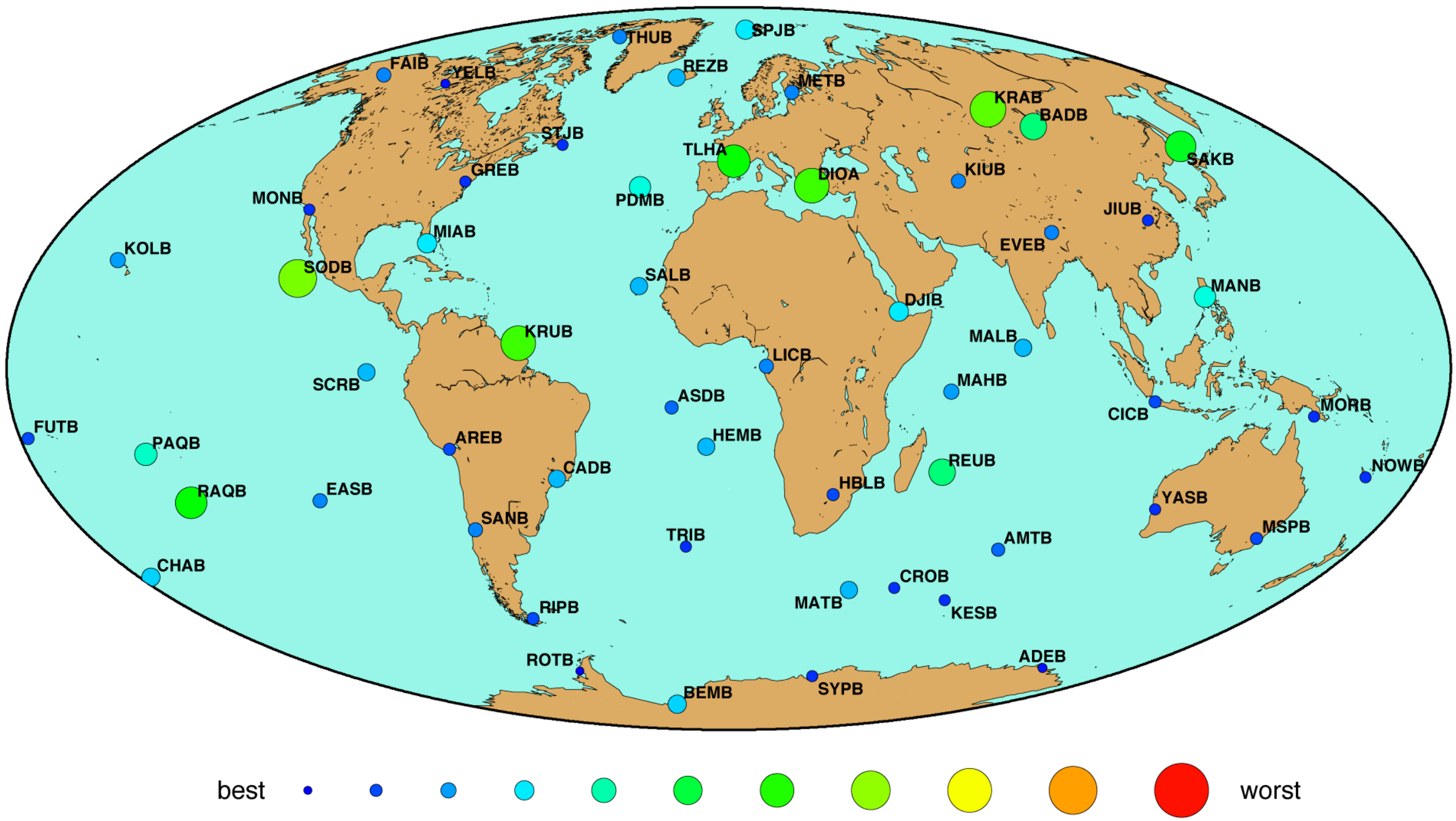
Intermediate upgrade

Renovation

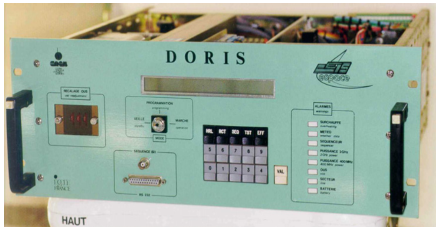
Stability assessment: before the renovation (2000/01)



Stability assessment: near the end of the renovation



Distribution of the DORIS equipment



1st generation (1.0 or 1.1) beacon

+

Alcatel antenna

↓

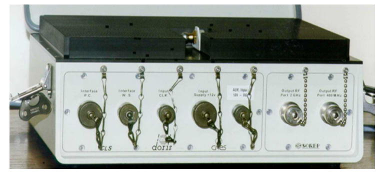
1 station

+

Starec antenna

↓

6 stations



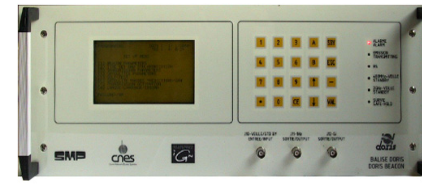
2nd generation beacon

+

Starec antenna

↓

7 stations



3rd generation beacon

+

Alcatel antenna

↓

1 station

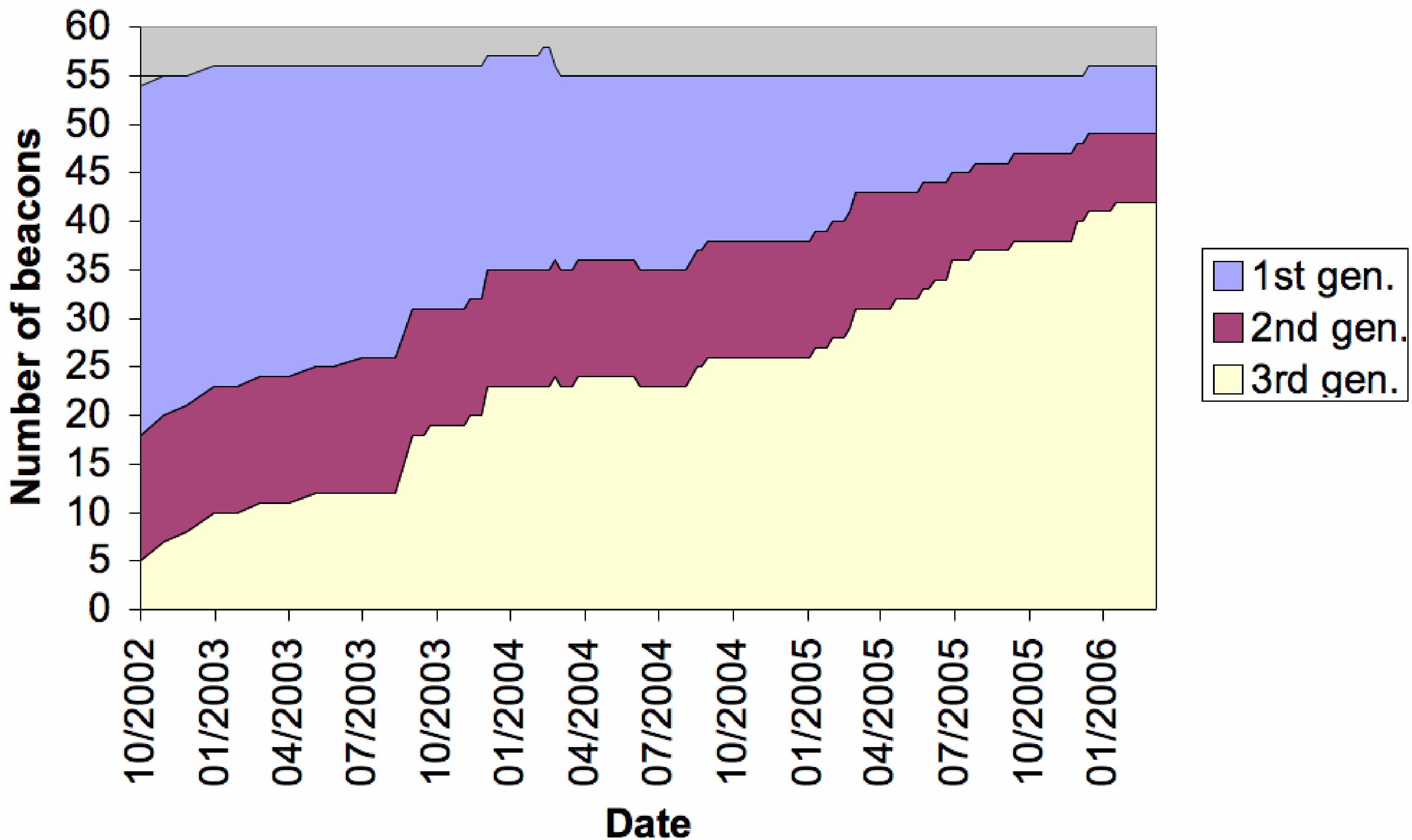
+

Starec antenna

↓

41 stations

Evolution of the beacon types over 3 years



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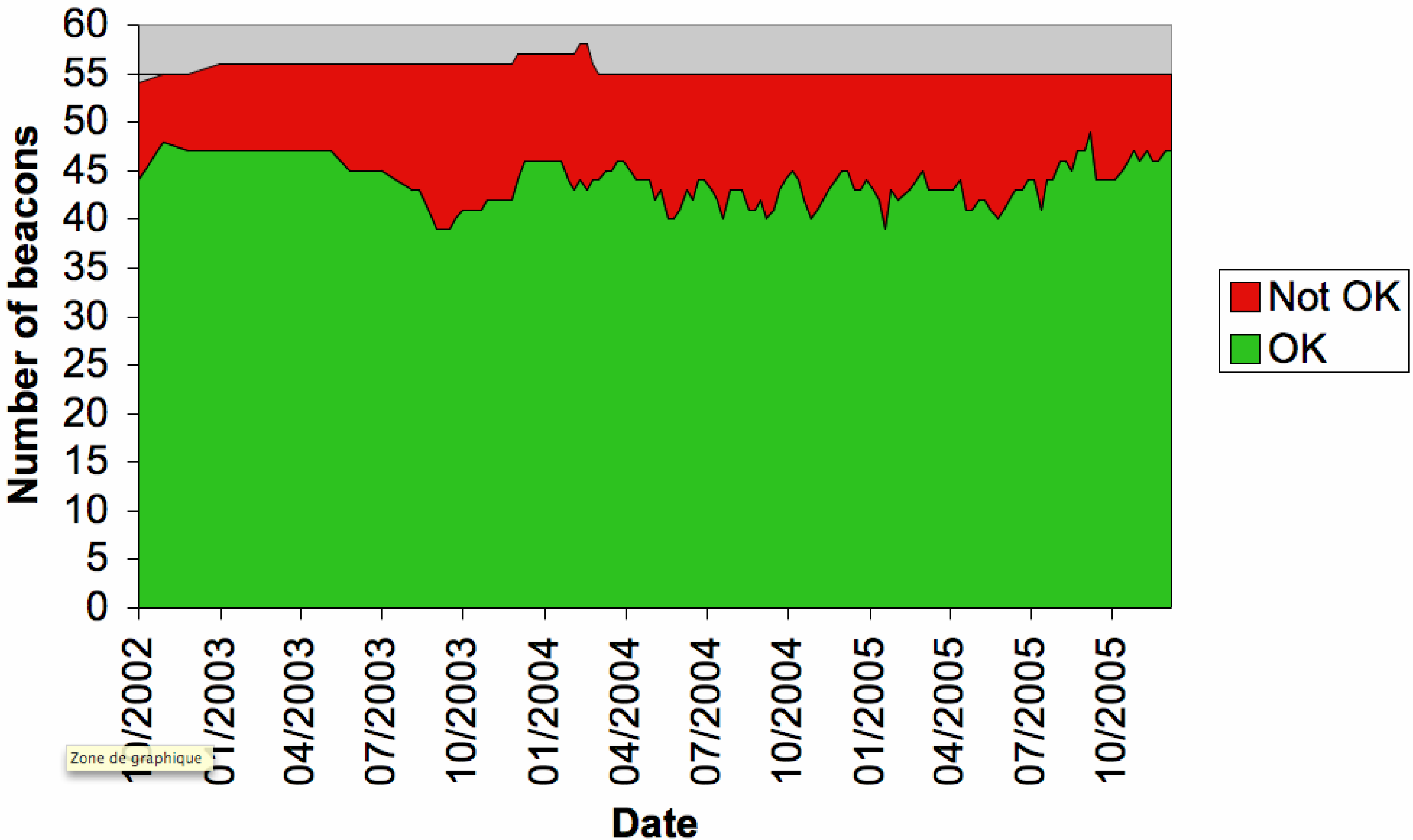
IDS

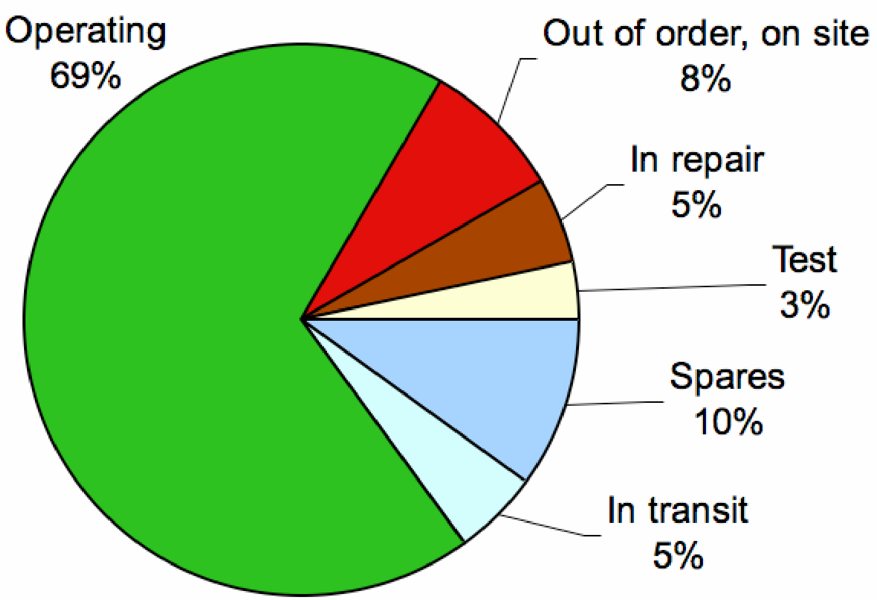
Operation rate over 3 years



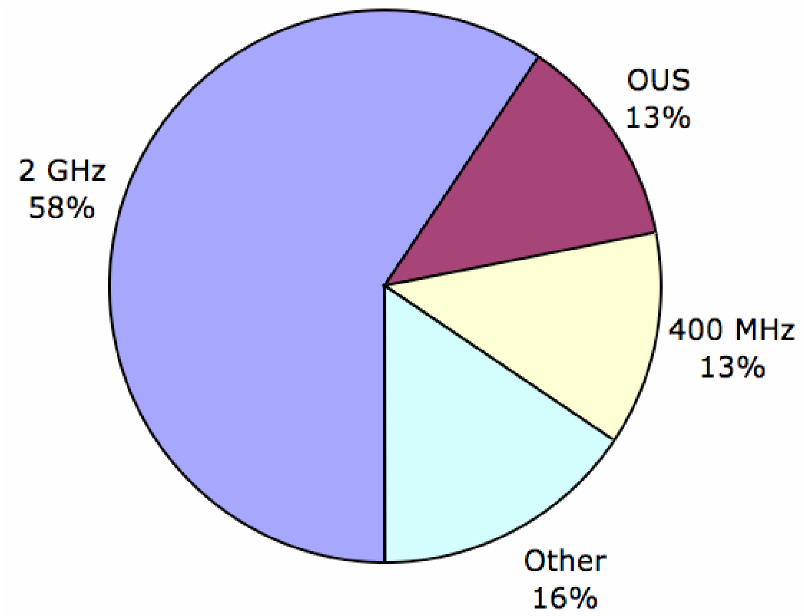
Average value: 79%

3rd generation beacons: current status & failures

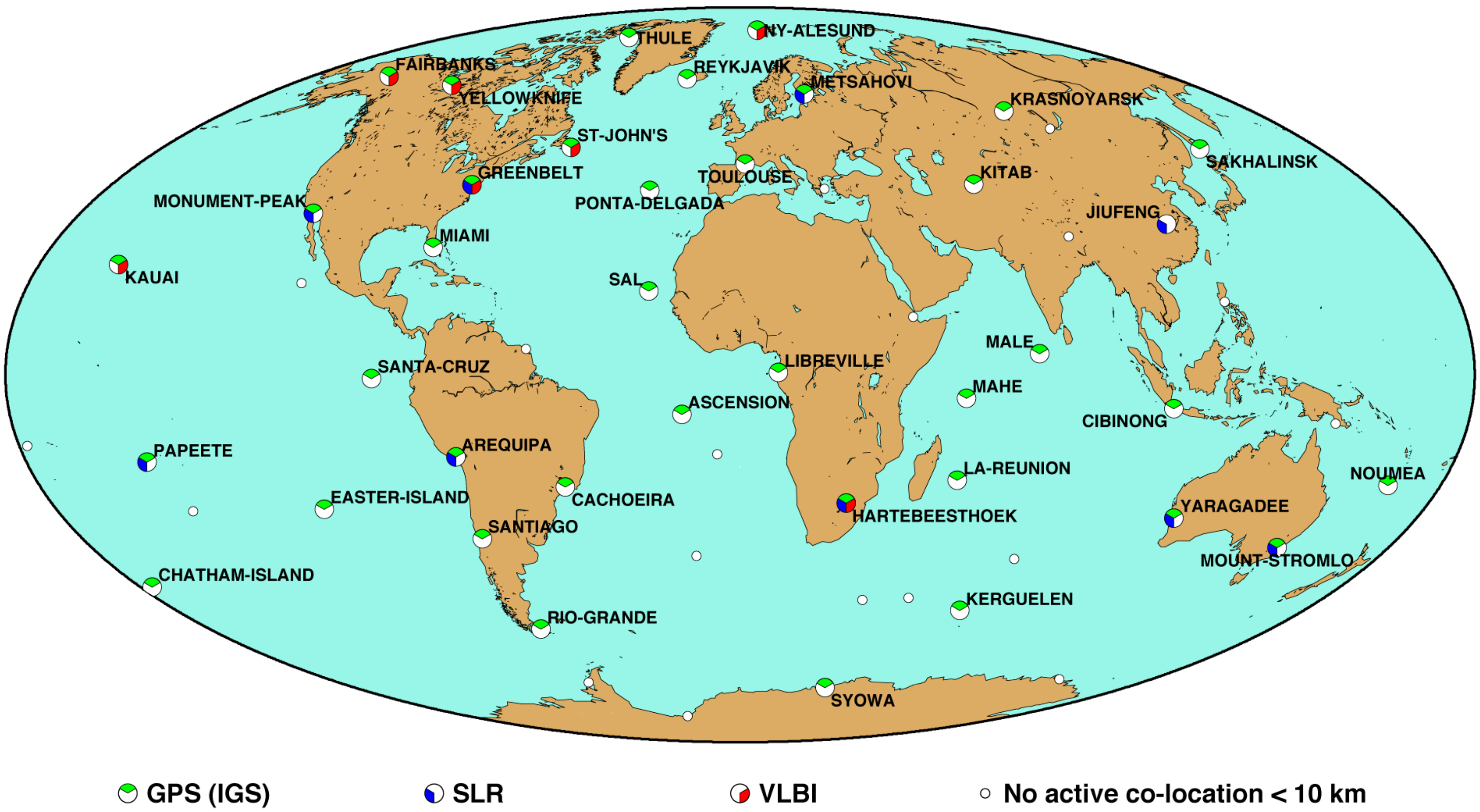
Status of the 60 delivered beacons



Nature of the 32 failures since delivery



Co-locations (<10 km) with other active IERS techniques



Summary of currently active co-locations

DORIS + GPS: 37 sites

+ SLR: 9 sites

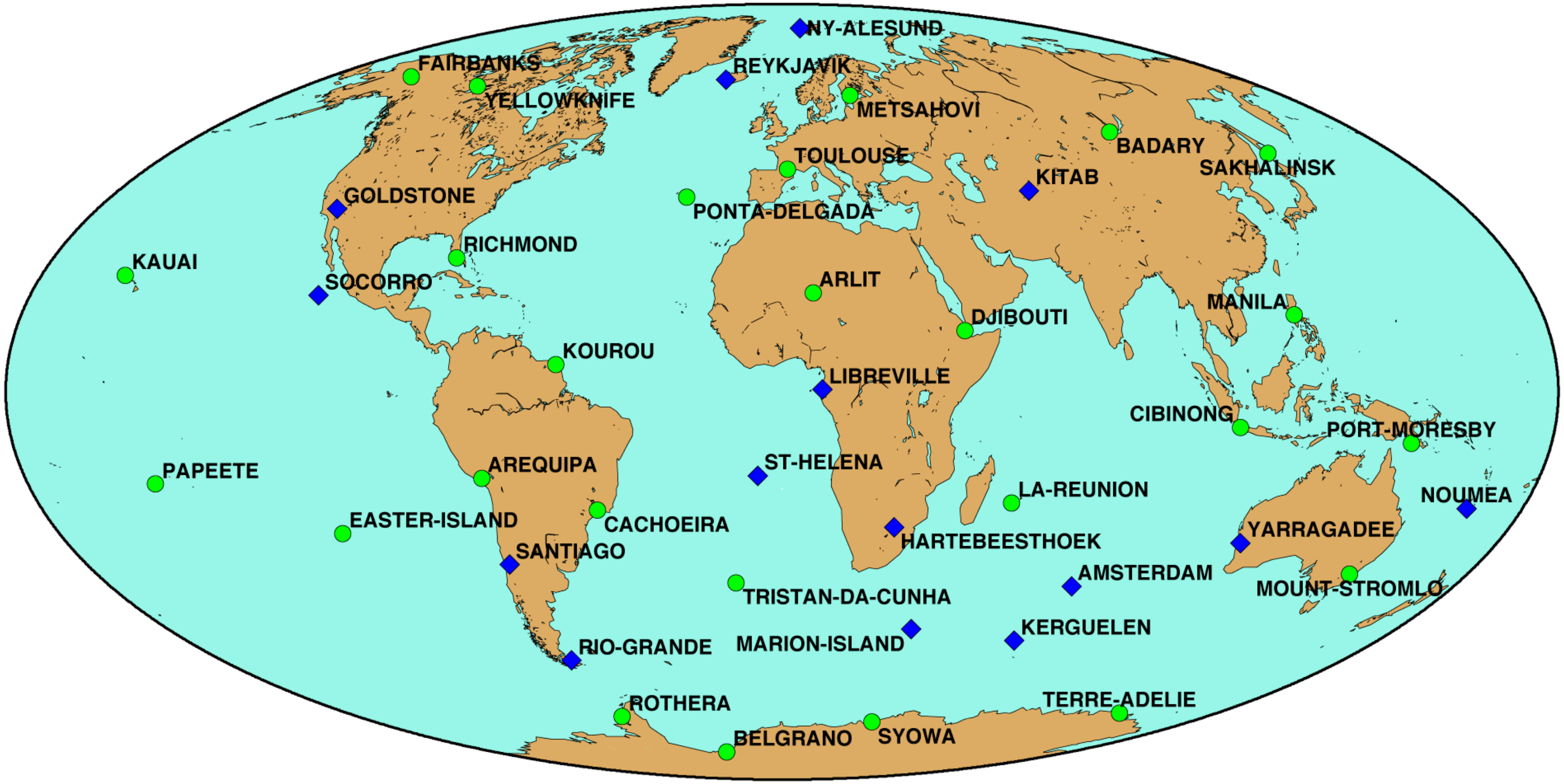
+ VLBI: 7 sites

+ GPS + SLR: 8 sites

+ GPS + VLBI: 7 sites

+ GPS + SLR + VLBI: 2 sites

DORIS-DORIS co-locations



● 2 DORIS antenna positions ◆ 3 DORIS antenna positions

Multiple DORIS occupations are available at 41 sites

Tide gauges co-locations (<10 km)

Co-locations quality assessment

Principle:

- Evaluate the quality of each co-location with another technique, taking into account:
  - The status of the technique
  - The continuity of the data delivery
  - The distance between DORIS and the other instrument
  - The quality of the available survey
- This results in a quality degree for each technique (the higher the better)
- Sum up the individual degrees, giving a lower weight to the (abundant) GPS co-locations than to the other techniques

  --> Co-location Degree (CD) for each antenna
- Criteria are evaluated, and CD calculated using a spreadsheet

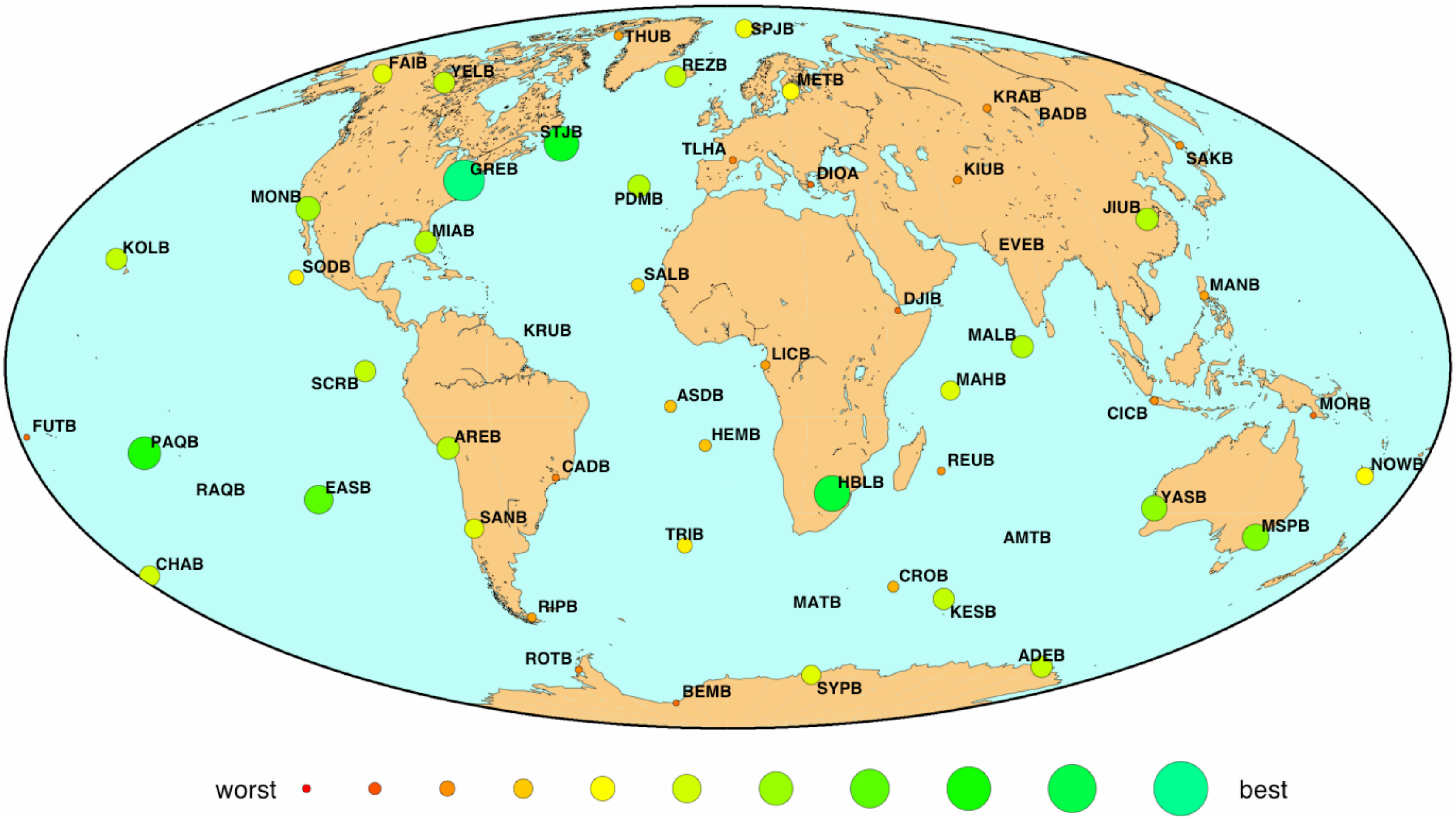
Results:

- Only the current DORIS occupations have been assessed + two projects
- CD ranges between 0 (no co-location) and 34 (best, four-technique site)

Co-locations quality assessment: examples

Co-located technique	Criteria	Weight	AMTB	RIPB	TRIB	AREB	SPJB	KESB	GREB	Proposed new sites	
										Riyad	Tamanrasset
GPS											
	Type of GPS station		0	3	0	3	3	3	3	3	1
	Status			2		2	2	2	2	2	2
	Distance (km)			0,04		0,04	1,58	0,03	0,21	0,05	0,05
	Survey quality			3		2	2	3	3	3	2
	GPS assessment	1	0,0	7,8	0,0	6,8	5,7	7,8	7,5	7,8	4,8
SLR											
	Continuity		0	0	0	2	0	0	2	2	1
	Status (ILRS)					2			2	2	2
	Distance (km)					*0,02*			0,06	0,05	0,05
	Survey quality					2			3	3	2
	SLR assessment	2	0,0	0,0	0,0	5,9	0,0	0,0	6,8	6,8	4,8
VLBI											
	Continuity		0	0	0	0	2	0	2		
	Status (IVS)						2		2		
	Distance (km)						1,48		0,24		
	Survey quality						2		3		
	VLBI assessment	2	0,0	0,0	0,0	0,0	4,8	0,0	6,5	0,0	0,0
Tide gauge											
	Data availability		0	0	3	0	0	3	0	0	0
	Status				2			2			
	Distance (km)				0,12			3,3			
	Survey quality				2			2			
	TG assessment	2	0,0	0,0	6,7	0,0	0,0	5,2	0,0	0,0	0,0
	Co-location degree (CD):		0	8	13	19	15	18	34	21	14

Co-locations quality assessment: results



Planned evolutions in 2006

- Remaining renovations:
  - Dionysos: under way, April?
  - Krasnoyarsk: this summer
  - Toulouse: autumn
  - Socorro: pending issue

- New stations in project:
  - Betio (Tarawa, Republic of Kiribati): replacement of Guam, co-location with GPS + tide gauge
  - Rikitea (French Polynesia): replacement of Rapa, co-location with GPS + tide gauge
  - Tamanrasset, Algeria (replacement for Arlit): GPS, planned SLR
  - Riyad, Saudi Arabia: SLR + GPS co-location
  - Other projects: Adak, Kiritimati

Planned new stations