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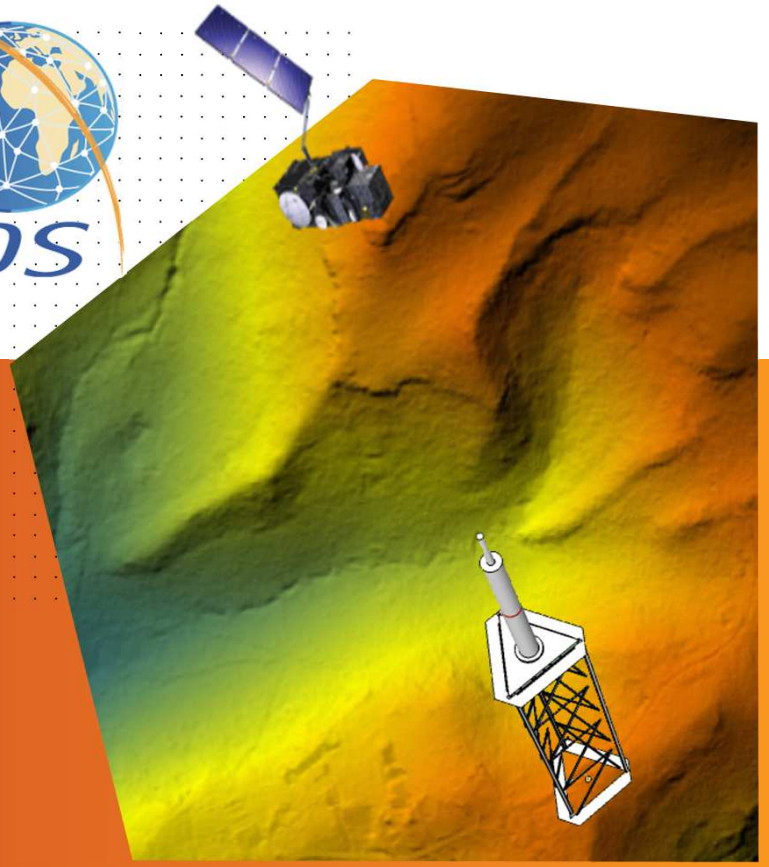

DORIS NETWORK STATUS REPORT

IDS Workshop, Ponta Delgada, Azores
24 September 2018

Jérôme Saunier, IGN - France

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THE NETWORK SERVING THE SPACE ALTIMETRY MISSIONS FOR MORE THAN 25 YEARS

Overall performance review

NETWORK INFRASTRUCTURE: 25Y OF SERVICE (1/4)

Very homogeneous geographical distribution

Coverage of about 90% for LEO satellites (when all DORIS stations are operating)

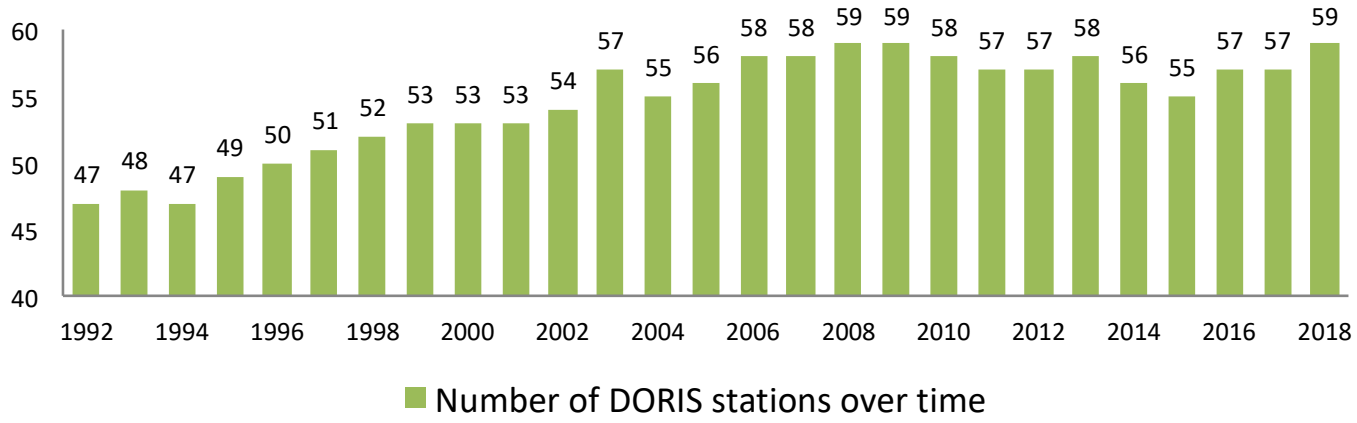
More than half of the network located on islands or coastal areas (38 stations)

Nearly sixty stations over the past fifteen years

This number of stations allows to maintain a sufficient supply of operational services

Fully meets the orbit determination requirements for satellite altimetry

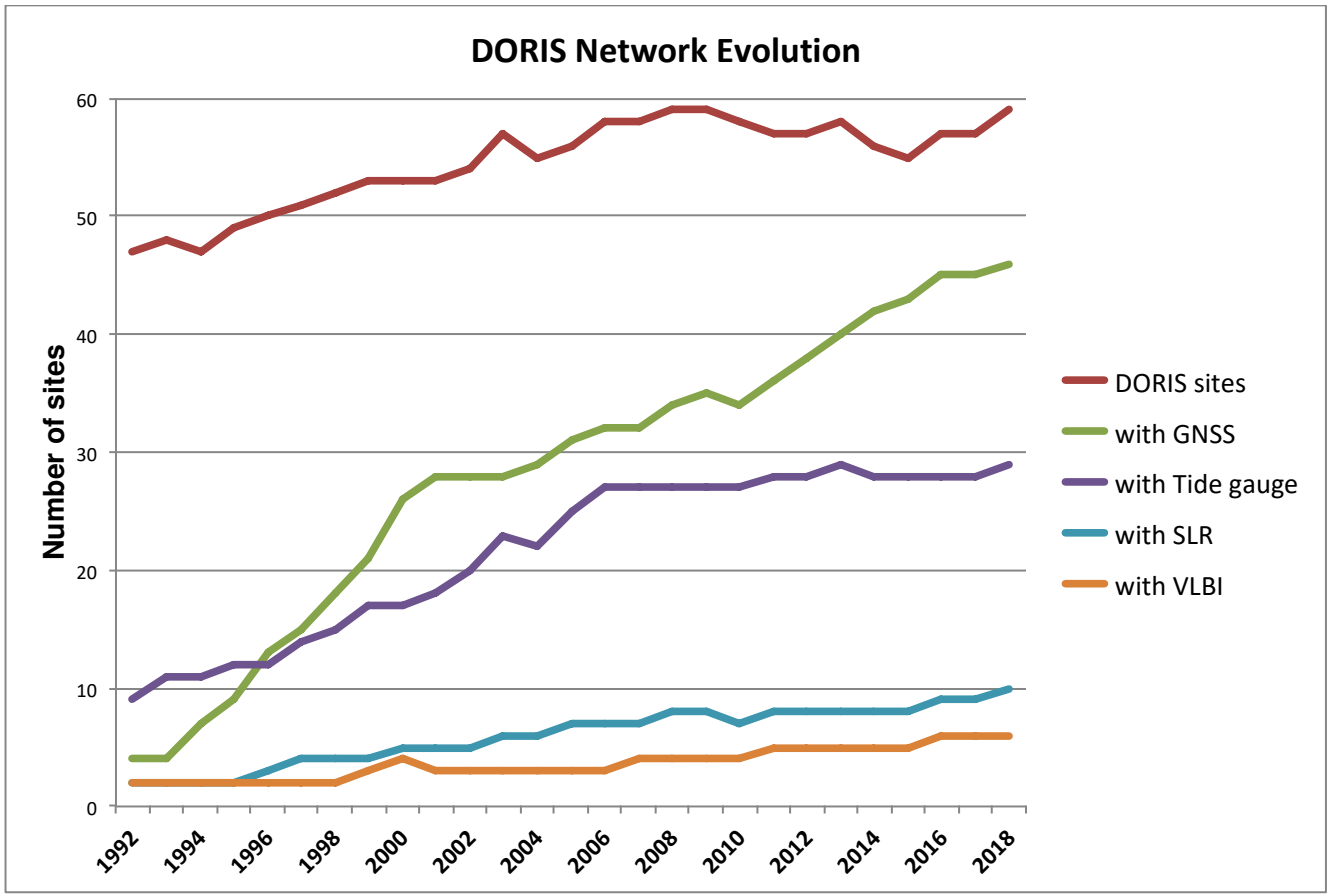
Coverage gaps can be awkward for the orbit determination (especially for near-real time orbit)



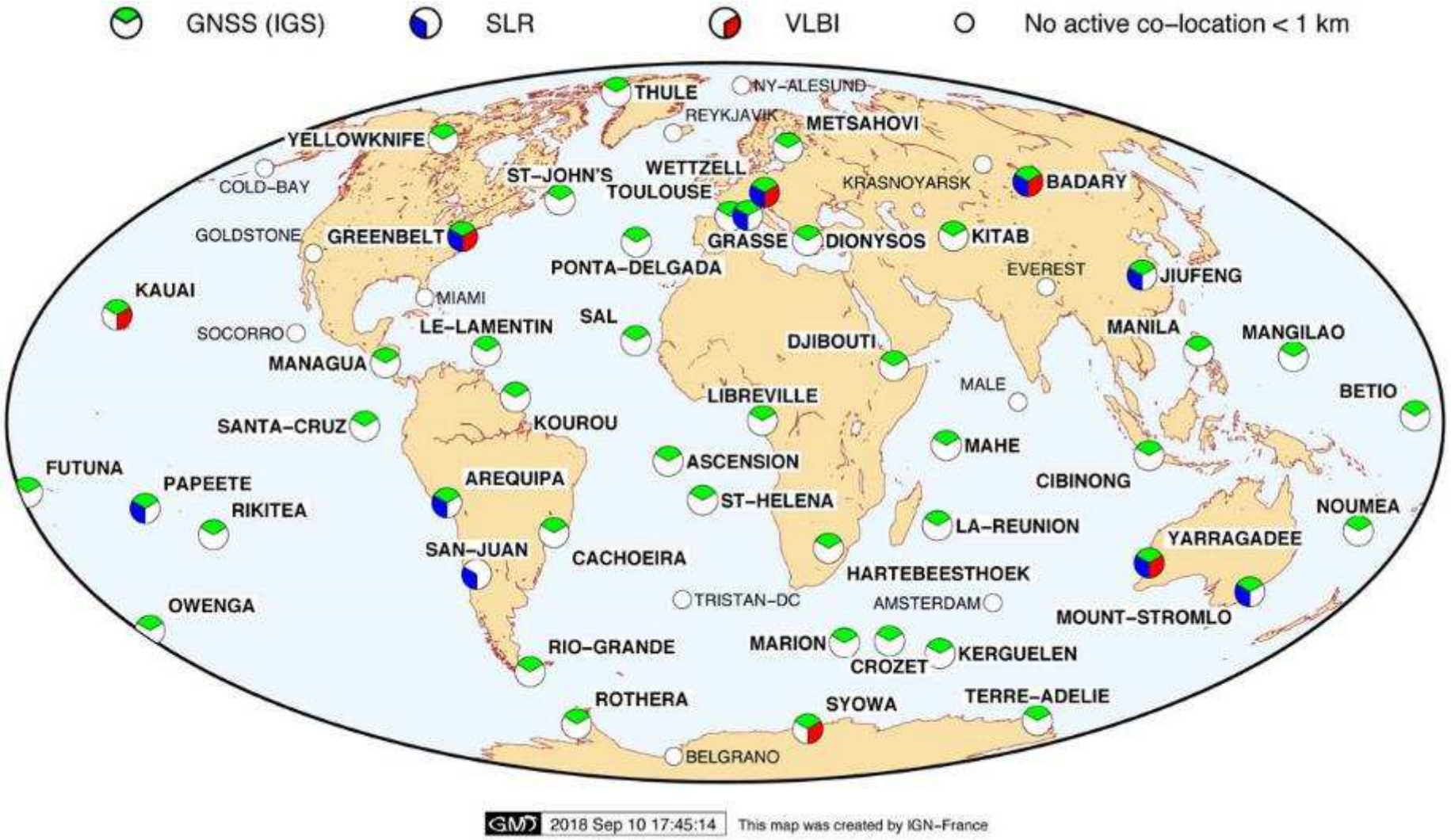
NETWORK INFRASTRUCTURE: 25Y OF SERVICE (2/4)

Continuing effort to co-locate DORIS with others techniques

Improving the geodetic reference systems for the space oceanography

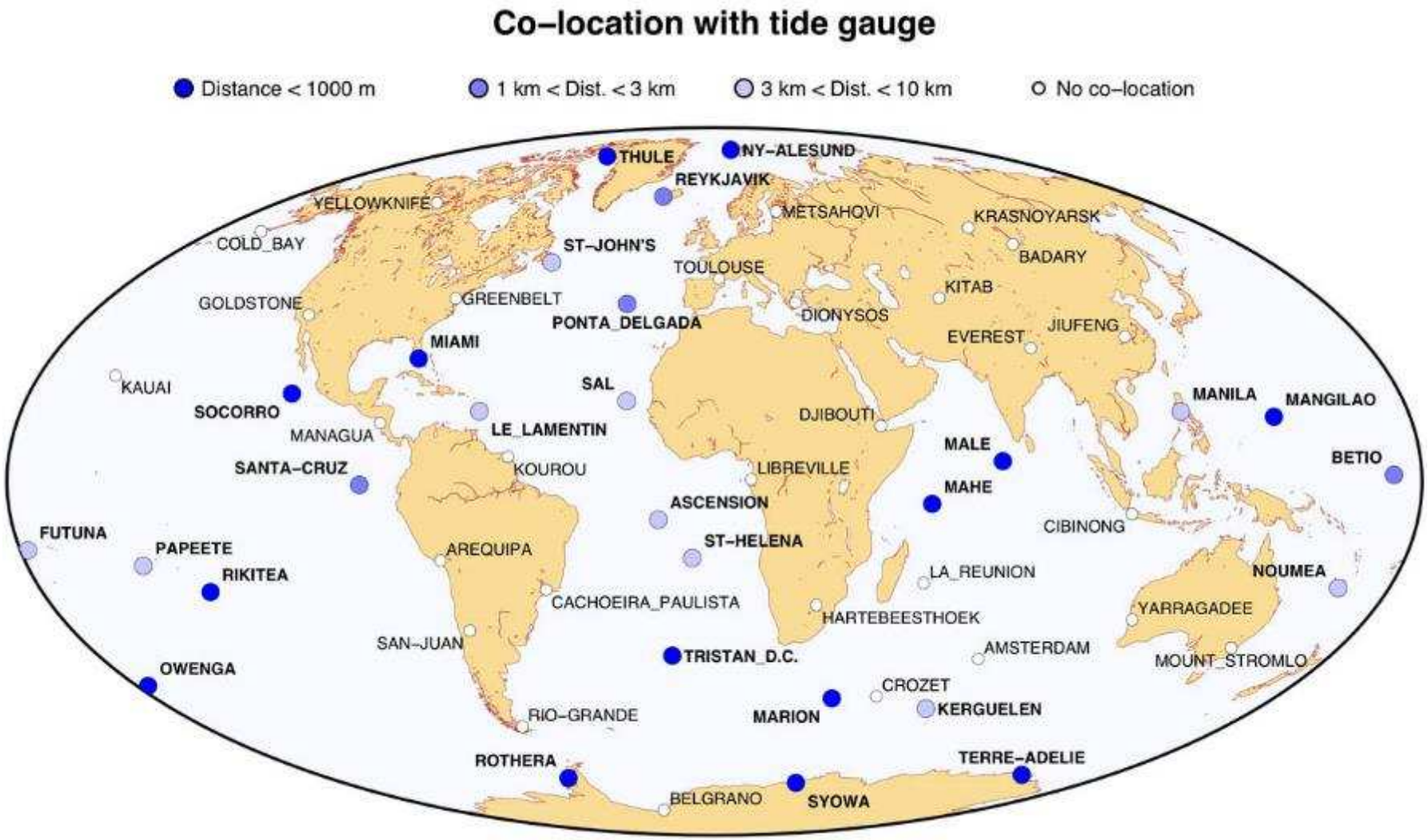


NETWORK INFRASTRUCTURE: 25Y OF SERVICE (3/4)



today: 47 co-locations out of 59 DORIS sites

NETWORK INFRASTRUCTURE: 25Y OF SERVICE (4/4)



NETWORK EQUIPMENT: 25Y OF SERVICE (1/2)

3 generations of beacons have been developed

Improving reliability, robustness and performance (Auriol & Tourain, 2010)

The third-generation beacon is implemented everywhere since 2010

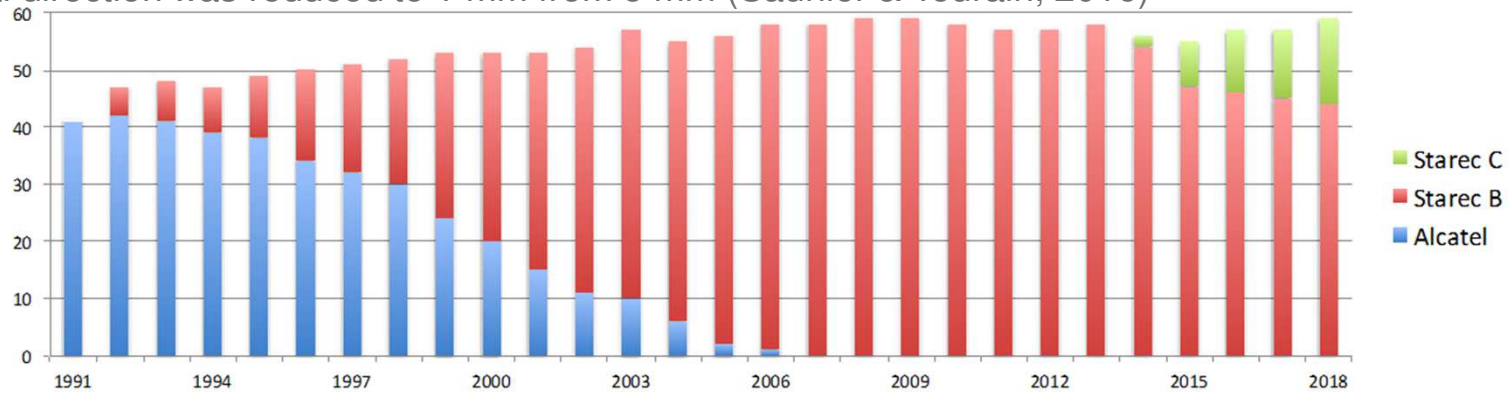
With the capacity to shift the frequencies to eliminate the risk of jamming between neighboring stations

Development of antennae to improve measurements accuracy

Gradual replacement of Alcatel antennae with Starec antennae from 1992 to 2006 (Fagard, 2006)

Continual improvement in manufacturing processes of the Starec antennae to improve the repeatability

Key development: Starec C type from Sept. 2014: standard uncertainty of the 2GHz phase center in the vertical direction was reduced to 1 mm from 5 mm (Saunier & Tourain, 2016)



NETWORK EQUIPMENT: 25Y OF SERVICE (2/2)

Standardization of the network monumentation

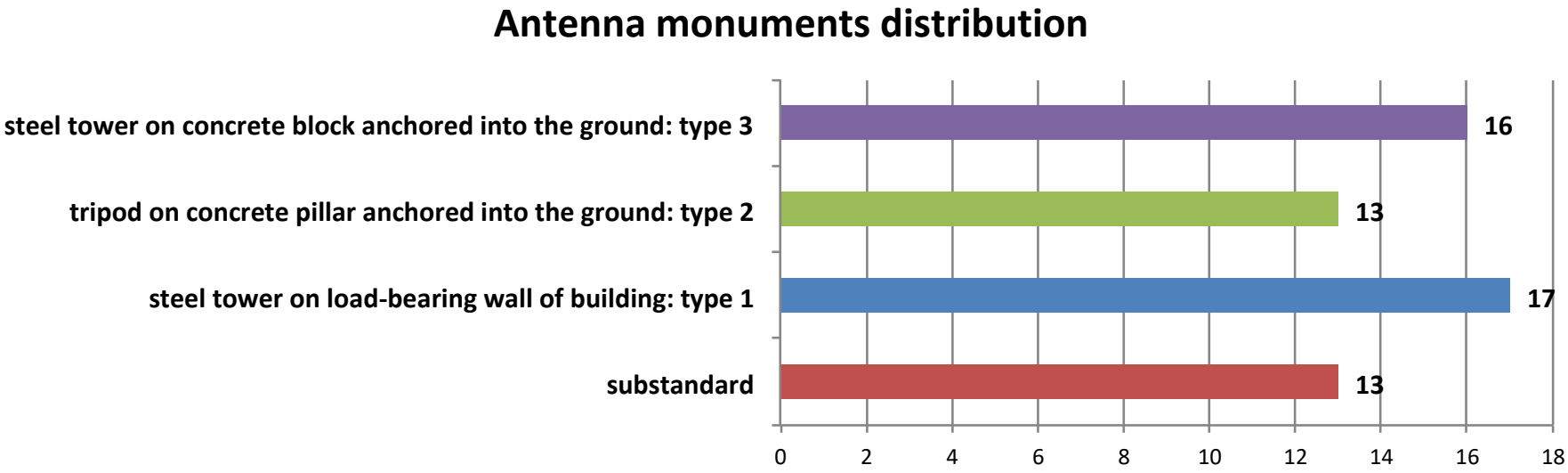
Specifying 3 standard monuments compliant with the DORIS system requirements in 2009

Today 3/4 of the network monuments are compliant with standards

Monument stability steadily improved

Progressive renovation of the network monuments started in 2000 (Fagard, 2006)

The 3 standard monuments are compliant with the GGOS stability goal of 0.1 mm/y (Saunier, 2016)



NETWORK RELIABILITY: 25Y OF SERVICE

Long-term life and stability

Several time series extremely long and most of them longer than 22 years

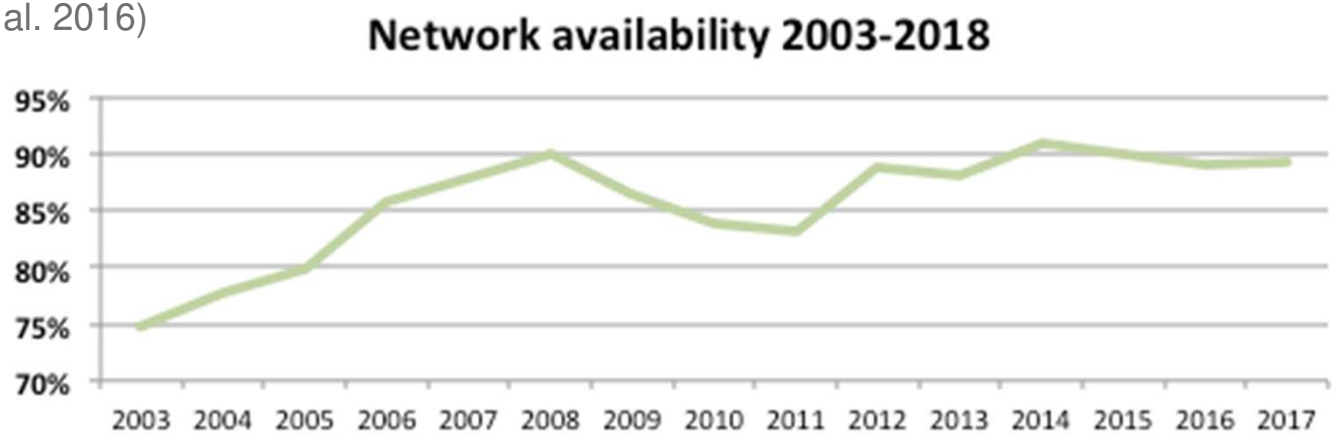
Very few changes of antennas or sites

Standardizing installations (since 2007)

System requirements for a DORIS station to ensure smooth operation and good performance

Integrity monitoring system (since 2010)

Immediate detection of a faulty beacon; checking of the signal quality and reliability for each station (Jayles et al. 2016)



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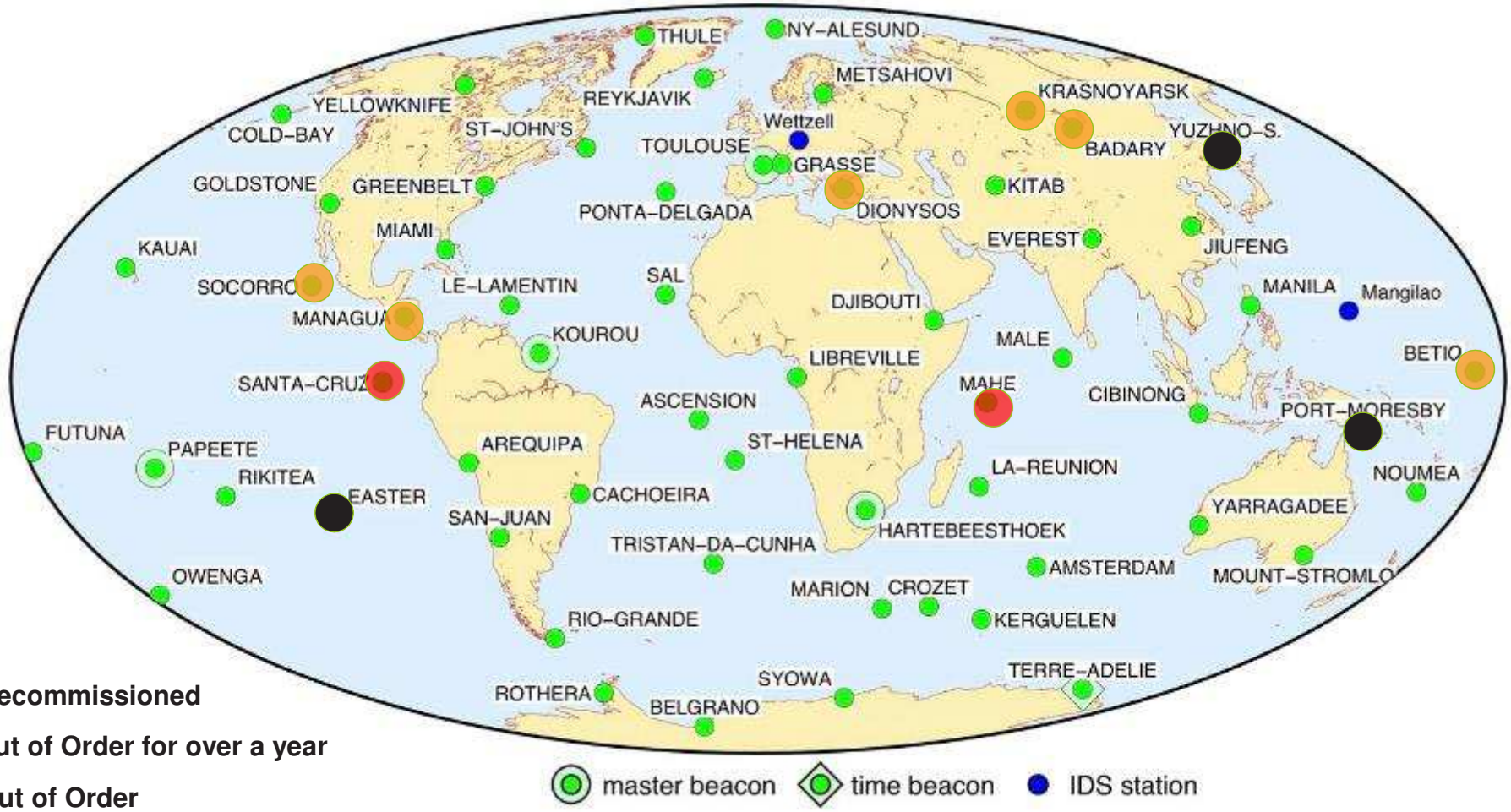
San Juan

THE CURRENT STATUS OF THE NETWORK

Recent events and evolution and outlook for the coming years

OPERATIONAL STATUS

60 permanent stations of which: 11 beacons are out of order (3 decommissioned)



Decommissioned

Out of Order for over a year

Out of Order

GMT 2018 Aug 31 17:33:41

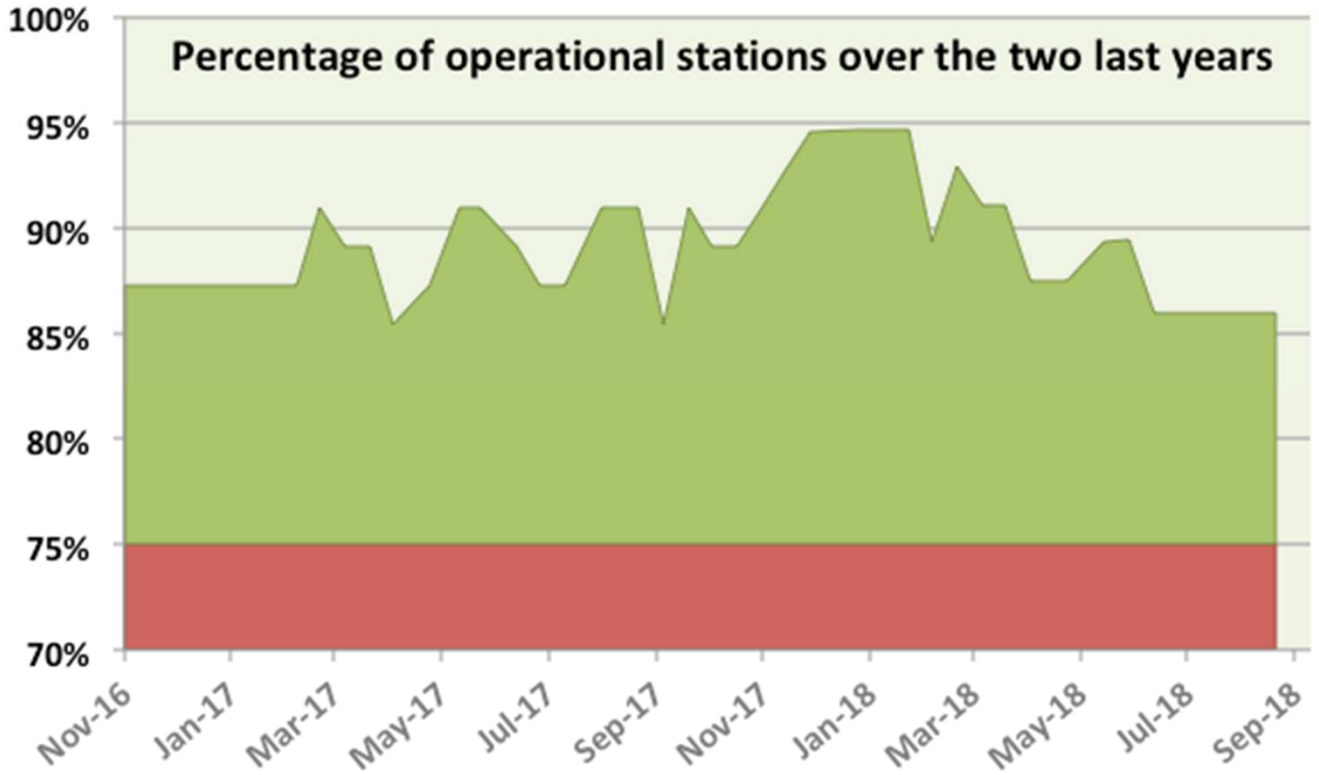
Decommissioned (pending replacement):

Yuzhno-Sakhalinsk (11/2005), Port-Moresby (06/2013) , Easter (08/2015)

NETWORK AVAILABILITY

12 maintenance operations (equipment replacement) in 2017-2018

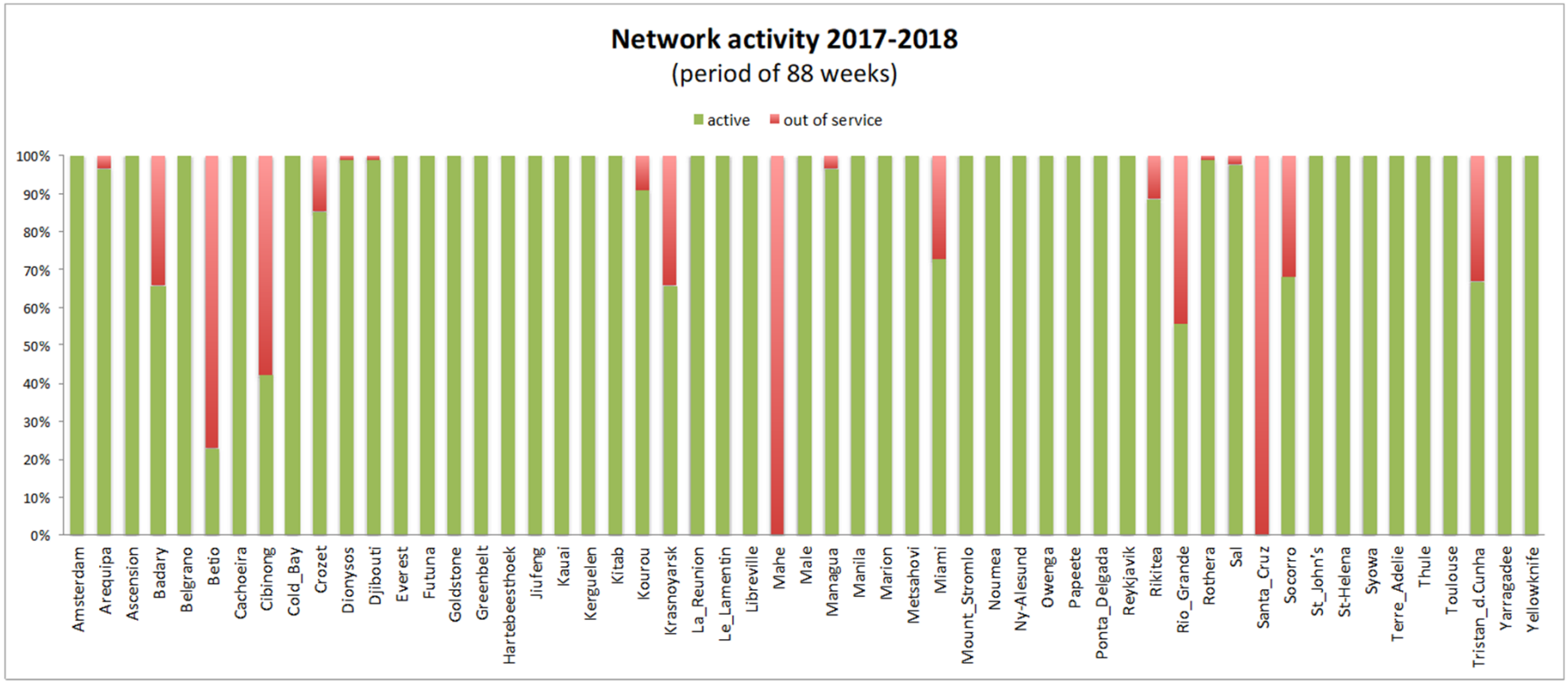
Network availability maintained over 85% of operating stations from 2012



From CNES/SALP data

NETWORK PERFORMANCE

Highly satisfactory overall performance thanks to the combined effort of all maintenance teams at CNES, IGN and all Host Agencies



From CNES/SALP data

NETWORK EVENTS 2017

2017	Station		Event
Feb.	PAUB	Papeete	Local tie survey
Mar.	SOFC	***Socorro***	***Restarting**: equipment replacement (antenna + beacon)*
	RIMB	*Rikitea*	*Beacon replacement*
	-	**Papenoo**	**Reconnaissance and RF compatibility tests**
Apr.	MIAB	*Miami*	*Service interruption: power supply outage (18/04 – 05/05)*
Aug.	TRJB	*Tristan DC*	*Beacon replacement*
Nov.	CRQB	*Crozet*	*Beacon replacement*
	SARC	Sal	Antenna verticality adjustment
	GR4B	*Grasse*	*Part of the Permanent Network*
Dec.	ARFB	*Arequipa*	*Beacon replacement*
	CIDB	*Cibinong*	*Beacon replacement*

In bold: main events

In normal font: on-site operations carried out by IGN

In italics: operational maintenance (equipment replacement) managed by CNES with the participation of Host Agencies

NETWORK EVENTS 2018

2018	Station		Event
Feb.	ROXC	**Rothera**	**Station relocation** and local tie survey
	BADB	*Badary*	*Shutdown for indefinite period*
	KRBB	*Krasnoyarsk*	*Shutdown for indefinite period*
Apr.	WEUC	*Wettzell*	*Beacon replacement*
	MLAC	**Mangilao**	**Station installation** and local tie survey
Jun.	CRQB	*Crozet*	*Service disruption from 19 June*
Aug.	RIRB	***Rio Grande***	***Restarting*** *after a two-years outage (equipment replacement)*
Sep.	SJUC	**San Juan**	**Station installation** and local tie survey

In bold: main events

In normal font: on-site operations carried out by IGN

In italics: operational maintenance (equipment replacement) managed by CNES with the participation of Host Agencies

NETWORK FUTURE PROSPECTS

Restarting in:

Santa-Cruz, Ecuador: new tripartite agreement recently signed; full replacement of the equipment

Badary, Russia: negotiating with local authorities to restart transmission

Krasnoyarsk, Russia: negotiating with local authorities to restart transmission + possible relocation

Relocation in:

Ny-Alesund, Norway (co-location GNSS + SLR + VLBI): planned in October 2018

Easter island, Chile following site closure in 2015: reconnaissance planned at the end of 2018

Reykjavik, Iceland (co-location GNSS) to get better performance: reconnaissance planned mid 2019

New sites in:

Changchun, China (co-location GNSS + SLR): awaiting for government agreement

Katherine, Australia (co-location GNSS + VLBI): awaiting for the VLBI upgrade

Papenoo, French Polynesia (co-location GNSS + SLR + VLBI):

4th generation beacon deployment from early spring 2019

Improving the network robustness and performance

Opportunity to relocate antennas to get better visibility (cable length 50 m compared with 15 m before)

NETWORK MAIN CHALLENGES

Continuous operation of the stations: reliable service

Facing local difficulties: withdrawal, site refurbishment; frequency clearance…

Equipment failures: ageing network

DORIS / VLBI RF compatibility (at GGOS core sites)

3 RF compatibility tests performed at: Greenbelt (2014); Wettzell (2015-16); Papenoo (2017)

Requirements for the installation at co-located sites were set

Monument stability monitoring

GGOS goal: 0.1mm/year

Equipping sites with control points and targets to carry out stability monitoring surveys

Installing devices such as tiltmeter or Geocube (small GPS receiver)

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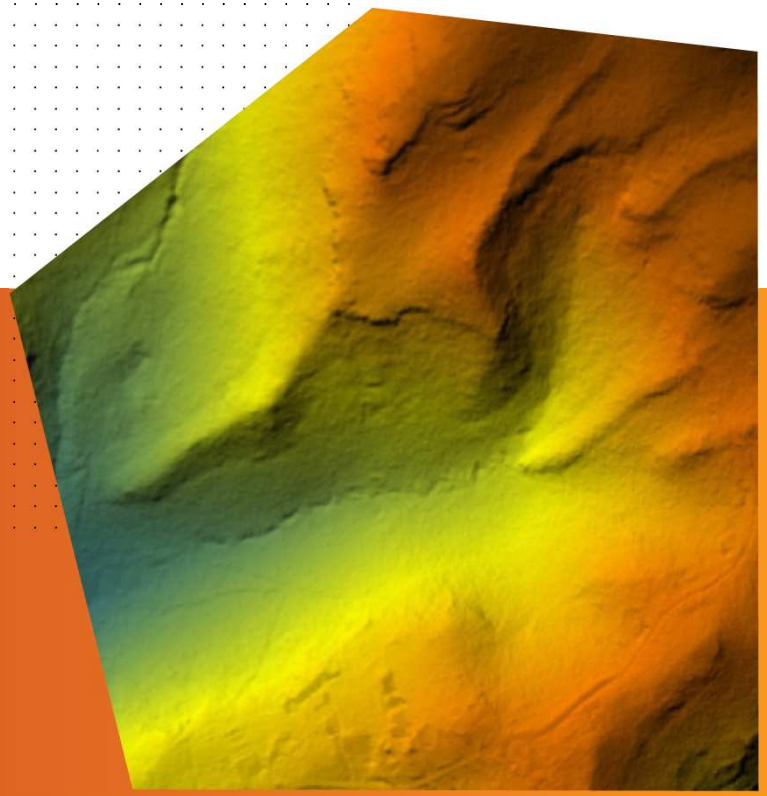

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