

living planet symposium

BONN
23–27 May
2022

TAKING THE PULSE
OF OUR PLANET FROM SPACE

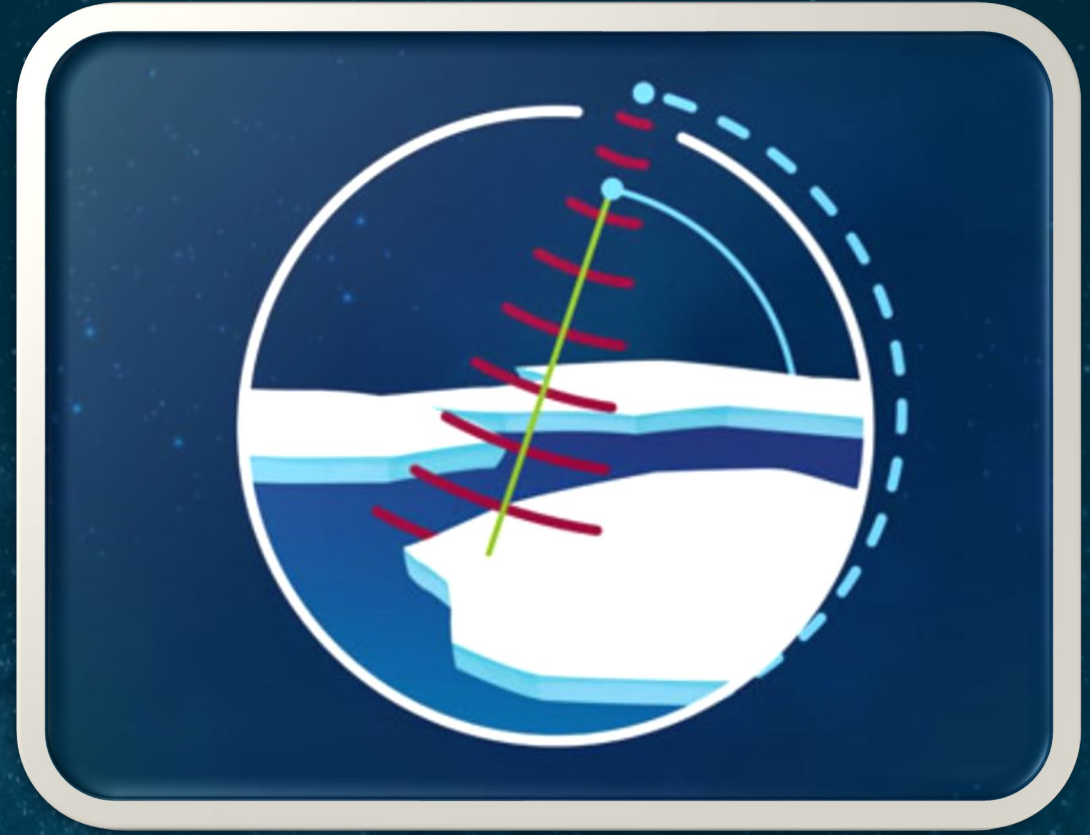


CryoSat-2 re-phasing to support Antarctic campaign in resonance with ICESat-2

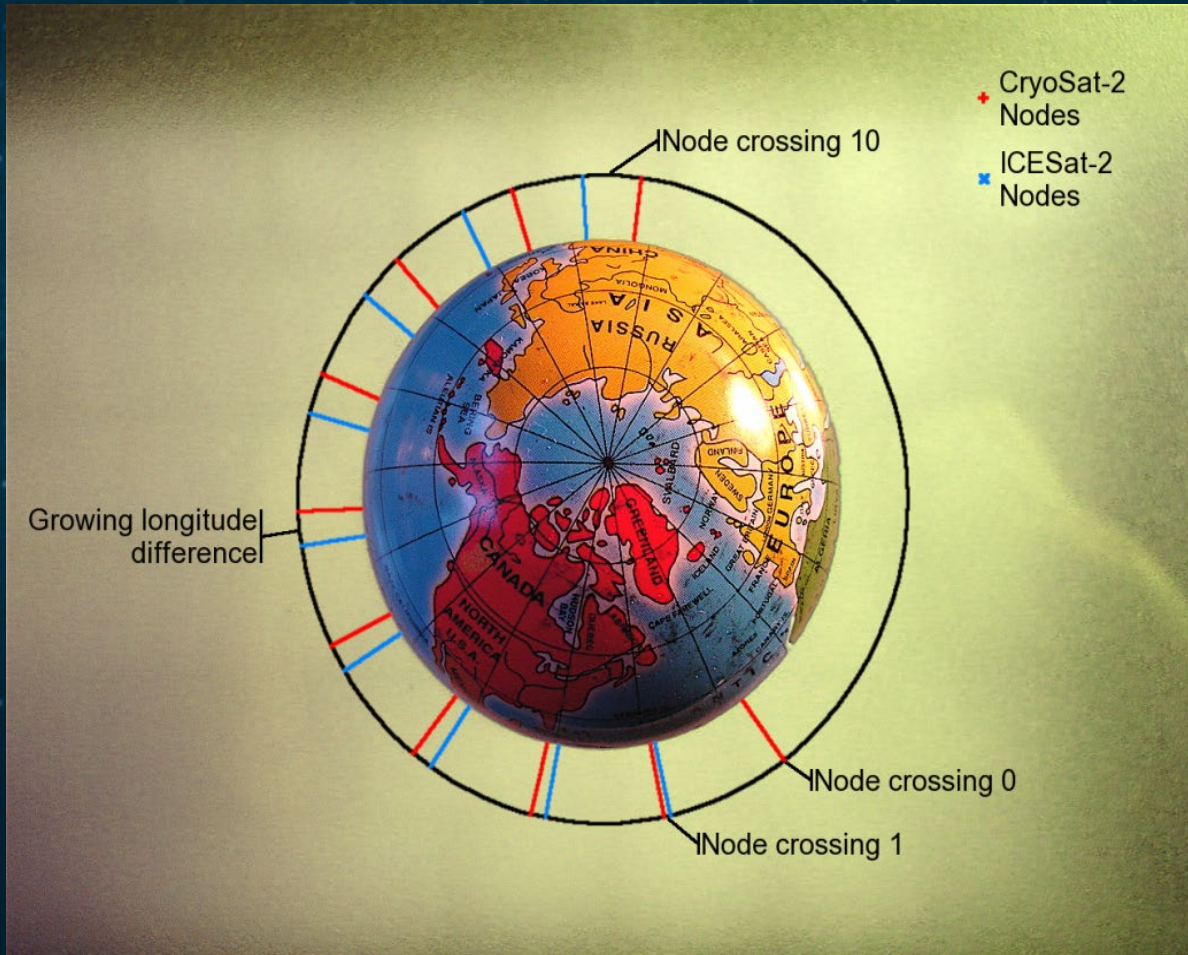
Javier Sánchez, J. Herrera, J. Lerch, G. Albin, S. Badessi, V. Torroni, M. Scagliola,
R. Guerrieri, J. Bouffard, B. Hoyos Ortega, T. G. D. Casal, T. Parrinello

23 May 2022

- The concept & chronology
- Common tracks
- The manoeuvre campaign
- Arctic & Antarctic
- The future



#CRYOSCOPE



CryoSat-2 in resonance with ICESat-2:

- Thanks to the CryoSat-2 orbital change in July 2020 the two satellites are orbiting in a 19 to 20 resonance.
- This enables systematic coincidences of both instruments in the polar regions every 1.33 days approximately.
- The time difference between the observations taken by one of the spacecraft and the other is directly linked to the local time difference between the two orbits.

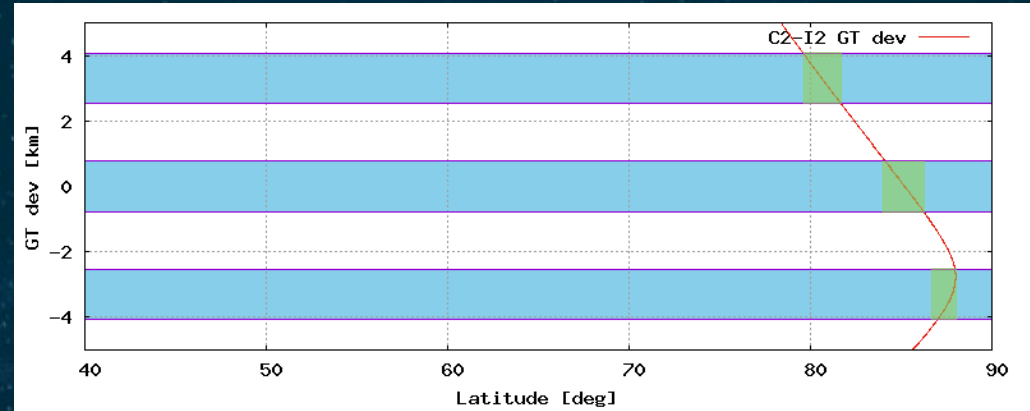
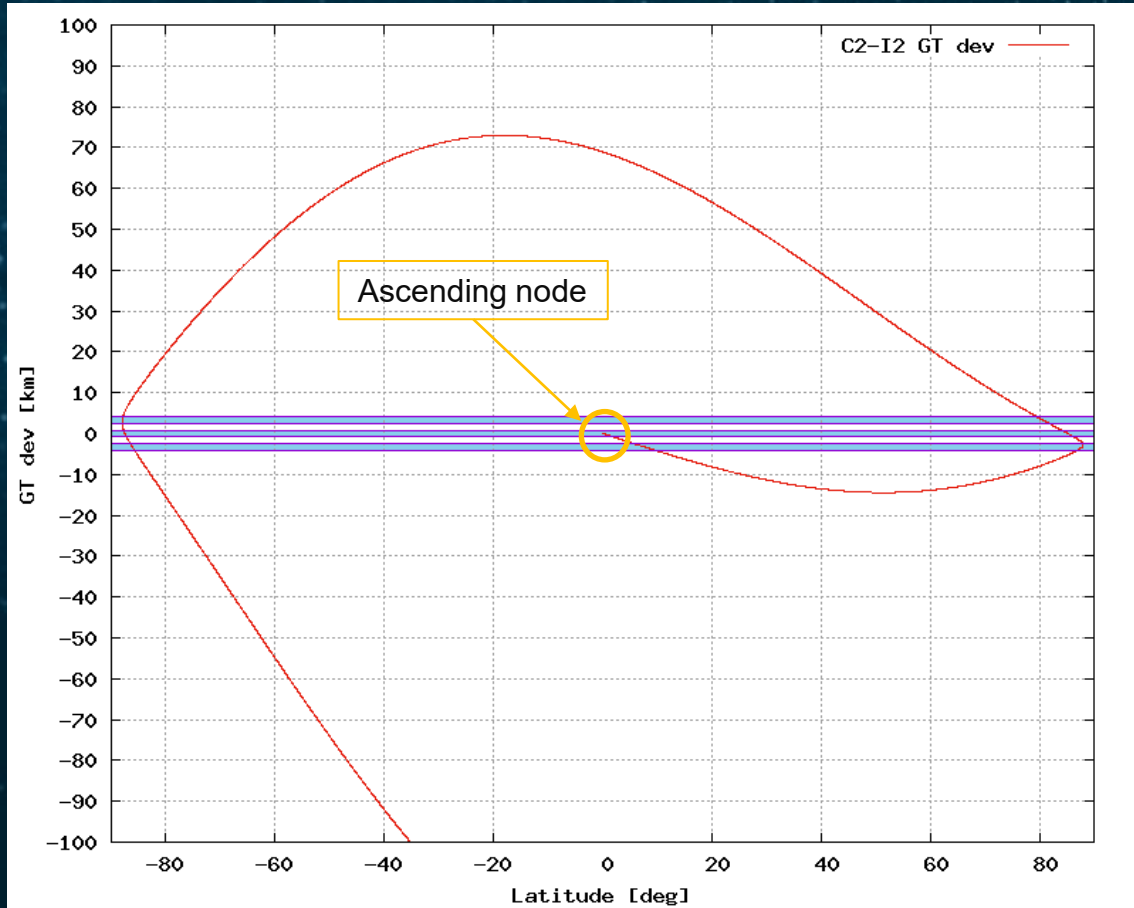
CRYO2ICE Arctic mission (July 2020):

- The resonant orbit was acquired at an orbital phase that maximized coincidences with ICESat-2 in the Arctic. The spacecraft is currently orbiting in that configuration.

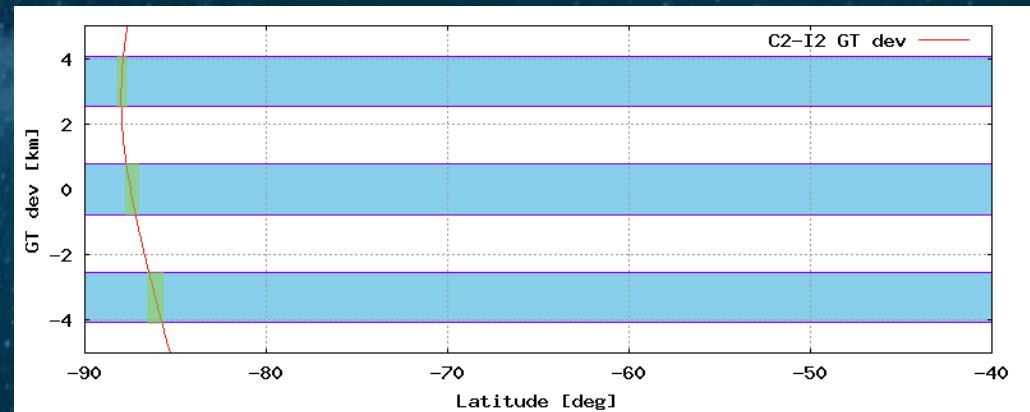
CRYO2ICE Antarctic mission (June 2022):

- This new phase will put the focus on the Antarctic region, it will be acquired after the manoeuvre campaign schedule in June 2022.

Common tracks

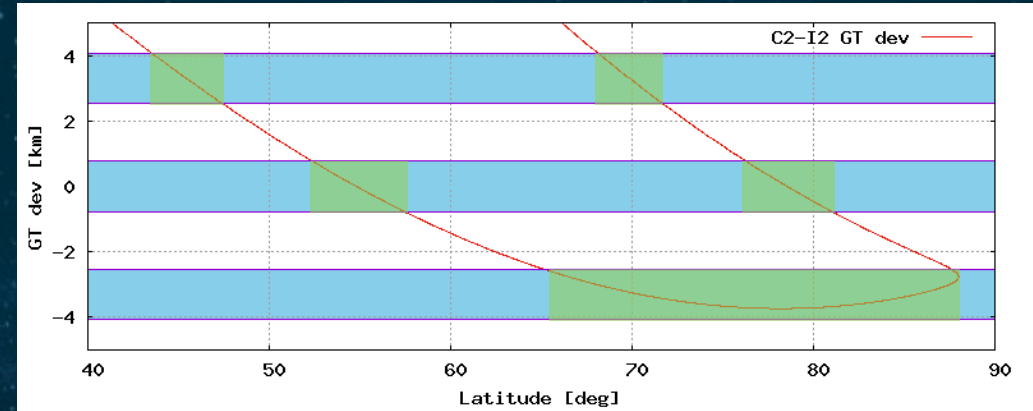
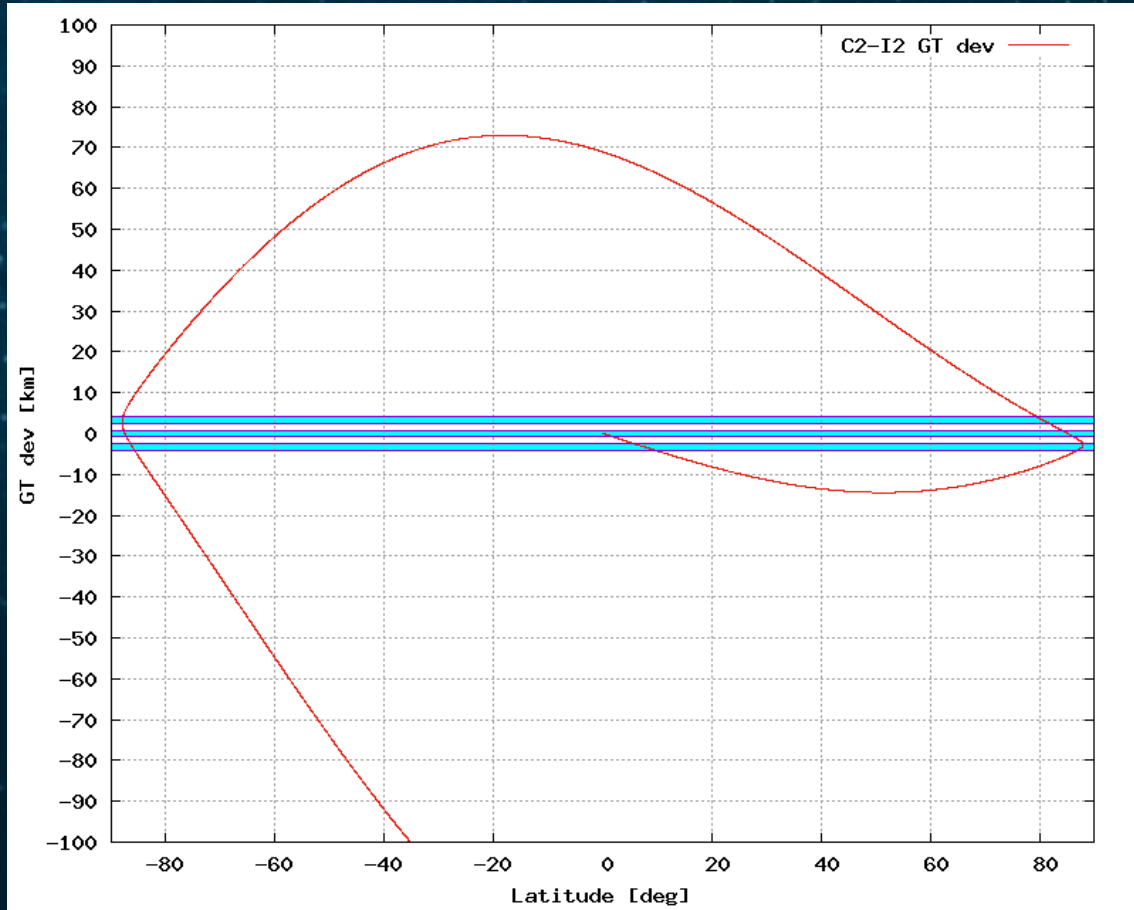


Arctic

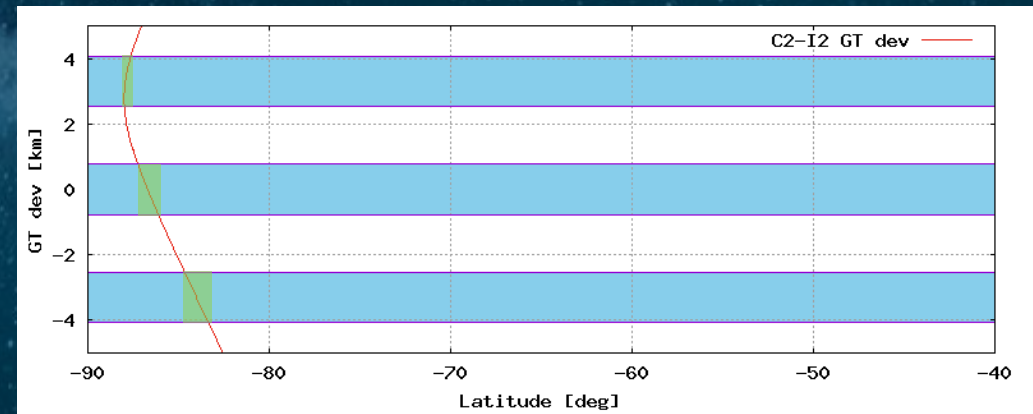


Antarctic

Common tracks

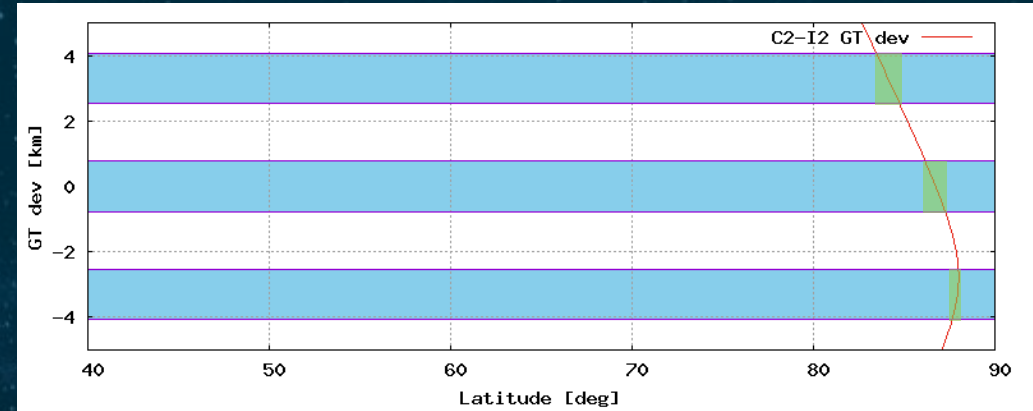
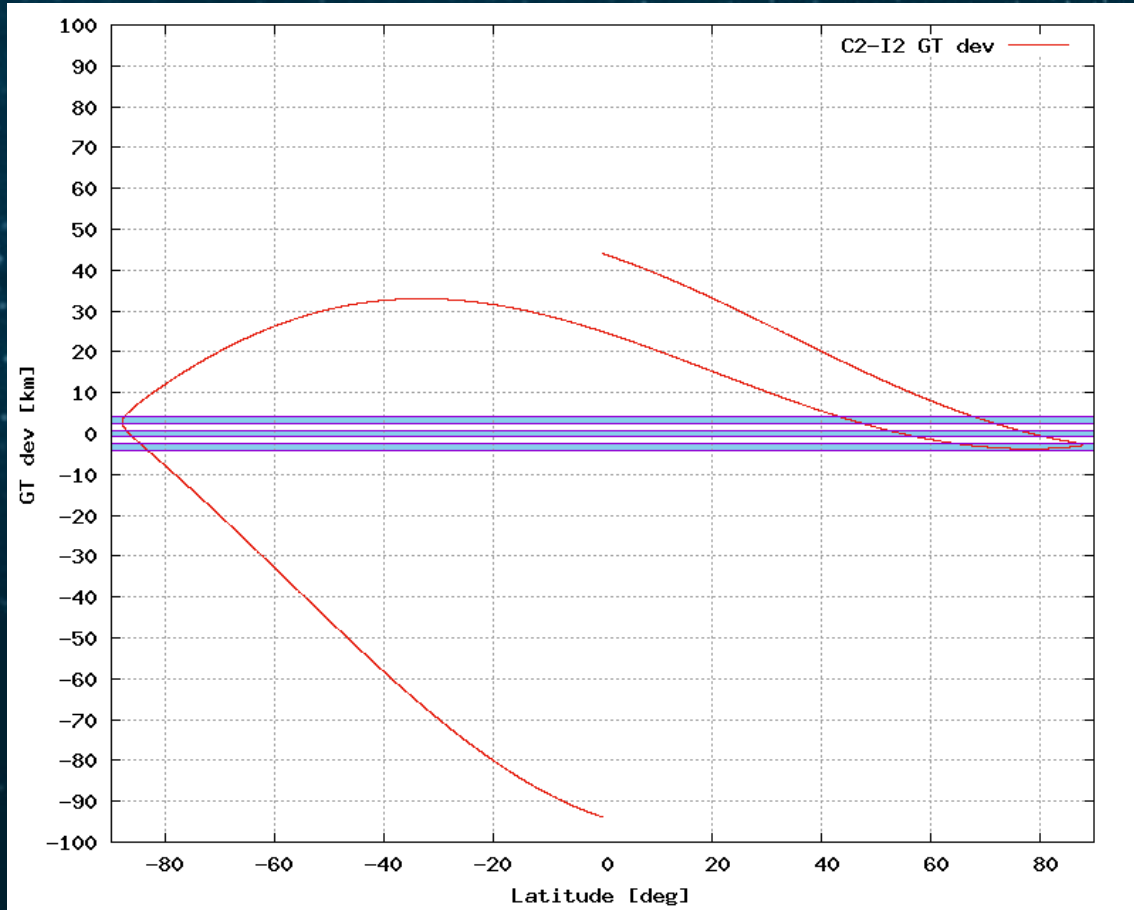


Arctic

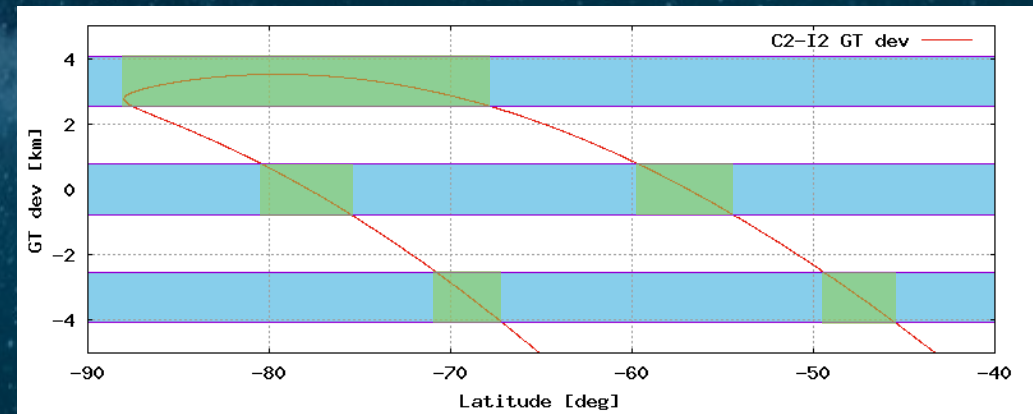


Antarctic

Common tracks

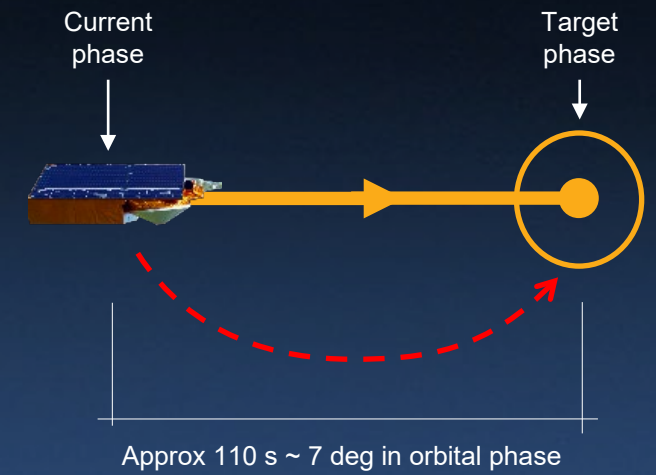
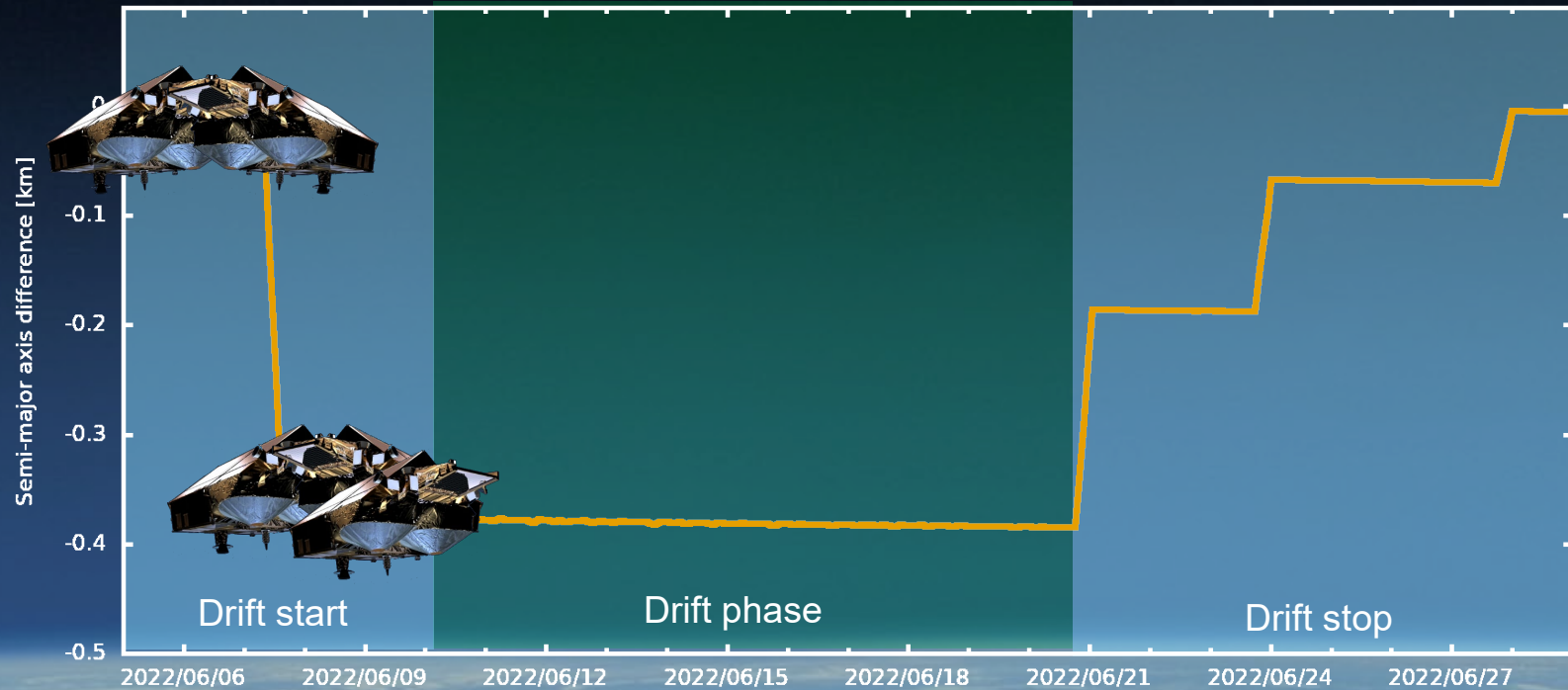


Arctic



Antarctic

The manoeuvre campaign



Drift start:

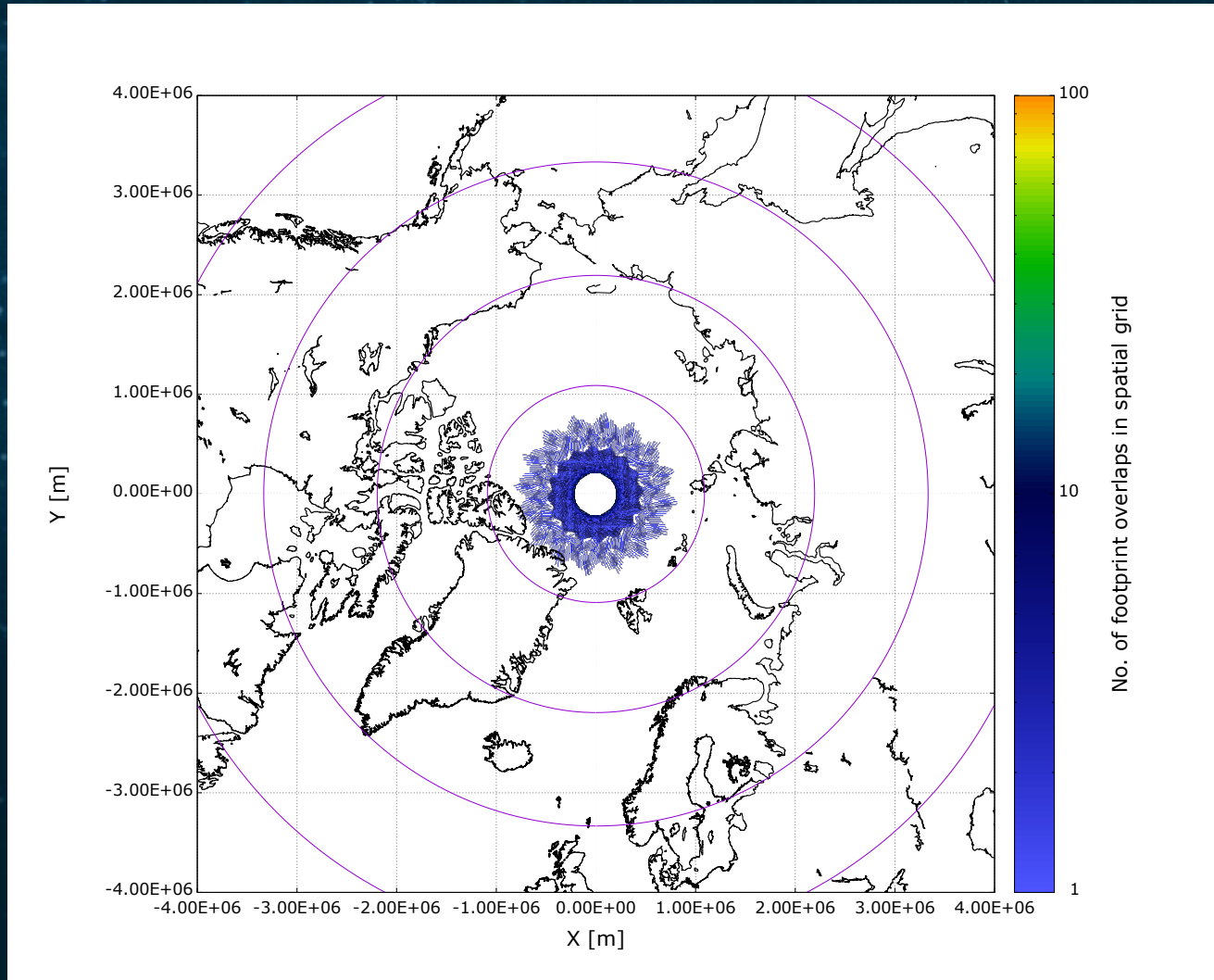
- Two manoeuvre batches against the flight direction to start the drift towards the target phase.

Drift stop:

- Three manoeuvre batches in the flight direction to stop the drift, and to acquire the same altitude.

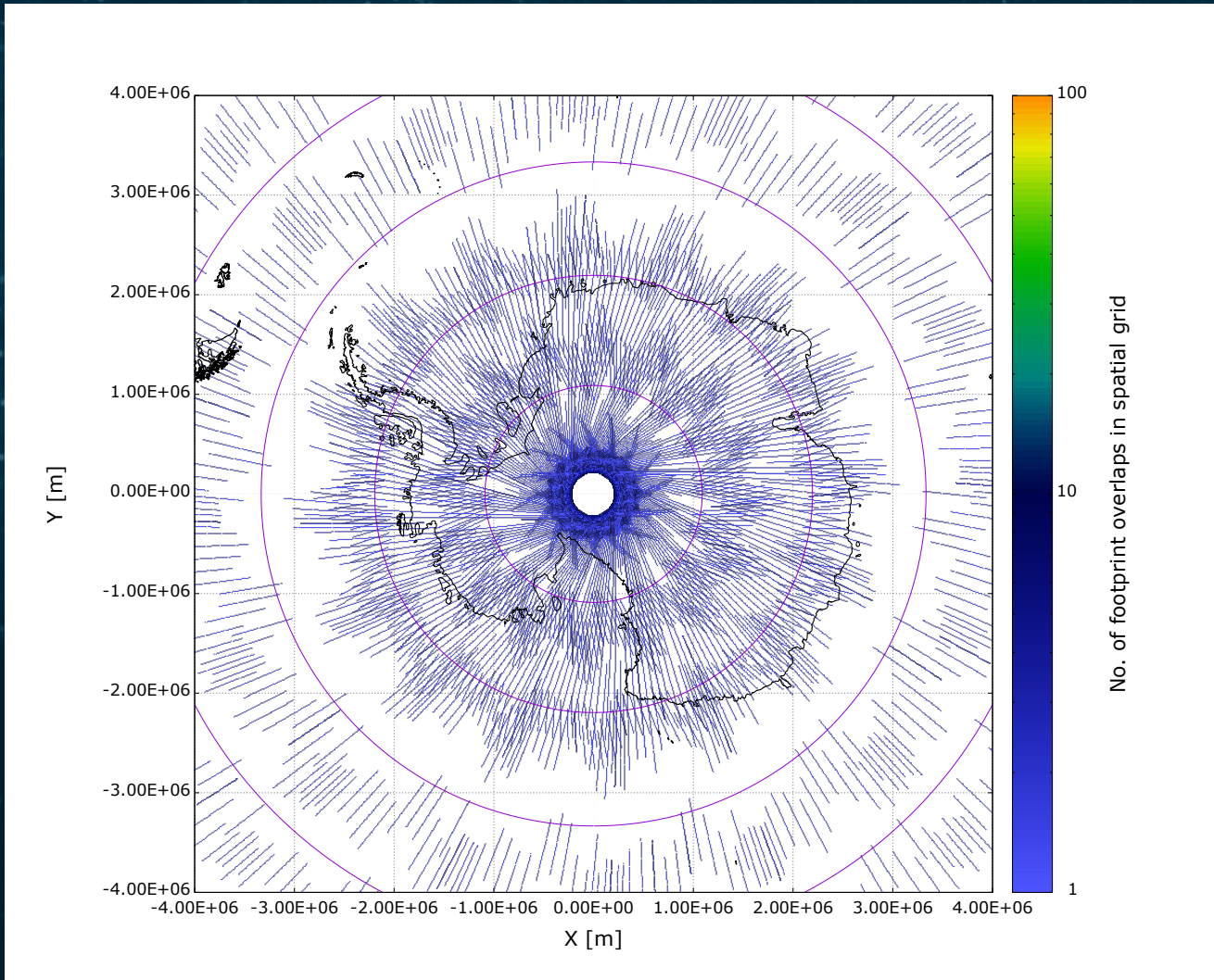
Total Δv cost: 0.4 m/s

June 2022	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		



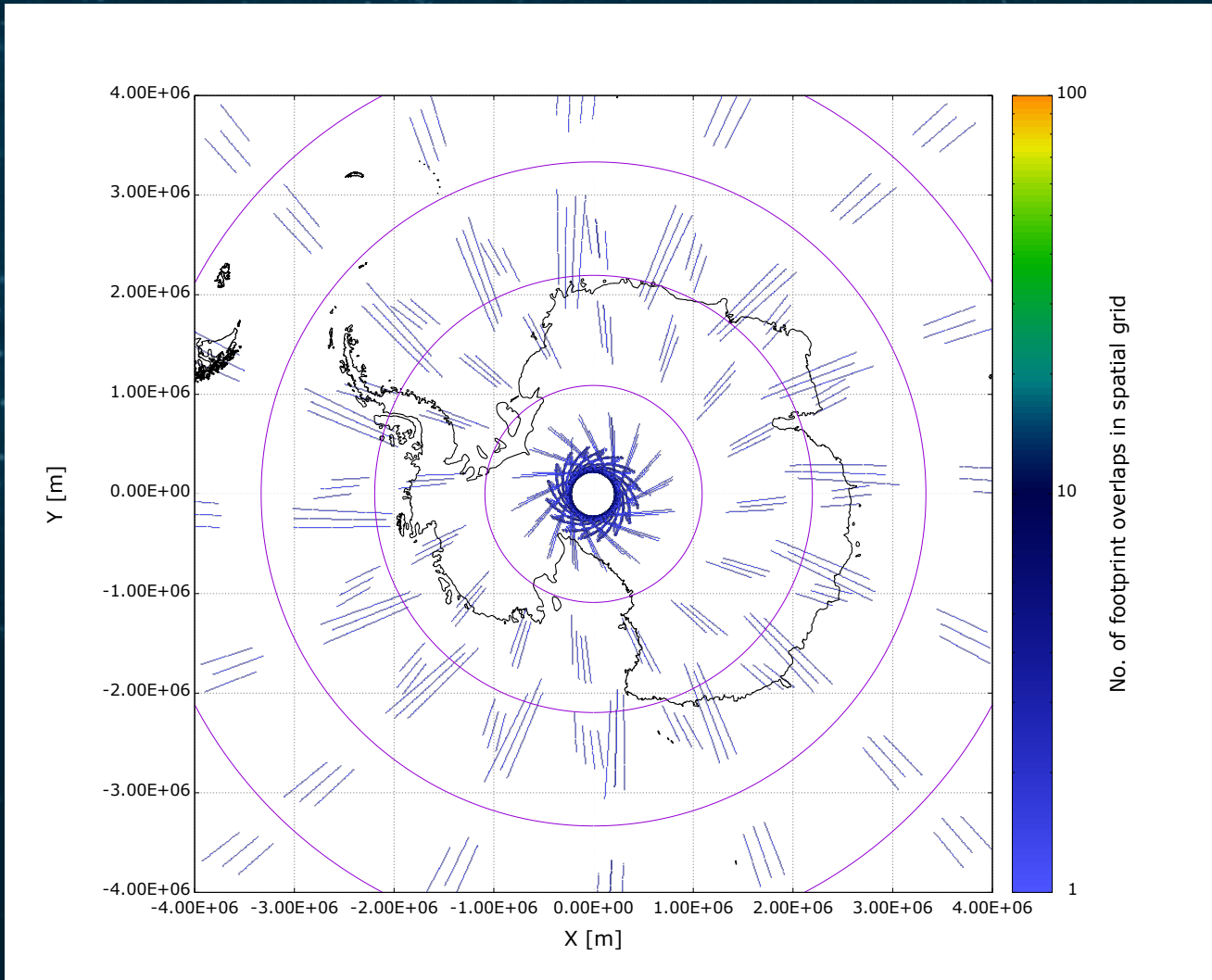
Analysis of coincidences in the Arctic:

- Equatorial bias of $B = 95$ km
- Analysis period : 2022-07 to 2023-05
- Polar stereographic projection
- Coincidences confined to the highest latitudes.
- Duration of coincidences: ~ 20 s



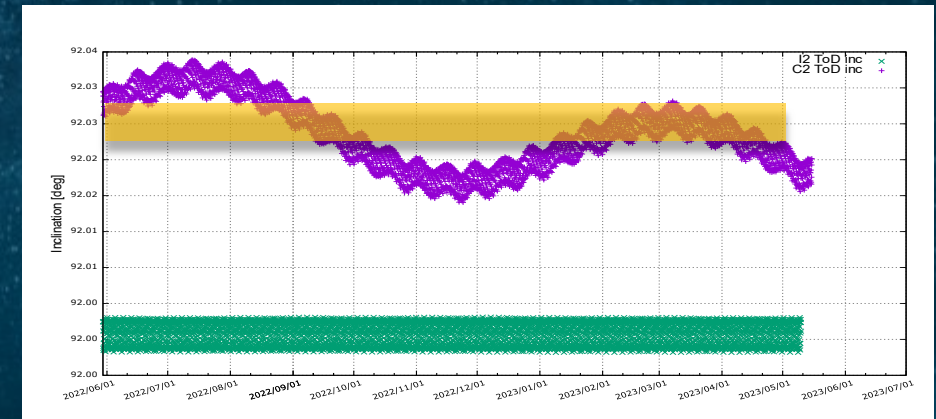
Analysis of coincidences in the Antarctic:

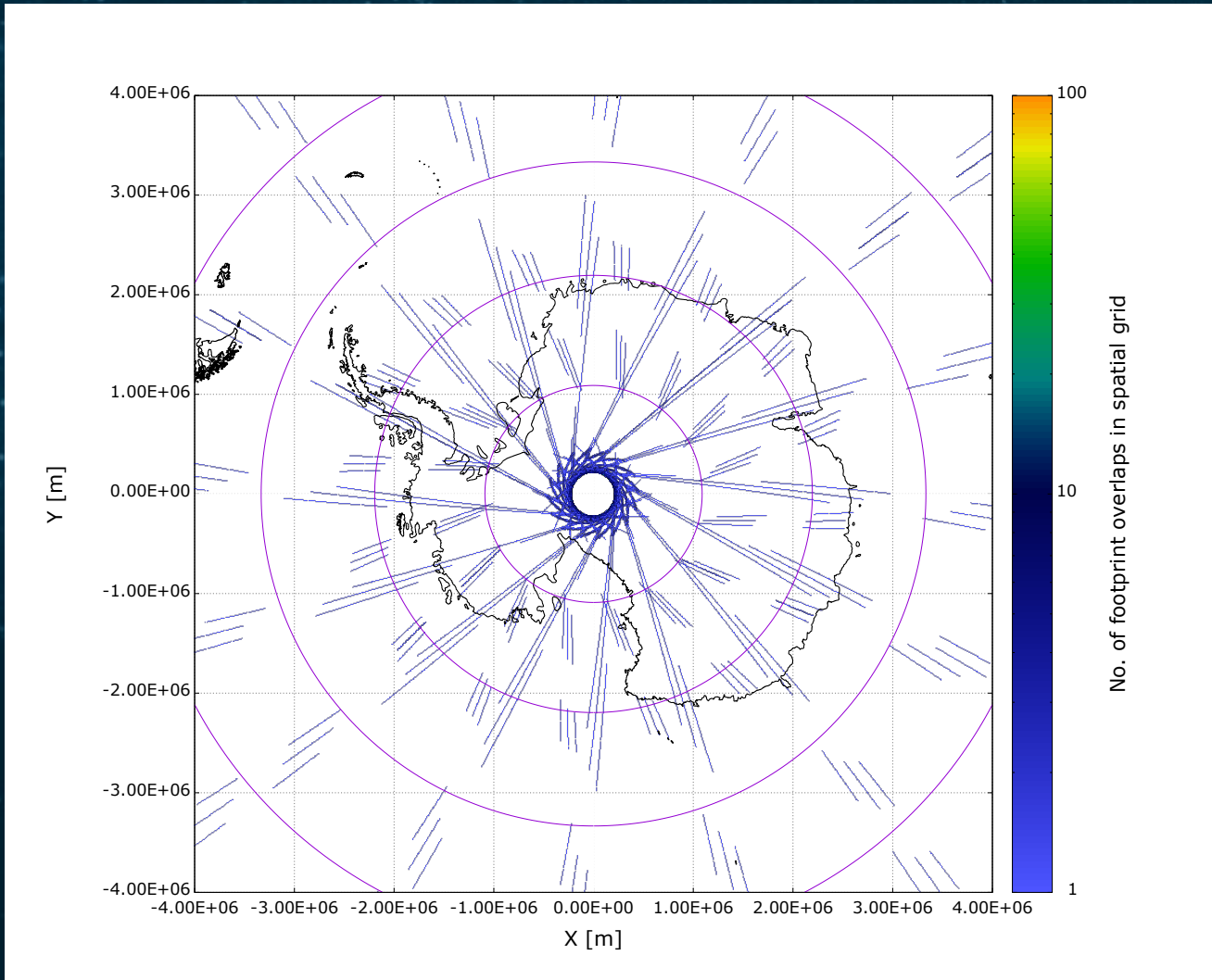
- Equatorial bias of $B = 95$ km
- Analysis period : 2022-07 to 2023-05
- Polar stereographic projection
- Coincidences magnified in the Antarctic as a result of the new orbital phase.
- Duration of coincidences:
 - With central pair: ~80 s
 - With left pair: ~60 s
 - With right pair: ~400 s



Analysis of coincidences in the Antarctic:

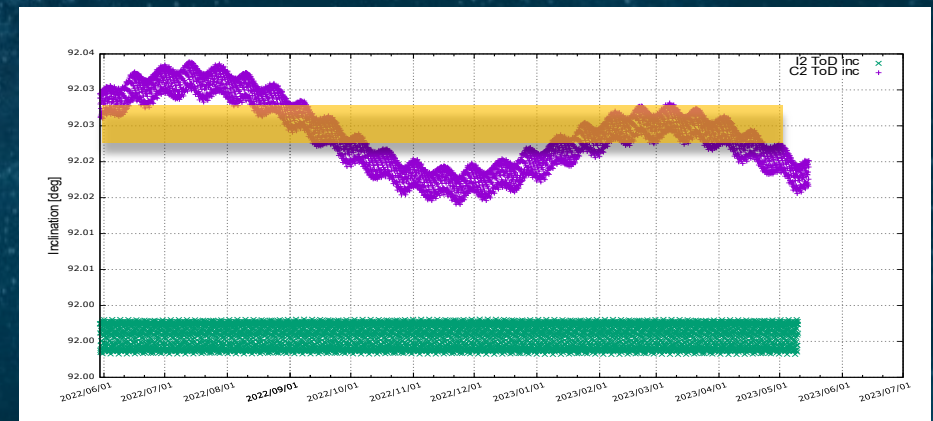
- Equatorial bias of $B = 95$ km
- Analysis period : 2022-07 to 2023-08
- Polar stereographic projection
- Coincidences with right beam interrupted due to a large excursion in inclination
- Duration of coincidences: ~ 130 s



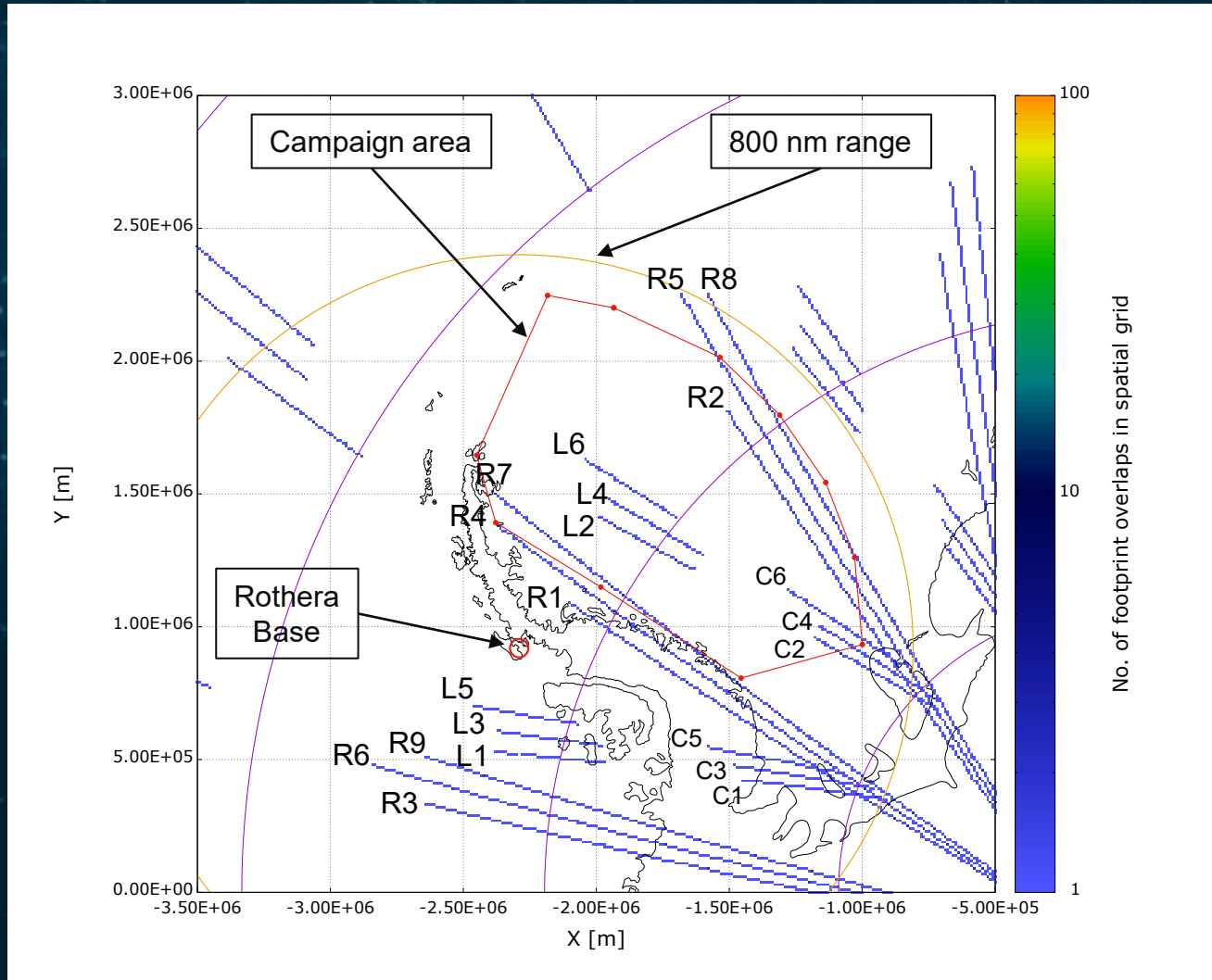


Analysis of coincidences in the Antarctic:

- Equatorial bias of $B = 95$ km
- Analysis period : 2022-09 to 2023-10
- Polar stereographic projection
- Coincidences with right beam interrupted due to a large excursion in inclination
- Duration of coincidences: ~ 400 s



The Antarctic. Coincidences Dec 22 - Jan 23



Key for coincidences:

No	Epoch	Beam (pair)
R8:	2023/01/18-04:36:48.632	Right
R5:	2022/12/28-05:46:23.309	Right
R2:	2022/12/07-06:56:23.628	Right
L6:	2023/01/24-17:58:23.479	Left
L4:	2023/01/03-19:07:35.128	Left
L2:	2022/12/13-20:17:02.835	Left
C6:	2023/01/24-17:55:57.722	Central
C4:	2023/01/03-19:05:05.388	Central
C2:	2022/12/13-20:14:33.529	Central
R7:	2023/01/14-06:19:40.294	Right
R4:	2022/12/24-07:29:24.751	Right
R1:	2022/12/03-08:39:25.985	Right
L5:	2023/01/20-19:41:56.324	Left
L3:	2022/12/30-20:51:05.997	Left
L1:	2022/12/09-22:00:22.019	Left
C5:	2023/01/20-19:39:18.059	Central
C3:	2022/12/30-20:48:27.112	Central
C1:	2022/12/09-21:57:43.306	Central
R9:	2023/01/31-06:55:50.593	Right
R6:	2023/01/10-08:05:28.441	Right
R3:	2022/12/20-09:15:03.908	Right

- The upcoming manoeuvre campaign will allow to put the focus on the Antarctic region, and to benefit from the synergies of these two instruments also in this area, with support to the CryoVex campaign.
- After this phase, the spacecraft will return to the Arctic configuration.
- Possible improvement of the coincidences by optimizing a diachronic change in the equatorial bias.
- The CRYO2ICE project has boosted the partnership of ESA and NASA in the study of the Cryosphere and in spacecraft operations.

Thank you very much to the ICESat-2 Team!!!

