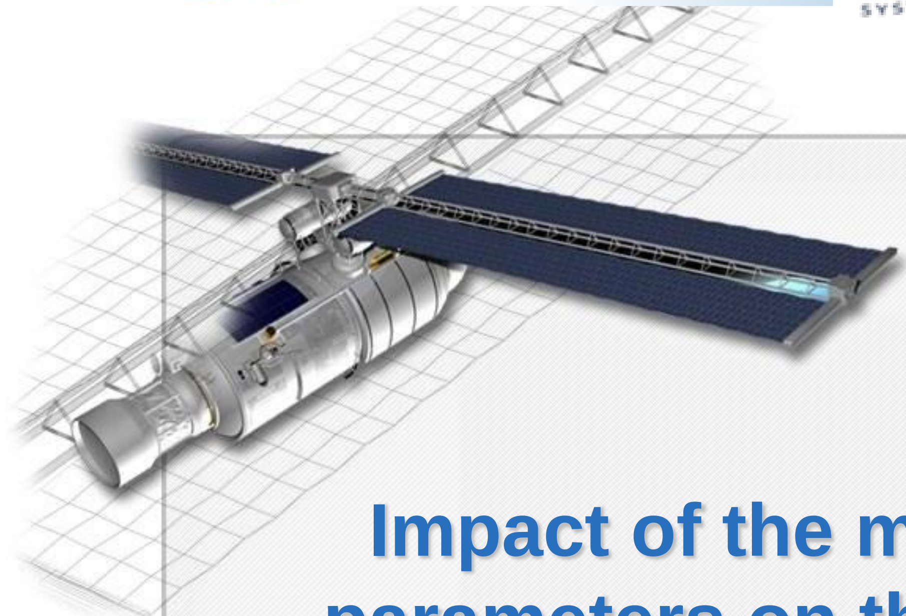

Impact of the mission definition parameters on the space radiation environment specification

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Context

- When calculating the radiation environment in terms of energetic particle fluxes, to be experienced during a specific mission, a certain number of orbits is chosen as representative.
- The engineer in charge needs to define the resolution of the calculation:
  - Number of orbits * number of points/orbit, in the OMERE tool

Objectives

- How will the radiation environment specification be impacted by the chosen resolution?
- Recommendations per orbit type for precise calculation and gain of time

Outline

- Description of activities
- Comparison results
- Conclusions - Recommendations

Description of activities

- OMERE v5.0 was used (see next presentation)
- Determine the impact on:
  - Particle fluxes
  - Dose-depth curve
  - Equivalent fluence-depth curve (10 MeV protons)
  - South Atlantic Anomaly (SAA) definition
- Conclude on the adequacy of usually defined resolutions (per orbit type)

Description of activities

- Multiple space mission types were studied
  - Here we present:
    - LEO: 670 km, 98°,5 y
    - Highly Elliptical: 600 x 40 000 km, 64.3°, 10 y
    - Electrical Orbital Rising transfer, defined via a trajectory file
      - From a circular orbit (11000 km x 11000 km, inc = 7 deg)
      - GTO from 200 km perigee (200 km x 35486 km, inc = 7 deg)
      - GTO 2000 km perigee (2000 km x 35486 km, inc = 7 deg)

Description of activities

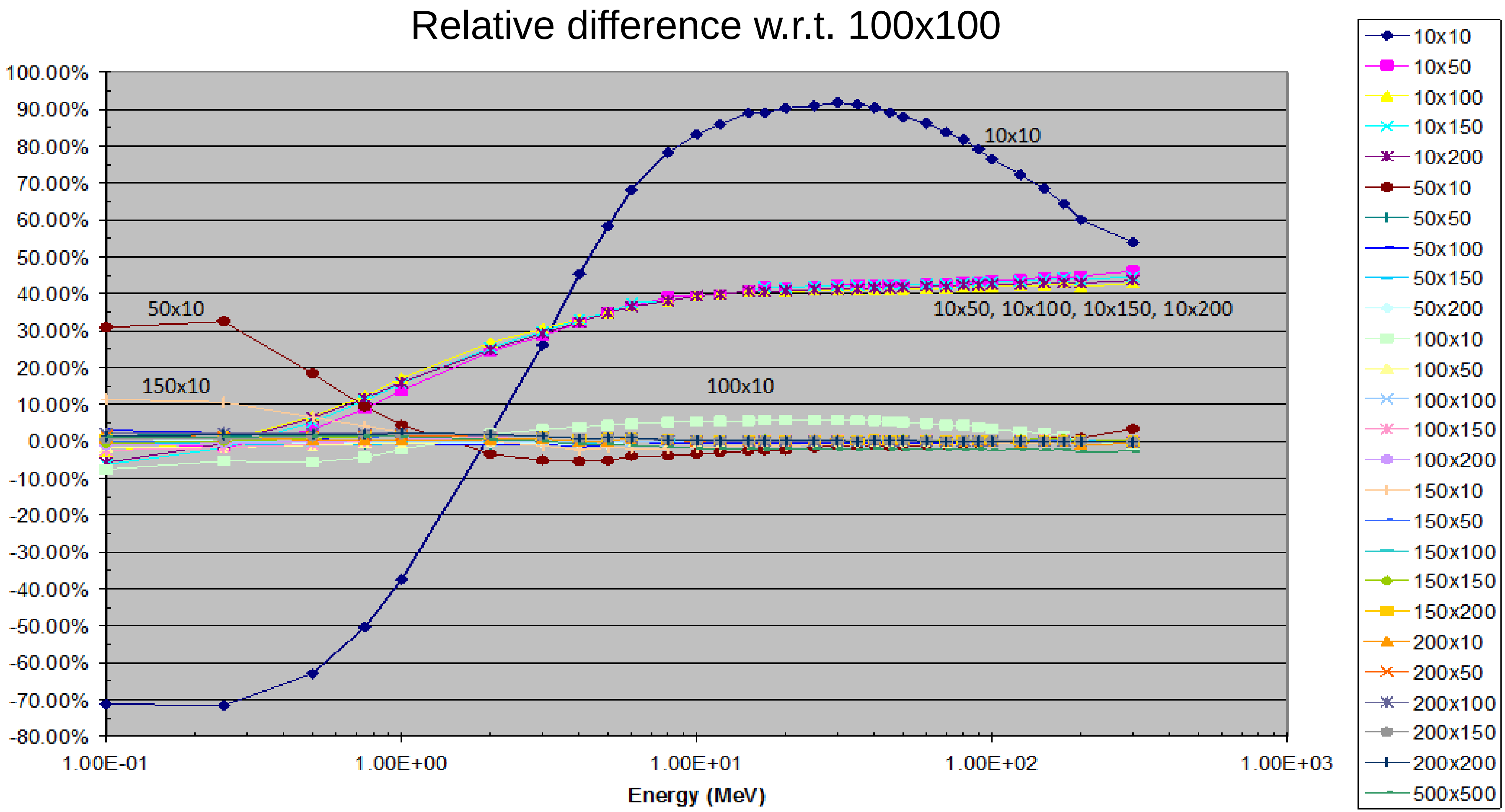
- Configurations studied for each orbit

		Number of points/orbit					
		10	50	100	150	200	500
Number of orbits	10	10x10	10x50	10x100	10x150	10x200	
	50	50x10	50x50	50x100	50x150	50x200	
	100	100x10	100x50	100x100	100x150	100x200	
	150	150x10	150x50	150x100	150x150	150x200	
	200	200x10	200x50	200x100	200x150	200x200	
	500						500x500

  - 1x1, 10x10, 2x50, 100x100 for GEO
  - Whole file (20 000 points), 2/3, ½, 1/3 et 1/10 for EOR
  - In some cases more orbits/points were studied to validate conclusions

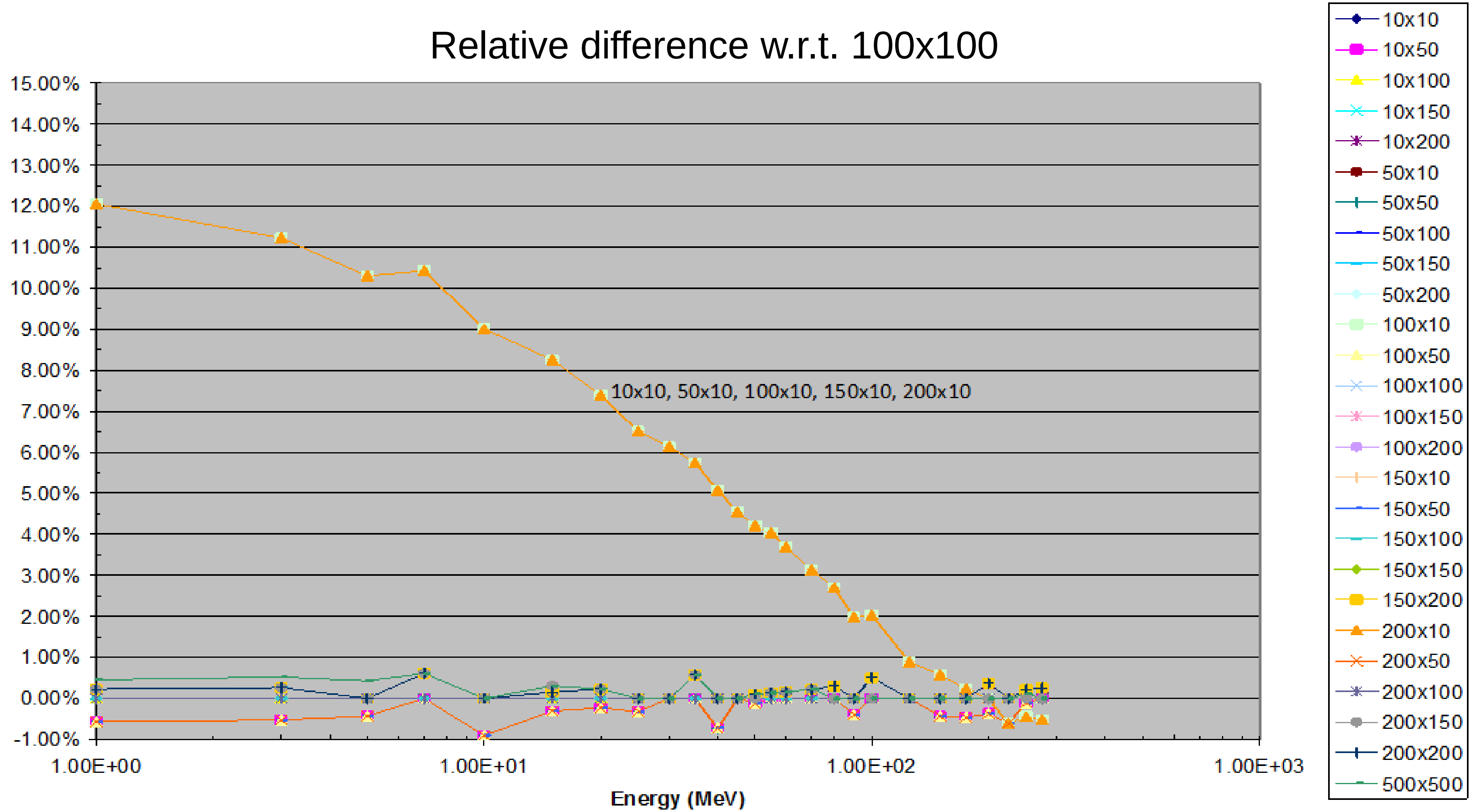
Comparison results

- Trapped protons (AP8) for LEO (670 km, 98°, 5y)



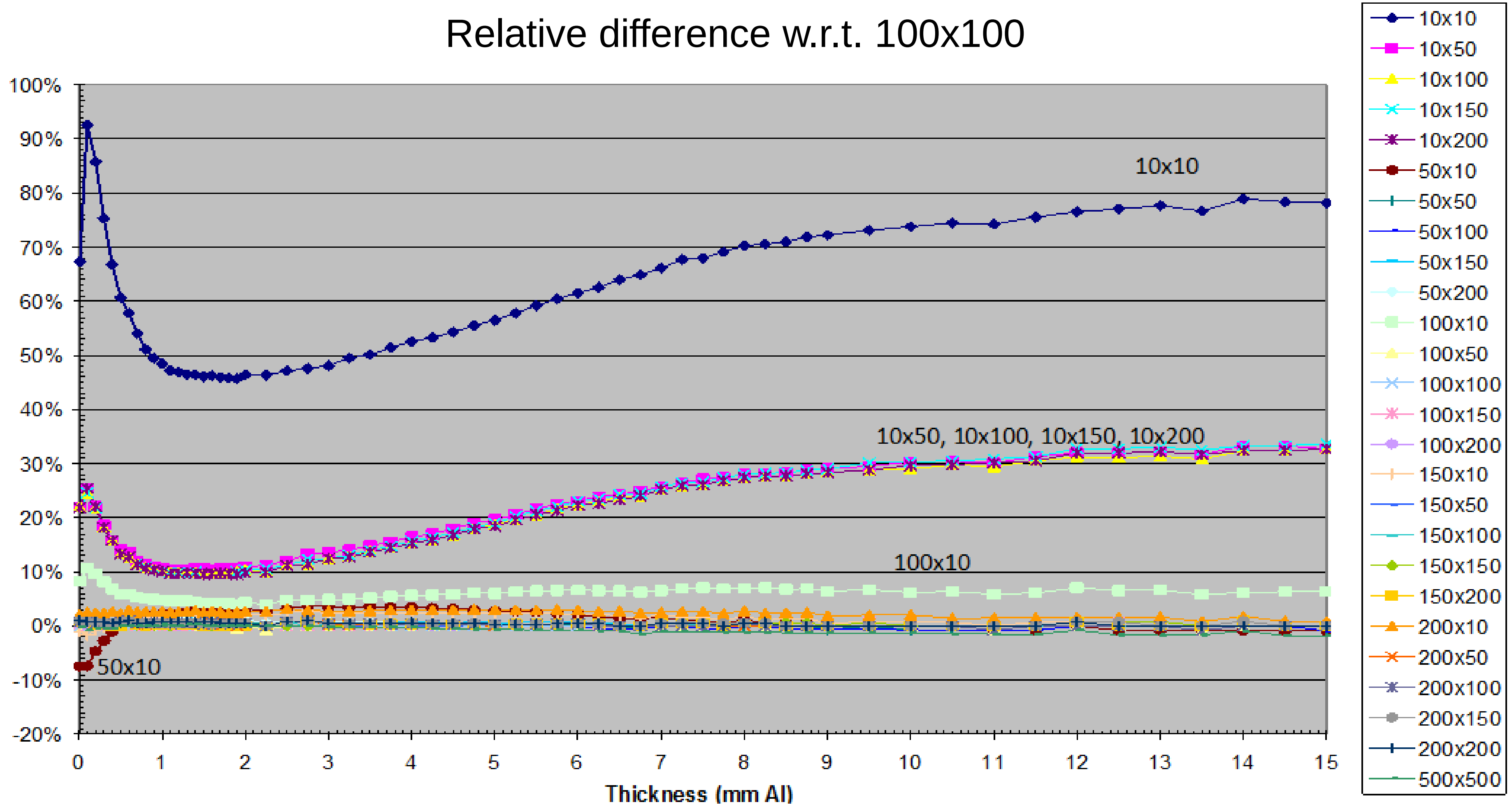
Comparison results

- Solar protons (ESP 85%) for LEO (670 km, 98°, 5y)



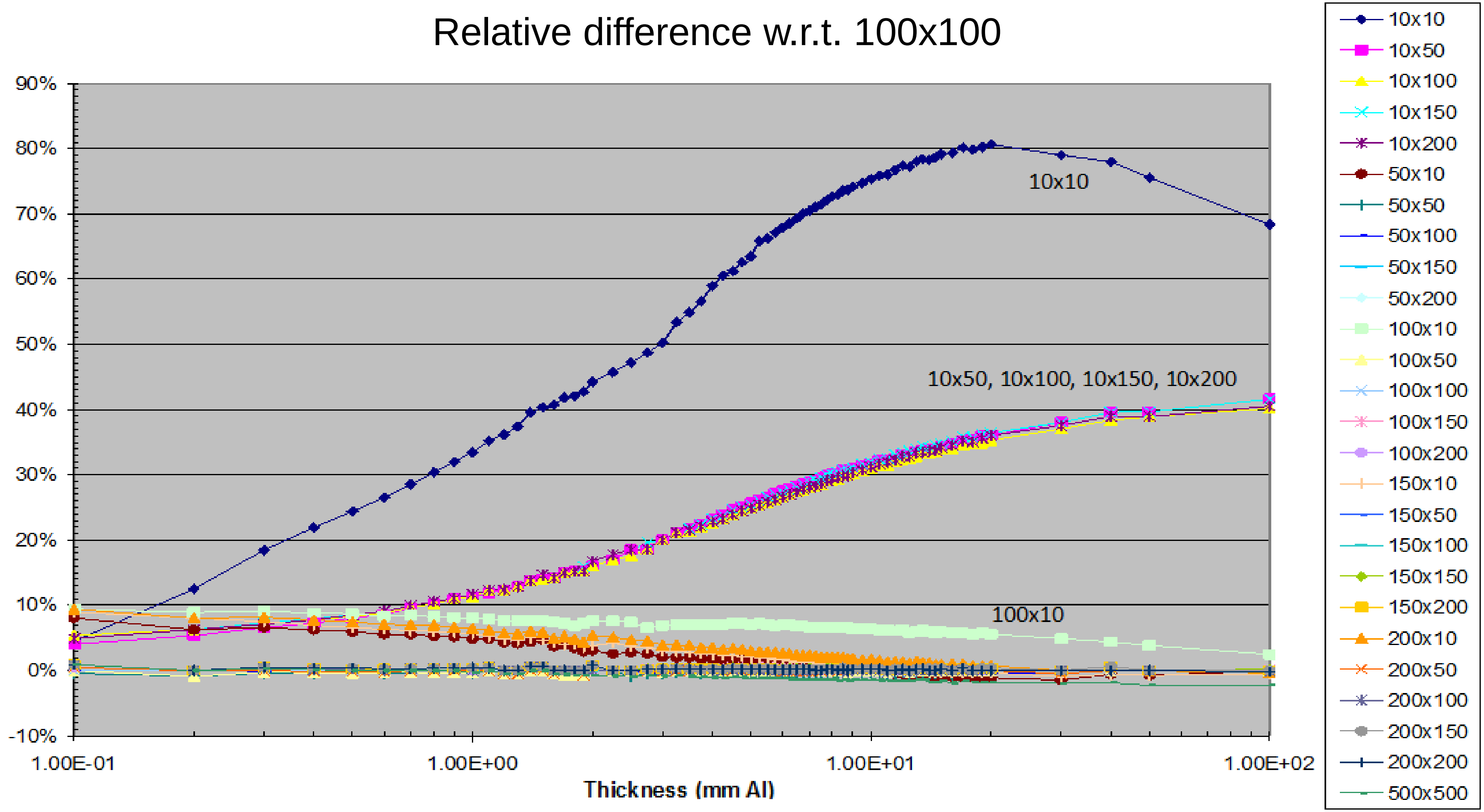
Comparison results

- Dose-depth curve for LEO (670 km, 98°, 5y)



Comparison results

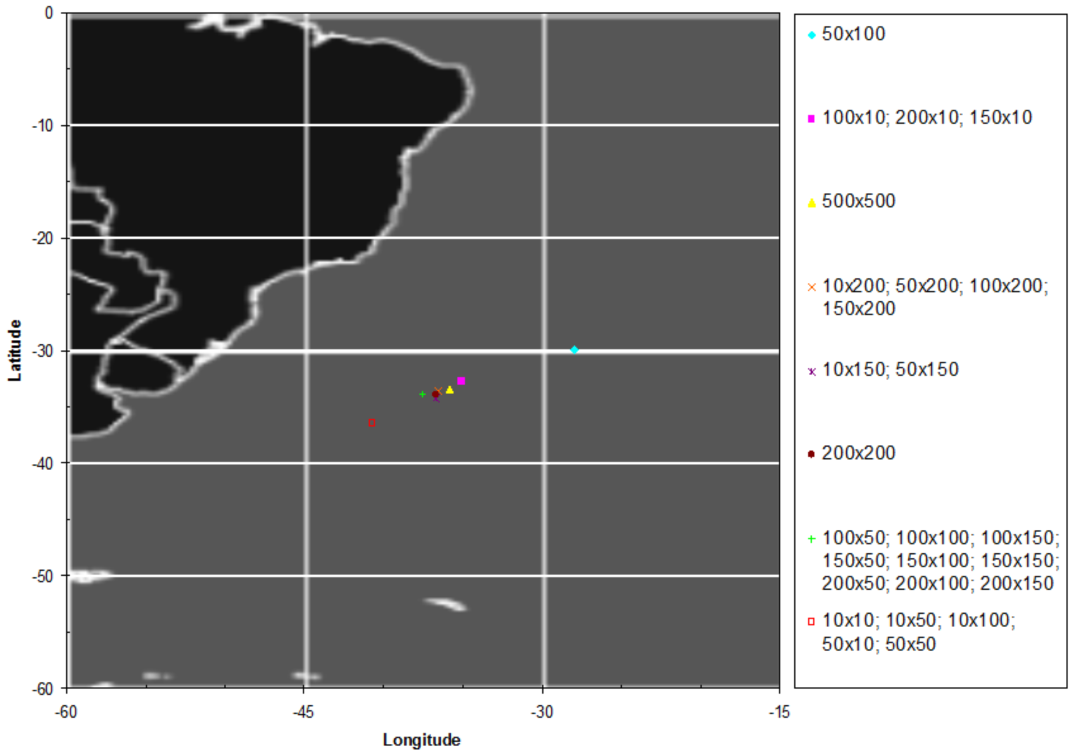
- Equivalent fluence-depth curve for LEO (670 km, 98°, 5y)



Comparison results

- Peak proton flux (E>30 MeV) for LEO (670 km, 98°, 5y)

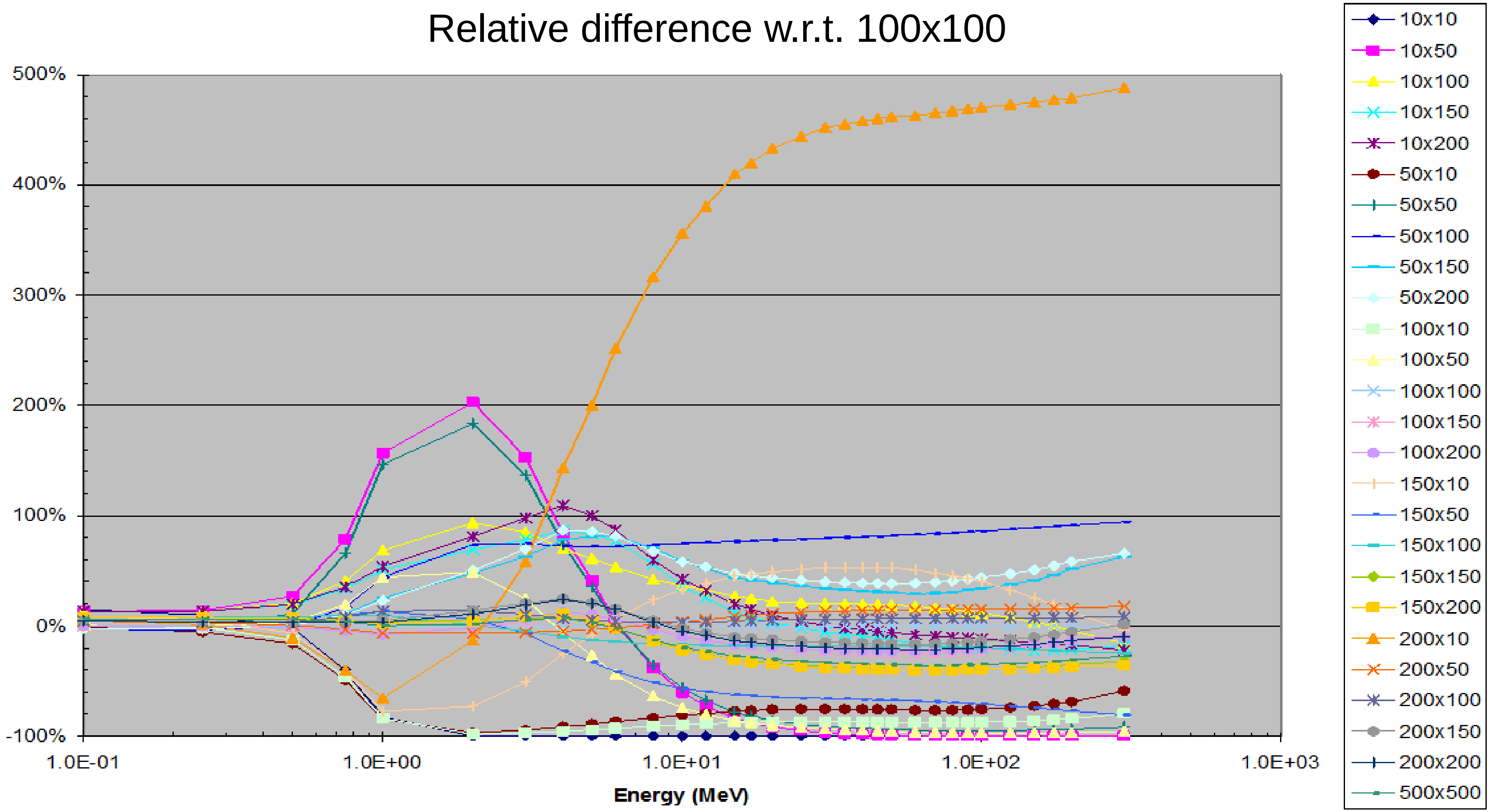
  - Small variation of the peak position in the SAA for high resolutions



  - Small variations of proton peak fluxes (E>30 MeV) between high resolution cases: ~ 5%max

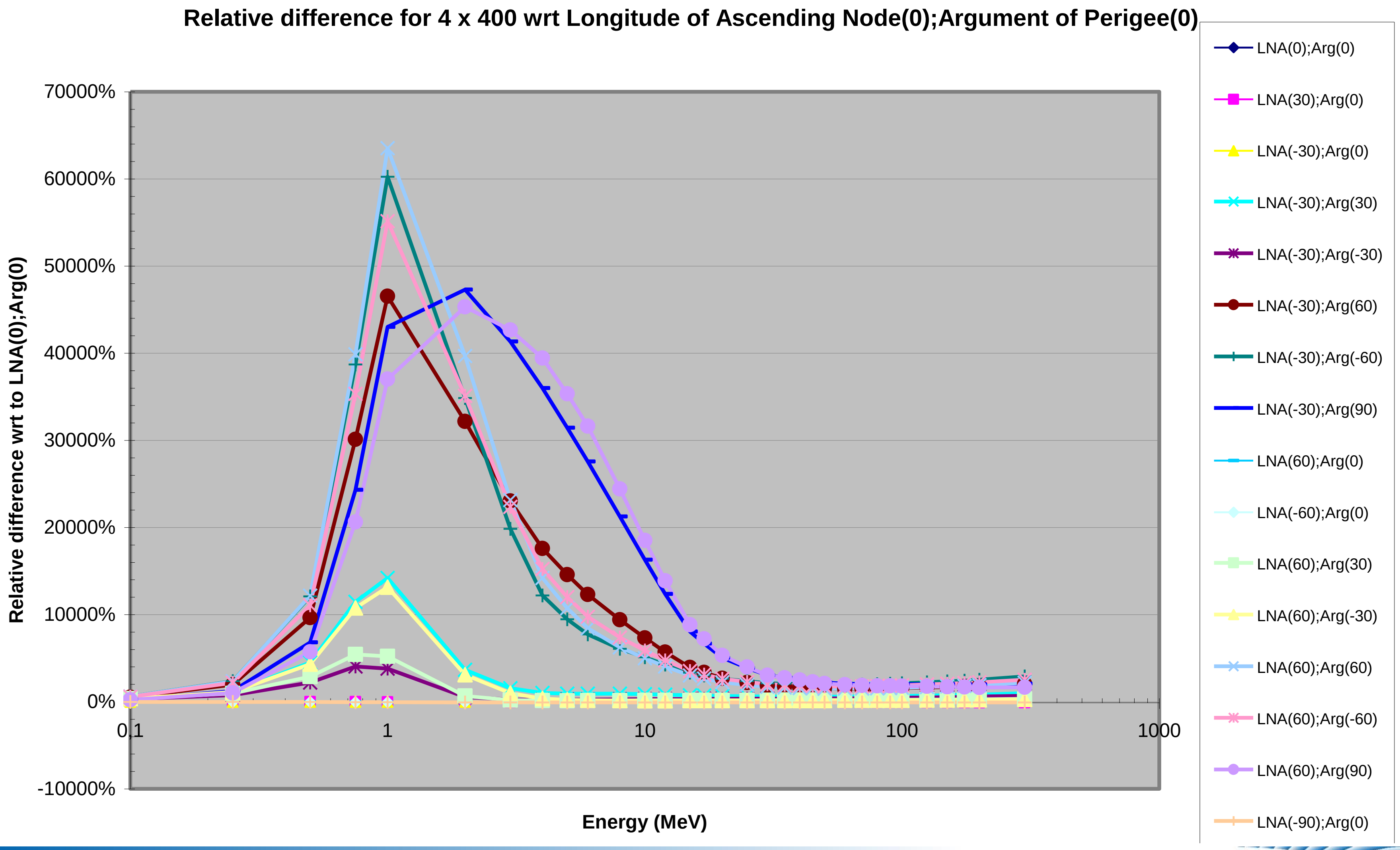
Comparison results

- Trapped protons (AP8) for highly elliptical orbit (600x40 000 km, 64.3°,10y)



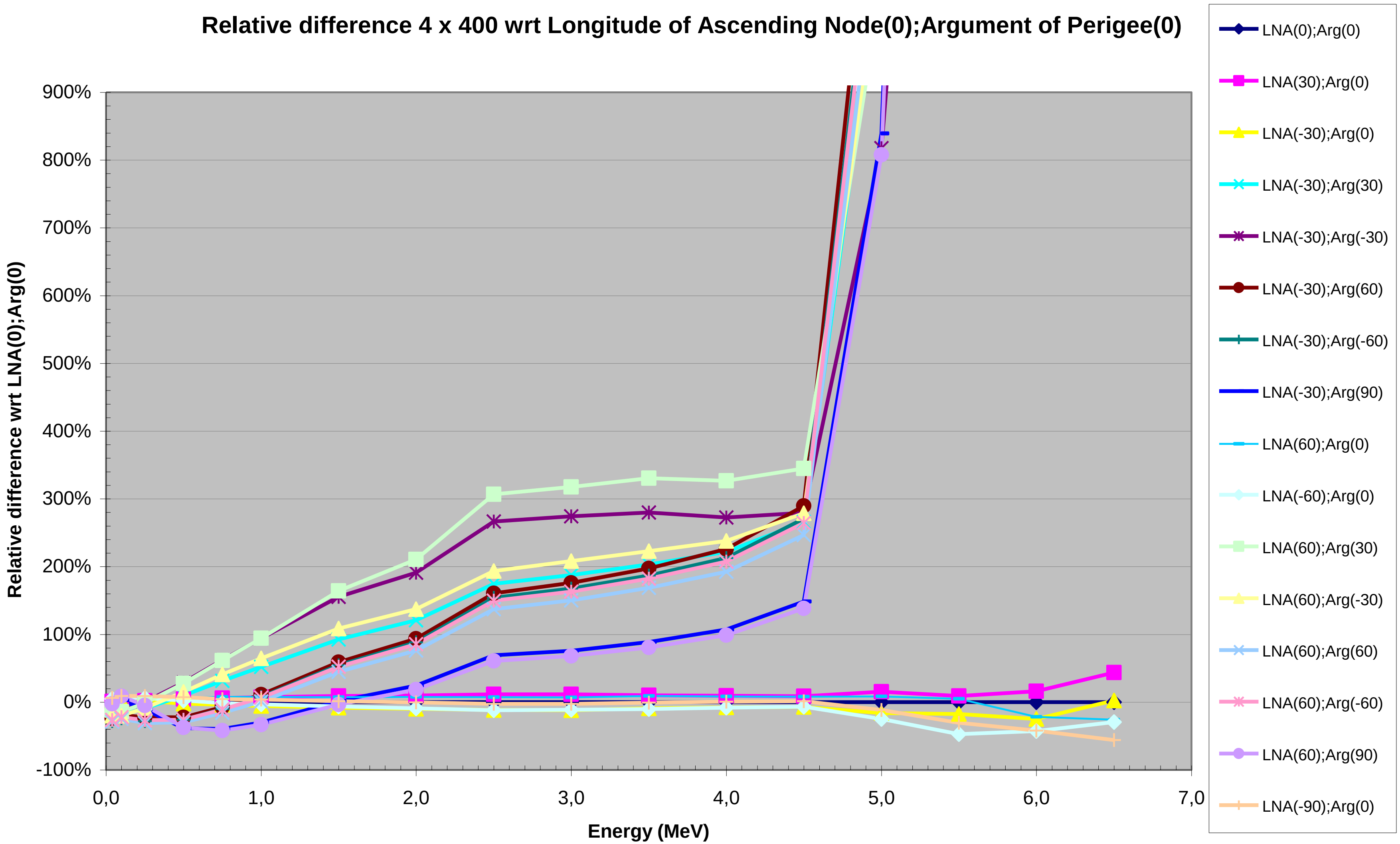
Comparison results

- Trapped protons (AP8) for highly elliptical orbit (600x40 000 km, 64.3°,10y)



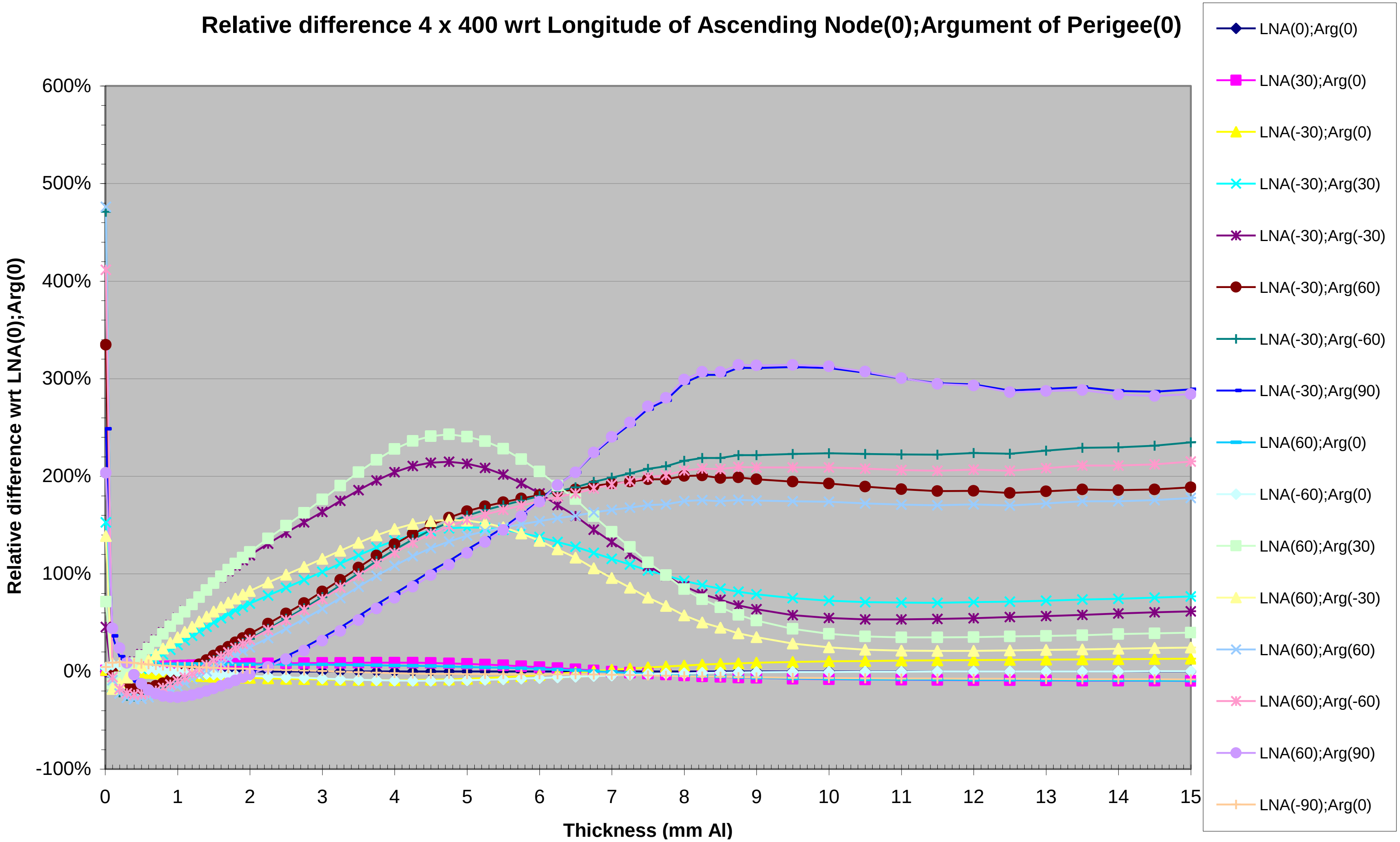
Comparison results

- Trapped electrons (AE8) for highly elliptical orbit (600x40 000 km, 64.3°,10y)



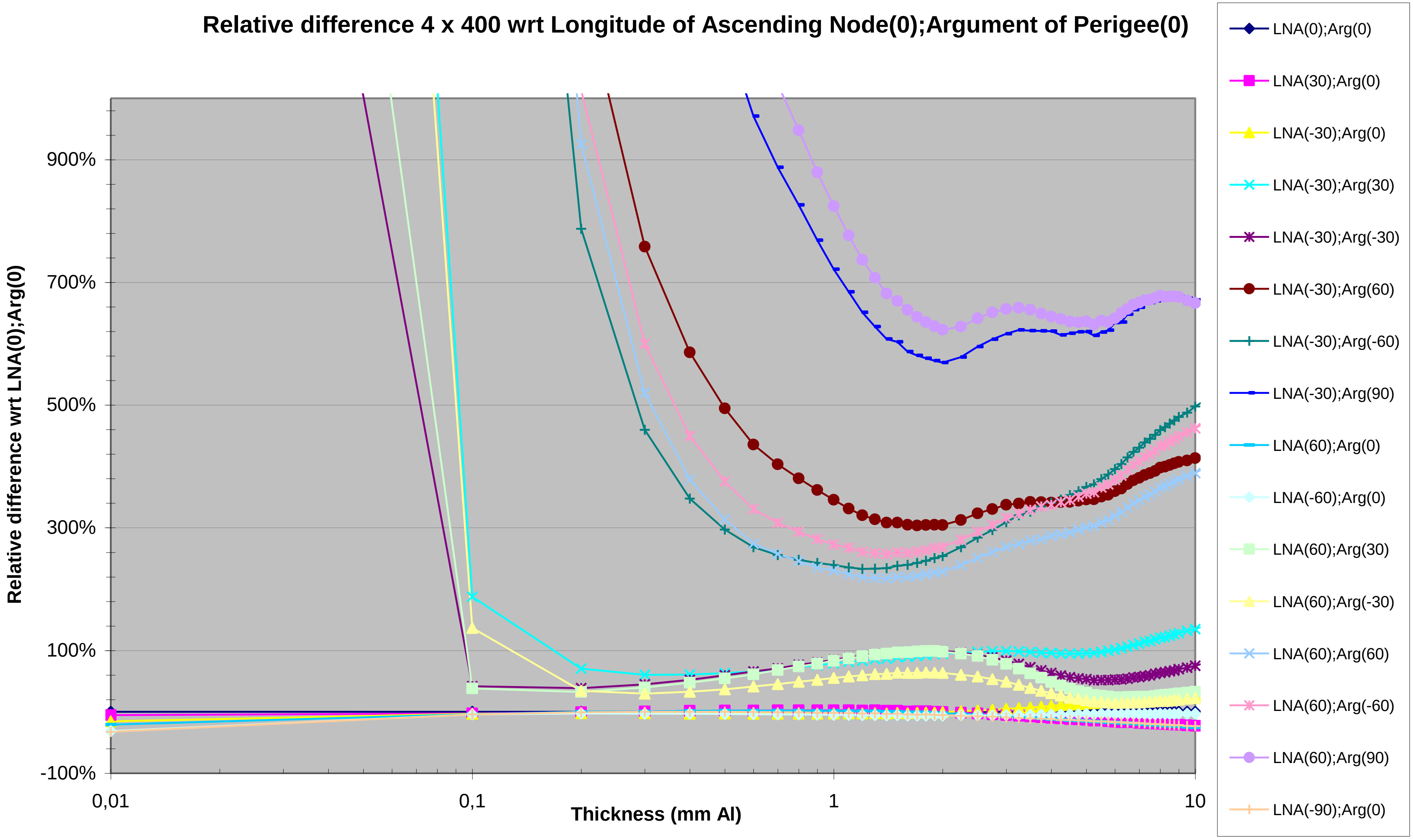
Comparison results

- Dose-depth curve for highly elliptical orbit (600x40 000 km, 64.3°,10y)



Comparison results

- Equ. fluence-depth curve for highly elliptical orbit (600x40 000 km, 64.3°,10y)



Comparison results

- EOR trajectories

Max relative difference 1 out of 10 points from input file	EOR circular from 11000 km		EOR GTO from 200 km		EOR GTO from 2000 km	
	Case A	Case B	Case A	Case B	Case A	Case B
Trapped e-	+0.12%	+0.14%	+6.87%	+14.52%	+4.39%	+9.44%
Trapped p+	+4.41%	-5.82%	+4.98%	+12.04%	+4.16%	+8.98%
Solar p+	-0.44%	-0.40%	+0.15%	+0.43%	-0.48%	-0.20%
LET spectrum	-0.2%	+0.08%	-0.25%	-0.45%	-0.16%	-0.14%
TID	0.09%	0.09%	4.77%	11.79%	3.47%	7.44%
10 MeV p+ equ. fluence	0.90%	0.81%	5.62%	13.86%	4.25%	8.82%

Conclusions - Recommendations

- For LEO missions
  - 100 orbits x 100 points/orbit
- For circular slot region and MEO missions
  - 100 orbits x 100 points/orbit (50 x 50 is sufficient)
- For GEO missions
  - 1 orbit/point
- Highly elliptical phased missions
  - Caution should be used
  - Maintained or not maintained mission?
  - Important impact from LAN and Arg. of Perigee parameters
- EOR missions
  - Low impact between 20 000 and 2 000 trajectory points for a 100-150 day orbit