Universidade do Minho
Escola de Engenharia

Bárbara Filipa Vasquez Vieira

Engineering with Nature: An innovative solution for coastal erosion protection

Appendices

setembro de 2022

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Bárbara Filipa Vasquez Vieira
UMinho | 2022

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Appendices

Tese de Doutoramento
Programa Doutoral em Engenharia Civil

Trabalho realizado sob a orientação de
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Professor Doutor Joaquim António Oliveira de Barros

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LIST OF APPENDICES

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APPENDIX 1

Concrete mixes and mechanical properties

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Appendix 1A

Concrete mix and mechanical properties of plain concrete armour units

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Concrete mix and mechanical properties of plain concrete armour units

Reference	Location	Shape	Concrete Mix	Average Concrete Density (kg/m³)	Average Concrete Modulus of Elasticity (GPa)	Average Compressive Strength (MPa)	Average Splitting Tensile Strength (MPa)	Notes
Franco *et al.* (2000)	Gioia Tauro, 1979 (Italy)	Dolos (15 tonnes)	**Cement:** Pozolanic **Aggregates:** – **Admixtures:** – **w/c ratio:** 0.4-0.5 **Average concrete porosity:** Gioia Tauro: 7.91 Cagliari: 7.91 Chioggia: 6.75 *See notes*	2442	48.60	33.81	4.06	The armour blocks were prefabricated with pozolanic cements in different mixes by different contactors. A water/cement ratio of 0.4–0.5 with 300 kg/m³ of cement is typically used in this kind of works in Italy to achieve a compressive strength of 35 MPa at 28 days curing time. Degradation process may be due to thermal stresses on the emerged units, rather than to fatigue phenomena associated with cyclic wave impact loadings on the lower wet blocks.
	Cagliari, 1975 (Italy)	Tetrapod (15 tonnes)		2346	43.40	–	3.49	
	Chioggia, 1971 (Italy)	Tetrapod (15 tonnes)		2548	56.22	60.94	4.35	

Concrete mix and mechanical properties of plain concrete armour units (cont.)

Reference	Location	Shape	Concrete Mix	Average Concrete Density (kg/m³)	Average Concrete Modulus of Elasticity (GPa)	Average Compressive Strength (MPa)	Average Splitting Tensile Strength (MPa)	Notes
Burcharth, (1984)	–	Dolos (0.2 tonnes)	**Cement:** Portland: 380 kg/m³ **Aggregates:** Sand: 525 kg/m³ Pebbles (4-8 mm): 80 kg/m³ Pebbles (8-16 mm): 1095 kg/m³ **Flyash:** 125 kg/m³ **w/c ratio:** 0.45	2330	44.0	44.4	3.65	–
Hakenberg *et al.* (2004)	–	Xbloc (9.4 tonnes)	**Cement:** Portland C30/37 **Aggregate:** 32 mm (max.) **w/c ratio:** 0.5 (max.)	2383	30.6	41.3	5.2	–
Gómez-Martín and Medina (2008)	–	Cube (15 tonnes) Cubipod (16 tonnes)	**Cement:** CEM I 42.5R **Aggregate:** 25 mm (max.) **w/c ratio:** 0.5	–	–	**Cube:** 63.5 **Cubipod:** 58.7	–	–

Concrete mix and mechanical properties of plain concrete armour units (cont.)

Reference	Location	Shape	Concrete Mix	Average Concrete Density (kg/m³)	Average Concrete Modulus of Elasticity (GPa)	Average Compressive Strength (MPa)	Average Tensile Strength (MPa)	Notes
Azenha *et al.* (2011)	–	Tetrapod	**Cement:** CEM I 42.5R: 310 kg/m³ **Aggregates:** Sand: 590 kg/m³ Coarse aggregate (4-65 mm): 1360 kg/m³ **Flyash:** 105 kg/m³ **Superplasticizer:** 3.1 kg/m³ **w/c ratio:** 0.45	–	31	33	2.6	–

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Appendix 1B

Concrete mix composition and mechanical properties of industrial steel fibre reinforced concrete armour units

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Concrete mix composition and mechanical properties of industrial steel fibre reinforced concrete armour units

Reference	Location	Shape	Concrete Mix	Average Fibre Dimensions	Fibre Content (% V Fraction of Concrete)	Average Compressive Strength (MPa)	Average Splitting Tensile Strength (MPa)	Average Flexural Strength (MPa)	Notes
Appleton *et al.* (1996) Melby and Turk (1992) Myrick and Melby (2005)	Crescent City (California, USA), 1986	Dolos (42 tonnes)	**Cement:** Standard type II **Aggregates:** – **Admixtures:** – **w/c ratio:** –	**Diameter:** – **Length:** 50.8 mm **Aspect ratio (l/d):** –	1	62.8	3.60	10.1	Plain concrete had 6.48 MPa flexural strength
Burcharth (1984)	–	Dolos (0.2 tonnes)	**Cement:** Portland flyash: 435 kg/m³ **Aggregates:** Sand: 788 kg/m³ Pebbles (8-16 mm): 416 kg/m³ Stones (16-32 mm): 416 kg/m³ **Plasticizer BV 40:** 3.3 kg **Steel fibres (Wirex):** 160 kg/m³ **w/c ratio:** 0.40 **Average concrete density:** 2300 kg/m³	**Diameter:** 1 mm **Length:** 45 mm **Aspect ratio (l/d):** 45	2	30.0	3.85	–	–

Concrete mix composition and mechanical properties of industrial steel fibre reinforced concrete armour units (cont.)

Reference	Location	Shape	Concrete Mix	Average Fibre Dimensions	Fibre Content (% V Fraction of Concrete)	Average Compressive Strength (MPa)	Average Splitting Tensile Strength (MPa)	Average Flexural Strength (MPa)	Notes
Hoff (1975)	Humboldt Bay (California, USA)	Dolos (38.5 tonnes)	**Mix 1** **Cement:** 323 kg/m³ **Aggregates:** Sand: 748 kg/m³ Coarse aggregate (19 mm): 807 kg/m³ Coarse aggregate (38.1 mm): 439 kg/m³ **Steel fibres:** 47 kg/m³ **w/c ratio:** 0.41	**Diameter:** 0.25 mm **Length:** 25 mm **Aspect ratio (l/d):** 100	–	**Mix 1** 50.5	**Mix 1** 3.8	**Mix 1** 4.9	–
Hoff (1975)	Humboldt Bay (California, USA)	Dolos (38.5 tonnes)	**Mix 2** **Cement:** 390 kg/m³ **Aggregates:** Sand: 842 kg/m³ Coarse aggregate (19 mm): 504 kg/m³ Coarse aggregate (38.1 mm): 480 kg/m³ **Steel fibres:** 119 kg/m³ **w/c ratio:** 0.41	**Diameter:** 0.25 mm **Length:** 25 mm **Aspect ratio (l/d):** 100	–	**Mix 2** 54.8	**Mix 2** 4.0	**Mix 2** 5.8	–

Appendix 1C

Concrete mix composition and mechanical properties of recycled steel fibre reinforced concrete

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Concrete mix composition of recycled steel fibre reinforced concrete

Reference	Concrete Mix
Aghaee *et al.* (2015)	Structural lightweight concrete reinforced with waste steel wires **Cement:** Type 2 Portland (ASTM C150): 1160 kg/m³ **Aggregates:** River sand (max. 5 mm): 1520 kg/m³ Perlite (max. 5 mm): 93 kg/m³ **Liquid super silica gel:** 8% of cement content **Steel fibres:** 7850 kg/m³ **Fibre recycling method:** – **Sources:** Previously used waste steel wires from reinforcement and formworks **w/c ratio:** 0.4
Sengul (2016)	**Cement:** Portland CEM I 42.5R: 366 kg/m³ **Aggregates:** Natural sand (0-1 mm): 312 kg/m³ Natural sand (0-4 mm): 631 kg/m³ Crushed stone (4-12 mm): 380 kg/m³ Crushed stone (12-22 mm) 567 kg/m³ **Superplasticizer:** 5 kg/m³ **Steel fibres:** 5; 10; 15; 20; 30; 40; 60 (kg/m³) **Fibre recycling method:** Pyrolysis and mechanical recycling **Sources:** Waste tyres **w/c ratio:** 0.5 **Average concrete density:** 2455 kg/m³

Concrete mix composition of recycled steel fibre reinforced concrete (cont.)

Reference	Concrete Mix
Köroğlu (2019)	Self-compacting concrete (SCC) **Cement:** Portland CEM I 42.5R: 480 kg/m³ **Aggregates:** Fine (crushed limestone and crushed sand) (0-4 mm): 1396 kg/m³ Coarse (crushed limestone) (4-8 mm): 404 kg/m³ **Modified polycarboxylates based polymer plasticizer:** 32 kg/m³ **Steel fibres:** – **Fibre recycling method:** Shredding **Sources:** Waste tyres **w/c ratio:** 0.4
Sengul (2018)	SIFCON (high performance cementitious composite) **Cement:** Portland CEM I 42.5R: 960 kg/m³ **Aggregate:** Siliceous sand (max. 0.5 mm): 2630 kg/m³ **Plasticizer:** 1.5 % of the cement weight **Steel fibres:** balled up state (without separating individually): **% by weight:** **Fibres 41/0.18:** 9.1 **Fibres 143/0.26:** 37.2 **Fibres 208/0.32:** 17.6 **Fibres 152/0.74:** 12.4 **Fibres 137/1.26:** 12.1 **Fibres 114/2.00:** 11.6 **Fibre recycling method:** Mechanical recycling **Sources:** Waste tyres **w/c ratio:** 0.33

Mechanical properties of recycled steel fibre reinforced concrete

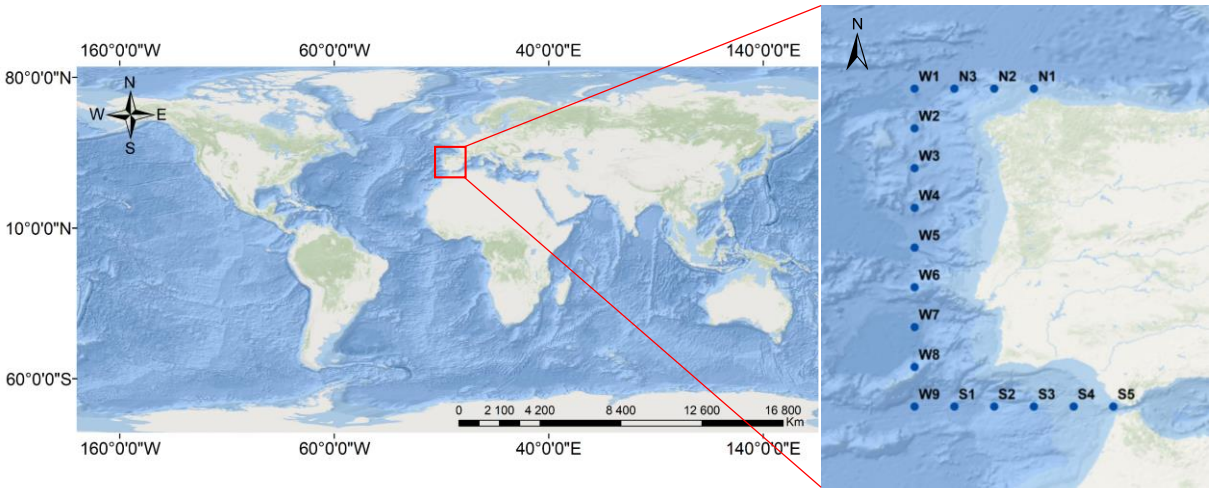
Reference	Average Fibre Dimensions	Fibre Tensile Strength (MPa)	Fibre Content (% V Fraction of Concrete)	Average Compressive Strength (MPa)	Average Splitting Tensile Strength (MPa)	Average Flexural Strength (MPa)	
						First Crack Strength (MPa)	Ultimate Strength (MPa)
Aghaee *et al.* (2015)	–	–	0 (plain concrete)	20.5	1.9	2.7	–
	Diameter: 1.2 mm **Length:** 50 mm **Aspect ratio (l/d):** 42	1100	0.25	21.8	2.3	3.0	–
			0.5	24.0	2.3	3.3	–
			0.75	19.0	2.8	3.7	–
Sengul (2016)	–	–	0 (plain concrete)	69.3	6.7	–	5.6
	Diameter: 0.29 mm **Length:** 52 mm **Aspect ratio (l/d):** 179	–	5; 10; 15 (kg/m³)	69.5; 65.8; 70.6	5.6; 6.5; 6.6	–	7.4; 5.1; 7.2
	Diameter: 0.62 mm **Length:** 50 mm **Aspect ratio (l/d):** 81	1330	10; 20; 30; 40 (kg/m³)	64.1; 64.7; 71.5; 75.3	6.0; 7.2; 7.9; 9.0	–	5.7; 5.4; 7.7; 9.4
	Diameter: 1.37 mm **Length:** 50 mm **Aspect ratio (l/d):** 37	1160	20; 40; 60 (kg/m³)	68.7; 69.1; 63.6	6.8; 7.2; 7.0	–	6.8; 6.7; 6.7
Köroğlu (2019)	**Diameter:** 0.22 mm – 0.27 mm **Length:** 30 mm – 60 mm (irregular shape)	–	0	36.5	2.7	–	2.1
			1	36.3	3.1	–	3.6
			2	43.1	3.8	–	3.9
			3	44.2	4.2	–	5.4
			4	46.2	4.8	–	11.7
			5	43.8	4.9	–	11.1

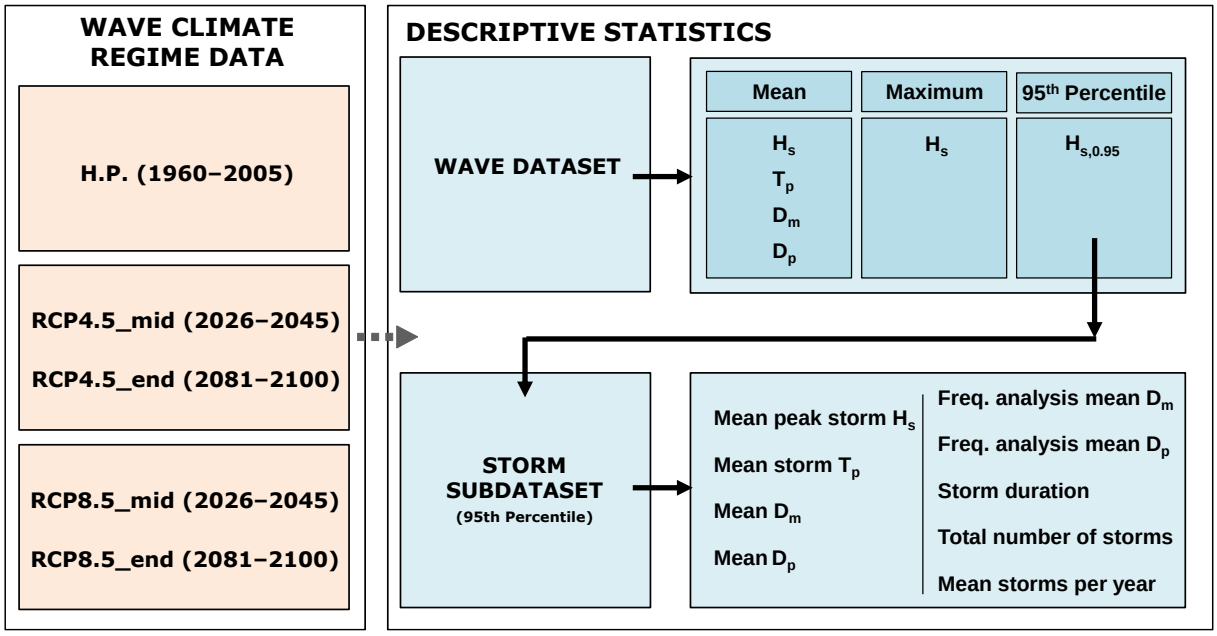
Mechanical properties of recycled steel Fibre reinforced concrete (cont.)

Reference	Average Fibre Dimensions	Fibre Tensile Strength (MPa)	Fibre Content (% V Fraction of Concrete)	Average Compressive Strength (MPa)	Average Splitting Tensile Strength (MPa)	Average Flexural Strength (MPa)	
						First Crack Strength (MPa)	Ultimate Strength (MPa)
Sengul (2018)	**Diameter:** 0.18 mm **Length:** 41 mm **Aspect ratio (l/d):** 228	–					
	Diameter: 0.26 mm **Length:** 143 mm **Aspect ratio (l/d):** 543	1180					
	Diameter: 0.32 mm **Length:** 208 mm **Aspect ratio (l/d):** 643	1260	0	94.7	8.1	–	4.3
			0.5	89.8	12.6	–	6.2
			1	96.0	13.9	–	13.6
			2	87.3	18.4	–	23.0
	Diameter: 0.74 mm **Length:** 152 mm **Aspect ratio (l/d):** 204	1190	3	93.6	20.1	–	33.1
			4	96.4	22.1	–	42.3
			5	87.8	25.4	–	63.8
	Diameter: 1.26 mm **Length:** 137 mm **Aspect ratio (l/d):** 108	1390					
	Diameter: 2.00 mm **Length:** 114 mm **Aspect ratio (l/d):** 57	–					

APPENDIX 2

Wave statistics off Iberian Peninsula





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Appendix 2A

Wave dataset descriptive statistics:

Parameters per wave climate regime scenario

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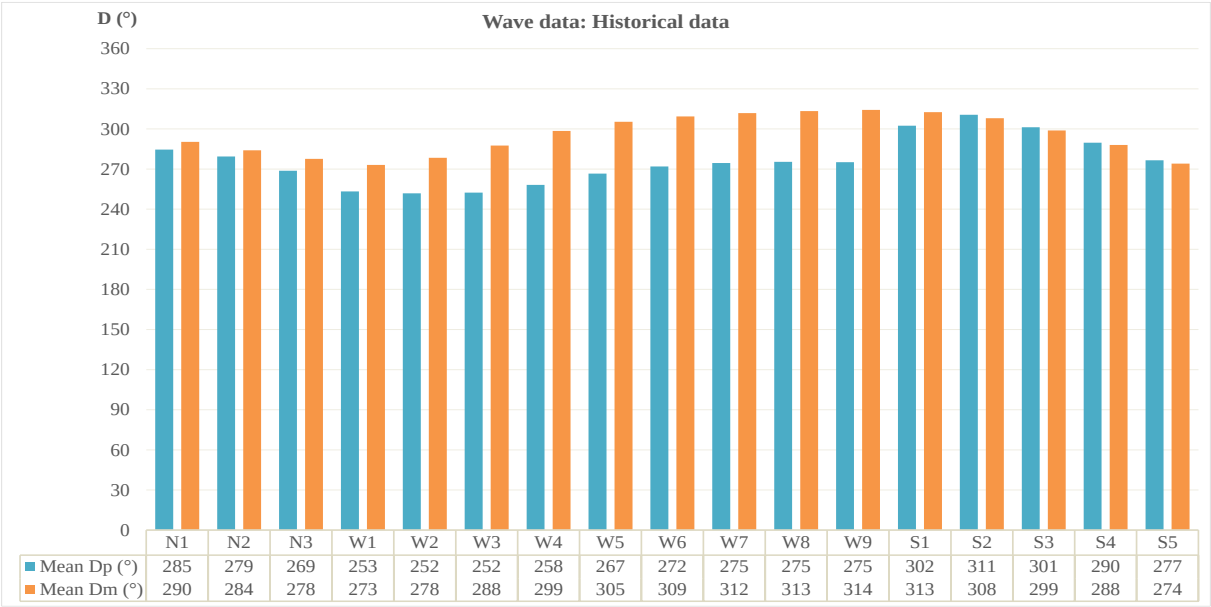
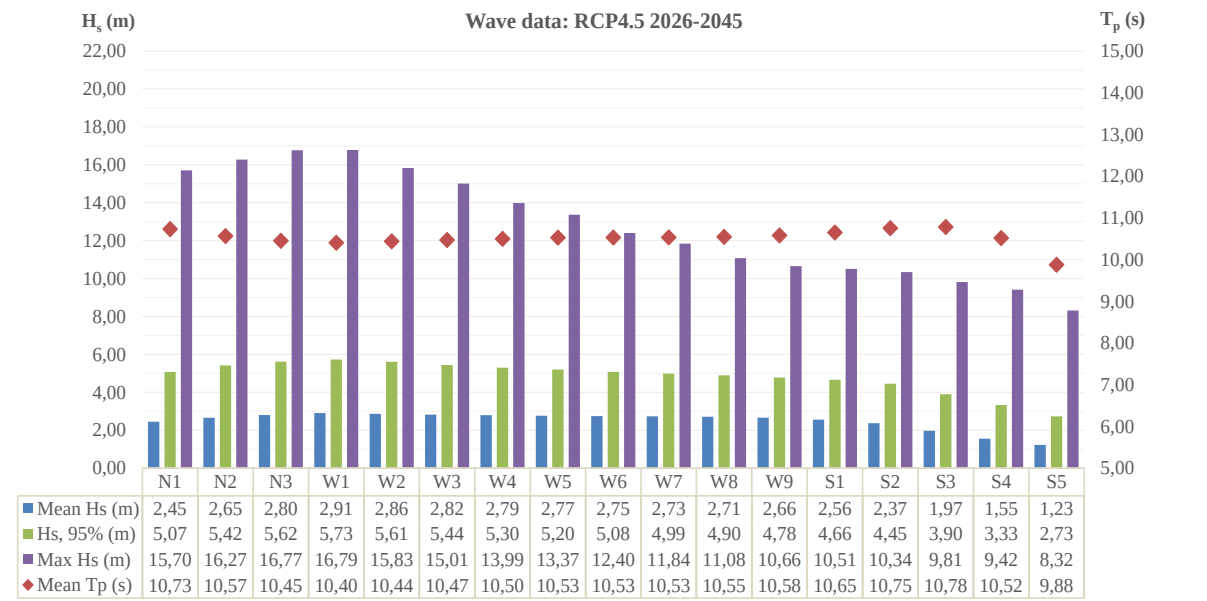
Historical data: 1960–2005

	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Hs (m)	2,52	2,73	2,87	2,97	2,92	2,88	2,84	2,81	2,78	2,75	2,73	2,68	2,58	2,41	2,02	1,59	1,25
Hs, 95% (m)	5,20	5,55	5,78	5,91	5,78	5,63	5,48	5,38	5,26	5,16	5,05	4,92	4,82	4,64	4,08	3,44	2,82
Max Hs (m)	13,98	14,78	15,17	15,41	14,70	14,94	14,80	14,22	15,11	15,59	15,11	13,82	12,58	11,60	10,81	10,04	8,54
Mean Tp (s)	10,89	10,73	10,61	10,57	10,60	10,64	10,67	10,69	10,69	10,70	10,71	10,73	10,80	10,90	10,92	10,66	10,05

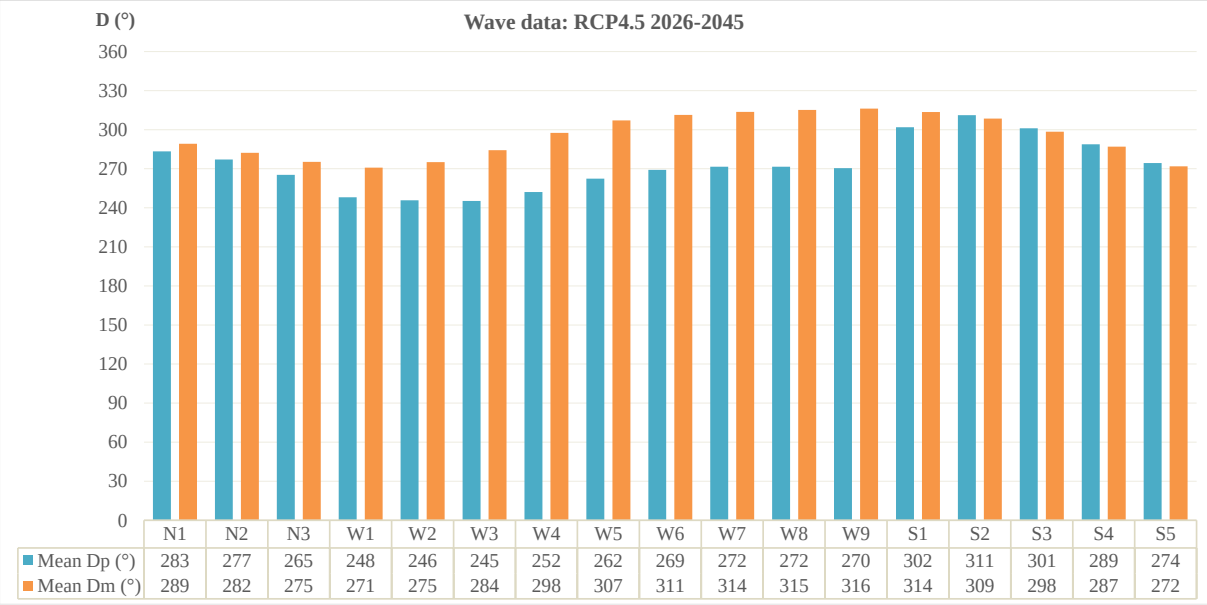


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	285	279	269	253	252	252	258	267	272	275	275	275	302	311	301	290	277
Mean Dm (°)	290	284	278	273	278	288	299	305	309	312	313	314	313	308	299	288	274

RCP4.5: 2026–2045

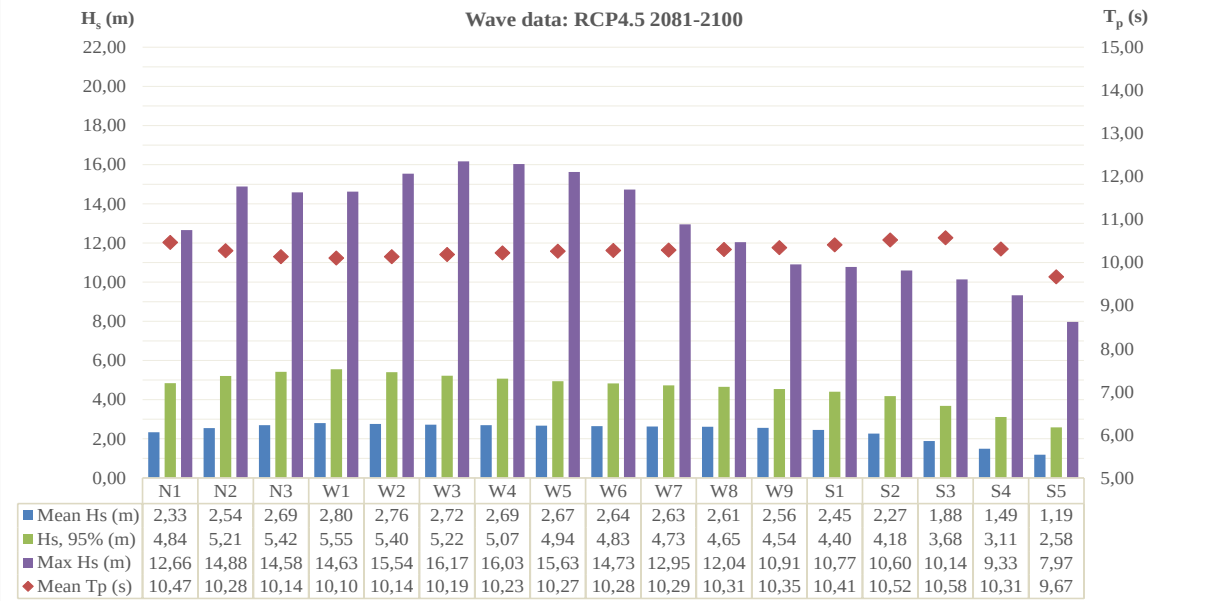


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Hs (m)	2,45	2,65	2,80	2,91	2,86	2,82	2,79	2,77	2,75	2,73	2,71	2,66	2,56	2,37	1,97	1,55	1,23
Hs, 95% (m)	5,07	5,42	5,62	5,73	5,61	5,44	5,30	5,20	5,08	4,99	4,90	4,78	4,66	4,45	3,90	3,33	2,73
Max Hs (m)	15,70	16,27	16,77	16,79	15,83	15,01	13,99	13,37	12,40	11,84	11,08	10,66	10,51	10,34	9,81	9,42	8,32
Mean Tp (s)	10,73	10,57	10,45	10,40	10,44	10,47	10,50	10,53	10,53	10,53	10,55	10,58	10,65	10,75	10,78	10,52	9,88

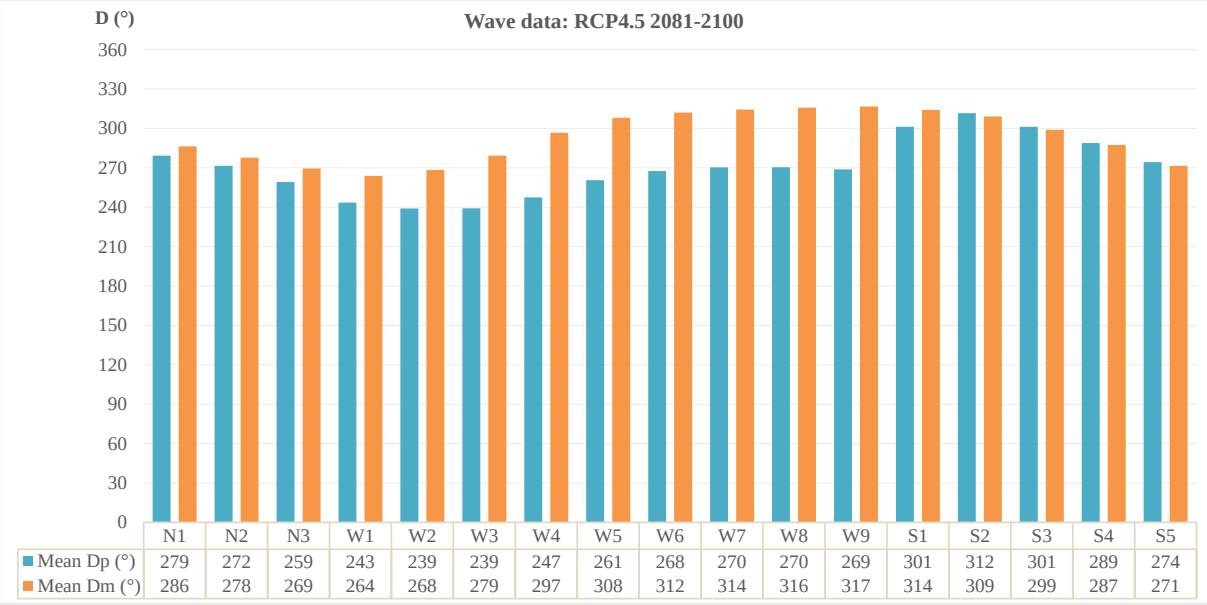


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	283	277	265	248	246	245	252	262	269	272	272	270	302	311	301	289	274
Mean Dm (°)	289	282	275	271	275	284	298	307	311	314	315	316	314	309	298	287	272

RCP4.5: 2081–2100

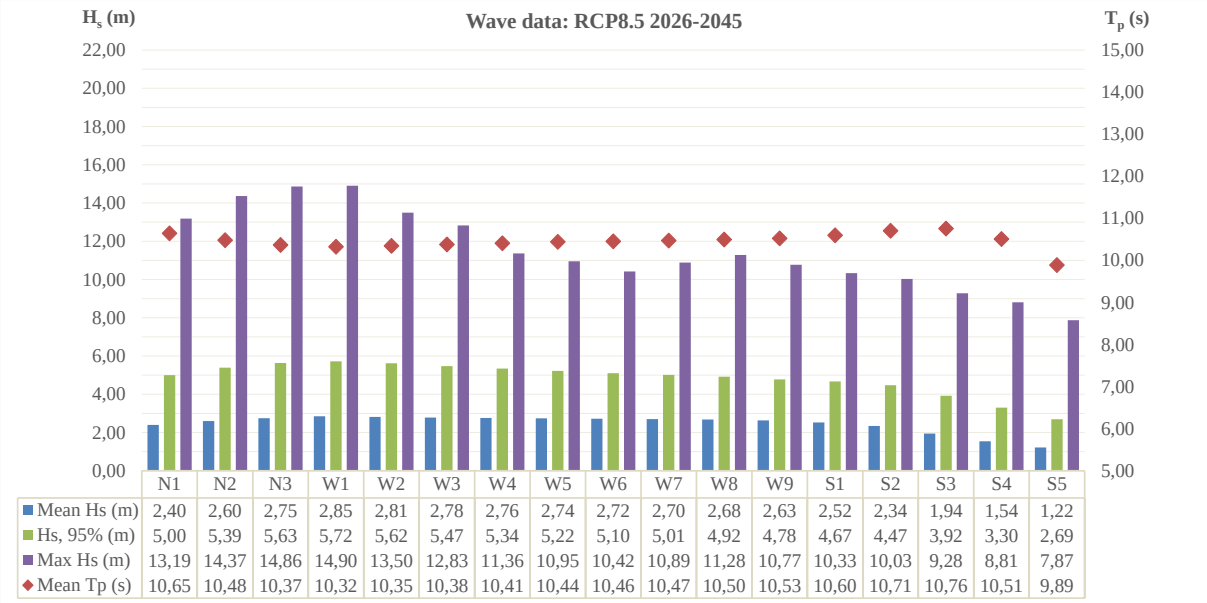


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Hs (m)	2,33	2,54	2,69	2,80	2,76	2,72	2,69	2,67	2,64	2,63	2,61	2,56	2,45	2,27	1,88	1,49	1,19
Hs, 95% (m)	4,84	5,21	5,42	5,55	5,40	5,22	5,07	4,94	4,83	4,73	4,65	4,54	4,40	4,18	3,68	3,11	2,58
Max Hs (m)	12,66	14,88	14,58	14,63	15,54	16,17	16,03	15,63	14,73	12,95	12,04	10,91	10,77	10,60	10,14	9,33	7,97
Mean Tp (s)	10,47	10,28	10,14	10,10	10,14	10,19	10,23	10,27	10,28	10,29	10,31	10,35	10,41	10,52	10,58	10,31	9,67

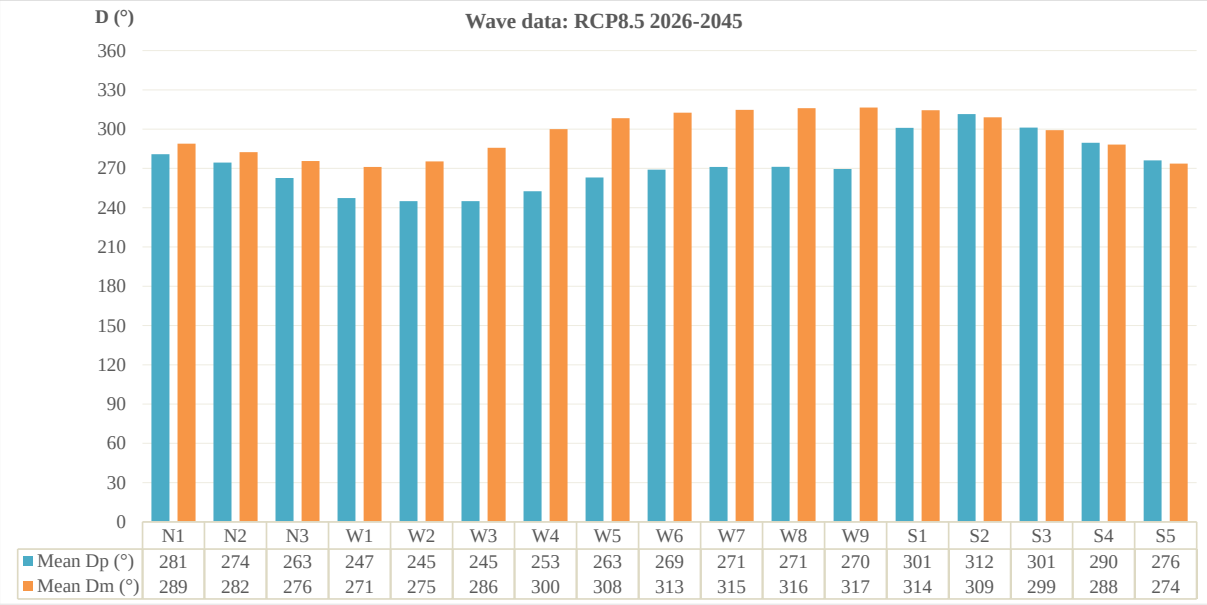


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	279	272	259	243	239	239	247	261	268	270	270	269	301	312	301	289	274
Mean Dm (°)	286	278	269	264	268	279	297	308	312	314	316	317	314	309	299	287	271

RCP8.5: 2026–2045

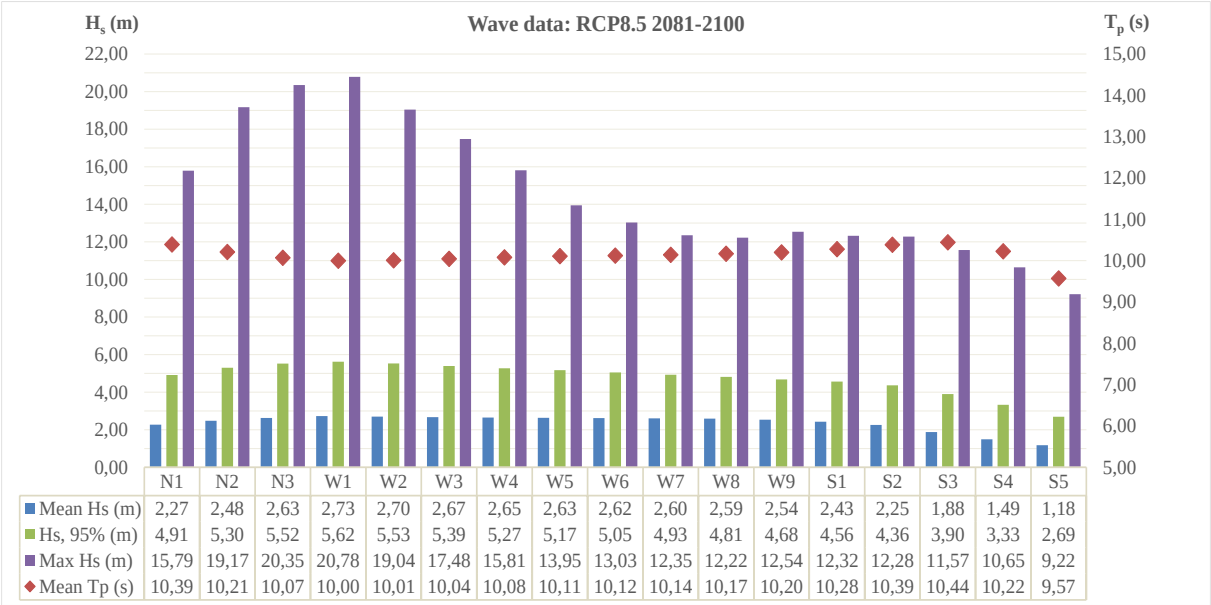


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Hs (m)	2,40	2,60	2,75	2,85	2,81	2,78	2,76	2,74	2,72	2,70	2,68	2,63	2,52	2,34	1,94	1,54	1,22
Hs, 95% (m)	5,00	5,39	5,63	5,72	5,62	5,47	5,34	5,22	5,10	5,01	4,92	4,78	4,67	4,47	3,92	3,30	2,69
Max Hs (m)	13,19	14,37	14,86	14,90	13,50	12,83	11,36	10,95	10,42	10,89	11,28	10,77	10,33	10,03	9,28	8,81	7,87
Mean Tp (s)	10,65	10,48	10,37	10,32	10,35	10,38	10,41	10,44	10,46	10,47	10,50	10,53	10,60	10,71	10,76	10,51	9,89

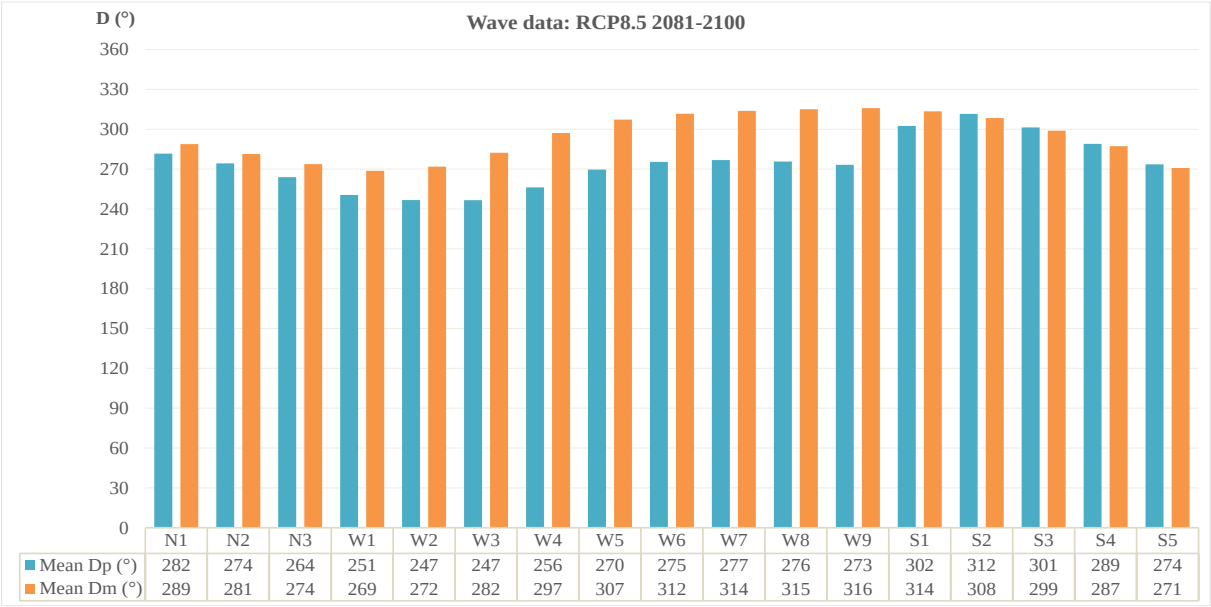


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	281	274	263	247	245	245	253	263	269	271	271	270	301	312	301	290	276
Mean Dm (°)	289	282	276	271	275	286	300	308	313	315	316	317	314	309	299	288	274

RCP8.5: 2081–2100



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Hs (m)	2,27	2,48	2,63	2,73	2,70	2,67	2,65	2,63	2,62	2,60	2,59	2,54	2,43	2,25	1,88	1,49	1,18
Hs, 95% (m)	4,91	5,30	5,52	5,62	5,53	5,39	5,27	5,17	5,05	4,93	4,81	4,68	4,56	4,36	3,90	3,33	2,69
Max Hs (m)	15,79	19,17	20,35	20,78	19,04	17,48	15,81	13,95	13,03	12,35	12,22	12,54	12,32	12,28	11,57	10,65	9,22
Mean Tp (s)	10,39	10,21	10,07	10,00	10,01	10,04	10,08	10,11	10,12	10,14	10,17	10,20	10,28	10,39	10,44	10,22	9,57



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	282	274	264	251	247	247	256	270	275	277	276	273	302	312	301	289	274
Mean Dm (°)	289	281	274	269	272	282	297	307	312	314	315	316	314	308	299	287	271

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Appendix 2B

Wave dataset descriptive statistics:

Individual parameters under 5 wave climate regime scenarios

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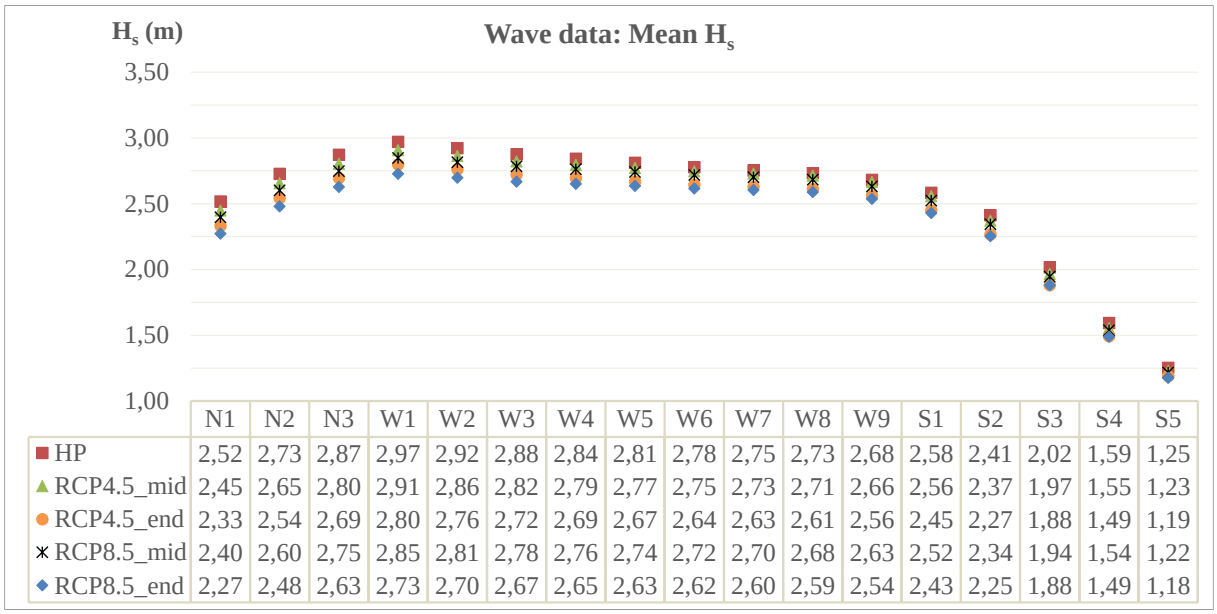
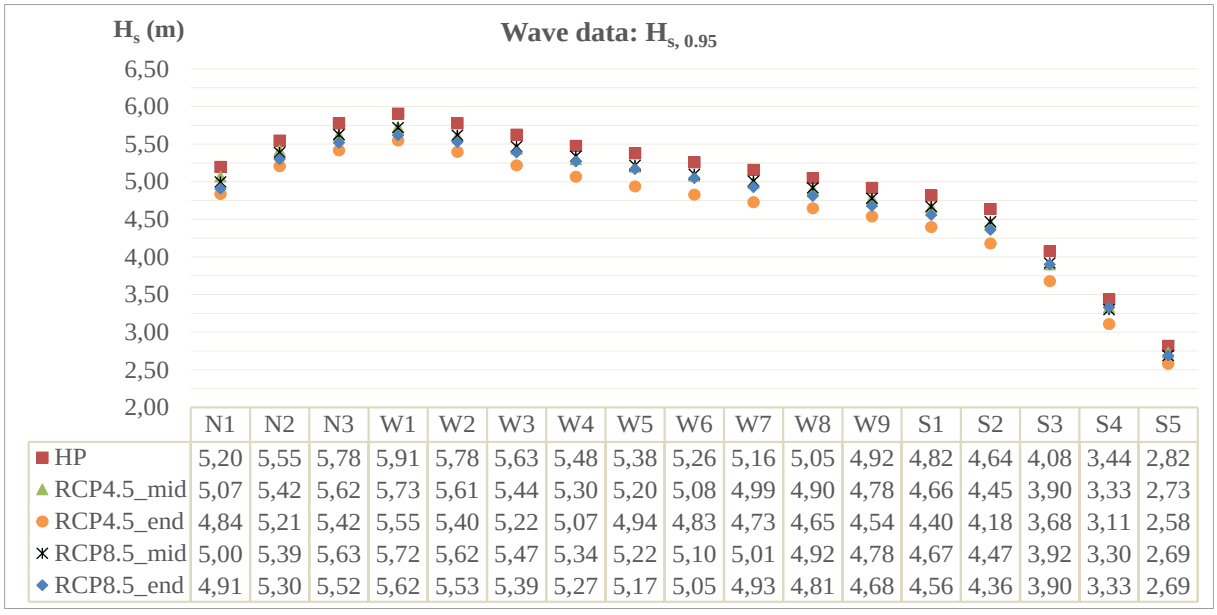
Mean H_s



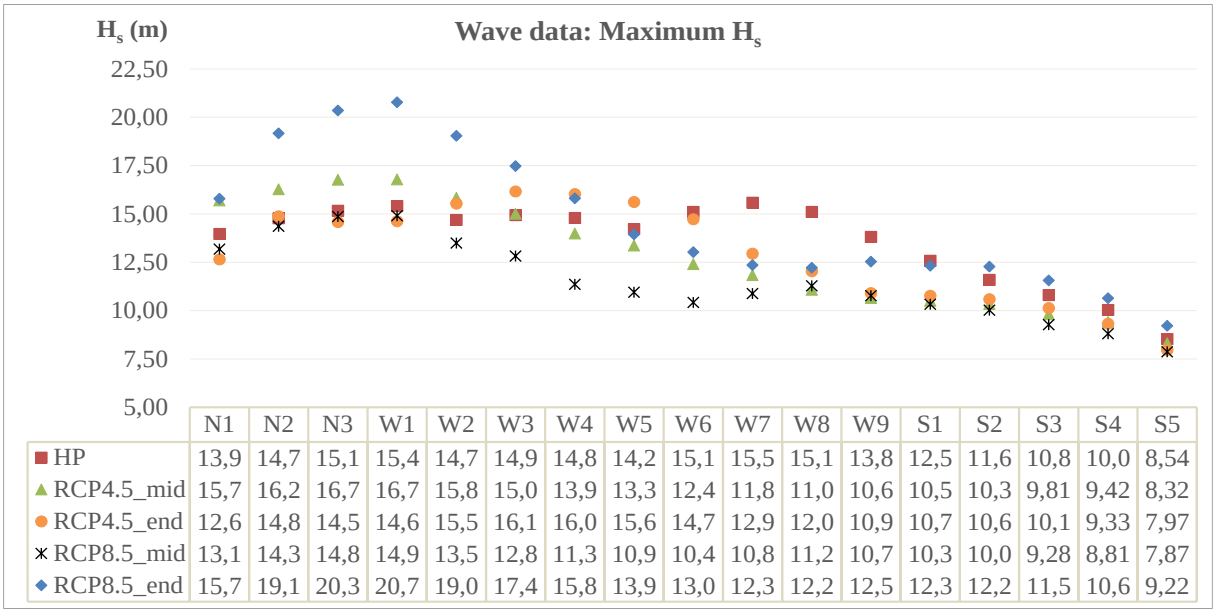
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	2,52	2,73	2,87	2,97	2,92	2,88	2,84	2,81	2,78	2,75	2,73	2,68	2,58	2,41	2,02	1,59	1,25
RCP4.5_mid	2,45	2,65	2,80	2,91	2,86	2,82	2,79	2,77	2,75	2,73	2,71	2,66	2,56	2,37	1,97	1,55	1,23
RCP4.5_end	2,33	2,54	2,69	2,80	2,76	2,72	2,69	2,67	2,64	2,63	2,61	2,56	2,45	2,27	1,88	1,49	1,19
RCP8.5_mid	2,40	2,60	2,75	2,85	2,81	2,78	2,76	2,74	2,72	2,70	2,68	2,63	2,52	2,34	1,94	1,54	1,22
RCP8.5_end	2,27	2,48	2,63	2,73	2,70	2,67	2,65	2,63	2,62	2,60	2,59	2,54	2,43	2,25	1,88	1,49	1,18

$H_{s,\,0.95}$



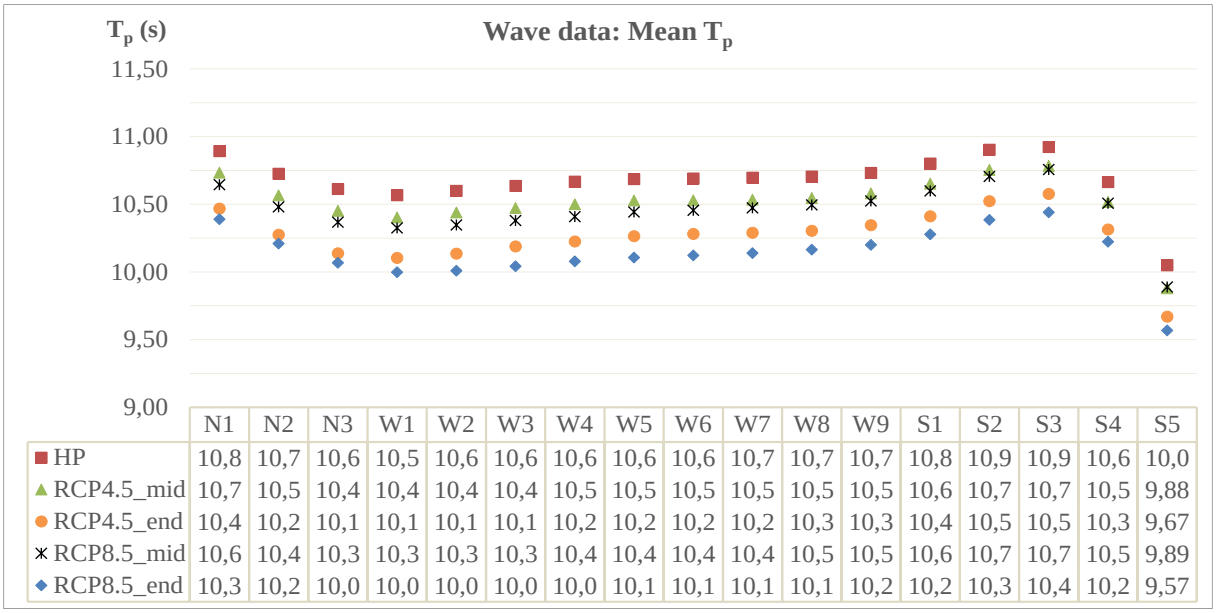
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	5,20	5,55	5,78	5,91	5,78	5,63	5,48	5,38	5,26	5,16	5,05	4,92	4,82	4,64	4,08	3,44	2,82
RCP4.5_mid	5,07	5,42	5,62	5,73	5,61	5,44	5,30	5,20	5,08	4,99	4,90	4,78	4,66	4,45	3,90	3,33	2,73
RCP4.5_end	4,84	5,21	5,42	5,55	5,40	5,22	5,07	4,94	4,83	4,73	4,65	4,54	4,40	4,18	3,68	3,11	2,58
RCP8.5_mid	5,00	5,39	5,63	5,72	5,62	5,47	5,34	5,22	5,10	5,01	4,92	4,78	4,67	4,47	3,92	3,30	2,69
RCP8.5_end	4,91	5,30	5,52	5,62	5,53	5,39	5,27	5,17	5,05	4,93	4,81	4,68	4,56	4,36	3,90	3,33	2,69

Maximum H_s



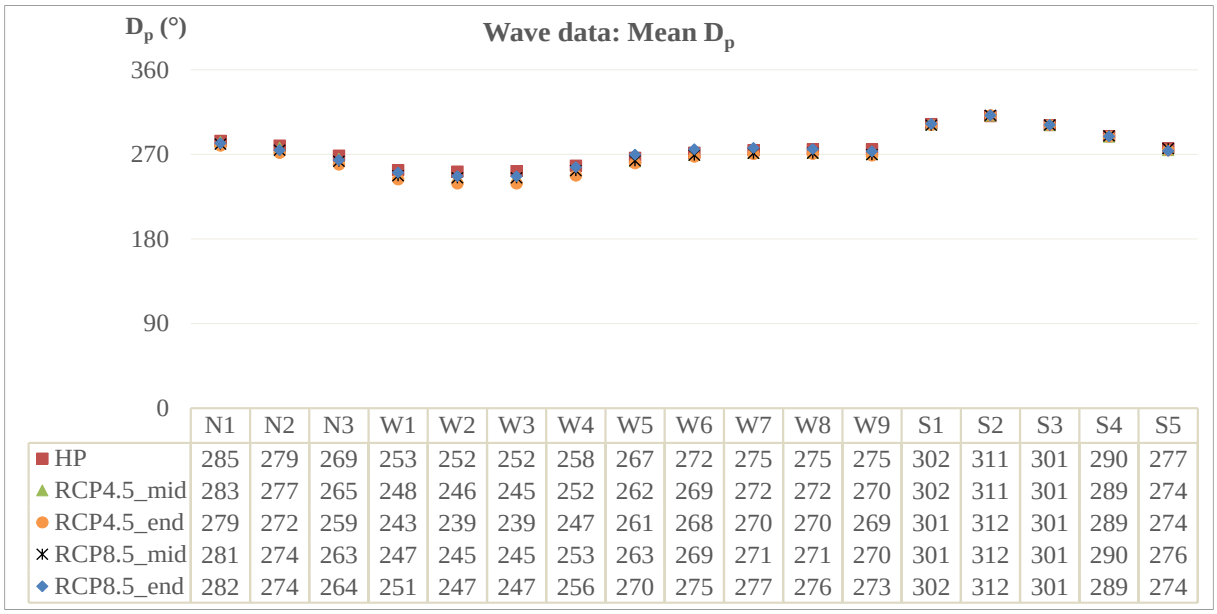
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	13,9	14,7	15,1	15,4	14,7	14,9	14,8	14,2	15,1	15,5	15,1	13,8	12,5	11,6	10,8	10,0	8,54
RCP4.5_mid	15,7	16,2	16,7	16,7	15,8	15,0	13,9	13,3	12,4	11,8	11,0	10,6	10,5	10,3	9,81	9,42	8,32
RCP4.5_end	12,6	14,8	14,5	14,6	15,5	16,1	16,0	15,6	14,7	12,9	12,0	10,9	10,7	10,6	10,1	9,33	7,97
RCP8.5_mid	13,1	14,3	14,8	14,9	13,5	12,8	11,3	10,9	10,4	10,8	11,2	10,7	10,3	10,0	9,28	8,81	7,87
RCP8.5_end	15,7	19,1	20,3	20,7	19,0	17,4	15,8	13,9	13,0	12,3	12,2	12,5	12,3	12,2	11,5	10,6	9,22

Mean T_p



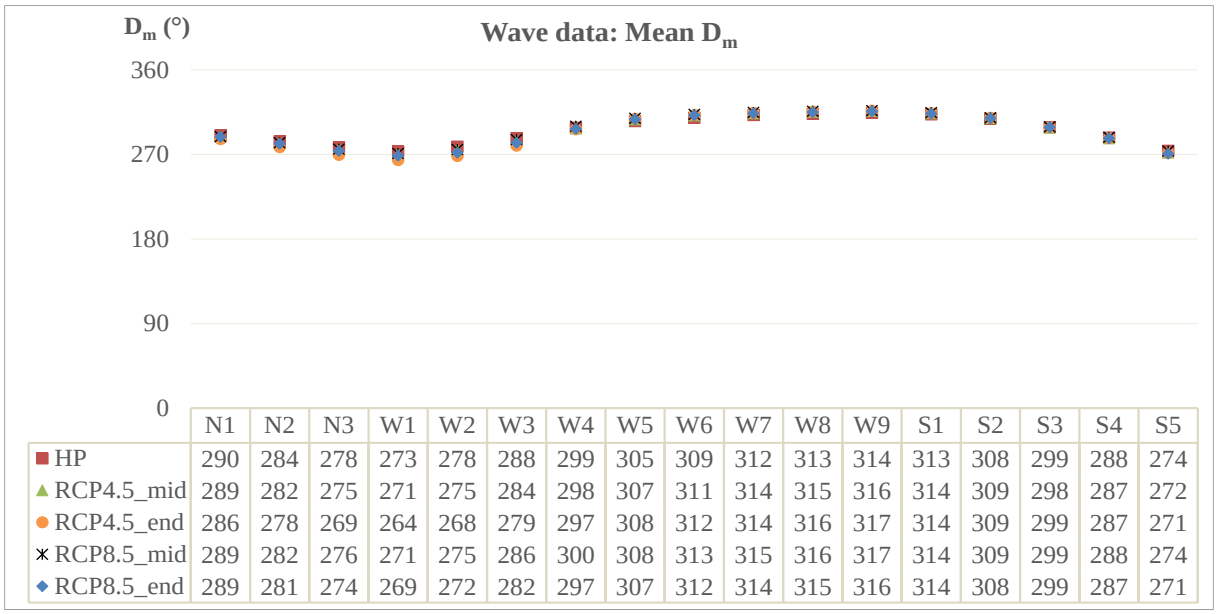
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	10,8	10,7	10,6	10,5	10,6	10,6	10,6	10,6	10,6	10,7	10,7	10,7	10,8	10,9	10,9	10,6	10,0
RCP4.5_mid	10,7	10,5	10,4	10,4	10,4	10,4	10,5	10,5	10,5	10,5	10,5	10,5	10,6	10,7	10,7	10,5	9,88
RCP4.5_end	10,4	10,2	10,1	10,1	10,1	10,1	10,2	10,2	10,2	10,2	10,3	10,3	10,4	10,5	10,5	10,3	9,67
RCP8.5_mid	10,6	10,4	10,3	10,3	10,3	10,3	10,4	10,4	10,4	10,4	10,5	10,5	10,6	10,7	10,7	10,5	9,89
RCP8.5_end	10,3	10,2	10,0	10,0	10,0	10,0	10,0	10,1	10,1	10,1	10,1	10,2	10,2	10,3	10,4	10,2	9,57

Mean D_p



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	285	279	269	253	252	252	258	267	272	275	275	275	302	311	301	290	277
RCP4.5_mid	283	277	265	248	246	245	252	262	269	272	272	270	302	311	301	289	274
RCP4.5_end	279	272	259	243	239	239	247	261	268	270	270	269	301	312	301	289	274
RCP8.5_mid	281	274	263	247	245	245	253	263	269	271	271	270	301	312	301	290	276
RCP8.5_end	282	274	264	251	247	247	256	270	275	277	276	273	302	312	301	289	274

Mean D_m



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	290	284	278	273	278	288	299	305	309	312	313	314	313	308	299	288	274
RCP4.5_mid	289	282	275	271	275	284	298	307	311	314	315	316	314	309	298	287	272
RCP4.5_end	286	278	269	264	268	279	297	308	312	314	316	317	314	309	299	287	271
RCP8.5_mid	289	282	276	271	275	286	300	308	313	315	316	317	314	309	299	288	274
RCP8.5_end	289	281	274	269	272	282	297	307	312	314	315	316	314	308	299	287	271

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Appendix 2C

Storm subdataset descriptive statistics:

Parameters per wave climate regime scenario

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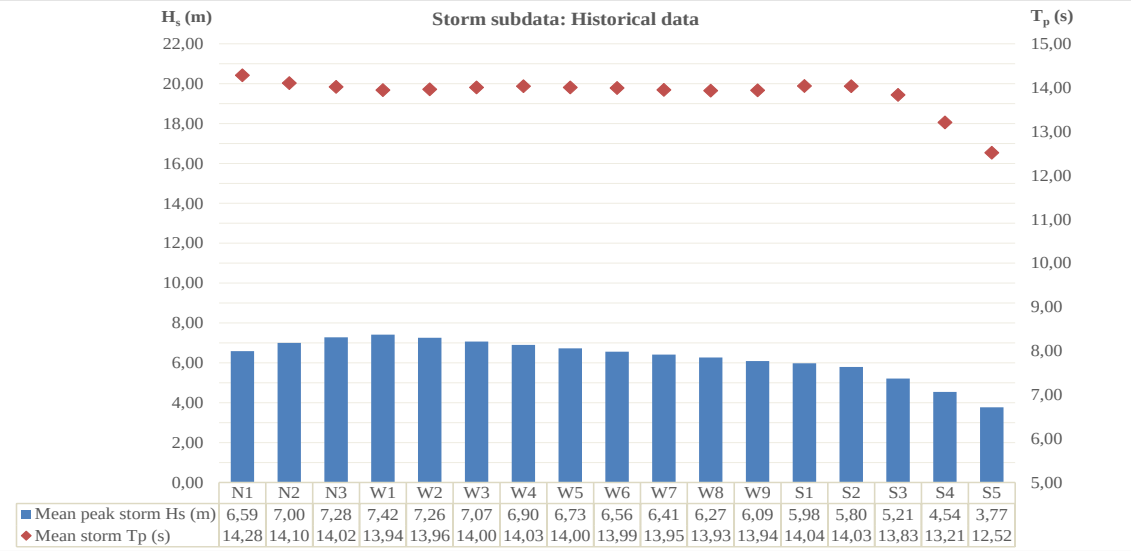
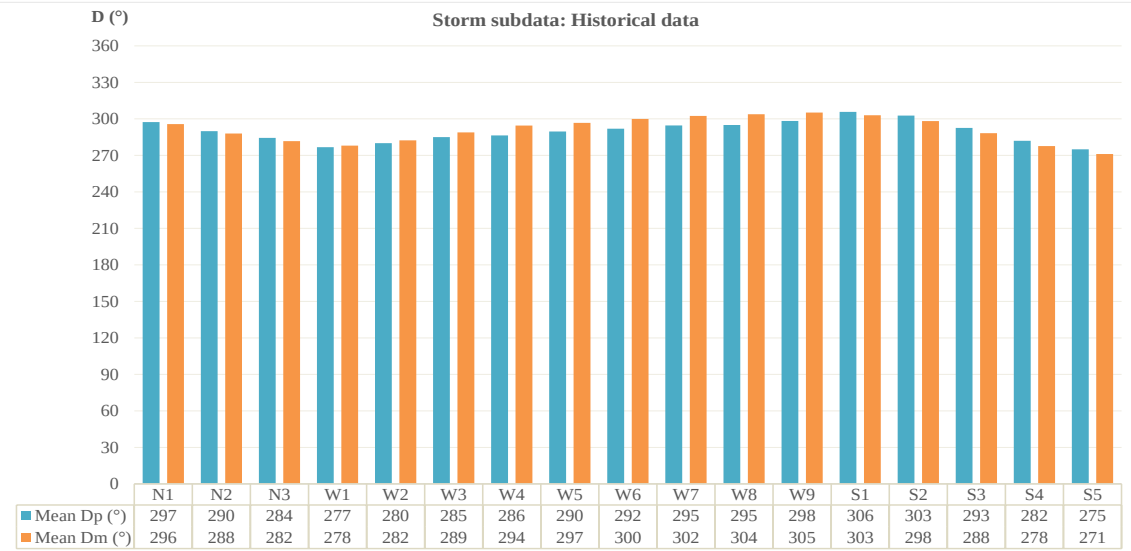
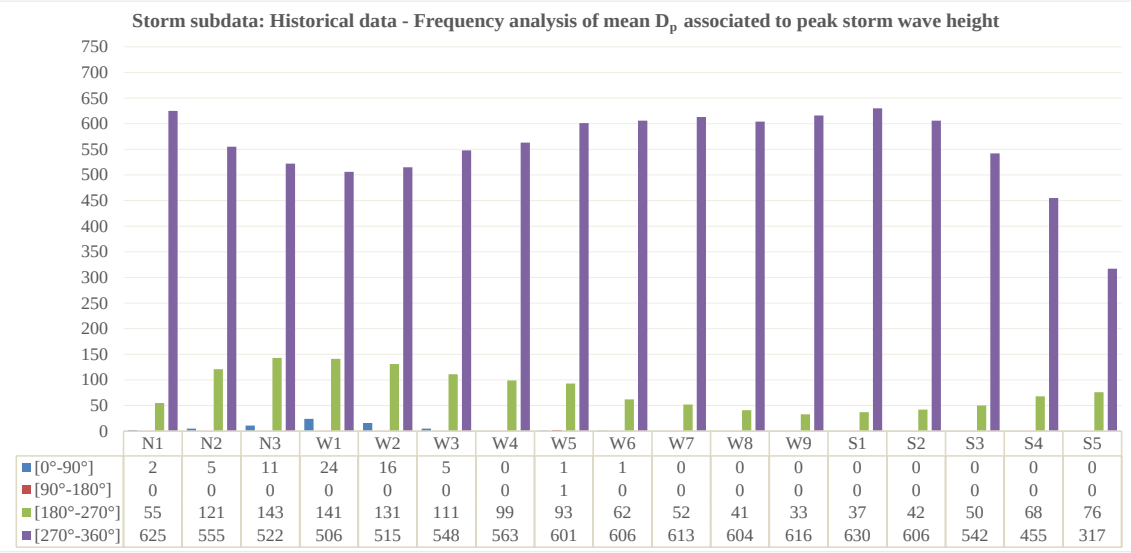
Historical data: 1960–2005



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean peak storm Hs (m)	6,59	7,00	7,28	7,42	7,26	7,07	6,90	6,73	6,56	6,41	6,27	6,09	5,98	5,80	5,21	4,54	3,77
Mean storm Tp (s)	14,28	14,10	14,02	13,94	13,96	14,00	14,03	14,00	13,99	13,95	13,93	13,94	14,04	14,03	13,83	13,21	12,52

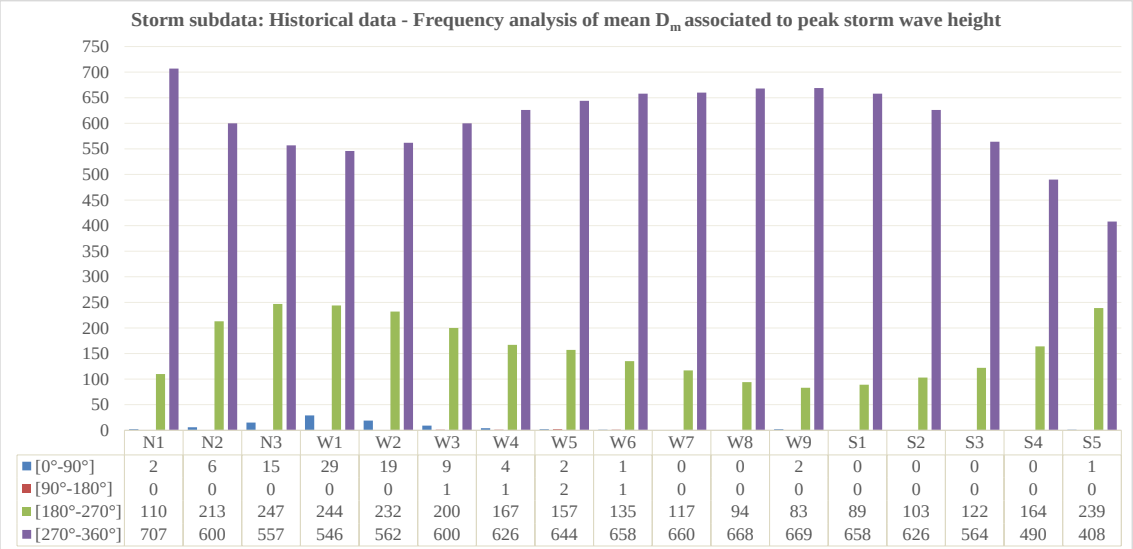


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	297	290	284	277	280	285	286	290	292	295	295	298	306	303	293	282	275
Mean Dm (°)	296	288	282	278	282	289	294	297	300	302	304	305	303	298	288	278	271

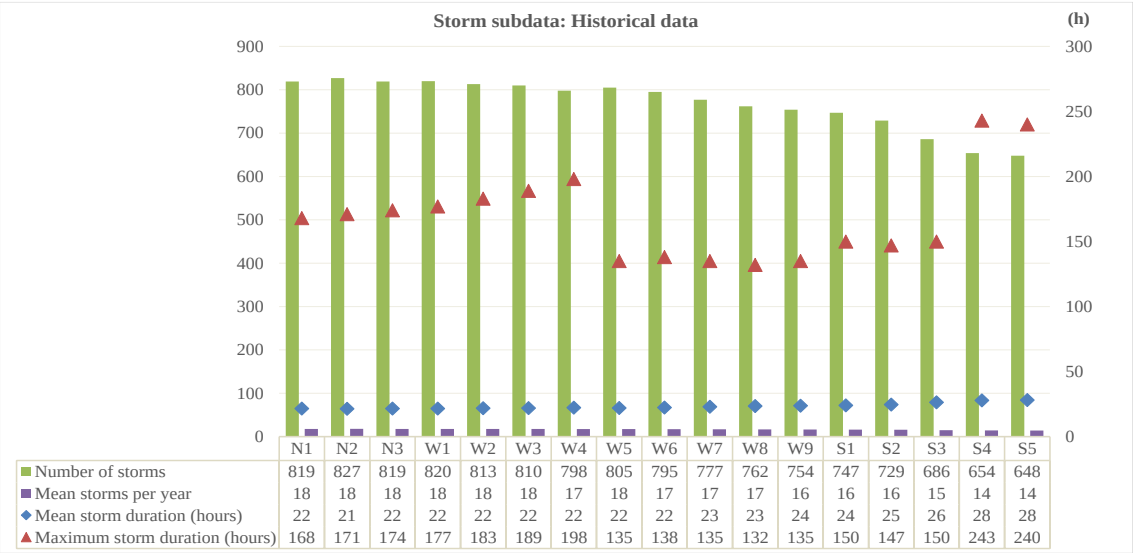


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	2	5	11	24	16	5	0	1	1	0	0	0	0	0	0	0	0
[90°-180°]	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
[180°-270°]	55	121	143	141	131	111	99	93	62	52	41	33	37	42	50	68	76
[270°-360°]	625	555	522	506	515	548	563	601	606	613	604	616	630	606	542	455	317

Historical data: 1960–2005 (cont.)

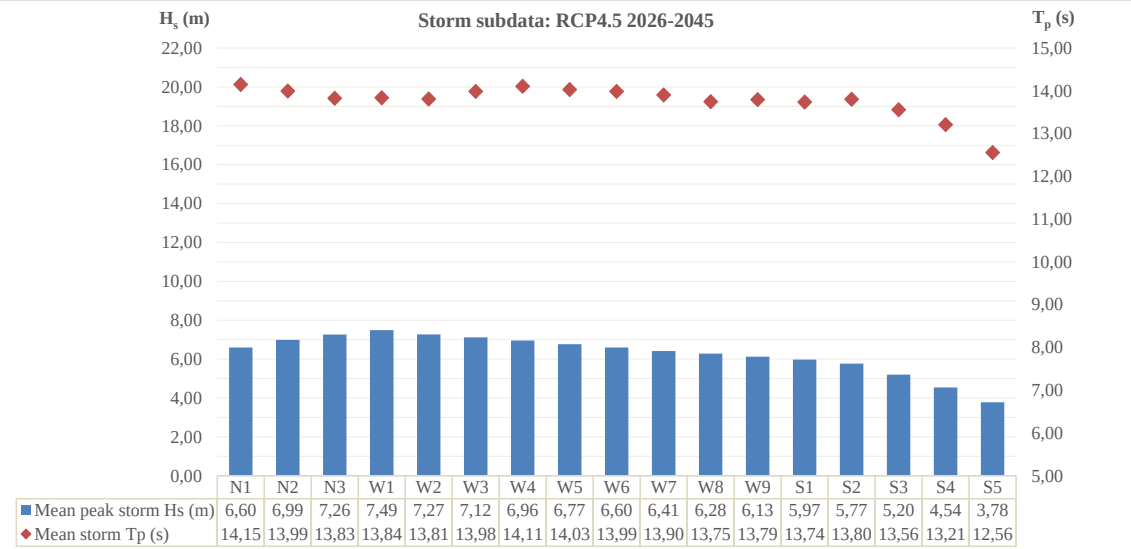


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	2	6	15	29	19	9	4	2	1	0	0	2	0	0	0	0	1
[90°-180°]	0	0	0	0	0	1	1	2	1	0	0	0	0	0	0	0	0
[180°-270°]	110	213	247	244	232	200	167	157	135	117	94	83	89	103	122	164	239
[270°-360°]	707	600	557	546	562	600	626	644	658	660	668	669	658	626	564	490	408

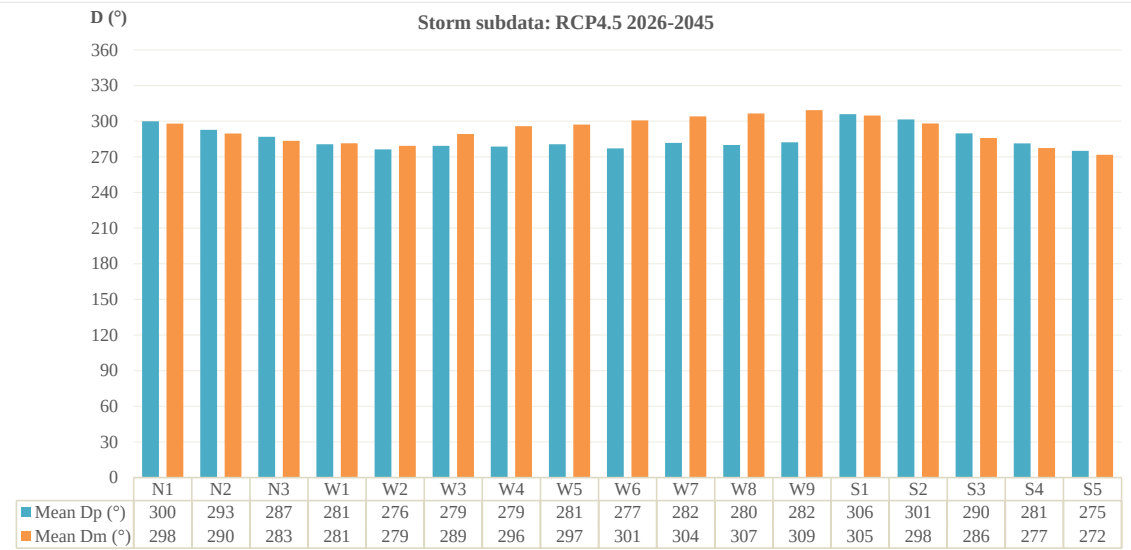


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Number of storms	819	827	819	820	813	810	798	805	795	777	762	754	747	729	686	654	648
Mean storms per year	18	18	18	18	18	18	17	18	17	17	17	16	16	16	15	14	14
Mean storm duration (hours)	22	21	22	22	22	22	22	22	22	23	23	24	24	25	26	28	28
Maximum storm duration (hours)	168	171	174	177	183	189	198	135	138	135	132	135	150	147	150	243	240

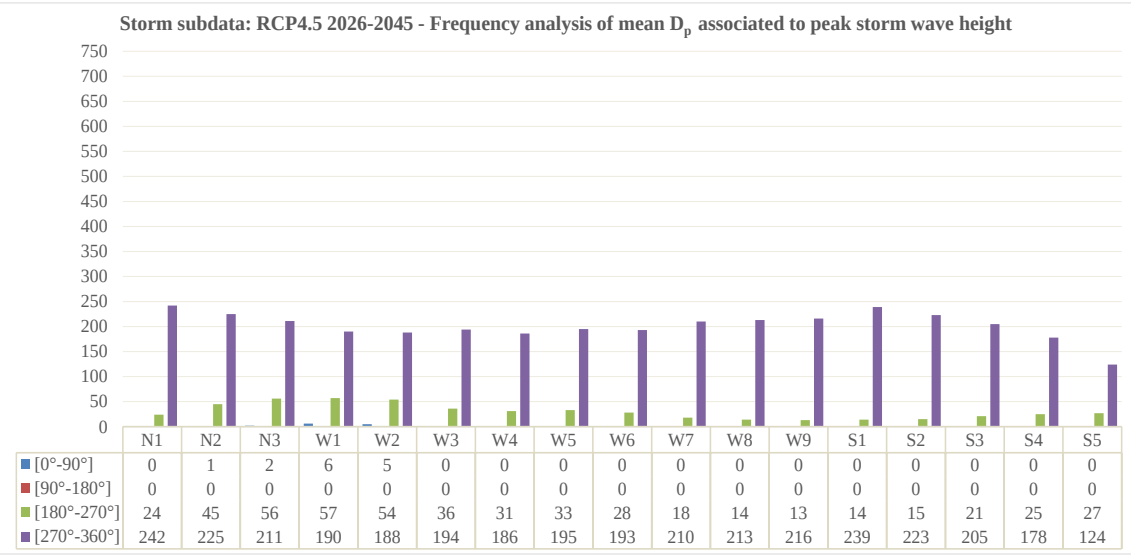
RCP4.5: 2026–2045



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean peak storm Hs (m)	6,60	6,99	7,26	7,49	7,27	7,12	6,96	6,77	6,60	6,41	6,28	6,13	5,97	5,77	5,20	4,54	3,78
Mean storm Tp (s)	14,15	13,99	13,83	13,84	13,81	13,98	14,11	14,03	13,99	13,90	13,75	13,79	13,74	13,80	13,56	13,21	12,56

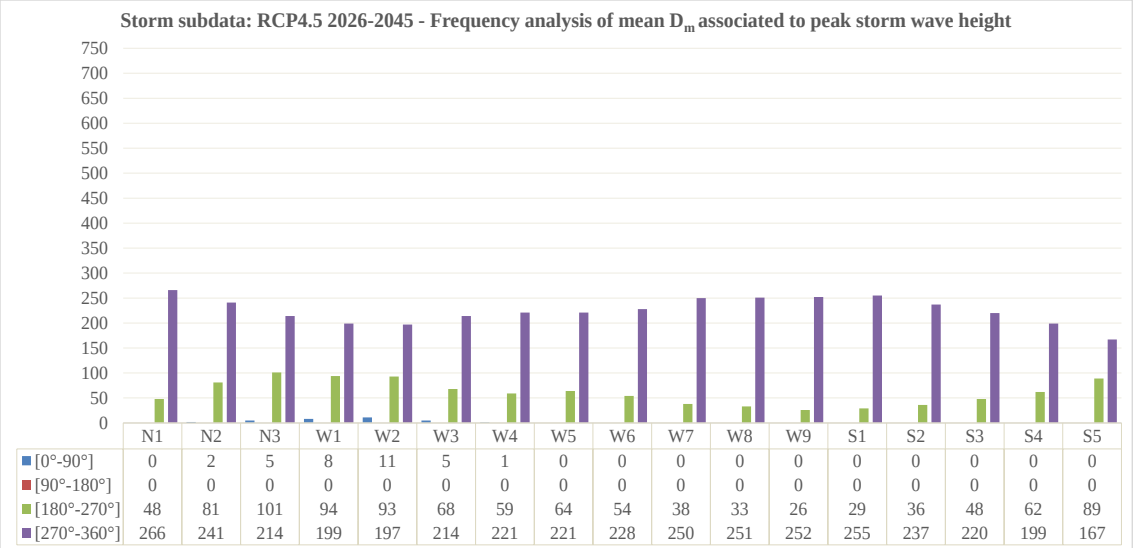


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	300	293	287	281	276	279	279	281	277	282	280	282	306	301	290	281	275
Mean Dm (°)	298	290	283	281	279	289	296	297	301	304	307	309	305	298	286	277	272

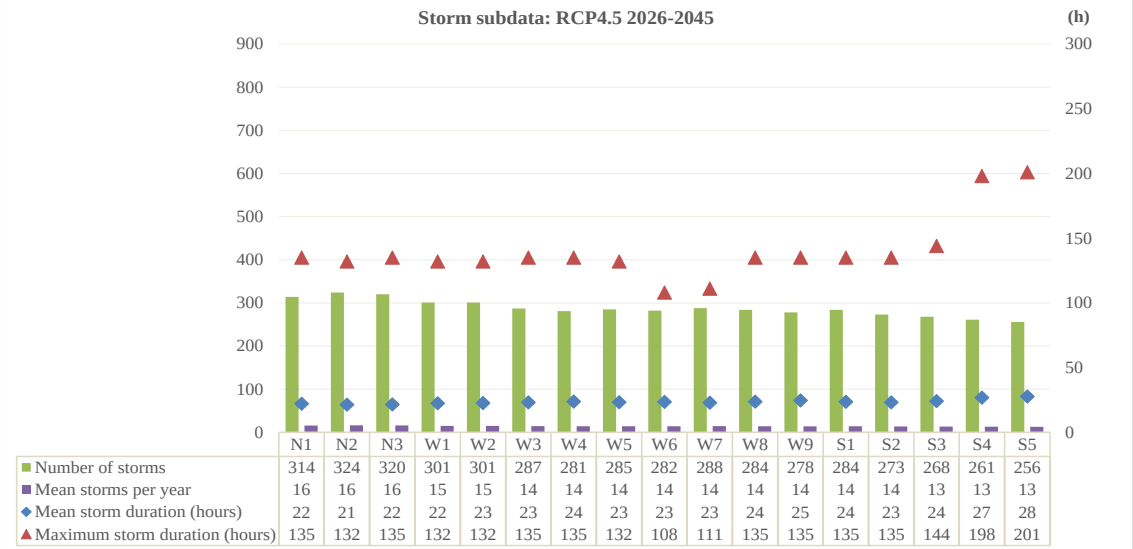


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	0	1	2	6	5	0	0	0	0	0	0	0	0	0	0	0	0
[90°-180°]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[180°-270°]	24	45	56	57	54	36	31	33	28	18	14	13	14	15	21	25	27
[270°-360°]	242	225	211	190	188	194	186	195	193	210	213	216	239	223	205	178	124

RCP4.5: 2026–2045 (cont.)

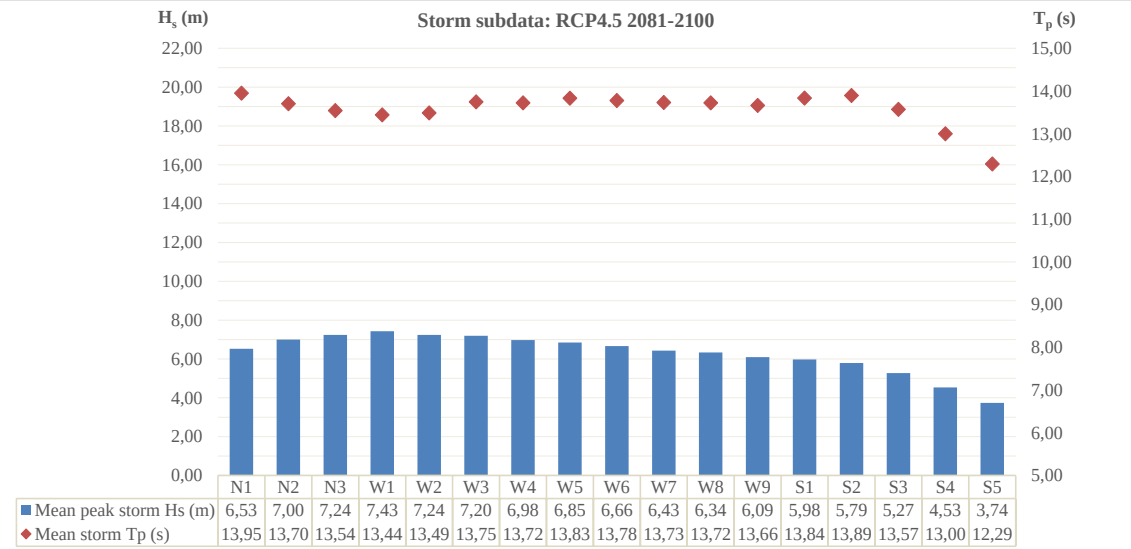


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	0	2	5	8	11	5	1	0	0	0	0	0	0	0	0	0	0
[90°-180°]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[180°-270°]	48	81	101	94	93	68	59	64	54	38	33	26	29	36	48	62	89
[270°-360°]	266	241	214	199	197	214	221	221	228	250	251	252	255	237	220	199	167

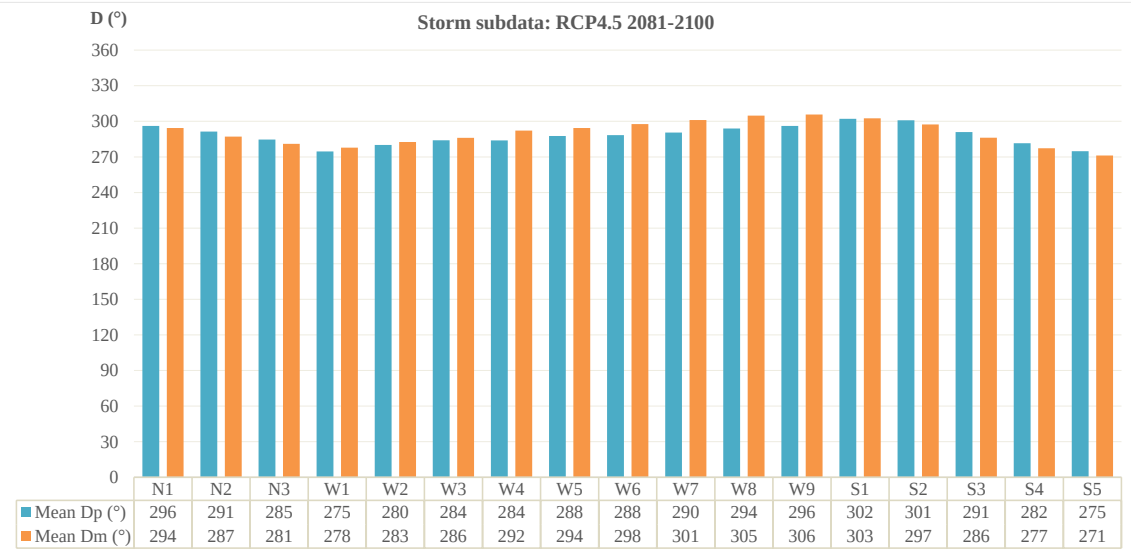


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Number of storms	314	324	320	301	301	287	281	285	282	288	284	278	284	273	268	261	256
Mean storms per year	16	16	16	15	15	14	14	14	14	14	14	14	14	14	13	13	13
Mean storm duration (hours)	22	21	22	22	23	23	24	23	23	23	24	25	24	23	24	27	28
Maximum storm duration (hours)	135	132	135	132	132	135	135	132	108	111	135	135	135	135	144	198	201

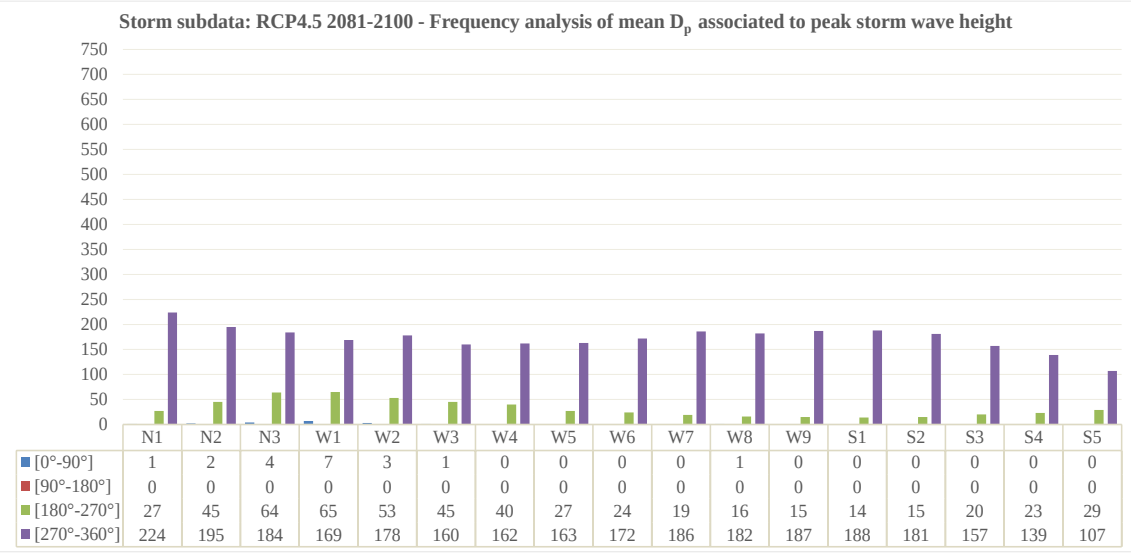
RCP4.5: 2081–2100



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean peak storm Hs (m)	6,53	7,00	7,24	7,43	7,24	7,20	6,98	6,85	6,66	6,43	6,34	6,09	5,98	5,79	5,27	4,53	3,74
Mean storm Tp (s)	13,95	13,70	13,54	13,44	13,49	13,75	13,72	13,83	13,78	13,73	13,72	13,66	13,84	13,89	13,57	13,00	12,29

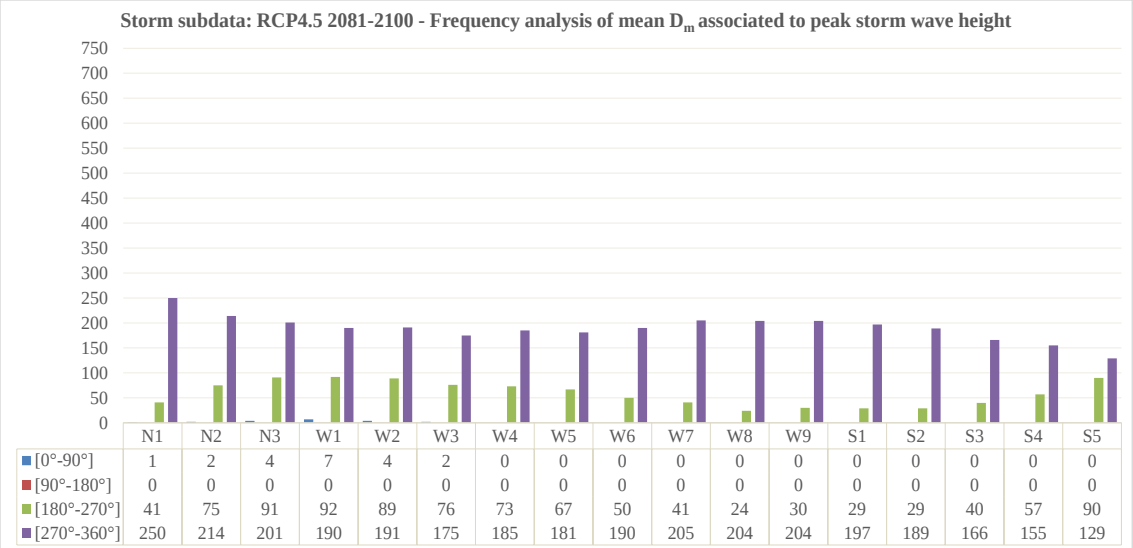


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	296	291	285	275	280	284	284	288	288	290	294	296	302	301	291	282	275
Mean Dm (°)	294	287	281	278	283	286	292	294	298	301	305	306	303	297	286	277	271

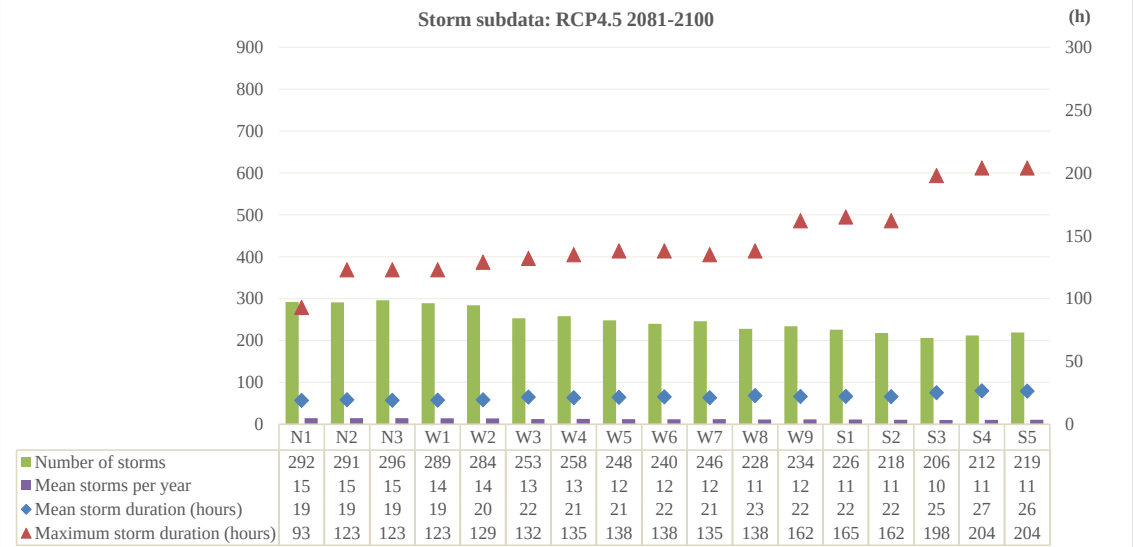


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	1	2	4	7	3	1	0	0	0	0	1	0	0	0	0	0	0
[90°-180°]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[180°-270°]	27	45	64	65	53	45	40	27	24	19	16	15	14	15	20	23	29
[270°-360°]	224	195	184	169	178	160	162	163	172	186	182	187	188	181	157	139	107

RCP4.5: 2081–2100 (cont.)

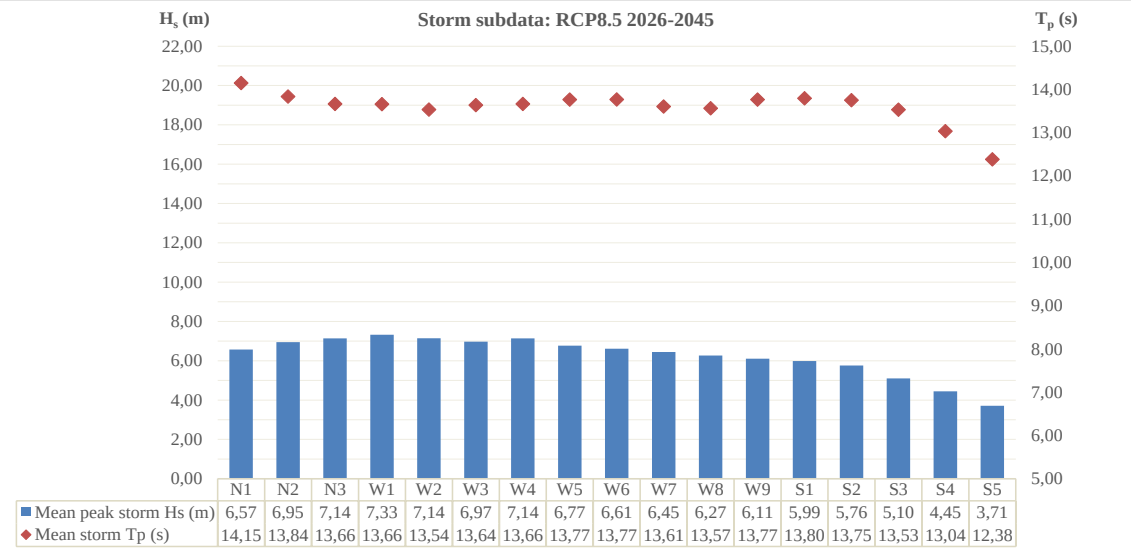


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	1	2	4	7	4	2	0	0	0	0	0	0	0	0	0	0	0
[90°-180°]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[180°-270°]	41	75	91	92	89	76	73	67	50	41	24	30	29	29	40	57	90
[270°-360°]	250	214	201	190	191	175	185	181	190	205	204	204	197	189	166	155	129

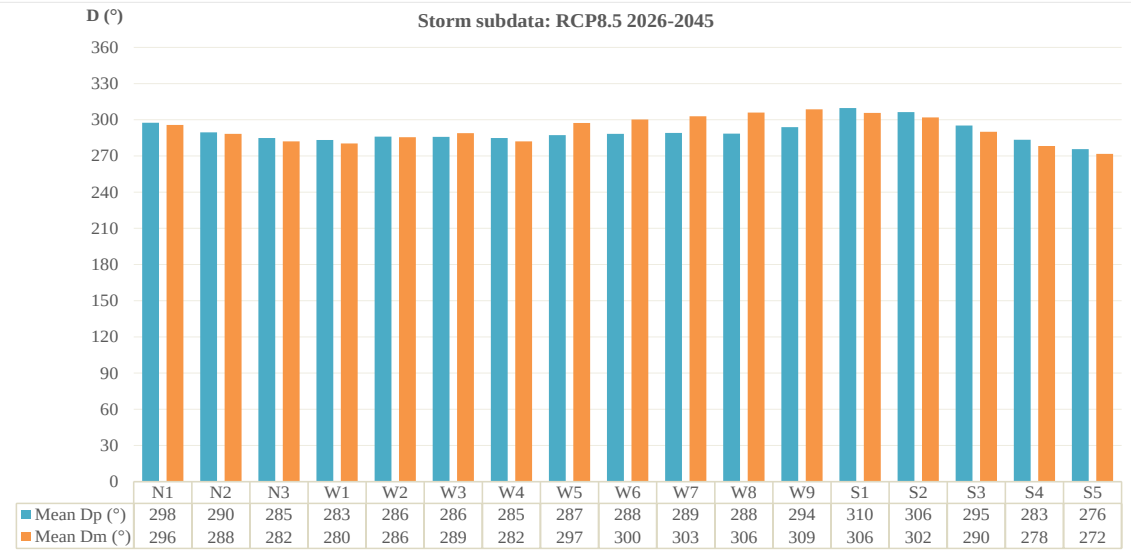


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Number of storms	292	291	296	289	284	253	258	248	240	246	228	234	226	218	206	212	219
Mean storms per year	15	15	15	14	14	13	13	12	12	12	11	12	11	11	10	11	11
Mean storm duration (hours)	19	19	19	19	20	22	21	21	22	21	23	22	22	22	25	27	26
Maximum storm duration (hours)	93	123	123	123	129	132	135	138	138	135	138	162	165	162	198	204	204

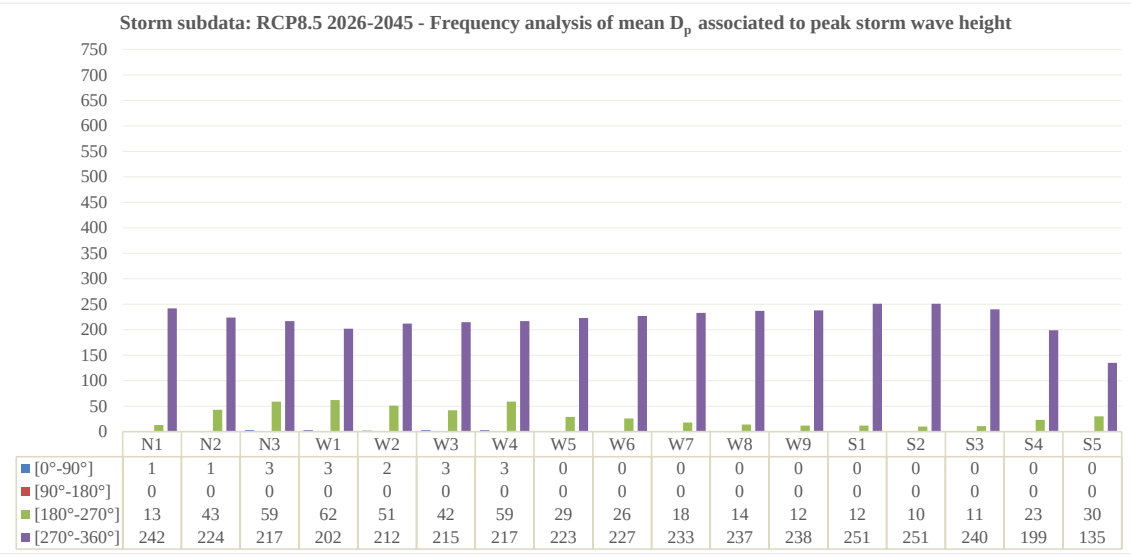
RCP8.5: 2026–2045



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean peak storm Hs (m)	6,57	6,95	7,14	7,33	7,14	6,97	7,14	6,77	6,61	6,45	6,27	6,11	5,99	5,76	5,10	4,45	3,71
Mean storm Tp (s)	14,15	13,84	13,66	13,66	13,54	13,64	13,66	13,77	13,77	13,61	13,57	13,77	13,80	13,75	13,53	13,04	12,38

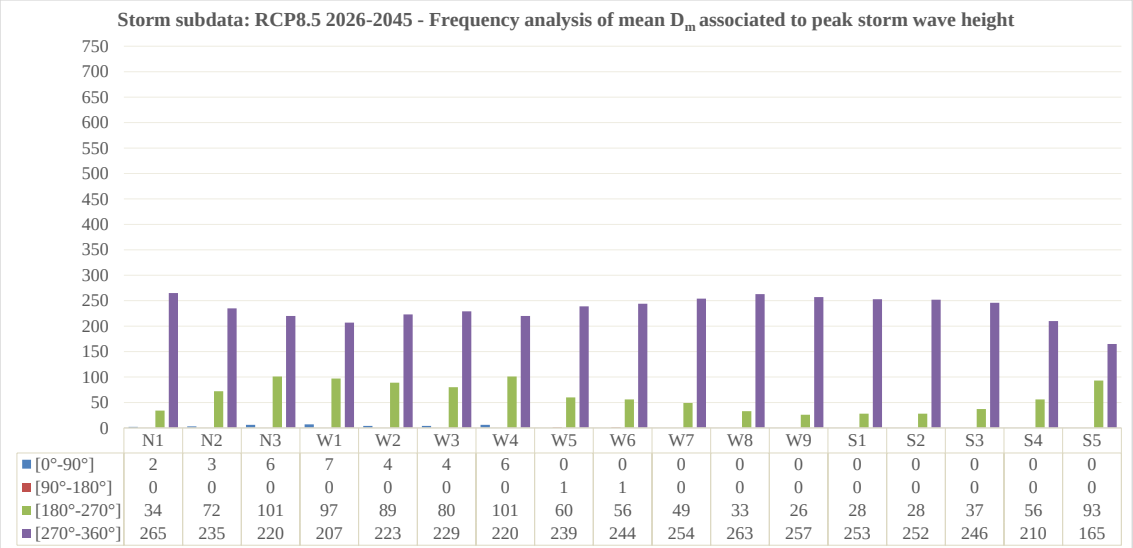


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	298	290	285	283	286	286	285	287	288	289	288	294	310	306	295	283	276
Mean Dm (°)	296	288	282	280	286	289	282	297	300	303	306	309	306	302	290	278	272

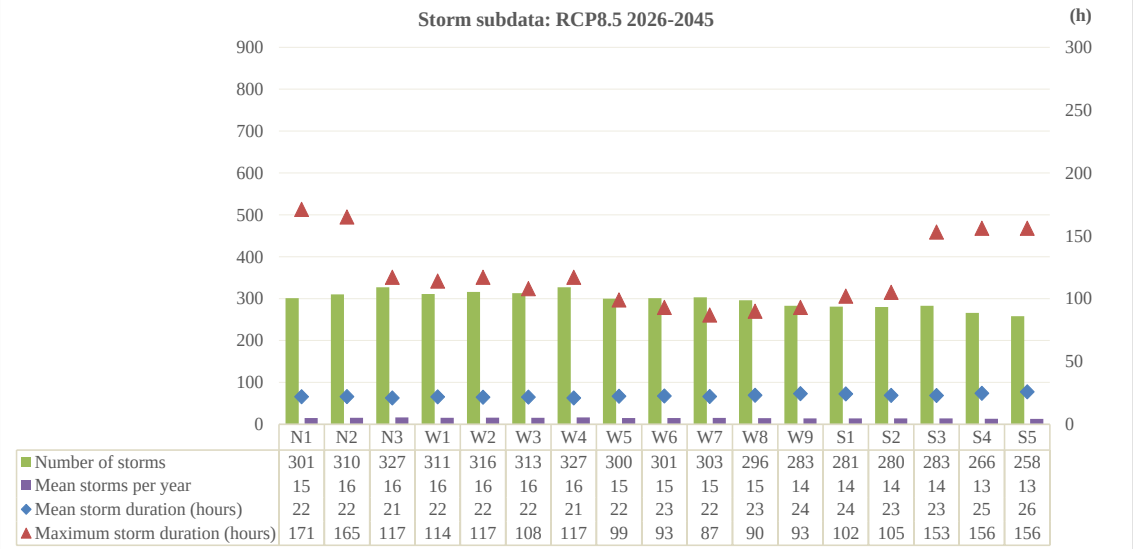


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	1	1	3	3	2	3	3	0	0	0	0	0	0	0	0	0	0
[90°-180°]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[180°-270°]	13	43	59	62	51	42	59	29	26	18	14	12	12	10	11	23	30
[270°-360°]	242	224	217	202	212	215	217	223	227	233	237	238	251	251	240	199	135

RCP8.5: 2026–2045 (cont.)

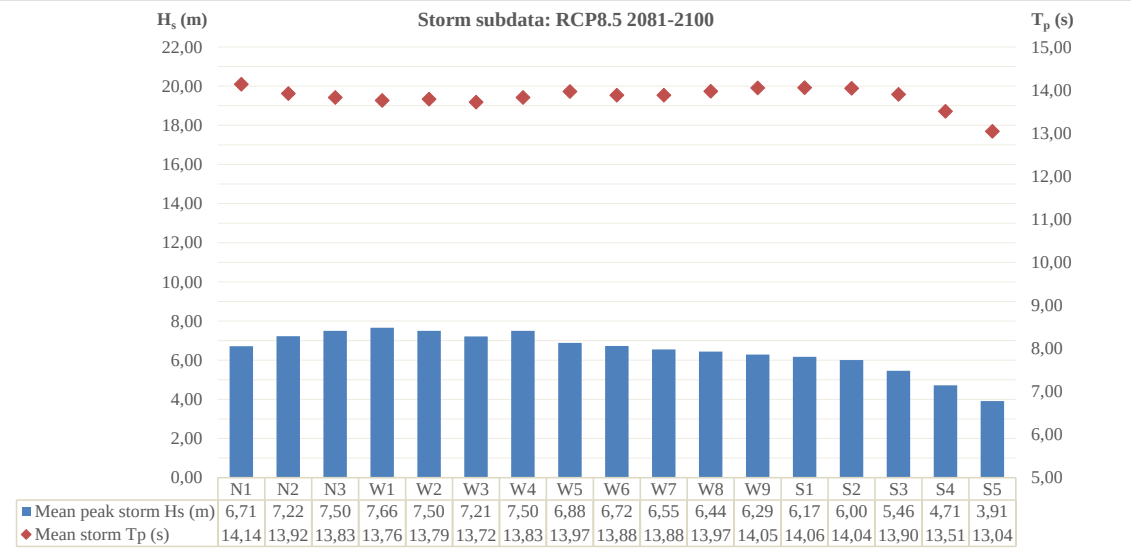


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	2	3	6	7	4	4	6	0	0	0	0	0	0	0	0	0	0
[90°-180°]	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
[180°-270°]	34	72	101	97	89	80	101	60	56	49	33	26	28	28	37	56	93
[270°-360°]	265	235	220	207	223	229	220	239	244	254	263	257	253	252	246	210	165

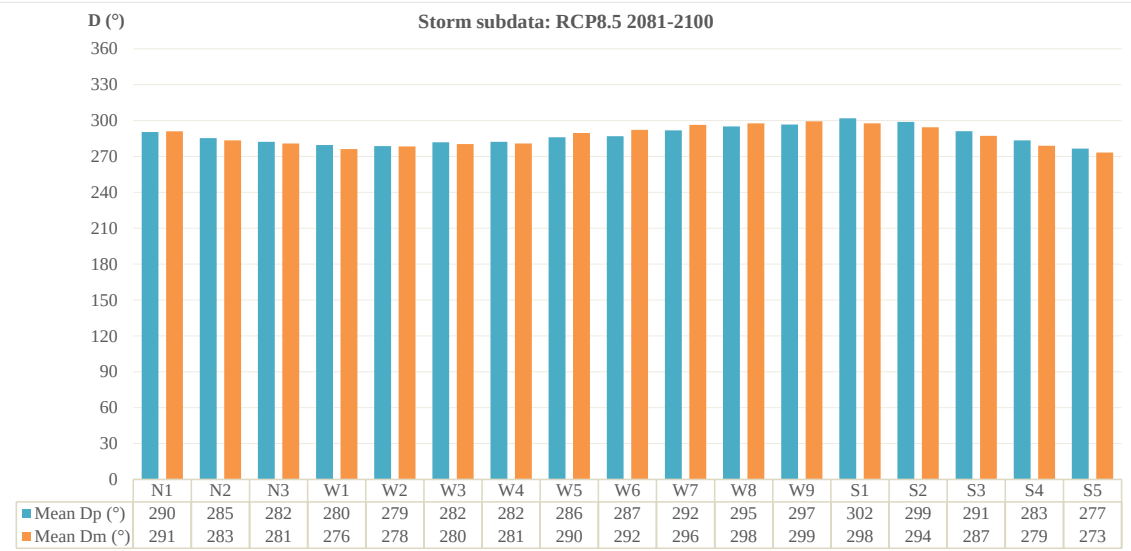


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Number of storms	301	310	327	311	316	313	327	300	301	303	296	283	281	280	283	266	258
Mean storms per year	15	16	16	16	16	16	16	15	15	15	15	14	14	14	14	13	13
Mean storm duration (hours)	22	22	21	22	22	22	21	22	23	22	23	24	24	23	23	25	26
Maximum storm duration (hours)	171	165	117	114	117	108	117	99	93	87	90	93	102	105	153	156	156

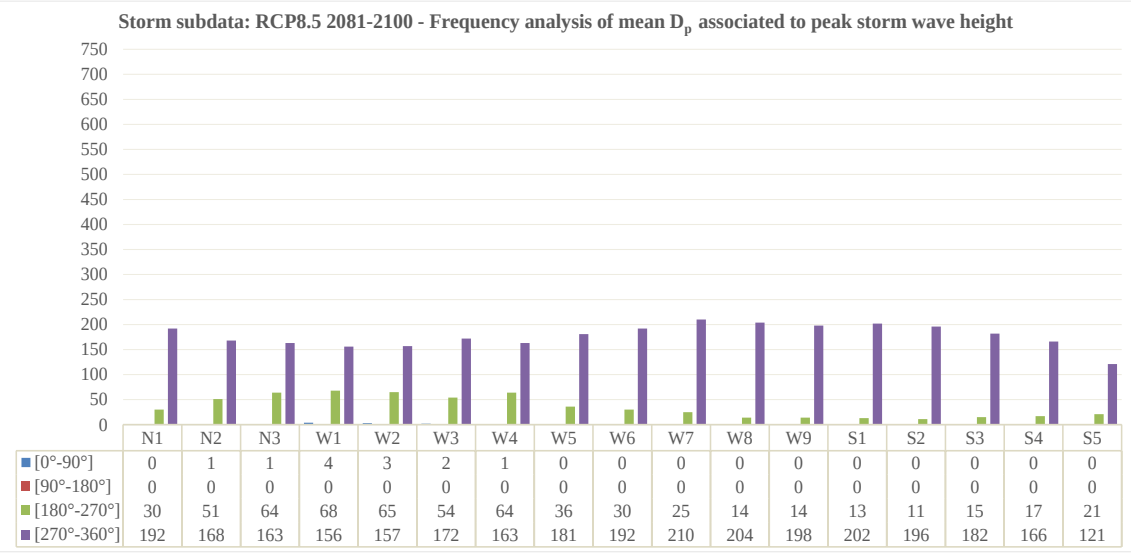
RCP8.5: 2081–2100



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean peak storm Hs (m)	6,71	7,22	7,50	7,66	7,50	7,21	7,50	6,88	6,72	6,55	6,44	6,29	6,17	6,00	5,46	4,71	3,91
Mean storm Tp (s)	14,14	13,92	13,83	13,76	13,79	13,72	13,83	13,97	13,88	13,88	13,97	14,05	14,06	14,04	13,90	13,51	13,04

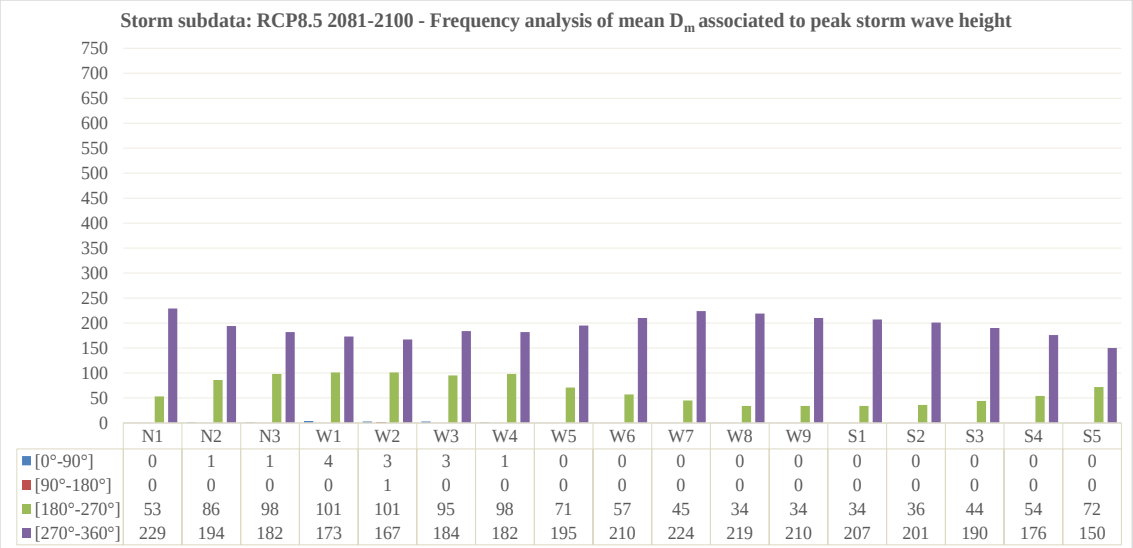


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Mean Dp (°)	290	285	282	280	279	282	282	286	287	292	295	297	302	299	291	283	277
Mean Dm (°)	291	283	281	276	278	280	281	290	292	296	298	299	298	294	287	279	273

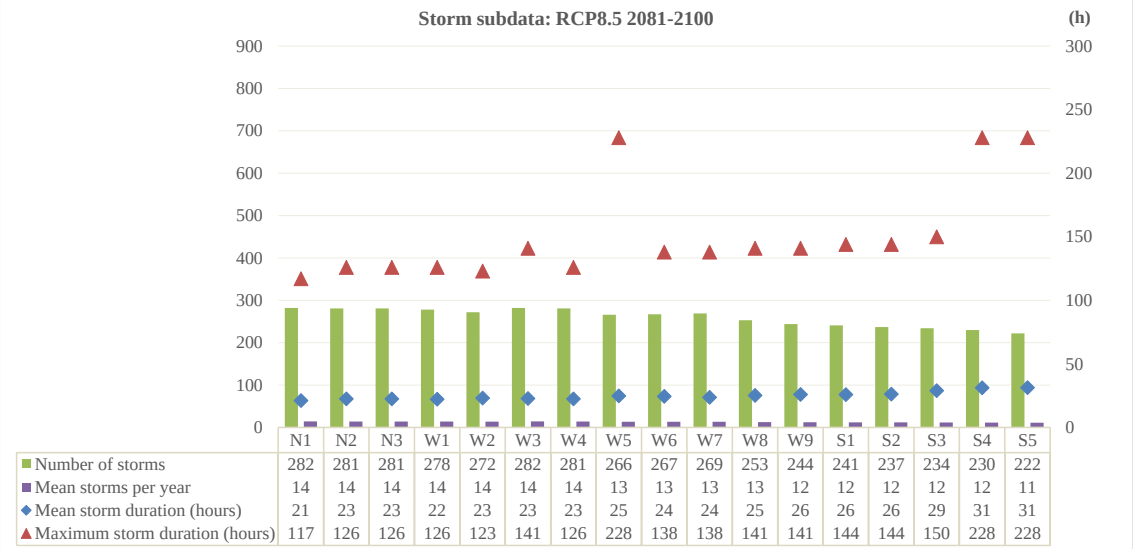


	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	0	1	1	4	3	2	1	0	0	0	0	0	0	0	0	0	0
[90°-180°]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
[180°-270°]	30	51	64	68	65	54	64	36	30	25	14	14	13	11	15	17	21
[270°-360°]	192	168	163	156	157	172	163	181	192	210	204	198	202	196	182	166	121

RCP8.5: 2081–2100 (cont.)



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
[0°-90°]	0	1	1	4	3	3	1	0	0	0	0	0	0	0	0	0	0
[90°-180°]	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
[180°-270°]	53	86	98	101	101	95	98	71	57	45	34	34	34	36	44	54	72
[270°-360°]	229	194	182	173	167	184	182	195	210	224	219	210	207	201	190	176	150



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
Number of storms	282	281	281	278	272	282	281	266	267	269	253	244	241	237	234	230	222
Mean storms per year	14	14	14	14	14	14	14	13	13	13	13	12	12	12	12	12	11
Mean storm duration (hours)	21	23	23	22	23	23	23	25	24	24	25	26	26	26	29	31	31
Maximum storm duration (hours)	117	126	126	126	123	141	126	228	138	138	141	141	144	144	150	228	228

Appendix 2D

Storm subdataset descriptive statistics:

Individual parameters under 5 wave climate regime scenarios

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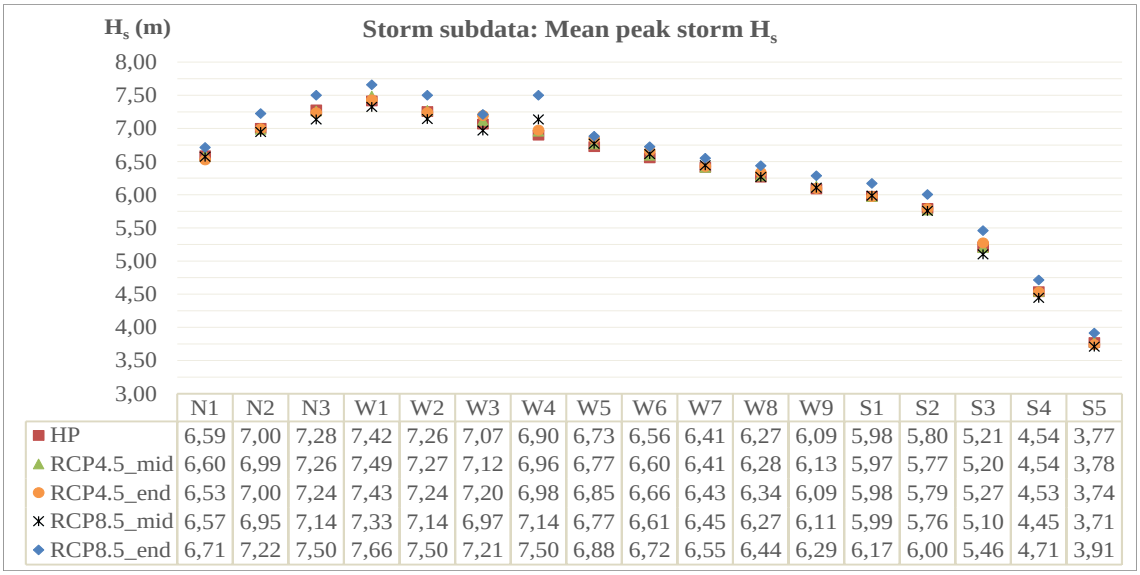
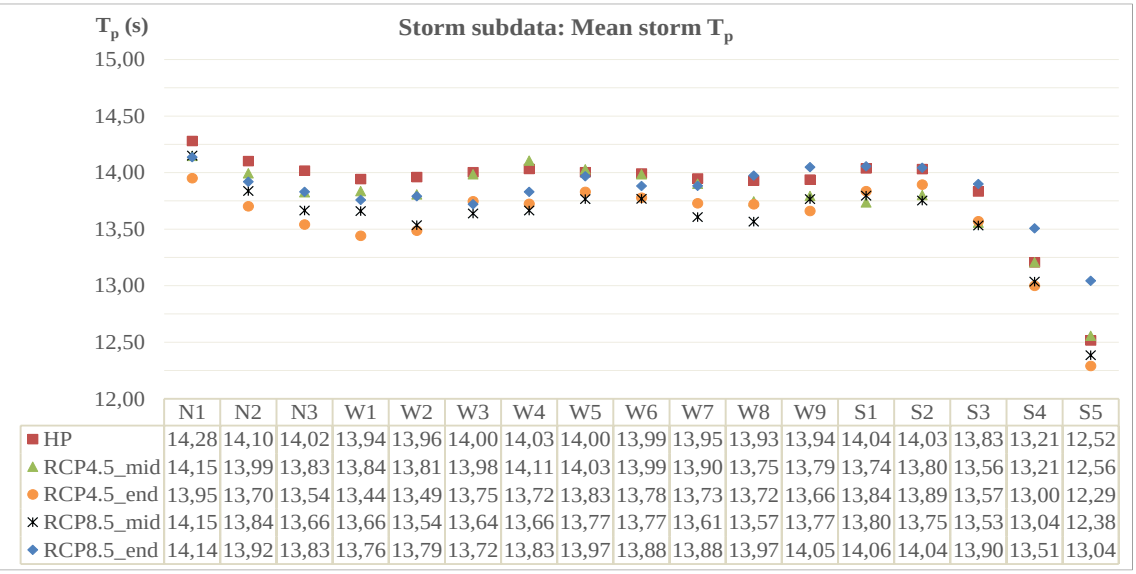
Mean peak storm H_s



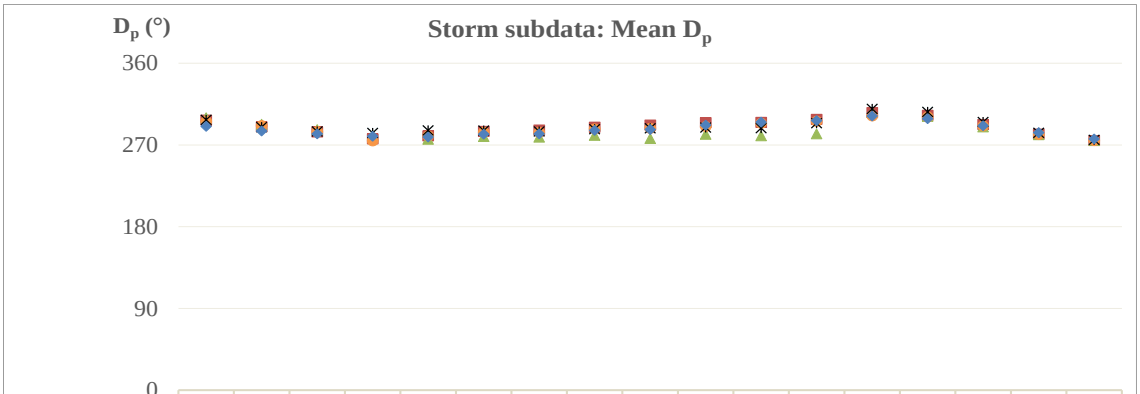
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	6,59	7,00	7,28	7,42	7,26	7,07	6,90	6,73	6,56	6,41	6,27	6,09	5,98	5,80	5,21	4,54	3,77
RCP4.5_mid	6,60	6,99	7,26	7,49	7,27	7,12	6,96	6,77	6,60	6,41	6,28	6,13	5,97	5,77	5,20	4,54	3,78
RCP4.5_end	6,53	7,00	7,24	7,43	7,24	7,20	6,98	6,85	6,66	6,43	6,34	6,09	5,98	5,79	5,27	4,53	3,74
RCP8.5_mid	6,57	6,95	7,14	7,33	7,14	6,97	7,14	6,77	6,61	6,45	6,27	6,11	5,99	5,76	5,10	4,45	3,71
RCP8.5_end	6,71	7,22	7,50	7,66	7,50	7,21	7,50	6,88	6,72	6,55	6,44	6,29	6,17	6,00	5,46	4,71	3,91

Mean storm T_p



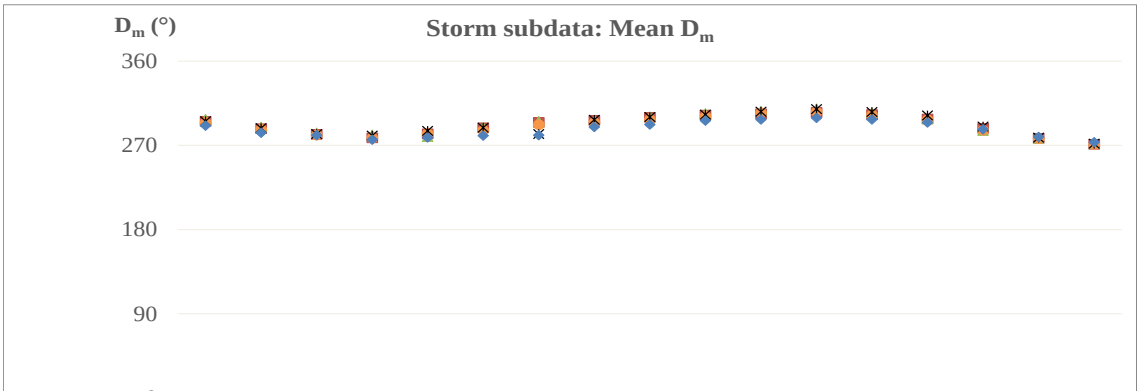
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	14,28	14,10	14,02	13,94	13,96	14,00	14,03	14,00	13,99	13,95	13,93	13,94	14,04	14,03	13,83	13,21	12,52
RCP4.5_mid	14,15	13,99	13,83	13,84	13,81	13,98	14,11	14,03	13,99	13,90	13,75	13,79	13,74	13,80	13,56	13,21	12,56
RCP4.5_end	13,95	13,70	13,54	13,44	13,49	13,75	13,72	13,83	13,78	13,73	13,72	13,66	13,84	13,89	13,57	13,00	12,29
RCP8.5_mid	14,15	13,84	13,66	13,66	13,54	13,64	13,66	13,77	13,77	13,61	13,57	13,77	13,80	13,75	13,53	13,04	12,38
RCP8.5_end	14,14	13,92	13,83	13,76	13,79	13,72	13,83	13,97	13,88	13,88	13,97	14,05	14,06	14,04	13,90	13,51	13,04

Mean D_p



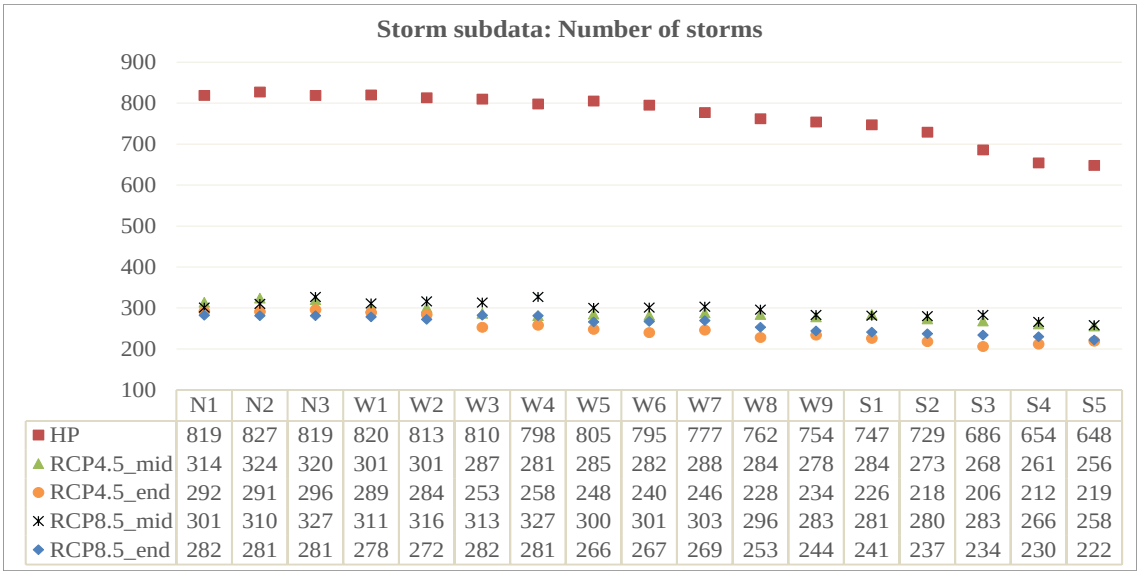
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	297	290	284	277	280	285	286	290	292	295	295	298	306	303	293	282	275
RCP4.5_mid	300	293	287	281	276	279	279	281	277	282	280	282	306	301	290	281	275
RCP4.5_end	296	291	285	275	280	284	284	288	288	290	294	296	302	301	291	282	275
RCP8.5_mid	298	290	285	283	286	286	285	287	288	289	288	294	310	306	295	283	276
RCP8.5_end	290	285	282	280	279	282	282	286	287	292	295	297	302	299	291	283	277

Mean D_m



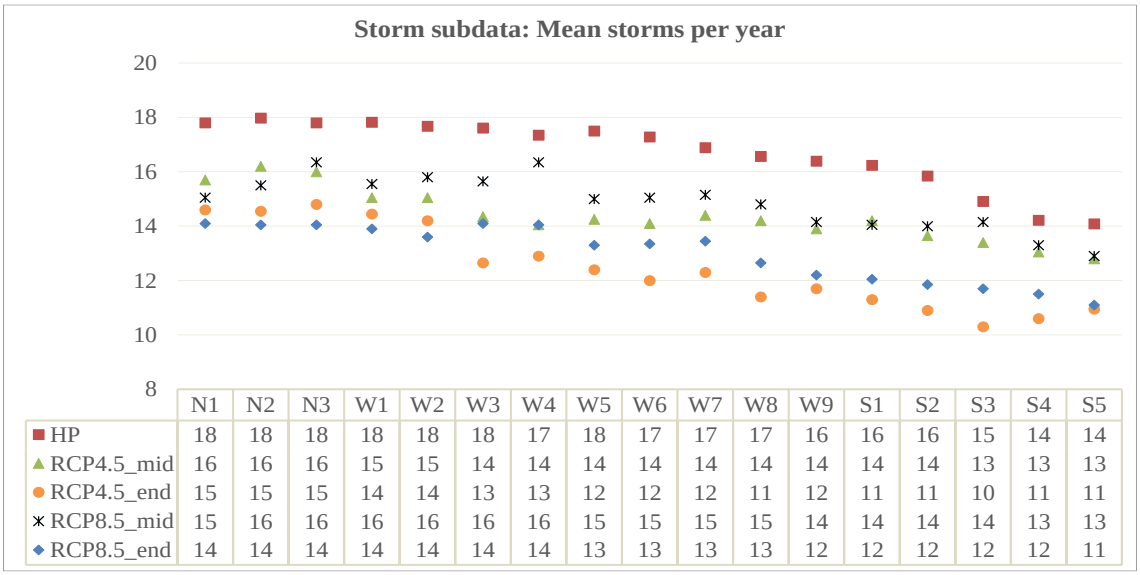
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	296	288	282	278	282	289	294	297	300	302	304	305	303	298	288	278	271
RCP4.5_mid	298	290	283	281	279	289	296	297	301	304	307	309	305	298	286	277	272
RCP4.5_end	294	287	281	278	283	286	292	294	298	301	305	306	303	297	286	277	271
RCP8.5_mid	296	288	282	280	286	289	282	297	300	303	306	309	306	302	290	278	272
RCP8.5_end	291	283	281	276	278	280	281	290	292	296	298	299	298	294	287	279	273

Number of storms



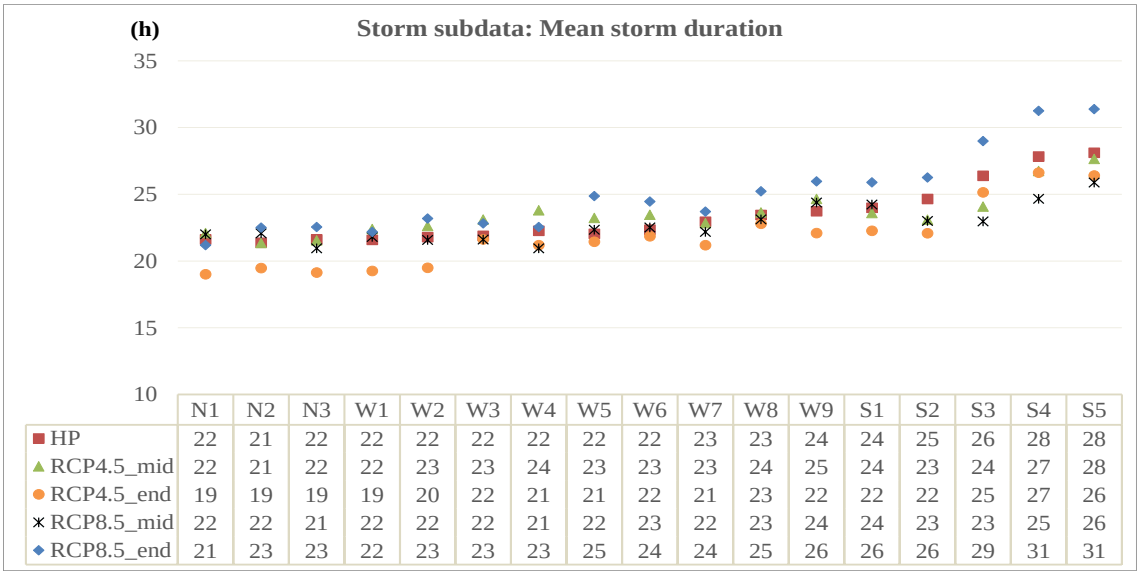
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	819	827	819	820	813	810	798	805	795	777	762	754	747	729	686	654	648
RCP4.5_mid	314	324	320	301	301	287	281	285	282	288	284	278	284	273	268	261	256
RCP4.5_end	292	291	296	289	284	253	258	248	240	246	228	234	226	218	206	212	219
RCP8.5_mid	301	310	327	311	316	313	327	300	301	303	296	283	281	280	283	266	258
RCP8.5_end	282	281	281	278	272	282	281	266	267	269	253	244	241	237	234	230	222

Mean storms per year



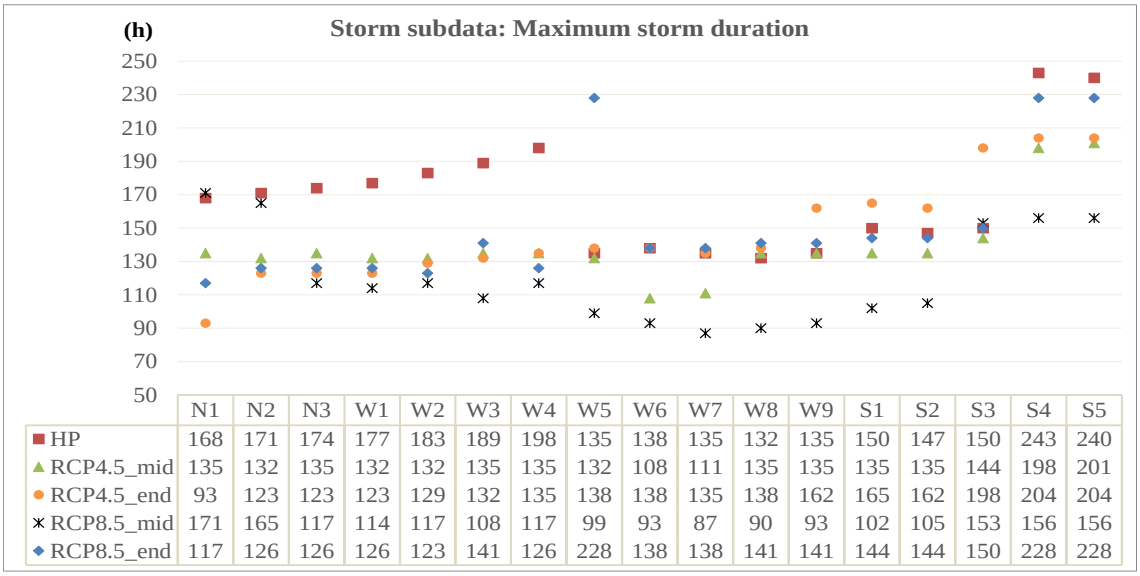
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	18	18	18	18	18	18	17	18	17	17	17	16	16	16	15	14	14
RCP4.5_mid	16	16	16	15	15	14	14	14	14	14	14	14	14	14	13	13	13
RCP4.5_end	15	15	15	14	14	13	13	12	12	12	11	12	11	11	10	11	11
RCP8.5_mid	15	16	16	16	16	16	16	15	15	15	15	14	14	14	14	13	13
RCP8.5_end	14	14	14	14	14	14	14	13	13	13	13	12	12	12	12	12	11

Mean storm duration



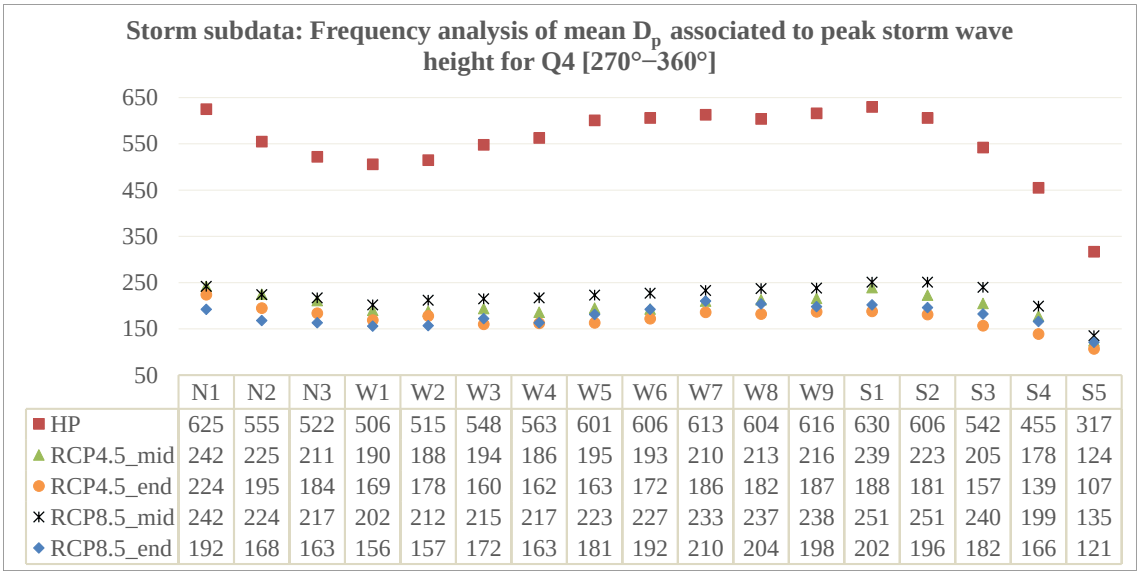
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	22	21	22	22	22	22	22	22	22	23	23	24	24	25	26	28	28
RCP4.5_mid	22	21	22	22	23	23	24	23	23	23	24	25	24	23	24	27	28
RCP4.5_end	19	19	19	19	20	22	21	21	22	21	23	22	22	22	25	27	26
RCP8.5_mid	22	22	21	22	22	22	21	22	23	22	23	24	24	23	23	25	26
RCP8.5_end	21	23	23	22	23	23	23	25	24	24	25	26	26	26	29	31	31

Maximum storm duration



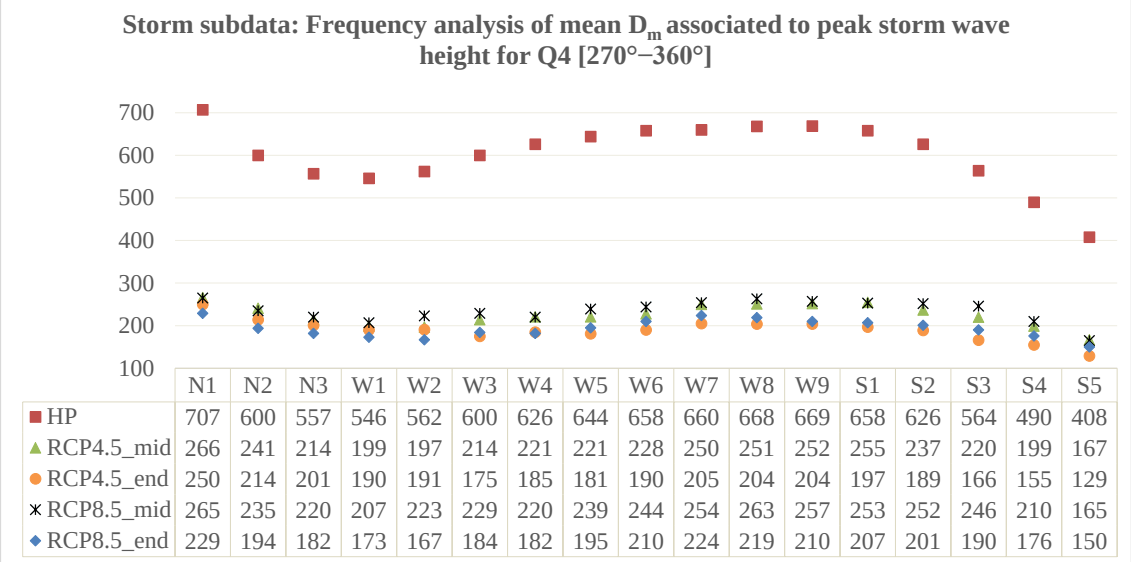
	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	168	171	174	177	183	189	198	135	138	135	132	135	150	147	150	243	240
RCP4.5_mid	135	132	135	132	132	135	135	132	108	111	135	135	135	135	144	198	201
RCP4.5_end	93	123	123	123	129	132	135	138	138	135	138	162	165	162	198	204	204
RCP8.5_mid	171	165	117	114	117	108	117	99	93	87	90	93	102	105	153	156	156
RCP8.5_end	117	126	126	126	123	141	126	228	138	138	141	141	144	144	150	228	228

Frequency analysis of mean D_p associated to peak storm wave height for Q4 [270°–360°]



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	625	555	522	506	515	548	563	601	606	613	604	616	630	606	542	455	317
RCP4.5_mid	242	225	211	190	188	194	186	195	193	210	213	216	239	223	205	178	124
RCP4.5_end	224	195	184	169	178	160	162	163	172	186	182	187	188	181	157	139	107
RCP8.5_mid	242	224	217	202	212	215	217	223	227	233	237	238	251	251	240	199	135
RCP8.5_end	192	168	163	156	157	172	163	181	192	210	204	198	202	196	182	166	121

Frequency analysis of mean D_m associated to peak storm wave height for Q4 [270°–360°]



	N1	N2	N3	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S2	S3	S4	S5
HP	707	600	557	546	562	600	626	644	658	660	668	669	658	626	564	490	408
RCP4.5_mid	266	241	214	199	197	214	221	221	228	250	251	252	255	237	220	199	167
RCP4.5_end	250	214	201	190	191	175	185	181	190	205	204	204	197	189	166	155	129
RCP8.5_mid	265	235	220	207	223	229	220	239	244	254	263	257	253	252	246	210	165
RCP8.5_end	229	194	182	173	167	184	182	195	210	224	219	210	207	201	190	176	150

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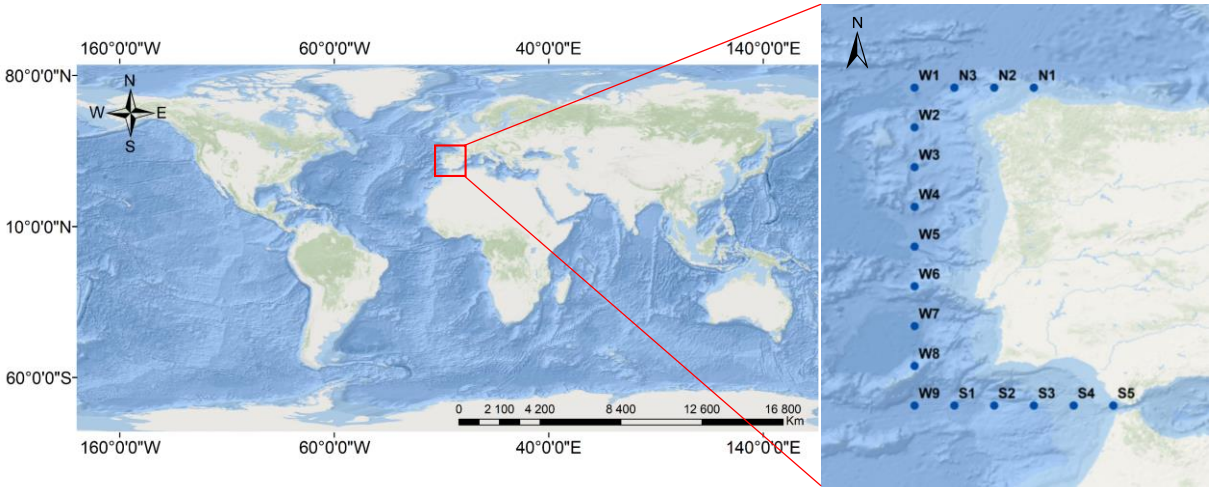
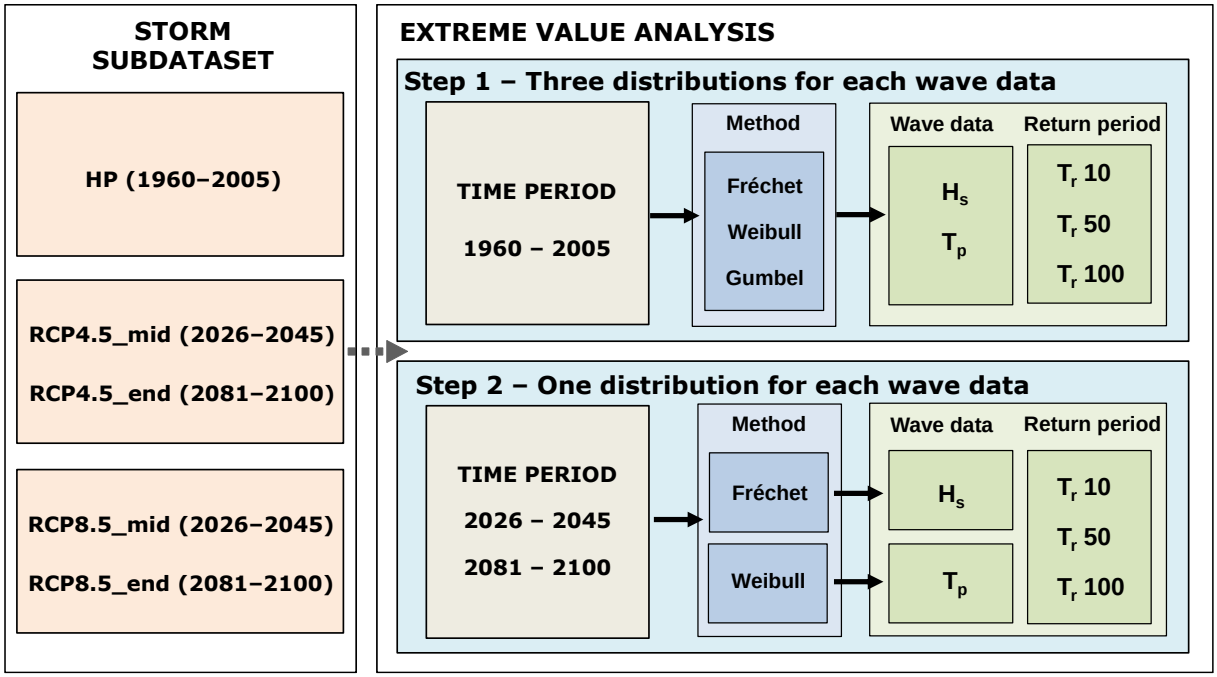
APPENDIX 3

Extreme wave data analysis off Iberian Peninsula:

Calculated values in 17 stations under 5 wave climate regime scenarios





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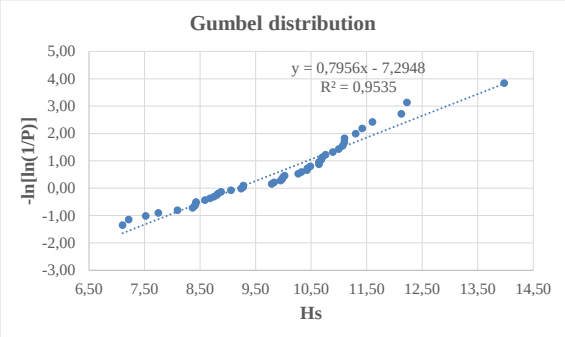
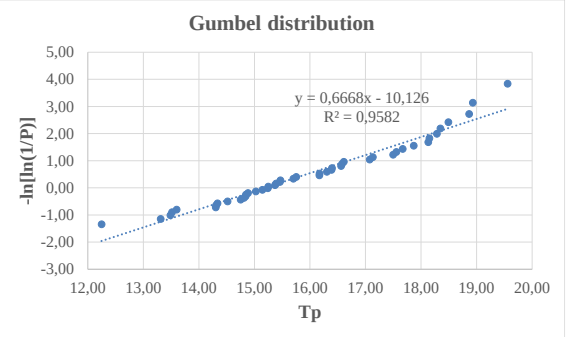
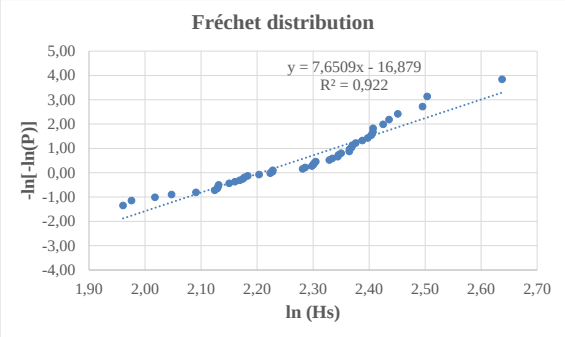
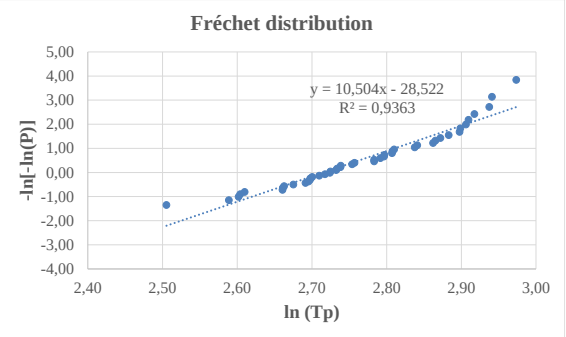
Historical data: 1960–2005

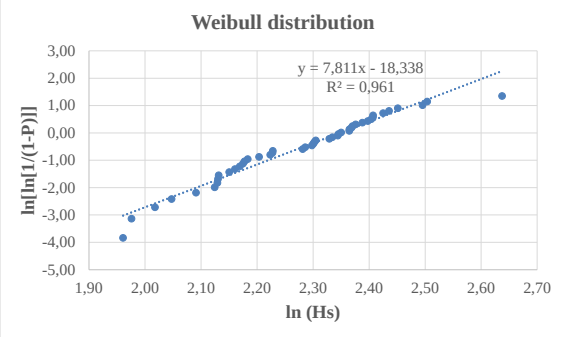
Station N1

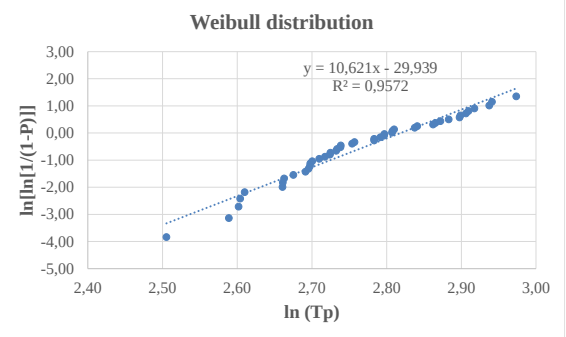






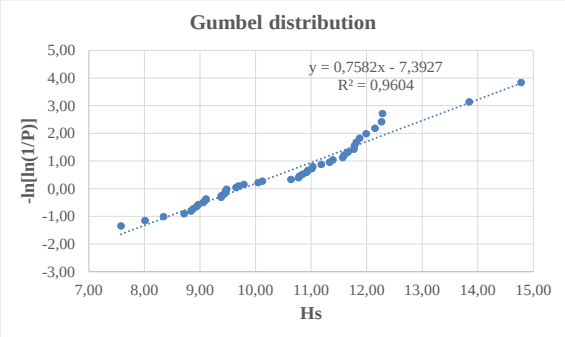


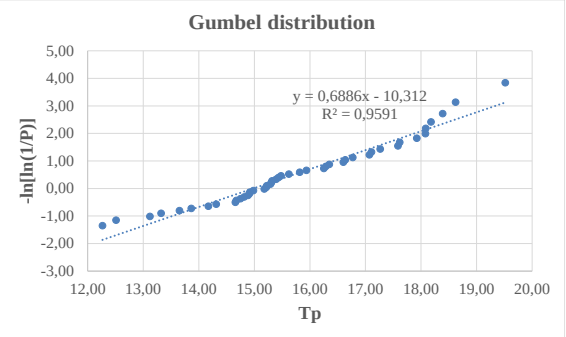


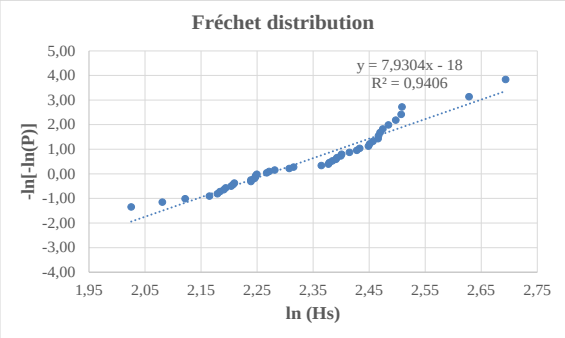


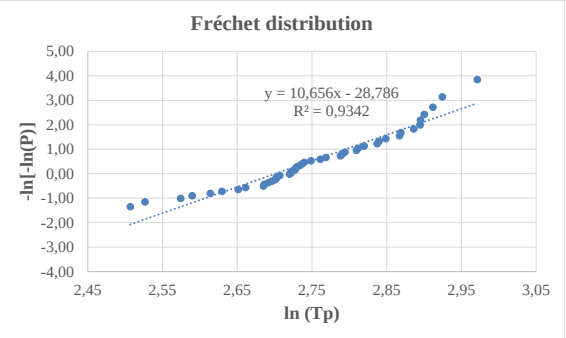
Historical data: 1960–2005

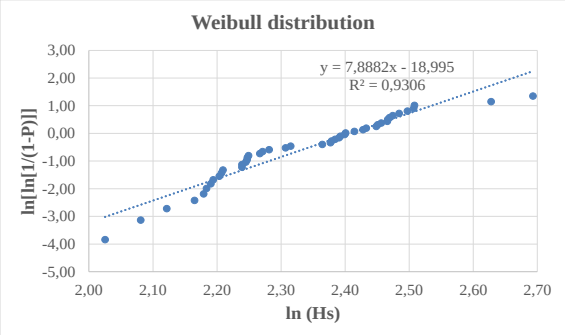
Station N2

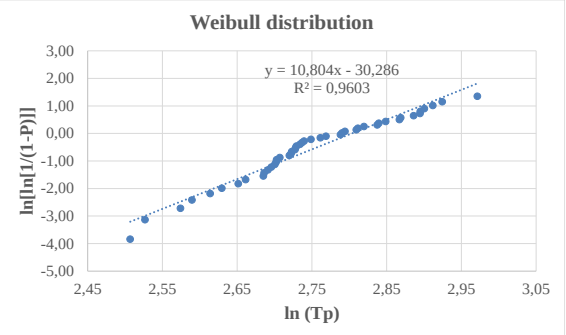






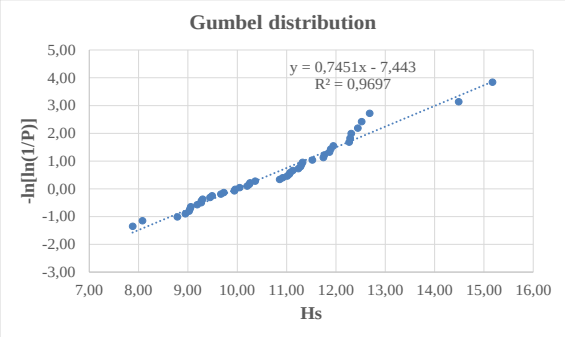


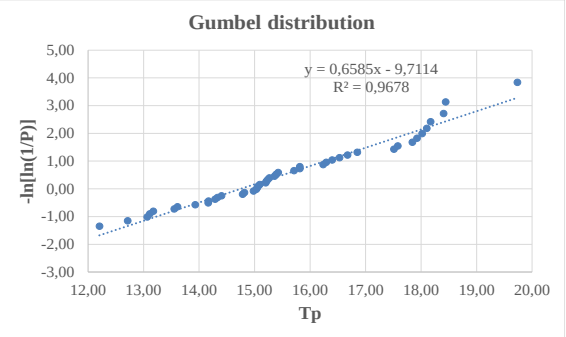


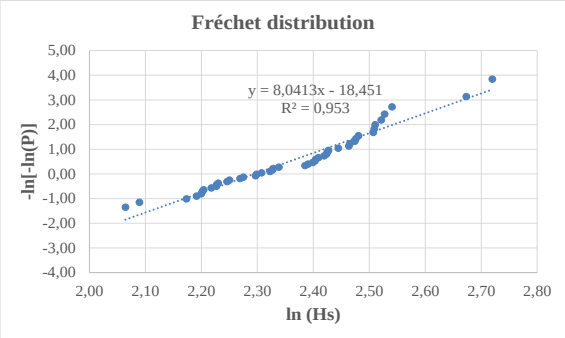


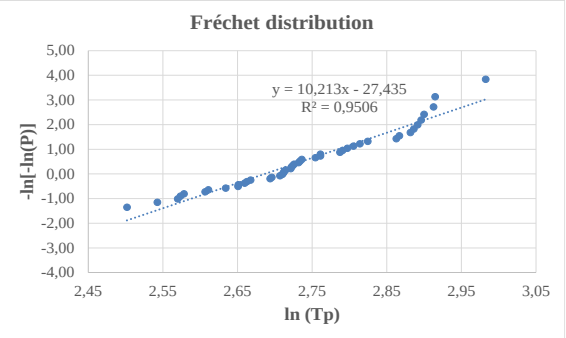
Historical data: 1960–2005

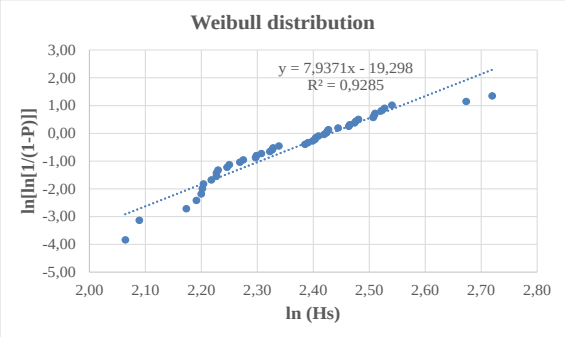
Station N3

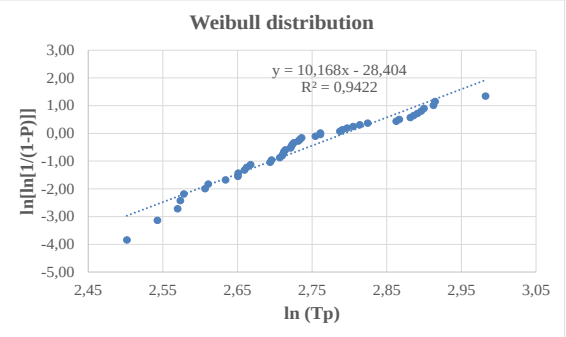






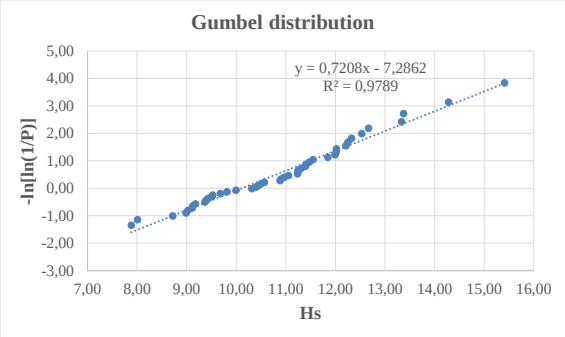


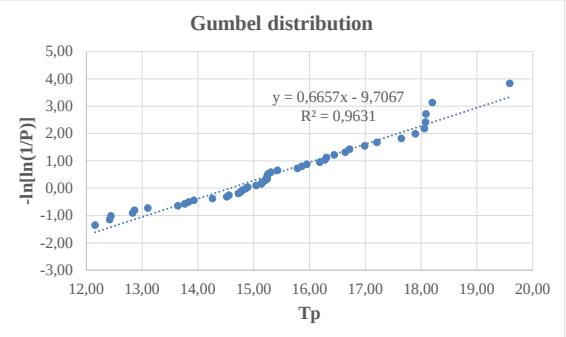


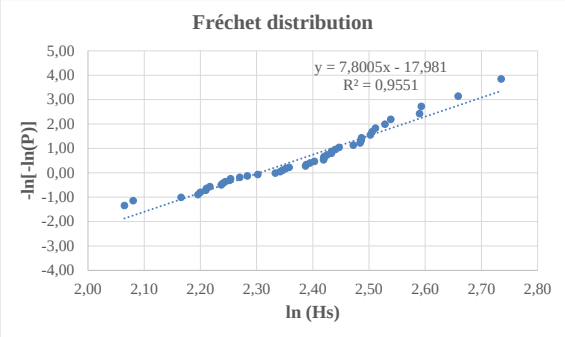


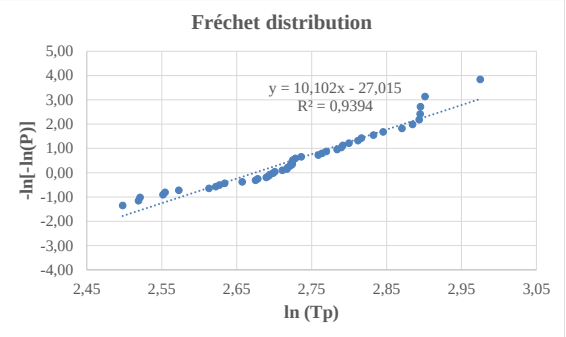
Historical data: 1960–2005

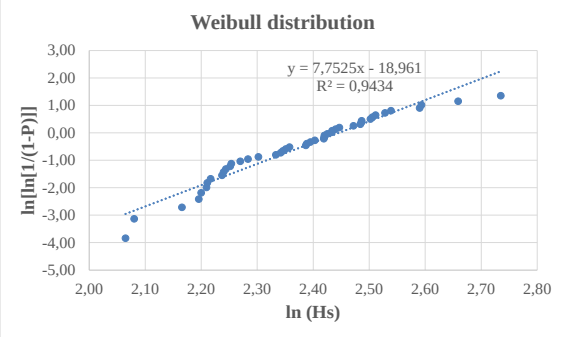
Station W1

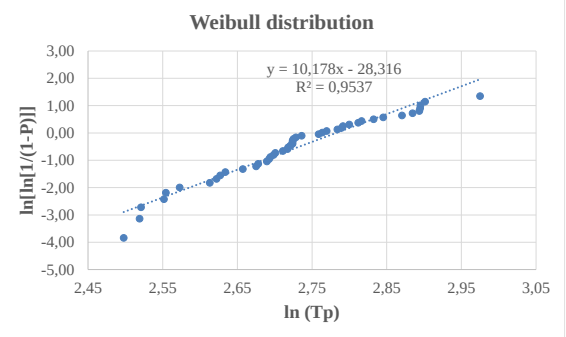






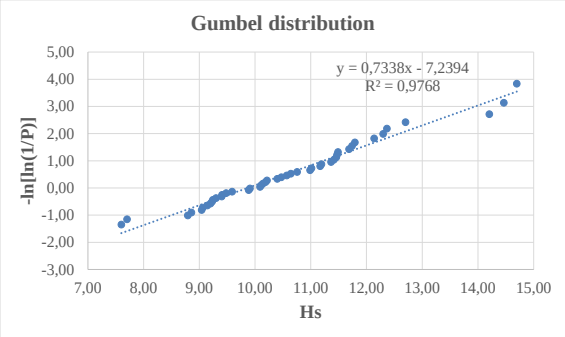


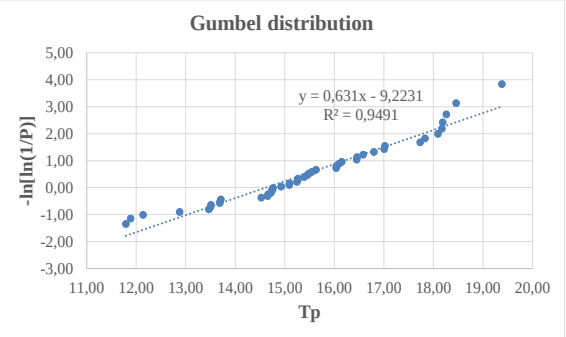


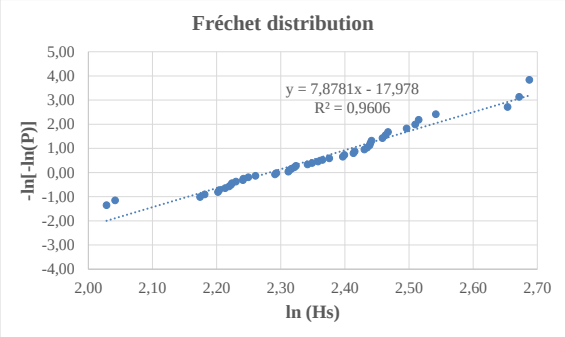


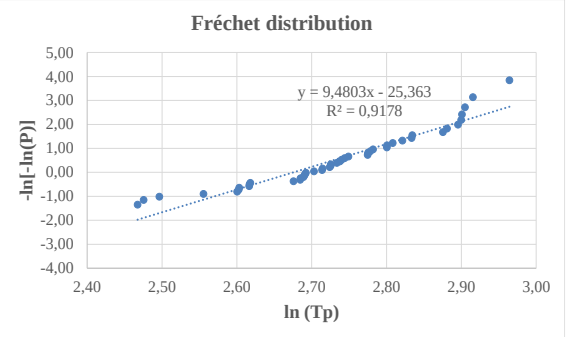
Historical data: 1960–2005

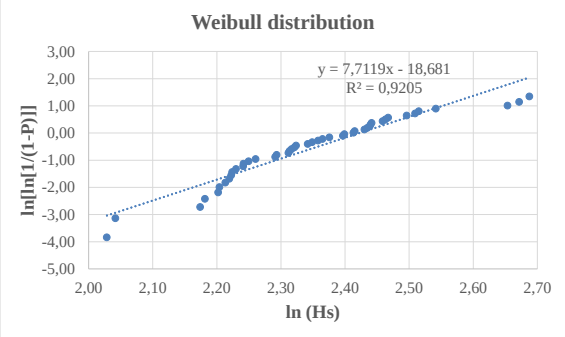
Station W2

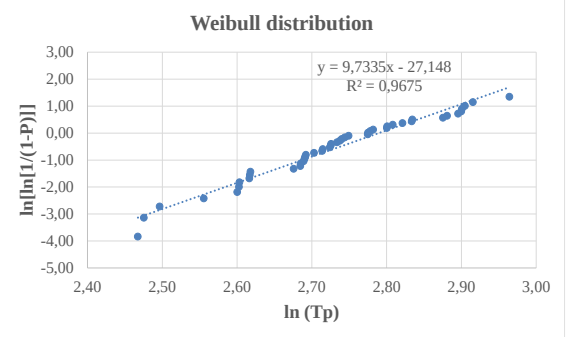






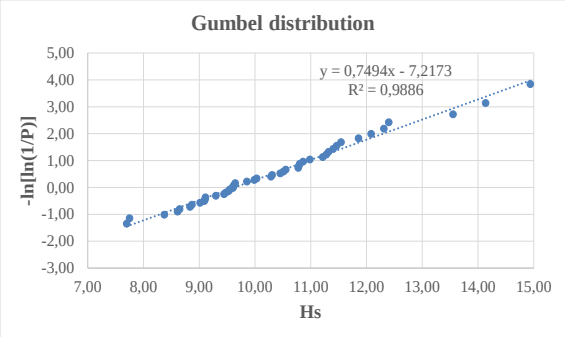


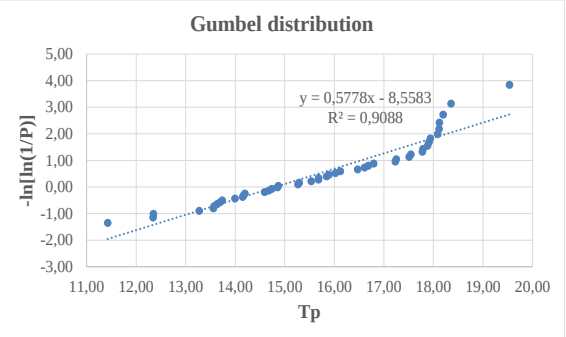


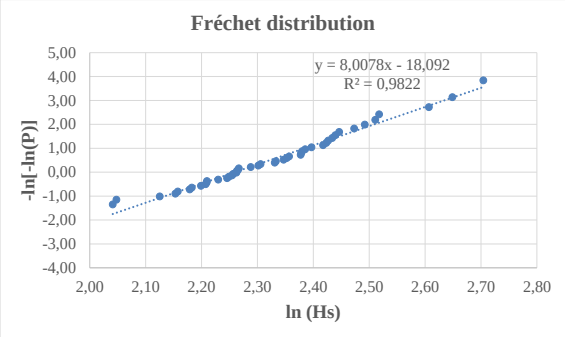


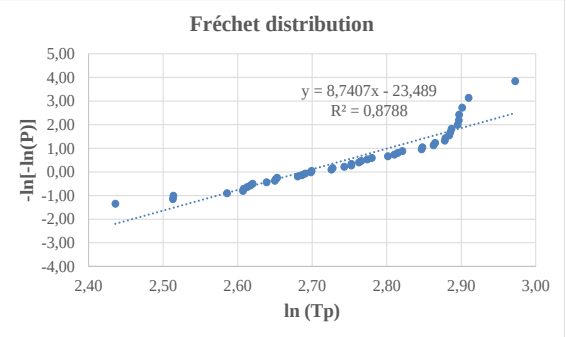
Historical data: 1960–2005

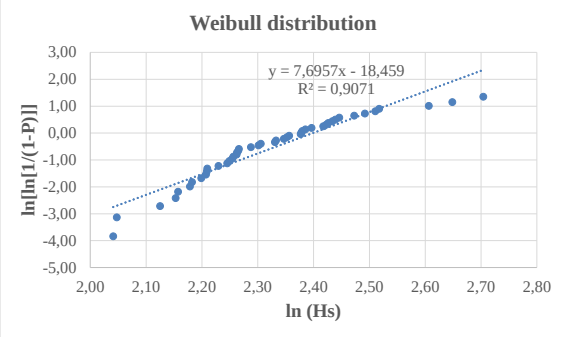
Station W3

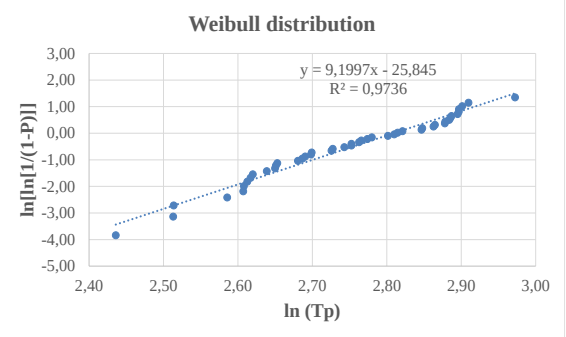






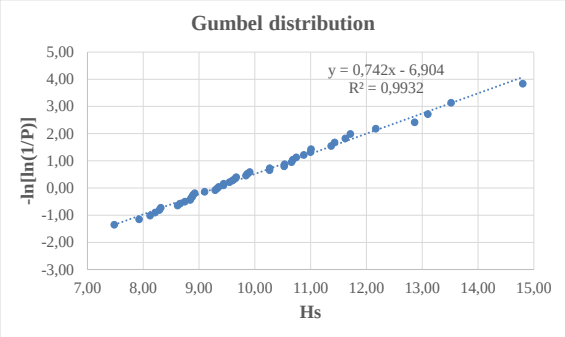


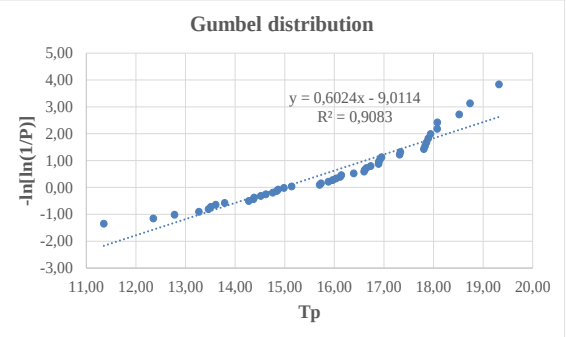


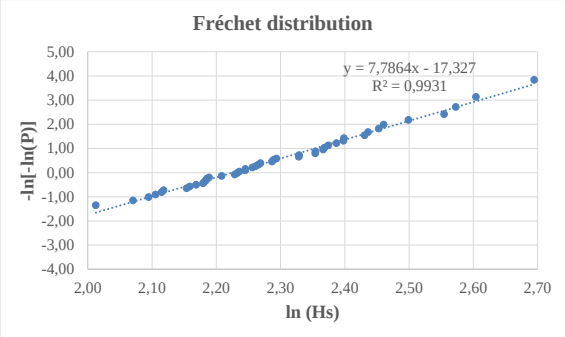


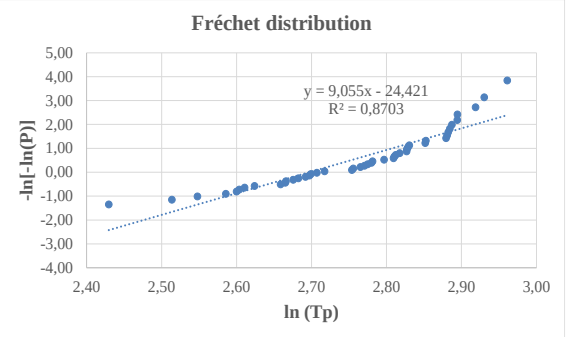
Historical data: 1960–2005

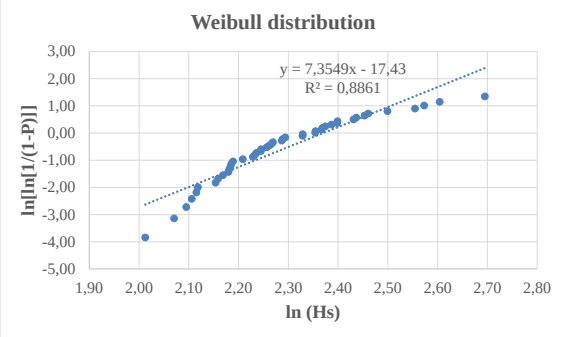
Station W4

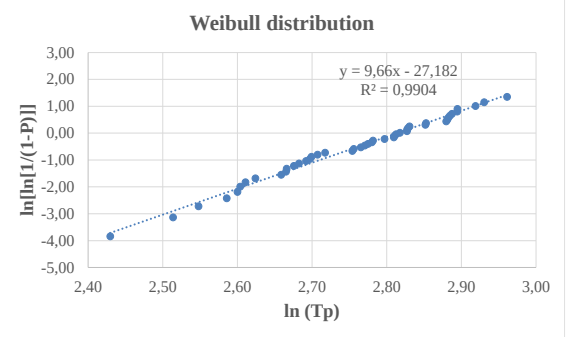






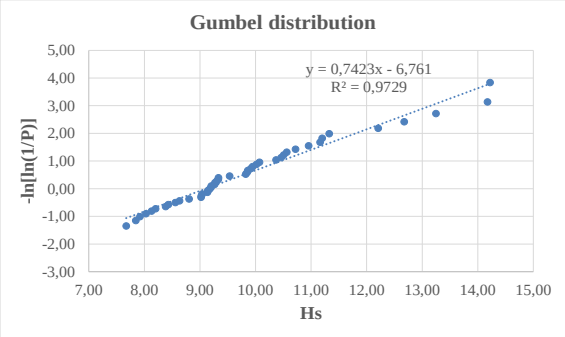


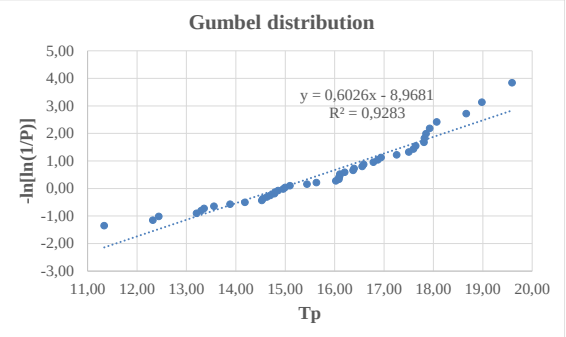


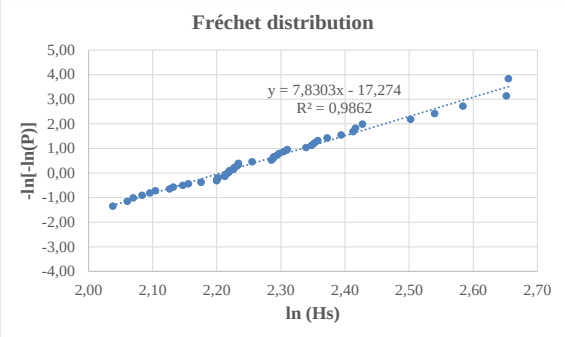


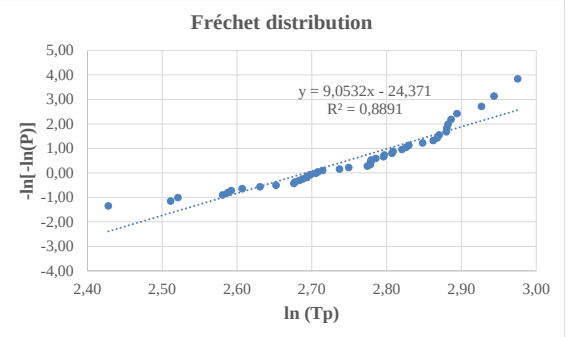
Historical data: 1960–2005

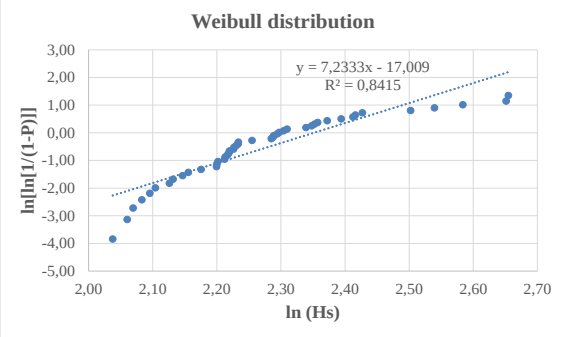
Station W5

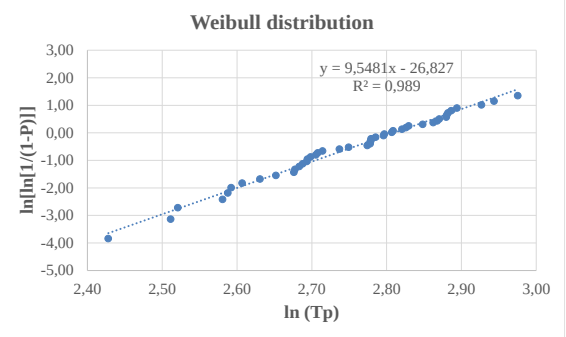






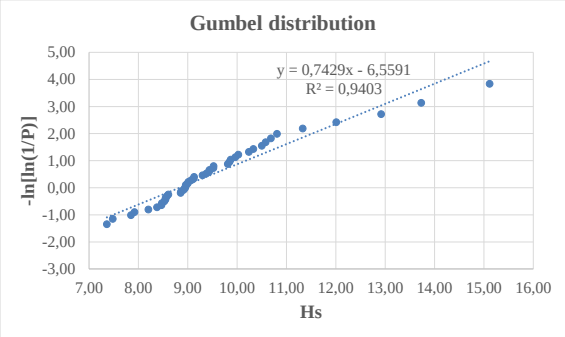


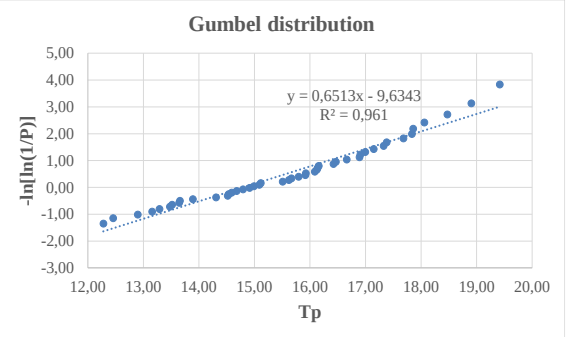


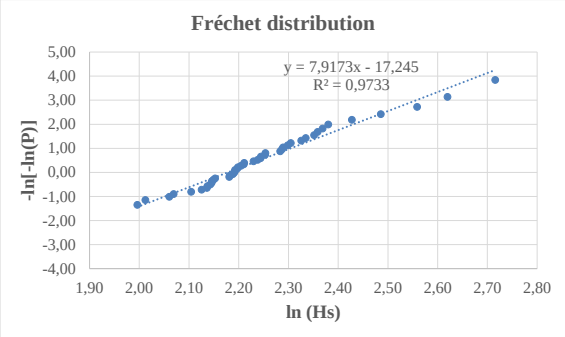


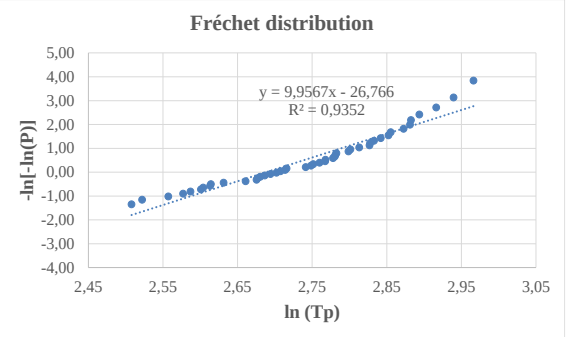
Historical data: 1960–2005

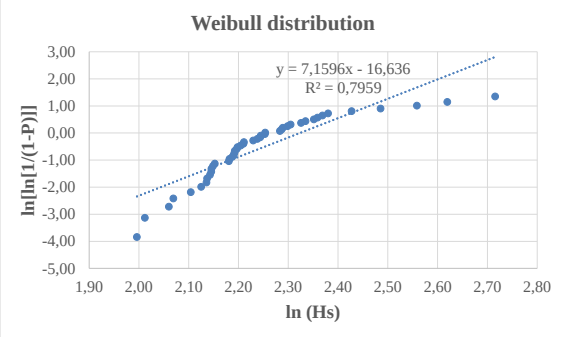
Station W6

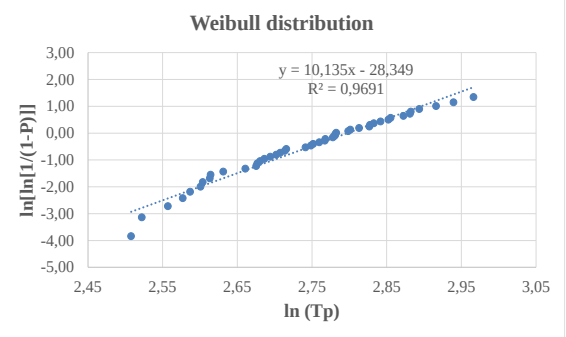






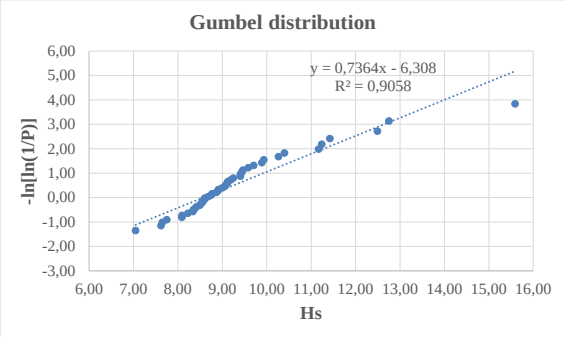


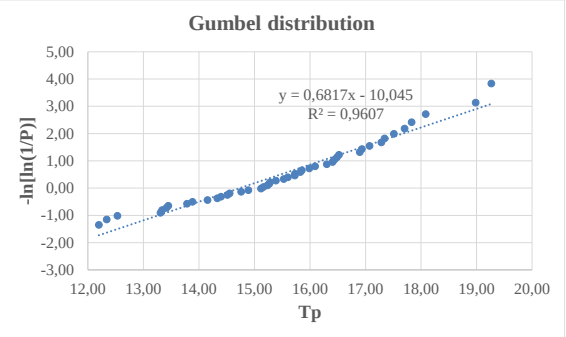


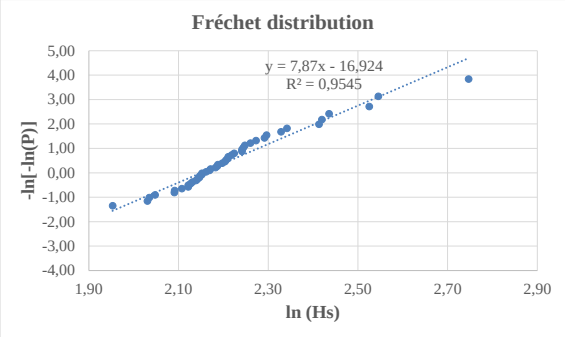


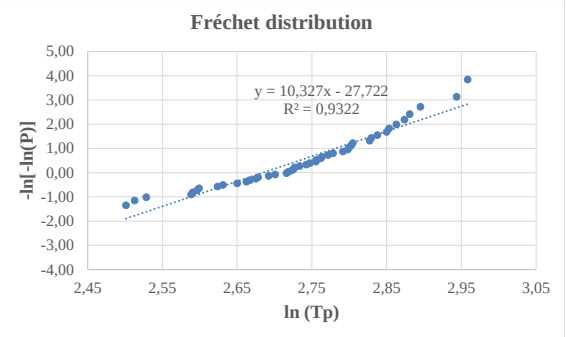
Historical data: 1960–2005

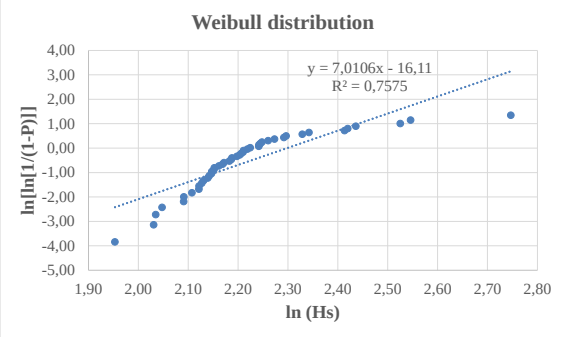
Station W7

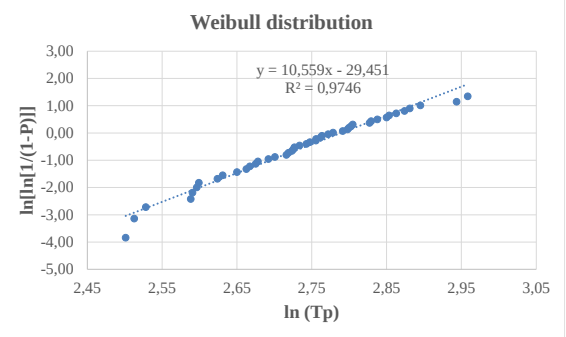






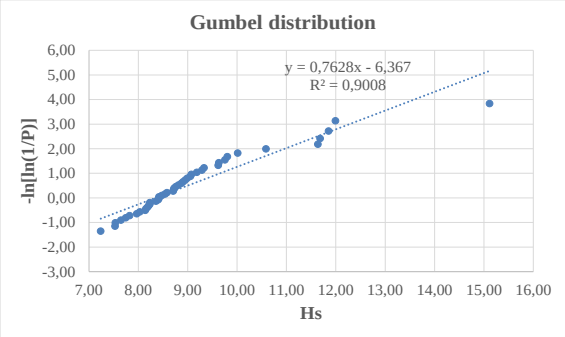


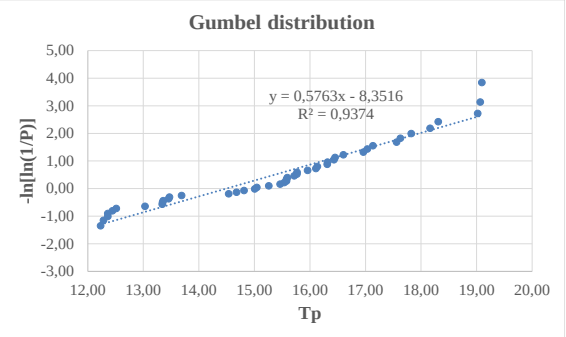


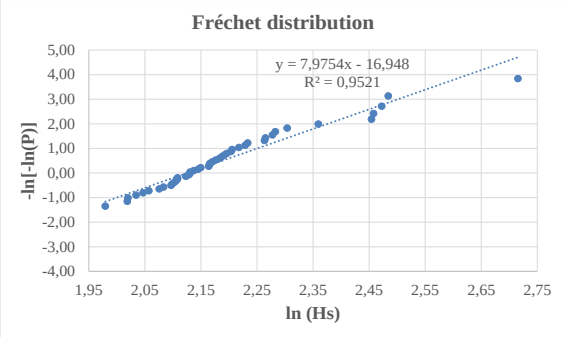


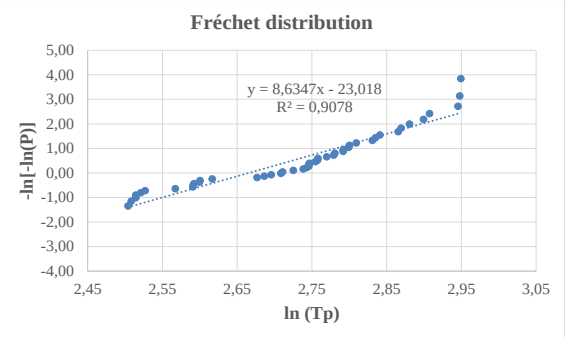
Historical data: 1960–2005

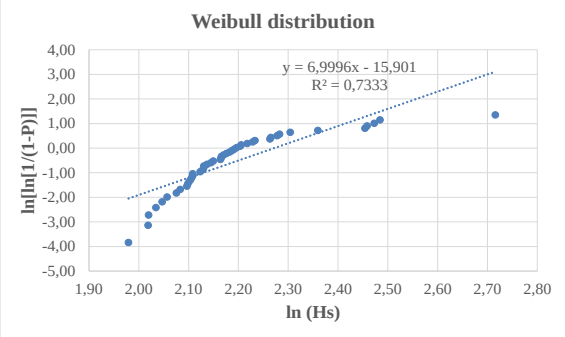
Station W8

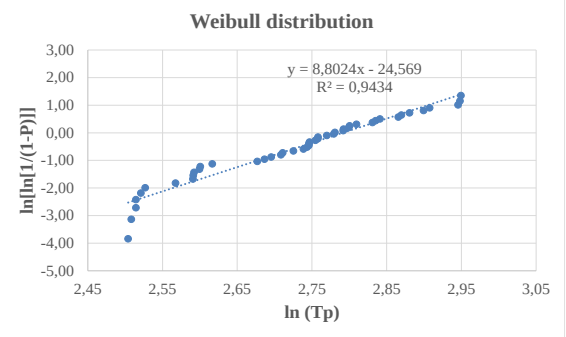






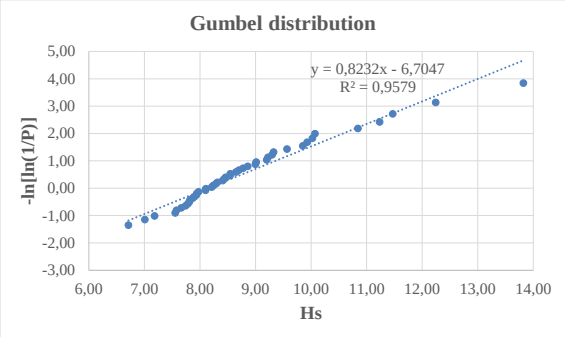


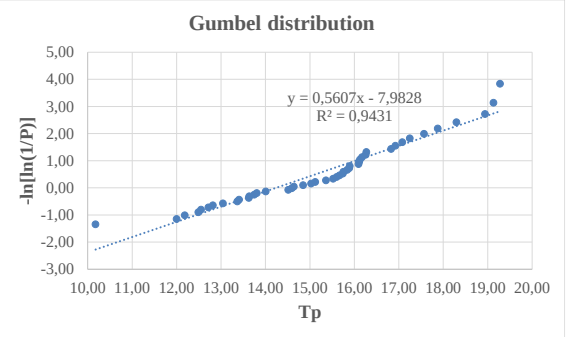


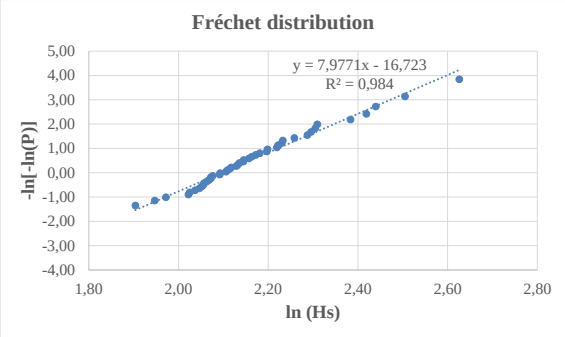


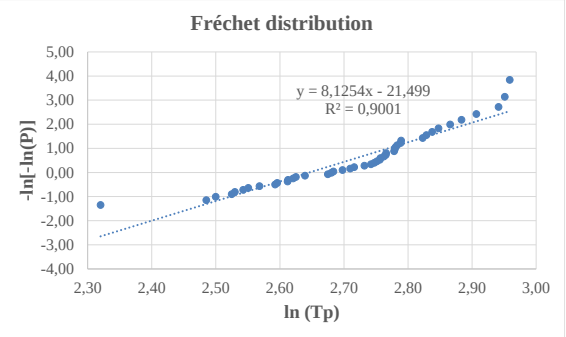
Historical data: 1960–2005

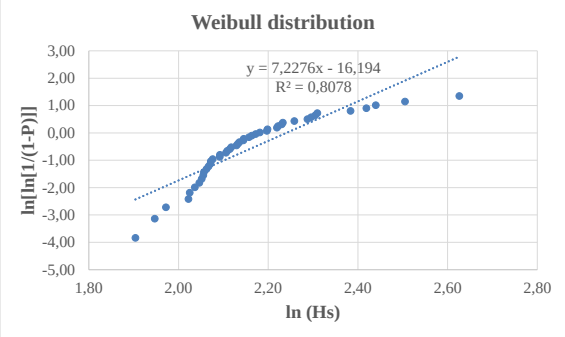
Station W9

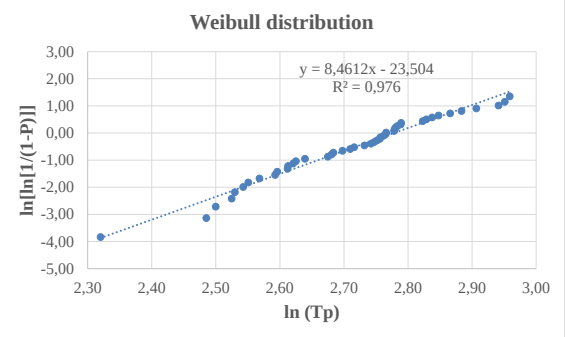






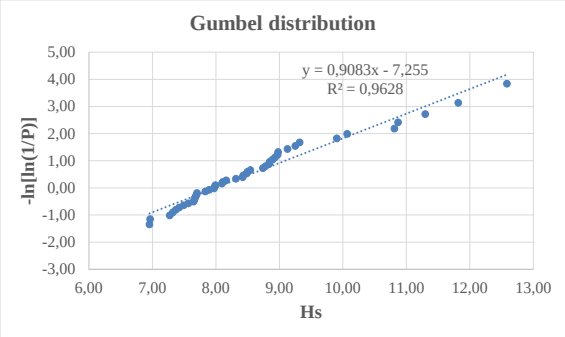


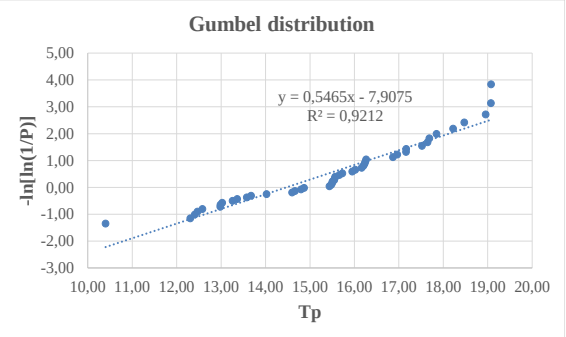


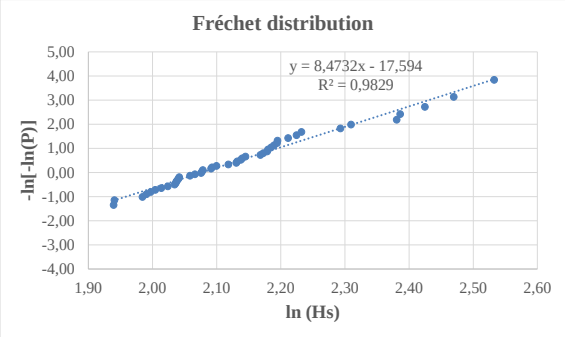


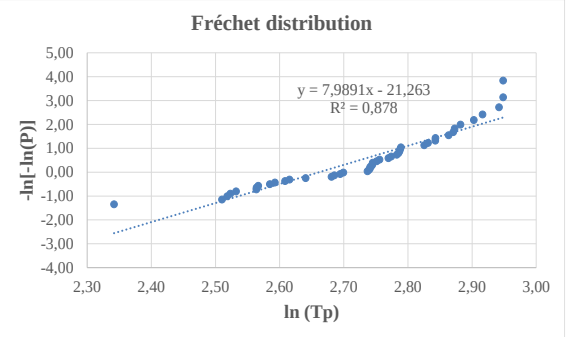
Historical data: 1960–2005

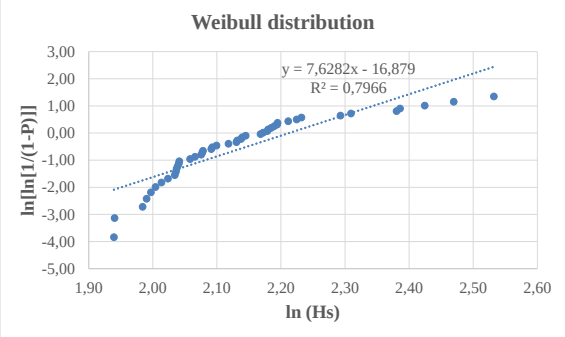
Station S1

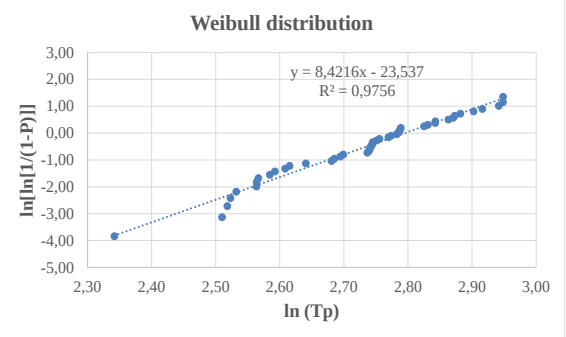






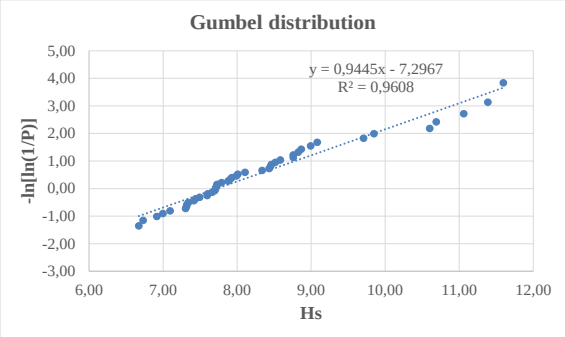


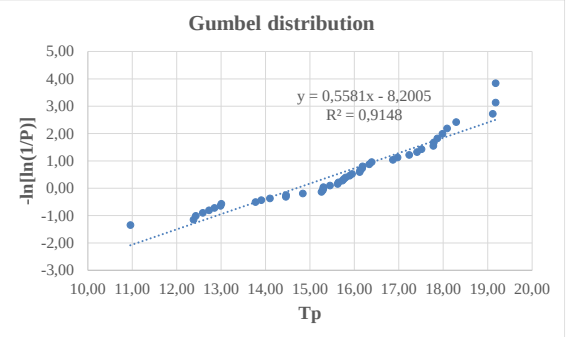


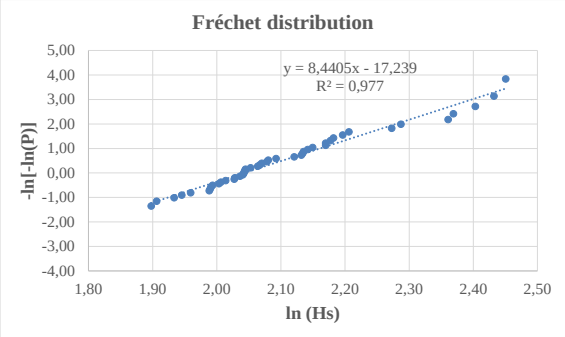


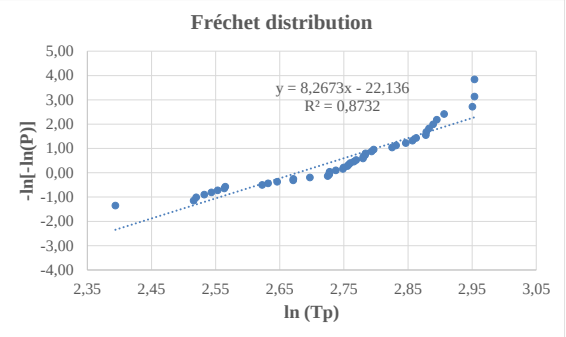
Historical data: 1960–2005

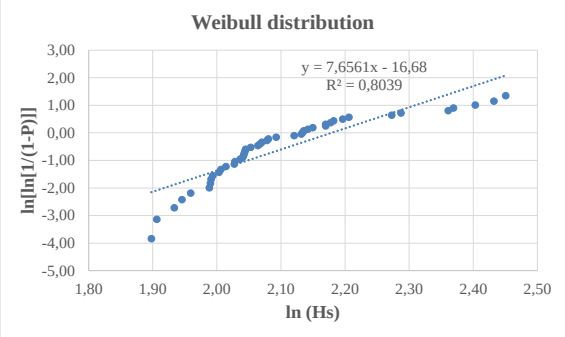
Station S2

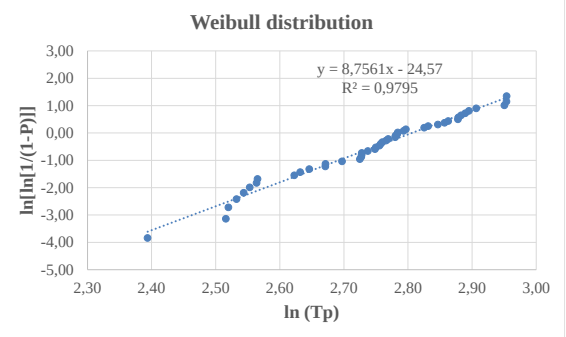






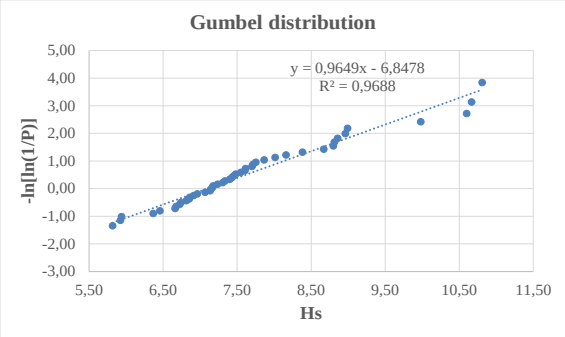


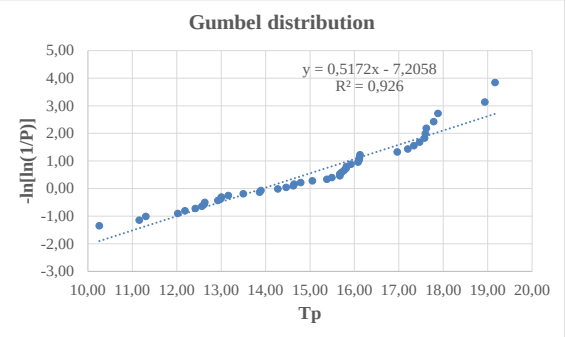


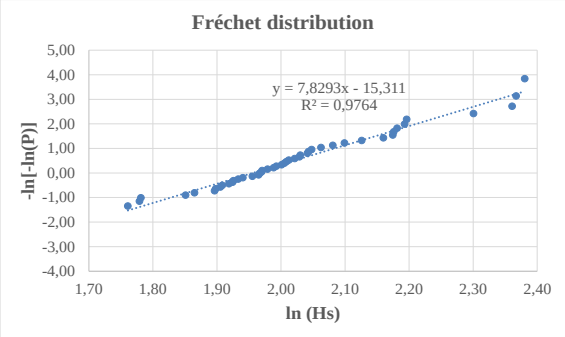


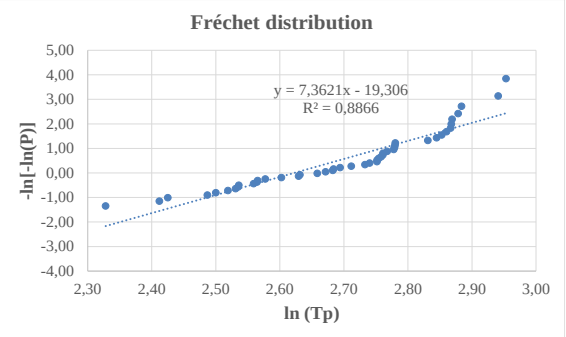
Historical data: 1960–2005

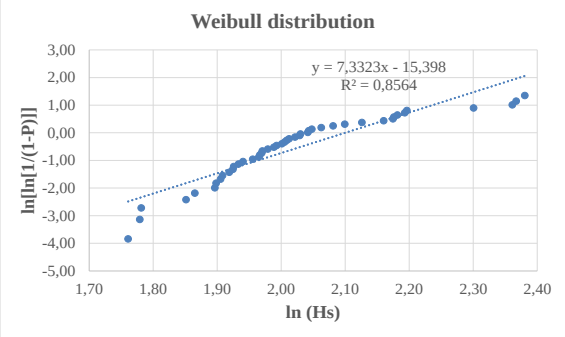
Station S3

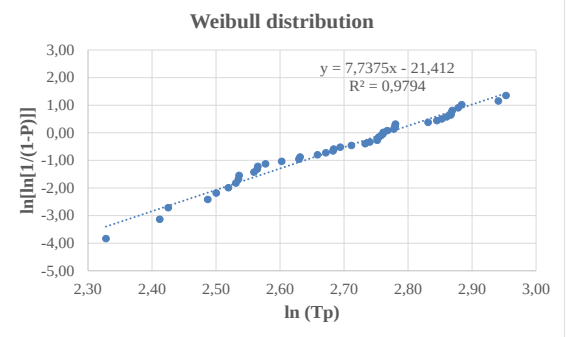






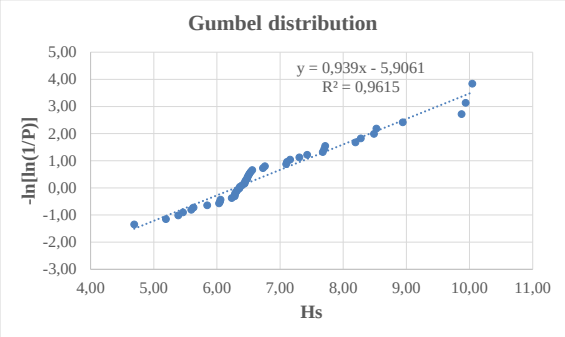


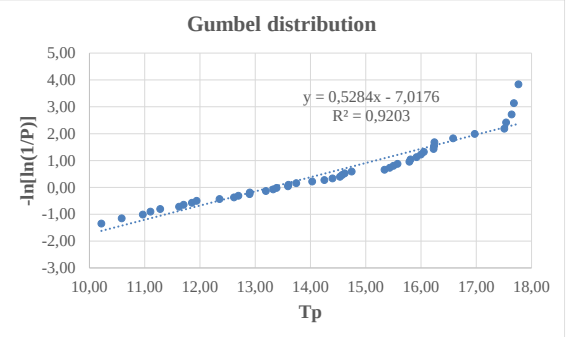


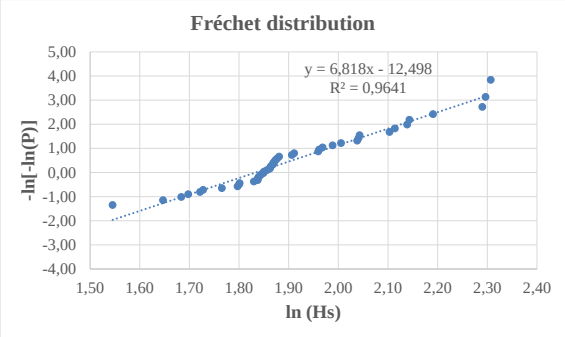


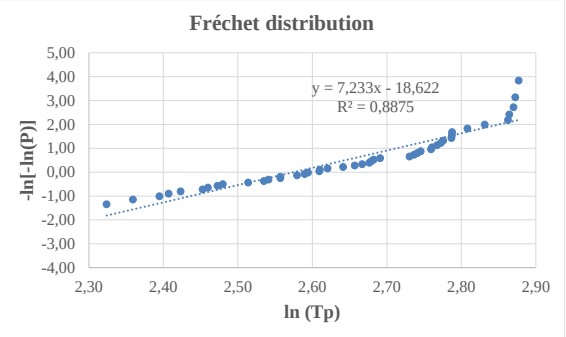
Historical data: 1960–2005

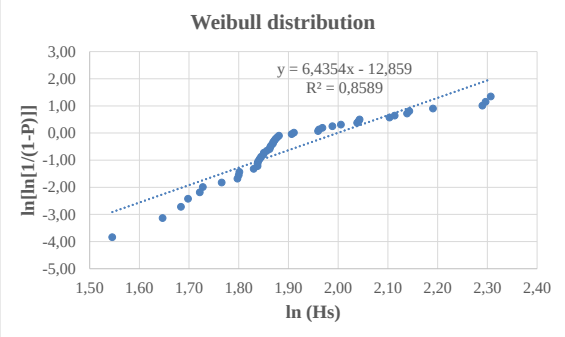
Station S4

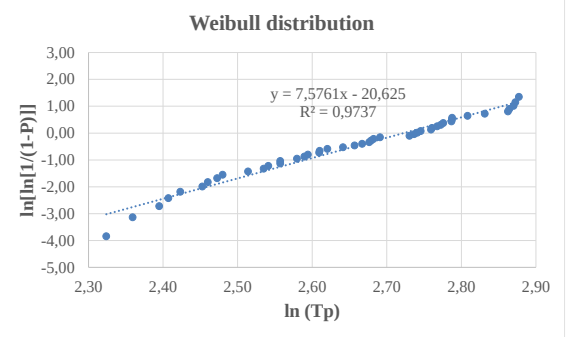






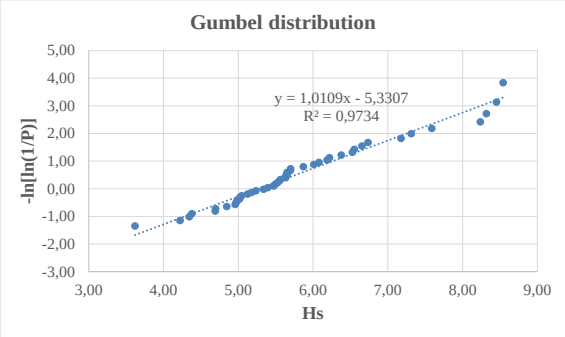


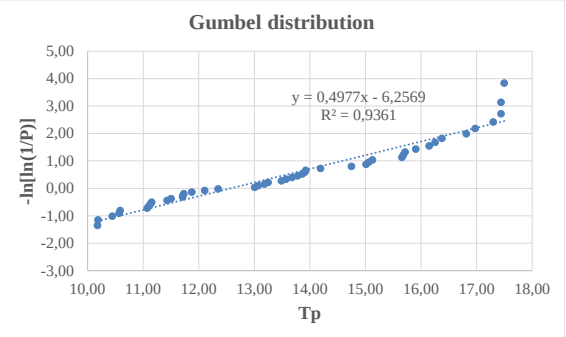


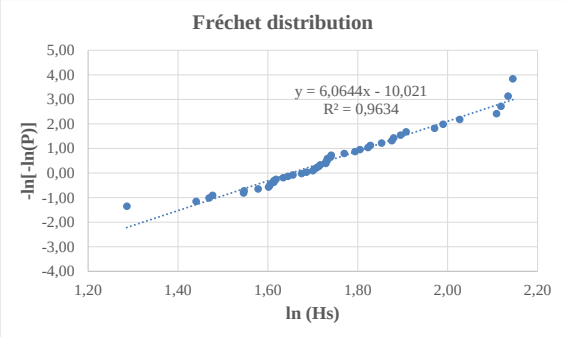


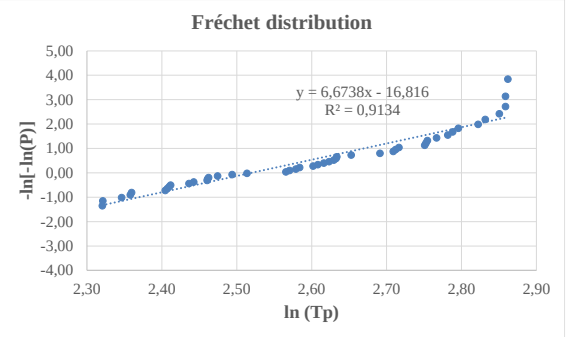
Historical data: 1960–2005

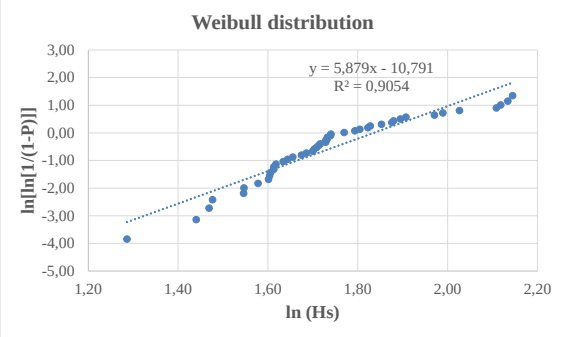
Station S5

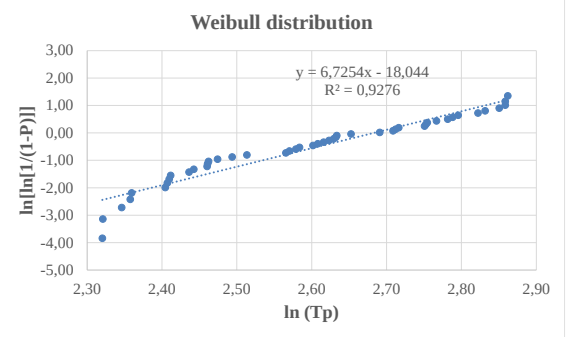






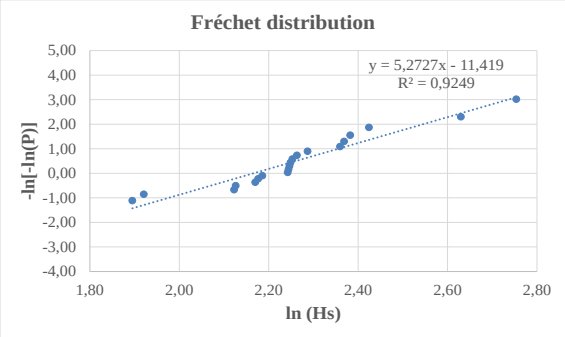


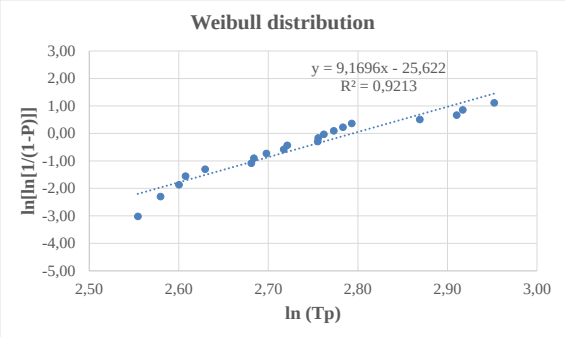




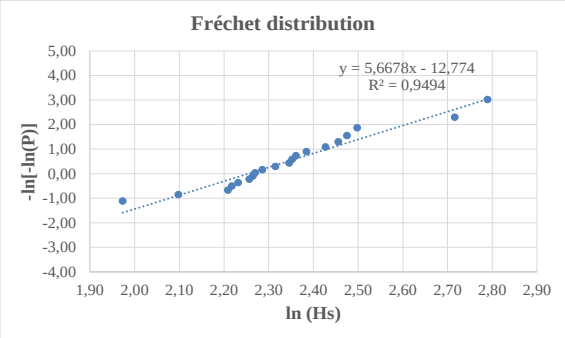
RCP4.5: 2026–2045

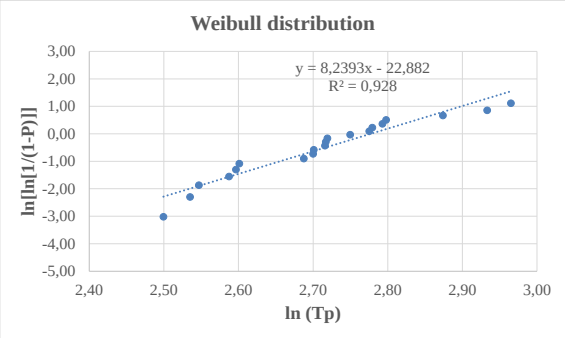
Station N1



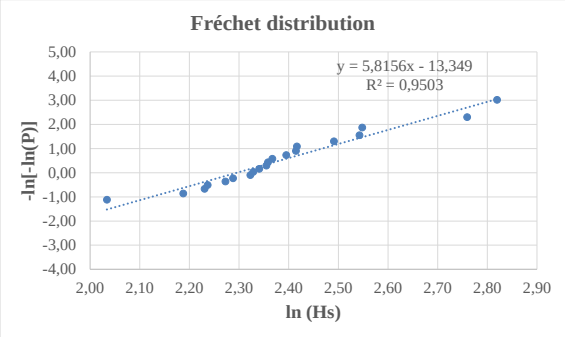


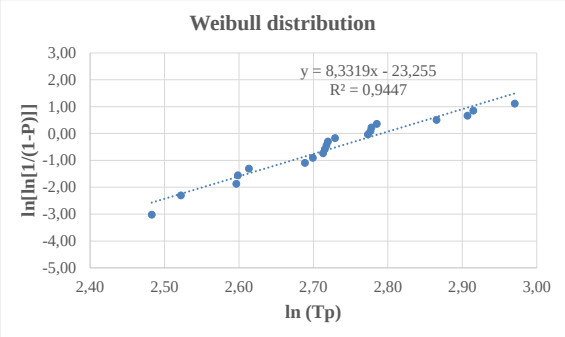
Station N2





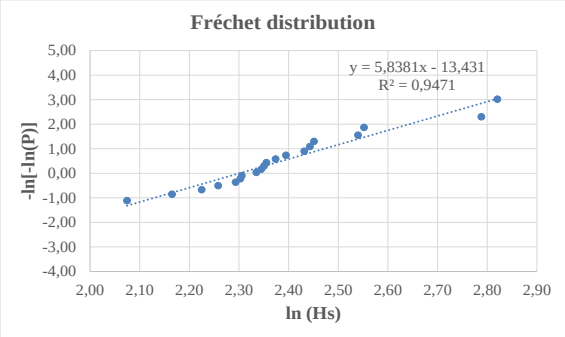
Station N3

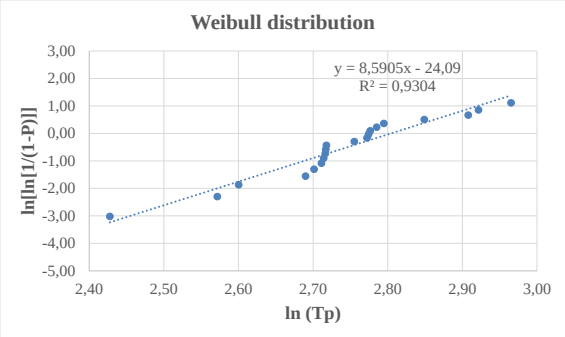




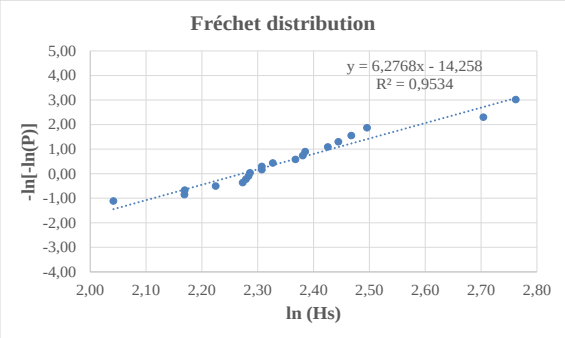
RCP4.5: 2026–2045

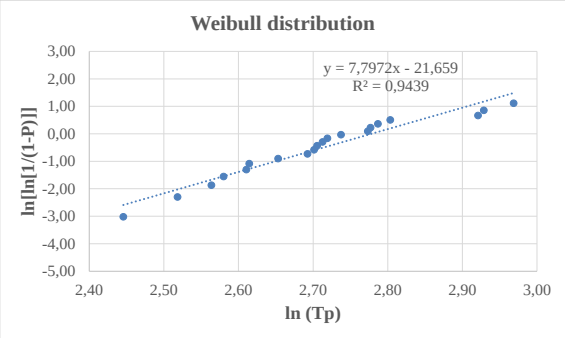
Station W1



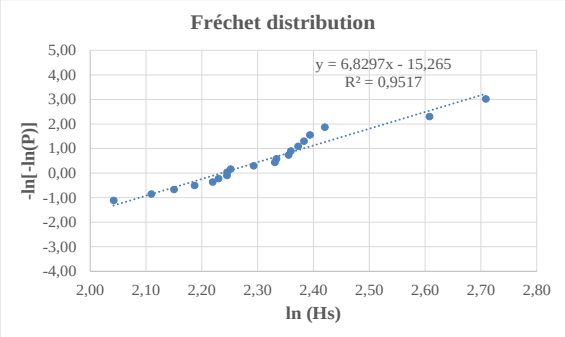


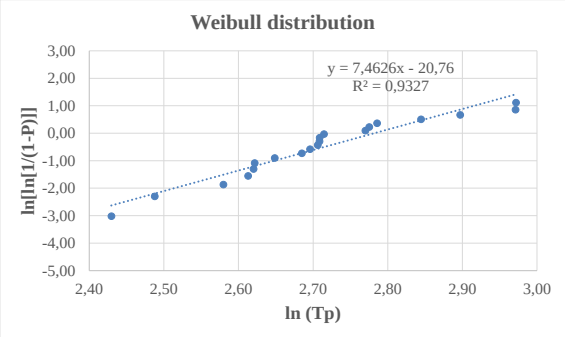
Station W2





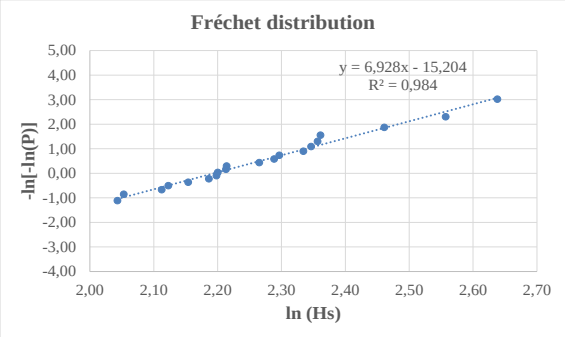
Station W3

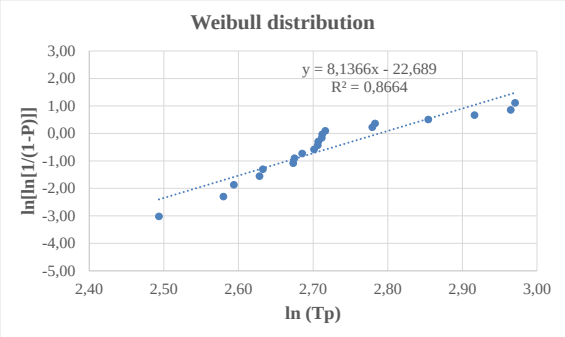




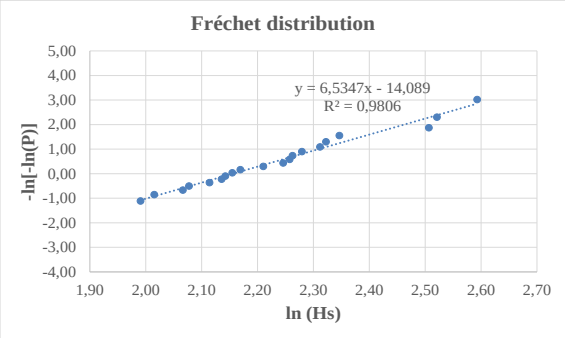
RCP4.5: 2026–2045

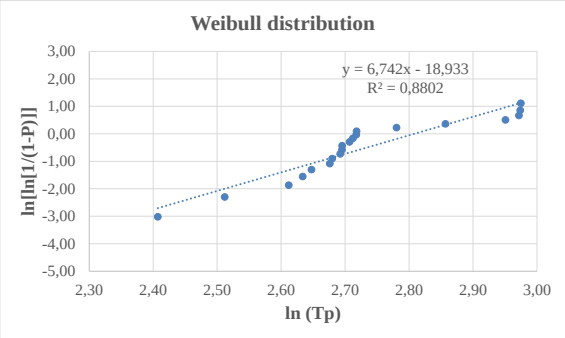
Station W4



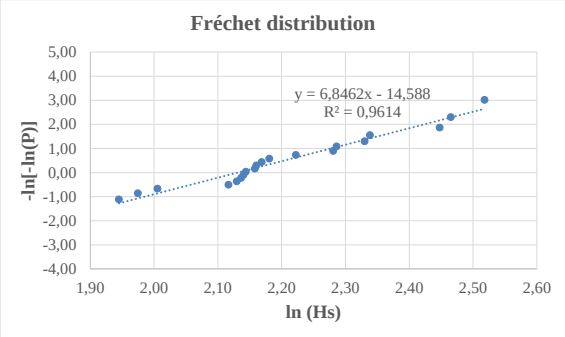


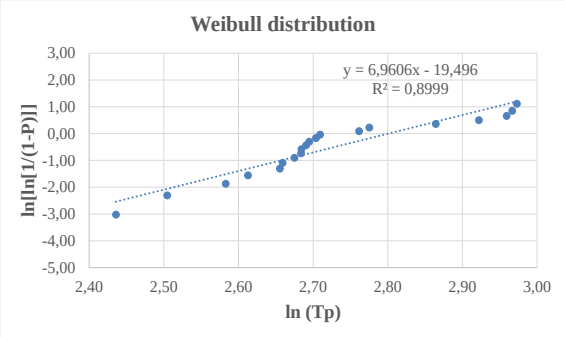
Station W5





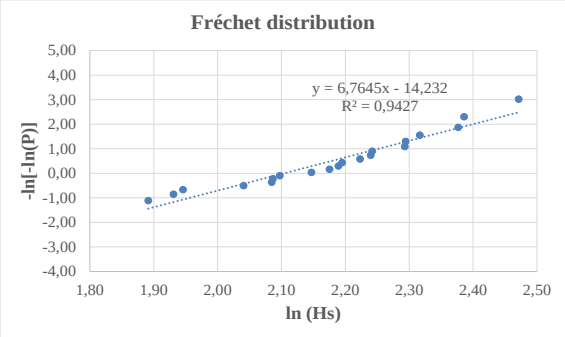
Station W6

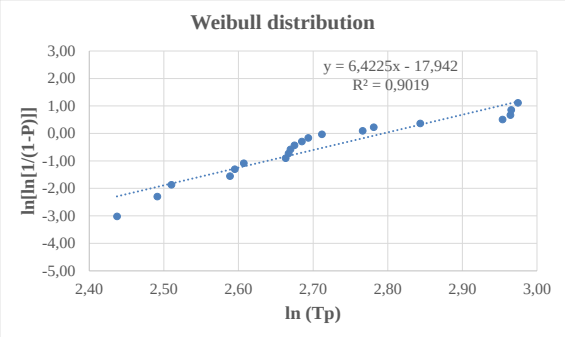




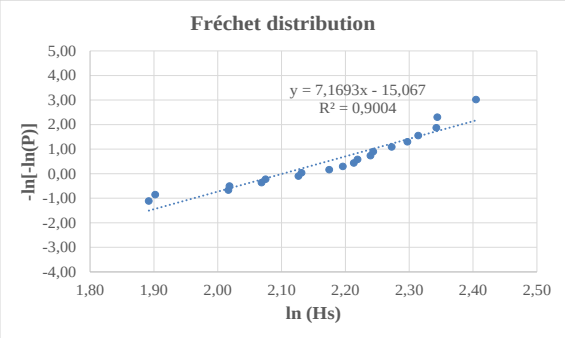
RCP4.5: 2026–2045

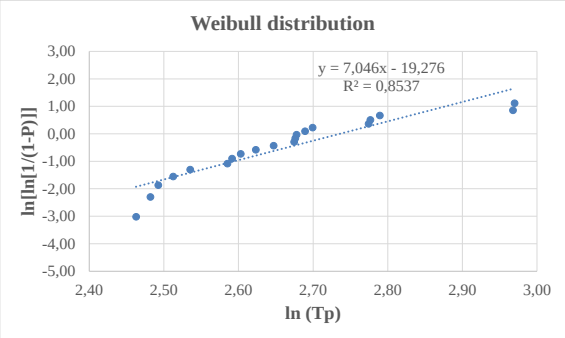
Station W7



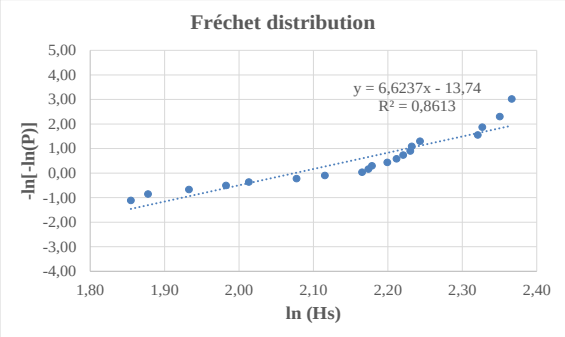


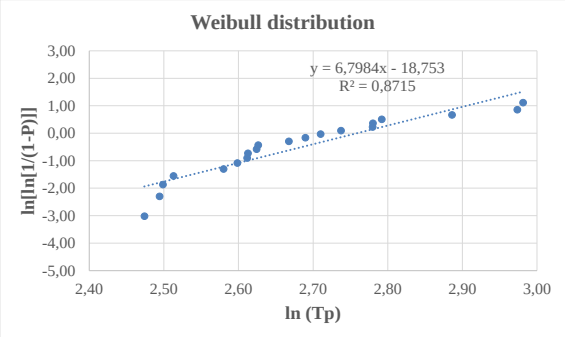
Station W8





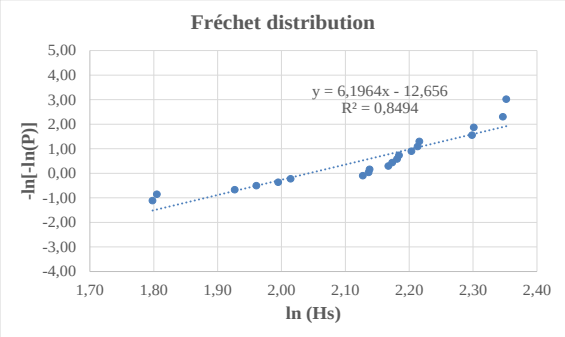
Station W9

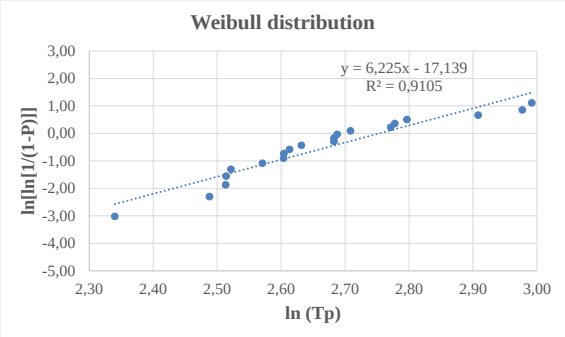




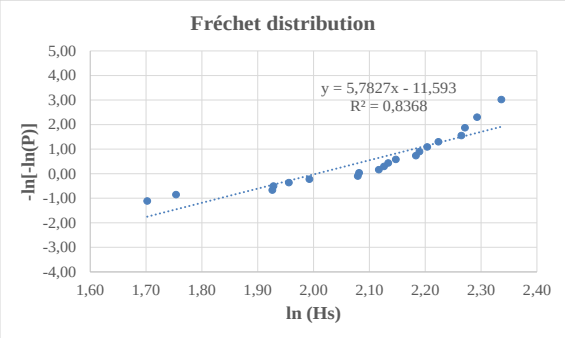
RCP4.5: 2026–2045

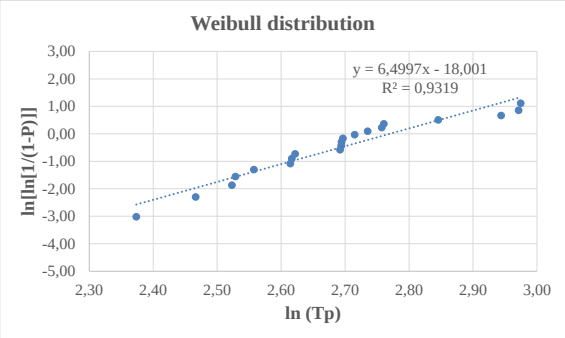
Station S1



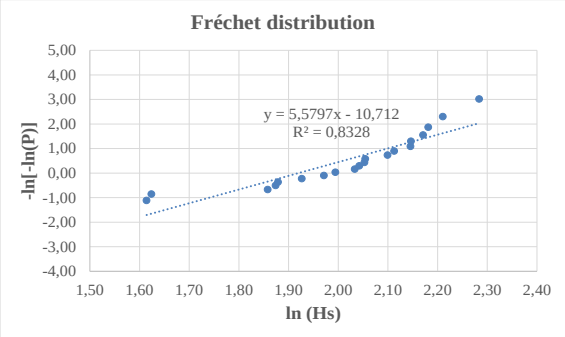


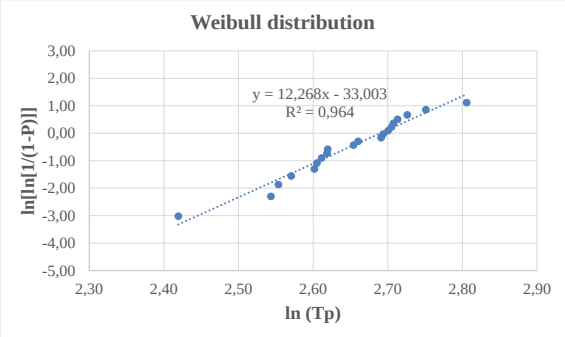
Station S2





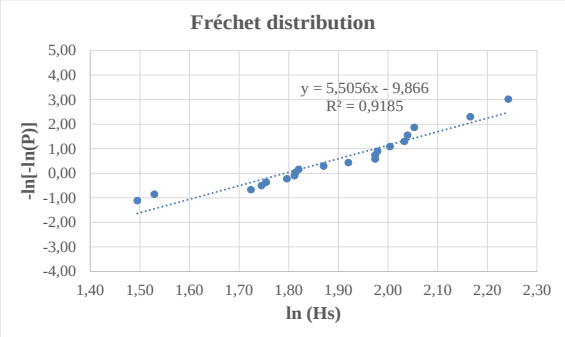
Station S3

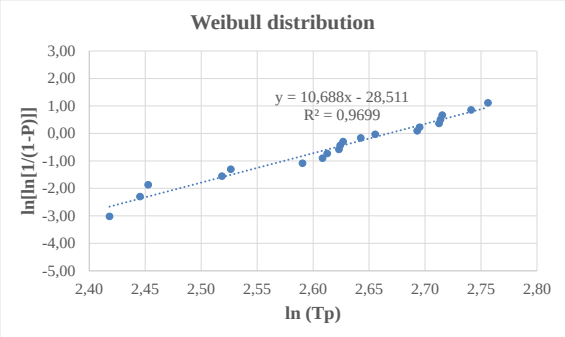




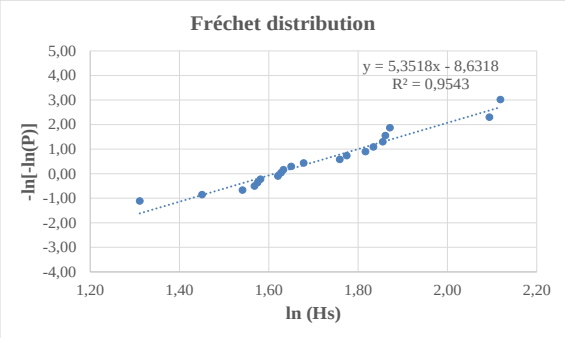
RCP4.5: 2026–2045

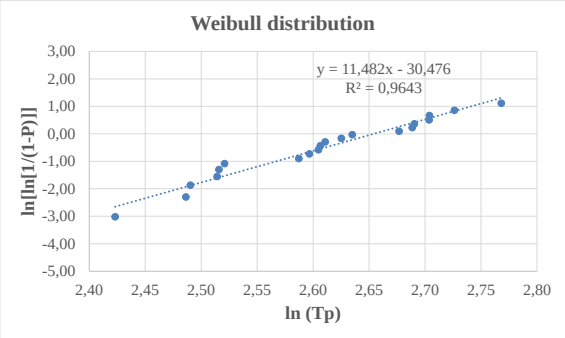
Station S4





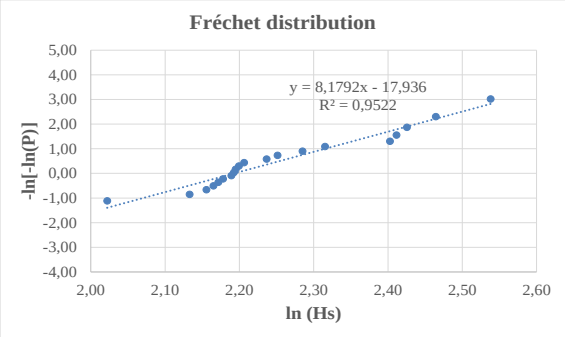
Station S5

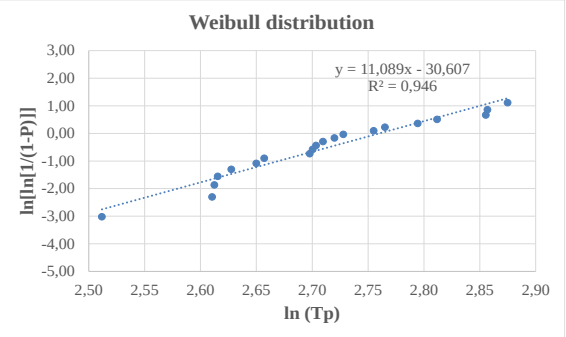




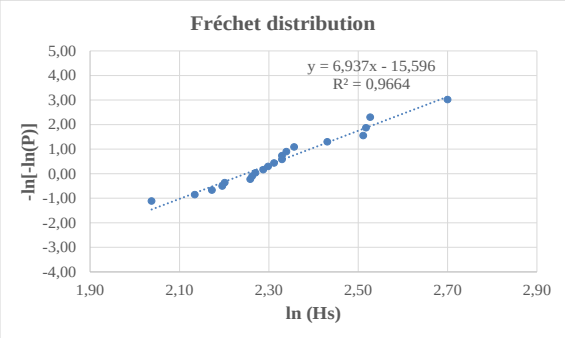
RCP4.5: 2081–2100

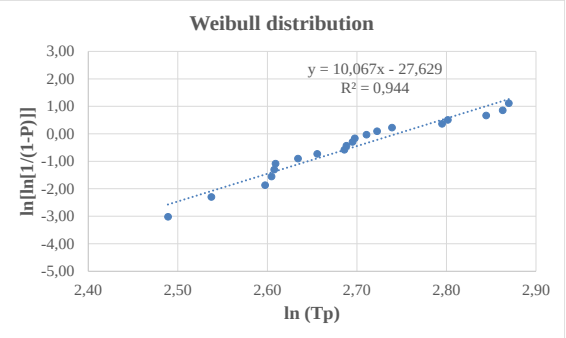
Station N1



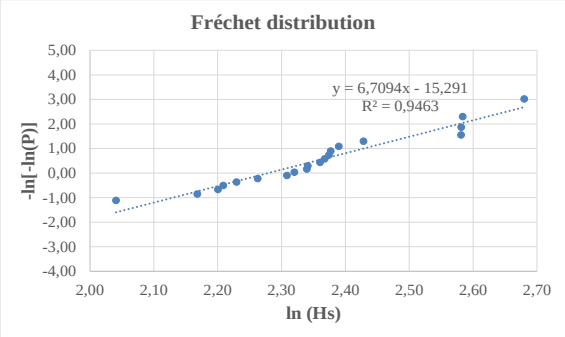


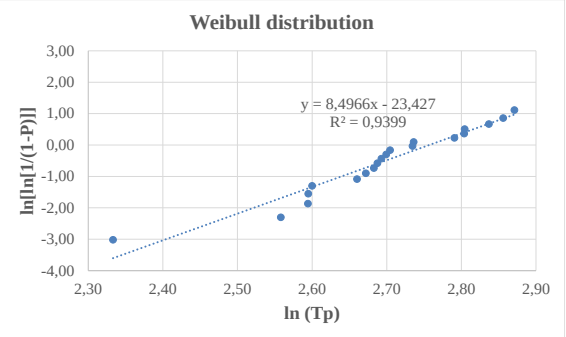
Station N2





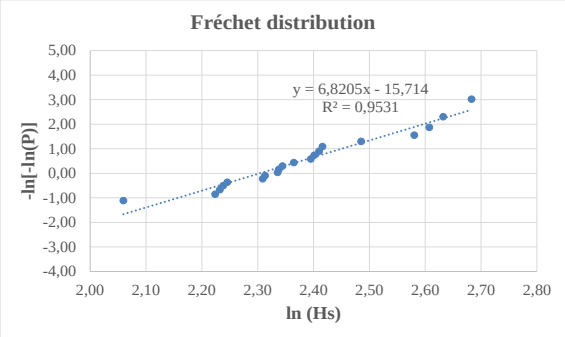
Station N3

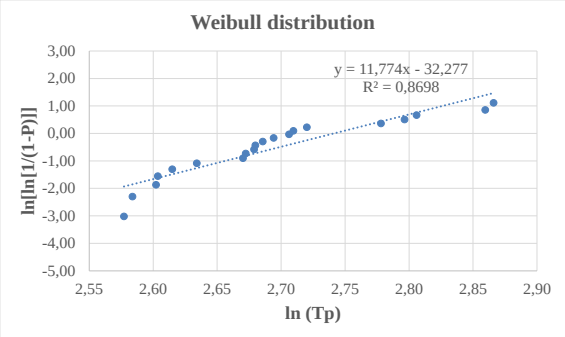




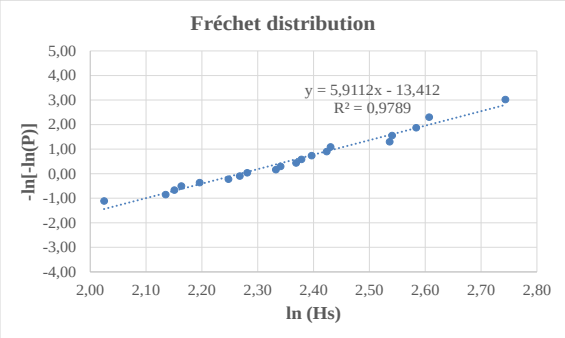
RCP4.5: 2081–2100

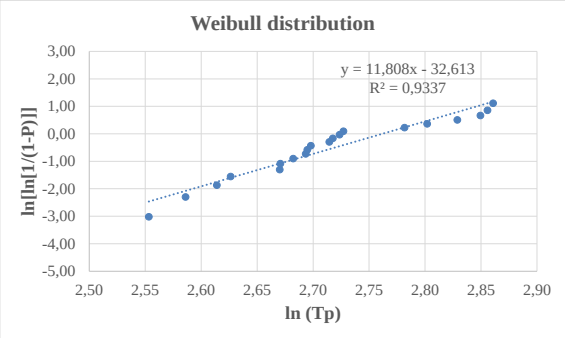
Station W1



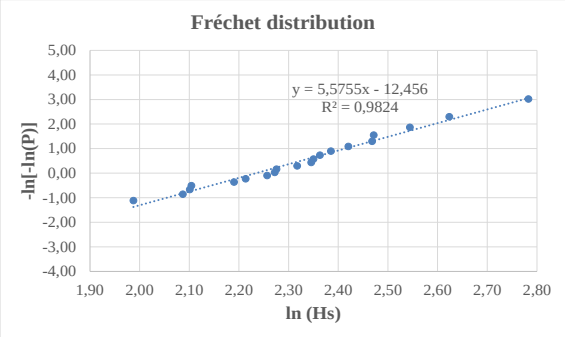


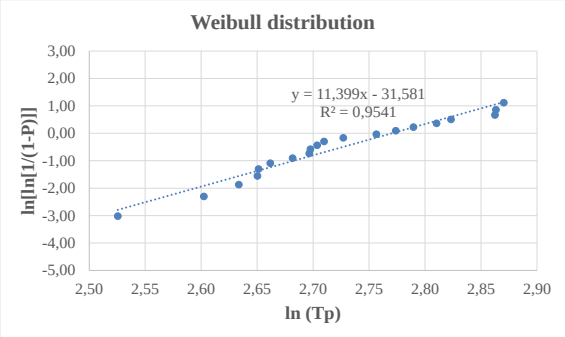
Station W2





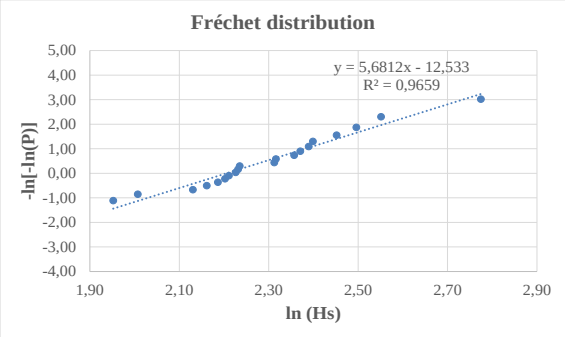
Station W3

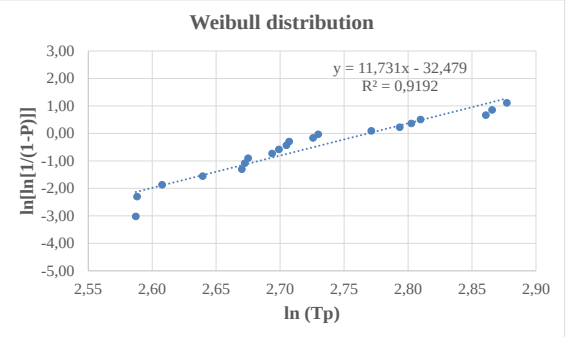




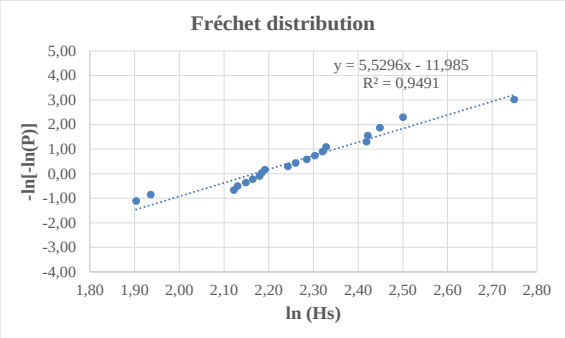
RCP4.5: 2081–2100

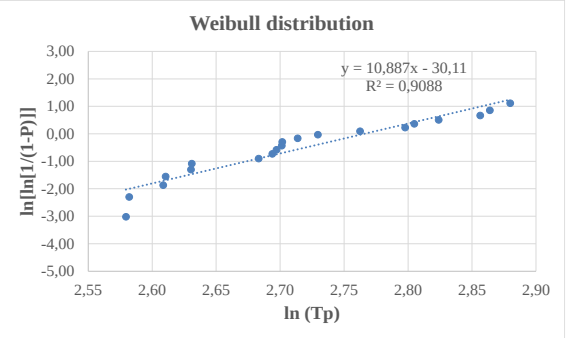
Station W4



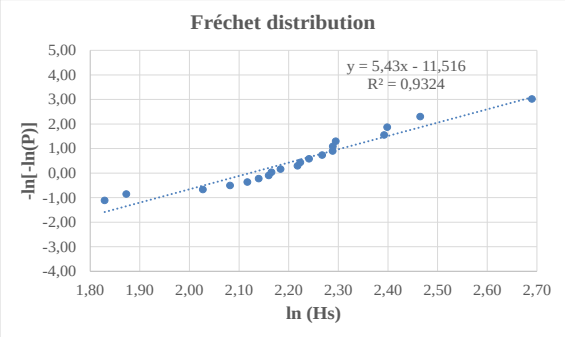


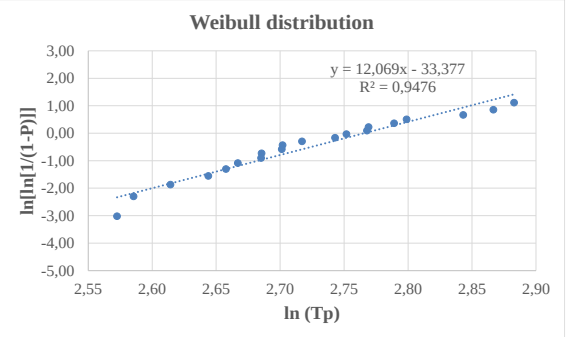
Station W5





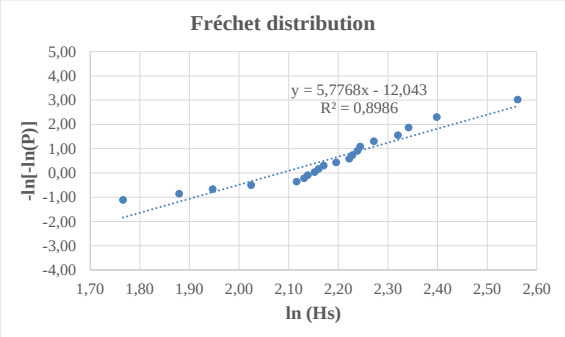
Station W6

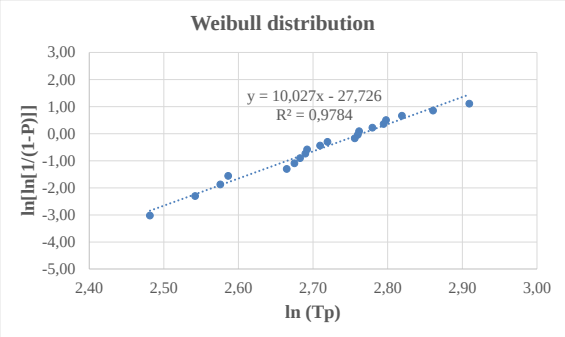




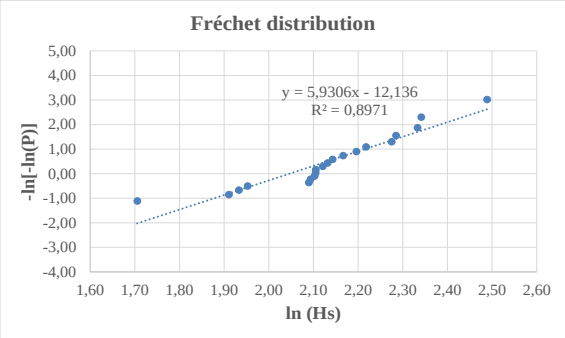
RCP4.5: 2081–2100

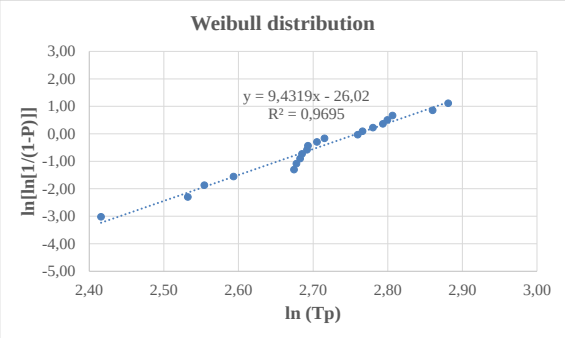
Station W7



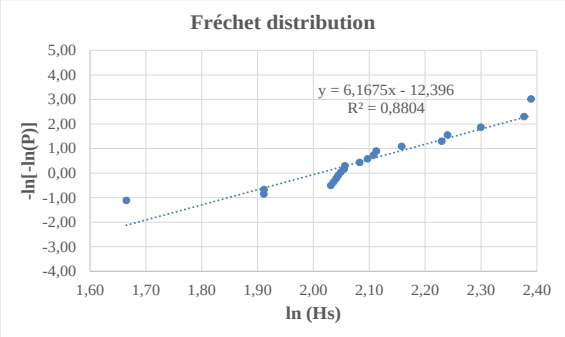


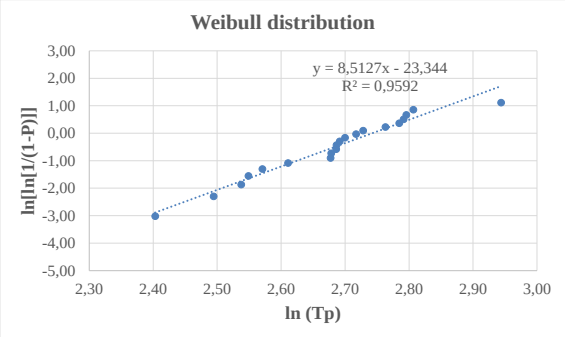
Station W8





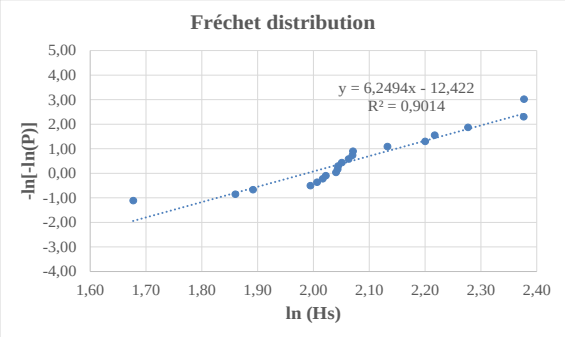
Station W9

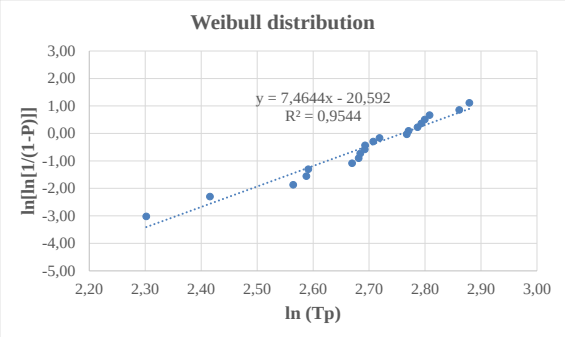




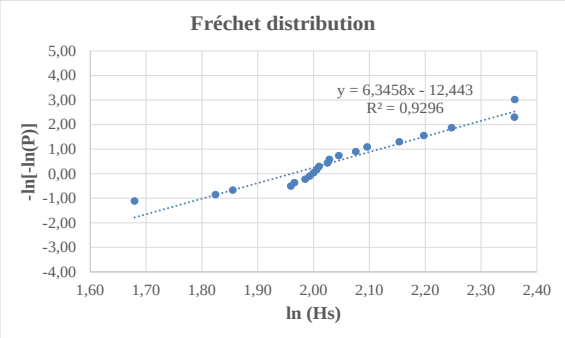
RCP4.5: 2081–2100

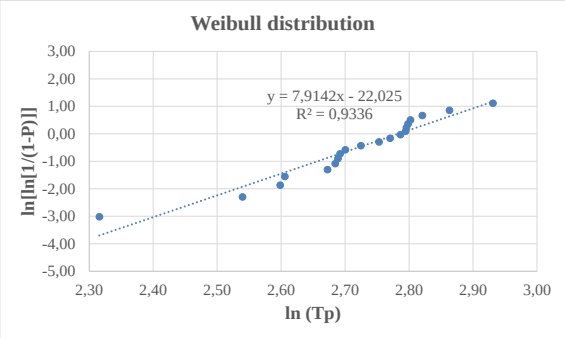
Station S1



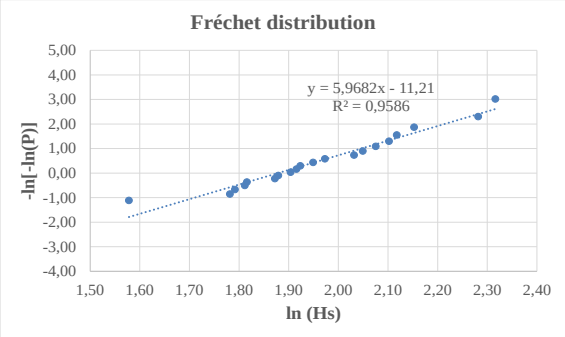


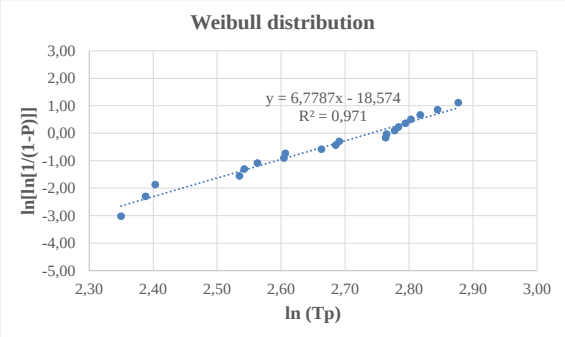
Station S2





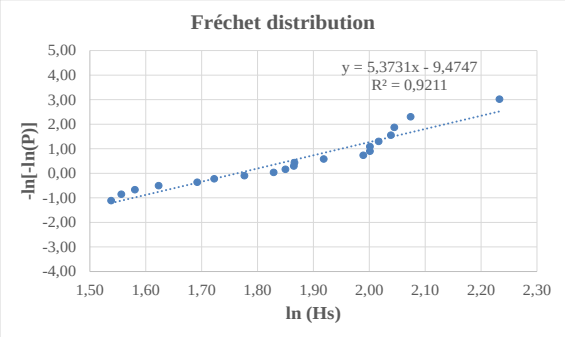
Station S3

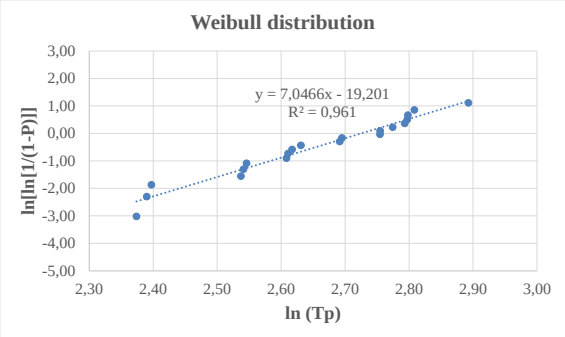




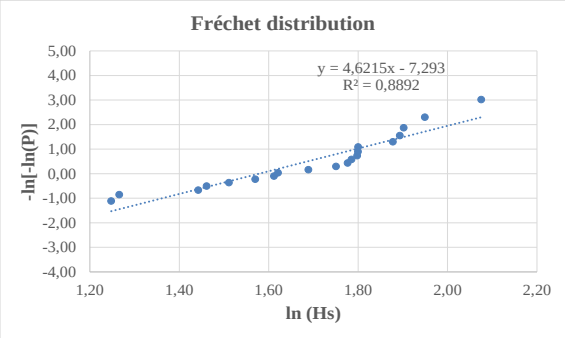
RCP4.5: 2081–2100

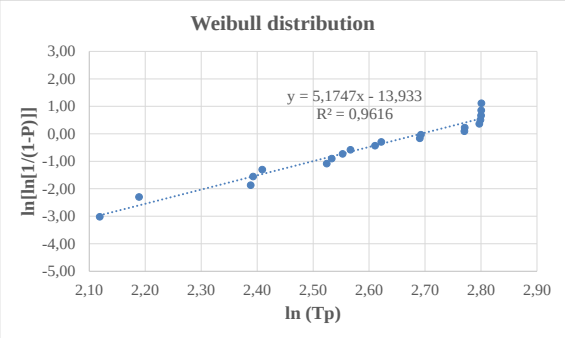
Station S4





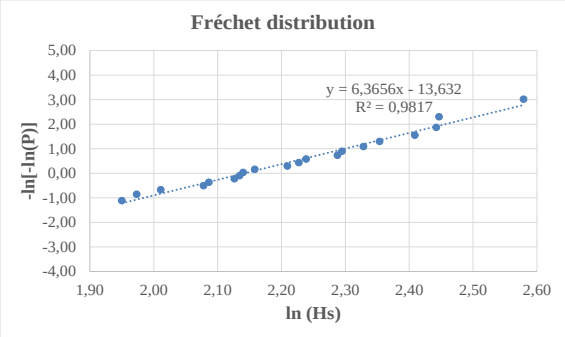
Station S5

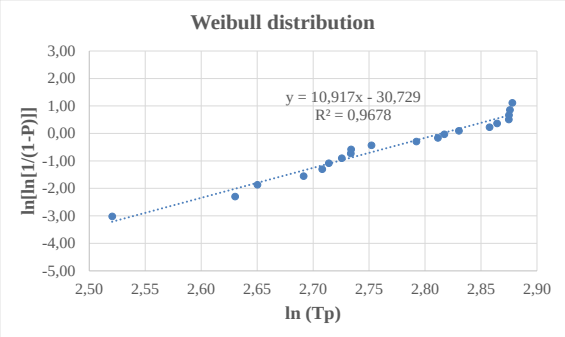




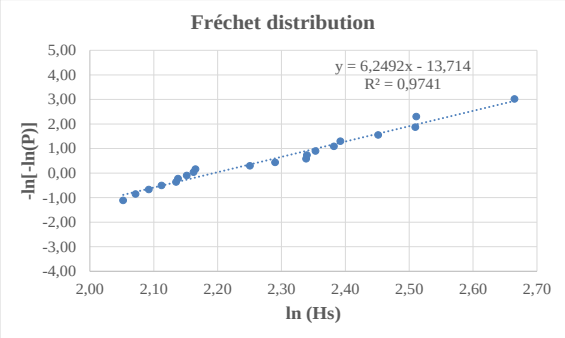
RCP8.5: 2026–2045

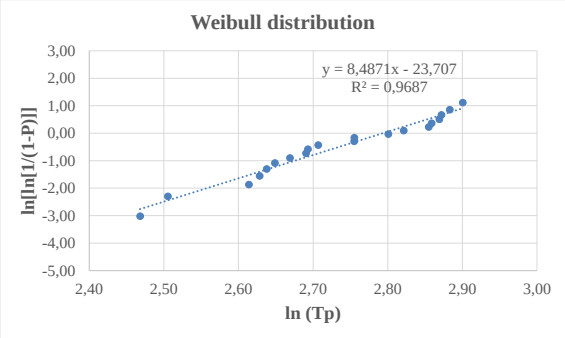
Station N1



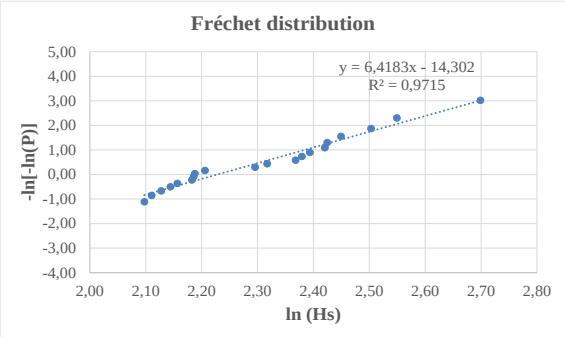


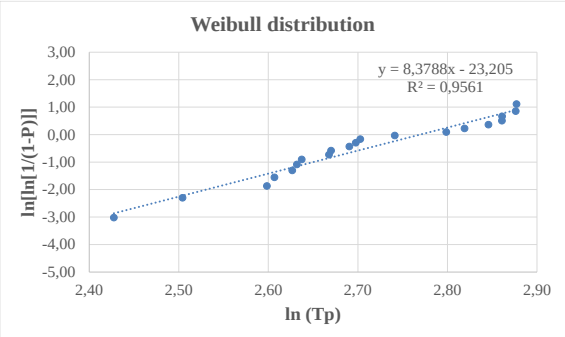
Station N2





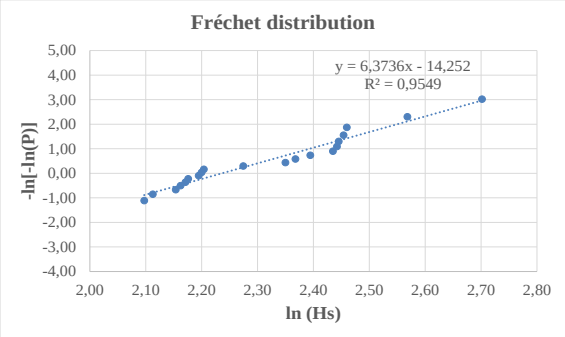
Station N3

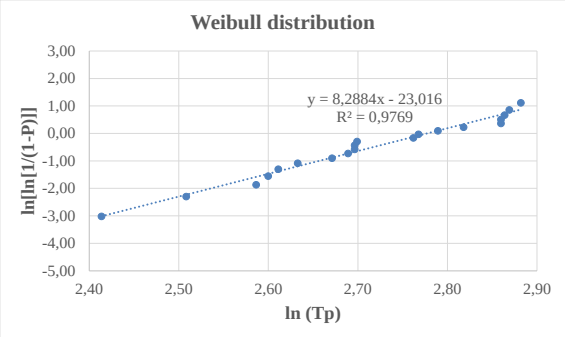




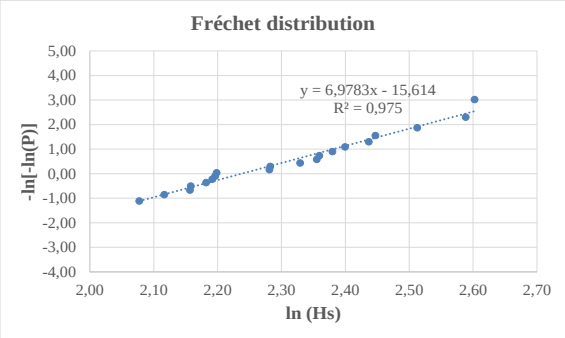
RCP8.5: 2026–2045

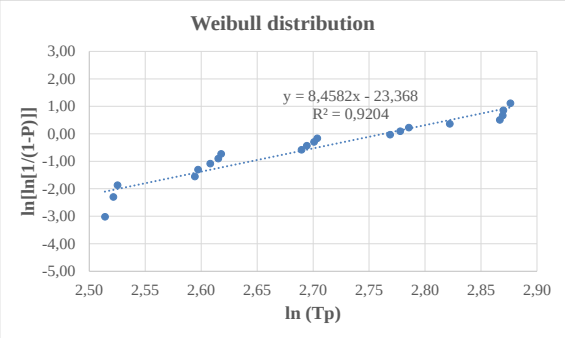
Station W1



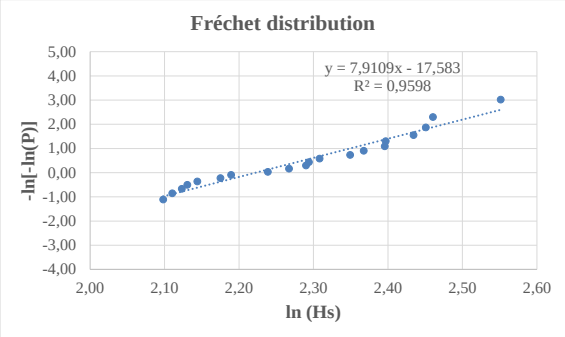


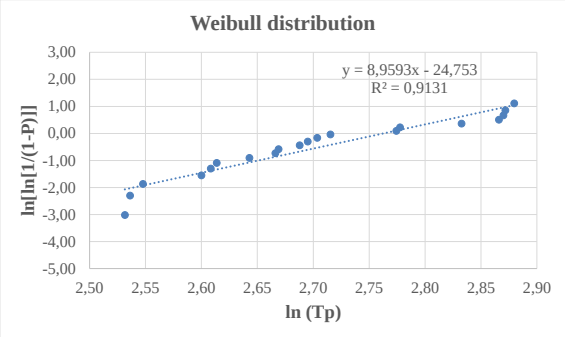
Station W2





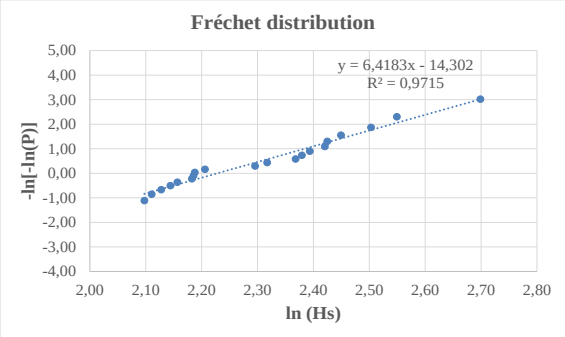
Station W3

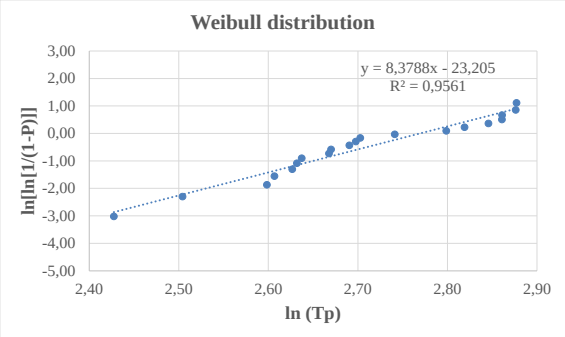




RCP8.5: 2026–2045

Station W4





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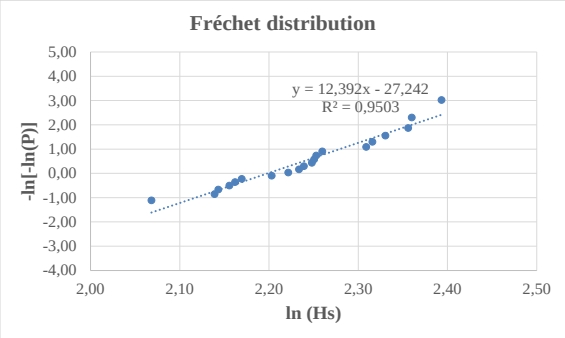

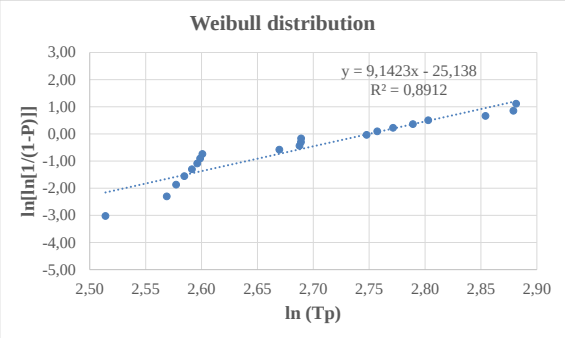

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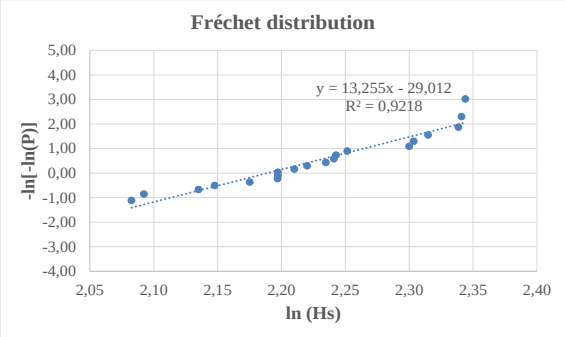

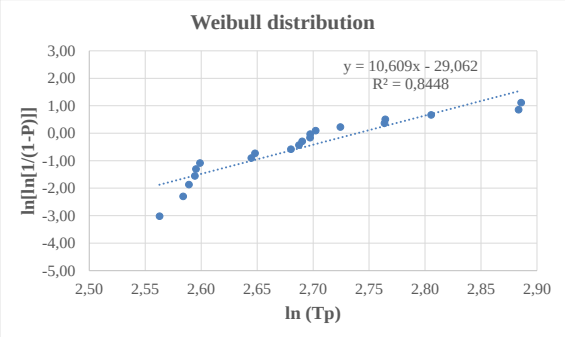

RCP8.5: 2026–2045

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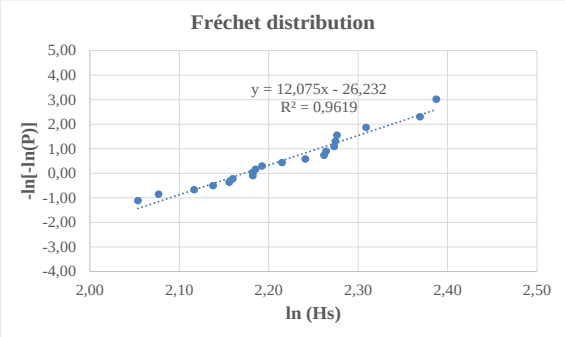

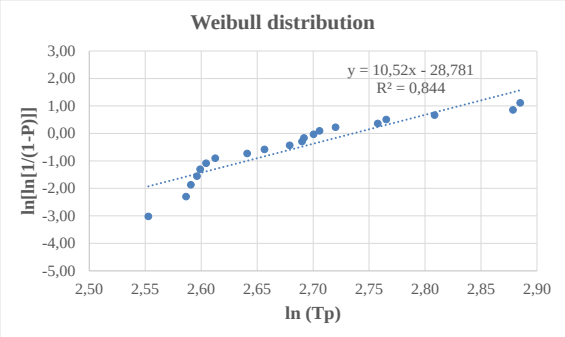

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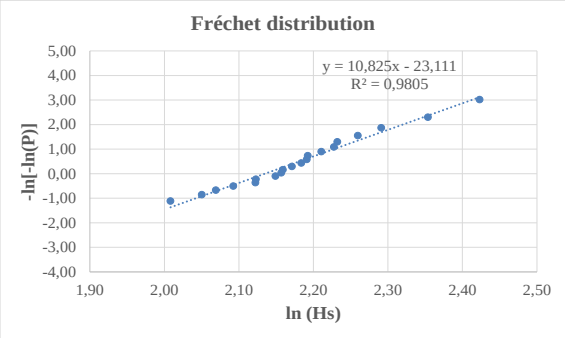

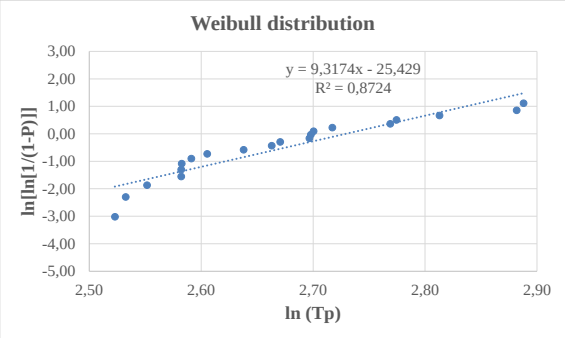

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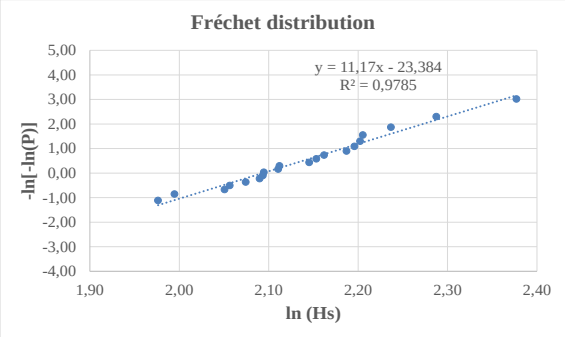

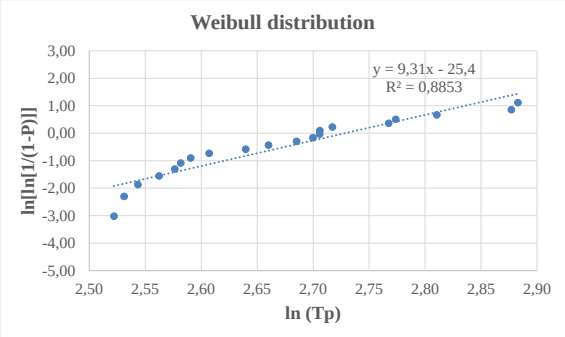

RCP8.5: 2026–2045

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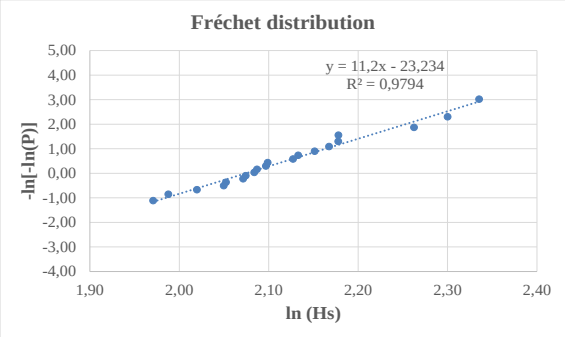

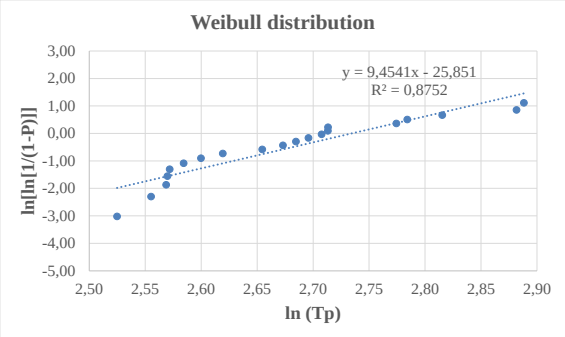

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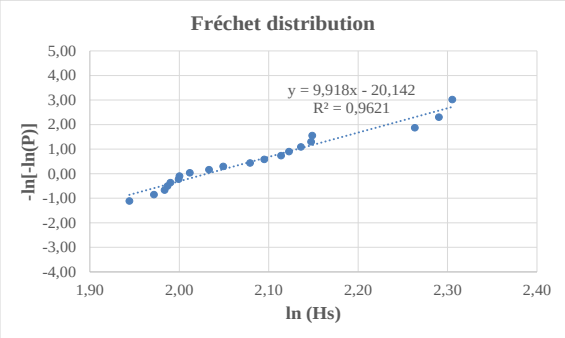

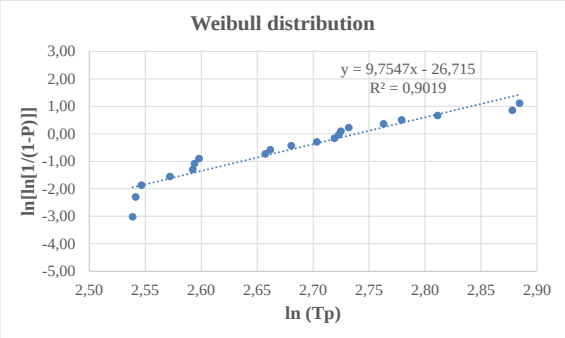

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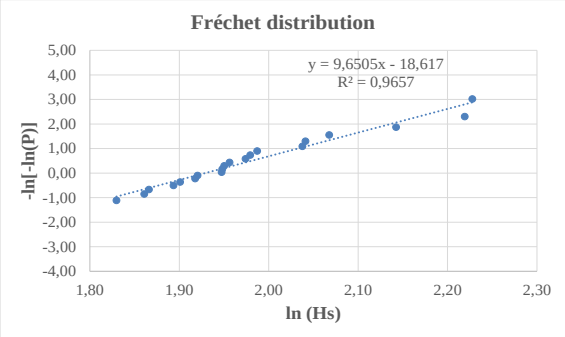

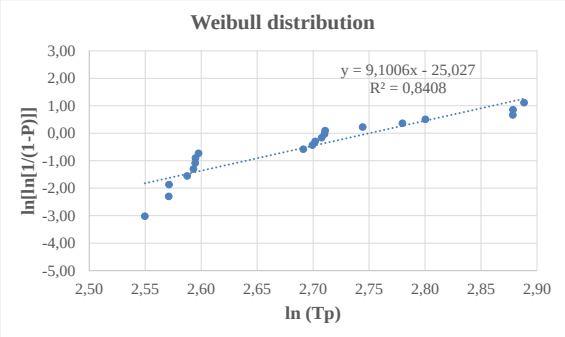

RCP8.5: 2026–2045

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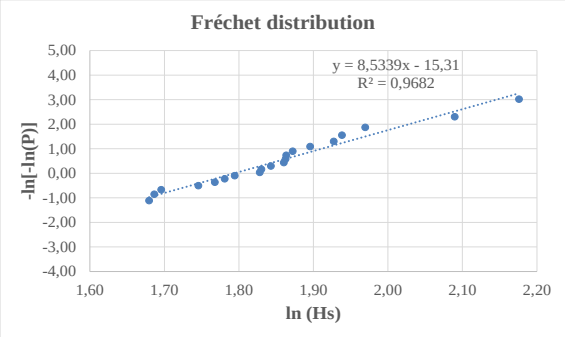

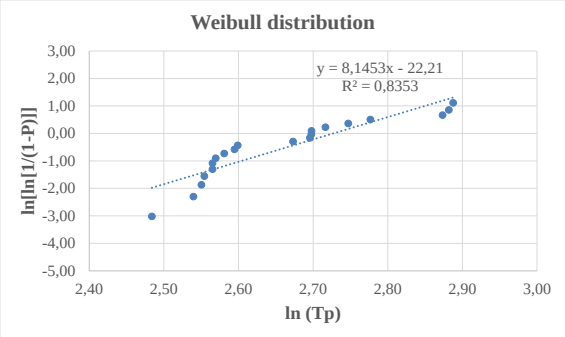

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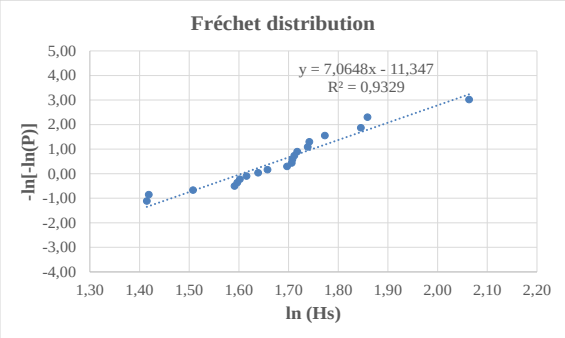

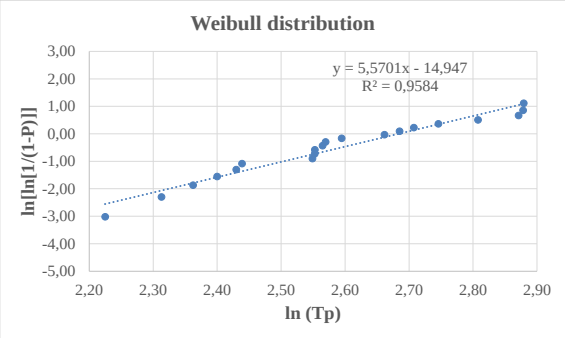

RCP8.5: 2081–2100

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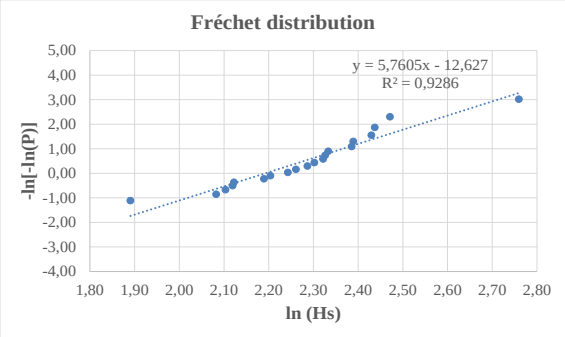

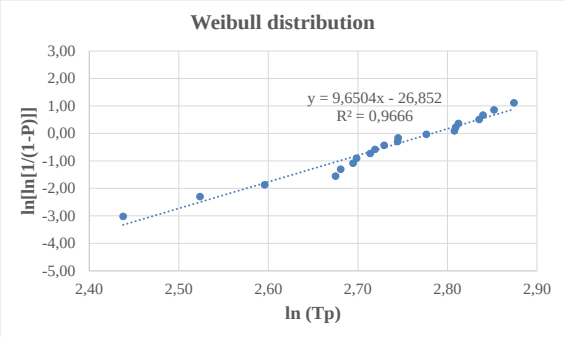

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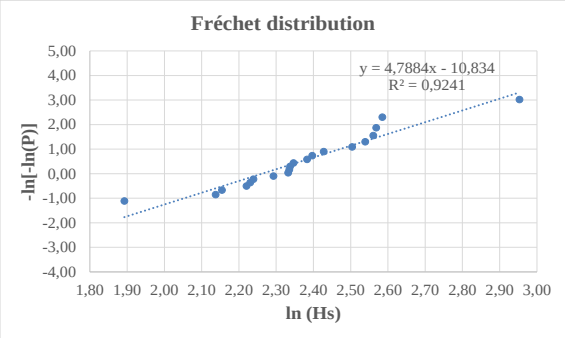

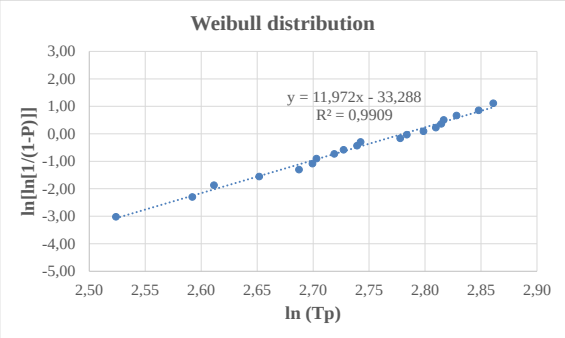

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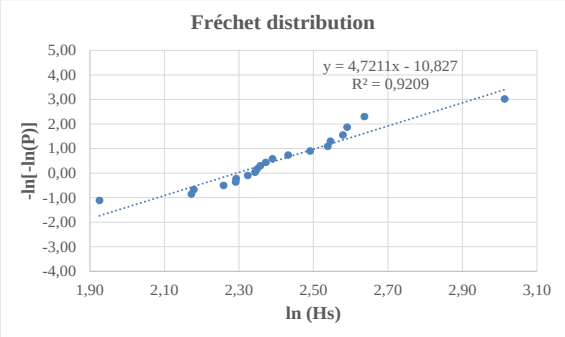

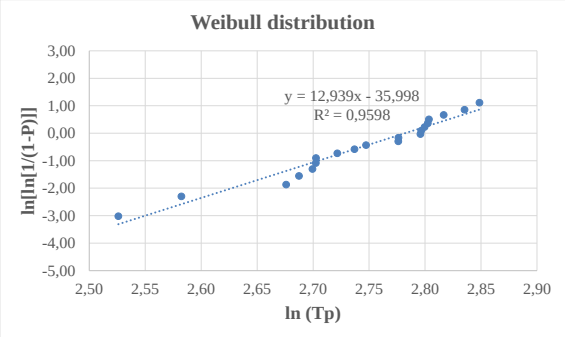

RCP8.5: 2081–2100

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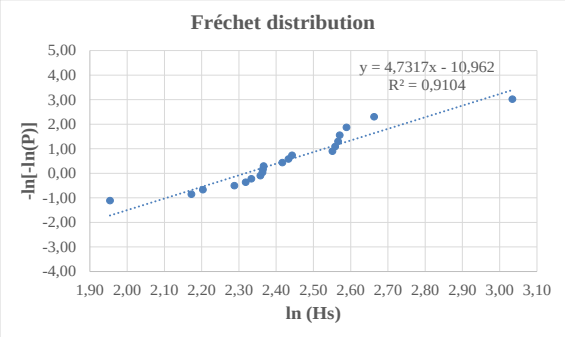

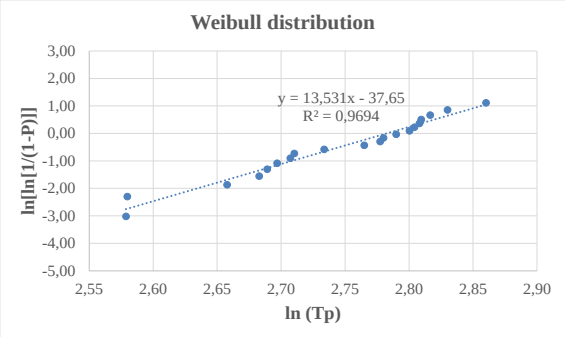

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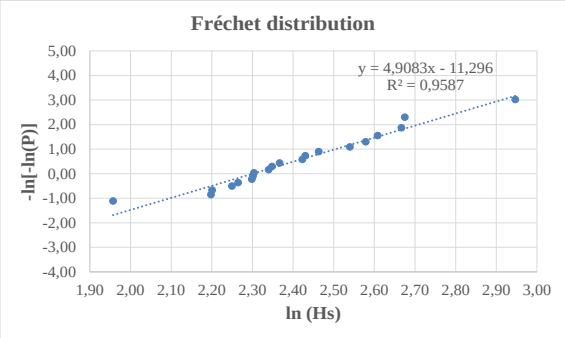

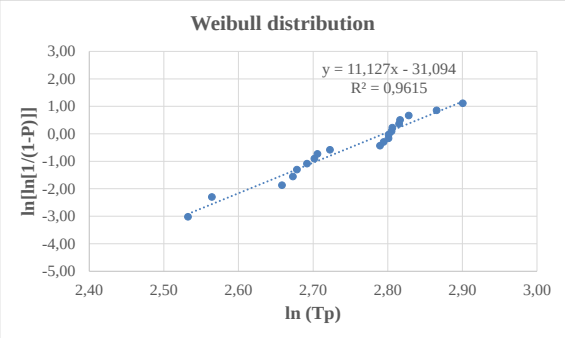

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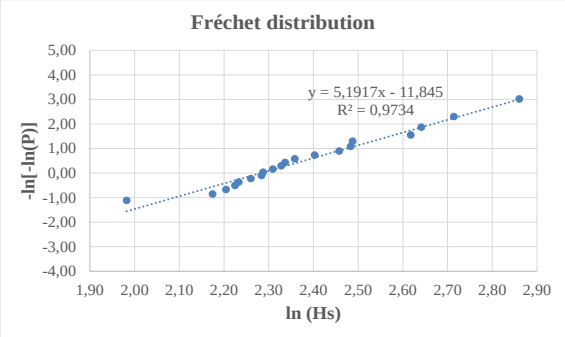

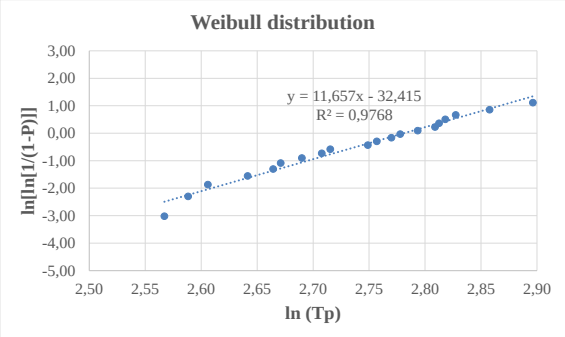

RCP8.5: 2081–2100

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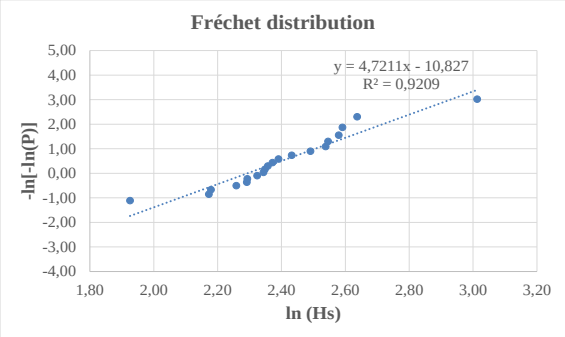

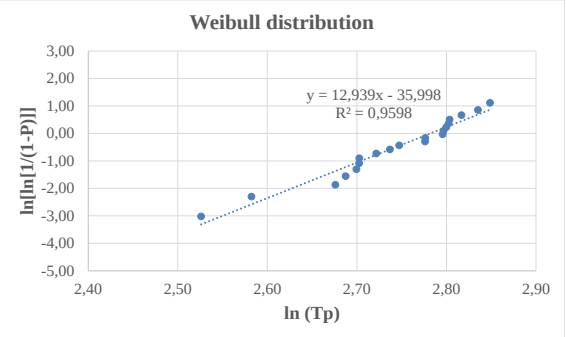

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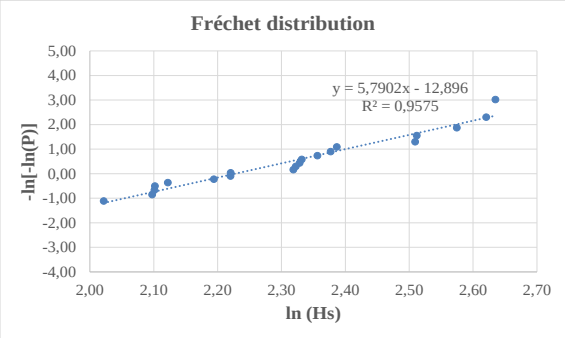

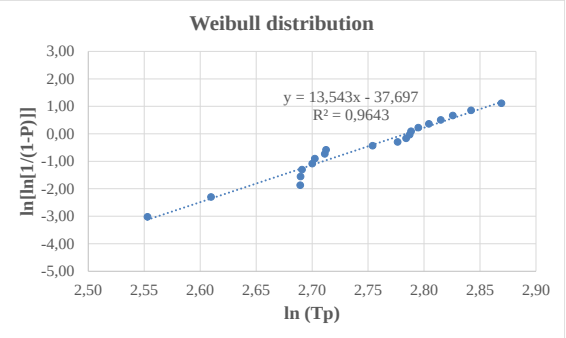

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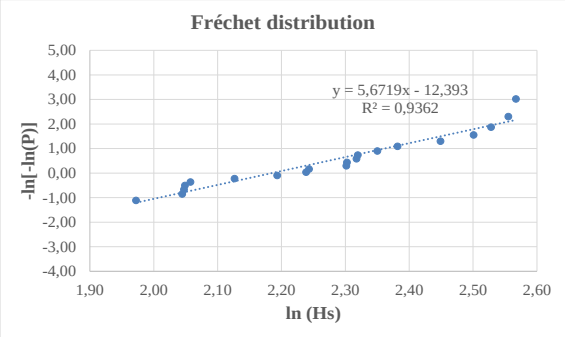

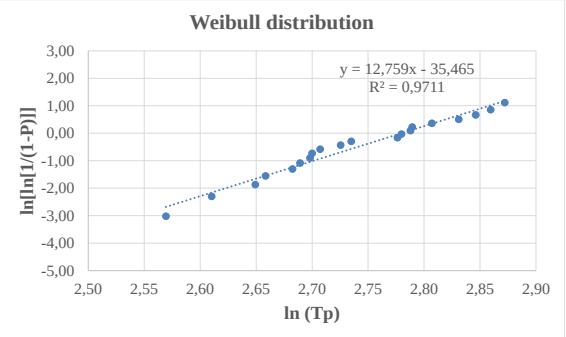

RCP8.5: 2081–2100

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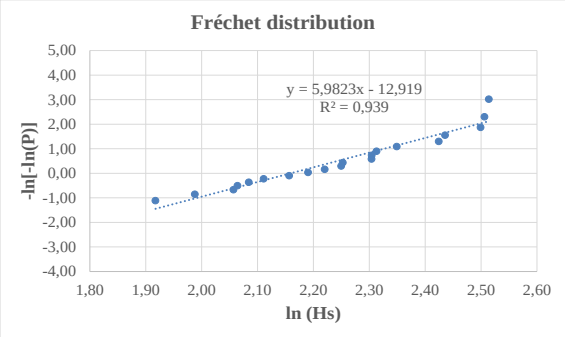

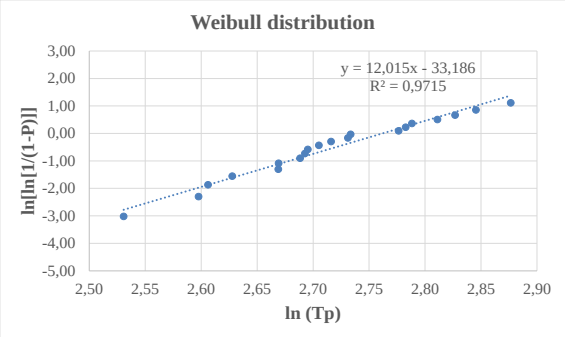

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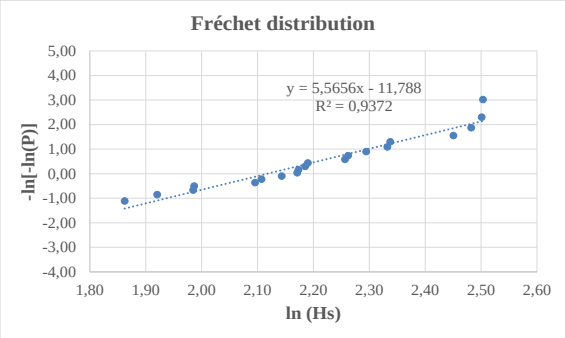

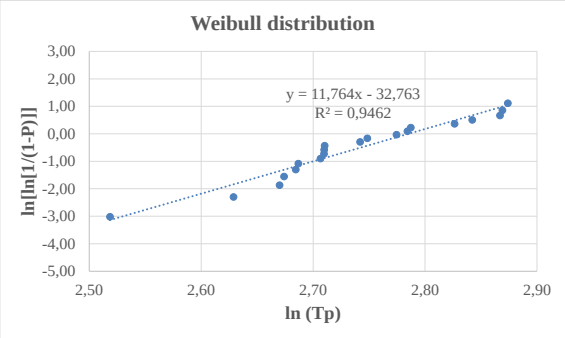

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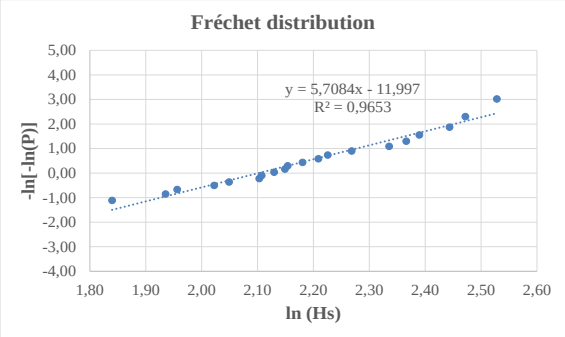

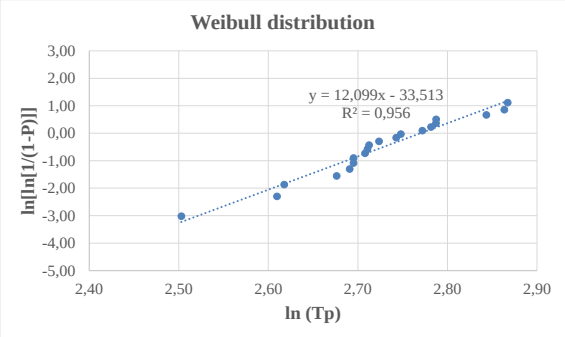

RCP8.5: 2081–2100

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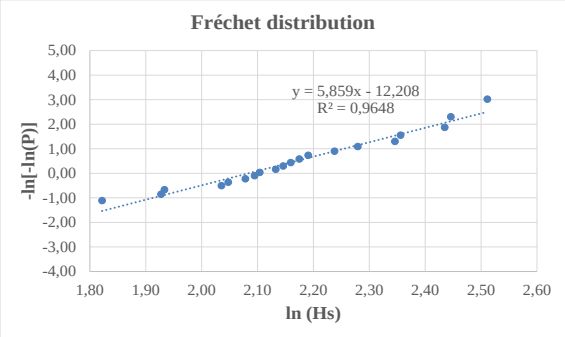

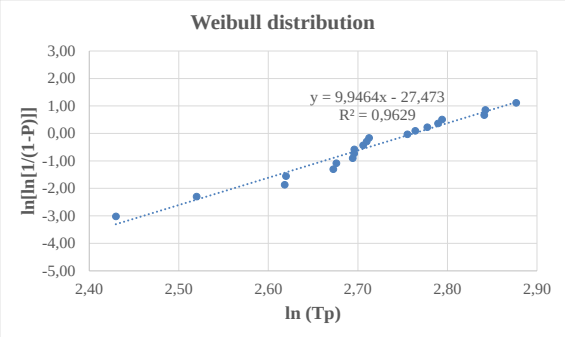

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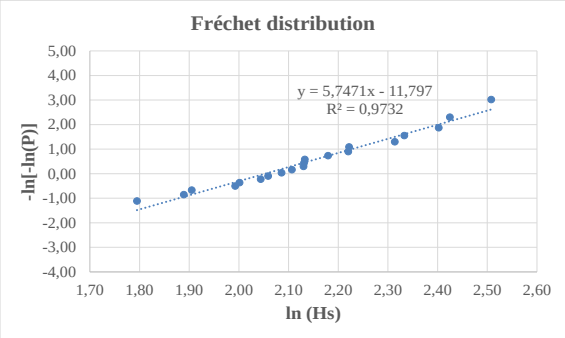

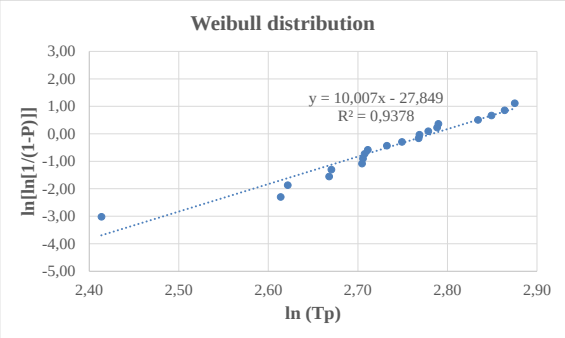

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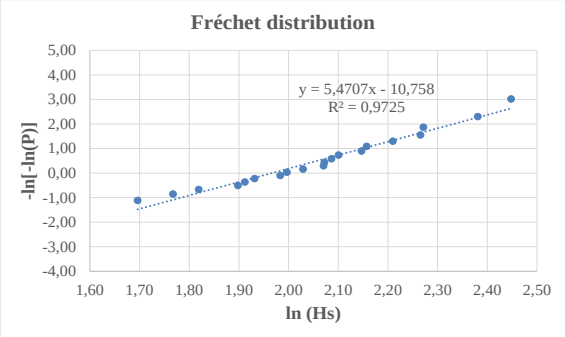
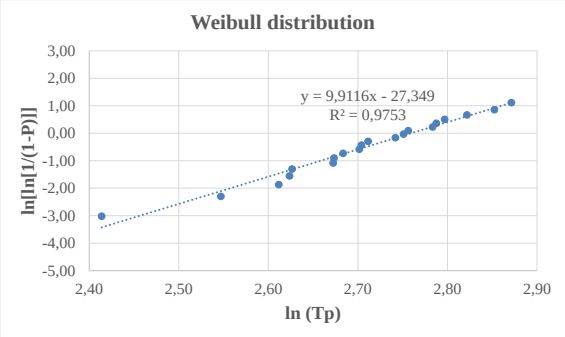
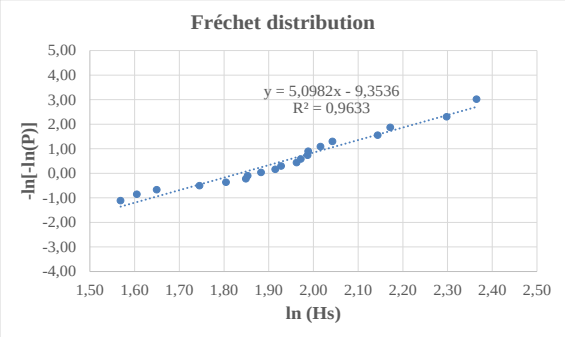
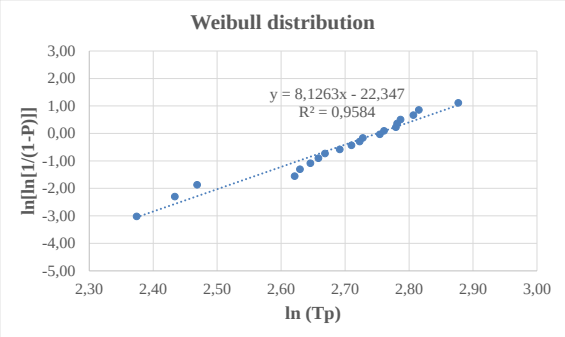




RCP8.5: 2081–2100

Station S4





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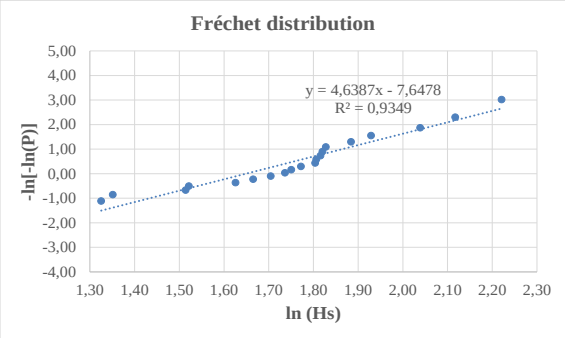

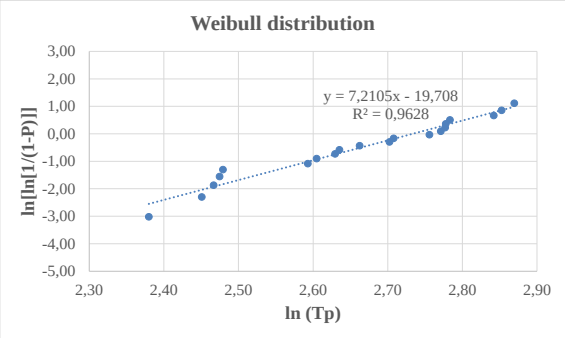

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APPENDIX 4

Thermo-mechanical analysis of the proposed concrete armour unit

Thermal Scenarios | Simulation Time: 192 h (8 days)				
Scenario	**Mesh**	**Cement content (kg/m³)**	**Cement type**	**Observation points**
SC1.1	005	400	CEM I 42.5R	4
SC1.2	01	400	CEM I 42.5R	4
SC1.3	015	400	CEM I 42.5R	4
SC2	015	310	CEM I 42.5R	2
SC3	015	368	CEM I 42.5R	2
SC4	015	435	CEM I 42.5R	2
SC5	015	368	CEM IV 32.5N	2
SC6	015	368	CEM I 52.5R	2

Mechanical Scenarios | Simulation Time: 192 h (8 days)						
Scenario	**Mesh**	**Cement content (kg/m³)**	**Cement type**	**Concrete strength class**	**RSFRC toughness class**	**Analysis type**
SC1.2	01	400	CEM I 42.5R	C40/50	4d	MNL1
SC1.3	015	400	CEM I 42.5R	C40/50	4d	ML; MNL1; MNL2; SC
SC2	015	310	CEM I 42.5R	C20/25	3b	SC
SC3	015	368	CEM I 42.5R	C35/45	4c	SC
SC4	015	435	CEM I 42.5R	C50/60	5e	SC
SC5	015	368	CEM IV 32.5N	C30/37	3b	SC
SC6	015	368	CEM I 52.5R	C40/50	5e	SC

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Appendix 4A

Temperature evolution

Thermal Scenarios | Simulation Time: 192 h (8 days)				
Scenario	**Mesh**	**Cement content (kg/m³)**	**Cement type**	**Observation points**
SC1.1	005	400	CEM I 42.5R	4
SC1.2	01	400	CEM I 42.5R	4
SC1.3	015	400	CEM I 42.5R	4
SC2	015	310	CEM I 42.5R	2
SC3	015	368	CEM I 42.5R	2
SC4	015	435	CEM I 42.5R	2
SC5	015	368	CEM IV 32.5N	2
SC6	015	368	CEM I 52.5R	2

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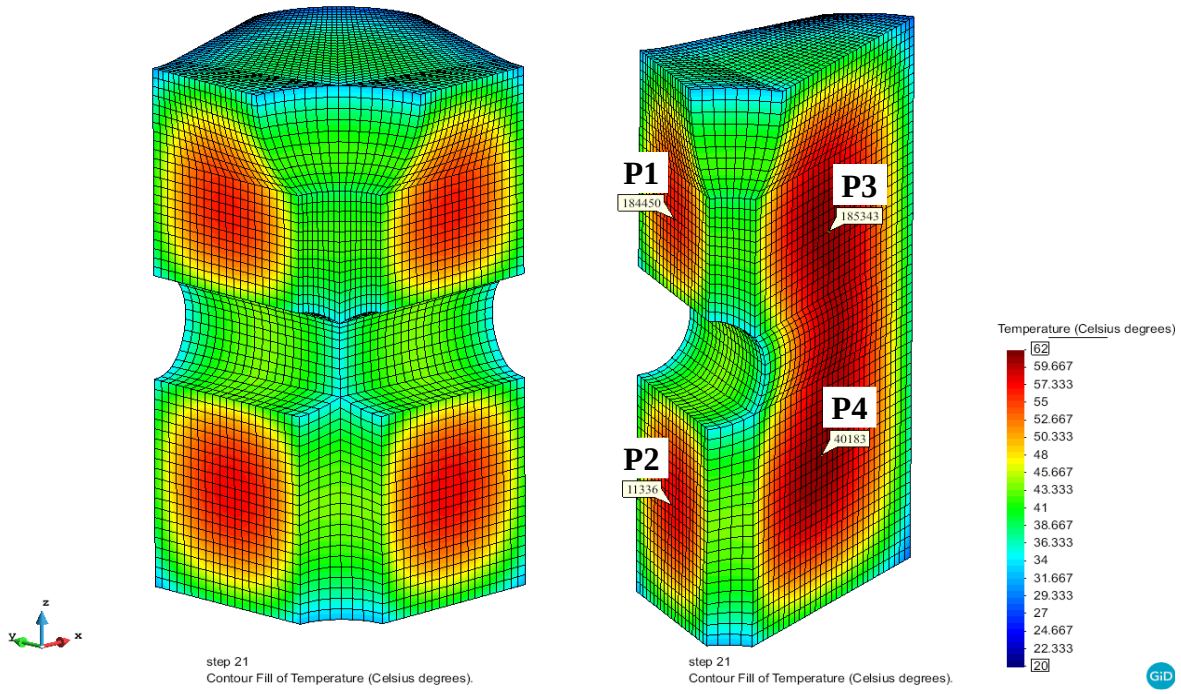
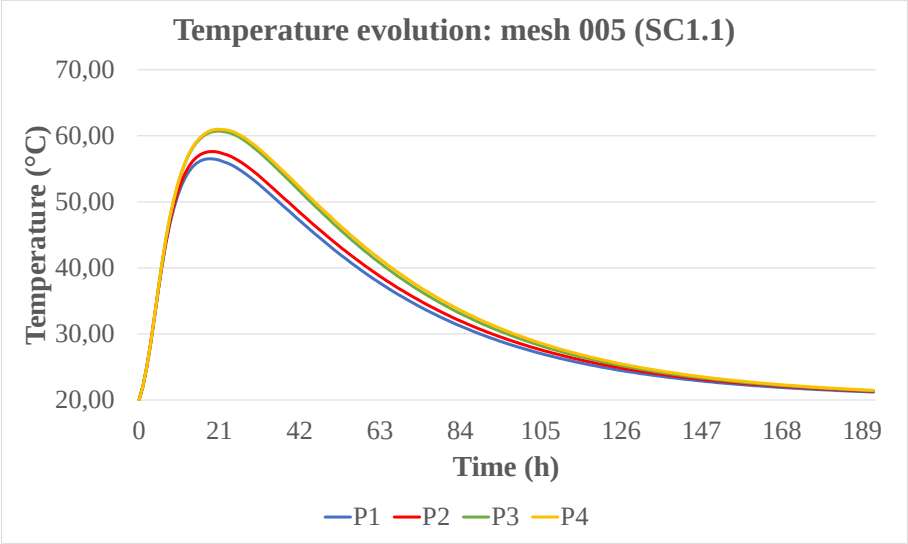
Parametric analysis: SC1.1, SC1.2 and SC1.3

SC1.1: mesh 005

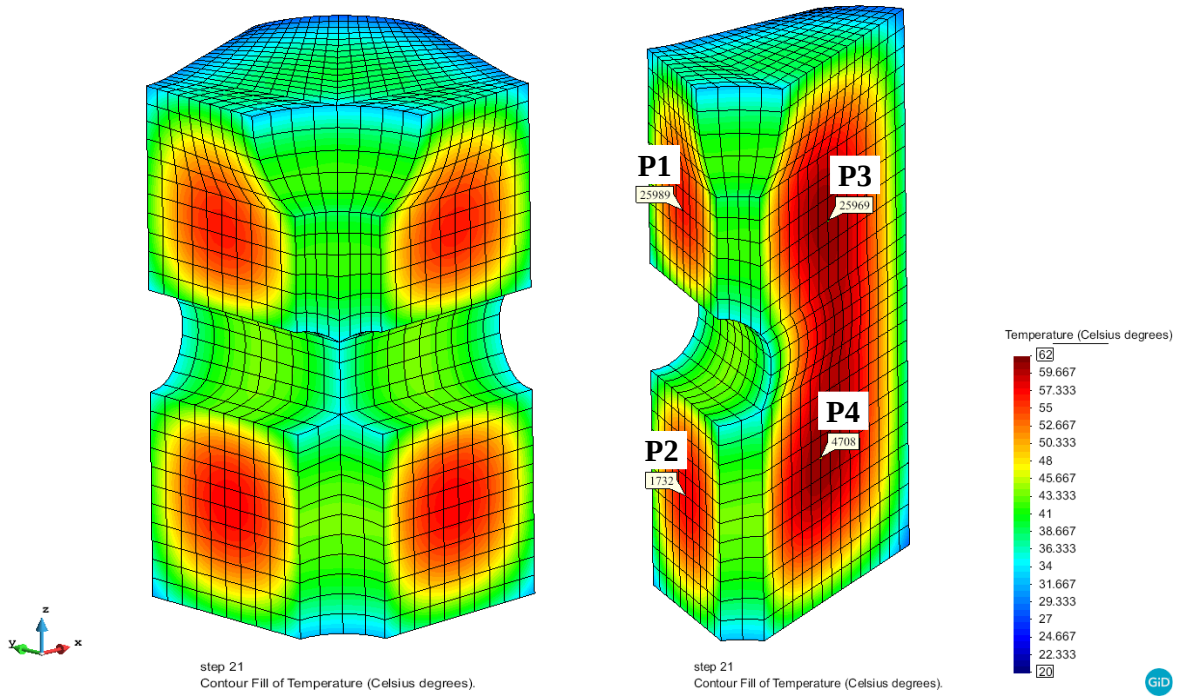


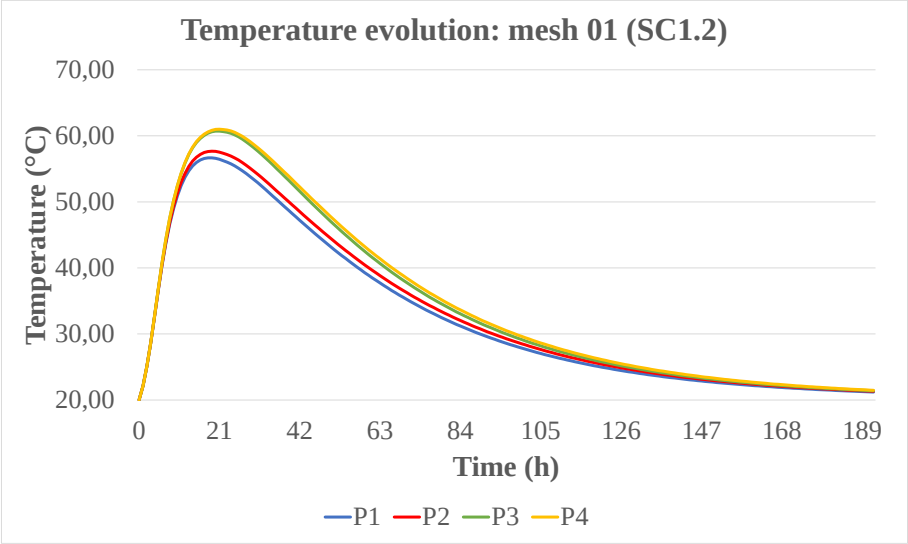


Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	56.52	18	21.21	192
P2	57.62	19	21.32	192
P3	60.70	21	21.40	192
P4	61.01	21	21.47	192

Parametric analysis: SC1.1, SC1.2 and SC1.3

SC1.2: mesh 01

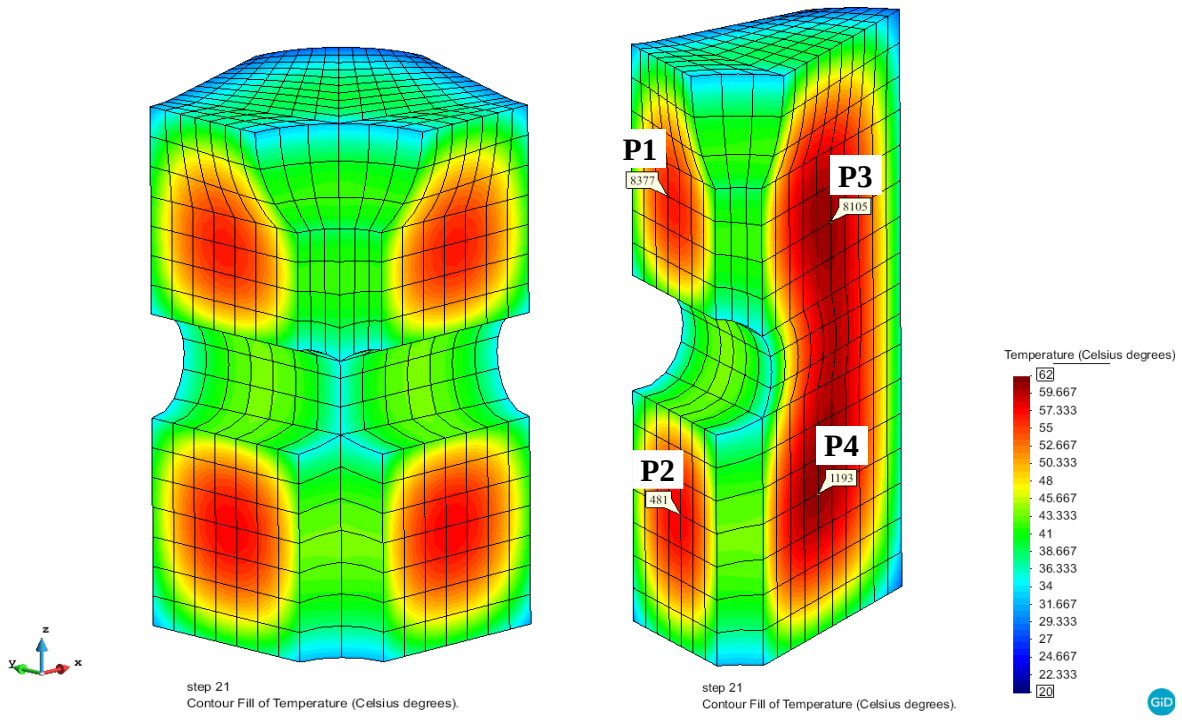


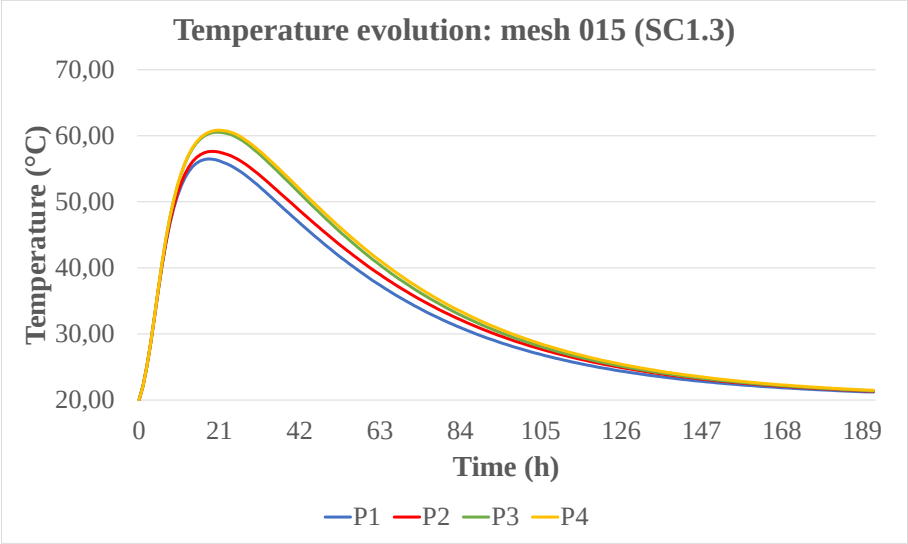


Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	56.67	18	21.21	192
P2	57.67	19	21.32	192
P3	60.72	21	21.39	192
P4	61.00	21	21.47	192

Parametric analysis: SC1.1, SC1.2 and SC1.3

SC1.3: mesh 015

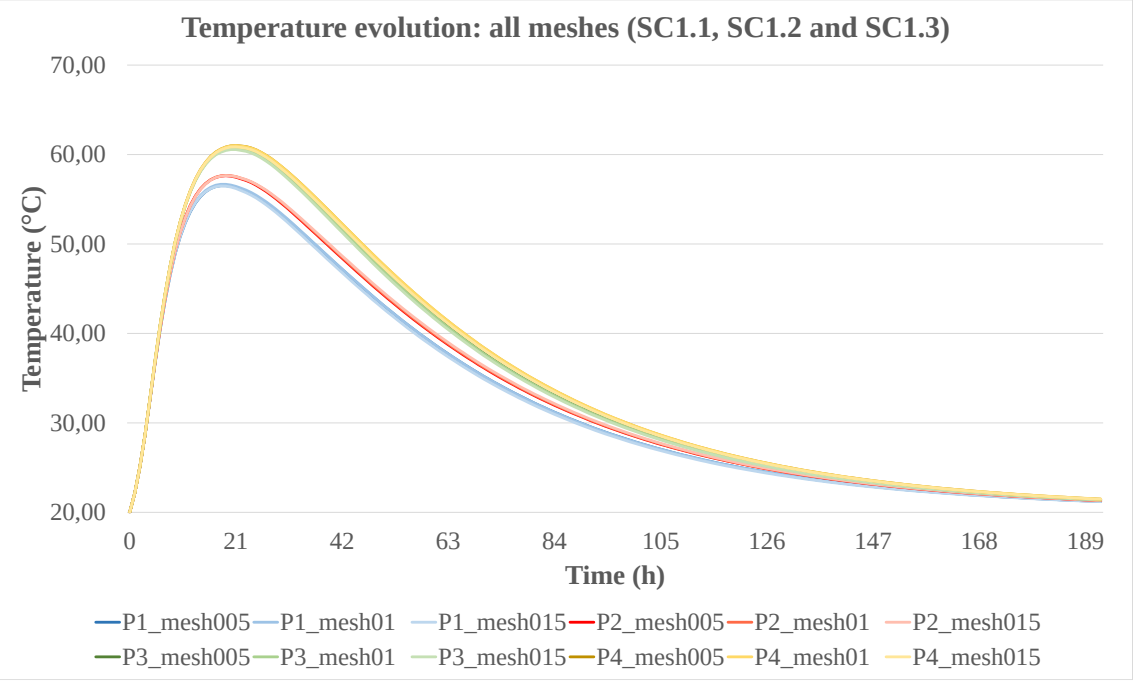


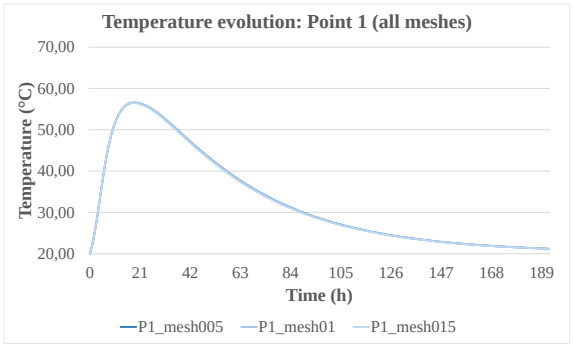


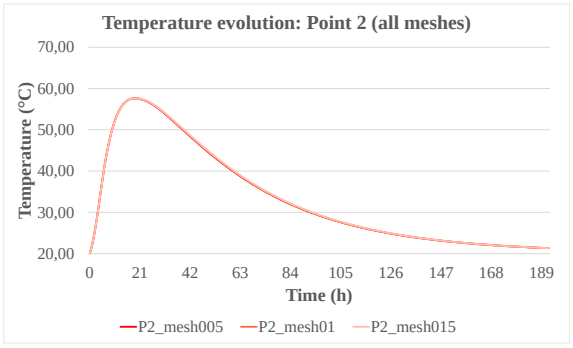
Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	56.48	18	21.19	192
P2	57.64	19	21.33	192
P3	60.55	21	21.38	192
P4	60.85	21	21.46	192

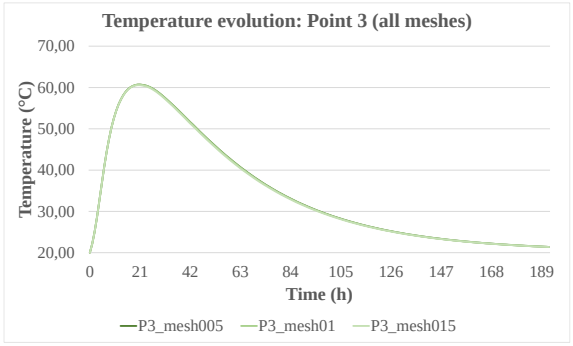
Parametric analysis: SC1.1, SC1.2 and SC1.3

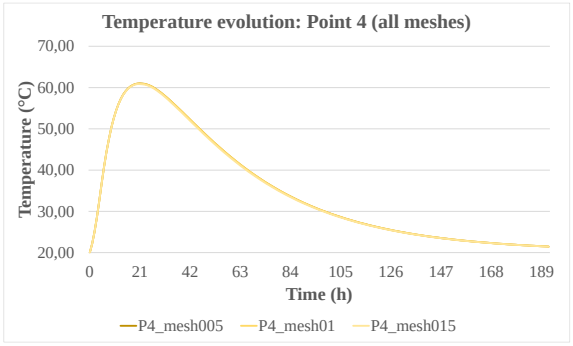
All meshes



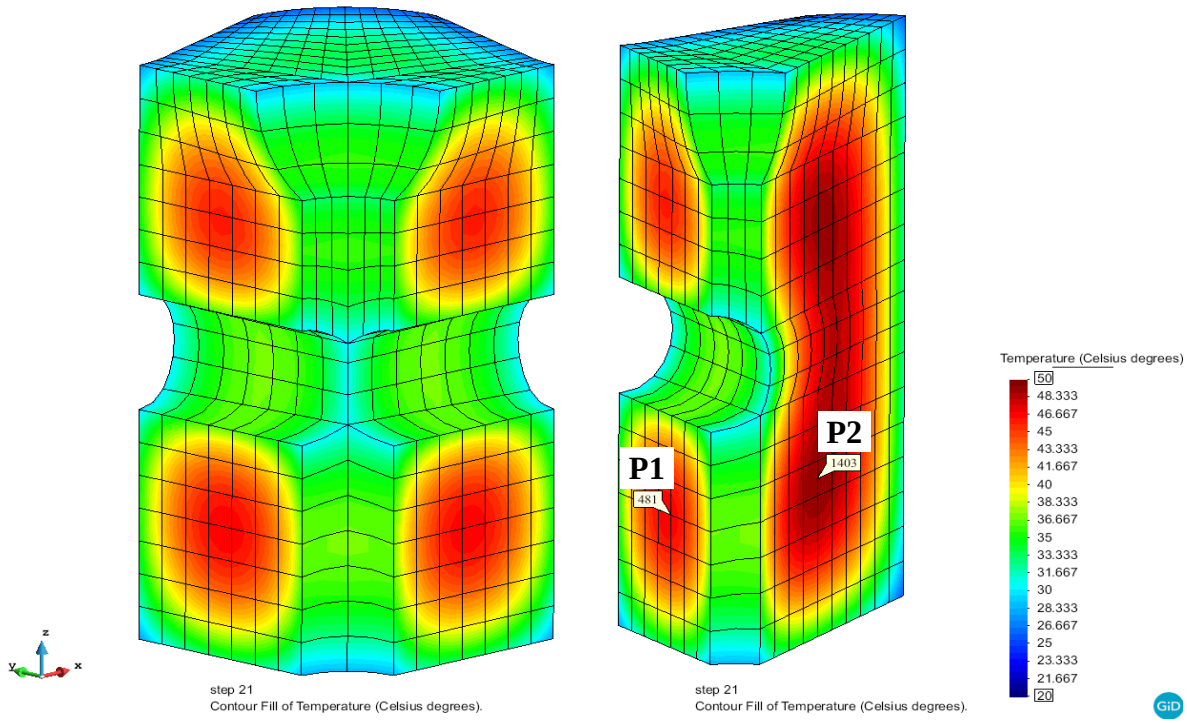


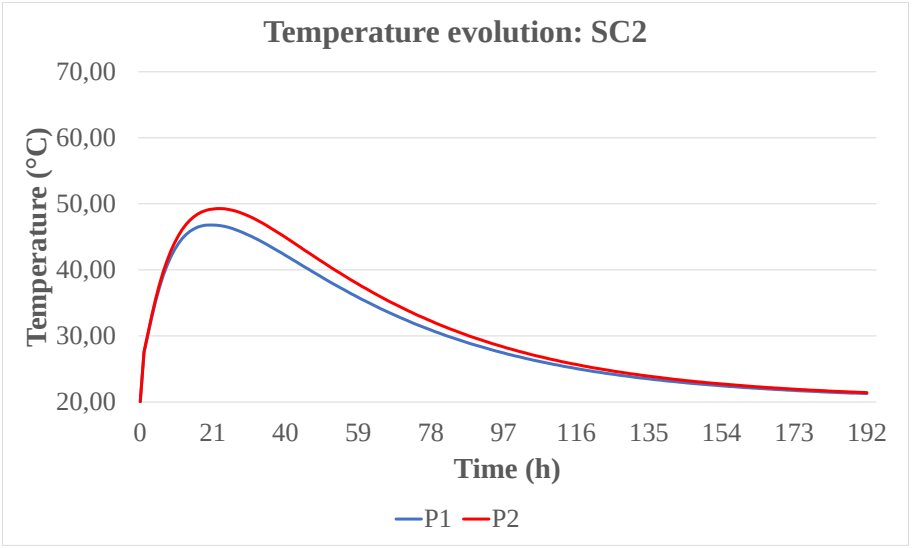






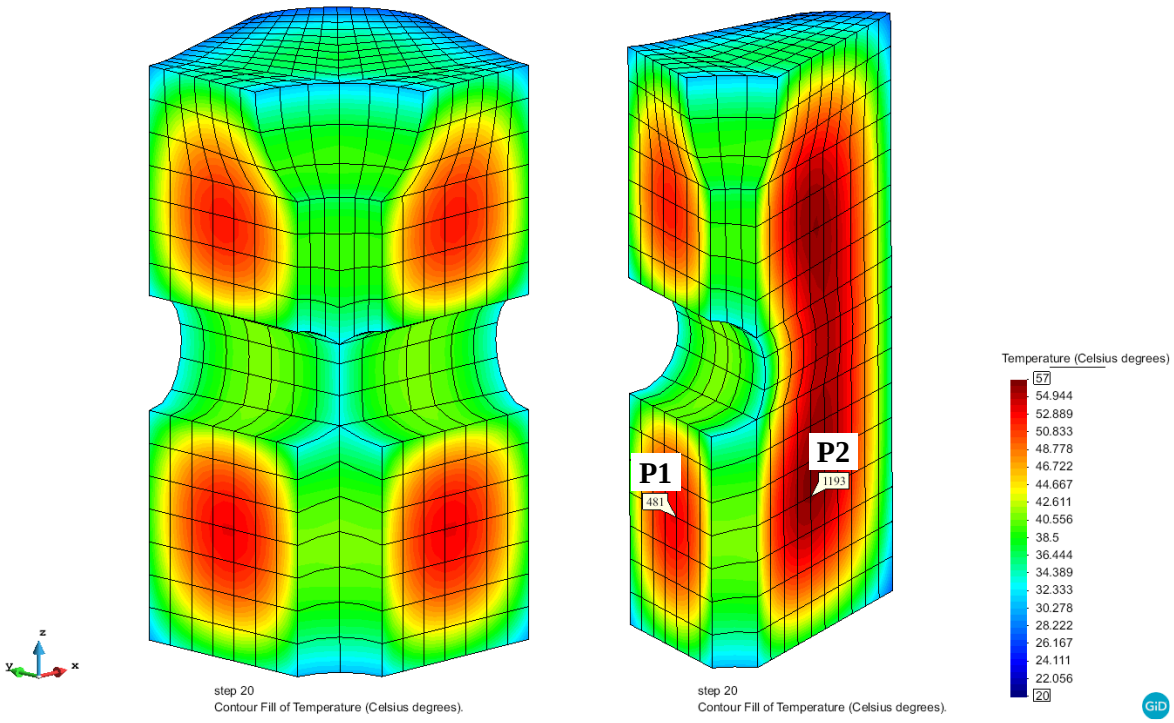
SC2

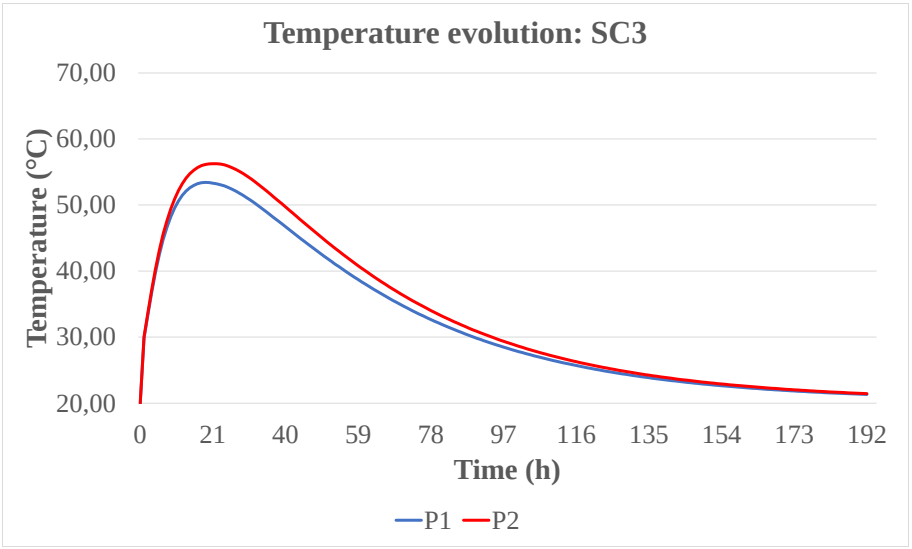




Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	46.80	20	21.27	192
P2	49.29	23	21.41	192

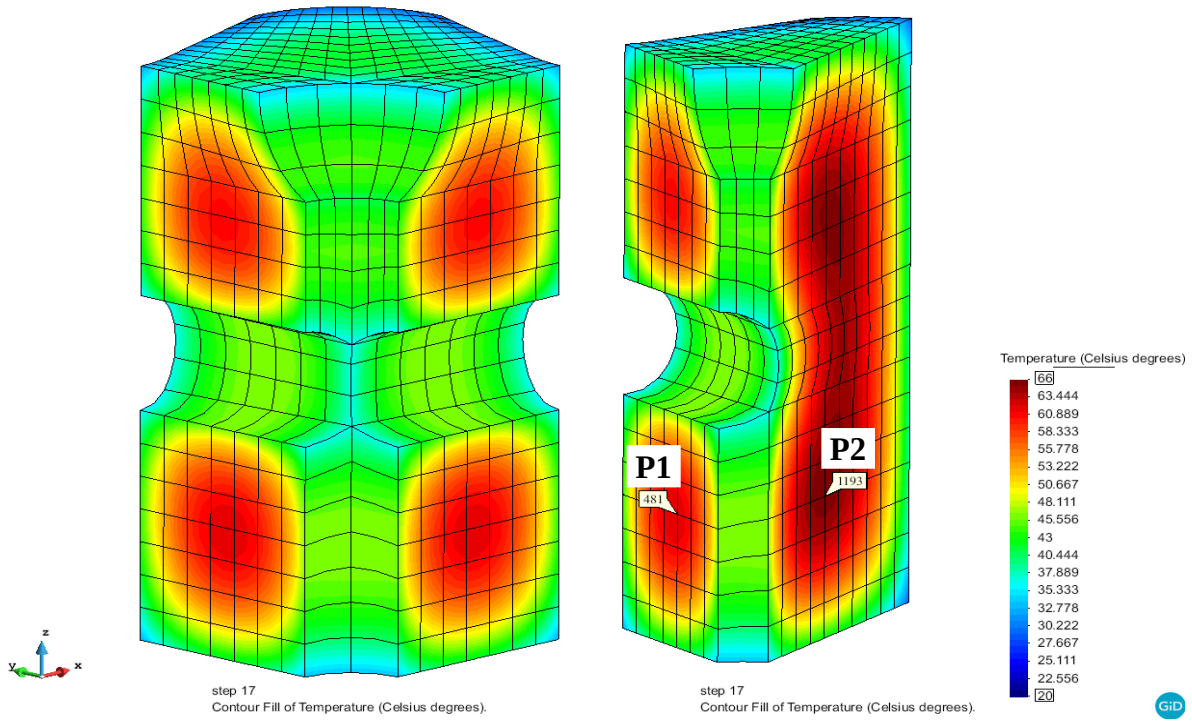
SC3

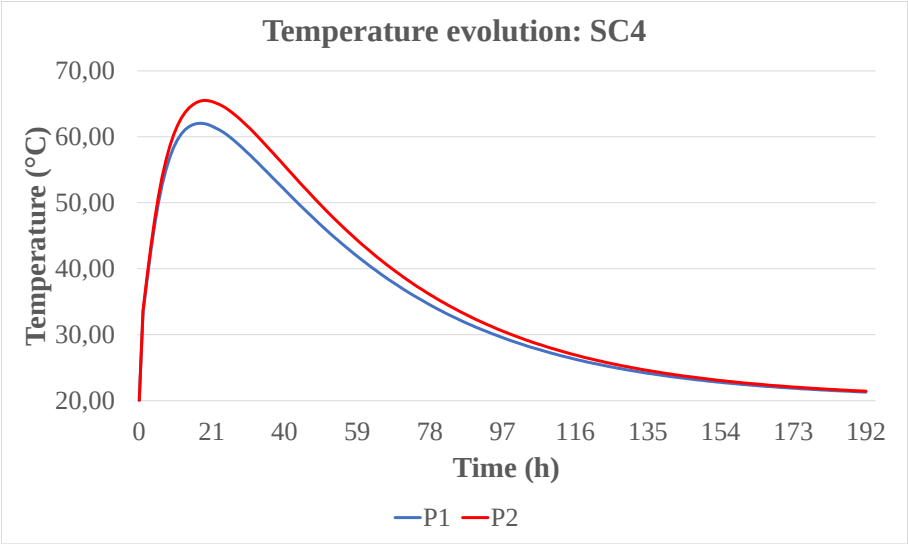




Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	53.42	19	21.31	192
P2	56.26	22	21.44	192

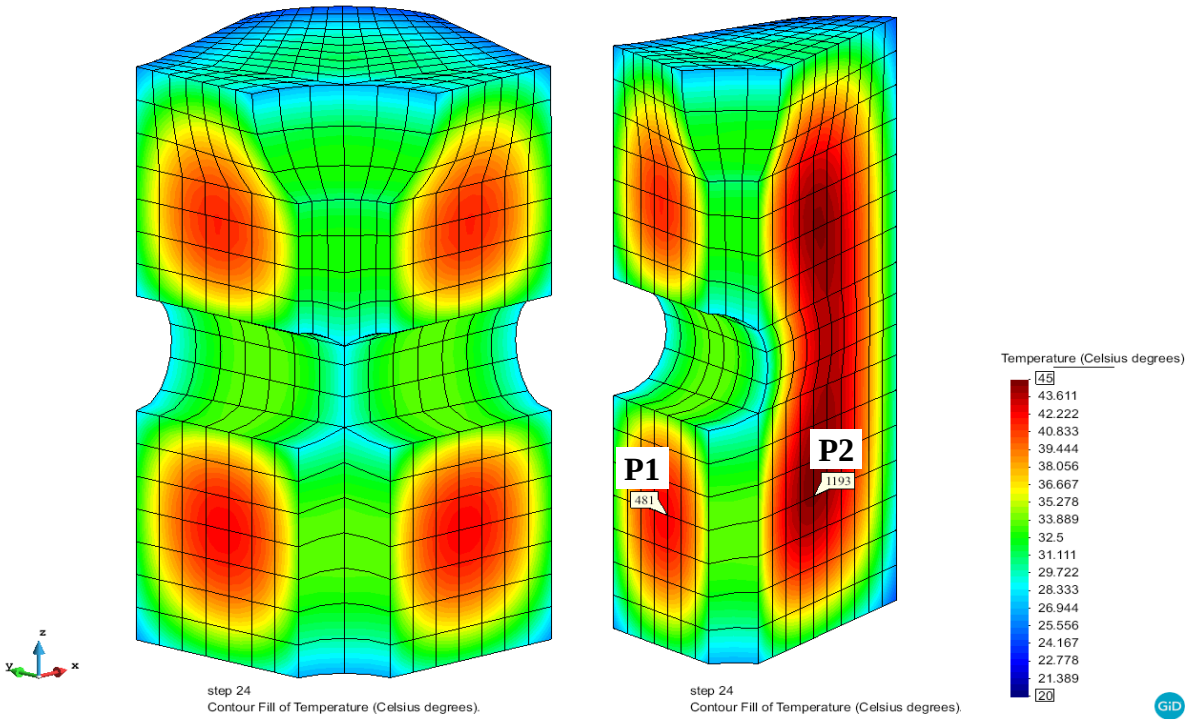
SC4

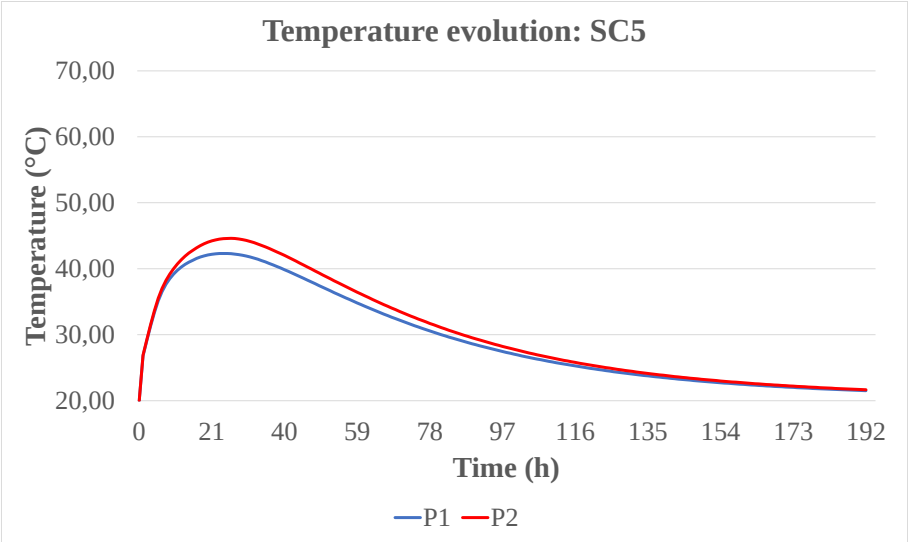




Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	62.04	18	21.30	192
P2	65.51	19	21.43	192

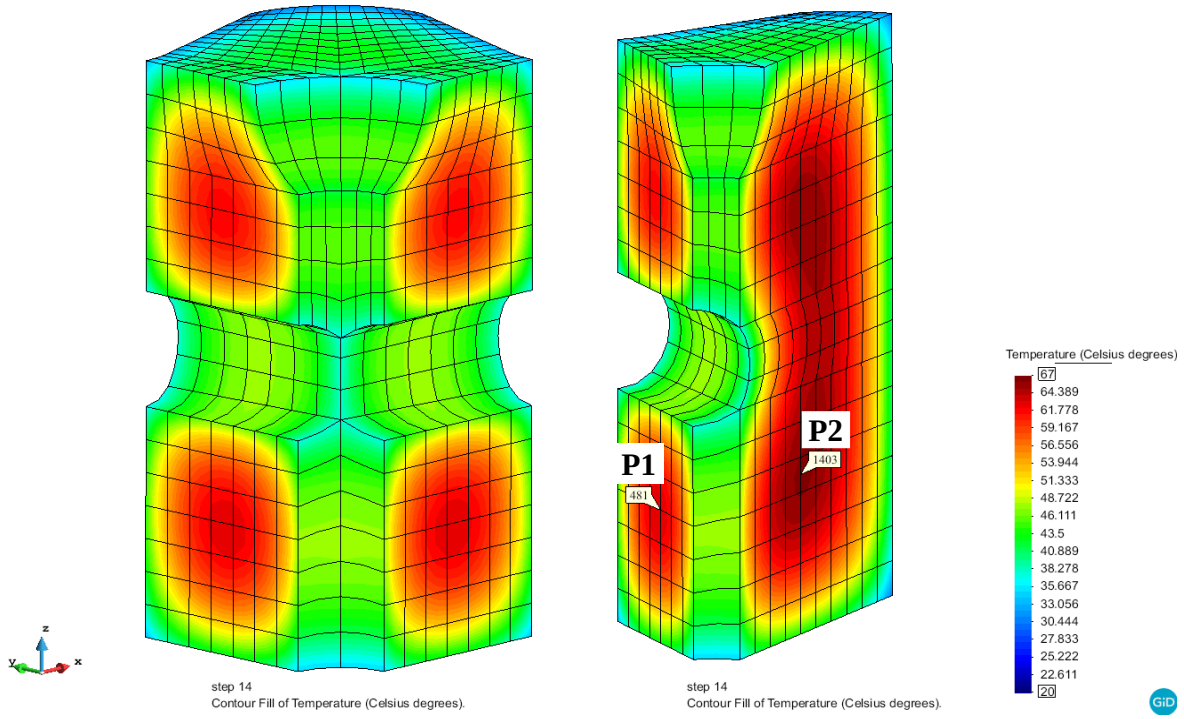
SC5

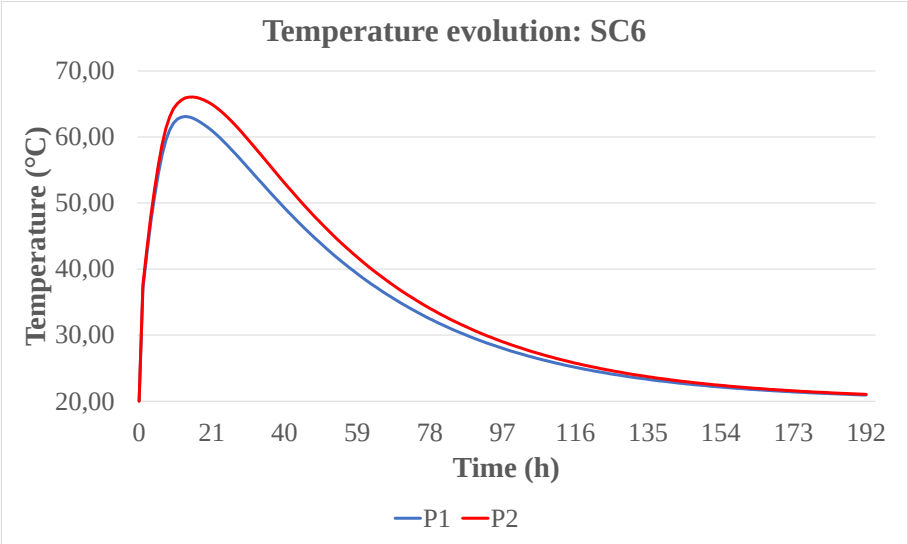




Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	42.32	24	21.51	192
P2	44.60	26	21.65	192

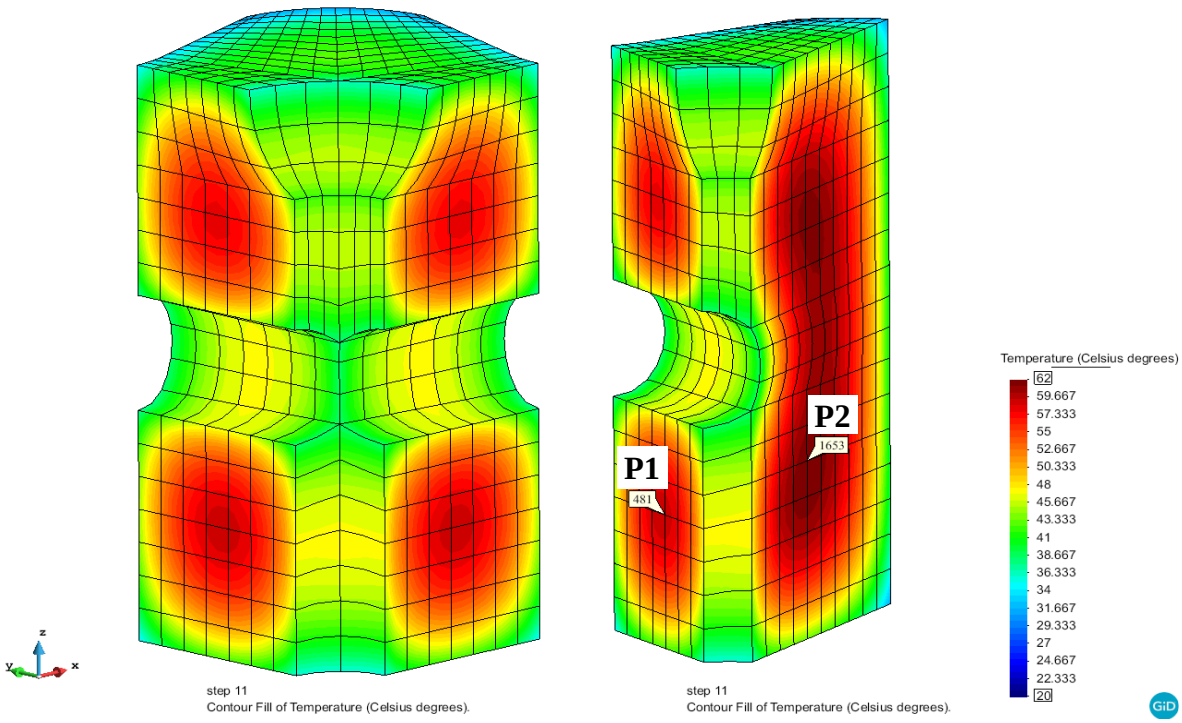
SC6

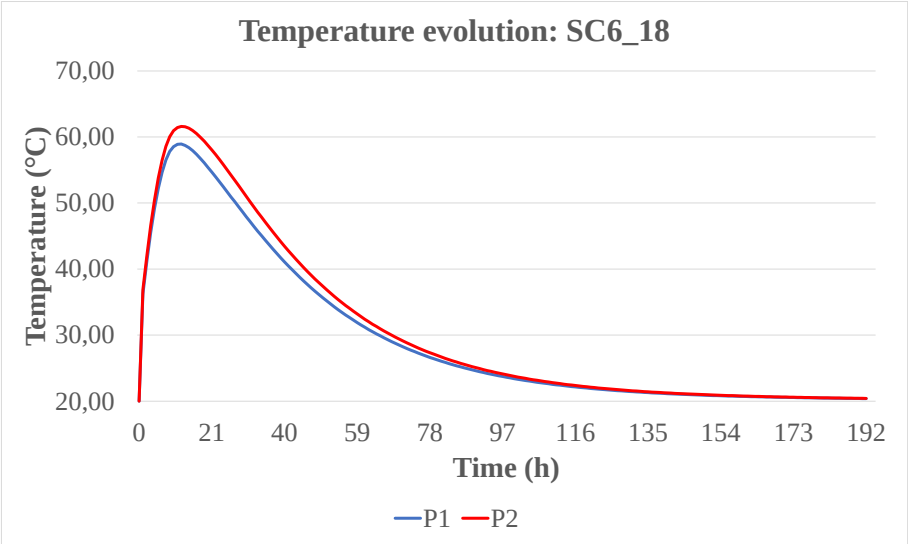




Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	63.09	14	20.93	192
P2	66.05	16	21.04	192

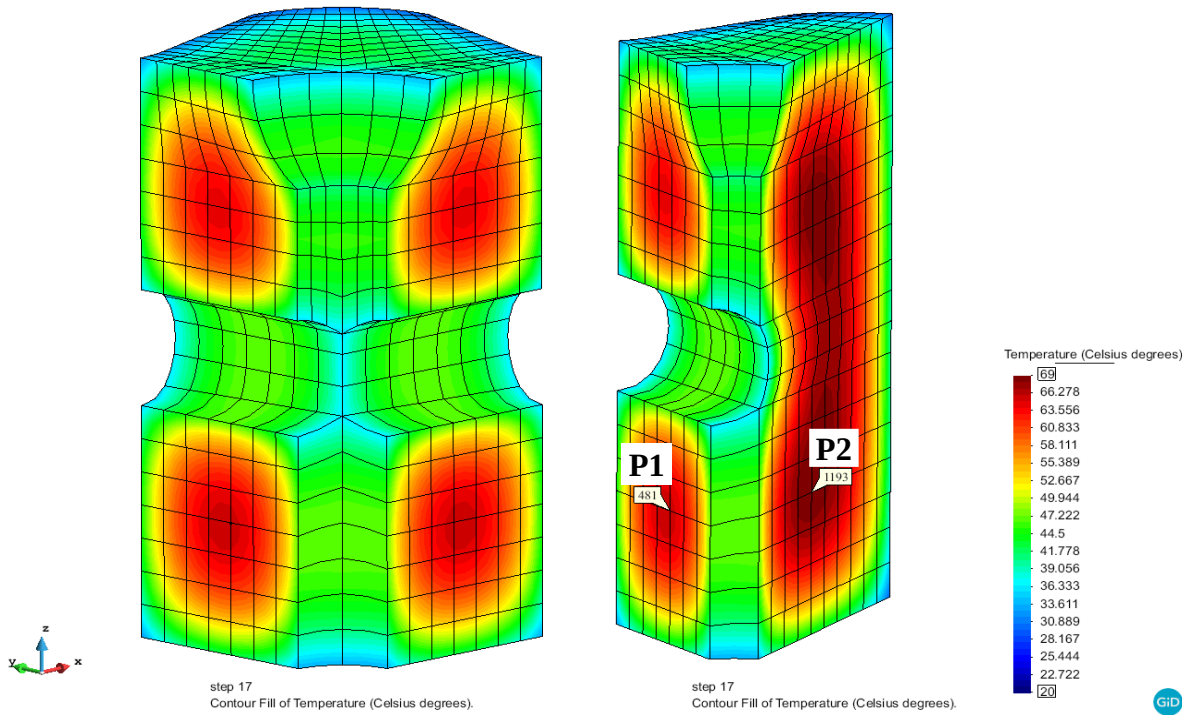
SC6_18

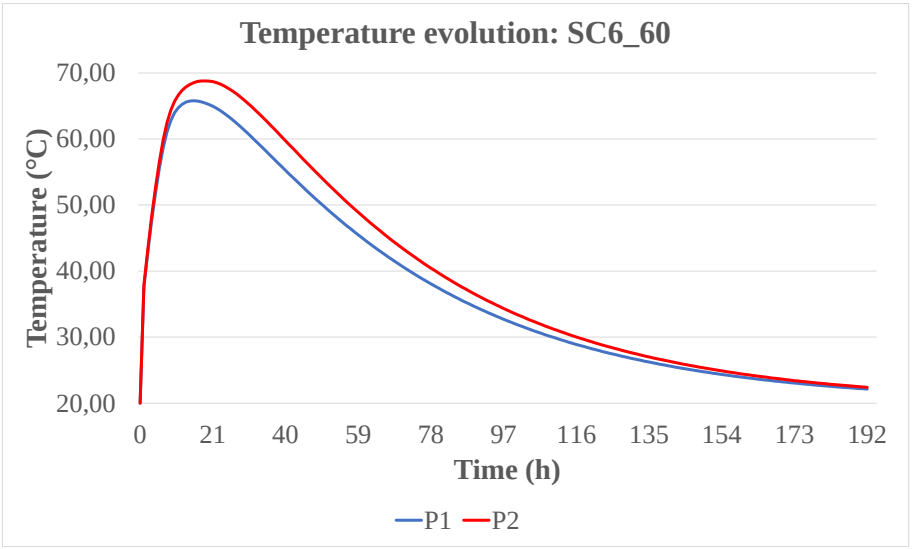




Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	58.93	13	20.39	192
P2	61.59	13	20.42	192

SC6_60





Obs. Point	Max. Temperature (°C)	Time (h)	Min. Temperature (°C)	Time (h)
P1	65.78	16	22.13	192
P2	68.79	19	22.40	192

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Appendix 4B

Normal stress evolution:

Mechanical linear analysis

Mechanical nonlinear analysis

Shrinkage and creep analysis

Mechanical Scenarios | Simulation Time: 192 h (8 days)						
Scenario	**Mesh**	**Cement content (kg/m³)**	**Cement type**	**Concrete strength class**	**RSFRC toughness class**	**Analysis type**
SC1.2	01	400	CEM I 42.5R	C40/50	4d	MNL1
SC1.3	015	400	CEM I 42.5R	C40/50	4d	ML; MNL1; MNL2; SC
SC2	015	310	CEM I 42.5R	C20/25	3b	SC
SC3	015	368	CEM I 42.5R	C35/45	4c	SC
SC4	015	435	CEM I 42.5R	C50/60	5e	SC
SC5	015	368	CEM IV 32.5N	C30/37	3b	SC
SC6	015	368	CEM I 52.5R	C40/50	5e	SC

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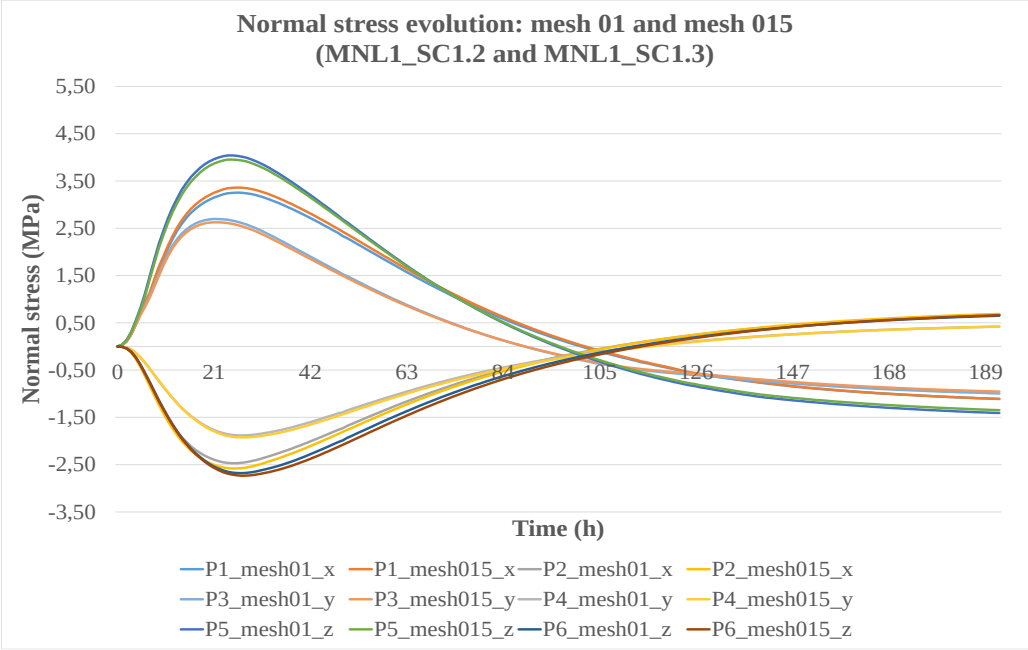
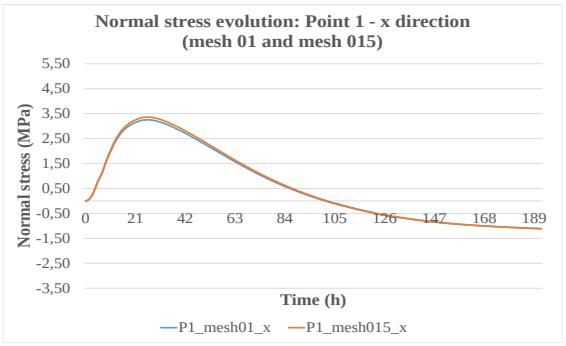
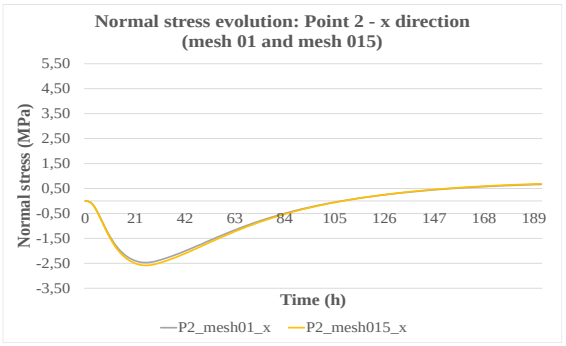
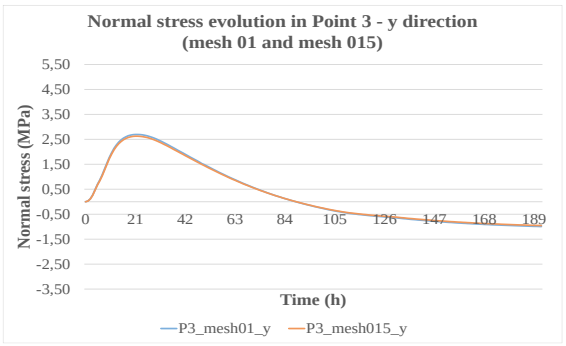
Parametric analysis: MNL1_SC1.2 and MNL1_SC1.3

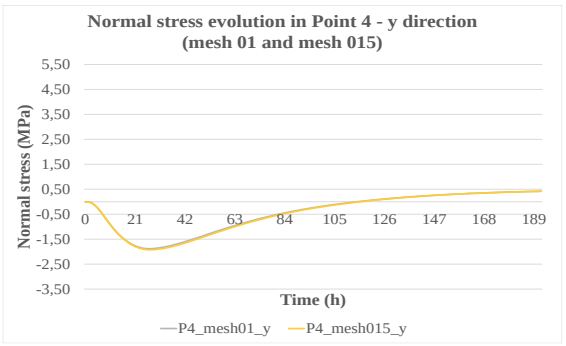
Mesh 01 and mesh 015

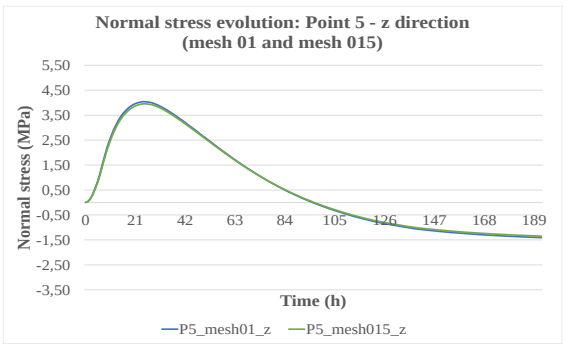


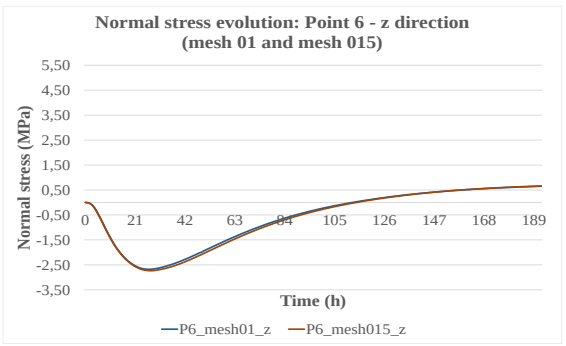




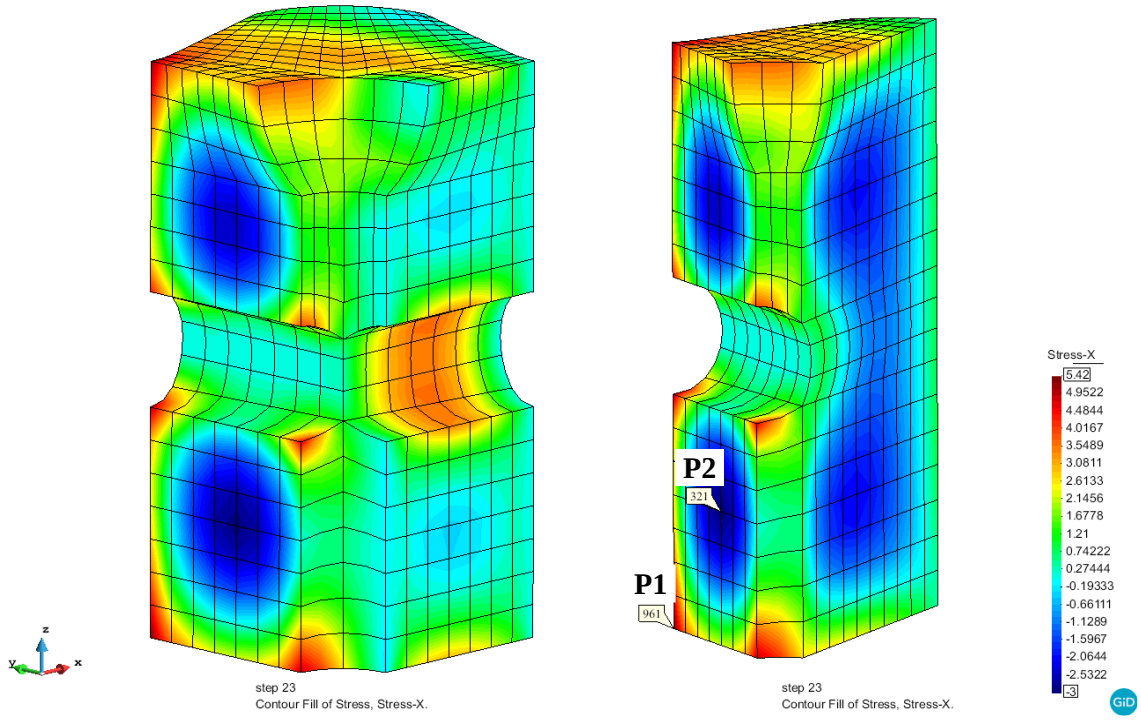


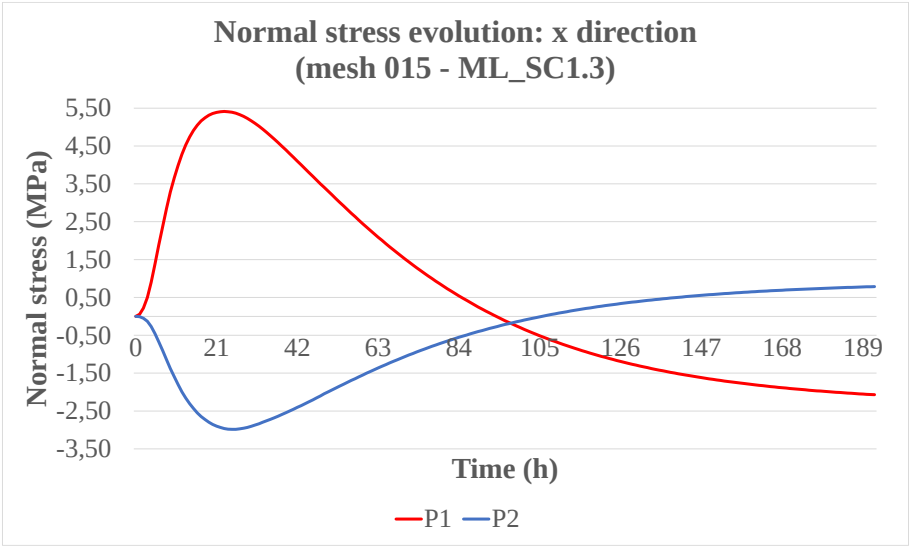






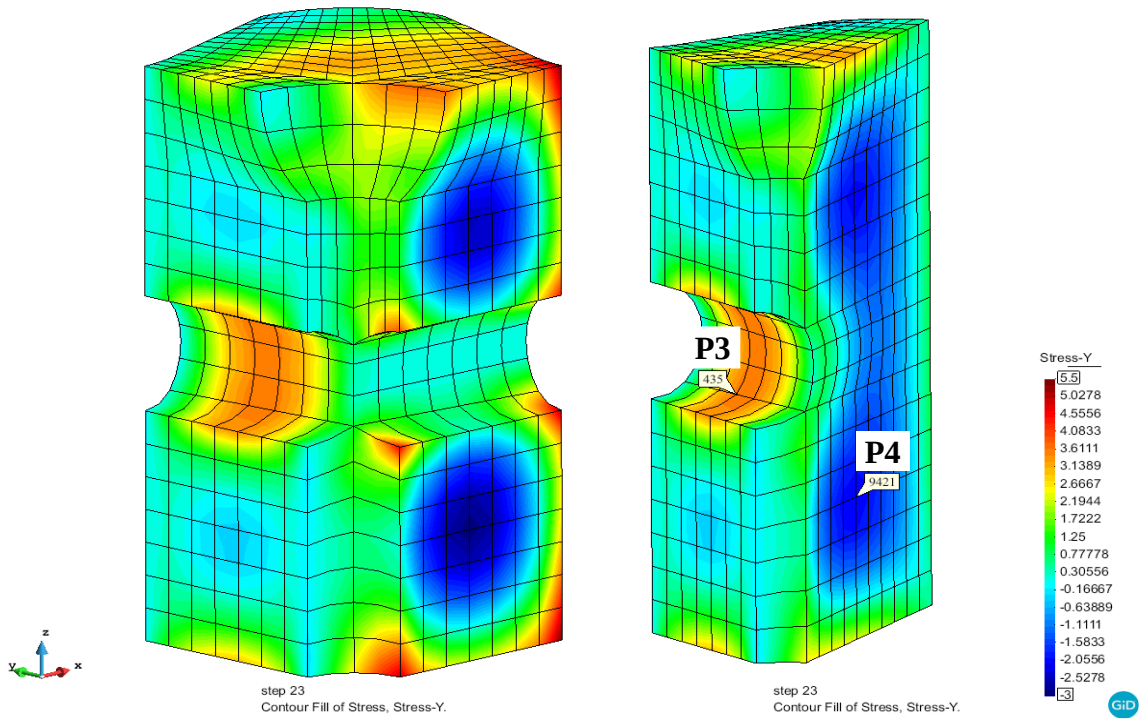
ML_SC1.3

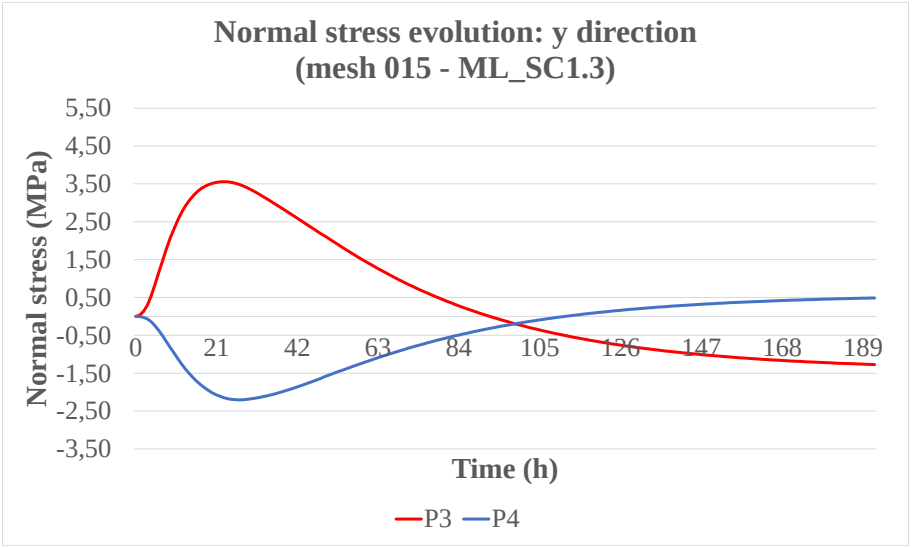




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	5.41	23	-2.07	192	x
P2	0.79	192	-2.99	25	x

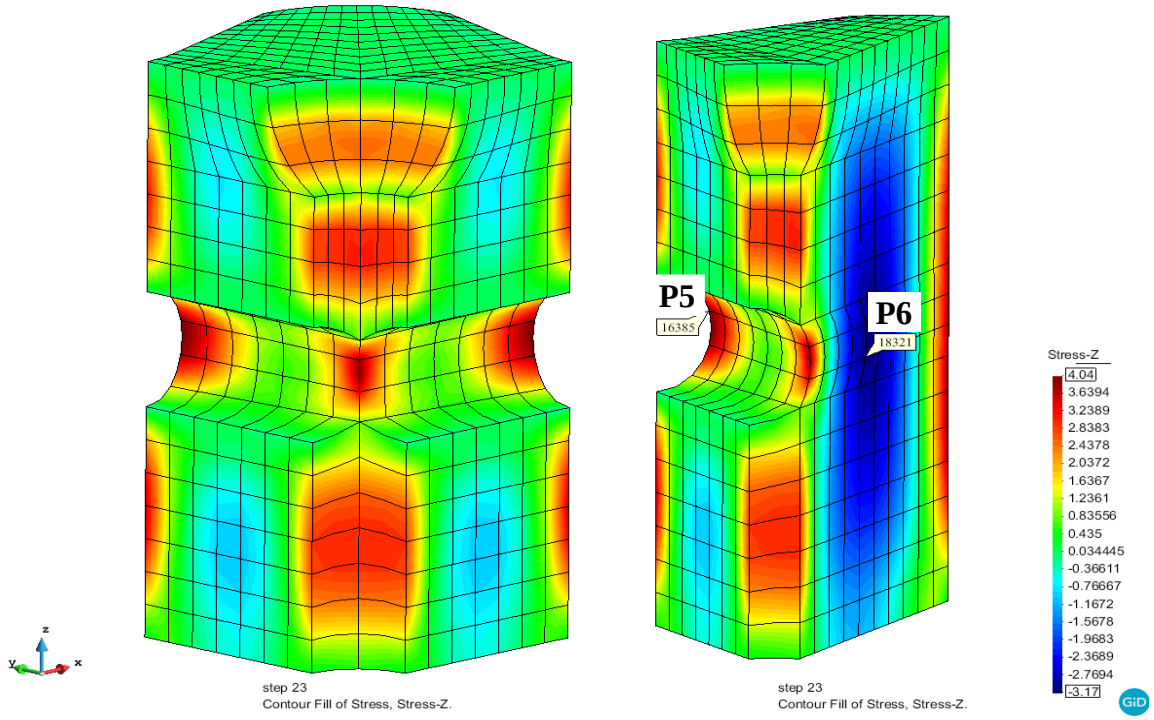
ML_SC1.3 (cont.)

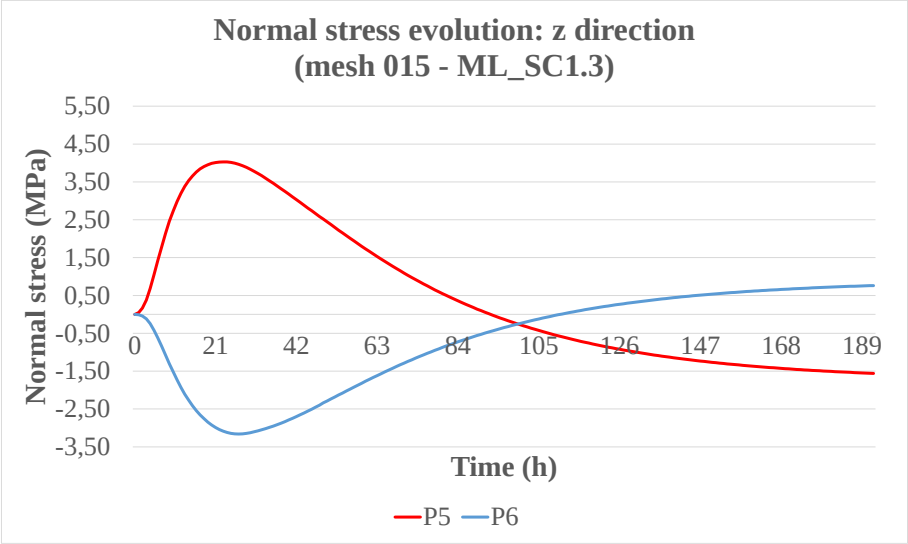




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	3.56	23	-1.27	192	y
P4	0.49	192	-2.20	27	y

ML_SC1.3 (cont.)

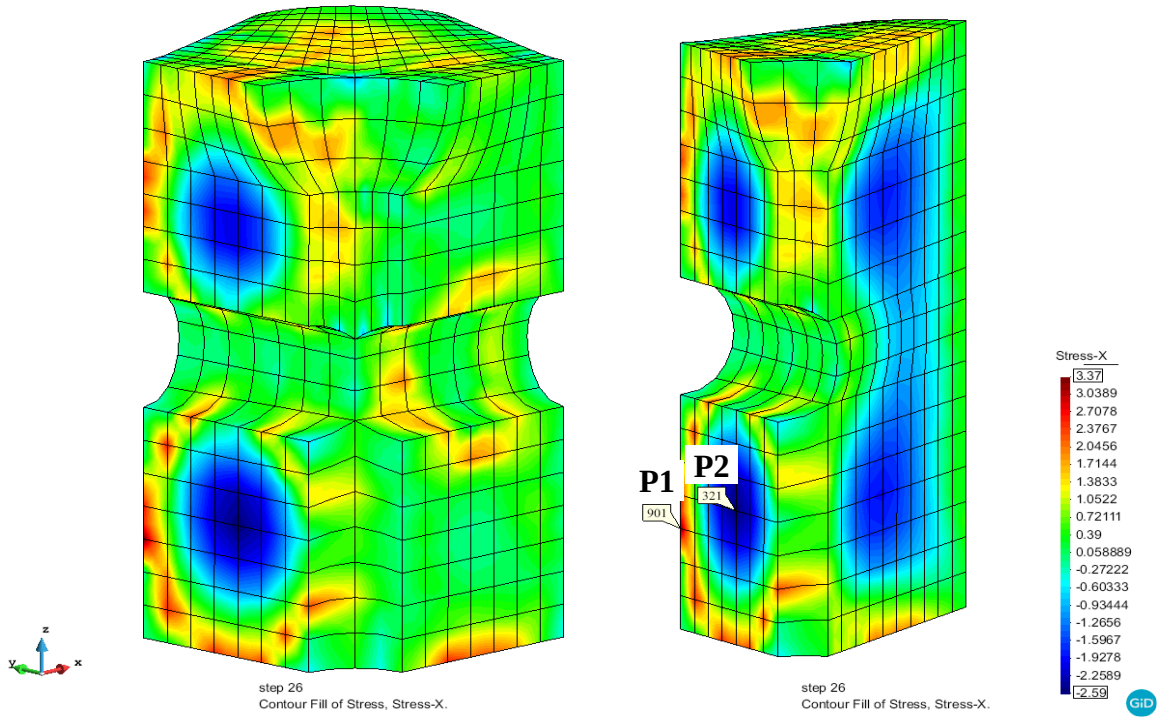


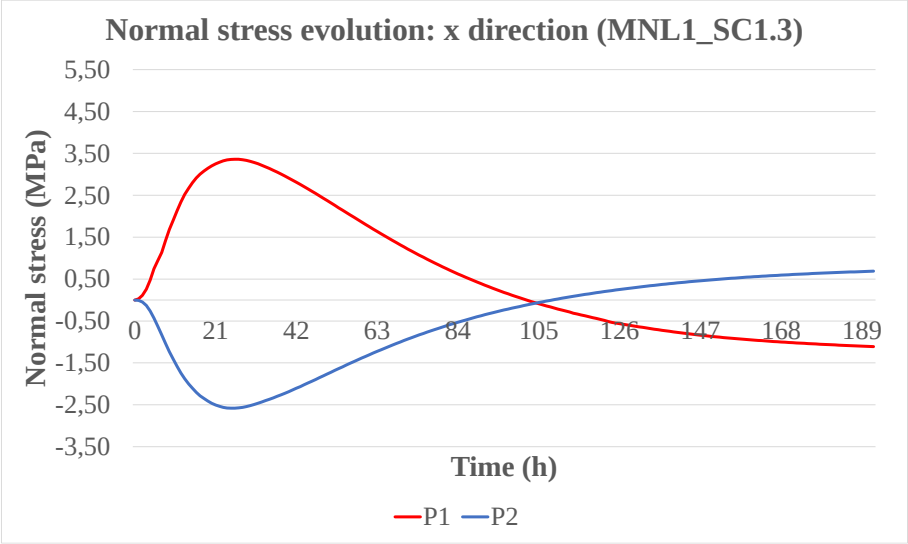


O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	4.03	23	-1.56	192	z
P6	0.76	192	-3.16	27	z

Parametric analysis: MNL1_SC1.3 and MNL2_SC1.3

MNL1_SC1.3

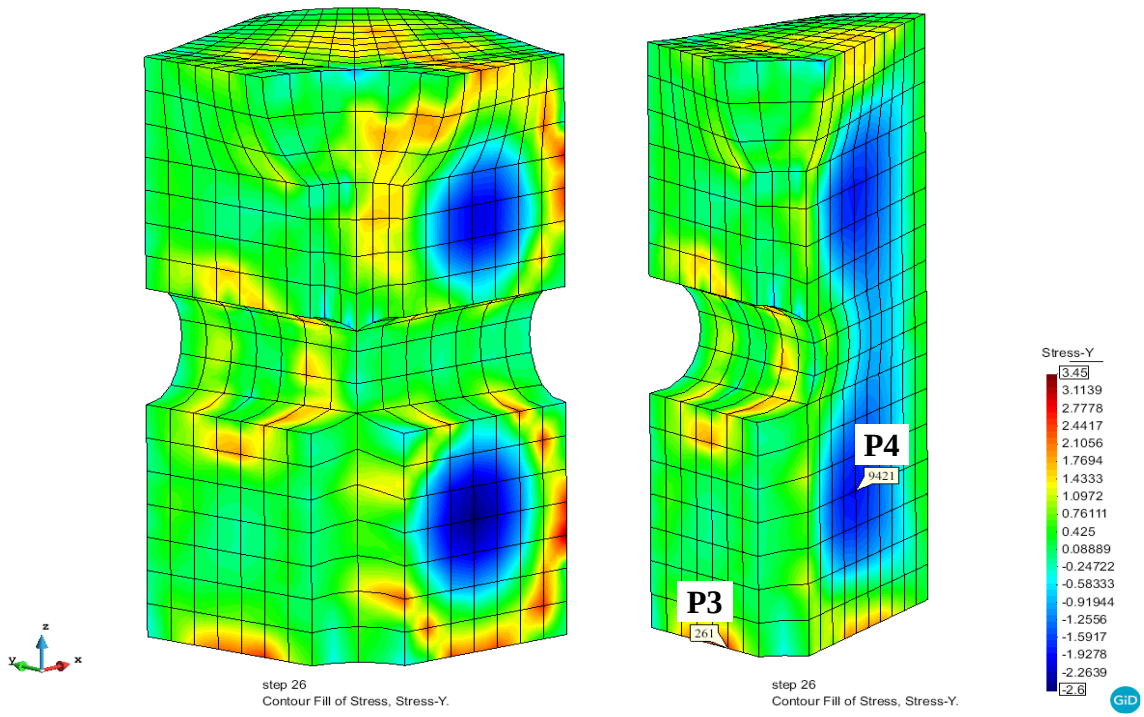


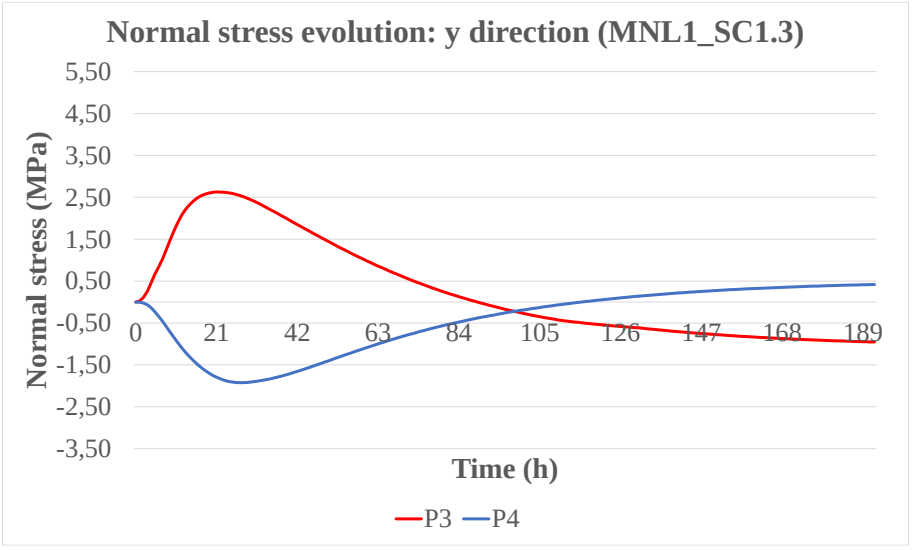


O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	3.36	26	-1.11	192	x
P2	0.69	192	-2.58	26	x

Parametric analysis: MNL1_SC1.3 and MNL2_SC1.3

MNL1_SC1.3 (cont.)

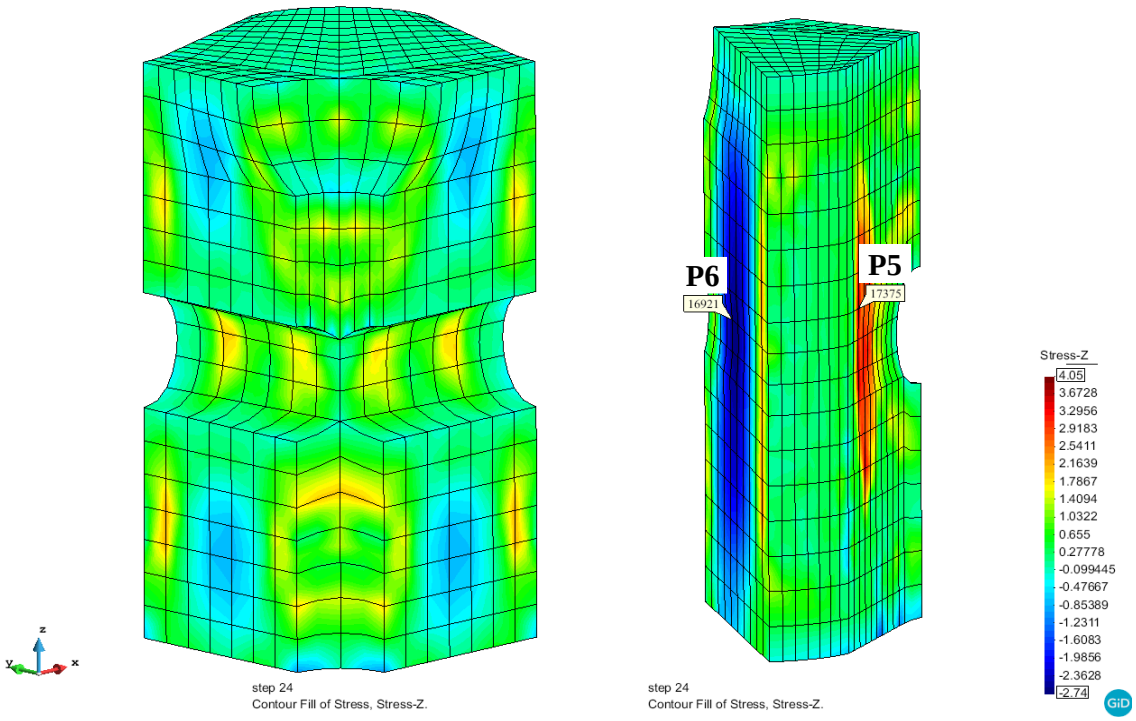


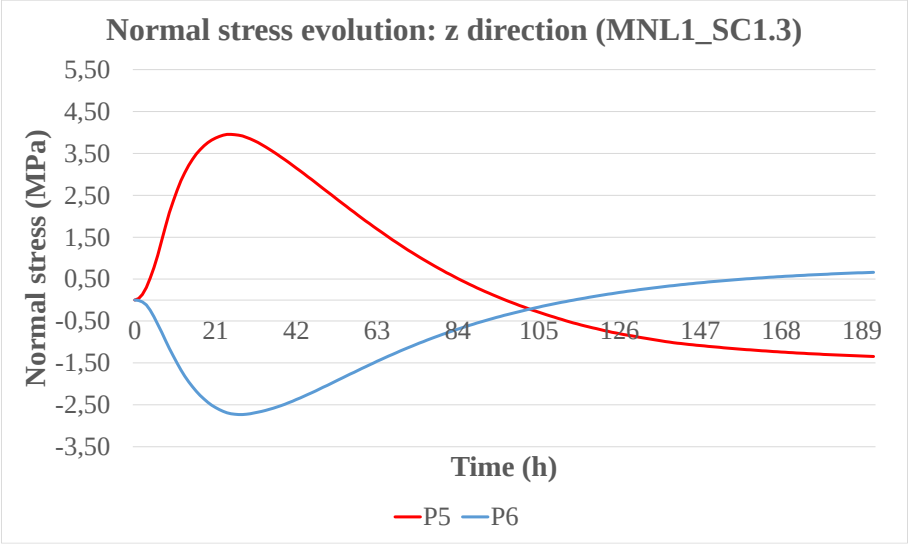


O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	2.63	21	-0.95	192	y
P4	0.42	192	-1.92	27	y

Parametric analysis: MNL1_SC1.3 and MNL2_SC1.3

MNL1_SC1.3 (cont.)

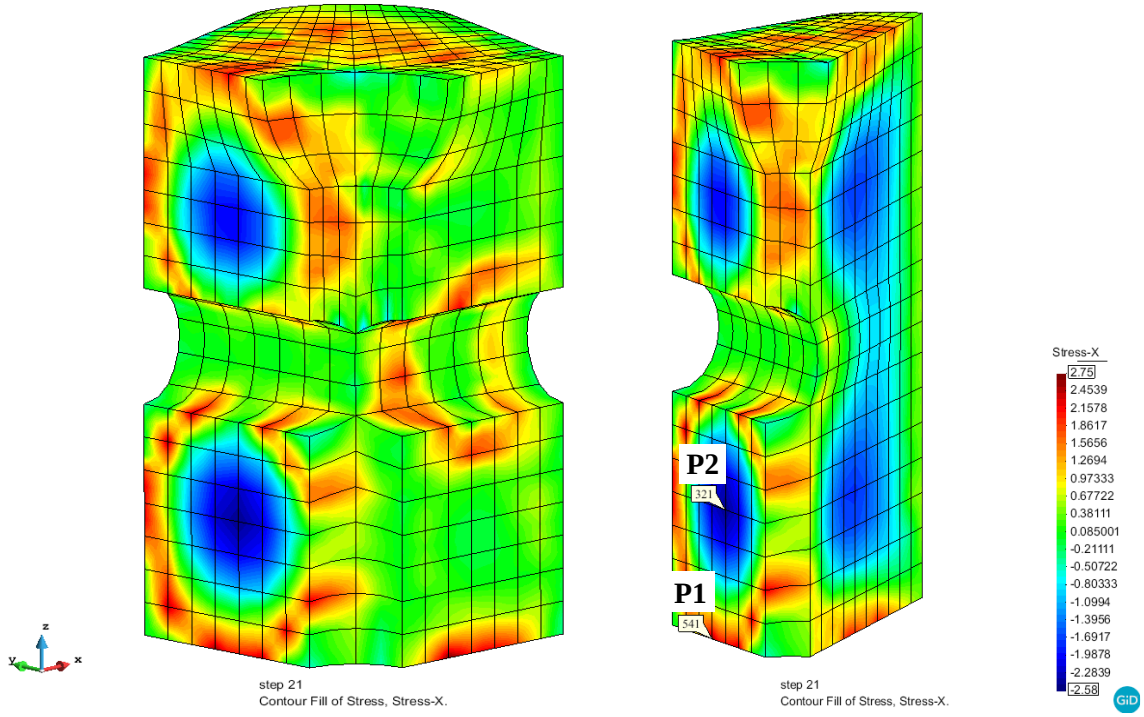


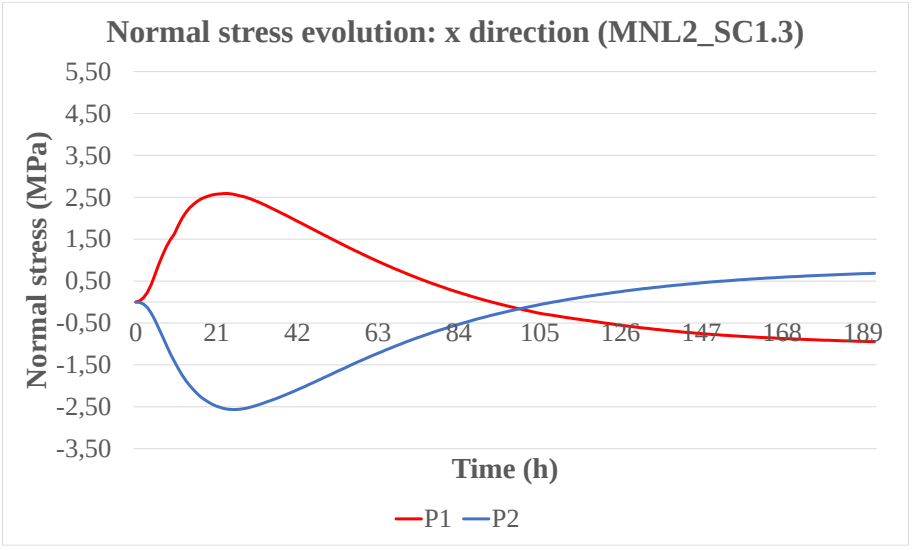


O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	3.95	25	-1.35	192	z
P6	0.66	192	-2.73	27	z

Parametric analysis: MNL1_SC1.3 and MNL2_SC1.3

MNL2_SC1.3

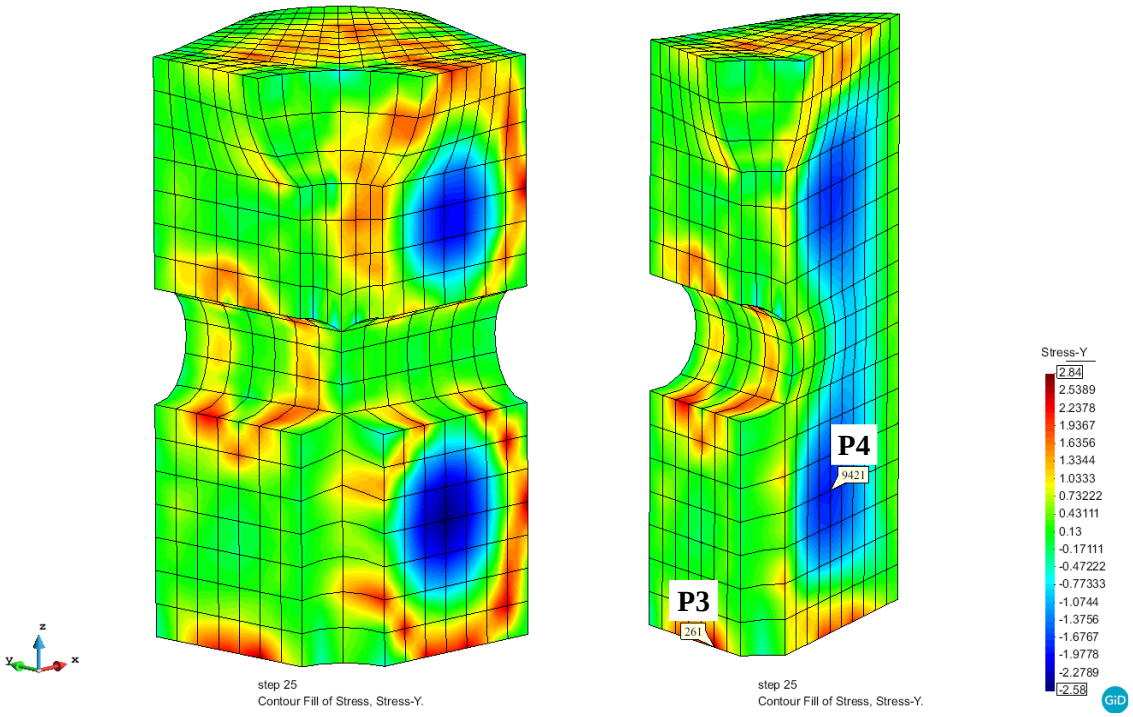


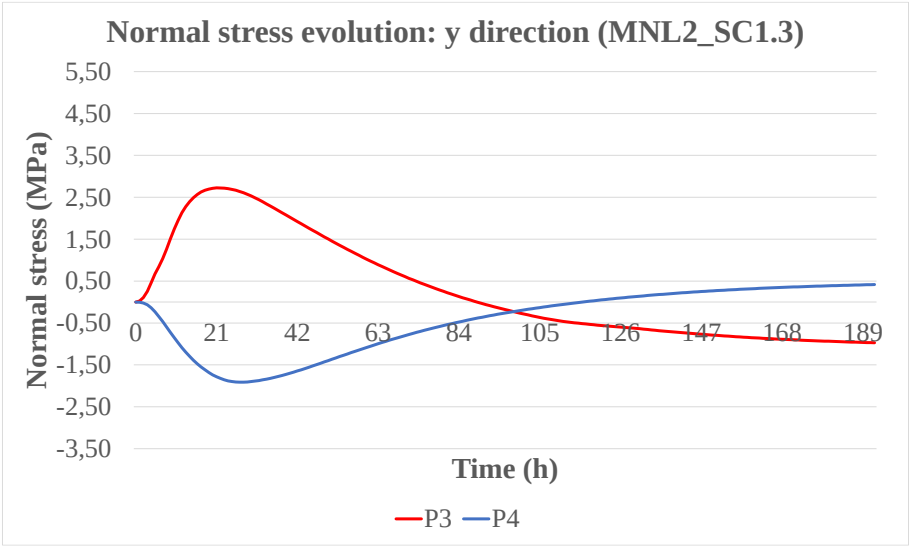


O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	2.59	23	-0.95	192	x
P2	0.69	192	-2.57	25	x

Parametric analysis: MNL1_SC1.3 and MNL2_SC1.3

MNL2_SC1.3 (cont.)

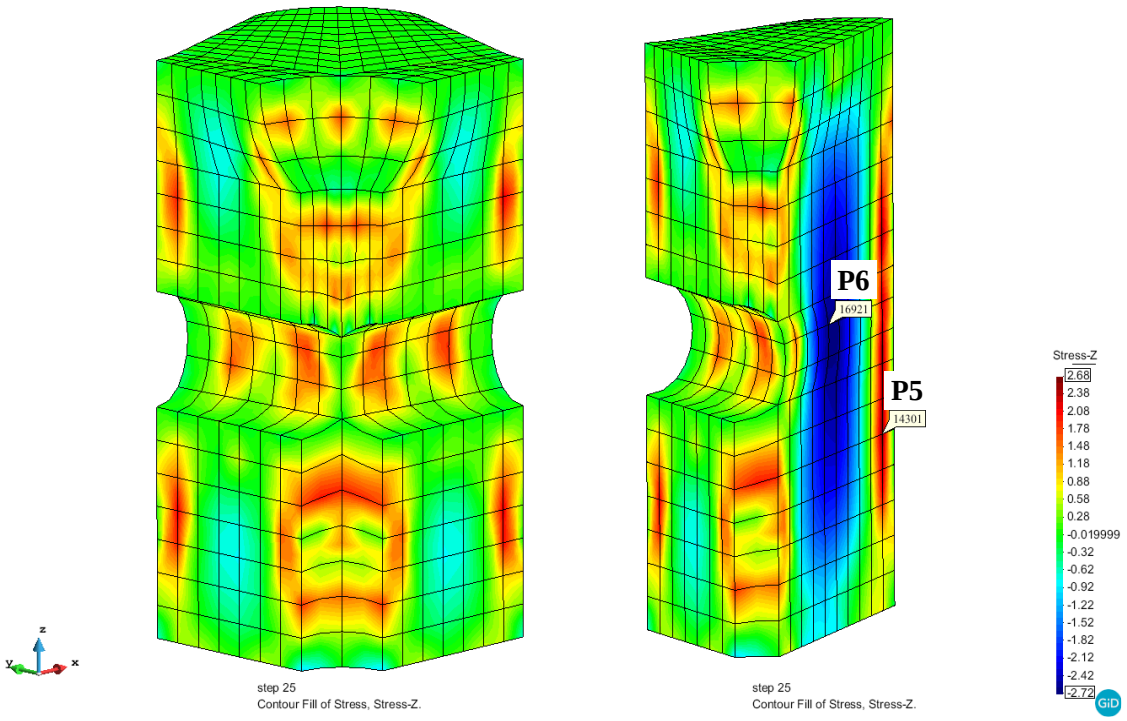


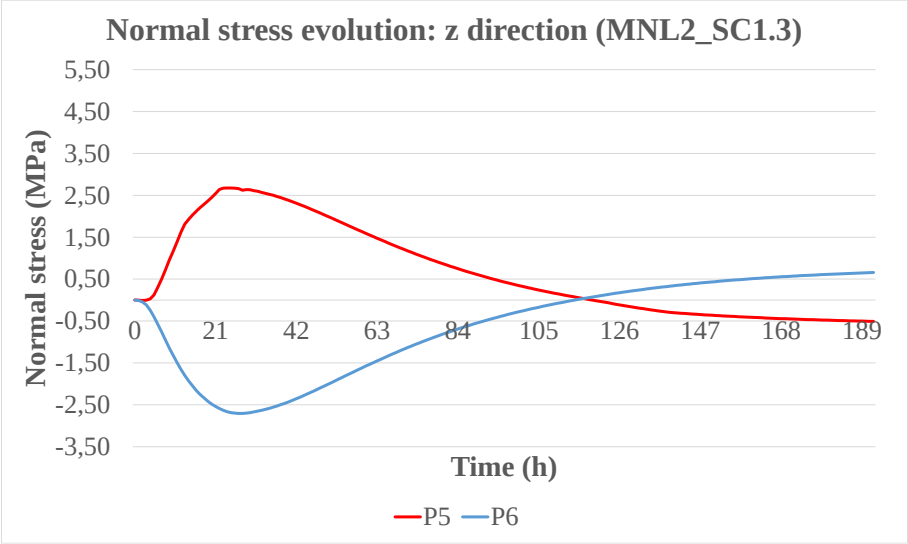


O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	2.72	21	-0.97	192	y
P4	0.42	192	-1.91	27	y

Parametric analysis: MNL1_SC1.3 and MNL2_SC1.3

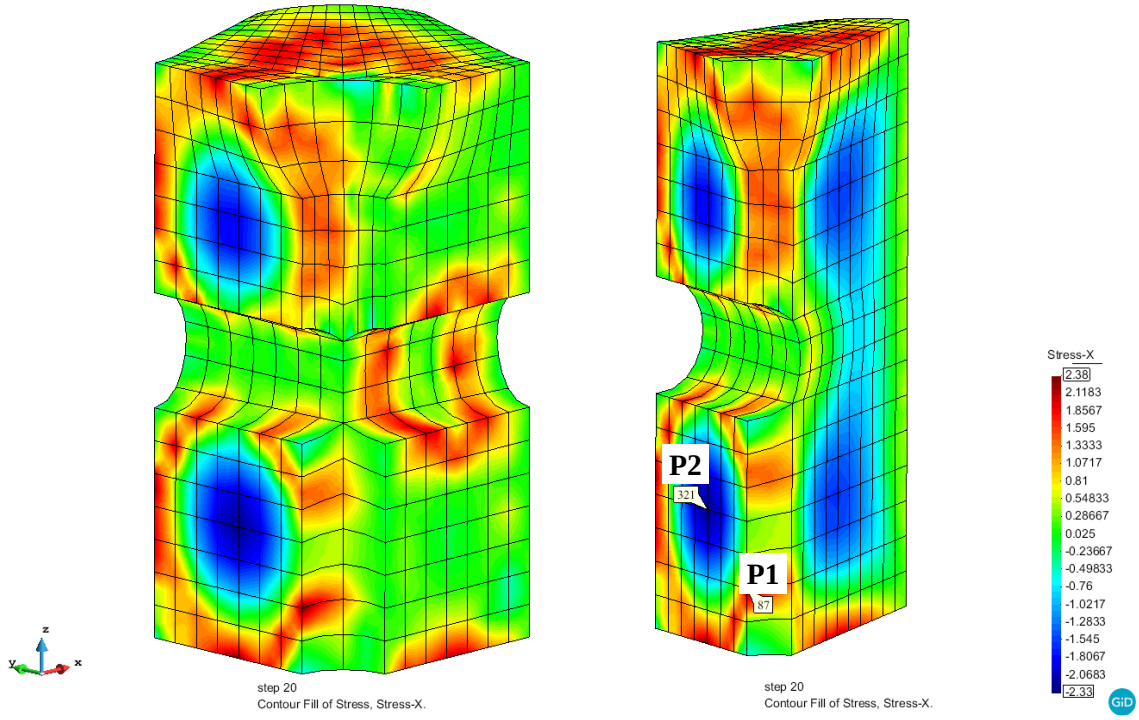
MNL2_SC1.3 (cont.)

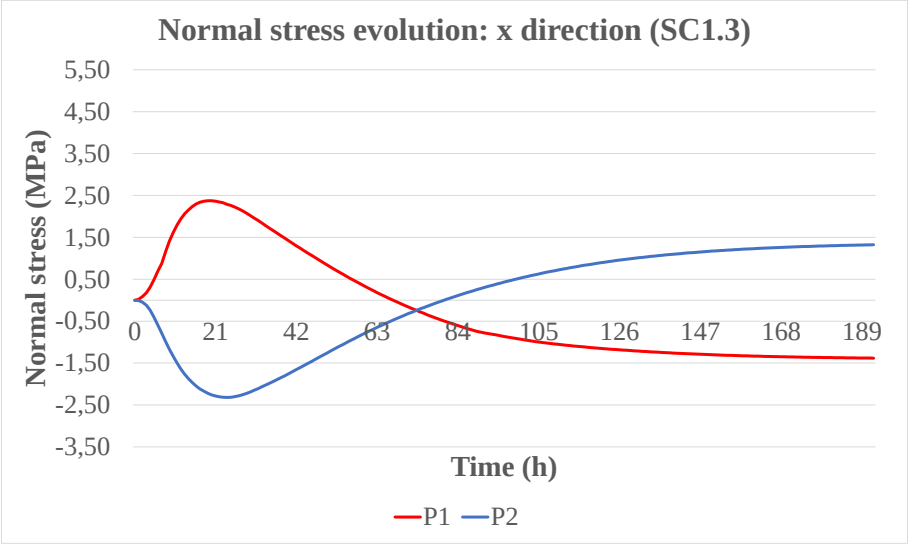




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	2.67	25	-0.51	192	z
P6	0.66	192	-2.71	27	z

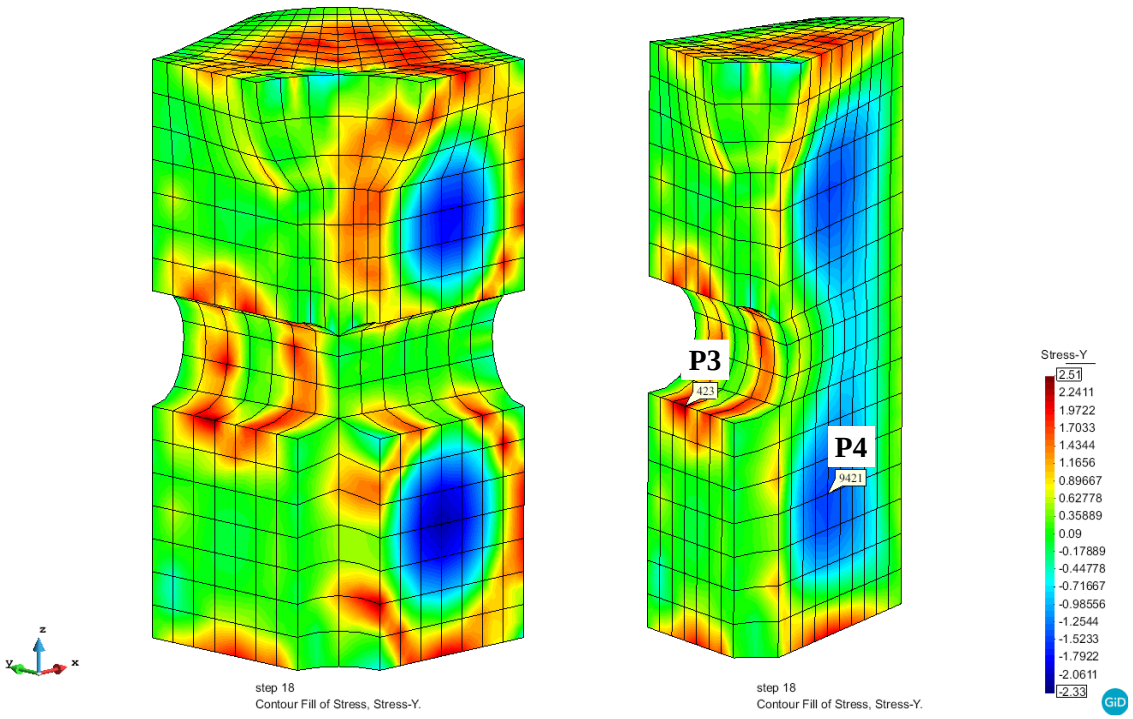
SC1.3

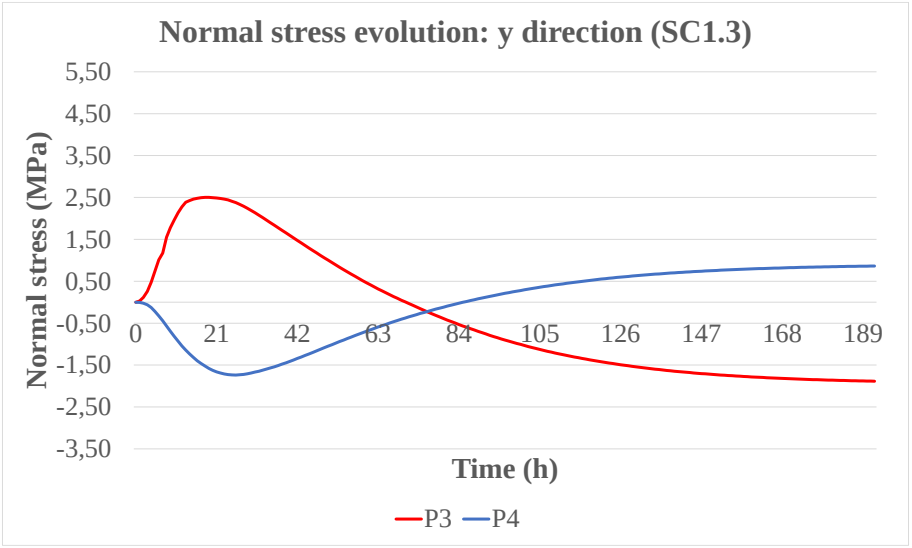




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	2.37	20	-1.38	192	x
P2	1.32	192	-2.32	24	x

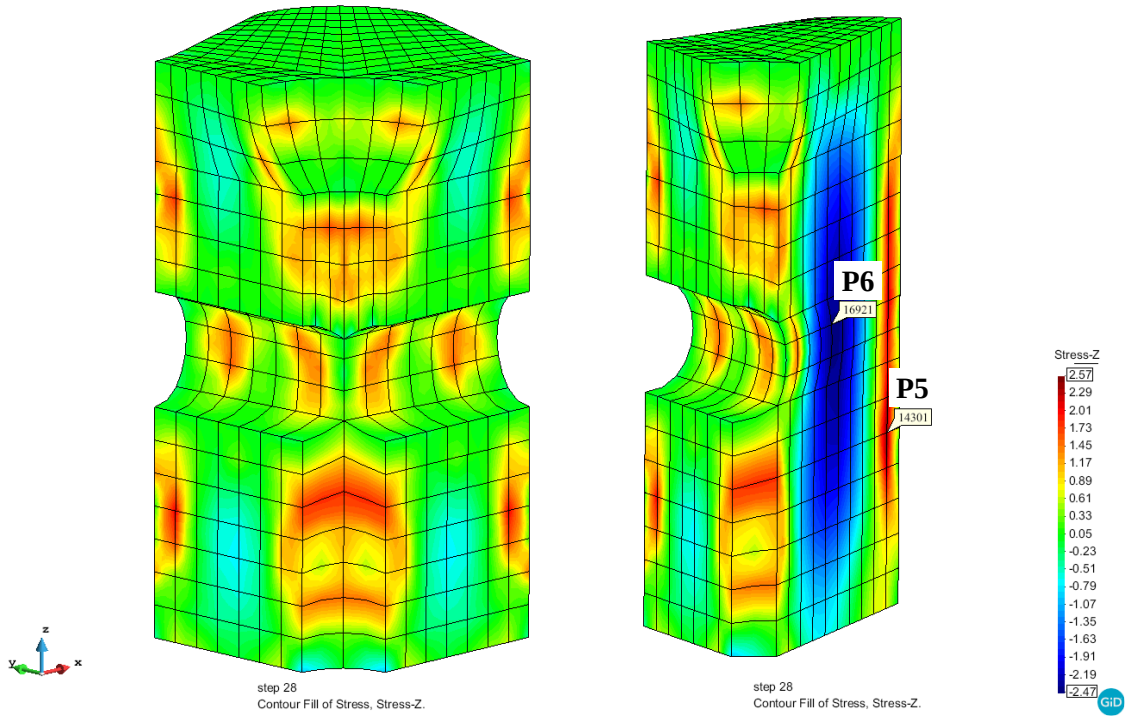
SC1.3 (cont.)

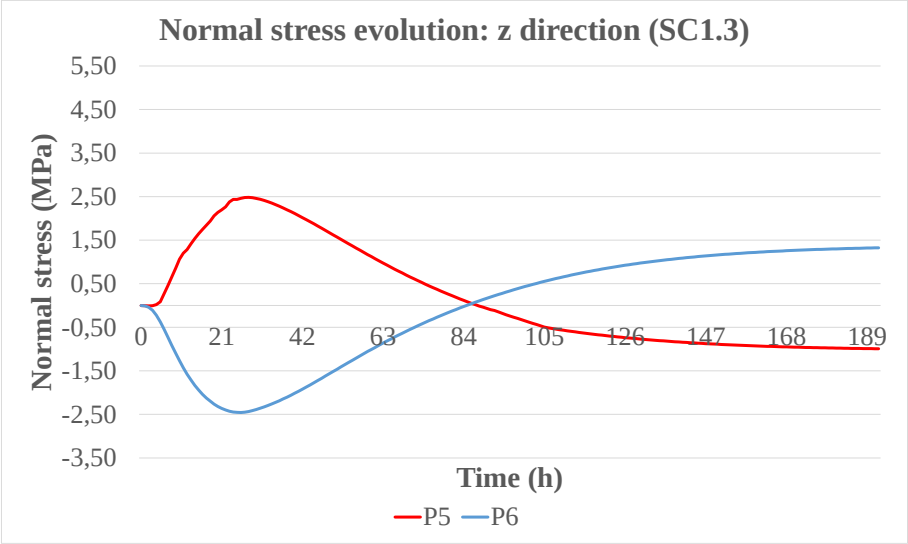




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	2.50	18	-1.88	192	y
P4	0.86	192	-1.74	26	y

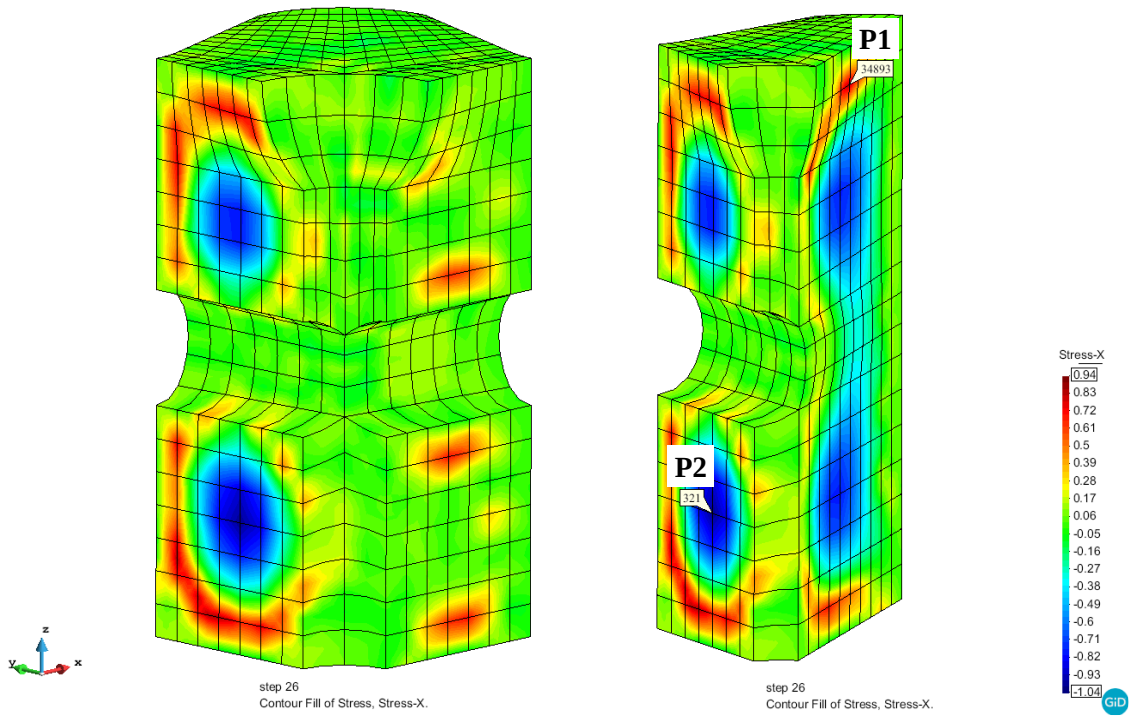
SC1.3 (cont.)

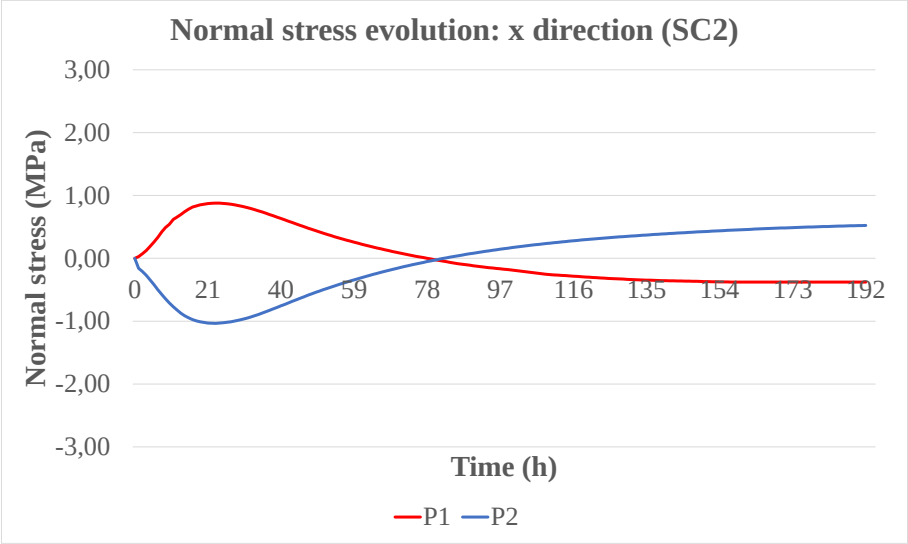




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	2.48	28	-0.99	192	z
P6	1.32	192	-2.46	26	z

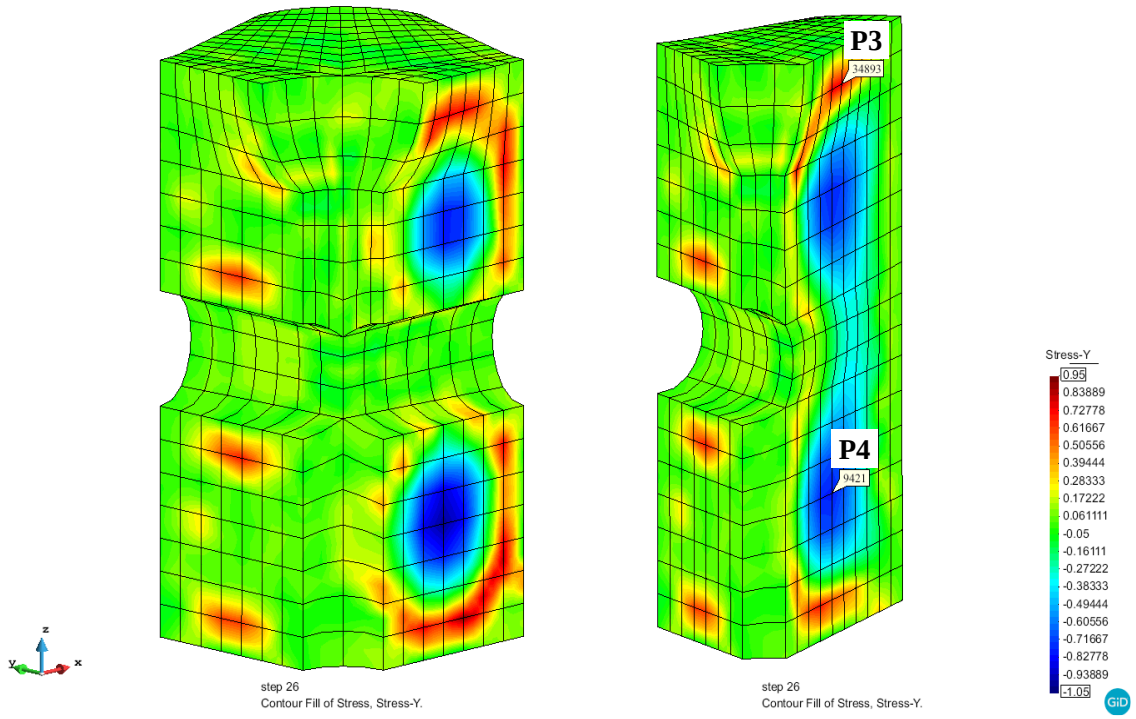
SC2

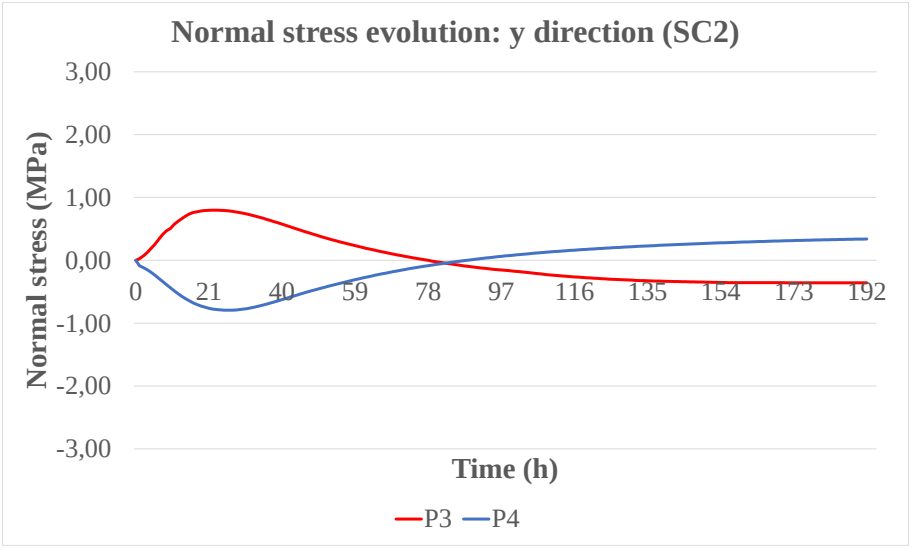




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	0.88	23	-0.38	192	x
P2	0.52	192	-1.03	23	x

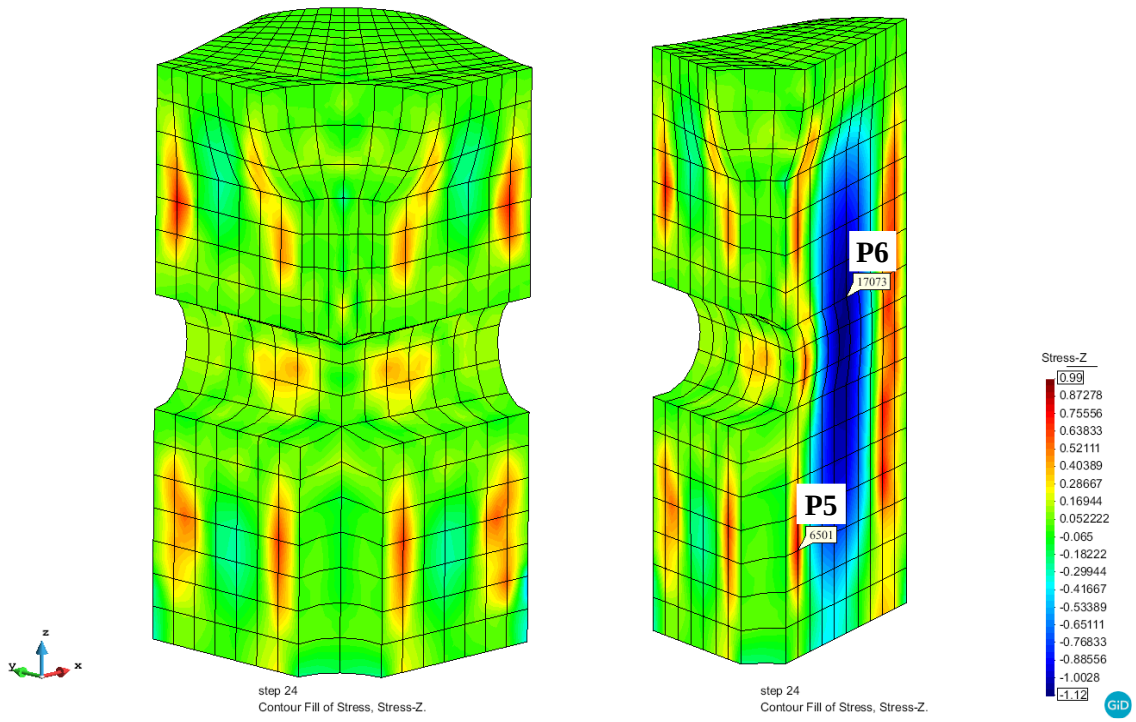
SC2 (cont.)

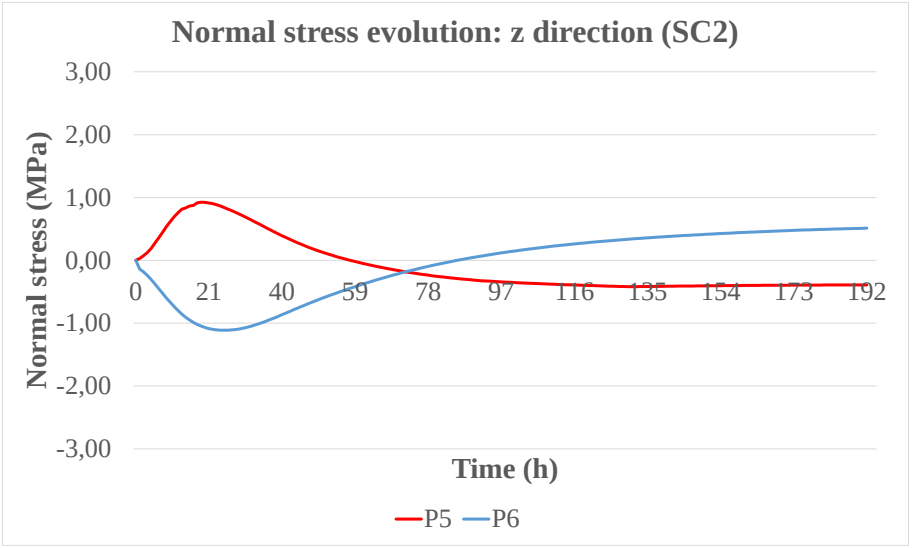




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	0.80	22	-0.36	192	y
P4	0.34	192	-0.79	26	y

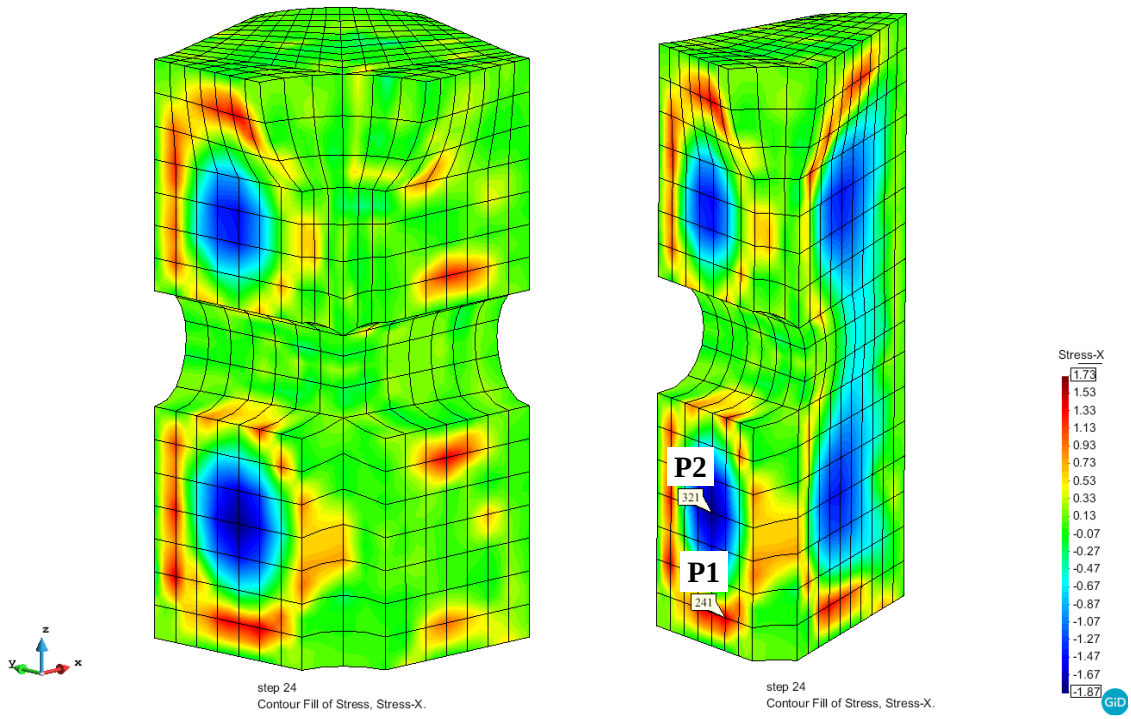
SC2 (cont.)

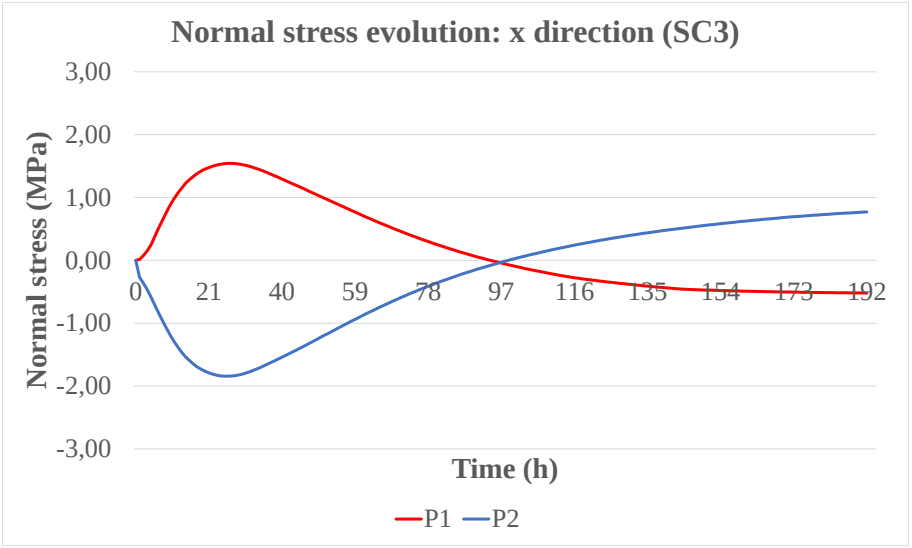




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	0.92	19	-0.42	131	z
P6	0.51	192	-1.11	25	z

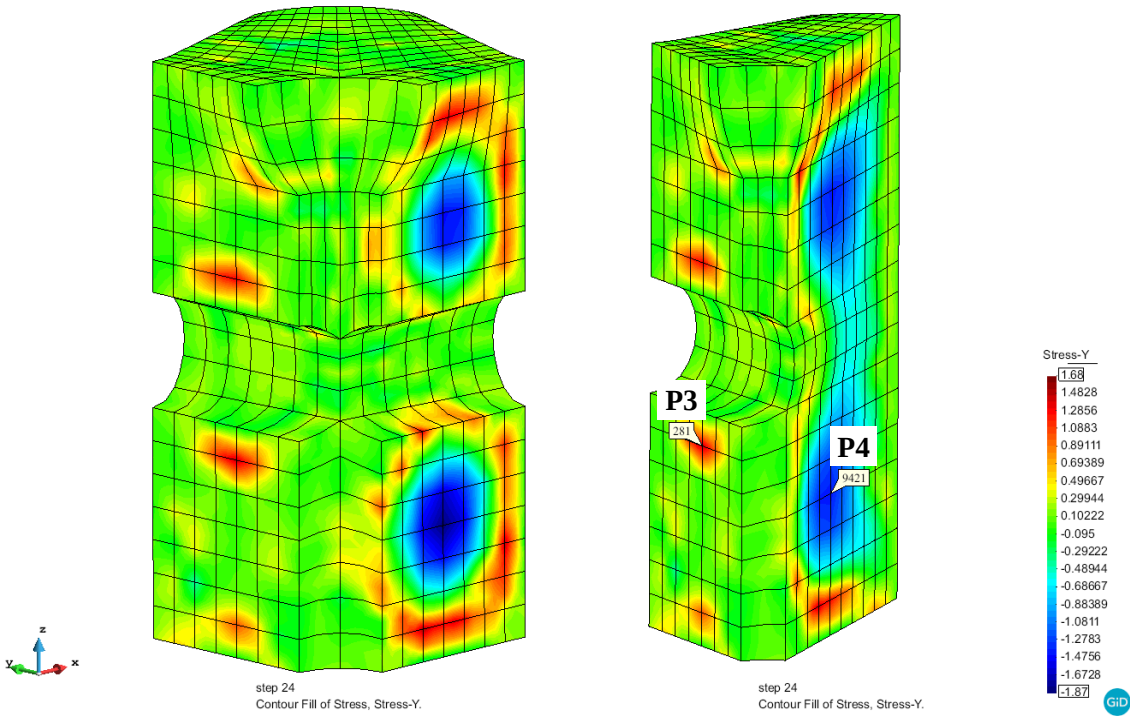
SC3

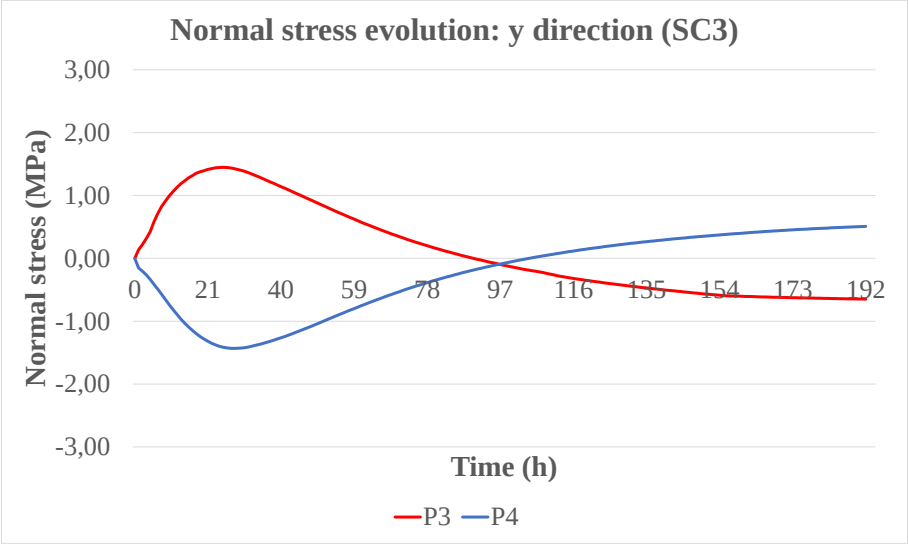




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	1.54	27	-0.52	192	x
P2	0.77	192	-1.84	26	x

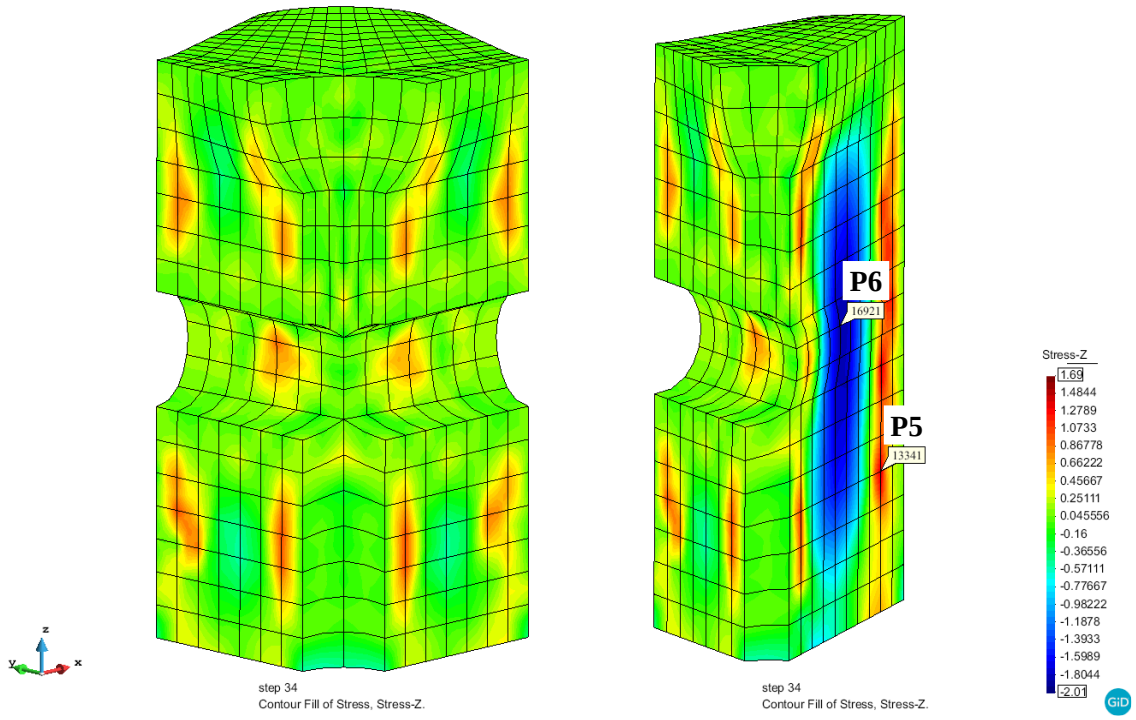
SC3 (cont.)

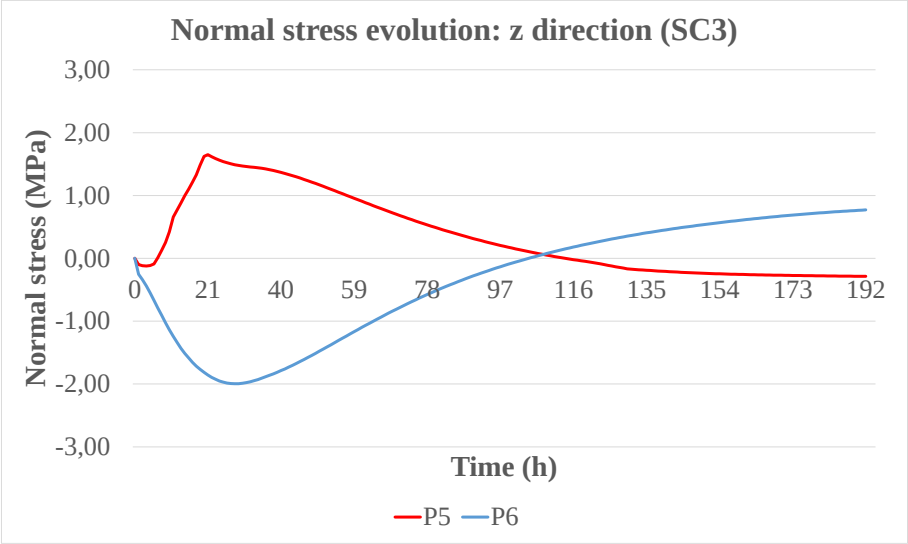




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	1.45	25	-0.65	192	y
P4	0.51	192	-1.43	28	y

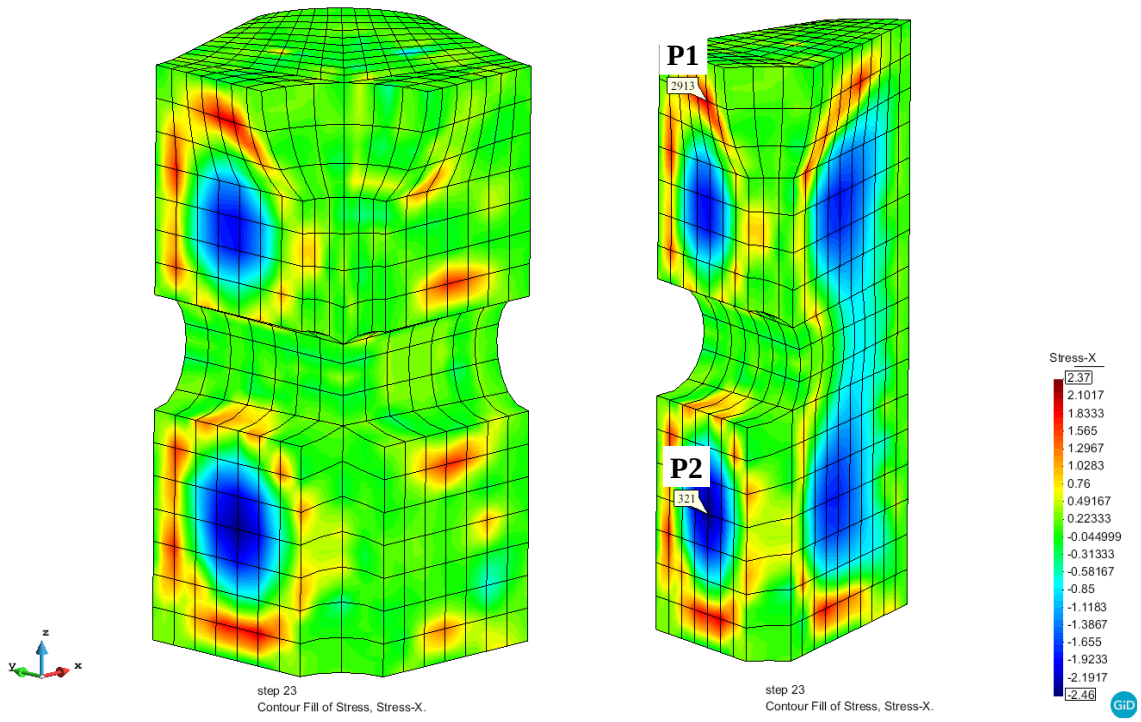
SC3 (cont.)

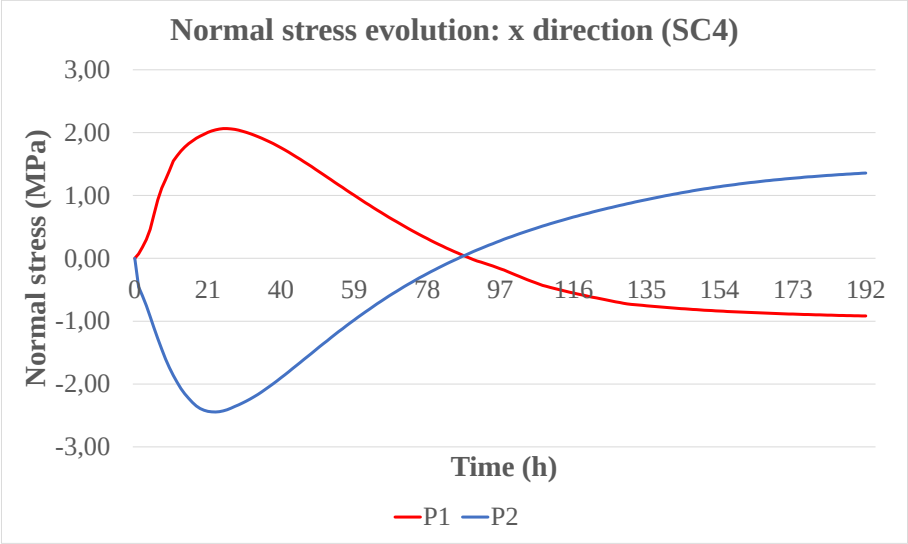




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	1.65	21	-0.29	192	z
P6	0.77	192	-2.00	28	z

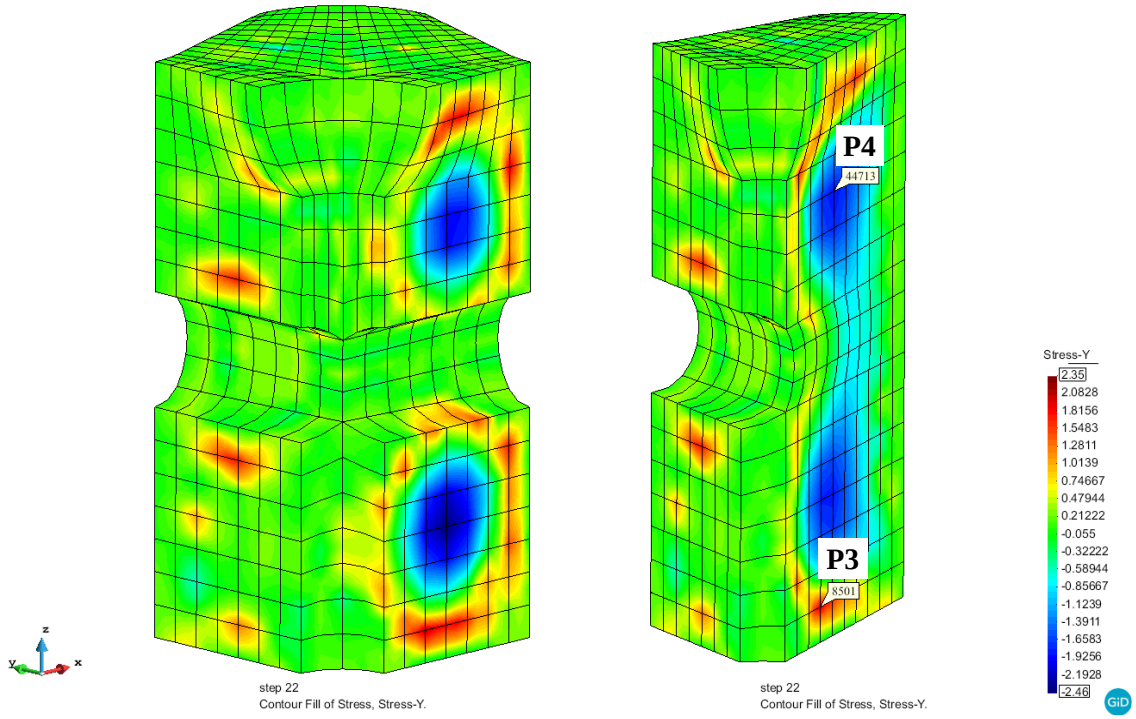
SC4

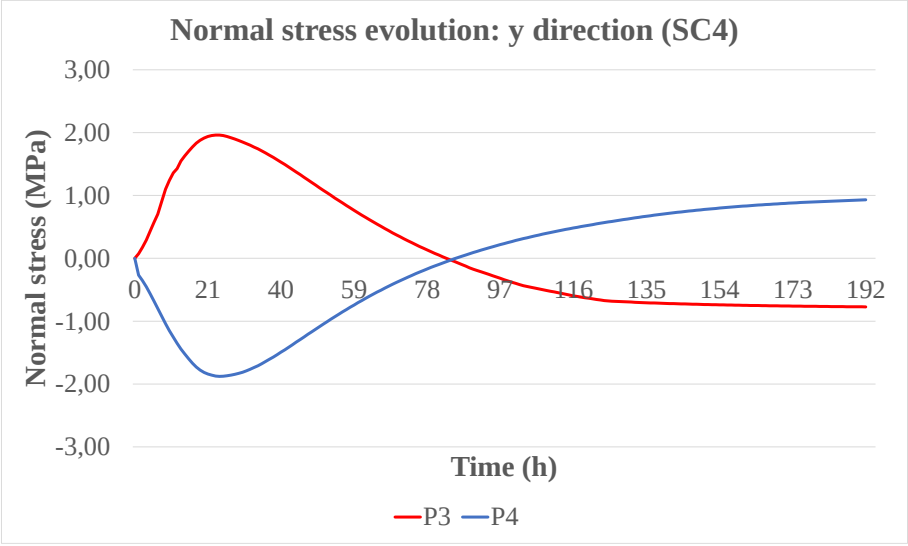




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	2.06	26	-0.92	192	x
P2	1.36	192	-2.45	23	x

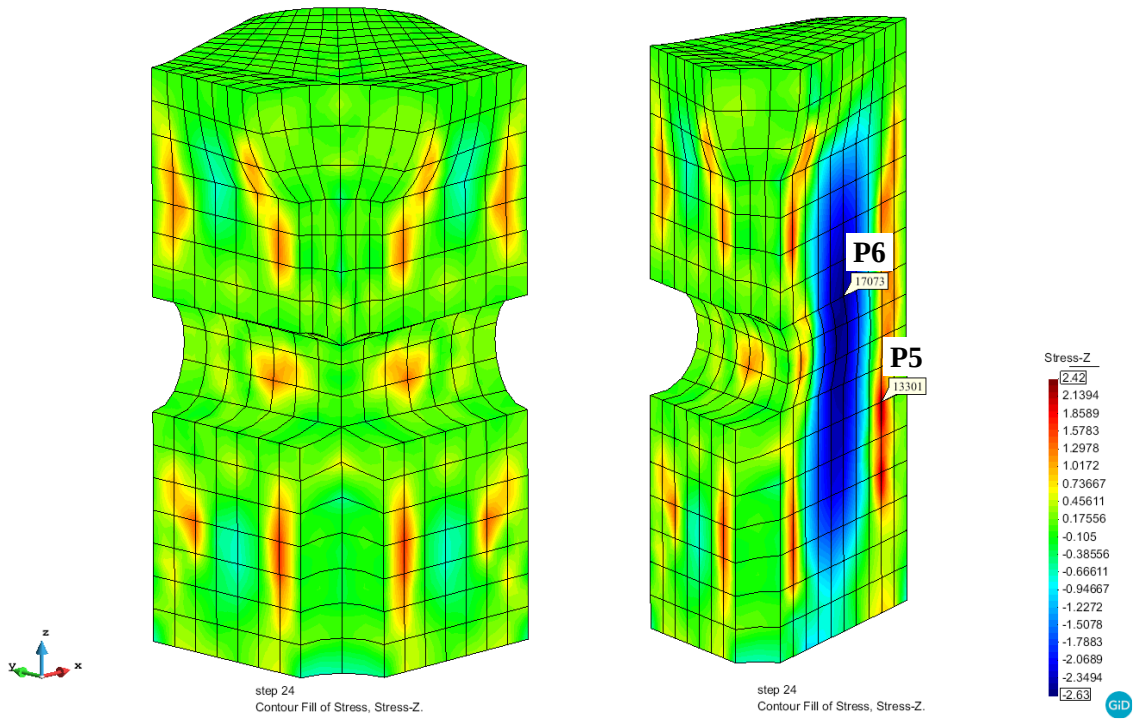
SC4 (cont.)

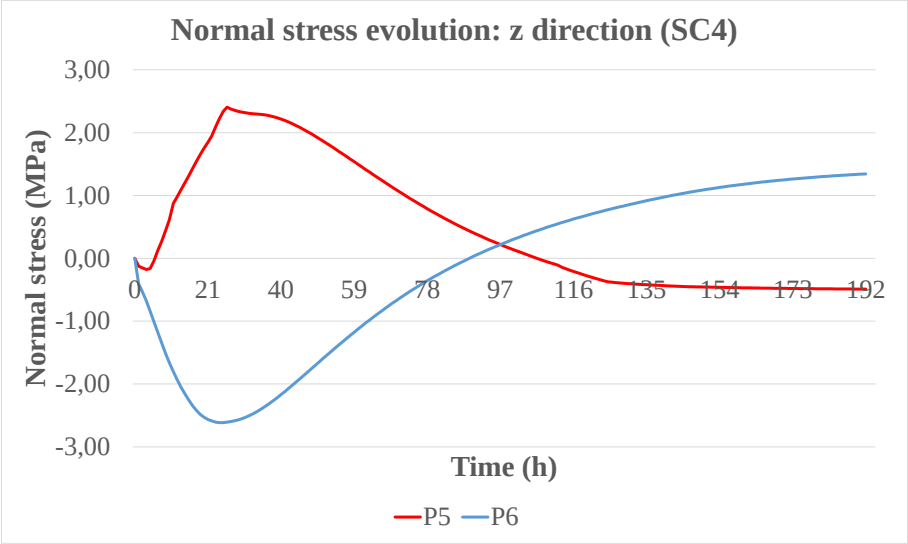




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	1.96	23	-0.77	192	y
P4	0.93	192	-1.88	24	y

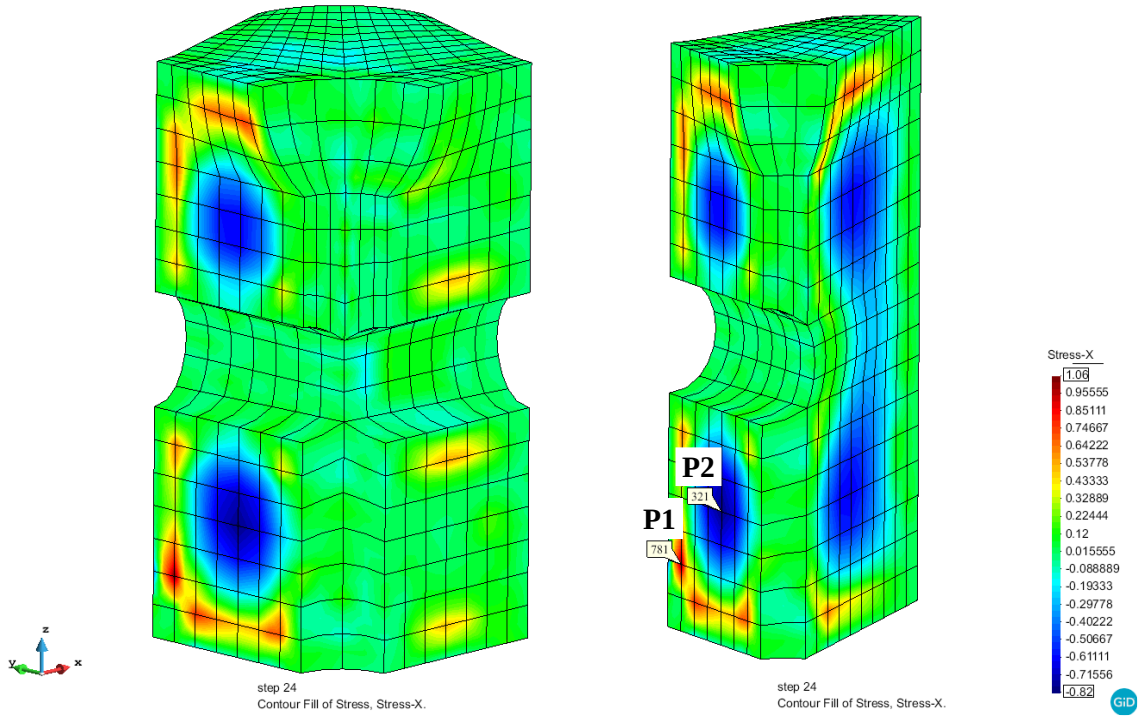
SC4 (cont.)

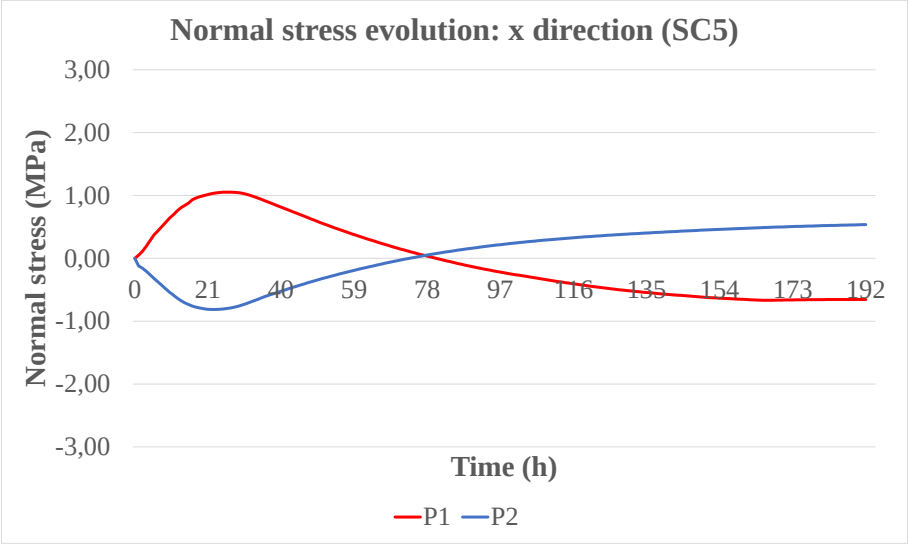




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	2.40	26	-0.49	192	z
P6	1.34	192	-2.62	24	z

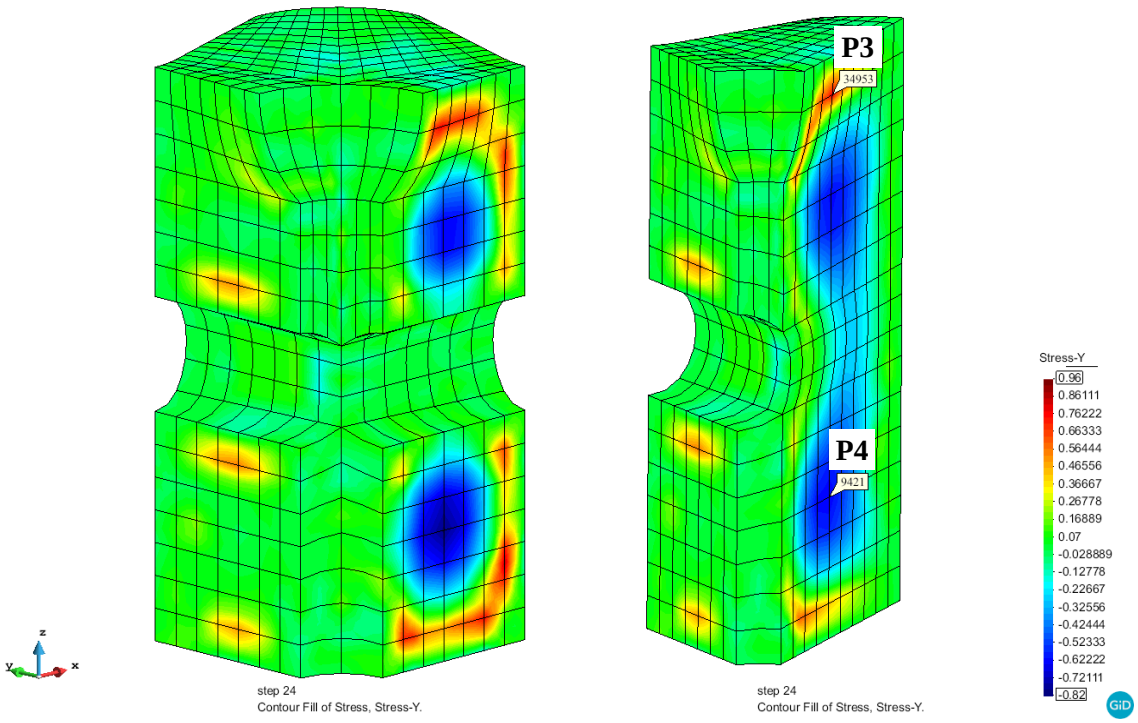
SC5

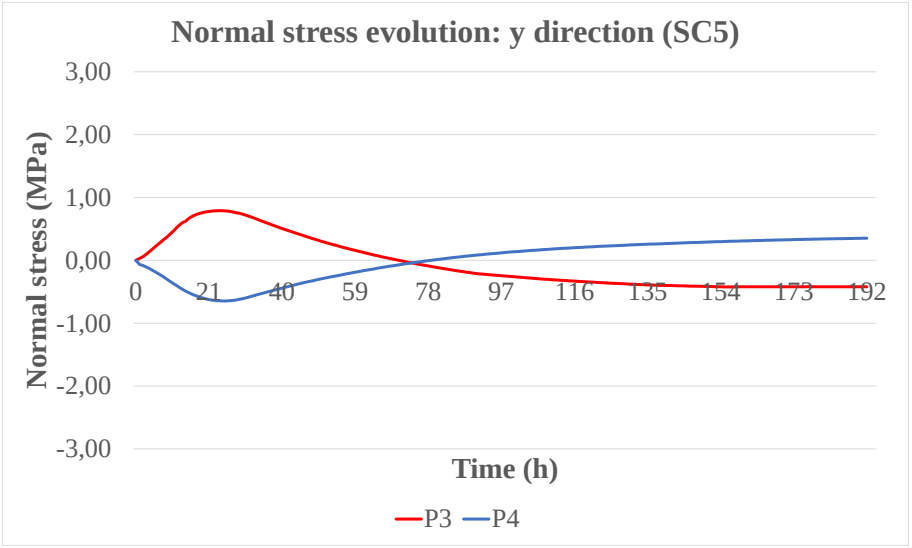




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	1.05	26	-0.67	166	x
P2	0.54	192	-0.81	23	x

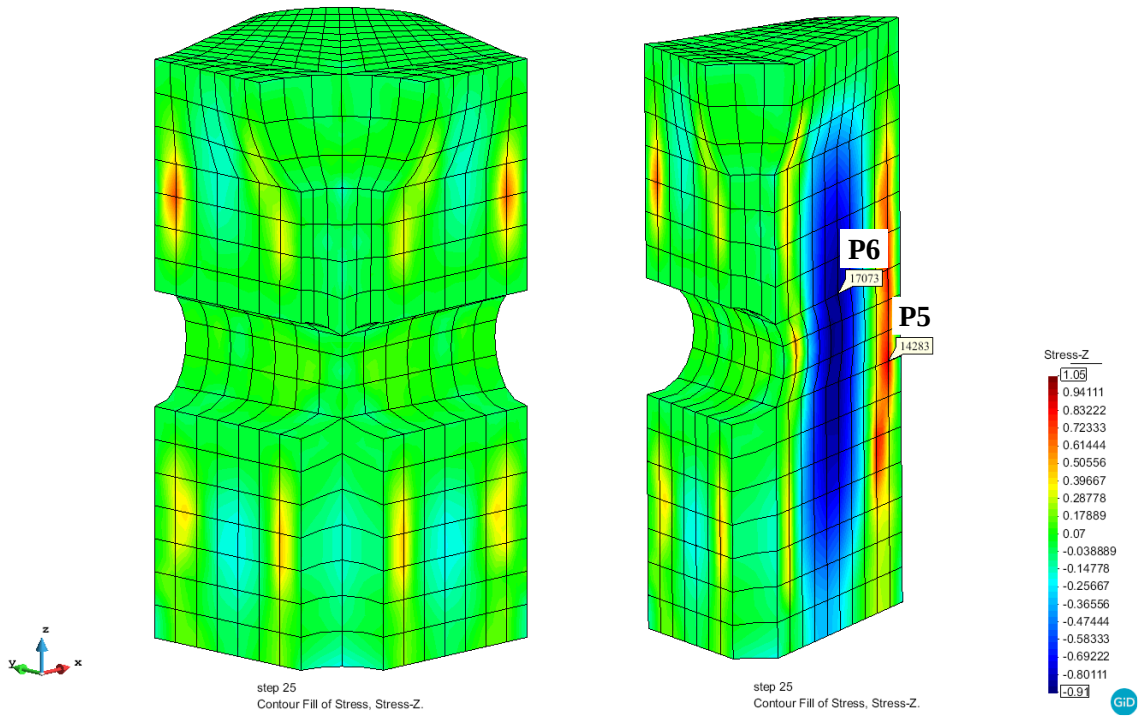
SC5 (cont.)

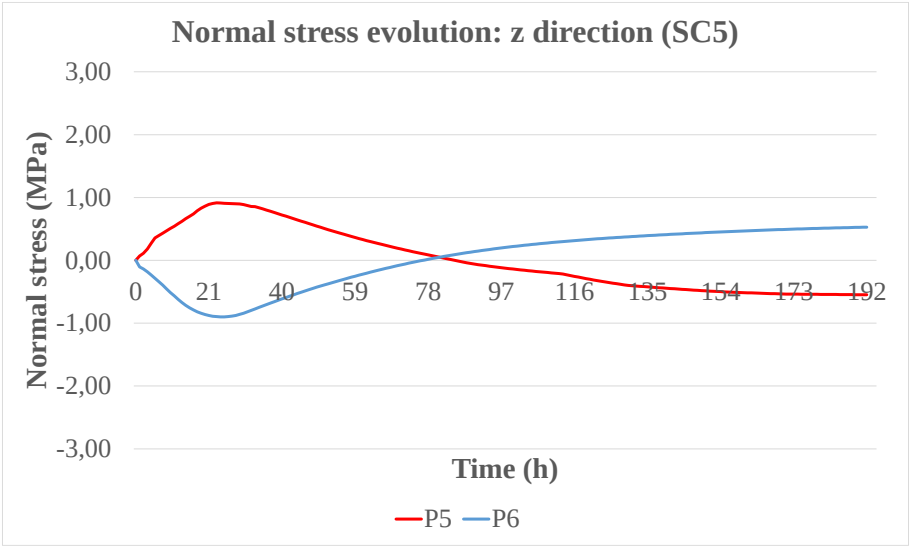




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	0.79	24	-0.42	156	y
P4	0.35	192	-0.65	25	y

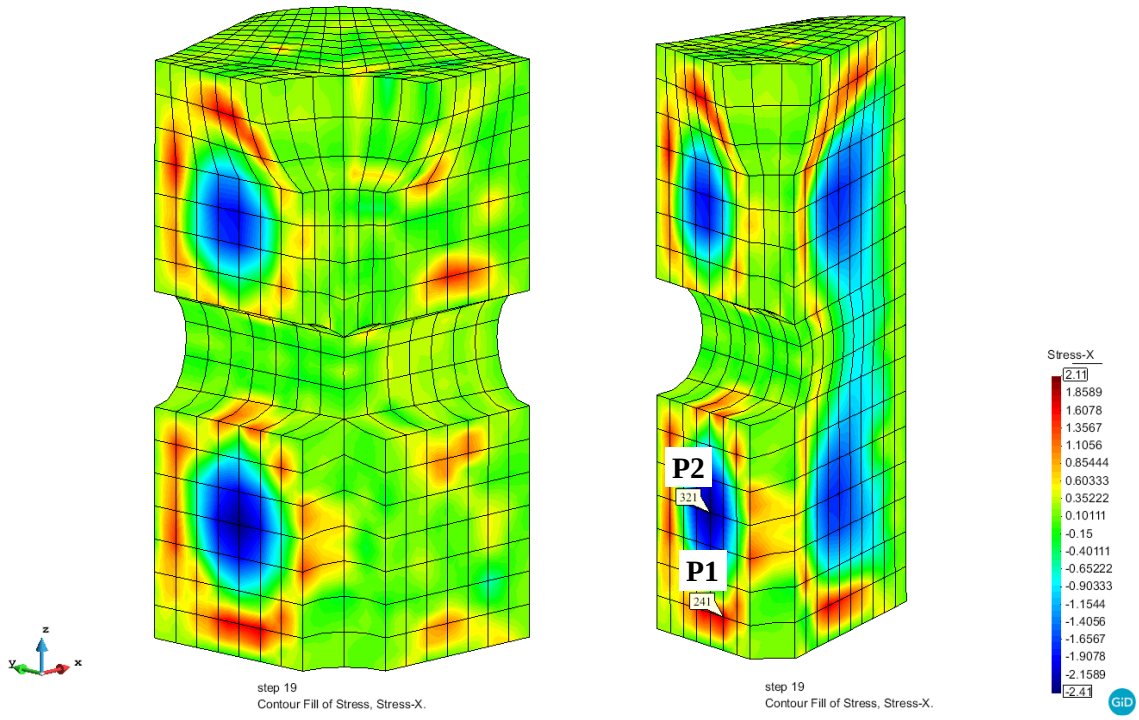
SC5 (cont.)

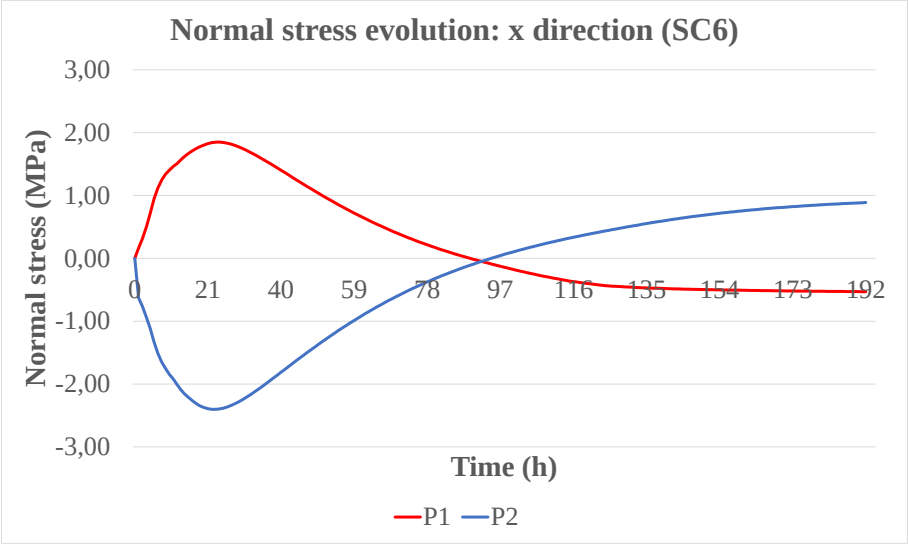




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	0.92	23	-0.55	192	z
P6	0.53	192	-0.90	24	z

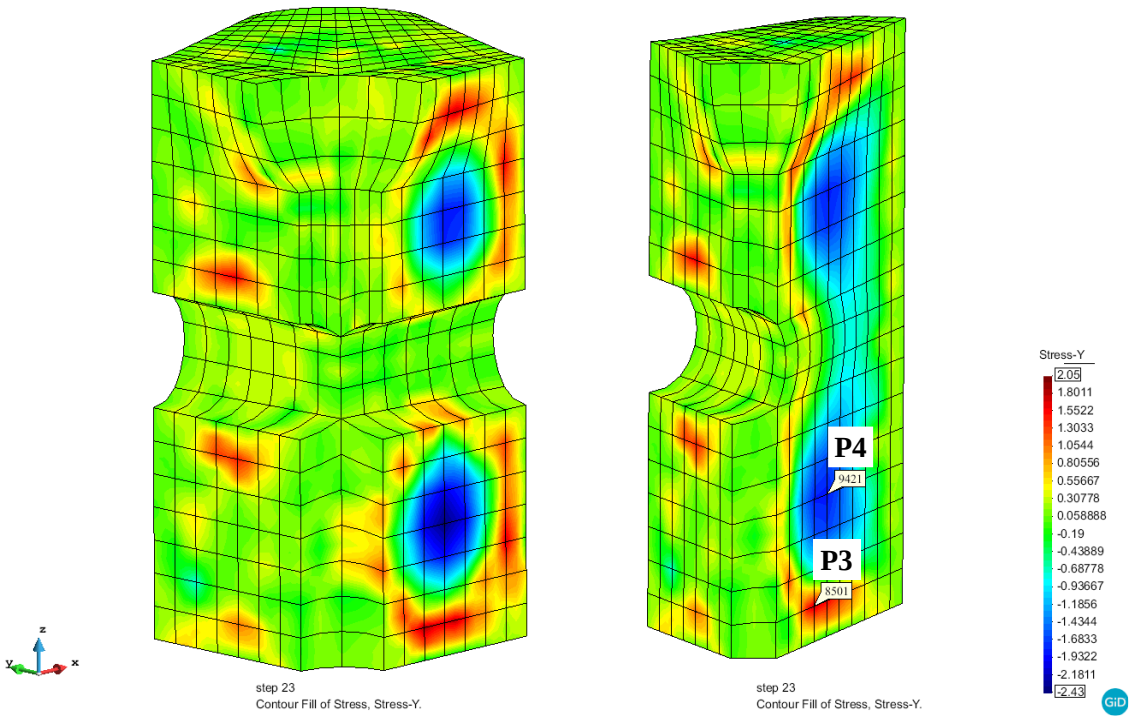
SC6

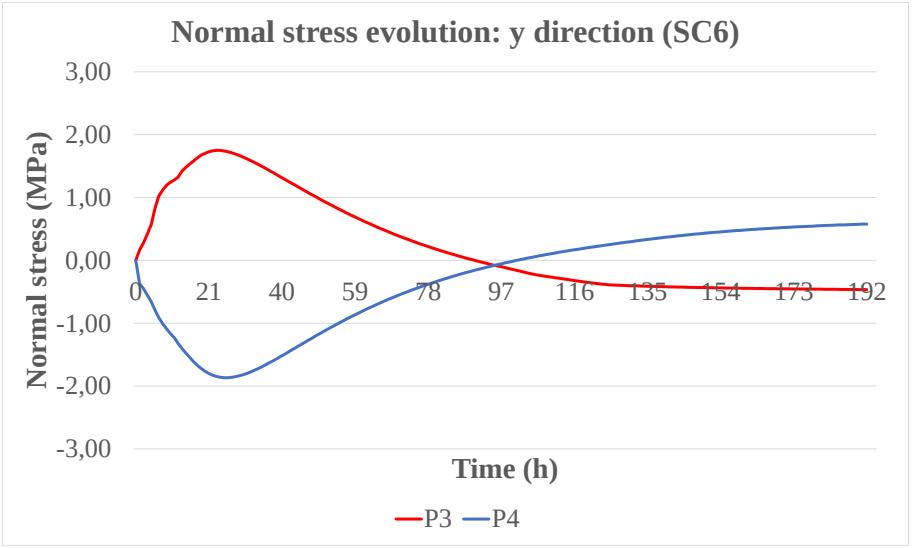




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	1.85	24	-0.53	192	x
P2	0.89	192	-2.40	23	x

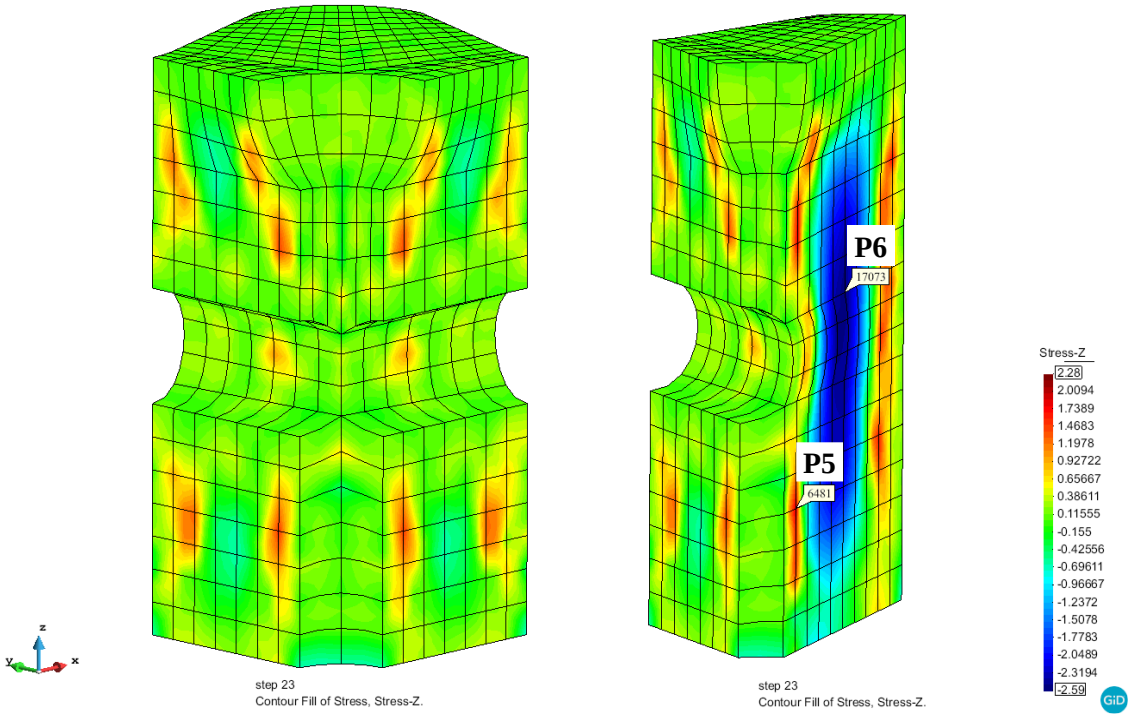
SC6 (cont.)

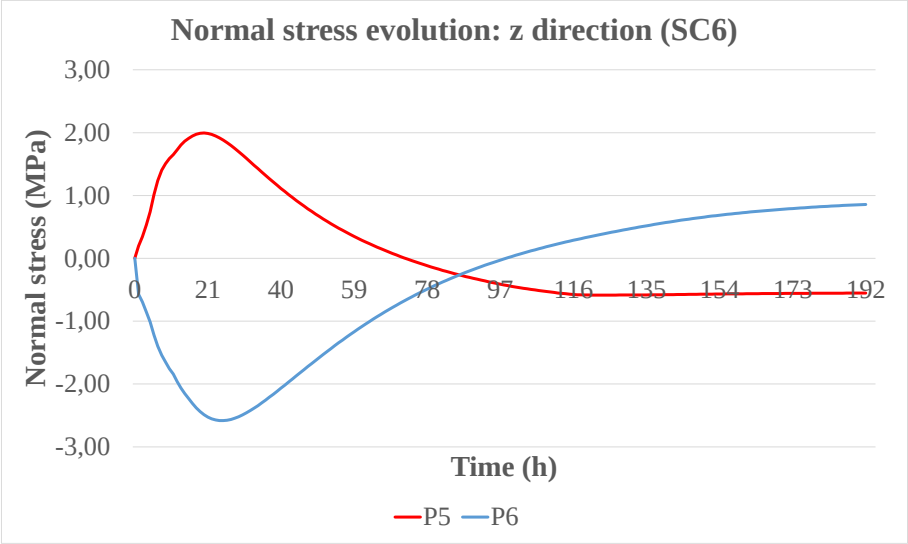




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	1.75	23	-0.47	192	y
P4	0.58	192	-1.87	26	y

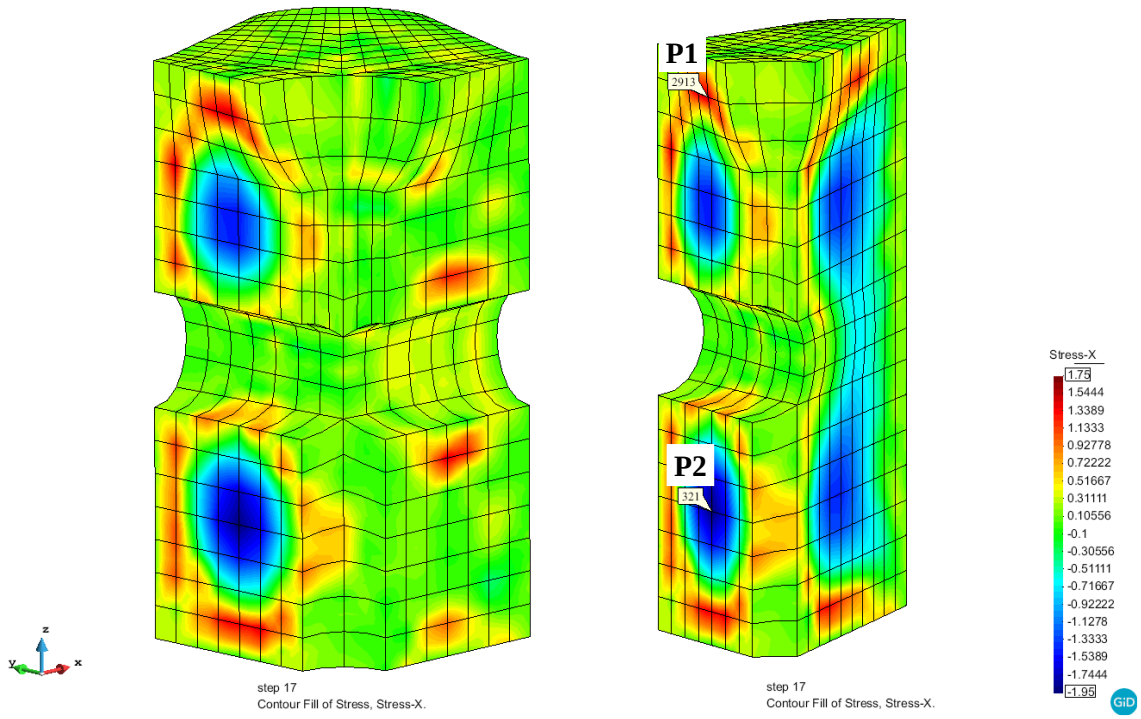
SC6 (cont.)

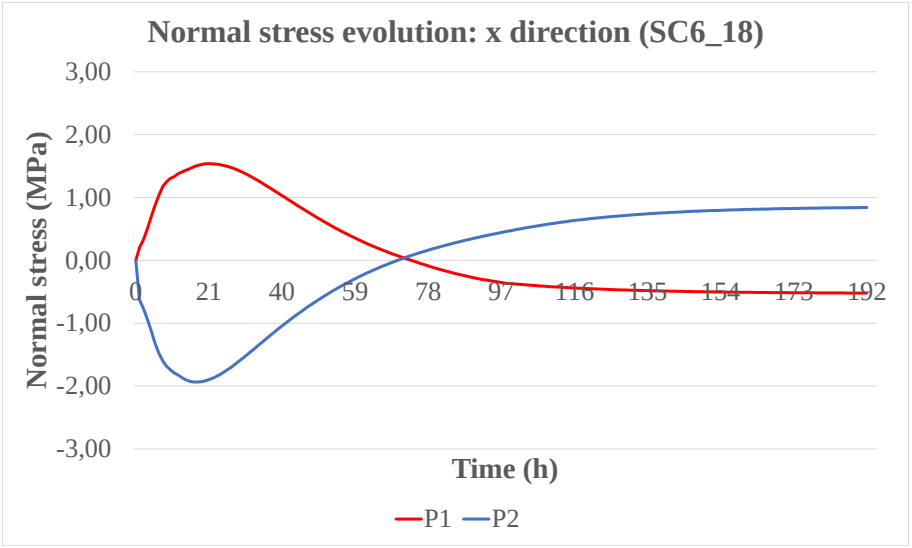




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	1.99	20	-0.58	122	z
P6	0.86	192	-2.58	25	z

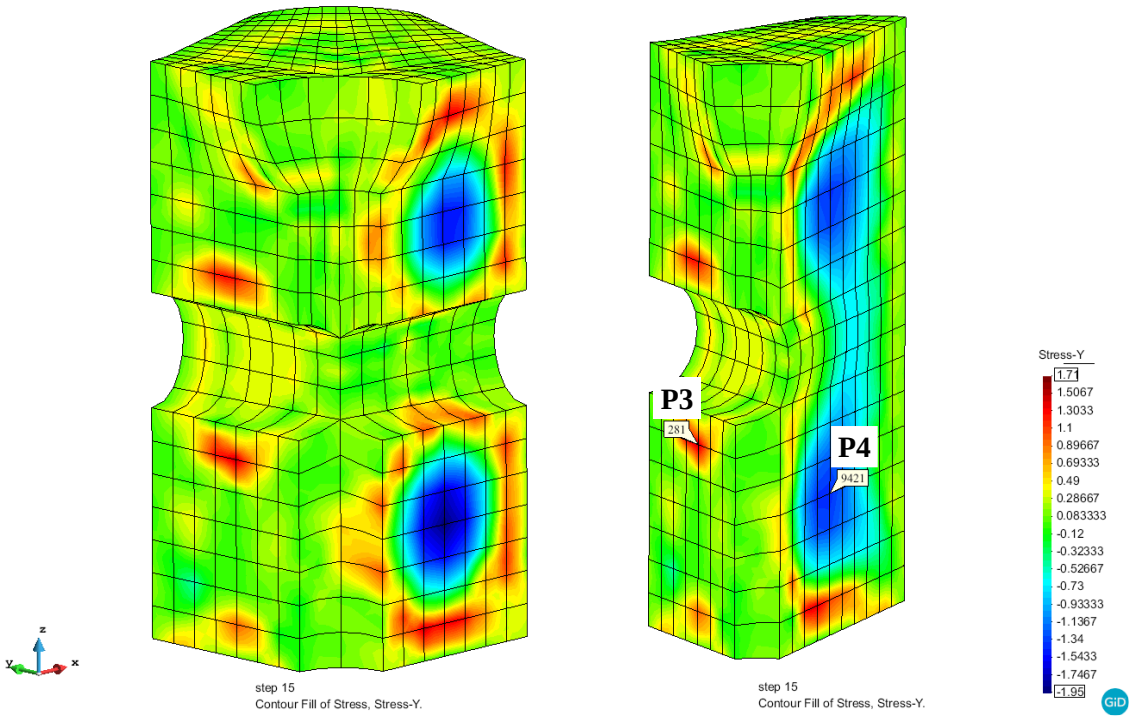
SC6_18

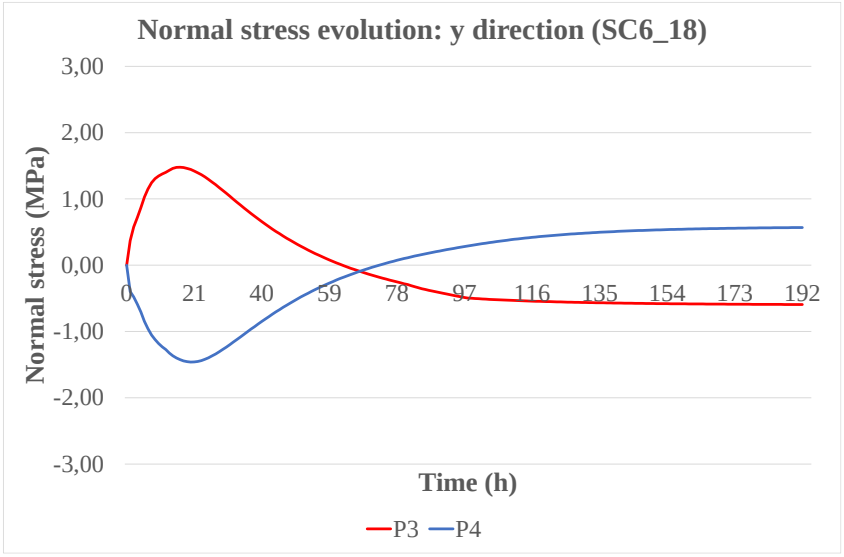




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	1.54	21	-0.52	192	x
P2	0.84	192	-1.94	18	x

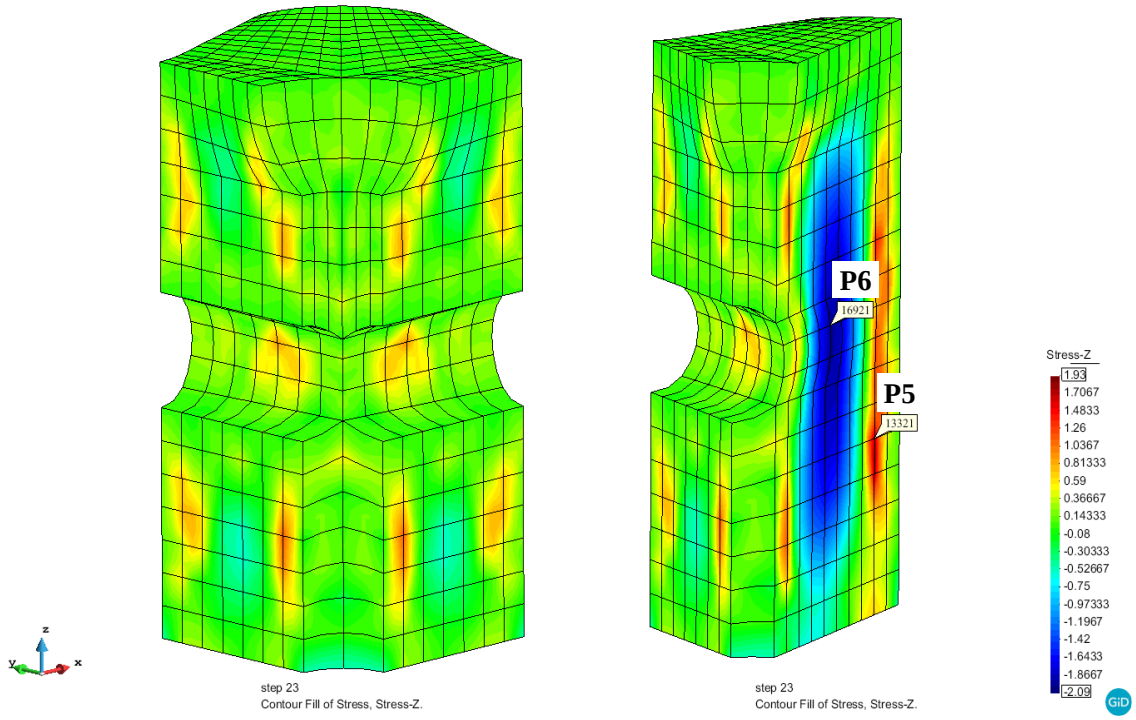
SC6_18 (cont.)

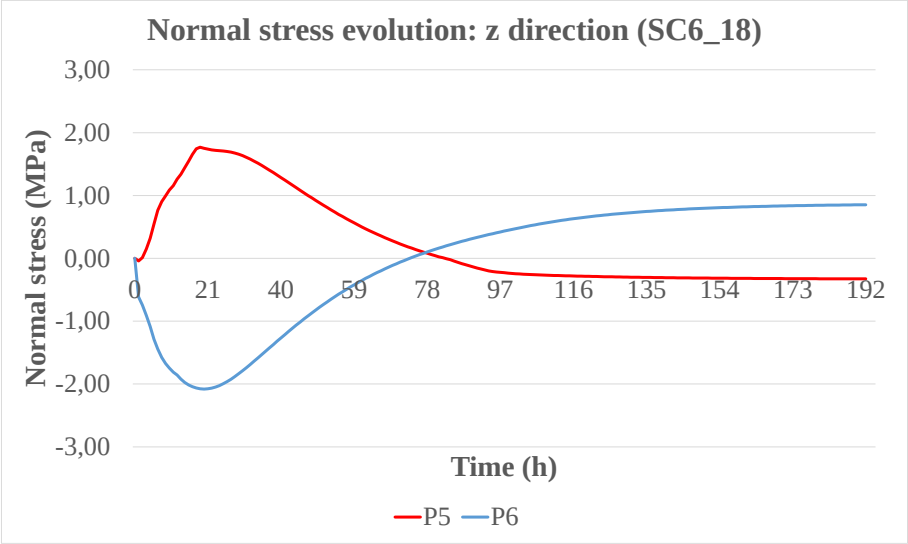




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	1.48	17	-0.59	192	y
P4	0.57	192	-1.46	20	y

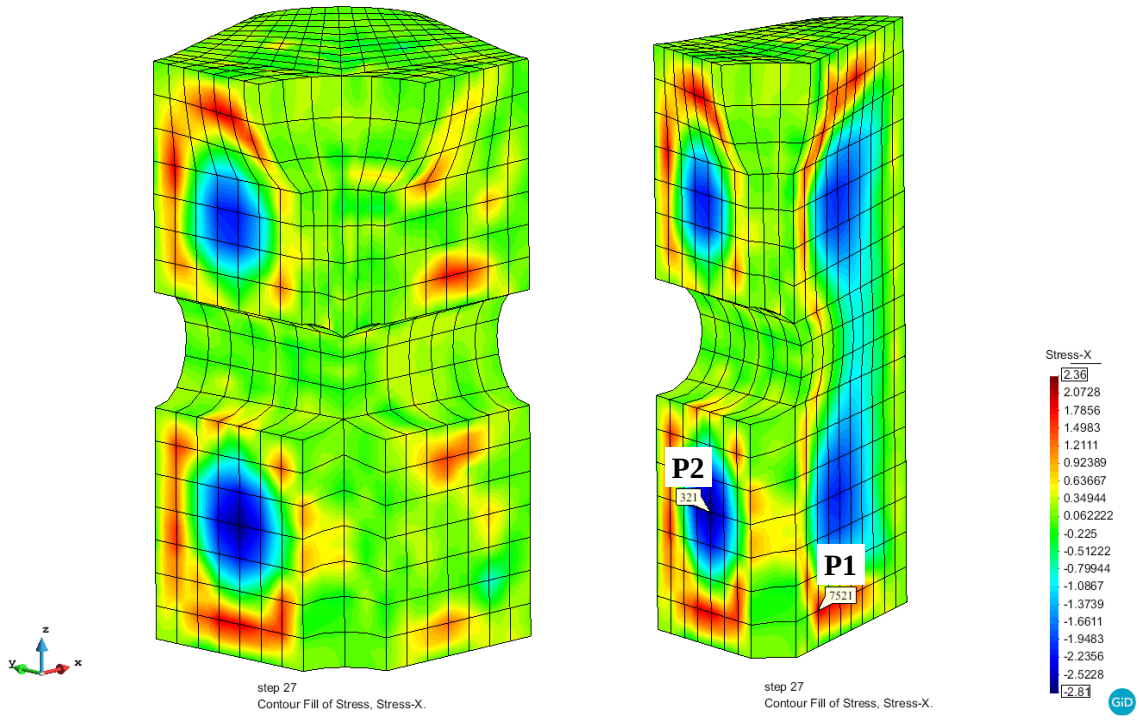
SC6_18 (cont.)

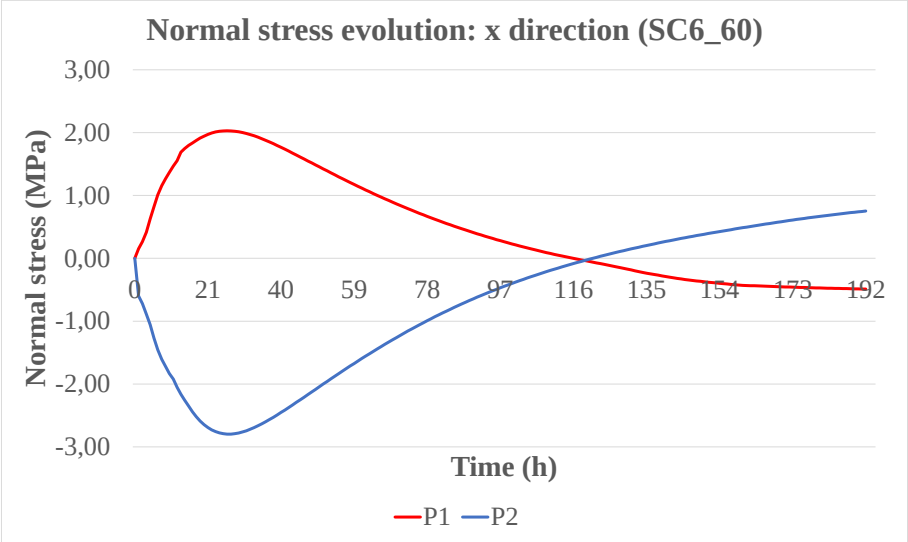




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	1.77	19	-0.33	192	z
P6	0.85	192	-2.08	20	z

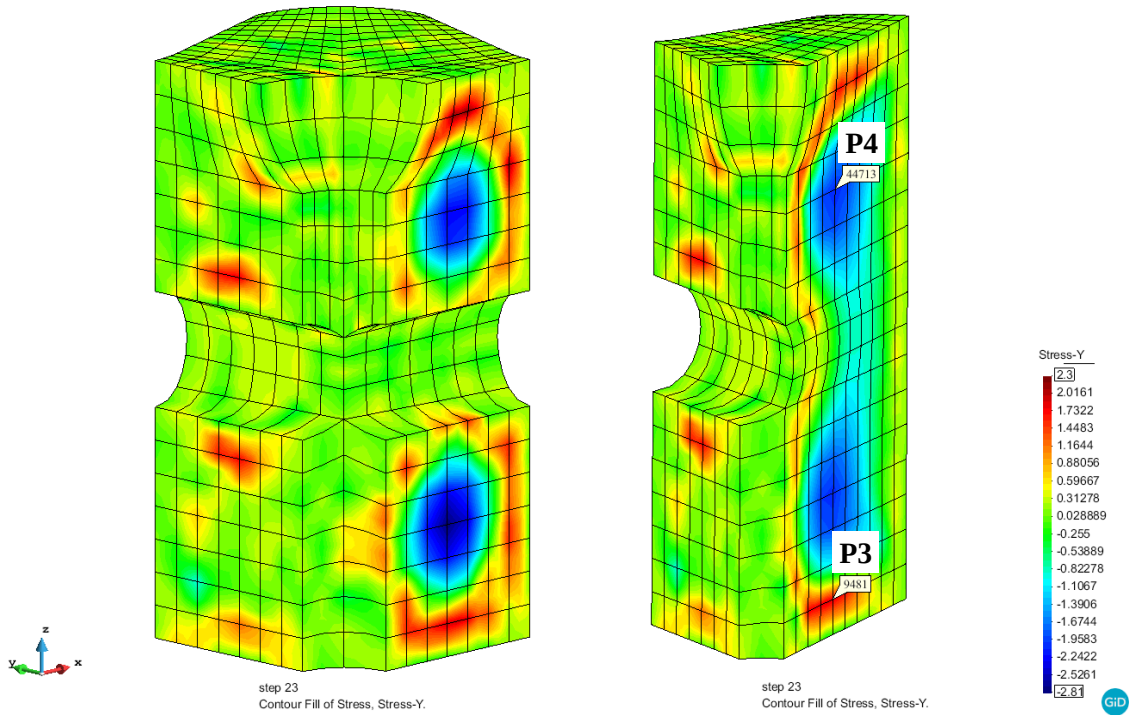
SC6_60

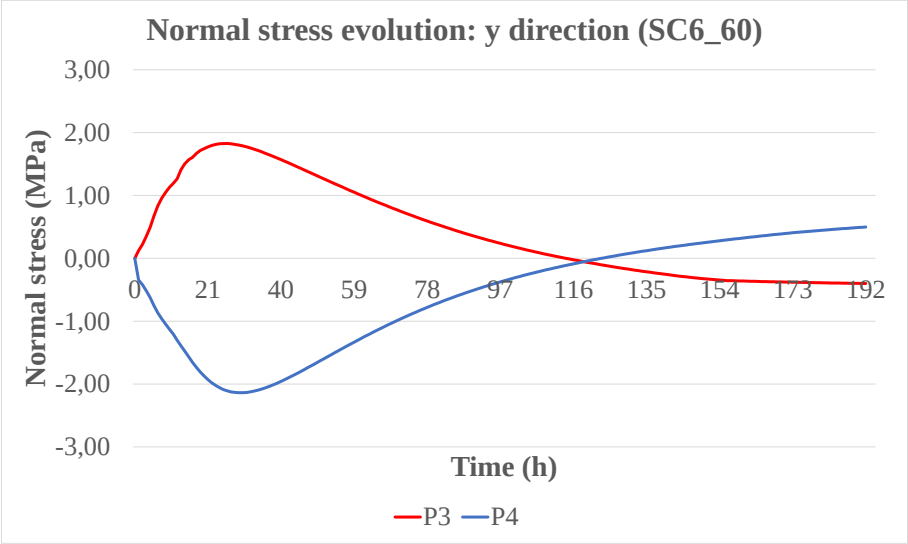




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	2.03	26	-0.49	192	x
P2	0.75	192	-2.80	26	x

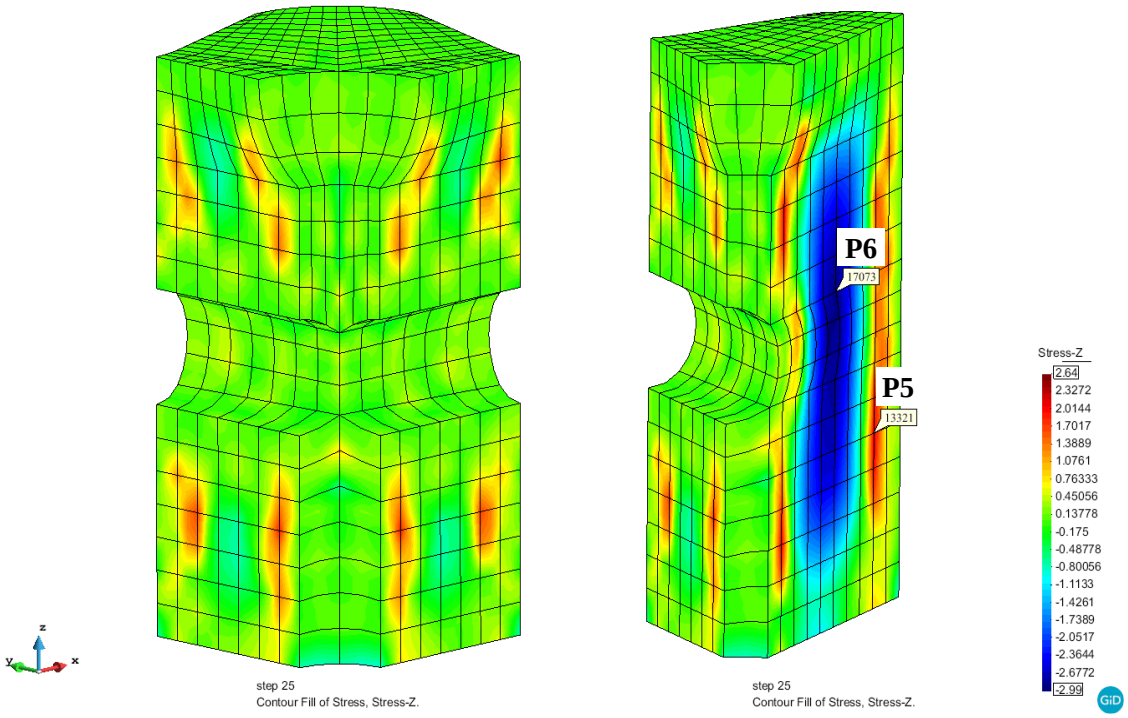
SC6_60 (cont.)

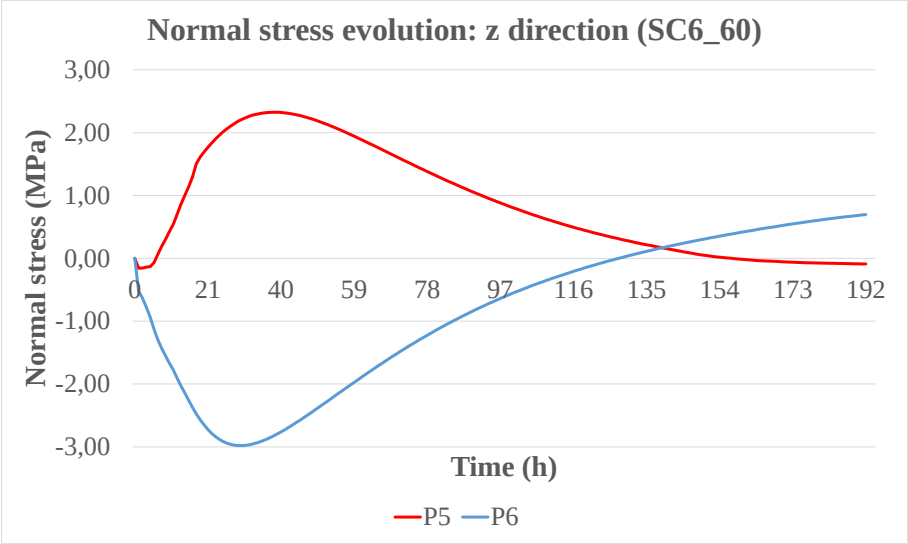




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	1.83	26	-0.40	192	y
P4	0.50	192	-2.14	29	y

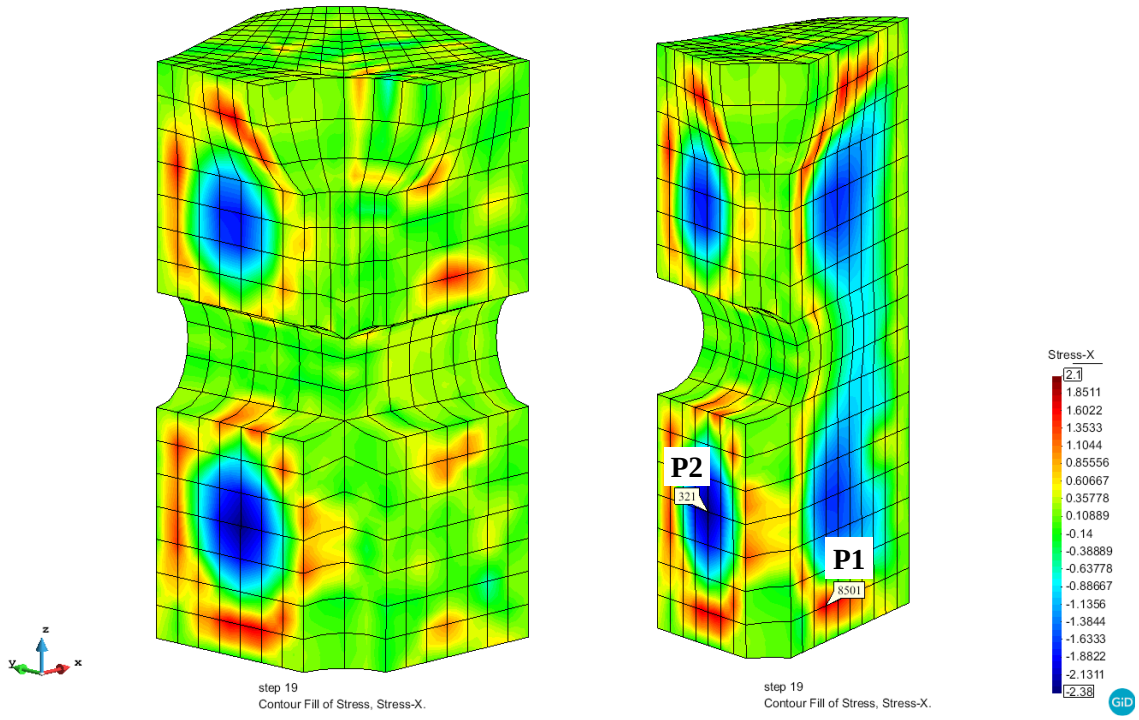
SC6_60 (cont.)

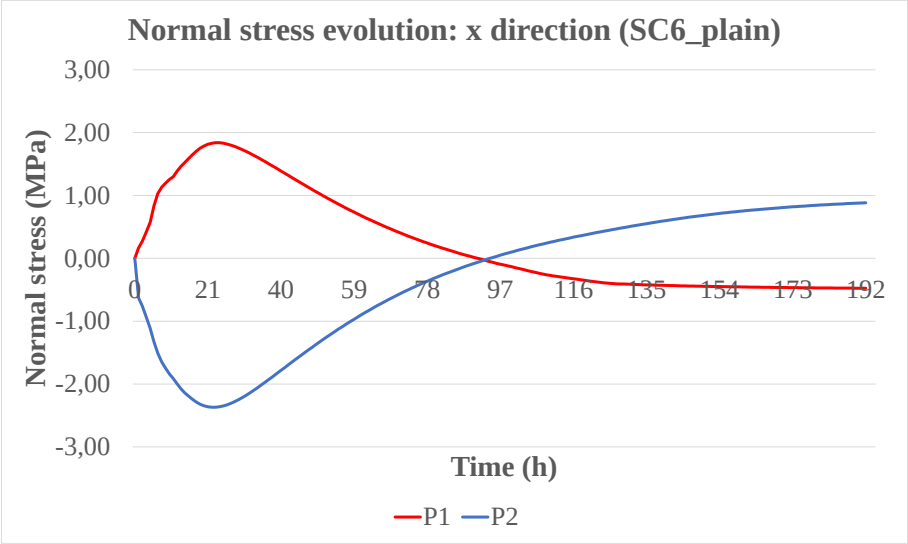




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	2.32	38	-0.16	3	z
P6	0.70	192	-2.98	29	z

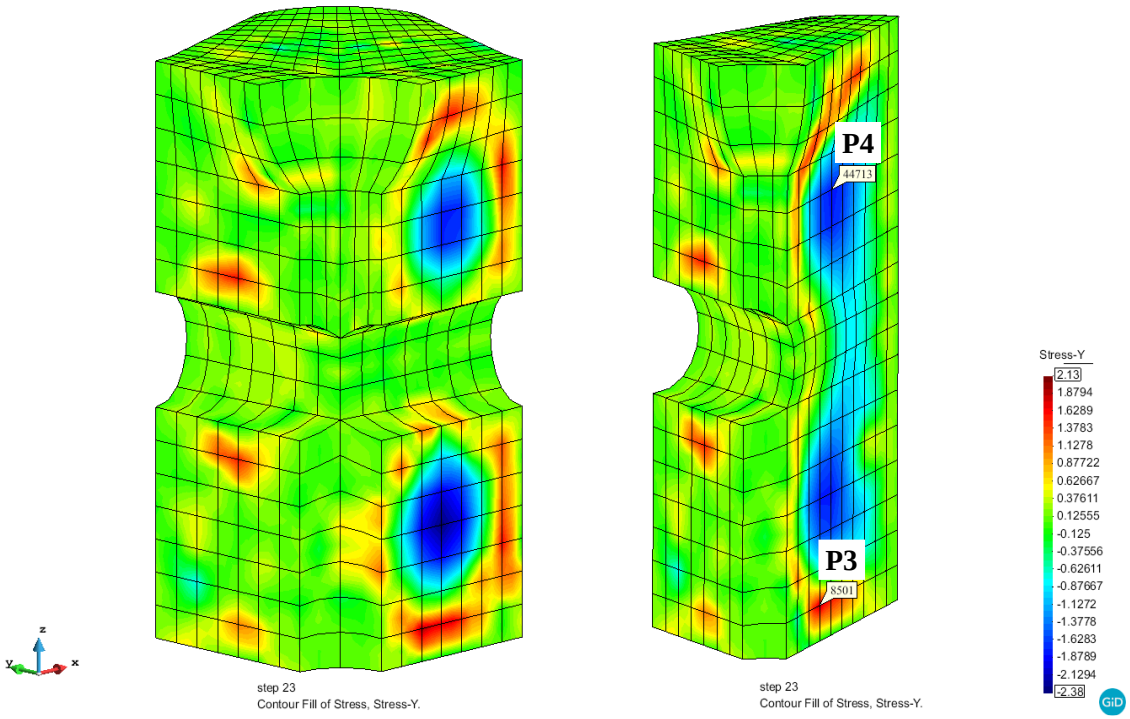
SC6_plain

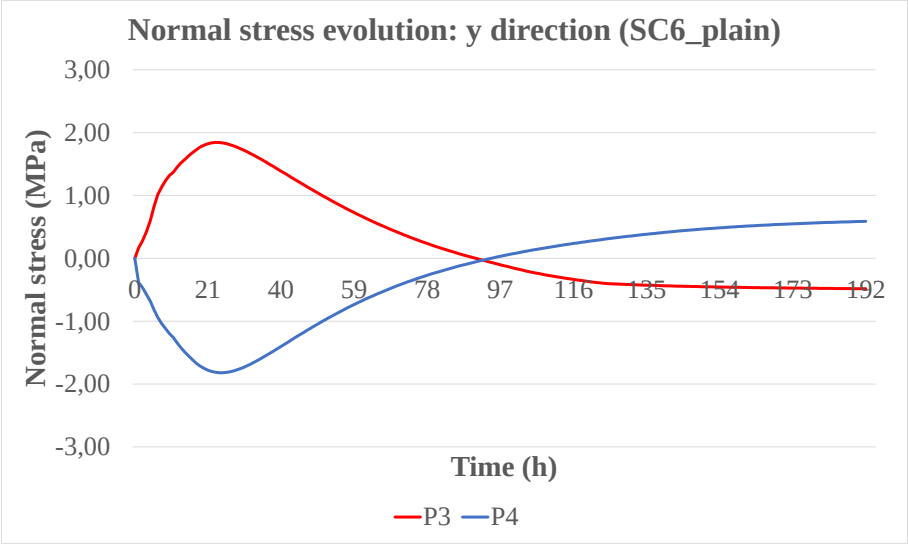




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P1	1.84	23	-0.48	192	x
P2	0.88	192	-2.37	23	x

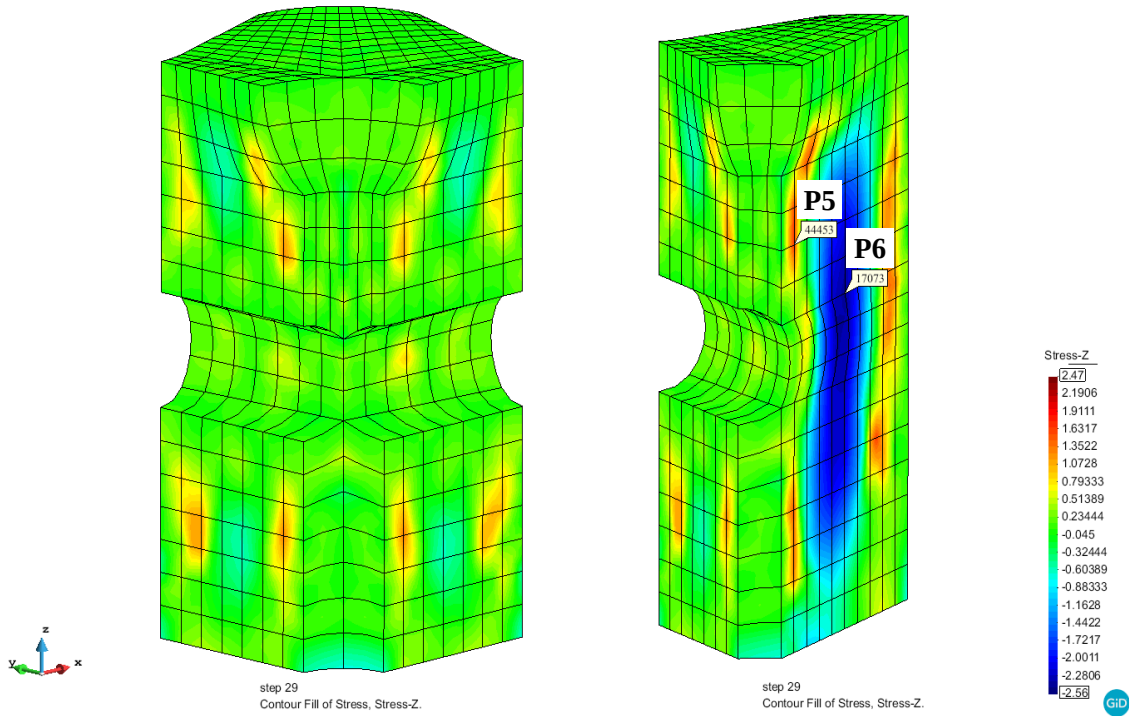
SC6_plain (cont.)

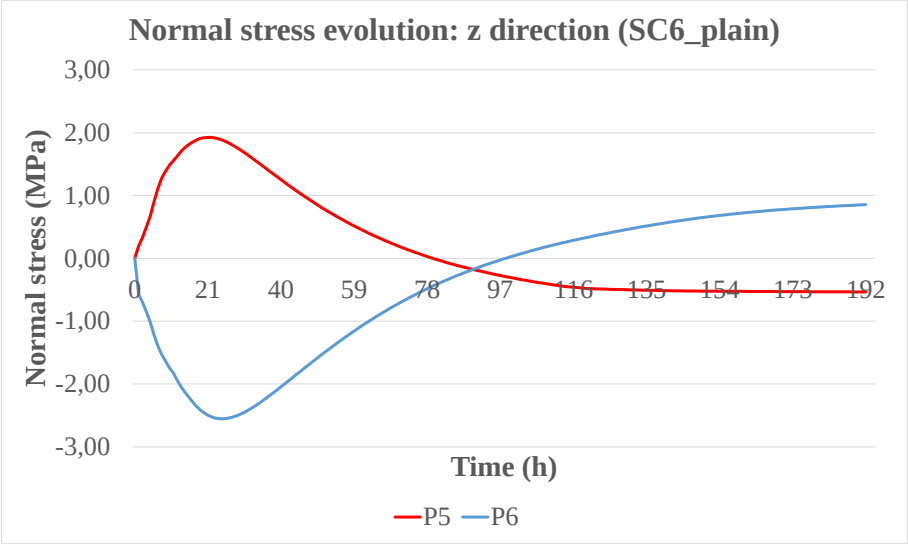




O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P3	1.85	23	-0.48	192	y
P4	0.59	192	-1.82	24	y

SC6_plain (cont.)





O.P.	Max. tensile stress (MPa)	Time (h)	Max. compressive stress (MPa)	Time (h)	Direction
P5	1.93	21	-0.53	192	z
P6	0.85	192	-2.55	25	z

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Appendix 4C

Maximum crack opening

Mechanical Scenarios | Simulation Time: 192 h (8 days)						
Scenario	**Mesh**	**Cement content (kg/m³)**	**Cement type**	**Concrete strength class**	**RSFRC toughness class**	**Analysis type**
SC1.2	01	400	CEM I 42.5R	C40/50	4d	MNL1
SC1.3	015	400	CEM I 42.5R	C40/50	4d	ML; MNL1; MNL2; SC
SC2	015	310	CEM I 42.5R	C20/25	3b	SC
SC3	015	368	CEM I 42.5R	C35/45	4c	SC
SC4	015	435	CEM I 42.5R	C50/60	5e	SC
SC5	015	368	CEM IV 32.5N	C30/37	3b	SC
SC6	015	368	CEM I 52.5R	C40/50	5e	SC

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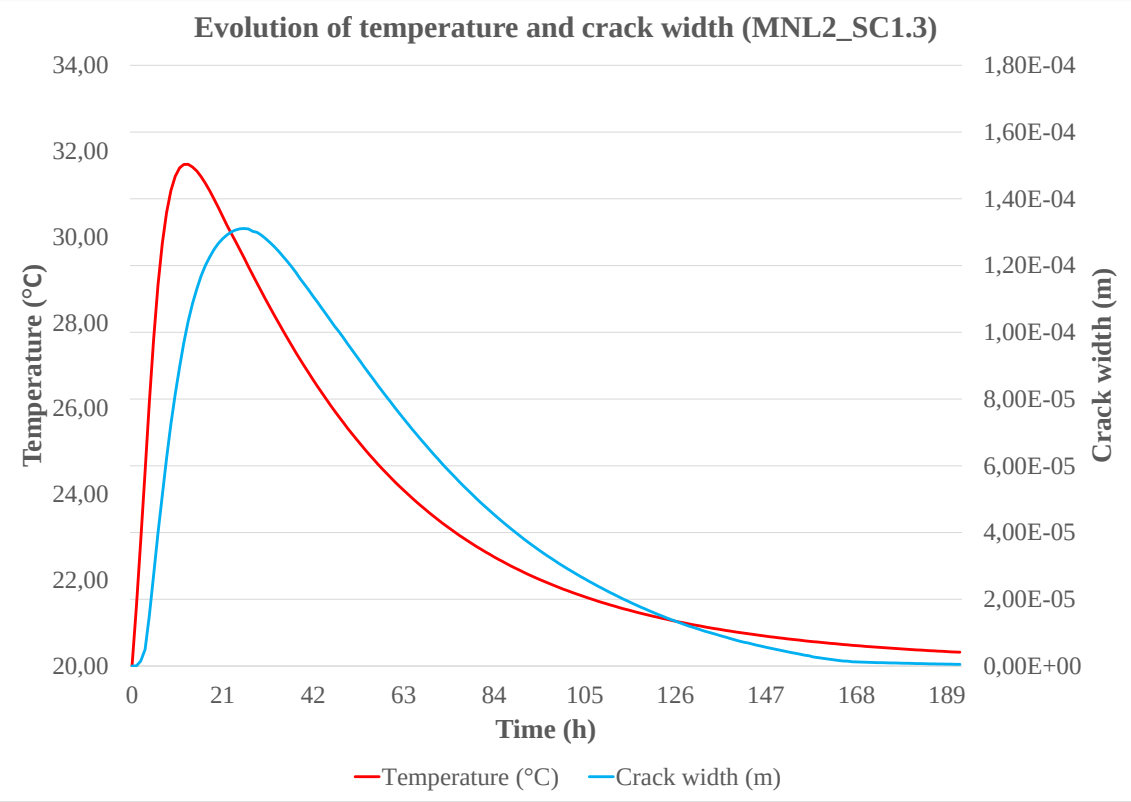
Parametric analysis: MNL2_SC1.3 and SC1.3

MNL2_SC1.3 (t = 20 hours)

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P3	21	3	1.79	**20**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack width (m)**
20	2198	3	31.69	0.09	2.75E-03	0.0477	1.31E-04

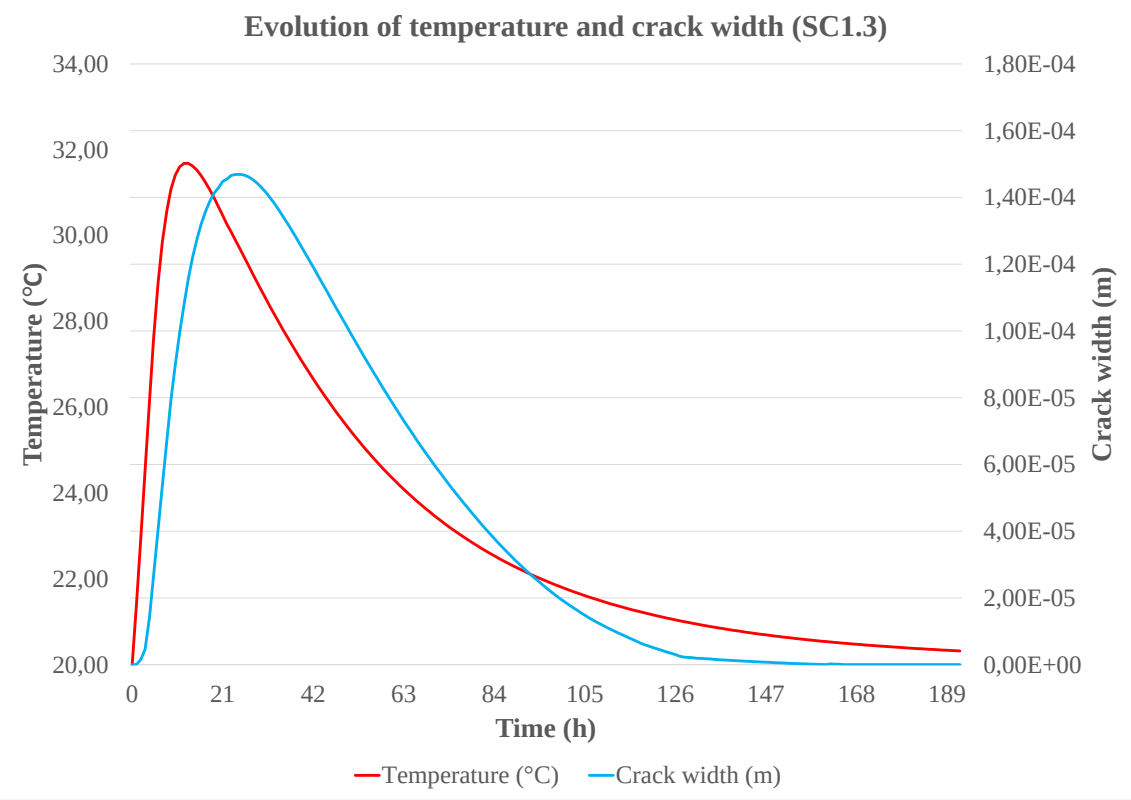


Parametric analysis: MNL2_SC1.3 and SC1.3

SC1.3 (t = 19 hours)

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P3	29	4	1.79	**19**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
19	176	4	31.69	0.08	3.04E-03	0.0484	1.47E-04

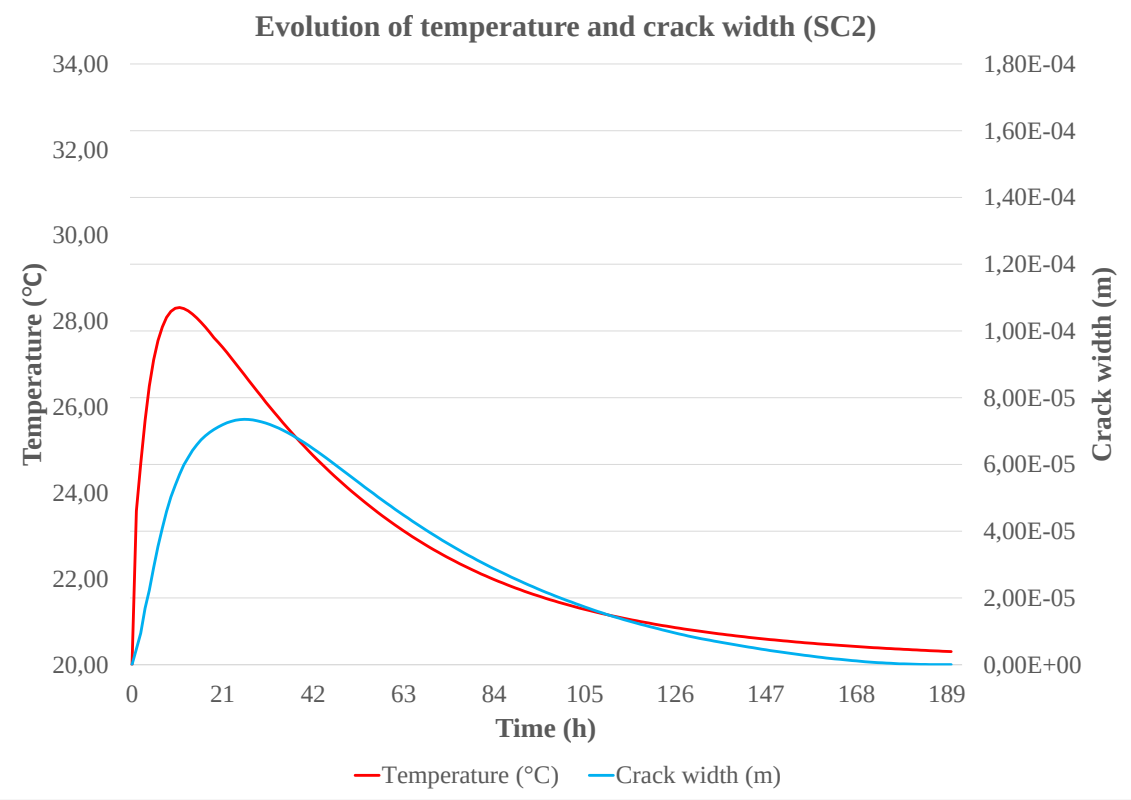


SC2

t = 18 hours

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P5	326	2	0.75	**18**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
18	2198	1	28.32	0.12	1.55E-03	0.0473	7.35E-05

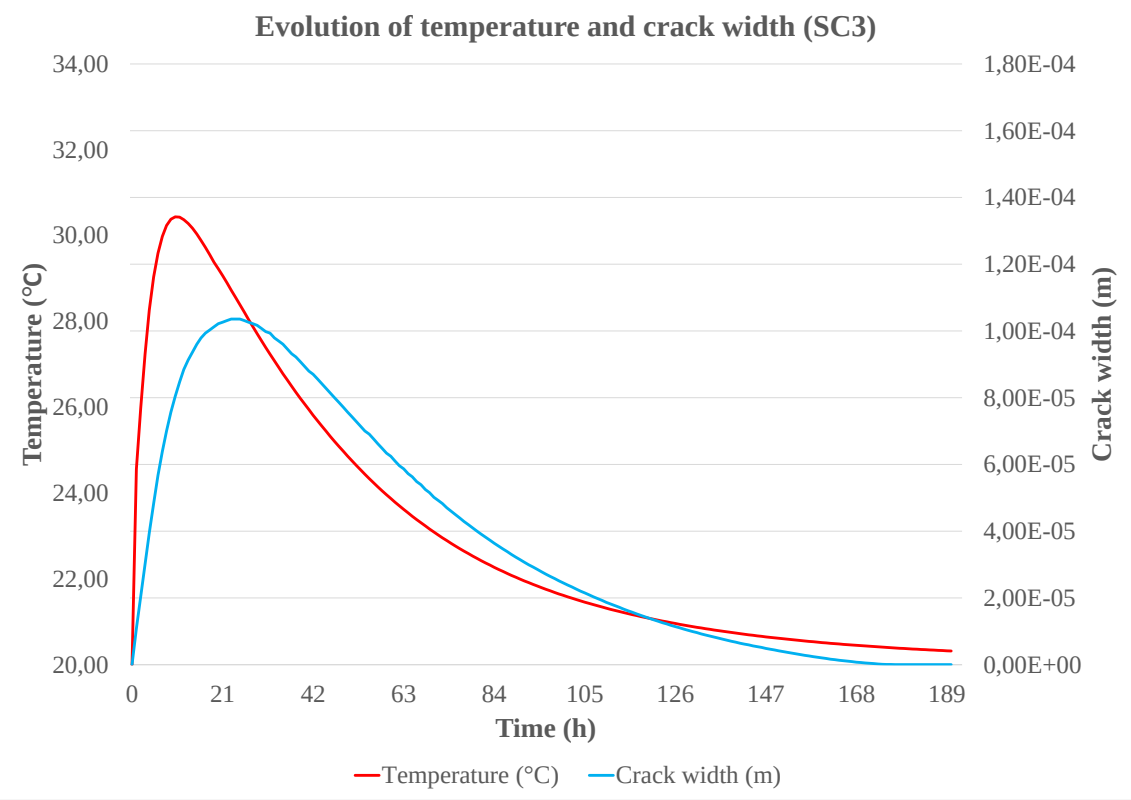


SC3

t = 21 hours

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P5	669	2	1.40	**21**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
21	2198	1	30.44	0.17	2.19E-03	0.0473	1.04E-04

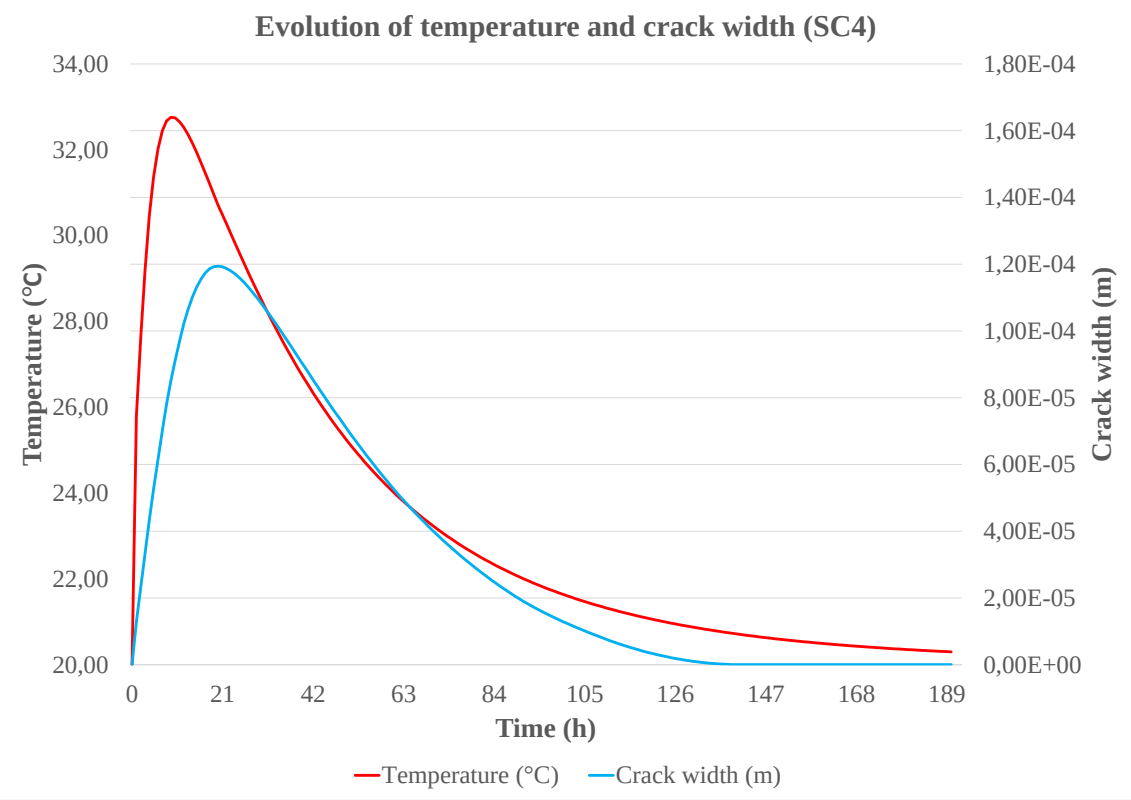


SC4

t = 26 hours

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P5	716	5	1.64	**26**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
26	2140	1	32.76	0.21	2.35E-03	0.0509	1.19E-04

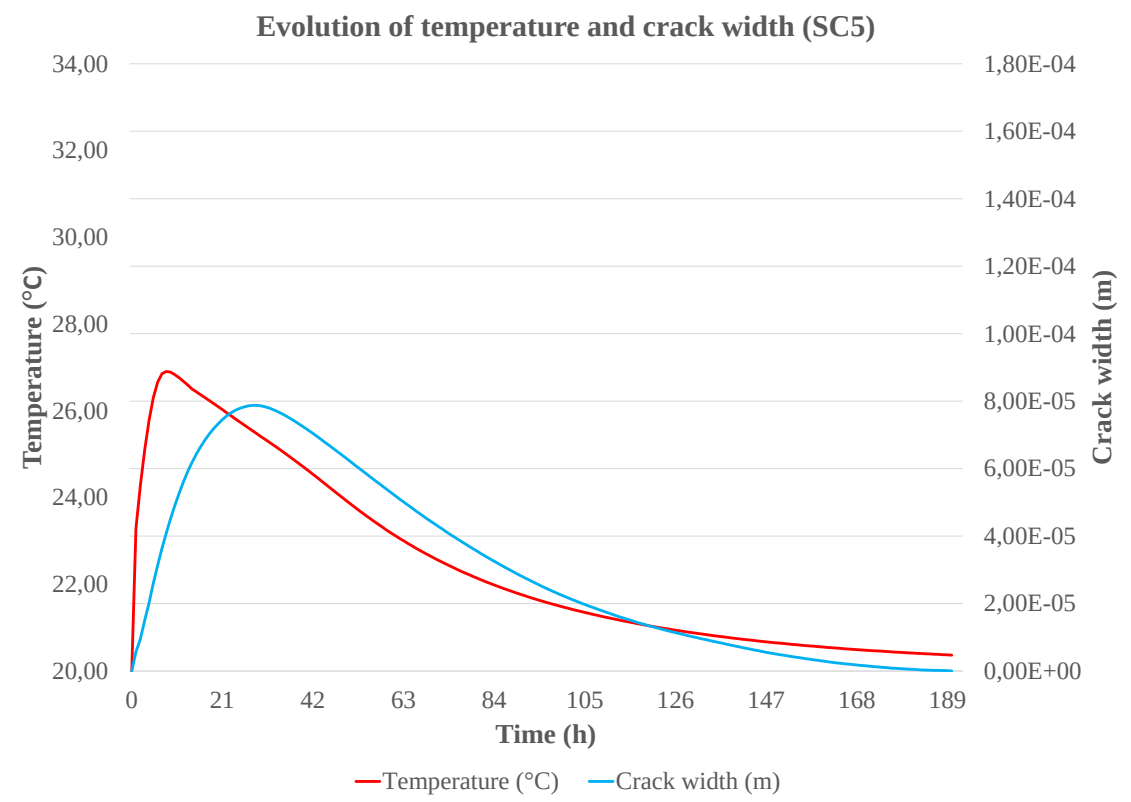


SC5

t = 24 hours

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P1	47	3	0.89	**24**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
24	2198	1	26.91	0.08	1.67E-03	0.0473	7.88E-05

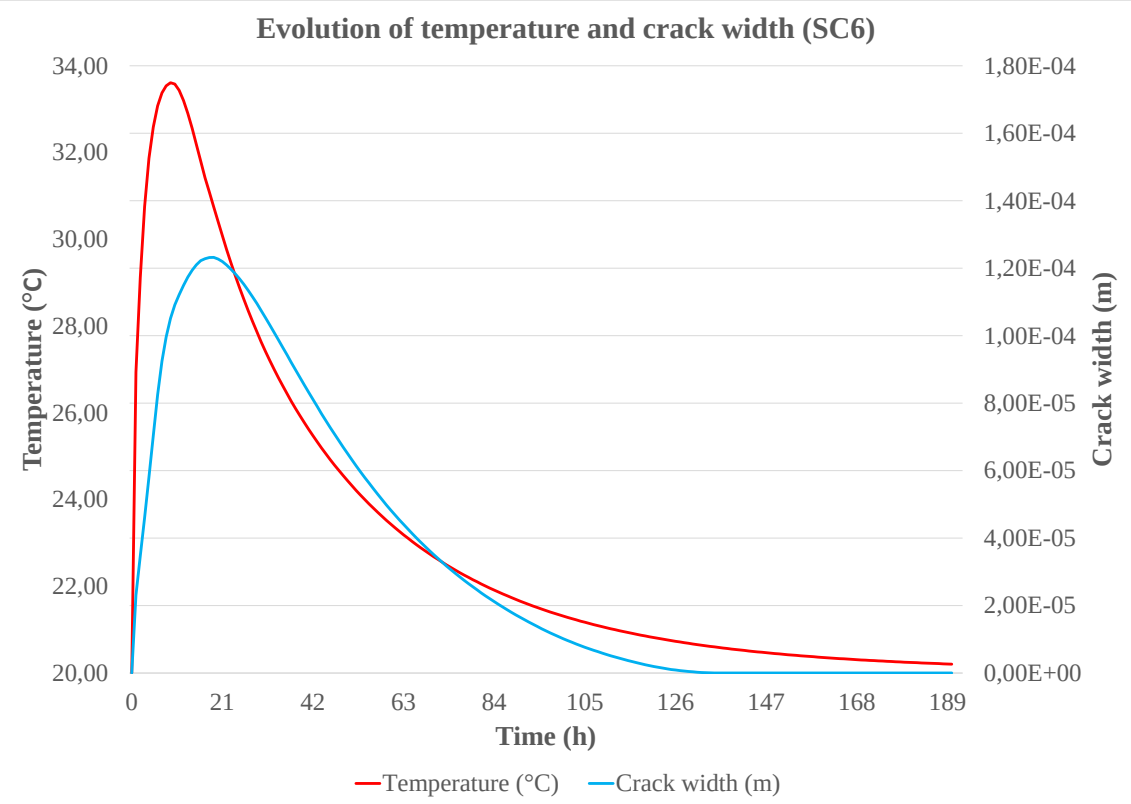


SC6

t = 20 hours

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P5	326	2	1.51	**20**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
20	1928	4	33.61	0.19	2.48E-03	0.0497	1.23E-04

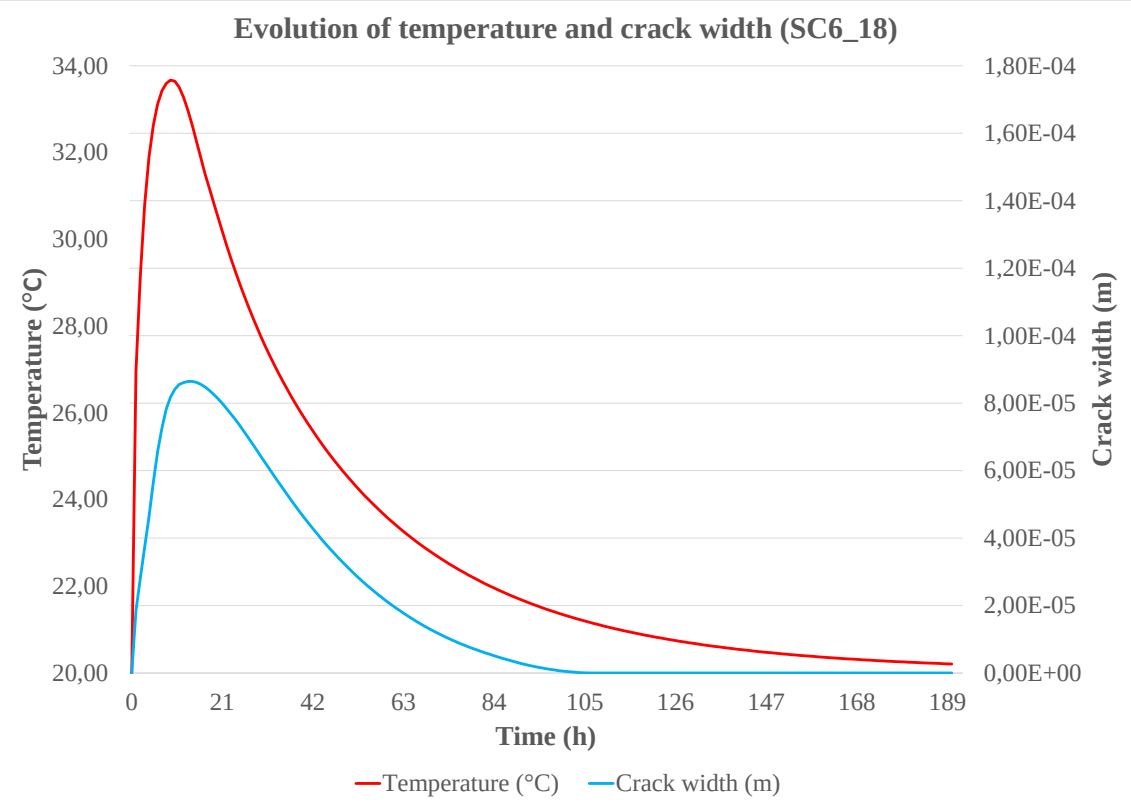


SC6_18

t = 19 hours

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P5	717	5	1.49	**19**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
19	2143	3	33.67	0.20	2.10E-03	0.0411	8.65E-05

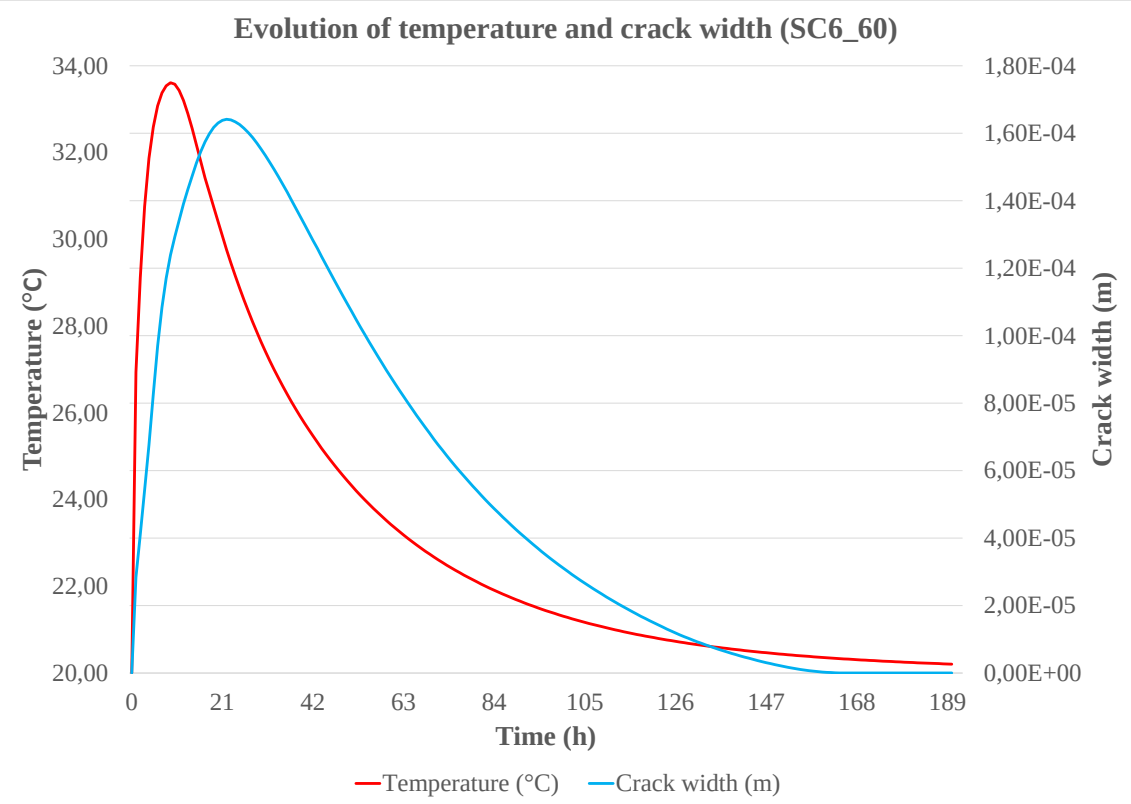


SC6_60

t = 35 hours

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P5	717	6	1.99	**35**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
35	2140	3	33.61	0.20	2.80E-03	0.0586	1.64E-04



SC6_plain

t = 21 hours

Obs. Point	Element	IP	Max. Normal Stress (MPa)	Time (h)
P5	2233	5	1.68	**21**

Maximum Crack Opening							
Time (h)	**Element**	**IP**	**Max. Temperature (°C)**	**Max. Normal Stress (MPa)**	**Max. Crack Normal Strain (%)**	**Crack Band Width (m)**	**Max. Crack Width (m)**
21	1928	4	33.61	0.18	3.05E-03	0.0497	1.52E-04