

Contents

Session 1 Reference Frames Implementation for Geoscience's Applications: From Local to Global Scales

Convenors: Z. Altamimi, C. Brunini

1 Improved Analysis Strategy and Accessibility of the SIRGAS Reference Frame	3
C. Brunini, L. Sanchez, H. Drewes, S. Costa, V. Mackern, W. Martínez, W. Seemuller, and A. da Silva	
2 Improved GPS Data Analysis Strategy for Tide Gauge Benchmark Monitoring	11
Alvaro Santamaría-Gómez, Marie-Noëlle Bouin, and Guy Wöppelmann	
3 A Dense Global Velocity Field Based on GNSS Observations: Preliminary Results	19
C. Bruyninx, Z. Altamimi, M. Becker, M. Craymer, L. Combrinck, A. Combrink, J. Dawson, R. Dietrich, R. Fernandes, R. Govind, T. Herring, A. Kenyeres, R. King, C. Kreemer, D. Lavallée, J. Legrand, L. Sánchez, G. Sella, Z. Shen, A. Santamaría-Gómez, and G. Wöppelmann	
4 Enhancement of the EUREF Permanent Network Services and Products	27
C. Bruyninx, H. Habrich, W. Söhne, A. Kenyeres, G. Stangl, and C. Völksen	
5 Can We Really Promise a mm-Accuracy for the Local Ties on a Geo-VLBI Antenna	35
Ulla Kallio and Markku Poutanen	
6 Recent Improvements in DORIS Data Processing at IGN in View of ITRF2008, the ignwd08 Solution	43
P. Willis, M.L. Gobinddass, B. Garayt, and H. Fagard	
7 Towards a Combination of Space-Geodetic Measurements	51
A. Pollet, D. Coulot, and N. Capitaine	
8 Improving Length and Scale Traceability in Local Geodynamical Measurements	59
J. Jokela, P. Häkli, M. Poutanen, U. Kallio, and J. Ahola	

9	How to Fix the Geodetic Datum for Reference Frames in Geosciences Applications?	67
	H. Drewes	
10	Transforming ITRF Coordinates to National ETRS89 Realization in the Presence of Postglacial Rebound: An Evaluation of the Nordic Geodynamical Model in Finland	77
	P. Häkli and H. Koivula	
11	Global Terrestrial Reference Frame Realization Within the GGOS-D Project	87
	D. Angermann, H. Drewes, and M. Seitz	
12	Comparison of Regional and Global GNSS Positions, Velocities and Residual Time Series	95
	J. Legrand, N. Bergeot, C. Bruyninx, G. Wöppelmann, A. Santamaría-Gómez, M.-N. Bouin, and Z. Altamimi	
13	GPS Metrology: Bringing Traceable Scale to a Local Crustal Deformation GPS Network	105
	H. Koivula, P. Häkli, J. Jokela, A. Buga, and R. Putrimas	
14	Impact of Albedo Radiation on GPS Satellites	113
	C.J. Rodriguez-Solano, U. Hugentobler, and P. Steigenberger	
Session 2 Gravity of the Planet Earth		
Convenors: Y. Fukuda, P. Visser		
15	On the Determination of Sea Level Changes by Combining Altimetric, Tide Gauge, Satellite Gravity and Atmospheric Observations	123
	G.S. Vergos, I.N. Tziavos, and M.G. Sideris	
16	Arctic Sea Ice Thickness in the Winters of 2004 and 2007 from Coincident Satellite and Submarine Measurements	131
	J. Calvao, J. Rodrigues, and P. Wadhams	
17	The Impact of Attitude Control on GRACE Accelerometry and Orbits	139
	U. Meyer, A. Jäggi, and G. Beutler	
18	Using Atmospheric Uncertainties for GRACE De-aliasing: First Results	147
	L. Zenner, T. Gruber, G. Beutler, A. Jäggi, F. Flechtner, T. Schmidt, J. Wickert, E. Fagiolini, G. Schwarz, and T. Trautmann	
19	Challenges in Deriving Trends from GRACE	153
	A. Eicker, T. Mayer-Guerr, and E. Kurtenbach	
20	AIUB-GRACE02S: Status of GRACE Gravity Field Recovery Using the Celestial Mechanics Approach	161
	A. Jäggi, G. Beutler, U. Meyer, L. Prange, R. Dach, and L. Mervart	

21	Comparison of Regional and Global GRACE Gravity Field Models at High Latitudes	171
	B.C. Gunter, T. Wittwer, W. Stolk, R. Klees, and P. Ditmar	
22	A New Approach for Pure Kinematical and Reduced-Kinematical Determination of LEO Orbit Based on GNSS Observations	179
	A. Shabanloui and K.H. Ilk	
23	Pure Geometrical Precise Orbit Determination of a LEO Based on GNSS Carrier Phase Observations	187
	A. Shabanloui and K.H. Ilk	
24	On a Combined Use of Satellite and Terrestrial Data in Refined Studies on Earth Gravity Field: Boundary Problems and a Target Function	195
	P. Holota and O. Nesvadba	
25	Moho Estimation Using GOCE Data: A Numerical Simulation	205
	M. Reguzzoni and D. Sampietro	
26	CHAMP, GRACE, GOCE Instruments and Beyond	215
	P. Touboul, B. Foulon, B. Christophe, and J.P. Marque	
27	The Future of the Satellite Gravimetry After the GOCE Mission	223
	P. Silvestrin, M. Aguirre, L. Massotti, B. Leone, S. Cesare, M. Kern, and R. Haagmans	
28	Future Satellite Gravity Field Missions: Feasibility Study of Post-Newtonian Method	231
	R. Mayrhofer and R. Pail	
29	Local and Regional Comparisons of Gravity and Magnetic Fields	239
	C. Jekeli, O. Huang, and T.L. Abt	
30	Combination of Local Gravimetry and Magnetic Data to Locate Subsurface Anomalies Using a Matched Filter	247
	T. Abt, O. Huang, and C. Jekeli	
31	On the Use of UAVs for Strapdown Airborne Gravimetry	255
	Richard Deurloo, Luisa Bastos, and Machiel Bos	
32	Updating the Precise Gravity Network at the BIPM	263
	Z. Jiang, E.F. Arias, L. Tisserand, K.U. Kessler-Schulz, H.R. Schulz, V. Palinkas, C. Rothleitner, O. Francis, and M. Becker	
33	Precise Gravimetric Surveys with the Field Absolute Gravimeter A-10	273
	R. Falk, Ja. Müller, N. Lux, H. Wilmes, and H. Wziontek	
34	Reconstruction of a Torsion Balance and the Results of the Test Measurements	281
	L. Völgyesi and Z. Ulmann	

35	The Superconducting Gravimeter as a Field Instrument Applied to Hydrology	291
	C.R. Wilson, H. Wu, L. Longuevergne, B. Scanlon, and J. Sharp	
36	Local Hydrological Information in Gravity Time Series: Application and Reduction	297
	M. Naujoks, S. Eisner, C. Kroner, A. Weise, P. Krause, and T. Jahr	
37	Signals of Mass Redistribution at the South African Gravimeter Site SAGOS	305
	C. Kroner, S. Werth, H. Pflug, A. Güntner, B. Creutzfeldt, M. Thomas, H. Dobslaw, P. Fourie, and P.H. Charles	
38	Gravity System and Network in Estonia	315
	Tõnis Oja	
39	Evaluation of EGM2008 Within Geopotential Space from GPS, Tide Gauges and Altimetry	323
	N. Dayoub, P. Moore, N.T. Penna, and S.J. Edwards	
40	Fixed Gravimetric BVP for the Vertical Datum Problem	333
	R. Čunderlík, Z. Fašková, and K. Mikula	
41	Realization of the World Height System in New Zealand: Preliminary Study	343
	R. Tenzer, V. Vatrt, and M. Amos	
42	Comparisons of Global Geopotential Models with Terrestrial Gravity Field Data Over <i>Santiago del Estero</i> Region, NW: Argentine	351
	L. Galván, C. Infante, E. Lauría, and R. Ramos	
43	Intermap's Airborne Inertial Gravimetry System	357
	Ming Wei	
44	Galathea-3: A Global Marine Gravity Profile	365
	G. Strykowski, K.S. Cordua, R. Forsberg, A.V. Olesen, and O.B. Andersen	
45	Dependency of Resolvable Gravitational Spatial Resolution on Space-Borne Observation Techniques	373
	P.N.A.M. Visser, E.J.O. Schrama, N. Sneeuw, and M. Weigelt	
46	A Comparison of Different Integral-Equation-Based Approaches for Local Gravity Field Modelling: Case Study for the Canadian Rocky Mountains	381
	R. Tenzer, I. Prutkin, and R. Klees	
47	Global Topographically Corrected and Topo-Density Contrast Stripped Gravity Field from EGM08 and CRUST 2.0	389
	R. Tenzer, Hamayun, and P. Vajda	

48	Local Gravity Field Modelling in Rugged Terrain Using Spherical Radial Basis Functions: Case Study for the Canadian Rocky Mountains	401
	R. Tenzer, R. Klees, and T. Wittwer	
49	A Sensitivity Analysis in Spectral Gravity Field Modeling Using Systems Theory	411
	Vassilios D. Andritsanos and Ilias N. Tziavos	
50	Investigation of Topographic Reductions for Marine Geoid Determination in the Presence of an Ultra-High Resolution Reference Geopotential Model	419
	C. Tocho, G.S. Vergos, and M.G. Sideris	
51	Effects of Hypothetical Complex Mass-Density Distributions on Geoidal Height	427
	Robert Kingdon, Petr Vaniček, and Marcelo Santos	
52	Evaluation of Gravity and Altimetry Data in Australian Coastal Regions	435
	S.J. Claessens	
53	Development and User Testing of a Python Interface to the GRAVSOFTE Gravity Field Programs	443
	J. Nielsen, C.C. Tscherning, T.R.N. Jansson, and R. Forsberg	
54	Progress and Prospects of the Antarctic Geoid Project (Commission Project 2.4)	451
	Mirko Scheinert	
55	Regional Geoid Improvement over the Antarctic Peninsula Utilizing Airborne Gravity Data	457
	J. Schwabe, M. Scheinert, R. Dietrich, F. Ferraccioli, and T. Jordan	
56	Auvergne Dataset: Testing Several Geoid Computation Methods ...	465
	P. Valtý, H. Duquenne, and I. Panet	
57	In Pursuit of a cm-Accurate Local Geoid Model for Ohio	473
	K.R. Edwards, Dorota Grejner-Brzezinska, and Dru Smith	
58	Adjustment of Collocated GPS, Geoid and Orthometric Height Observations in Greece. Geoid or Orthometric Height Improvement?	481
	I.N. Tziavos, G.S. Vergos, V.N. Grigoriadis, and V.D. Andritsanos	
Session 3 Geodesy and Geodynamics: Global and Regional Scales		
Convenors: M. Bevis, S. Bonvalot		
59	Regional Geophysical Excitation Functions of Polar Motion over Land Areas	491
	J. Nastula and D.A. Salstein	
60	Geophysical Excitation of the Chandler Wobble Revisited	499
	Aleksander Brzeziński, Henryk Dobslaw, Robert Dill, and Maik Thomas	

61	On the Origin of the Bi-Decadal and the Semi-Secular Oscillations in the Length of the Day	507
	S. Duhau and C. de Jager	
62	Future Improvements in EOP Prediction	513
	W. Kosek	
63	Determination of Nutation Coefficients from Lunar Laser Ranging	521
	L. Biskupek, J. Müller, and F. Hofmann	
64	A Set of Analytical Formulae to Model Deglaciation-Induced Polar Wander	527
	W. Keller, M. Kuhn, and W.E. Featherstone	
65	Stabilization of Satellite Derived Gravity Field Coefficients by Earth Orientation Parameters and Excitation Functions	537
	Andrea Heiker, Hansjörg Kutterer, and Jürgen Müller	
66	The Statistical Characteristics of Altimetric Sea Level Anomaly Time Series	545
	T. Niedzielski and W. Kosek	
67	Testing Past Sea Level Reconstruction Methodology (1958–2006)	551
	J. Viarre and R. Abarca-del-Río	
68	Precise Determination of Relative Mean Sea Level Trends at Tide Gauges in the Adriatic	561
	M. Repanic and T. Bašić	
69	Quantile Analysis of Relative Sea-Level at the Hornbæk and Gedser Tide Gauges	567
	S.M. Barbosa and K.S. Madsen	
70	Assessment of the FES2004 Derived OTL Model in the West of France and Preliminary Results About Impacts of Tropospheric Models	573
	F. Fund, L. Morel, and A. Mocquet	
71	Gravimetric Time Series Recording at the Argentine Antarctic Stations Belgrano II and San Martín for the Improvement of Ocean Tide Models	581
	Mirko Scheinert, Andrés F. Zakrajsek, Lutz Eberlein, Reinhard Dietrich, Sergio A. Marensi, and Marta E. Ghidella	
72	Mass-Change Acceleration in Antarctica from GRACE Monthly Gravity Field Solutions	591
	Lóránt Földvály	
73	Mass Variations in the Siberian Permafrost Region from GRACE	597
	Holger Steffen, Jürgen Müller, and Nadja Peterseim	

74	Seasonal Variability of Land Water Storage in South America Using GRACE Data	605
	Claudia Tocho, Luis Guarracino, Leonardo Monachesi, Andrés Cesanelli, and Pablo Antico	
75	Water Storage Changes from GRACE Data in the La Plata Basin	613
	A. Pereira, S. Miranda, M.C. Pacino, and R. Forsberg	
76	Second and Third Order Ionospheric Effects on GNSS Positioning: A Case Study in Brazil	619
	H.A. Marques, J.F.G. Monico, G.P.S. Rosa, M.L. Chuerubim, and Márcio Aquino	
77	Advanced Techniques for Discontinuity Detection in GNSS Coordinate Time-Series. An Italian Case Study	627
	A. Borghi, L. Cannizzaro, and A. Vitti	
78	Traditional and Alternative Network Adjustment Approach for the TAMDEF GPS in Antarctica	635
	G. Esteban Vázquez, Dorota A. Grejner-Brzezinska, and Burkhard Schaffrin	
79	Impact of Loading Phenomena on Velocity Field Computation from GPS Campaigns: Application to ResPyr GPS Campaign in the Pyrenees	643
	J. Nicolas, F. Perosanz, A. Rigo, G. Bliguet, L. Morel, and F. Fund	
80	Comparison of the Coordinates Solutions Between the Absolute and the Relative Phase Center Variation Models in the Dense Regional GPS Network in Japan	651
	S. Shimada	
81	The 2009 Horizontal Velocity Field for South America and the Caribbean	657
	H. Drewes and O. Heidbach	
82	New Estimates of Present-Day Crustal/Land Motions in the British Isles Based on the BIGF Network	665
	D.N. Hansen, F.N. Teferle, R.M. Bingley, and S.D.P. Williams	
83	GURN (GNSS Upper Rhine Graben Network): Research Goals and First Results of a Transnational Geo-scientific Network .	673
	M. Mayer, A. Knöpfler, B. Heck, F. Masson, P. Ulrich, and G. Ferhat	
84	Determination of Horizontal and Vertical Movements of the Adriatic Microplate on the Basis of GPS Measurements	683
	M. Marjanović, Ž. Bačić, and T. Bačić	
85	Determination of Tectonic Movements in the Swiss Alps Using GNSS and Levelling	689
	E. Brockmann, D. Ineichen, U. Marti, S. Schaer, A. Schlatter, and A. Villiger	

86	A Compilation of a Preliminary Map of Vertical Deformations in New Zealand from Continuous GPS Data	697
	R. Tenzer, M. Stevenson, and P. Denys	
87	Detection of Vertical Temporal Behaviour of IGS Stations in Canada Using Least Squares Spectral Analysis	705
	James Mtamakaya, Marcelo C. Santos, and Michael Craymer	
Session 4 Positioning and Remote Sensing of Land, Ocean and Atmosphere		
Convenors: S. Verhagen, P. Wielgosz		
88	Positioning and Applications for Planet Earth	713
	S. Verhagen, G. Retscher, M.C. Santos, X.L. Ding, Y. Gao, and S.G. Jin	
89	Report of Sub-commission 4.2 “Applications of Geodesy in Engineering”	719
	G. Retscher, A. Reiterer, and G. Mentes	
90	A Fixed-σ Digital Representation of a Random Scalar Field	725
	K. Becek	
91	The Impact of Adding SBAS Data on GPS Data Processing in Southeast of Brazil: Preliminary Result	733
	W.C. Machado, F. Albarici, E.S. Fonseca Junior, J.F.G. Monico, and W.G.C. Polezel	
92	First Results of Relative Field Calibration of a GPS Antenna at BCAL/UFPR (Baseline Calibration Station for GNSS Antennas at UFPR/Brazil)	739
	S.C.M. Huinca, C.P. Krueger, M. Mayer, A. Knöpfler, and B. Heck	
93	Medium-Distance GPS Ambiguity Resolution with Controlled Failure Rate	745
	D. Odijk, S. Verhagen, and P.J.G. Teunissen	
94	Toward a SIRGAS Service for Mapping the Ionosphere’s Electron Density Distribution	753
	C. Brunini, F. Azpilicueta, M. Gende, A. Aragón-Ángel, M. Hernández-Pajares, J.M. Juan, and J. Sanz	
95	Assisted Code Point Positioning at Sub-meter Accuracy Level with Ionospheric Corrections Estimated in a Local GNSS Permanent Network	761
	M. Crespi, A. Mazzoni, and C. Brunini	
96	Semi-annual Anomaly and Annual Asymmetry on TOPEX TEC During a Full Solar Cycle	769
	F. Azpilicueta, C. Brunini, and S.M. Radicella	
97	Numerical Simulation and Prediction of Atmospheric Aerosol Extinction Using Singular Value Decomposition	775
	J. Shin, S. Lim, C. Rizados, and K. Zhang	

98	Impact of Atmospheric Delay Reduction Using KARAT on GPS/PPP Analysis	781
	Ryuichi Ichikawa, Thomas Hobiger, Yasuhiro Koyama, and Tetsuro Kondo	
99	Modelling Tropospheric Zenith Delays Using Regression Models Based on Surface Meteorology Data	789
	Tamás Tuchband and Szabolcs Rózsa	
100	Calibration of Wet Tropospheric Delays in GPS Observation Using Raman Lidar Measurements	795
	P. Bosser, C. Thom, O. Bock, J. Pelon, and P. Willis	
101	Generation of Slant Tropospheric Delay Time Series Based on Turbulence Theory	801
	M. Vennebusch and S. Schön	
102	Fitting of NWM Ray-Traced Slant Factors to Closed-Form Tropospheric Mapping Functions	809
	Landon Urquhart, Marcelo Santos, and Felipe Nievinski	
103	Estimation of Integrated Water Vapour from GPS Observations Using Local Models in Hungary	817
	Sz. Rózsa	
104	GNSS Remote Sensing in the Atmosphere, Oceans, Land and Hydrology	825
	Shuanggen Jin	
105	Mean Sea Surface Model of the Caspian Sea Based on TOPEX/Poseidon and Jason-1 Satellite Altimetry Data	833
	S.A. Lebedev	
Session 5 Geodesy in Latin America		
Convenors: D. Blitzkow, C. Tocho		
106	Combination of the Weekly Solutions Delivered by the SIRGAS Processing Centres for the SIRGAS-CON Reference Frame	845
	L. Sánchez, W. Seemüller, and M. Seitz	
107	Report on the SIRGAS-CON Combined Solution, by IBGE Analysis Center	853
	S.M.A. Costa, A.L. Silva, and J.A. Vaz	
108	Processing Evaluation of SIRGAS-CON Network by IBGE Analysis Center	859
	S.M.A. Costa, A.L. Silva, and J.A. Vaz	
109	ProGrid: The Transformation Package for the Adoption of SIRGAS2000 in Brazil	869
	Marcos F. Santos, Marcelo C. Santos, Leonardo C. Oliveira, Sonia A. Costa, João B. Azevedo, and Maurício Galo	

110	The New Multi-year Position and Velocity Solution SIR09P01 of the IGS Regional Network Associate Analysis Centre (IGS RNAAC SIR)	877
	W. Seemüller, M. Seitz, L. Sánchez, and H. Drewes	
111	Analysis of the Crust Displacement in Amazon Basin	885
	G.N. Guimarães, D. Blitzkow, A.C.O.C. de Matos, F.G.V. Almeida, and A.C.B. Barbosa	
112	The Progress of the Geoid Model for South America Under GRACE and EGM2008	893
	D. Blitzkow, A.C.O.C. de Matos, J.D. Fairhead, M.C. Pacino, M.C.B. Lobianco, and I.O. Campos	
113	Combining High Resolution Global Geopotential and Terrain Models to Increase National and Regional Geoid Determinations, Maracaibo Lake and Venezuelan Andes Case Study	901
	E. Wildermann, G. Royero, L. Bacaicoa, V. Cioce, G. Acuña, H. Codallo, J. León, M. Barrios, and M. Hoyer	
114	Evaluation of a Few Interpolation Techniques of Gravity Values in the Border Region of Brazil and Argentina	909
	R.A.D. Pereira, S.R.C. De Freitas, V.G. Ferreira, P.L. Faggion, D.P. dos Santos, R.T. Luz, A.R. Tierra Criollo, and D. Del Cogliano	
115	RBMC in Real Time via NTRIP and Its Benefits in RTK and DGPS Surveys	917
	S.M.A. Costa, M.A. de Almeida Lima, N.J. de Moura Jr, M.A. Abreu, A.L. de Silva, L.P. Souto Fortes, and A.M. Ramos	
Session 6 Joint ION/FIG/ISPRS Session on Navigation and Earth Observation		
Convenors: D.A. Grejner-Brzezinska, C.K. Toth		
116	Bootstrapping with Multi-frequency Mixed Code Carrier Linear Combinations and Partial Integer Decorrelation in the Presence of Biases	925
	P. Henkel	
117	Real Time Satellite Clocks in Precise Point Positioning	935
	R.J.P. van Bree, S. Verhagen, and A. Hauschild	
118	Improving the GNSS Attitude Ambiguity Success Rate with the Multivariate Constrained LAMBDA Method	941
	G. Giorgi, P.J.G. Teunissen, S. Verhagen, and P.J. Buist	
119	An Intelligent Personal Navigator Integrating GNSS, RFID and INS	949
	G. Retscher	
120	Integration of Image-Based and Artificial Intelligence Algorithms: A Novel Approach to Personal Navigation	957
	Dorota A. Grejner-Brzezinska, Charles K. Toth, J. Nikki Markiel, Shahram Moafipoor, and Krystyna Czarnecka	

121	Modernization and New Services of the Brazilian Active Control Network	967
	L.P.S. Fortes, S.M.A. Costa, M.A. Abreu, A.L. Silva, N.J.M Júnior, K. Barbosa, E. Gomes, J.G. Monico, M.C. Santos, and P. Tétréault	
122	<i>magicSBAS</i>: A South-American SBAS Experiment with NTRIP Data	973
	I. Alcantarilla, J. Caro, A. Cezón, J. Ostolaza, and F. Azpilicueta	
Session 7 The Global Geodetic Observing System: Science and Applications		
Convenors: R. Gross, H.-P. Plas, L.P. Forles		
123	Scientific Rationale and Development of the Global Geodetic Observing System	987
	G. Beutler and R. Rummel	
124	GGOS Bureau for Standards and Conventions: Integrated Standards and Conventions for Geodesy	995
	U. Hugentobler, T. Gruber, P. Steigenberger, D. Angermann, J. Bouman, M. Gerstl, and B. Richter	
125	VLBI2010: Next Generation VLBI System for Geodesy and Astrometry	999
	W.T. Petrachenko, A.E. Niell, B.E. Corey, D. Behrend, H. Schuh, and J. Wresnik	
126	The New Vienna VLBI Software VieVS	1007
	J. Böhm, S. Böhm, T. Nilsson, A. Pany, L. Plank, H. Spicakova, K. Teke, and H. Schuh	
127	Estimating Horizontal Tropospheric Gradients in DORIS Data Processing: Preliminary Results	1013
	P. Willis, Y.E. Bar-Sever, and O. Bock	
Session 8 The IAG International Services and their Role for Earth Observation		
Convenors: R. Neilan, R. Forsberg		
128	The BIPM: International References for Earth Sciences	1023
	E.F. Arias	
129	Development of the GLONASS Ultra-Rapid Orbit Determination at Geodetic Observatory Pecny	1029
	J. Dousa	
130	AGrav: An International Database for Absolute Gravity Measurements	1037
	H. Wziontek, H. Wilmes, and S. Bonvalot	
Index	1043



<http://www.springer.com/978-3-642-20337-4>

Geodesy for Planet Earth

Proceedings of the 2009 IAG Symposium, Buenos Aires,
Argentina, 31 August 31 - 4 September 2009

Kenyon, S.; Pacino, M.C.; Marti, U. (Eds.)

2012, XIX, 1046 p. 691 illus., 156 illus. in color.,

Hardcover

ISBN: 978-3-642-20337-4