1. Record Nr. UNINA9910830813403321 Titolo Applied multidimensional geological modeling: informing sustainable human interactions with the shallow subsurface / / edited by Alan Keith Turner, Holger Kessler, Michiel J. van der Meulen Hoboken, NJ:,: John Wiley & Sons, Inc.,, [2021] Pubbl/distr/stampa ©2021 **ISBN** 1-119-16311-0 1-119-16310-2 1-119-16309-9 Descrizione fisica 1 online resource (675 pages) Disciplina 550.113 Geological modeling - Simulation methods Soggetti Geological surveys - Simulation methods Lingua di pubblicazione Inglese **Formato** Materiale a stampa Livello bibliografico Monografia Nota di contenuto

Cover -- Title Page -- Copyright -- Contents -- List of Contributors --Acknowledgments -- Part I Introduction and Background -- Chapter 1 Introduction to Modeling Terminology and Concepts -- 1.1 Mapping or Modeling - Which Is Correct? -- 1.1.1 Definition of the Term "Model" --1.1.2 Evolution of the Geological Model Concept -- 1.2 Why Use "Multidimensional"? -- 1.3 Evolution of Digital Geological Modeling --1.4 Overview of the Book -- 1.4.1 Intended Audience -- 1.4.2 Part I: Introduction and Background -- 1.4.3 Part II: Building and Managing Models -- 1.4.3.1 Technical Considerations - Chapters 5-8 -- 1.4.3.2 Alternative Model Building Approaches - Chapters 9-12 -- 1.4.3.3 Model Application and Evaluation - Chapters 13-15 -- 1.4.4 Part III: Using and Disseminating Models -- 1.4.5 Part IV: Case Studies -- 1.4.6 Part V: Future Possibilities and Challenges -- References -- Chapter 2 Geological Survey Data and the Move from 2-D to 4-D -- 2.1 Introduction -- 2.2 The Role of Geological Survey Organizations --2.2.1 Establishment of Geological Surveys -- 2.2.2 Systematic versus Strategic Mapping Approaches -- 2.2.3 Geological Mapping by Geological Surveys -- 2.2.4 Difficulty in Maintaining Adequate Financial Support -- 2.3 Challenges Facing Geological Survey Organizations -- 2.4 A Geological Map is Not a Piece of Paper -- 2.4.1 Early Geological Maps -- 2.4.2 Early Digital Mapping and Modeling -- 2.4.3 Advantages of Digital Mapping -- 2.5 The Importance of Effective Data Management -- 2.6 The Challenges of Parameterization - Putting Numbers on the Geology -- 2.6.1 Parameterization of Geological Models -- 2.6.2 Model Scale -- 2.6.3 Parameter Heterogeneity -- 2.6.4 Model Uncertainty -- 2.7 Use of 3D Geological Models with Process Models -- 2.8 The Evolving Mission of the Geological Survey of the Netherlands

Netherlands. 2.9 Experience With a Multiagency and Multijurisdictional Approach to 3D Mapping in the Great Lakes Region -- 2.10 Conclusions --References -- Chapter 3 Legislation, Regulation, and Management --3.1 Introduction -- 3.2 Layers of the Subsurface -- 3.3 Legal Systems -- 3.4 Land Ownership -- 3.5 Regulation and Management -- 3.5.1 Ground Investigation -- 3.5.2 Spatial Planning -- 3.5.3 Natural Resources -- 3.5.4 Environmental and Cultural Issues -- 3.6 Approaches to Subsurface Development -- 3.6.1 Existing Spaces --3.6.2 New Developments -- 3.7 Involving Stakeholders -- 3.8 Delivery of Information -- 3.9 The Role of 3D Subsurface Models -- 3.10 Conclusions -- References -- Chapter 4 The Economic Case for Establishing Subsurface Ground Conditions and the Use of Geological Models -- 4.1 Introduction -- 4.2 The Nature of Geotechnical Investigations -- 4.2.1 Geotechnical Investigations for Management of Geotechnical Risk -- 4.2.2 How Geological Models Sit Within the Geotechnical Investigation Process -- 4.2.3 Potential Impact of Geotechnical Risks -- 4.3 Benefits of Using 3D Models and Establishing Subsurface Ground Conditions -- 4.3.1 Cost of Geotechnical Investigations -- 4.3.2 Geotechnical Baseline Report --4.4 Processes, Codes, and Guidelines for Establishing Subsurface Conditions and Managing Risk -- 4.4.1 Risk Reduction Strategies to Manage Deficient Ground Information -- 4.4.2 Investments to Mitigate Against Deficient Ground Information -- 4.4.3 Code Requirements --4.5 Examples of the Use of 3D Geological Models for Infrastructure Projects -- 4.5.1 Investigating ThreeDimensional Geological Modeling as a Tool for Consultancy -- 4.5.2 ThreeDimensional Geological Modeling for a Nuclear Power Facility in Anglesey, Wales, UK, to Enhance Ground Investigation Quality and Optimize Value. 4.5.3 Integrating 3D Models Within Project Workflow to Control Geotechnical Risk -- 4.5.4 The Economic Value of Digital Ground Models for Linear Rail Infrastructure Assets in the United Kingdom --4.5.5 Employing an Integrated 3D Geological Model for the Reference Design of the Silvertown Tunnel, East London -- 4.5.6 A New Dutch Law on Subsurface Information to Enable Better Spatial Planning --Acknowledgments -- References -- Part II Building and Managing Models -- Chapter 5 Overview and History of 3D Modeling Approaches -- 5.1 Introduction -- 5.2 Historical Development of 3D Modeling --5.2.1 Representation of the Third Dimension -- 5.2.2 Electrical Analog Models -- 5.2.3 The Adoption of Digital Mapping Technologies --5.2.4 Evolution of 3D Mapping and Modeling Collaborative Forums --5.3 The Mahomet Aquifer: An Example of Evolving Subsurface Modeling -- 5.3.1 Early Modeling Efforts -- 5.3.2 Initial 3D Geological and Hydrogeological Evaluations -- 5.3.3 Recent Geological and Hydrogeological Models -- 5.4 Digital 3D Geological Modeling Approaches Discussed in This Book -- 5.4.1 StackedSurface Approach to Model Creation -- 5.4.2 Modeling Based on CrossSections and Boreholes -- 5.4.3 ThreeDimensional Gridded Voxel Models -- 5.4.4 Integrated RuleBased (Implicit) Geological Models -- References --

Chapter 6 Effective and Efficient Workflows -- 6.1 Introduction -- 6.1.1 Understanding the Geologic Modeling Process -- 6.1.2 Developing Custom Workflows -- 6.2 Operational Considerations -- 6.2.1 User Requirements -- 6.2.2 Defining Mapping Objectives -- 6.2.2.1 Delineation of Model Domain -- 6.2.2.2 Definition of the General Geologic Framework Model -- 6.2.2.3 Determination and Representation of the Desired Model Accuracy -- 6.2.2.4 Consideration of Formats for Final Deliverables -- 6.2.3 Geologic Setting and Natural Complexity.

6.2.4 Existing Data Availability and Management -- 6.2.5 Collection of New Data -- 6.2.6 Staff Availability and Expertise -- 6.3 Selection of Modeling Methods and Software -- 6.4 Products and Distribution --6.5 Model Maintenance and Upgrades -- 6.6 Illinois State Geological Survey 3D Modeling Workflows -- 6.6.1 Project Objectives -- 6.6.2 Project Schedule -- 6.6.3 Project Staffing Considerations -- 6.6.4 Software Selection -- 6.6.5 Data Assessment -- 6.6.6 Project Deliverables -- 6.6.7 PostProject Model Management -- 6.7 Modeling Workflow Solutions by Other Organizations -- 6.7.1 University of Waterloo, Department of Earth and Environmental Sciences -- 6.7.2 Delaware Geological Survey -- 6.7.3 Ontario Geological Survey -- 6.7.4 Geological Survey of Denmark and Greenland -- 6.8 Creating a Custom Workflow -- Acknowledgments -- References -- Chapter 7 Data Sources for Building Geological Models -- 7.1 Introduction -- 7.2 Defining and Classifying Data -- 7.2.1 Data Versus Information --7.2.2 Classifying Data -- 7.2.2.1 Spatial Location and Extent Using Points, Lines, and Polygons -- 7.2.2.2 Framework Versus Property Data -- 7.2.2.3 Elevation, Surficial, and Subsurface Data -- 7.3 Legacy Data -- 7.4 Elevation Data -- 7.5 Surficial and Subsurface Geological Data --7.5.1 Geological Survey Data -- 7.5.1.1 Map Data -- 7.5.1.2 Boreholes -- 7.5.1.3 Analytical Databases -- 7.5.1.4 Reports and Academic Contributions -- 7.5.1.5 3D Models -- 7.5.1.6 Accessibility -- 7.5.2 Soil Data -- 7.5.3 Geotechnical Data -- 7.5.4 Water Well Data -- 7.5.5 Petroleum Data -- 7.6 Geophysical Data -- 7.6.1 Seismic Survey Method -- 7.6.1.1 Seismic Refraction Surveys -- 7.6.1.2 Seismic Reflection Surveys -- 7.6.1.3 Surface Wave Surveys -- 7.6.2 Resistivity Survey Method -- 7.6.3 Electromagnetic Survey Method -- 7.6.3.1 Time Domain Electromagnetic Surveys (TDEM). 7.6.3.2 Frequency Domain Electromagnetic Surveys -- 7.6.3.3 Airborne

Electromagnetic Surveys -- 7.6.4 Gravity Surveys -- 7.6.4.1 Ground based Gravity Surveys -- 7.6.4.2 Airborne Gravity Surveys -- 7.6.5 Ground Penetrating Radar -- 7.6.6 Borehole Geophysics -- 7.6.6.1 Borehole Geophysical Logging -- 7.6.6.2 Inhole Seismic Geophysical Logging -- Acknowledgments -- References -- Chapter 8 Data Management Considerations -- 8.1 Introduction -- 8.2 Data Management Methods -- 8.2.1 Standards and Best Practice -- 8.2.2 The Database System -- 8.2.3 Data Modeling -- 8.2.4 Relational Databases -- 8.2.5 EntityRelationship Diagrams -- 8.2.6 Normalization Process -- 8.2.7 Denormalization Process -- 8.2.8 Extract, Transform, Load (ETL) Processes -- 8.2.9 Data Warehousing --8.2.10 The Important Role of Metadata -- 8.3 Managing Source Data for Modeling -- 8.3.1 Data from Multiple Data Sources -- 8.3.2 Managing the Connectivity among Data Sources -- 8.3.3 Facilitating Sharing of Database Designs -- 8.4 Managing Geological Framework Models -- 8.4.1 BGS Model Database Design Principles -- 8.4.2 Versioning Existing Models -- 8.4.3 Creating New Models Based on Existing Models - "Model Interoperability" -- 8.5 Managing Geological Properties Data and Property Models -- 8.5.1 Characteristics of Property Data Sources and Models -- 8.5.2 Applications within the

British Geological Survey -- 8.6 Managing Process Models -- 8.7 Integrated Data Management in the Danish National Groundwater Mapping Program -- 8.8 Transboundary Modeling -- 8.8.1 The H3O Program: Toward Consistency of 3D Hydrogeological Models Across the DutchBelgian and DutchGerman Borders -- 8.8.2 The Polish-German TransGeoTherm Project -- 8.8.3 The GeoMol Project -- Acknowledgments -- References -- Chapter 9 Model Creation Using Stacked Surfaces -- 9.1 Introduction -- 9.2 Rationale for Using Stacked Surfaces.

9.3 Software Functionality to Support StackedSurface Modeling.

## Sommario/riassunto

"This book has been developed to provide a citable central source that documents the current capabilities and contributions of several GSO's and other practitioners in industry and academia that are already producing multidimensional geological models. Each of these groups has their own agenda, aims, and remit. They employ a variety of modeling approaches developed in response to local geological characteristics, historical data collections, and economic, societal, and regulatory requirements. The book contents are arranged to provide a "shop window" describing what multidimensional geological modeling can do and the value of this information to a large and varied potential stakeholder community. The subtitle emphasizes that this book focuses on applications related to human interactions with subsurface conditions; these interactions mostly occur in the shallow subsurface, typically considered to be within 100-200 m (300-600 ft) of the surface. This has been defined as the zone of human interaction"--