

Preface

Since the 2007 Annual Meeting in Bangkok, the Asia Oceania Geosciences Society (AOGS) has hosted a series of sessions on data assimilation (DA), named “Yoshi K. Sasaki Symposium on Data Assimilation for Atmospheric, Oceanic and Hydrologic Applications.” We started this symposium after the first DA session in the 2005 AOGS meeting in Singapore to honor Dr. Yoshi Kazu Sasaki, the former George Lynn Cross Professor of the School of Meteorology at University of Oklahoma, for his lifelong contributions to DA. Yoshi was a pioneer in broaching the use of variational method to produce optimal initial conditions for numerical prediction. His approach is further developed and nowadays widely adopted in various prediction systems in geosciences. Unfortunately and sadly we lost this great scientist on March 12, 2015, and we decided to make this volume be a memorial to Dr. Sasaki. Yoshi had contributed superior chapters to the previous two volumes—both frontline works on tornado DA.

The first volume of this book was published in March 2009 with 27 chapters—a collection of notable invited papers along with those selected from the previous symposiums. Among many important chapters in the volume, John M. Lewis, one of Yoshi’s Ph.D. students, contributed a chapter titled “Sasaki’s Pathway to Deterministic Data Assimilation.” Milija Županski, the last Ph.D. student of Yoshi, discussed theoretical and practical issues of ensemble DA. François-Xavier Le Dimet, who was a postdoctoral scientist under Yoshi’s supervision, described application of the variational approach to hydrologic DA. Yoshi himself proposed a new theory based on the entropic balance, titled “Real Challenge of Data Assimilation for Tornadogenesis.” I. Michael Navon provided a thorough review of DA for numerical weather prediction, especially on 4D-Var, which became the most cited chapter in this series (66 times as of April 2016 from Google Scholar).

The second volume was published in May 2013, again with 27 chapters, by collecting both invited papers and selected papers from the previous symposiums held in 2009 (Singapore), 2010 (Hyderabad) and 2011 (Taipei). Volume II included excellent overviews of estimation theory, nudging and variational methods, and Markov chain Monte Carlo methods. Most prominently, Yoshi extended his entropy balance theory for tornado DA from the previous volume, and contributed a

chapter titled “Entropic Balance Theory and Radar Observation for Prospective Tornado Data Assimilation.”

We have felt a need to publish another volume because some new research results had been presented at the symposiums since publication of the last volume. When we heard about Yoshi’s passing, we immediately decided to publish a memorial volume for him. Here we include a special dedication section, titled “In Memory of Yoshi,” by collecting memories on and photos of Yoshi from some authors. This volume includes excellent overviews of variational DA (François-Xavier Le Dimet et al.), coupled system DA (Milija Županski), representer-based variational DA (Boon Chua and Liang Xu), and soil moisture DA (Viviana Maggioni and Paul Houser).

In this volume, theoretical and methodological aspects encompass inverse theory, variational methods with/without adjoint model, representer-based variational method, quantification of information and forecast uncertainty, sensitivity tools, error representation modeling, the maximum likelihood ensemble filter, ensemble forecast, conditional nonlinear optimal perturbation approach, etc., with applications to oceanic, atmospheric, and land surface DA; coupled atmosphere-chemistry DA; stratospheric and mesospheric DA; terrestrial ecosystem; bottom topography mapping; radar/lidar/satellite assimilation; adjoint sensitivity; and targeting observations. Operational 4D-Var applications are also included for the JMA Nonhydrostatic Model (NHM) and the US Navy Coastal Ocean Model (NCOM).

This book will be useful to individual researchers as well as graduate students as a reference to the most recent progresses in the field of data assimilation. The publication is partly supported by the Korea Environmental Industry & Technology Institute through the Eco Innovation Program (ARQ201204015). We appreciate Boon Chua at Naval Research Laboratory, Takeshi Enomoto at Kyoto University, and François-Xavier Le Dimet at University of Joseph Fourier, who have served as the co-conveners of the Sasaki Symposium. We are very honored to dedicate this book to the late Yoshi Sasaki—our friend and mentor, for his monumental contributions to the advance of data assimilation.

Seoul, Republic of Korea
Monterey, USA
April 2016

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Data Assimilation for Atmospheric, Oceanic and
Hydrologic Applications (Vol. III)

Park, S.K.; Xu, L. (Eds.)

2017, XXXVI, 553 p. 216 illus., 155 illus. in color.,
Hardcover

ISBN: 978-3-319-43414-8