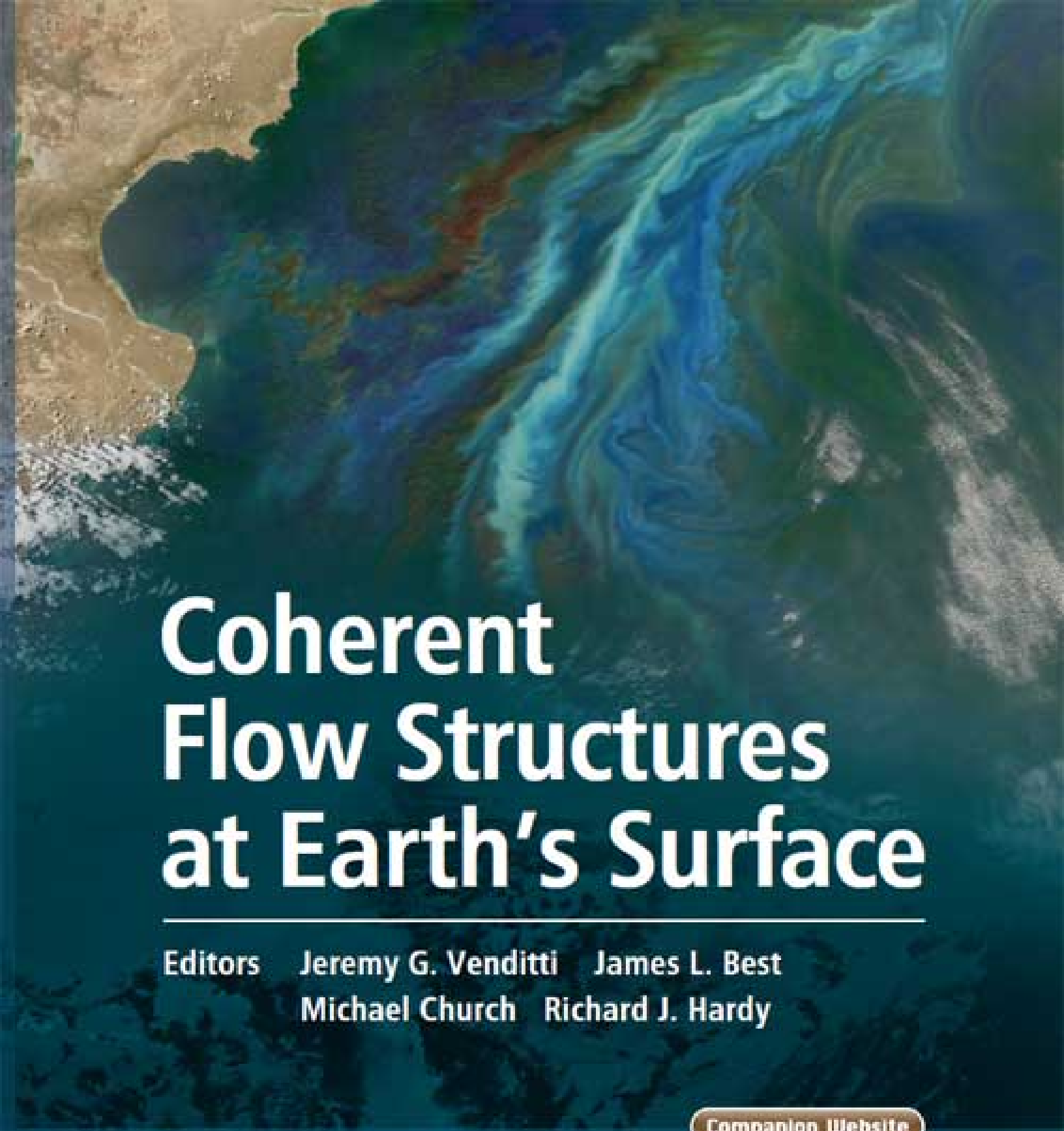

Coherent Flow Structures at Earth's Surface

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Contents

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The western edge of the South Atlantic ocean gyre that brings warmer, saltier water from the subtropics where it collides with cooler fresher waters flowing up from the south. The currents meet at the eastern edge of the continental shelf, pulling nutrients up from the deep ocean and resulting in a phytoplankton bloom that highlights interfacial instabilities along the edges of the ocean currents. Captured with the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA’s Aqua satellite on December 21, 2010. (Image courtesy of NASA’s Earth

Observatory, http://earthobservatory.nasa.gov/IOTD/view.php?id=48244).
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Coherent flow structures generated in ice floes along the Kamchatka Peninsula in Russia by the southwestward-flowing Kamchatka ocean current on March 15, 2012. The image was taken by the Expedition 30 crew from the International Space Station (Image courtesy of NASA's Earth Observatory, http://earthobservatory.nasa.gov/IOTD/view.php?id=77589).
Cover design by Gary Thompson

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Preface

Understanding fluid flow at Earth's surface is of central importance to understanding the dynamics of Earth's surface and its lower atmosphere. These geophysical flows, in environments ranging from deserts to forests and from rivers to the oceans and atmosphere, are structured across a wide range of spatial and temporal scales, from small-scale turbulent vortices generated at the boundaries and responsible for grain motion, to large-scale circulation patterns that generate atmospheric and geomorphic features visible from space. This book derives from a conference held at Simon Fraser University, Burnaby, British Columbia, Canada, 3–5 August 2011 entitled *Coherent Flow Structures in Geophysical Flows at the Earth's Surface*. The conference built on the success of an earlier meeting entitled *Coherent Flow Structures in Open Channel Flows* held at the University of Leeds, UK, in 1995, which produced a well-cited book of the same name (edited by Ashworth, Bennett, Best and McLelland and published in 1996 by John Wiley & Sons, Ltd). The 1995 conference launched an impressive array of research into the structure of fluid flows in rivers. The 2011 meeting had a wider scope than the earlier conference, expanding beyond rivers to flows in all natural environments at Earth's surface. The 2011 conference brought together the research community that uses numerical simulations, laboratory modelling and field observation to study coherent flow structures (CFS), their interaction with sediment, vegetation, and benthic communities, the manipulation of such flow structures for managing sedimentary environments, and the key roles they play in Earth surface dynamics.

The conference would not have been possible without the dedicated volunteer efforts of a small group of graduate students, postdocs and staff at Simon Fraser University including Maureen Attard, Ryan Bradley, Megan Hendershot, Caroline Le Bouteiller, Martin Lin, John Ng, Dan Shugar and Andrea Vigna. Justin Ankenmann from SFU Meeting, Event and Conference Services arranged many of the conference logistics and made the process much easier for the organizers. The US National Science Foundation (nsf.gov), the National Center for Earth Surface Dynamics (nced.umn.edu) and TSI (tsi.com) provided funds for student conference registration and accommodation, allowing an impressive, enthusiastic and motivated group of young researchers to attend the meeting. Additional funds for coffee breaks, lunches, keynote speaker travel costs, student awards and a field trip on the Fraser River were provided through generous support from the British Society for Geomorphology (geomorphology.org.uk), the Canadian Geomorphology Research Group (cgrg.geog.uvic.ca), Dantec Dynamics (dantecdynamics.com), Golder Associates Ltd. (golder.ca), LAVision (lavision.de), Met-Flow (met-flow.com), Nortek USA (nortekusa.com), Reson (reson.com), Rockland Scientific (rocklandscientific.com), Simon Fraser University (sfu.ca), SFU Geography (sfu.ca/geography/), SonTek/YSI (sontek.com), Teledyne RD Instruments (rdinstruments.com), the Jack and Richard Threet Chair at the University of Illinois at Urbana-Champaign (illinois.edu) and Wiley (wiley.com).

There were 107 abstracts submitted to the *Coherent Flow Structures in Geophysical Flows at the Earth's Surface* conference and it was not possible to produce a book with a chapter from each contributor. With this volume, the editors attempted to compile a group of contributions that represent the very best reviews and the most exciting new research presented at the meeting, and attempted also to

achieve a breadth that covers the field so that this book might become a state-of-the-art treatment on CFS in flows at Earth's surface. Ultimately, this volume illustrates how the study of coherent flow structures is now being applied to geophysical flows at Earth's surface.

The first chapter represents the editors' attempt to define what a coherent flow structure is in geophysical flows and how the idea is currently being applied. In the second chapter, Ron Adrian describes the primary coherent flow structures identified in hydraulically smooth boundary layer flows at low Reynolds numbers. Chapters 3–5 deal with the dynamics of CFS in flows at Earth's surface. Subsequent chapters deal with CFS in airflows (6–8) and through vegetation canopies (6 and 9–11). New methods for examining CFS are reviewed in Chapters 12–14. The final group of chapters deals with coherent flow structures in sediment-transporting flows. This includes chapters on CFS in estuarine tidal flows (14 and 15), morphological scale CFS in rivers (16–18), the dynamic linkage between CFS and sediment movement (19 and 20), the statistical properties of turbulence in sediment transporting flows (21 and 22) and CFS associated with gravity currents (23 and 24).

The editors are extremely grateful to the volume contributors for all their hard work, cooperation and for

making this book possible. Each paper was fully peer reviewed and, where possible, by someone who attended the conference and someone who did not. The editors thank this group of reviewers for their essential, yet uncredited, contribution to the volume. The staff at Wiley, especially Rachael Ballard, Fiona Seymour and Lucy Sayer, have been very helpful and supportive in bringing this volume to publication.

We hope that this volume, like its predecessor, will become an authoritative record of advances in our understanding of coherent flow structures in flows at Earth's surface and that it will set the stage for new research developments in the field.

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About the Companion Website

This book is accompanied by a companion website:

www.wiley.com/go/venditti/coherentflowstructures

The website includes:

- Powerpoints of all figures from the book for downloading
- PDFs of tables from the book
- Animation videos