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Ocean Colour Remote Sensing of Flood Plumes in the Great Barrier Reef

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ABSTRACT

The objective of the research reported in this thesis was to develop a technique to monitor the dynamics of sediments and nutrients entering the coastal ocean with river plumes associated with high intensity low frequency events (e.g. floods), using ocean colour remote sensing. To achieve this objective, an inverse bio-optical model was developed, based on analytical and empirical relationships between concentrations of optically significant substances and remote sensing of water-leaving radiance. The model determines concentrations of water-colouring substances such as chlorophyll, suspended sediments, and coloured dissolved organic matter, as well as the values of optical parameters using water-leaving radiances derived from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS). To solve atmospheric correction in coastal waters, the aerosol type over clear waters is transferred to adjacent turbid water pixels.

The vicinity of the Herbert River, central Great Barrier Reef zone, Australia, was used as a case study for the application of the algorithm developed. The satellite ocean colour technique was successfully validated using sea-truth measurements of water-colouring constituents acquired in the area during various seasons throughout 2002-2004. A high correlation between chlorophyll and dissolved organic matter was found in the coastal waters of the region, and when the bio-optical model was constrained to make chlorophyll a function of dissolved organic matter, the relationship between in situ and satellite-derived data was substantially improved. With reliable retrieval of the major water-colouring constituents, the technique was subsequently applied to study fluxes of particulate and dissolved organic and inorganic matter following a flood event in the Herbert River during the austral summer of 1999.

Extensive field observations covering a seasonal flood in the Herbert River in February 2004 revealed high sediment and nutrient exports from the river to the adjacent coastal waters during the flood event. Due to rapid settling, the bulk of the sediment-rich influx was deposited close inshore, while the majority of nutrients exported from the river were consumed by phytoplankton in a relatively small area of the coastal ocean. With the help of ocean colour remote sensing, it was demonstrated that river-borne sediments and nutrients discharged by a typical flood in the Herbert River are mostly precipitated or consumed within the first 20 km from the coast and therefore are unlikely to reach and possibly affect the mid-shelf coral reefs of this section of the Great Barrier Reef lagoon.

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CONTENTS

Chapter 1. SETTING THE PROBLEM 1

1.1. Great Barrier Reef health status 3
1.2. Effects of nutrient and sediment on corals 3
1.3. Human alterations to river discharge 7
1.4. Need to monitor 7
1.5. Satellite remote sensing 9
1.6. Study area 10
1.7. Research questions and objectives of the study 13
1.8. Thesis structure 14

Chapter 2. BIO-OPTICAL MODEL 15

2.1. HISTORICAL OVERVIEW OF BIO-OPTICAL MODELLING 17

2.1.1. Forward and inverse problems in ocean optics 17
2.1.2. Algorithm evolution 18
2.1.3. Semi-analytical inverse models of case II waters 20
2.1.4. Future of bio-optical modelling 22

2.2. BIO-OPTICAL MODEL DESCRIPTION 23

2.2.1. SeaWiFS water-leaving radiance 23
2.2.2. Apparent and inherent optical properties 24
2.2.3. Absorption of phytoplankton 27
2.2.4. Backscatter of phytoplankton 28
2.2.5. Coloured dissolved organic matter 29
2.2.6. Inherent optical properties of suspended sediments 31
2.2.7. Bottom reflection 34
2.2.8. Assumptions of the model 35
2.2.9. Inversion of the bio-optical model 38

2.3. MODEL SENSITIVITY 41

2.3.1. Coastal ocean scenarios 41
2.3.2. Forward model sensitivity to water colouring constituents 42
2.3.3. Forward model sensitivity to model parameters 43
2.3.4. Inverse model sensitivity to input water-leaving radiance 46

Chapter 3. MODEL APPLICABILITY 51

3.1. DATA COLLECTION 53

3.1.1. Field trip overview 53
3.1.2. Methodology 54
3.1.3. Implications for remote sensing 66

3.2. MODEL VALIDATION 75

3.2.1. SeaWiFS atmospheric correction background 75
3.2.2. Atmospheric correction modification procedure 78
3.2.3. Application of modified atmospheric correction to validation stations 79
3.2.4. Validation analysis 84

3.3. APPLICATION OF THE OCEAN COLOUR REMOTE SENSING TECHNIQUE TO A FLOOD EVENT IN THE HERBERT RIVER 95

3.3.1. Flood plumes 95
3.3.2. 1999 flood event 96
3.3.3. Conclusion 102

Chapter 4. BEYOND SEAWIFS 107

4.1. FLOOD-MEDIATED TRANSPORT FROM THE HERBERT RIVER TO THE COASTAL OCEAN 109

4.1.1. Introduction 109
4.1.2. Data overview 110
4.1.3. Herbert River hydraulic regimes 114
4.1.4. Discharge rate versus water properties relationships 116
4.1.5. Sediment dynamics in the coastal ocean 117
4.1.6. Sediment and nutrient export 120
4.1.7. Conclusion 121

Chapter 5. CONCLUSIONS 123

5.1. MAJOR FINDINGS OF THE PRESENT STUDY 125

5.1.1. Research question 1: Is satellite remote sensing suitable for studying flood plumes? 125
5.1.2. Research question 2: Can SeaWiFS be used in coastal waters? 126
5.1.3. Research question 3: What is the fate of biogeochemical substances of Herbert River plumes in the coastal ocean? 126
5.1.4. Research question 4: Do riverine sediments and nutrients reach coral reefs? 128

5.2. ISSUES RAISED BY THE PRESENT STUDY 129

5.3. WHERE TO GO NEXT 132

5.3.1. MERIS potential 132
5.3.2. Numerical modelling 133
5.3.3. Linking science and management 134

5.4. SUMMARY 135

REFERENCES 137

APPENDICES 151
APPENDIX 1. List of abbreviations 153
APPENDIX 2. List of symbols 155
APPENDIX 3. Lucinda experiment plan, 8-21 February 2004 157
APPENDIX 4. Field data for expeditions in the Lucinda region in 2002-2004 163
APPENDIX 5. Atmospheric correction modification procedure 185