

TABLE OF CONTENTS

CERTIFICATE	ii
DECLARATION.....	iii
DEDICATION.....	iv
ACKNOWLEDGEMENT.....	v
TABLE OF CONTENTS.....	viii
LIST OF FIGURES.....	xiii
LIST OF TABLES.....	xxi
ABBREVIATIONS.....	xxii

Chapter 1	Introduction	1 – 18
------------------	---------------------	---------------

1.1	Importance of Oceans	2
	1.1.1 Oceans as Heat Sinks.....	2
	1.1.2 Oceans as Sinks of Carbon dioxide.....	3
	1.1.3 Biological Productivity in Oceans.....	6
1.2	Climate Change and Oceans.....	8
	1.2.1 Impacts of Climate Change on Physical Properties of Oceans.	9
	1.2.2 Impacts of Climate Change on Marine Ecosystem and Productivity.....	9
		9
1.3	Studies Done to assess the impacts of Climate Change in Arabian Sea.	11
1.4	Research Gaps.....	15
1.5	Objectives of the Present Study.....	16
1.6	Thesis Structure.....	16

Chapter 2	Study Area: The Arabian Sea	19-30
2.1	Introduction.....	20
2.2	The Gulfs of the Arabian Sea.....	23
2.3	The Islands in the Arabian Sea.....	25
2.4	Climate of the Arabian Sea.....	25
2.5	Hydrography of the Arabian Sea.....	26
2.6	Biological Significance of the Arabian Sea.....	28
2.7	Need to Assess the Impact of Climate Change in the Arabian Sea.....	30
 Chapter 3	 Evidence of Climate Change in the Arabian Sea from Multi-Decadal study of SST	 31-73
3.1	Introduction.....	32
3.2	Data Used.....	35
3.3	Methodology.....	37
3.4	Results and Discussion.....	44
3.4.1	Data Compatibility between NOAA AVHRR and MODIS Aqua SST variability of Arabian Sea SST during the period 1950 to 2015.....	44
3.4.2	Interannual variability of Arabian Sea SST during the period 1950 to 2015.....	45
3.4.3	Seasonal variability of Arabian Sea SST during the period 1950 to 2015.....	46
3.4.4	Inter-decadal variability of Arabian Sea SST during the period 1950 to 2015.....	49
3.4.5	Monthly Climatological Mean SST of Arabian Sea (1985- 2015).....	51
3.4.6	Interannual variability of SST in different sub-domains of the Arabian Sea.....	58
3.4.6.1	Northern, Southern, Eastern and Western Arabian Sea	58

3.4.6.2.	Eastern & Western Gulfs of Arabian Sea and Red Sea	62
3.4.7	Trend Analysis of Monthly & Annual Mean SST of Arabian Sea.....	67
3.5	Conclusions.....	70
Chapter 4	Climatological study of the Variability of Wind speed over Arabian Sea	74-91
4.1	Introduction.....	75
4.2	Data Used.....	78
4.3	Methodology.....	79
4.4	Results and Discussion.....	81
4.4.1	Intraannual Variability of Wind Speed over Arabian Sea.....	81
4.4.2	Spatial Variability of Wind Speed over Arabian Sea.....	82
4.4.3	Temporal Variability of Wind Speed over Arabian Sea in different months.....	84
4.4.4	Interannual Variability of Wind Speed over Arabian Sea.....	89
4.4.5	Man-Kendall Test Statistics for Wind Speed Trend over Arabian Sea.....	90
4.5	Conclusions.....	91
Chapter 5	Spatio-Temporal variability of Phytoplankton Productivity in the Arabian Sea	92-143
5.1	Introduction.....	93
5.2	Data Used.....	99
5.3	Methodology.....	100
5.4	Results and Discussion.....	104
5.4.1	Monthly Variability of Phytoplankton Biomass in the Arabian Sea.....	104
5.4.2	Decadal Change in Productive Areas of the Arabian Sea.....	109
5.4.2.1	Decadal Change from 1998 to 2008.....	109

5.4.2.2	Decadal Change from 2005 to 2015.....	111
5.4.3.	Variability of Phytoplankton Biomass in the Arabian Sea	114
5.4.3.1	Temporal Variability from 1998 to 2009	114
5.4.3.2	Temporal Variability from 2003 to 2015.....	118
5.4.4	Variability of Phytoplankton Biomass in different domains of the Arabian Sea.....	122
5.4.4.1	Variability of Phytoplankton Biomass in Northern Arabian Sea	122
5.4.4.2	Variability of Phytoplankton Biomass in Southern Arabian Sea	124
5.4.4.3	Variability of Phytoplankton Biomass in Eastern Arabian Sea	126
5.4.4.4	Variability of Phytoplankton Biomass in Western Arabian Sea.....	128
5.4.4.5	Variability of Phytoplankton Biomass in Eastern and Western Gulfs and the Red	130
5.4.5.	Trend Analysis of Phytoplankton Biomass.....	135
5.5	Conclusion.....	140

Chapter 6	Correlation of the Changing Climate on the Biological productivity of the Arabian Sea	144-199
------------------	--	----------------

6.1	Introduction.....	145
6.2	Data Used.....	149
6.3	Methodology.....	150
6.4	Results & Discussion.....	151
6.4.1	Intra-annual variability of SST, Wind Speed and phytoplankton biomass in Northern Arabian Sea.....	151
6.4.2	Inter-annual variability of SST, Wind Speed and phytoplankton biomass in Northern Arabian Sea	156
6.4.3	Intra-annual variability of SST, Wind Speed and Phytoplankton biomass in Southern Arabian Sea.....	160

6.4.4	Inter-annual variability of SST, Wind Speed and phytoplankton biomass in Southern Arabian Sea	163
6.4.5	Intra-annual variability of SST, Wind Speed and phytoplankton biomass in Eastern Arabian Sea	166
6.4.6	Inter-annual variability of SST, Wind Speed and phytoplankton biomass in Eastern Arabian Sea.....	169
6.4.7	Intra-annual variability of SST, Wind Speed and phytoplankton biomass in Western Arabian Sea.....	172
6.4.8	Inter-annual variability of SST, Wind Speed and phytoplankton biomass in Western Arabian Sea.....	175
6.4.9	Intra-annual variability of SST, Wind Speed and phytoplankton biomass in Arabian Sea Basin.....	178
6.4.10	Inter-annual variability of SST, Wind Speed and phytoplankton biomass in Arabian Sea Basin.....	181
6.4.11	Monthly variability of SST, Wind Speed and phytoplankton biomass in Arabian Sea Basin.....	184
6.4.12	Interannual variability of SST and Phytoplankton biomass in the Eastern and Western Gulfs and the Red Sea.....	187
6.4.13	Statistical Analysis of the Correlation between SST, Wind Speed and Phytoplankton Biomass.....	193
6.5	Conclusion.....	197

Chapter 7	Summary and Conclusions.....	200-
		206
	References	207-
		233