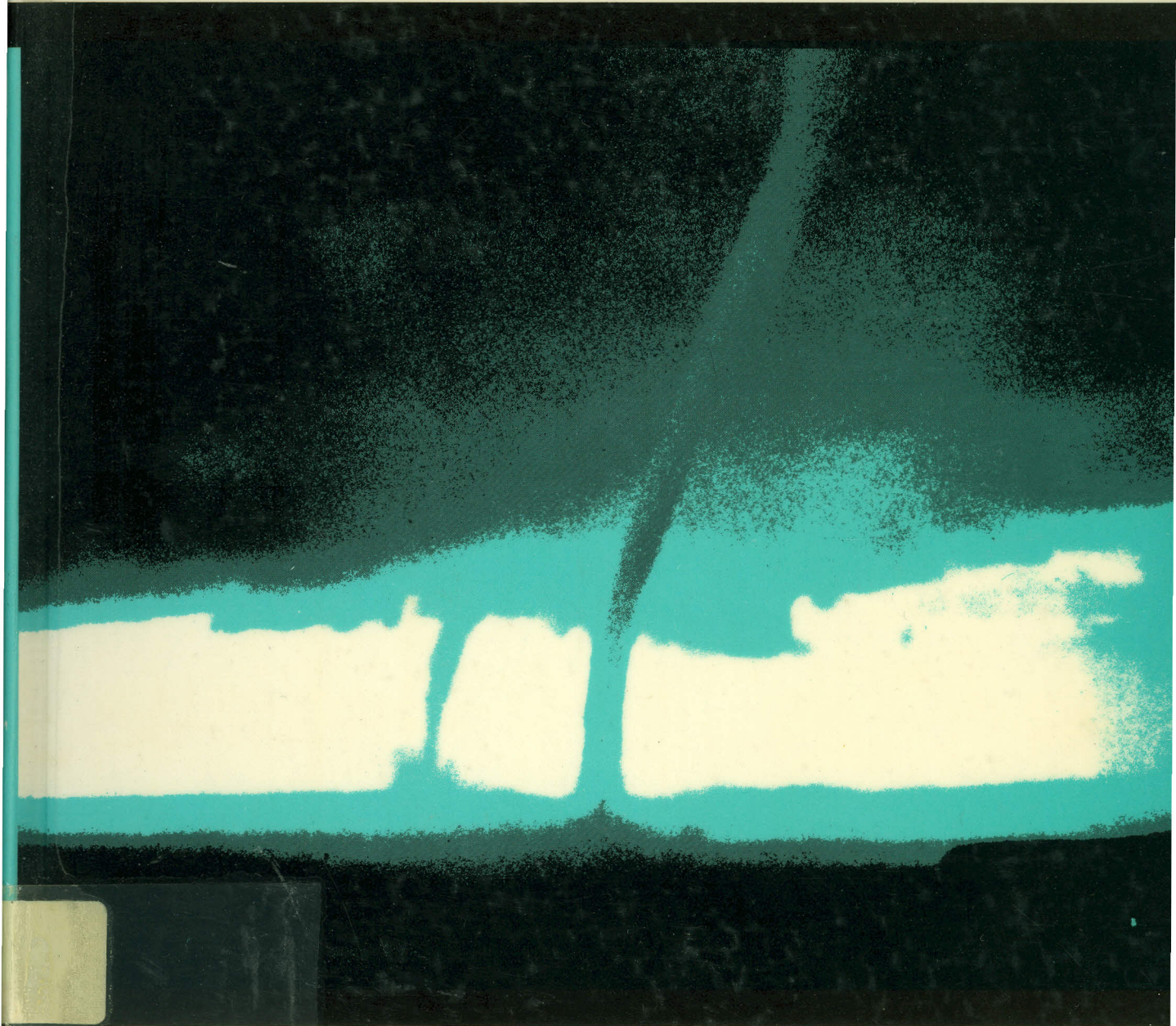


The ocean-atmosphere system



**A. H. Perry
and J. M. Walker**

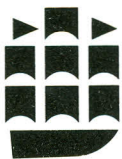
INSTITUT
FÜR METEOROLOGIE U. KLIMATOLOGIE
DER TECHNISCHE UNIVERSITÄT
3 HANNOVER · HERRENHAUSER STR. 2

Mv. Nr. 112/2408

The ocean - atmosphere system

Dk 551.46
551.51

A. H. Perry and J. M. Walker



Longman
London and New York

Contents

Preface	v
Abbreviations and acronyms	vi
Acknowledgements	ix
<hr/>	
1 The nature and characteristics of the ocean–atmosphere system	1
Reasons for studying the ocean–atmosphere system 1 The nature of the ocean–atmosphere system 3 A sketch of the historical background 4 Marine observations 12	
<hr/>	
2 Oceanic macro-circulations	15
Solar radiation 15 Terrestrial radiation 16 Radiation balance 16 The general circulation of the atmosphere 16 What causes ocean currents? 17 Winds and currents of the Indian Ocean 19 Air-flows over the Arabian Sea 22 The extent of the monsoon influence on the Indian Ocean 23 The topography of the Indian Ocean surface 25 The Somali Current 26 The origin of the Gulf Stream 27 The significance of the Gulf Stream System 32 The nature of the Gulf Stream 33 The North Atlantic Current 37 The Arctic Ocean 38 The Southern Ocean 40 The formation of bottom water 45 The significance of deep-water circulations 46 The magnitude of the thermohaline contribution to the general oceanic circulation 48	
<hr/>	
3 The action of wind on the sea	50
The generation and growth of waves 50 Wave forecasting 52 Wave spectra 54 Swell propagation 56 Breaking waves 56 The meteorological significance of breaking waves 57 Contamination of the sea-surface 58 The origin of drift currents 60 Ekman's idealized theory of wind-driven currents 62 Turbulence in the upper ocean 64 Some further aspects of Ekman's assumptions 65 Upwelling – an application of Ekman's theory 67 Surges 68	
<hr/>	
4 Ocean–atmosphere heat exchange	73
Radiation patterns 73 Components of the energy budget 77 Global patterns of evaporation from the ocean surface 77 Fluxes of sensible heat 80 Heat fluxes within the ocean 84 The annual march of energy–budget components 85 The energy budget of the ocean–atmosphere system 86 Features of the atmospheric boundary layer 91 Transfer of heat in the atmospheric boundary layer 93 The formation of sea-ice 94 The growth and decay of sea-ice 96 Advection fog and sea smoke 96 Cumulus convection 98 Mesoscale organization of cumuliform clouds 99 An example of intermediate-scale convective organization 101 Tropical cyclonic storms 102 Extra-tropical cyclones 106	
<hr/>	
5 Thermal behaviour of the ocean–atmosphere system and climatic responses	108
Monitoring and forecasting ocean temperature 108 North Atlantic sea temperature record 111 Persistence of sea temperature anomalies 112 Short-period variations of sea temperature 113 Classification of sea temperature anomaly fields 113 Air–sea temperature difference 114 Air temperature over the oceans 114 Synoptic heat budget studies 117 Lag-associations between North Atlantic sea temperatures and European atmospheric pressure 118 Complex coupled air–sea systems in temperate latitudes 120 Air–sea systems in tropical latitudes 122 Climatic change and the ocean–atmosphere system 125	

6	International projects and numerical models	129
	The Global Atmospheric Research Programme 130	Some advanced numerical models of climate 135
	Appendix: The temperature–salinity diagram	140
	References	141
	Index	155
