A Forecasters' Handbook for West Africa

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Motivations, Overall Aim, Specific Objectives and Book Format

- Book is motivated by the demand of National Meteorological Services in West Africa for up-to-date forecasting techniques, meeting the increasing demand for accurate forecasts to prevent weather-related hazards and economic loss.
- Overall aim is to synthesize the latest knowledge of West African meteorology with operational tools and methods for weather forecasting in West Africa.
- One specific objective was to transfer new insights into the dynamics of West African weather systems, which emerged from recent international efforts like AMMA (African Monsoon Multidisciplinary Analyses), into operational forecasting.
- A second objective was to summarize the recent status of understanding of the West African climate systems across scales from planetary to local.
- As a consequence, the Handbook has a textbook-style, with each chapter starting with the science background, followed by operational methods, and case studies, with the latter being also available and updated online.
- Readership is weather forecasters with interest in tropical prediction, researchers, and students of Meteorology and related fields.

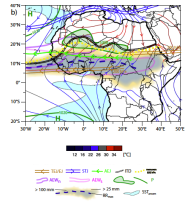
List of Chapters

Editors: Douglas J. Parker and Mariane Diop-Kane

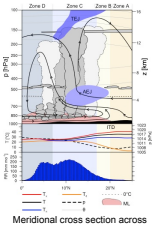
		Reviewers
1. Mean climate and annual cycle	A. H. Fink	Serge Janicot
2. Synoptic	R. Conforth/ Z. Mumba	Chris Thorncroft
3. Convective storms	J.-P. Lafore	Mitch Moncrieff
4. Local weather	D. J. Parker	Chris Tubbs Paul Hutcheon
5. Dust	P. Knippertz	Andreas Fink
6. Now-casting	R. Roberts/J. Wilson	Charles Yorke Jim Galvin CNRM
7. Sub-seasonal forecasting	W. Thiaw	George Kiladis
8. Seasonal forecasting	A. Colman	Doug Parker Mariane Diop
9. Remote sensing	A. Laing	Mariane Diop Tony Wardle
10. Numerical Weather Prediction	Sean Milton	Fred Semazzi Philippe Bougeault
11. West African Synthetic Analysis and Forecast: WASA-F	J. –P. Lafore/N. Chapelon	ACMAD / Abdou Kassimou

Chapter 1: „Mean climate and seasonal cycle„

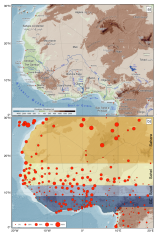
Chapter 1 discusses the mean climate and seasonal cycle of West Africa (see map) using traditional *in-situ* ground and upper-air observations, a state-of-the-art re-analysis, as well as a variety of satellite-derived maps. Focus is on the hydrologic cycle, including clouds, surface, and upper-air circulations, as well as climatologies of African Easterly Waves. The complex climate system over West Africa is synthesized in a map and meridional cross section.



Map showing major climate feature of the West African monsoon in July.



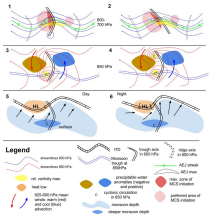
Meridional cross section across the West African monsoon in July with classical weather zones A-D.



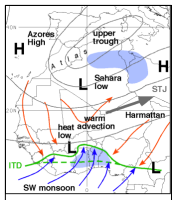
Region covered in the Forecaster's Handbook.

Chapter 2: „Synoptic Systems„

Chapter 2 reviews the synoptic systems in which many of the convective rainfall events in the WAM are embedded. AMMA has brought about a considerable progress in the understanding and modeling of synoptic systems. Prime examples are African Easterly Waves (AEWs) and their diversity, as they appear on daily weather maps. The chapter also discusses Tropical-Extratropical Interactions that are important in the dry and transition seasons.



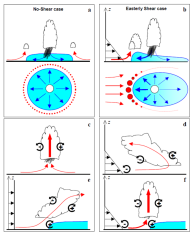
Schematic of the various observable elements of an AEW, and likely relationships between these. Left hand panels show a "normal" situation, as far as this exists, while right hand panels show common alternatives.



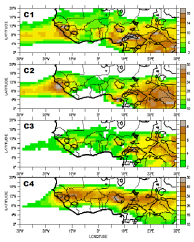
Schematic depictions of the large-scale circulation associated with dry-season precipitation over West Africa associated with low-latitude upper-level disturbances from the extratropics. These rainfalls have a higher predictability.

Chapter 3: „Deep convection„

Chapter 3 discusses the deep convective systems that provide the bulk of the rainfall in West Africa. The types of convective systems range from isolated cells to huge organized Mesoscale Convective Systems (MCSs). The type of convection depends on the ambient profiles of vertical wind shear and humidity distribution. Mid-level dry layers are pivotal in the creation of deep convective density currents that in turn favor organization and longevity of convection.



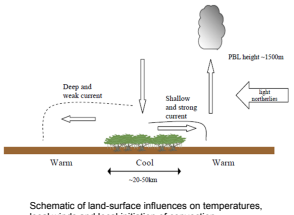
Schematic view c the impact of the shear on convection organisation in cases of no shea (left column) and unidirectional easterly shear (right column).



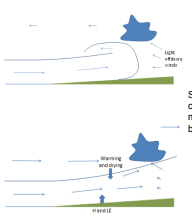
Spatial distribution of cloud cover JJAS climatology of MCSs over 25 years of Meteosat for the 4 types of MCSs:
C1: $D < 9$ hr; $V < 10$ ms^{-1}
C2: $D > 9$ hr; $V_s < 10$ ms^{-1}
C3: $D < 9$ hr; $V_s > 10$ ms^{-1}
C4: $D > 9$ hr; $V_s > 10$ ms^{-1}
Resolution is 1° square and the unit is h/month. Heavy isolines represent surface altitude above 600 and 1200 m.

Chapter 4: „Local Weather„

Chapter 4 discusses phenomena that shape the local weather and are thus particularly important for the forecaster. Topics Include, but are not restricted to, gravity waves, inertial oscillations, land sea breezes and related cloudiness, winds and convective initiation related to land-surface characteristics, surface energy fluxes, low-level shear, and fog.



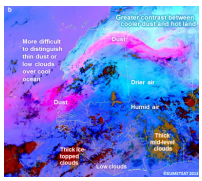
Schematic of land-surface influences on temperatures, local winds and local initiation of convection.



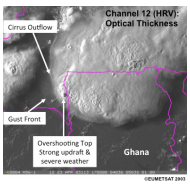
Schematics of gravity current / PBL transition models for the sea breeze during the day.

Chapter 9: „Remote Sensing„

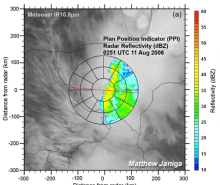
Chapter 9 introduces all kinds of satellite sensors, which are an inevitable and growing source of information in a ground and upper-air data sparse region. The lead author also led the COMET online textbook development and this is reflected in a scholarly review on the use of more classical (e.g., visible, infrared and water vapor images) and more advanced (e.g., RBG multi-channel composites, spaceborne microwave and radar products) satellite information.



Dust over West Africa detected by Dust RGB



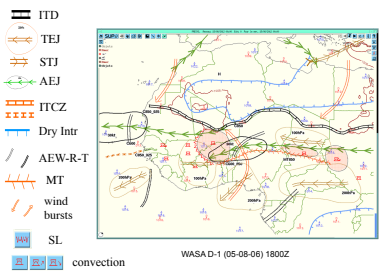
High-Resolution-Visible (HRV) image of convection over Ghana and Burkina Faso.



Plan Position Indicator (PPI) base reflectivity produced by an MCS over Niamey, Niger at 0251 UTC on 11 August 2006 overlaid on Meteosat IR 10.8µm. (Courtesy, Matthew Janiga)

Chapter 11: „West African Synthetic Analysis and Forecast: WASA/F„

Chapter 11 describes the creation and interpretation of the WASA/F maps that emerged from the AMMA 2006 ground campaign. The maps synthesize the major weather features on an analyses and forecast map that help the forecasters to capture complex weather situation at a glance. The WASA/F maps are produced operationally at ACMAD.



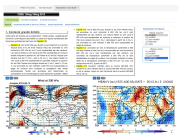
WASA D-1 (05-08-06) 1800Z

List of 10 key features to put in WASA/F

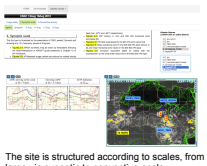
1. Inter-tropical Discontinuity (ITD)
2. Heat Low
3. Subtropical Jet (STJ)
4. Trough from mid-latitude
5. Tropical Easterly Jet (TEJ)
6. African Easterly Jet (AEJ)
7. Troughs and cyclonic centres associated to African Easterly Waves (AEW)
8. Midlevel dry intrusions
9. Monsoon Trough ()MT)
10. Convective Activity
    a) Suppressed Convection
    b) Convection: Isolated, Mesoscale Convective Systems (MCSs) (e.g., Squall Lines(SL))

Online Training Material (En/Fr)

Case studies can be selected from online training website in French and English (under construction)



Users can visualize selected maps and obtain scholarly explanations



The site is structured according to scales, from large via synoptic to convective-scale

Publication Date and Acknowledgements

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ACMAD and AMMA-THORPEX WG5.

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… ***and very many contributors to chapters.***