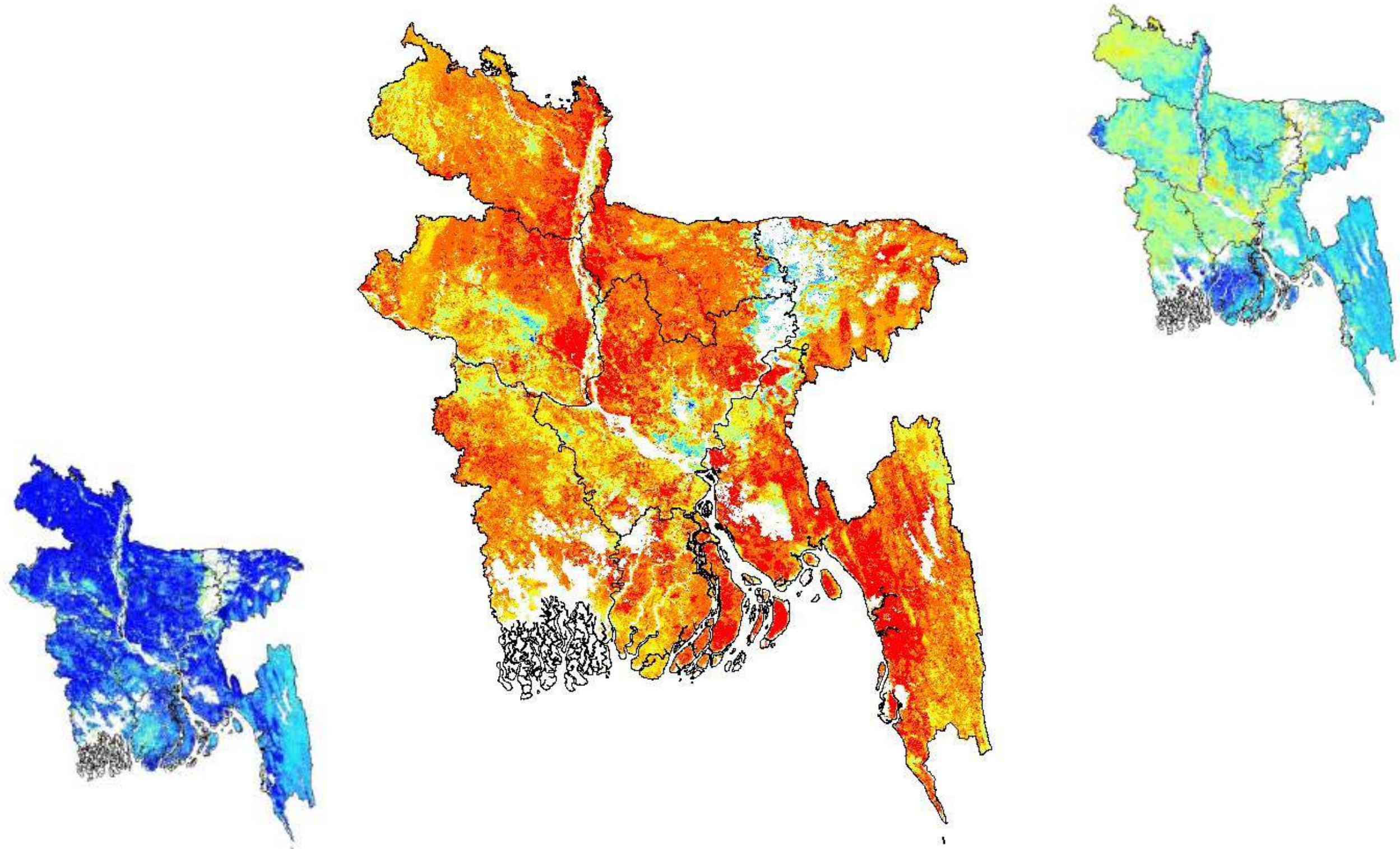


THE DROUGHT ATLAS OF BANGLADESH

Dr. Hemu Kharel Kafle





The Drought Atlas of Bangladesh

Dr. Hemu Kharel Kafle

Center for Water and Atmospheric Research



The Drought Atlas of Bangladesh

(Historical monthly drought of Bangladesh from 2000-2020)

Dr. Hemu Kharel Kafle

**Publisher: Kathmandu Institute of Applied Sciences
Bagdol, Lalitpur,
Kathmandu, Nepal.**

Figures/Maps: Ms. Soni Khaitu

Edition: First, 2022, January

Price: Rs. 5000.00 (NPR)

ISBN: 978-9937-1-3063-9

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher.

Acknowledgement

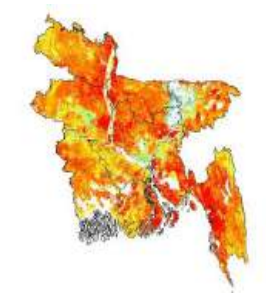
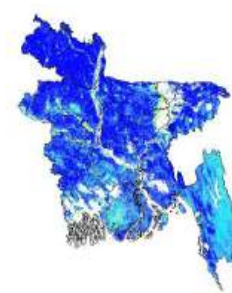
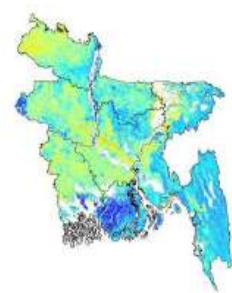
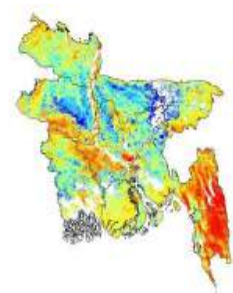
The Center for Water and Atmospheric Research (CENWAR) at Kathmandu Institute of Applied Sciences has produced the first edition of the Bangladesh Drought Atlas. This Atlas uses a Drought Severity Index (DSI) to highlight the intensity of drought in Bangladesh. It uses geospatial analysis, as well as descriptive graphs and visuals, to highlight the drivers and effects of drought in Bangladesh.

We would like to thank our collaborator, Prof. Dr. Mohammad Kamurazaman from the Forestry and Wood Technology Discipline at Khulna University in Khulna, Bangladesh for his valuable inputs.

We are grateful to our technical supervisors Prof. Dr. Yasushi Yamaguchi from Nagoya University and Dr. Shinichi Sobue from GEOGLAM for their advice and inputs in this study. We sincerely thank Asia Pacific Network for Global Change Research (APN) for funding this research work.

Table of Contents

Chapters	Page no.
1. What is Drought?	2
2. Bangladesh Overview	3
3. Remotely Sensed Data	4
4. Drought Severity Index (DSI)	5
5. January DSI Maps	6
6. February DSI Maps	17
7. March DSI Maps	28
8. April DSI Maps	39
9. May DSI Maps	50
10. June DSI Maps	61
11. July DSI Maps	72
12. August DSI Maps	83
13. September DSI Maps	94
14. October DSI Maps	105
15. November DSI Maps	116
16. December DSI Maps	127
17. Drought Severity Index of Bangladesh	138
18. References	139

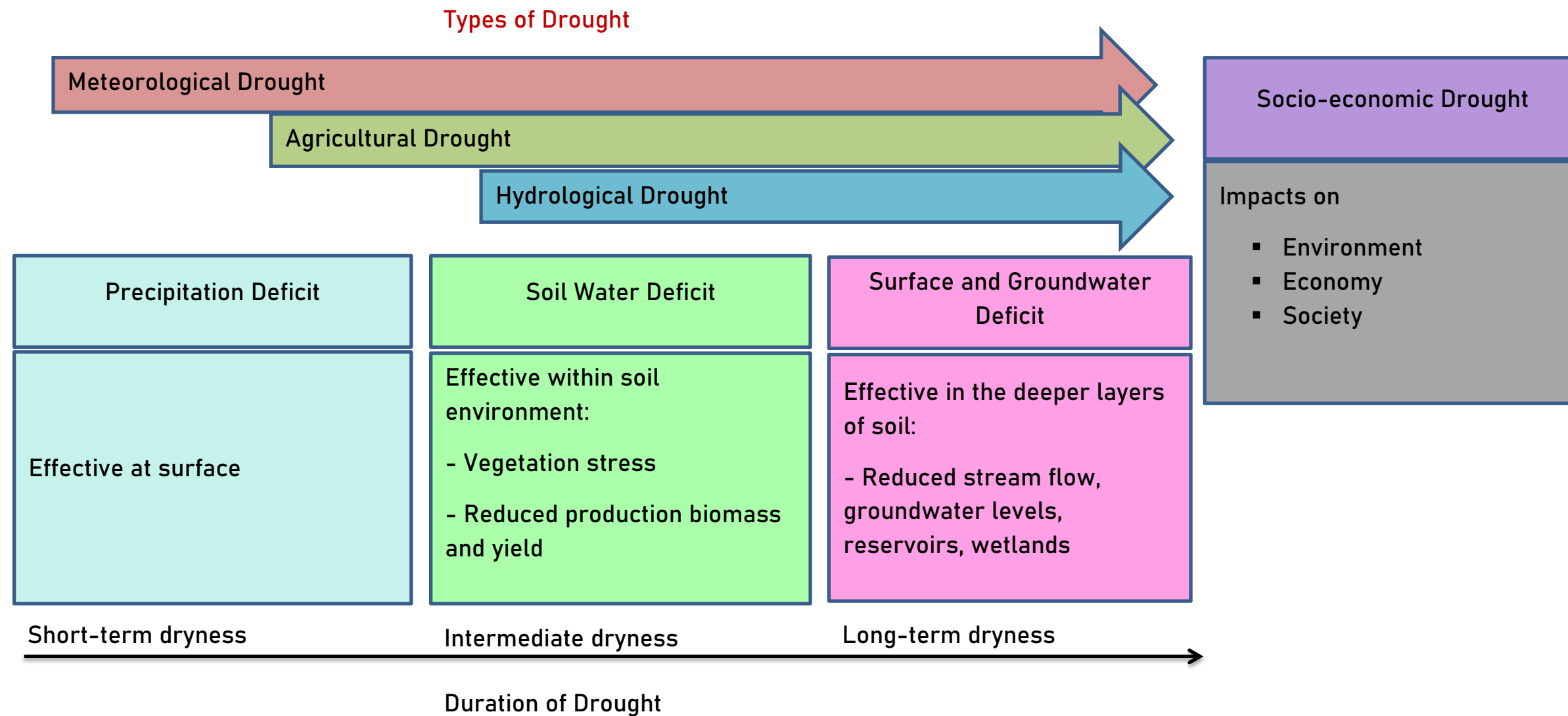


What is Drought?

Drought is a period of time when there is a lack of water on land. Drought mainly results from abnormally low rainfall leading to water scarcity (Wilhite, 2000b). It is defined as “severe water shortage”.

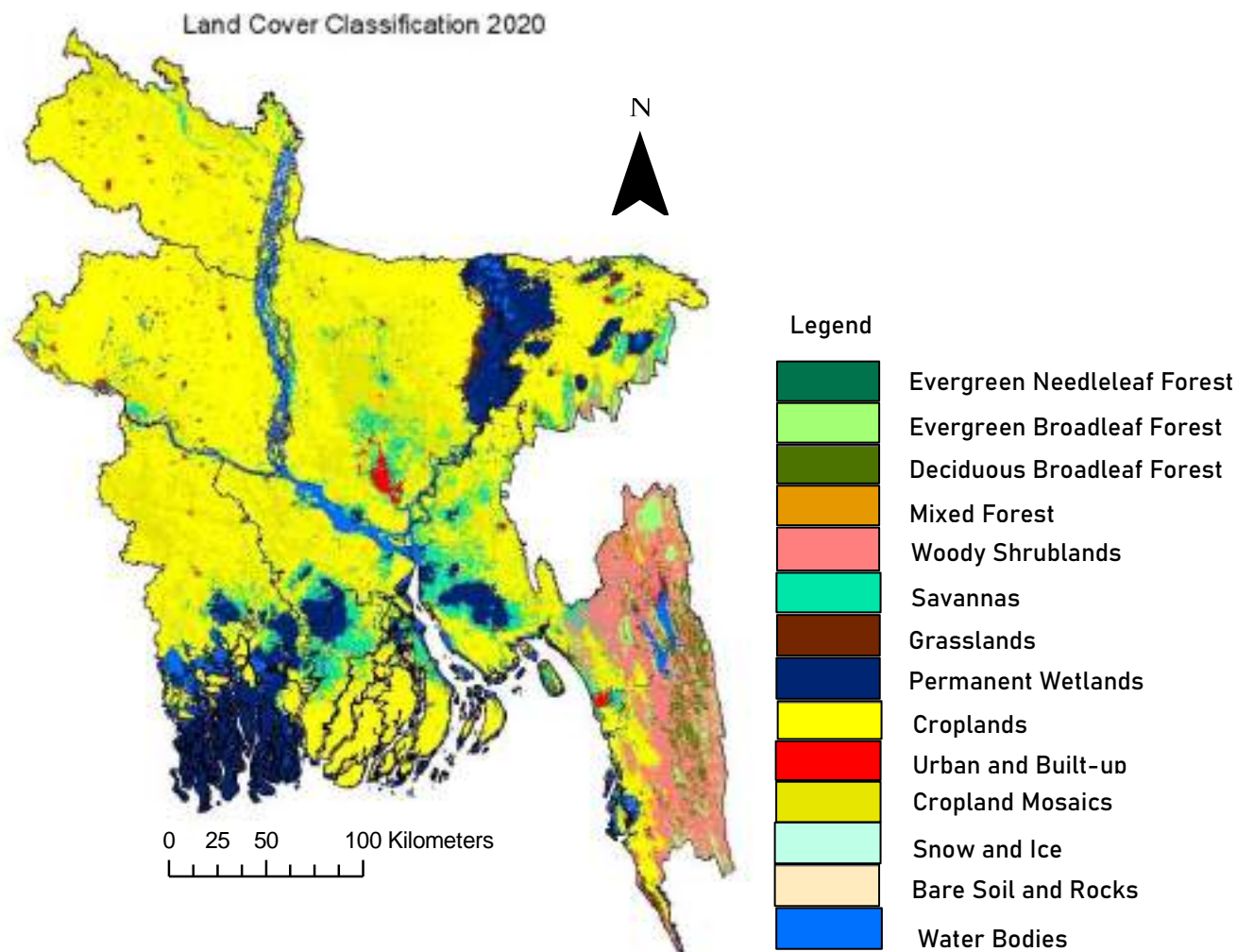
Drought is a complicated phenomenon, yet one of the least understood of all natural hazards impacting more people than any other disaster (Obasi, 1994). Since the demand for water is increasing along with the population in many parts of the world, water supply interruptions caused by drought can be expected to produce greater impacts (Hewitt, 1997).

Drought is a global phenomenon; however, their effects are more vulnerable in developing countries because of the lesser potential to mitigate the impacts of such extreme events (Wilhite, 2000).



Bangladesh Overview

Bangladesh lies in South Asia, with a land area of 144,000 km² with latitudes of 20°34'0"-26°38'0" N and longitudes of 88°01'0"-92°41'0" E. The country is divided into 8 major divisions, 64 districts, and 534 sub-districts administratively. The country is in the subtropical zone, with a typical monsoon climate characterized by significant seasonal fluctuations in rainfall, generally mild temperatures, and high humidity. In general, there are three climatic seasons in the country: a dry and mild winter (post-monsoon) from November to February, a hot summer or pre-monsoon from March to May, and a humid summer or monsoon (rainy) from June to October (Rahman and Lateh, 2016). The country's average annual rainfall is 2428 mm, ranging from 1400 to 4400 mm across the country, according to historical



data (BMD, 2013). The average relative humidity in the country is between 70 and 78 %. Warmer temperatures, more variable rainfall, more extreme weather events, and a rise in sea level have all lately occurred in Bangladesh as a result of climate change and global warming (Rahman and Lateh, 2015). The land cover type data were derived from MCD12Q1 data (collection v005, 500m) of Terra and Aqua combined MODIS for the years 2000-2020 obtained from Earth Data (Earth data Search (<https://earthdata.nasa.gov>)). According to the International Geosphere-Biosphere Programme (IGBP), the landcover was classified into 17 categories (International Geosphere Biosphere Programme,2017).

Remotely Sensed Data

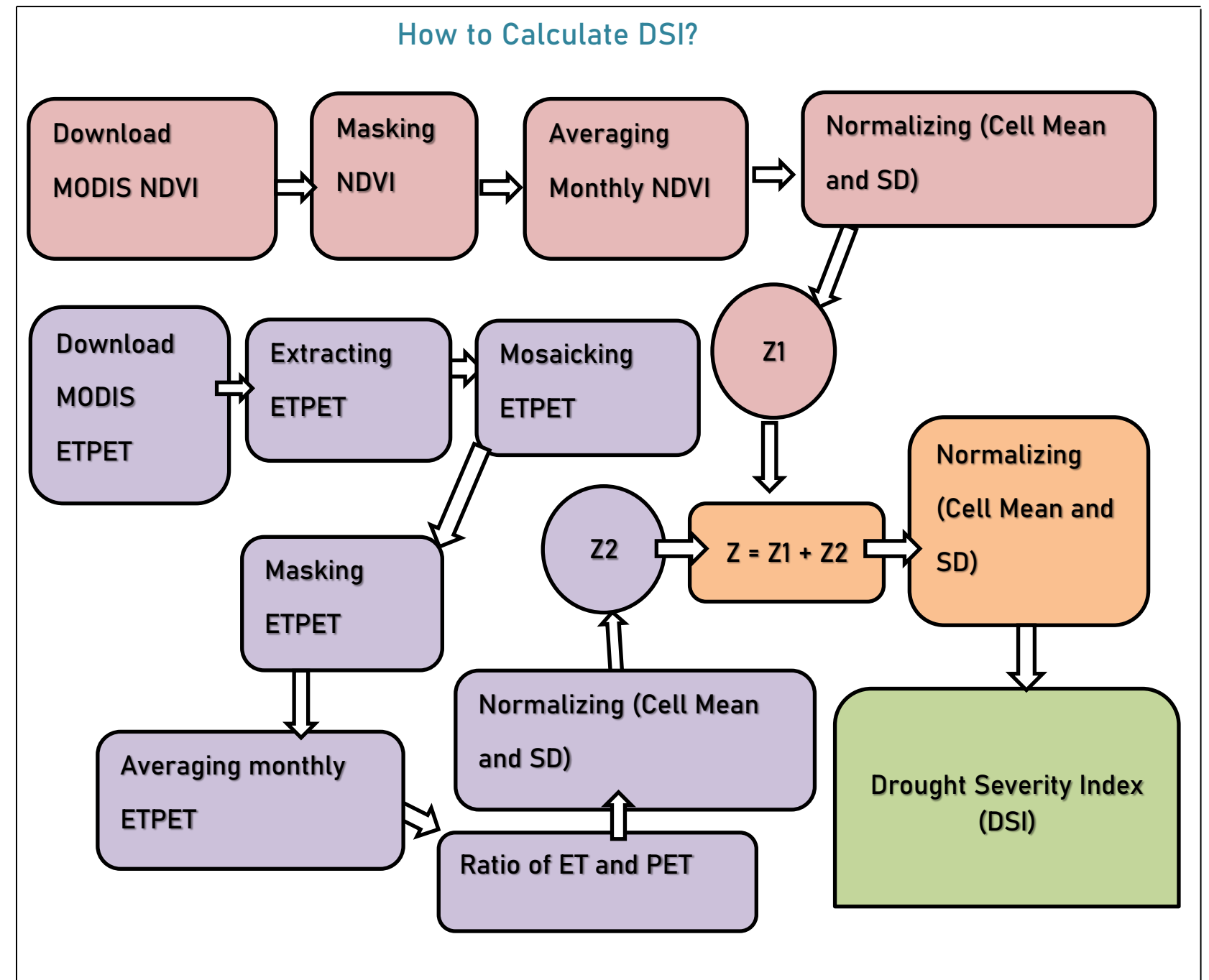
The Moderate-Resolution Imaging Spectrometer (MODIS) is an advanced narrowband-width sensor from which NASA and the USGS allow free composited reflectance data available every eight days via the Earth Resources Observation Systems (EROS) data center (Justice and Townshend, 2002a). MODIS products of Land cover, NDVI and ET/PET have been used for this study.

MODIS NDVI Data

This data includes MOD13A1 (MODIS/Terra Vegetation Indices 16-Day L3 Global 500m SIN Grid) NDVI products at 500m spatial resolution for twenty one years (2000-2020). Global MOD13A1 data are provided every 16 days at 500-meter spatial resolution as a gridded level-3 product in the Sinusoidal projection i.e obtained from NASA Land Processes Distributed Active Archive Center (LP DAAC, <https://lpdaac.usgs.gov/>).

MODIS ET, PET

This data set includes 8-day MOD16A2 Gap-Filled ET/PET (MODIS/Terra Net Evapotranspiration Gap-Filled 8-Day L4 Global 500m SIN Grid V006). The MOD16A2GF Version 6 product is a year-end gap-filled 8-day composite dataset produced at 500 meter (m) pixel resolution. The ET/PET datasets are obtained from Earth Data (<https://earthdata.nasa.gov/>).



Drought Severity Index (DSI)

DSI was chosen to investigate the spatiotemporal variability of droughts across the country using observed satellite products from 2000 to 2020. This newly proposed remote sensing index by Mu et al., 2013 has performed well in many parts of the world. According to Mu et al. (2013), the DSI Index, which combines the NDVI and ET/PET, is calculated as shown in equations (1) to (4). The incorporation of both transpiration and vegetation indicator data in DSI has been regarded as an improvement over other drought index. To study drought in Bangladesh, monthly DSI values were calculated over a twenty one year period (2000–2020). Following are the equation systems that were used:

$$Z_{Ratio} = \frac{ET/PET - \overline{ET/PET}}{\sigma_{ET/PET}} \quad (1)$$

$$Z_{NDVI} = \frac{NDVI - \overline{NDVI}}{\sigma_{NDVI}} \quad (2)$$

$$Z = Z_{Ratio} + Z_{NDVI} \quad (3)$$

$$DSI = \frac{Z - \bar{Z}}{\sigma_Z} \quad (4)$$

Where Z_{Ratio} and Z_{NDVI} is the standardized value of ET/PET ratio and NDVI respectively. $\overline{ET/PET}$ and \overline{NDVI} is mean. σ_{Ratio} and σ_{NDVI} is the standard deviation of ET/PET ratio and NDVI respectively. \bar{Z} and σ_Z represents the mean and standard deviation of the sum of Z_{Ratio} and Z_{NDVI} respectively. Drought Severity Index is represented by the DSI calculated in equation (4). Positive DSI value indicates wet condition, while negative values indicate dry conditions, Mu et al. (2013) classified DSI, as shown in table.

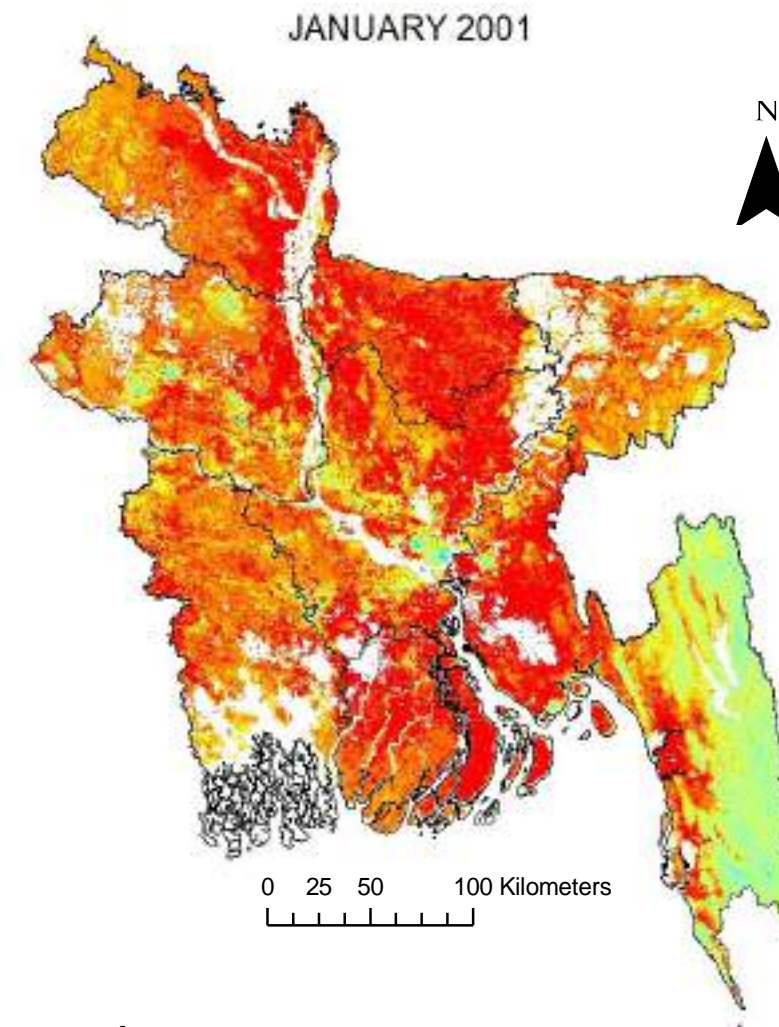
The generate DSI is then imported to ArcGis to export monthly DSI maps i.e displayed in this atlas. In mean monthly DSI maps of Bangladesh, extreme dry condition is denoted by Red colour whereas dark blue colour denotes extreme wet condition.

Category	DSI Values	Colour
Extreme Drought	-1.5 or less	Red
Severe Drought	-1.2 to -1.49	Orange
Moderate Drought	-0.9 to -1.19	Yellow-Orange
Mild Drought	-0.6 to -0.89	Yellow
Incipient Drought	-0.3 to -0.59	Light Green
Near Normal	0.29 to -0.29	Light Green
Incipient Wet Spell	0.3 to 0.59	Light Cyan
Slightly Wet	0.6 to 0.89	Cyan
Moderately Wet	0.9 to 1.19	Blue-Cyan
Very Wet	1.2 to 1.49	Blue
Extremely Wet	1.5 or greater	Dark Blue

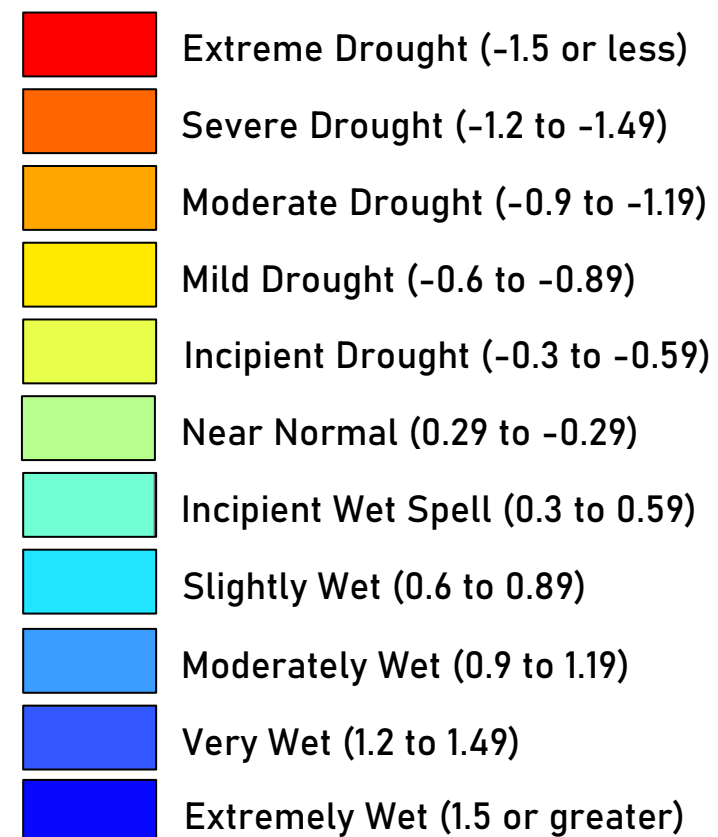
January DSI Maps

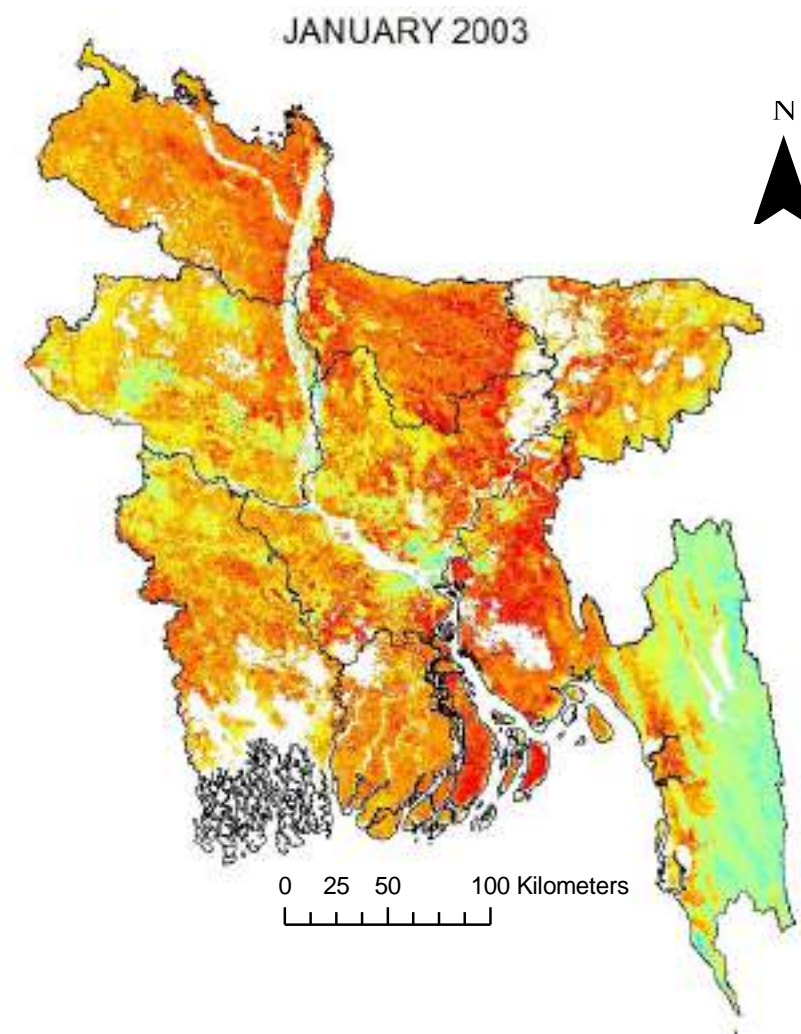
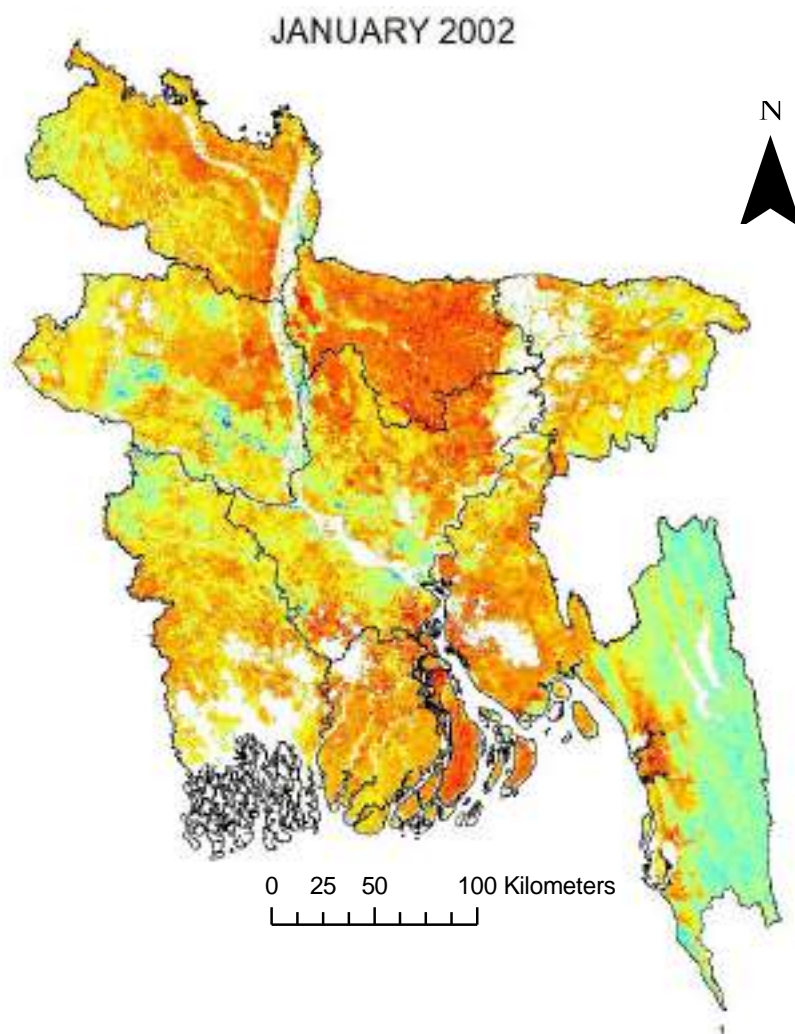
Drought conditions in January typically vary from moderate to incipient drought. The characteristics of this winter month are frequently characterized by incipient drought.

Mean January DSI Values		
Years	Values	Drought Condition
2001	-1.15	Moderate Drought
2002	-0.68	Mild Drought
2003	-0.87	Mild Drought
2004	-0.87	Mild Drought
2005	-0.72	Mild Drought
2006	-0.72	Mild Drought
2007	-1.13	Moderate Drought
2008	-0.67	Mild Drought
2009	-0.78	Mild Drought
2010	-0.96	Moderate Drought
2011	-0.71	Mild Drought
2012	-0.94	Mild Drought
2013	-0.97	Mild Drought
2014	-0.54	Incipient Drought
2015	-0.63	Mild Drought
2016	-0.72	Mild Drought
2017	-0.57	Incipient Drought
2018	-0.39	Incipient Drought
2019	-0.77	Mild Drought
2020	-0.47	Incipient Drought



Legend



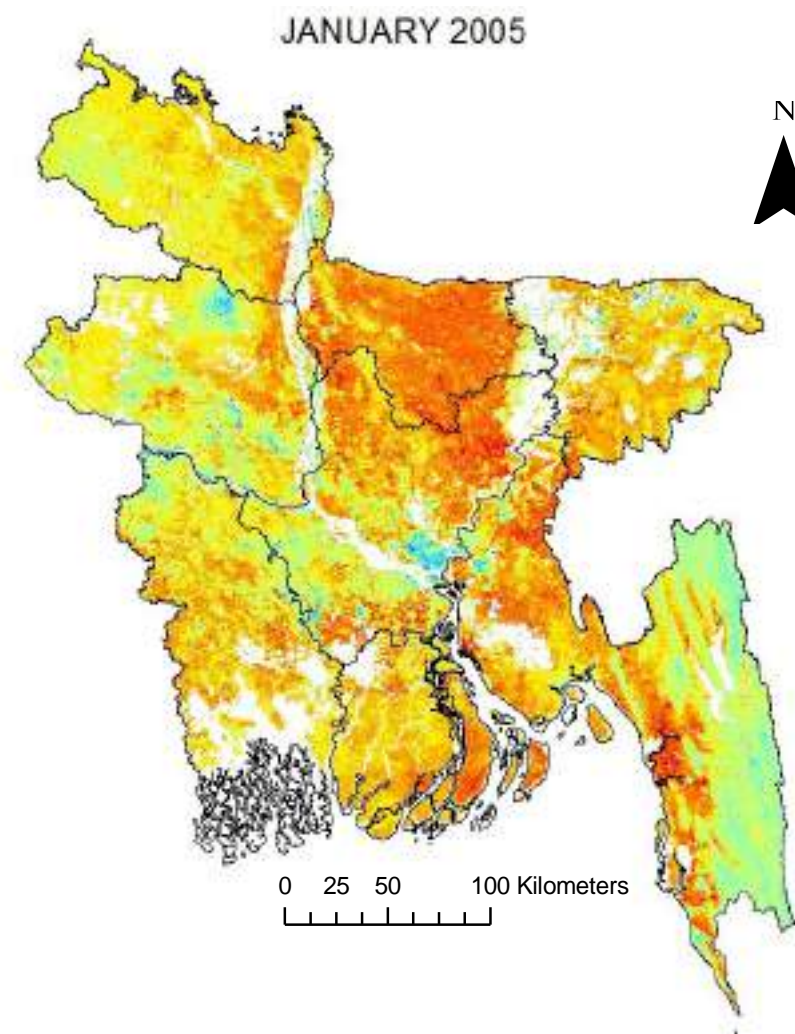
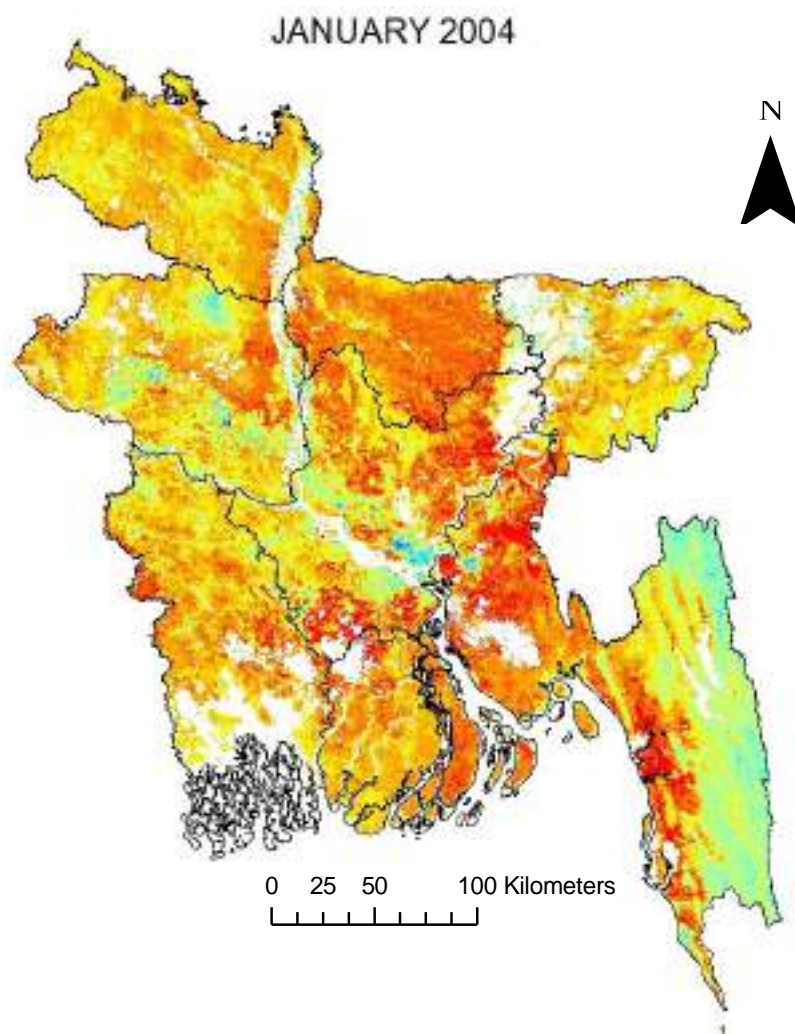


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)





- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)




- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

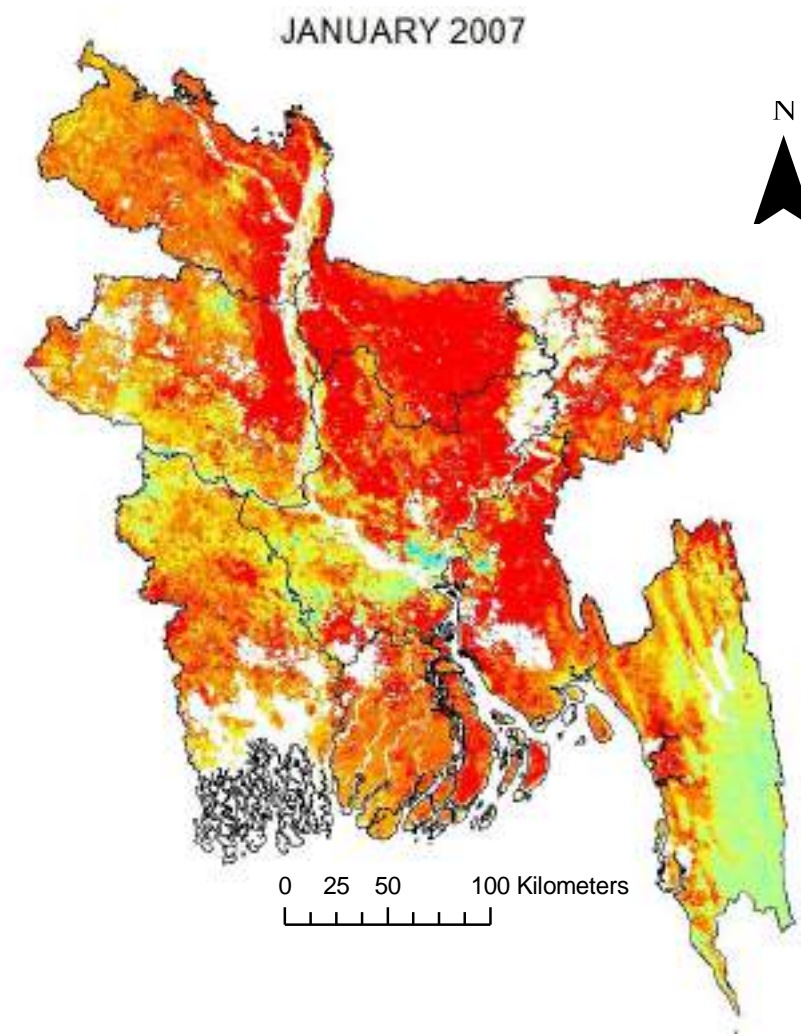
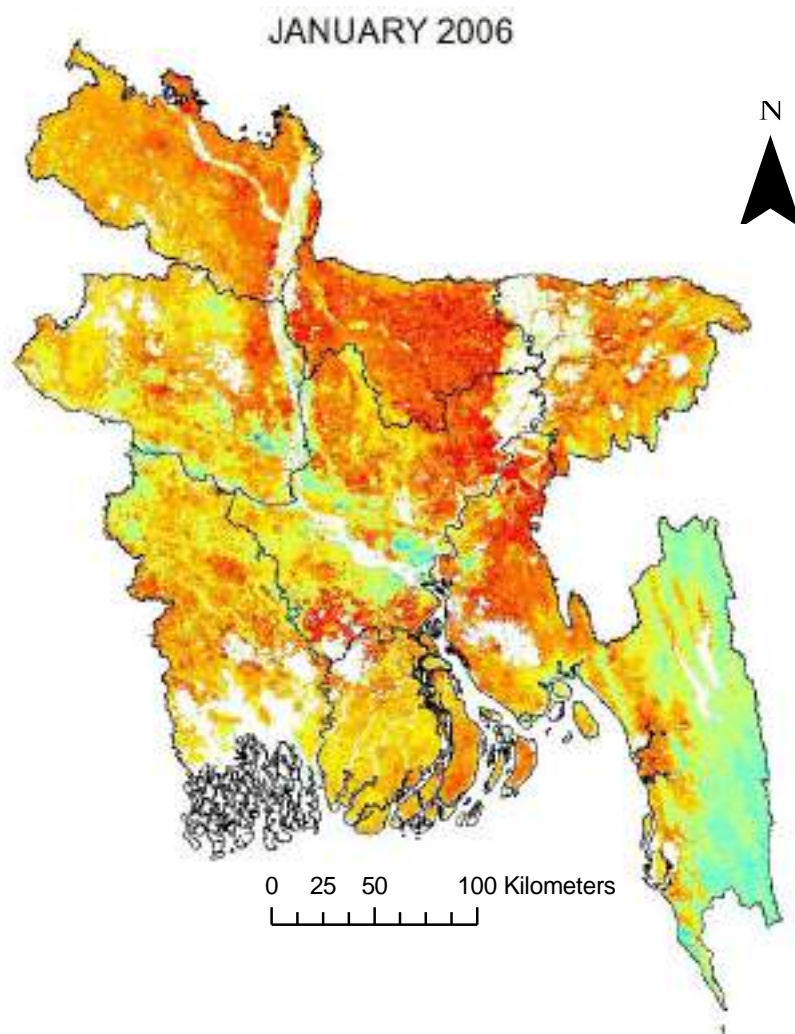


Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

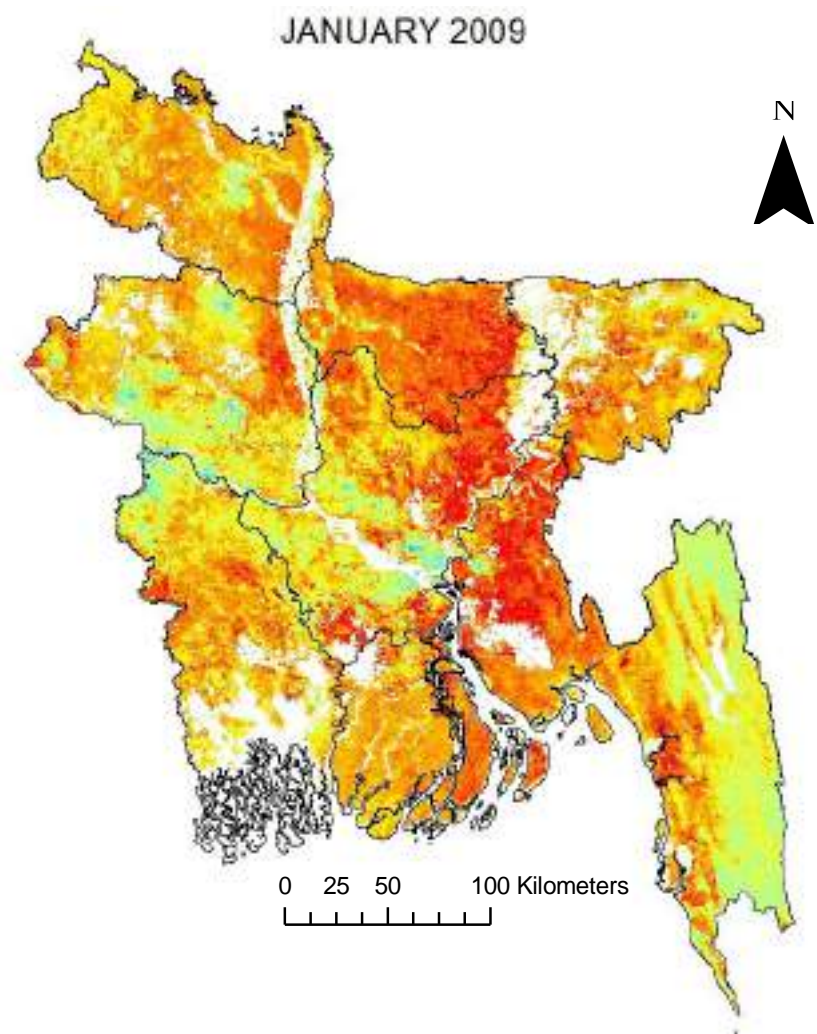
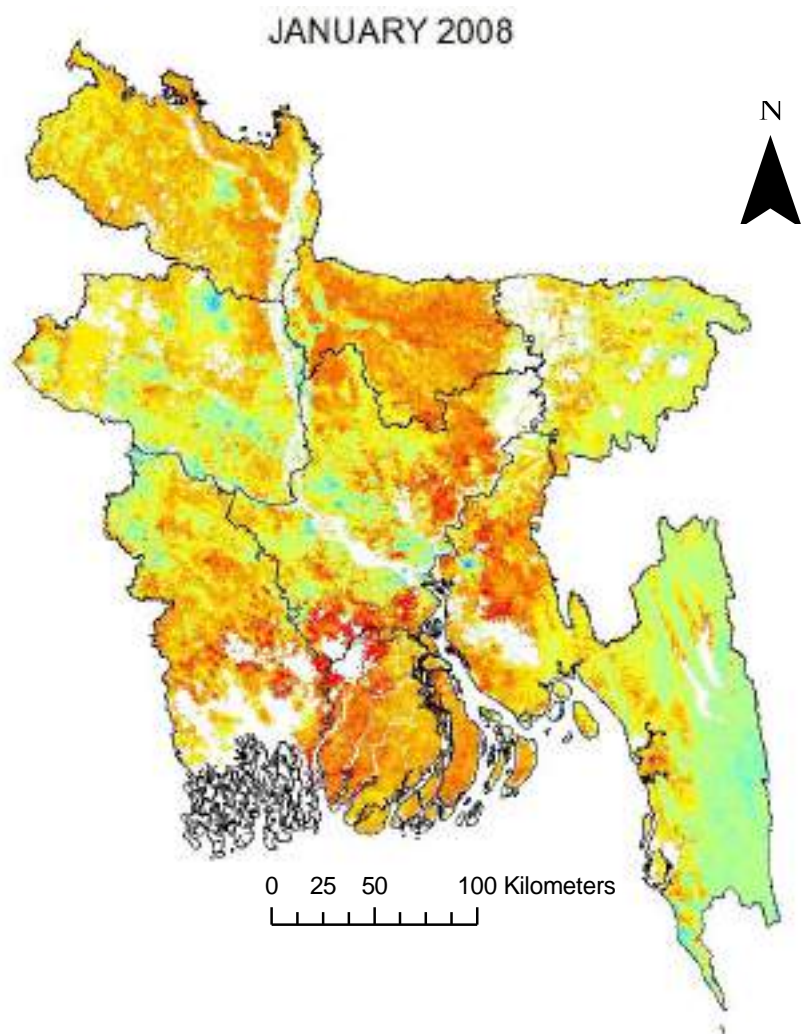


Legend

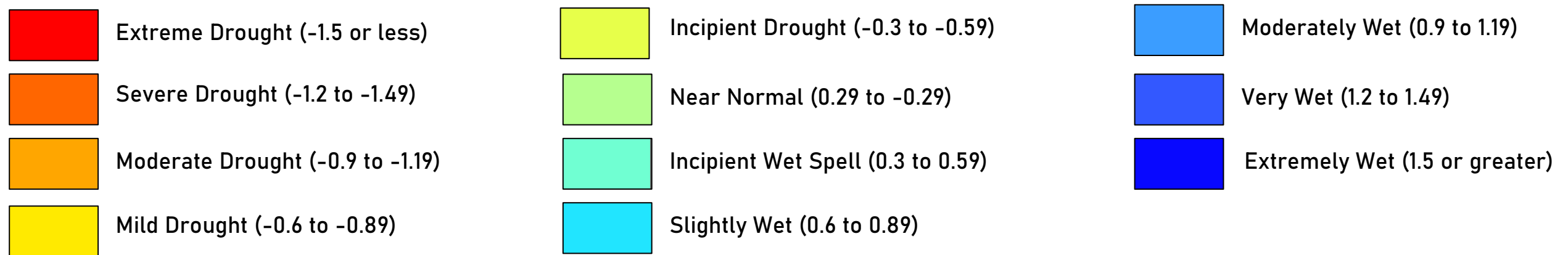
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

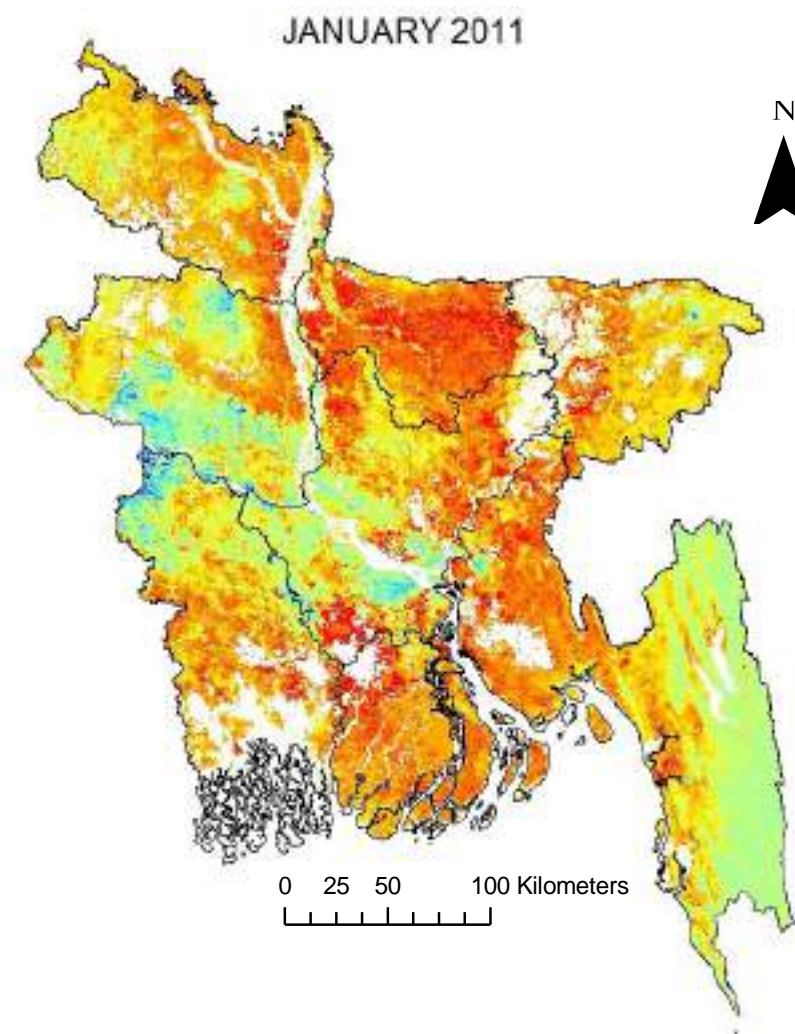
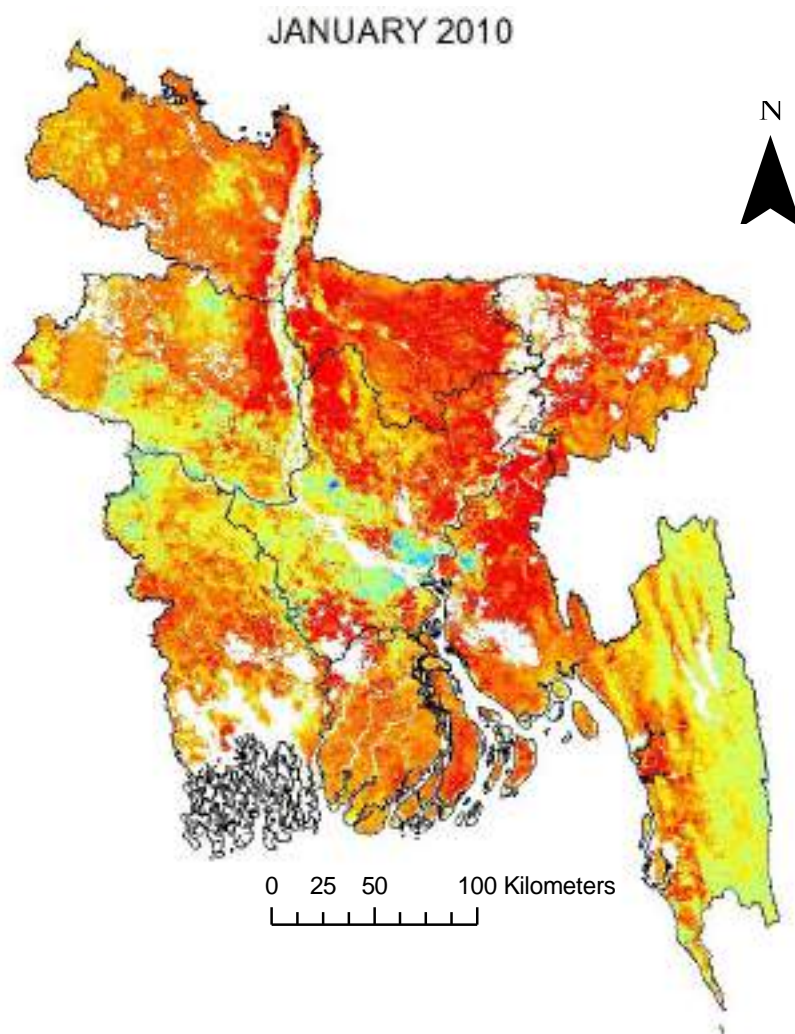
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend



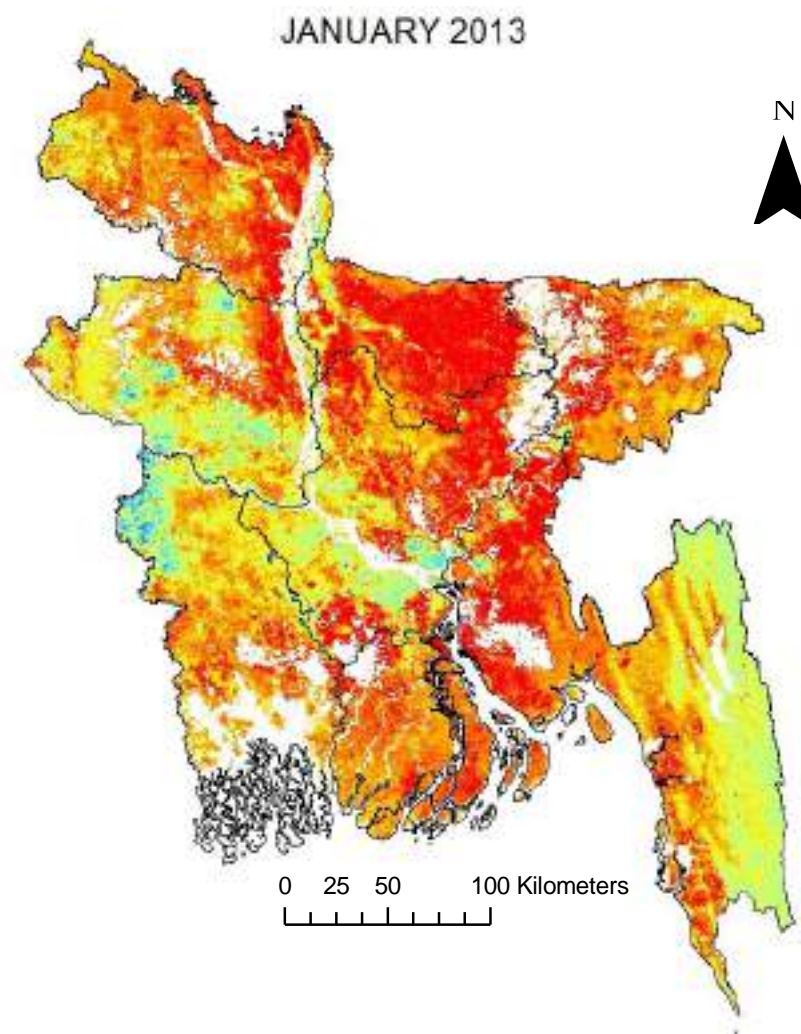
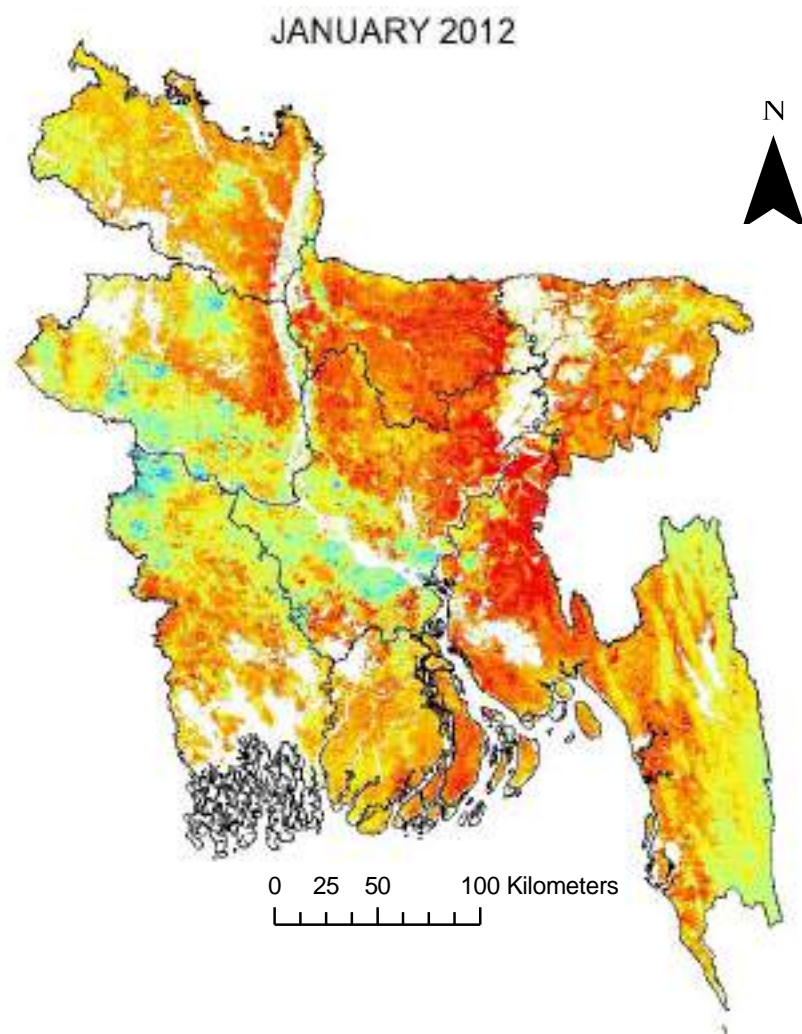


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

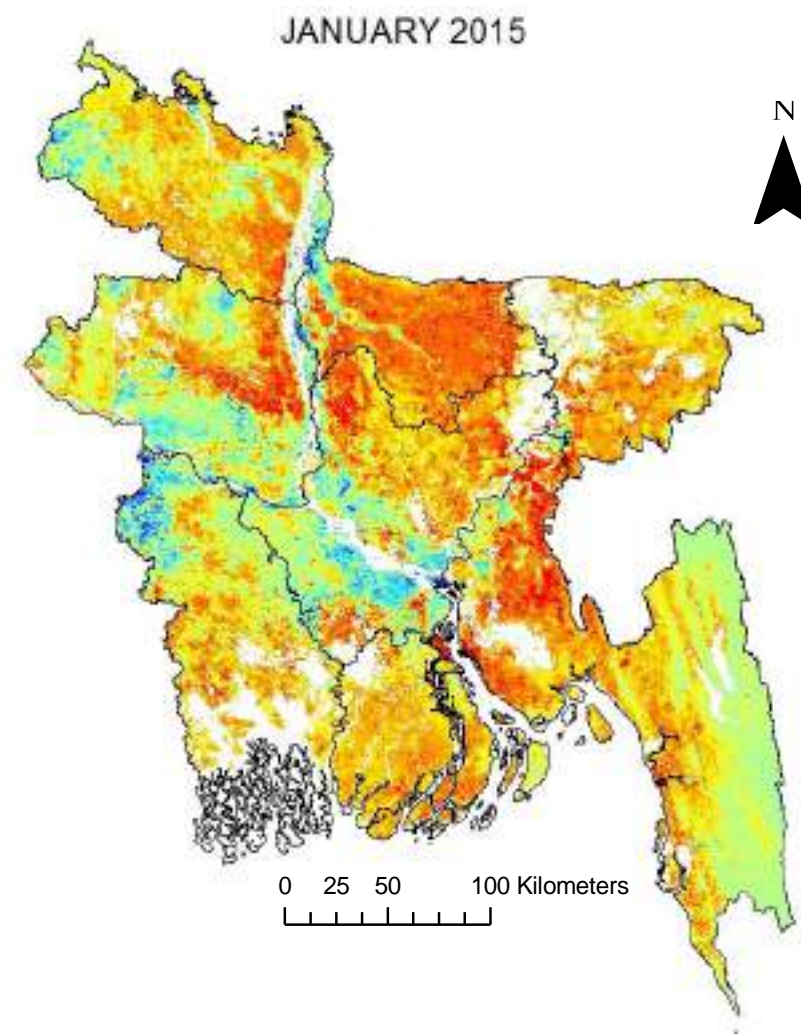
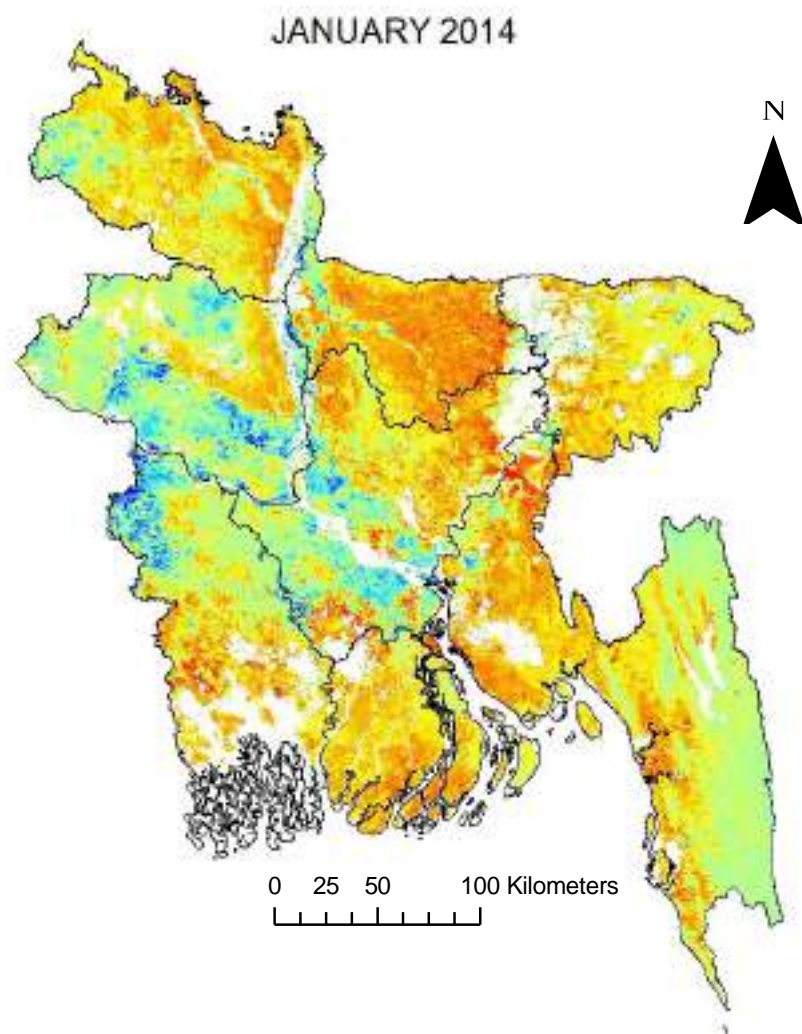


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)





- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)




- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

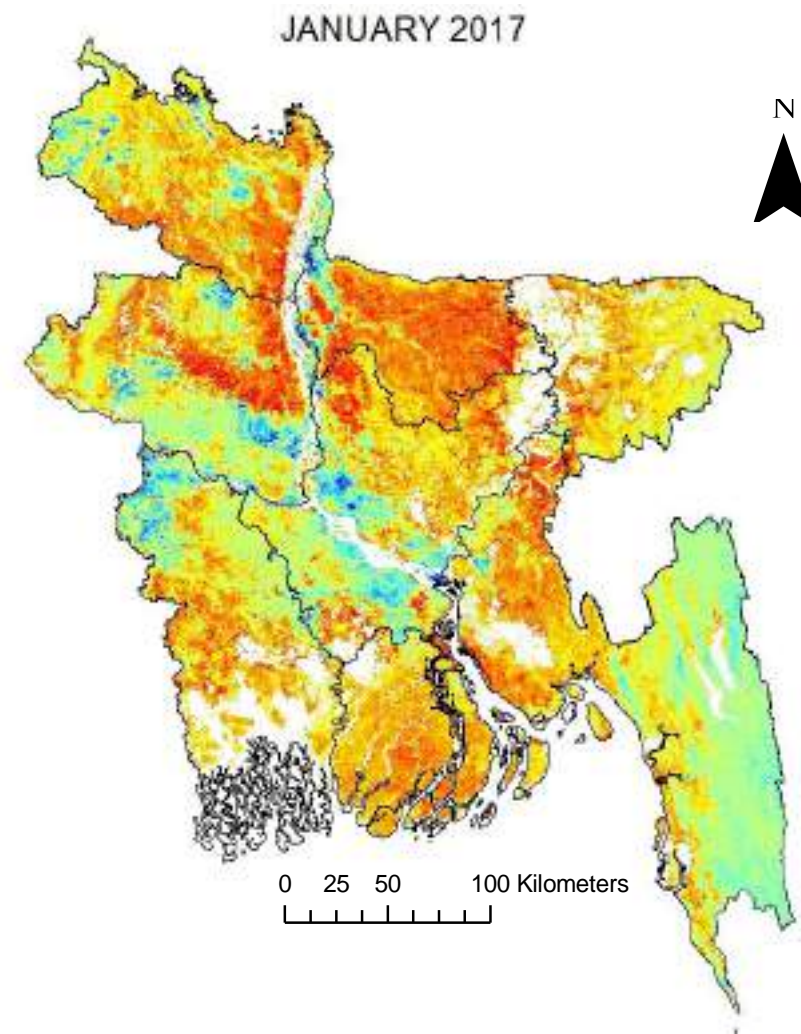
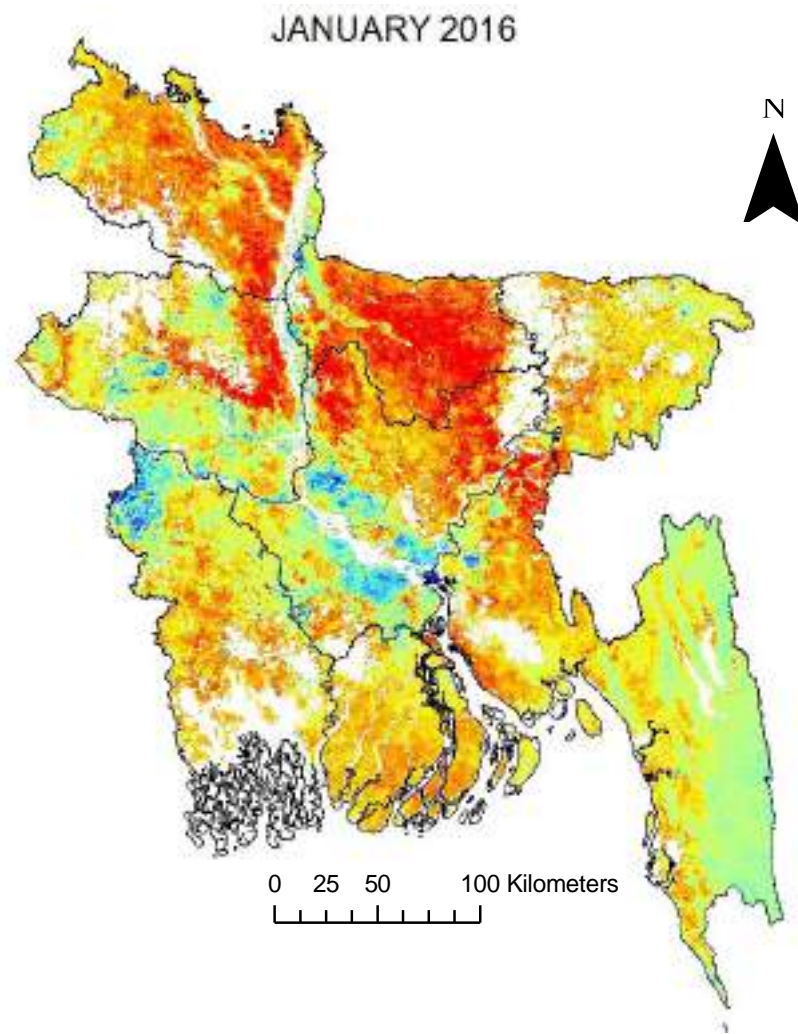


Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

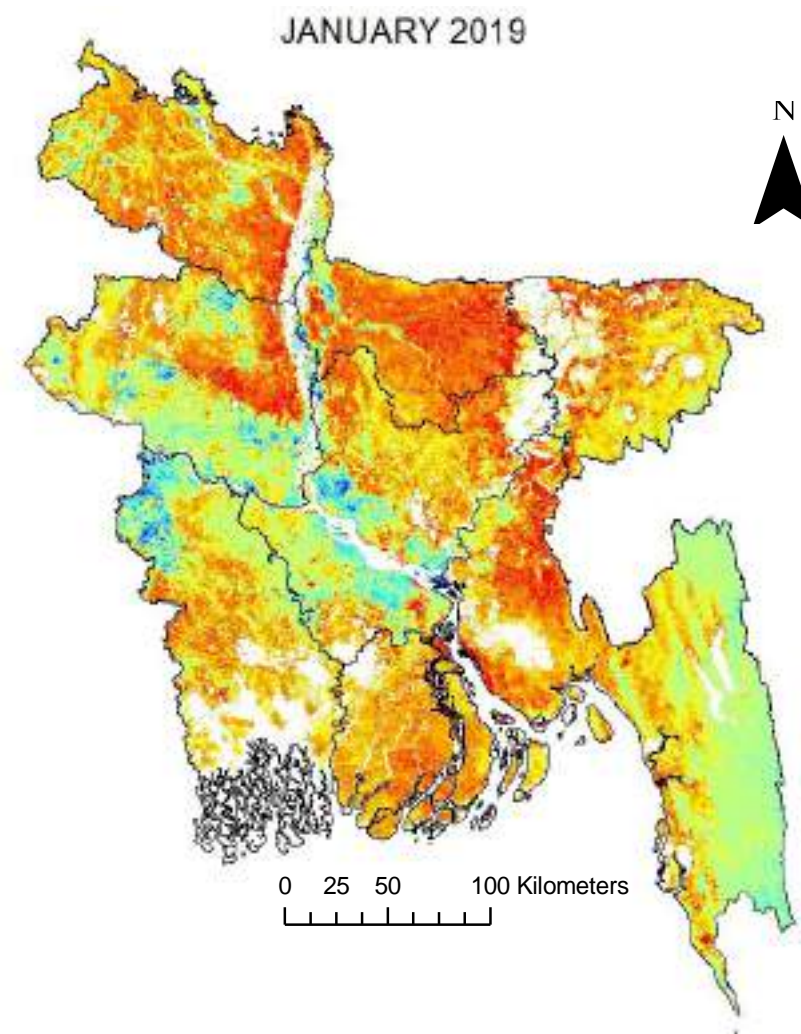
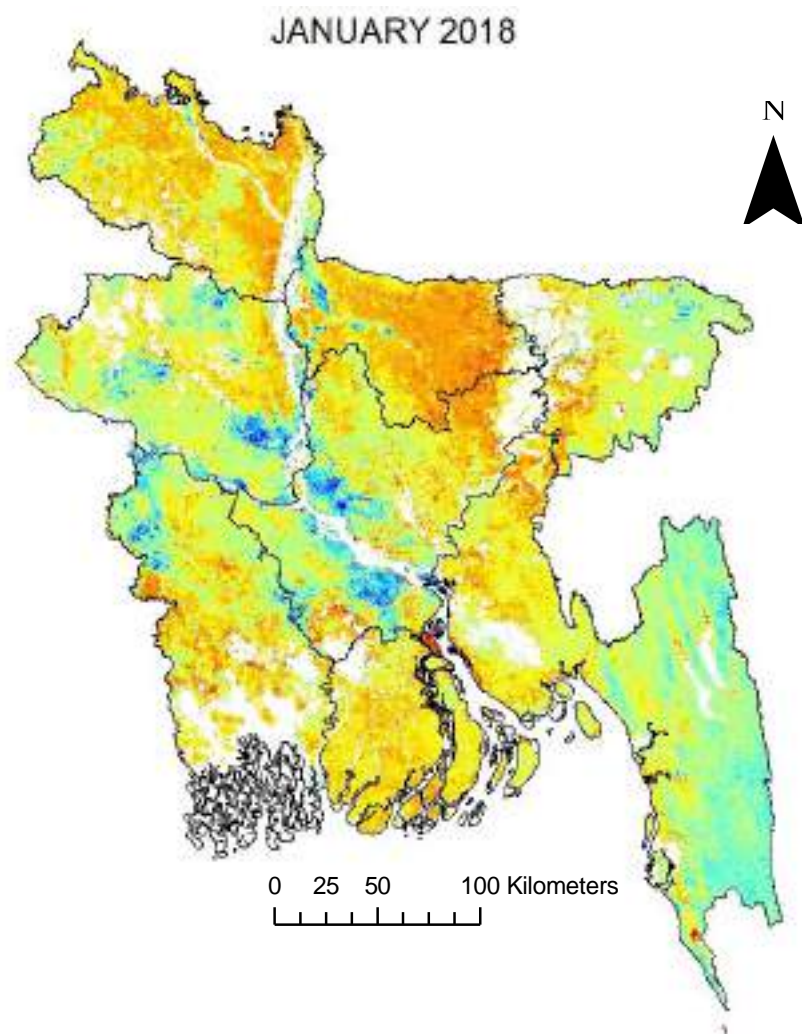


Legend

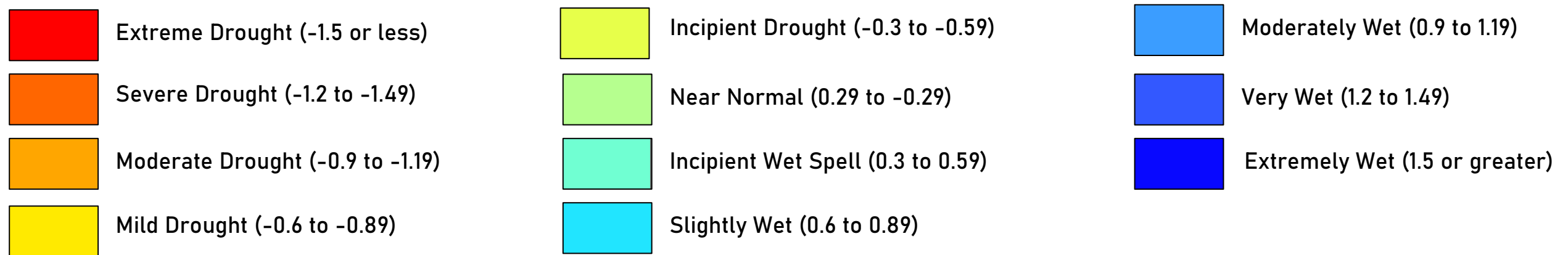
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

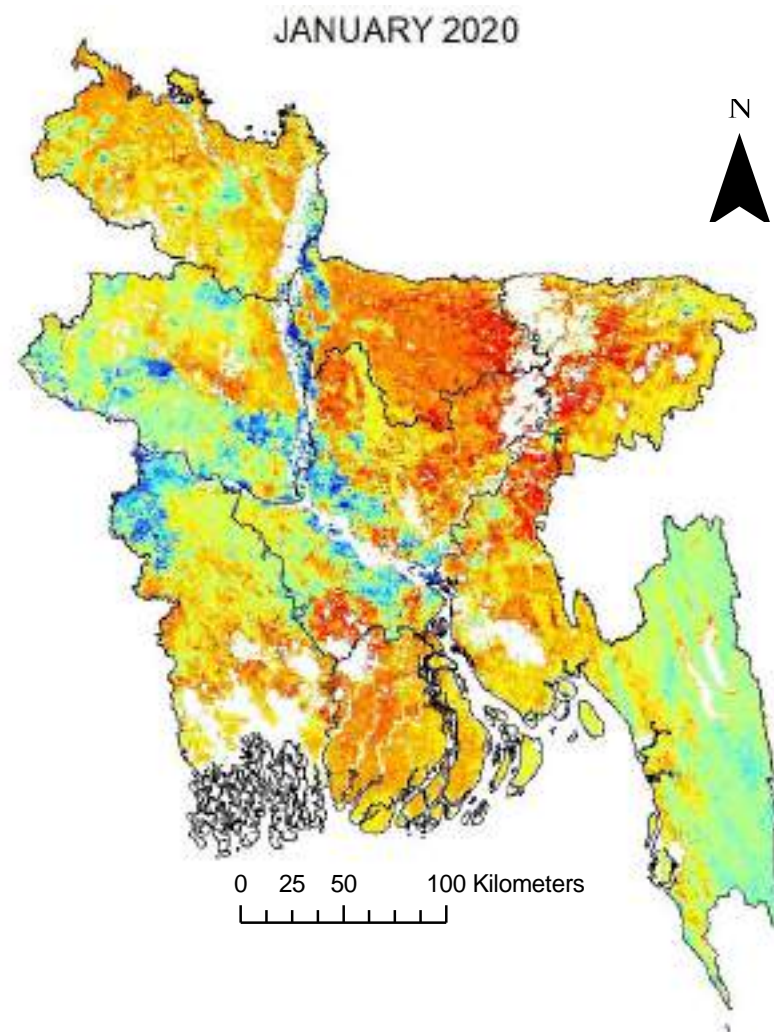
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend





Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

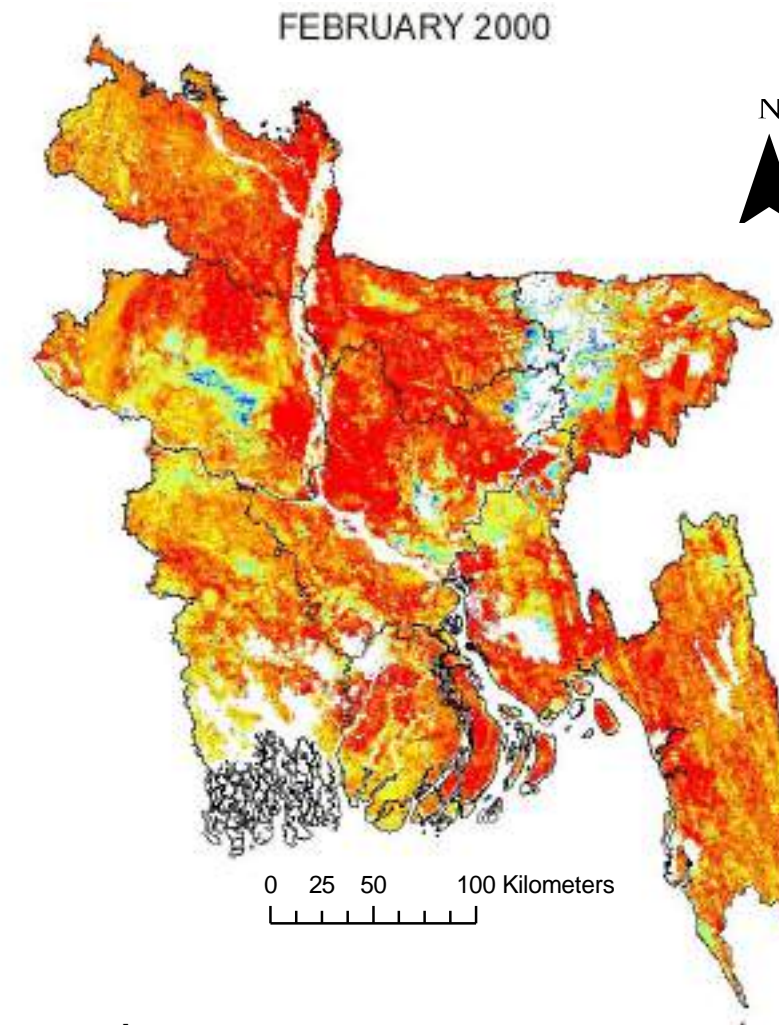
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

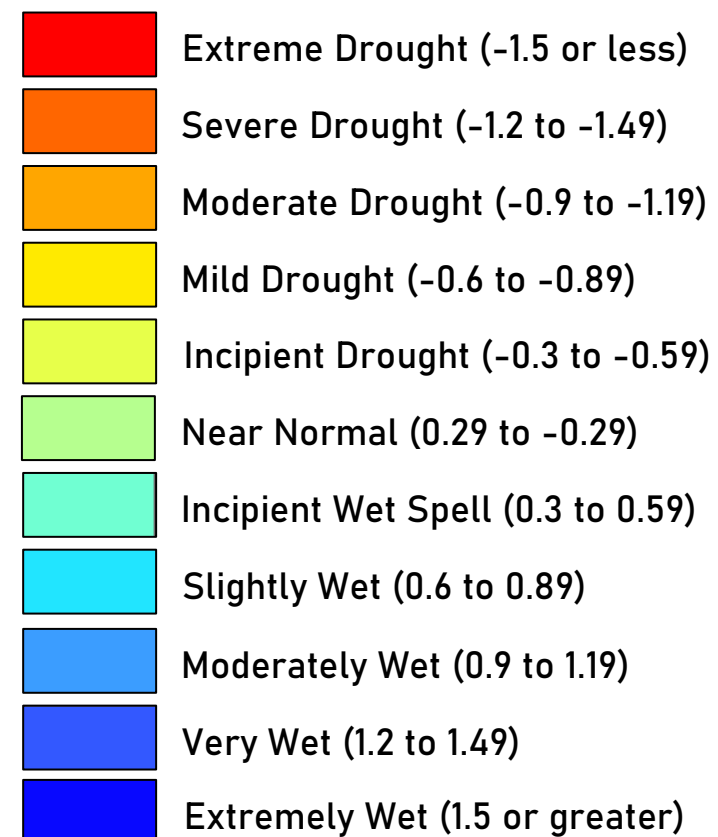
February DSI Maps

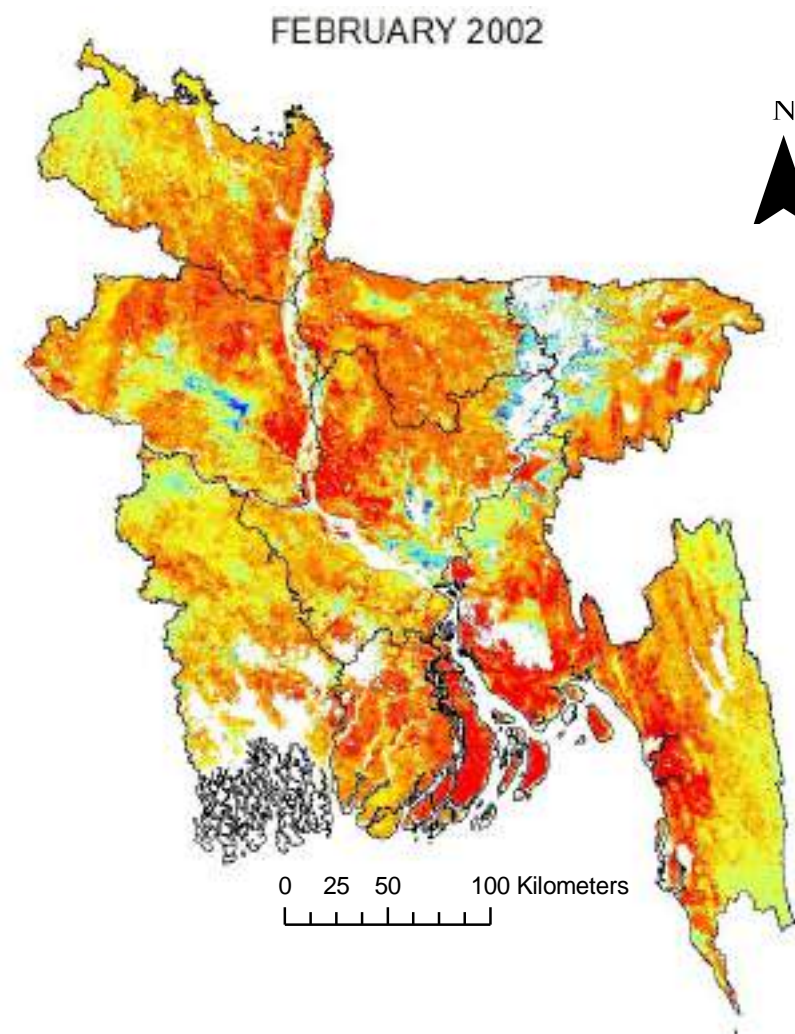
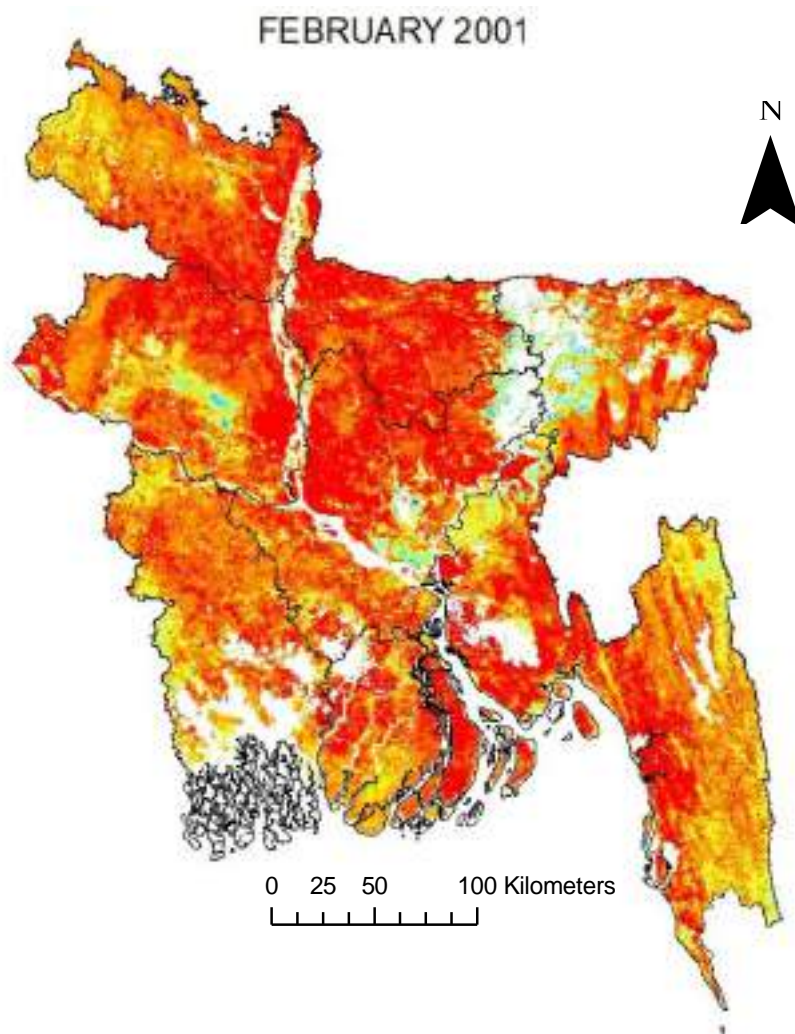
In February, drought conditions often range from severe to mild. This winter month experienced moderate drought for the most of the year. Droughts were severe in 2001, 2004, 2010, and 2012.

Mean February DSI Values		
Years	Values	Drought Condition
2000	-1.01	Moderate Drought
2001	-1.32	Severe Drought
2002	-1.04	Moderate Drought
2003	-1.15	Moderate Drought
2004	-1.23	Severe Drought
2005	-1.05	Moderate Drought
2006	-1.06	Moderate Drought
2007	-0.71	Mild Drought
2008	-0.82	Mild Drought
2009	-1.12	Moderate Drought
2010	-1.34	Severe Drought
2011	-1.10	Moderate Drought
2012	-1.27	Severe Drought
2013	-1.15	Moderate Drought
2014	-0.80	Mild Drought
2015	-0.93	Moderate Drought
2016	-0.77	Mild Drought
2017	-0.99	Moderate Drought
2018	-0.87	Mild Drought
2019	-0.90	Moderate Drought
2020	-0.98	Moderate Drought



Legend



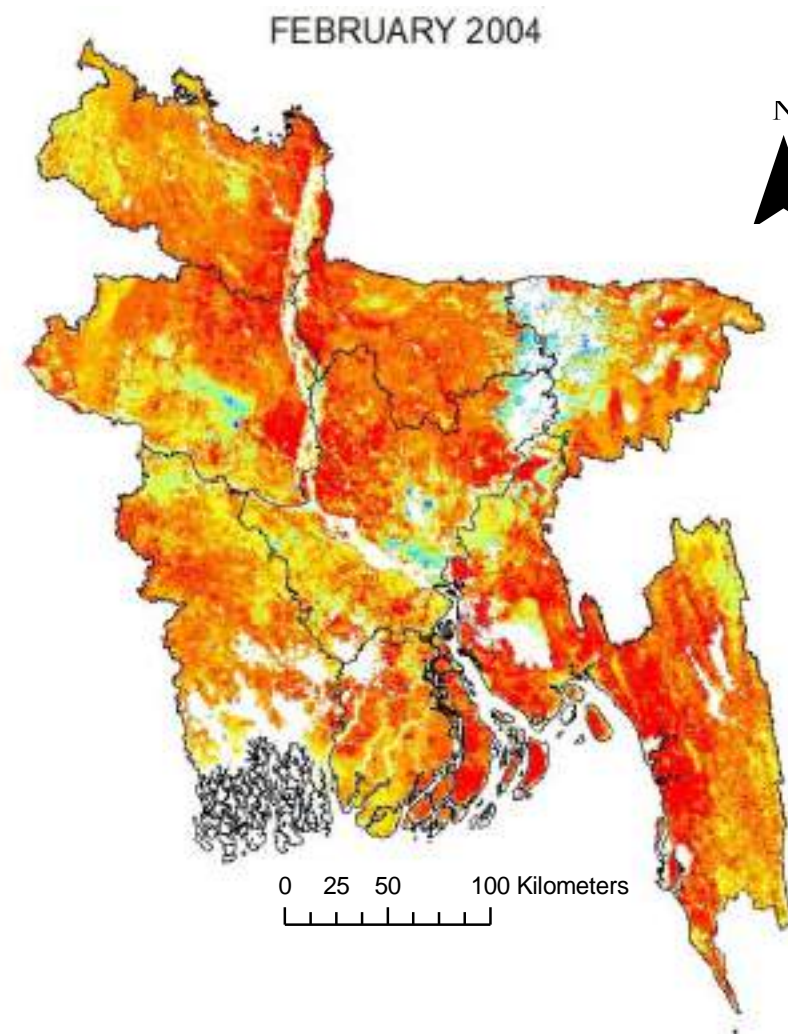
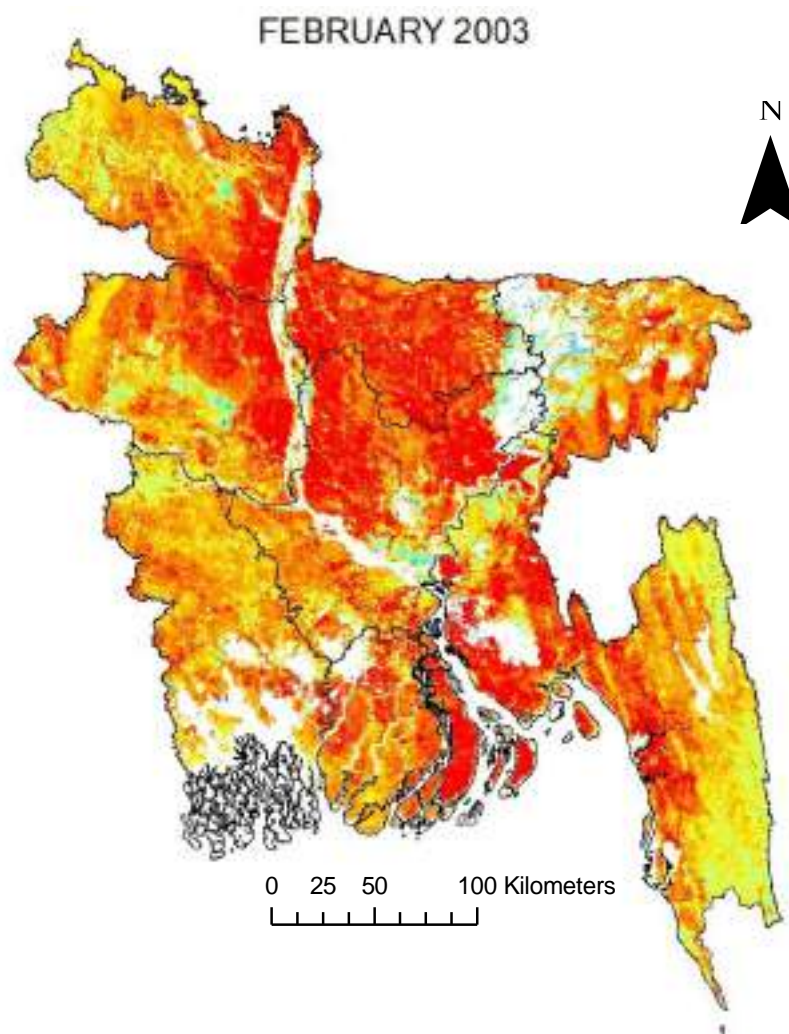


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

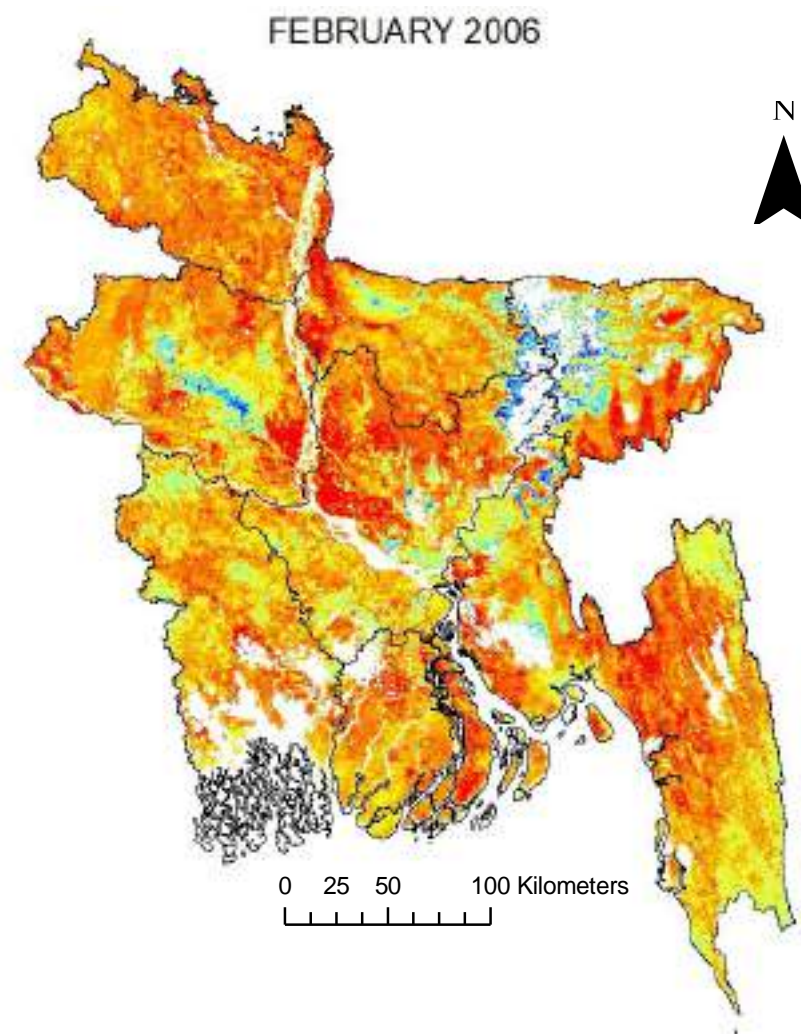
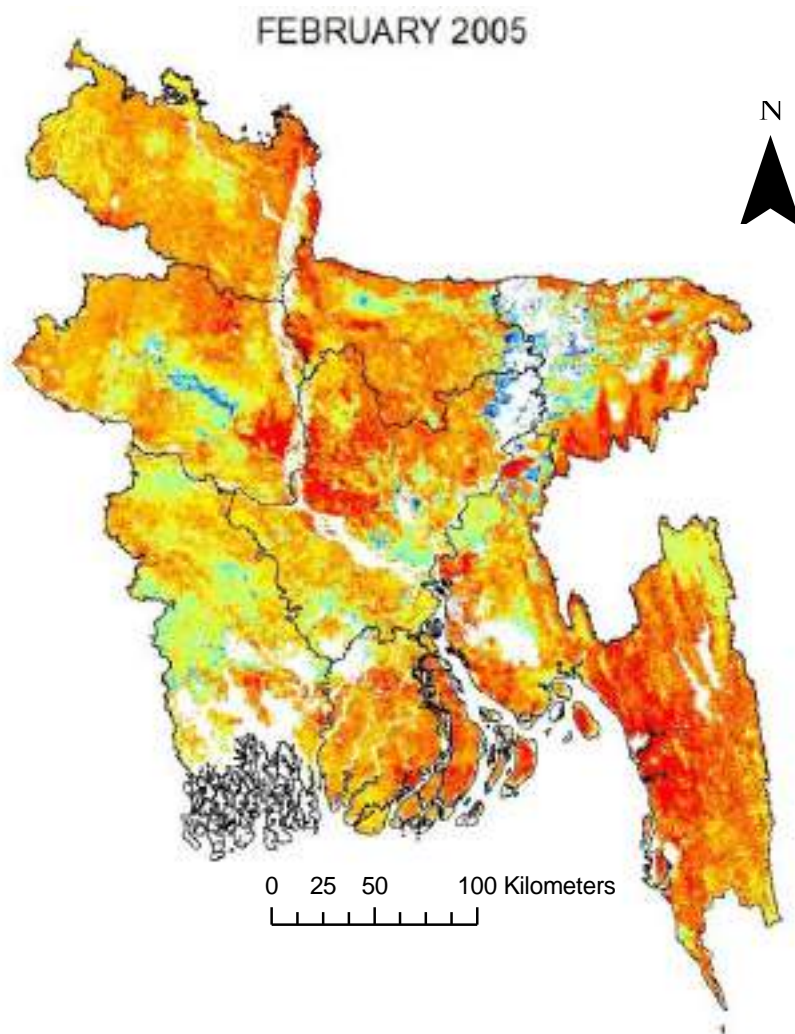


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

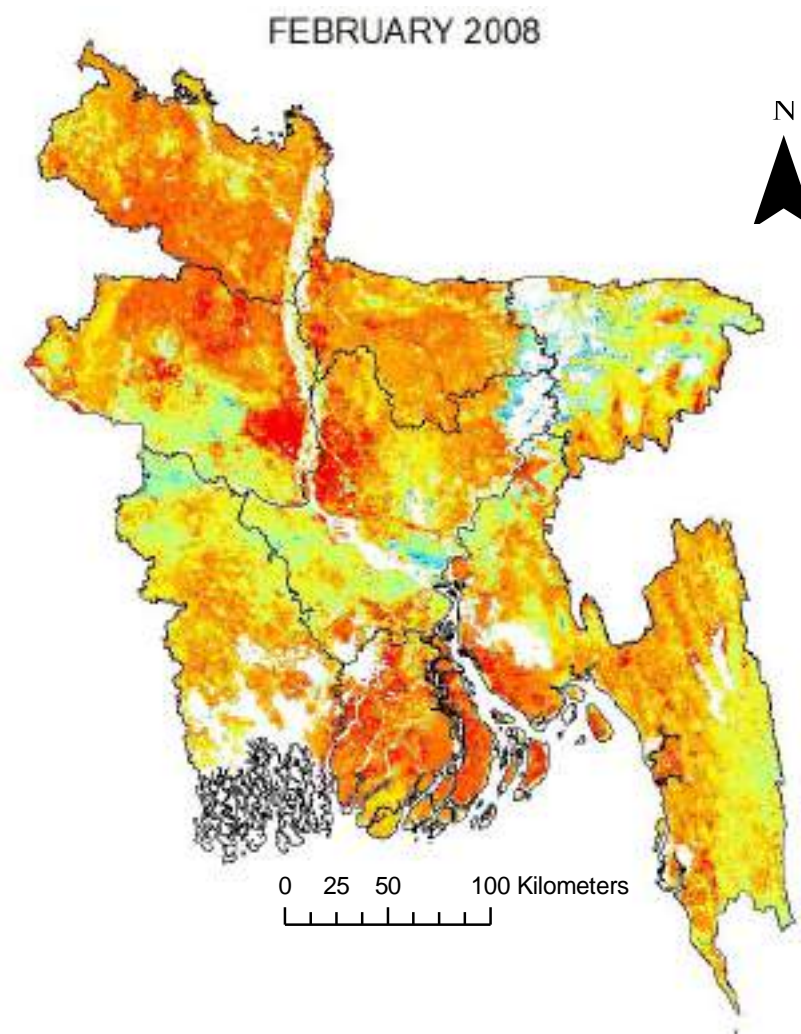
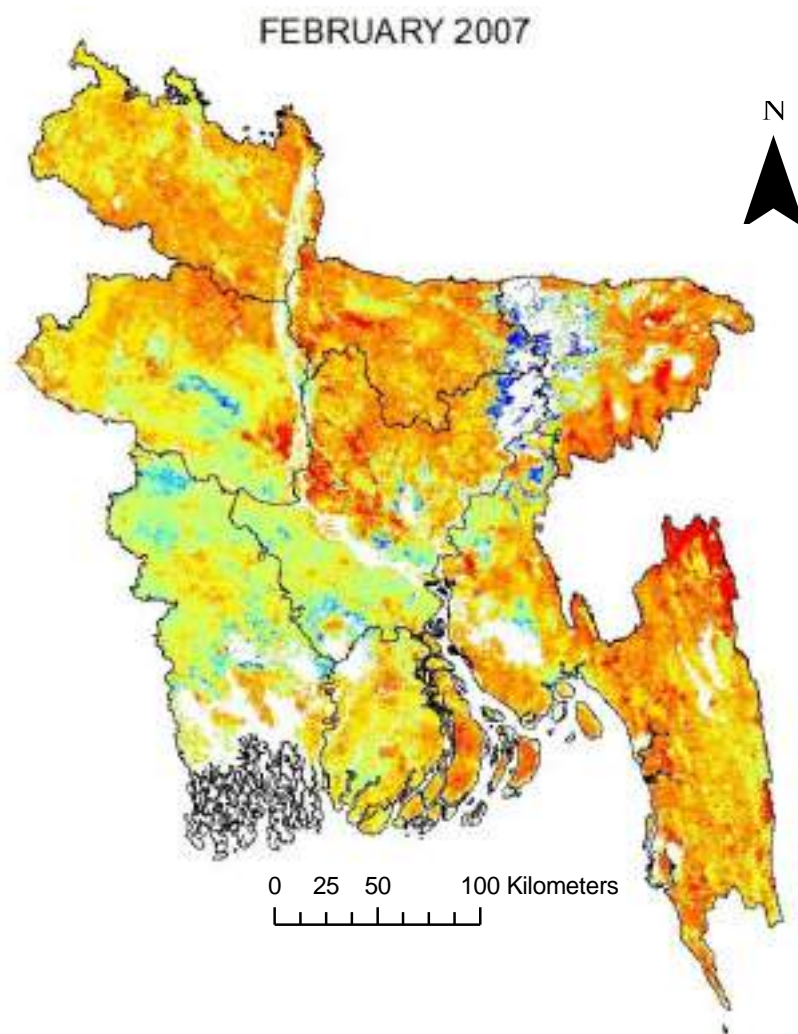


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

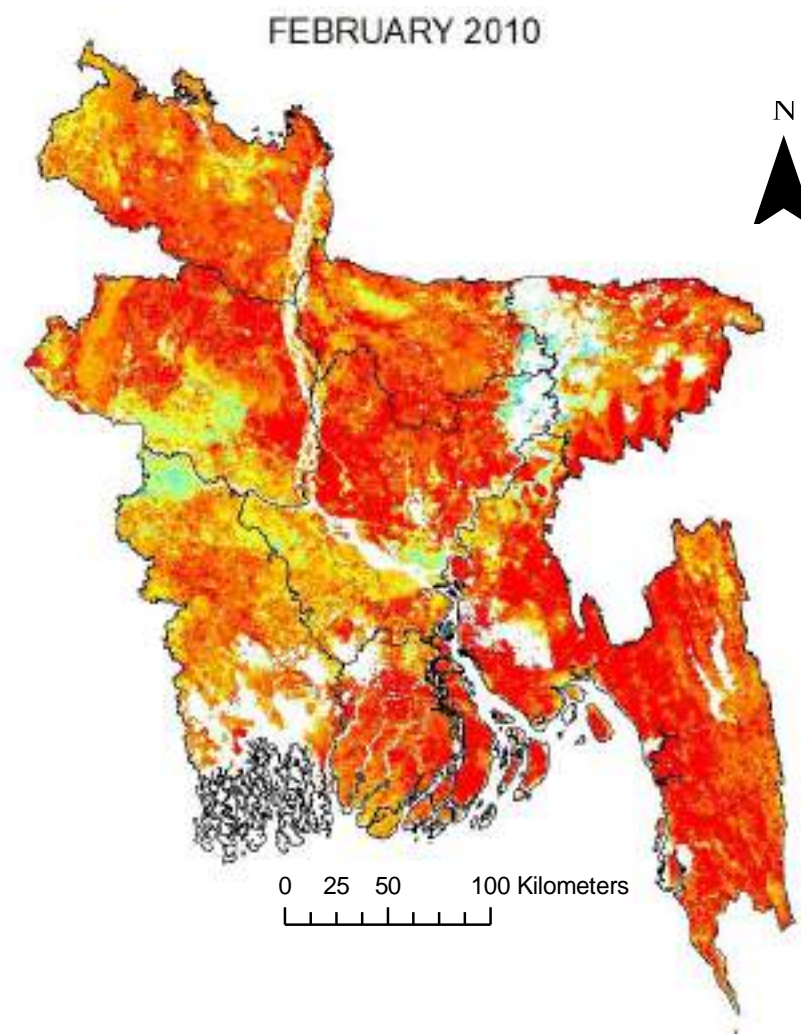
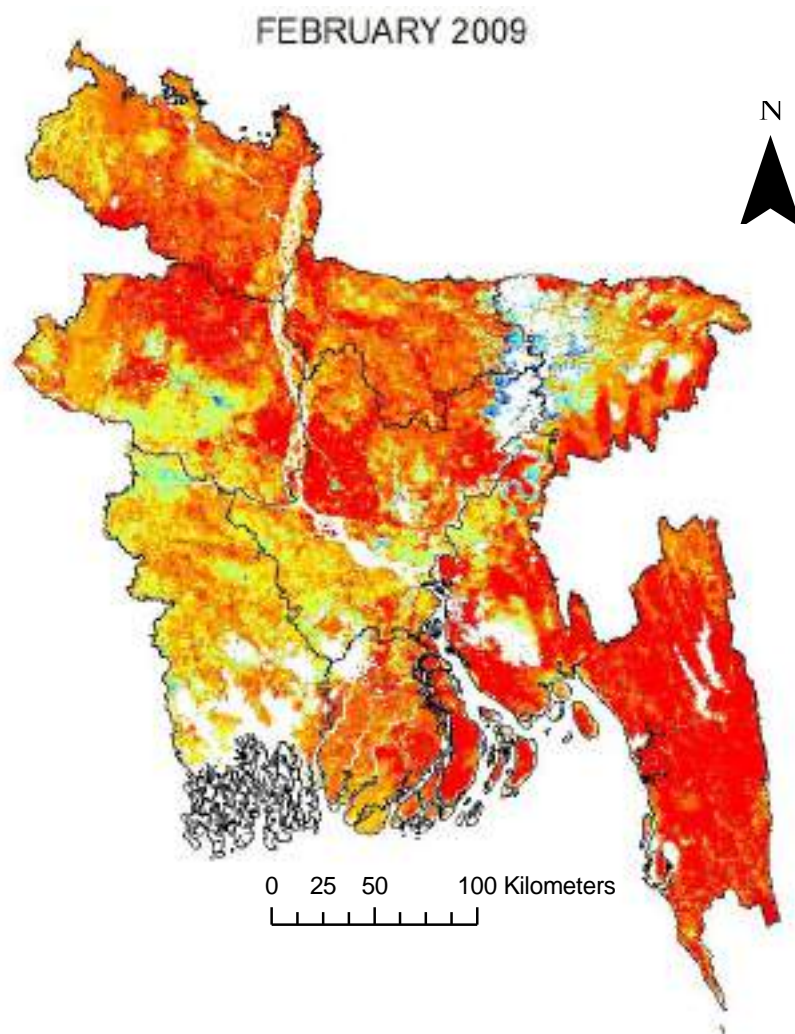


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

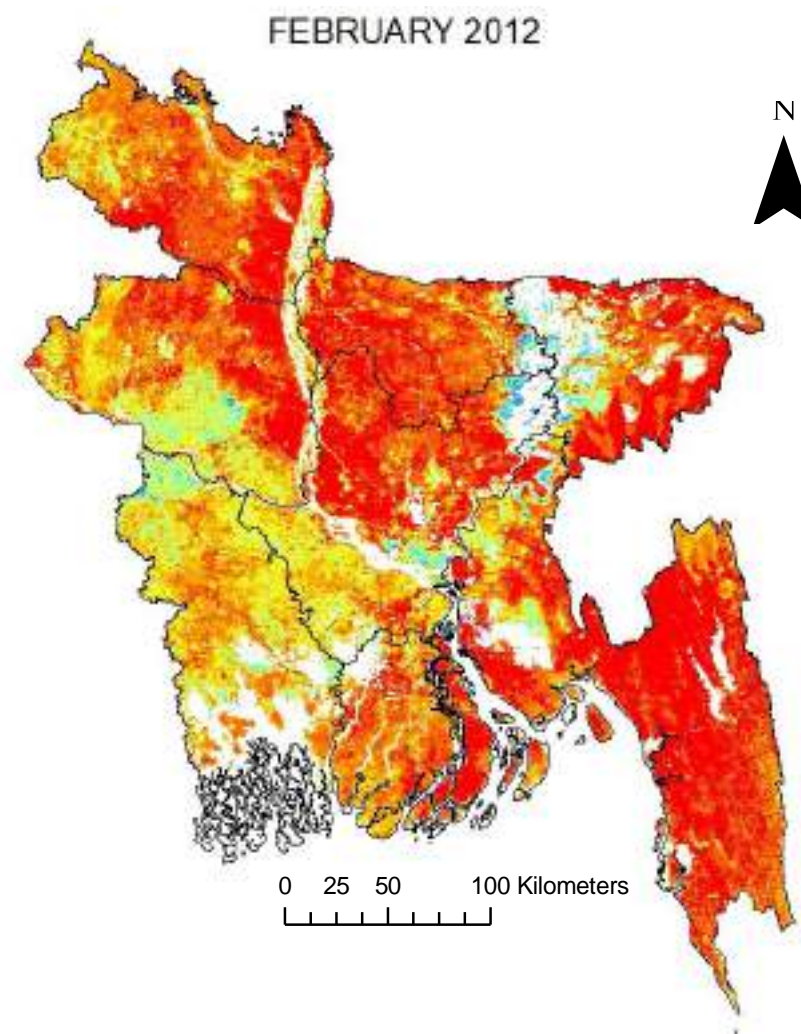
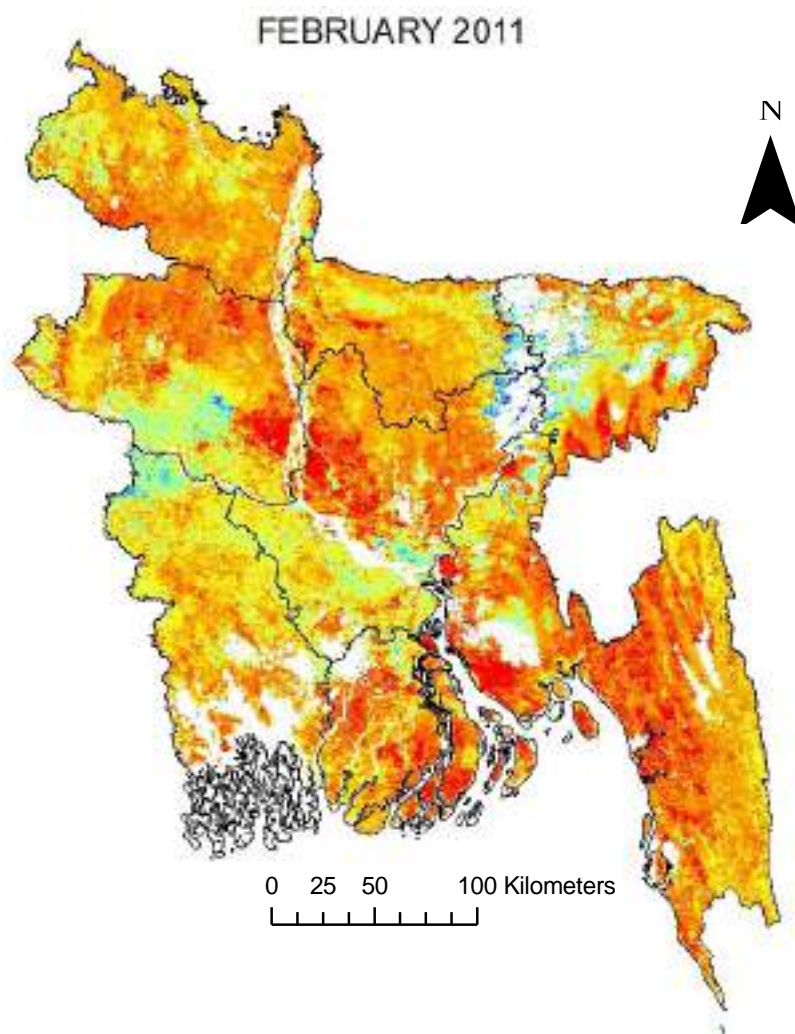


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

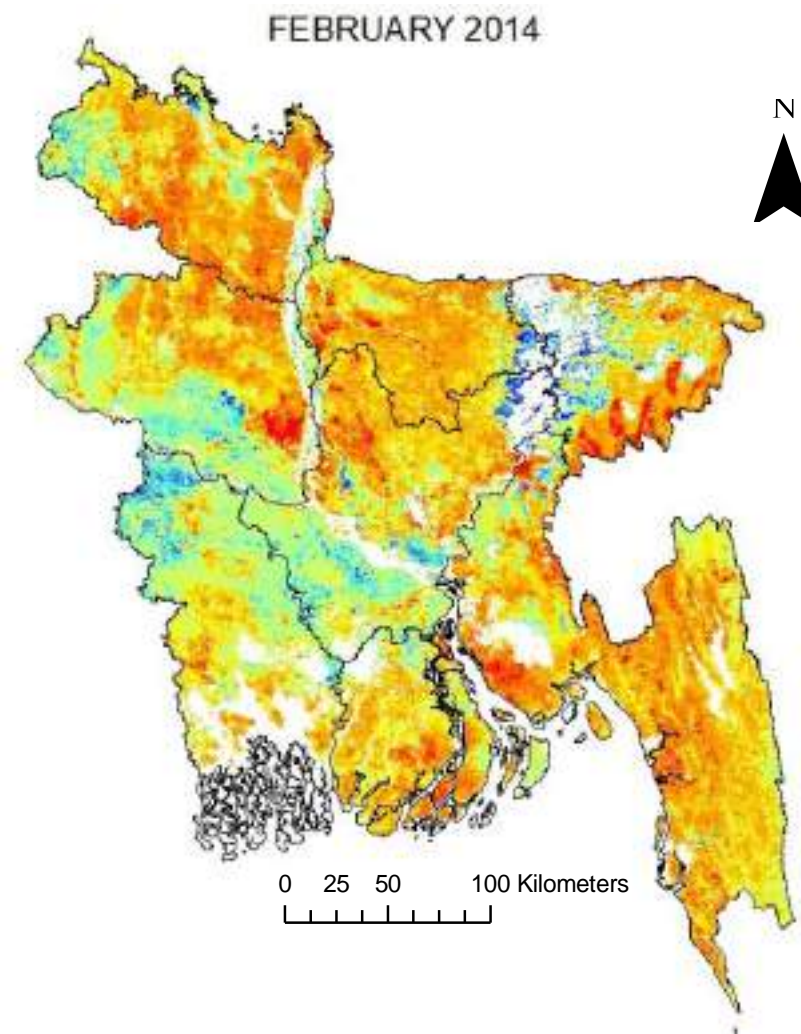
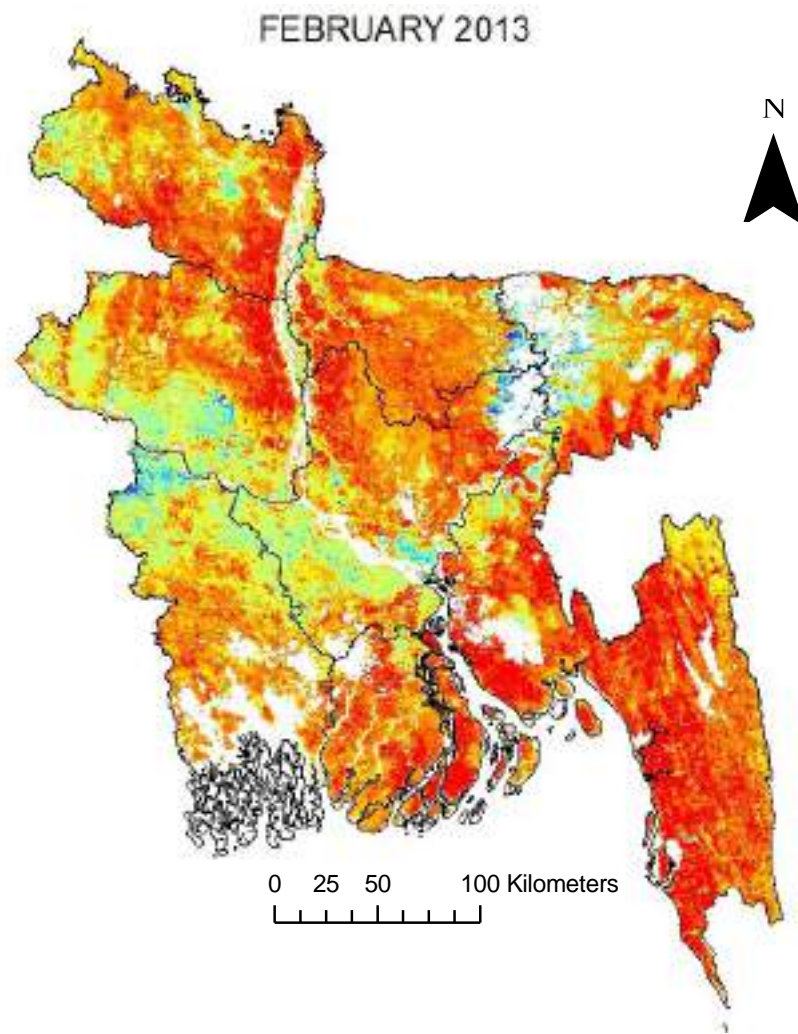


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

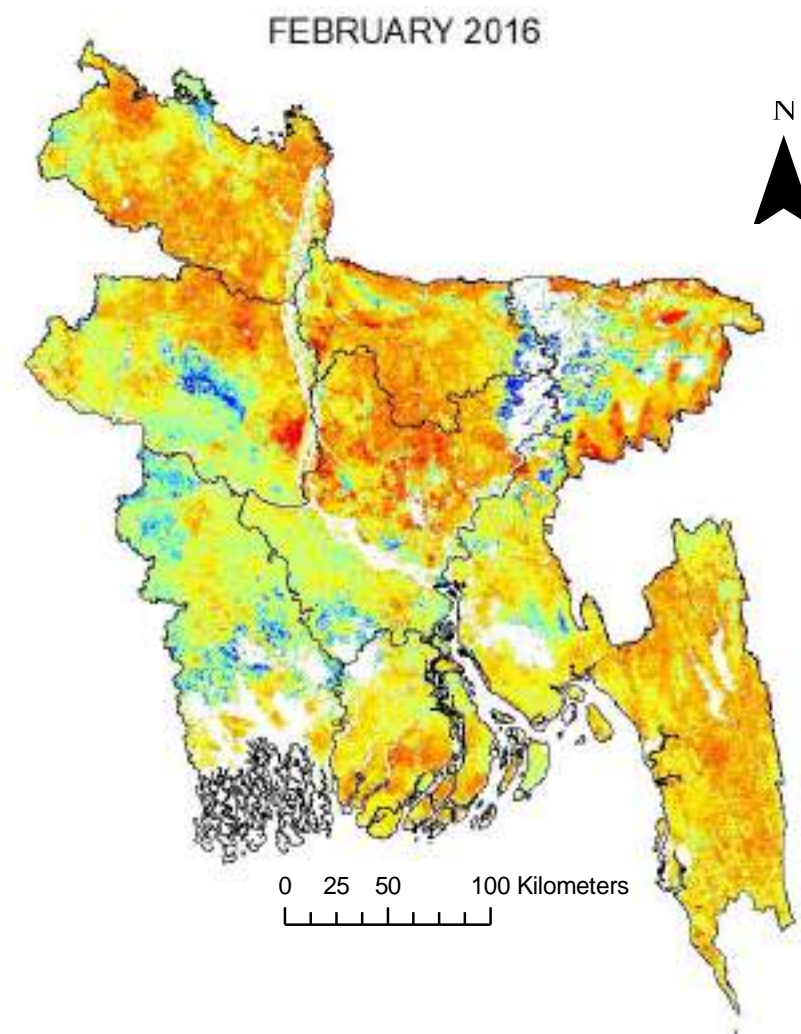
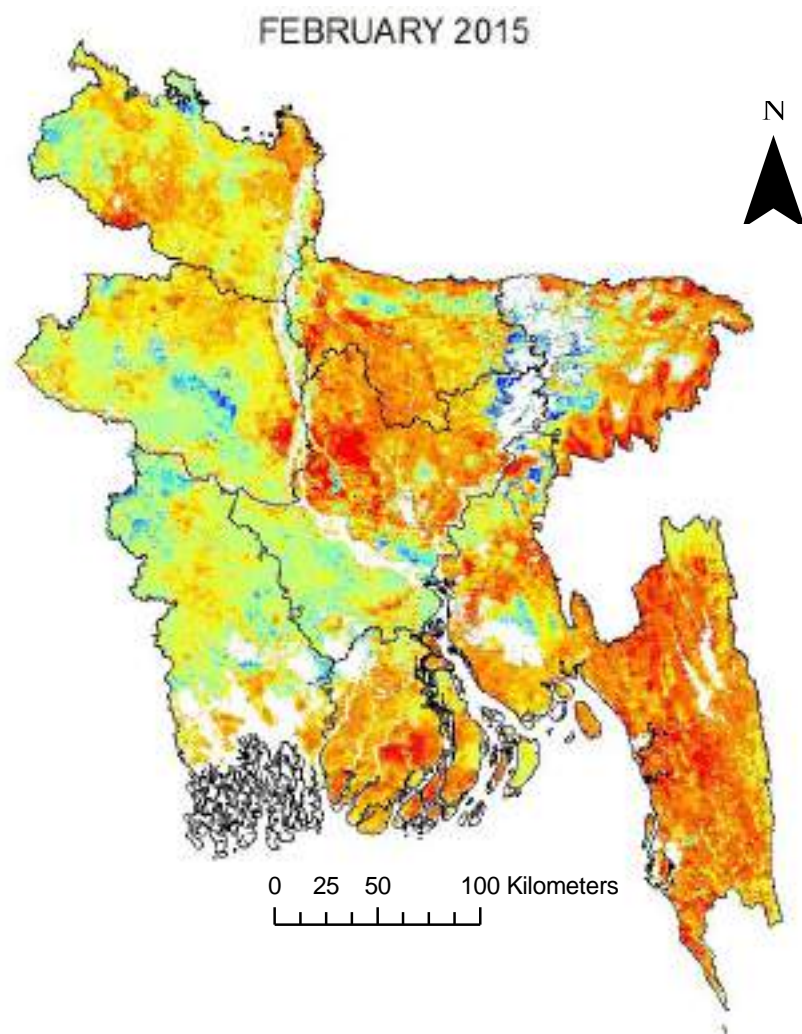


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)





- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)




- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

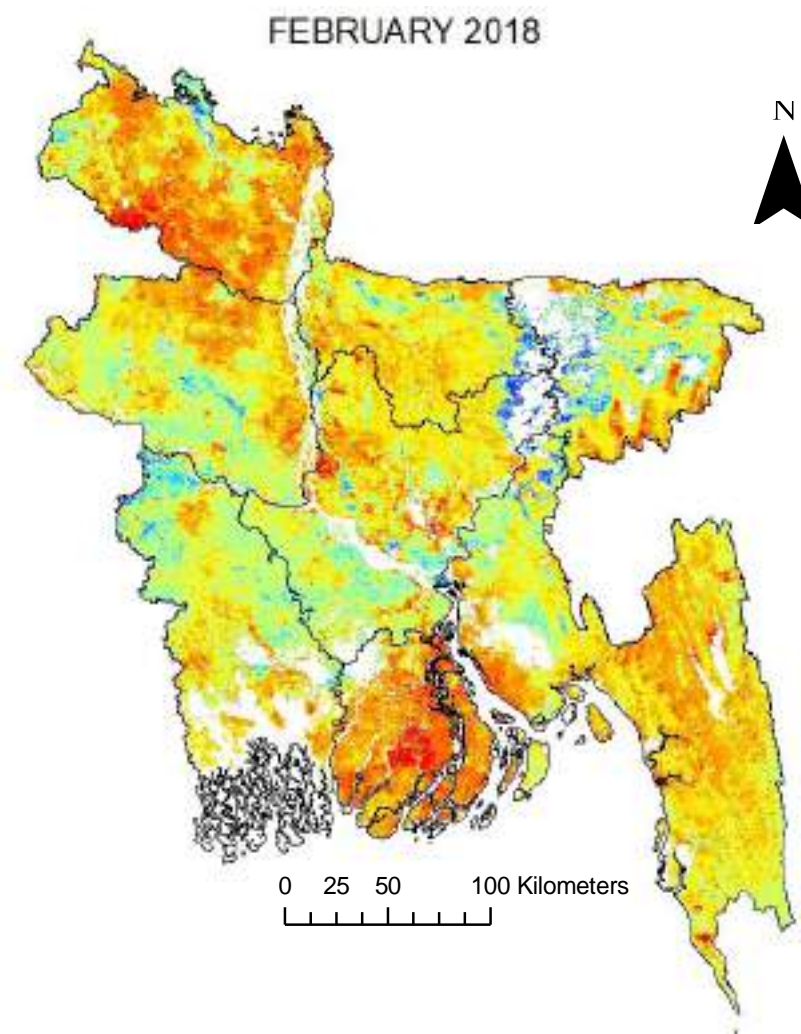
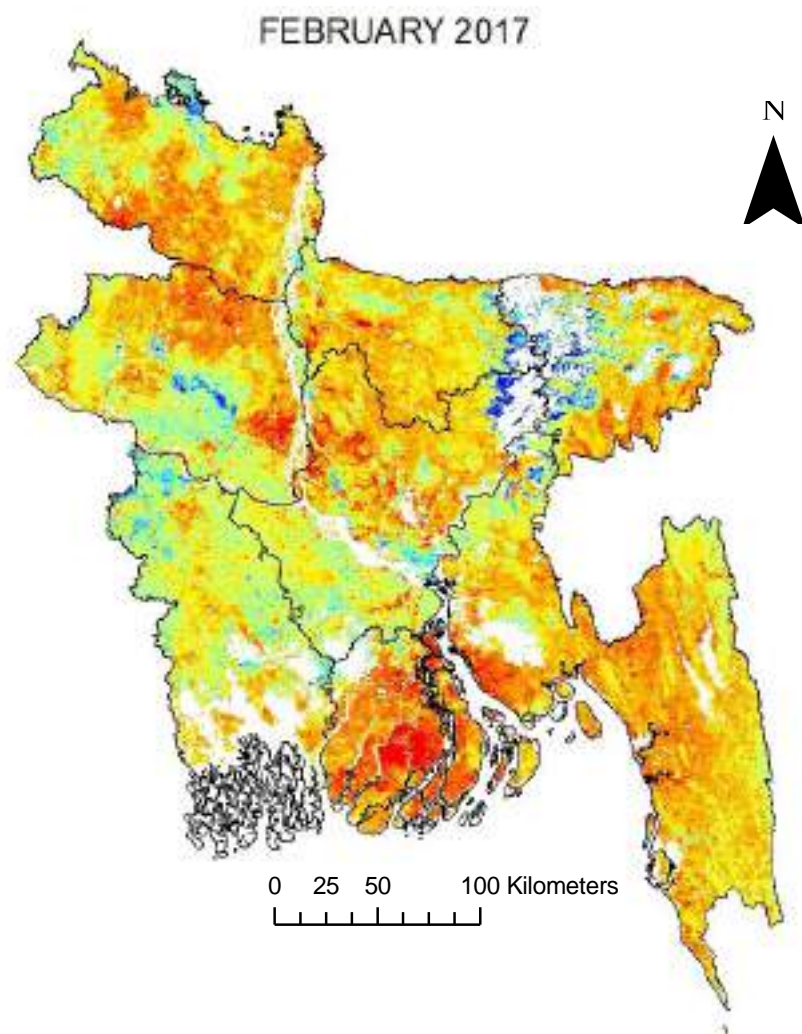


Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

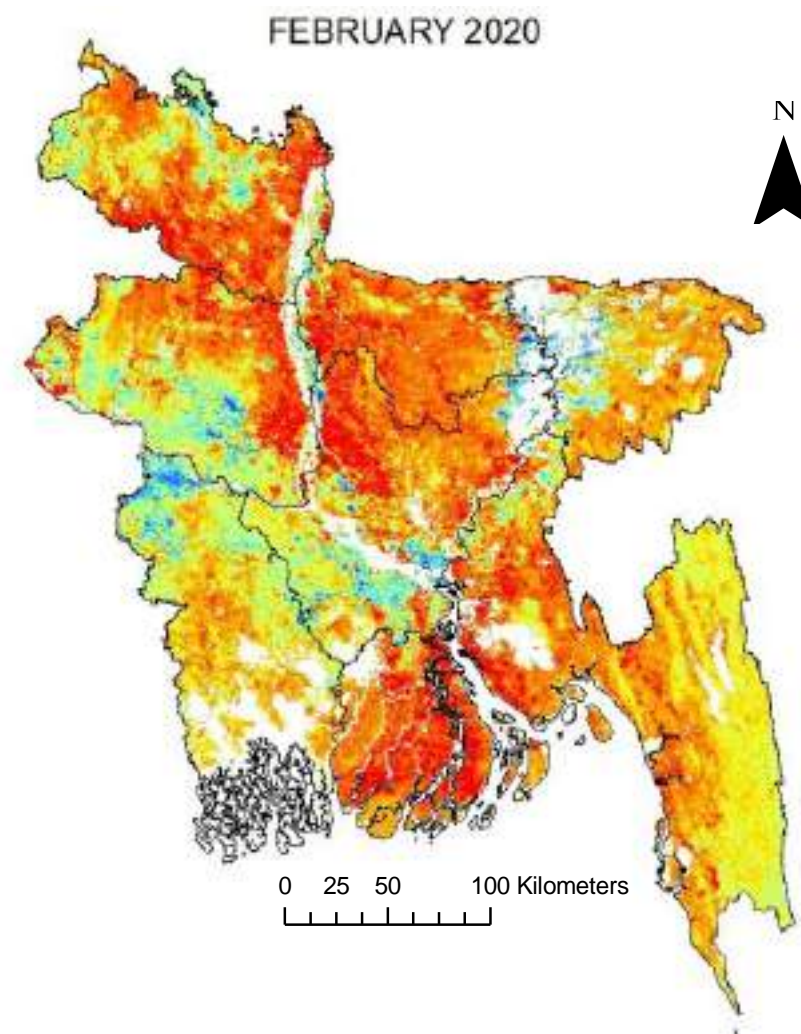
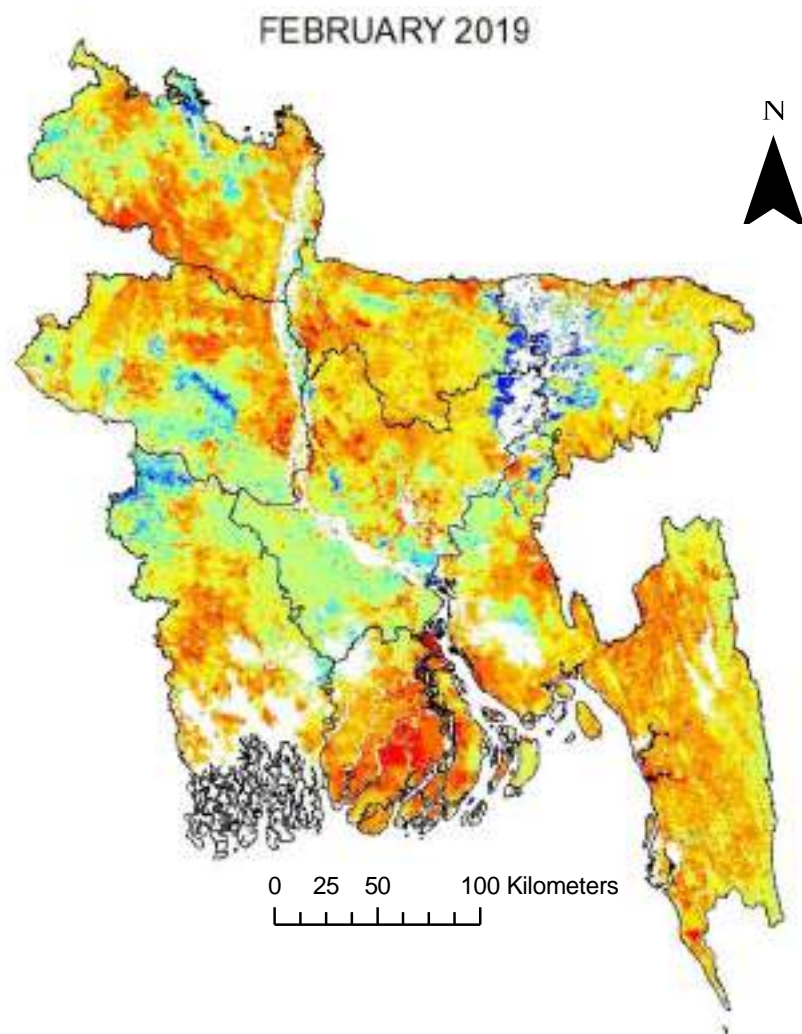


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

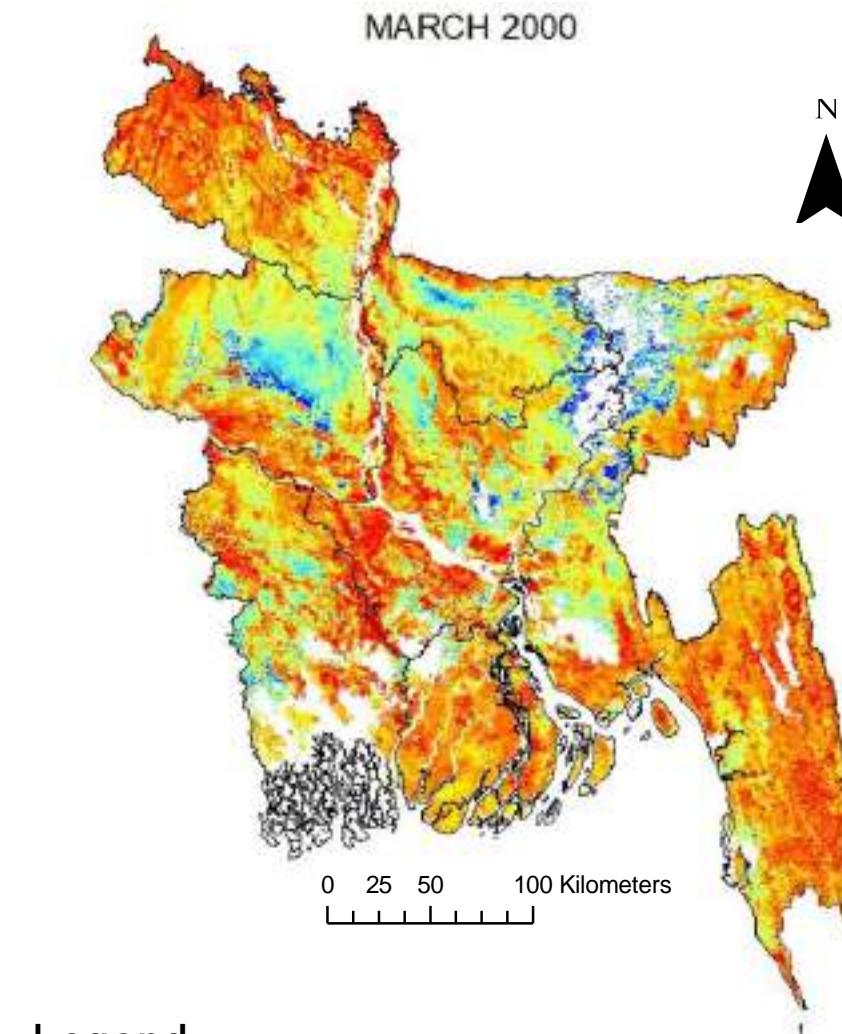
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

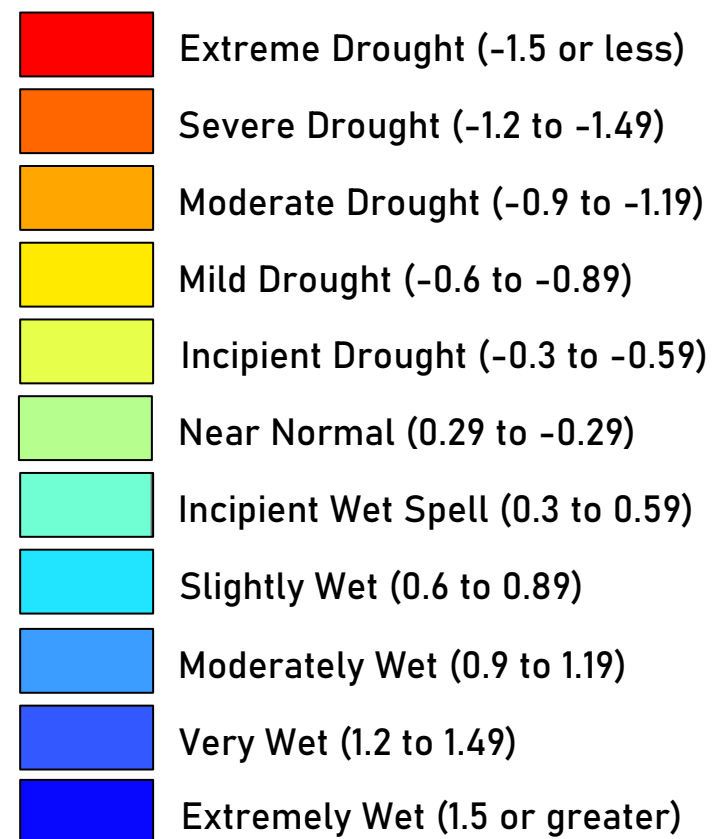
March DSI Maps

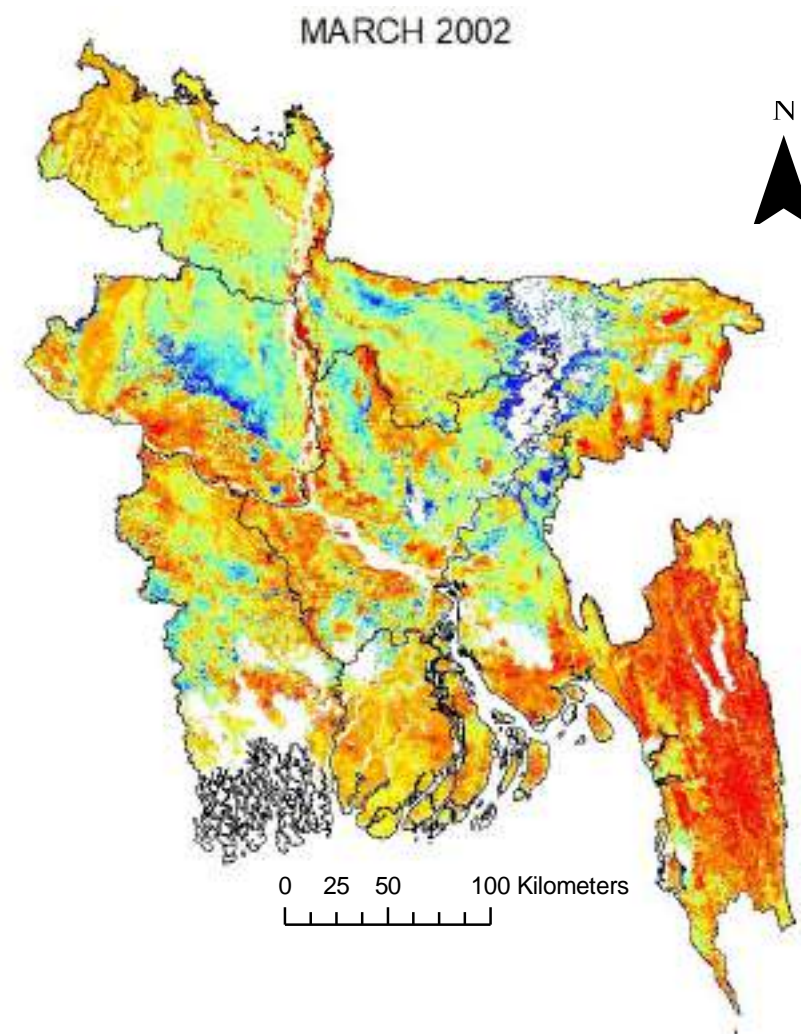
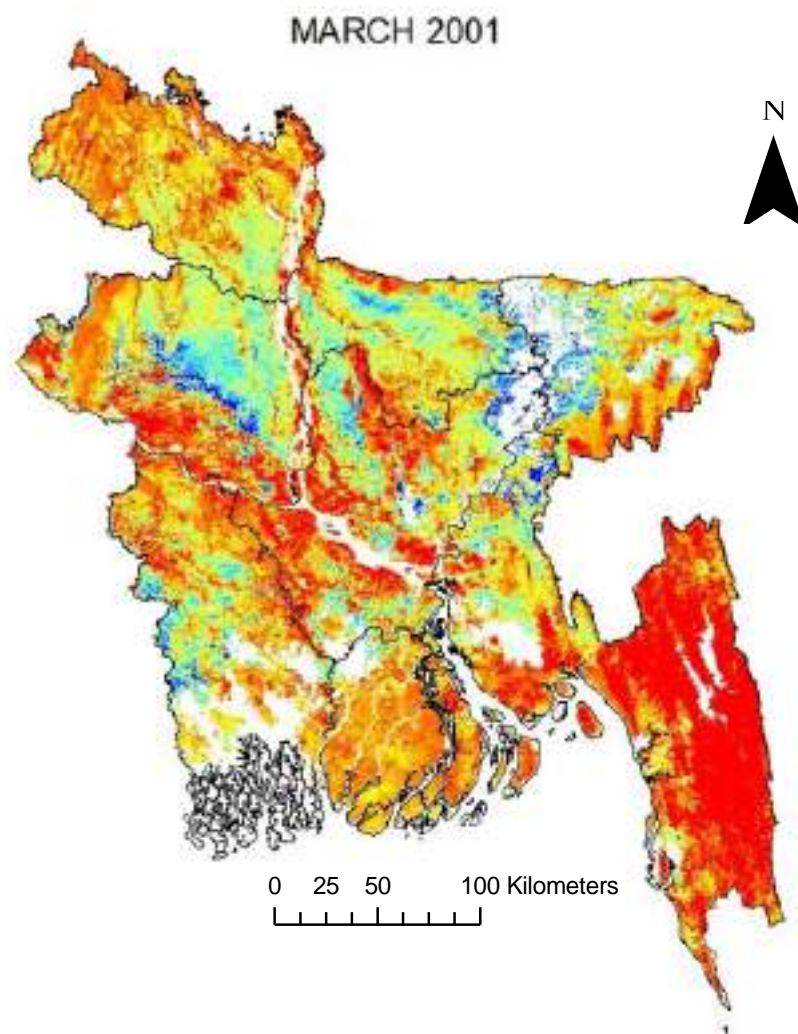
Drought conditions range from severe to incipient drought in March. This pre-monsoon month have suffered from mild drought the most. Drought conditions were severe in 2001.

Mean March DSI Values		
Years	Values	Drought Condition
2000	-1.12	Moderate Drought
2001	-1.28	Severe Drought
2002	-0.80	Mild Drought
2003	-0.85	Mild Drought
2004	-0.88	Mild Drought
2005	-0.50	Incipient Drought
2006	-0.79	Mild Drought
2007	-0.75	Mild Drought
2008	-0.44	Incipient Drought
2009	-0.88	Mild Drought
2010	-0.98	Moderate Drought
2011	-0.66	Mild Drought
2012	-0.94	Moderate Drought
2013	-0.80	Mild Drought
2014	-0.74	Mild Drought
2015	-0.69	Mild Drought
2016	-0.48	Incipient Drought
2017	-0.40	Incipient Drought
2018	-0.45	Incipient Drought
2019	-0.42	Incipient Drought
2020	-0.76	Mild Drought











Legend






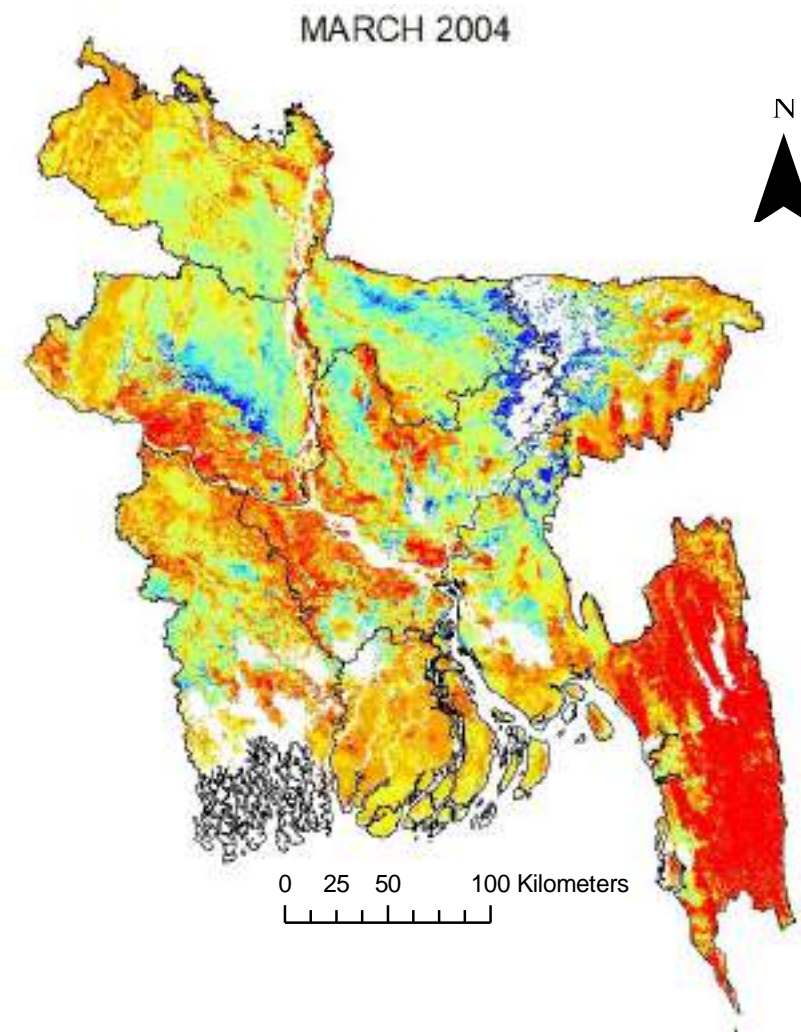
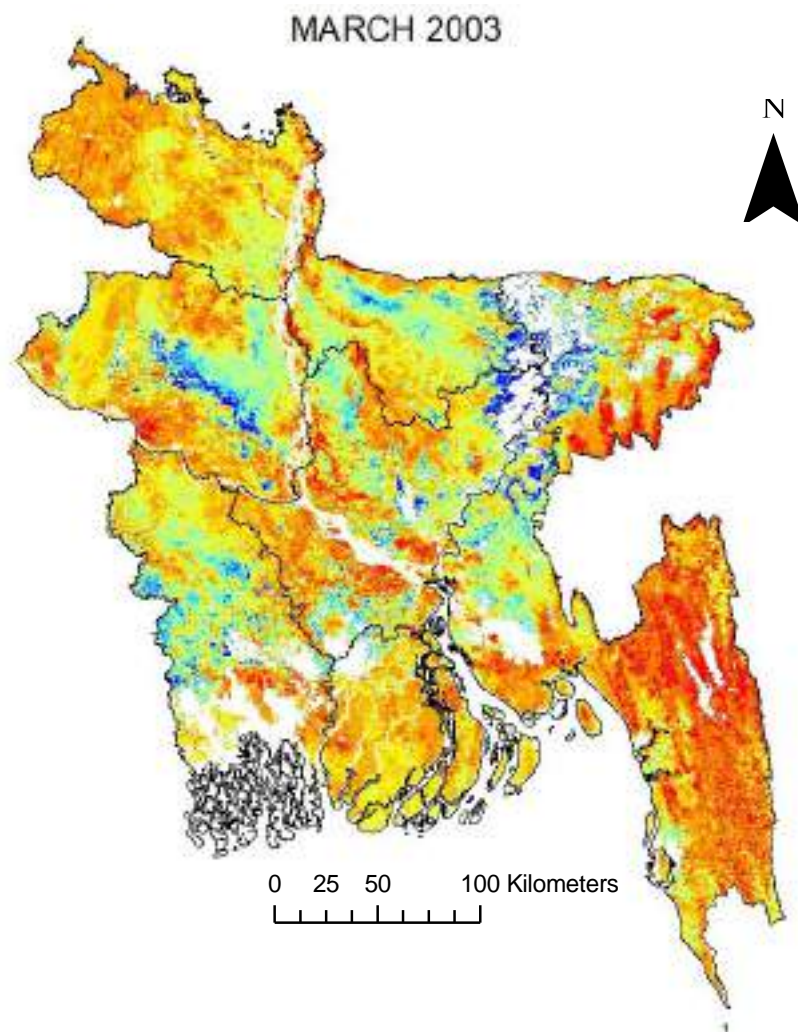


Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

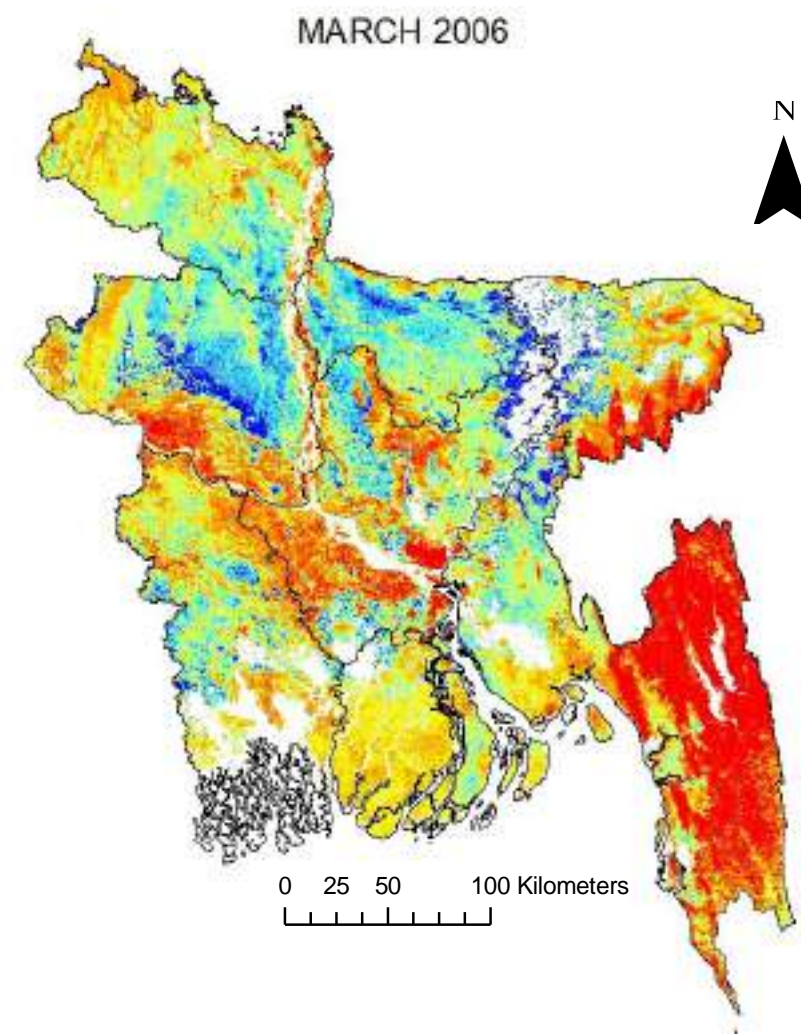
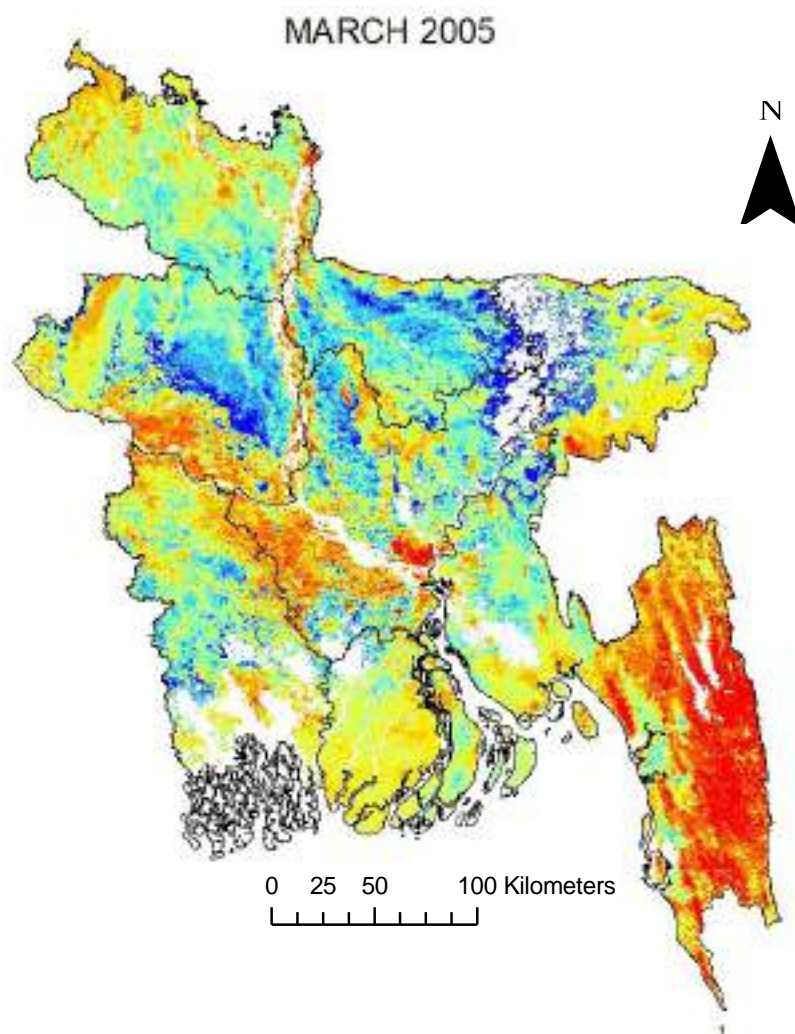


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

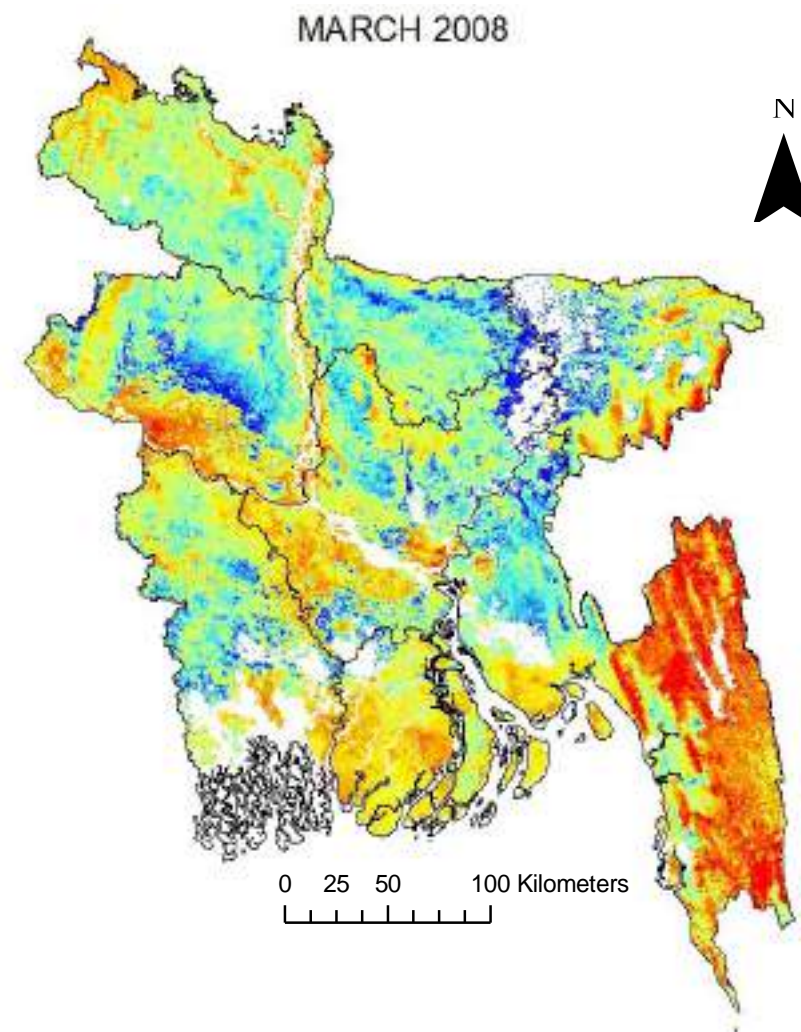
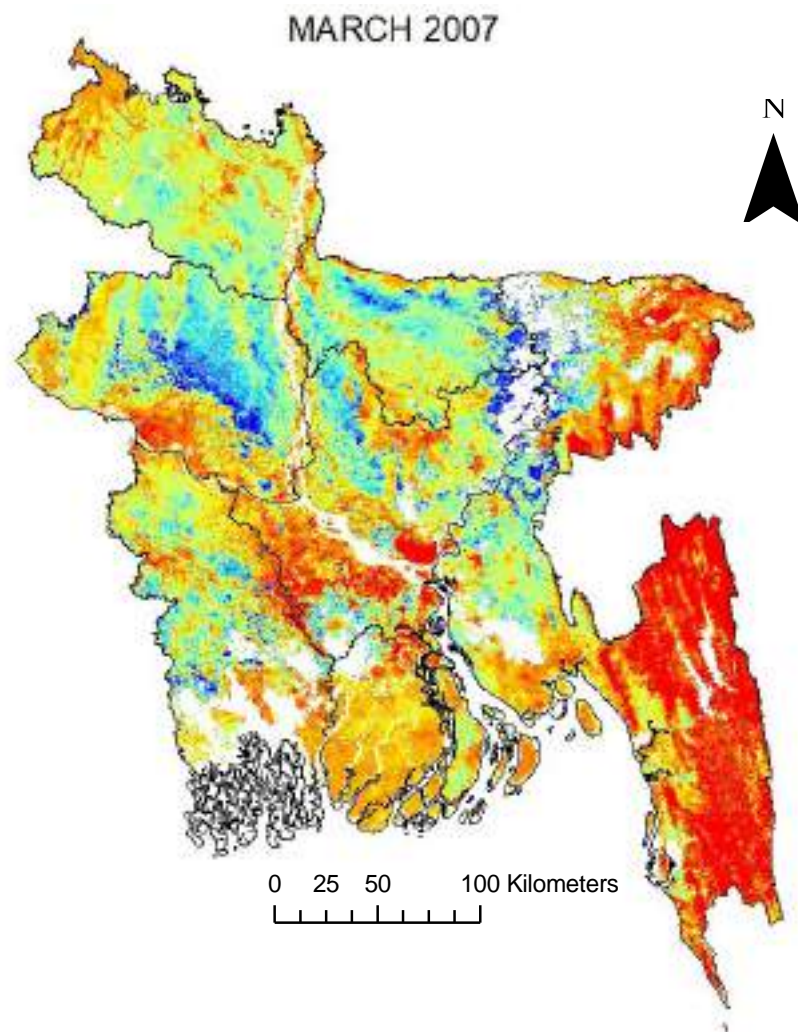


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

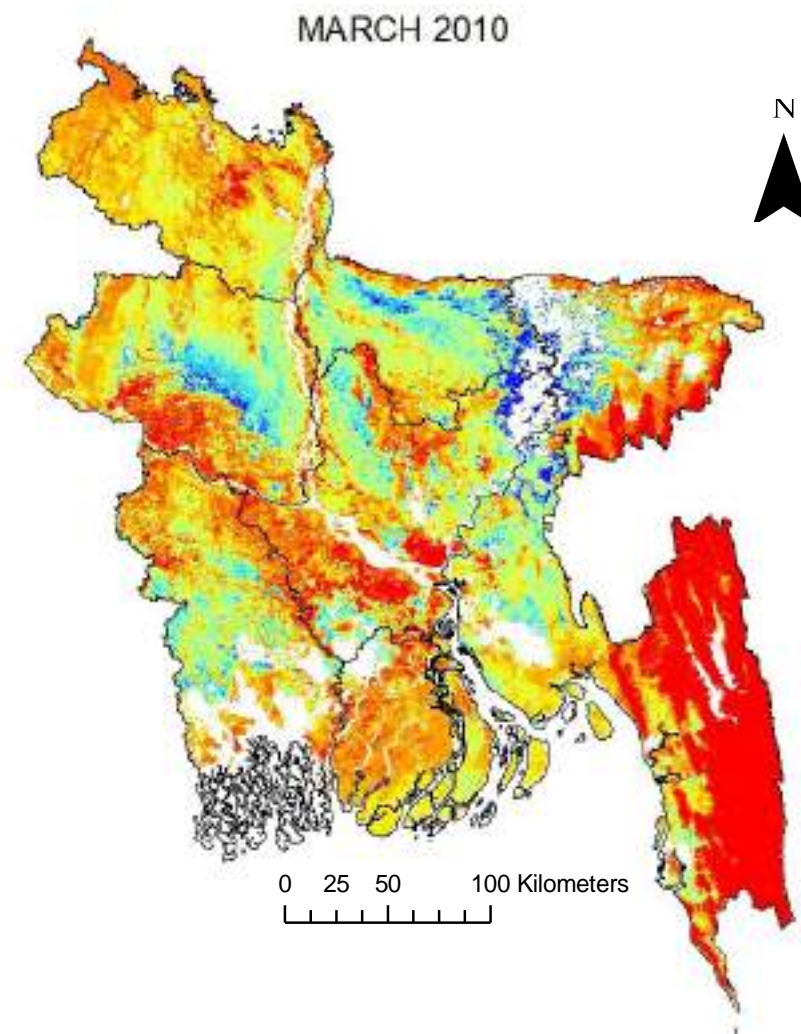
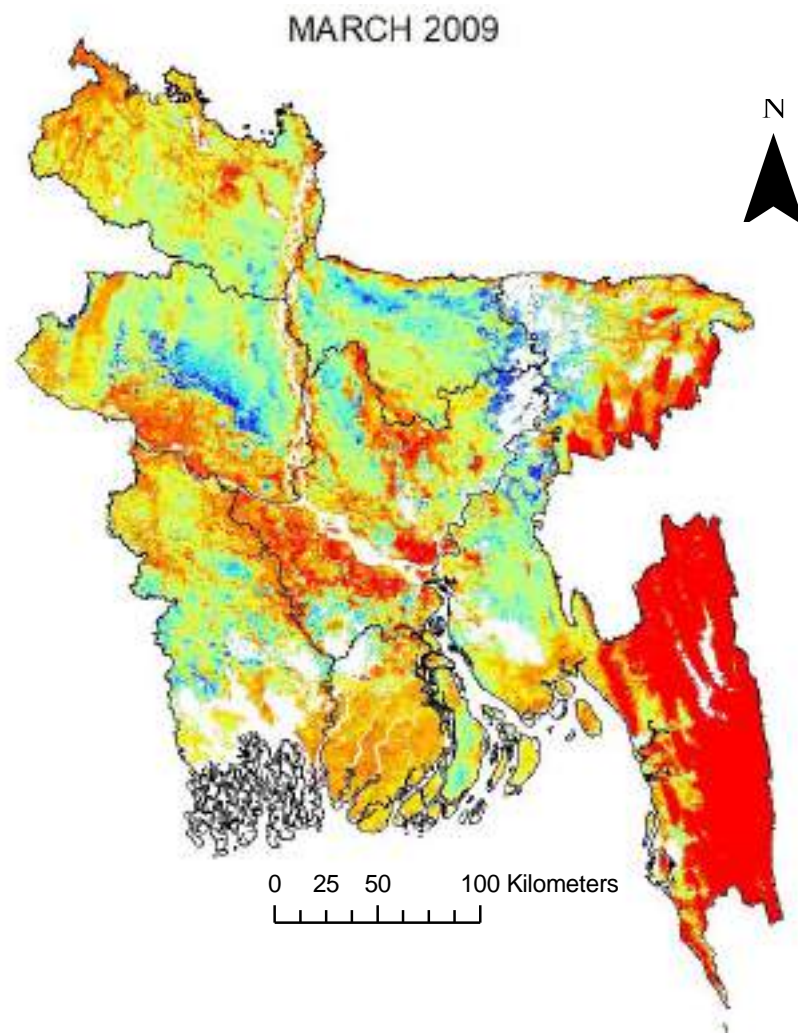


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)





- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

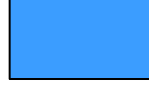


- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

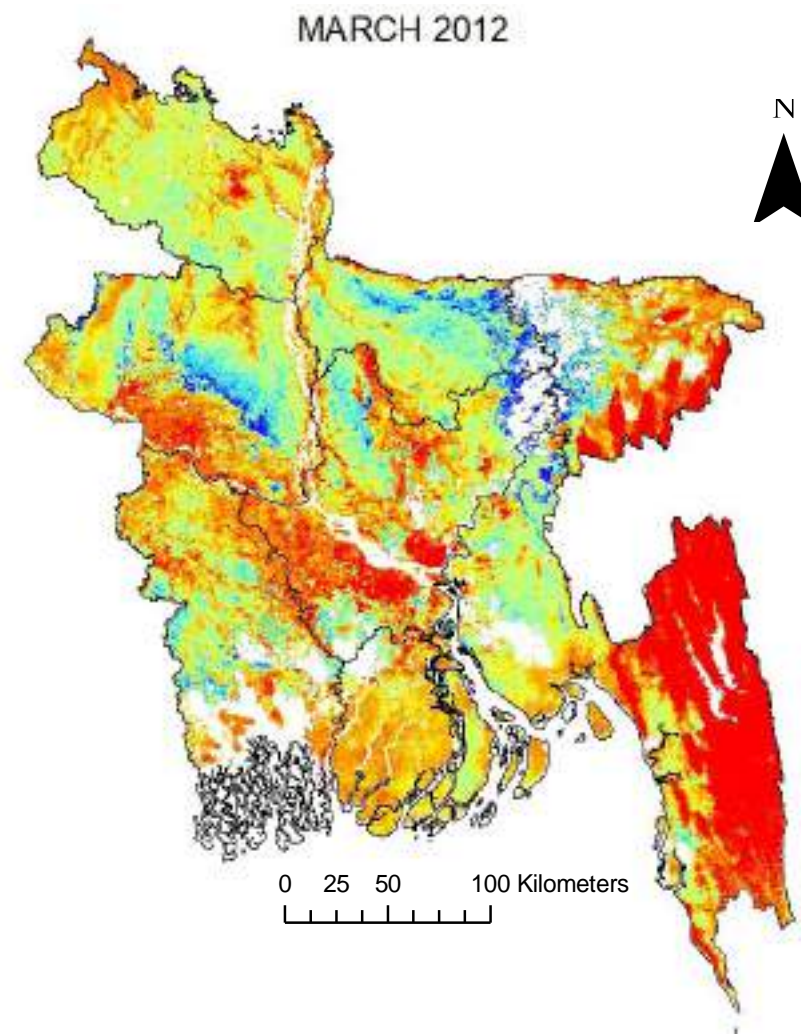
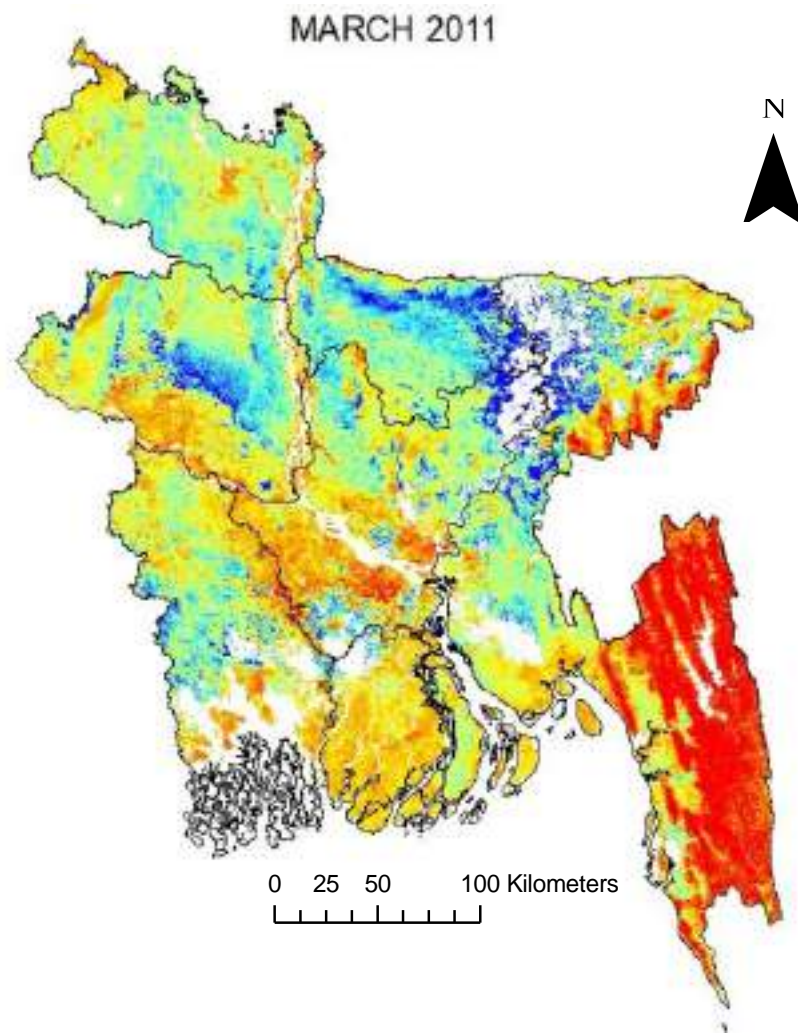


Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

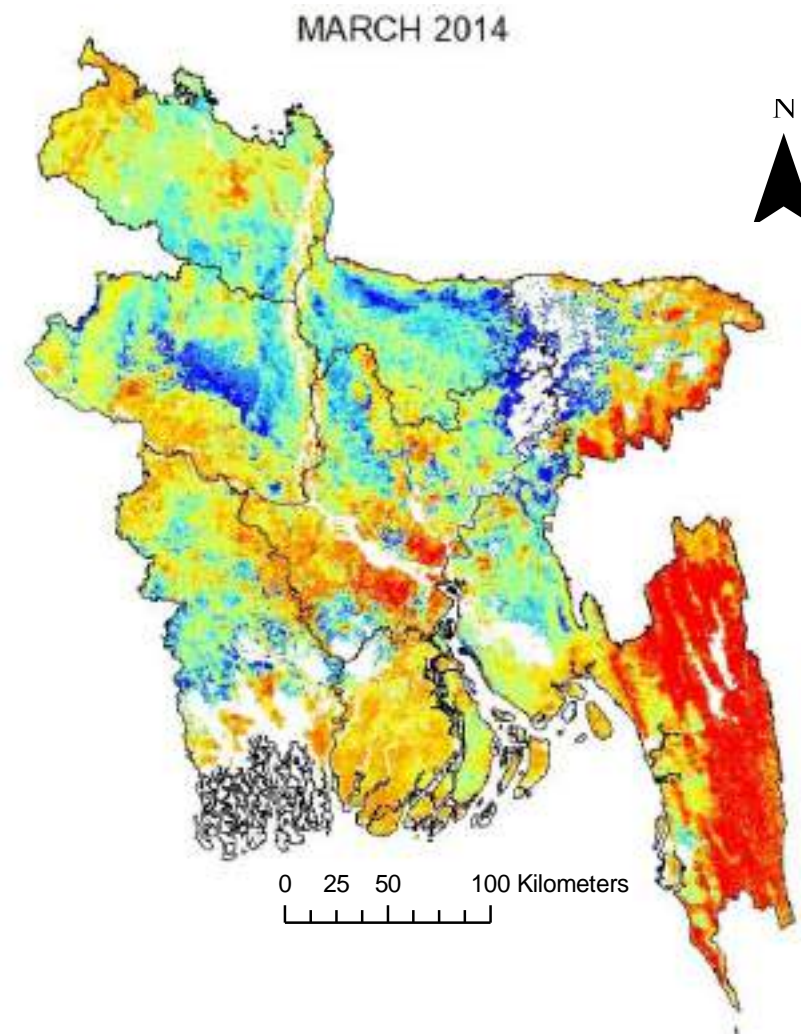
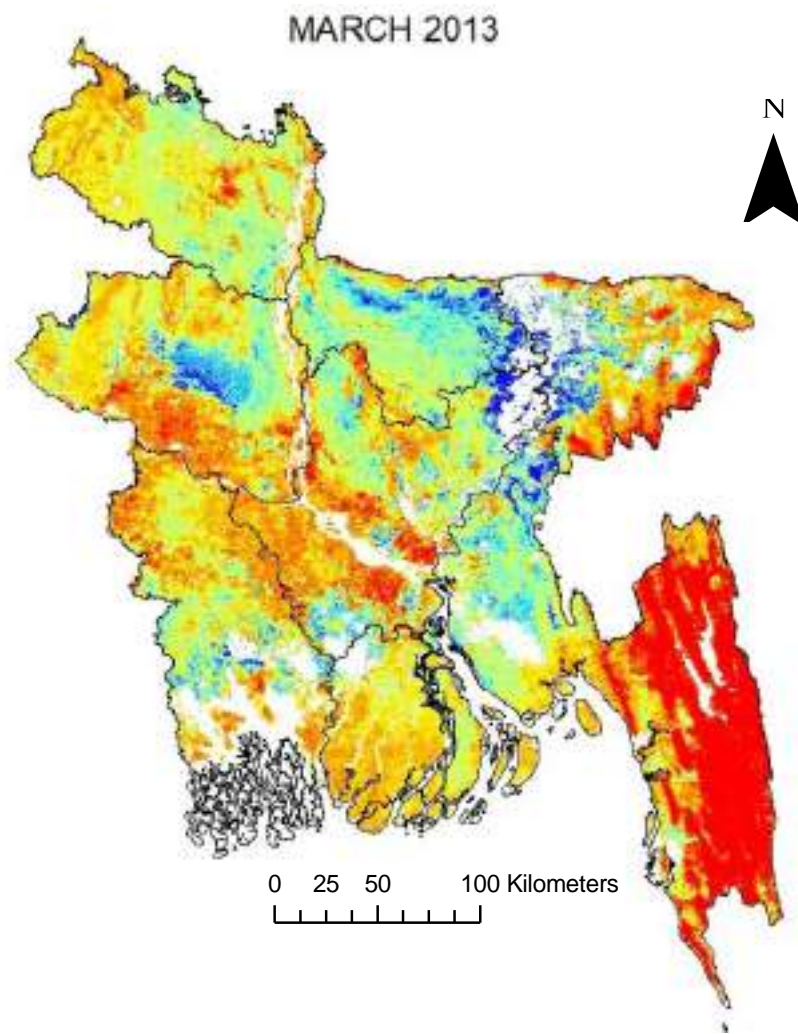


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)





- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

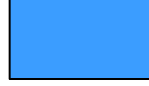


- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

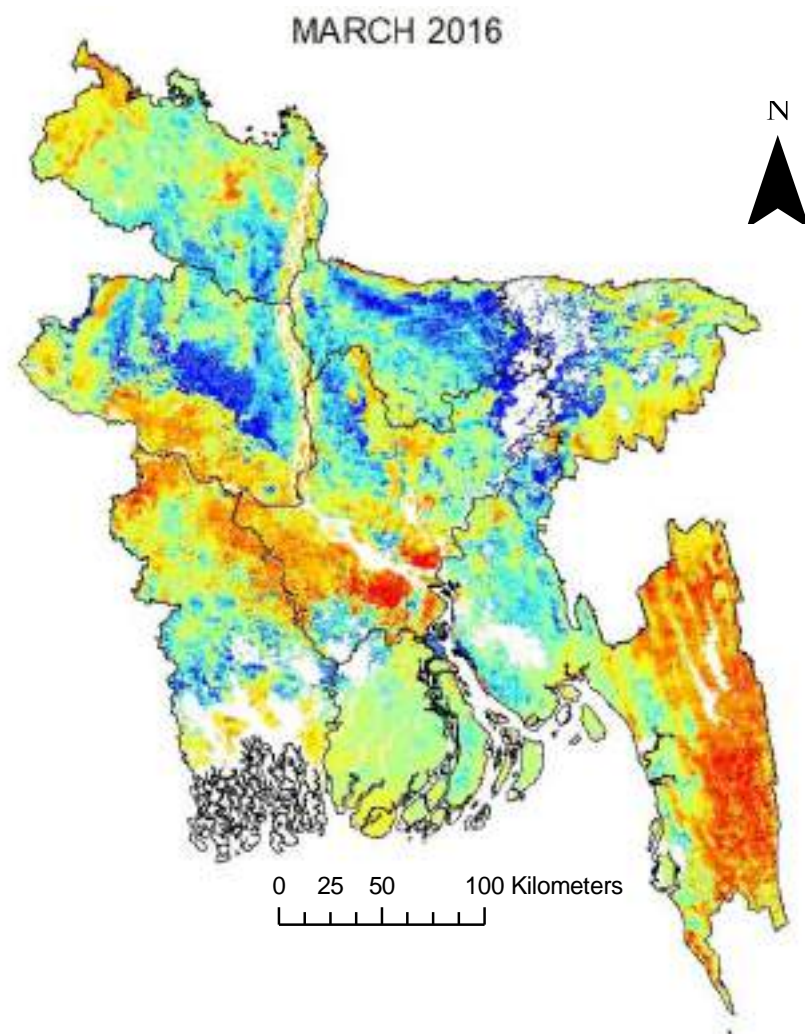
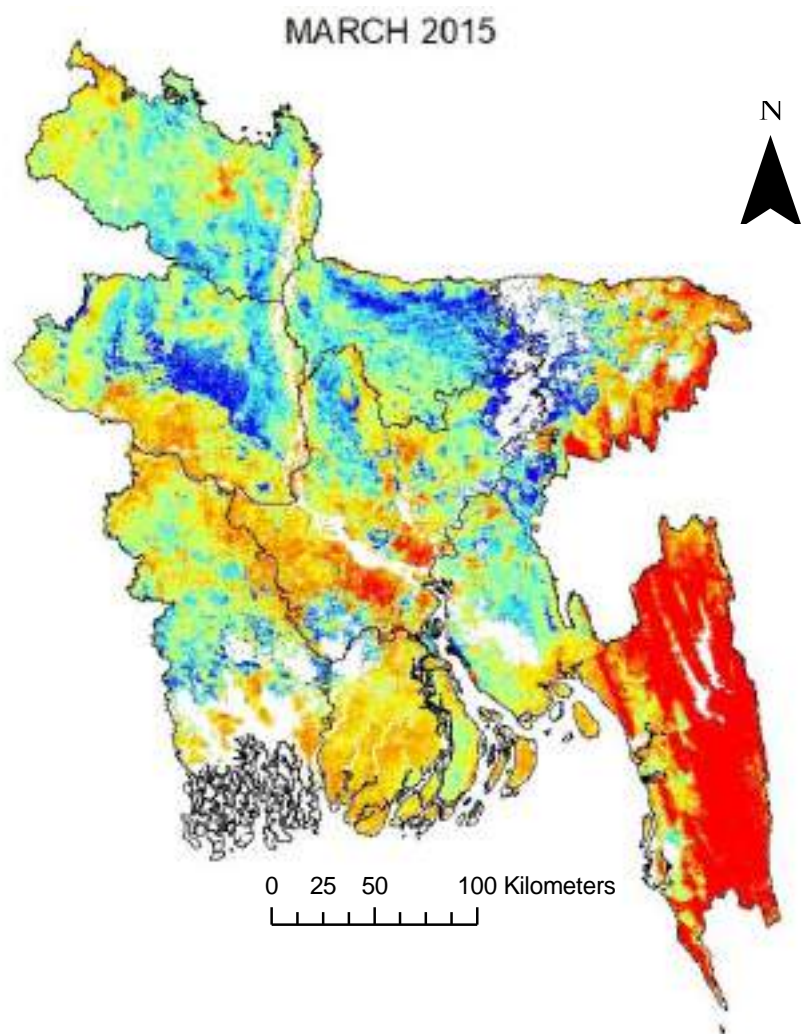


Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

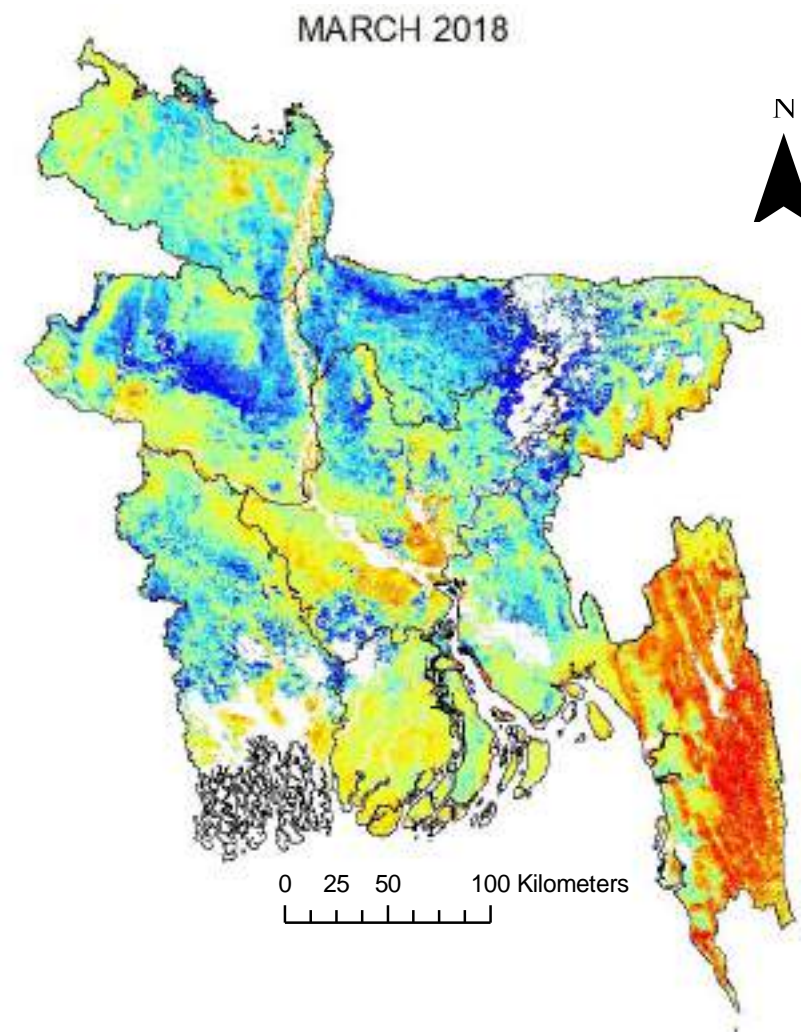
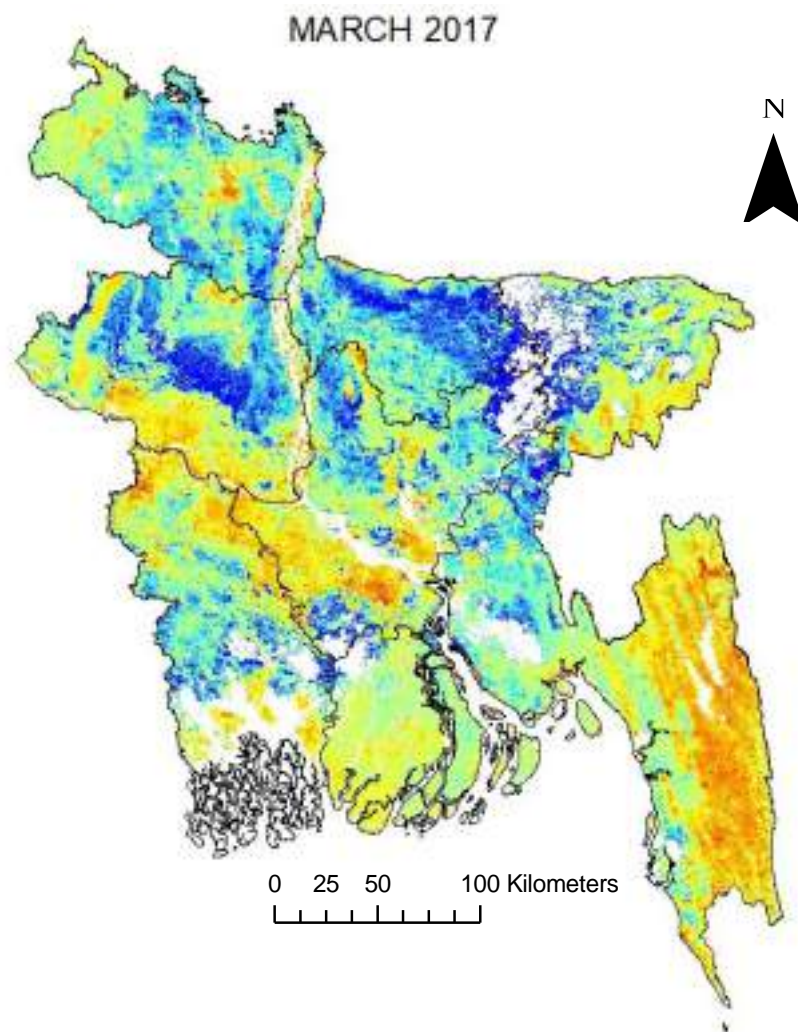


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

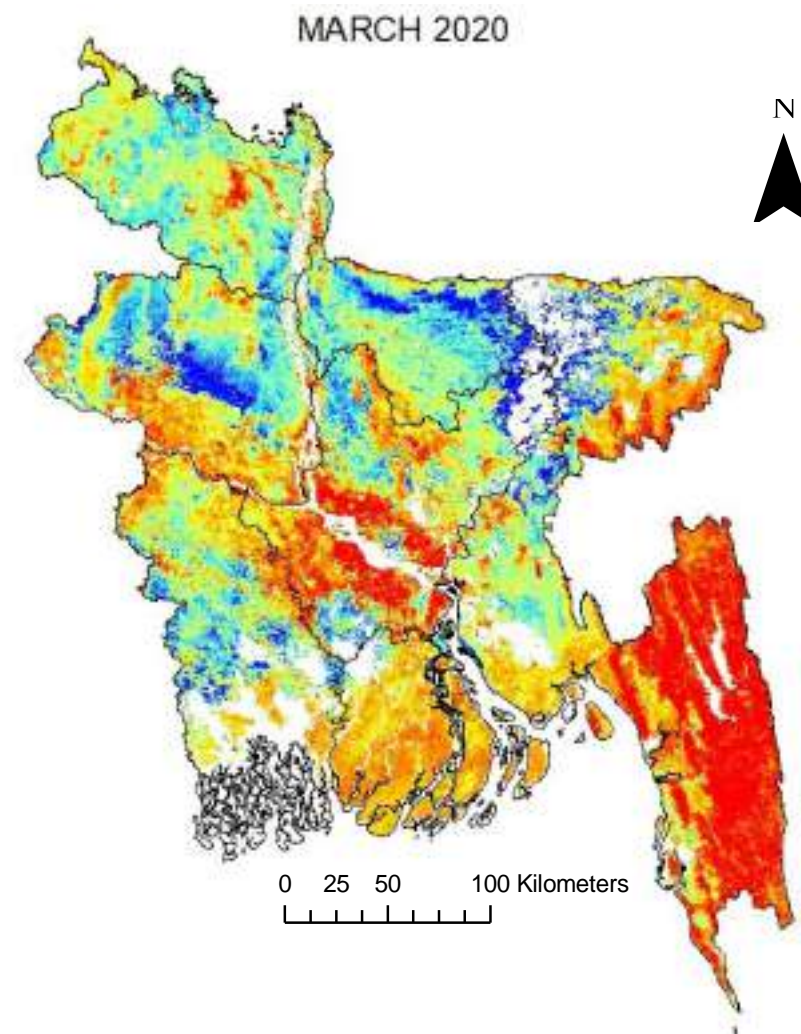
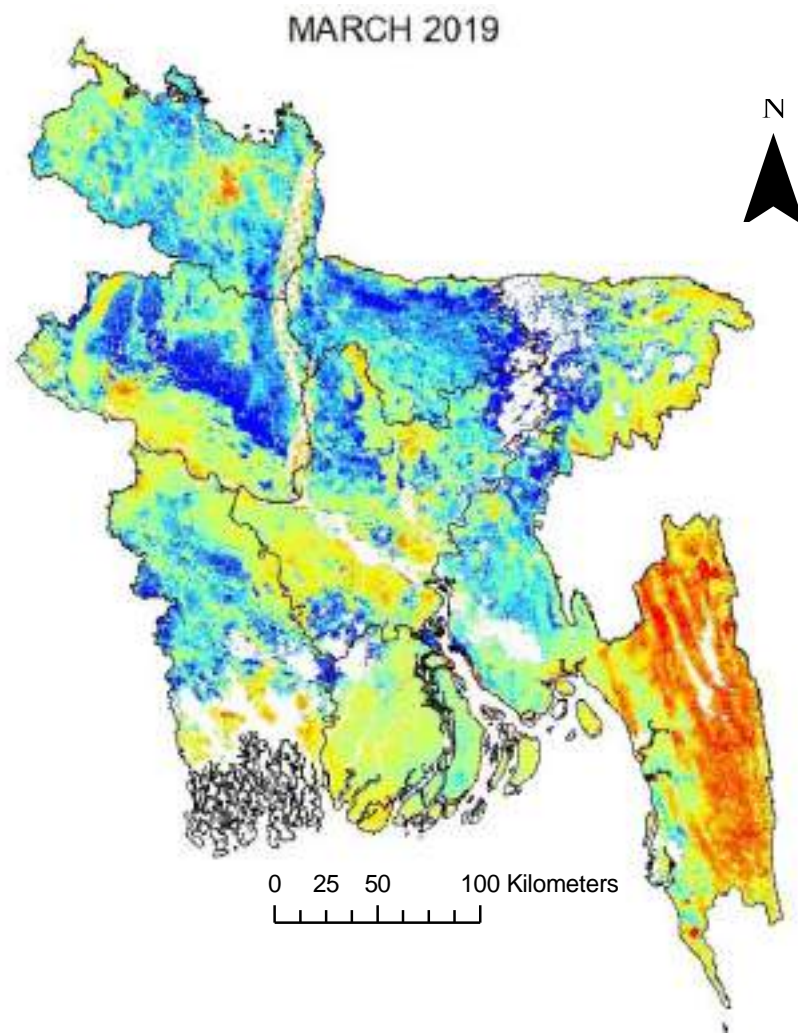


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

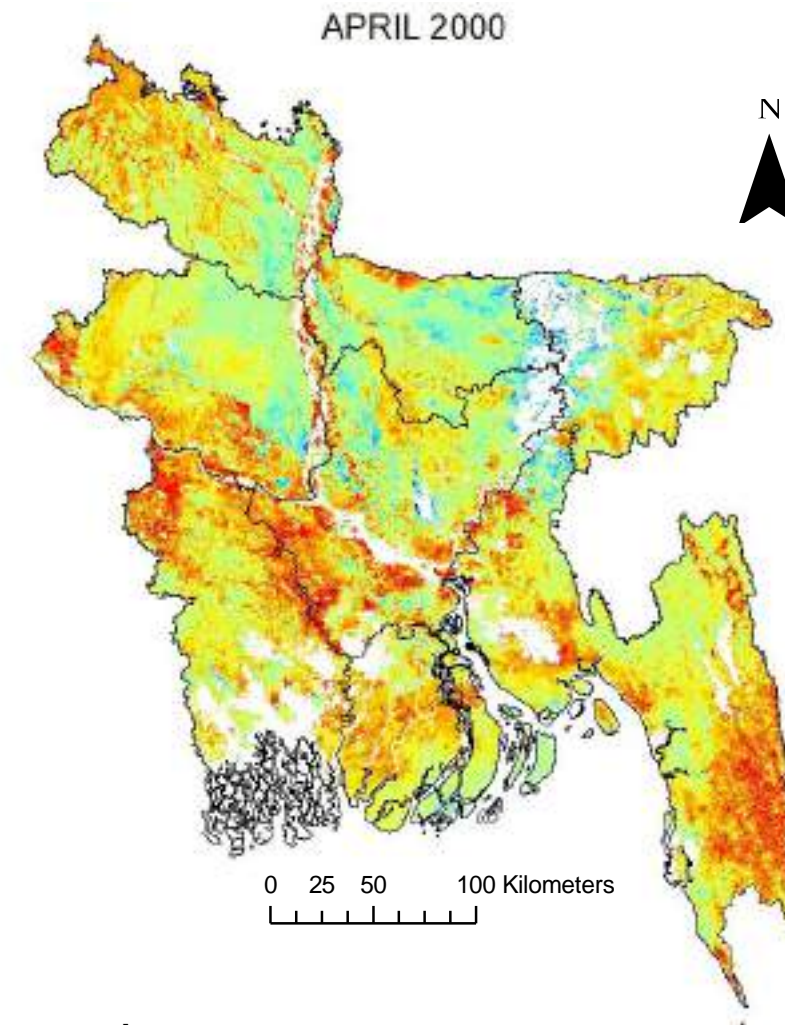
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

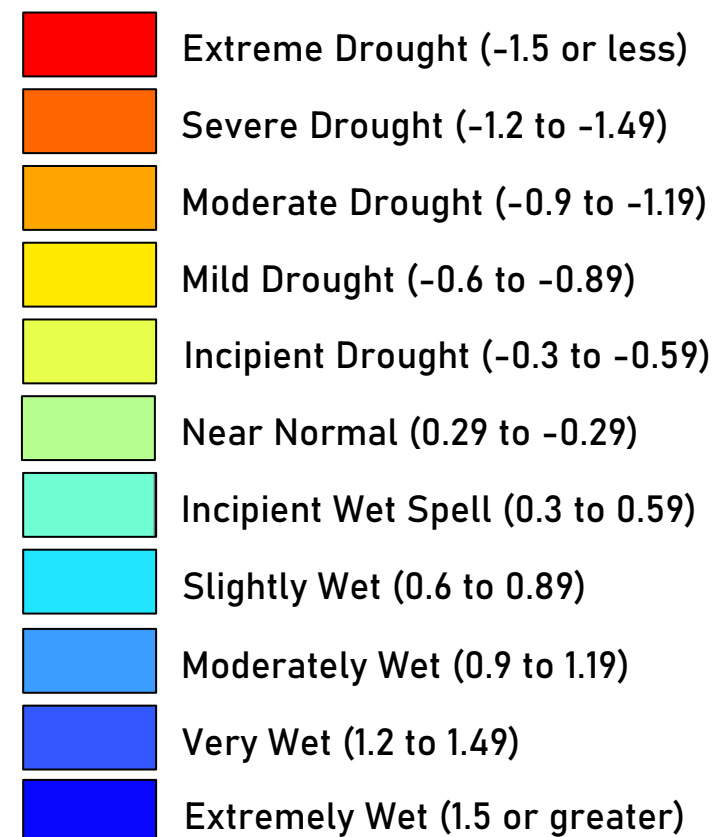
April DSI Maps

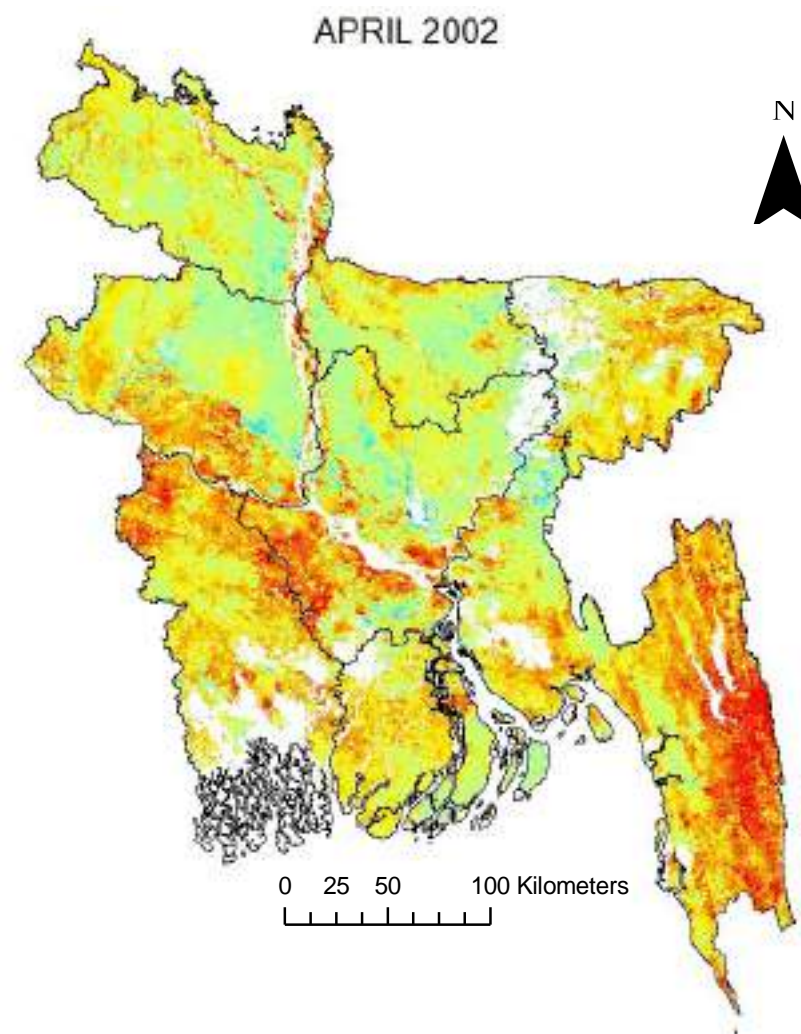
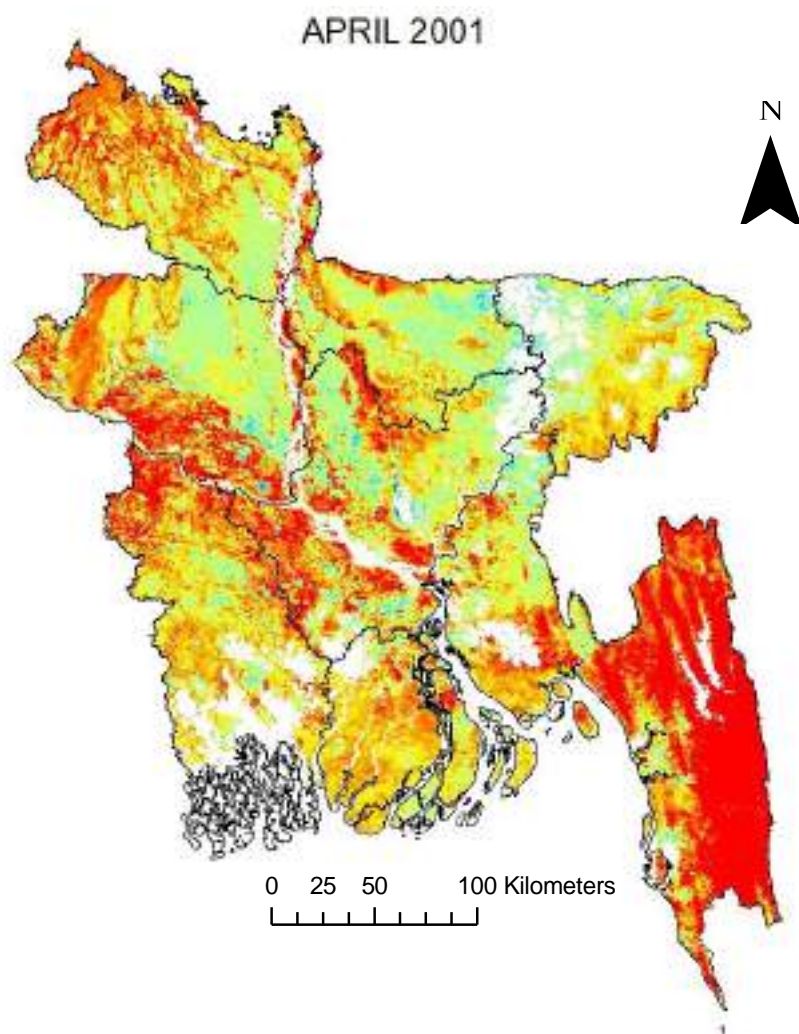
Drought conditions in April typically range from mild to near-normal condition. In most years, the pre-monsoon month has had mild to moderate drought.

Mean April DSI Values		
Years	Values	Drought Condition
2000	-0.75	Mild Drought
2001	-0.98	Moderate Drought
2002	-0.65	Mild Drought
2003	-0.48	Incipient Drought
2004	-0.72	Mild Drought
2005	-0.58	Incipient Drought
2006	-0.83	Mild Drought
2007	-0.42	Incipient Drought
2008	-0.74	Mild Drought
2009	-0.66	Mild Drought
2010	-0.62	Mild Drought
2011	-0.37	Incipient Drought
2012	-0.30	Incipient Drought
2013	-0.36	Incipient Drought
2014	-0.85	Mild Drought
2015	-0.15	Near Normal
2016	-0.40	Incipient Drought
2017	-0.21	Near Normal
2018	-0.24	Near Normal
2019	-0.13	Near Normal
2020	-0.42	Incipient Drought



Legend





Legend



Extreme Drought (-1.5 or less)



Severe Drought (-1.2 to -1.49)



Moderate Drought (-0.9 to -1.19)



Mild Drought (-0.6 to -0.89)



Incipient Drought (-0.3 to -0.59)



Near Normal (0.29 to -0.29)



Incipient Wet Spell (0.3 to 0.59)



Slightly Wet (0.6 to 0.89)



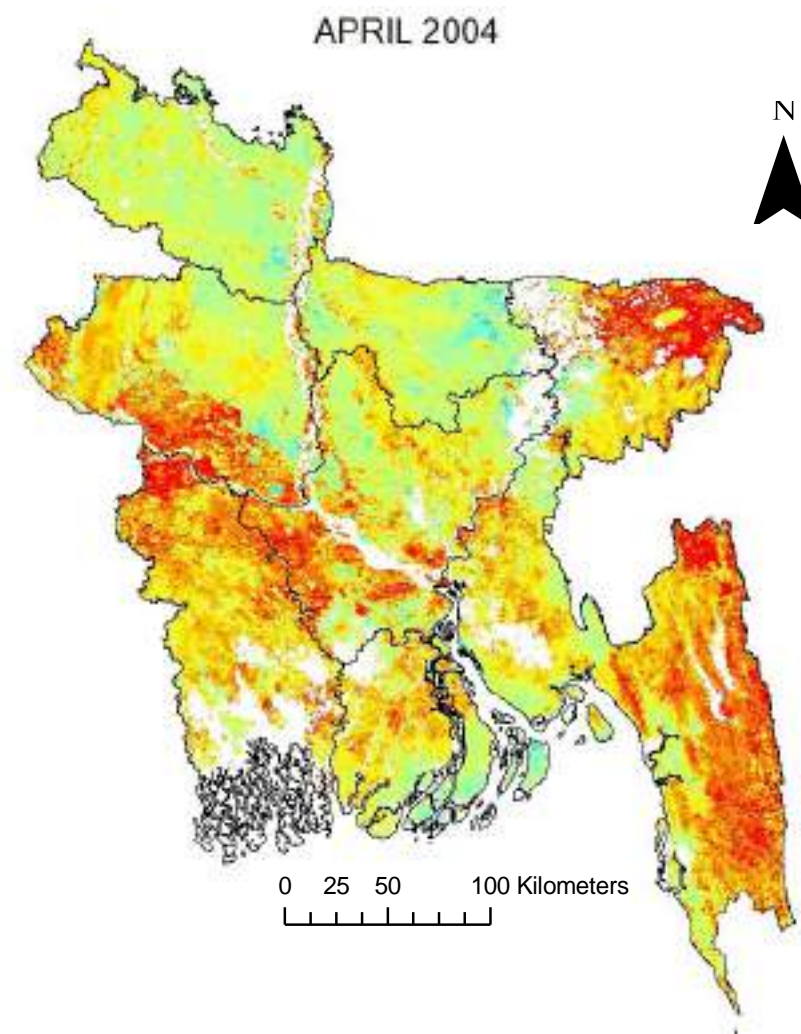
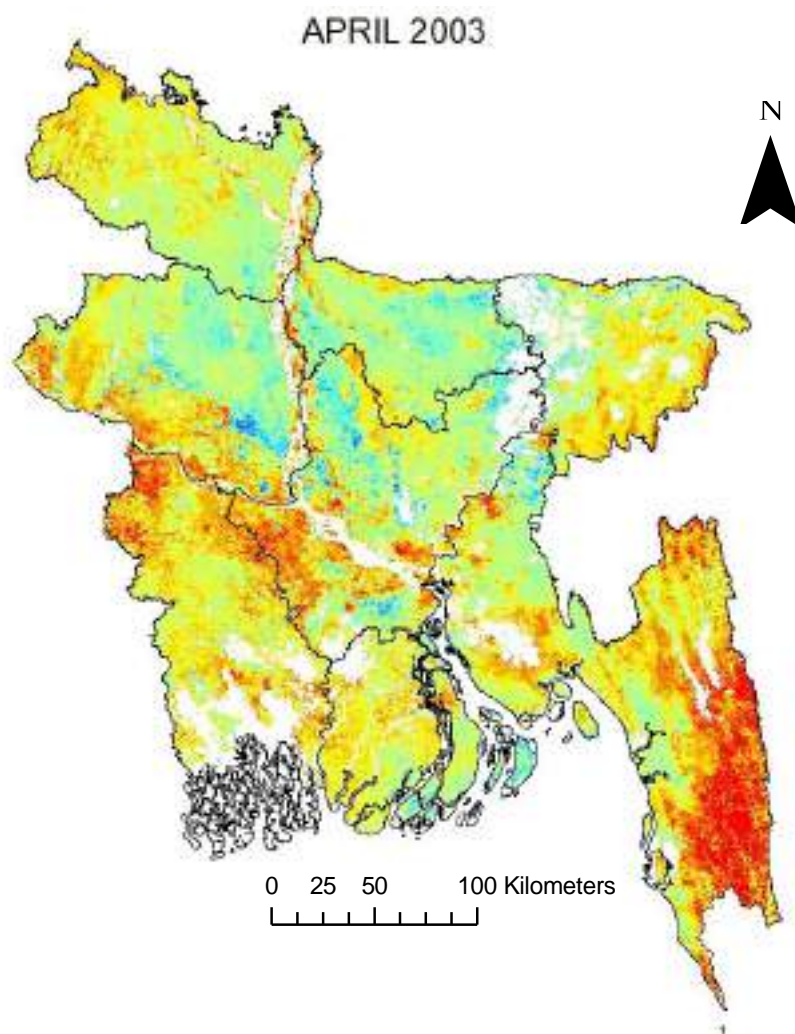
Moderately Wet (0.9 to 1.19)



Very Wet (1.2 to 1.49)



Extremely Wet (1.5 or greater)

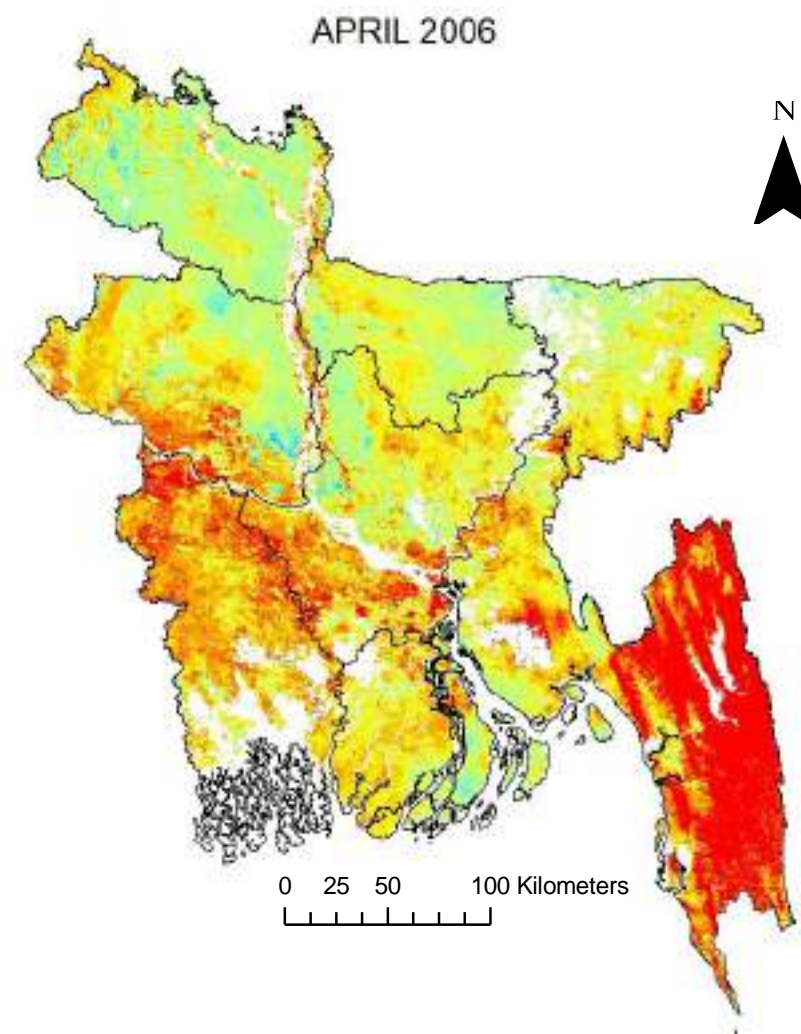
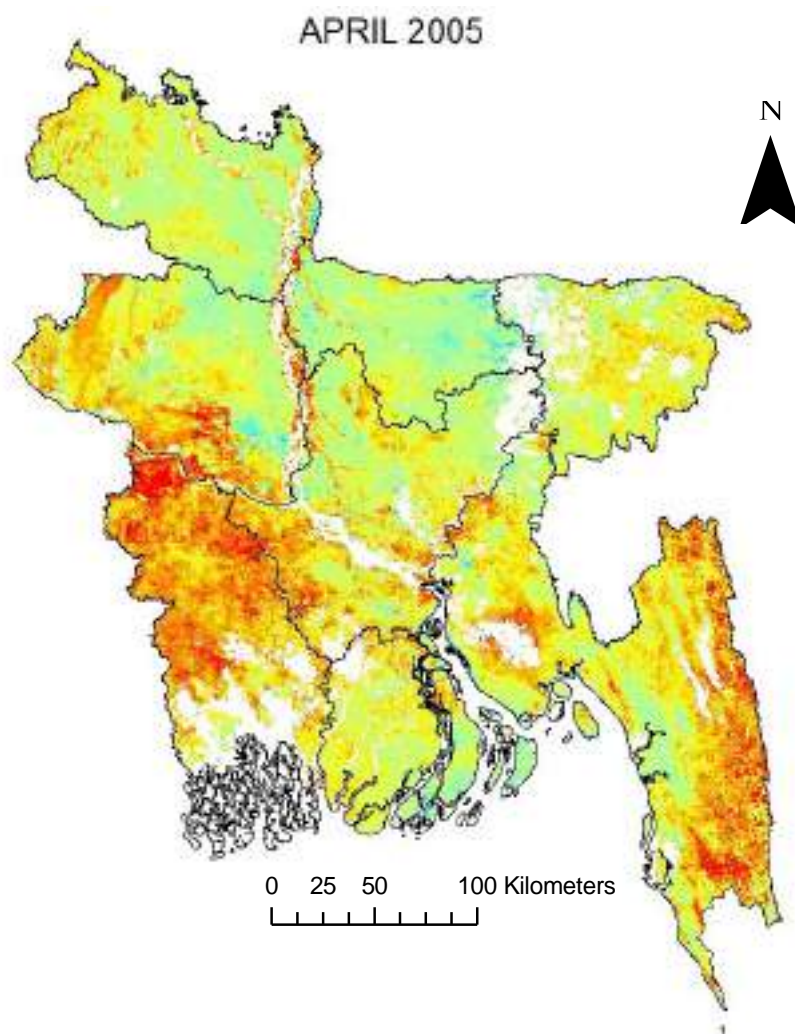


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)





- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)




- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

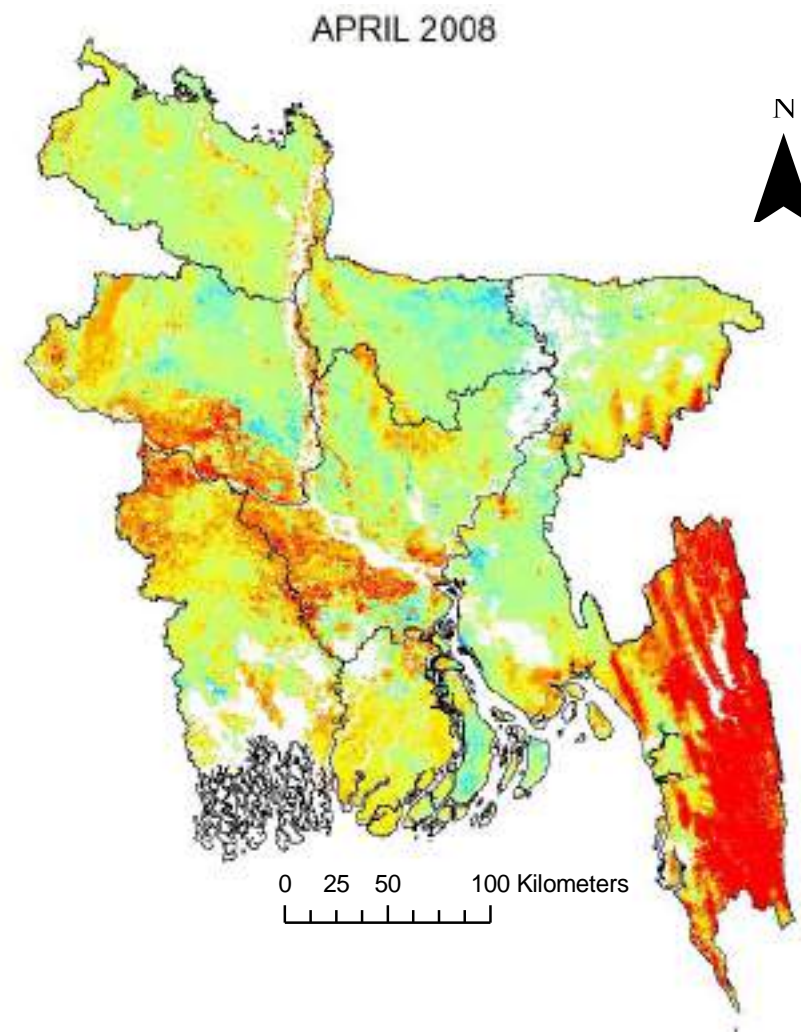
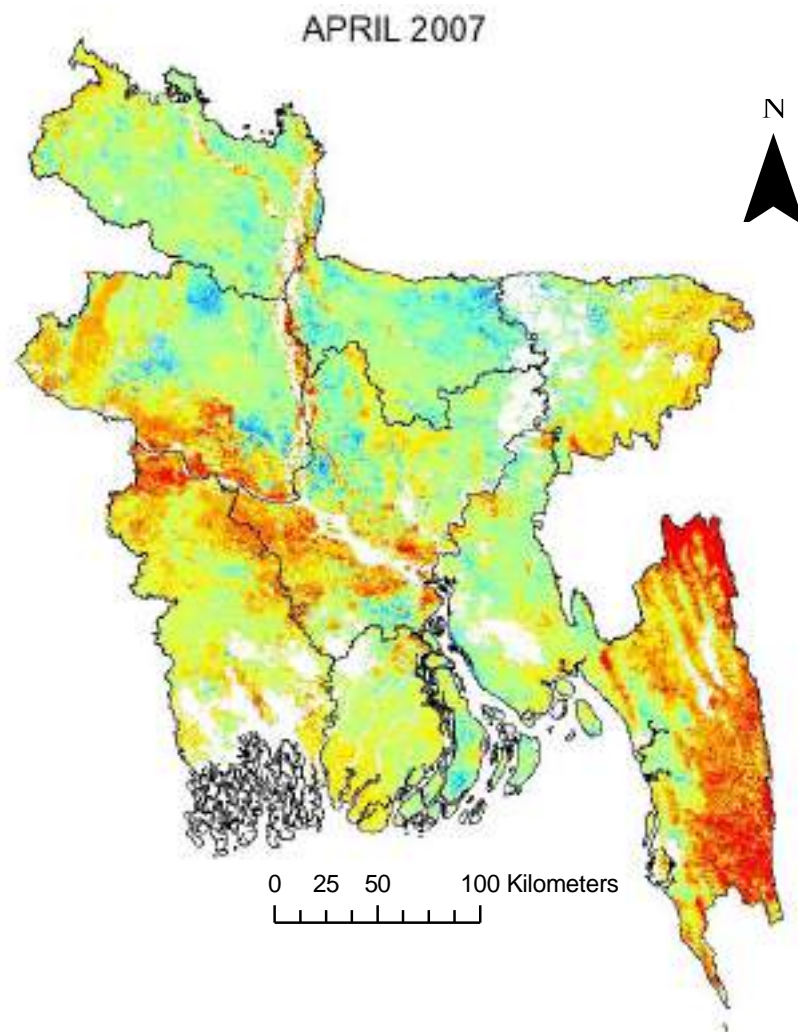


Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

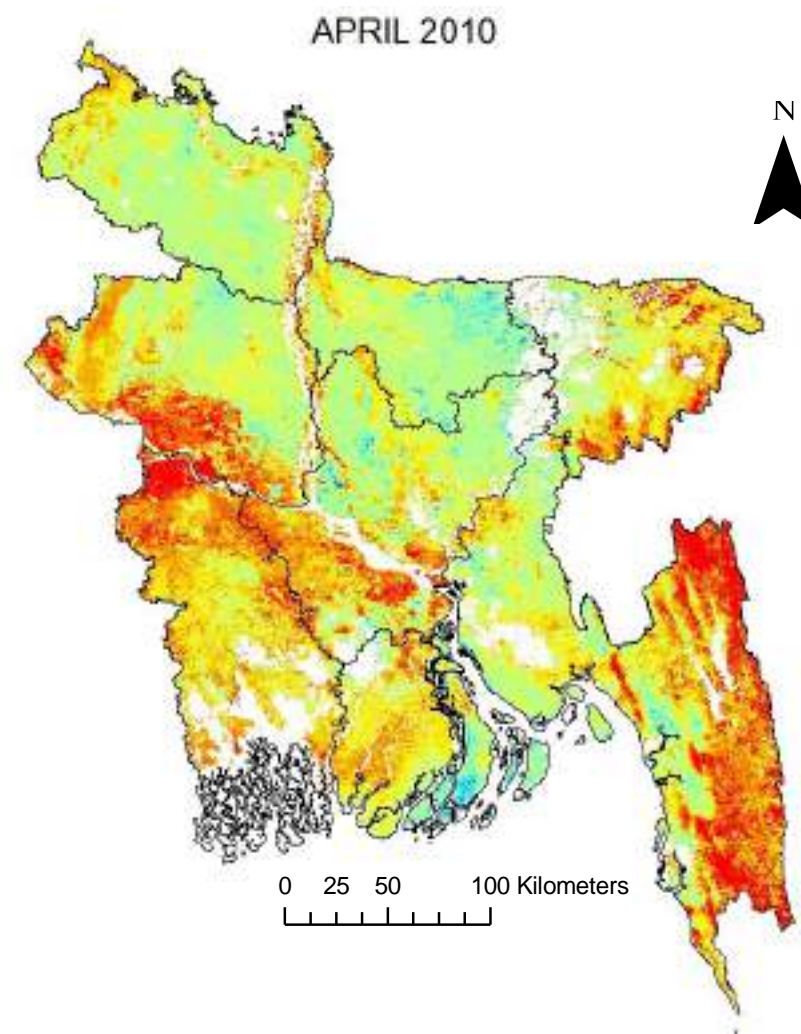
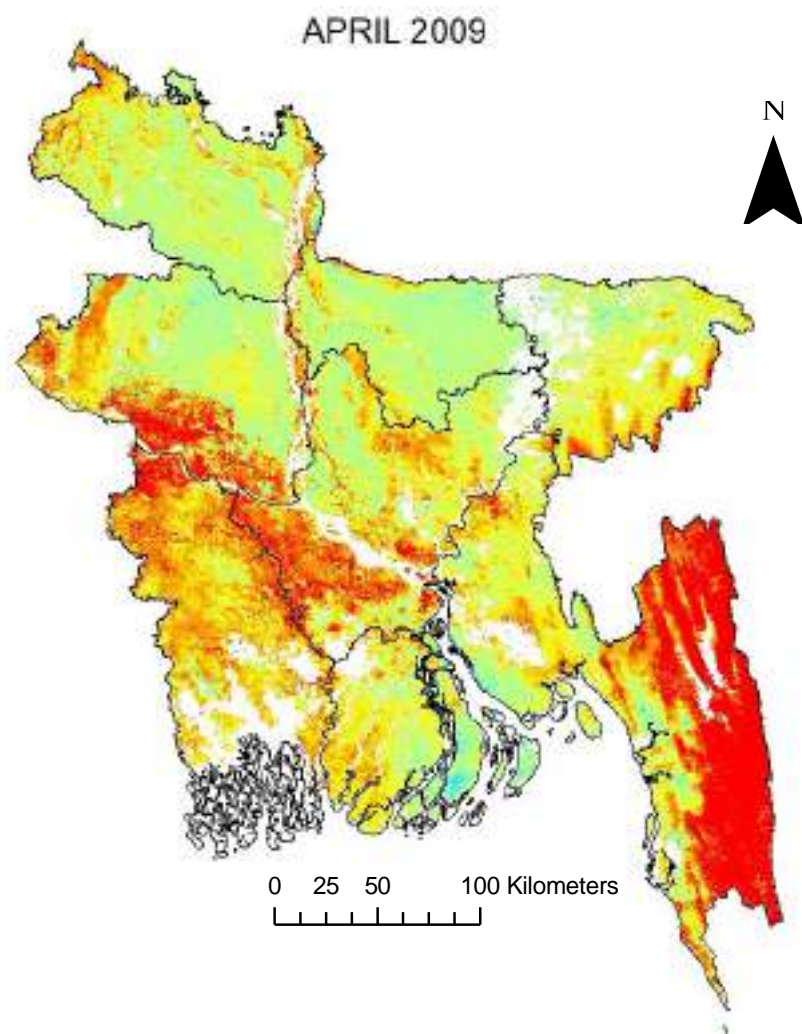


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

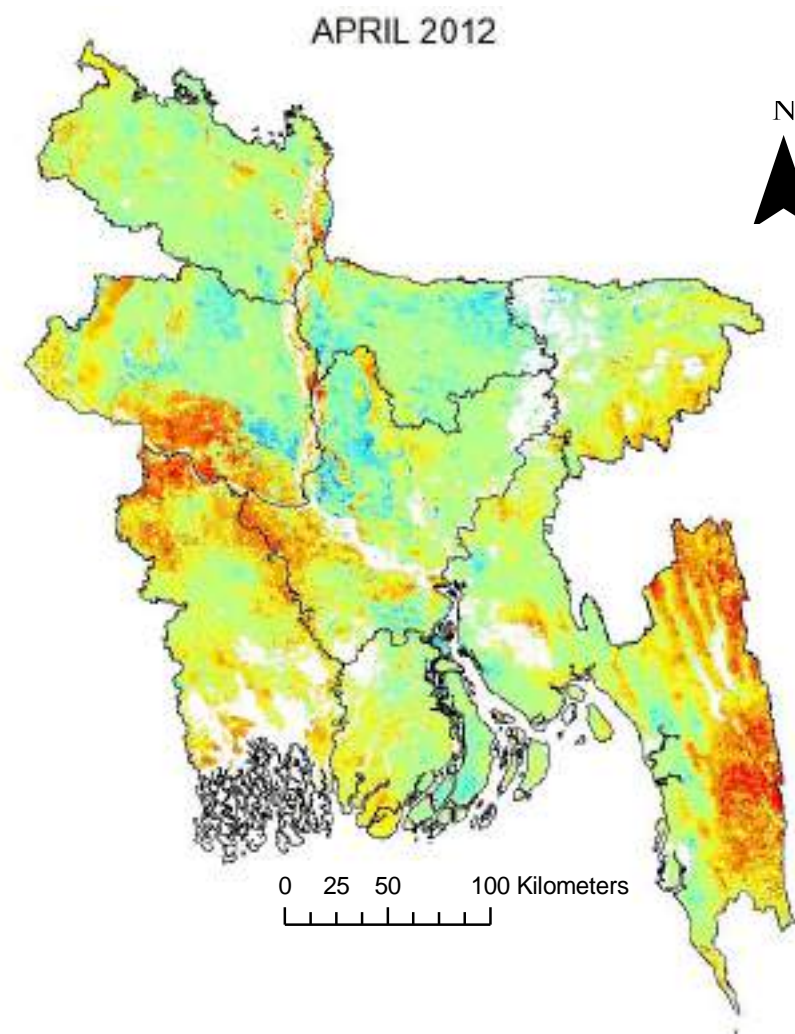
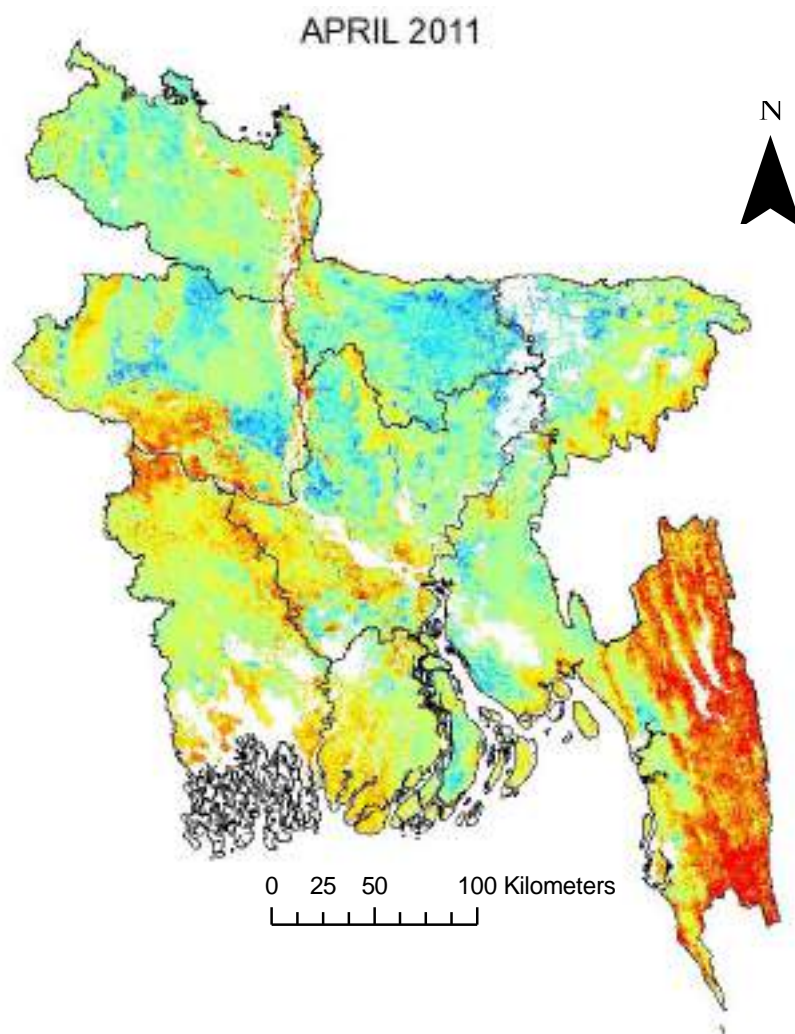


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)





- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)




- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

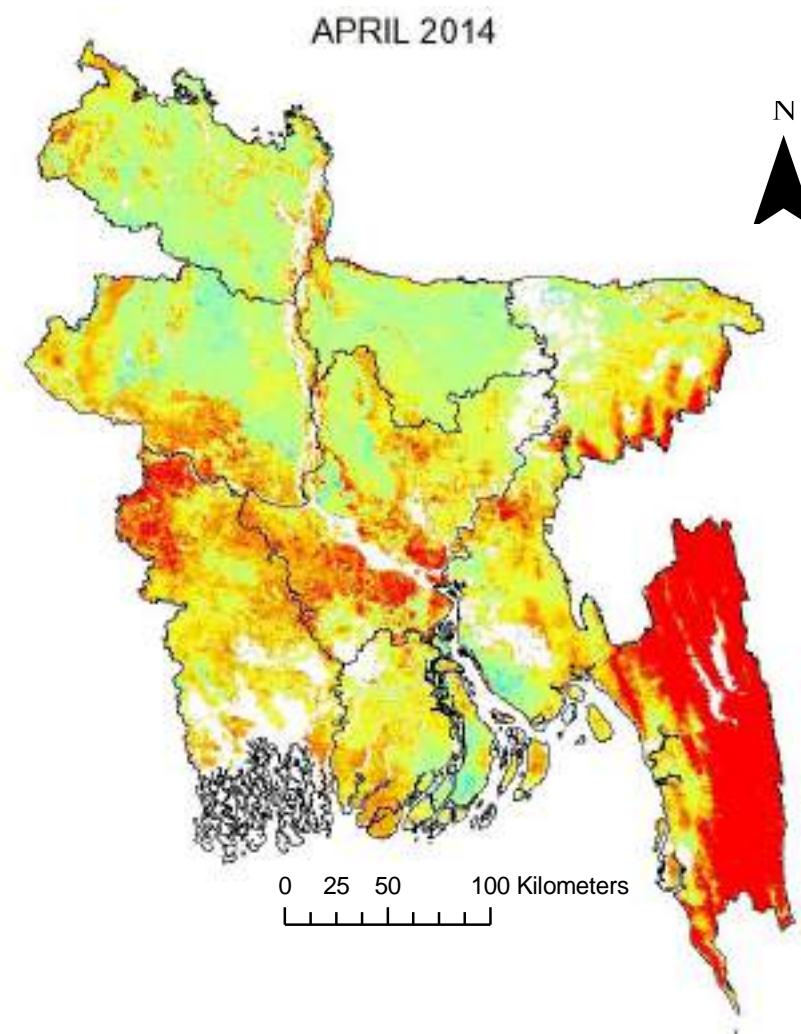
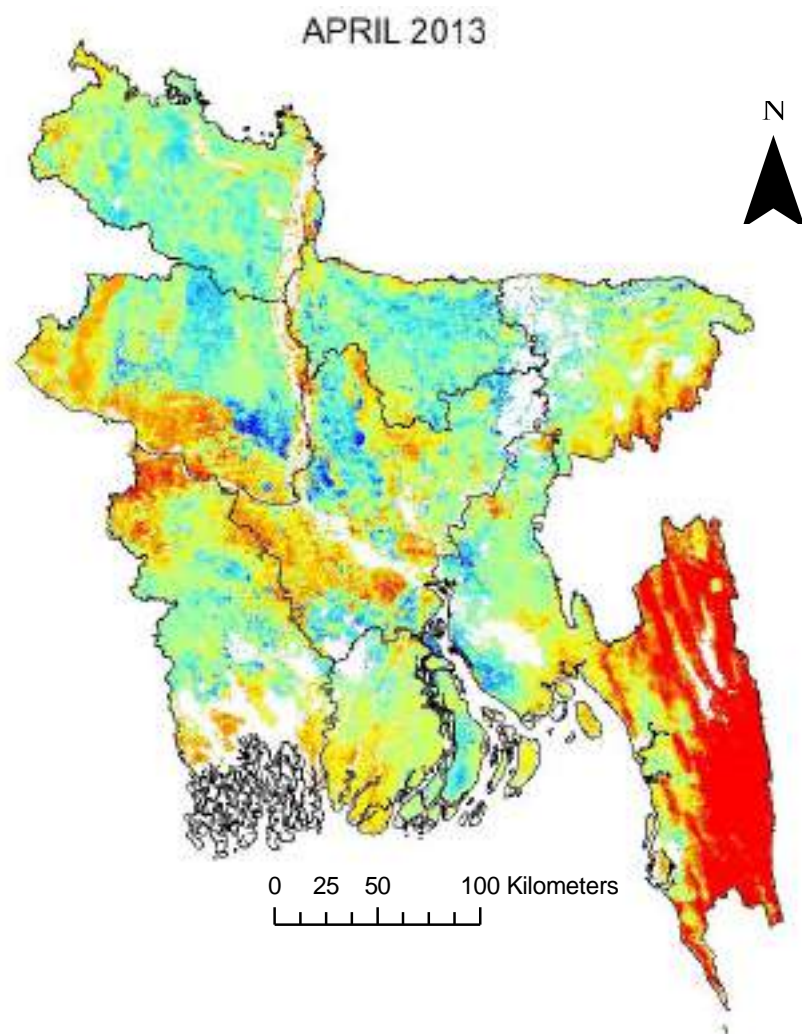


Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

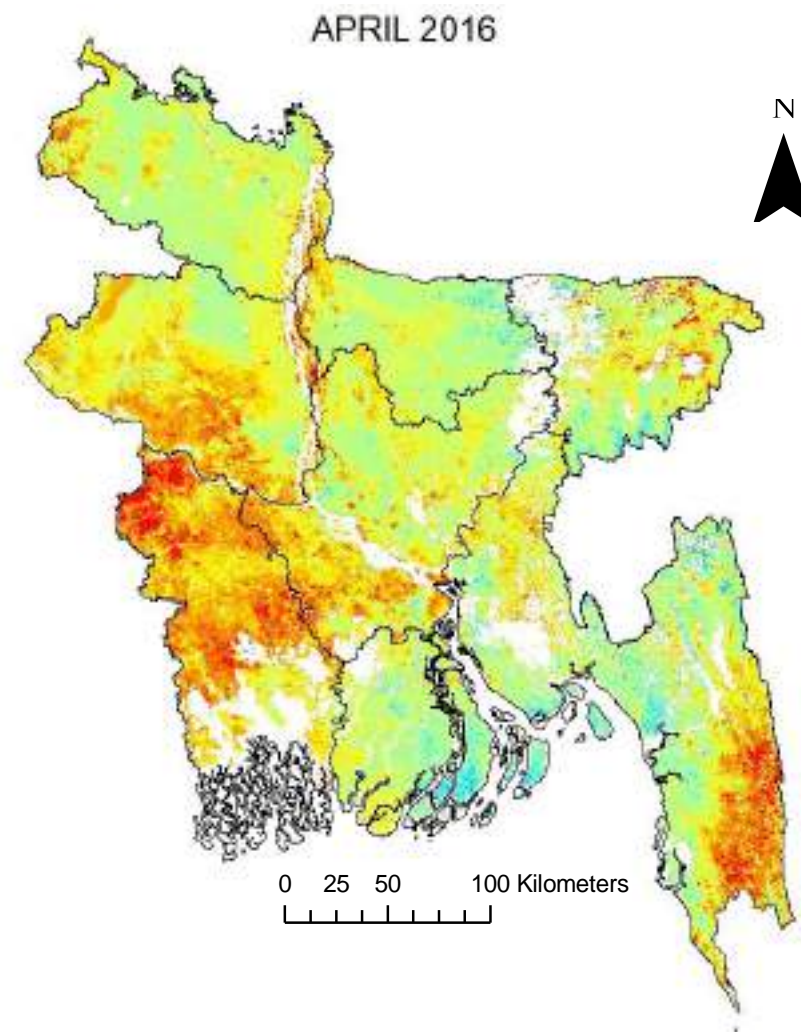
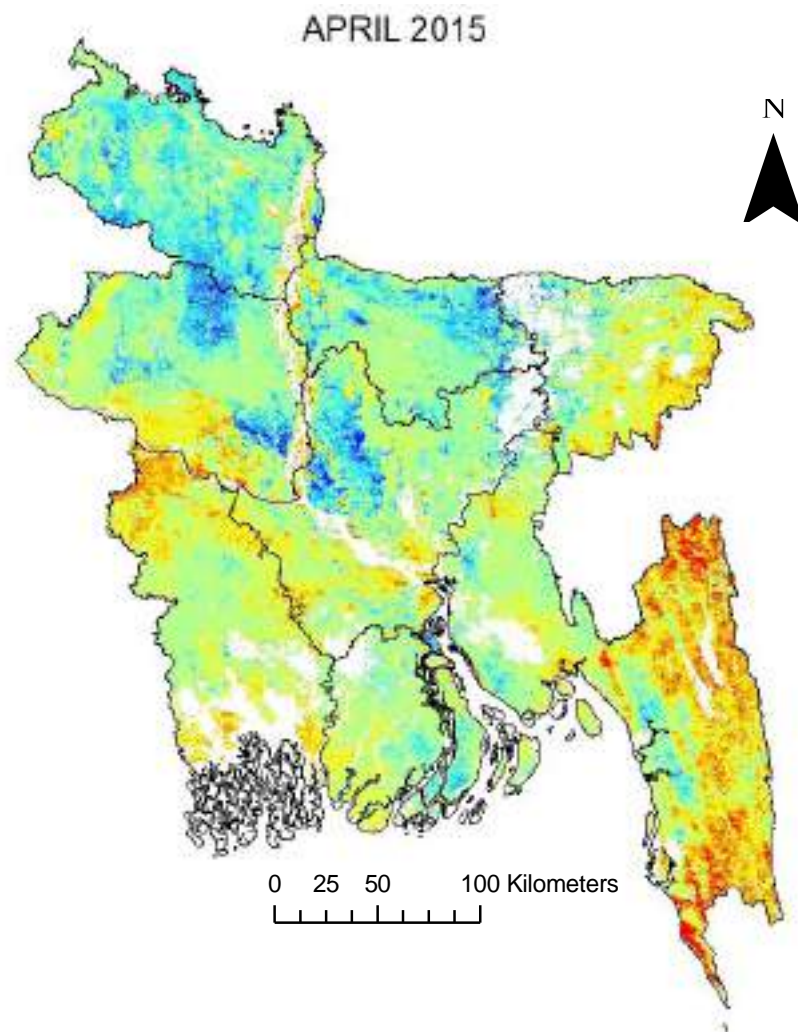


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

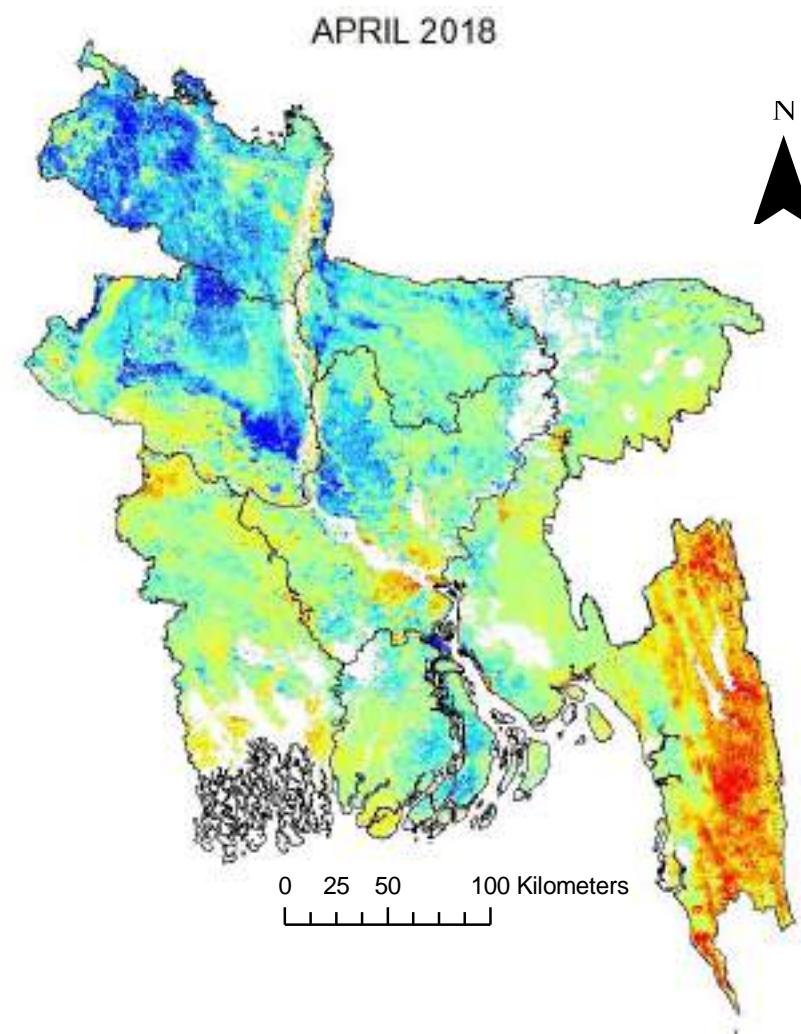
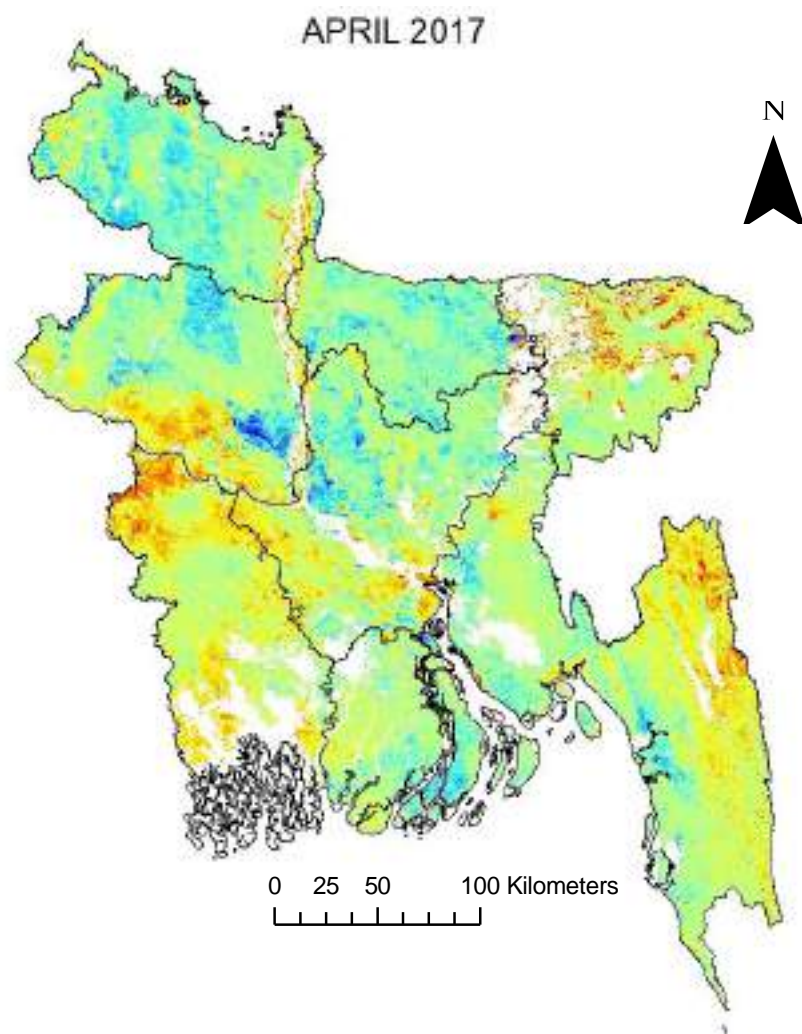


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

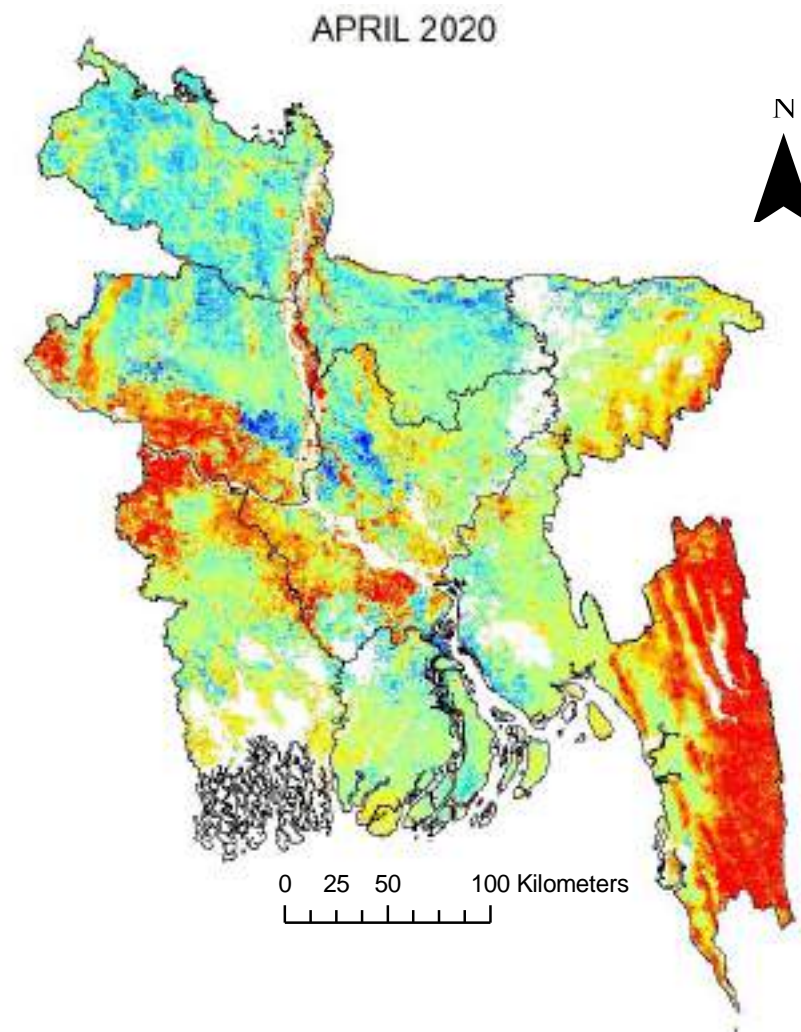
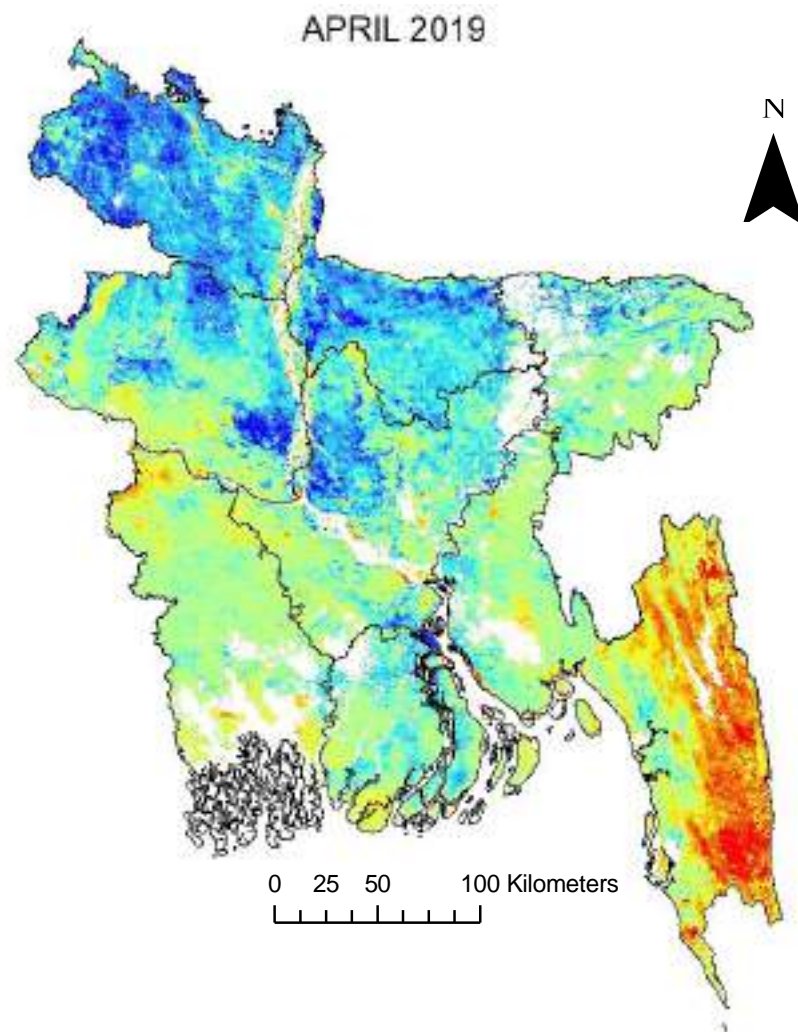


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)


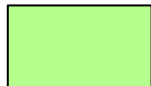


- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)




- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend

-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

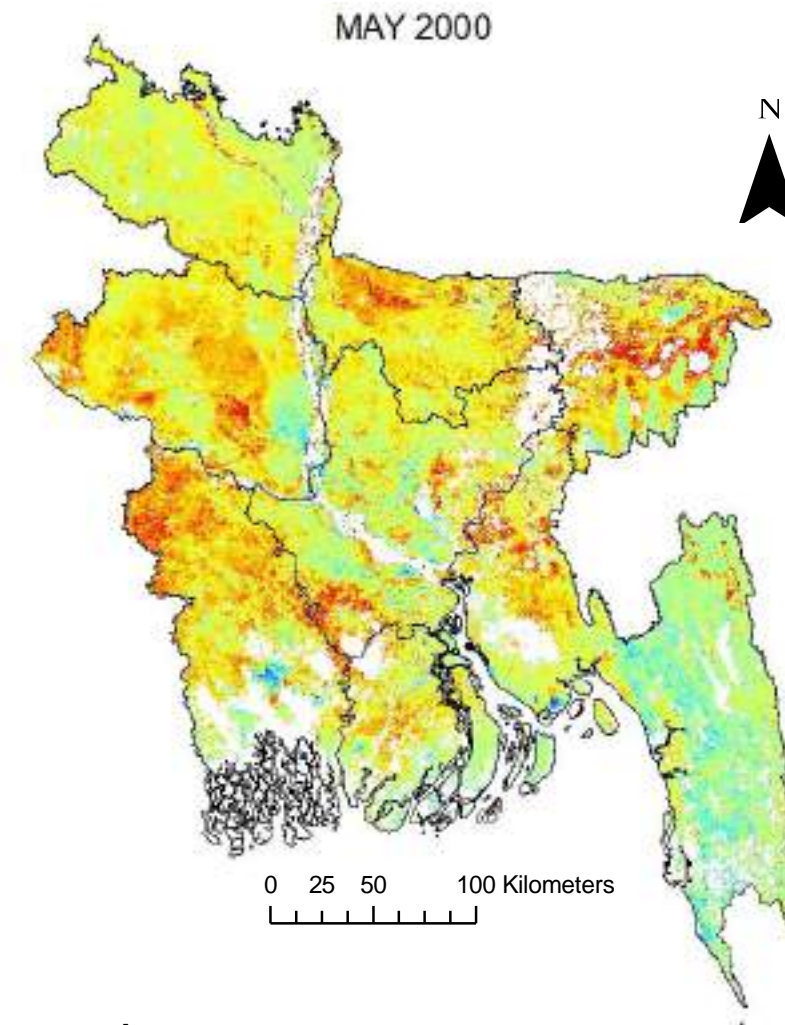
-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

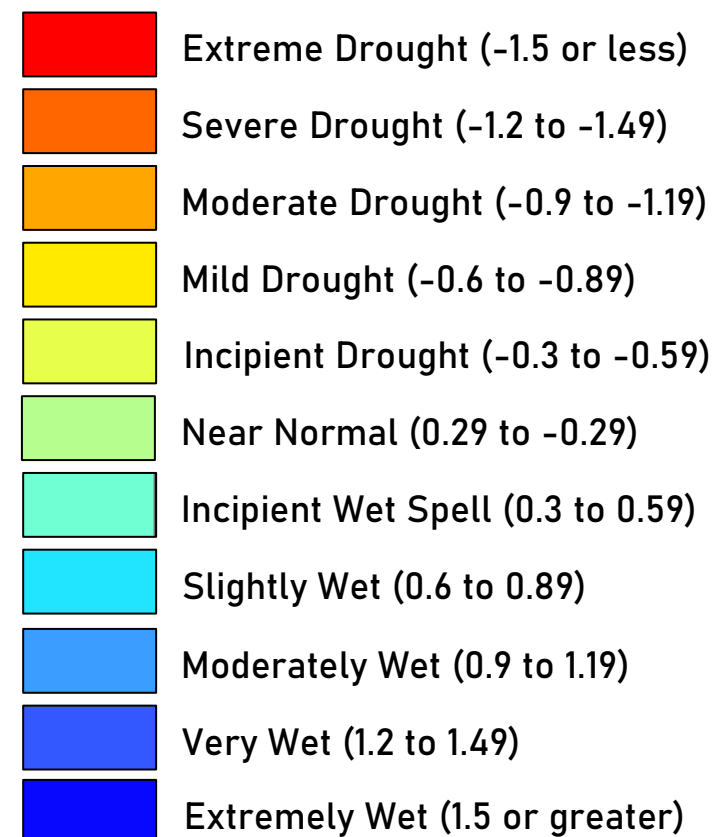
May DSI Maps

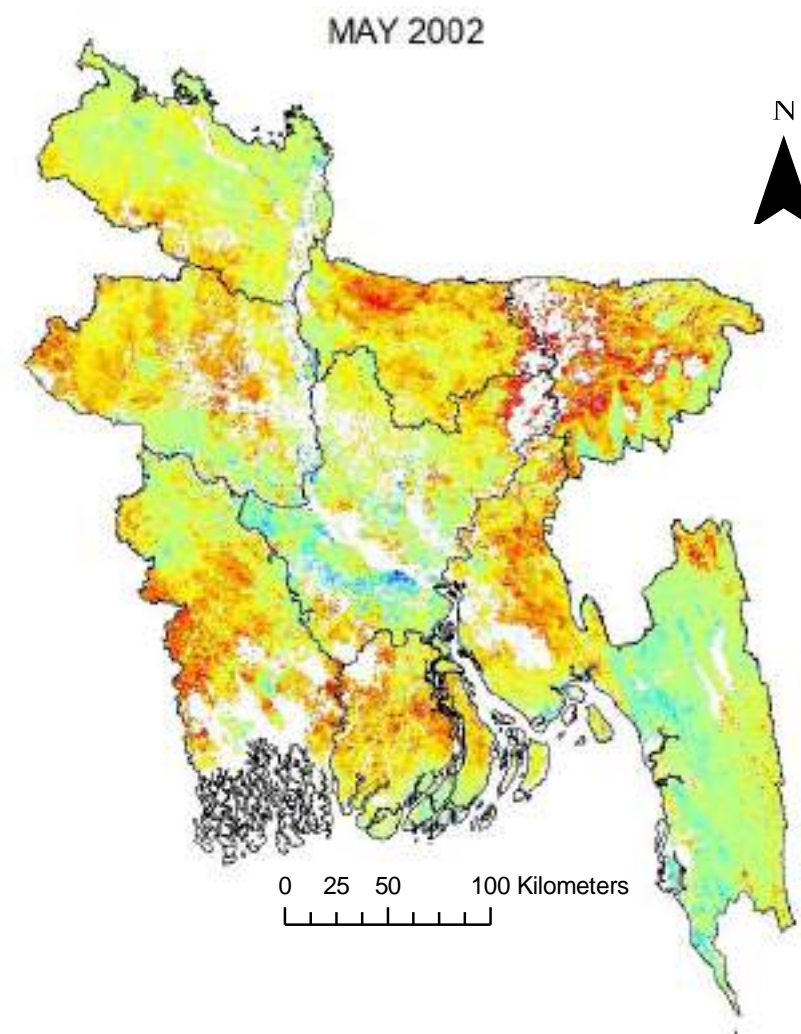
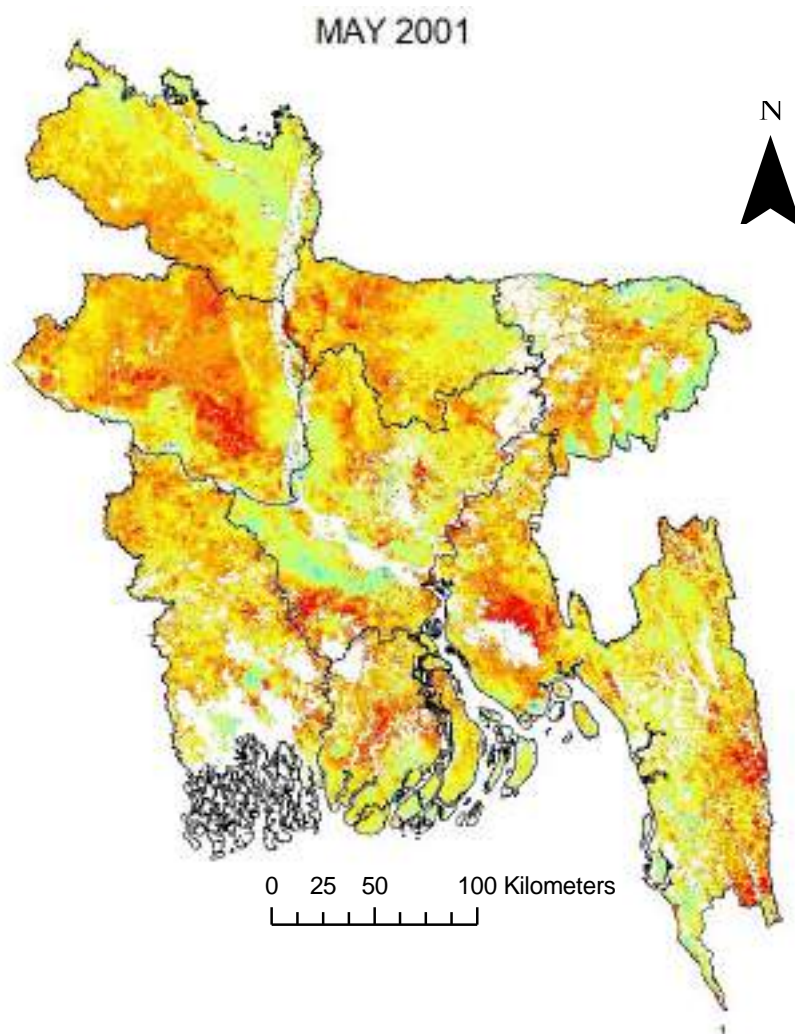
Drought conditions in May can range from mild to near-normal. This pre-monsoon month is characterized by incipient drought to near-normal drought.

Mean May DSI Values		
Years	Values	Drought Condition
2000	-0.38	Incipient Drought
2001	-0.51	Incipient Drought
2002	-0.43	Incipient Drought
2003	-0.69	Mild Drought
2004	-0.63	Mild Drought
2005	-0.47	Incipient Drought
2006	-0.42	Incipient Drought
2007	-0.28	Near Normal
2008	-0.52	Incipient Drought
2009	-0.46	Incipient Drought
2010	-0.57	Incipient Drought
2011	-0.21	Near Normal
2012	-0.46	Incipient Drought
2013	0.08	Near Normal
2014	-0.56	Incipient Drought
2015	-0.09	Near Normal
2016	-0.15	Near Normal
2017	0.19	Near Normal
2018	-0.02	Near Normal
2019	0.18	Near Normal
2020	-0.16	Near Normal



Legend



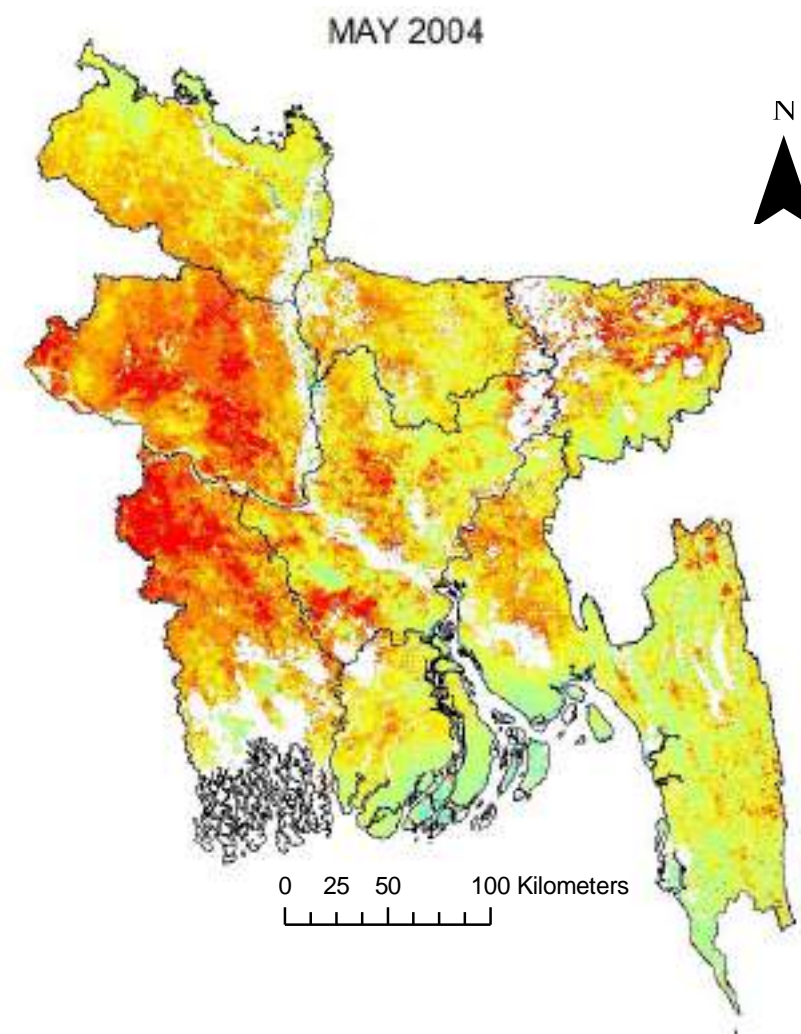
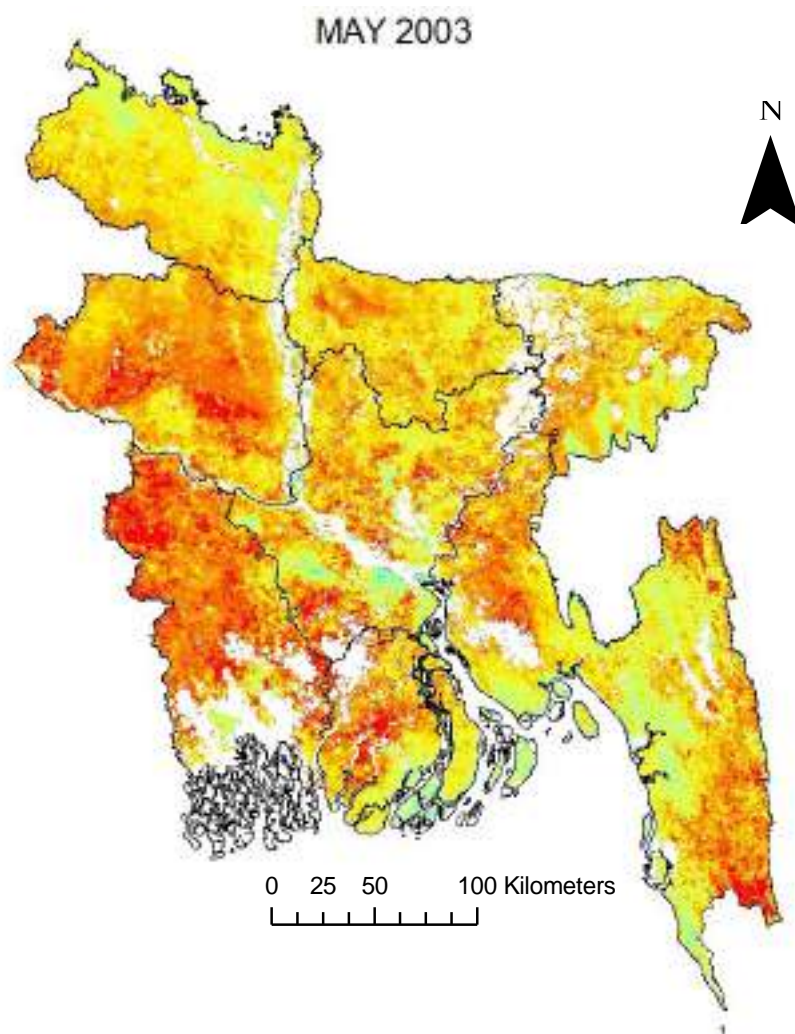


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

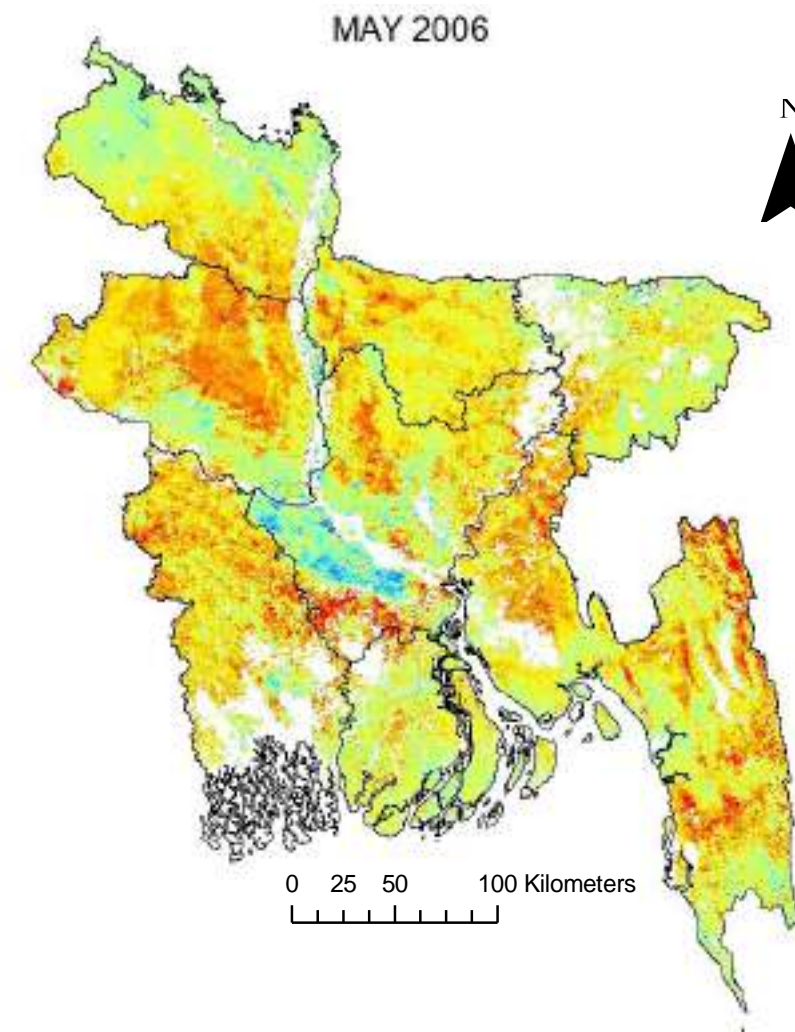
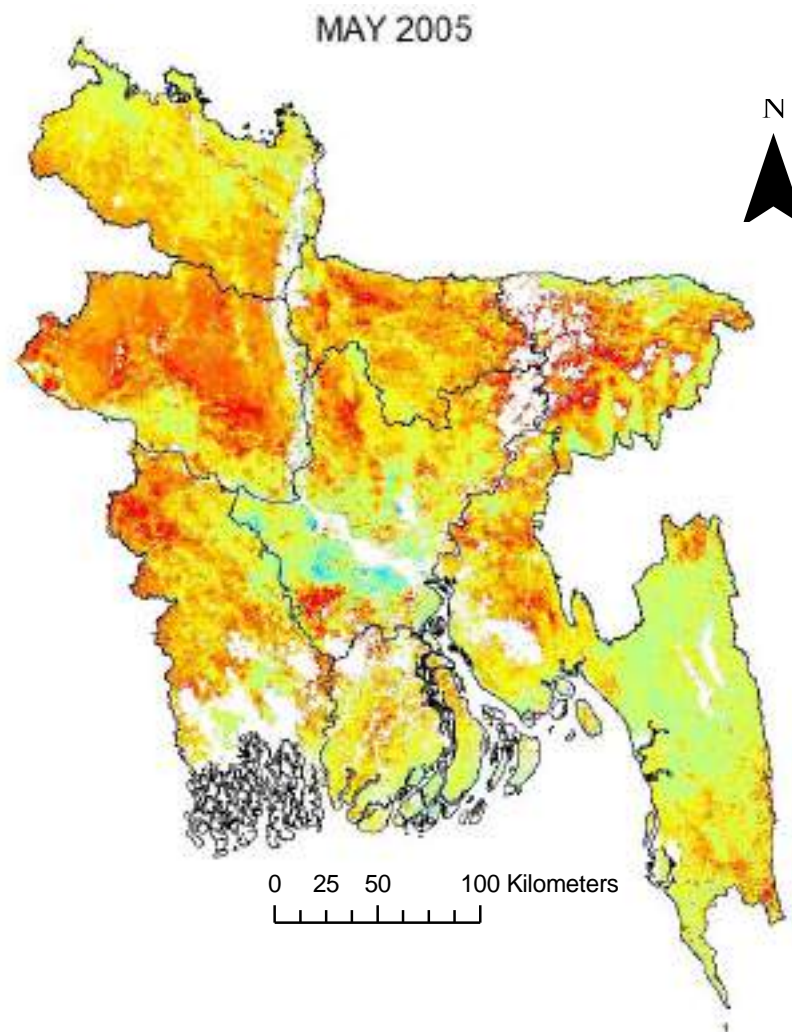


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

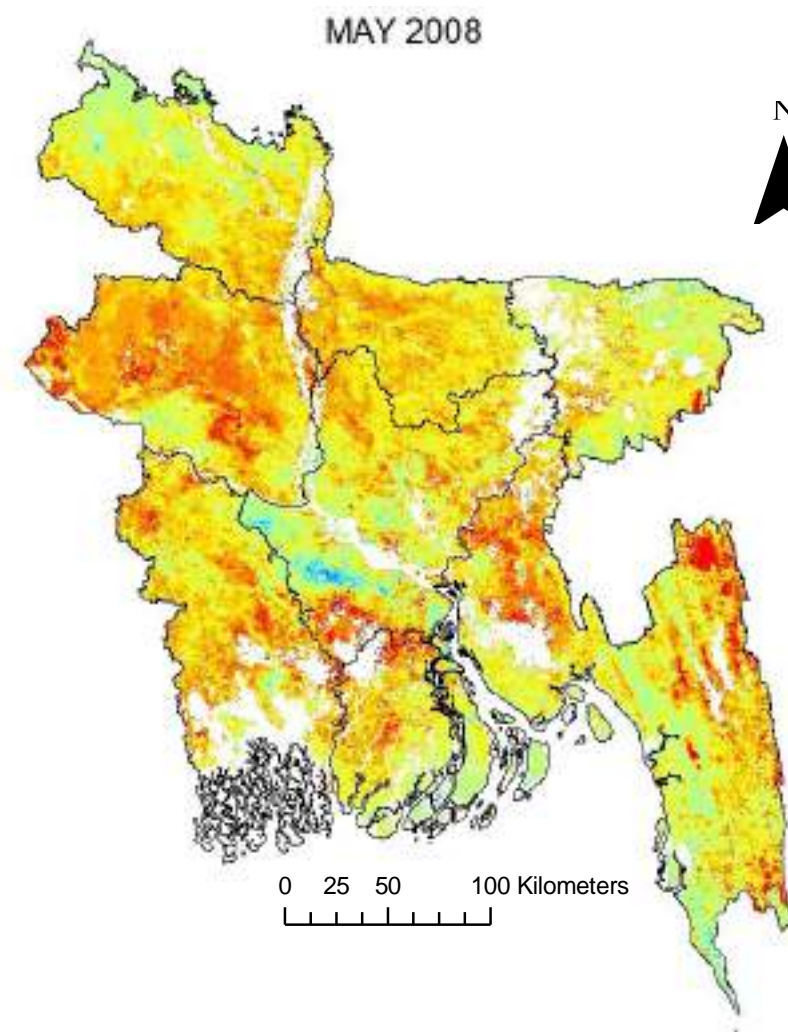
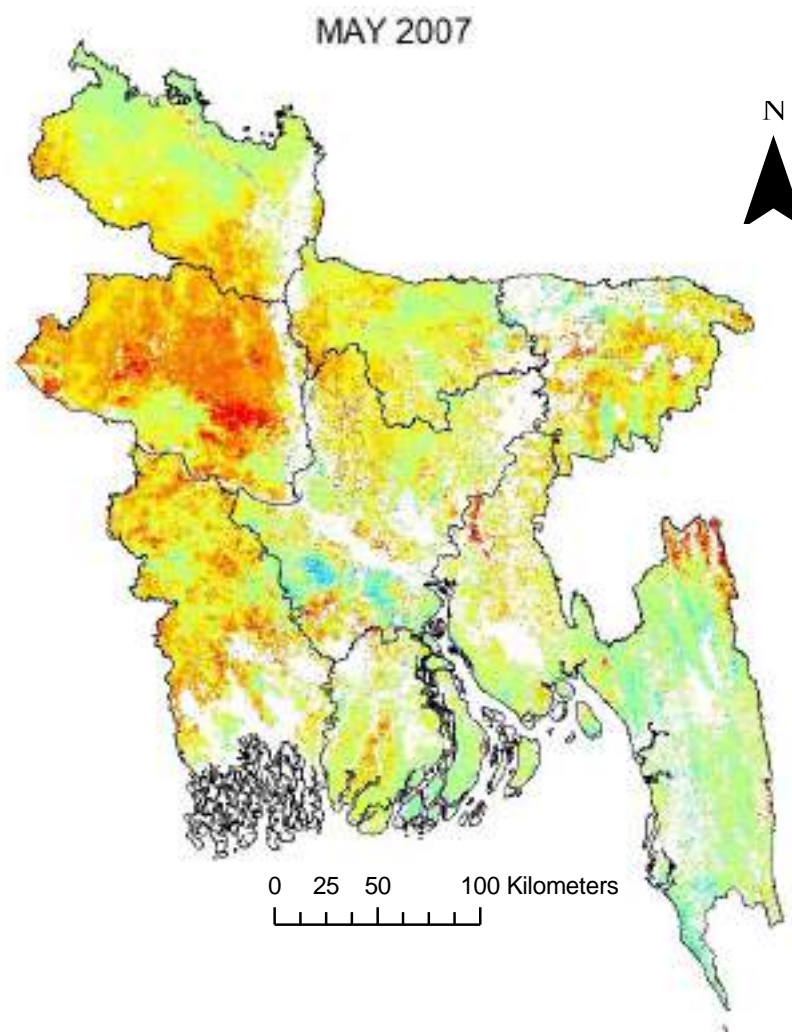


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

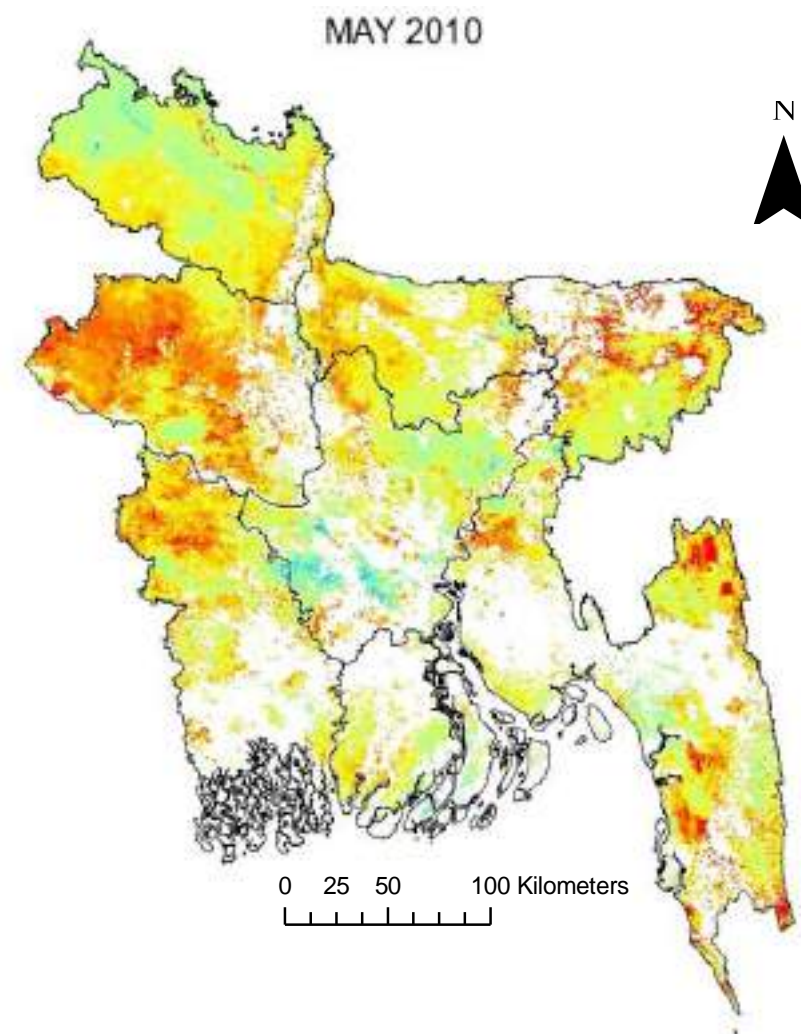
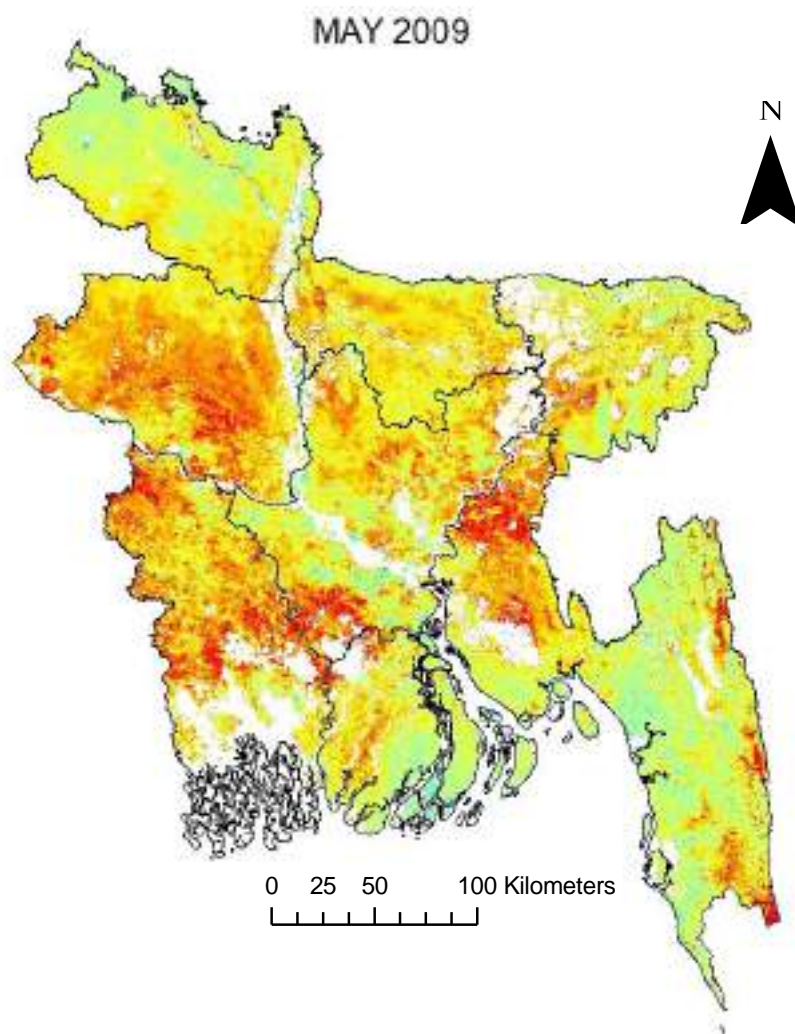


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

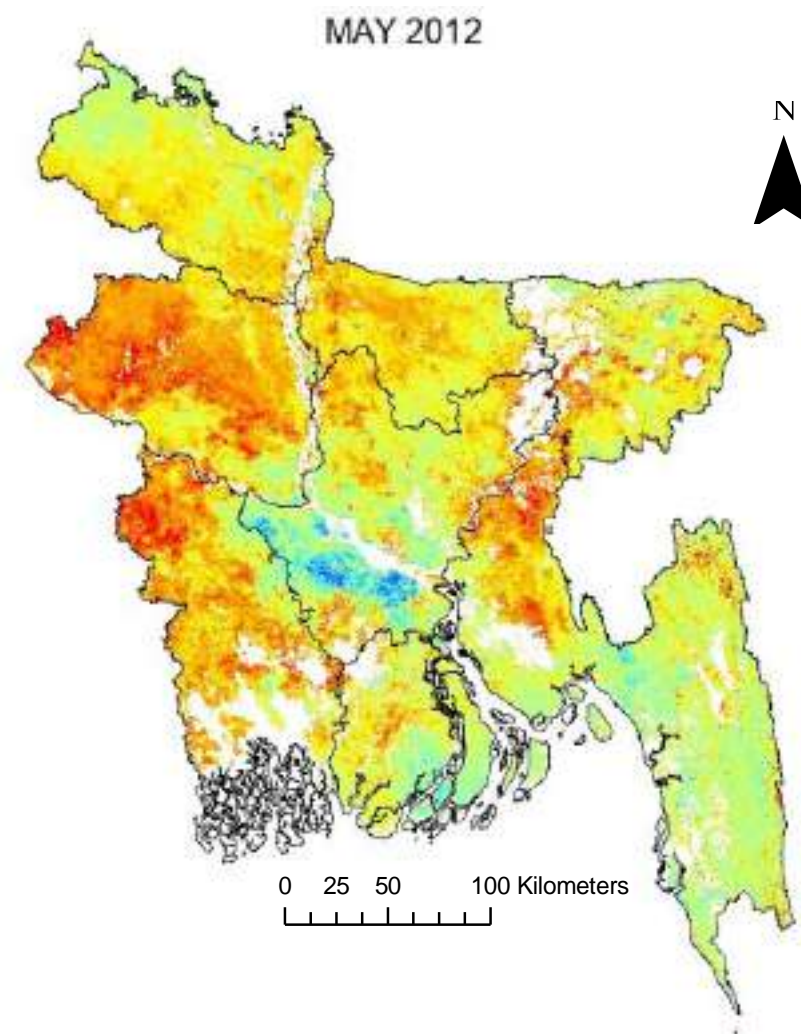
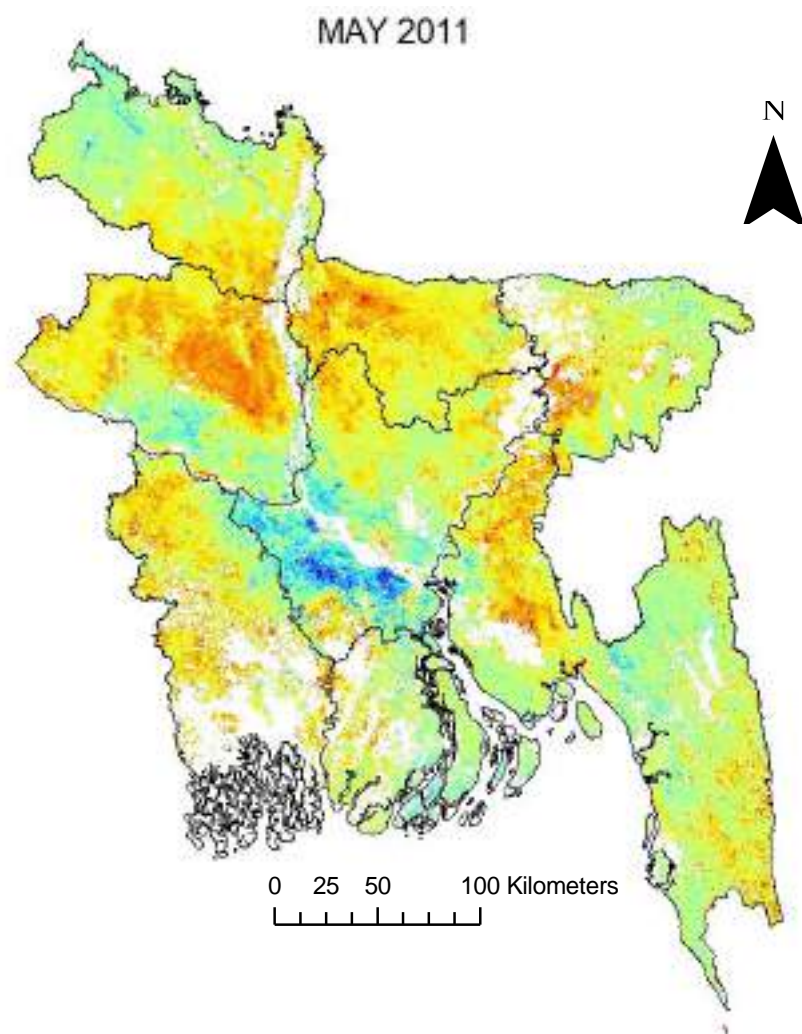


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

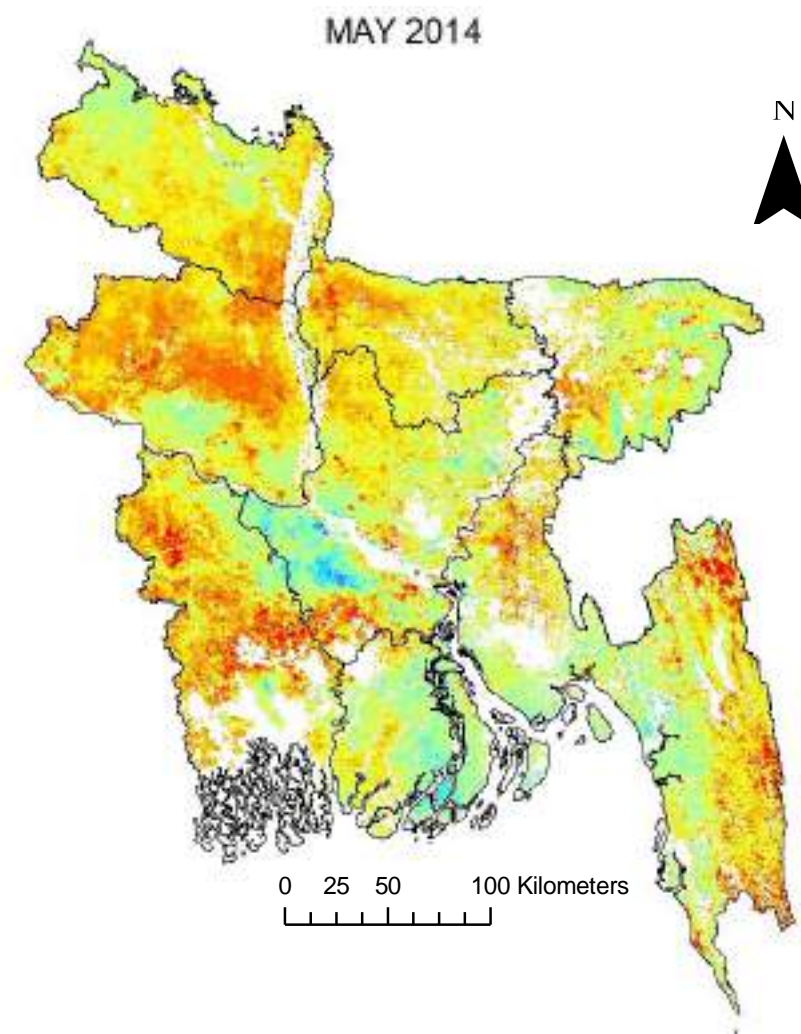
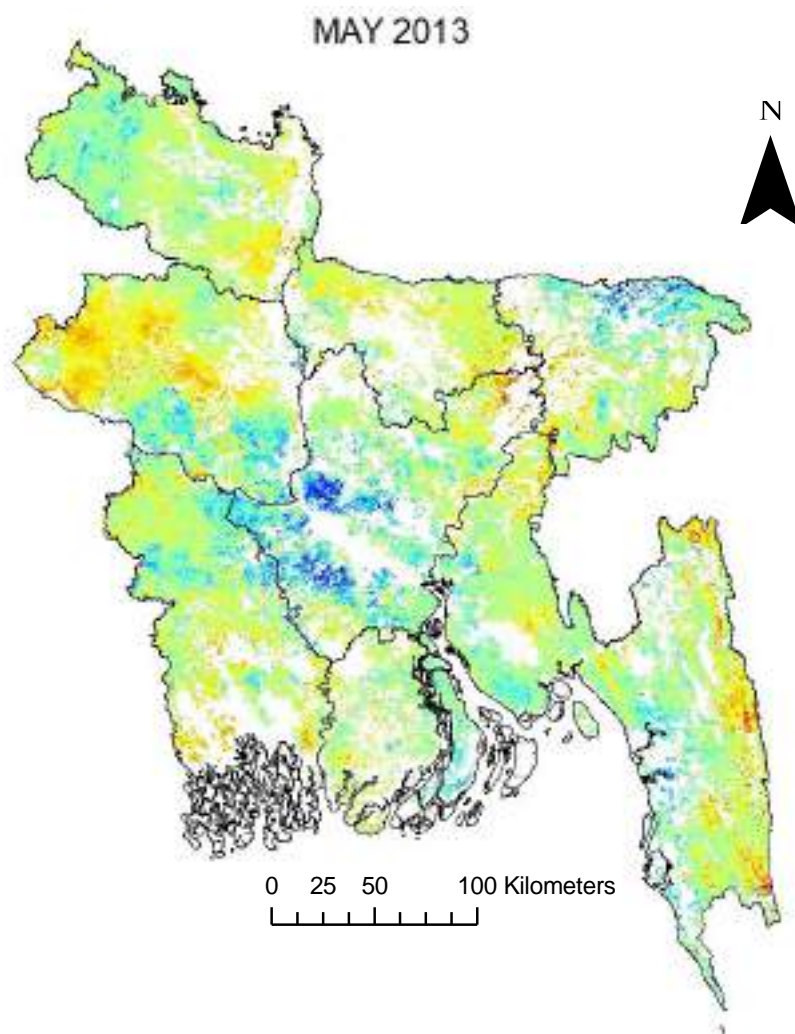


Legend

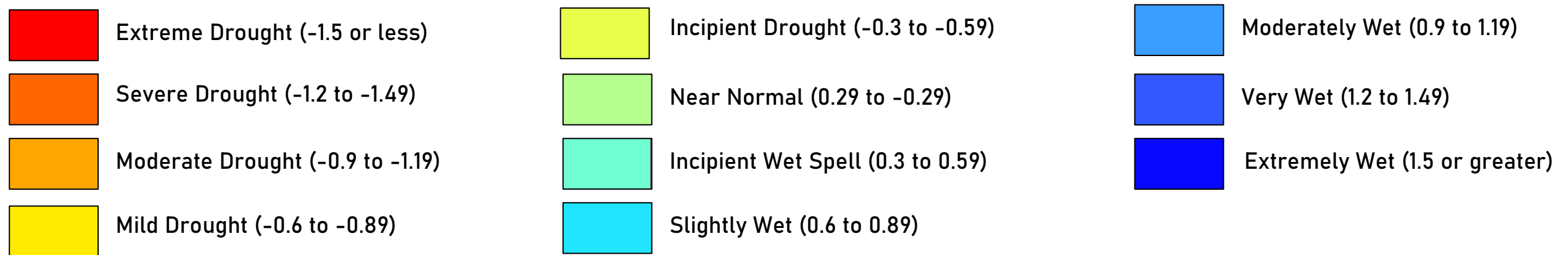
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

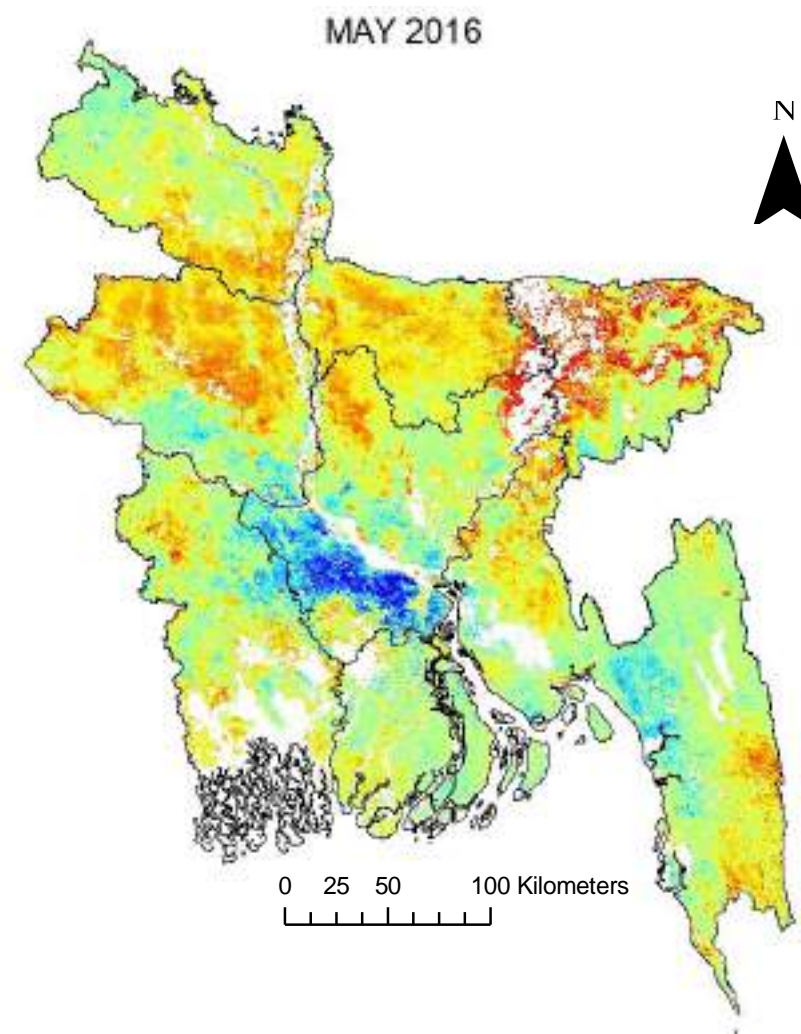
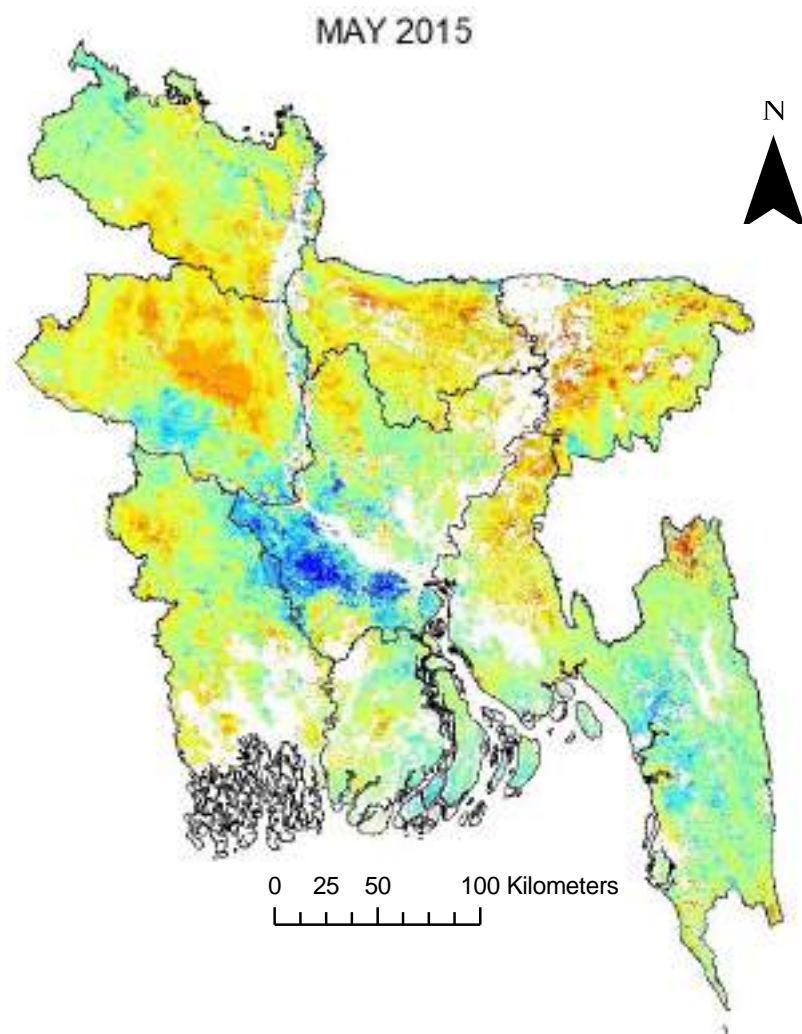
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)











Legend

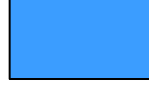




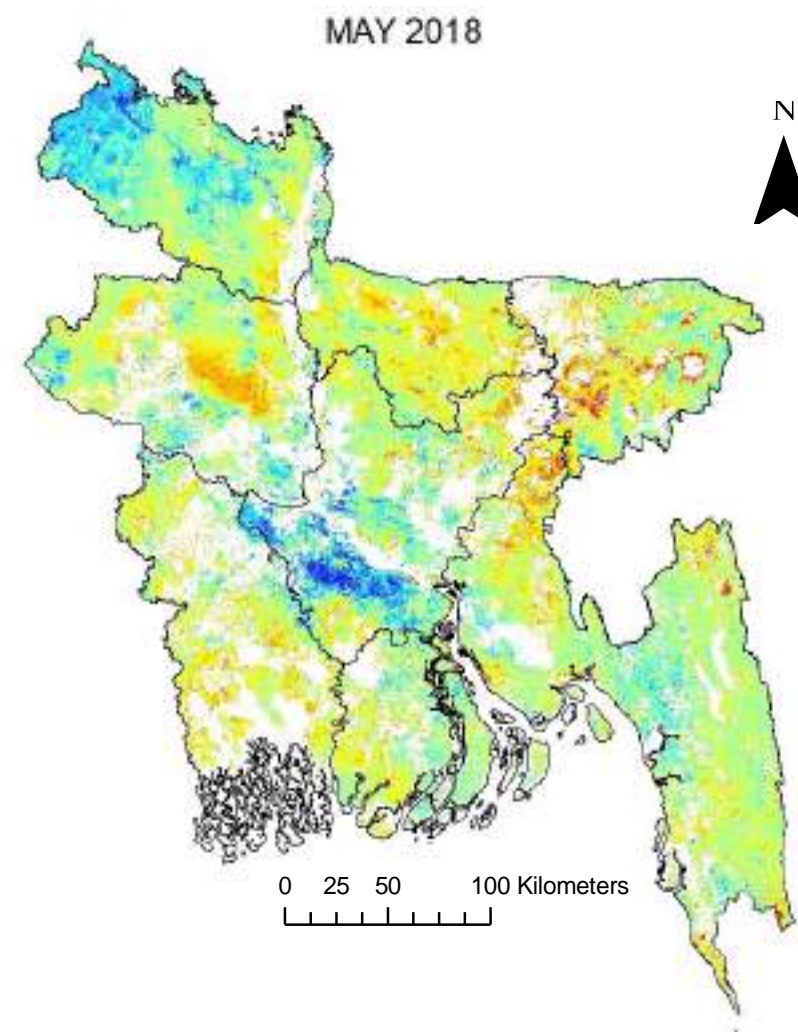
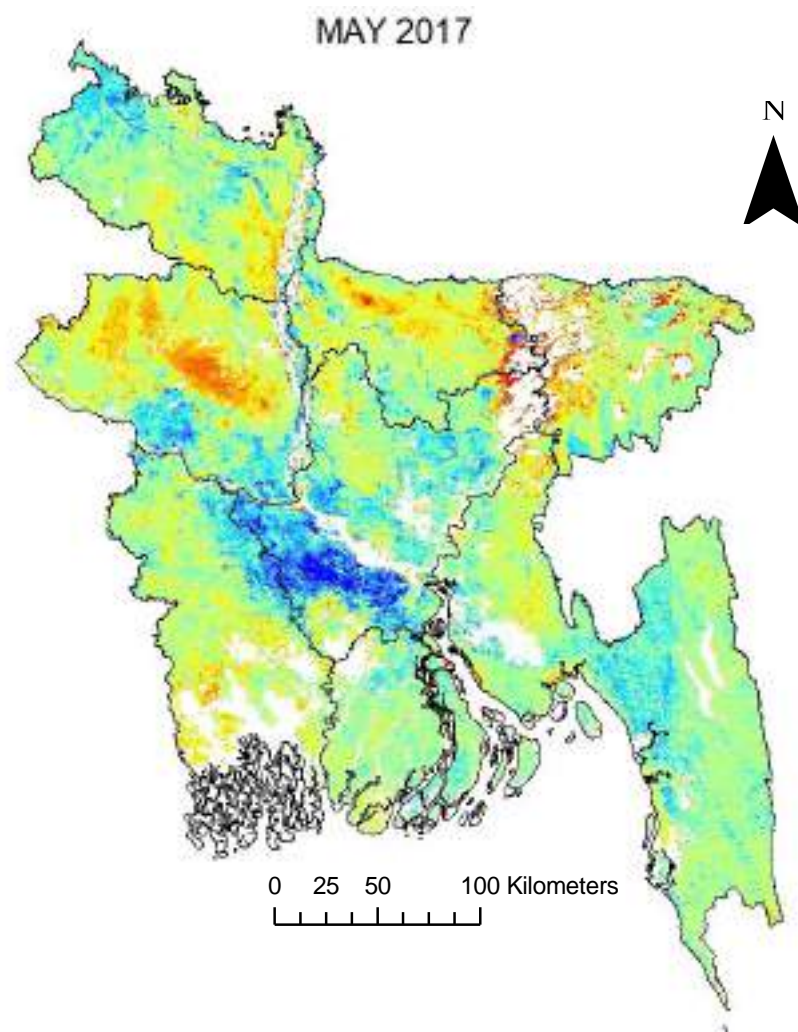


Legend

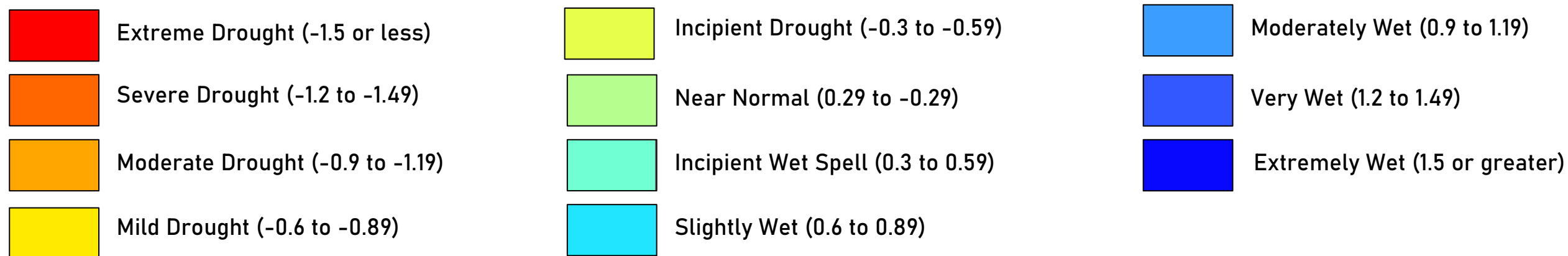
-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

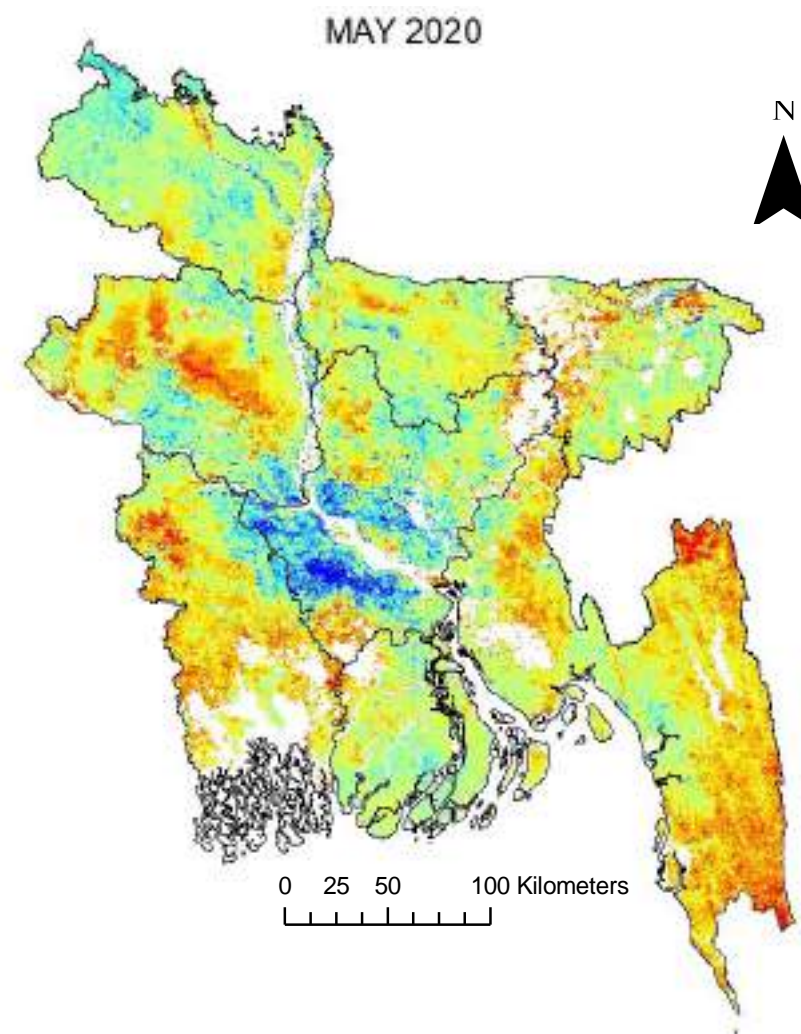
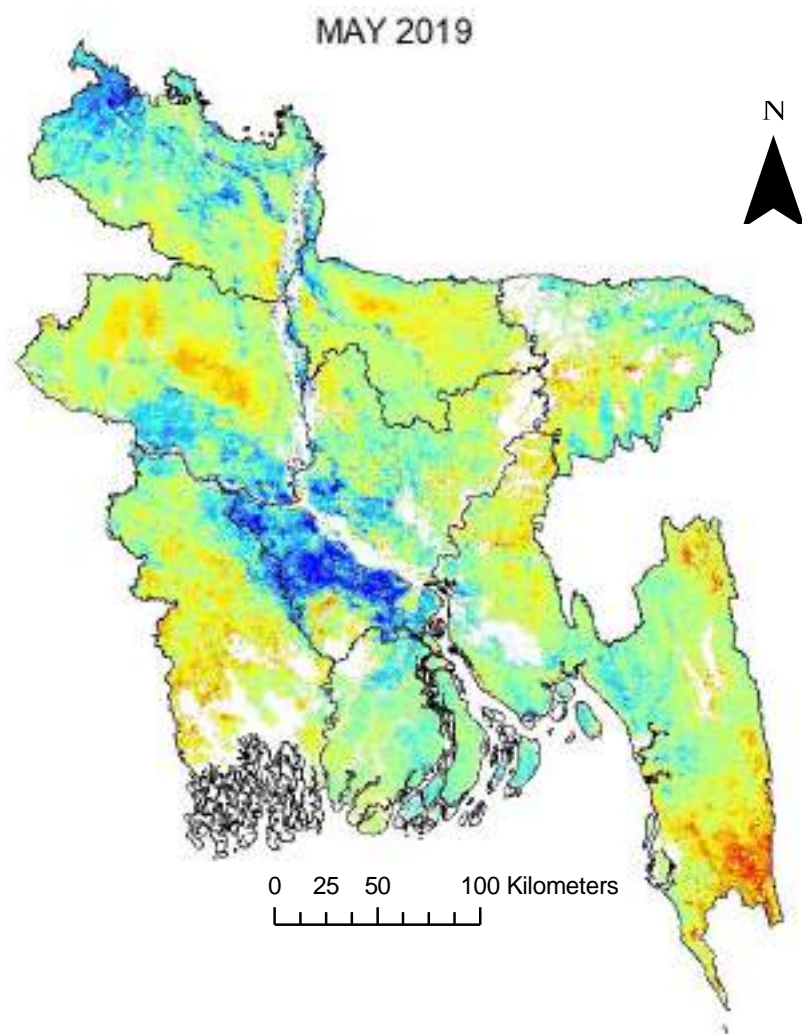
-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)

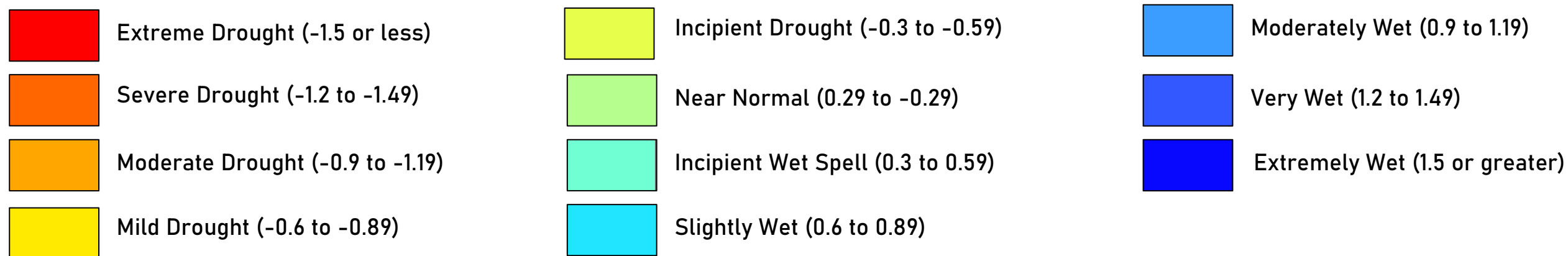


Legend





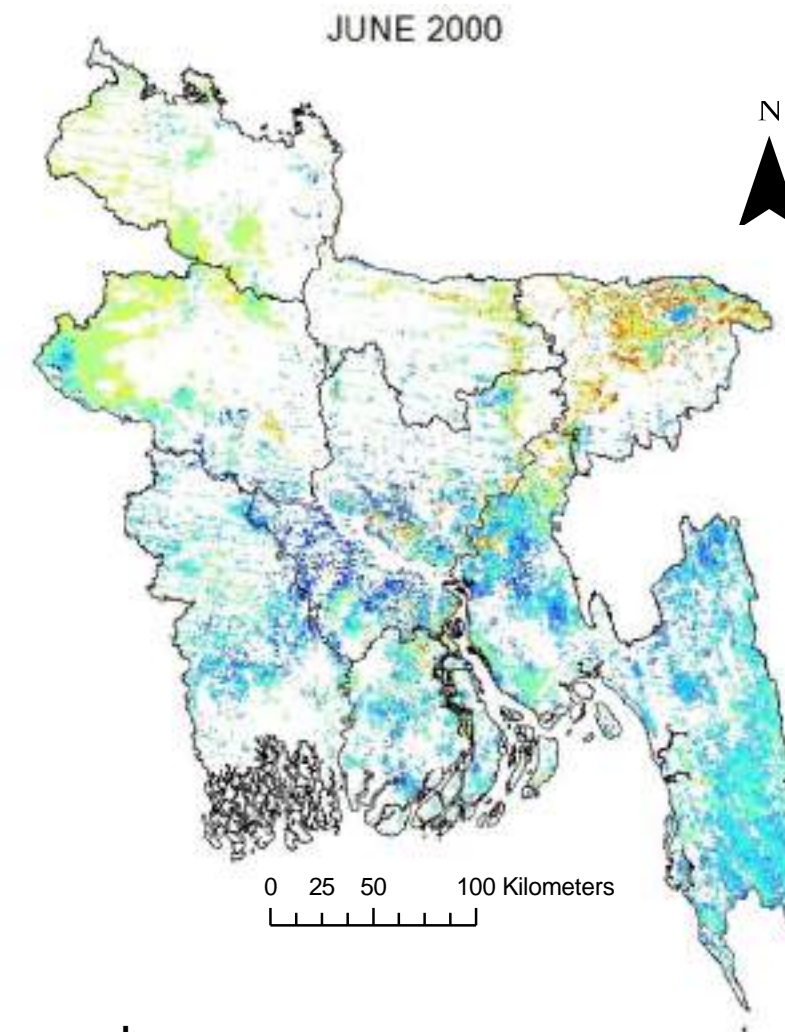
Legend



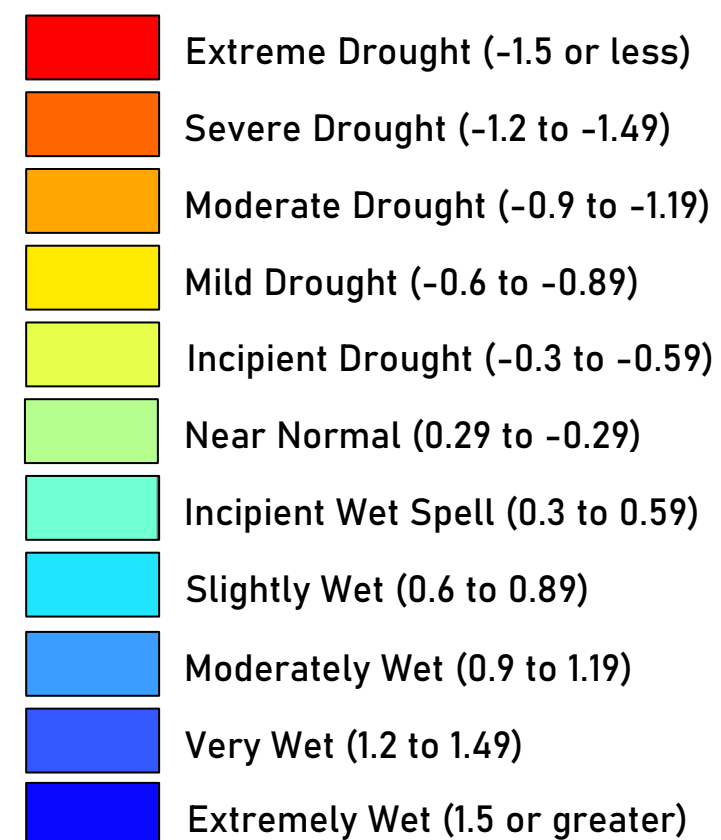
June DSI Maps

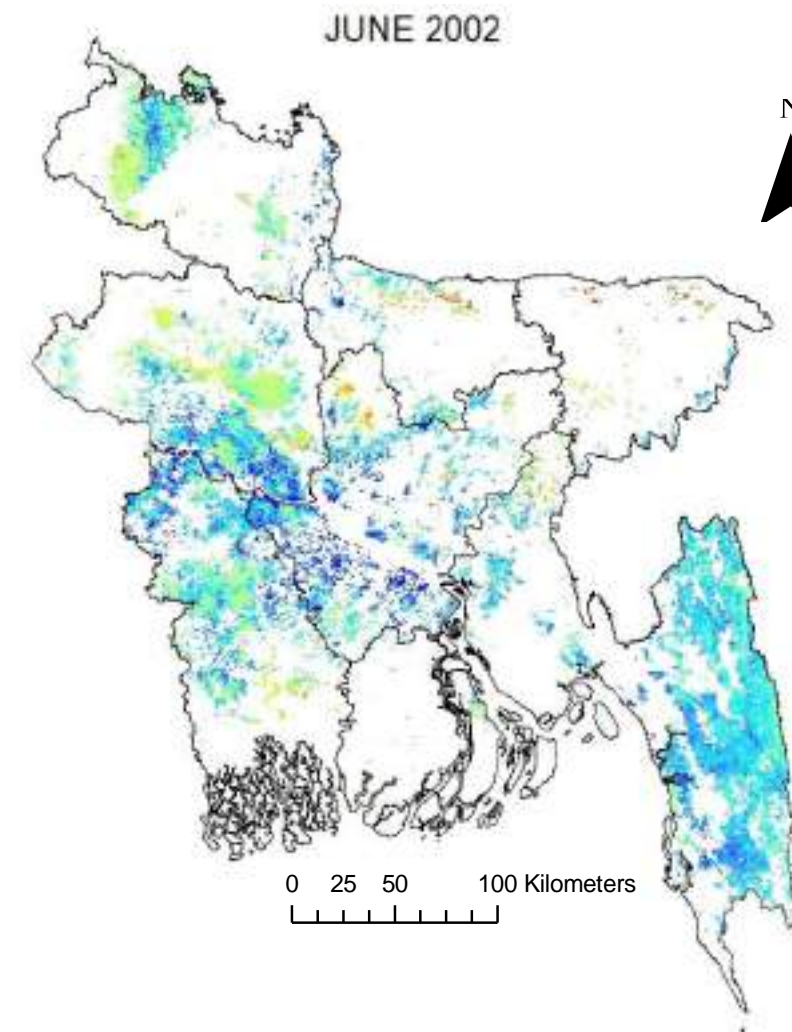
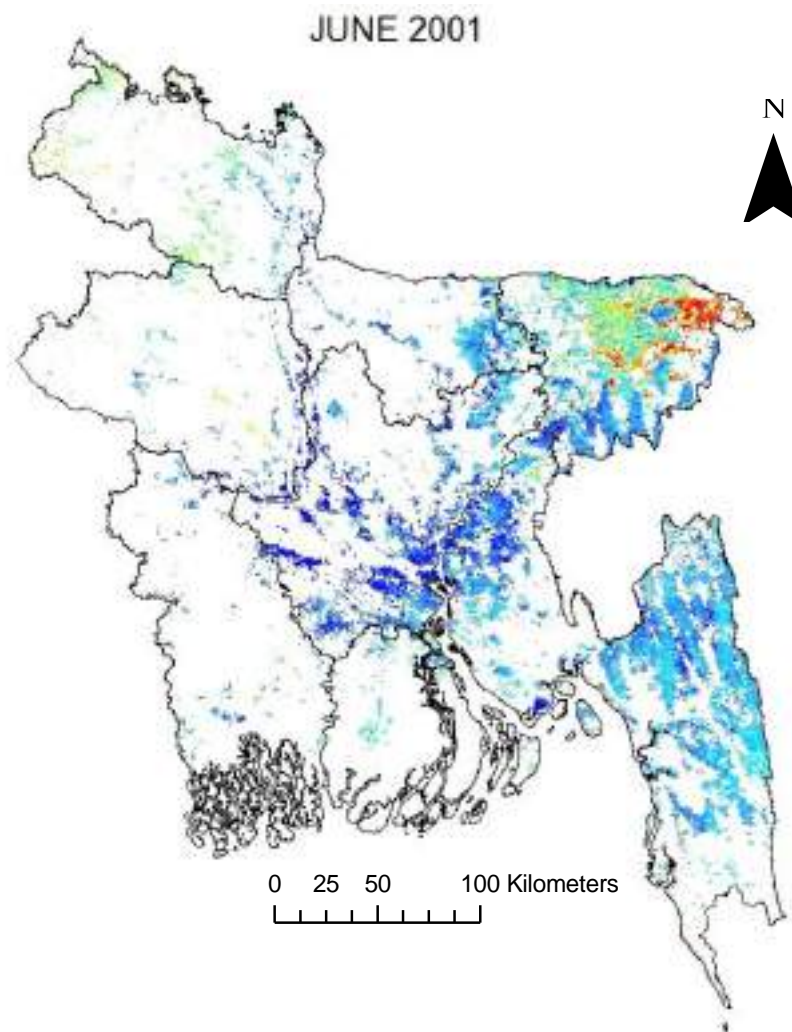
Drought conditions are near normal to moderately wet in June (monsoon month). In most years, June experiences near-normal to slightly wet weather.

Mean June DSI Values		
Years	Values	Drought Condition
2000	0.67	Slightly Wet
2001	0.36	Incipient Wet Spell
2002	1.11	Moderately Wet
2003	0.26	Near Normal
2004	0.24	Near Normal
2005	0.00	Near Normal
2006	0.88	Slightly Wet
2007	0.74	Slightly Wet
2008	0.67	Slightly Wet
2009	0.12	Near Normal
2010	0.55	Incipient Wet Spell
2011	0.31	Incipient Wet Spell
2012	0.00	Near Normal
2013	1.02	Moderately Wet
2014	0.19	Near Normal
2015	0.76	Slightly Wet
2016	0.72	Slightly Wet
2017	0.74	Slightly Wet
2018	-0.05	Near Normal
2019	0.48	Incipient Wet Spell
2020	0.37	Incipient Wet Spell

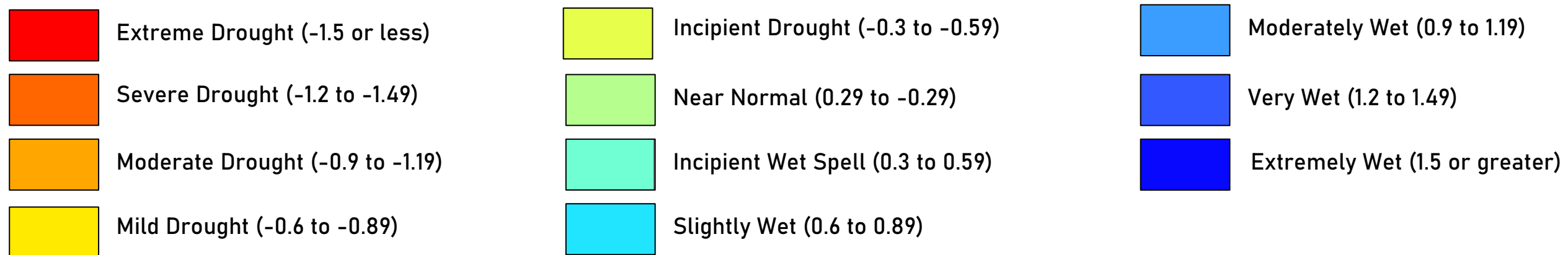


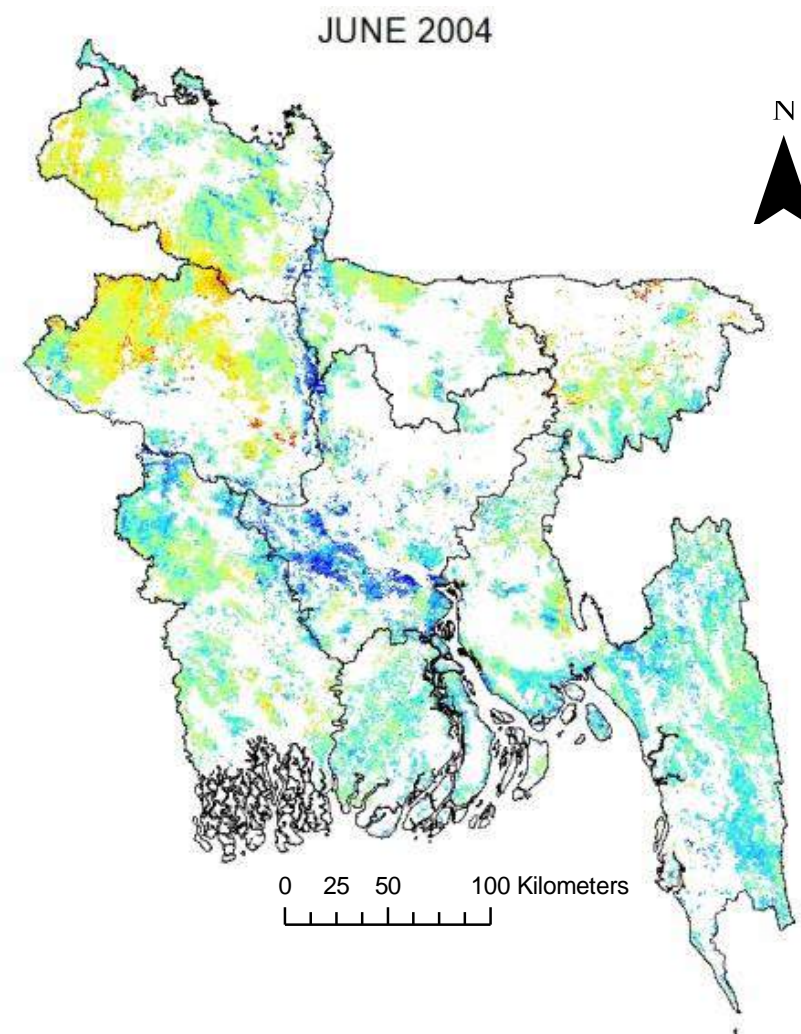
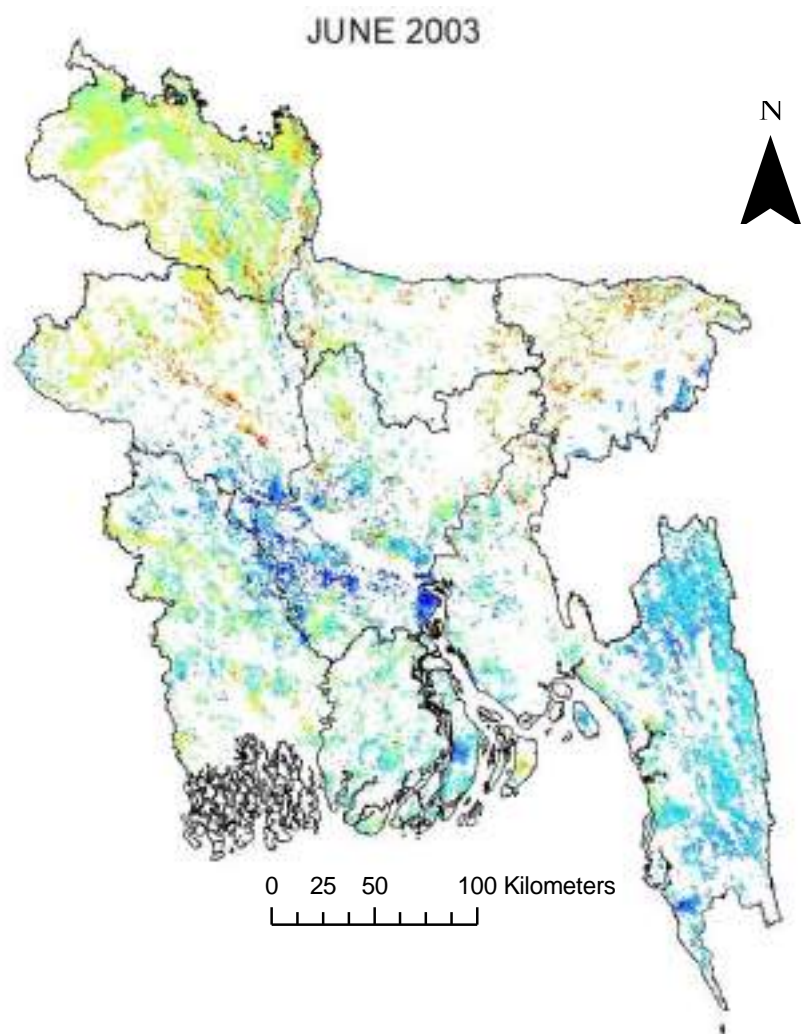
Legend



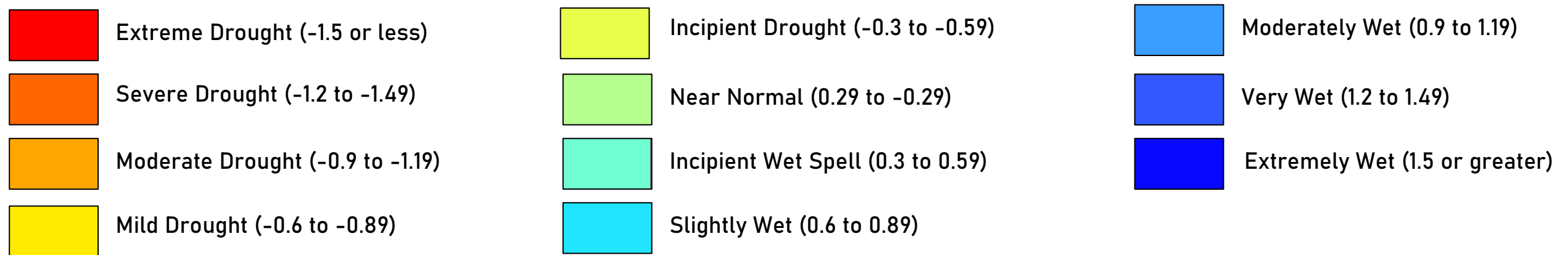


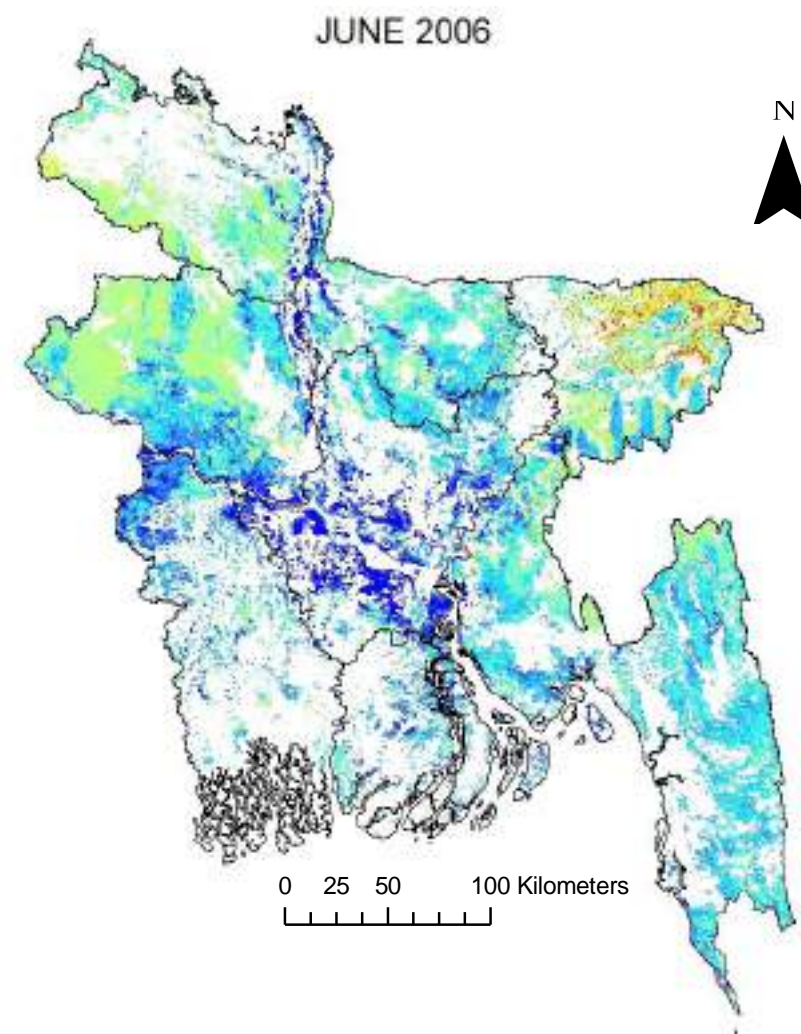
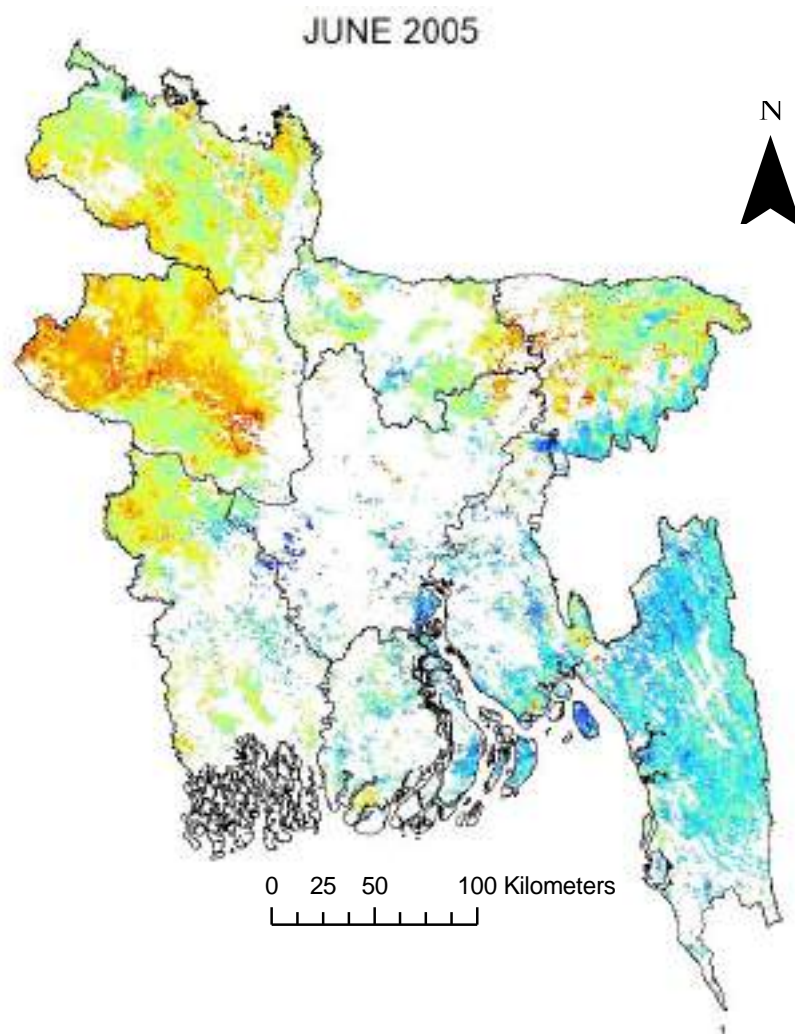
Legend





Legend



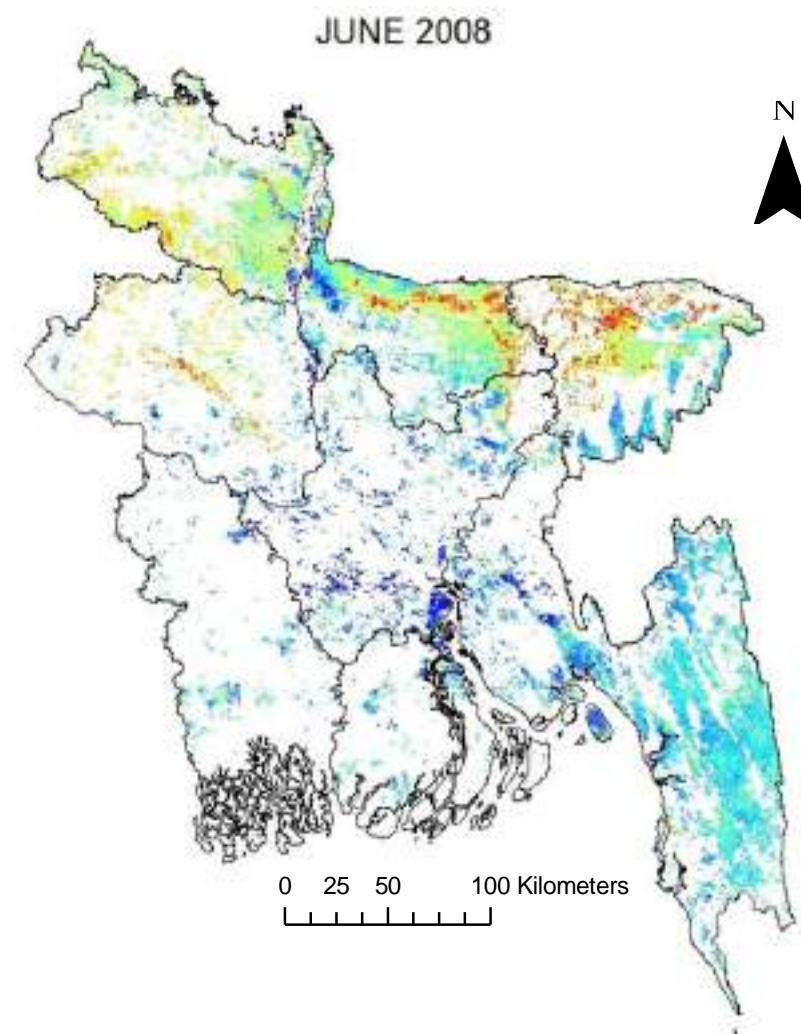
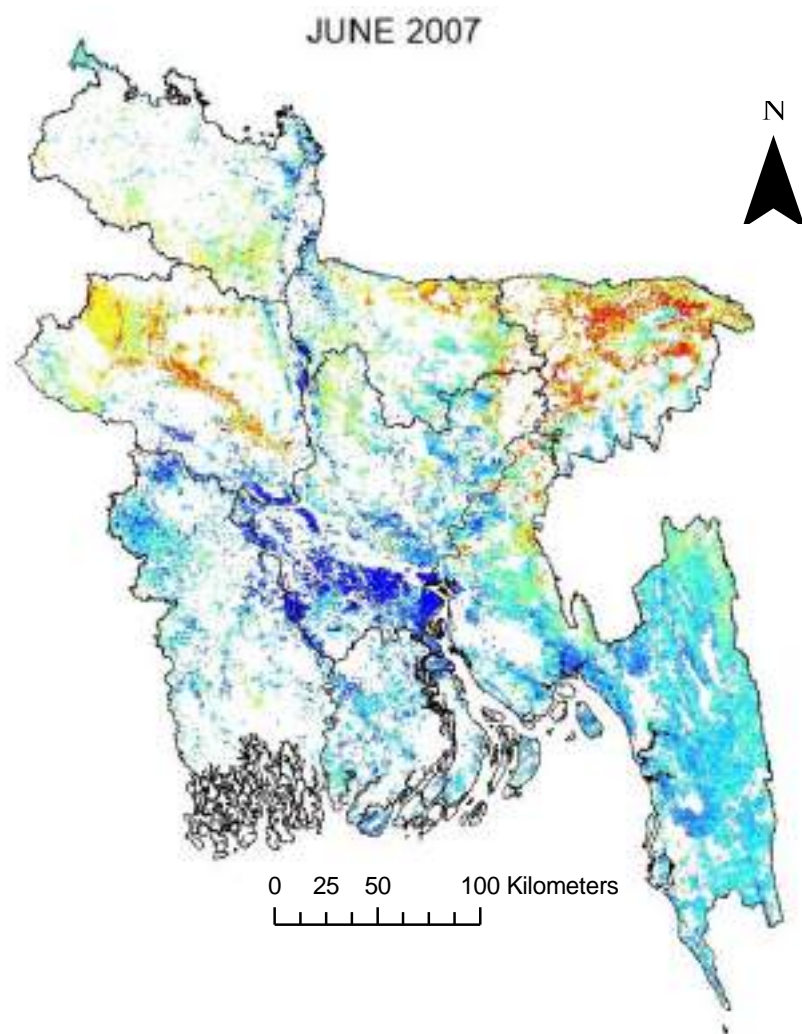


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend



Extreme Drought (-1.5 or less)



Severe Drought (-1.2 to -1.49)



Moderate Drought (-0.9 to -1.19)



Mild Drought (-0.6 to -0.89)



Incipient Drought (-0.3 to -0.59)



Near Normal (0.29 to -0.29)



Incipient Wet Spell (0.3 to 0.59)



Slightly Wet (0.6 to 0.89)



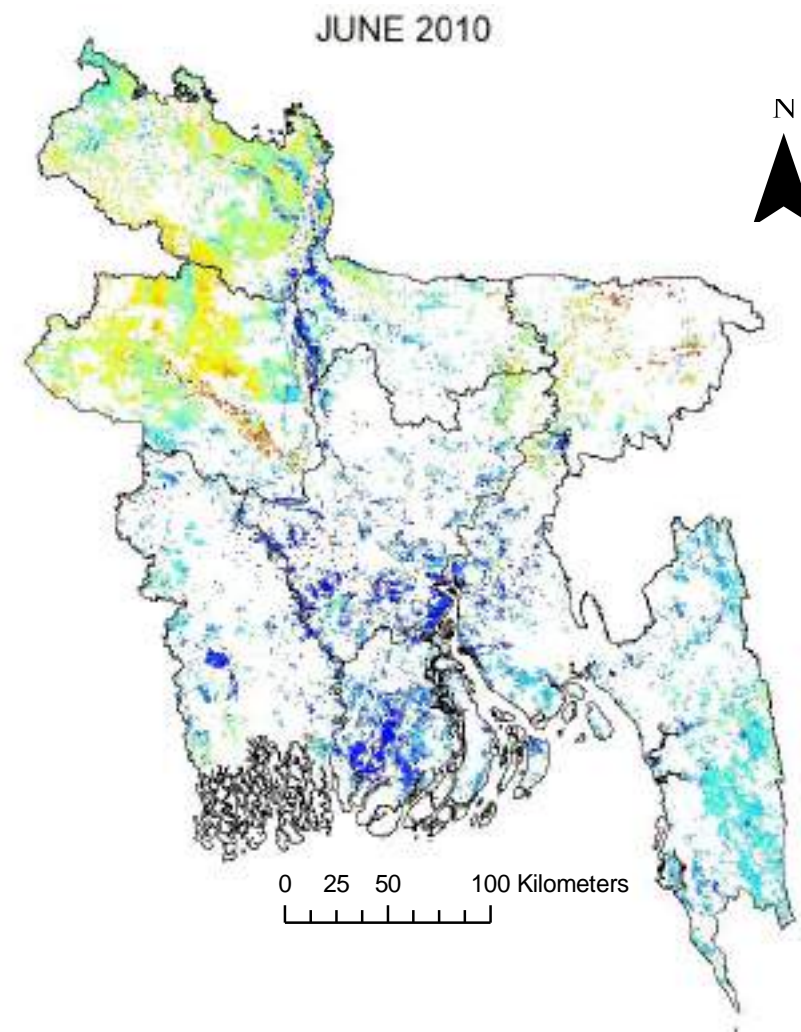
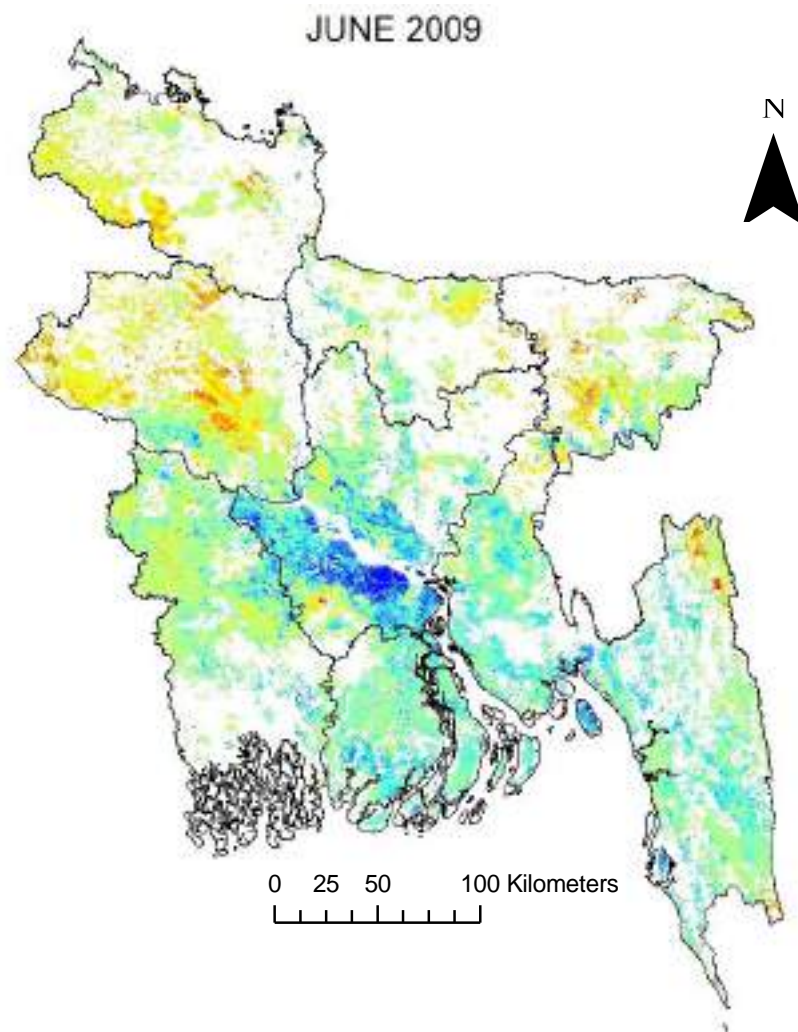
Moderately Wet (0.9 to 1.19)



Very Wet (1.2 to 1.49)



Extremely Wet (1.5 or greater)

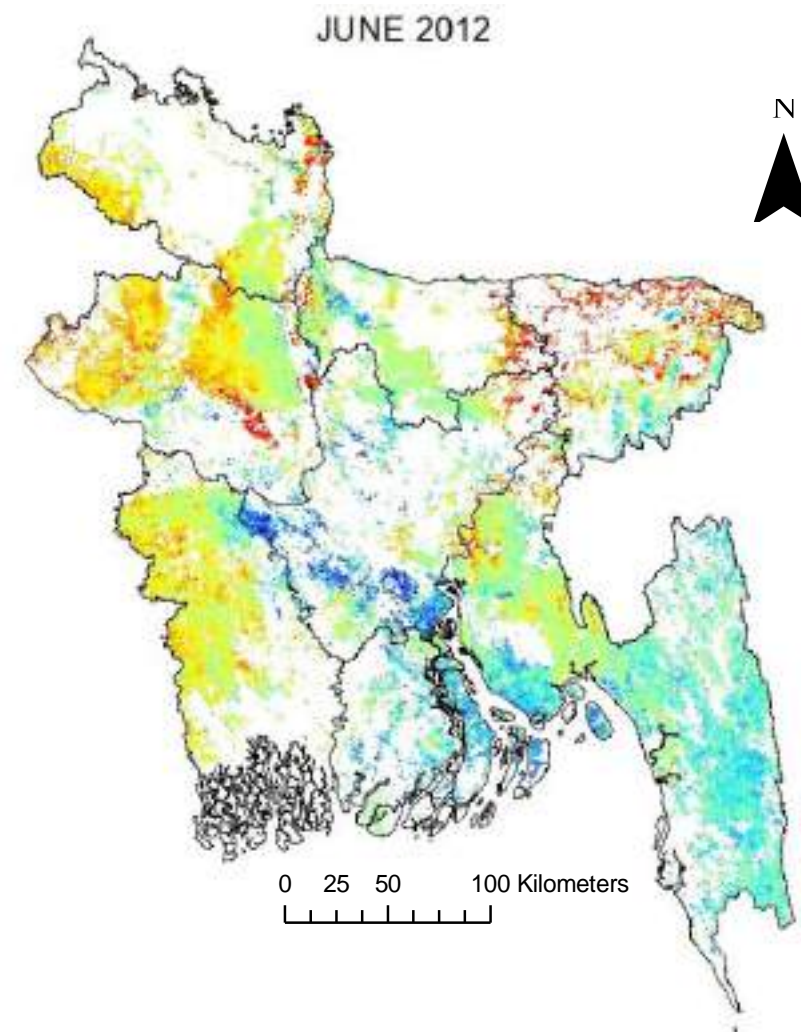
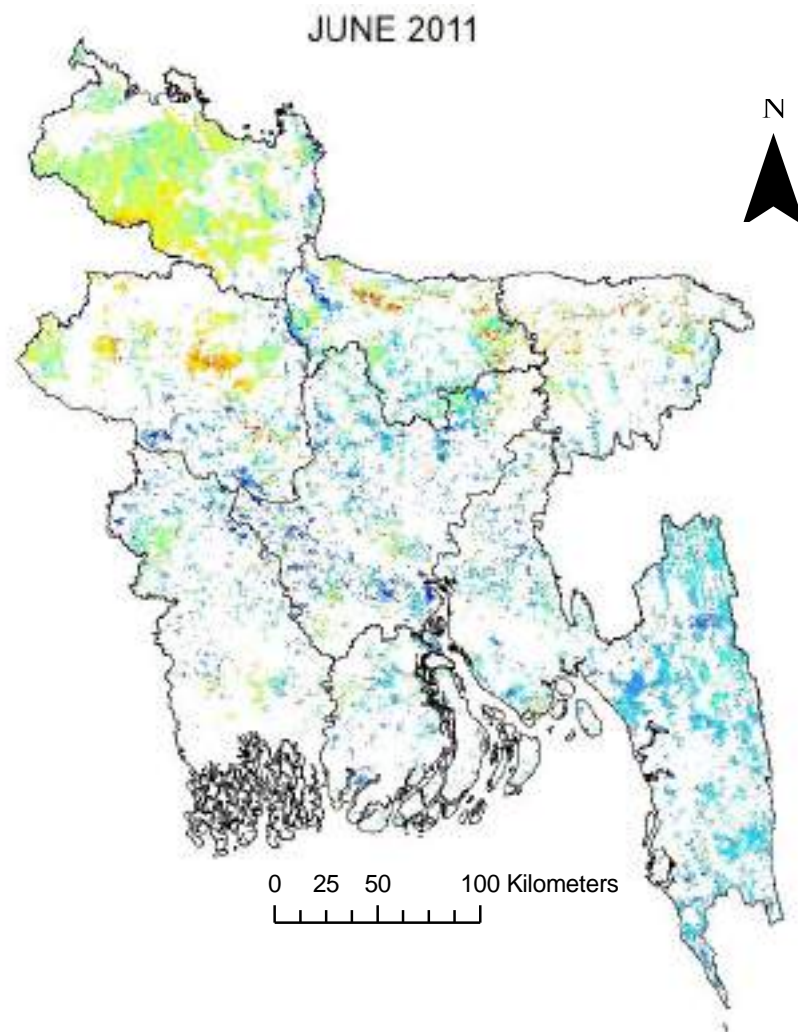


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)


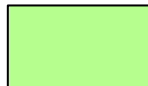


- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)




- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

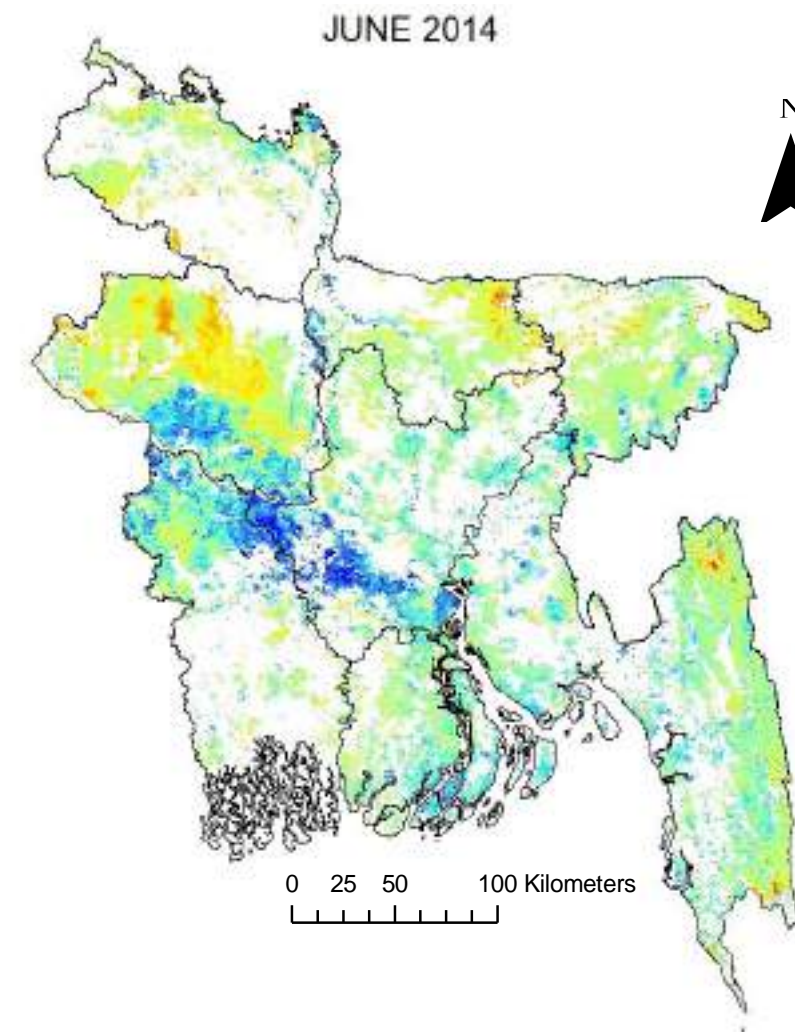
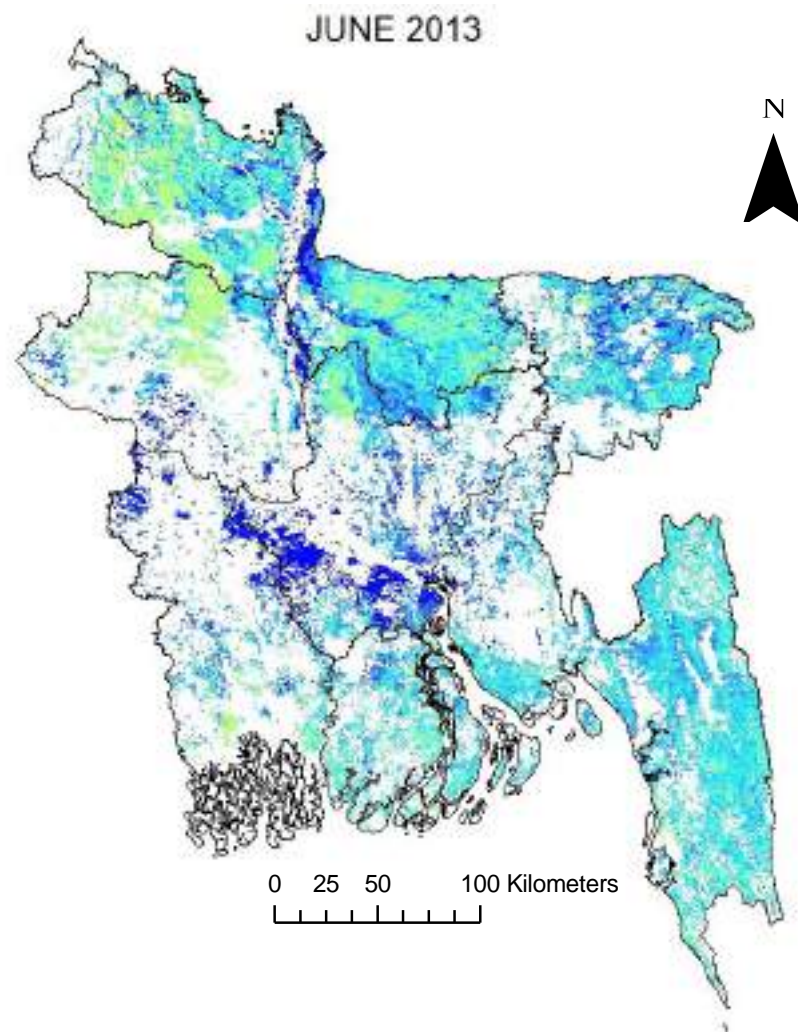


Legend

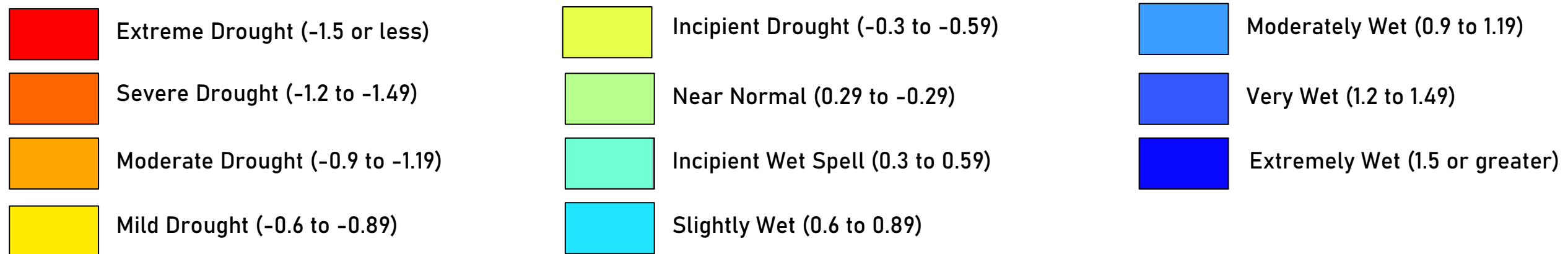
-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

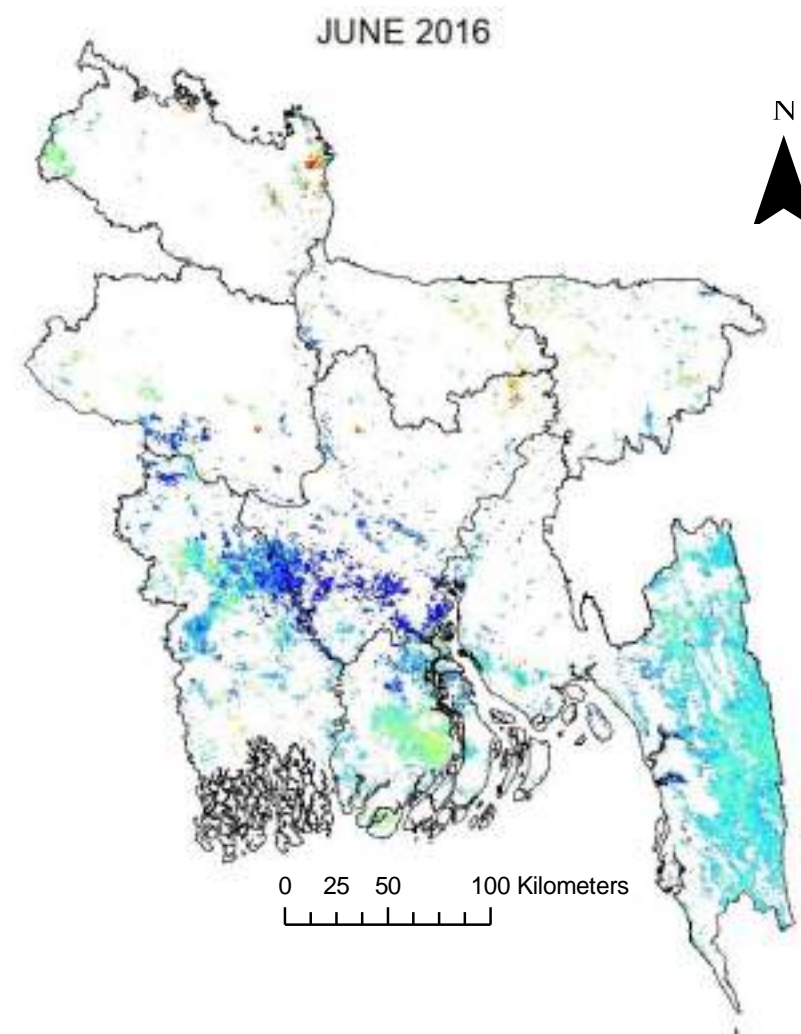
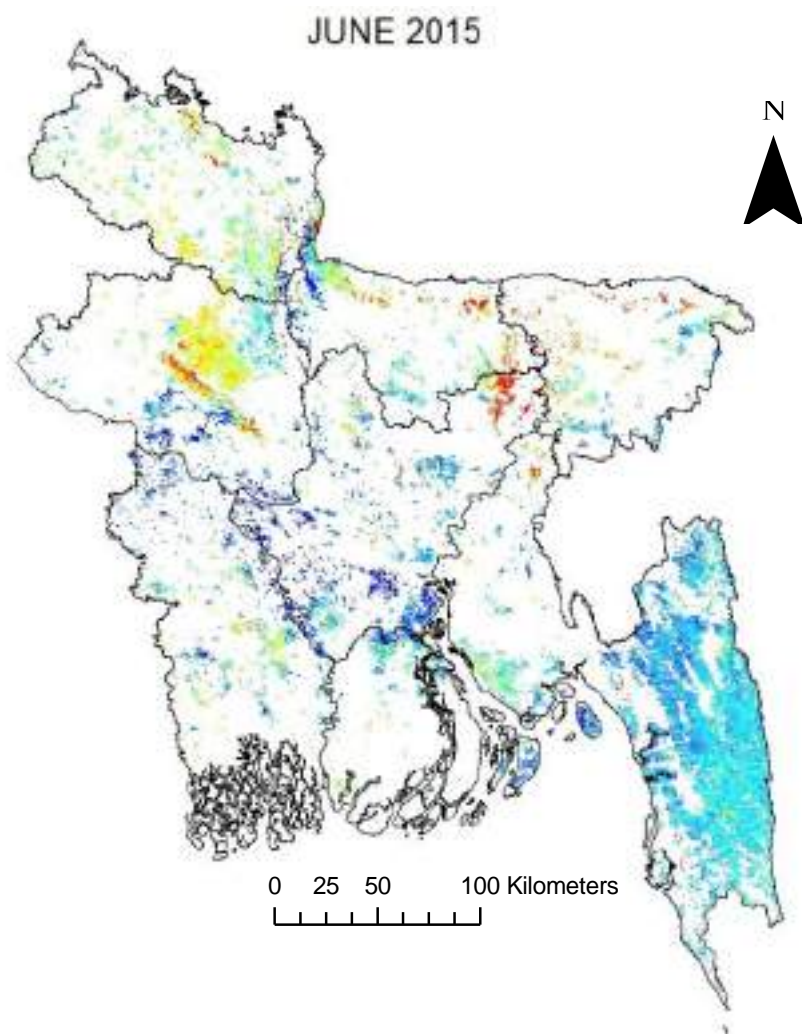
-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)



Legend



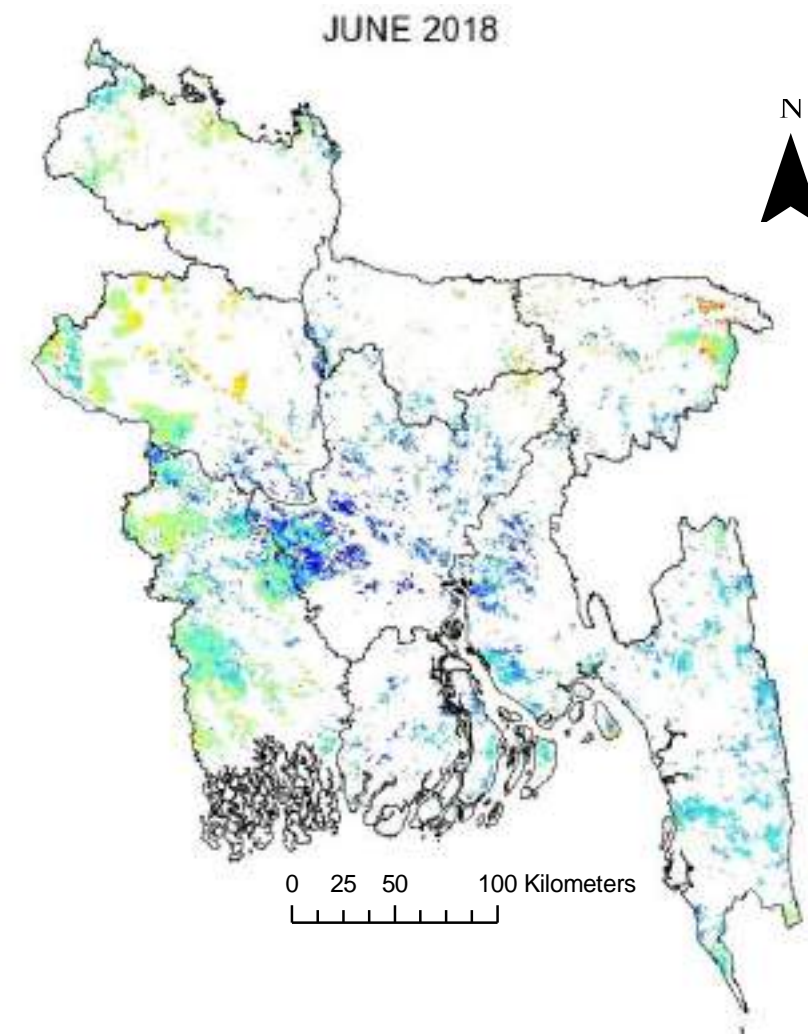
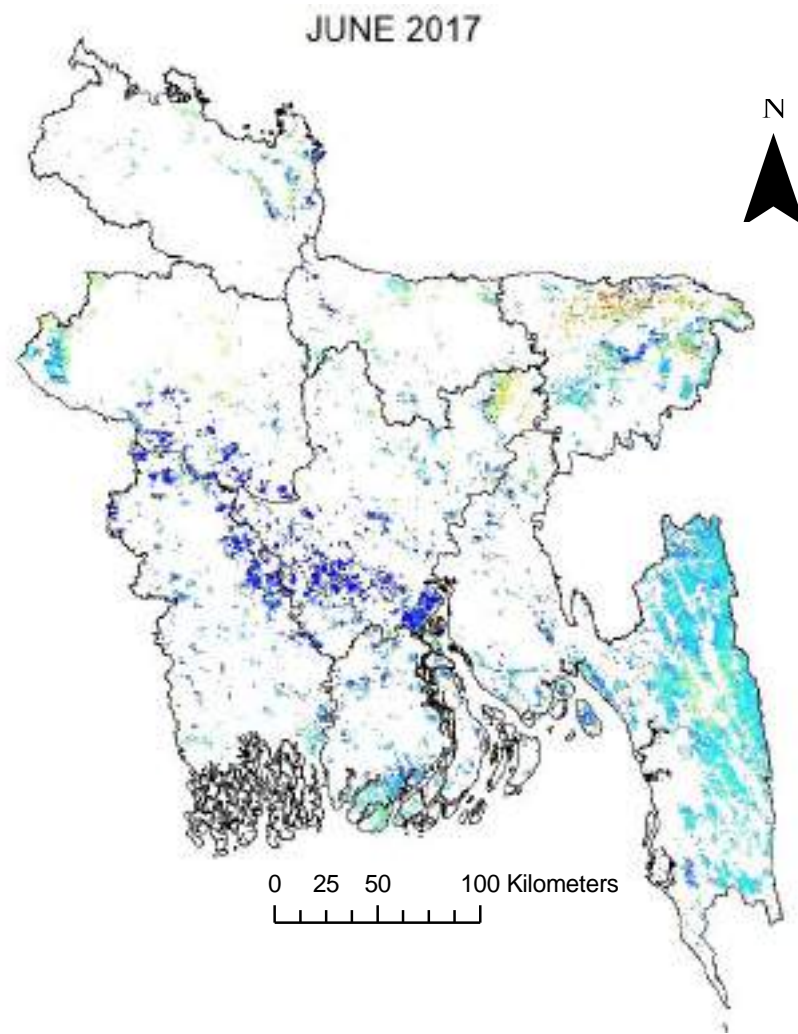


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

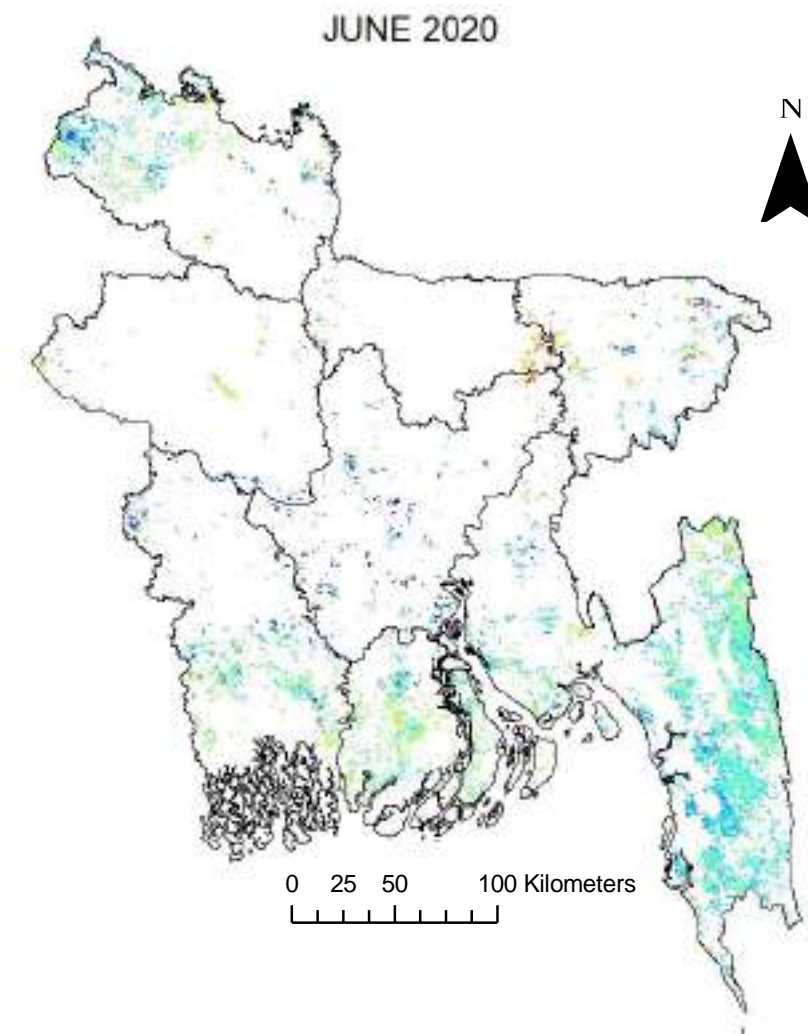
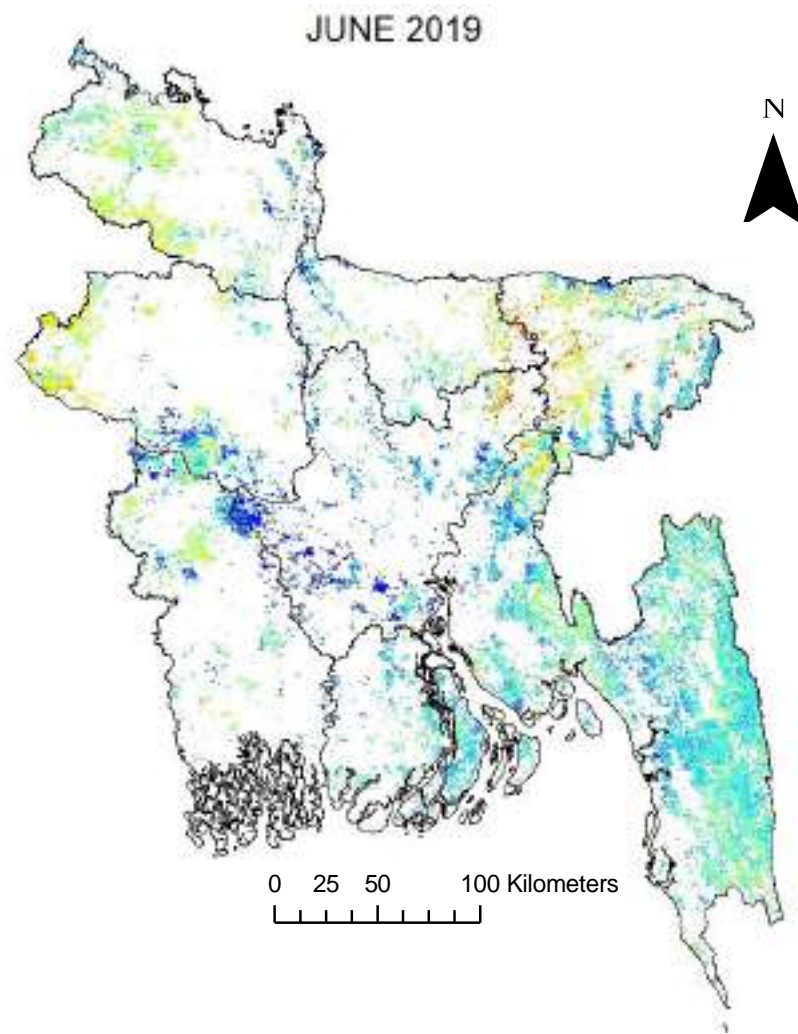


Legend

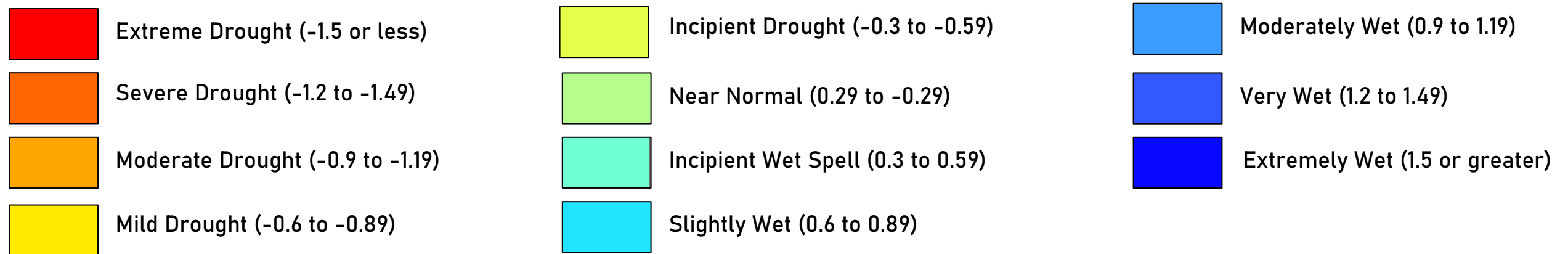
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



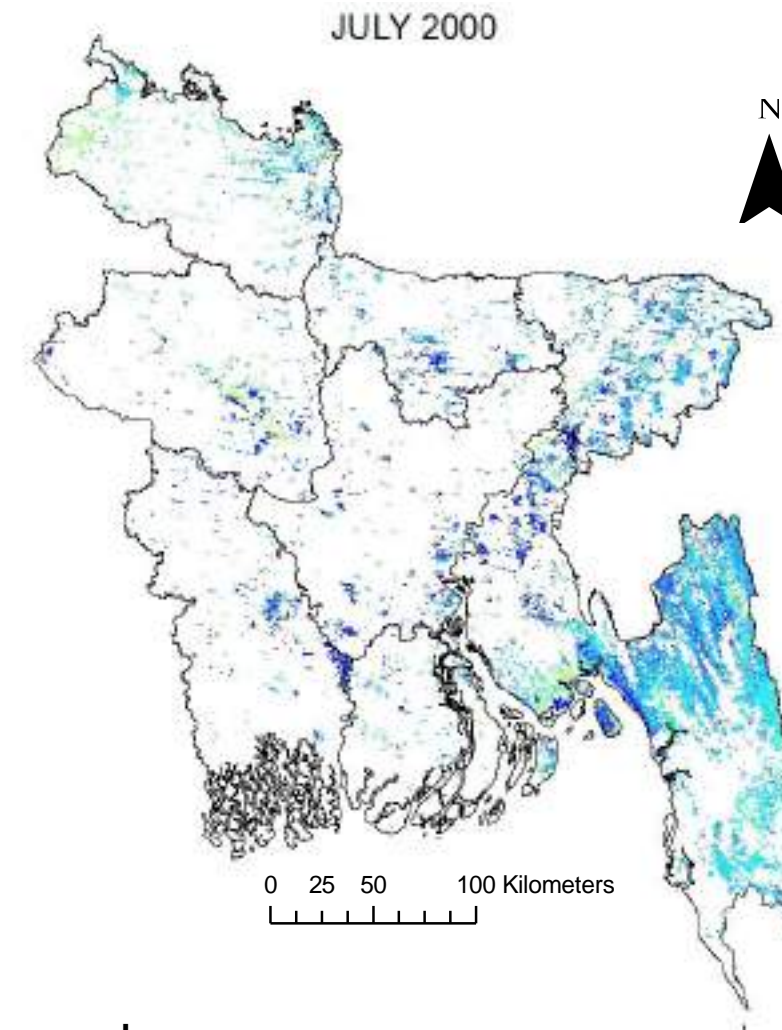
Legend



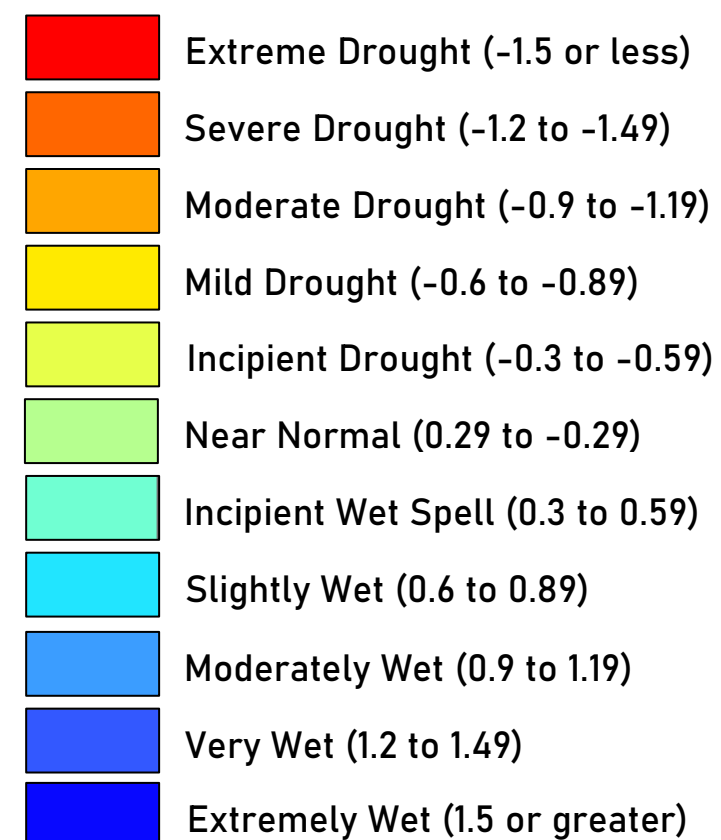
July DSI Maps

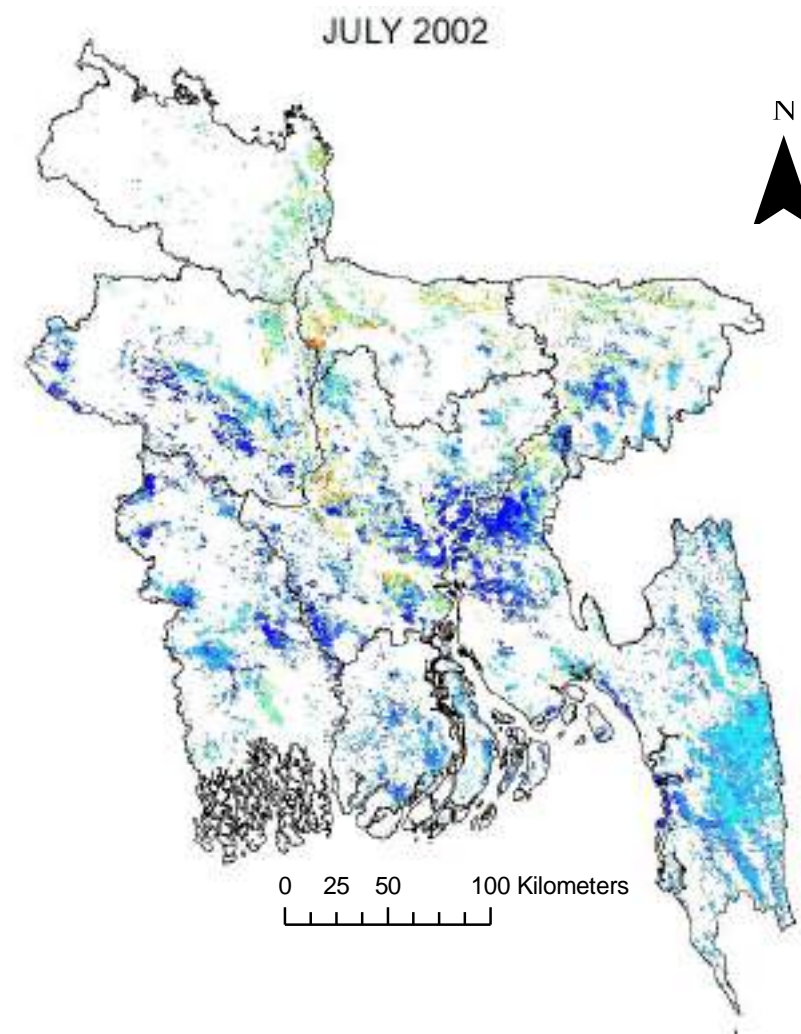
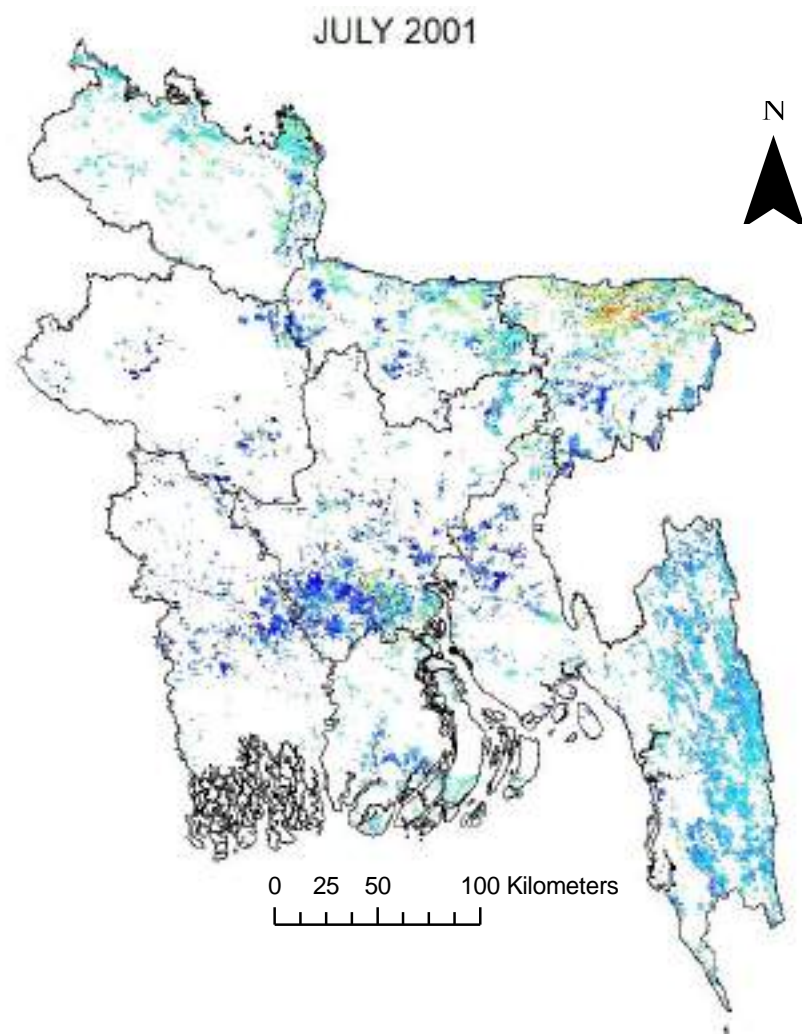
In July, drought condition varies from near normal to very wet condition. July is the monsoon month and was seen in wet condition in most of the years.

Mean July DSI Values		
Years	Values	Drought Condition
2000	1.18	Moderately Wet
2001	0.70	Slightly Wet
2002	1.21	Very Wet
2003	1.19	Moderately Wet
2004	1.26	Very Wet
2005	1.23	Very Wet
2006	1.03	Moderately Wet
2007	0.86	Slightly Wet
2008	1.00	Moderately Wet
2009	0.18	Near Normal
2010	0.77	Slightly Wet
2011	0.71	Slightly Wet
2012	1.14	Moderately Wet
2013	1.26	Very Wet
2014	1.22	Very Wet
2015	1.06	Moderately Wet
2016	1.37	Very Wet
2017	0.73	Slightly Wet
2018	0.44	Incipient Wet Spell
2019	1.09	Moderately Wet
2020	0.54	Incipient Wet Spell



Legend





Legend



Extreme Drought (-1.5 or less)



Severe Drought (-1.2 to -1.49)



Moderate Drought (-0.9 to -1.19)



Mild Drought (-0.6 to -0.89)



Incipient Drought (-0.3 to -0.59)



Near Normal (0.29 to -0.29)



Incipient Wet Spell (0.3 to 0.59)



Slightly Wet (0.6 to 0.89)



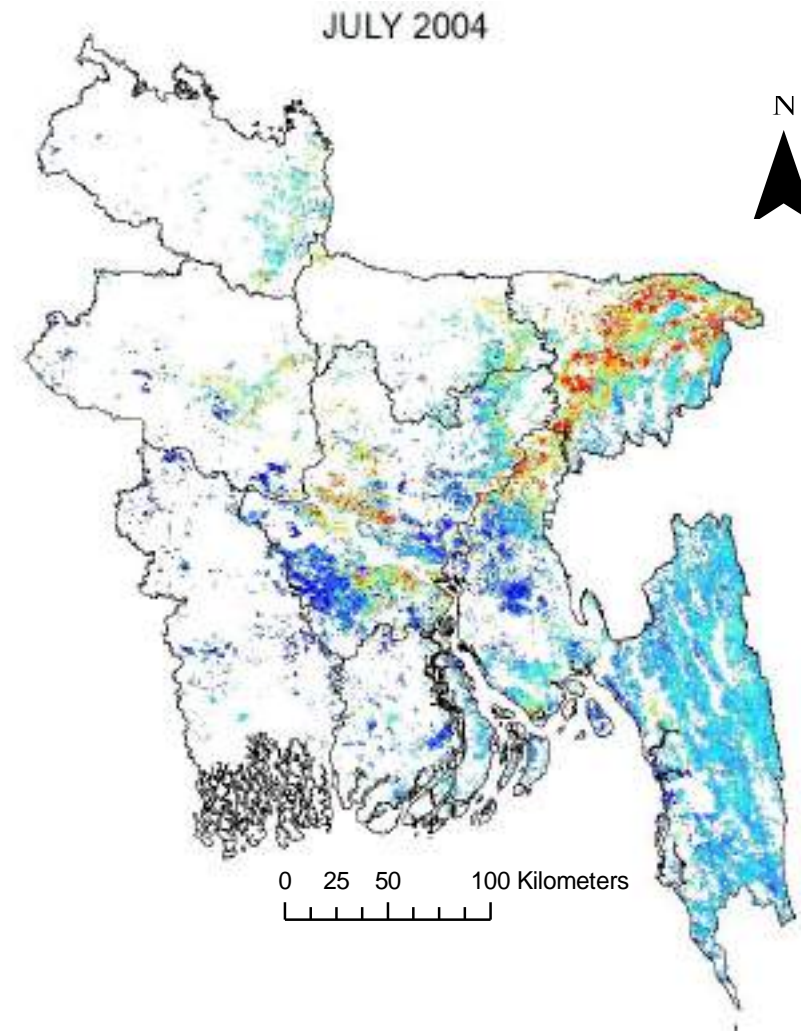
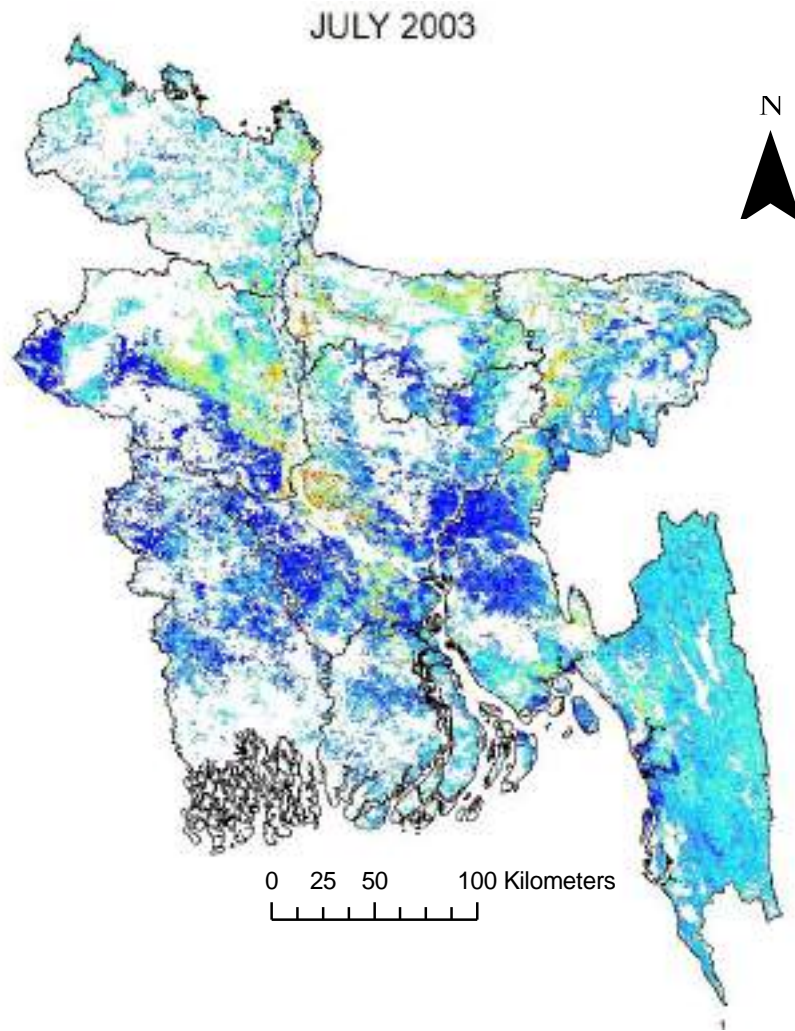
Moderately Wet (0.9 to 1.19)



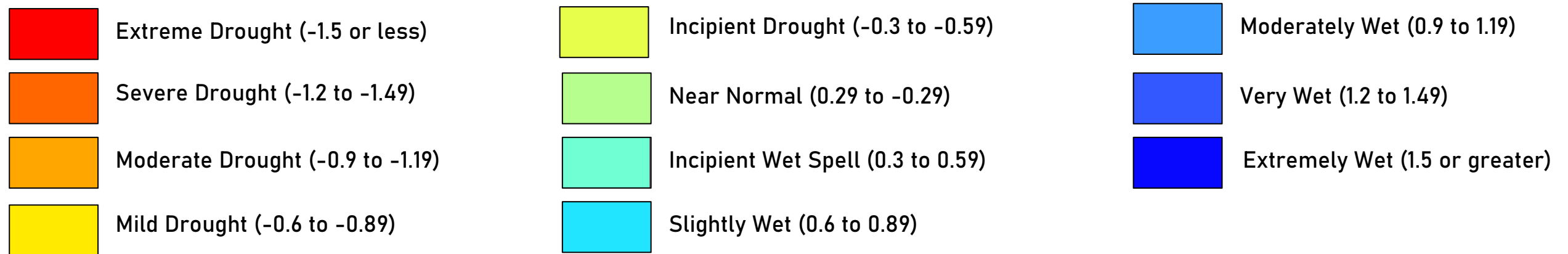
Very Wet (1.2 to 1.49)

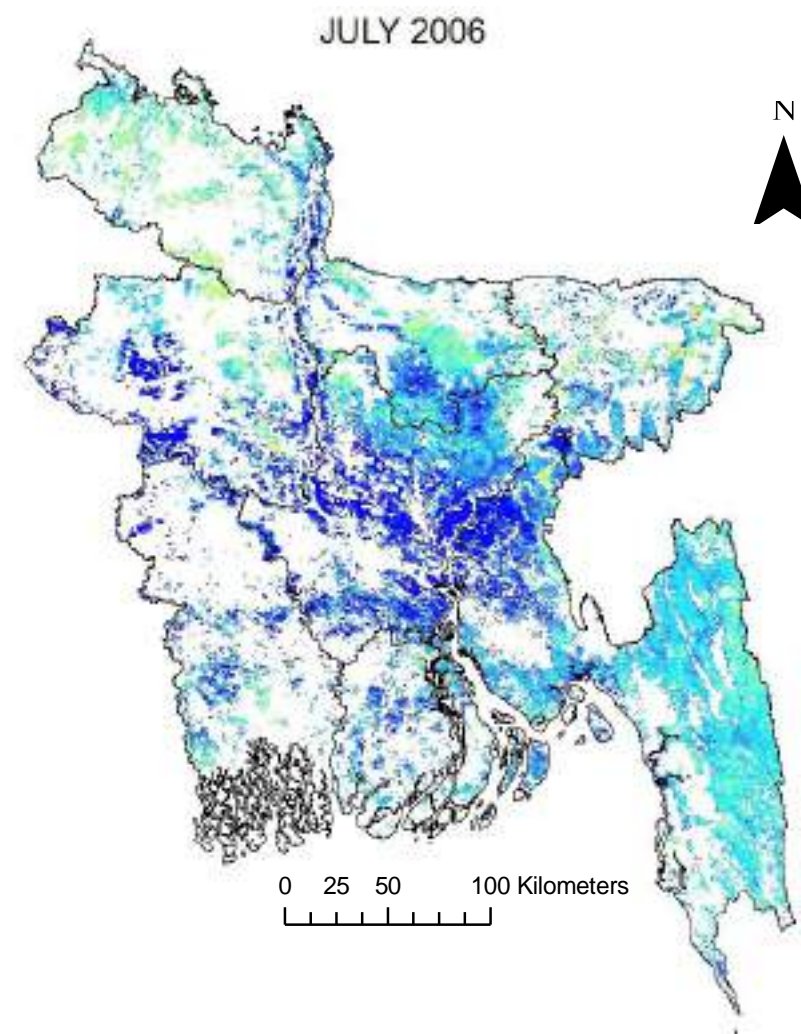
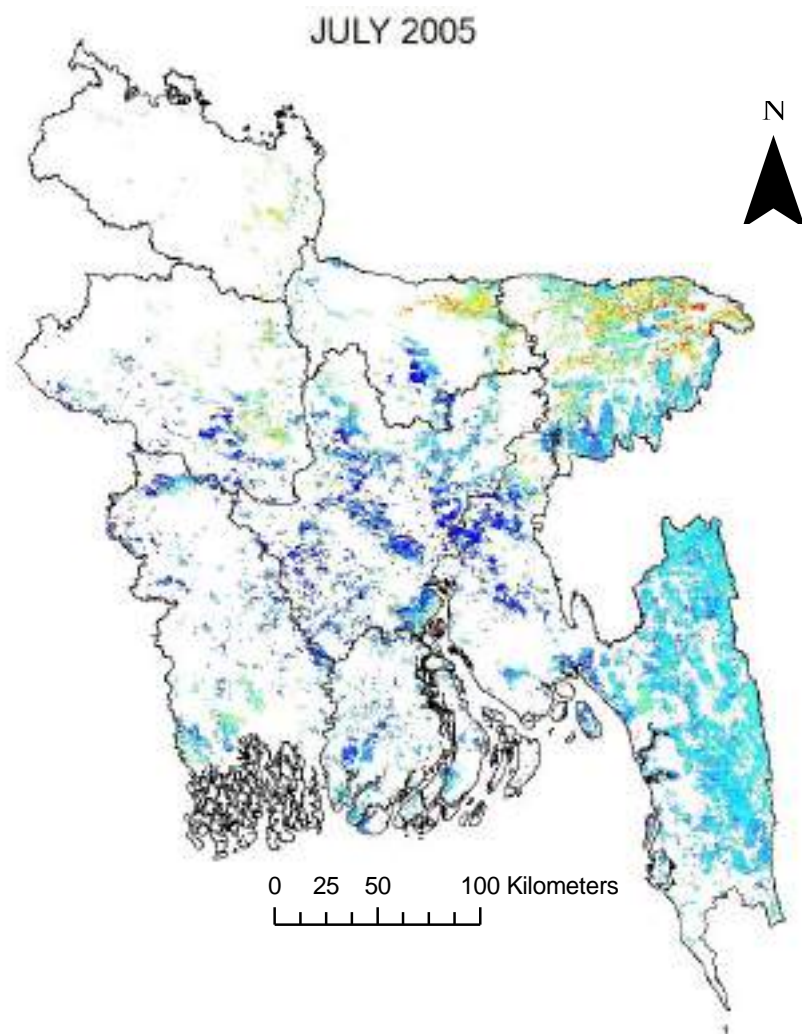


Extremely Wet (1.5 or greater)



Legend





Legend



Extreme Drought (-1.5 or less)



Severe Drought (-1.2 to -1.49)



Moderate Drought (-0.9 to -1.19)



Mild Drought (-0.6 to -0.89)



Incipient Drought (-0.3 to -0.59)



Near Normal (0.29 to -0.29)



Incipient Wet Spell (0.3 to 0.59)



Slightly Wet (0.6 to 0.89)



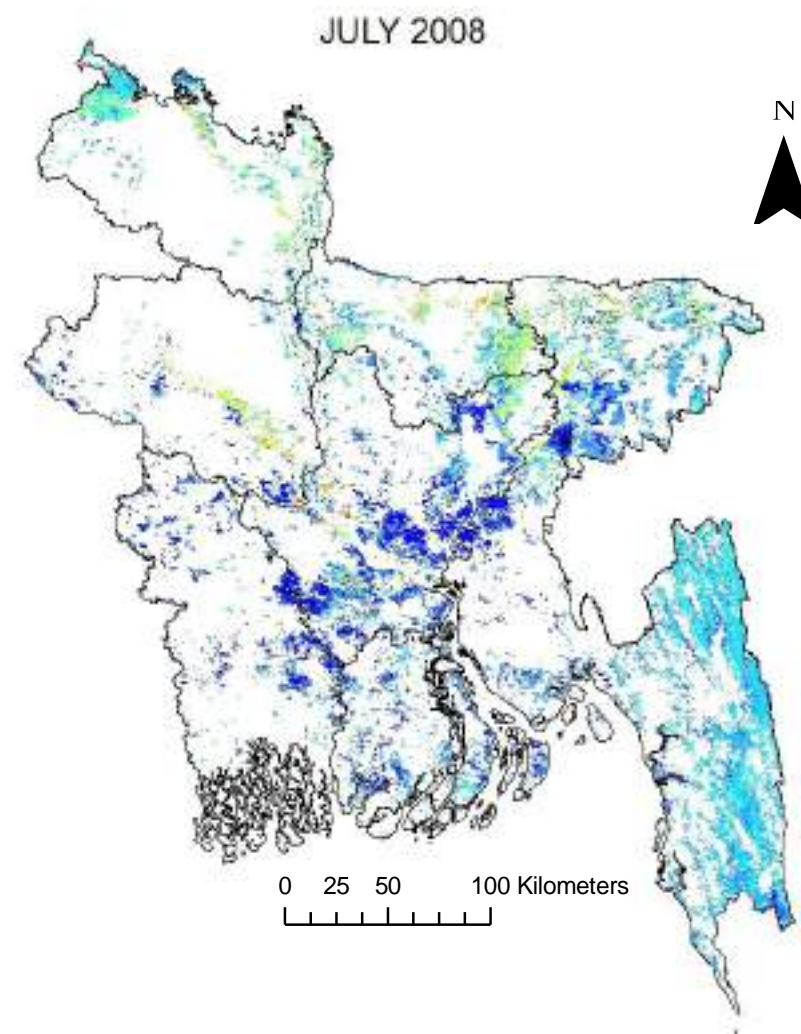
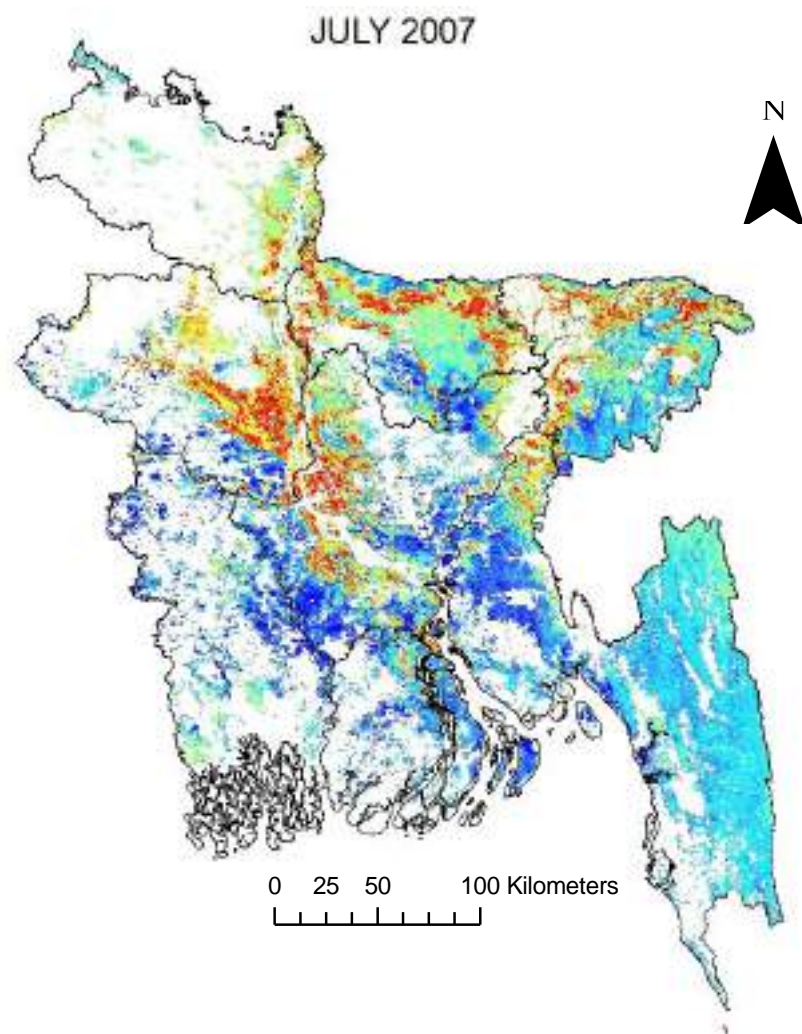
Moderately Wet (0.9 to 1.19)



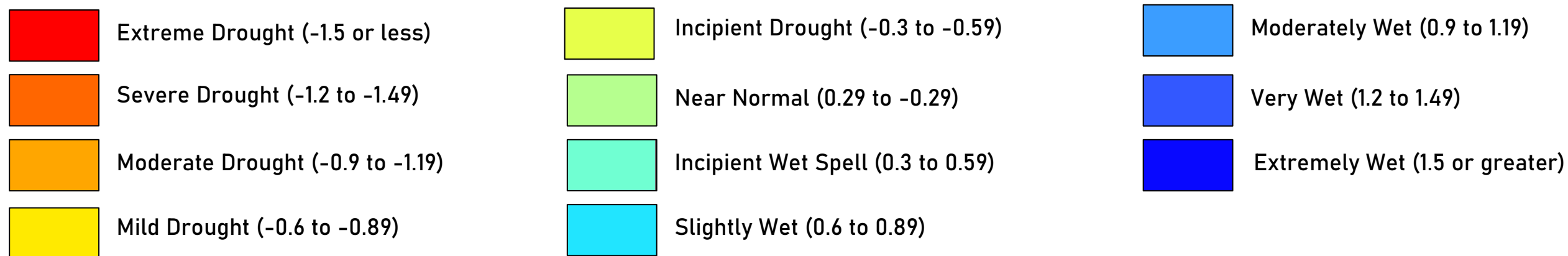
Very Wet (1.2 to 1.49)

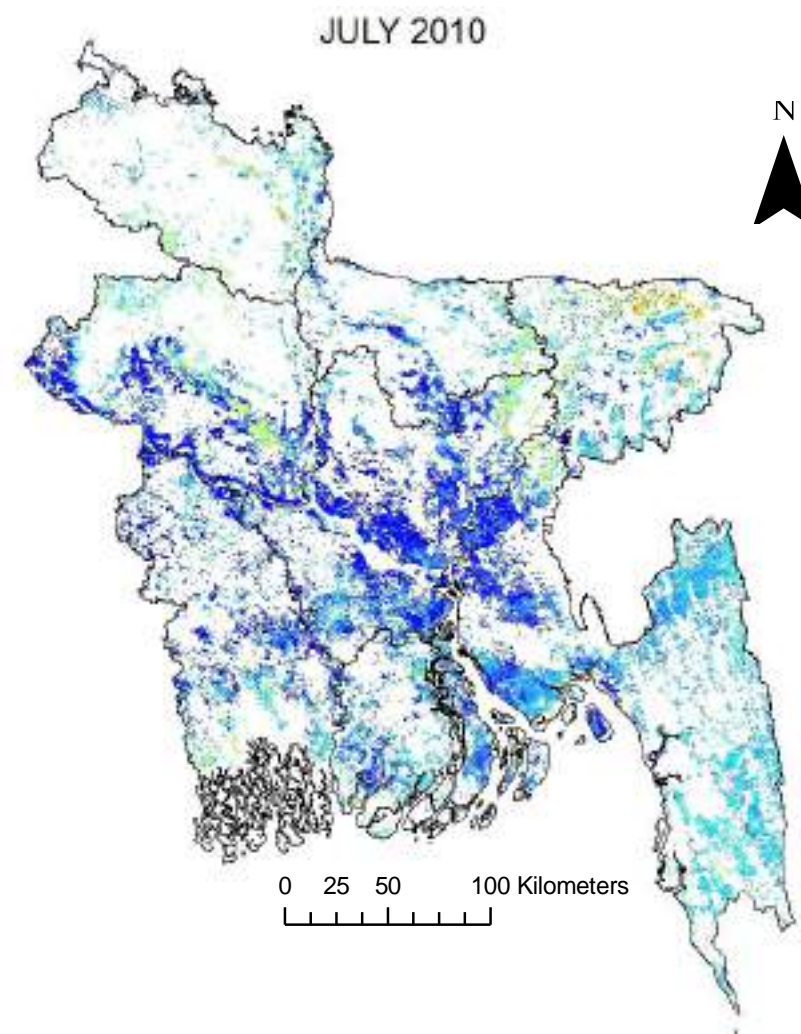
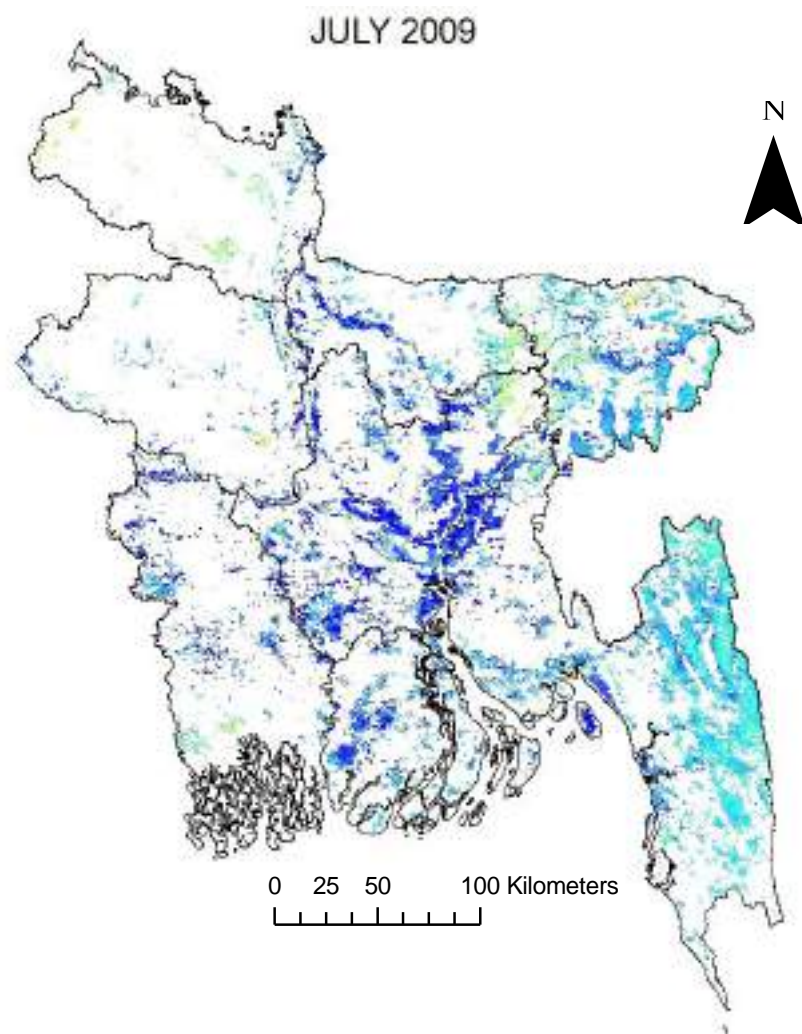


Extremely Wet (1.5 or greater)



Legend





Legend



Extreme Drought (-1.5 or less)



Severe Drought (-1.2 to -1.49)



Moderate Drought (-0.9 to -1.19)



Mild Drought (-0.6 to -0.89)



Incipient Drought (-0.3 to -0.59)



Near Normal (0.29 to -0.29)



Incipient Wet Spell (0.3 to 0.59)



Slightly Wet (0.6 to 0.89)



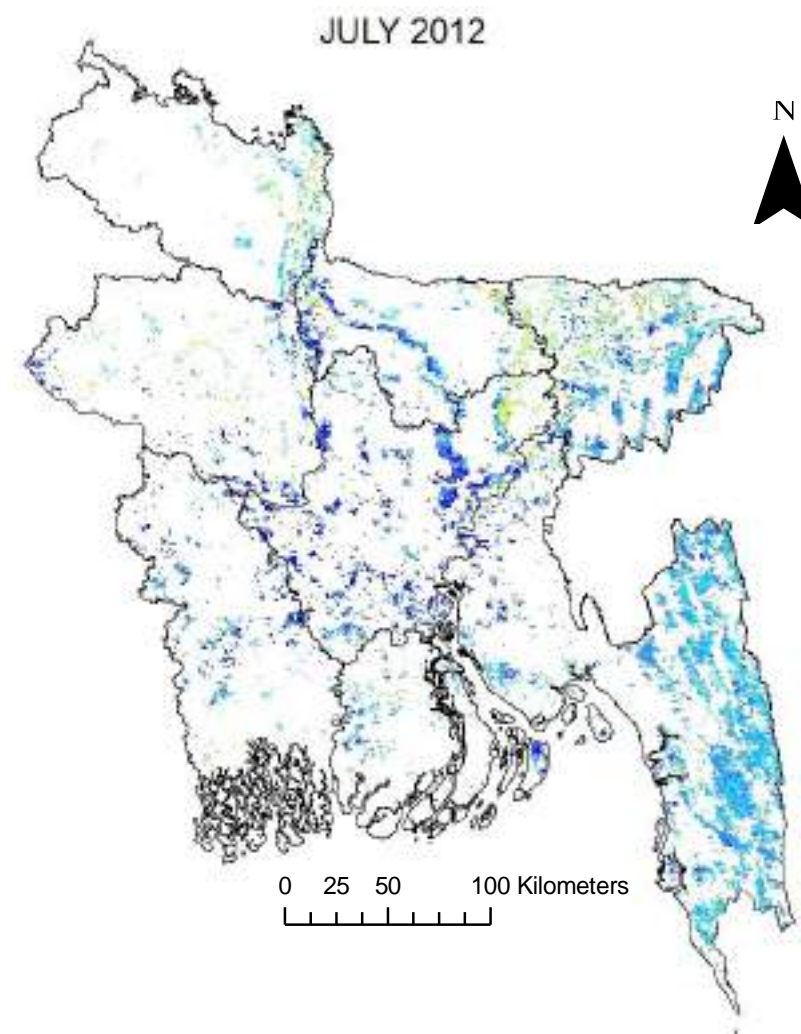
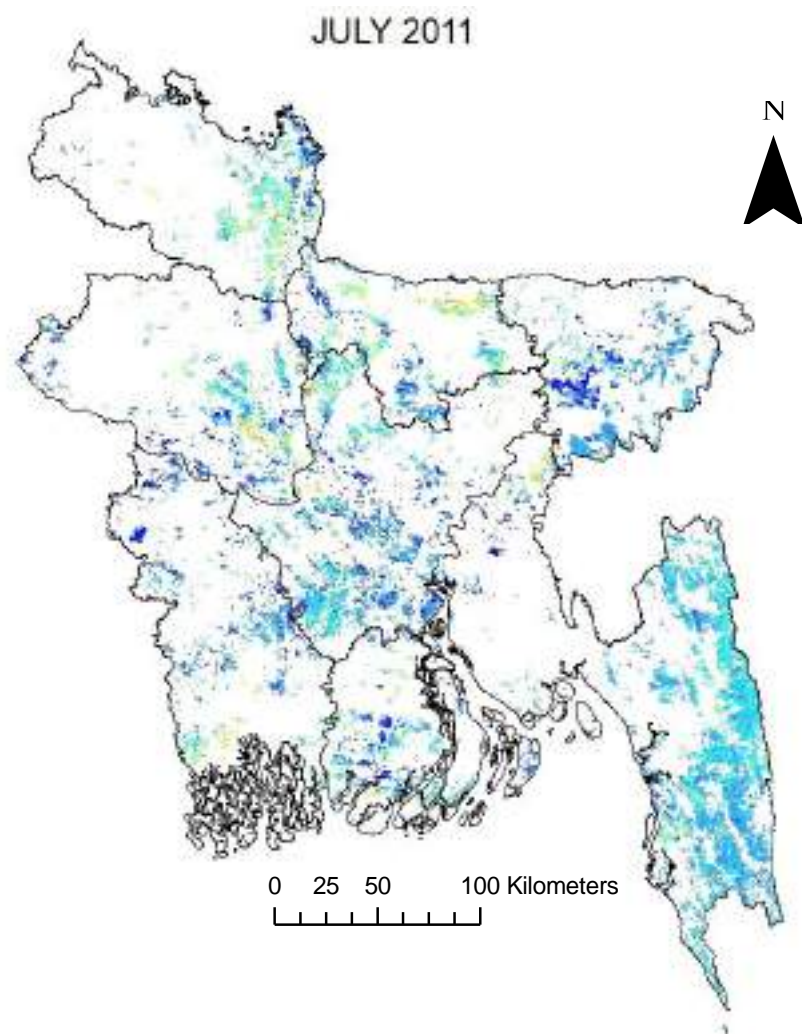
Moderately Wet (0.9 to 1.19)



Very Wet (1.2 to 1.49)



Extremely Wet (1.5 or greater)

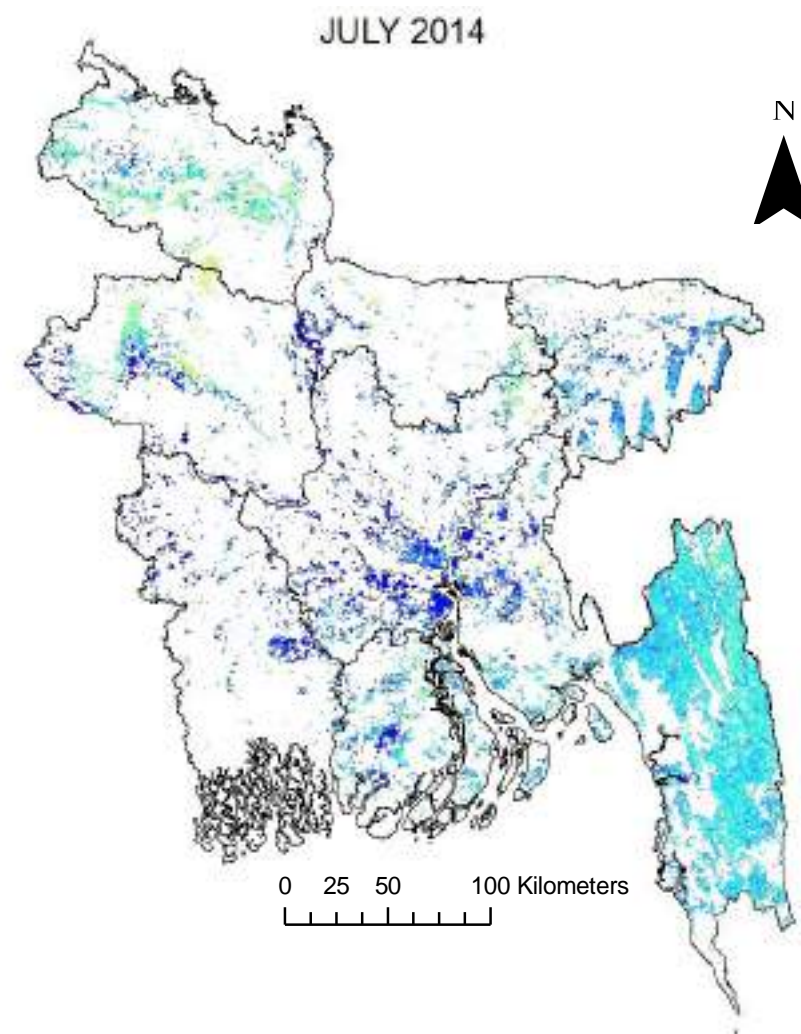
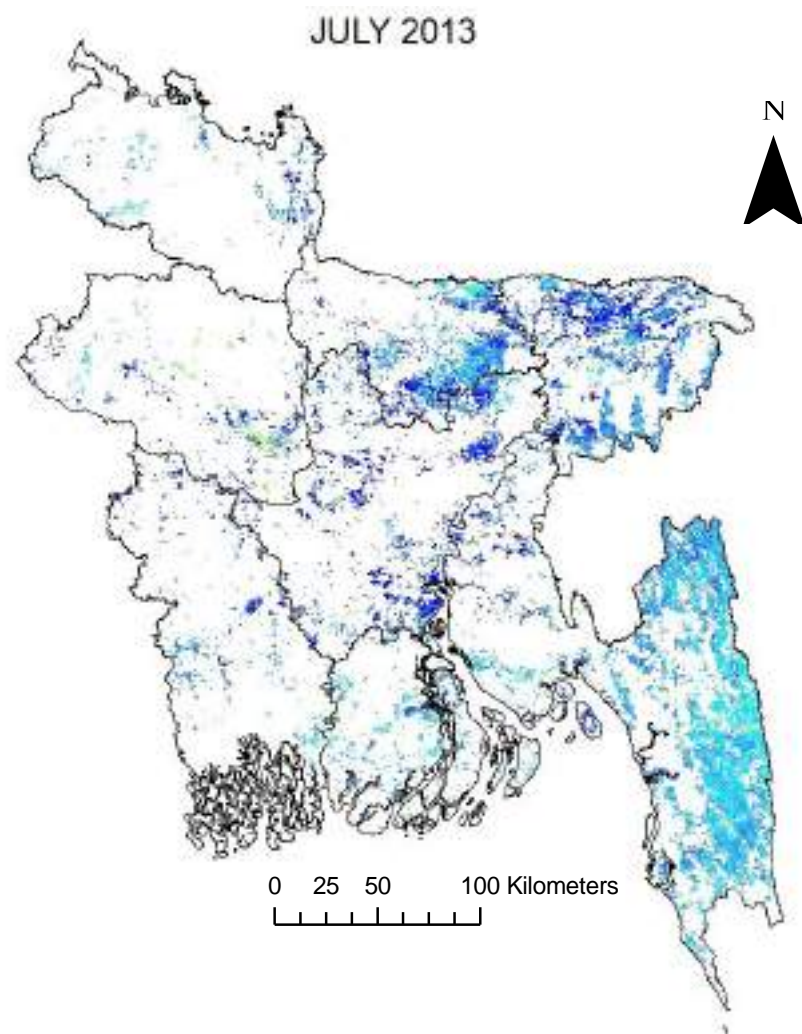


Legend

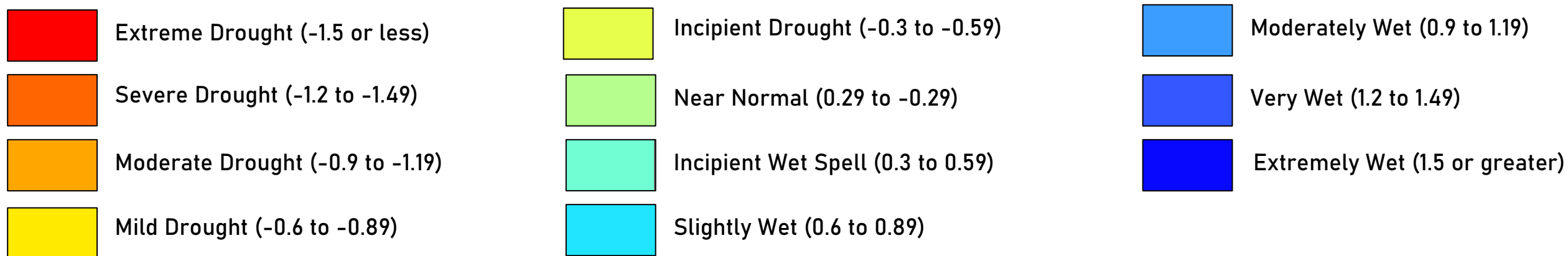
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

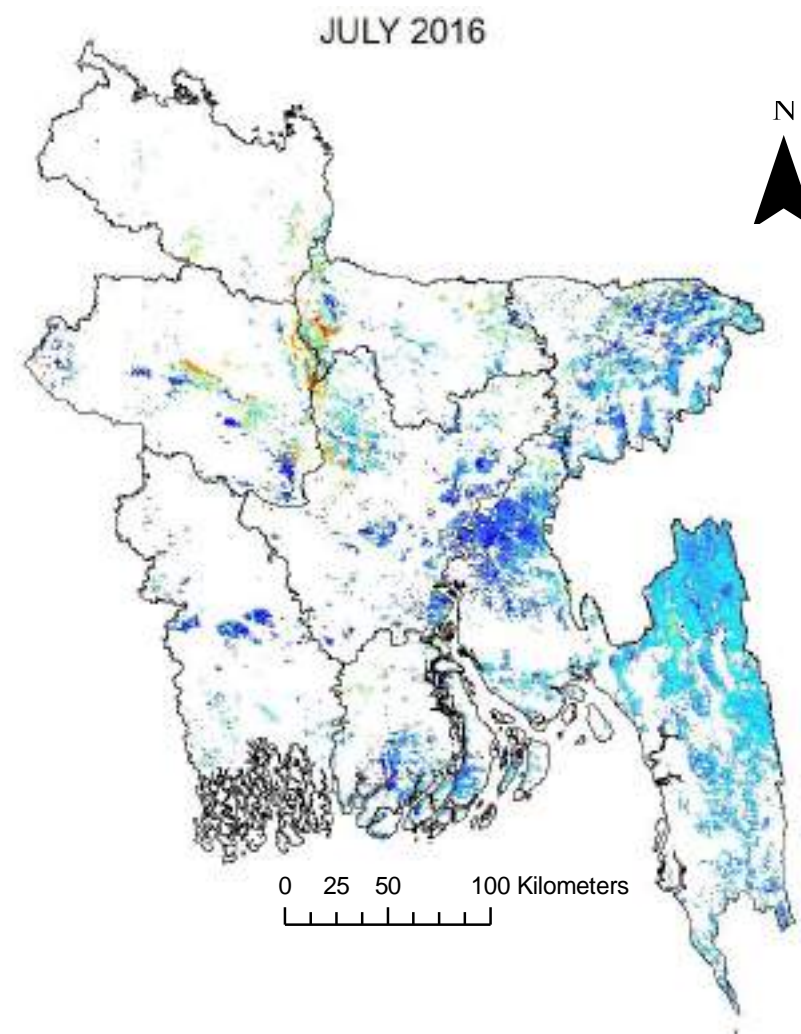
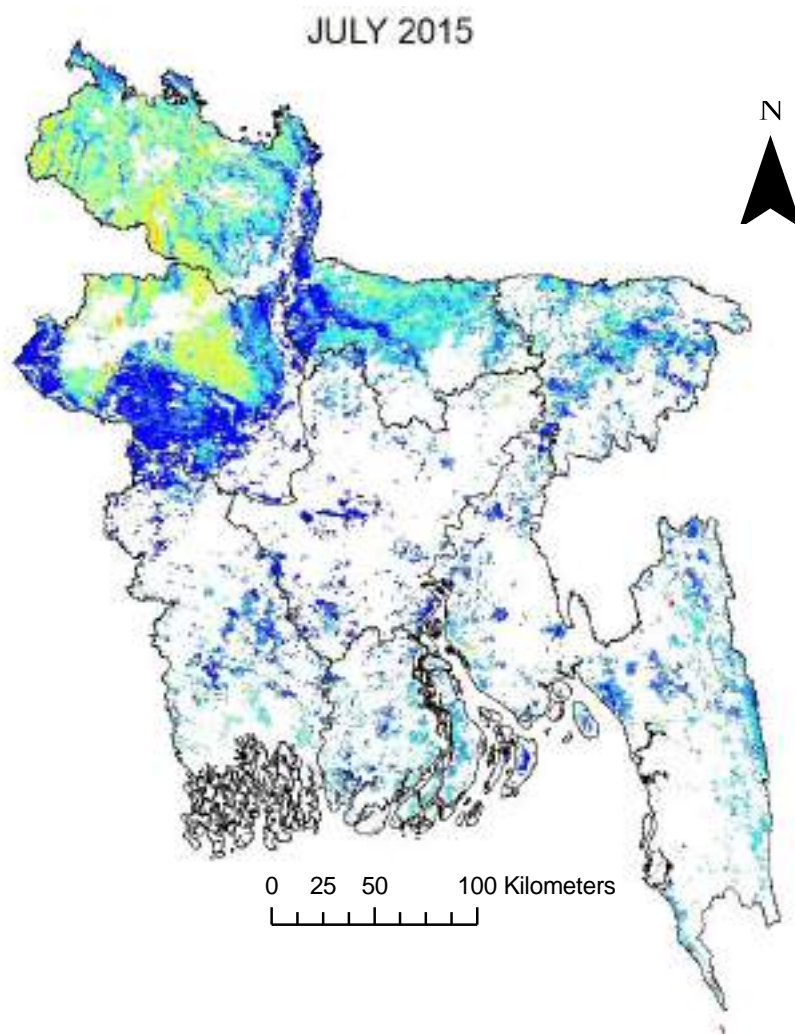
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend



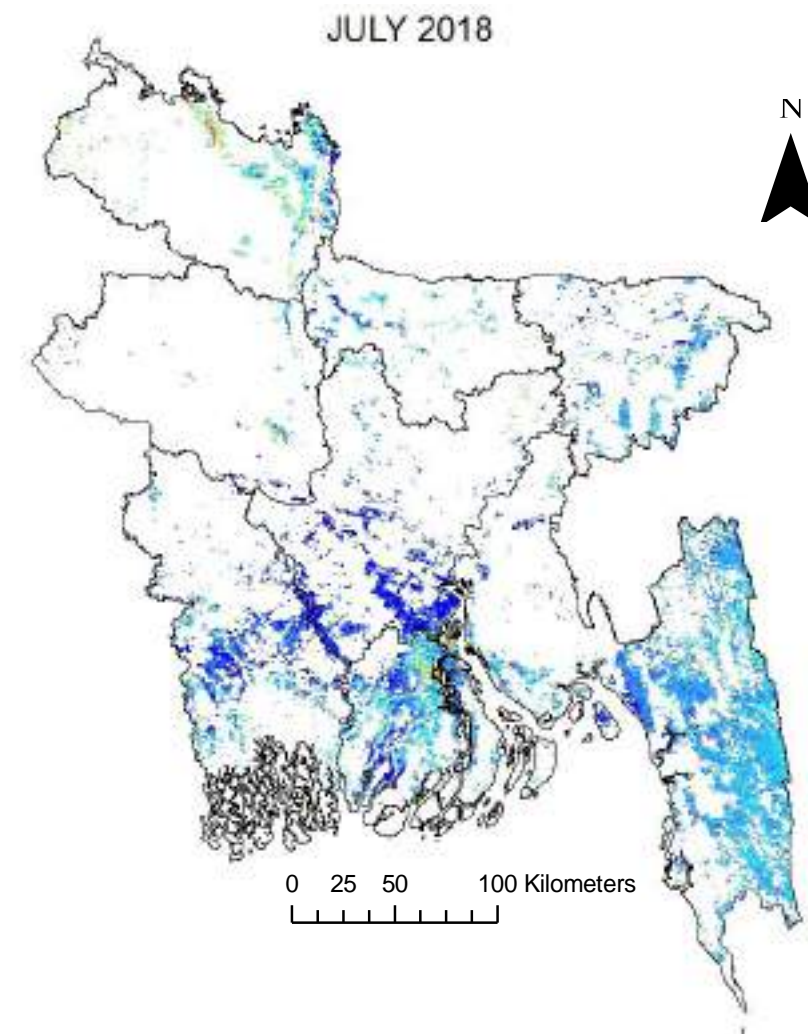
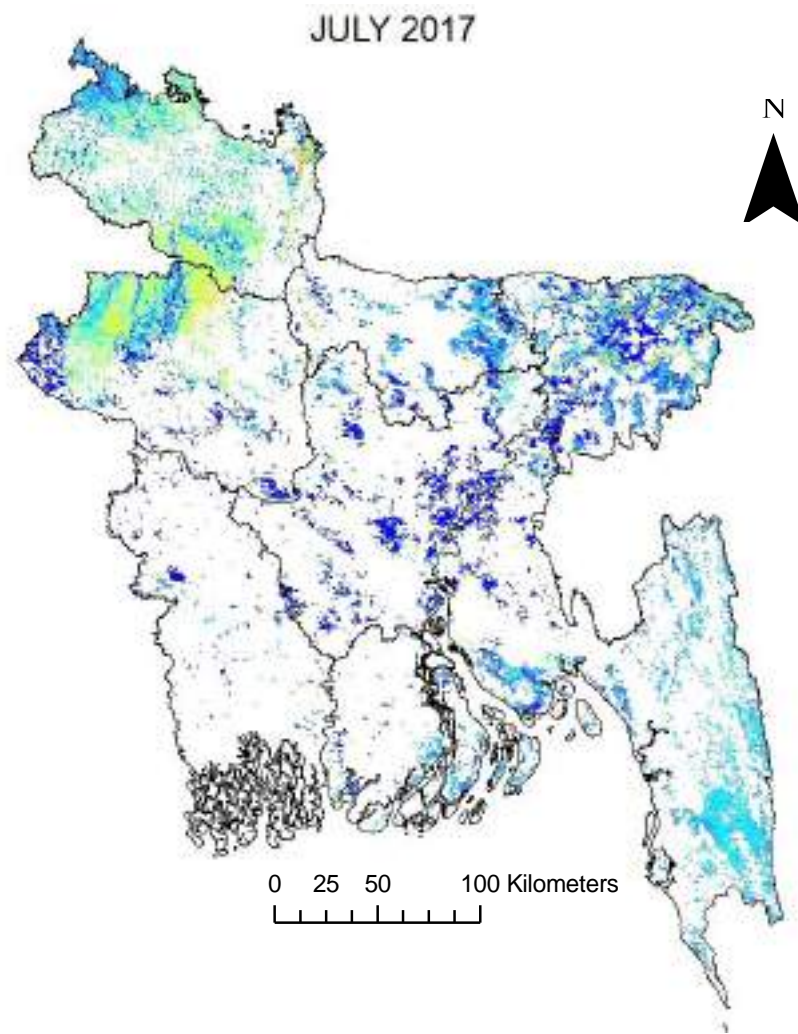


Legend





- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)





- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

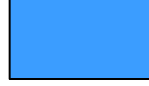


- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

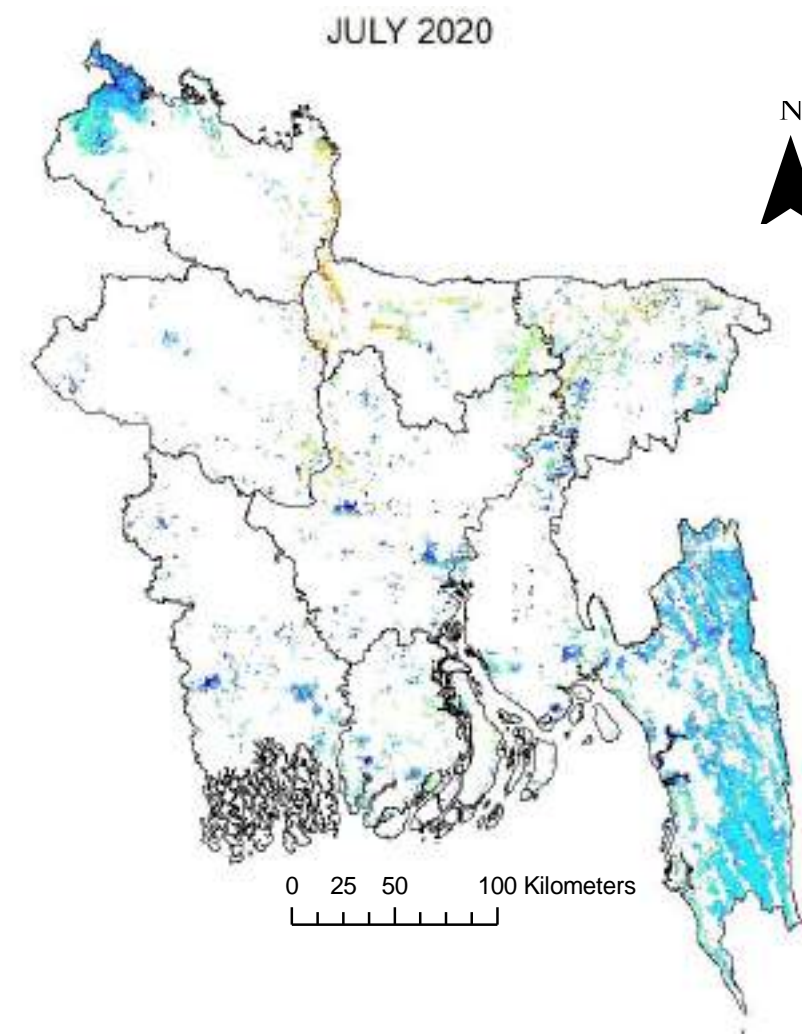
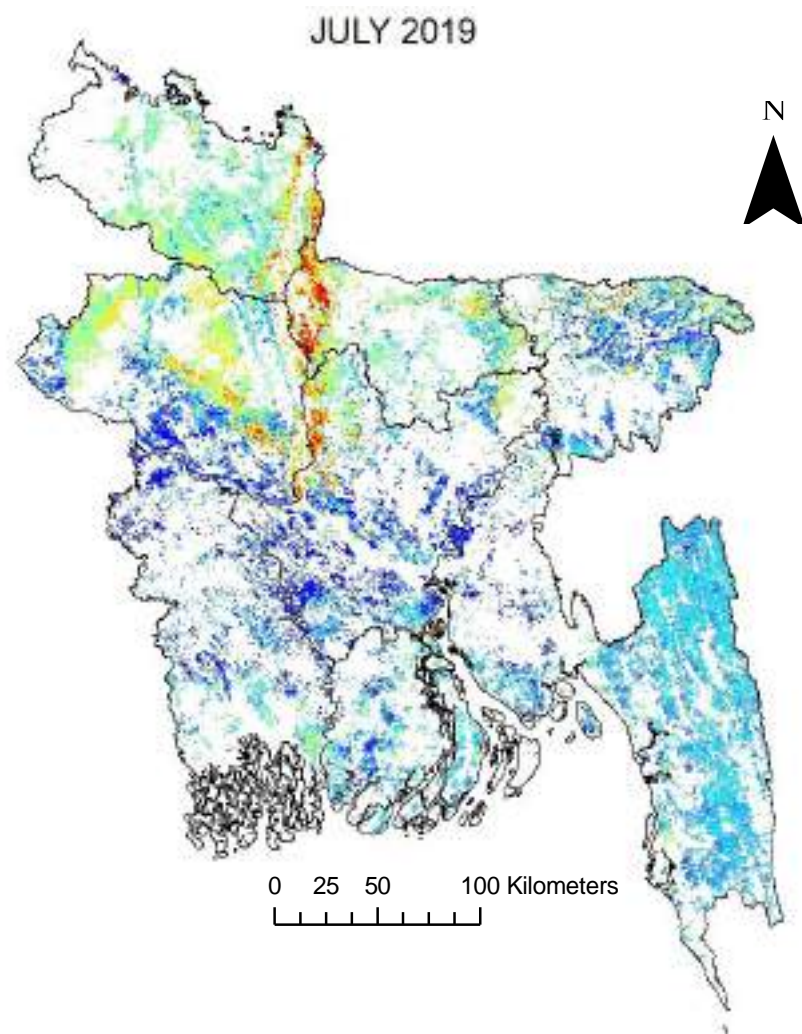


Legend

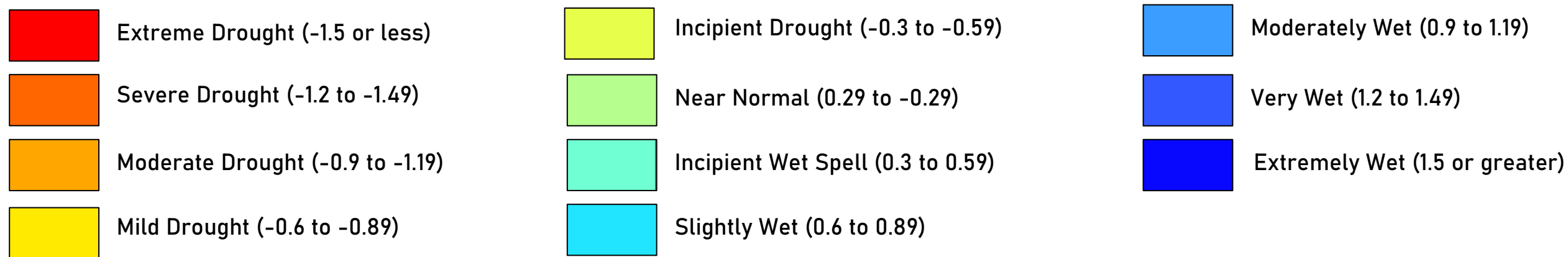
-  Extreme Drought (-1.5 or less)
-  Severe Drought (-1.2 to -1.49)
-  Moderate Drought (-0.9 to -1.19)
-  Mild Drought (-0.6 to -0.89)

-  Incipient Drought (-0.3 to -0.59)
-  Near Normal (0.29 to -0.29)
-  Incipient Wet Spell (0.3 to 0.59)
-  Slightly Wet (0.6 to 0.89)

-  Moderately Wet (0.9 to 1.19)
-  Very Wet (1.2 to 1.49)
-  Extremely Wet (1.5 or greater)



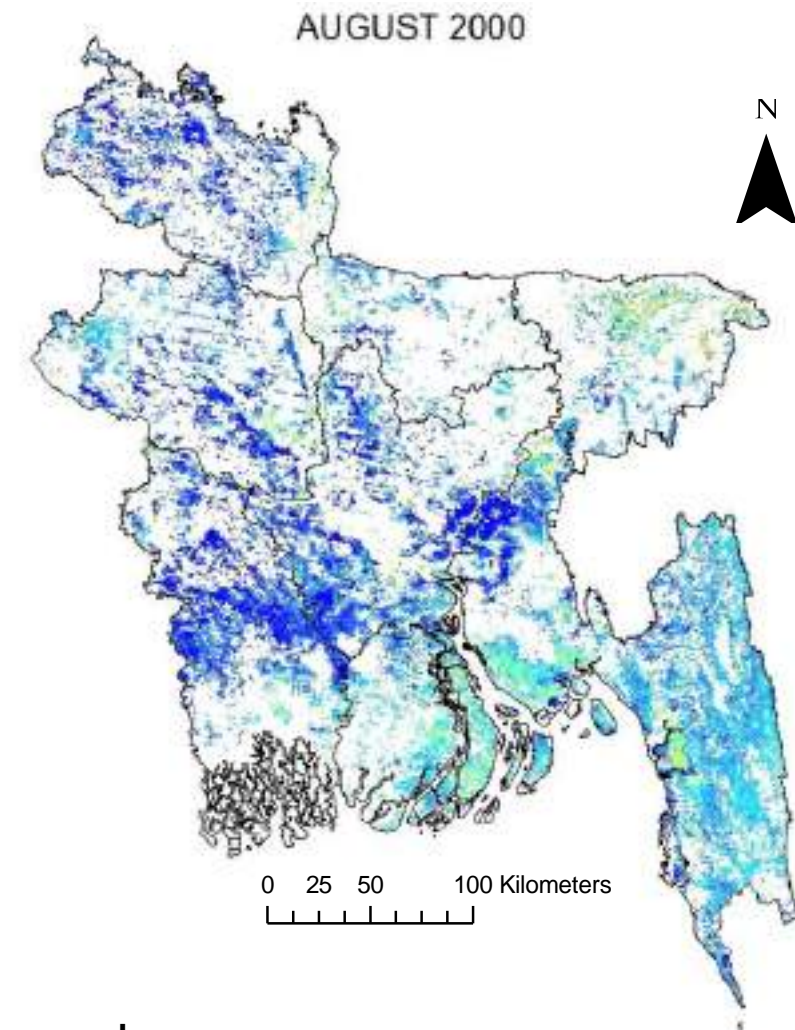
Legend



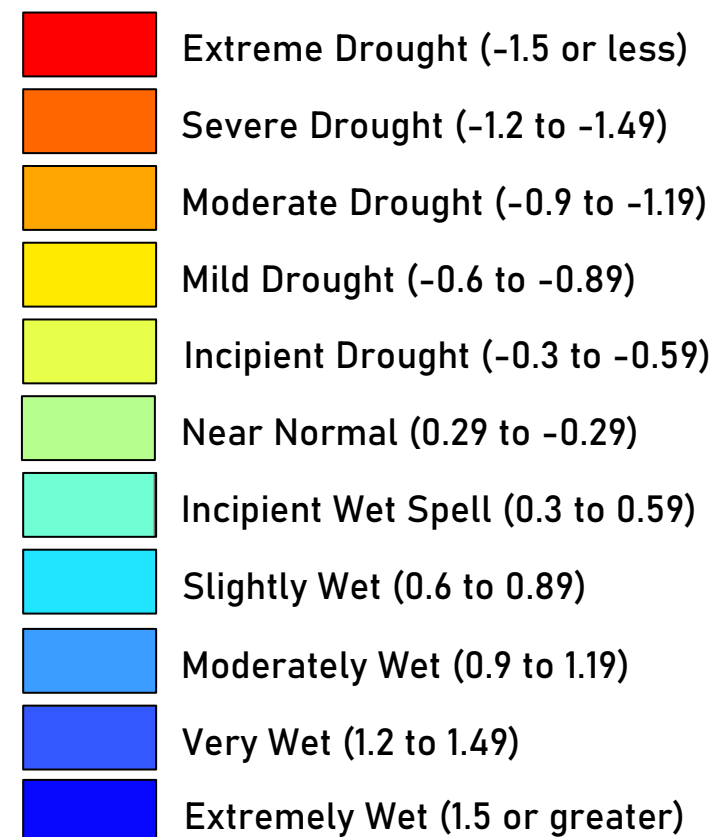
August DSI Maps

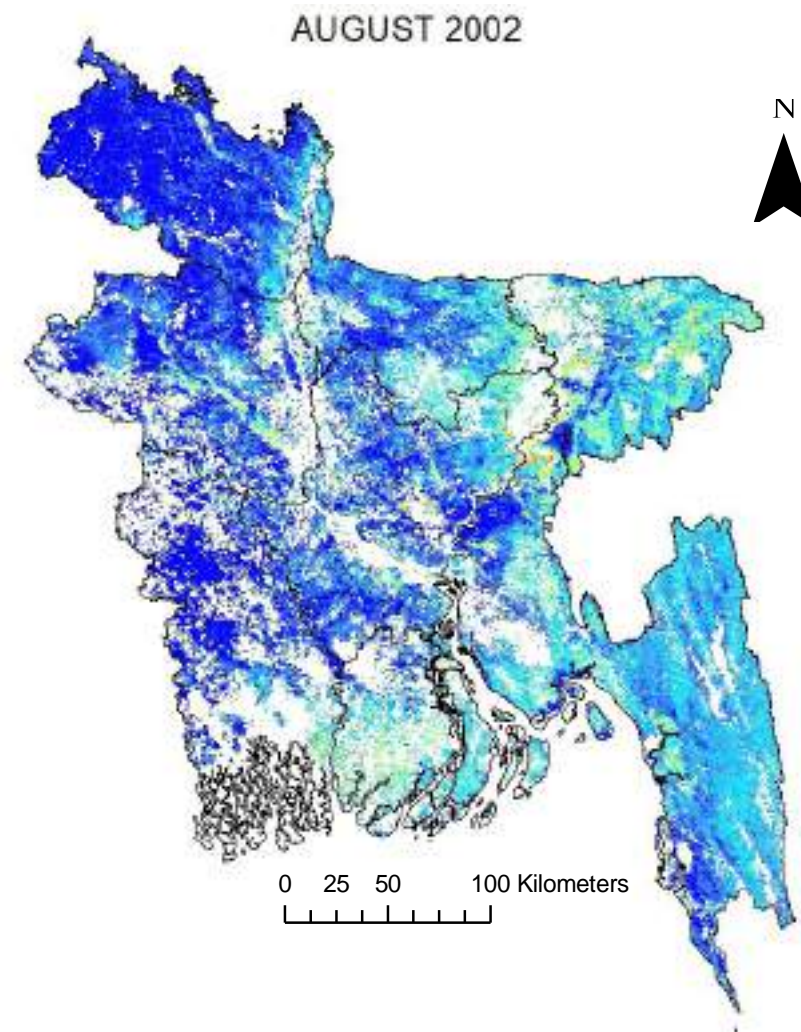
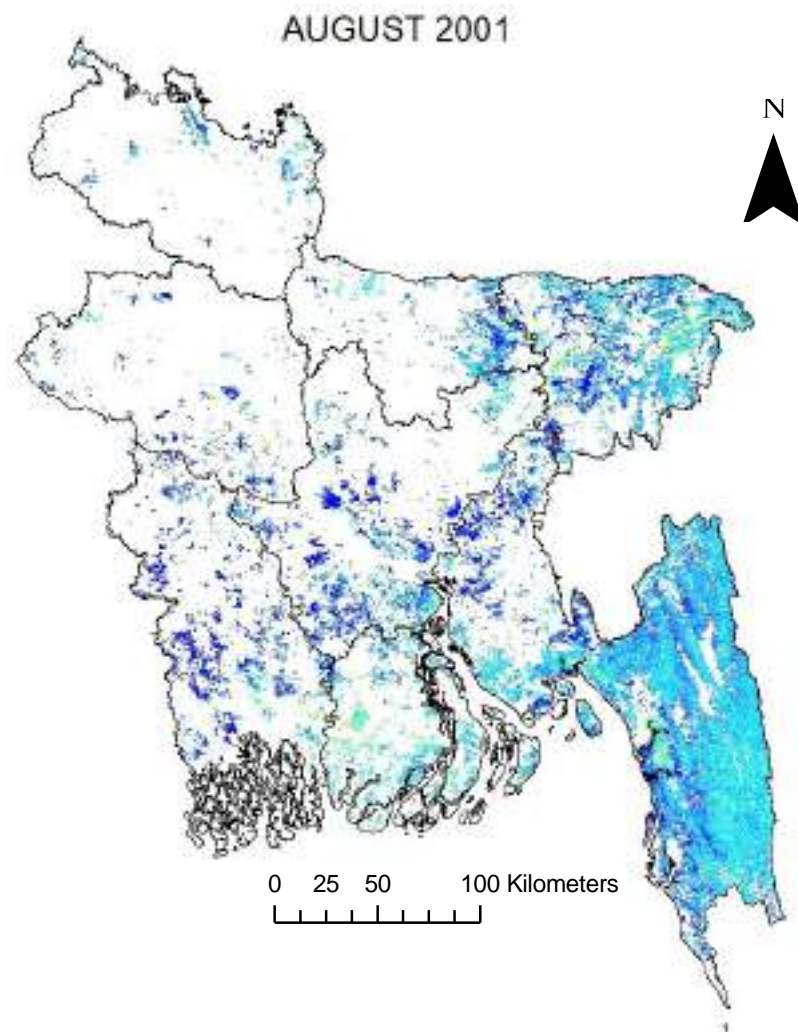
August is the monsoon month. This month is generally seen in wet condition ranging from slightly wet to extremely wet condition.

Mean August DSI Values		
Years	Values	Drought Condition
2000	1.16	Moderately Wet
2001	1.36	Very Wet
2002	1.52	Extremely Wet
2003	0.89	Slightly Wet
2004	1.15	Moderately Wet
2005	1.44	Very Wet
2006	1.35	Very Wet
2007	1.04	Moderately Wet
2008	1.13	Moderately Wet
2009	1.47	Very Wet
2010	1.94	Extremely Wet
2011	1.62	Extremely Wet
2012	1.65	Extremely Wet
2013	1.48	Very Wet
2014	1.31	Very Wet
2015	1.45	Very Wet
2016	1.24	Very Wet
2017	1.21	Very Wet
2018	1.14	Moderately Wet
2019	1.26	Very Wet
2020	0.94	Moderately Wet



Legend



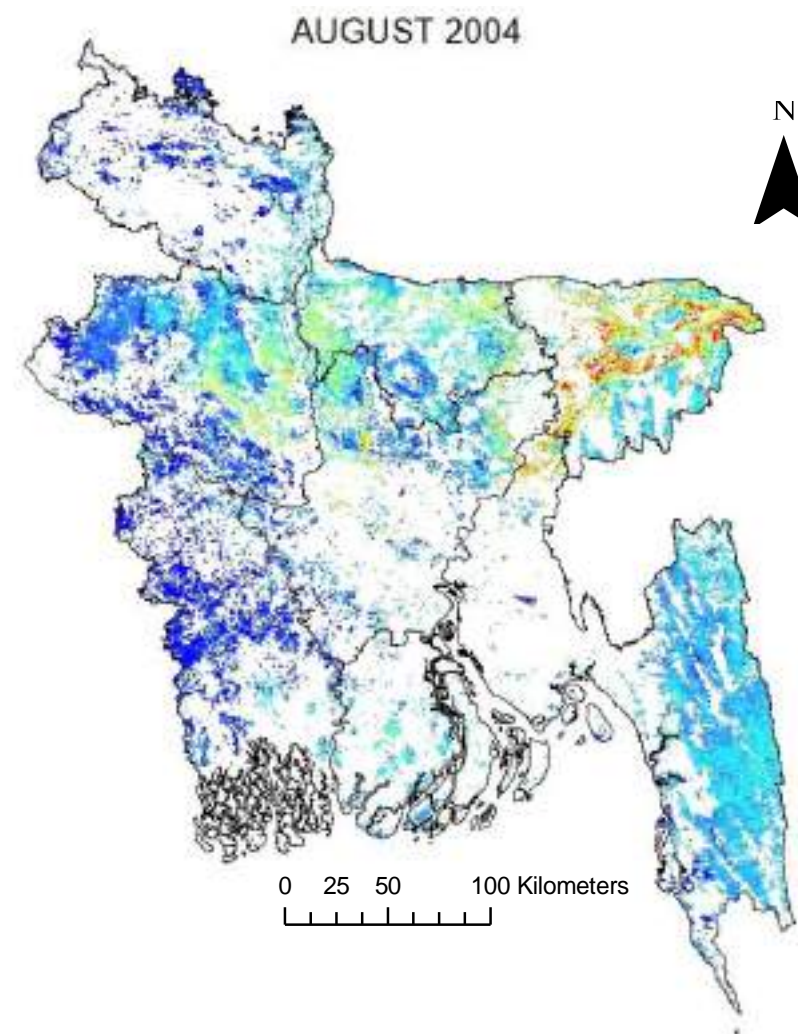
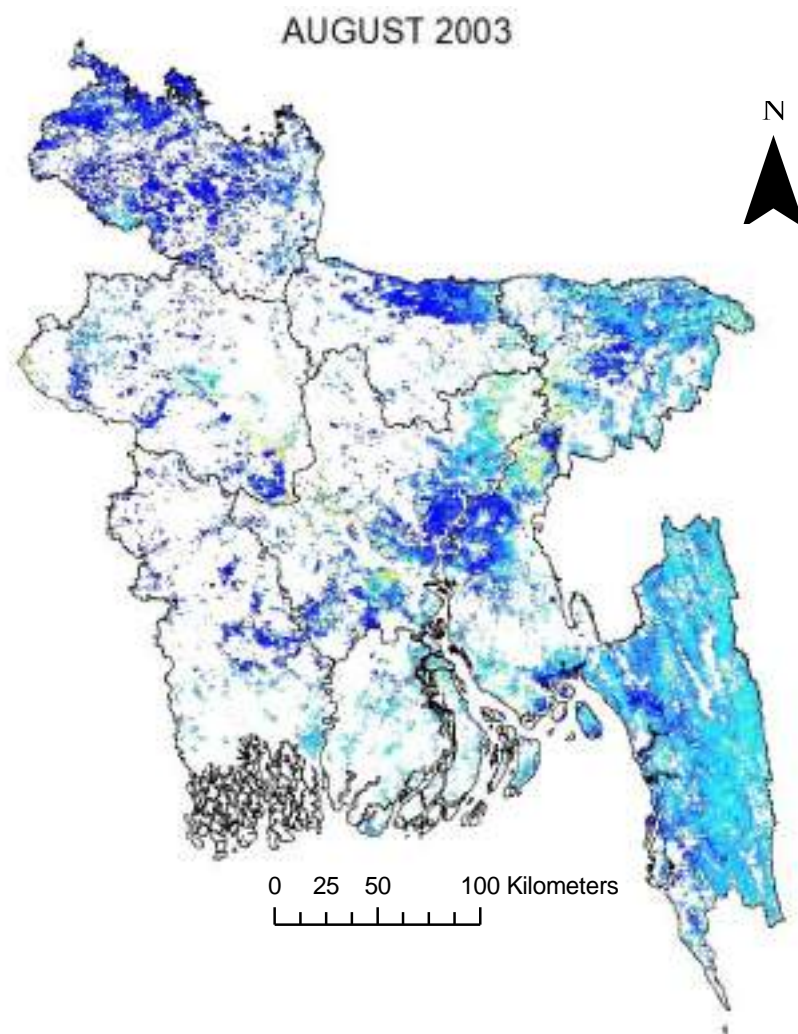


Legend

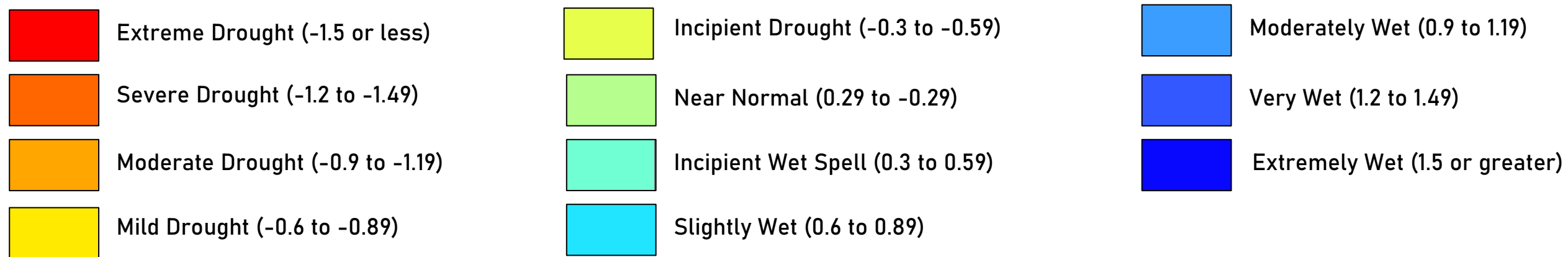
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

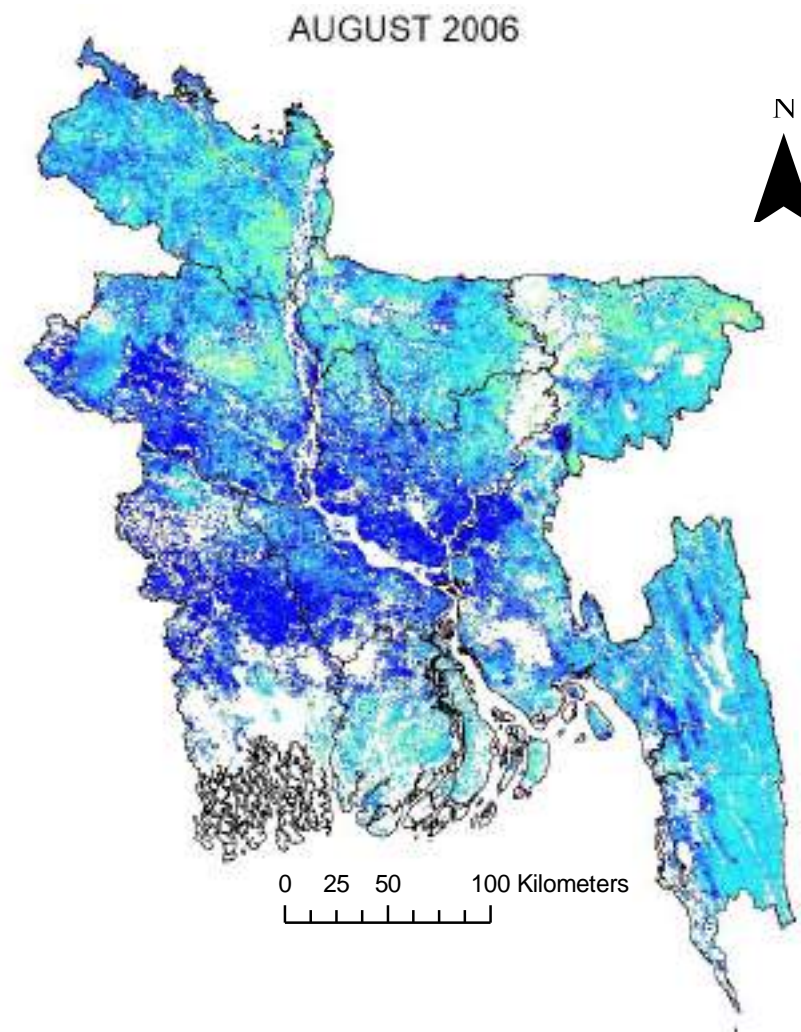
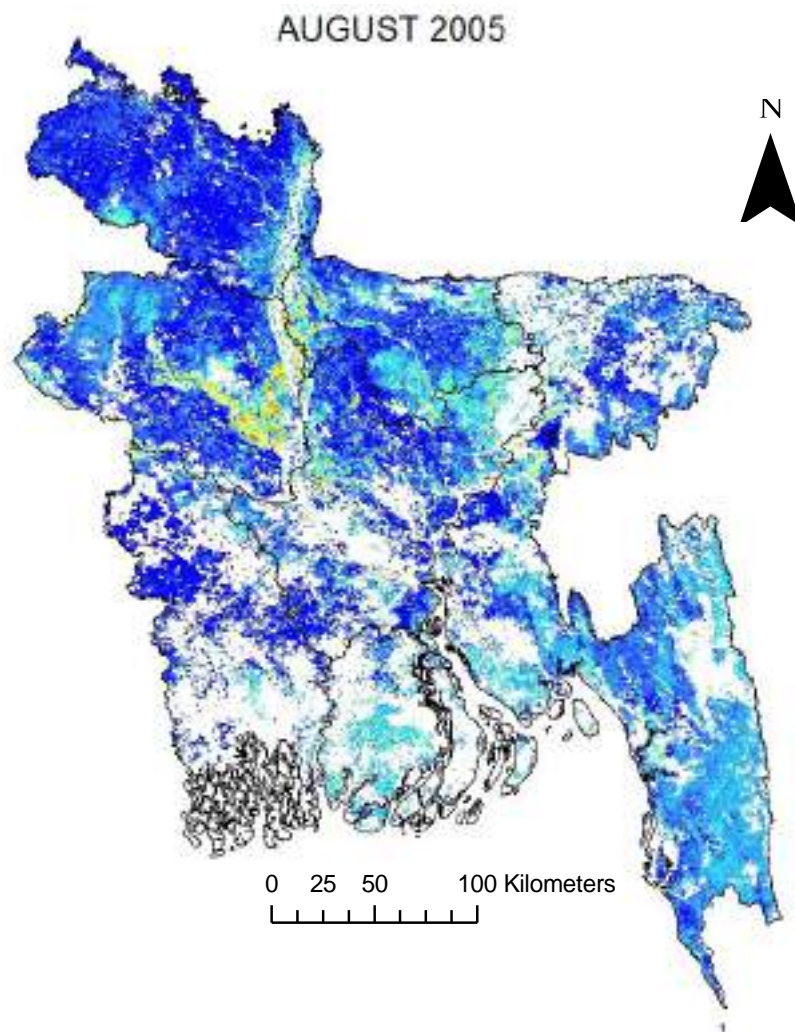
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend



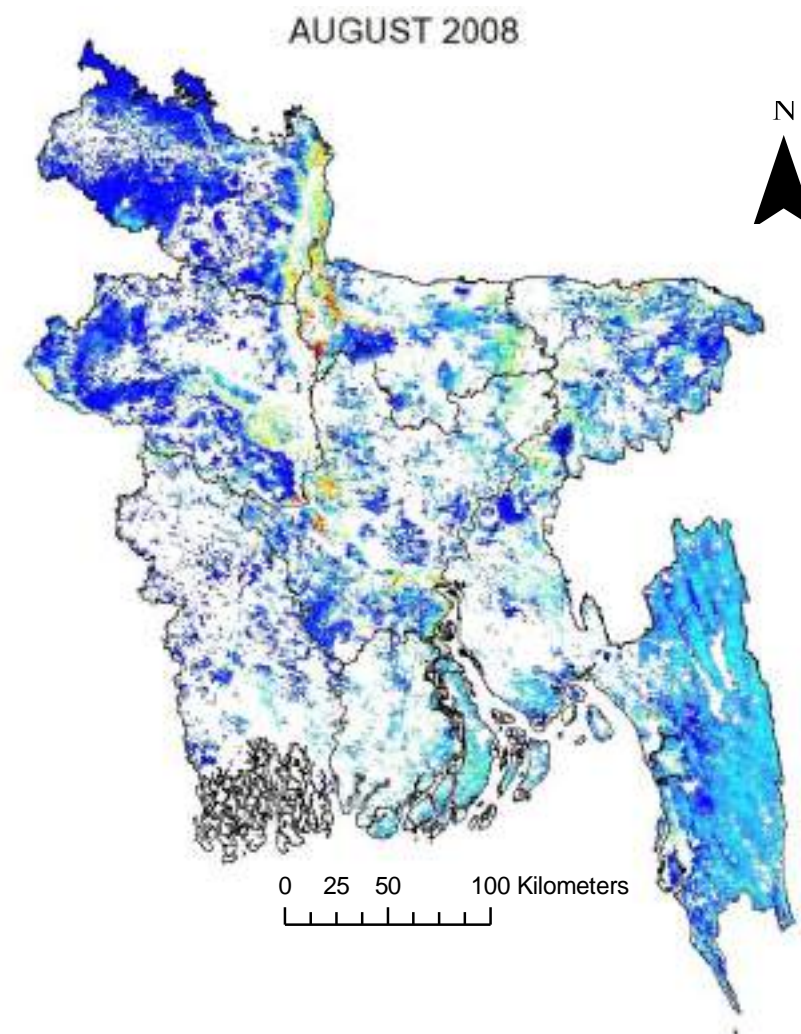
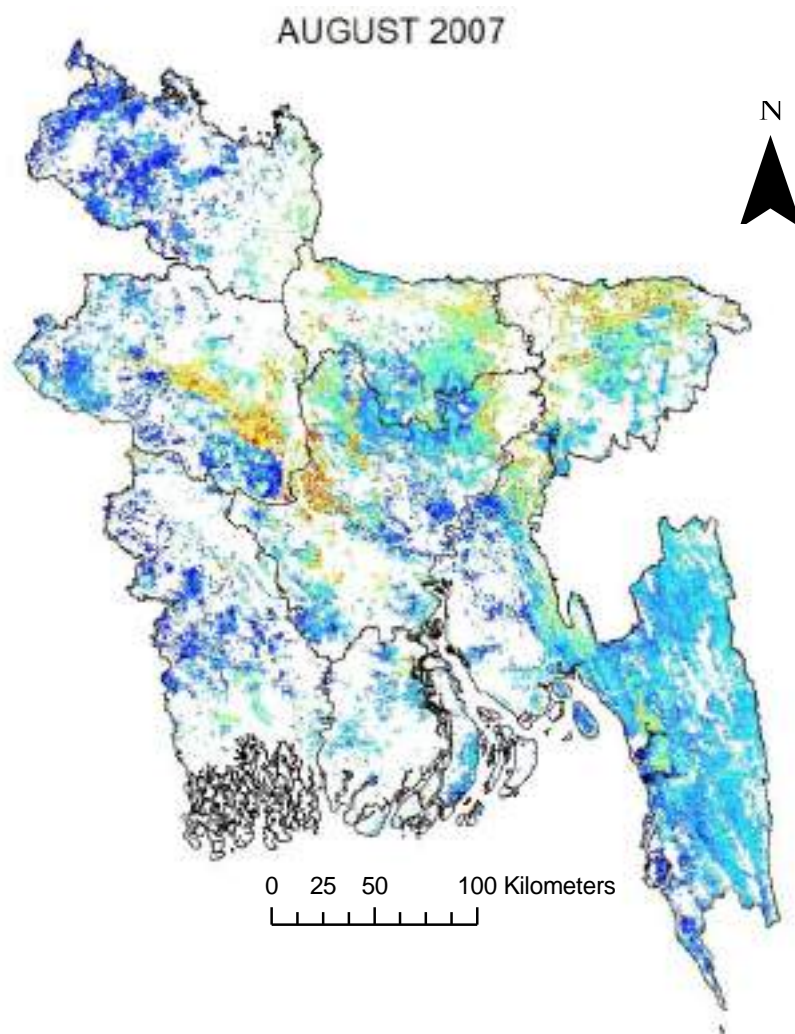


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

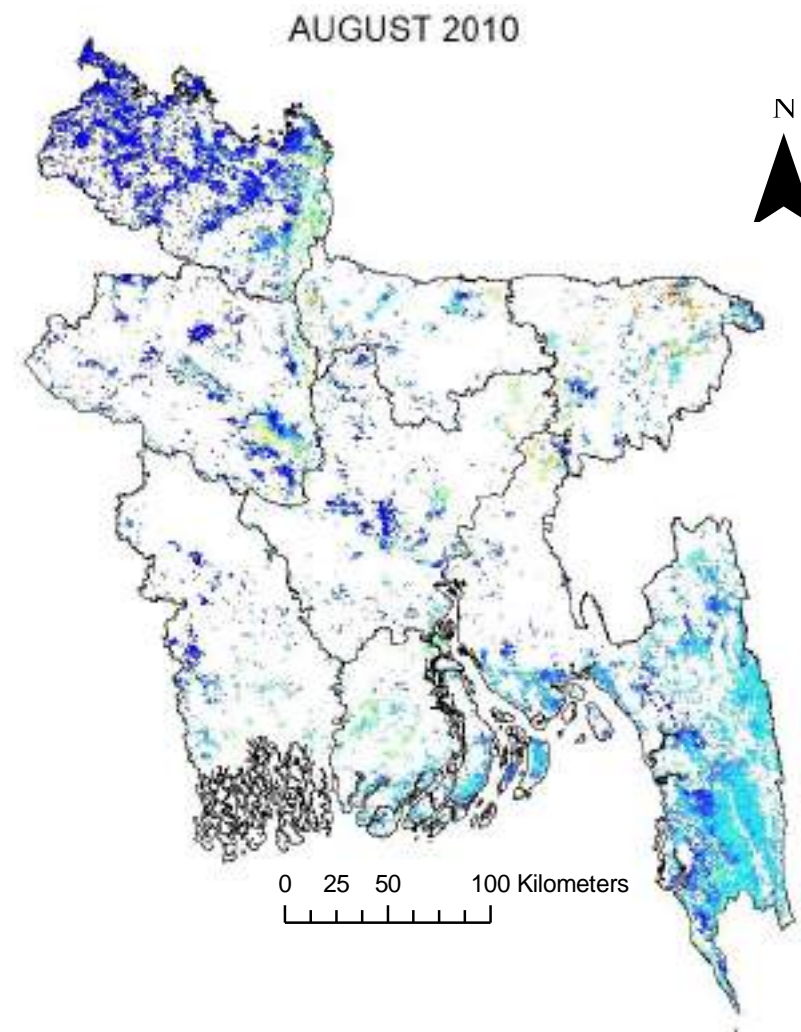
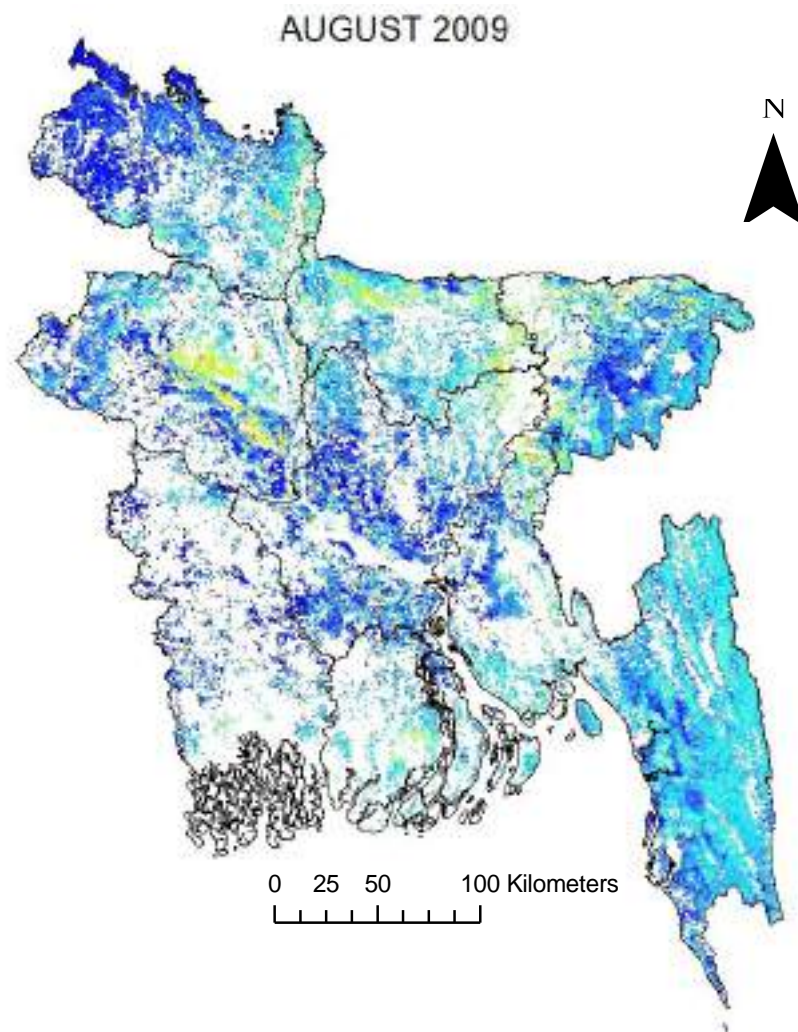


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

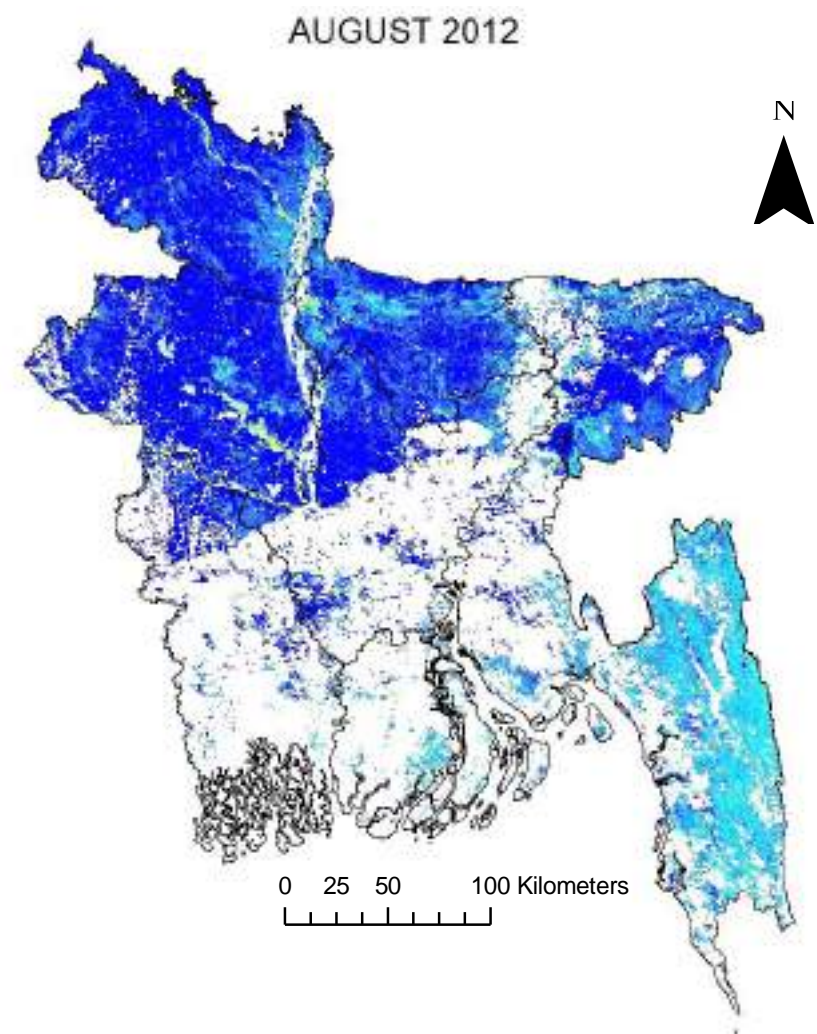
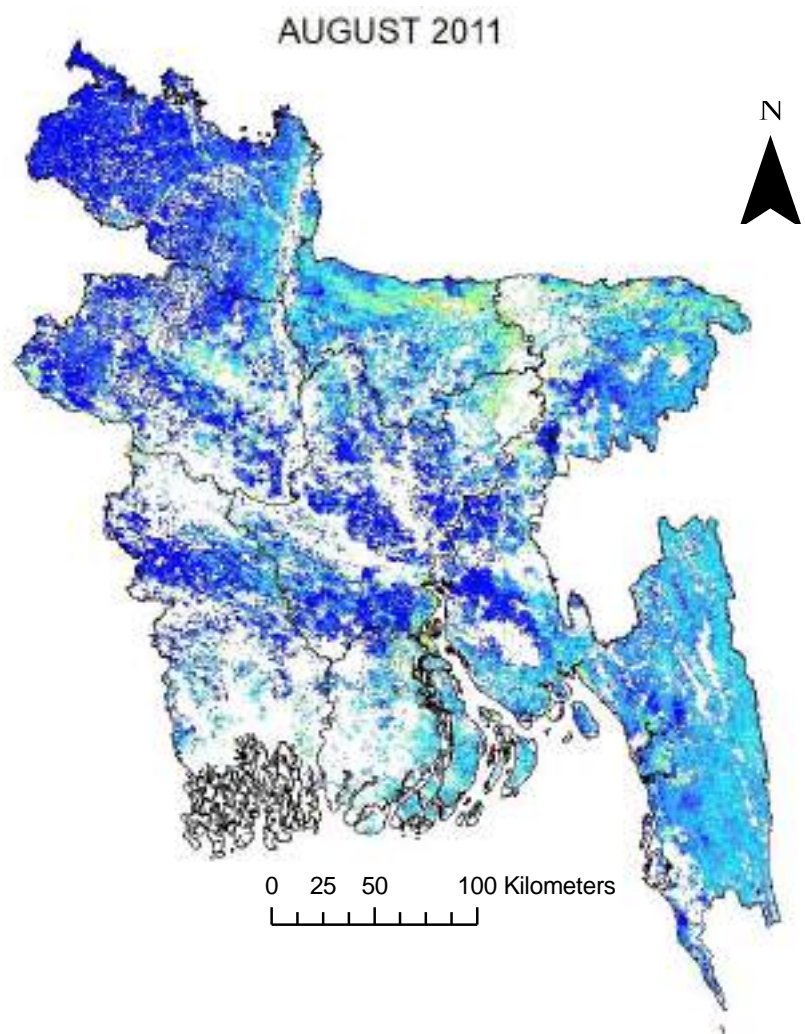


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

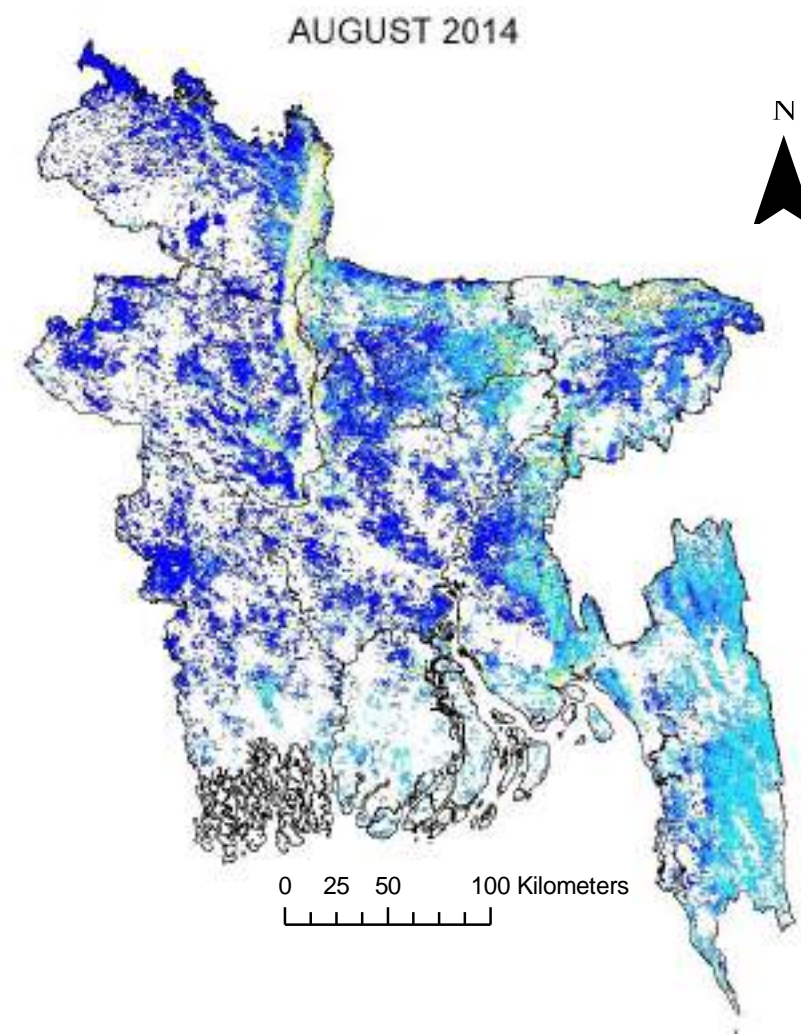
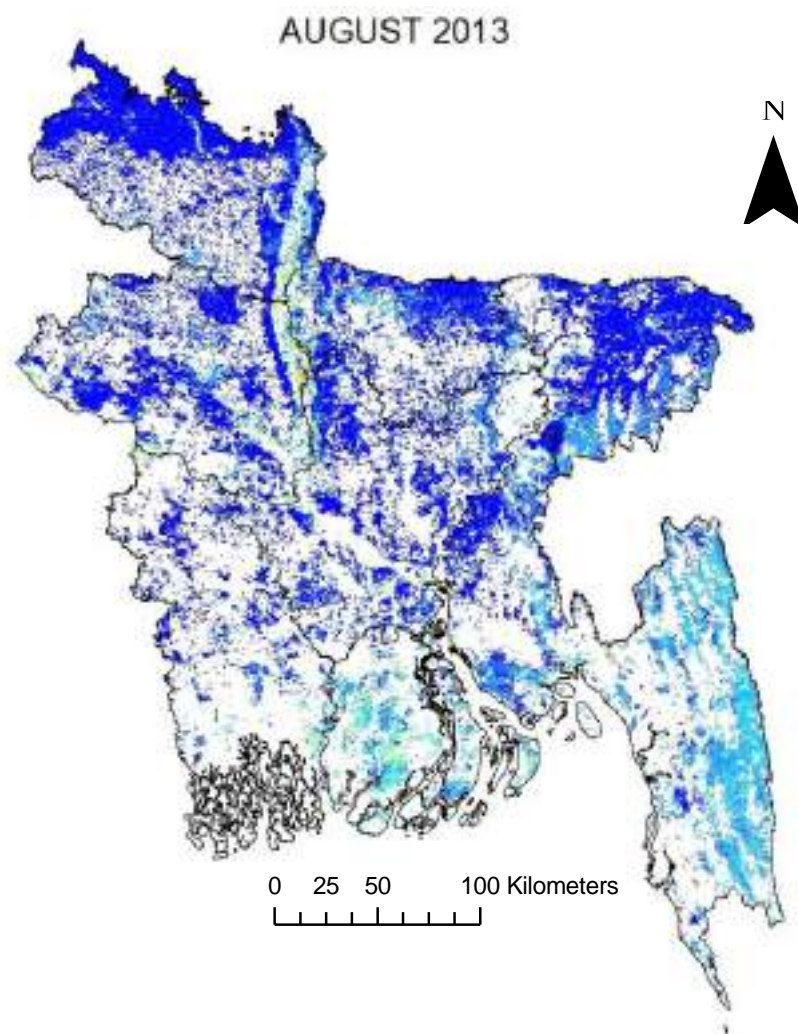


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

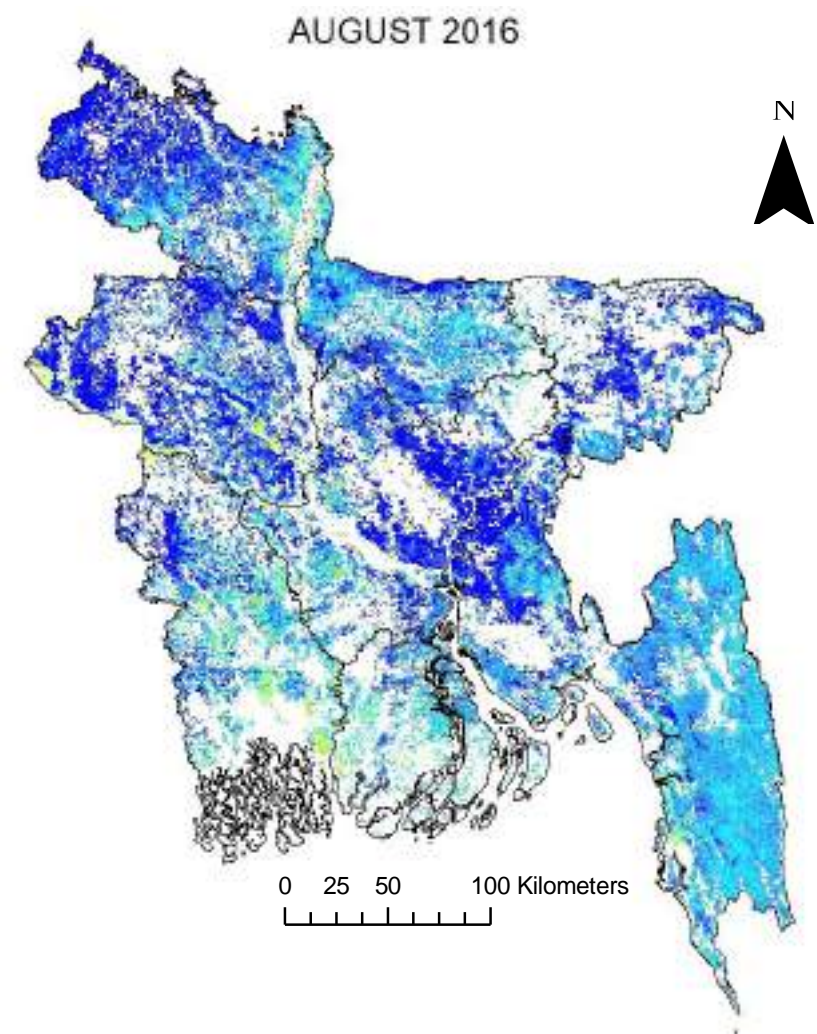
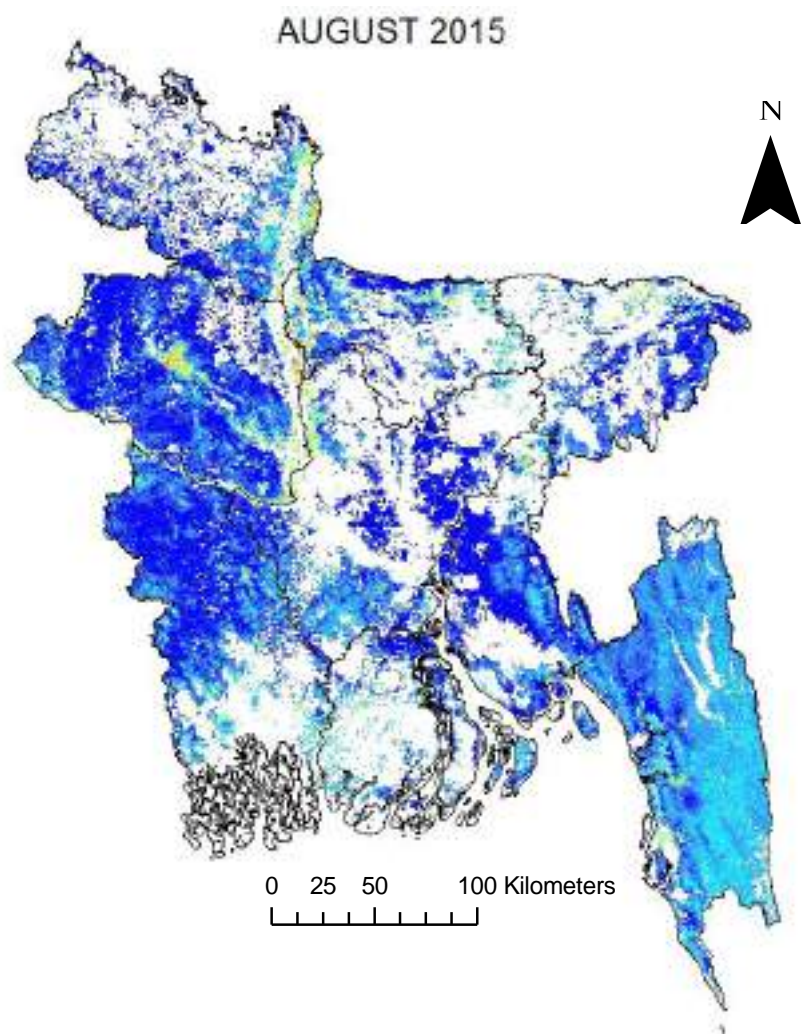


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

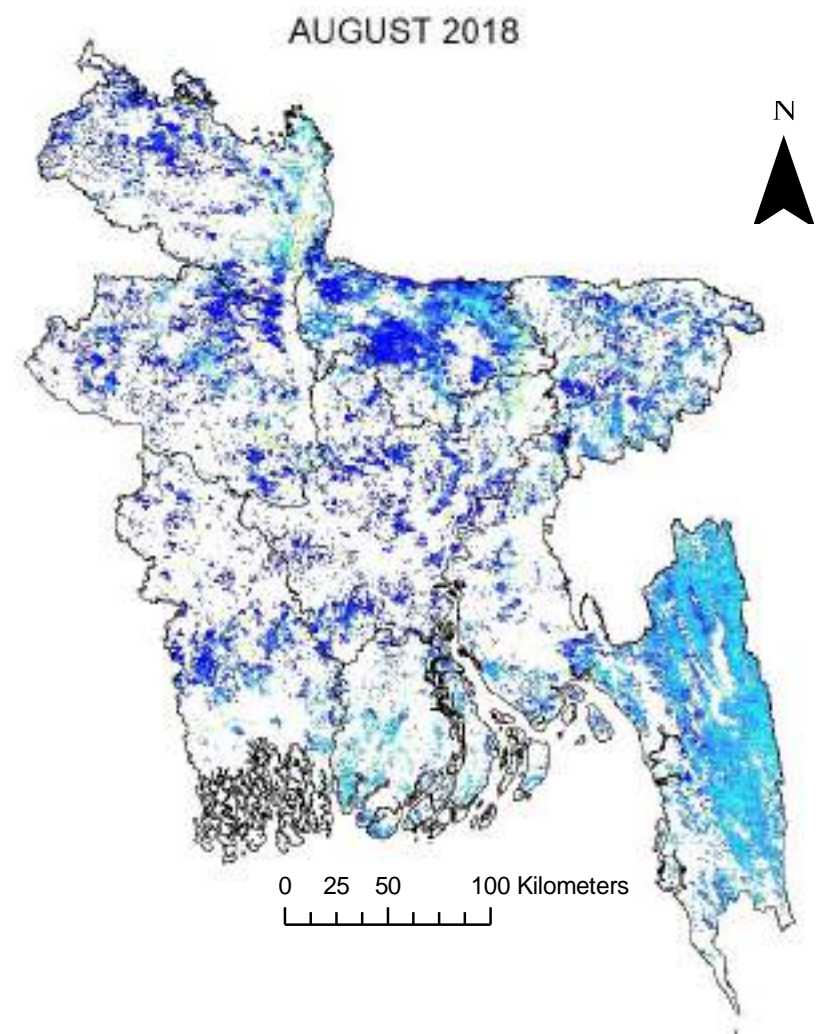
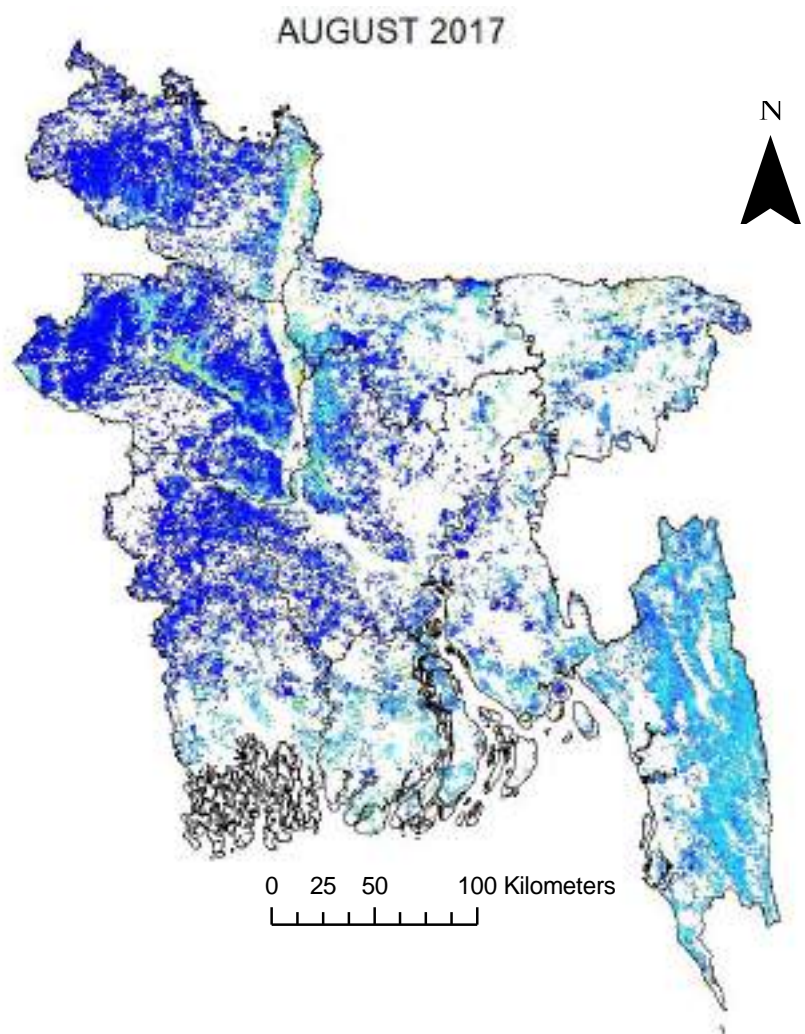


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

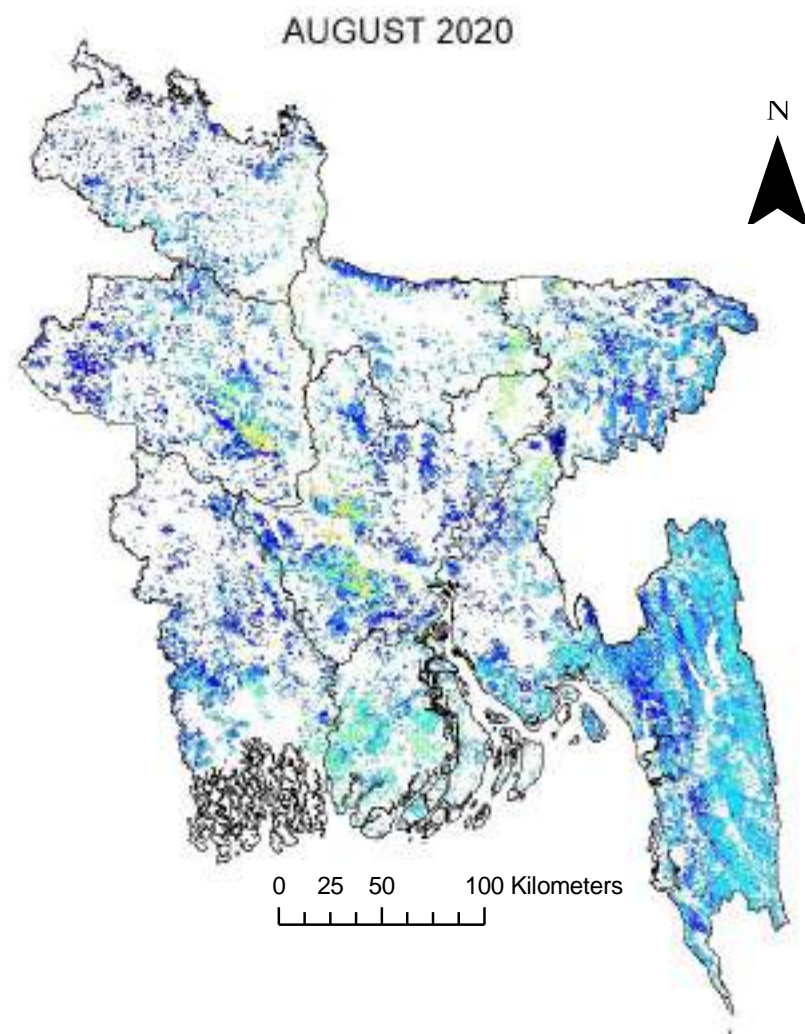
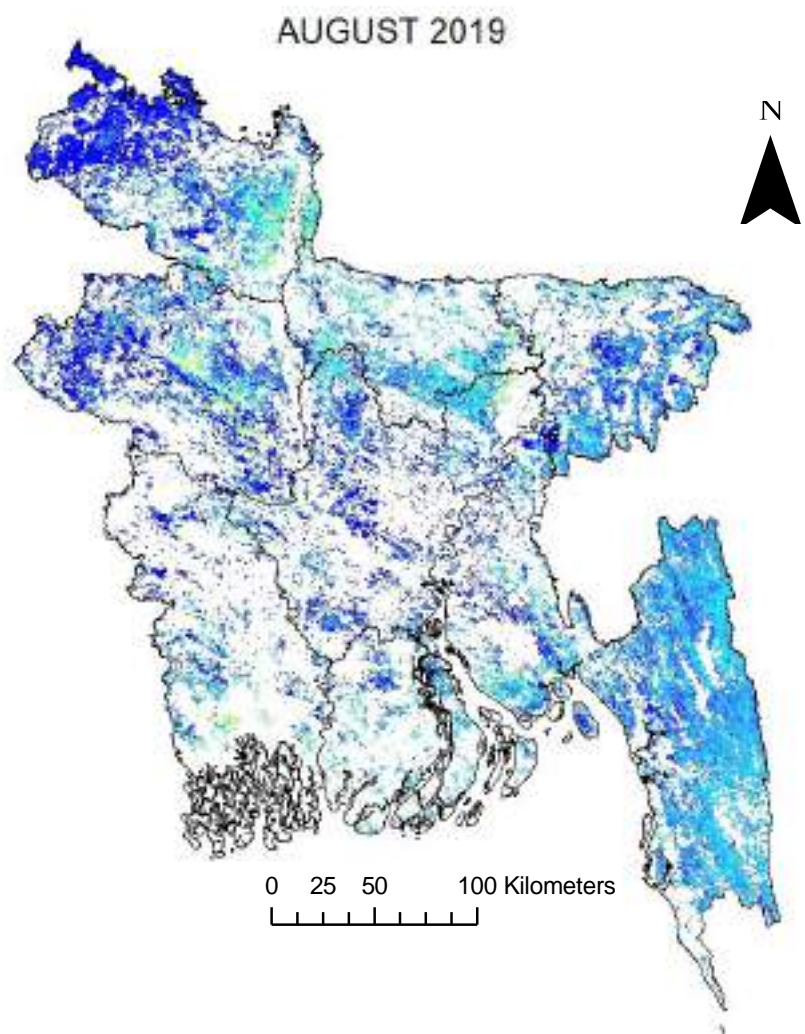


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

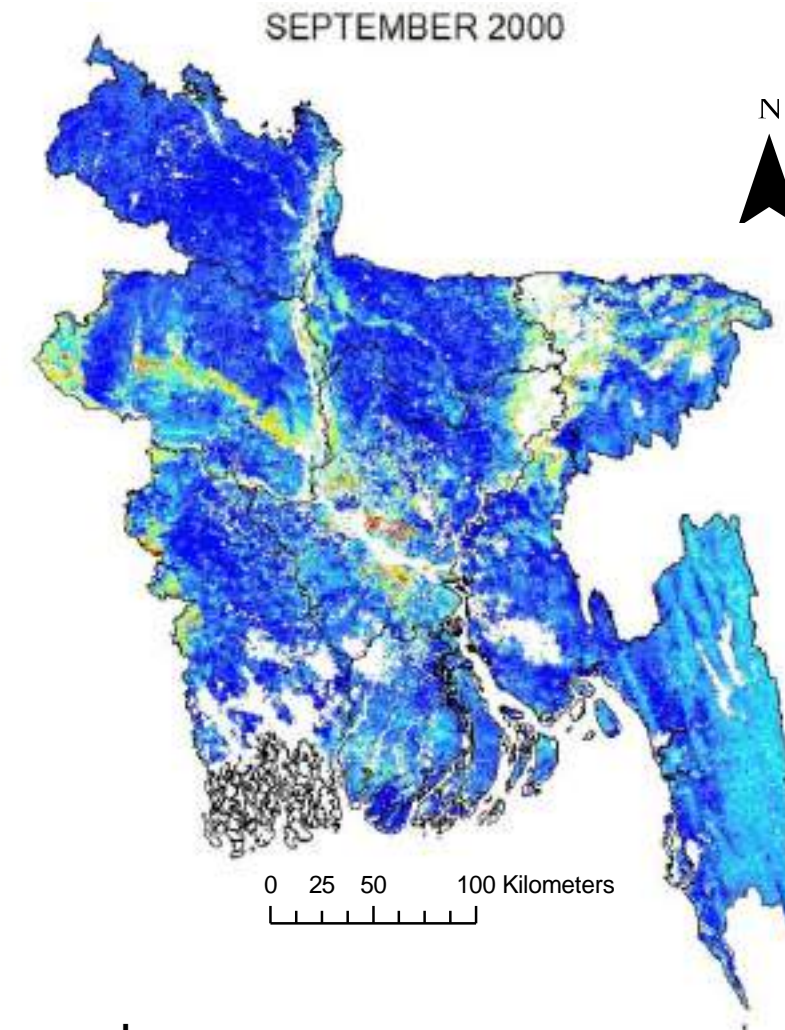
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

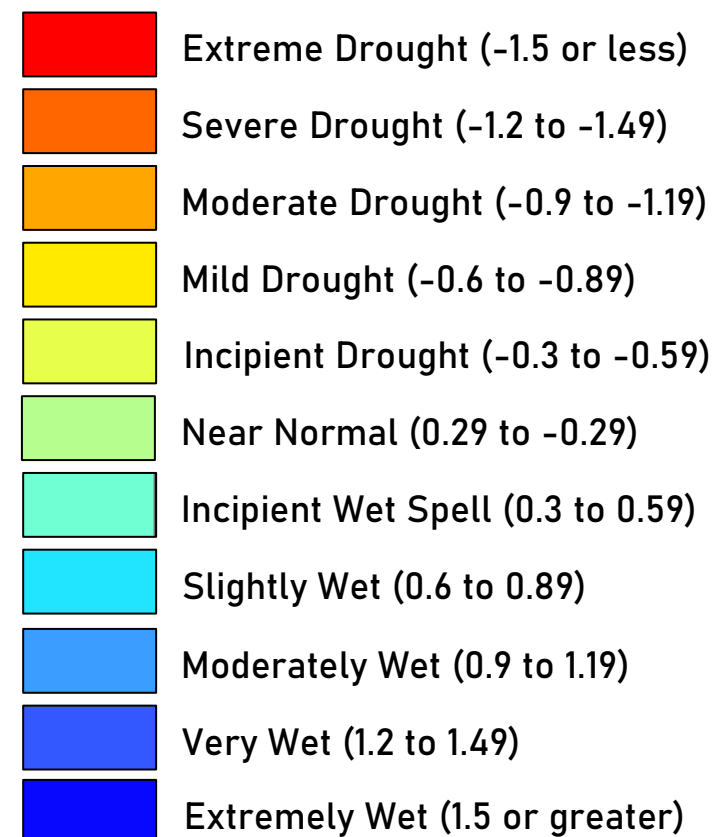
September DSI Maps

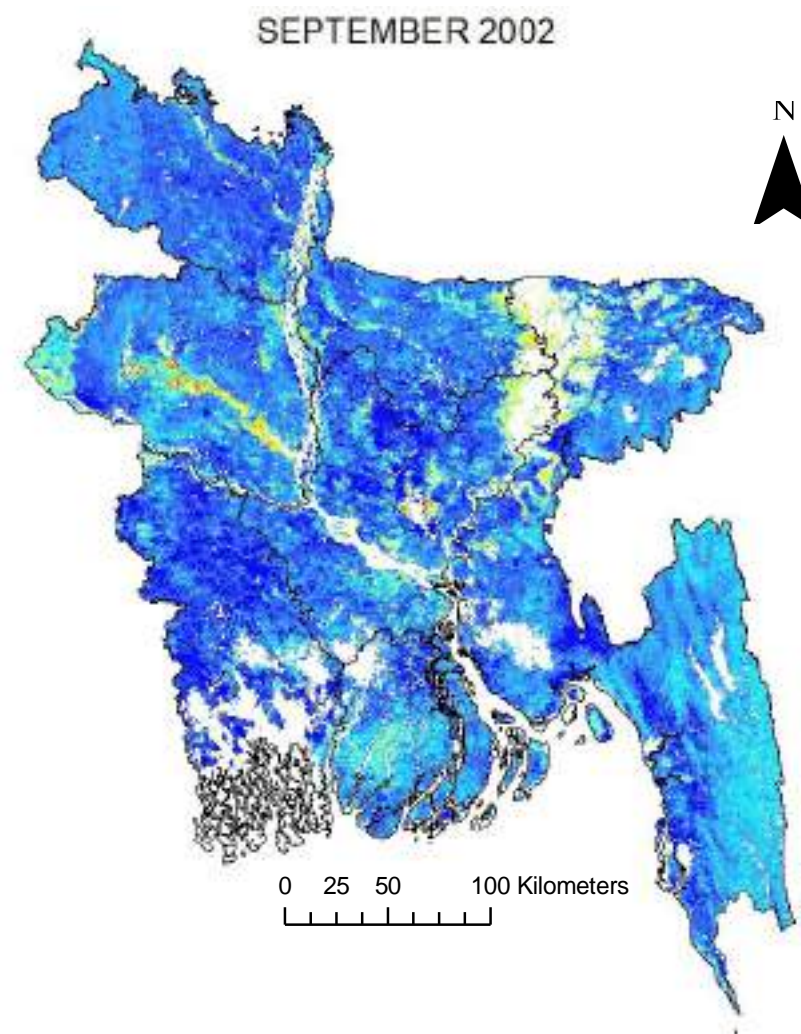
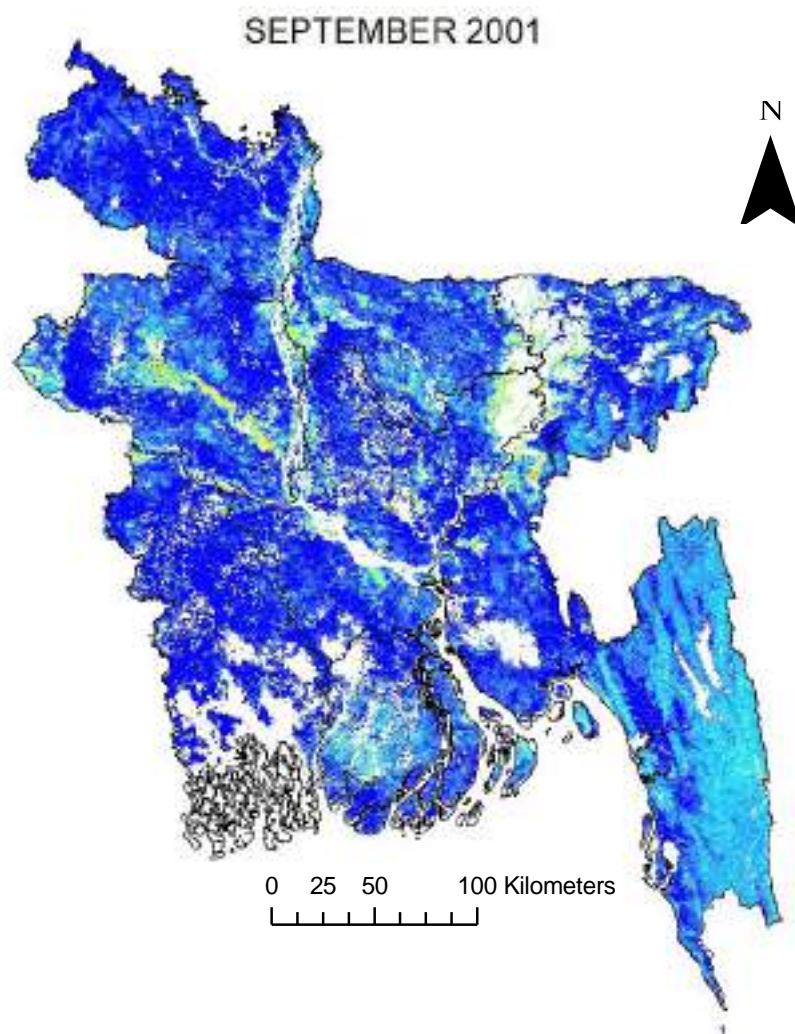
In September, drought conditions are characterized by very wet to extremely wet condition. This monsoon month is extremely wet in all parts of the country.

Mean September DSI Values		
Years	Values	Drought Condition
2000	1.42	Very Wet
2001	1.80	Extremely Wet
2002	1.33	Very Wet
2003	1.57	Extremely Wet
2004	1.49	Very Wet
2005	1.73	Extremely Wet
2006	1.42	Very Wet
2007	1.34	Very Wet
2008	1.58	Extremely Wet
2009	1.65	Extremely Wet
2010	1.64	Extremely Wet
2011	1.42	Very Wet
2012	1.53	Extremely Wet
2013	1.66	Extremely Wet
2014	1.23	Very Wet
2015	1.34	Very Wet
2016	1.33	Very Wet
2017	1.53	Extremely Wet
2018	1.23	Very Wet
2019	1.58	Extremely Wet
2020	1.58	Extremely Wet



Legend



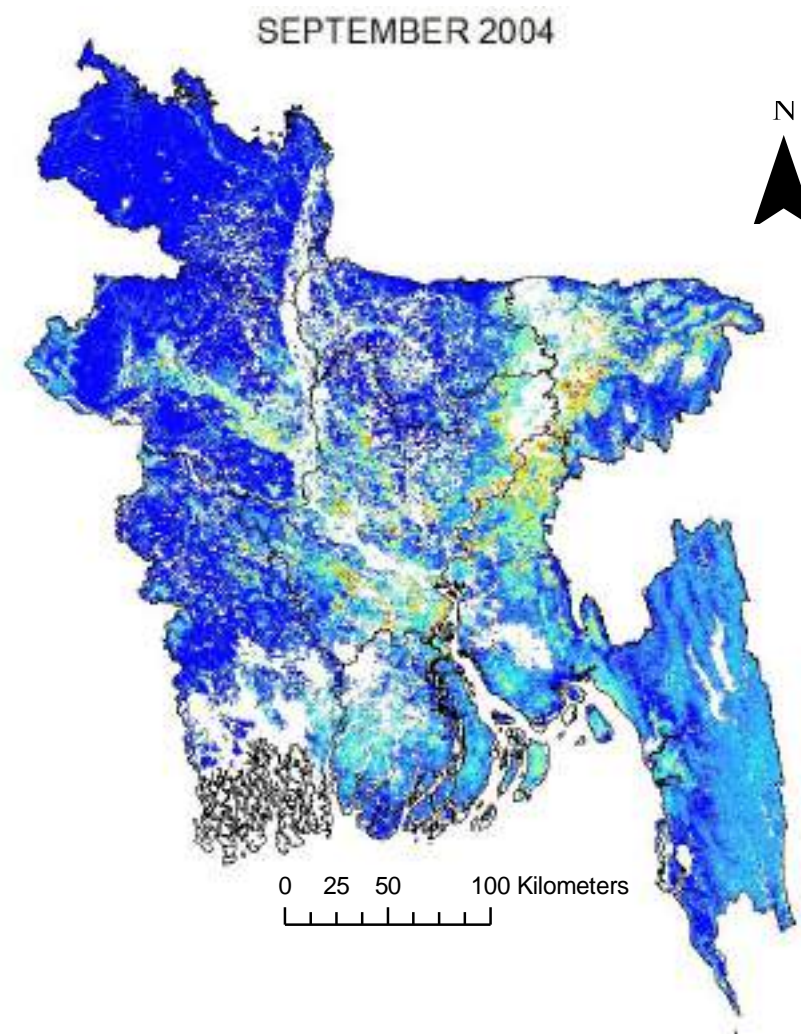
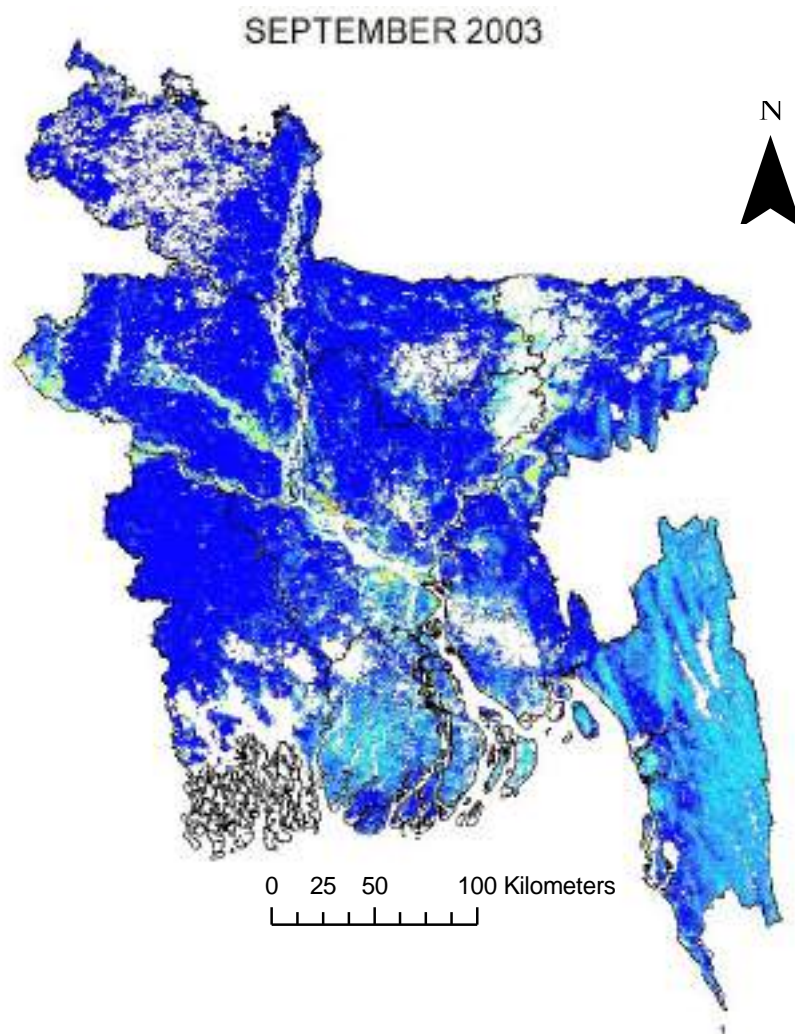


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

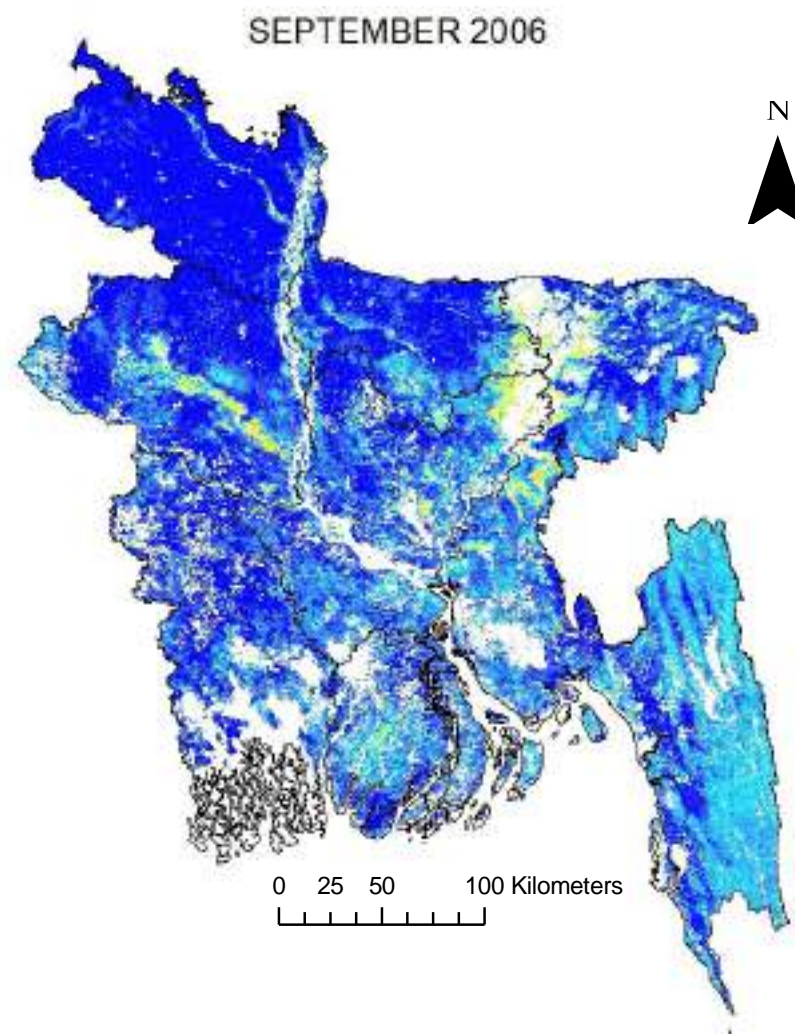
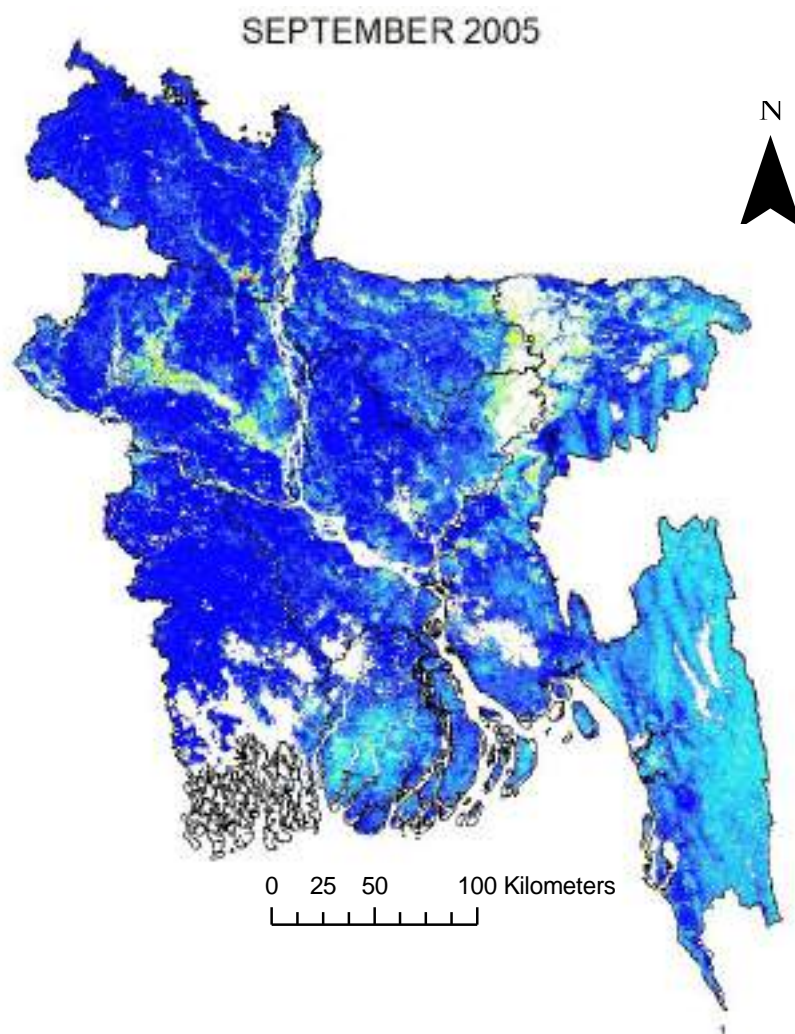


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

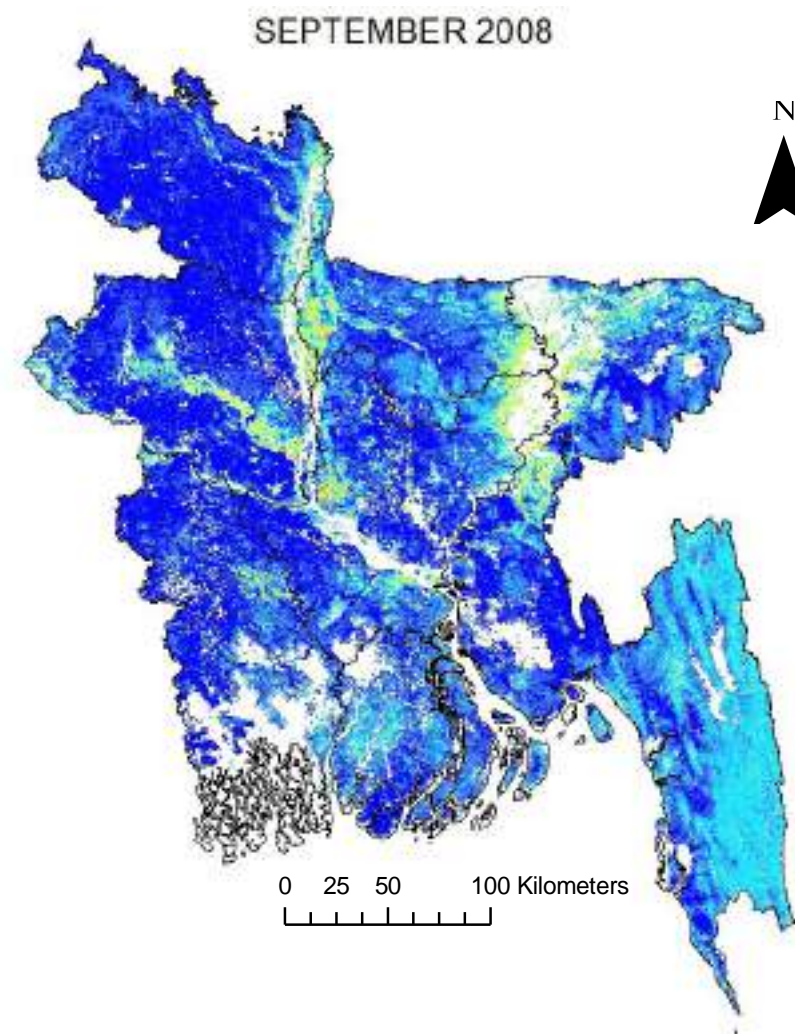
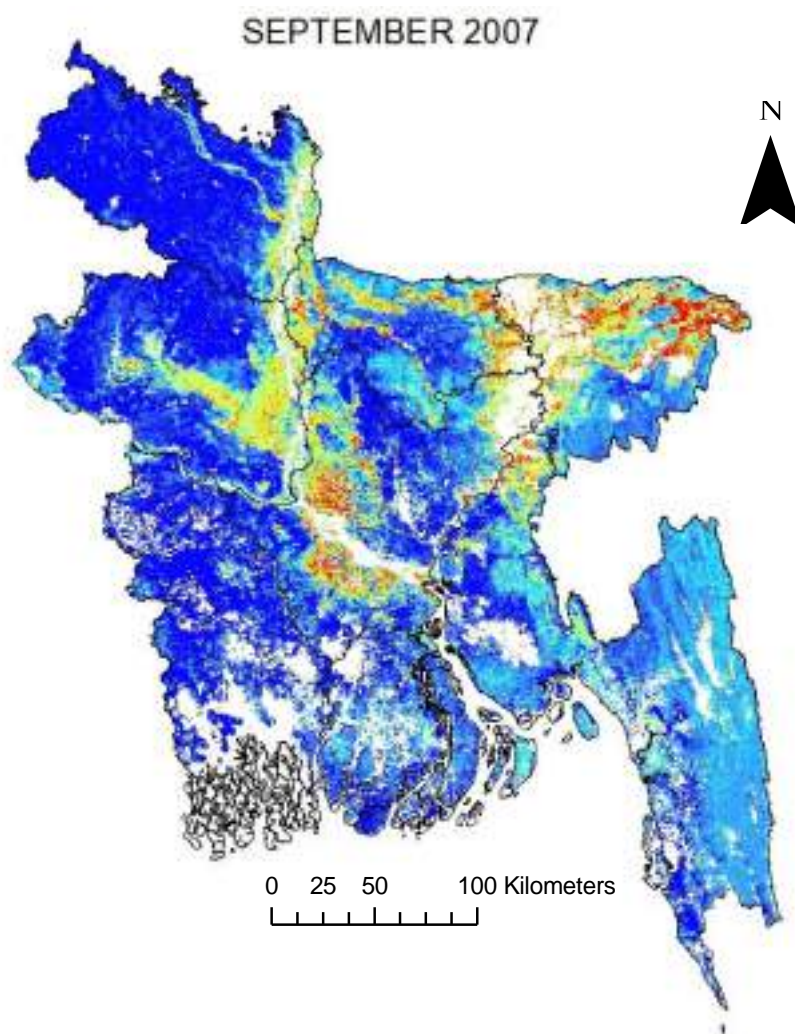


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

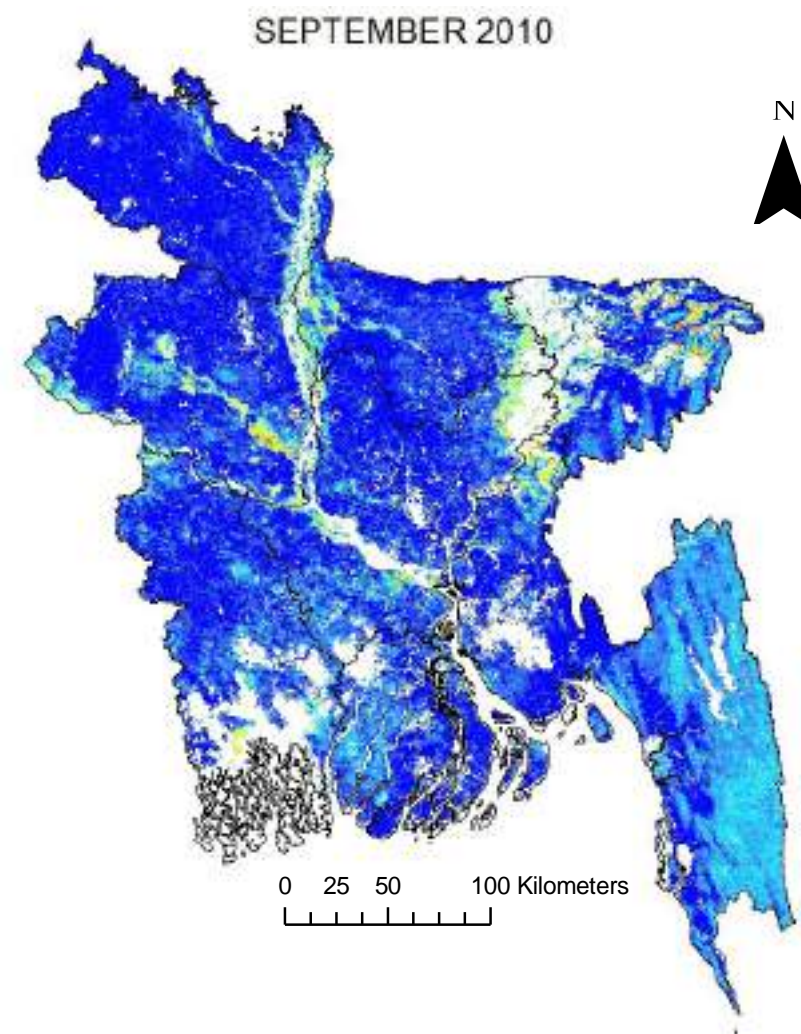
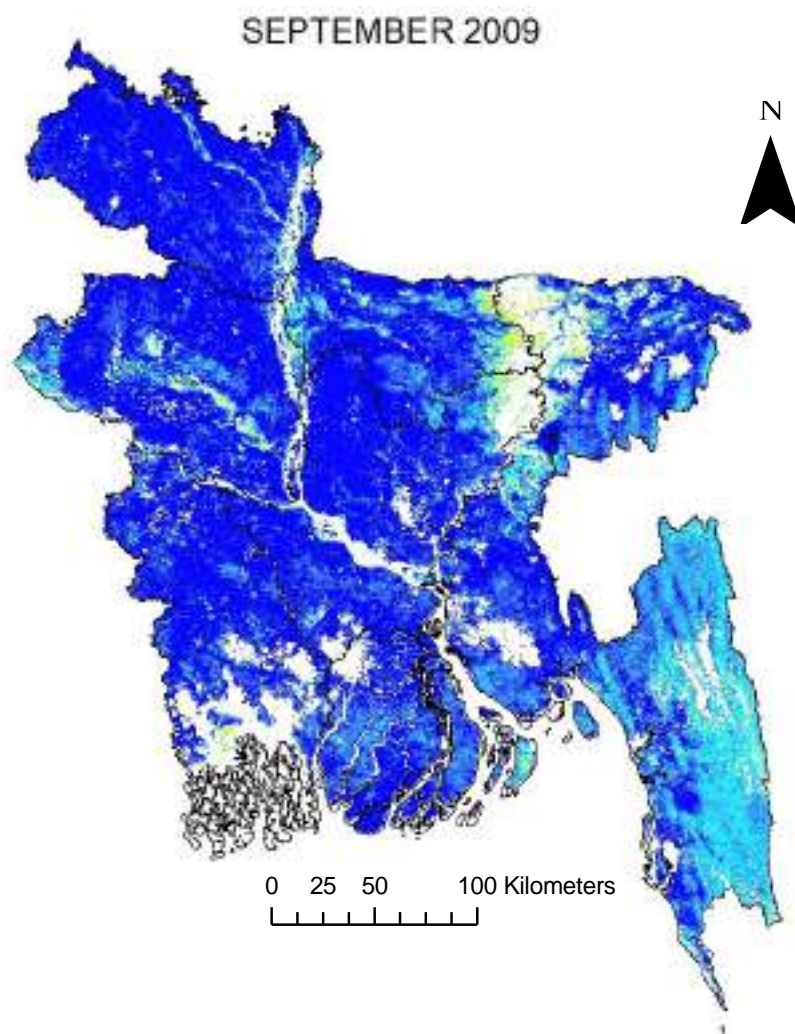


Legend

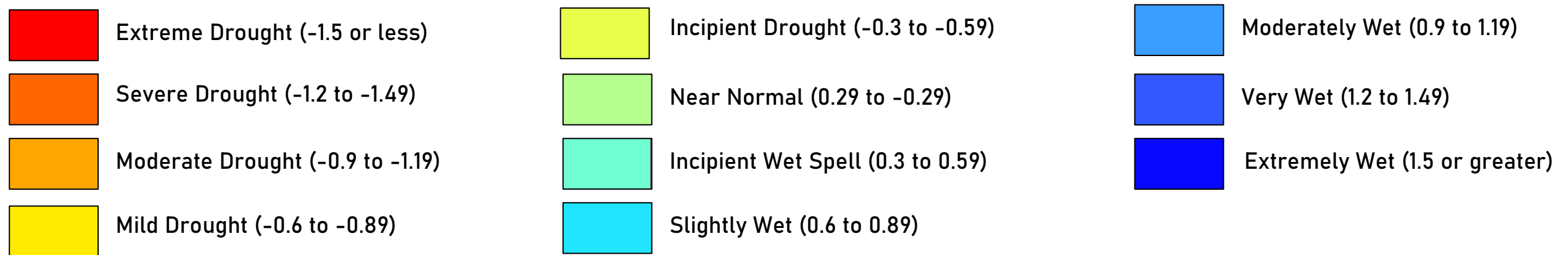
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

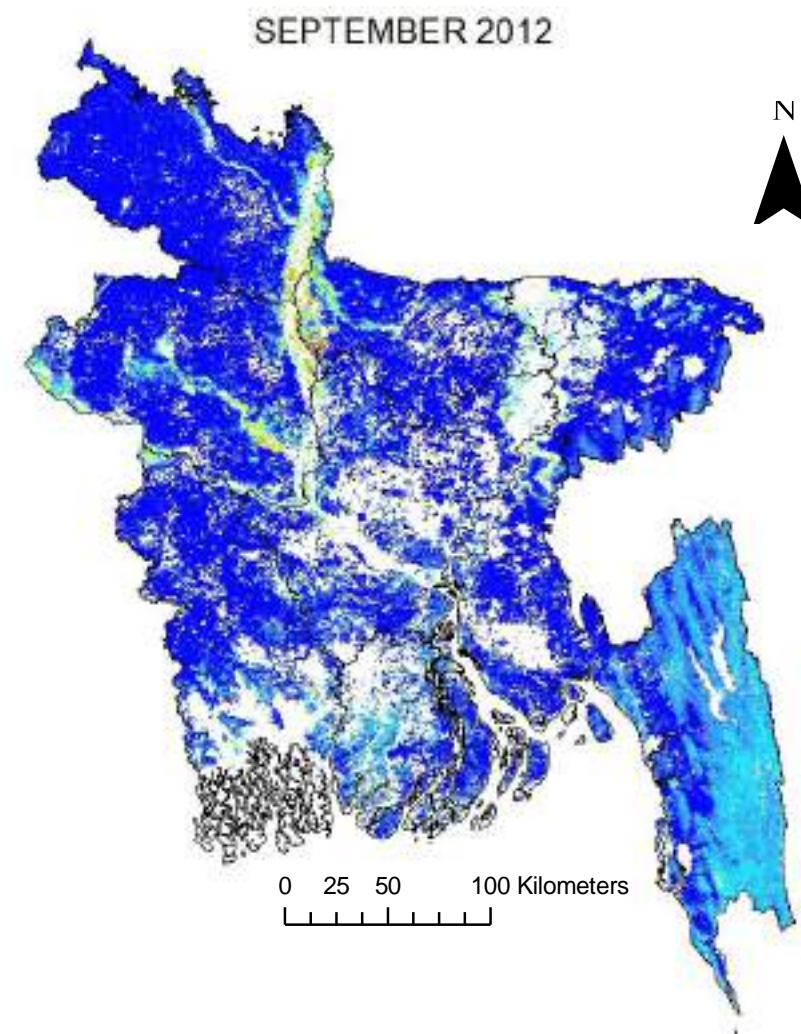
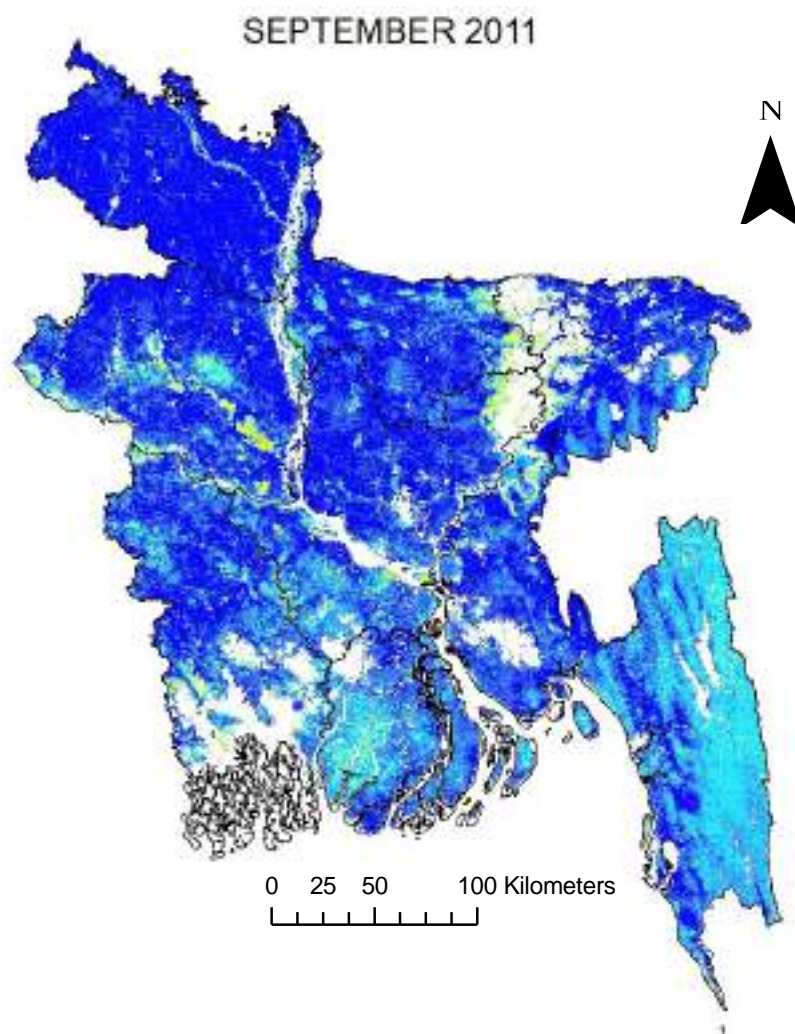
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend



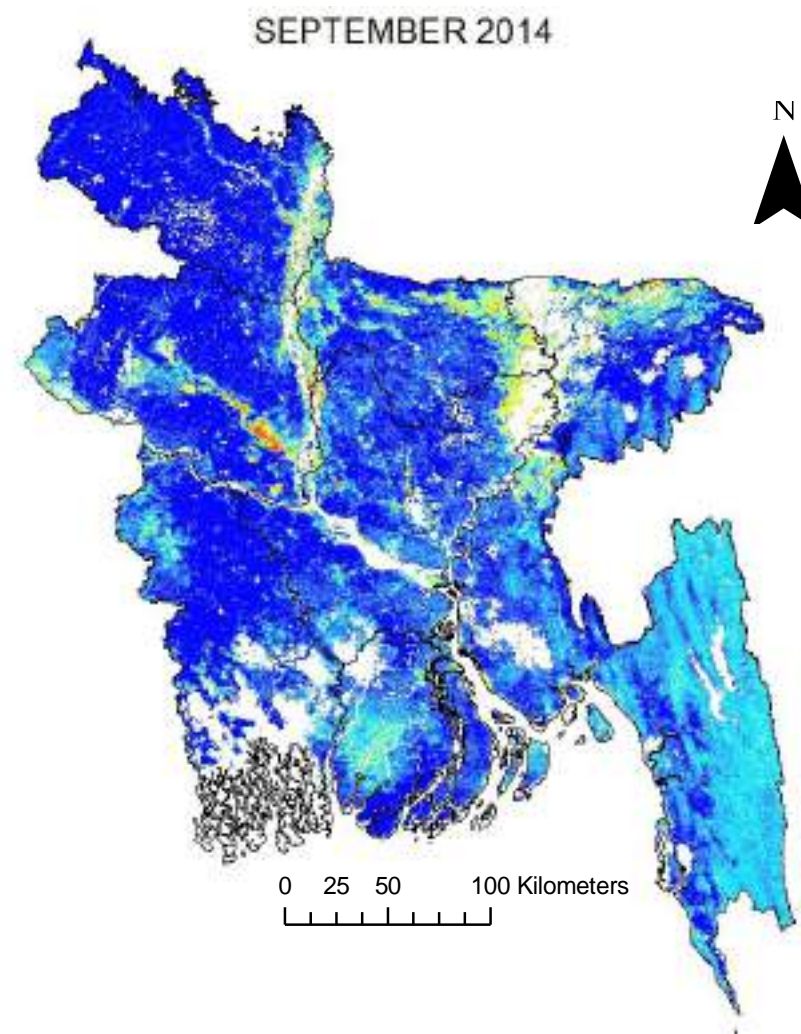
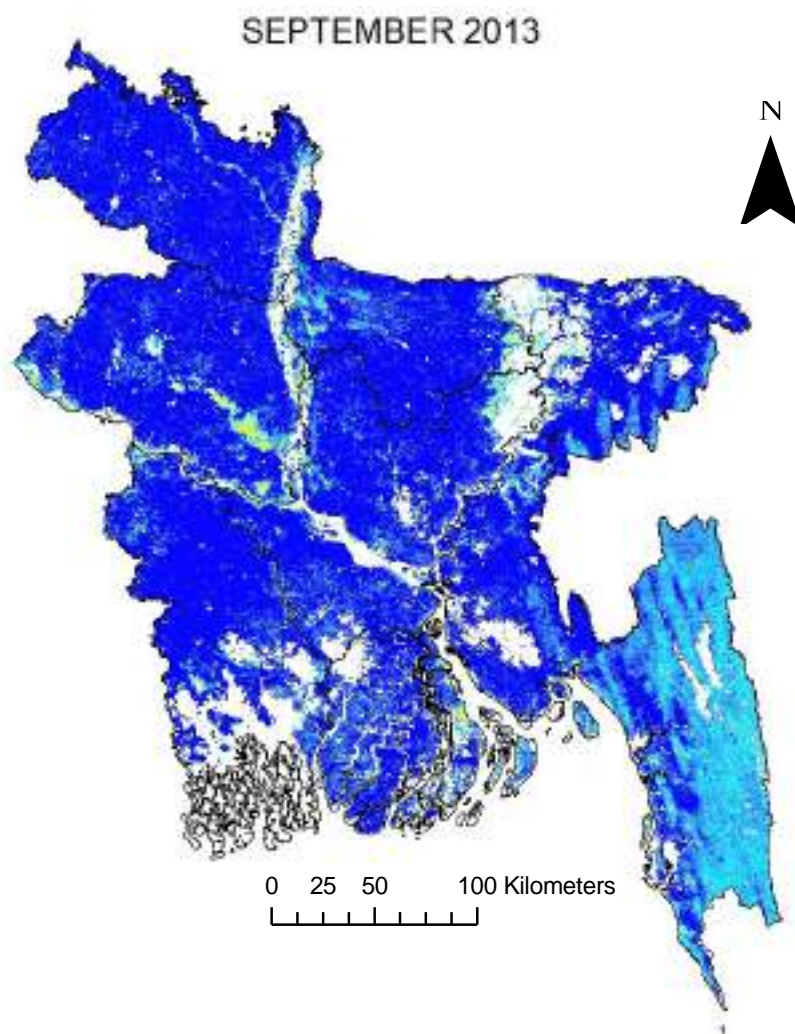


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

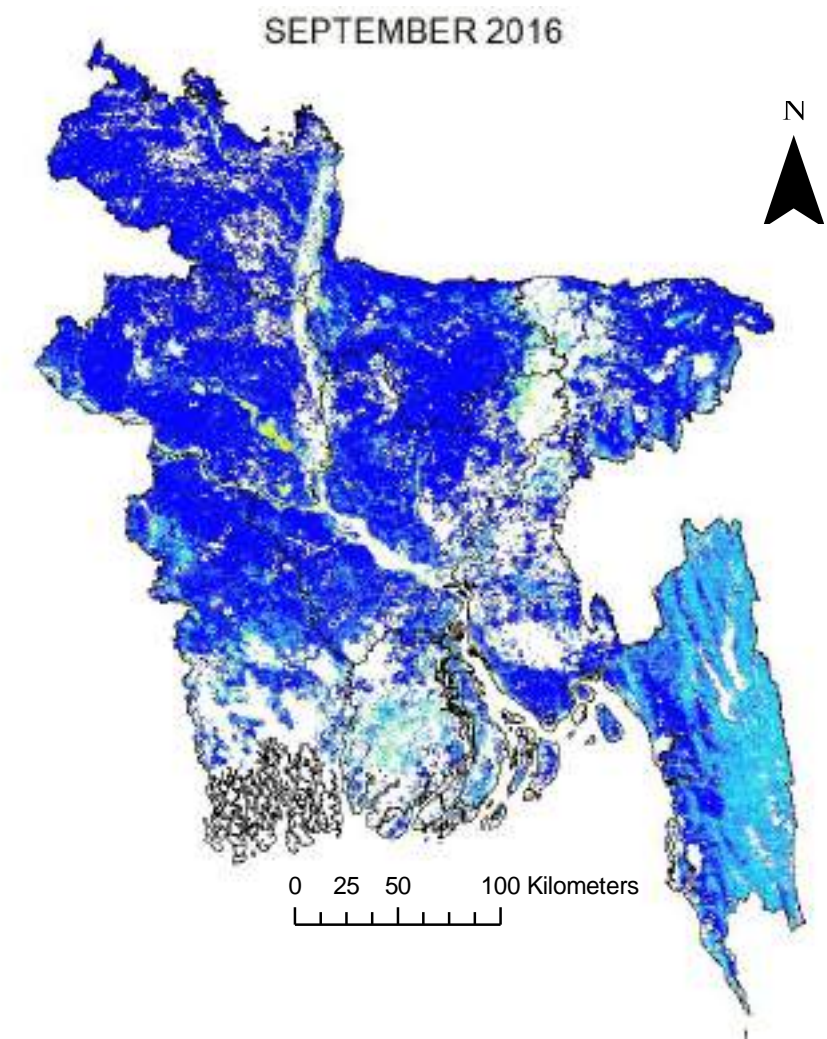
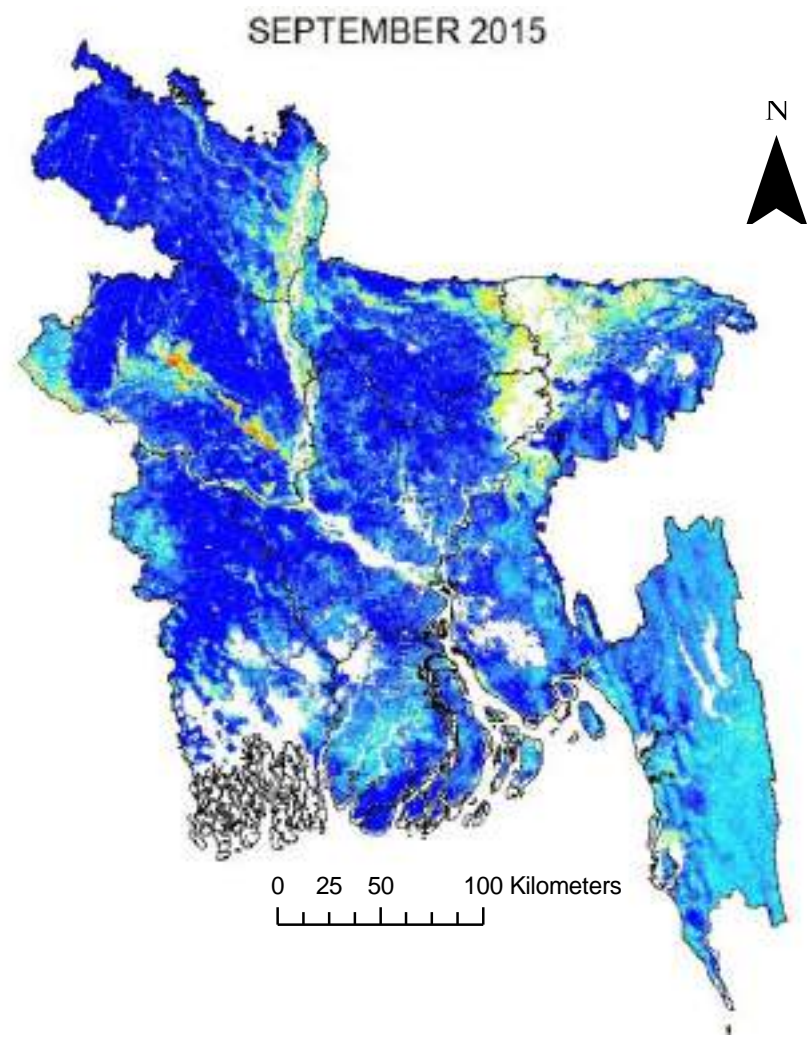


Legend

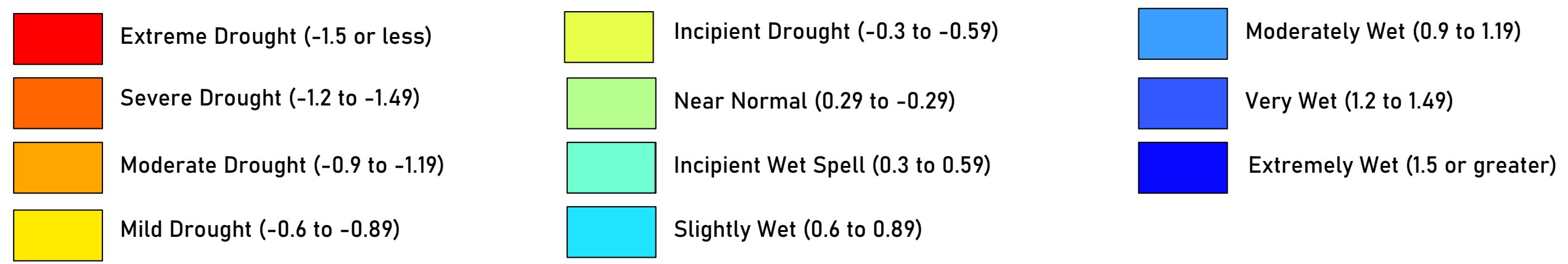
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

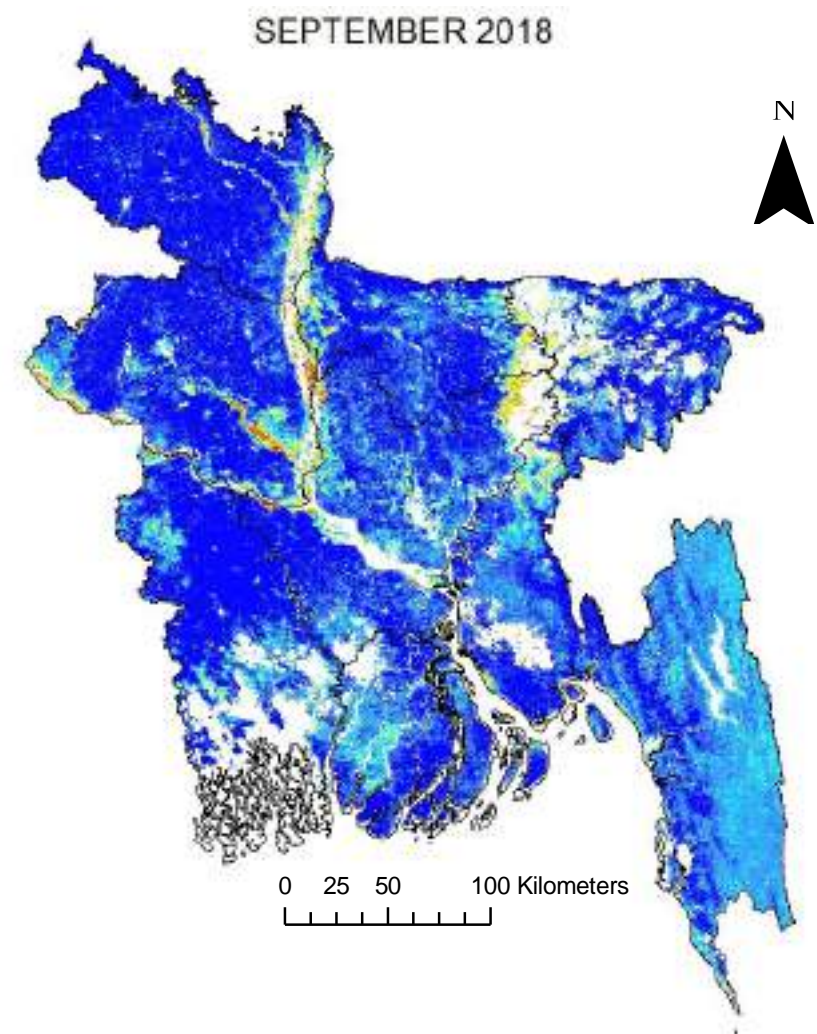
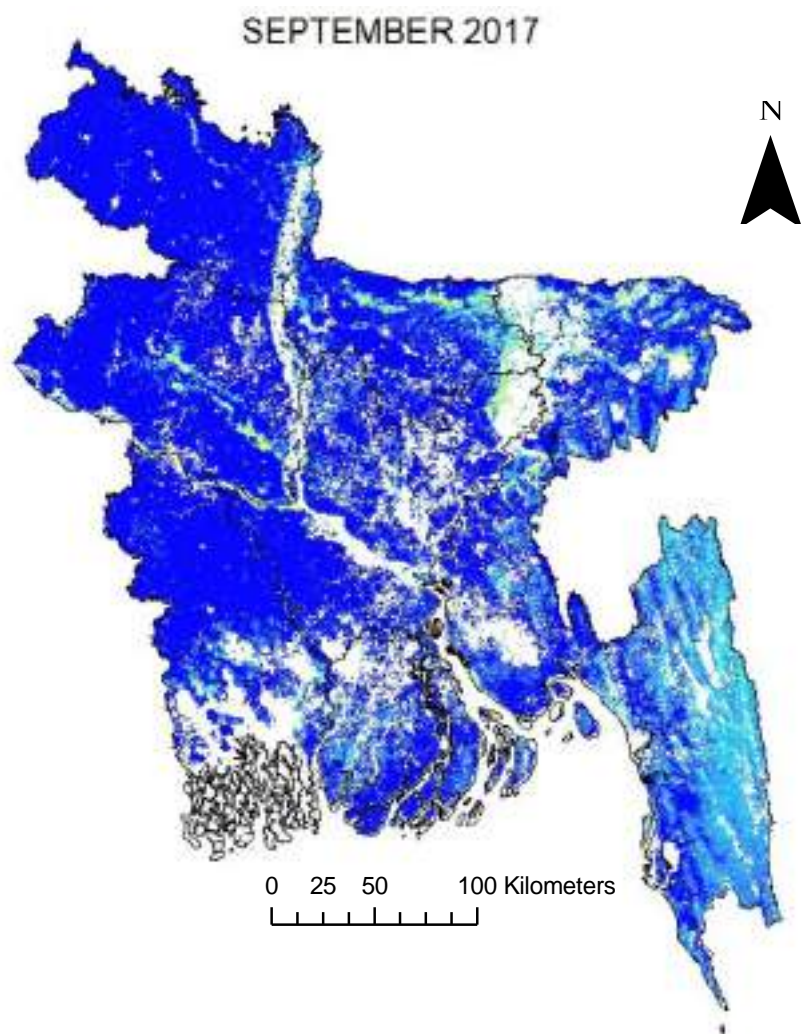
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend



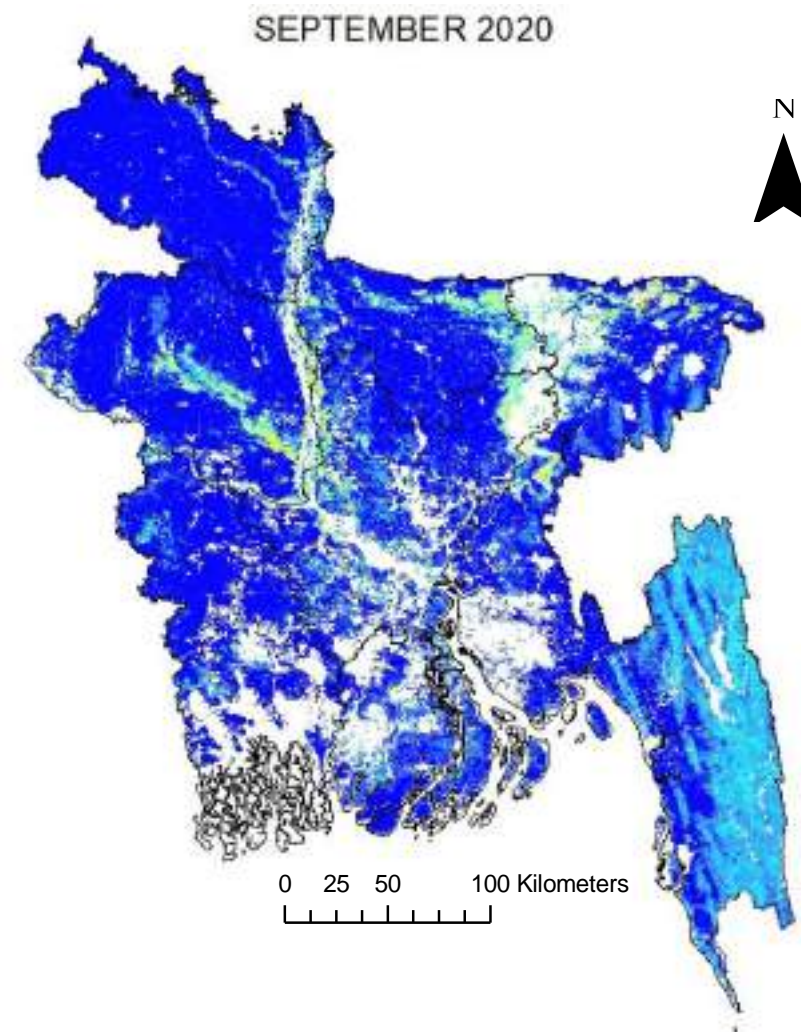
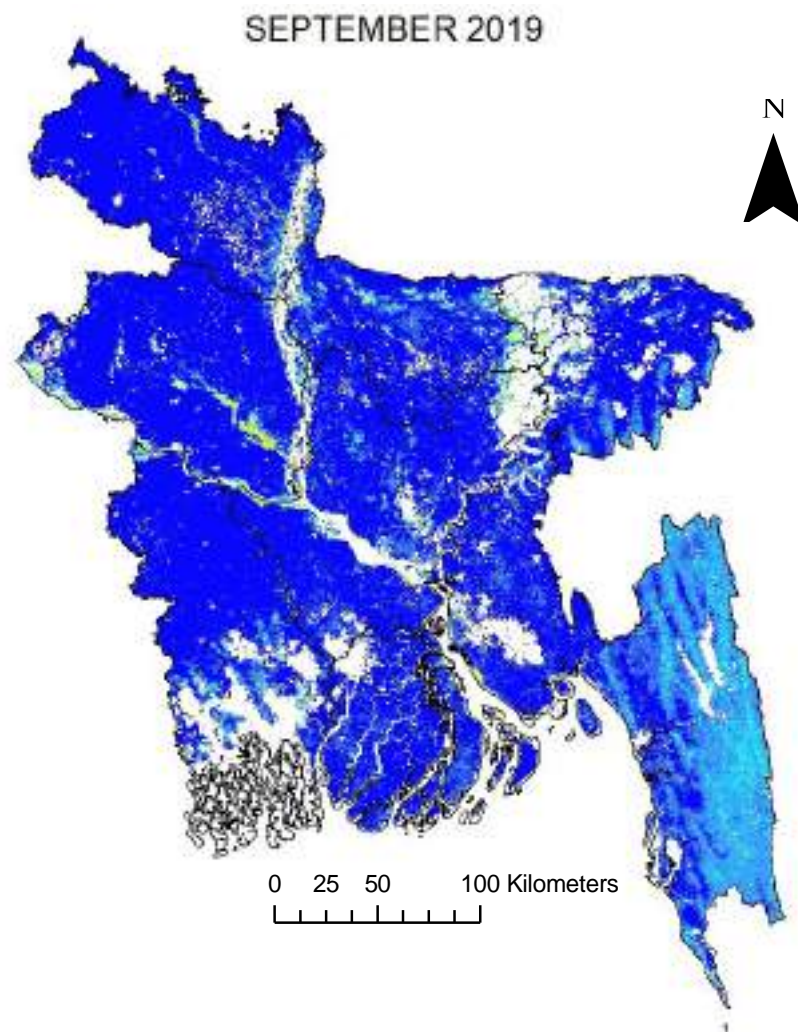


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

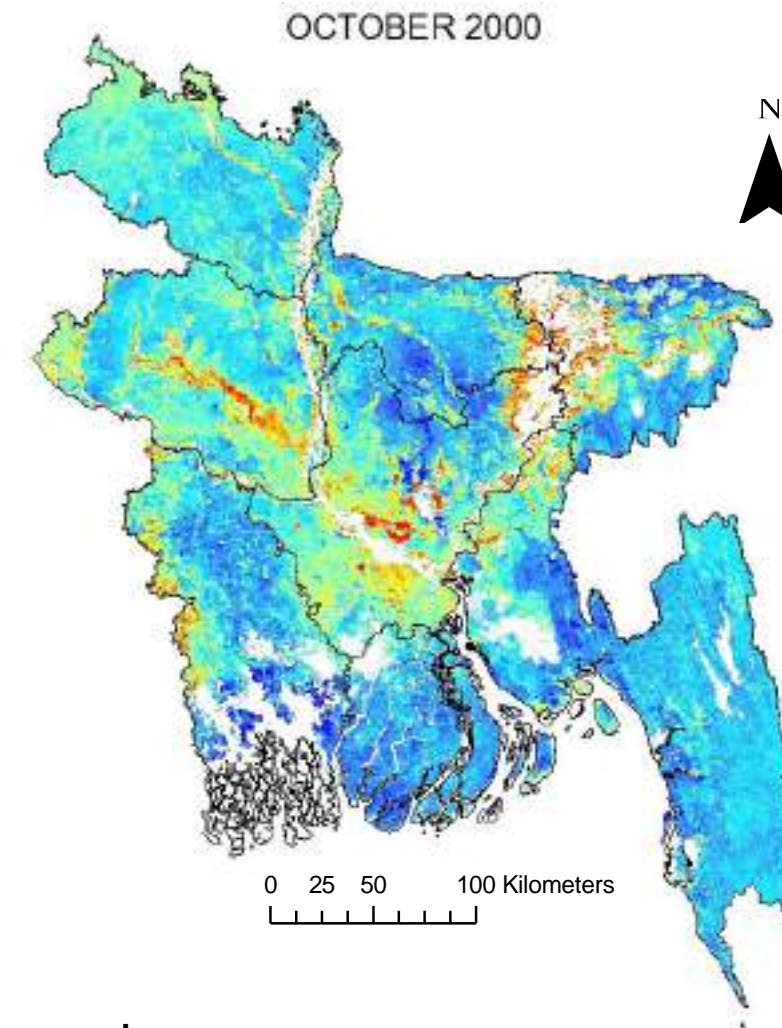
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

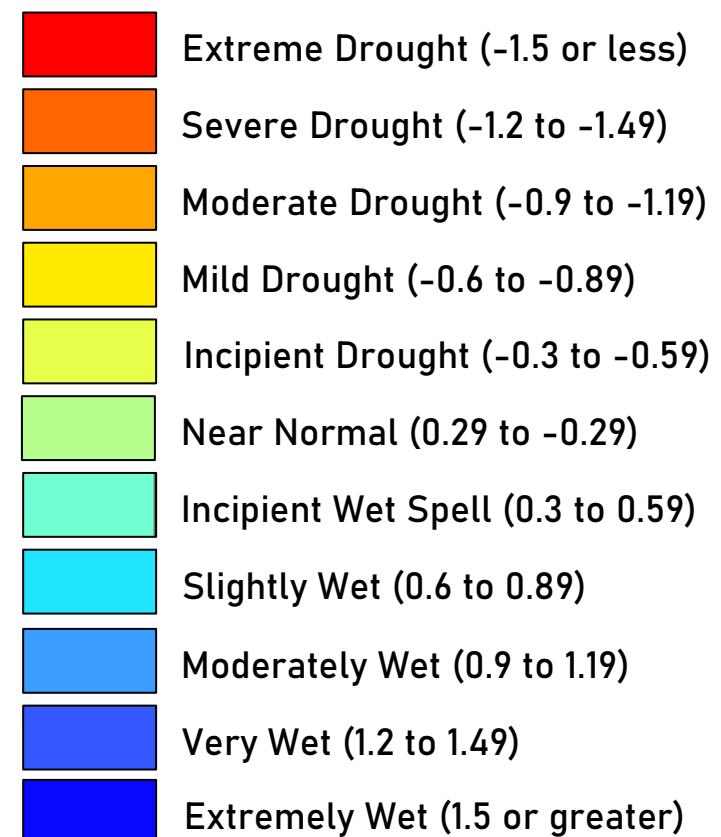
October DSI Maps

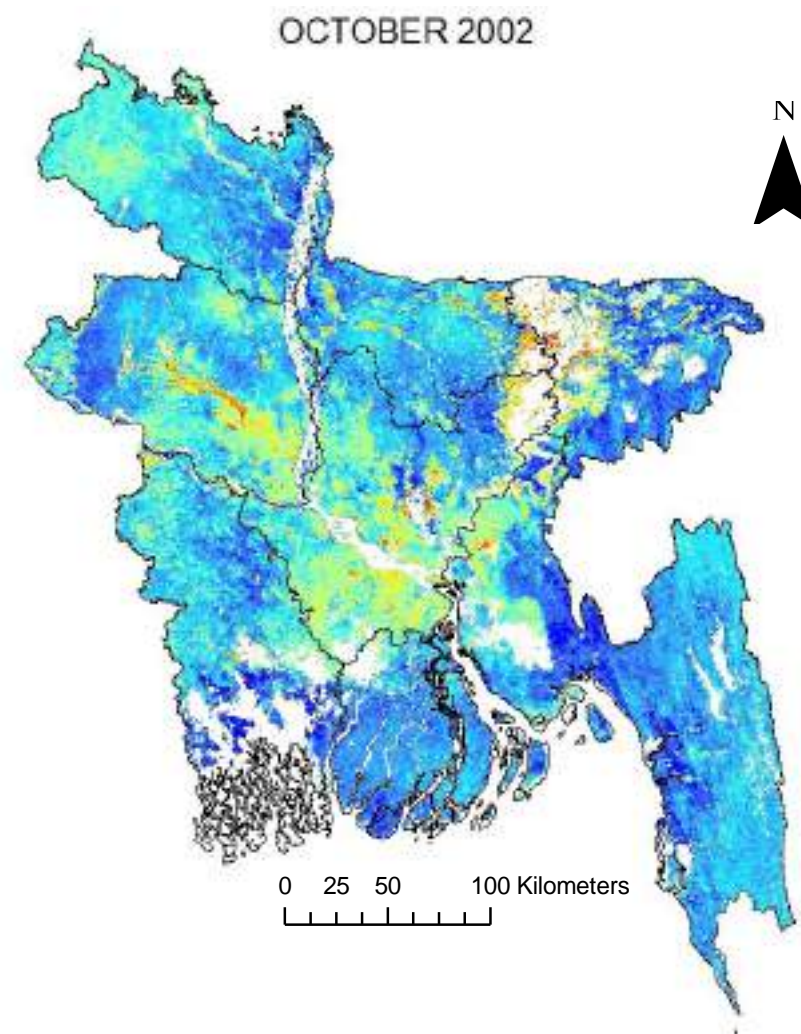
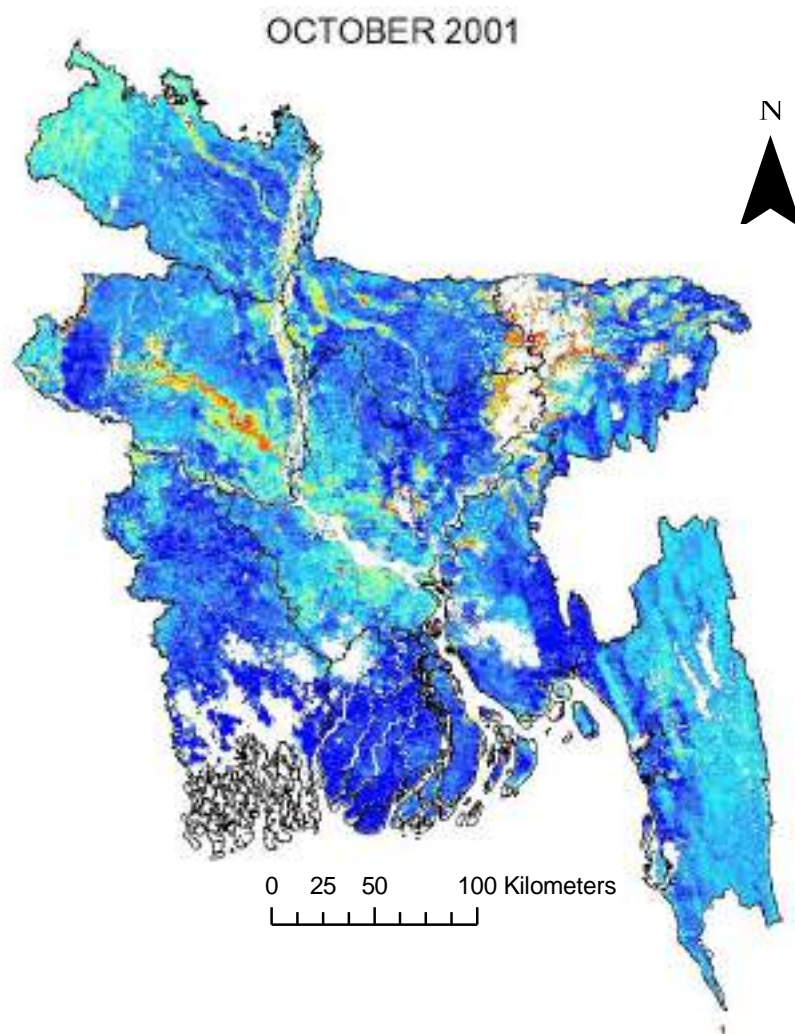
In October (monsoon), drought conditions can range from slightly wet to very wet condition. Moderately wet condition is majorly identified in October.

Mean October DSI Values		
Years	Values	Drought Condition
2000	0.79	Slightly Wet
2001	1.25	Very Wet
2002	0.88	Slightly Wet
2003	1.48	Very Wet
2004	0.66	Slightly Wet
2005	1.29	Very Wet
2006	1.12	Moderately Wet
2007	1.04	Moderately Wet
2008	1.03	Moderately Wet
2009	1.04	Moderately Wet
2010	1.28	Very Wet
2011	0.96	Moderately Wet
2012	0.92	Moderately Wet
2013	1.42	Very Wet
2014	1.00	Moderately Wet
2015	0.82	Slightly Wet
2016	1.00	Moderately Wet
2017	1.22	Very Wet
2018	0.85	Slightly Wet
2019	1.24	Very Wet
2020	1.28	Very Wet

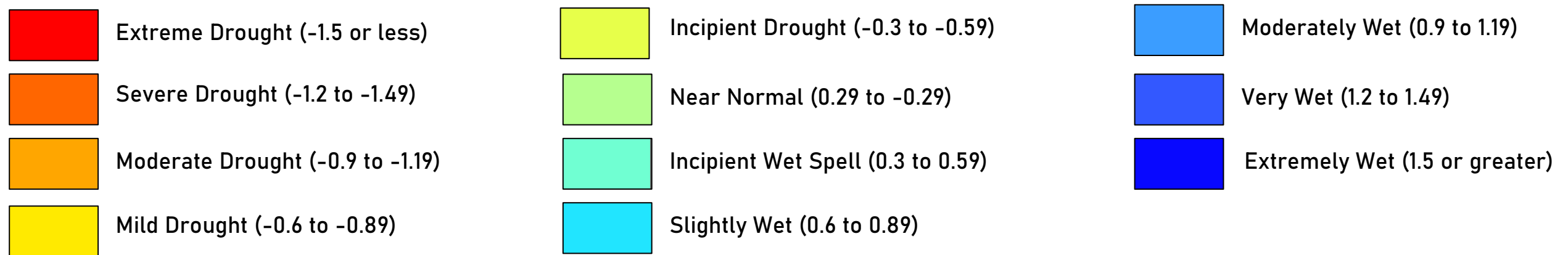


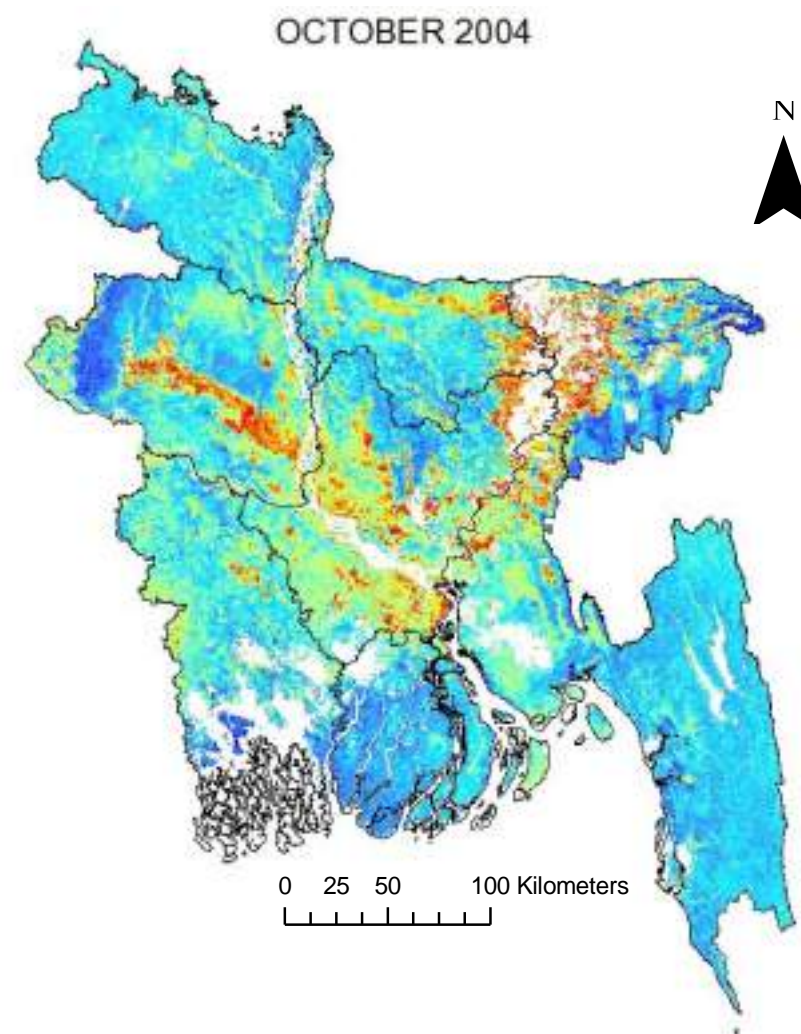
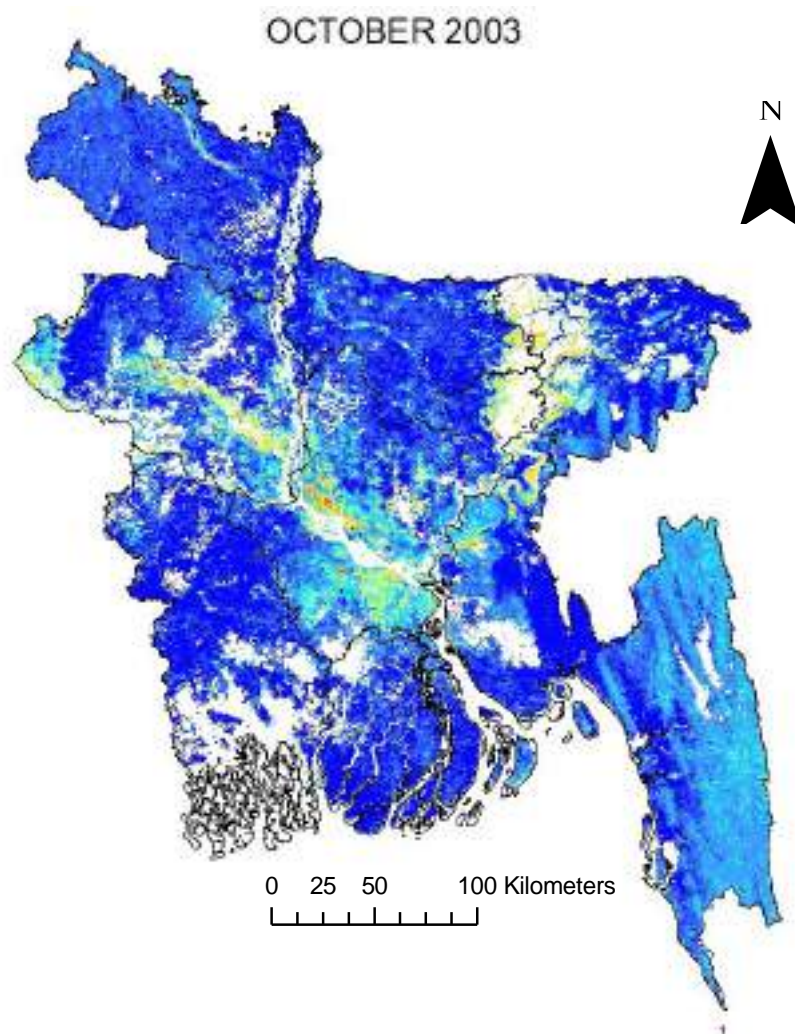
Legend



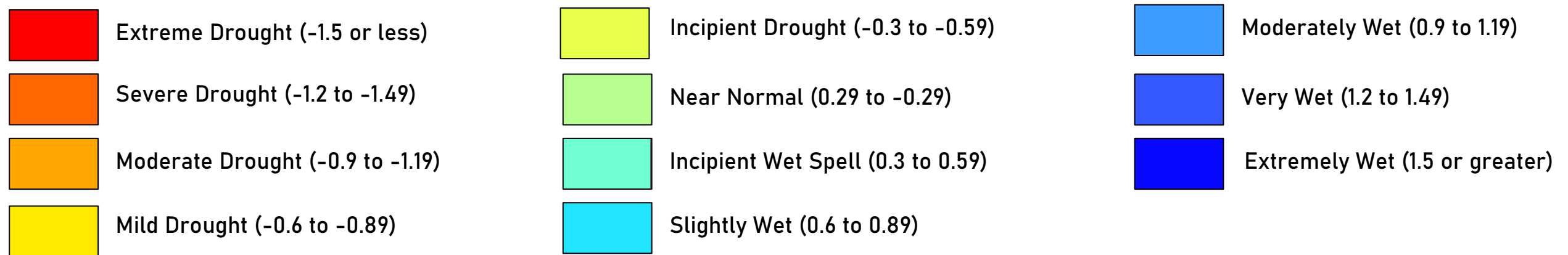


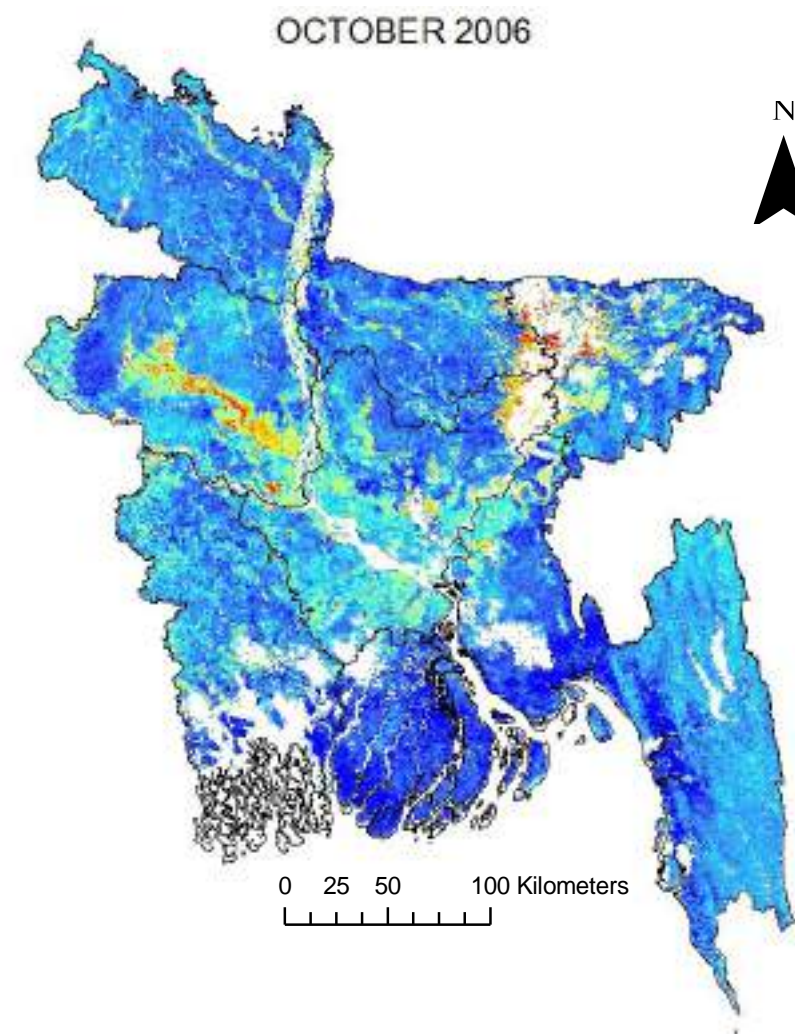
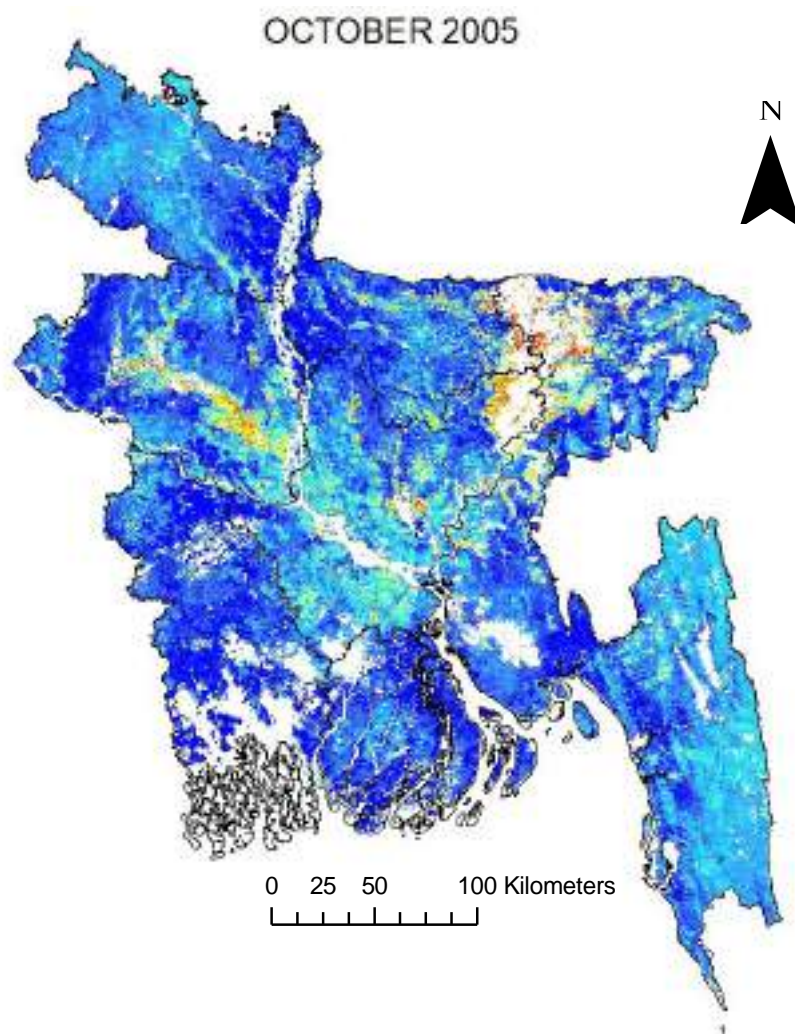
Legend





Legend



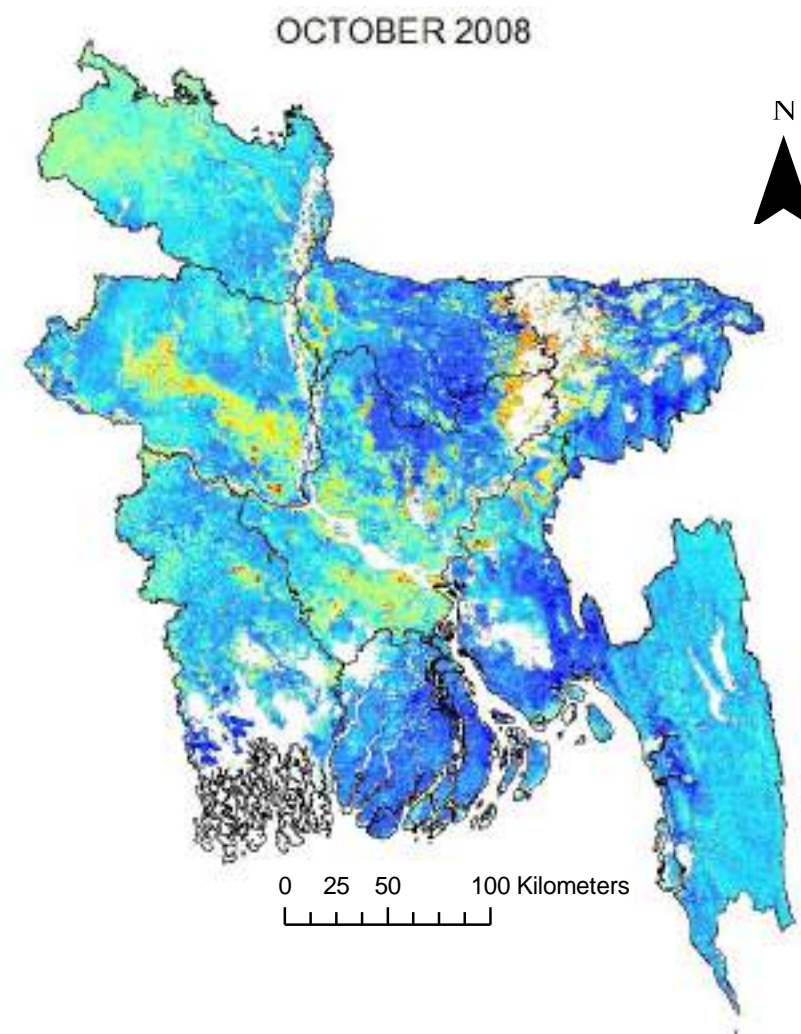
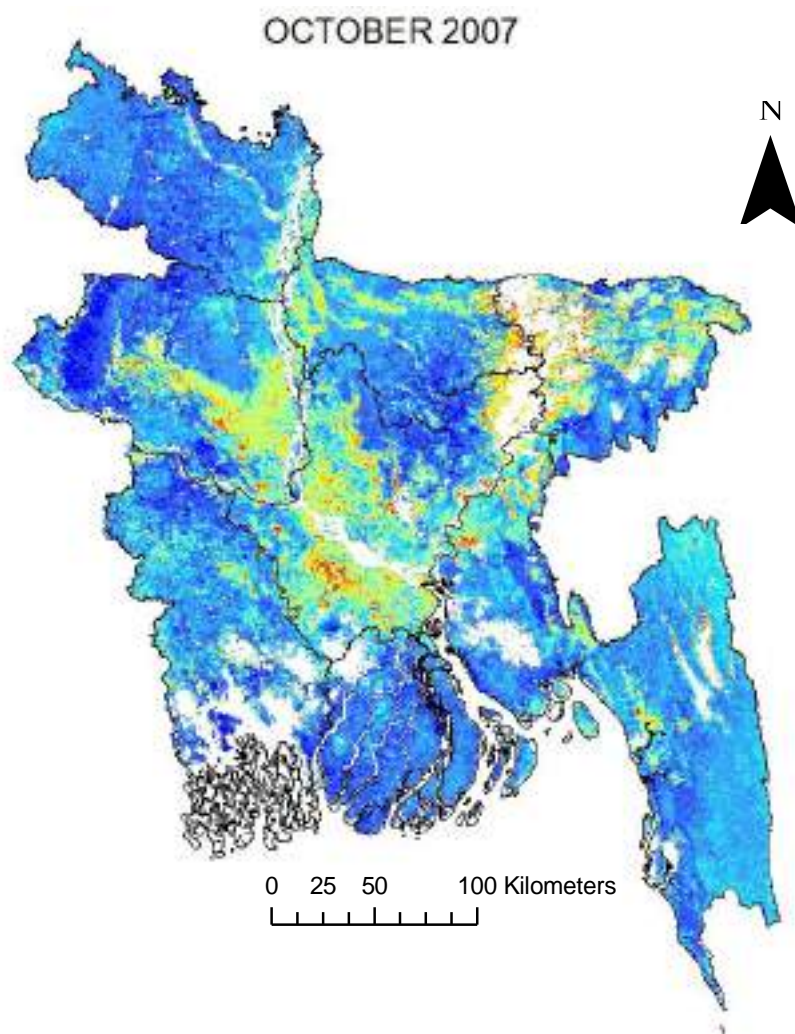


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

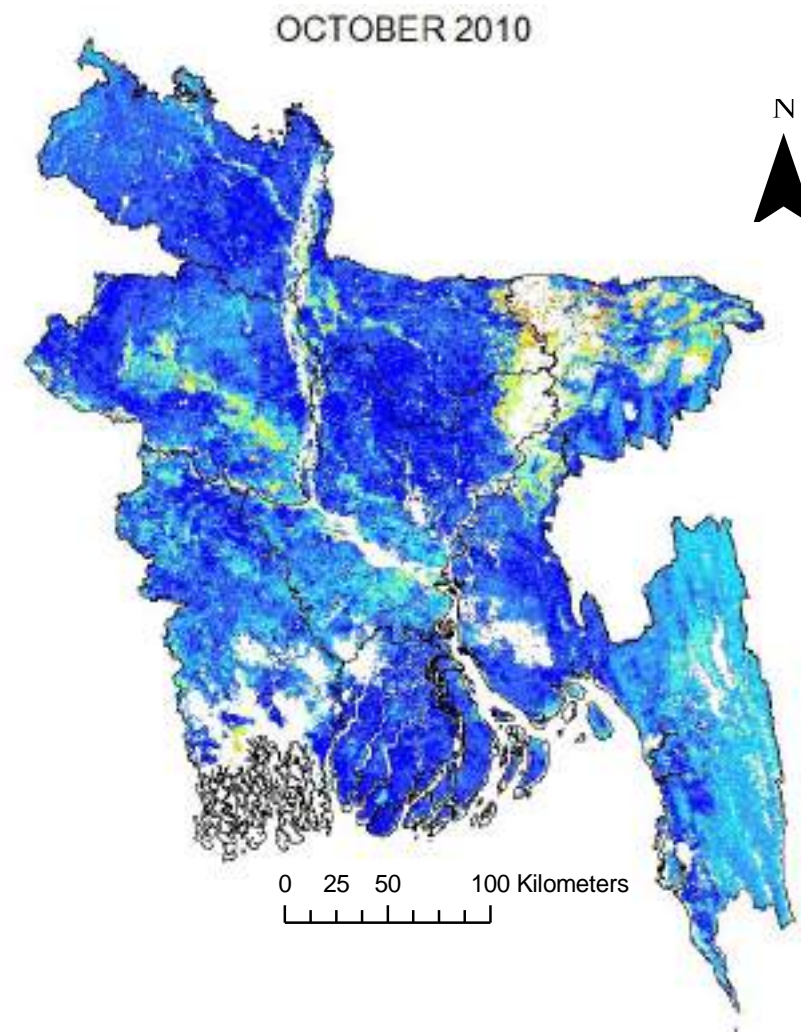
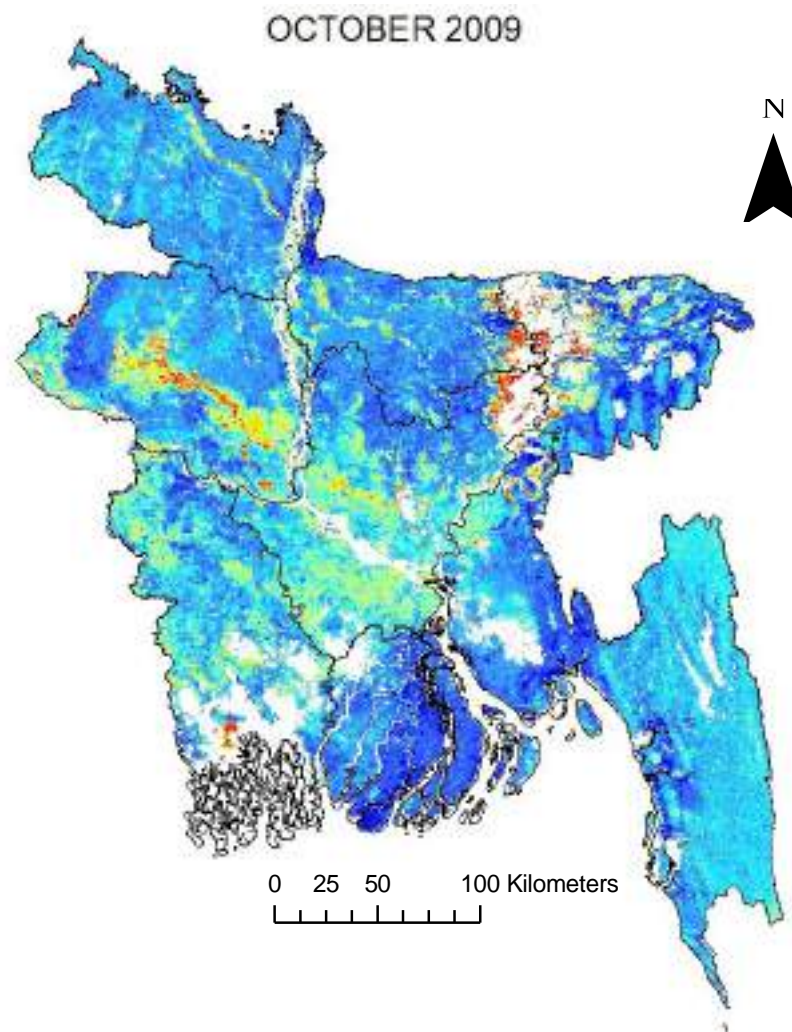


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

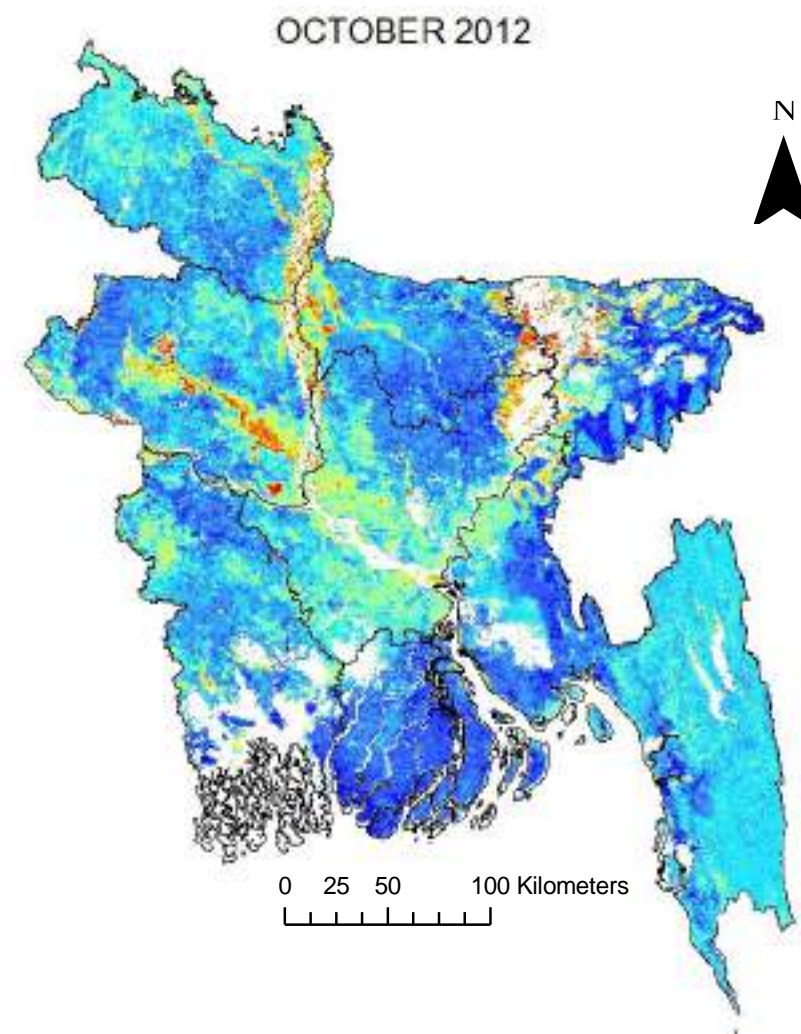
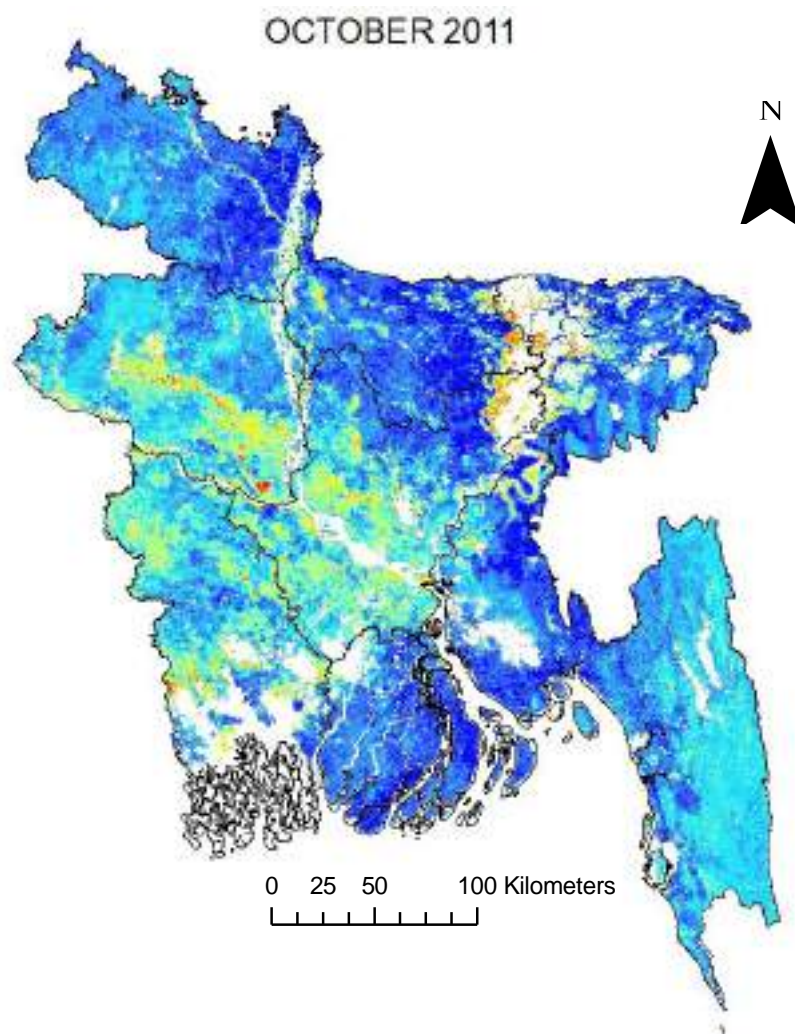


Legend

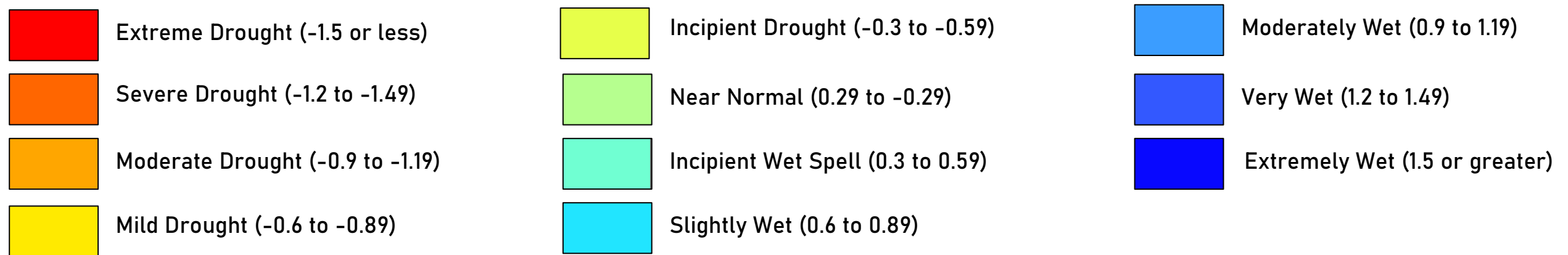
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

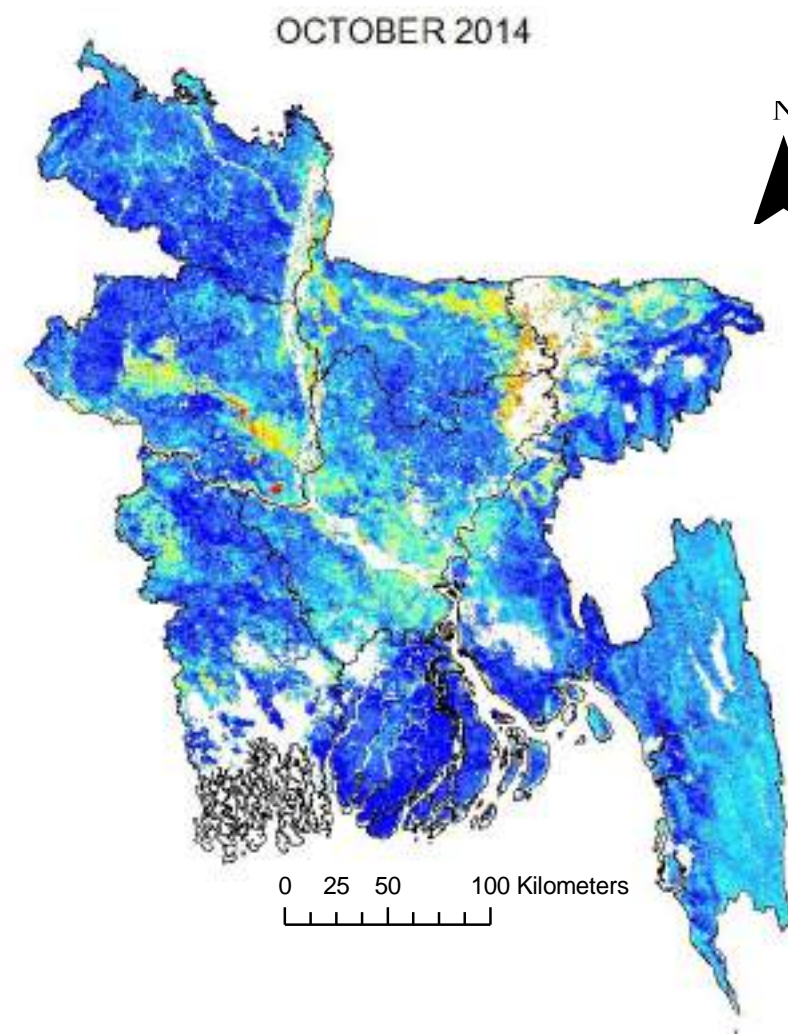
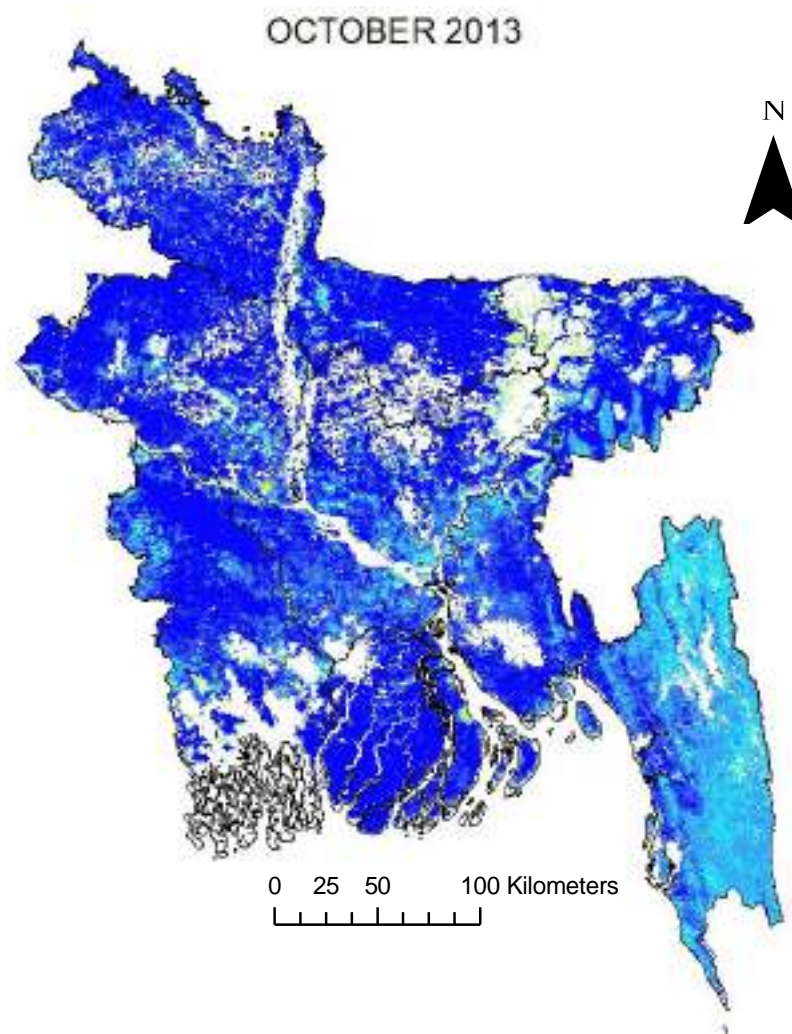
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

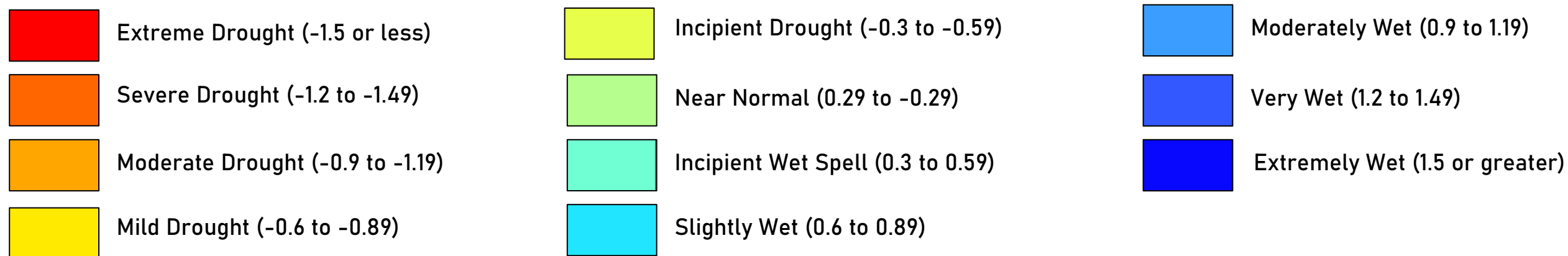


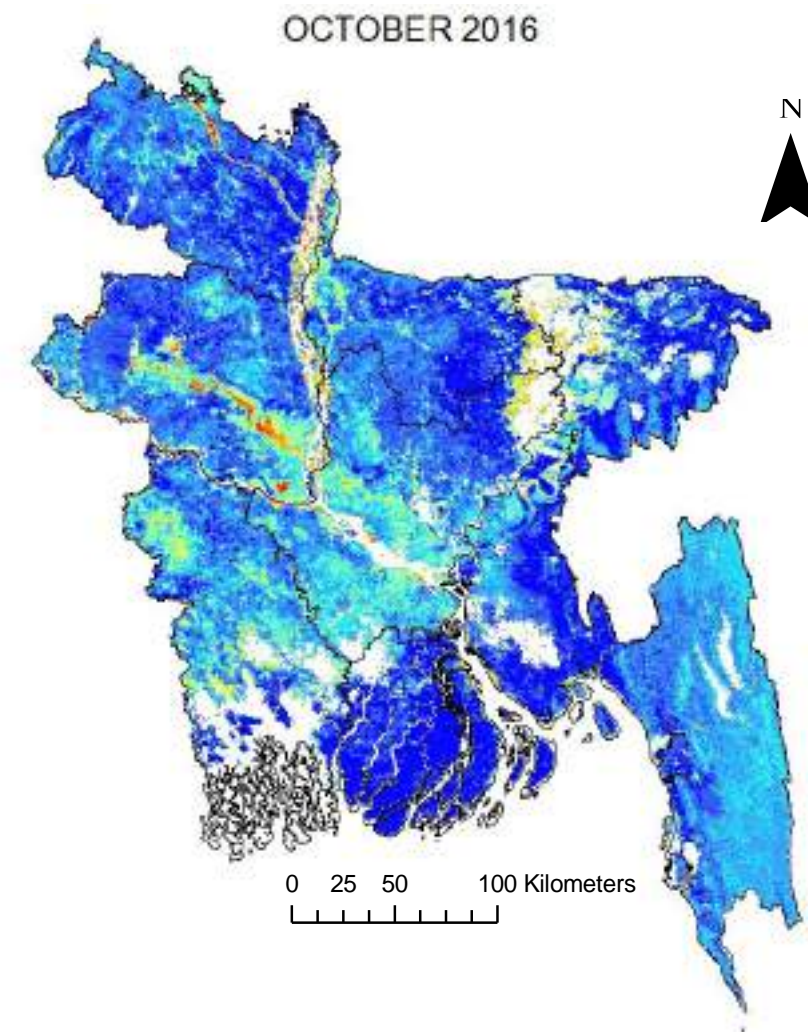
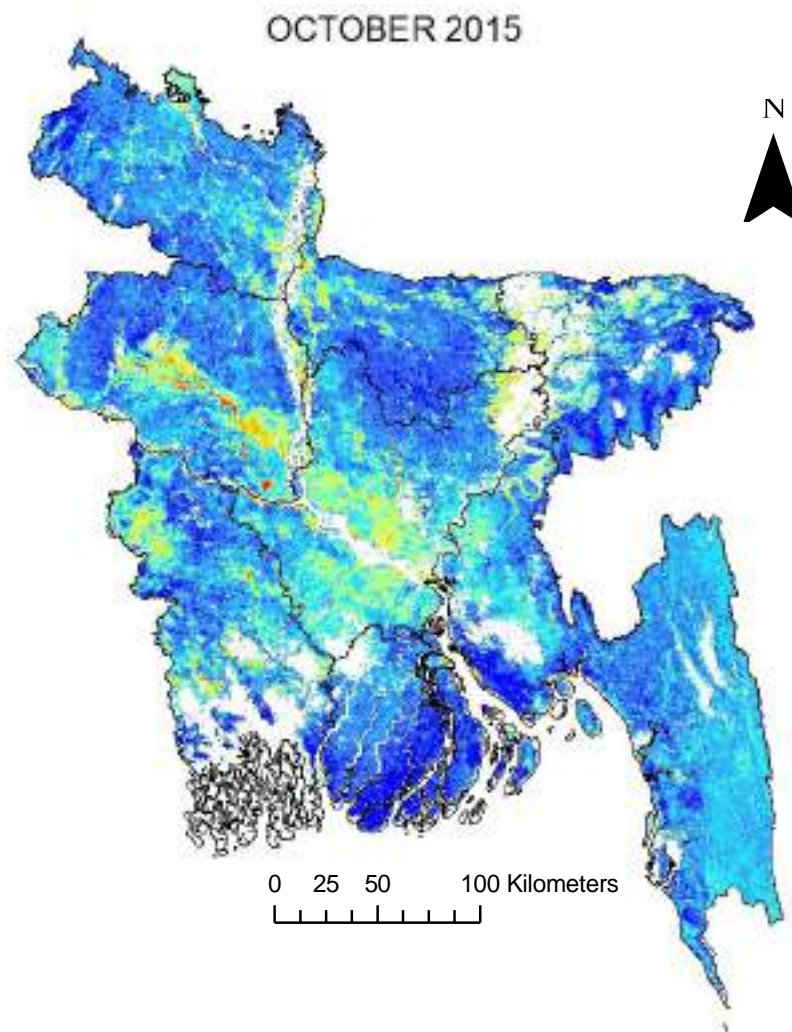
Legend





Legend



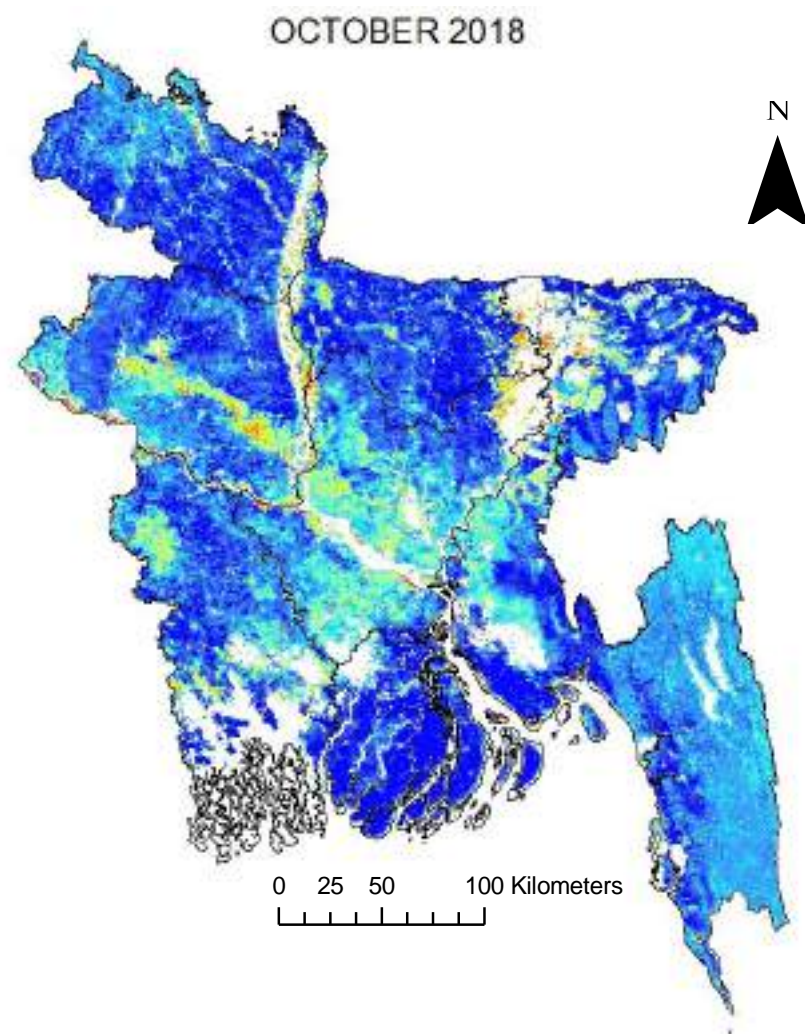
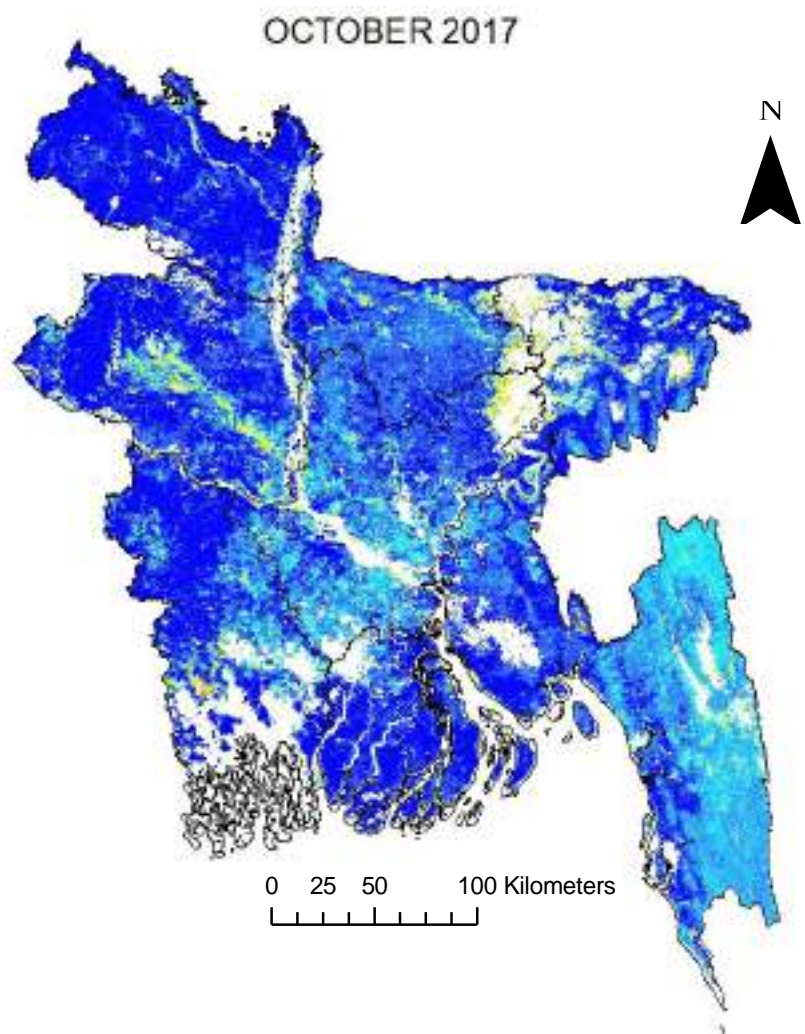


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

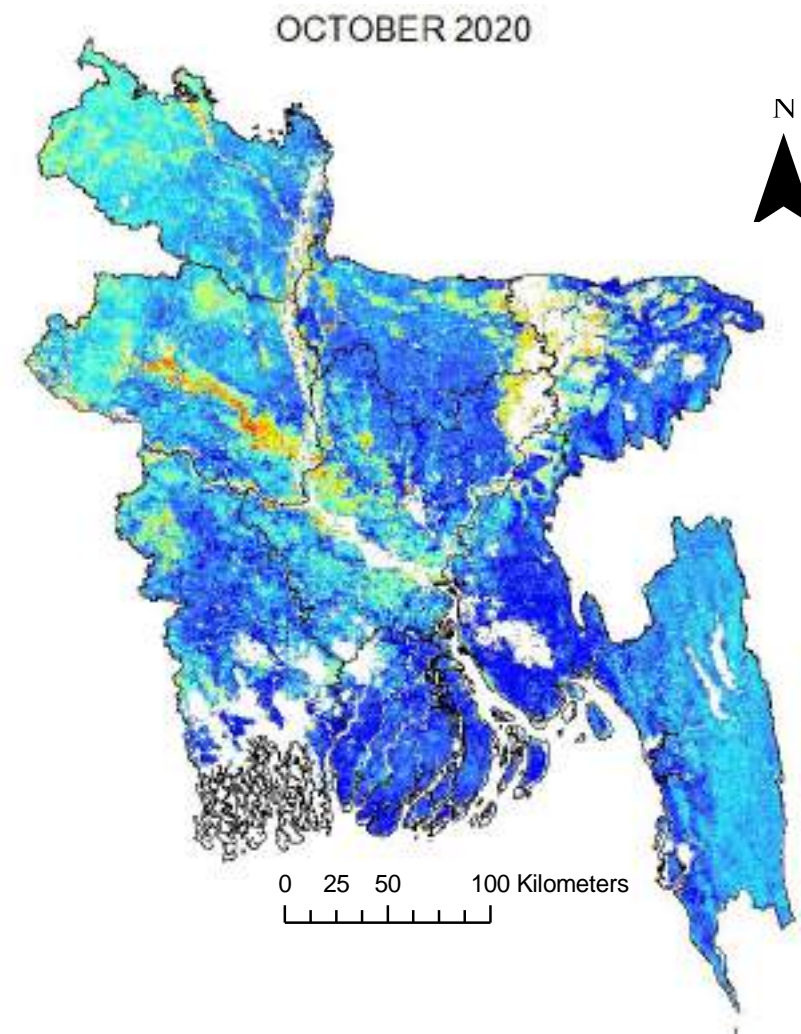
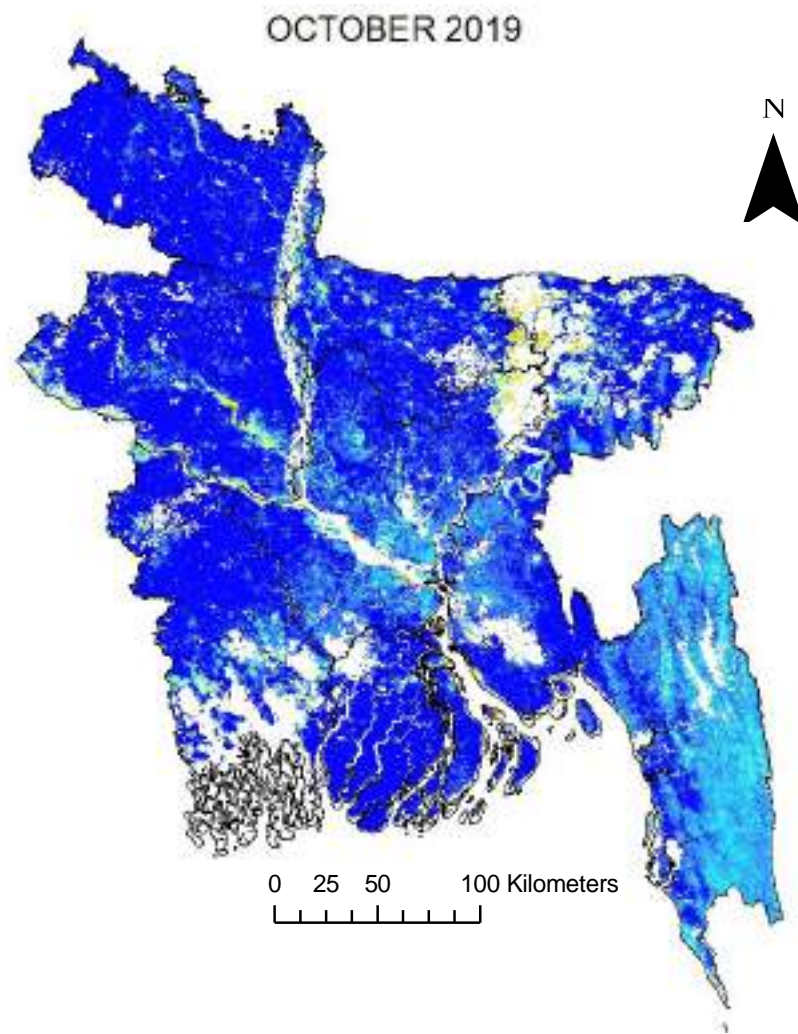


Legend

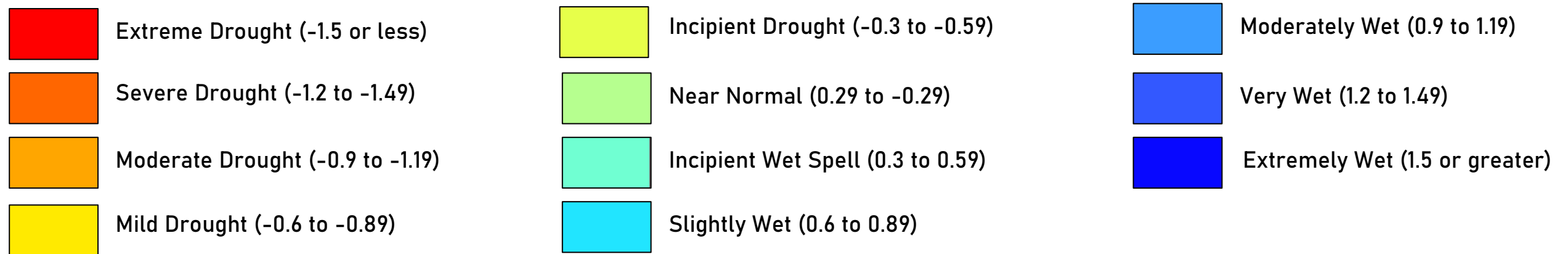
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



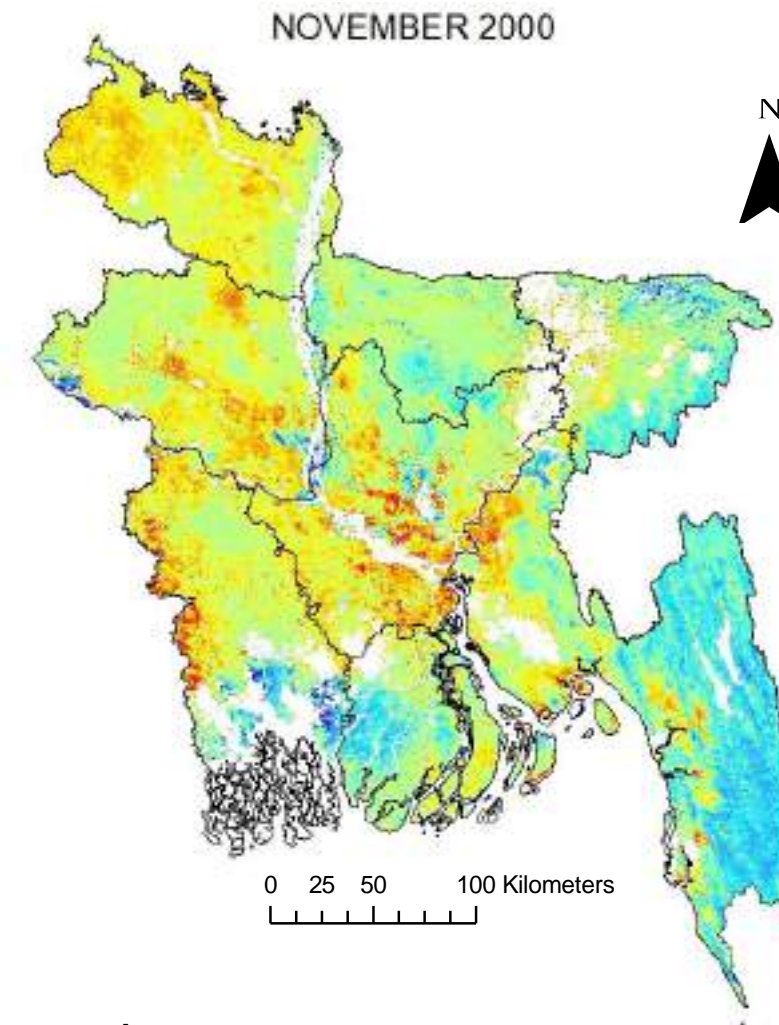
Legend



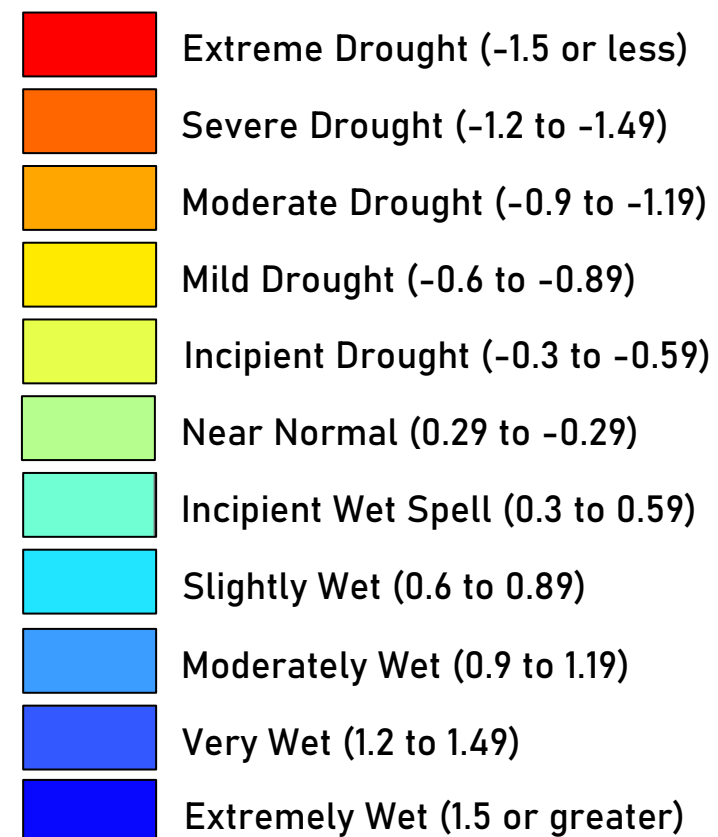
November DSI Maps

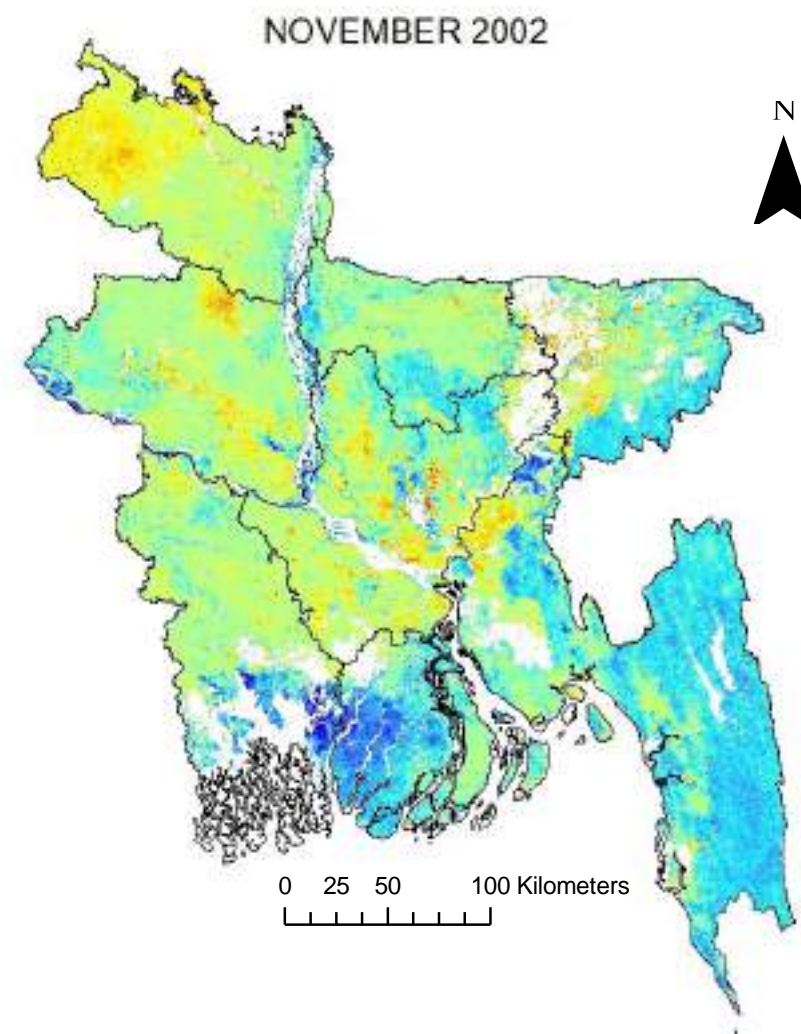
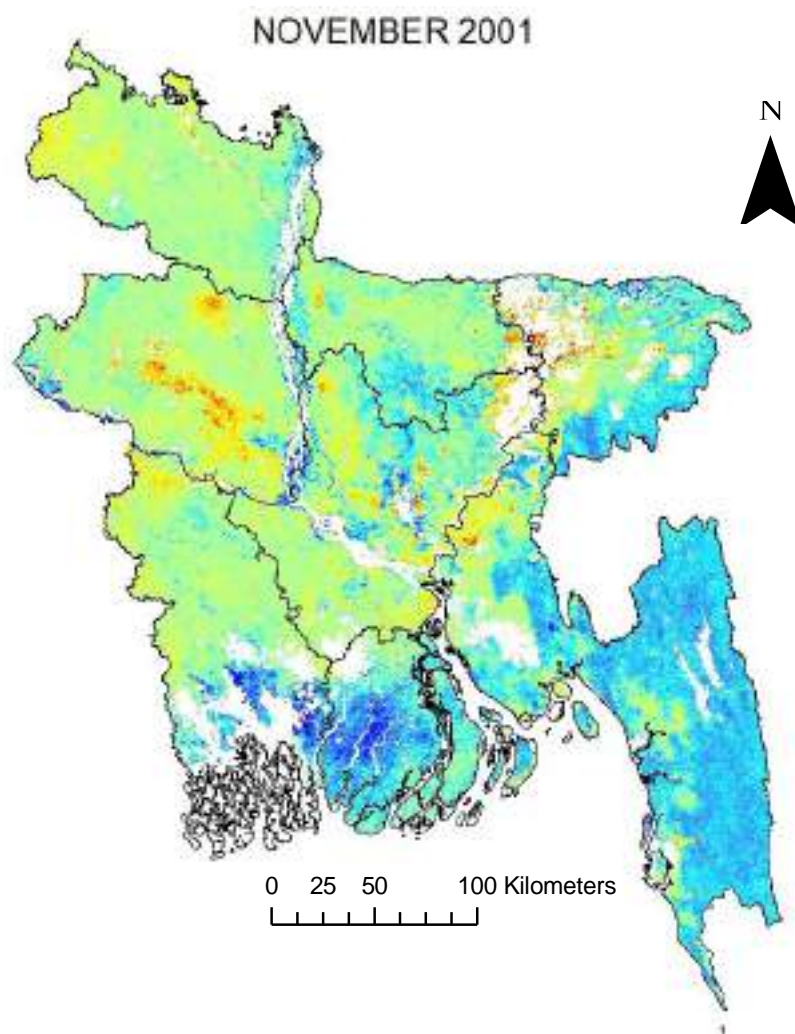
In November, drought normally ranges from near normal to slightly wet condition. As November is post monsoon month, drought condition is mostly in near normal to incipient wet spell state.

Mean November DSI Values		
Years	Values	Drought Condition
2000	-0.05	Near Normal
2001	0.41	Incipient Wet Spell
2002	0.35	Incipient Wet Spell
2003	0.15	Near Normal
2004	-0.20	Near Normal
2005	0.48	Incipient Wet Spell
2006	0.55	Incipient Wet Spell
2007	0.57	Incipient Wet Spell
2008	0.15	Near Normal
2009	0.43	Incipient Wet Spell
2010	0.56	Incipient Wet Spell
2011	0.25	Near Normal
2012	0.26	Near Normal
2013	0.60	Slightly Wet
2014	0.14	Near Normal
2015	0.35	Incipient Wet Spell
2016	0.15	Near Normal
2017	0.69	Slightly Wet
2018	0.24	Near Normal
2019	0.71	Slightly Wet
2020	0.37	Incipient Wet Spell

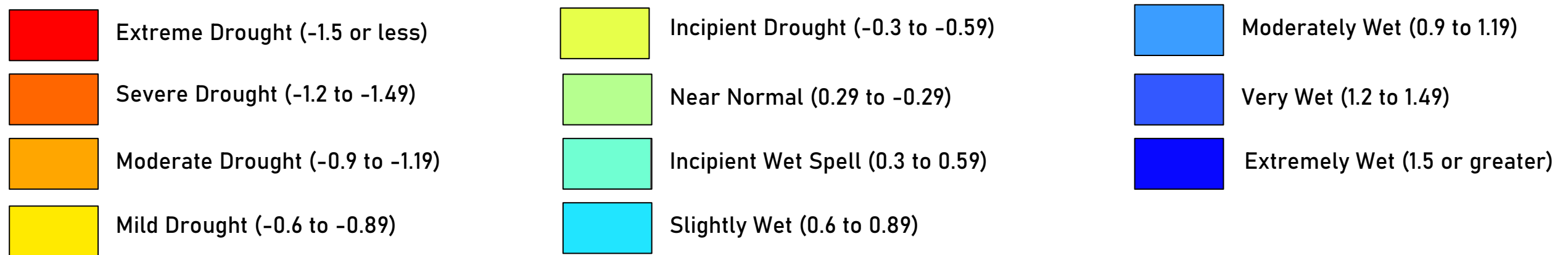


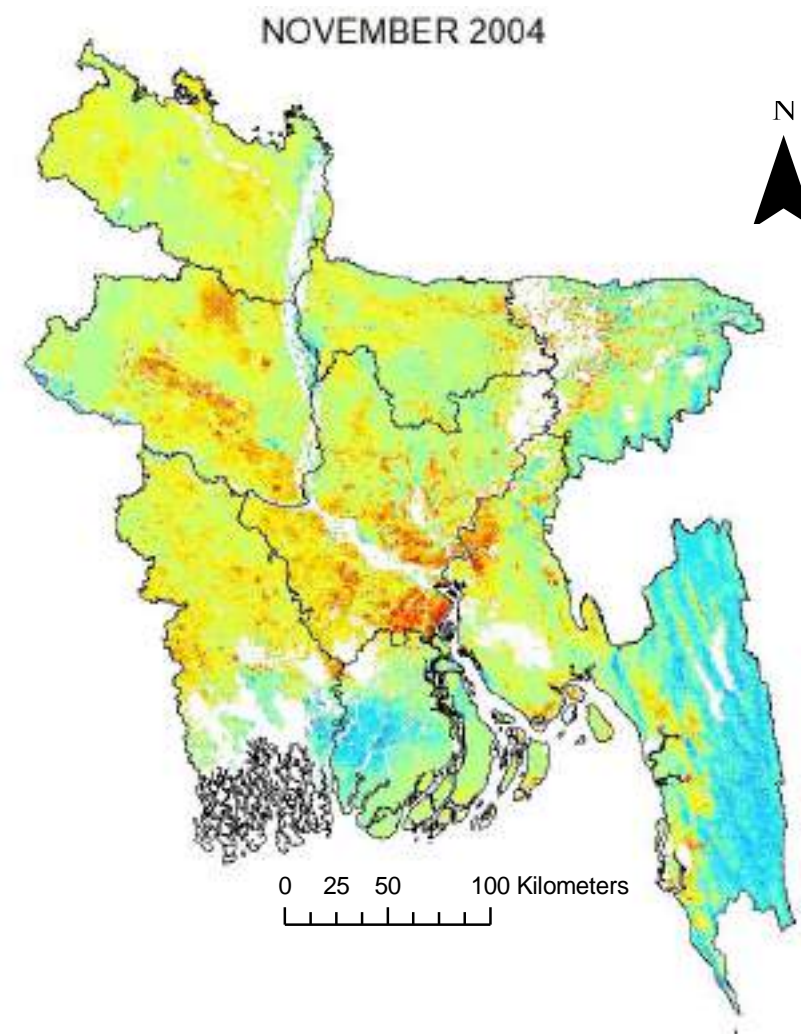
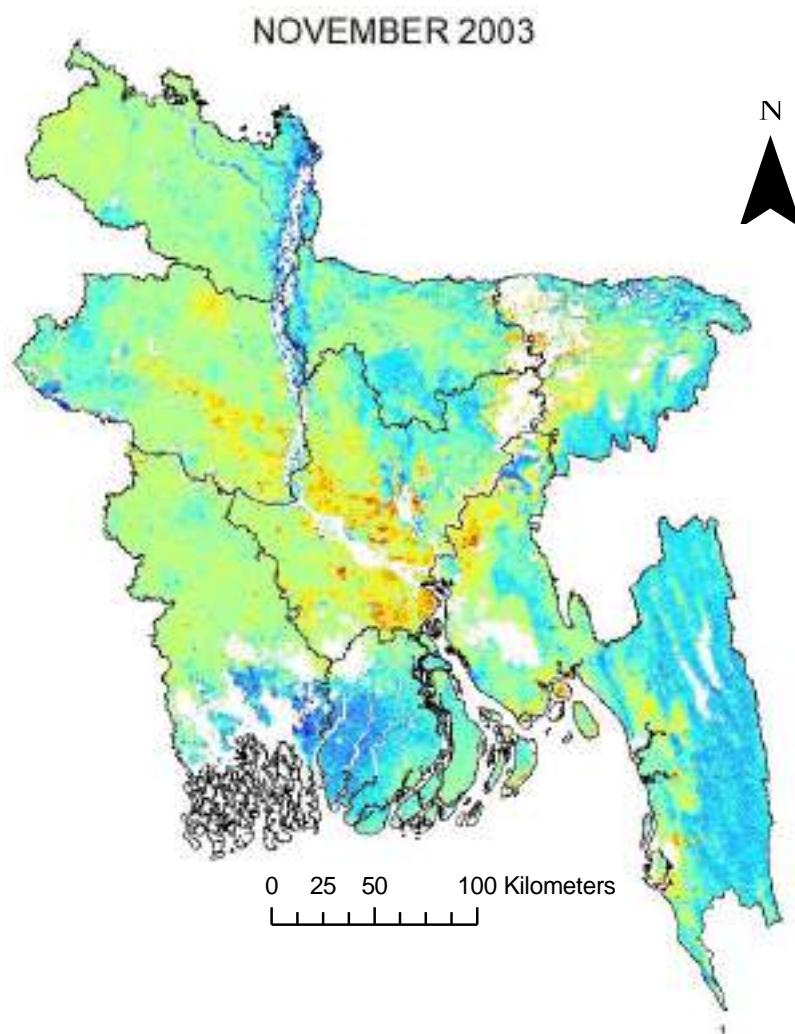
Legend





Legend



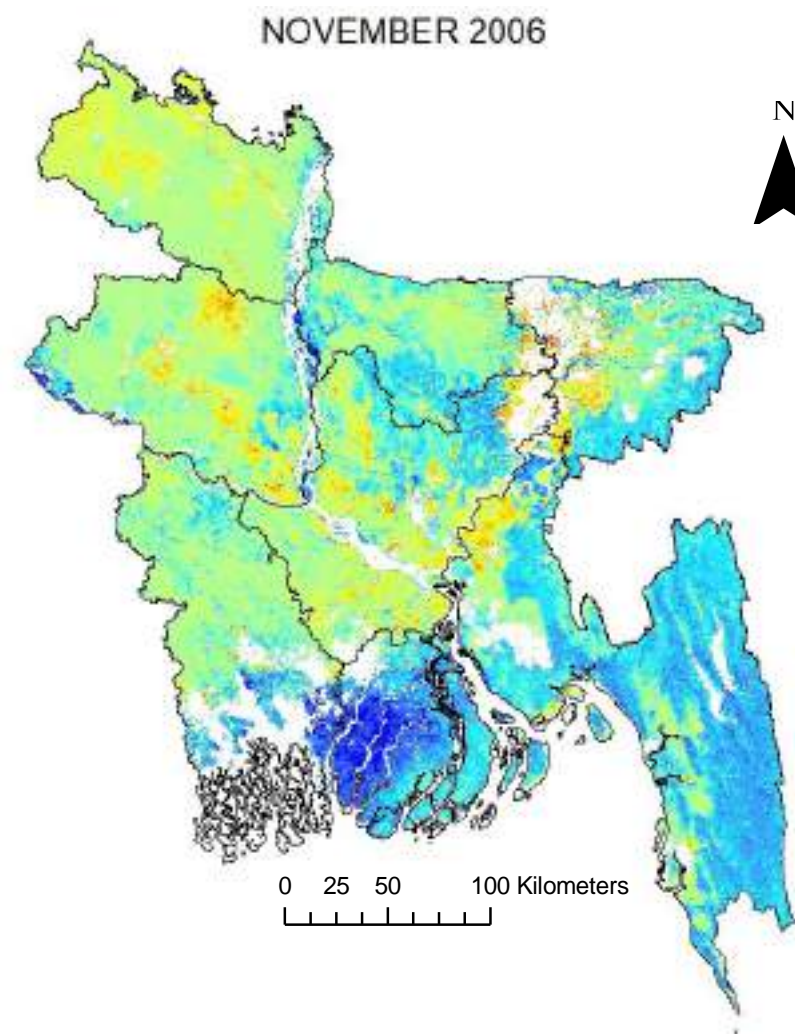
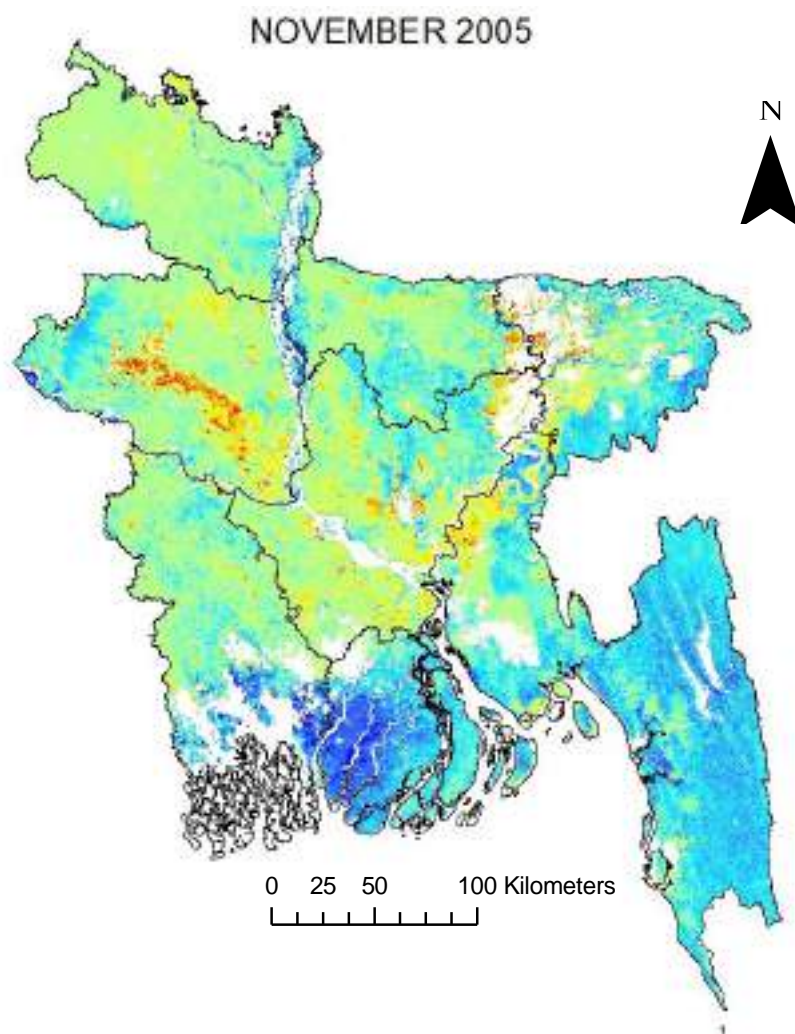


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

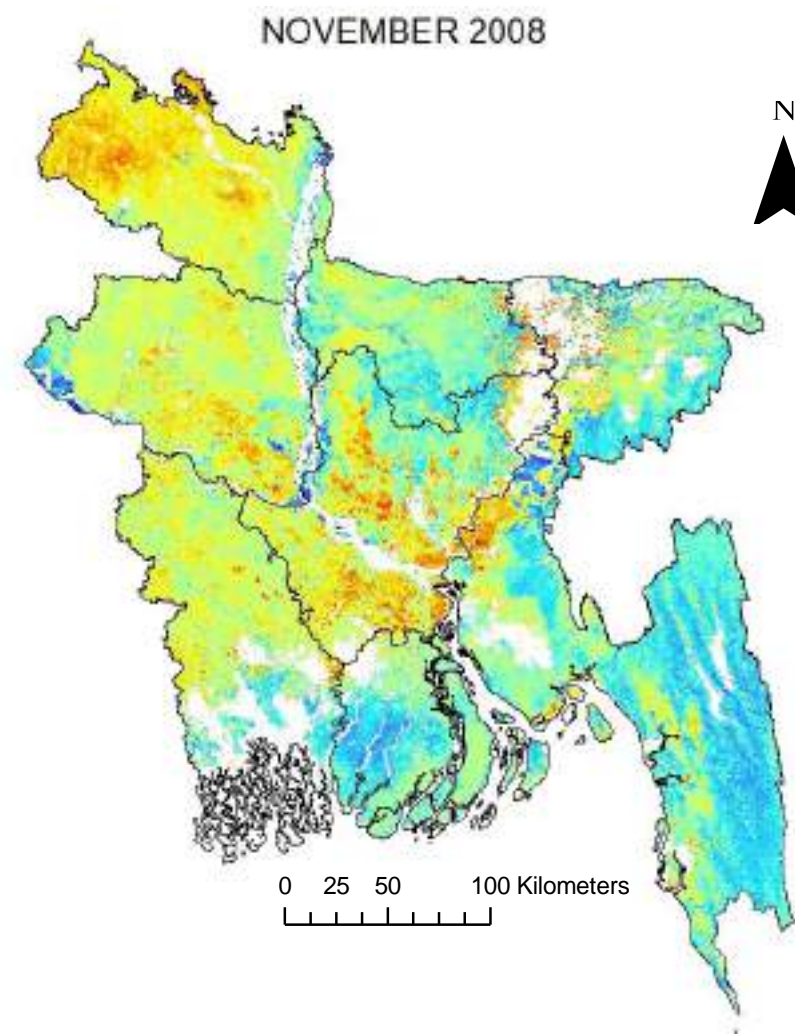
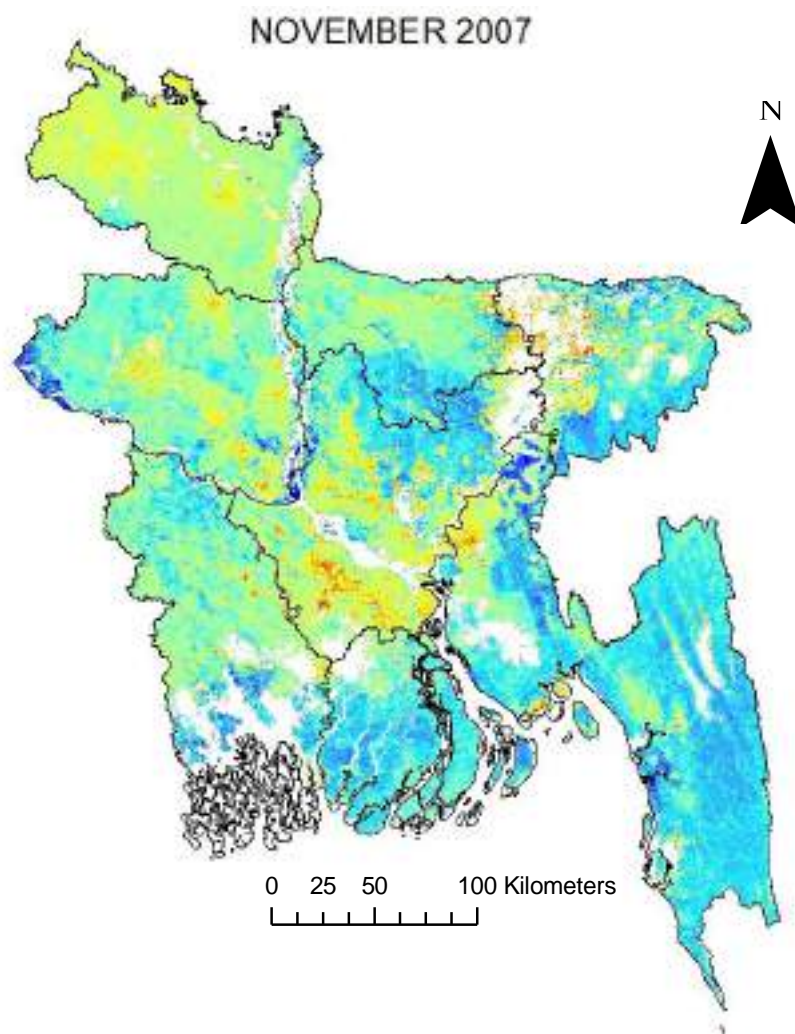


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

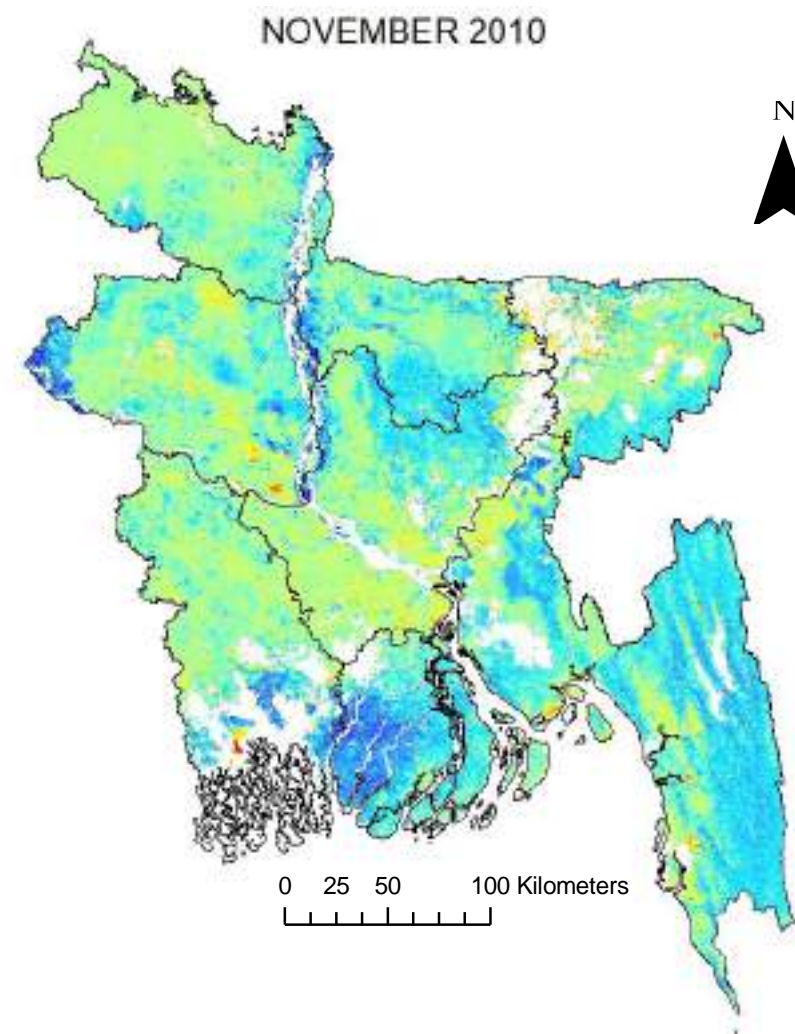
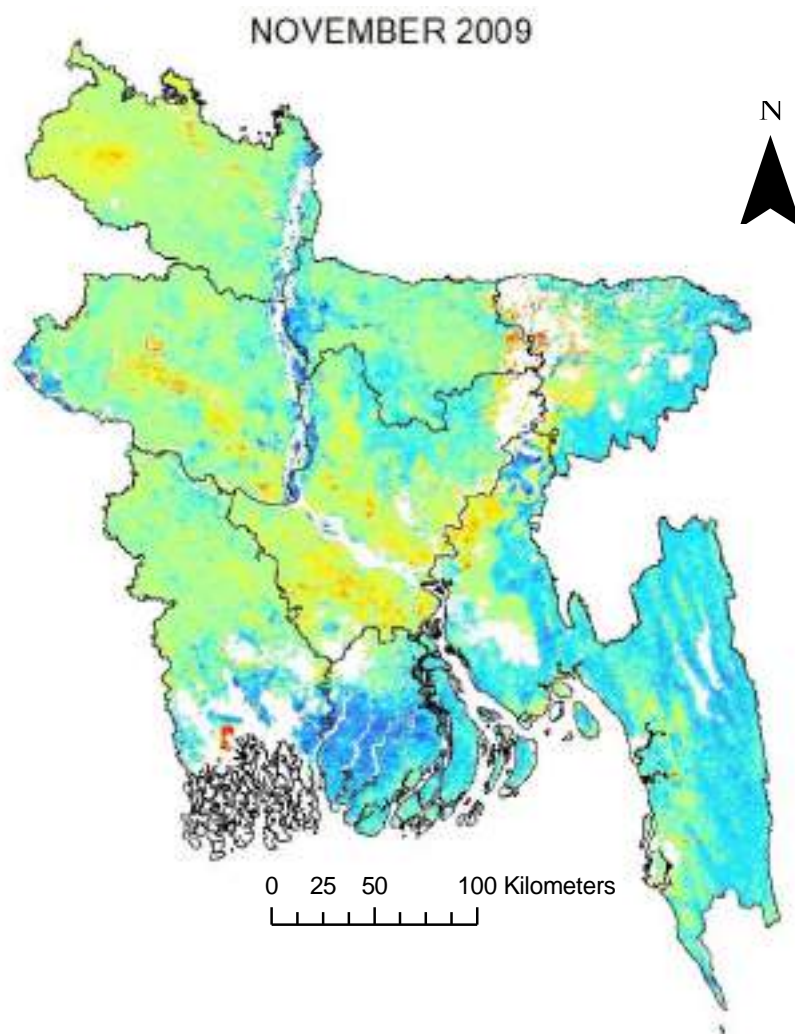


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

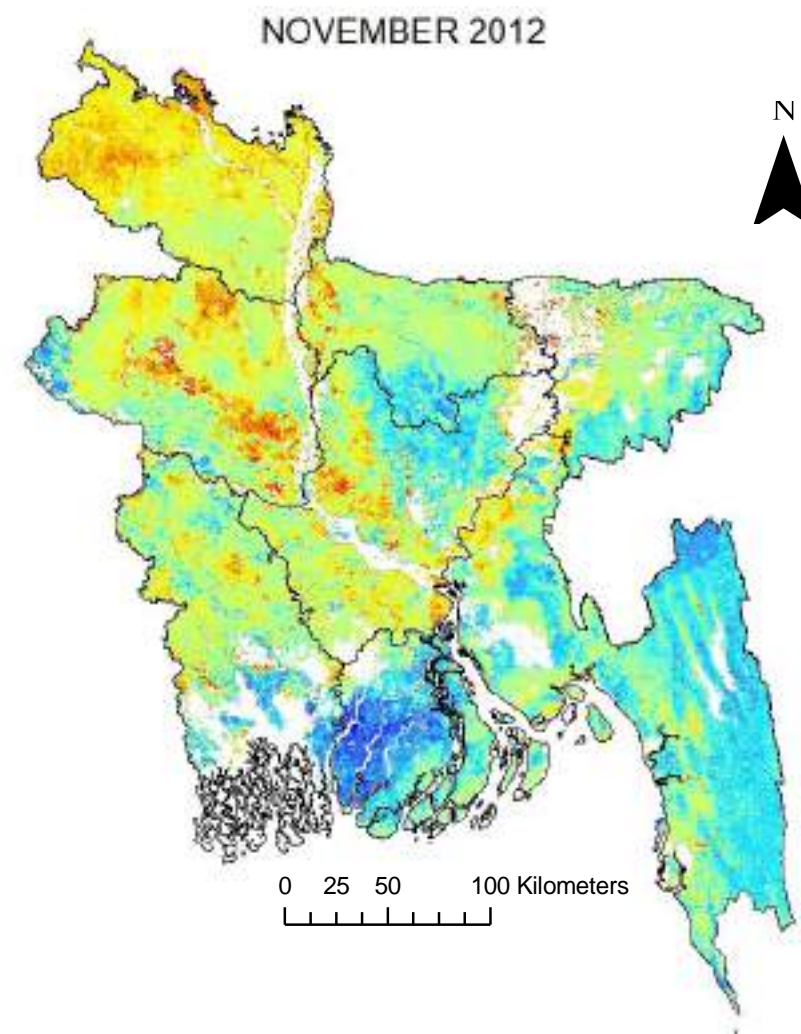
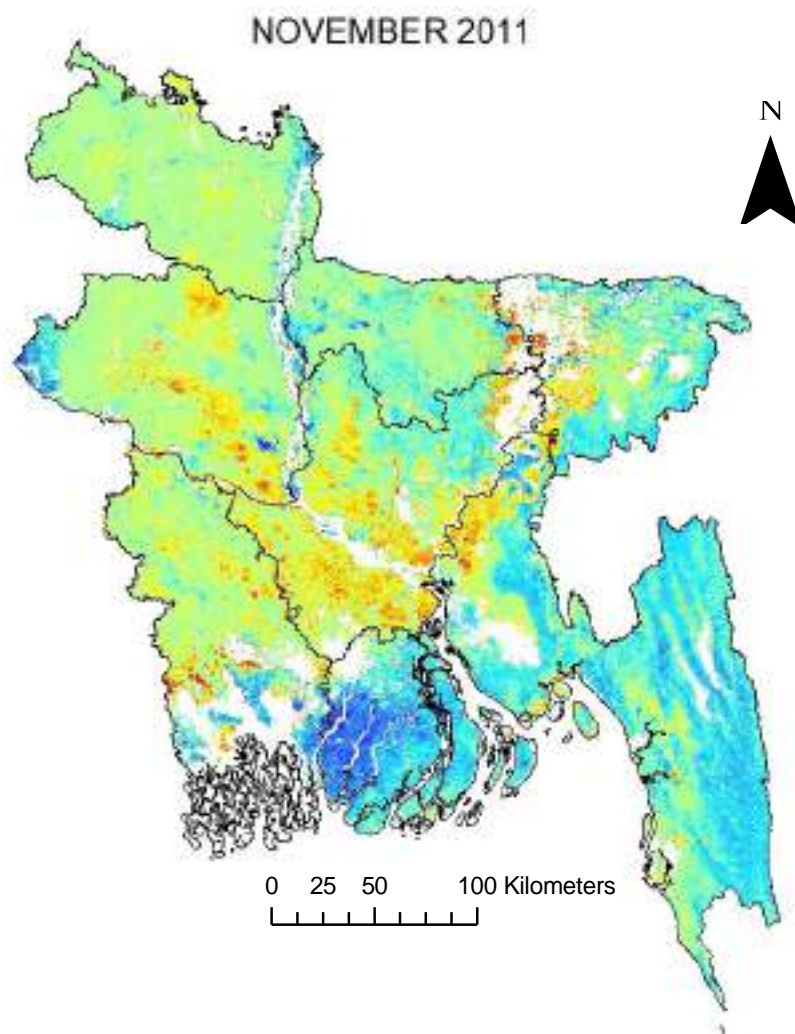


Legend

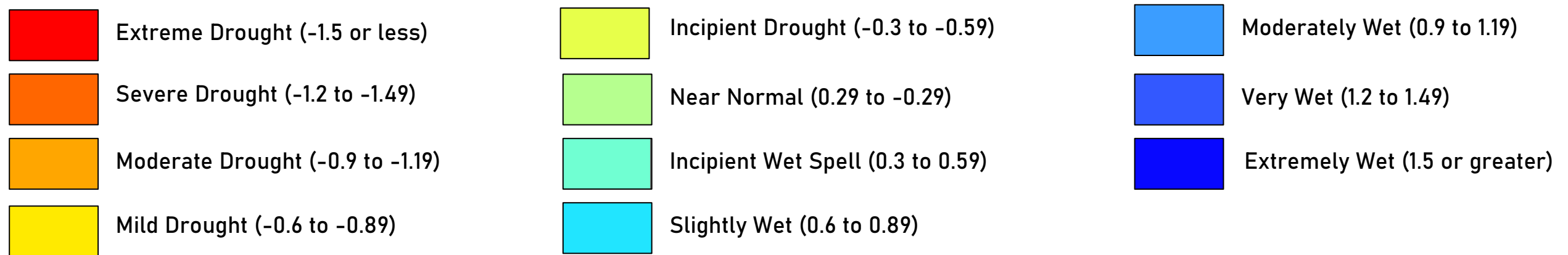
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

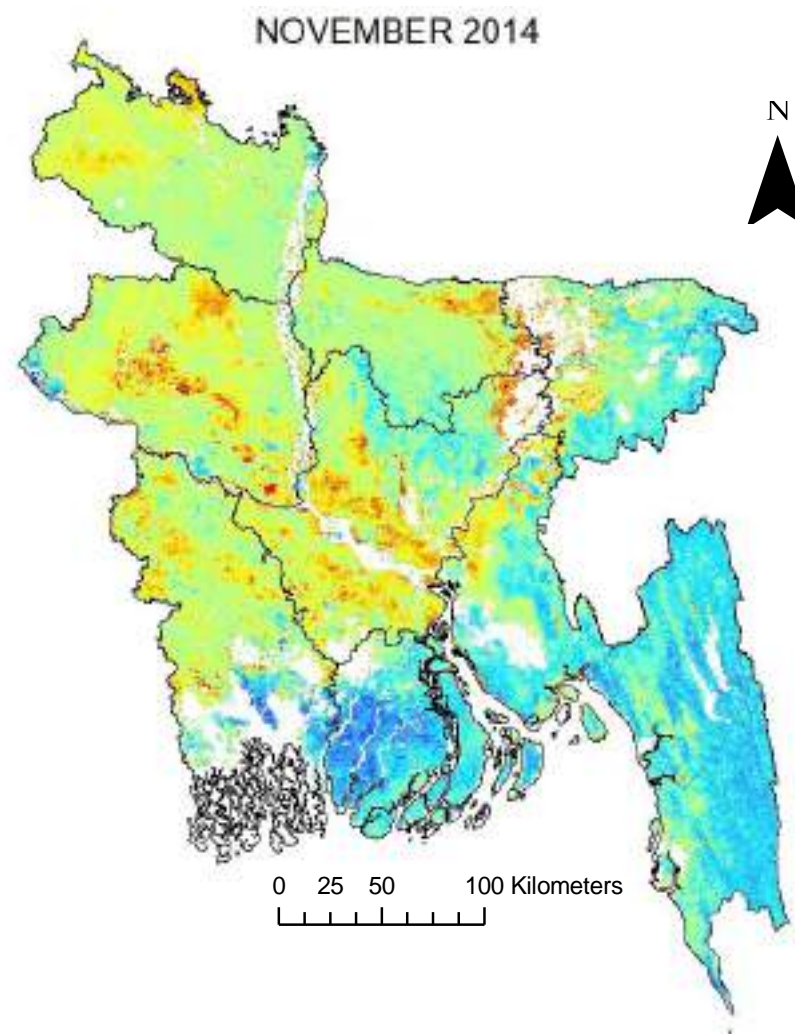
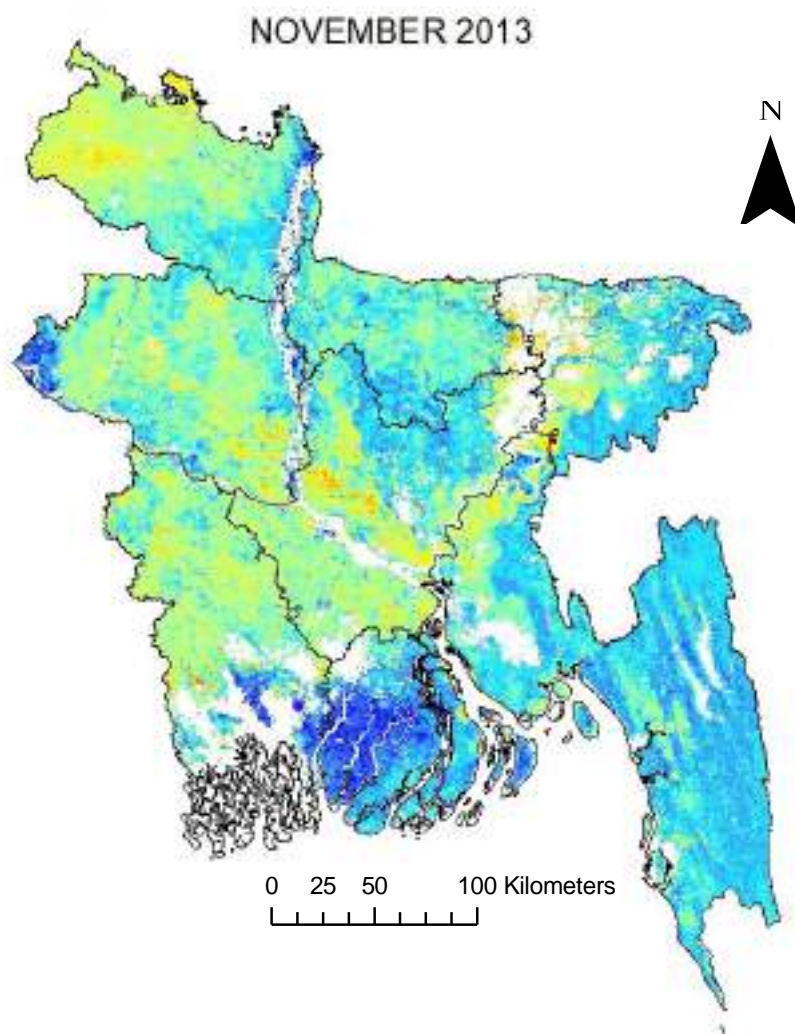
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend



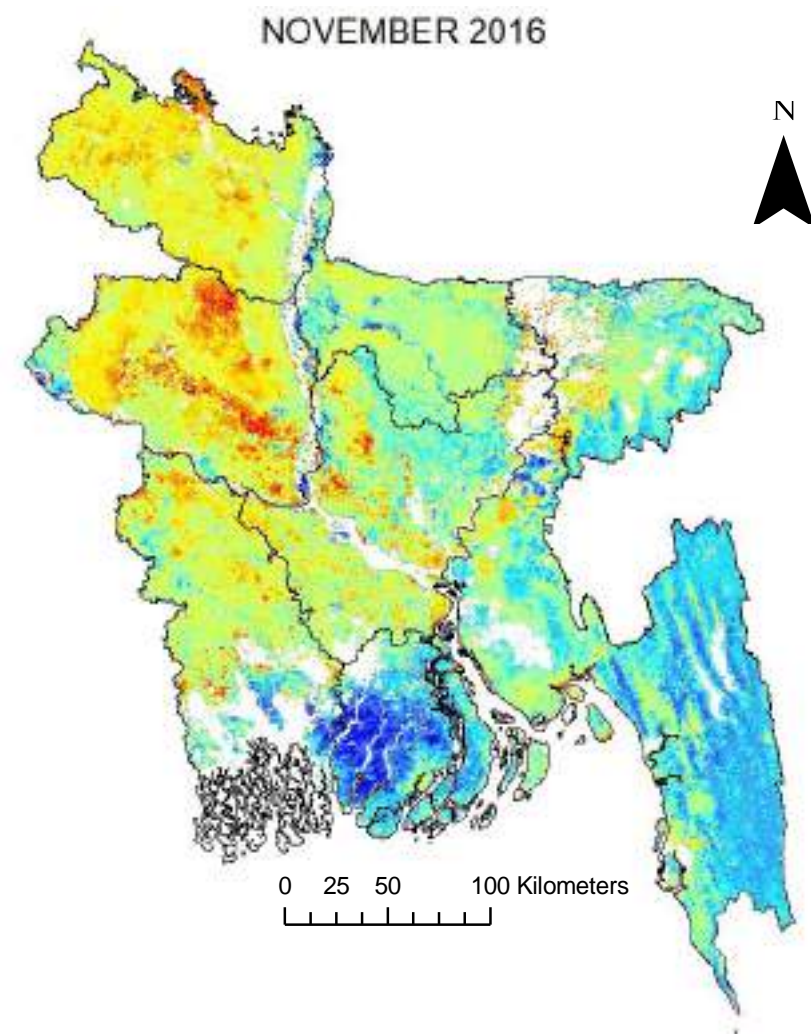
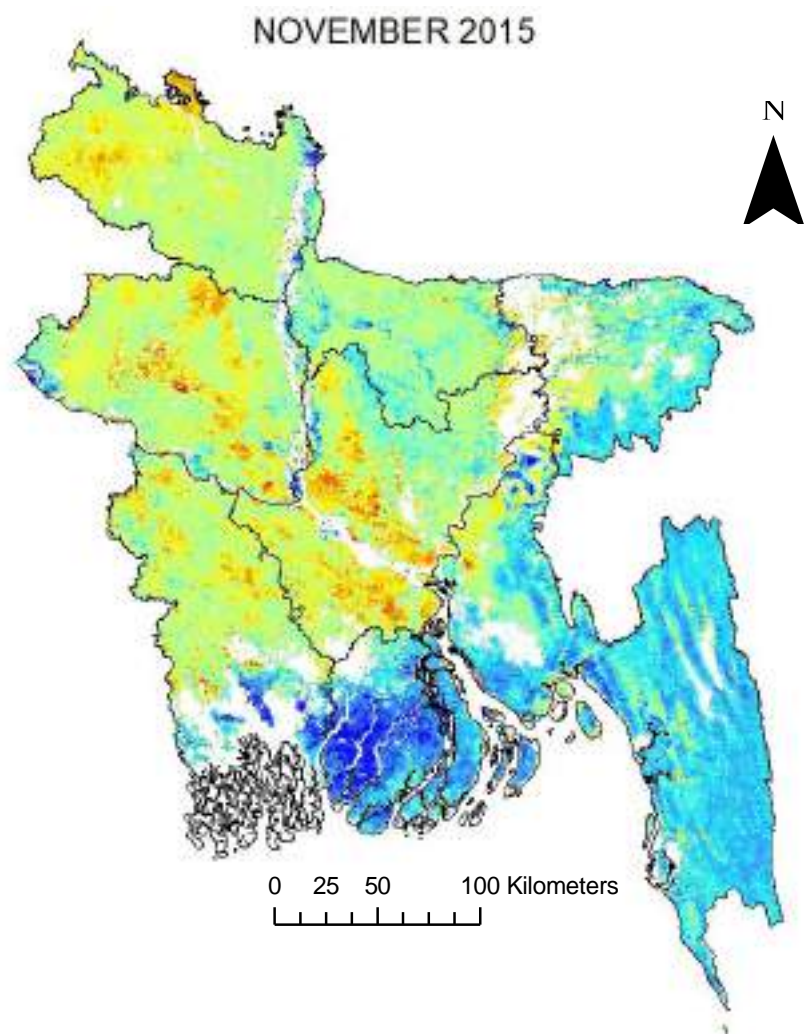


Legend

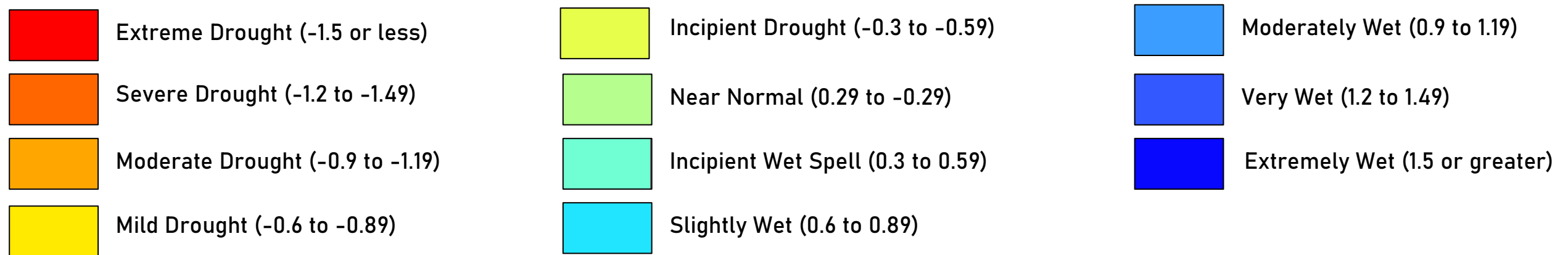
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

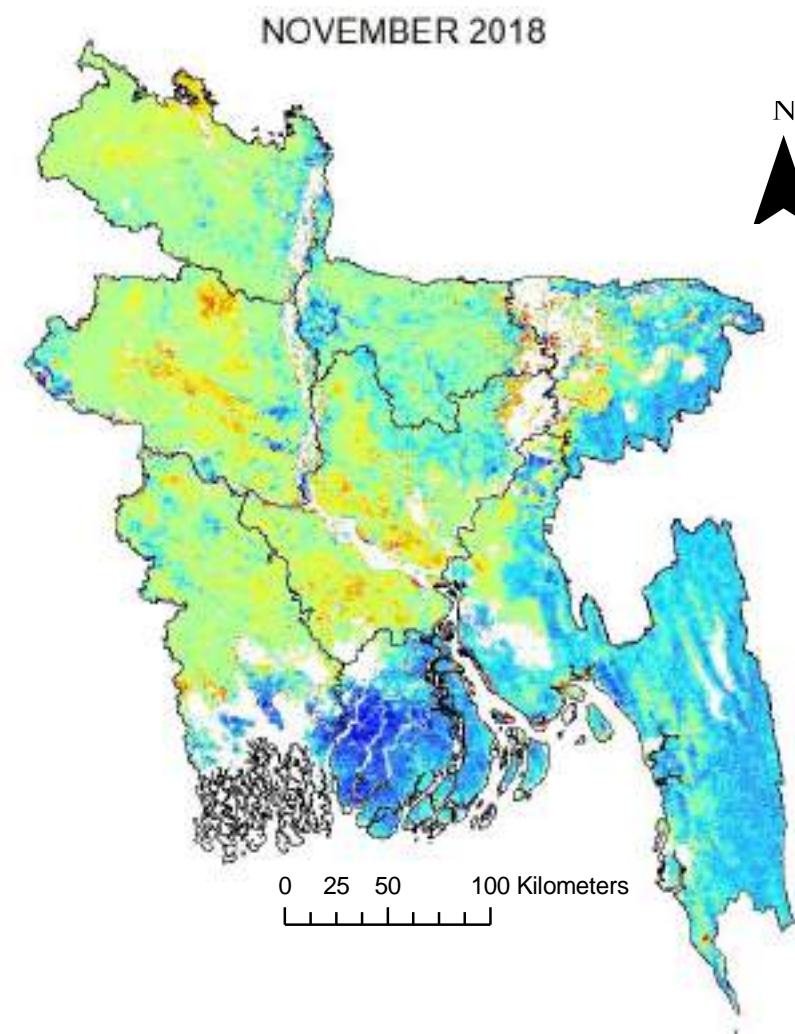
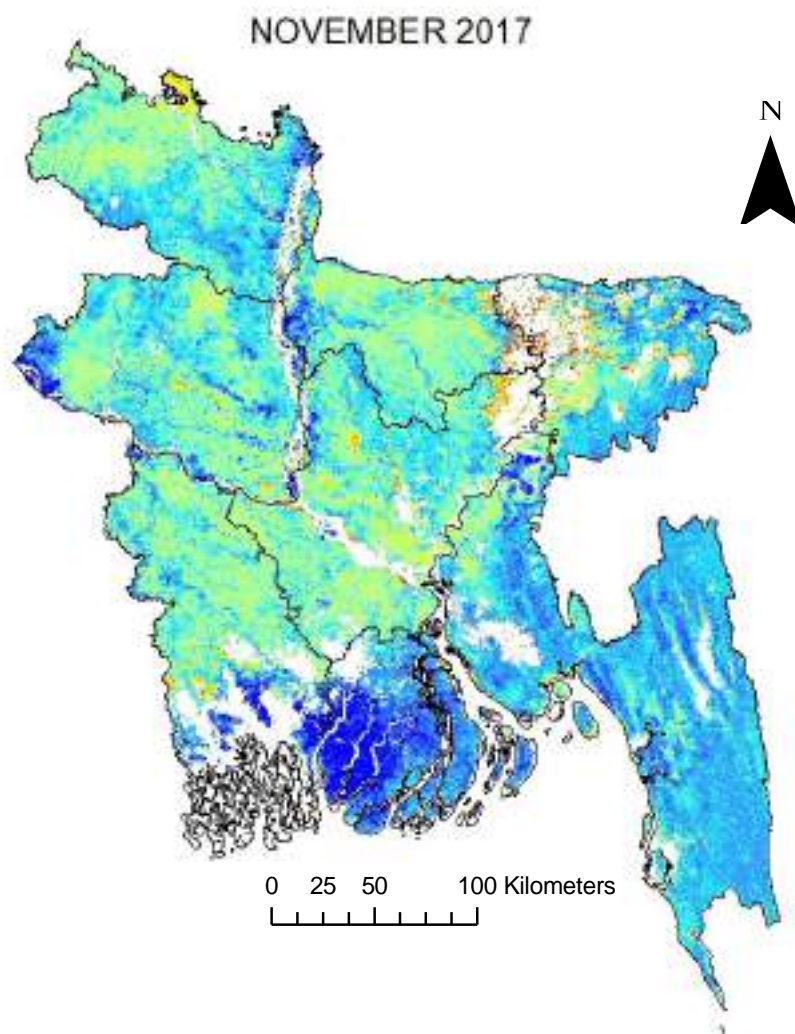
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

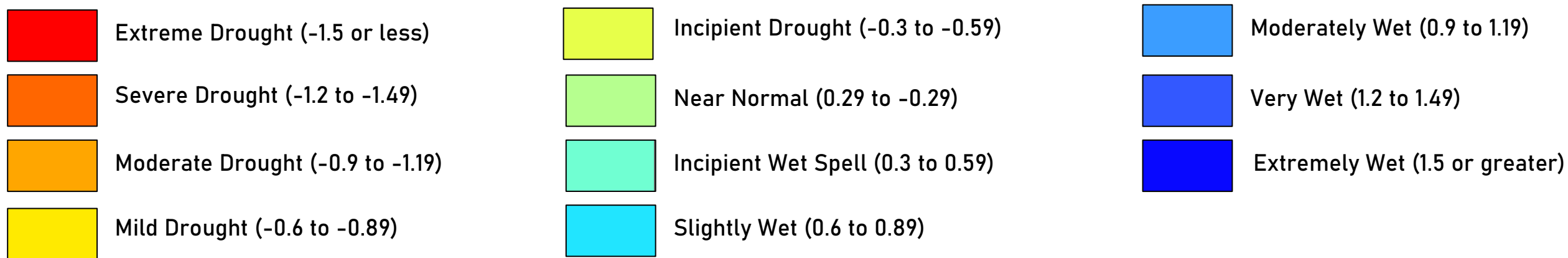


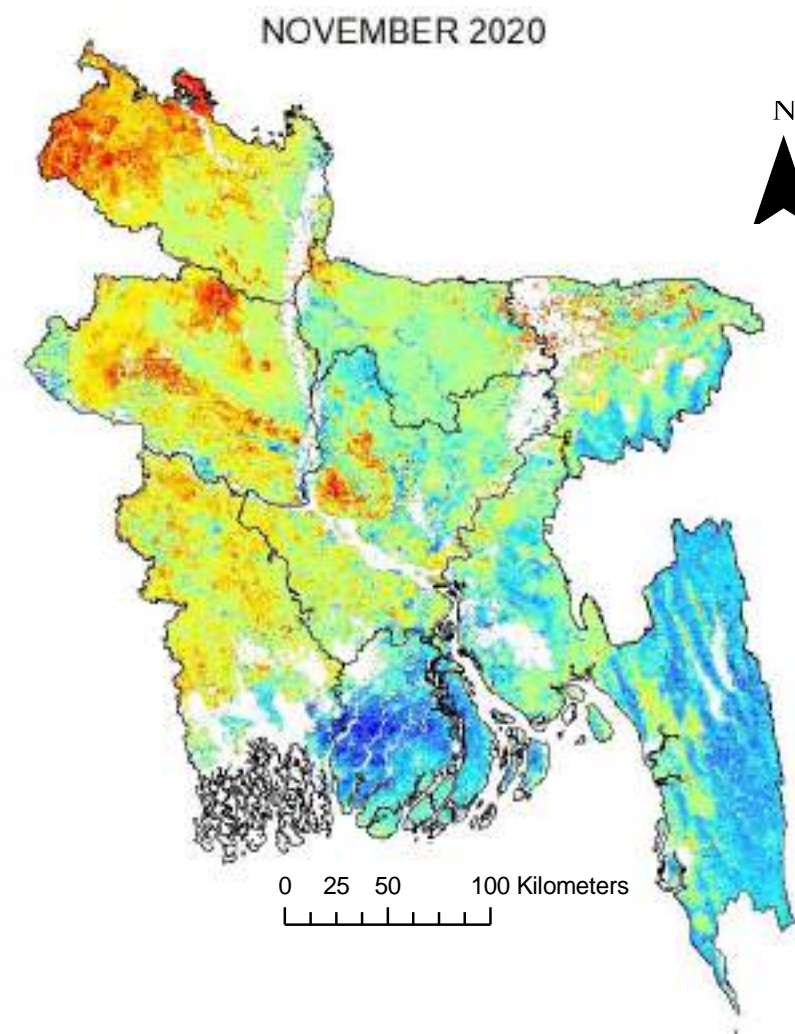
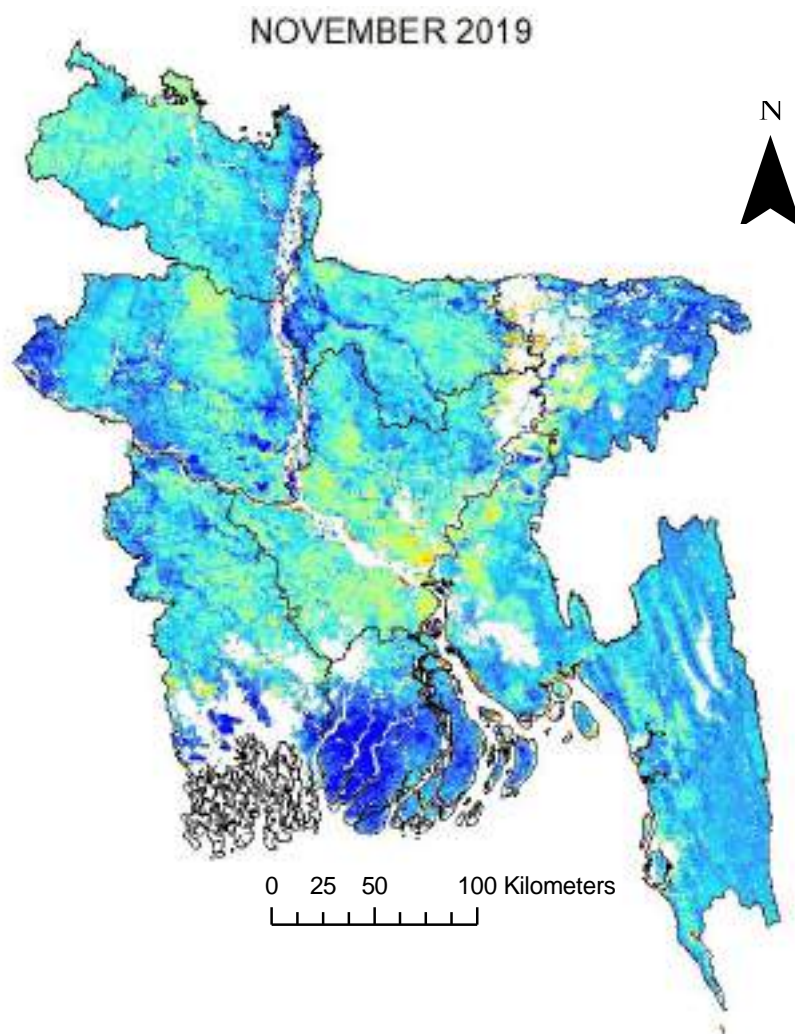
Legend



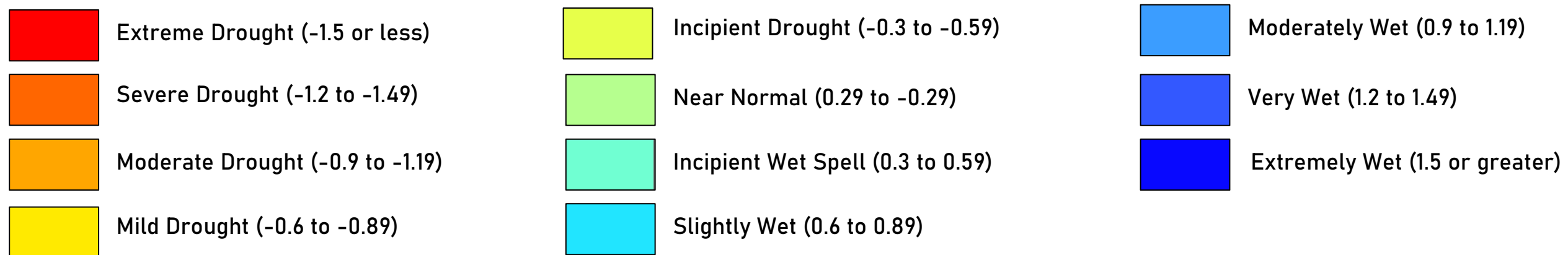


Legend





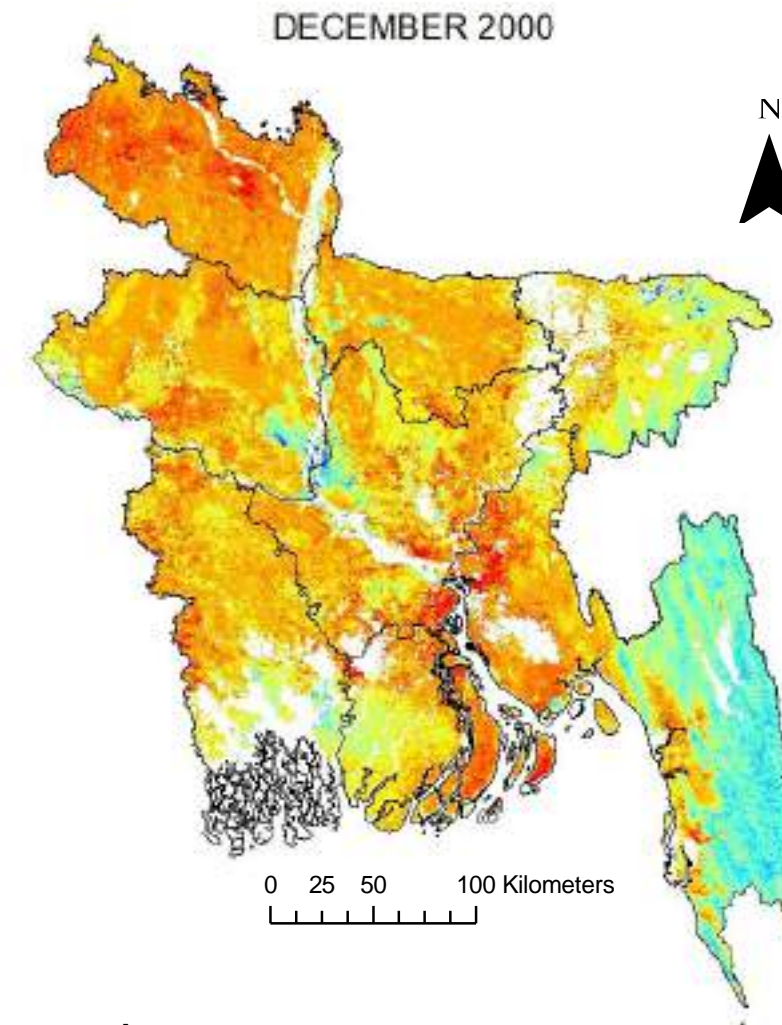
Legend



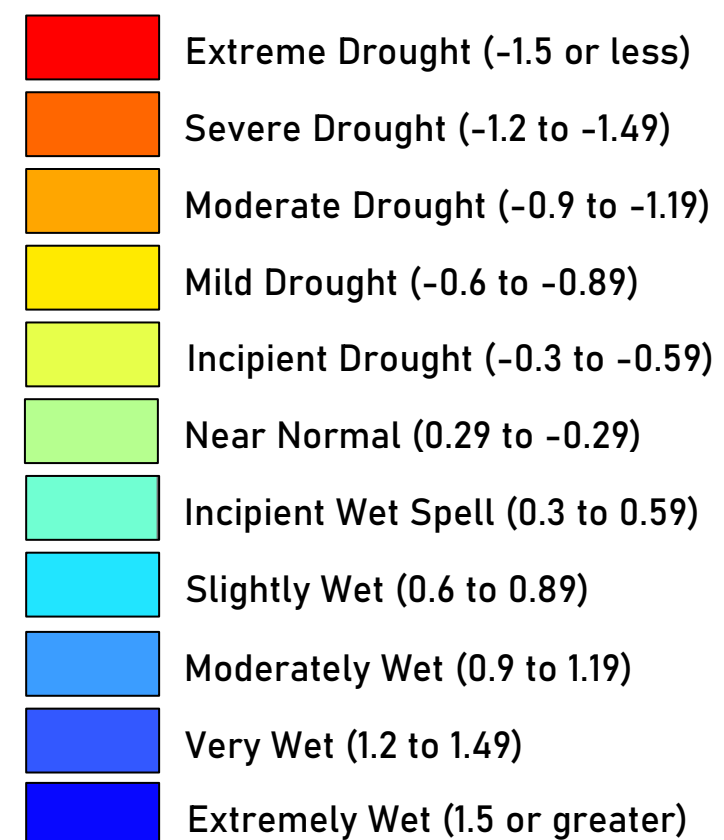
December DSI Maps

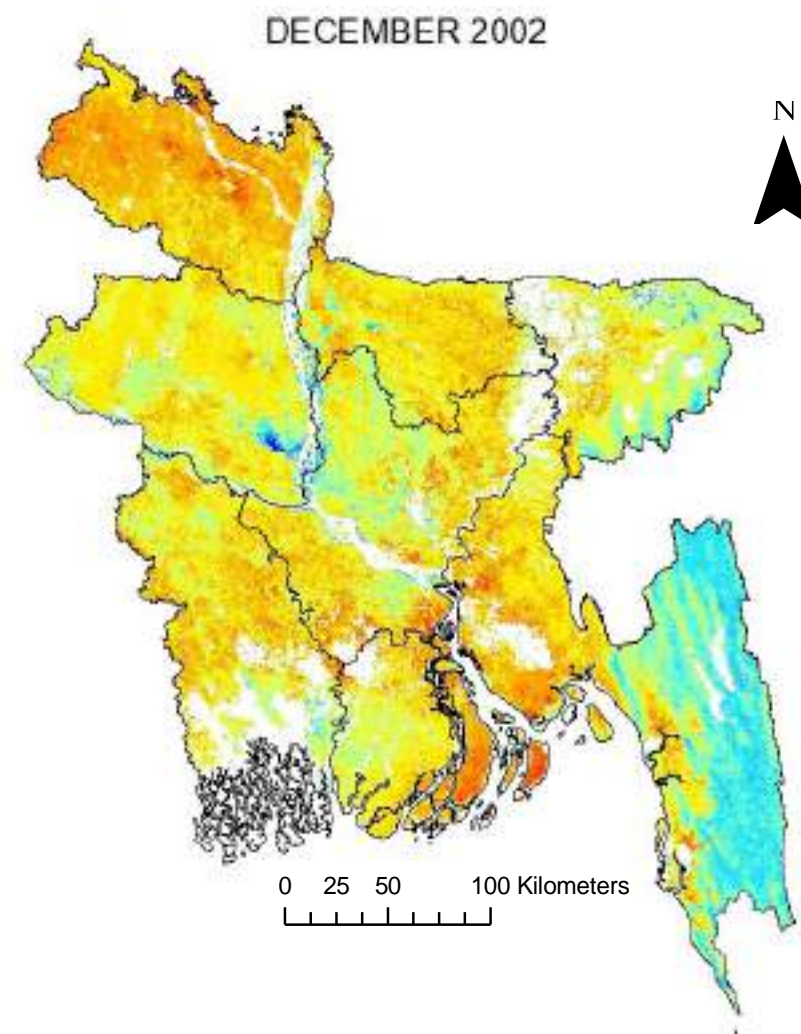
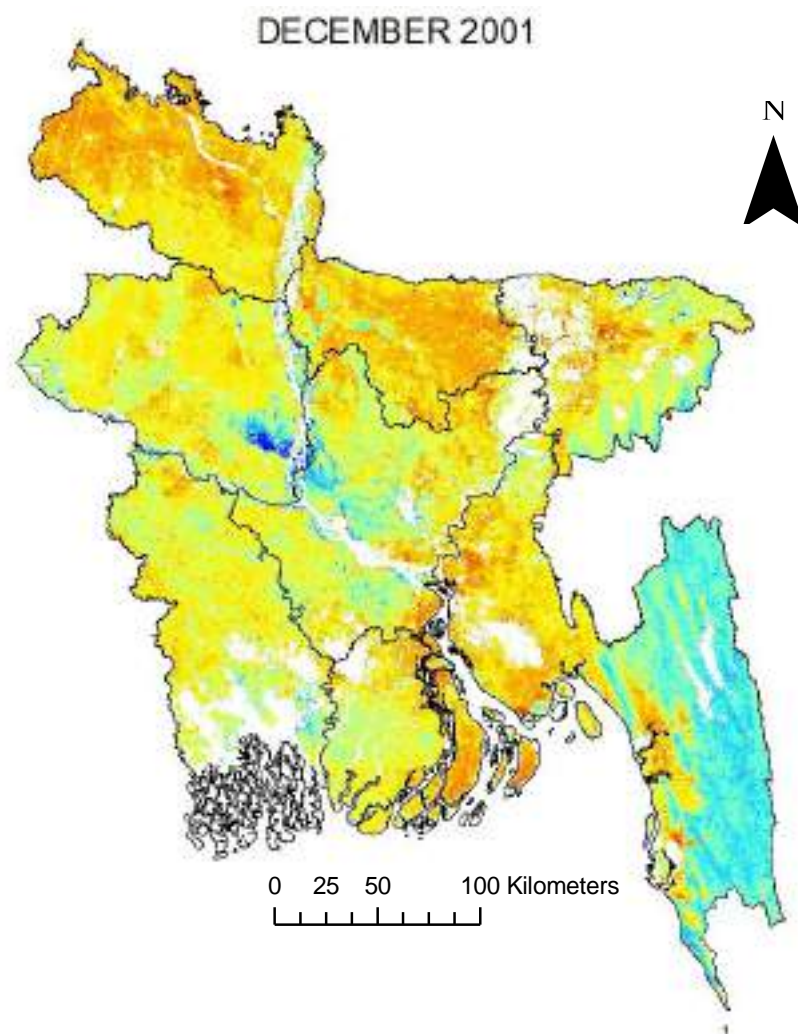
Drought conditions in December typically vary from mild drought to near normal. The characteristics of this dry and mild winter month are frequently characterized by near normal.

Mean December DSI Values		
Years	Values	Drought Condition
2000	-0.66	Mild Drought
2001	-0.29	Near Normal
2002	-0.39	Incipient Drought
2003	-0.09	Near Normal
2004	-0.45	Incipient Drought
2005	-0.09	Near Normal
2006	-0.34	Incipient Drought
2007	-0.25	Near Normal
2008	-0.22	Near Normal
2009	-0.35	Incipient Drought
2010	-0.06	Near Normal
2011	-0.34	Incipient Drought
2012	-0.36	Incipient Drought
2013	-0.05	Near Normal
2014	-0.41	Incipient Drought
2015	-0.36	Incipient Drought
2016	-0.12	Near Normal
2017	0.19	Near Normal
2018	-0.26	Near Normal
2019	0.04	Near Normal
2020	-0.18	Near Normal



Legend



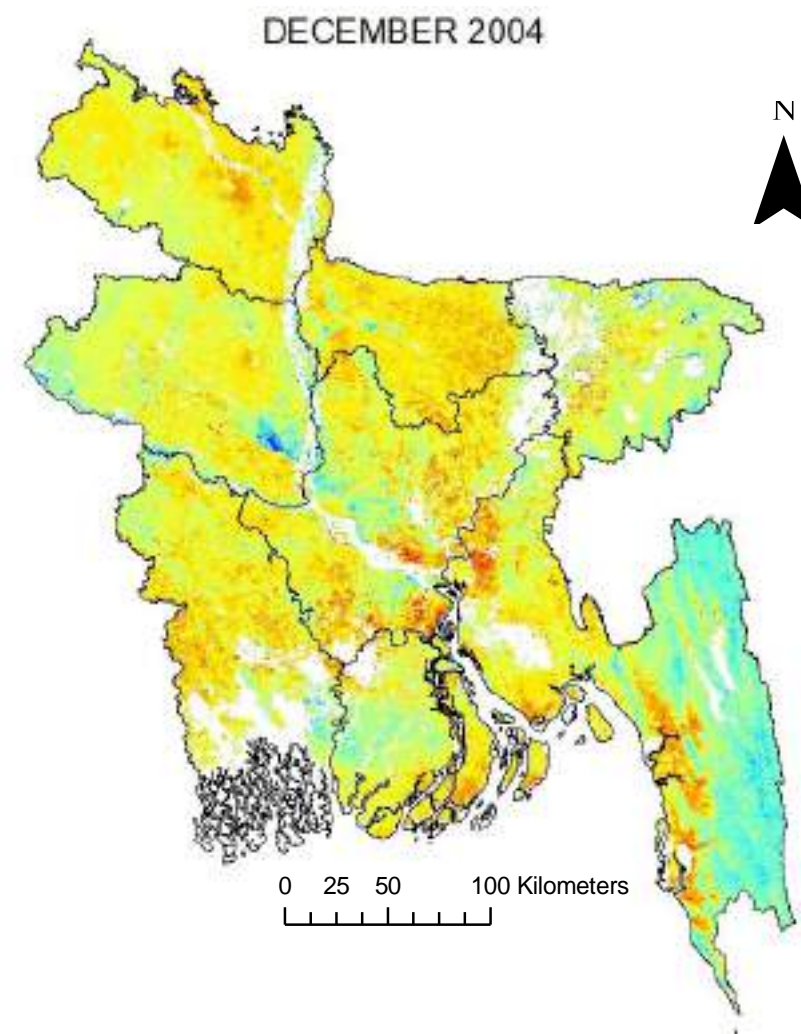
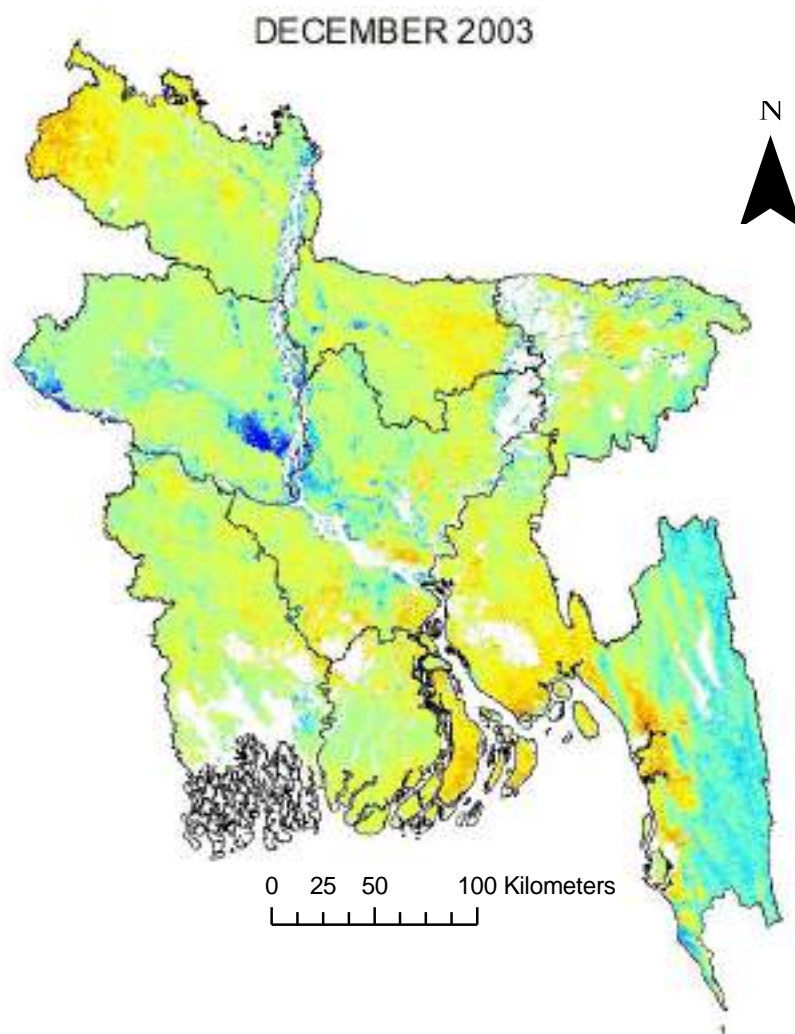


Legend

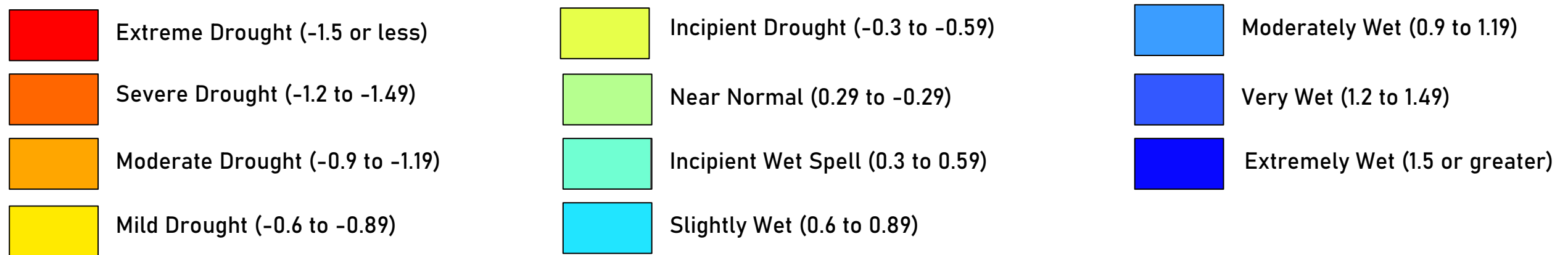
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

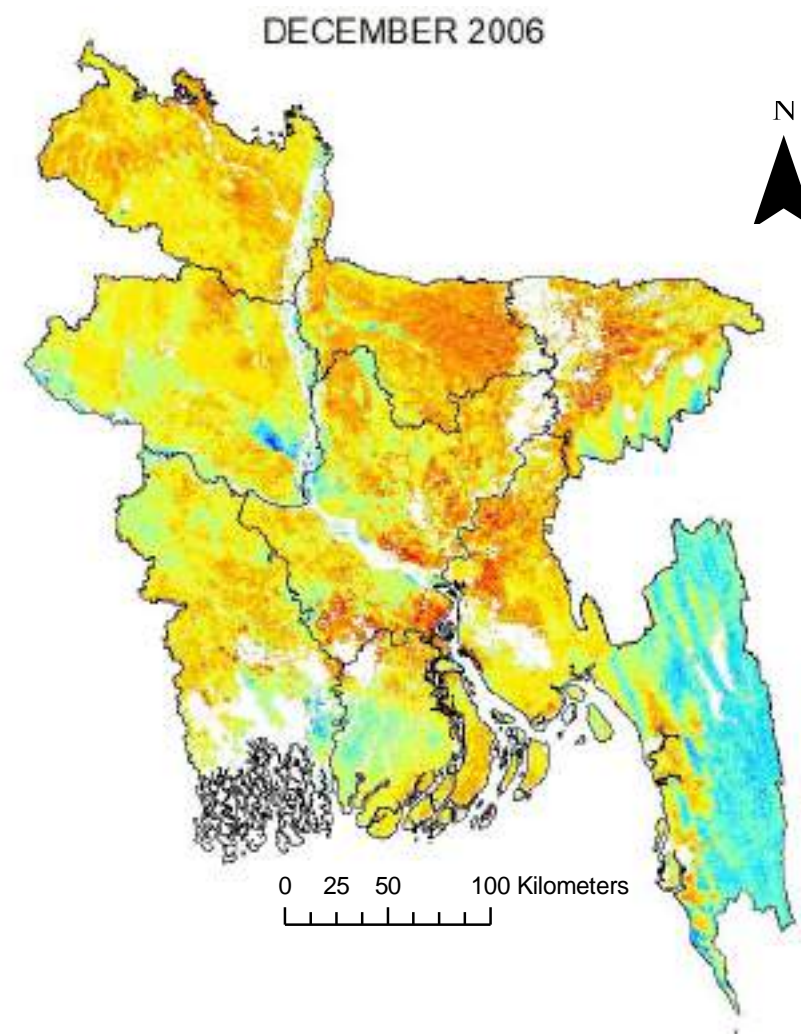
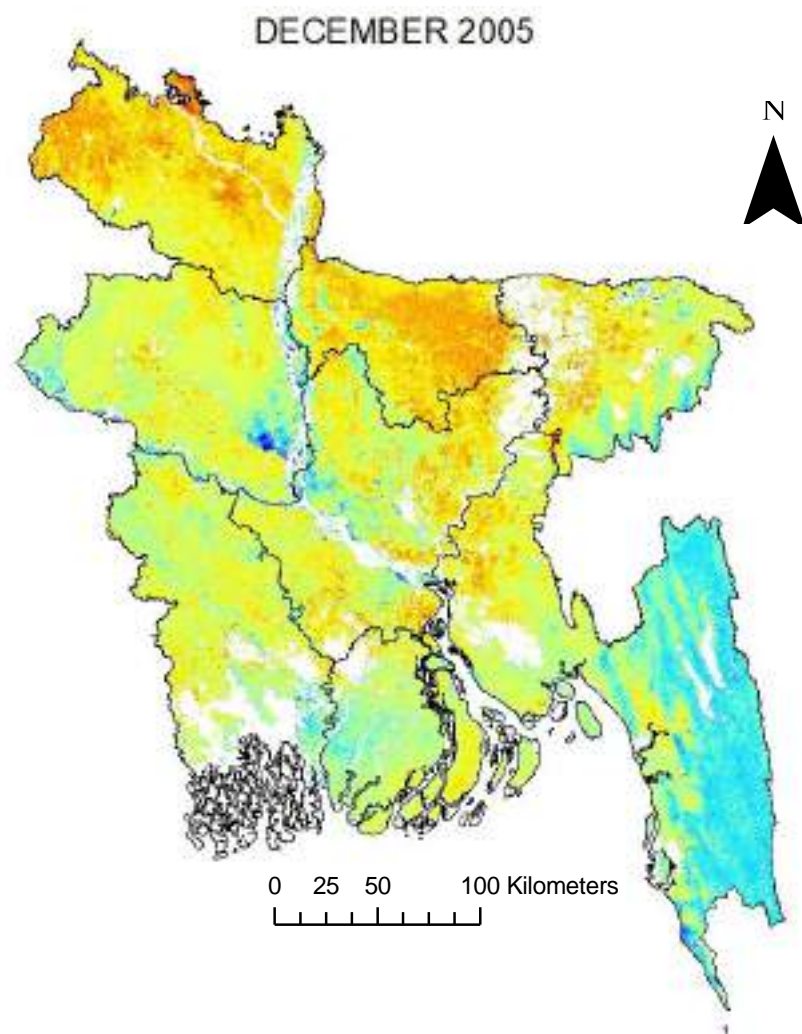
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend



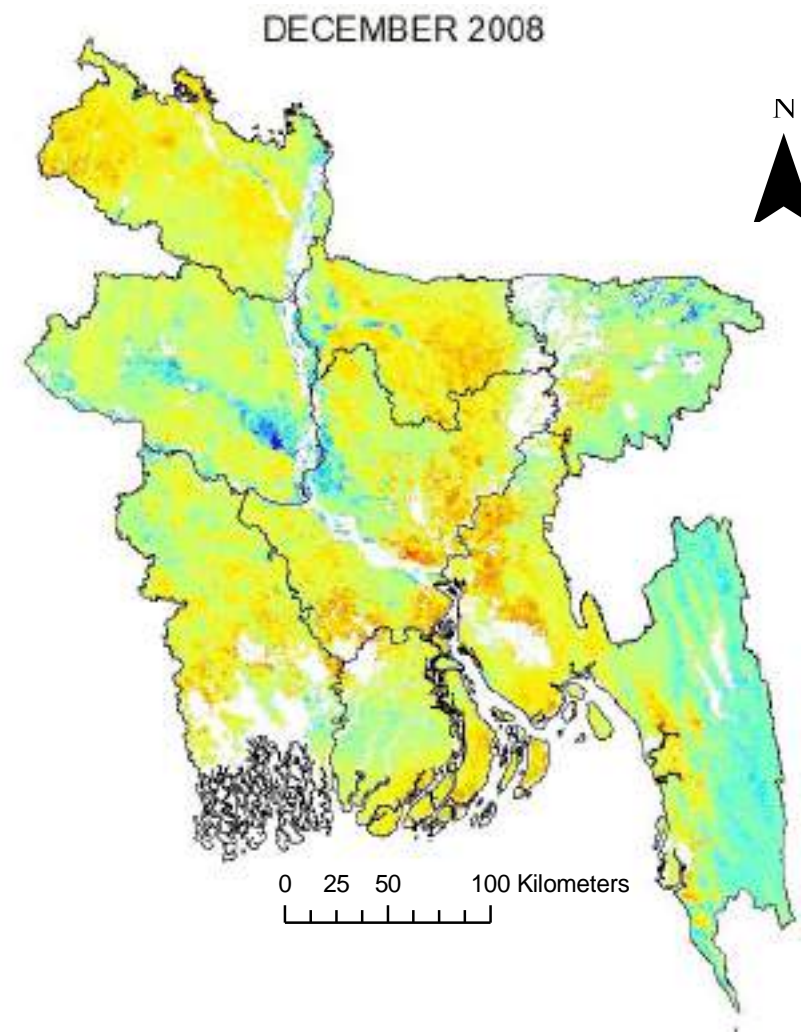
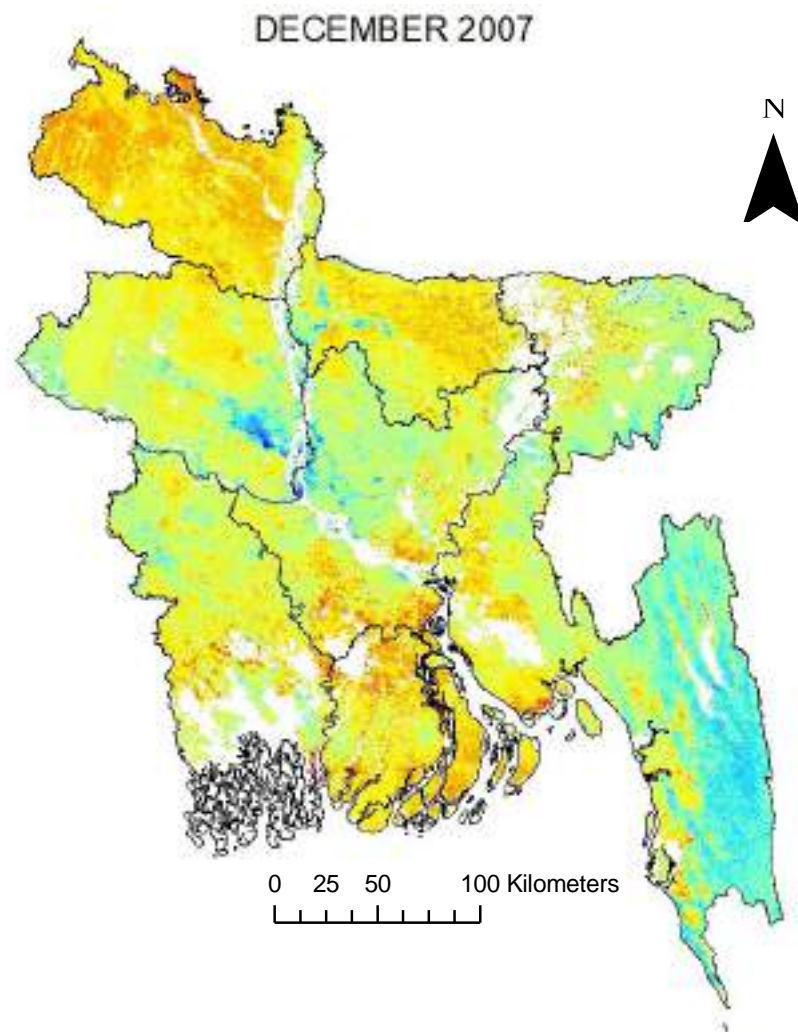


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

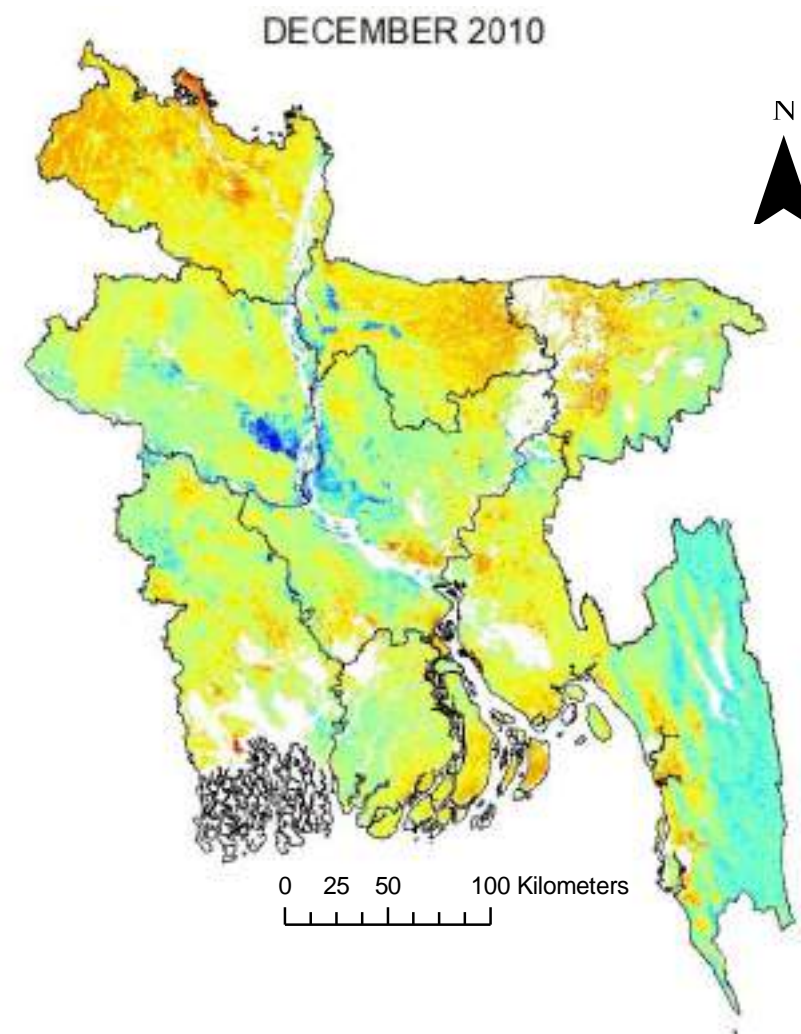
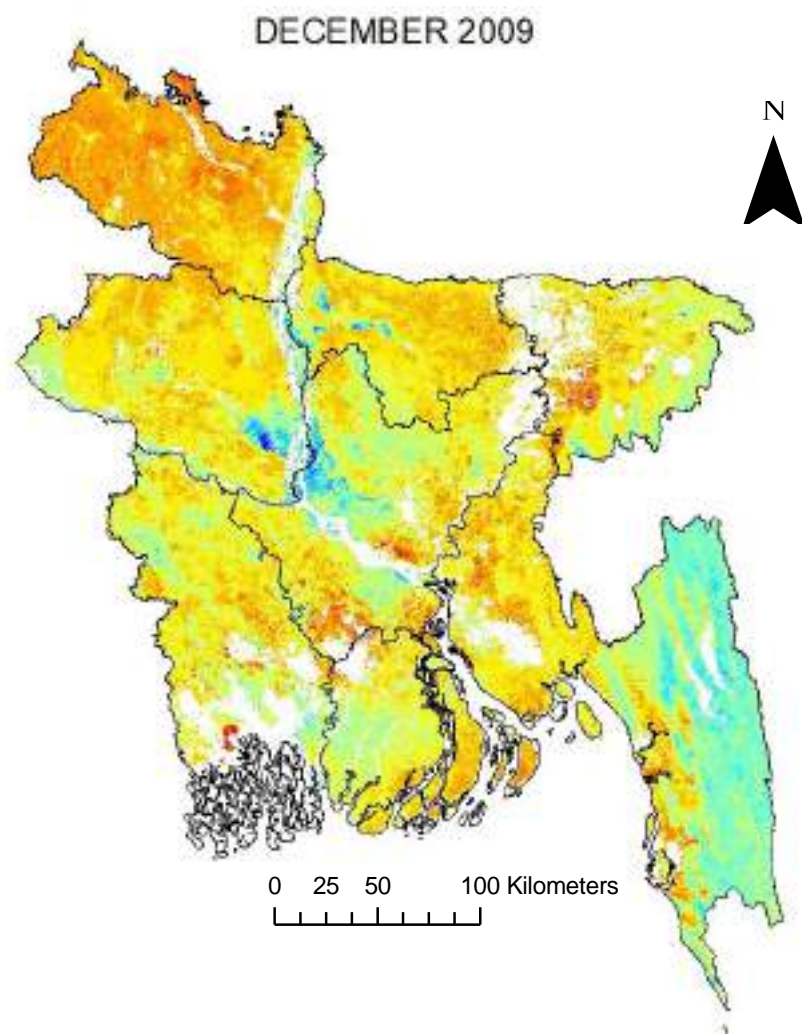


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

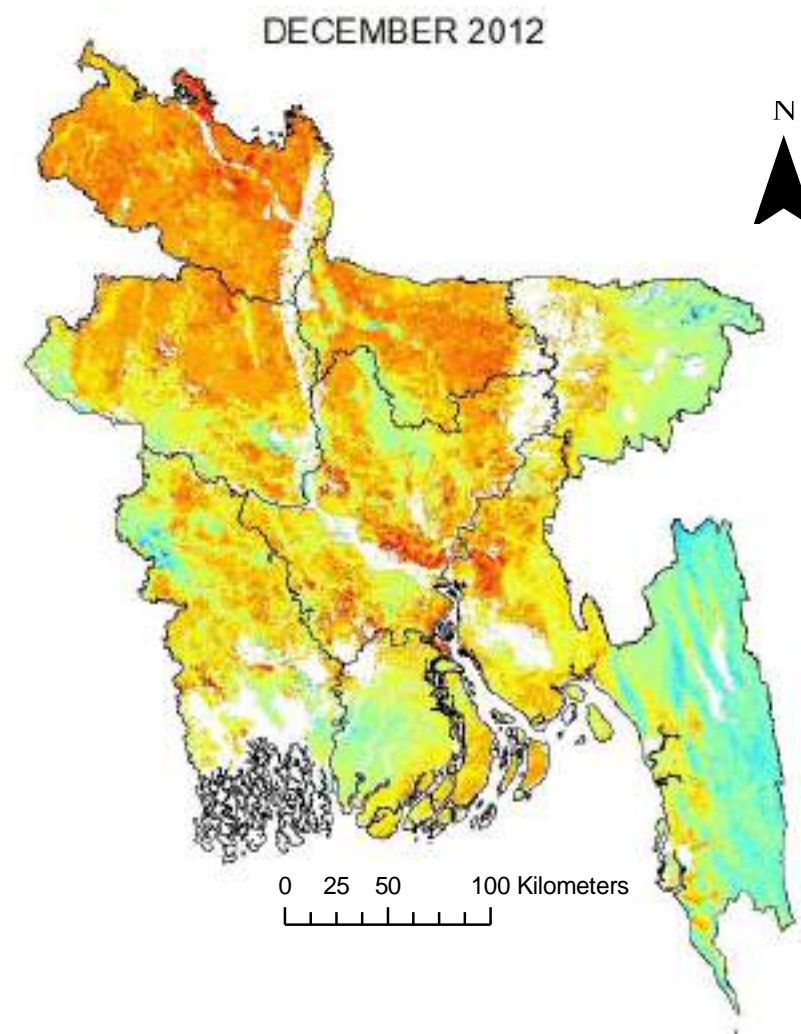
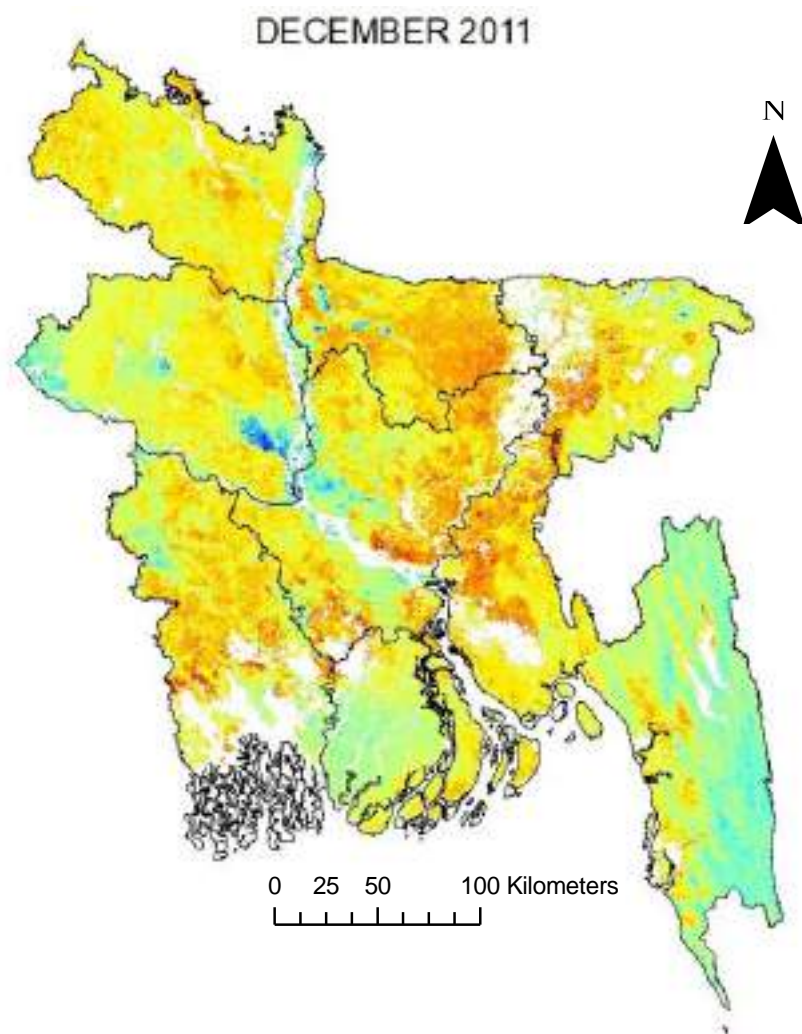


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

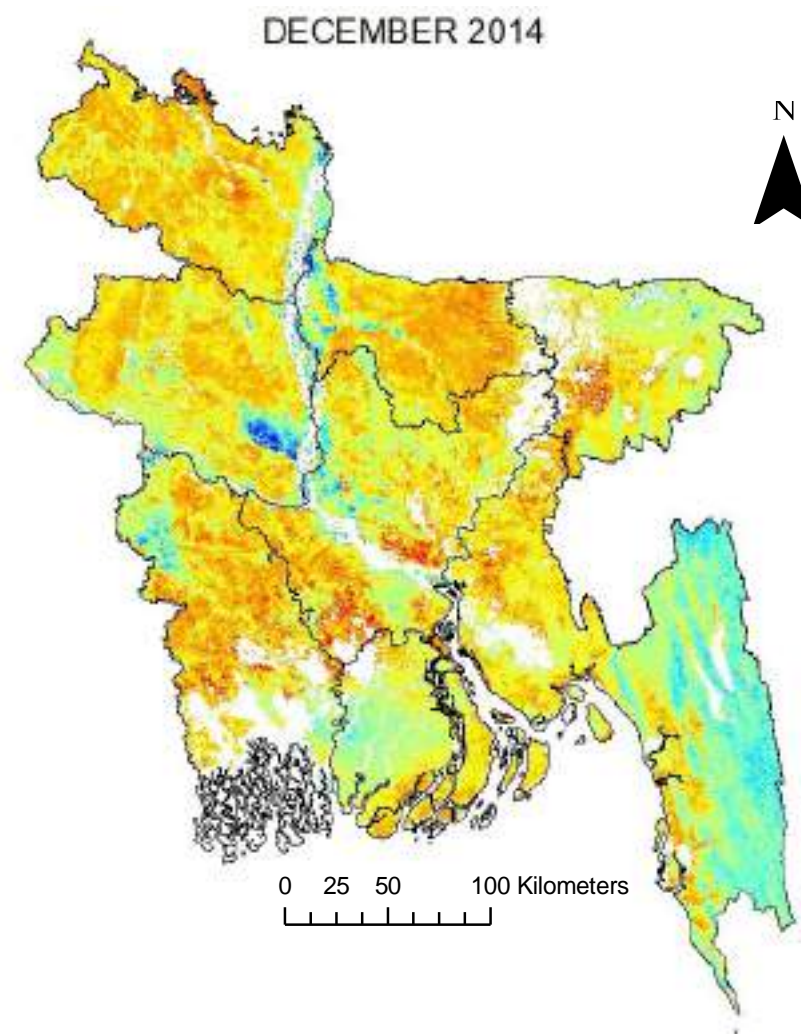
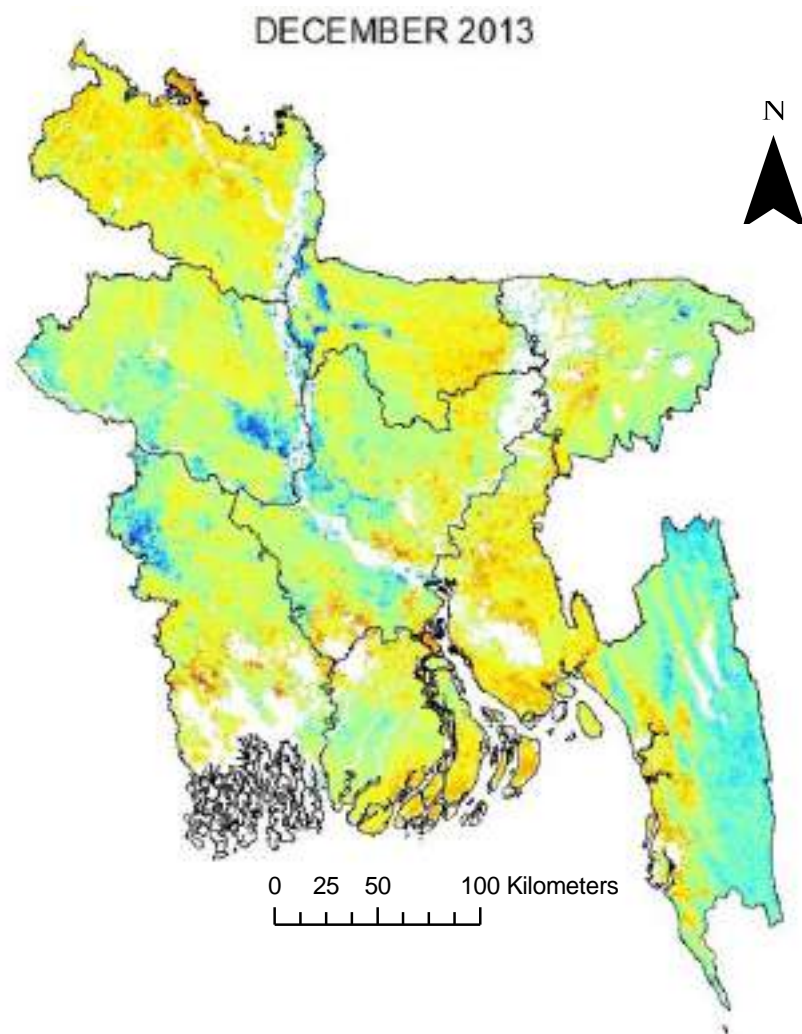


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

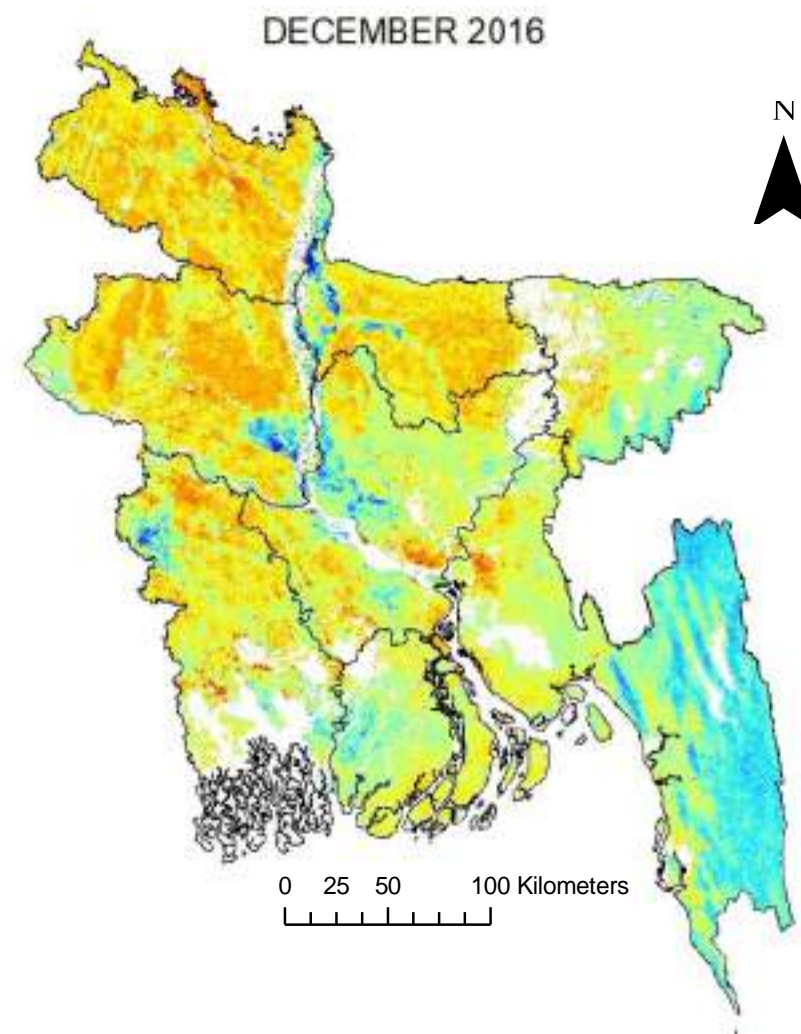
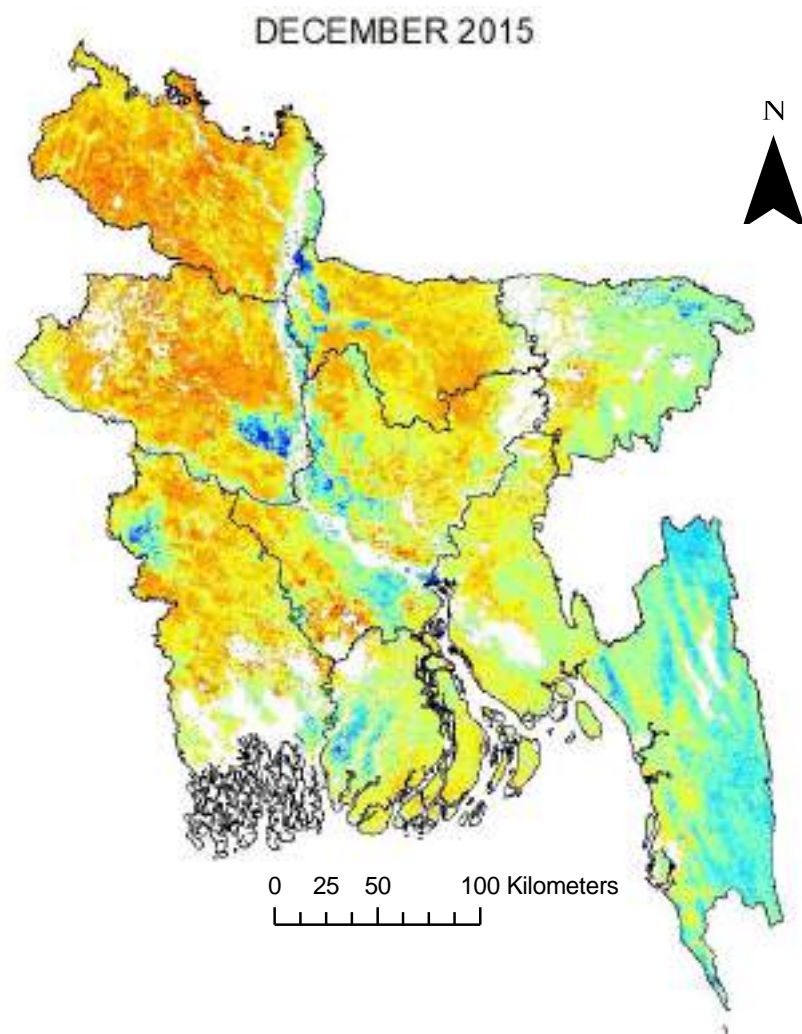


Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

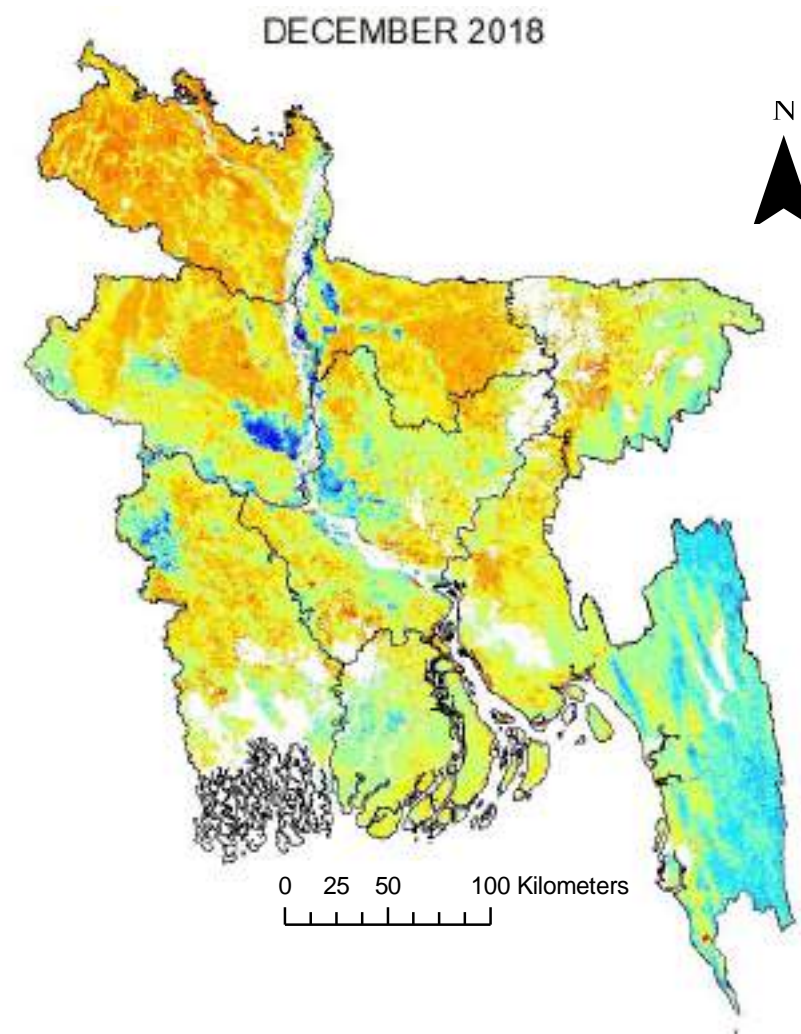
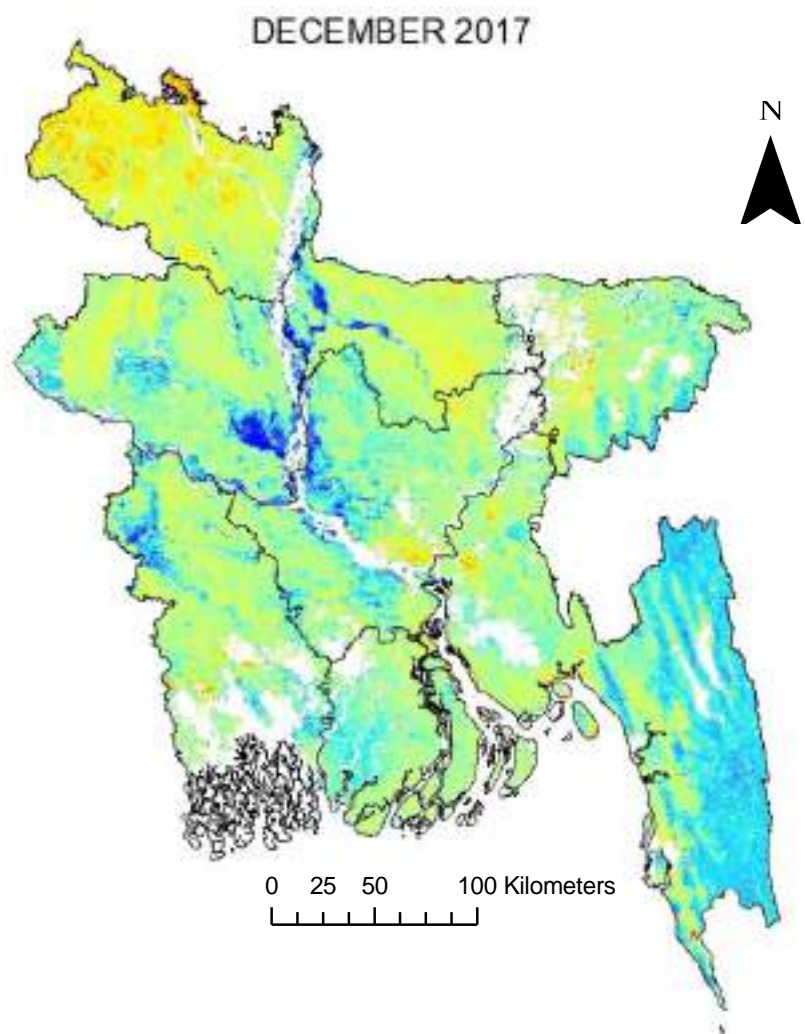


Legend

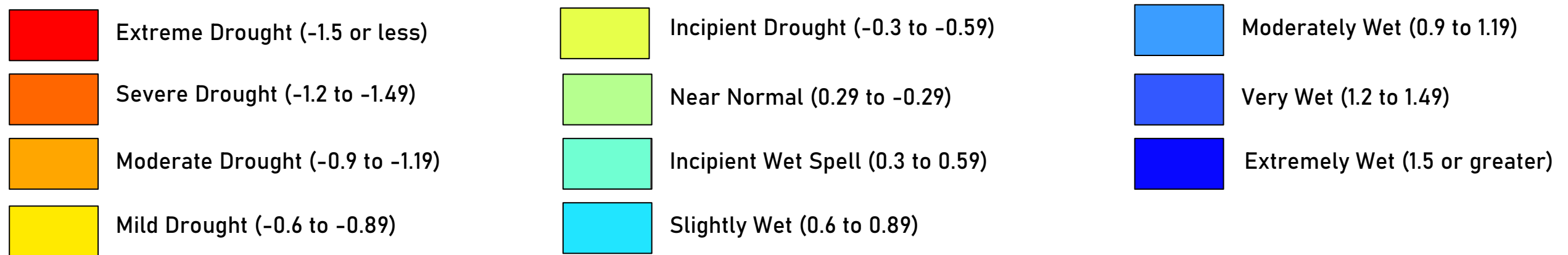
- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

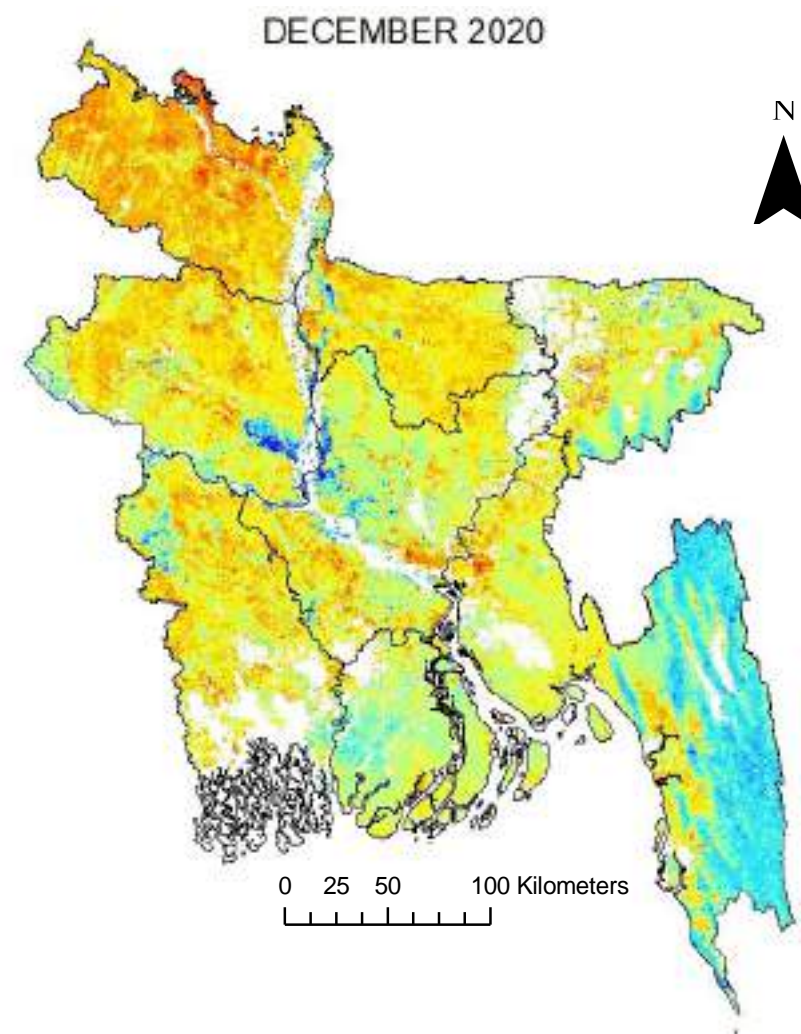
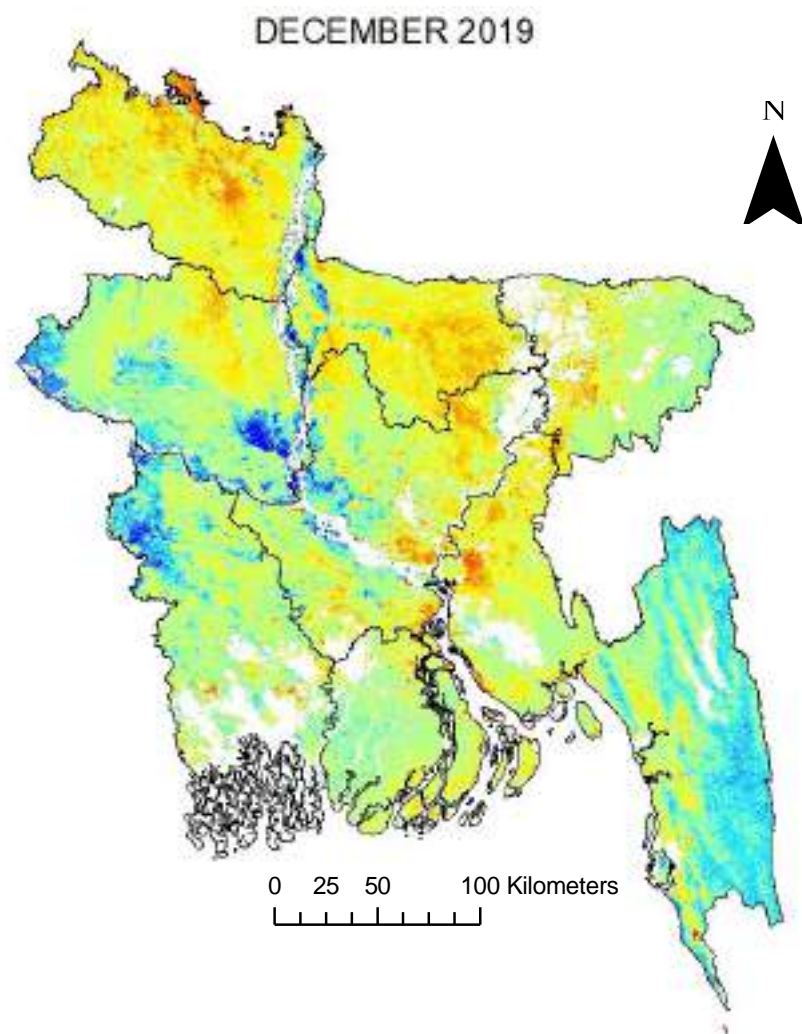
- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)



Legend





Legend

- Extreme Drought (-1.5 or less)
- Severe Drought (-1.2 to -1.49)
- Moderate Drought (-0.9 to -1.19)
- Mild Drought (-0.6 to -0.89)

- Incipient Drought (-0.3 to -0.59)
- Near Normal (0.29 to -0.29)
- Incipient Wet Spell (0.3 to 0.59)
- Slightly Wet (0.6 to 0.89)

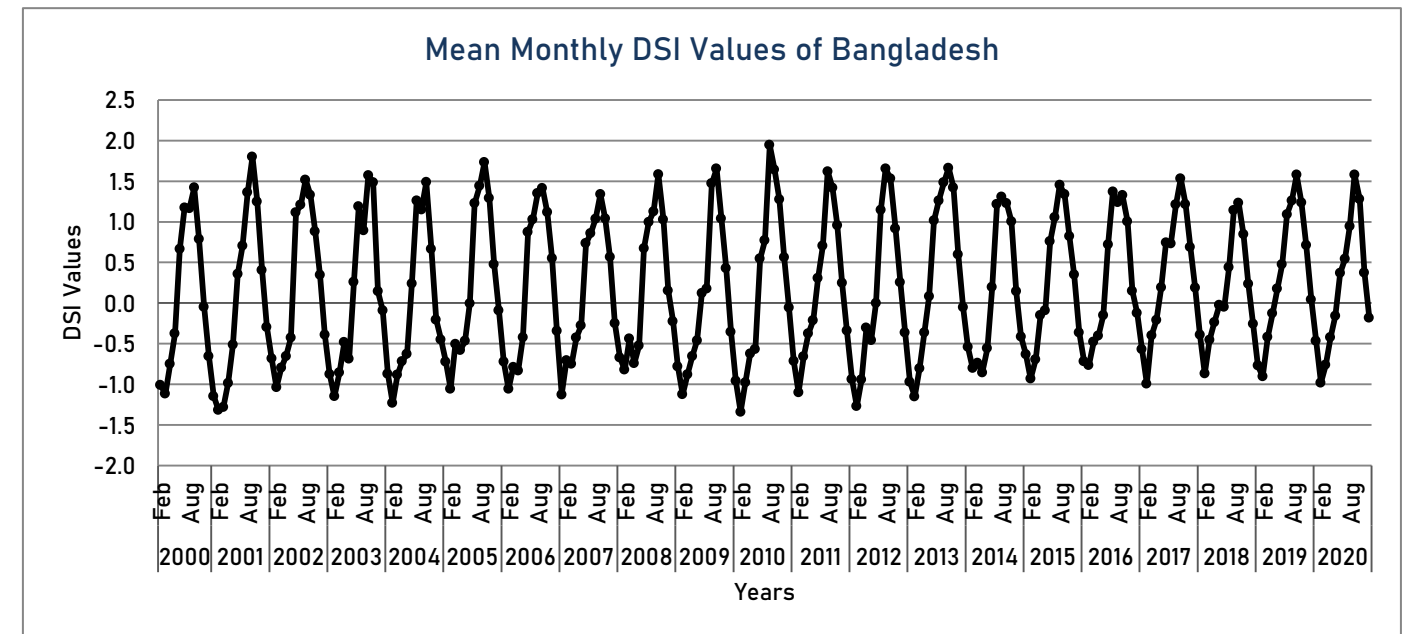
- Moderately Wet (0.9 to 1.19)
- Very Wet (1.2 to 1.49)
- Extremely Wet (1.5 or greater)

Drought Severity Index of Bangladesh

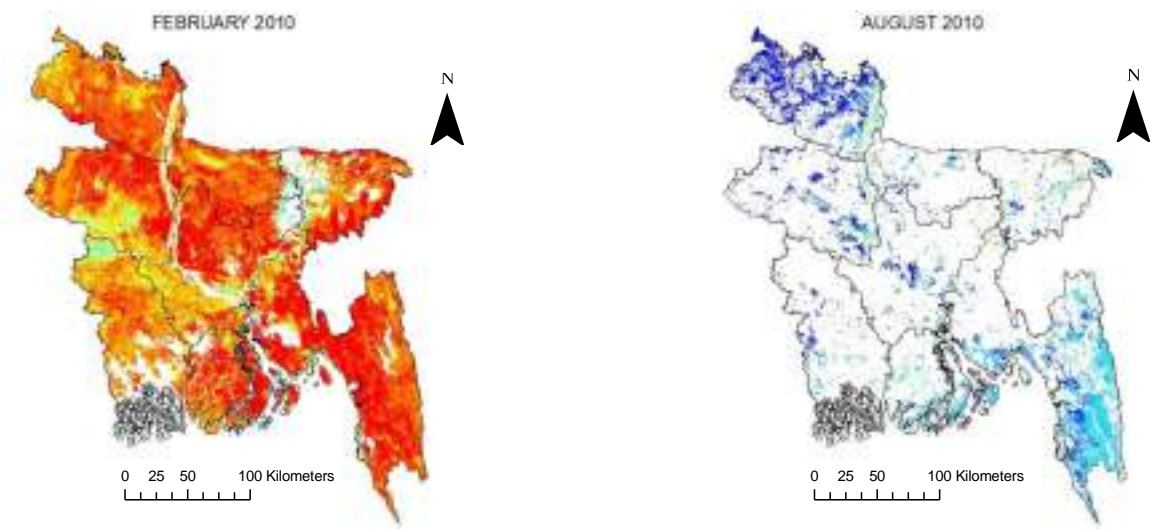
Droughts are one of the most serious risks to Bangladesh's agricultural crop production, as the country's economy is primarily largely dependent on agriculture. Using satellite-based MODIS data, this study shows geographical and temporal drought characteristics.

The temporal aspects of the DSI were investigated by plotting the mean monthly DSI for Bangladesh from 2000 to 2020. The lowest DSI value (-1.34) was recorded in February 2010, indicating significant drought throughout the research period. August 2010 was the wettest month (1.94). The years 2000 and 2001 were also the driest. In most of the analyzed year, February was the most affected by extreme drought intensity. Droughts of mild to moderate intensity were seen for the majority of the investigated years in December, January, March, and April. From April onwards, the DSI values gradually increased towards near normal levels until ending in June.

Five years (2001, 2002, 2004, 2006, 2009, 2010) stood out as the most frequent drought years in Bangladesh, with at least mild drought conditions ($DSI < -0.6$) occurring for four months in a row. Droughts occurred from December 2000 to April 2001; from January to April in 2002, 2006, 2009, 2010, and 2020; and from January to May in 2004.



According to spatial maps, the south eastern region of Bangladesh was the worst impacted in March and April. In Bangladesh, the entire country appears to be impacted by drought in February, with February being the driest month in our study period. The provinces of Mymensingh and Rangpur are experiencing severe to extreme drought in January, while the rest of the country is experiencing mild drought. The northwestern half of the country is dry in December, whereas the south eastern part is slightly moist. The beginning of the drought in Bangladesh was discovered to be November, and the drought ended in June. Bangladesh experiences wet conditions from June to October.



References

1. BMD (2013) Bangladesh Meteorological Department. Agargoan, Dhaka, Government of Bangladesh (GOB)
2. Hewitt, K. 1997. *Regions at Risk: A Geographical Introduction to Disasters*. Addison-Wesley Longman, UK.
3. Justice, C.; Townshend, J. 2002a. Special issue on the moderate resolution imaging spectroradiometer (MODIS): A new generation of land surface monitoring. *Remote Sensing of Environment* 83: 1–2.
4. Mu Q, Zhao M, Kimball JS, McDowell NG, Running SW (2013) A remotely sensed global terrestrial drought severity index. *Bull Am Meteorol Soc* 94:83–98
5. National Center for Atmospheric Research Staff (Eds). Last modified 10 Feb 2017. "The Climate Data Guide: CERES: IGBP Land Classification." Retrieved from: <https://climatedataguide.ucar.edu/climate-data/ceres-igbp-land-classification>
6. Obasi, G.O.P. 1994. WMO's role in the international decade for natural disaster reduction. *Bull. Am. Meteorol. Soc.* 75 (9), 1655–1661.
7. Rahman MR, Lateh H (2015) Climate change in Bangladesh: a spatio-temporal analysis and simulation of recent temperature and rainfall data using GIS and time series analysis model. *Theor Appl Climatol*. doi:10.1007/s00704-015-1688-3
8. Rahman MR, Lateh H (2016) Meteorological drought in Bangladesh: assessing, analyzing and hazard mapping using SPI, GIS and monthly rainfall data. *Environ Earth Sci* 75(12):1026
9. Wilhite, D.A. 2000. Drought as a Natural Hazard: Concepts and Definitions (Chapter 1, 3–18p.). In: *Drought: A Global Assessment* Wilhite, D.A. (ed.) (Volume 1), Routledge Publishers, London, U.K.
10. Wilhite, D.A. 2000b. Drought as a natural hazard: concepts and definitions. In: *Drought: A Global Assessment* Wilhite, D.A. (Ed.), vol. 1. Routledge, New York, 1–18p.





As a result of changing climatic conditions, alter in precipitation events such as drought have emerged as a source of vulnerability in several South Asian nations, including Nepal, India, Pakistan, and Bangladesh. Recent declines in agricultural productivity have weakened rural economies, encouraging widespread famine and urban migration.

Drought monitoring and assessment techniques are used to forecast drought and identify drought-prone areas, allowing drought mitigation measures to be put in place to lessen the impact of drought on food production and water supplies. To estimate the severity of the drought in Bangladesh, we applied the Drought Severity Index (DSI), which combines the Normalized Difference Vegetation Index (NDVI) and the ratio of Evapotranspiration to Potential Evapotranspiration (ET/PET).

This Atlas provides an overview of Bangladesh's drought frequency during the last two decades. It portrays the spatiotemporal occurrences of drought in Bangladesh's several provinces. I hope this atlas will assist in the creation of policies and plans for timely drought mitigation and forecasting in the agricultural sector.

Dr. Hemu Kharel Kafle



ISBN: 978-9937-1-3063-9

