



World Meteorological Organization

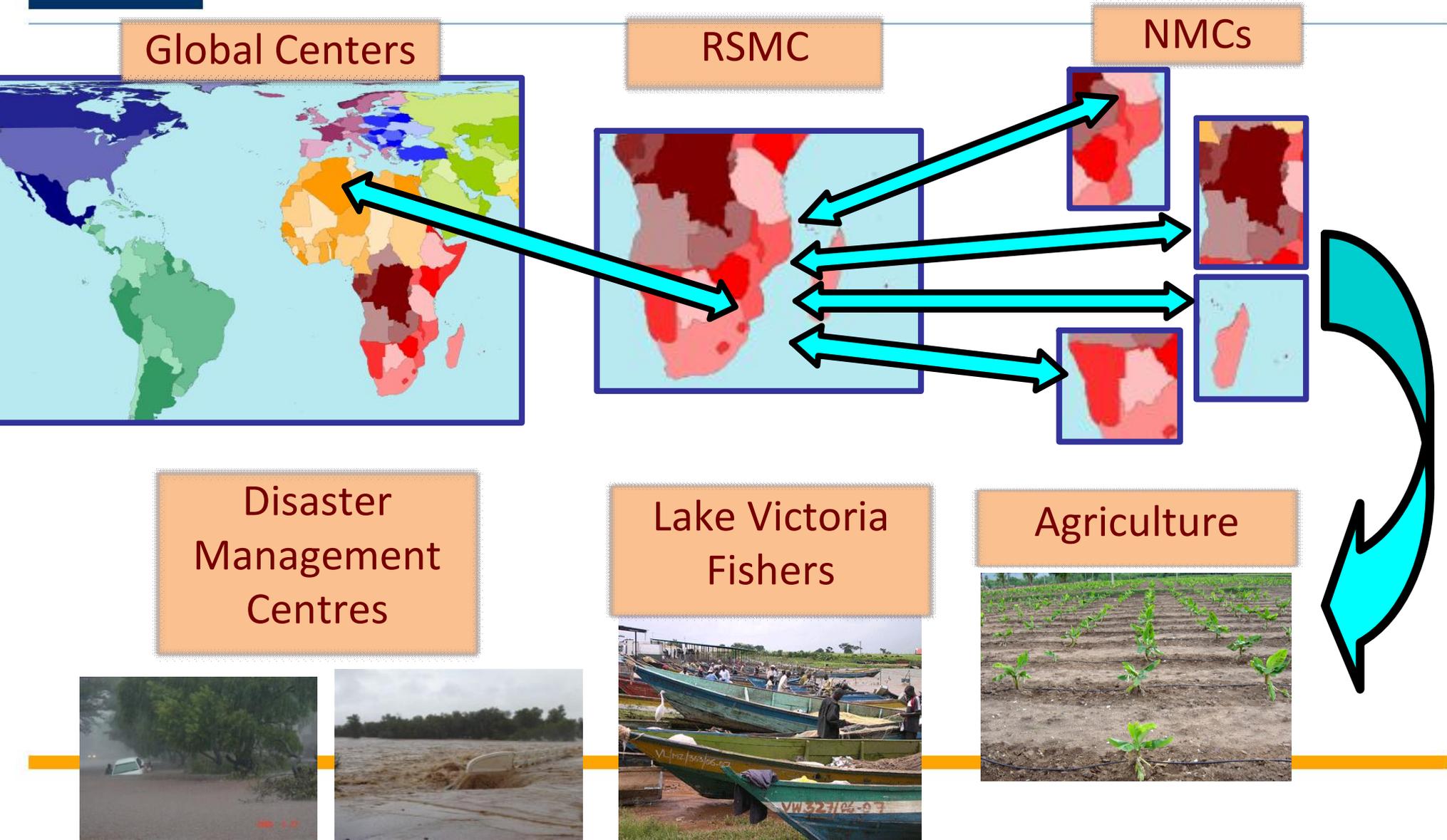
Working together in weather, climate and water

Agricultural Meteorology

Robert Stefanski

Chief, Agricultural Meteorology Division

Cascading Forecasting Process





WMO OMM

Impact of Agrometeorological services

2009 Seminar - Mali Met Service Presentation



2009 Seminar – Farmers ask Questions



2009 Seminar – Demonstration of Raingauge





Economic impact using 3-7 Day Weather Forecasts in India

Crop	Station name	% change in cost of Prod. (per acre)	% change in crop yield (per acre)	% change in profit (per acre)
Cotton	Hissar	1	14	10
	Coimbatore	-4	16	16
Rice	Ludhiana	-6	9	18
	Kalyani	-3	21	29
Wheat	Ludhiana	-6	9	17
Mustard	Hissar	-3	8	13



WMO Technical Commissions

- Commission for Aeronautical Meteorology (CAeM)
- **Commission for Agricultural Meteorology (CAgM)**
- Commission for Atmospheric Sciences (CAS)
- **Commission for Basic Systems (CBS)**
- Commission for Climatology (CCI)
- Commission for Hydrology (CHy)
- Commission for Instruments and Methods of Observation (CIMO)
- Joint WMO-IOC Commission for Oceanography and Marine Meteorology (JCOMM)



Commission for Agricultural Meteorology

- **Applications of meteorology to agricultural cropping systems, forestry, fisheries, and agricultural land use and livestock management**
 - **Development of agromet services** of Members by transfer of knowledge and methodology and by providing advice on various subjects;
 - Methods, procedures and techniques for the **provision of meteorological services to agriculture** (all sectors);
 - Formulation of **data requirements** for agricultural purposes;
 - Introduction of **effective methods for disseminating agromet information, advice and warnings** to agriculture by mass media;
 - Meteorological aspects of **drought and desertification**.
-



Guide to Agricultural Meteorological Practices (2010)

1. General
2. Agricultural Meteorological Variables & Their Observations
3. Agricultural Meteorological Data & Statistical Analysis
4. Remote Sensing & GIS Applications in Agrometeorology
5. **Weather And Climate Forecasts For Agriculture**
6. Agrometeorological Forecasting
7. Climate & Weather Risk Assessment for Disaster Preparedness & Agricultural Planning
8. Effects of Climate Change on Agriculture
9. Applications of Meteorology to Agriculture



Guide to Agricultural Meteorological Practices (2010)

10. Agrometeorology of Some Selected Crops (8)
11. Applications of Meteorology to Forestry & Non-Forest Trees
12. Weather & Climate & Animal Production
13. Application of Agrometeorology to Aquaculture & Fisheries
14. Agrometeorological Aspects of Desertification
15. Aerobiology
16. Applications of Climatic Resources in Mountainous Regions
17. **Communicating Agroclimatological Information, including Forecasts, for Agricultural Decisions**

www.wmo.int/agm

click on Guide on right-hand menu



Utility of Weather Forecasts

- **Protection of Life (safety)**
- **Protection of Property**
- **Safeguarding the Environment**
- **Sustainable Development (Livelihoods)**



Users of Agrometeorological Information

Any agricultural decision-maker:

- International officials (i.e. Red Cross, WFP, UN)
- **Government official**
- **Extension agent**
- **Farmers, ranchers, foresters, fishers**
- **Media**
- **General public**

Requirements for Basic Calculations

- **Evapotranspiration or crop protection models - average daily:**
 - maximum and minimum air temperatures ($^{\circ}$ C)
 - actual vapour pressure in kilopascals (kPa)
 - net radiation expressed in megajoules per square metre per day (MJ m⁻² day⁻¹)
 - wind speed in metres per second (m/s) measured at 2 m above the ground level
- Other applications, model requirements also include precipitation (mm), relative humidity (%), and atmospheric pressure (hPa)



Key Questions in AgroMeteorology

- **What are the weather / climate events that impact agricultural decision-making?**
- **How to relate weather / climate information to meaningful agricultural actions / practices?**

Tactical vs Strategic

- **Tactical Applications - Weather**
 - Operational decisions from a few hours to a few days.
 - Decisions based on crop state and current or forecast weather
 - Cultivating, irrigating, spraying, and harvesting.
- **Strategic Applications - Climate**
 - Issues and decisions on seasonal or yearly basis or planning
 - specific crop or crop variety to plant
 - designing and planning where or if greenhouses or animal shelters should be built
 - aiding governments in setting agricultural pricing policies.



Direct Agricultural Losses from Weather Hazards

- Frost
- Heavy rain / Floods
- Strong Winds
- Hail
- Sand and dust storm
- Forest and bush fires
- Drought – slow onset

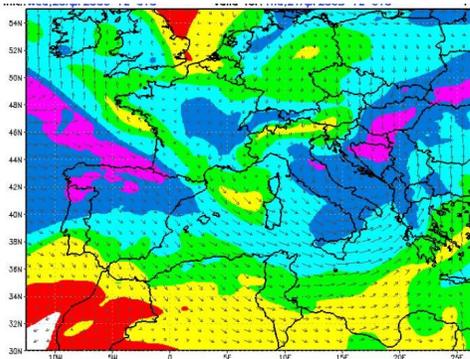
**Based on
NWP forecasts**



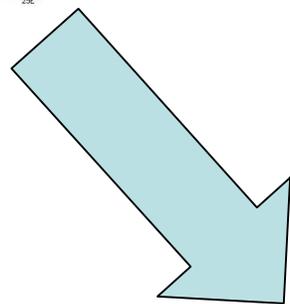
WMO OMM

NWP Application for Agriculture

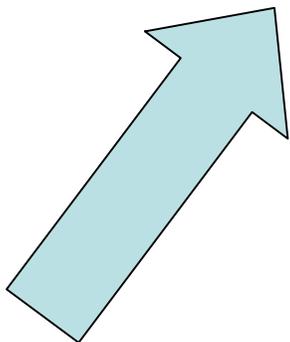
NWP & Agricultural Applications



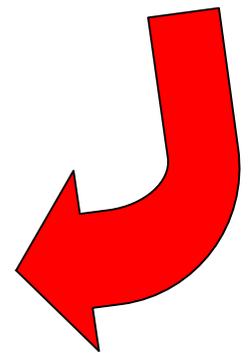
NWP Output



Crop / Pest / Disease Models
Downscaling
Product Generation



Dissemination
User Interaction



Feedback

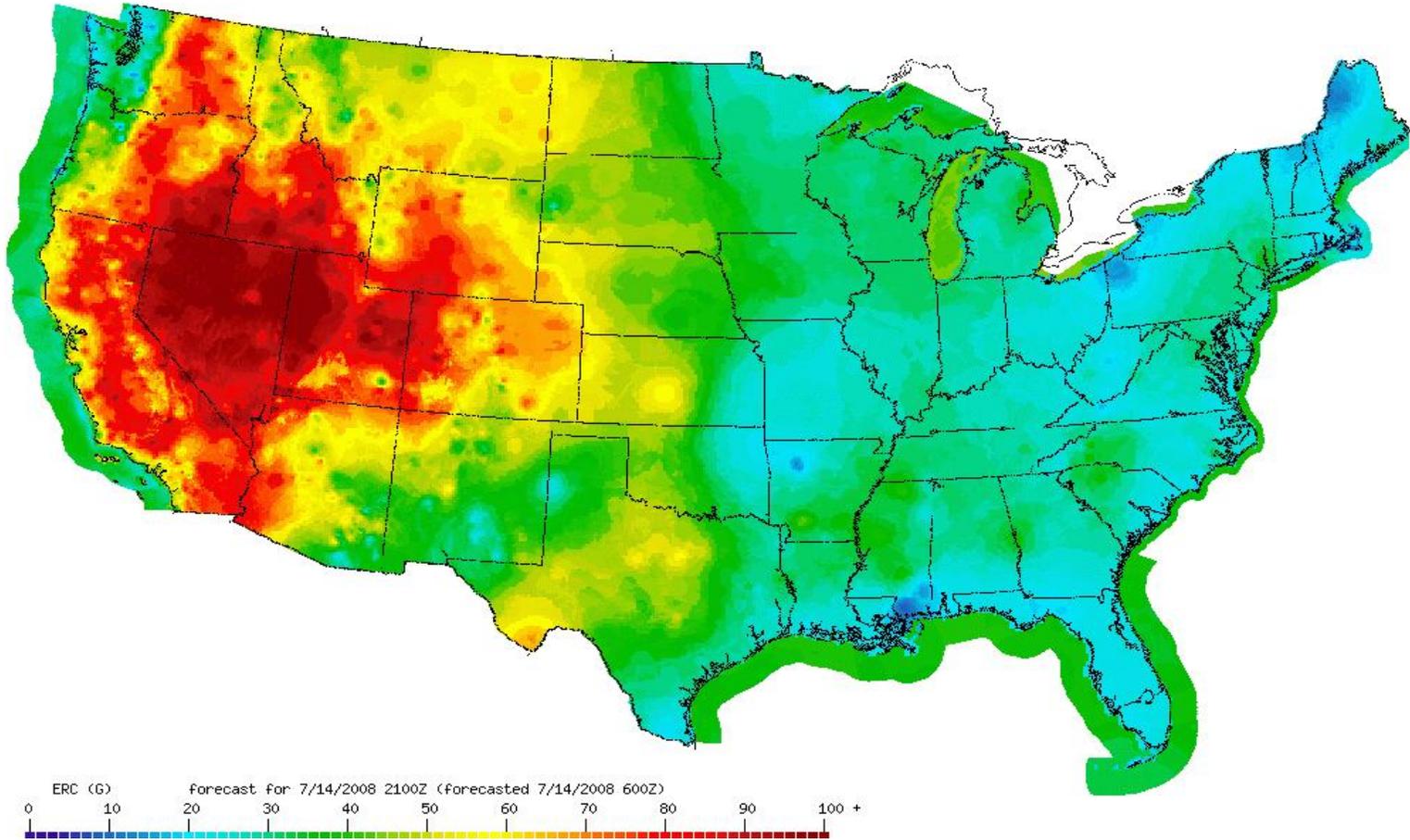


NWP Applications

- **Statistical Downscaling of NWP**
- **Forest Fire Danger Rating & Fire Behaviour**
- **Crop Pest and disease forecasting**
- **Animal pest and disease forecasting**
- **Irrigation – scheduling**
- **Drought Prediction (up to two weeks)**
- **Crop Production forecasting**

Seven Day Fire Danger Forecast

7/14/2008 2100Z ERC(g) Normal



Europe Fire Danger Forecast

- **MeteoFrance**

- Spatial resolution 0.5° (~ 50 km)
- Forecast up to 3 days

- **DWD**

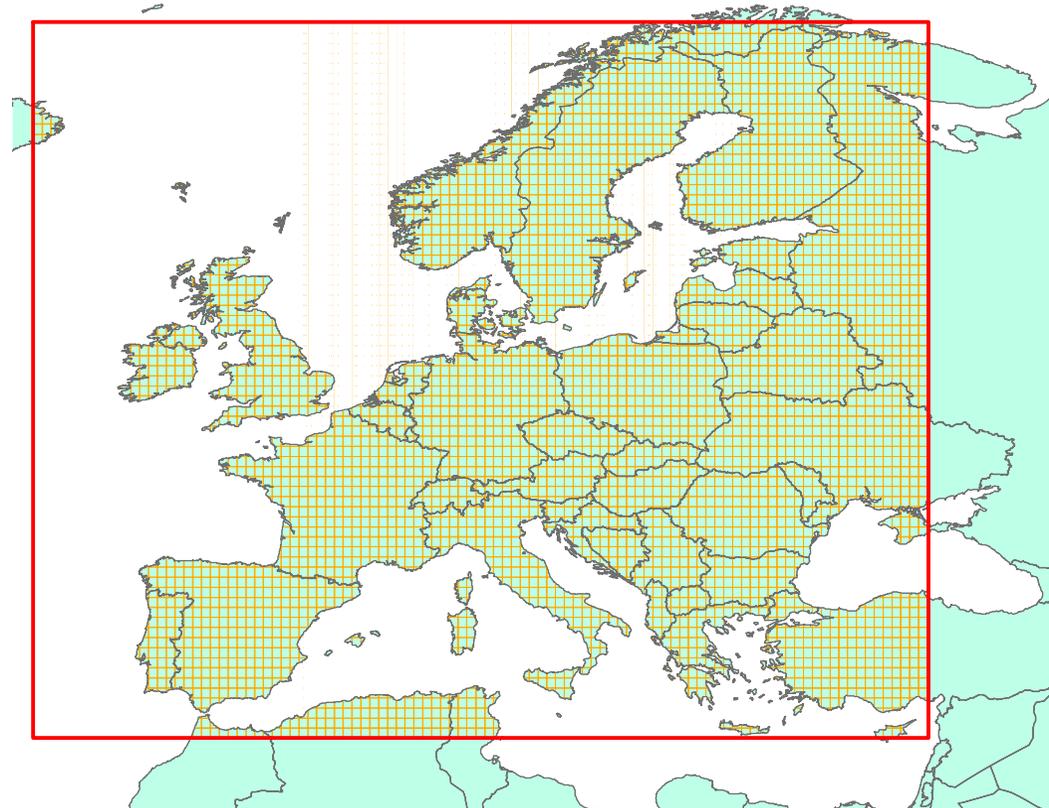
- Medium resolution map

- Spatial resolution 0.36° (~ 35 km)
- Forecast up to 7 days

- High resolution map

- Spatial resolution 0.0625° (~ 7 km)
- Forecast up to 3 days

- **ECMWF ensemble forecast under consideration**





WMO OMM

SWFDP-EA Agrometeorology Working Group



AgM representative Responsibilities

(3.3.5)

- **Isack Yonah (TMA)**
 - researching and defining required forecast products relevant for agrometeorology;
 - coordinate the agromet working group on relevant issues, including service delivery to the agriculture community;
 - advising NMHSs on using products from the SWFDP project to improve agricultural weather forecasts and advisories, and in determining potential crop production impacts, especially due to extreme events.
-



SWFDP Agromet Working Group

- **Isack Yonah (Tanzania, Regional Representative)**
 - **Liliane Hatungimana (Burundi)**
 - **Tsegaye Ketema (Ethiopia)**
 - **Peter Njuguna (Kenya)**
 - **Jean-Claude Bucumi (Rwanda)**
 - **Charles Obeke / Samuel Senkunda (Uganda)**
-



NWP Models

Regional Products

- » HRM
- » COSMO
- » WRF
- » Lake Victoria Nested HRM Products
- » Aladin La Re-Union
- » Indian Ocean Waves
- » UK MET Office LAM

Global Products

- » NOAA GFS
- » NOAA EPS
- » ECMWF EPS
- » UK MET Office EPS
- » African Desk NCEP TIGGE-GIFS products for East Africa (under-development)

Training Website Links

- » Met E-Learning
- » WMO Project Website

Others

- » RSMC Guidance Archive

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GUIDANCE PRODUCTS

Short Range Forecasts (1-2 days)

- » Day 1
- » Day 2
- » Risk Table
- » Discussion

Medium Range Forecasts (3-5 days)

- » Day 3
- » Day 4
- » Day 5
- » Risk Table
- » Discussion

Agrometeorology Products

- » 10-days

SWFDP Evaluation

- » Evaluation Form

Satellite Products

- » RFE Dekadals
- » RFE anomalies

Links to International Centers

- » ECMWF
- » NCEP
- » UK MET Office
- » WMO
- » DWD
- » KMA
- » RSMC- Pretoria
- » ICPAC
- » ICMWF
- » ACMAD
- » AGRHYMET

Links to National Met Services

- » Kenya
- » Ethiopia
- » Rwanda
- » Tanzania
- » Uganda

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- » Day 1
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Medium Range Forecasts (3-5 days)

- » Day 3
- » Day 4
- » Day 5
- » Risk Table
- » Discussion

Agrometeorology Products

- » 10 Day NDVI
- » NDVI Current Dekad
- » NDVI Diff LTM

SWFDP Evaluation

- » Evaluation Form

Satellite Products

Links to International Centers

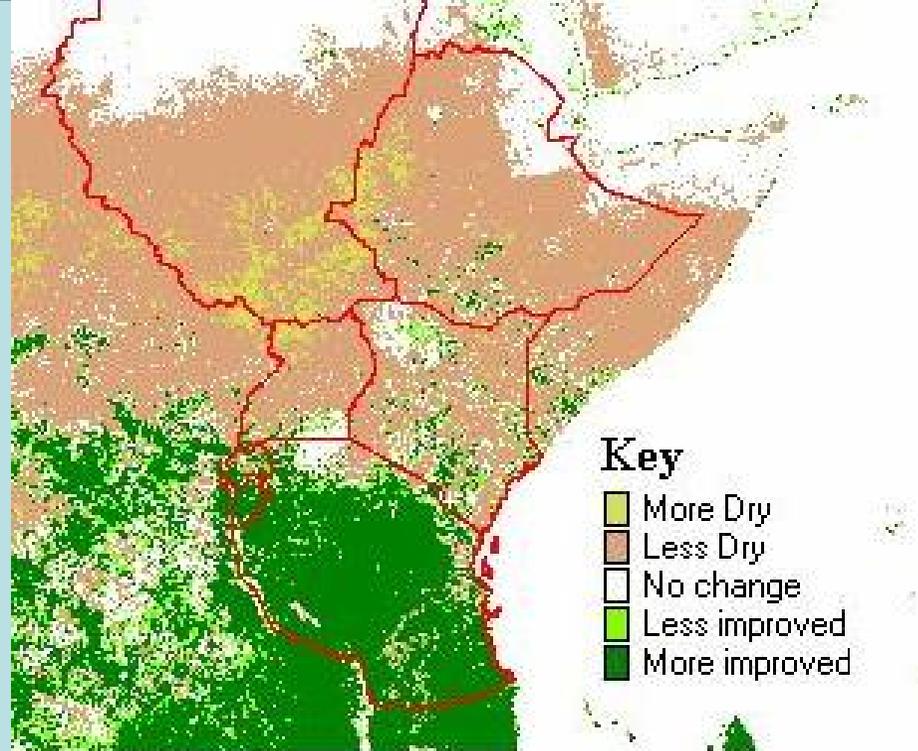
- » ECMWF
- » NCEP
- » UK MET Office
- » WMO
- » DWD
- » KMA
- » RSMC- Pretoria
- » ICPAC
- » ICMWF
- » ACMAD

Links to National Met Services

- » Kenya
- » Ethiopia
- » Rwanda
- » Tanzania
- » Uganda

Agromet Links

- » AGRHYMET
- » FEWSNET
- » WAMIS
- » ICPAC climate outlook



NDVI difference between dekad 1(1-10) and 2(1-10) February 2012

The comparison of the Normalized Difference Vegetation Index (NDVI) between dekad 1(1-10) and dekad 2(11-20) February 2012 indicates improved vegetation conditions mostly over most parts of Tanzania; and Burundi. The rest of the region indicated degenerated or no change in vegetation conditions.

The climate outlook for dekad 3(21 - 28) February 2012 indicates that much of the southern sector is likely to experience near to below normal rainfall with near to above normal conditions likely to be limited to the extreme southern parts of Tanzania. The rest of the region is likely to remain generally dry.



Recommendations

- **Research and develop list of existing agrometeorological products. Identify products for portal.**
 - **Revise SWDFP RSMC-Nairobi portal**
 - **Revise SWDFP RFSC-Dar Es Saalem portal**
 - **Add Day 1 & Day 2 Rainfall; TMA WRF, max temperature**
 - **Liaise with fisheries community to on possible portal products**
 - **Develop a regional Agromet Guidance Product**
 - **Could be used for early warning (disasters: drought/floods)**
 - **Potential linkages with existing products (NOAA Africa Desk , FEWSNET)**
 - **Define regional and country training needs**
-



Possible Products-RSMC Nairobi

- **Previous 10-day rainfall anomaly maps**
 - **Cumulative forecast rainfall (regional maps)**
 - 1-5 day forecast from RSMC-LAM; 10-day forecast from global centers
 - Number of rainy days (>3mm)
 - Rainfall Intensity (>20 mm per hour)
 - Chances of dry and wet spell during rainy season (global centers)
 - **NDVI**
 - **Extreme temperature Forecasts (same map)**
 - Chance of Maximum Temp > 35 C occurring during 5 day period
 - Chance of Minimum Temp < 10, 5, 0 C occurring during 5 day period
 - **Evapotranspiration (ETo) maps**
 - **Moisture index (rainfall / ETo)**
-



Possible Products-RSMC Nairobi

- **Soil moisture maps**
 - Forecast soil moisture
 - previous 10 day from Global centers
 - **EUMETSAT / GEONETCAST products**
 - **Rangeland condition index forecast**
 - **Crop water requirement satisfaction index (WRSI)**
-



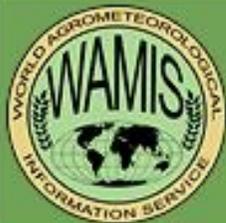
Summary – EA and BOB

- **NWP can benefit agrometeorological applications in several aspects:**
- **Improving guidance to NMHS agromets (now - internal)**
- **Wave, wind, and severe weather forecasts over Bay of Bengal / Lake Victoria**
- **Improving forecasting and advice to farming community (now – bulletins)**
- **Directly using NWP output for agromet products (future)**



Links to other Projects / Proposals

- **Marine Impacts on Lowlands Agriculture and Coastal resources (MILAC) - Joint CAgM and JCOMM Proposal**
- **There would be 3 major products;**
 - **socio-economic analysis of impacts of storm surges on lowland agriculture and coastal resources;**
 - **short term forecasting system in support of decision making, a hindcast/climatological study of historical events giving guidance to future agricultural planning**
 - **Interaction mechanism with public and mechanisms for mitigation of natural disasters.**
- **In possible coordination with Coastal Inundation Forecasting Demonstration Project (CIFDP)**



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[World Weather](#)
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Products Available For:

ACMAD	Italy
Albania	Kenya
Argentina	Lesotho
Australia (2)	Malawi
Bangladesh	Malaysia
Belgium	Mali
Belize	Mauritania
Brazil (2)	Mozambique
Bulgaria	Mexico
Burkina Faso	New Zealand (2)
Canada	Niger
Chile	Nigeria
China	Pakistan
Colombia	Peru
Côte d'Ivoire	Philippines
Cuba	SADC
Dominican Republic	Sénégal
DMCSEE	Sri Lanka
Ecuador	South Pacific
El Salvador	Swaziland
Ethiopia	Tanzania
EU-MARS	Turkey
Fiji	USA (2)
Gambia	
Germany	
India	



www.wamis.org



Benefits of WAMIS to Members

- **WAMIS helps members to disseminate and improve their agrometeorological products.**
- **As a dedicated web server, it allows countries to place their existing agrometeorological bulletins and advisories on a near real-time basis.**
- **Provides tools and resources to help members improve the quality and presentation of their agrometeorological bulletins.**
- **Provides a central location for agrometeorological information so that members can quickly and easily evaluate the various bulletins.**



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Africa

- [African Centre of Meteorological Applications for Development \(ACMAD\)](#)
- [Burkina Faso](#)
- [Côte d'Ivoire](#)
- [Ethiopia](#)
- [Gambia](#)
- [Kenya](#)
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- [Malawi](#)
- [Mali](#)
- [Mauritania](#)
- [Mozambique](#)
- [Niger](#)
- [Nigeria](#)
- [Southern African Development Community \(SADC\)](#)
- [Sénégal](#)
- [Swaziland](#)
- [Tanzania](#)





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United Republic of Tanzania

Dekadal Weather Review Monthly Weather Bulletin

Tanzania Meteorological Agency

The **Tanzania Meteorological Agency (TMA)** produces a decadal (10 day) and monthly weather bulletin. The [Dekadal Weather Review](#) provides a 10 day summary of the synoptic situation, rainfall, agrometeorological and hydrometeorological impacts, and a weather outlook for next decade. The Review also provides a rainfall map and relevant graphs and is only produced during the crop growing season. The [Monthly Weather Bulletin](#) provides a synoptic and weather summary; information on temperature, sunshine hours, and windspeed; satellite information including NDVI; an agrometeorological and hydrometeorological summary; and the expected synoptic and rainfall situation for the next month. The monthly bulletin is produced every month of the year. A [Seasonal Weather Forecast Bulletin](#) is also produced every few months. The [TMA website](#) also provides detailed daily, 10 day, monthly, and seasonal weather forecasts.

Dekadal Weather Review

- [Nov 11-20, 2011 #08](#)
- [Nov 01-10, 2011 #07](#)
- [Oct 21-31, 2011 #06](#)
- [Sep 21-30, 2011 #03](#)
- [Sep 11-20, 2011 #02](#)
- [Seasonal Weather Forecast Oct-Dec 2011](#)
- [Sep 01-10, 2011 #01](#)

- [Aug 21-30, 2011 #36](#)
- [Aug 01-10, 2011 #34](#)
- [Jul 21-31, 2011 #33](#)
- [Jul 11-20, 2011 #32](#)
- [Jun 21-30, 2011 #30](#)
- [Jun 11-20, 2011 #29](#)
- [Jun 01-10, 2011 #28](#)
- [May 21-31, 2011 #27](#)

NATIONAL METEOROLOGICAL SERVICES AGENCY

TEN-DAY AGROMETEOROLOGICAL BULLETIN

P.BOX 1090 ADDIS ABABA TEL 512299 FAX 517066 E-mail nmsa@ethionet.et

1-10 July 2009 Vol. 19 No.

Date of issue July 15 , 2009

SUMMARY

During the third dekad of June 2009, as result of the strengthening of kiremt rain bearing weather systems over western half of the country and central parts of the country exhibited rainfall. In addition over eastern and southern highlands observed rainfall. The situation might have favored for meher agricultural activities like land preparation and sowing activities, perennial crops and for pasture and drinking water availabilities over pastoral and agro-pastoral areas.

During the first dekad of July 2009, the rainfall was improved from day to day over kiremt rain benefited areas of the country. Especially, over northern and northeastern parts of the country better rainfall condition was observed. This situation might have favored Kiremt agricultural activities like land preparation and sowing activities, for perennial crops and availability of drinking water and pasture. According to the report, heavy fall was observed over southwestern, northeastern and northern part of the country. As result over Pawe and Bati the heavy fall caused damage on Maize crop and soil erosion from the plot farm respectively.

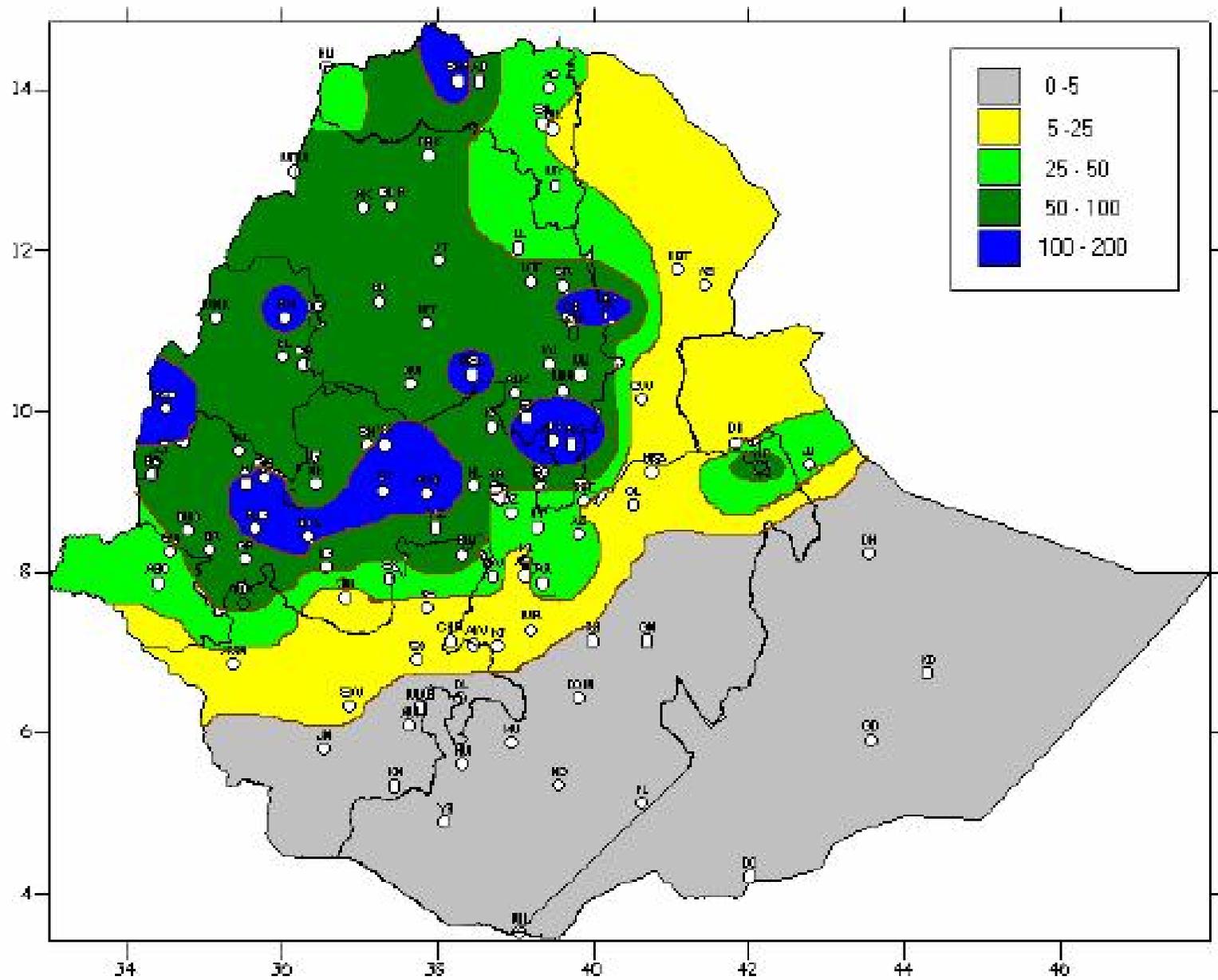


Fig 1 Rainfall distribution in mm (1-10 July 2009)

In the coming dekad the rain bearing meteorological phenomena will be a better strength over most of Kiremet rain benefited areas. As result, normal rainfall will be expected over Tigray, Amhara, central and western Oromia, Benshangul-Gumuz and Gambela. The **near normal and in some place below normal rainfall** will be expect over eastern Oromia, Afar, northern Somali and northern half of SNNPR. This situation will have a **positive impact for Kerimt agricultural activities, general agricultural activities, perennial crops and for drinking water and pasture over pastoral and agro-pastoral areas.** On the other hand, **dry and cloudy weather condition** will be dominant over southern Oromia and southern Somali. The situation will have a **negative impact for pastoral and agro pastoral activities.**



Future Directions

- **Improve access and operation of online bulletins**
- **Improve Agrometeorological bulletins for members**
- **Online Applications**
- **Training Modules**
- **Partnership with RANET**

Issues of using NWP outputs

- Need technical resources (computers, programmers)
- NWP outputs at the surface are modelled estimates not observed data
- Use with Caution
- Best used to derive parameters
 - Potential evaporation
 - Leaf wetness duration
 - Soil moisture estimates
 - Fire danger ratings

**WAMIS Next Phase
as test-bed and/or
production server**

Training



World Meteorological Organization

Working together in weather, climate and water

Thank You

rstefanski@wmo.int