
DoD Interest in Seasonal & Sub-seasonal Climate Prediction



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Overview



- **Background on 14th Weather Squadron (14 WS)**
- **Motivation for climate-scale awareness**
- **Climate Monitoring, Analysis, and Prediction (CMAP)**
- **DoD Interest in (Sub-) Seasonal Climate Prediction**
 - **DoD Climate Services Partners**
 - **DoD/Intel Community Climate Prediction Questions**
 - **DoD (Sub-) Seasonal Prediction Needs**
- **Questions**

***NOTE: Definition of “DoD” in this briefing refers to the Service components that make up the Department of Defense served by climate services, not the policy level.**

Background on 14 WS



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History

- 1941: Army AF established Climate Services
- 1952: Climate data ops move to Asheville, NC
- 2007: Air Force Combat Climatology Center (AFCCC) renamed 14 WS



Mission: Collect, protect and exploit authoritative climate data to optimize military and intelligence community operations and planning

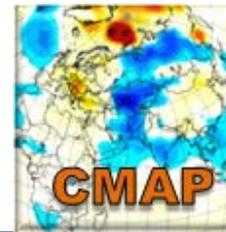
Co-located w/ Internat'l renowned climate experts

Access to Asheville's growing Nat'l climate consortium (NOAA, academia, small business)

22 Standard Climate Products/520K web hits/yr

900 Tailored Climate Supports/yr

Authoritative DoD climate archive

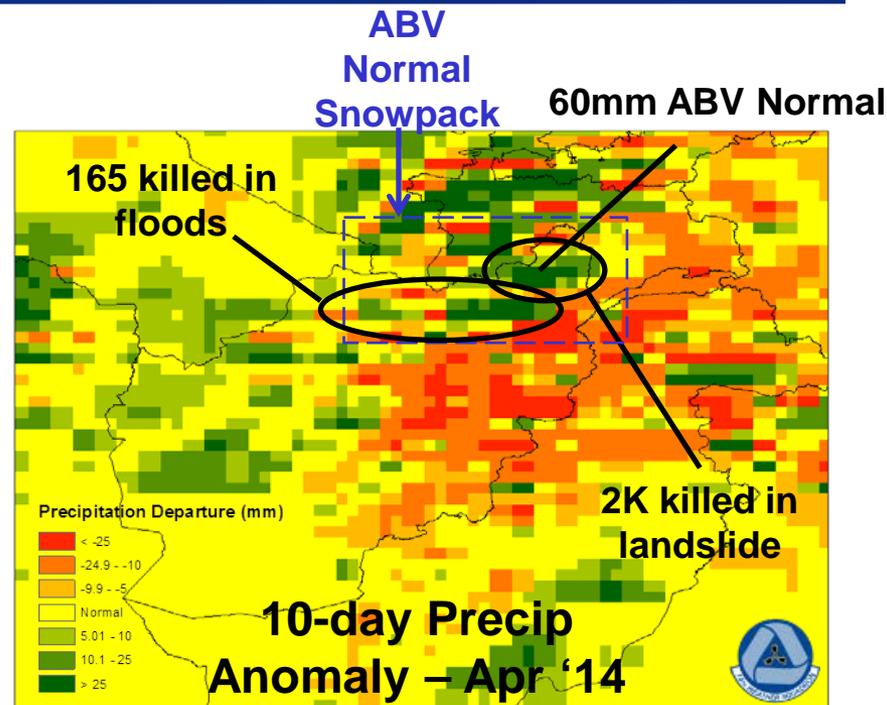


Temperature Extreme
Temperature Mean Ma
Temperature Mean (°F)
Temperature Mean Mir
Temperature Maximum





Motivation for climate-scale awareness



“There have now been more Afghans killed through natural disasters in the past seven days than all of 2013.”

– United Nations

“We stand ready to help our Afghan partners as they respond to this disaster.” – President Obama



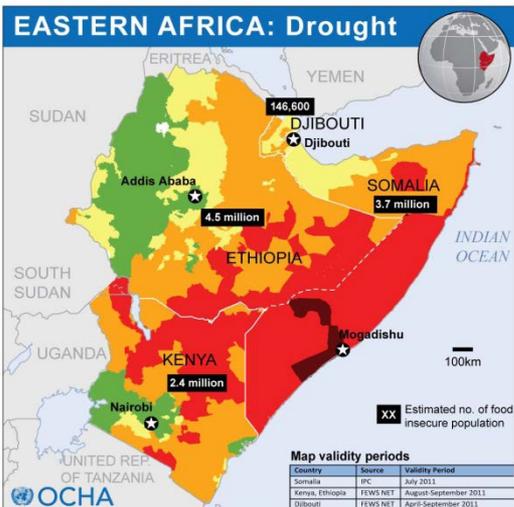
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Climate & National Security

Driving force for Climate Monitoring, Analysis & Prediction (CMAP)



Future Drought and Flooding Impacts on Water and Food Resources



■ Significant Societal Challenges

- Population growth
- Coastal urbanization
- Globalization

■ In many cases, a changing climate is a “**threat multiplier**” to Nat’l & Global Security

■ Strategic DoD and IC planning needs and improved climate science have driven demand for informative and relevant CMAP applications

- Climate monitoring (Diagnosis)
- **(Sub-) Seasonal (Prognosis)**
- Annual to Decadal (Prognosis)



Potential for Humanitarian Assistance & Refugee Displacement due to Climate Variability



Future Operations, Installations & Military Systems



Aim High...Fly, Fight, Win



The Climate Monitoring, Analysis, and Prediction (CMAP) capability optimizes DoD & IC strategic environmental awareness and planning.



AF's Climate Monitoring, Analysis, and Prediction (CMAP) Capability



Drought

2014 January 10 Day Precipitation Summation

Days 1-10
Precipitation (mm)

MONITORING

Temp/Precip trends
Drought monitoring

END USERS

Joint Force planning
DoD / IC Hot-spot SA



El Nino

APR/MAY MEI ENSOMETER

ANALYSIS

Fuse monitor/prediction
Climate signal info

PREDICTION

Region-focused 1-6-mo fcsts
Climate variability impacts



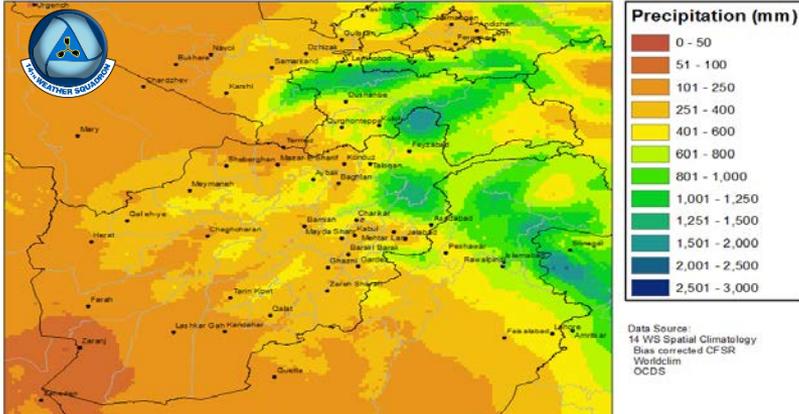
AF's Current CMAP Product Suite



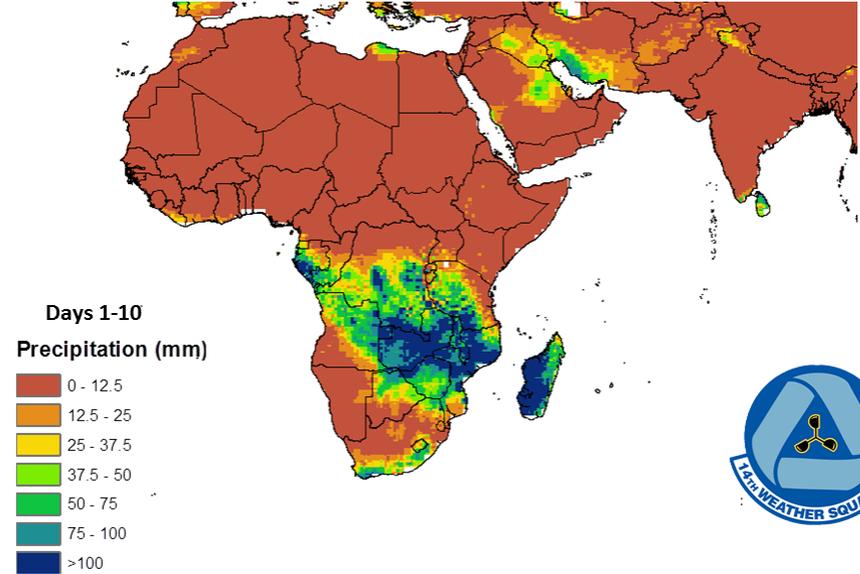
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Temperature & Precipitation Monitoring

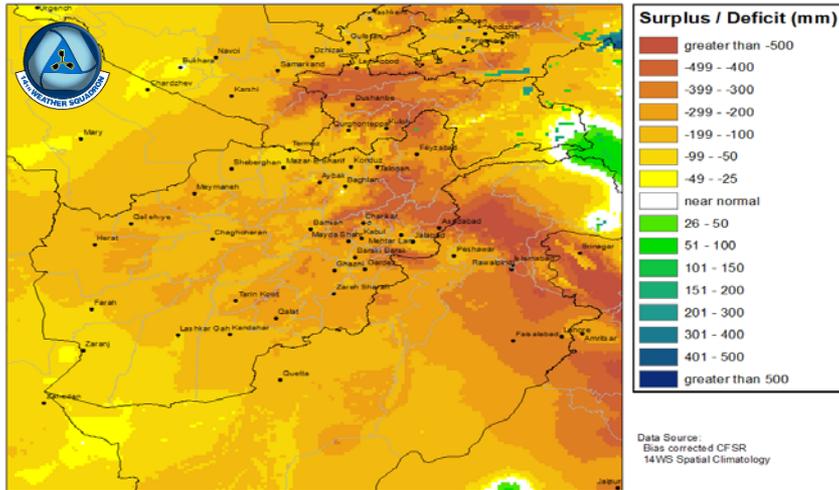
Afghanistan: Annual Rainfall - Climatology



2014 January 10 Day Precipitation Summation



Afghanistan: Rainfall Surplus / Deficit - 2001





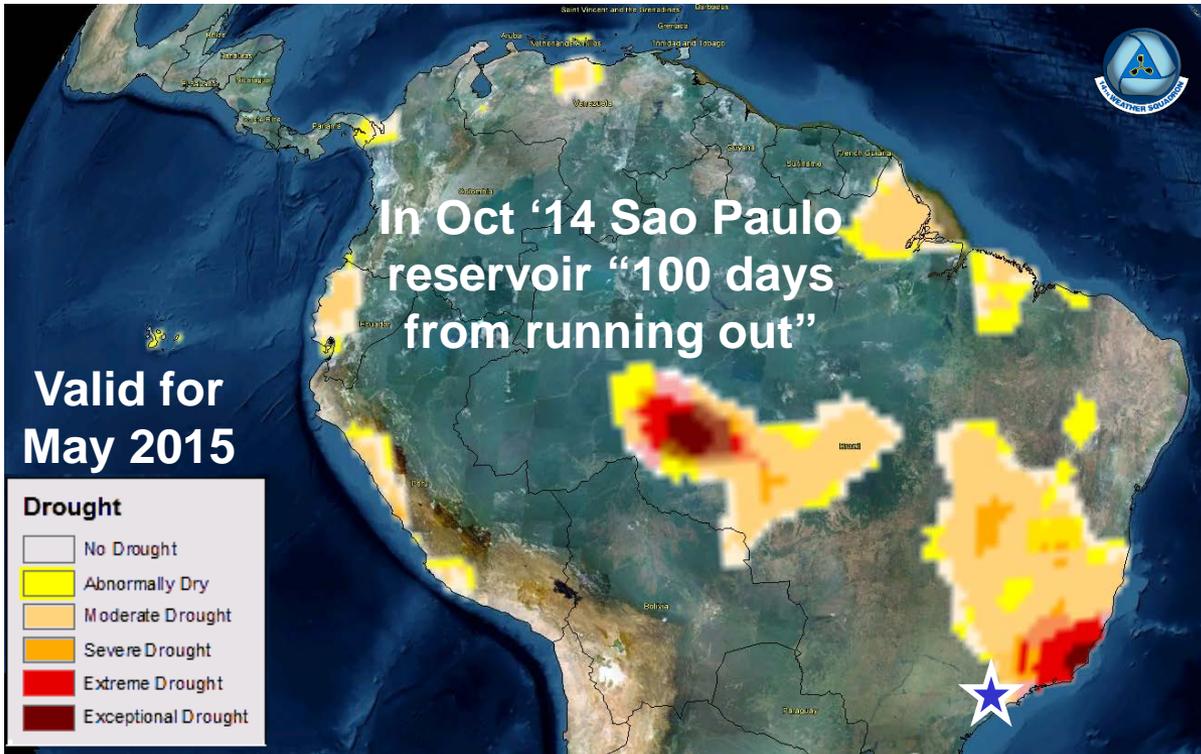
AF's Current CMAP Product Suite



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Global Drought Monitoring & Prediction

- **Global Drought (Monitor) Forecast**
 - Uses Standardized Precip Index (SPI)
 - Same thresholds as US Nat'l Drought Monitor
 - Agricultural drought (9-month period)
 - Long-term Water Security (24-month period)
 - Forecast applies seasonal fcst & climo to monitor



REUTERS EDITION: U.S. SIGN

HOME BUSINESS MARKETS WORLD POLITICS TECH OPINION BREAKINGVIEWS

BREAKING NEWS: FBI warns that unknown hackers have launched cyber attack with 'destructive malware'

Drought-hit Sao Paulo may 'get water from mud': TRFN

BY ADRIANA BRASILEIRO
Sat Nov 29, 2014 3:41am EST

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A resident looks out of her apartment in a building painted with a drought-related mural, painted by Brazilian artist Mundano, depicting a man getting water from a cactus plant, in Sao Paulo November 25, 2014.
CREDIT: REUTERS/NACHO DOCE





AF's Current CMAP Product Suite



Location-specific Temp & Precip Trends

Freetown Sierra Leone
Elev: 493 Meters
Lat: 8.48 Lon: 13.23

Temps/Precip Trends Through August 31, 2014

(Data Derived from the Climate Forecast System Model, 1979 - 2014)

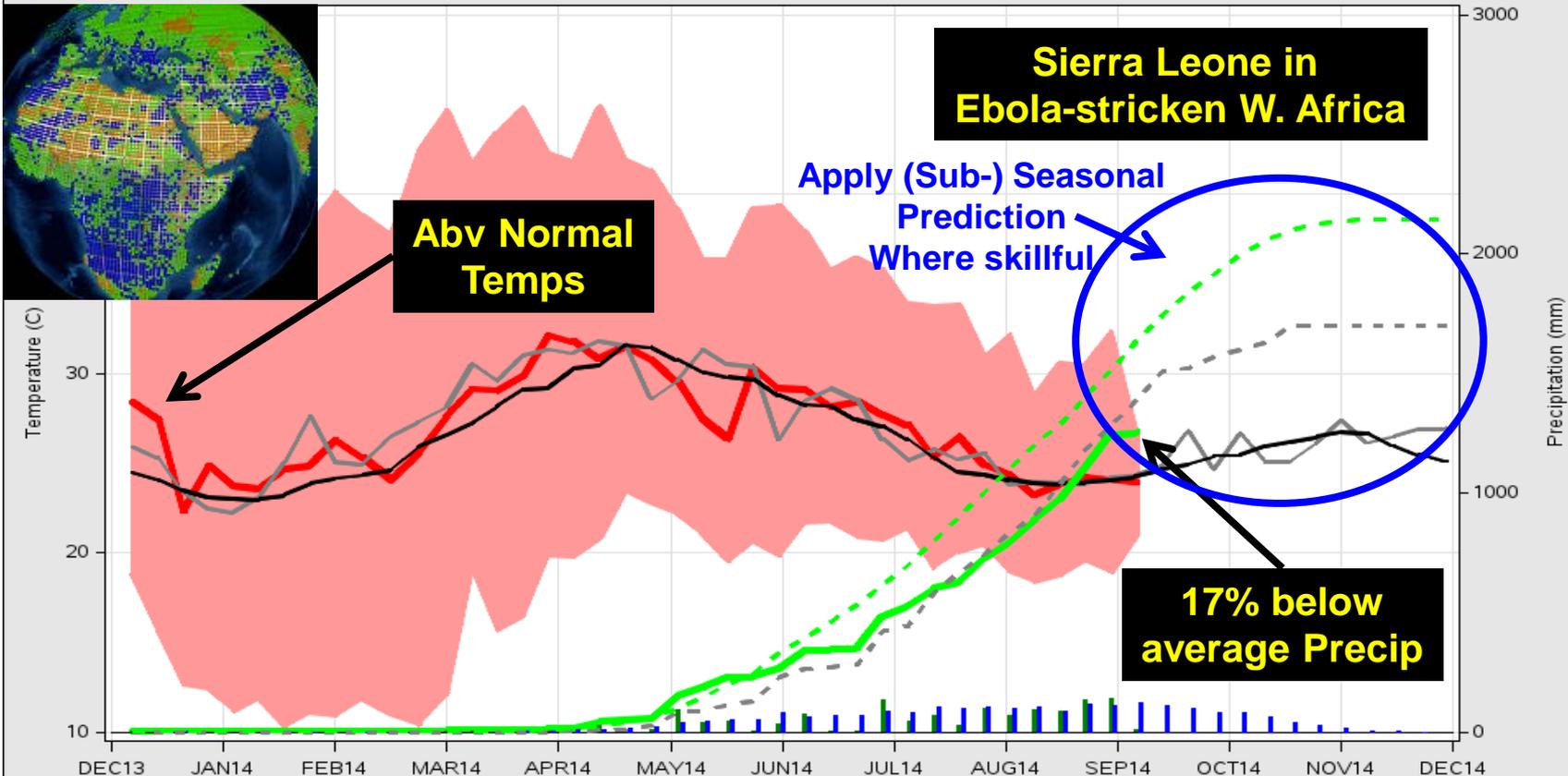


Sierra Leone in Ebola-stricken W. Africa

Apply (Sub-) Seasonal Prediction Where skillful

Abv Normal Temps

17% below average Precip



Temperatures	During August 2015	Precipitation
<ul style="list-style-type: none"> Temperature Range Current Year's Temperatures Last Year's Temperature Normal Temperature 	<ul style="list-style-type: none"> Top 10% Coldest Days 1 Top 25% Coldest Days 6 Top 10% Wettest Days 1 9-Month Departure from Norm: -257 mm/-10.11 in (-17%) Top 10% Warmest Days 0 Top 25% Warmest Days 2 Top 25% Wettest Days 10 	<ul style="list-style-type: none"> Cumulative Precip this Year Weekly Precip Normal Weekly Precip Last Year's Cumulative Precip Normal Cumulative Precip



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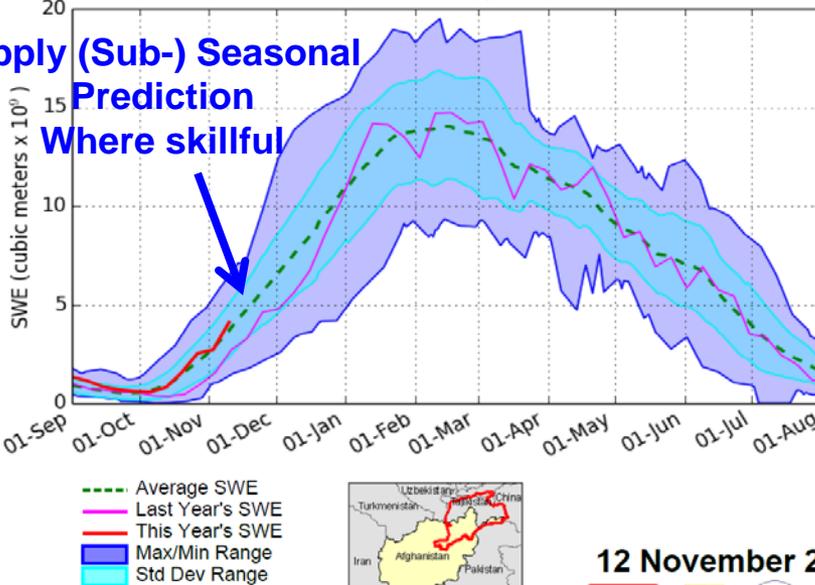
Regional Snowshed Monitoring

- Current & historical snow content
- AFPAK, Tigris/Euphrates, Tajik/Kyrg, Baltic States watersheds
- Expert snow assessment presented
- Collaborative product with CRREL



Amu Darya Watershed SWE

The total watershed SWE volume compared to the historical data



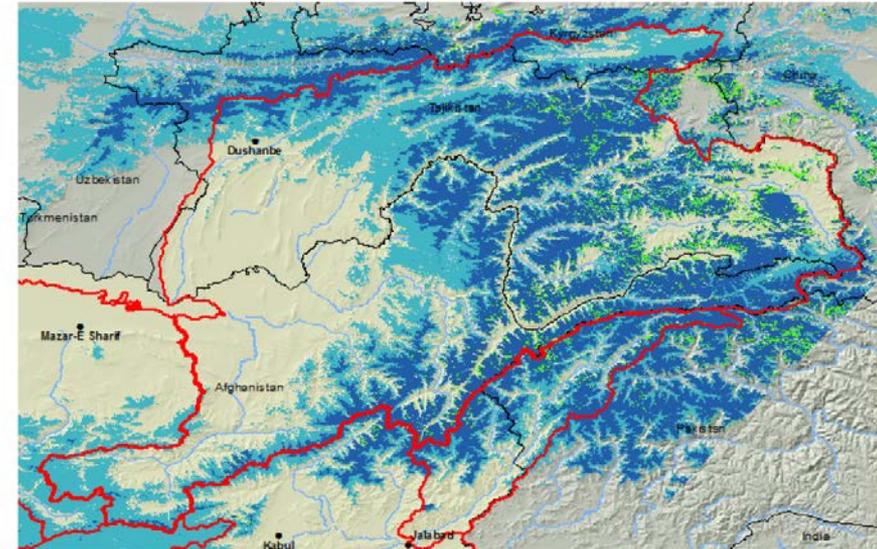
12 November 2014



Unclassified

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Amu Darya Watershed Snow Covered Area Change



Country Boundary
 Watershed Boundary
 2 Week SCA Change
 Persistent Loss/Cloud Gain

12 November 2014



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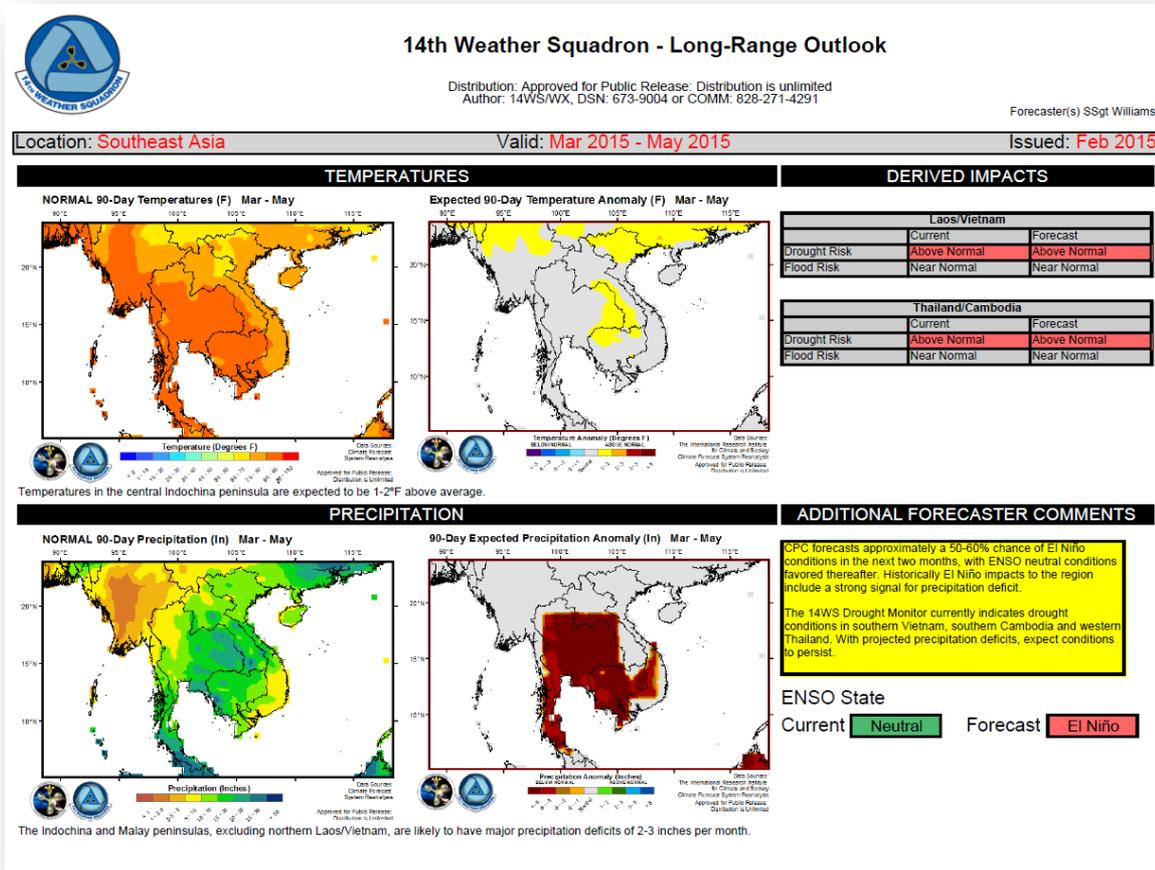


AF's Current CMAP Product Suite

Seasonal Long-Range Outlooks (LROs)



- Compares climatology to seasonal model
- 1- to 6-month climate prediction for 12 regions
- Skill mask applied
- Short description of expected conditions
- Derived impacts noted for DoD & IC awareness
- Looking at going to monthly output versus seasonal





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AF's Current CMAP Product Suite

Seasonal Long-Range Outlooks (LROs)

Topic of the Arctic is "heating up"



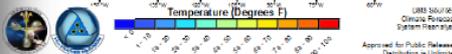
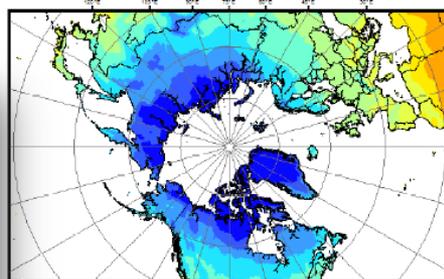
Location: Arctic

Valid: Mar 2015 - May 2015

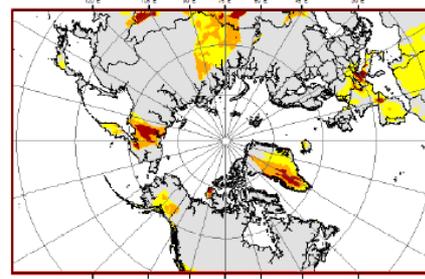
Issued: Feb 2015

TEMPERATURES

NORMAL 90-Day Temperatures (F) Mar - May



Expected 90-Day Temperature Anomaly (F) Mar - May



temperatures over land are expected to be 1-3°F above average in Alaska and 1-5°F above average in parts of Siberia and Greenland. The NMME model guidance show above normal temperature anomalies to be widespread over Alaska, western Canada, Siberia, and Eurasia.

DERIVED IMPACTS

Canadian Archipelago/Alaska		
	Current	Forecast
Snow Pack	Near Normal	Below Normal

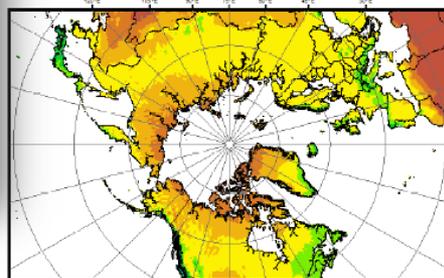
Northern Europe		
	Current	Forecast
Snow Pack	Near Normal	Below Normal

Sea Ice		
	Current	Forecast
Concentration	Below Normal	Below Normal
Extent	Below Normal	Below Normal

Siberia		
	Current	Forecast
Snow Pack	Near Normal	Below Normal

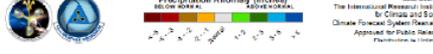
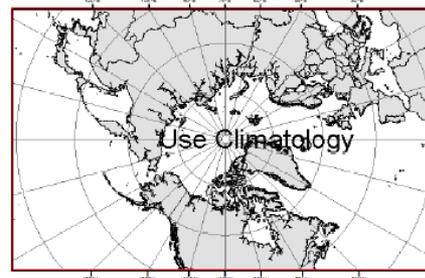
PRECIPITATION

NORMAL 90-Day Precipitation (In) Mar - May



With no anomalous climate drivers, use climatology for precipitation totals.

90-Day Expected Precipitation Anomaly (In) Mar - May



ADDITIONAL FORECASTER COMMENTS

CPC forecasts a 50-60% chance of El Niño conditions within the late Northern Hemisphere winter and early spring, with ENSO-neutral conditions favored thereafter. El Niño impacts to this region are minimal.

CFSv2 and NMME are showing sea surface temperatures to be anomalously high which could be causing below average sea ice extent and concentration. Snow pack is expected to stay below average according to the CFSv2 snow depth forecasts.

ENSO State

Current **Neutral** Forecast **El Niño**



Arctic seasonal prediction requested by NORTHCOM

Aim High...Fly, Fight, Win



AF's Current CMAP Product Suite



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Recent Sub-Seasonal Climate Prediction Vignettes

2-month Forecast for European Theater Global Power Exercise

March Fcst for June '14 US-UK Exercise

- Built In-house statistical model
- High prob. of favorable flying wx
- CIG/VIS expected to be better than climatology

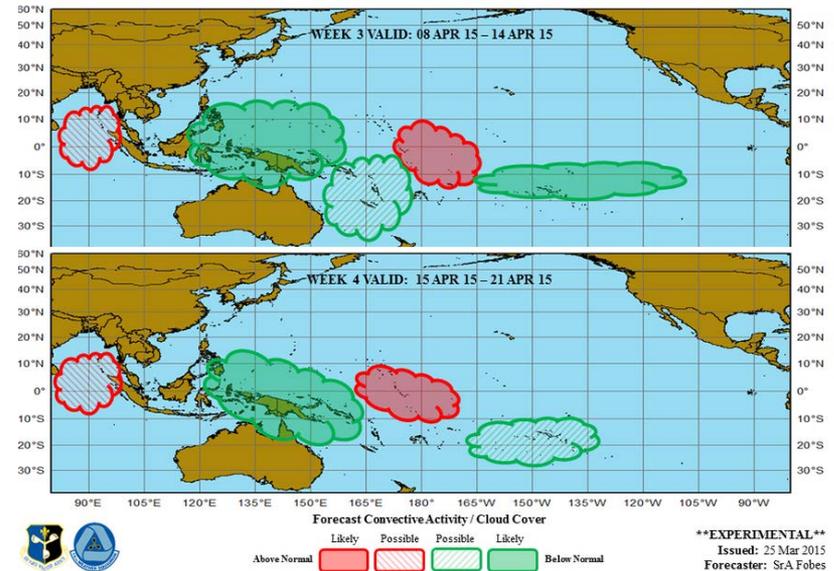
Verification:

- Route planning adjusted
- Forecast verified within 1%



1-month Cloud Forecast for Pacific Route Planning

Tropical Pacific Convective Outlook



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DoD Interest in (Sub-) Seasonal Climate Prediction

DoD Climate Services Partners



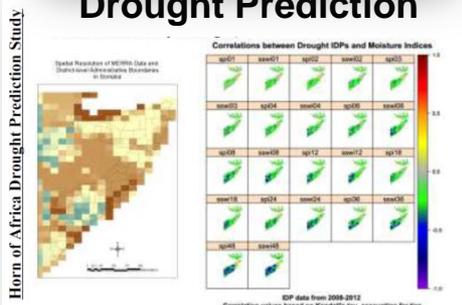
CMAP



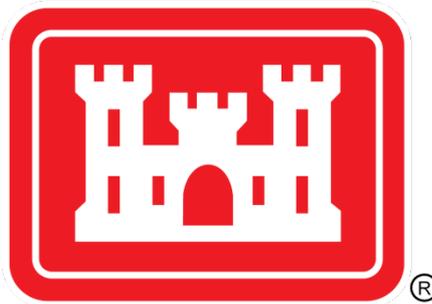
Humanitarian Assistance / Disaster Relief



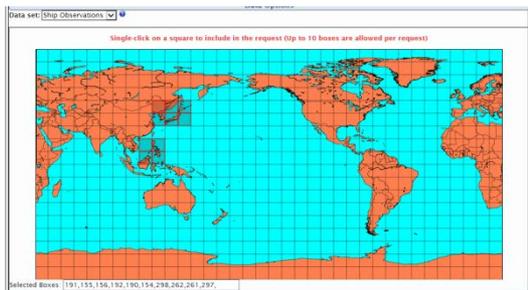
Drought Prediction



7th Warfighting Function: Engagement



Advanced Climate Analysis and Forecast (ACAF) Tool



Arctic & Trans-Oceanic Missions & more



Aim High...Fly, Fight, Win

Will drought in Country X persist or worsen causing human geography concerns?

Will the exercise I'm planning in 1-2 months see anomalous or extreme weather/climate? Should I plan for a different time if I have flexibility?

Will this watershed see anomalously low/high rain or snow that may increase risk for hydrological disasters?

What anomalous conditions may arise to cause food or water security concerns?

What extreme conditions may arise to increase risk for Humanitarian Assistance or Disaster Relief needs?

Will Southwest Asia locations see dustier conditions than normal in the next month or 2?

And more...



■ Forecast updates

- Monthly or Semi-monthly sufficient now...wkly/daily as skill improves

■ Forecast variables / future operational requirements

- T, P, Z considering state of science
- As skill improves...include Snow (depth & cover), Clouds, Humidity, Sea Ice Coverage, SSTs, MJO parameters, Wave Heights, 10m Winds, Evapotranspiration, Soil Moisture and other Drought Parameters, and other variables similar to CFS and GEOS-5 output
- Probabilistic Output & Extremes (e.g. precip, winds, etc)
- Skill Mask

■ Spatial Resolution Desired

- 1/2 degree or less (Recent User: “at city scale”)

■ Specific Data Flow Requirements

- Push/pull via sftp, http, or other secure means



US Army Corps
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Questions

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<http://afwws.afwa.ic.gov/>

[confluence/display/14WSCP](http://afwws.afwa.ic.gov/confluence/display/14WSCP)

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