Applying Climatology for Strategic Planning:
The 14th Weather Squadron Capabilities in Eastern Europe

14th Weather Squadron, USAF

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Climate Monitoring, Analysis and Prediction Team

Overview

- **14 WS Overview**

- **Scenario Buildup**

- **Product Development and Overview**

- **On-going Support & Product Evolution**

- **Summary**

14th Weather Squadron (14 WS)

- *Collect, protect, and exploit authoritative climate data to develop competitive advantages for the DoD, Intelligence Community, and NATO.*

Weather Drives Behavior

Scenario Overview

- **Multiple media reports of troop build-up in Eastern Europe in 2021**

- **Developed a monthly climate analysis and prediction brief in December 2021**
  - **Analysis of Teleconnections**
  - **Recent 30-Day Analysis**
  - **Probability of Frozen Ground**
  - **Sub-seasonal to Seasonal Prediction**

- **Evolving monthly analysis and prediction**
  - **Soil Moisture, Drought, Fire Analysis**

DEFENSE

Satellite images show new Russian military buildup near Ukraine

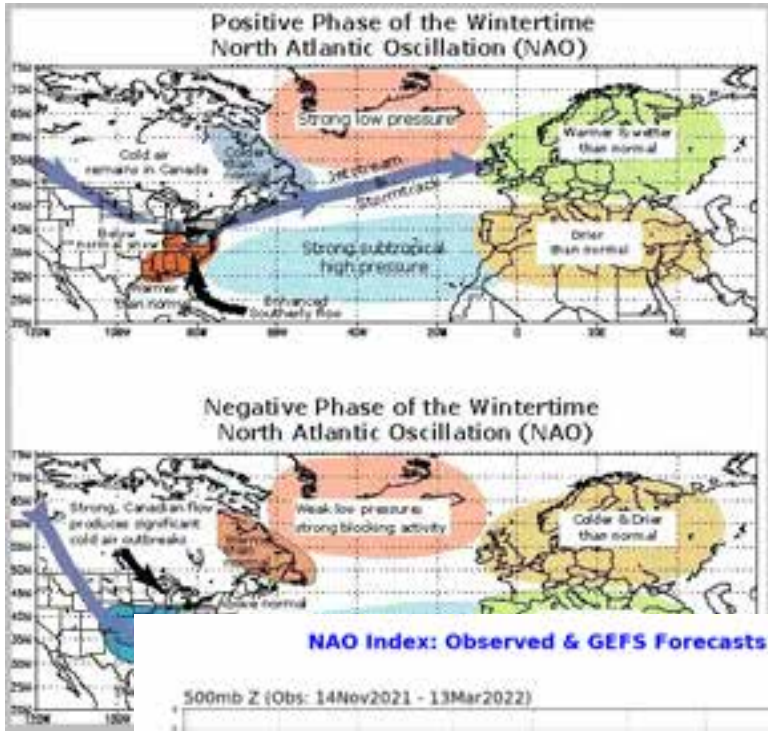The deployments come as tension is rising between Moscow and the West.

A high-resolution satellite imagery shows armored units and support equipment in Yelnya, Russia. | Satellite image ©2021 Maxar Technologies

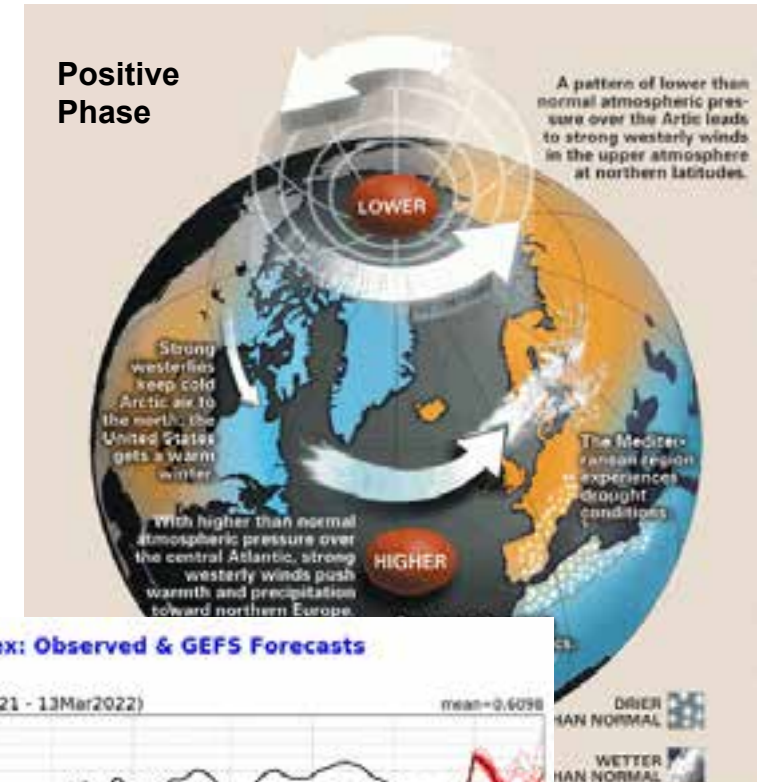Satellite images show new Russian military buildup near Ukraine - POLITICO

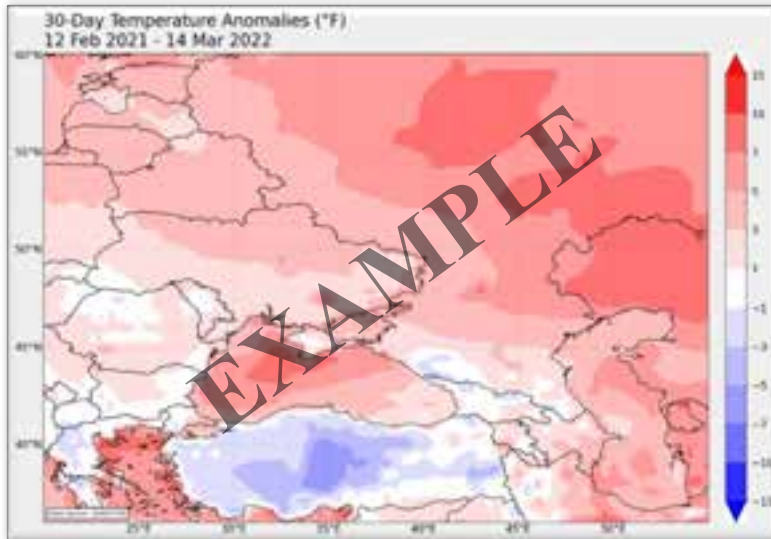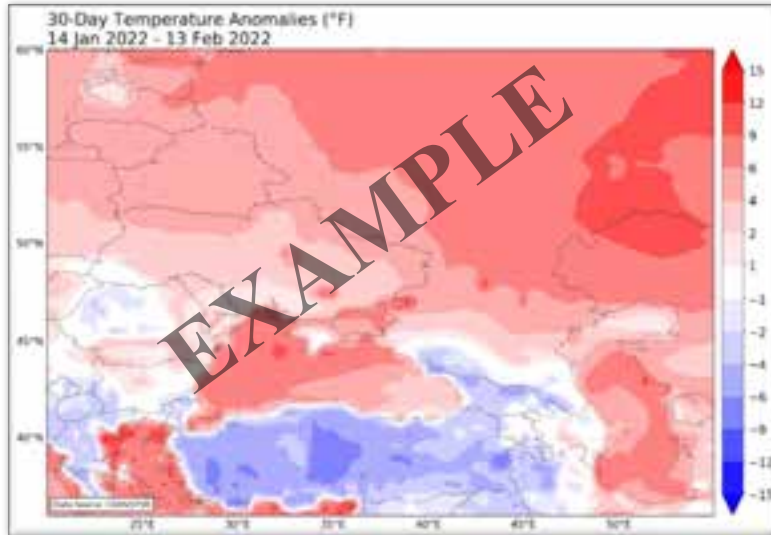# *Teleconnections and Oscillations*

North Atlantic Oscillation (NAO)

Positive Phase of the Wintertime
North Atlantic Oscillation (NAO)

Negative Phase of the Wintertime
North Atlantic Oscillation (NAO)

NAO Index: Observed & GEFS Forecasts

500mb Z (Obs: 14Nov2021 - 13Mar2022)   mean=0.3937

- **Both were predominately positive through Jan – Feb 2022**

- **Impacts can be warmer than normal temperatures**

Arctic Oscillation (AO)

Positive Phase

AO Index: Observed & GEFS Forecasts

1000mb Z (Obs: 14Nov2021 - 13Mar2022)   mean=0.6098

30-Day Temperature Anomalies (°F)
14 Jan 2022 – 13 Feb 2022

30-Day Temperature Anomalies (°F)
12 Feb 2021 – 14 Mar 2022

30-Day Precipitation Totals (in)
12 Feb 2022 – 14 Mar 2022

30-Day Percent of Normal Precipitation
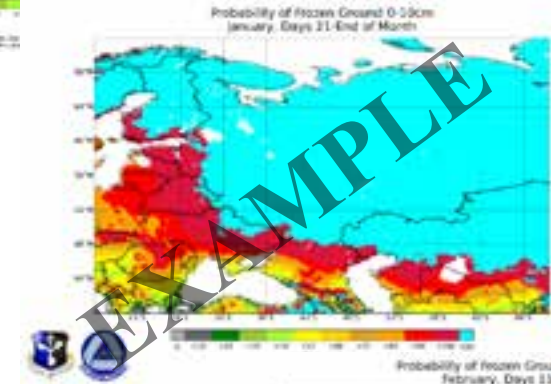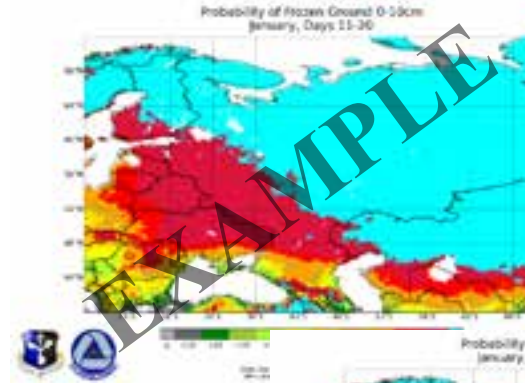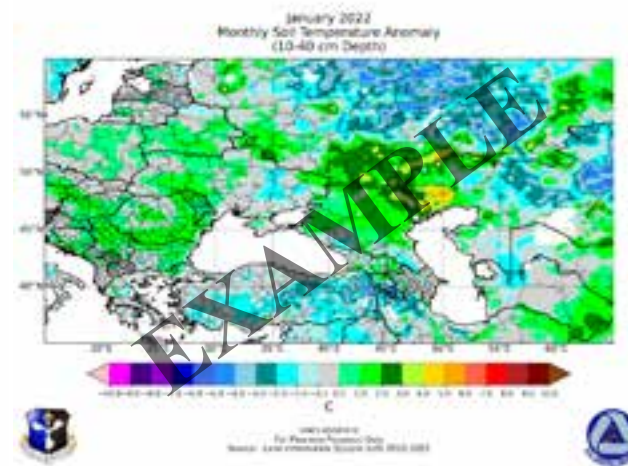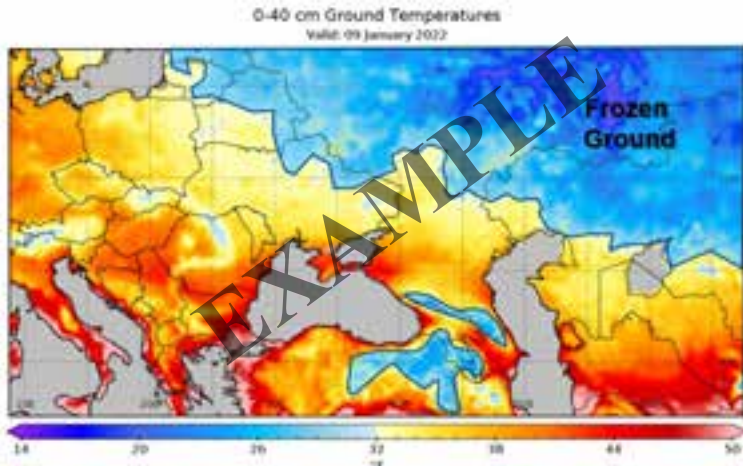12 Feb 2022 – 14 Mar 2022

- **CFSR dataset used for observed temperature and precipitation**

- **Anomalies and percent of normal created with a 1980-2010 climatology**

Frozen Ground

0-40 cm Ground Temperatures
Valid: 09 January 2022

Frozen Ground

January 2022
Monthly Soil Temperature Anomaly
(10-40 cm Depth)

Probability of Frozen Ground 0-10cm
January, Days 11-20

Probability of Frozen Ground 0-10cm
January, Days 21-End of Month

Probability of Frozen Ground 0-40cm
February, Days 11-20
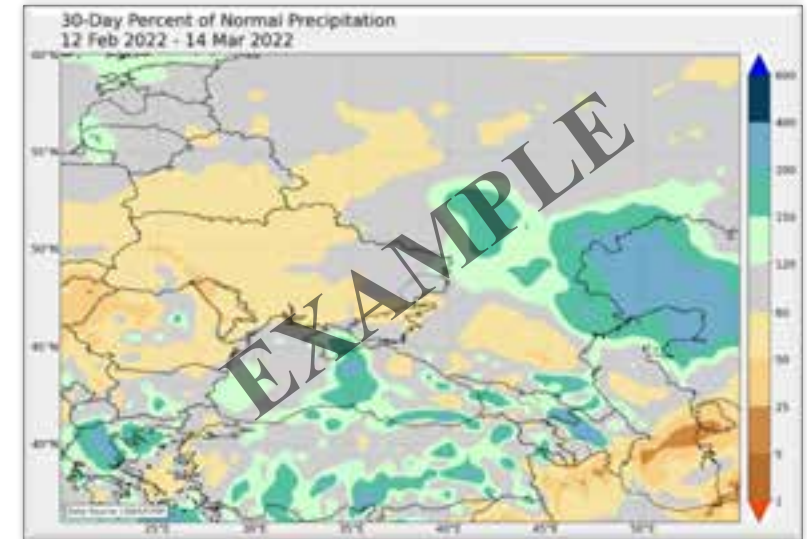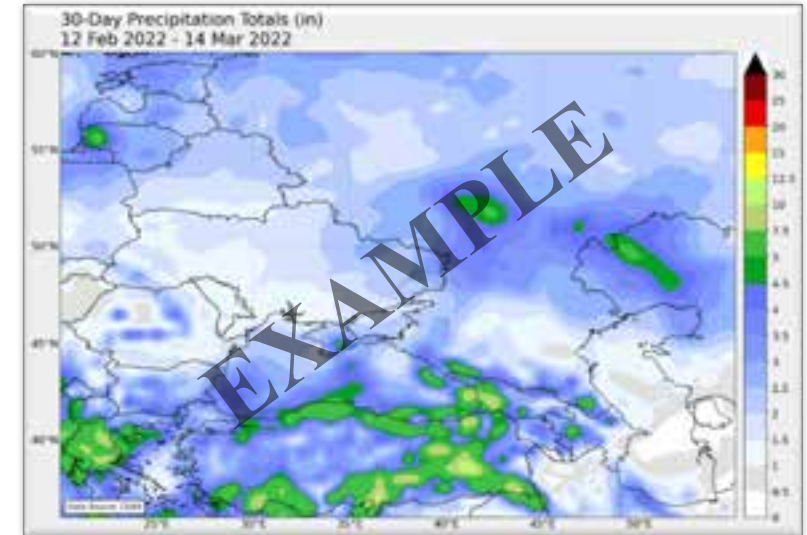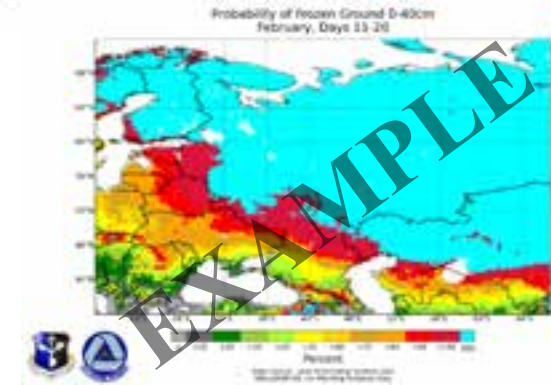
- **NASA Land Systems Information (LIS) dataset**
  - **2009-2018 climatology (10 years)**
- **Ground temperatures were used as a proxy to analyze**
  - **Current state ground temperatures**
  - **Climatology of ground temperatures and anomalies**
- **Frozen and thawed ground impact trafficability**

Weather Drives Behavior

Snow Cover Analysis

Source: National Ice Center Interactive Multi-sensor Snow and Ice Mapping System

LIS Snow Depth
Valid: 12 March 2022
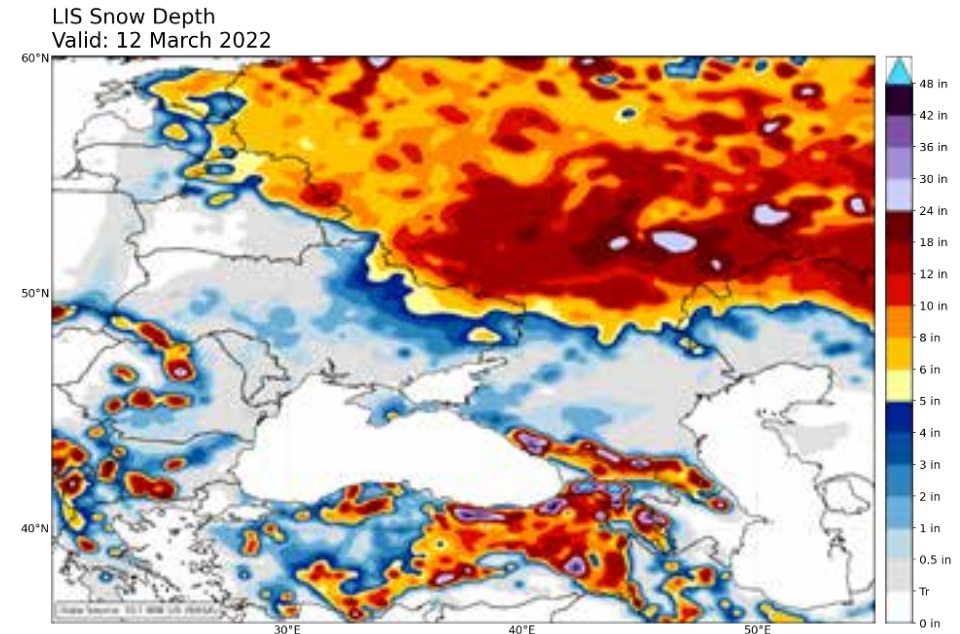
- **Snow cover extent from Visible Infrared Imaging Radiometer Suite (VIIRS)**

- **Snow depth from Land Information Systems v7.3 (LIS)**
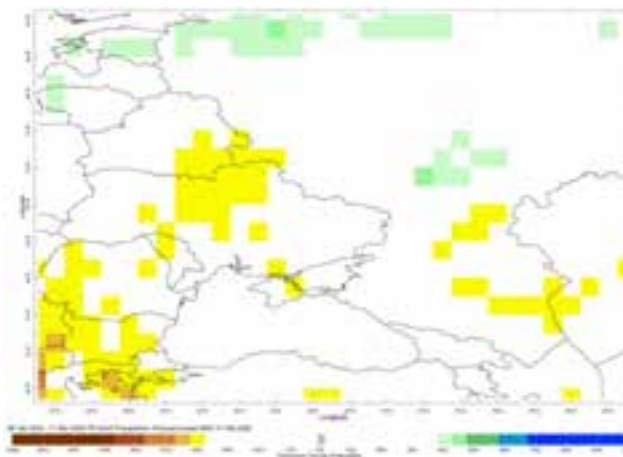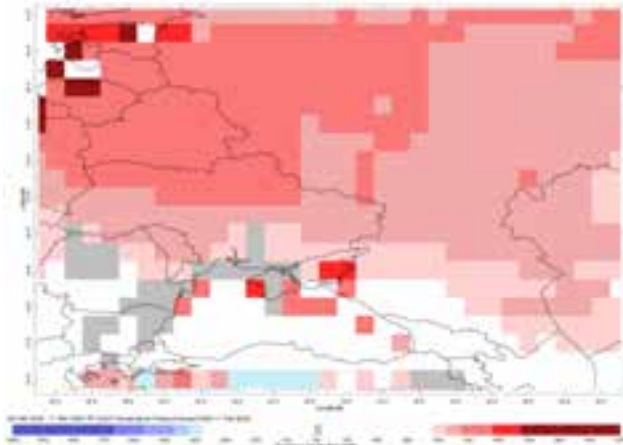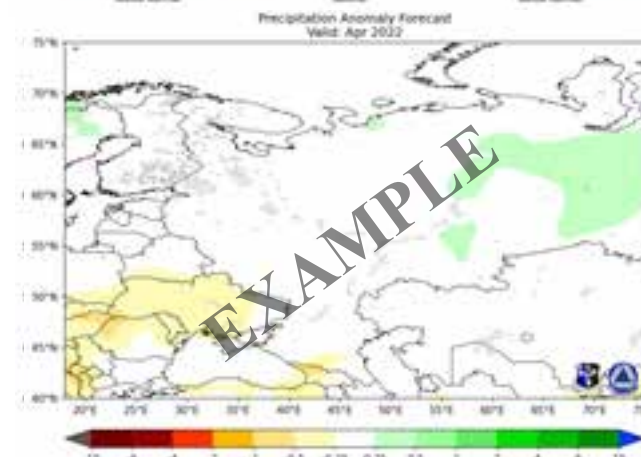
- **Aids with extent of frozen ground**

Weather Drives Behavior

S2S Prediction

Subseasonal
Weeks 3-4; SubX

Monthly
NMME

Seasonal
NMME

Source: IRI

Data Source: NOAA/NWS/CPC

WEATHER DRIVES BEHAVIOR
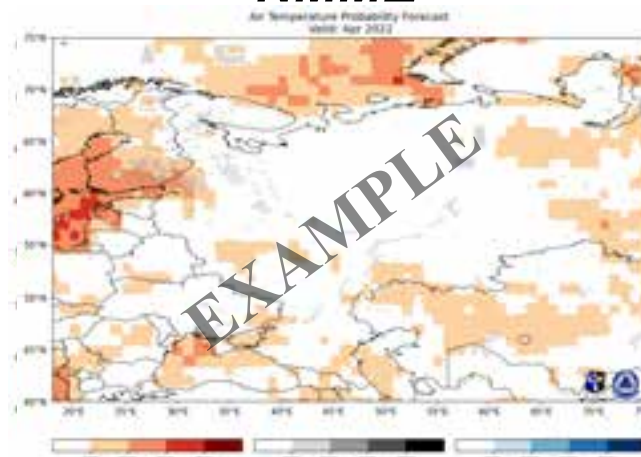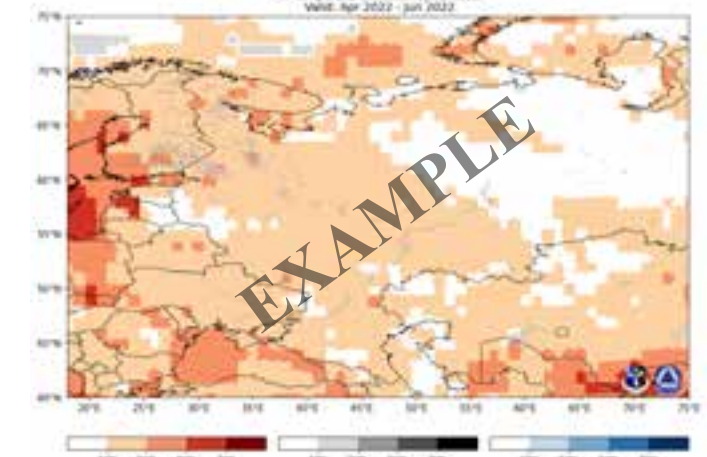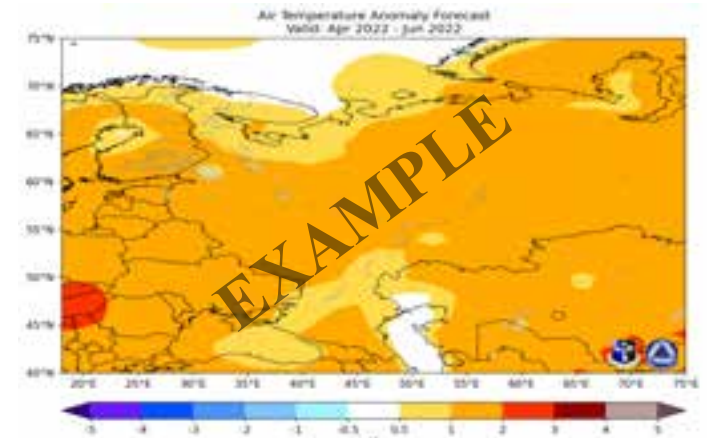
Derived Impacts From Climo + Subseasonal Prediction

- **Observed:**
  - *Warmer than normal temperatures through much of winter '21-'22 led to slower southwestward expansion of frozen ground and snow cover when compared to climatology; impacts to vehicle movement (trafficability)*

A Russian army vehicle bogged down in Ukraine – one of many adding to the 40-mile tailback leading into Kyiv CREDIT: Twitter/Trent Telenko, TelegraphUK
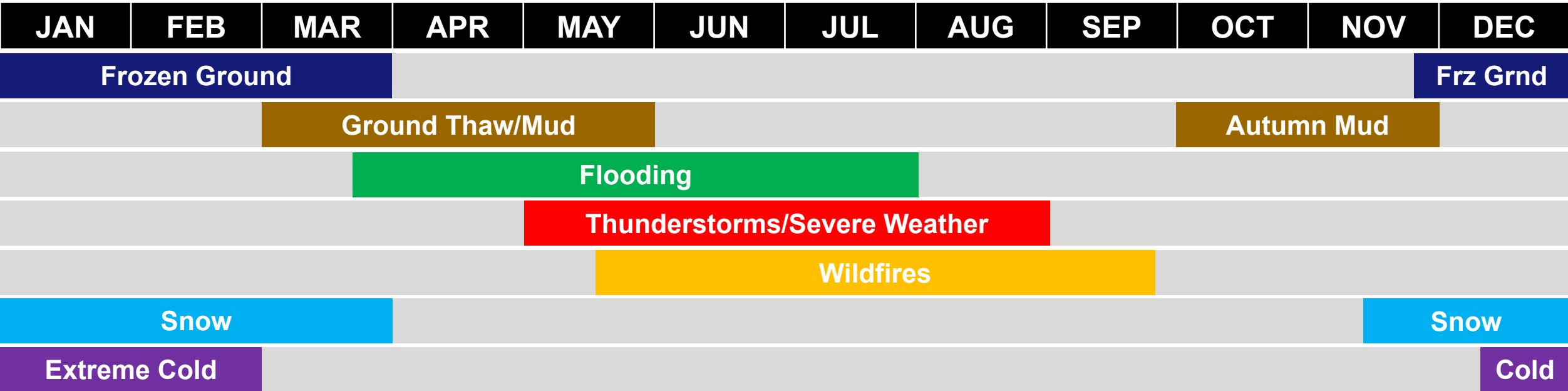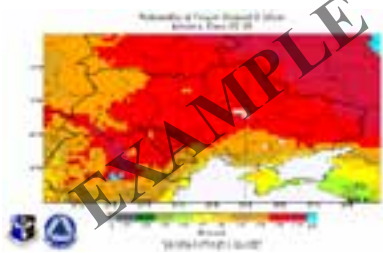
- **Prediction:**
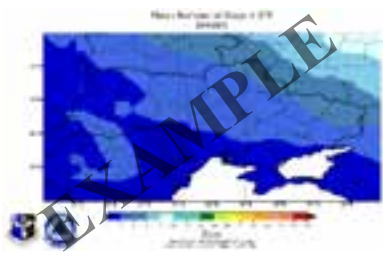 - *Predicted above normal temperatures in Jan-Feb '22 could lead to a continued slower expansion of frozen ground*
  - *Colder temperatures predicted for March could slow the thaw of frozen ground; below normal precipitation/snow extent aids in thaw*

Eastern Europe Climate Hazards Timeline

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Frozen Ground — JAN through MAR; **Frz Grnd** — DEC

Ground Thaw/Mud — MAR through MAY; **Autumn Mud** — OCT through NOV

Flooding — APR through AUG

Thunderstorms/Severe Weather — MAY through SEP

Wildfires — JUN through SEP

Snow — JAN through MAR; **Snow** — NOV through DEC

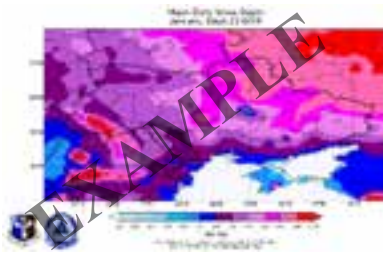**Extreme Cold** — JAN through FEB; **Cold** — DEC

Frozen Ground	Extreme Cold	Snow Cover	Precipitation	T-Storm Days	Fire Conditions
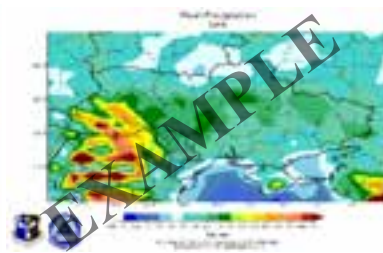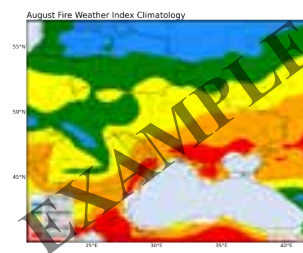
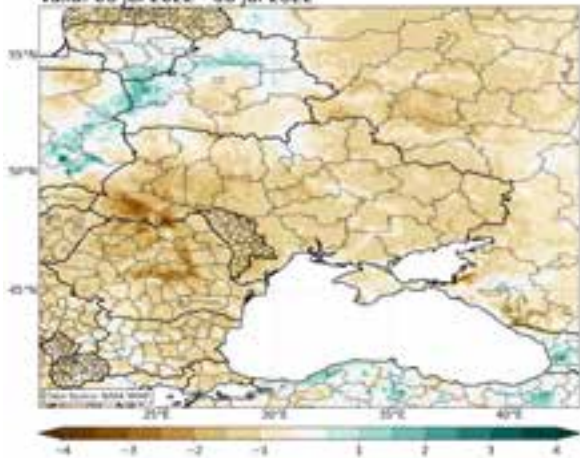# On-Going Support & Product Evolution

Soil Moisture & Flooding

Soil Moisture Anomaly (mm)
Valid: 06 Jul 2022 - 08 Jul 2022

River Levels: 13 July 2022
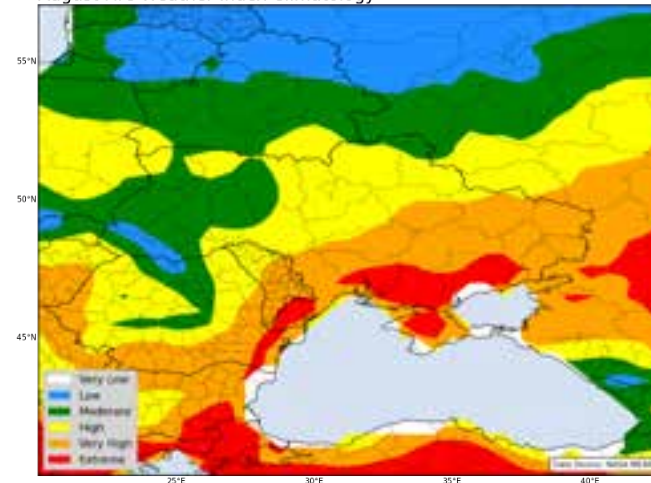
Source: Ukraine Hydrometeorological Center

Drought & Agriculture

Drought Condition Based on Previous 9 Months Precipitation
Valid: Jun 2022

EXAMPLE

Ukraine: Wheat Production

Foreign Agricultural Service
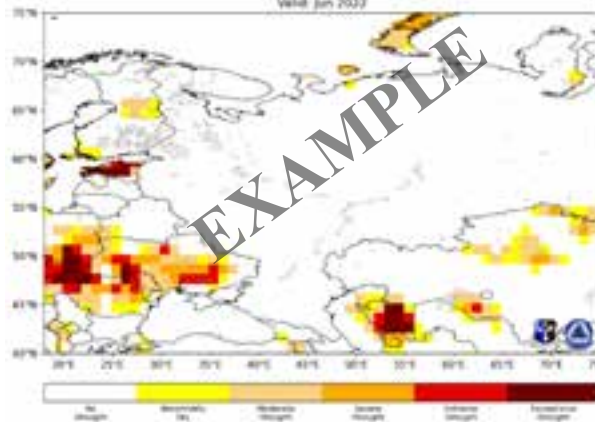
Fire Weather & Fire Activity

August Fire Weather Index Climatology

MODIS/Sentinel-2 Burnt Areas Last 30 Days
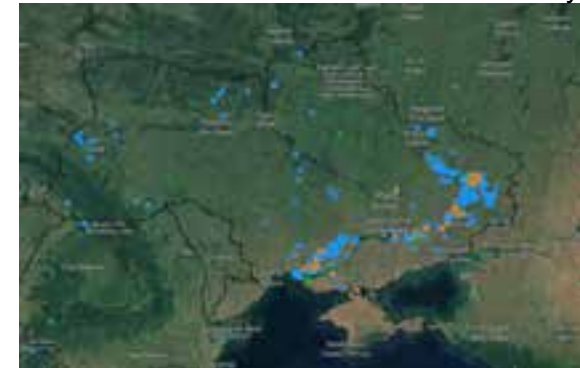
Source: Copernicus European Forest Fire Information System

Summary

- **The 14WS utilized climatology and subseasonal to seasonal forecasts to provide environmental intelligence about ground and air conditions**
  - **These conditions can provide insight into mission planning and/or trafficability**

- **Derived impacts using climatology and S2S**
  - **State of ground conditions**

- **Product evolved to provide context for weather and climate hazards through several seasons**
  - **Feedback from the field helped shape new analyses**

- **Limited by spatial and temporal resolution at subseasonal and seasonal timescales, especially when focused on a small region**

Questions?

WEATHER DRIVES BEHAVIOR