2nd U.S. Climate Modeling Summit (US-CMS)

USGCRP: Interagency Group on Integrative Modeling (IGIM)

Charge and opening remarks

- Background
- Broad goals for USCMS
- Goals for today's meeting
- Agenda

March 9-10, 2016

Background

2nd annual USGCRP IGIM Climate Modeling Summit (CMS) to convene the leads from the major ("CMIP-class") national climate and weather model development groups.

IGIM: Interagency Group on Integrative Modeling, is one of several USGCRP working groups, and consists of managers from DOE, EPA, NASA, Navy, NOAA, NSF, USDA, DOT with climate modeling interests and investments. Meets monthly to improve coordination of federal climate modeling activities. Note that IGIM interests are broader than "USCMS".

Overarching Goal for CMS: To enhance coordination and collaboration toward a common national climate modeling strategy and communication with the broader modeling community.

The CMS is an annual opportunity for:

- Modeling center leaders to engage in discussion on major objectives and difficulties
- Agency representatives to present relevant current priorities, directions, issues
- Dialogue regarding whether and how we might improve strategies to further U.S. climate science and mission objectives

USCMS 2016

This year's themes were influenced by a) activities and priorities at IGIM, b) the first USCMS report, c) phone-call with Center leads

Themes for 2016:

1. Weather-to-climate, high resolution modeling challenges
   "*There is the opportunity and/or need for coordination among modeling centers in reference to modeling at high resolution and with advanced physical representations in order to address important scientific challenges.*"
2. Climate modeling, CMIP6
   "There is the opportunity through national coordination of modeling centers to enhance the scientific utility of some subset of CMIP activities."
3. High Performance Computing landscapes
4. Integrated Assessment, Impacts-Adaptation-Vulnerability [and how these relate to climate/weather models]

Forums:
Agency briefings (Wed AM)
Center briefings (Wed PM)
Topical discussions (on 1 and 2) (Thurs AM)
Organizational (Thurs PM)

Organizational and Logistical items

Organizational (Thurs PM)

- Leadership, “chair”
- Report from this meeting (plan, due-date)
- Any follow-up activities
- Themes for next year

Rapporteurs critical for meeting report!

Agency representatives will mainly “observe” except for agency presentations and designated discussion sessions

Original Goals for USCMS

1. **Strategic**: Enhance understanding of groups' directions and implementations:

- Common vision for national climate modeling and a roadmap for the roles of the groups within that vision.
- Document groups' scientific goals, strengths, differences and commonalities.
- Articulate linkages between the US and the international climate community.
- Inform one another and IGIM on activities, updates in plans (e.g. MIP plans), progress.
- Identify critical gaps in US climate modeling capabilities.

2. **Coordination & collaboration**: Identify opportunities for enhanced coordination among modeling groups:

- Potential areas of collaboration on shared infrastructure (e.g. data standards, workflows, archives, etc.), software, and modeling approaches.
- Consider the development of a unified weather-climate capability for the US.
- Discuss coordination of U.S. model participation in Model Intercomparison Projects (MIPs).
- Consider common approaches to modeling science and climate prediction and projections.

3. **Outreach**: Identify outreach opportunities, e.g.:

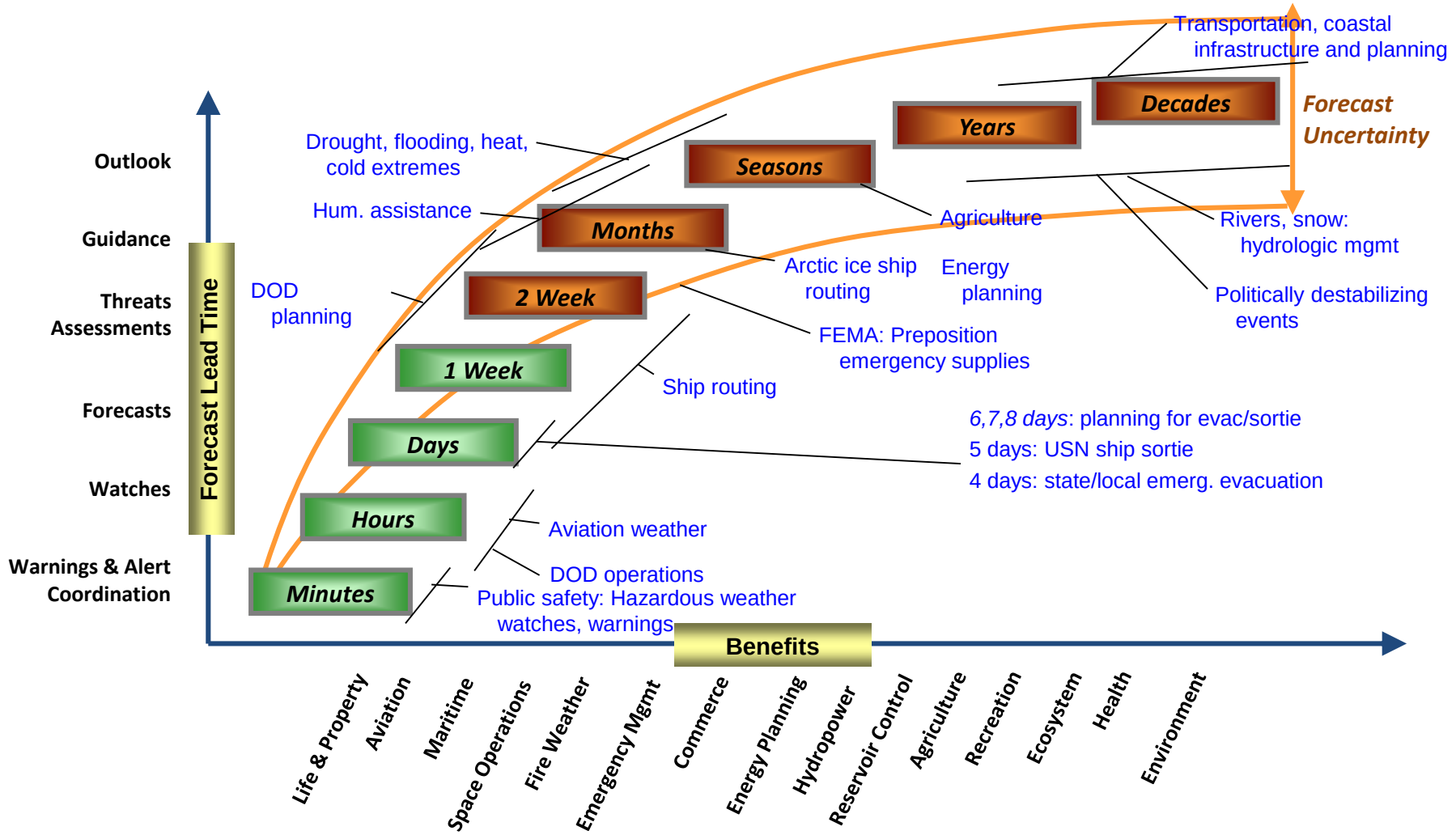
- Convene targeted "Forum" meetings to enhance communication within the broader modeling community (e.g. regional climate modelers) and with model users, e.g. the CMIP6 meeting.
- Coordinate interaction with climate model stakeholder communities.
- Foster a program for climate model interpreters.

USCMS 2015

http://www.globalchange.gov/about/iwgs/igim-resources

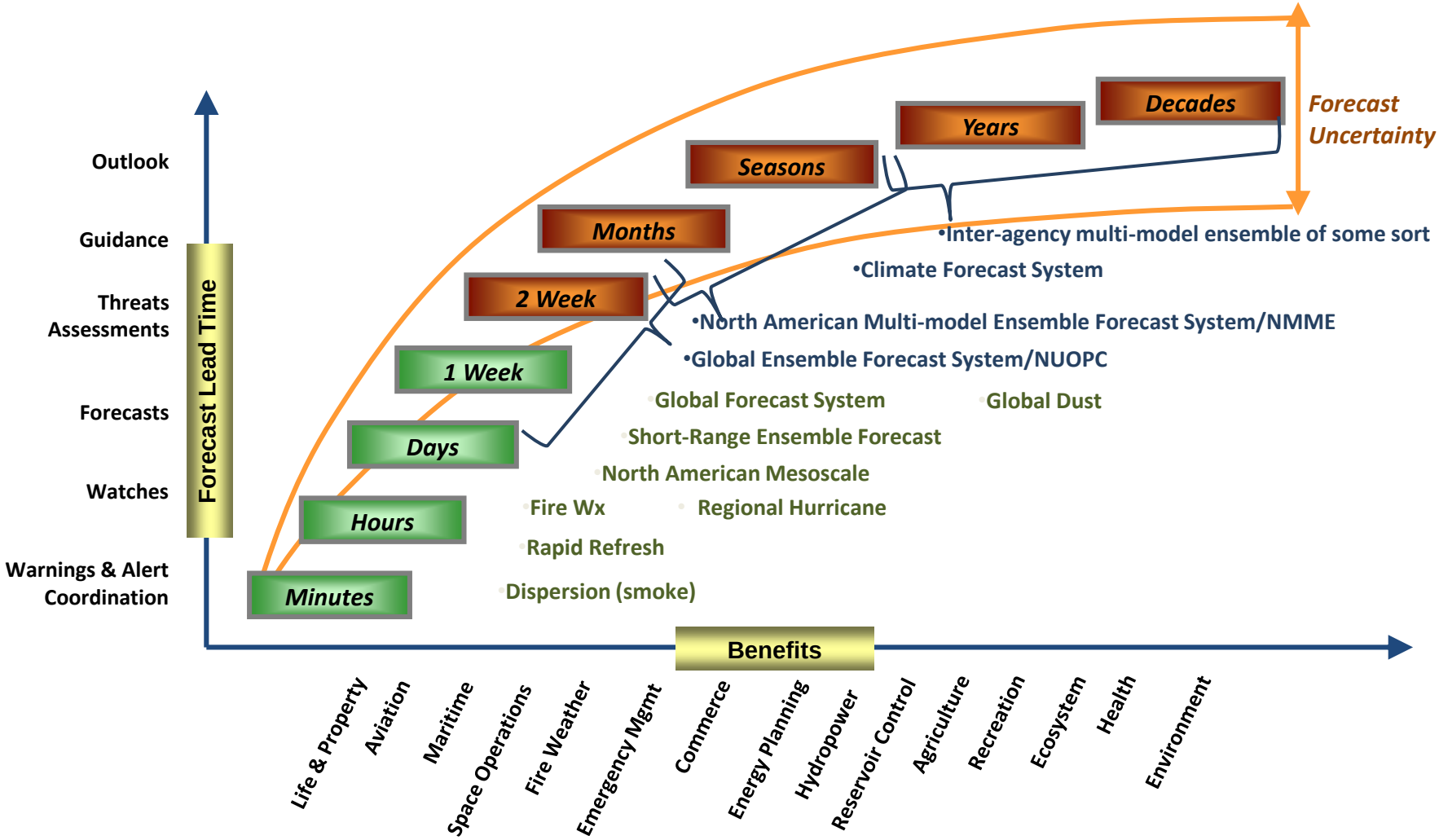
National ESPC

Need for "Seamless" (Internally Consistent) Decision Support



Vision:

Multi-model ensemble system across scales



Seamless Weather–Climate Science and Prediction – OAR

Filling the gap between NOAA's weather and seasonal prediction capabilities

- Understanding of processes and predictability underpinning predictions
- Linking weather phenomena and extremes with underlying climate
- Modeling of processes across spatial and temporal scales (scale-aware physics, high-resolution modeling)
- Understanding prediction system setup for weather to climate prediction (representation of predictability, coupled phenomena, initial states)
- Supporting NWS effort to develop a unified coupled modeling system weather to climate
- Testing and transitioning systems for subseasonal to seasonal prediction (e.g. SubX experiment)

NASA's Interest in Seamless Prediction

NASA ESD activities are driven by strategic objective: "Advance knowledge of **Earth as a system** to meet the challenges of environmental change, and improve life on our planet."

NASA modeling objectives formulated in response to this ESS objective:

- Understand the Earth as a Complete, Dynamical System
- "Observation-Driven Modeling"
  - Observations chosen to further strategic objective of developing ESS understanding necessary to confront environmental change and improve life.
  - Modeling goal is to exploit and add value to available observations, particularly NASA observations, to promote ESS understanding.
  - Note – available observations focus modeling efforts on those topics facilitated by available observations.

NASA modeling emphases resulting from objectives:

- Focus on Earth system modeling – Earth as a complete, dynamic, interacting system.
- Span entirety of Earth system length and spatial scales relevant to ESD.
  - GMAO GEOS5 – up to decadal focus, GISS – up to multidecadal.
- Increase comprehensiveness and resolution as resources allow.
  - Computational resource limitations require choices.
  - Resource limitations drive need for interagency coordination, enabling coding standards/software engineering, open and available code, elimination of

Seamless Earth-System Modeling

Accurate and consistent representation of the statistics of phenomena over varying spatial and temporal scales.

- Dynamical, physical, biological, chemical interactions and feedbacks across time and space scales
- Societal impacts and feedbacks.

Research Challenges:

Physical processes: parameterizations scale interactions; Data assimilation and predictability science; Grid resolution and its impact on parameterizations

Process Studies: field observations and modeling

Data Assimilation

- Composite data assimilation that provides for varying assimilation steps applied to different scales and components of the Earth-system model
- Application to data impacts, types, and networks, and predictability science

Computing

- Enhanced computer capability for efficient numerical modeling, advanced experimental design, improved data processing and analysis;
- National Strategic Computing Initiative

DOE's Interests in Seamless Weather-Climate Science and Prediction

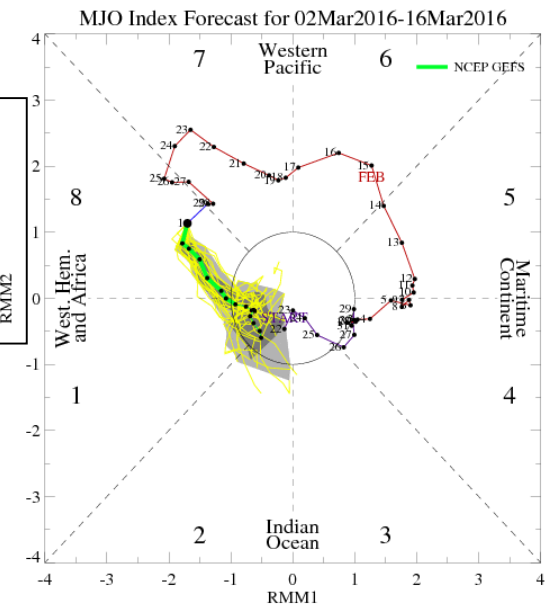
- Primary interests are in Climate
  - Focusing on Process research (e.g., NGEE, ARM campaigns)
  - Developing High Resolution, Computationally efficient models (ACME)
  - Using them to understand the underlying events at all spatial and temporal resolutions
    - Extreme events; MCS; MJO

      ENSO; Droughts

Examples

- NMME involvement
  - Funds CESM participation
  - Analysis wrt ENSO predictability
- ESPC involvement
  - Sea-Ice Prediction Network
- Joint Workshop on High-Resolution Coupling and Initialization to Improve Predictability and Predictions in Climate Models

Real-time multi-model MJO forecast for March 2-16, 2016. The forecast calls for weakening of an ongoing active phase of the MJO as it transitions into the western hemisphere.



Some of DOE's contributions Inteaseasonal timescales

- **Encouraging leadership on national and international panels**, including those that have impacted the fidelity with which the dominant mode of subseasonal variability is represented (e.g., Madden-Julian Oscillation Working Group/Task Force, GEWEX Atmosphere System Study, Asian-Australian Monsoon Panel)

- **Establishment of protocols for making real-time experimental forecasts** of the Madden-Julian Oscillation (e.g., Gottschalck et al. 2010, BAMS)

- **Contributions of ensembles of numerical simulations to assess skill and predictability of intraseasonal variability** in free-running and initialized hindcast experiments (e.g., Jiang et al. 2015, JGR; Klingaman et al. 2015a, b, JGR; Xavier et al. 2015, JGR)

- **Benchmark observations and assessments of model skill in representing synoptic to intraseasonal variability** (e.g., Slingo et al. 1992, JGR; Slingo et al. 1996, Clim. Dynam.; Sperber et al. 1997, 2004, 2005, 2013, Clim. Dynam.; Sperber et al. 2000, QJRMS: Sperber 2003, MWR; Annamalai and Sperber 2005, JAS; Sperber and Annamalai 2008, Clim. Dynam.; CLIVAR et al. 2009, J. Clim.; Kim et al. 2009, J. Clim.; Boyle et al. 2015, JGR)

- **Development of insightful process-oriented diagnostics of intraseasonal variability** that guide model improvement (e.g., Kim et al. 2014, J. Clim.)

Workshop on High-Resolution Coupling and Initialization to Improve Predictability and Predictions in Climate Models

When & where: September 30–October 2, 2015 at NCWCP, College Park, Maryland

Organizers & participants:

Scientific community: J. Kinter (COLA/GMU), **T. O'Brien (LBNL), S. Klein (LLNL),** S.-J. Lin, (GFDL), **B. Medeiros (NCAR**), S. Penny (UMD/NCEP), W. Putman (NASA), K. Raeder (NCAR)

Agency representatives: A. Mariotti (CPO/MAPP), **R. Joseph (DOE)**

- 40+ participants from U.S., international modeling & operational prediction institutions

Goals:

1. Enhance interaction between climate prediction & projections communities
2. Synthesize status of research & document challenges for initialized high-res. simulations for both communities
3. Identify criteria for multi-model experimental framework to address critical research questions in context of available computing resources

Key outcomes:

- Opportunity for a coordinated investment through common experimental frameworks for investigating (1) coupled system biases, (2) high-resolution for model components
- Suggestion to define and share process-based metrics to aid model development & stakeholder-defined operational prediction metrics
- Comprehensive workshop report

Draft Workshop report: *http://climatemodeling.science.energy.gov/workshop-reports*

Air Force Climate Services

Col Mike Gremillion
Chief, Weather Strategic Plans and Interagency Integration Division
Headquarters Air Force

U.S. AIR FORCE

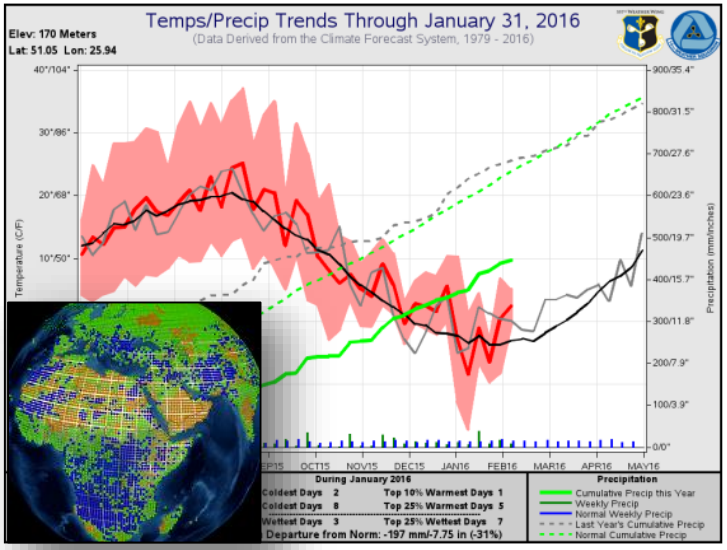
9 March 2016

Air Force Climate Services

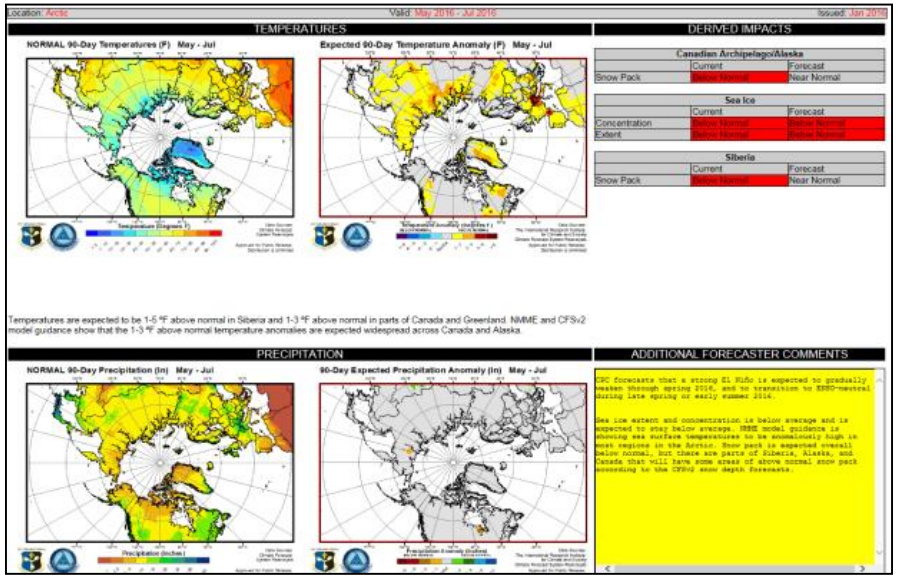
- **Leader in operationalizing relevant tailored climate decision aids**
  - **Monthly Situational Report for 25+ countries**
  - **Global/Regional Long-Range Outlooks**
- **Climate monitoring, analysis & prediction requests have grown each year**
  - **DoD Climate Change Roadmap release Oct '14**
  - **800+ DoD/IC/DoS requests in 2015**
  - **Expected increase of requests with new DoD Directive 4715.21**
- **Partners with other modeling centers for output**
  - **Envisions future beneficial partnership in multi-model ensemble**

Air Force Climate Services

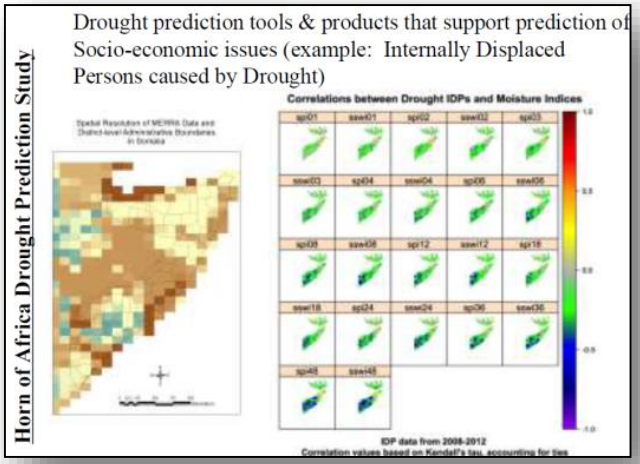
Temperature & Precipitation Trends



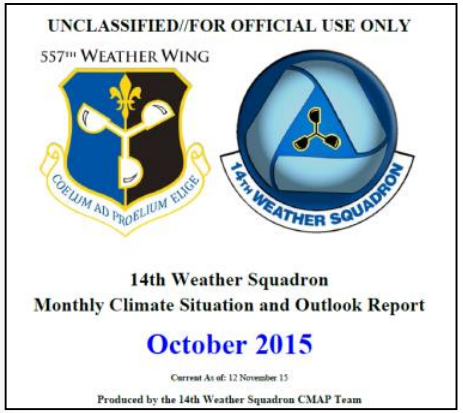
Long Range Outlooks



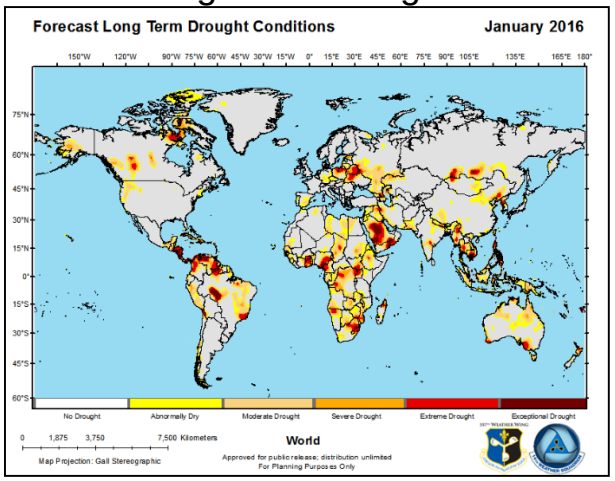
Decisional Aids



Global Situational Report



Long Term Drought



Aim High…Fly, Fight, Win

Questions?