

Headquarters U.S. Air Force

Integrity - Service - Excellence

U.S. Air Force Global Weather Modeling: Status Update and Future Vision



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Air Force Weather**

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Overview

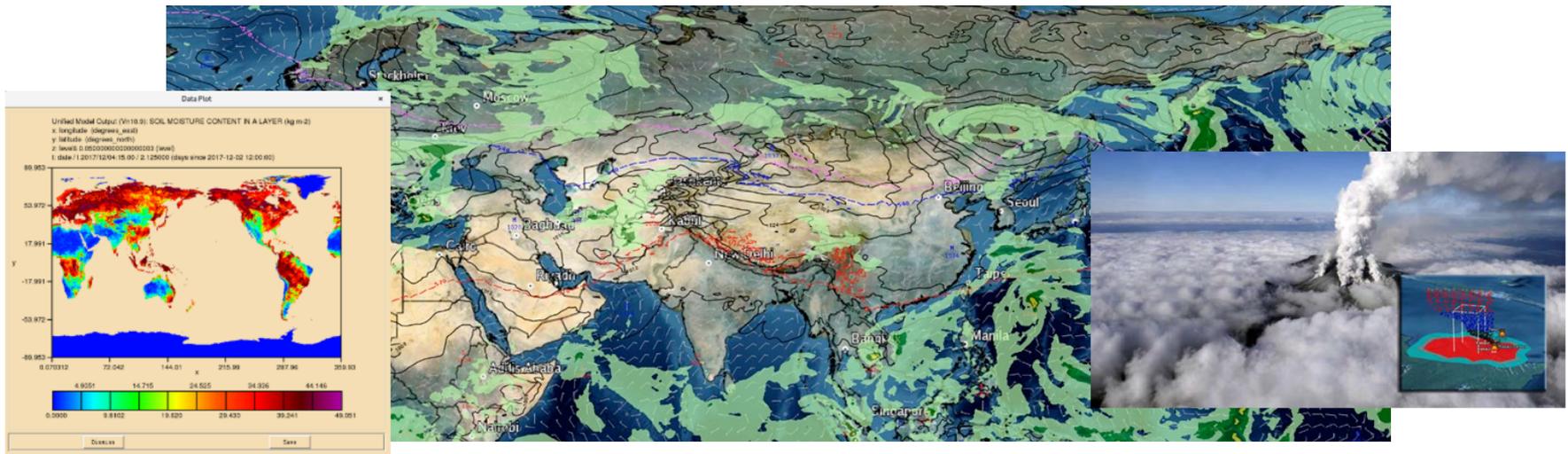
- **Current Global Air Land Weather Exploitation Model (GALWEM) Status**
- **USAF Contributions to JCSDA AOP**
- **USAF Modeling Modernization Concept**



Current GALWEM Status

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- **Global Air-Land Weather Exploitation Model (GALWEM)**
 - **Primary numerical model input for all AF and Army operations**
 - **Runs 4x/day to 240 hours at ~17 km horizontal resolution**
 - **0.25 degree product output to shield users from internal configuration changes**
 - **Unified Model V. 10.9 based, fed with UK Met Office initial data**
 - **Products/gridded data available via web services/web pages**





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Data Assimilation

- **GALWEM Parallel Suite (June 2019)**
 - **Runs 4x/day to 240 hrs at ~17 km resolution**
 - **Based on UK Met Office Unified Model (UM) v. 10.9**
 - **Hybrid 4DVAR DA based on a combination of 557 WW organic and UKMO observation data**

- **GALWEM Parallel Suite (July 2019)**
 - **DA with 557 WW organic database**
 - **Operational Fall 2019**

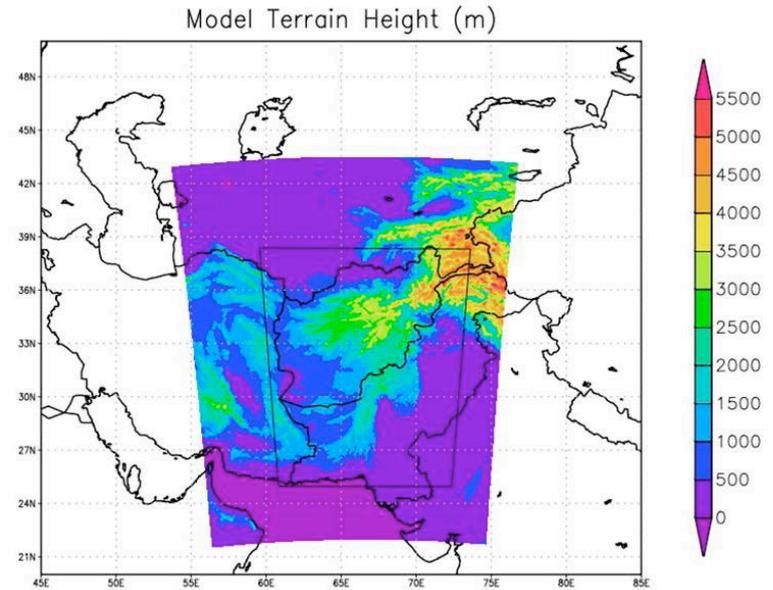




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Regional Modeling

- We have run a 4 km and 1.5 km horizontal resolution Afghanistan regional window in development
 - Window showed improved skill over 17 km GALWEM, especially for wind speed, cloud cover, and precipitation $<0.25''$
 - 1.5 km window did not show significant improvement over 4 km window
- Future Development
 - Evaluating Korea Domain
 - Korea/Afghanistan domain user evaluation through June
 - Operational Late Summer 2019





Global Ensemble

■ GALWEM Global Ensemble in development currently

- 21 members
- 40 km horizontal res
- 70 vertical levels
- Forecast to 16 days
- Initial Uncertainty: global analysis + 44 member ETKF perturbations

■ Future Development

- Operational Late Summer 2019

■ GALWEM Global Ensemble Compared to other Global Ensembles

- Continuous Ranked Probability Score at 120 and 240 hours for 250/850 wind speed, 500 heights, MSLP, and 850 temps

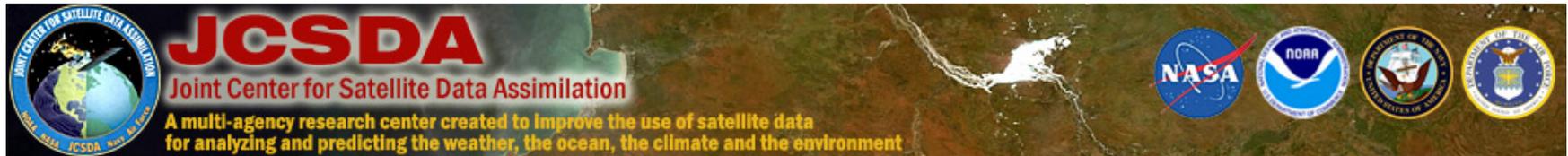
	GALWEM	GEM	GFS	FNC
850T 120	0.62	0.75	0.65	0.84
850T 240	0.96	1.10	1.00	1.16
SLP 120	0.86	1.10	1.00	1.22
SLP 240	1.80	2.00	2.00	2.10
850WS 120	2.13	2.21	2.24	2.40
850WS 240	2.91	2.96	3.00	3.00
250WS 120	4.42	4.39	4.52	5.00
250WS 240	6.70	7.03	7.16	7.50
500GPH 120	8.70	9.80	9.80	11.80
500GPH 240	20.10	21.00	22.30	22.90
		9.3%	7.3%	19.6%



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Partnerships

- AF Weather will continue to partner with Academia and the Labs to improve our global modeling capability





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JCSDA Contributions

- **\$200K**

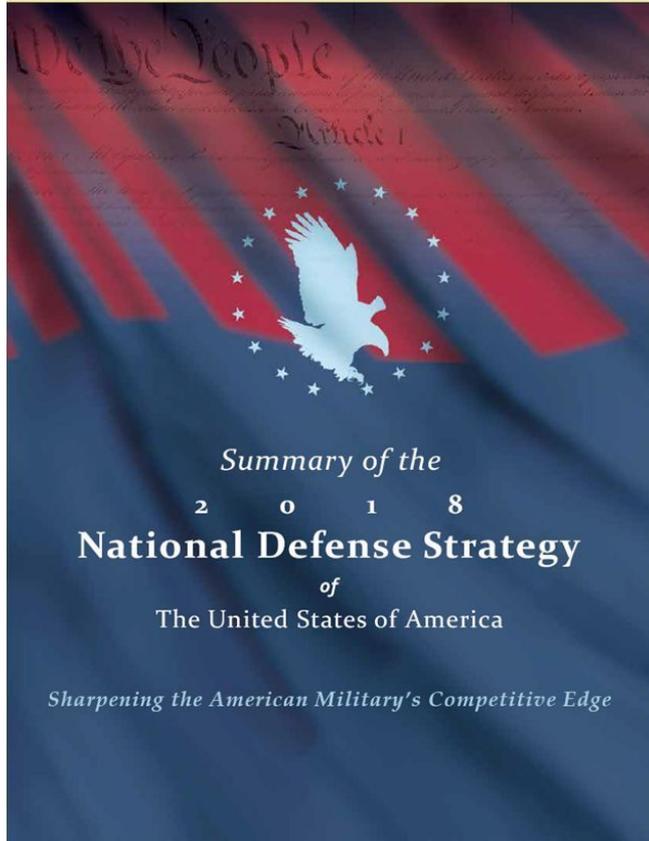
- **Core**
 - **JEDI**

- **In Kind**
 - **Director's Office (ET)**
 - **CRTM**
 - **NIO**
 - **IOS**
 - **JEDI**



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AF Weather Strategic Vision based on the National Defense Strategy



- **Lethality and Readiness**
 - *Improve Integration*
 - *Enhance Resiliency*
 - *Realign Our Force*
- **Alliances & Partnering**
 - *DoD & Government Agencies*
 - *Allies & Trusted Coalition Partners*
 - *Industry & Academia*
- **Reform for Performance and Affordability**
 - *Rapidly Modernize*
 - *Attack our inefficiencies*
 - *Redesign our Force*



Challenge

- **The future challenge of near-peer conflict and the needs of future weapons systems to compete in that conflict will not be met by our current modeling approach**



- **Improve/Evolve/Sustain Existing Capability to Fully Meet Current User Needs**
- **Provide Modeling Capability to Meet Gaps**
- **Add Resilience To Our Modeling System**



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Major Decisions

- **Model Operations**
- **Model Configuration**
- **Distributed Computing**
- **Hydrology**
- **Unclassified/Classified processing**
- **Sub-Seasonal to Seasonal Forecasting**
- **Cloud Modeling**



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Lines of Effort

- **Objective: Improve/Evolve/Sustain Existing Capability to Fully Meet Current User Needs**
 - **Global Numerical Weather Prediction (NWP) Model**
 - **Regional NWP Model**
 - **Cloud Model**
 - **Pursue Explicit Cloud Forecast Capabilities**
 - **Land Modeling**
 - **Dust/Volcanic Ash Model**



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Lines of Effort

- **Objective: Improve/Evolve/Sustain Existing Capability to Fully Meet Current User Needs**
 - **Stochastic Modeling Approaches**
 - **Post Processing**
 - **Machine-to-Machine Applications**
 - **Stochastic post-processing**
 - **Verification**



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- **Objective: Provide Modeling Capability to Meet Gaps**
 - **Polar Regional Model**
 - **Global/Regional Hydrology Model**
 - **Sub-seasonal-to-Seasonal Model**
 - **High Altitude NWP Model**
 - **Machine Learning/Artificial Intelligence**
 - **Aerosol/Chemistry Modeling**



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Lines of Effort

- **Objective: Add Resilience To Our Modeling System**
 - **Modular Hardware and Software**
 - **Distributed Computing**
 - **Non-Traditional Data Sources**
 - **Modeling Operations with Limited Data Sets**
 - **Operational Back Up**
 - **Multiple Model Ingest for Model Blending**
 - **Multiple data sources**



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Questions?