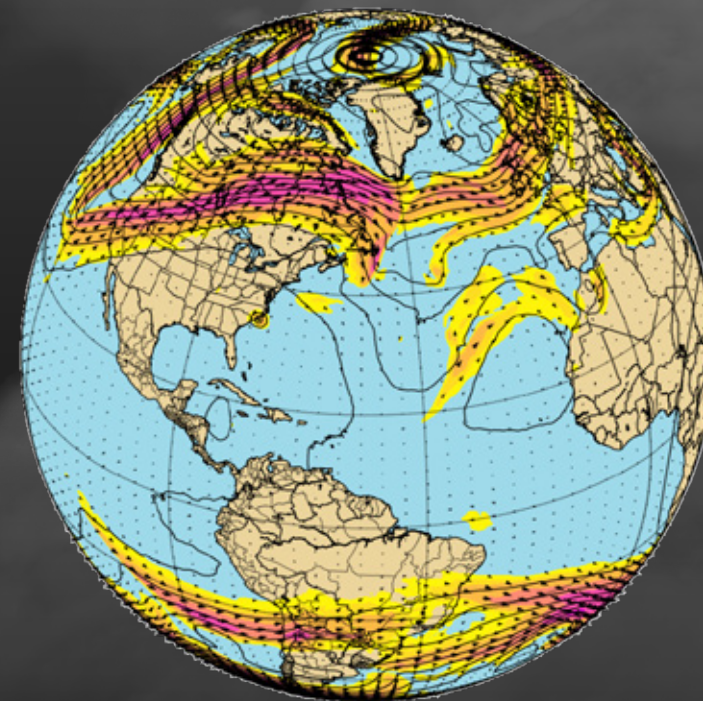
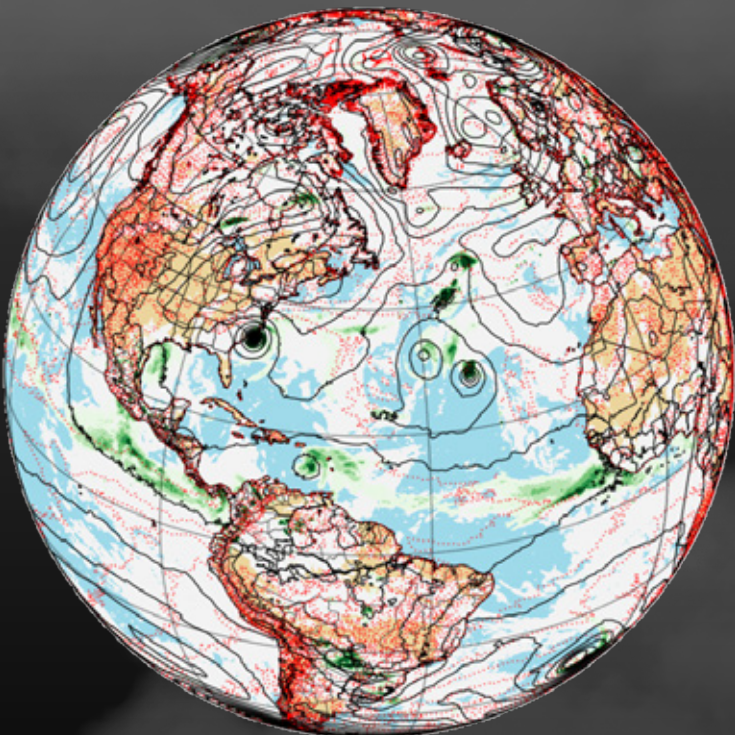


# USAF Modeling Updates

16<sup>th</sup> Weather Squadron Advancements in Providing Actionable Environmental Intelligence for Unique Air Force and Army Mission Requirements



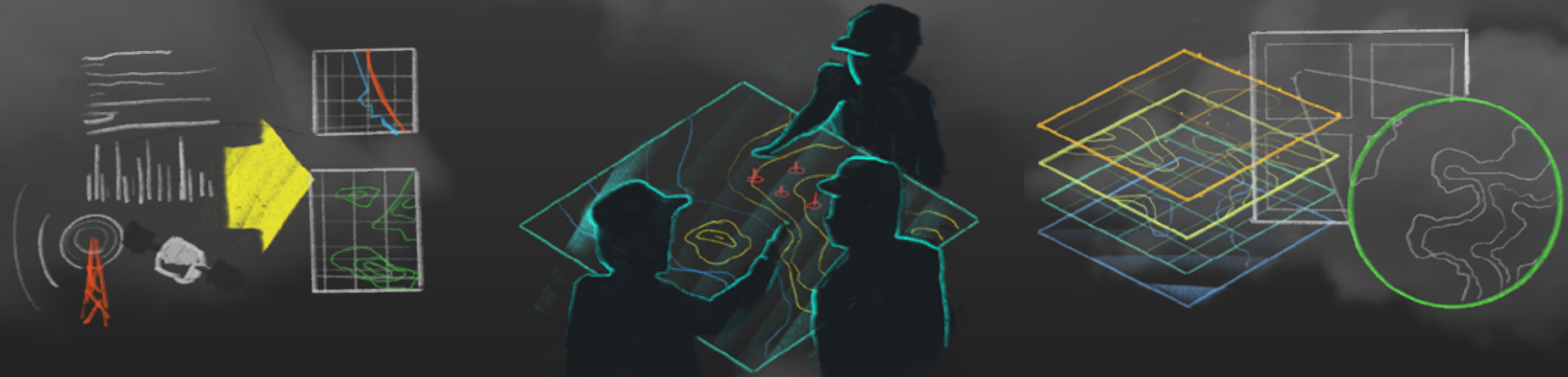
Mr. Evan Kuchera  
On Behalf of  
16<sup>th</sup> Weather Squadron

# Mission / Vision



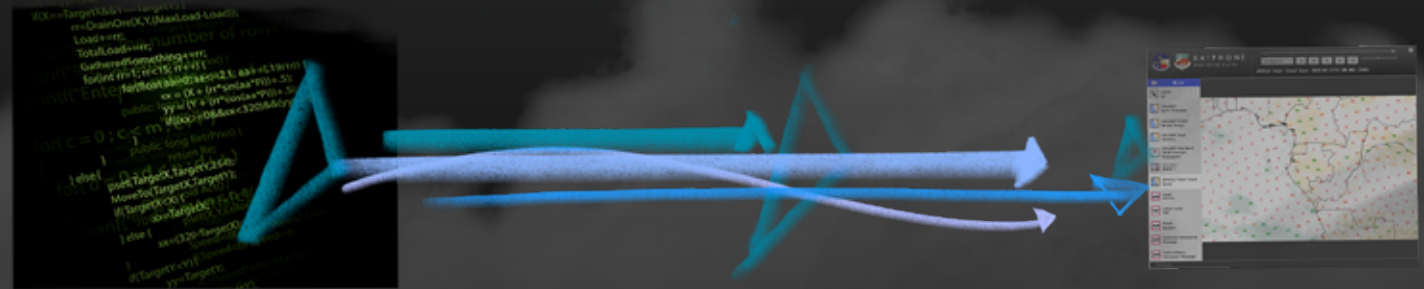
## Mission

Rapidly innovate, exploit, and operate cutting-edge software applications to generate environmental and Information Warfare insights to support national interests



## Vision

A high performing team empowered to take calculated risk to solve problems, accelerate change, and bring the future faster



# Current Global Capabilities



## Global Air-Land Weather Exploitation Model (GALWEM)

- USAF version of Unified Model
- Operational since 2016
- Current configuration (OS3) based on UKMO OS4I
  - UM 10.9; N768 (17 km)
  - Main and update runs 4x per day (glm to 240h)
  - Surface conditions and observations provided by UKMO

# 2020 Atlantic Track Verification Summary



	Deterministic Model Track Forecast Rankings (error NM)				
	GALWEM	UKMET	GFS	NAVGEM	CMC
<b>FH 12</b>	4 (30.98)	1 (24.18)	2 (26.11)	5 (33.00)	3 (28.84)
<b>FH 24</b>	3 (43.31)	1 (36.88)	2 (39.30)	5 (49.60)	4 (43.66)
<b>FH 36</b>	4 (58.50)	2 (52.13)	1 (51.12)	5 (64.58)	3 (57.55)
<b>FH 48</b>	4 (76.96)	3 (72.83)	1 (65.17)	5 (84.14)	2 (70.44)
<b>FH 60</b>	4 (100.06)	3 (87.68)	1 (83.18)	5 (104.45)	2 (84.54)
<b>FH 72</b>	5 (123.53)	3 (116.49)	2 (110.07)	4 (122.61)	1 (97.29)
<b>FH 96</b>	5 (186.21)	4 (181.75)	3 (178.37)	2 (172.04)	1 (131.53)
<b>FH 120</b>	2 (236.93)	5 (274.28)	4 (251.00)	3 (238.25)	1 (183.50)
<b>FH 144</b>	2 (294.19)	5 (359.06)	4 (324.51)	3 (295.89)	1 (247.23)
<b>FH 168</b>	3 (389.60)	N/A	2 (350.01)	4 (400.84)	1 (296.43)
<b>Average</b>	<b>3.6</b>	<b>3</b>	<b>2.2</b>	<b>4.1</b>	<b>1.9</b>

# Track Verification Summary Cont



	Ensemble Mean Track Forecast Rankings (error NM)		
	GFS	NAVGENM	CMC
<b>FH 12</b>	1 (24.74)	3 (39.63)	2 (30.19)
<b>FH 24</b>	1 (36.54)	3 (53.48)	2 (45.62)
<b>FH 36</b>	1 (48.94)	3 (74.77)	2 (59.05)
<b>FH 48</b>	1 (63.90)	3 (97.89)	2 (75.34)
<b>FH 60</b>	1 (80.90)	3 (124.25)	2 (91.75)
<b>FH 72</b>	1 (104.32)	3 (152.07)	2 (109.24)
<b>FH 96</b>	2 (160.29)	3 (200.90)	1 (146.51)
<b>FH 120</b>	2 (215.35)	3 (280.99)	1 (210.21)
<b>FH 144</b>	1 (259.68)	3 (363.33)	2 (346.07)
<b>FH 168</b>	1 (298.40)	2 (380.97)	3 (477.75)
<b>Average</b>	<b>1.2</b>	<b>2.9</b>	<b>1.9</b>

	Ensemble Control Track Forecast Rankings (error NM)		
	GFS	NAVGENM	CMC
<b>FH 12</b>	1 (25.51)	3 (40.77)	2 (33.48)
<b>FH 24</b>	1 (37.37)	3 (53.14)	2 (50.91)
<b>FH 36</b>	1 (49.73)	3 (68.69)	2 (68.24)
<b>FH 48</b>	1 (66.72)	3 (85.60)	2 (84.55)
<b>FH 60</b>	1 (87.57)	3 (107.52)	2 (100.98)
<b>FH 72</b>	1 (114.44)	3 (126.07)	2 (124.08)
<b>FH 96</b>	3 (180.44)	1 (166.53)	2 (172.08)
<b>FH 120</b>	3 (250.06)	1 (245.79)	2 (249.45)
<b>FH 144</b>	1 (320.20)	2 (325.84)	3 (366.84)
<b>FH 168</b>	1 (328.58)	2 (432.24)	3 (504.19)
<b>Average</b>	<b>1.4</b>	<b>2.4</b>	<b>2.2</b>



# Global Ensemble Capabilities

## Global Ensemble Prediction Suite (GEPS)


- 63 members from NCEP, CMC, FNMOC
- Tailored products specific to USAF needs
- 2x daily to 16 days

## GALWEM Global Ensemble

- 21 members at 40 km (half-degree output) run at 557 WW
- 16 day forecasts
- Blend in with other 63 in GEPS for improved global ensemble (+4.4%)
- Generate TC tracker bulletins for each member

# New TC tracker products



 Air Force Weather Web Services (AFW-WEBS) Search City, Zip, ICAO or WMO

[Home](#) [Interactive](#) [Theater](#) [Category](#) [Links](#) [Contact](#) [Op Field Notices](#)

*Welcome* *Interactive Applications* *Products by Region* *Products by Category* *Additional Links* *Provide Feedback* *Latest Updates*

[Dashboard / Home](#) [Space Admin](#) [Save for later](#) [Watching](#) [Share](#)

## Ensembles Main Page

**NEW!** See Info tab or ? icons for updated documentation. See Special Products tab for Tropical Support products. **(Recent changes)**

[Products](#) [PEP Bulletins](#) [Aerostats](#) [Special Products](#) [Info](#) [Contact](#) Dark Theme

**1. Select a Model**  
GEPS Flood Support  
**GEPS Tropical Support**

**2. Select a region**  
North Atlantic  
West N Pacific  
Central N Pacific  
East N Pacific  
N Indian Ocean  
**S Hemisphere**

**3. Select a product suite**  
**TC Track Plots**

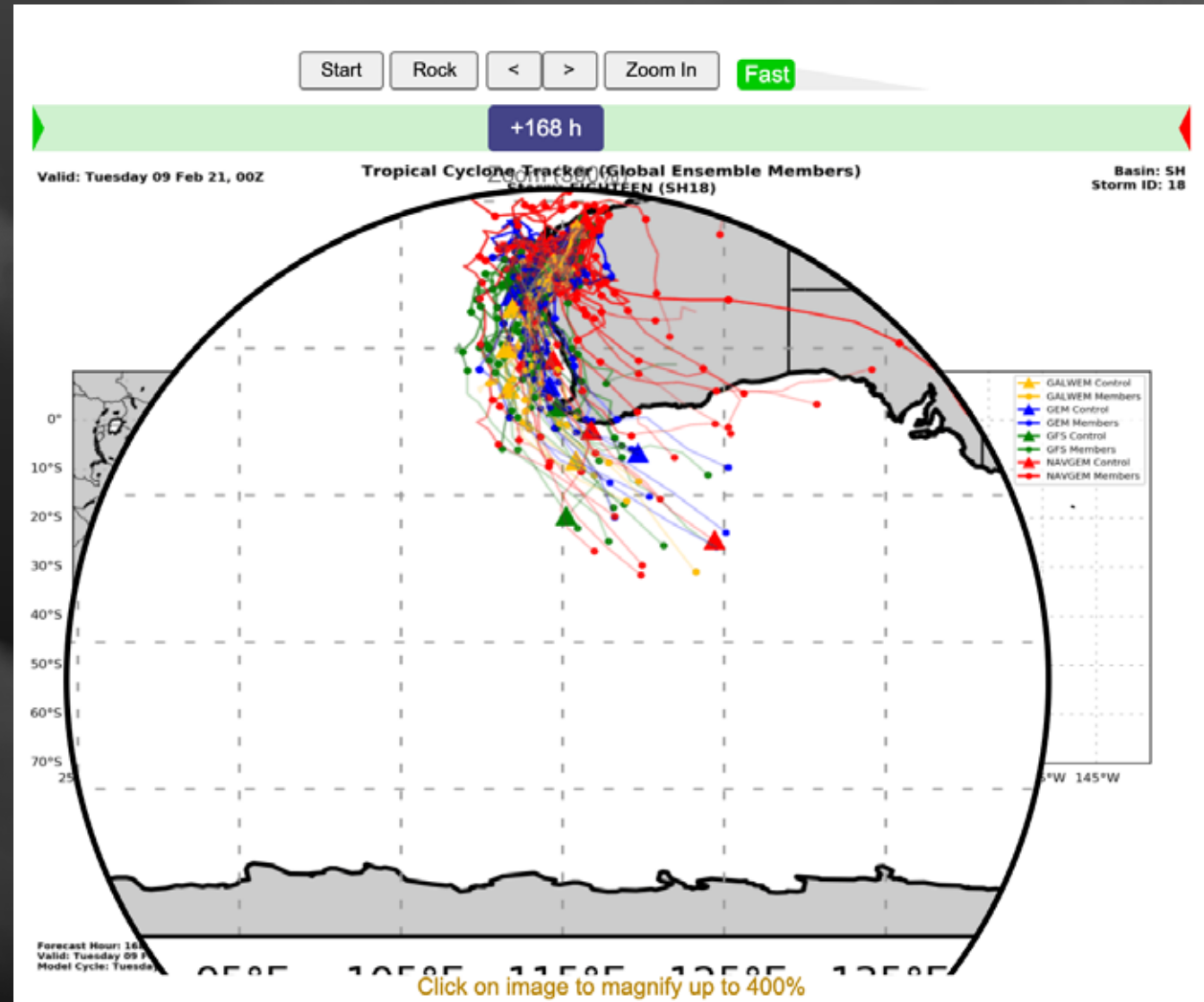
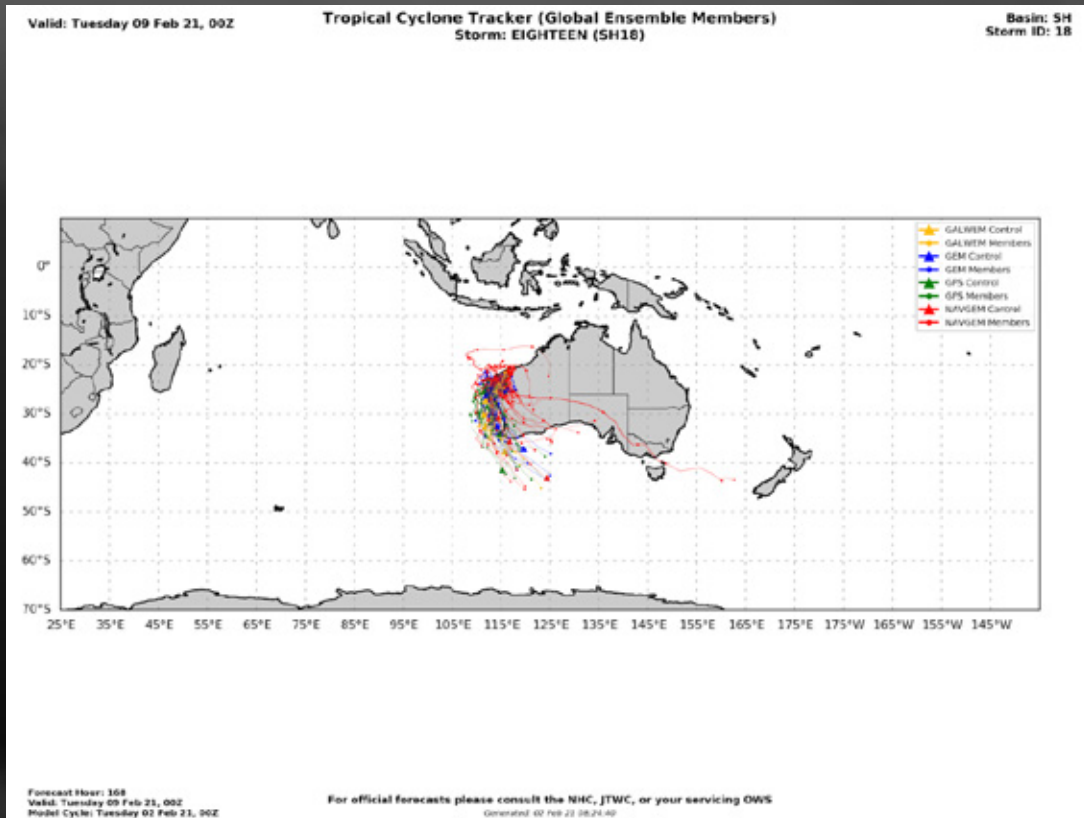
**4. Select a Product**  
GEPS (Tropical) - S Hemisphere TC Track Plots  
TC Track 19 - "Faraji"  
TC Invest 93

? +

Loop  Single Forecast Hour

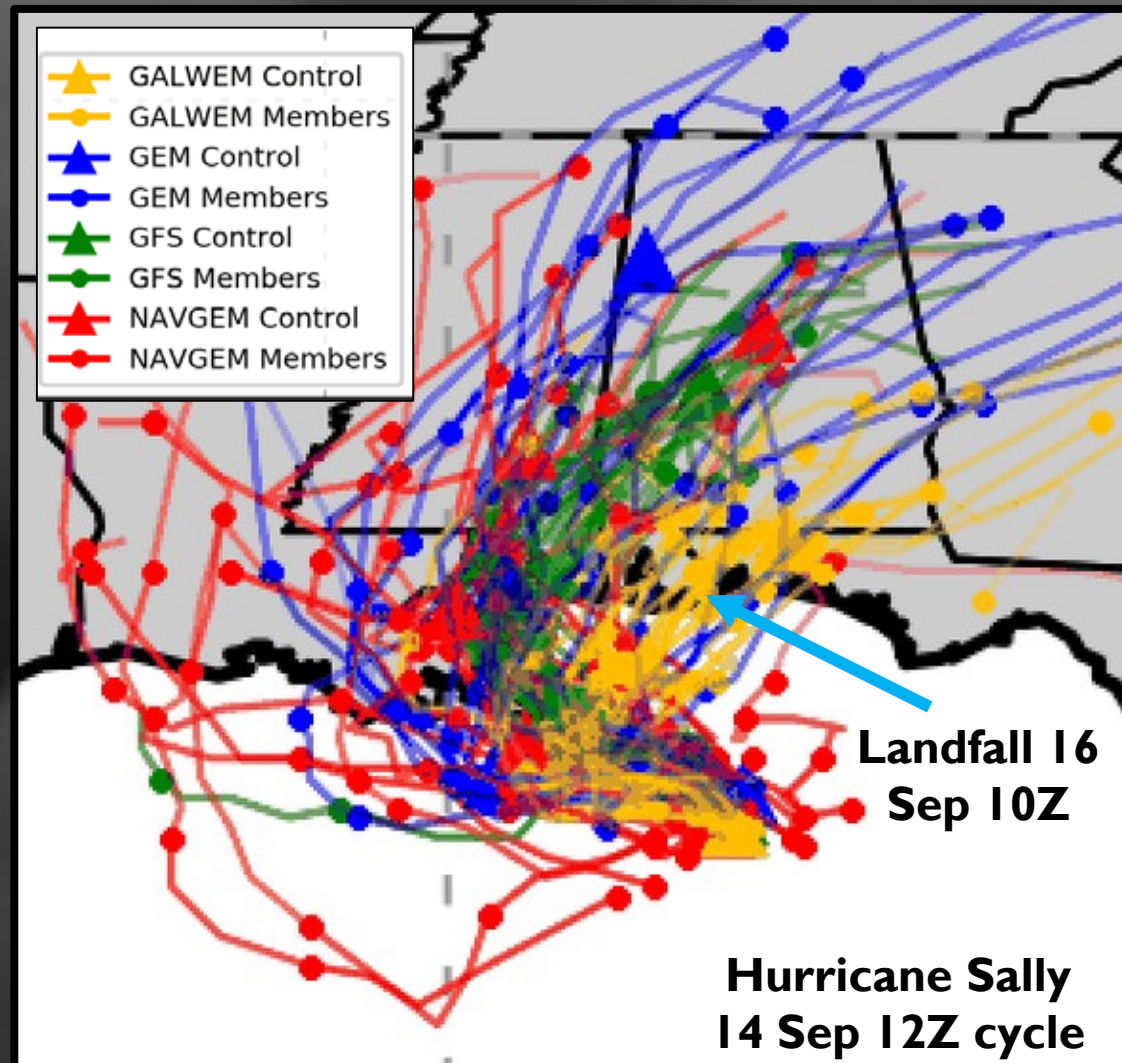
Please select one ▼  
 Please select one ▼

# New TC tracker products





# Ensemble Case Study: Hurricane Sally

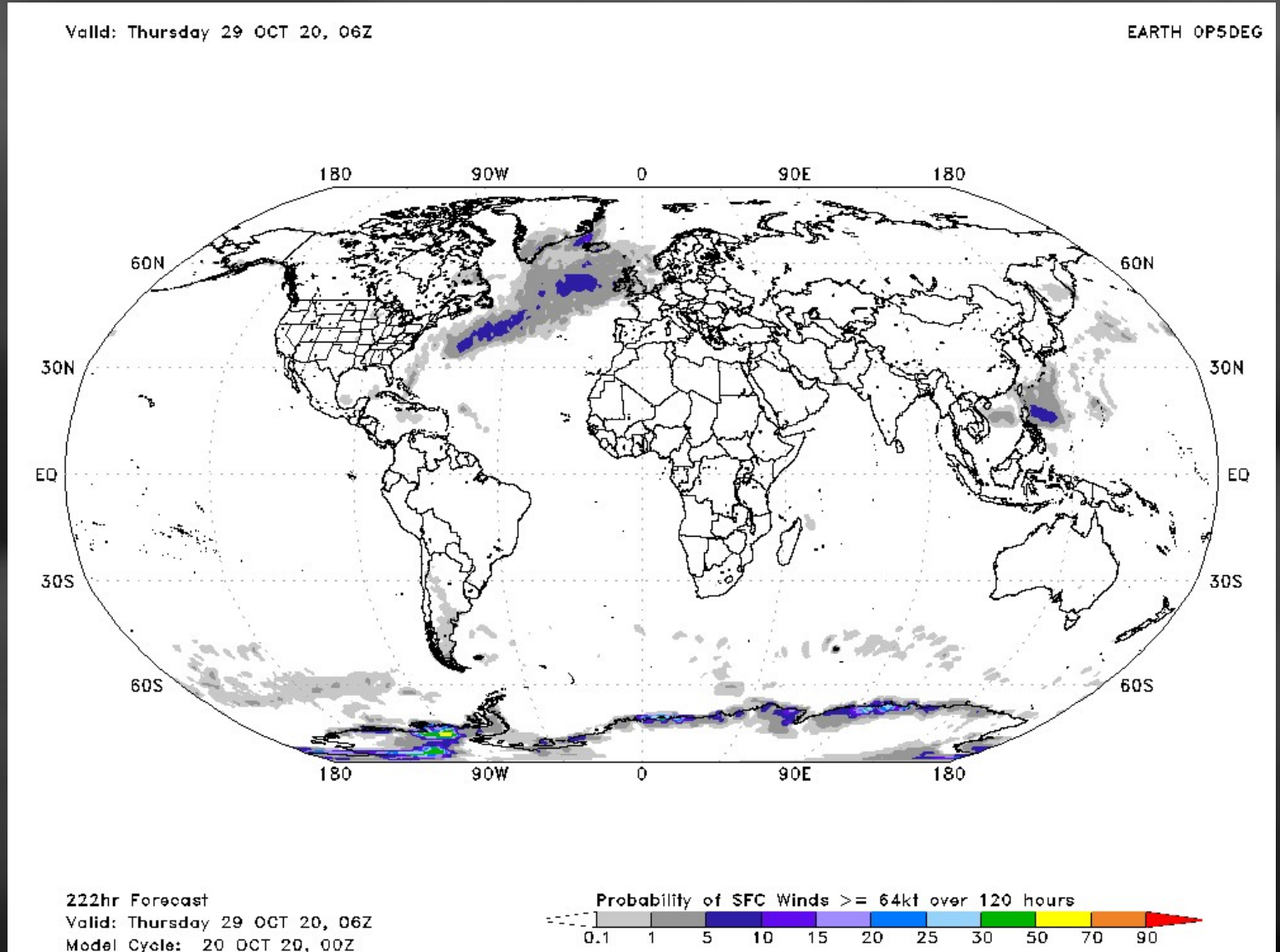


# 5-day smears in GEPS



Probability of exceeding 34, 64, and 96 knots in the previous 120 hours

Designed for long-range forecasts where timing/location uncertainties are high, to better show areas of TC potential

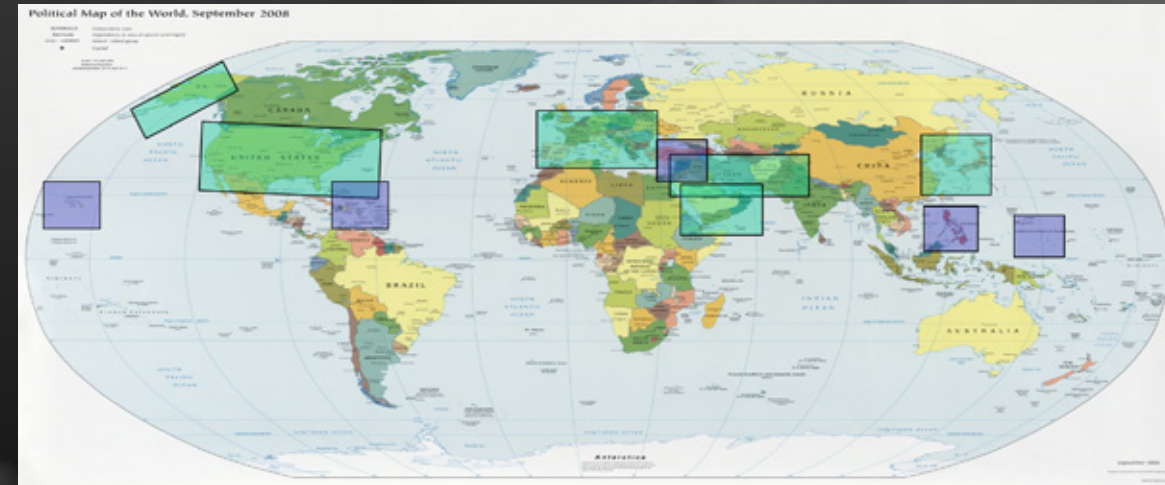


# Regional Capabilities



## Mesoscale Ensemble Prediction System (MEPS)

- 16 members of WRF-ARW with diverse initial conditions and varied physics packages (Time Lagged)
- “Global” at 20 km resolution (to 144h)
- Regional at 4 km (to 72h)
- 8 Static domains (9 Relocatable)
- ~200M product views per year
- Data used to create new crosswind point forecasts



**Green—static**  
**Purple—relocatable\***  
**Each domain runs to 84 h every 2h**

**\*Sample of relocatable positions subject to change / for example only**

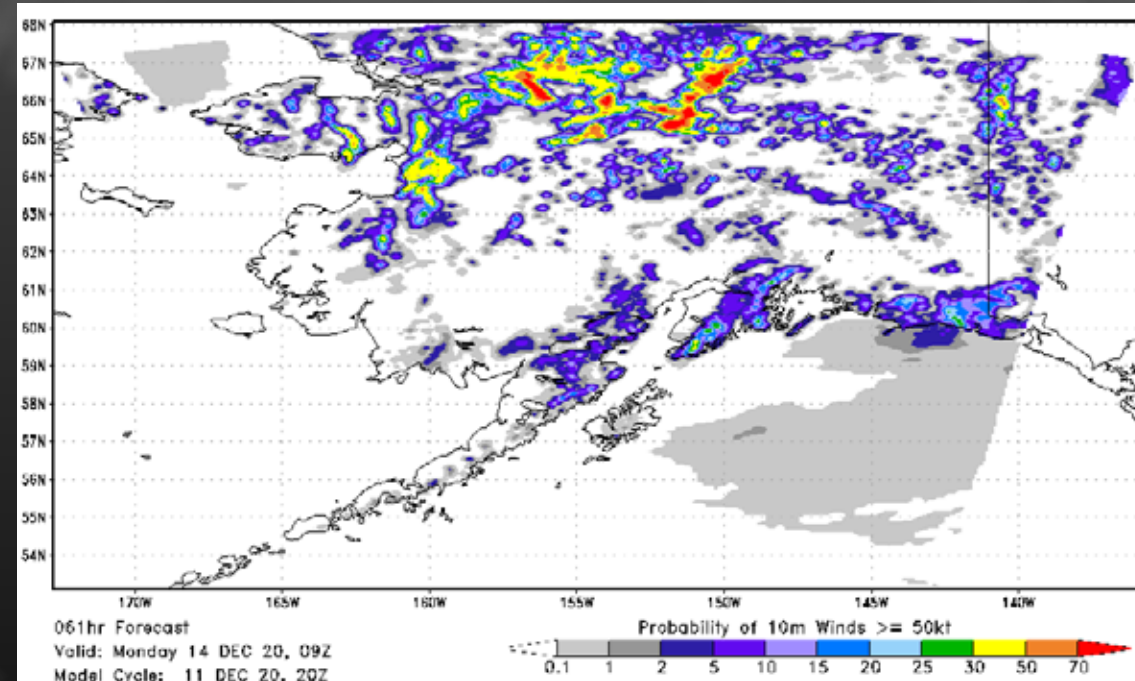


# Future: Ensembles in the Cloud



- Current regional ensembles (4 km, 16-member)
  - Cited by 93% of surveyed users as significantly or critically important to their ops
- Working to use AWS Cloud as a potential COOP capability for regional ensembles ...
  - Some success doing this
  - **Cloud allows us to scale up / down to meet demand**

Alaska Domain 4 km Ensembles



Probability of 10m  
Winds  $\geq$  50 kts

- Distant Future: Could cloud computing enable on-demand ensembles?
  - **User-defined** location, resolution, areal coverage, number of members, etc.
  - 16 WS provides guardrails/guidance on usage
  - Enable more focus on: computing resources / challenges faced by users
  - As user needs surpass computing capes, explore Cloud computing / cost sharing with users

# Questions or Comments?



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