



712CD

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Enough Already! Balancing the data resolution, temporal and spatial, issues between the data providers and the data users

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Balancing Data Resolution Issues Between Providers and Users

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Report Documentation Page

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Balancing Data Resolution Issues Between Providers and Users

*75th MORS Symposium
12-14 June 2007*



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14 June 2007



- **Background**
- **LPD 17 Testbed Example**
 - Process used to determine required resolution
 - Uses of Interpolation
 - Integration of Models
- **General Resolutions / Recommendations**
- **Questions**



Navy Enterprise (PEO IWS) PRA Testbed (M&S)

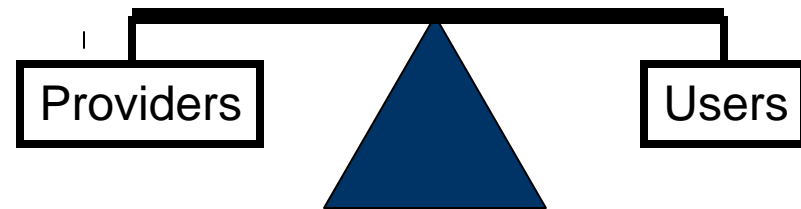
- **Test & evaluate the performance of the Ship Self Defense System (SSDS) against threat raids**
- **Analyze how the environment affects the performance of the individual military entities as well as the SSDS**
- **Provide the integrated, consistent and sufficient scenario natural environment representation required.**

- **Why sufficient?**

- Conserves resources
- Avoids risk

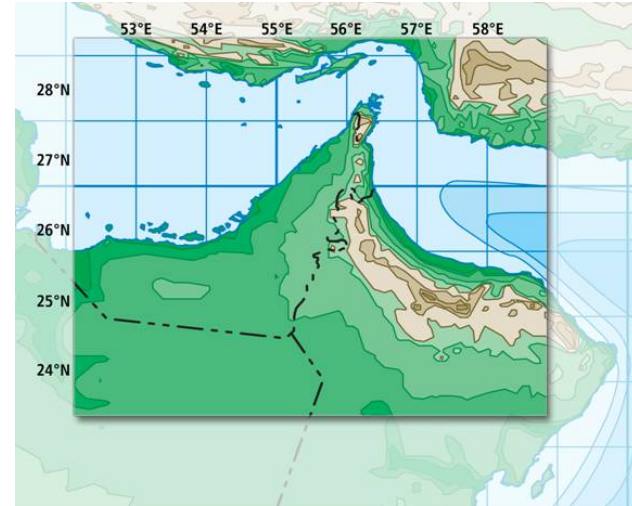
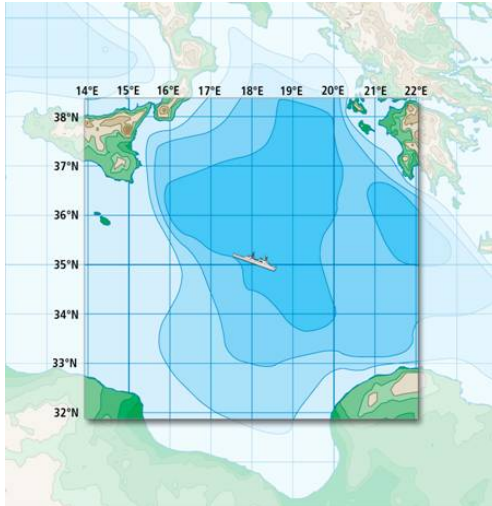
- **How much resolution is sufficient?**

- Balance between providers and users





Exemplar - LPD 17 Ship Class



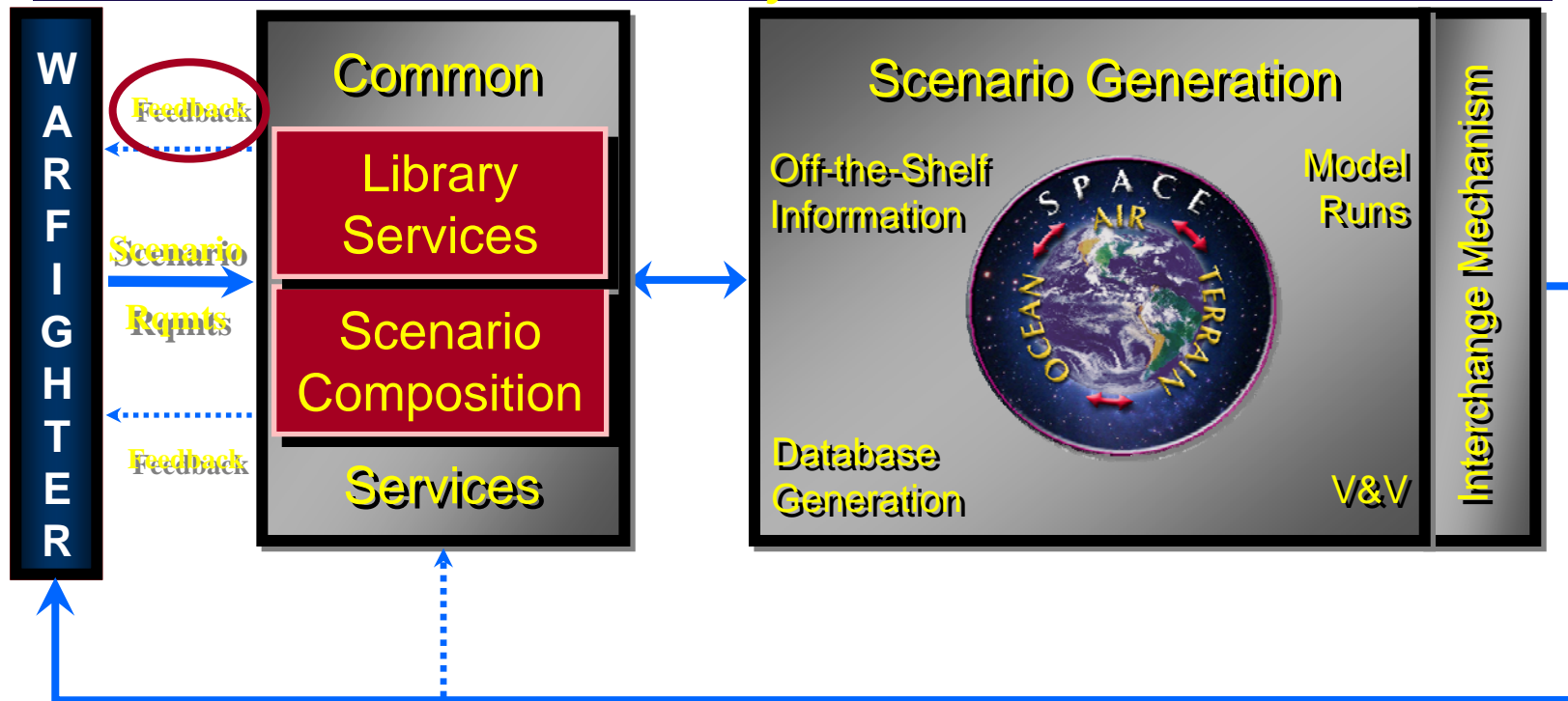
- **Two Locations – Central Mediterranean & Straits of Hormuz**
- **Two Seasons – Summer & Winter**
- **Five Times of Day – Sunrise, Noon, Mid-afternoon, Sunset & Midnight**
- **Four Domains – Air, Sea Surface, Terrain & Ephemeris**
- **8 Primary Radials, or Line of Sight (LOS) directions from Ship**
- **Sea State 3**



Integrated Natural Environment Authoritative Representation Process (INEARP)

The Challenge

Create a physically consistent, cross-domain authoritative “ground truth” of the natural environment that meets user requirements but does not unnecessarily overly exceed them. Put your resources where they’re needed.





Determining the Balance

- **Radar performance can be strongly affected by weather conditions**
- **Radar *model* performance is very sensitive to atmosphere data variability and, hence, resolution in data**
- **Modified Refractivity is the critical effects parameter**
 - obtained from a standard algorithm
- **Need to work with the radar model developers closely**
 - Offer multiple solutions, work in cycles



Modified Refractivity

$$MR = \frac{77.6p}{T} + \frac{e_s * 3.73 * 10^5}{T^2} + 0.157H$$

where e_s = the partial pressure of water vapor in hPa

$$e_s = \frac{rh * 6.105 * e^x}{100},$$

$$x = 25.22 * \frac{(T - 273.2)}{T} - 5.31 * \log_e \left(\frac{T}{273.2} \right),$$

p = barometric pressure in hPa,
 T = absolute temperature in Kelvin,
 rh = relative humidity in percent and
 H = altitude in meters



- **Early rounds of delivered data:**
 - 27km resolution (over 2052km x 1566km grid) of modified COAMPS data (30 vertical levels)
 - Modifications included changes to modified refractivity, conditioning of variables, etc.
 - Also delivered: 9km resolution data sets (1143km x 792km grid)

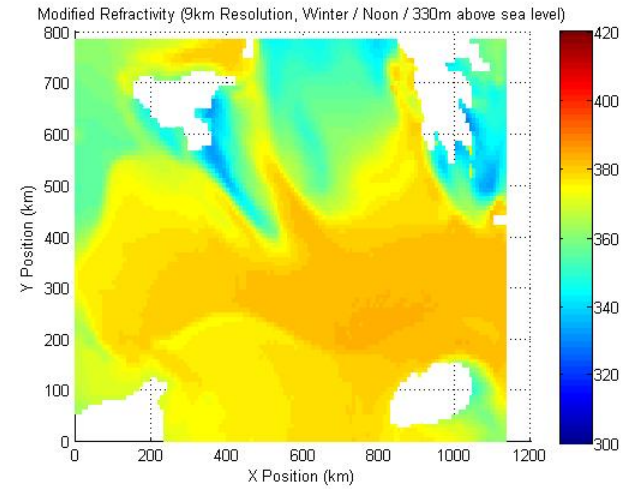
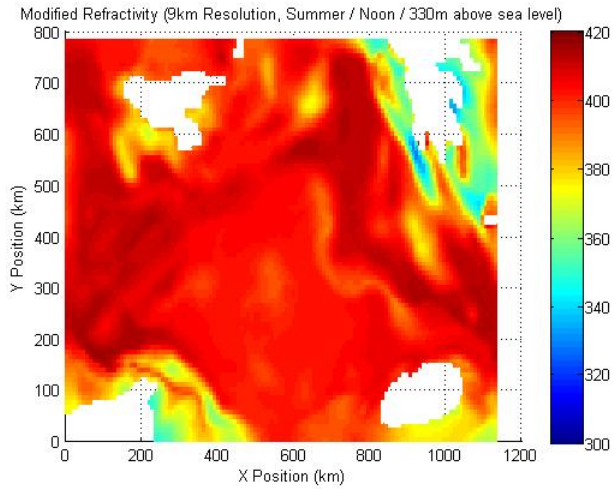


Modified Refractivity Summer & Winter - Noon & Midnight

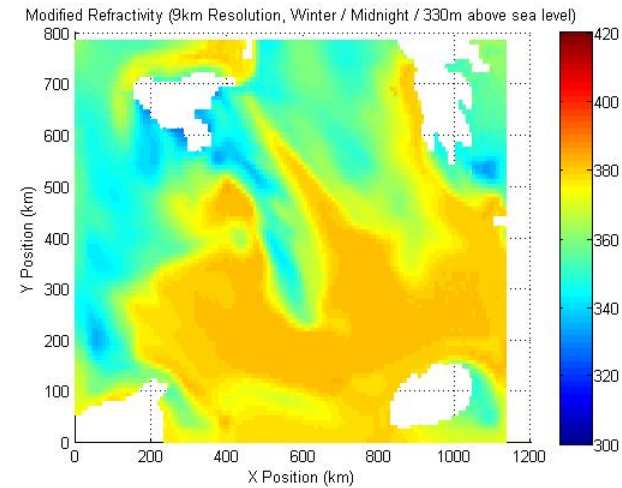
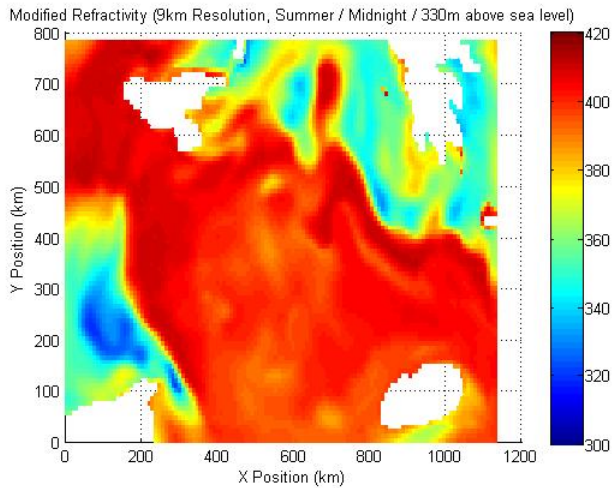
Summer

Winter

Noon

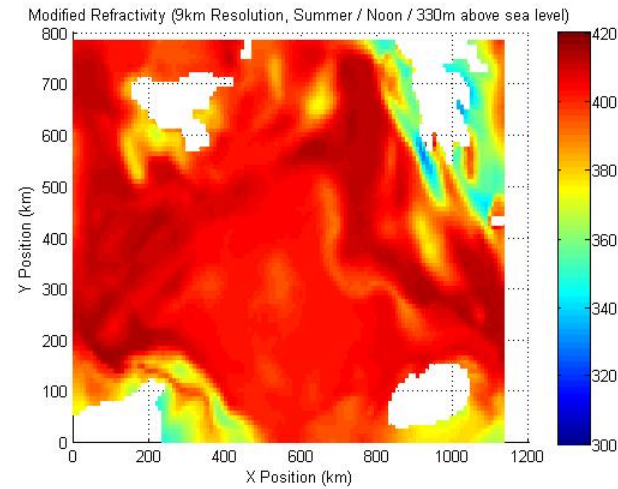
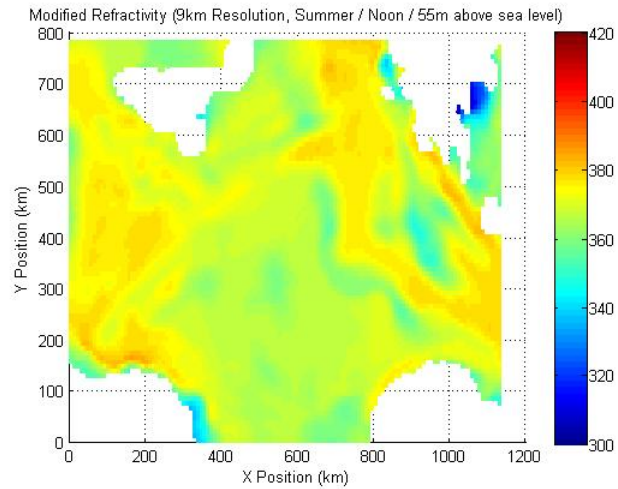
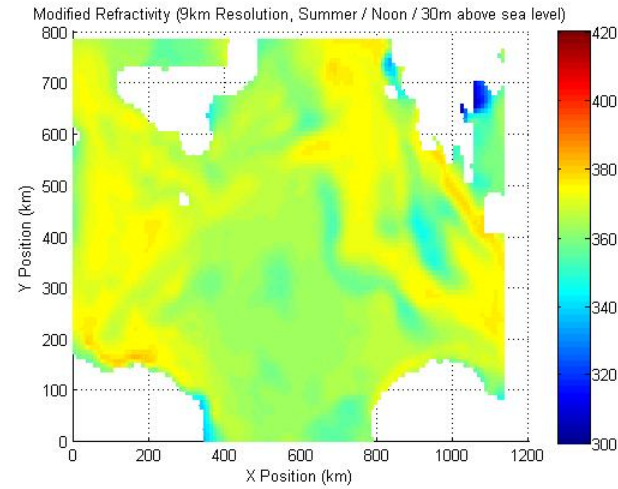
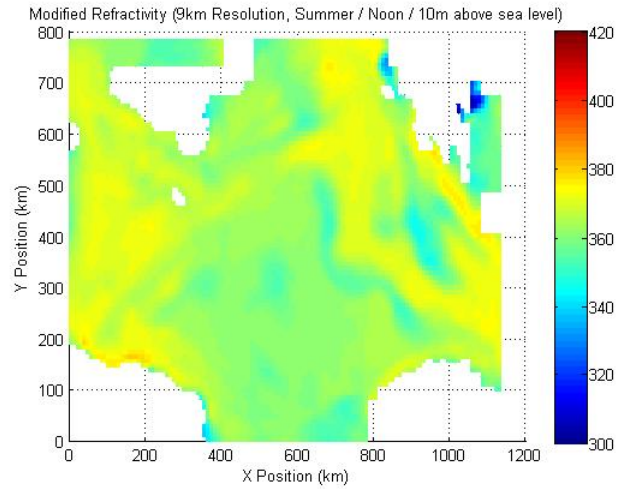


Midnight



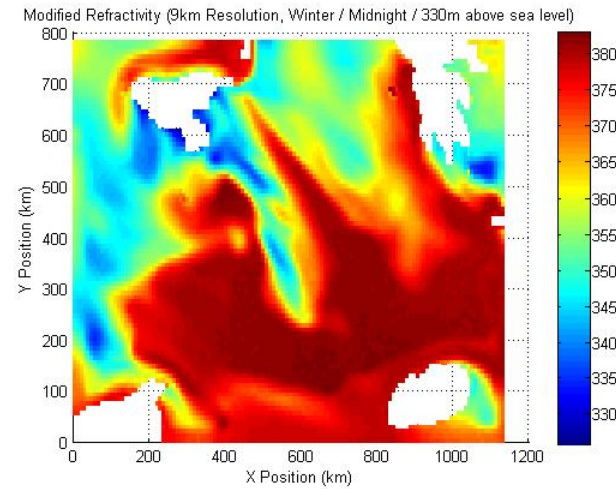
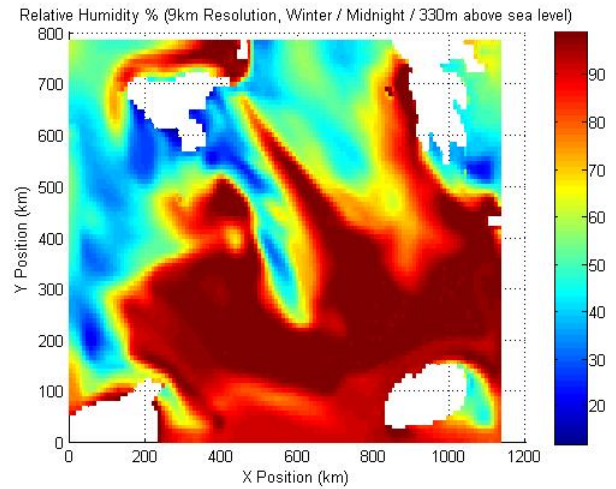
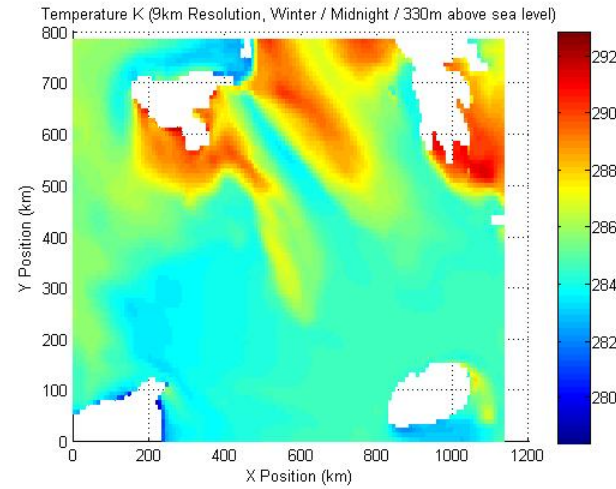
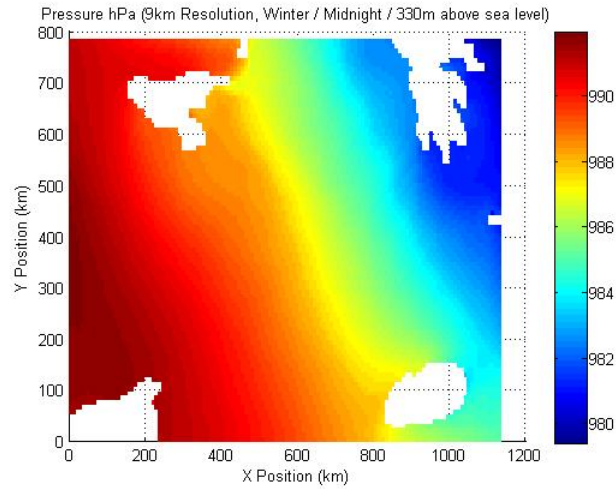


Modified Refractivity Summer/Noon @ 10, 30, 55 & 330 m





Atmospheric Parameters Winter Midnight @ 330 m



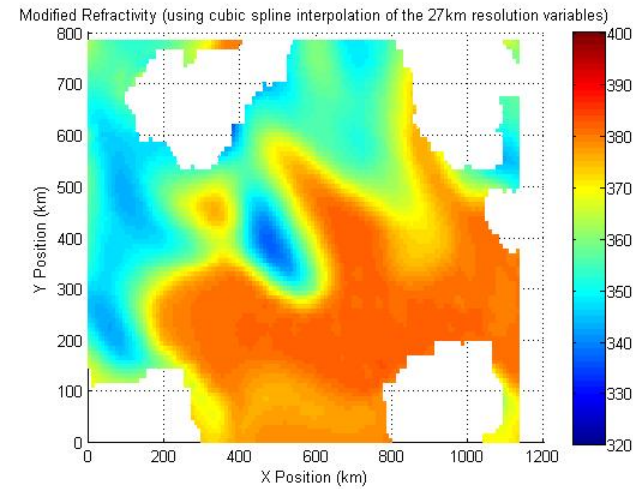
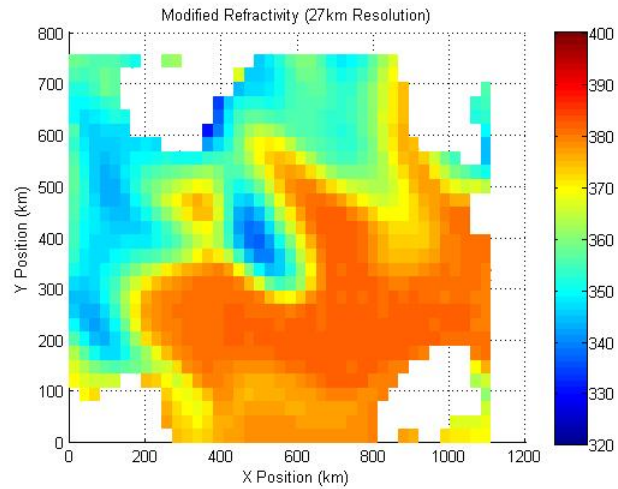
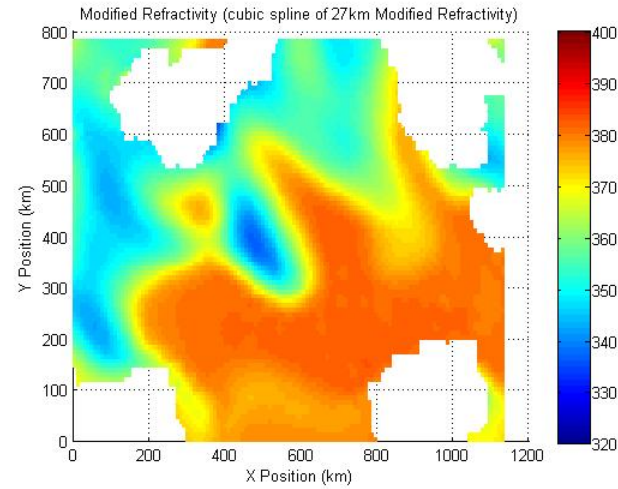
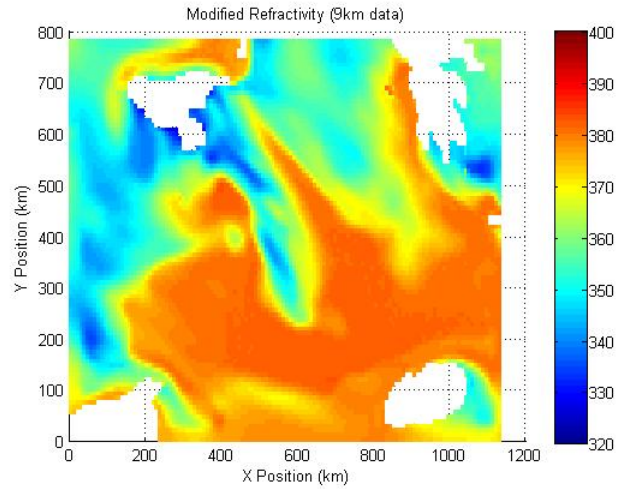


Round 2: Interpolation and Radials

- **Radar models wanted more resolution**
 - Why?
 - What was most important for the data to capture?
- **Consistent interpolation methods between developers**
- **Even if COAMPS rerun @ higher resolution – essential problem still there**
 - Offered solutions
 - Horizontally: finer grid vs. along radials, cubic spline vs. linear
 - Vertically: interpolation vs. none, use of evaporative duct model for the lowest levels
 - What duct model?



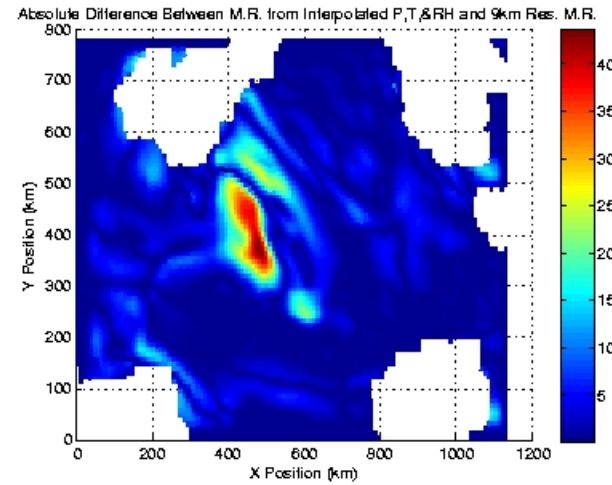
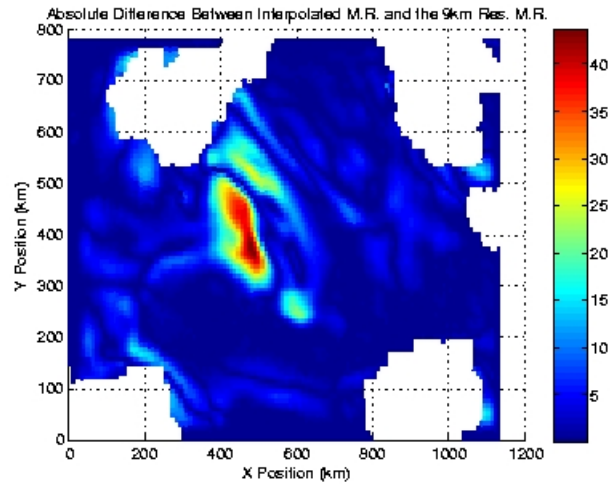
Horizontal Interpolation Techniques Winter Midnight @ 330 m



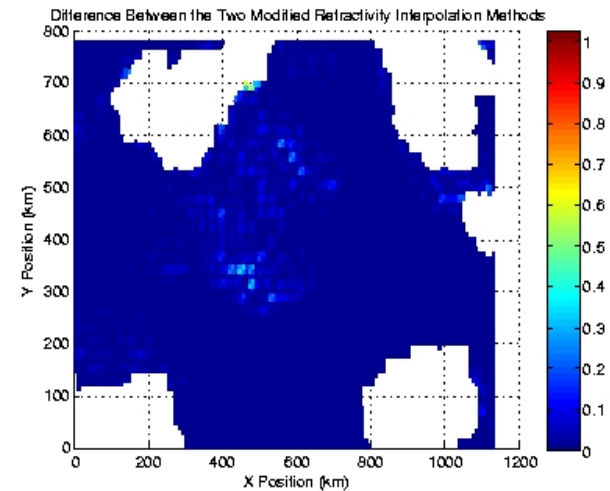


Horizontal Interpolation Techniques II

Winter Midnight @ 330 m

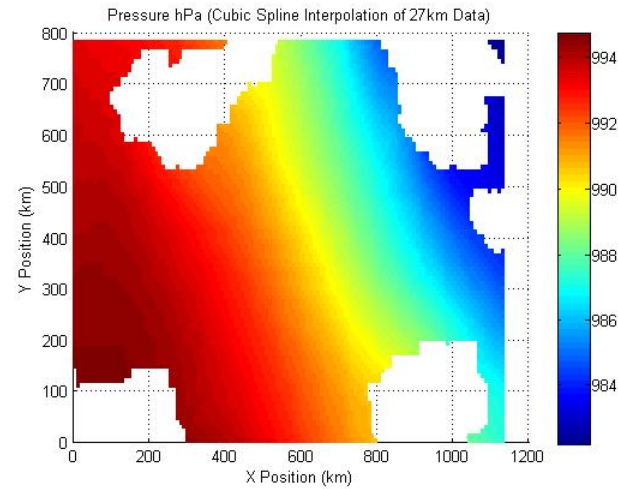
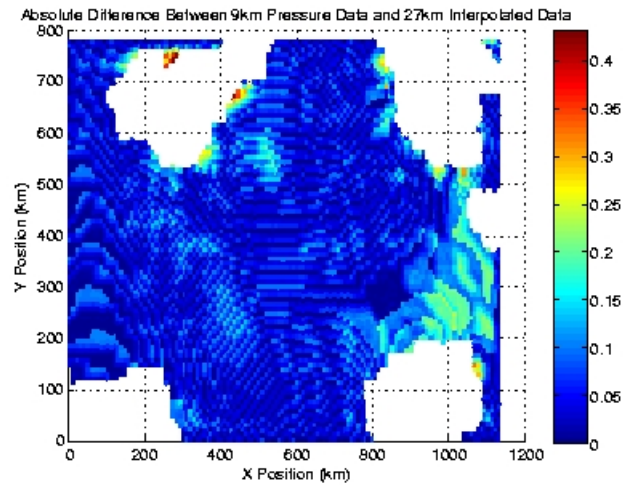
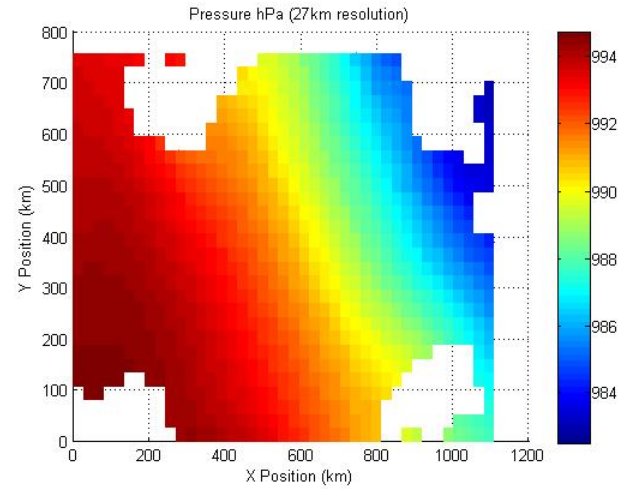
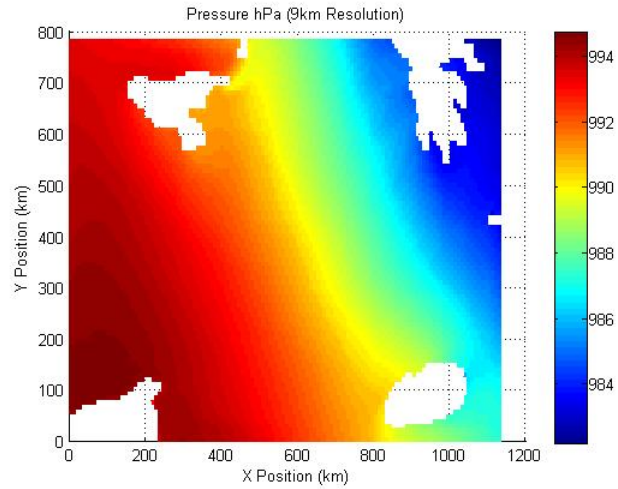


- Surprised to see no real difference in the results
- Geography specific?



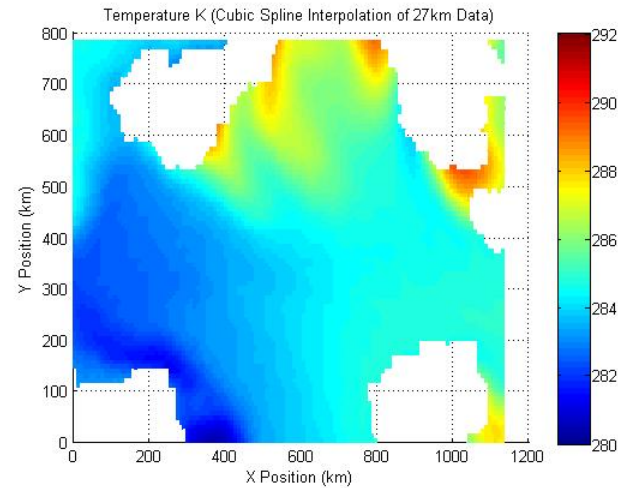
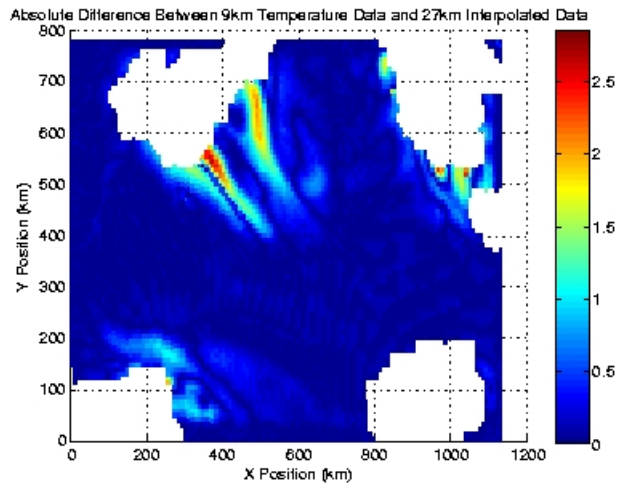
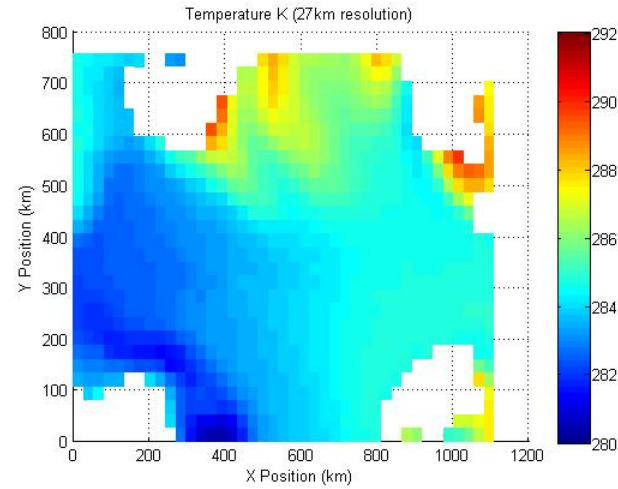
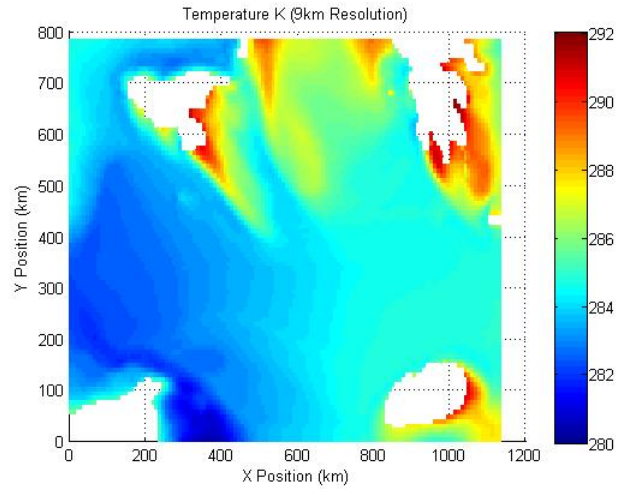


Pressure Winter Noon @ 330 m



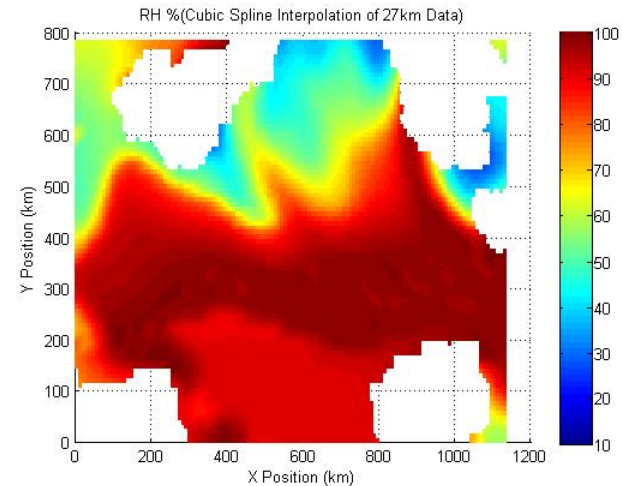
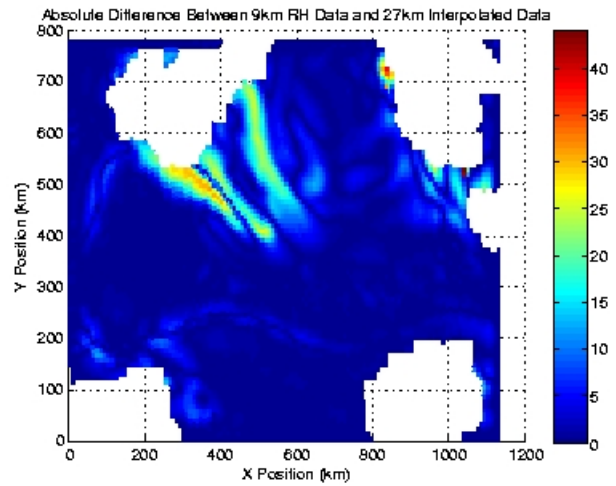
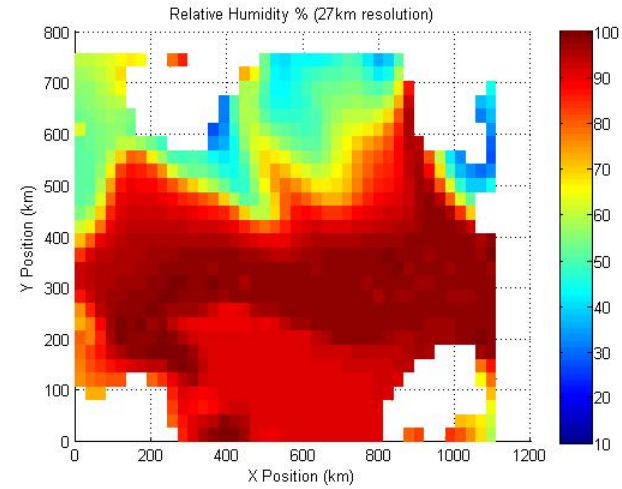
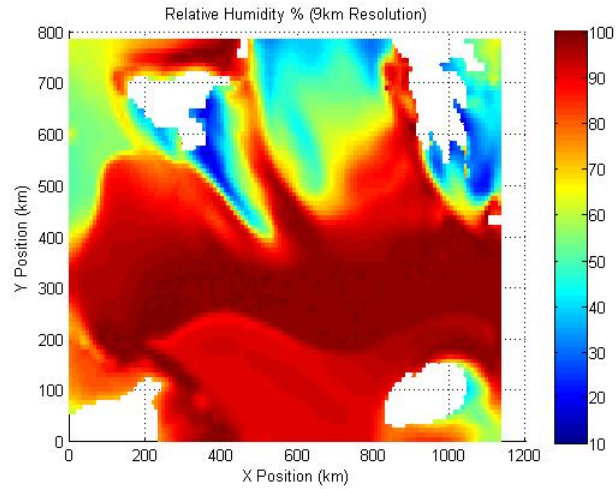


Temperature Winter Noon @ 330 m





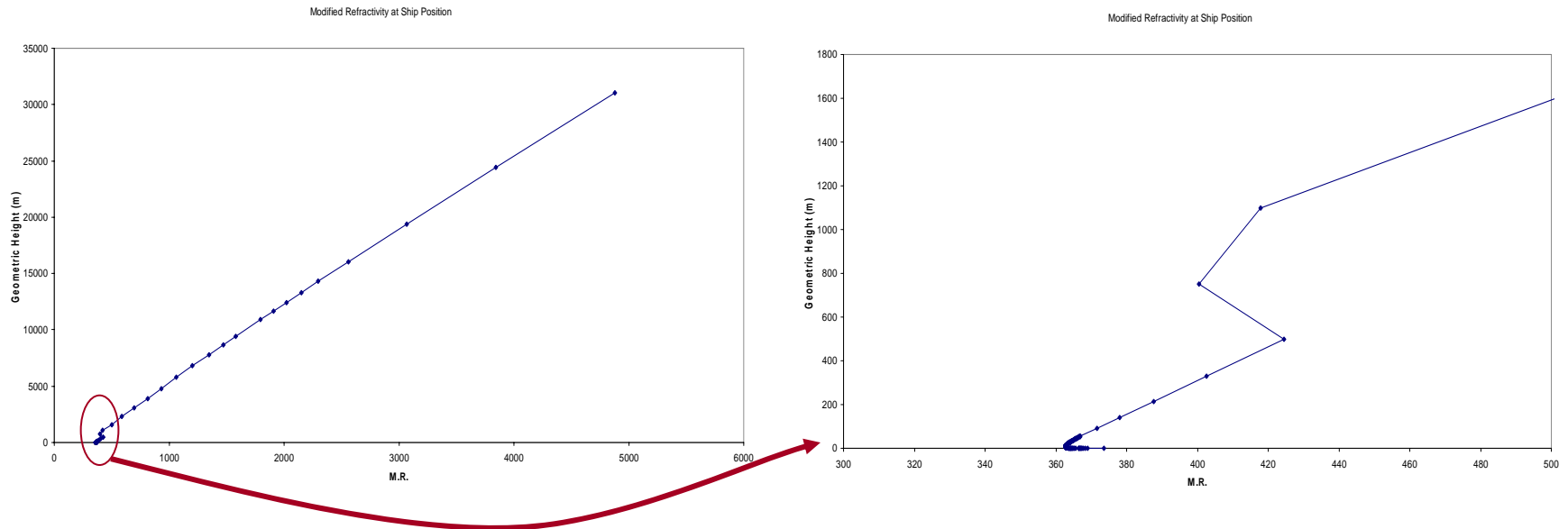
Relative Humidity Winter Noon @ 330 m





Sample Vertical Data

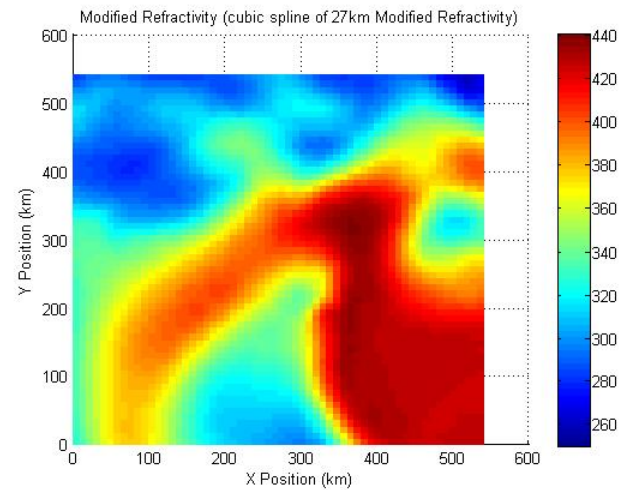
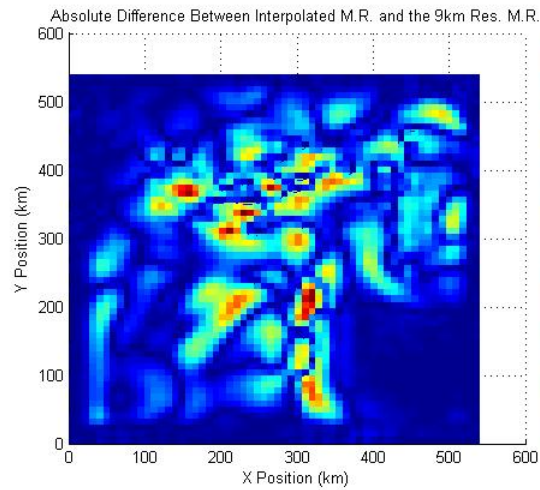
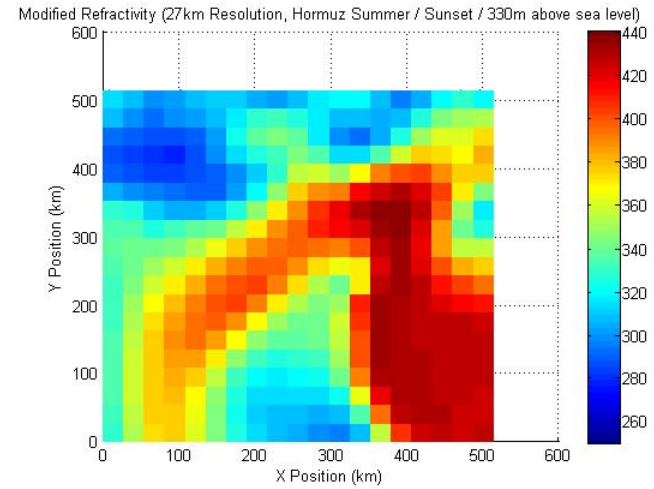
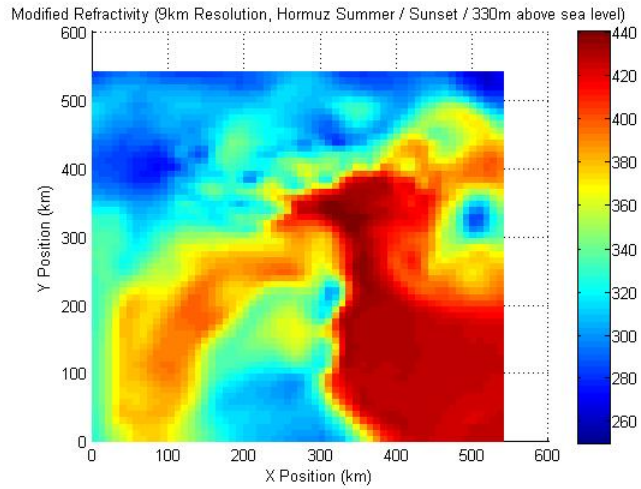
Summer Noon Data (Provided at Every Point Along Radials)



- **Blended Evaporative Duct Model (provided by JHU/APL) with COAMPS data**
- **Interpolation Offered and demonstrated to smooth out the corners, but the radar models already handled it - no need.**



Straits of Hormuz Summer Sunset @330 m





Next Round and Future Ship Classes

- **Next Round Plan of Action**

- Blending the 9km with 27km data
 - Increase LOS while maintaining local high resolution
- Offer more Evaporative Duct models as possibilities for implementation
- Runs Reduction, and what it could mean for Hormuz

- **Future Ship Classes**

- Offer More Grid Options
 - Dynamic / Mesh Grid: Higher resolution near ship, log-scale
 - Polar Coordinate Grid



Conclusions

- **Ask Lots of Questions... find out “Why” the users are asking for more.**
- **Cycle as many times as possible**
 - Offer Options Each time... keep finding the answer to “why?”
- **Keep Track of the requirements**
- **Higher resolution does not always provide additional insight into military system performance... What’s really important?**
- **Prioritize**
- **The required data resolutions depends on**
 - the parameter
 - The military system
 - The use the military system



Questions

- **Questions**