Data Quality

Advanced Warning Operations Course

IC Core 4

Lesson 1: Radar

Warning Decision Training Branch

Welcome to the IC Core 4 Data Quality portion of the Advance Warning Operations Course (AWOC). Lesson 1 will focus on the impacts poor radar data quality can have on the warning process and external users. This lesson should about 20 minutes long.

Overview of Data Quality

- Lesson 1: Radar
- Lesson 2: Spotter Reports
- Lesson 3: Ground Truth
- Lesson 4: Satellite
- Lesson 5: VCP Explorer

Before we begin Lesson 1…I would like to give you a brief overview of the five lessons that comprise the Data Quality portion of AWOC.

Lesson 1: Radar – we'll cover in just a moment.

Lesson 2: Spotter Reports – gives a brief background on the source of spotter reports, their strengths and limitations, and some basic steps to quality control these reports.

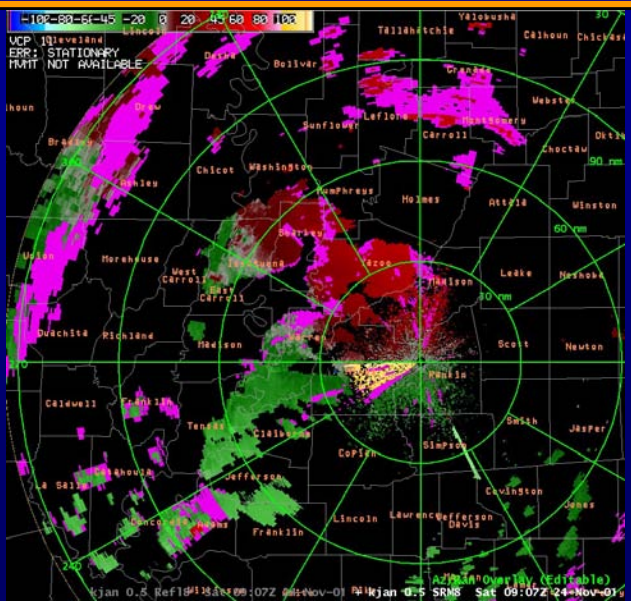
Lesson 3: Ground Truth – discusses the different types of ground truth data available, the limits of that data, and how to mitigate potential problems due to those limitations.

Lesson 4: Satellite – describes data quality issues that most strongly impact the interpretation of satellite data during warning operations such as: parallax errors, reception delays, resolution and the quality of derived products.

Lesson 5: VCP Explorer – The VCP Explorer job sheet is an **OPTIONAL** exercise that examines the source of ground clutter patterns and radar sampling limitations regarding echo heights as a function of different VCPs. The learner can also examine the impacts of nonstandard atmospheric refractivity on the path of the beams and the resulting ground clutter. There is **NO exam** for lesson 5.

The exam for IC CORE 4 will be a multiple choice exam and cover Lessons 1 through 4.

Data Quality - Lesson 1
Radar



Of all the lessons in the Data Quality portion of AWOC, IC Core 4, Lesson 1 should be the one you are most familiar with. This will be a very brief review of AP, Range Folding, and Improperly Dealiased Velocities, focusing on the impacts each has on operations and emergency managers. You will be directed to the WDTB web site for training resources that focus on radar data quality mitigation techniques latter on in the presentation.

Learning Objectives

- Radar (Lesson 1)
  1) Identify the impacts of poor data quality on:
     a. radar interpretation at the local office
     b. outside decision makers (EMs)
  2) Identify training resources for data quality mitigation techniques,
     a. from the legacy system (DLOC)
     b. from system upgrades (RPG and ORDA builds)

As is our policy at WDTB, the exam questions will be based upon the stated objectives.

(Read the Learning Objectives with the emphasis on **IMPACTS** and **TRAINING RESOURCES**)

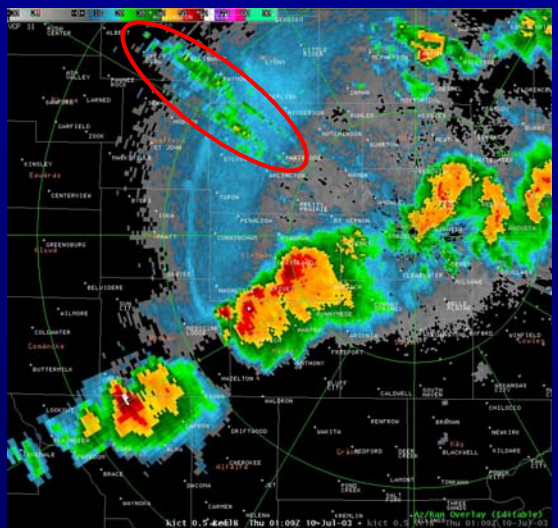
Performance Objective

- <u>Radar</u>
  1) Using any or all of the three base moments (REF, VEL, SW) demonstrate the ability to detect and then mitigate:
     a) anomalous propagation
     b) range folding
     c) improperly dealiased velocities

Performance Objectives are precise, measurable statements of the behaviors that trainees will be able to demonstrate **On-The-Job**. They often specify the condition under which the behaviors will be demonstrated as well as the criteria for acceptable performance. (The Performance Objective will **NOT** be part of the examination process)

Anomalous Propagation

- Where's the AP ?



Take a look at this 0.5 degree reflectivity product and locate the area of anomalous propagation (AP). Remember that AP is caused by super refraction of the radar beam…therefore it will appear along radials and can extend out to great distances from the RDA. Once you think you located the AP…arrow over and we'll see how you did. (The area of AP is located NW of the RDA)

Impacts of Not Suppressing AP

- Can affect precipitation estimates
- Can affect algorithm output
- Can be misinterpreted by users:
  - aviation
  - emergency managers
  - media
  - public
- Can impact the warning process

-Precipitation can be overestimated.

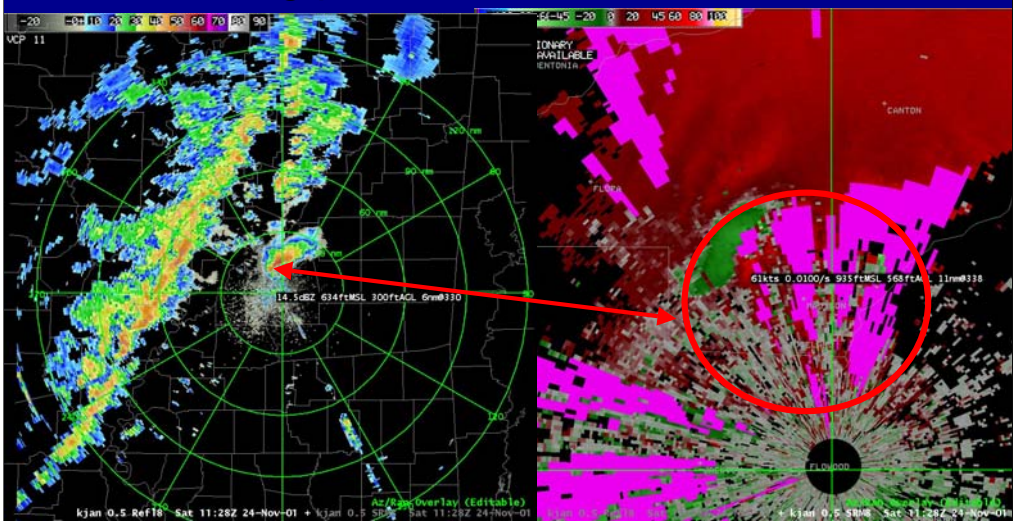
-Garbage-in…Garbage-out

-Diversion of aircraft…time/money, misdirection of spotters, false reports and panicked public…lose of confidence in products.

-All of the above can contribute to the impact on the warning process.

Range Folding

- RF causing problems?



Possible “Hook” near the radar on the reflectivity product…you zoom-in on the velocity product to check out the circulation... and then *things come to a screeching halt*… Range Folding is obscuring your view. In addition, the obscured data is not available for algorithm processing. This is an excellent example of how Range Folding can impact the warning process.

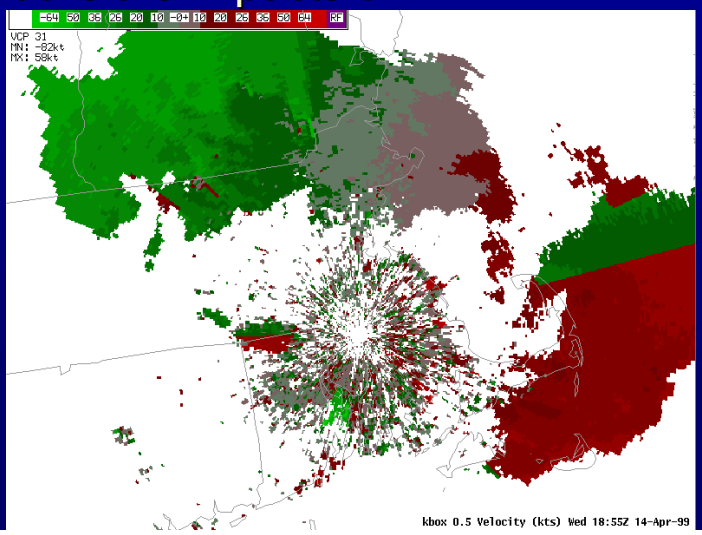
Impacts of Range Folding

- Obscures velocity and spectrum width data
- Obscured data is not available for algorithm input
- Can impact the warning process

(Read bullets referring back to previous slide)

Improperly Dealiased Velocities

- What are the impacts of IDV?



I'd like you to think about the impacts of IDV…if your head starts to hurt go to the next slide…but before you do…I got a question for you: What is the one step YOU can perform at the RPG HCI that could help reduce IDV? A hint: EWT…(update the Environmental Winds Table!)

Impacts of IDV

- Can affect the preservation of meteorological features such as:
  - TVS
  - Mesos
  - Shear
- Can affect algorithm output
- Generates strange azimuthal shears
- Can impact the warning process

-Improperly Dealiased Velocities can mask the analysis of significant meteorological features.

-Garbage-in…Garbage-out.

-IDV can “create” features that do not exist…areas of shear that just aren’t there!

-All of the above can significantly impact the warning process.

Response Item

- Which of the following is(are) true?
  a) Range folding obscures both velocity and reflectivity data.
  b) Range folded (obscured) data is not available for algorithm input.
  c) Range folded data can not impact the warning process.
  d) None of the above.

Read the question…after the student responds review the correct and incorrect responses.

a) RF “Purple Haze” (obscured data) only appears on VEL and SW products. RF can (rarely) occur on REF products, however it is NOT obscured with “Purple Haze”.
b) CORRECT ANSWER - RF data, both VEL and SW, is not available for algorithm input.
c) Lack of VEL and/or SW data can seriously impact the warning process (circulations, VEL reliability, etc.)
d) Fagitaboutit!

Response Item

- Which of the following is(are) an impact(s) of not suppressing AP?
  a) Precipitation estimation
  b) Misinterpretation by users
  c) Algorithm output
  d) All of the above

Read the question…once the student responds review the answers.

a) If you do not suppress AP the algorithm may interpret AP as a meteorological target and use the REF data to calculate precipitation estimates.

b) Users (aviation, EMs, media, etc.) may not have the training to distinguish met. targets from AP.

c) Garbage-in…garbage-out!

d) All of the above are impacts…therefore (d) is the CORRECT answer!

Training Resources
-- Legacy System --

- DLOC
  - IC 5.3: Principles of Meteorological Doppler Radar (student guide/presentation)
    - Clutter Suppression
    - Range Unfolding
    - Velocity Dealiasing

http://wdtb.noaa.gov/

If you need to review the algorithms and procedures used to mitigate the effects of AP, RF, and IDV…I strongly recommend that you visit WDTB's web site (URL on the bottom of slide) and look for the Information by Topic section and select DLOC…then selection IC 5.3: Principles of Meteorological Doppler Radar. You will find both the student guide (PDF) and the presentations that pertain to this topic.

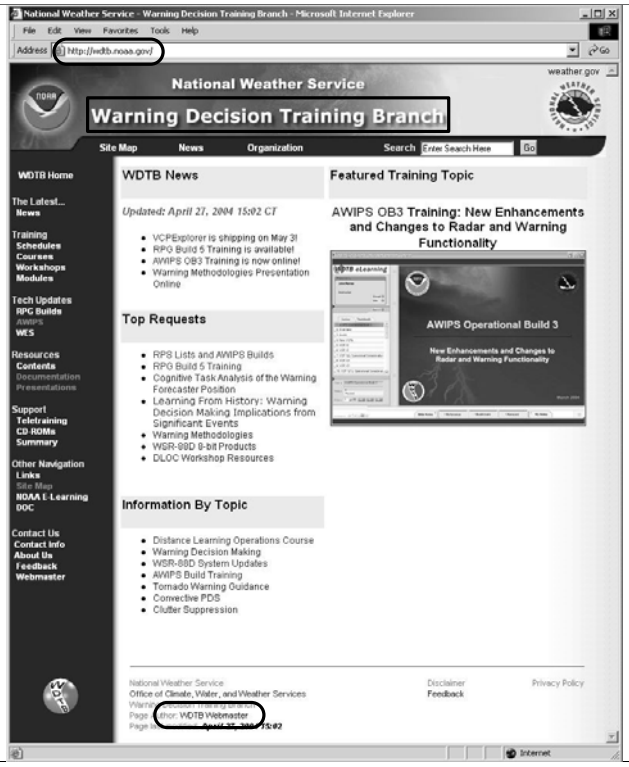
Training Resources
-- System Upgrades --

- Build training
  - RPG (student guide/presentation)
    - Beta (synchronous)
    - Deployment (asynchronous)
  - ORDA (calendar year 2005)
    - Beta
    - Deployment

http://wdtb.noaa.gov/

In addition to the legacy information on the previous slide, as RPG and ORDA (2005) Builds are released WDTB develops training materials for these Builds. Once again go to WDTB's web site (URL on bottom of slide) looking for the Information by Topic section and select WSR-88D System Upgrades…then select the Build you are looking for. You will find both the training guide (PDF) and the presentations that pertain to this topic.

- Living document



- Check often

- Provide feedback

This is what the WDTB web site should look like. I say should because as a “living” document it is frequently being changed to reflect the latest training material. We recommend that you check this site often. The WDTB Webmaster would appreciate your feedback if things are not working as planned (click on Webmaster hyperlink near bottom of page).

Response Item

- An excellent location to find training resources that help mitigate the impacts of poor data quality is(are)?
  a) WDTB's web site: http://wdtb.noaa.gov
  b) WDTB's web site: http://wdtb.noaa.gov
  c) WDTB's web site: http://wdtb.noaa.gov
  d) All of the above

Read question…emphasize importance of training resources available at WDTB's web site:

-Legacy data quality mitigation…DLOC.

-Build training material…RRPG and ORDA.

Impact of Data Quality on External Users

- You are a data provider.
  - In today's information-sharing environment, external decisions are based upon radar information ***you*** provide.
  - External use of WSR-88D data will grow as the private sector redistributes Level II (wideband) data along with products based on Level III.
- Bottom Line: Importance of high-quality radar data cannot be overstated.

Let's take a look at the impact of Data Quality on our external users…focusing on Emergency Managers. Remember… that we rely on these folks to be our "eyes in the storm" and to help get the word out about significant weather events. (Read bullets with emphasis on the Bottom Line)

Emergency Managers (EMs)

- EMs are particularly important external users.
- Modern EMs utilize radar as one of their tools.
- Most EMs have a ***local*** geographic area of responsibility.
- EMs often manage human resources – directing responders as well as positioning spotters.

(read bullets – with an emphasis on developing and maintaining partnerships)

Radar Applications for Emergency Managers

- Find boundaries in non-convective situations: firefighting, haz-mat, homeland security, etc.
- Close roads/bridges preemptively for flooding.
- Monitor conditions for safety of outdoor workers & responders.
- Making decisions of how best to alert the public of severe weather (sirens, police sirens, cable TV override, etc.)

(Read bullets – ask students to check with their WCM on any additional applications that may specifically apply for their local EMs.)

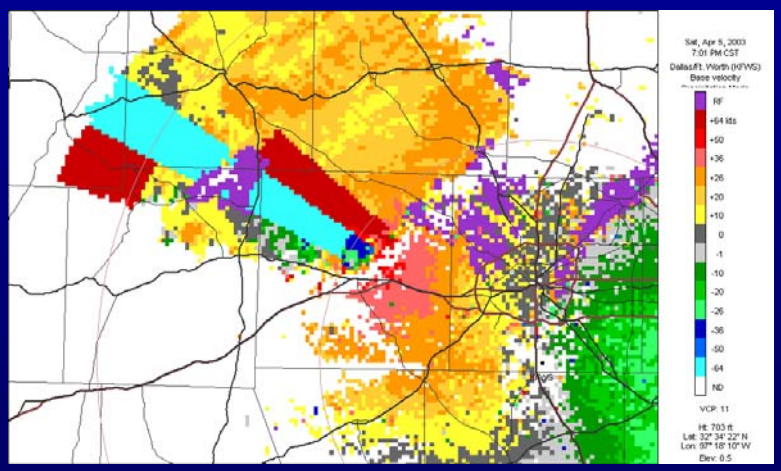
Data Quality Impacts for EMs

- Improperly Dealiased Velocities/Range Folding:
  - obscure significant features
  - possible misdirection of spotters due to false signatures

(read bullets – with an emphasis on developing and maintaining partnerships…verbally relate back to the AP/RF/IDV slides presented earlier… additional examples follow)

Example 1

What does an *untrained* EM think:

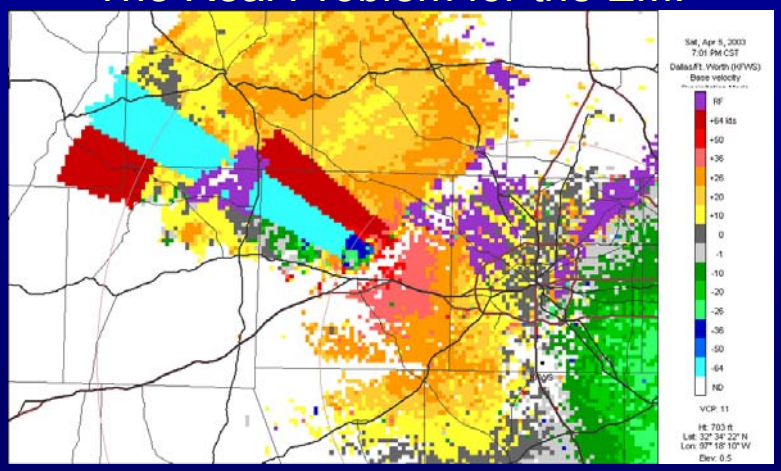


"Man, that's the *biggest* circulation I ever saw!!!"

(Read question posed…and response…HAM it up!)

Example 1

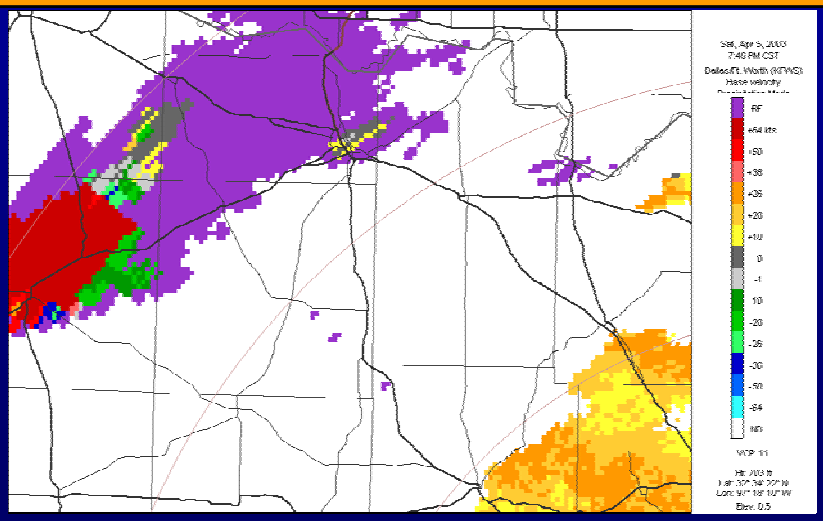
The Real Problem for the EM:



Improperly Dealiased Velocities mask real circulation → difficult to direct spotters.

(This slide basically speaks for itself…popup text…read statements.)

Example 2



Supercell masked at times by improperly dealiased velocities and/or range folding

(Animation – emphasis placed on the area of IDV and RF)

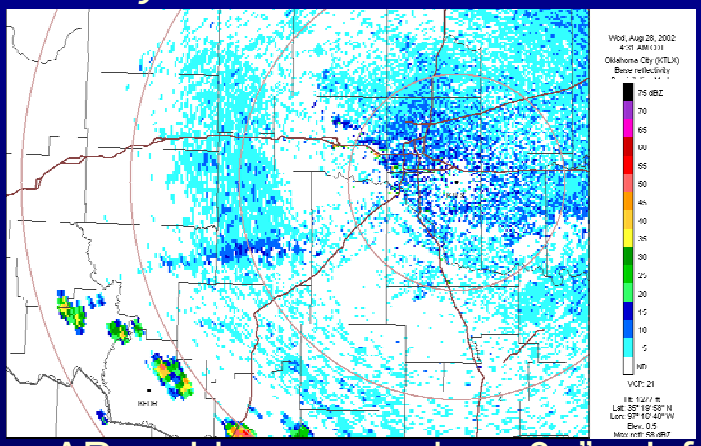
Data Quality Impacts for EMs

- AP can lead to:
  - misdirection of spotters
  - spurious rainfall accumulations
  - no reset of storm-total rainfall

(Read slides – similar slide 7)

Example 3

Rainfall Products are used by EMs and
many other downstream users

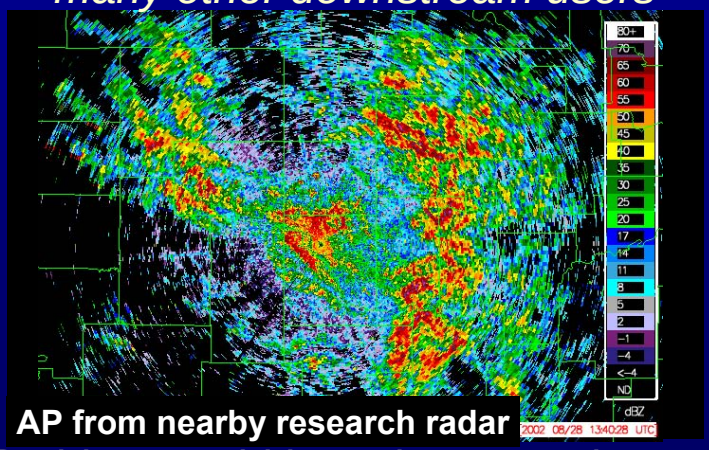


Severe AP problems: spurious 3+” rainfall total!

This animation is an example of how AP can cause erroneous precipitation estimation problems for EMs. Look at the small area of 3+” of rainfall near El Reno…it’s only AP. (This is an animation..it has to be run to see the affect)

Example 3

Rainfall Products are used by EMs and
many other downstream users



AP from nearby research radar

Problem could have been much worse!

Remember…the WSR-88D is only as smart as the operator. The radar does not know if this is reflectivity (input for precipitation processing) or AP (erroneous input). Garbage-in…Garbage-out!!!

Data Quality Impacts for EMs

- Emergency managers often use algorithm output from the attribute table in the composite reflectivity product.
- Any data quality issue that affects the performance of Mesocyclone, TDA, SCIT, Hail, or Rainfall algorithms may impact the operations of an emergency manager, especially an *untrained* EM.

These are some additional IMPACTS that poor data quality has on the EMs. (read bullets) Remember…we have more and more people looking at our data who are decision makers…we need to provide them with the best quality products we can.

Response Item

- Emergency Managers are concerned with which of the following impacts of poor data quality?
  a) Misdirection of spotters
  b) Obscured significant meteorological features
  c) Algorithm performance
  d) All of the above

Read question…once student responds review answers.

a) AP, IDV, and RF can all cause misinterpretation and misdirection of spotters.

b) RF and IDV can obscure significant met. features for both the trained and untrained EMs.

c) EMs are now using algorithm output as part of their job…therefore accurate algorithm performance is essential.

d) Correct answer…EMs are concerned about all three impacts!

Data Quality
Lesson 1: Radar -- Objectives

- Radar (Lesson 1)
  1) Identify the impacts of poor data quality on:
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http://wdtb.noaa.gov/

This is a review of the objectives for IC Core 4 Data Quality Lesson 1: Radar. (Emphasis on the terms **IMPACTS** and **TRAINING RESOURCES)**

End of Lesson 1

Questions about Lesson 1

iccore4@wdtb.noaa.gov

You have completed Lesson 1 of AWOC IC Core 4!!!! Remember…there are four more lessons in IC Core 4. If you have any questions about this lesson: 1) first ask your SOO 2) if you need additional help send an e-mail to….(instructor's group – answers will be cc:'d to the SOO and considered for the FAQ page.) The test should be taken as soon as possible after completing IC Core 4 Lesson 4.

Remember…the exam ONLY covers Lessons 1 – 4 and it is multiple choice.