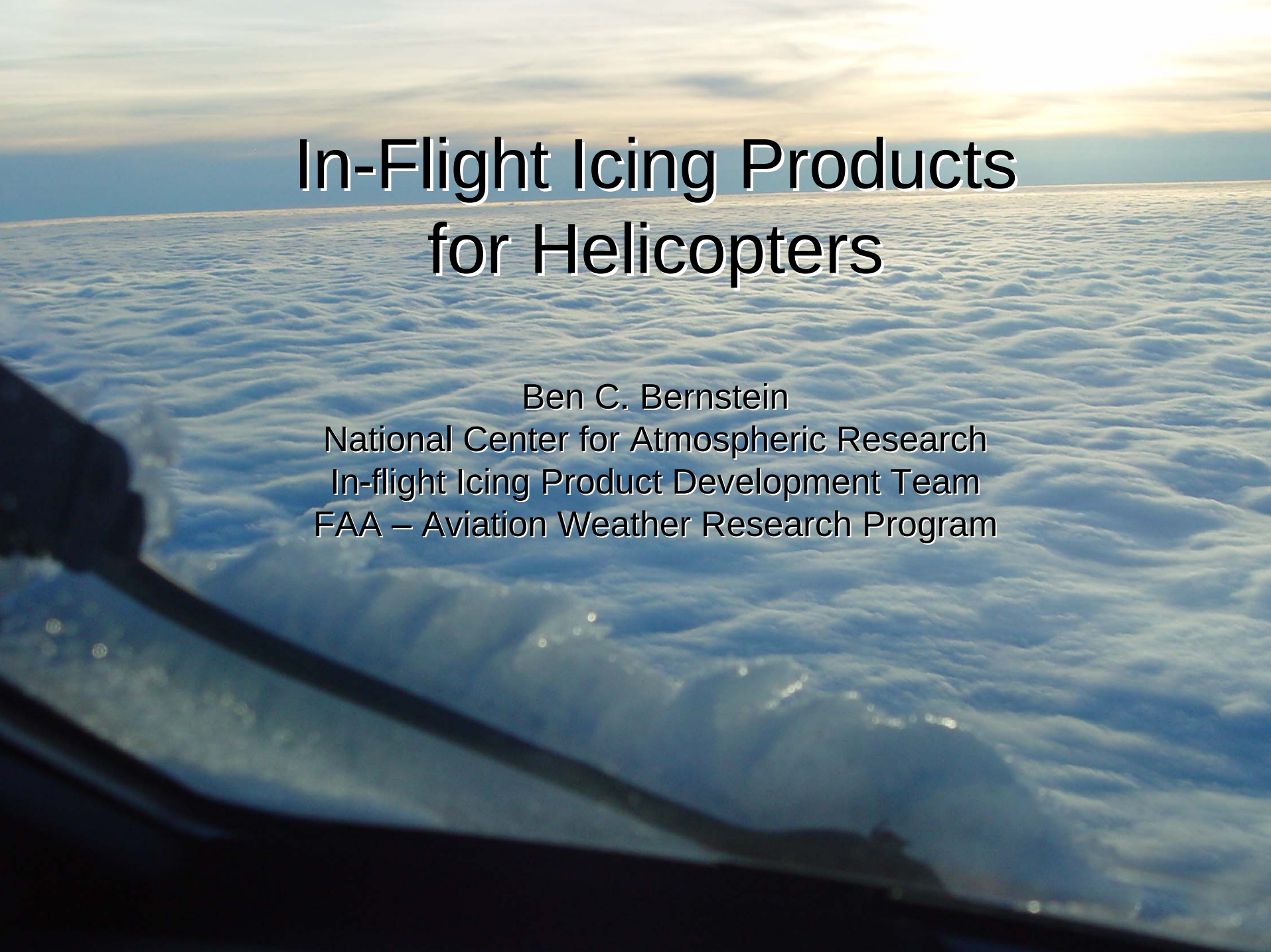


In-Flight Icing Products for Helicopters

Ben C. Bernstein
National Center for Atmospheric Research
In-flight Icing Product Development Team
FAA – Aviation Weather Research Program

In-Flight Icing

- Encounters with supercooled liquid water
  - Liquid water at T < 0°C
    - Ram air rise, depending on aircraft speed
  - Clouds
  - Precipitation (FZDZ, FZRA) – SLD
- Most helicopters are not certified for icing
  - Avoidance is the focus
    - Clouds, precipitation at T < 0°C (+10°C & vis moist – engine)
  - Some have ice protection
    - Good to avoid icing
    - If you're going to encounter it
      - Where will it be (3-D space)
      - When will it be there?
      - How likely is it?
      - Will there be large drops? Certification is for small drop icing.
      - How severe will it be?

IFIPDT Products – CIP & FIP

- Current Icing Product (CIP)
  - Hourly diagnoses of icing, blending info from many sources
    - 20km horizontal spacing CONUS & surroundings
    - 1000ft (305m) vertical spacing
    - Icing Probability – Chance of ANY icing (avoidance)
    - SLD “Potential” – Uncalibrated chance of large drops
    - Icing Severity – Categorical (trace, light, mod, heavy)
  - Fully operational Dec 2006, pending approval
    - Will be usable by pilots, dispatchers, meteorologists
  - Current operational version
    - Icing “Potential”, SLD “Potential” - on Operational ADDS (Thompson)
    - Severity available on Experimental ADDS
- Forecast Icing Product (FIP)
  - Forecasts out to 12 hours, updated every 1-3 hours
  - Operational Products: Icing Potential, SLD Potential
    - Experimental Severity in March 2007, Operational Fall 2008
- Alaskan versions – Experimental. Operational: FY09, FY10

The CIP Concept


SATELLITE (GOES)

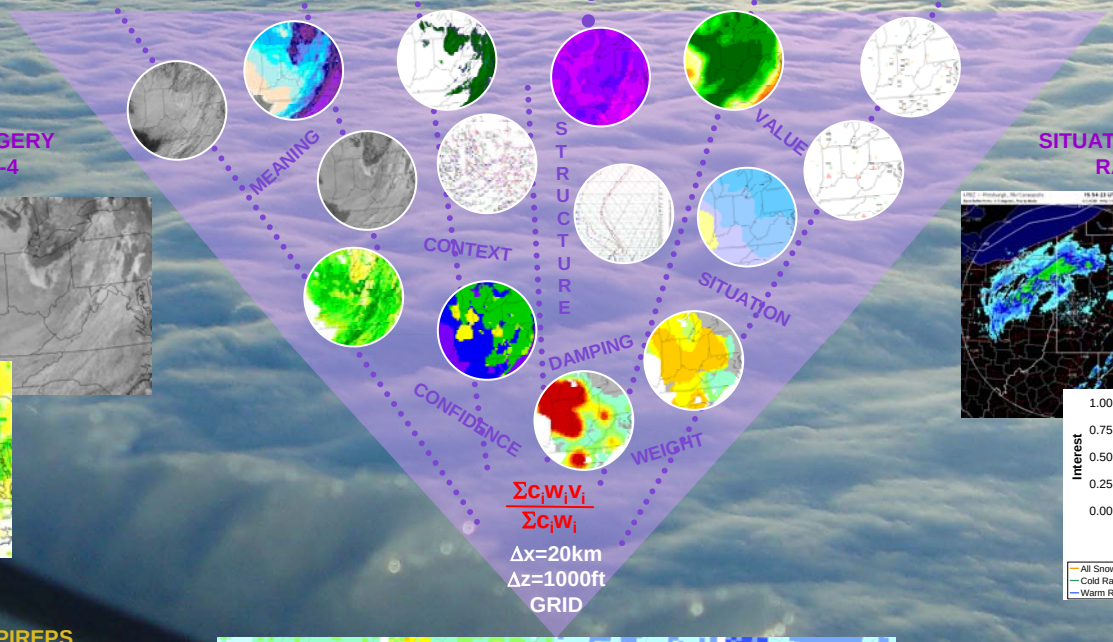

RADAR (NEXRAD)


SURFACE OBS (ASOS, etc)


MODEL (RUC)


LIGHTNING (NLDN)

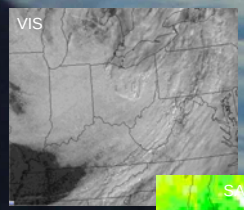

PIREPS



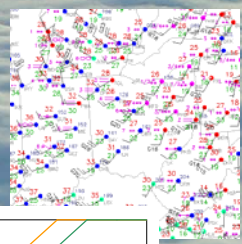
$$\frac{\Sigma c_i w_i v_i}{\Sigma c_i w_i}$$

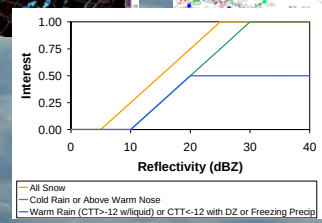
Δx=20km
Δz=1000ft
GRID

BLENDED SATELLITE IMAGERY ALBEDO & CHANNEL 2-4

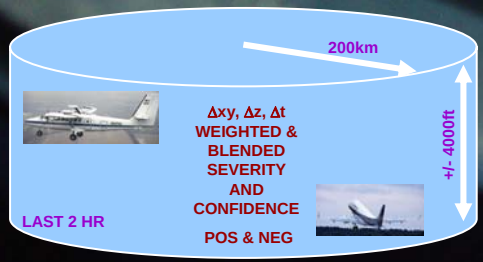


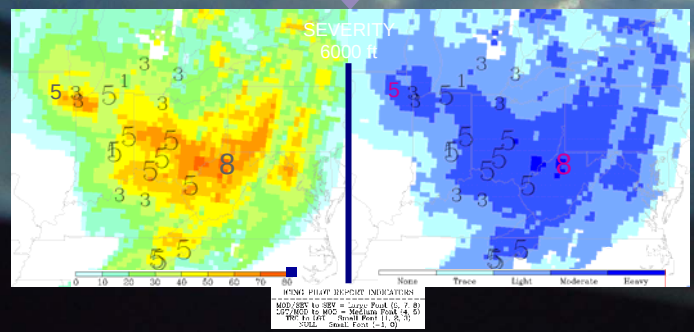
SITUATIONAL APPLICATION OF RADAR REFLECTIVITY



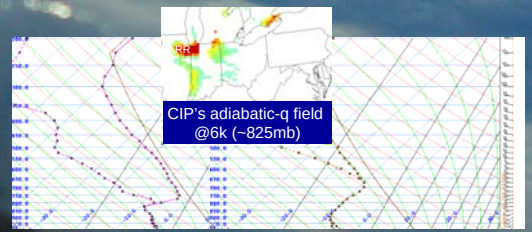


SPACE & TIME WEIGHTED PIREPS

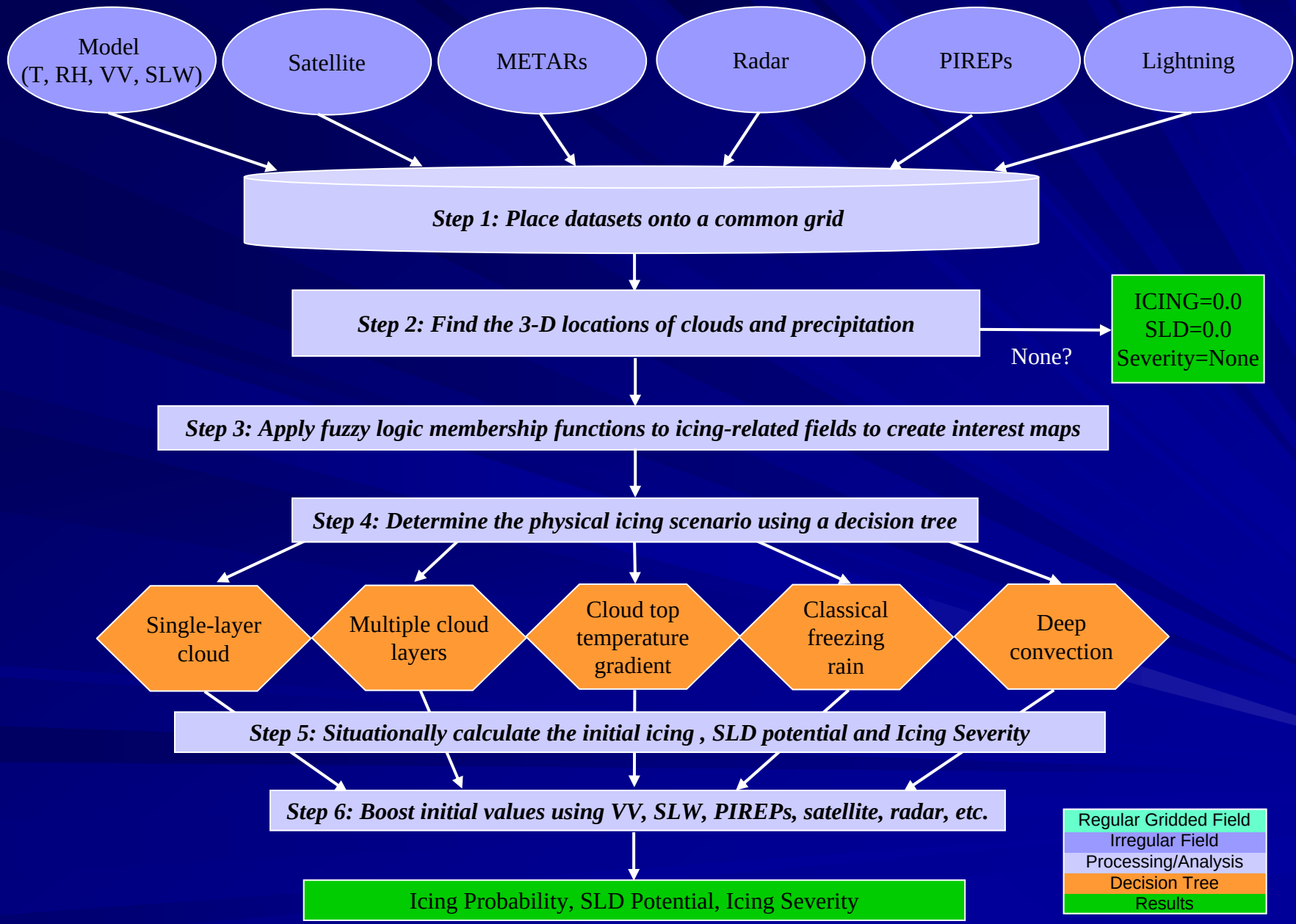




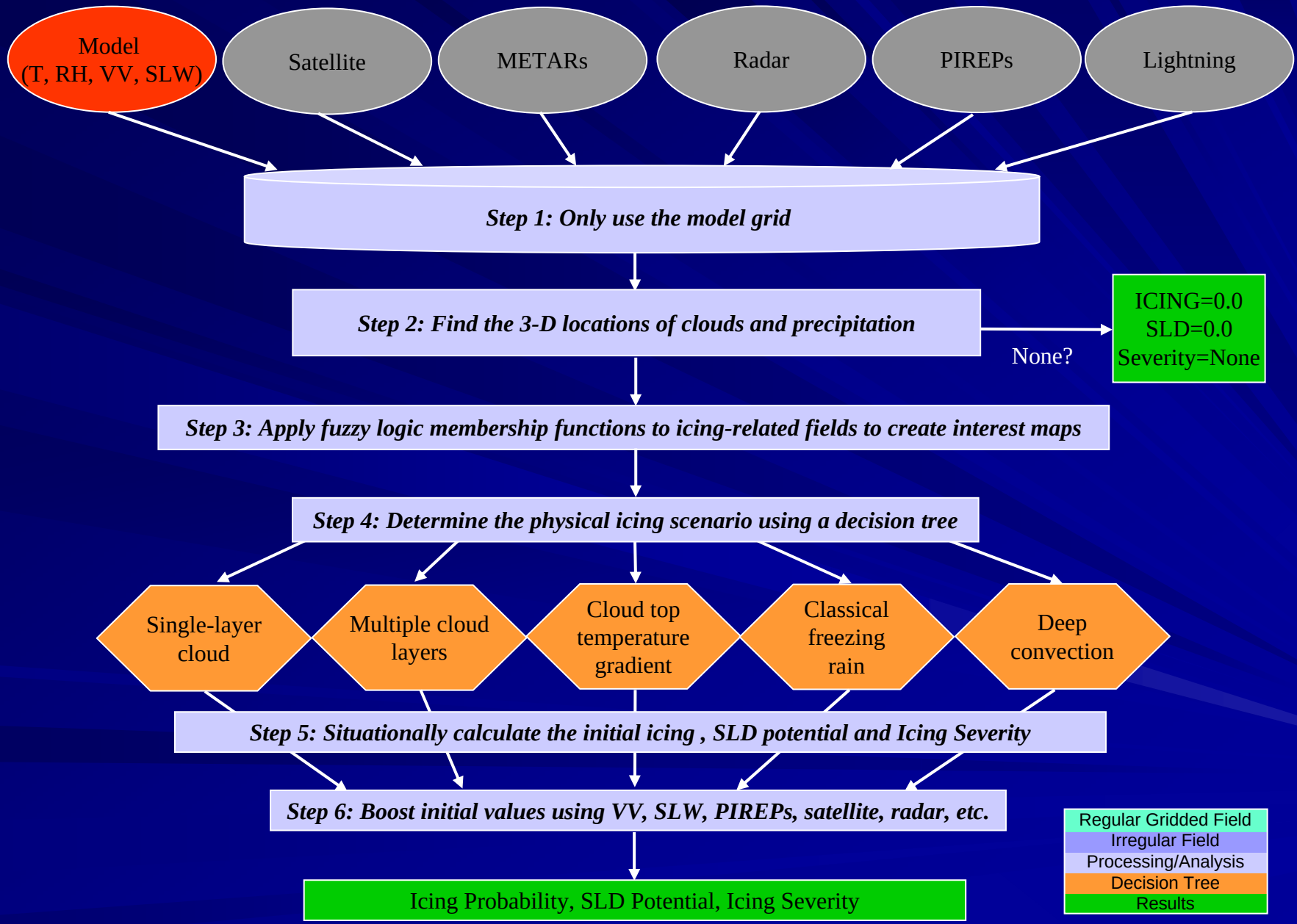
STABILITY DAMPED LWC CALCULATION



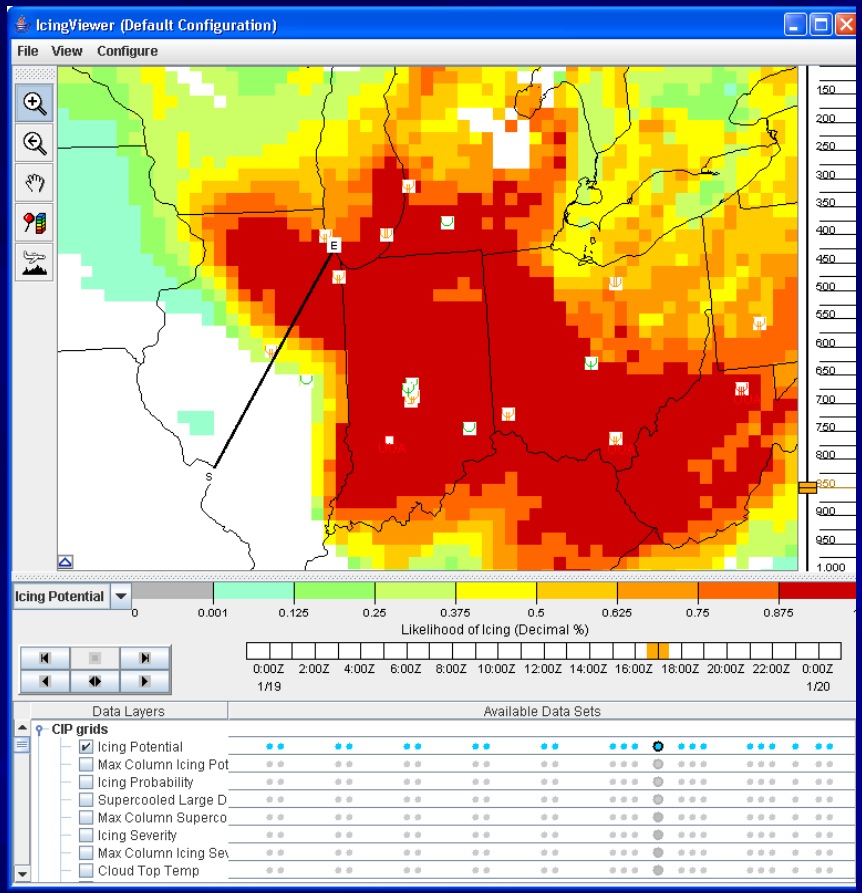
The CIP Process

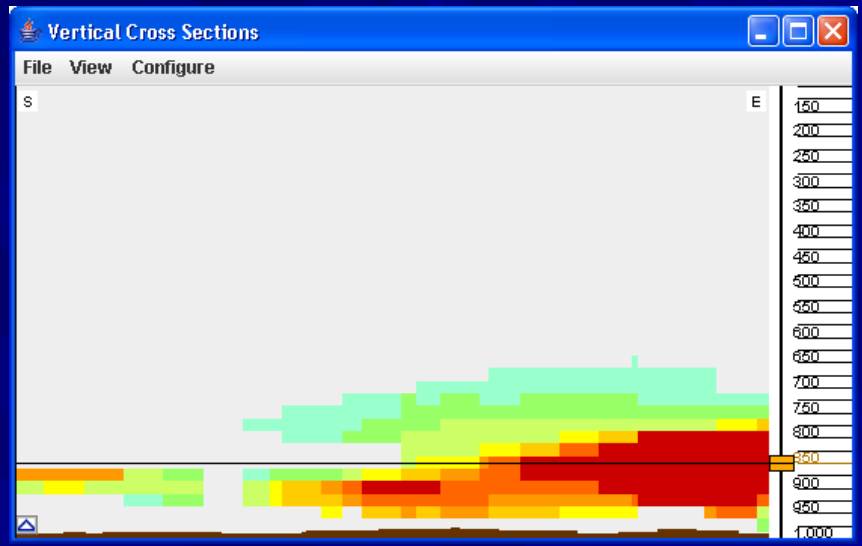


The FIP Process



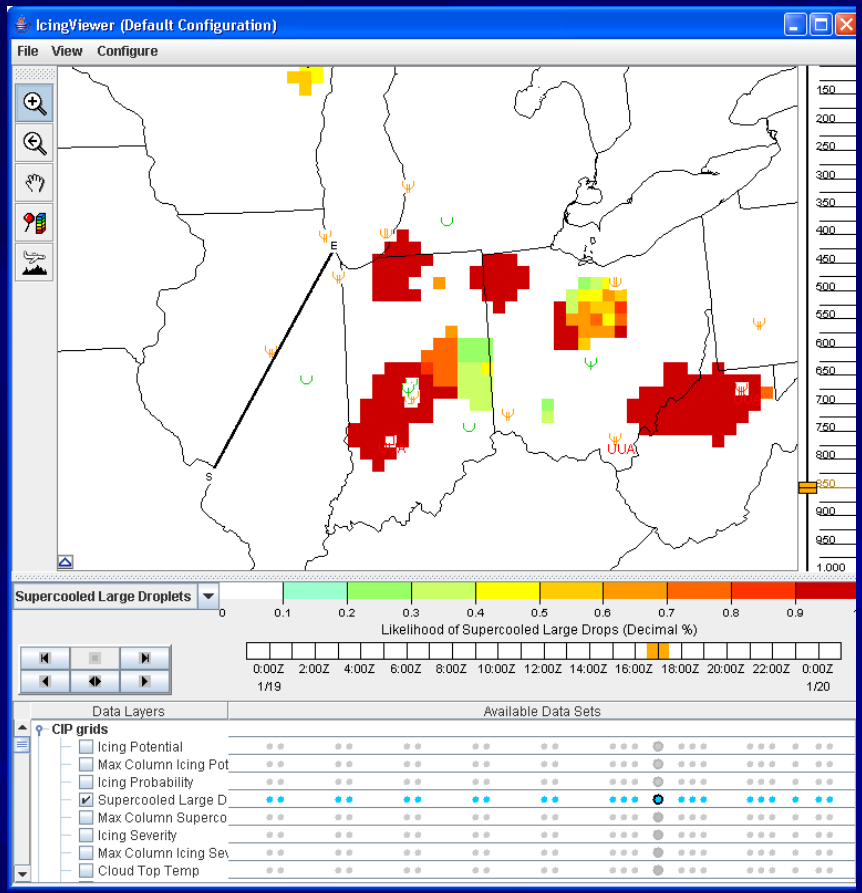
Examples of CIP (Icing Probability)

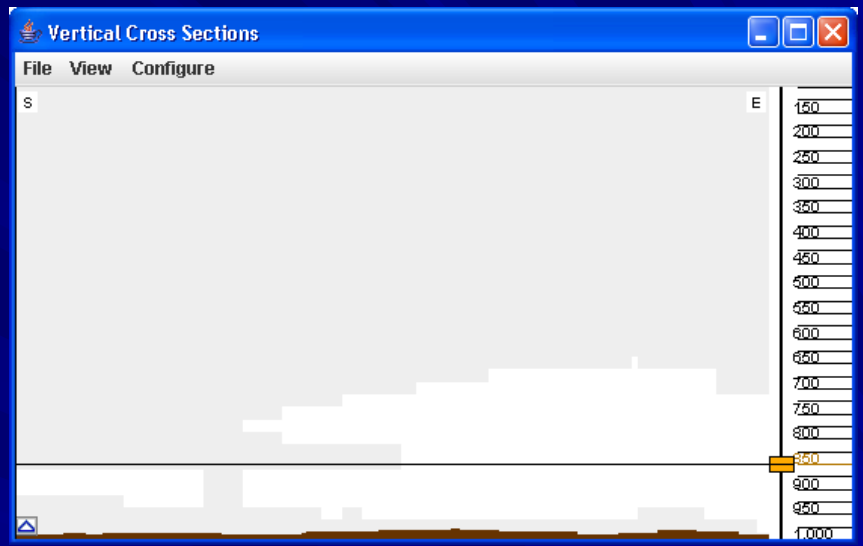


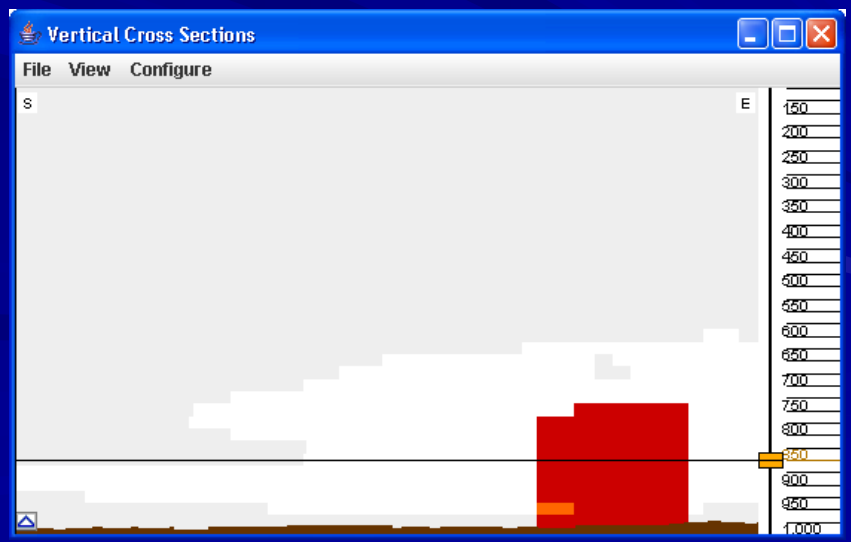


- Unprotected
  - Any chance of icing = no go?
- Protected
  - Where do you draw the line?
  - Mission dependent?
- Visible moisture (T < +10°C)

Examples of CIP (SLD Potential)

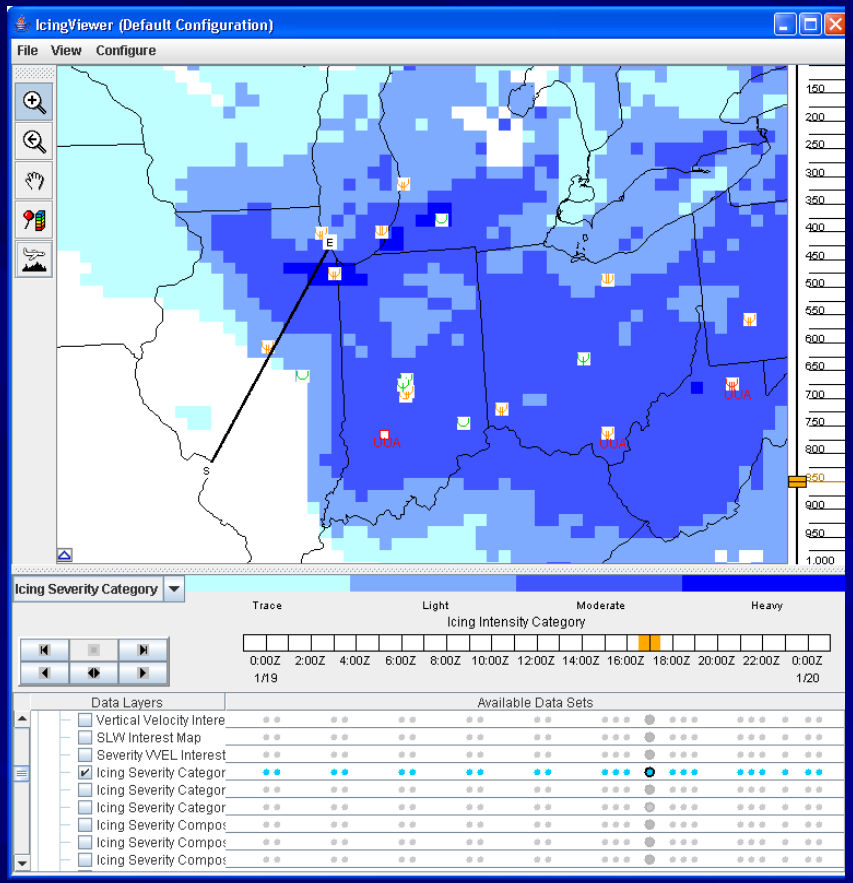


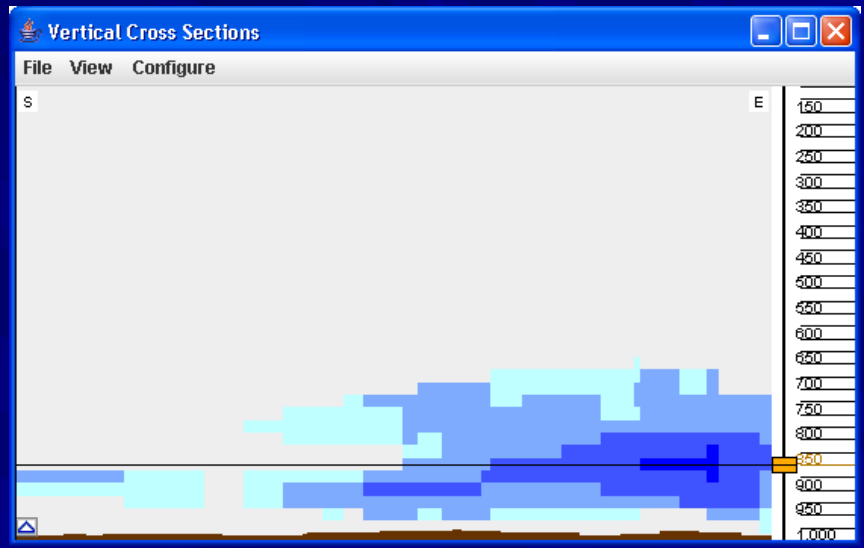




- Protected, but not for SLD!
  - Any chance of SLD icing = no go?

Examples of CIP (Icing Severity)





- Unprotected
  - Trace or higher = no go?
- Protected
  - Where do you draw the line?
- Put icing into context of other things
  - C/V, winds, turb, traffic, MVAs

Thank You

Ben C. Bernstein
IFIPDT Alternate Lead
bernstei@rap.ucar.edu
(303) 497-8424