CRUISING FOR SPEED

TECHNIQUES FOR EFFICIENT INTERTHERMAL SOARING

INTRODUCTION

- CRUISING = 60%-80% OF FLIGHT
- HOW FAST TO FLY BETWEEN THERMALS?
- MACREADY STILL RULES – BUT WITH NUANCES WORTH UNDERSTANDING
- OUT MACREADYING MACREADY – FOLLOW THAT ENERGY PATH!

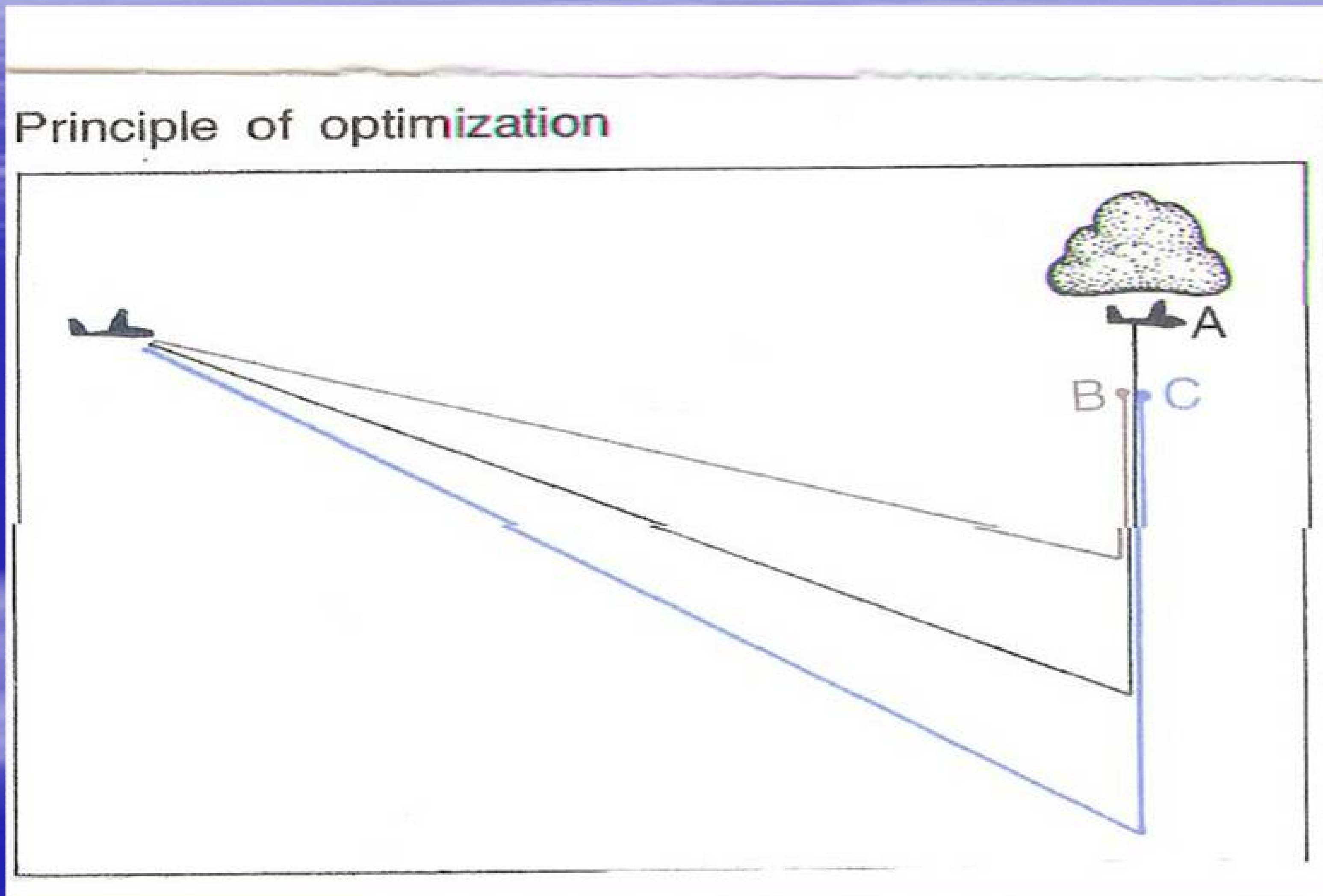
PROGRAM PLAN

- REVIEW CLASSIC MACREADY THEORY
- WIL SCHUEMANN'S PAPER
  – <u>The Price You Pay For Macready Speeds</u>
- JOHN COCHRANE'S PAPER
  – <u>Just A Little Faster Please</u>
- TECHNIQUES FOR SPECIFIC SITUATIONS

Classic Macready Theory

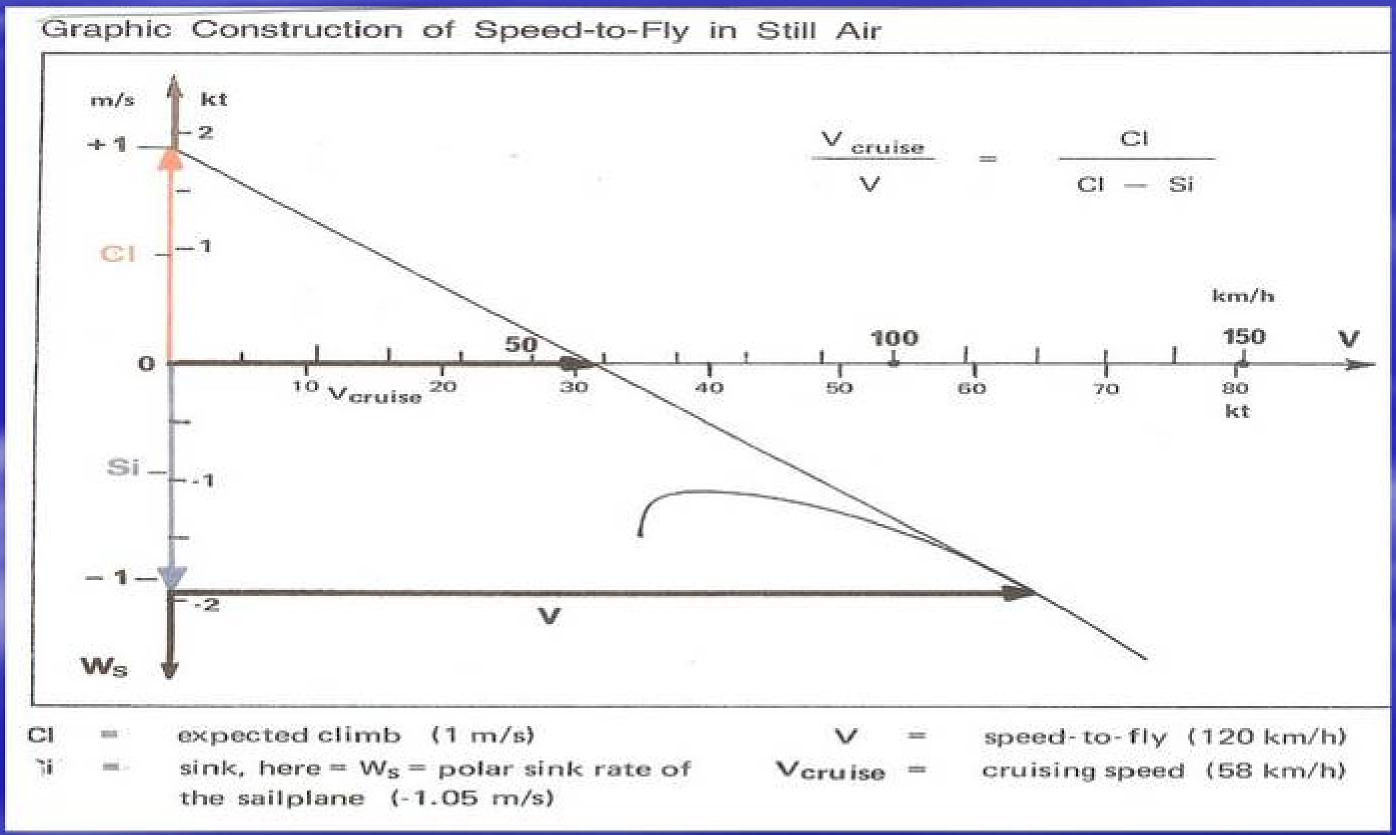
- Assumptions
  - All thermals same strength at all altitudes
  - Strength of next thermal is known
  - Interthermal sink/lift is assumed constant
- Three Pilots
  - Hair on fire Pilot C
  - Namby pamby Pilot B
  - Ollie Optimal Pilot A

PRINCIPLE OF OPTIMIZATION



Classic Macready Theory

- Optimal inter-thermal speed for maximum average cross country speed can be calculated



- Effect of inter-thermal sink/lift– essentially subtracts from/adds to achieved climb rate
- Effect of Headwind/Tailwind--none except on final glide
- Water ballast-- shifts polar down to right
- Put in an anticipated thermal strength, a polar and a wing loading to the on-board computer and a speed to fly emerges as a tone and needle indication

PROBLEMS WITH MACREADY

- Don’t know next climb rate
- Climb rate varies with altitude
- And time to center the climb – achieved climb rate
- Don’t know sink/lift between thermals– varies constantly

- Wil Schuemann- renaissance soaring man
  - – Total energy compensation box
  - – Water ballast
  - – Winglets
  - – Discus plan-form
  - – Seminal paper on modified MacCready flight
    - Soaring symposia—1972– see references

The Price You Pay For Macready Speeds

by Wil Schuemann

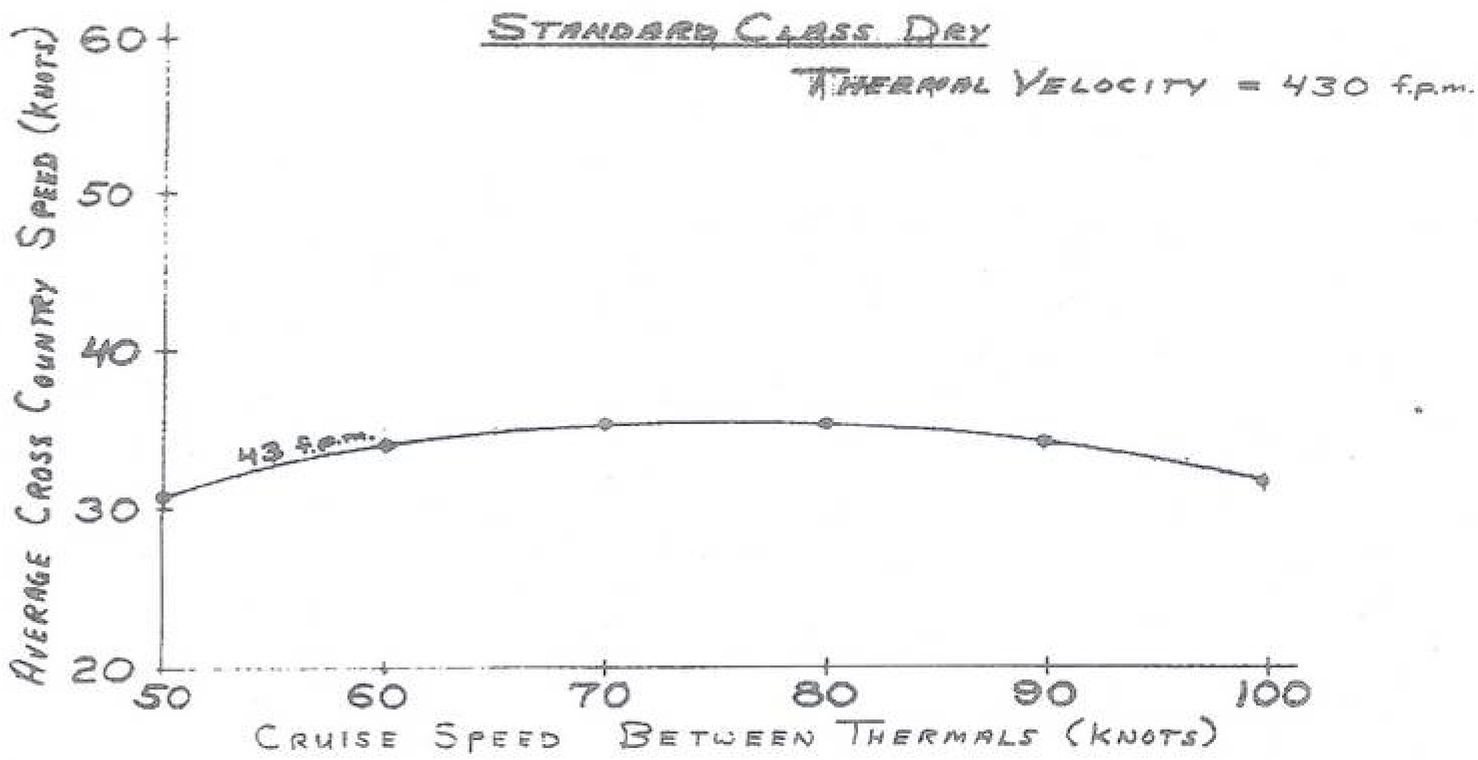
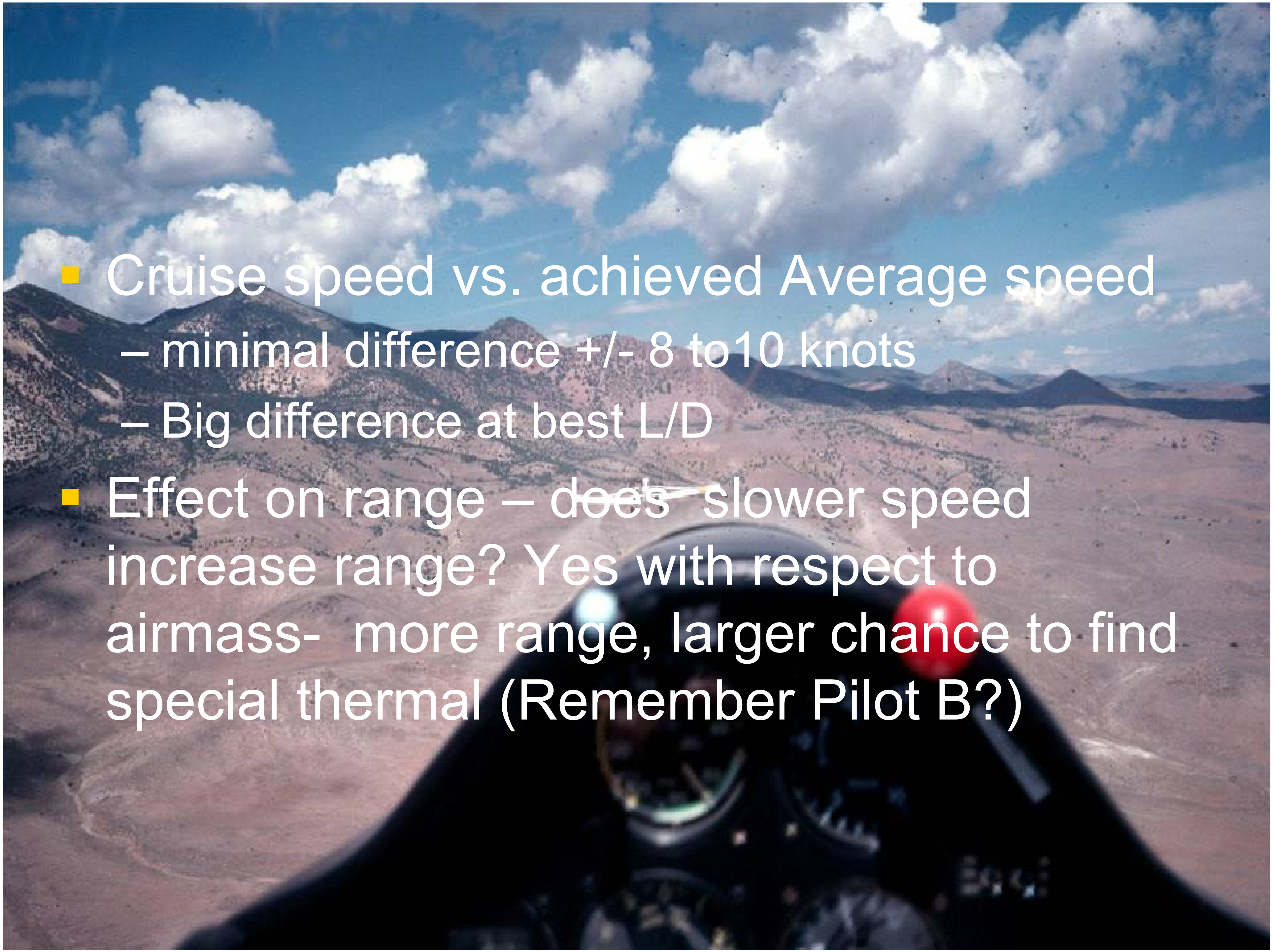
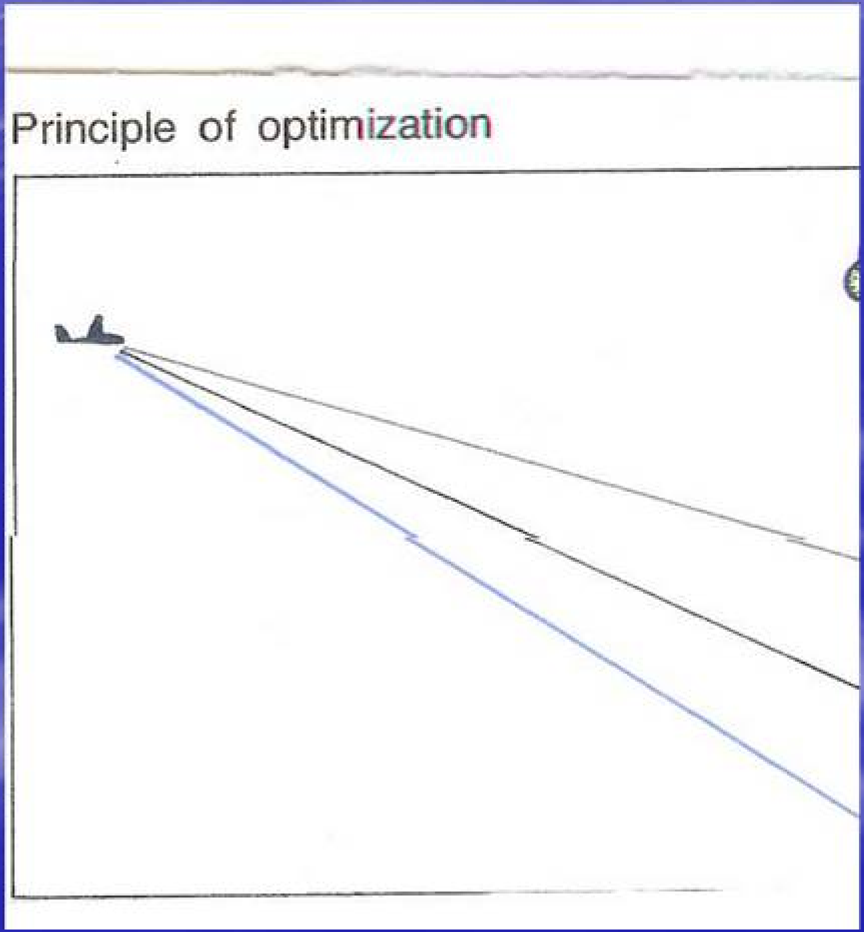


FIGURE 3


Cruise speed vs. achieved Average speed
– minimal difference +/- 8 to10 knots
– Big difference at best L/D
Effect on range – ~~does~~ slower speed increase range? Yes with respect to airmass- more range, larger chance to find special thermal (Remember Pilot B?)

Who would you rather be if you don't know where the next thermal is?



Pilots

B

A

C

Flying MaCready accurately ain't easy

- What is the next (achieved) thermal strength??
- Chasing the needle may do more damage than good
  - Control drag
  - Non-optimal G loading
  - Damp out airframe responses
  - Scare the s--- out of fellow pilots
- Distracts from other tasks

Lessons learned

- Speed variations 8-10 knots from ideal Macready minimal impact on ave. x/c speed
- Speeding in sink gains little
- Range gained with slowing
- But **perfect** speed adherence would give slightly higher speeds.

- Schuemann’s conclusions
  - A moderate speed with little variation costs very little speed
  - Reducing MacCready intensity yields more time to think!!! And look outside
  - Increasing range may improve thermal selection
  - Slower flight makes air easier to assess

John Cochrane

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  - PHD economics, U. of Chicago dept. Finance
  - Highly successful competition pilot
  - Regular contributor to Soaring magazine

Just A Little Faster Please
John Cochrane

- Speed and modern MacCready theory-observations
  - MacCready still key to in-flight speed decisions
  - MacCready determines cruise speed--- the mathematical solution is still valid
  - **<u>But what is the correct MacCready value?</u>**
    - Reichmann’s elliptical thermal lift concept- bottom and top are usually less than mid-level climb rate
    - Likelihood of finding best thermals goes down with altitude

- Random lift distribution curve plotted against altitude
  - Assumes thermals vary in strength quite a bit
  - There are many weak thermals to use to save a flight low
  - There are a few really good thermals
- Seems to fit with pilots’ real world observations

Proper MacCready setting drifts down as glider gets lower

Thermal Strength	1	5	10
		Miles	
1 knot	20%	90%	99%
2 knots	10%	61%	84%
4 knots	5%	30%	52%
6 knots	2%	10%	18%

Table 1. Probability of finding a thermal at least this strong in the indicated number of miles

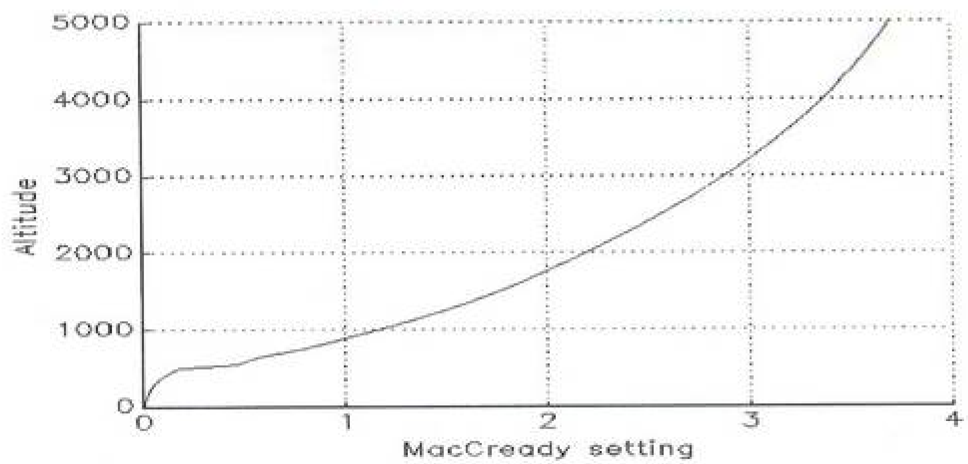


Figure 2. MacCready value vs. altitude, for a Discus facing the thermals of Table 1.

John Cochrane (cont.)

- CENTERING TIME-AT THERMAL ENTRY
  - Often several circles
  - Dilutes average rate of climb
  - Makes stopping for short climbs less efficient
  - Longer down low and on windy days
  - Effect larger for strong thermals
  - Supports trying to pick easily centered thermals

Implications for Flying Tactics

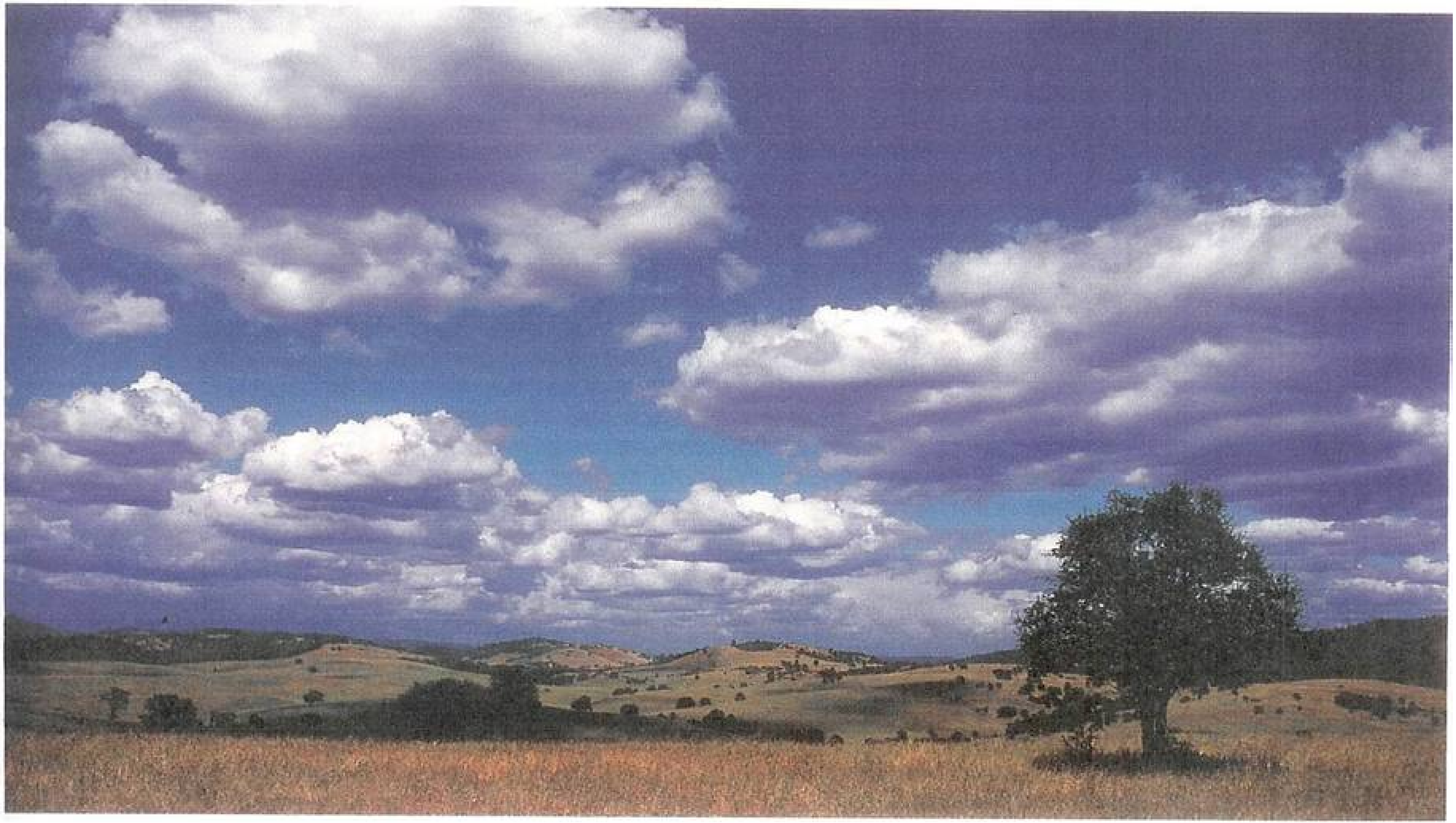
- Recognize that thermals are variable
- Steadily reduce MacCready as altitude lower
- Leave weak thermals to search as get higher
- Average MacCready much lower than best seen
- Always adjust MacCready to expected future—save altitude now!!!

DJ Practical Observations

- In a modern glass ship
  - Fly 60-70 knots if nervous
  - Fly 80 knots if feels OK
  - Fly 90-100 knots if great day
- MaCready on 2 and leave it alone
- No zoomies - gentle pull-ups and pushovers to feel the air
- Concentrate instead on following the max energy path
- Other observations???

Flying Energy Paths

Well Formed Cu’s



Isolated or random cumulus clouds read tops as well as bottoms

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Cumulus congestus

Cu-nim

Cruising techniques

- Cruising with cumulus clouds
  - Classic Streets
    - Speed to fly– MacCready still applies
    - Altitude-- higher better but need to see
    - Deviation angles up to 30 degrees, occ. more
    - Bridging to next street
    - Often best speed will cause falling away from clouds
    - “End of street” planning
      - Get high

Cruising techniques

– “Make your owns”

- Even a random pattern of dots can be connected
- Optimize the time spent “in the shade”
- Fully utilize the clouds you have

Departing the Cloud

- When the lift drops off, not necessarily at cloudbase!
  - Want to maximize average climb
- plan ahead – while you’re topping out
- speed choices – maximize the weak lift
- use the rest of the cloud
- look for bridges to next energy path step
- Ideally should have idea where next stop will be

When to stop in general

- Long cruise legs reduce centering loss
- No point in stopping high – centering time loss
- Set a height band floor—usually ~ top 30-40% of thermal–
  - Below 50%, lift begins to disconnect from clouds
- Try to end streets high
- Understand the thermal strength profile for the day- changes with height

Big Blue Holes

- Assess– why blue??
  - – Lake/sea shadow?
  - – Airmass change
  - – Wave influence
  - – High wind streeting
- Get high and try to stay high
- Go slow until you've had time for assessment –may be good but dry– or not!!!
- Look for gliders- good thermal markers

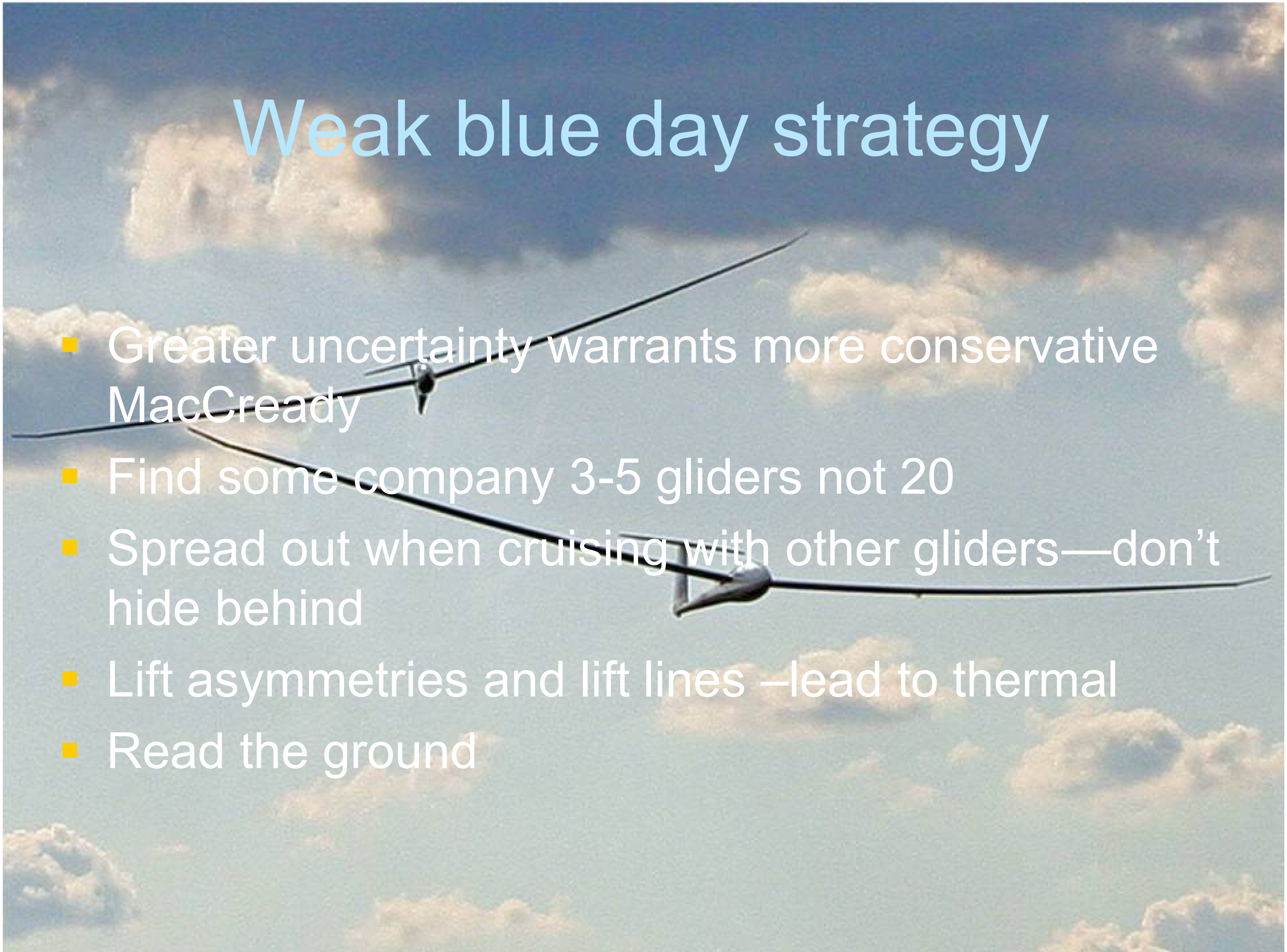
Blue thermal cruising

- Read the ground
- Streeting prominent on blue days
- Wind direction key!!!
  - Wind arrow on Ilec or GNII, etc
  - Streets almost always on the wind
  - Feel for the lines of lift and do this continuously
  - Deviate onto the lines of lift (energy paths)

Blue thermal cruising

- Go slower?– greater range when weak and blue
- Practice centering lines of lift on blue days
  - Feel for asymmetric lift, and make small turns into it
  - Try to sustain reduced sink – can augment achieved L/D substantially, extend range, lead to a thermal

Weak blue day strategy



- Greater uncertainty warrants more conservative MacCready
- Find some company 3-5 gliders not 20
- Spread out when cruising with other gliders—don't hide behind
- Lift asymmetries and lift lines –lead to thermal
- Read the ground

When to slow up (changing gears)

- Cochrane’s theory– progressive
- When going from cu to blue
- Approaching overdeveloped area
- Cirrus overcast ahead
- Known or visible wet area ahead—lake, known shower history, standing water,
- Multiple low gliders ahead
- Lots of whining on the radio
- “No see-um’s” ahead

Low saves

- Go slow for max range
- Look for birds, other gliders, dust devils
- ridges, rock piles, fire, smoke, edge of lake or woods
- Take anything and work its edges, especially up-wind-- be patient
- Quit at a safe altitude– know your limits

Water ballast

- Adjustable wing-loading
  - Slows climb directly, increased circle speed and diameter (farther away from core)
  - Improves glide performance-greater range, ave. speed
  - Rule of thumb-keep water if ave. lift 350 ft./min or more
  - Especially helpful on long streets, ridges

Water ballast use (cont.)

- Don’t dump too soon
- May need to dump a portion
  – Low saves
  – Thermals generally small in diameter

  Don’t dump in gaggle thermals

Water ballast (cont.)

- Check your system
- Practice before you go to a contest
  – Loading's a hassle
  – Flies differently

Adds an interesting element of complexity

What we really do

- Conservative MacCready dictates ave. Speed
- Plan ahead, WAY AHEAD
- Not a lot of zooming—gentle speed changes
- Slower with lower highly variable
- Major emphasis on best track (thus improved L/D)
- Extreme emphasis on finding best thermals
- Leave mediocre thermals as soon as safe

What we do (cont.)

- Major deviations are the norm
- Do what it takes to avoid out-landings
- Remember the sky usually is not falling
- Have fun, don't obsess about falling behind
- Everybody has a bad day sometime
- Practice, practice, practice
- Fly for speed every time you fly
- Get better!!!

Recommended reading

- Cross-Country Soaring: Helmut Reichmann
- Introduction To Cross-Country Soaring: Kai Gertson http://www.flsc.org/XCountry/Cross-CountryB0202.pdf
- The Price You Pay For MacCready Speeds: Wil Schuemann http://www.betsybyars.com/guy/soaring_symposia/

- Just A Little Faster Please: john Cochrane http://faculty.chicagogsb.edu/john.cochrane/research/Papers/#maccready

Let's fly

- The end