XC SOARING 2019

Famous Yogi Quotes

- 90% of This Game is Half Mental!
- It Ain't Over 'Til It's Over!
- Yogi Berra

- Famous BC Quote…You already know this stuff!!

What is Holding You Back?

- FEAR! of Landing Out!!
- You Must Control Your Mind
- You're a Soaring Pilot…Damn it
- Prepare for Land Outs with Other Pilots
- It is an Adventure and Only an Inconvenience

Psychological Factors

- Once Out of Glide of Home The Mental Part of XC Flying is Almost Always the Fear of Landing Out.
- The One Rule That Must be Obeyed is to Always Have a Safe Place to Land Within Range BUT That Doesn't Have to be an Airport.
- You Must Control Your Mind to be Able to Fly Well.
- Landing Out is Only an Inconvenience.
- The Attention You Pay to a Potential Outlanding is Directly Related to Your Altitude and Location.
- When You are High with Lots of Options Your Focus Has to be On Flying NOT Landing

What is XC Soaring?

- The Simple Answer is That it is Just Soaring but with the Possible Landing Not Being at Your Home Airport.
- Cutting the Cord That Attaches You to Your Home Airport is Liberating.
- If You Can Soar Within Glide of Home and Conditions Look Good Ahead You Can Soar There Too!!

What to Cover Here

- Preparation- Glider and Trailer
- Weather- But You Are Going Anyway
- Terrain
- Flying Skills
- XC Skills
- Flight Planning
- Execution and Analysis
- Safety

Preparation-Glider

- All Maintenance Done
- Familiarity with Instruments/Flight Computer
- Flarm Familiarity & Updated with All Files & Flarmnet
- Boulder Turnpoints and Airspace WARNING DEN Class B and Arrival/Departure Routes
- Map and Sectionals
- Tasks for Badge Flights Pre-Planned
- Water, Food, Relief System
- Land Out Kit

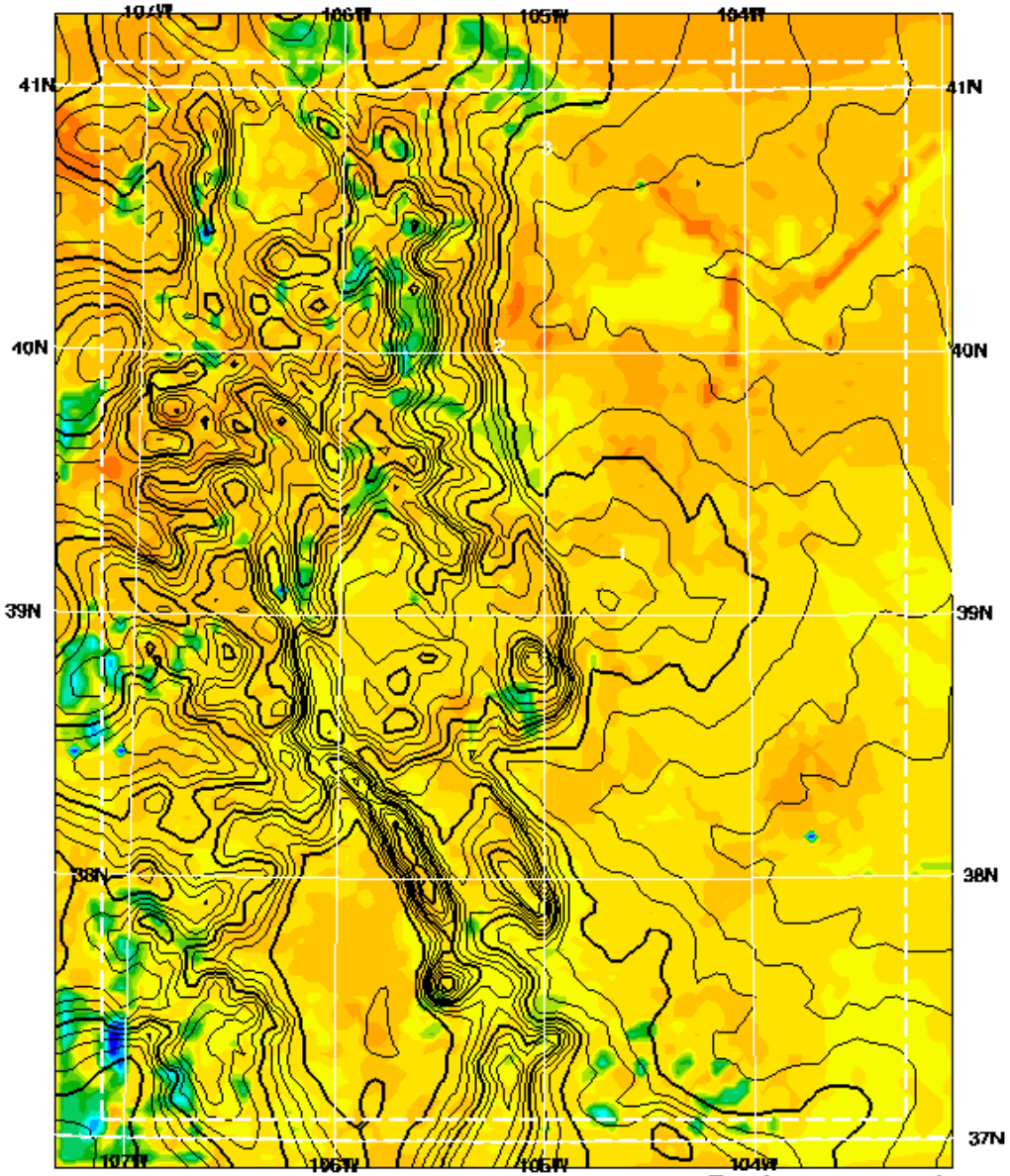
Preparation-Trailer/Retrieve

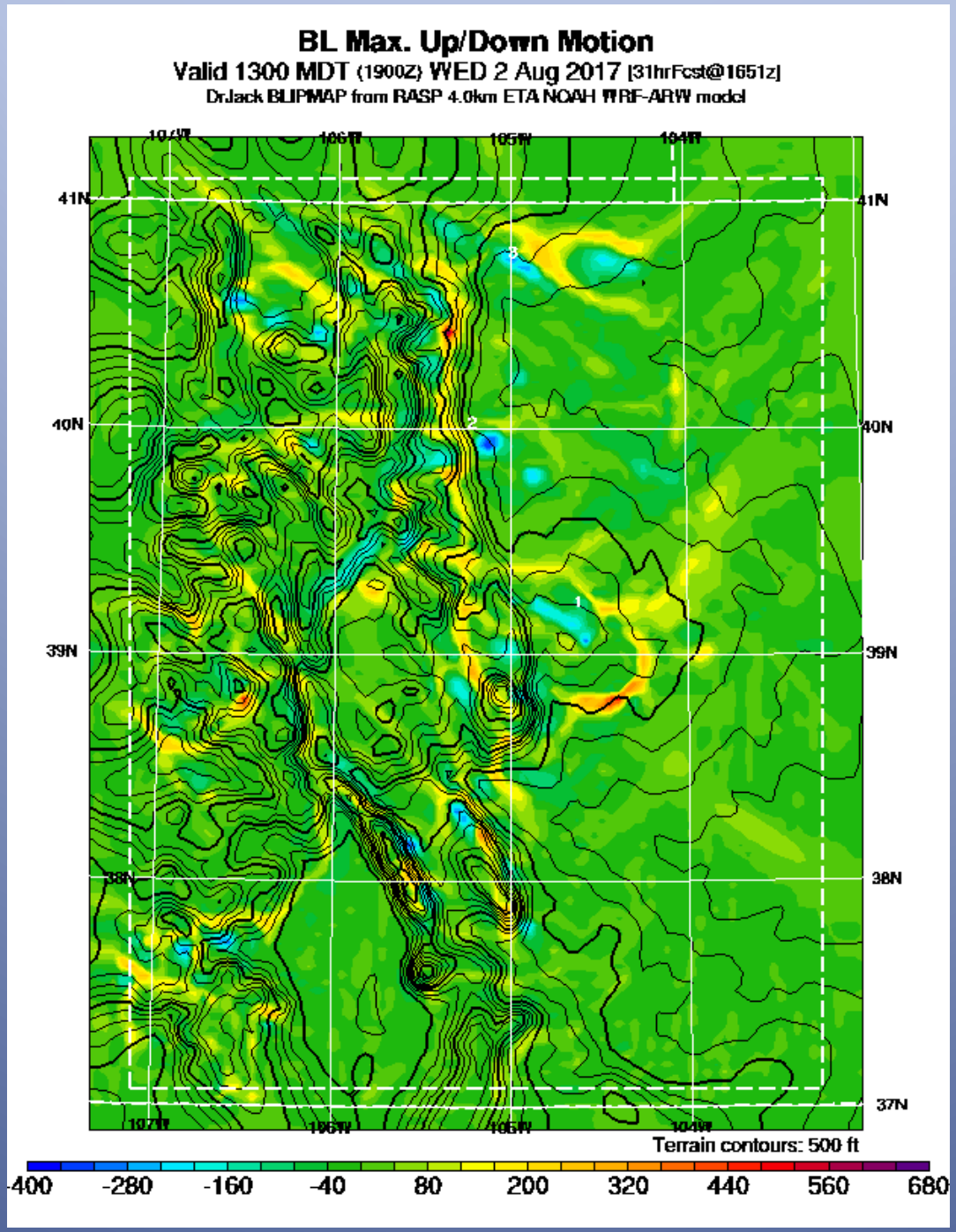
- Tires!!!, Fuel!!!, Registration, Insurance Card
- Tow Out Gear
- Lifting 2x4, Bolt Cutter, Fence Wire, Tools, Padlock, Ground Handling Equipment
- Phone List, Cell Phone, Spot, GPS, Handheld Radio
- Crew Plan
- Communicate

Thermal Updraft Velocity (W')

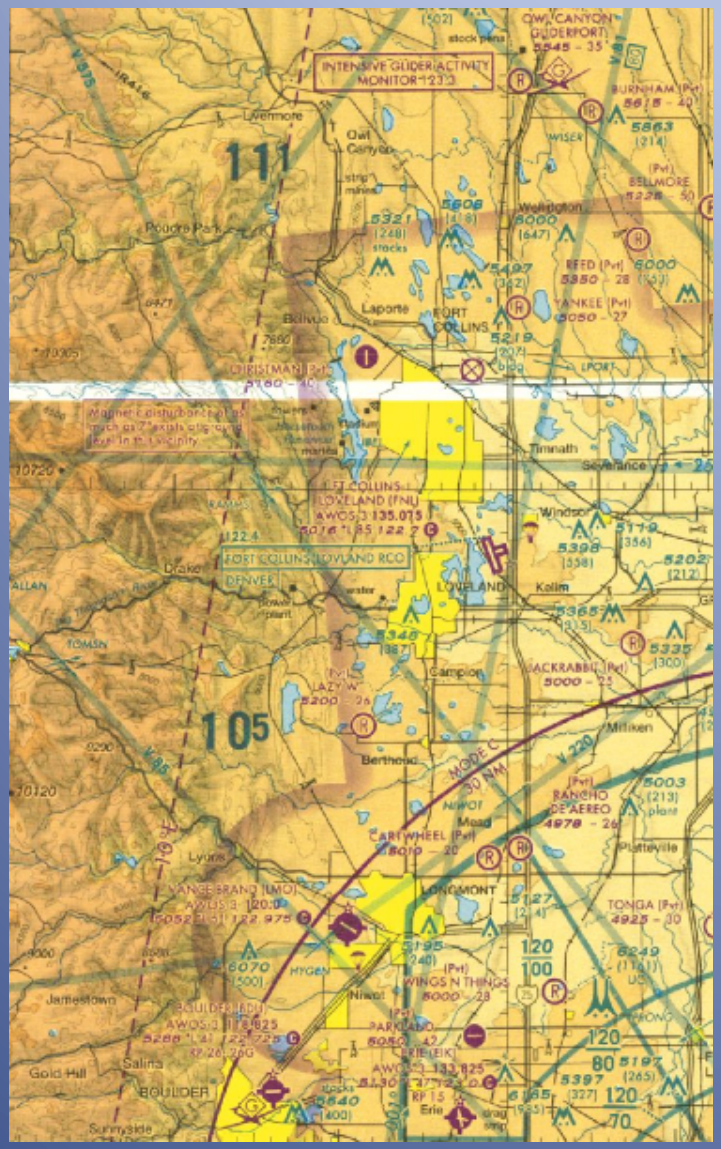
Valid 1300 MDT (1900Z) TUE 1 Aug 2017 [7hrFcst@1418z]

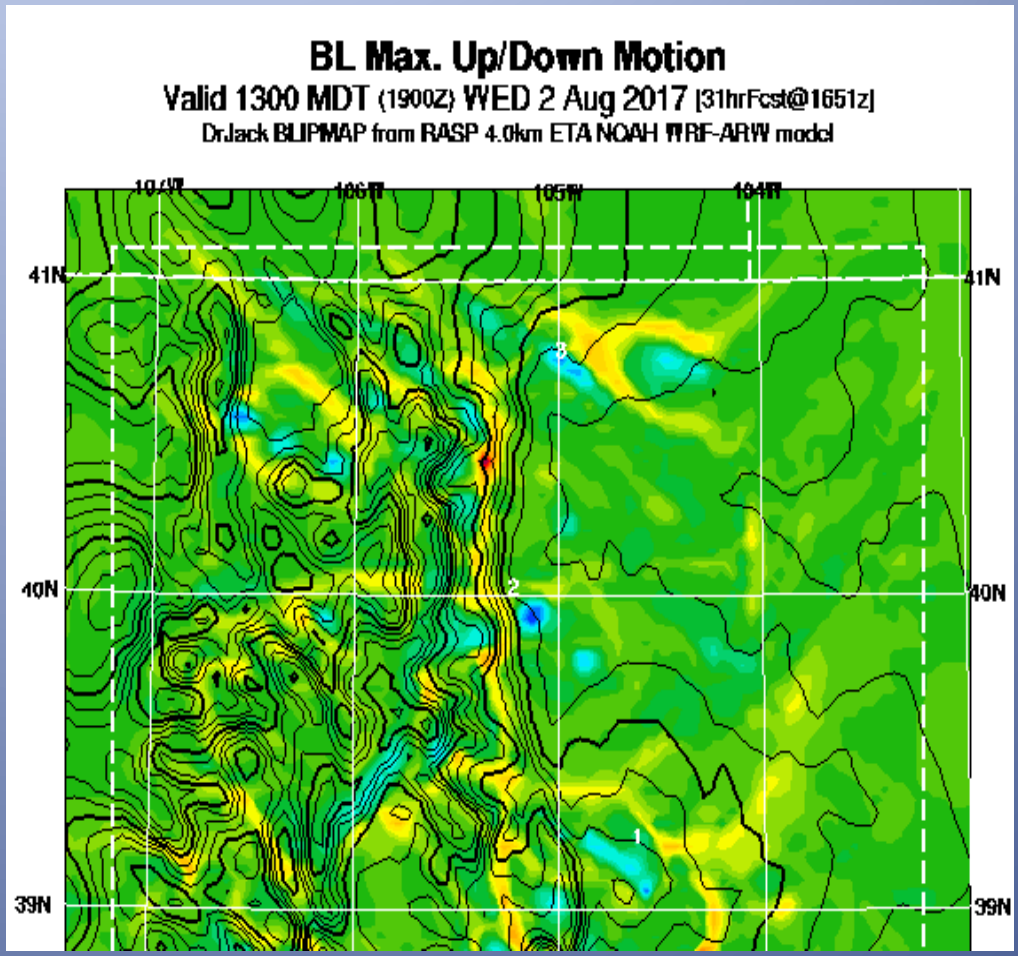
DrJack BLIPMAP from RASP 4.0km ETA NOAH WRF-ARW model




BL Max. Up/Down Motion
Valid 1300 MDT (1900Z) WED 2 Aug 2017 [31hrFcst@1651z]
DrJack BLIPMAP from RASP 4.0km ETA NOAH WRF-ARW model
41N
40N
39N
38N
37N
Terrain contours: 500 ft
-400
-280
-160
-40
80
200
320
440
560
680

Cheyenne Sectional



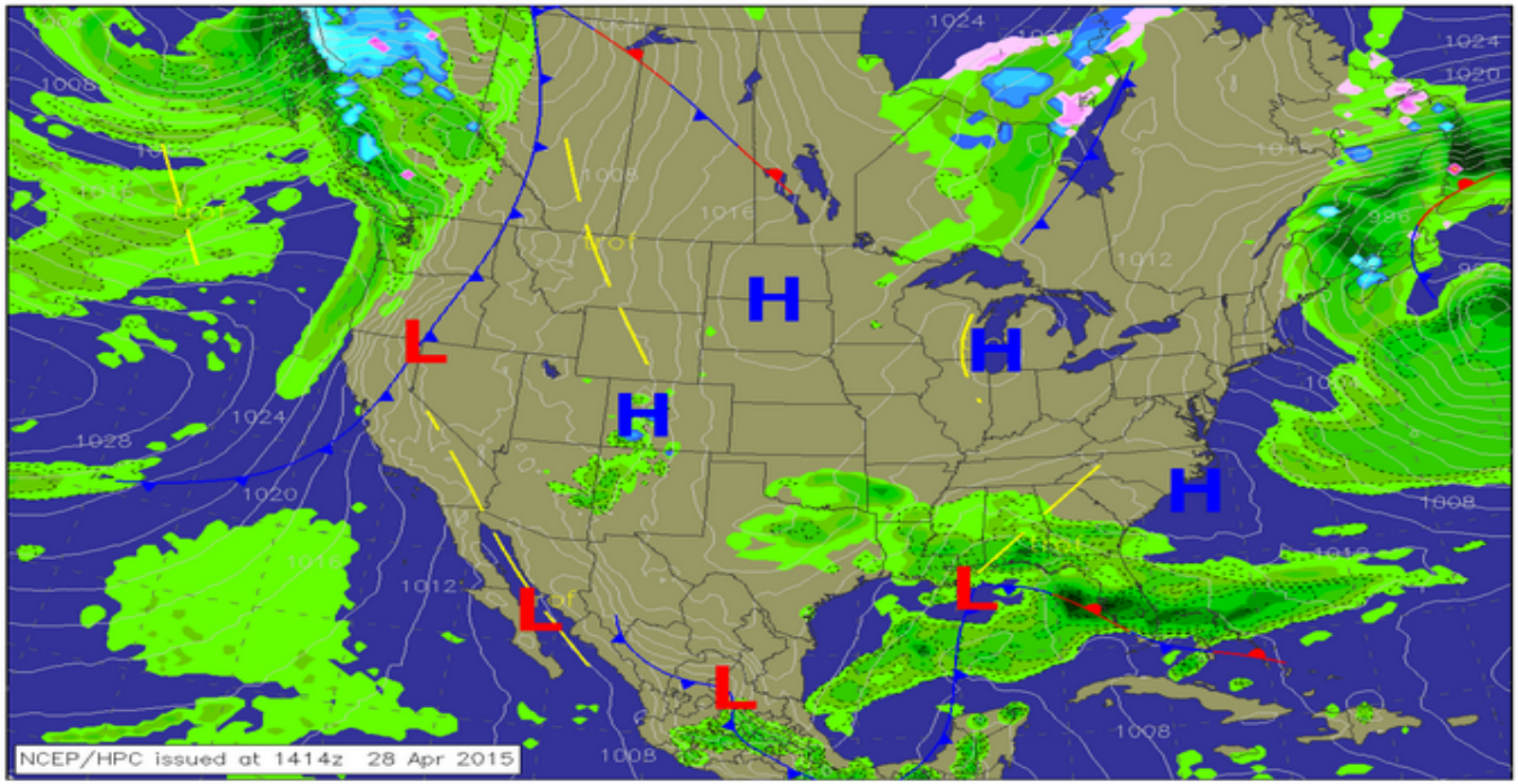


http://weather.rap.ucar.edu/progs/index.php?prog=12

Quick-look forecast charts. Click the Forecast tab above for more details.

previous forecast: 00 or next forecast: 24

12 hr forecast valid 0000 UTC Wed 29 Apr 2015



Satellite Imagery

Colin's Favorite the Water Vapor Loop

Images from GOES-12 and GOES-10 satellites:

- (•) Visible
- ( ) Infrared (Color)
- ( ) Infrared (B/W)
- ( ) Water Vapor*
- ( ) Shortwave IR*

*Contiguous U.S. images only

Multi-Spectral:

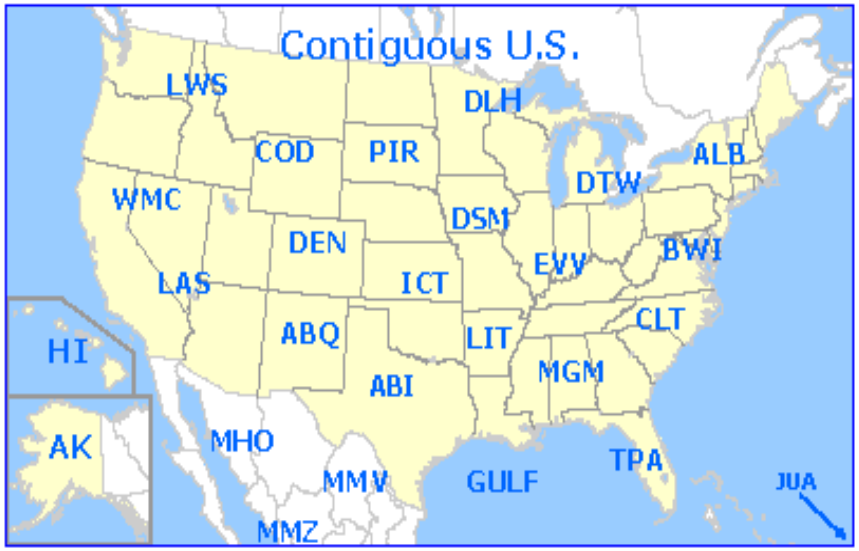
- ( ) Channels 2-4*
- ( ) s/w IR reflectance*
- ( ) Icing Product*

End date: Today

End time: Most recent

Loop duration: Single image

(•) Small size ( ) Large size



Satellite images from other internet sources

Links

- http://soaringdata.info/aviation/airportsTab.html
- http://soaringweb.org/TP
- http://soarbfss.org/rasp/univiewer.html
- http://www.drjack.info/BLIP/univiewer.html
- https://skysight.io/secure/
- http://weather.rap.ucar.edu/progs/index.php?prog=12

The Vario

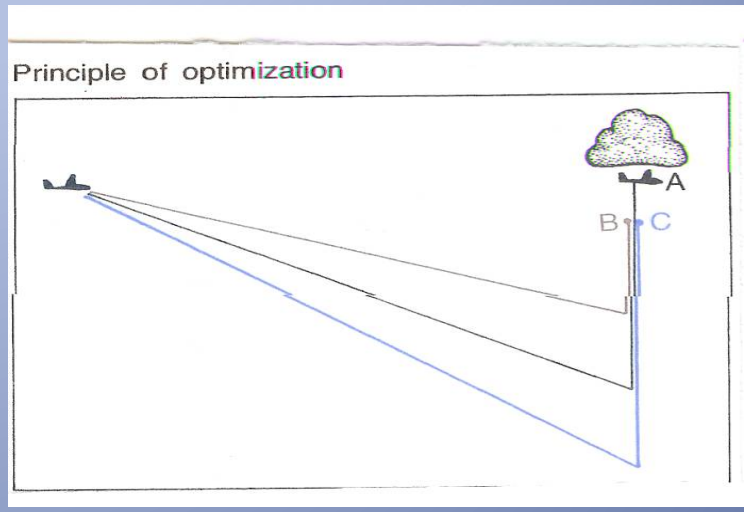
- The Questions the Vario Can Answer:
- Basic: How Fast are We Climbing or Descending? (Rate of Change of Static Pressure).
- TE (Total Energy): How Fast are We Gaining or Losing Energy? (Add in Airspeed)
- Netto: How Fast is the Air Mass Rising or Sinking? (Add in the Glider's Polar)
- Relative Netto: How Fast Would We Climb if We Circled? (Add in Circling Polar)

A little history

- Classic thermal x-country speed to fly theory was first published in 1938 by Wolfgang Spate
  - Used the theory to win 1938 Rhon competition
- About 1947 two independent pilots, Ernest Dewing and George Pirie, added vertical air motion between thermals to the theory
- So why is it now commonly called MacCready Speed to Fly theory?
  - MacCready published the design of a simple “Speed Selector” ring in a 1954 Soaring magazine article based on this theory.

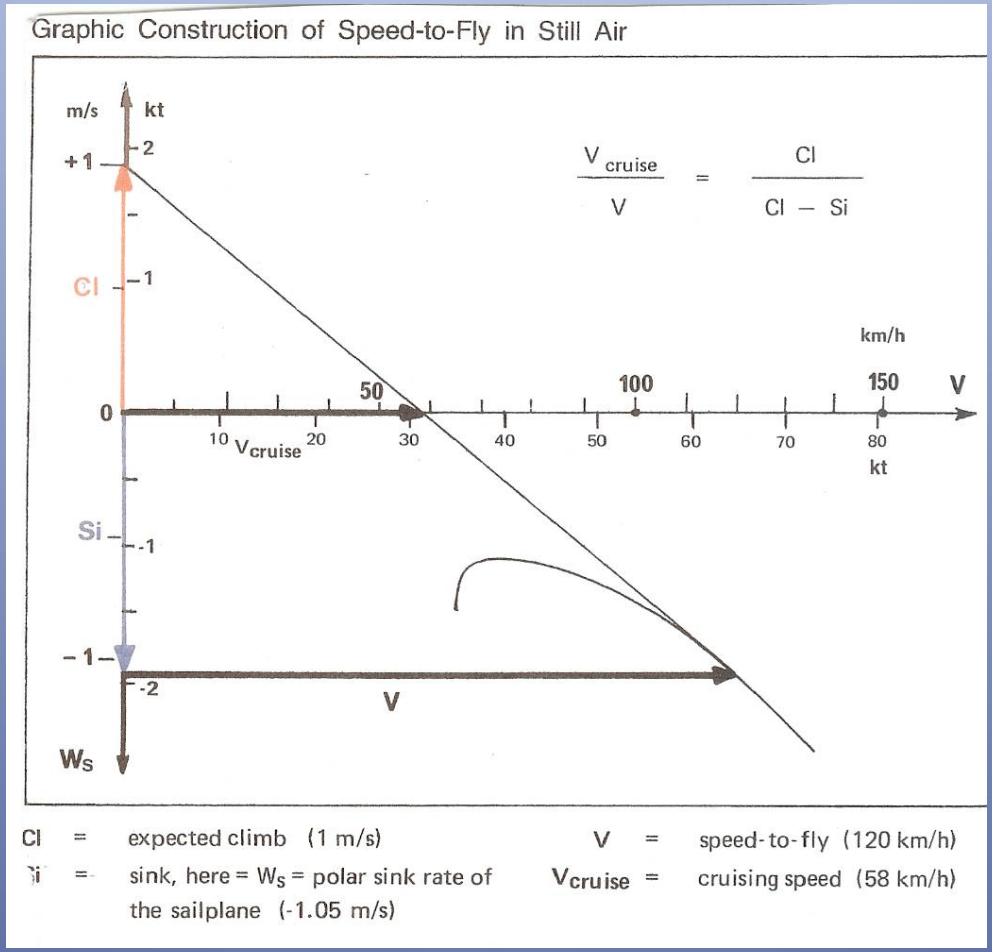
A bit of theory

- Classic speed to fly theory is based on optimizing avg x-country speed thermal to thermal



1) time = dist / velocity + height / climb rate
2) - height = (sink rate + air vert velocity) *dist / velocity
substituting 2) into 1) and….

Graphical interpretation of result

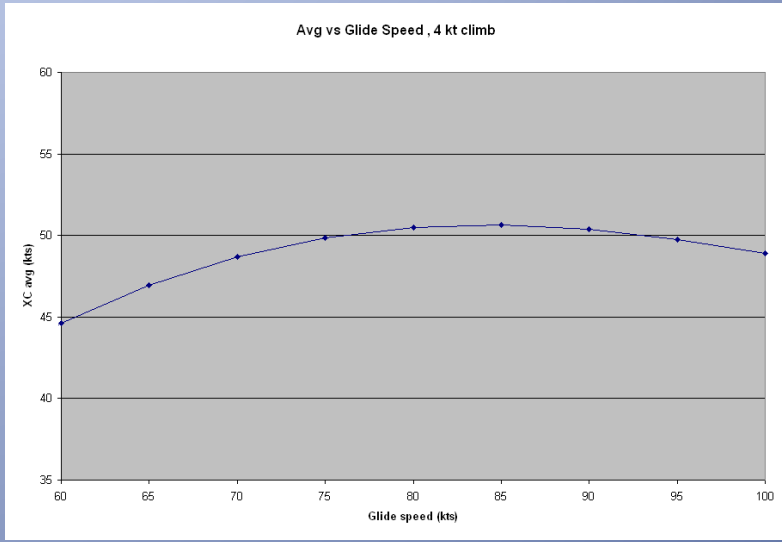


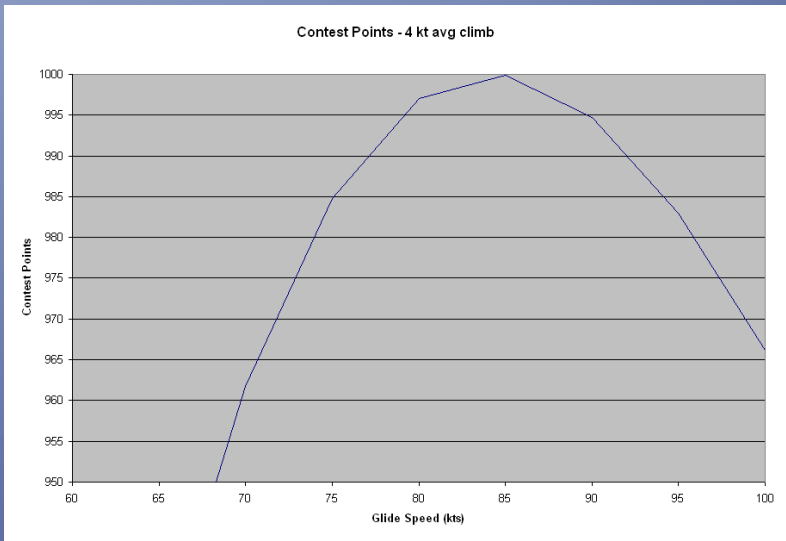
What do the Masters do?

- Moderate speed between thermals
  - Typically less than theory might indicate for achieved average climb rate
- Fly faster and more choosey when up high
- Fly slower and less picky when down low
- Mostly ignore speed-to-fly indicator
- Surprisingly large course deviations chasing good air

Why does that work so well?

- Flying 5-10 kts too slow costs very little
  - Improves chances of finding great thermal
  - Avoids getting stuck
- Deviations cost more time, but payoff can be bigger





A little more modern theory

- What is missing from the original classical theory is what climb rate / MacCready value to use in real conditions
- The problem is
  - We don't know where the next thermal is
  - We don't know how strong it is
- One approach is to assume the distribution of thermals is random and optimize accordingly

See "MacCready Theory with Uncertain Lift and Limited Altitude," *Technical Soaring* 23(3) (July 1999) 88-96, also available at http://faculty.chicagogsb.edu/john.cochrane/research/Papers/index.htm#For_glider

Thermal Rules of Thumb

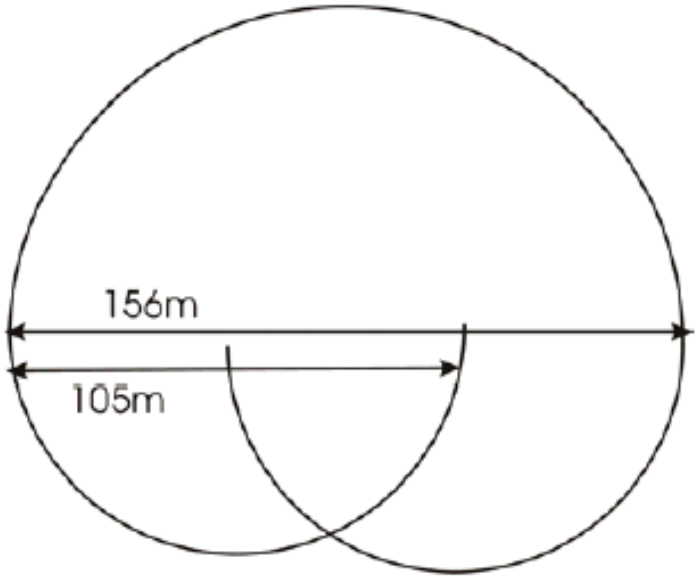
- Choose Good Thermals. You Can be Picky When High but Take Any Climb When Low.
- Fly Precisely: Bank Angle and Airspeed (Attitude). Make Centering Changes to Move Toward the Core or Away From the Weak Side.
- Get High and Stay High-BUT-Work an Altitude Band. 3000 Feet +/- Depending on the Day.
- Don’t Stop for Weak Lift Unless it is Required.
- Don’t Stop to Climb Unless You Can at Least Gain 1000 Feet.

Below is a chart giving angle of bank, on the left, against speed in knots along the top. The figures given in the grid are the diameter of the circle. E.g. a speed of 50 knots and 45° angle of bank will give a circle of 129 meters.

	40	45	50	55	60
30°	145	184	227	275	328
35°	112	152	188	227	270
40°	100	126	156	189	226
45°	82	105	129	156	186
50°	70	89	110	133	159
55°	59	74	92	111	132

Now let us consider a pilot with an angle of bank of 45° and speed from 45 Knots giving a circle of 105 meters diameter. He maintains this for half a turn, and follows it by a further half a turn of 40° at 50 Knots. The very small change in speed and angle of bank but giving 156-metre diameter turn, for the next half circle, It can now be seen that these small changes of speed and angles of bank will move the centre of the original circle by around 25%.

The answer is therefore fly accurately, fly very accurately.



XC Required Skills

- Flying Safely and Carefully…Autopilot
- Totally Comfortable with Your Aircraft
- Familiarity with Instruments/Flight Computer
- Map Reading and Basic Navigation
- Thermal Efficiency: Bank Angle, Airspeed (Attitude), Centering within Two turns
- Cruising: Holding Desired Course, Airspeed (Attitude), Speed to Fly-MacCready
- Recognizing the Route to Fly based on Weather
- Flight Planning, Tasks, Badges

XC Cruise Rules of Thumb

- MacCready Setting for Speed to Fly
- Modify MacCready by Probability Theory- Chances of Finding Lift Ahead – Not Complicated: When High and It Looks Good Ahead – Go Faster. When Low and Worried Slow Down
- Lift and Sink: Don't Chase the Needle (Unless it is REALLY Needed). You Will Be Late Responding to Changes. A Net Loss Will Occur

Planning and Flying Your Flight

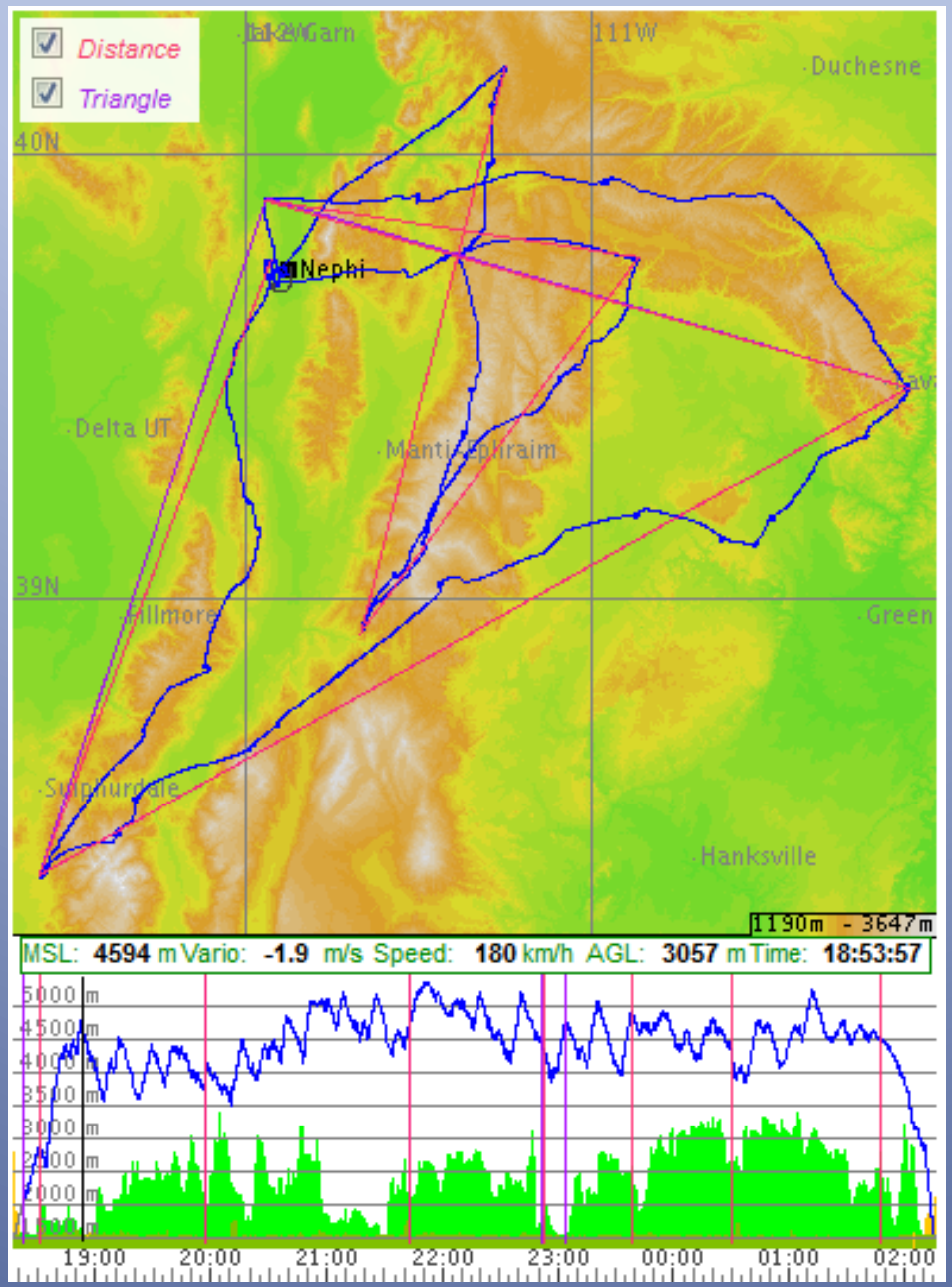
- Best Weather
- Choose your Flight Area: High Ground, Plains, Etc.
- Declared Badge, Contest Task or OLC (6 Legs Max Optimized to Max Distance)
- 3 Turnpoints or FAI Triangle
- Choice of Turnpoints is Important…Use Database or Create Your Own…Location and Elevation are Important

XC Flying Out of Boulder

- The High Ground Focus Lift/Clouds but OD First
- Convergence is Often the Key
- Blue Days - Follow the Ridges/High Ground
- Plains Flying with Clouds/Without Clouds
- Point A to B is Rarely a Straight Line, Fly Lift
- Turnpoint Choice is Critical
- Don't "Shade" Your Route to Airports. Colin's Rule: If You Insist on Landing at an Airport…You Will!
- Be Willing to Land Out

XC Flying Out of Boulder 2

- Weather on Course: Be Flexible, Willing to Divert or Change Plans. Constantly Evaluate.
- Work an Altitude Band. Get High and Stay High…But Work a 3000’ +/- Band. Selective Lift
- Weather at Home: It Doesn’t Matter Because it Will be Different When You Get There!! If You Go Home When the WX is Bad You Will Get There When it Sucks!!!
- Have a Plan and Fly It. Don’t Wonder Around. Be Decisive
- Don’t Ever Give Up!


Distance
Triangle
111W
Duchesne
40N
Nephi
Delta UT
Manti
Ephraim
39N
Fillmore
Green
Hanksville
1190m - 3647m
MSL: 4594 m Vario: -1.9 m/s Speed: 180 km/h AGL: 3057 m Time: 18:53:57
5000 m
4500 m
4000 m
3500 m
3000 m
2500 m
2000 m
1500 m
19:00
20:00
21:00
22:00
23:00
00:00
01:00
02:00

Flight statistics

Maximum altitude gained: 10873ft, low point 6769ft at 18:23:29, high point 17642ft at 21:51:56

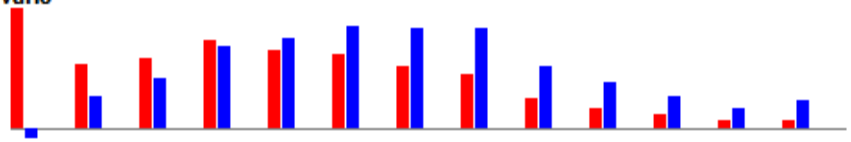
Circling:	Time	Vario	Alt.Gain	Alt.Loss	Thermals
Total	01:49:04 (23%)	4.7kts	54117ft	-2520ft	39
Left	00:44:27 (41%)	5.1kts	23835ft	-787ft	13
Right	01:04:37 (59%)	4.4kts	30282ft	-1732ft	26
Tries (<45s)	00:14:32 (3%)	1.1kts	3901ft	-2310ft	17

Straight:	Time	Dis.Done	Alt.diff	Netto	Avg.GS	IAS	Glides	Avg.Glide	Mean L/D
Total	06:04:21 (77%)	732.3mi	-53412ft	1.8kts	105kts	84kts	40	18.3mi	72
Rising	01:35:20 (26%)	172.6mi	53087ft	7.5kts	94kts	76kts			-17
Sinking	04:29:01 (74%)	559.8mi	-106499ft	-0.2kts	108kts	87kts			28
Netto rising	03:52:23 (64%)	463.1mi	22300ft	4.2kts	104kts	84kts			-110

Wind

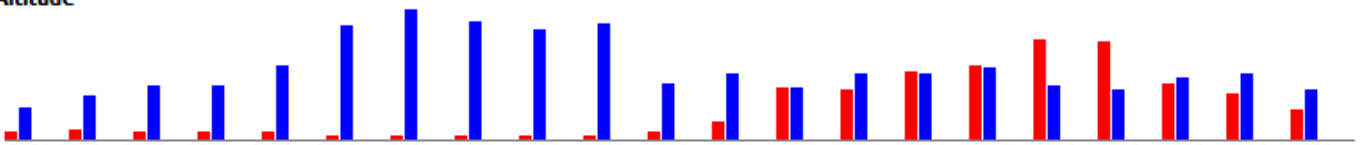
	<7250	7500	8000	8500	9000	9500	10000	10500	11000	11500	12000	12500	13000	13500	14000	14500	15000	15500	16000	16500	17000	17250>	
	5.1	1.9	2.0	2.9	3.7	5.0	2.2	3.2	1.3	2.5	9.5	18.1	34.7	35.7	54.1	59.2	72.7	65.1	36.7	35.0	18.3	5.0	[min]
	269°/4	192°/2	251°/3	176°/2	182°/2	258°/4	271°/7	274°/8	257°/7	247°/7	232°/5	220°/6	227°/6	242°/6	237°/6	246°/7	259°/7	251°/6	235°/7	223°/7	222°/8	196°/9	[°/kts]

Vario



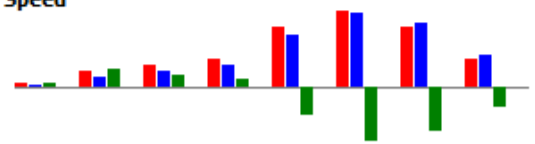
	<1.5	2	3	4	5	6	7	8	9	10	11	12	12.5>	
	19.0	10.2	11.1	13.9	12.4	11.7	9.7	8.7	4.7	3.1	2.1	1.2	1.3	[min]
	-722	2316	3507	5778	6289	7169	7008	7064	4419	3176	2198	1371	2024	[ft]

Altitude

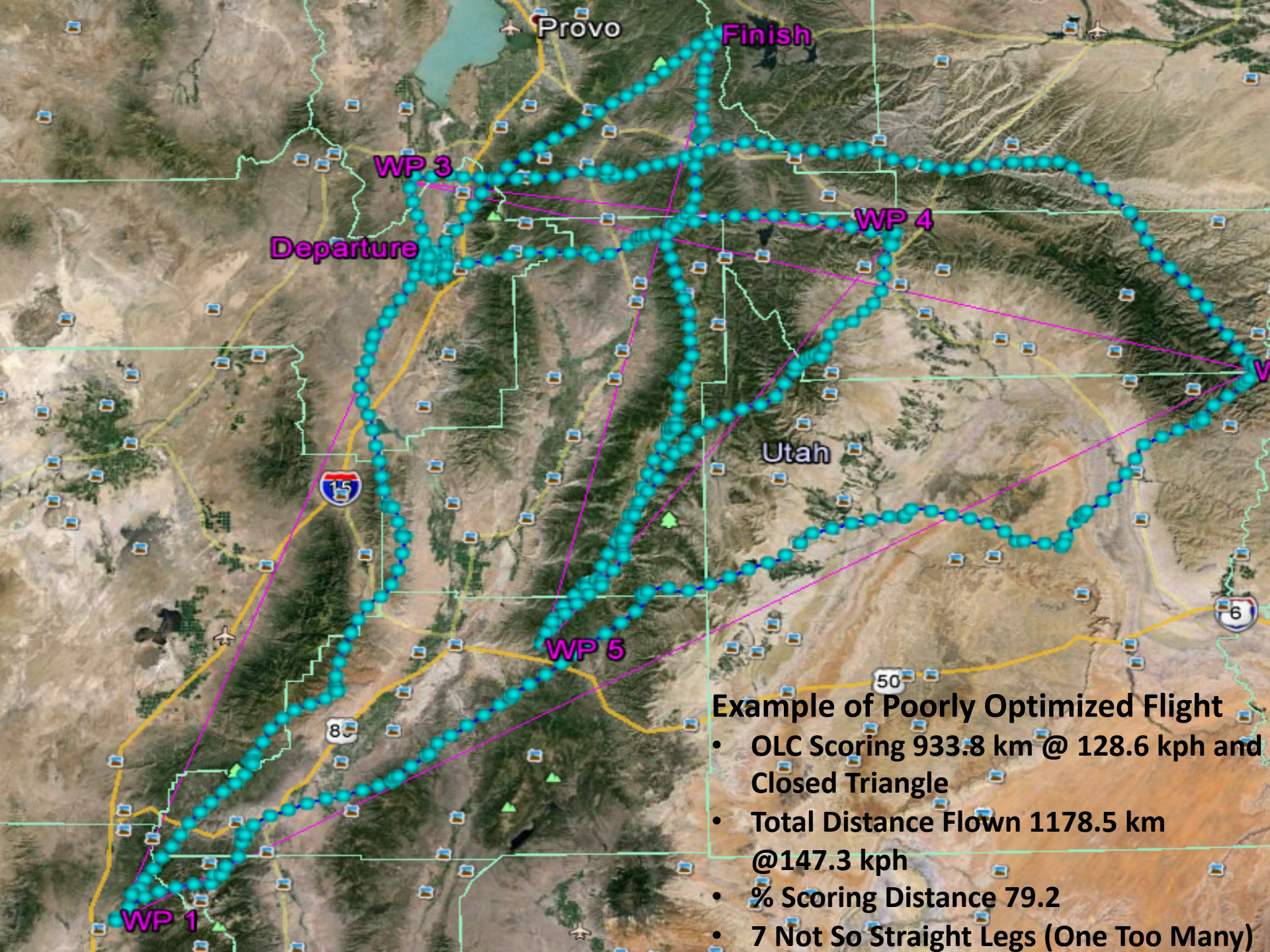


	<7250	7500	8000	8500	9000	9500	10000	10500	11000	11500	12000	12500	13000	13500	14000	14500	15000	15500	16000	16500	16750>	
	1.3	1.5	1.2	1.3	1.5	0.5	0.5	0.5	0.6	0.6	1.4	3.1	8.6	8.4	11.3	12.3	16.6	16.2	9.2	7.5	4.9	[min]
	2.4	3.3	4.0	4.0	5.6	8.6	9.7	8.8	8.1	8.7	4.2	5.0	3.9	5.0	5.0	5.4	4.1	3.8	4.6	5.0	3.7	[kts]

Speed



	<65	70	80	90	100	110	120	125>	
	5.5	20.3	27.6	34.3	73.7	94.2	74.0	34.8	[min]
	6.4	27.5	42.3	59.5	142.1	198.6	169.6	86.4	[mi]
	1745	8573	5748	3602	-14058	-26759	-21942	-10322	[ft]



Example of Poorly Optimized Flight

- **OLC Scoring 933.8 km @ 128.6 kph and Closed Triangle**
- **Total Distance Flown 1178.5 km @147.3 kph**
- **% Scoring Distance 79.2**
- **7 Not So Straight Legs (One Too Many)**