

RESULTS A

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INTRODUCTION

This is a collection of examples that I looked at while thinking about Line Following.

SUMMARY TABLE

Case No	START POINT	INTENDED DESINATION	COMMENTS
Cases 1 to 10A are based on Plover flights between Alaska and Hawaii. Various parameters are changed to show the effect on the Allowed Lines.			
1	Alaska 15 th August	Hawaii	dsr=24h 0m 35 kph. East of target
2	Alaska 15 th August	Hawaii	dsr=24h 0m 18 kph. East of target. Nearly same line as Case #1. However, each case must be treated on its merits. Flight speed can affect the line. You have to find out by how much.
3	Alaska 15 th August	Hawaii	dsr=25h 0m 35 kph. Does not reach target. Turns West too soon
4	Alaska 15 th August	Hawaii	dsr=24h 30m 35 kph. Reaches target
4A	Alaska 1 st August	Hawaii	Changed starting date. dsr=24h 30m 35 kph. Reaches target. Modest date changes do not affect the lines very much.
5	Alaska 1 st August	Hawaii	Changed starting date. dsr=24h 40m 35 kph. Does not reach target. Turns west too soon
6	Alaska 15 th August	Hawaii	dsr=23h 50m 35 kph. Well to the East of the target
7	Alaska 15 th August	Hawaii	dsr=23h 30m 35 kph. Even further to the East than Case #6. Shortening dsr moves the course to the East
8	Alaska 15 th August	Hawaii	dsr=23h 20m 35 kph. More East than Case #7
9	Alaska 15 th August	Hawaii	dsr=23h 10m 35 kph. Bird cannot match sunrise with its internal clock
10	Hawaii 7 th May	Alaska	dsr=24h 0m 35 kph. West of target
10A	Hawaii 7 th May	Alaska	dsr=23h 30m 35 kph. Reaches target. Shortening dsr moves the course to the East
Cases 11 to 15 deal with a small bird such as an Arctic Warbler <i>Acrocephalus borealis</i> flying from Alaska to the Philippines. Although there is an Allowed Line it is an enormously long path. More likely the birds would fly West to China and follow the coast.			
Cases 16 and 17 Bewick's Swans <i>Cygnus bewickii</i> flying between Russia and England			
Case 18 A Marsh Warbler <i>Acrocephalus palustris</i> flying south but resting between flight days. This is to explore Prof Bertold's picture.			
Cases 19 and 20 Ruby Throated Humming Bird <i>Archilochus colubris</i>			

Case #1

A bird starts from Anchorage on 15 August at sunrise, which is at 14:12 GMT, and flies at 35 km/hour in such a way that the subsequent sunrises are at 24 hour intervals so that the bird flies 840 km between sunrises. Then, by trial and error we find that the bird will leave on a course roughly 148° and will pass through the positions shown in the Table :

Date in August	Position	Course
15	61° 10'N 150° 01'W	148
16	54° 33'N 143° 07'W	152
17	47° 45'N 137° 51'W	158
18	40° 41'N 134° 07'W	162
19	33° 28'N 131° 20'W	163
20	26° 13'N 128° 52'W	166
21	18° 52'N 126° 56'W	166
22	11° 32'N 125° 04'W	168
23	04° 09'N 123° 30'W	171
24	03° 19'S 122° 19'W	
Great Circle Route 7458		This flight 7560 km

Of course, the table is somewhat of an idea; the bird can be blown of course, it might not be able to see sunrise sometimes, and might, therefore, have to make substantial corrections. If the bird sees a sunset too early, then it is too far east. The bird could equally well fly so that the sunsets were at 24 hour intervals. Note that this particular line will take the bird east of the Hawaiian chain.

Case #2

Consider the same 24 hour interval, but with the bird travelling at half the speed, say 18 km/hr and so travelling 432 km between surises.

Date in August	Position	Course
15	61° 10'N 150° 01'W	145
16	57° 55'N 145° 49'W	148
17	54° 34'N 142° 16'W	153
18	51° 04'N 139° 28'W	156
19	47° 30'N 137° 08'W	158
20	43° 53'N 135° 07'W	159
21	40° 14'N 133° 18'W	160
22	36° 34'N 131° 39'W	163
23	32° 51'N 130° 18'W	166
24	29° 05'N 129° 14'W	166
25	25° 19'N 128° 12'W	

So halving the speed does not noticeably affect the line followed. The bird just takes longer to get to the same destination area. However, it is not generally true that speed does not affect the line; you have to work out the line taken for each speed.

Case #3

In the above case, the bird flies on a line which will pass well to the east of the Hawaiian chain. Let us assume therefore that it flies in such a way that sunrises are separated by 25 hours instead of 24 hours so that at 35 km/hr it flies 875 km between sunrises. As before the

bird starts from Anchorage on 15 August at sunrise, which is at 14:12 GMT. A little arithmetic soon shows that the bird cannot follow such a course to any purpose; it will soon be flying due West.

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	211
16	15:12	54° 28'N 157° 47'W	260
17	16:12	52° 24'N 170° 33'W	

Case #4

As in Case #1 a bird starts from Anchorage on 15 August at sunrise, which is at 14:12 GMT, let the bird fly at 35 km hour. Let the bird fly so that sunrises are separated by 24h 30 mins so that the bird flies 857.5 km between sunrises. The bird is again assumed to leave at sunrise, 14:12 GMT, on 15th August.

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	177
16	14:42	53° 28'N 149° 20'W	193
17	15:12	45° 55'N 151° 49'W	204
18	15:42	38° 48'N 155° 50'W	212
19	16:12	32° 09'N 160° 39'W	222
20	16:42	26° 17'N 166° 24'W	226
21	17:12	20° 48'N 172° 20'W	230
22	17:42	15° 44'N 178° 28'W	236
23	18:12	11° 20'N 175° 01'E	240
24	18:42	07° 25'N 168° 17'E	242
25	19:12	03° 45'N 161° 28'E	
Great Circle 7177		This flight 8575 km	

And this course is taking the bird further west than the 24-hour-interval course. So the longer the interval between observed sunrises, the more westerly the bird is heading. This particular interval will bring the bird over the island chain. The flight distance is about 8575 km and it should be noticed that this route is energetically very disadvantageous because the great circle distance is only 4328 km; the bird has flown twice distance of the direct path. See Case 10 A below for the return flight.

Case #4A (Effect of starting date)

As in Case #4 a bird starts from Anchorage but on the 1st of August instead of 15 August. Sunrise is at 13:37 GMT, and as before let the bird fly at 35 km hour. Let the bird fly so that sunrises are separated by 24h 30 mins so that the bird flies 857.5 km between sunrises. The bird is again assumed to leave at sunrise.

Date in August	SRX	Position	Course
01	13:37	61° 10'N 150° 01'W	161
02	14:07	52° 48'N 145° 52'W	185
03	14:37	45° 07'N 146° 49'W	197
04	15:07	37° 42'N 149° 40'W	207
05	15:37	30° 45'N 153° 44'W	215
06	16:07	24° 21'N 158° 35'W	220
07	16:37	18° 21'N 163° 48'W	

This also brings the birds across the island chain. So give or take a few days, the departure date doesn't matter

Case #5

A bird starts from Anchorage on 15 August at sunrise, which is at 14:12 GMT, let the bird again fly at 35 km/hr and let the sunsets be separated by 24h 40 mins so that the bird flies 863.34 km between sunrises

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	188
16	14:52	53° 28'N 151° 50'W	210
17	15:32	46° 32'N 157° 28'W	220
18	16:12	40° 43'N 164° 03'W	236
19	16:52	36° 06'N 172° 01'W	252
20	17:32	33° 22'N 179° 08'E	
Great Circle 3653 km		This flight 4317 km	

The course cannot be continued after this even flying due west; the sunrise appears too early.

There is a problem here, because we know Mead p58 that the Arctic Warbler can fly from Anchorage to the Philippines (15° 00'N 122° 00'E). See Case 11 below.

Case #6

A bird starts from Anchorage on 15 August at sunrise, which is at 14:12 GMT, let the bird again fly at 35 km/hr and let the sunsets be separated by 23h 50 mins so that the bird flies 834.2 km between sunrises

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	137
16	14:02	55° 20'N 141° 01'W	141
17	13:52	49° 16'N 133° 47'W	144
18	13:42	43° 01'N 127° 45'W	145
19	13:32	36° 44'N 122° 23'W	146
20	13:22	30° 24'N 117° 32'W	148
21	13:12	23° 58'N 113° 11'W	
Great Circle 4921 km		This flight 5005 km	

This flight is more easterly than the 24 hour flight. Passes well to the East of Hawaii.

Case #7

A bird starts from Anchorage on 15 August at sunrise, which is at 14:12 GMT, let the bird again fly at 35 km/hr and let the sunsets be separated by 23h 30 mins so that the bird flies 822.5 km between sunrises

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	116
16	13:42	57° 18'N 137° 39'W	117
17	13:12	53° 25'N 126° 41'W	115
18	12:42	49° 48'N 116° 08'W	111
19	12:12	46° 41'N 106° 03'W	117
20	11:42	42° 57'N 97° 02'W	113
21	11:12	39° 42'N 88° 10'W	
Great Circle 4658 km		This flight 4935 km	

Shortening the time between sunrises forces the flight more to the East

Case #8

A bird starts from Anchorage on 15 August at sunrise, which is at 14:12 GMT, let the bird again fly at 35 km/hr and let the sunsets be separated by 23h 20 mins so that the bird flies 816.67 km between sunrises

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	105
16	13:32	58° 32'N 136° 30'W	105
17	12:52	55° 58'N 123° 35'W	102
18	12:12	53° 48'N 111° 21'W	100
19	11:32	51° 56'N 99° 34'W	100
20	10:52	50° 06'N 88° 15'W	095
21	10:12	48° 55'N 77° 05'W	
Great Circle 4606 km		This flight 4900 km	

Shortening the time between sunrises forces the flight more to the East

Case #9

A bird starts from Anchorage on 15 August at sunrise, which is at 14:12 GMT, let the bird again fly at 35 km/hr and let the sunsets be separated by 23h 10 mins so that the bird flies 810.83 km between sunrises

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	93
16	13:22	59° 58'N 135° 21'W	93
17	12:32	58° 48'N 121° 12'W	91
18	11:42	57° 55'N 107° 23'W	

After this point the bird cannot fly east fast enough to keep up with the sunrise.

Case #10 (Return Flight)

A bird starts from the Island of Necker (23° 35'N 164° 42'W) on 07 May at sunrise, which is at 16:23 GMT. Let the bird fly at 35 km/hr and let the sunsets be separated by 24 hours so that the bird flies 840 km between sunrises

Date in May	Position	Course
07	23° 35'N 164° 42'W	340
08	30° 39'N 167° 42'W	338
09	37° 36'N 171° 26'W	336
10	44° 26'N 175° 34'W	

And it is obvious that this will be a course which is too westerly to reach Alaska.

Case #10 A (Return Flight)

A bird starts from the Island of Necker (23° 35'N 164° 42'W) on 07 May at sunrise, which is at 16:23 GMT. Let the bird fly at 35 km/hr and let the sunsets be separated by 23 hrs 30 mins so that the bird flies 822.5 km between sunrises

Date in May	SRX	Position	Course
07	16:23	23° 35'N 164° 42'W	35
08	15:53	29° 34'N 159° 50'W	30
09	15:23	35° 54'N 155° 17'W	19
10	14:53	42° 51'N 152° 00'W	8
11	14:23	50° 10'N 150° 24'W	356
12	13:53	57° 32'N 151° 22'W	341
13	13:23	64° 26'N 156° 56'W	
Great Circle 4596 km		This flight 4935 km	

This course is crossing the coast a little to the west of Anchorage. Reducing the time interval pushes the course more east.

Case #11 Cases #11 to #15 deal with a small bird flying from Anchorage to the Philippines

Now return to the note at the bottom of Case #5 regarding the Arctic Warbler. We know Mead p58 that the Arctic Warbler can fly from Anchorage to the Philippines (15° 00'N 122° 00'E), and the most westerly course we can find on 15th August is to 33° 22'N 179° 08'E.

Let us try moving the date forward 14 days to the 29th of August. Sunrise at Anchorage is then at 14:48.

Let the bird again fly at 35 km/hr and let the sunsets be separated by 24h 40 mins so that the bird flies 863.34 km between sunrises. 35 km/hr might be fast for an Arctic Warbler, but in Case #2 revealed that speed wasn't important.

Date in August	SRX	Position	Course
29	14:48	61° 10'N 150° 01'W	203
30	15:28	53° 54'N 155° 09'W	217
31	16:08	47° 29'N 161° 53'W	230
01 Sept	16:48	42° 12'N 170° 05'W	243
02	17:28	38° 20'N 178° 55'W	255
03	18:08	35° 57'N 171° 48'E	
Great Circle 3109 km		This flight 4316 km	

Obviously this will not be far enough West. However, it is more west than Case #5.

It's interesting to note in passing that the curvature of the course is for increasingly West headings while Mead tends to draw the curves the opposite way round. This is just his imagination I think. No data is given.

Case #12

Again, let the bird leave Anchorage at sunrise 14:48 GMT on the 29th of August. Try increasing the time between sunrises.

Let the bird again fly at 35 km/hr and let the sunsets be separated by 24h 50 mins so that the bird flies 869.16 km between sunrises.

Date in August	SRX	Position	Course
29	14:48	61° 10'N 150° 01'W	216
30	15:38	54° 34'N 157° 57'W	235
31	16:28	49° 38'N 167° 51'W	254
01 Sept	17:18	46° 56'N 178° 53'W	

The course cannot be followed further; even flying due west sunrise is earlier than expected.

Case #13

Try moving the date forward by a month to 30th September. Sunrise is at 16:07 GMT. Let the bird again fly at 35 km/hr and let the sunsets be separated by 24h 40 mins so that the bird flies 863.34 km between sunrises.

Date	Position	Course
30 Sept	61° 10'N 150° 01'W	229
01 Oct	55° 37'N 160° 25'W	

It is obvious that this isn't going to work

Case #14

After looking back at Cases #4 and #5 I am wondering whether the bird leaving at sunrise 14:12 GMT on 15th August could not fly with 24h 35 mins between sunrises a distance of 860.42 km at 35 km/hr

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	183
16	14:47	53° 26'N 150° 42'W	200
17	15:22	46° 06'N 154° 30'W	212
18	15:57	39° 24'N 159° 48'W	222
19	16:32	32° 29'N 166° 00'W	232
20	17:07	27° 32'N 172° 52'W	245
21	17:42	24° 03'N 179° 27'E	260
22	18:17	22° 29'N 171° 12'E	270
23	18:52	22° 16'N 162° 50'E	270
24	19:27	22° 03'N 154° 29'E	
Great Circle 6012 km		This flight 7743 km	

On 23 August actual sunset was one minute before 24h 35 mins. On 24 August actual sunrise was three minutes early. The bird can go on flying west and will pass a little to the N of the Philippines.

Case #15

Considering Cases #4 and #14 try letting the bird leave at sunrise 14:12 GMT on 15th August could not fly with 24h 33 mins between sunrises, a distance of 859.25 if the bird is flying at 35 km/hr

Date in August	SRX	Position	Course
15	14:12	61° 10'N 150° 01'W	182
16	14:45	53° 27'N 150° 28'W	196
17	15:18	45° 59'N 153° 31'W	208
18	15:51	39° 04'N 158° 11'W	220
19	16:24	33° 00'N 164° 06'W	227
20	16:57	27° 34'N 170° 28'W	234
21	17:30	22° 52'N 177° 15'W	243
22	18:03	19° 12'N 175° 28'E	250
23	18:36	16° 24'N 167° 54'E	258
24	19:09	14° 39'N 160° 05'E	268
25	19:42	14° 15'N 152° 07'E	270
26	20:15	14° 07'N 144° 09'E	
Great Circle to Manilla 8536 km		This flight continued to Philippine coast, approx 11,000 km	

Thereafter the bird is flying west and will pass over the Philippines in a further three days.

It has to be said that this looks a very risky adventure for a bird as small as the Arctic Warbler. It would have to fly for 14 days over the Pacific Ocean, and a distance of no less than 11,000 km. Not understanding the motivation of birds, one would think that a short flight West, followed by a relatively leisurely journey down the coast of China might serve them better.

Case #16

Consider the Bewick's Swans flying from North Russia. This is another very south westerly direction which we might find difficult for this method of flying. The swans nest in the tundra generally near the latitude of the arctic circle. They can be found all along the north shore of Russia and, as far as is known, they leave the western parts of this area at the end of September and fly to Western Europe including the UK. I suppose that the birds nesting in the eastern part of Russia simply fly west, and start earlier.

Consider, by trial and error, some flights from the Kanin Peninsula 68°N 46°E to southern England 51°N 02°W. The total distance is 3176 km. Eventually we find the following : Suppose the birds leave on 01 October and fly at 50 km/hr and arrange to see sunrises separated by 25 hrs 20 mins. The distance flown each day is 1266.5 km. Sunrise is 03:11 GMT on 1st October.

Date in October	SRX	Position	Course
01	03:11	68° 00'N 46° 00'E	242
02	04:31	60° 57'N 24° 57'E	256
03	05:51	56° 29'N 04° 38'E	270
04	07:11	54° 49'N 15° 25'W	
Great Circle to 54°N 2° W 2911 km		This flight taken to 54°N 2° W only, approx 2900 km	

Then the birds are flying across northern England on their third day.

Case #17

Bewick's Swans flying back to Russia.

Consider, by trial and error, some flights from southern England 51°N 02°W to the Kanin Peninsula 68°N 46°E. Eventually we find the following : Suppose the birds leave on 10 March and fly at 50 km/hr for 23 hrs so that the birds fly 1150 km between sunrises. Sunrise is 06:36 GMT on 10th of March.

Date in March	SRX	Position	Course
10	06:36	51° 00'N 02° 00'W	55
11	05:36	56° 02'N 13° 16'E	44
12	04:36	62° 38'N 29° 00'E	32
13	03:36	70° 48'N 45° 20'E	
Great Circle to 3176 km		This flight 3450 km	

Case #18 Marsh Warbler flying south

Here, we shall address Berthold's scenario with birds flying one day in five. He says p75 para 2 :

"But even songbirds, such as Marsh Warblers, can be on the move for a considerable length of time (Fig 5.14). Marsh Warblers start to leave Central Europe by mid-July, pass through Ethiopia from mid-August, arrive in Kenya from October onwards and are not found in large numbers in South Africa until the end of December or January. Their outward migration thus

lasts six months, which means that, with the additional three months needed for their return, they are on the move for about three quarters of the year.”

We shall fix our attention on the flight south from Central Europe 15 July to Ethiopia 15th August. This is pretty well South on the 40°E meridian and from 50°N to 10°N. The distance is 4448 km, so the birds cover $4448/31 = 143$ km a day on average.

By trial and error, assuming the birds do actually fly every day, we find that if we let the birds leave at sunrise on 15 July, and fly at 5.94 km/hr then they will travel 143 km a day between sunrises separated by 24 hrs + 3mins (24.05 hrs)

Date in July	SRX	Position	Course
15	01:30	50° 00'N 40° 01'E	160
16	01:33	48° 47'N 40° 40'E	158
17	01:36	47° 35'N 41° 23'E	156
18	01:39	46° 24'N 42° 09'E	160
19	01:42	45° 11'N 42° 46'E	165
20	01:45	43° 56'N 43° 14'E	165
21	01:48	42° 41'N 43° 41'E	165
22	01:51	41° 26'N 44° 08'E	170
23	01:54	40° 10'N 44° 26'E	175
24	01:57	38° 54'N 44° 43'E	175
25	02:00	37° 37'N 44° 51'E	170
26	02:03	36° 21'N 45° 08'E	170
27	02:06	35° 05'N 45° 24'E	170
28	02:09	33° 49'N 45° 40'E	175
29	02:12	32° 32'N 45° 48'E	180
30	02:14	31° 15'N 45° 48'E	180
31	02:17	29° 58'N 45° 48'E	180

Date in August	SRX	Position	Course
01	02:20	28° 41'N 45° 48'E	180
02	02:23	27° 24'N 45° 48'E	185
03	02:26	26° 07'N 45° 41'E	185
04	02:29	24° 50'N 45° 34'E	185
05	02:32	23° 33'N 45° 27'E	190
06	02:35	22° 17'N 45° 13'E	190
07	02:38	21° 01'N 45° 59'E	195
08	02:41	19° 46'N 44° 38'E	195
09	02:44	18° 31'N 44° 17'E	195
10	02:47	17° 16'N 43° 56'E	195
11	02:50	16° 01'N 43° 35'E	195
12	02:53	14° 46'N 43° 14'E	195
13	02:56	13° 31'N 42° 53'E	195
14	02:59	12° 16'N 42° 33'E	195
15	03:02	11° 01'N 42° 13'E	

NOTE : To get the time interval roughly, I let the bird fly 143 km due south everyday and worked out its position. Then I found the time of sunrise at that position. The change from day to day was 24hrs + 6 mins at the start and 24 hrs + 1 min at the end. I therefore fixed a period of 24 hrs + 3 mins.

Case #19 Ruby Throated Hummingbird *Archilochus colubris* Going South

The latest time this bird has been recorded in the USA is 18 Oct. It breeds all the way up the Eastern half and up into Canada. It is assumed here to leave the southern parts say 32N 85W near to Montgomery, Alabama on 20th September and fly generally across the Gulf of Mexico at 35 kph. Experiment reveals that the birds can fly course which will take it over Tampico (most Westerly course) or just past the most Easterly point of South America. A time-between-sunrises of 24 hours would take the birds to the northern part of the Panama Republic.

Case #20 Ruby Throated Hummingbird *Archilochus colubris* Going North

The earliest recorded arrival is 27th March. So we could guess that the birds leave generally about 25th March from a nominal point near to Medellin, Columbia.

The birds can then fly a course along the Eastern side of the Central American Republics coming ashore near Brownsville to other more easterly courses which will take them into the known breeding areas. They can also fly course which are too far East and courses that are West enough to miss their observed breeding grounds. A time-between-sunrises of 24 hours would take the birds to Wilmington.

APPENDIX

Times of Sunrise and Sunset at Anchorage, Alaska

Date in August	Sunrise GMT	Time since previous sunrise	Sunset GMT	Time since previous sunset	Day length
10	13:59		06:13		16h 14m
11	14:02	24 hrs +3 mins	06:10	24 hrs -3 mins	16h 08m
12	14:05	+3	06:08	-2	16h 03m
13	14:07	+2	06:05	-3	15h 58m
14	14:10	+3	06:02	-3	15h 52m
15	14:12	+2	05:59	-3	15h 47m
16	14:15	+3	05:56	-3	15h 41m
17	14:17	+2	05:53	-3	15h 36m
18	14:20	+3	05:50	-3	15h 30m
19	14:22	+2	05:47	-3	15h 25m
20	14:25	+3	05:44	-3	15h 19m

CALCULATIONS OF THE PATHS

Assign the time between sunrises. Assign the speed of the bird. Work out the distance the bird will fly between sunrises. Use w.movable-type.co.uk > Destination Point given distance and bearing to obtain the new position. Work out the expected time of sunrise on the next day. Use Alcyone to work out the actual sunrise. If they don't agree adjust the bearing and try again.

GEOGRAPHICAL DETAILS

Anchorage in Alaska is at $61^{\circ} 10' N 150^{\circ} 01' W$

Hawaii, taken loosely, consists of a number of islands extending roughly 2000 km to the NW from Hawaii itself as shown in the table

Name	Position	Distance from previous island (km)
Midway	$28^{\circ} 13' N 177^{\circ} 22' W$	
Lisianski	$26^{\circ} 02' N 173^{\circ} 58' W$	411
Laysan	$25^{\circ} 42' N 171^{\circ} 44' W$	227
Gardner	$25^{\circ} 01' N 167^{\circ} 59' W$	384
Necker	$23^{\circ} 35' N 164^{\circ} 42' W$	368
Nihoa	$23^{\circ} 05' N 161^{\circ} 58' W$	284
Kauai	$22^{\circ} 00' N 159^{\circ} 30' W$	280
Oahu (Honolulu)	$21^{\circ} 25' N 158^{\circ} 00' W$	100
Molokai	$21^{\circ} 05' N 157^{\circ} 02' W$	50
Maui	$20^{\circ} 58' N 156^{\circ} 49' W$	85
Hawaii	$19^{\circ} 43' N 157^{\circ} 04' W$	145

Great circle distance Midway to Hawaii is 2450 km. I used w.movable-type.co.uk to calculate this and other great circle distances. At 1000 m altitude the horizon is 125 km distant.

Great circle distance from Anchorage to Honolulu is 4300 km

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