Verification of thermal forecasts with glider flight data

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Erland Lorenzen, Ralf Thehos, Germany

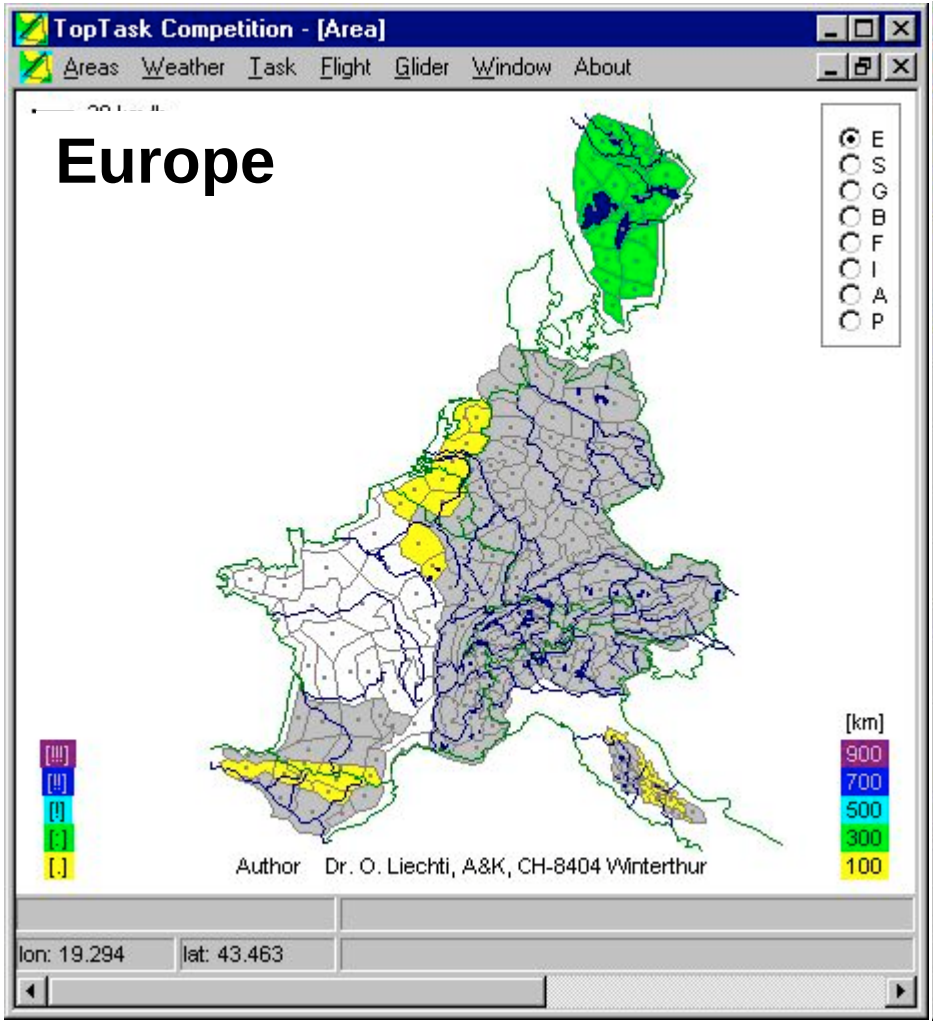
Bernt Olofsson, Esbjörn Olsson, Sweden

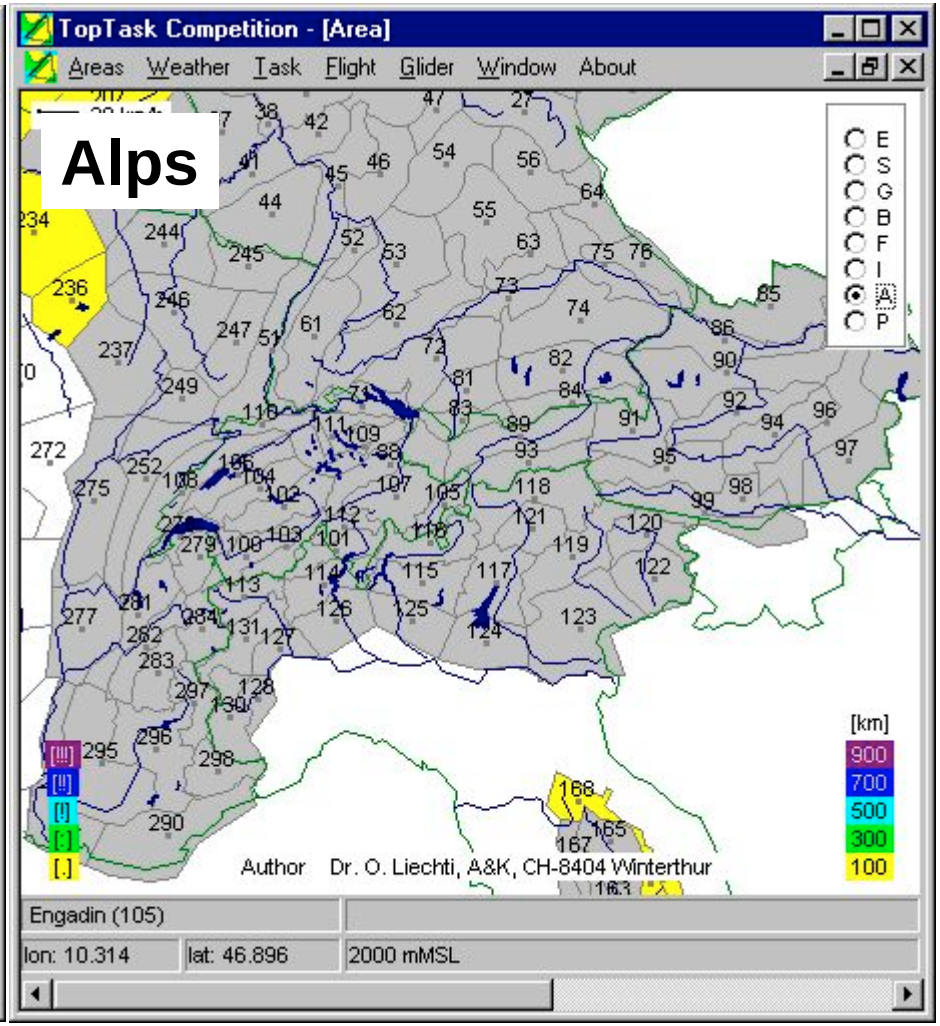
OSTIV Met Panel Berlin 2006

Outline

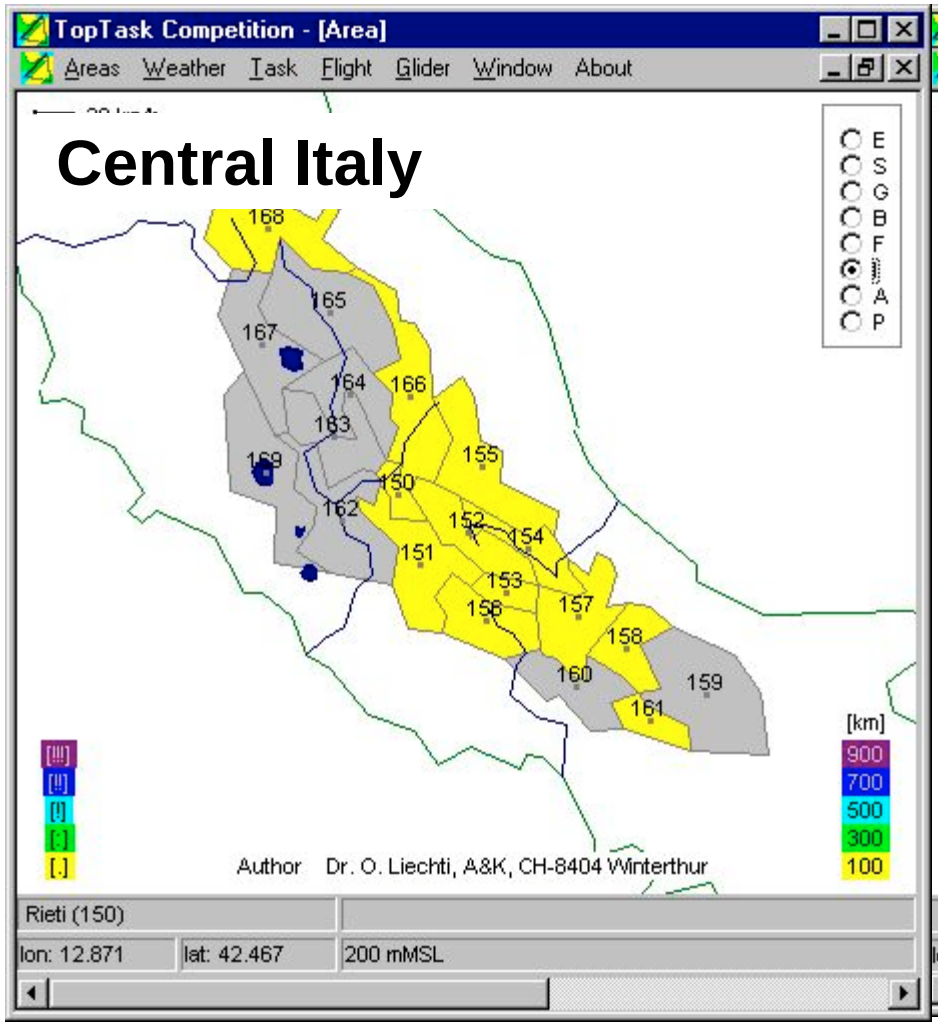
- **Regional thermal forecasts**
- **Meteorological flight planning**
- **Verification: Tasks, Flights**
- **Model intercomparison**

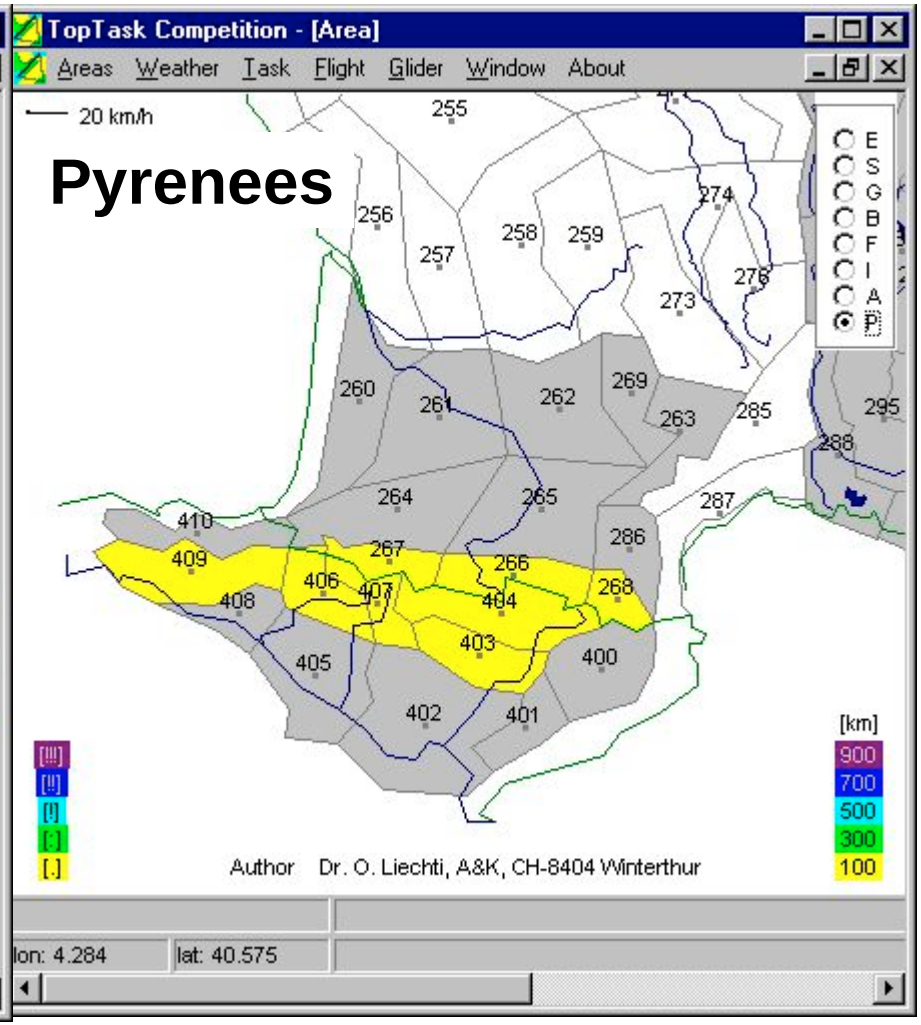
Forecast Regions





Topography


TopTask Competition - [Area]
Areas Weather Task Flight Glider Window About
Central Italy
E S G B F A P
168 165 167 164 166 163 169 155 150 162 152 154 151 153 156 157 158 160 159 161
[km]
900 700 500 300 100
Author Dr. O. Liechti, A&K, CH-8404 Winterthur
Rieti (150)
lon: 12.871 lat: 42.467 200 mMSL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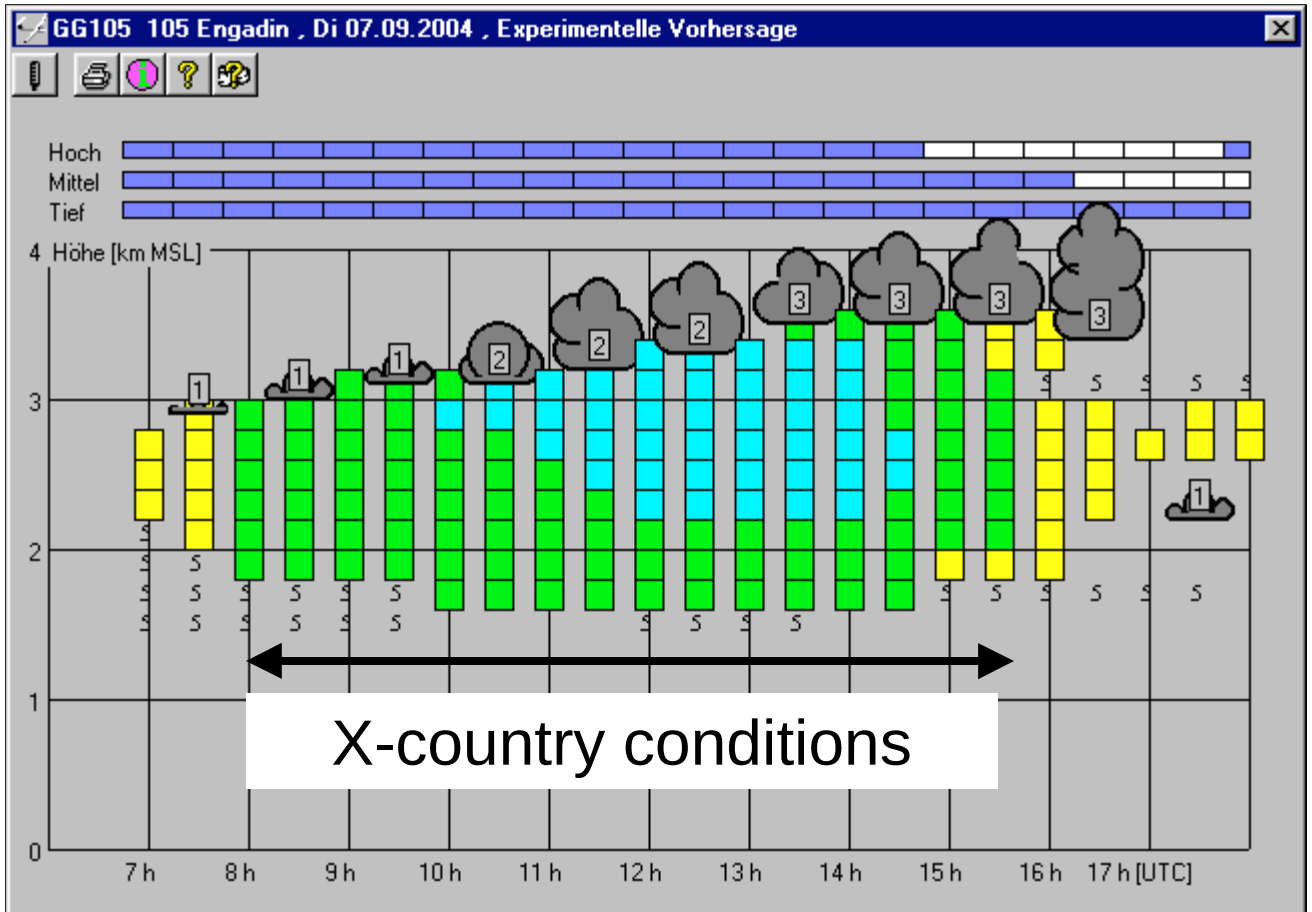
Areas Weather Task Flight Glider Window About
20 km/h
Pyrenees
E S G B F I A P
255 256 257 258 259 274 276 273 260 261 262 269 263 285 295 288 264 265 287 410 409 267 286 266 406 407 404 268 408 403 400 405 402 401
[km]
900 700 500 300 100
Author Dr. O. Liechti, A&K, CH-8404 Winterthur
lon: 4.284 lat: 40.575

Criteria for the Selection of Forecast Regions

homogeneous weather

- depth of convection
- cloud base altitude
- lift rate

Regional Forecast



Source: pc-met@DWD

Stratiform Clouds

Cumulus Clouds

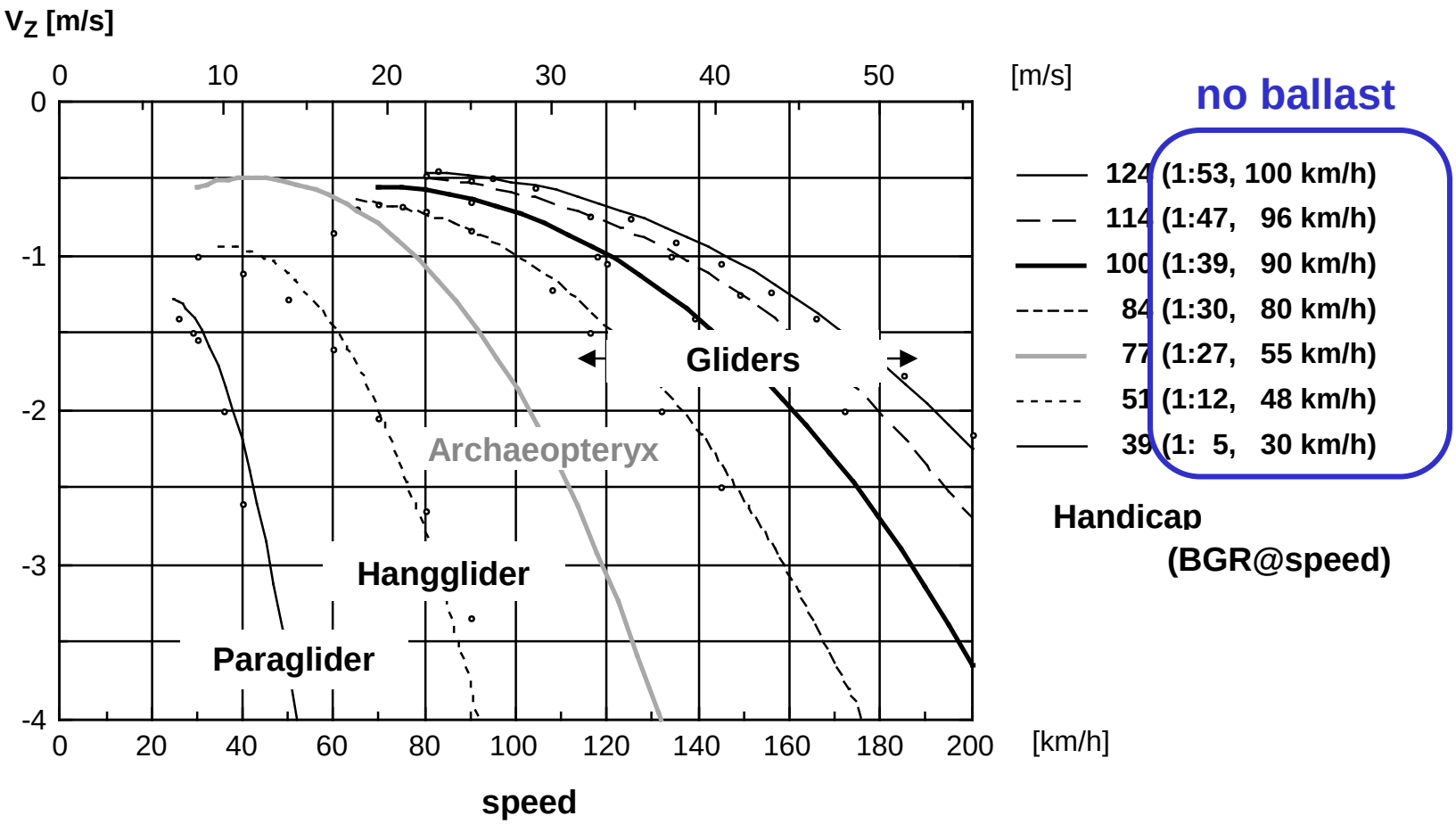
mittleres Steigen	Schichtwolken
< 0.1 m/s	0 Achtel
01. - 0.8 m/s	1-2 Achtel
0,9 - 2 m/s	3-4 Achtel
2,1 - 3 m/s	5-7 Achtel
> 3 m/s	8 Achtel

Avg. Lift **Clouds**

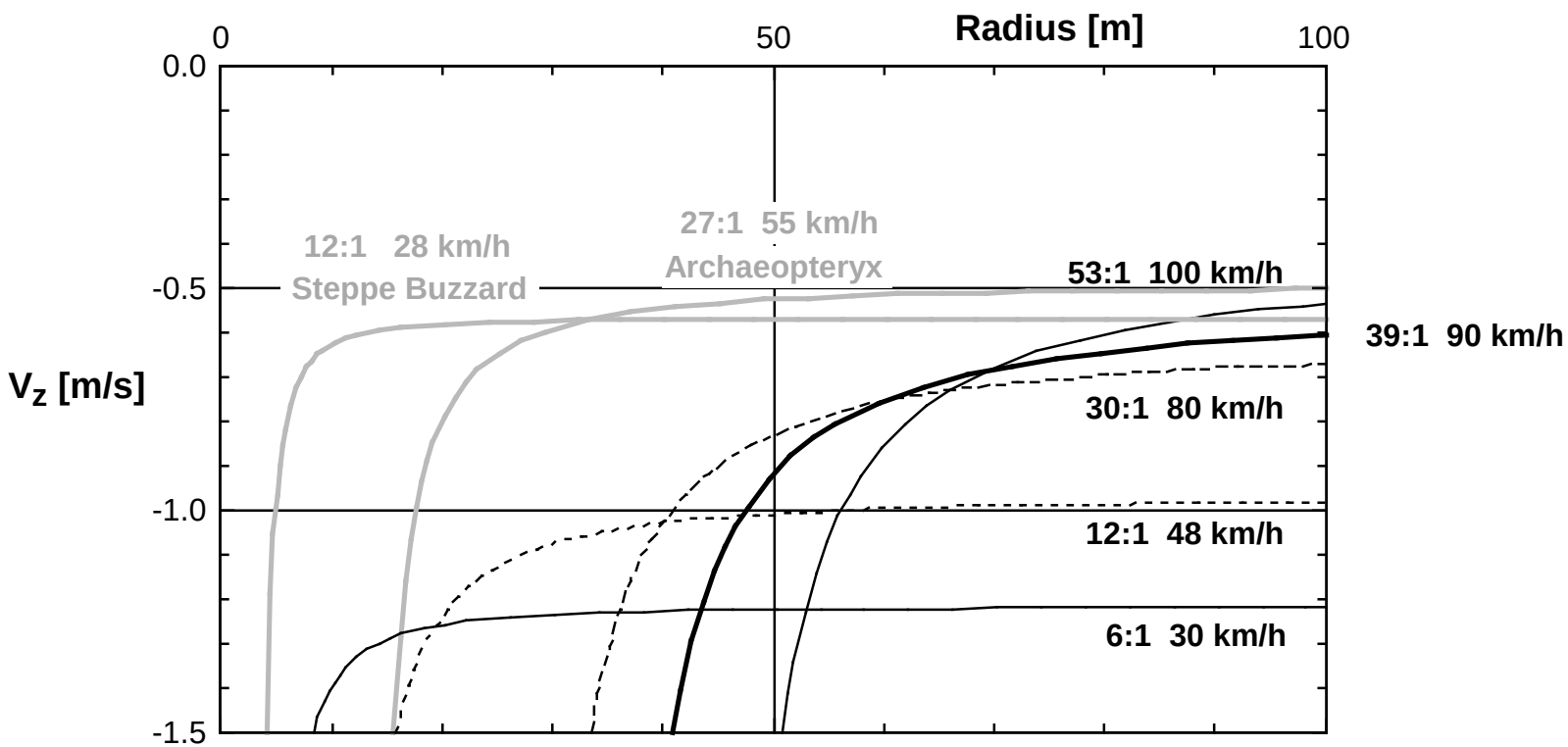
Meteorological flight planning

- flight polar
- speed to fly theory
- cruising speed
- potential flight distance (PFD)
- task setting

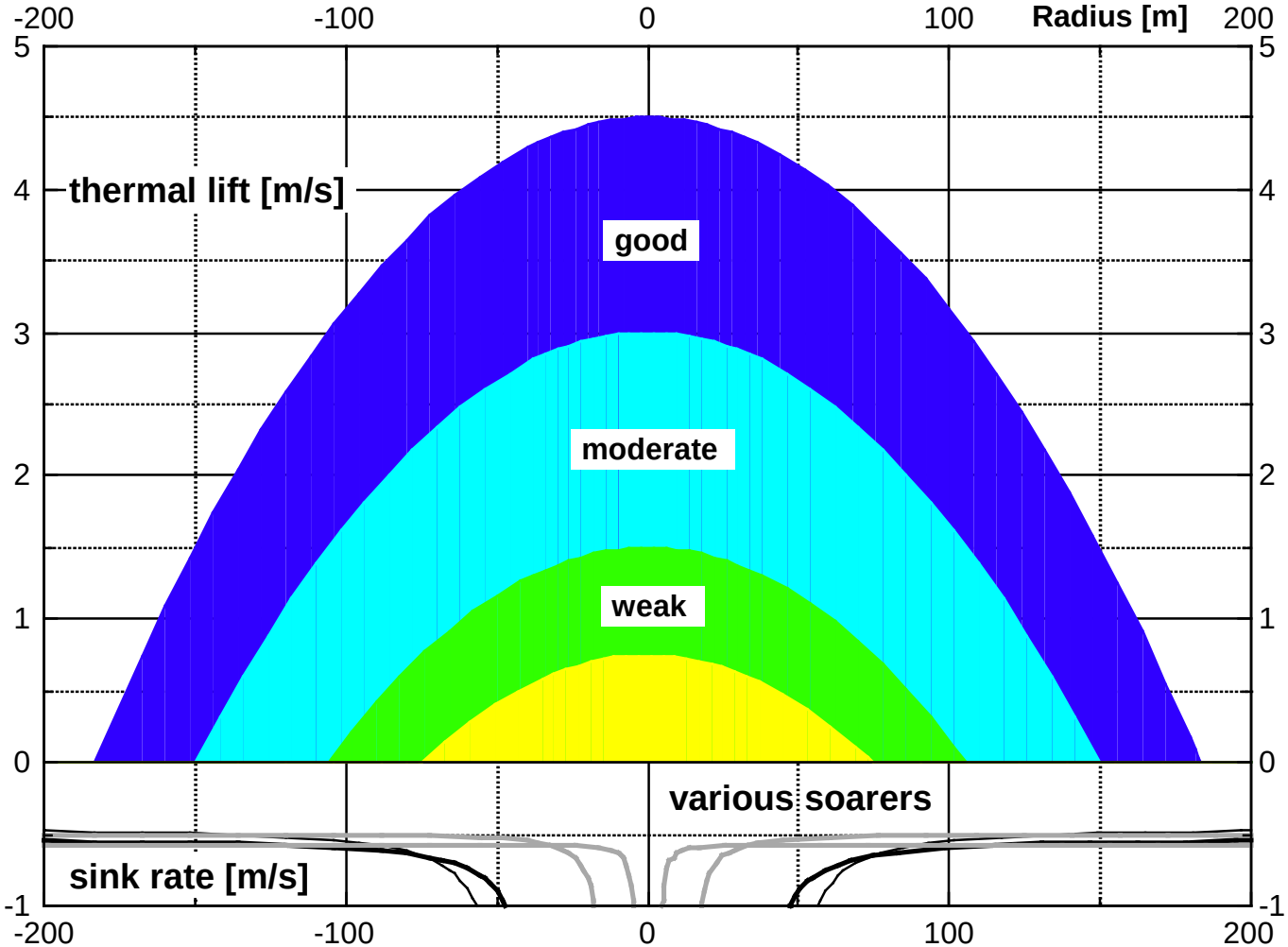
Flight Polar



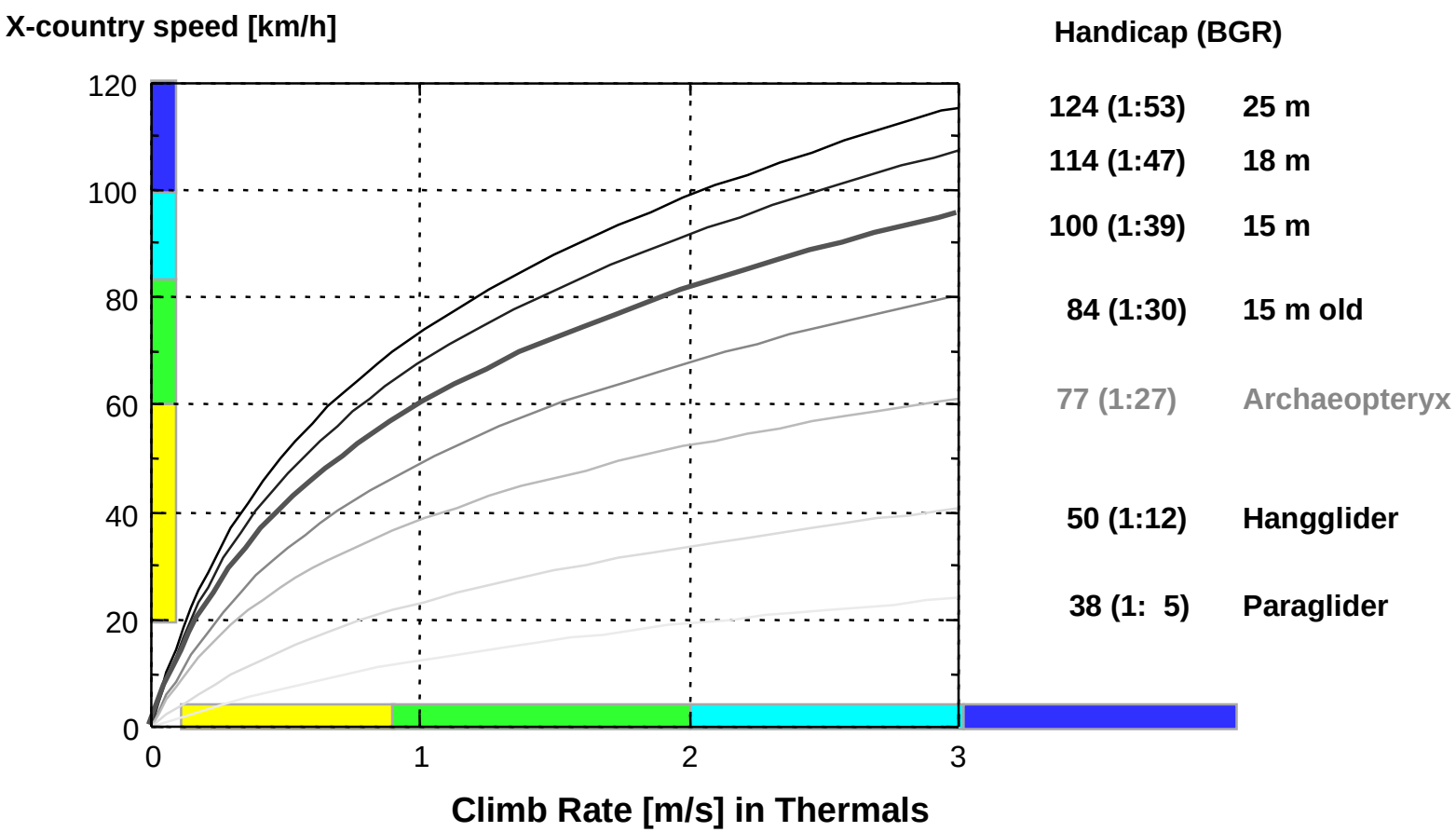
Flight polar in circular flight



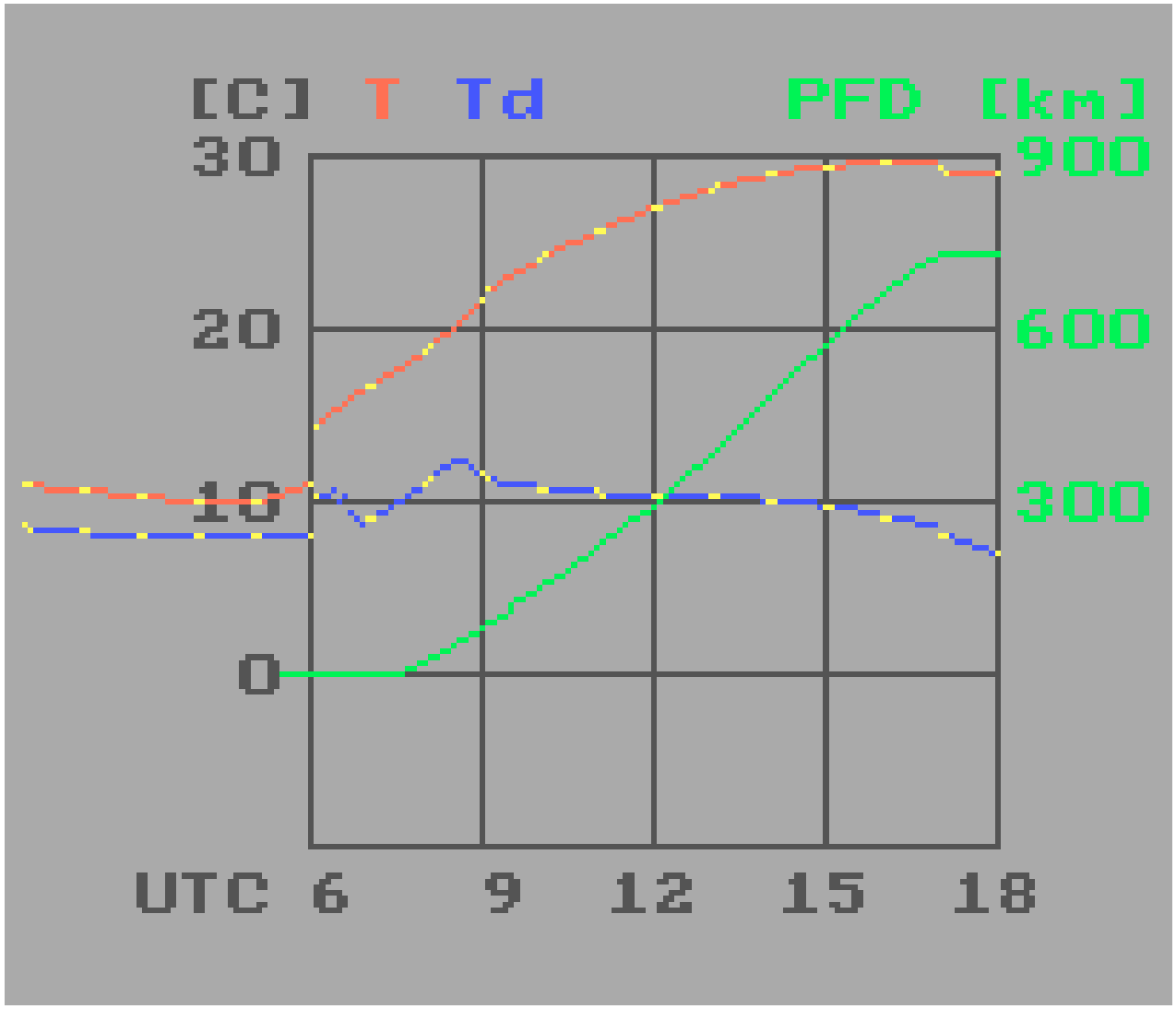
Radial lift profile in thermals



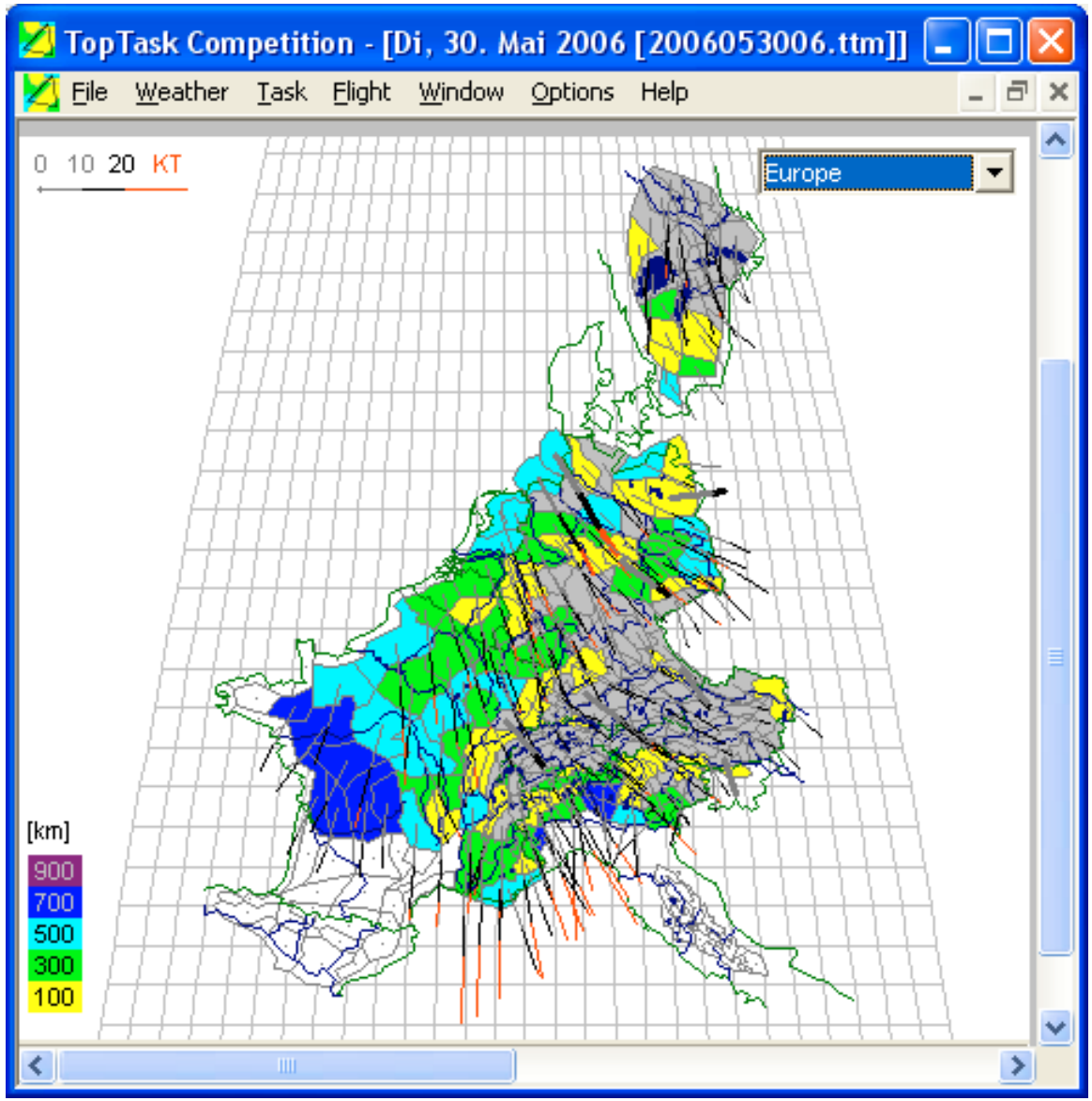
X-country Speed



Potential Flight Distance (PFD)



2006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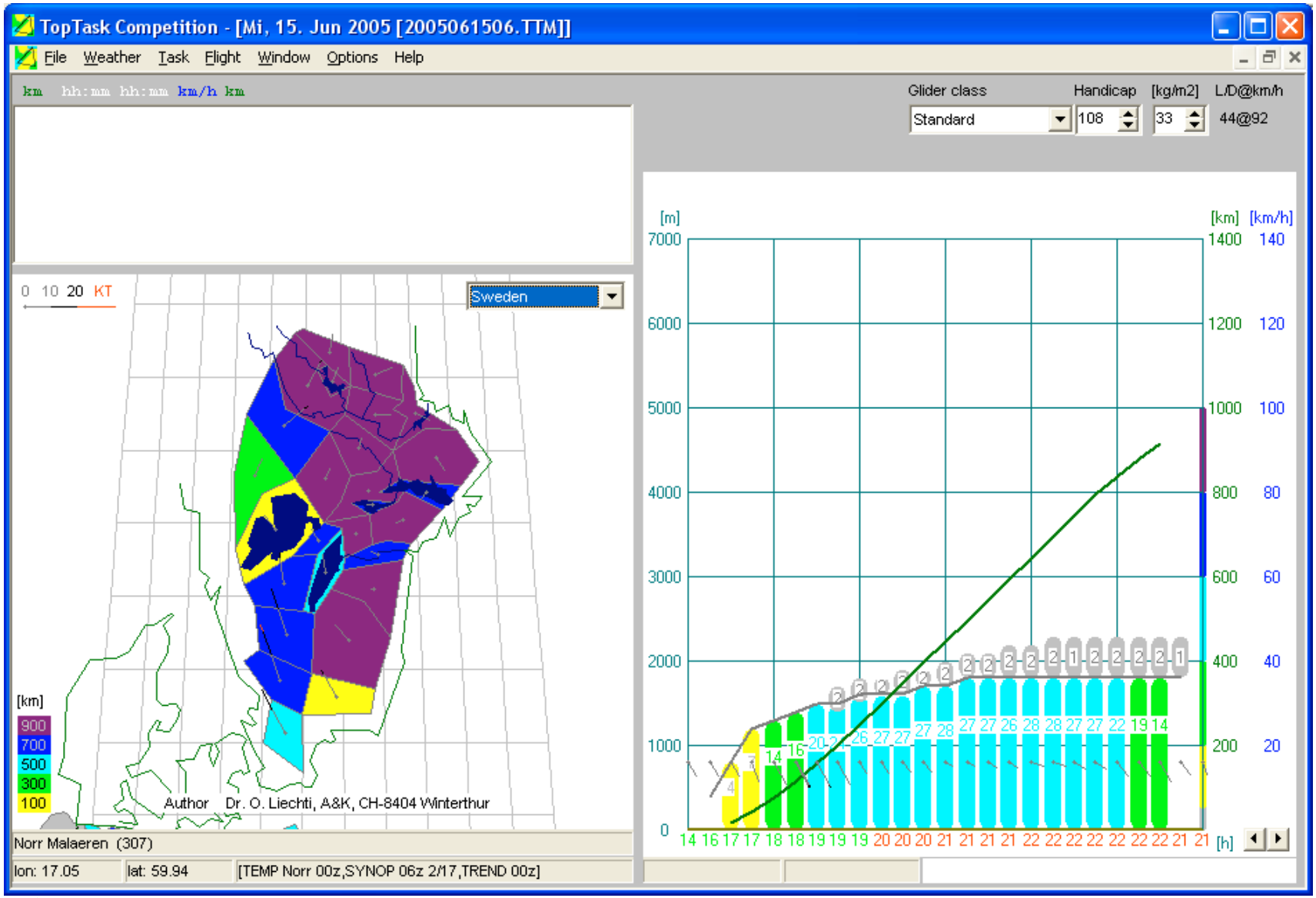
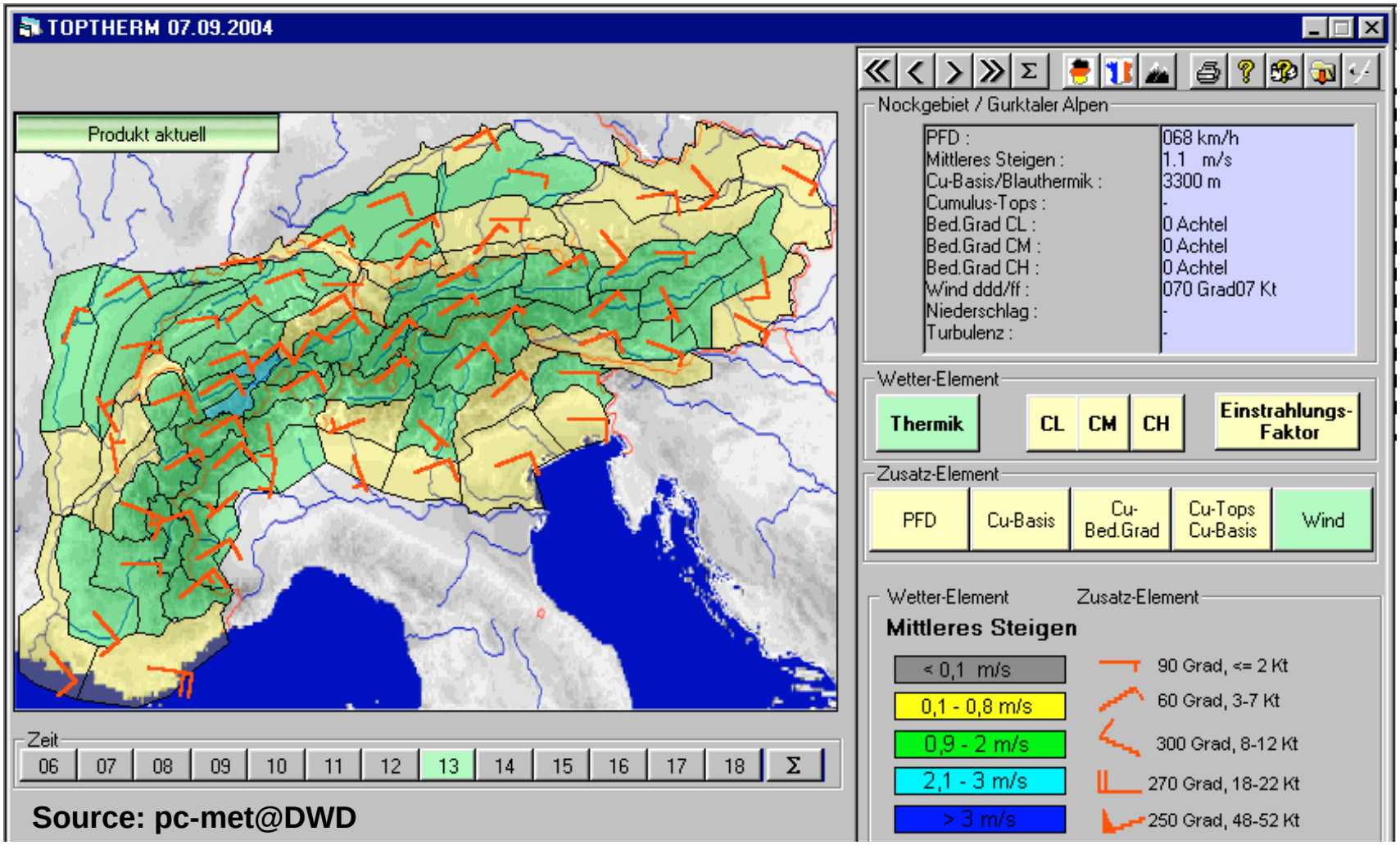
File
Weather
Task
Flight
Window
Options
Help
0 10 20 KT
Europe
[km]
900
700
500
300
100

2005: Sweden


TopTask Competition - [Mi, 15. Jun 2005 [2005061506.TTM]]
File Weather Task Flight Window Options Help
km hh:mm hh:mm km/h km
Glider class
Handicap
[kg/m2]
L/D@km/h
Standard
108
33
44@92
0 10 20 KT
Sweden
[km]
900
700
500
300
100
Author Dr. O. Liechti, A&K, CH-8404 Winterthur
Norr Malaeren (307)
lon: 17.05
lat: 59.94
[TEMP Norr 00z,SYNOP 06z 2/17,TREND 00z]
[m]
[km]
[km/h]
[h]

Regional Forecasts: Lift & Wind



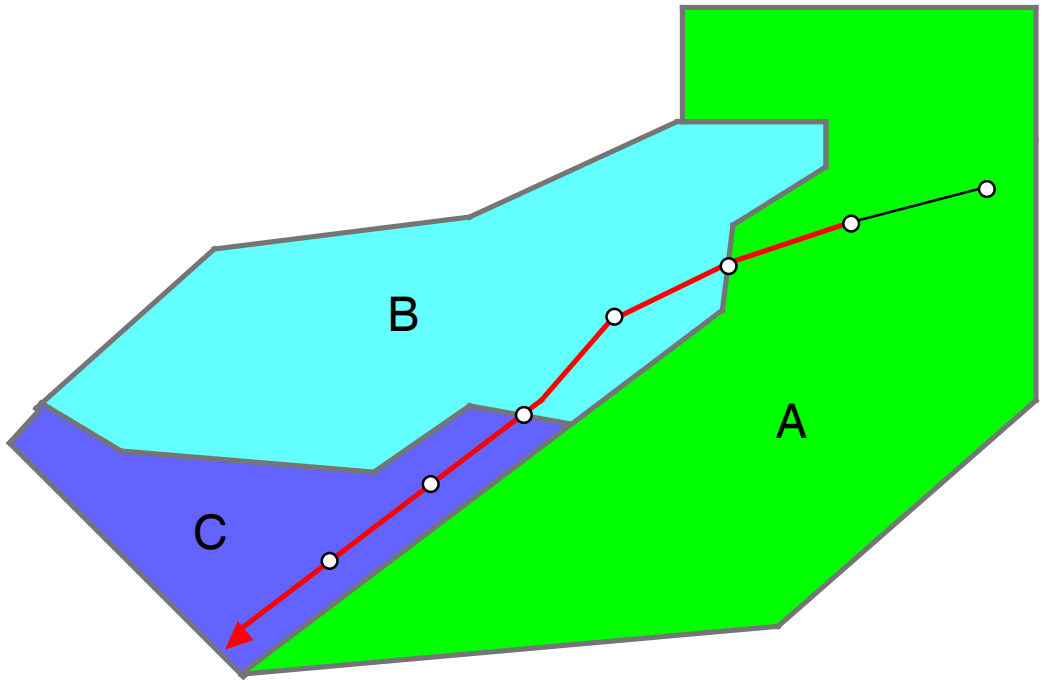
Source: pc-met@DWD

Temporal and Spatial Resolution of Meteorological Information

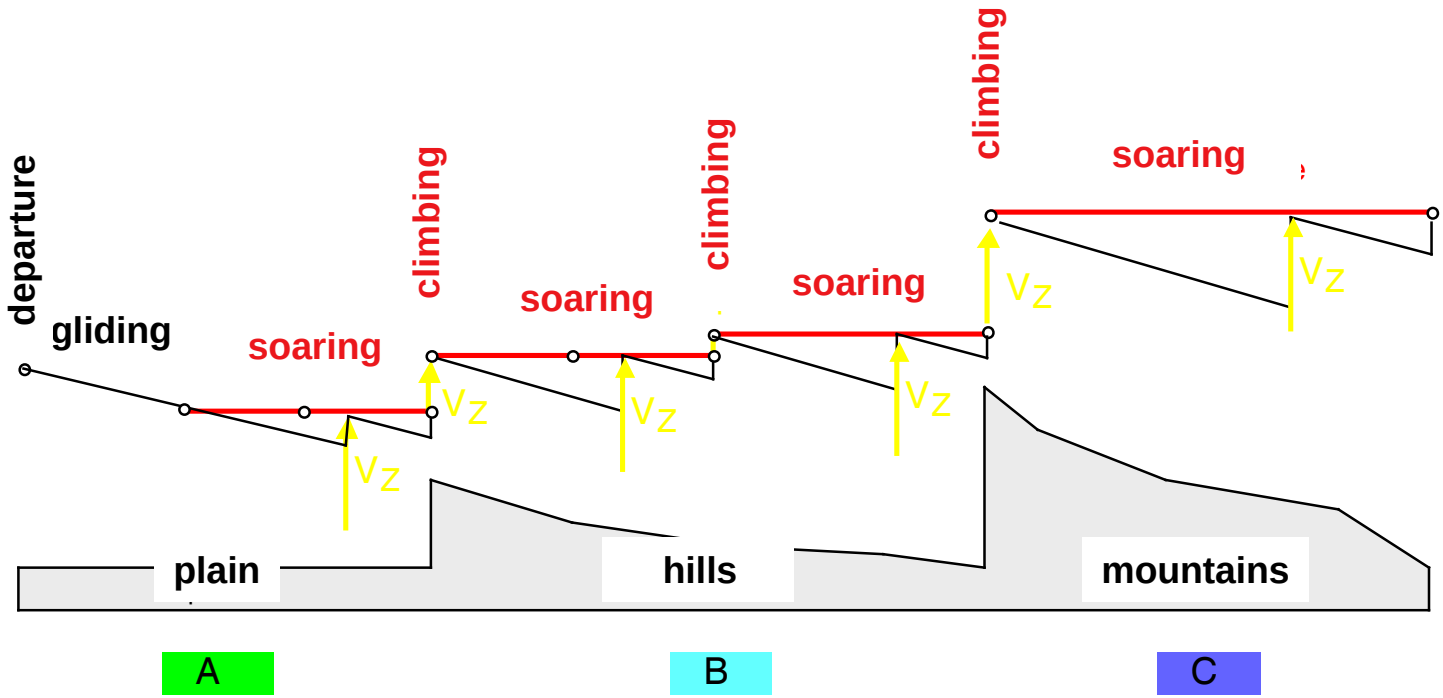
- **cruising speed** $v = 100\ km/h = \Delta x / \Delta t$
- $\Delta t = 30\ min$
- $\Delta x = 50\ km$ **i.e.** $\Delta A = \Delta x * \Delta x = 2'500\ km2$

Such resolution is required for flight planning ... and it is available !

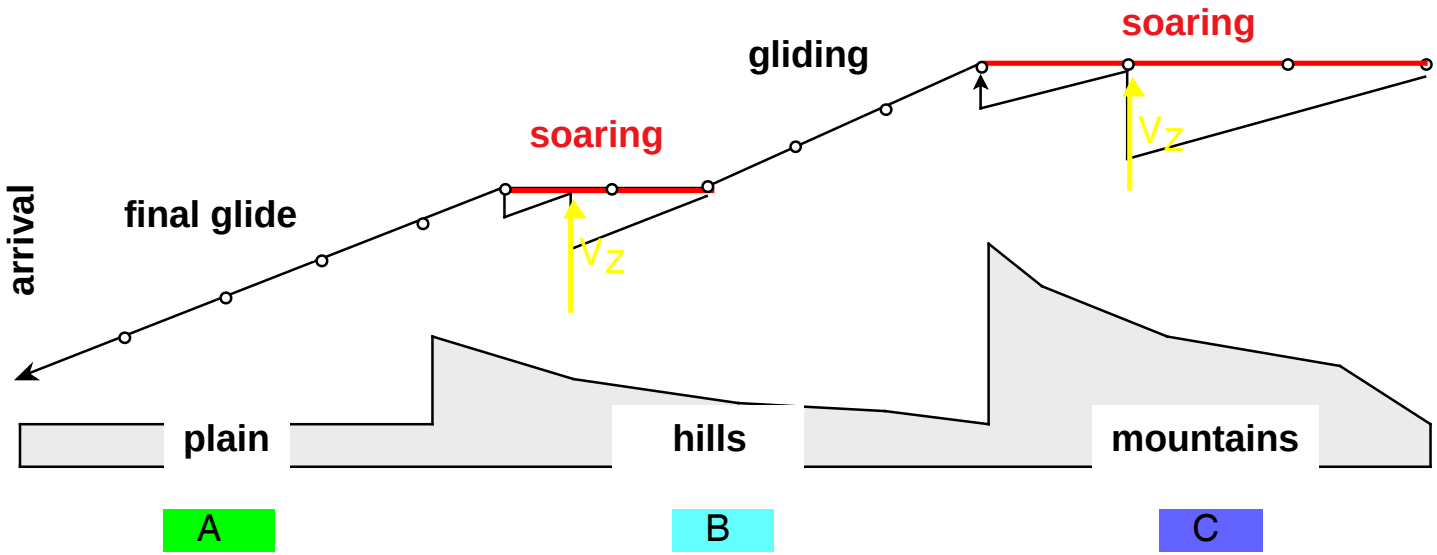
Flight Task



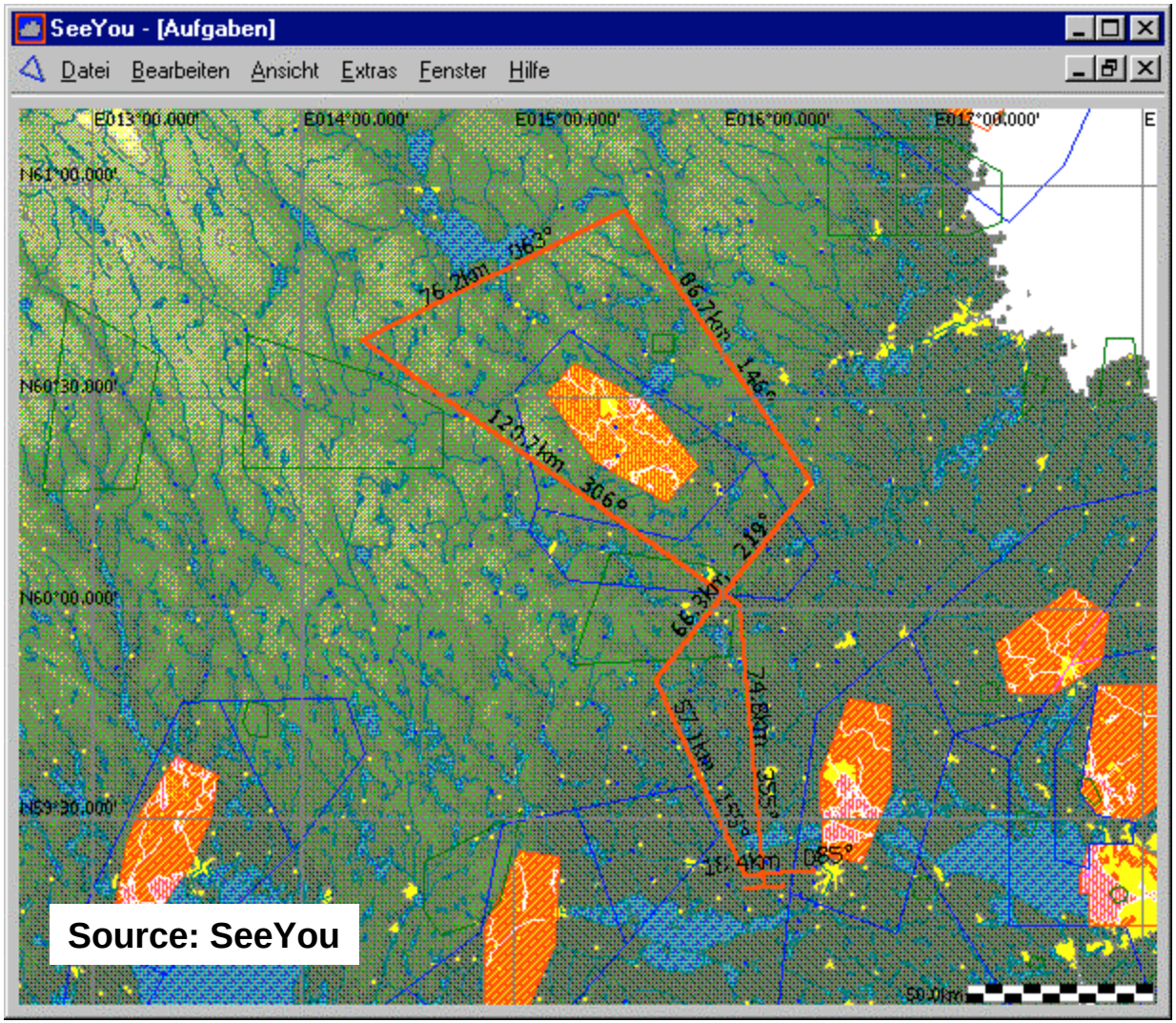
Flight Phases



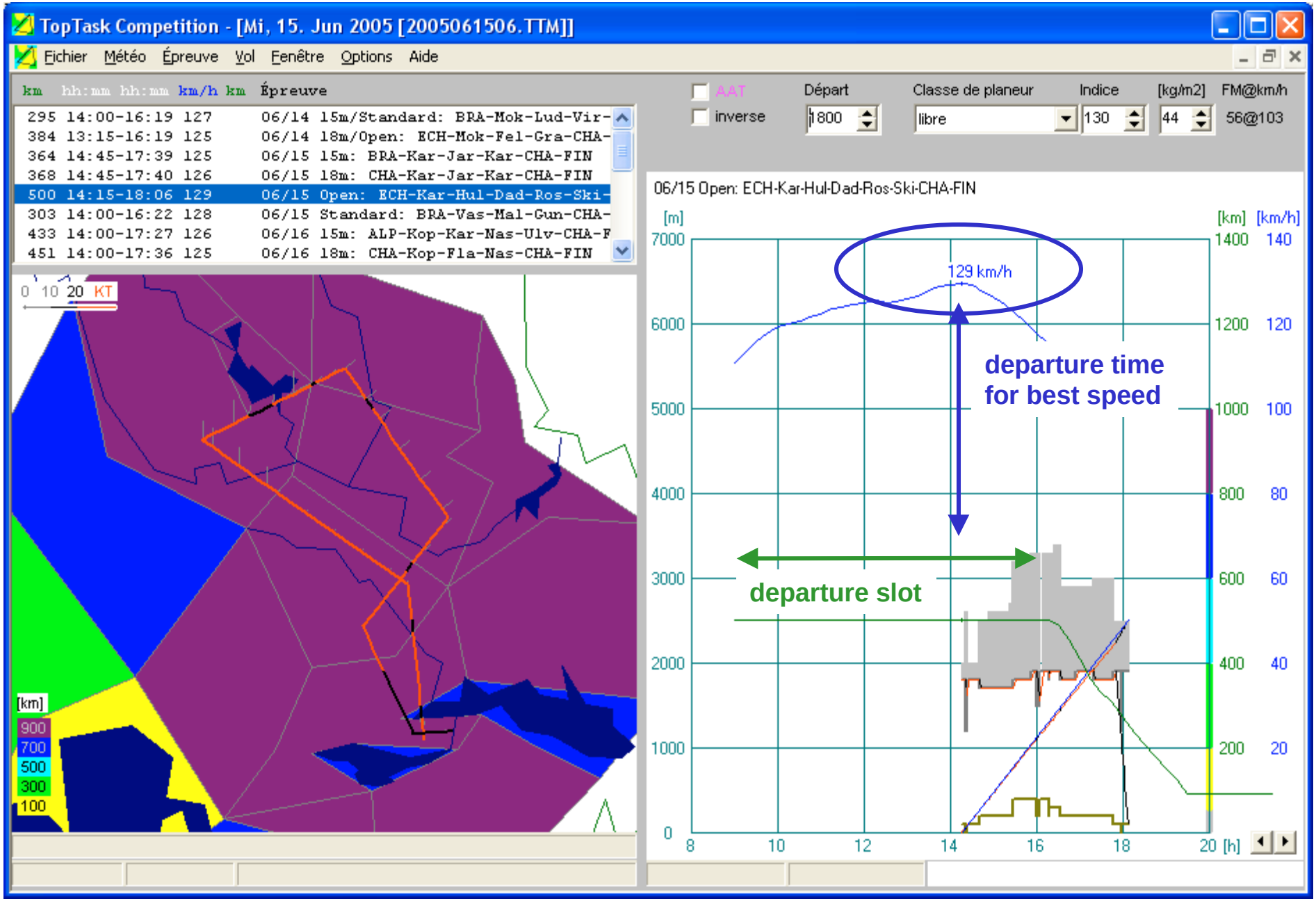
Flight Phases



Task



Source: SeeYou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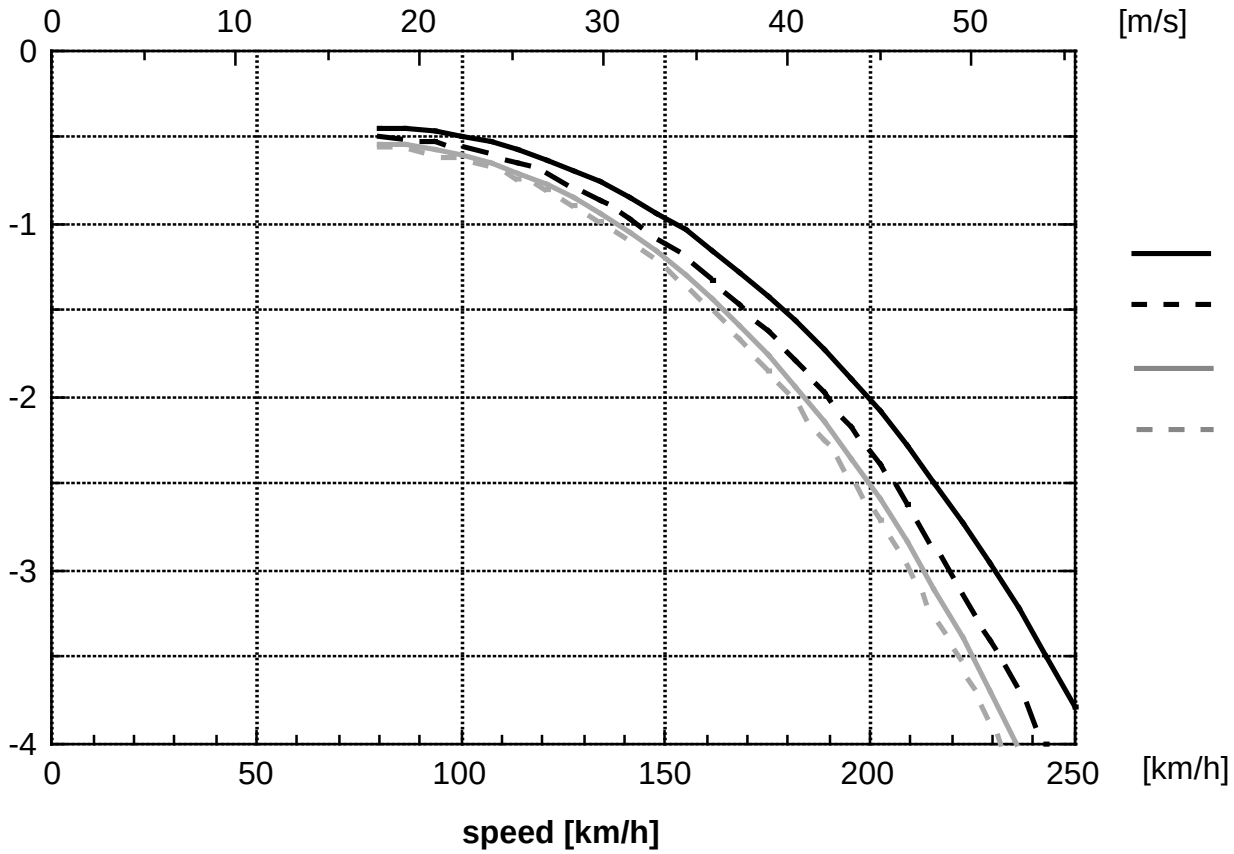
Fichier Météo Épreuve Vol Fenêtre Options Aide
km hh:mm hh:mm km/h km Épreuve
295 14:00-16:19 127 06/14 15m/Standard: BRA-Mok-Lud-Vir-
384 13:15-16:19 125 06/14 18m/Open: ECH-Mok-Fel-Gra-CHA-
364 14:45-17:39 125 06/15 15m: BRA-Kar-Jar-Kar-CHA-FIN
368 14:45-17:40 126 06/15 18m: CHA-Kar-Jar-Kar-CHA-FIN
500 14:15-18:06 129 06/15 Open: ECH-Kar-Hul-Dad-Ros-Ski-
303 14:00-16:22 128 06/15 Standard: BRA-Vas-Mal-Gun-CHA-
433 14:00-17:27 126 06/16 15m: ALP-Kop-Kar-Nas-Ulv-CHA-F
451 14:00-17:36 125 06/16 18m: CHA-Kop-Fla-Nas-CHA-FIN
AAT
inverse
Départ
1800
Classe de planeur
libre
Indice
130
[kg/m2]
44
FM@km/h
56@103
0 10 20 KT
[km]
900
700
500
300
100
06/15 Open: ECH-Kar-Hul-Dad-Ros-Ski-CHA-FIN
[m]
[km] [km/h]
129 km/h
departure time
for best speed
departure slot
[h]

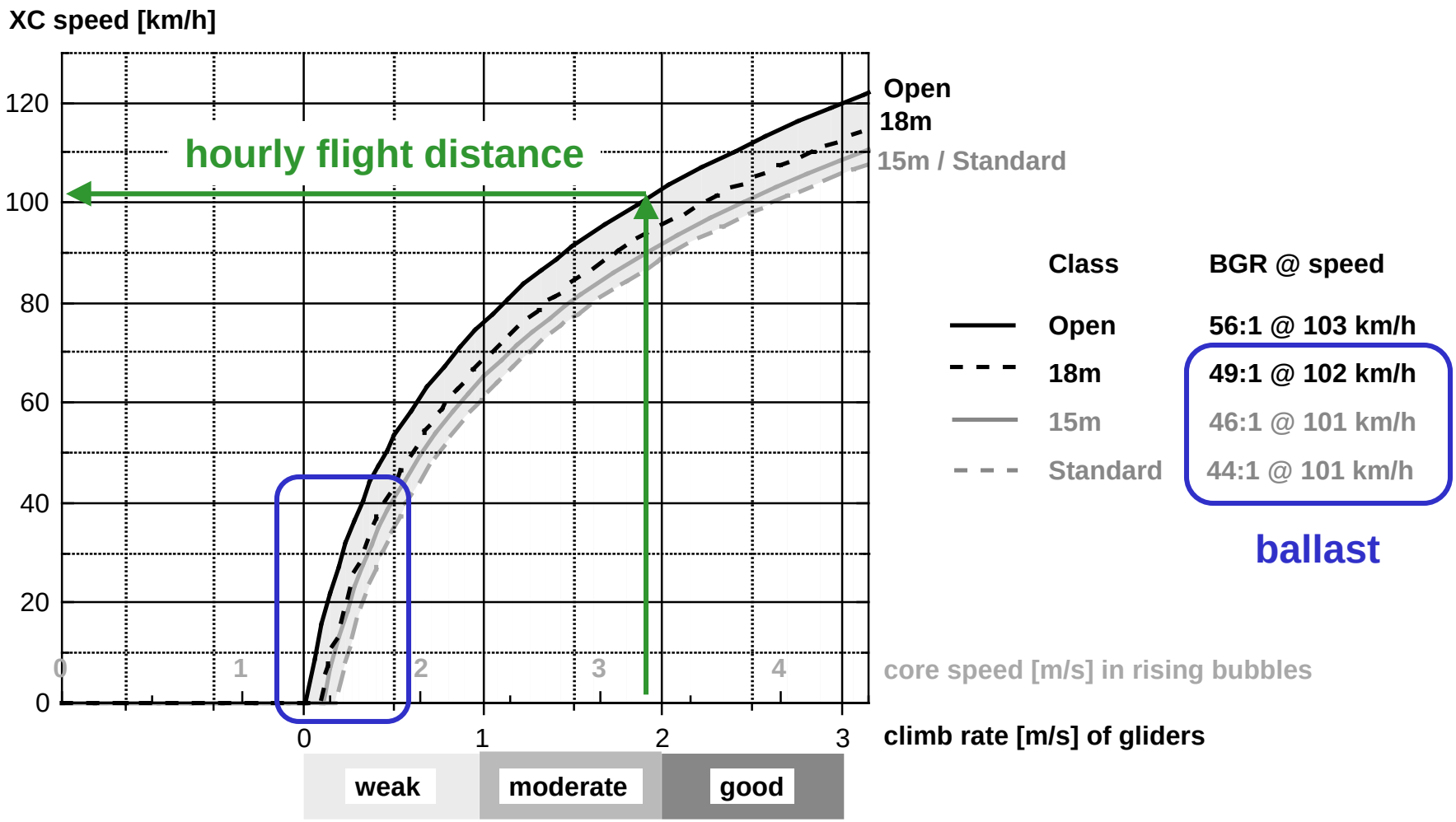
Flight Polar in Contest Soaring



Class	BGR @ speed
Open	56:1 @ 103 km/h
18m	49:1 @ 102 km/h
15m	46:1 @ 101 km/h
Standard	44:1 @ 101 km/h

ballast

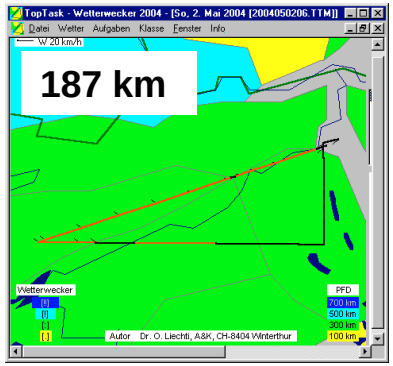
X-country Speed

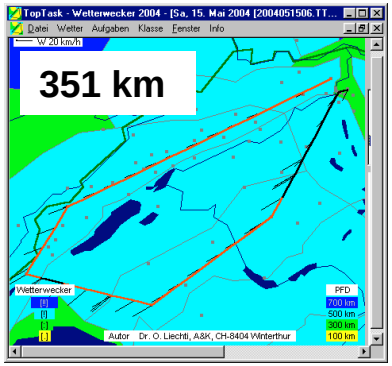


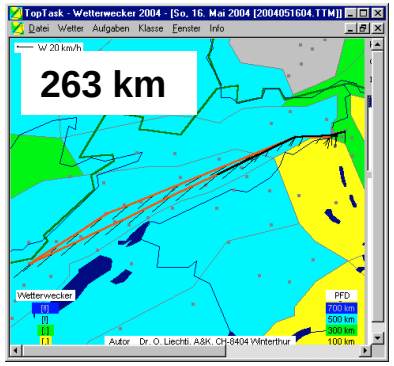
Verifications

- **Tasks: 2004, 2005, 2006**
- **Flights: 2006**

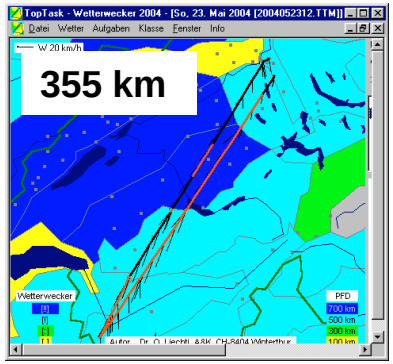
Swiss Glide 2004

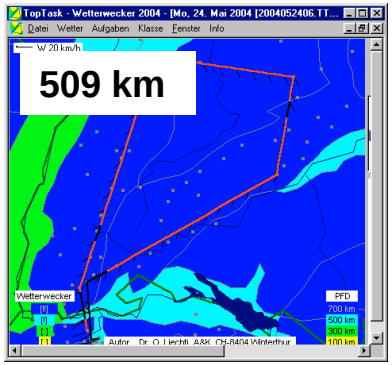


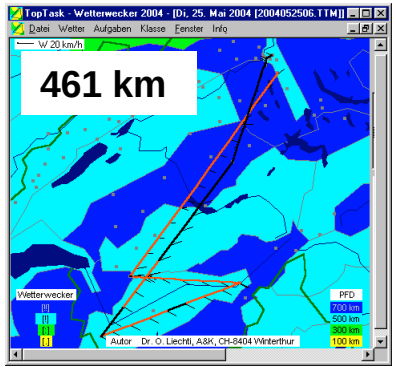




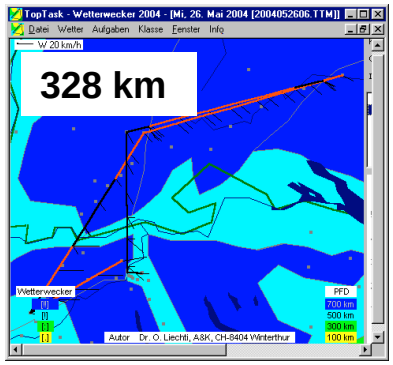
RC

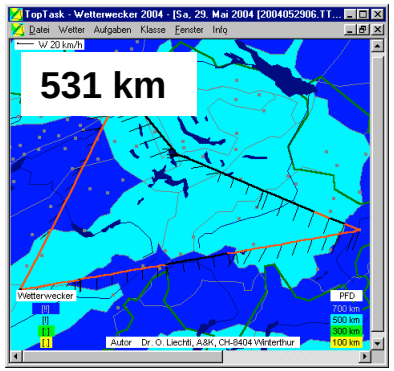






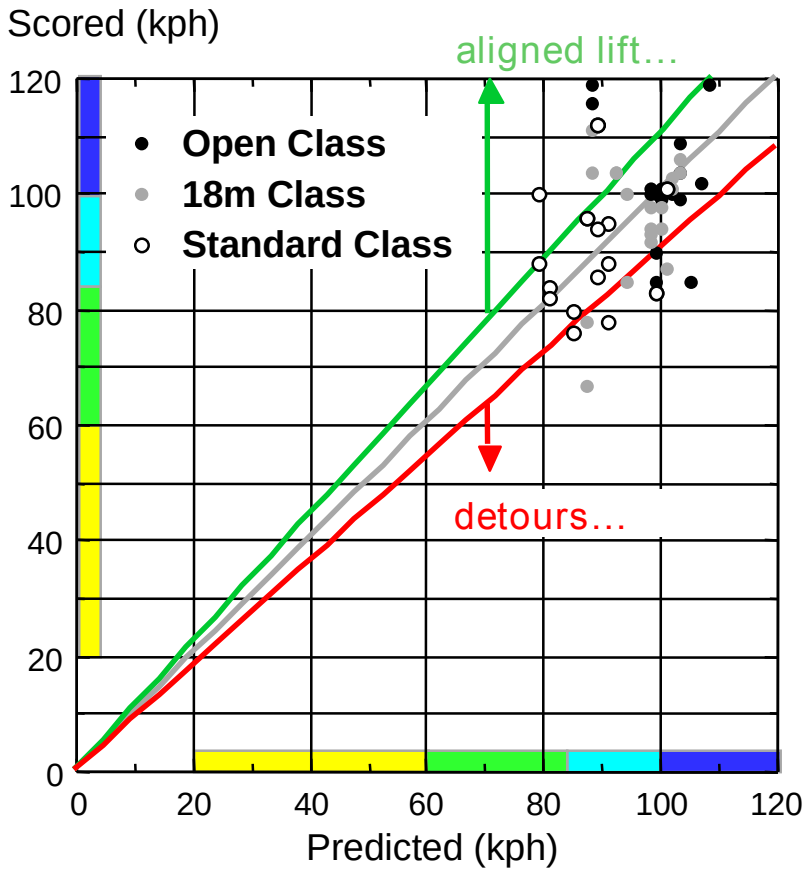
NC

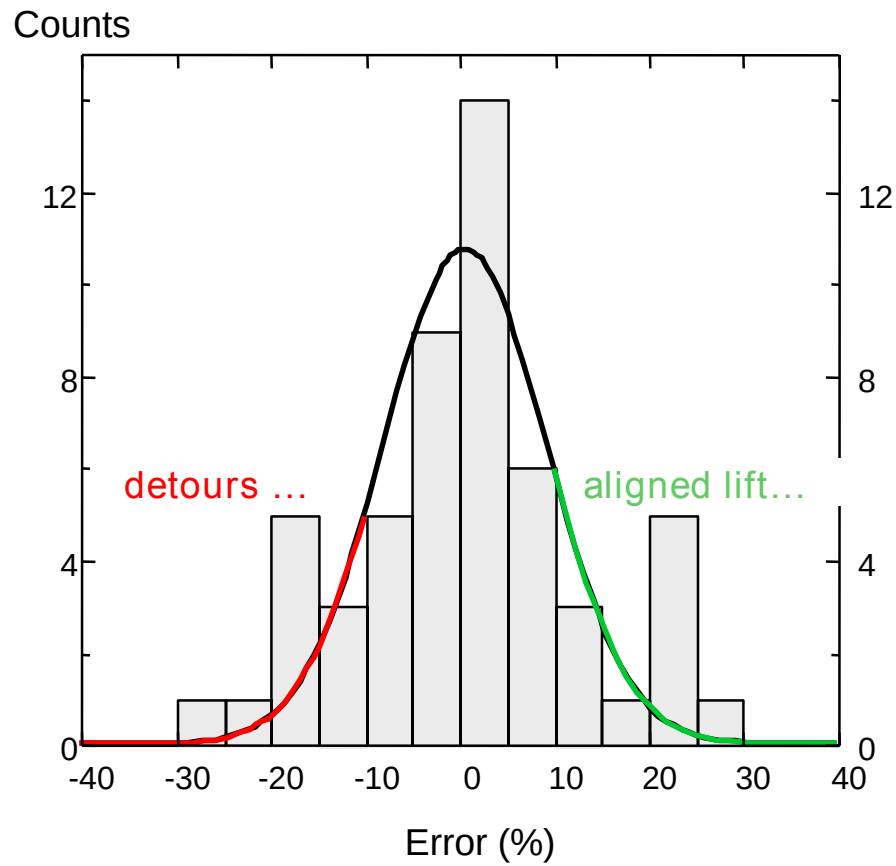




NC

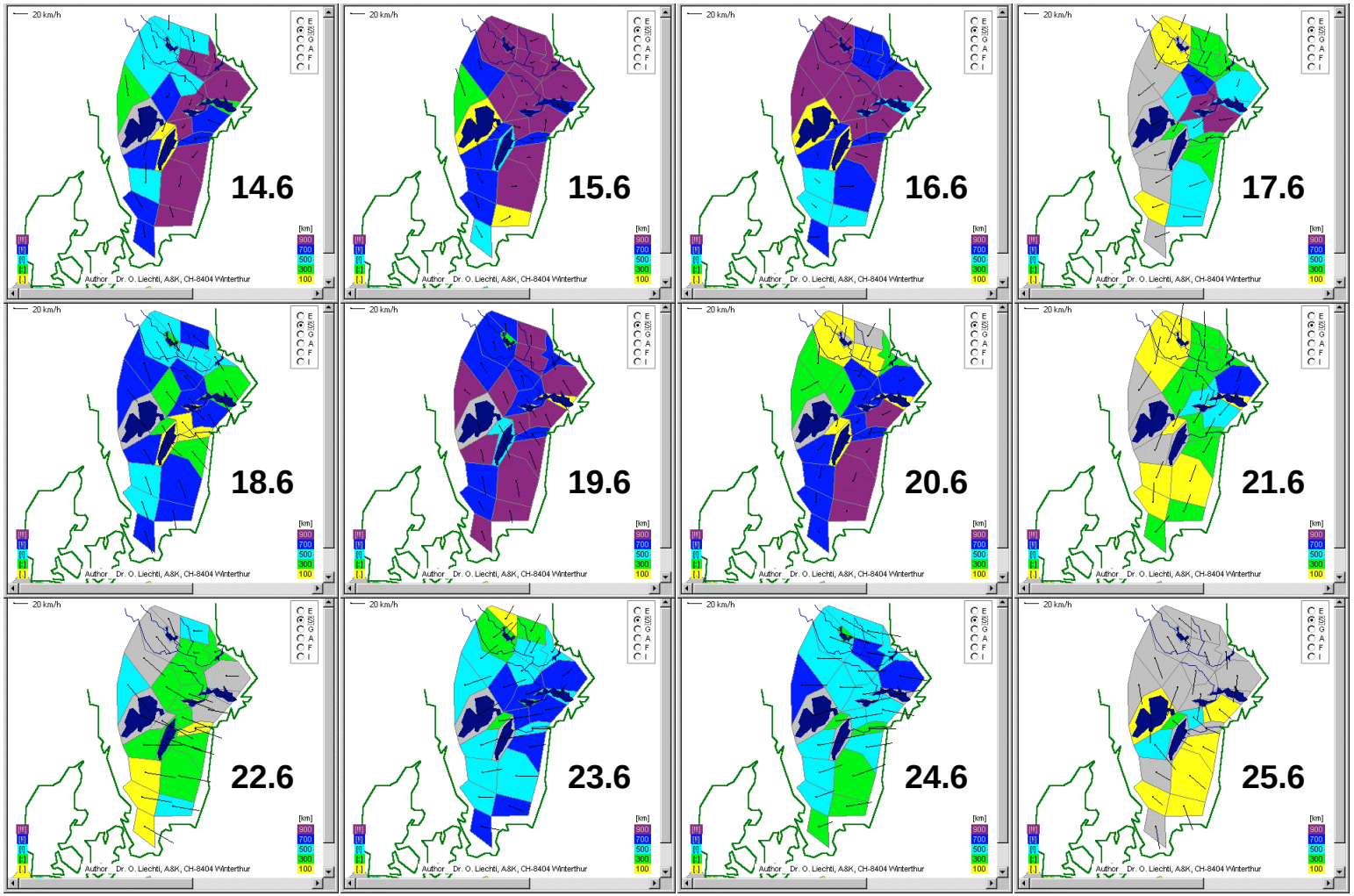
Task Verification @ Swiss Glide 2004



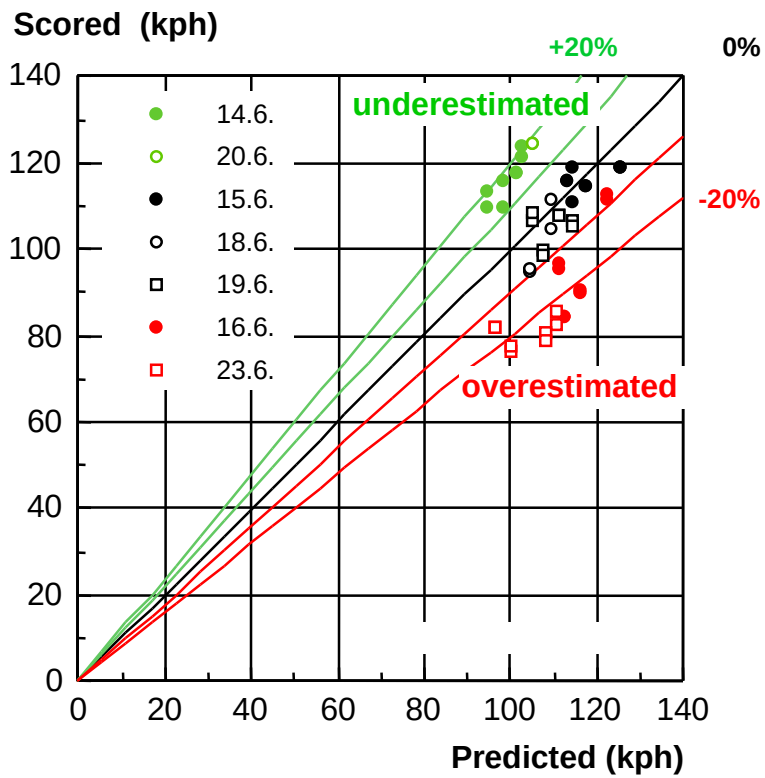


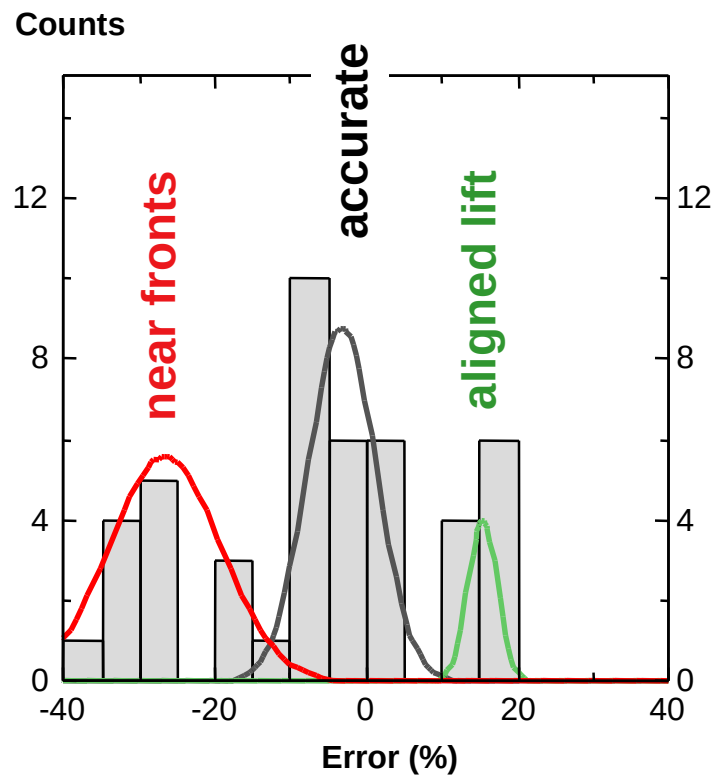
54 scored flights @ Swiss Glide 2004
(9 days with 3 tasks, 1. and 2. place)

VikingGlide 2005



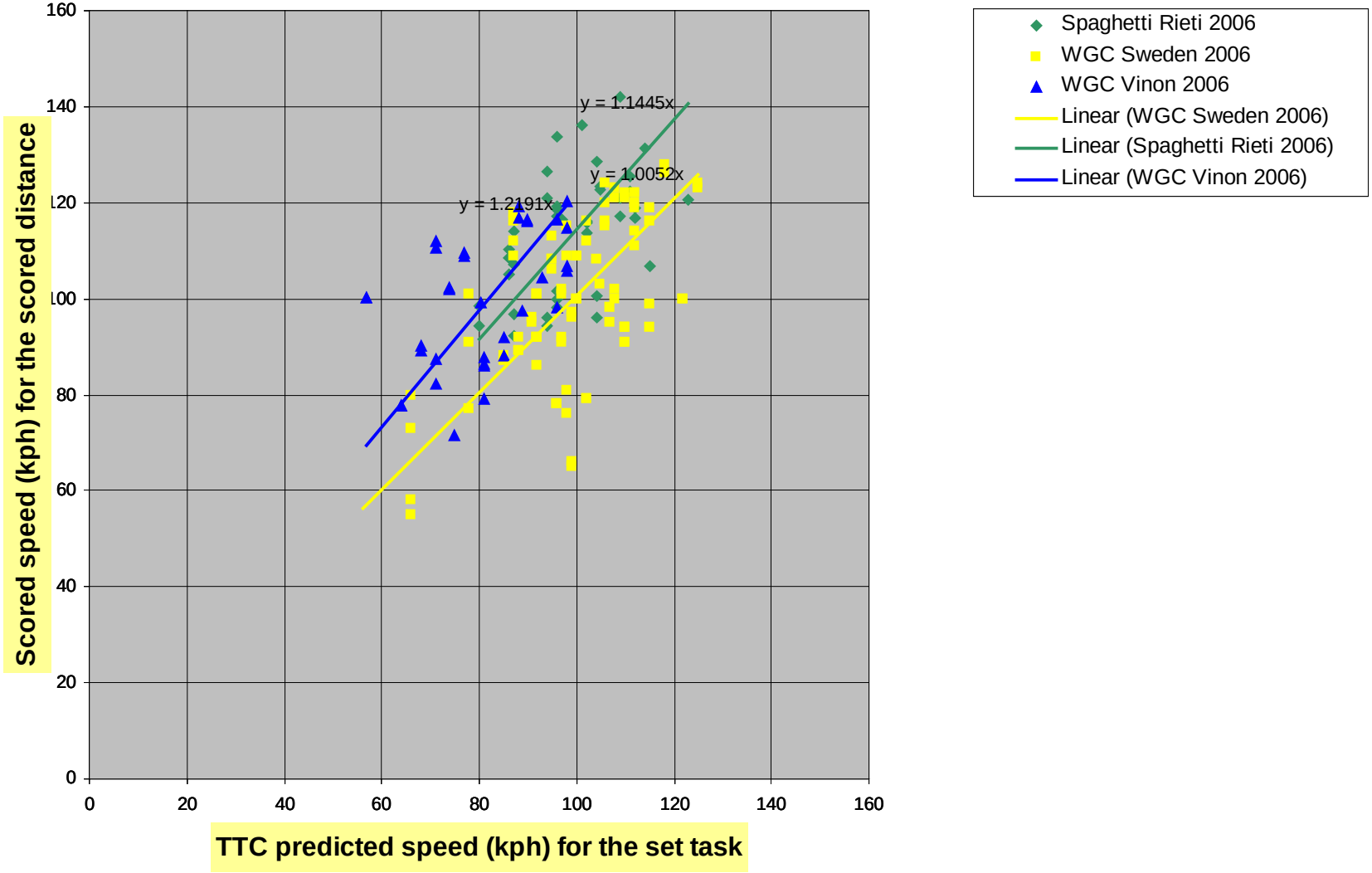
Task Verification @ Viking Glide 2005





46 scored flights @ Viking Glide 2005
(7 days, 23 tasks, 1. and 2. place)

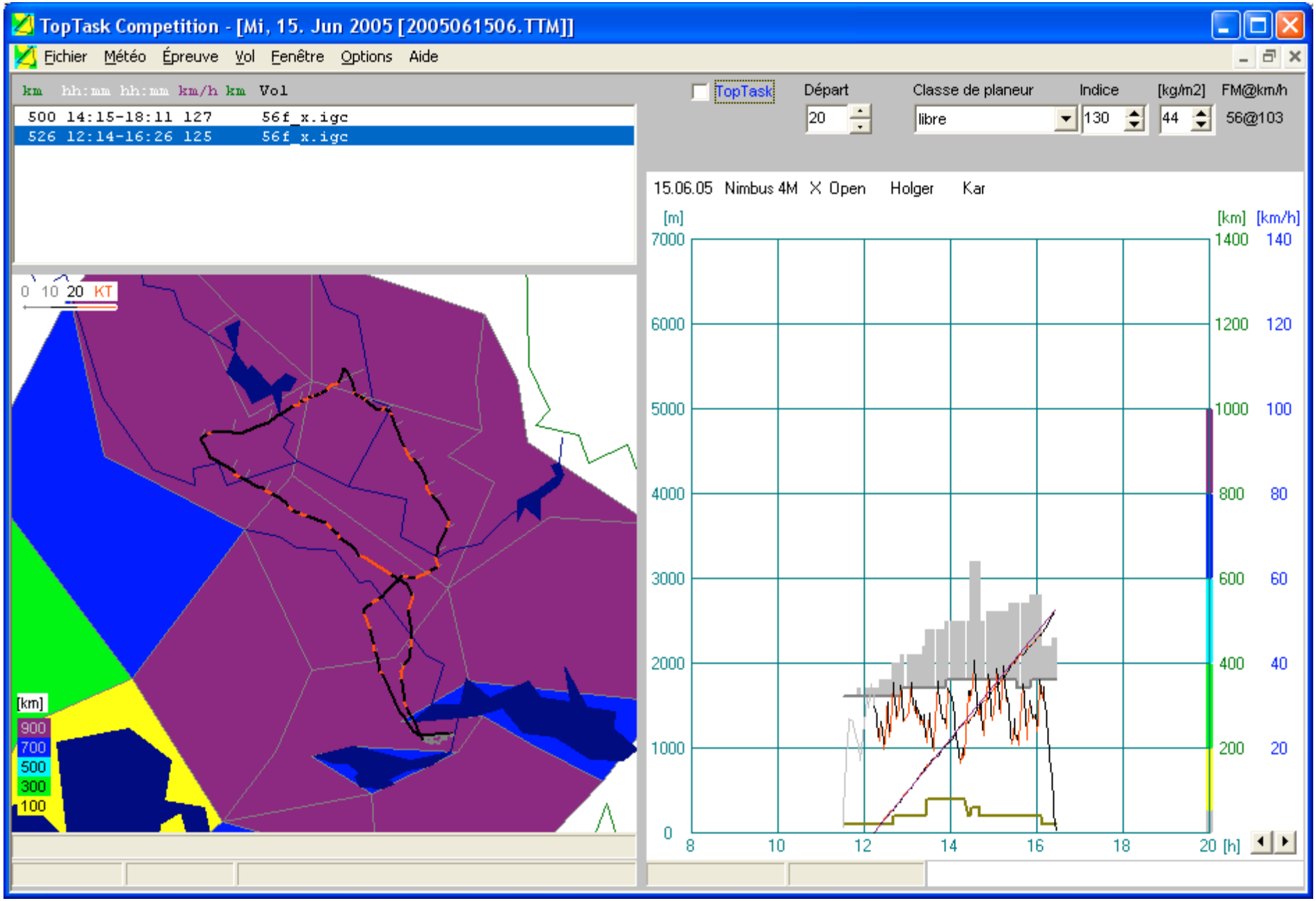
Tasks @ Eskilstuna, Rieti, Vinon in 2006



TopTask flight verifications

- 2005: Sweden (1 flight)
- 2006: France (1 flight)

- 2006: Sweden, Italy, France (WGC flights)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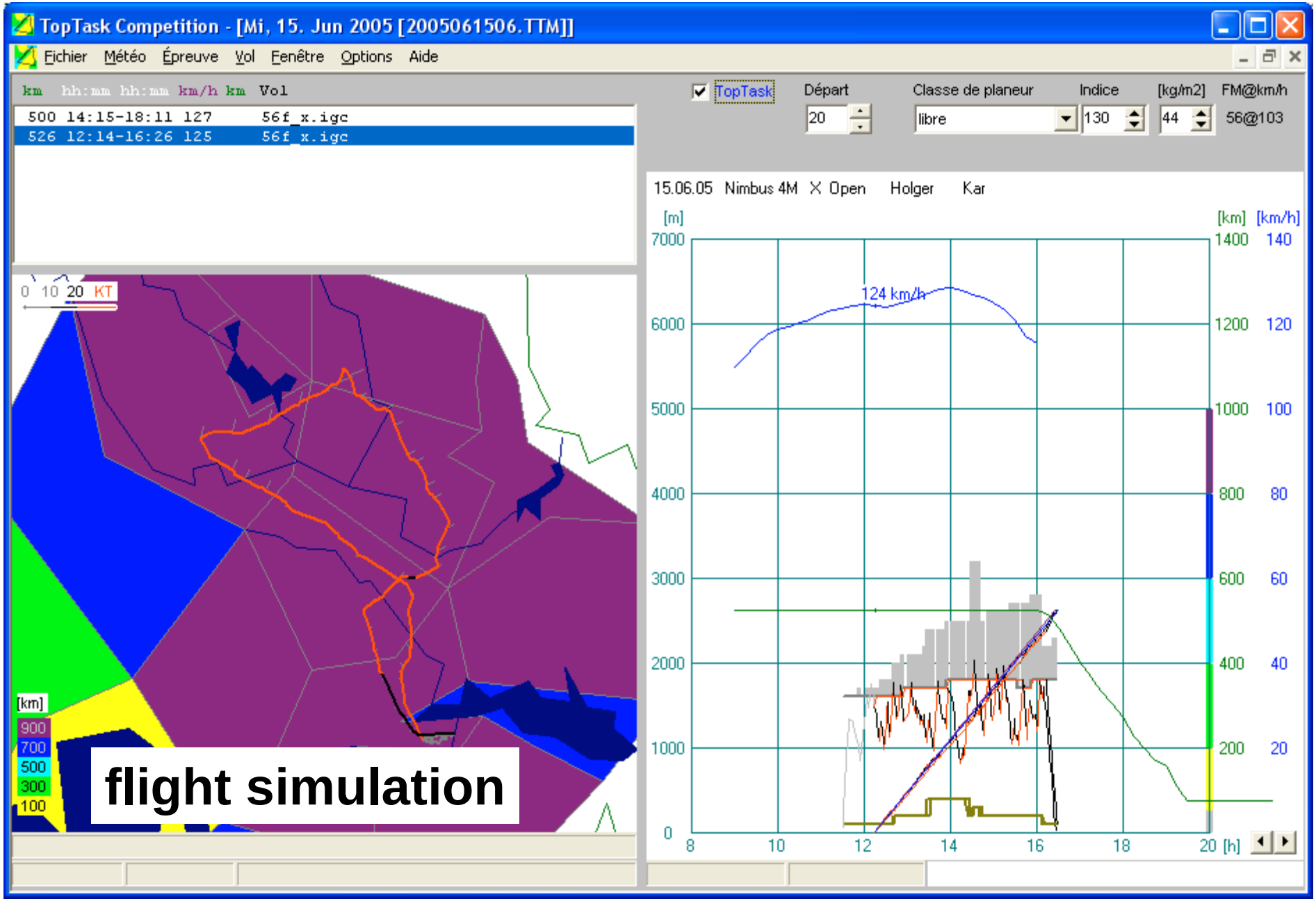
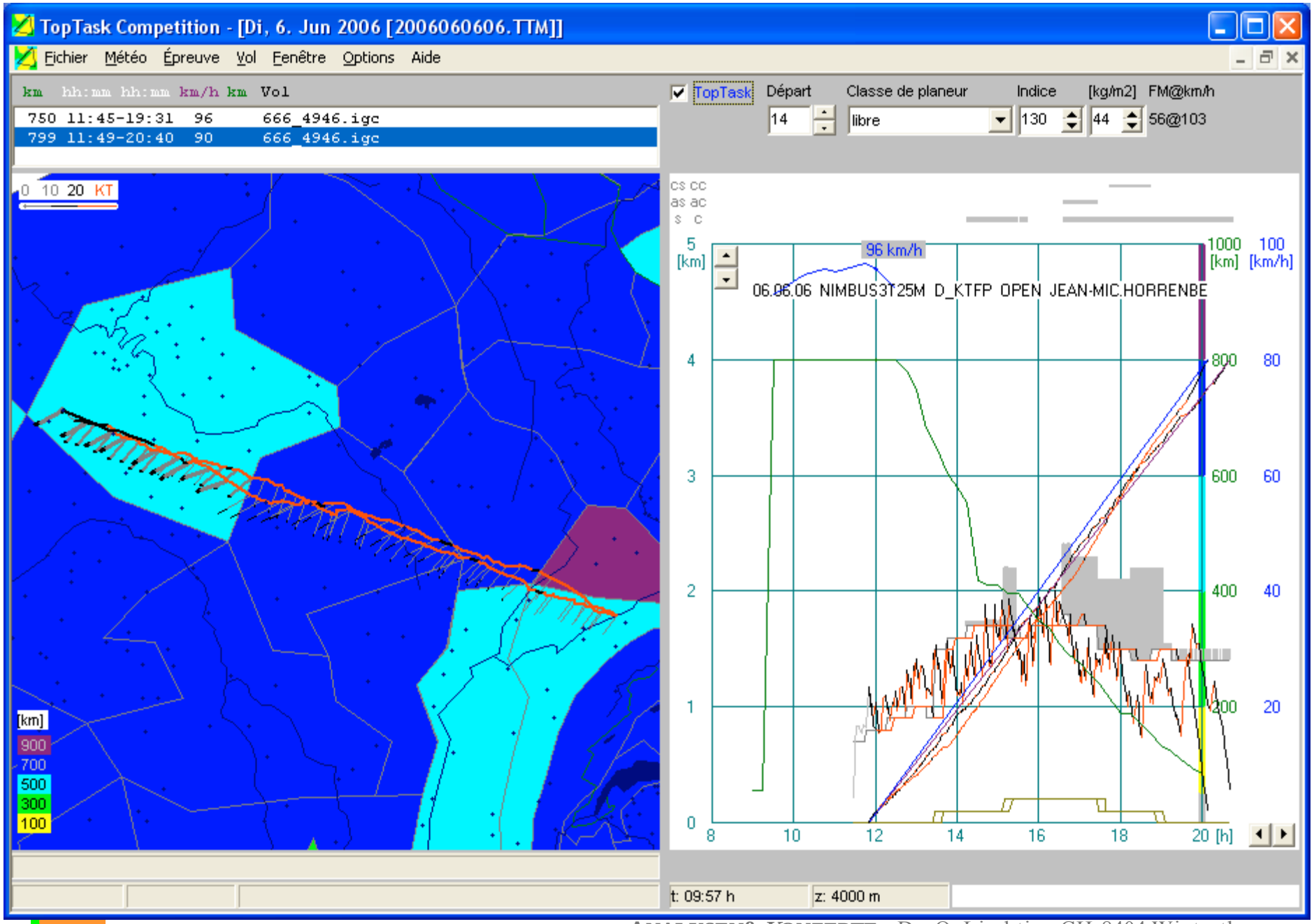
km hh:mm hh:mm km/h km Vol
500 14:15-18:11 127 56f_x.igc
526 12:14-16:26 125 56f_x.igc
TopTask
Départ
20
Classe de planeur
libre
Indice
130
[kg/m2]
44
FM@km/h
56@103
15.06.05 Nimbus 4M X Open Holger Kar
0 10 20 KT
[km]
900
700
500
300
100
[m]
7000
6000
5000
4000
3000
2000
1000
0
[km] [km/h]
1400 140
1200 120
1000 100
800 80
600 60
400 40
200 20
8 10 12 14 16 18 20 [h]


TopTask Competition - [Mi, 15. Jun 2005 [2005061506.TTM]]
Fichier Météo Épreuve Vol Fenêtre Options Aide
km hh:mm hh:mm km/h km Vol
500 14:15-18:11 127 56f_x.igc
526 12:14-16:26 125 56f_x.igc
TopTask
Départ
20
Classe de planeur
libre
Indice
130
[kg/m2]
44
FM@km/h
56@103
15.06.05 Nimbus 4M X Open Holger Kar
[m]
[km] [km/h]
124 km/h
0 10 20 KT
[km]
900
700
500
300
100
flight simulation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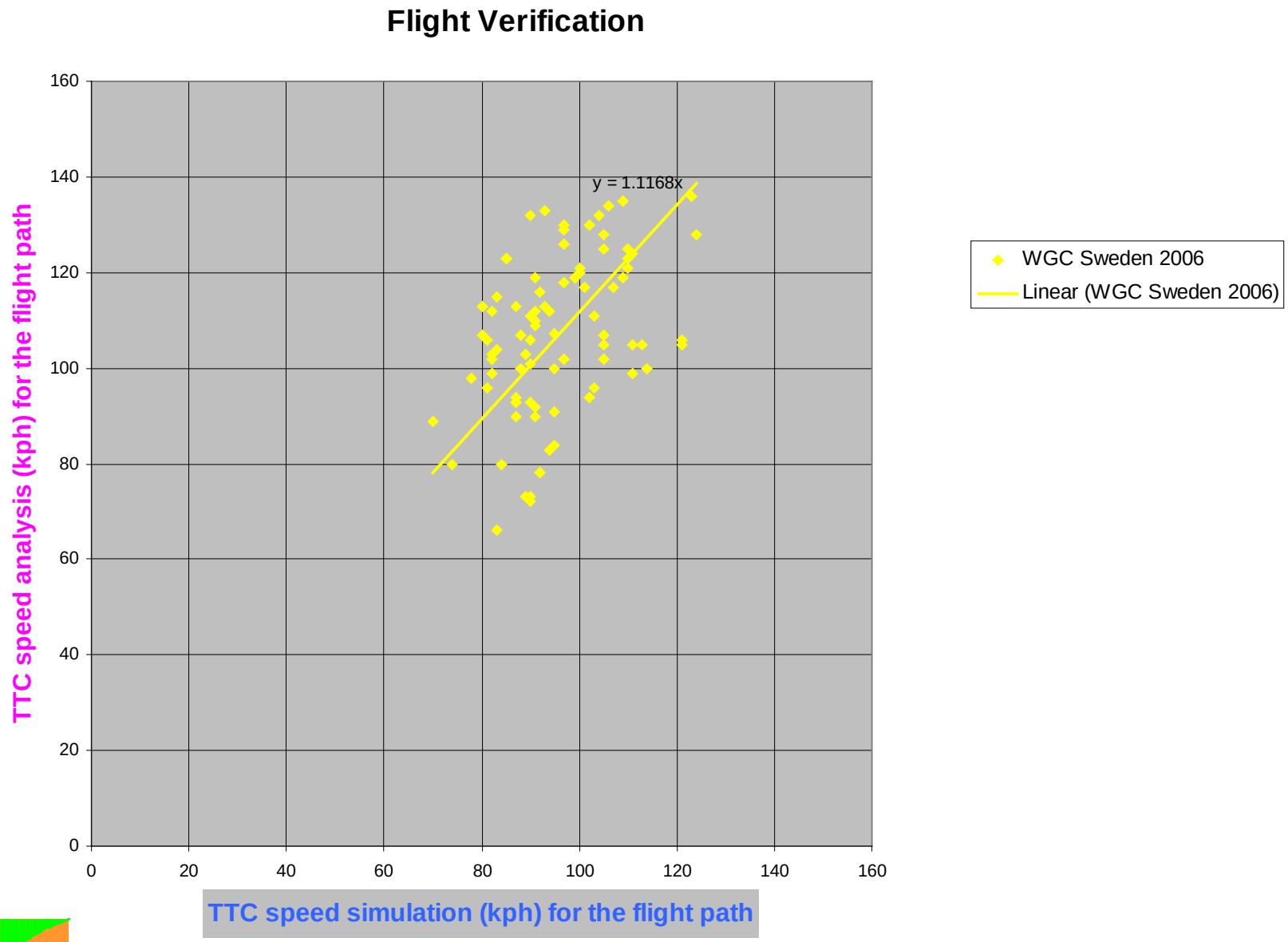
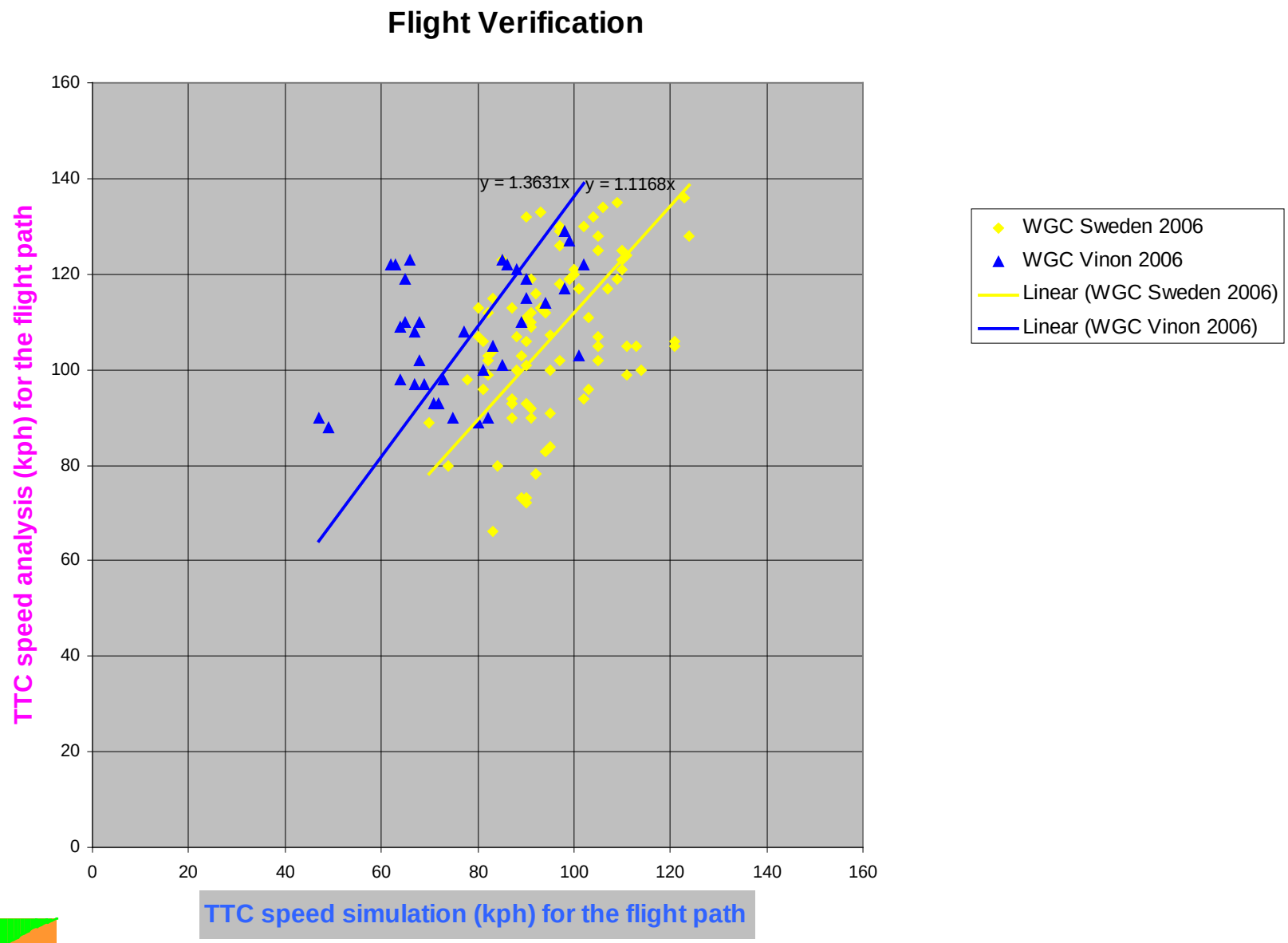
km hh:mm hh:mm km/h km Vol
750 11:45-19:31 96 666_4946.igc
799 11:49-20:40 90 666_4946.igc
TopTask
Départ
Classe de planeur
Indice
[kg/m2]
FM@km/h
14
libre
130
44
56@103
0 10 20 KT
[km]
900
700
500
300
100
96 km/h
06.06.06 NIMBUS3T25M D_KTFP OPEN JEAN-MIC.HORRENBE
[km]
[km/h]
[h]
t: 09:57 h
z: 4000 m

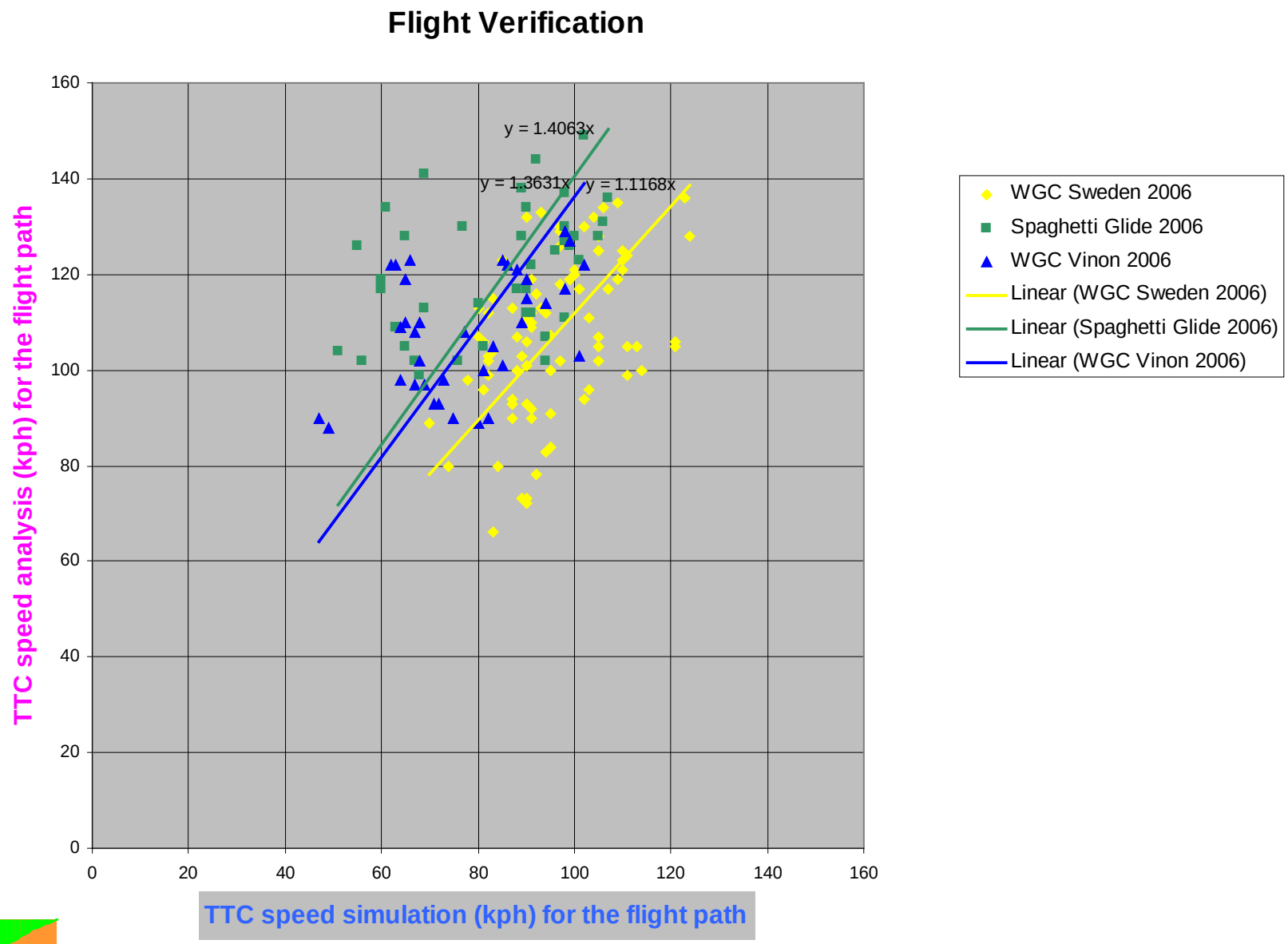
2006: Eskilstuna



2006: Eskilstuna, Vinon

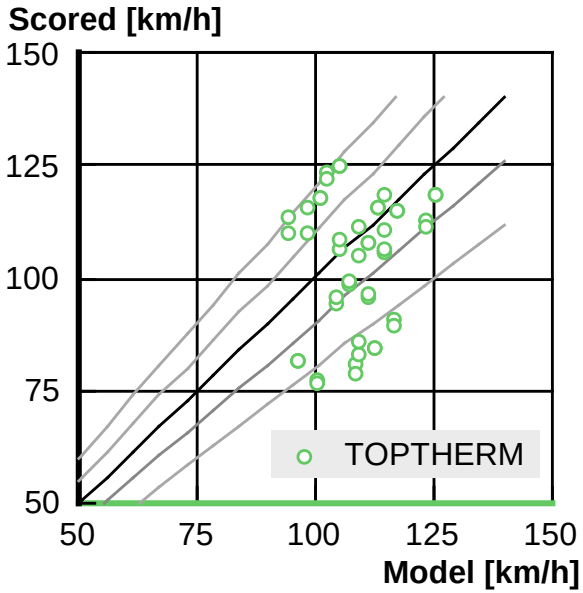


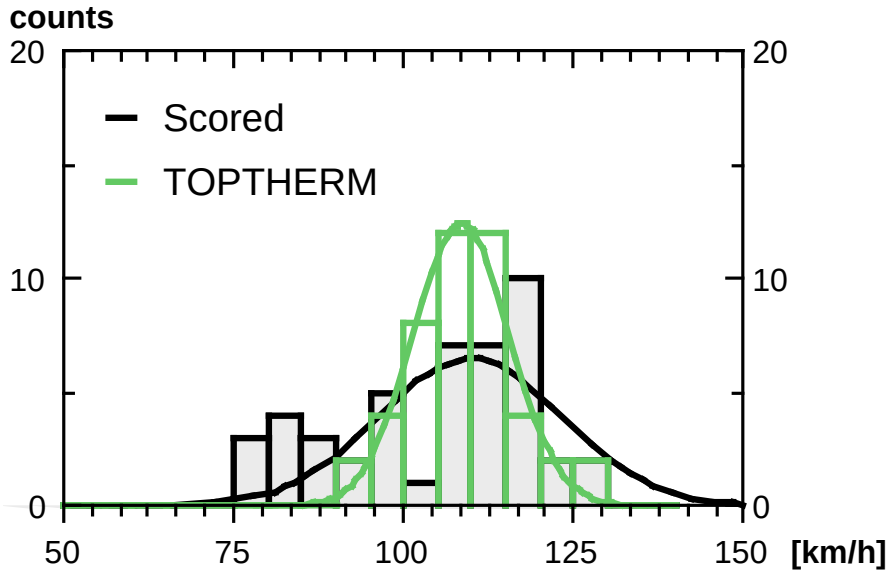
2006: Eskilstuna, Vinon , Rieti



Intercomparison

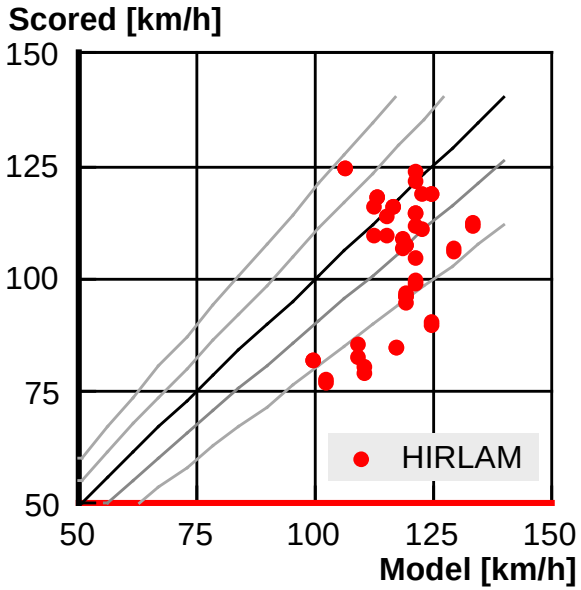
TOPTHERM @ Viking Glide

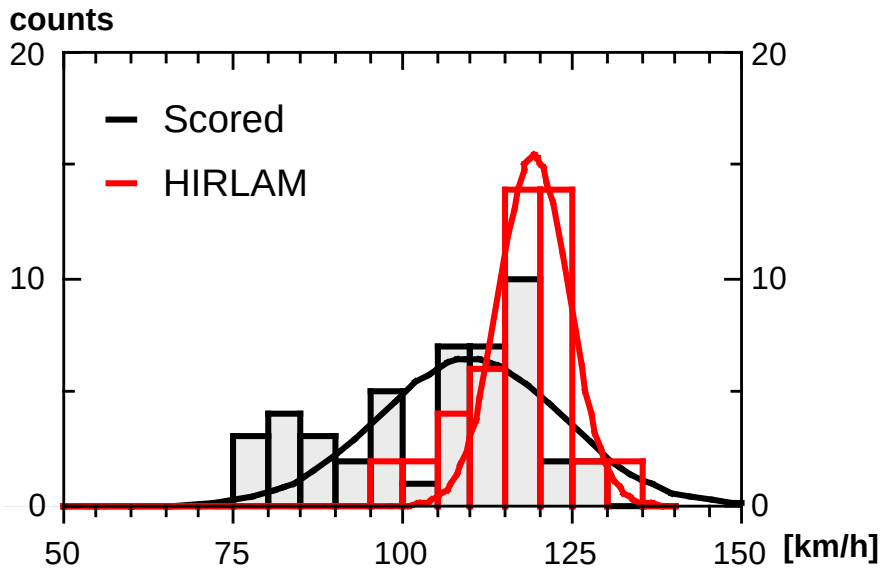




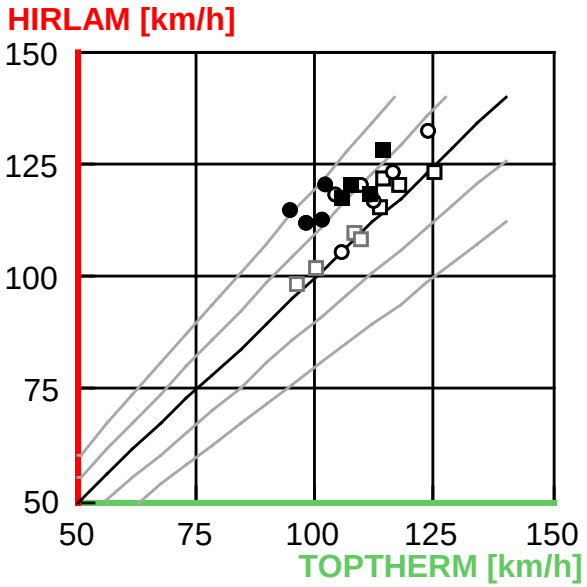
Intercomparison

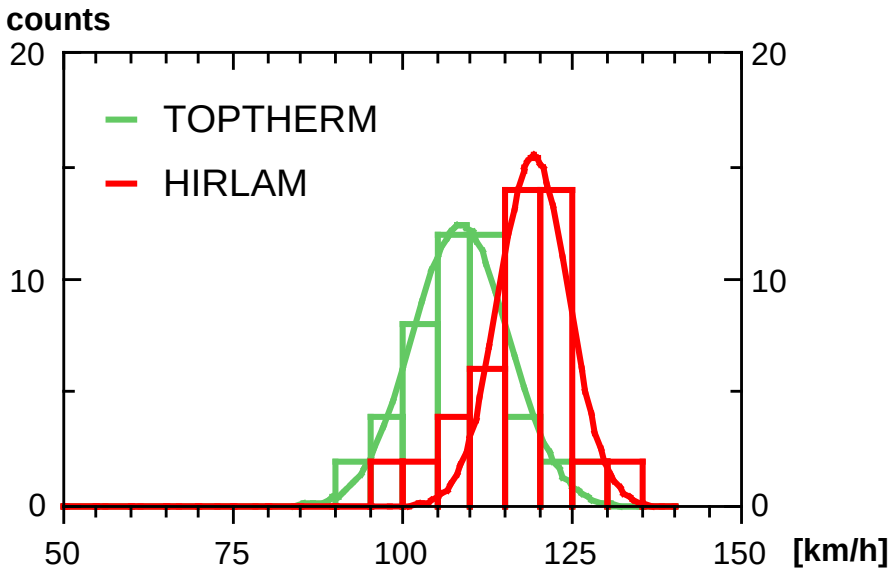
HIRLAM @ Viking Glide



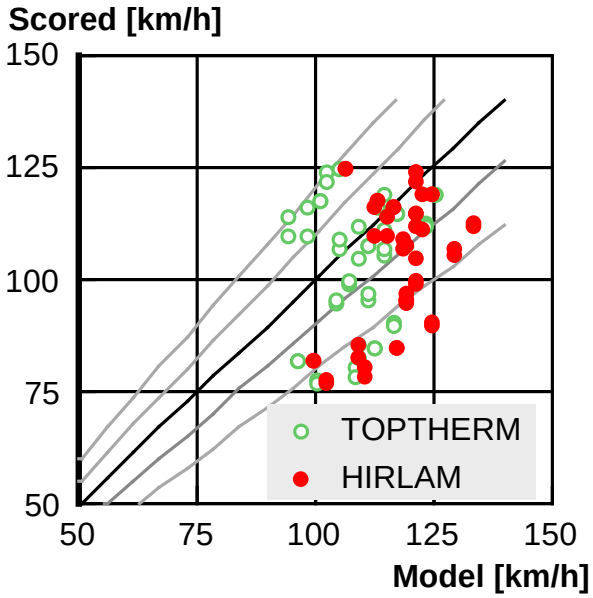


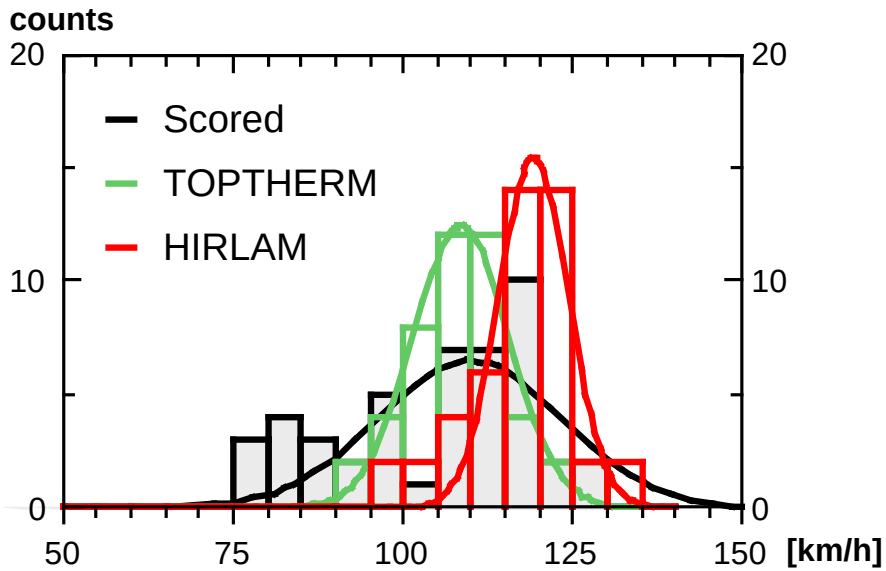
Intercomparison of HL and TT





Verification of HL and TT





46 scored flights @ Viking Glide 2005
(7 days, 23 tasks, 1. and 2. place)

Conclusions (1)

- **50% of the task speed forecasts are good to excellent**
- **Aligned lift can be present**
- **Timing of moving fronts may be tricky**
- **Large sized regions are a limiting factor for the precision**
- **Model tuning with recorded flights: increase of the TOPTHERM climb rates for Rieti and Vinon in 2007**

Conclusions (2)

- **At gliding competitions the forecast TopTask speed is a good estimate of the winner‘s speed**

- **The concept of regionalized thermal forecasts provides meteorological flight planning to the soaring community in useful quality.**

Outlook

- **Meteorological flight planning can be expected to be available also for future WGC**
- **Numerical predictions of aligned lift rates and their use in flight planning are under development**
- **Thank you for your attention!**