Future Upper-Air Network Development (FUND)

WMO ET-UASI, Payerne June 2008, Agenda Item 3.4

Next Generation Upper-Air Network

- **Large-scale' project to produce costed options for the future (2010 – 2020)**
- **Meet User Requirements. (i.e. Higher spatial and temporal resolution) for high resolution model (1km grid) for winds, temperature, humidity, cloud profile**
- **Resolve structures of mesoscale storms on a scale of less than 100 km**

- FUND – Future Upper-air Network Development

Future Upper Air requirements?

Parameter	Horizontal resolution	Vertical resolution	Observing cycle	Accuracy
Wind (u,v)	1 to 30 km Min 100 km	1 km [300m] to 100m	3 to 0.5 h [0.25h]	0.5 to1.0 ms^{-1}
Humidity	1 to 30 km Min 100 km	1 km [300m] to 150 [100m]	1h to 0.5 h	3 to 7 per cent
Temperature profile	1 to 30 km Min 100 km	300m to 100m	3 to 0.5 h	0.5 K
Aerosol profile	10 to 30 km Min 200 km	> 2 km	6h to 1h	20 per cent
Cloud base height	3 to 30 km Min 100 km		3h to 5 min	90 m
Cloud cover	1 to 30 km Min 100 km		3h to 5 min	10 per cent
Cloud top height	1 to 10 km Min 50km		3h to 10 min	100 m

FUND

- **Dense network needed**
  - **Or exploit high time-res 4DVAR**
- **Optimize current network with surface measurement, weather radar and AMDAR**
- **Probably a mixture of radiosonde and ground remote sensing**
- **Ground-based remote sensing likely to have most impact**
  - **Information concentrated in BL**
  - **Rapid sampling captures BL variability**

Working packages

- Instrumentation
- Integration
- Test bed
- Assimilation

Instrumentation

- Provide connections to project data base
- Instrument Validation activities

  (radiometer: calibration, stability, cloud radar calibration, lidar Calibration) use of cloudnet experience in this domain, use of intercomparison, error characterisation
- Develop Data paths to tips account
- Data Formats identified for data users

Integration 1

- Goal extract new information from combination of instrumentation
- ie cloud radar+ceilometer+radiometer> cloud classification :identification of drizzle, super cool water, ice cloud (use of Cloudnet algorithm)
- Complementarity allow less tight spec for instrumentation development ie:vertical speed in rain from wind profiler rather than from cloud radar

Integration 2

- Investigate combination of Wind profiler +weather radar +AMDAR wind to give 3D wind field?
- Investigate and classify the use of wind profiler signal to noise + cloud radar in identifying the heights and characteristics of boundary layer inversions
- Quality control procedures need to be developed

Testbed

Long field experiment

(instrumentation installation)

Aim: capture of small scale meteorological events compatible with high resolution NWP.

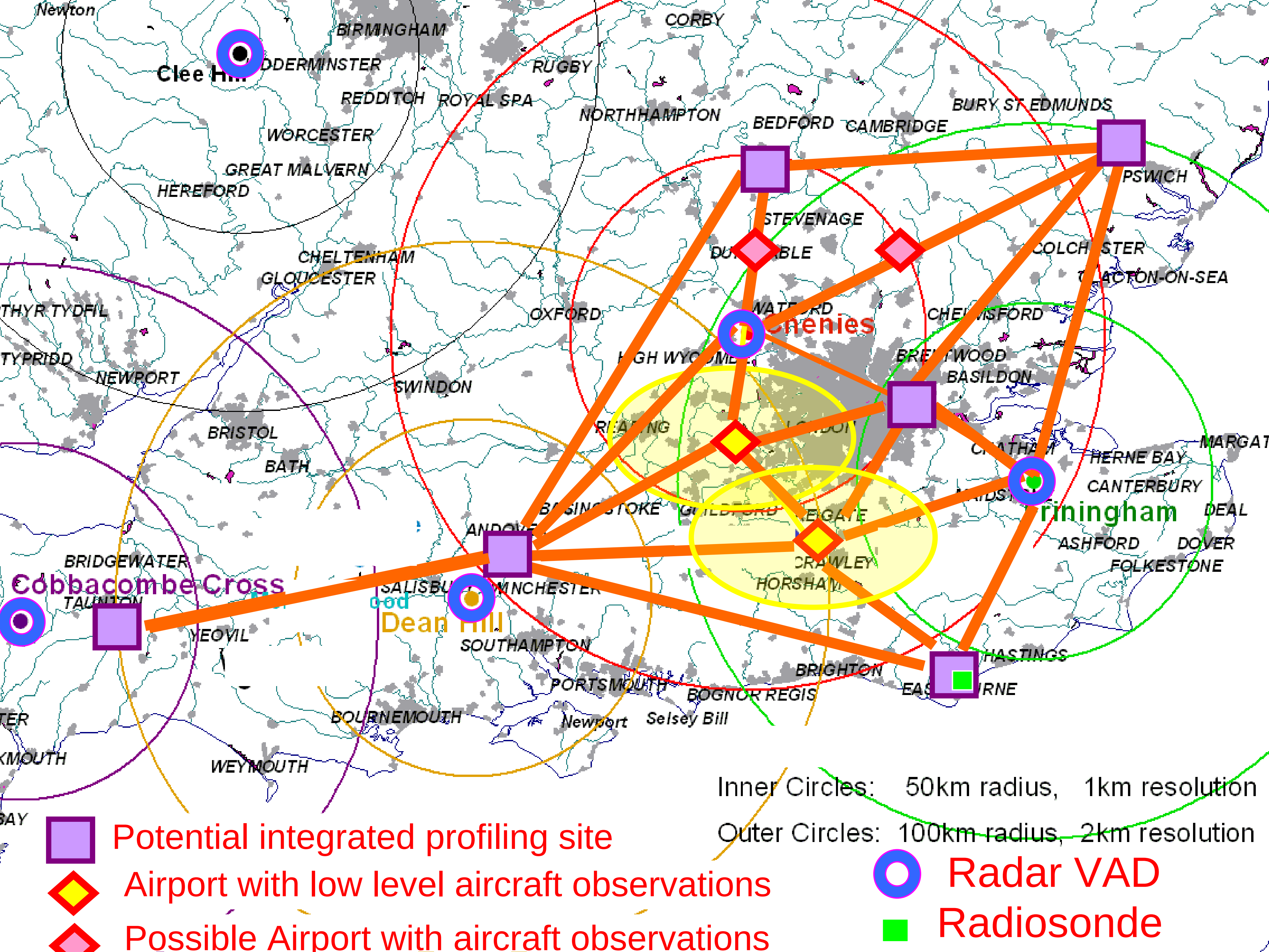
Cost effectiveness of combination of instruments

Validation of algorithms

Providing Inputs for data assimilation developments

Collaboration with COST ES 0702:

- Centralise data for data exchange all data? (weather, radar, surface data, amdar, upper air, model data)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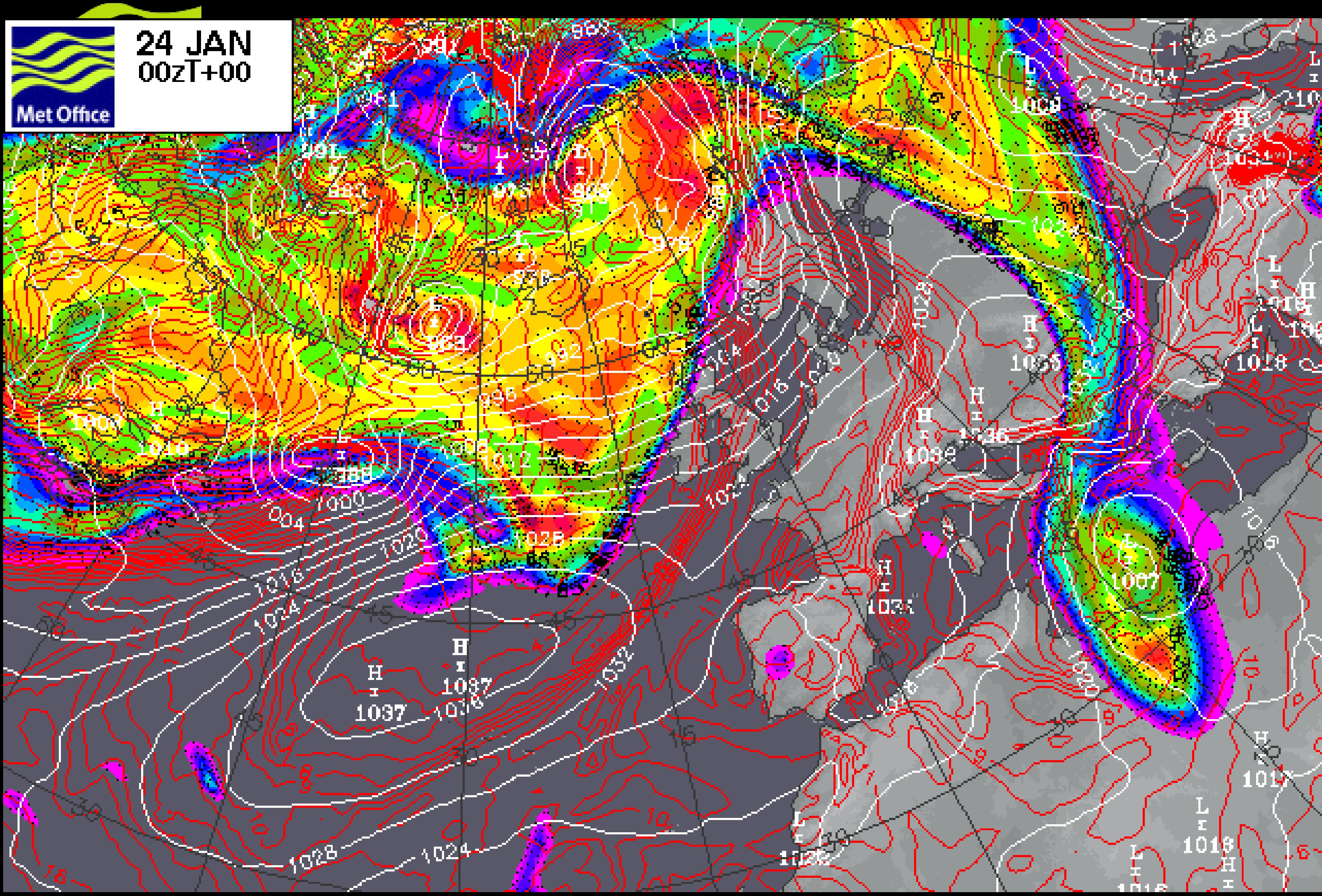
YEOVIL
SOUTHAMPTON
HASTINGS
BRIGHTON
PORTSMOUTH
BOGNOR REGIS
BOURNEMOUTH
Newport
Selsey Bill
WEYMOUTH
Inner Circles: 50km radius, 1km resolution
Outer Circles: 100km radius, 2km resolution
Potential integrated profiling site
Airport with low level aircraft observations
Possible Airport with aircraft observations
Radar VAD
Radiosonde

Introduction to potential vorticity plot,

- 850 hPa WBPT is in red, with PMSL in white. The coloured regions represent potential vorticity 0f 1.5 PV units or more on the 315K isentropic surface, intersecting the tropopause in mid latitudes, this intersection being marked by the first coloured zone. In adiabatic flow PV is conserved on an isentropic surface.

- Cyclonic conditions at the surface are favoured by high PV on the 315K surface or high WBPT at low levels, with cyclonic development taking place where high PV comes close enough to the surface front to engage the warm low level air.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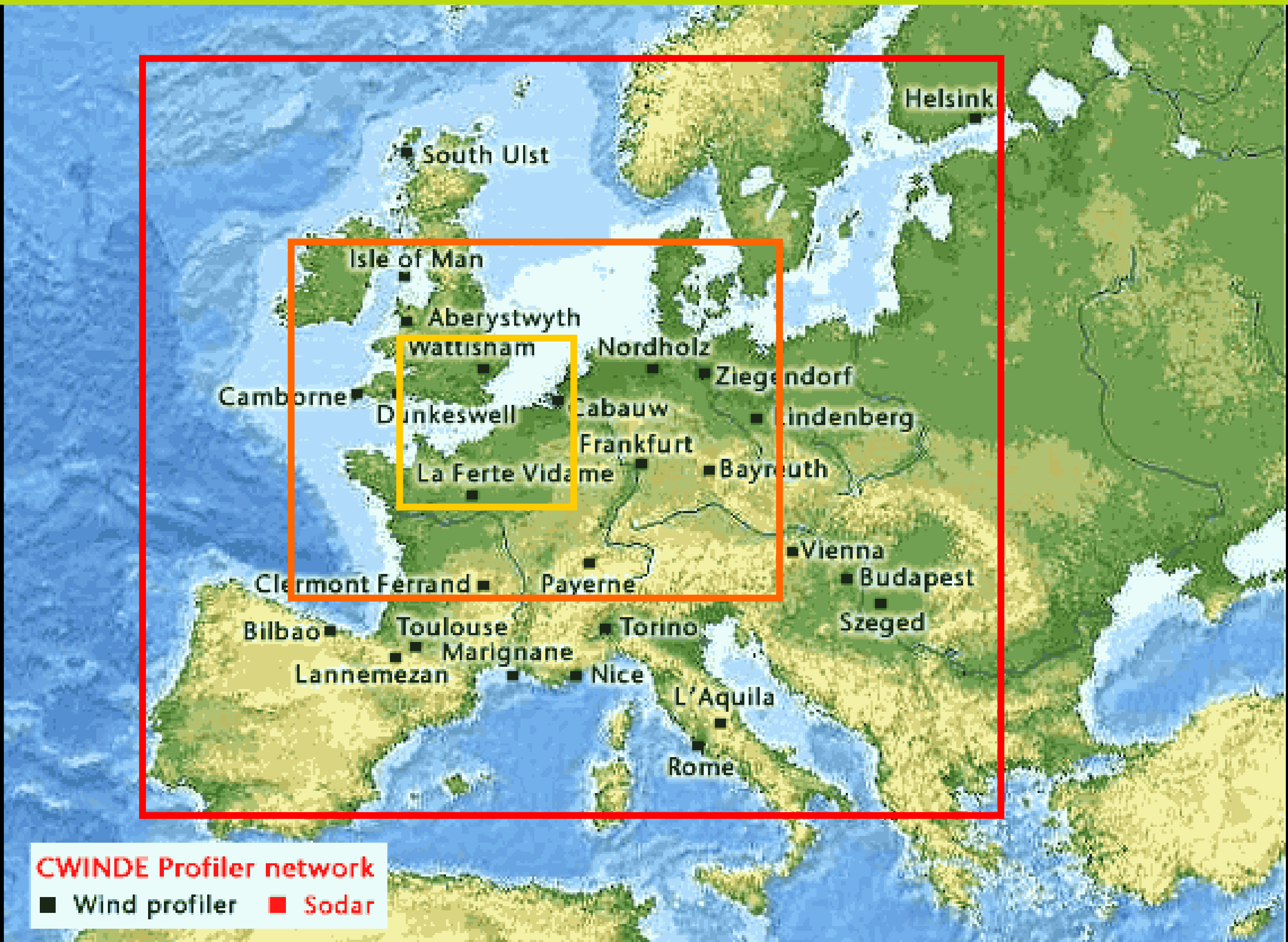
What scale should Eg-CLIMET observing experiments consider in 2009-2010?
Depends on willingness of different organisations to contribute, but larger mesoscale [PV measurements] needs larger area , and UK testbed needs minimum of yellow box?



Assimilation

- Definition of forward operator : means being able to compute from model variable an equivalent instrumentation product. (can be raw data or derived product from integration. This can be slightly incestuous e.g. cloudnet uses model temperature to derive a product which then can be compared to model cloud fraction, so need to be careful if the data are to be assimilated in future)
- O-B statistics need to be generated and interpreted

Assimilation

- Assess Information content
- Interms of Value added to model .
- **Analysis error A** = $(\mathbf{H}^T\mathbf{R}^{-1}\mathbf{H} + \mathbf{B}^{-1})^{-1}$
- *Degrees of freedom for signal DFS* = $\mathrm{Tr}(\mathbf{I}-\mathbf{A}\mathbf{B}^{-1})$
- Can be used to trade-off different obs. Strategies
- However might not measure the societal impact of extreme event which will not show in the statistics .

Assimilation

O-B : implementation

2 options Peter Clark archive or OPS

Information Content of Observations from Tim H PhD

Table 2 – Degrees of Freedom for Signal in temperature (*DFSt*) and humidity (*DFSq*) available from Radiometrics TP/WVP-3000 in different configurations with/out averaging 55-59 GHz channels.

	Instrument Combination	Averaging Period	Clear		Cloudy	
			DFS_t	DFS_q	DFS_t	DFS_q
a	Radiosonde		8.6	7.1	8.6	7.1
b	Surface sensors only		1.0	1.0	1.0	1.0
c	(b) + Radiometrics TP/WVP-3000	Instantaneous Zenith obs. only	2.8	1.8	2.9	3.0
d	(b) + Radiometrics TP/WVP-3000	Averaging obs. over 300 s	3.2	2.0	3.3	3.0
e	(c) at 4 elevation angles +zenith IR	Averaging obs. over 300 s	4.4	2.7	4.4	5.0

Conclusion

- A lot of work
- Format netcdf, metdb bufr ?
- Data base for COST ES 0702
- Need to develop links with work of WMO-ETUASI and –ET-RSUT&T