



Meteorological Data from Numerical Weather Prediction or Observations for Dispersion Modelling

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- Synoptic observations (OBS) are widely used as input data for dispersion modelling.
- Numerical Weather Prediction (NWP) data are easily formatted for input to dispersion models.
- Met Office and NSCA surveyed model user views on met data.

AIMS:

- 1. Lessons learnt from the survey.
- 2. Compare NWP and OBS data sets at locations across the UK.

1. User Survey - Met Data for Dispersion

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- Met data for dispersion models has been debated for some years.
- EA - research project looking at implications of using NWP data.
- NSCA AQC supported online survey asking for views on met data.
 - Questions designed with help from Dr Rob Pilling (NSCA).
 - Web page went live on Monday 3rd October 2005 on NSCA web site.

- Type of activity e.g. consultancy.
- Which models.
- Types of met data.
- Numbers of met stations.
- Familiarity with NWP data.
- Factors that would influence use of NWP data.

ACTIVITY OF ORGANISATION

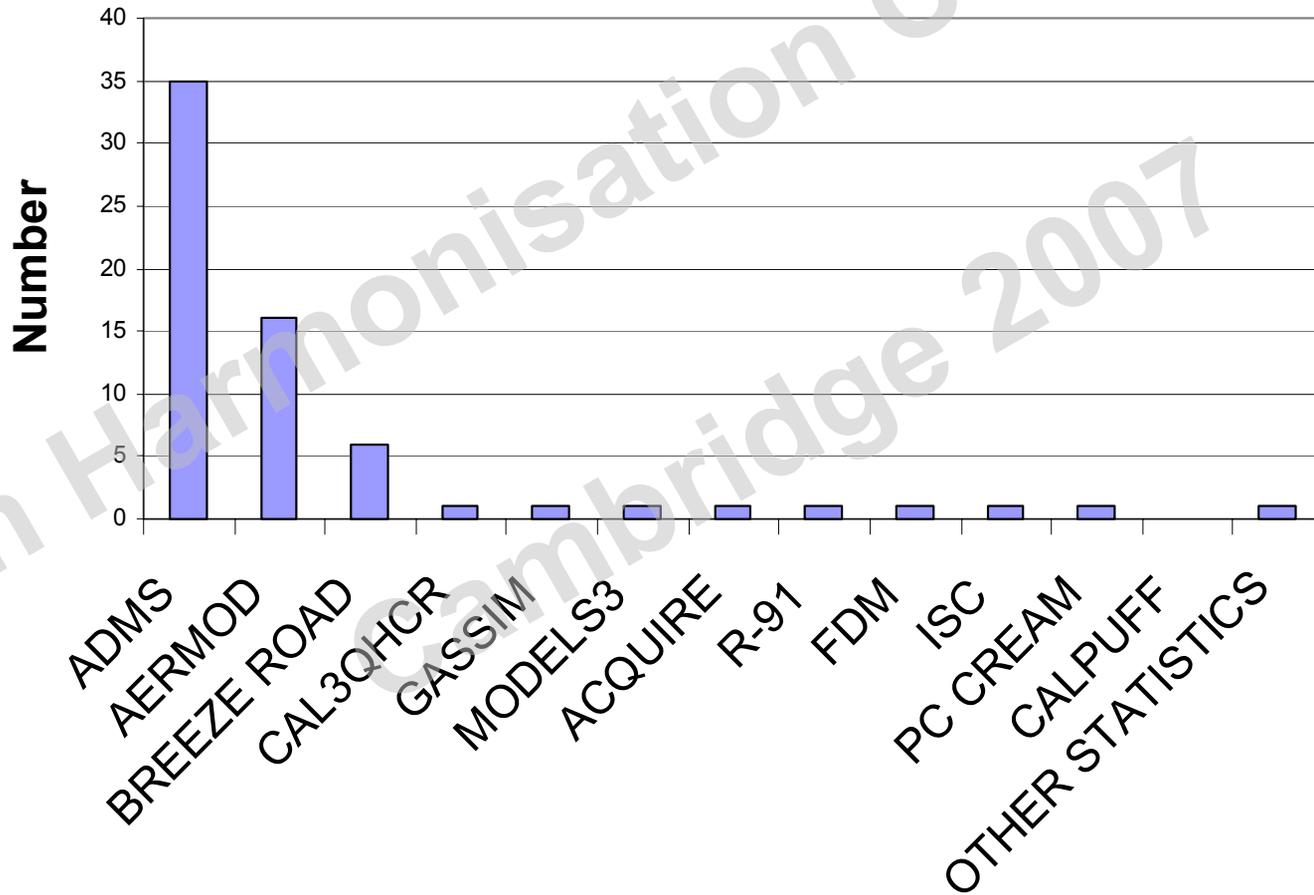


- What applications or models use met data?
- What period & type of met data?
- What met station(s) are data from?
- National Met Office site or local authority site?
- What are dispersion model results used for?

Numbers Using Each Dispersion Model

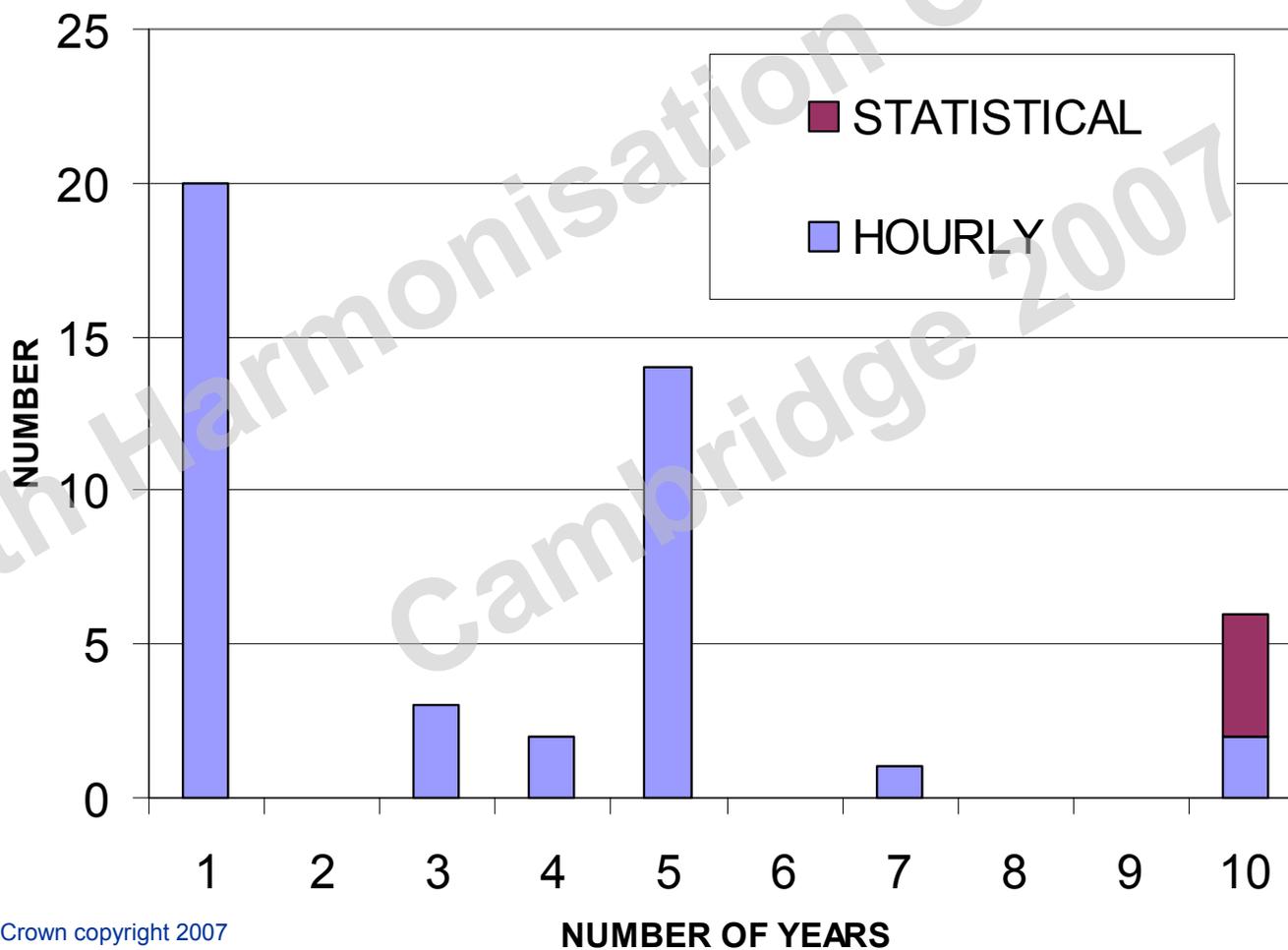


Number using Each Model

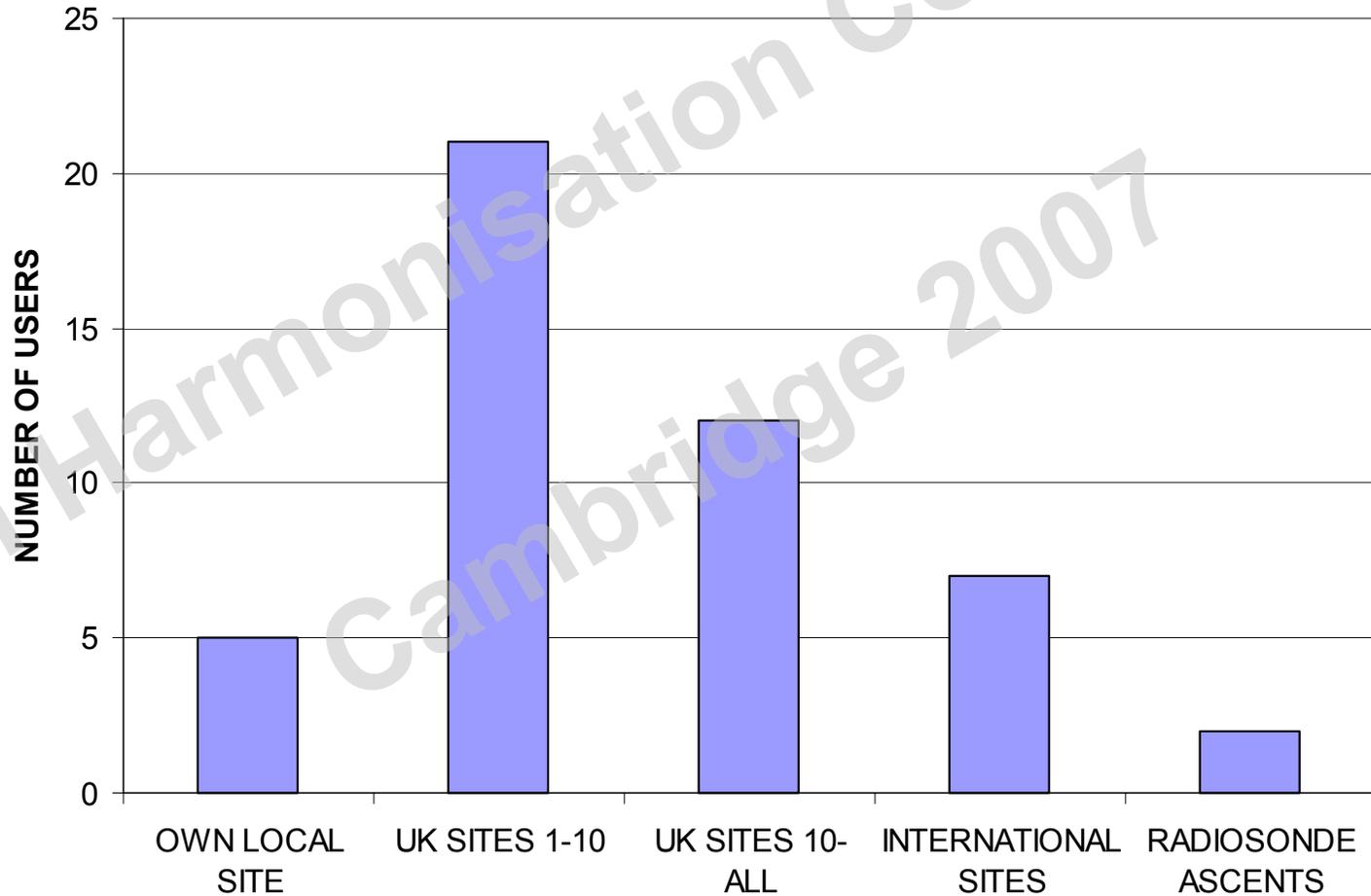


- Annual met files – several years' of data, in separate 1 year files.
- Number of years is according to severity or risk:
 - residential or low impact – maybe 1 year.
 - Most PPC/IPPC applications – maybe 3 years.
 - High risk or high profile PPC/IPPC – 5 years.
- Some use 2 years from their local site, plus say 5 from further away to assess variability.
- Some use Merged Data & avoid lidar cloud:
 - LA wind speed with UKMO cloud, T, rain
 - Cloud at site A with wind speed/direction at site B
- UK use of met data is not harmonised.

Duration and Type of Met Files



Site Locations



- Knowledge/experience of NWP data?
- Interested in using NWP data for dispersion modelling if it was easily available?
- Interested in a training course to learn more about NWP data?
- Main implications or concerns of a switch from observations to NWP data?
- Interested in using fields of NWP data to cover several locations or to support more complex models that have meteorology changing in space as well as time?

Level of Knowledge	Number
None	15
Some exposure e.g. via NSCA DMUG Meetings	16
MSc or Career Experience using NWP Data	5

There is an important training gap to be filled if NWP data are to be used with confidence and in an appropriate manner.

Using NWP Data – Criteria for Use



Criterion	Number
Acceptability to Regulators: EA/SEPA or DEFRA	19
Represents local geography: terrain/climate	16
Robustness: model verifications, previous permit applications	20
Price, Delivery, Download	6
Format Compatible to Input	6
Overseas Locations	1
Acceptable to Public	4

- Consultants report quickly & require:
 - contact point,
 - download of data & site information.
- Strong support for using NWP data in principle, if:
 - approved by Regulators,
 - shown to be robust re previous studies,
 - suits local geography/terrain.
- Need to test NWP data on existing case studies with test data: NWP & OBS.
- Need to develop NWP met data training.
- Regulators need to prepare criteria for use of NWP data.

- Established practice in using met data must evolve with:
 - Automation of observations
 - Developments in numerical weather prediction models
- Regulators should define acceptable procedures for using the newer forms of met data
- There is pressure from the community:
 - For data fit for modelling,
 - For training on NWP met data and its proper use.
 - For dialogue between Users, Model Developers, Regulators, and Data Suppliers.

2. Comparison of OBS and NWP Met Data for Dispersion Modelling

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- Synoptic observations: from 1995 – 2005, 50 UK stations.
- Global Analysis NWP data: 1995 – 2005, ~60 km resolution.
- Mesoscale Analysis NWP Data: 2004 – 2005, ~ 12 km resolution.

- OBS & NWP: 10m wind speed, direction; temperature; precipitation; cloud;
- NWP: sensible heat flux; boundary layer depth.
- Used linear 3–D interpolation in space/time for getting NWP data at station position (lat/long)

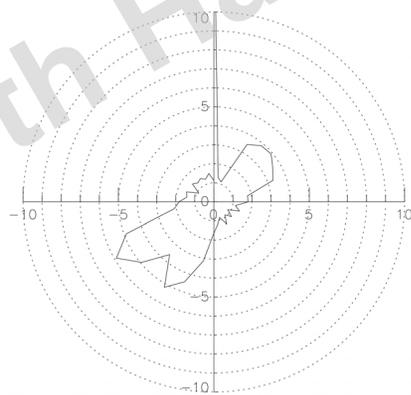
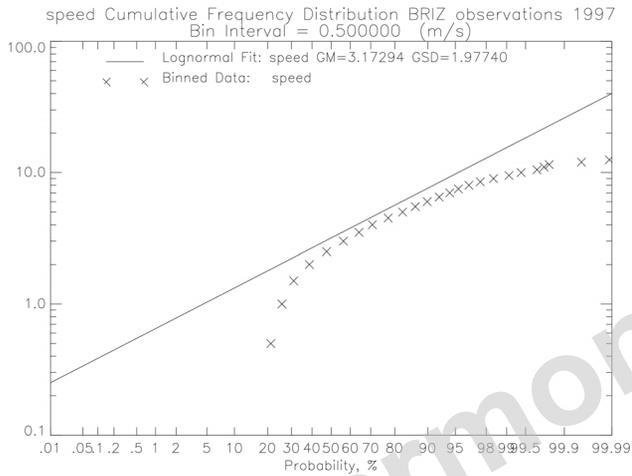
Wind Speed & Direction

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OBS speed & direction: old style anemometer

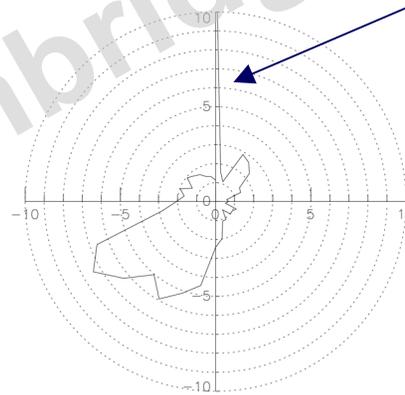
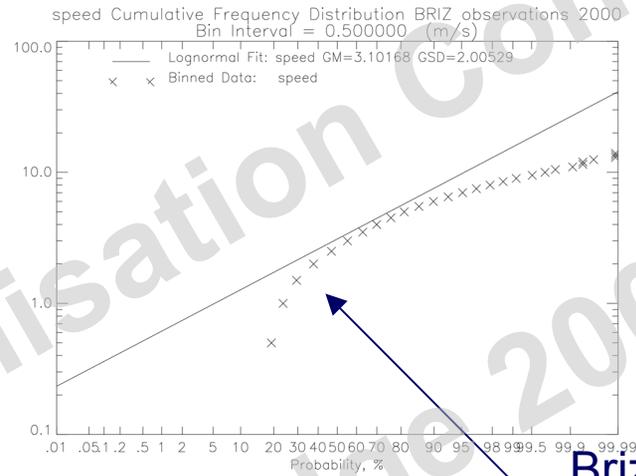


OBS Brize Norton 1997



Wind Direction Rose for BRIZ observations 1997

OBS Brize Norton 2000



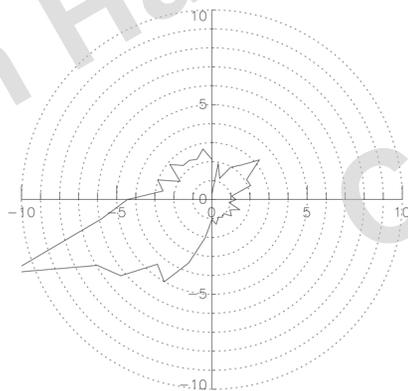
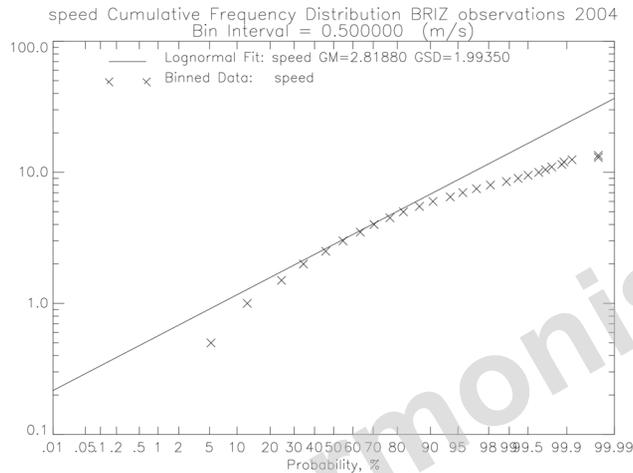
Wind Direction Rose for BRIZ observations 2000

Brize Norton OBS data:
Wind rose & low speeds
reflect sensitivity of
Munro MK4 anemometer
up to 2000

OBS speed & direction: new style anemometer

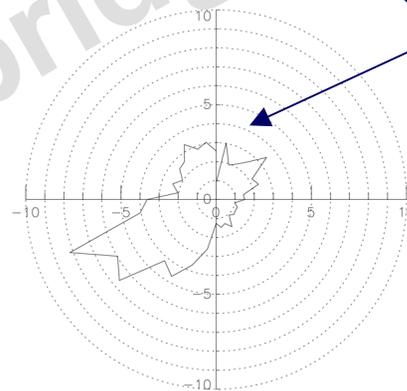
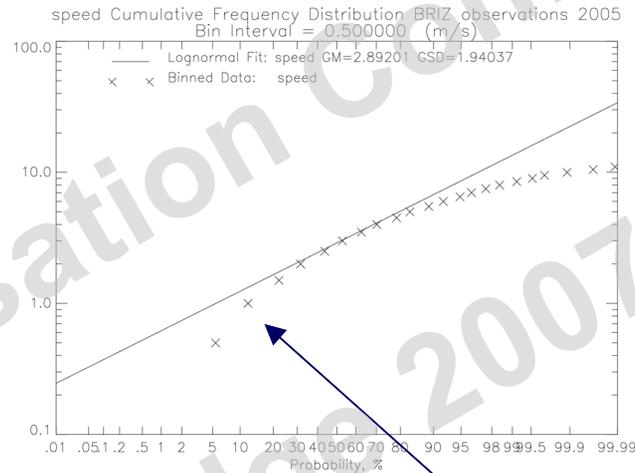


OBS Brize Norton 2004



Wind Direction Rose for BRIZ observations 2004

OBS Brize Norton 2005



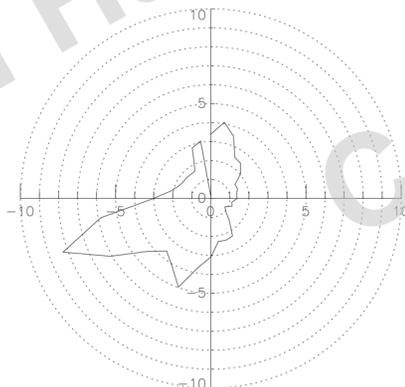
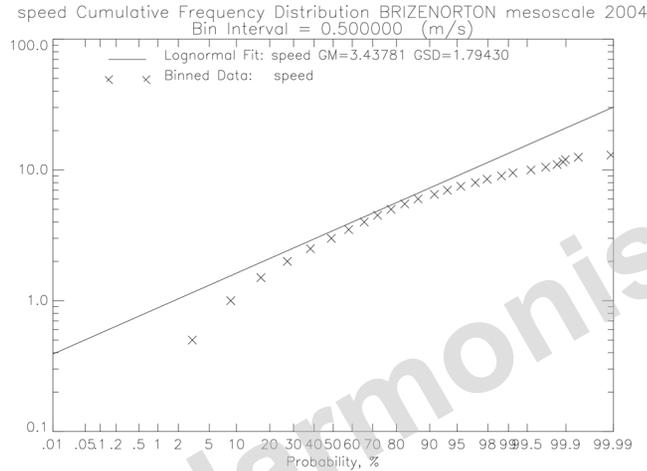
Wind Direction Rose for BRIZ observations 2005

Brize Norton OBS data:
Wind rose & low speeds
improved with Vector
MK6 anemometer from
11 March 2001

NWP speed & direction: ~ 12 km mesoscale model

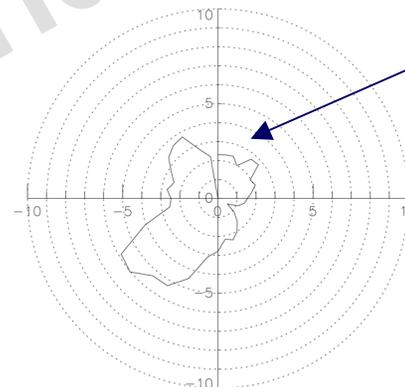
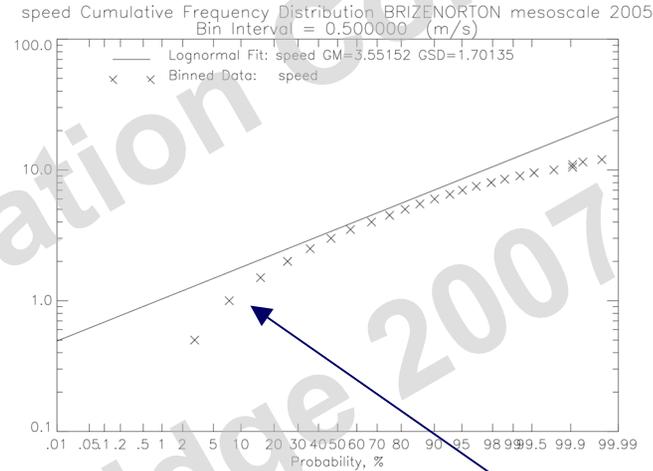


NWP 12km Brize Norton 2004



Wind Direction Rose for BRISTOL mesoscale 2005

NWP 12km Brize Norton 2005

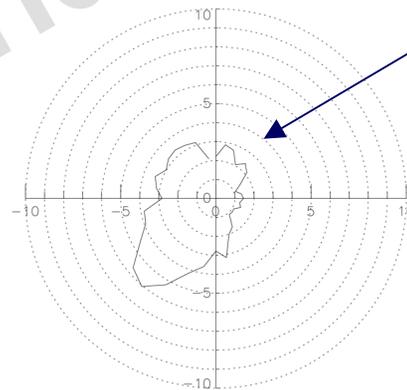
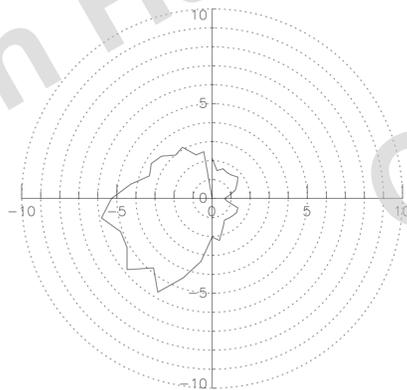
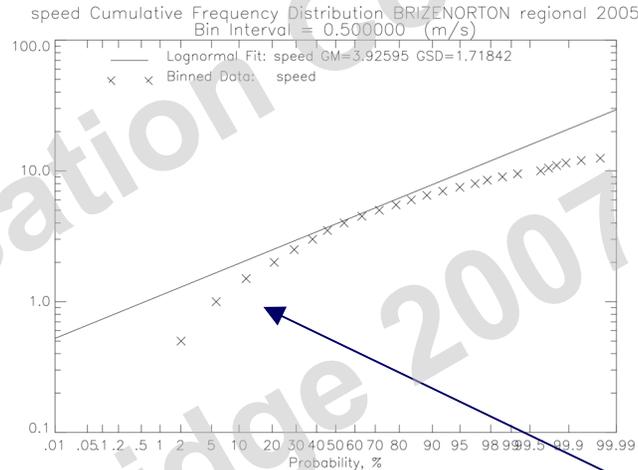
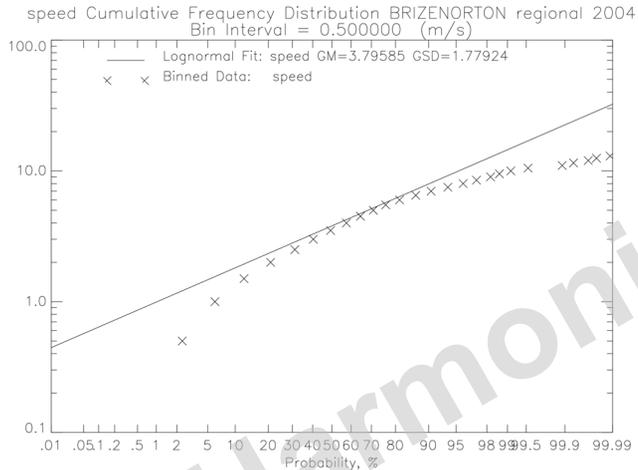


Wind Direction Rose for BRIZENORTON mesoscale 2005

NWP Distribution resembles that from observations using the more sensitive anemometer/vane

NWP 60km Brize Norton 2004

NWP 60km Brize Norton 2005



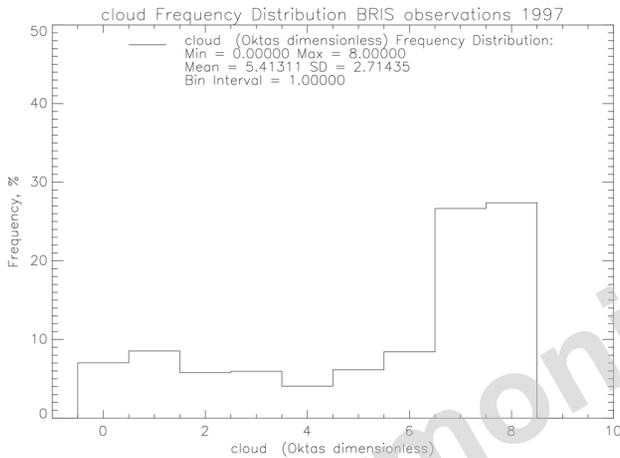
60 km model has similar speed distribution but more spread out wind direction rose than 12 km model.



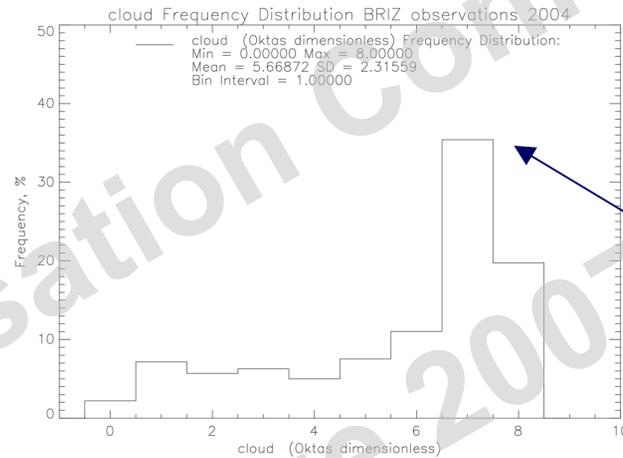
Cloud Cover

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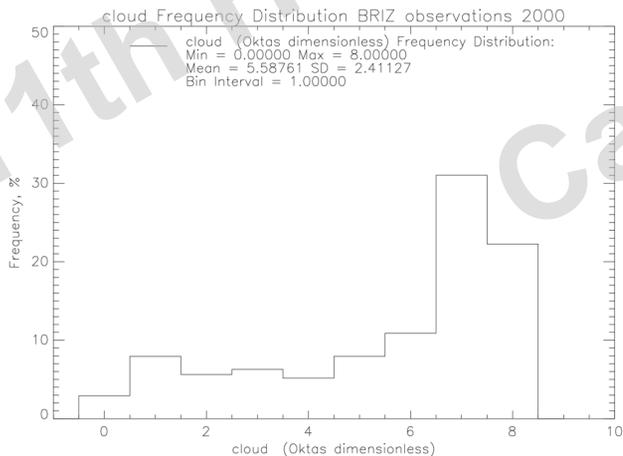
OBS Brize Norton 1997



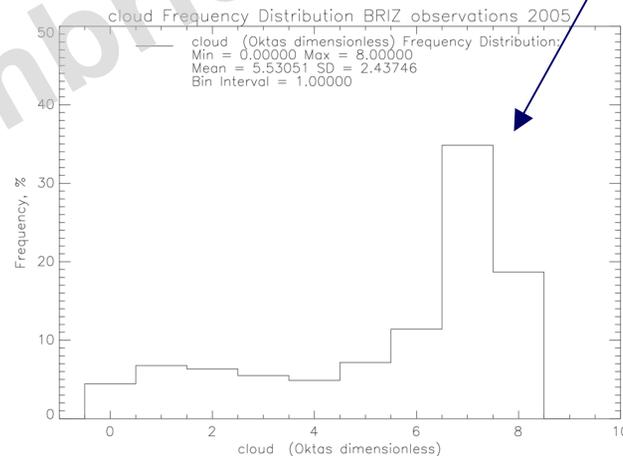
OBS Brize Norton 2004



OBS Brize Norton 2000



OBS Brize Norton 2005

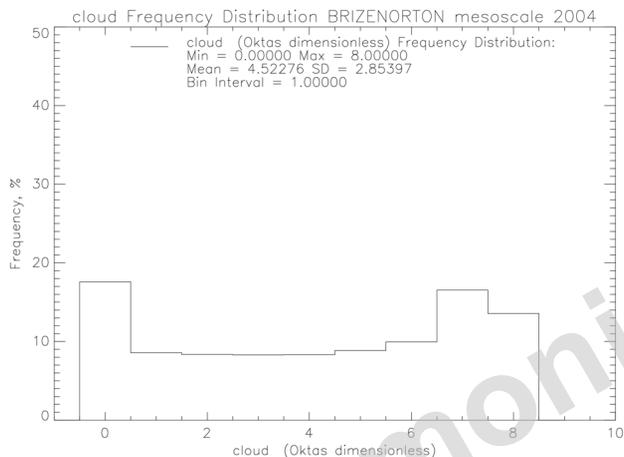


Manual cloud observations have a high incidence of 7 oktas.

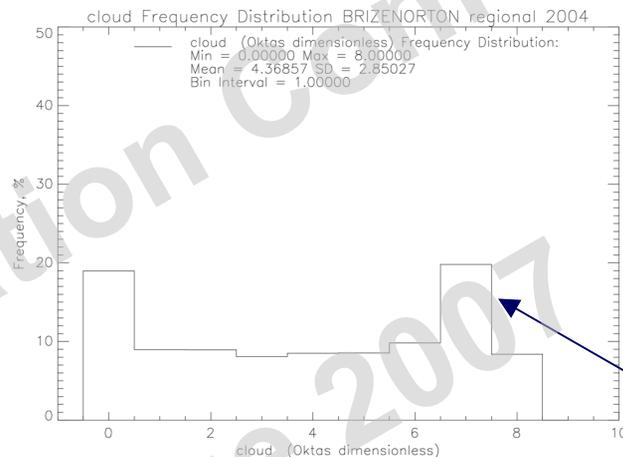
NWP cloud cover: ~ 12 km and ~ 60 km



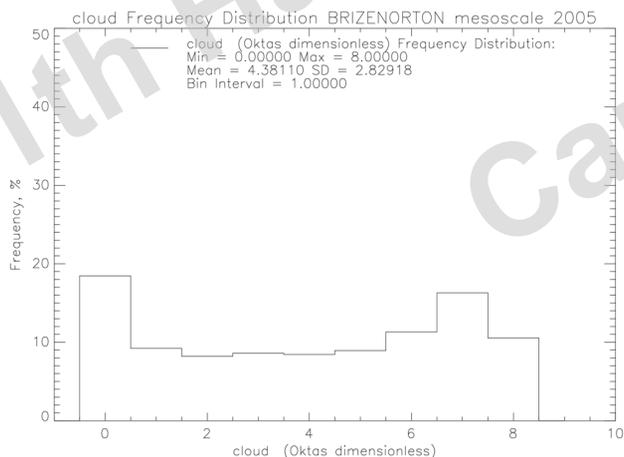
NWP 12km Brize Norton 2004



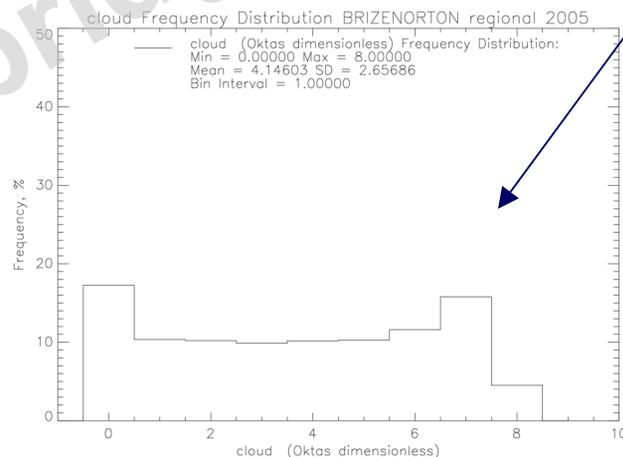
NWP 60km Brize Norton 2004



NWP 12km Brize Norton 2005



NWP 60km Brize Norton 2005



NWP cloud cover at both model scales 12 km and 60 km has a more equal distribution than manual observations.



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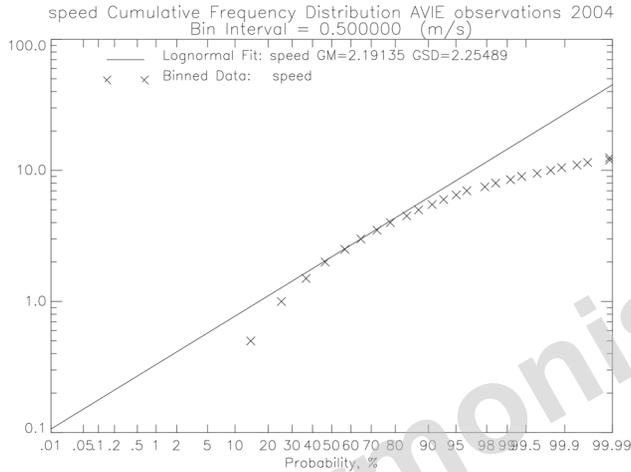
Topography

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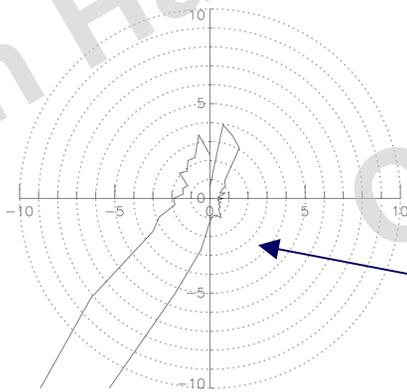
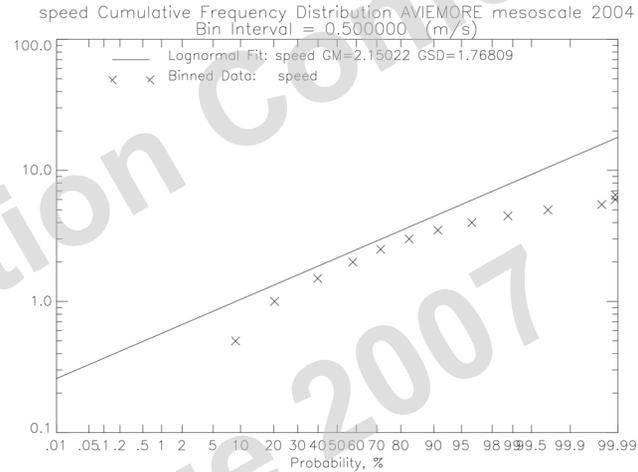
Wind speed & direction in a valley from SW to NE



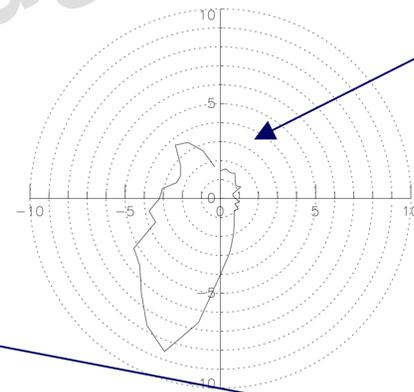
OBS Aviemore 2004



NWP ~12km Aviemore 2004



Wind Direction Rose for AVIE observations 2004



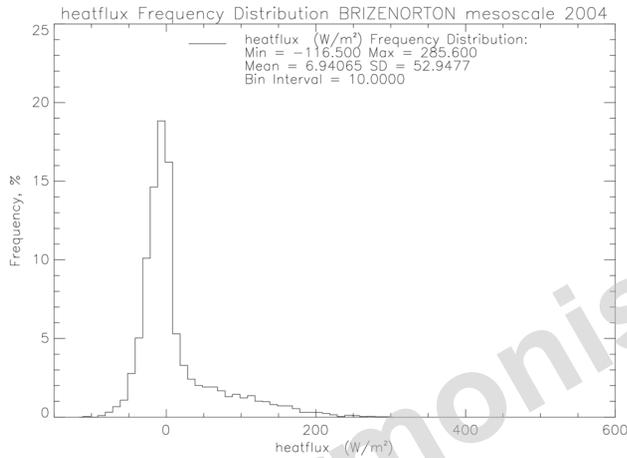
Wind Direction Rose for AVIEMORE mesoscale 2004

NWP ~12km mesoscale wind directions do not fully capture the observed valley flows.

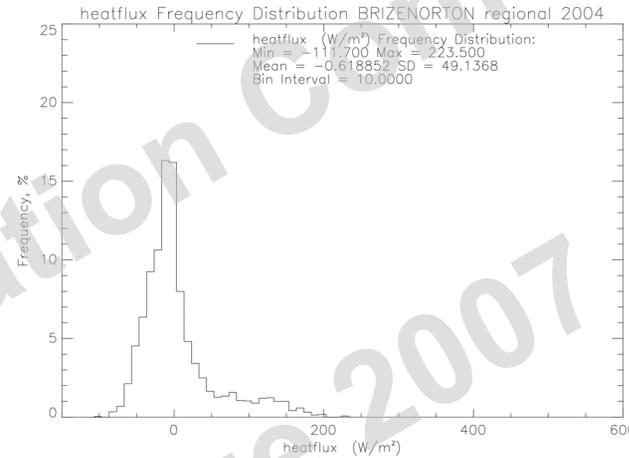
**NWP Heat Flux &
Boundary layer Depth**

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NWP 12km Brize Norton 2004

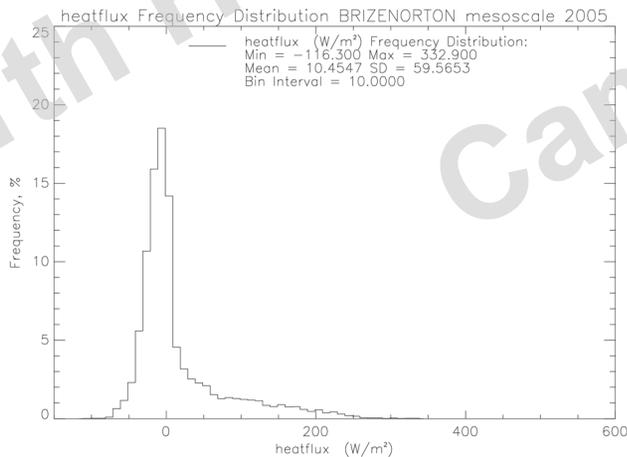


NWP 60km Brize Norton 2004

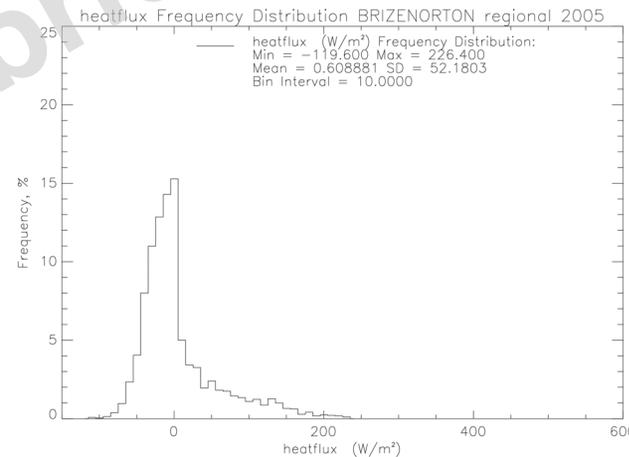


Mesoscale & global heat flux distributions are similar.

NWP 12km Brize Norton 2005



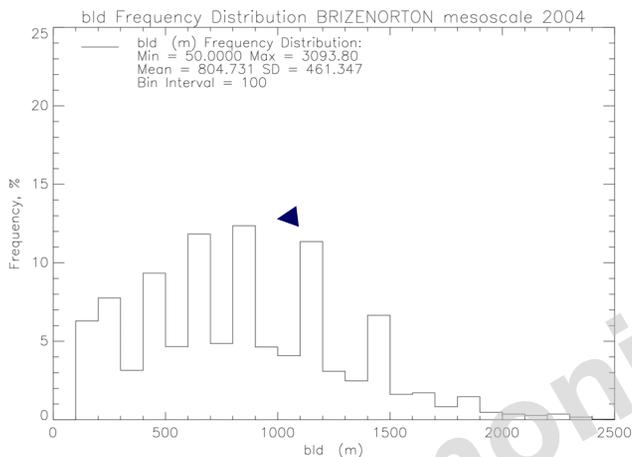
NWP 60km Brize Norton 2005



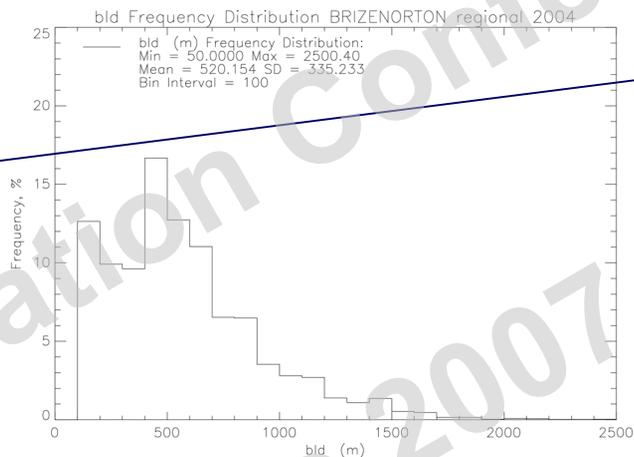
NWP Boundary Layer Depth



NWP 12km Brize Norton 2004

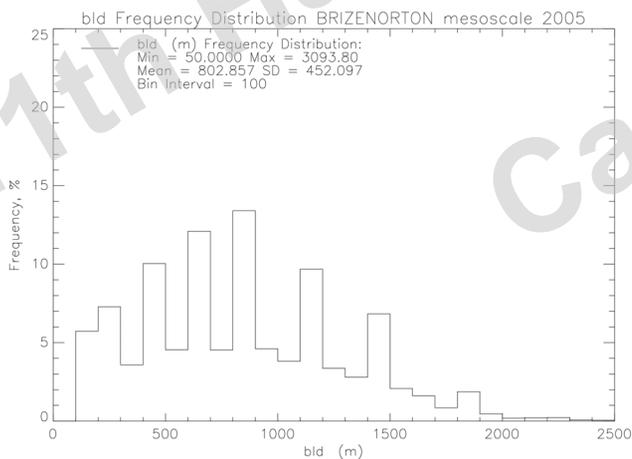


NWP 60km Brize Norton 2004

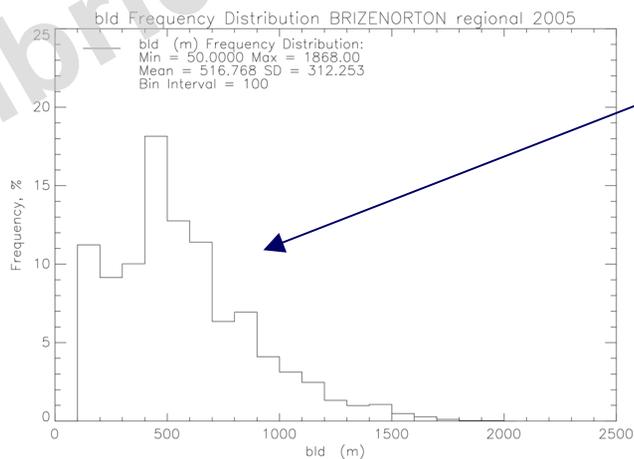


Artifact seen in NWP mesoscale BLD distribution

NWP 12km Brize Norton 2005



NWP 60km Brize Norton 2005



Global BLD distribution is smoother than for mesoscale.

Discussion of NWP & OBS data

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- Reported calm/light winds less frequent with the newer anemometer/vane.
- Dispersion modellers tend to ignore calms.
- NWP wind distributions resemble OBS, except for directions in a valley. Will affect point source plumes.
- Mesoscale model seems better for wind directions.
- Mesoscale and global do equally well for wind speeds.
- OBS and NWP cloud distributions are noticeably different and may affect stability diagnosis.
- NWP BLD distribution has step-like artifacts at mesoscale, but not at global scale. BLD validation measurements are required to improve the NWP BLD.



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Conclusions

- Survey shows some acceptance of NWP data for regulatory dispersion modelling.
- Few were familiar with NWP models & data.
- Clear training need to explain the advantages and limitations of NWP data, including background on how NWP models are initialised and run.
- Plots of NWP data point to mesoscale wind speeds and directions, with global boundary layer depths.
- Cloud data are similar from mesoscale & global models, though different from manual observations of cloud cover.

- Further work needed to establish NWP data in regulatory modelling.
- Where possible, OBS and NWP data should be used as complementary sources of information – if both are used this could indicate the uncertainty due to meteorology.
- Further measurements are required to validate the parameters being derived from NWP, especially BLD data.
- Regulatory guidance could help to harmonise met data for dispersion modelling.



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End