Use of Ground based GNSS data in NWP at UK Met Office

Gemma Bennitt, E-GVAP workshop, 6th Nov 2008

Presentation Outline

- Introduction to the operational Met Office NWP models
- Pre-processing of ZTD observations
- Forward modelling
- What we assimilate and why
- Benefits
- Future developments
- Questions

Introduction

Our main NWP models

Global Model:

40km

4D-VAR

NAE Model:

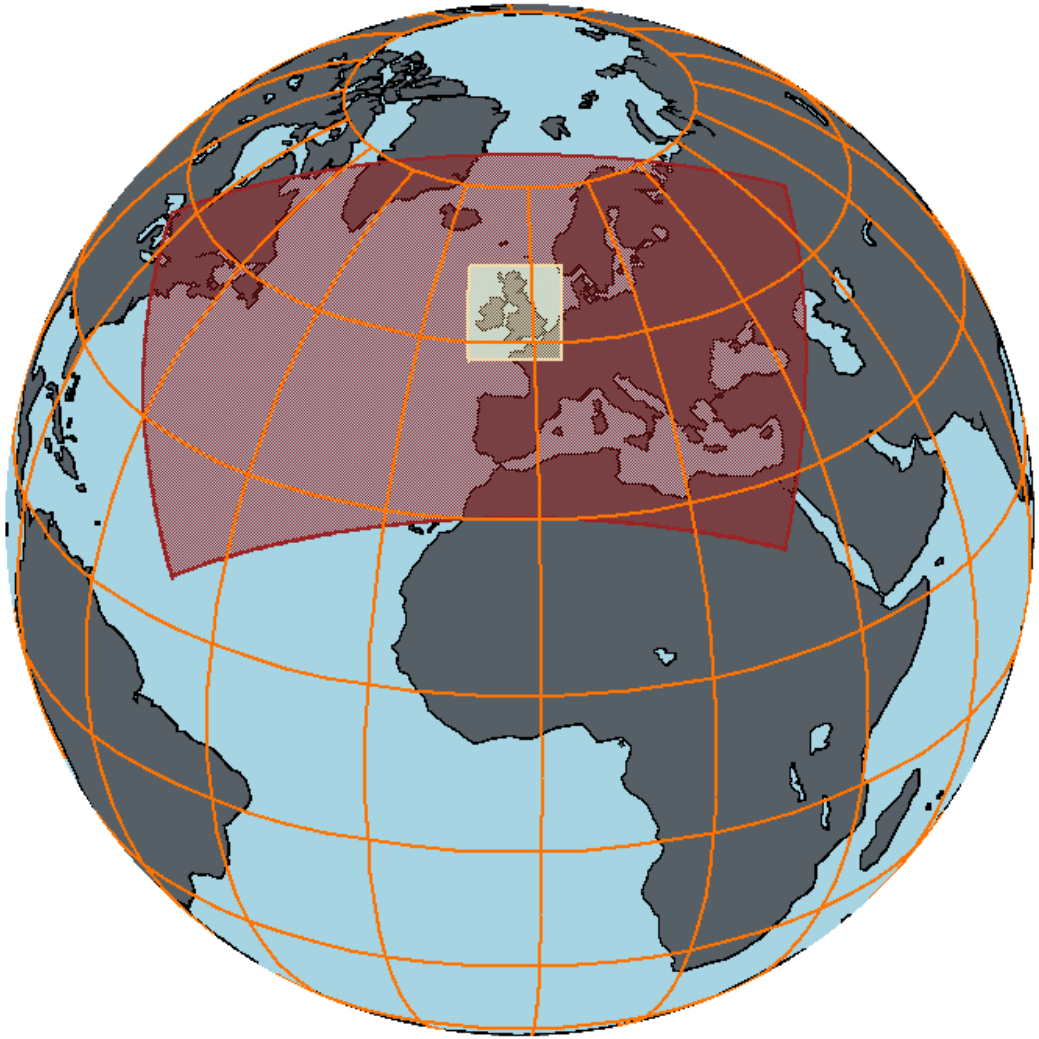
12km

4D-VAR

UK Model:

4km

3D-VAR



Pre-Processing

Processing incoming data

- Whitelist
- Stationlist
- Observation Processing System

Observation Processing System

Forward Model

Bias Correction

Quality Control Checks

Temporal Thinning

Observation Processing System

Forward Model

Bias Correction

Quality Control Checks

Temporal Thinning

28-day mean Obs-Model

Site-Processing centre specific

Fixed value of bias

Observation Processing System

Forward Model

Bias Correction

Quality Control Checks

Temporal Thinning

Obs-Model ZTD

55mm

Station height-

model surface

300.0m

Observation Processing System

Forward Model

Bias Correction

Quality Control Checks

Temporal Thinning →

NAE Model: 1 Obs per station per hour

UK Model: 1 Obs per station closest to analysis time

Forward Modelling

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$$ZTD = 10^{-6} \int_0^{\infty} N dz$$

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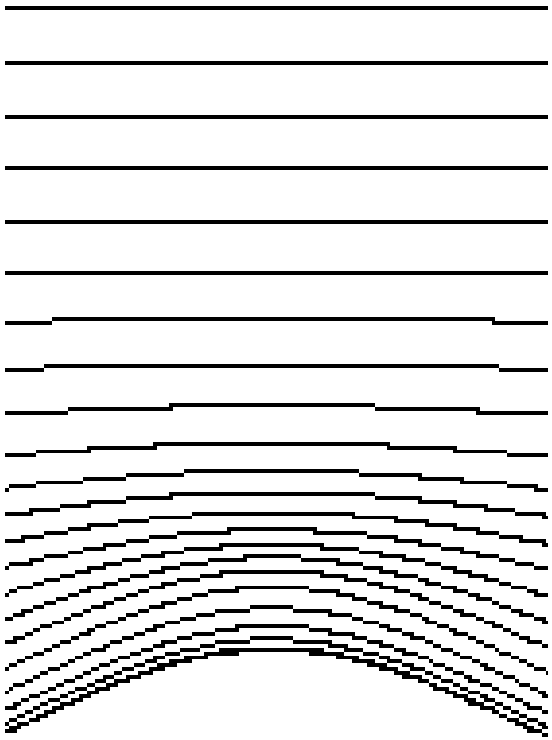
$$N = \frac{ap}{T} + \frac{be}{T^2}$$



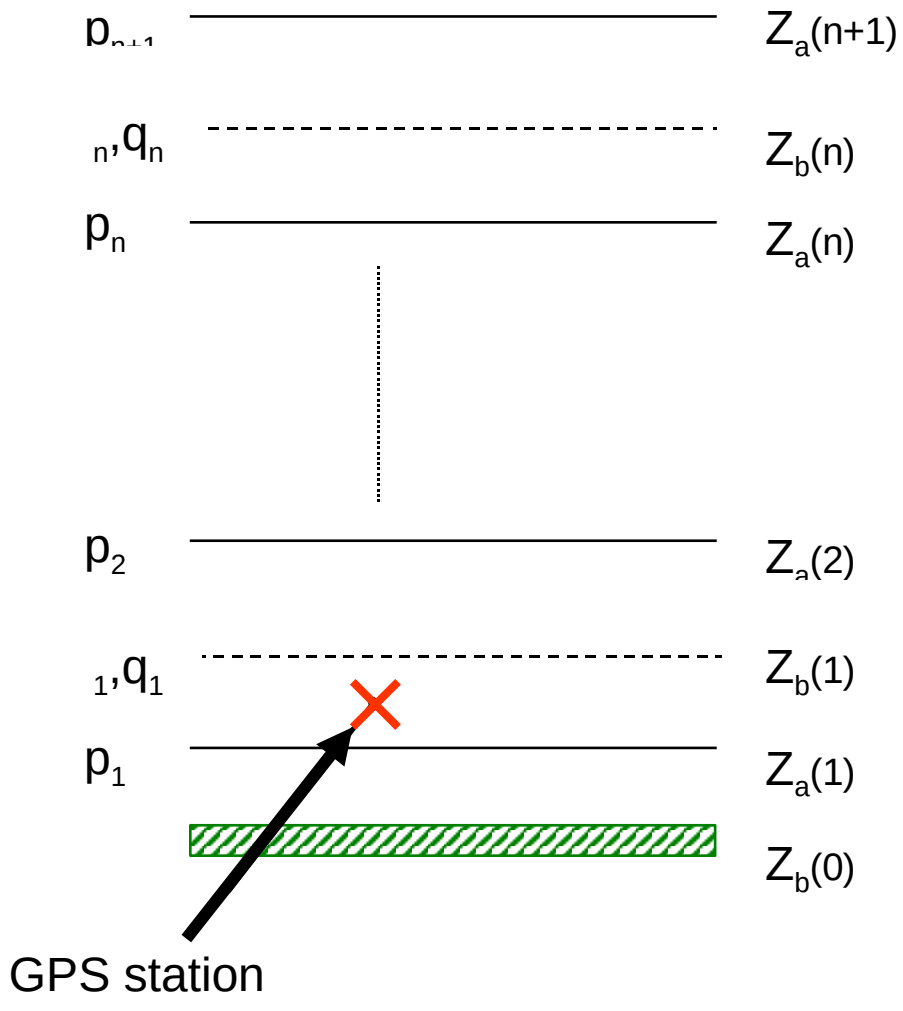
Forward Modelling

$$ZTD = 10^{-6} \int_0^{\infty} N dz$$

$$N = \frac{ap}{T} + \frac{be}{T^2}$$

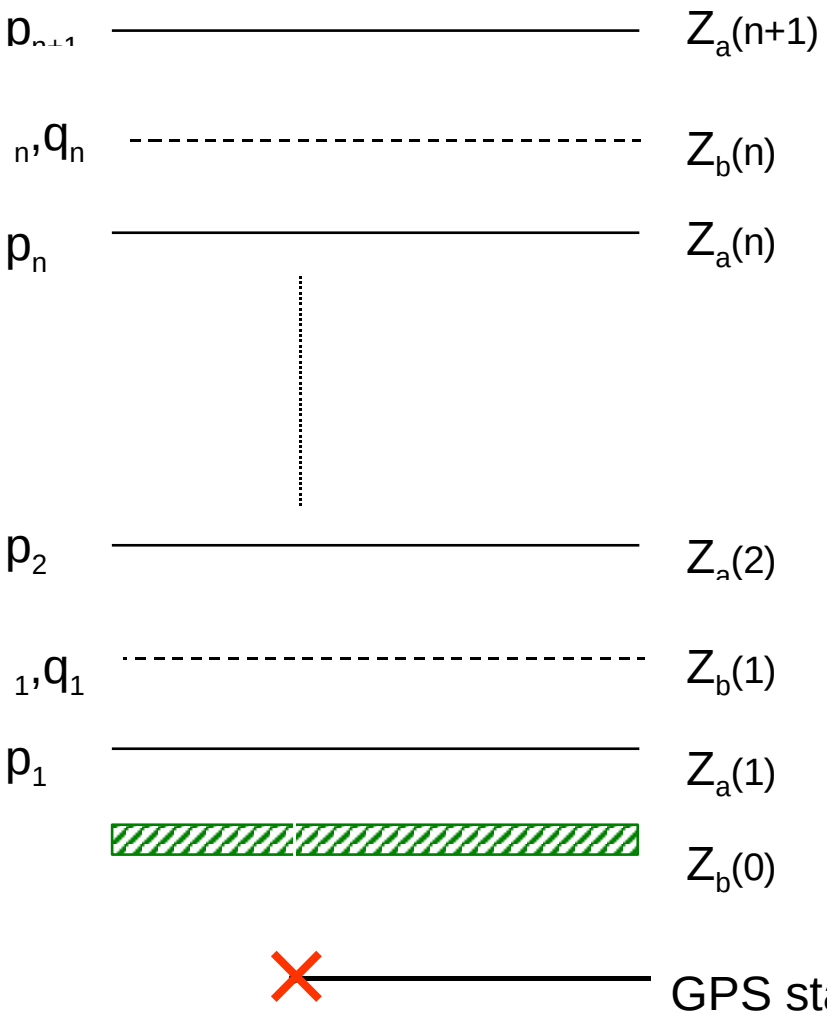
$$ZTD_i = 10^{-6} N_i (z_{i+1} - z_i)$$

Forward Modelling



- Assume constant potential temperature and humidity within model layers
- Linearly interpolate pressure onto ‘b’ layers
- Linearly interpolate pressure from top of model layer down to station height

Forward Modelling



- Assume potential temperature and humidity are the same below model surface as at level 1
- Linearly extrapolate pressure down to station height

What do we assimilate and why?

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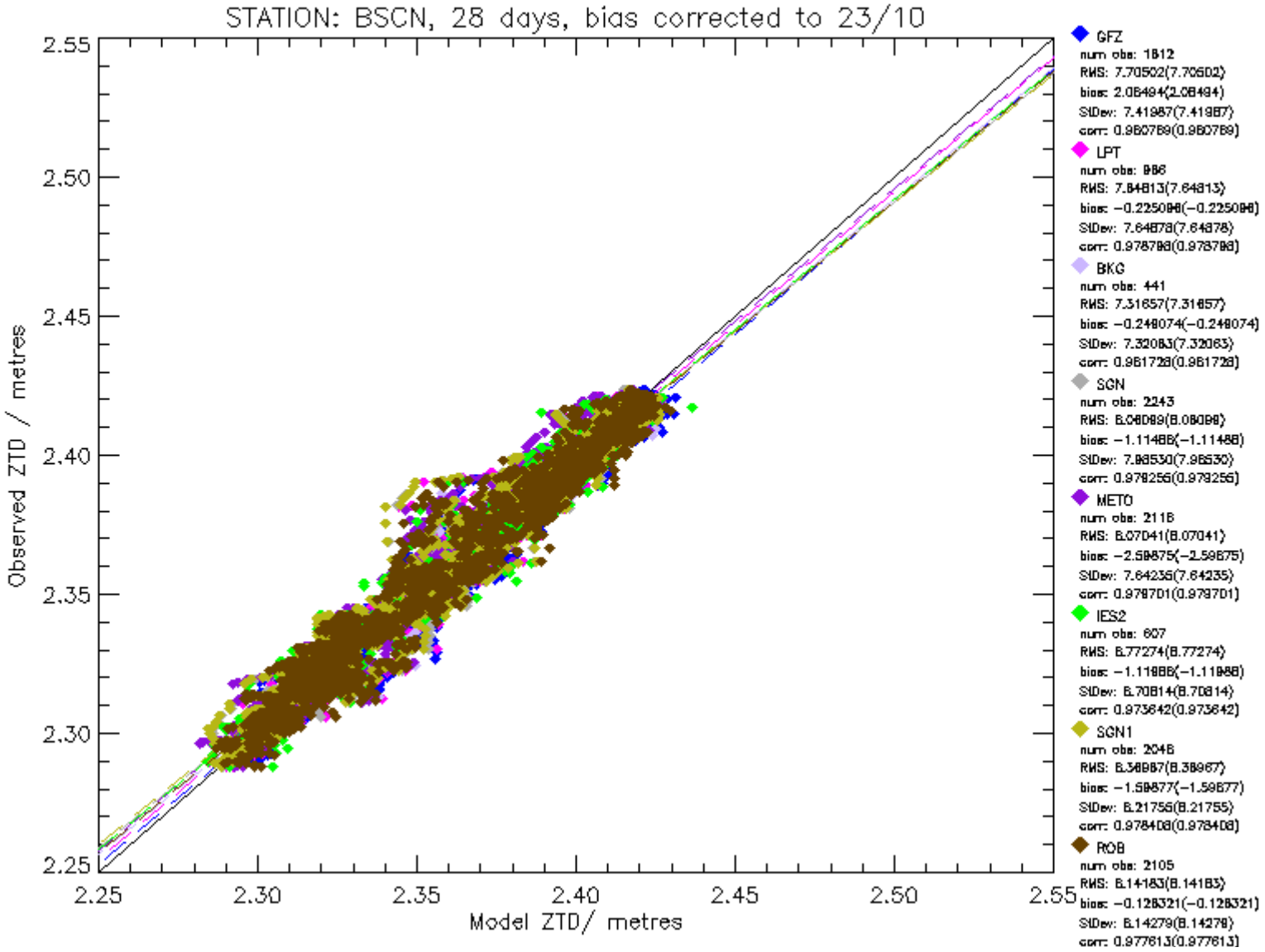
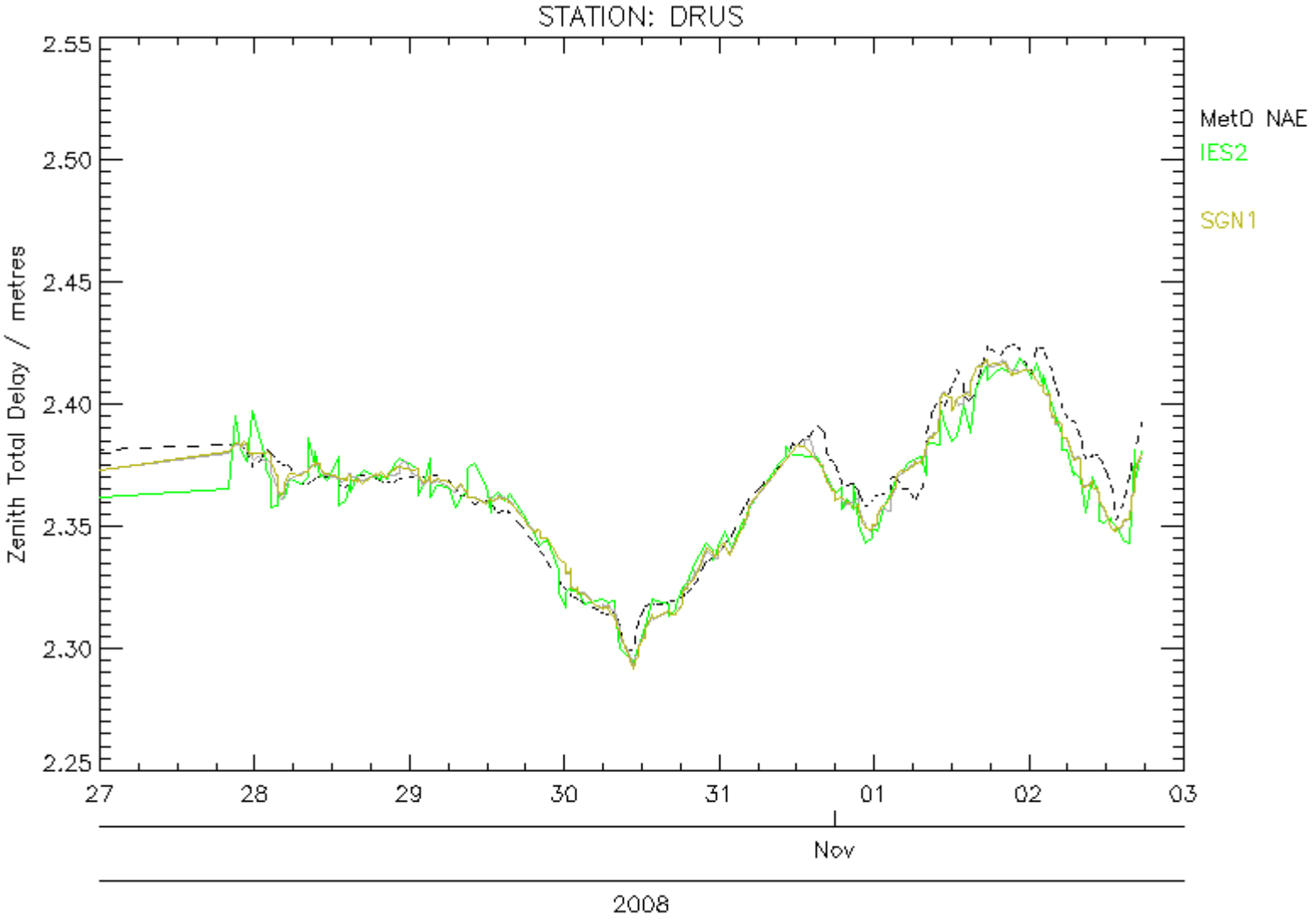
- Assimilating into operational models since March 2007
- Only assimilate data from GOP, GFZ and METO
- Monitoring – we use this to help us decide what data to use

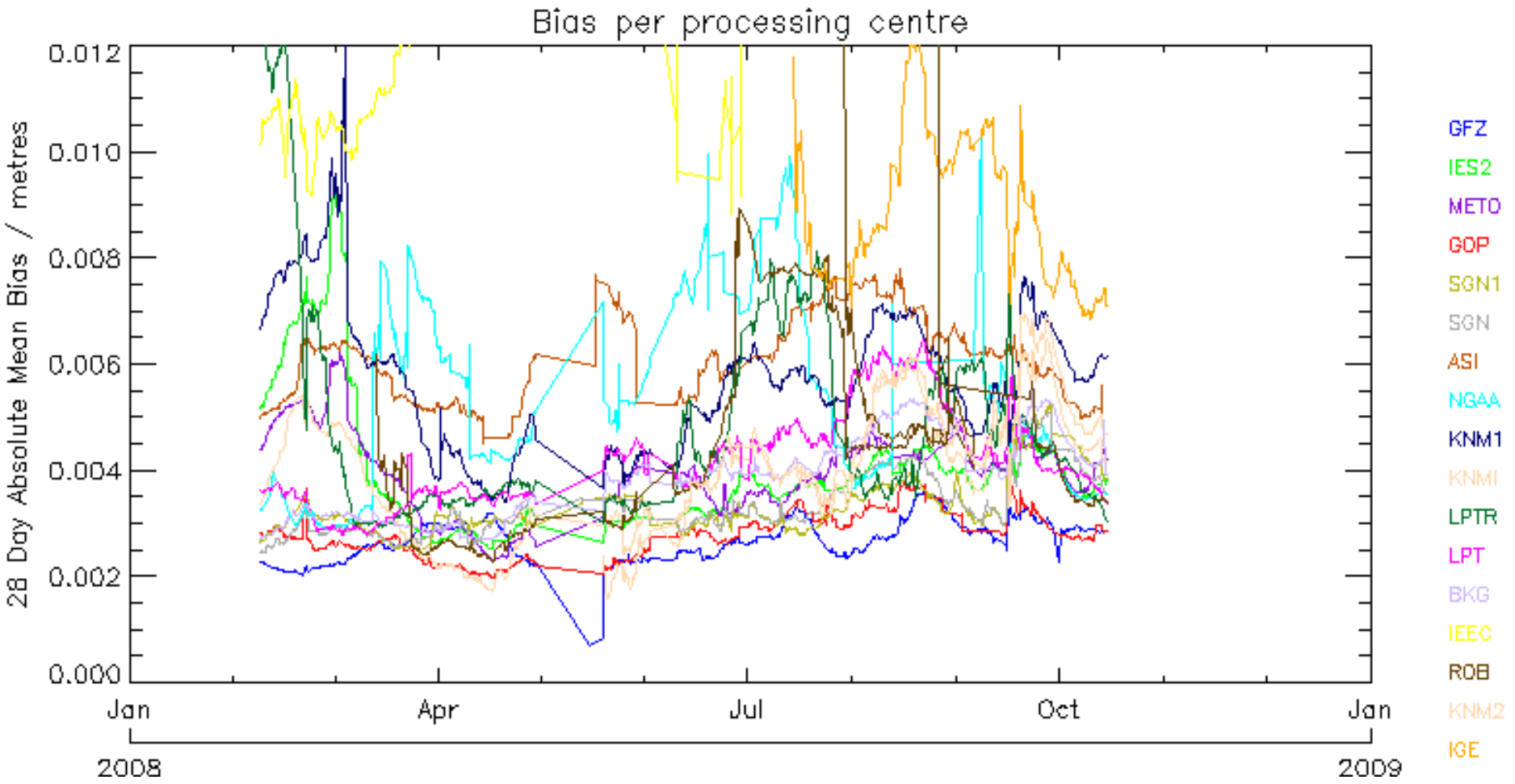
Monitoring



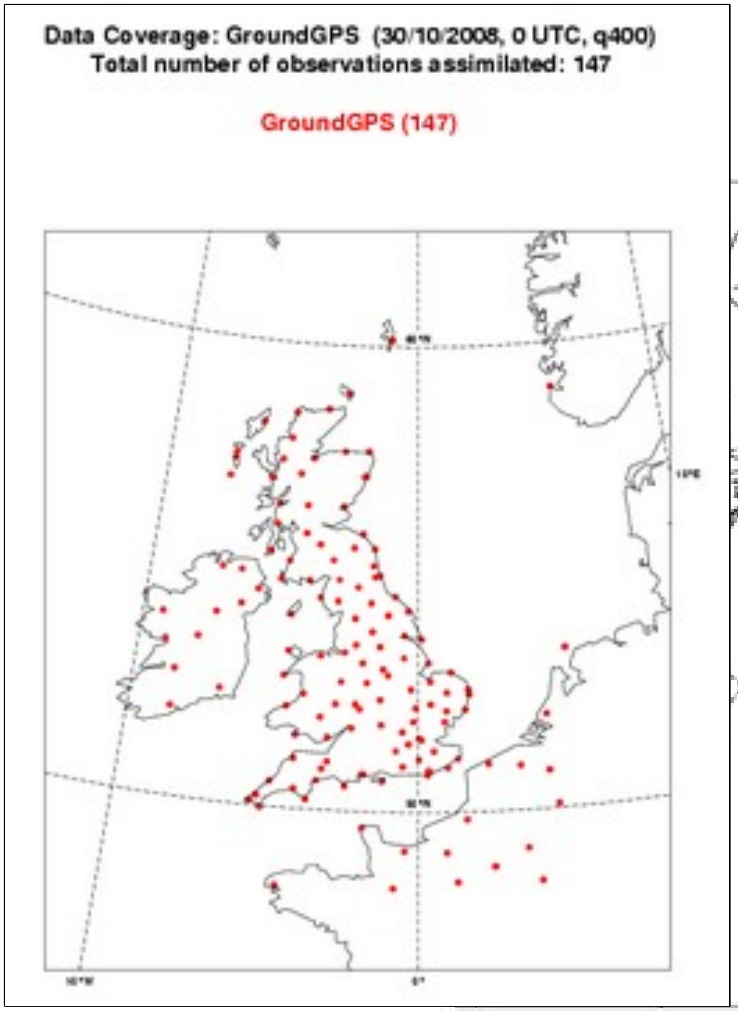
Monitoring

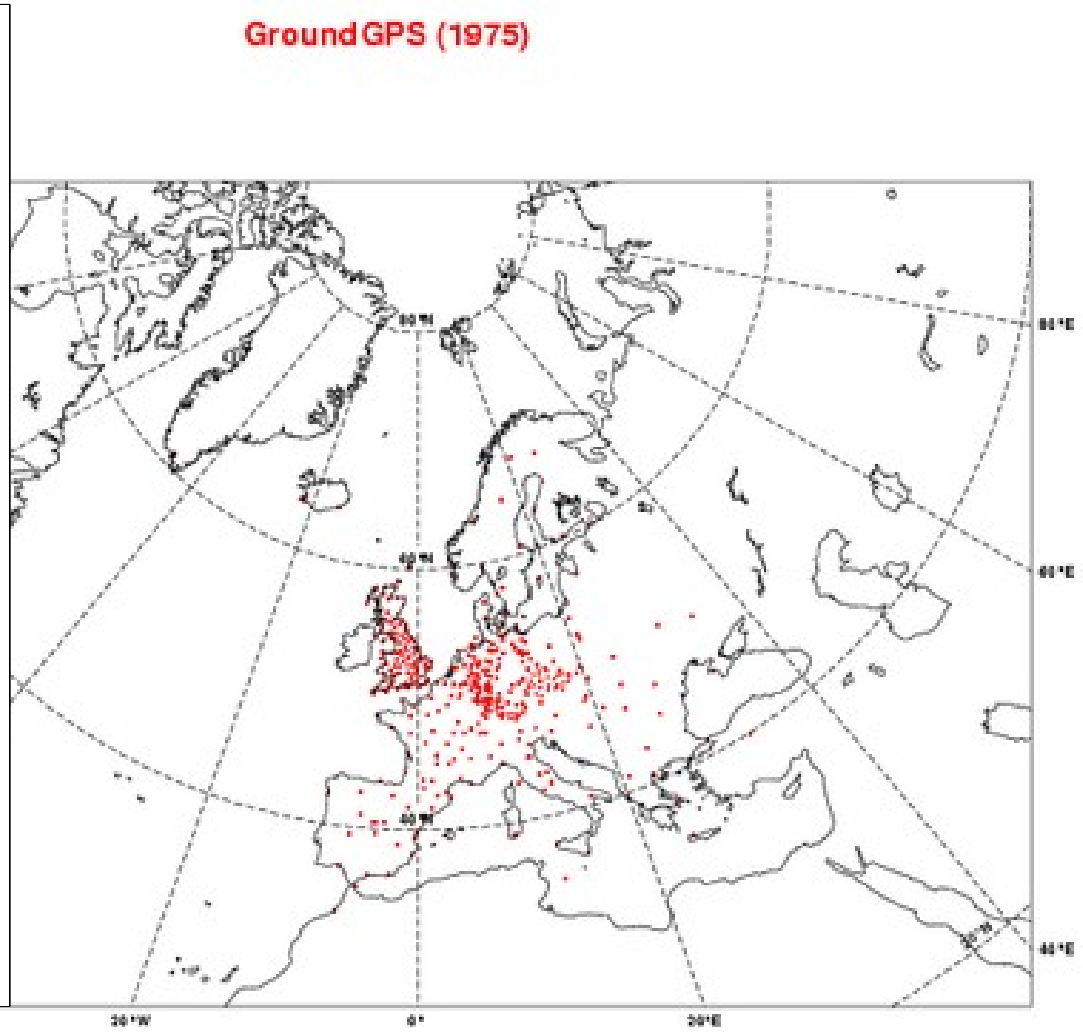


Monitoring



Data assimilated





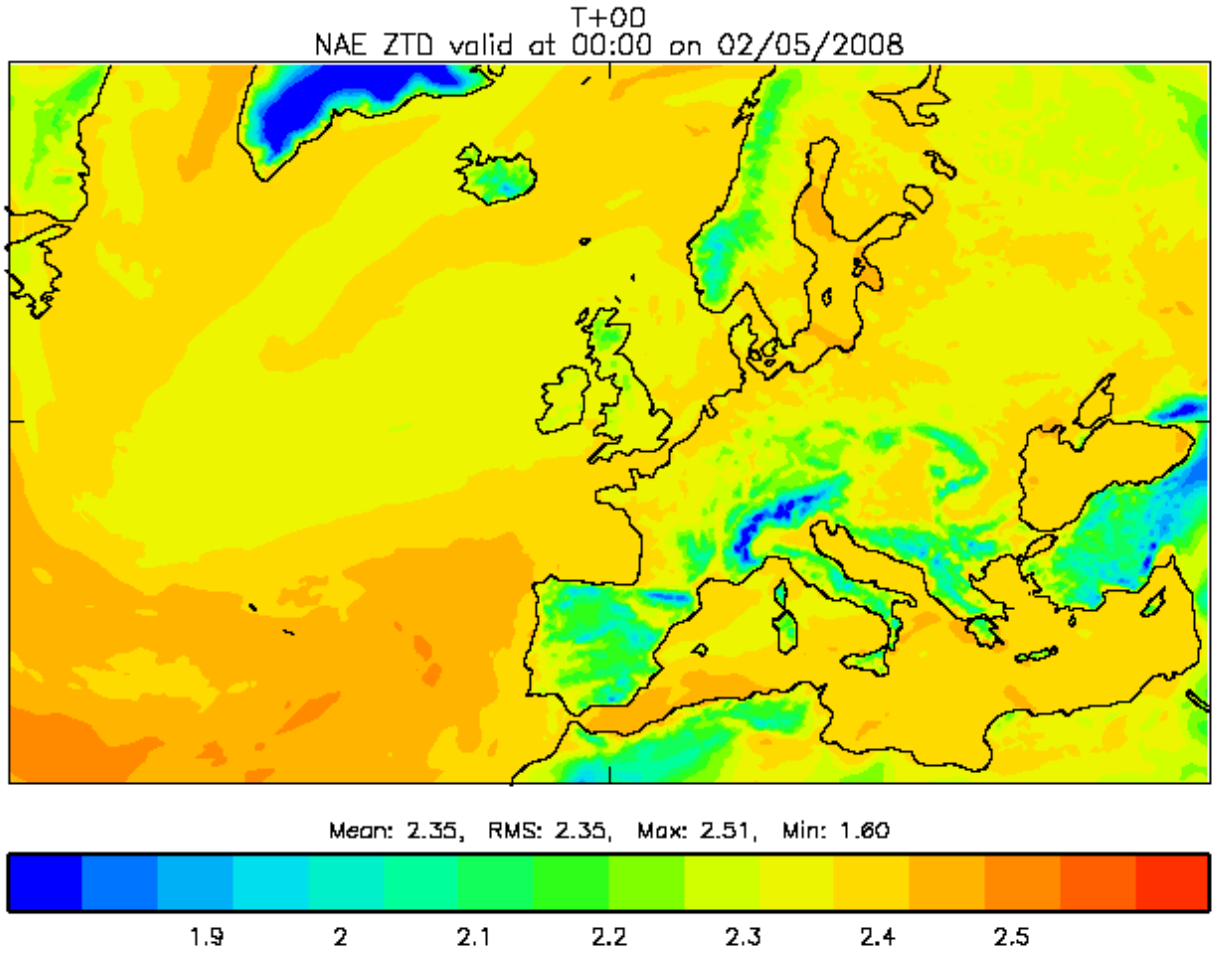
Benefits

Benefits of ZTD Observations

Forecast Range (hours)	RMS fit to observations for Surface temperature	RMS fit to observations for Surface winds
T+6	3.1%	0.1%
T+12	4.1%	-0.2%
T+18	4.3%	0.1%
T+24	4.2%	0.3%

- Also small improvement in visibility, precipitation and cloud
- Overall weighted score showed 1.85% improvement

ZTD Forecasts

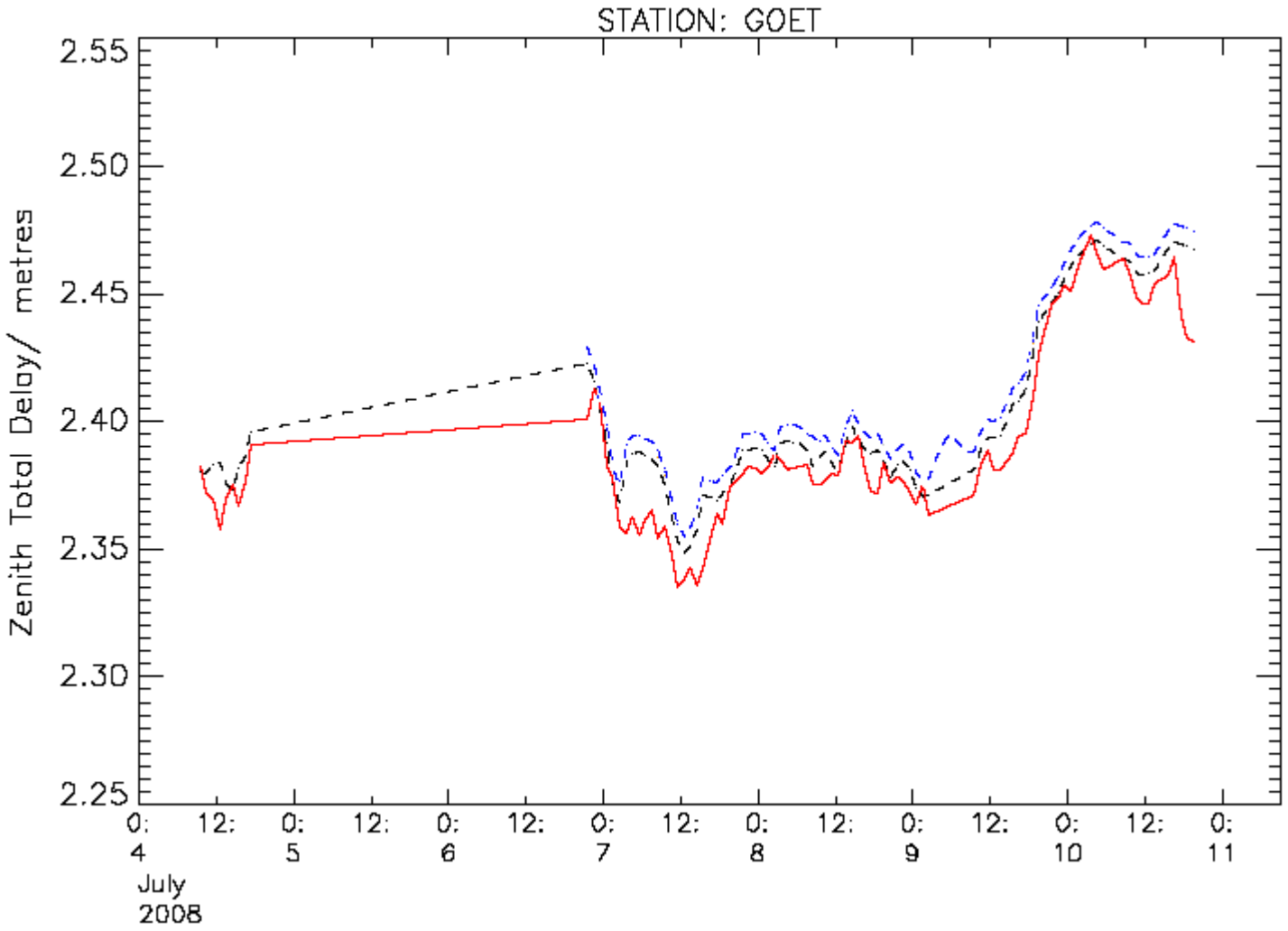


Future Work

Possible future developments

- Global data may become available
- Use a site specific whitelist approach
- Automatic bias correction updates
- New forward model

New Forward Model Monitoring



Summary

- Operational assimilation into NAE and UK models since March 2007
- Assimilate GOP, GFZ and METO
- Static bias correction scheme
- Basic forward model assumes constant refractivity within model layers
- Overall 1.85% improvement in forecast

Questions and answers

Further questions e-mail: gemma.bennitt@metoffice.gov.uk