A WRF investigation of 18th December 2010: a disruptive UK snow event during the coldest December for over a century.

Photographer: Ian Nicholson/PA Wire

Trafalgar Square, London

Dr Clare Allen - MeteoGroup UK

Acknowledge: Daniël van Dijke - MeteoGroup
December 2010: UK

- Coldest December for 120 years
- Coldest individual calendar month since February 1986
- Snow fell widely and heavily on several days, causing disruption to road, rail and air transport
- Mean maximum temperatures were between 3.0 and 5.5°C below average
- Mean minimum temperatures were between 3.5 and 6.5°C below average
- Lowest minimum was -21.1°C at Altnaharra
- The lowest daytime maximum was -15.8°C at Altnaharra
The Office for National Statistics estimated that the widespread snow in December depressed the level of Gross Domestic Product by approximately 0.5% in the fourth quarter of the 2010
18th December 2010 - snow

• Many shops closed
  – a popular shopping centre in North London closed, unable to clear the car parks for prospective Christmas shoppers

• Motorways were closed for many hours in places
  – Hundreds of drivers were stranded on the M6 in Lancashire for up to seven hours

• London Heathrow airport received about 9cm of snow
  – 7cm of snow fell between 11UTC and 12UTC
  – over 4000 flights were cancelled

Photographer: David Davies/PA Wire
ECMWF synoptic chart

18-12-2010 12UTC
ECWMF forecast

18-12-2010 12UTC
ECMWF precipitation amount

9UTC-12UTC
ECMWF precipitation amount

15UTC-18UTC
WRF setup

9 km horizontal resolution

3 km horizontal resolution
WRF setup

- Input: ECWMF forecast data
- 39 vertical levels
- 12 hour spinup assimilating surface observations
- Landuse GlobCover (European Space Agency)
  - 115 land use categories

<table>
<thead>
<tr>
<th>Microphysics</th>
<th>WRF Single Moment 6-Class Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortwave radiation</td>
<td>Goddard</td>
</tr>
<tr>
<td>Longwave radiation</td>
<td>RRTM</td>
</tr>
<tr>
<td>PBL</td>
<td>YSU</td>
</tr>
</tbody>
</table>
WRF forecast – simulated radar

- Using ECMWF forecast data
- WRF Single-Moment 6-class scheme
WRF forecast – snow water equivalent

Using ECMWF forecast data

WRF Single-Moment 6-class scheme
WRF – simulated radar

- Using ECMWF analysis data
- WRF Single-Moment 6-class scheme
WRF – snow water equivalent

- Using ECMWF analysis data
- WRF Single-Moment 6-class scheme
WRF – simulated radar

- Using ECMWF analysis data
- Morrison double-moment scheme
- Using ECMWF analysis data
- Morrison double-moment scheme
WRF – simulated radar

- Using ECMWF analysis data
- Milbrandt-Yau Double-Moment 7-class scheme
WRF – snow water equivalent

Using ECMWF analysis data

Milbrandt-Yau Double-Moment 7-class scheme
Summary

• All of the runs gave a good forecast of the snow in the south-east of England
• Single moment scheme would have under forecast the snow in the West Midlands
• Double moment schemes gave better representation of snow for 18\textsuperscript{th} December
• Further investigation required to see how well double moment microphysics scheme perform in:
  – other case studies
  – forecast mode
Thank you!

Photographer: Matthew Baker/PA Wire

Finsbury Park North London