Doppler radar wind observations for high resolution data assimilation
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Doppler radar observations

What do we get?

- 1° increments
- 250 or 500 m range bins
- Max range 150-300 km
- Nyquist velocity 26 to 52 m s⁻¹
- 6-10 minute scans
- 14 PPI scan elevations

This is data overload!

- QC and thinning required
- Limit correlated observations (esp. spatial proximity)
- Limit range due to location uncertainty
- Limit frequency of use
## Evolution of ACCESS City scale

### Australian Parallel Suite releases

<table>
<thead>
<tr>
<th>Version</th>
<th>Resolution</th>
<th>Assimilation</th>
<th>Date operational</th>
</tr>
</thead>
<tbody>
<tr>
<td>APS0</td>
<td>0.05° (~5 km)</td>
<td>No</td>
<td>2010</td>
</tr>
<tr>
<td>APS1</td>
<td>0.036° (~4 km)</td>
<td>No</td>
<td>2013</td>
</tr>
<tr>
<td>APS2</td>
<td>0.015° (1.5 km)</td>
<td>No</td>
<td>2016</td>
</tr>
<tr>
<td>APS3</td>
<td><strong>0.015° (1.5 km)</strong></td>
<td>Yes</td>
<td>2018</td>
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<tr>
<td>APS4</td>
<td>0.015° (1.5 km)?</td>
<td>Yes</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Comparable to radar observation resolution
Observation selection

What constitutes useful velocity observations?
Data assimilation QC

DA requires strict filtering of valid observations

New QC methods developed for Forecast Demonstration Project

- Clutter removal using clutter maps
- Filters of other artefacts
- Naïve Bayes Classifier of echo types

Assimilated classes: precipitation, insects (under assessment)

Not assimilated: smoke, chaff, birds/bats, permanent and anomalous propagation ground and sea clutter, speckle, spikes
Classified echoes around Sydney
The Forecast Demonstration Project

- 10 weeks of real-time forecasting products
- Hourly assimilation in the 1.5 km resolution domain
- Doppler radar wind velocity assimilated for first time
  - Precipitation and insects
- Sydney testbed domain
- Spring 2014 (lots of severe weather, and insects)
Assimilation of radar data

Radar velocity coverage in FDP domain

Separate treatment of precipitation and clear air

Observation processing (OPS)

Echo classification
Number of observations assimilated

30% of obs contributed from insect echo

Coarser horizontal resolution
More sensitive to clear air
Speed bias (model – obs)

Larger bias in elevations with most ground or sea clutter

Clutter not filtered on-site and not classified correctly

Not enough data because only part of scan in domain
Mean of assimilated innovations

These have undergone OPS QC and superobbing

No major differences between precipitation and insect observations after all QC
Estimate of probability of gross error

Histogram of normalised innovations conforms to combined truncated Gaussian and uniform distributions.
Observation limits
3 radars, 0.9° elevation scan obs are lowest

Meridional velocity at 151.1° E, 20141013 0300, with assimilated radar obs within 0.5° longitude

Southerly change
Conclusions

Next generation high-resolution NWP will include Doppler radar data assimilation

Most ACCESS-City domains contain multiple radars

QC has been an ongoing issue. Further improvements will come with dual-polarisation

Assimilated observation quality appears okay, and similar for precipitation and insects

Better BL coverage if the 0.5° elevation scan was used

Observation impact study planned once APS3 city suite developed