



The interaction between Nowcasting and NWP for coastal locations

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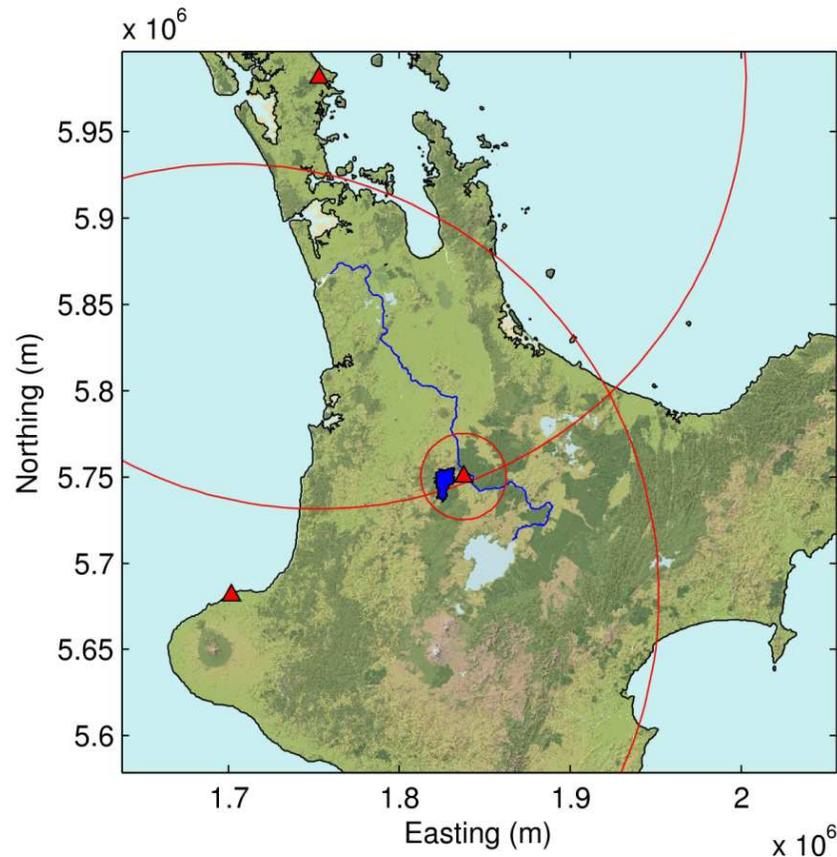


- ▶ Introduction
 - High resolution rainfall patterns
 - Sampling Errors
- ▶ Radar and VAR sampling errors
- ▶ Unfolding strategies using model wind patterns and nowcast rainfall patterns
- 100 Case studies
- Ocean regions and satellite rain areas
- ▶ Conclusions



Compare model output (with and without National radar data ingestion) to X-band radar data logged during recent field work in a hydro catchment.

- “Waipapa” Catchment, Central North Island. $\sim 130\text{km}^2$
- Very fast hydrological response time, sensitive to rainfall distribution and peak intensity



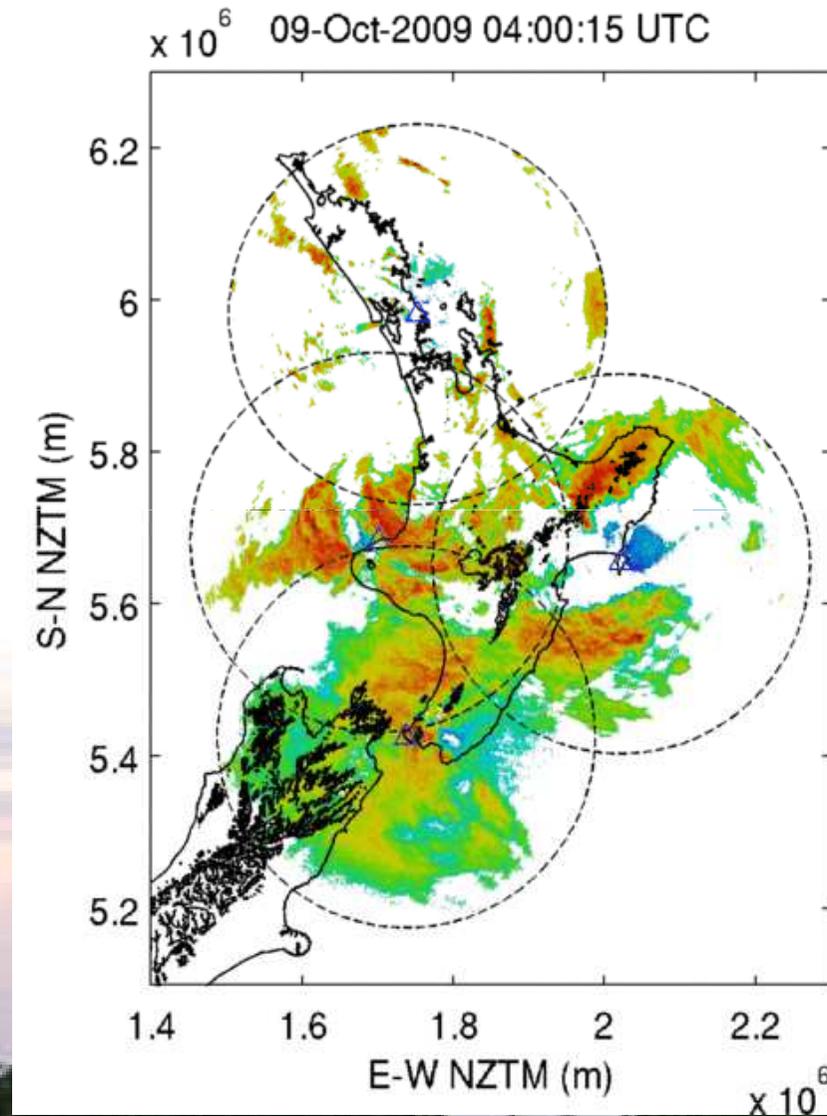
A Mobile Radar Rain Radar for High Resolution Hydrological Observations in New Zealand, Sutherland-Stacey L., Shucksmith P. and Austin G., [New Zealand] Journal of Hydrology (2011 – accepted for publication)



7 (+2) Doppler C-band radars run by the New Zealand metservice

Radar Specifications:

- ▶ 250km maximum range
- ▶ 7.5min volume scan cycle
- ▶ 0.86 / 1.65 deg beam width
- ▶ 250m range resolution
- ▶ Dual PRF for $\pm 16\text{ms}^{-1}$ Nyquist Velocity Ambiguity (will be higher in the future)
- ▶ Archived data available to the Atmospheric Physics Group for research purposes.

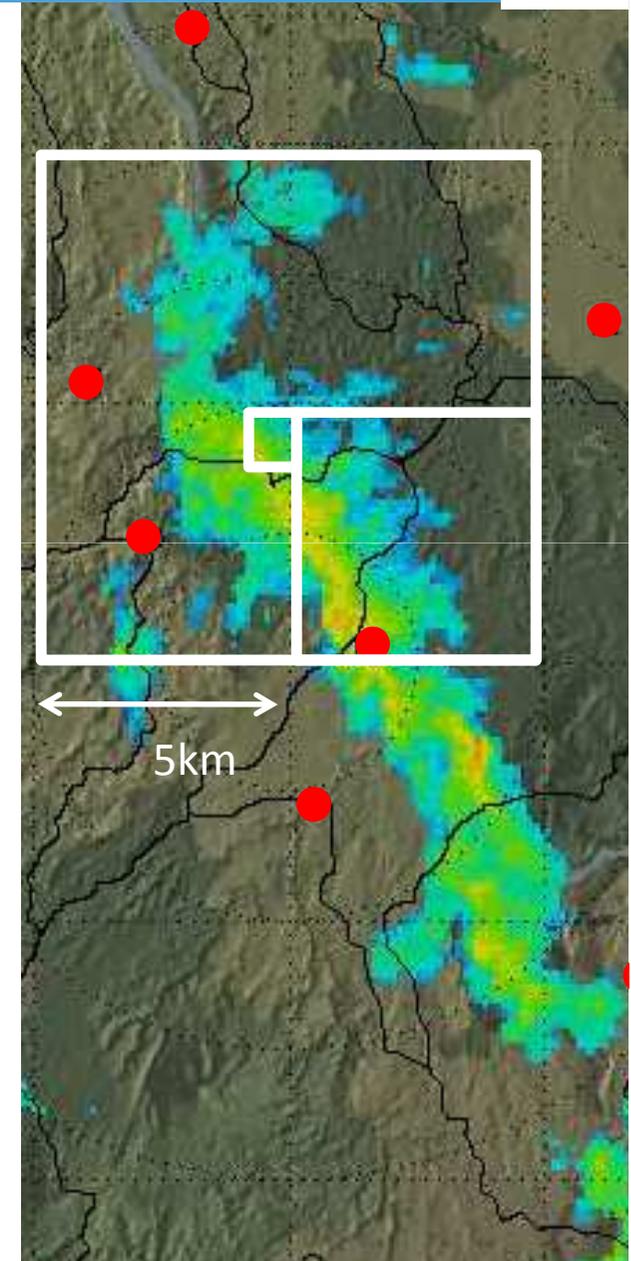




The Scale Problem



- Rain fields exhibit extreme spatial and temporal variability.
- Accuracy of most rain measurement techniques (rain gauge, national radars, intermittent satellite retrievals) over short time periods is poor.
- QPE for hydrological modelling of small catchments with steep terrain is therefore difficult.
- It is also difficult to verify QPF on small catchment scales.

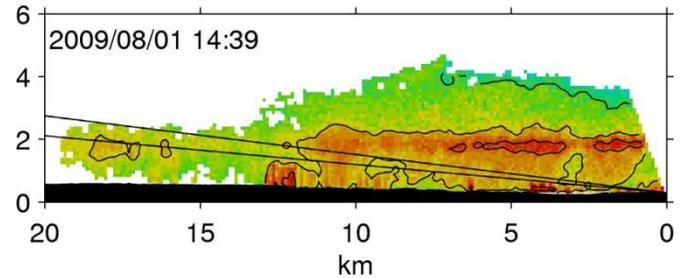
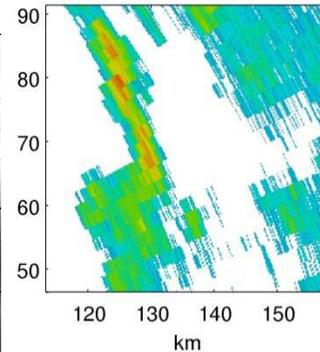
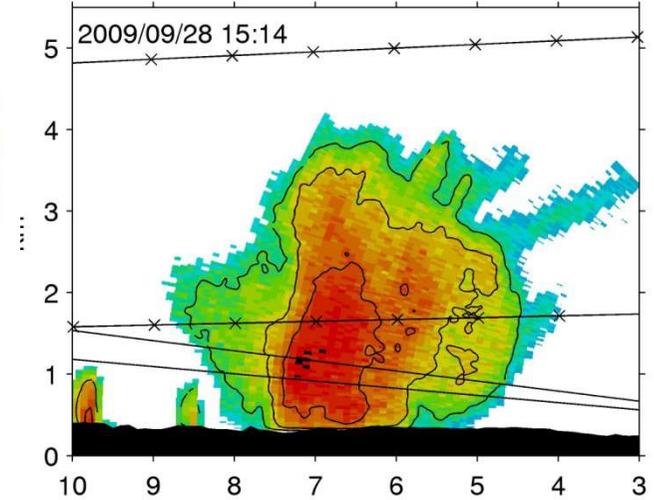
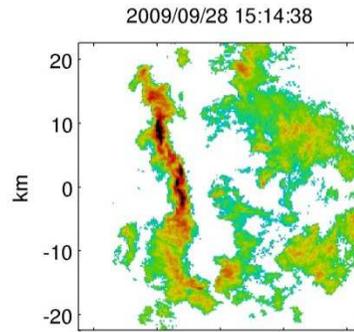
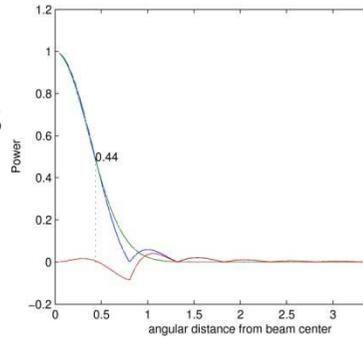




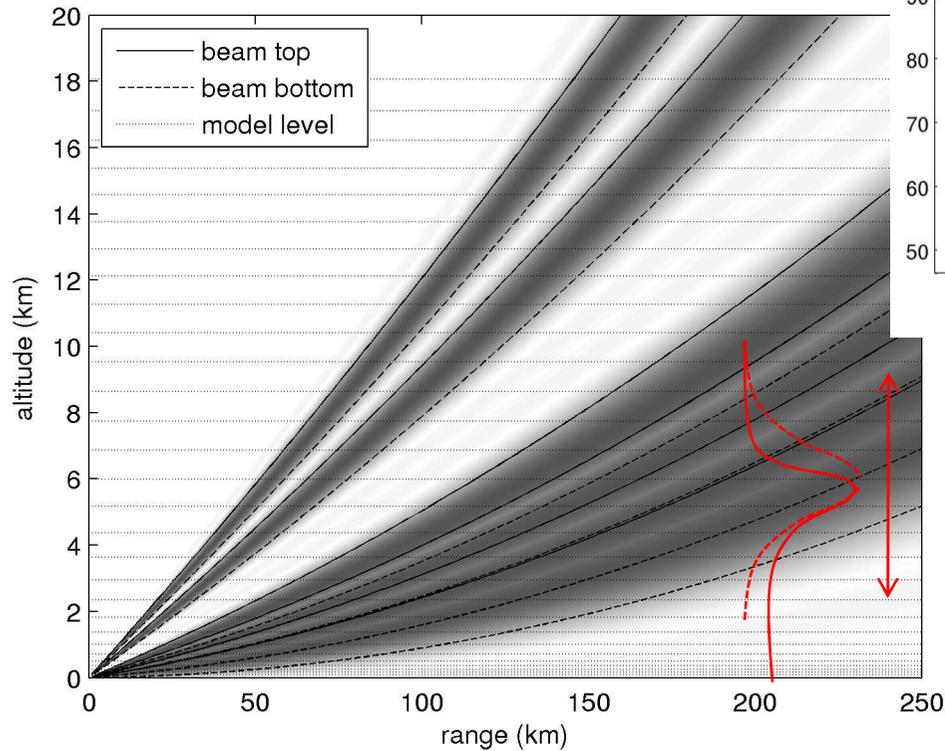
Obs Error...



Some important representativity issues related to the beam width for Doppler and rainfall estimates



Radar beam intersection with model levels

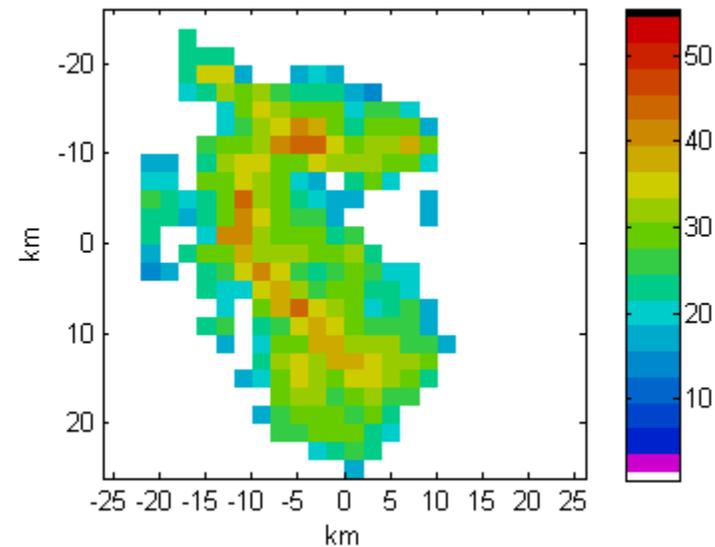
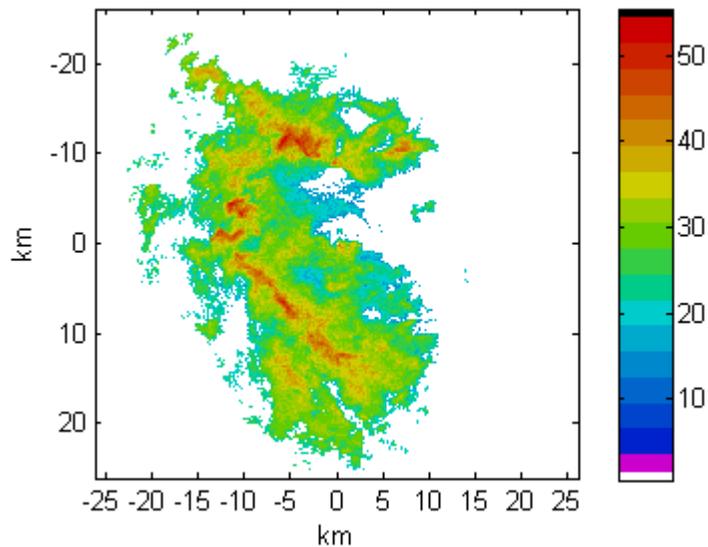


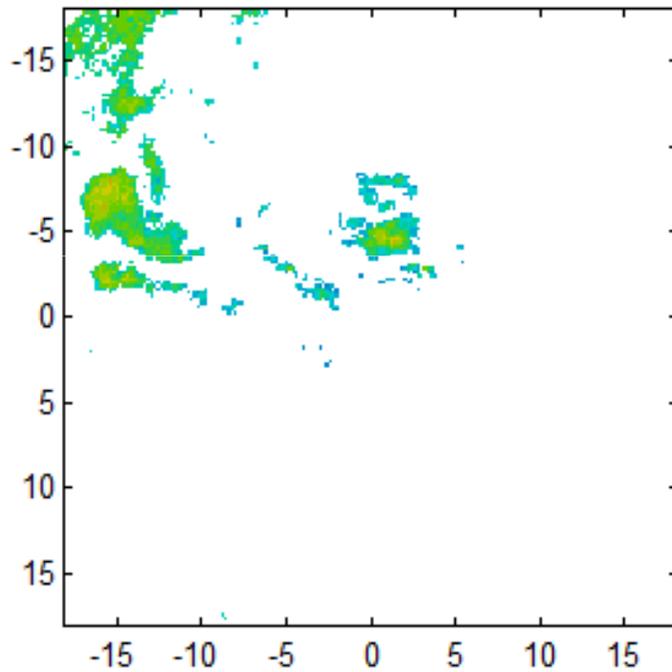
- At range the beam cross-section Sweeps out several model levels
- More weather lower down do the beam volume average is usually biased to low altitude

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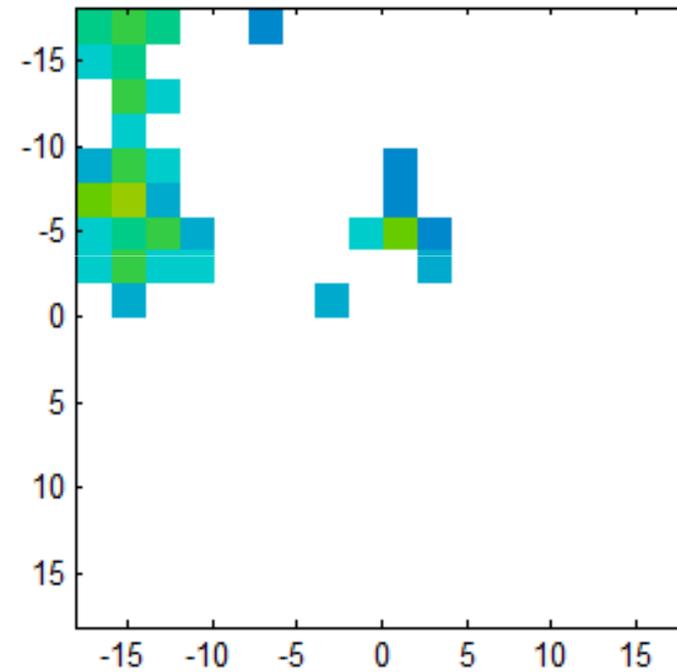


- ▶ Benefits of high resolution radar:
 - Capture short term evolution
 - Measure sharp gradients in reflectivity





Scan Period: 73s
Pixel Size: 200 m



Scan Period: 584 s
Pixel Size: 2000 m



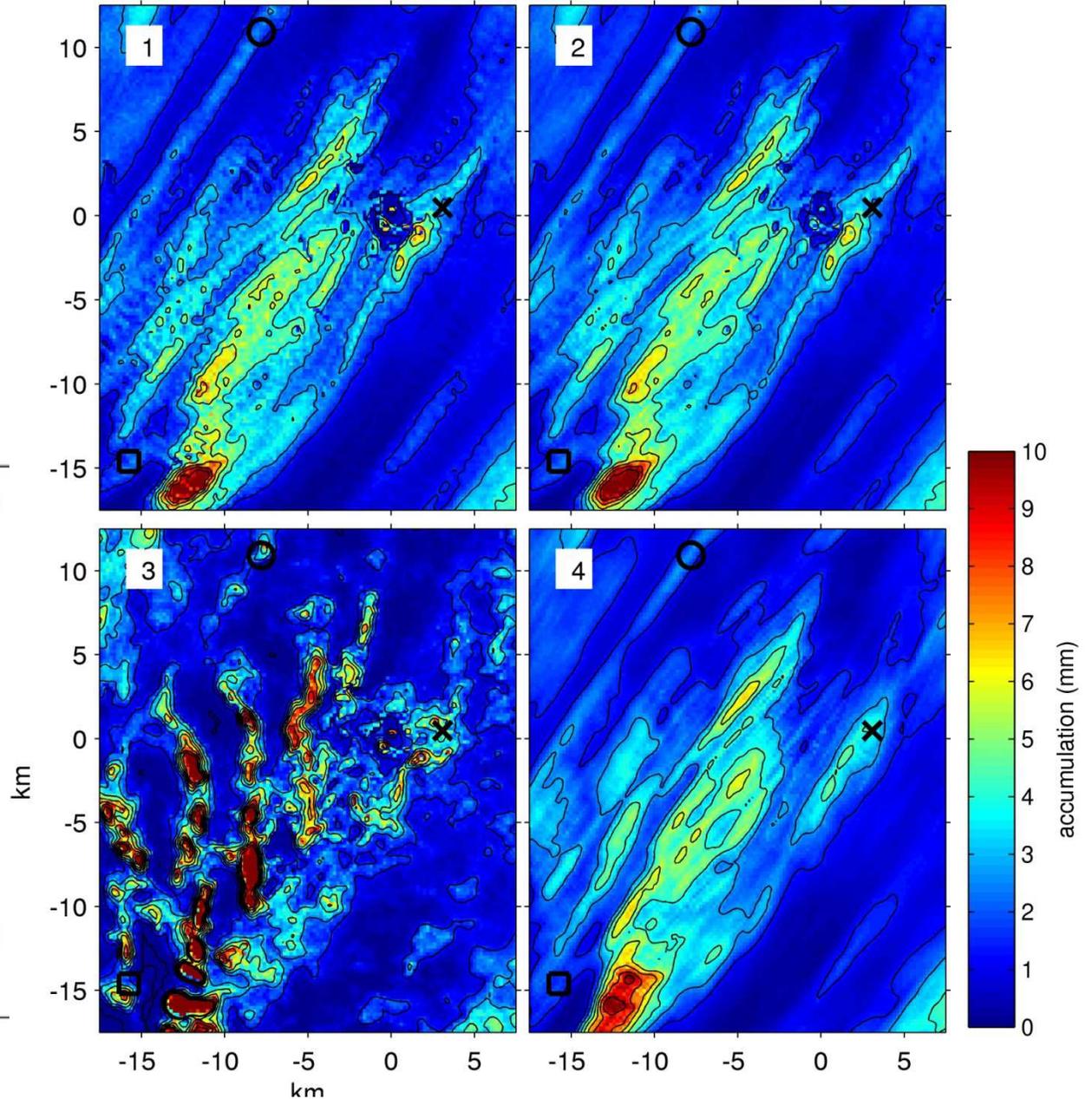
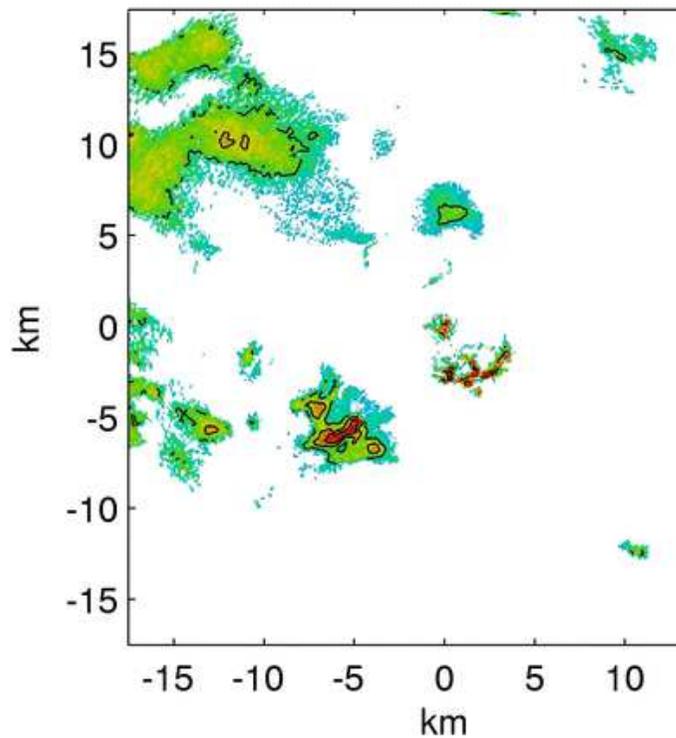
Obs Error...



Scale errors

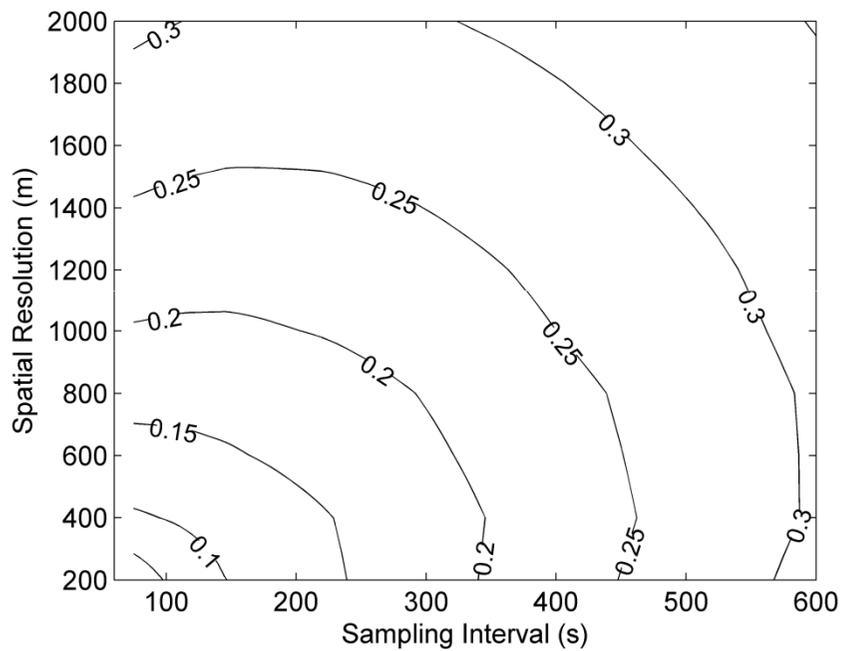
(not directly important for 'low res' data assimilation but interesting in the wider context of verification against radar observations)

2009/12/03 11:44:51

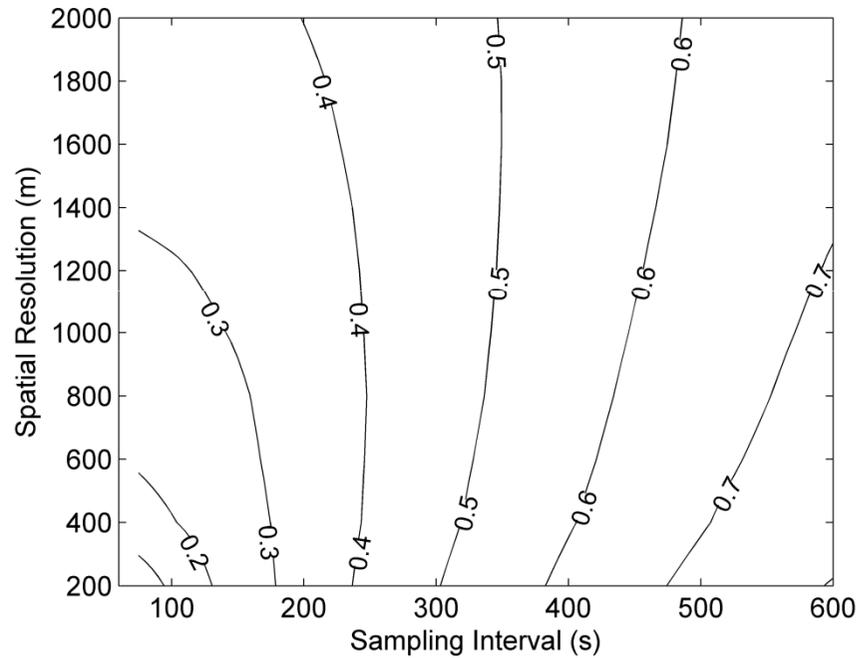




Method: Interpolation



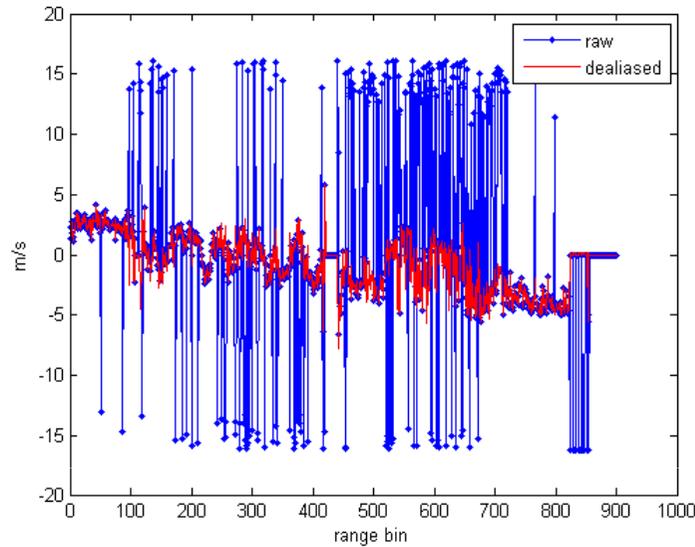
With advection interpolation



Without advection interpolation



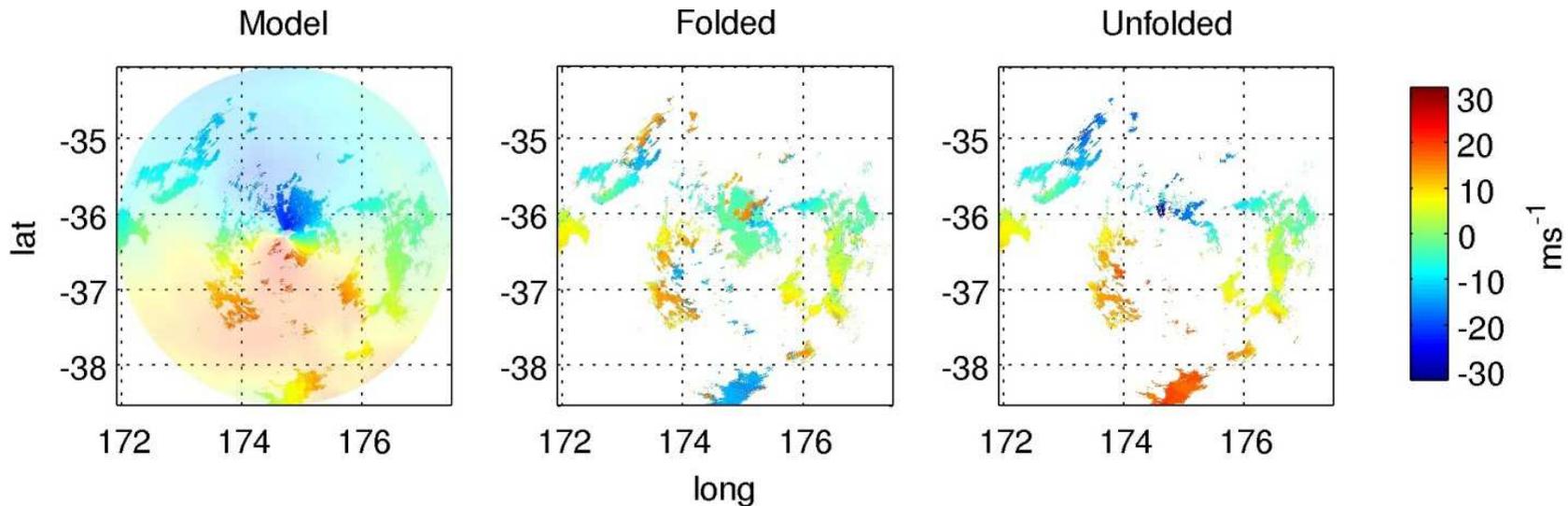
Doppler Unfolding



Toolbox containing various unfolding code:

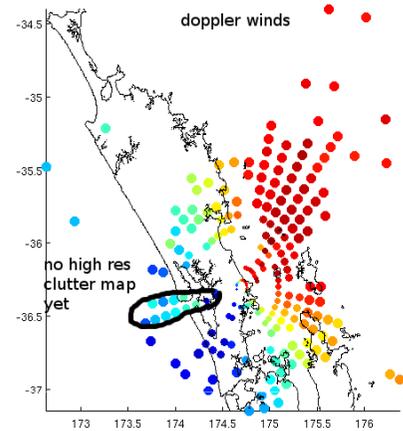
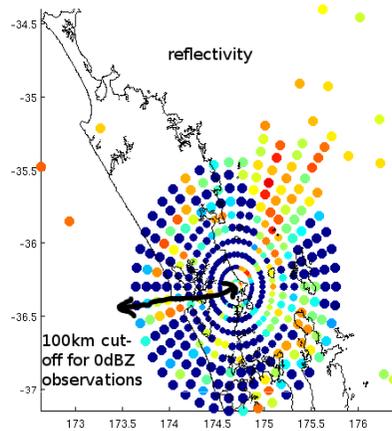
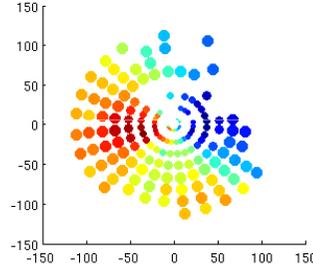
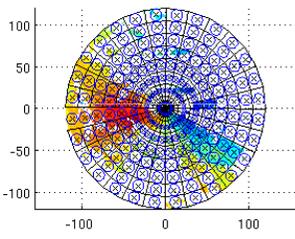
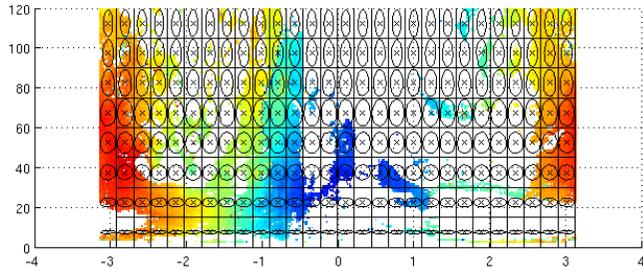
- Continuity(1D/2D/3D)
- Nowcast Echo Motion Vector
- Model Comparison

Most robust method at present is model Comparison followed by 2D continuity to reduce noise.



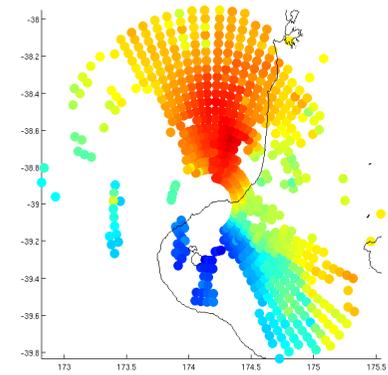
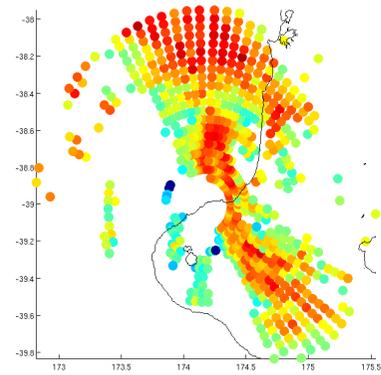
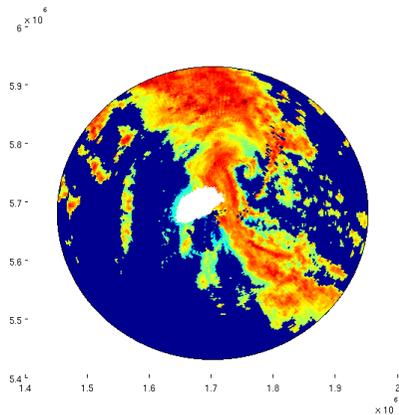


RADAR Data preconditioning



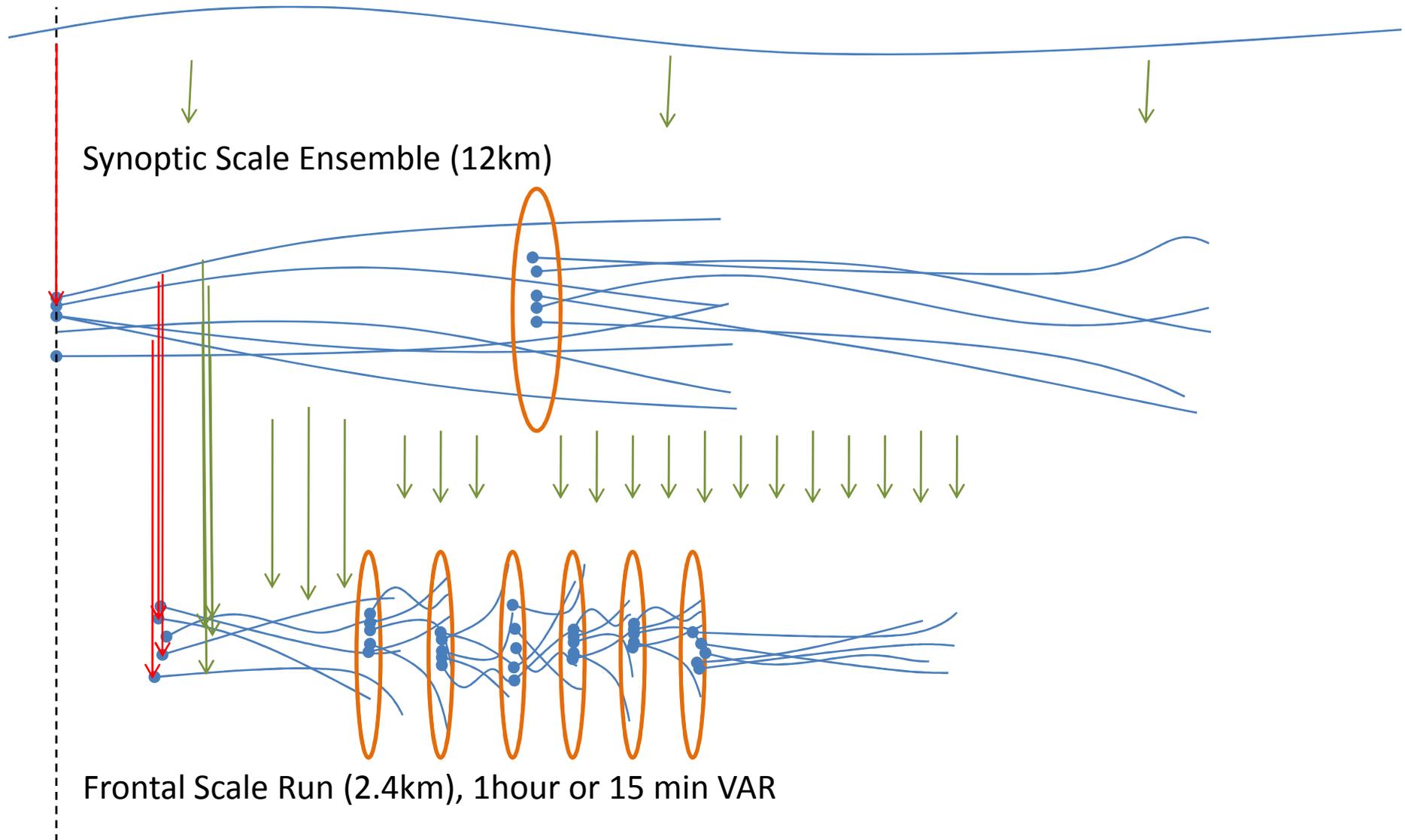
Superobbing geometry after Salonen (2009)

- downgrade to something like the model resolution
- Estimate of observation variance





Global Model (NCEP)



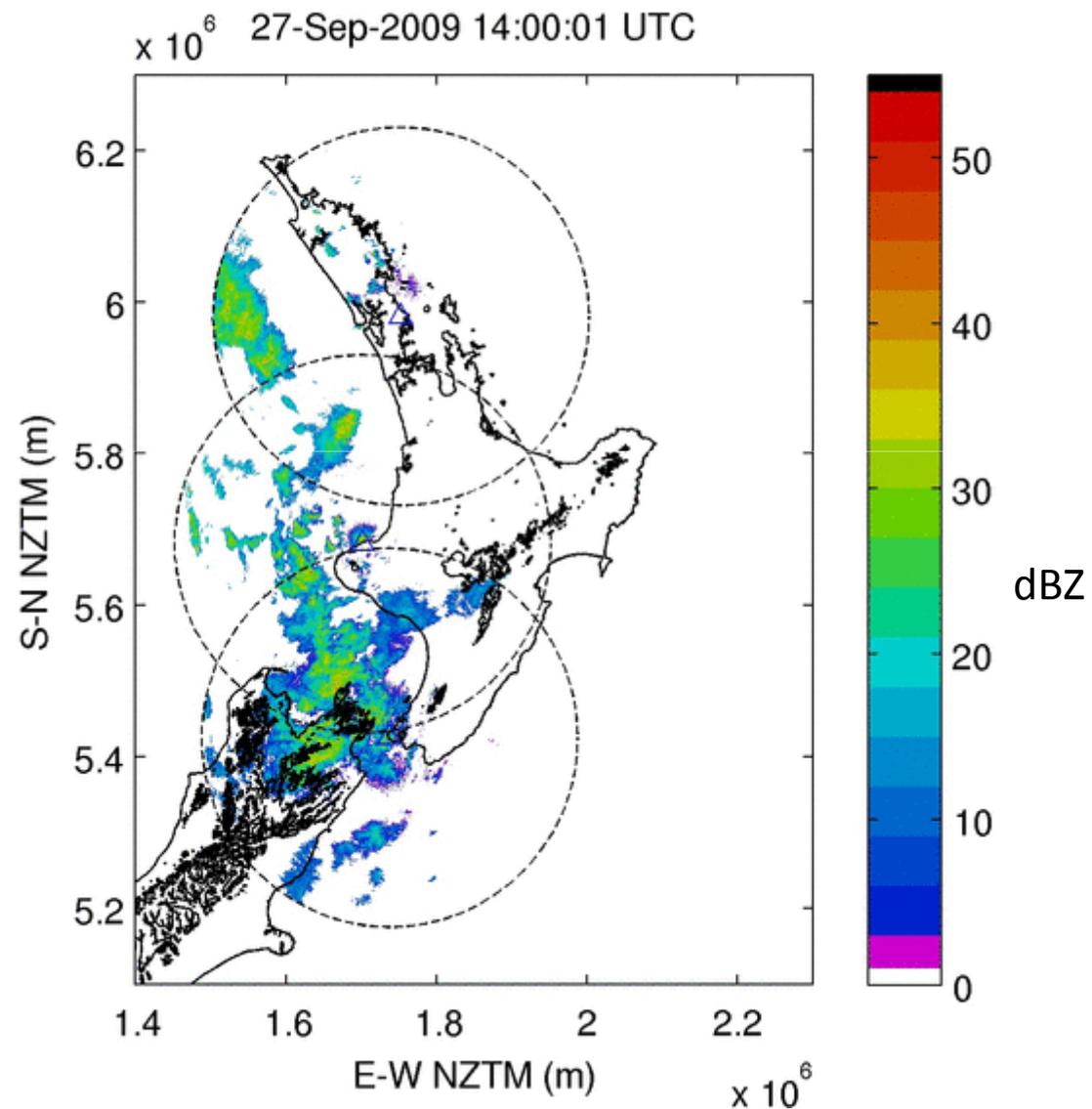
Frontal Scale Run (2.4km), 1 hour or 15 min VAR



Frontal System
advancing from the
West,

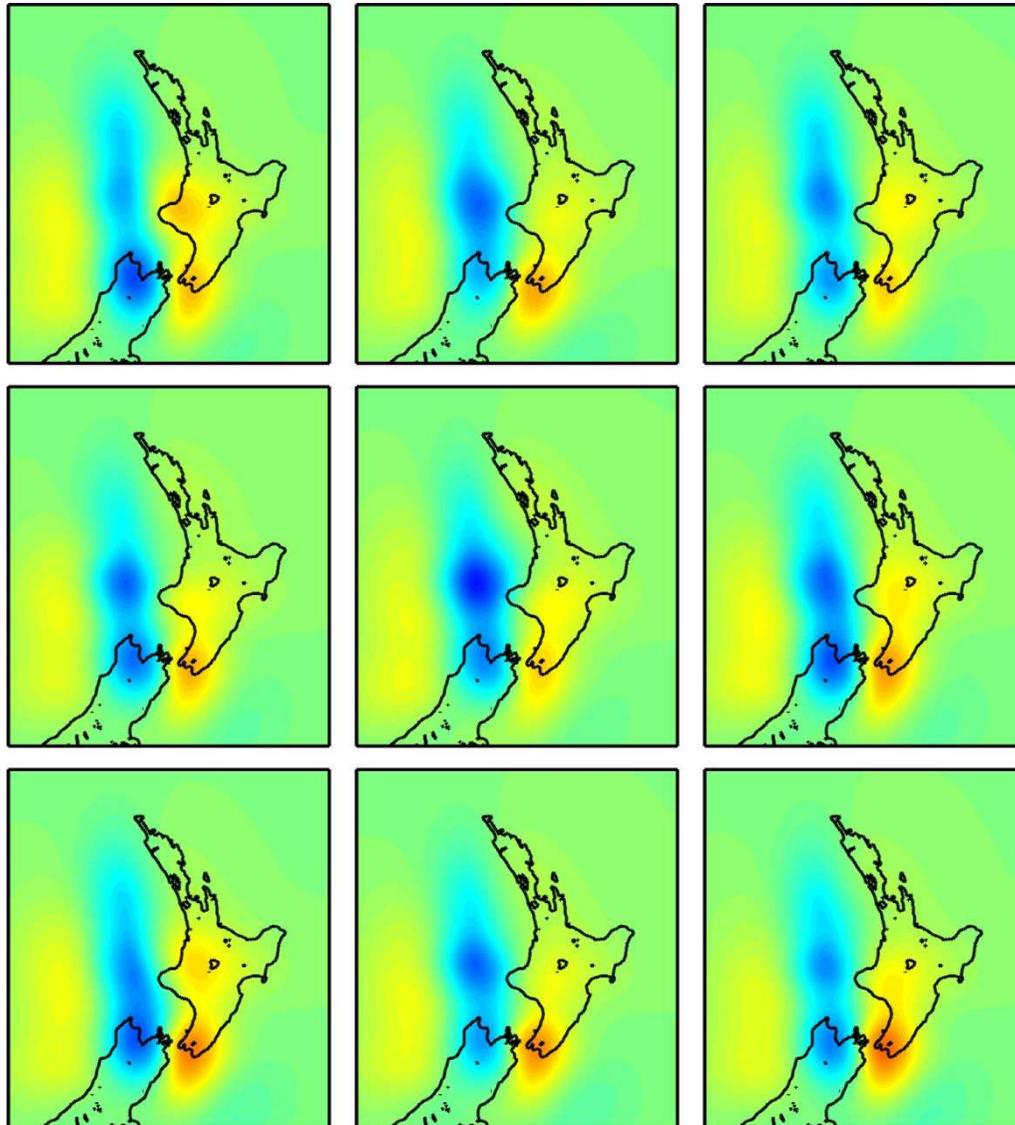
Addition of radar data
qualitatively improves
model distribution of
rain

BUT- one rain band still
missing

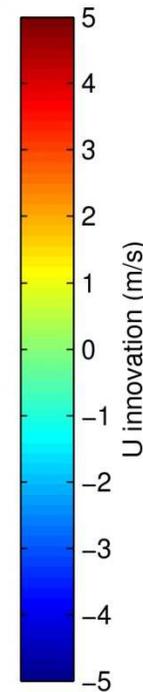




NWP - Experiment



Model level 6, U innovation at
1200 UTC (1st VAR cycle)



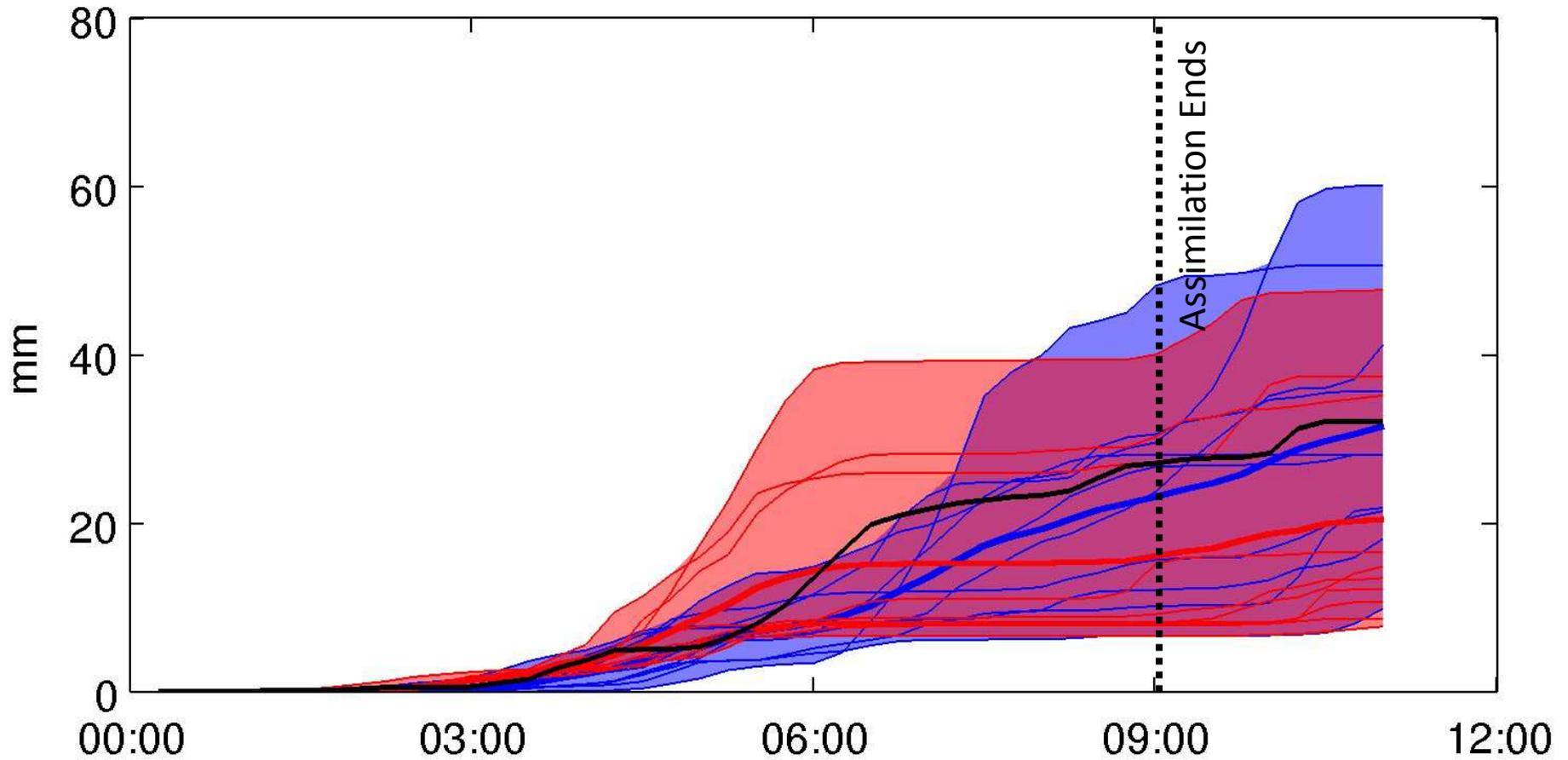
- increases U convergence
near Wellington



NWP - Radar Comparison



- X-band analysis
- Model with Doppler Winds
- Model Control

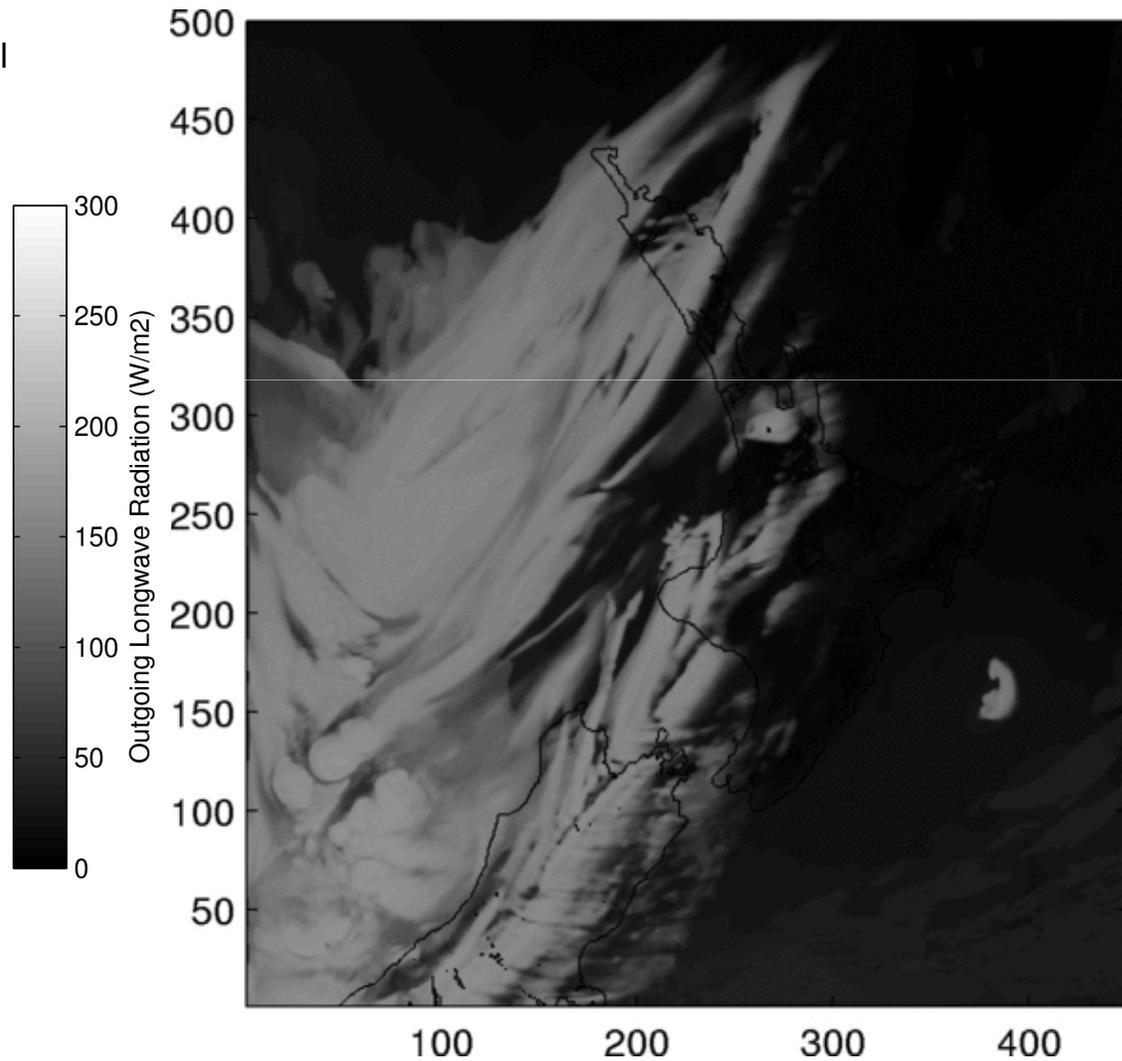
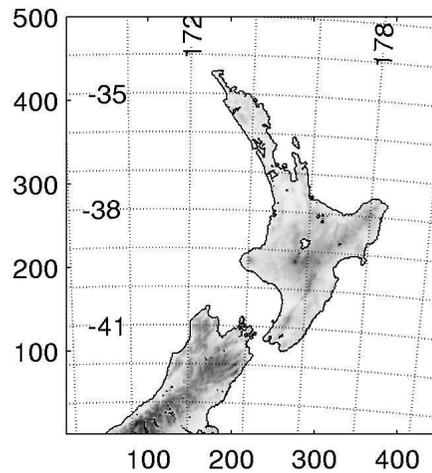
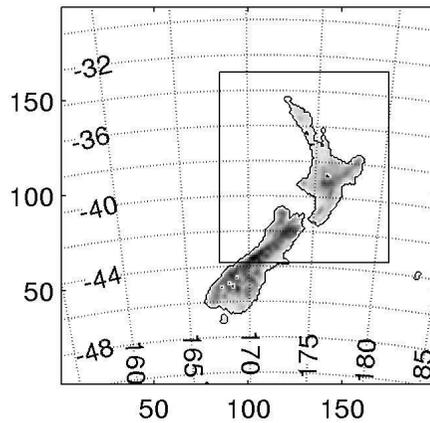




12km outer nest → 2.4km grid length
inner nest. (no cumulus
parameterization)

One way nesting to reduce computational
overheads

2009/09/27 00:00 – 2009/09/28 12:00



Results

- ▶ Doppler radar data needs to be carefully unfolded before going to VAR and then gives useful improvement in QPF
- ▶ VAR sampling error horrible
- ▶ Satellite data required for initialization more than 3 hours out due to limited range of radars and small island geometry.



- ▶ Spatial and temporal resolution problems are associated with VAR and the initialization of models for QPF
- ▶ Explicit external satellite rainfall estimation schemes (Rainsat) seem to work much better than radiance assimilation via VAR