Current issues with time—distance inversions for flows at AsÚ

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Motivation

- Time—distance inversions for flows at various depths using Born kernels with combined ridge+phase-speed filtering schemes for Charles's series
- Inversions validated using synthetic data (hence assuming perfect sensitivity kernels)
- Data testing the sanity of the inversion: an average supergranule
  - Failed

Principal method

- **OLA** – *Backus & Gilbert 1968*; **SOLA** (*Pijpers & Thompson 1992)* is based on explicitly constructed spatially confined averaging kernels by taking linear combination of the sensitivity kernels, while bounding error magnification
- *Multichannel* formulation – in Fourier space assuming the translation invariance of the background
  - *Jackiewicz et al. 2012*
  - *Švanda et al. 2011*
- The code returns the inverted flow map, averaging kernel, and the level of random noise

Improved Multichannel SOLA

- A new MC-SOLA code with the following properties:
  - Born sensitivity kernels
  - Full travel-time noise covariance matrix
  - Control over the random error in the results, amount of cross-talk, and the smoothness of the solution
  - The code is validated for flows using synthetic data
  - Code is embarrassingly parallel

  - Code validated using synthetic data (frozen field, only inversion validated, travel times forward-modelled, consistency between the forward and inverse problem automatically fulfilled)
  - Full pipeline validated for *f*-mode inversions (*Švanda et al. 2013*) by comparing to direct surface measurements

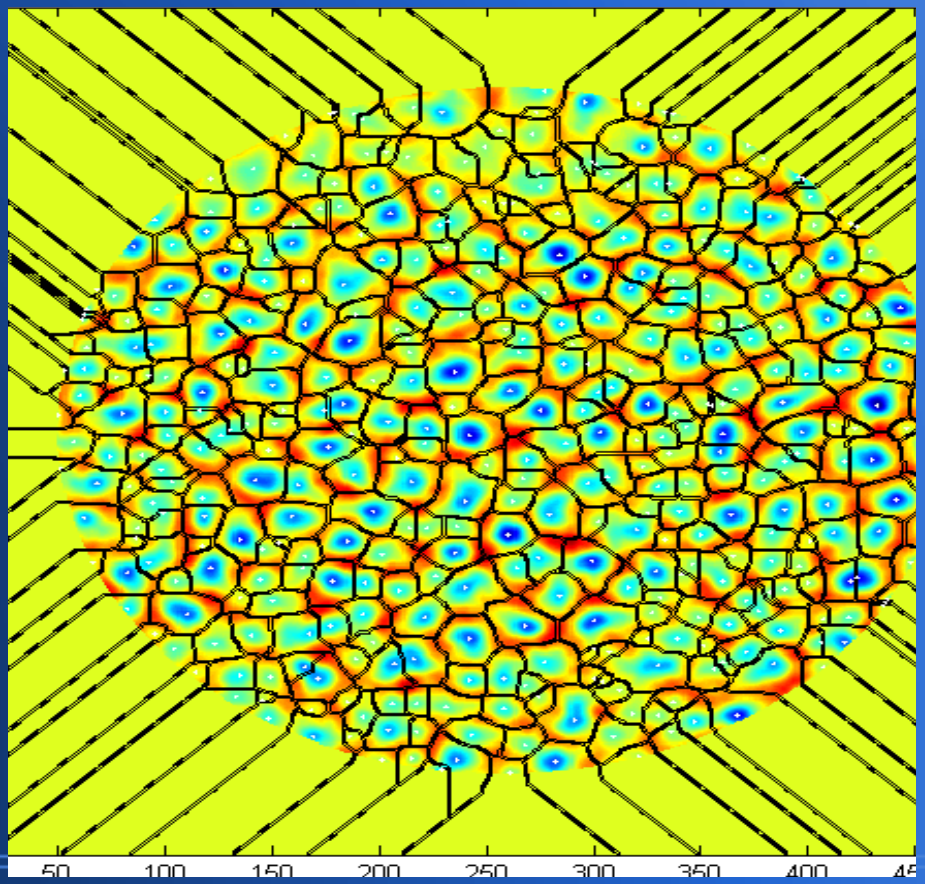
Inversions

- Depths of 1.9, 2.9. 4.3, 6.2, (and deeper, not discussed here)
- Formal error levels <10 m/s for the statistical sample (inversion cost function is kernels-dominated)
- Two sets of inversion:

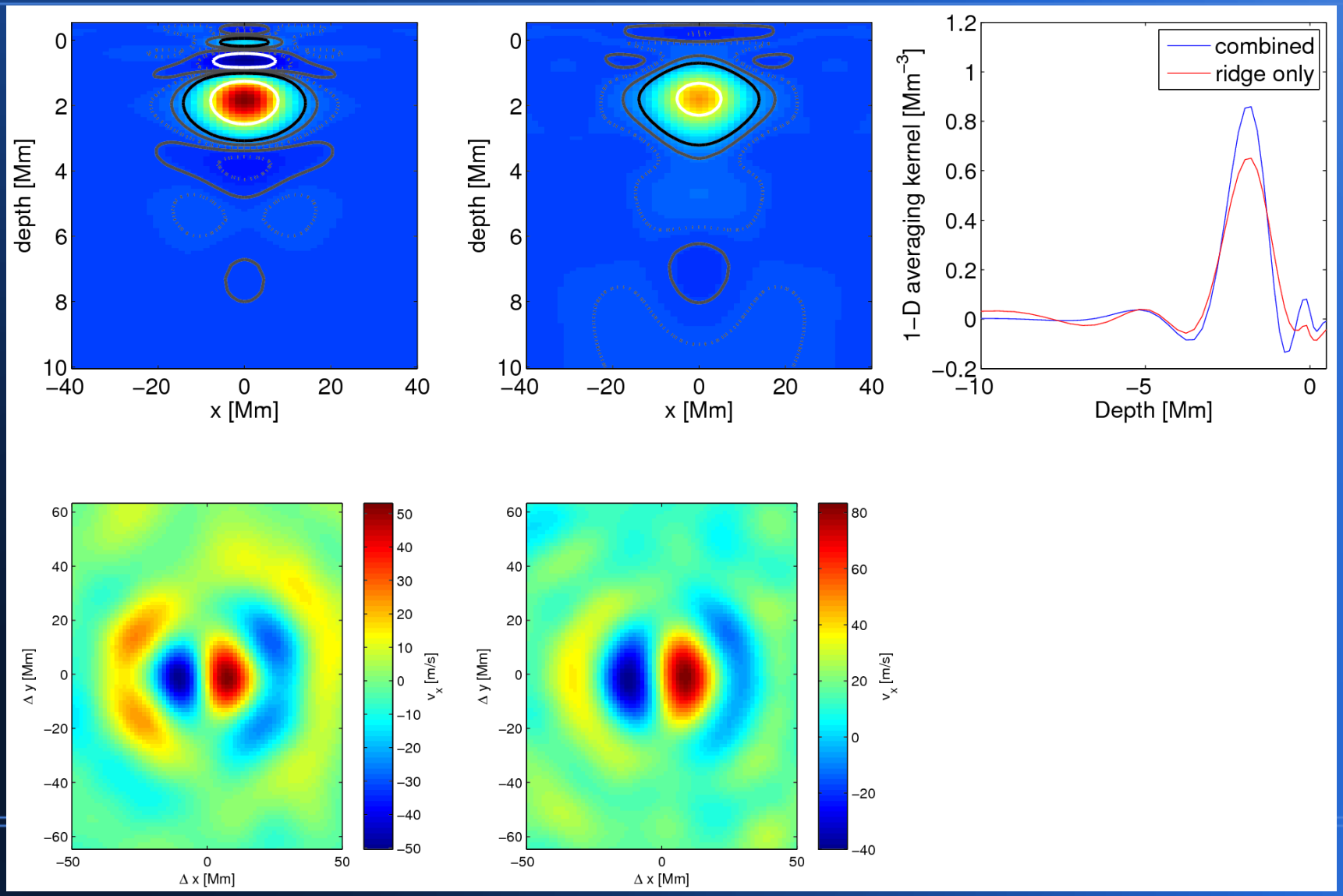
  1. combined ridge+phase-speed filters (405 different kernels)
  2. ridge filters only (240 kernels)

Testing sample

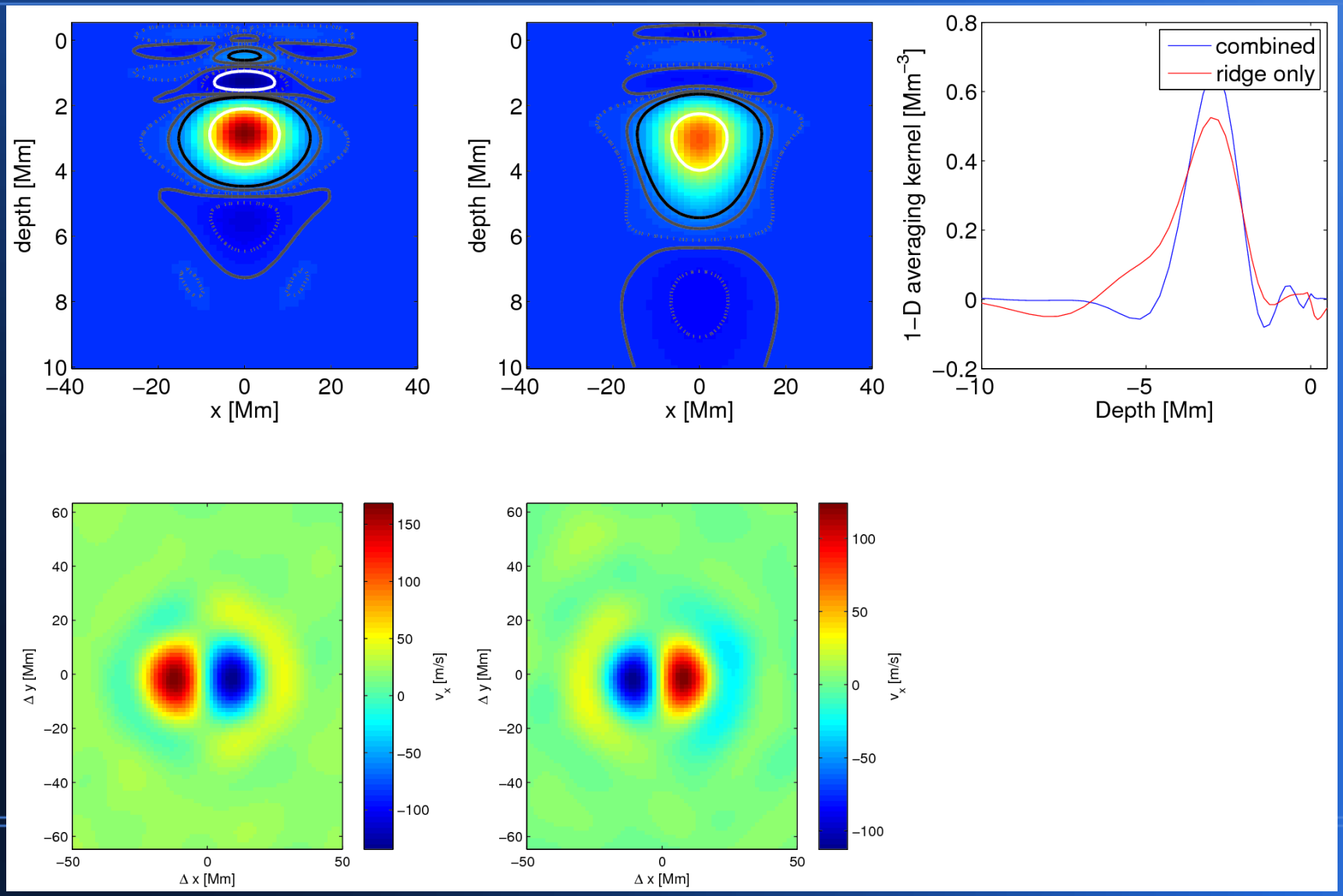
- Watershed segmentation of supergranules
- Averaging of all detected supergranules



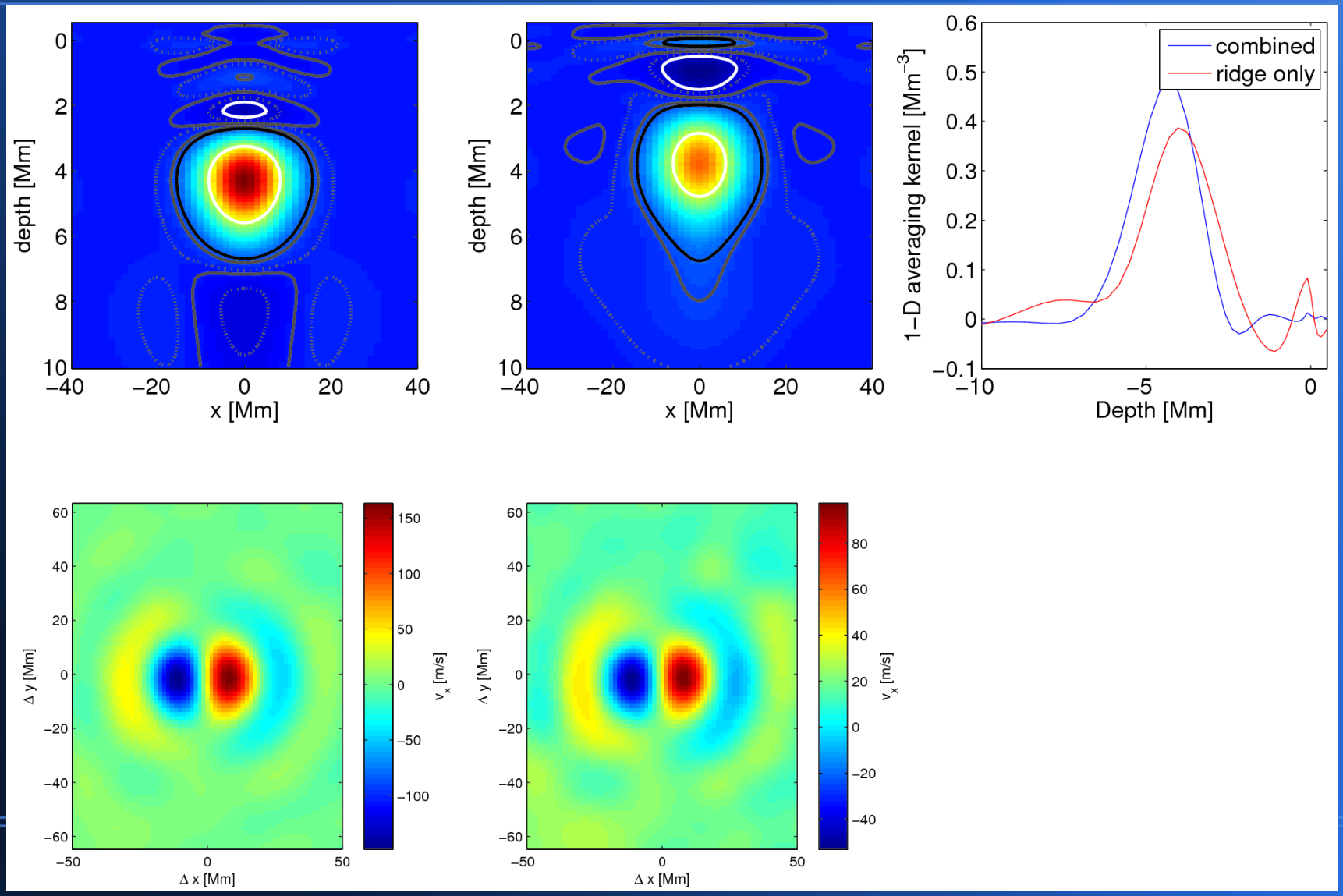
Results for 1.9 Mm



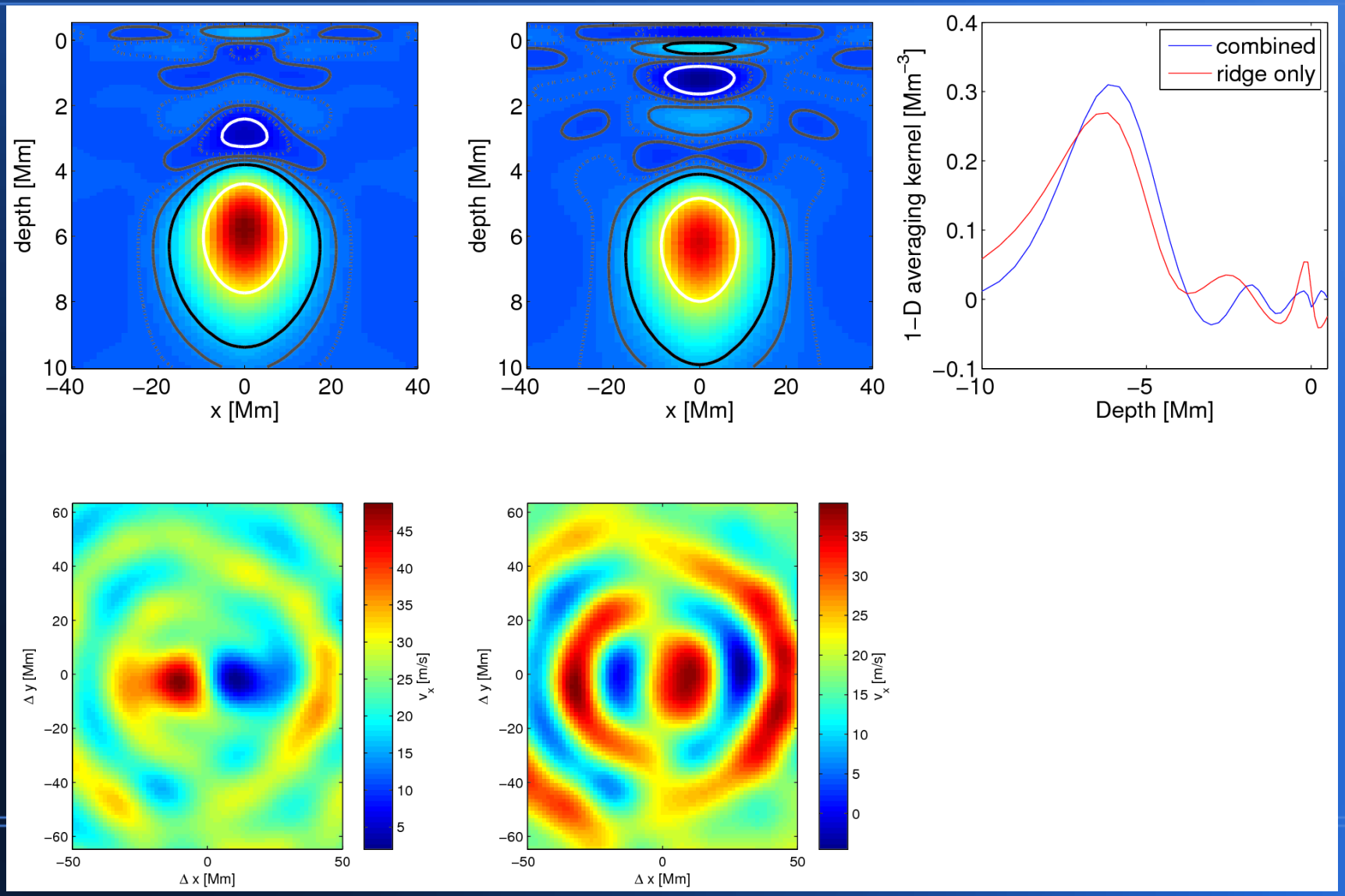
Results for 2.9 Mm



Results for 4.3 Mm



Results for 6.2 Mm



Origin?

- Forward problem issue?
- Amplified kernel errors? (cf. Ben's talk)
  - Weakly regularised OLA more sensitive?
  - Phase-speed kernels more sensitive?

Forward problem issue?