Wave-based time-lapse imaging

wavespeeds & *fiducial* wavespeed at $k = 1$

Update wavespeeds & simulate M seismic datasets (start from baseline $\bar{\mathbf{v}}_0$)

$$\mathbf{v}_k^{(m)} = \mathscr{R}(\bar{\mathbf{v}}_0, \mathbf{x}_k^{(m)}), \quad m = 1 \cdots M \qquad \mathbf{y}_k^{(m)} = \mathscr{F}(\mathbf{v}_k^{(m)}), \quad m = 1 \cdots M$$

Update *reference* wavespeed & simulate *reference* dataset

$$\bar{\mathbf{v}}_k = \mathscr{R}(\bar{\mathbf{v}}_0, \bar{\mathbf{x}}_k), \quad \bar{\mathbf{x}}_k = \frac{1}{M}\sum_{m=1}^{M} \mathbf{x}_k^{(m)} \qquad \bar{\mathbf{y}}_k = \mathscr{F}(\bar{\mathbf{v}}_k)$$

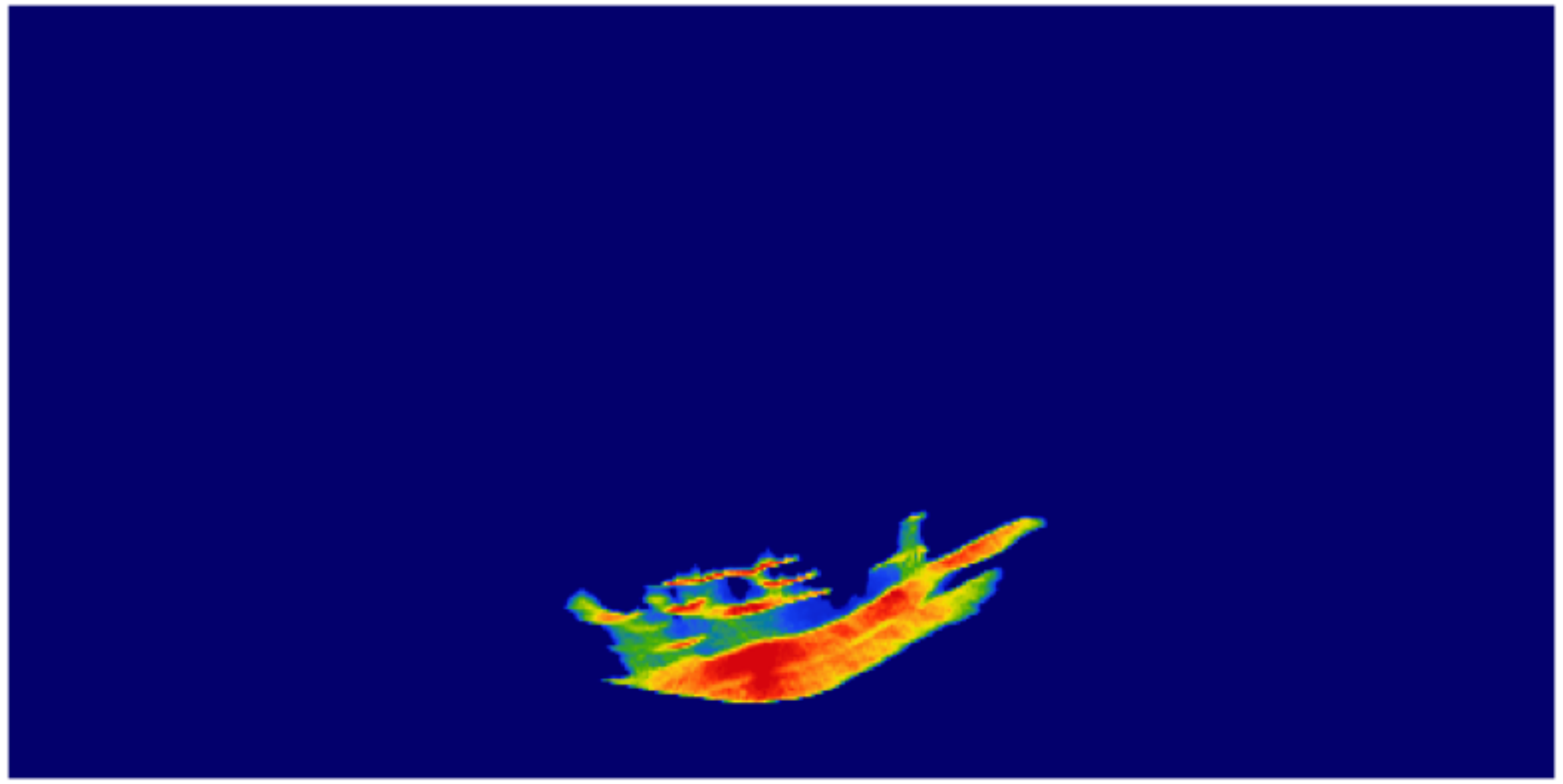
Compute *fiducial* point & summarize M datasets

$$\widetilde{\mathbf{v}}_k = \text{smooth}(\bar{\mathbf{v}}_k) \qquad \bar{\mathbf{y}}_k^{(m)} = \mathbf{J}^\top[\widetilde{\mathbf{v}}_k]\left(\bar{\mathbf{y}}_k - \mathbf{y}_k^{(m)}\right), \quad m = 1 \cdots M$$

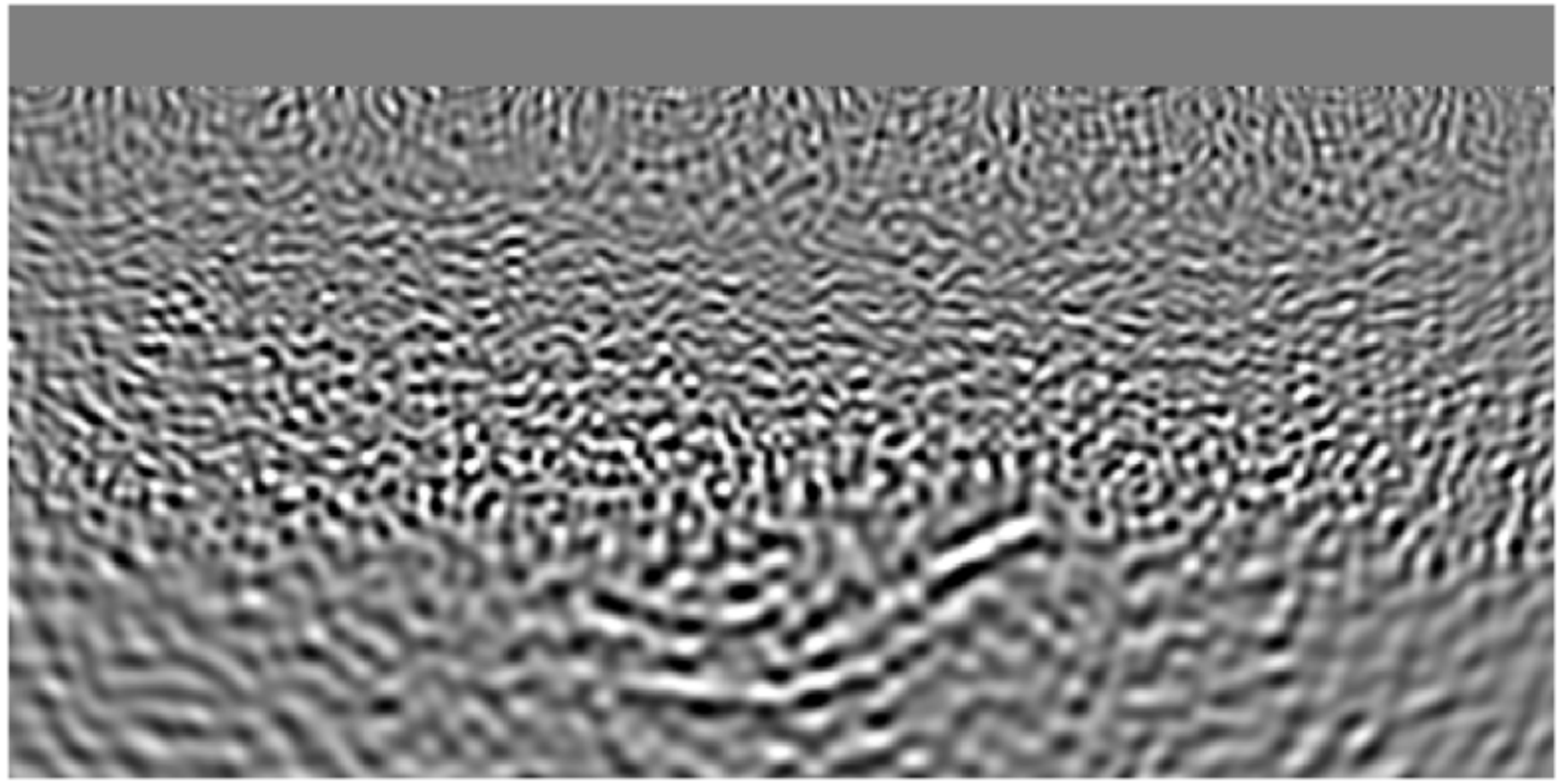
Training Pairs

at $k = 1$

simulated plumes
$\mathbf{x}_k \sim p(\mathbf{x}_k \mid \mathbf{x}_{k-1})$



simulated imaged
time-lapse data
$\bar{\mathbf{y}}_k \sim p(\bar{\mathbf{y}}_k \mid \mathbf{x}_k)$



Simulated training pairs $\{(\mathbf{x}^{(m)}, \bar{\mathbf{y}}^{(m)})\}_{m=1}^{M}$

- hinges on *complex* set of *dependencies*
- can be *probabilistic*