Tracing Wave Source Motion Inside the Magnetosheath Using CLUSTER Data

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   - Source Locator
2. Test on Artificial Data
   - Results for Static Case
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3. Magnetosheath Case Study
   - Measured Data
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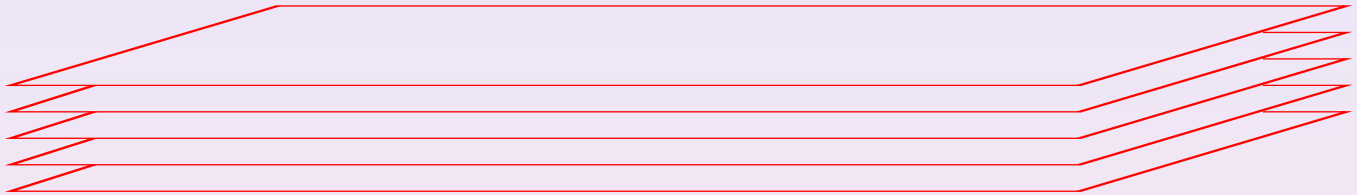
Wave Telescope



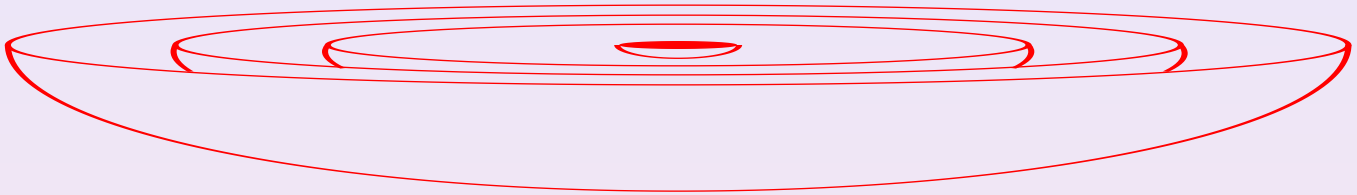
measured wave field $B_{\text{sensor}} = B_0 e^{i\mathbf{k}\cdot\mathbf{r}_{\text{sensor}}}$

array output matrix $\mathcal{B}_{ij} = B_i B_j$

test pattern $w_{\text{sensor}}(\mathbf{k}') = Ce^{i\mathbf{k}'\cdot\mathbf{r}_{\text{sensor}}}$

output power $P(\mathbf{k}') = [\mathbf{w}^\dagger(\mathbf{k}')\mathcal{B}^{-1}\mathbf{w}(\mathbf{k}')]^{-1}$

Source Locator



measured wave field $B_{\text{sensor}} = B_0 \frac{1}{\rho_{\text{sensor}}} e^{ik\rho_{\text{sensor}}}$

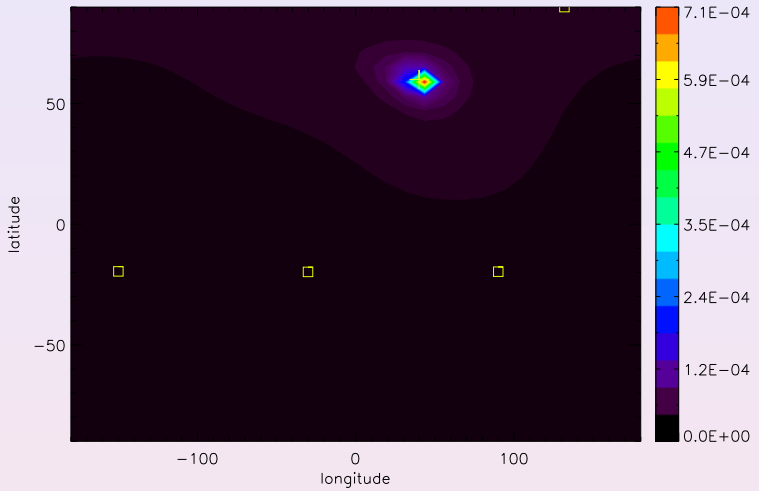
array output matrix $\mathcal{B}_{ij} = B_i B_j$

test pattern $w_{\text{sensor}}(k', \mathbf{r'}) = C \frac{1}{\rho'_{\text{sensor}}} e^{ik'\rho'_{\text{sensor}}}$

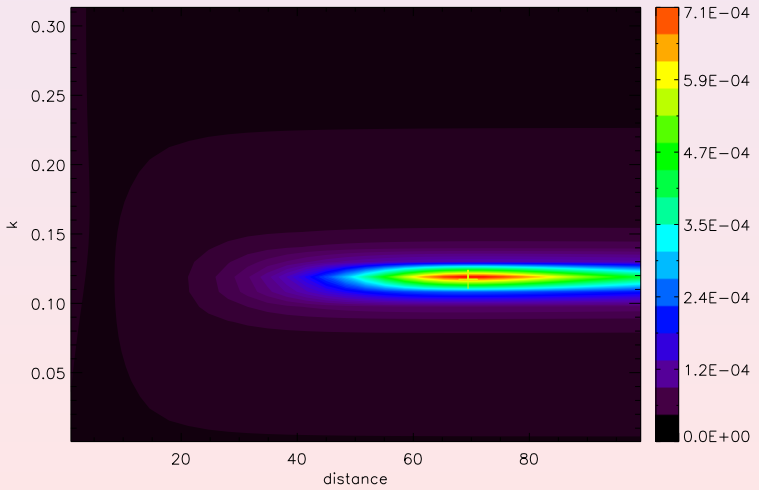
output power $P(k', \mathbf{r'}) = [\mathbf{w}^\dagger(k', \mathbf{r'}) \mathcal{B}^{-1} \mathbf{w}(k', \mathbf{r'})]^{-1}$

Results for Static Case

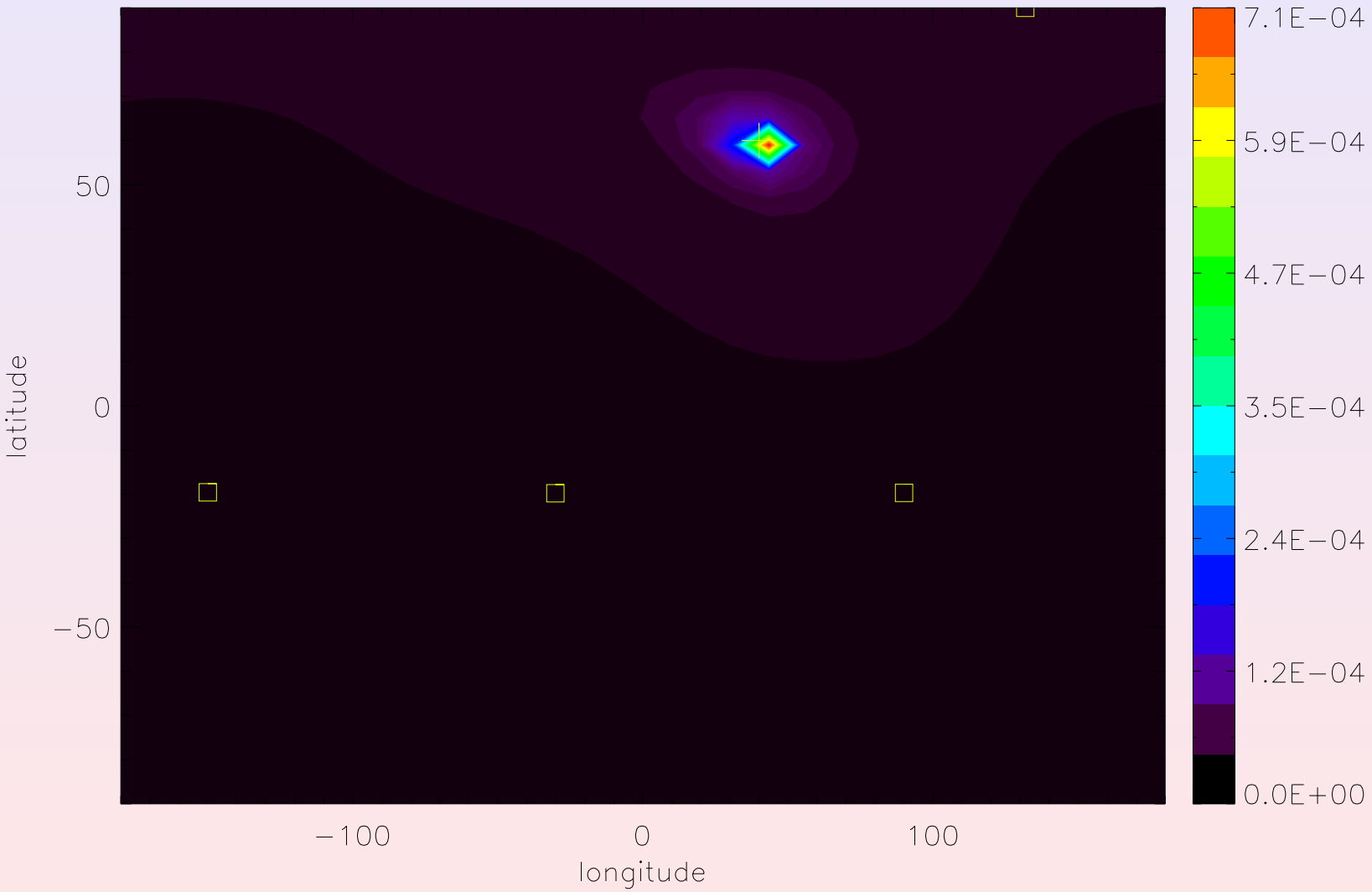
- artificial data
- regular tetrahedron
- 10 km separation



	given	found
dist.	70 km	69 km
long.	40°	43°
lat.	60°	59°
k	0.11 km^{-1}	0.10 km^{-1}



Results for Static Case



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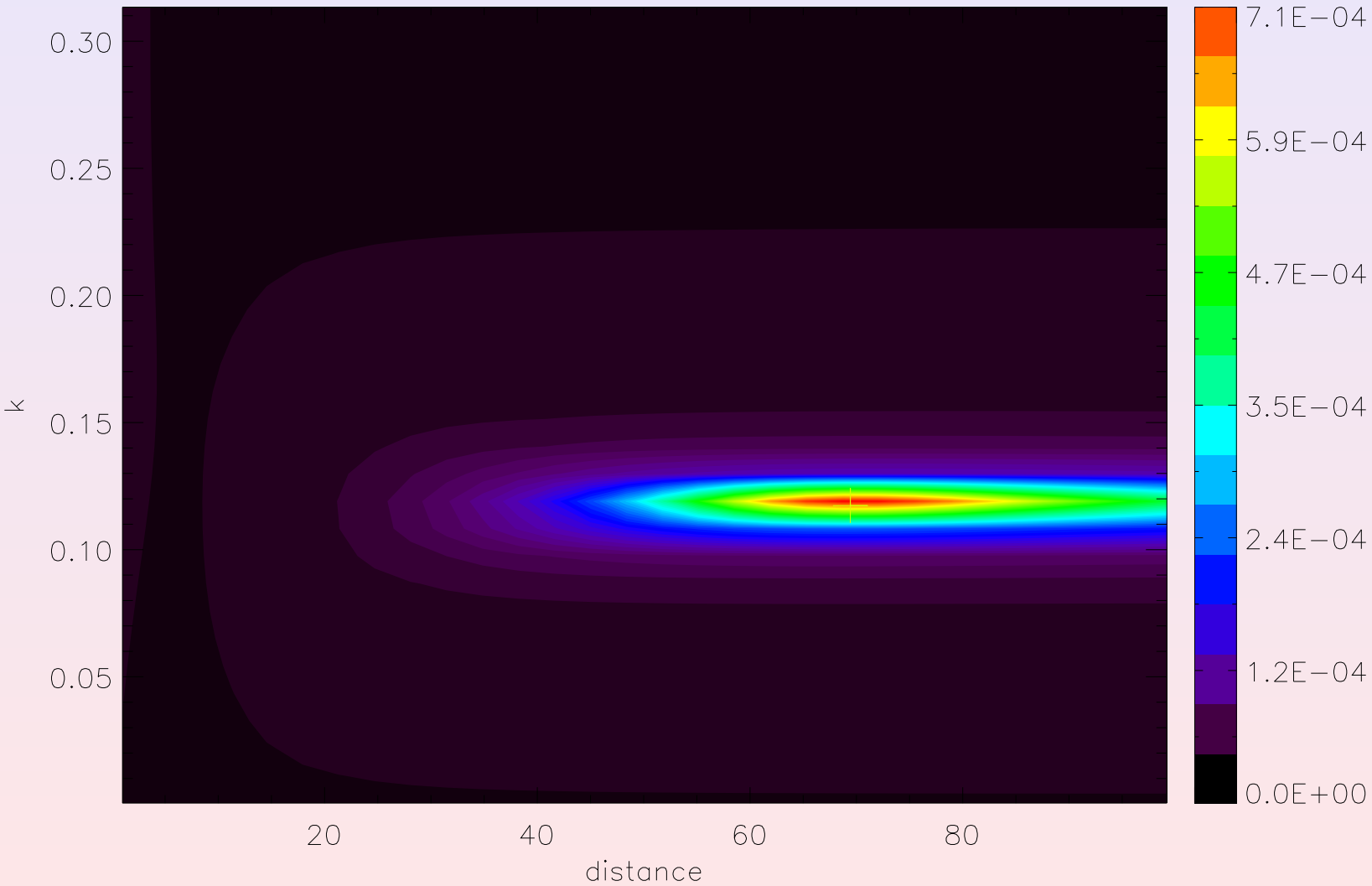
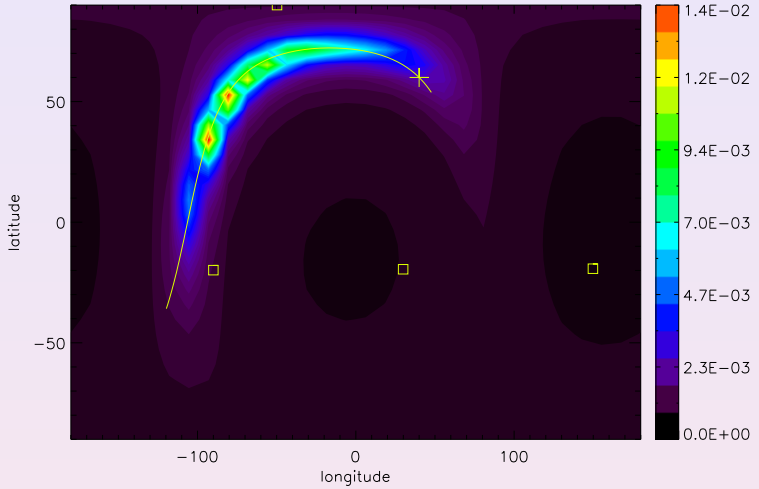
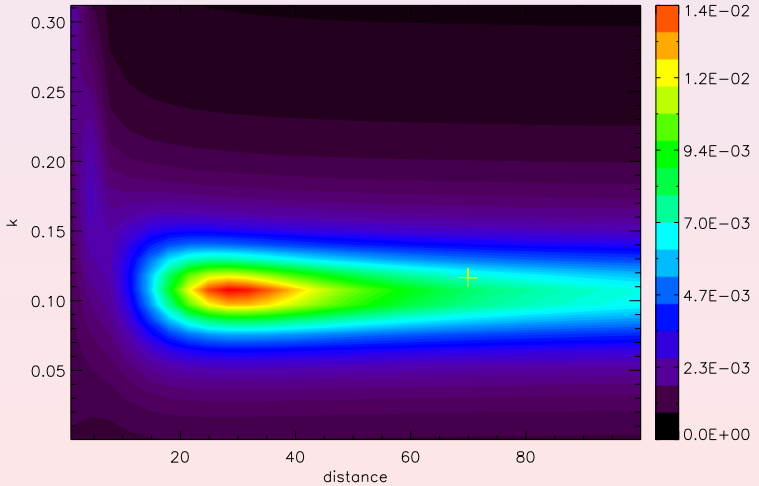


Results for Dynamic Case

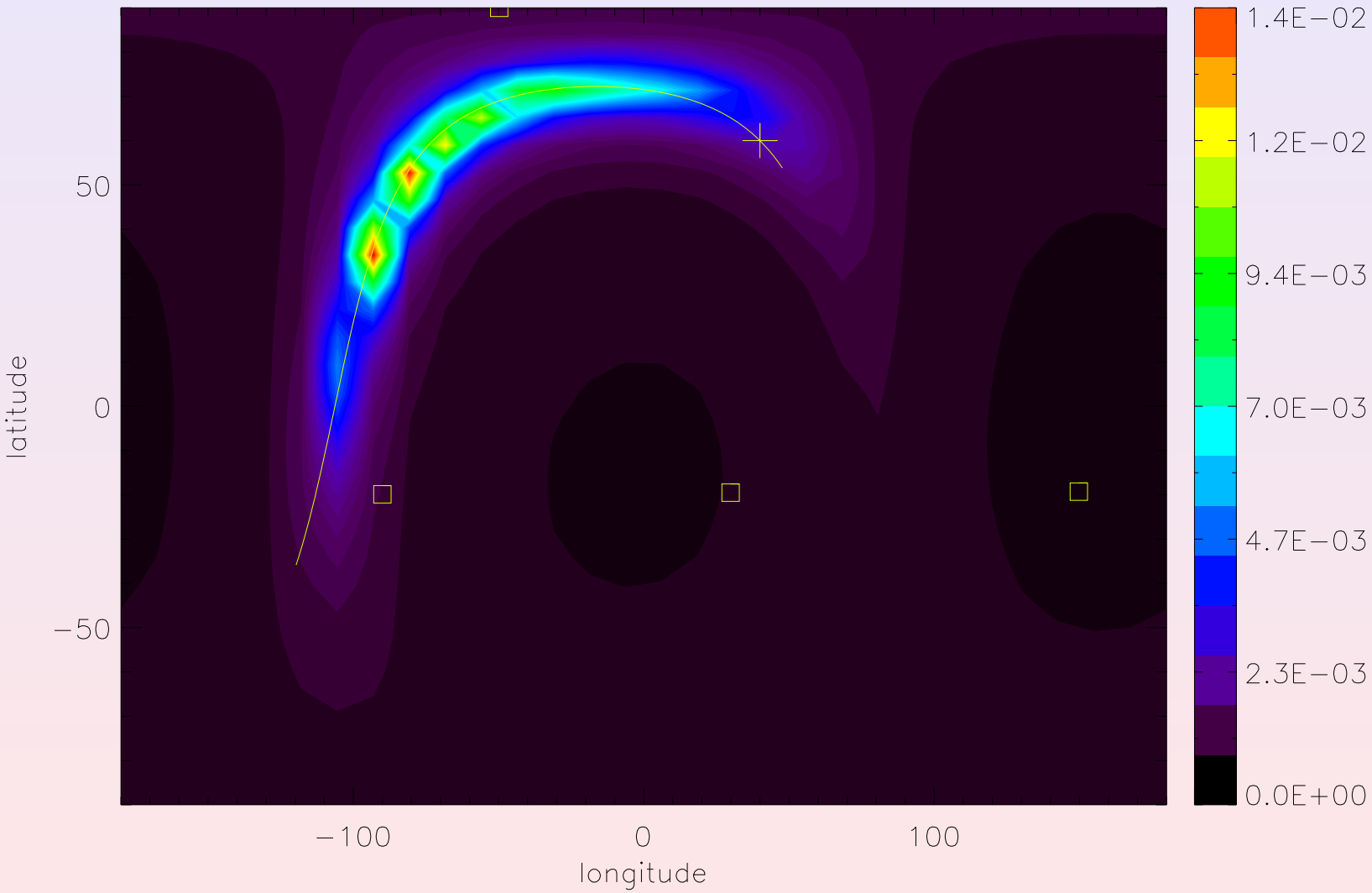
- artificial data
- regular tetrahedron
- 10 km separation
- velocity: 170 km/s



	closest approach	found
dist.	21 km	28 km
long.	$-91°$	$-93°$
lat.	$39°$	$34°$
k	0.11 km^{-1}	0.10 km^{-1}



Results for Dynamic Case



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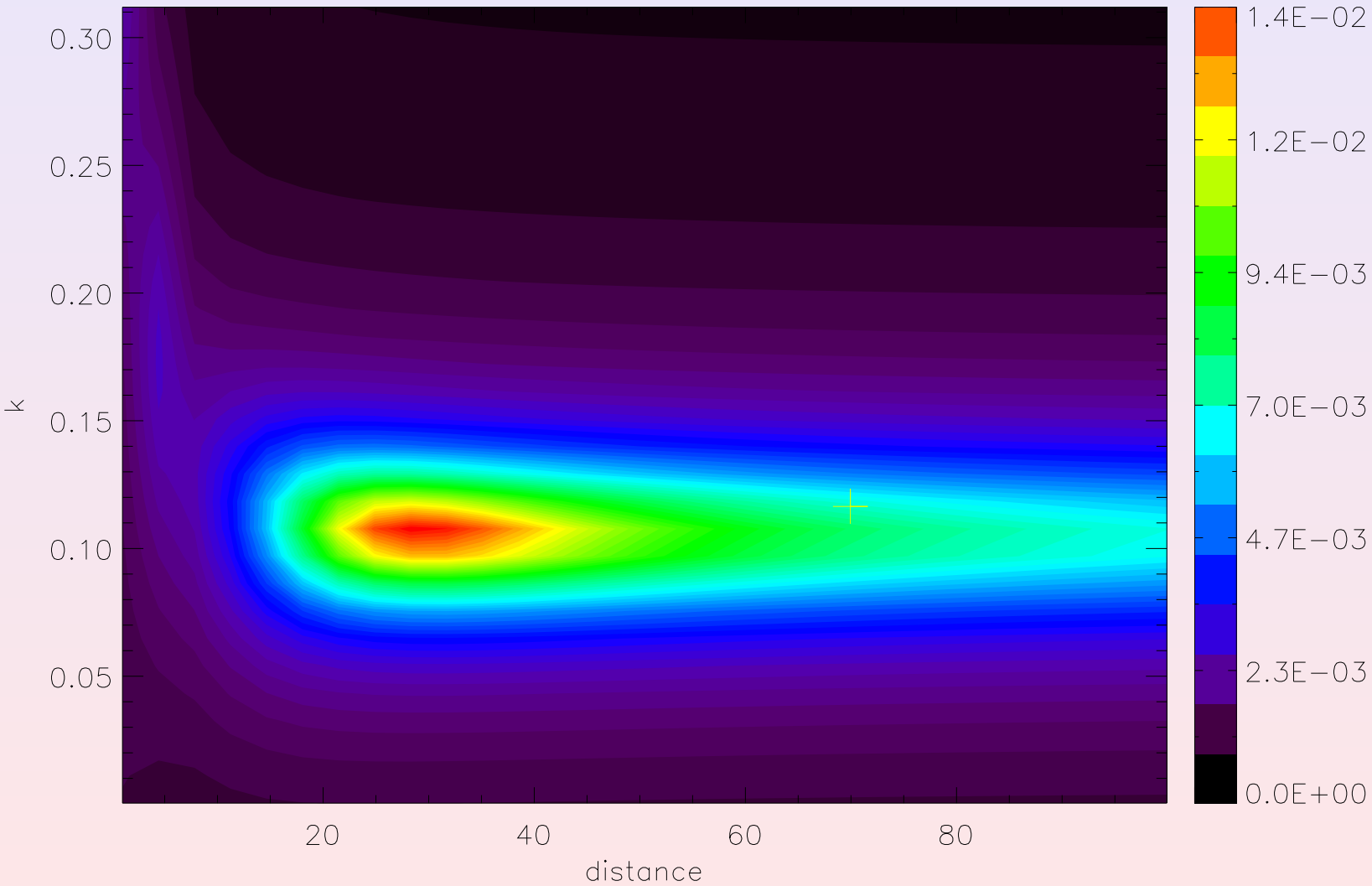
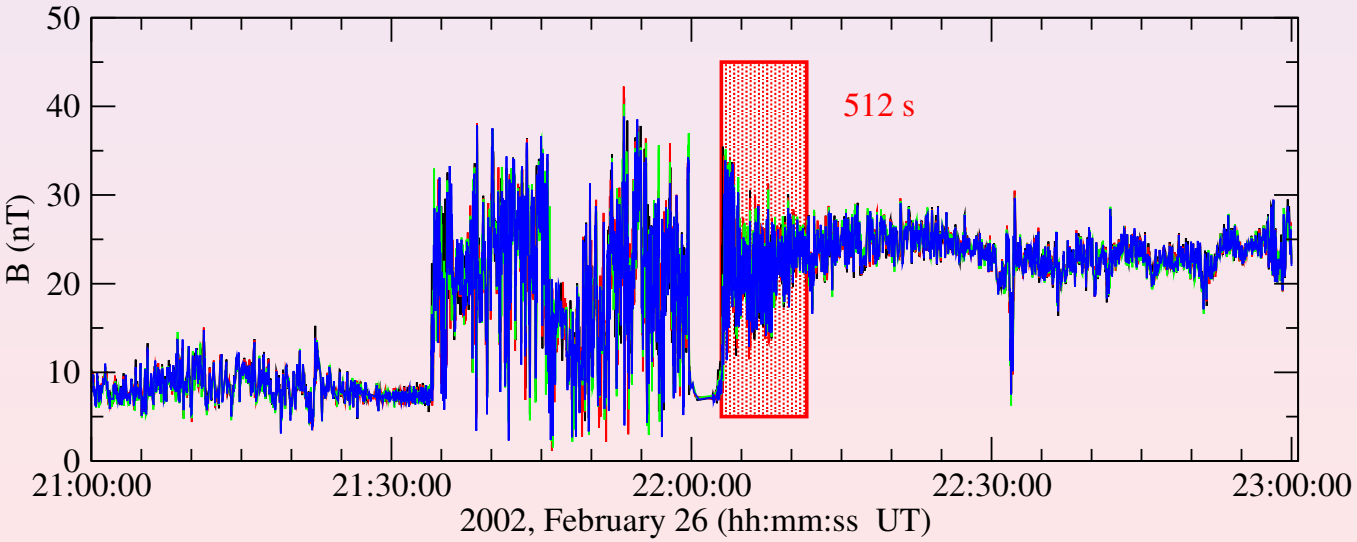


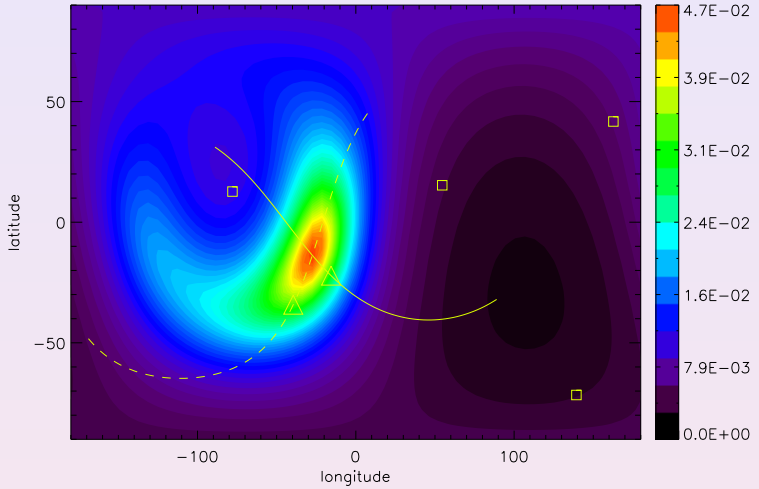
Case Study: Measured Data

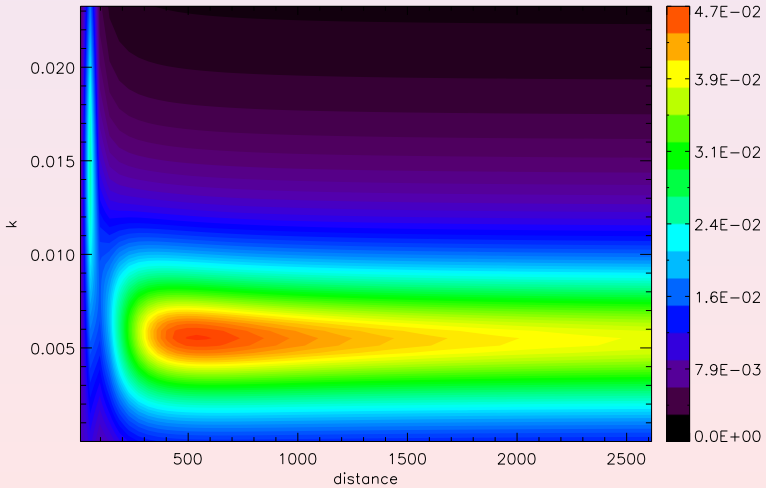
Time interval:	2002 February 26, 22:03 – 22:11 UT
Location:	Magnetosheath
Plasma flow velocity:	140 km/s
Spacecraft separation:	between 87 and 135 km
Shock regime:	Quasi-parallel

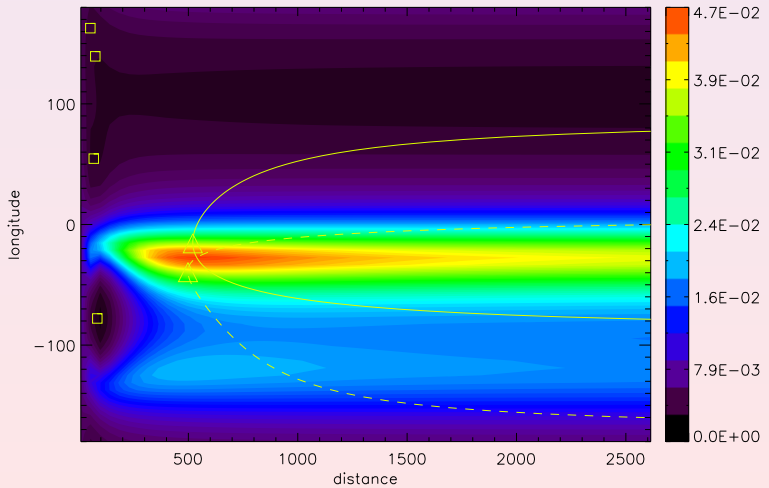


Case Study Results

frequency:	66 mHz
wave length:	1142 km
distance:	538 km
longitude:	-27°
latitude:	-13°







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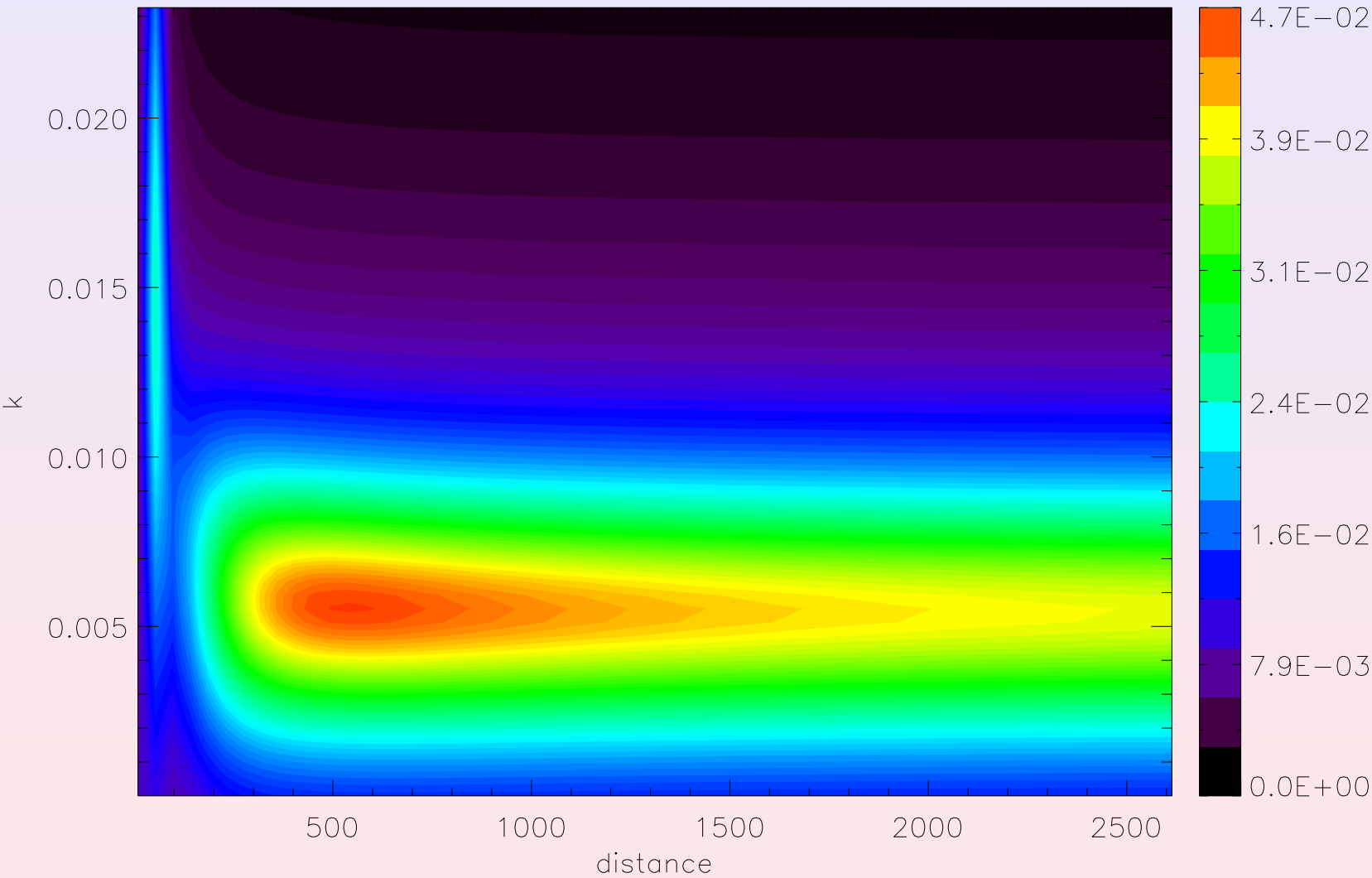

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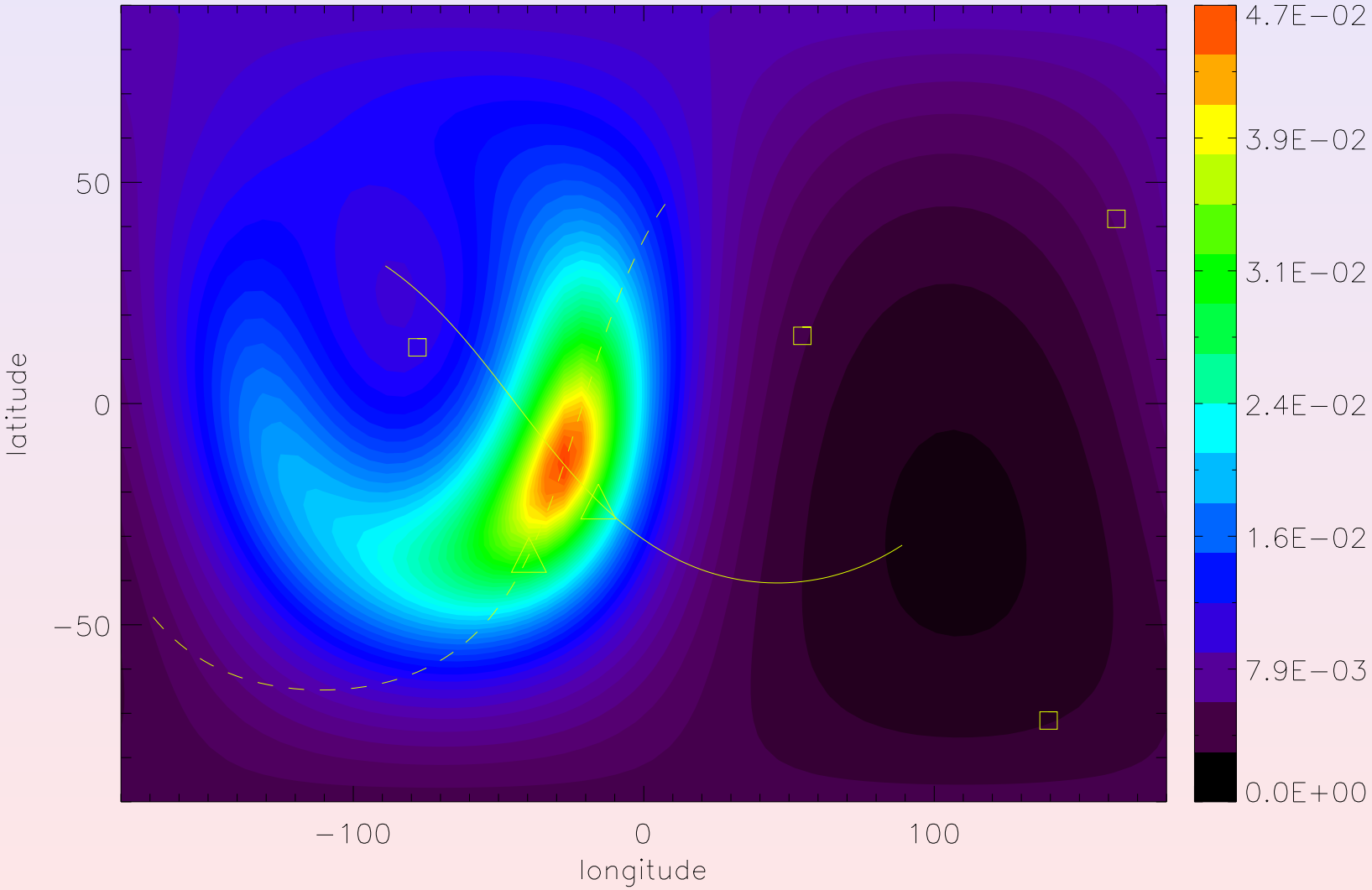

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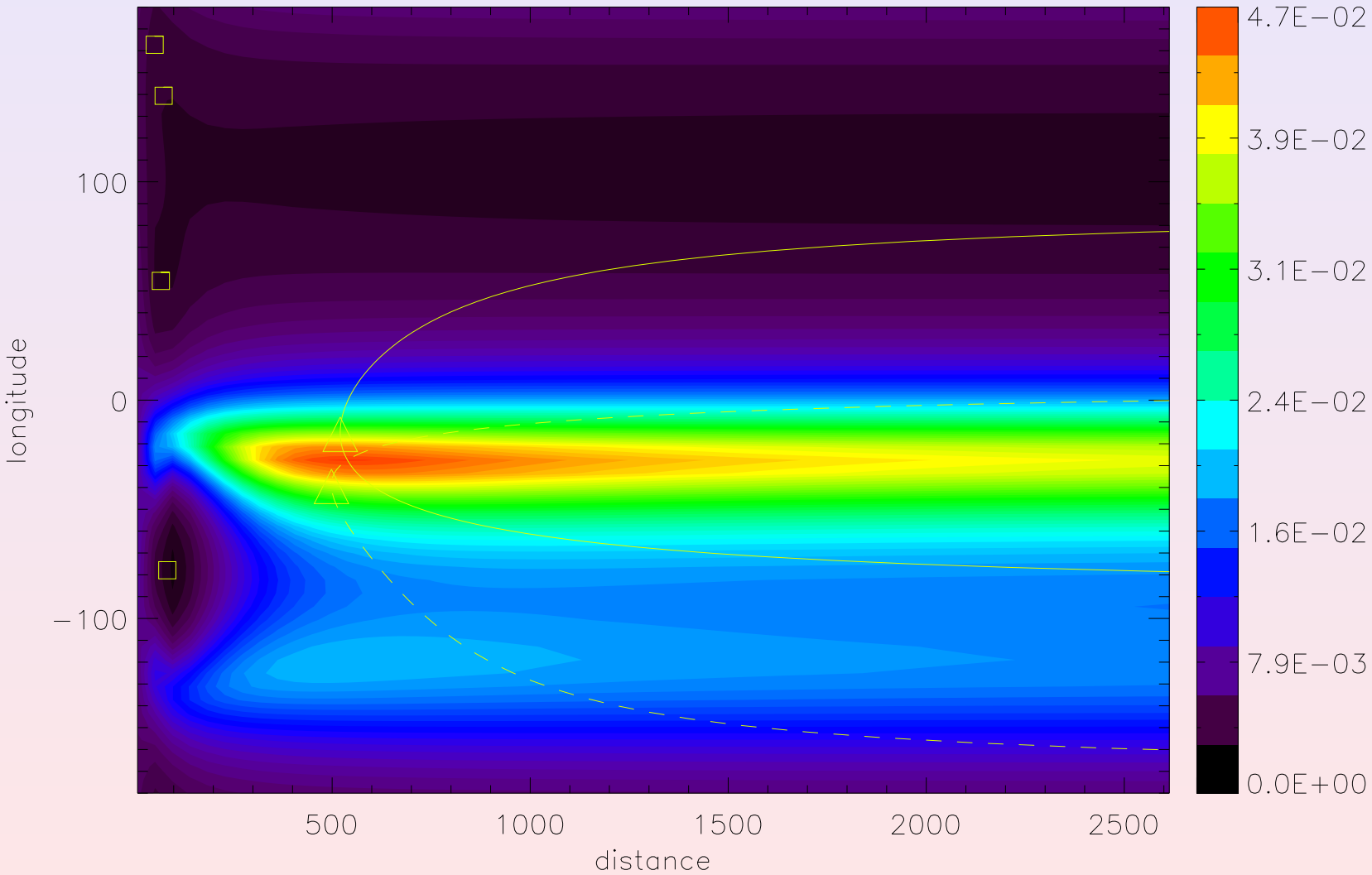

Conclusions

1. We have generalized the wave telescope technique to spherical waves
2. The new method provides the distance to the source
3. We have identified a wave source in the magnetosheath, close to the shock
4. The finite distance to the identified source suggest that waves are locally generated in this region
5. The identified source seems to move with the plasma flow

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