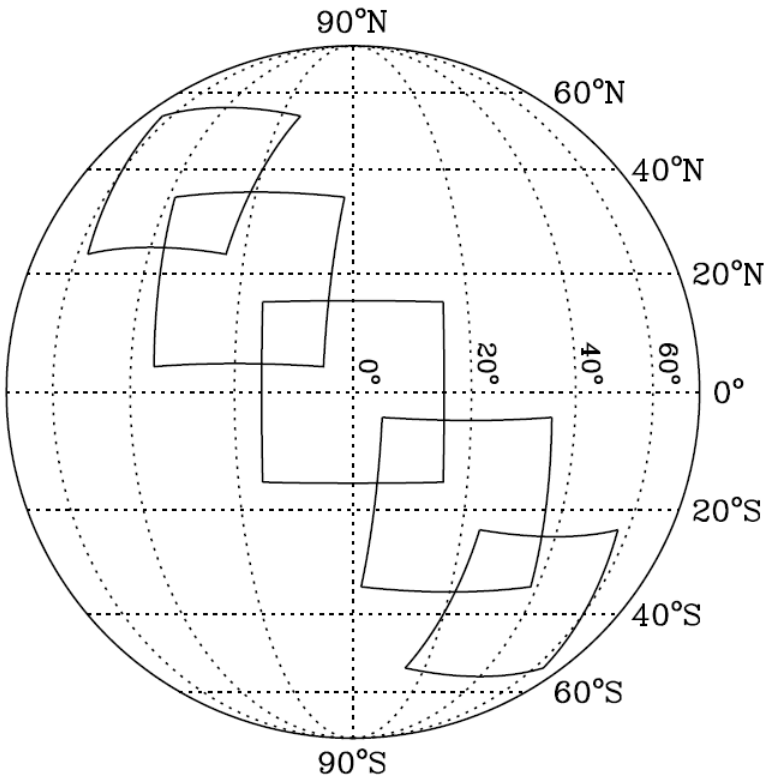
Time-Distance Pipeline Status Update & First HMI Results from the Pipeline

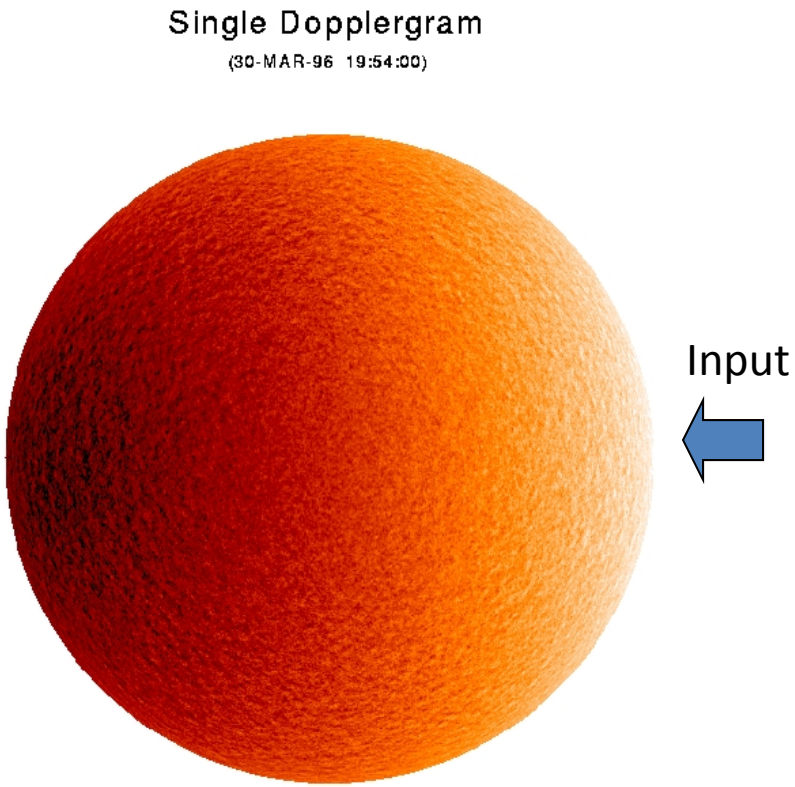
Time-Distance Pipeline Team

Time-distance pipeline generates subsurface (up to 30Mm below the photosphere) flow maps and sound-speed perturbation maps for the following two types:

1. Routine production: daily (nearly) full disk maps and synoptic maps
2. User selected areas (most likely, active regions)

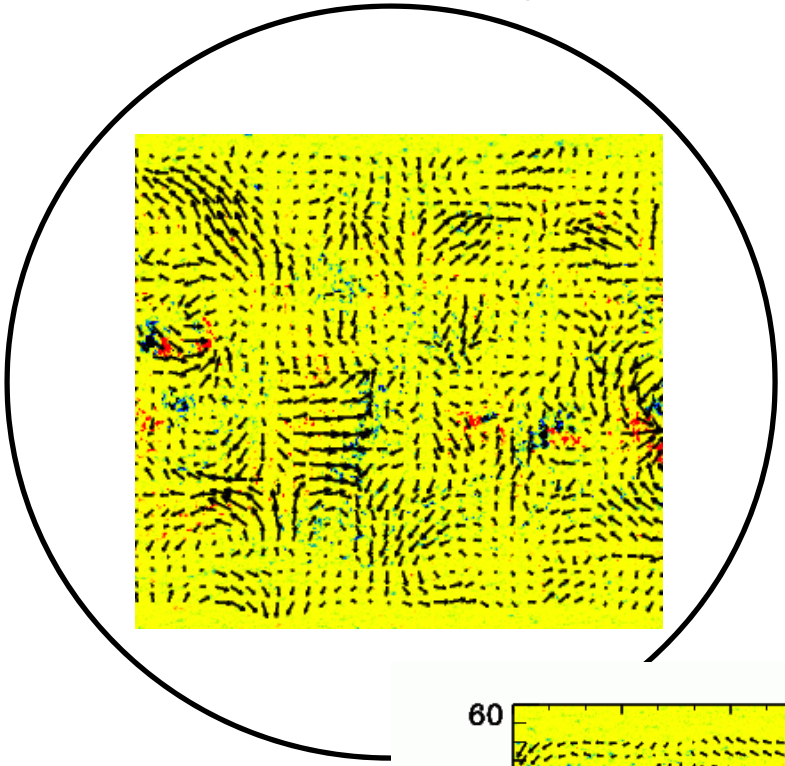
1. Routine Production





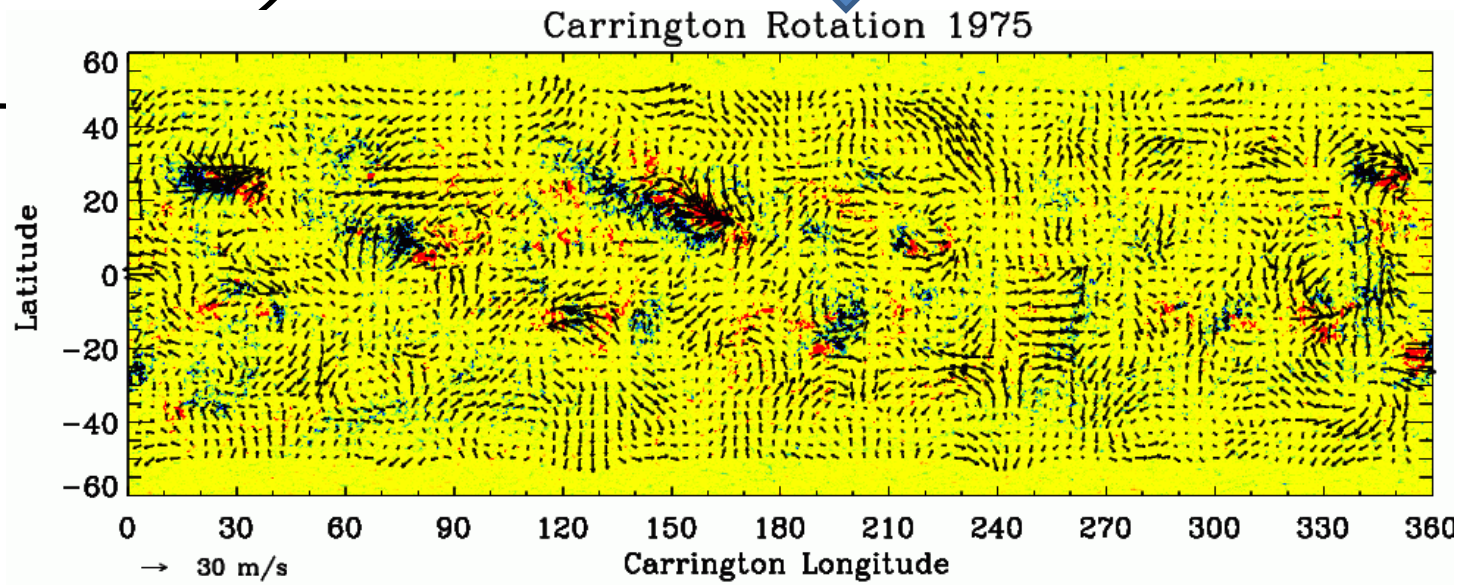
Every 8 hours, we select 480-minute Doppler observations and make time-distance measurements. Inversions are done to derive subsurface flow fields and sound-speed perturbations. A total of 25 areas are selected and used to generate full-disk subsurface map.

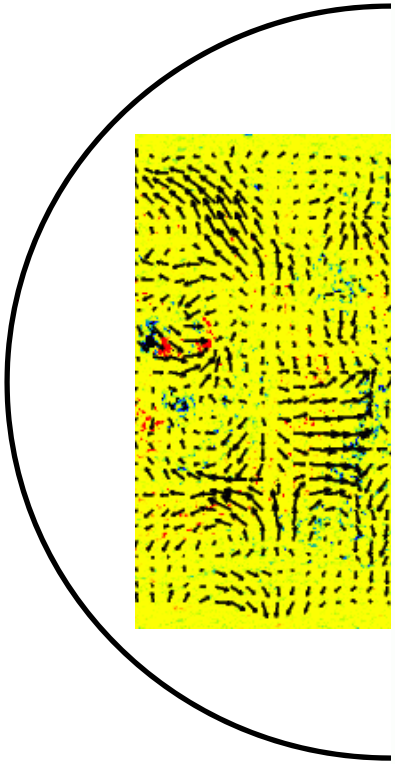
1. Routine Production

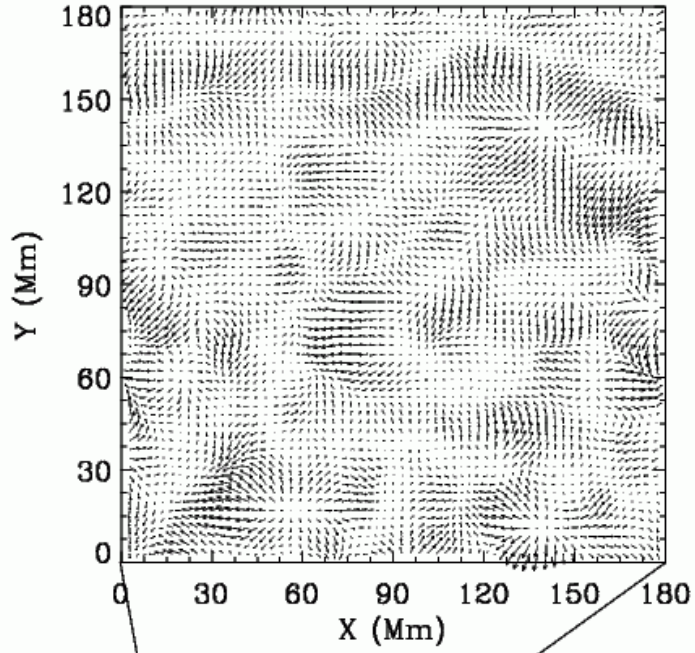


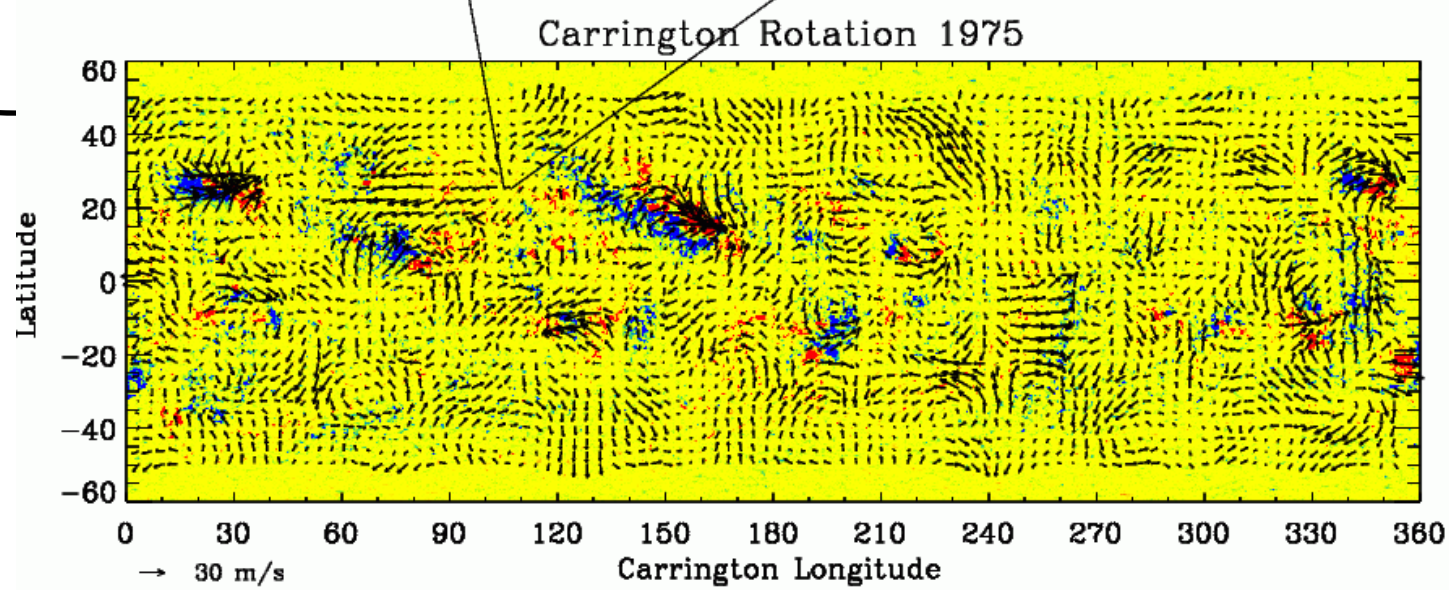
Every 8 hours, we generate a nearly full-disk map.

For every Carrington rotation, we generate a synoptic map, updated daily though.

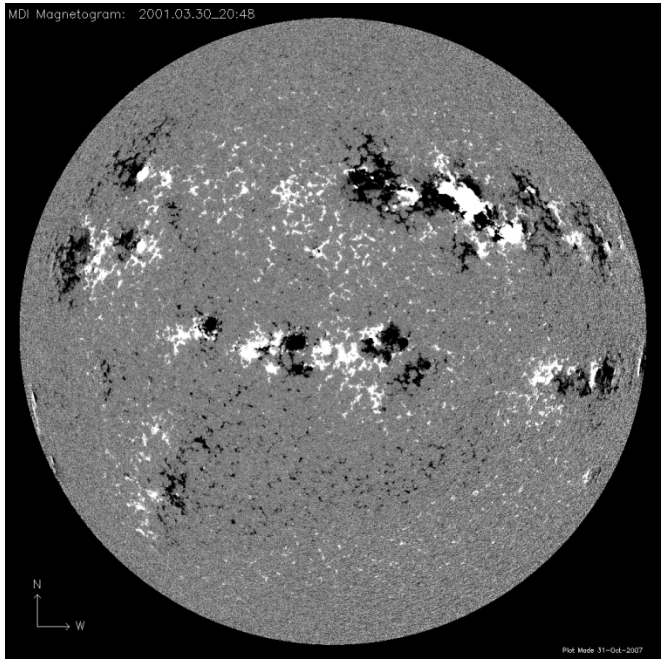


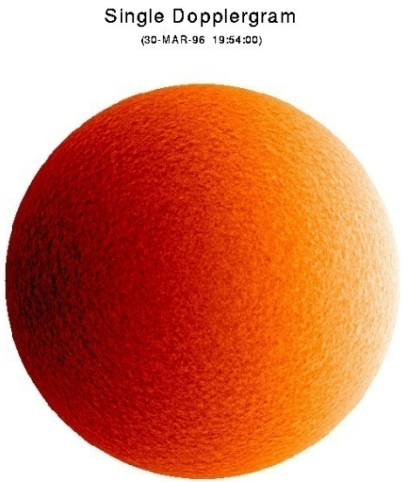



Y (Mm)
X (Mm)
0
30
60
90
120
150
180


Carrington Rotation 1975
Latitude
60
40
20
0
−20
−40
−60
0
30
60
90
120
150
180
210
240
270
300
330
360
→ 30 m/s
Carrington Longitude

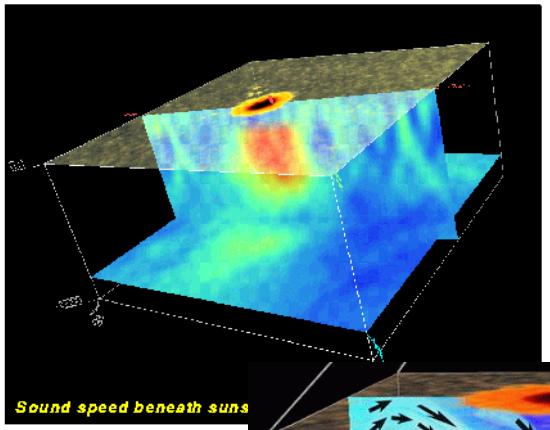
2. User Selected Area

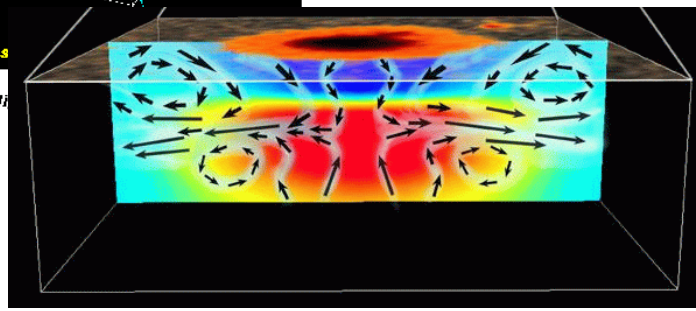




Input

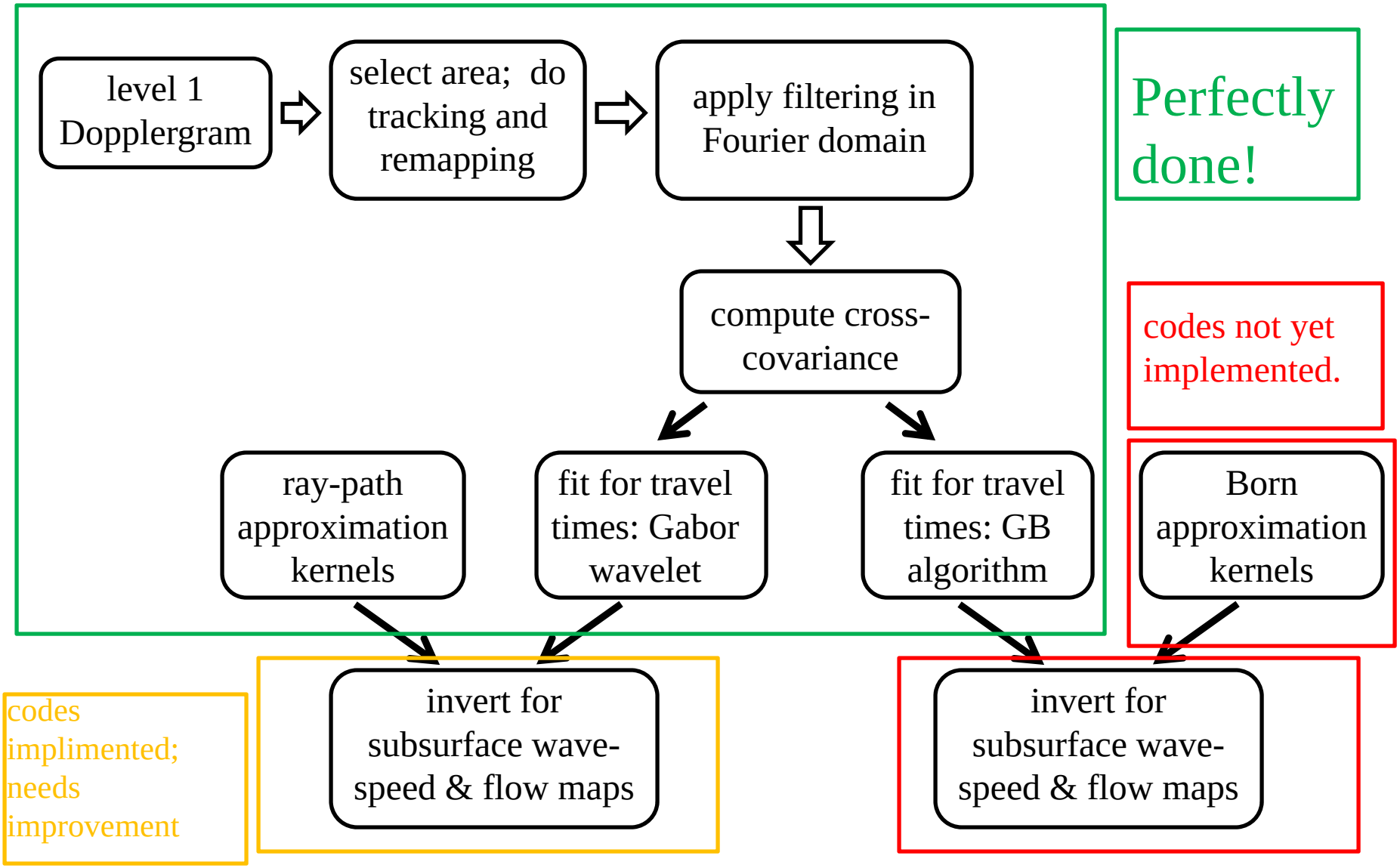
output





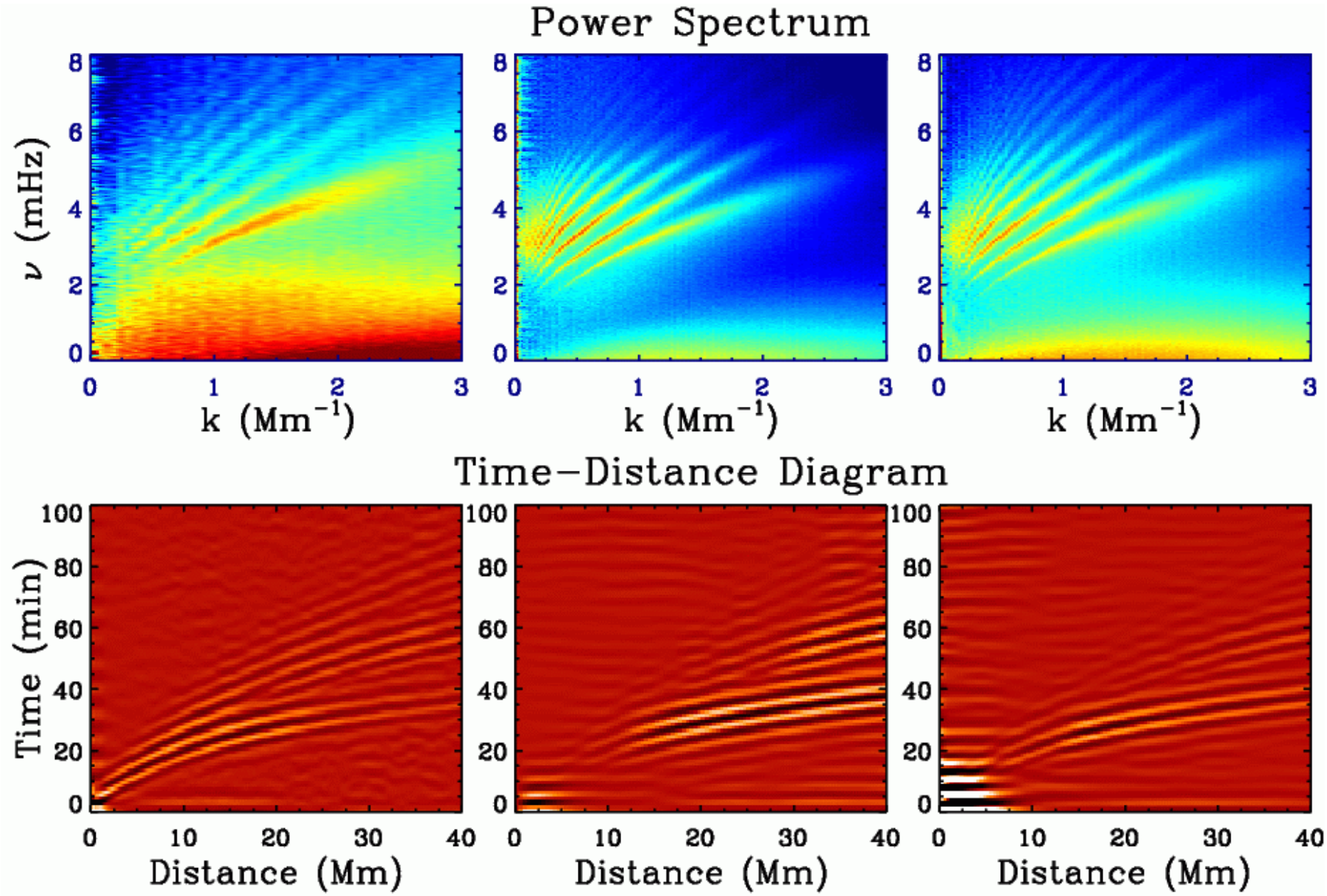
Users are free to select their interested active regions, and request a computation of cross-covariances or subsurface structures.

Pipeline Flow Chart

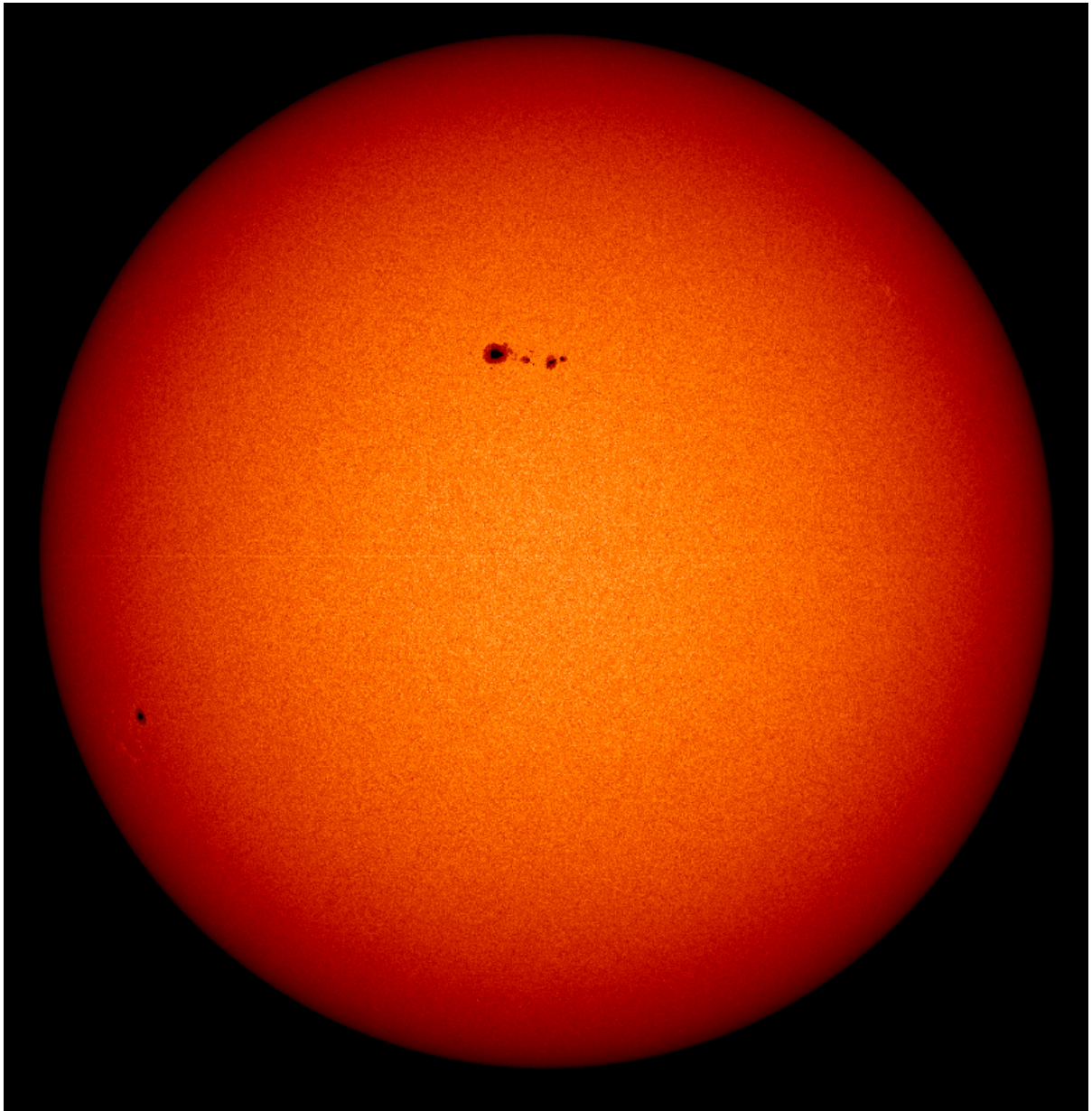


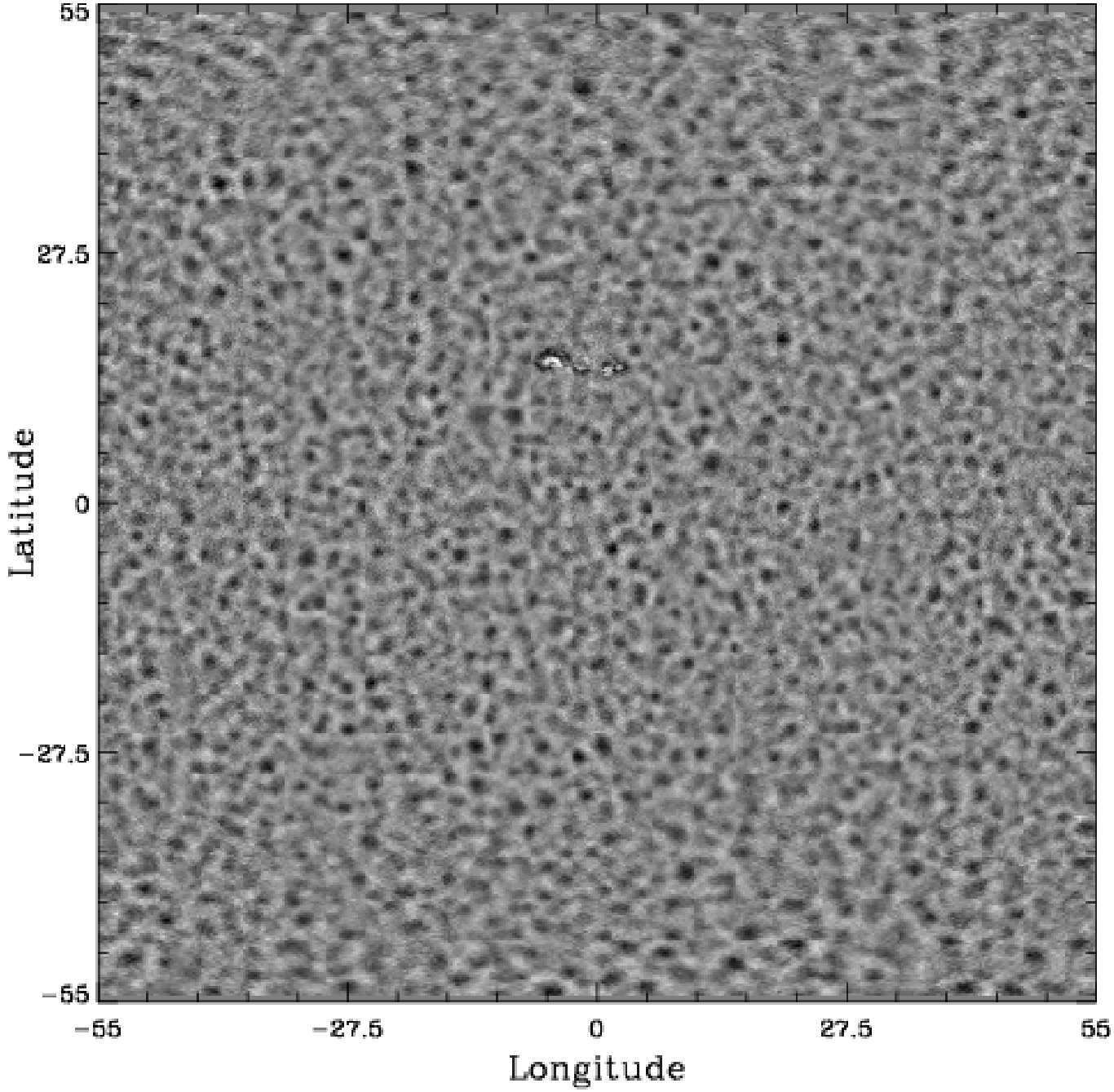
HMI First Results from Our Pipeline

A Sense of How Good (Bad) HMI Observations Are

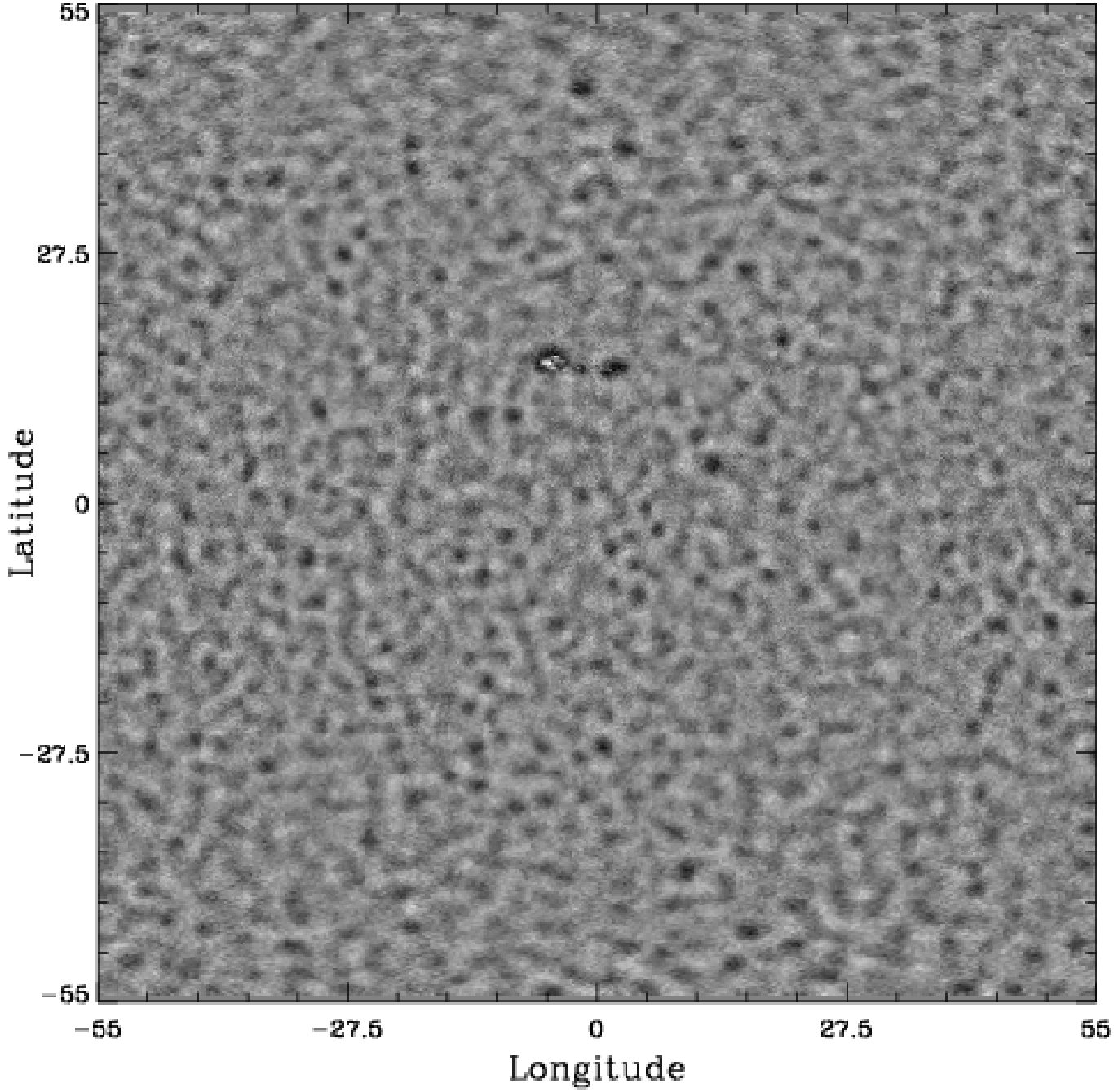


Data We Analyzed: Mar 29, 2010

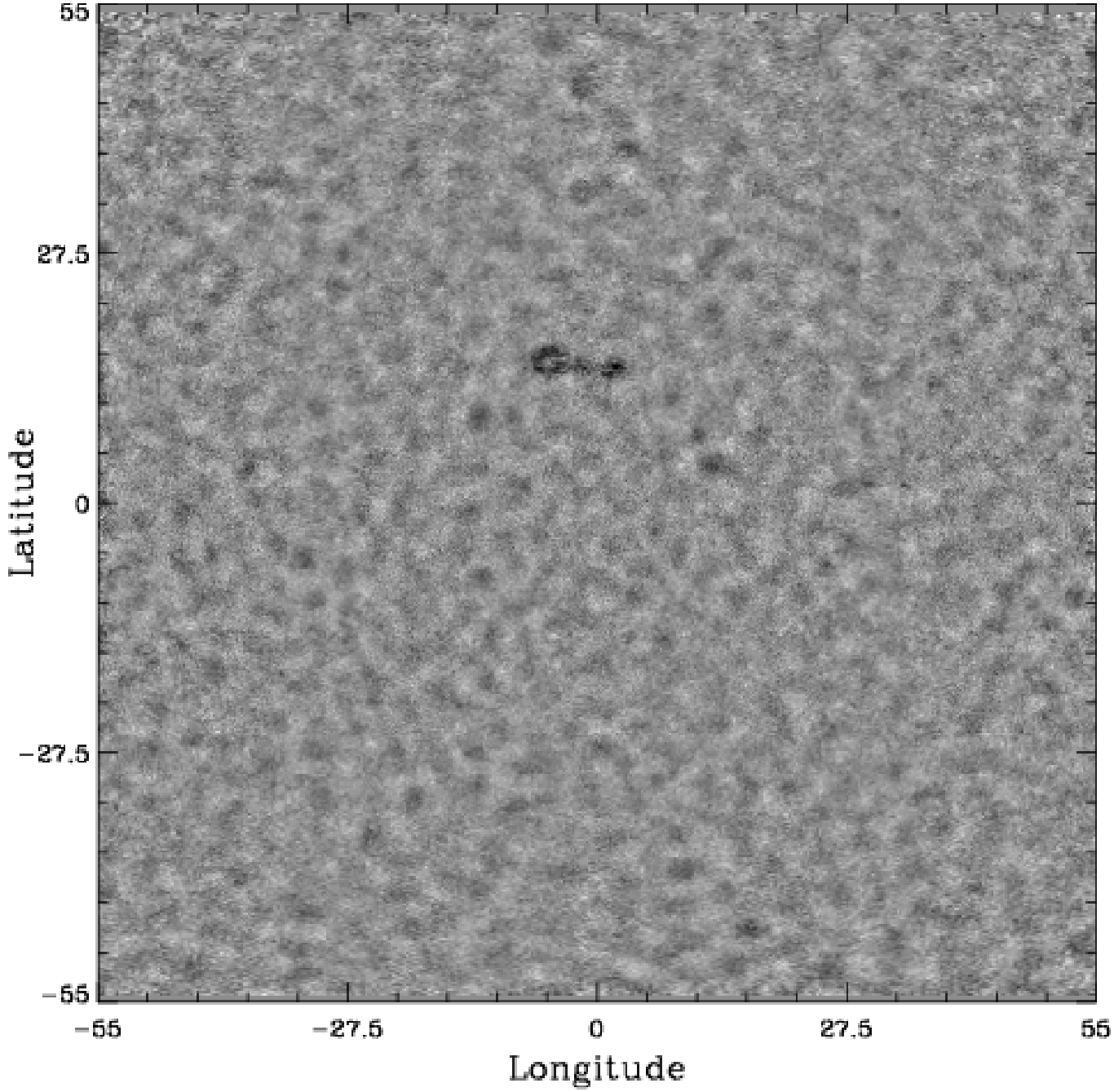




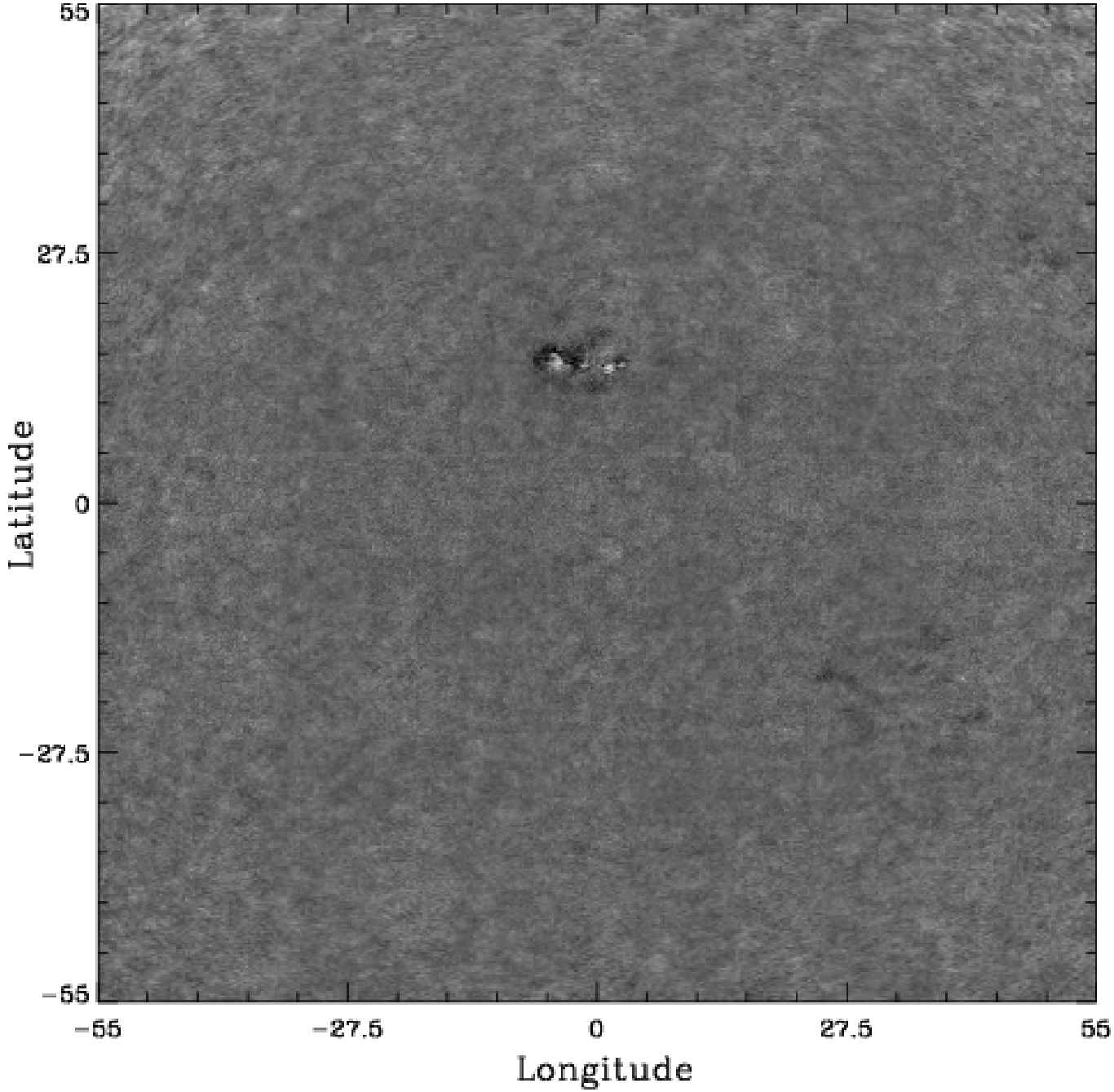
Outgoing ingoing travel time difference, with annulus range of 0.60-0.96 degrees.



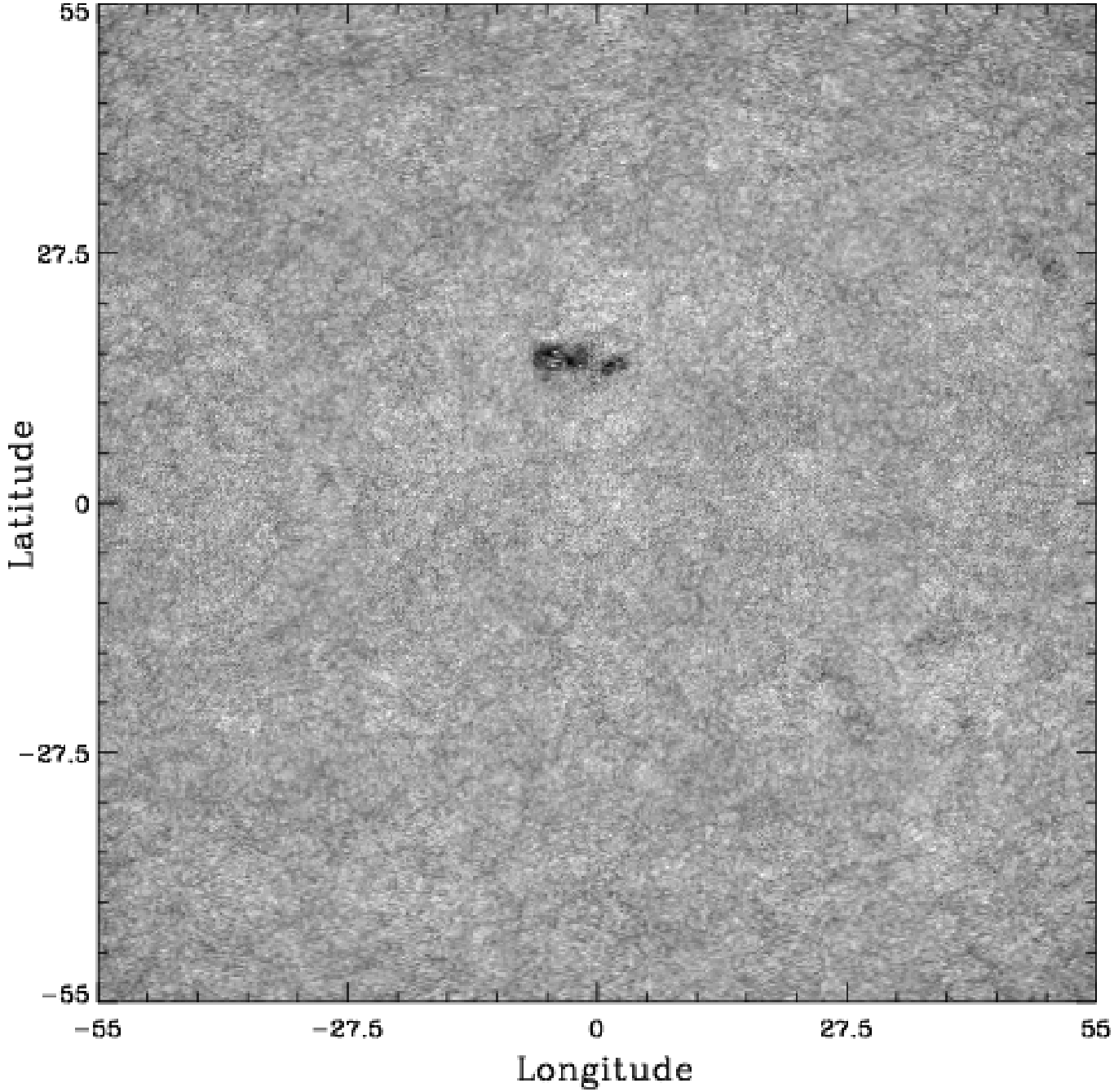
Outgoing ingoing travel time difference, with annulus range of 1.08-1.32 degrees.



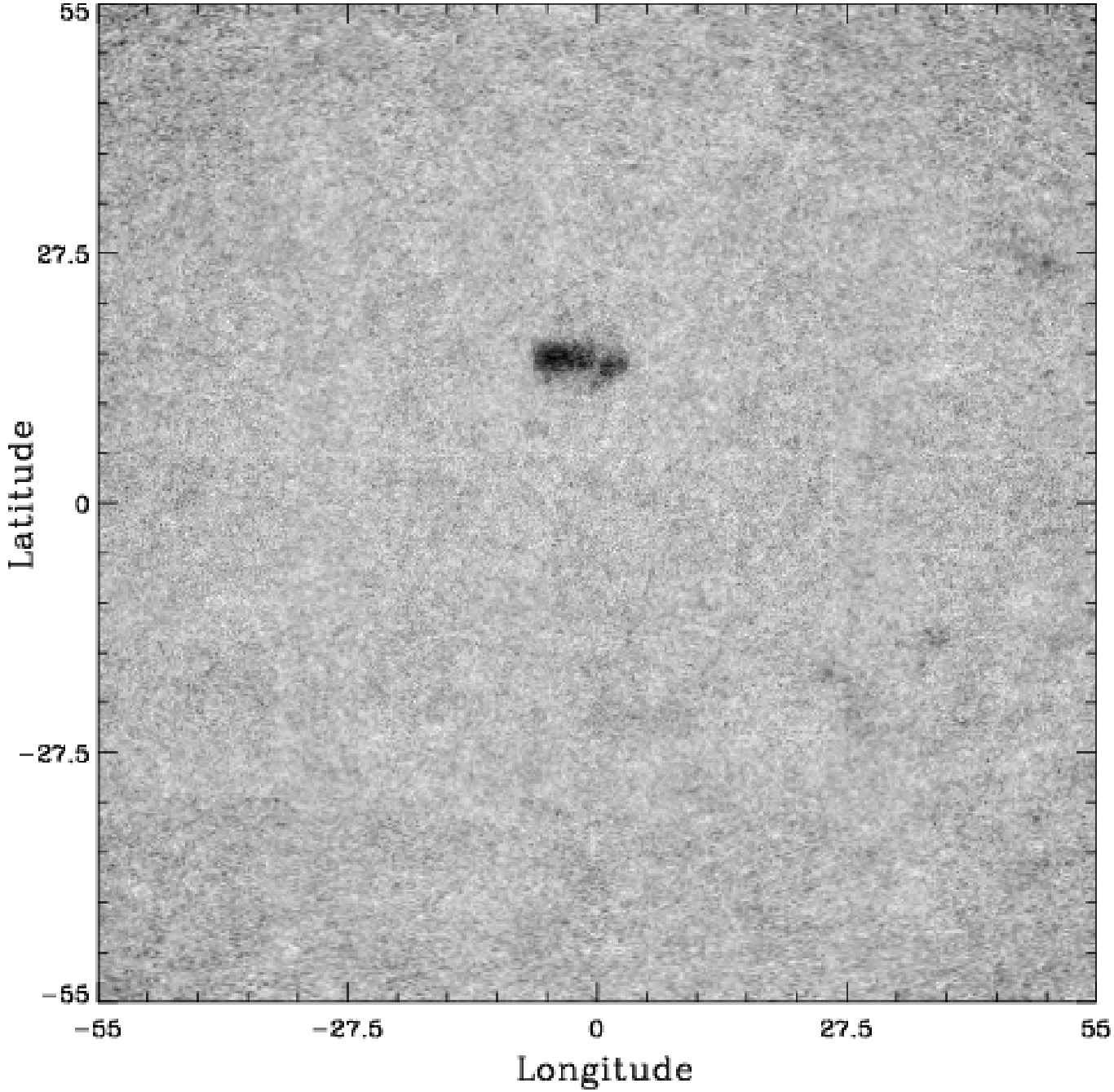
Outgoing ingoing travel time difference, with annulus range of 1.44-1.80 degrees.



Outgoing ingoing mean travel times, with annulus range of 0.60-0.96 degrees.

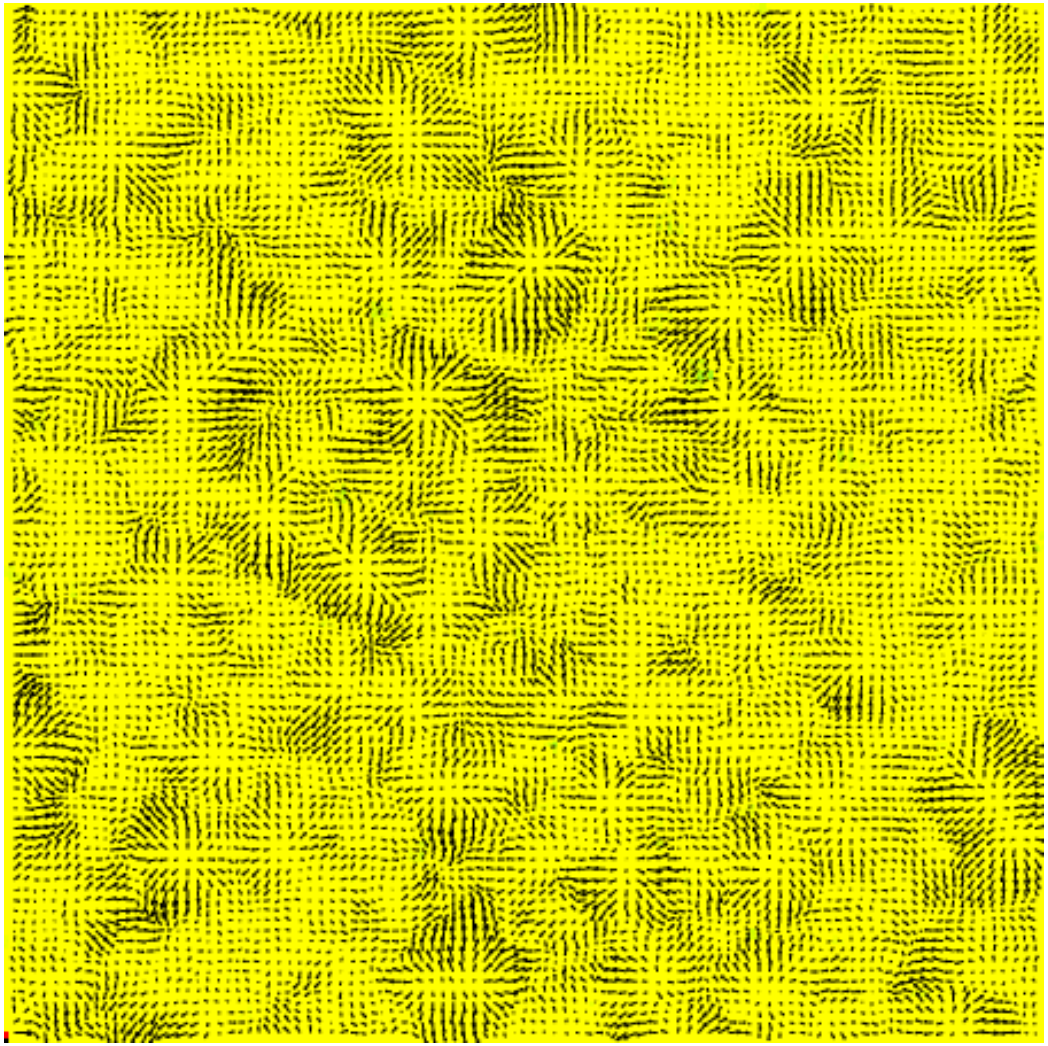


Outgoing ingoing mean travel times, with annulus range of 1.08-1.32 degrees.

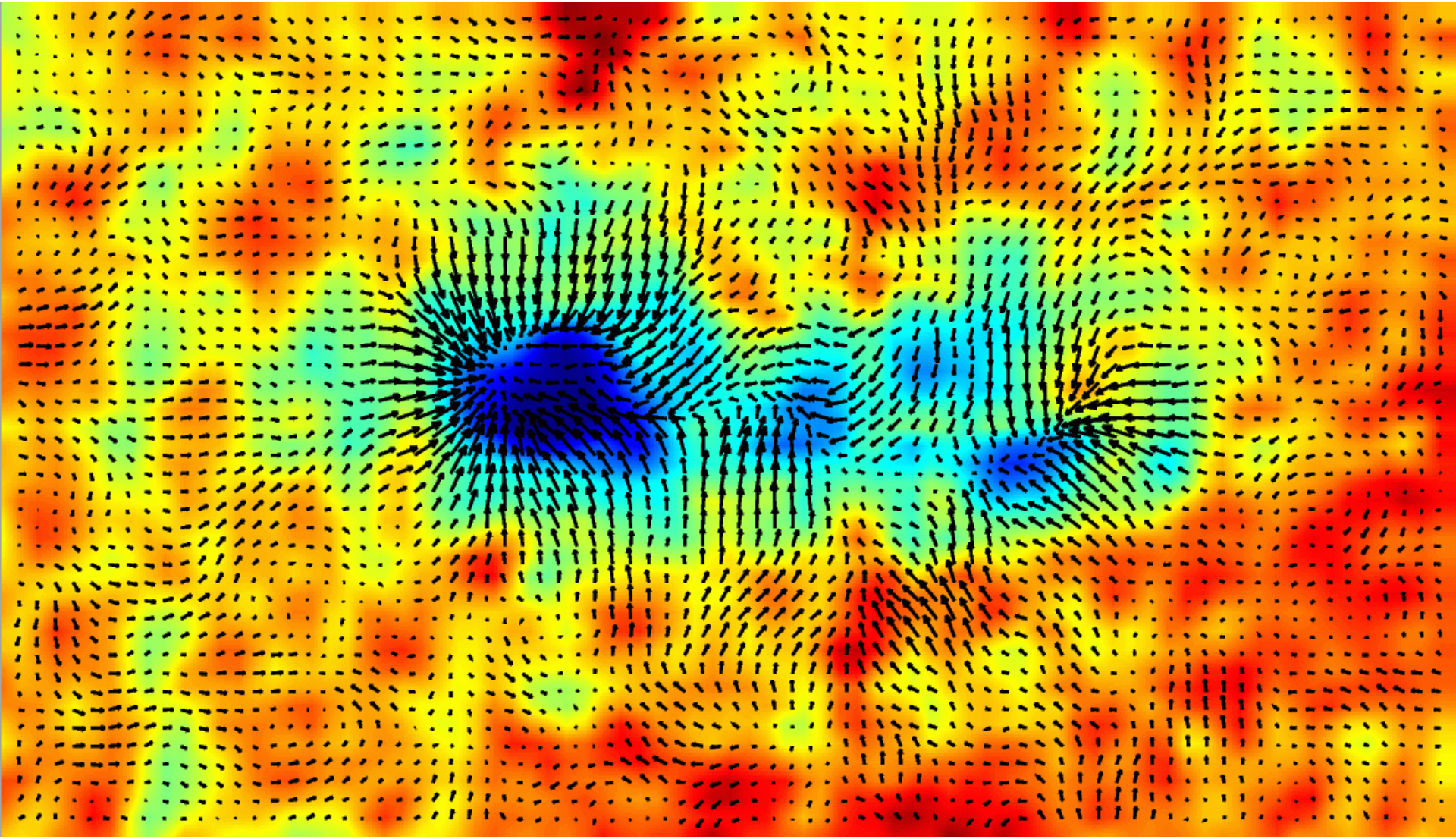


Outgoing ingoing mean travel times, with annulus range of 1.44-1.80 degrees.

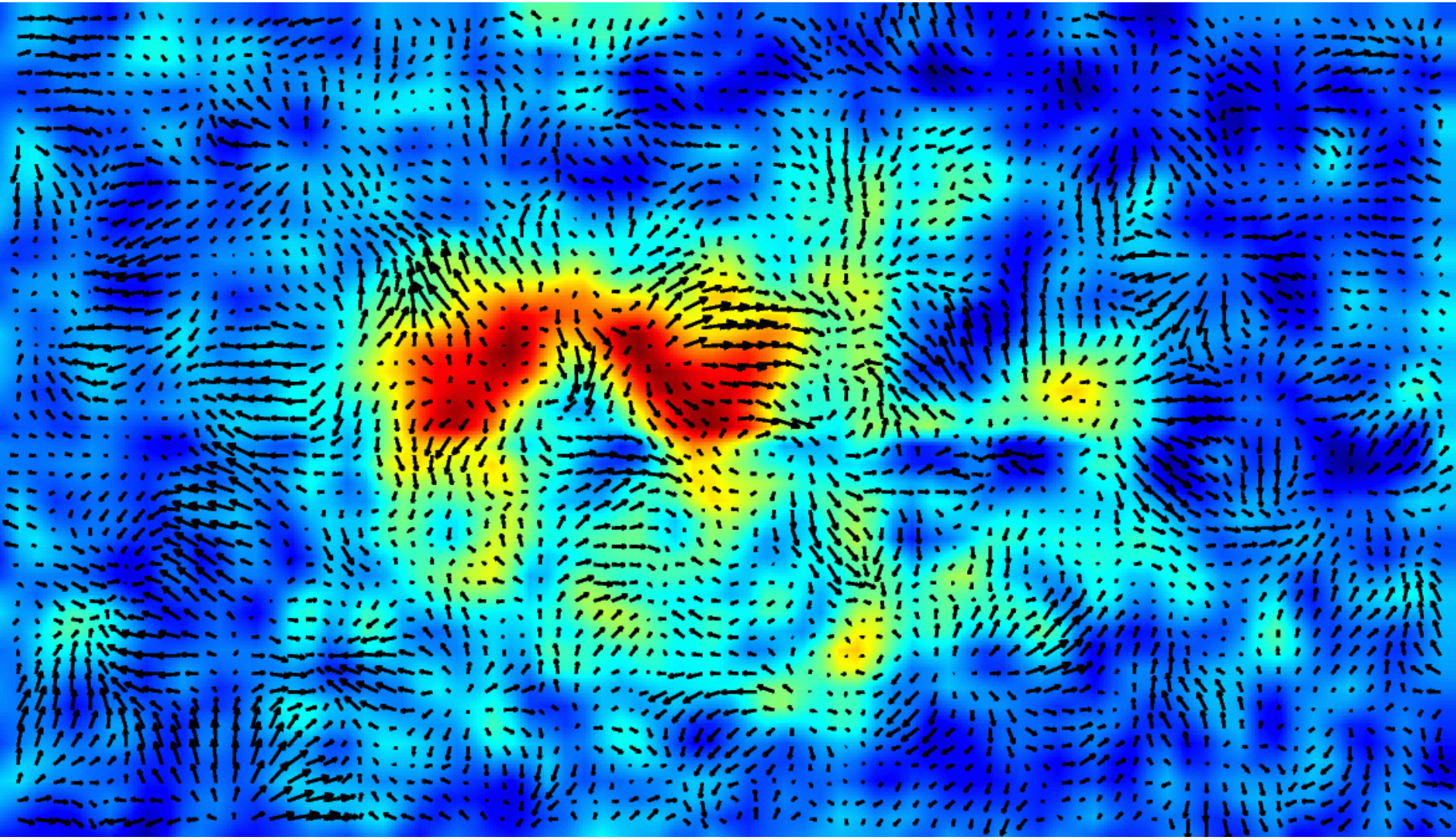
Inverted Flow Maps



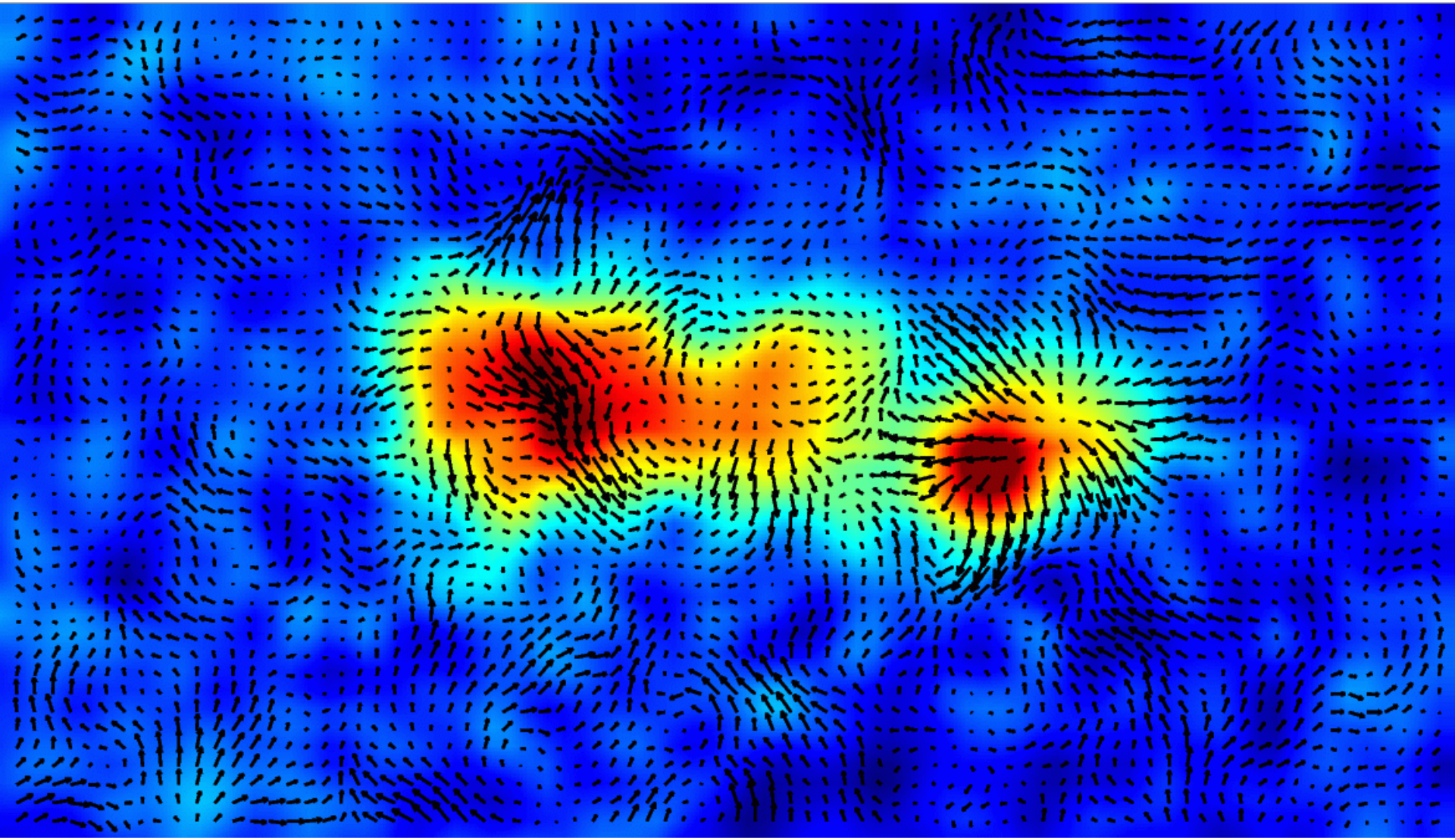
Inverted Wave-Speed and Velocities in the Active Region (0-1 Mm)



Inverted Wave-Speed and Velocities in the Active Region (1-3 Mm)

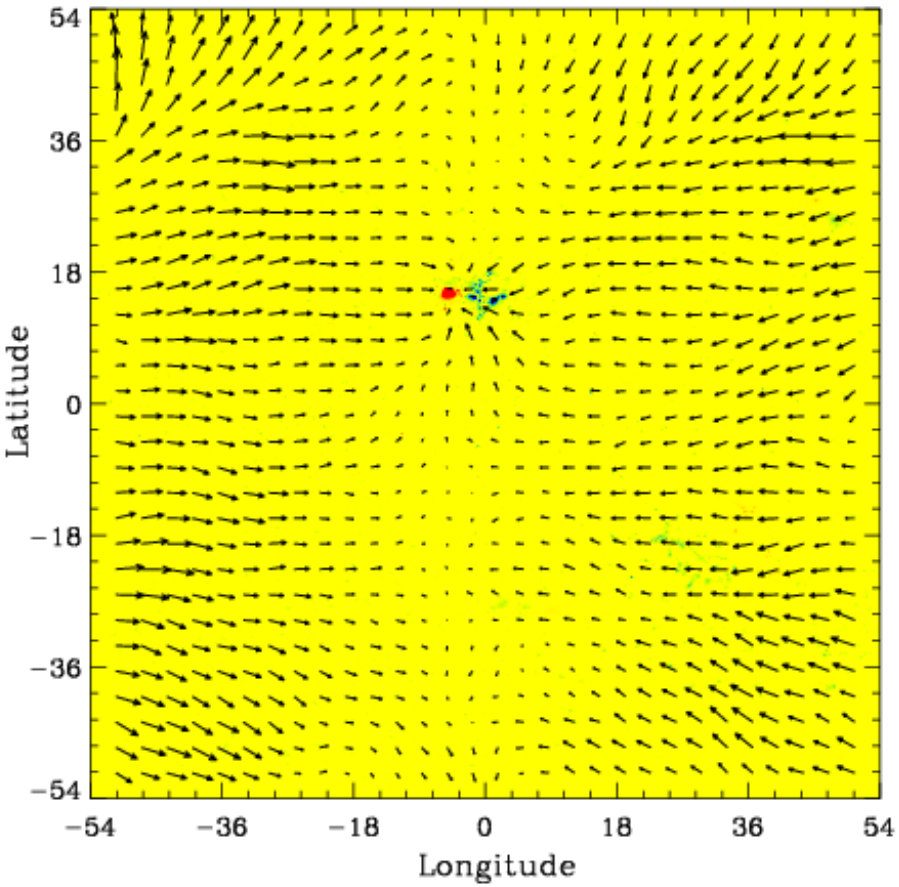


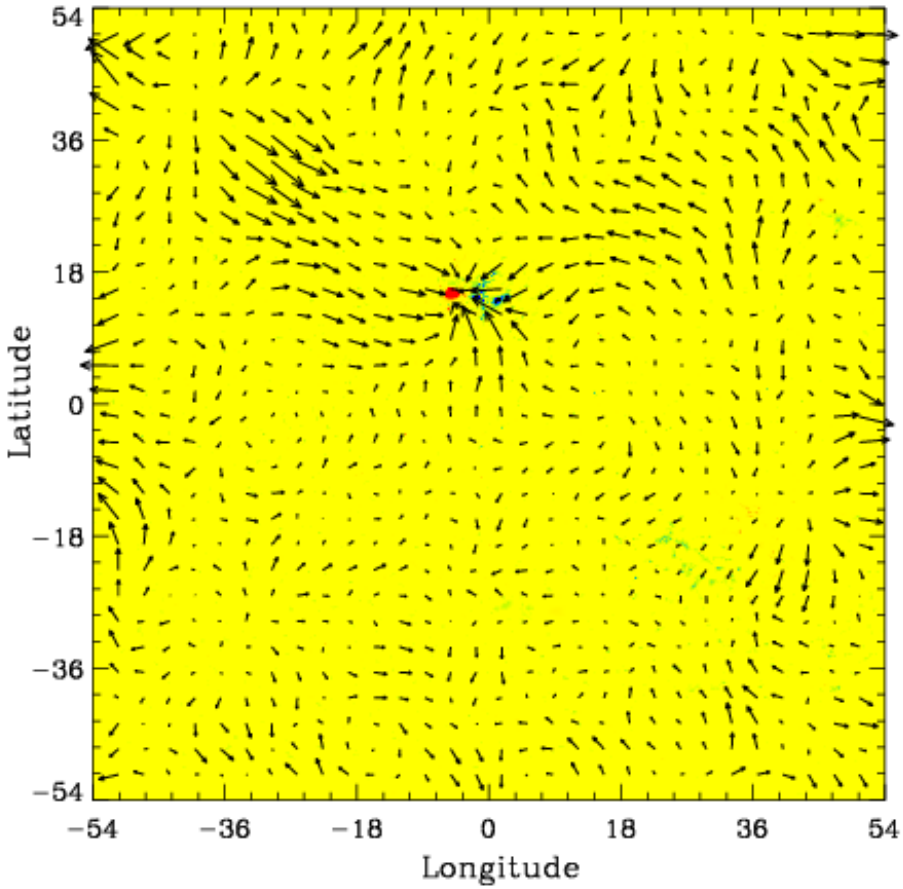
Inverted Wave-Speed and Velocities in the Active Region (3-5 Mm)



Things are not that rosy if we bin down the flows to see only the full-disk large scale flow fields.

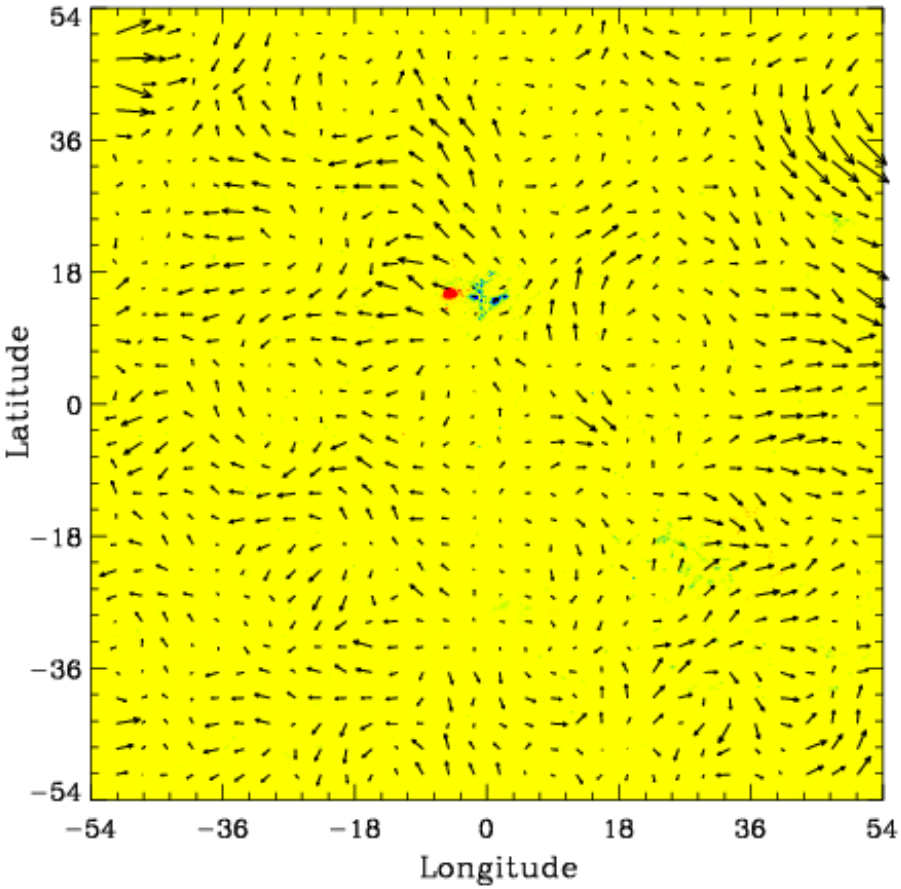
Full-Disk Large Scale Flows (0-1 Mm)

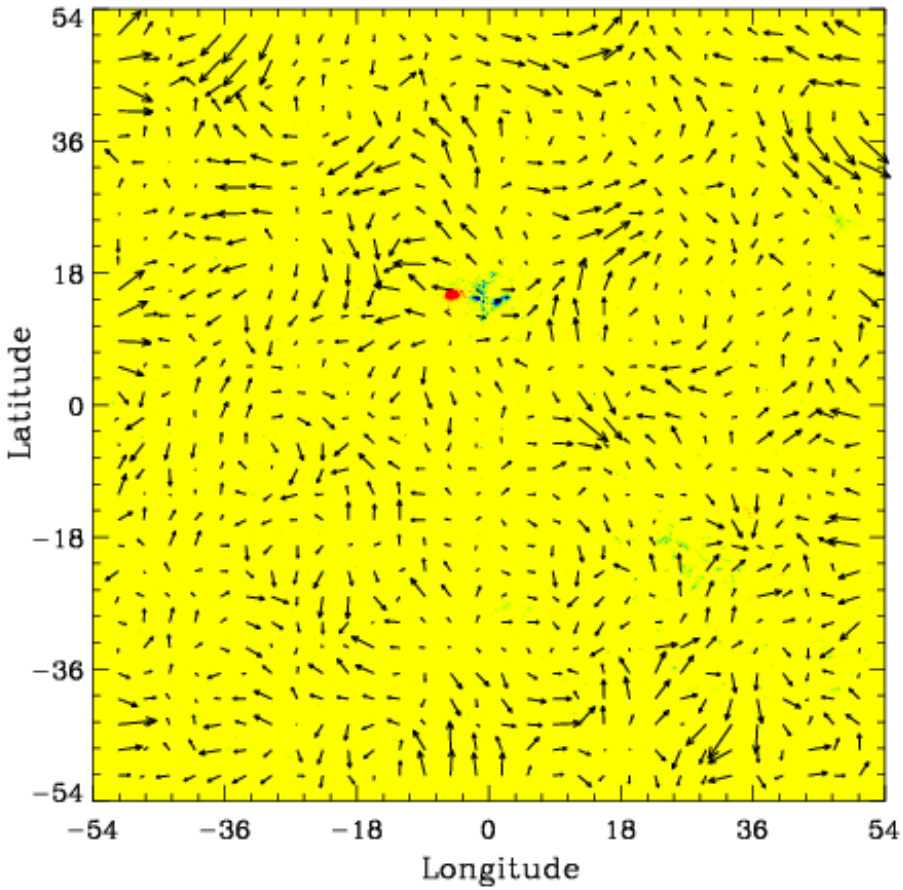




After a fit of background was removed.

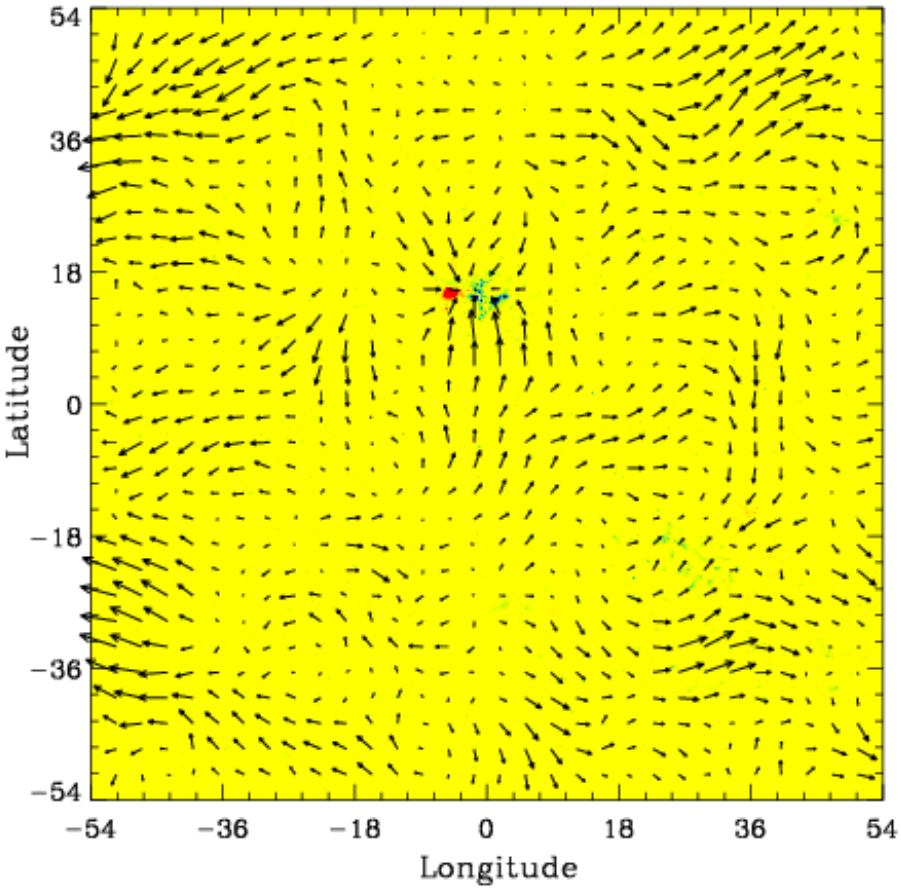
Full-Disk Large Scale Flows (1-3 Mm)

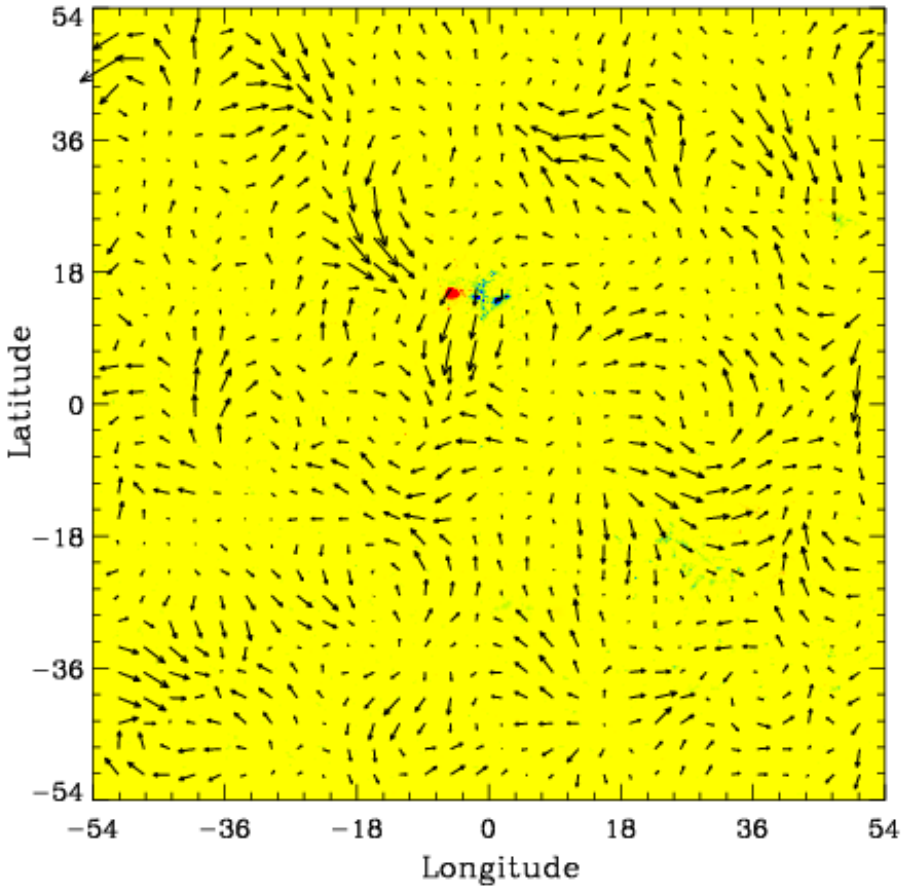




After a fit of background was removed.

Full-Disk Large Scale Flows (3-5 Mm)

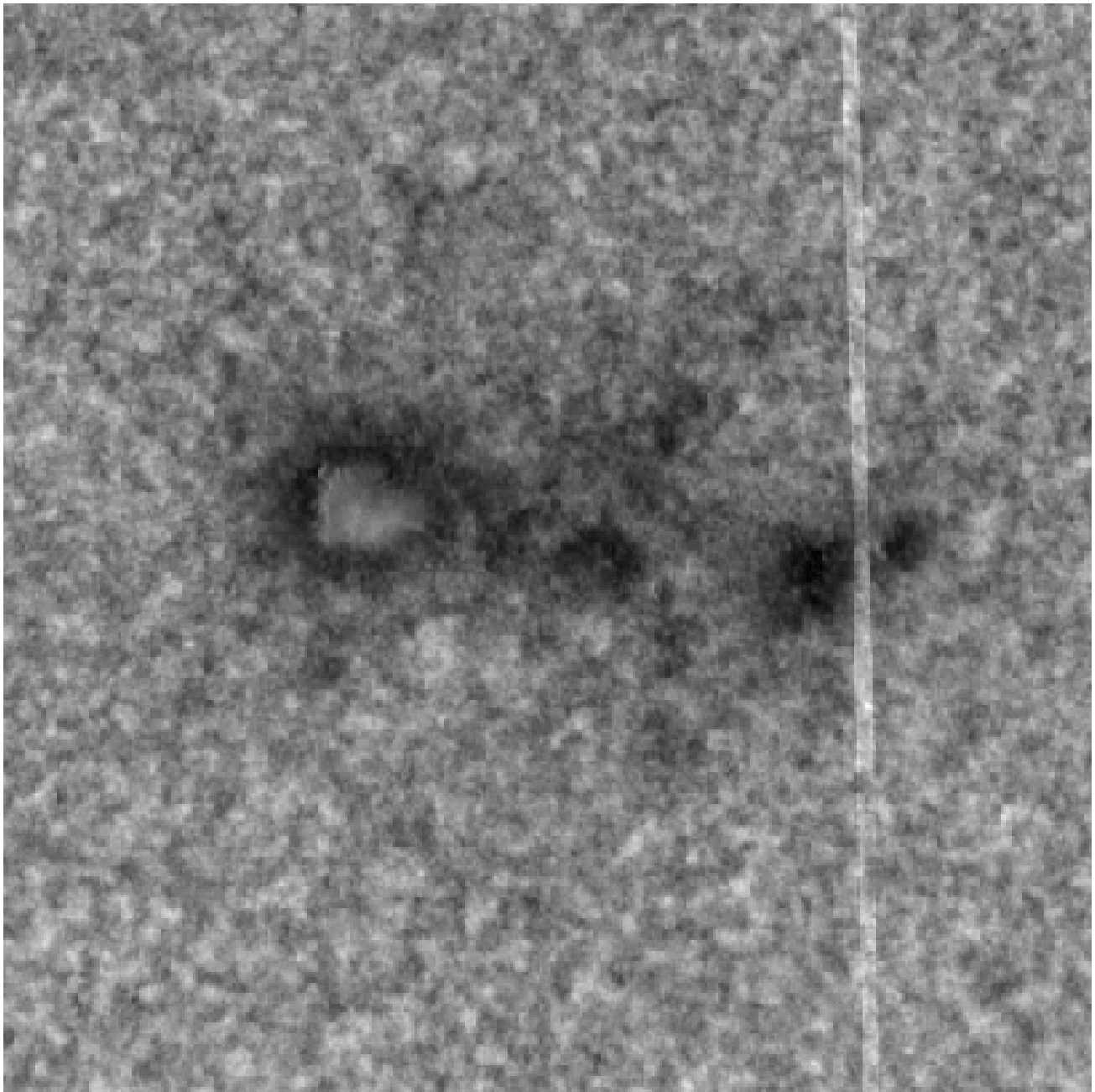




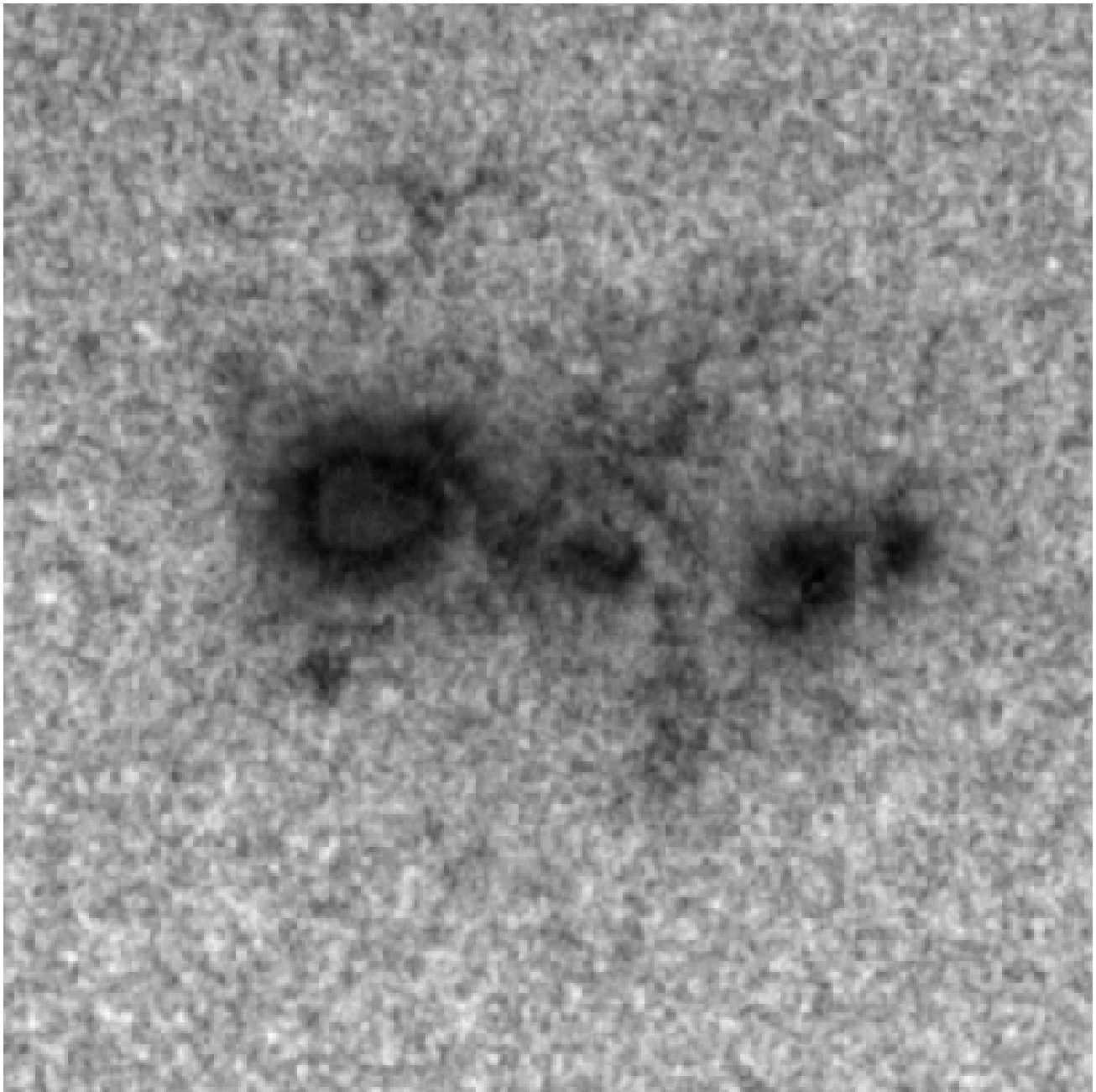
After a fit of background was removed.

Doppler velocity inside sunspot is not well calibrated

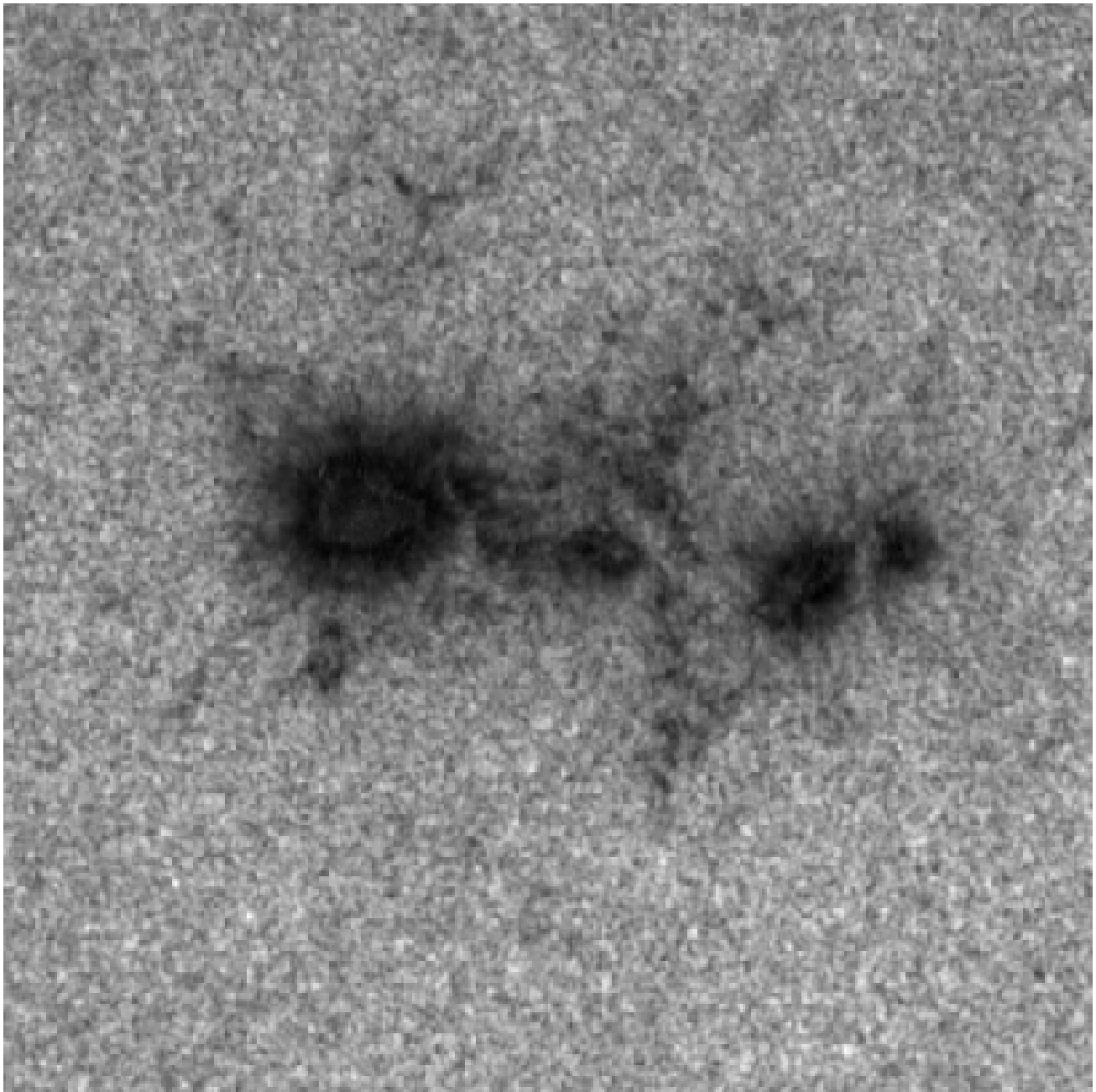
Power Map: 2.0 – 3.0 mHz



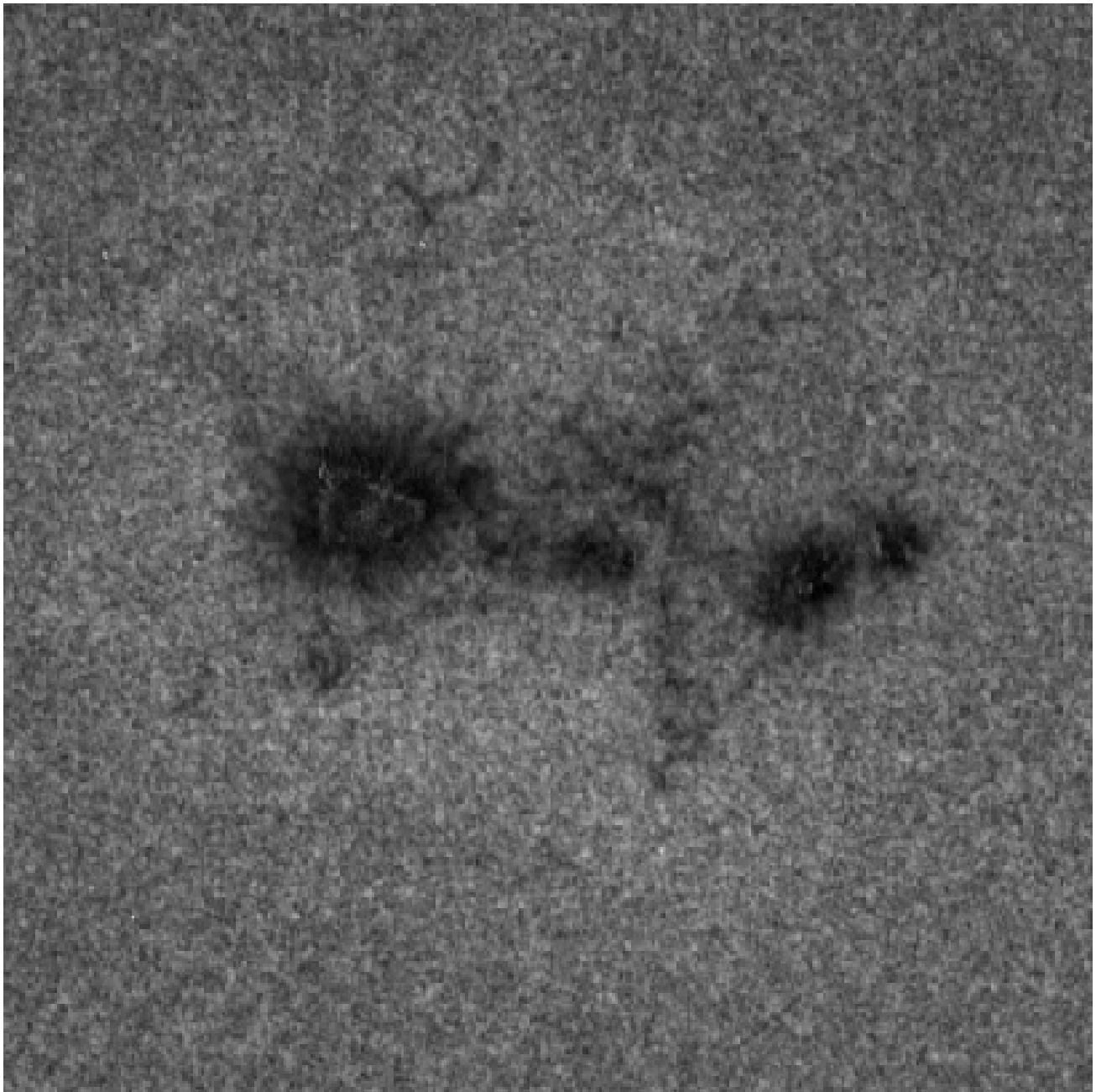
Power Map: 3.0 – 4.0 mHz



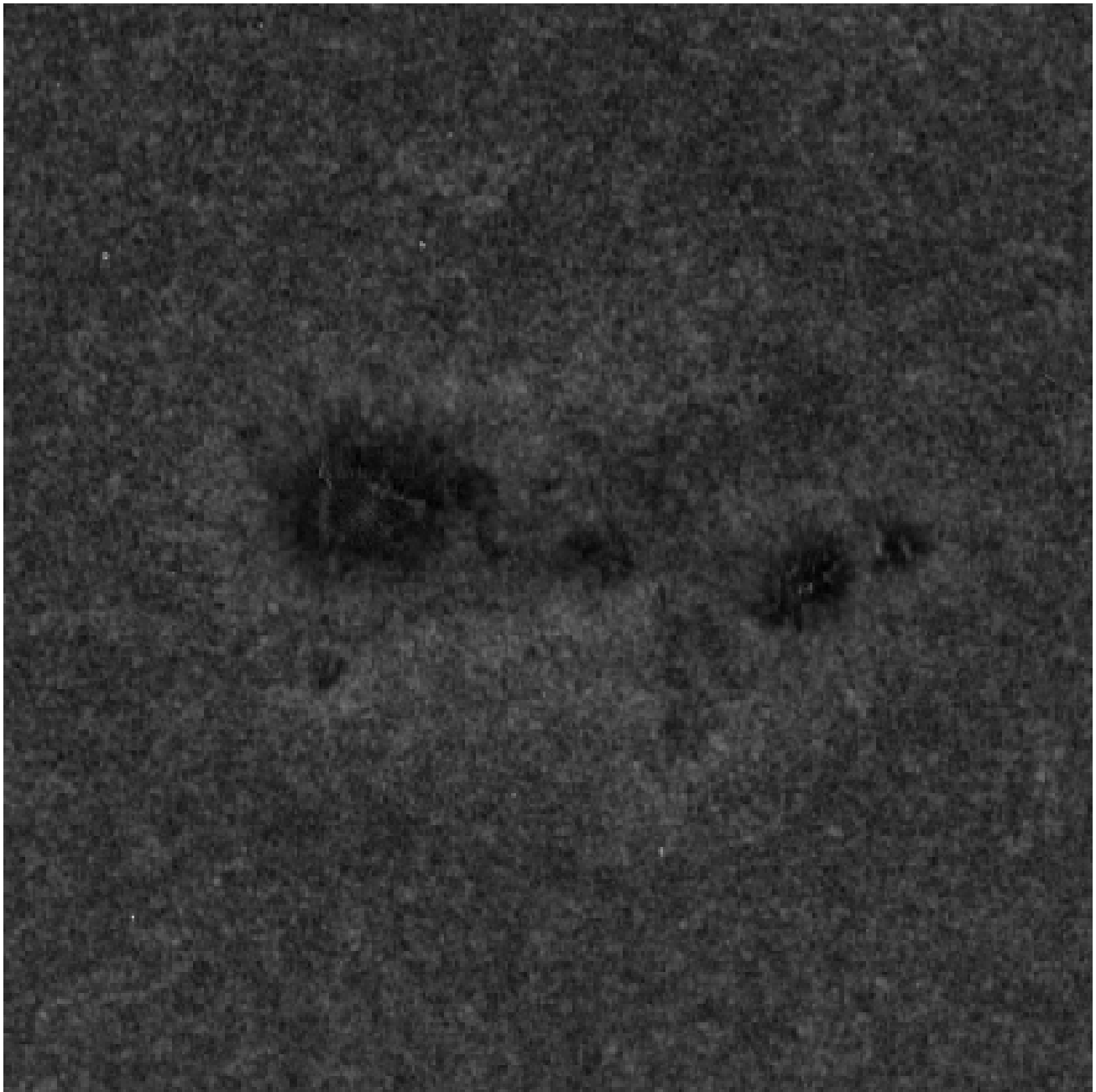
Power Map: 4.0 – 5.0 mHz



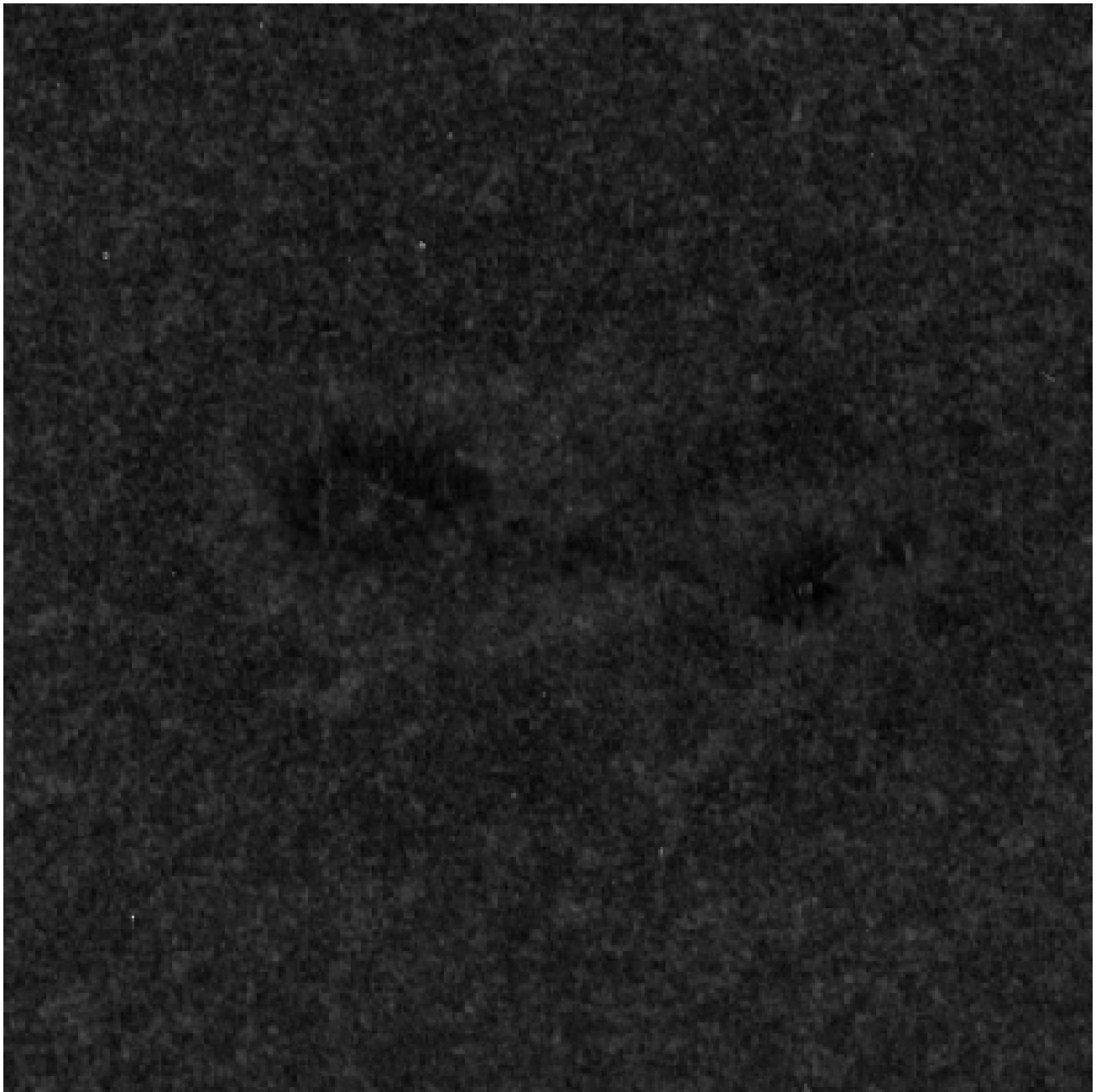
Power Map: 5.0 – 6.0 mHz



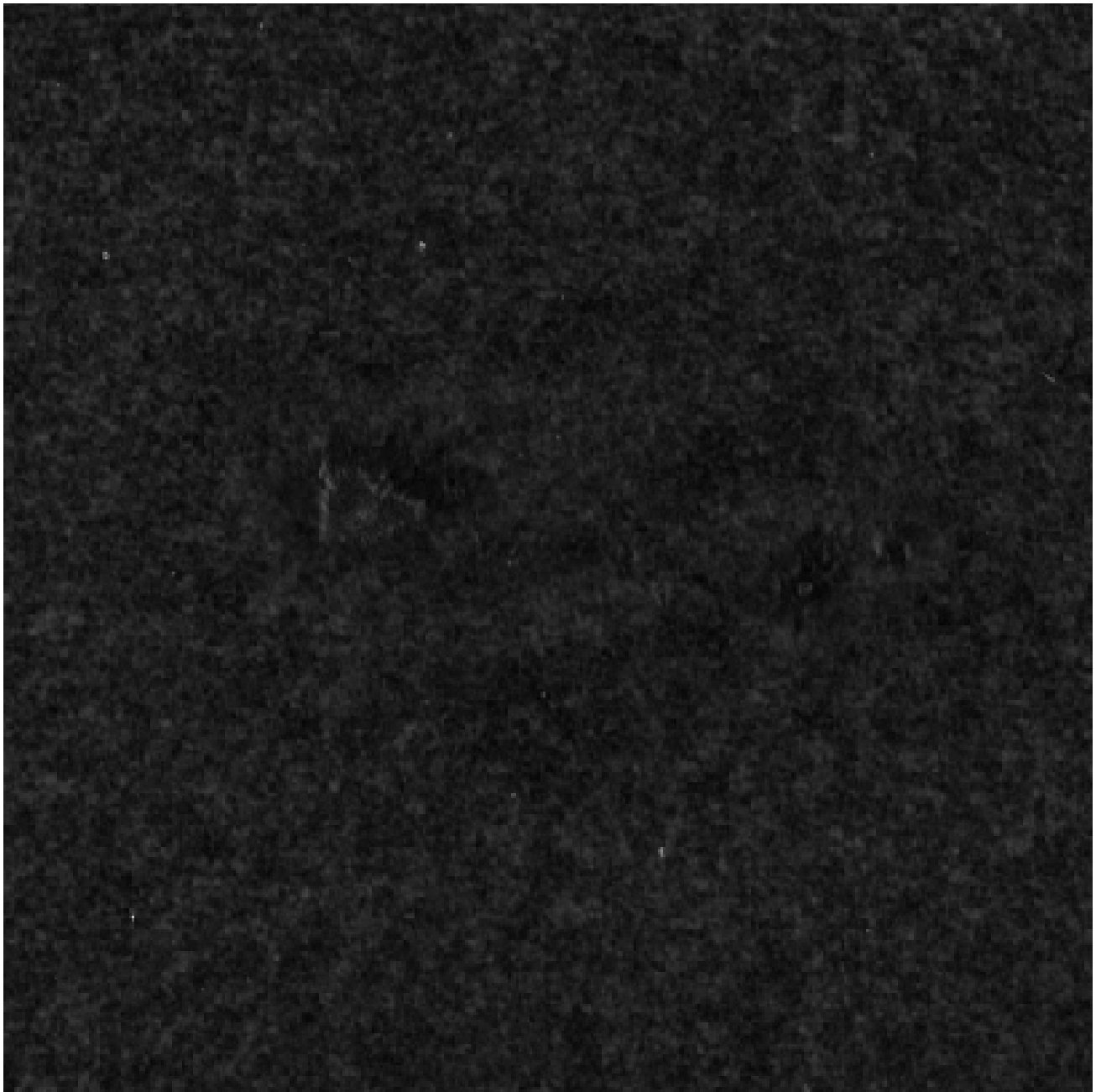
Power Map: 6.0 – 7.0 mHz



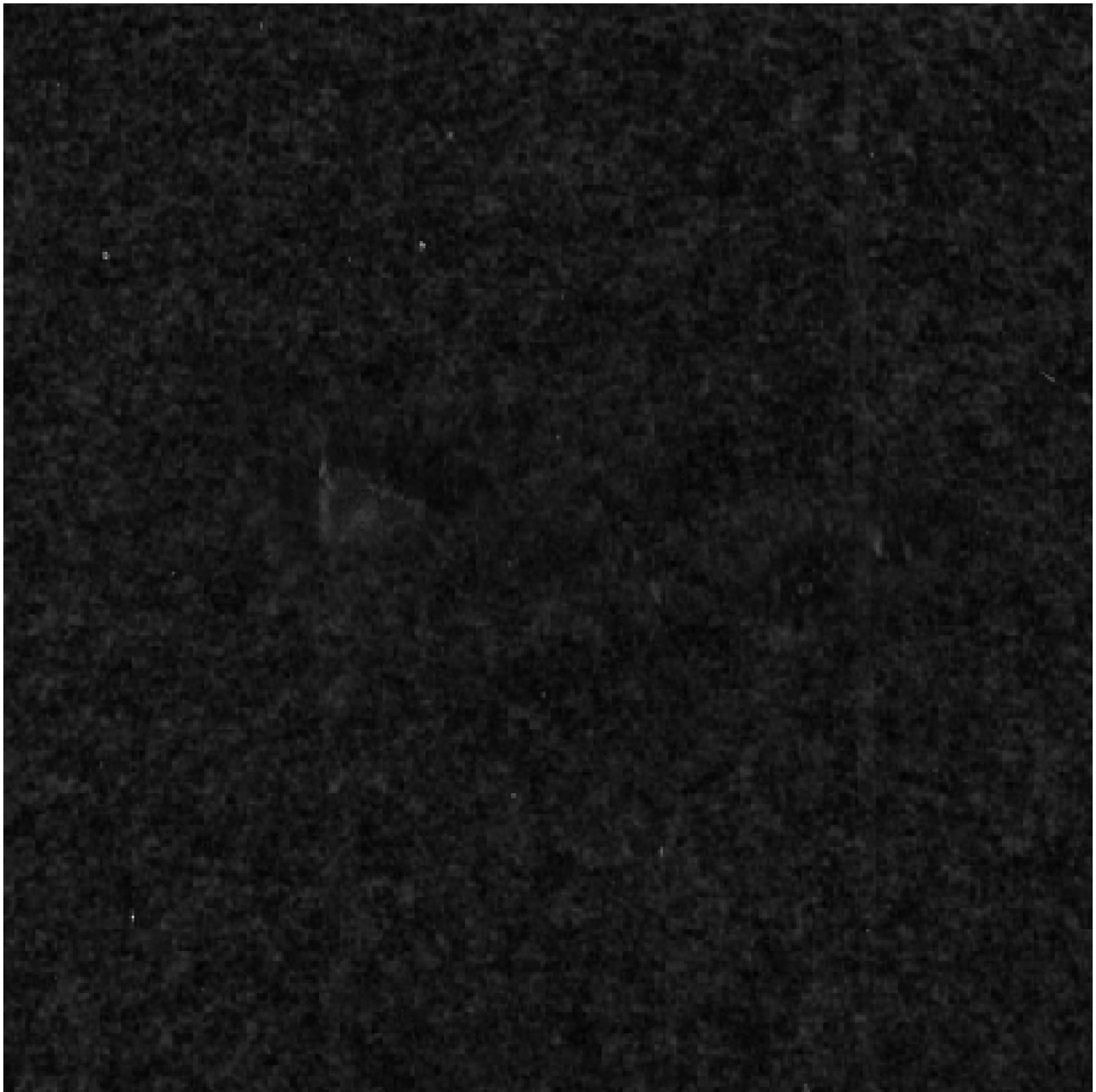
Power Map: 7.0 – 8.0 mHz



Power Map: 8.0 – 9.0 mHz



Power Map: 9.0 – 10.0 mHz



Conclusion

- Time-distance diagram shows HMI data are about the same quality as MDI high-res observations.

- Local scale wave-speed perturbation and flow fields results seem consistent with MDI full-disk results (I will show these results tomorrow or the day after).

- Large scale flow fields (after binning down local scales) show some systematic flows. Seems everything flow toward the disk center for shallow depths. This is not true in deeper areas, though.

- Power maps of sunspots areas show that calibration inside sunspots are not good yet.