

# Potential Bias in Recorded Ground Motions

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## **Question:**

Are ground motions recorded from recent large magnitude, non-California EQs (Izmit, Chi-Chi, Denali) representative of these types of events or do they have systematic bias?

## **Approach:**

Use numerical simulations to generate broadband ground motions on a dense grid of sites covering the near-fault region of these events.

- 1) Can the simulations reproduced the recorded motions?
- 2) Do the simulations suggest any systematic bias in these events or in the recorded motions?

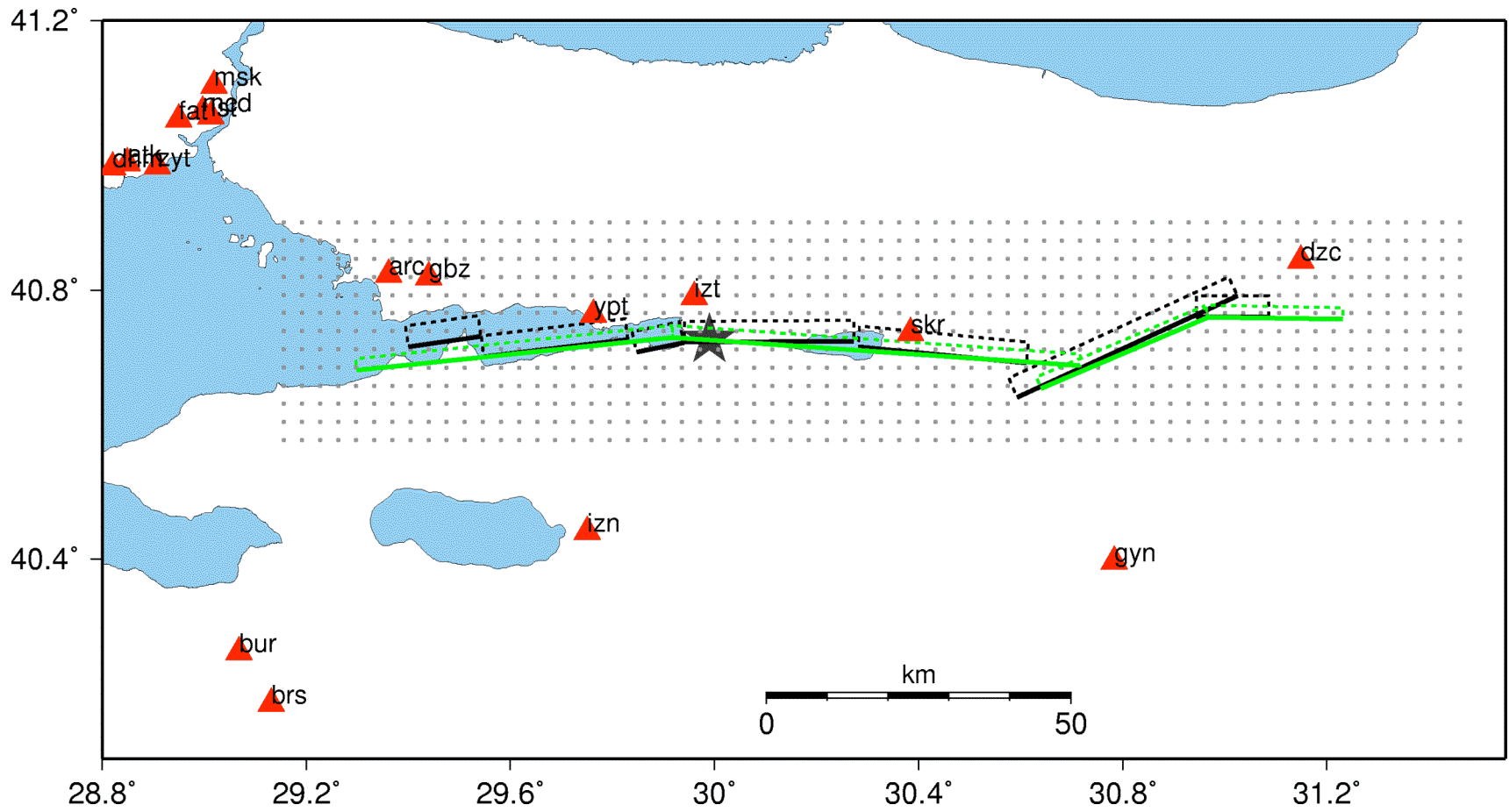
# Application to 1999 Mw 7.4 Izmit, Turkey earthquake (preliminary results)

**Broadband Simulation Methodology:** Graves and Pitarka (2004)

**Source Rupture Models:** Delouis et al (2002)  
Thio et al (2004)  
Sekiguchi et al (2004)

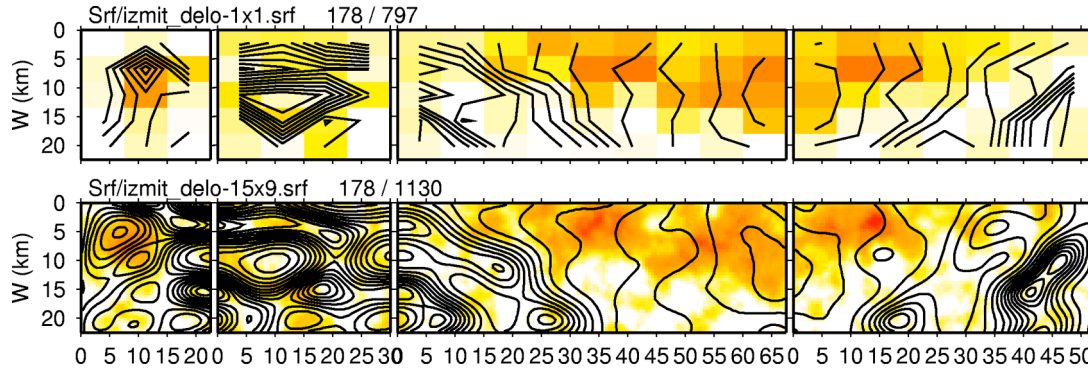
**Recording sites:** 5 sites < 20 km  
18 sites < 80 km

**Ground Motion Characteristics:** relatively low short period level  
strong rupture directivity

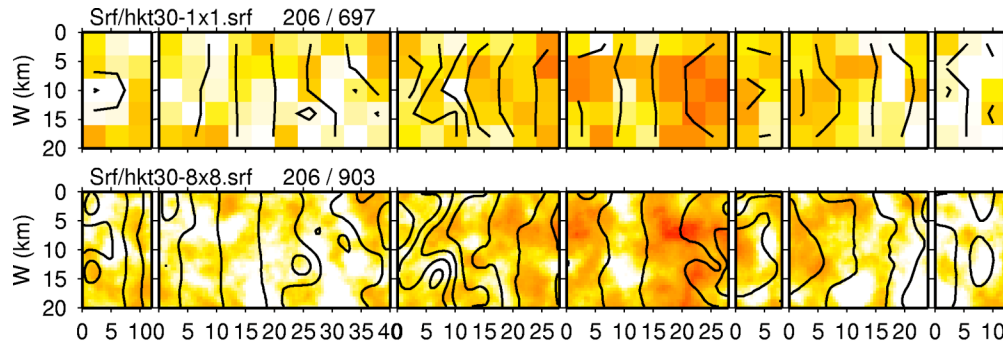
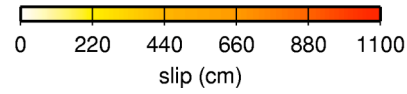


**EAST**

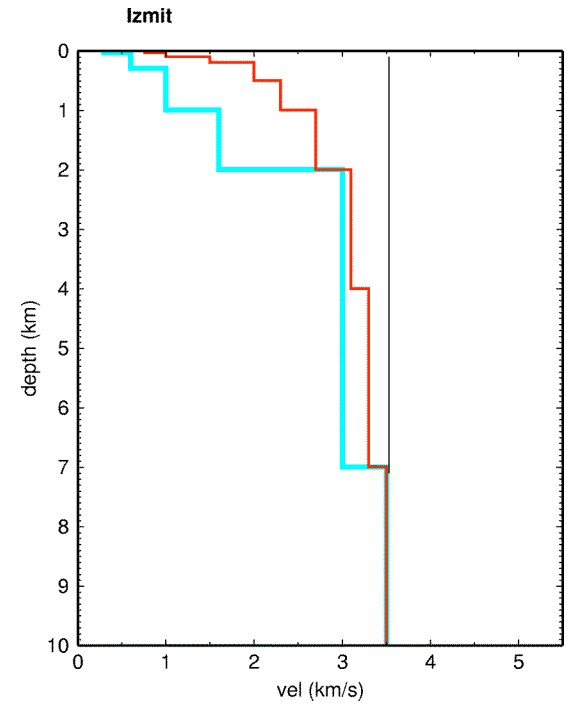
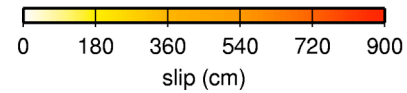
**WEST**



**DeLouis**

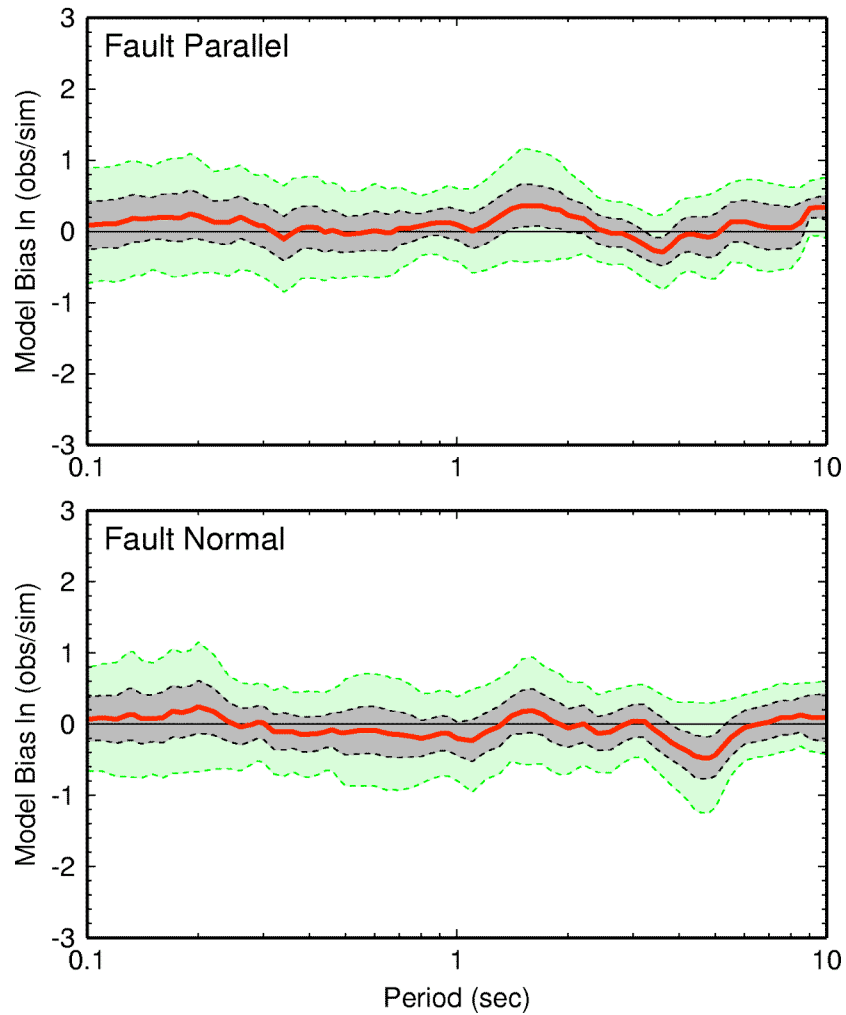


**Thio**



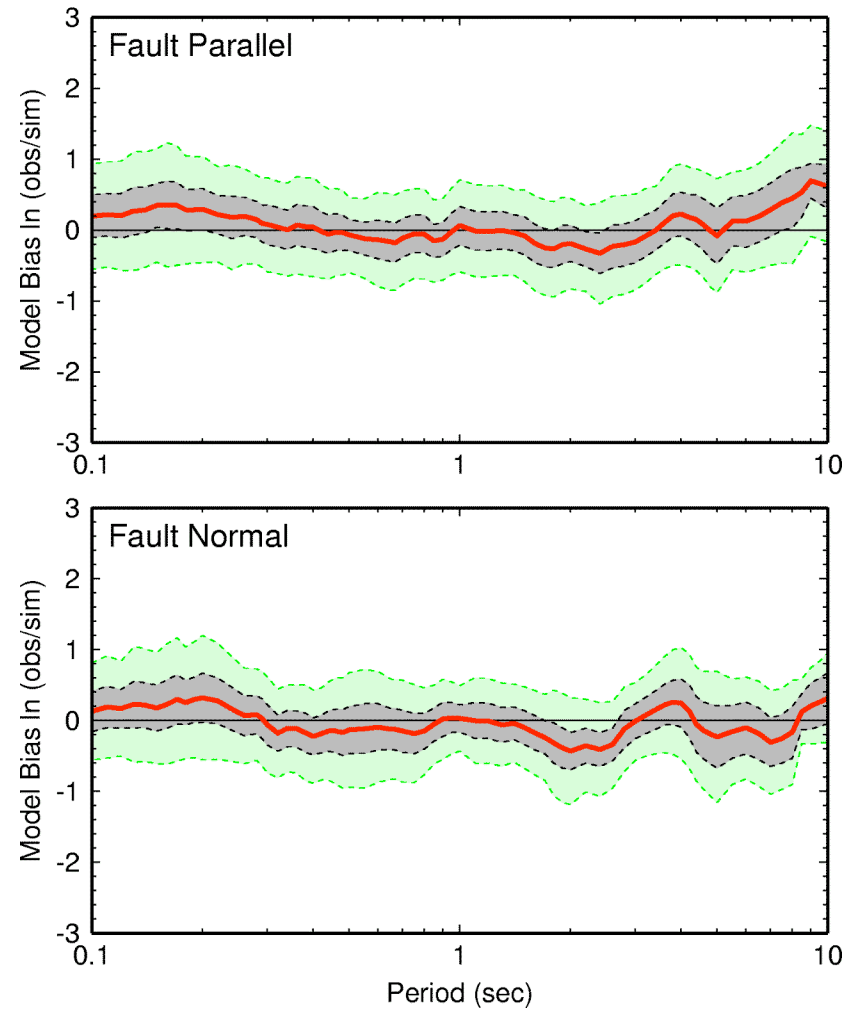
# DeLouis

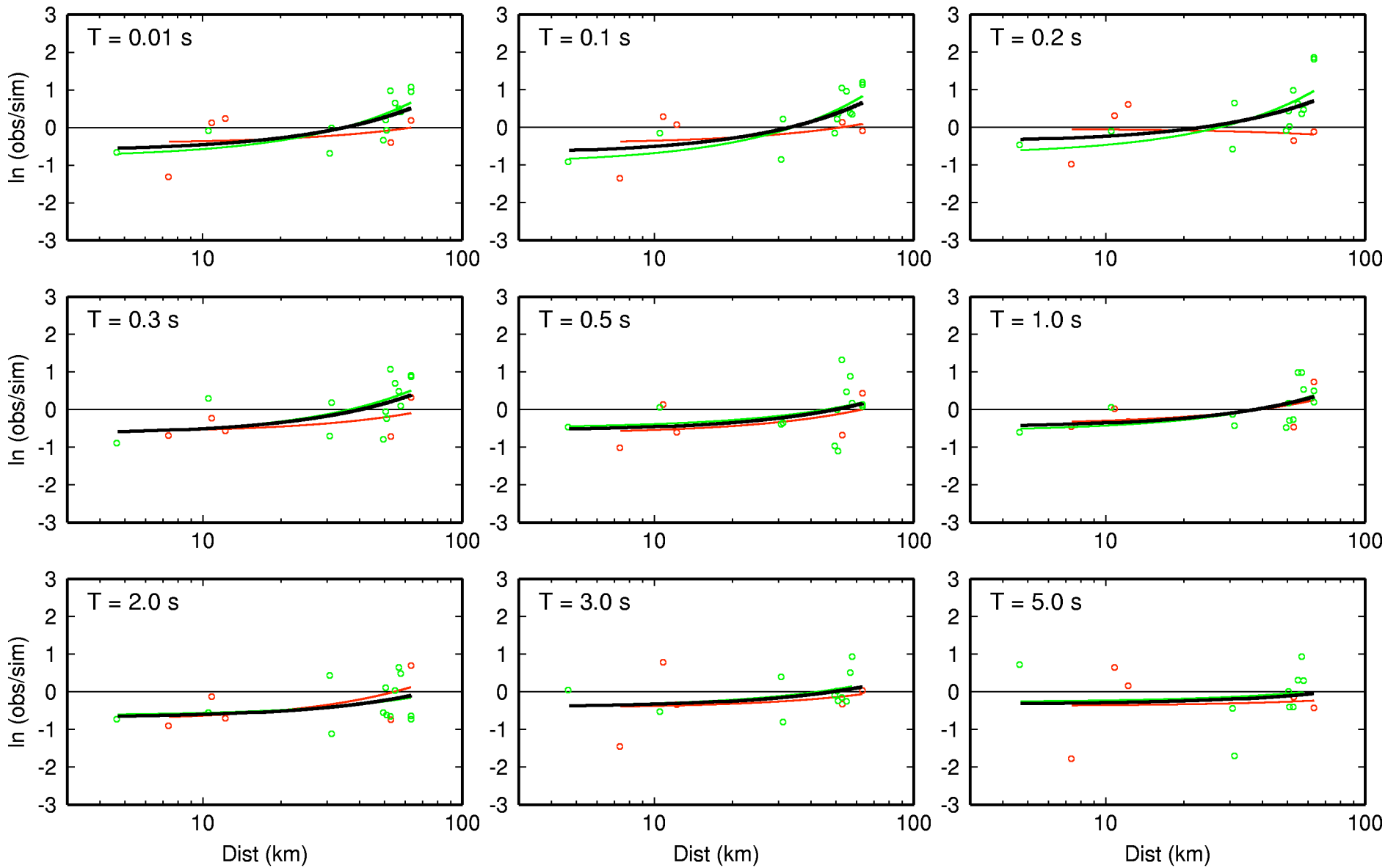
Izmit:  $R < 500$  km (18 sites)



# Thio

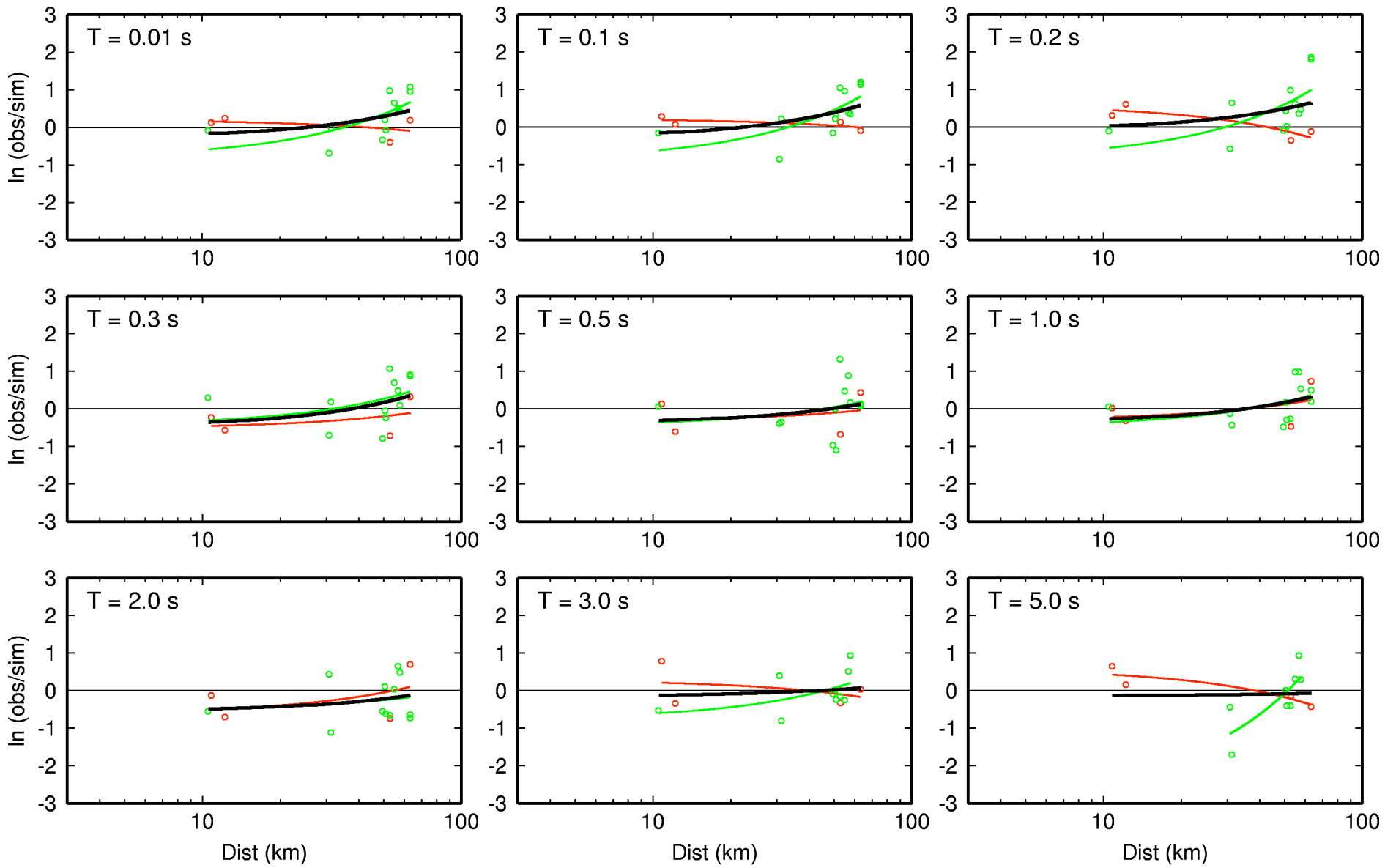
Izmit:  $R < 500$  km (18 sites)





- Vs30 > 500 m/s
- Vs30 < 500 m/s

izmit\_T-urs01\_nga: avgh

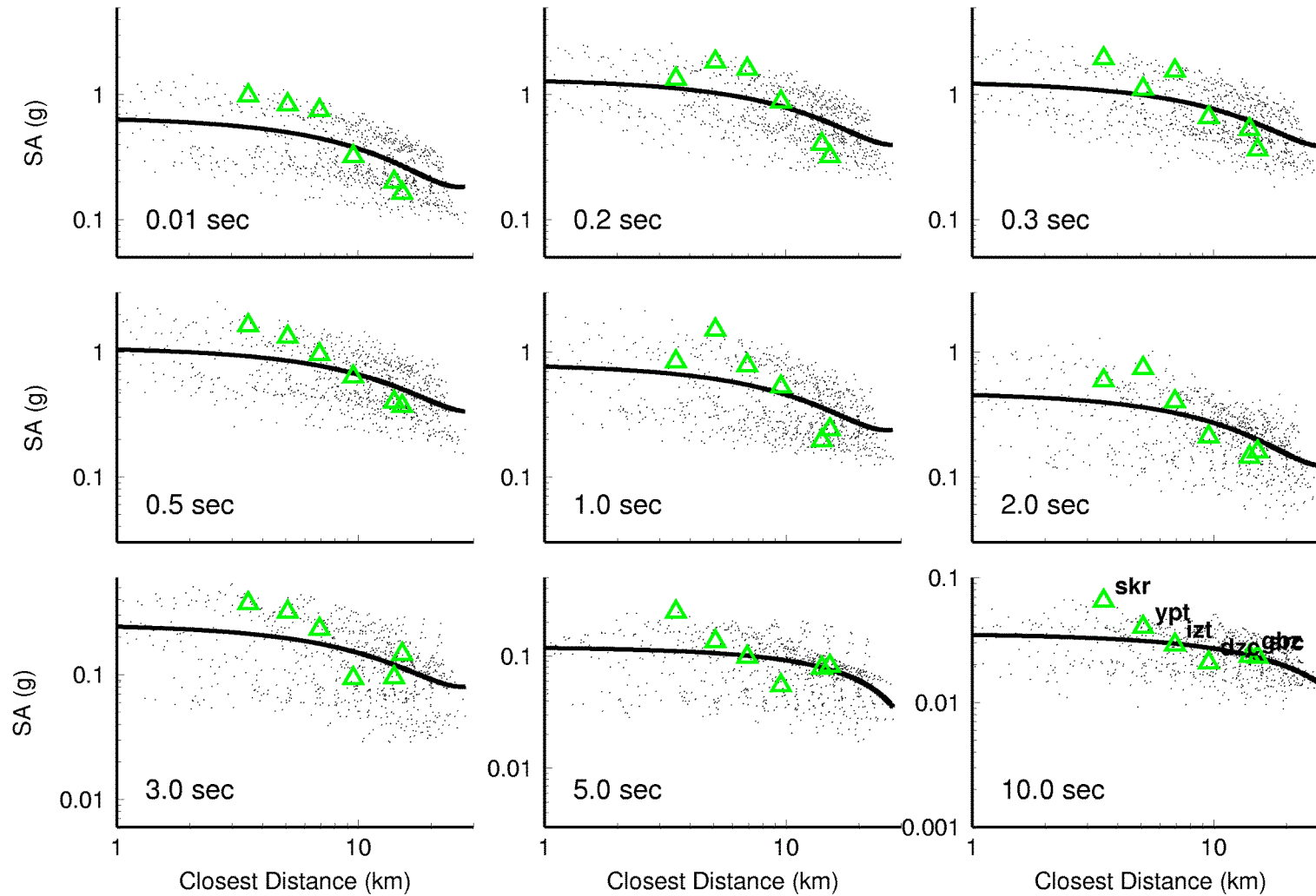


- Vs30 > 500 m/s
- Vs30 < 500 m/s

**izmit\_T-urs01\_nga: avgh**

# izmit\_delo-15x9 - Average Horizontal

- Simulations at 3x3km Grid Points
- Least Squares Fit to Grid Points
- △ RspSpec of Simulation of Recording

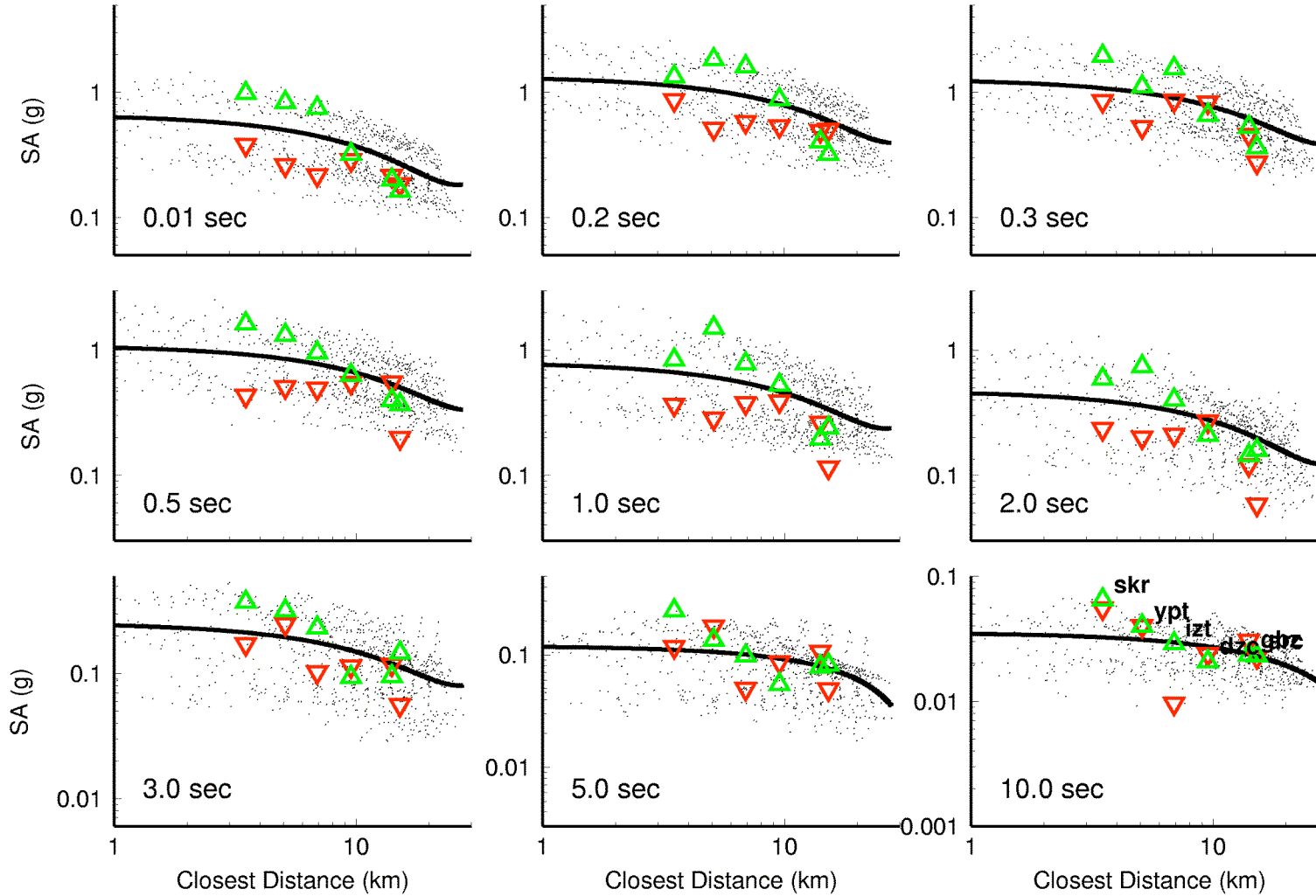


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# izmit\_delo-15x9 - Average Horizontal

- Simulations at 3x3km Grid Points
- Least Squares Fit to Grid Points
- △ RspSpec of Simulation of Recording
- ▽ RspSpec of Recording



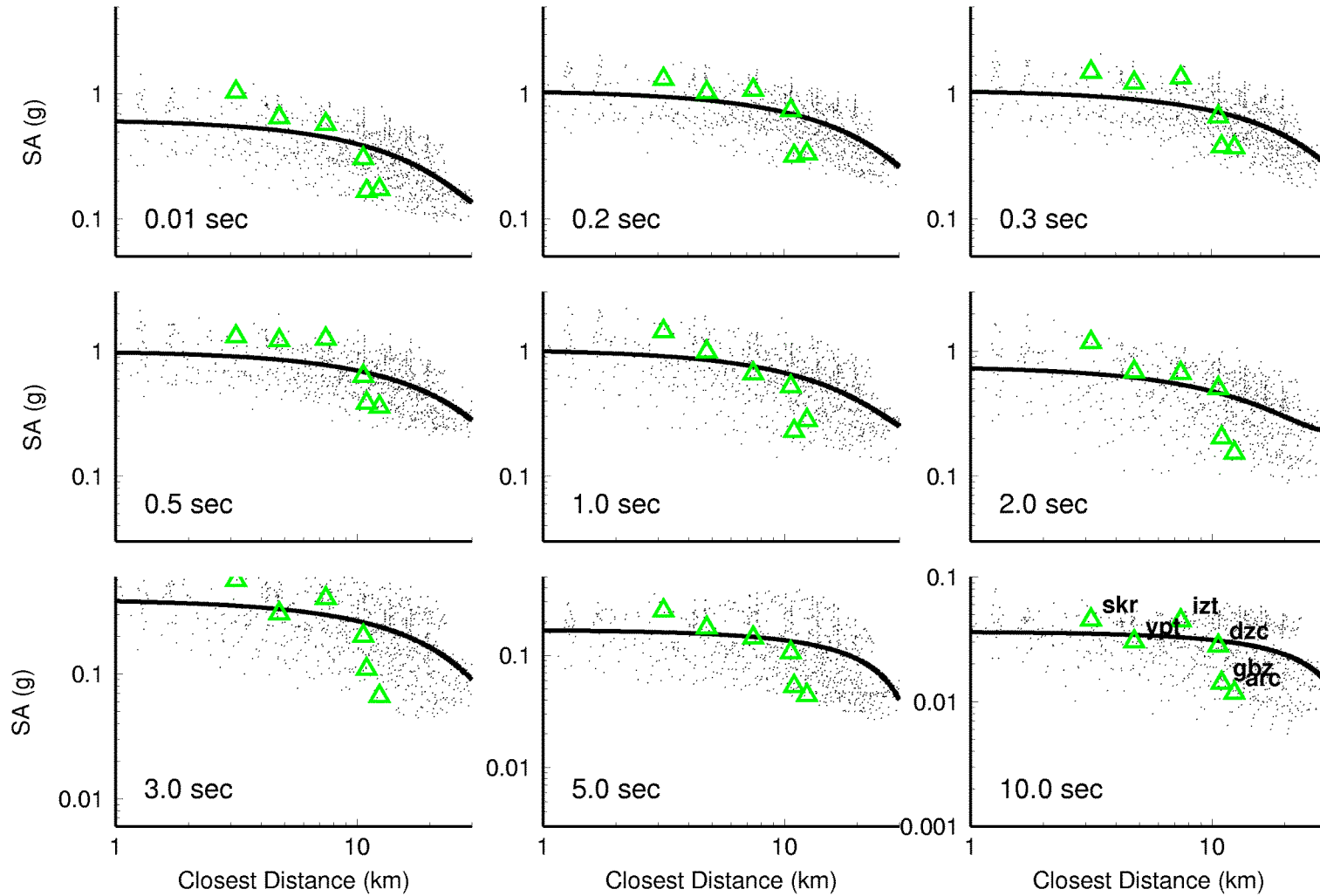
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# Summary of Preliminary Results

- Broadband simulations can reproduce the general level of the recorded ground motions at most sites for the Izmit EQ using both the DeLouis and Thio rupture models (**event looks like California EQ**)
- Simulations on dense grid of sites do not indicate any systematic bias in the locations of recording sites in terms of the ground motion response
- Simulations with both rupture models overpredict the ground motion level at the nearest sites along the fault in the epicentral region (**ypt, izt**), particularly at the shorter periods (**highest slip in rupture models occurs here**)
- Larger simulated response at **ypt** and **izt** could be due to several factors, including inappropriate site characterization, unmodeled wave propagation effects (e.g., 3D), and poorly constrained short period source radiation in the rupture models (source inversions use only long period data)

# izmit\_thio-8x8 - Average Horizontal

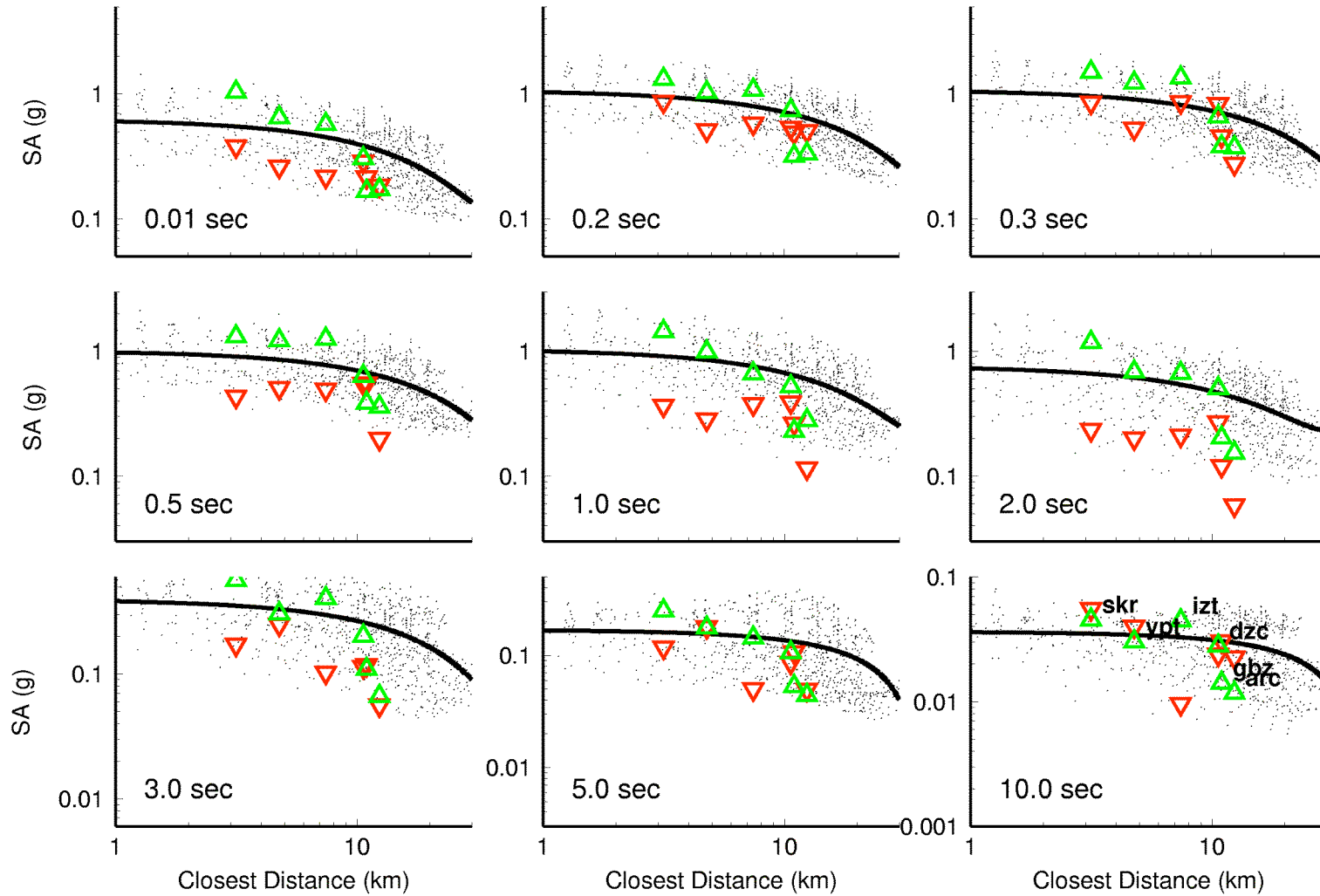
- Simulations at 3x3km Grid Points
- Least Squares Fit to Grid Points
- △ RspSpec of Simulation of Recording



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# izmit\_thio-8x8 - Average Horizontal

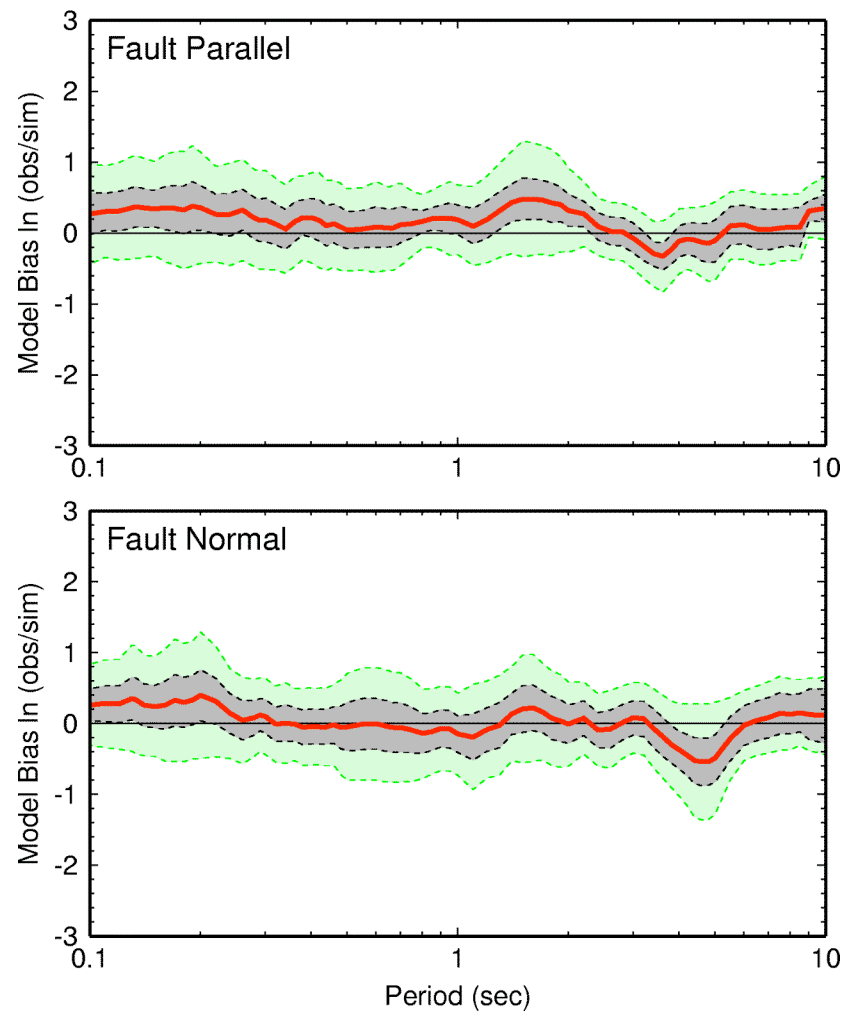
- Simulations at 3x3km Grid Points
- Least Squares Fit to Grid Points
- ▲ RspSpec of Simulation of Recording
- ▼ RspSpec of Recording



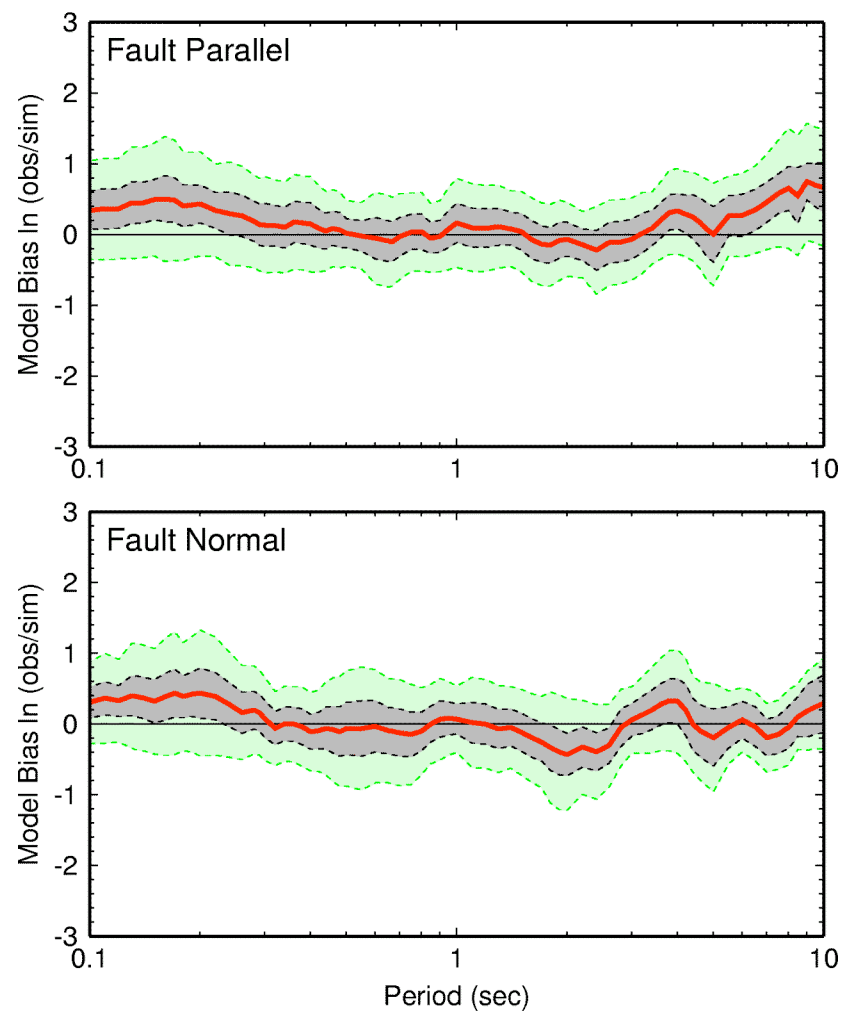
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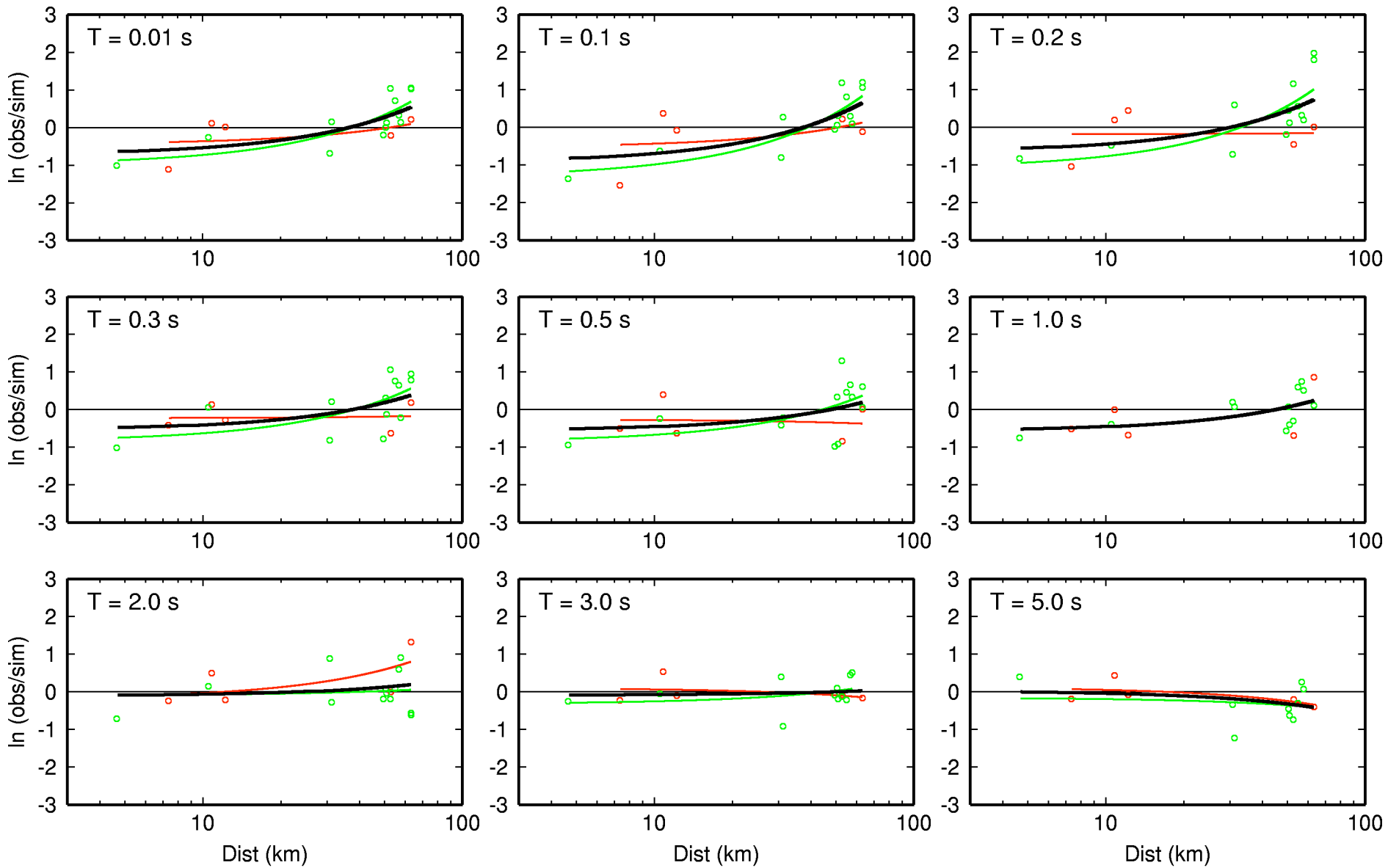


Izmit: R > 10 km (16 sites)



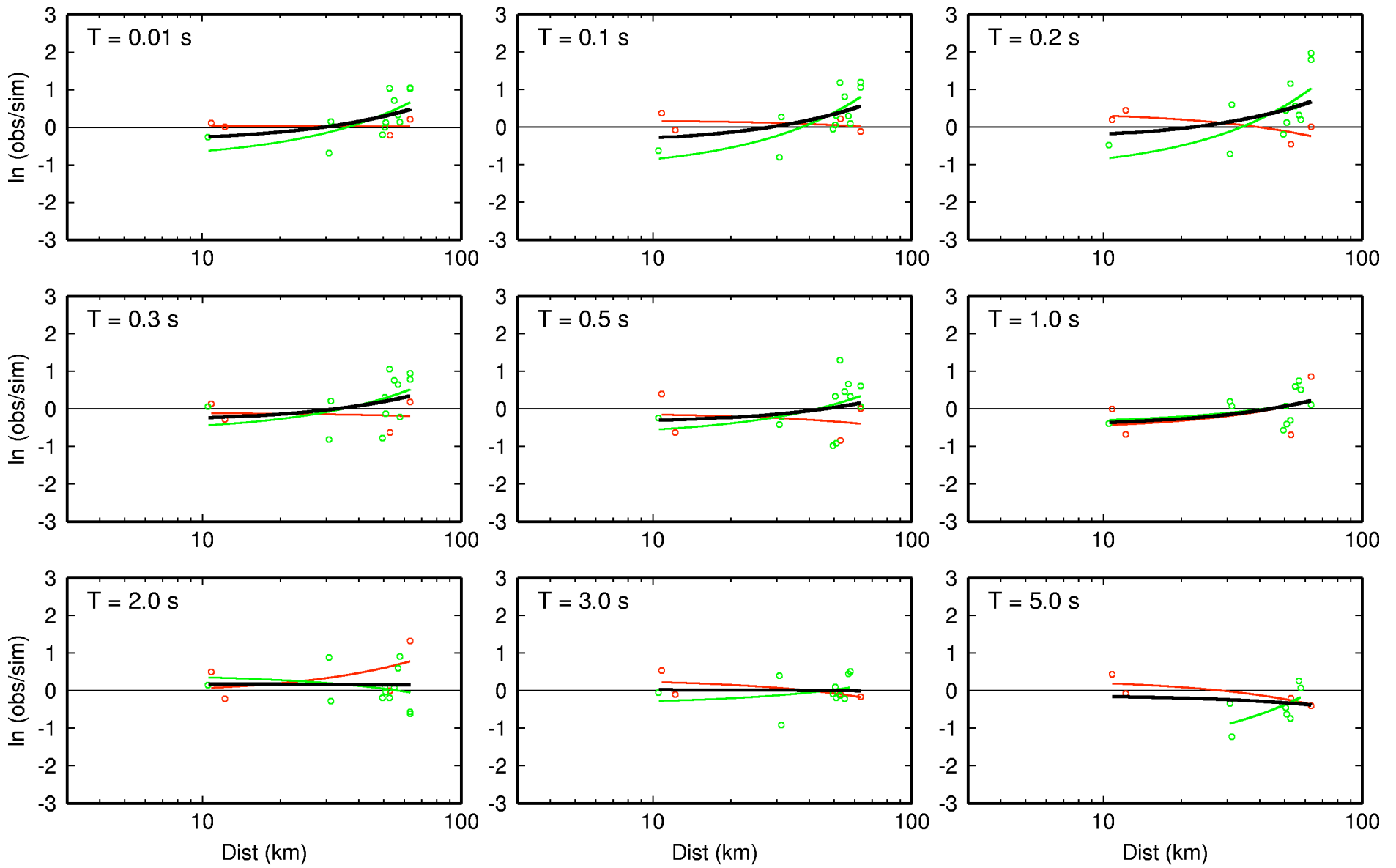
Izmit: R > 10 km (16 sites)





- $V_{s30} > 500 \text{ m/s}$
- $V_{s30} < 500 \text{ m/s}$

**izmit\_D-urs01\_nga: avgh**



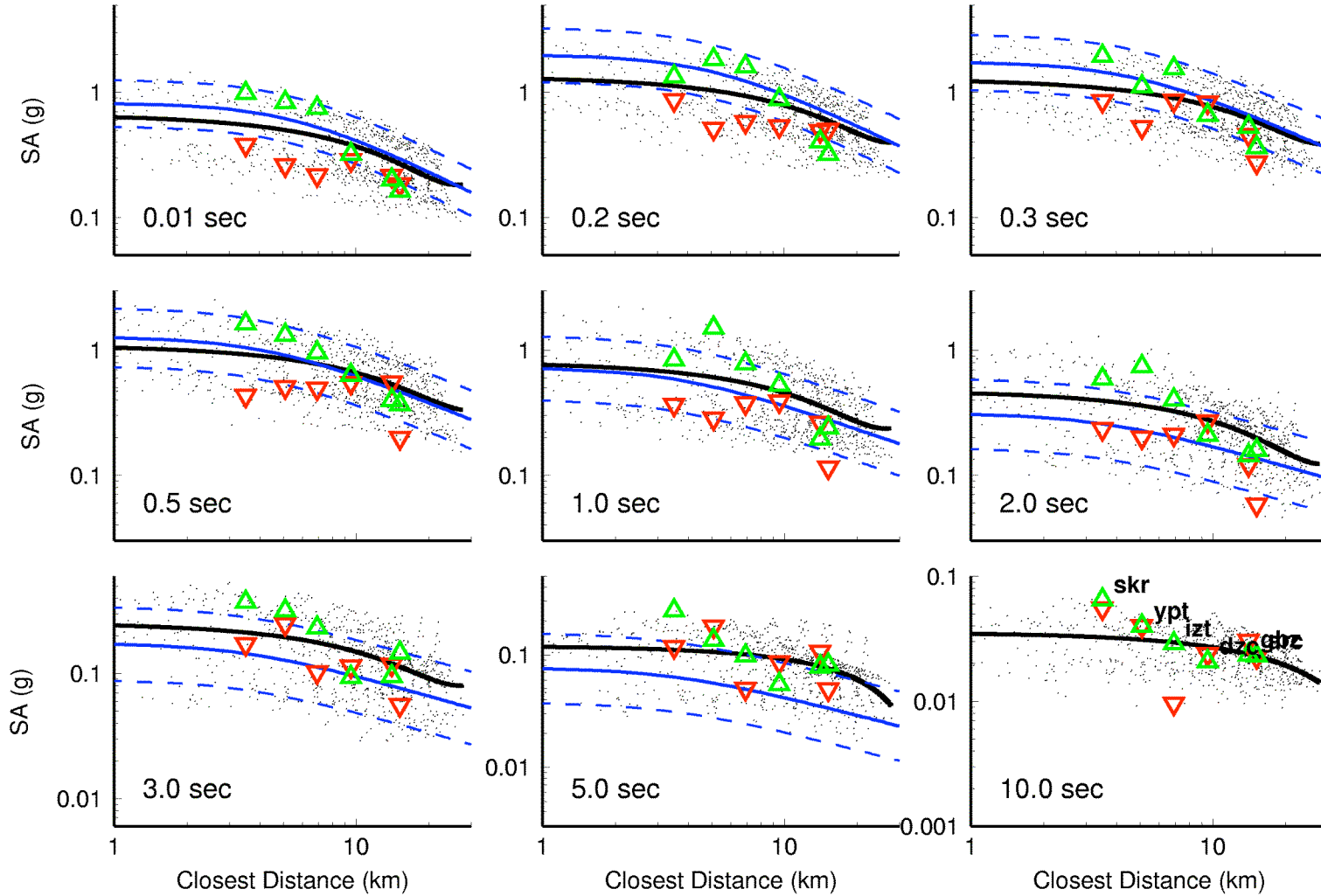
- Vs30 > 500 m/s
- Vs30 < 500 m/s

**izmit\_D-urs01\_nga: avgh**



# izmit\_delo-15x9 - Average Horizontal

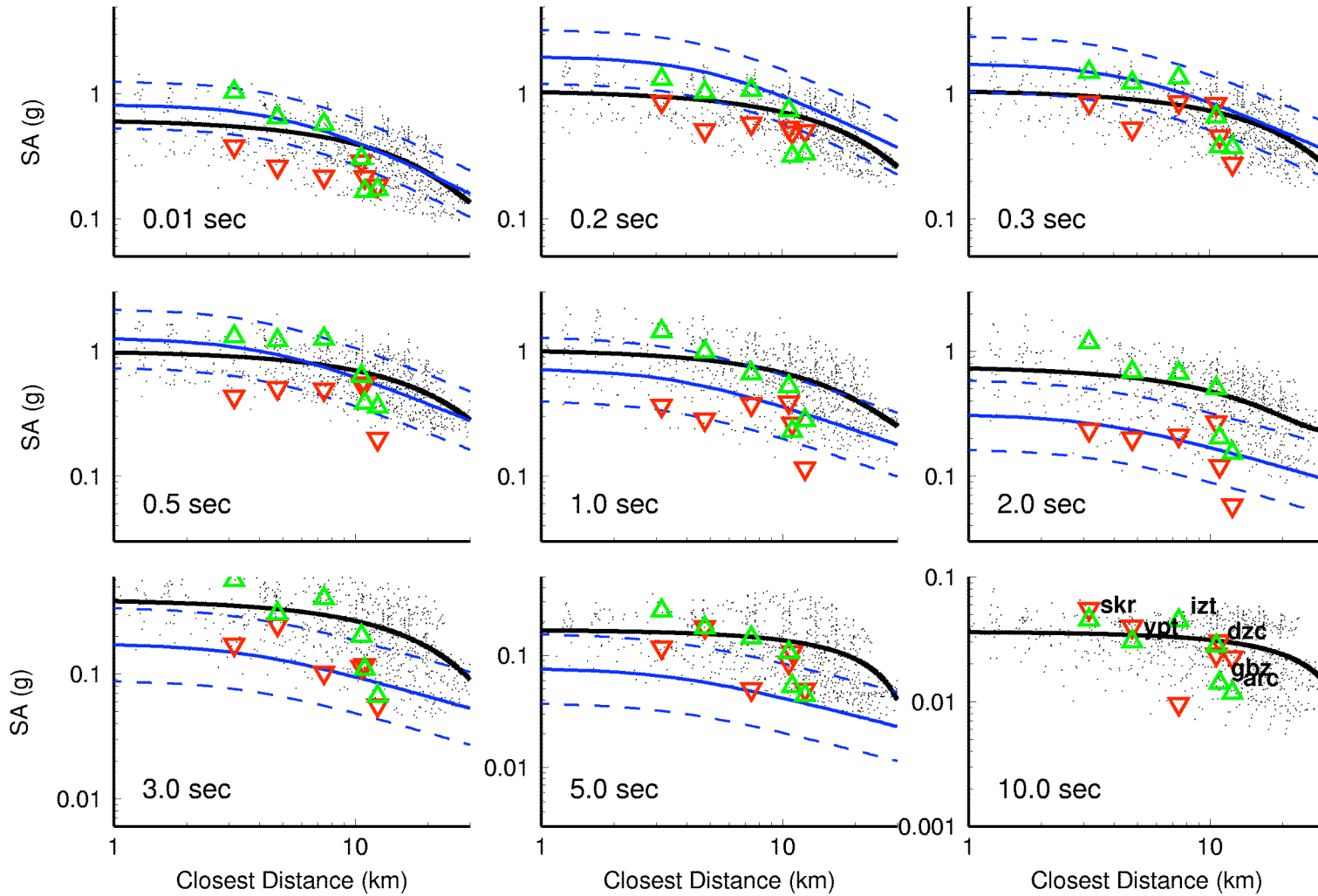
- Simulations at 3x3km Grid Points
- Least Squares Fit to Grid Points
- △ RspSpec of Simulation of Recording
- ▽ RspSpec of Recording
- AS97 (SS,Rock,Not HW,Mw7.4)



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# izmit\_thio-8x8 - Average Horizontal

- Simulations at 3x3km Grid Points
- Least Squares Fit to Grid Points
- ▲ RspSpec of Simulation of Recording
- ▼ RspSpec of Recording
- AS97 (SS,Rock,Not HW,Mw7.4)



GMT 2006 Sep 22 15:55:49 /u1/nancy/USGS\_NearFault.2006/izmit/Analysis/gmt\_cd-sa\_9pp.csh-PlotFiles/cd\_sa\_izmit\_thio-8x8\_avg\_3.ps