Supplement of Solid Earth, 10, 1555–1579, 2019
https://doi.org/10.5194/se-10-1555-2019-supplement

Solid Earth
Open Access

Supplement of

From mapped faults to fault-length earthquake magnitude (FLEM): a test on Italy with methodological implications

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1 Additional supporting information (Files uploaded separately)

Dataset-S1-ItalianFaults.kmz
Dataset-S2-Selected_ITHACA_faults.txt
Dataset-S3-Selected_GNTD_faults.txt
Dataset-S4-Selected_StructuralModel_faults.txt
Dataset-S5-Selected_GeologicMap_faults.txt
Dataset-S6-Selected_literature_faults.txt

2 Additional supporting figures

FigureS1
FigureS2
FigureS3

3 Additional supporting figures

TableS1
TableS2

4 Introduction

Dataset-S1-ItalianFaults.kmz. Compressed file (to be opened in Google Earth) containing georeferenced traces from the fault datasets belonging to the collection utilized for this work (see the main text). It is composed by eight layers classified according to colors utilized in Fig. 2 in the main text, i.e.: blue (ITHACA dataset), red (GNDT dataset), pink (faults selected from literature), dark grey (Structural Model of Italy dataset). Each dataset is also classified by the class of confidence (A or B) adopted for calculations and again described in the main text.

Dataset-S2-Selected_ITHACA_faults.txt. ASCII file containing polylines coordinates (longitude, latitude) at nodes of only those faults selected for calculation from the ITHACA dataset. Each single fault is delimited by the symbol ">" as header.

Dataset-S3-Selected_GNTD_faults.txt. ASCII file containing polylines coordinates (longitude, latitude) at nodes of only those faults selected for calculation from the GNDT dataset. Each single fault is delimited by the symbol ">" as header.

Dataset-S4-Selected_StructuralModel_faults.txt. ASCII file containing polylines coordinates (longitude, latitude) at nodes of only those fault sselected for calculation from the Structural Model of Italy dataset. Each single fault is delimited by the symbol ">" as header.

Dataset-S5-Selected_GeologicMap_faults.txt. ASCII file containing polylines coordinates (longitude, latitude) at nodes of only those faults selected for calculation from the Geologic Map of Italy dataset. Each single fault is delimited by the symbol ">" as header.

Dataset-S6-Selected_literature_faults.txt. ASCII file containing polylines coordinates (longitude, latitude) at nodes of only those faults selected for calculation from the literature. Each single fault is delimited by the symbol ">" as header.

Tables S1 and S2. Tables containing results of statistical tests of FLEM values on the CSIv1.1 (Table S1) and ISIDe (Table S2) databases. The listed cells (column 1) have a FLEM value (column 2) larger than the related historical/instrumental catalogued magnitude and pass the Goodness of Fit Test (Wiemer and Wyss, 2000), at 95% confidence level, for the Gutenberg-Richter model, with a b-value equal to 1, and a completeness magnitude Mc (column 4). The variable N (column 5) marks the number of events in each cell above Mc. Two tests are done, assuming as null hypothesis a double truncated (DTGR), with FLEM as the maximum magnitude, and an unbounded (UGR) Gutenberg-Richter laws. For both distributions, we keep only cells (marked in boldface) passing the Log-likelihood (LL) test, at 95% confidence level (see text for details). The related p-values (pLL) are reported in columns 6 and 9, for DTGR e UGR distributions, respectively. The LL test is passed if pLL>0.05. Finally, we apply, on remaining cells, the test proposed by Holschneider et al. (2014), rejecting a FLEM value if the maximum observed magnitude (column 4), oMmax) is larger than a suitable threshold. This last is computed both on all N events (Mt1, columns 8 and 10) and, if possible, for events in the last two degrees of magnitudes (Mt2, column 9 and 11).

5 Figures captions

FigureS1. Maps (central Italy) of the calculated Fault-Length Earthquake Magnitude (FLEM), for each cell, from the length of class A faults. Black lines are the longest A class faults in each cell. FLEM values are obtained from these faults using L10. Grey filling is used for cells with no data. (a) Grid with square cells 12.5 km in size. (b) Grid with square cells 25 km in size. (c) Grid with square cells 50 km in size.

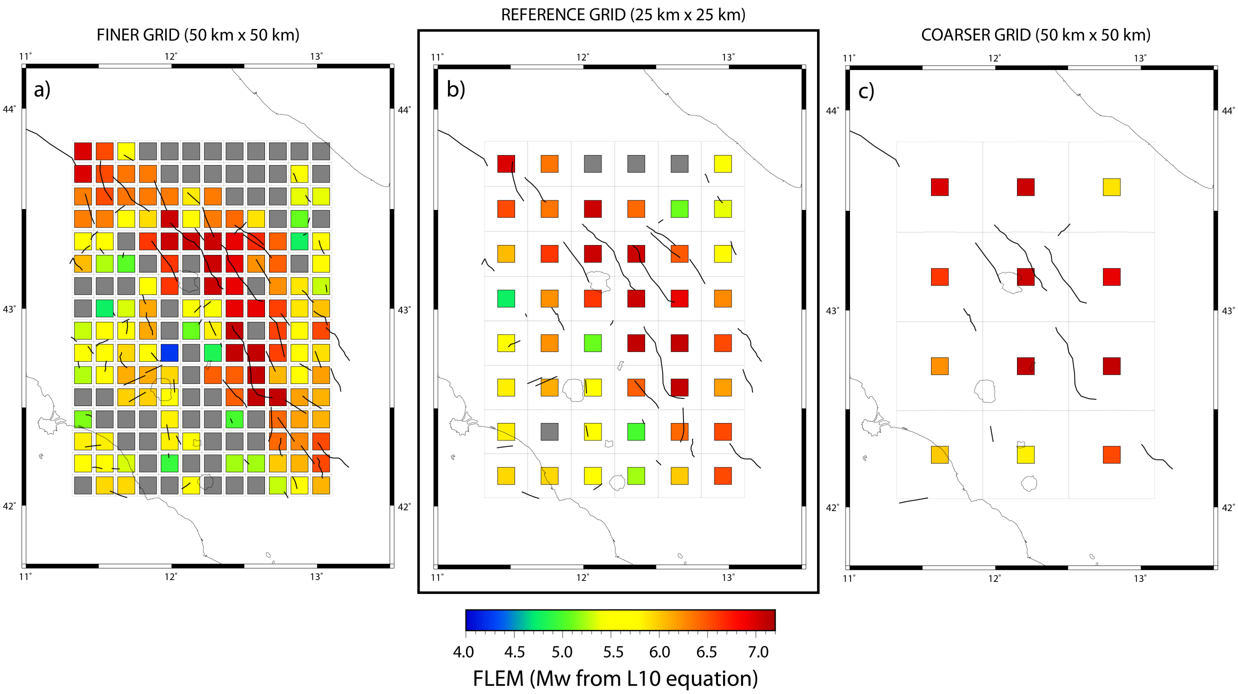
FigureS2. Maps (central Italy) of the difference between FLEM values (only from class A faults) and maximum magnitudes from historic or instrumental earthquakes. Black lines are the longest A class faults in each cell. FLEM values are obtained from these faults using L10. Grey filling is used for cells with no data. (a) Grid with square cells 12.5 km in size. (b) Grid with square cells 25 km in size. (c) Grid with square cells 50 km in size.

FigureS3. a) FLEM vs. cell diagram referring to FLEMs from cells in Fig. S1. On the abscissas, all cells from NW to SE are aligned. On the ordinates, the corresponding FLEM values are reported. Orange, red, and black colours are for FLEMs from the grids with 12.5, 25, and 50 km sized cells, respectively (Fig. S1). (b) FLEM minus FLEM diagram referring to FLEMs from cells in Fig. S1. Orange line represents, cell by cell, the FLEM from the 50 km grid (FLEM$_{50km}$) minus the FLEM from the 25 km grid (FLEM$_{25km}$). Red line represents, cell by cell, the FLEM from the 12.5 km grid (FLEM$_{12.5km}$) minus the FLEM from the 25 km grid (FLEM$_{25km}$). Black line line represents, cell by cell, the FLEM from the 25 km grid (FLEM$_{25km}$) minus the FLEM from the 25 km grid (FLEM$_{25km}$). The latter one is obviously equal to 0.

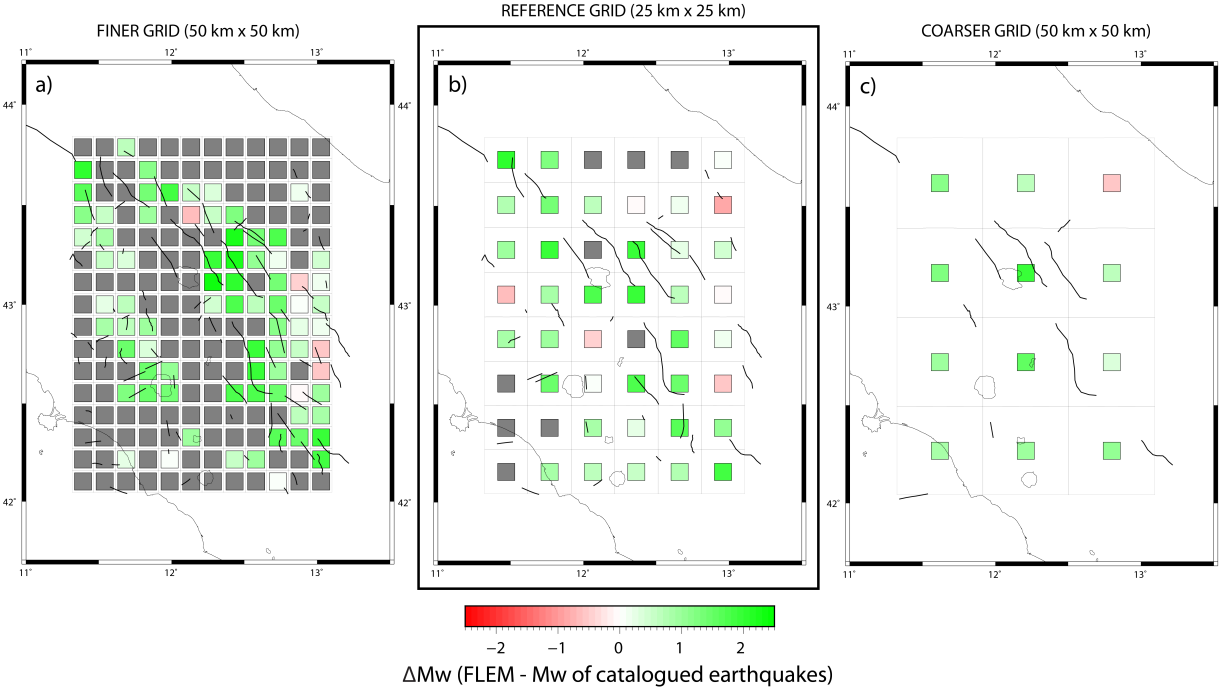
6 Table captions

TableS1. Test of FLEM values on the CSIv1.1 database.

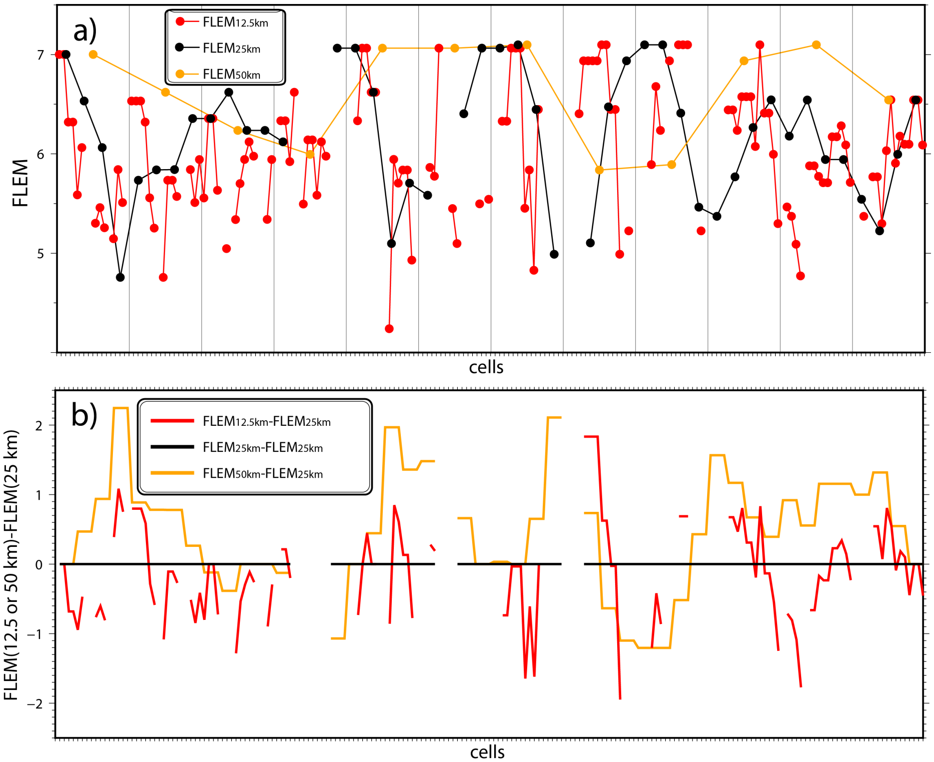
TableS2. Test of FLEM values on the ISIDe database.


FINER GRID (50 km x 50 km)
REFERENCE GRID (25 km x 25 km)
COARSER GRID (50 km x 50 km)
a)
b)
c)
11°
12°
13°
44°
43°
42°
4.0
4.5
5.0
5.5
6.0
6.5
7.0
FLEM (Mw from L10 equation)

FigureS1.


FINER GRID (50 km x 50 km)
REFERENCE GRID (25 km x 25 km)
COARSER GRID (50 km x 50 km)
a)
b)
c)
11°
12°
13°
44°
43°
42°
−2
−1
0
1
2
ΔMw (FLEM - Mw of catalogued earthquakes)

FigureS2.


a)
FLEM12.5km
FLEM25km
FLEM50km
7
6
5
FLEM
cells
b)
FLEM12.5km-FLEM25km
FLEM25km-FLEM25km
FLEM50km-FLEM25km
2
1
0
−1
−2
FLEM(12.5 or 50 km)-FLEM(25 km)
cells

FigureS3.

					DTGR			UGR		
ID cell	**FLEM**	**Mc**	**oMmax**	**N**	**pLL**	**Mt1**	**Mt2**	**pLL**	**Mt1**	**Mt2**
E13	**5.9**	**2.0**	**3.4**	**68**	**0.0562**	**5.1**		**0.0533**	**5.1**	
M13	7.1	1.9	3.0	49	0.0166			0.0160		
N12	7.1	1.9	3.7	72	0.0032			0.0029		
Q14	**6.4**	**1.7**	**3.5**	**173**	**0.0728**	**5.2**		**0.0817**	**5.2**	
Q17	**5.7**	**1.8**	**2.4**	**24**	**0.3962**	**4.4**		**0.3922**	**4.5**	
Q19	6.1	1.8	3.5	37	0.0002			0.0007		
T15	**6.8**	**2.1**	**3.7**	**71**	**0.0897**	**5.2**		**0.0946**	**5.2**	
U14	7.4	2.5	4.4	153	0.0456			0.0480		
U17	**7.1**	**1.7**	**4.4**	**216**	**0.1401**	**5.3**	**5.2**	**0.1392**	**5.3**	**5.2**
W18	**6.5**	**1.6**	**5.3**	**793**	**1.0000**	**5.7**	**5.6**	**1.0000**	**5.8**	**5.7**
W19	**6.9**	**1.6**	**4.3**	**825**	**1.0000**	**5.8**	**5.7**	**1.0000**	**5.8**	**5.7**
W20	**7.1**	**1.6**	**4.5**	**569**	**0.2190**	**5.6**	**5.7**	**0.2126**	**5.6**	**5.7**
W22	**6.4**	**1.7**	**3.7**	**81**	**0.0768**	**4.9**	**4.8**	**0.0758**	**4.9**	**4.8**
W24	**5.7**	**1.9**	**3.7**	**50**	**0.0693**	**4.8**		**0.0678**	**4.9**	
X18	6.4	1.6	3.0	100	0.0336			0.0392		
X20	6.5	1.7	5.5	1310	0.0400			0.0430		
X39	7.2	2.3	4.1	50	0.0016			0.0008		
Y16	7.8	1.8	3.2	32	0.0044			0.0041		
Y19	**6.2**	**1.6**	**3.8**	**200**	**0.0553**	**5.2**	**5.2**	**0.0506**	**5.2**	**5.2**
Y20	**6.5**	**1.6**	**3.8**	**243**	**0.9991**	**5.3**	**5.2**	**0.9982**	**5.3**	**5.2**
Y21	6.3	2.1	4.1	74	0.0017			0.0023		
AA18	7.7	1.7	5.0	106	0.0410			0.0010		
AA25	**6.8**	**2.1**	**3.1**	**59**	**0.6361**	**5.2**		**0.6335**	**5.2**	
AB42	**6.8**	**2.2**	**4.2**	**179**	**0.4082**	**5.7**		**0.4137**	**5.7**	
AD26	5.7	1.5	4.2	366	0.0036			0.0032		
AD42	**5.8**	**2.2**	**4.2**	**181**	**0.0793**	**5.5**		**0.0713**	**5.7**	
AD43	**5.4**	**2.3**	**4.4**	**147**	**0.4897**	**5.2**	**5.2**	**0.4927**	**5.8**	**5.6**
AE43	**6.8**	**2.3**	**4.8**	**$<10^{-45}$**	**0.9740**	**6.4**	**6.4**	**0.9761**	**6.6**	**6.7**
AH32	**6.4**	**1.9**	**5.6**	**400**	**0.4233**	**5.7**	**5.5**	**0.4274**	**5.8**	**5.6**
AH33	**6.4**	**1.9**	**3.7**	**270**	**0.8254**	**5.6**		**0.8311**	**5.6**	

TableS1.

ISIDe

					DTGR			UGR		
ID cell	FLEM	Mc	oMmax	N	pLL	Mt1	Mt2	pLL	Mt1	Mt2
C13	7.2	1.1	4.7	491	0.0075			0.0062		
E12	**6.5**	**1.6**	**3.8**	**180**	**0.2486**	**5.1**	**5.1**	**0.2424**	**5.1**	**5.1**
E13	5.9	1.8	3.9	180	0.0310			0.0275		
L12	7.1	2	4	105	0.0011			0.0006		
N14	**6.2**	**1.6**	**4**	**114**	**0.2100**	**4.9**	**4.9**	**0.2064**	**4.9**	**5.0**
O14	**6.6**	**1.3**	**5.2**	**1588**	**0.8986**	**5.7**	**5.7**	**0.9029**	**5.8**	**5.8**
P7	6.8	1.2	4	96	0.0010			0.0040		
P13	6.6	2.1	4	46	0.0030			0.0042		
P14	**6.6**	**1.5**	**4.8**	**547**	**0.9369**	**5.5**	**5.4**	**0.9346**	**5.5**	**5.4**
Q11	7.4	2.2	5.3	468	0.0428			0.0455		
Q14	**6.4**	**1.7**	**3.7**	**681**	**0.9992**	**5.7**	**5.6**	**0.9994**	**5.8**	**5.7**
R11	**7.7**	**2.2**	**5.9**	**1187**	**0.8261**	**6.5**	**6.5**	**0.8249**	**6.6**	**6.5**
R14	**6.6**	**1.8**	**4.1**	**325**	**0.8453**	**5.6**	**5.5**	**0.8491**	**5.6**	**5.6**
R16	7	1.7	3.6	79	0.0208			0.0192		
R17	6.2	1.6	4.1	441	0.0064			0.006		
R20	**5.7**	**1.4**	**2.4**	**65**	**0.5513**	**4.5**		**0.5594**	**4.5**	
T15	**6.8**	**1.4**	**4.1**	**581**	**0.1350**	**5.4**	**5.4**	**0.1385**	**5.5**	**5.4**
T20	**5.9**	**1.5**	**3.4**	**112**	**0.9065**	**4.8**		**0.9084**	**4.8**	
U15	**6.5**	**1.2**	**3.9**	**1082**	**0.9800**	**5.5**	**5.4**	**0.9822**	**5.5**	**5.5**
U16	**6.8**	**1.2**	**3.9**	**1058**	**0.9596**	**5.5**	**5.5**	**0.9647**	**5.5**	**5.5**
U17	**7.1**	**1.4**	**3.6**	**134**	**0.3868**	**4.8**	**4.8**	**0.3847**	**4.8**	**4.8**
U21	5.9	1.4	4.1	128	0.0036			0.0038		
V16	**6.2**	**1.2**	**3.8**	**391**	**0.3503**	**5.1**	**5.0**	**0.3493**	**5.1**	**5.0**
V18	**7.1**	**1**	**3.5**	**1106**	**1.0000**	**5.3**	**5.2**	**1.0000**	**5.3**	**5.2**
W17	**6.5**	**1.3**	**2.9**	**1013**	**1.0000**	**5.5**		**1.0000**	**5.6**	
W18	**6.5**	**1.1**	**4**	**5431**	**1.0000**	**6**	**5.8**	**1.0000**	**6.1**	**5.9**
W19	**6.9**	**1.3**	**3.3**	**639**	**1.0000**	**5.4**		**1.0000**	**5.4**	
W20	**7.1**	**1.4**	**4.2**	**1343**	**0.9997**	**5.8**	**5.7**	**0.9996**	**5.8**	**5.7**
W21	**7.1**	**1.7**	**3.6**	**246**	**0.9683**	**5.4**		**0.9706**	**5.4**	
W22	6.4	1.4	3.8	194	0.0394			0.0407		
X20	**6.5**	**1.4**	**4.6**	**6218**	**1.0000**	**6.2**	**6.2**	**1.0000**	**6.5**	**6.5**
X22	**6.5**	**1.6**	**3.9**	**223**	**0.7886**	**5.2**	**5.2**	**0.7935**	**5.2**	**5.2**
X23	**6.5**	**1.4**	**3**	**200**	**1.0000**	**5**		**1.0000**	**5.0**	
X25	5.7	1.5	3	45	0.0071			0.0061		
Y5	7.3	1.1	3.2	55	0.0014			0.0014		
Y17	7.5	0.9	3.3	408	0.0020			0.0011		
Y19	**6.2**	**1.5**	**4.7**	**2796**	**0.9946**	**5.9**	**5.9**	**0.9946**	**6.2**	**6.3**
Y20	**6.5**	**1.5**	**6.1**	**15544**	**1.0000**	**6.4**	**6.3**	**1.0000**	**7.0**	**6.8**
Y21	**6.3**	**1.4**	**6**	**13868**	**1.0000**	**6.2**	**6.2**	**1.0000**	**6.8**	**6.8**
Y24	**6.4**	**1.8**	**3.2**	**69**	**0.1894**	**4.9**		**0.1831**	**4.9**	
Z21	**6.5**	**1.9**	**3.4**	**151**	**0.8860**	**5.3**		**0.8916**	**5.4**	

Z23	**6.1**	**1.5**	**4.2**	**1676**	**0.9994**	**5.8**	**5.7**	**0.9992**	**6.0**	**6.0**
Z25	6.5	1.2	4.7	368	0.0041			0.0042		
AA24	**6.4**	**1.6**	**3.5**	**139**	**0.7212**	**5.0**		**0.7192**	**5.0**	
AB24	**6.2**	**1.5**	**3.8**	**208**	**0.2761**	**5.1**	**5.0**	**0.2895**	**5.1**	**5.1**
AB25	**6.8**	**1.7**	**3.2**	**252**	**0.9449**	**5.4**		**0.943**	**5.4**	
AD26	**5.7**	**1.6**	**4.1**	**275**	**0.4015**	**5.2**	**5.2**	**0.4015**	**5.3**	**5.3**
AD39	**7**	**2.7**	**4.3**	**69**	**0.2315**	**5.8**		**0.2331**	**5.8**	
AD42	5.8	1.9	4.3	121	0.0018			0.0026		
AD43	**5.4**	**2.1**	**3.5**	**76**	**0.2330**	**5.0**		**0.2323**	**5.3**	
AE29	**6.1**	**1.6**	**3.7**	**79**	**0.2077**	**4.8**	**4.6**	**0.2138**	**4.8**	**4.7**
AE41	**7.1**	**1.9**	**4.2**	**423**	**0.8959**	**5.8**	**5.8**	**0.8926**	**5.8**	**5.8**
AE42	**6.1**	**3.1**	**4.4**	**49**	**0.0884**	**5.8**		**0.0843**	**6.1**	
AE46	6.4	1.7	3.9	151	0.0073			0.0070		
AF31	6.6	1.2	2.9	64	0.0011			0.0015		
AF39	**6.1**	**2.4**	**4.5**	**128**	**0.9810**	**5.6**	**5.6**	**0.9806**	**5.8**	**5.7**
AF41	**7**	**1.8**	**4.1**	**68**	**0.0739**	**4.9**	**4.9**	**0.0800**	**4.9**	**4.9**
AG31	**6.7**	**1.1**	**3.8**	**176**	**0.1366**	**4.6**	**4.6**	**0.1400**	**4.6**	**4.6**
AG32	6.7	1.3	3.7	142	0.0020			0.002		
AH32	**6.4**	**1.1**	**3.7**	**428**	**0.2253**	**5.0**	**4.9**	**0.221**	**5.0**	**4.9**
AH33	**6.4**	**1.3**	**5**	**2645**	**1.0000**	**5.9**	**5.8**	**1.0000**	**6.0**	**5.9**
AH39	6.7	1.6	3.6	94	0.0385			0.0375		
AI33	**6.4**	**1.3**	**4.3**	**767**	**0.3373**	**5.4**	**5.4**	**0.3247**	**5.5**	**5.5**
AI35	6.8	1.4	3.7	120	0.0153			0.0188		
AJ29	**6.1**	**1.6**	**3.1**	**74**	**0.2705**	**4.7**	**4.7**	**0.2662**	**4.8**	**4.8**
AJ35	5.9	1.9	3.4	57	0.0017			0.0019		
AJ37	**6.8**	**1.9**	**3.4**	**81**	**0.0499**			**0.0542**	**5.1**	

TableS2.