Analyse du séisme du 21 juin 2019 06h50 UTC de Ml 4.8

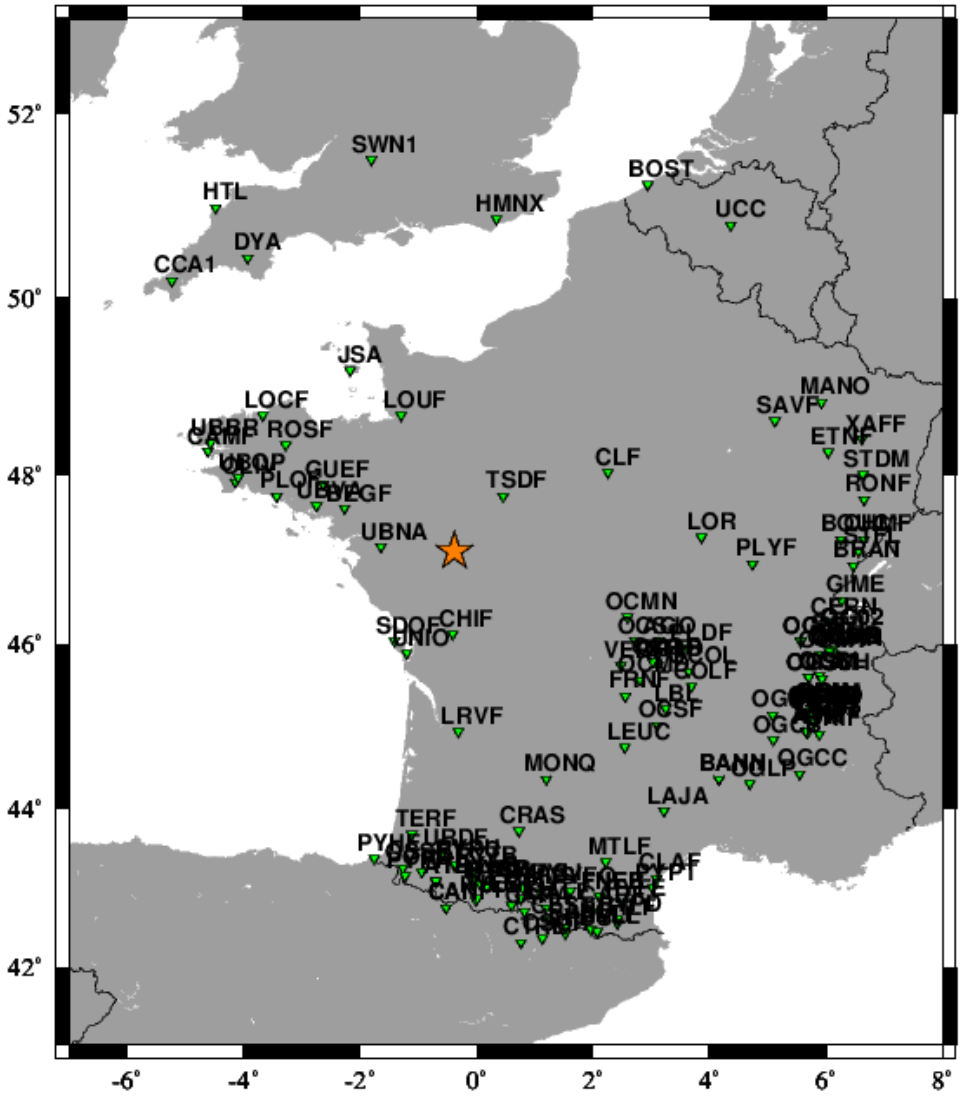
Environ 30 km au Nord de Bressuire, Deux-Sèvres (79)

Bertrand Delouis, Géoazur, 25 juin 2019
delouis@geoazur.unice.fr

Avec étude de l'impact de l'incertitude sur le modèle de vitesse

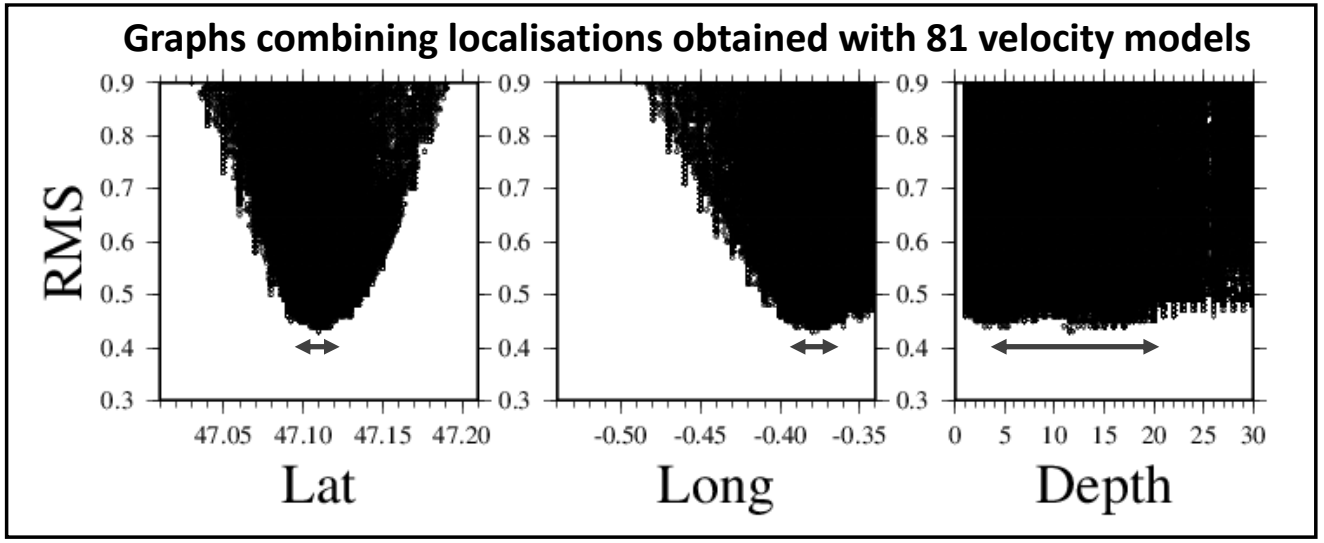
- Inversion de la localisation hypocentrale avec différents modèles de vitesse
- Inversion des formes d'ondes FMNEAR avec filtrage ajusté manuellement et deux modèles de vitesse

Stations disponibles pour la localisation hypocentrale



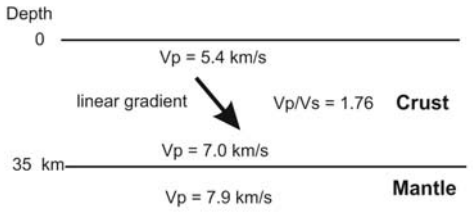
Inversion of P and S arrival times for lat, long, depth, and T0 combining a grid search, simulated annealing, and HYPOINVERSE-2000 (Klein, 2002), testing a series of velocity models with varying velocity gradient (Vp_top and Vp_base in the crust), Moho depth (25, 30, 35 km), and the Vp/Vs ratio (1.70, 1.73, 1.76)
Vp mantle fixed to 7.9 km/s
Distance weighting: weight is 1 if dist < 70 km, then weight decreases until reaching 0 for dist ≥ 420 km

Weighted phases retained:
35 P + 6 S



Best solution found:

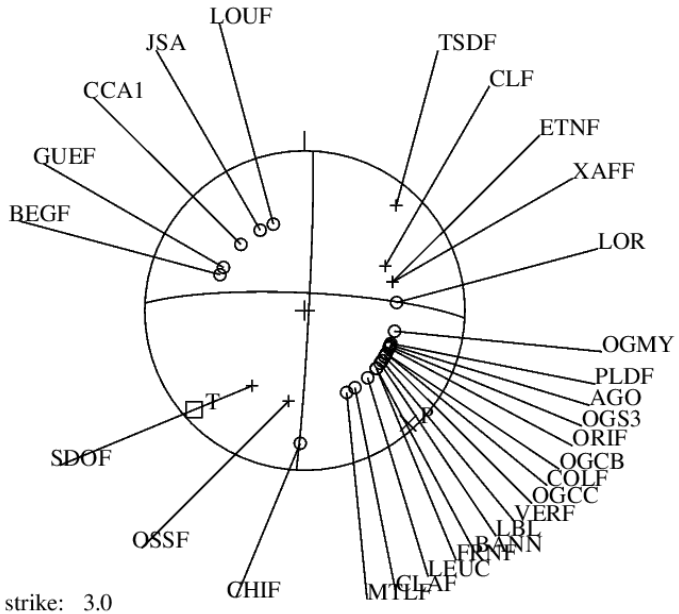
Lat: 47.110 Lon: -0.377 Depth: 12 km
T0: 56.6s RMS_{LOC}: 0.43s
Vp_top, Vp_base, depth_moho
5.40 km/s 7.00 km/s 35.0 km
best Vp/Vs= 1.76



Focal mechanism from P first motions

With the best depth found, 12 km (RMS_{loc} = 0.43)

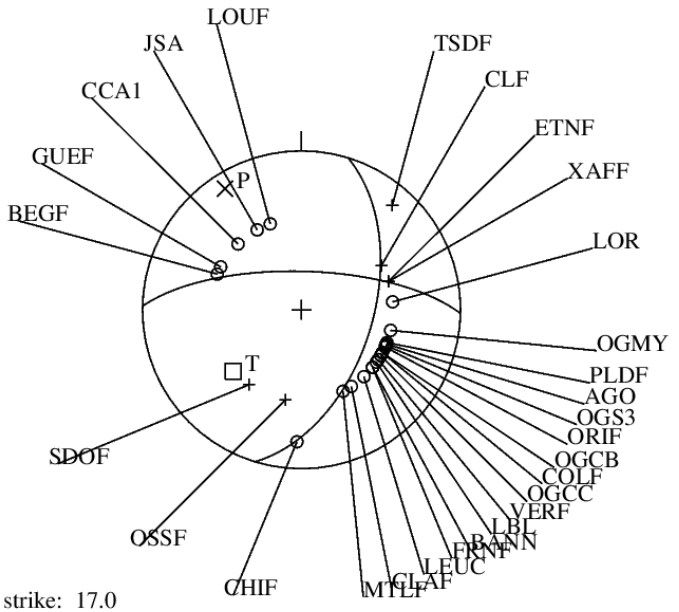
Sol FMP 1



strike: 3.0
dip: 88.0
rake: 9.0

Plan 2:
Strike 273
Dip 81
Rake 178

Sol FMP 2



strike: 17.0
dip: 53.0
rake: 25.0

Plan 2:
Strike 271
Dip 70
Rake 140

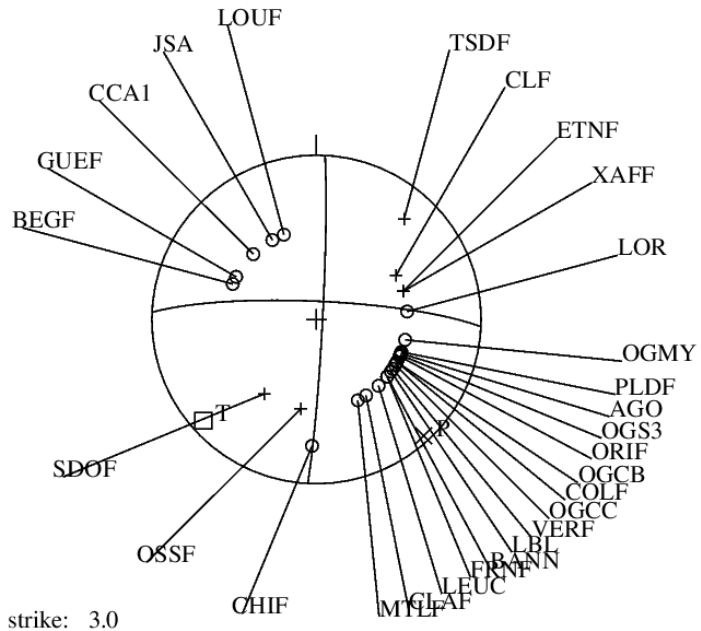
\+ : first motion in compression (Zup) o : first motion in dilatation (Z down) ◯ : polarity in disagreement with the FM

Focal mechanism from P first motions

With depth 7 km (RMS_{loc} = 0.45)

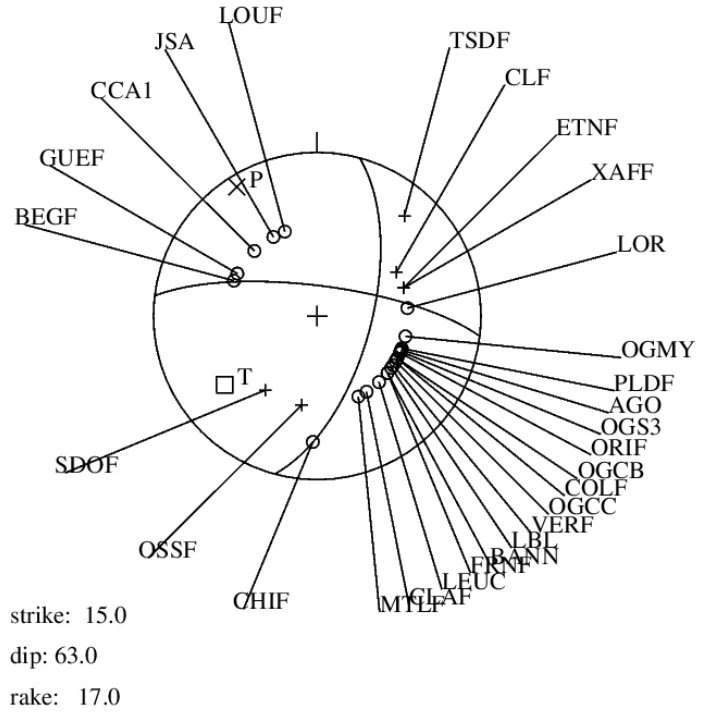
This is the depth corresponding to the best solution found with FMNEAR (next page)

Sol FMP 1



Plan 2:
Strike 273
Dip 81
Rake 177

Sol FMP 2

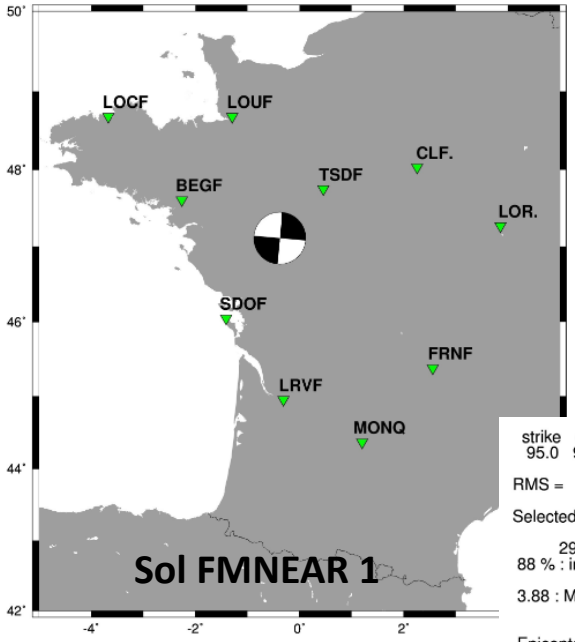


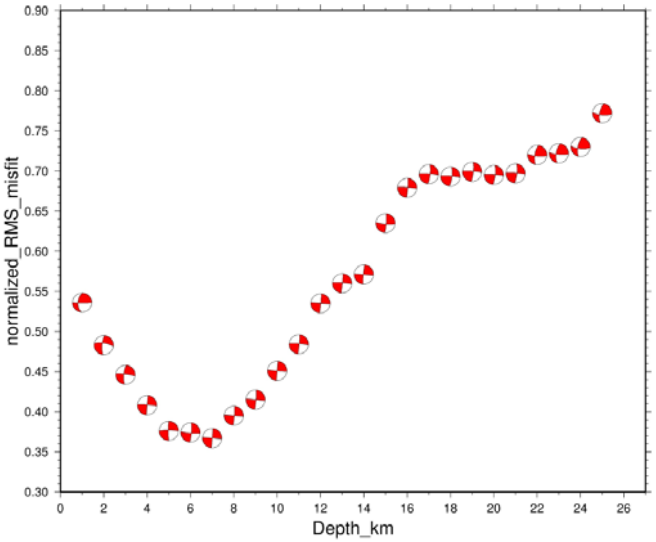
Plan 2:
Strike 277
Dip 75
Rake 152

\+ : first motion in compression (Zup) o : first motion in dilatation (Z down) ◯ : polarity in disagreement with the FM

Focal mechanism from waveform inversion (FMNEAR)

Standard velocity model
from routine FMNEAR inversions





strike dip rake
95.0 90.0 -179.0 : best focal mechanism

RMS = 0.367

Selected depth: 7.0 km

29 = number of components with freqband > 0.015Hz
88 % : index of confidence

3.88 : Mw from waveform inversion

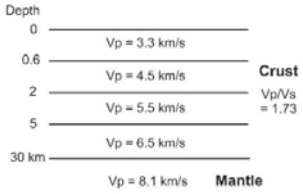
Epicenter used (lat,long): 47.110 -0.378
Starting depth(km): 7.0

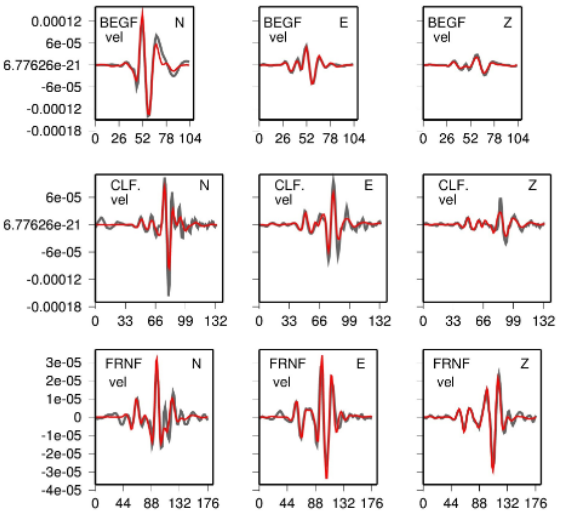
strike dip rake of the second nodal plane:
5.0 89.0 0.0

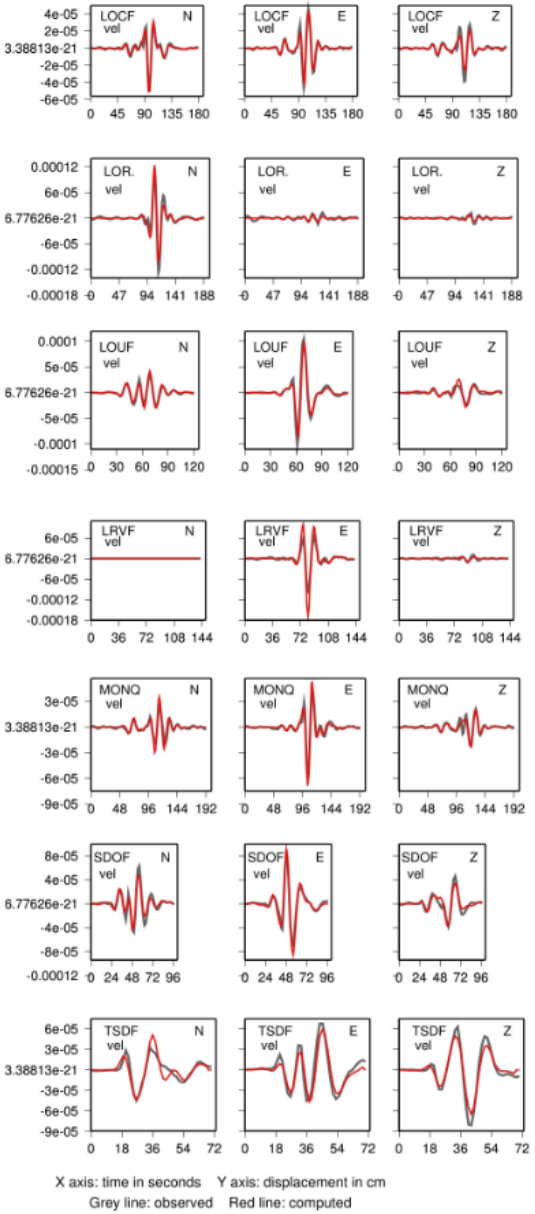
****
****** quality: A ******
****

**** Signification of quality *******
A: focal mechanism STONGLY CONSTRAINED
B: focal mechanism WELL CONSTRAINED
C: focal mechanism MODERATELY CONSTRAINED
D: focal mechanism WEAKLY CONSTRAINED
E: focal mechanism BARELY CONSTRAINED
F: focal mechanism NOT CONSTRAINED
****

Vélocity model

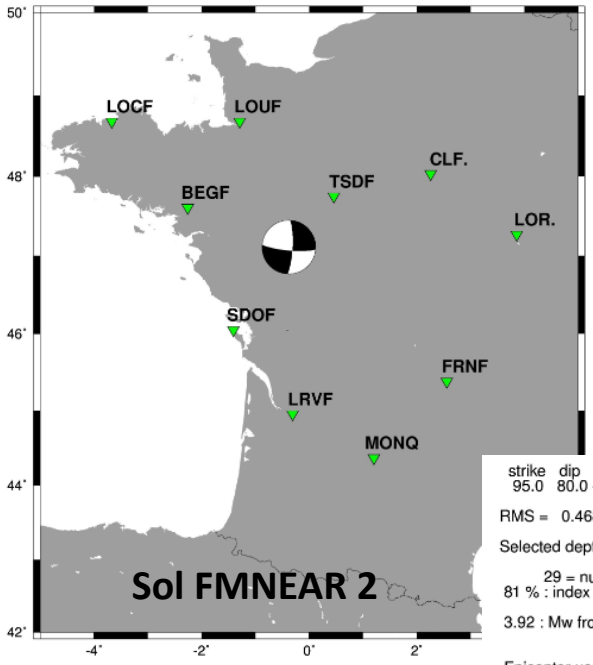


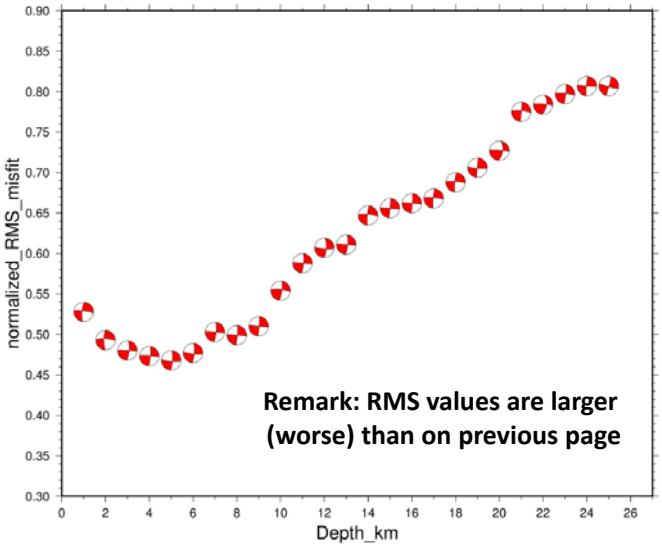




Focal mechanism from waveform inversion (FMNEAR)

Specific velocity model
close to the gradient model found





Remark: RMS values are larger (worse) than on previous page

strike dip rake
95.0 80.0 -168.3 : best focal mechanism

RMS = 0.468

Selected depth: 5.0 km

29 = number of components with freqband > 0.015Hz
81 % : index of confidence

3.92 : Mw from waveform inversion

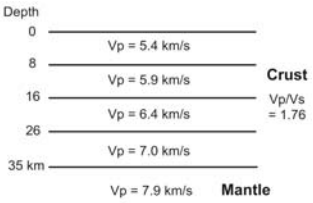
Epicenter used (lat,long): 47.110 -0.378
Starting depth(km): 5.0

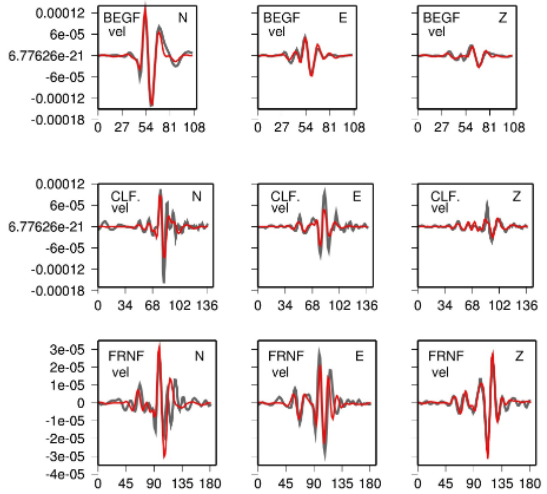
strike dip rake of the second nodal plane:
2.9 78.5 -10.2

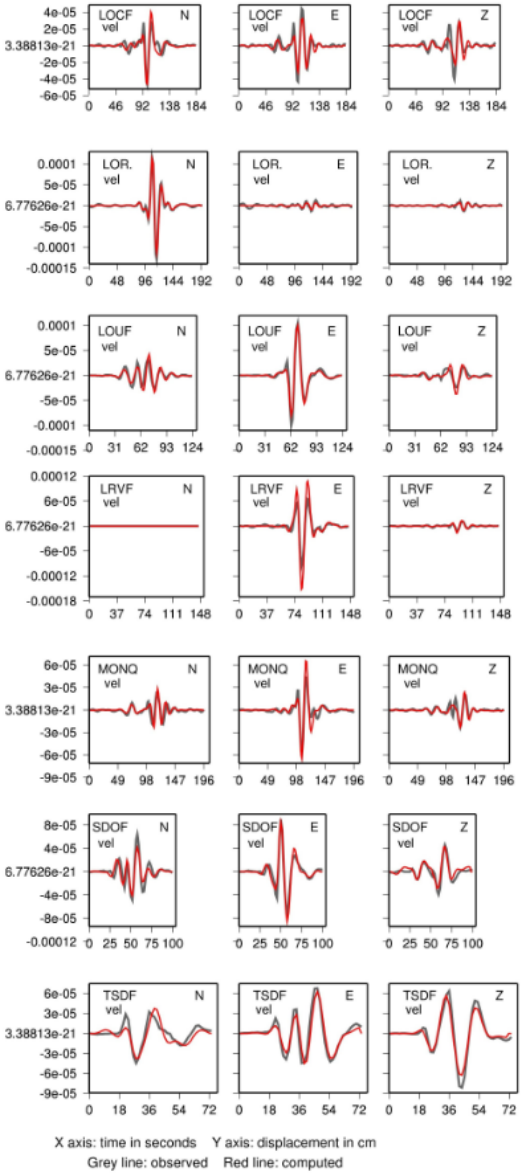
****
****** quality: A ******
****

**** Signification of quality *******
A: focal mechanism STONGLY CONSTRAINED
B: focal mechanism WELL CONSTRAINED
C: focal mechanism MODERATELY CONSTRAINED
D: focal mechanism WEAKLY CONSTRAINED
E: focal mechanism BARELY CONSTRAINED
F: focal mechanism NOT CONSTRAINED
****

Vélocity model







X axis: time in seconds Y axis: displacement in cm
Grey line: observed Red line: computed

Bande de fréquence (filtrage) utilisée par composante dans FMNEAR

```
BEGF N vel    0.0300 Hz to   0.0800 Hz
BEGF E vel    0.0300 Hz to   0.0800 Hz
BEGF Z vel    0.0300 Hz to   0.0800 Hz
CLF. N vel    0.0500 Hz to   0.1200 Hz
CLF. E vel    0.0500 Hz to   0.1200 Hz
CLF. Z vel    0.0500 Hz to   0.1200 Hz
FRNF N vel    0.0300 Hz to   0.0800 Hz
FRNF E vel    0.0300 Hz to   0.0800 Hz
FRNF Z vel    0.0300 Hz to   0.0800 Hz
LOCF N vel    0.0300 Hz to   0.0800 Hz
LOCF E vel    0.0300 Hz to   0.0800 Hz
LOCF Z vel    0.0300 Hz to   0.0800 Hz
LOR. N vel    0.0300 Hz to   0.0800 Hz
LOR. E vel    0.0300 Hz to   0.0800 Hz
LOR. Z vel    0.0300 Hz to   0.0800 Hz
LOUF N vel    0.0300 Hz to   0.0800 Hz
LOUF E vel    0.0300 Hz to   0.0800 Hz
LOUF Z vel    0.0300 Hz to   0.0800 Hz
LRVF E vel    0.0300 Hz to   0.0800 Hz
LRVF Z vel    0.0300 Hz to   0.0800 Hz
MONQ N vel    0.0300 Hz to   0.0800 Hz
MONQ E vel    0.0300 Hz to   0.0800 Hz
MONQ Z vel    0.0300 Hz to   0.0800 Hz
SDOF N vel    0.0300 Hz to   0.0800 Hz
SDOF E vel    0.0300 Hz to   0.0800 Hz
SDOF Z vel    0.0300 Hz to   0.0800 Hz
TSDF N vel    0.0300 Hz to   0.0800 Hz
TSDF E vel    0.0300 Hz to   0.0800 Hz
TSDF Z vel    0.0300 Hz to   0.0800 Hz
```

Mw par MWSYNTH (comparaison des plateaux des spectres en déplacement entre sismogrammes complets observés et sismogrammes synthétiques précalculés pour différentes valeurs de Mw)

```
   4.12 +/-     0.12
  as computed Mw (mean) with +/- one sigma
   number of stations included:            9

 rem1: the minimum and maximum magnitudes that
 can be computed with this version are 2.0 and 9.0

 rem2: only stations incuding the S wave plus
 20s of signal are retained

 rem3: stations whose Mw differs by more than 0.8
 from the median Mw are discarded from the final
 computation



 detail by station

 stat inst   dist      azim  freq    Mw       weight
BEGF  vel    152.4    291.6  .1000  4.02     10.000000
CHIF  vel    108.5    181.2  .1000  4.09     10.000000
CLF.  vel    222.3     62.8  .1000  4.16     10.000000
FRNF  vel    296.1    130.3  .1000  3.91     10.000000
LOCF  vel    300.9    305.4  .1000  4.18     10.000000
LOUF  vel    186.6    338.8  .1500  4.01      6.666667
LRVF  vel    240.1    178.7  .1000  4.36     10.000000
SDOF  vel    142.0    213.7  .1000  4.11     10.000000
TSDF  vel     94.7     41.5  .1000  4.18     10.000000
~
```

Conclusions

Profondeur hypocentrale :

- Inversion des temps Tp et Ts : profondeur mal contrainte entre 3 et 20 km

- Inversion des formes d'ondes FMNEAR : profondeur bien contrainte entre 5 et 7 km, pour les deux modèles de vitesses différents

La profondeur préférentielle est donc 5 à 7 km

Mécanisme au foyer:

Avec les polarités : deux solutions un peu différentes, indépendamment de la profondeur. Une décrochante à peu près pure (sol FMP 1), l'autre avec une composante inverse plus marquée (sol FMP 2).

FMNEAR : mécanisme stable, très proche de la solution FMP 1 par polarités

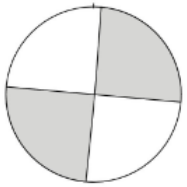
Avec la similarité des solutions FMP 1 et FMNEAR le mécanisme au foyer peut être considéré comme bien contraint

Mw : 3.9 (par FMNEAR)

(Mw = 4.1 par MWSYNTH, méthode rapide et automatique, un peu moins précise que FMNEAR)

Solution retenue:

strike dip rake
95. 90. -179.



Plan 2:
Strike 5
Dip 89
Rake 0