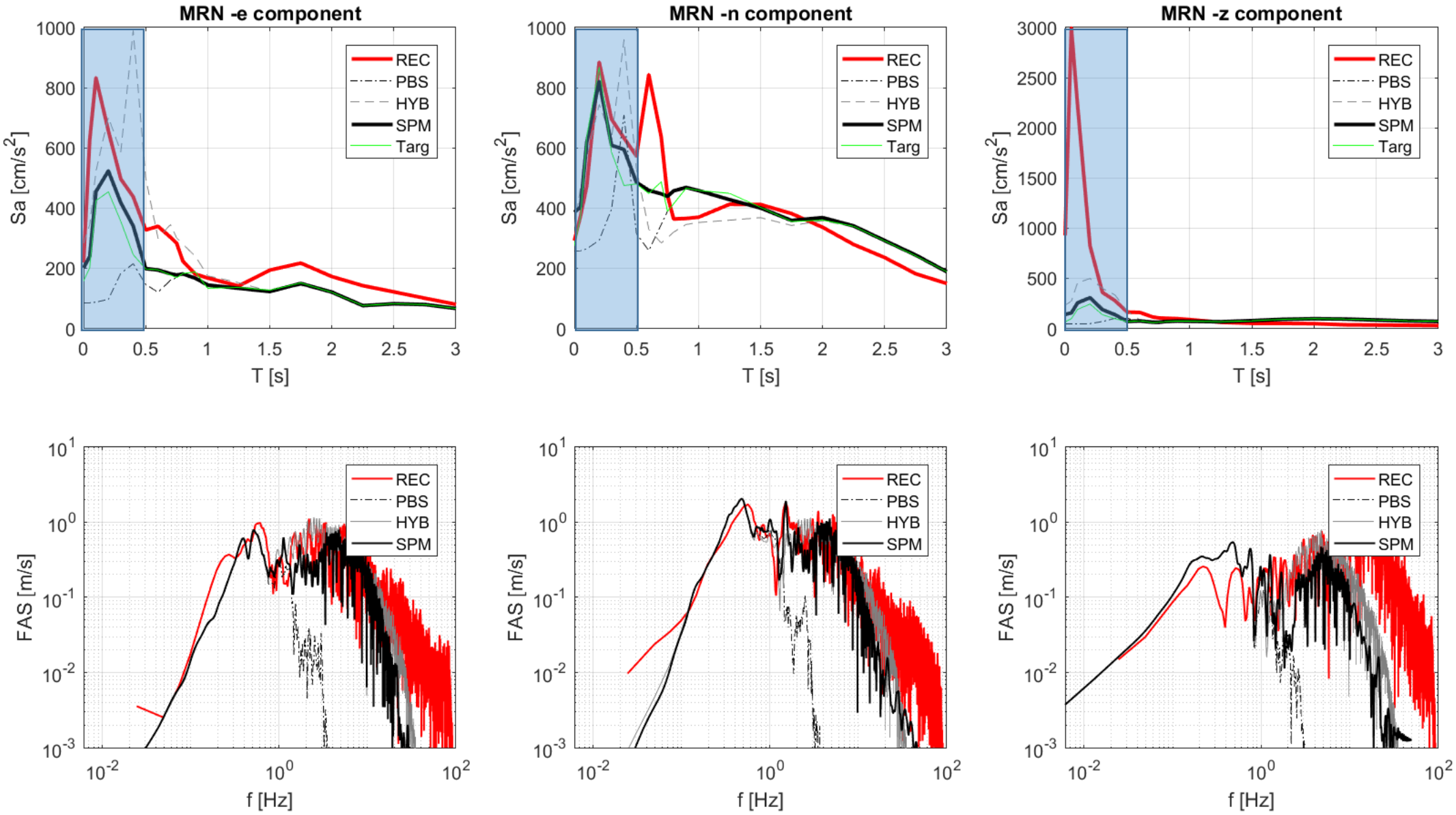
Brand new implementation of variability

into ANN & Hyb & SPM code



- Variability on short periods, that is smaller than T=0.75 s (safely taken as 0.5s)
- Note that SPM spectral ordinates are in parallel with the hybrid spectral ordinates, being greater or smaller than the target ones

```
if T_in(i)<T_sc
if Sp_acc(i)>3*Sp_in(i)
    mult(i)=(1+0.75*tol_upp);
    Sp_in(i)=Sp_in(i)*mult(i);
else
    if Sp_acc(i)<0.333*Sp_in(i)
        mult(i)=(1-0.75*tol_low);
        Sp_in(i)=Sp_in(i)*mult(i);
    else
       logr=log10(Sp_acc(i)/Sp_in(i));
       mult(i)=((1-0.75*tol_low)+((1+0.75*tol_upp)-(1-0.75*tol_low))*...
           (logr-log10(0.333))/(log10(3)-log10(0.333)));
       Sp_in(i)=mult(i)*Sp_in(i);
    end
end
```

50% is used for x3 and /3

- Note that its implementation is such that if the spectral ordinate is 3 times greater than the target, then the target spectral acceleration for the same period is increased by a factor (1+0.75tol_upp). 0.75 is used as an initial multiplier, since it will be further modified in the next steps.

- Similarly, if the spectral ordinate is 3 times smaller than the target, then the target spectral acceleration for the same period is decreased by a factor (1-0.75tol_low). 0.75 is used as an initial multiplier, since it will be further modified in the next steps.

- Intermediate ratios are interpolated in logarithmic range (**thus, significantly lower than 50%, in the majority of the cases**).

- After, the re-arrangement of these new “targets”, classical matching is provided.

```
clc;
clear all;
close all;
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%% Step 0: Defining input data
Setup;

%% Step 1: Loading the Input motions

load_the_motions;

%% Step 2: Calculating Synthetic with Sabetta and Pugliese '96
Synthetic_SP96;

%% Step 3: LF-HF Hybridization
LF_HF_Hybridization;

%% Step 4: Combining hybrid with ANN-DATABASE
ANN_Combination;

%% Step 5: Final Results
Final_Results
```

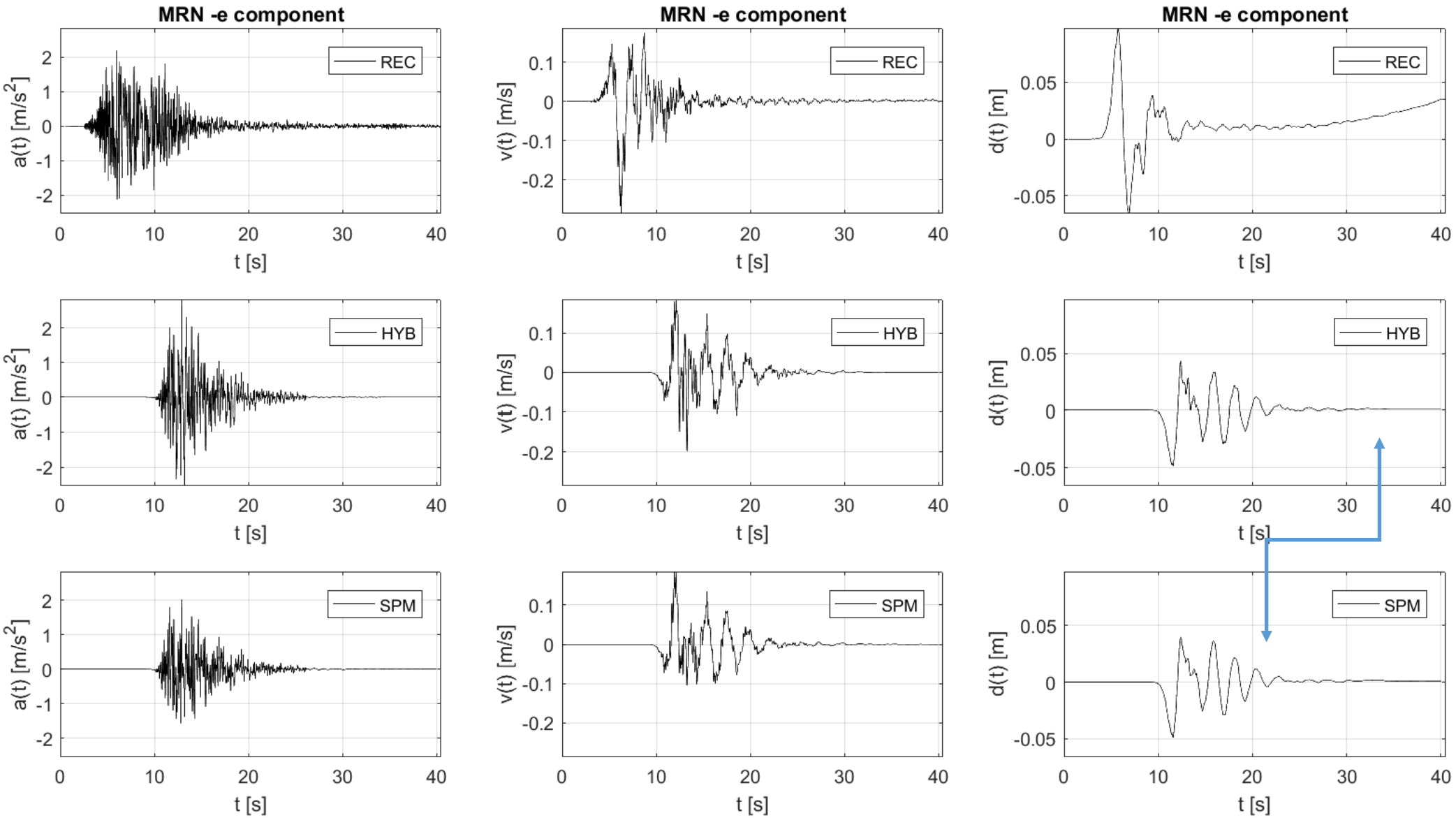
Criteria not met

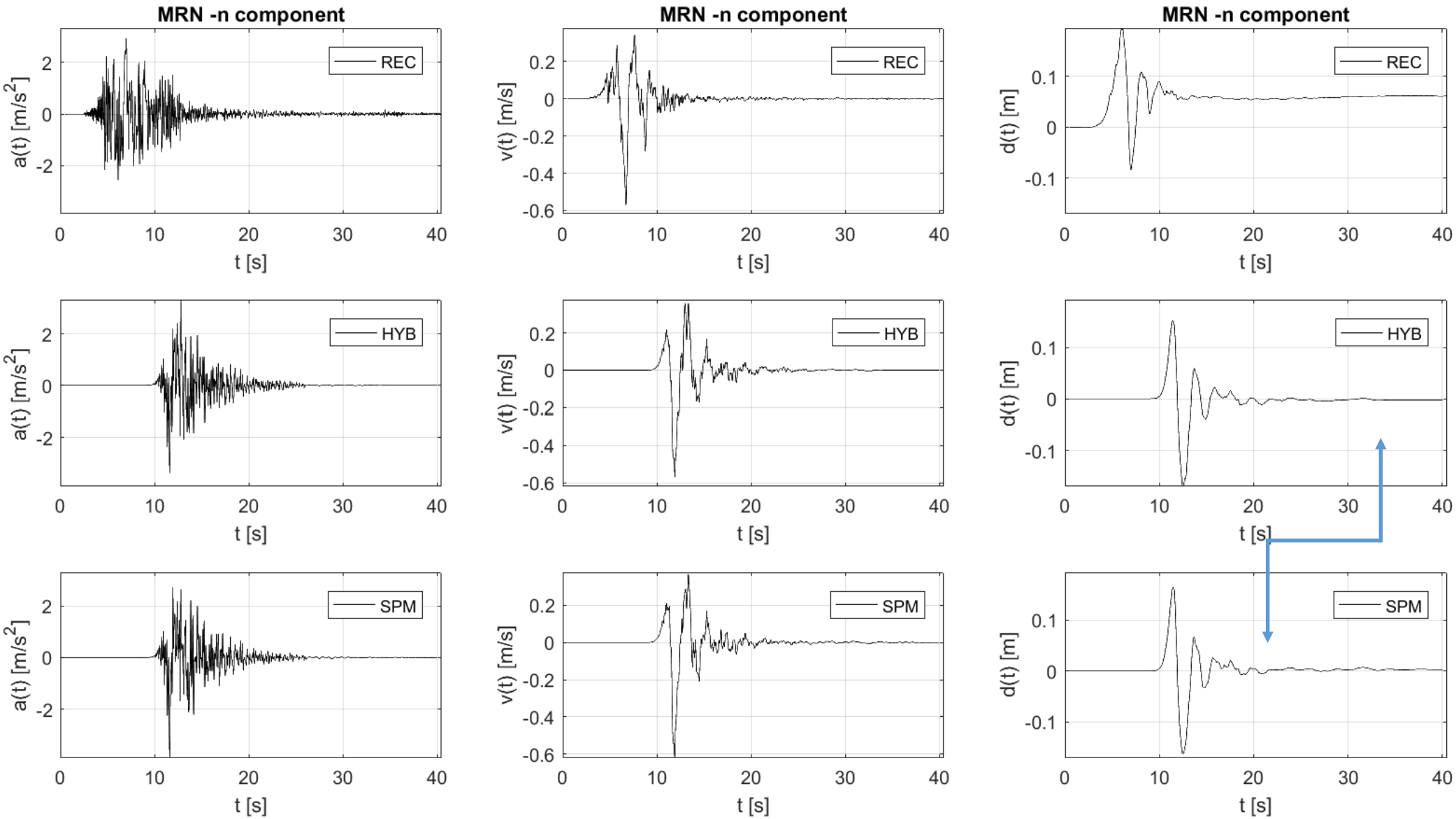
Criteria met

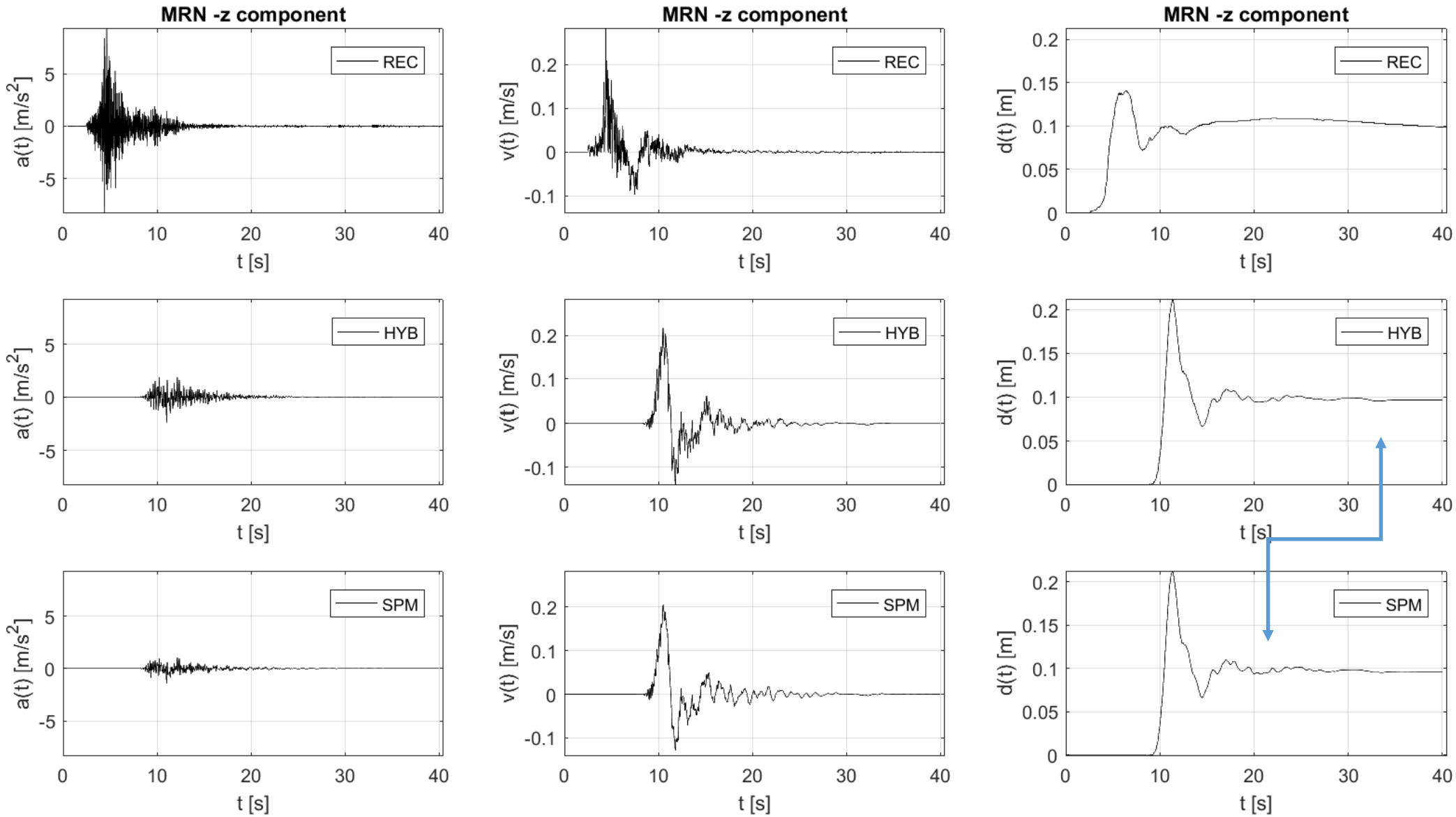
Convergence criteria are added at step 4

```
for i=2:length(T_in)
        Sp_acc_pro_final(i)=newmark_sa(acc_pro,T_in(i),0.05,dt);
        rat_real(i)=Sp_acc_pro_final(i)/Sp_in(i);
        if T_in(i)<=0.75
            if rat_real(i)<1+tol_upp && rat_real(i)>1-tol_low
            n_=n_+1;
            end
        else
            if rat_real(i)<1.05 && rat_real(i)>0.95
            n_=n_+1;
            end
        end
end
```

n_>=26 condition is seeked, thus apart from the PGA
Only two spectral quantities could be accepted to be outside the set tolerances (noting that the criterion for PBS periods Is strict compared to the smaller frequencies)


MRN -e component
REC
HYB
SPM
a(t) [m/s^2]
v(t) [m/s]
d(t) [m]
t [s]
Good agreement


MRN -n component
REC
HYB
SPM
a(t) [m/s2]
v(t) [m/s]
d(t) [m]
t [s]
Good agreement



Good agreement
& ability of recovering residual disps