

Comparison of
source localization methods
- Single dipoles -

2015/09/02 O.Yamashita

Simulation Datasets

627 simulated MEG data were generated by changing the true dipole vertex in the left hemisphere.

For each data set, source localization methods were applied and their performance was evaluated with **localization error**, **number of false positives** and **point spread**.

Two types of observation noise were added,

- SIM1 : single dipole, low noise ($N/S = 0.5$), Gaussian noise
- SIM1_1 : single dipole, low noise ($N/S=0.5$), real MEG noise.

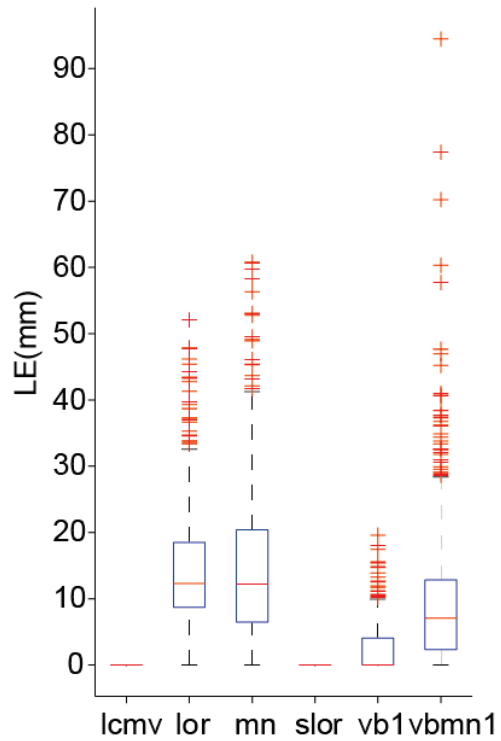
Source localization methods

- **LCMV** : Linear constraint minimum variance beamformer (normalized with noise variance)
- **MN** : L2 minimum-norm
- **LOR** : LORETA
- **SLOR** : standardized LORETA
- **VB** : VBMEG, uniform prior, small gamma, Gaussian smoothing 8mm
- **VB+MN** : VBMEG, MN prior, middle gamma. Gaussian smoothing 8mm

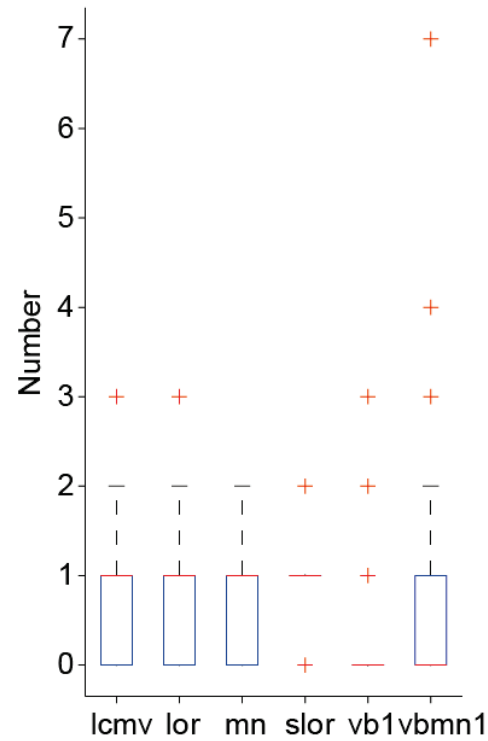
SIM1

Localization error, False Positive, Point Spread

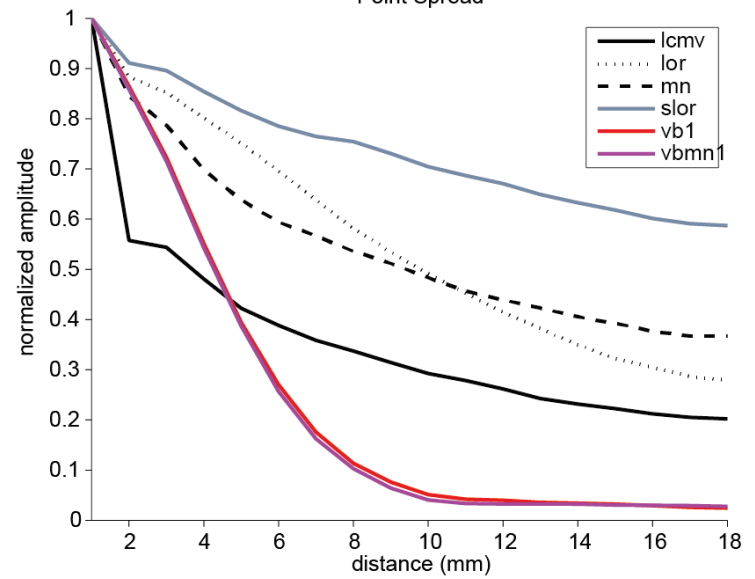
Localization Error



Number of FP

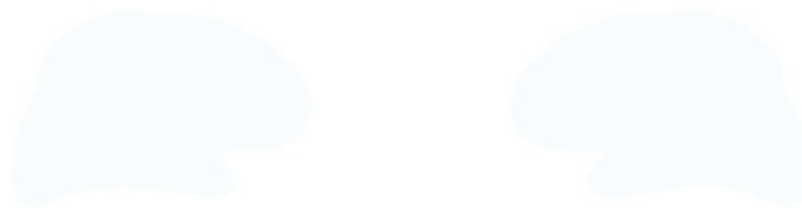


Point Spread



LE map

LCMV



MN



LOR



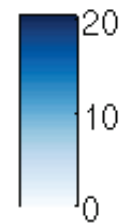
SLOR



VB
($w = 0.001/50.001$)

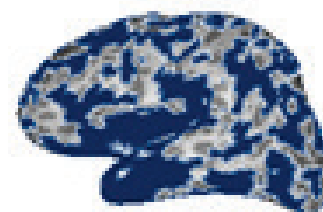


VB+MN
($w = 1/51$)

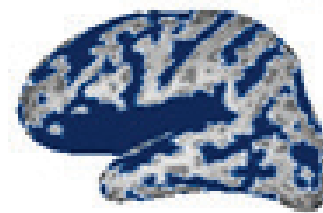


**LE map
(LE >
10mm)**

LCMV



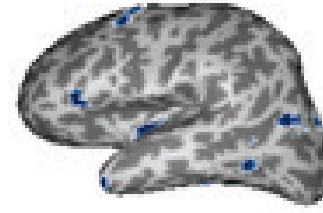
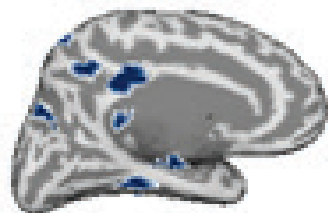
MN



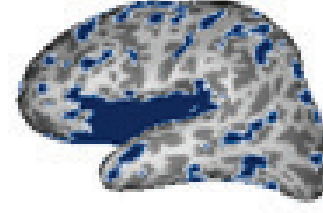
LOR



SLOR



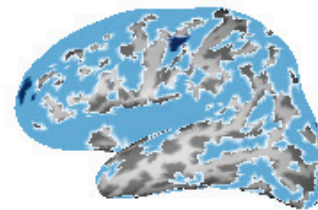
VB
(w = 0.001/50.001)



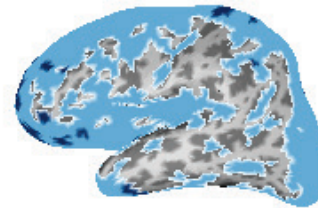
VB+MN
(w = 1/51)

FP map

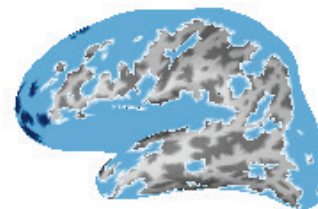
LCMV



MN



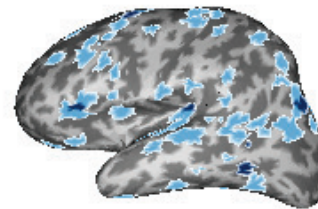
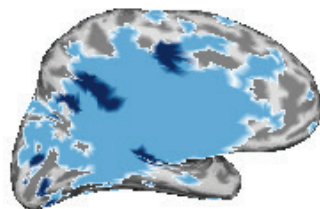
LOR



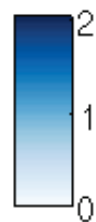
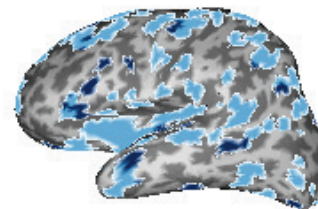
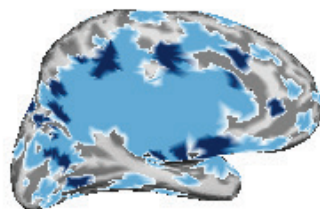
SLOR



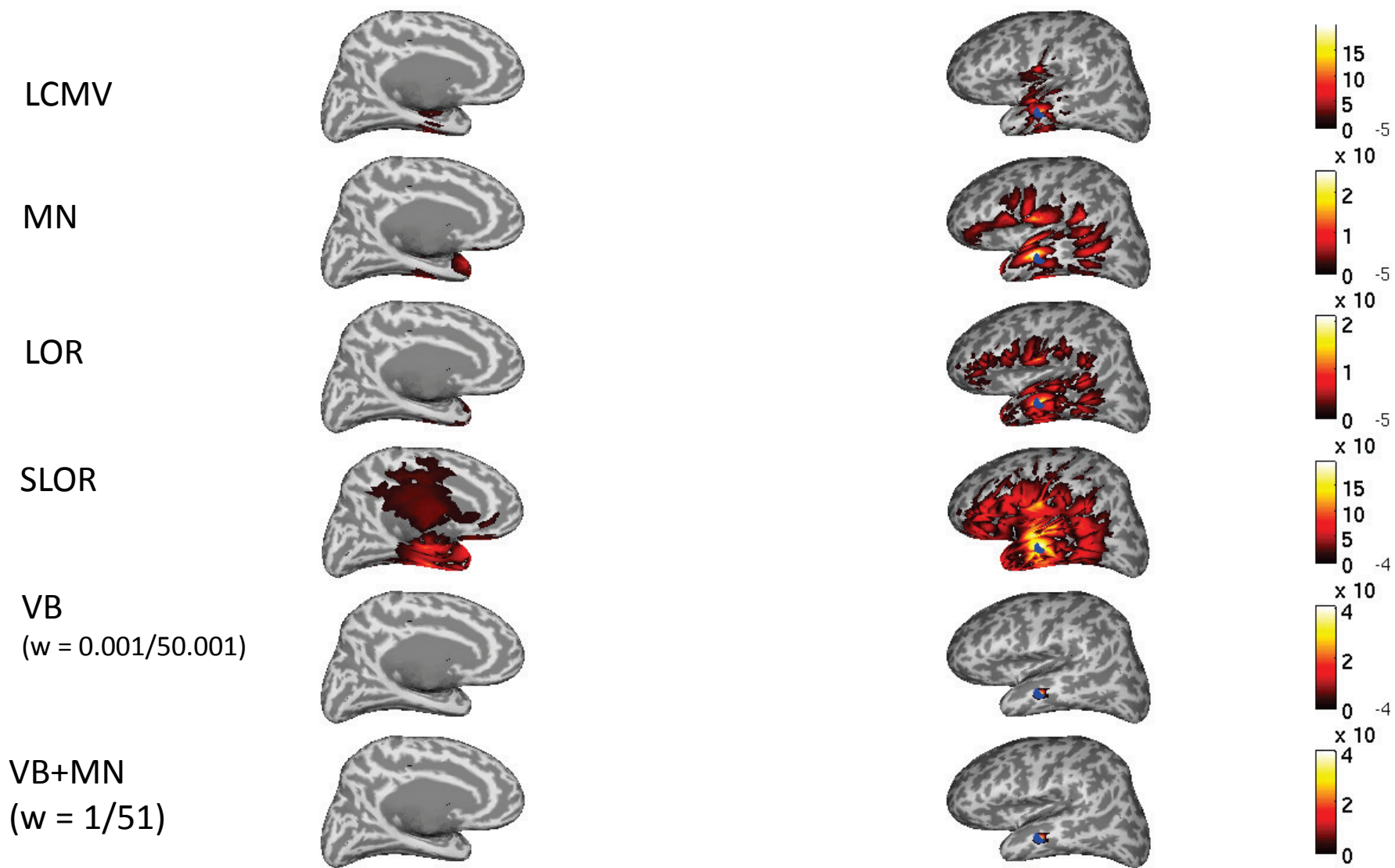
VB
($w = 0.001/50.001$)



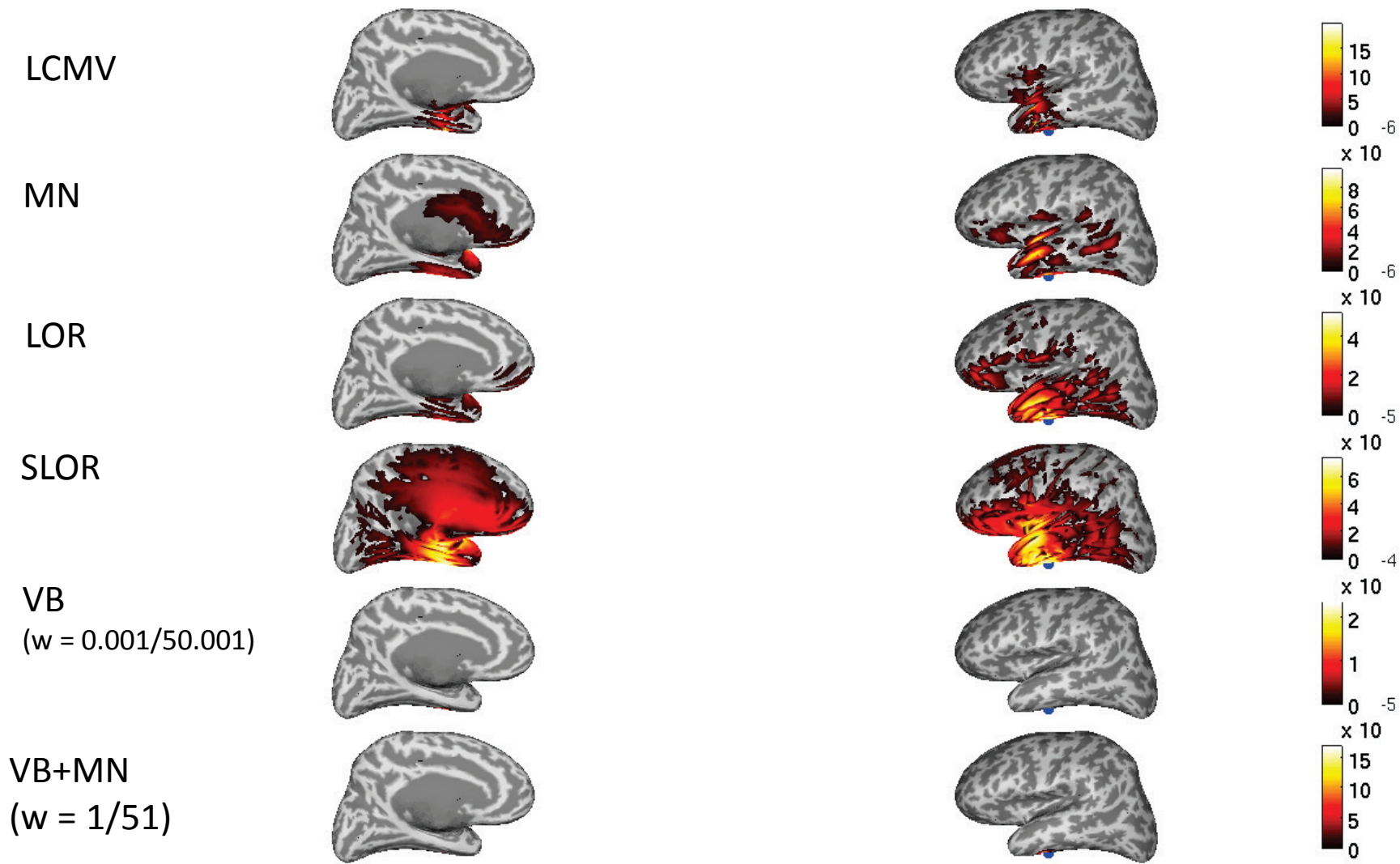
VB+MN
($w = 1/51$)



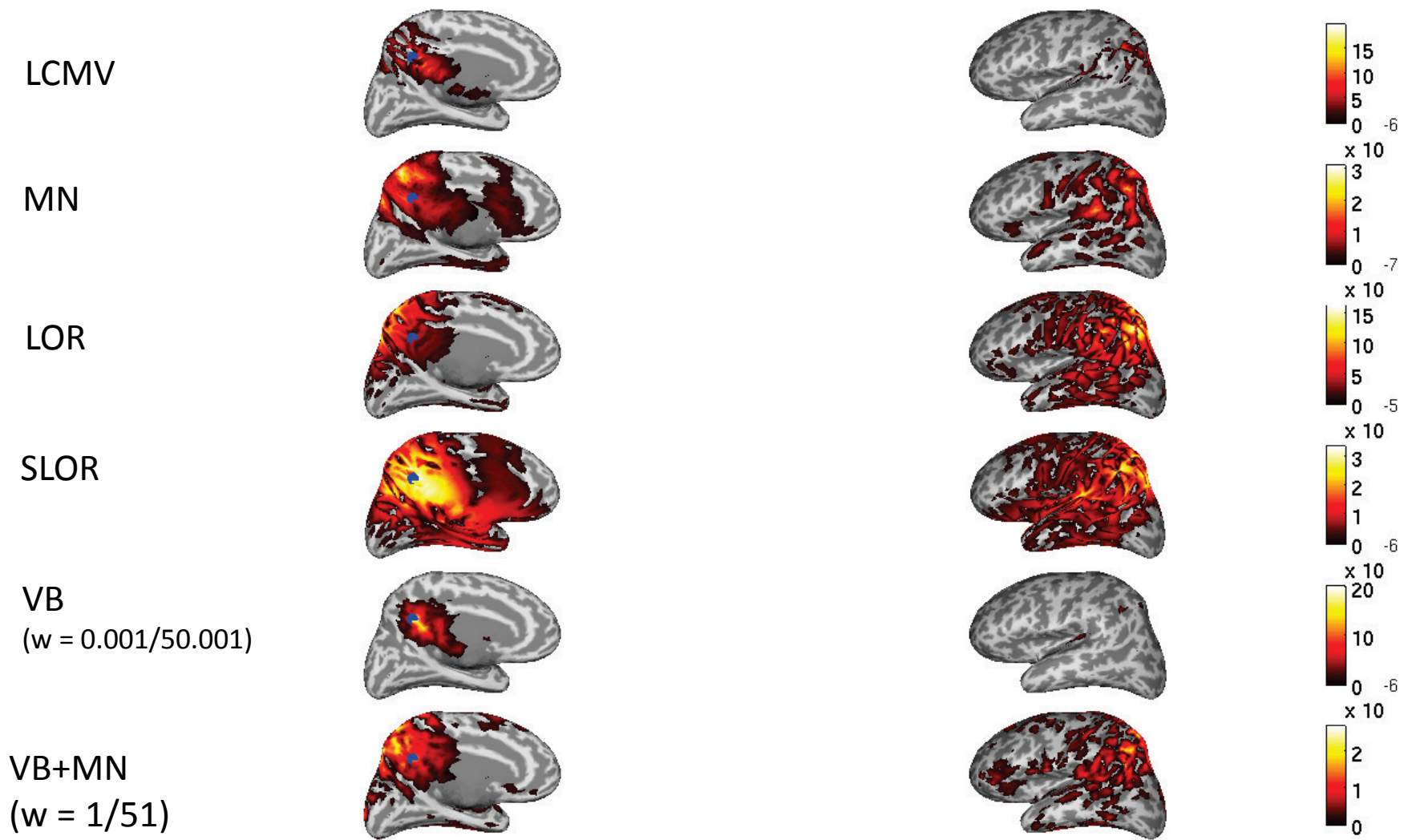
Examples of source localization



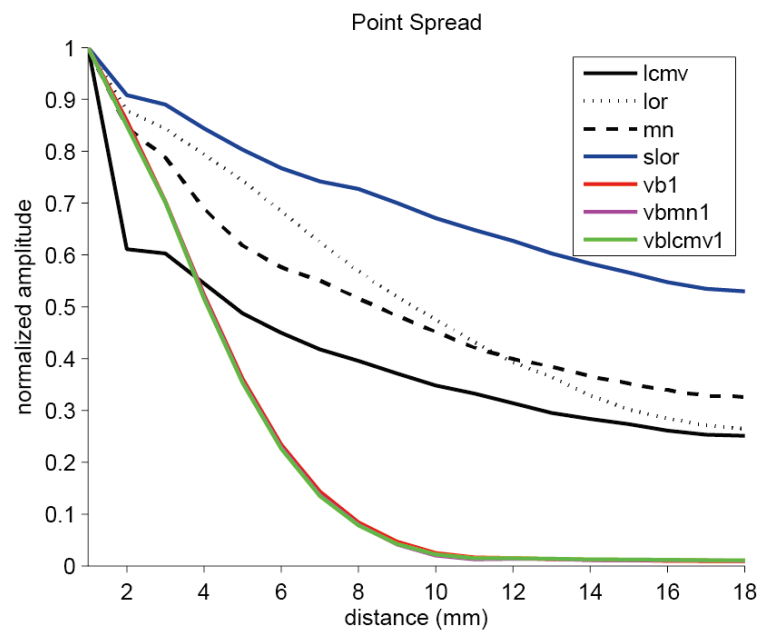
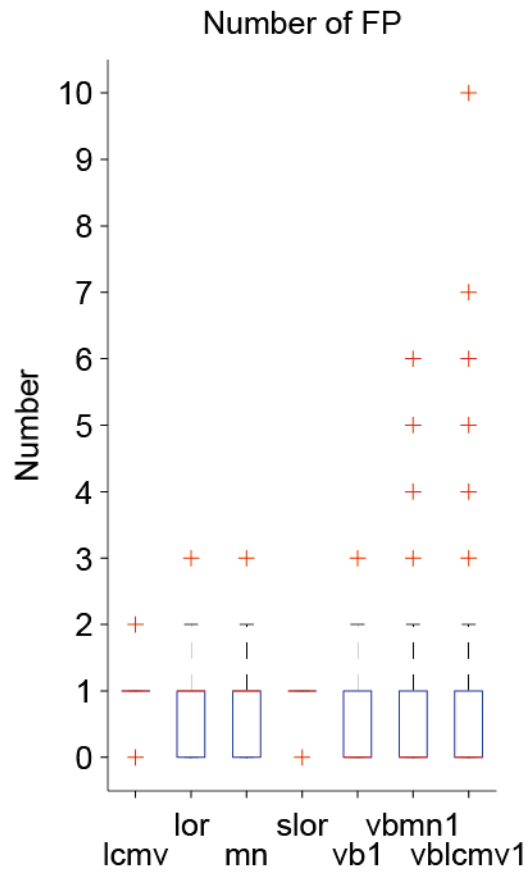
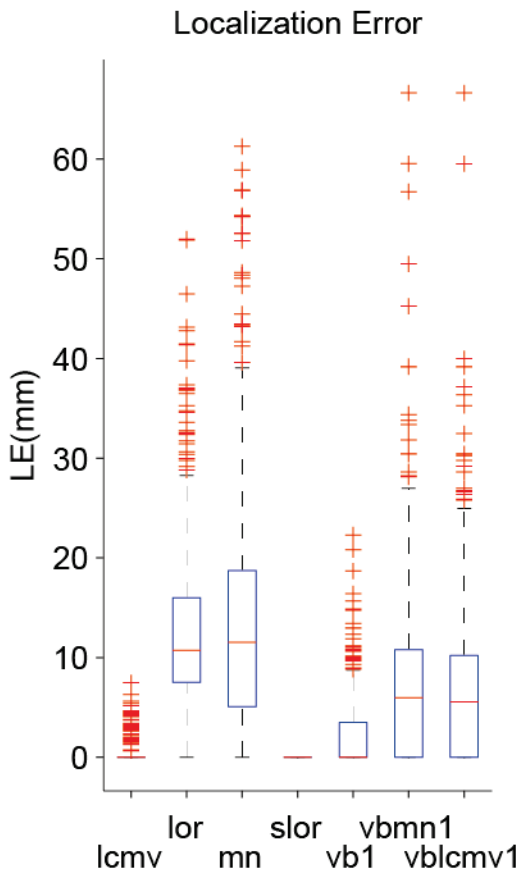
Examples of source localization



Examples of source localization

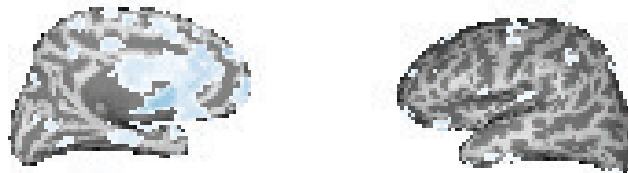


SIM1_1



LE map

LCMV



MN



LOR



SLOR



VB

($w = 0.001/50.001$)



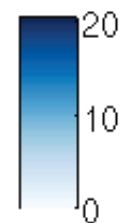
VB+MN

($w = 1/51$)



VB+LCMV

($w = 1/51$)



**LE map
(LE >
10mm)**

LCMV

MN

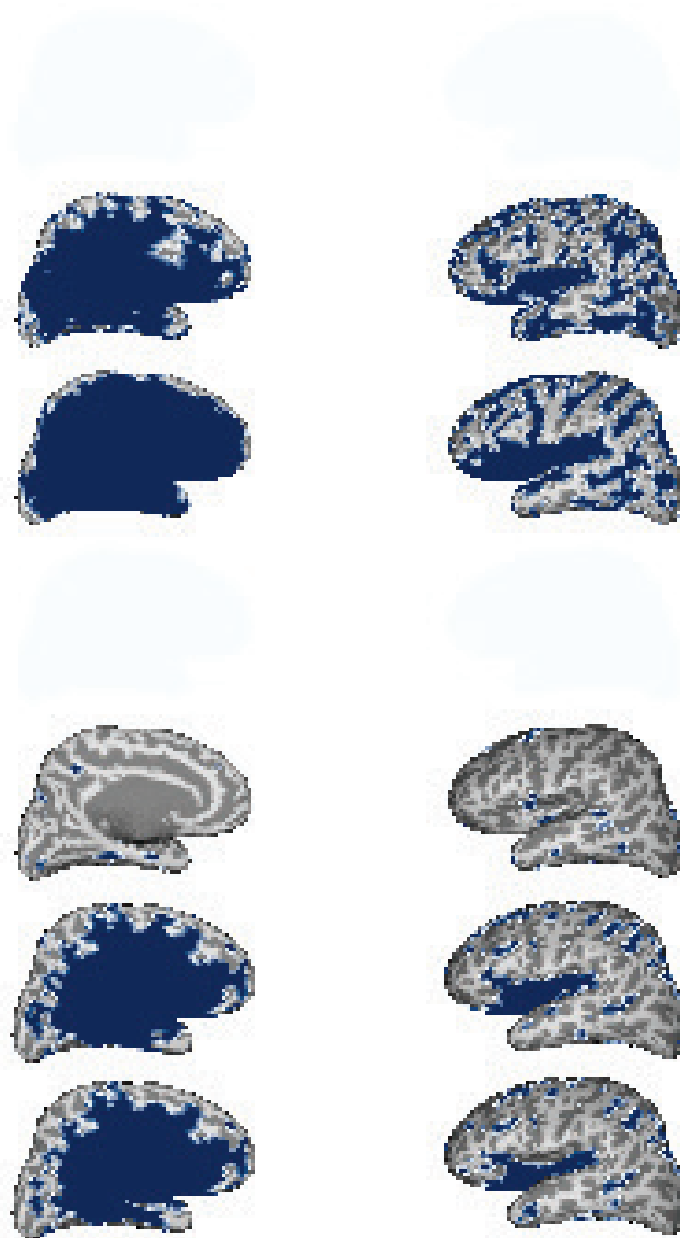
LOR

SLOR

VB
(w = 0.001/50.001)

VB+MN
(w = 1/51)

VB+LCMV
(w = 1/51)

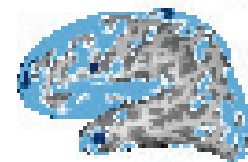


FP map

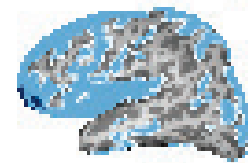
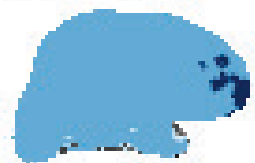
LCMV



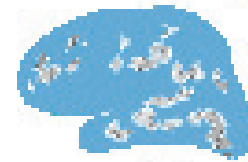
MN



LOR

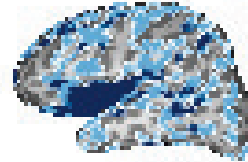
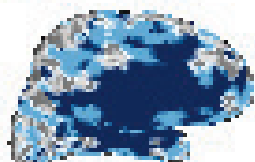


SLOR



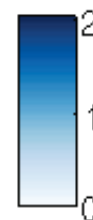
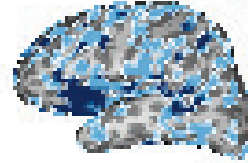
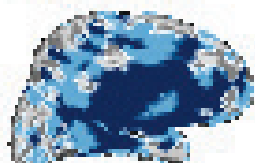
VB

($w = 0.001/50.001$)



VB+MN

($w = 1/51$)



Conclusions

- LCMV, sLORETA : $LE=0$ for all the cases which is expected from theory (see Sekihara paper 2005), often observed false positives, wide point spread
- MN, LORETA : Large $LE (\geq 10\text{mm})$, often observed false positives, wide point spread
- VB : almost no $LE (\sim 0\text{mm})$, no false positives, point spread depends on smoothing filter
- VB+MN : small $LE (\sim 5\text{mm})$, less false positives, point spread depends on smoothing filter