Physiological imaging of sport related head injury

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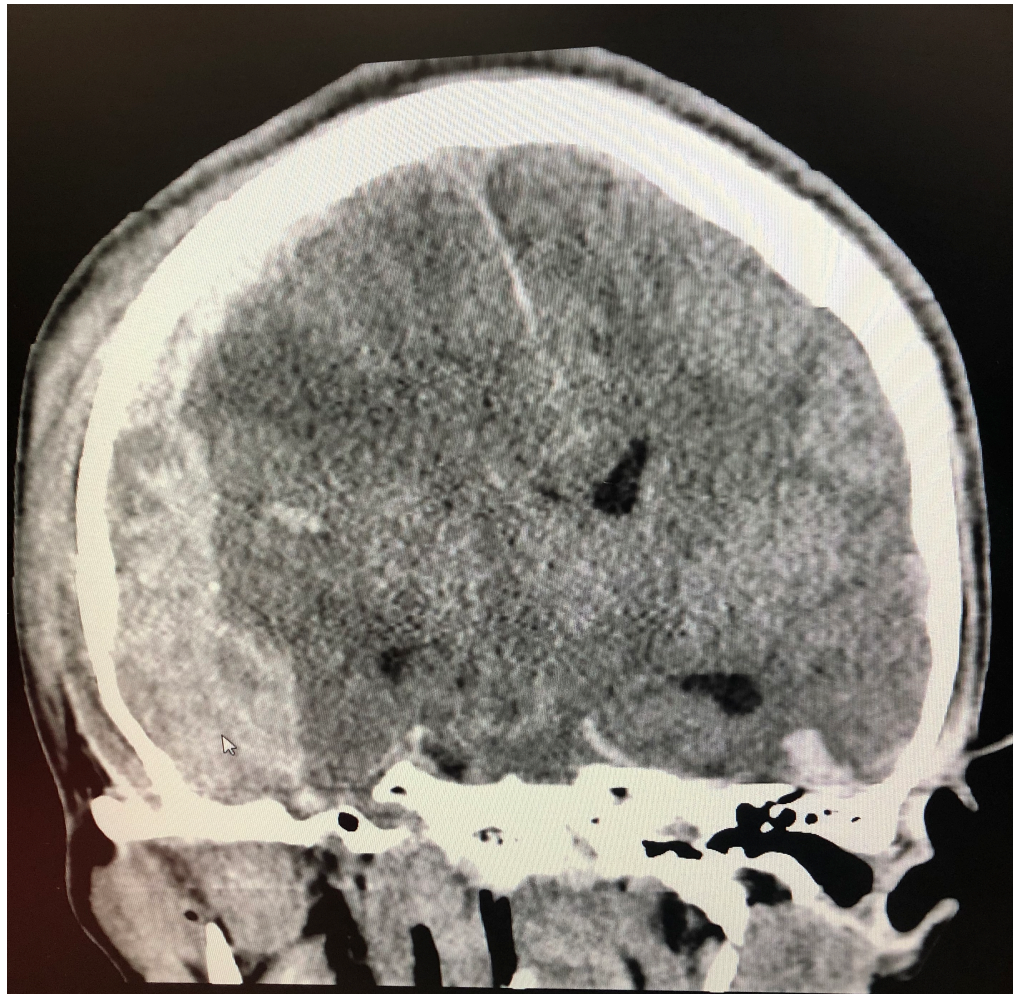
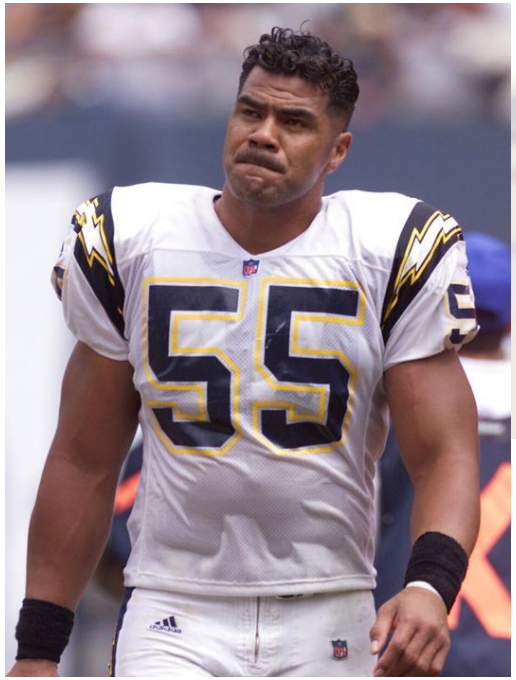
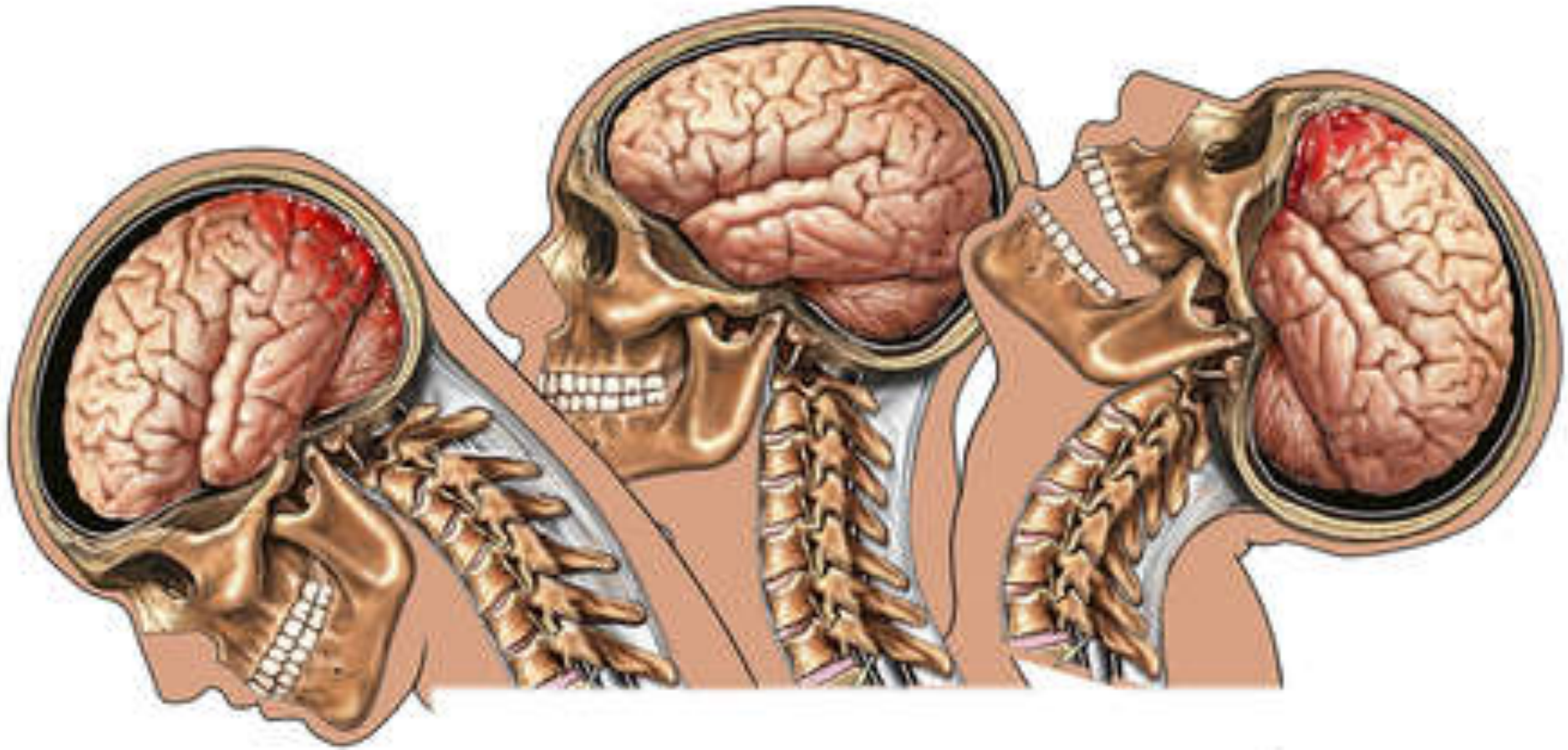
CENTRE FOR NEUROSCIENCE STUDIES
AT QUEEN'S UNIVERSITY

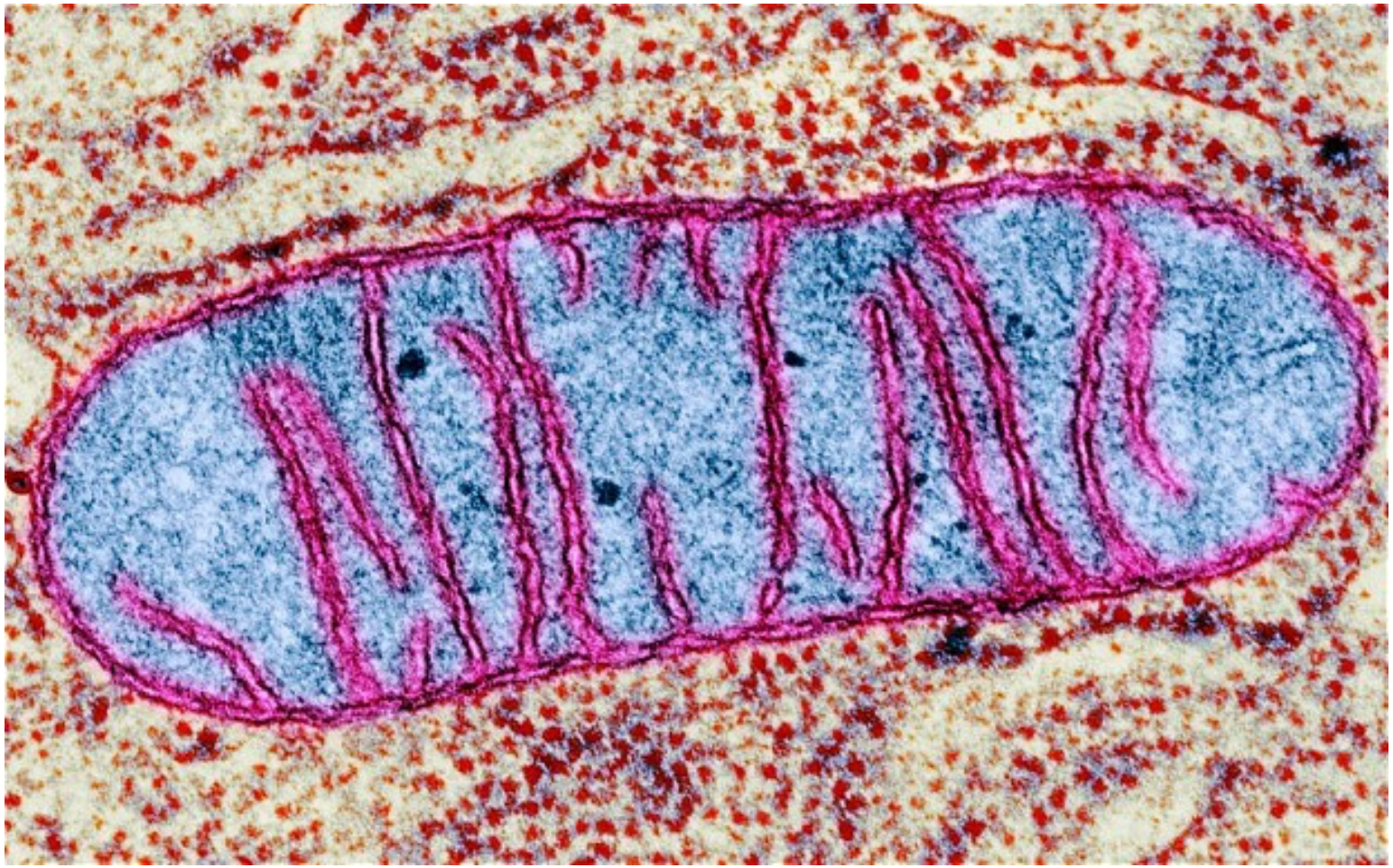


R
P
4.8 L
2.9 P
16.3 F
FRAME: 1/1
ECHO: 1/1
SLICE: 17/28
HEAD





Concussion as a Metabolic Syndrome

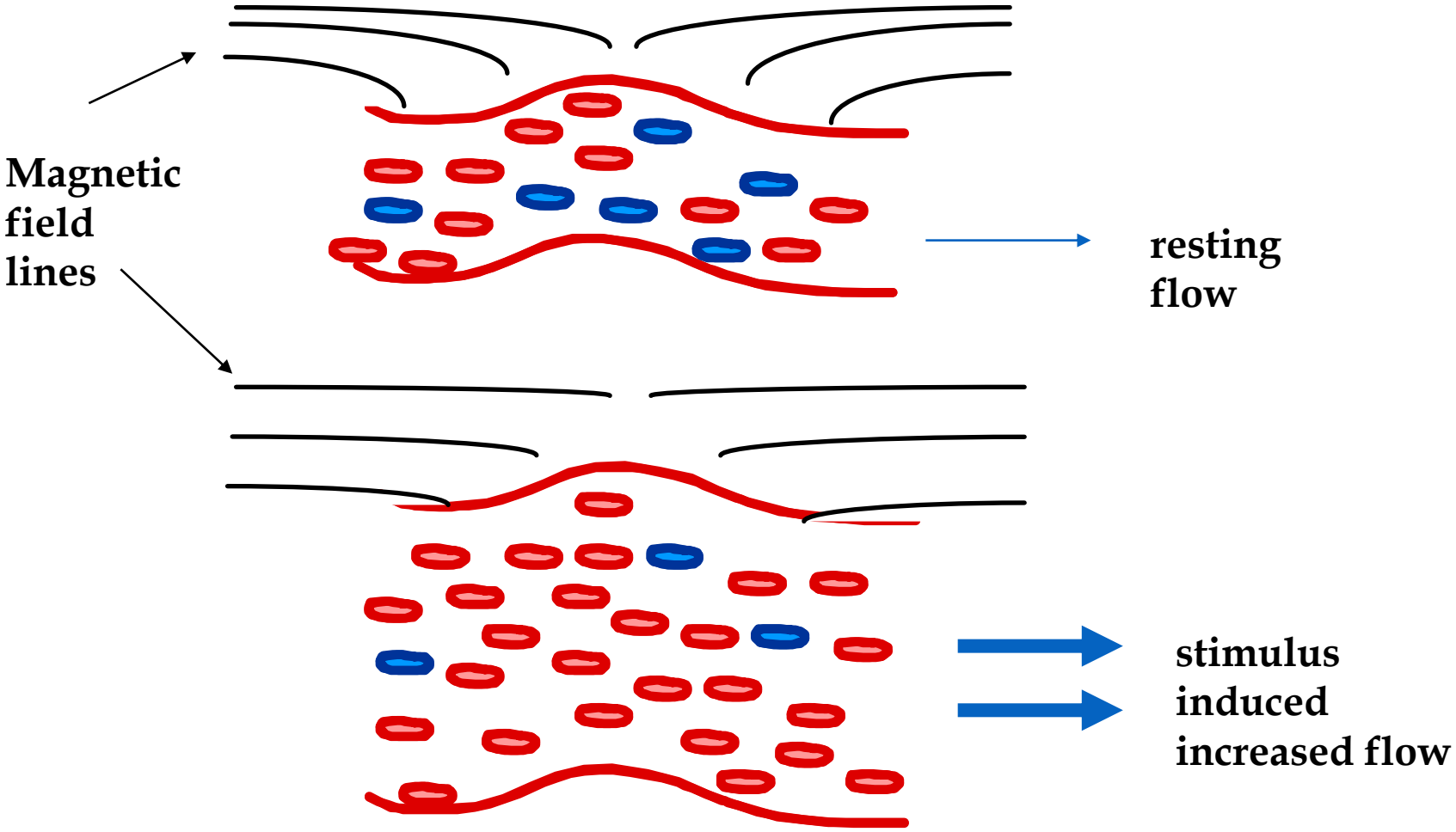


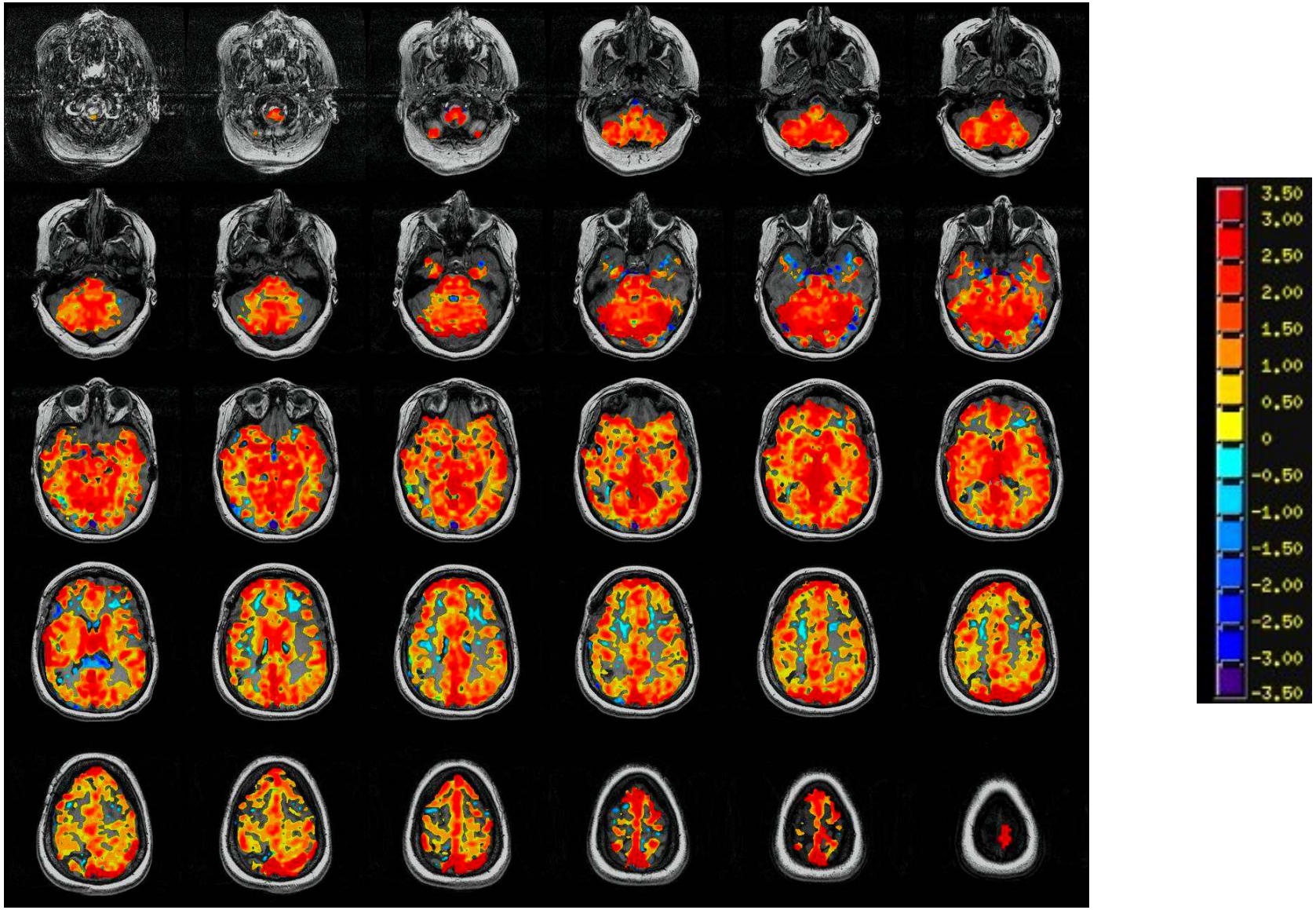
Following Initial Injury:
-Vulnerability to Subsequent Injury
-Exacerbation of Symptoms: Activity, Cognition, Screen time, Lack of Sleep
-Rest as an element of recovery

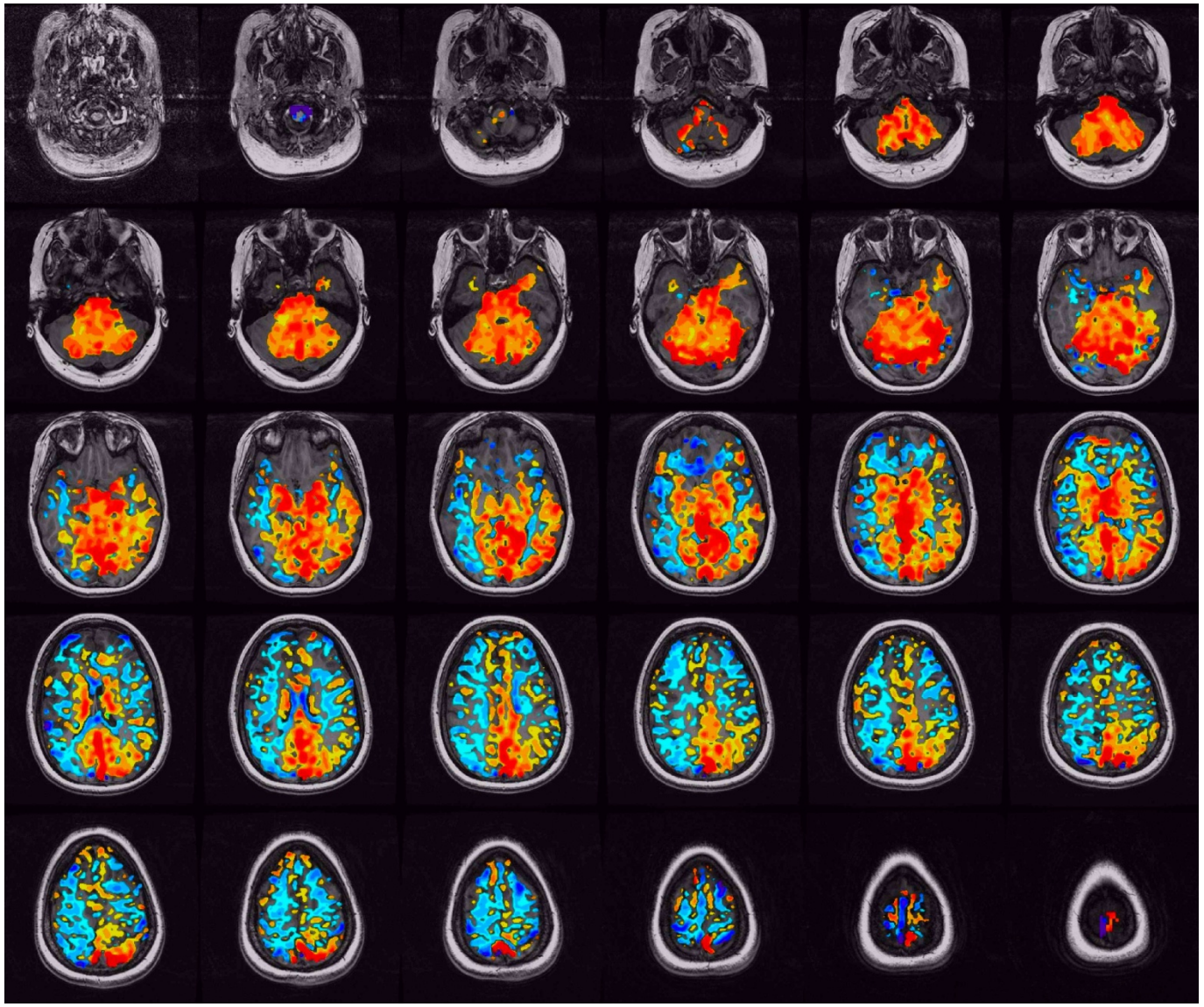
***THEREFORE IMAGING METABOLISM AS BIOMARKER OF CONCUSSION**

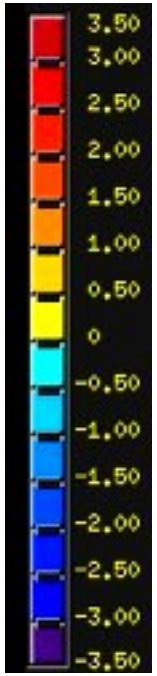
Imaging Cerebrovascular Autoregulation

Blood Oxygen Level Dependent "BOLD" MRI




3.50
3.00
2.50
2.00
1.50
1.00
0.50
0
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50




3.50
3.00
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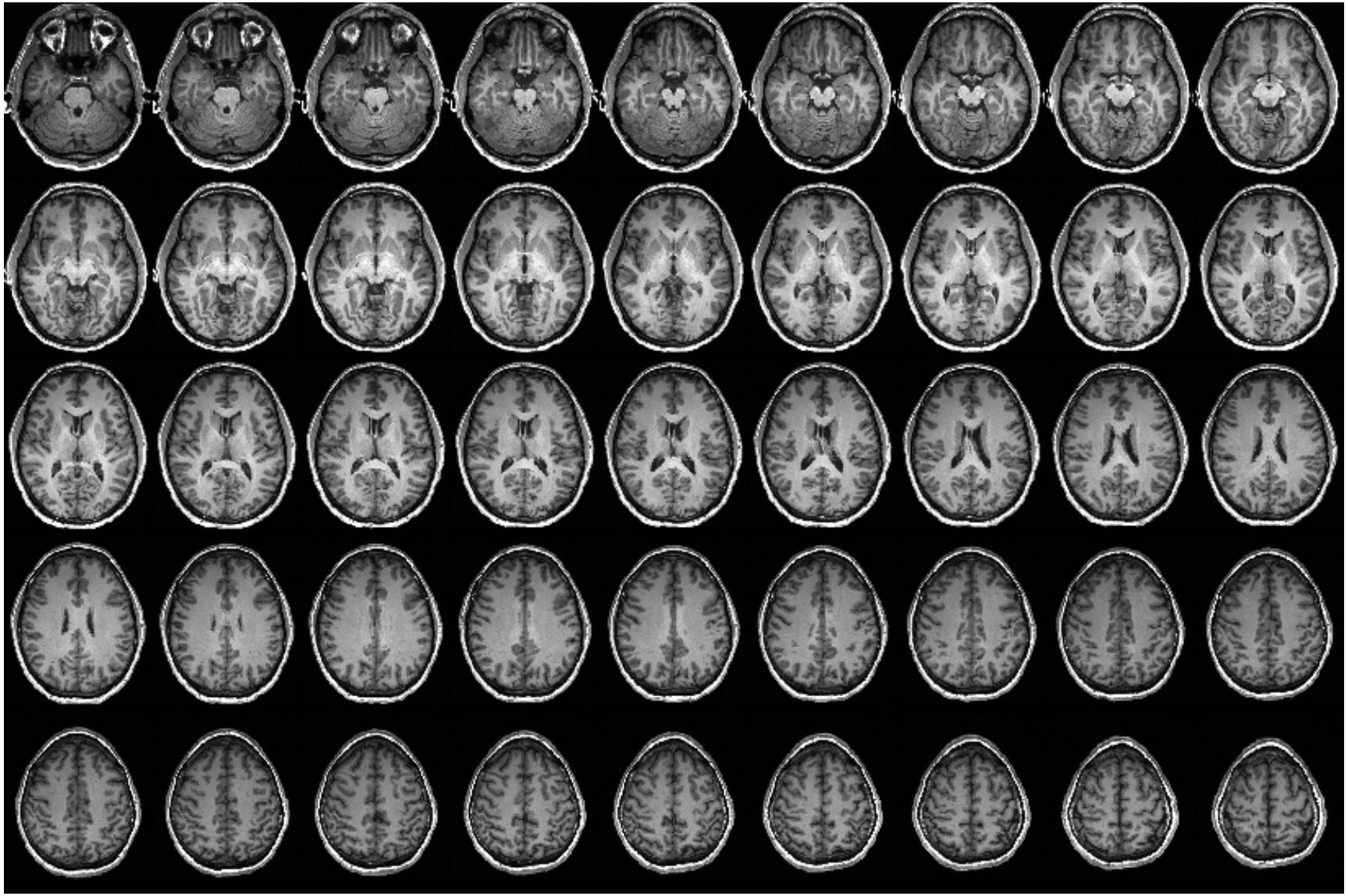
1.50
1.00
0.50
0
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50

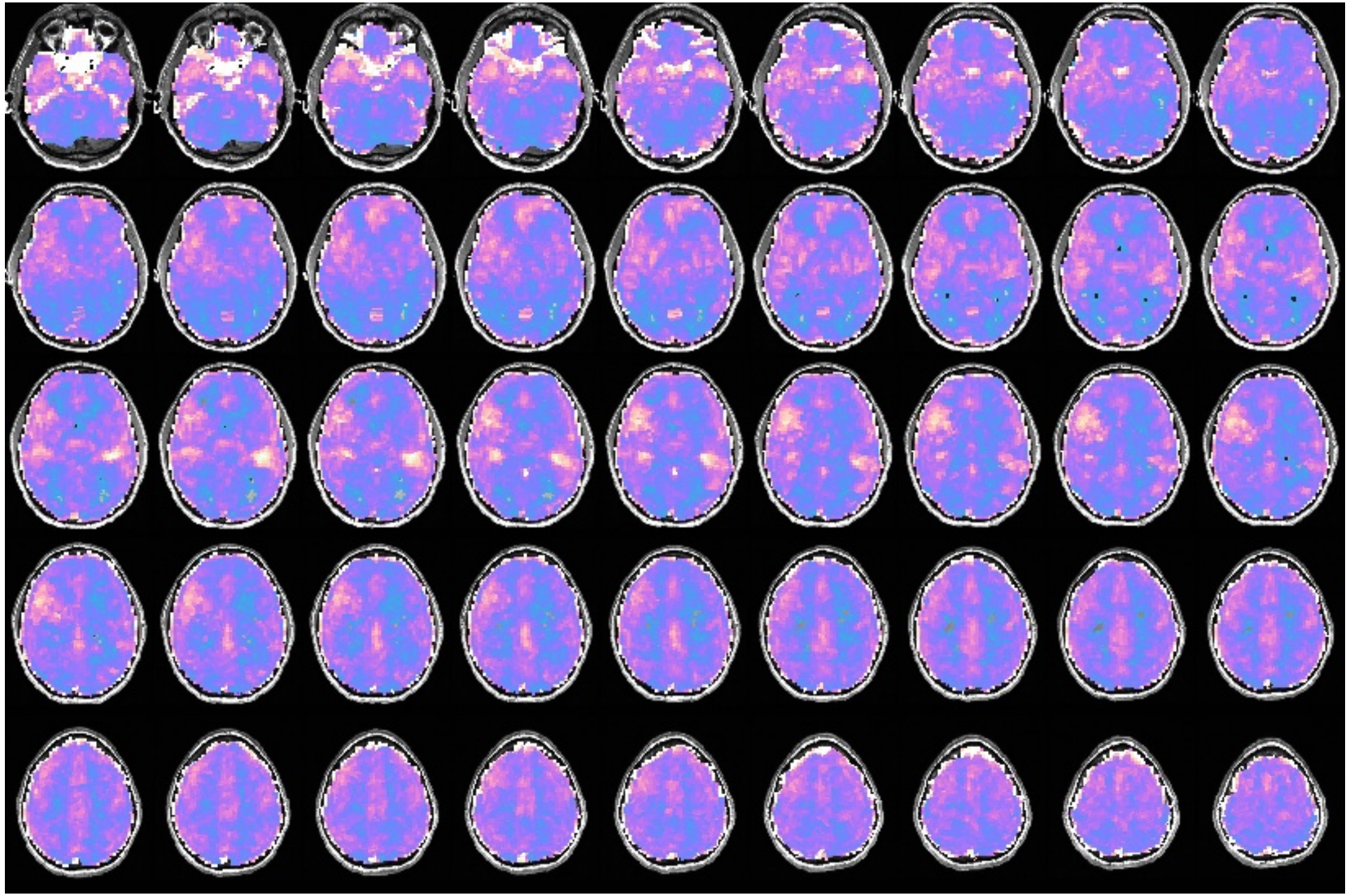
Imaging Acute Injury

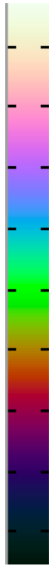
- 32yo hockey player
- Left side check with right temple area striking glass
- Headache 2 days post injury
- Persistent headache and fatigue 7 days post injury
- Scan obtained 8 days post injury
- Symptom inventory 32/122
- Normal neurological examination

T1 MPRAGE

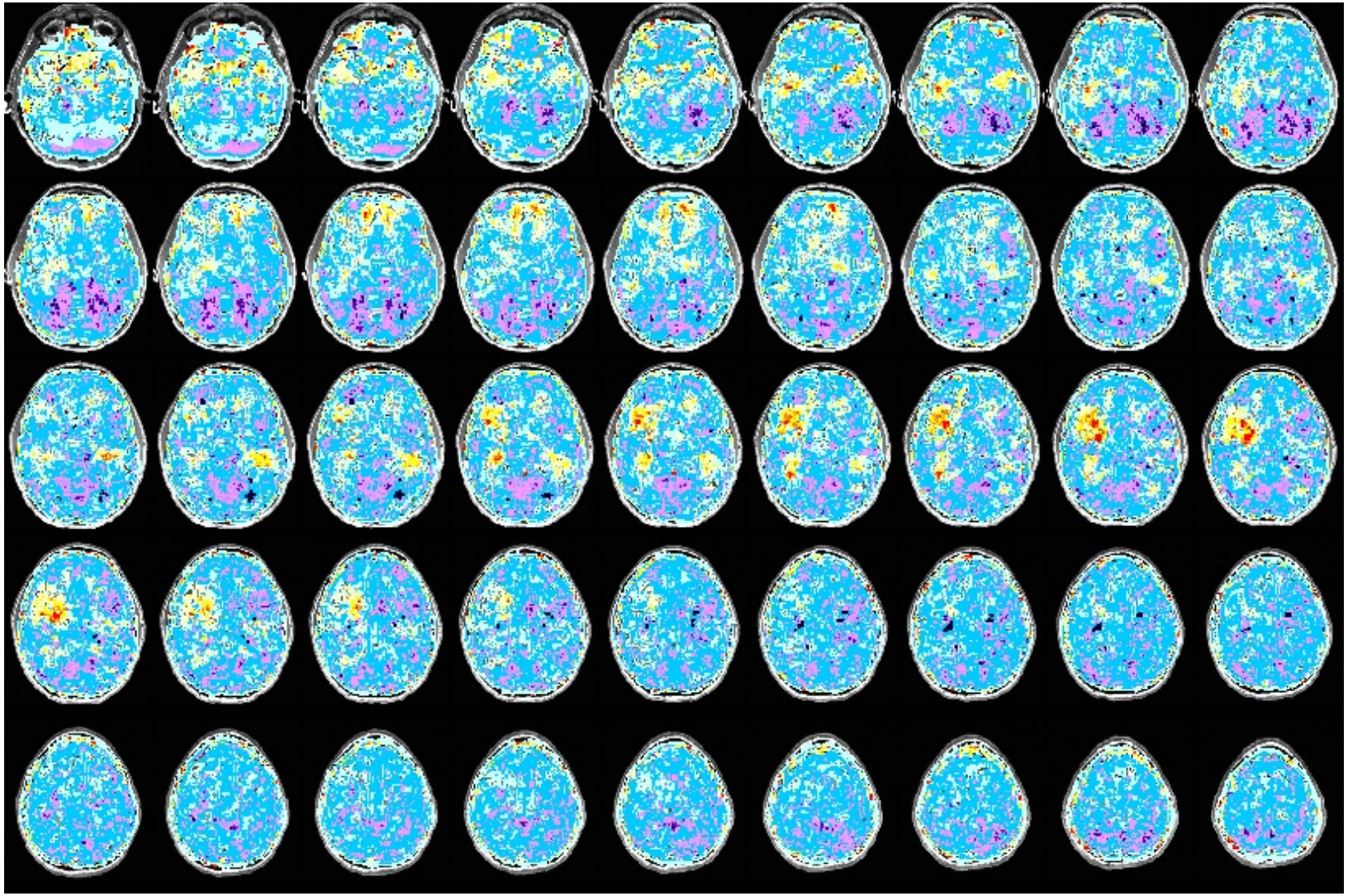


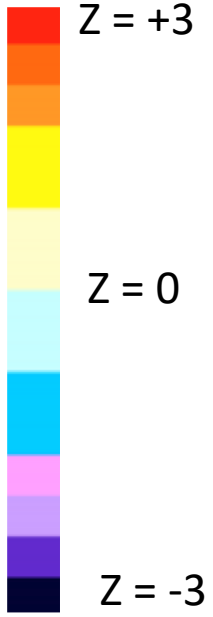
Baseline perfusion map



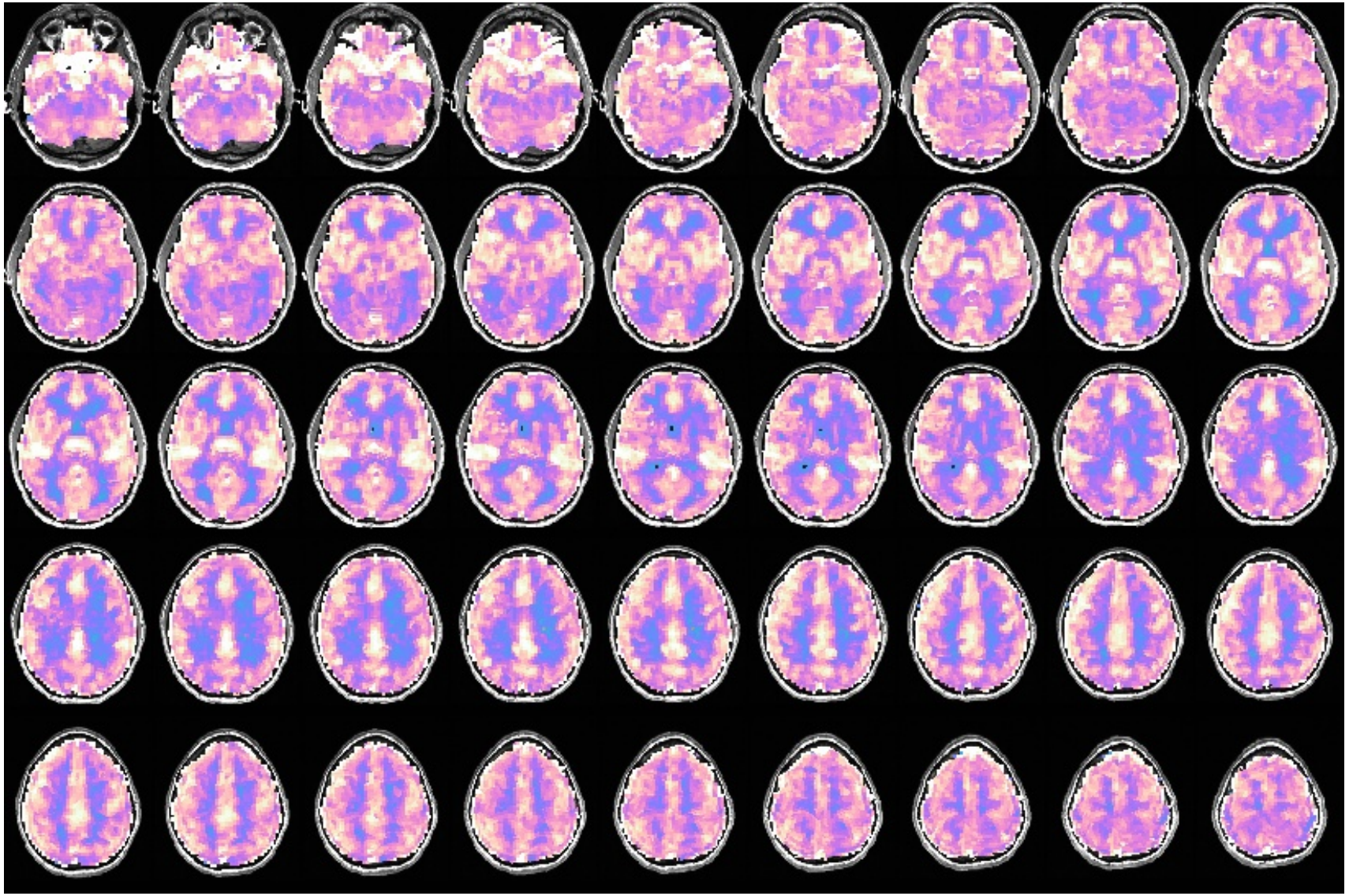


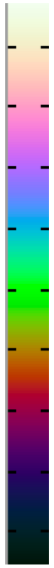
Baseline perfusion Zmap



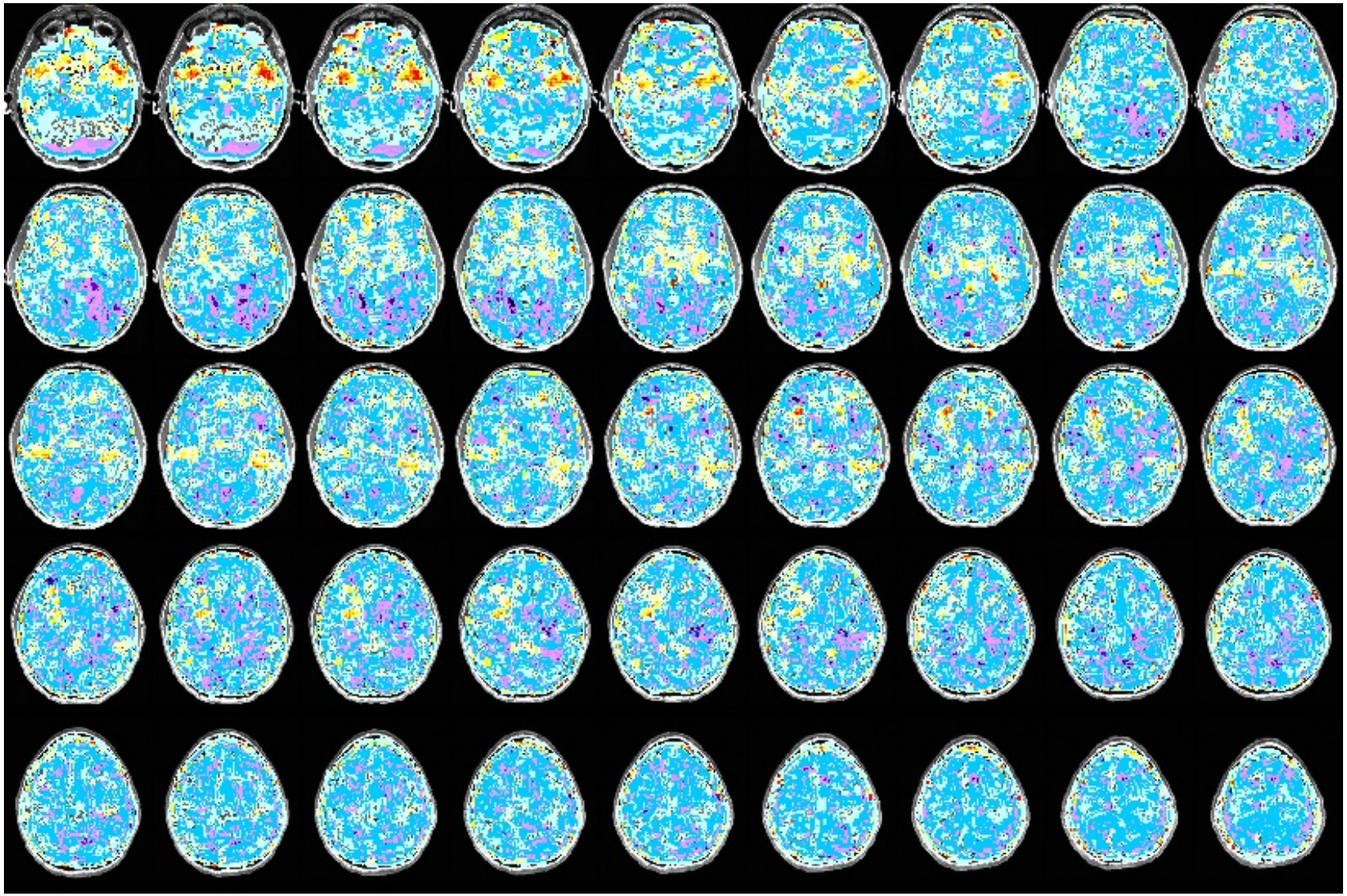


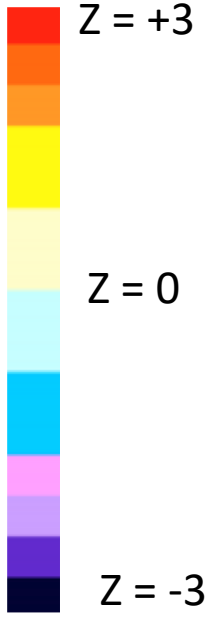
Stimulus perfusion map



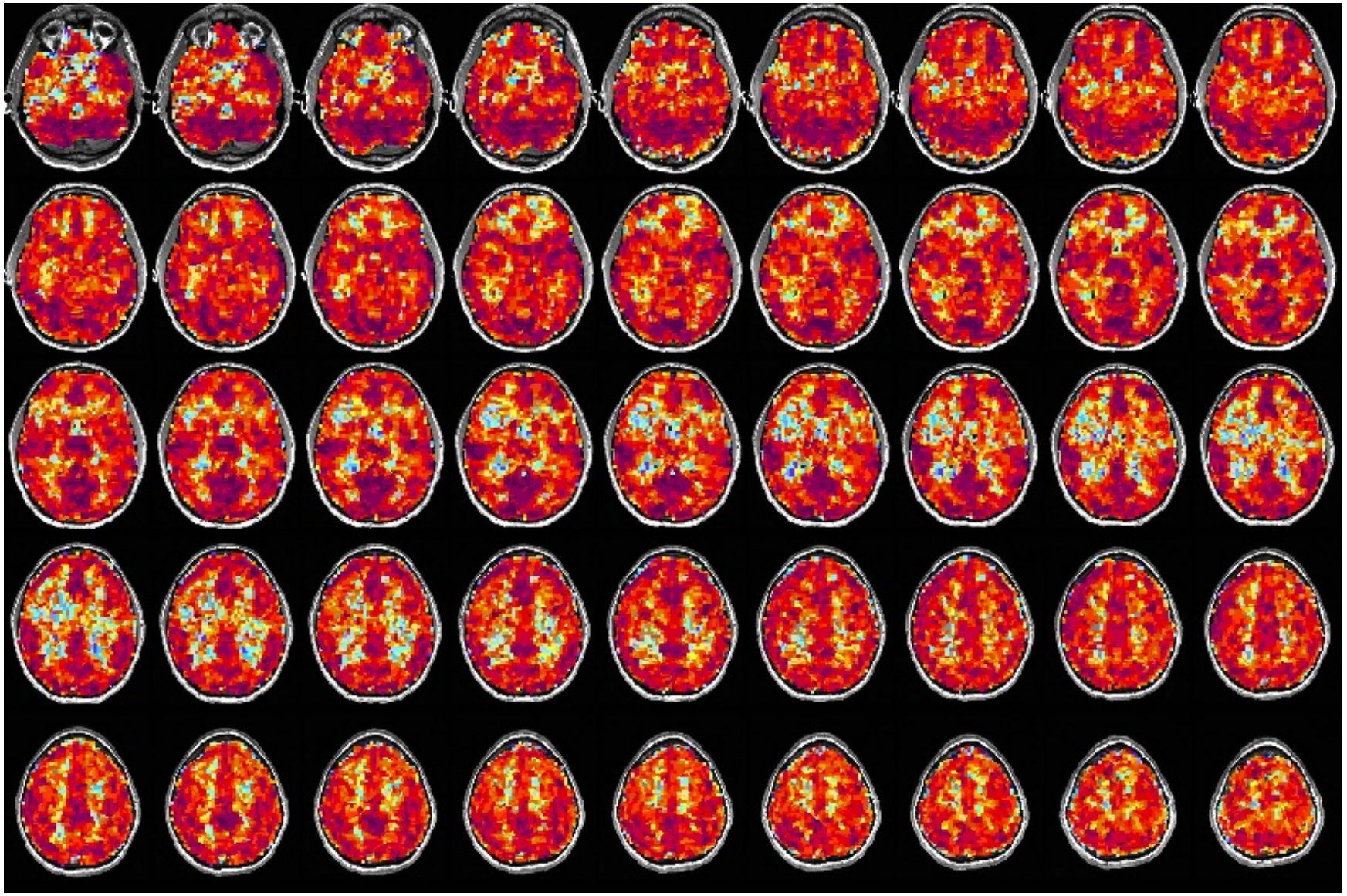


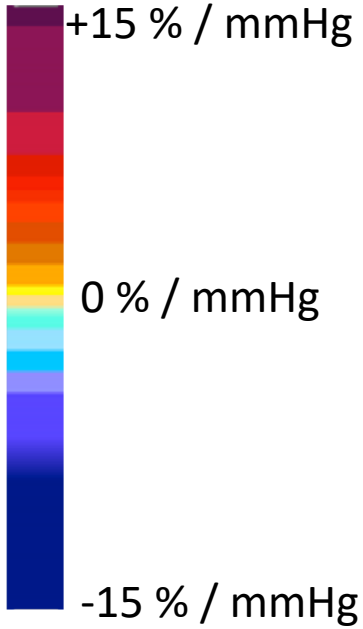
Stimulus perfusion Zmap



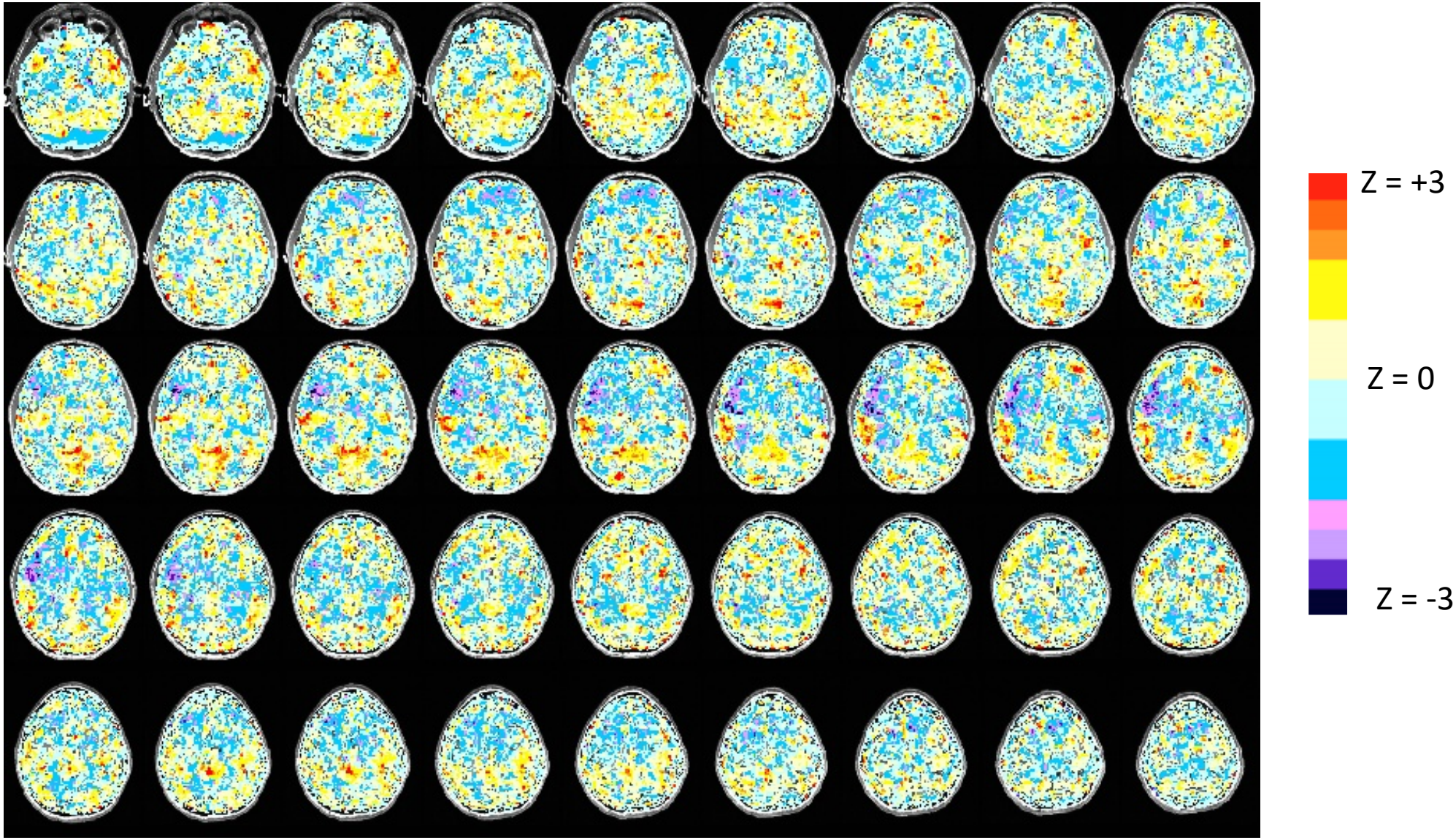


ASL CVR map

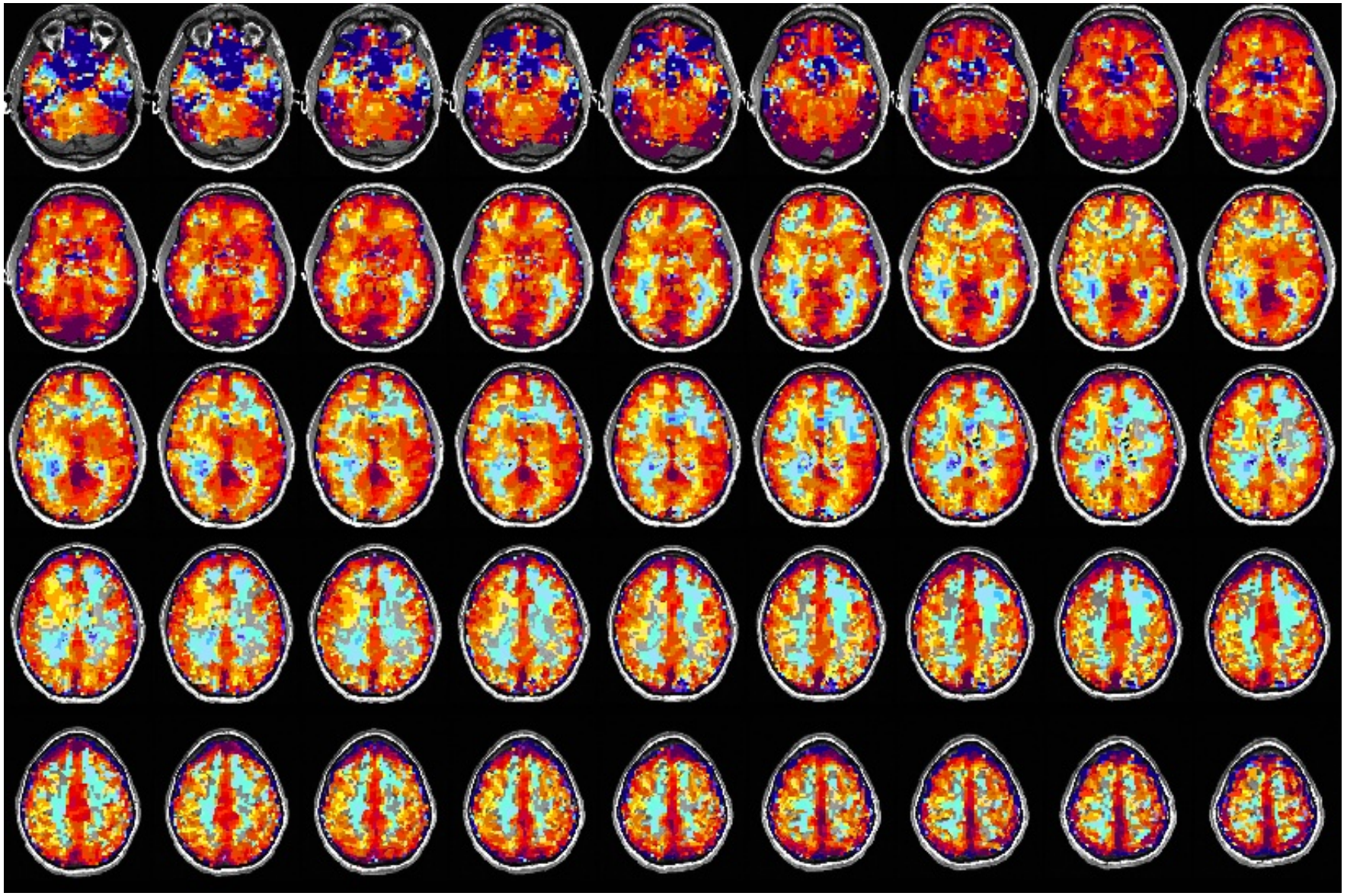


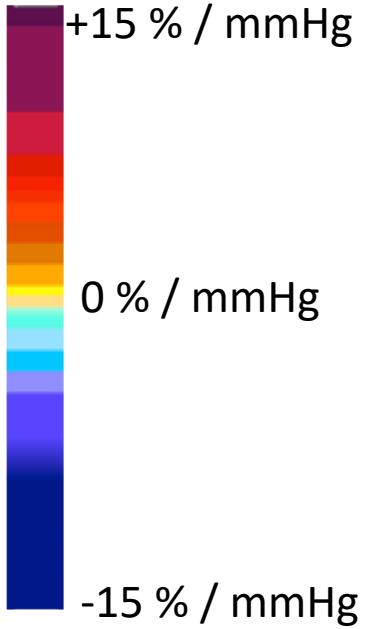


ASL CVR Zmap

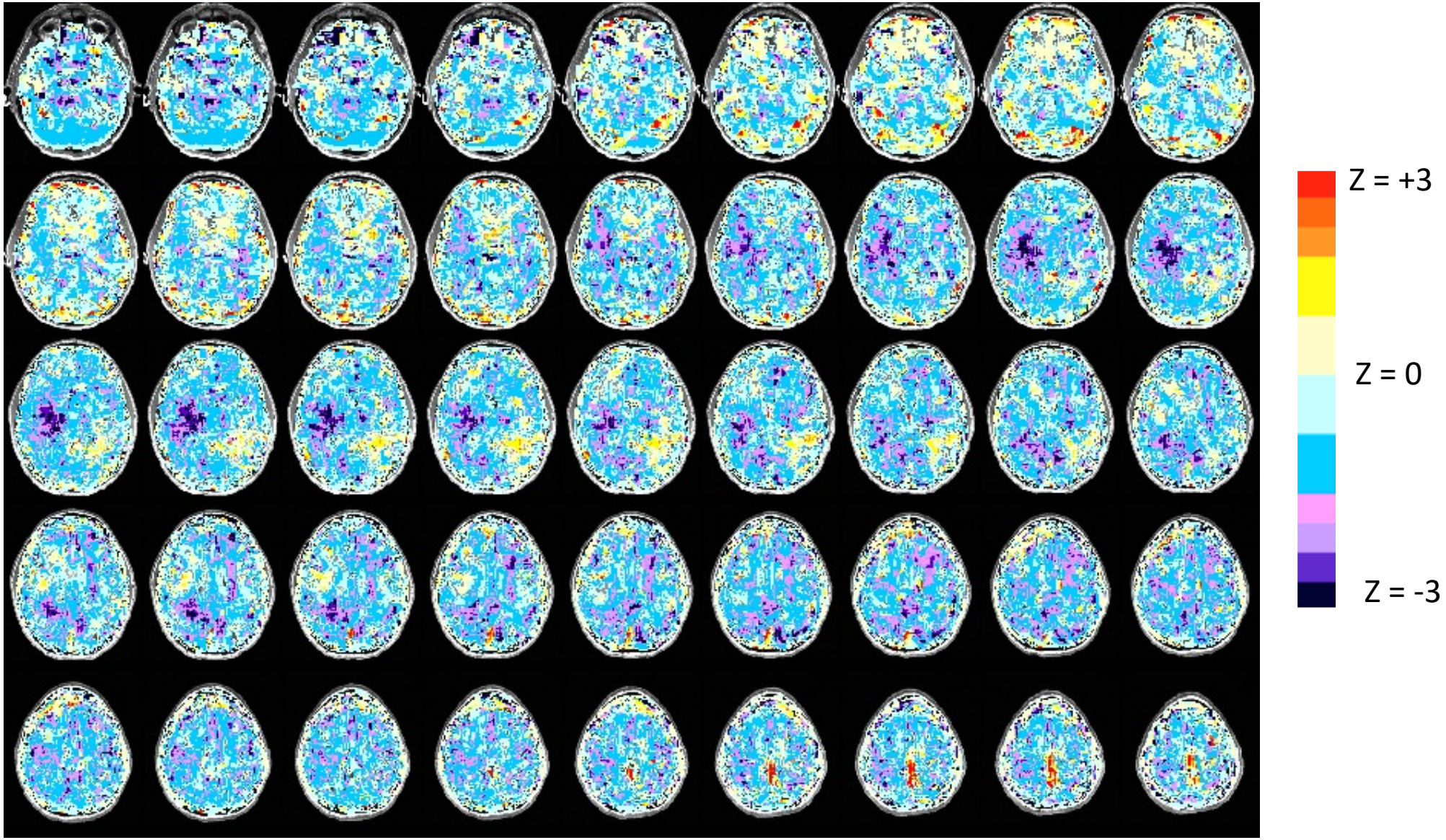


BOLD CVR map



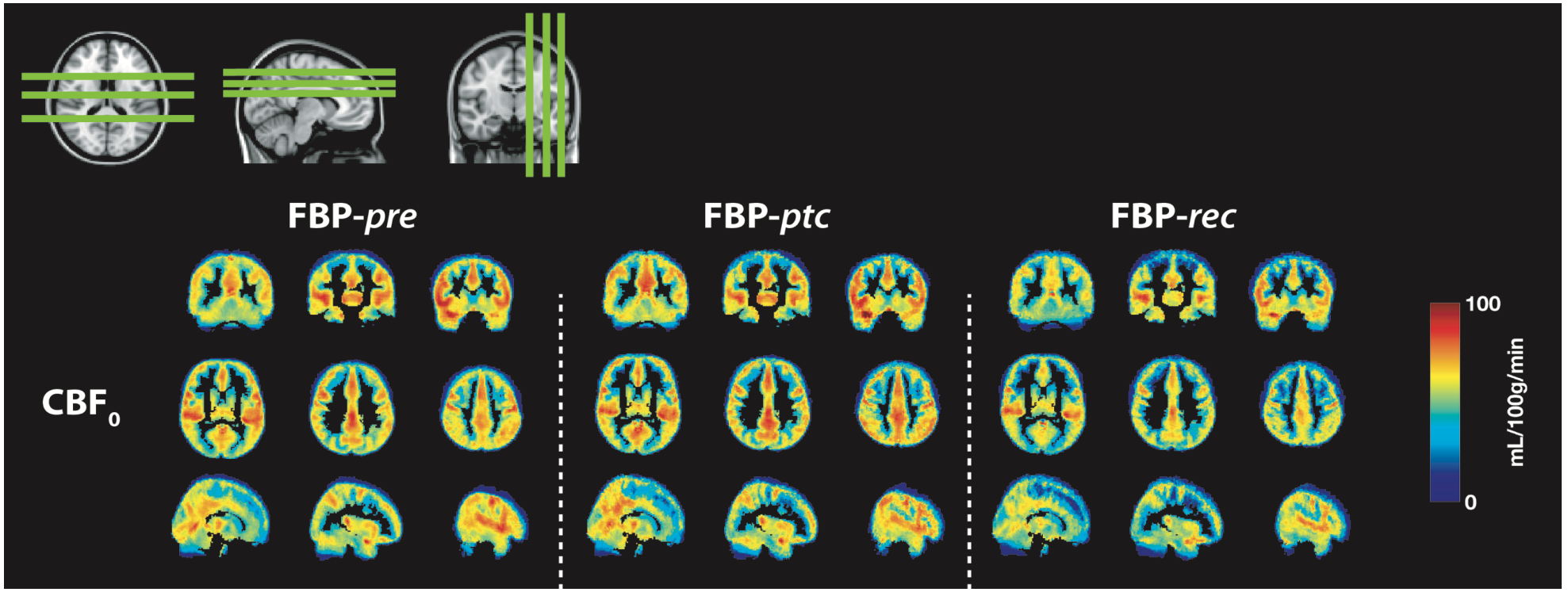


ASL CVR Zmap

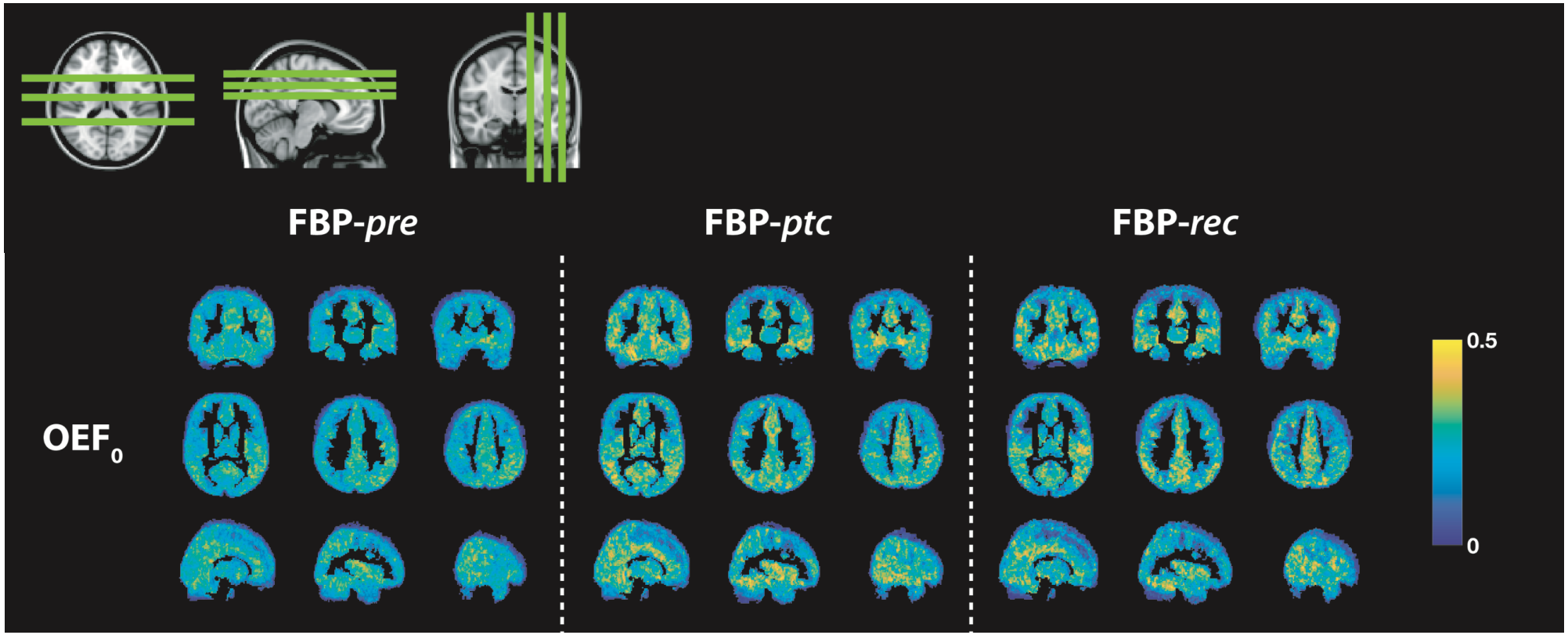


Accumulation of Metabolic Stress in Training and Competition

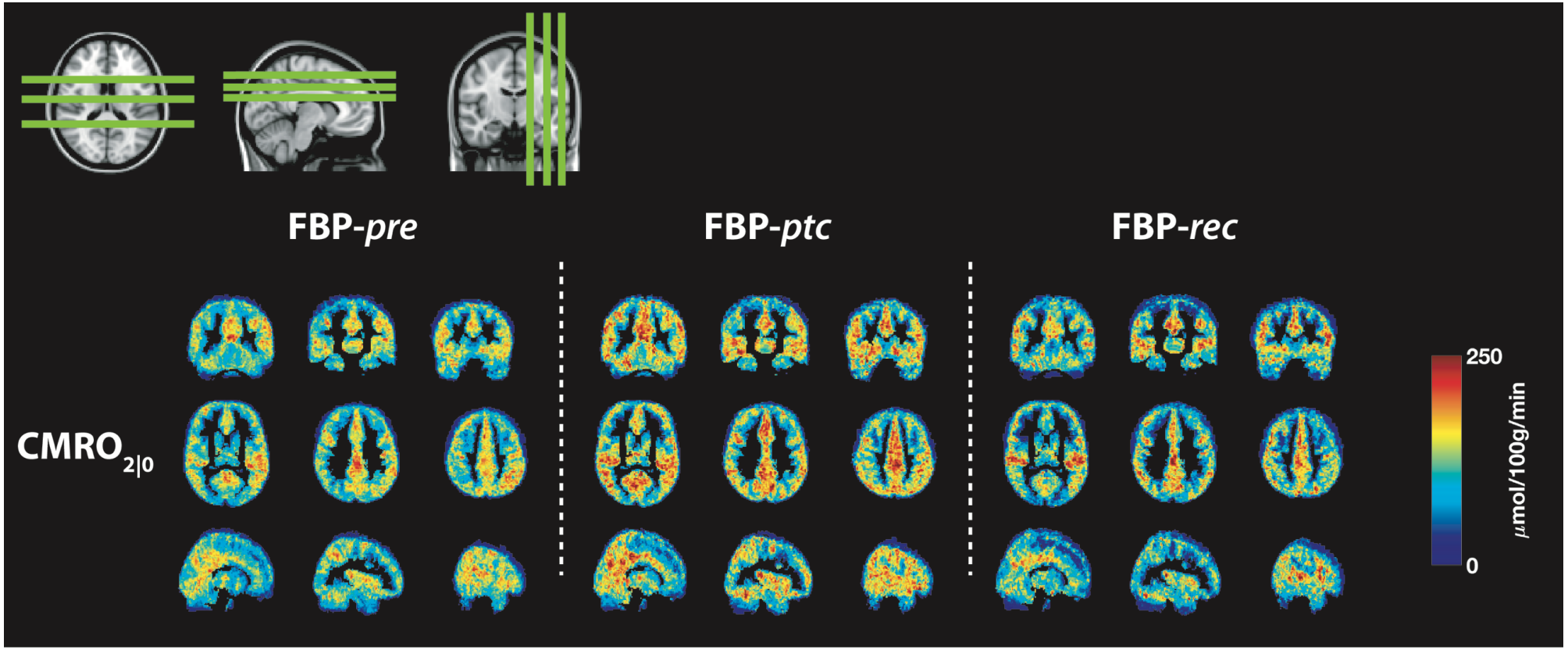
Blood Flow



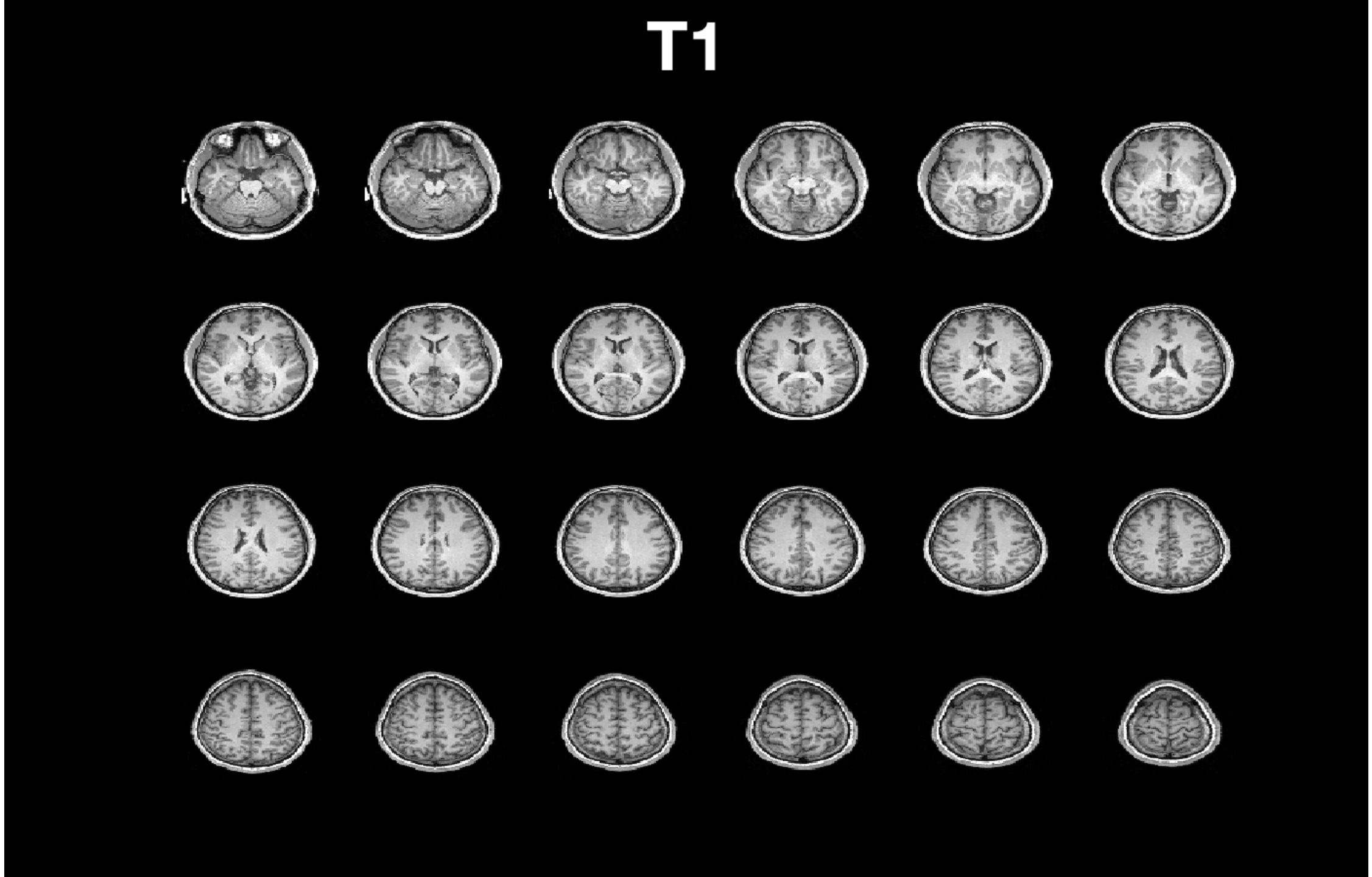
Oxygen Extraction Fraction



Cerebral Metabolic Rate of Oxygen Consumption



Chronic Exposure to TBI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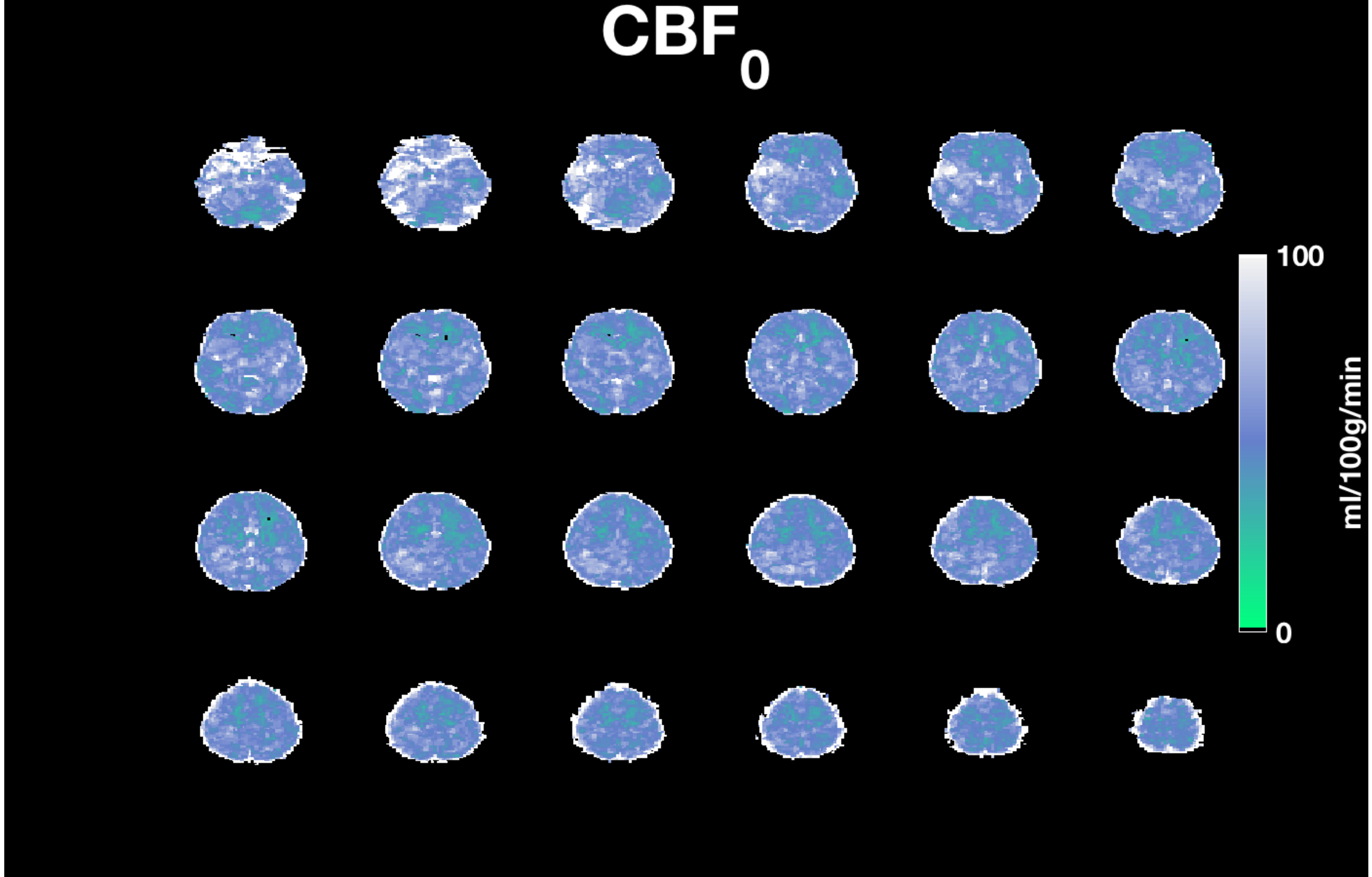
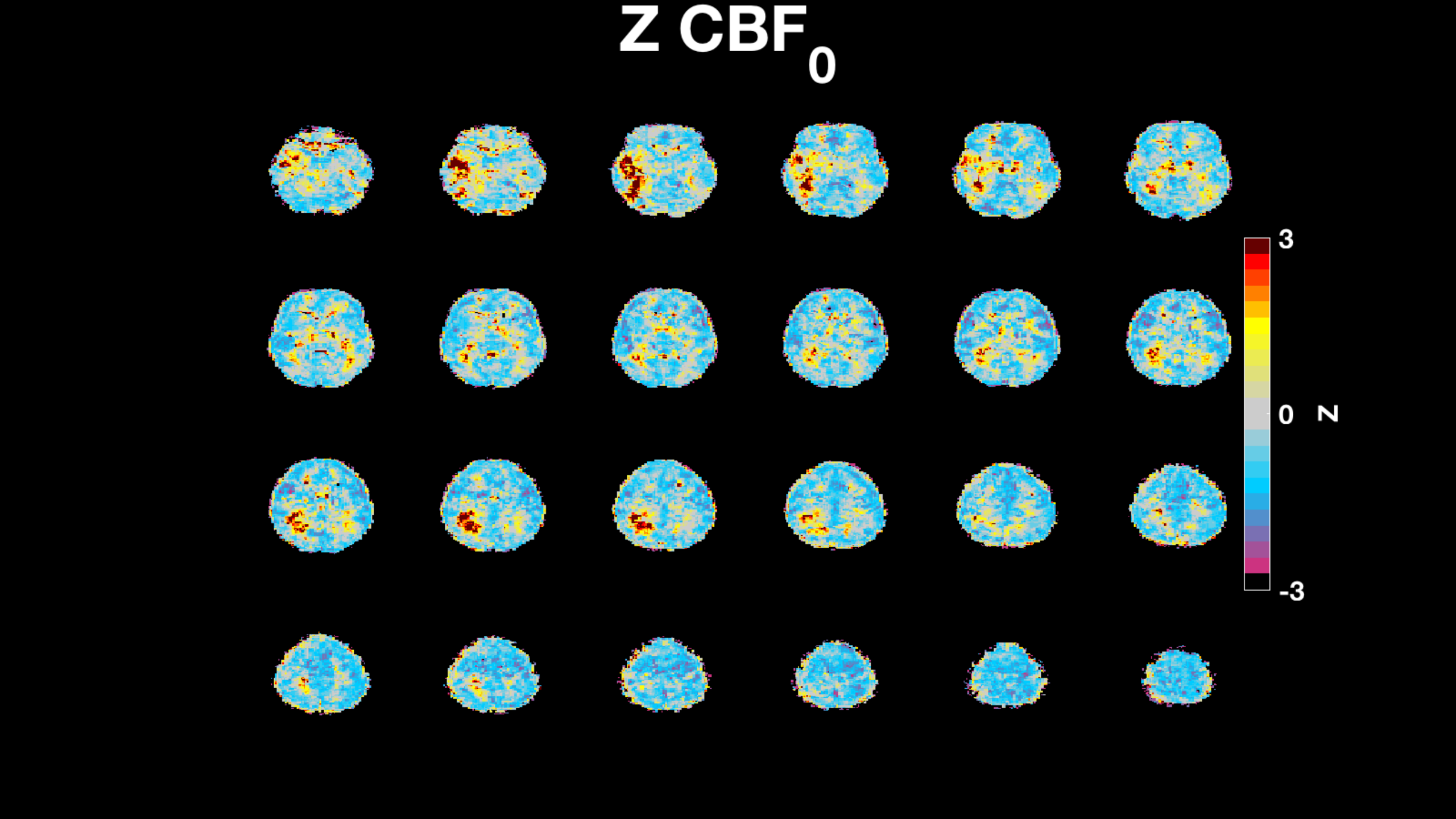
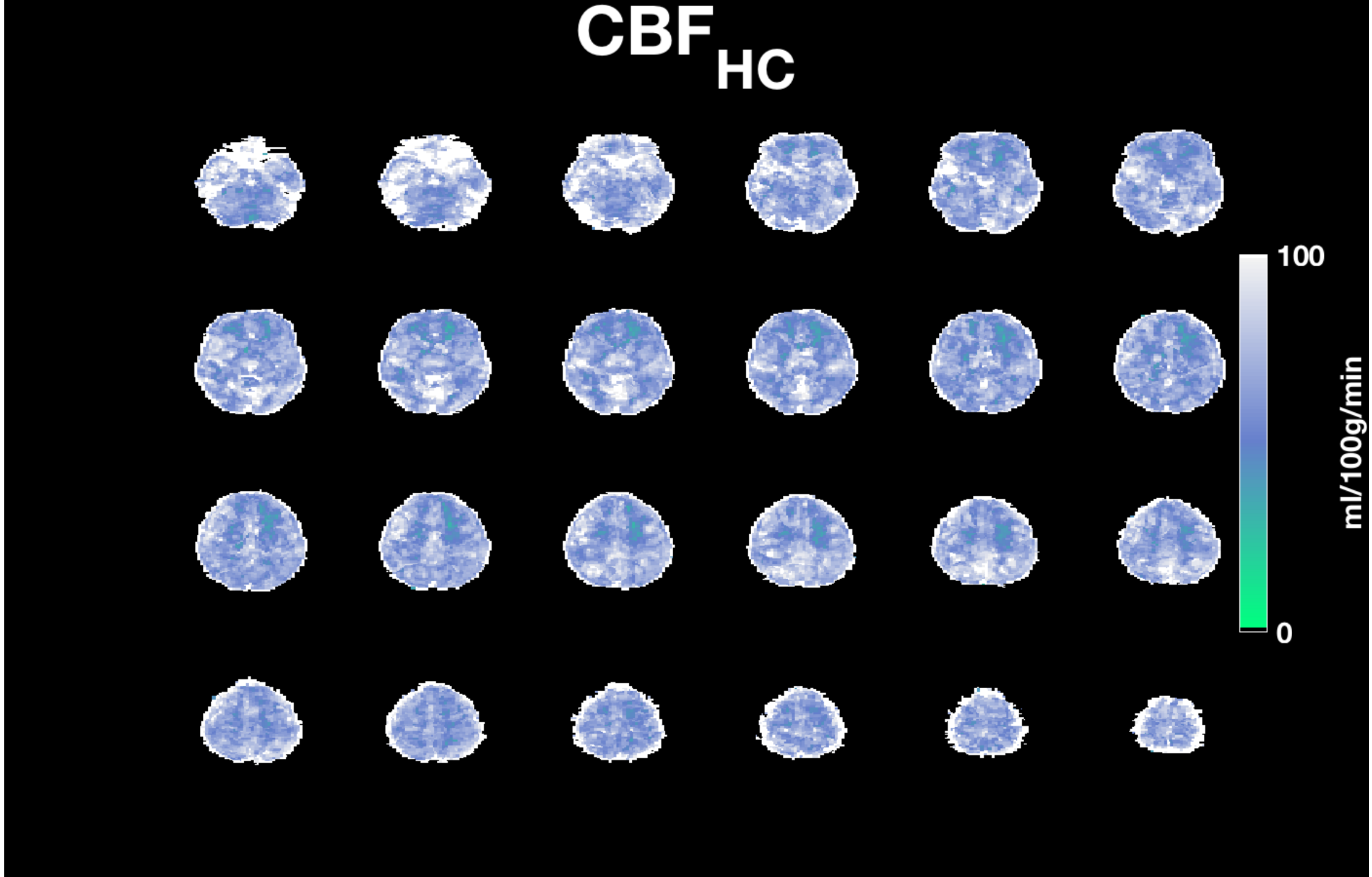
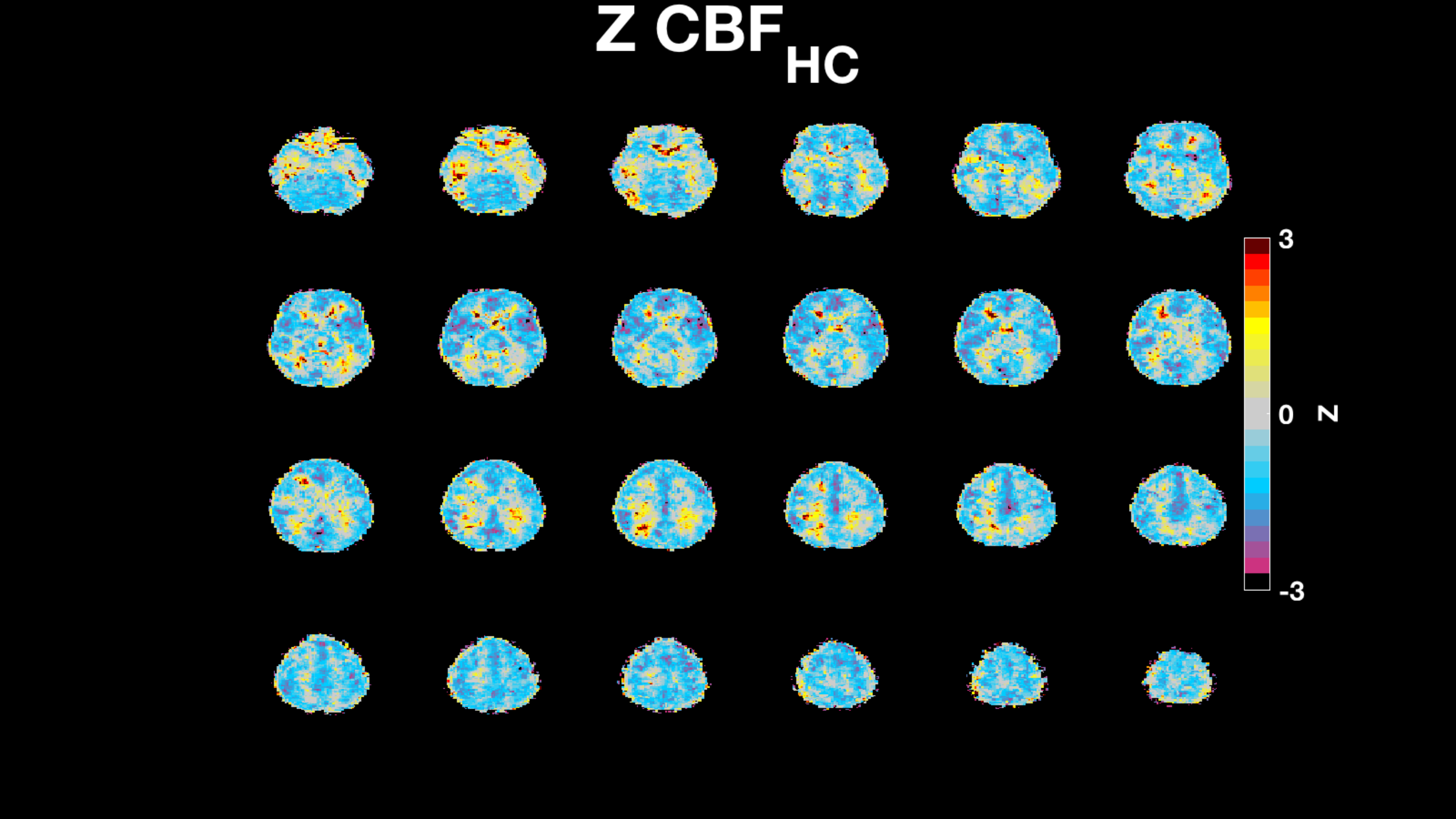
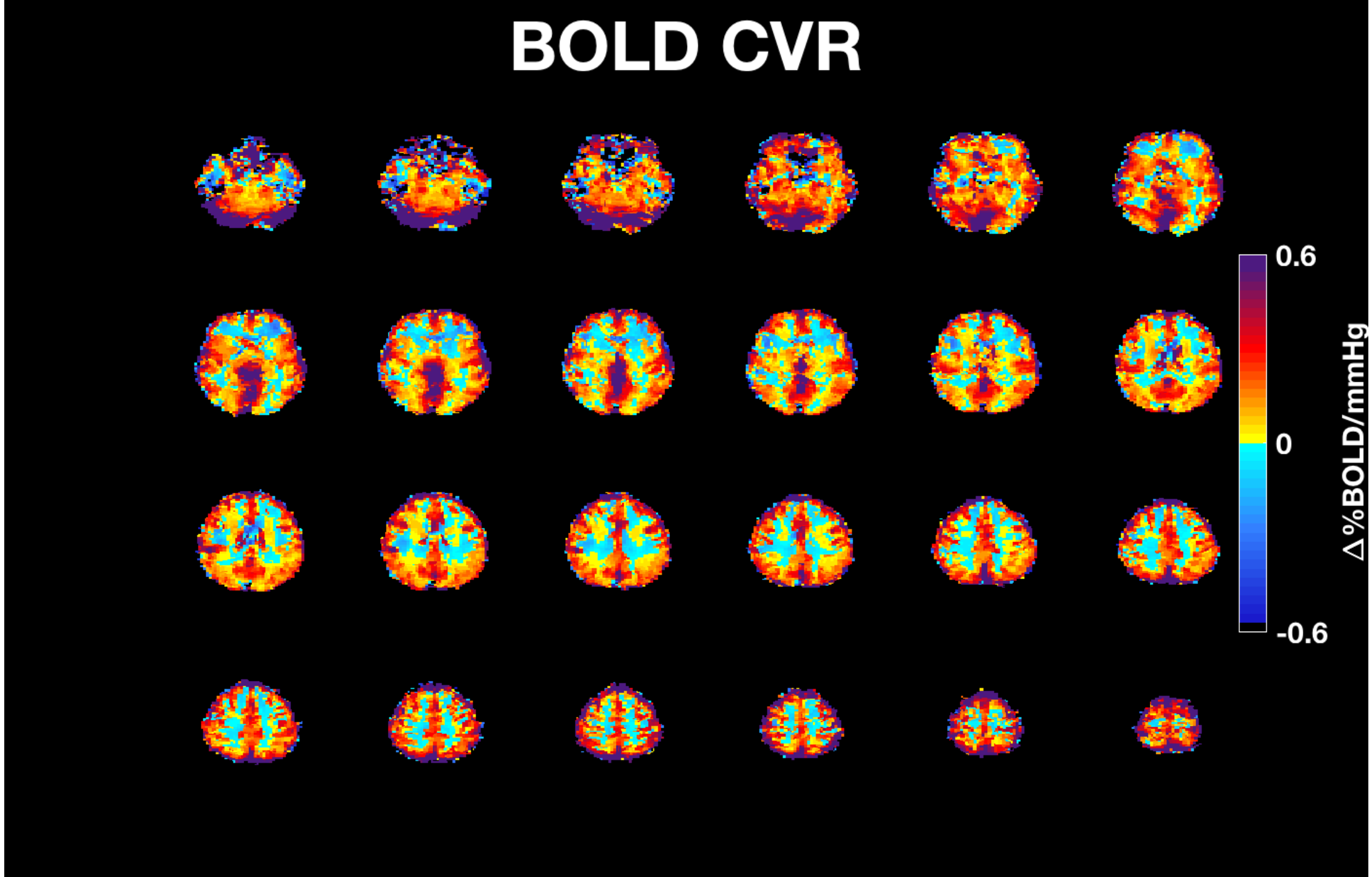
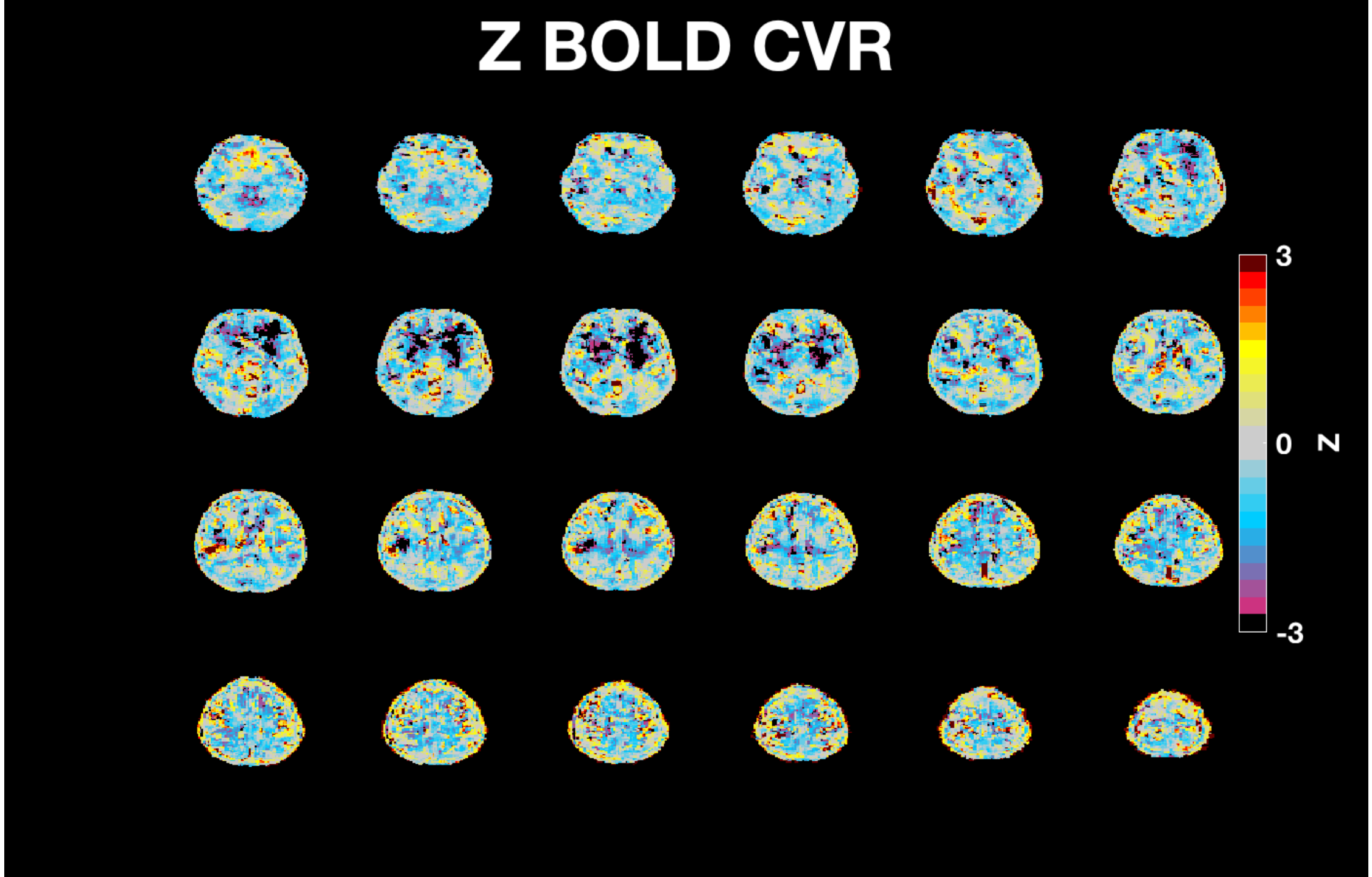

CBF0
100
0
ml/100g/min


Z CBF0
3
0
-3
N


CBF HC
100
0
ml/100g/min


Z CBF HC
3
0
N
-3


BOLD CVR
0.6
0
-0.6
Δ%BOLD/mmHg


Z BOLD CVR
3
0
N
-3

Physiological Imaging and Concussion

- Baseline scanning
- Acute symptomatic injury
- Imaging During Training
- Measuring Recovery

Future Directions

- Ongoing Clinical studies in Athletes and Military Personnel
- Combined modality MRI imaging to separate acute from chronic injury
  - Machine Learning applications to process, sort and separate data
  - Predictive analytics for recovery based on brain imaging
- Application of Near Infrared Spectroscopy for Acute, non-invasive, bedside/portable brain imaging

Questions?