



# Changes in Brain Network States While Switching Tasks after Abrupt Awakening



## The Challenge

In military environments, soldiers and other service members may be required to make cognitively-taxing decisions under life-and-death situations soon after being abruptly woken up from sleep (sleep inertia) or in sleep deprived states. In these situations, the need for optimizing sleep and returning to full alertness after sleep as fast as possible is critical to mission safety and success.

Research Question/Technical Goal: We aim to understand the underlying brain mechanisms, causes and negative consequences of sleep inertia. Furthermore, our goal is to develop countermeasures for soldiers to recover from sleep-deprived states and periods of impaired performance soon after waking.

Collaborators: NASA Ames, Naval Postgraduate School  
Area Leaders: NASA Ames, LyonU, France, HarvardU, UPenn

## Methodology

- Assessment and application of interventions to counteract the cognitive deficits that arise during sleep inertia by using robust psychometric measures of behavior and cognition, recordings of brain activity via electroencephalography, and use of graph/network-theoretical approaches to understand brain networks.

Type: 6.1

CC: N&N

Sub: E&PH

Exe: Intramural

Size: Small

## Expected outcomes

### Expected impact at completion of project:

- Creation of techniques that service members could use in operational environments to counter the negative consequences of sleep deprivation and sleep inertia.
- Testing and development of neuroscientific and behavioral theories of sleep inertia

### Impactful results to date:

- Assessed the effects of blue-enriched light during sleep inertial on behavior (Hilditch et al. 2022) and brain states (Hilditch et al. 2021)

### Expected deliverable types

Knowledge Products	X
Methods and techniques	X
Design Guidance:	
-Software	
-Hardware	
-Algorithms	
Models	X
Other	

## Milestones & Progress

- Assessed the effects of blue-enriched light during sleep inertial on behavior (Hilditch et al. 2022) and brain states (Hilditch et al. 2021)
- *Planned Milestones-*
  - Creating novel measurements of the waking brain that capture a more diverse set of cognitive abilities and brain states
  - Transition studies of sleep inertia from controlled experimental paradigms to realistic operational environments

### Notables:

- Description of changes to small-world network dynamics in the waking brain and the impact of blue-enriched light on this profile
- Key Publication: Hilditch, C. J., et al. "Reconfigurations in brain networks upon awakening from slow wave sleep: Interventions and implications in neural communication." (2021).
- Key Publication: Hilditch, Cassie J., et al. "Rise and shine: The use of polychromatic short-wavelength-enriched light to mitigate sleep inertia at night following awakening from slow-wave sleep." Journal of Sleep Research (2022): e13558.

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