Title: Enhancing Mechanistic Understanding of midlatitude LArge-scale circulaTion Errors (**EMULATE**)

Personnel: Stefan Sobolowski (UNI), **Erica Madonna (co-leader, UiB)**, Anne Britt Sandø (IMR), Stephen Outten (NERSC), Camille Li (UiB), Anne-Katrine Faber (UiB), Clio Michel (UiB), NN PhD (UiB); associated researchers (unfunded): Martin King (UNI), Mats Bentsen (UNI), Erik Kolstad (UNI), Noel Keenlyside (UiB), Asgeir Sorteberg (UiB), Marie Pontopiddan (UNI)

Tentative budget: UNI & NERSC personnel, 2.4pm/year; UiB co-leader 4pm/yr, UiB 4-year PhD; **Total from SKD: 8,000,159 NOK**. In-kind: 4pm (UNI); 16 pm (UiB); **Total in-kind: 1.6 million NOK**

Short background / purpose: Models continue to struggle to represent important features of the large-scale circulation (e.g. storm tracks, jets, blocking). However, these features play critical roles in determining climate variability and change, especially at regional scales. In both prediction and projection contexts reducing these errors is important especially for constraining regional impacts and effects. Physical understanding of the drivers of these features and the drivers of their biases is still limited, although there are many diagnostic studies of the biases themselves. Likewise, knowledge of the implications of these biases for remote areas (e.g. the Arctic) and downstream effects (e.g. extremes over Europe/North America) remains incomplete.

Methodology: Combine observational analyses and physical understanding to build new lines of evidence that improve our understanding of the phenomena in question and lead to more credible representations in our modeling tools. In short:
1. Perform a more detailed and nuanced investigation of the CMIP5/CMIP6 archive to identify which models accurately reproduce jets, stormtracks and blocking, how and why;
2. Integrate observations into the analyses in order to critically assess model performance and provide better constraints on projected regional changes that depend on these features (e.g., extreme weather related to blocking)

The project will center around the PhD, who will focus first on a deep investigation of the CMIP archives. This knowledge will then feed into complementary investigations such as: (1) Do models that do a better job at simulating [some aspect of the atmospheric circulation] also do better at simulating [some aspect of the Nordic Seas circulation - e.g., inflow variability]? (2) How sensitive are climate and weather extremes over Europe to midlatitude circulation biases? (3) How do tropical influences drive or modulate midlatitude circulation biases? The project team is expected to work together across themes with the following personnel spearheading these focus topics: Nordic seas (**Sandø**); extremes (**Outten, King**); stormtracks, jets, blocking (**Madonna**, **Michel**); tropical influences (**Sobolowski**).

Deliverables: Project manuscripts are expected to be highly relevant for the IPCC AR6. At least 3 manuscripts from the PhD. Relevant manuscripts from related projects (DynAMiTe, JETSTREAM) are expected in the first two years. Additional manuscripts can be expected from funded project partners. We will plan for at least one synthesis workshop early in the project to gather all relevant actors at the BCCR including the NorESM modelling group. The usual dissemination through international conferences and workshops will be expected. These biases affect the simulation of weather and climate phenomena that are of high relevance and interest to society. Li and Sobolowski currently work on simple animations and outreach tools, which aim to improve public awareness, engage students and communicate the complexity of our climate system in ways that are fun and educational. This activity will continue through EMULATE and will increase BCCR's visibility.

Strategic considerations: EMULATE strengthens BCCR collaboration and will feed back into the NorESM modelling group (e.g. Mats Bentsen, Thomas Toniazzo). Further we leverage compatibility with existing projects linked to the project team (DynAMiTe, R3, Hordaklim, JETSTREAM, ice2ice). EMULATE is also of relevance to numerous other BCCR projects (Blue Action, EPOCASA, STERC). EMUALATE will include researchers from these projects and provide a platform for intra-project collaborations. We will increase BCCR's visibility through popular science outreach in mainstream media as well as high impact interactional conferences and workshops. The project will improve our competitiveness in upcoming EU H2020 calls on addressing knowledge gaps (2018) and polar processes in a global context (2020). Two of the five funded scientists are female with a female co-leader. Six of the core project team are within 10 years of PhD, including the co-leaders. The project includes all BCCR partners, a recruiting position, and funding is nearly balanced.