Seventh Workshop on Data Mining in Earth System Science (DMESS)

The Roosevelt New Orleans, New Orleans, Louisiana, USA

November 18, 2017

How Can Physics Inform Deep Learning Methods in Earth System Science?: Recent Progress and Future Prospects

Anuj Karpatne[1]

[1]Department of Computer Science & Engineering, University of Minnesota, Minneapolis, Minnesota, USA

Deep learning, that has gained immense success in commercial domains involving large volumes of data, holds huge promise for advancing our knowledge of complex scientific problems encountered in Earth system science. However, success in this endeavor requires significant advancements over black-box application of deep learning methods, which have found limited success in scientific problems. This is especially true for domains as rich and complex as Earth system science, where the number of data samples is usually small (relative to Internet-scale applications such as image recognition where deep learning has been highly successful), while the physical relationships of interest are complex, high-dimensional, and non-stationary. This talk will introduce an emerging paradigm of scientific discovery, termed as physics-guided data science, that uses the unique capability of data science methods to automatically extract patterns and features from data, but without ignoring the wealth of physical knowledge available in scientific problems. We will present some novel applications of this paradigm in hydrology and limnology, where deep learning methods are suitably integrated with physics-based models to improve the estimation of key geoscience variables such as lake temperature and their dynamics.