21st century Ecotoxicology and Human toxicology: Applications and perspectives for the use of OMICs data

Bruno Campos, Jinhee Choi, Xiaowei Zhang, Geoff Hodges

May 10, 8:35 - 16:00, Hall 300

There are currently in the region of 100,000 chemicals in commercial use, making it impossible to monitor and assess the biological effects of exposure to each individual compound, much less mixtures given the finite scientific resources available. Historically, regulatory requirements on chemical risk assessments are largely based upon in vivo toxicity testing of individual substances on "representative" single species, supported by some in vitro and in silico approaches. Thus extrapolation to more relevant endpoints in relevant species is required. Many traditional (eco)toxicological studies use lab-based tests with apical endpoints as a proxy for more relevant exposure scenarios, and while these studies are useful and have provided valuable insights, they are inherently flawed and cannot provide deep mechanistic insights into the biological significance of exposure.

It is analytically, physically, and financially impractical to detect and test the chronic toxicity and sub-lethal endpoints (relevant to better understand population effects) of all of the man-made chemicals in the environment. Therefore, better methods must be developed and validated to quantify biologically relevant endpoints of chronic toxicity. OMICs technologies (genomics, transcriptomics, proteomics, lipidomics, epigenomics and metabolomics, etc) are gaining increased prominence in human and environmentaltoxicology because they can provide insights into the biological significance of chemical exposure. However, this mechanistic knowledge is currently rare and difficult to obtain, especially given the purpose of predicting adverse effects to individuals and populations (of all species, including human) from these early indicators of toxicity. Recognizing that this knowledge gap stems from the lack of useful experimental data, an innovative and coordinated scientific approach is needed. Current breakthroughs of molecular and OMICS biology revealed major toxicity and stress response pathways are often conserved in various species, from model organisms for human health studies to wildlife species used for ecotoxicity testing. Moreover, some model species, such as, the nematode, C.elegans and zebrafish, D. rerio, are frequently being used both in human biology, as well as in ecotoxicology. From this context, in this session, we attempt to address OMICS in cross-species extrapolation aspect, by focusing on common molecular level response of various species, including model species for human health, aiming at integration of ecotoxicity and human toxicity.

This session aims to assemble environmental and human health scientists for discussions on how omics technologies can advance the field of (eco)toxicology, while providing data relevant for risk assessment.

We invite presentations of research in both human health and environmental science that use omics technology to gain a better understanding of the adverse effects from chemicals and natural stressors on organisms. These may include examples of omics-based predictions of apical endpoints, cross-species extrapolations, studies integrating chemical monitoring and omics, biomonitoring, exposure biomarker development, chemical risk assessment and non-invasive omics applications.

Both field- and laboratory-based research is welcome, along with research studies utilizing novel methodologies.

We propose to bring together scientists and regulators from around the globe with different perspectives to discuss novel approaches and applications for integrating omics and (eco)toxicology together to advance our understanding of the molecular underpinnings of toxicity. Such discussion will increase the value and robustness of this data-driven knowledge and its applications in risk assessment to better protect the environment. It has become apparent that a better understanding of the molecular events leading to adverse effects can improve both human health and environmental risk assessment and OMICs approaches provide unbiased approaches that can help achieve this goal.