

## Identified knowledge gaps

At the 2020 BECC-MERGE Spring Meeting our members identified the following knowledge gaps at the intersection of our two Strategic Research Areas (SRAs), the filling of which will require joint activities and a commitment to facilitate these on the part of the SRA Boards.

**Evaluation of existing land use & management scenarios:** What impact would the global land use scenarios employed by global ESMs have on Sweden's climate (CC), its air quality (AQ), its biodiversity (BD) and ecosystem services (ES)? Biodiversity and ecosystem service researchers, as well as related stakeholders (e.g. LU Land, BECC & MERGE SRG), are often either unaware of or largely unfamiliar with the land use and management scenarios used in climate models, even though they often contain very significant land-use changes in their study regions. BECC & MERGE could contribute to closing this gap, by communicating how these land-use scenarios are constructed and used, and what their limitations are. We could also do a novel, thorough analysis for what the land-use scenarios mean for Sweden's climate, AQ, BD, and ES.

**Scenario building:** How can we jointly develop integrated modelling/assessment approaches that account for the full range of climate/biodiversity/land use interactions relevant to a Swedish context? What impacts do local land-use scenarios developed using social-ecological modelling have on BD, CC, AQ and ES? Can indicators for analysis of scenarios be developed? Can benefits and trade-offs be assessed in a combined framework? Can such a framework be applied to study the interactions in different ecosystems, including agricultural land, forests, arctic-alpine ecosystems and wetlands? How do we then scale this up to the national level?? What is the best way to engage our SRGs in this effort?

**Biofuels:** What consequences will the increased cultivation and use of biofuels (crops and forests) have for CC, AQ, BD and ES? Can we identify how and where best to cultivate these crops in order to maximize any benefits and to minimize negative effects, considering multiple time horizons?

**Wildfires:** How big a role will wildfires play in the future development of Sweden's ecosystems and feedbacks to CC and AQ? How will BD and ES be affected in model-generated scenarios? Are there co-benefits for BD/ES and wildfire management of using mixed stands with a greater broadleaf fraction in forestry? Can we use historical records of fire occurrence to better constrain models? How do we integrate ICOS/ACTRIS observations associated with wildfires to constrain and calibrate our models?

**Agriculture:** How will climate change affect agricultural production in Sweden? How can we maintain BD in traditional agricultural landscapes, maintain or increase quantity/quality of yields, and simultaneously decrease the net climate forcing resulting from CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions and biophysical impacts? Can we reduce NH<sub>3</sub> emissions and leaching, both for AQ (PM<sub>2.5</sub>) and eutrophication, respectively? How can we systematically use ICOS/ACTRIS observations made near agricultural land to constrain and calibrate our models?

**Forestry practices:** What alternative afforestation and forest management measures and strategies (mixing deciduous with evergreen species, reforestation of abandoned agricultural land, intensification, optimized thinning practices) are best for BD and ES provision, and still useful for climate mitigation, taking into account both biogeochemical and biogeophysical effects? How will AQ be affected by such choices? How do we integrate ICOS/ACTRIS observations to constrain and calibrate our models? How can BECC and MERGE devise a modelling and assessment framework across scales that can be used to inform policy and decision making based on this science?

**Wetlands and their management:** What impacts will climate change have on wetlands, including their BD and ES? How will CC and AQ affect and be affected by CO<sub>2</sub>, CH<sub>4</sub> & N<sub>2</sub>O emissions from wetlands? How will the rewetting of wetlands and/or wetland restoration affect BD, CC, AQ and ES?

**Extreme events:** How will the projected occurrence of extreme events (type, intensity, frequency and duration) impact the BD and ES provided by Sweden's ecosystems, including arctic-alpine environments? How do we integrate ICOS/ACTRIS observations associated with such events to constrain and calibrate our models? How should we account for the risk of extreme events in conservation strategies or efforts to benefit ecosystem services (which are often supported by models)?

**Biodiversity impacts on local climate, incl. urban environments:** Does biotic stress result from altered biodiversity? What effects do this stress have on climate, e.g. through altered albedo, BVOC emissions etc.?

**Integrated Sustainability Assessment:** Can an integrated sustainability assessment of Sweden's climate and biodiversity policies identify with confidence synergies and trade-offs between biodiversity conservation and climate change mitigation/adaption?