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Detection and Attribution of anthropogenic Climate Impacts on Phenological Phases

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An important effect of climate change is associated with its impact on phenological events during spring. Although there is scientific agreement that mankind plays a major part in global warming and that phenological occurrence dates are largely driven by temperature, the direct linkage between anthropogenically driven changes of the atmosphere's chemistry and alterations in phenological entry date has not yet been shown quantitatively.

This study aims at providing this evidence by carrying out a one-step attribution to external forcings. This approach links increasingly earlier occurrence dates of phenological spring events to changing climate conditions (increasing temperature) and - in turn - to external (anthropogenic) forcings. Technically this shall be attained by a so-called ‚optimal fingerprint' technique, which detects and attributes external (anthropogenic) forcings shifting phenological occurrence events towards earlier dates (Hasselmann et al., 1997).

This requires historical Global Climate Model (GCM) simulations driven by various forcings. Pre-industrial (piControl) simulations are needed to assess internal climate variability. GCM runs driven by natural forcings alone on one hand and GCM runs forced with natural and anthropogenic forcings on the other hand are required to detect effects on climate addressable to mankind's activities. The attribution part of this technique is based on consistency checks, which involve climate's internal variability (determined by via piControl runs) too, and yields confidence levels revealing the significance of the anthropogenic impact.

In case the null hypothesis - that the observed shift in phenological occurrence dates can be simulated by natural forcings alone – has to be rejected with high confidence and observations can be well reproduced via natural and anthropogenic forcings, it can be inferred that mankind is responsible for recorded changes concerning occurrence dates of phenological phases.

Hasselmann, K., S. Hasselmann, R. Giering, V. Ocana, H. von Storch, 1997: Optimization of CO_2 emissions using coupled integral response and simplified cost models. A sensitivity study. Climatic Change 37, 345-386