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How do S2S systems beat seasonal forecasts?

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There are several reasons why one might expect forecasts from sub-seasonal to seasonal (S2S) systems to be more skilful than those provided by seasonal forecasts. Firstly, the shorter forecast length permits greater computational resources to be allocated to the forecast framework, and thus S2S can employ higher spatial resolution and larger ensembles, referred to as the "setup advantage". Secondly, at forecast centres where burst initialisation is used, and seasonal forecasts are typically initialised once a month, S2S systems are initiated more frequently and thus have a "lead-time advantage". Put another way, for any given date, the newest S2S forecast will be more recent than the newest seasonal forecast. Thirdly, the expense of conducting the seasonal system hindcast suite required for forecast calibration implies that many centres update seasonal forecast systems less frequently than S2S systems, which tend to follow and adopt the operational NWP updates. Thus S2S systems tend to have more up-to-date model physics and use fresher model cycles, the "model cycle advantage". All these three reasons are valid for the ECMWF S2S and seasonal systems. Separating these causes for skill improvements would ideally require a computationally expensive and complex experiment involving a large number of forecasts. Instead, by making some justifiable assumptions, the existing hindcast suites for the S2S and system 4 seasonal forecast from 2008 to 2014 are used as a "database of opportunity" and sub-sampled in such a way as to allow an estimate of all three skill benefit contributions for varying geographical areas. For example, it is found that for 2 meter temperature at the S2S week 3-4 lead time, the lead-time, model cycle and setup advantages all contribution approximately equally to the skill in the Tropics, while the gain is mostly from lead-time and setup in the northern hemisphere extra-tropics. Results for winds and precipitation will also be presented.