SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year	2022
Project Title:	Towards operational attribution of predicted signals in sub-seasonal forecasts
Computer Project Account:	spfikarp
Principal Investigator(s):	Dr. Alexey Karpechko
Affiliation:	Finnish Meteorological Institute (FMI)
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Dr. Inna Polichtchouk
Start date of the project:	1.1.2021
Expected end date:	31.12.2023

Computer resources allocated/used for the current year and the previous one

(if applicable)

Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	10,900,000	635,299	3,309,000	5,992
Data storage capacity	(Gbytes)	21,715	441	7,221	441

Summary of project objectives (10 lines max)

This project aims to investigate sources of predicted signals in sub-seasonal forecasts for Europe and to test feasibility of detecting such sources in operational forecasting. To this end, we aim to perform a set of relaxation experiments towards selected ensemble members of the control forecasts that exhibit pronounced signals in the stratosphere and/or the Tropics - regions of the atmosphere known for their extended predictability. The experiments will allow quantifying strength of the signal associated with these sources, and, potentially, signal attribution. The rationale behind our approach is the assumption that the knowledge of sources of forecasted signals can help operational forecast users in their applications.

Summary of problems encountered (10 lines max)

No problems

Summary of plans for the continuation of the project (10 lines max)

So far, only the role of the stratosphere in predictability of two events was studied (see summary of results); therefore the plan for the continuation of the project is to analyse other case studies as well as to analyse the role of the tropics in the predictability. While the progress was too slow due to other work commitments, the plan for the next year remains the same since more cases are necessary to draw the conclusions.

List of publications/reports from the project with complete references

n/a……
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Summary of results

If submitted **during the first project year**, please summarise the results achieved during the period from the project start to June of the current year. A few paragraphs might be sufficient. If submitted **during the second project year**, this summary should be more detailed and cover the period from the project start. The length, at most 8 pages, should reflect the complexity of the project. Alternatively, it could be replaced by a short summary plus an existing scientific report on the project attached to this document. If submitted **during the third project year**, please summarise the results achieved during the period from July of the previous year to June of the current year. A few paragraphs might be sufficient.

Unfortunately, due to other commitments the progress was slow. In addition to the last year results, only one more nudging experiment was performed for the cold outbreak in Europe in January-February 2012. Overall, three 51-member ensemble forecasts were performed for this case, including the two forecasts performed during the last year. The 2012 January case was characterised by a minor stratospheric warming that took place in January. A control forecast initiated on 13.1.2012 predicted only a weak cooling over Eurasia and did not catch the main cold outbreak at the end of January. The control forecast predicted a weakened stratospheric vortex; however, the simulated vortex remained stronger than in ERA-I, suggesting that the predicted stratospheric forcing was underestimated. On the other hand, a forecast ensemble in which relative vorticity and air temperature in the stratosphere above 70 hPa were nudged towards observed values predicted a stronger Eurasian cooling, by 2K on average, with two members predicting a cold outbreak near the end of January with the magnitude comparable to that seen in ERA-I. In the third experiment, the

nudging was done towards a member from the control experiment that predicted an earlier recovery of the stratospheric polar vortex from the minor warming. In this experiment, the Eurasian cooling was comparable to that found in the control experiment during January, but the temperatures started to increase faster in early February, being ~1K warmer on average than the control, suggesting a small influence from the stronger stratospheric vortex via stratosphere-troposphere coupling in this experiment. Like the 2018 case studied in the previous year, the stratospheric signal was much smaller in comparison to the internal tropospheric variability.