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The impact of stratospheric volcanic aerosol on decadal-scale climate predictions

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The possibility of a large future volcanic eruption provides arguably the largest uncertainty concerning the evolution of the climate system on the time scale of a few years; but also the greatest opportunity to learn about the behavior of the climate system, and our models thereof. So the question emerges how large will the uncertainty be for future decadal climate predictions if no volcanic aerosol is taken into account? And how strong has volcanic aerosol affected decadal prediction skill on annual and multi-year seasonal scales over the CMIP5 hindcast period? To understand the impact of volcanic aerosol on multi-year seasonal and decadal climate predictions we performed CMIP5-type hindcasts without volcanic aerosol using the German MiKlip prediction system system baseline 1 from 1961 to 1991 and compared them to the corresponding simulations including aerosols. Our results show that volcanic aerosol significantly affects the prediction skill for global mean surface air temperature in the first five years after strong volcanic eruptions. Also on the regional scale a volcanic imprint on decadal-scale variability is detectable. Neglecting volcanic aerosol leads to a reduced prediction skill over the tropical and subtropical Atlantic, Indic and West Pacific but to an improvement over the tropical East-Pacific, where the model has in general no skill. Multi-seasonal differences in the skill for seasonal-mean temperatures are evident over Continental Europe with significant skill loss due to neglection of volcanic aerosol in boreal winter over central Europe, Scandinavia and over south-eastern Europe and the East-Mediterranean in boreal summer.