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Was There a Basis for Anticipating the 2010 Russian Heat Wave?

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The 2010 summer heat wave in western Russia was extraordinary. Unabated abnormally hot conditions persisted from the beginning of July through mid-August, with high temperatures smashing previous all-time records extending back to at least 1880. The intense heat combined with drought conditions led to extensive fires and crop losses, while high temperatures combined with poor air quality produced large increases in death rates. This study explores whether early warning of this heat wave could have been provided through knowledge of natural and human-caused climate forcings. The heat wave is considered first within the context of the recent period and long-term trends in regional climate, including extremes. Model simulations are then used to determine potential effects of observed boundary conditions and greenhouse gas concentrations. Coupled model simulations with natural and anthropogenic forcings and atmospheric model experiments forced with observed SSTs, sea ice and greenhouse gas concentrations suggest that neither increased greenhouse gas concentrations nor other slowly evolving boundary conditions provided major contributions to this heat wave's magnitude. They also provide evidence that such an intense event could be produced through natural variability alone. Observational analyses are consistent with the interpretation that this heat wave was mainly due to internal atmospheric dynamical processes manifested by a strong and long-lived blocking event, and that similar atmospheric patterns have occurred with prior heat waves in this region. We conclude that the intense 2010 Russian heat wave was mainly due to natural internal atmospheric processes, and that slowly varying boundary conditions that could provide climate predictability and the potential for early warning did not play a strong role in this event.