

# **Global Warming in the 20th Century: distinguishing between natural and forced climate variability**

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The surface temperature record of the last century and a half exhibits a global warming of about 1K. This overall increase is punctuated by variations on decadal and longer time scale. Moreover, the pattern of temperature change is not uniform in space exhibiting spatial variations in the rate of warming. The prevailing hypothesis is that these changes are the results of the uneven impact of external forcing (human induced and solar) and of the interference between forced and internal or natural climate variability. Distinguishing between these two types of variations from the data alone is challenging if not impossible. We attempt to sort out the origin of decadal and longer time scale variations in the record by employing the output of state-of-the-art coupled climate models that as part of the most recent IPCC assessment process, were forced with the 20th Century changes in solar irradiance and greenhouse gas and aerosol (natural and anthropogenic) concentrations. These models were subjected to multiple integrations with the same external forcing but with different initial conditions and thus allow a separation between internal and forced climate variability. We focus on variations in the eastern hemisphere, including the Atlantic Basin and Eurasia, to separate the regional impact of forced and internal variability on the circulation, surface temperature, and precipitation. We use these results to draw conclusions regarding the observations.