## Contribution of the MJO to sub-seasonal prediction in Northern Hemisphere extratropics during winter

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The Madden-Julian Oscillation (MJO) provides an important signal source for the global sub-seasonal prediction. In this presentation we focus on influences of the MJO on wintertime sub-seasonal variability in North America and Europe, and its contribution to prediction on this time-scale. Observed evidence is presented to show significant lagged signal in surface air temperature and precipitation over Canada associated with a dipole structure of the tropical MJO convection. The MJO has a far-reaching impact on the Northern Hemisphere circulation. A significant increase of the North Atlantic Oscillation (NAO) amplitude occurs about 5 to 15 days after the MJO-related convection anomaly reaches the tropical Indian Ocean and western Pacific region. This process is linked to the development of a Rossby wave train in the North Pacific and North American region. Using the output of the intraseasonal hindcast experiment conducted with the Global Environmental Multiscale (GEM) atmospheric model during 24 extended winters, it is found that with a lead time up to about one month the NAO forecast skill is significantly influenced by the existence of the MJO signal in the initial condition. A strong MJO leads to a better NAO forecast skill than a weak MJO.