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Subseasonal prediction of valley inversions in the Intermountain West

Robert Gillies[†]; Shih-Yu Wang; Marty Booth
[†] Utah State University, USA
Leading author: robert.gillies@usu.edu

Persistent winter inversions resulting in poor air quality in the U.S. Intermountain West are a well known yet serious phenomenon. Although the onset of inversions is relatively easy to predict, forecasting the life span and then the breakup of prolonged inversion episodes remains challenging. Analyzing historic soundings at Salt Lake City (Utah) together with reanalysis and station data, this study investigates how those prolonged inversion episodes are modulated by synoptic and intraseasonal variabilities. The results point to a close link of the prolonged inversions with an intraseasonal oscillation (ISO) that characterizes the winter circulation regime over the Northeast Pacific. The intraseasonal mode also modulates the characteristics of the synoptic (6-day) variability which further influences inversion development. Such links suggest that the forecast of prolonged inversion episodes is beyond numerical weather prediction models intended for the medium range (~10 day). Given that the NCEP's Climate Forecast System (CFS) has demonstrated skill in the prediction of the tropical ISO as far out as one month, we examined the CFS's prediction capability of such persistent inversions. We coupled a regression scheme to the CFS output of geopotential height as a way to predict the occurrence of persistent inversion events. Analysis of the CFS hindcasts through the period 1981-2008 indicates that the coupled regression-CFS method can predict persistent inversion events with lead times of up to four weeks, extending the current limite of medium-range weather forecast models.