The Extreme Value Toolkit (extRemes):
Weather and Climate Applications of Extreme Value Statistics

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The Extremes toolkit, **extRemes**, is part of the recent Weather and Climate Impact Assessment Science Initiative undertaken at the National Center for Atmospheric Research (NCAR). The toolkit reflects an effort to develop software for the fitting of meteorological extremes in a form accessible to the broader atmospheric science community. The software used by the toolkit for fitting meteorological extremes was provided by Stuart Coles and ported into R by Alec Stephenson as the R package **ismev**. The primary exciting new applications in R are graphical user interface (GUI) dialogs via **tcltk** for the ismev functions (plus a few new functions) with an accompanying tutorial on how to use the toolkit, with examples of modeling meteorological extremes. The package has been implemented and tested on unix, linux and Windows operating systems. Although the emphasis of the toolkit, and particularly the accompanying tutorial, is on extreme weather and climate events, the toolkit itself can be used with any sort of data where extreme value methods are appropriate.

An important part of the initiative focuses on extreme weather and climate events, and the toolkit is integral to meeting the goals for this component of the initiative. Specifically, it is hoped that the toolkit will prompt more use of (i) extreme value methodology when analzying weather and climate extremes, (ii) information about upper tail of distribution (via point process approach instead of block maxima), (iii) climate change detection by way of extreme value methodology with trends introduced through covariates and (iv) development of more physically realistic statistical models for extremes (via covariates for annual and diurnal cycles as well as for physical variables such as El Niño events).

To accomplish these goals, the toolkit uses GUI dialogs to make it as easy as possible for scientists not familiar with R to get started and have access to extreme value software with a small learning curve; provides an in-depth accompanying tutorial to introduce scientists who may be unfamiliar with extreme value methods to some of the basic principles; and through both the tutorial and the design of the software facilitates easy adaptation of the code for specific problems.

So far the toolkit only handles univariate data, except that covariates may be incorporated into model parameters. One possible future addition to the toolkit would be to add software that can directly support multivariate models; because weather and climate studies generally occur spatially and it is desired to incorporate spatial dependence into the models.