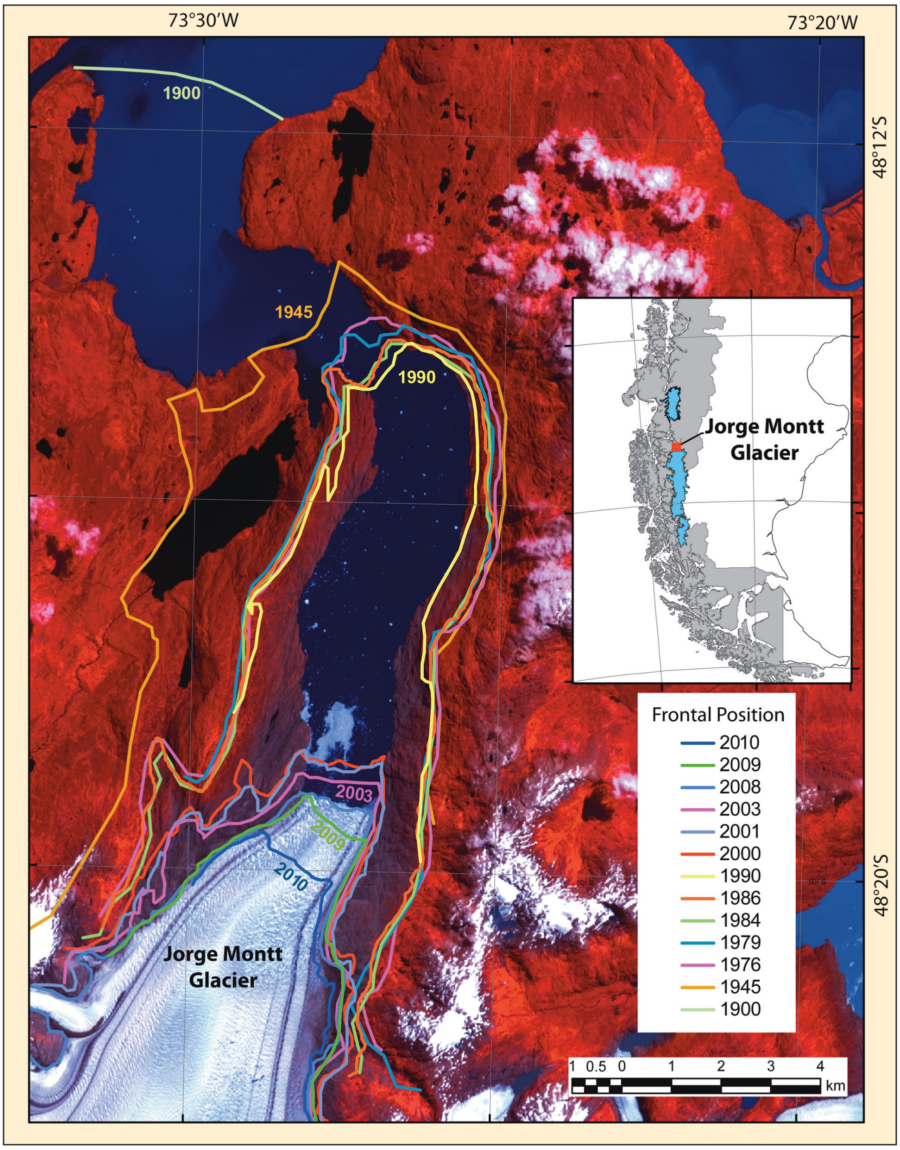

Figure 1: Frontal variations of Jorge Montt glacier as determined by historical records, satellite imagery and aerial photographs. This is one of the biggest tidewater calving glaciers of the South Patagonian Icefield where a maximum frontal retreat of 18 km between 1900 and 2010 was documented (Rivera et al., 2010).

regional forced and unforced climate variability, as well as environmental changes during the past millennia. The main idea is to improve the production of gridded data sets of climate variables from high-resolution multi-proxy time series.

This conference brought together senior and young scientists working on tree rings, glacier records, lake and marine sediments, geomorphology, ice cores, historical documents, speleothems and other paleoclimate archives. All these experts were interested in paleoclimatic reconstructions for different regions of tropical, extra-tropical and sub-Antarctic South America and the Antarctic Peninsula. The meeting also greatly benefited from the participation of climatologists working on modeling of the present climate of South America, providing a dynamically meaningful and physically plausible framework for the interpretation of past environmental records. One of the most exciting outcomes of this conference was the significant assistance it provided to young scientists and the great enthusiasm demonstrated by all in attendance.

At present we are working on a Special Issue of *Climate of the Past*, which will include the most outstanding contributions presented in the symposium. This special issue will provide an updated and comprehensive outline of ongoing research on this topic.

Guidelines for collaboration and contributions to LOTRED-SA are available at www.pages-igbp.org/workinggroups/lotred-sa or by contacting one of the co-ordinators: Ricardo Villalba (ricardo@lab.cricyt.edu.ar), Martin Grosjean (grosjean@giub.unibe.ch). For detailed information about this Symposium, and photos and videos of the conference presentations, please visit www.cecs.cl/pages2010/.

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Bayesian hierarchical models for climate field reconstruction

Lamont Doherty Earth Observatory of Columbia University, USA, 8-11 February 2011

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Bayesian Hierarchical Models (BHMs) have emerged as a powerful new method for inferring spatially complete climate fields from sparse and noisy proxy time series. BHMs have a potential theoretical advantage over "traditional" linear subspace-based (EOF) methods for inferring climate fields, because the Bayesian "posterior" distribution of the reconstructed climate, once estimated, can be directly sampled to yield complete uncertainty estimates of the reconstructions, along with a point estimate of the expected value. The Bayesian estimates of the climate field encapsulate the uncertainties involved in the estimation of all model parameters, which cannot readily be done using traditional linear subspace methods.

A primary goal of the workshop was to bring together reconstruction experts who currently employ reduced-space multivariate regression models for climate field reconstruction, and provide an in-depth exposure to the theory and application of BHMs for climate reconstruction. Dr. Andrew Gelman of Columbia University gave the opening keynote address, and Drs. Martin Tingley of NCAR, Bo Li of Purdue University, Johannes Werner of the University of Giessen, Matthew Schofield of the University of Kentucky, and Naresh Devineni of Columbia University led the workshop with regard to the use and implementation of BHMs for spatially explicit climate reconstruction.

A second important purpose of the workshop was to explore how the more established multivariate regression based methods performed in comparison to BHMs, and to examine the extent to which the traditional methods could offer equally or near-equally valid ways to characterize reconstruction uncertainties in practice (see Fig. 1). This latter goal is important due to the additional complexity and computational expense of BHM approaches, and the more formal and complete treatment of uncertainties afforded by BHMs.

A strong focus was also put on separating model building, per se, from inference of model parameters. It was noted that climate scientists sometimes mix these two concepts, which can result in significant attention being paid to inference issues and comparisons of performance within a closely-related set of models (such as "flavors" of regression, cf., Bürger et al., 2006), rather than to the more general issue of developing conceptually appropriate yet computationally tractable models. In this regard, the key shift in thinking is not to Bayesian methods but to models—which would likely be hierarchical in nature. Inference can then be conducted using a range of tools, but as models become more involved, Bayesian inference strategies may be the (conceptually) simplest option.

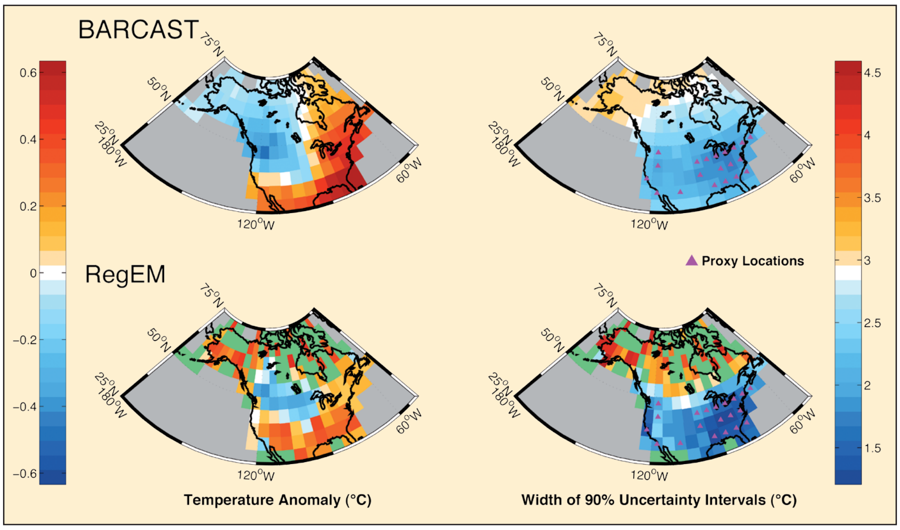

Figure 1: Results of a pseudo-proxy reconstruction experiment comparing Bayesian estimates from BARCAST (upper row; Tingley and Huybers, 2010) with frequentist estimates from RegEM (lower row; Schneider, 2001), an important "state-of-the-art" approach to climate field reconstruction. The left column shows point estimates of the temperature field, while the right column gives the width of 90% uncertainty estimates and indicates the locations of the pseudo-proxies. Results are for the year 1890 of the "medium" experiment described in Tingley and Huybers (2010). The additional assumptions made by BARCAST allow for spatially complete inference, while RegEM does not provide inference at locations where there are no instrumental observations during the calibration interval (indicated by the green shading)

Several presenters stressed that BHMs are not "one size fits all". A given model, such as BARCAST (Tingley and Huybers, 2010), may be appropriate for inferring a particular target process from a particular data set, in the sense that all diagnostics indicate the modeling assumptions are suitable, the Markov Chain Monte Carlo (MCMC) estimation process converges, and the resulting ensemble of draws has reasonable properties. However, the same model may produce results that are physically unreasonable or otherwise problematic if applied to a different data set, or used to infer a different target process examples of which were presented and discussed in the workshop. Such results can often be interpreted as an indication of model misspecification, and it was stressed that model building is an iterative process. Akin to the residual analysis that follows standard linear regression, BHMs allow for posterior checks of the suitability of the model assumptions for the data under analysis.

Bayesian Hierarchical Modeling is still in its infancy in the context of paleoclimate field reconstructions. A key goal of this workshop was to develop a common language, and to focus on formalizing scientific understanding through collaboration between paleoclimate scientists and statisticians. This first (and hopefully not last) workshop took significant steps towards enabling this necessary collaboration to proceed.

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Synthesis of transient climate evolution of the last 21 ka (SynTRaCE-21) workshop

Mount Hood, Oregon, 10-13 October 2010

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Climate reconstructions covering the last 21 ka provide critical observational data for testing state-of-the-art climate models for the simulation of climate evolution and abrupt climate changes. New proxy evidences and modeling activities have led to rapid advances in our understanding of climate change for this period. Therefore, a new PAGES Working Group, SynTraCE-21, was initiated in 2009 to synthesize the transient climate evolution of the last 21 ka. The overarching goals of the Working Group and the associated workshop series are (i) to facilitate an international synthesis effort of proxy climate records to better describe the major features of global climate during the last 21 ka, and (ii) to compare these data to transient