UP 12: Climate - Modelling, joint session with jDPG

Time: Thursday 10:00–12:30 Location: HFT-FT 131

Invited Talk UP 12.1 Thu 10:00 HFT-FT 131

The first Arctic ozone hole in spring 2011 - observations, current understanding and relation to climate change — •Markus Rex, Ingo Wohltmann, Peter von der Gathen, and Ralph Lehmann — Alfred-Wegener-Institut für Polar- und Meeresforschung

The Arctic winter 2010/2011 was characterized by an unusually stable and cold polar vortex in the lower stratosphere. Conditions for the formation of polar stratospheric clouds were widespread and the fraction of the polar vortex exposed to such conditions was the largest in the observational record, which started in the mid-1960s. The combination of extremely cold conditions throughout the winter with a long lived and stable vortex in spring led to record chemical destruction of ozone in the Arctic. Based on the measurements of the Match ozonesonde network and the Microwave Limb Sounder (MLS) instrument on Aura we will discuss the degree and the time evolution of this record loss and compare the Arctic ozone loss in 2011 with the range of ozone losses that occurred in early and recent Antarctic ozone holes. Model calculations of our fully lagrangian Chemical Transport Model ATLAS are used to assess our current theoretical understanding of the processes that lead to Arctic ozone loss and to highlight the role of denitrification for the record loss in 2010/2011. Analyses of the long term evolution of meteorological conditions in the lower polar stratosphere and approaches to diagnose climate change related changes in these from Climate Model output suggest a link between climate change and the occurrence of increasing degrees of Arctic ozone loss.

30 min coffee break

Invited Talk UP 12.2 Thu 11:00 HFT-FT 131

Potential tipping elements of the climate system — •Anders Levermann — Potsdam Institute for Climate Impact Research, Potsdam, Germany — Physics Institute of Potsdam University, Potsdam, Germany

Some regions and processes within the global climate system respond strongly non-linear to gradual changes in background climate with potentially dramatic impact on human society and nature. The talk discusses a number of these so-called tipping elements with respect to their underlying physical feedbacks: North Atlantic Current, Indian monsoon circulation and West Antarctic Ice Sheet. (Levermann et al. 2012, Climatic Change.)

UP 12.3 Thu 11:30 HFT-FT 131

Skaleninvariante Horizontaldiffusion in einem Globalen Zirkulationsmodell — •Urs Schaefer-Rolffs und Erich Becker — Leibniz-Institut für Atmosphärenphysik, D-18225 Kühlungsborn

Globale Zirkulationsmodelle (General Circulation Models, GCMs) sind für das Verständnis der Dynamik der globalen Zirkulation der Atmosphäre unentbehrlich. Grundlagen bilden die hydro- und thermodynamischen Gleichungen sowie die Wechselwirkungen der aufgelösten mit den nicht aufgelösten Skalen. So ist für die vollständige Beschreibung des Lorenzschen Energiezyklus die horizontale Energiekaskade in den subskaligen Bereich essentiell. Die dazu konventionell verwendete Hyperdiffusion ist jedoch nicht physikalisch konsistent.

Im *Kühlungborn Mechanistic general Circulation Model* verwenden wir seit 2007 das nichtlineare Smagorinsky-Schema basierend auf dem Mischungsweg-Konzept zur Parametrisierung der Horizontaldiffusion. Trotz einer erstmalig thermodynamisch korrekten Simulation des Energiezyklus zeigt das Smagorinsky-Schema Defizite. Um diese zu lösen, erweitern wir unser GCM mit dem Dynamischen Smagorinsky-Modell (DSM). Das DSM vermag die Mischungslänge lokal aus den kleinsten aufgelösten Skalen abzuschätzen.

In unserer Präsentation werden wir zunächst kurz auf die Theorie des DSM eingehen; nach unserem Kenntnisstand wurde das DSM bisher nicht in GCMs zur Parametrisierung der Horizontaldiffusion verwendet. Wir zeigen außerdem detailliert, welche Verbesserungen im Energiespektrum erreicht werden können.

UP 12.4 Thu 11:45 HFT-FT 131

Calculation of climate trend functions from local time series using a Monte-Carlo-enhanced process — •Dieter Ihrig — FH Südwestfalen, Iserlohn, Germany

Most of the scientific community accepts the fact that there is a temperature increase since pre-industrial time looking to the yearly mean temperature. But not overall the world the yearly mean temperature is clearly increasing. In Germany for example the yearly mean temperature is decreasing during the last 3 years. It is not really helpful to calculate a trend function as a straight line over few years. To understand the climate system and climate models it will be helpful to know the temperature trends in the sens of new time series depending on the locality or at least to latitude. A method to extract trends from time series using a Monte-Carlo-enhanced filtering process was presented 2008 in Darmstadt. The performance of the method will be demonstrated using simulated climate trend functions. The method will be applied at real climate series (1881 to 2011) of 40 stations. The calculations are made for yearly mean temperature and 12 monthly mean temperature. The results in temperature trends are compared with respect to the latitude. Using the temperature trend the change of net radiation energy input is calculated and discussed with respect to the latitude.

Invited Talk UP 12.5 Thu 12:00 HFT-FT 131

How variable is our climate? — •Thomas Laepple[1] and Peter Huybers[2] — [1]Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany — [2]Harvard University, USA

Determining the magnitude of natural climate variability is neccessary for predicting the plausible range of future climates. While the instrumental record is too short to determine slow climate variations, the analysis of climate archives of the mid-late Holocene (7000yr BP to modern) provides information about variations on decadal to millenial timescales. In a systematic comparison of paleo-temperature records and general circulation model (GCM) simulations, we show that current models systematically underestimate the variance in regional ocean temperature variability during the mid-late Holocene, with the discrepancy increasing from decadal to millennial timescales to more than an order of magnitude. The possibility that the greater variability results from noise in temperature proxies is rejected after analysis of the covariability between instrumental temperature records and coral, alkenone, and Mg/Ca proxies of temperature. The balance of evidence indicates that internal climate variability is much larger than simulated by GCMs on decadal and longer timescales, though the sensitivity of the climate system and magnitude of external forcing could also be greater at multi-decadal and longer timescales than presently accounted for in GCMs. In either case, these results suggests that model simulations are biased toward showing a too stable climate.