Victoria updates

International ad hoc Detection and Attribution Group, Boulder, CO

Francis Zwiers
PCIC, University of Victoria
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Outline

• NH snow cover extent
• Snow mass and streamflow in key BC river basins
• Arctic sea ice extent
• D&A of urban warming influences (methods – see Ying’s talk for results)
• 13IMSC
NH Snow Cover Extent

Introduction

- We use 4 “observational” snow cover extent datasets
  - NOAA CDR (1968-2012)
  - Brown/NOAA merged dataset (1923-2012)
  - GLDAS-NOAH reanalysis (1951-2010)
  - 20CR2 reanalysis ensemble mean (1948-2012)
  - There was previously one published D&A study (Rupp et al, 2013) based on the Brown/NOAA dataset
- We study changes in these datasets using CMIP5 runs
  - ALL forcings runs (33 models, 121 simulations, extended to 2012 with RCP4.5 simulations)
  - NAT forcings runs ending in 2012 (8 models, 32 simulations)
  - 17,000 years of control simulations (37 models)
- Obs and models are compared using Regularized Optimal Fingerprinting (Ribes et al, 2013)
  - Dimensionality is kept low
  - We use non-overlapping 5 year spatial means for the NH as a whole and North America and Eurasia separately
LINEAR TRENDS IN SNOW COVER FRACTION (%/DECADE)

MAR-APR

MAY-JUN

NAT_{1968–2012}
NORTHERN HEMISPHERE SNOW COVER EXTENT ANOMALIES

MARCH-APRIL

MAY-JUNE

SCE Anomaly (million sq km)

Year


GLDAS  ALL  NAT  CTL

20CR2  Brown/NOAA

MARCH-APRIL

MAY-JUNE

SCE Anomaly (million sq km)

Year


GLDAS  ALL  NAT  CTL
SCALING FACTOR ESTIMATES

Model simulated internal variability (*) too low; (#) too high
Snowmass and stream flow


Introduction

• Approach is similar to Barnett et al (2008), but using ROF
• Consider 4 BC basins
• Snow mass variable is annual April 1st snow water equivalent normalized by October to March total precipitation (nSWE)
• Streamflow variable is JJA discharge normalized by water year (Oct to Sept) precipitation
• We analyze observed nSWE (from snow courses), reconstructed nSWE, and observed normalized discharge

• ALL, NAT and CTL simulations from 8 models (40 ALL and NAT runs, ~4200 year CTL)
• Model simulations are bias corrected and downscaled to 1/16° resolution, and are used to drive the VIC hydrologic model
Linear trends in Normalized SWE 1961-2005
SCALING FACTORS AND THEIR CORRESPONDING 5%-95% CONFIDENCE INTERVALS

Model simulated internal variability (*) too low; (#) too high
Streamflow

Climatology

Fraser

Peace

Columbia

Campbell

△ Gauging stations
NORMAlIZED SUMMER STREAMFLOW

Fraser

Peace

Columbia

Campbell
1951-2005 trends in normalized JJA streamflow

- Observed
  - ALL forcings
  - NAT forcings
Scaling factors for normalized JJA streamflow

1 – Signal_{R_{JJA}}

2 – Signal_{R_{JJA}}

Scaling Factor (β)

BC  Fraser  Peace  Columbia  Campbell  BC  Fraser  Peace  Columbia  Campbell
Arctic Sea Ice Extent

Kirchmeier-Young, Gillett, Zwiers
Event Attribution of Arctic SIE

- Goal: Attribution of extreme minimum (Sep.) events in Arctic sea ice extent (SIE)

- Large ensembles from two models:
  - CanESM2 (50 members)
  - CESM1 (30 members)

  - no NAT simulations for this large ensemble, so using pre-industrial control shifted to match 1930-1960 means
FAR and Risk Ratio

Density functions for ALL, NAT

Sep. 2012 Record Minimum

To avoid selection bias, using 4 methods to define the extreme event in SIE:

- Realized values
- Anomalies relative to the 1981-2010 mean
- Fraction of the 1979-1989 mean
- 5-year means (ending in 2012)

The 2012 record minimum in Arctic SIE is consistent with a scenario including both anthropogenic and natural forcing and is extremely unlikely to occur under natural forcing alone.
Urban Warming Impact on the Chinese Temperature Record

Sun, Zhang, Ren, Zwiers, Hu (NCC – submitted)
Estimating urban warming impact

• Problem
  – most Chinese stations are somewhat affected by urban warming
  – Comparison between urban and “rural” stations likely provides a biased estimate of the urban warming influence on the warming that is recorded in Chinese observations

• Idea is to
  – use observations to estimate the time evolution of the urban warming signal (URB), and
  – use a D&A formalism to estimate the amplitude of that signal

• Challenge is that uncertainty in the URB the signal pattern is fundamentally different from that of the ALL and NAT signals

• Our pragmatic solution involves …
Approach

• Calculate the time evolution of regional mean differences between urban and “rural” stations
  – Separately for eastern and western China

• Fit a sigmoid function
  – The effect is expected to establish itself over some period of time, and subsequently stabilize

• Use the fitted function as the URB signal in a TLS-based D&A analysis, with uncertainty on the URB signal artificially set to virtually zero (i.e., treat the URB component as OLS)

• Use a resampling procedure applied to the observations to repeatedly re-estimate the URB signal

• Ying will describe the results
Urban minus “rural” annual mean temperature differences

a. Eastern China

b. Western China
Canmore, Alberta
Abstract deadline: 15 February 2016
13imsc.pacificclimate.org
Sessions on Event Attribution, DAMIP, Grand Challenge on Extremes, Extreme value theory, etc
Questions?