WGSIP Shock/Drift Project

Bill Merryfield – CCCma, Environment Canada

Mikhail Tolstykh - Institute of Numerical Mathematics, Russian Academy of Sciences (INM RAS) and Hydrometcentre of Russia (HMCR)

WGSIP 17, 13-14 Sep 2015

Objectives

1) Develop an online “library” of hindcast climatologies and related diagnostics

2) Address science questions, including
   - influence of different initialization methods on transient behavior of climate system components
   - identification of any impacts (likely negative) on climate forecast quality

3) Possibly at a later stage: perform hindcast initialization experiments (same model, different initialization methods) that will contribute to (1) and inform (2)

An aside

(For later discussion)

- We have been referring to this project informally as WGSIP's "shock/drift project", etc.
- Should it be given an official name and acronym?
- Initial suggestion was LRFTIP, for "Long Range Forecast Transient Intercomparison Project" ("long range forecast" is WMO terminology for ranges $\geq$ 1 month)
- Other possibilities include CFSDIP for "Climate Forecast Shock-Drift Intercomparison Project"
- Feedback welcome

Project framework

- Hindcast climatologies for many ocean, atmosphere, land and sea ice variables are being computed and archived
- These represent the mean shock/drift behavior of each forecast model, as a function of lead time (and possibly initialization method)
- Initially drawing from existing data sources (S2S for subseasonal, CHFP for seasonal, CMIP5 for decadal)
- Computationally this is not trivial! N×M model years must be processed to obtain each year of climatology, where N = number of forecasts
  M = number of ensemble members
  → Typically N×M ~ 300+ for seasonal forecasts

Project components

- Subseasonal component (Mikhail Tolstykh lead)
- Seasonal and decadal component (Bill Merryfield lead)

  Seasonal hindcast climatologies

  - monthly means, some daily (first month only)
  - four start dates per year: Feb, May*, Aug, Nov*
  - 1981-2010 preferred but not enforced

  Decadal hindcast climatologies

  - yearly and monthly means, possibly some daily for 1st mon
  - one start date per year (e.g. 1 Nov for some systems, 1 Jan for others)
  - consider CMIP5 initial years 1961, 1966,…,2006 at first

*higher priority

Seasonal/decadal variables

- Ocean
  - 3D state variables: to, so, uo, vo, wo
  - surface variables: SST, SSS, SSH, MLD, heat content, etc.
  - meridional overturning streamfunctions: glb, Atl, Pac
- Atmosphere
  - 3D state variables: ta, hus, ua, va, wa
  - 2D variables: precip, near-surf T, humid, winds
  - TOA and surface fluxes (heat, freshwater, momentum)
- Land
  - vol. liquid & frozen soil moisture, snow, LAI?
- Sea Ice
  - concentration & thickness

Archive at CCCma

- Under construction, will remain so for some time
- Data nonetheless publically accessible
- FTP only – can't post html for administrative reasons
- Currently at

  `ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP`

  (could change if name of project changes)

Data standards

- File format: CF-compliant NetCDF
  - how rigidly to enforce metadata standards?
  - .nc or .nc4 ?
- File names: CMIP5 standards, adapted to hindcast climatological context; for example,

  Single hindcast run (ensemble member 1, initialized near or at end of 1960):

  tas_Amon_CanCM4_decadal1960_r1i1p1_196101-197012.nc

  Hindcast climatology (ensemble avg of 1-10, member 1, CMIP5 experiments initialized every 5 years:

  tas_Amon_CanCM4_decadal-clim-s5_r1-10i1p1_196101-201512.nc
- Data paths: CMIP5 standards, adapted to hindcast climatological context; for example,

  Single hindcast run (ensemble member 1, initialized near or at end of 1960):

  ~/CanCM4/decadal1960/mon/atmos/tas/r1i1p1

  Hindcast climatology (ensemble avg of 1-10, member 1, CMIP5 experiments initialized every 5 years:

  ~/CanCM4/decadal-clim-s5/mon/atmos/tas/r1-10i1p1

Ancilliary reference climatologies

- When available, include also climatologies of
  1) Freely running model (ideally CMIP5 historical simulations, averaging over multiple ensemble members)
  2) Hindcast initial conditions, represented by assimilating model run or reanalysis used for initialization
- Construct using same years as for hindcasts
- These represent “endpoints” of hindcast drifts:

- Differences with hindcast climatology will illustrate drifts away from IC, toward model climate

Hindcast diagnostics

- Objective is to establish a standard set of diagnostics for hindcast climatologies, somewhat as was developed for model MJO behavior by the US Clivar MJO Working Group
- Archive will include
  - plots of diagnostics for available models
  - R scripts used to produce plots (user specifies input files, otherwise can function as “black box”)
  - diagnostic data files?
- Various levels of sophistication, from SST bias vs lead time to Hovmoller plots of showing behavior along a section vs lead time, etc., drawing from existing literature
- Focus areas will include equatorial Pacific, North Atlantic

Beginnings of the archive

- Initial focus is on decadal hindcasts
- Currently serving ocean hindcast climatologies (every 5 years initialization) for CMIP5 decadal predictions from

  - CanCM4 i1 (includes subsurface ocean initialization)

  - CanCM4 i2 (ocean initialized through surface forcings only)

  - GFDL CM2.1

    + climatologies from 10 historical runs for both models

- More models to be added after ESGF returns in late September

Your contributions welcomed!

Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/

Up to higher level directory

Name	Size	Last Modified
DECADAL		15-09-10 11:33:00 PM
SEASONAL		15-09-10 11:34:00 PM

Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/DECADAL/

Up to higher level directory

Name	Size	Last Modified
data		15-08-26 11:23:00 PM
diag		15-08-26 11:40:00 PM

Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/DECADAL/data/

Up to higher level directory

Name	Size	Last Modified
CanCM4		15-08-26 11:31:00 PM
GFDL-CM2p1		15-09-03 05:08:00 PM

Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/DECADAL/data/CanCM4/

Up to higher level directory

Name	Size	Last Modified
analysis-clim-s5		15-08-26 11:18:00 PM
decadal-clim-s5		15-08-26 11:31:00 PM
historical-clim-s5		15-08-26 11:31:00 PM

Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/DECADAL/data/CanCM4/decadal-clim-s5/

Up to higher level directory

Name	Size	Last Modified
day		15-08-26 11:31:00 PM
fx		15-08-26 11:31:00 PM
mon		15-08-26 11:31:00 PM
yr		15-08-26 11:31:00 PM

Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/DECADAL/data/CanCM4/decadal-clim-s5/mon/

Up to higher level directory

Name	Size	Last Modified
ocean		15-09-02 11:39:00 PM

Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/DECADAL/data/CanCM4/decadal-clim-s5/mon/ocean/

Up to higher level directory

Name	Size	Last Modified
hc300		15-09-02 11:38:00 PM
mlotst		15-09-02 11:38:00 PM
msftbarot		15-09-02 11:38:00 PM
msftmyzv		15-09-02 11:39:00 PM
so		15-09-02 11:38:00 PM
sos		15-09-02 11:38:00 PM
t20d		15-09-02 11:38:00 PM
thetao		15-09-02 11:38:00 PM
tos		15-08-26 11:31:00 PM
uo		15-09-02 11:38:00 PM
vo		15-09-02 11:38:00 PM
wo		15-09-02 11:38:00 PM
zos		15-09-02 11:38:00 PM

Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/DECADAL/data/CanCM4/decadal-clim-s5/mon/ocean/thetao/

Up to higher level directory

Name	Size	Last Modified
r1-10i1p1		15-09-02 11:43:00 PM
r1-10i2p1		15-09-03 04:51:00 PM

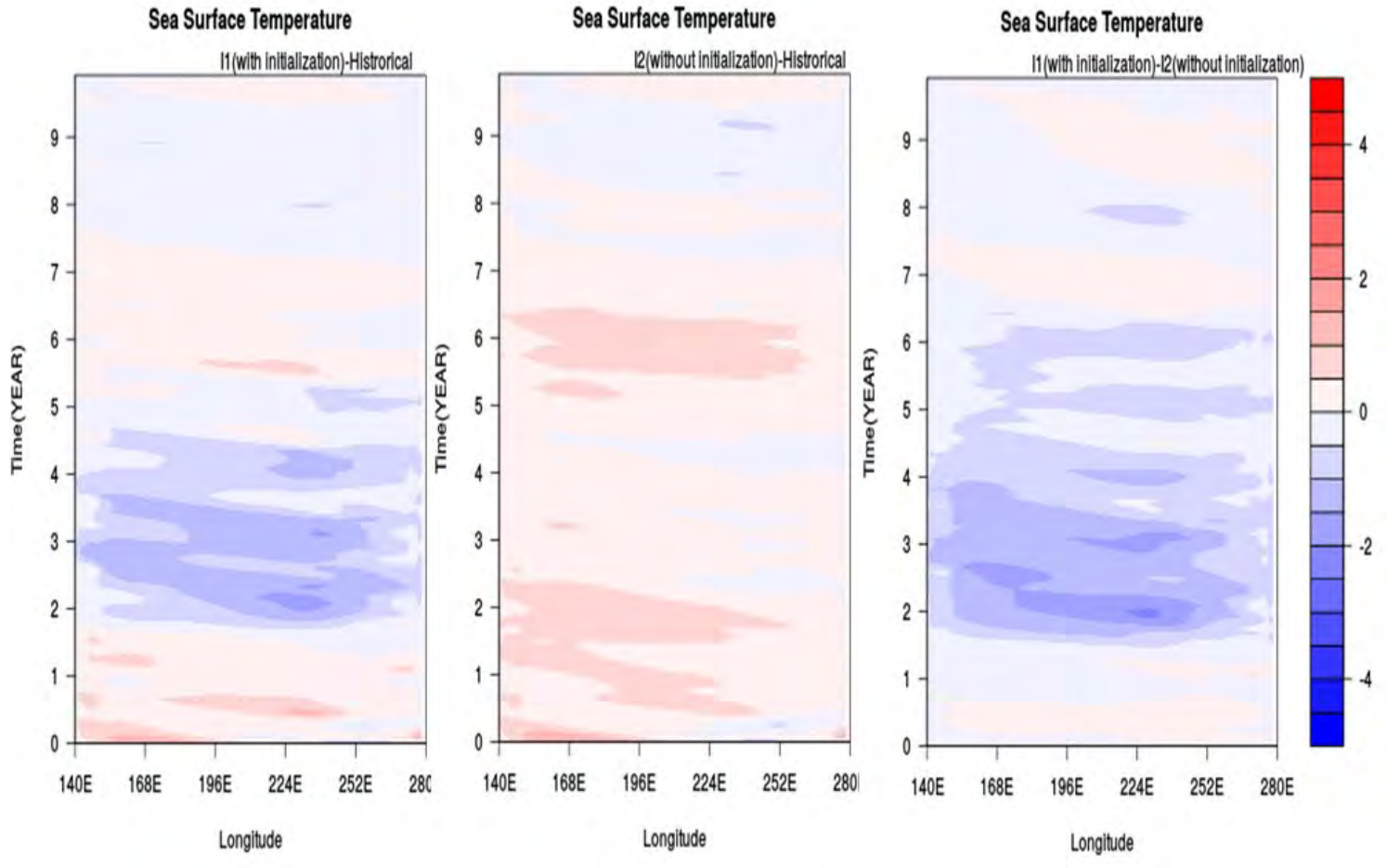
Index of ftp://dapp2p.cccma.ec.gc.ca/pub/goapp/LRFTIP/DECADAL/data/CanCM4/decadal-clim-s5/mon/ocean/thetao/r1-10i1p1/

Up to higher level directory

Name	Size	Last Modified
thetao_Omon_CanCM4_decadal-clim-s5_r1-10i1p1_196101-201512.nc	921607 KB	15-08-17 08:15:00 PM

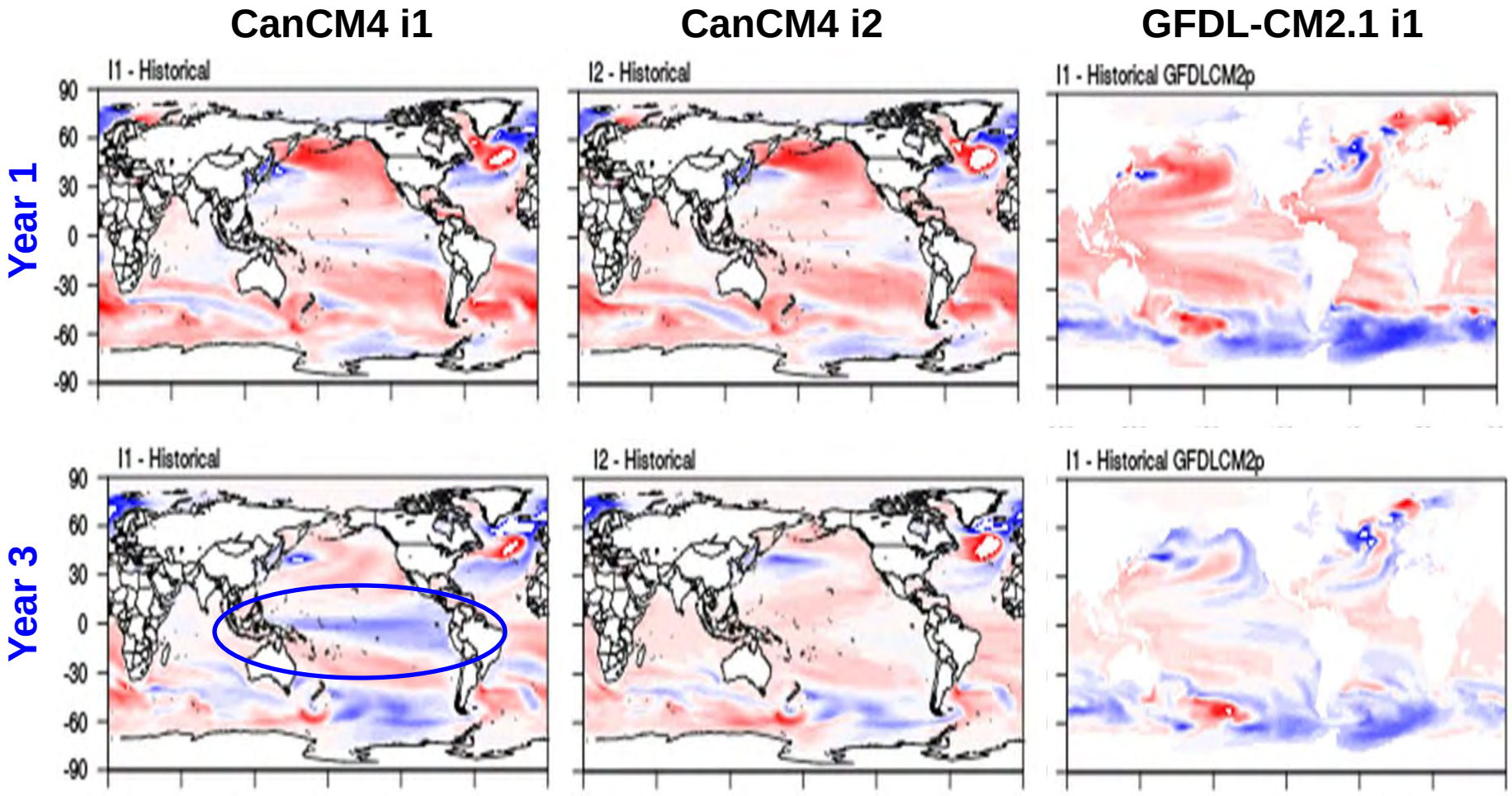
Some early results

- Hovmoller plots of equatorial Pacific SST (initialized – historical)



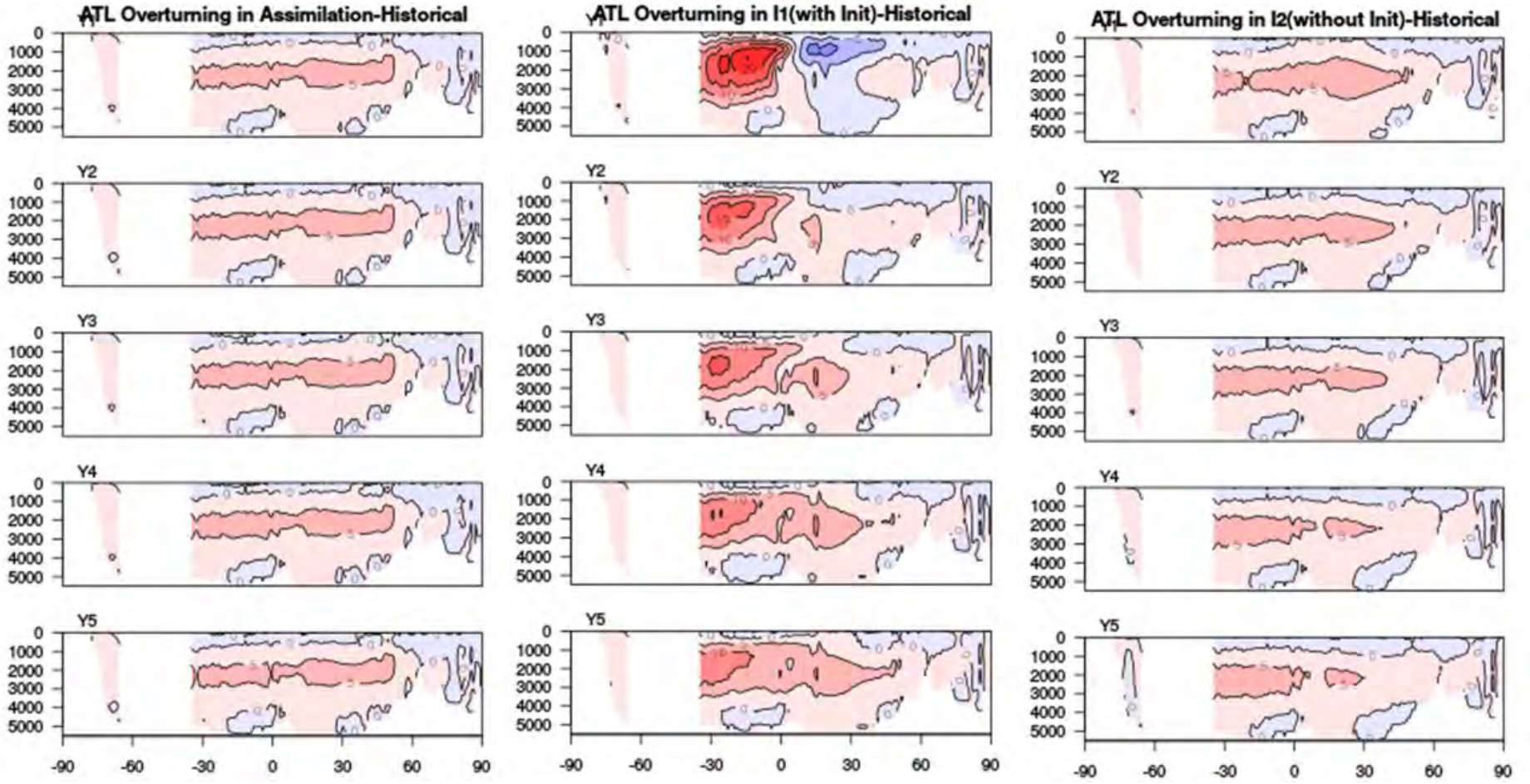
Some early results

- Evolution of SST biases (initialized – historical)



Some early results

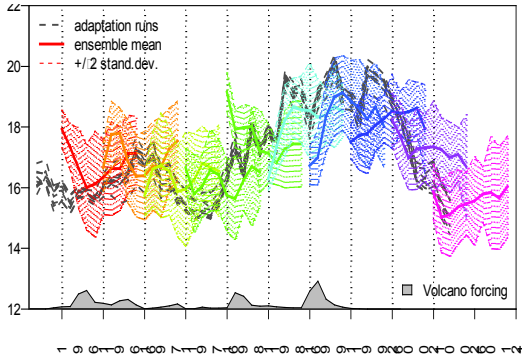
- Evolution of Atlantic MOC (CanCM4 assim, i1, i2 – historical)



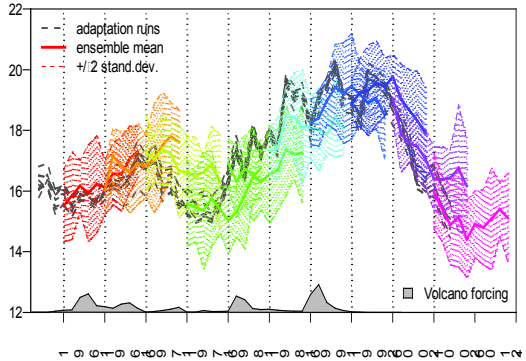
Some early results

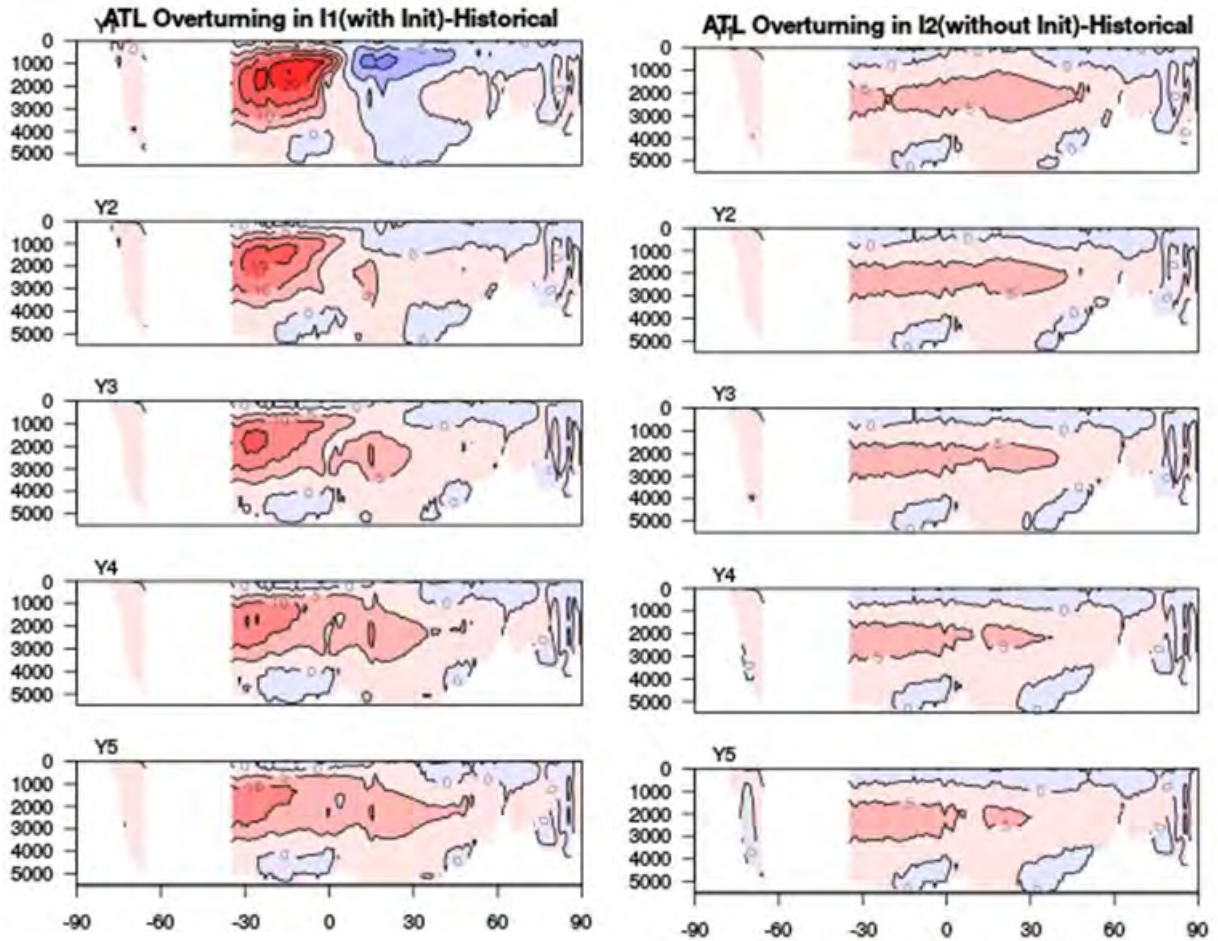
- Evolution of Atlantic MOC (CanCM4 assim, i1, i2 – historical)

i1 predictions



i2 predictions





→ shocks clearly affect forecast quality in this instance

CanCM4 i1 vertical velocity at model level 30: i1 – assim (120 month animation)