How predictable was the 2014 North American cold wave in medium-range forecasts?

- TIGGE
- Extreme Event in NH in January 2014
- Forecast Skill of the Event
- Source of the Event

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TIGGE
THORPEX Interactive Grand Global Ensemble

- A major component of THORPEX: a World Weather Research Programme to accelerate the improvements in the accuracy of 1-day to 2-week high-impact weather forecasts

- Over 500 GB data flow a day from 10 Operation Centers

Objectives:

- Enhance collaboration on ensemble prediction, both internationally and between operational centres & universities.
- Facilitate research on ensemble prediction methods, especially methods to combine ensembles and to correct systematic errors.
- Enable evolution towards a prototype operational system, the “Global Interactive Forecast System”
The TIGGE Museum

Welcome to the TIGGE museum!

The THORPEX Interactive Grand Global Ensemble (TIGGE) is a key component of the THORPEX project, which provides operational global ensemble forecast data quasi-operationally (2-day delay). The TIGGE portals provide the TIGGE data freely only for research and education purposes. For details, visit the WMO THORPEX website or the TIGGE website.

This page is operated for a promotion of utilization of the TIGGE data by Dr. Mio MATSUEDA (University of Oxford and MRI) in cooperation with Dr. Tetsuo NAKAZAWA (WMO and MRI). This page is updated every day with a 2-day delay, and is available for non-commercial use.

If you want to use the TIGGE data, sample scripts (tar.gz, 48MB) (readme) would help you to enjoy your TIGGE life!

Real-time monitors of the TIGGE forecasts Updated every day!

- Spaghetti diagram, ensemble mean, and ensemble spread for Z500
- Ensemble forecasts for specific atmospheric phenomena
  - MJO forecasts (verifications New!)
  - Probabilistic forecasts of blocking over the NH and SH
- Ensemble-based early warning products for extreme weather events (heavy rain, strong winds, and high/low temperature) (a short guide about early warning products [pdf])

Products are available for past forecast cases after October 2006.

-or-

Google “tigge mio”

Updated everyday with a 2.5-day delay

Real time products
- spaghetti plots
- MJO forecast
- blocking forecast
- early warning of severe weather
- EPS meteogram
- forecast skills
- model biases
Early warning products for high impact weather using TIGGE

http://gpvjma.ccs.hpcc.jp/TIGGE/tigge_extreme_prob.html
http://gpvjma.ccs.hpcc.jp/TIGGE/tigge_SWFDP.html (for SWFDP regions)

You will be able to look at all the forecasts during TIGGE period.
(including obs.)

Now plots with obs. are making for 2006.10-2011.06.

Initial time of forecast (2006.10-current)

Russian heatwave (August 2011)
TIGGE Database

Advantage

❖ Without having your model, several hundreds of forecasts from sophisticated ensemble models are in your hands
❖ Using the database, you will investigate the dynamic predictability and forecast skill for any atmospheric phenomena
❖ Improved forecast skill gives us the opportunity to examine the mechanism of the events in depth.

Disadvantage

❖ Data size is huge! (download time, storage, etc)
❖ Data format is not familiar to the academic people!
❖ Sparse vertical resolution in upper troposphere and stratosphere
ERA-Interim $T'$ and $Z'$

Temperature anomaly (27DEC2013–02JAN2014)

T850&Z500

30 Dec 2013

T2m&Z500

[Temperature anomaly map with contours and color scale]
10-day Forecasts of T2m in TIGGE

Occurrence probability of extreme low T2m
Initial: 2013.12.22.12UTC, Valid: 2014.01.01.12UTC

(a) MCGE mem:147
(b) ECMWF mem:51
(c) JMA mem:51
(d) NCEP mem:21
(e) UKMO mem:24

(f) Extremes observed

contour: observed Z500 [m]
observed extremes defined with 10th, 5th and 1st percentiles

+: extremes observed (5th)
contour: control Z500 [m]
probability falling below climatological 5th percentile [%]
Verification — reliability diagram of TIGGE database for cold temperature —

Medium-range EPS reliability diagram (June 2007—May 2013) probability of T2m falling below climatological 5th percentile (90°S—90°N, 30°W—330°E)

Obs: ERA-Interim
An Extreme Cold Event was well predicted, but

Where did the cold outbreak over N. America come from?
Z 500 hPa does not show any horizontal progression of Rossby wave train ....

Suggesting vertical progression?

Difficult to see it in the TIGGE database due to sparse vertical resolution!

Only eight levels (1000, 925, 850, 700, 500, 300, 250 and 200 hPa)

Use the JMA data with full vertical resolutions
○ In both Normal Winter and 2013/14 Winter, upward progression of the WAF from a trough in Siberia to an Aleutian Ridge in the stratosphere and downward progression toward a trough over North America and Atlantic.
○ In 2013/14 Winter the downward progress is more evident.
5-day mean of the Wave Activity Flux  
30 Dec - 3 Jan

Lon-hight cross section of the 60°- 90°N averaged WAF (Plumb,1985) and Geopotential height anomaly

WAF at 100 hPa (Plumb,1985) and Stream function anomaly at 200 hPa

※ Arrow: WAF
   (Unit：H-comp - m²/s²、V-comp— Pa m/s²)
   Contour: Height anomaly (m)

※ Arrow: H-component of WAF(m²/s²) Shade: V-component of WAF(Pa m/s²) Contour: Stream function anomaly(10^6m²/s) of WN1-3.
Summary

Using TIGGE ensemble-based early warning products for extreme weather events, extreme warm in Europe and cold in N. America in early January 2014 was examined.

- The early warning products from four of the leading global NWP centres: ECMWF, JMA, NCEP, and UKMO, show good predictive skill in warm/cold events with consistent forecast feature in occurrence probabilities.
- Such extreme events are related with a deep trough along the west coast in North America and a deep ridge along the east coast in Europe.
- One of the sources would be a downward progression from a ridge, in the lower stratosphere over Aleutian Sea, which was originated from a trough in Siberia and reflected in the stratosphere.
- Next step: to examine the spread in the ensemble on representation of the downward progression using the ensemble database.

Thanks for listening!