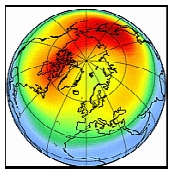
THORPEX

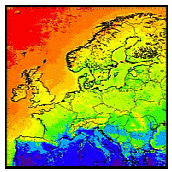
A GLOBAL ATMOSPHERIC RESEARCH PROGRAMME

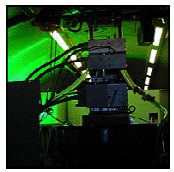
http://www.wmo.int/thorpex

George Craig, European Regional Committee

DLR Institut für Physik der Atmosphäre



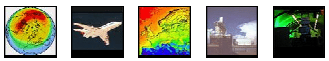




The THORPEX Mission

THORPEX: a Global Atmospheric Research Programme **is an international research programme to accelerate improvements in the accuracy of *1 to 14-day* weather forecasts for the benefit of society and the economy.**

The programme builds upon ongoing advances within the research and operational-forecasting communities. It will make progress by enhancing international collaboration between these communities and with users of forecast products.



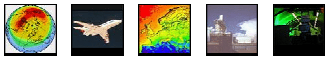
THORPEX Priorities

Advance the knowledge of global-to-regional influences on the initiation, evolution, and predictability of high-impact weather; Design the strategy for interactive forecasting and targeted observations;

Create and evaluate systems for the assimilation of targeted observations from satellites and in-situ measurements;

Test and demonstrate effectiveness of a multinational multi-model multi-analysis global ensemble forecasting system;

Improve and demonstrate decision support tools, which utilise advanced forecasting products.



International Science Plan

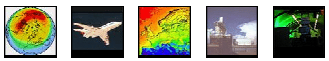
THORPEX Research has 4 themes:

A) Predictability And Dynamical Processes
- increased knowledge of global-to-regional influences on the initiation, evolution and predictability of high-impact weather

B) Observing System
- interactive forecast systems (e.g. targeted observations)

C) Data Assimilation and Observing Strategies
- advanced data assimilation systems and numerical forecast models

D) Social and Economic Applications
- user-specific probabilistic forecast products



THORPEX Implementation Plan (TIP)

Scientific Objective to be achieved through several instruments:

THORPEX Observing System Experiments (TOST)

- new observing systems, innovative use of current systems

THORPEX Regional Campaigns (TReC)

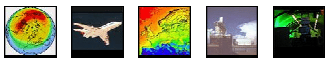
- testing of all components of interactive prediction system in a specific region (coordinated by regional committees)

THORPEX Interactive Grand Global Ensemble (TIGGE)

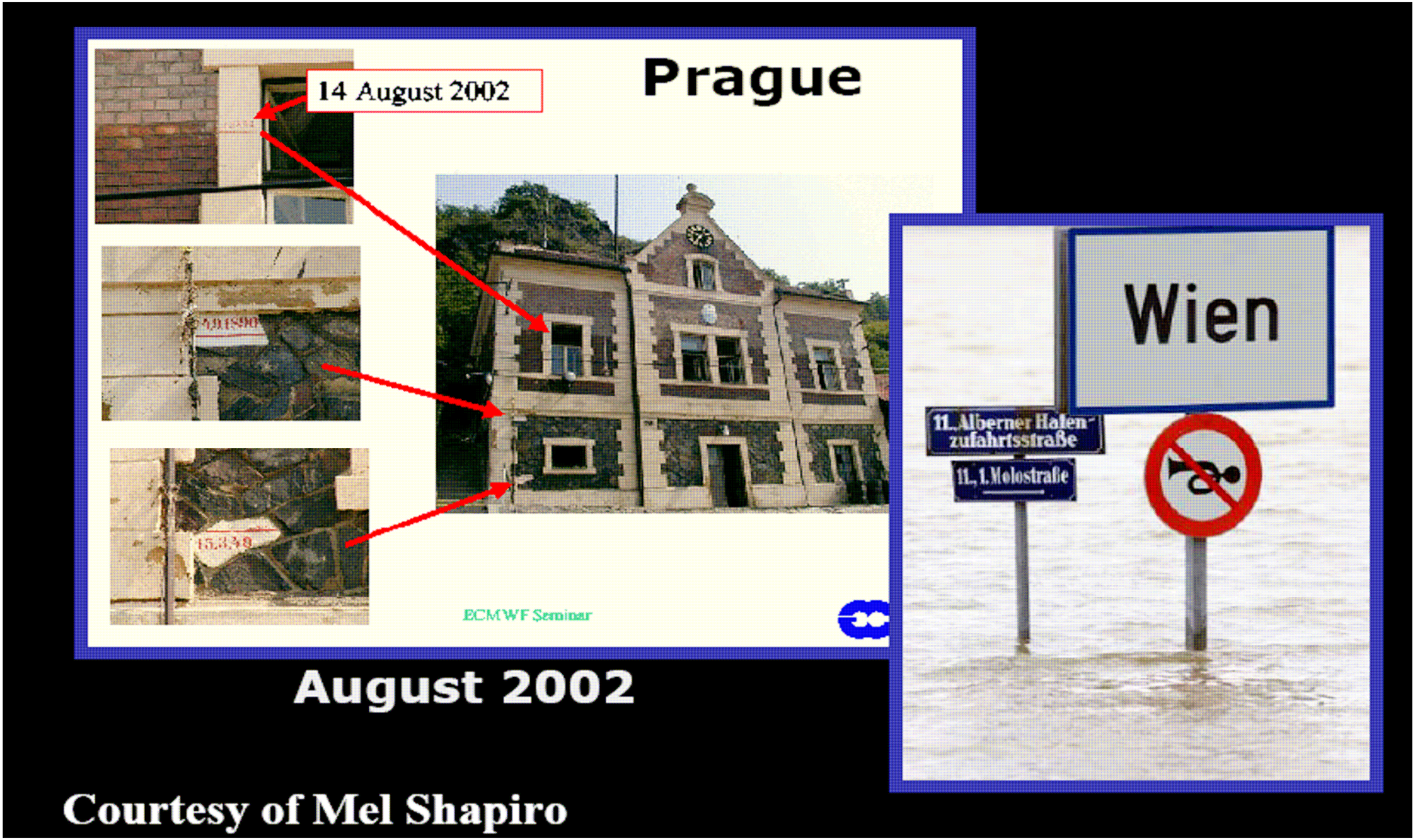
- global demonstration project, including global observing system experiment and multi-model, multi-analysis ensemble prediction system

Links to other programmes in and out of WMO:

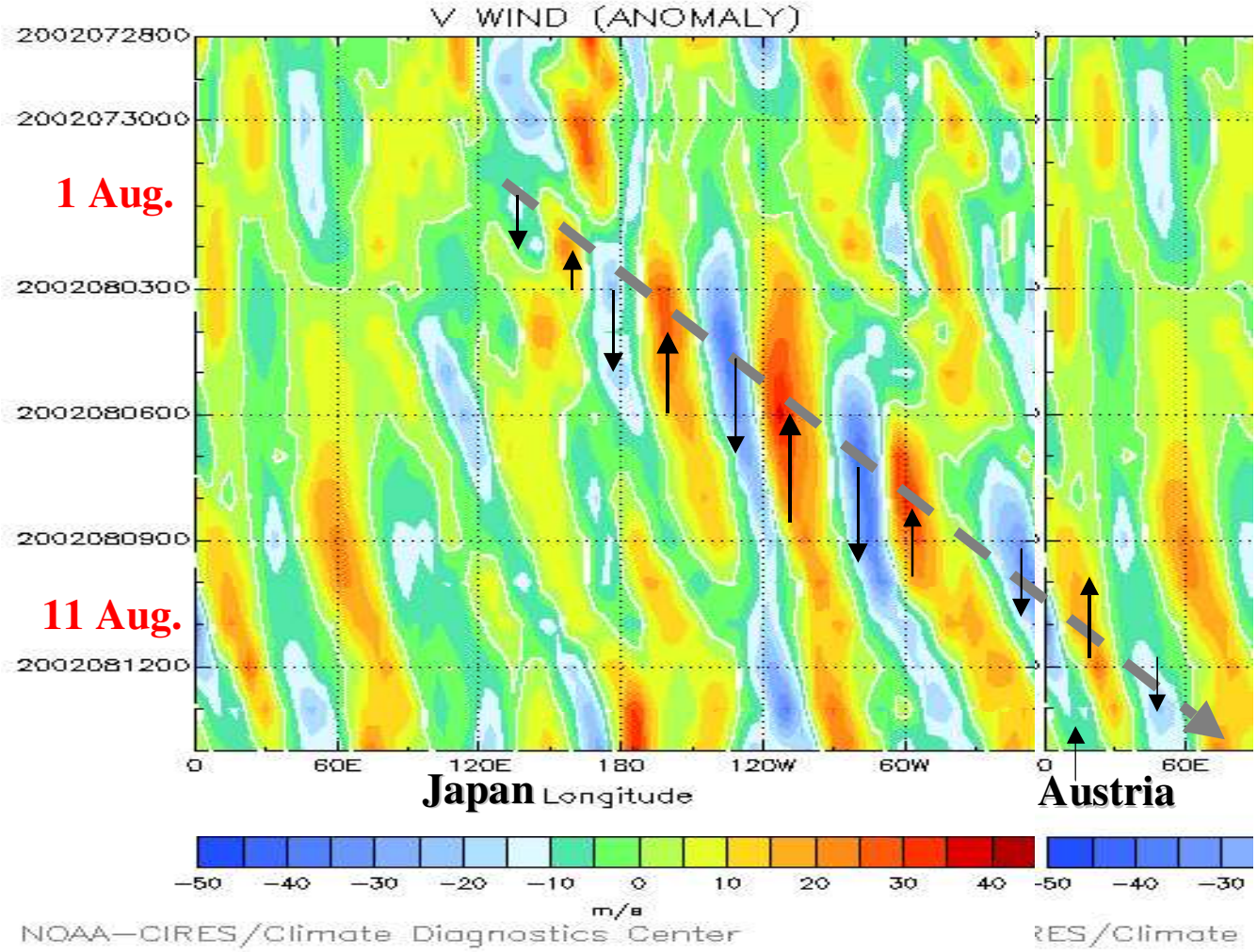
- e.g. CBS, WNGE, WCRP, COPES, IPY, AMMA



Warm-Season High-Impact Weather



Upstream Influence on Severe Weather



Hovmöller (time-longitude) diagram of the 250-mb meridional wind component (ms^{-1}) for the period 28 July - 14 August 2002 and the latitudinal belt 40-60º N.

A Rossby wave train was excited by cyclogenesis off Japan, followed by rapid downstream development of high-amplitude Rossby waves, *culminating in extreme flooding in central Europe.*

Figure reproduced from *THORPEX International Science Plan*

Climatology: Streamer + Heavy Precipitation

(Martius et al. 2005)

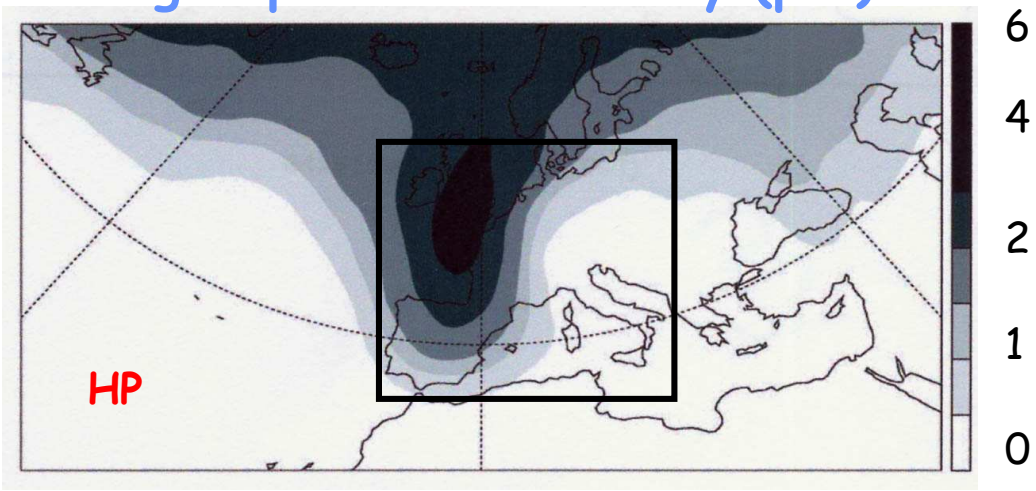
Data

* period 1966 - 1999
* precipitation data (Frei and Schär, '98)
  - Swiss Alpine southside
  - daily area-averaged
* reanalysis data (ERA40)

Procedure

* sample: "high precipitation events" **HP**
  P > 29 mm/d; 1 % (125 d) --->
  73% (85% fall) PVS; rest e.g. Genoa-cyclone
* sample: **non-HP**
  P < 29 mm/d; 99% (12285 d)

Averaged potential vorticity (pvu)



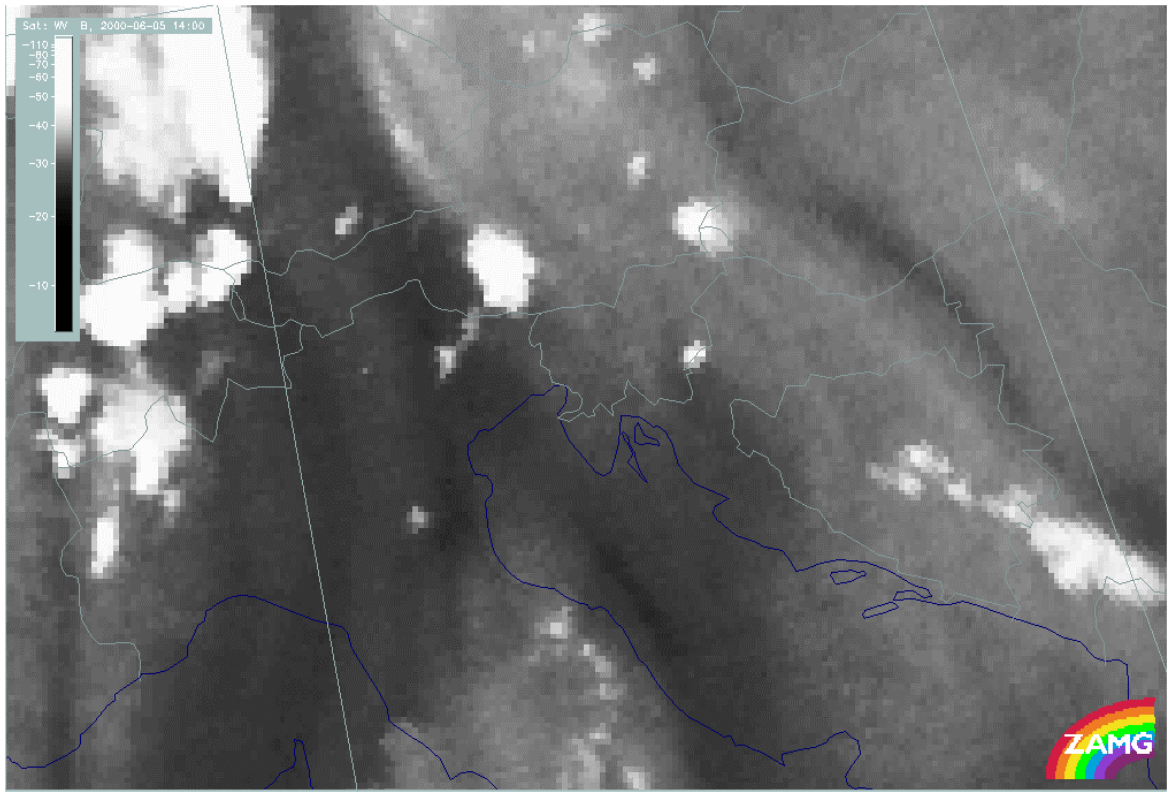
Seasonal Variation (%)

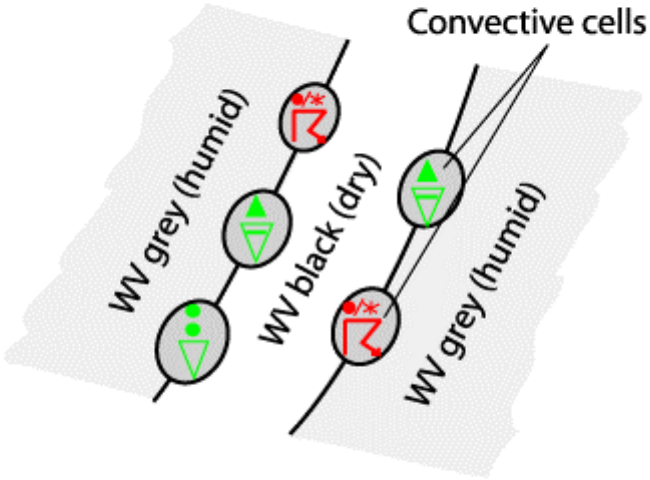
H: heavy precipitation
S: streamer

	H	S	S + H
SON	44	28	51
DJF	8	20	1
MAM	22	28	18
JJA	25	27	30

(courtesy K-P Hoinka)

Convective initiation at water vapor boundaries



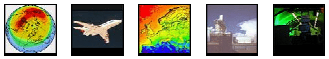


Mechanism unknown!

(Krennert and Zwatz-Meise)

The State of the Art: Conclusions from MAP

1. Very successful field campaign with many high resolution, and especially remote-sensing, data sets
2. Upper level dynamics important - local field program provides verification data, but not complete enough for forecast impact
3. Small-scale, 3D topography crucial – high resolution models can handle this usefully
4. Sensitivity to microphysics smaller although significant (esp. stable situations)
5. Predictability of different events varies widely according to sensitivity tests

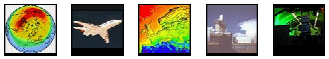


A-TReC 2003: Targeted Observation Trial

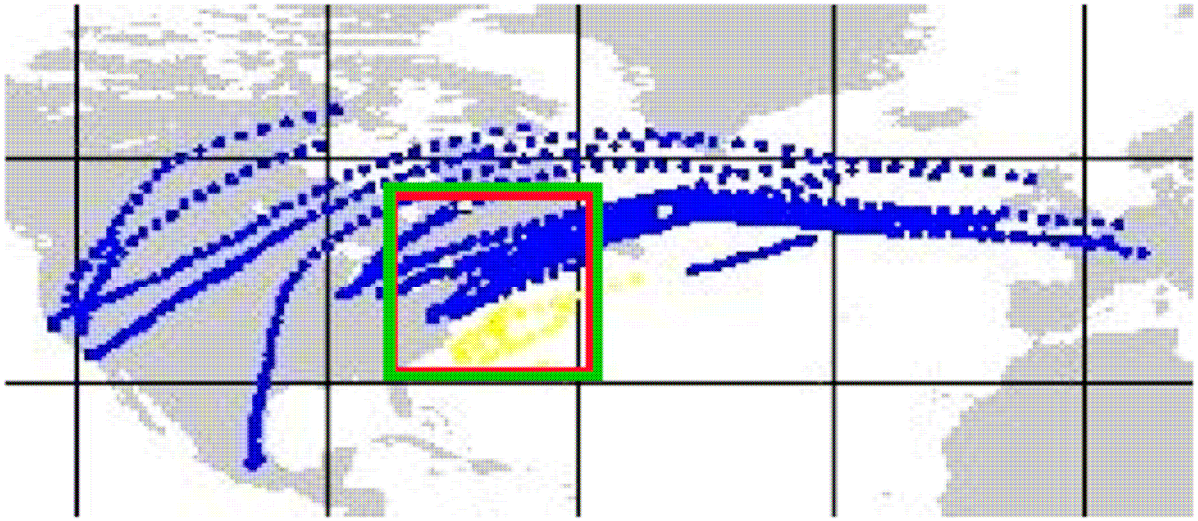
- T-5 days - Compute sensitive regions
  - ECMWF
  - Met Office
  - MeteoFrance
  - Naval Research Laboratory

- T-4 days - Make targeted observations
  - 23000 additional AMDAR observation reports,
  - 65 extra ascents from ASAP ships,
  - 214 additional radiosonde ascents and
  - 277 aircraft dropsonde profiles

- T-3 days - Forecast using new observations



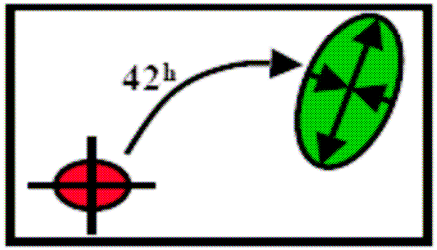
Observation Campaign 5 Dec 18 UTC---Verification 7 Dec 12 UTC



TargetIN/NOTargetIN %	
AMDAR	2.5
SONDE	5.5

Targeting = Verification Region

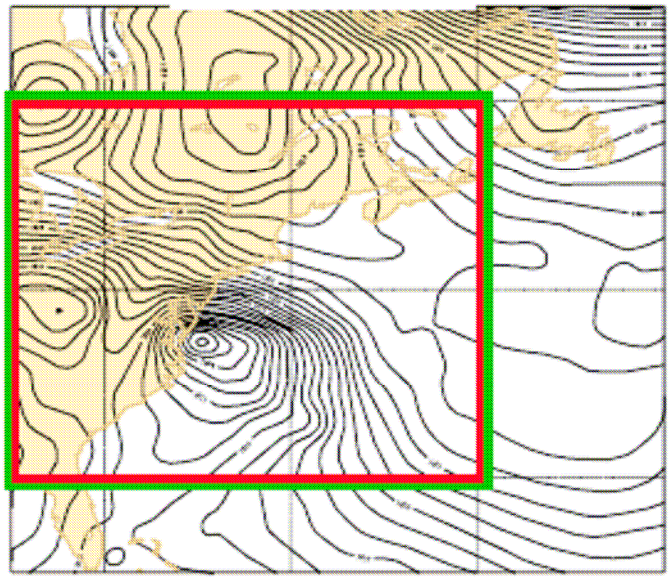
Lat(30,50)-Lon(-85,-60)



AtreC 13% MSLP Relative Fc Improvement

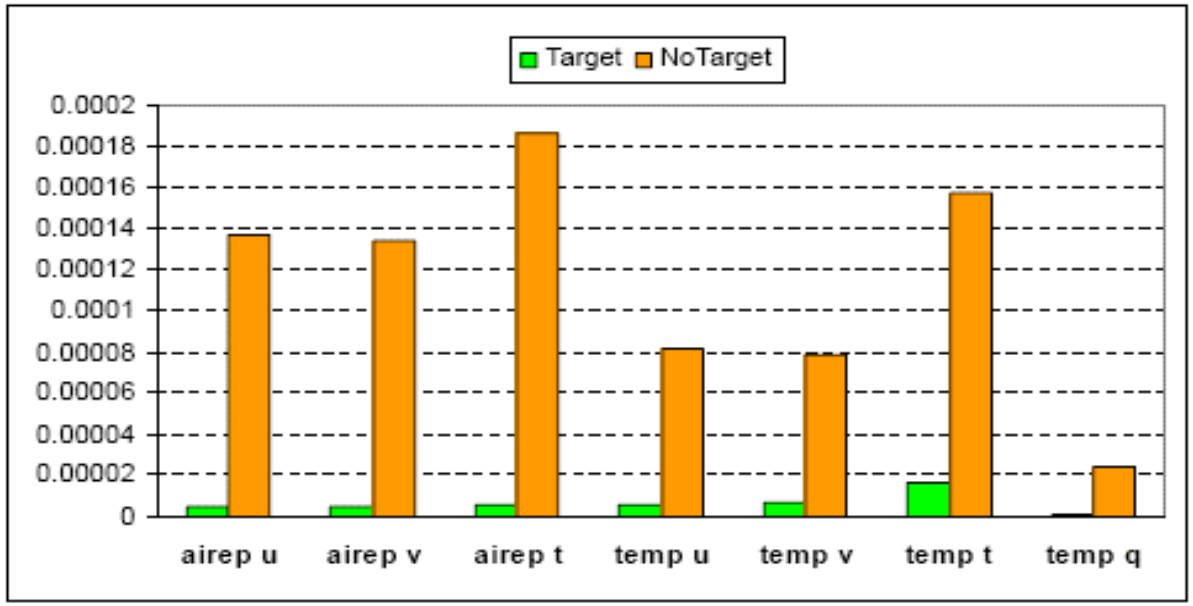
9% Total Energy

An 5 Dec 18 UTC



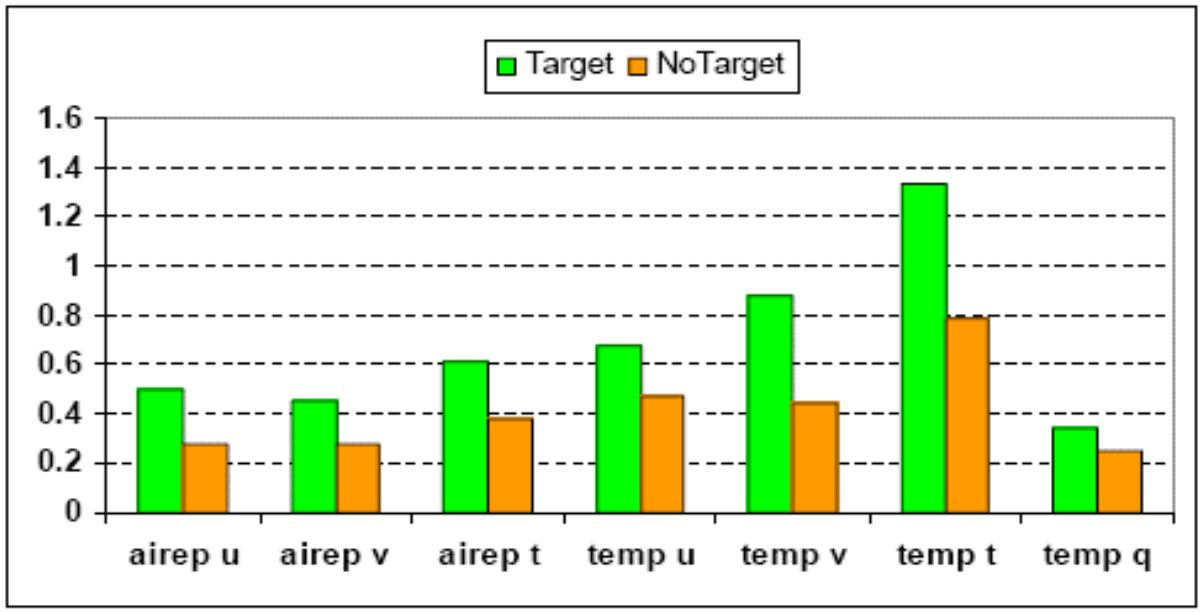
(Carla Cardinali)

Observations Contribution to Forecast



Total Contribution

$$\sum_N \left| \frac{\partial \mathbf{J}}{\partial \mathbf{y}} \right|$$



Mean Contribution

$$\frac{1}{N} \sum_N \left| \frac{\partial \mathbf{J}}{\partial \mathbf{y}} \right|$$

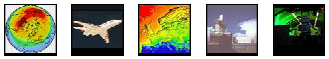
(Carla Cardinali)

A-TReC Conclusions

- Different/models methods agreed about location of sensitive regions in only 15% of cases
- Best impact from sondes (either vertical structure or correct level)
- All cases reasonably well forecast at 3 days - little opportunity for big impacts

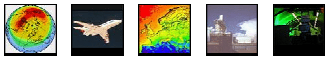
Next Steps:

- Pacific TReC - less propagation of information from upstream; link from tropics to IPY
- ETReC 2007 - Warm season precipitation; inherently less predictable



COPS Hypotheses

- large-scale conditions important for QPF
- orographic controls are important
- humidity field in PBL dominant factor for initiation
- aerosol affects cloud development, but not precipitation
- sub-grid parameterisations improved through synergistic use of new instruments
- real time data assimilation beneficial to short-range QPF



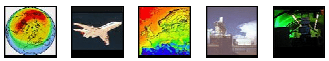
ETReC 2007: A THORPEX Regional Campaign

Summer is different:

- convection fast (hours) compared to forecast time (days)
- less synoptic influence, more orography and surface
- more like climate prediction than medium-range forecasting

Issues:

- Reconsider targeting - three met services can do this
- Understand role of different scales, measure, assimilate - COPS
- Link global to regional ensembles - D-PHASE



ETReC 2007: What needs to be done

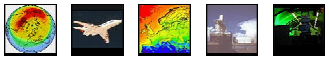
(with input from Martin Leutbecher, Roberto Buizza, Florence Rabier, John Eyre, David Richardson)

Extended seasonal trials

1. Calculation of sensitive regions for summer season
2. Targeted data denial experiments
3. Assimilation of redundant data; targeted thinning of satellite data

Case Studies

1. Short-range targeting methods
2. Targeted observations: EUCOS, airborne
3. Coupling of global and regional ensembles



2007 will be an important opportunity

A prediction:

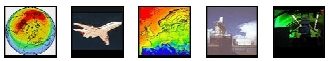
There will be good and bad forecasts in 2007!

Why are they good and why are they bad?

What we can do:

Quantify uncertainty - global and regional ensembles (single and multi-model)

Additional data - targeted by climatology or interactively (observing and assimilating)



Working Together