Recent Developments in CPTEC/INPE Systems

14th Workshop on meteorological operational systems: From Research to Operational Products

ECMWF – Reading - UK

waldenio.almeida@cptec.inpe.br
Centro de Previsão de Tempo e Estudos Climáticos – CPTEC
Instituto Nacional de Pesquisas Espaciais - INPE
Outline

- A brief (very quick) description of CPTEC
- Some Products and Services
- Internal Organization
- Research and development to Operations Process
- Important question:
  - New developments, products and services... Are they being effective?
- Work on progress: management based on indicators.
  - ... from “to have” to “how good it is?”
  - How are we going?
- Examples of indicators:
  - Met Data, Models, SMS for control,
The CPTEC/INPE

- Center for Weather Forecast and Climate Analysis (CPTEC)
- Part of the National Institute for Space Research (INPE)
- Center for Research and Operations in Numerical Weather and Climatic Prediction
- Began at Cachoeira Paulista in 1994
Some CPTEC’s products:

- Weather Forecasts
- Seasonal Forecasts
- Meteorological Monitoring and warnings
- Provide information for Brazilian news networks
- Satellite imagery and products
- Several Global and Regional Numerical Products distributed freely
Numerical Models:

- Global Weather Forecast model (COLA/CPTEC)
- Regional models for South America:
  - 15 Km to 5 km resolution + Ensemble 40 Km
- Air-Quality Model South America: BRAMS
- Coupled model (Global-MOM4)
- Sea waves model (WWATCH)
- Ocean model (MOM4)
- Global and Regional Ensembles for NWP
- ...
2010: CRAY XT6

- 1272 nodes, with 30528 cores
- Peak: 244 Tflops
- Effective: 16.6 Tflops
- Disks SATA: 3.84 Petabytes (PB)
- System with 8,000 tapes LTO4: 6 PB
AVISO DE TEMPO SEVERO (23/05/2005)
Nos dias 24/05 (terça-feira) e 25/05 (quarta-feira) áreas de instabilidade em altos e médios níveis da atmosfera em combinação com a chegada de uma frente fria... provocarão chuvas fortes com possibilidade de queda de granizo e acumulados significativos em algumas localidades dos estados de PR e SP.

AVISO DE TEMPO SEVERO (25/05/2005)
No decorrer do dia de hoje 25/05 (quarta-feira), áreas de instabilidade provocadas pela passagem de uma frente fria provocarão chuvas fortes com trovoadas, possibilidade de queda de granizo e acumulados significativos em algumas localidades do nordeste e norte do Estado de SP, no RJ (incluindo a capital)...

Chuva estimada por satélite 25/05/2005

São Paulo –113mm
São José dos Campos –76mm
Página do CPTEC - Média Diária

Núm. Acessos

Mês/Ano

jun/04 | jul/04 | ago/04 | set/04 | out/04 | nov/04 | dez/04 | jan/05 | fev/05 | mar/05 | abr/05 | mai/05

45000 | 40000 | 35000 | 30000 | 25000 | 20000 | 15000 | 10000 | 5000 | 0

Servidor Principal | Servidor Tempo | Servidor Satélite
Deterministic and Ensemble Forecasts

Modelo Regional ETA com 4 0km de resolução

Modelo Global com previsão por conjunto

PROBABILITY PLUMES - GLOBAL ENSEMBLE FORECAST - T126L28
CPTEC: 12.5°S - 22.5°S  SÃO JOSÉ DOS CAMPOS (SP)
26JUN2005 12:00:00 - Vertical Dotted Line: Midnight

- 1 - 20 %
- 20 - 40 %
- 40 - 60 %
- 60 - 80 %
- 80 - 100 %

Central Forecast

Ensemble Members of Precipitation (mm/h)

Surface Temperature (°C) - Probability for 0.6 deg intervals

Relative Humidity (%) - Probability for 1.0% intervals

Surface Wind (m/s) - Probability for 0.2 m/s intervals

Surface Pressure (hPa) - Probability for 3.5 hPa intervals
Atmospheric Pollution and Forest Fires

Escala regional
Seasonal Numerical Prediction
Satellite Products...
WMO’s Global Data-Processing and Forecasting System
Global Producing Centres for Long Range Forecasts
TIGGE Archive Centers and Data Providers

IDD/LDM
Internet Data Distribution / Local Data Manager
Commodity internet application to send and receive data
Expansion of Facilities
Doubling office area... For January 2014
New Front view... Not finished yet.
Now the important question...

- In the past meetings CPTEC’s representatives always bring news about new products and services under implementation.
  - 2005: CPTEC’s Data Management System ...
  - 2009: Numerical Forecast Products
  - 2011: Use of ECMWF’s SMS and Supercomputer migration

- But the Point is:
  - These products are good enough?
  - Are they competitive?

- => Is the R2O Process working well? <=
Initiative to improve production and R2O...

- Internal Organization (it affects the R2O process...)
- How is the R2O process now?
- Can it be changed?
- The Improvement Strategy:
  - Quantitative performance indicators + External references
  - Where we are? - Where we want to go? - Are we improving over time?
- It is a cultural change in progress now…
  - From “to have the products” to “how good are they”
- Some indicators on place, some on development
- Experience and conclusions ... So far.
CPTEC´s Internal Organization

- IT Support Section
- Administrative Section
- Modelling Division (Research)
  - Basically 1 team for each model...
- Satellite Division (Research and Operation)
  - Basically 1 team for each product/service...
- Operations Division:
  - Weather Forecast Team
  - Seasonal Forecast Team
  - Database development Team
  - Operational Implementation Team (SMS for models suite)
  - Pre-processing (Meteorological Data) Team
  - Webpage team
  - WebTV and Videos
Research to Operation Process...
Where we are ? Present status...

- Development is made on the 3 divisions:
  - To bring and install systems and solutions from other centers
  - To adapt these systems for local needs
  - To develop local solutions (home-made solutions)

- Operational implementation is done at Op. Division, who develops all scripts and verification processes for production

- Everything is very informal ...

- Testing is made by own developers, some times is not enough...

- Problem finding and solving process is very informal, made “on demand”

- No tracking or numbers or time spent ...
It is not the ideal, ... Can it be changed?

- Continuous innovation is needed!
- Optimization of resources and clear goals are critical for the success...
- => R2O must be well focused!
- >>> In CPTEC structure, R&D people have a lot of freedom..
- A cultural change in the R2O process this affect all the organization, including: high-ranking researchers and experienced developers..
- It is very difficult to “Break” the culture of R&D people.
- Personnel resistance is capital for any major change ...
- ... No resources to create a “QC Team” ...
Creating some movement...

- R&D people have a lot of freedom (and resistance to changes), so they need to be convinced ...

- Proposal under implementation:
  - Performance indicators
  - Comparison with external benchmarks

- We got some help from TIGGE project participation..
  - First time that CPTEC´s products were used and compared with international products...

- Slow process… started in 2010. With some MBA training at INPE

- Already created an internal impact…
  - Researchers are paying more attention to “external benchmarks”
  - A cultural change is happening..
Theory behind: Technological Capability

Acummulation of Capability

Tech Frontier

Latecomers
Example of indicator: Met. Data
Examples of indicator: Met. Data II

COMPARACAO DAS MEDIAS DOS TOTAIS DIARIOS DOS DADOS SYNOP CPTEC/INPE E NCEP

- SYNOP/NCEP
- SYNOPY CPTEC

MEDIA MENSAL DO TOTAL DIARIO

ANOS

199401 199601 199801 200001 200201 200401 200601 200801 201001 201201
RMSE T+72h - South Hem.

- **CPTEC**
- **China**
- **Australia**
- **ecmwf**
- **UKMet**
- **Korea**
- **USA**
- **3DVar**
More indicators and controls under development

- Are the products available at the right time?
- Is the performance improving over the time?
Concluding Remarks:

- The implementation of indicators is a slow process,
- It creates a cultural change and new parameters for evaluation.
- Creates some conflicts sometimes – Nobody likes to be evaluated...
- It takes researchers and developers out of “the comfort zone”
- A well-designed indicator, it is an effective instrument:
  - to monitor the quality of the products and services
  - to force developments focused on the objectives
Thank You.

Questions ?

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