VAMOS and THORPEX

Celeste Saulo, VPM13 – Buenos Aires, 29July 2010

Based on documents from VAMOS and THORPEX communities, specially those from the Modeling Working Group for VAMOS and the International Core Steering Committee for Thorpex (eighth session report)

Outline

- What is THORPEX?
- Reviewing main issues in VAMOS and THORPEX
- Possible linkages

- THORPEX: The Observing System Research and Predictability Experiment

THORPEX inside WMO scientific and technical programmes

- World Weather Watch (WWW) Programme
- World Climate Programme (WCP)
- Atmospheric Research and Environment Programme (AREP)
  - Global Atmosphere Watch
  - World Weather Research Programme
  - THORPEX
- Applications of Meteorology Programme (AMP)
- Hydrology and Water Resources Programme (HWRP)
- Education and Training Programme (ETRP)
- Technical Cooperation Programme (TCP)
- Regional Programme (RP)
- WMO Space Programme (SAT)
- Disaster Risk Reduction Programme (DRR)

VAMOS inside WMO scientific structure

WMO Co-sponsored programmes

- Intergovernmental Panel on Climate Change (IPCC)
- World Climate Research Programme (WCRP)
  - CLIVAR (Climate Variability and Predictability)
    - VAMOS
- Global Climate Observing System (GCOS)
- Global Ocean Observing System (GOOS)

The Observing System Research and Predictability Experiment (THORPEX)

THORPEX MISSION:

- THORPEX is a 10-year international research and development programme to **accelerate improvements in the accuracy of one-day to two-week high impact weather forecasts** for the benefit of society, the economy and the environment.
- THORPEX establishes an organizational framework that **addresses weather research and forecast problems** whose solutions will be accelerated through international collaboration among academic institutions, operational forecast centres and users of forecast products.

THORPEX
A World Weather Research Programme

Working Groups inside THORPEX

- Observing System (OS) and Data Assimilation and Observing Strategies (DAOS) WGs are merged
- **Predictability and Dynamical Processes** (PDP)
- **Global Interactive Forecasting System - THORPEX Interactive Grand Global Ensemble** (GIFS-TIGGE)

GIFS-TIGGE Global Interactive Forecasting System - THORPEX Interactive Grand Global Ensemble

- TIGGE (2005 onwards). Is an international data archive where numerical ensemble forecast providers share their data to advance scientific research related to improving high impact weather forecasting. TIGGE data are made available for research purposes with a time delay at three volunteer archive centers via site specific web interfaces.
- GIFS Development (2008-2012). Building on the TIGGE data set, this initial phase of GIFS entails developing real time access to basic ensemble forecast data and creating an infrastructure for the generation of derived products and the provision of other related services. This phase began with the real-time exchange of tropical cyclone track information between a majority of the TIGGE data providers.

VAMOS

- To investigate the **variability and predictability** of the American monsoon system (VAMOS) in the context of global climate variability and predictability.
- **To advise** the CLIVAR numerical experimentation groups (e.g. WGSIP, WGCM) **on modelling investigations** which need to be carried out to meet VAMOS objectives.
- **To work closely and coordinate with other** national, regional and international **projects** and organizations **interested in this area of research**

VAMOS modeling approach

- VAMOS Modeling and Data Assimilation For Improved Prediction: A Multi Scale Approach

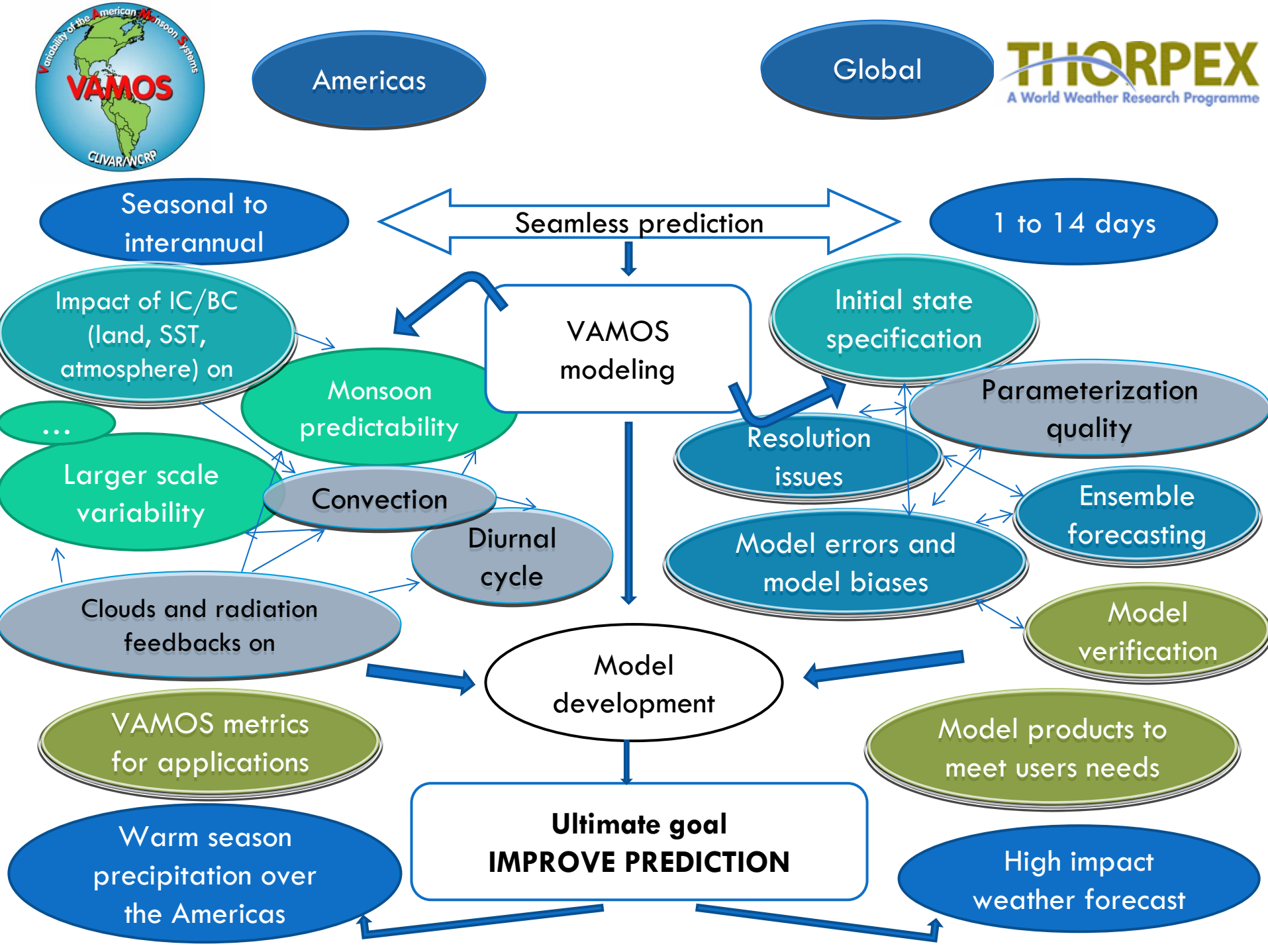
The overarching goal of VAMOS modeling is to improve the prediction of warm season precipitation over the Americas, for societal benefit, and to assess the implications of climate change.

VAMOS modeling approach

- VAMOS focuses on rainfall and the probability of occurrence of significant weather events such as tropical storms, mesoscale convective systems, persistent and heavy rains associated with synoptic systems and temperature extremes.
- (…) This complexity in terms of spatial and temporal scales and climate system interactions (i.e., land-atmosphere or ocean-atmosphere) necessitates an integrated multi-tiered modeling and data analysis and assimilation strategy.

VAMOS modeling plan

- A key aspect of the modeling strategy is to develop partnerships among the VAMOS observational, model development and data assimilation, and forecasting communities with the specific goal of assessing and improving predictions.
- It is organized into four science themes:
  - **(A) simulating, understanding and predicting the diurnal cycle**,
  - (B) predicting and describing the pan-American monsoon onset, mature and demise stages,
  - (C) modeling and predicting SST variability in the Pan-American Seas, and
  - **(D) improving the prediction of droughts and floods**.


Variability of the American Monsoon Systems
VAMOS
CLIVAR/WCRP
Americas
Global
THORPEX
A World Weather Research Programme
Seasonal to interannual
Seamless prediction
1 to 14 days
Impact of IC/BC (land, SST, atmosphere) on
VAMOS modeling
Initial state specification
Monsoon predictability
Parameterization quality
…
Resolution issues
Larger scale variability
Convection
Ensemble forecasting
Diurnal cycle
Model errors and model biases
Clouds and radiation feedbacks on
Model verification
Model development
VAMOS metrics for applications
Model products to meet users needs
Ultimate goal
IMPROVE PREDICTION
Warm season precipitation over the Americas
High impact weather forecast

Back to THORPEX- GIFS/TIGGE

- Develop and test high quality advanced ensemble-based probabilistic warnings on high impact weather events
  - With special emphasis on developing areas of globe
  - Built on THORPEX research utilizing TIGGE and other datasets
  - Focus on heavy precipitation

Notes taken from Zoltan Toth & Richard Swinbank (Co-Chairs THORPEX GIFS-TIGGE WG) at the USTEC meeting, october 2009.

Possible linkages

- Identifying really challenging research topics for joint action….

e.g.: Mesoscale Convective Systems over LPB

- Heavy precipitation (high impact weather)
- Process studies:
  - Diurnal cycle
  - Microphysical processes
  - Land-surface interactions
  - Multiscale interactions
- Sensitivity to resolution, parameterization, initialization, targetting observations
- Quantify the increased value of EPS
- Develop model products critical for operations, warnings, etc.

Closing remarks

- One of the key measures of success of the VAMOS program will be the extent to which predictions of the pan-American Monsoon are improved. The prediction problem for VAMOS is rather broad and includes time scales ranging from diurnal to weather to interannual.
- A key is to determine the extent to which model improvements made at the process level (e.g. convection, land/atmospheric interaction), and associated improvements made in the simulation of regional-scale phenomena (diurnal cycle, basic monsoon evolution, low level jets, moisture surges etc), validated against improved data sets, ultimately translate into improved dynamical predictions

- Thank you!

Scientific questions, combined

- Which is the added value of multi-Centre ensembles? (TIGGE data base is far from being extensively exploited over VAMOS region)
- Can the physical processes responsible for degradation of the 1-7 day forecast over any specific region be identified?
  - What spatial resolution is required to adequately resolve the convective systems and their diurnal cycle?
  - What resolution is required to capture the nocturnal maximum in the low level jets?
  - How do the MCSs impact the related diurnal cycle given their relatively long life cycle?
- Which is the best way to combine ensembles, optimal statistical corrections, product design and best training practices?
- Which is the relative impact of initial state specification on realizing maximum predictability?
  - how sensitive are model simulations of NAMS and SAMS precipitation (and the components of the large scale circulation driven by monsoonal convection) to accurate specification of SSTs, land-surface state, etc.?
  - how local observations can be used to improve the large scale models and forecasts?
- Increasing understanding of atmospheric processes
- Future WWRP research would focus on high resolution convection permitting models, mesoscale DA, the representation/parameterisation of convection, the role of the surface and reduction in model imbalance and "spin up". The EC-RTT report encouraged an expanded scope including collaboration with the climate and environment communities.
- Better co-ordinate and accelerate prediction research. Accomplish this means: (these are just examples) identifying the really challenging research topics for joint action, parametrization packages, cloud parametrization and convection generally