INPE / CPTEC National Institute for Space Research. Brazil

Observation System for Severe Weather (SOS): The Precipitation Nowcasting by Meteorological Satellite and Radar

Alan James P. Calheiros*, Luiz Augusto Toledo Machado, Carlos Frederico Angelis, Antonio Paulo de Queiroz
*alan.calheiros@cptec.inpe.br

CPTEC-INPE

Main facilities and data:
- NEC supercomputers SX-4 e SX-6;
- GOES, METEOSAT, NPOES, ACQUA,TERRA,TRMM database;
- ~ 1500 Rain gauges;
- Access to 8 Weather Radars
- Access to the Lightning Detection Network.

Products:
- Remote Sensing of the Atmosphere
- Meteorological And Environmental Data
- Climate Prediction
- Numerical Weather Forecasts
- Data Assimilation

INPE / CPTEC / DSA - WEB PAGE

The primary mission of the Environmental Satellite Division of the Center for Weather Forecast and Climatic Studies (CPTEC/INPE) is to provide state-of-the-art in meteorological and environmental information on operational basis. CPTEC/INPE activities include operation of ground stations for detection and processing geostationary and polar satellites and also research for the development of satellite derived products dedicated to a broad range o users like agricultue, hidrology, water resources management, energy, flight safety and others.

http://satelite.cptec.inpe.br

Main users:

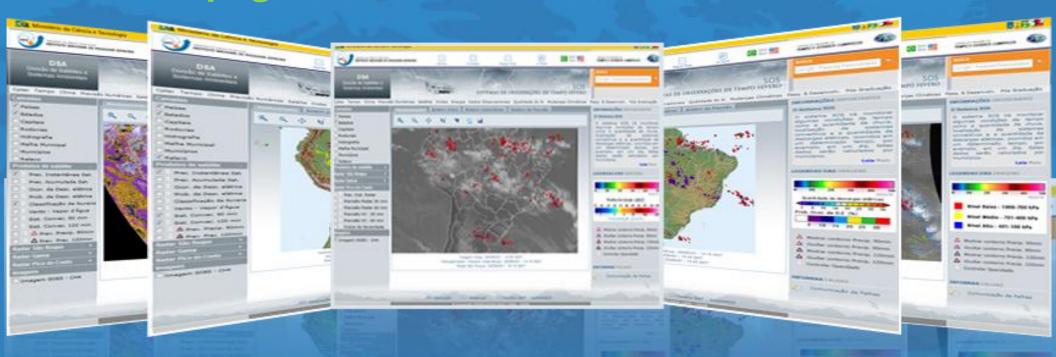|		
Agriculture companies	Flight safety	Energy companies
Meteorological Regional Centers	Water Resource Companies	Partners in South America

ABSTRACT

Observation system for severe weather (SOS) is an integrating information system applied to severe system identification and forecasting. this system use meteorological satellite and radar techniques. The precipitation nowcasting is very important for civil defense, air transit, power supply, and agriculture. The knowledge of convective system evolution is of fundamental importance for understanding weather and climate, particularly in the tropics, and it is essential to improve forecasting of these systems to reduce vulnerability to extreme weather damage. The identification of predictor parameters of the evolution of precipitation system, based on its previous evolution, could give valuable contribution to nowcasting schemes. This work evaluate two techniques based on Forecasting and Tracking of the evolution of the Cloud Clusters (ForTraCC) system for rainfall in operation on Center for Weather Forecast and Climate Studies (DSA/CPTEC/INPE) for precipitation nowcasting: Hydroestimator Tracking and Nowcaster (HydroTrack) and ForTraCC-RADAR (radar reflectivity). The HydroTrack is using GOES channel 4 images. The ForTraCC-RADAR use radar reflectivity each 15 minutes. The results show this probability of detection (POD) is superior to 70%, in both schemes. However, the skill decrease with prediction time (2 hour). The biggest error is associate to system position. But there are a good skill to area and rain rate prediction. The evaluate this systems were used GOES and RADAR images (São Roque) above São Paulo during November (2008) to January (2009).

SOS - web page

Nowadays, SOS has seven satellite and three radar products for monitoring systems on the South America.
Satellite Products:
Precipitation Estimation (Hydroestimator), Precipitation Nowcasting (HydroTrack), Convective System Nowcasting (ForTraCC), Cloud Classification, Lightning probability, Lightning Detection, and Wind.
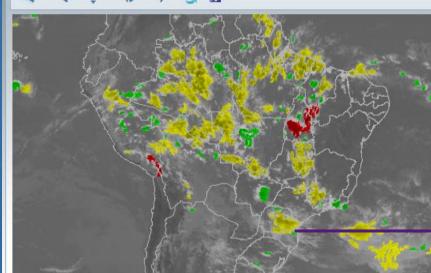**Radar Products:**
Precipitation Nowcasting (ForTraCC-RADAR), Vertically Integrated Liquid Nowcasting (ForTraCC-VIL), and Severity Index.
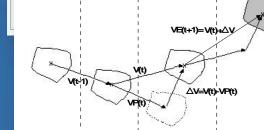
PRECIPITATION TOOLS

ForTraCC

This technique was develop to obtain the time evolution and the tracking of the convective systems using a the thresholds of 235 K.
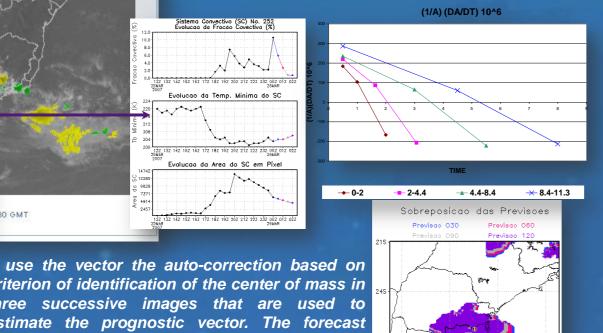
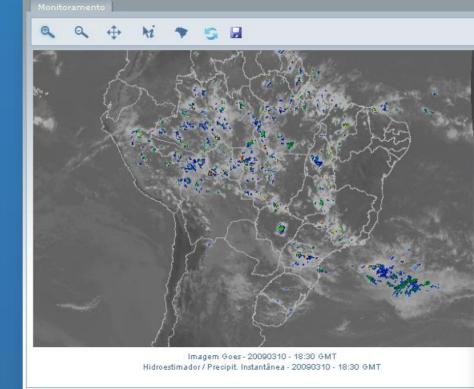It use the vector the auto-correction based on criterion of identification of the center of mass in three successive images that are used to estimate the prognostic vector. The forecast model needs information about the growth/decay trend. Therefore, it's necessary to describe the climatology of expansion/dissipation of the cloud area as function of the rainfall system lifecycle.
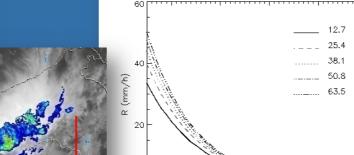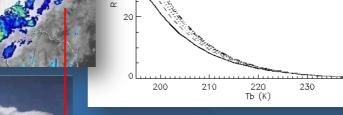
Hydroestimator

It use the GOES-IR images to compute real-time precipitation amounts based on a power-law regression algorithm (Vicente et al. 1998).
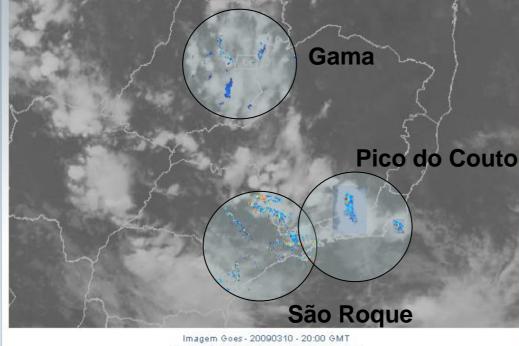
$$R = 1.1183 \cdot 10^{11} \exp\left(-3.6382 \cdot 10^{-2} T^{1.2}\right)$$
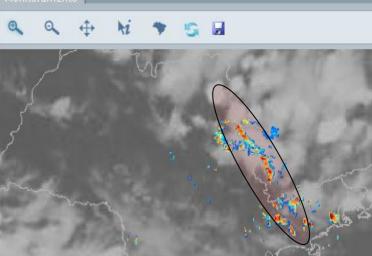
HydroTrack

The HydroTrack (Hydroestimator Tracking and Nowcaster) is a precipitation nowcasting method, using GOES channel 4 images, based on the ForTraCC and the Hydroestimator. The ForTraCC was adapted to assimilate the rainfall fields contrary to brightness temperature.

Radar Reflectivity

Gama

Pico do Couto

São Roque

ForTraCC-Radar
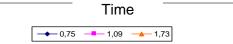
Based on ForTraCC for monitoring structures of precipitation present in the reflectivity fields. Using the thresholds of 20 dBZ.

ForTraCC-RADAR: Forecast 30 min

SKILL

HydroTrack

	30	60	90	120
POD	0,7205012	0,6217472	0,5849453	0,5078174
FAR	0,3029918	0,4441636	0,5065705	0,5420523
PREC	0,9545538	0,9922852	0,9906238	0,9889542
BIAS	1,032583133	1,0659126	1,033789567	0,9760033

ForTraCC-RADAR

	30	60	90	120
POD	0,856189	0,817121	0,6658	0,645863
FAR	0,169691	0,188625	0,24886	0,261633
PREC	0,999808	0,999696	0,999696	0,99984
BIAS	0,931726	0,803674	0,685763	0,592971