

## **READINESS OF USER COMMUNITIES**

### **NOWCASTING**

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#### **Summary and Purpose of Document**

This document presents the needs of a nowcasting system to reduce vulnerability of the population and the potential of the new satellite generation to support nowcasting. A discussion about the weather services preparation for nowcasting is presented and the different steps in the nowcasting service. The document presents a list of potential products for nowcasting, highlighting those produced using satellites. Finally, the document proposes the development of a nowcasting system, only based on satellites data, that can be easily implemented in weather services if products are available in real time.

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#### **ACTION PROPOSED**

The second session is invited to:

- (a) Take note of the needs for nowcasting and the potential exploitation of the new satellite generation;
  - (b) Discuss and criticize the proposed contribution in view to start an effort toward a satellite – based nowcasting system implementation;
  - (c) Discuss how to evolve in this matter, and if this should be an action inside the SCOPE or as a specific action of IPET-SUP.
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## DISCUSSION

### Introduction

#### 1. *The need of a Nowcasting service*

The increase in the Earth's population, the occupation of the regions with high risk of natural disasters such as river banks or deforested mountain slopes increases the population vulnerability. In addition, climate change increases the frequency of severe weather on the Earth (IPCC, 2012) consequently; the number of affected populations by weather events has been strongly increased." The costs of weather-related disasters have doubled or tripled each decade over the last 35 years. Weather-related natural disasters alone have taken lives, damaged property and produced other costs averaging at least \$50 billion per year or roughly \$1 billion per week over the last few years in the United States alone (NOAA natural disaster reduction initiative). A survey prepared by the IBGE (Brazilian Institute of Geography and Statistics) presents a clear picture of the situation, cities with more than 500.000 habitants incur the largest number of disasters related to weather events. At the same time, 70% of these cities have no system of risk management.

A nowcasting service coordinated with civil defence and population can provide strong benefits to society, reducing loss of life, injury, and damage to the economy. This is a considerable challenge, because it depends on a nowcasting system as well as the coordination with civil defence, the warning to the population, the near real-time information system, etc.

One of the main problems was availability of near real-time data, but now with the new satellite generation, with new capabilities to nowcasting, one of the challenges could be overcome with the implementation of a satellite-based nowcasting system.

#### 2. *Are the weather services prepared to provide Nowcasting?*

In general, many weather services are not prepared for nowcasting. The meteorologist has synoptic background skills and is well prepared for weather forecast, as well as all information for weather forecast is available through different systems and numerical models. However, the physics behind nowcasting is very different from the traditional weather forecast. It is based in different physics, different conceptual models, different numerical models, and different tools. The access to the weather data has a long latency, the warning system does not exist, and the coordination with the stakeholders and population is not adapted to nowcasting. The meteorologist is not prepared to nowcasting, firstly because, in general, it is not employed in the weather service, the universities do not teach nowcasting techniques, and there is no nowcasting system implemented.

Therefore, it is necessary to begin the process toward the implementation of a nowcasting system in the weather services and the new satellite generation provides an easier way to start up a nowcasting service.

Figure 1 clearly shows the skill and methodology employed for the different scales of the weather forecasting.

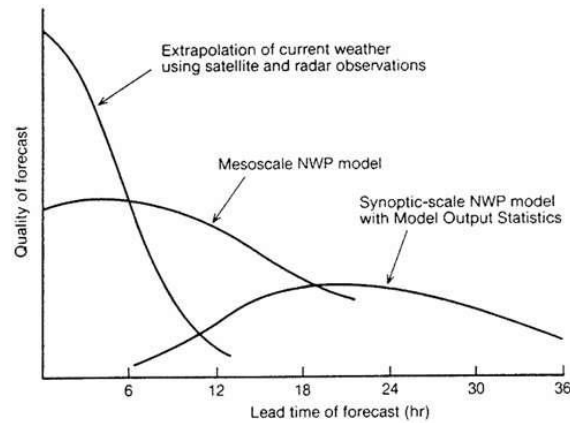


Figure 1: Lead Time and different skills for nowcasting and synoptic scale forecast. (From Pierce et al., 2012)

### 3. *The Nowcasting stages and products*

Nowcasting can be separated in several steps: a) the pre-convective analysis, b) convective initiation analysis, c) the mature convective analysis, d) the extrapolation analysis.

For pre-convective analysis satellite can provide stability indexes, wind shear, winds to detect short waves, helicity, among others.

For convective initiation, satellite can also provide several information as visible high-resolution imagen animation, multichannel imagens, area expansion, Lagrangian brightness temperature time derivation, among several others utilities.

For mature convection, to define the severity of the convection, the following products can be computed from new satellite generation as: retrieval of V and U shapes, lighting density, lighting jump, the Tre diagram (Temperature and effective radius), the amount of rainfall, the rain rate, among several others products.

Finally, the extrapolation analysis can be done using the several existing tools as Fortracc, Titan, among several others.

### 4. *The new satellite generation and the potential products for Nowcasting*

The new satellite generation provides high time space resolution for a large range of channels. Several algorithms were already developed for different products retrievals. The new channels in near infrared band provides information about ice water cloud, ice amount, ice size. The multiple channels can also provide information about the humidity in different levels, the instability indexes. The lighting sensor is a very new information providing in near real time very useful information for nowcasting as lighting jump and lighting densities, very well correlated to intense weather events.

### 5. *Towards a Nowcasting system.*

In general, the new satellite generation has developed a large set of products as those described above. All these products are already available and if any specific product is needed, the implementation would not be a big challenge. With the Geonetcast system, these products could be delivered in the time-space resolution and with a short latency. With the products being delivered by Geonetcast the nowcasting system would consist of a nowcasting software running in the user computer that only manage the nowcasting data, visualize the information and combine with local geographical information. This geographical information system can have local layers and be separated by the different nowcasting steps as described above.

This software, ready to read and process Geonetcast data, associated to a training in nowcasting are the steps in system implementation.

## **6. *An Application Example***

The set of products are available through GNC. A computer accessing this data base runs the nowcasting application. This application has 4 main items in the menu: 1) Pre-convective analysis, 2) Convective initiation, 3) Mature Convection, 4) Extrapolation.

In the early morning, the meteorologist consults the pre-convective situation by selecting this item. There is a list of products including different instability index, look for short waves, wind shear, etc. This analysis will be useful to define if the day has potential to have severe convection and the potential regions. Later, when convection starts, the meteorologist will focus on the clouds over these potential regions. They will select the item pre-convective and the following products will be available: Brightness trend decrease, cloud are expansion, Effective radius vertical gradient, multichannel images, visible high resolution animation images, lightning density, etc.

With these analyses, the meteorologist will be able to select the clouds with strong development and with potential to become severe. These clouds will be followed and extrapolated in the space by selecting the item Extrapolation. As the cloud evolves to severe weather, the meteorologist will be able to evaluate the severity by selecting the item Mature convection. The products in this item will allow to check how severe is the cloud by looking products like: lighting jump, U/V shapes, rain rate, accumulated rainfall.

Following these steps, the meteorologist in conjunction with Civil Defense authorities, will be able to warn about specific severe events.

## **7. *Suggestion of the first Actions.***

The design of this system should be discussed with the specialists to define the specific products in each nowcasting step, as for instance the resolution, latency and formats. A discussion with the Space Agencies would contribute to provide the list of products as well as the possibilities to have new products. The discussion with specialists in geographical information system would be another step to design the application.

A working group including people from IPET-SUP and the WMO Nowcasting group would be the first action to discuss and prepare this project.

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