MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

PÁTRIA AMADA BRASIL
GOVERNO FEDERAL

The RaioSat Project

Kleber P. Naccarato
Earth System Science Center

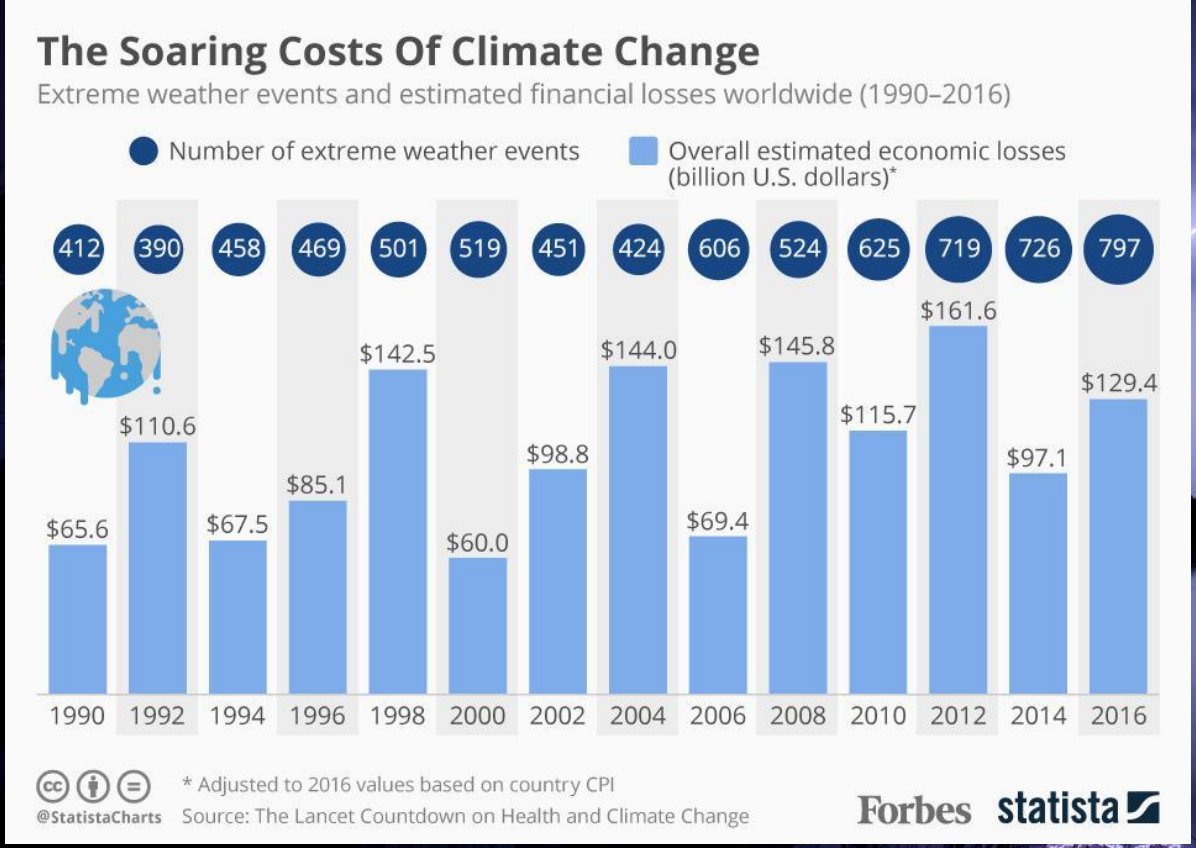
Lazaro A. P. de Camargo
Space Sciences and Atmospherics

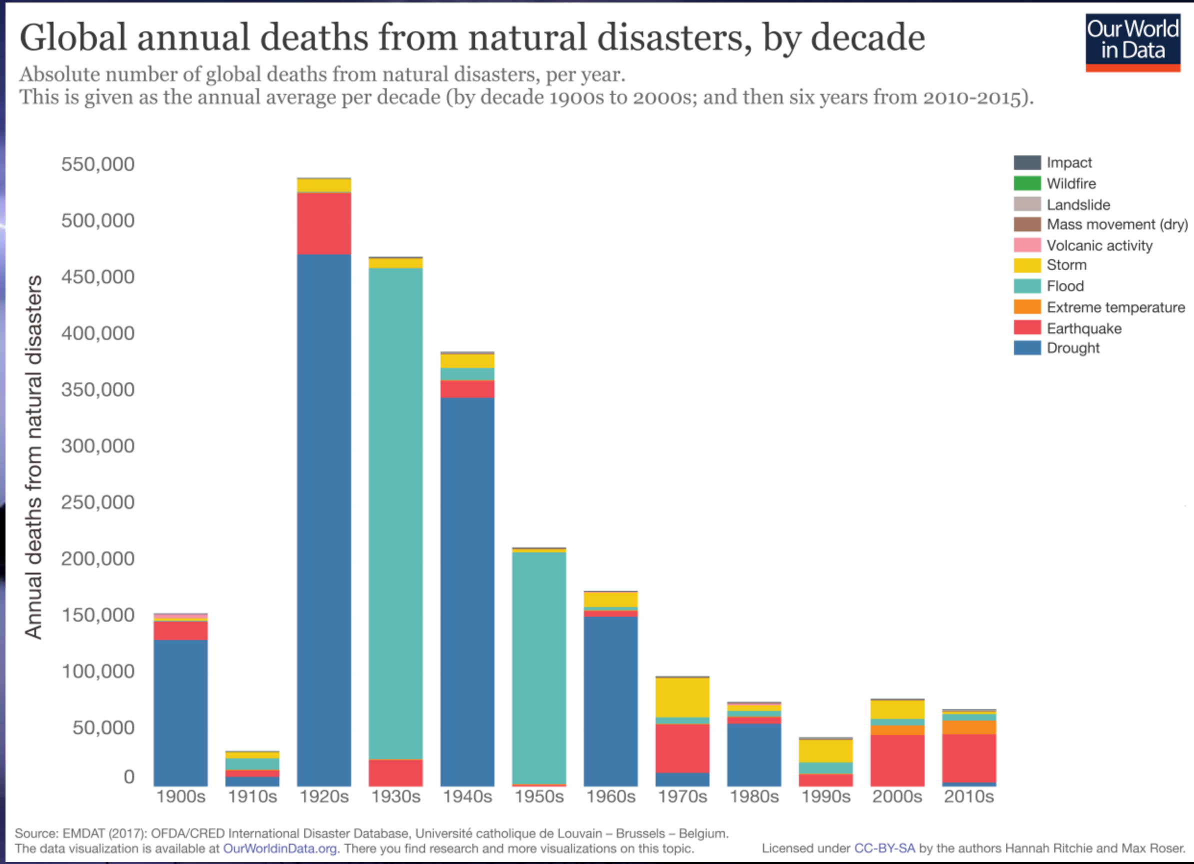
Graziela F. de S. Maia, Elaine de S. F. de Paula,
Mateus de O. Pereira, Ronan A. J. Chagas,
Candido O. de Moura, Auro Tikami, Walter A. dos Santos
Engineering and Space Technology

COPUOS - 56th Session - Scientific and Technical Subcommittee – Vienna, 2019

Severe Weather Impacts

Can we improve the accuracy of severe weather forecasts and save more human lives?



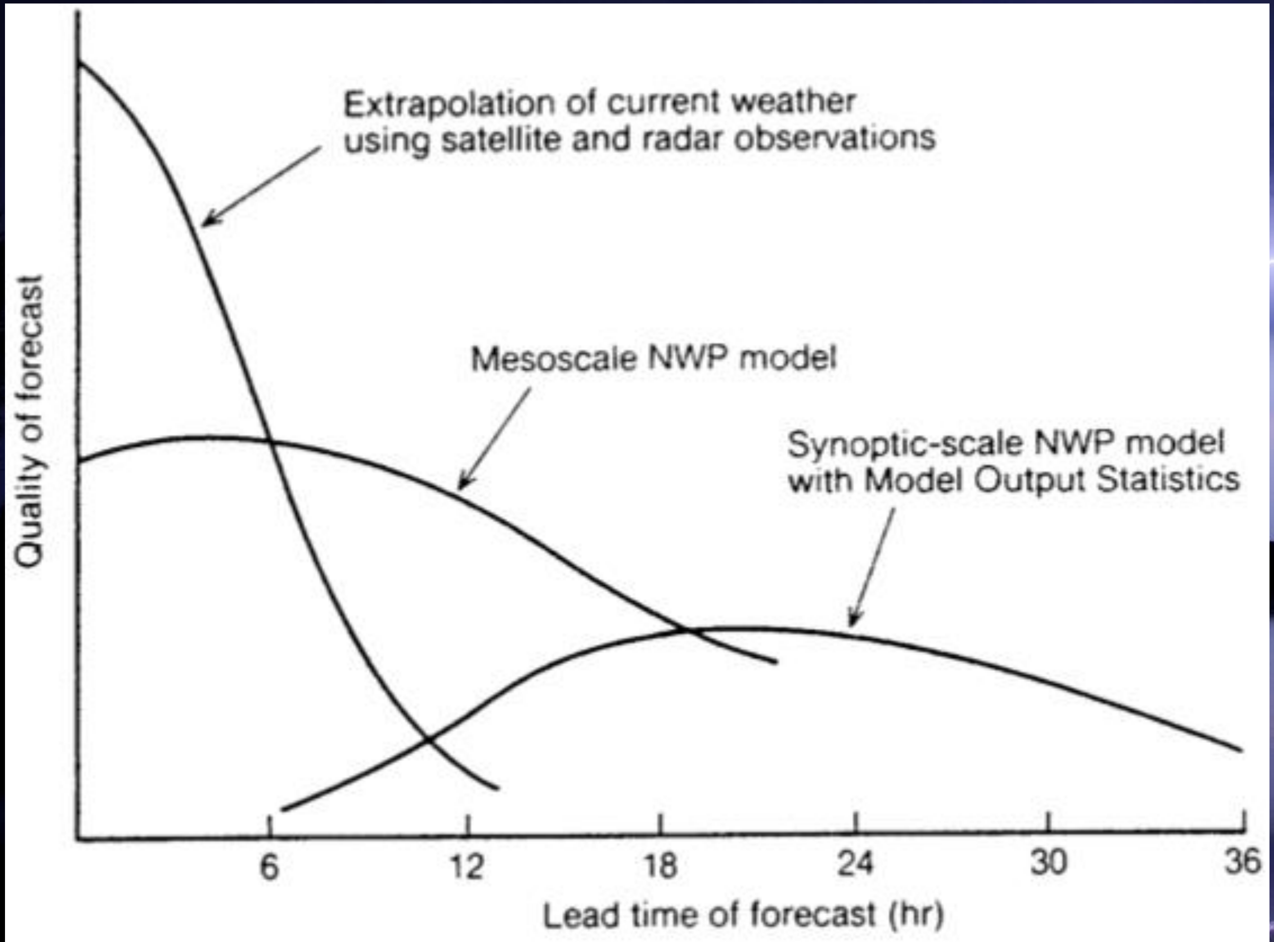


https://www.forbes.com/sites/niallmccarthy/2017/11/01/extreme-weather-caused-129-billion-of-economic-losses-globally-last-year-infographic/

https://ourworldindata.org/natural-disasters

Severe Weather Nowcasting

What is the present status?



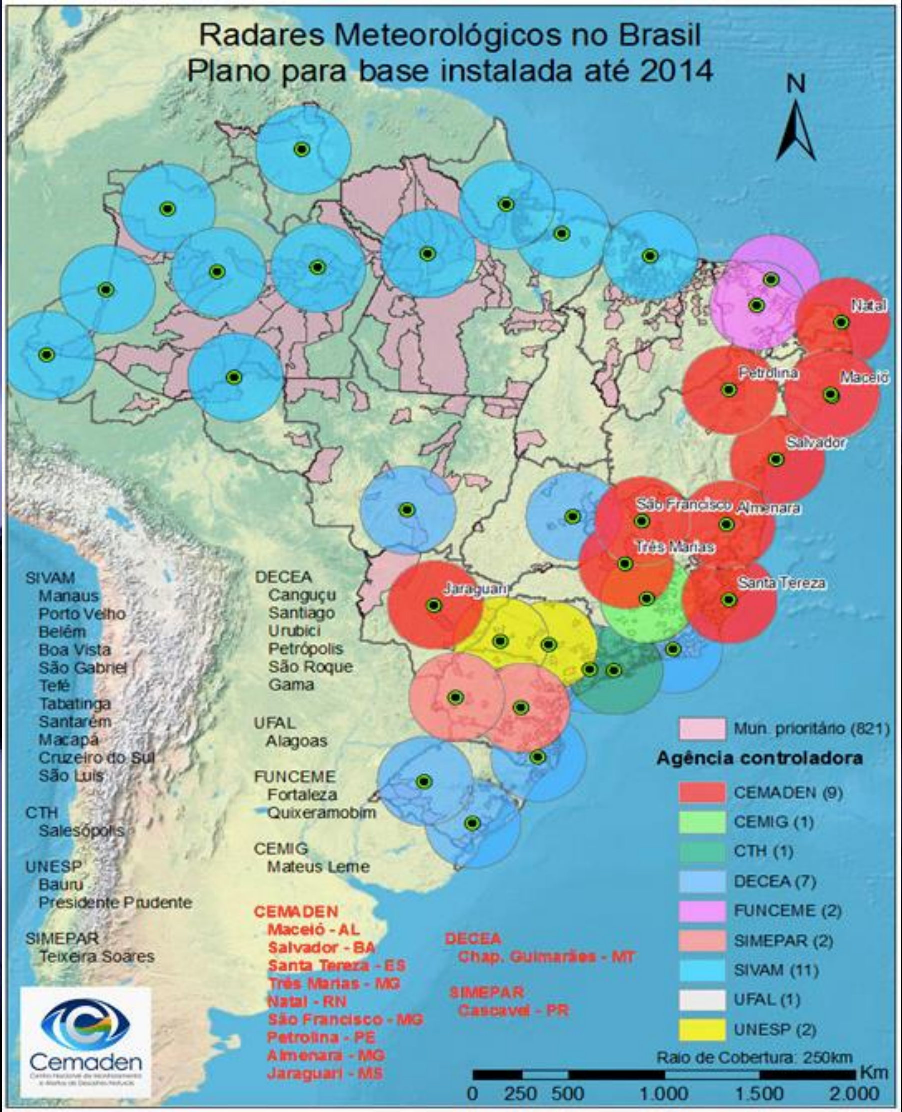
“Nowcasting plays an increasing role in crisis management and risk prevention, but its realization is a highly complex and integrated task”

WMO, Guidelines for Nowcasting Techniques, 2017 Edition

Bech J.; Chau, J.L. Doppler Radar Observations, Chapter 4: Nowcasting, DOI: 10.5772/2036, 2012

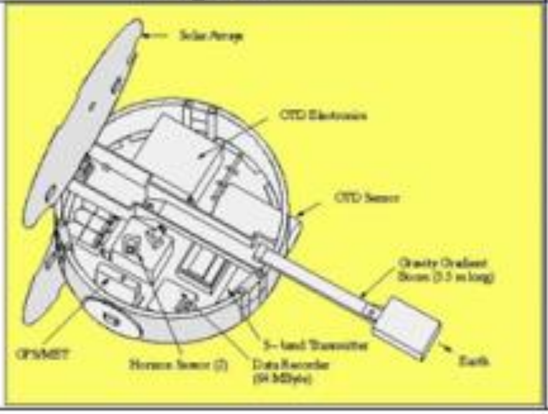
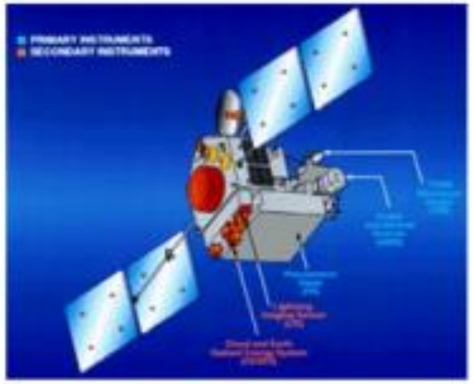
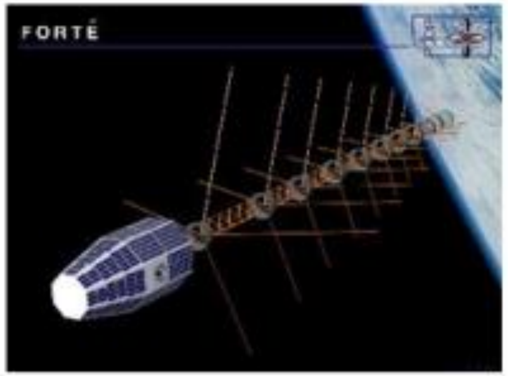
Advances in Realtime Data Observations

Satellite and Ground Networks



The RaioSat Project

Detecting lightning from space: previous missions

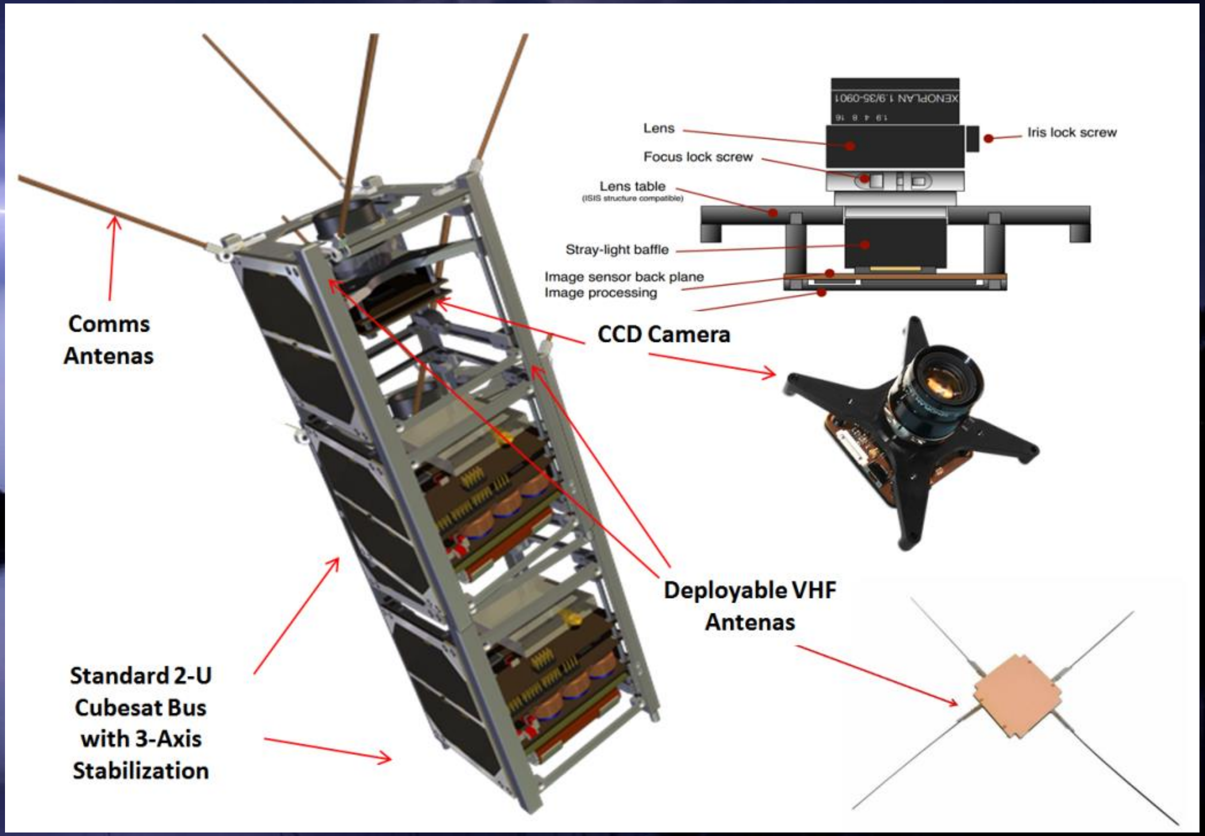
Satellite	OrbView-1/ MicroLab	TRMM- Tropical Rainfall Measuring Mission	FORTE - Fast On-orbit Recording of Transient
Lightning Detecting Payload	OTD - Optical Transient Detector	LIS - Lightning Imaging Sensor	RF antenna OLS – Optical Lightning Sensor
Mass	74 kg	3620 kg	210 kg
Altitude	785 km	350 e 402 Km	800 Km
Inclination	70°	35°	70°
Launch Date	01/04/1995	27/11/1997	29/08/1997
End of Life	April/2000	08/04/2015	
Ilustration			

Naccarato et al. “Total Lightning Flash Detection from Space: a CubeSat Approach”, ILDC / ILMC, 2016.
https://my.vaisala.net/en/events/ildcilmc/archive/Pages/ILDCILMC-2016-Archive.aspx

The RaioSat Project

Detecting lightning from space using a CubeSat

- The RaioSat small satellite intends to be a 3-U CubeSat capable of detecting total lightning (cloud-to-ground and intra-cloud lightning) using:
- A broad spectrum radio antenna (in the range of tens of kHz to hundreds of MHz) to detect the electromagnetic emissions of the radioactive component of the lightning.
- An imaging device (CDD) since the visible emission of the lightning flashes can be detected from space



Naccarato et al. "Total Lightning Flash Detection from Space: a CubeSat Approach", ILDC / ILMC, 2016.
https://my.vaisala.net/en/events/ildcilmc/archive/Pages/ILDCILMC-2016-Archive.aspx

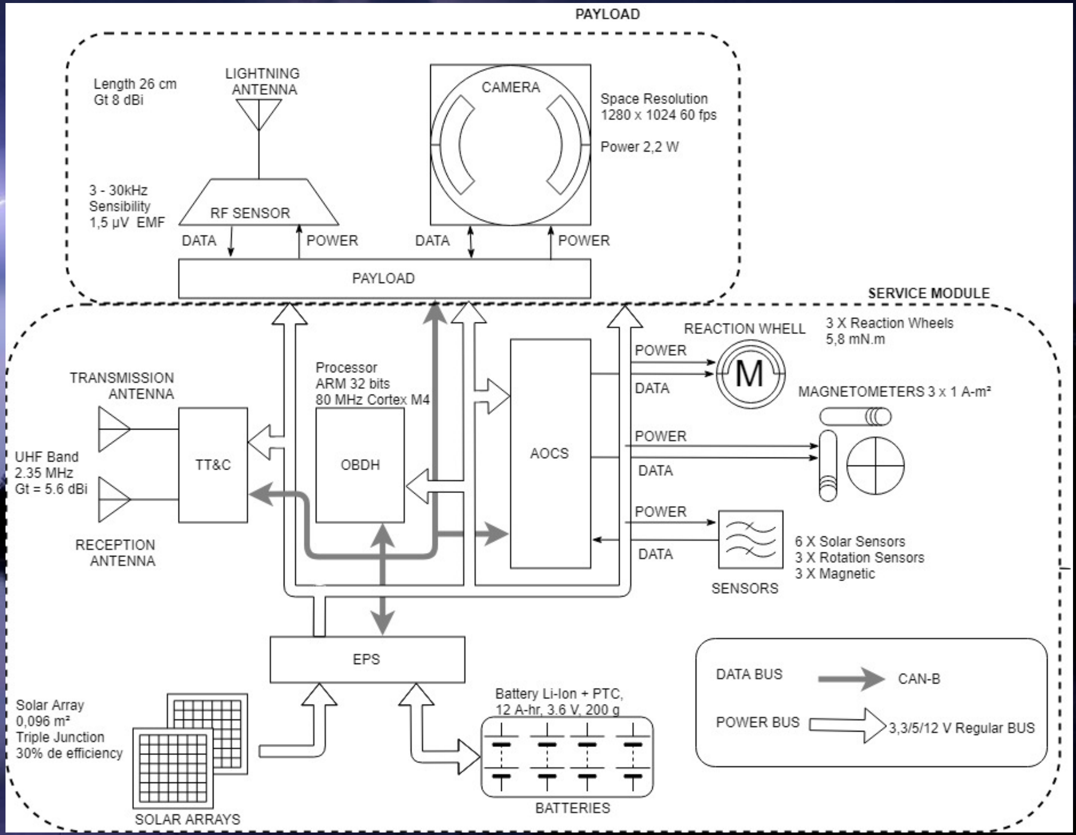
The RaioSat Project

Detecting lightning from space using a CubeSat

RaioSat System requirements.

ID	Description	F/D /C	P/O	Verificability
01	After separation of the rocket, the CubeSat should be ejected from the P-POD with a speed and kept in orbit.	D	P	Test
02	The RaioSat should be in a LEO orbit at 650 km altitude.	C	P	Analysis / Test
03	The payload module must have a GPS to mark the location and time of any potential lighting event.	F	P	Analysis / Test
04	The payload module shall have a broad - spectrum radio antenna for detecting the electromagnetic emissions of the radioactive component from atmospheric discharges - passive VHF antenna, ranging from 50 to 200 MHz.	F	P	Analysis / Test
05	The payload module shall have a spectral image camera and an imaging device. The camera requires high performance image processing capability and large data storage memory and its resolution should be 2,048 x 1,536 pixels, leading to a surface image of 80 m / pixel at 650 km altitude and a spectral range of 700 to 900 nm using an optical bandpass filter.	F	P	Analysis / Test
06	The development organization shall design a CubeSat 3U with aluminum frame with the following measurements (10x10x30 cm) to accommodate the platform and payload.	C	O	Analysis / Test
07	The development organization must design the RaioSat System that can be produced in 07 months.	D	O	Analysis

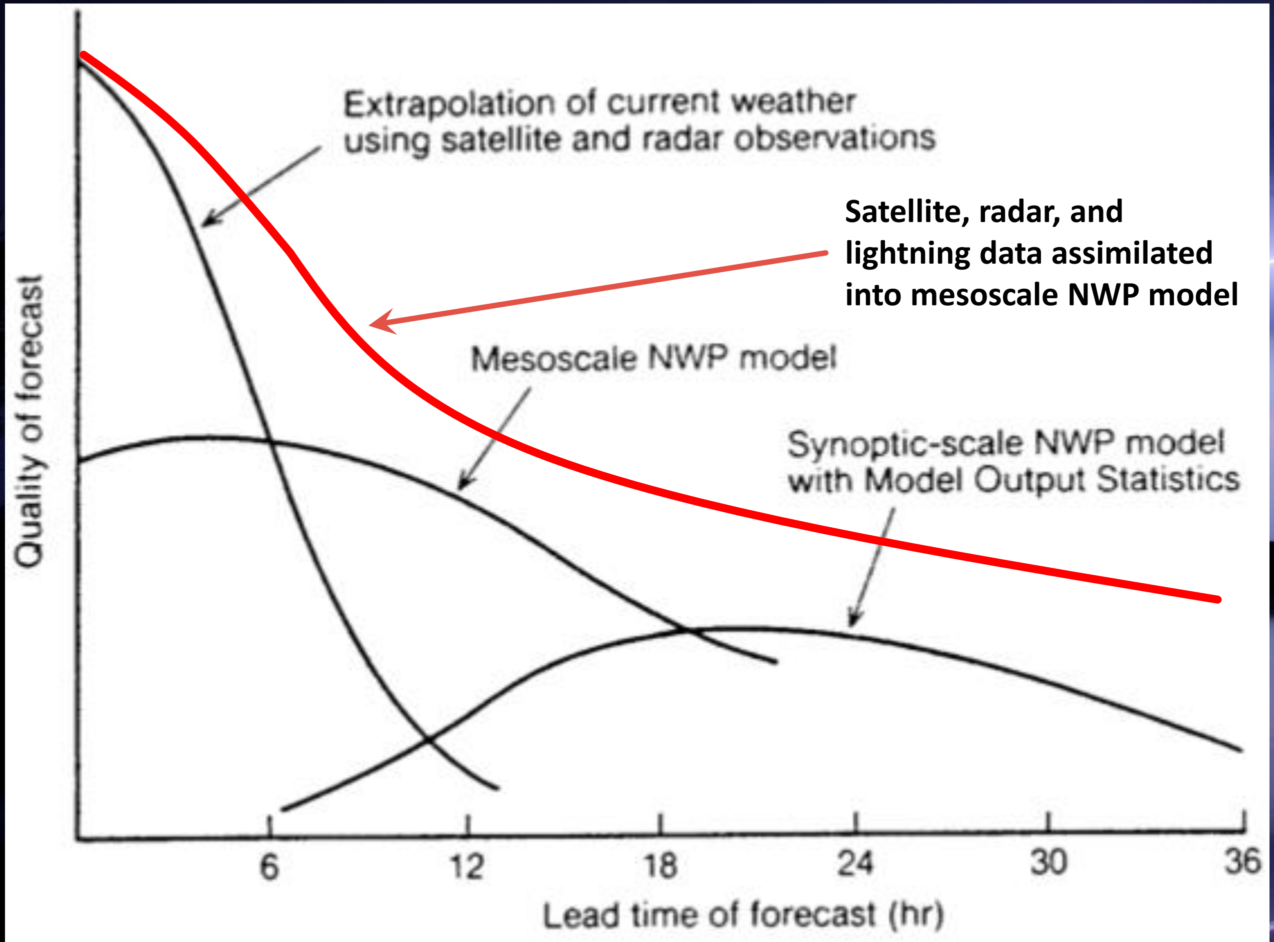
Type (F/C/P): F-Functional / C-Condition / P-Performance. Complice (M/D/O): M-Mandatory, D-Desirable, O-Optional. Type (Co/ Ca): Co-Constrain / Ca-Capability. Status (OK/TBD/TBC): TBD-to be defined / TBC-to be confirmed. P/P/O: P-Process / P-Product / O-Organization. T/I/D: T-Test / I-Inspection / D-Demonstration.



Maia et al. “High-level Developments in Space Systems Engineering of the RaioSat Project” ,3rd IAA-LACW, 2018.

Severe Weather Nowcasting

What we expect then to have in the near future?



The establishment of strong positive correlations between total lightning flash rate and deep convective intensity in the past decade has fostered interest in determining whether near real-time lightning data could be used to improve convection forecast skill

Geernaert, G., S. Businger, C. Jeffery, T. Dunn, R. Elsberry, and D. R. MacGorman, 2010: Using novel lightning data and advanced modeling approaches to predict maritime cyclogenesis. Bull. Amer. Meteor. Soc., 91, 1091–1093.

INPE

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES

INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

PÁTRIA AMADA BRASIL

GOVERNO FEDERAL

The RaioSat Project

Thank you for your attention!