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TAKING THE PULSE OF OUR PLANET FROM SPACE

EUMETSAT ECMWF EUSPA

Satellite and Station Data for Meteo Services

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Wider Context

WFP is increasingly working with National Meteorological Services through initiatives driven by WFP Country Offices.

These initiatives are focused in enhancing NMS capacity to generate timely Early Warning and Seasonal Monitoring information, improve its provision of climate services and support to AA/FbF initiatives.

WFP Climate and EO unit frequently provides the technical support to these initiatives. As such, it developed a package of support to NMS to improve their status as a service provider to national stakeholders.

Wider Context

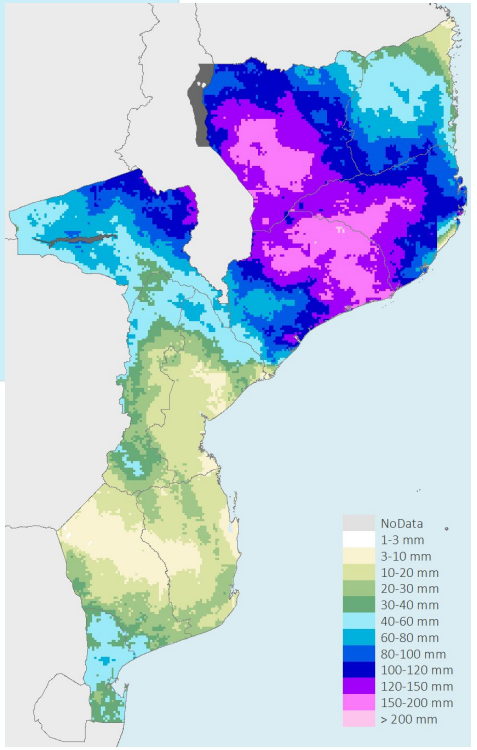
This support package includes:

- Development of enhanced agro-meteorological products based on blending station and EO data. Improve internal station data flows and assimilation, increase the number of active real time stations (including AWS)
- Provision of access to real time Earth Observation data and indicators suitable for early warning and seasonal monitoring work
- Recovery of old climate records, upgrade of climatological database (WMO/UKMet support)
- Support multi-stakeholder Technical Working Groups and NMS leadership in key areas of responsibility

Active in: Mozambique, Namibia, Zimbabwe, Sri Lanka, Cuba

Blending Station and Satellite Data

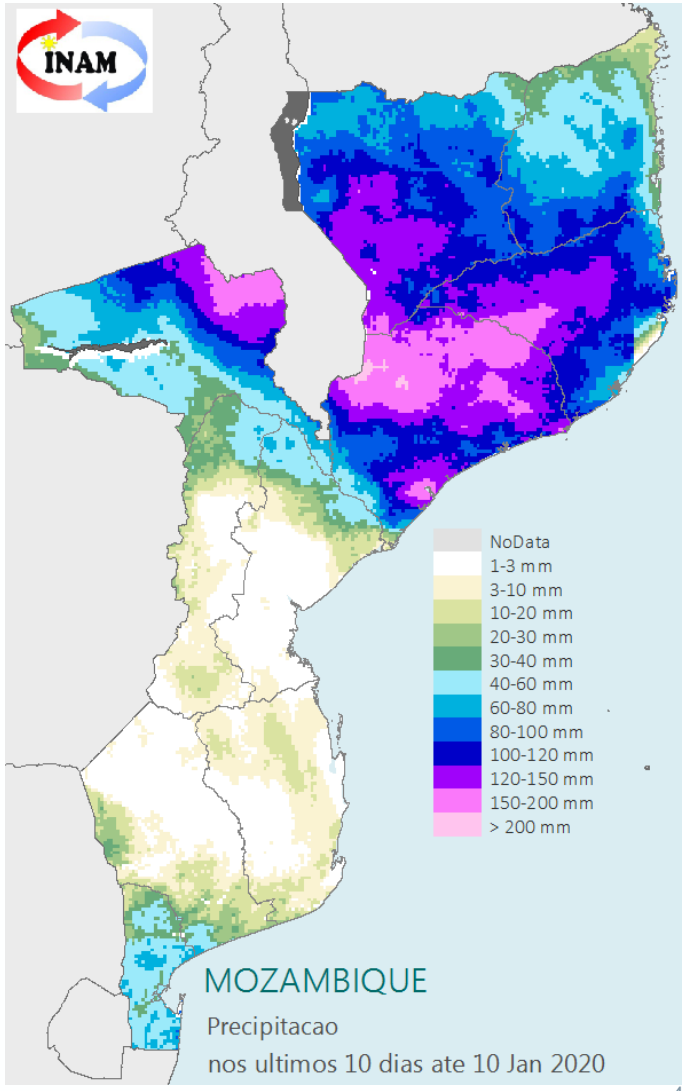
Station Data:
Point Coverage
Locally Accurate



Satellite:
Full spatial Coverage
High Resolution
Less Accurate

Blended:

- Improved Accuracy
- Full country cover
- Reduced conditional bias
- Better representation of extremes



Blending Approach

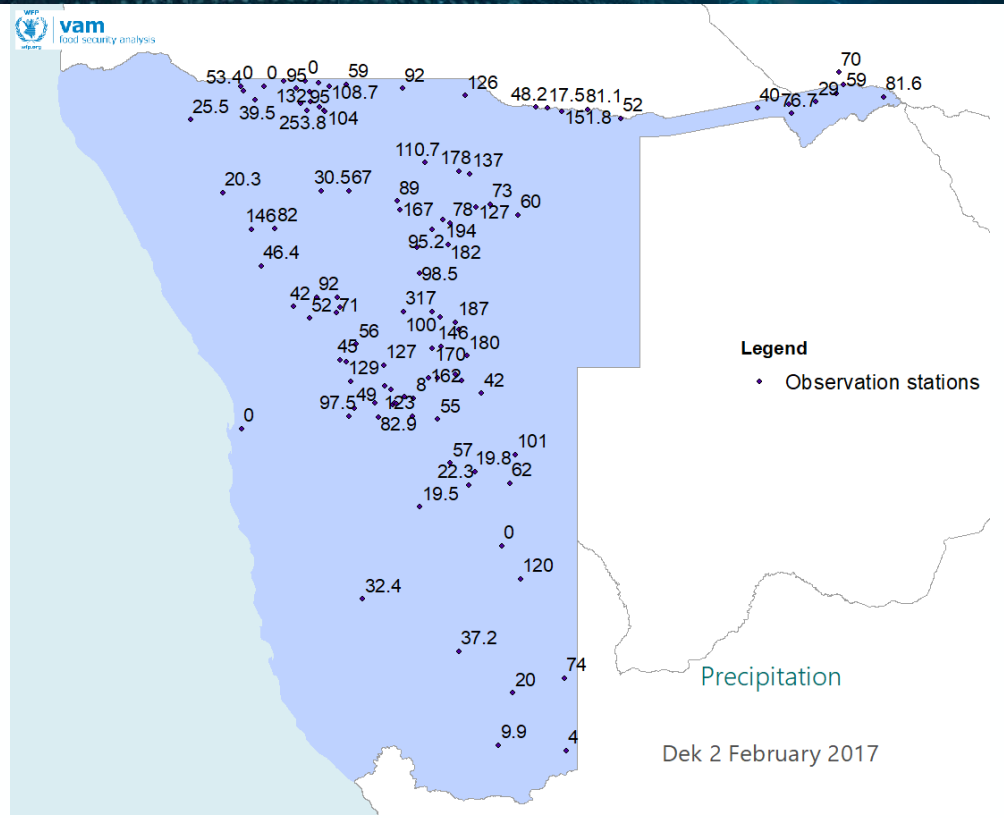
Blending is the combination of two estimates into a single value. We use a well known approach, where by the SRE is taken as a so called *first-guess* that is adjusted by observations from ground measurements of rainfall. The approach used is as follows:

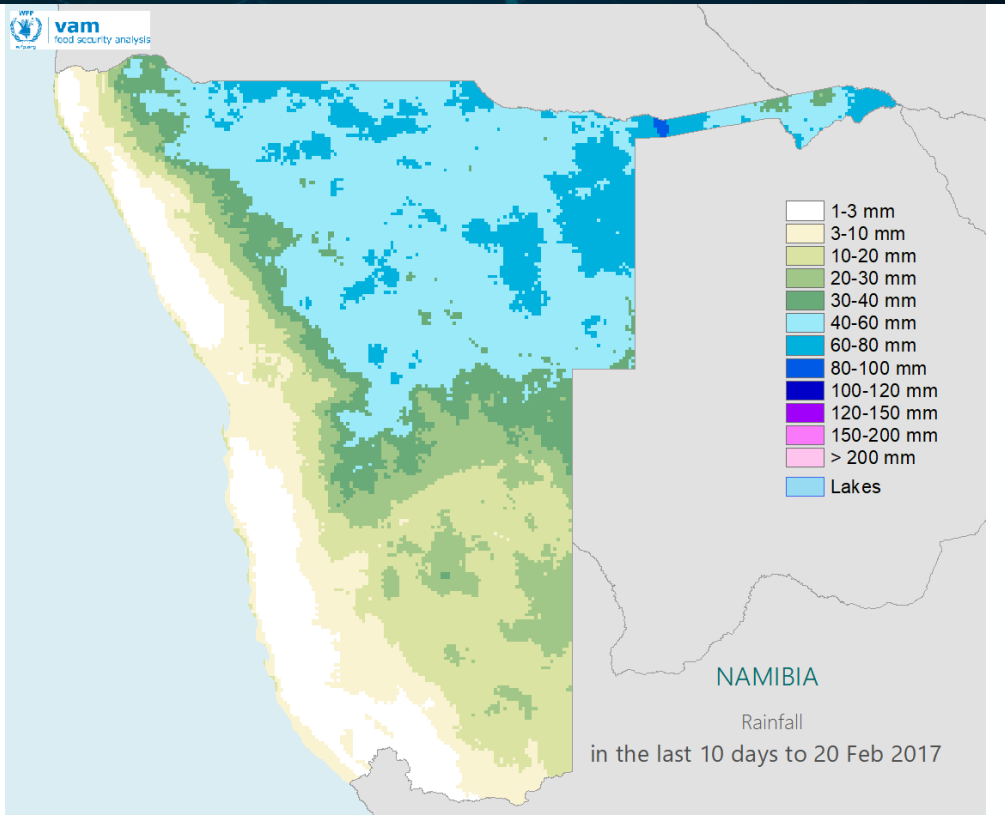
$$BRE = SRE + \boldsymbol{f}(SRE - OBS)$$

This means that we take the SRE and apply a correction **f** that is related to the differences between observations and the SRE.

f is derived from interpolation methods applied to the point differences between the SRE and the gauge rainfall (the SRE undergoes a bias correction).

Blending Approach





Ingredients (Original Data):

Rainfall from the NMS (left) and the CHIRP rainfall estimate (right) for February Dekad 2, 2017

Note the very high rainfall values registered by the raingauges, some close to 200mm and the very high spatial variability of the rainfall data. In contrast the SRE values barely exceed 80mm

Blending Approach

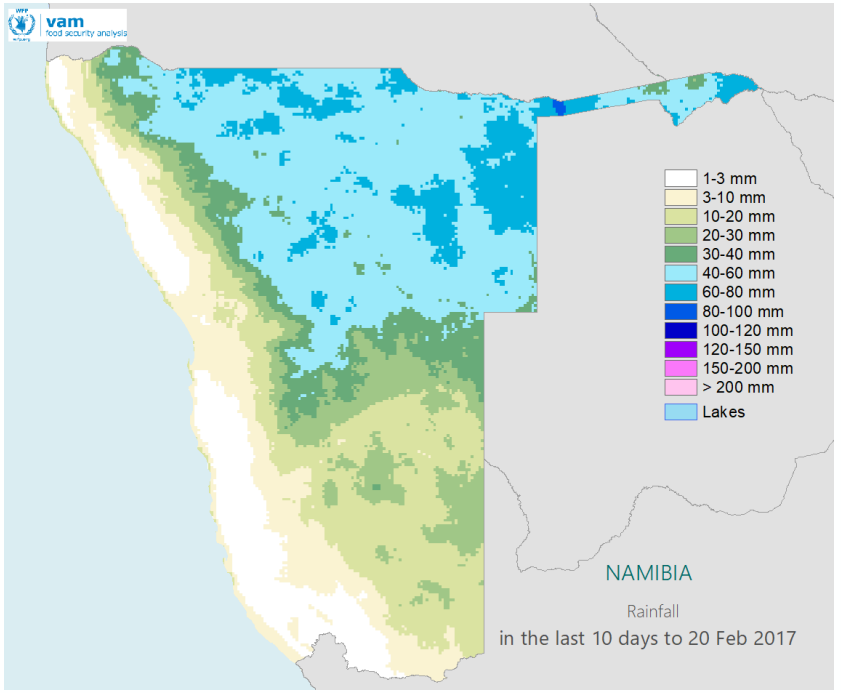
Procedure:

- Bias correct CHIRP.
- Form residuals between CHIRP-BC and raingauge data
- Interpolate residuals into same grid as CHIRP data.
- Combine residual grid with CHIRP-BC to form a blended estimate

Interpolation:

- Uses geo-statistical method (Kriging)
- Operational blending uses a pre-defined climatological variogram
- Setting up an operational blending process requires some historical data to define the climatological variogram(s)

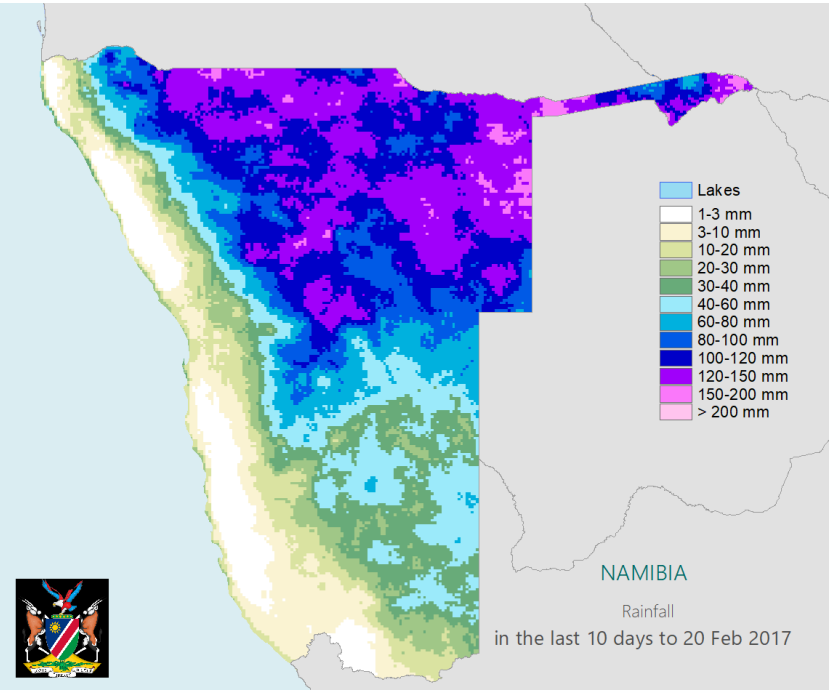
Blending Approach



* Bias Correction Factor =

$$BC = \frac{Gauge\ Avg+C}{CHIRP\ Avg+C}$$

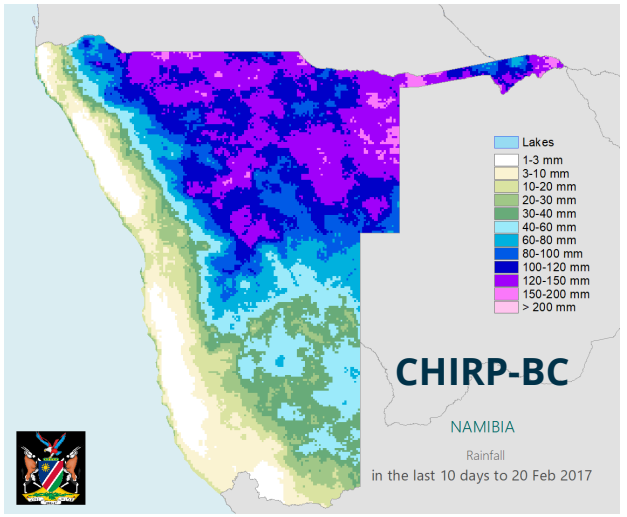
BC derived for each time step

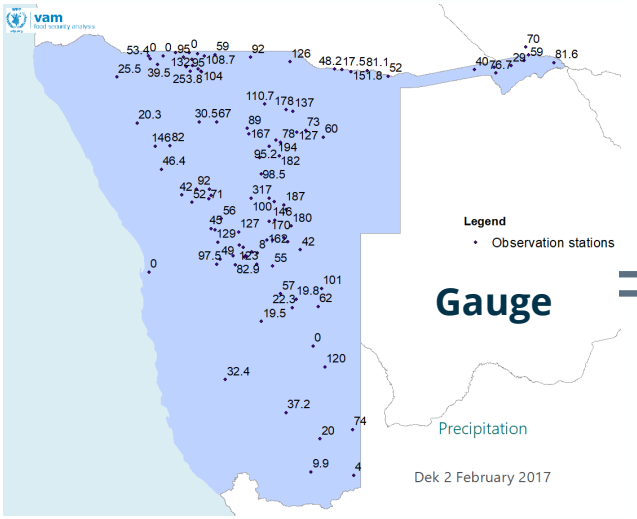


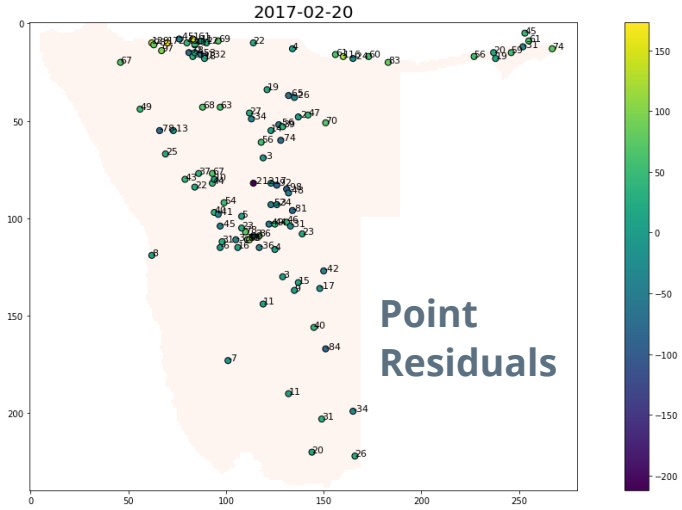
Bias Correction

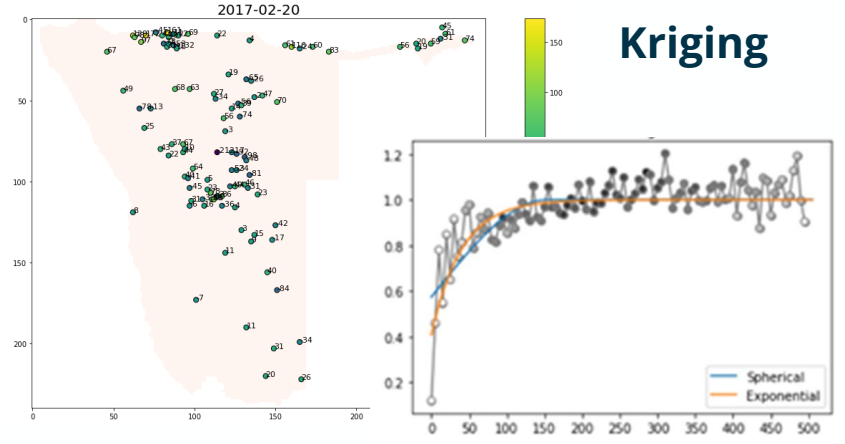
CHIRP rainfall is very biased (under-estimates), so for the interpolation of the residuals to work properly a first degree (mean value) bias correction is applied. C is a small value (1mm) to avoid division by 0 or tiny values.

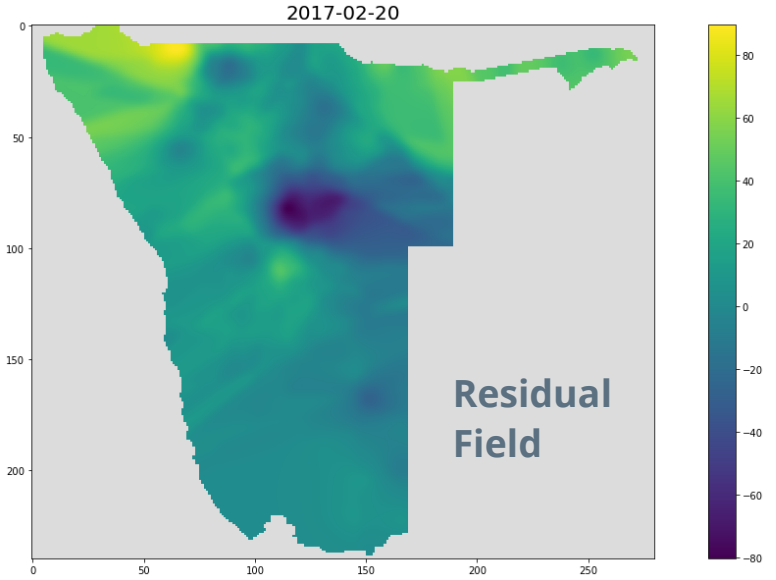
Blending Approach









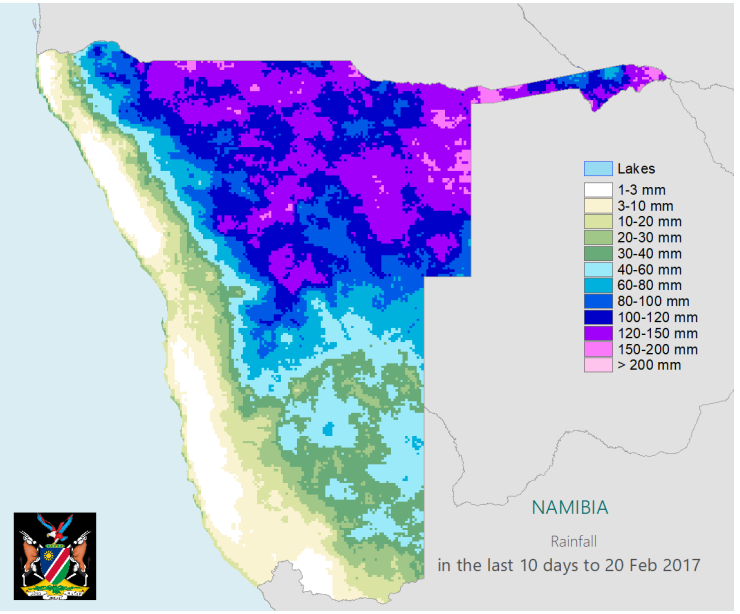


haracterizing Spatial ariability and Point ncertainty

esiduals are formed etween CHIRP-BC and gauge values and are derived for all time steps in the record.

A mean variogram is prepared. This describes spatial variability and point uncertainty and is a key input to kriging interpolation.

Blending Approach



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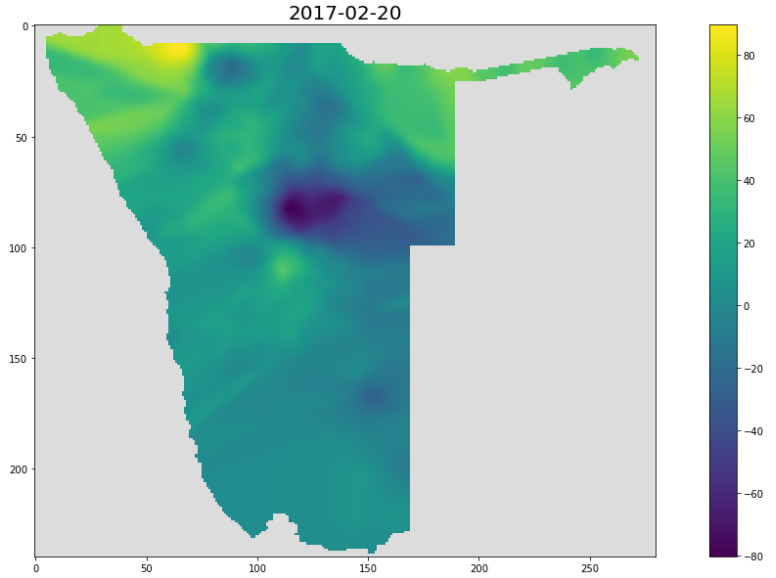

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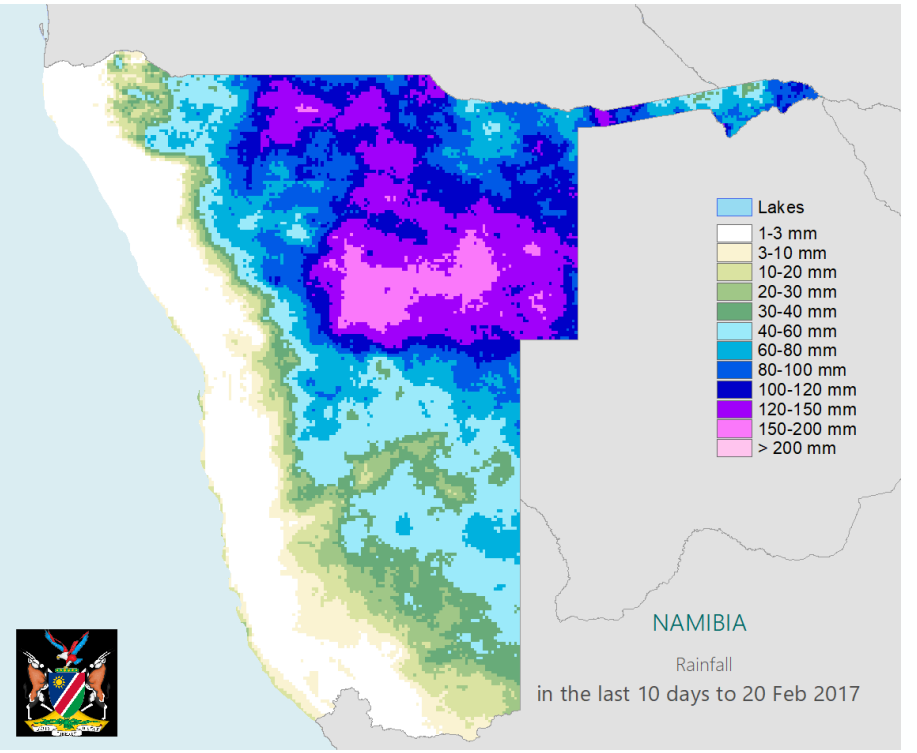
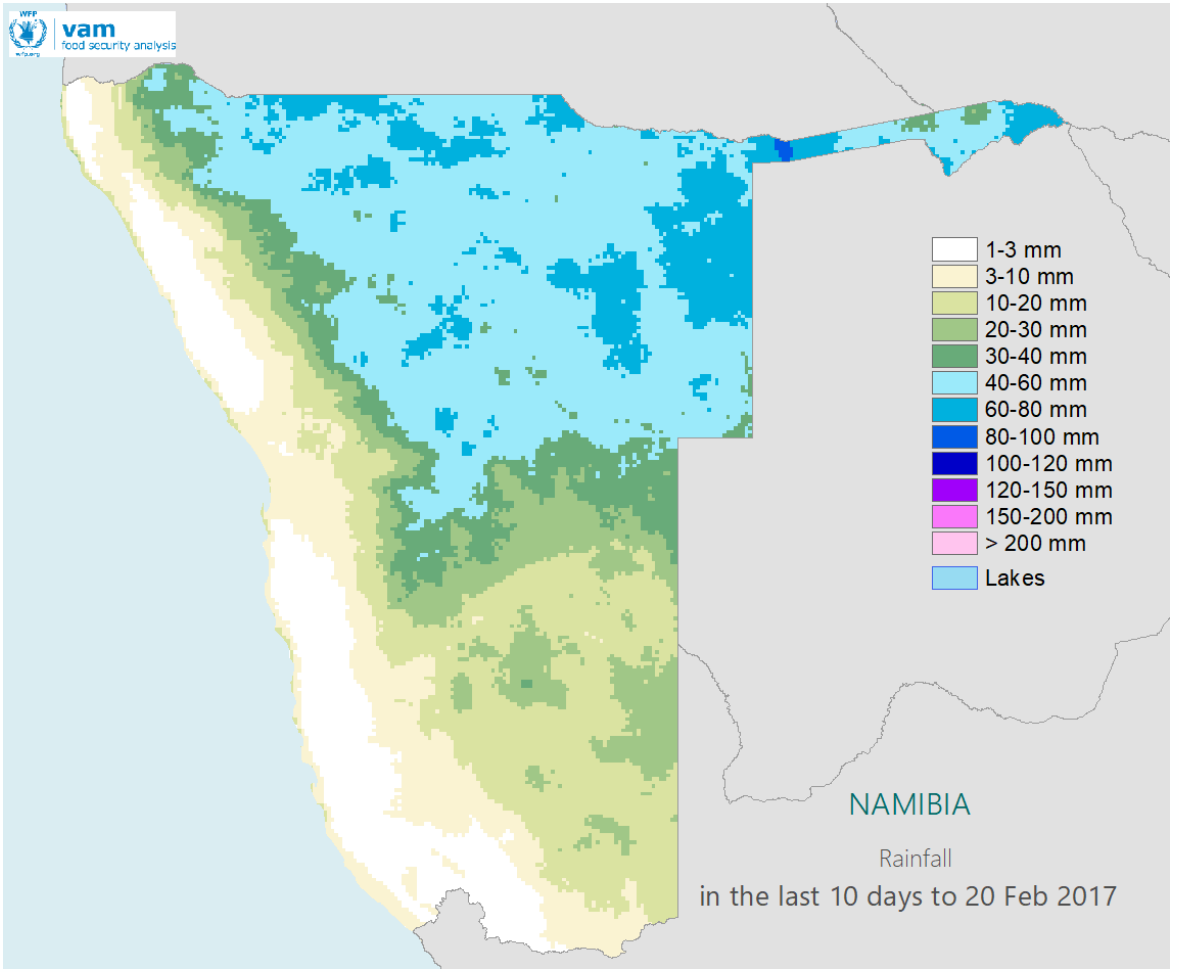
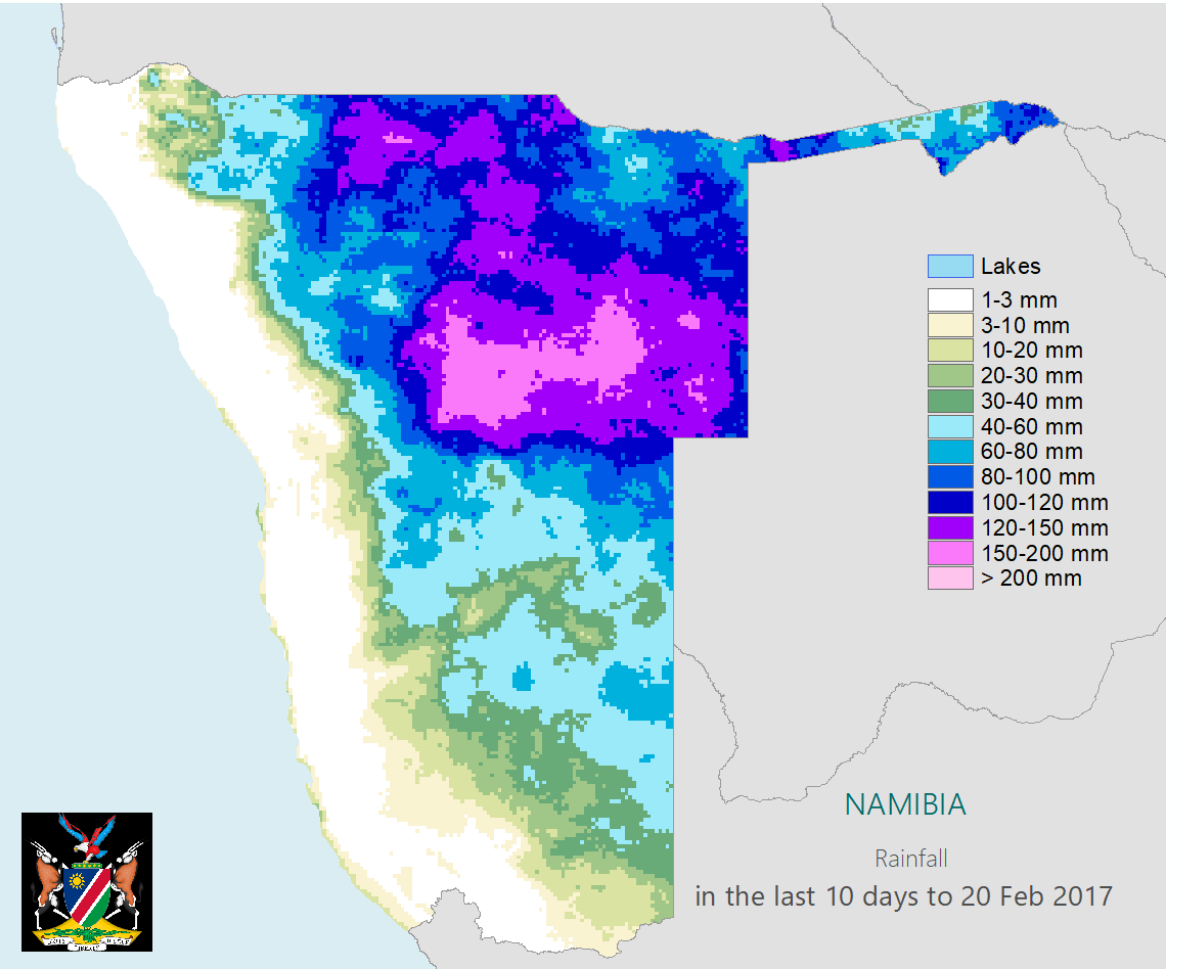


Applying Residual Correction

Once the residual field is derived, a plain operation applies the correction

Blending Approach





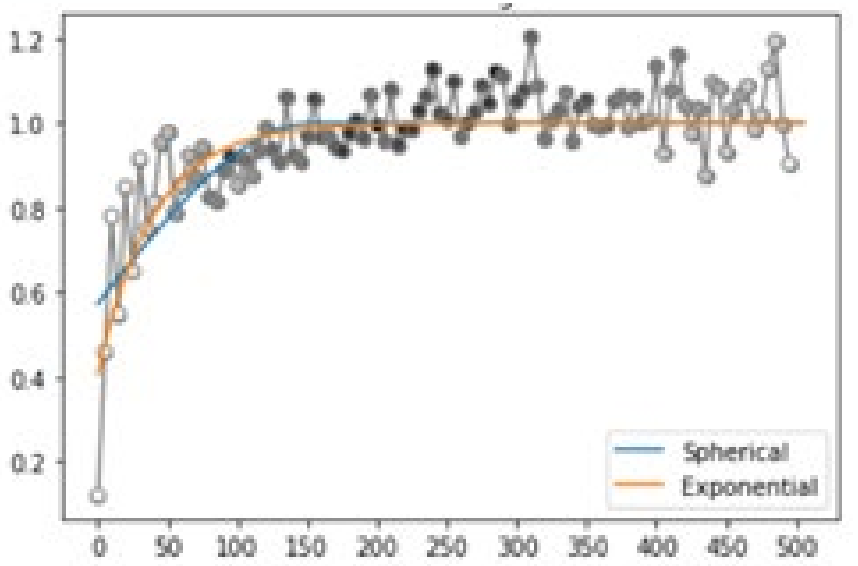
From biased SRE to fully blended improved product

Interpolation Details

Geo-statistical Interpolation

Classic methodology, accounts for irregular distribution of gauges and adapts to the spatial variability of the variable being interpolated.

The spatial variability is modelled by a specific function fitted to an empirical variogram, essentially a plot that described how variability between data values increases with distance.



Ideally you would use a different variogram for each time step. This is not a task easy to automate, and for each time step you might not have enough data to derive the empirical variogram.

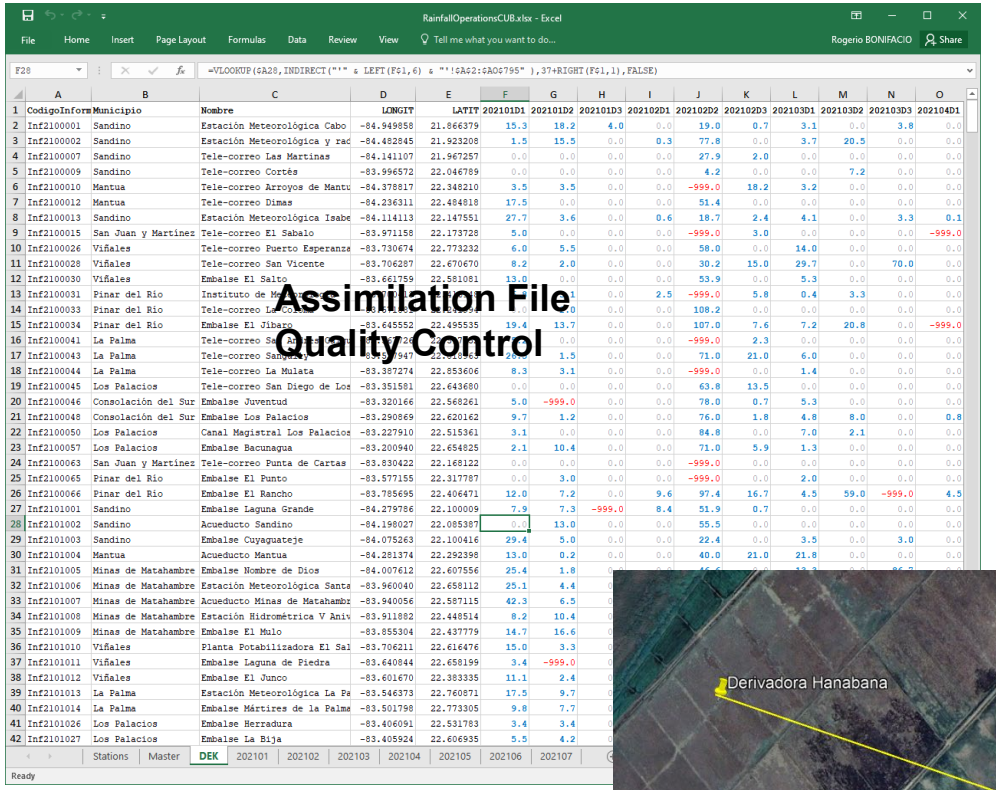
Solution: use a **mean or climatological variogram**.

This is a fixed, pre-defined variogram that is derived from an analysis of past data, e.g. for the past 5 years or longer.

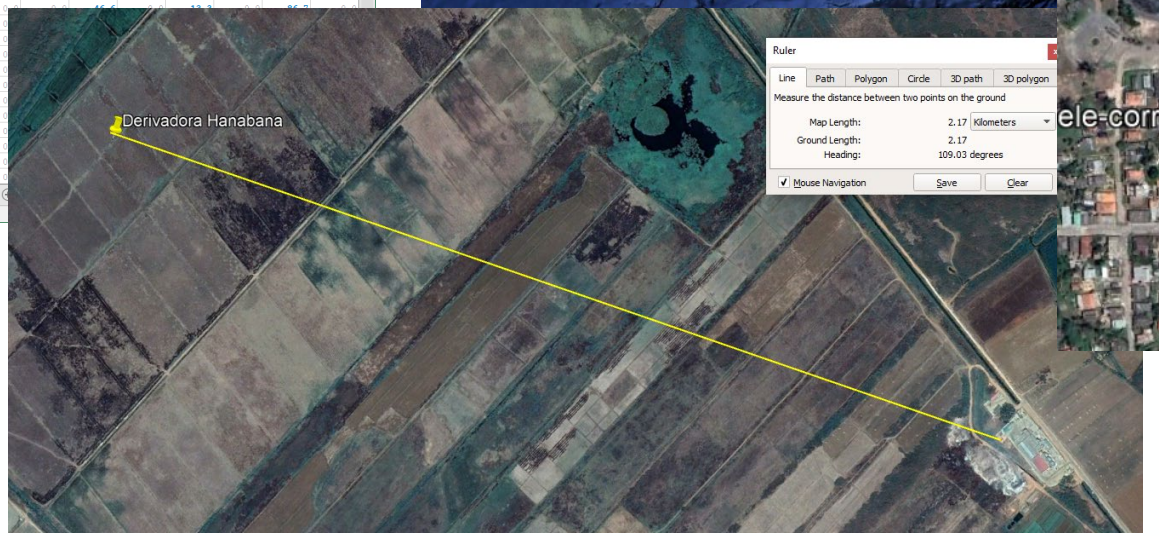
Depending on the amount of data, you could use monthly variograms or (more often) a variogram for the early and late stages of the rainfall season (including the dry season) and another for the wetter core rainfall season.

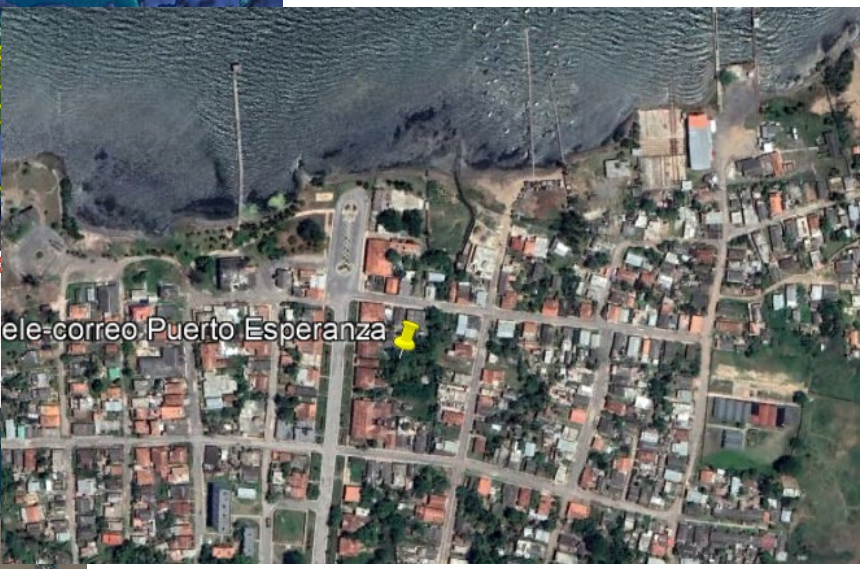
Station Data Assimilation

Assimilation File Quality Control

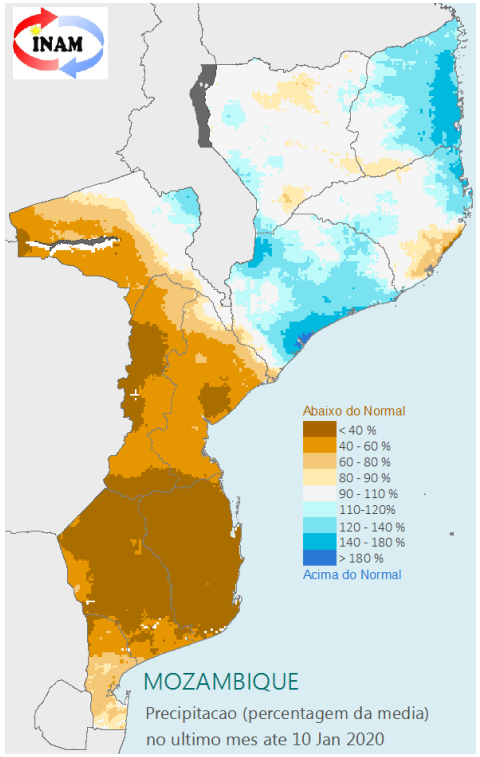


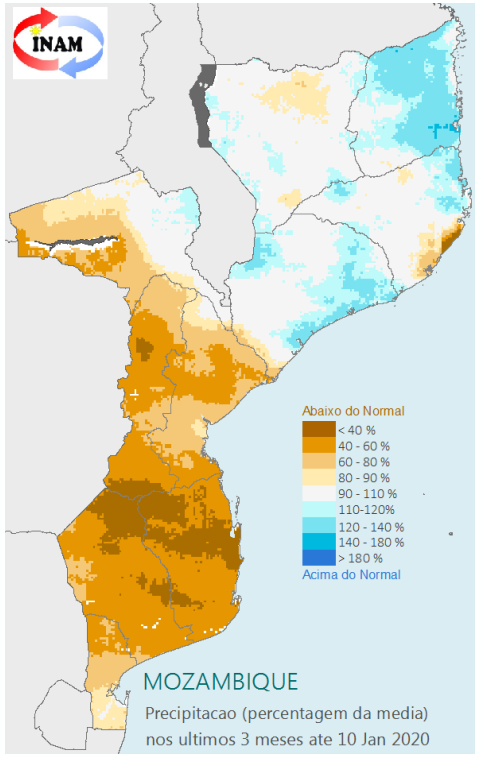
Station Location Checks





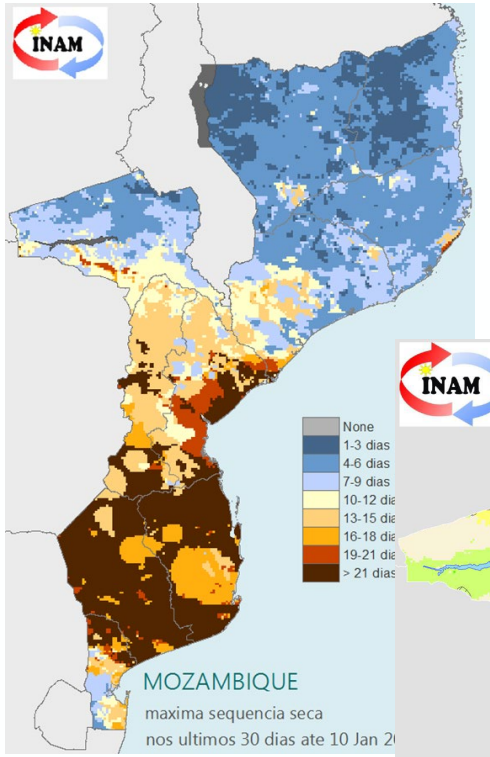
Product Portfolio

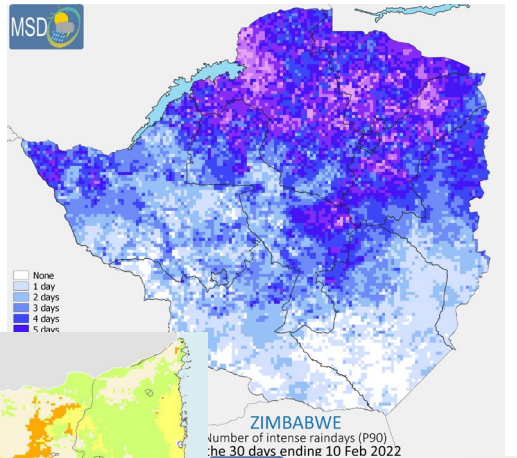


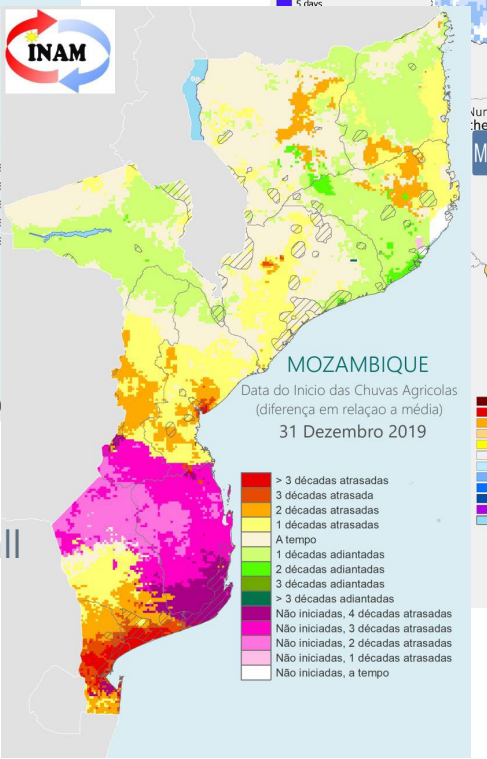


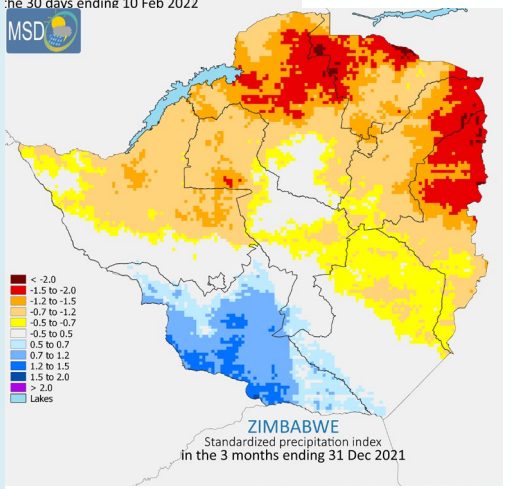
Blended

Rainfall accumulations
and respective anomalies









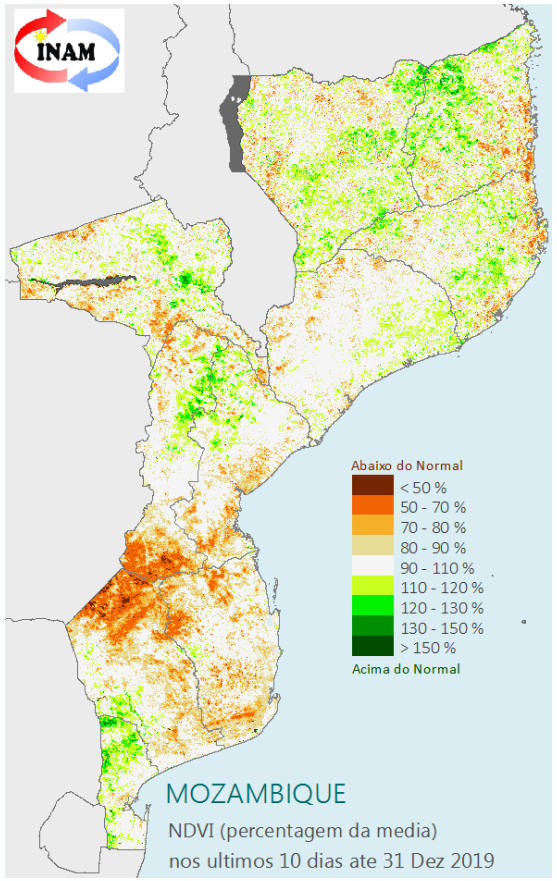
CHIRPS Derived

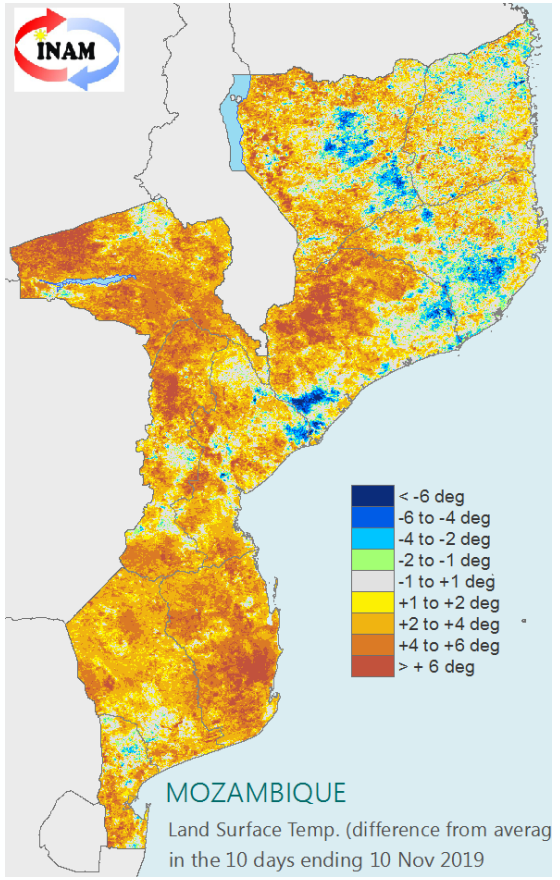
Dry Spell, Extreme Rainfall
Onset of season, SPI

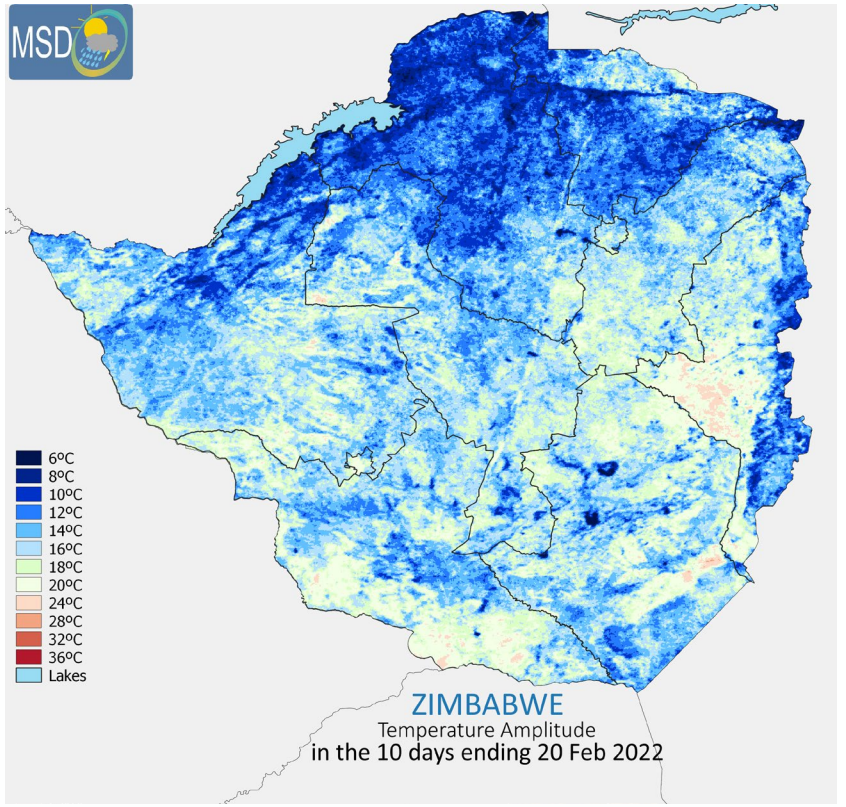
Product Portfolio

Biophysical

NDVI, LST, Amplitude







EO Data Access

Seasonal Monitor (Cloud based)

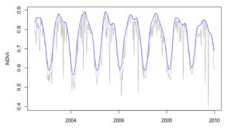
INPUTS

CHIRP/S:
Rainfall Estimates

MODIS:
Vegetation
Land Surface Temperature
Snow Cover
ETp (NASA)

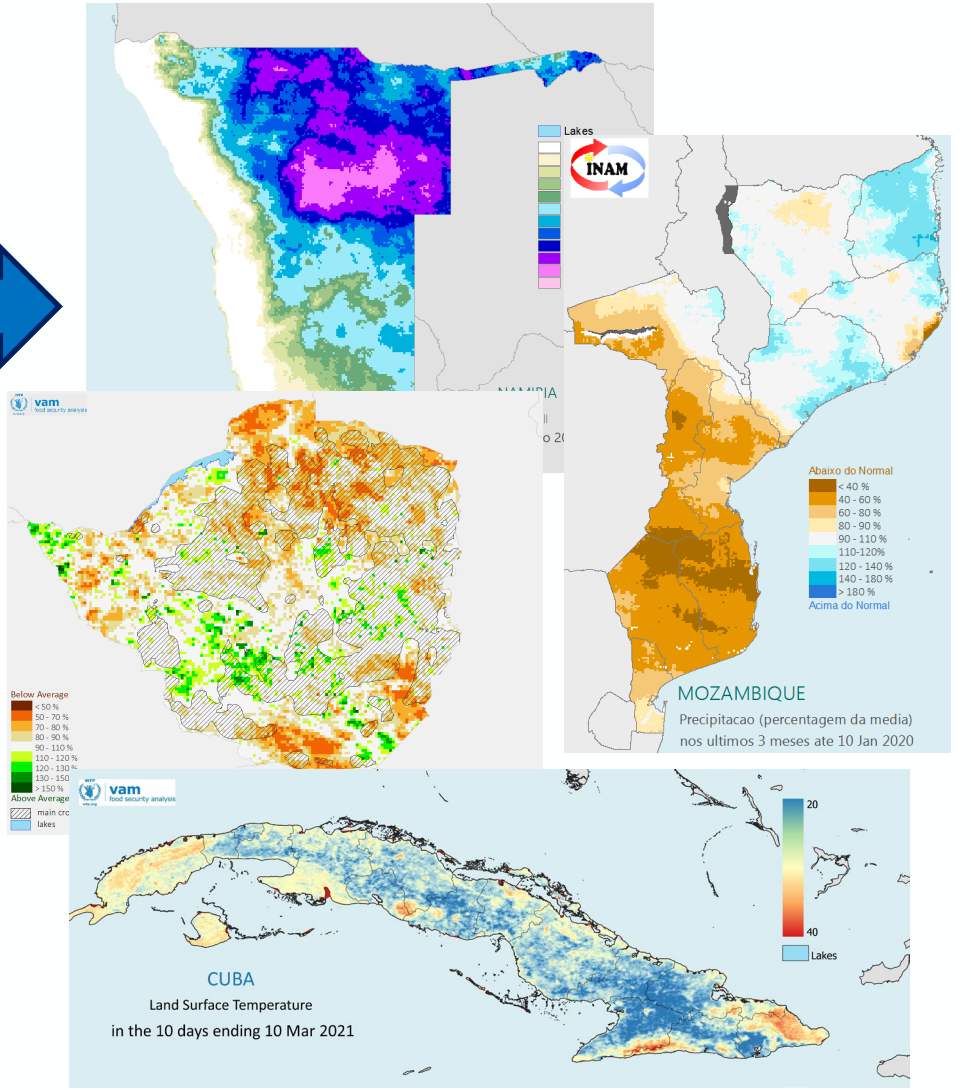
INAM:
Station Rainfall
Station Tmax, Tmin

aws



OPEN DATA CUBE

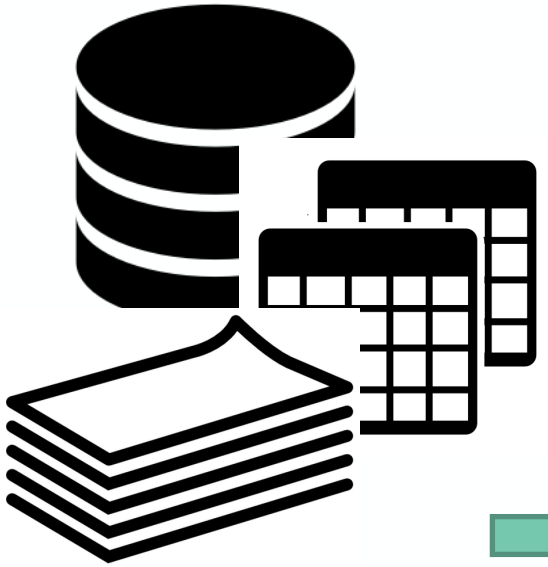
Accumulated Rainfall
Vegetation
Soil Temperature
Precip Extremes
Drought Indices
Crop Water Indices
(...)



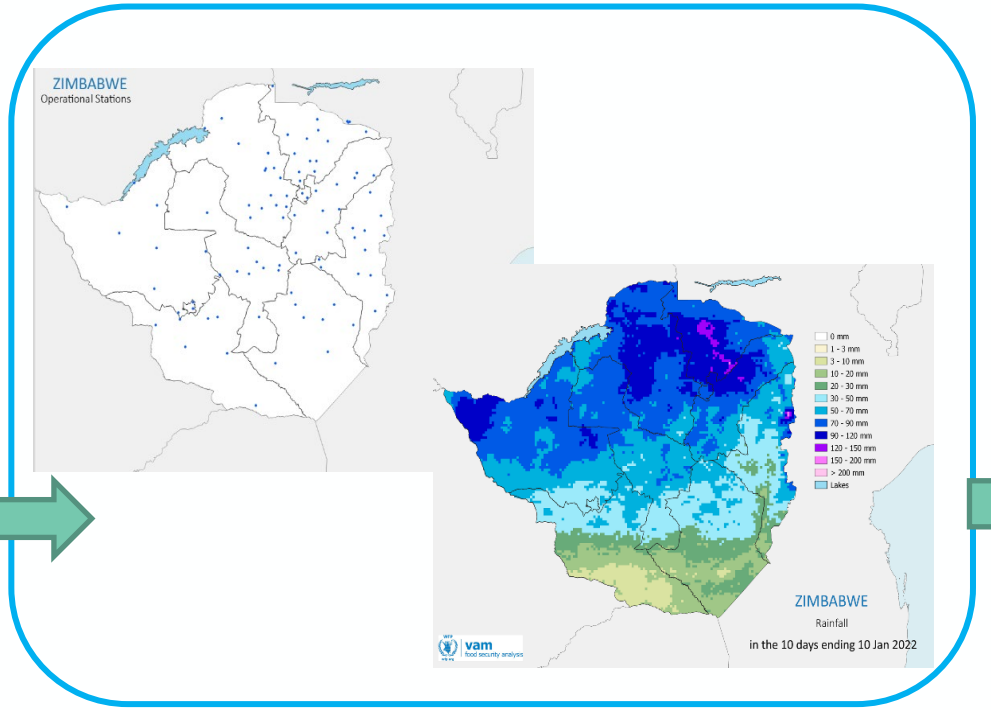
Climate Data Recovery

Meteo Data :

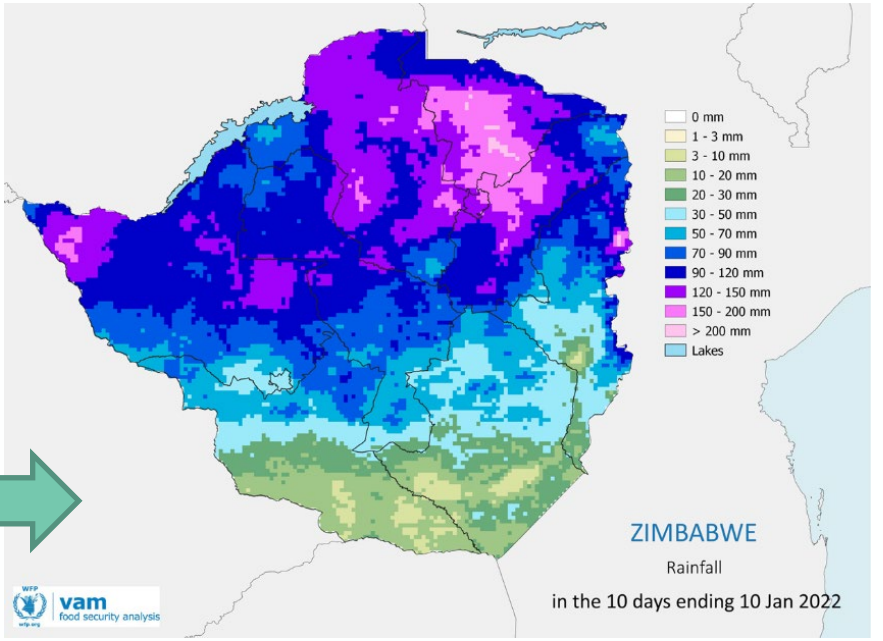
Precip, Temperature, Humidity, WindSpeed
Varying formats and sources



Paper, Excel, Old DB



40 year Rainfall Database

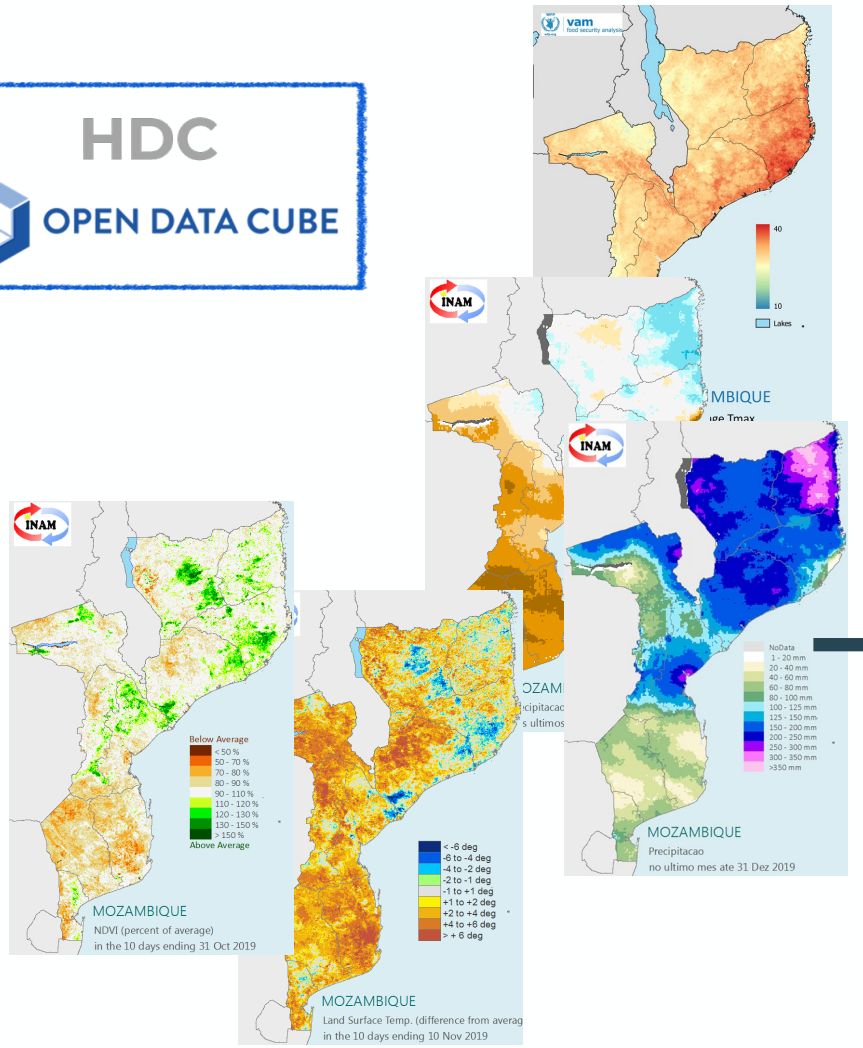


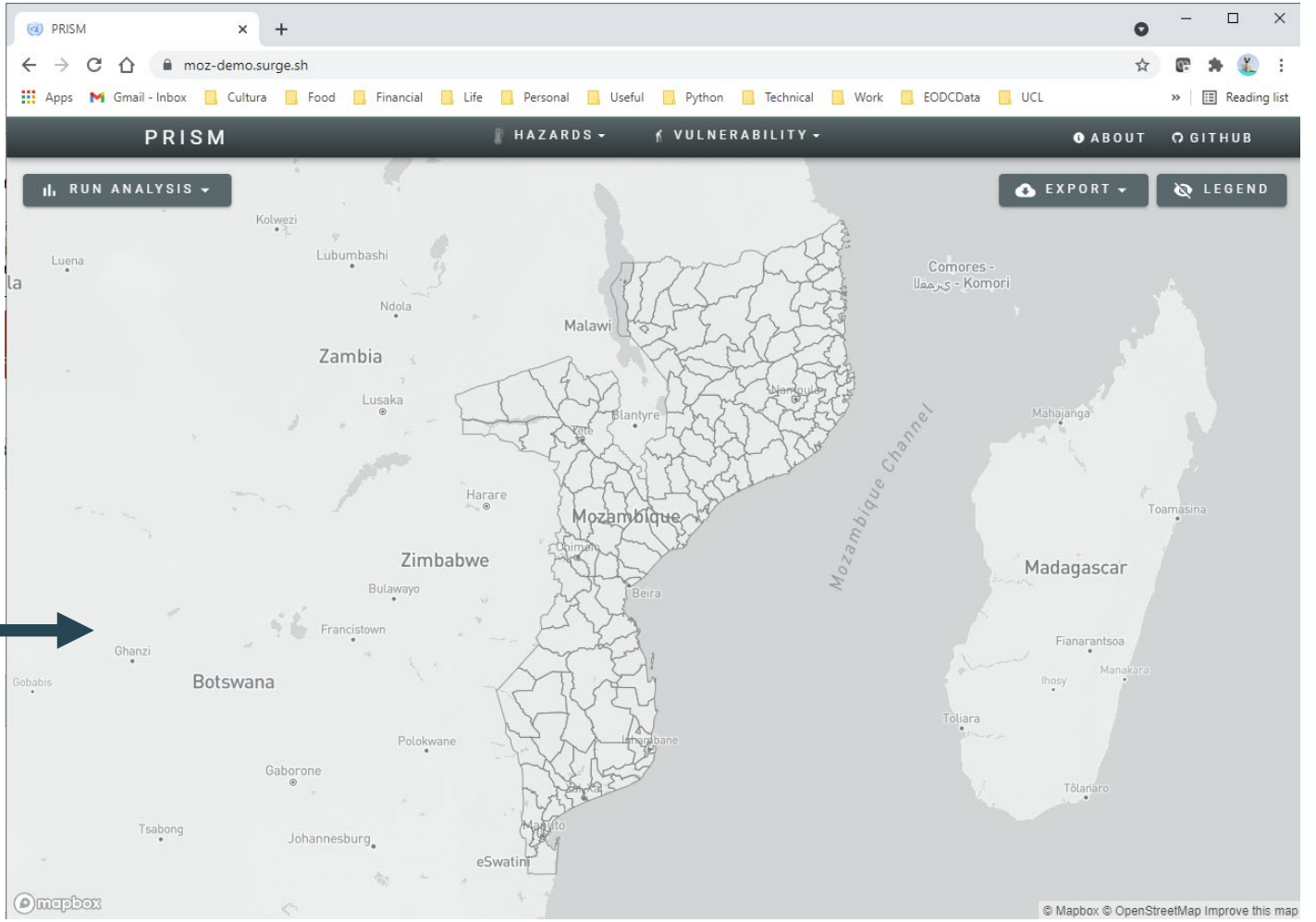
Applications:

Climate Risk Analysis, Improved FbF Triggers

PRISM: Government oriented Platform

HDC
OPEN DATA CUBE



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TAKING THE PULSE
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Thank You!