



Pacific GIS and
Remote Sensing Council

Conference 22-23 November 2021

Drought assessment from the combination of remote sensing and in-situ meteorological data

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World is Changing



Drought in the Pacific Islands

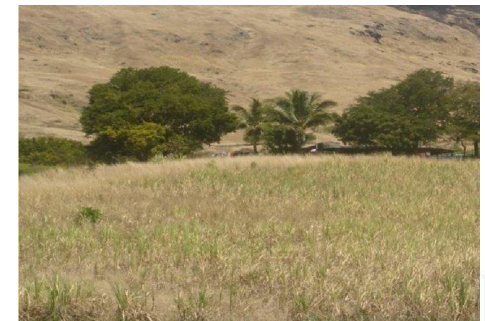
“Vanuatu: Tanna Island particularly affected by drought in 2015”
NC 1ère, 2015



“2019, a dry year in Caledonia”
Météo-France NC, 2020



“Meteorological drought affected Fiji in 2010”*

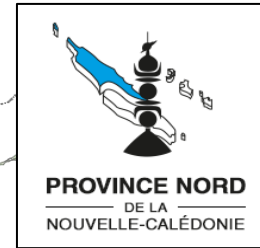


* *Extreme Weather and Climate Events and Their Impacts on Island Countries in the Western Pacific: Cyclones, Floods and Droughts (Kuleshov, 2014)*

Drought and Resilience in NC

Increase local agricultural production

Reduce the risk of shortages and conflicts of use



The Rural Agency facing the drought hazard :

- purchase of drought food for farmers
- compensation for producers of perennial crops

The drought plan of **the Northern Province** :

simulation tool for the need-resource balance



Increased vulnerability :

since 2010, institutions have come to the aid of farmers five times (2010, 2014, 2015, 2017, 2019)

METEO FRANCE

- **Rainfall information**
- **Medium and long-term forecasts**

Existing & Needs

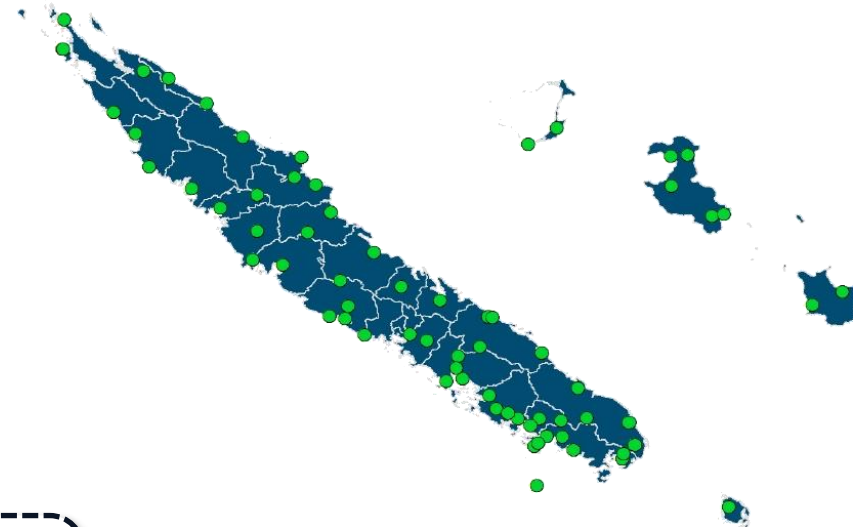
SPI : *Standard Precipitation Index*

- ❖ **Tool** for monitoring drought hazard
- ❖ **Universal index** to characterize meteorological drought
- ❖ **Precise quantification** of recurrence of accumulated precipitation over 50 years



SPI values	Precipitation regime	Return Period
2,00 and more	Extremely wet	RP > 43 years
1,50 to 1,99	Very wet	15 years < RP < 43 years
1,00 to 1,49	Moderately wet	6 years < RP < 15 years
-0,99 to 0,99	Normal precipitation	0 years < RP < 6 years
-1,00 to -1,49	Moderately dry	6 years < RP < 15 years
-1,50 to -1,99	Very dry	15 years < RP < 43 years
-2,00 and less	Extremely dry	RP > 43 years

SPI 3-months



*50 weather stations
over the territory*

- **Rainfall deficit \neq plant water stress**
- **Incomplete spatial coverage**

The global system

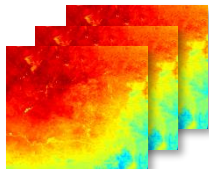
Complementary Earth Observation data



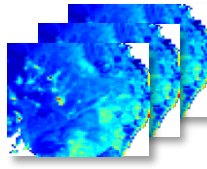
SPATIALIZED = localization



Vegetation
 (Optical)



Surface Temperature
 (Thermal)



Soil Moisture
 (Microwave)



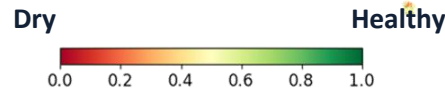
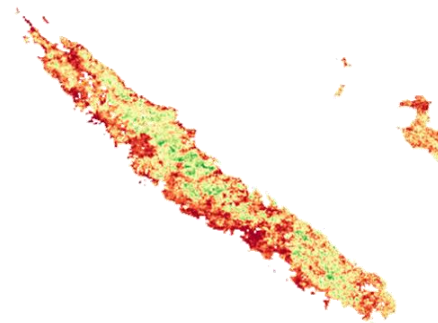
HISTORICAL = quantification



Expert meteorological data:
 precipitation, evapotranspiration, wind

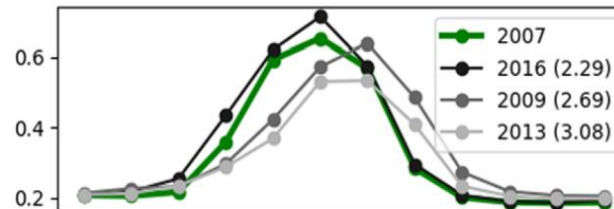
Agricultural Drought Indicator

Anomalies of surface indices



Forecast indicator

Meteorological statistical models



Le Page et Zribi (2019)

User platform



Methodology

1) GLOBAL INDICATOR:

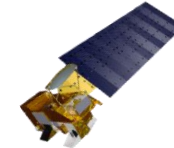
- Global scale
- Combined drought products
- Agricultural drought cause-effect relationship
(Sepulcre-Canto et al., 2012)



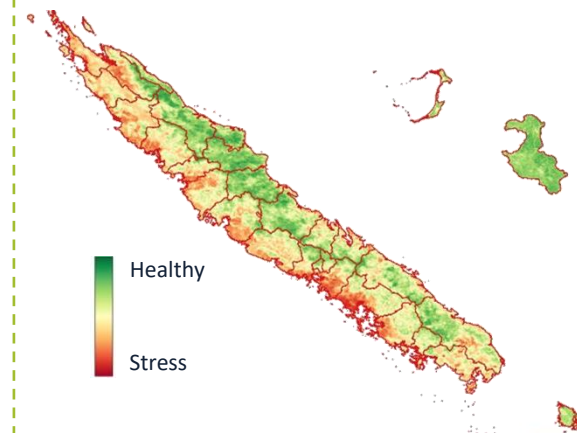
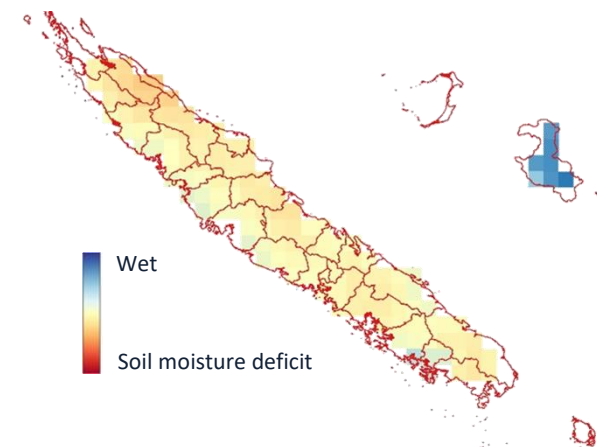
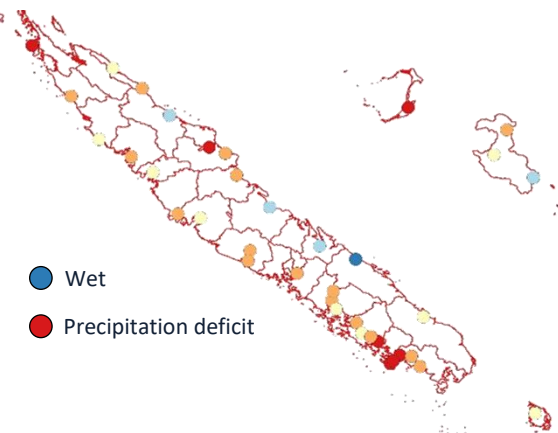
In-situ data
 SPI 3-months
 50 stations
 1960 - today



ASCAT (MetOp)
 Anomalies of Soil Water Index
 12 km
 2007 - today



MODIS (Aqua, Terra)
 Vegetation Health Index
 Combined anomalies of NDWI, LST
 1 km
 2000 - today



Methodology

1) GLOBAL INDICATOR:

- Global scale
- Updated every month
- Combined drought products
- Agricultural drought cause-effect relationship
(Sepulcre-Canto, 2012)

Precipitation deficit



Soil moisture deficit

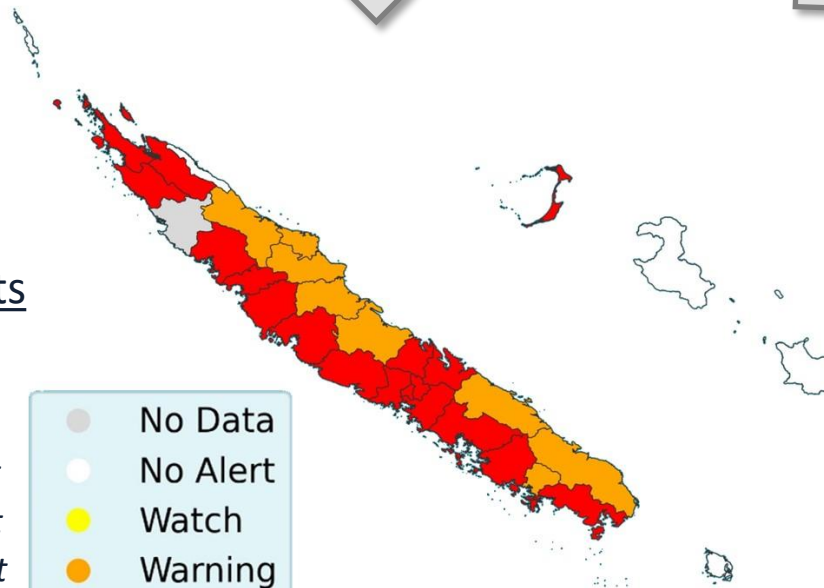


Vegetation stress



Drought Alerts

No deficit
Precipitation deficit
Soil moisture deficit
Vegetation stress



Methodology

2) LOCAL INDICATOR:

- Local scale
- Updated between 5 and 15 days
- Focus on vegetation stress



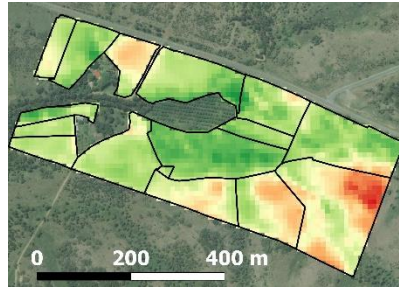
Landsat (L7, L8)
USGS Level 2 reflectances
30 m
2000 - today



Sentinel-2 (2A, 2B)
THEIA Level 2 reflectances
10 m
2016 - today

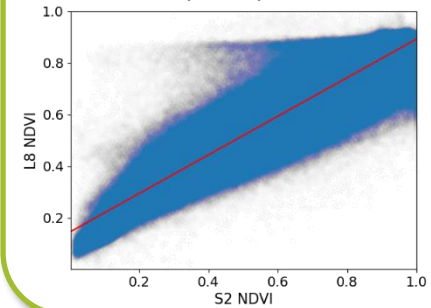
PREPROCESSING

- Computing NDWI, NDVI
- Clouds filtering and reprojection



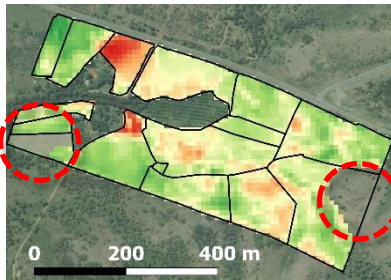
COMPOSITING

- Radiometric calibration
- 10-day composition



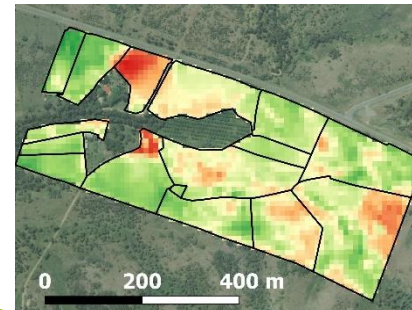
POSTPROCESSING

- Filtering bare soil, dense vegetation
- From NDVI 10-day composites

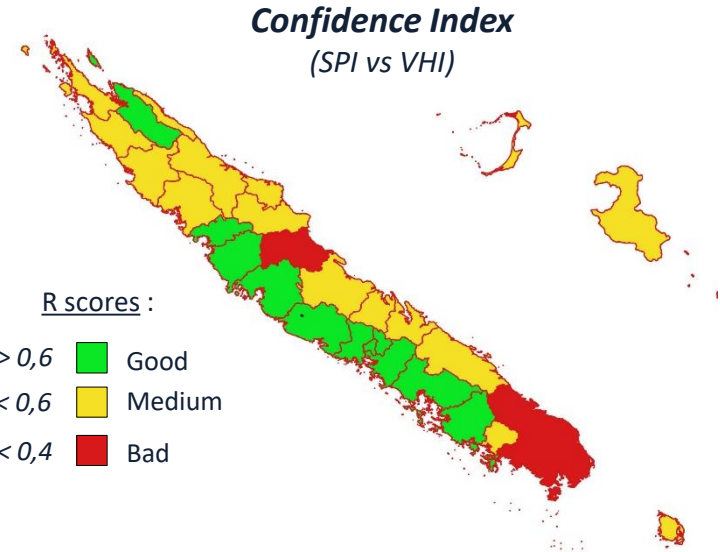
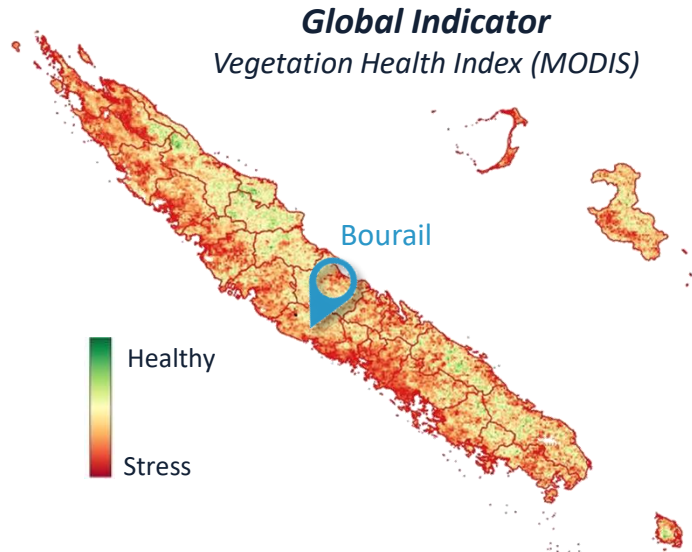


ANOMALIES

- NDWI Anomalies (*Amri et al., 2011*)

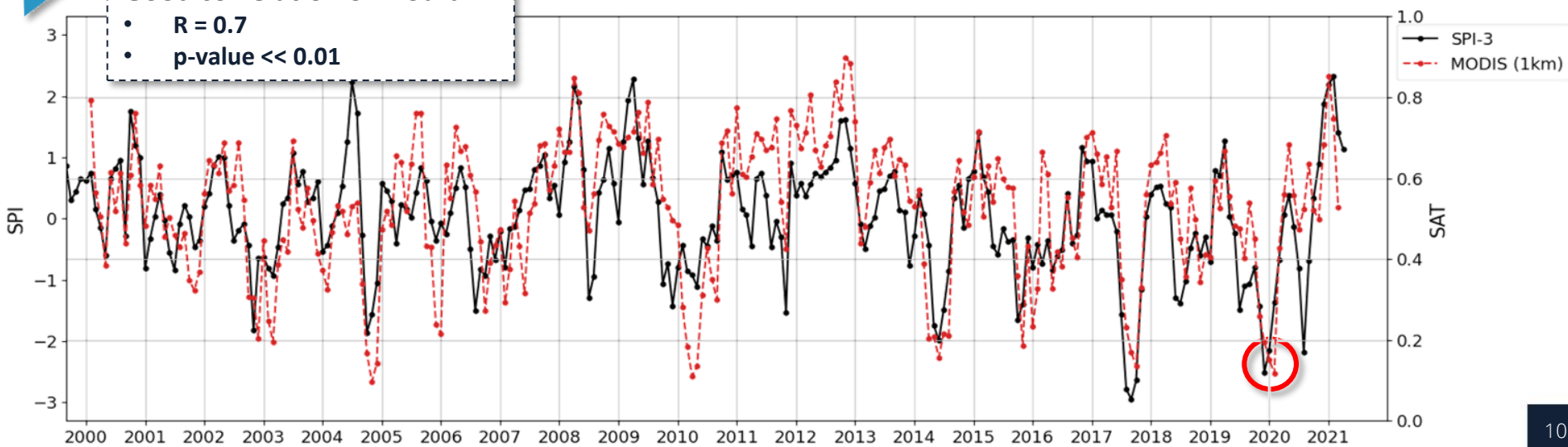


Some results : November 2019



Good correlation on Bourail :

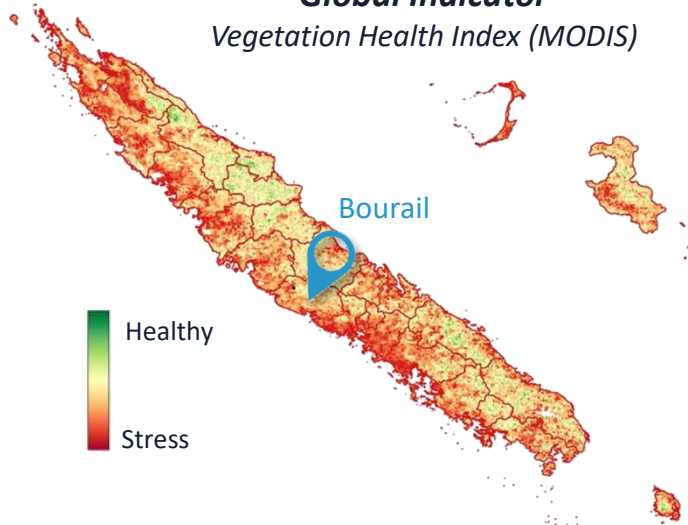
- $R = 0.7$
- $p\text{-value} \ll 0.01$



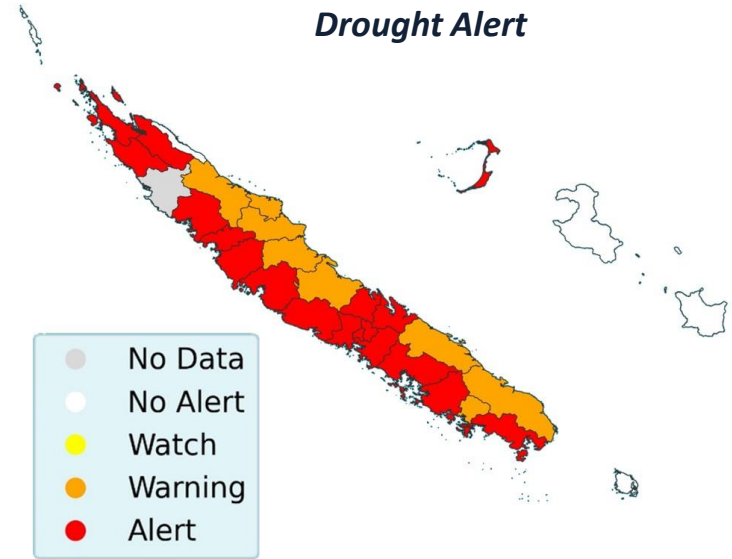
Some results : November 2019

Global Indicator

Vegetation Health Index (MODIS)

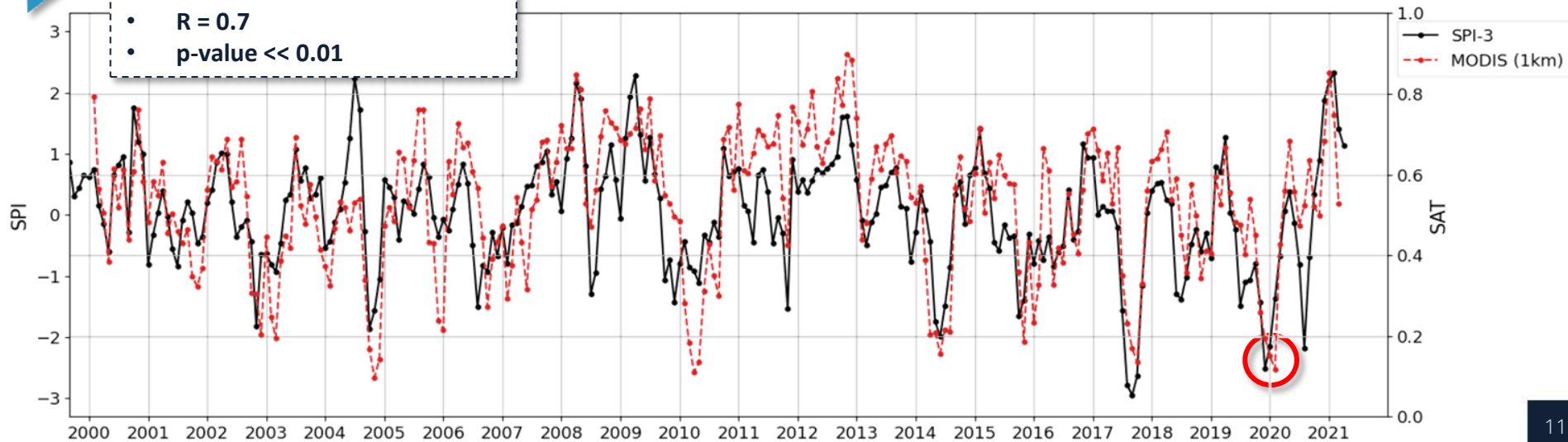


Drought Alert



Good correlation on Bourail :

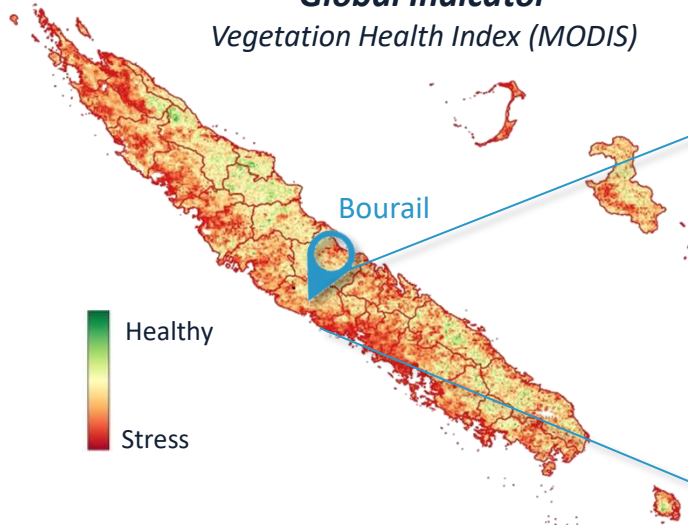
- $R = 0.7$
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Some results : November 2019

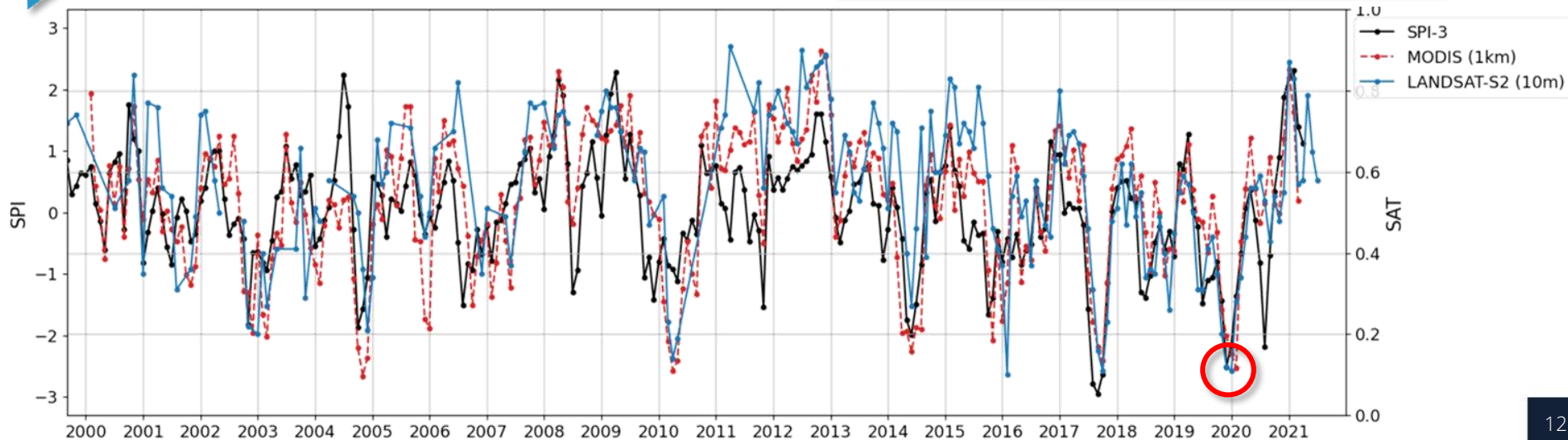
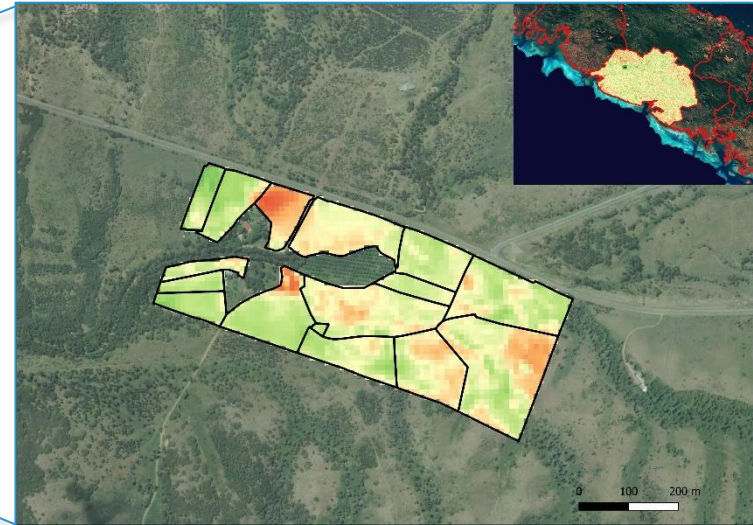
Global Indicator

Vegetation Health Index (MODIS)



Local Indicator

(Landsat, Sentinel-2)



User platform prototype

EARTH OBSERVATION 4 DROUGHT MONITORING

ABOUT

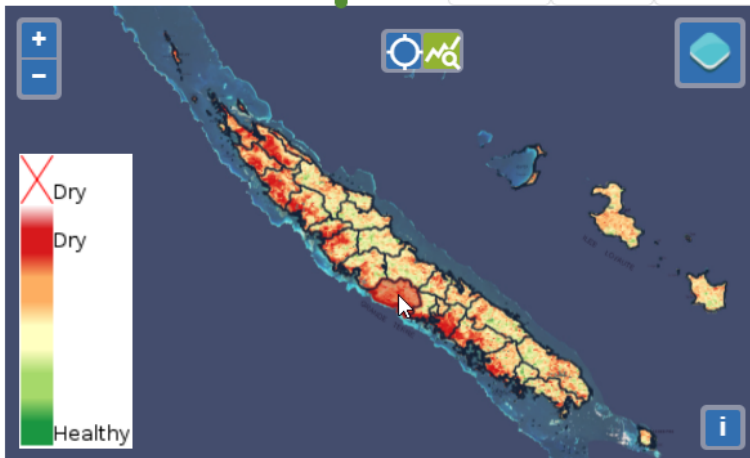


Index mode: VHI Global

- 1) Selection of the month map to display
- 2) Selection of the forecast map to display (in development)
- 3) Selection of a point on the map to display the time profile

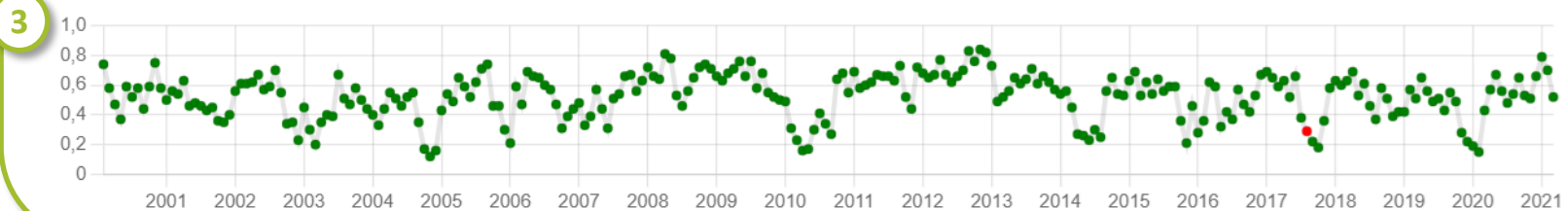
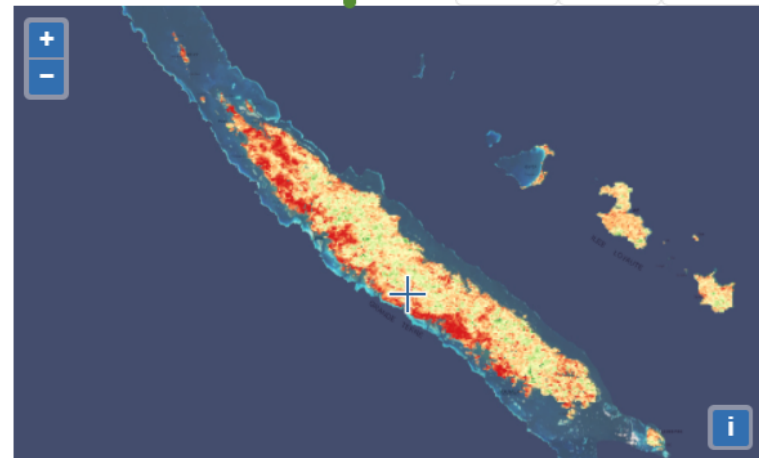
1 Current value

Tue Aug 01 2017



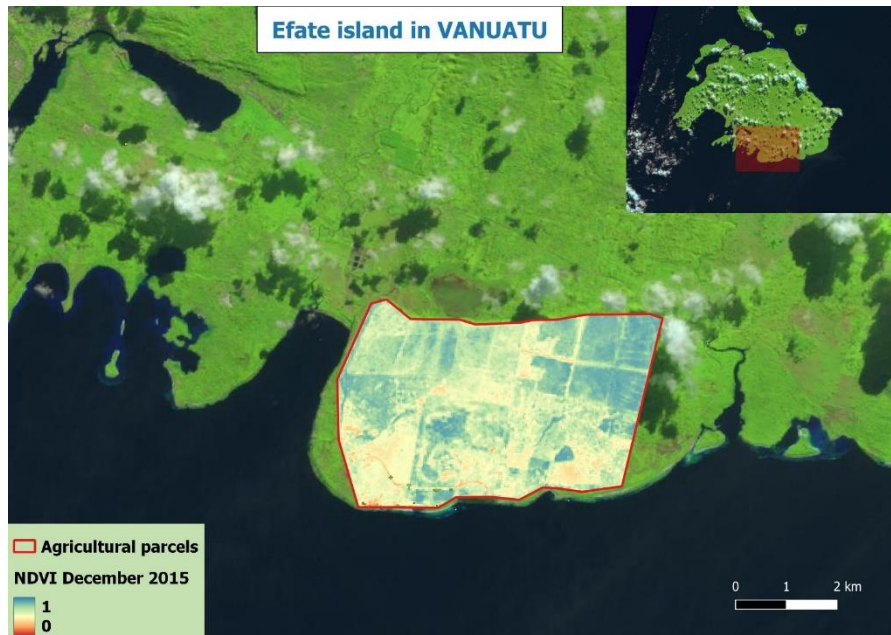
2 Forecast value

Tue Aug 01 2017



What next ?

- Integrating **forecast indicator** to the platform
- Conducting **field tests** with farmers
- Developping **operational production** on New Caledonia
- Demonstrating the applicability in other **Pacific island territories...**





**Thank you for your
attention**