



CITES Tree Species Programme

Project: CITES S608:

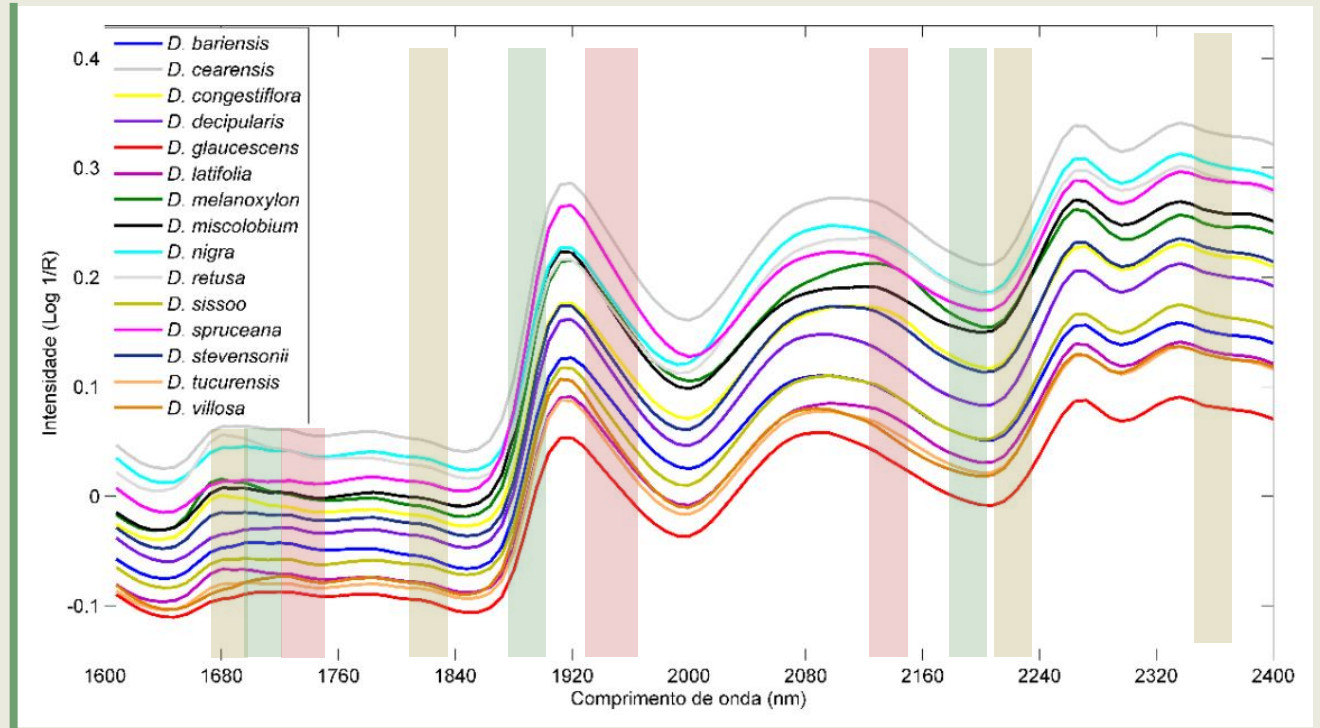
“Big-leaf Mahogany Provenance and Timber Identification by NIRS Technology”

Kuala Lumpur, October 05, 2022.

1. INTRODUCTION: NIR wood identification



- ❑ Minimum sample preparation.
- ❑ Fast data acquisition (~15 sec).
- ❑ Availability of Handheld equipment (U\$ 2000 to 30,000).
- ❑ NIR spectra contain chemical specific information:
 - Species identification
 - Origin/provenance

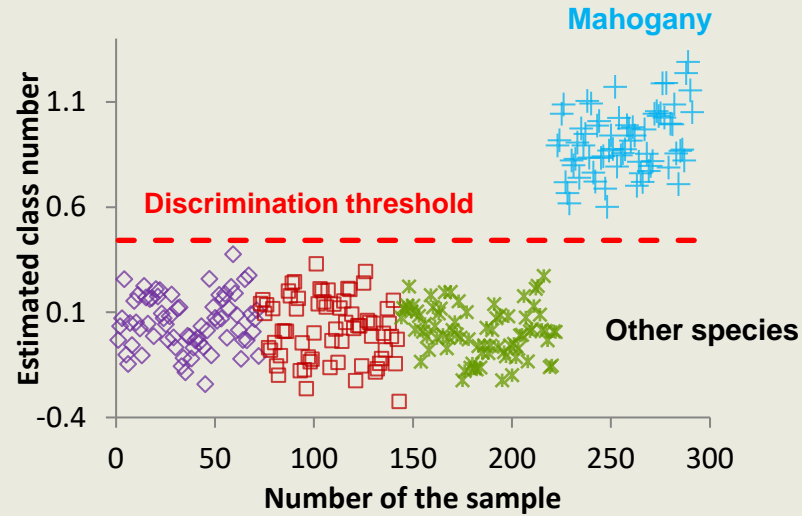


Lignin Extractives Cellulose

- ❑ Requires a representative number of samples of each interest species.
- ❑ Requires Chemometrics (e.g.: PLS-DA, SIMCA).
- ❑ Requires a relative control of the moisture content of the sample.

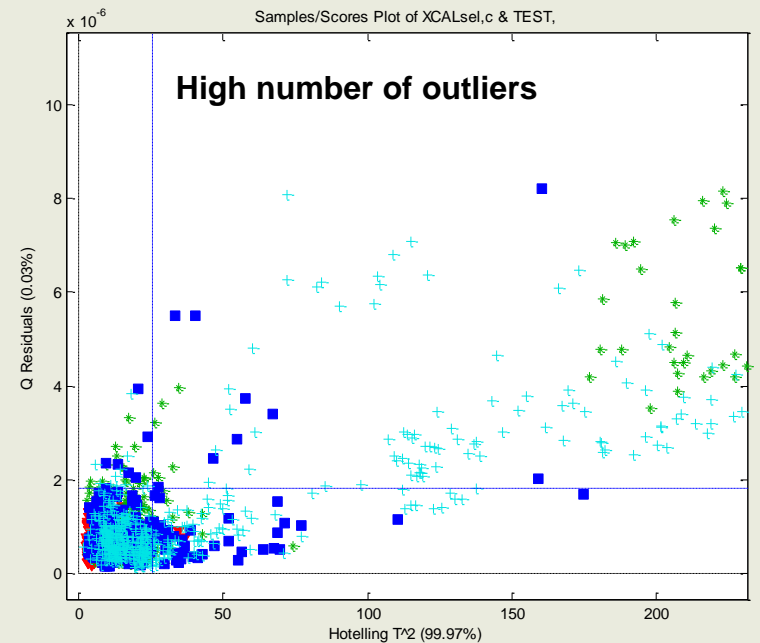
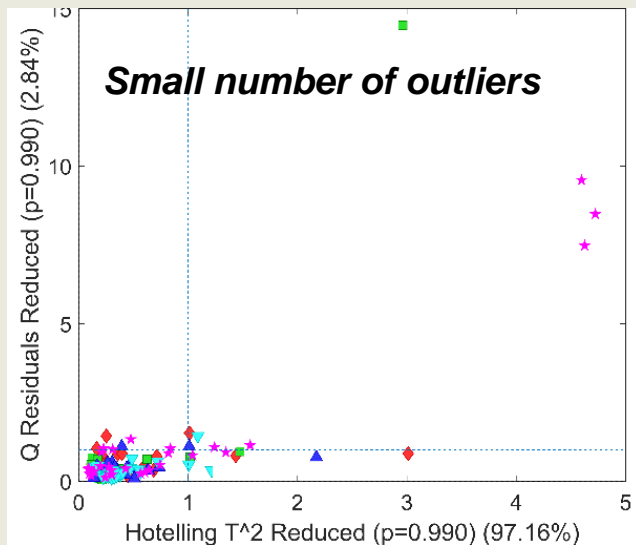
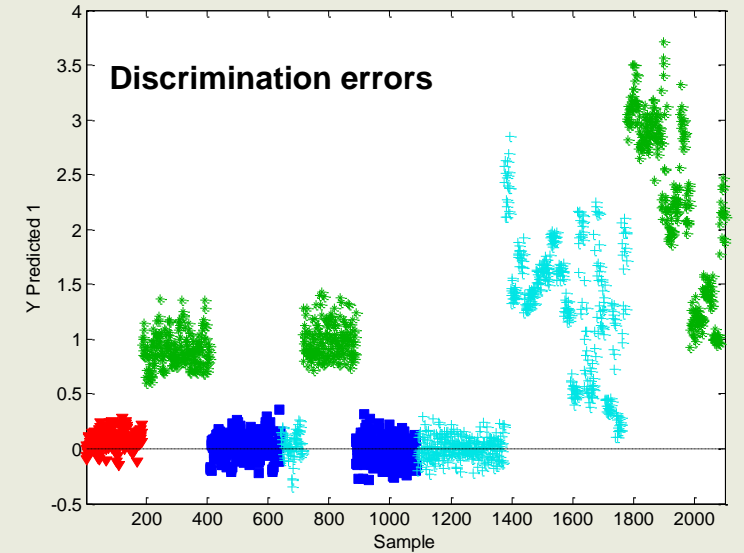
2. CONTEXT: NIR identification with different moisture contents

Laboratory conditions:

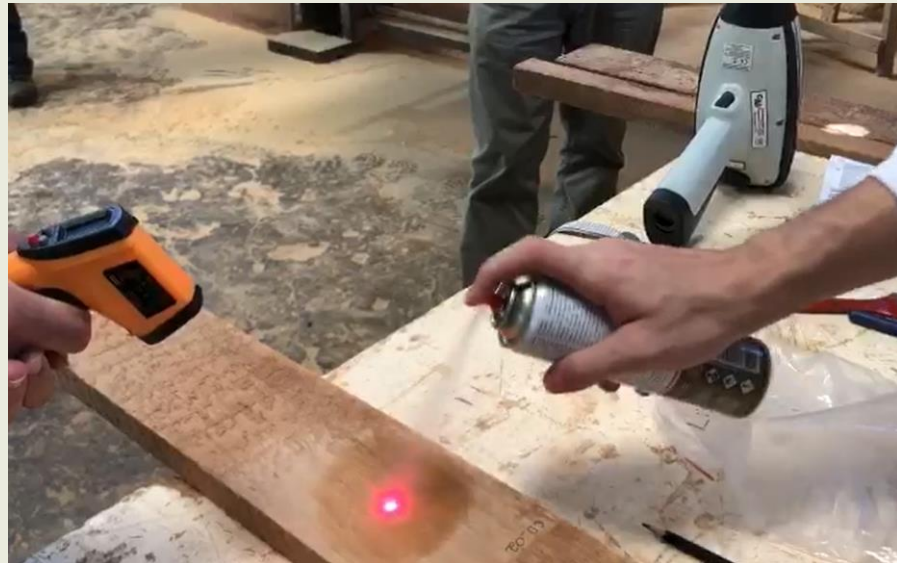
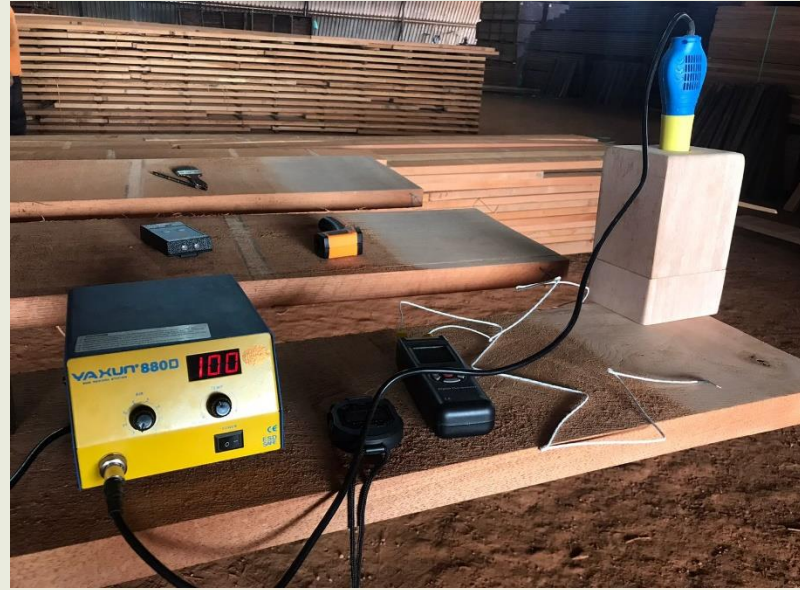


Field conditions:

- Moisture and temperature variation



3. Current design for in situ drying and NIR analysis



EXPERIMENTAL PROCEDURE:

- 1) Sanding the sample
- 2) Drying for 8 min.
- 3) Cooling the sample by applying a high volatile fluid.
- 4) Obtaining the spectra

4.1 Results: Two missions at the JB Madeiras sawmill (Brasília/DF, Brazil) to test the new drying method.

Three species were tested: *Erisma uncinatum* (cedrinho); *Micropholis melinoniana* (curupixá) and *Cedrela odorata* (cedar).



- ❑ Average moisture content before drying = 15 %
- ❑ Average moisture content after drying = 11 %

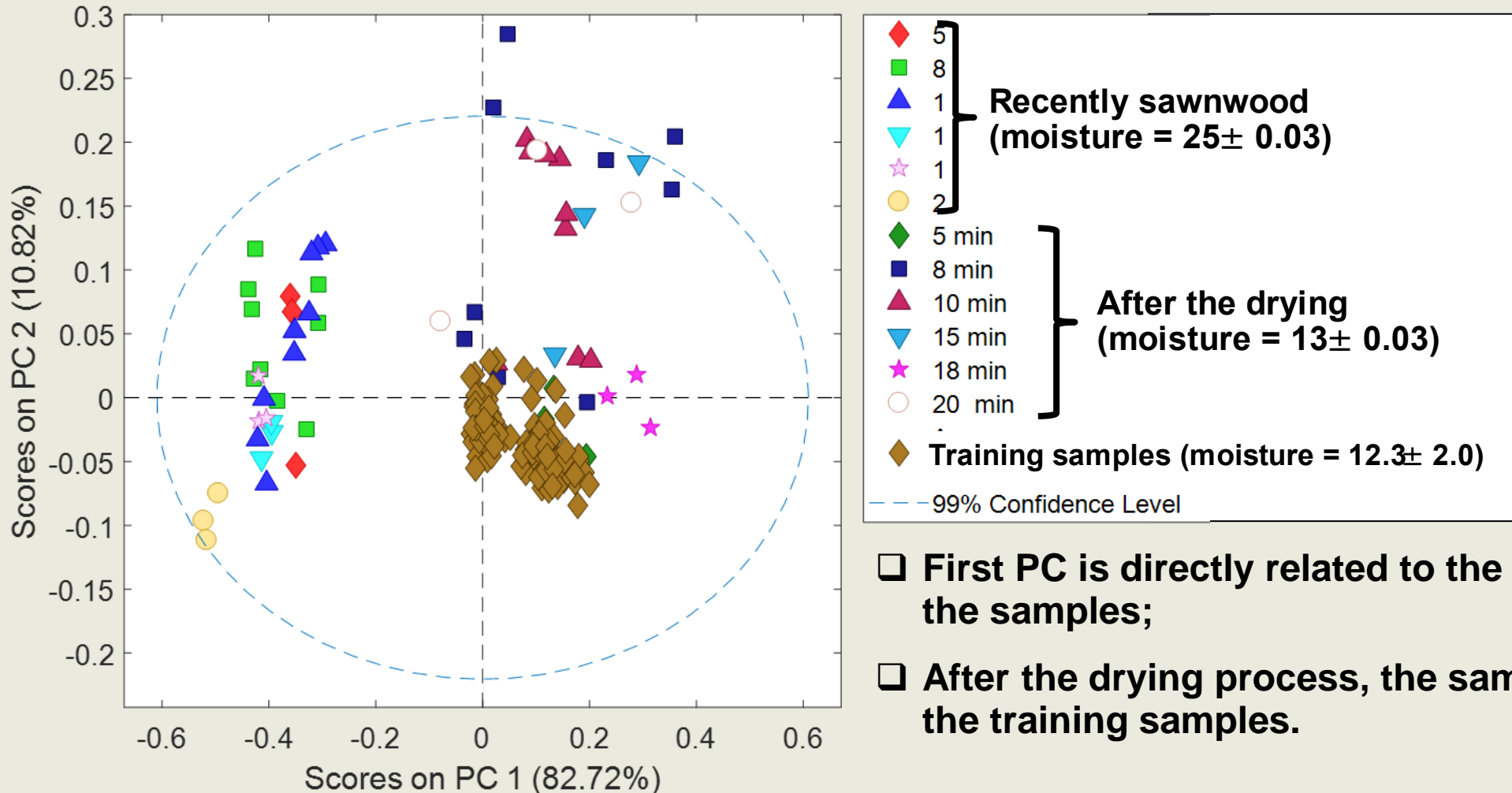
Species	Nº of samples	Nº of spectra	False positive rate	False negative rate	Efficiency Rate
Cedar	22	66	0.0 %	2.5 %	98.7 %
Cedrinho	13	39	4.1 %	15.8 %	89.9 %
Curupixá	18	54	3.4 %	0.0 %	98.3 %

- ❑ After drying, the results presented better precision and a lower rate of errors.

4.2 Results: mission at the Madeflona concessionaire, in Flona Jamari (Itapuã do Oeste – Rondônia state, Brazil)

NIR spectra were obtained on *C. odorata* boards recently sawn and after the drying method.

PCA results:

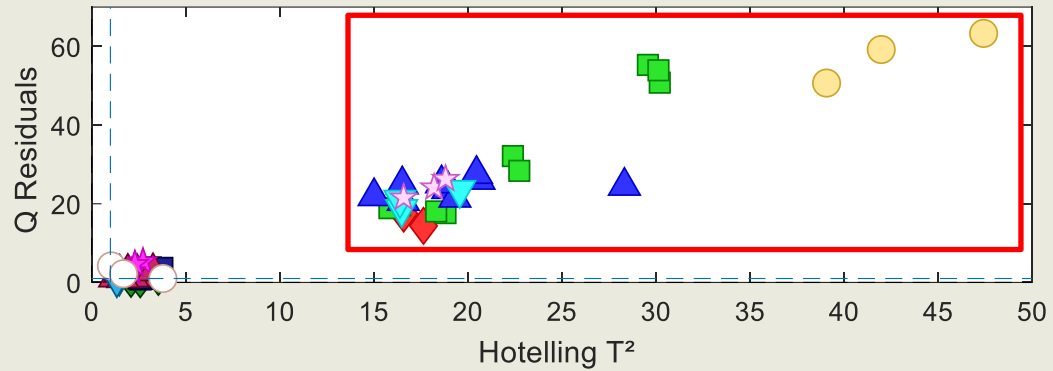


First PC is directly related to the moisture content in the samples;

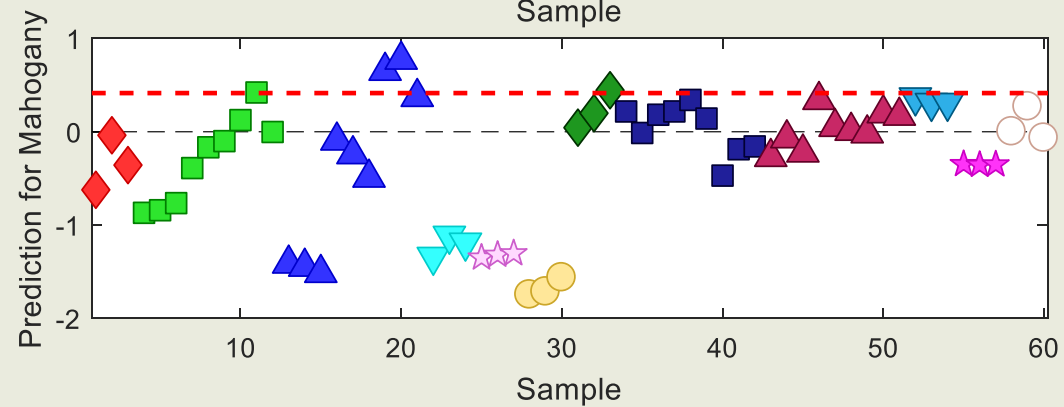
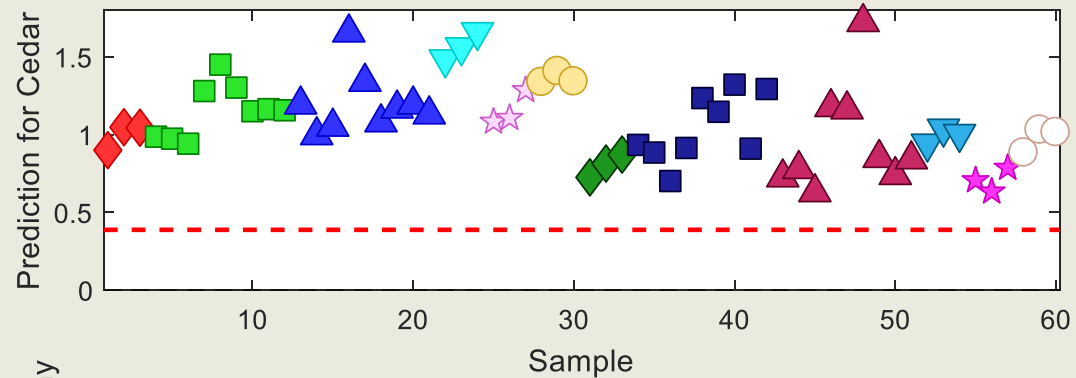
After the drying process, the samples are closer to the training samples.

4.2 Results: mission at the Madeflona concessionaire, in Flona Jamari (Itapuã do Oeste – Rondônia state, Brazil)

Discrimination results:



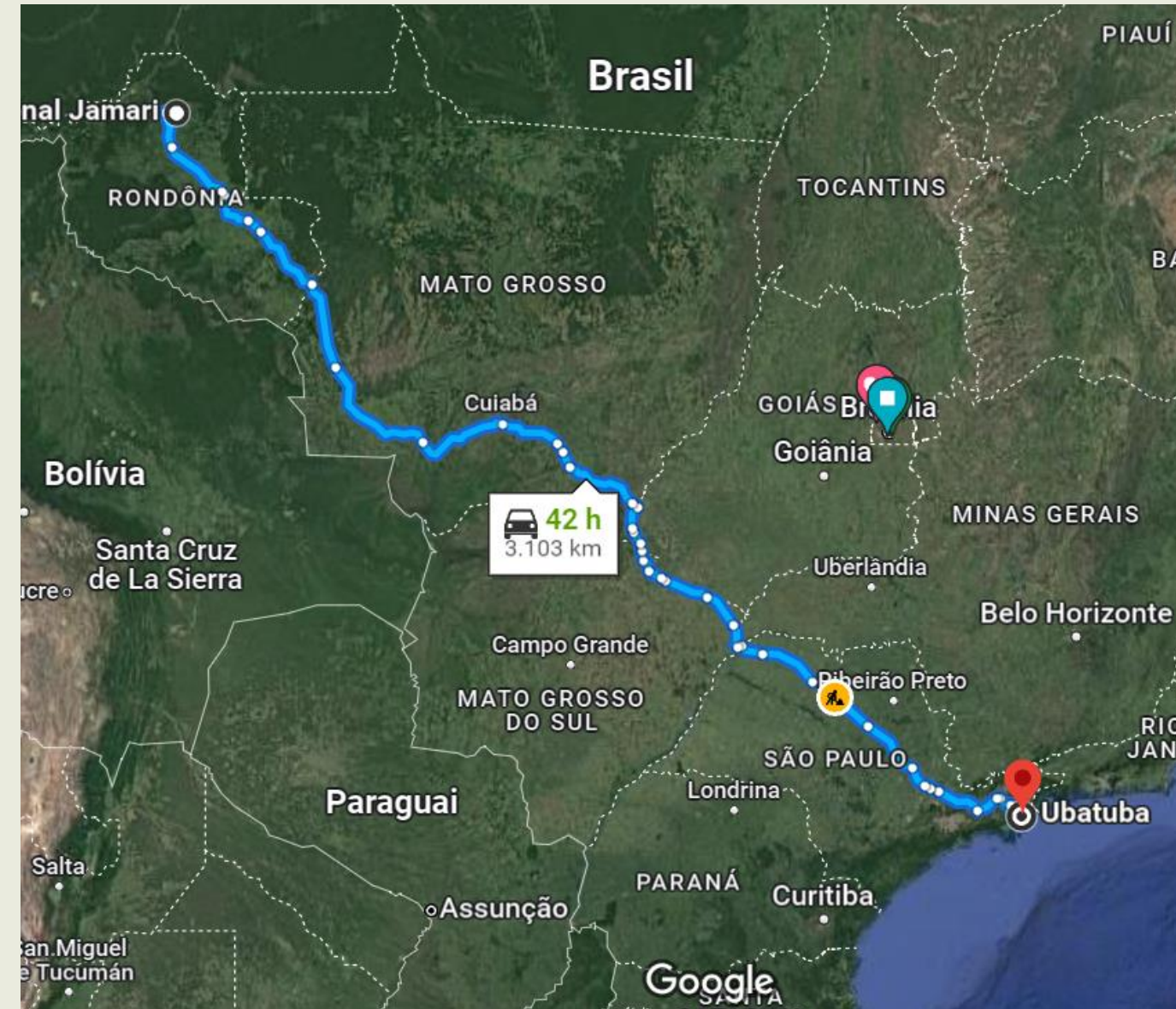
All samples before drying were outliers in the discrimination model.



	<i>Cedar model</i>				<i>Mahogany model</i>			
	TP	FN	FNR	ER	TN	FP	FPR	ER
<i>Cedar</i>	20	0	0%	100%	19	1	5%	95%

*TP: true positive
 FN: false negative
 FNR: false negative rate
 ER: efficiency rate
 TN: true negative
 FP: false positive
 FPR: false positive rate

4.3 Cedar cargo tracking:



Aproximately 20 m³ of Cedar

Cargo origin:

Madeflona concessionaire, in Flona Jamari (Itapua do Oeste – Rondônia state, Brazil)

Destination:

Ubatuba city, São Paulo State, Brazil

Distance: ~3100 km

Time between the measuring procedures: 22 days

4.3 Cedar cargo tracking: experimental procedure



❑ MEASUREMENTS AT THE ORIGIN AND FINAL DESTINATION:

- ❑ Origin: 252 spectra (126 before drying and 126 after drying).
- ❑ Final destination: 126 spectra.



- ❑ Measurement performed at the ends of the boards.

4.3 Results: Application of the Cedar cargo model for different samples:

Summary of results for cargo tracking:

Samples	Number of samples (spectra)	Probability of belonging to the target cargo	Conclusion
Training samples	56 (168)	100 %	Belong to the cargo
Validation samples	28 (84)	95.2 %	Belong to the cargo
Samples measured at final destination	42 (126)	81.0%	Belong to the cargo
Cedar (JB Madeiras)	12 (24)	20.8 %	Not compatible
Cedar (LPF)	37 (111)	31.1 %	Not compatible
Cedrinho (JB Madeiras)	10 (20)	25.0 %	Not compatible
Cedrinho (LPF)	63 (189)	2.4 %	Not compatible
Mahogany (Agrocortex)	24(75)	32 %	Not compatible
Mahogany (LPF)	48 (228)	20.8 %	Not compatible
Curupixá (LPF)	40 (120)	33.8 %	Not compatible

5. Conclusions:

- The proposed drying procedure is efficient and improved the results in field conditions.
- Measurements/drying are more effective at the ends of the boards
- The time for analysis increased to ~30min.
- Preliminary results indicate that the cargo tracking is possible.
- New experiments are being conducted to establish the acceptance probabilities and limitations.



[Thank you for your attention!](#)

tereza.pastore@agro.gov.br

jez@unb.br

tereza.pastore@gmail.com

jezwillian@gmail.com

