Modelling Seasonal Variations of Chlorophyll Fluorescence in Bamboo Leaves

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Why measuring chlorophyll fluorescence on bamboo?

- High yields (use for biomass production)

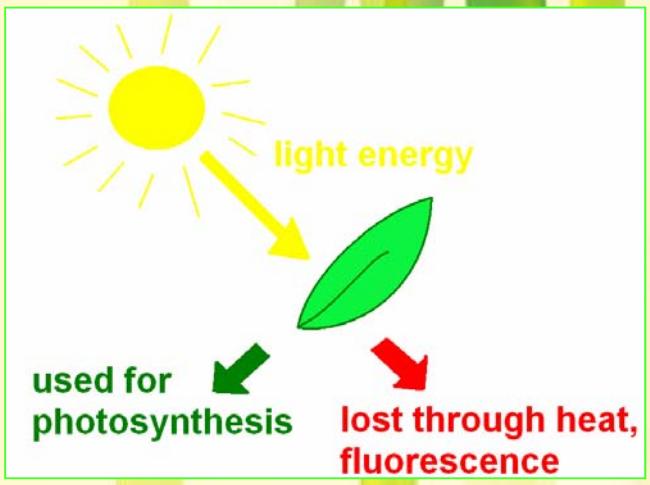
Phyllostachys species	Dry matter (tons / ha.year)
Japan, Taiwan, China	14
Ireland	8
Belgium	9

- Stress?
  - In Europe (≠ environmental conditions)
  - Model performance of the leaves under these conditions

Chlorophyll fluorescence

- To measure “plant health”
- Light energy can either be:
  - used in the process of photosynthesis
  - lost through heat
  - lost though fluorescence

=> Measured by the Handy Pea



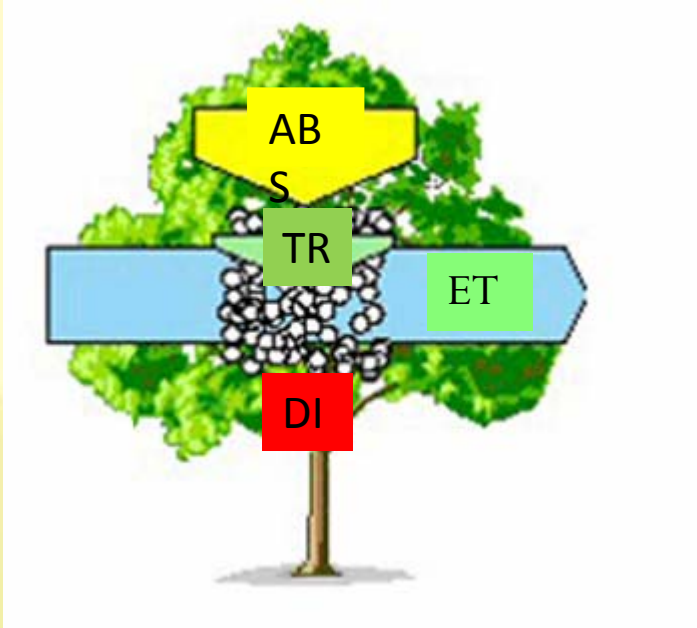
Chlorophyll fluorescence

- Parameters frequently used:
  TRo/RC, ABS/RC, Dio/RC, Eto/RC

=> Fv/Fm (=Tro/ABS)

= "How efficient is PSII"

- Value << 0,83 => STRESS!



Model development

- Morning - midday - afternoon
- 3 leaves / node
- Multiple nodes / culm
- ≠ culms each season

⇒ nested design (mixed model)

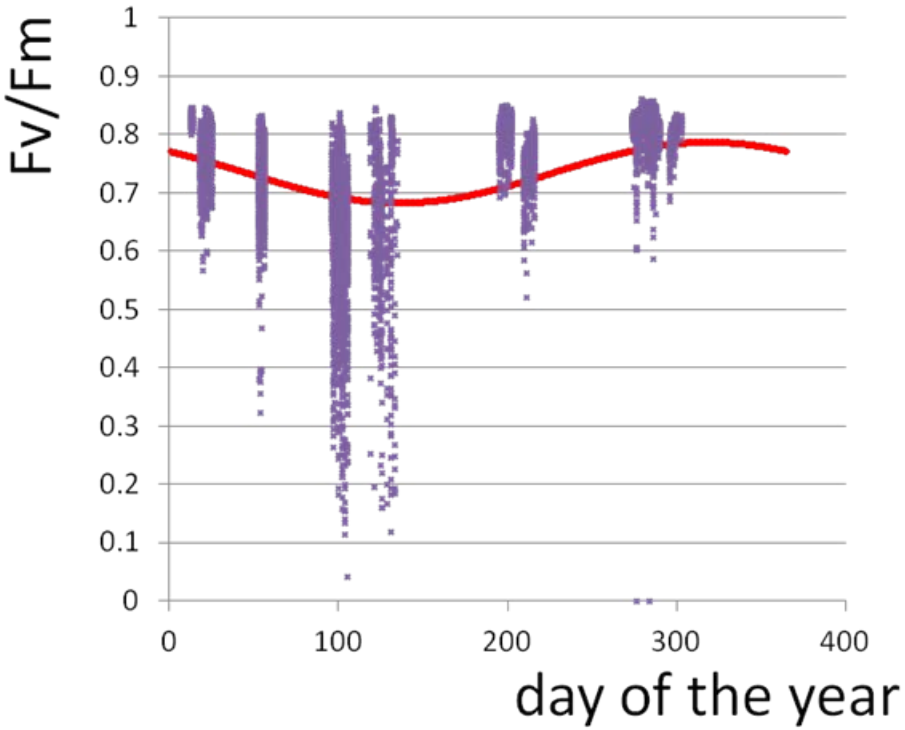
- ≠ variance between seasons
- ≠ variance between nodes

⇒ variance functions allowing for different standard deviations

Models

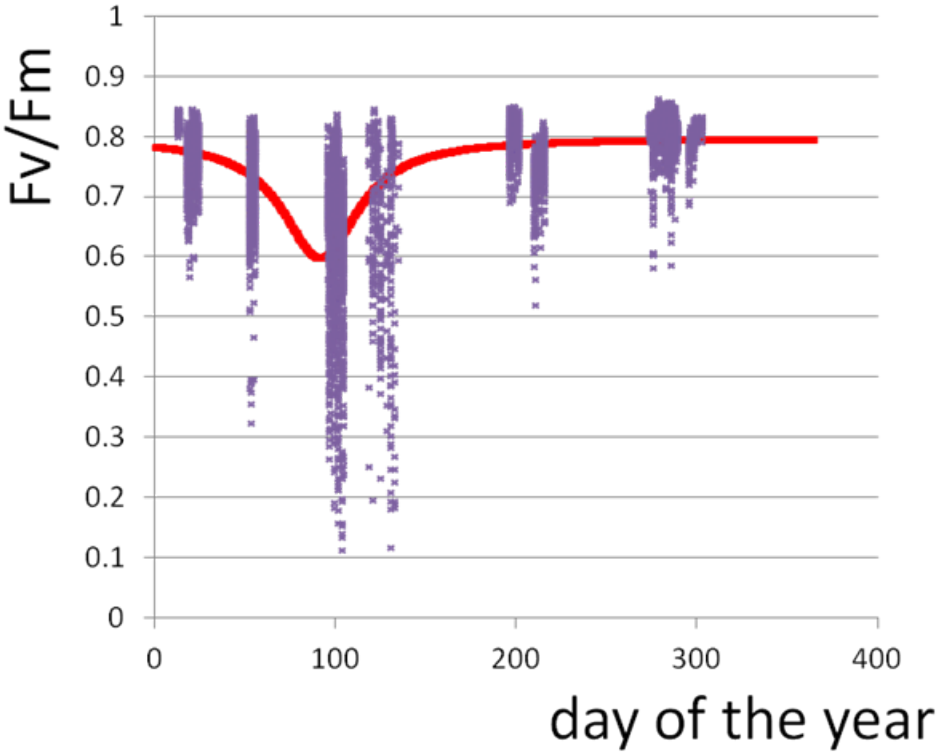
1. LINEAR MODEL

Harmonic function often used to model temporal data



2. NONLINEAR MODEL

Function based on measurements

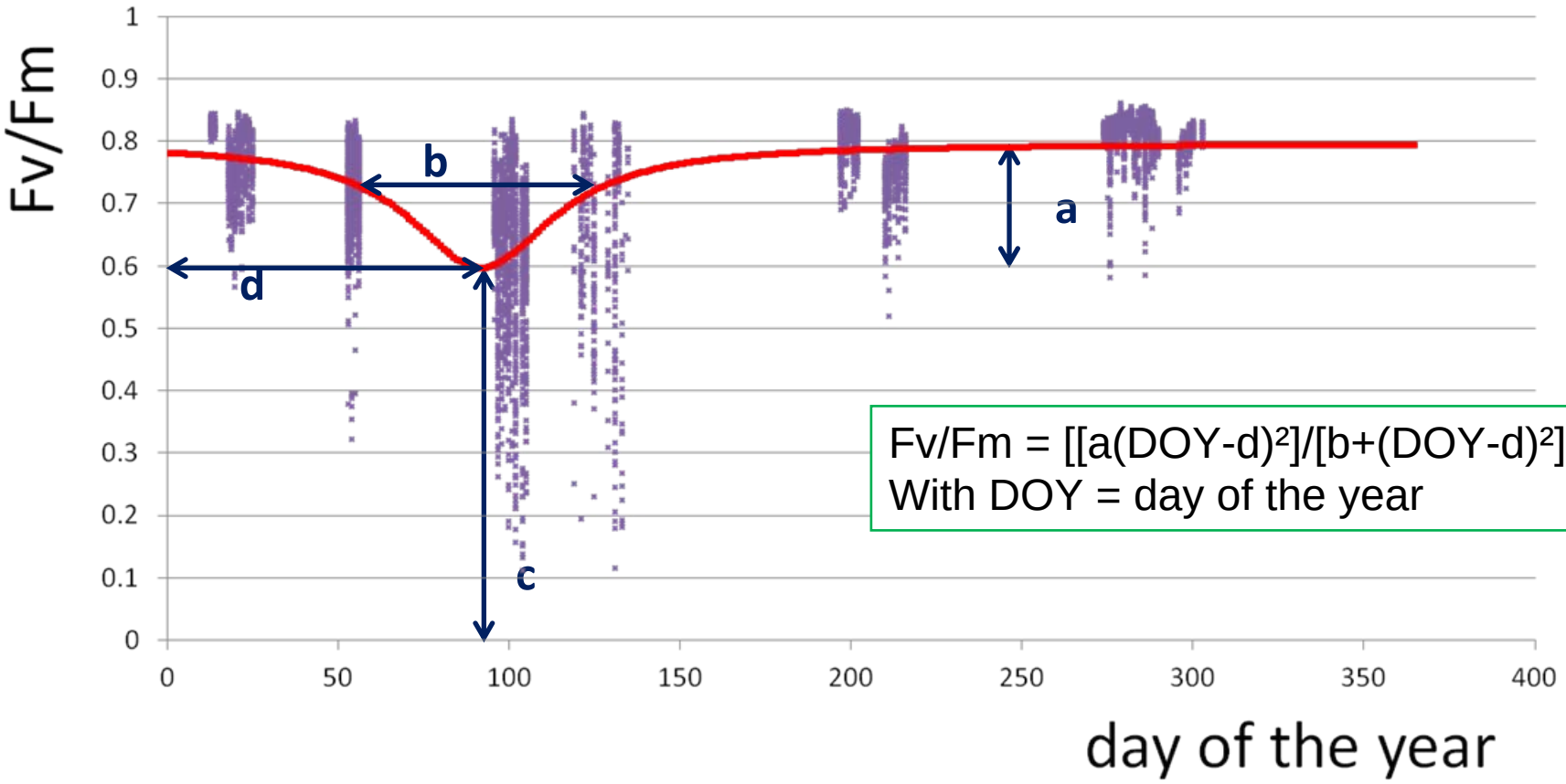


Best model

NONLINEAR MODEL:

Function based on measurements

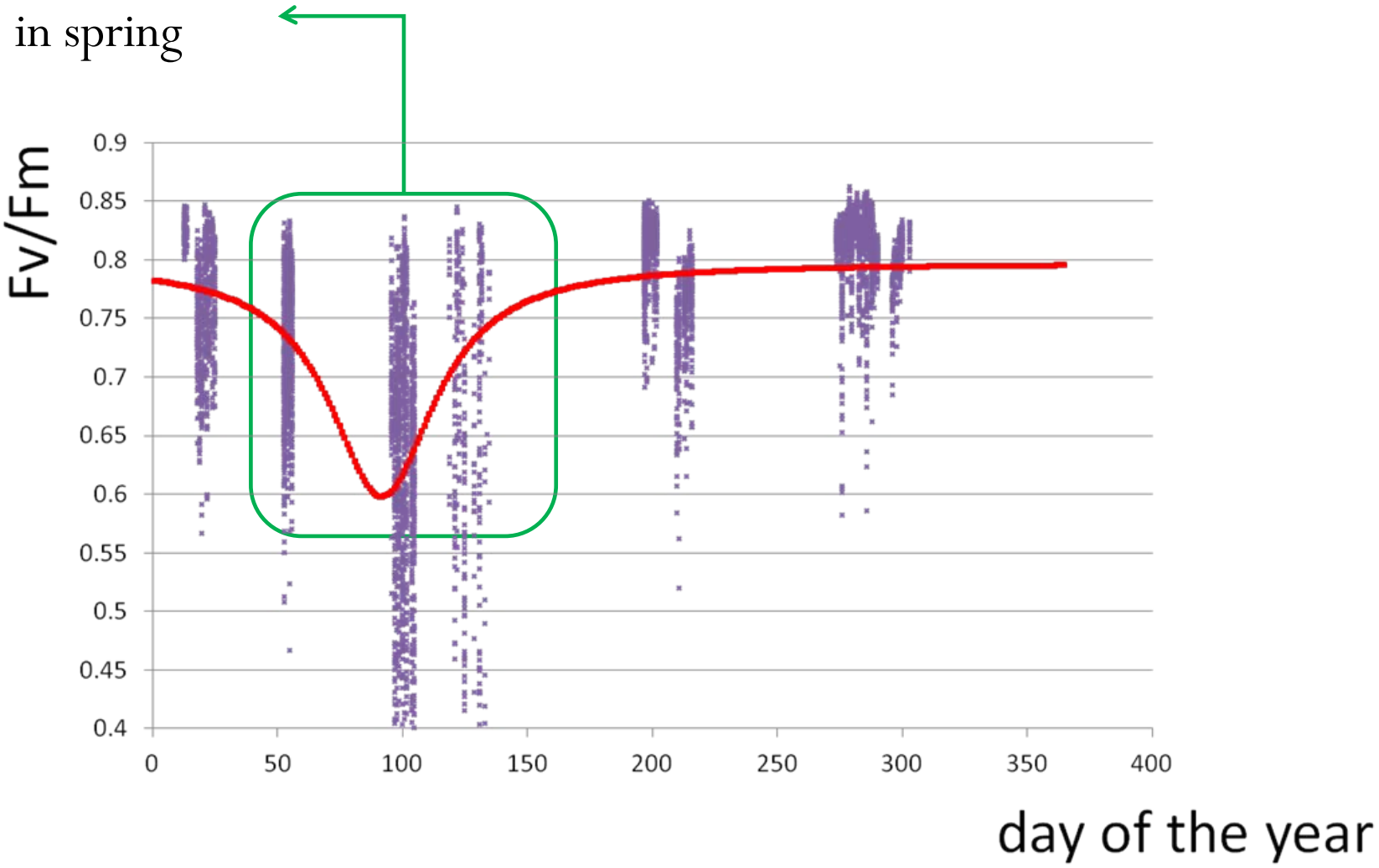
=> Seasonal, diurnal and spatial variations



1. Seasonal variation

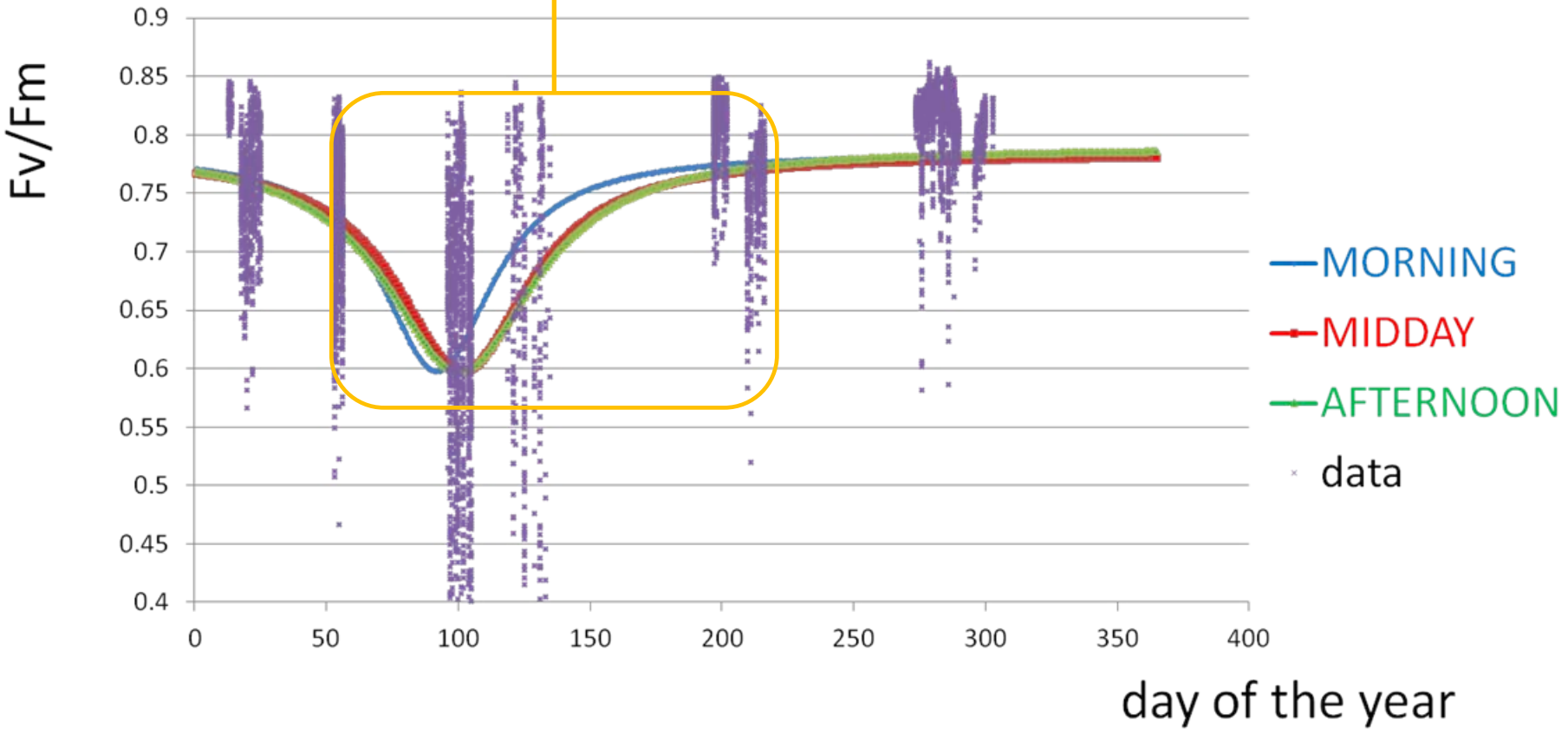
seasonal dip

in spring



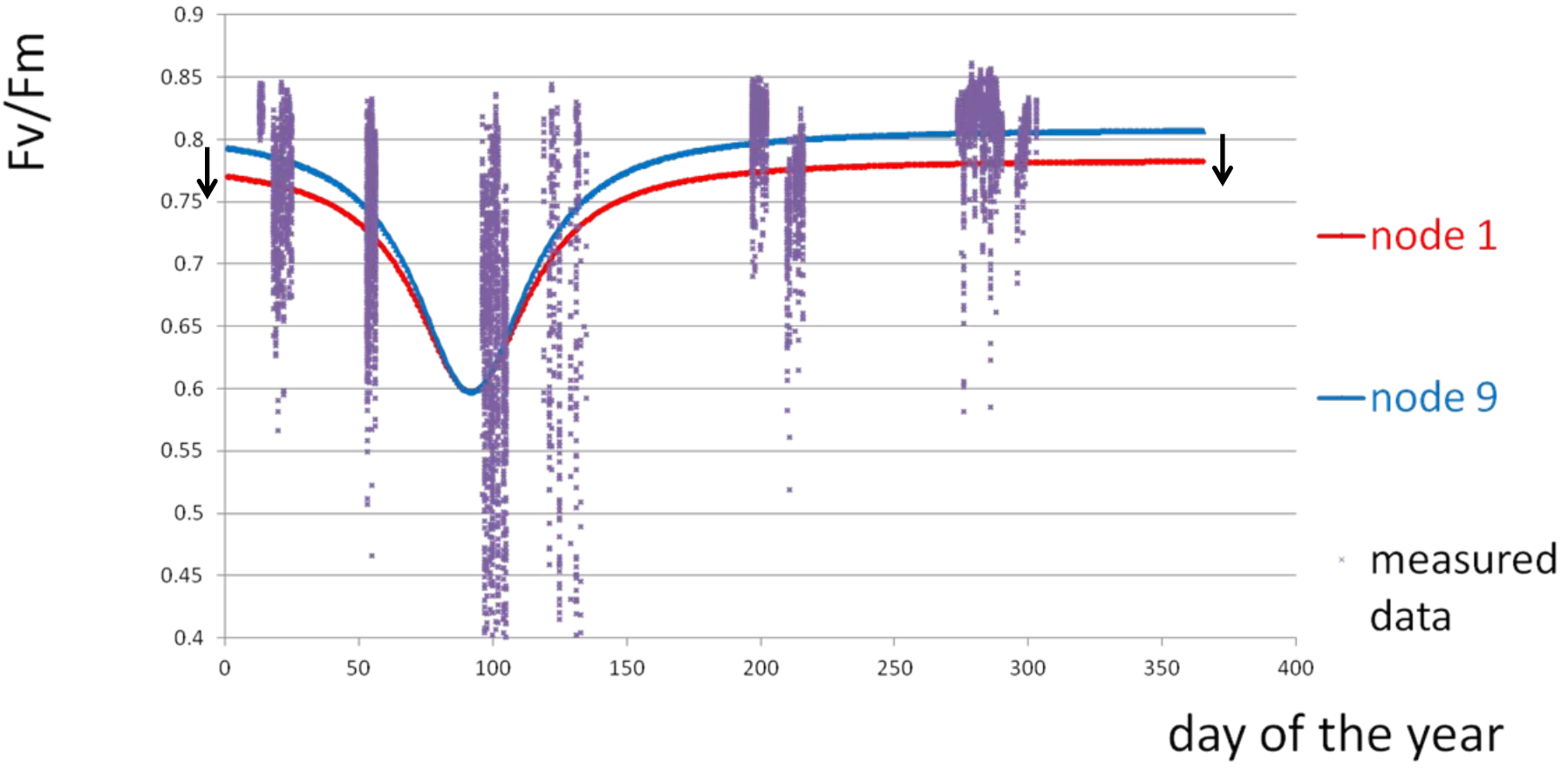
2. Diurnal variation

Small but significant diurnal variation



3. Spatial variation

Performance top leaves (sun-exposed) < bottom leaves (shaded)



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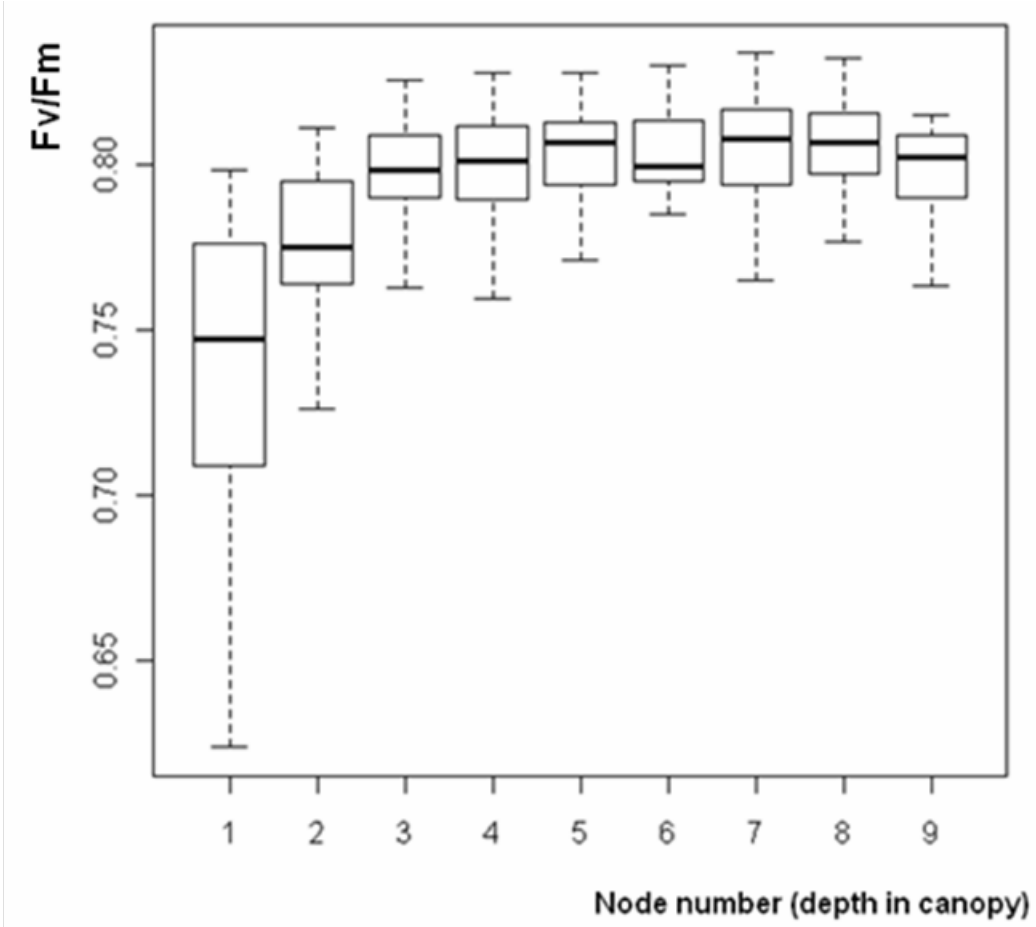
Performance top leaves < bottom leaves

(sun-exposed) (shaded)



Excitation pressure hypothese

- Light energy levels exceed potential of PS
- At low T => even under low light intensity
- Spatial variation?
  - High LAI (=8) => dense canopy limits light
  - In natural habitat: bamboo = understory
- Implications?
  - Better land use (yield of bamboo + overstory)
  - Inhibition PSII = ↓photosynthetic rate?

Future research

- Correlation PSII ~ photosynthetic rate

  => gas exchange measurements
- Test hypothesis in controlled condition (growth chamber)
- Model can be used when comparing different environmental condition

  ex. polluted ↔ non polluted soils