Precision viticulture:
The future of cameras and drones

Dr. Paul Dare

Spatial Scientific Pty. Ltd.

My background

- Spatial Scientific provides airborne remotely sensed imagery to the viticulture industry in SE Australia, and has done for over 5 years.
- We use the SpecTerra imaging sensor on a fixed wing manned aircraft.
- We’re currently developing new software and hardware systems to improve the efficiency of data acquisition, processing and delivery.
- We don’t fly drones.

spatial SCIENTIFIC

The new paradigm

1. Camera technology has improved rapidly: it's now possible to build your own multispectral camera. *But homebuilt MS cameras have not been validated scientifically.*

2. You no longer have to be a commercial pilot with a plane; you can just buy a drone and fly it. *But it's not as easy as it sounds.*

3. GIS software is free, and you don't have to be an expert to us it. *Or do you?*

→ The future will be interesting!

spatial SCIENTIFIC

Overview

- Sensors:
  - Narrow band / wide band
- Platforms:
  - Ground-based / airborne (manned / unmanned) / satellite
- Processing and delivery:
  - GIS software
  - Online / offline delivery

Overview

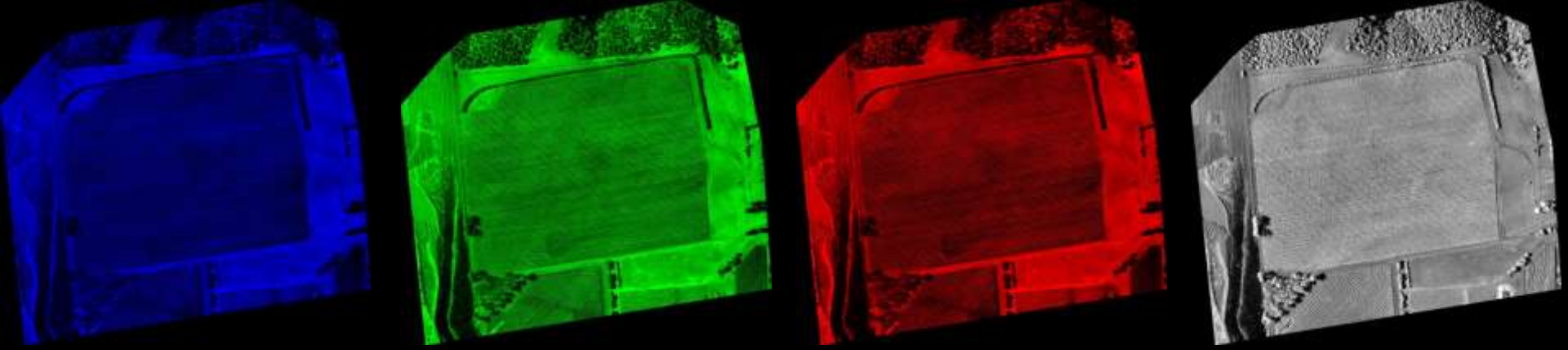
- Sensors:
  - Narrow band / wide band
- Platforms:
  - Ground-based / airborne (manned / unmanned) / satellite
- Processing and delivery:
  - GIS software
  - Online / offline delivery

spatial SCIENTIFIC

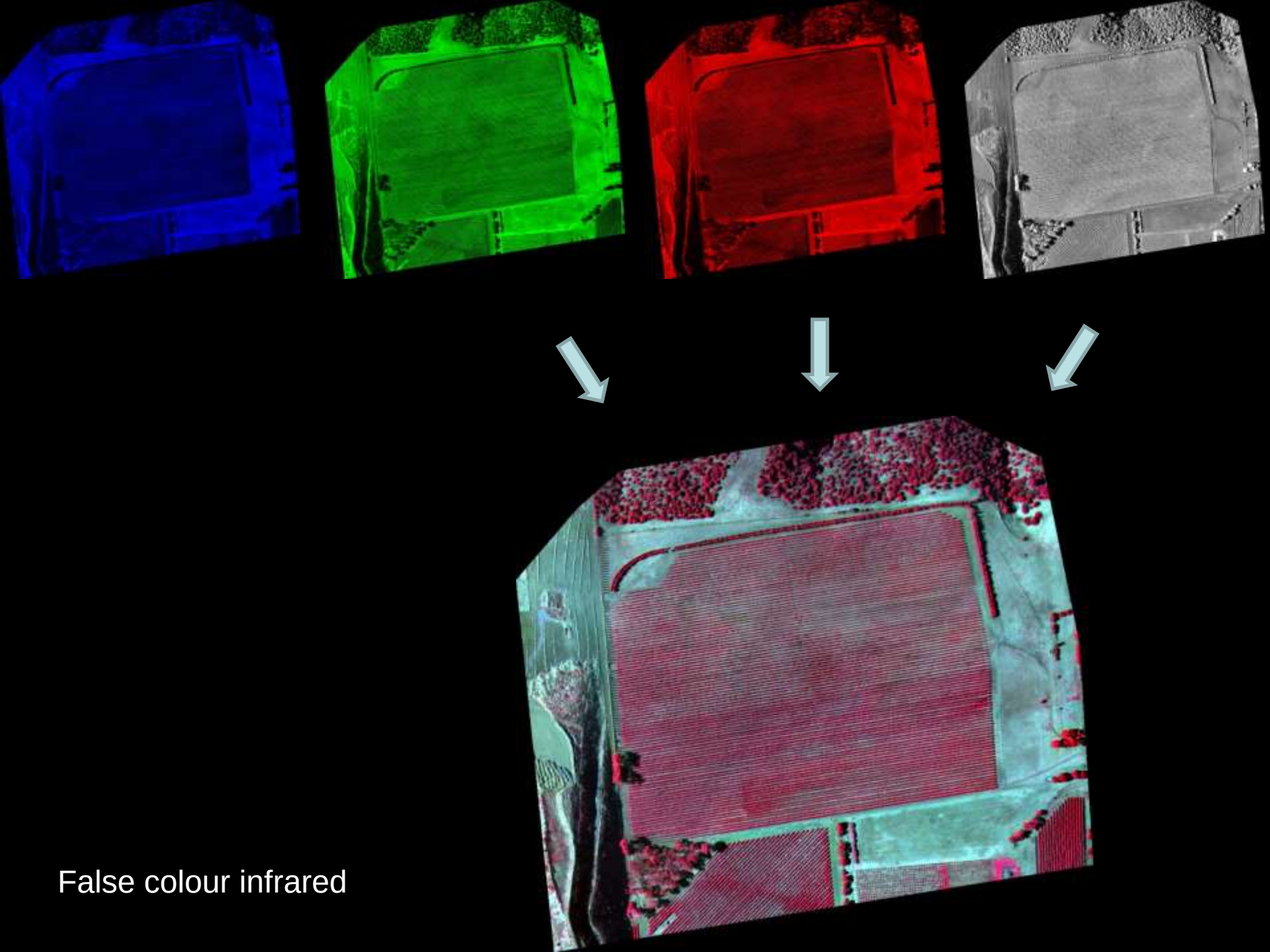
Sensors

- Sensors generally record data in four bands:
  - blue; green; red; near infrared
- Three bands are used to create natural colour and false colour infrared images
- Two bands are used to create “vegetation vigour maps”
- Spectral bands can be either broad or narrow:
  - Narrow band sensors are traditionally used in PV
  - Wide band sensors are used in environmental mapping

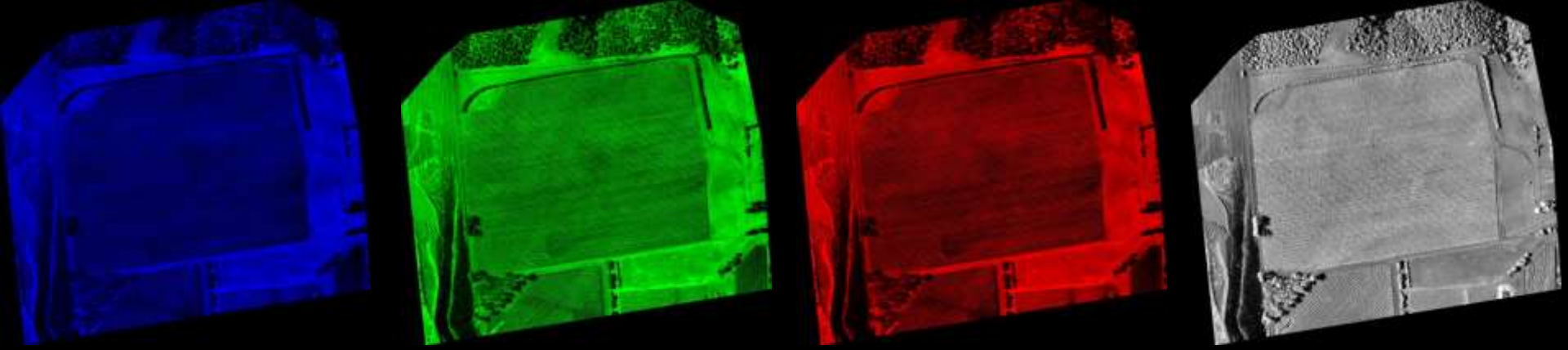
spatial SCIENTIFIC

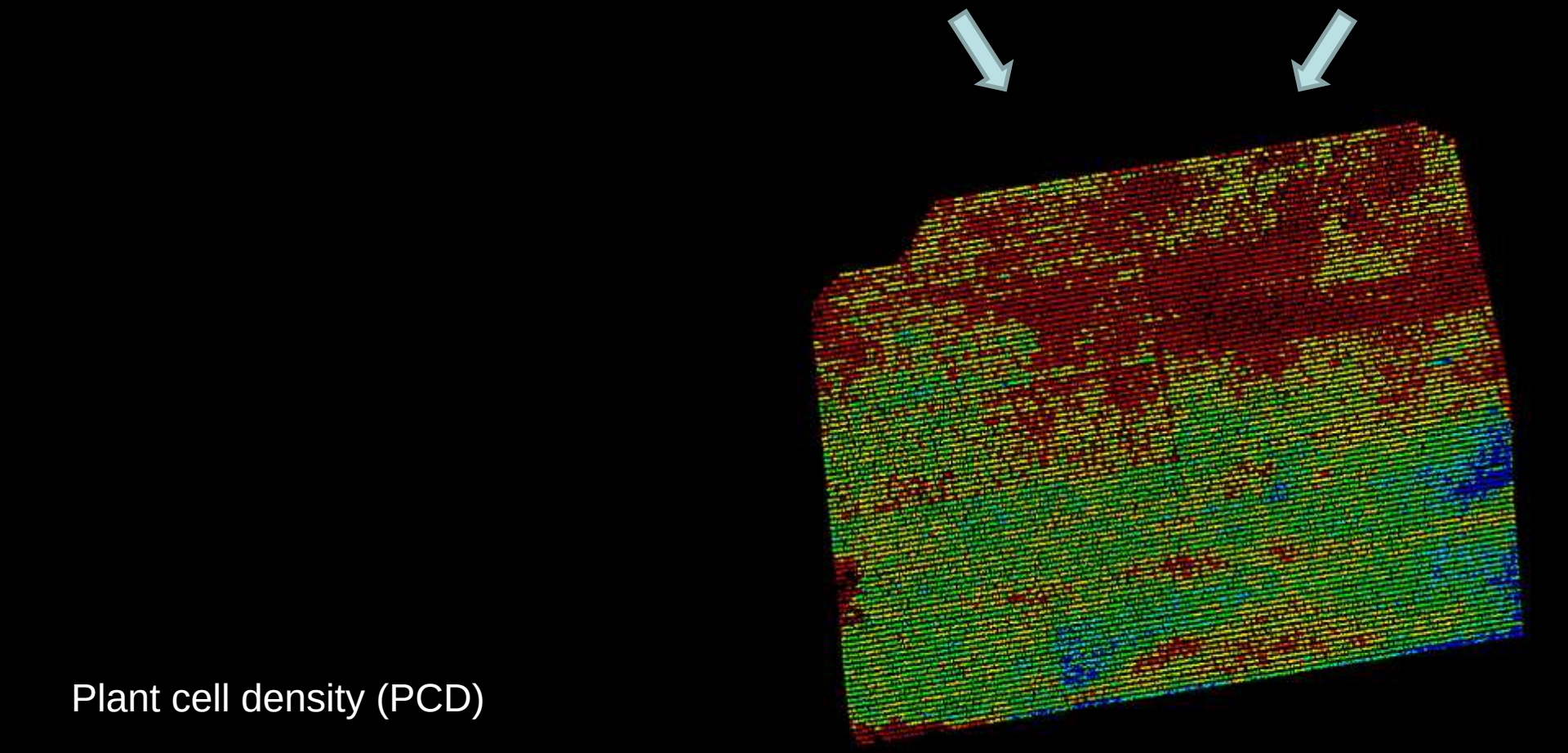


Natural colour image



False colour infrared





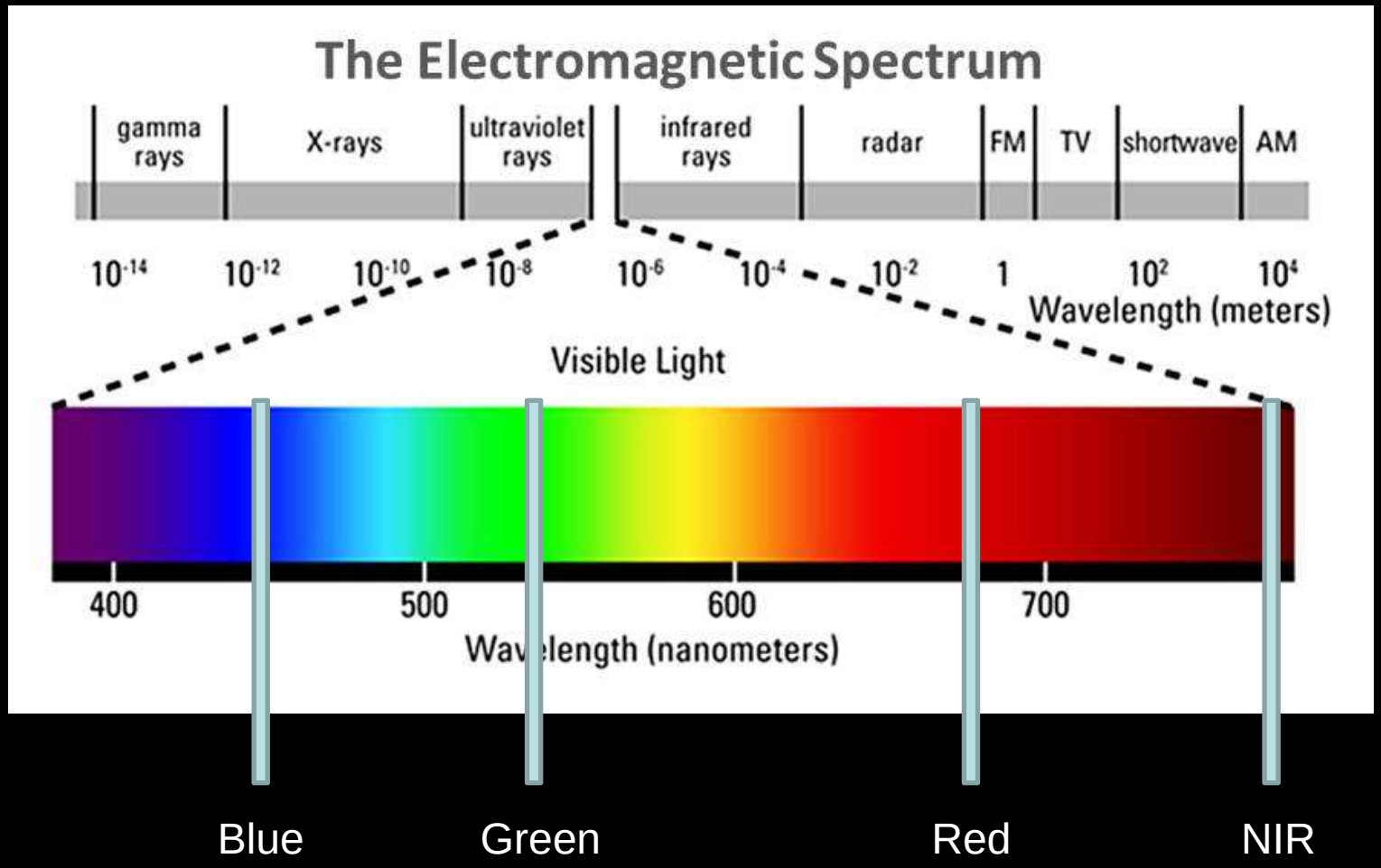
Plant cell density (PCD)

Sensors

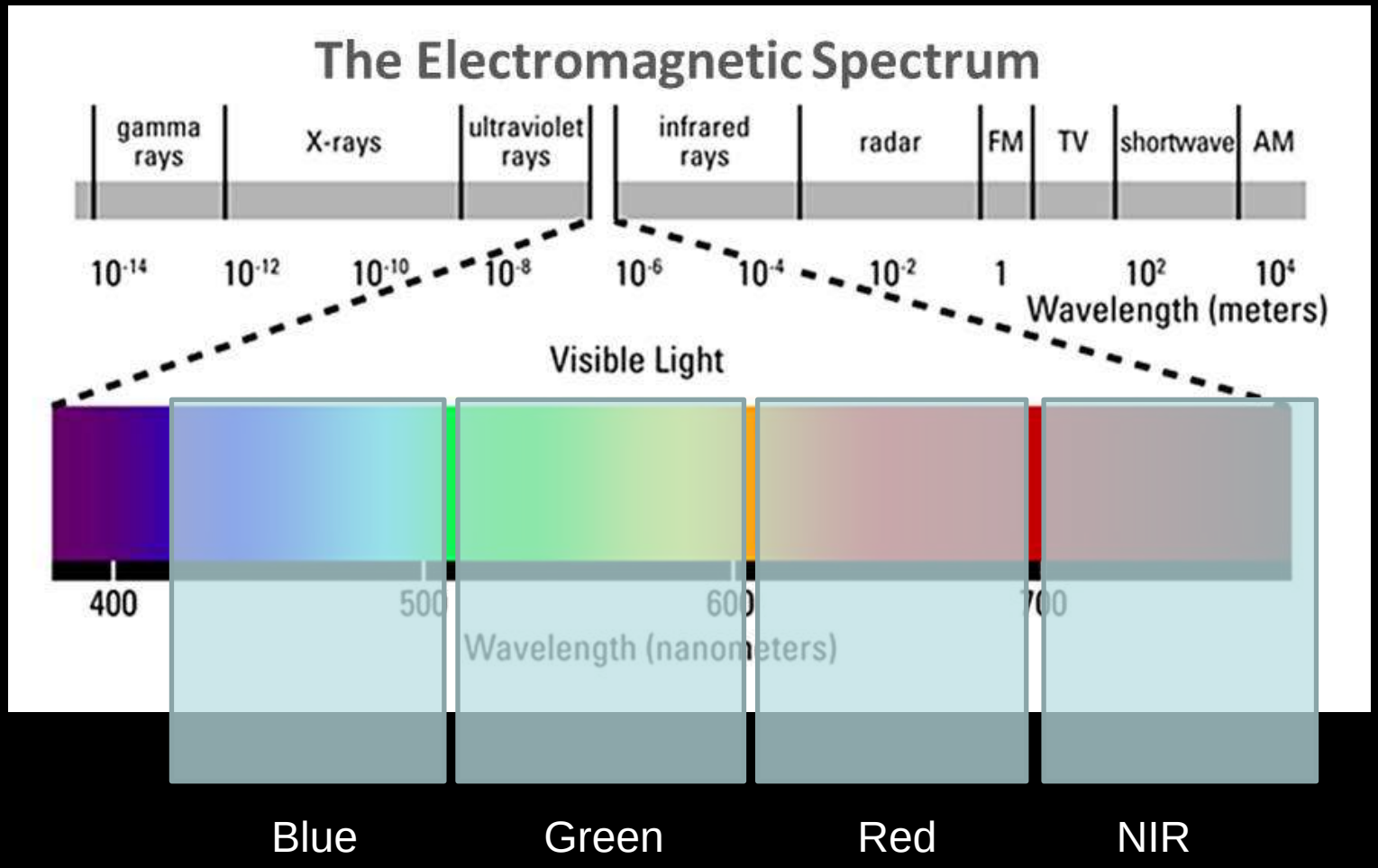
- Sensors generally record data in four bands:
  - blue; green; red; near infrared
- Three bands are used to create natural colour and false colour infrared images
- Two bands are used to create "vegetation vigour maps"
- Spectral bands can be either broad or narrow:
  - Narrow band sensors are traditionally used in PV
  - Wide band sensors are used in environmental mapping

spatial SCIENTIFIC

Narrow band sensors



Wide band sensors



Narrow band sensors

Typical machine vision sensor

- Record in one band only (multiple cameras required for multispectral sensor)
- Require an appropriate filter
- Require custom software
- Small sensor (<10 megapixels)
- Physically small body
- Expensive ($2000 to $5000)

spatial SCIENTIFIC

Narrow band sensors

Array of narrow band sensors

- Spectral bands of a narrow band sensor array can be chosen to suit the application (viticulture, broad-acre ag etc.)
- Choice of bands is driven by scientific research

spatial SCIENTIFIC

Wide band sensors

Typical wide band camera

- Records in three broad, overlapping spectral bands (two cameras required for four band data)
- Small or large sensors (2Mp to 80Mp)
- Small or medium sized body
- Broad price range ($500 to $50,000)

spatial SCIENTIFIC

Wide band sensors

Typical wide band camera

- Modified off-the-shelf camera, so therefore it is difficult to choose spectral bands
- The spectral bands are driven by available technology, not scientific research

spatial SCIENTIFIC

Narrow band vs. wide band

- Traditionally, narrow band sensors have been used for remote sensing (SpecTerra, Tetracam, Redlake / DuncanTech).
  - Scientifically validated data
  - Expensive to acquire and process data

- Today, there is movement away from narrow band sensors. Wide band sensors are commonly being used due to their accessibility.
  - Little scientific validation of the data
  - Cheap to acquire and process data
  - Can easily be used on UAVs

spatial SCIENTIFIC

Airborne platforms

- Airborne platforms can be either manned or unmanned (drones)

- Problems with drones include:
  - Payload
  - Flight duration
  - Weather (wind!)
  - Legal issues

- Advantage of drones:
  - Anyone can buy and fly one, and they're great fun!

spatial SCIENTIFIC

Airborne platforms

spatial SCIENTIFIC

Data processing

- GIS software is used to process aerial imagery
- ESRI ARCGIS has dominated the industry for decades, but it is expensive and difficult to use
- Nowadays, lots of cheap and even free GIS software is available (MapWindow, Global Mapper, Quantum GIS etc.)
- The cheaper software is much easier to use

Past vs. Future

The past:

- Data was acquired from scientific cameras on manned aircraft
- The user had no control over the acquisition
- Processing was a skilled task
- The supplier set the rules

The future:

- Data can be acquired from cheap cameras on drones
- The user can control the process of acquisition and processing
- GIS software is widely available
- The user will be able to set the rules

spatial SCIENTIFIC

Remote sensing today

Cheap drone

+

Modified off-the-shelf camera

+

Cheap and simple GIS software

=

Anyone can acquire and process multispectral data

spatial SCIENTIFIC

What does this mean?

The Positive view

- Cheap cameras and cheap platforms means lower costs
- Growers have the freedom to choose when they fly data
- Growers will develop products that really suit their needs
- The whole industry will benefit

The Negative view

- Cheap cameras and platforms will deliver poor quality data
- PV will cease to be driven by science
- Growers will loose confidence in remote sensing
- The whole industry will suffer

spatial SCIENTIFIC


spatial
SCIENTIFIC