



# Theory (academic) and practice (industry), dissimilar research fields and subject specific disciplines – an interdisciplinary approach

JP Beukes  
19 August 2016

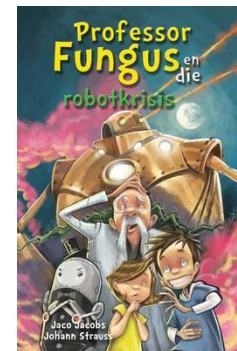
It all starts here<sup>®</sup>



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POTCHEFSTROOM CAMPUS

# Before I start

- Tonight is not about me
- Opportunity to acknowledge the contributions of so many people in my life that have mentored, guided, influenced, helped and supported me. Your contribution (and those of so many that could not be here tonight) is acknowledged
- I am humbled and thankful
- Not big on philosophy, but practical – stay true to nature
- Enjoy and laugh with me at myself
- Wiehan ...





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# Outline

- What do I do (currently)?
- The "conflicting" nature of my present/past work and how we've achieved (at least some) success
  - Theory (academia) vs. practice (industry)
  - Dissimilar research fields
  - Different subject specific disciplines
- Conclusions



# What do I do (currently)?

- **Lecture in Chemistry**
- **Research**
  - **Ferrocromium related research**
  - **Atmospheric chemistry related research**
- **Blessed, work my passion (developing young people and research)**

# What do I do (currently)?

## 1) Chromium Technology Group (Ferrochromium related)

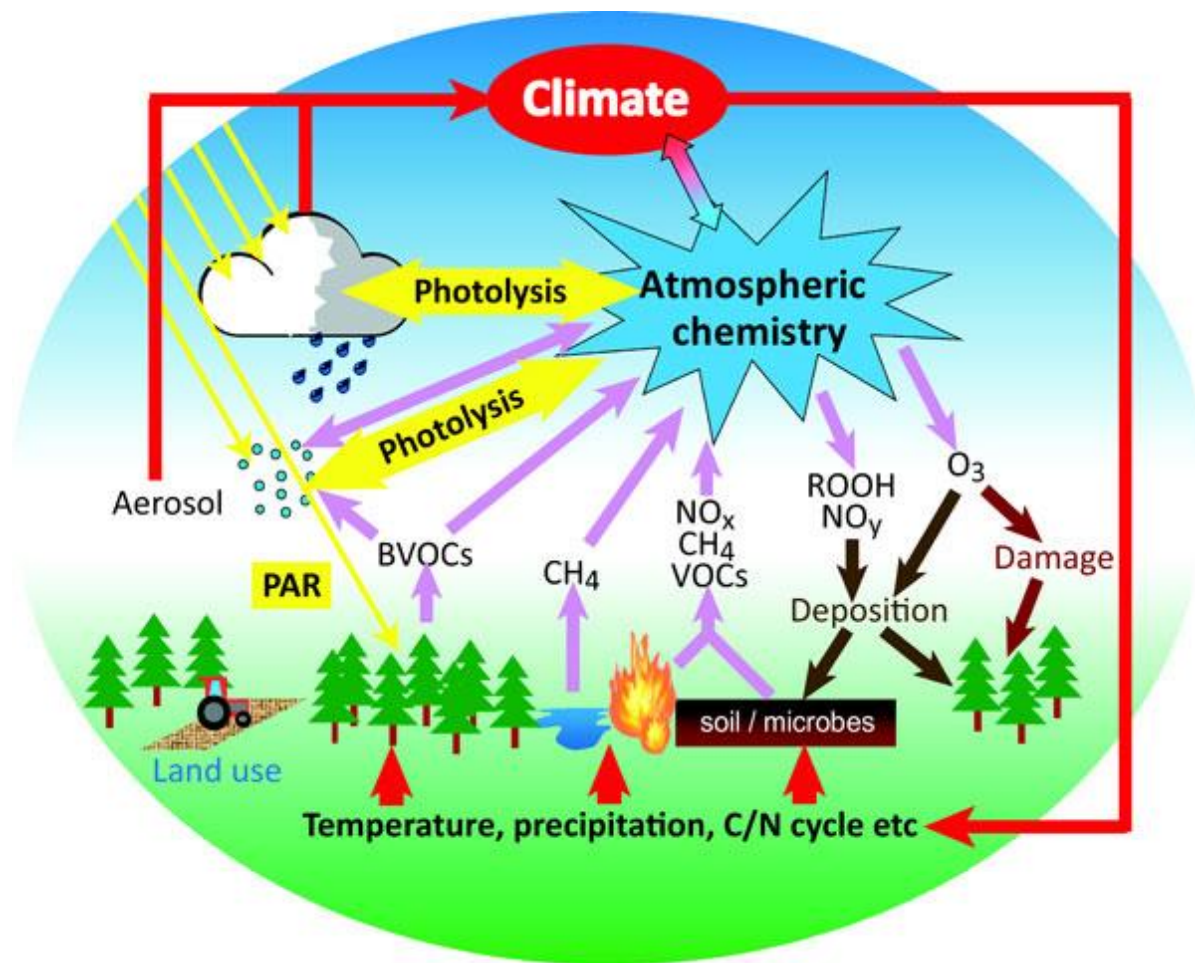
- SA holds approximately  $\frac{3}{4}$  of world's chromium ore reserves and is 2<sup>nd</sup> largest ferrochromium (FeCr) producer
- Ferrochromium (FeCr) is a crude alloy between Fe and Cr, mainly used in stainless steel production (>95% exported)
- Improve processes to reduce electricity consumption, improve Cr recoveries, recovery of valuables in waste, waste management, etc.



# What do I do (currently)?

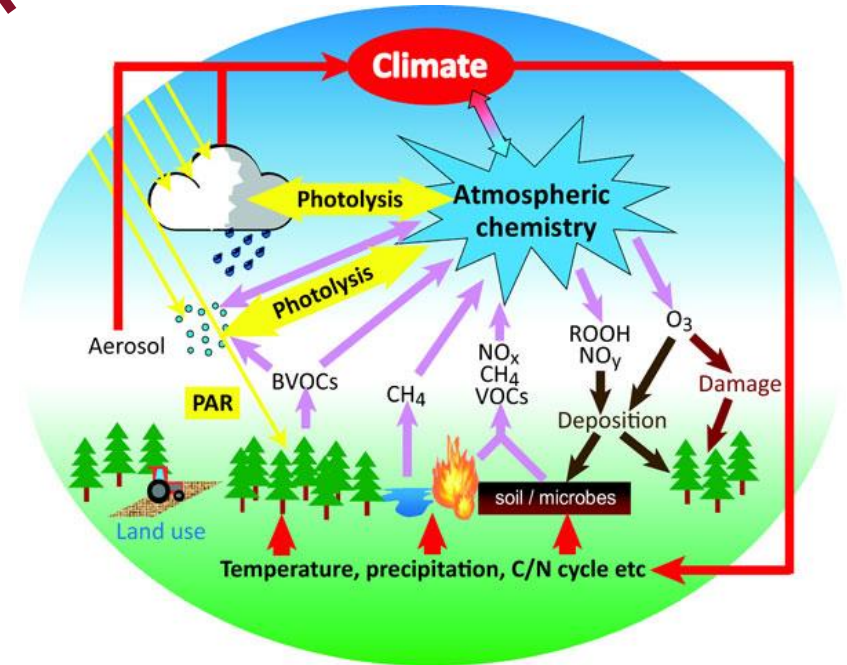
## 2) Atmospheric Chemistry Research Group (Atmospheric Chemistry)

- Explaining atmospheric observation and their effects/impacts on air quality (human/environmental health), precipitation (rain), climate, etc.





Apparent conflicting nature of research!



# Outline

- What do I do (currently)?
- The "conflicting" nature of my past/present and how we've achieved (at least some) success
  - Theory (academia) vs. practice (industry)
  - Dissimilar research fields
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# 1. Theory (academia) vs. practice (industry)

- Perception from an academic perspective, e.g.
  - Industrial experience does not improve your academic profile, i.e. it does not count for promotions, NRF rating (proven track record, focussed and international recognition) that is NB for funding, no (little) publications (publish or perish), *h-index* (measure productivity and citation impact of author)
- Perception from an industrial perspective, e.g.
  - Why do advance degree (MSc and/or PhD) (research) if it does not really improve your job opportunities and/or pay? E.g. I was never called “Dr” in all my years working at Glencore (Xstrata) and never promoted based on my academic pedigree (4 degrees!). Post graduate degree not required to achieve success in industry (especially production environment)

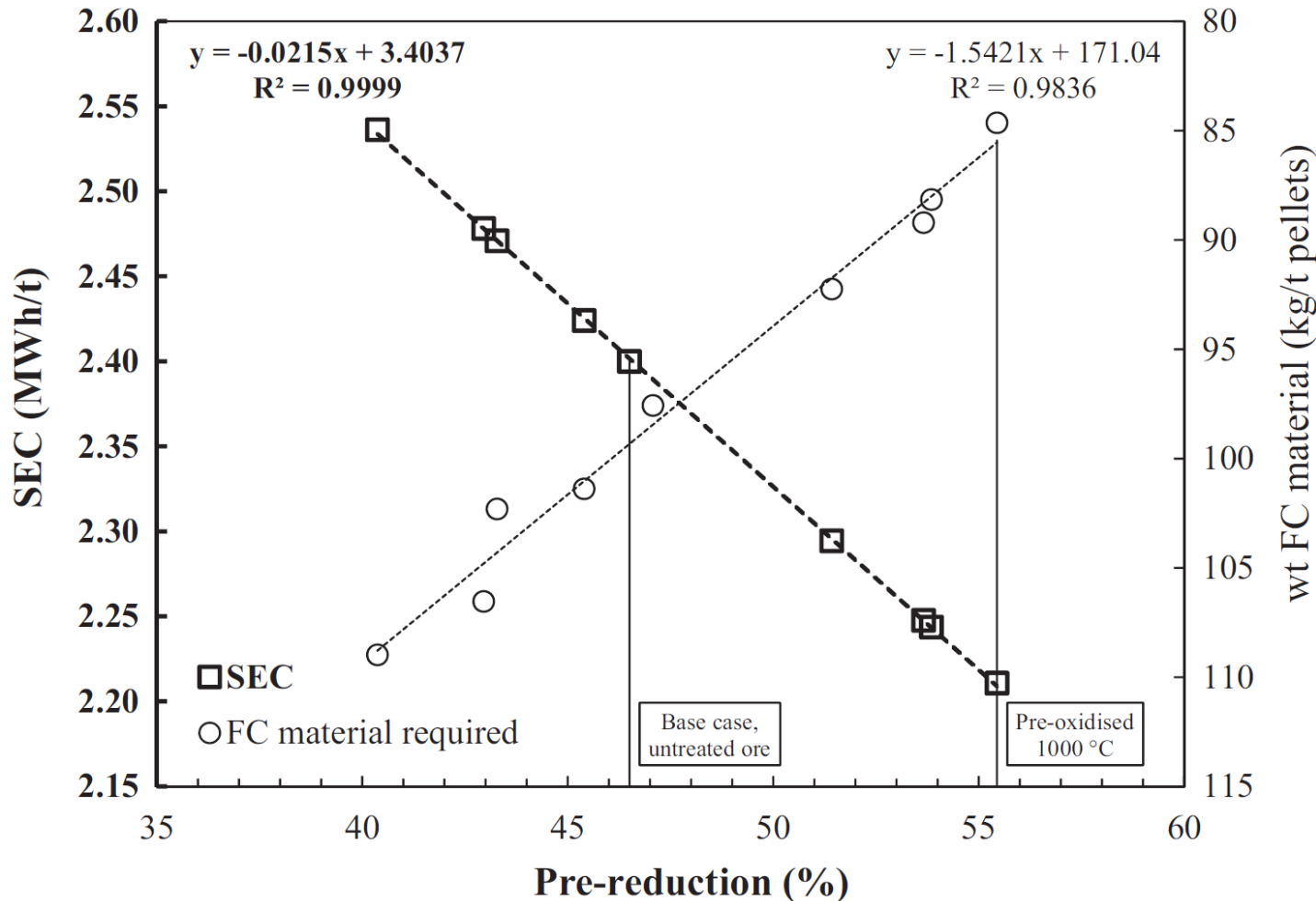
# 1. Theory (academia) vs. practice (industry)

- Counter arguments, e.g.:
  - Industrial experience gives insight into the practical problems that have to be addressed via research. This insight cannot be replaced by pure theoretical training by lecturers that have never spend any time in the relevant industry (Example 1.1)
  - A advance degree, even if you work in production industry such as FeCr industry (baked beans industry), generate the personal drive to understand and continually improve processes (Example 1.2)



# 1. Theory (academia) vs. practice (industry)

## 1.1 Reduced electricity (and carbon) consumption (Kleynhans et al., Minerals Engineering, 2016)

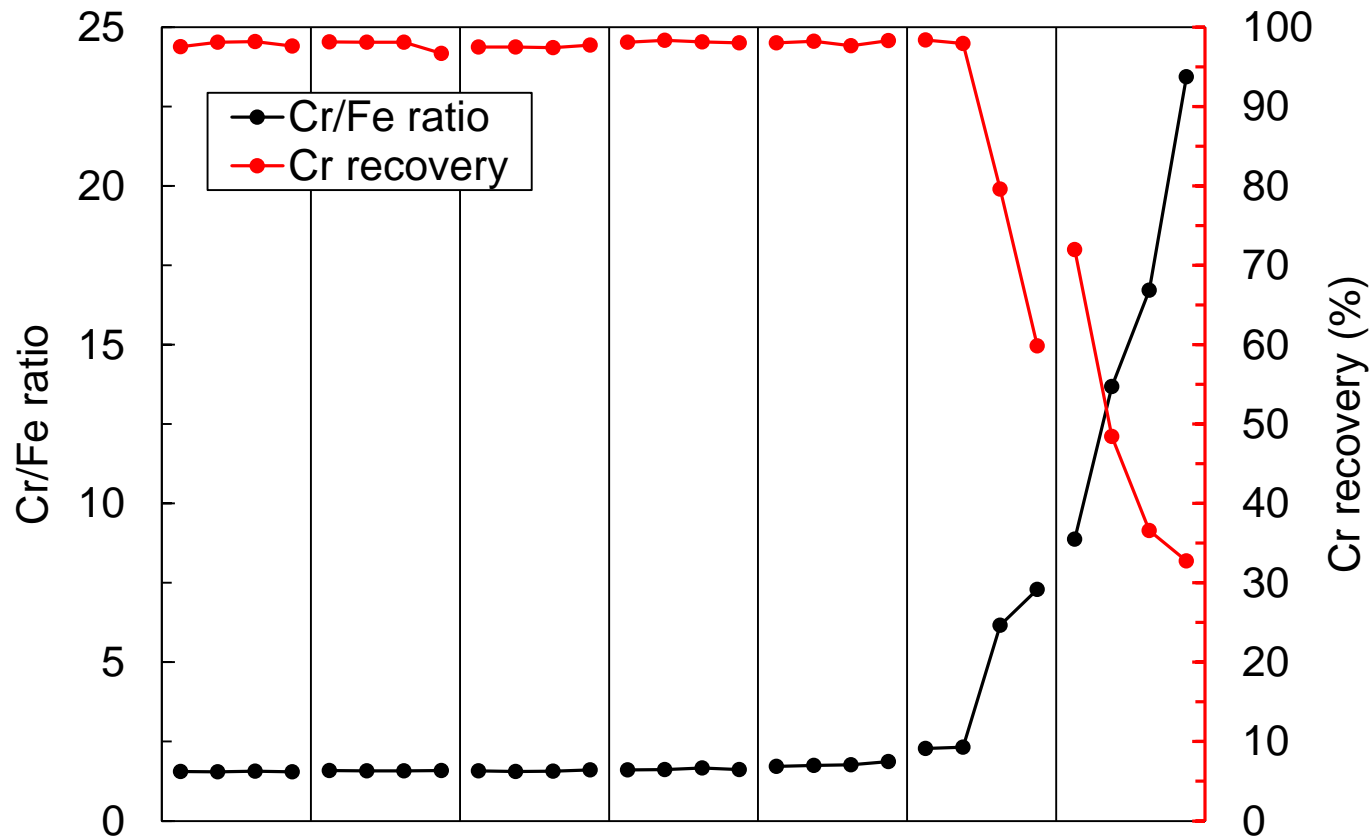


**FeCr  
smelter  
364 000  
t/a**

**~R78.5  
million/  
saving**

# 1. Theory (academia) vs. practice (industry)

## 1.1 Cr/Fe ratio of chromium ore (chromite) (Kleynhans et al., Unpublished, 2016)



**FeCr  
producers  
only paid  
for Cr**

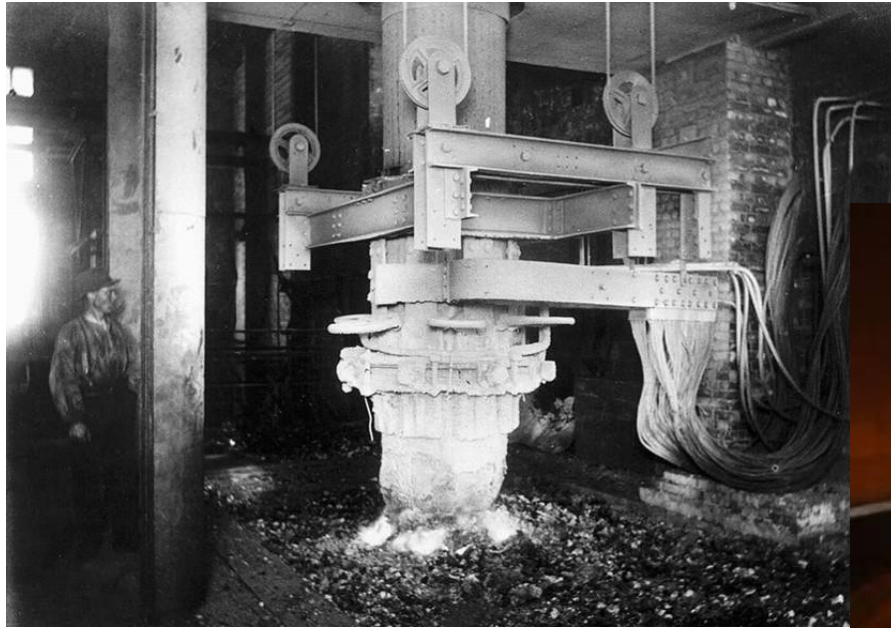
**Potentially  
worth  
R100s of  
millions**

# 1. Theory (academia) vs. practice (industry)

- Counter arguments, e.g.:
  - Industrial experience gives insight into the practical problems that have to be addressed via research, which cannot be replaced by pure theoretical training by lecturers that have never spend any time in the relevant industry (Example 1.1)
  - A advance degree, even if you work in production industry such as FeCr industry (“baked beans industry”), generate the personal drive to understand and continually improve processes (Example 1.2). Currently the production industry does not have such a drive (profit not used to improvements, high work load, fire fighting, etc.)

# 1. Theory (academia) vs. practice (industry)

1.2 Søderberg electrode research (Shoko et al., Int. J. Miner. Process., 2015 and Miner. Eng., 2013; Beukes et al., Miner. Eng., 2015)



**1919 vs. 2016**



**Last 10 years only 4 papers in peer reviewed journals, with 3 from our group! Does industry really want to improve electrode management?**

# 1. Theory (academia) vs. practice (industry)

My view:

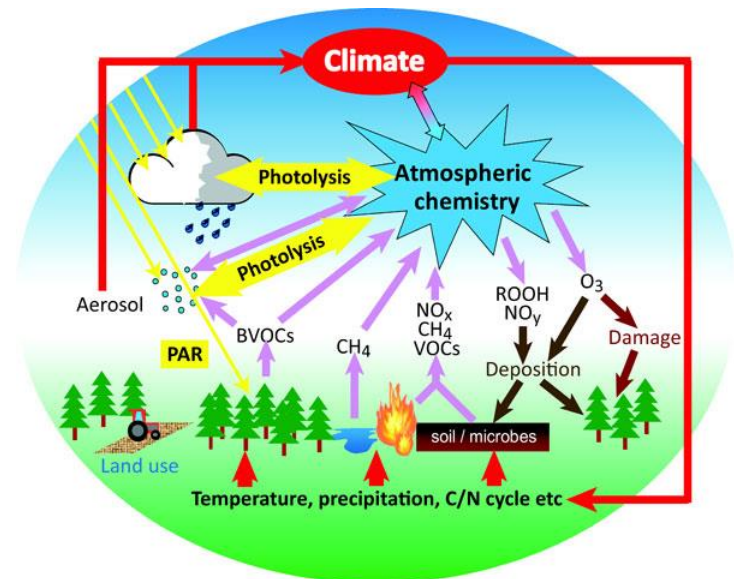
- Industrial experience underestimated by academia
- I consider industrial experience (industrial partners) as an additional “discipline” in the interdisciplinary approach to solving research questions
- Industry (especially the commodity based production industry in SA) underestimate the contribution research at tertiary level can make. Impossible and counter productive to duplicate resources already at universities. Industry’s fear of IP loss and too much time on fire fighting

## 2. Dissimilar research fields

- Perceptions:
  - In academia, research has to be **absolutely focussed**.  
E.g. NRF rating (proven track record, focussed and international recognition)
  - It is impossible to manage and excel at research that is so different



VS.





**Apparent conflicting nature of research!**

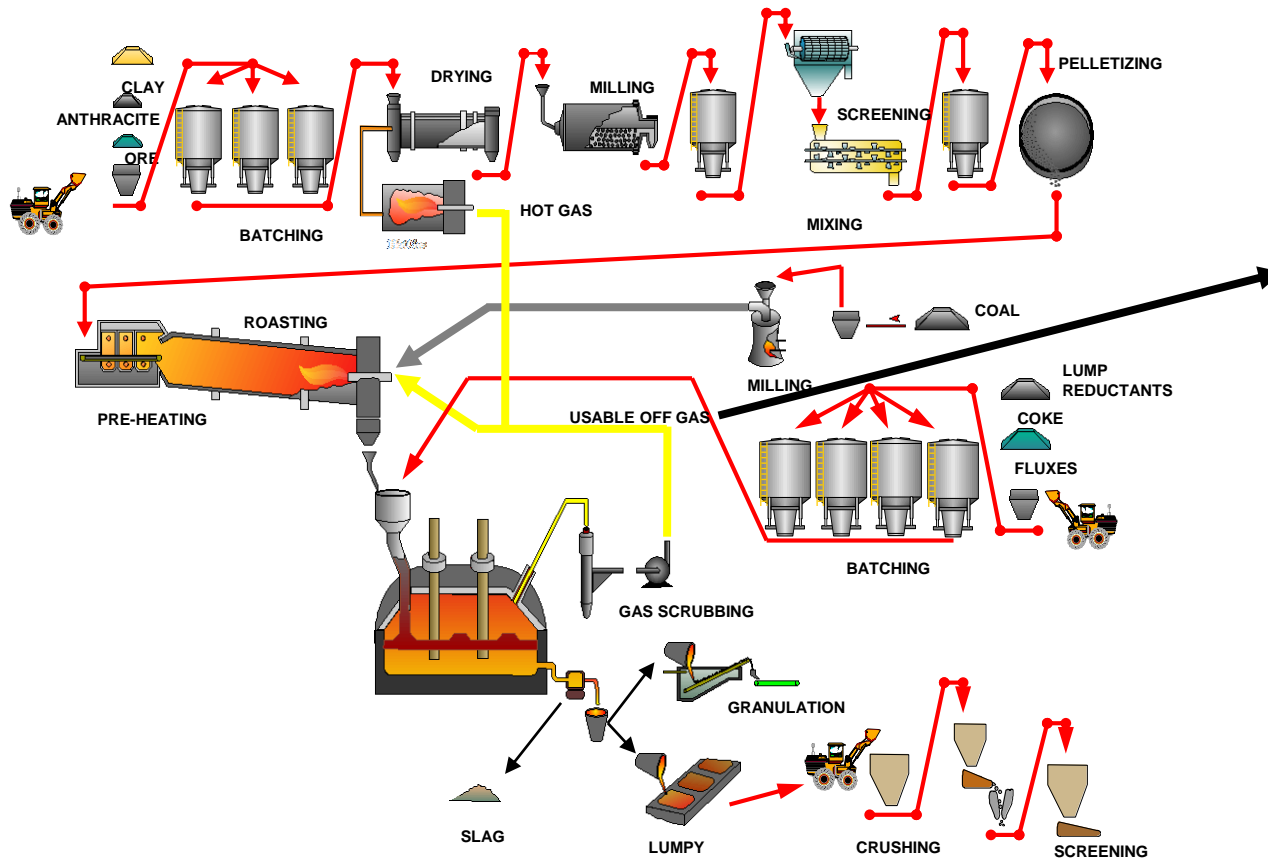


## 2. Dissimilar research fields

- Perceptions:
  - In academia, research has to be absolutely focussed. E.g. NRF rating (proven track record, focussed and international recognition)
  - It is impossible to manage and excel at research that is so different
- Counter arguments, e.g.:
  - A different/alternative opinion/approach is advantages. This could be from a different person/group, or from your own terms of reference (e.g. two research focusses in this case)
  - Be an environmental scientist that helps with solutions, rather than just criticizing
  - Two Examples (2.1 and 2.2)

## 2. Dissimilar research fields

### 2.1 Cr(VI) generation during flaring (Du Preez et al., Metall. Mater. Trans. B, 2015)



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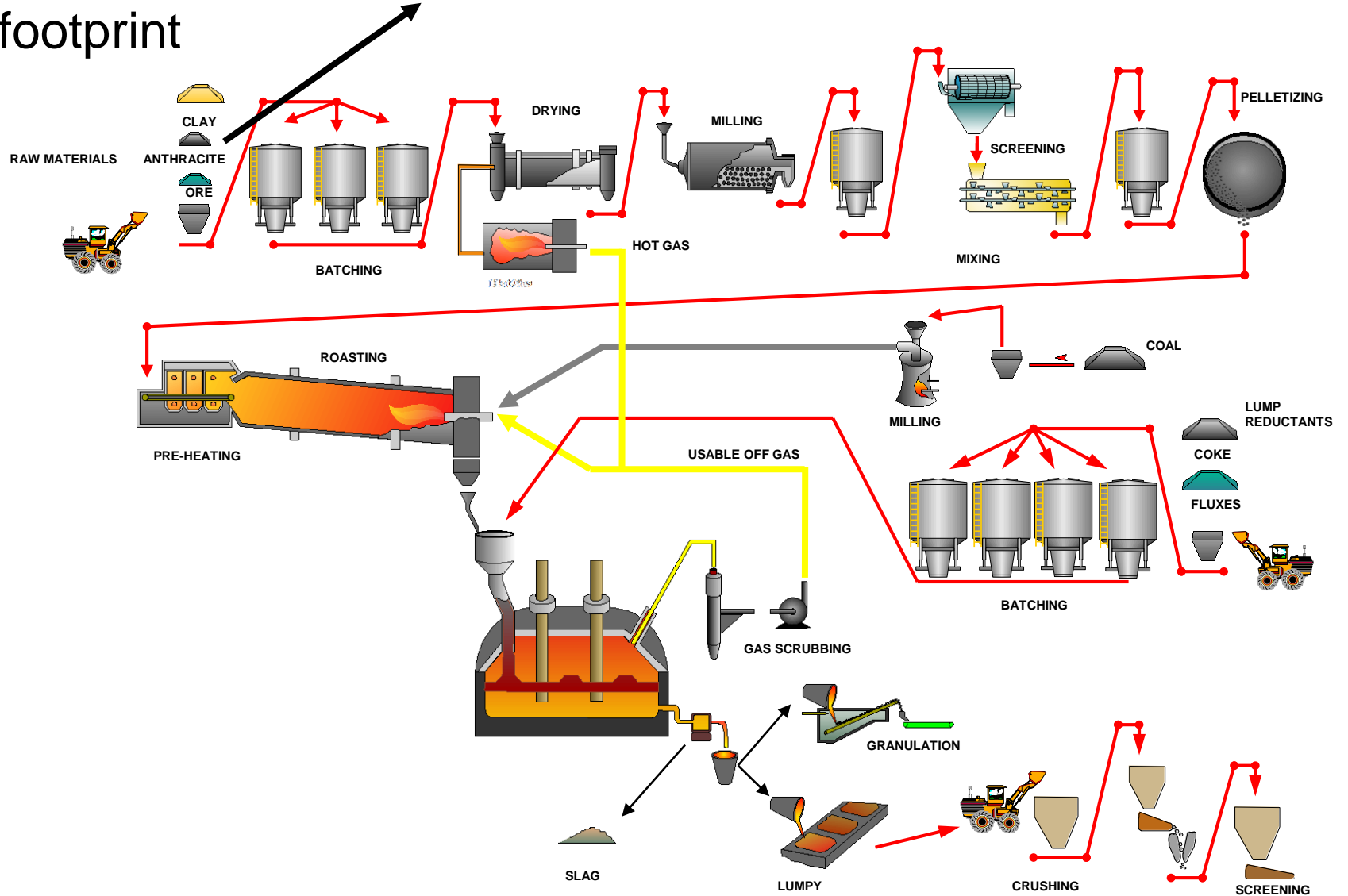


Cr(VI) carcinogenic  
How much Cr(VI)?



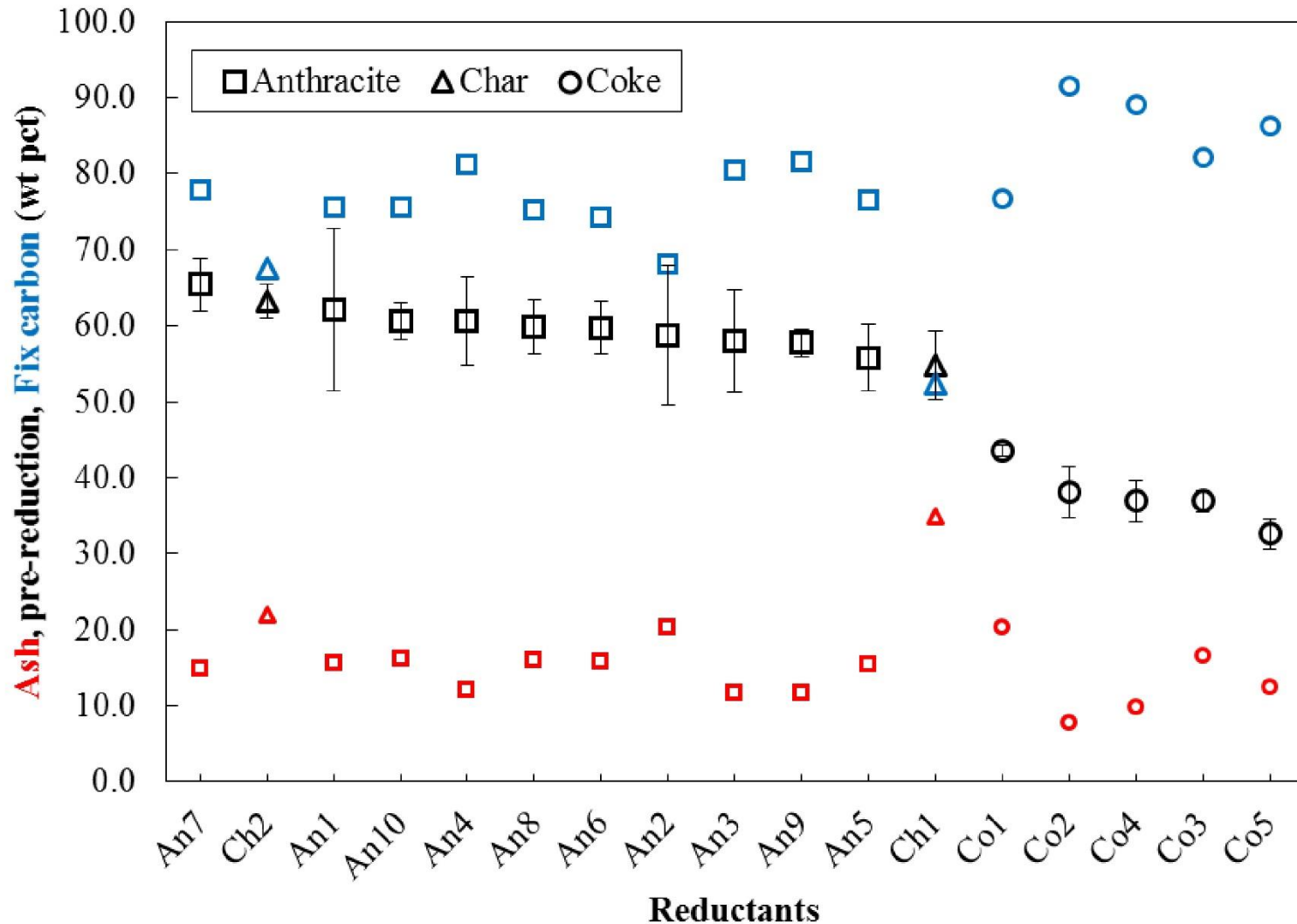
# 2. Dissimilar research fields

## 2.2 Reduced carbon consumption & reduced carbon footprint



## 2. Dissimilar research fields

### 2.2 Reduced carbon consumption & reduced carbon footprint (Kleynhans et al., Submitted to Metall. Mater. Trans. B, 2016)



## 2. Dissimilar research fields

2.2 Reduced carbon consumption & reduced carbon footprint (Kleynhans et al., Submitted to Metall. Mater. Trans. B, 2016)

	Variable	$\beta$	$r_s \cong r$	$(r_s)^2 \cong R_{yxz}^2$	Unique	Common	RIW pct
Pre-reduction	H	0.833	0.743	0.552	0.109	0.444	24.0
	N	0.256	0.688	0.473	0.007	0.466	15.1
	MgO	1.208	0.124	0.015	0.339	-0.324	15.9
	MnO	0.528	-0.602	0.362	0.029	0.334	11.6
	Na <sub>2</sub> O	-0.135	0.300	0.090	0.005	0.086	3.7
	TiO <sub>2</sub>	0.793	-0.025	0.001	0.162	-0.162	4.0
	V <sub>2</sub> O <sub>5</sub>	-1.424	-0.293	0.086	0.174	-0.088	12.4
	Ba	-0.488	-0.231	0.053	0.093	-0.040	7.1
	SO <sub>3</sub>	-0.292	0.245	0.060	0.041	0.019	2.5
	Reactivity	-0.067	0.381	0.145	0.003	0.142	3.8

## 2. Dissimilar research fields

My view:

- Hard core process and environmental research can be done concurrently, if expertise of both disciplines exist.
- Examples
  - E.g. Cr(VI) generation during industrial process (flaring) that causes atmospheric pollution or lack thereof
  - E.g. process improvements to reduce carbon consumption during ferrochromium will be economically (process), as well as environmentally (reduce carbon footprint) beneficial
- Study such as this is only possible if operational (industrial) expertise, as well as process and environmental research are pooled

### 3. Subject specific disciplines

- Perceptions:
  - You have to “stay” (be an expert) only in your own silo (e.g. Chemistry, Statistics, Botany, Engineering, etc.)

### 3. Subject specific disciplines

- Counter arguments, e.g.:
  - Interdisciplinary approach can lead to more research outputs (quantity) and of better quality
  - Achieved by working with other groups/individuals with different subject specific expertise (Example 3.1)
  - Or, by expanding your own horizons to include expertise beyond your own comfort zone (Example 3.2)

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## 3. Subject specific disciplines

3.1 60km radius vegetation survey (Botany, Siebert et al) to understand ambient BVOC concentrations (Jaars et al., Submitted to Atmos. Chem. Physics., 2016)



**Comprehensive  
measurements  
&  
Continuous  
&  
Long-term**

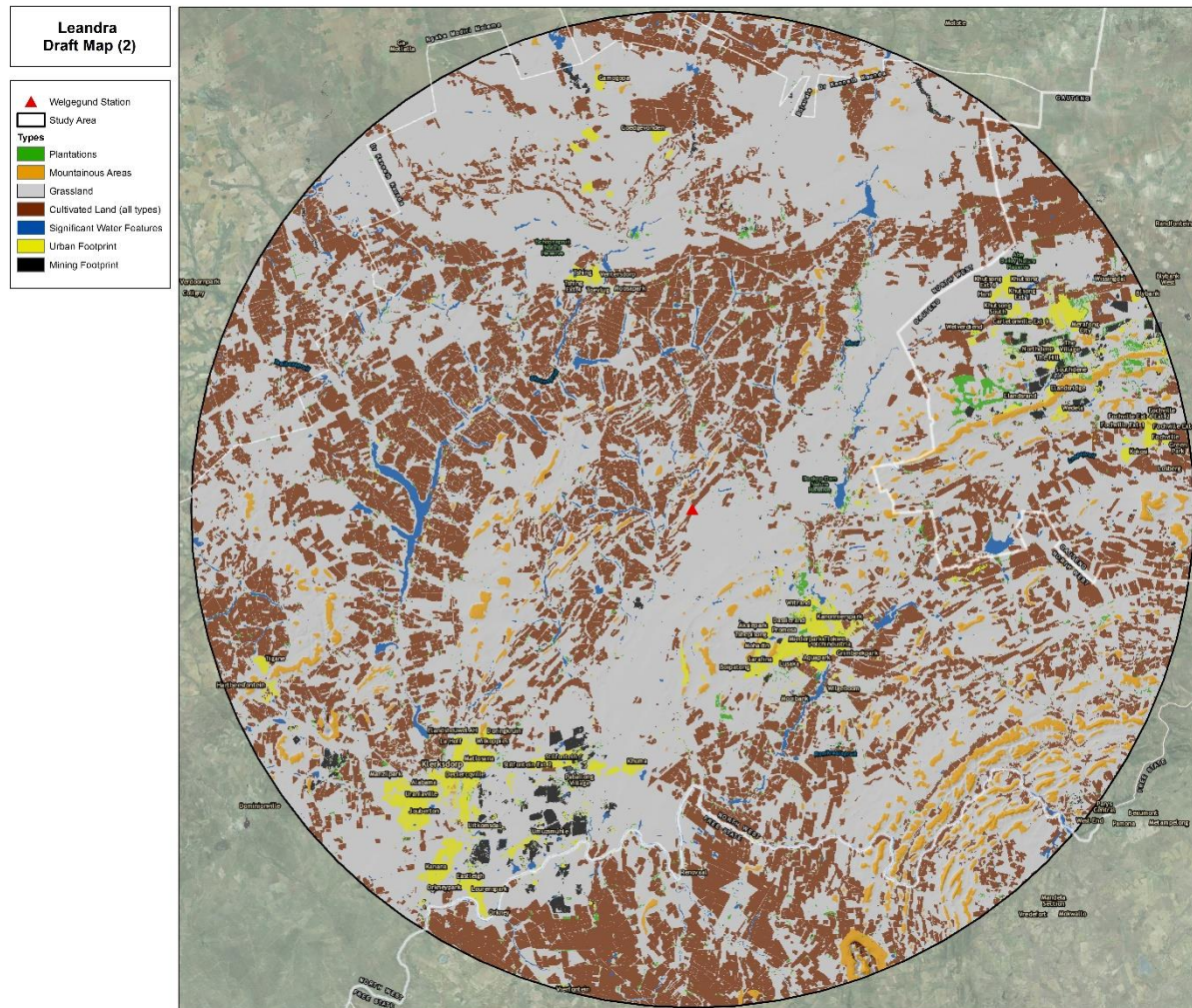
## 3. Subject specific disciplines

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- BVOCs important:
  - Tropospheric O<sub>3</sub> formation
  - Secondary aerosol formation

# 3. Subject specific disciplines

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to understand ambient BVOC concentrations (Jaars et al.,  
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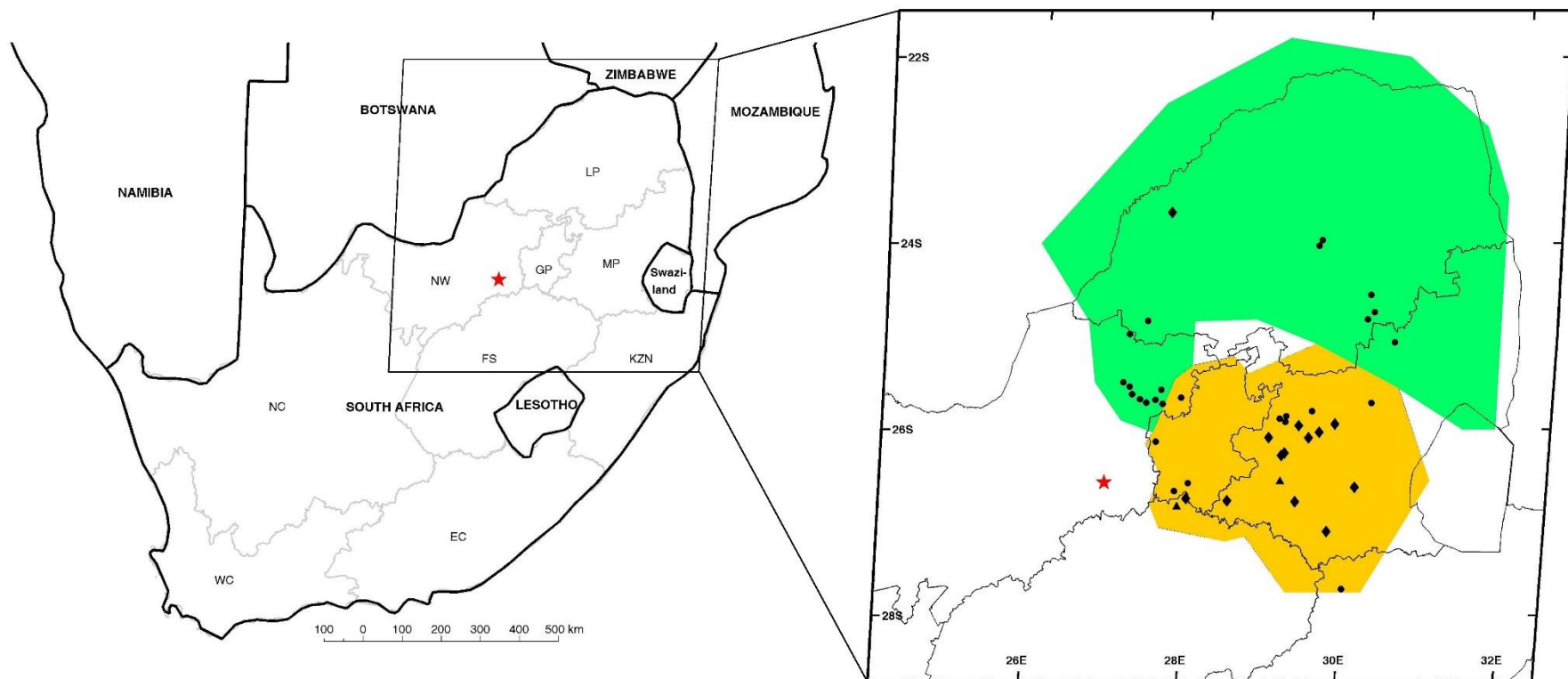


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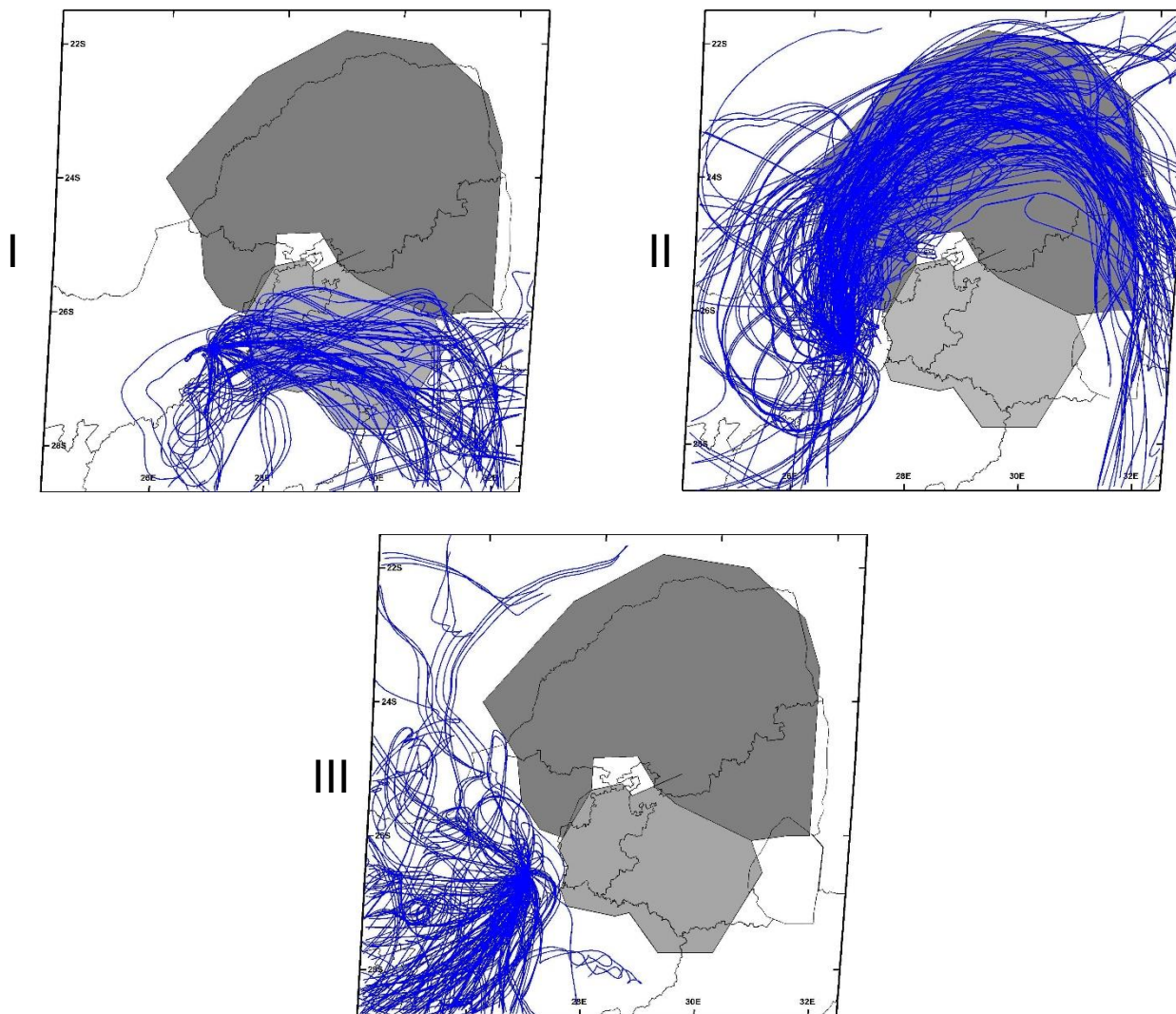
# 3. Subject specific disciplines

## 3.2 Meteorology to understand aromatic VOCs (Jaars et al., Atmos. Chem. Physics., 2014)



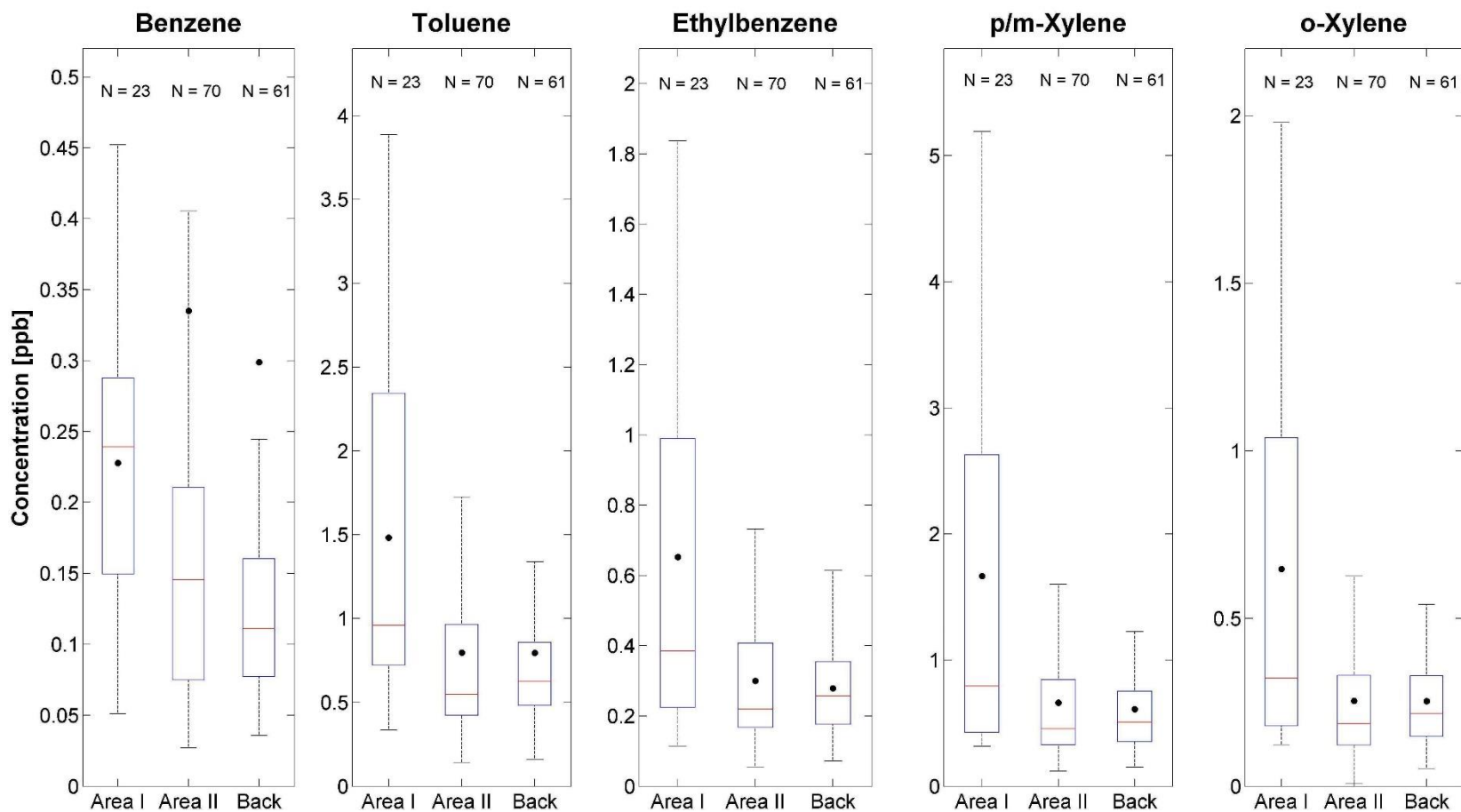
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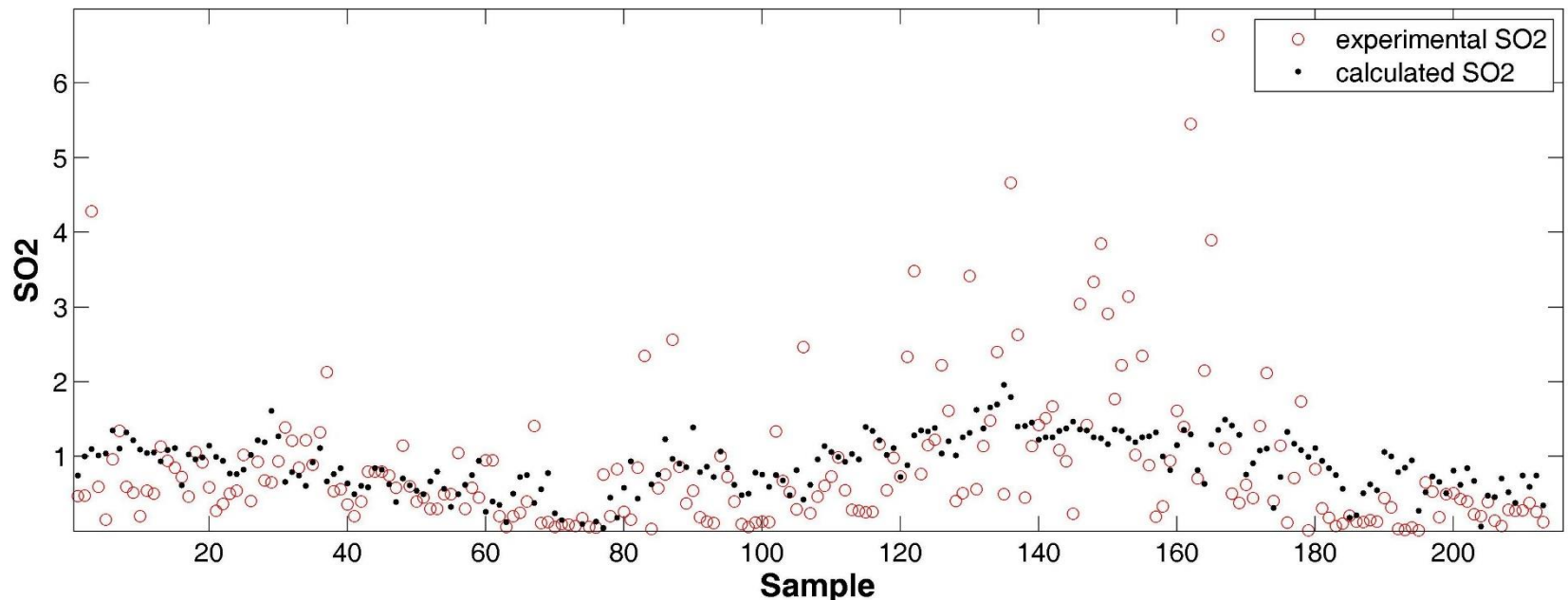
## 3.2 Meteorology to understand aromatic VOCs (Jaars et al., Atmos. Chem. Physics., 2014)



# 3. Subject specific disciplines

3.2 Datamining (Statistics, Mathematics & Programming) to understand atmospheric SO<sub>2</sub> at Cape Point (Swartz et al., Unpublished, 2016)

- Perform MLR for Cape Point monthly, 20 year dataset
- ? long-term trends in relation to global meteorological patterns, i.e. El Nino Southern Oscillation 3.4 region (ENSO 3.4), Southern Indian Ocean Dipole (SIOD), Southern Annular Mode (SAM), Total Solar Irradiation (TSI) and Quasi-Biennial Oscillation (QBO)



### 3. Subject specific disciplines

My view:

- You need to remain an expert on something (thus focused), with a subject specific expertise
- However, interdisciplinary research with other groups/individuals with different subject specific expertise have benefited us tremendously
- Also, we have also moved out of our own box (subject specific expertise), by expanding your own horizons to include expertise beyond own small area of expertise. We will never be perfect physicists, meteorologists, botanists, statisticians, mathematicians, programmers, etc., but we will surely try to be

# Conclusions

**Definition: Interdisciplinary research** involves the combining of two or more academic disciplines into one activity

- Interdisciplinary and/or multidisciplinary approach is advocated by many
- However, in academia “focus” required but NRF, university management structures and associated financial distribution of research income (e.g. preventing Sciences and Engineering to work together) still discourage/prevent true interdisciplinary research
- Although industrial experience is not highly regarded in academia, I regard my own industrial experience (and contribution from industrial partners) as an vital additional discipline in the interdisciplinary approach
- Industry (especially the commodity based production industry in SA) underestimate the contribution research at tertiary level can make

# Conclusions

- Although research focus is required, dissimilar research (e.g. industrial process and environmental research) can be done concurrently, if expertise of both disciplines, exist
- Study such as this is only possible if operational (industrial) expertise, as well as process and environmental research are pooled
- Remain an expert on something (thus focused), with a subject specific expertise
- However, interdisciplinary research vital for improved quality and quantity of research outputs
- Achieved with co-operation with other groups/individual with different subject specific expertise and expanding your own horizons to include expertise beyond your own small area of expertise

# Conclusions



**Thank you**  
**(time allowing a short story)**

