

# EARTH OBSERVATION IN SUPPORT OF PAYMENT FOR WATER ECOSYSTEM SERVICES

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# Presentation outline

## The focus of the presentation is on Earth Observation (EO)

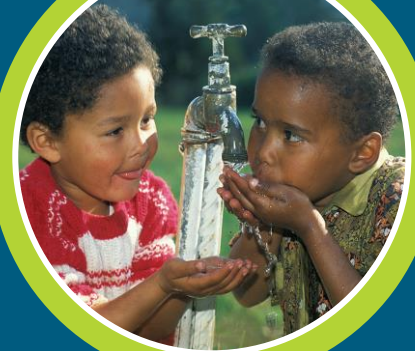
- Where in the world are we?
- The water cycle
- Components of water cycle most pertinent to CapeNature
- Off-the-shelf data products available
- Results
- Way forward





# South Africa

- Water scarce, largely semi-arid country
  - Estimated annual rainfall  $< 500\text{mm}\cdot\text{a}^{-1}$
- Fast growing population
  - demand of clean and sufficient water is increasing everyday.
- Many challenges, competing for limited financial resources
- Conservation agencies need to be innovative to motivate for additional funding
- Payment for (water) Ecosystem Services
  - Build the spatial database to quantitatively support claims



# Western Cape Province Mountainous terrain



**Sneeuberg**  
2026m

**CEDERBERG**

**Matroosberg**  
2249m

**BOLAND**

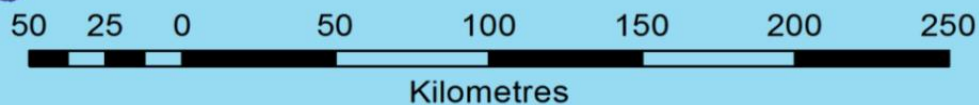
**Seweweekspoortpiek**  
2325m

**SWARTBERGE**

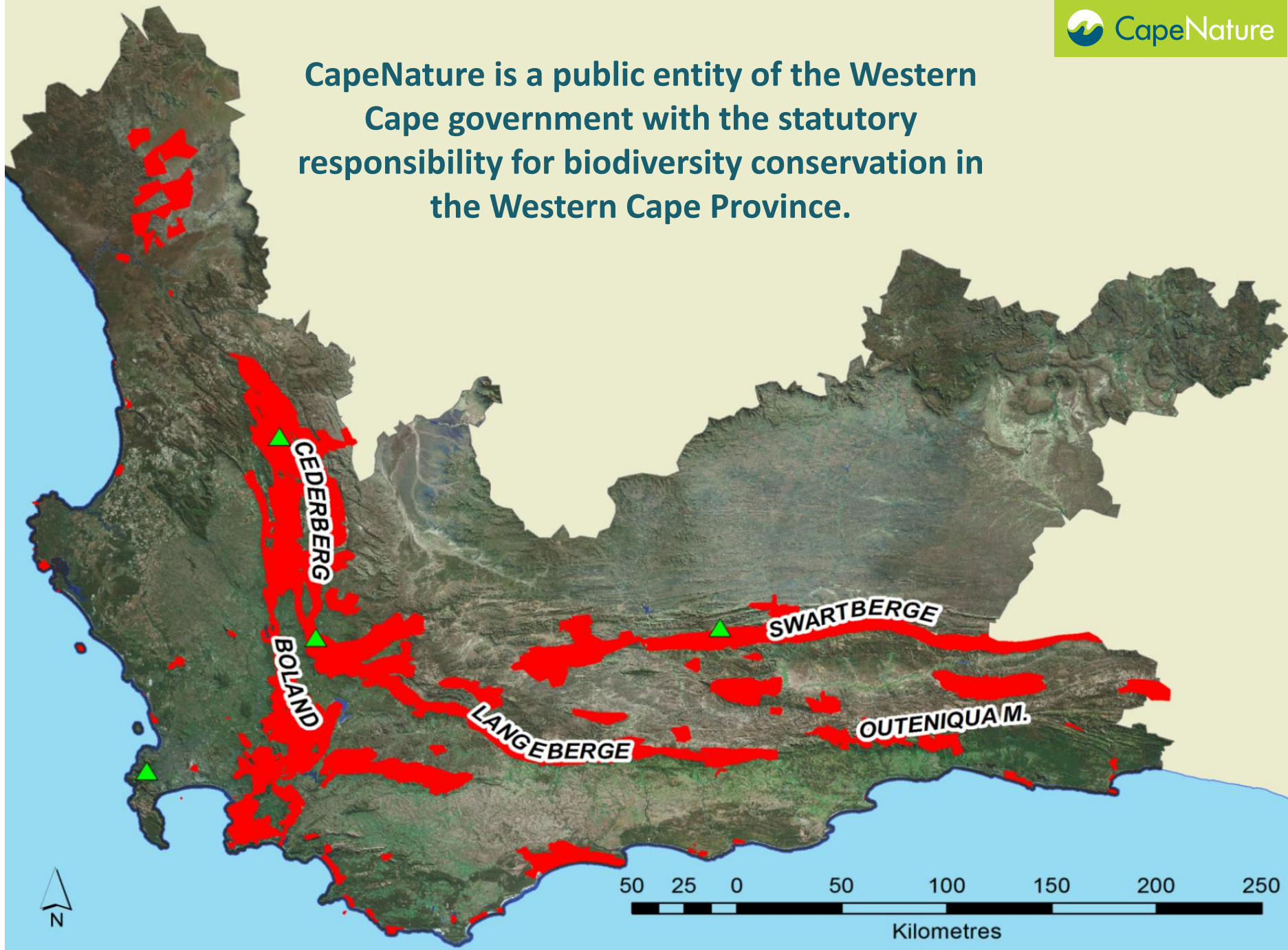
**LANGEBERGE**

**OUTENIQUA M.**

**Table Mountain**  
1084m



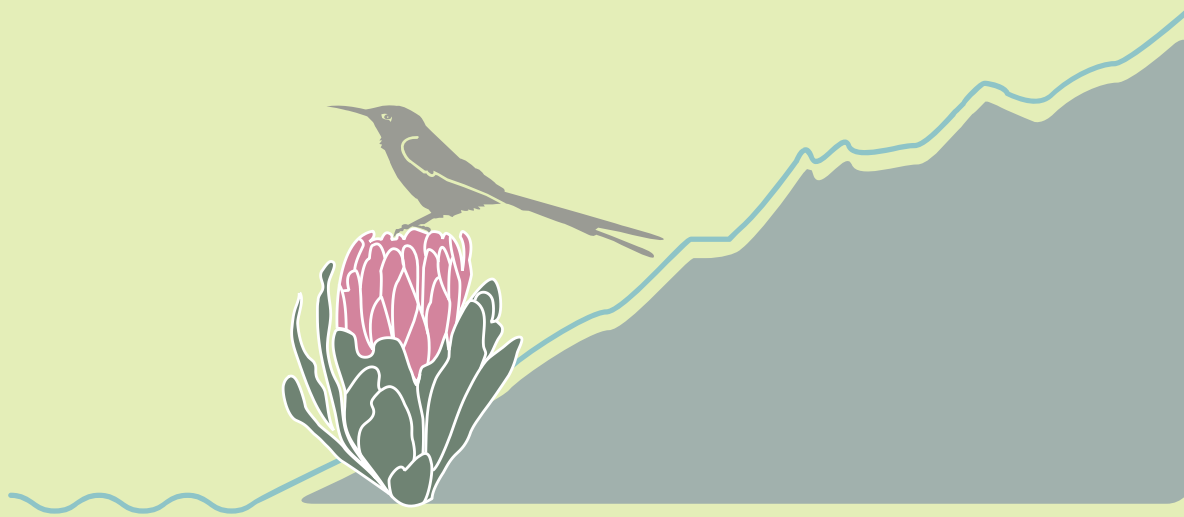
CapeNature is a public entity of the Western Cape government with the statutory responsibility for biodiversity conservation in the Western Cape Province.



# Cape Floristic Region

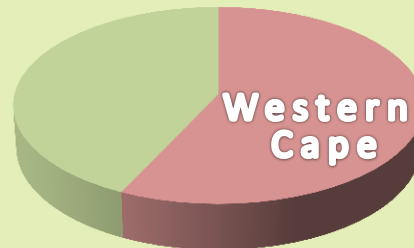
- Smallest of the six recognised floral kingdoms of the world
- Extraordinarily high diversity and endemism
- Threatened by:
  - permanent habitat loss;
  - invasive alien plant species;
  - habitat degradation (fires)
- Emerging threat of climate change





57%

of the strategic water resources in South Africa are held in the Western Cape

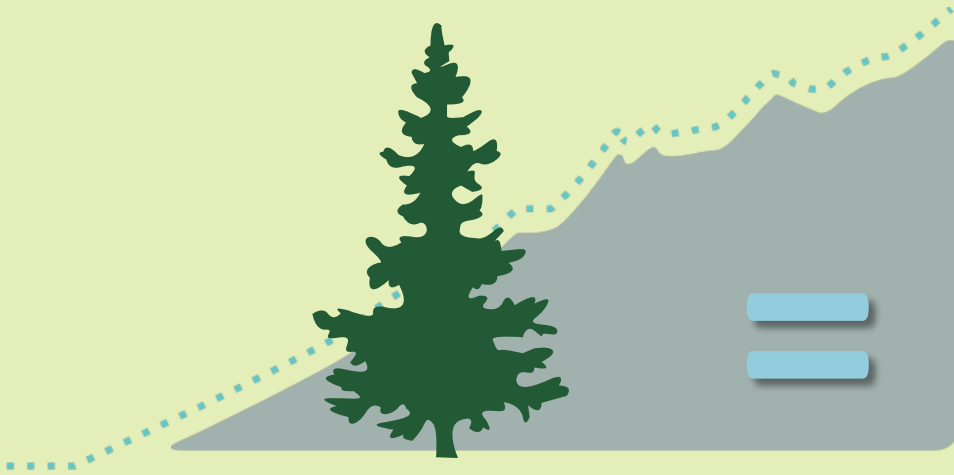


90%

of water catchment areas in the Western Cape are managed by CapeNature







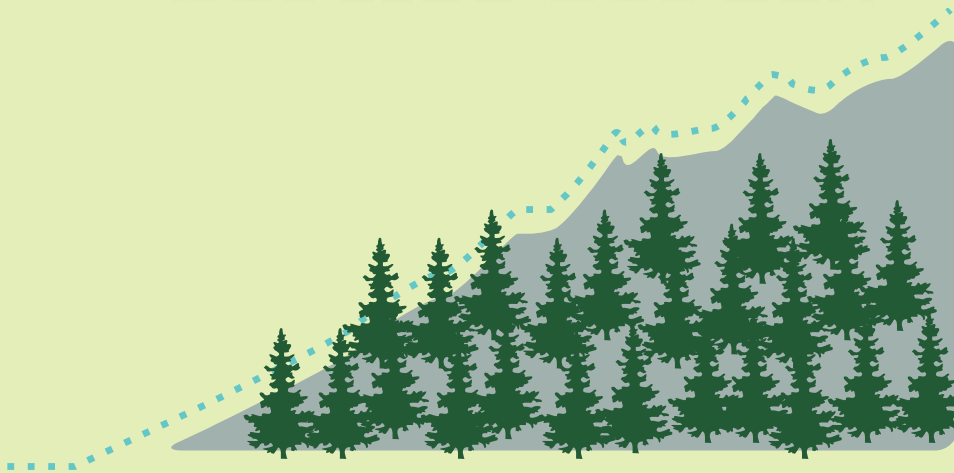
**40-50 litres  
per tree per day**



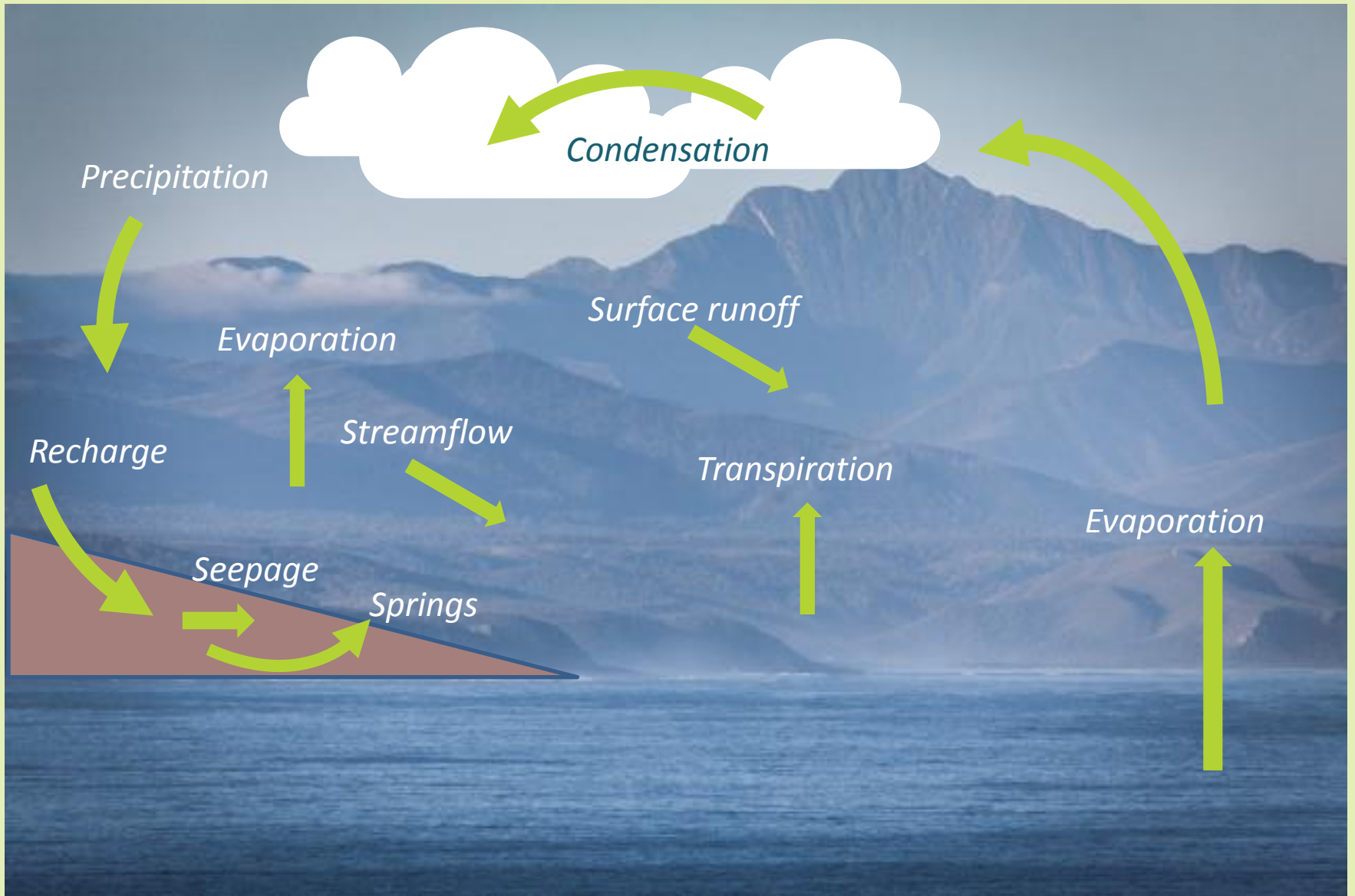
**INFESTATION**

**55%**

reduction in stream flow



# The water cycle

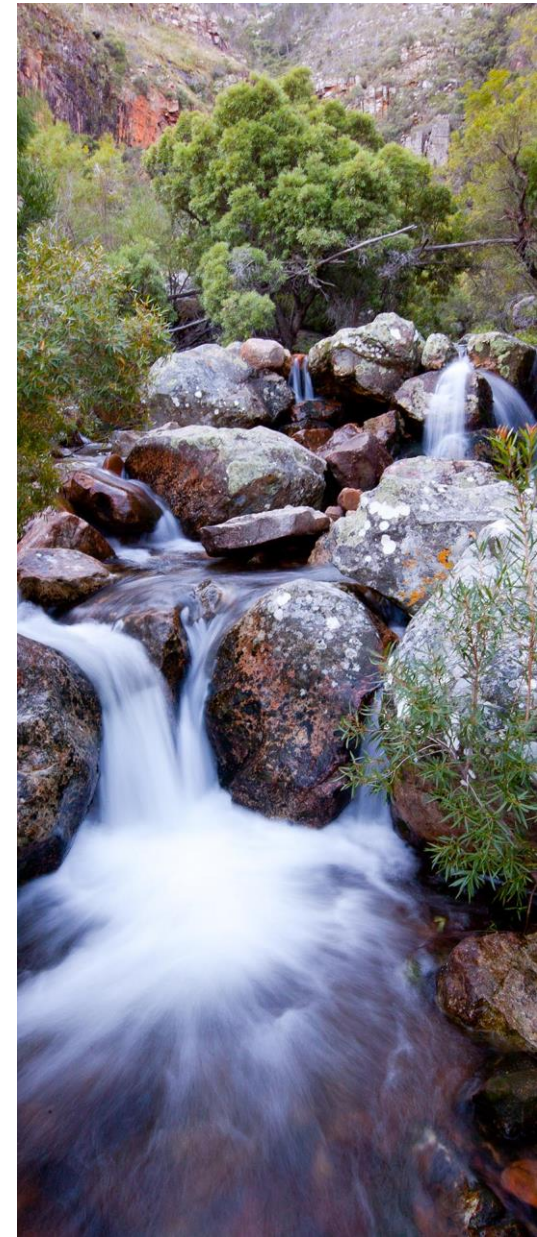


# Water production areas

**CapeNature managed land can generally be considered water production areas:**

- Mountainous areas = high precipitation
- If amount of precipitation (P) and evapotranspiration (ET) is known,  
 $P - ET = \text{amount of water "produced" as recharge or run-off}$

**Earth observation data can be used to calculate P and ET for each pixel and create spatially explicit maps**



# Precipitation and Evapotranspiration maps

**Complex methodologies for both these critical water cycle parameters but:**

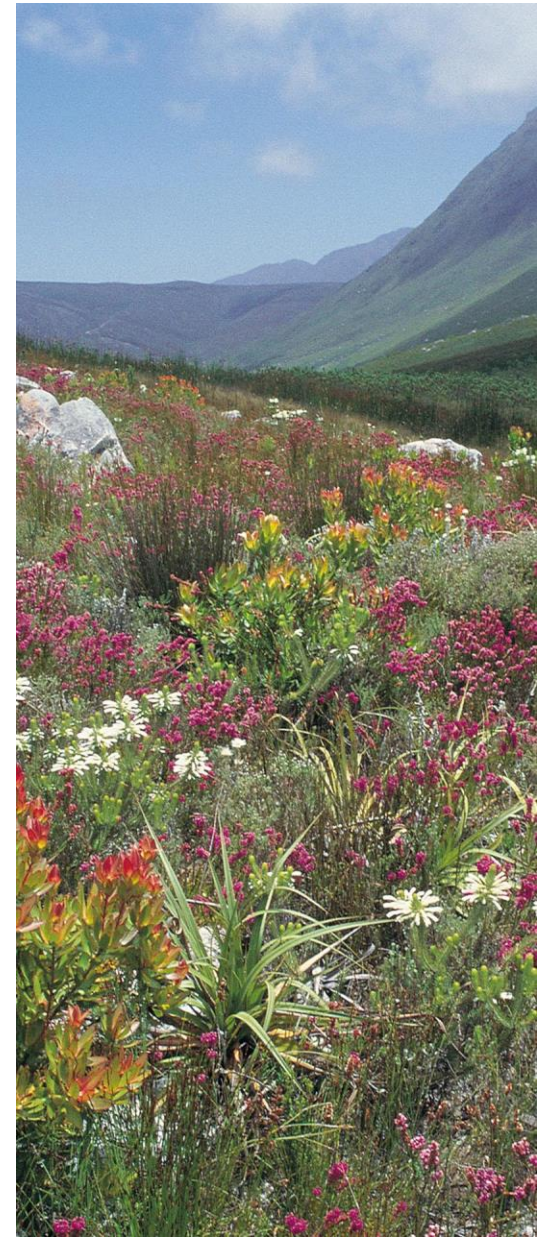
## **Rapid technology development**

- Number of satellites available
- Spatial, spectral and temporal resolution
- Algorithm development

## **Off-the-shelf data products available**

**Data collected for > 10 years**

**→ long term data**



# Off-the-shelf data products

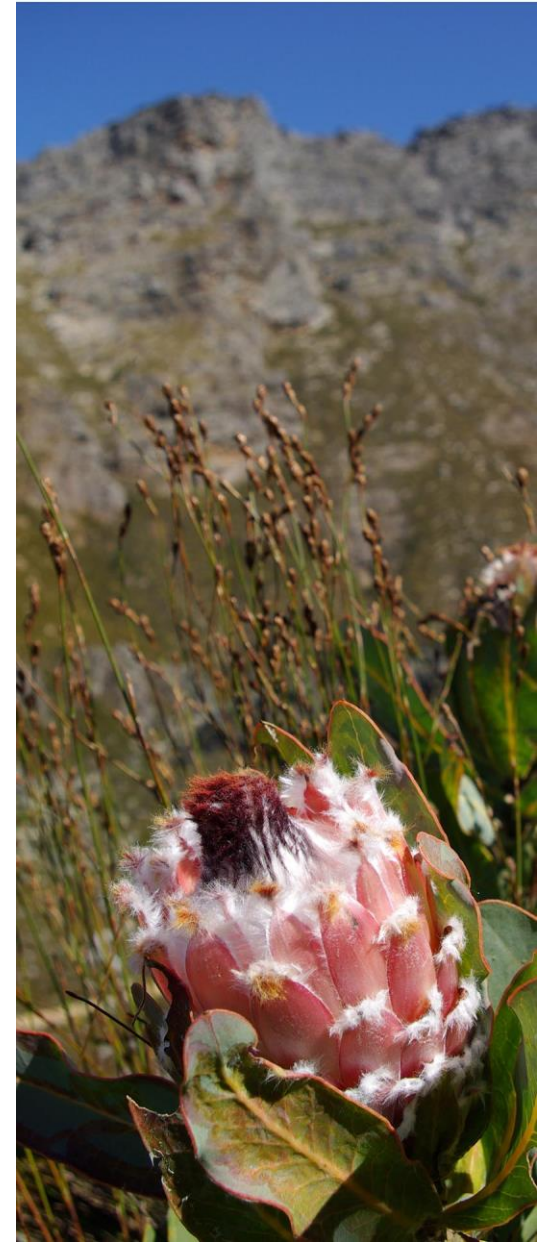
## Freely available:

### Precipitation – 25 km resolution

- Tropical Rainfall Measurement Mission (TRMM)
- Global Precipitation Mission (GPM)

### Evapotranspiration – 1 km resolution

- MODIS ET data product (MOD16)

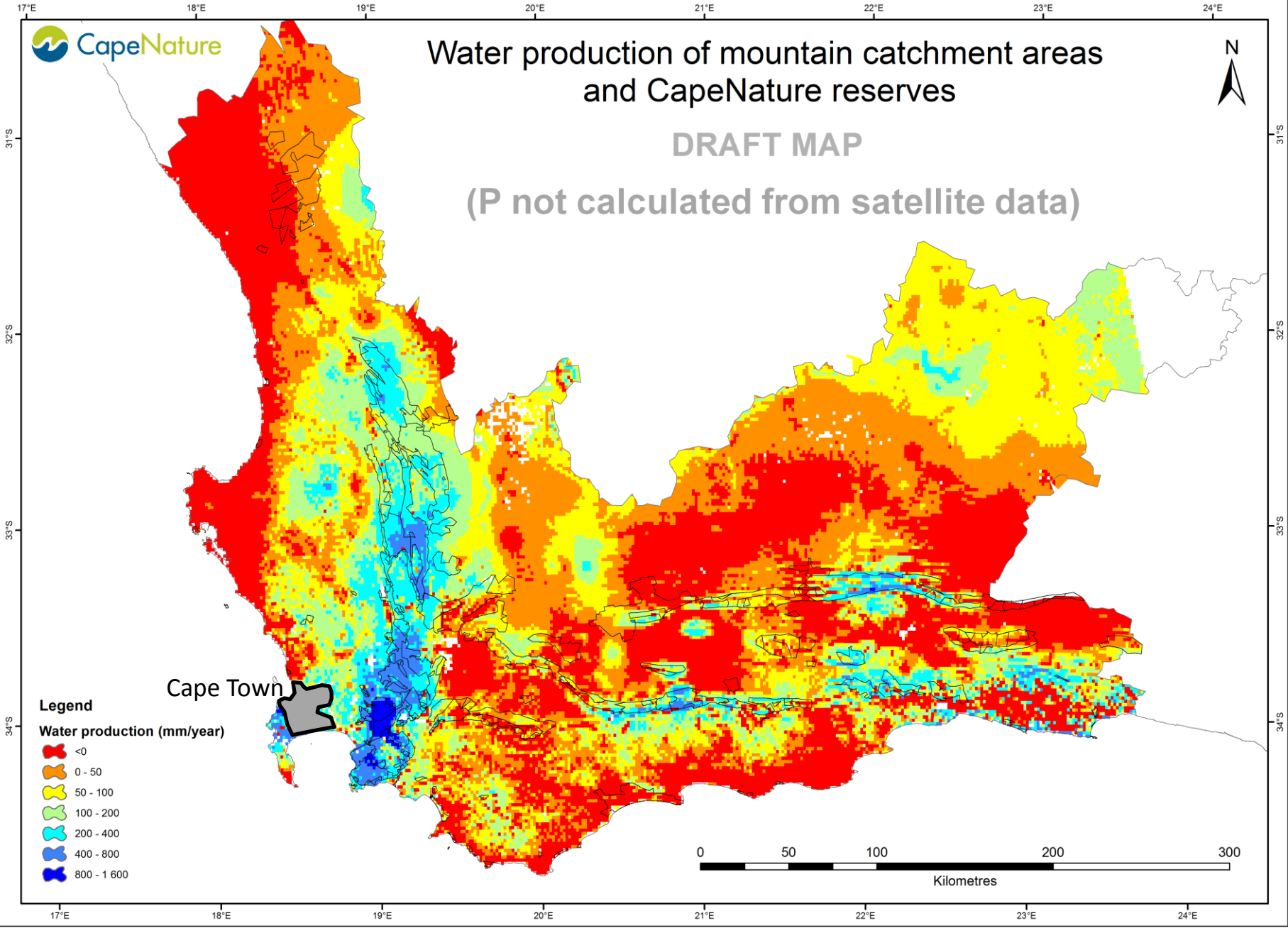




# Water production of mountain catchment areas and CapeNature reserves

DRAFT MAP

(P not calculated from satellite data)

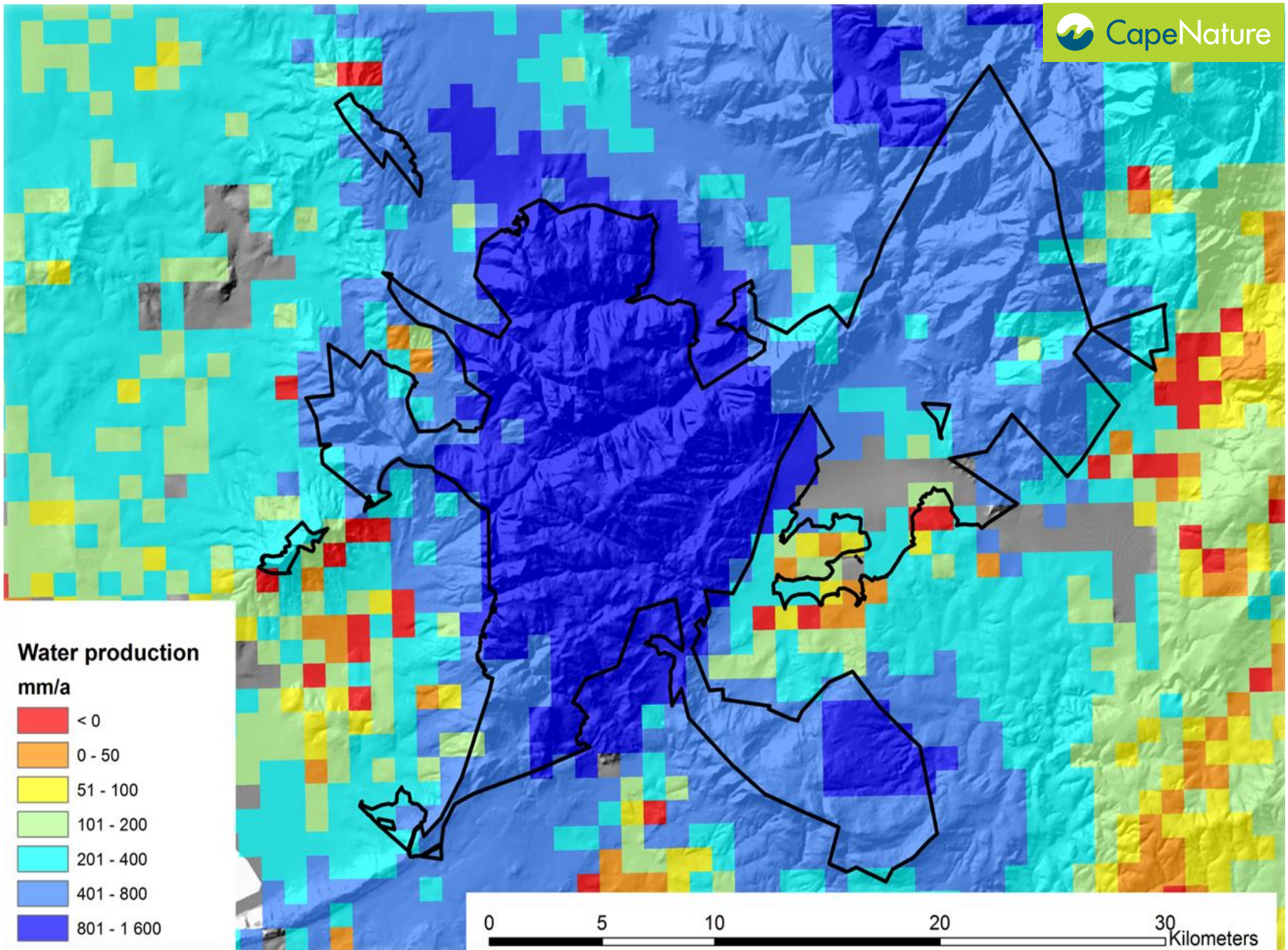


### Legend

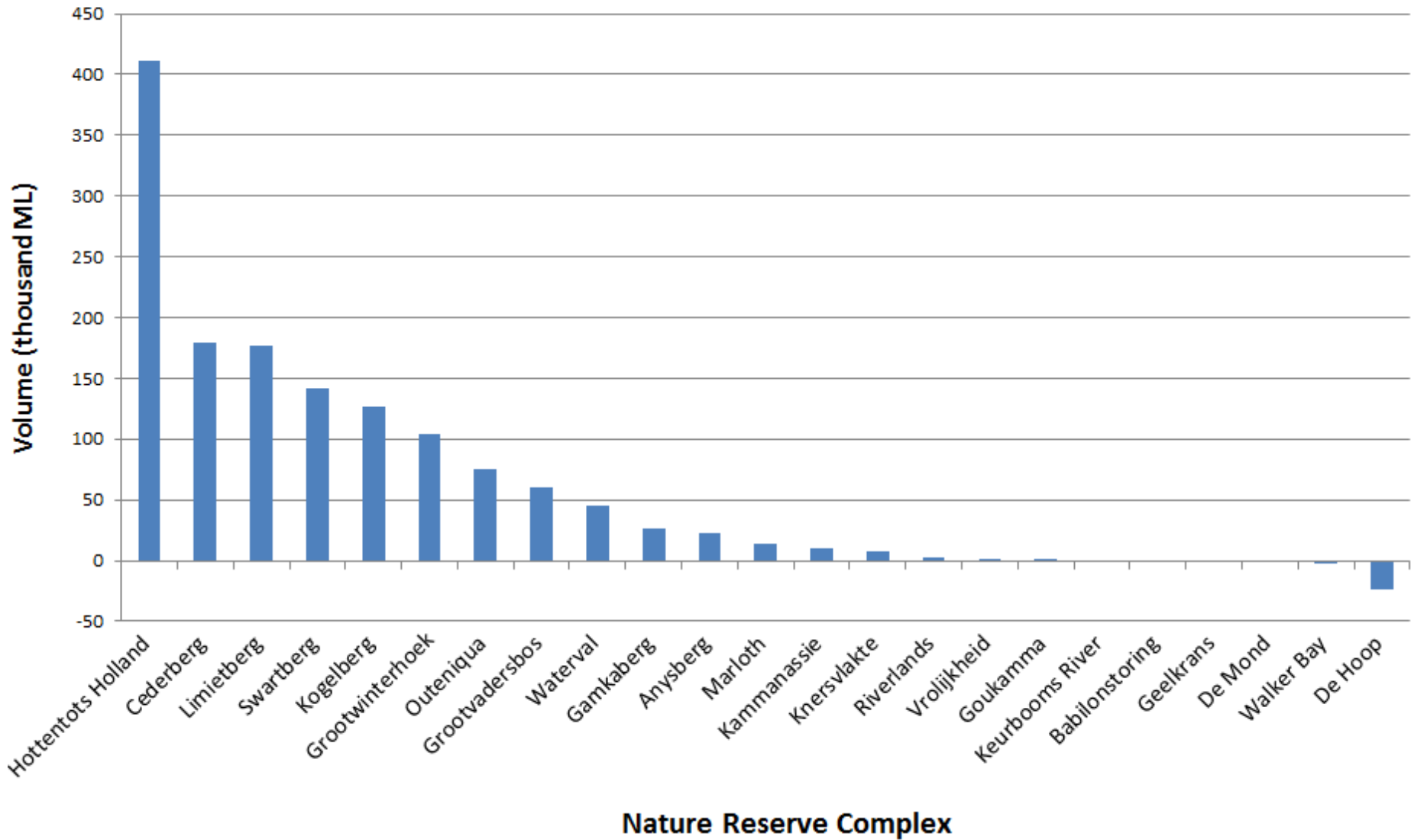
Water production (mm/year)

- <0
- 0 - 50
- 50 - 100
- 100 - 200
- 200 - 400
- 400 - 800
- 800 - 1 600

0 50 100 200 300  
Kilometres



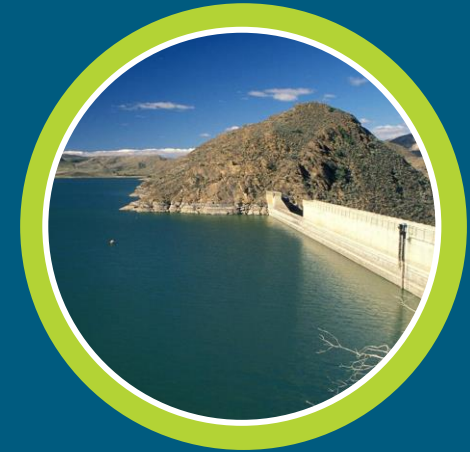
## Water production



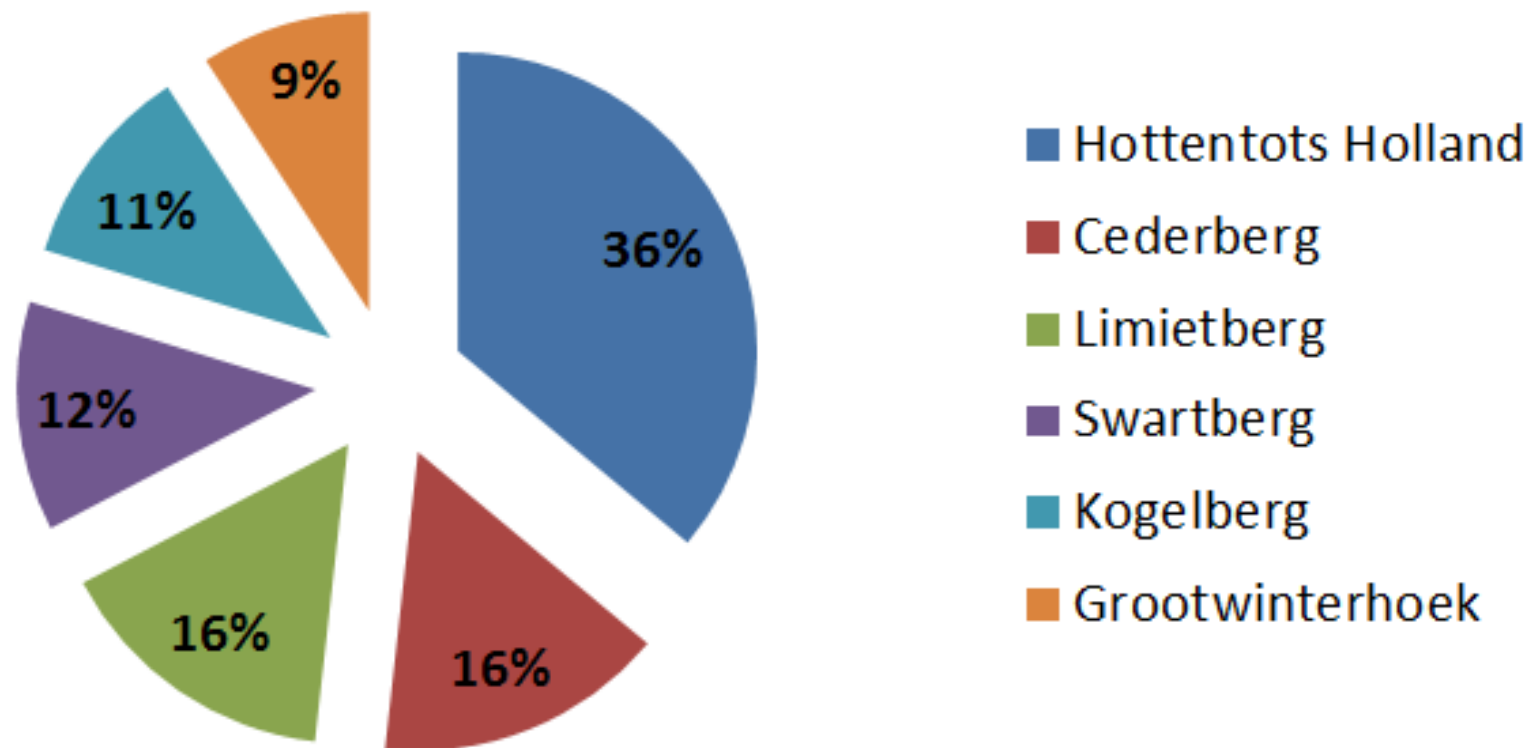


# City of Cape Town Supply Dams

	Vol (thousand ML)
WEMMERSHOEK	58,6
STEENBRAS LOWER	33,5
STEENBRAS UPPER	31,8
VOËLVLEI	164,1
THEEWATERSKLOOF	480,2
BERG RIVER	130,0
TOTAL STORED	898,2



## Contribution of reserve complex's producing greater than 100 000 ML



# Off-the-shelf data products

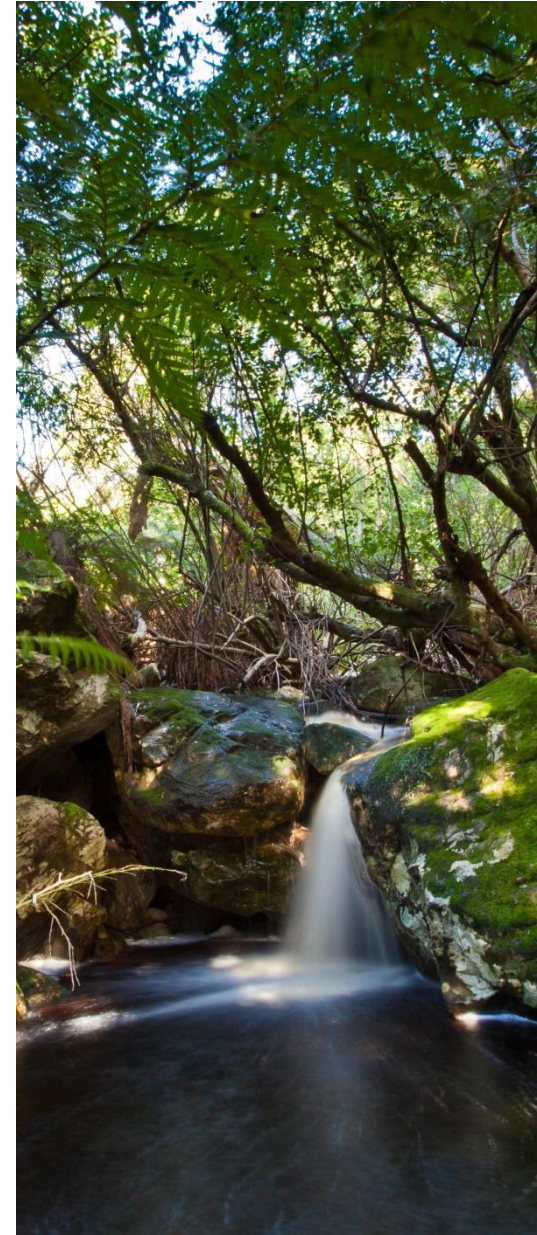
## Some limitations:

### Precipitation

- Spatial resolution,
- Resampling may be required – advanced skills
- Validation

### Evapotranspiration

- Coarse resolution inputs
- Generalisation around vegetation types
- More work needed on accuracies of water use of alien vegetation infestations versus indigenous vegetation



# Off-the-shelf data products

## Advantages:

**Spatial products help visualisation**

**Makes an impact**

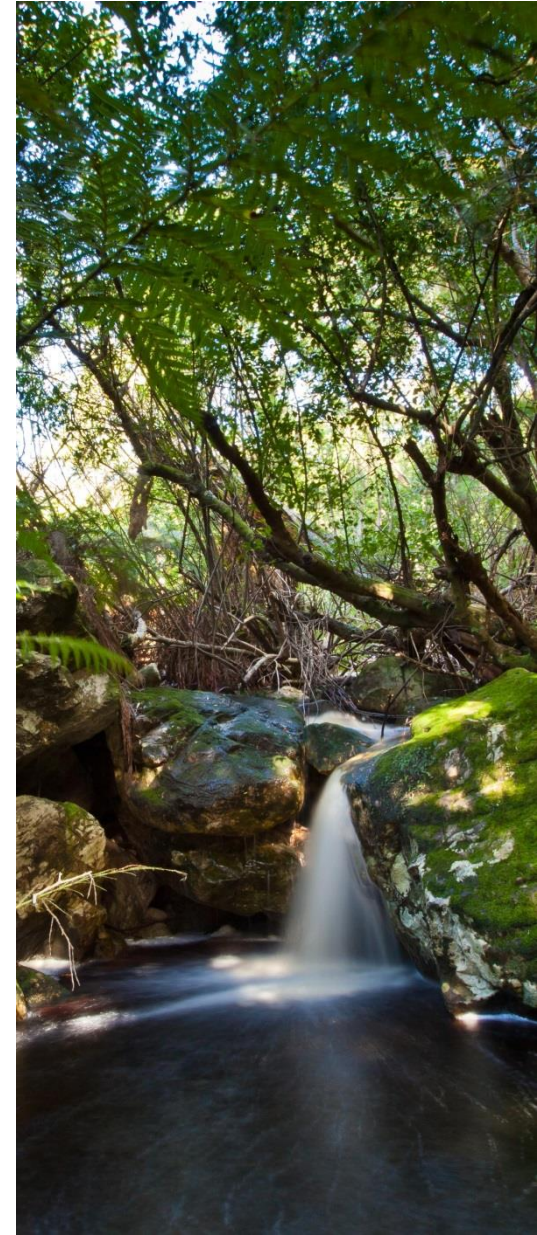
- Particularly when converted to volume
- Taking the dialogue forward

**Ease of use**

- GIS skills required

**Cost**

- Free and open source software can be used



# Way forward

- Improving the precipitation product
- Specifically accounting for alien invasive vegetation in ET product
- Validation
- Pricing strategies
  - Monies specifically used for securing water (removal of invasive alien plant species)



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