

EARTH OBSERVATION IN SUPPORT OF PAYMENT FOR WATER ECOSYSTEM SERVICES

Lesley Gibson¹ & Zahn Münch²

¹ CapeNature Scientific Services,
Assegaaibosch Nature Reserve, Jonkershoek, Stellenbosch

² Geography & Environmental Studies,
Stellenbosch University, 1031 Chamber of Mines Building,
Cnr Merriman & Ryneveld Street, Stellenbosch



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



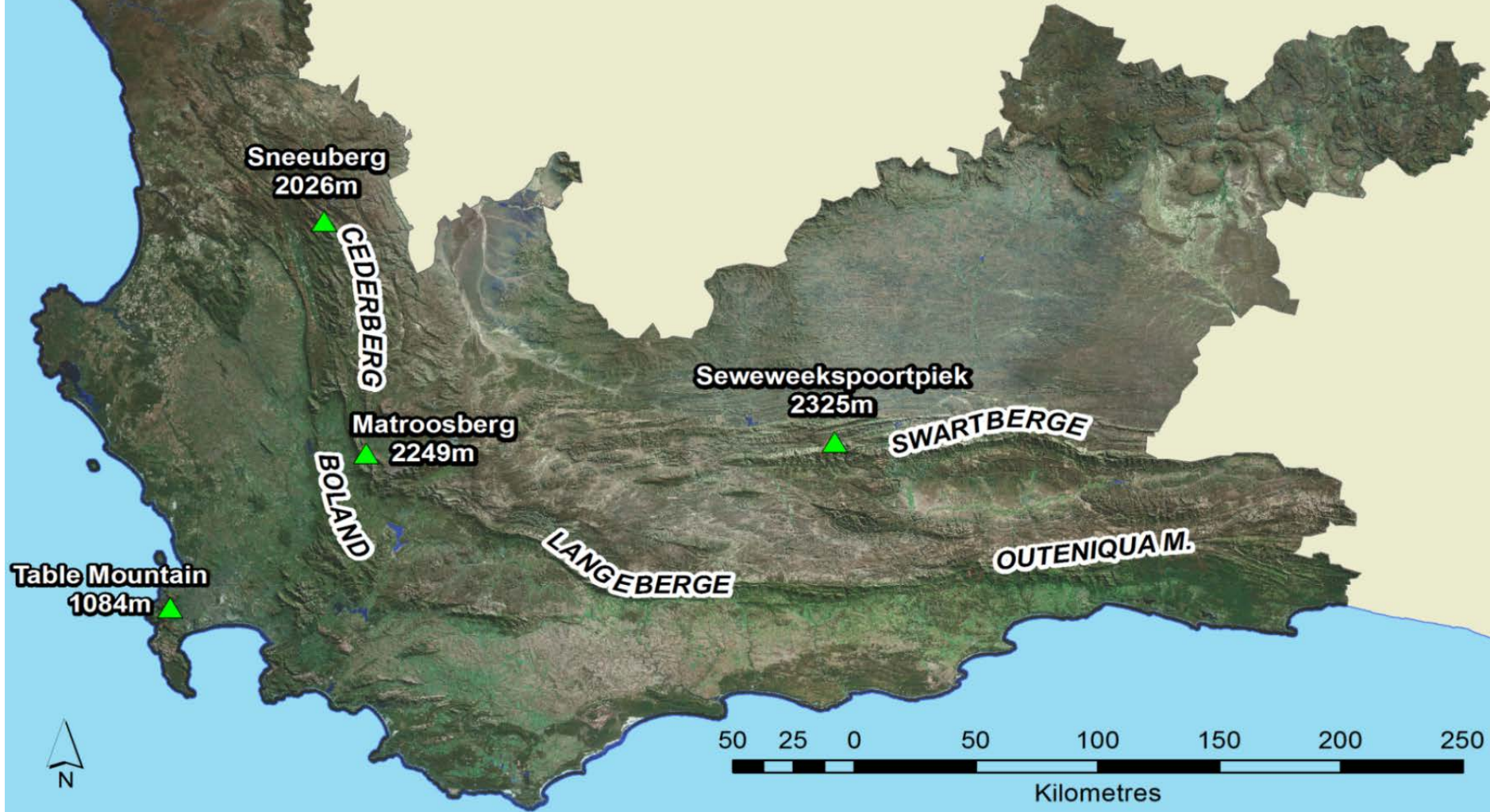
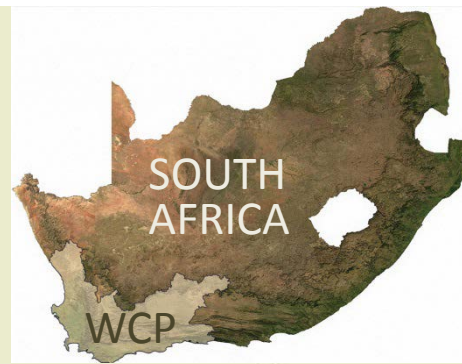


South Africa

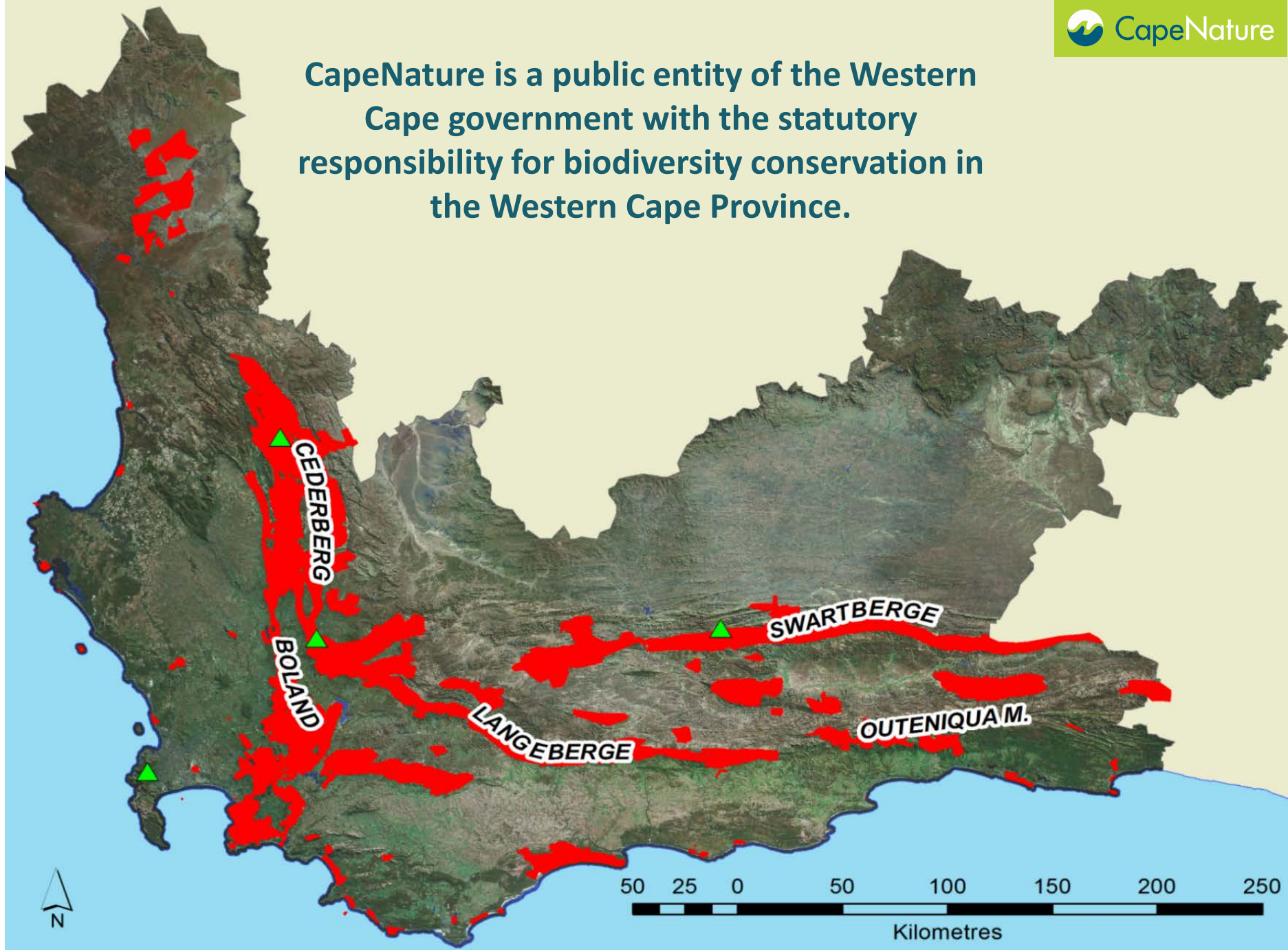
- Water scarce, largely semi-arid country
 - Estimated annual rainfall $< 500\text{mm.a}^{-1}$
- Fast growing population
 - demand of clean and sufficient water is increasing everyday.
- Many challenges, competing for limited financial resources
- Conservation agencies need to be innovative to motivate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



Western Cape Province Mountainous terrain



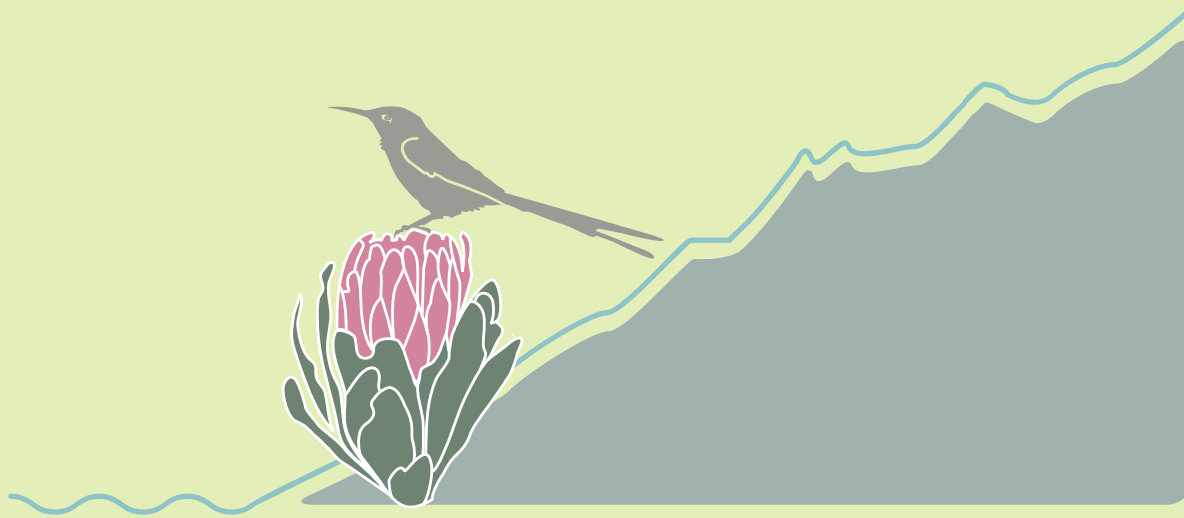
CapeNature is a public entity of the Western Cape government with the statutory responsibility for biodiversity conservation in the Western Cape Province.



Cape Floristic Region

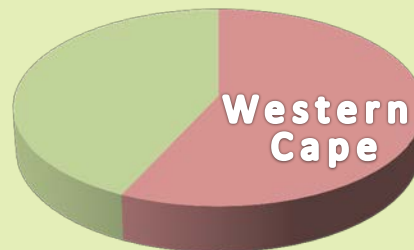
- Smallest of the six recognised floral kingdoms of the world
- Extraordinarily high diversity and endemism
- Threatened by:
 - permanent habitat loss;
 - invasive alien plant species;
 - habitat degradation (fires)
- Emerging threat of climate change





57%

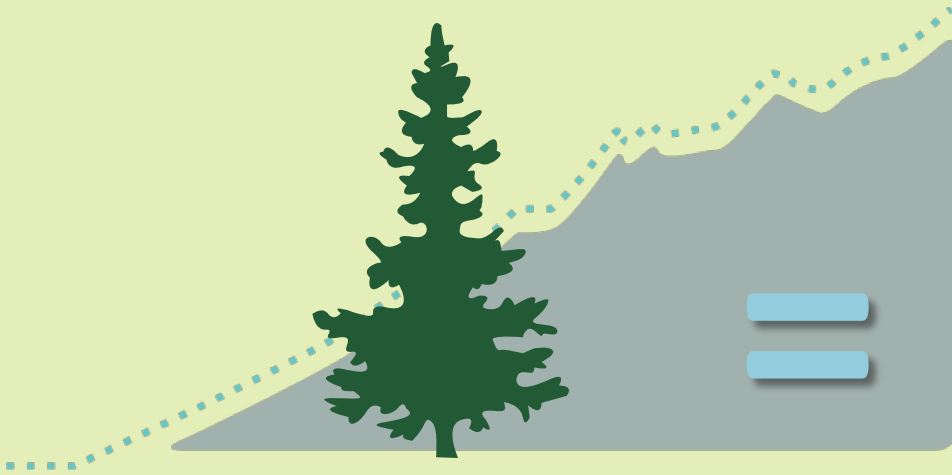
of the strategic water
resources in South
Africa are held in the
Western Cape



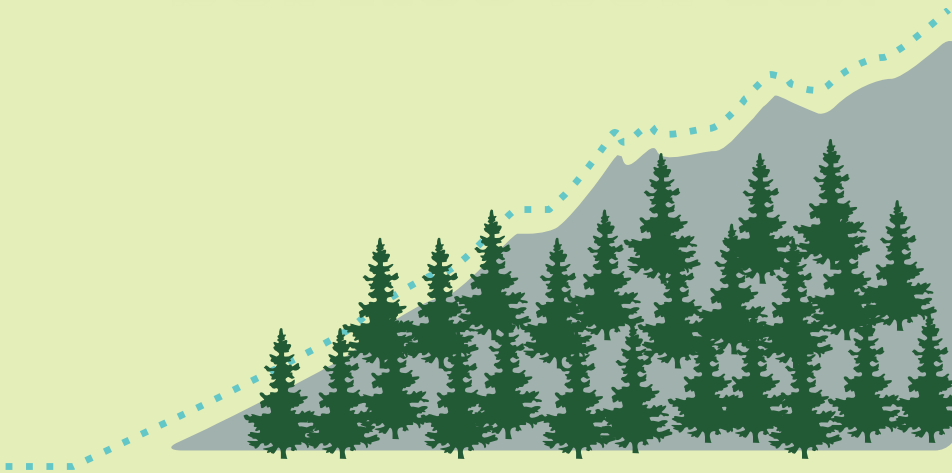
90%

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





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

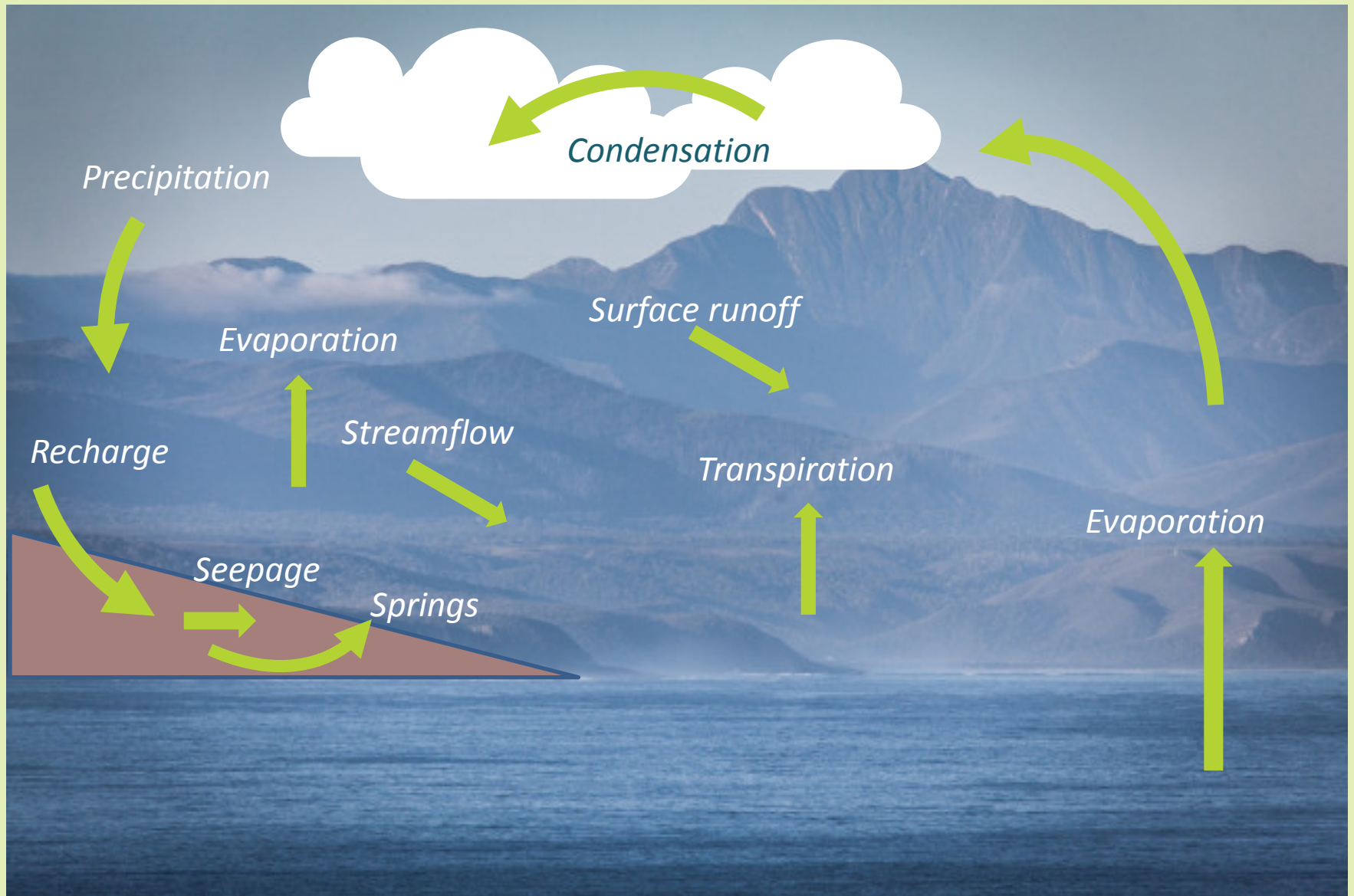


INFESTATION

55%

reduction in stream flow

The water cycle

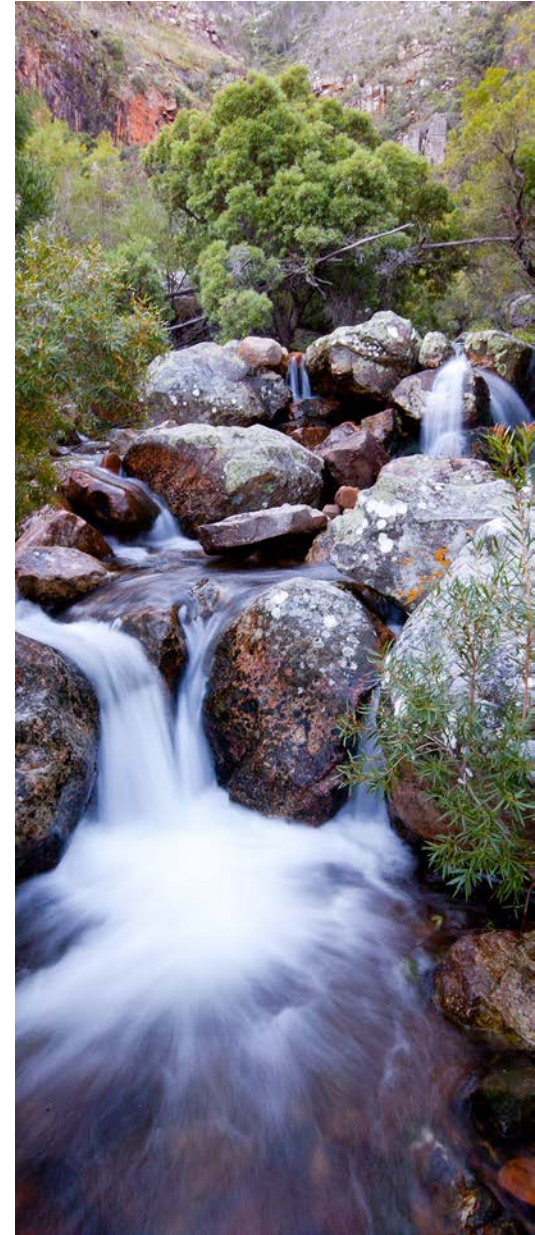


Water production areas

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

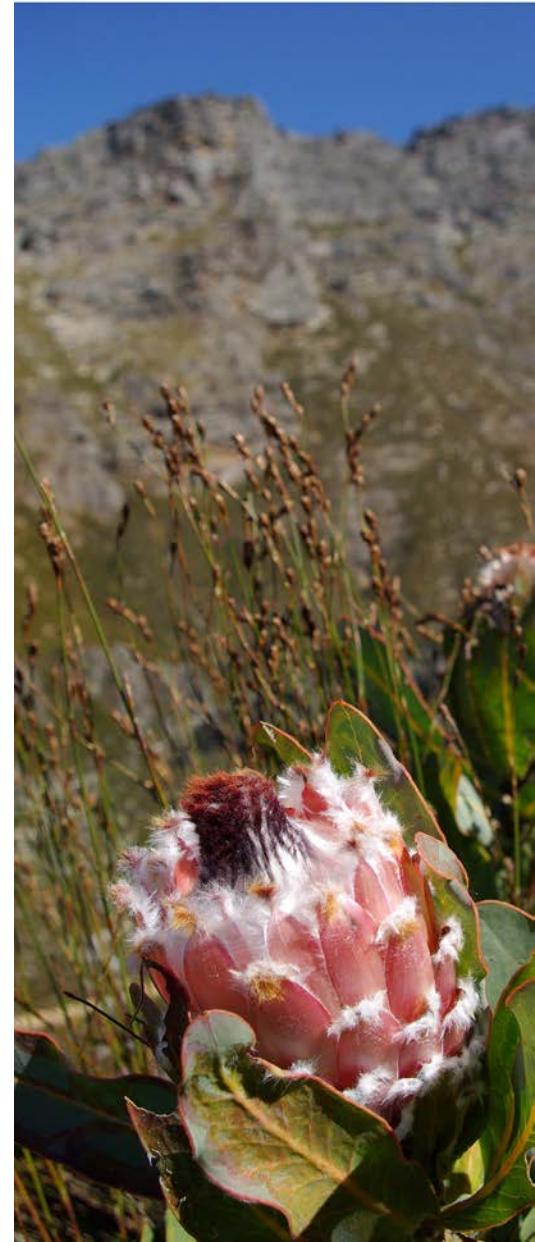
Freely available:

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

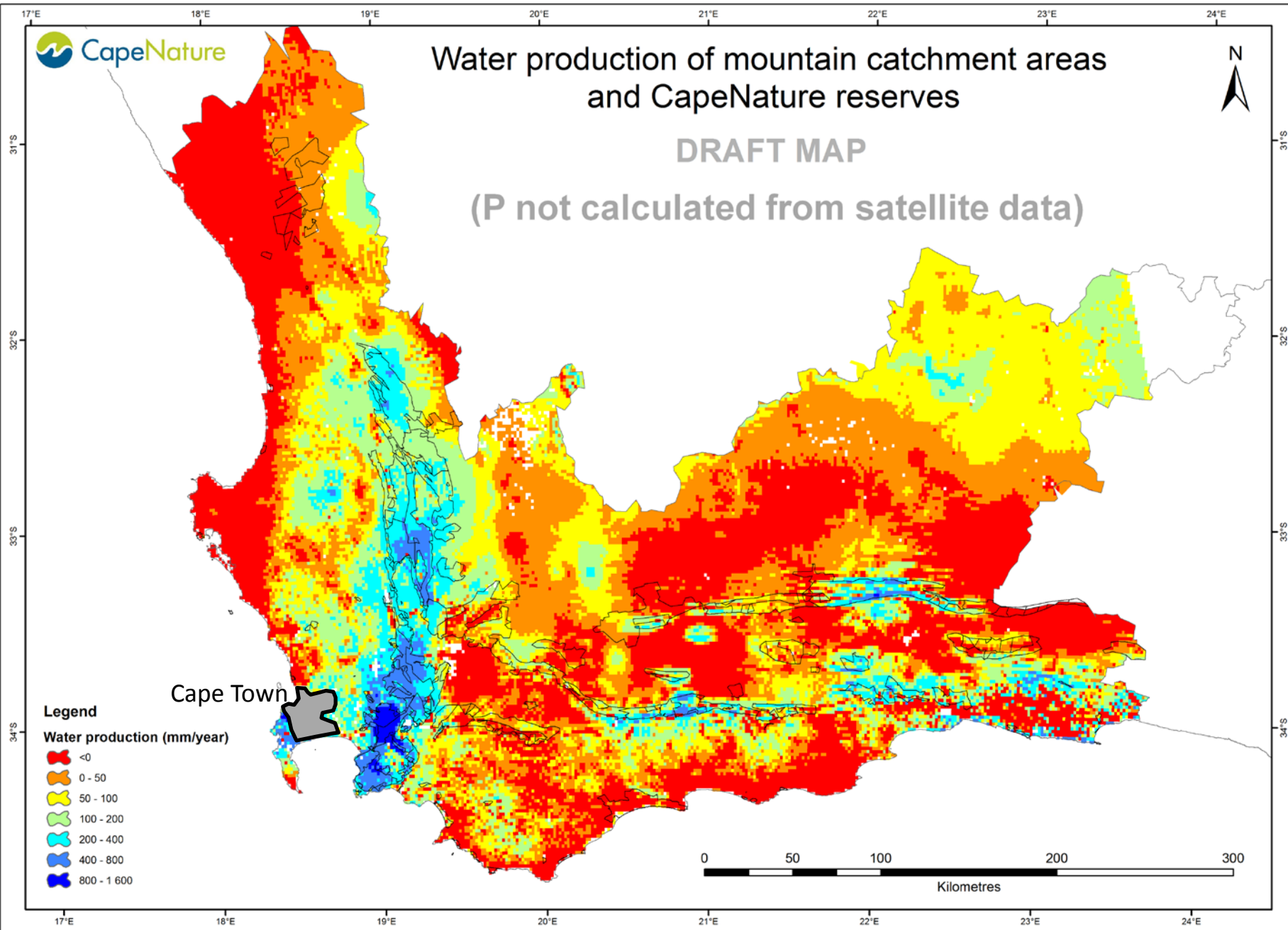
(P not calculated from satellite data)

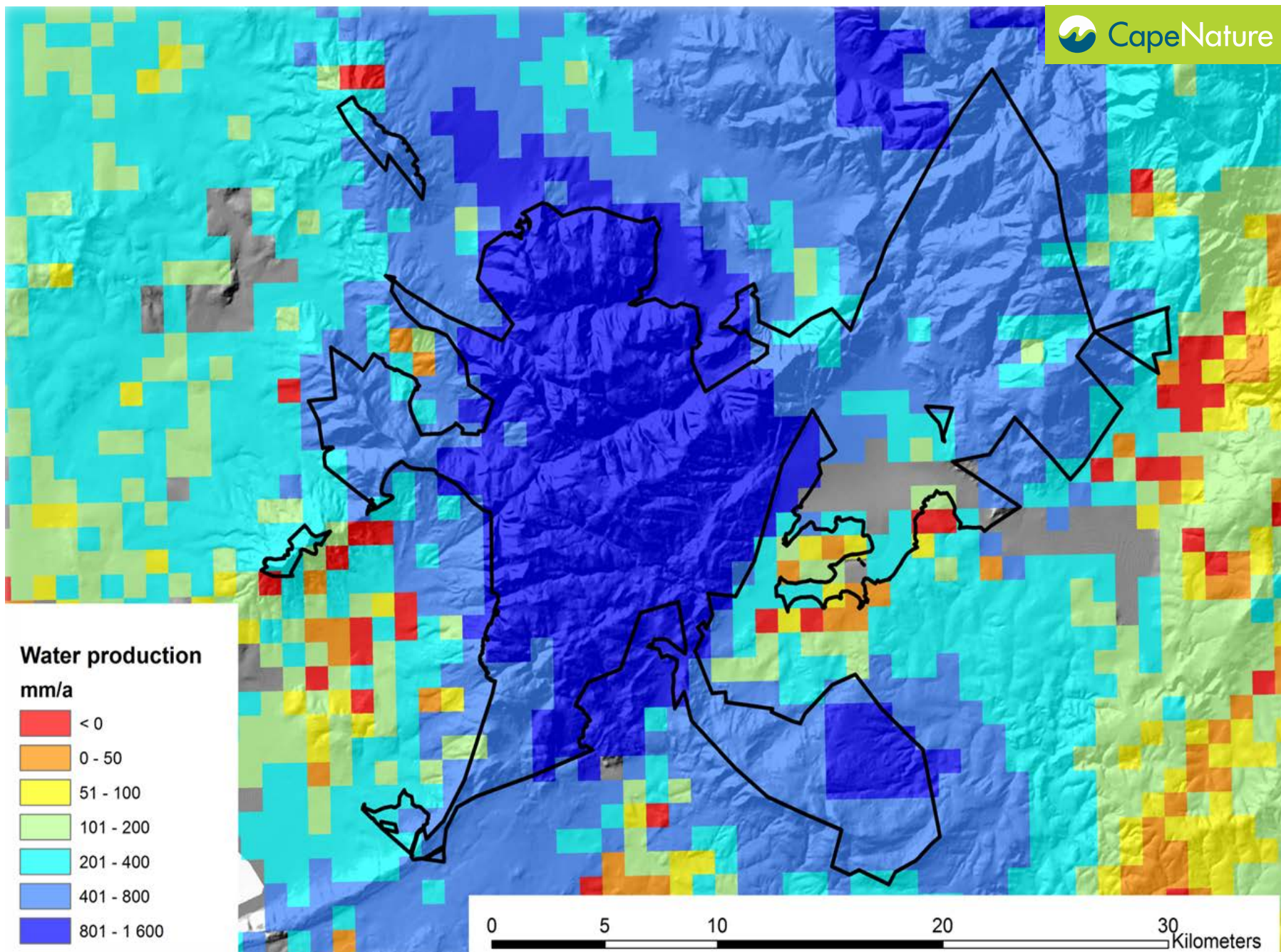


Cape Town

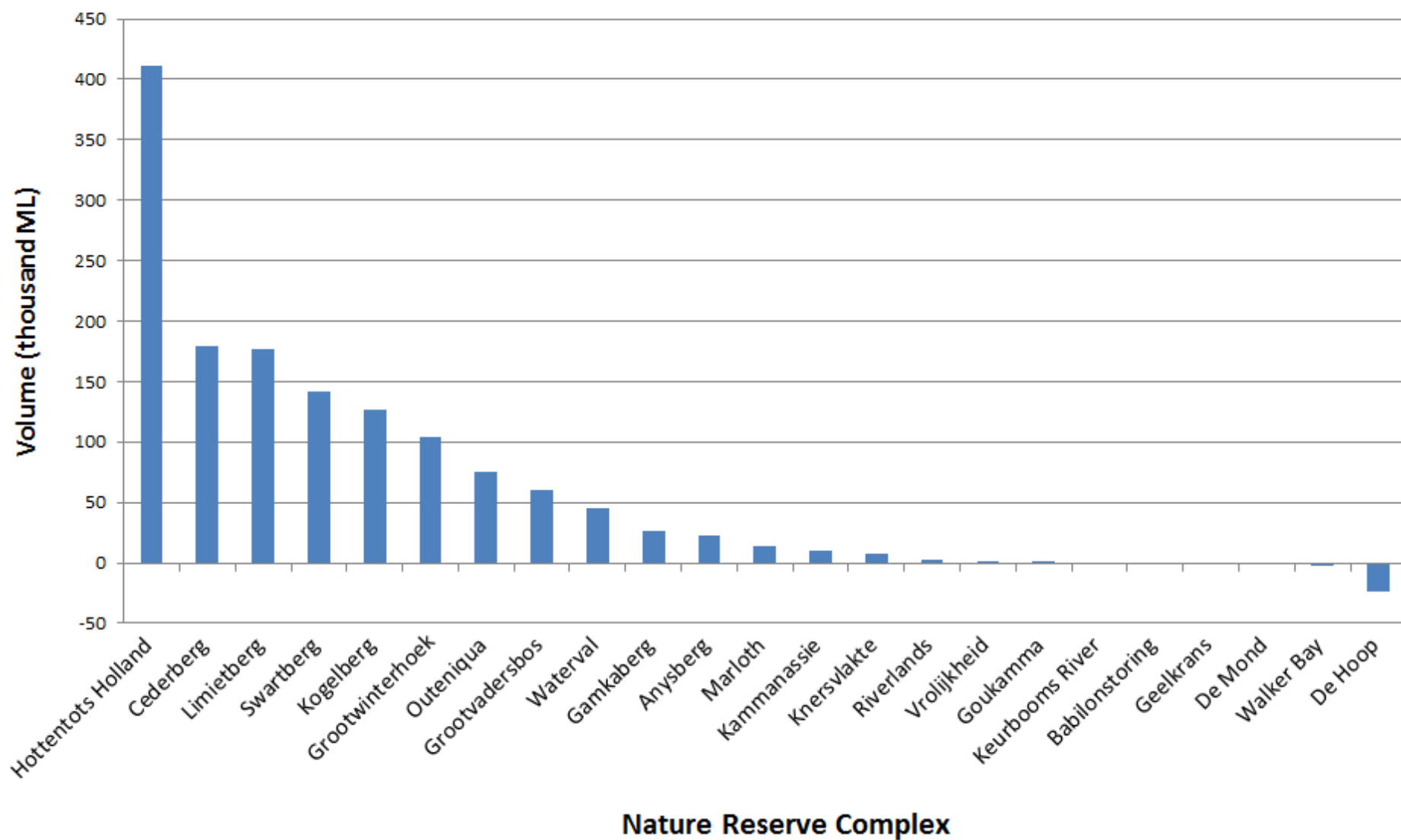
Legend

Water production (mm/year)



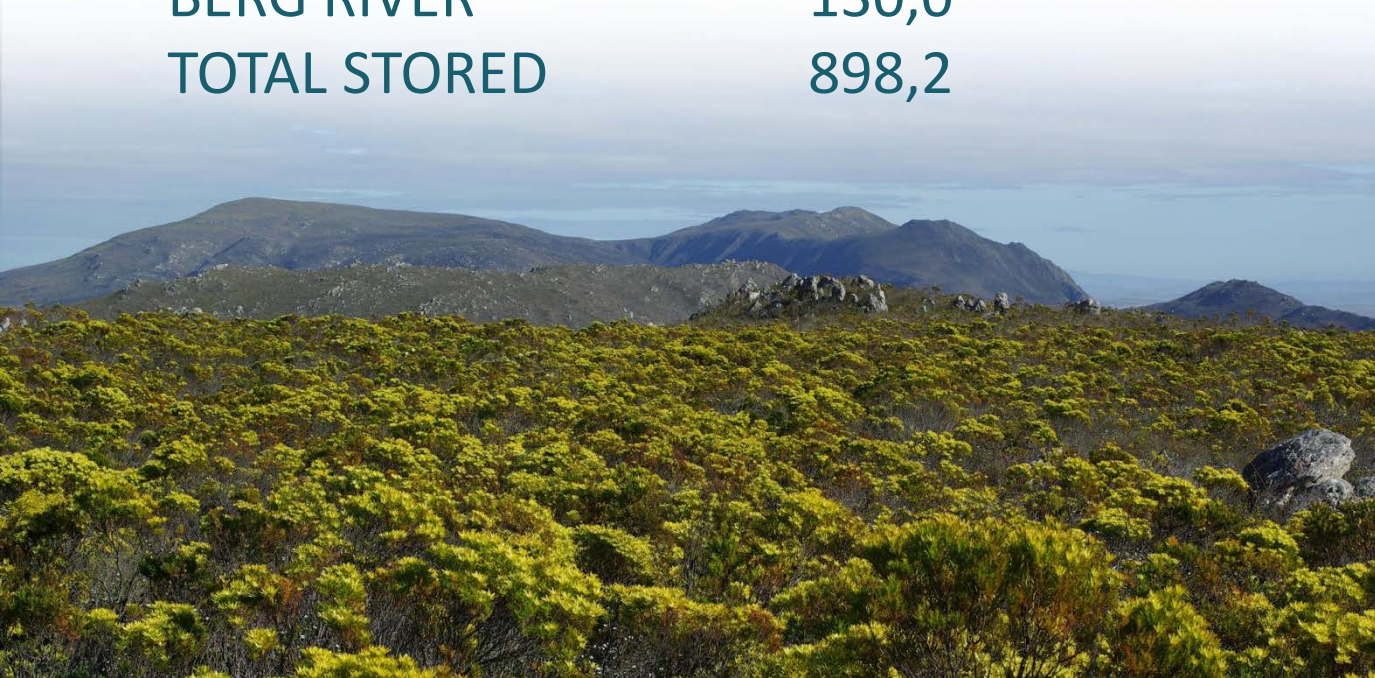


Water production

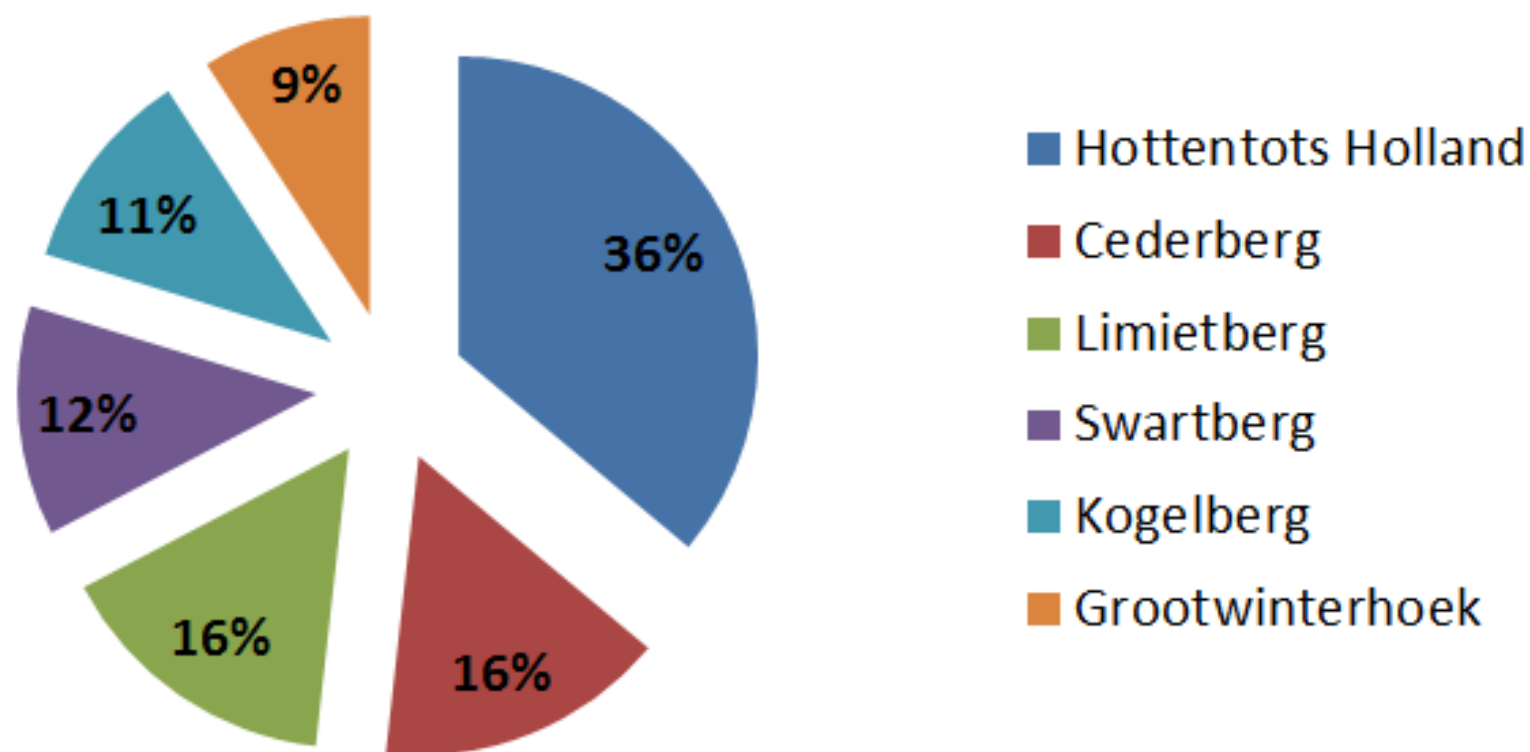


City of Cape Town Supply Dams

	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

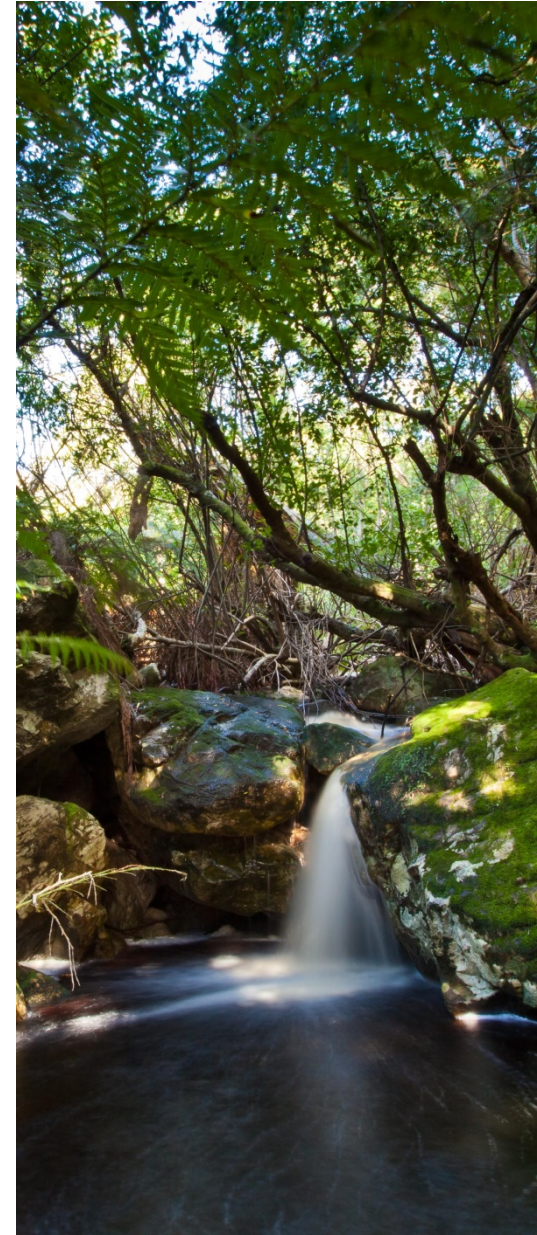
Some limitations:

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

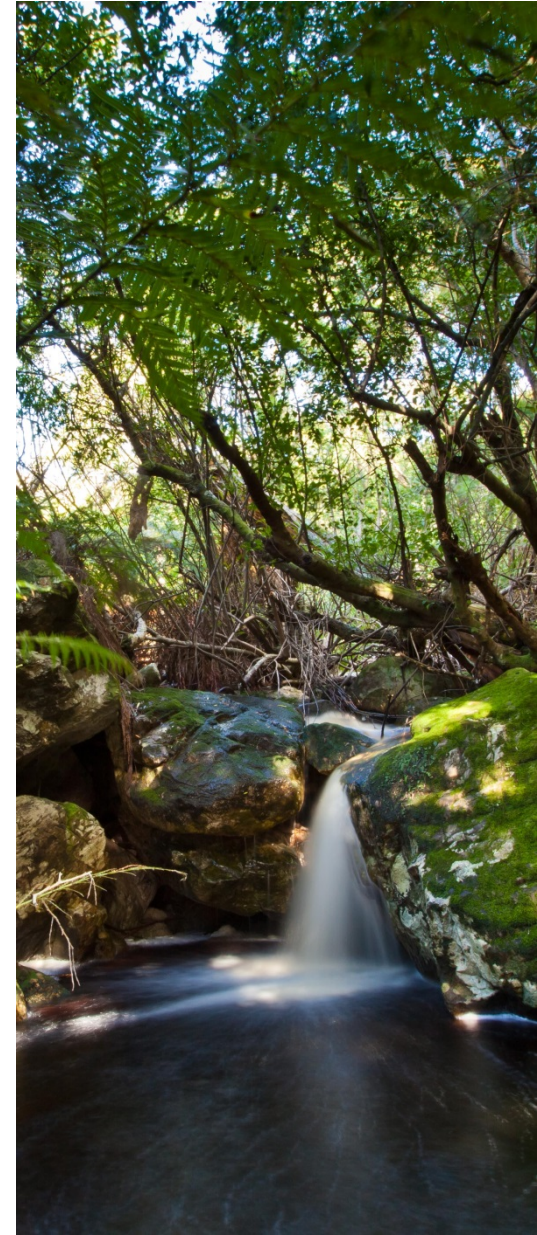
- Particularly when converted to volume
- Taking the dialogue forward

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)



Lesley Gibson

lgibson@capenature.co.za

www.capenature.co.za

