An Overview of Solar Thermal Research Activities at UKZN

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Introduction to GSET

- Solar thermal research has until very recently been conducted under the banner of the Sustainable Energy Research Group (SERG)
- SERG was formed in 2009 to coordinate existing research efforts: solar, wind & electric transport
- With time, solar-related research has become the predominant focus
- Consequently, the group has been "rebranded" as the Group for Solar Energy Thermodynamics

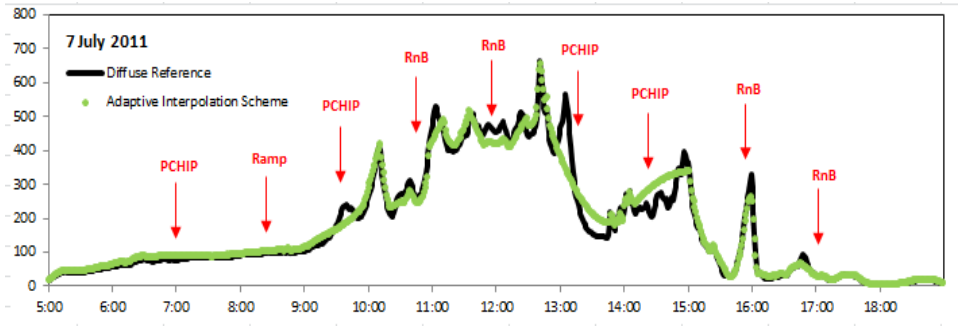
- GSET is a small group, with fairly limited financial and human resources
- Academic staff compliment: one senior lecturer (Michael Brooks) & one lecturer (Jean Pitot)
- Postgraduate student compliment: two MSc students (graduated 2013)
- Research focus areas:

Broadband Radiometry

Thermal Systems Analysis

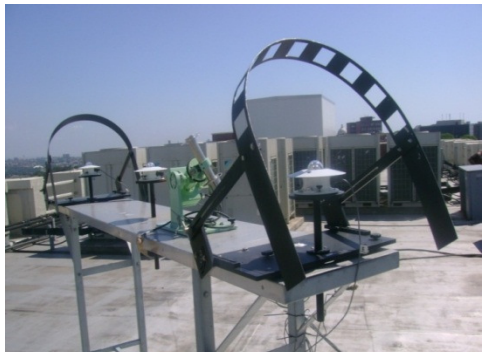
Concentrator Development

- Focus areas: solar resource assessment, radiometric modelling, instrumentation development and testing
- Flagship project: instrumentation development for low cost ground stations
- The perforated band permits decomposition of global irradiance into diffuse and direct normal parts
- Collaboration with US National Renewable Energy Laboratory since 2008



Measurement equipment

- Operational ground stations at UKZN Howard College (HC) and Westville campuses employing optimal measurement schemes (full redundancy)
- HC: Eppley PSPs, perforated band system, Eppley NIP, Kipp and Zonen CH1, CMP11s and CUV5 ultra violet sensor (280 to 400 nm)
- Westville: SOLYS tracker, CMP11s and CH1

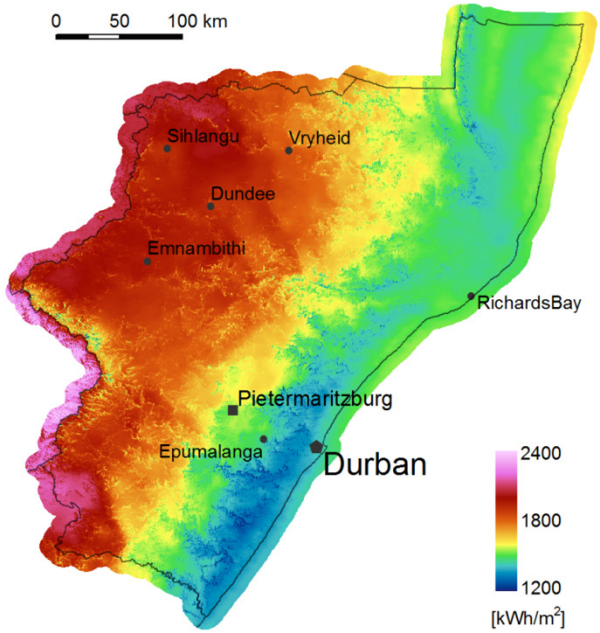


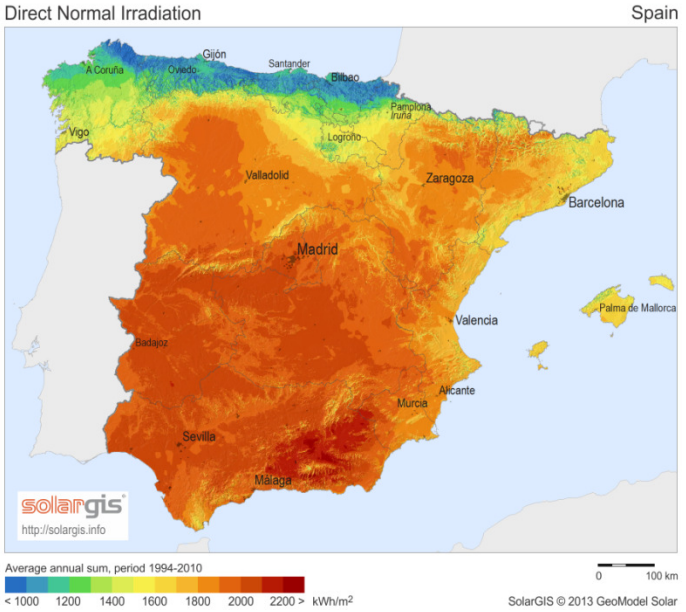
Greater Durban Radiometric Network (GRADRAD)

- An online radiometric database collecting data from three ground stations in Durban: UKZN – Howard College, UKZN – Westville & MUT
- Objectives: assessment of the local resource and quantification of micro-climatic effects
- Data is freely available to the public via www.gradrad.ukzn.ac.za/homepage.aspx (under construction!)

Solar resource mapping of KwaZulu-Natal

- Joint project: GeoSUN Africa, SU & UKZN (funded by TIKZN & KZN DEDT)
- Based on satellite-derived data, providing: DNI, GHI, GTI, optimal PV tilt & PV yield potential





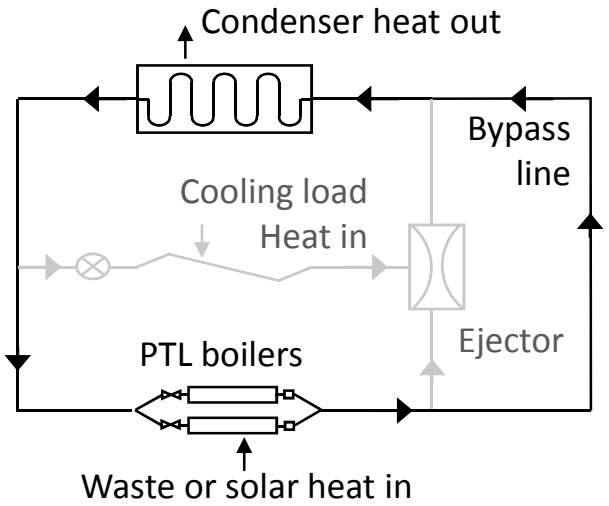
Radiometric modelling

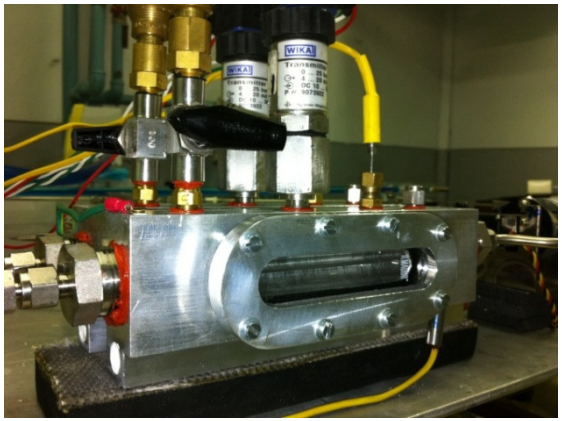
- Collaboration with the University of Reunion
- Focus: data and equipment exchange, validation of radiometric profiling methodology for solar forecasting
- Funded by research grant from eThekwini Municipality Energy Office

SPN-1 instrument

An ejector-based cooling system driven by waste-heat or solar energy (MSc)

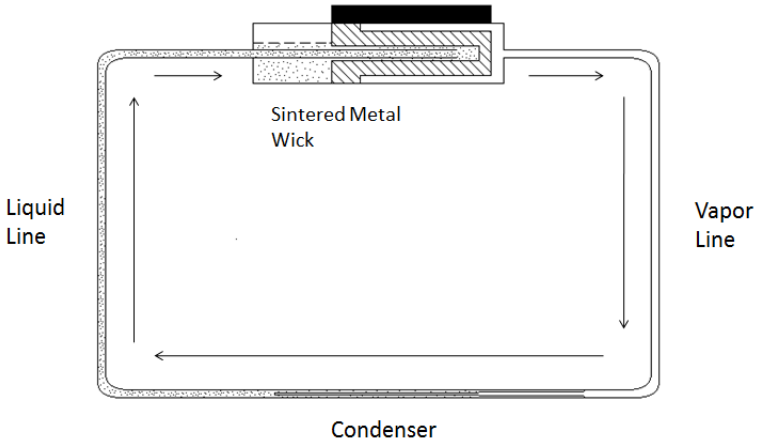
- Inclusion of an ejector within a pulse thermal loop heat transfer system to achieve pump-free cooling
- Transient, compressible, two-phase ejector flow modelled numerically





A loop heat pipe system for energy efficient thermal management (MSc)

- To our knowledge, a first in South Africa
- Applications: passive cooling of computer systems, spacecraft thermal management
- Steady-state thermal network model developed in conjunction with an experimental prototype



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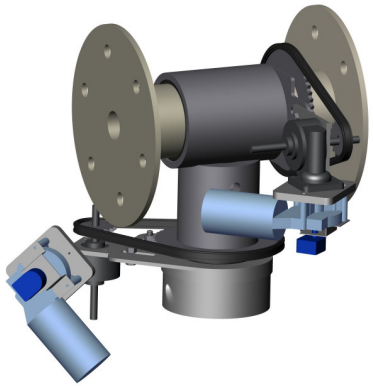
Development of a prototype heliostat

- 2011 undergraduate project (3 students)
- 5 m^2, azimuth-elevation tracking, standard glass mirror, compound curvature
- Great lessons in manufacturing precision and worm gear drives!

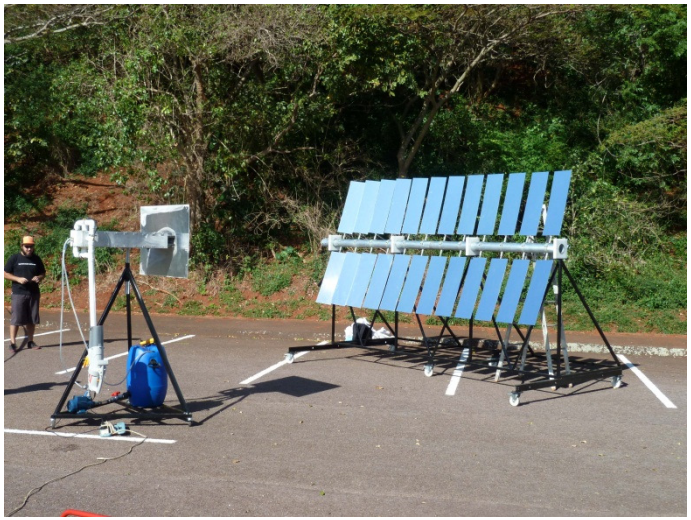


Paraboloidal solar concentrator and phase-change energy storage system

- 2012 undergraduate project (3 students)
- Heat transfer fluid: thermal oil, phase-change material: paraffin wax
- Mounted on dual-axis Small Power Systems tracker with 0.05 degree accuracy

A novel solar furnace concentrator system

- 2012/13 undergraduate project (3/2 students)
- Combines a “compound” linear Fresnel concentrator with a 2D compound parabolic concentrator
- Designed for medium-flux operations (~ 400 suns)



A novel solar furnace concentrator system

Some advantages:

- Interconnected facet arrangement reduces wind-induced azimuth torque
- Exclusively driven by linear actuators
- Relatively simple optics manufacture (no compound curvature)
- Distributed loading for rooftop lab operation

In Conclusion

- Solar thermal research is alive and kicking at UKZN
- A sharpening of research focus will enable GSET to build momentum into the future
- GSET aims to be nimble in its operation and to pursue human capital development and knowledge generation in research avenues of national importance
- We look forward to working with you!