MFAA
Array Prototypes

Pieter Benthem - ASTRON
Marco Drost - ASTRON

Array Prototypes

- Intro
- SOW
  - EMBRACE
  - SKA Karoo site environmental prototypes (Marco Drost)
  - SKA Karoo site array verification system
- Convince?

EMBRACE

- Get to know the system and astonishing results (Torchinsky)
- Create an EMBRACE to-do list (all)
- Get back to you in ~20 minutes. :-)

MFAA-environmental prototypes at South Afrika SKA site

Marco Drost

Who did what, and who paid for it?

Who were involved

- Andre Walker (SKA site SA)
- Eim Mulder
- Hiddo Hanenburg
- Marchel Gerbers
- Marco Drost
- Pieter Benthem
- Raymond van den Brink

Production:19 companies involved:

- VDL wientjes Roden
- 3EL
- BOZ
- GuDi
- Partnertec/hummiseal
- Greijn Form Technics
- Kunststof Frees Techniek
- Topa packaging
- Vinemare
- Salomons
- Technische Unie
- International Forwarding Services

Ministerie van Economische Zaken, Landbouw en Innovatie
SNN
SAMENWERKINGSVERBAND NOORD-NEDERLAND
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ASTRON Netherlands Institute for Radio Astronomy
NWO Netherlands Organisation for Scientific Research
SKA AFRICA SQUARE KILOMETRE ARRAY

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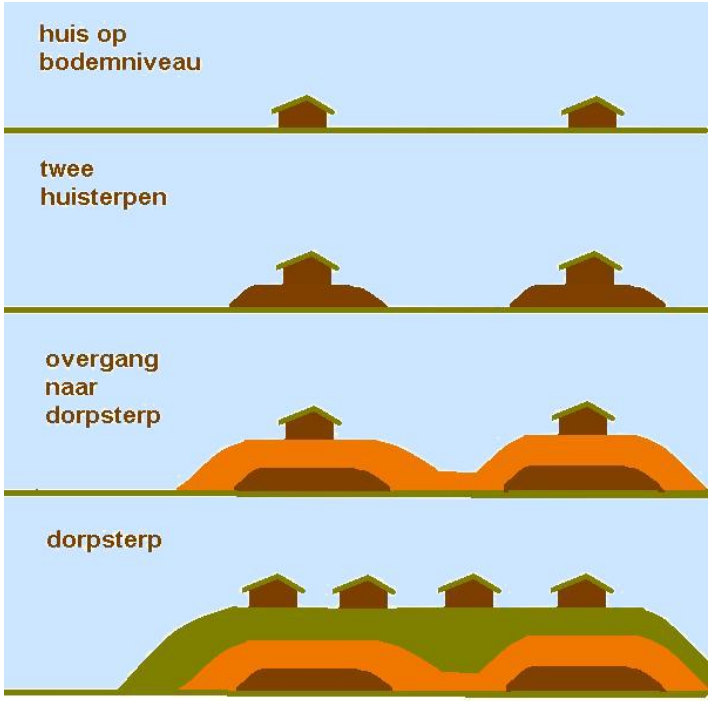
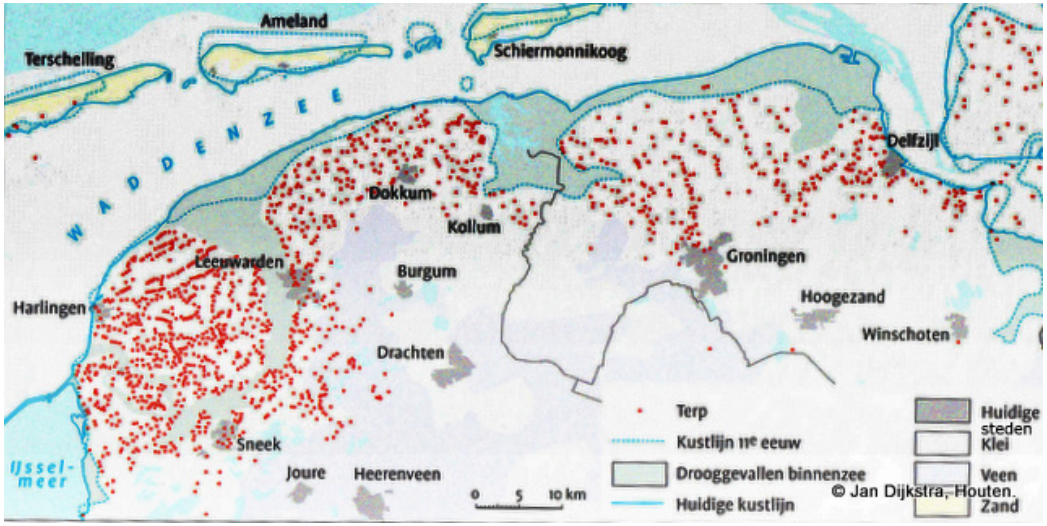
Presentation content

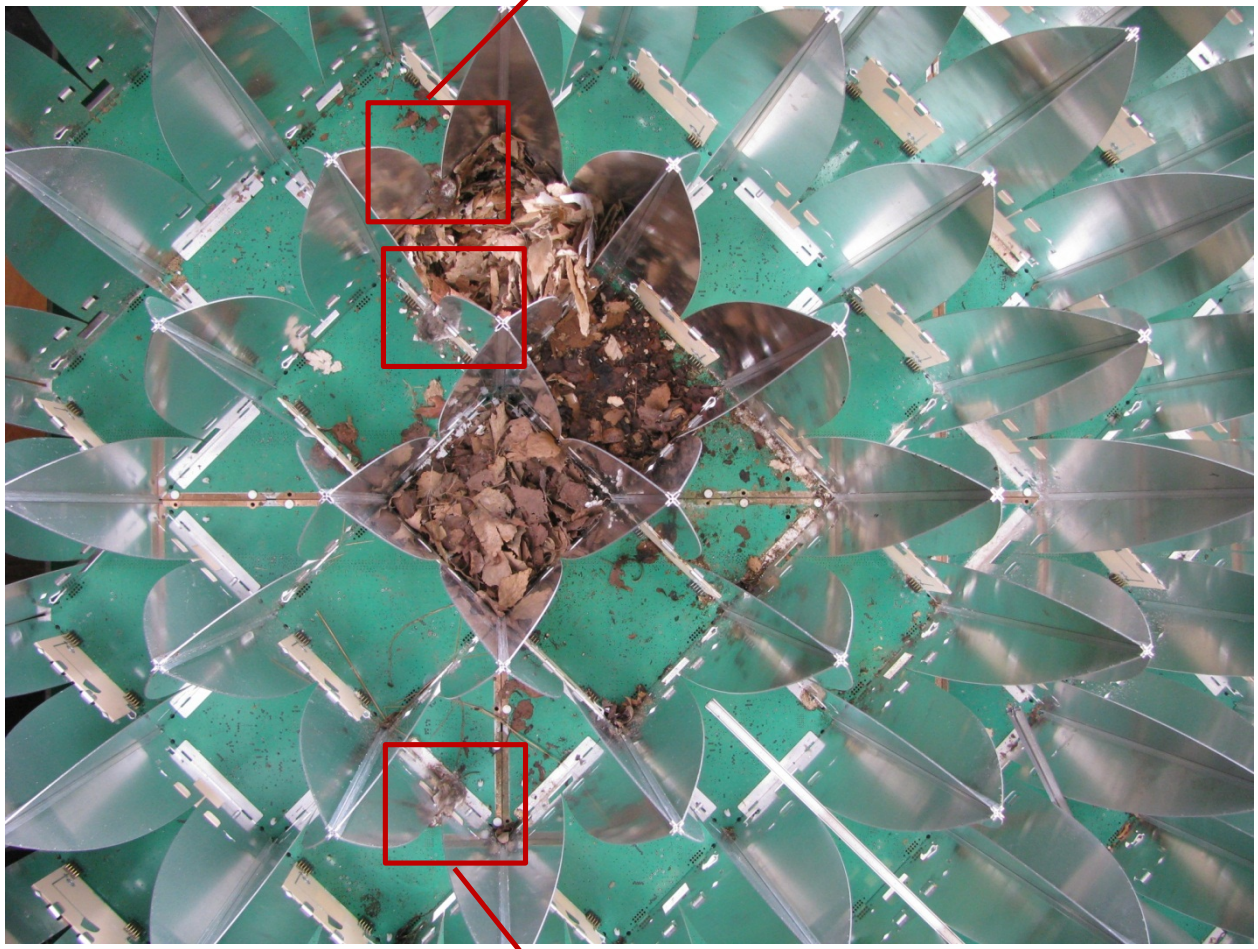
- Purpose environmental prototypes
- Thermal aspects
- Prototypes details
- Anchoring
- Early lessons learned

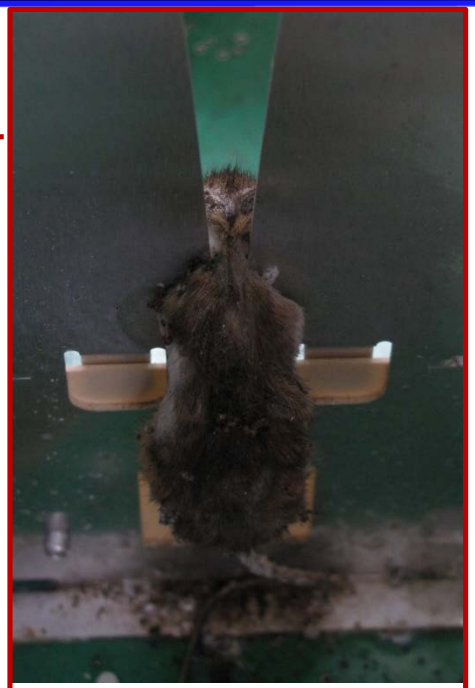
Dutch terp (artificial dwelling hill)

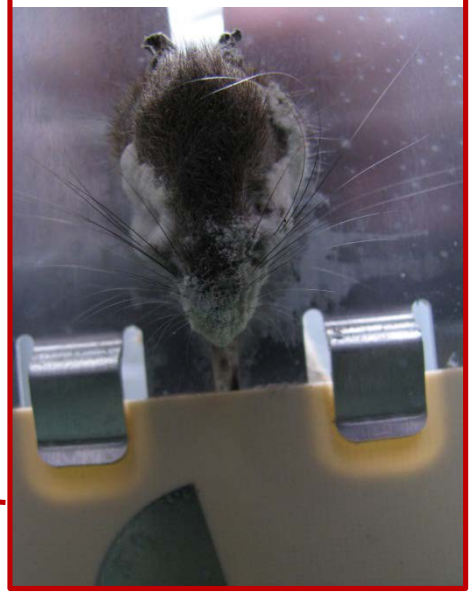




EMBRACE Mouse catcher

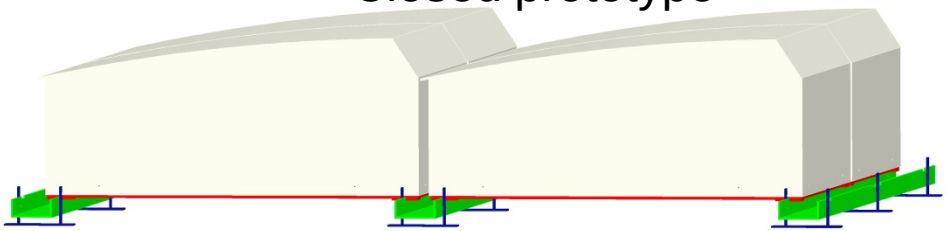




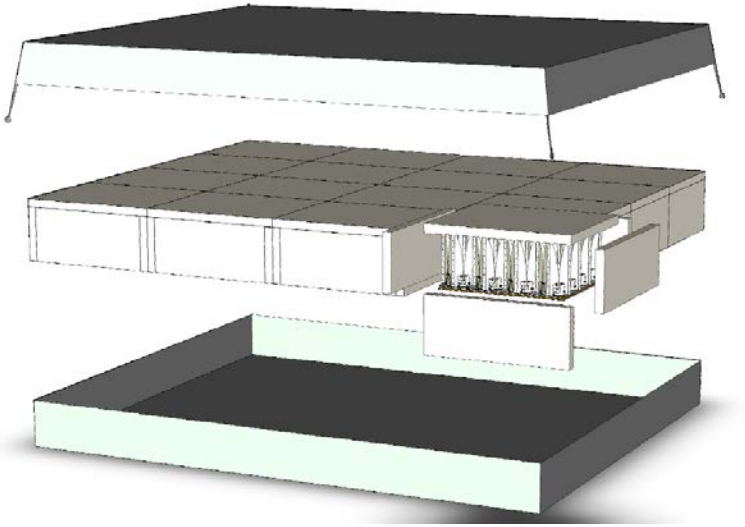


Four prototypes

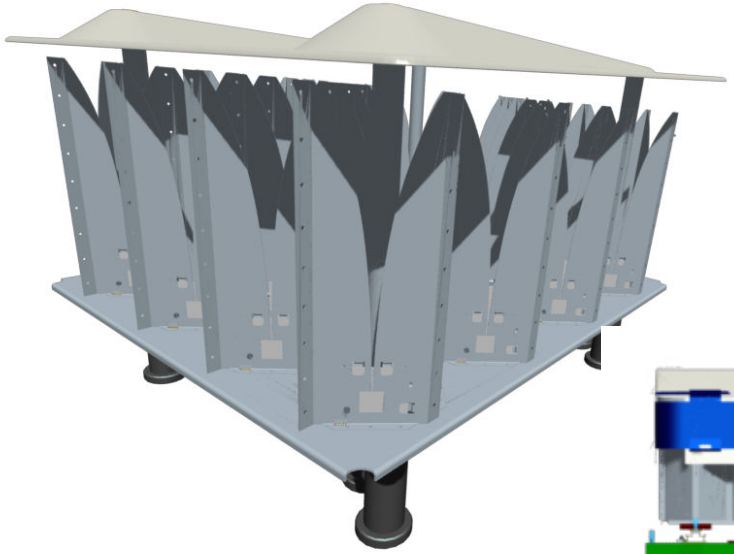
Closed prototype



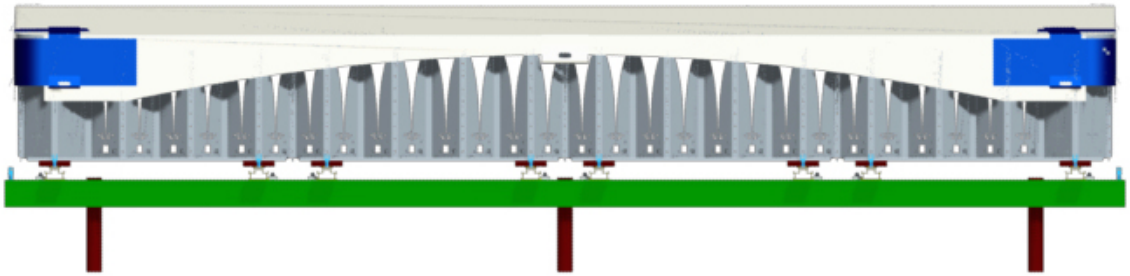
Insulated prototype



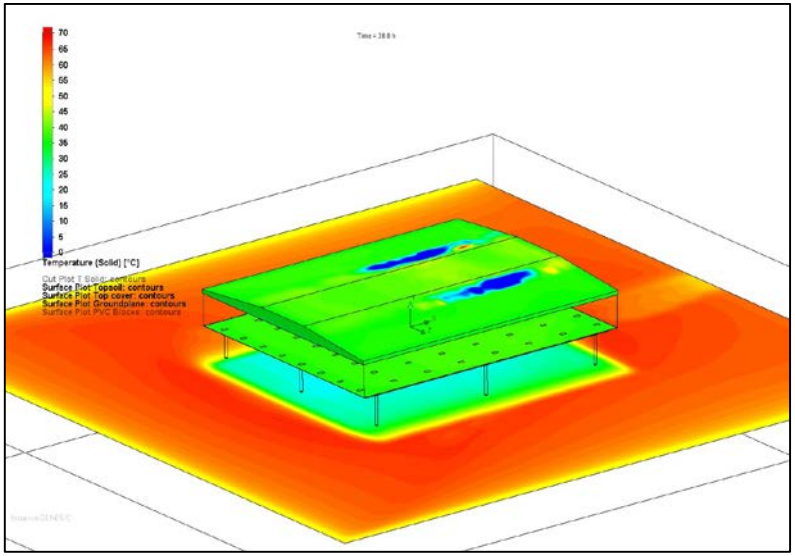
Open modular prototype



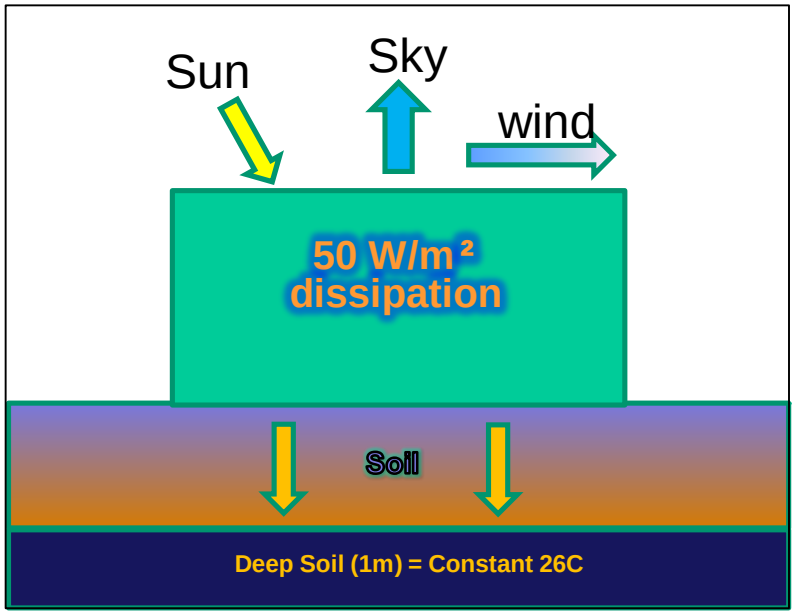
Open large prototype



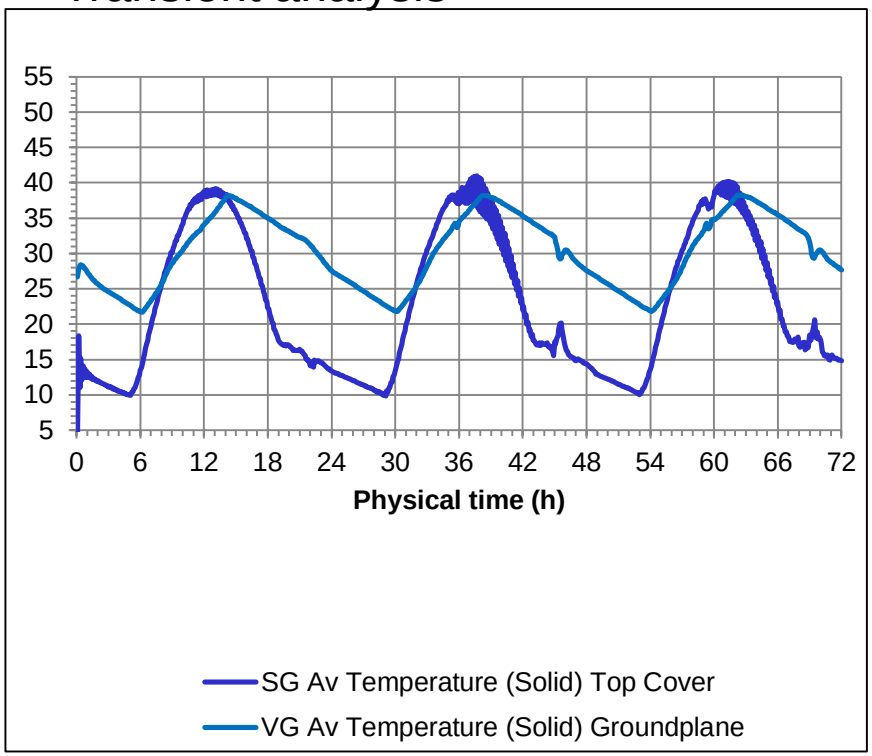
Thermal analysis



Basic model



Transient analysis



Thermal analysis result summary

Comparison of Prototype Designs

			Closed	Insulated	Open	Open Large
	T max	°C	47	41	41	38
Top	T min	°C	11	13	11	10
Of	Material		PP	EPS	PP	EPS
Box	Daily expansion	mm/m	5.4	2.0	4.5	2.0
	T max	°C	51	54	36	38
Ground-	T min	°C	28	47	20	22
plane	Daily expansion	mm/m	0.5	0.2	0.4	0.4
	Max ΔT in time	°C/h	3.3	1.1	1.9	1.9

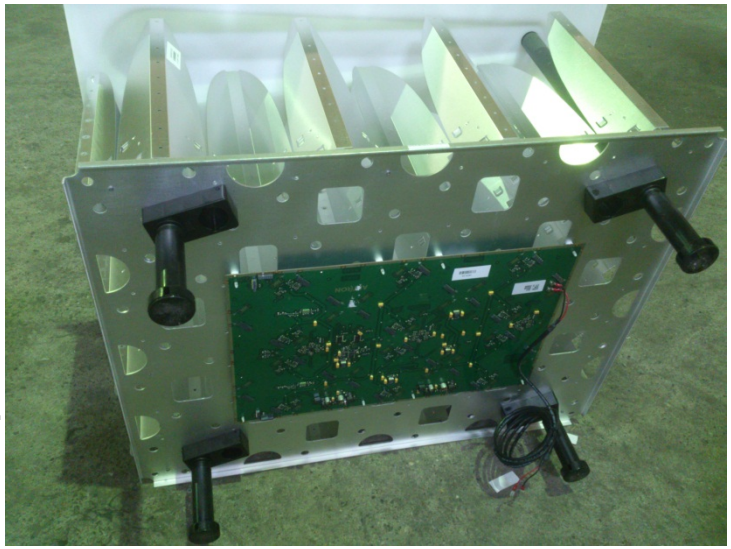
Electronics (power dissipation)

Closed prototypes:

- 4 EMBRACE tiles
- 4 connector boards
- Dissipation ~50W /tile

Aspects to be tested:

- Variety of connectors
- Cabling
- Shielding
- Variety of components
- Connection to antenna.
- Feed board
- Corrosion



Open prototypes:

- 4 hex boards
- 4 connector boards
- Dissipation ~16W/hex

Closed prototype

- Production method: based on injection moulding
- Materials: PP
- Housing design: Closed
- Antenna type: interrupted (EMBRACE tile)
- Placement: Rain gutter frame
- Anchoring: weight
- Coating board: non
- Thermal aspects (simulated):
  - Highest ΔT over time
  - High Tmax

Insulated prototype

- Production method: based on LOFAR HBA
- Materials: EPS and PVC foil
- Housign design: Closed
- Antenna type: interrupted (EMBRACE tile)
- Placement: On the soil as is
- Anchoring: Ground anchors
- Coating board: non
- Thermal aspects (simulated):
  - Lowest ΔT over time
  - Highest Tmax

Open large prototype

- Production method: Antenna as structure
- Materials: Al frame, EPS and PVC foil
- Housing design: Open
- Antenna type: Continued W-shape
- Placement: Al frame
- Anchoring: Weight and foil to frame
- Coating board: yes
- Thermal aspects (simulated):
  - low ΔT over time
  - low Tmax

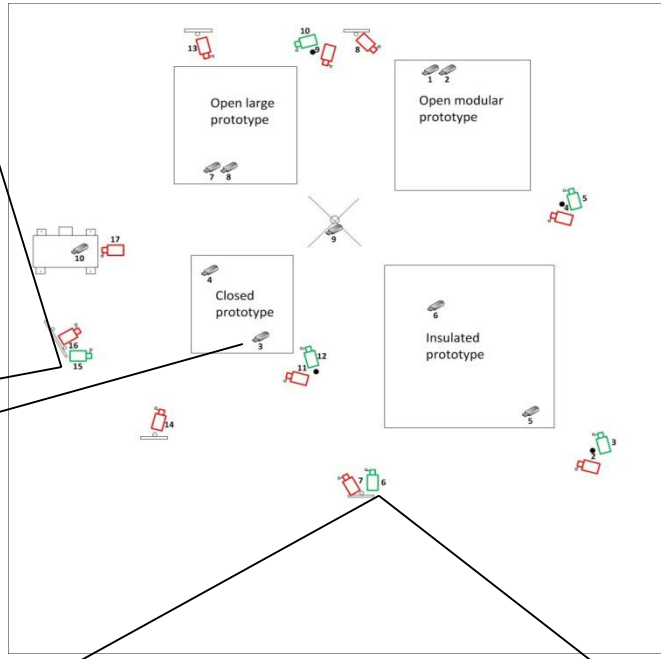
Open modular prototype

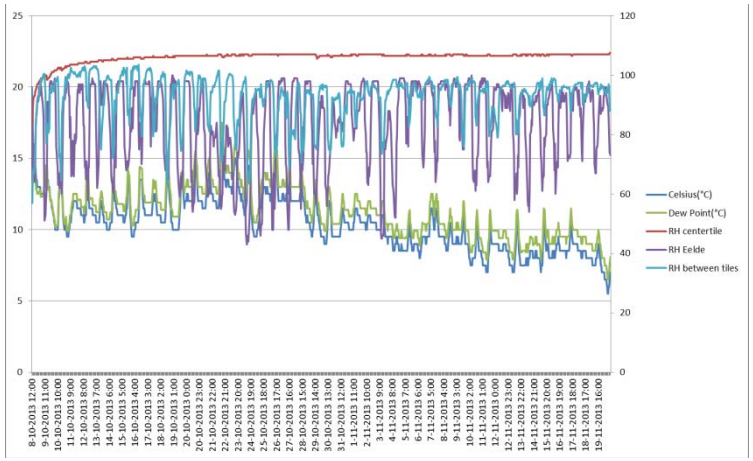
- Production method:
  - Vacuum formed roof
  - Injectionmoulded feet
  - Extruded roof pipes
- Materials: PP, PVC
- Housign design: Open
- Antenna type: interrupted W-shape
- Placement: Plastic feed
- Anchoring: Cable matrix, ground anchors
- Coating board: yes
- Thermal aspects (simulated):
  - Low ΔT over time
  - Lowest Tmax

Environmental prototypes (result)

Check up procedure

- Location of sensors
- Photo location and direction





Anchor (endurance) test

- Max holding and setting: 11 types tested
- Endurance test: 5 where used
- Prototypes: 2 types where used for the prototypes

Early lessons learned

- Transporting something over seas is not that easy
- South Africans are greet people to work with
- South Africa is beautiful
- Big country
- Fun to drive with a 4x4
- It can rain a lot
- Many hands make light work and anything is possible
- Very warm
- High solar loads
- A lot of dust especially in combination with wind

- Which results in looking like this!

Lessens learned!

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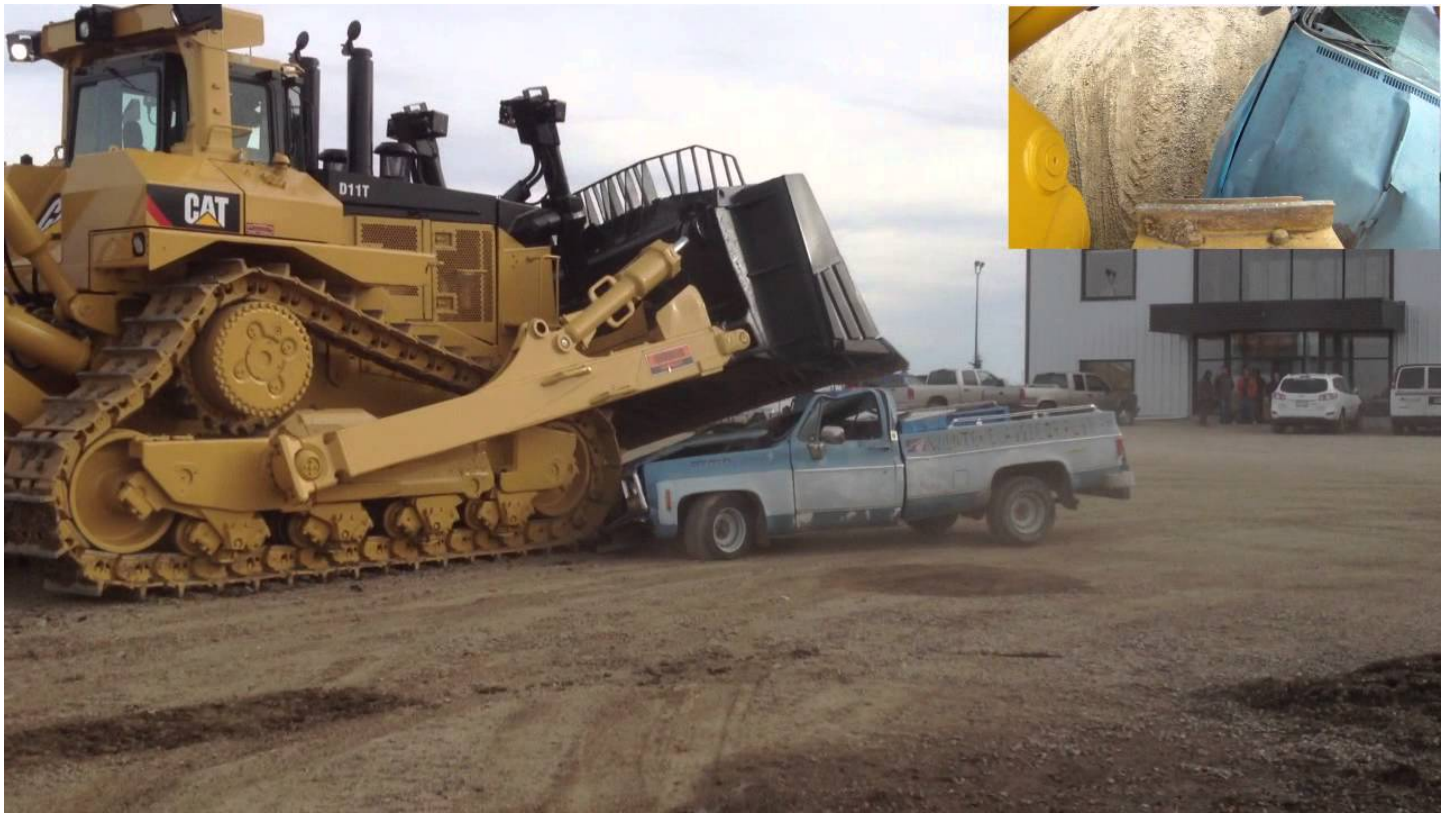
- We’re back!
- Any good thoughts or…..



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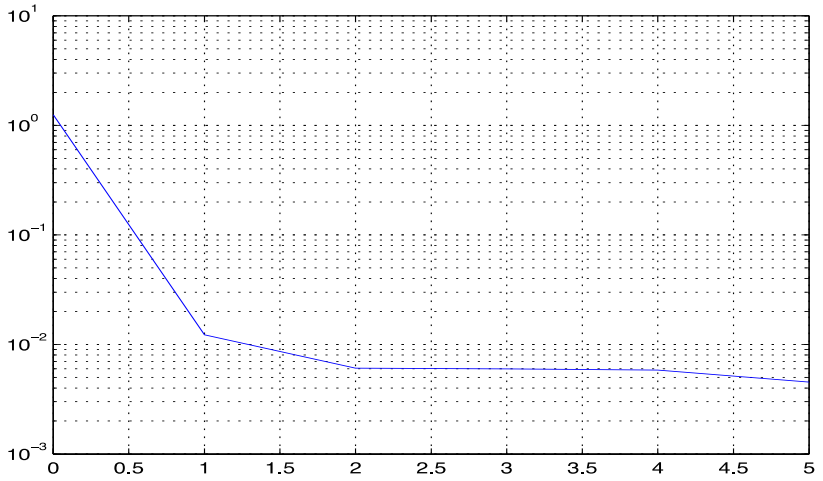
- **Tell me what to type here….. !**

EMBRACE

- **Continue with engineering tests providing relevant information as input for the next AA-Mid demonstrator.**
  - Subjects are: (on frequency, scan angle, time, ….)
    - beam shape
    - Stability
    - sensitivity
- **Improve (tileset) calibration**
  - What is holding us from improving beyond the current accuracy?
  - Create and maintain phase calibration database, to obtain a better defined pointing model.
- **Increase bandwidth**
  - Use all beamlets of current backend
  - Upgrade to Uniboard (2) backend



EMBRACE

- **Regular observations (semi weekly) of pulsars, CasA, CygA and TauA to demonstrate EMBRACE as a facility instrument.**
  - a good demonstration of long term stability and reliability
  - demonstrate dual beam widely separated simultaneous pulsar detections
  - possible detection of an accretion event on B0329
  - Simultaneous observations of Cas A and Cyg A and demonstrate beam swapping to find the flux ratio of the celestial sources;
  - Long term observations of Cas A, to measure 1% flux change and demonstrate long term stability of EMBRACE and flux calibration.
- **Galactic observations (M33 / M31 / M42)**
  - Multi beaming
- **Create full HI map**
  - Dwingeloo – Leiden survey
  - Detect Galactic neutral hydrogen with higher sensitivity;
- **VLBI with EMBRACE@Nancay and EMBRACE@Westerbork**
- **Correlate with WSRT dish**
- **Summer school / busy week(s)**

On site array verification system

- Testbed Frontend workpackage prototypes
  - Full signal chain test setup
  - Prototype arrays

- RFI monitoring
- MFAA initial station(s), including beamformer & postprocessing

Questions?