VERIFICATION OF SOIL MOISTURE ANALYSIS FROM ACCESS GLOBAL NWP MODELS

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An Australian Government Initiative

Data sets

◘ **CosmOz**

- 13 sites, 9 calibrated
- Cosmic ray probes
- Measures fast neutrons
- Varying depth profiles
- Measurement depth decreases non-linearly with increasing soil moisture.
- Larger horizontal foot print, about 660 m in diameter at sea level.

◘ **NWP**

- ACCESS-Global, ECMWF Operations
- APS1 ~40 km
- APS2 ~25km
- ECMWF-Op ~25km.
- ACCESS → Soil moisture nudging
- ECMWF → EKF

CosmOz site locations
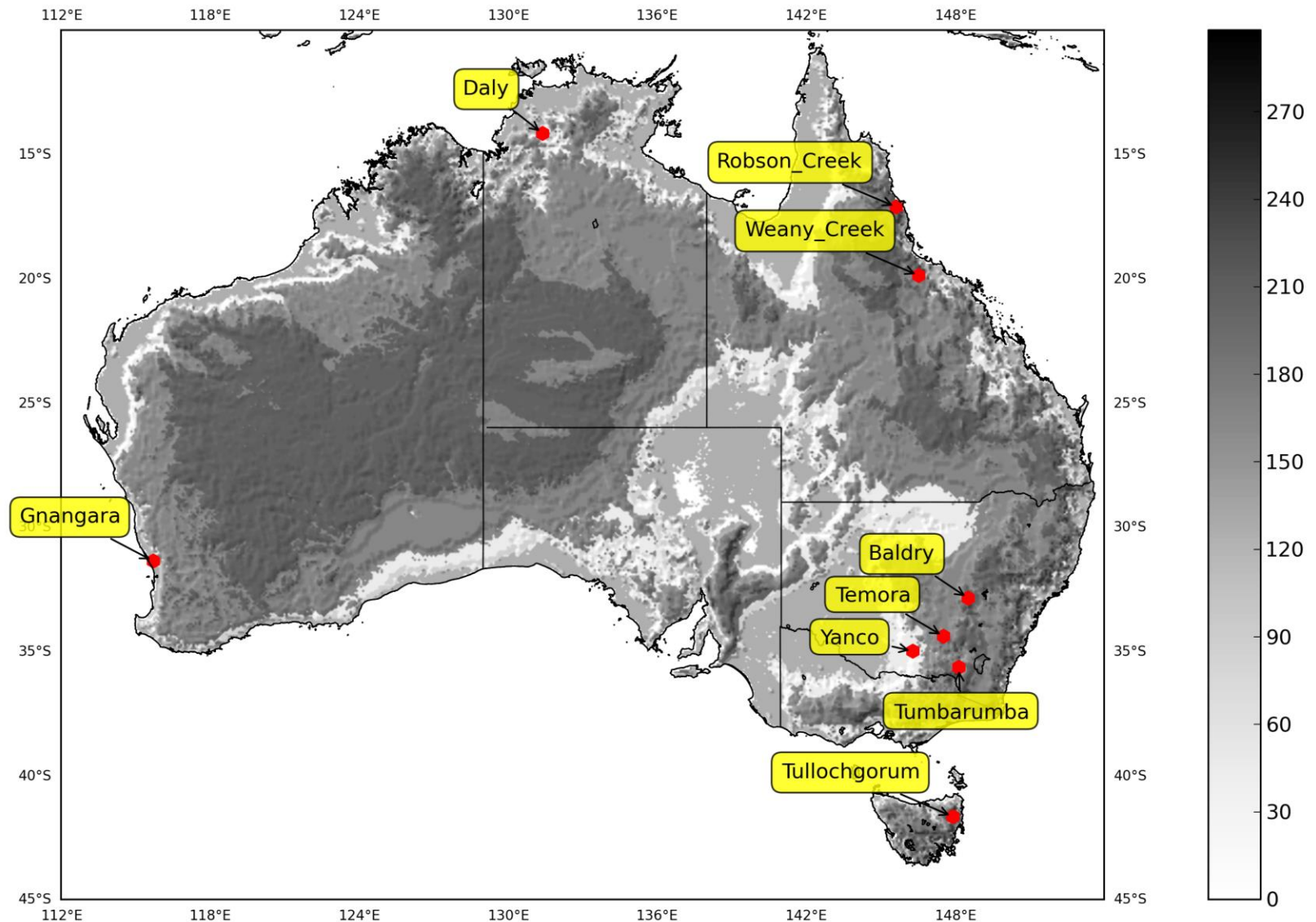
Data prep. & verification metrics

� Verification periods

- 1st Dec 2013 to 28th Feb 2015 (15 months)

�a Normalized soil moisture

- $SM_{Norm} = \dfrac{SM - SM_{Min}}{SM_{Max} - SM_{Min}}$

�a Anomalies

- $A(i) = \dfrac{SM(i) - \overline{SM(F)}}{\sigma_{SM(F)}}, \quad i = day \text{ and } F = [i - 15, i + 15]$

� CIs for correlation estimates

- $z = 0.5 \ln\left(\dfrac{1+r}{1-r}\right) \qquad \sigma = \sqrt{1/(N_{eff} - 3)}$

- $N_{eff} = N \dfrac{(1 - r_a r_b)}{(1 + r_a r_b)}$

Depth weighting of NWP soil moisture

Based on Franz et al., 2012.

$$wt(z) = \int_{Z_{n-1}}^{Z_n} a\left(1 - \left(\frac{z}{z^*}\right)^b\right) dz$$

wt - Weight
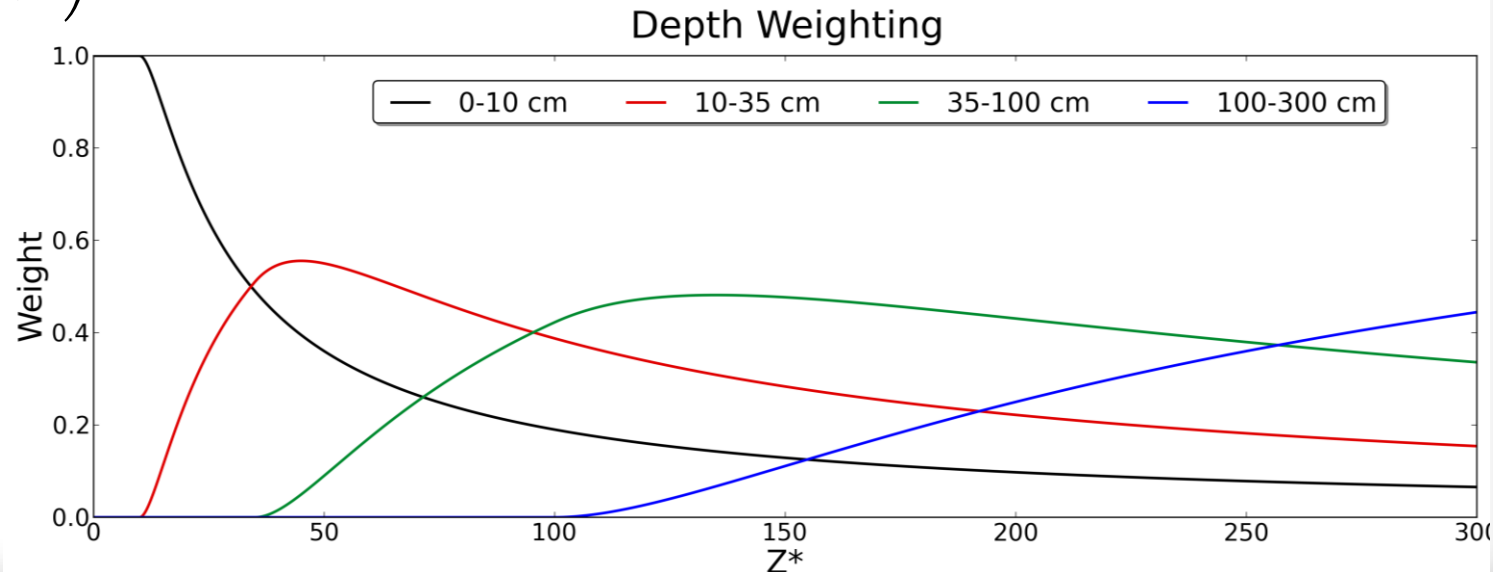z^* - CosmOz sensing depth
Z_n - Model soil layer depth at layer n
a,b - Constants

a is defined by:

$$1 = \int_0^{z^*} a\left(1 - \left(\frac{z}{z^*}\right)^b\right) dz$$

Depth Weighting

Legend: 0-10 cm, 10-35 cm, 35-100 cm, 100-300 cm

Axes: Weight (y-axis), Z* (x-axis)

Skill scores - Normalized

Metrics	APS1	APS2	ECMWF
Mean Correlation [-]	0.82	0.80	0.81
Anomaly Correlation [-]	0.49	0.56	0.58
Mean Bias [-]	-0.04	-0.06	-0.04
Mean RMSD [-]	0.16	0.17	0.17

Skill scores - Volumetric

Metrics	APS1	APS2	ECMWF
Mean Correlation [-]	0.82	0.80	0.81
Anomaly Correlation [-]	0.49	0.56	0.58
Mean Bias [m^3/m^3]	-0.06	-0.01	-0.08
Mean RMSD [m^3/m^3]	0.11	0.08	0.10

R & Cls

Normal
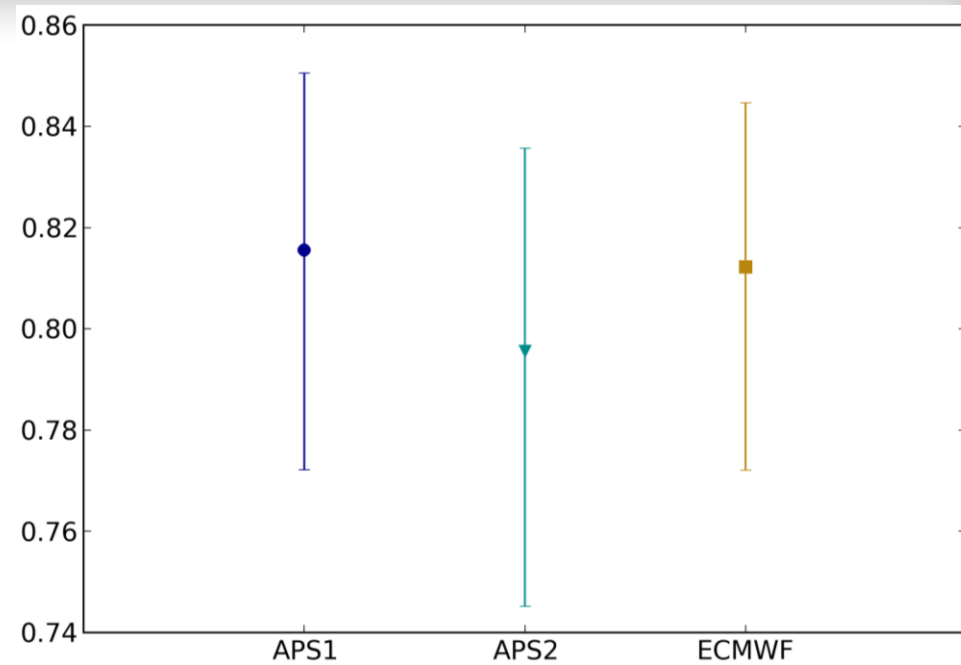
Anomalies
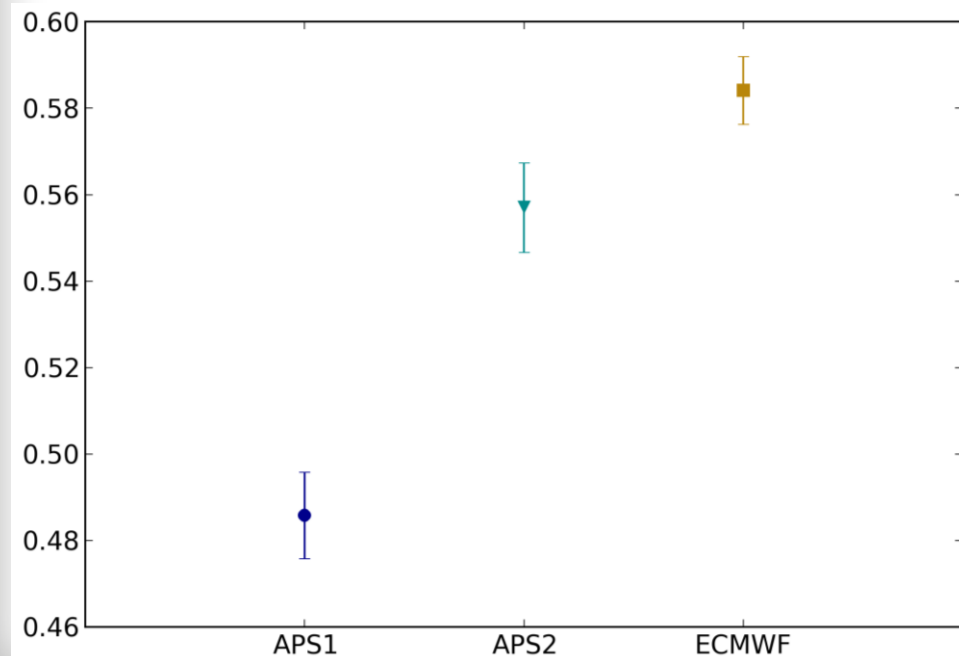
Taylor Diagram
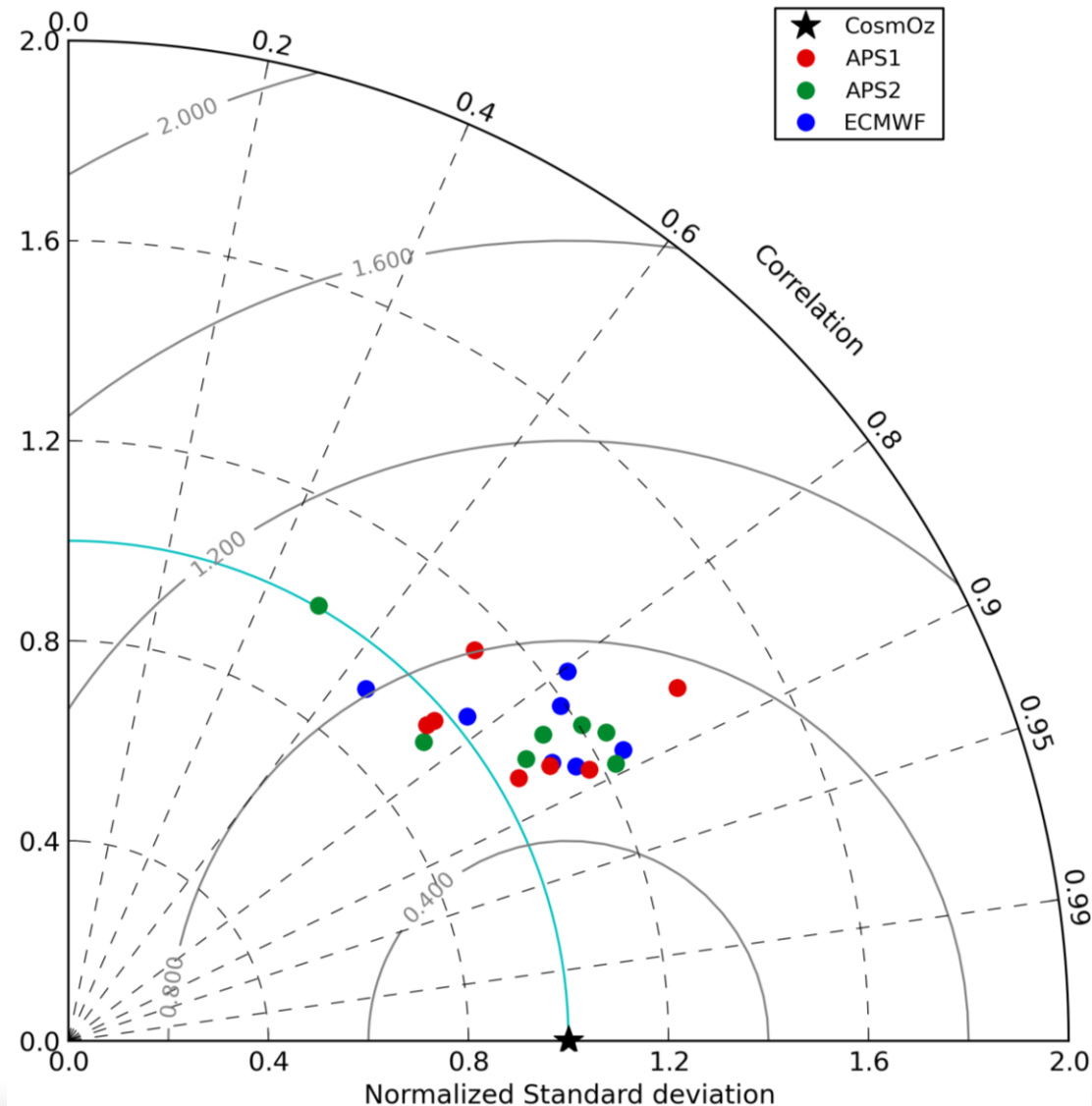
ASCAT SWI vs CosmOz Obs.

Station	Correlation[-]	Bias[-]	RMSD[-]
Baldry	0.83	-0.01	0.14
Daly	0.87	-0.1	0.16
Tullochgorum	0.69	0.07	0.18
Tumbarumba	0.4	0.26	0.35
Weany Creek	0.82	0.01	0.12
Yanco	0.83	-0.13	0.19
Average	0.74	0.01	0.19

- Verification period: 01 May 2012 to 31 December 2014 (**32 months**)
- Both ASCAT & CosmOz are **normalized** using their respective max & min values.
- SWI is derived using an **exponential filter** (T=3 days) to ASCAT surface soil moisture.

Conclusions & Future Work

Metrics	APS1	APS2	ECMWF
Mean Correlation [-]	0.82	0.80	0.81
Anomaly Correlation [-]	0.49	0.56	0.58

- All three models show fairly similar skills.

- Future plan is to develop an LDAS for Australia.

  - Based on the work funded by BoM & BNHCRC.

- LDAS plans:

  - 5 km resolution.

  - Primary use for fire danger ratings, NWP initialization.

  - Assimilate ASCAT & SMOS retrievals, LST

  - Use improved model datasets (e.g. soil texture, veg. frac., land-use etc.).

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THANK YOU

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