A Method for the Hierarchy of CALMO_MAX Tests (Reviseted)

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MOTIVATION

- Towards the effort of model opimization and upon gauging the model sensitivity, when the number ***n*** of considered model parameters increases, the number of their *pair* combinations regarding their min and max values *vastly* increases [$O(2\boldsymbol{n})^2$].

- In CALMO_MAX project , considering an extensive period of COSMO Model testing of order 1 year over a horizontal grid of ~1km, the number of tests becomes of $O[10^2(2\boldsymbol{n})^2]$ and upon the accounting of *intermediate* parameter values regarding the use of a metamodel, the number of tests rises to $O[10^3(2\boldsymbol{n})^2]$ or the equivalent of runs for 3 centuries for *n=5* !!

- An efficient methodology to constrain the number of tests should be to indicate their impact according to some quantitative criteria and decide upon the resulting *priority*.

- The methodology is expected to be of practical value if two goals could be accomplished:
  - The tests get a *priority order* and are performed according to it.
  - If the number of tests becomes too extensive, the method should be *flexible* enough to be terminated at the priority that suits the available computational resources. The recommended truncation, however, needs to be supported by some valid scientific arguments regarding the relative importance of the tests that will be included against those that will be omitted.

The proposed methodology will be presented in *STEPS* and *in reference* to the web presentation in the 17th COSMO General Meeting in Wrocław:

"Design and Evaluation of Sensitivity Tests for CALMO Project"

available at:
http://www.cosmo-model.org/content/consortium/generalMeetings/general2015/parallel.htm

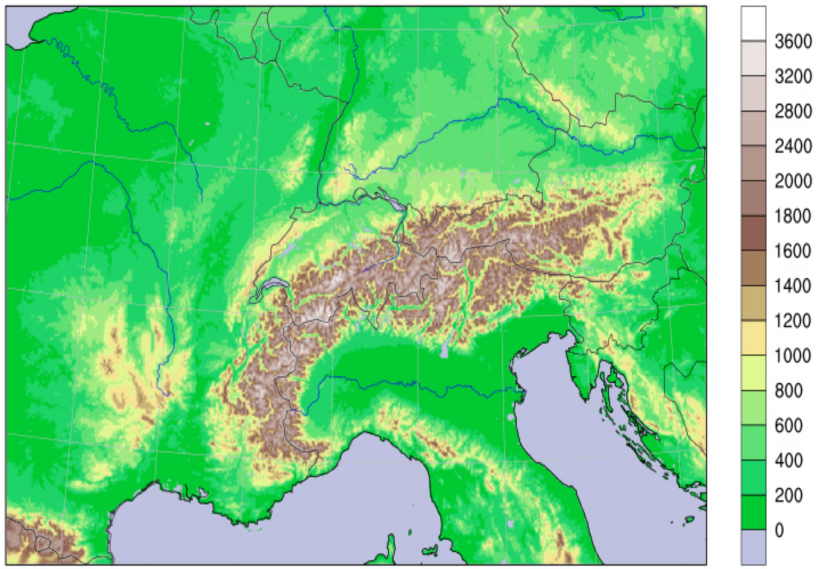
and referred as **EA_COSMO_GM_2015** herein.

STEPS OF THE METHOD

STEP 1

Decide the domain where the metamodel will be used for optimization.

In the application of the method, a domain that includes Switzerland and Northern Italy areas over a horizontal grid of ~1Km is chosen , i.e.



STEP 2

Choose the parameters that will be optimized by the meta model.

PARAMETER	INTERPRETATION	RANGE	TEST VALUES (default)
uc1	Parameter controlling the vertical variation of critical relative humidity for sub-grid cloud formation	0.0-1.0	0.0, 0.3, 1.0
radfac	Fraction of cloud water and ice considered by the radiation scheme	0.3-0.9	0.3, 0.6, 0.9
rlam_heat	Scaling factor of the laminar boundary layer for heat	0.1 – 2.0	0.1, 1.0, 2.0
tkhmin tkmmin	minimal value of diffusion coefficient for heat and momentum (kept equal)	0.1-1.0	0.1, 0.4, 1.0
v0snow	factor in the terminal velocity for snow	10.0 – 30.0	10.0, 20.0, 30.0

But *how* the priority order is going to be given?

This is presented in the following steps …

STEP 3:

- Decide on the *model variables* that will be used and tabulate them according to their importance denoted as *ranking* .
- At this stage of the work, this step is subjective but in my opinion, it can be done on meteorological arguments based on the internal knowledge of the model. The variables that are recommended below are as given in **EA_COSMO_GM_2015** but with some rearrangement according to their subjectively estimated importance.
- The subjective criteria on making this choice are not of importance for the presentation of the method and can be discussed at a later stage.

1. **< TOT_PREC>:** 0-24 hr period accummulated precipitation (kg m^{-2}).
2. **< TMIN_2M>:** Minimum 2m temperature 0-24 hr periods (every hr).
3. **< TMAX_2M>:** Maximum 2m temperature for 0-24 hr periods (every hr)
4. **< T_2M >:** 2m temperature for 0-24 hr periods.
5. **< TD_2M >:** Dew point temperature for 0-24 hr periods.
6. **< SNOW_GSP >:** 0-24 hr periods accumulated grid-scale snow (kg m^{-2})
7. **< CLCM >:** Medium cloud cover (%) average of 1hr time steps 03-24 hs.
8. **< CLCL >:** Low cloud cover (%) average of 1hr time steps 03-24 hs.
9. **< CLCH > :** High cloud cover (%) average of 1hr time steps 03-24 hs.

STEP 4:

Define the sensitivities (S) of these parameters. This is also a matter of choice. The choice made in **EA_COSMO_GM_2015** is followed.

$$S_{<P>}(\%) = \frac{<P>_{TEST} - <P>_{DEFAULT}}{<P>_{DEFAULT}} \bullet 100$$

$$<P> \text{ stands for } <SNOWGSP> or <TOTPREC> or <CLCL> or <CLCM> or <CLCH>$$

$$S_{\begin{bmatrix} TMIN\,2m \\ TMAX\,2m \end{bmatrix}} = \begin{bmatrix} <TMIN\,2m> \\ <TMAX\,2m> \end{bmatrix}_{TEST} - \begin{bmatrix} <TMIN\,2m> \\ <TMAX\,2m> \end{bmatrix}_{DEFAULT}$$

STEP 5:

- Perform *all* the model runs for the dates chosen for all the *default* values of the parameters chosen and produce *at least* *all* the considered variables mentioned before.

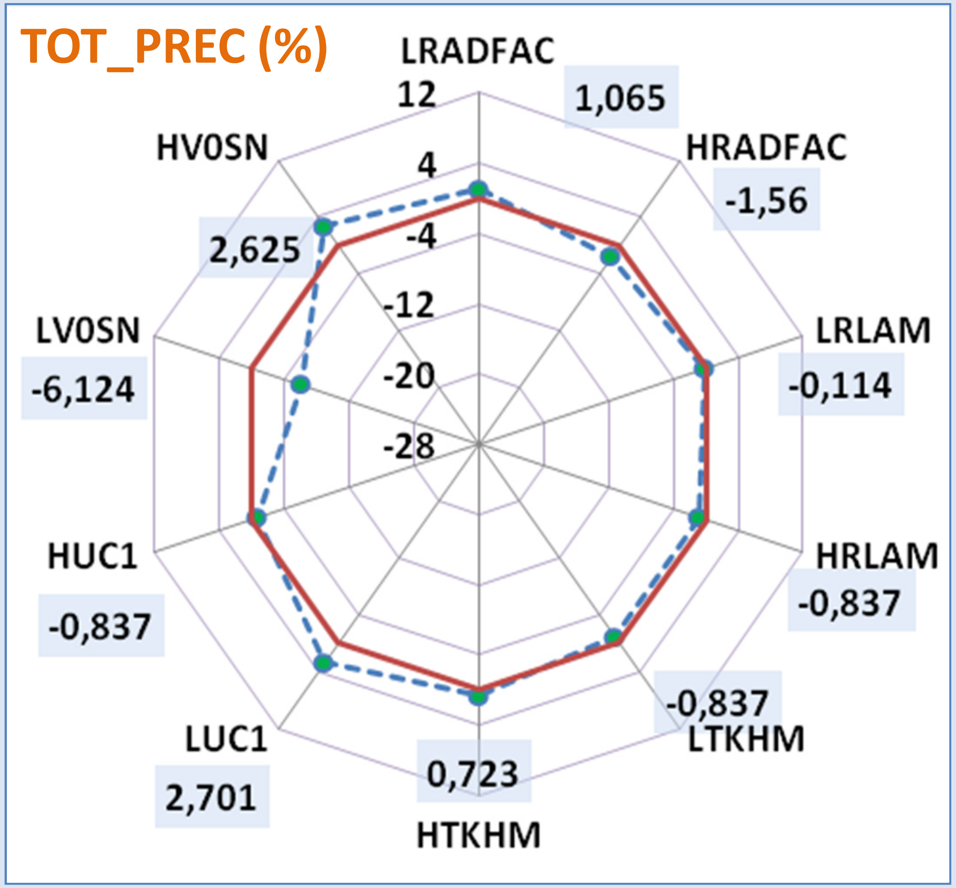
- Perform *all* the model runs for the dates chosen for all the *max* values of the parameters chosen and produce *at least* *all* the considered variables mentioned before.

- Perform *all* the model runs for the dates chosen for all the min values of all the parameters chosen and produce *at least* *all* the considered variables mentioned before.

In what follows, the results from **CALMO_MAX** are used for the whole 2013.

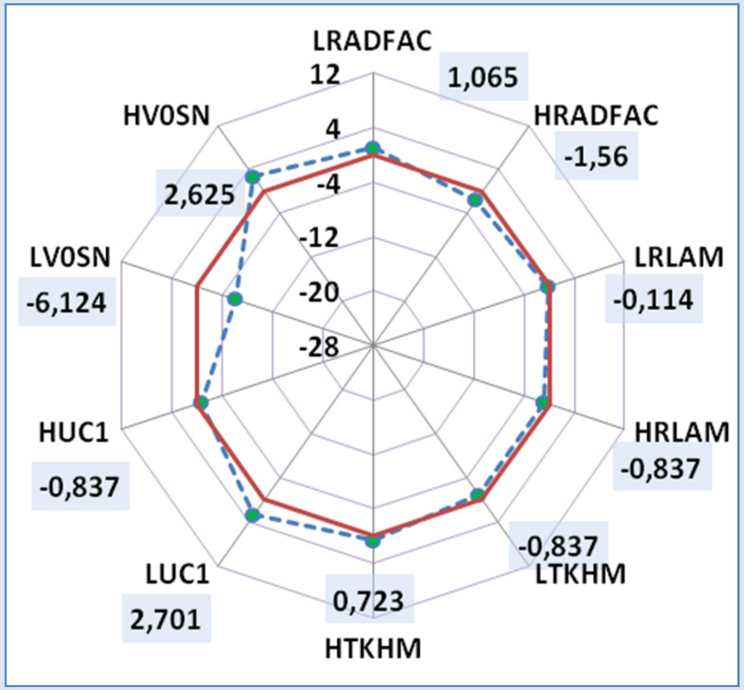
***STEP 6*:**

Present the sensitivity of the variable of the highest *ranking* in a ***spider-type*** graph, i.e TOT_PREC.



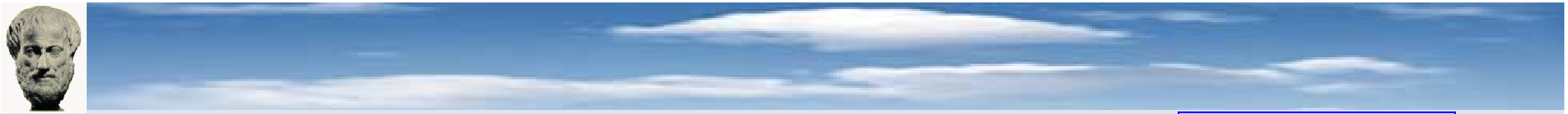
Analysis of STEP 6

- The red polygon refers to the *zero sensitivity "axis"*.
- The sensitivities are depicted with the green bullets ● .
- The dashed polygon line that connects the dots, although not neccessary in the present form of the method, denotes optically the overall sensitivity for the considered meteorological variable especially to the degree that it is *convex/concave and mainly in reference to the zero sensitivity red polygon*.

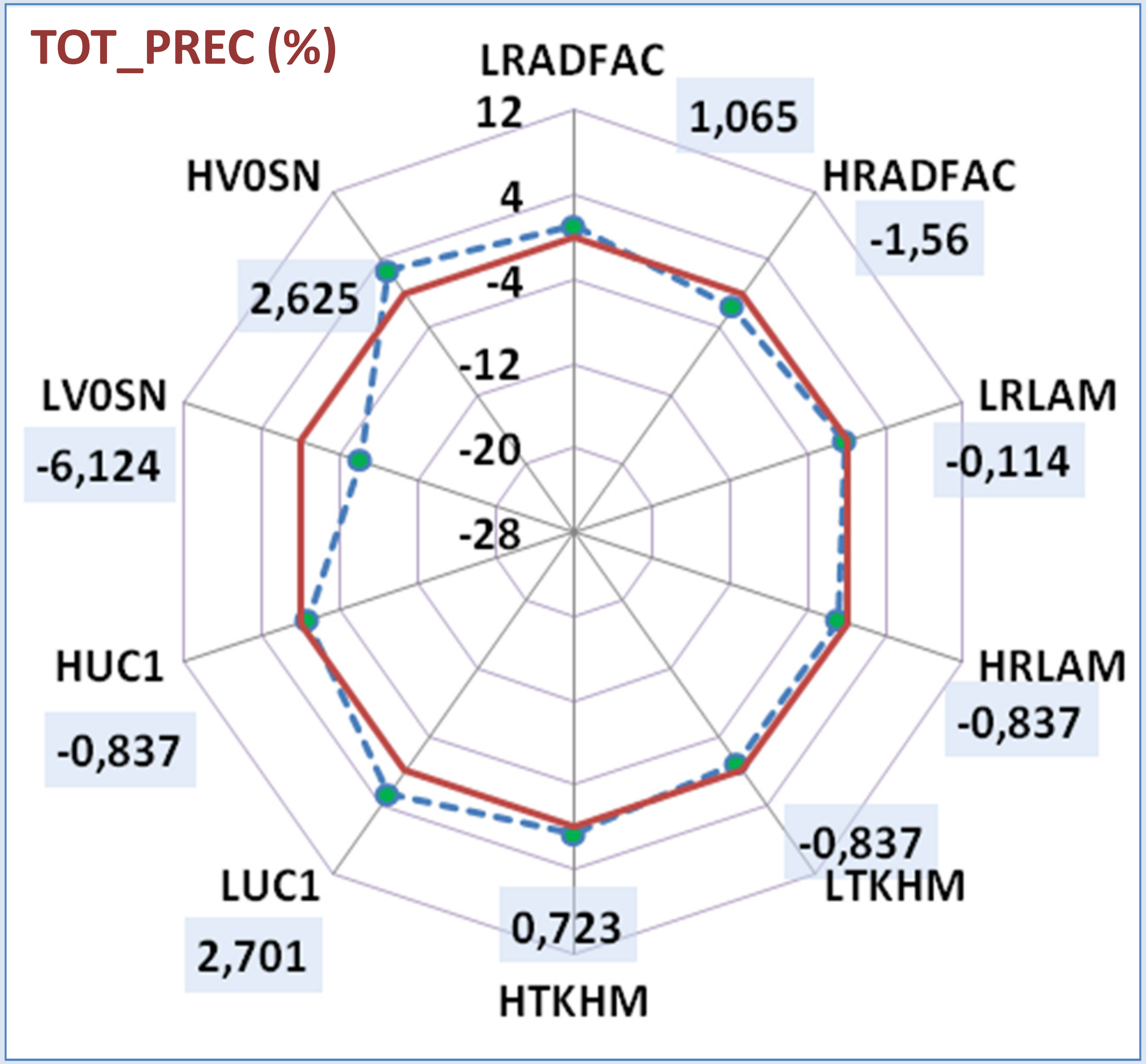


STEP 7:

- Evaluate the absolute values of the pair differences *for* all *different parameter sensitivities* given in the spider-type graphs.
- *Sort* these values and place them next to their corresponding spider graph «priority list».
- A value of «+1» or «-1» is also addressed to these differences depending whether the sensitivities have the same or different signs (i.e., they are at the same or opposite side of the sensitivity axis.
- The differences with the highest absolute value and sensitivities with *different* signs refer to the first group of combination of parameters with the highest priority.
- The differences with the highest absolute value and sensitivities with *the same* sign refer to the second group of combination of parameters with the highest priority.
- The same process is followed for all the considered meteorological fieds according to their estimated importance.



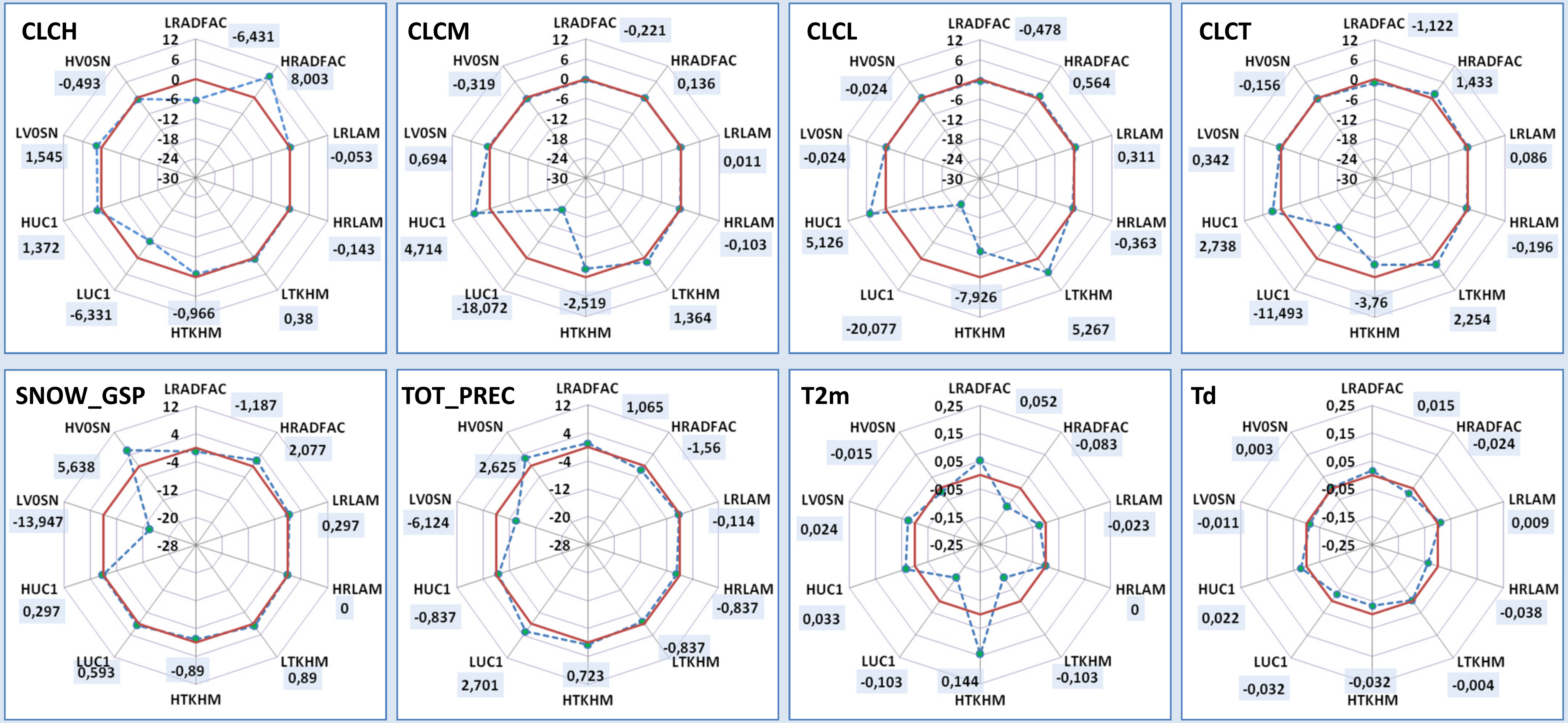
EXAMPLE OF STEP 7



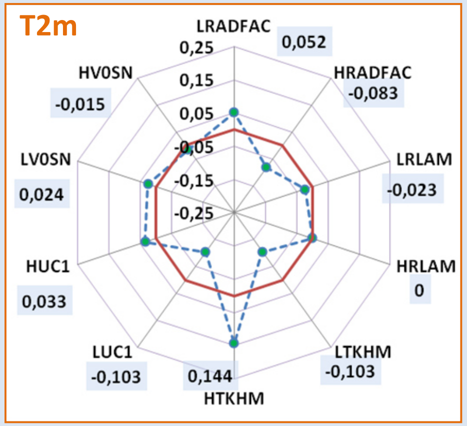
TOT_PREC		
LUC1-LV0SN:	8,825	-1
LRADFAC-LV0SN	7,189	-1
HTKHM-LV0SN:	6,847	-1
LRLAM-LV0SN:	6,01	1
LTKHM-LV0SN:	5,287	1
HUC1-LV0SN:	5,287	1
HRLAM-LV0SN:	5,287	1
HRADFAC-LV0SN	4,564	1
HRADFAC-LUC1:	4,261	-1
HRADFAC-HV0SN	4,185	-1
LTKHM-LUC1:	3,538	-1
HRLAM-LUC1:	3,538	-1
LTKHM-HV0SN:	3,462	-1
HUC1-HV0SN:	3,462	-1
HRLAM-HV0SN:	3,462	-1
LRLAM-LUC1:	2,815	-1
LRLAM-HV0SN:	2,739	-1
HRADFAC-HTKHI	2,283	-1
HTKHM-LUC1:	1,978	1
LRADFAC-LTKHM	1,902	-1
LRADFAC-HUC1:	1,902	-1
LRADFAC-HRLAM	1,902	-1
HTKHM-HV0SN:	1,902	1
LRADFAC-LUC1:	1,636	1
LRADFAC-HV0SN	1,56	1
HTKHM-HUC1:	1,56	-1
HRLAM-HTKHM:	1,56	-1
HRADFAC-LRLAN	1,446	1
LRADFAC-LRLAM	1,179	-1
LRLAM-HTKHM:	0,837	-1
LRLAM-LTKHM:	0,723	1
LRLAM-HUC1:	0,723	1
HRADFAC-LTKHN	0,723	1
HRADFAC-HUC1:	0,723	1
HRADFAC-HRLAI	0,723	1
LRADFAC-HTKHN	0,342	1
LUC1-HV0SN:	0,076	1
LTKHM-HUC1:	0	1
HRLAM-LTKHM:	0	1
HRLAM-HUC1:	0	1

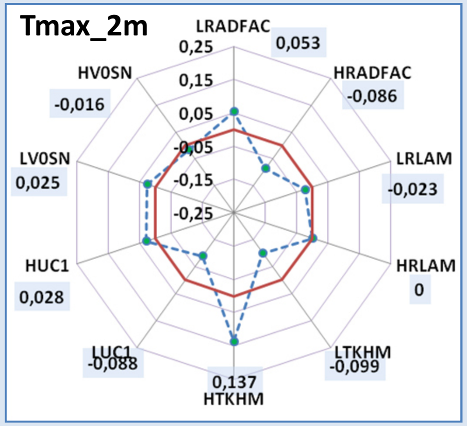
Nevertheless ,the spider-graphs provide a fair indication of the most sensitive parameters. However, it is higly recommended to put special care on the axis scaling.

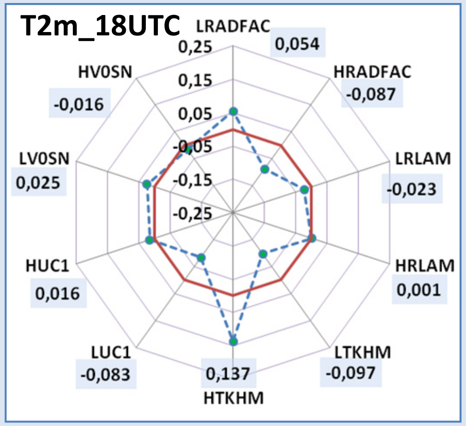
PANORAMA OF SENSITIVITIES OVER THE WHOLE 2013

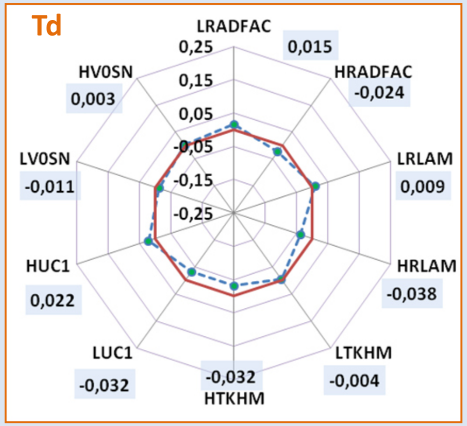


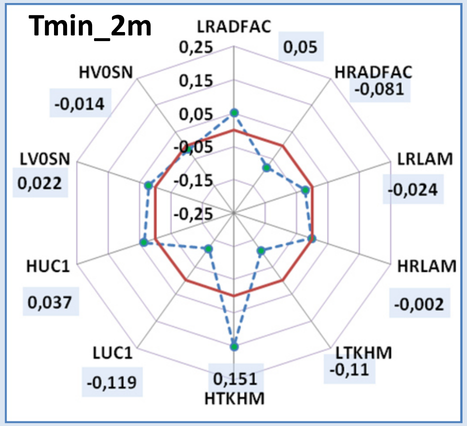
PANORAMA OF SENSITIVITIES OVER THE WHOLE 2013

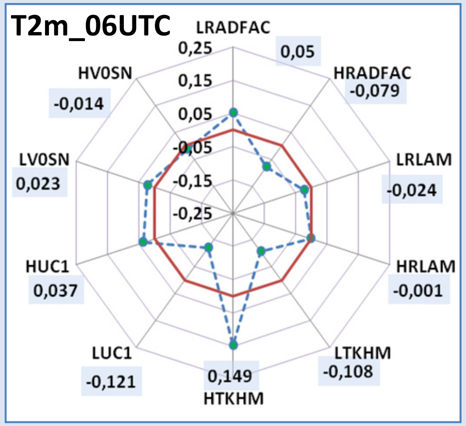






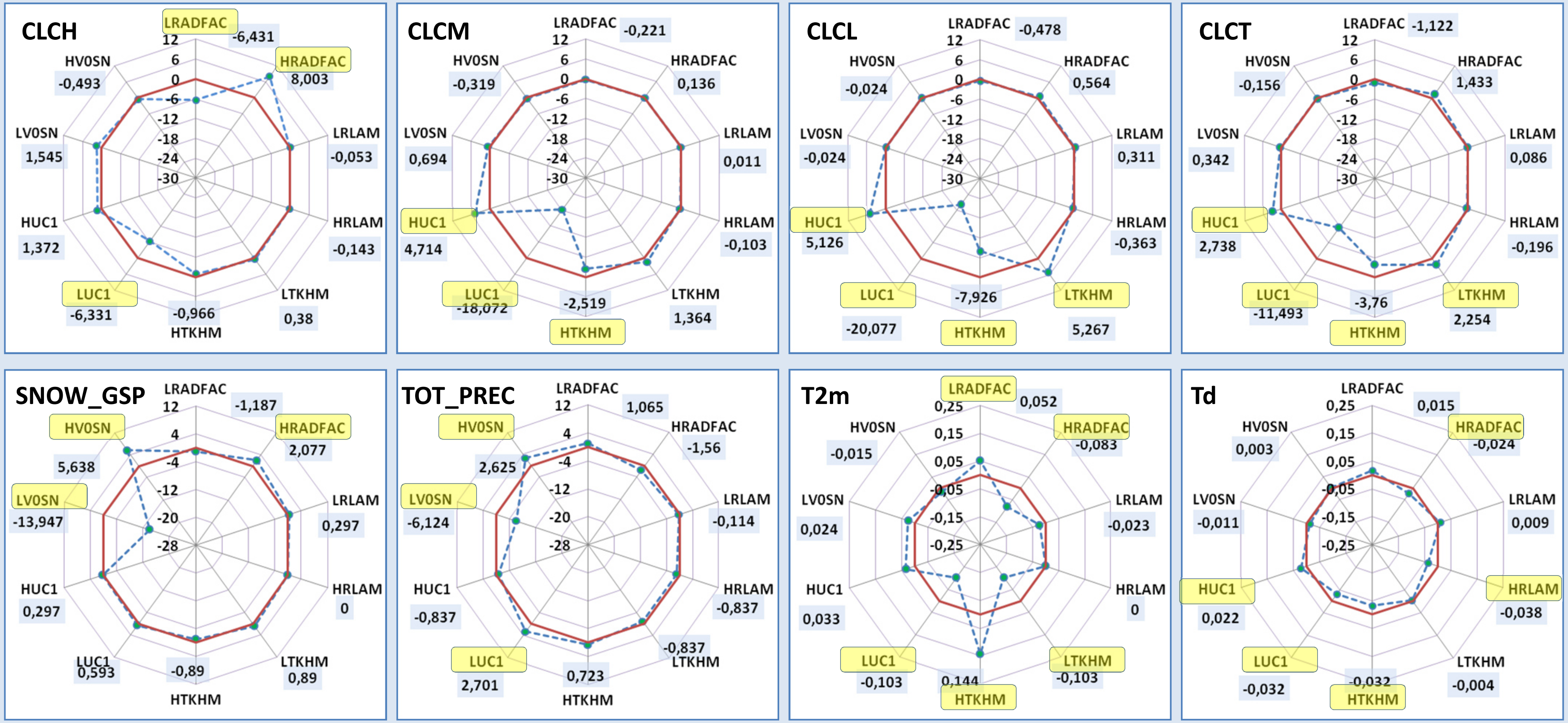






It can be seen that T2m, Tmax_2m, Tmin_2m, T2m_18UTC, T2m_06UTC display essentially the same sensitivity.

Practically, the most sensitive parameter combinations can be directly addressed from the spider-graphs !



Under the previous analysis, the resulting *priority board* depicts all sensitivities and further testing strategies can be developed.

PRIORITY BOARD FOR THE WHOLE 2013

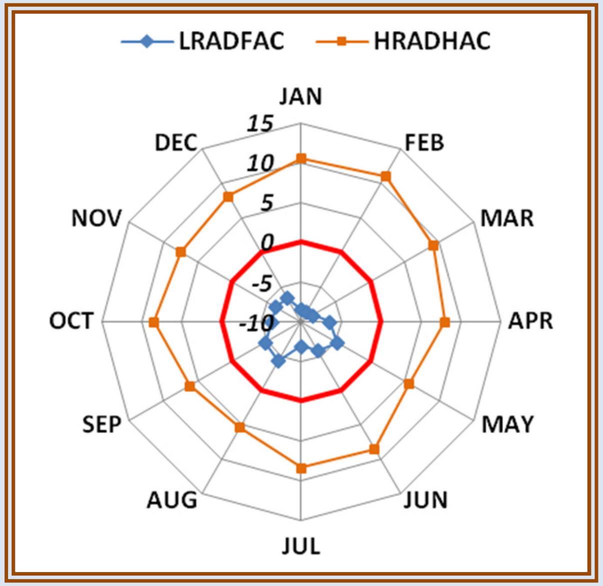
T_2M			TD_2M			TOT_PREC			SNOW_GSP			CLCL			CLCM			CLCH			CLCT		
HTKHM-LUC1:	0,247	-1	HRLAM-HUC1:	0,06	-1	LUC1-LV0SN:	8,825	-1	HRADFAC-LV0SN:	16,024	-1	LTKHM-LUC1:	25,344	-1	LTKHM-LUC1:	19,436	-1	HRADFAC-LUC1:	14,334	-1	LTKHM-LUC1:	13,747	-1
HRADFAC-HTKHM:	0,227	-1	HTKHM-HUC1:	0,054	-1	LRADFAC-LV0SN	7,189	-1	LTKHM-LV0SN:	14,837	-1	HRADFAC-LUC1:	20,641	-1	LUC1-LV0SN:	18,766	-1	HRADFAC-HTKHM	8,969	-1	HRADFAC-LUC1:	12,926	-1
LRLAM-HTKHM:	0,167	-1	LRADFAC-HRLAM:	0,053	-1	HTKHM-LV0SN:	6,847	-1	LUC1-LV0SN:	14,54	-1	LRLAM-LUC1:	20,388	-1	HRADFAC-LUC1:	18,208	-1	HRADFAC-HV0SN	8,496	-1	LUC1-LV0SN:	11,835	-1
HTKHM-HV0SN:	0,159	-1	LRADFAC-LUC1:	0,047	-1	LRLAM-LV0SN:	6,01	1	LRLAM-LV0SN:	14,244	-1	LUC1-LV0SN:	20,053	1	LRLAM-LUC1:	18,083	-1	HRADFAC-HRLAM	8,146	-1	LRLAM-LUC1:	11,579	-1
LRADFAC-LUC1:	0,155	-1	LRADFAC-HTKHM:	0,047	-1	LTKHM-LV0SN:	5,287	1	HUC1-LV0SN:	14,244	-1	LUC1-HV0SN:	20,053	1	HRLAM-LUC1:	17,969	1	HRADFAC-LRLAM:	8,056	-1	LUC1-HV0SN:	11,337	1
LRADFAC-LTKHM:	0,155	-1	HRADFAC-HUC1:	0,046	-1	HUC1-LV0SN:	5,287	1	HRLAM-LV0SN:	13,947	0	HRLAM-LUC1:	19,714	1	LRADFAC-LUC1:	17,851	1	LRADFAC-LV0SN:	7,976	-1	HRLAM-LUC1:	11,297	1
HRLAM-HTKHM:	0,144	0	LRLAM-LUC1:	0,041	-1	HRLAM-LV0SN:	5,287	1	HTKHM-LV0SN:	13,057	1	LRADFAC-LUC1:	19,599	1	LUC1-HV0SN:	17,753	1	LUC1-LV0SN:	7,876	-1	LRADFAC-LUC1:	10,371	1
LTKHM-HUC1:	0,136	-1	LRLAM-HTKHM:	0,041	-1	HRADFAC-LV0SN	4,564	1	LRADFAC-LV0SN:	12,76	1	HTKHM-HUC1:	13,052	-1	HTKHM-LUC1:	15,553	1	LRADFAC-HUC1:	7,803	-1	HTKHM-LUC1:	7,733	1
LUC1-LV0SN:	0,127	-1	HRLAM-HV0SN:	0,041	-1	HRADFAC-LUC1:	4,261	-1	LRADFAC-HV0SN:	6,825	-1	HTKHM-LUC1:	12,151	1	HTKHM-HUC1:	7,233	-1	HRADFAC-LTKHM	7,623	1	HTKHM-HUC1:	6,498	-1
LTKHM-LV0SN:	0,127	-1	LUC1-HV0SN:	0,035	-1	HRADFAC-HV0SN	4,185	-1	HTKHM-HV0SN:	6,528	-1	HRADFAC-HTKHM:	8,49	-1	HUC1-HV0SN:	5,033	-1	LRADFAC-LTKHM:	6,811	-1	HRADFAC-HTKHM	5,193	-1
HTKHM-LV0SN:	0,12	1	HTKHM-HV0SN:	0,035	-1	LTKHM-LUC1:	3,538	-1	HRLAM-HV0SN:	5,638	0	LRLAM-HTKHM:	8,237	-1	LRADFAC-HUC1:	4,935	-1	LTKHM-LUC1:	6,711	-1	HTKHM-LV0SN:	4,102	-1
HRADFAC-HUC1:	0,116	-1	HRLAM-LTKHM:	0,034	1	HRLAM-LUC1:	3,538	-1	LRLAM-HV0SN:	5,341	1	HTKHM-LV0SN:	7,902	1	HRLAM-HUC1:	4,817	-1	HRADFAC-HUC1:	6,631	1	LRADFAC-HUC1:	3,86	-1
HTKHM-HUC1:	0,111	1	HUC1-LV0SN:	0,033	-1	LTKHM-HV0SN:	3,462	-1	HUC1-HV0SN:	5,341	1	HTKHM-HV0SN:	7,902	1	LRLAM-HUC1:	4,703	1	HRADFAC-LV0SN:	6,458	1	LRLAM-HTKHM:	3,846	-1
HRADFAC-LV0SN:	0,107	-1	HRADFAC-LRLAM:	0,033	-1	HUC1-HV0SN:	3,462	-1	LUC1-HV0SN:	5,045	1	HRLAM-HTKHM:	7,563	1	HRADFAC-HUC1:	4,578	1	LRADFAC-LRLAM:	6,378	1	HTKHM-HV0SN:	3,604	1
HRLAM-LUC1:	0,103	0	LTKHM-LUC1:	0,028	1	HRLAM-HV0SN:	3,462	-1	LTKHM-HV0SN:	4,748	1	LRADFAC-HTKHM:	7,448	1	HUC1-LV0SN:	4,02	1	LRADFAC-HRLAM:	6,288	1	HRLAM-HTKHM:	3,564	1
HRLAM-LTKHM:	0,103	0	HRLAM-LV0SN:	0,027	1	LRLAM-LUC1:	2,815	-1	HRADFAC-HV0SN:	3,561	1	LRADFAC-LTKHM:	5,745	-1	LTKHM-HUC1:	3,35	1	LRLAM-LUC1:	6,278	1	LRADFAC-LTKHM:	3,376	-1
LRADFAC-HTKHM:	0,092	1	HRADFAC-HV0SN:	0,027	-1	LRLAM-HV0SN:	2,739	-1	HRADFAC-HTKHM:	2,967	-1	HRLAM-LTKHM:	5,63	-1	HTKHM-LV0SN:	3,213	-1	HRLAM-LUC1:	6,188	1	HRLAM-HUC1:	2,934	-1
LUC1-HV0SN:	0,088	1	LTKHM-HUC1:	0,026	-1	HRADFAC-HTKHI	2,283	-1	LRADFAC-LTKHM:	2,077	-1	LRADFAC-HUC1:	5,604	-1	HRADFAC-HTKHM:	2,655	-1	LRADFAC-HV0SN:	5,938	1	HUC1-HV0SN:	2,894	-1
LTKHM-HV0SN:	0,088	1	LRADFAC-LV0SN:	0,026	-1	HTKHM-LUC1:	1,978	1	HRADFAC-HRLAM:	2,077	0	HRLAM-HUC1:	5,489	-1	LRLAM-HTKHM:	2,53	-1	LUC1-HV0SN:	5,838	1	LRLAM-HUC1:	2,652	1
HRADFAC-HRLAM:	0,083	0	LUC1-LV0SN:	0,021	1	LRADFAC-LTKHM	1,902	-1	LRADFAC-LUC1:	1,78	-1	LTKHM-LV0SN:	5,291	-1	HRLAM-HTKHM:	2,416	1	LRADFAC-HTKHM	5,465	1	LRADFAC-HTKHM:	2,638	1
LRLAM-LUC1:	0,08	1	HTKHM-LV0SN:	0,021	1	LRADFAC-HUC1:	1,902	-1	HRADFAC-LRLAM:	1,78	1	LTKHM-HV0SN:	5,291	-1	LRADFAC-HTKHM:	2,298	1	HTKHM-LUC1:	5,365	1	HRLAM-LTKHM:	2,45	-1
LRLAM-LTKHM:	0,08	1	LRLAM-LV0SN:	0,02	-1	LRADFAC-HRLAN	1,902	-1	HRADFAC-HUC1:	1,78	1	HUC1-LV0SN:	5,15	-1	HTKHM-HV0SN:	2,2	1	HTKHM-LV0SN:	2,511	-1	LTKHM-HV0SN:	2,41	-1
LRADFAC-LRLAM:	0,075	-1	HRADFAC-LTKHM:	0,02	1	HTKHM-HV0SN:	1,902	1	LRADFAC-LRLAM:	1,484	-1	HUC1-HV0SN:	5,15	-1	LTKHM-HV0SN:	1,683	-1	HTKHM-HUC1:	2,338	-1	HUC1-LV0SN:	2,396	1
HRADFAC-HV0SN:	0,068	1	LRADFAC-LTKHM:	0,019	-1	LRADFAC-LUC1:	1,636	1	LRADFAC-HUC1:	1,484	-1	LRLAM-LTKHM:	4,956	1	LRADFAC-LTKHM:	1,585	-1	HUC1-HV0SN:	1,865	-1	LRLAM-LTKHM:	2,168	1
LRADFAC-HV0SN:	0,067	-1	HUC1-HV0SN:	0,019	1	LRADFAC-HV0SN	1,56	1	HRADFAC-LUC1:	1,484	1	LRLAM-HUC1:	4,815	1	HRLAM-LTKHM:	1,467	-1	HRLAM-LV0SN:	1,688	-1	LTKHM-LV0SN:	1,912	1
HRADFAC-LRLAM:	0,06	1	HRADFAC-HRLAM:	0,014	1	HTKHM-HUC1:	1,56	-1	HTKHM-LUC1:	1,483	-1	HRADFAC-LTKHM:	4,703	1	LRLAM-LTKHM:	1,353	1	LRLAM-LV0SN:	1,598	-1	HRADFAC-HRLAM:	1,629	-1
LRLAM-HUC1:	0,056	-1	LRLAM-LTKHM:	0,013	-1	HRLAM-HTKHM:	1,56	-1	LRLAM-HTKHM:	1,187	-1	HRADFAC-HUC1:	4,562	1	HRADFAC-LTKHM:	1,228	1	HRLAM-HUC1:	1,515	-1	HRADFAC-HV0SN:	1,589	-1
LRADFAC-HRLAM:	0,052	0	LRLAM-HUC1:	0,013	1	HRADFAC-HRLAN	1,446	1	LRADFAC-HRLAM:	1,187	0	HRADFAC-HRLAM:	0,927	-1	LRADFAC-LV0SN:	0,915	-1	LRLAM-HUC1:	1,425	-1	LRADFAC-LV0SN:	1,464	-1
HUC1-HV0SN:	0,048	-1	HRADFAC-LV0SN:	0,013	1	LRADFAC-LRLAM	1,179	-1	HTKHM-HUC1:	1,187	-1	LRADFAC-LRLAM:	0,789	-1	HRLAM-LV0SN:	0,797	-1	LTKHM-LV0SN:	1,165	1	HRADFAC-LRLAM:	1,347	1
LRLAM-LV0SN:	0,047	-1	LRADFAC-HV0SN:	0,012	1	LRLAM-HTKHM:	0,837	-1	HRADFAC-LTKHM:	1,187	1	HRADFAC-LV0SN:	0,588	-1	LRLAM-LV0SN:	0,683	1	LTKHM-HUC1:	0,992	1	HRADFAC-HUC1:	1,305	1
HRLAM-HUC1:	0,033	0	HRADFAC-LUC1:	0,008	1	LRLAM-LTKHM:	0,723	1	HRLAM-LTKHM:	0,89	0	HRADFAC-HV0SN:	0,588	-1	LTKHM-LV0SN:	0,67	1	LRLAM-HTKHM:	0,913	1	LRADFAC-LRLAM:	1,208	-1
LRADFAC-LV0SN:	0,028	1	HRADFAC-HTKHM:	0,008	1	LRLAM-HUC1:	0,723	1	HRLAM-HTKHM:	0,89	0	LRADFAC-LV0SN:	0,454	1	HRADFAC-LV0SN:	0,558	1	LTKHM-HV0SN:	0,873	-1	HRADFAC-LV0SN:	1,091	1
HRLAM-LV0SN:	0,024	0	LTKHM-LV0SN:	0,007	1	HRADFAC-LTKHN	0,723	1	LTKHM-HUC1:	0,593	1	LRADFAC-HV0SN:	0,454	1	HRADFAC-HV0SN:	0,455	-1	HRLAM-HTKHM:	0,823	1	LRADFAC-HV0SN:	0,966	1
HRADFAC-LUC1:	0,02	1	LTKHM-HV0SN:	0,007	-1	HRADFAC-HUC1:	0,723	1	LRLAM-LTKHM:	0,593	1	HRLAM-LV0SN:	0,339	1	LRLAM-HV0SN:	0,33	-1	HRLAM-LTKHM:	0,523	-1	LRADFAC-HRLAM:	0,926	1
HRADFAC-LTKHM:	0,02	1	LRADFAC-HUC1:	0,007	1	HRADFAC-HRLAI	0,723	1	HRLAM-LUC1:	0,593	0	HRLAM-HV0SN:	0,339	1	HRADFAC-HRLAM:	0,239	-1	HTKHM-HV0SN:	0,473	1	HRADFAC-LTKHM:	0,821	1
LRADFAC-HUC1:	0,019	1	LRLAM-HV0SN:	0,006	1	LRADFAC-HTKHN	0,342	1	LTKHM-LUC1:	0,297	1	LRLAM-LV0SN:	0,335	-1	LRADFAC-LRLAM:	0,232	-1	LRLAM-HV0SN:	0,44	1	HRLAM-LV0SN:	0,538	-1
HRLAM-HV0SN:	0,015	0	LRADFAC-LRLAM:	0,006	1	LUC1-HV0SN:	0,076	1	LRADFAC-HTKHM:	0,297	1	LRLAM-HV0SN:	0,335	-1	HRLAM-HV0SN:	0,216	1	LRLAM-LTKHM:	0,433	-1	LTKHM-HUC1:	0,484	1
HUC1-LV0SN:	0,009	1	HRLAM-LUC1:	0,006	1	LTKHM-HUC1:	0	1	HRLAM-HUC1:	0,297	0	HRADFAC-LRLAM:	0,253	1	HRADFAC-LRLAM:	0,125	1	HRLAM-HV0SN:	0,35	1	LRLAM-LV0SN:	0,256	1
LRLAM-HV0SN:	0,008	1	HRLAM-HTKHM:	0,006	1	HRLAM-LTKHM:	0	1	LRLAM-LUC1:	0,296	1	LTKHM-HUC1:	0,141	1	LRADFAC-HRLAM:	0,118	1	HUC1-LV0SN:	0,173	1	LRLAM-HV0SN:	0,242	-1
LTKHM-LUC1:	0	1	HTKHM-LUC1:	0	1	HRLAM-HUC1:	0	1	LRLAM-HUC1:	0	1	LRADFAC-HRLAM:	0,115	1	LRADFAC-HV0SN:	0,098	1	LRADFAC-LUC1:	0,1	1	HRLAM-HV0SN:	0,04	1

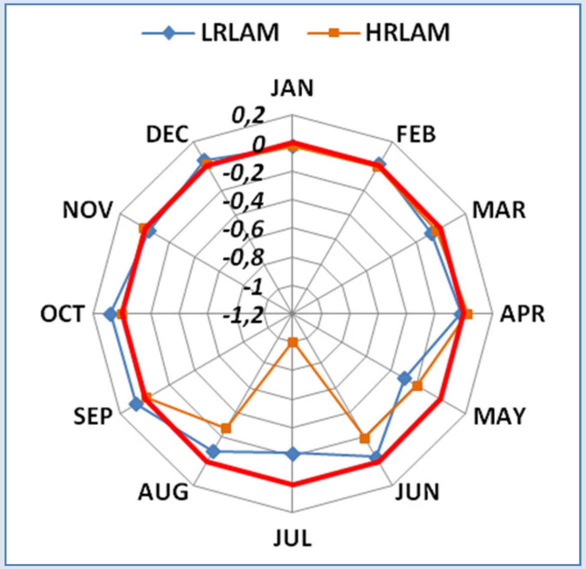
***EXTENSION OF THE METHODOLOGY*:**

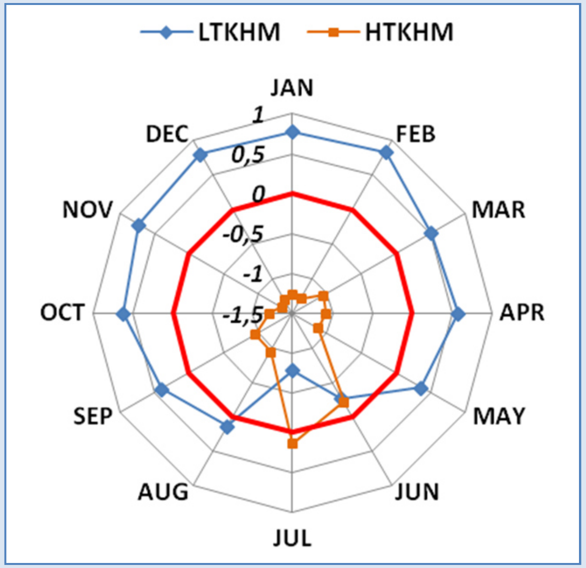
The above analysis can be readily used to get important insight to seasonal or monthly sensitivity through modified spider graphs.

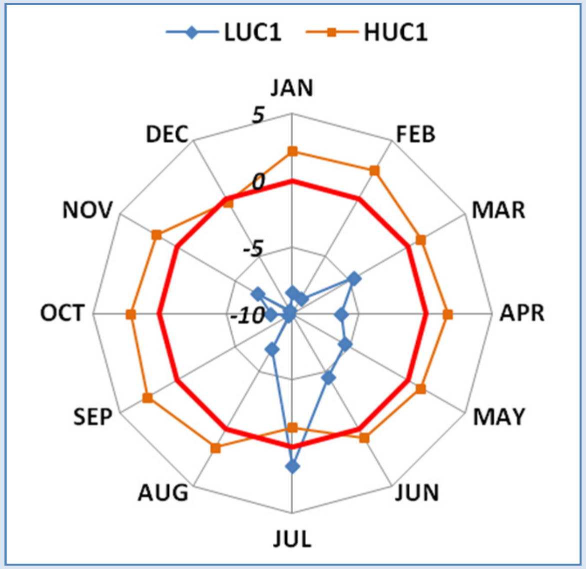
CLCH Monthly Sensitivities

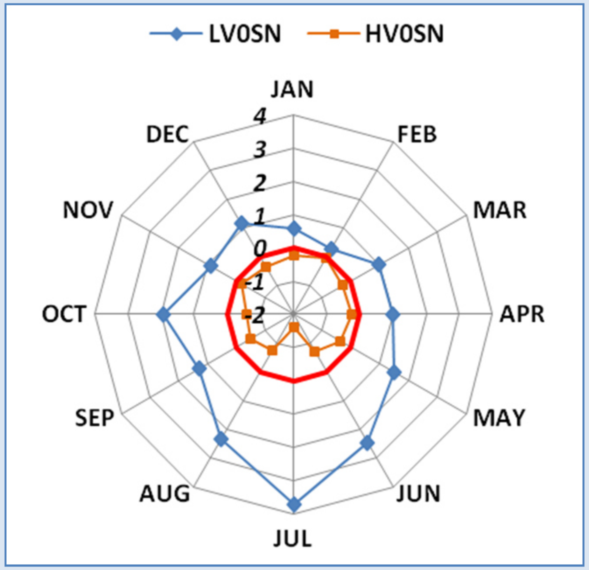
! Different scales. The graph with the largest scale range denotes the **most sensitive** parameter!





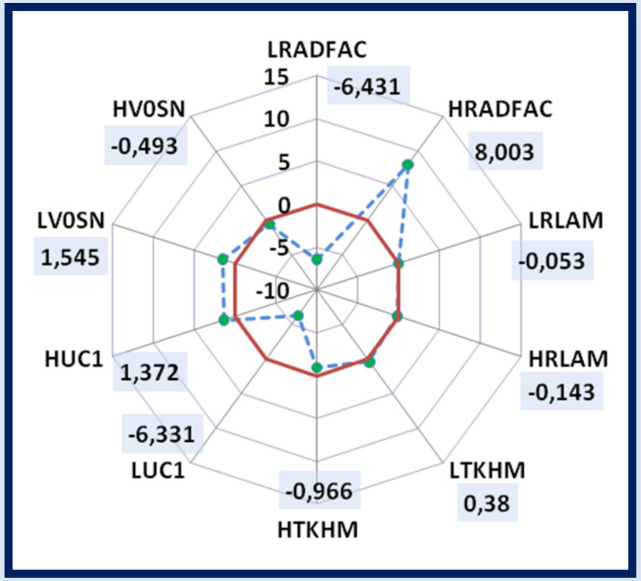


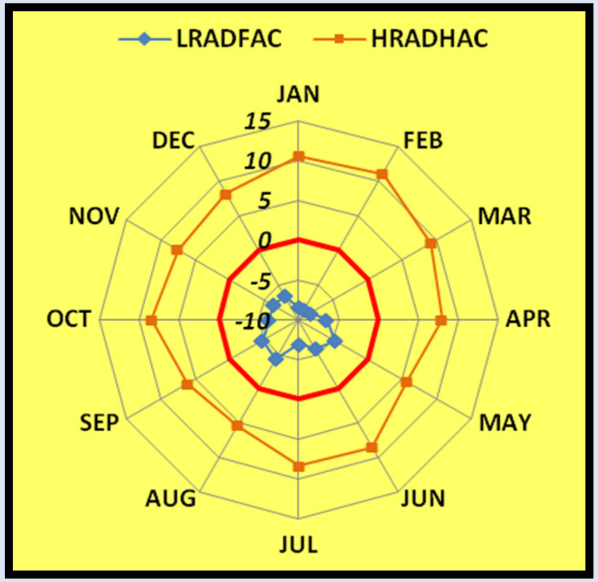


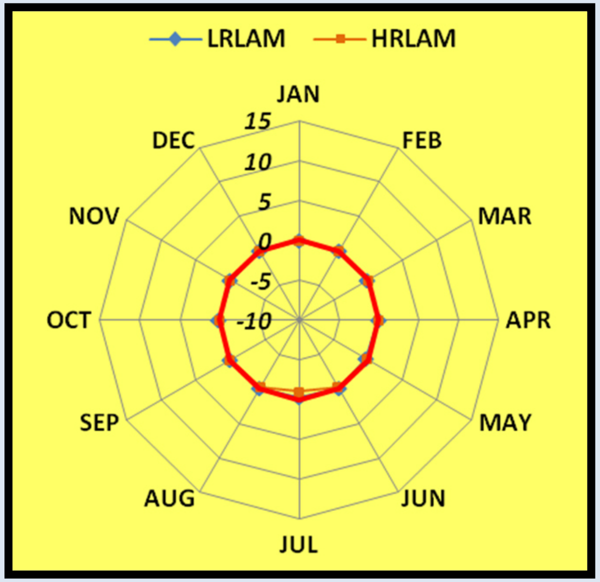


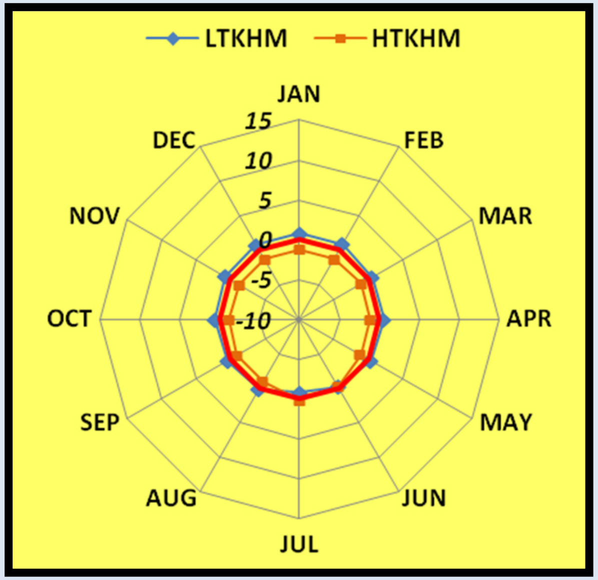
CLCH (Yearly vs Monthly Sensitivities)

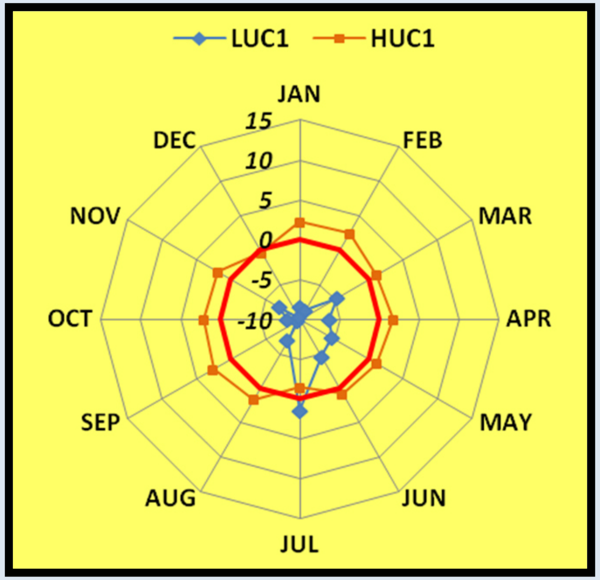
! Same scales

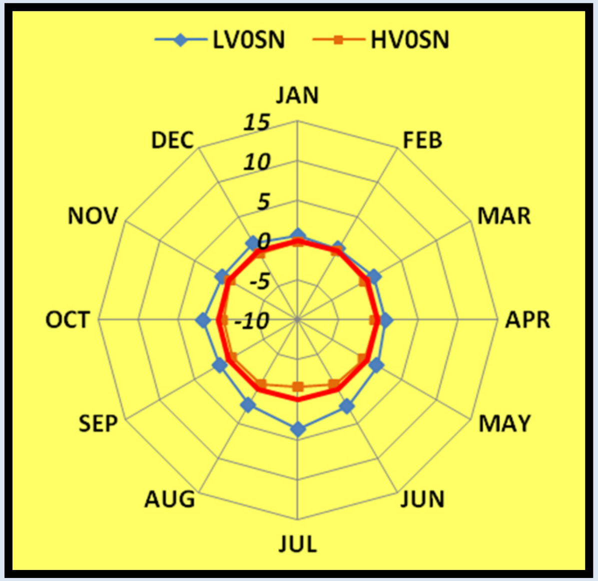




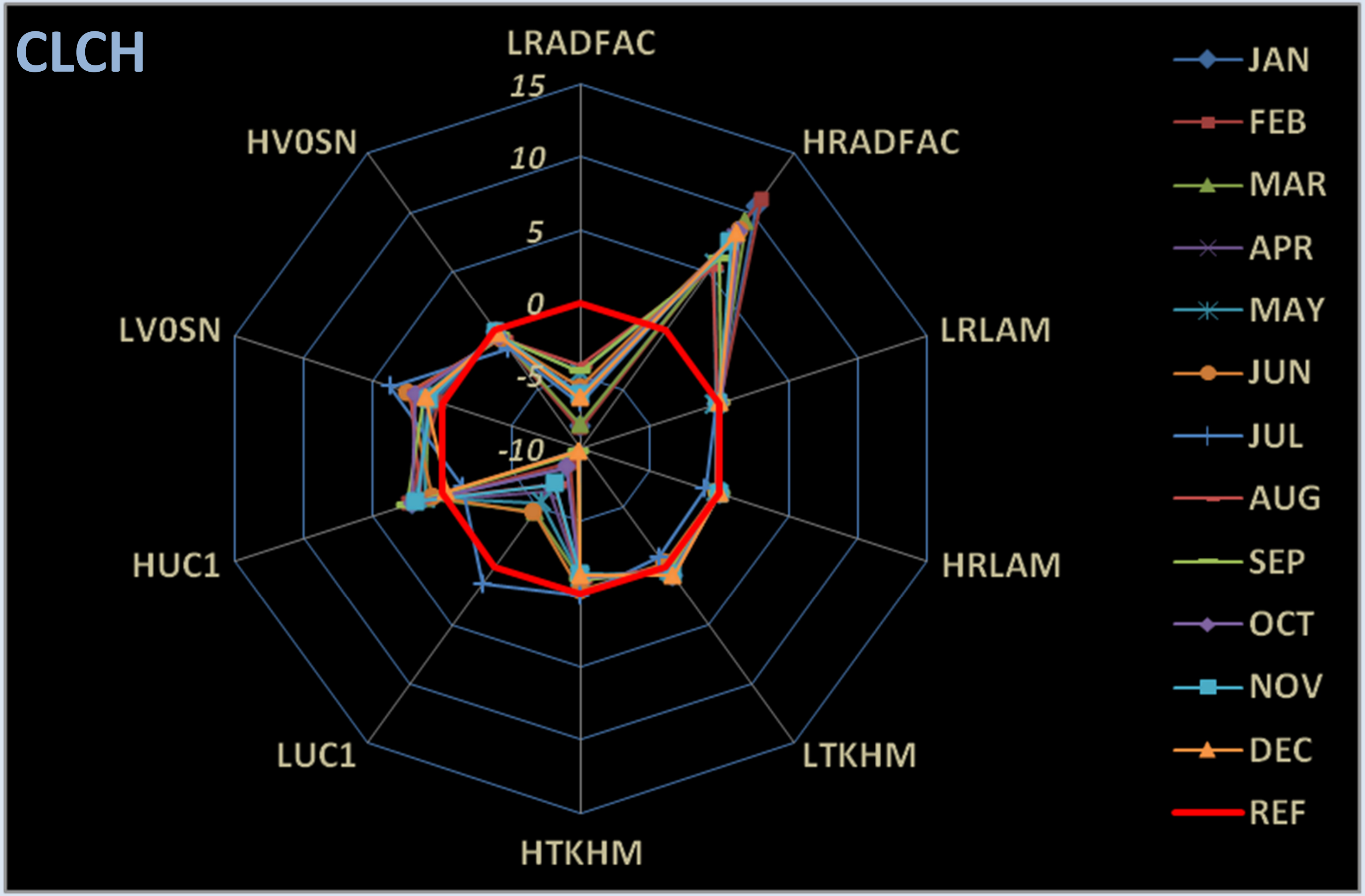




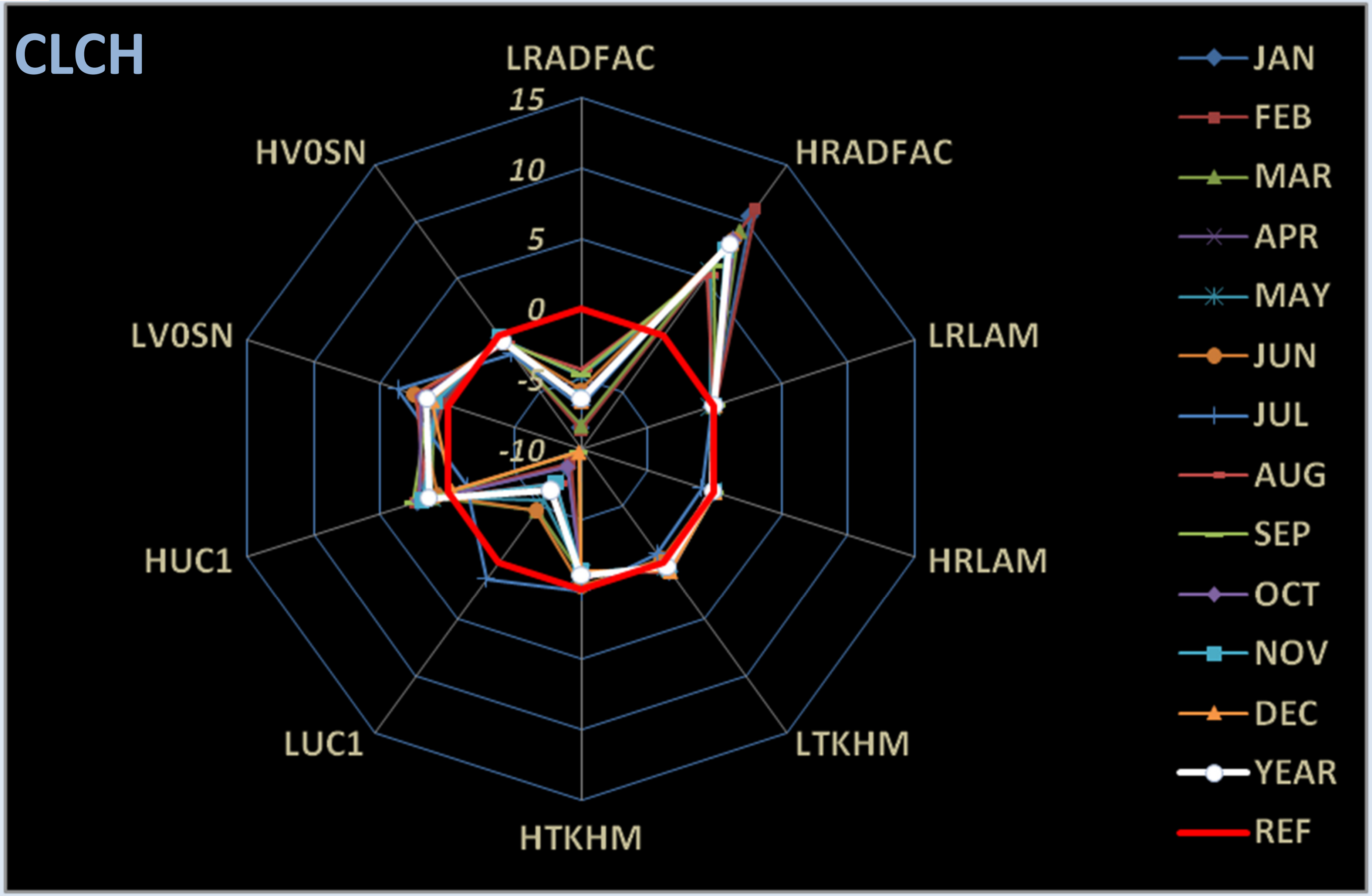




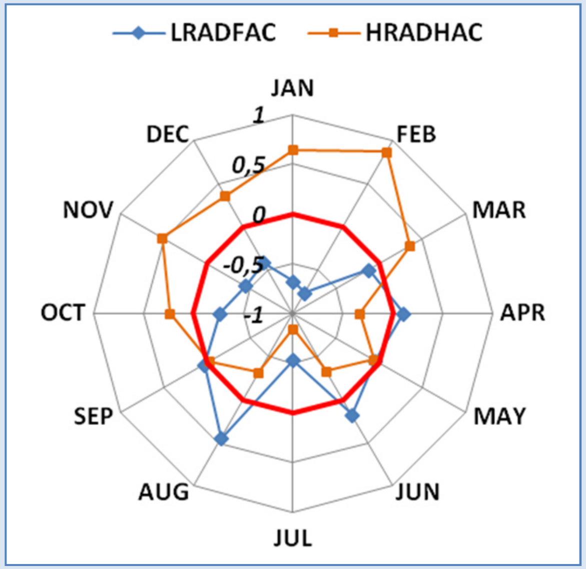
Monthly Sensitivities combined

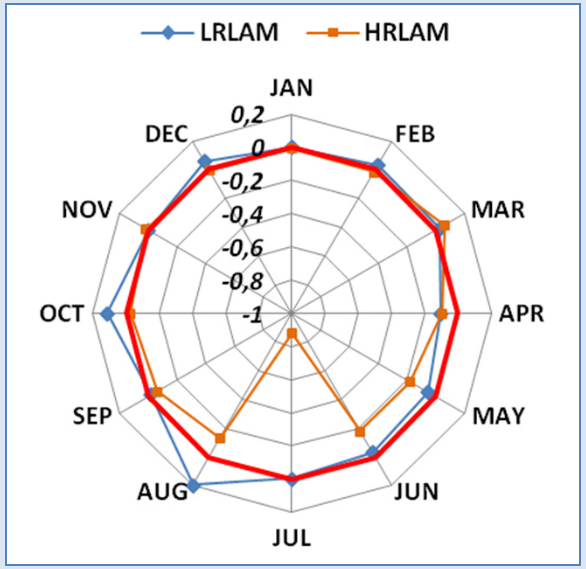


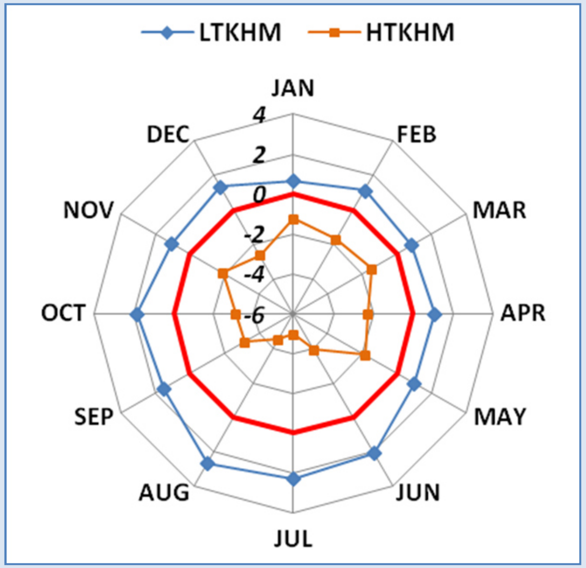
Yearly and Monthly Sensitivities combined

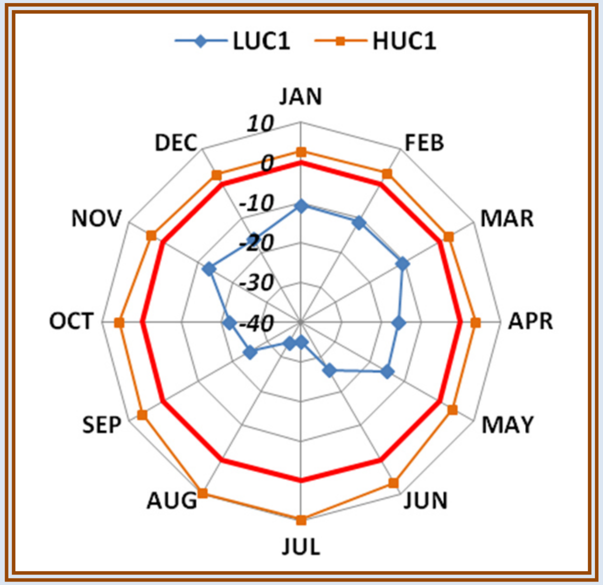


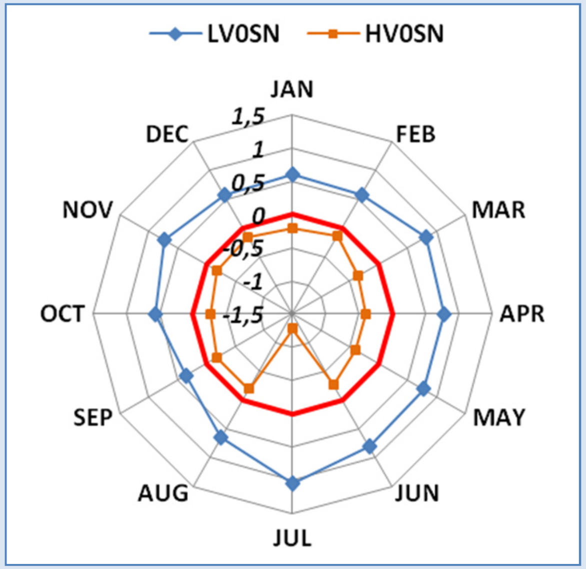
CLCM Monthly Sensitivities



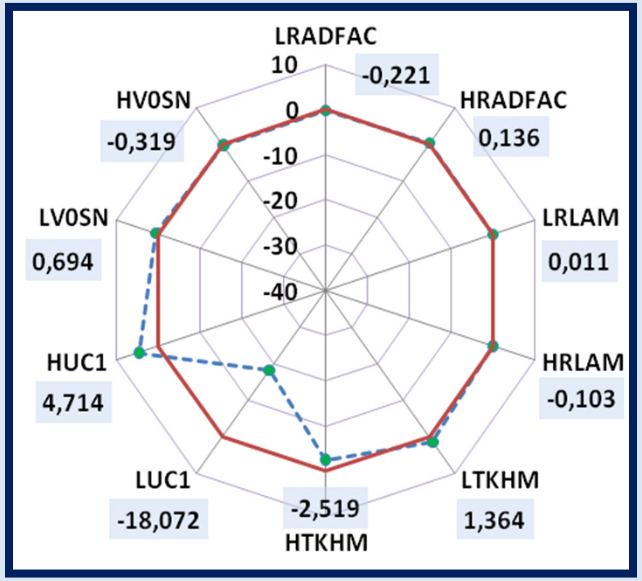


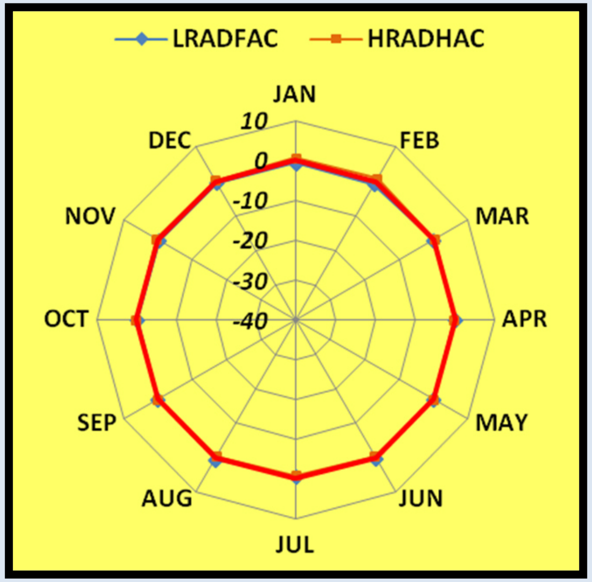


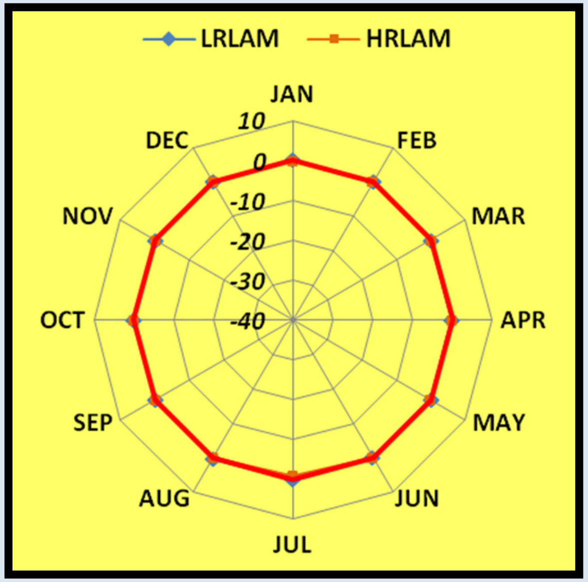


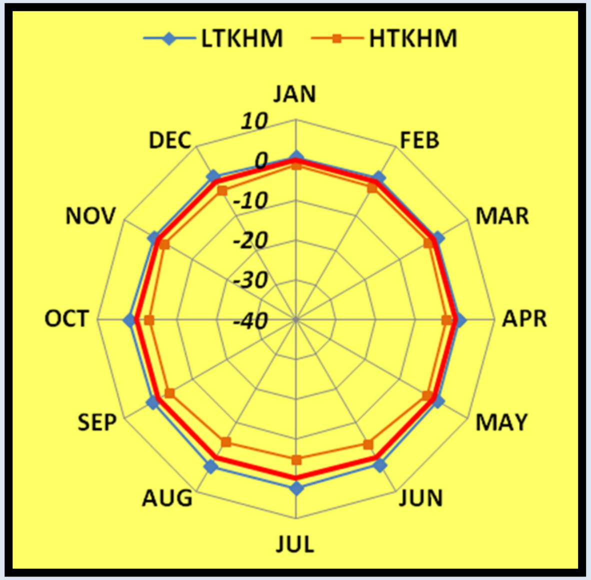


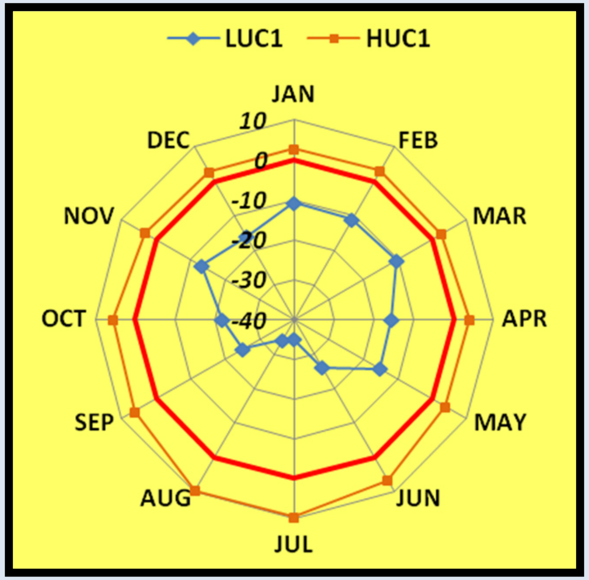
CLCM (Yearly vs Monthly Sensitivities)

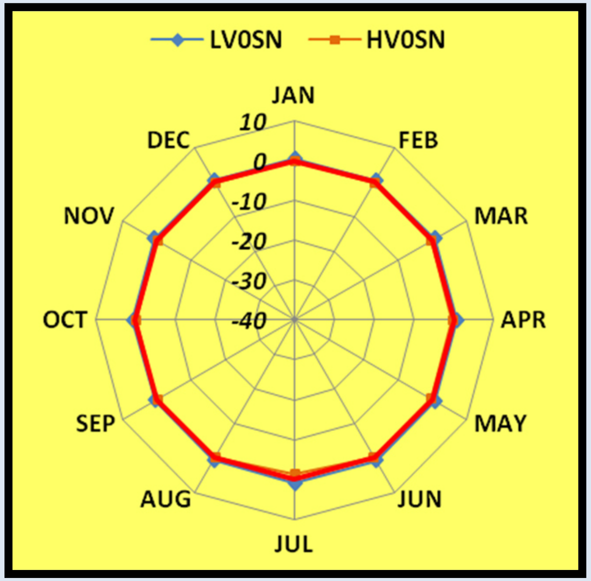




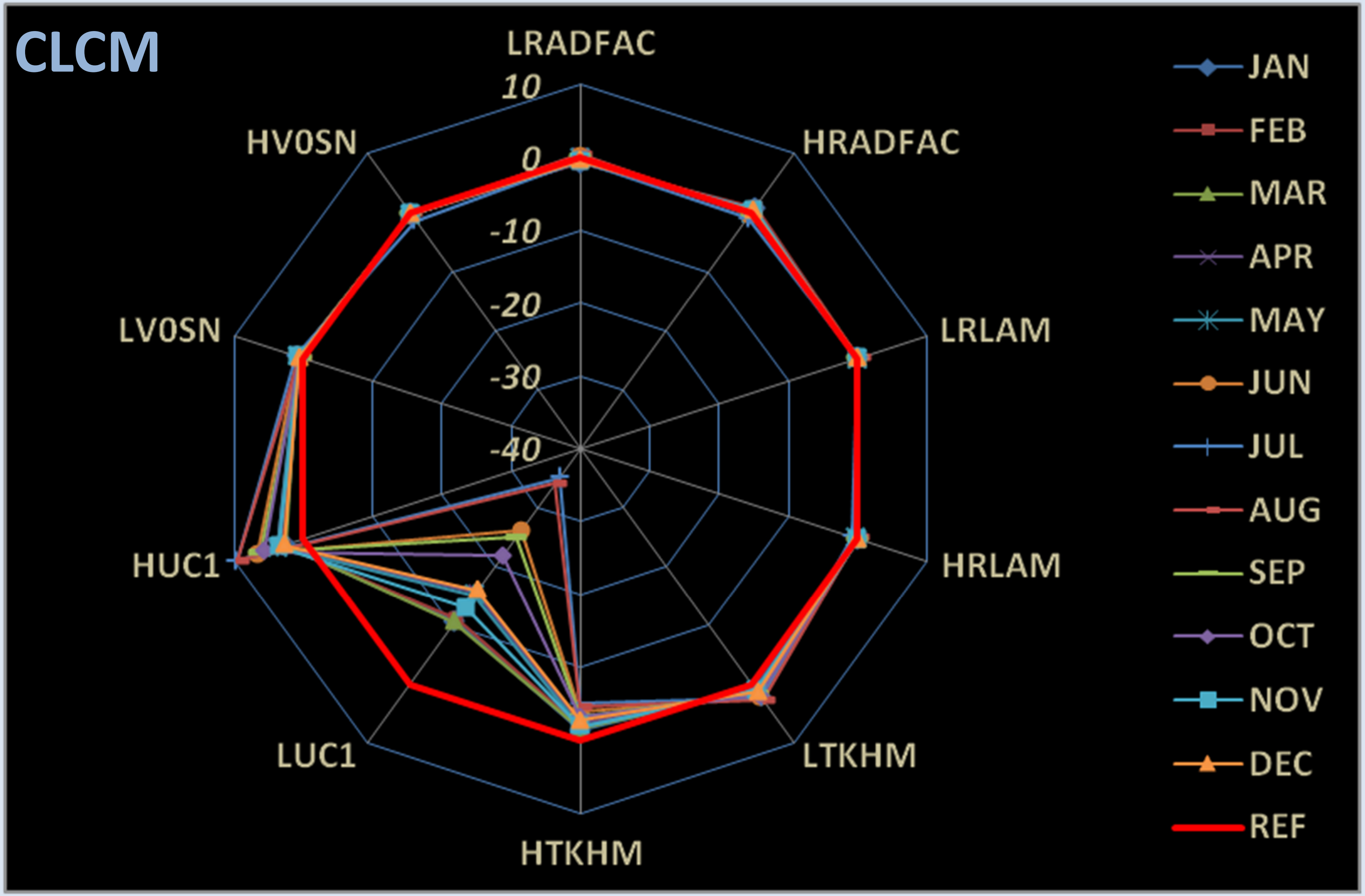




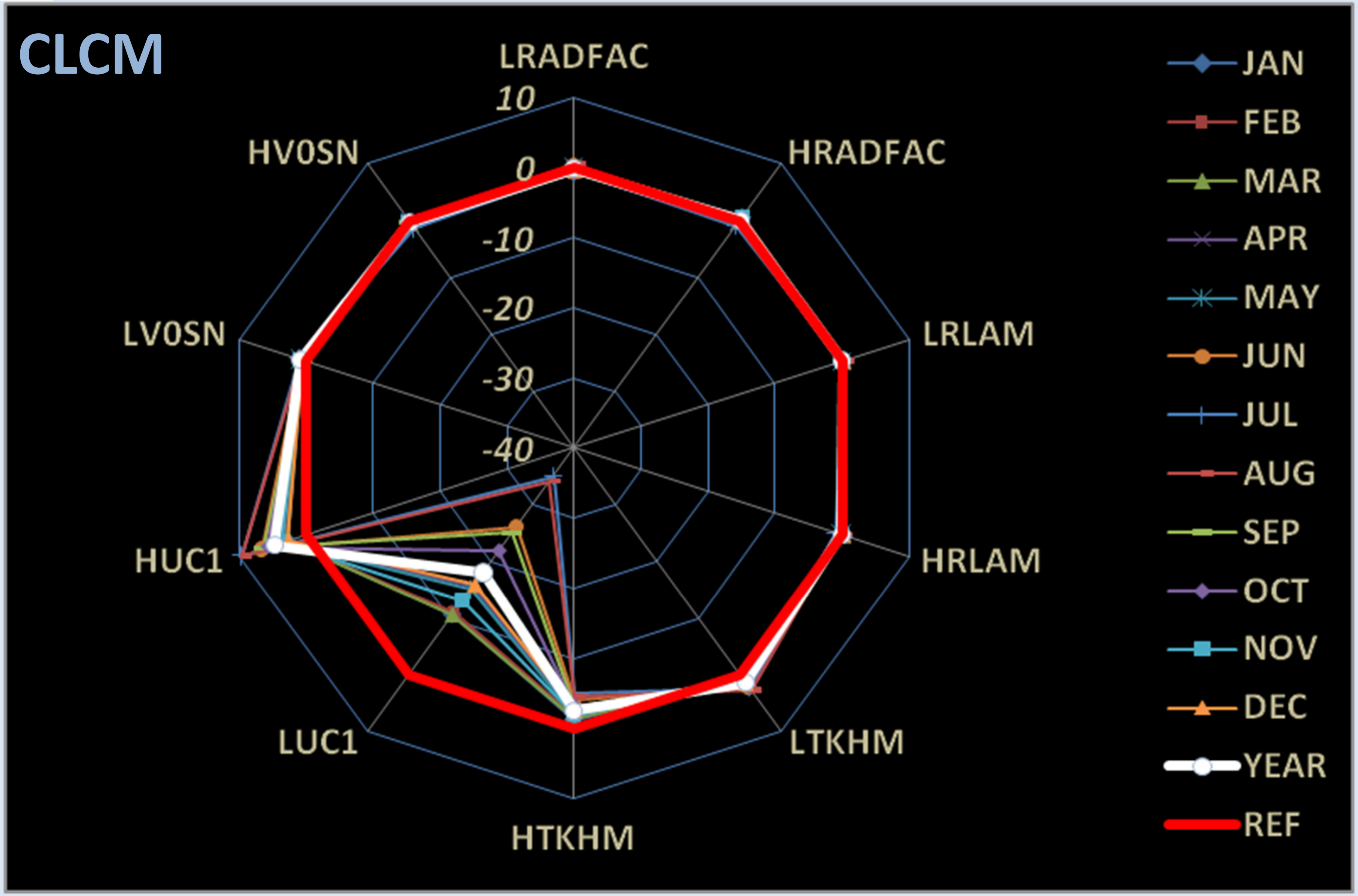




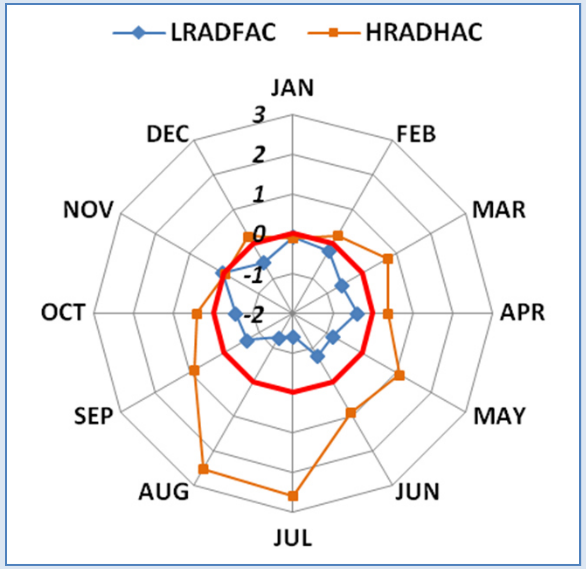
Monthly Sensitivities combined

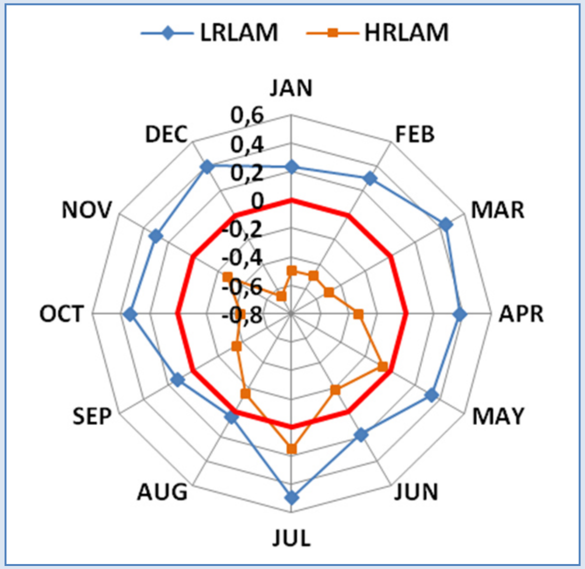


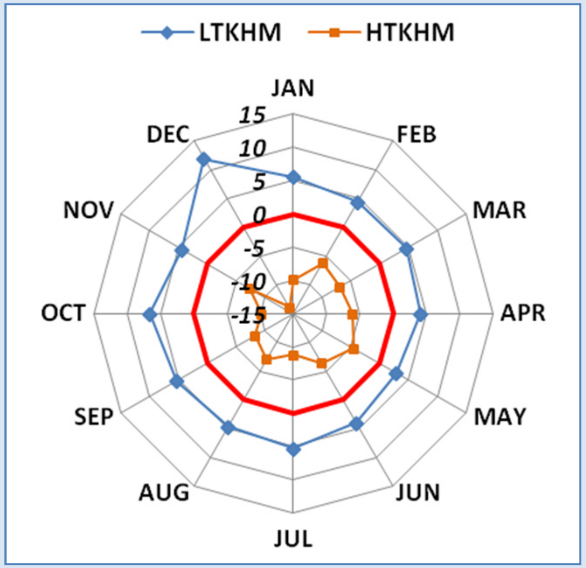
Yearly and Monthly Sensitivities combined

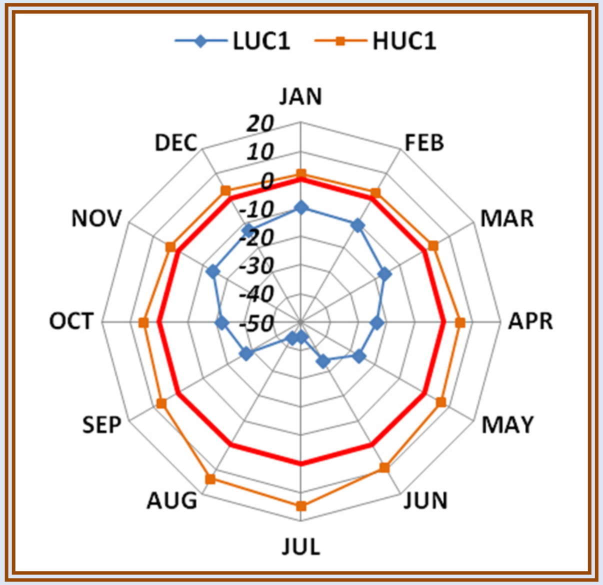


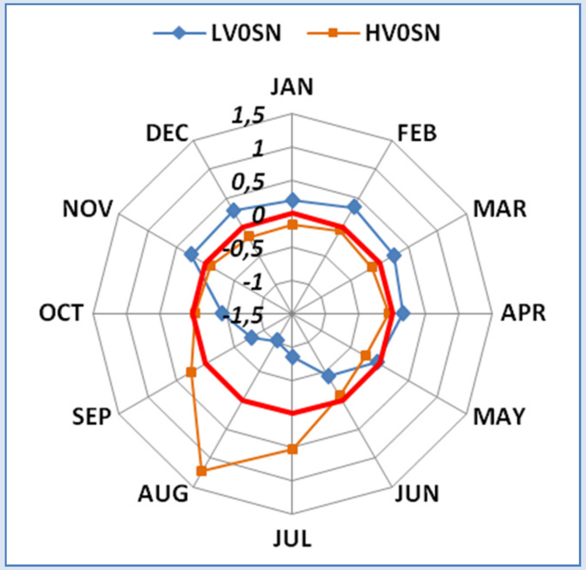
CLCL Monthly Sensitivities



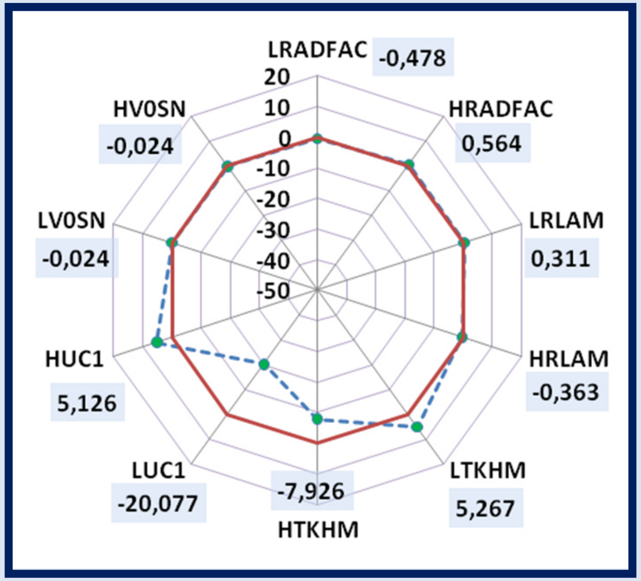


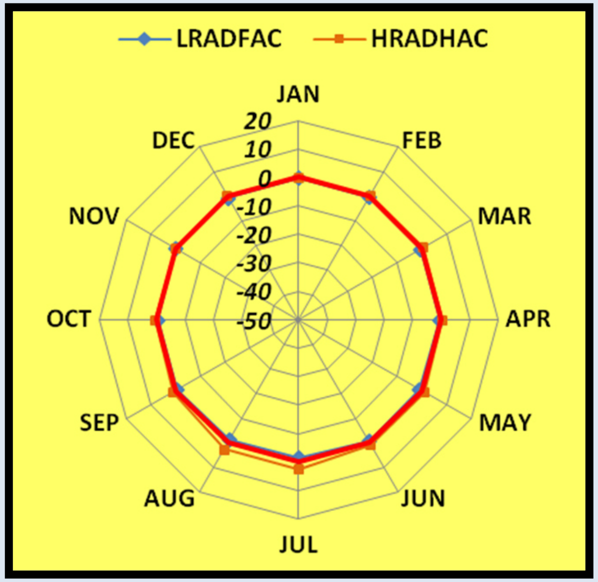


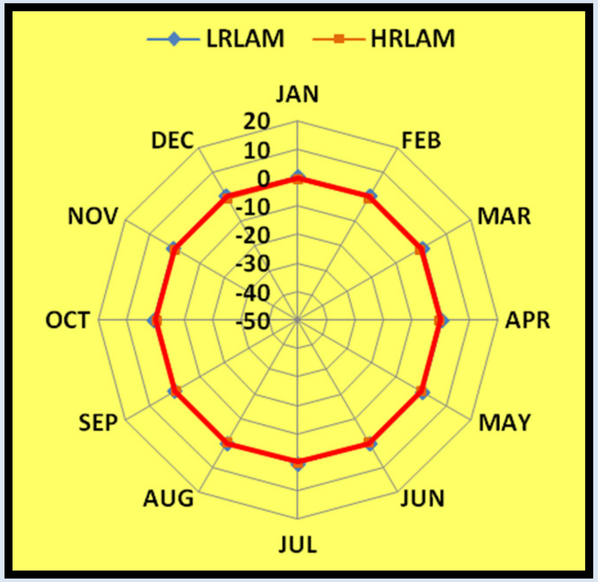


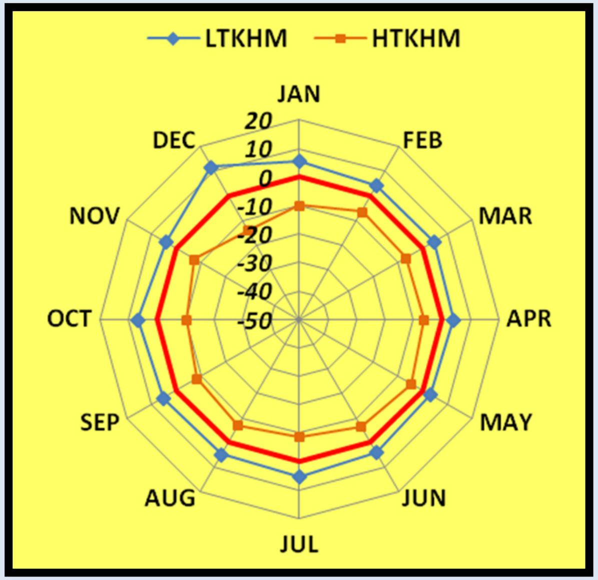


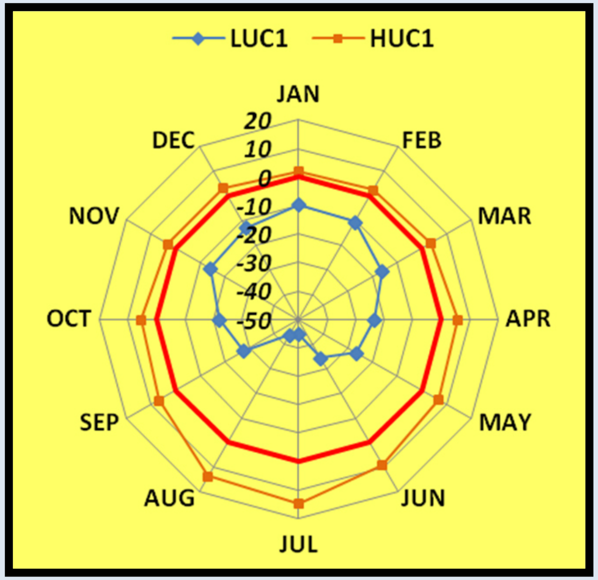
CLCL (Yearly vs Monthly Sensitivities)

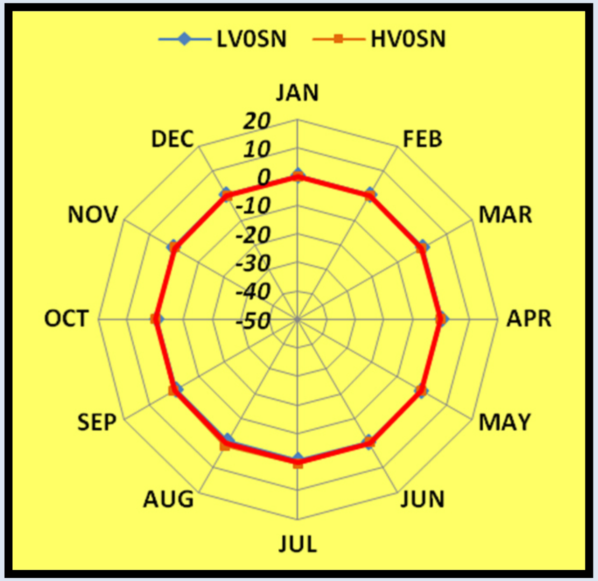




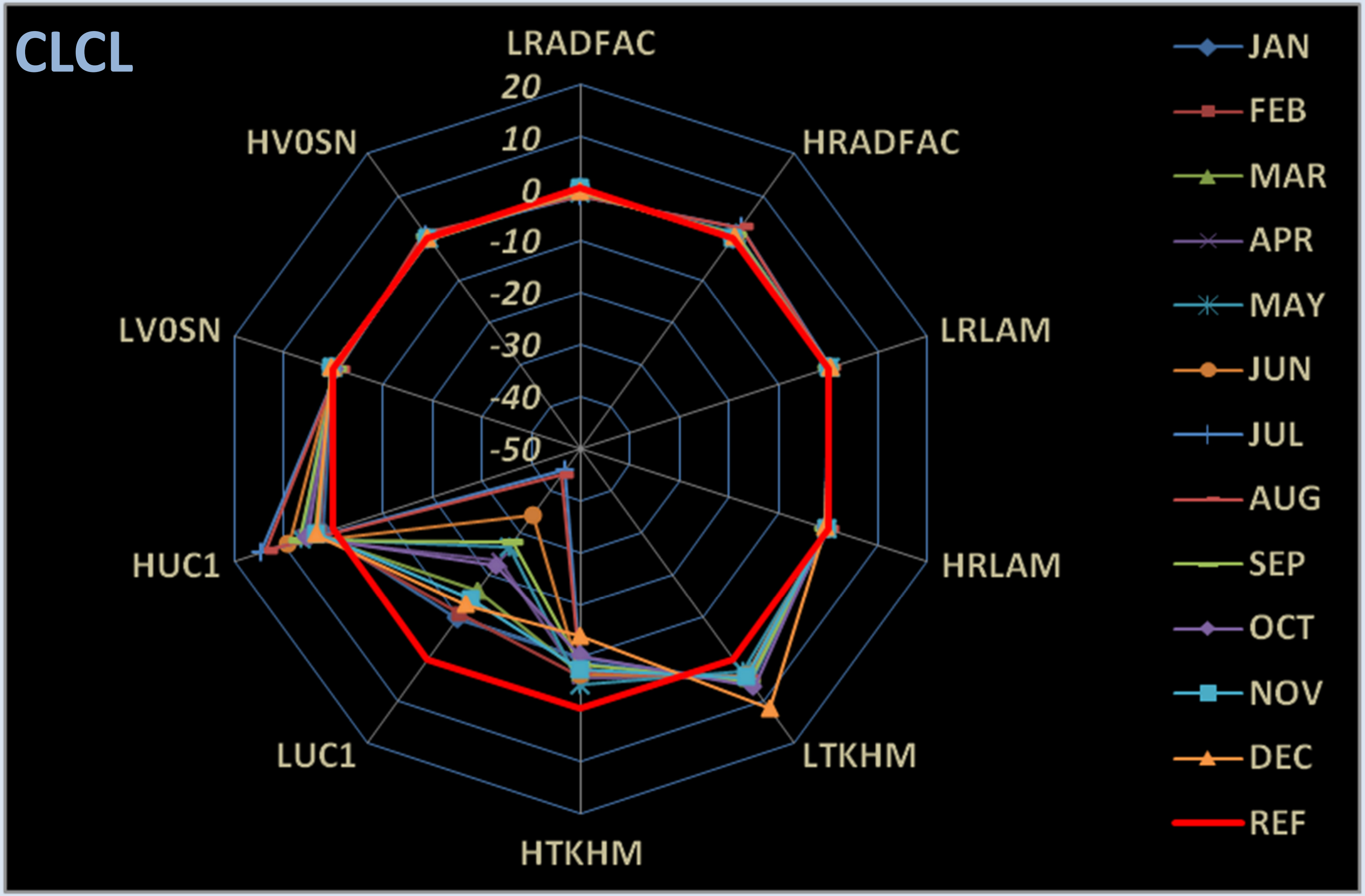




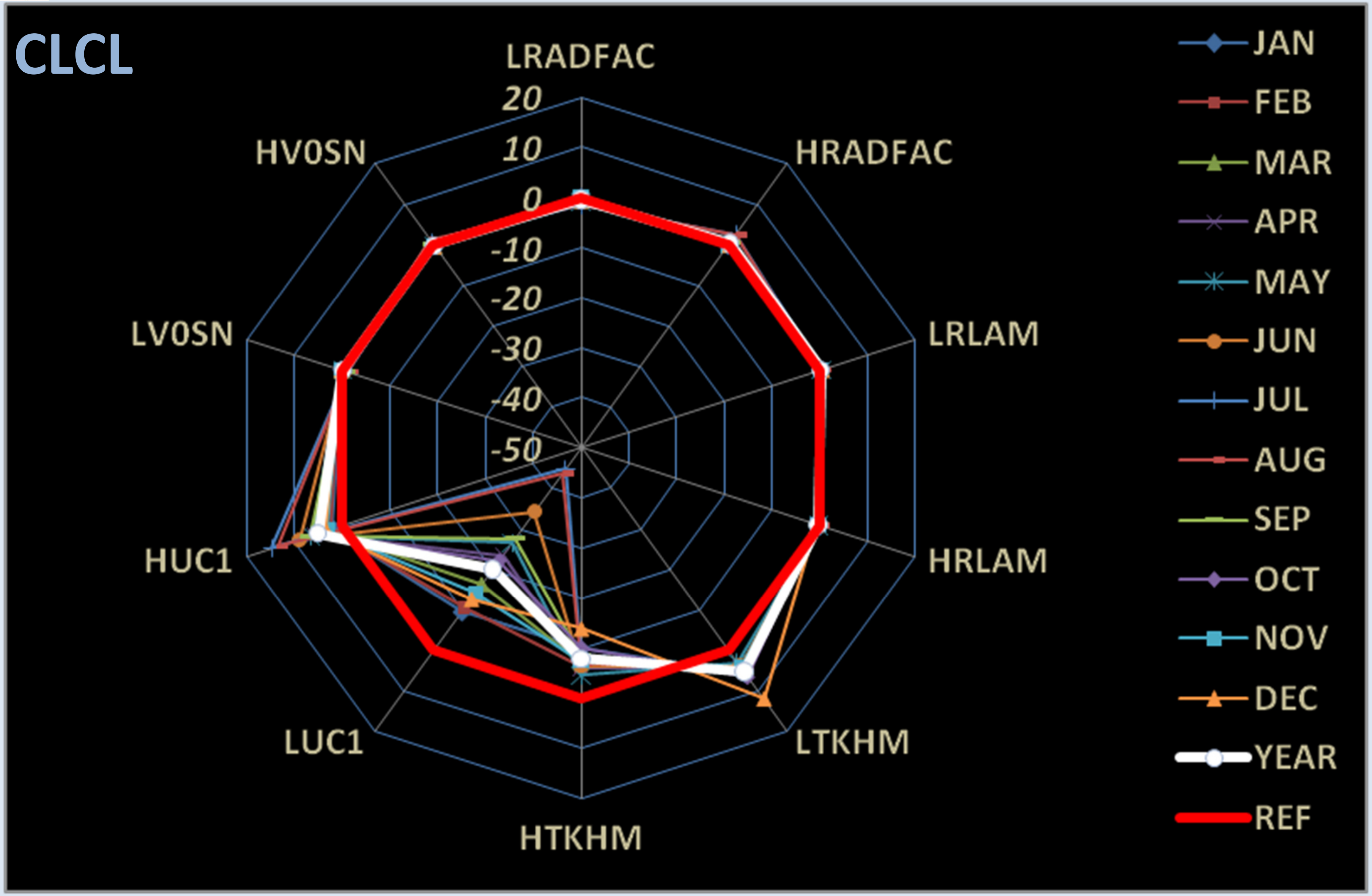




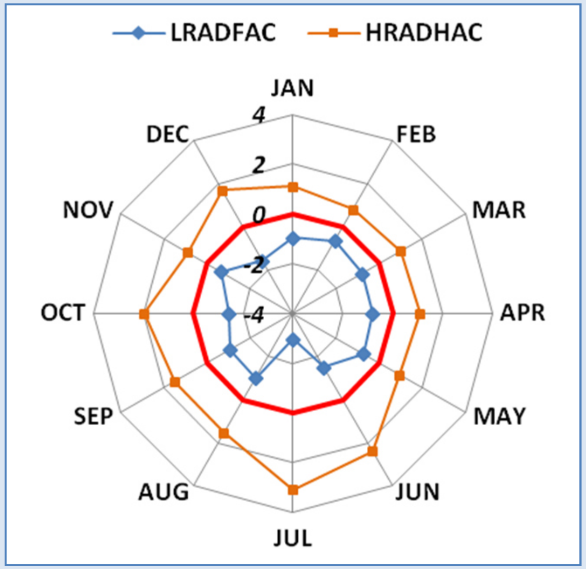
Monthly Sensitivities combined

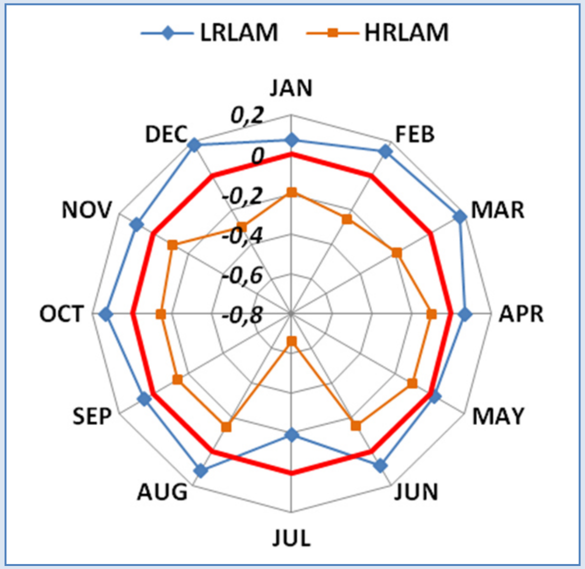


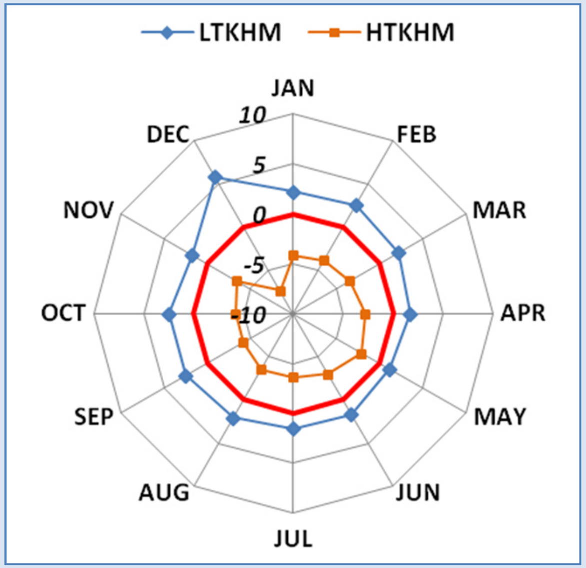
Yearly and Monthly Sensitivities combined

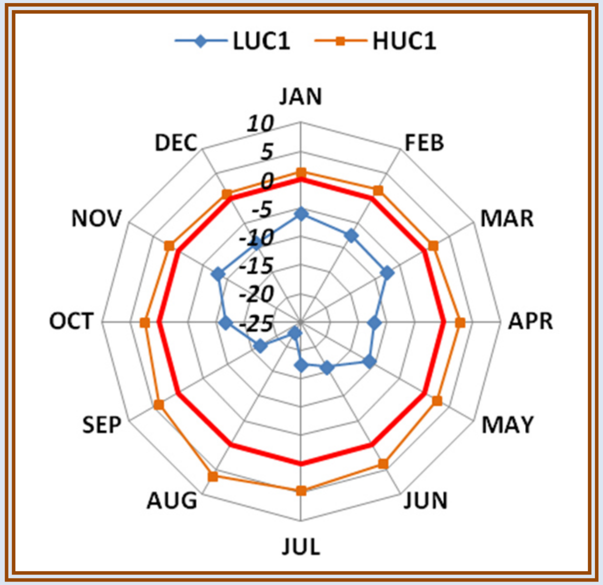


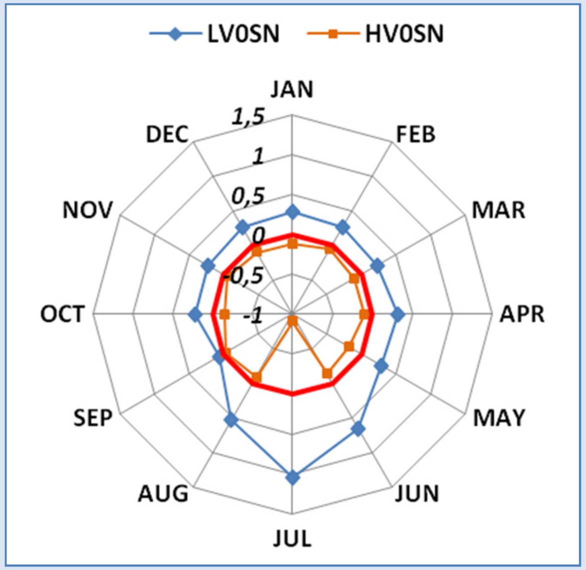
CLCT Monthly Sensitivities



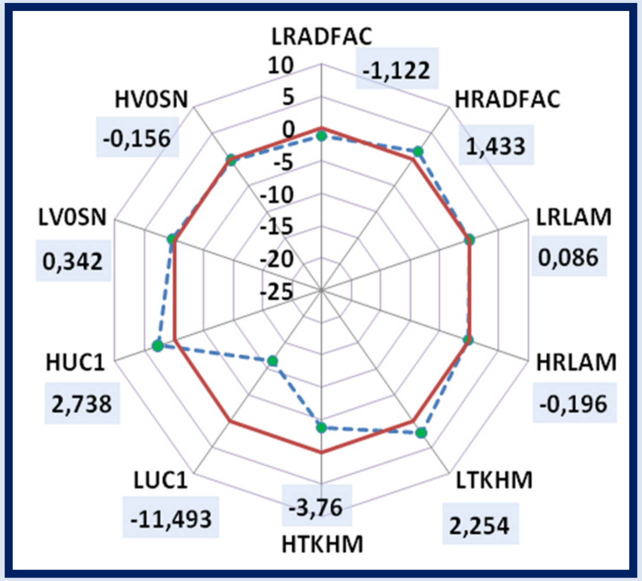


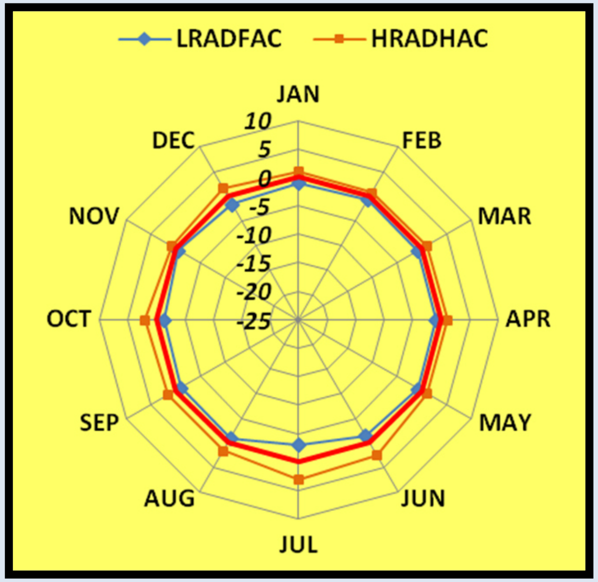


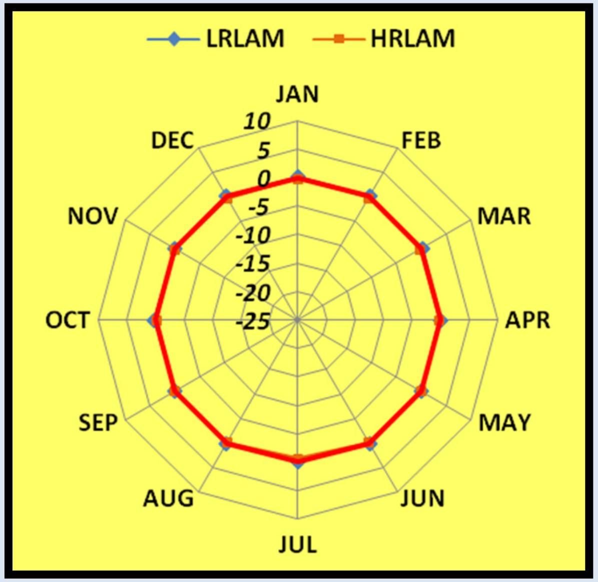


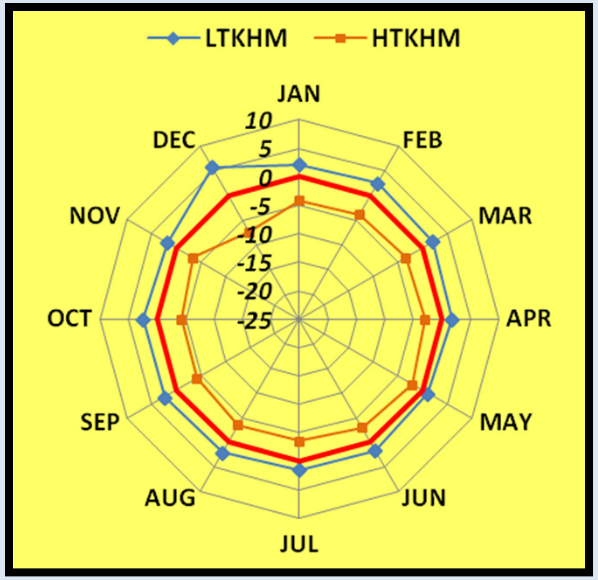


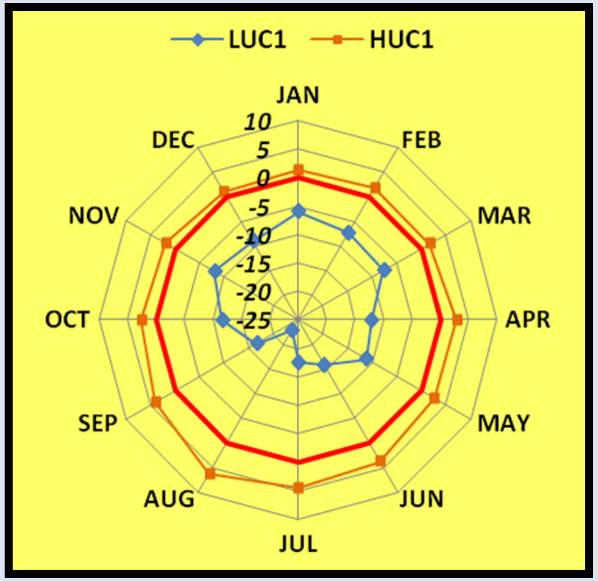
CLCT (Yearly vs Monthly Sensitivities)

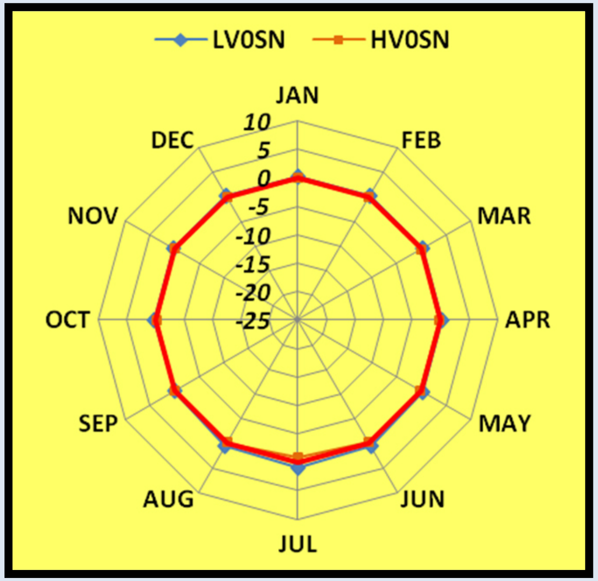




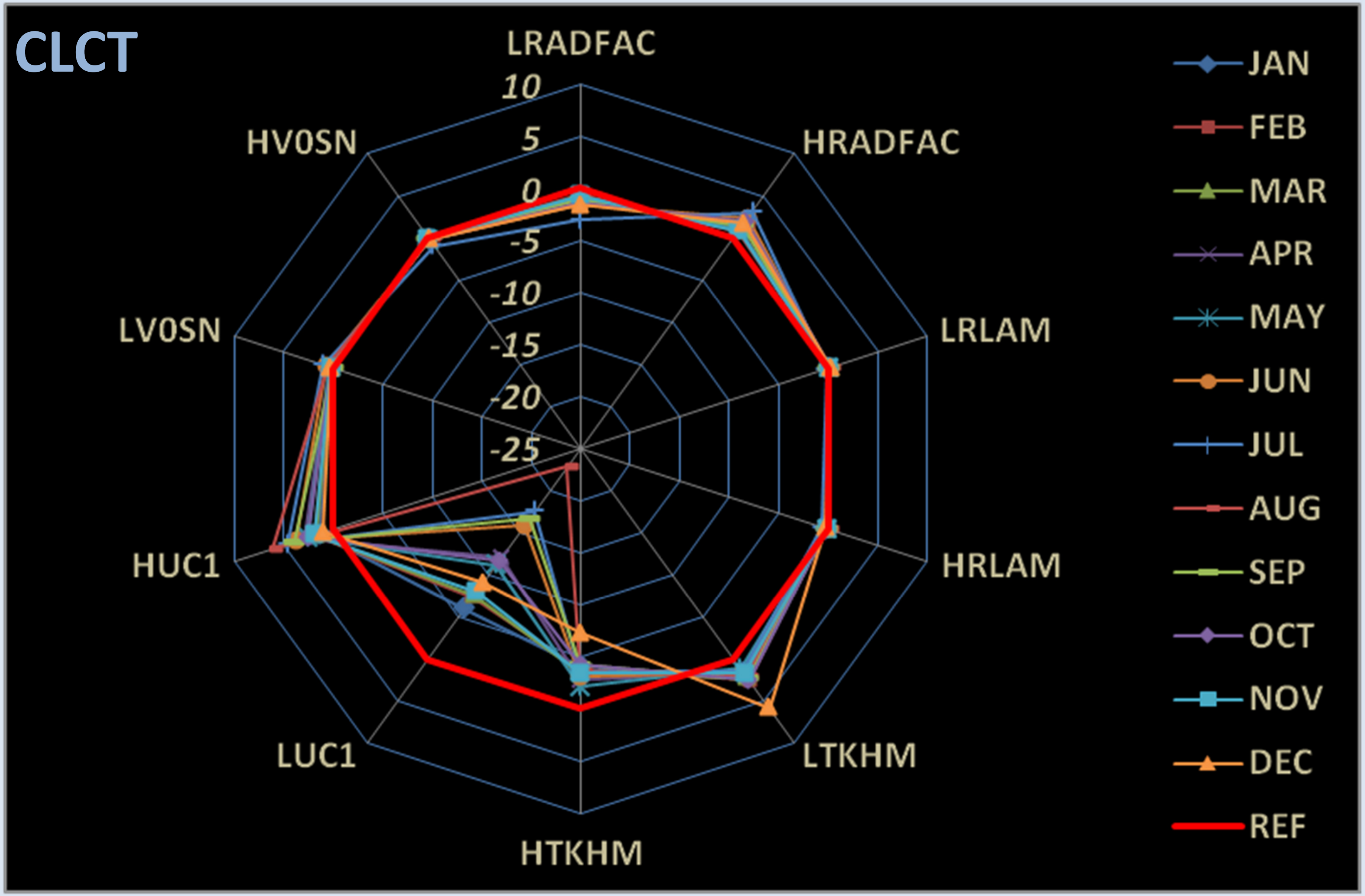




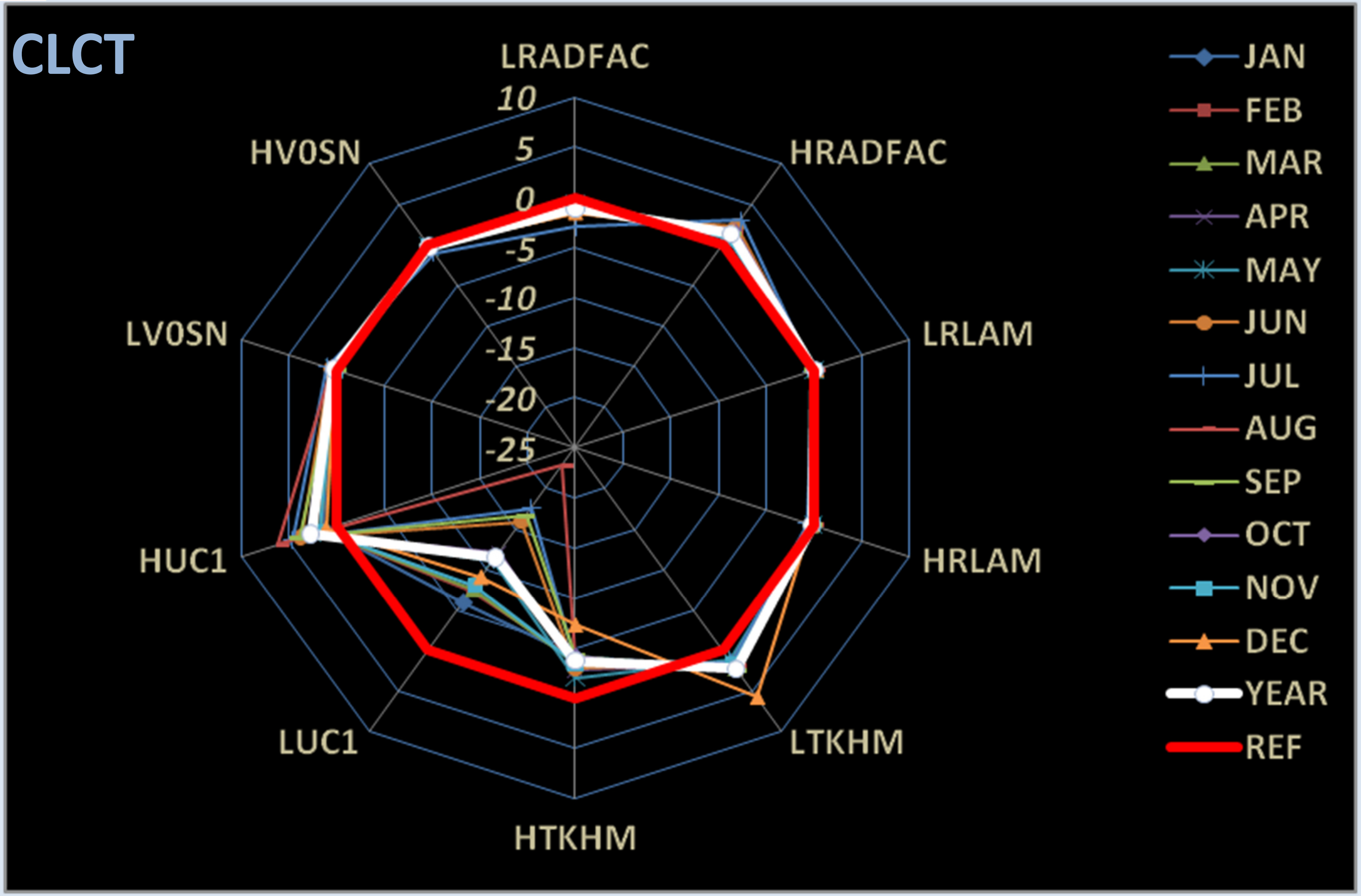




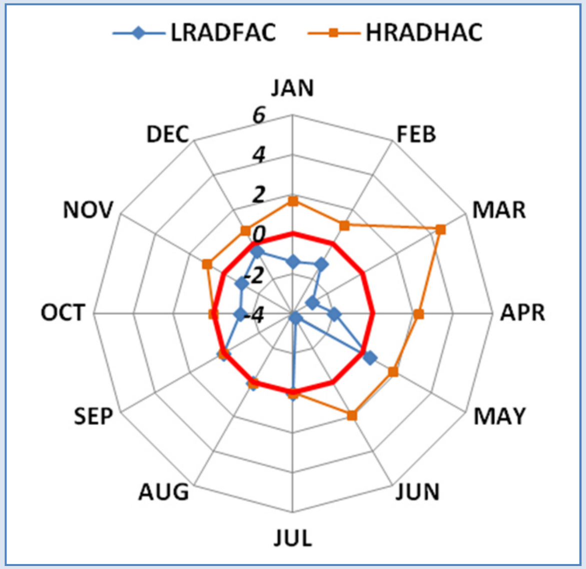
Monthly Sensitivities combined

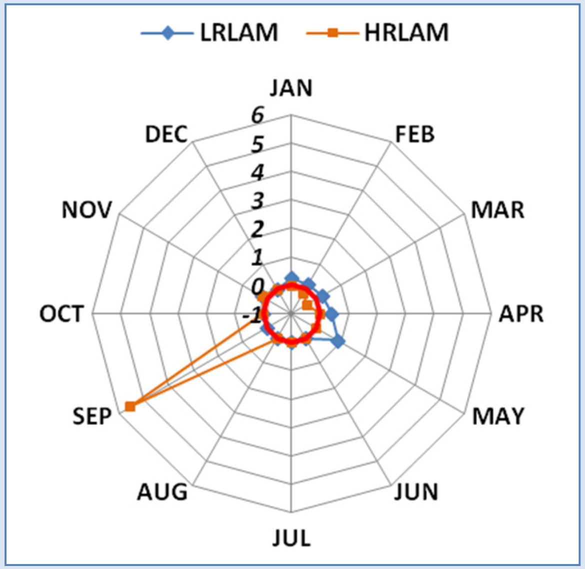


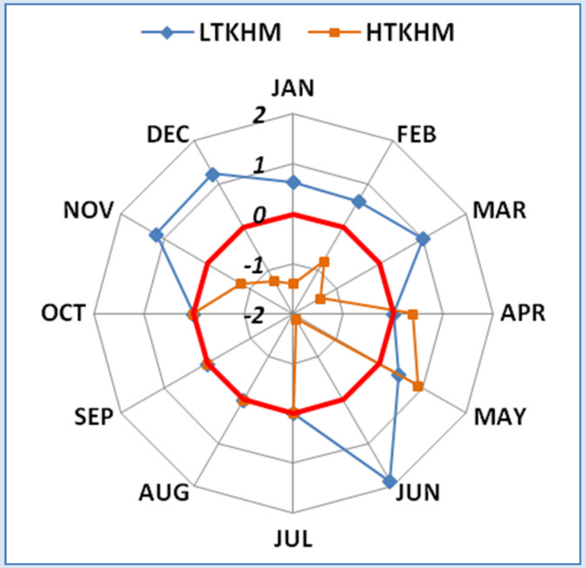
Yearly and Monthly Sensitivities combined

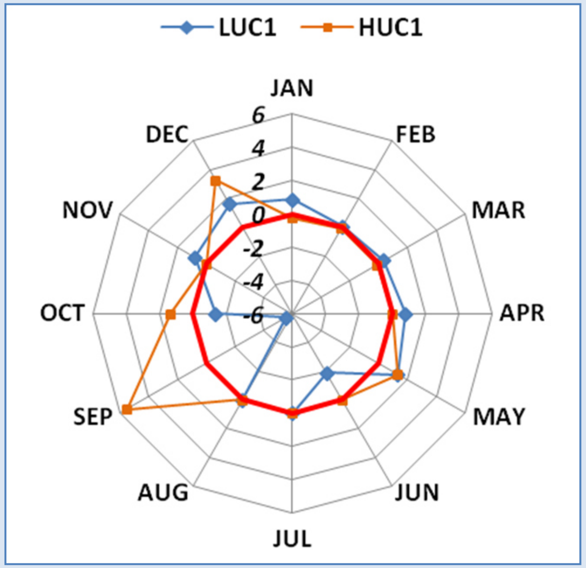


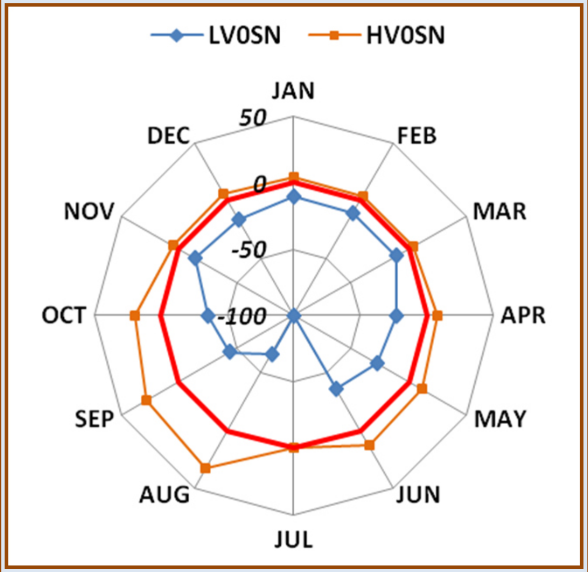
SNOW_GSP
Monthly Sensitivities



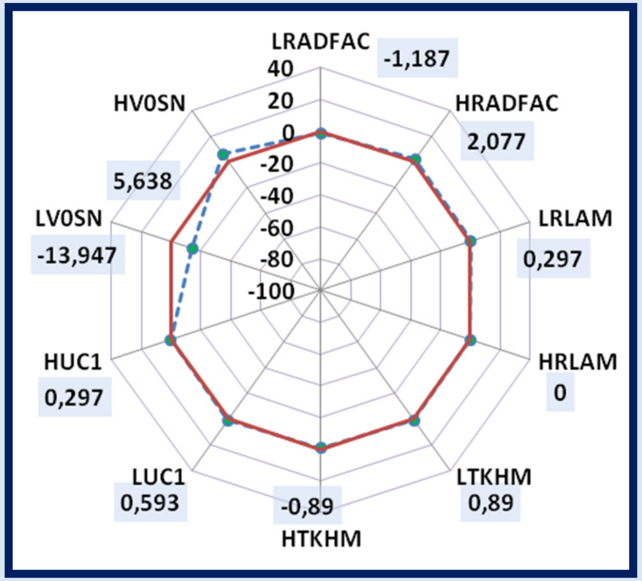


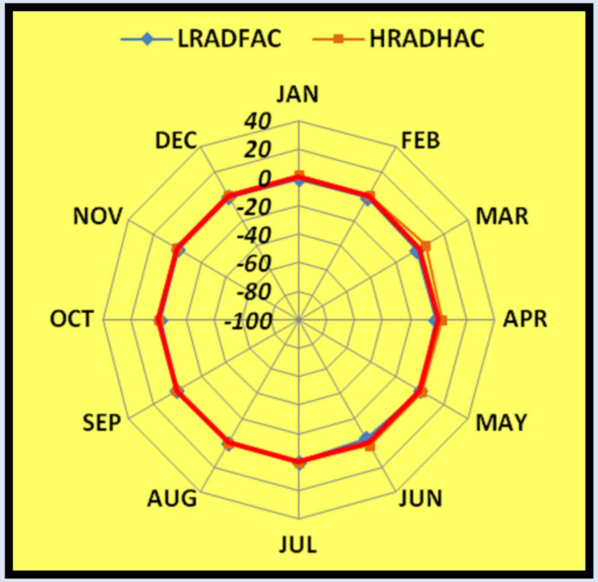


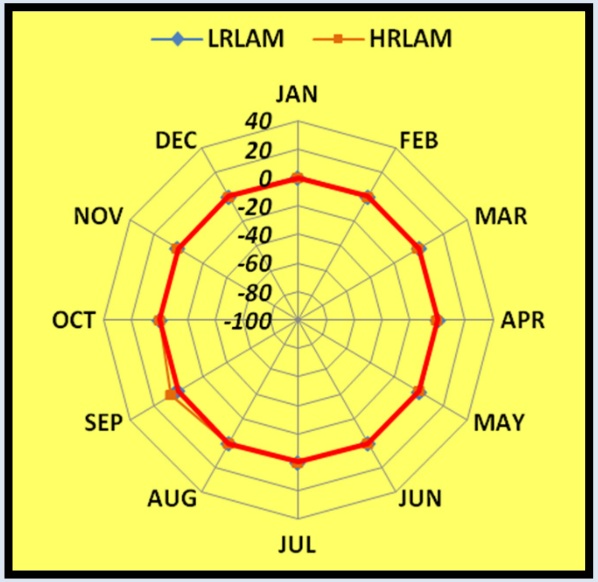


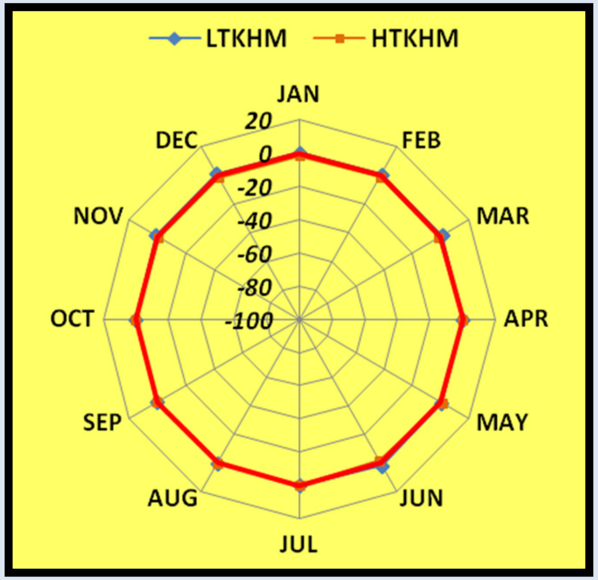


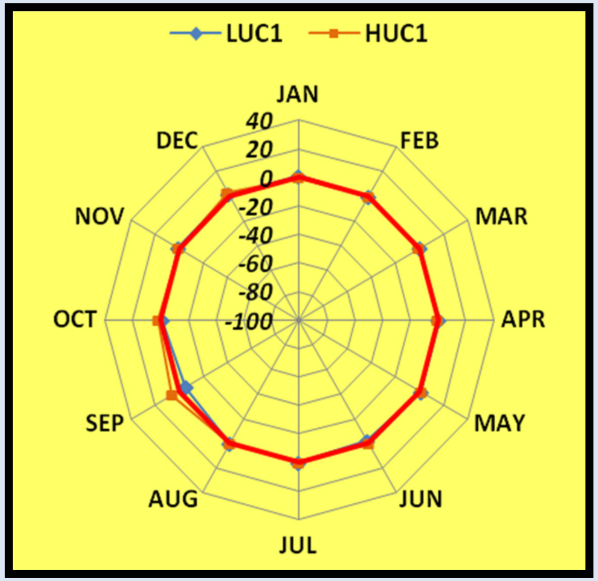
SNOW_GSP (Yearly vs Monthly Sensitivities)

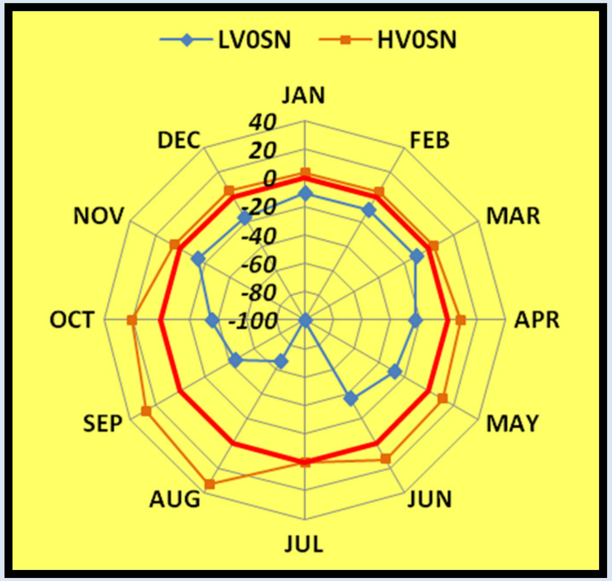




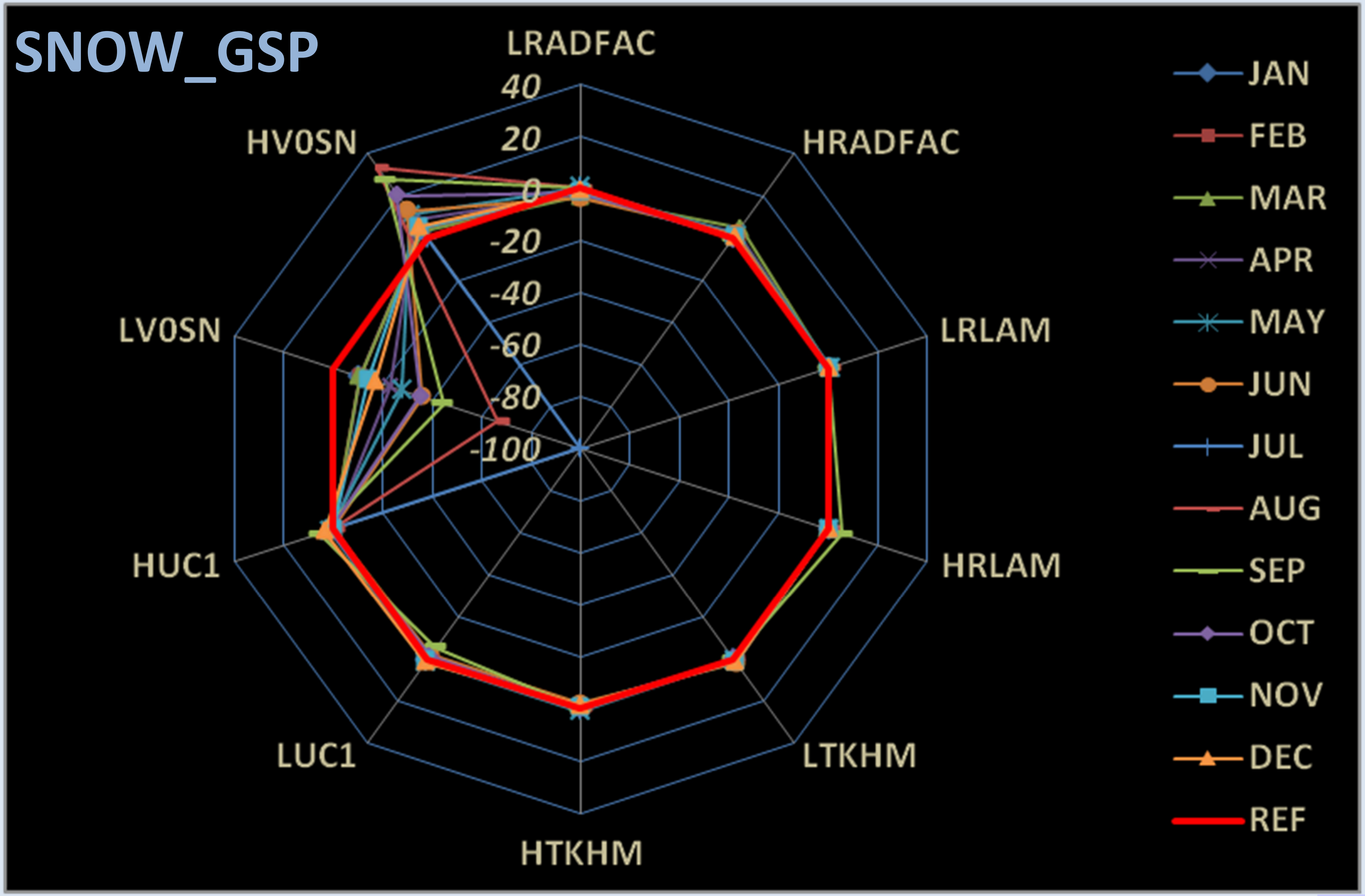




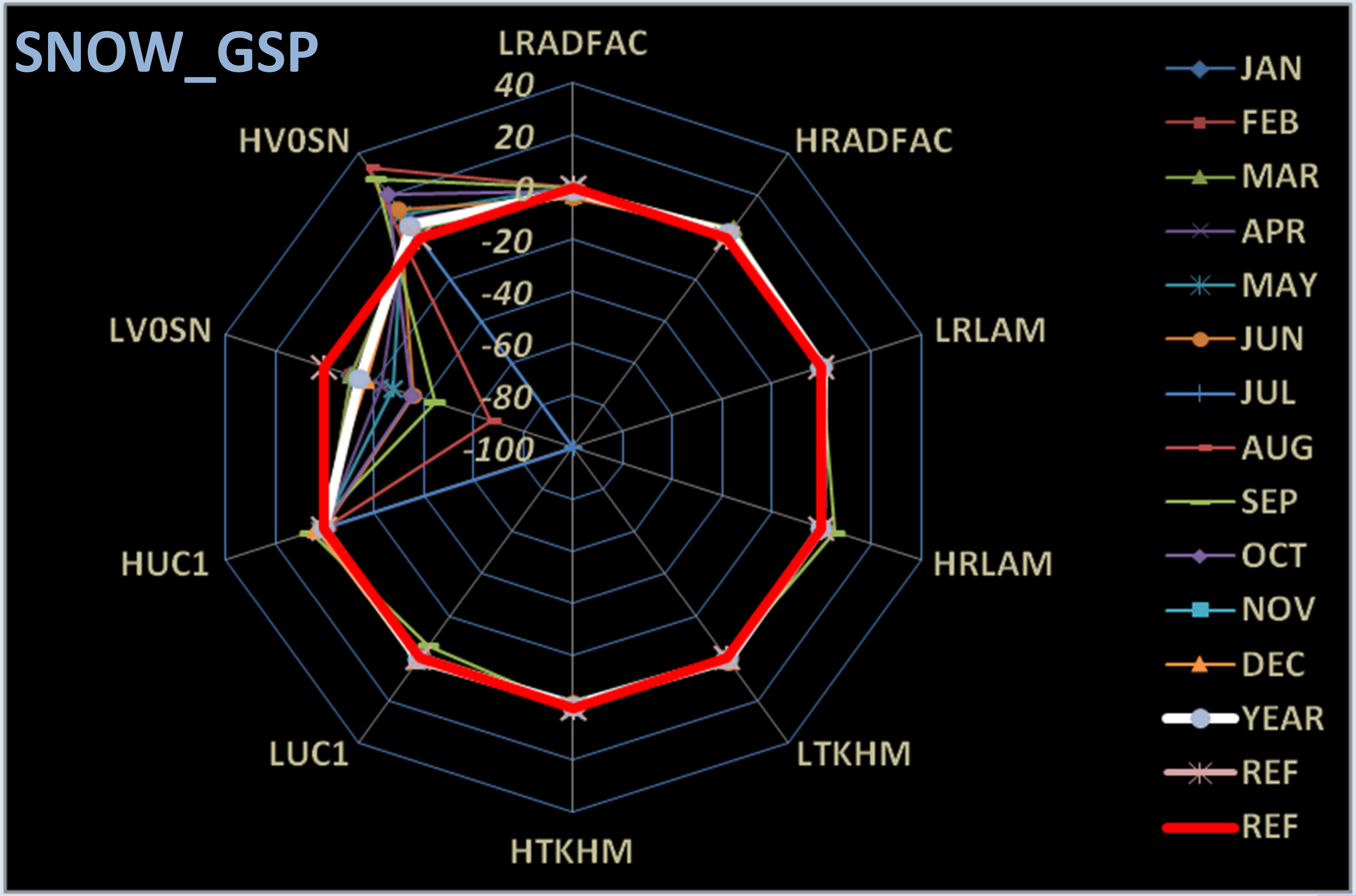




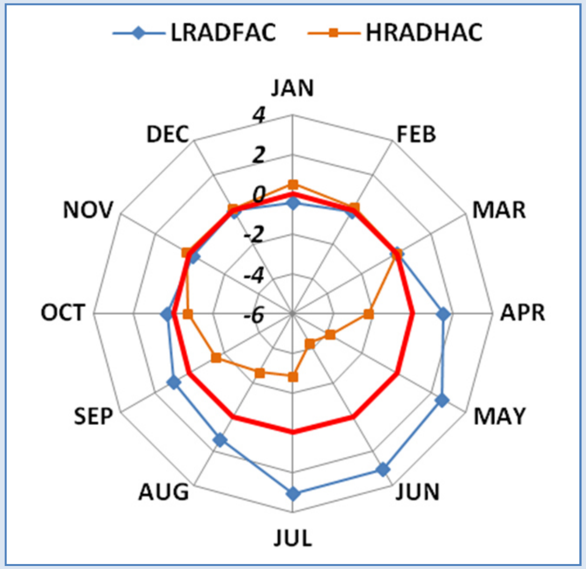
Monthly Sensitivities combined

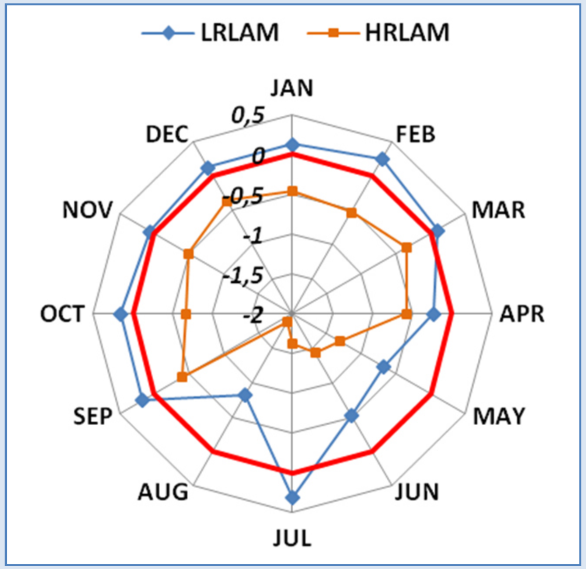


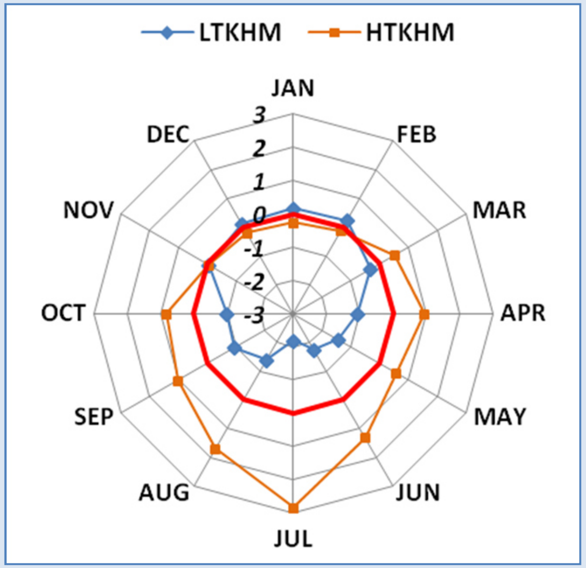
Yearly and Monthly Sensitivities combined

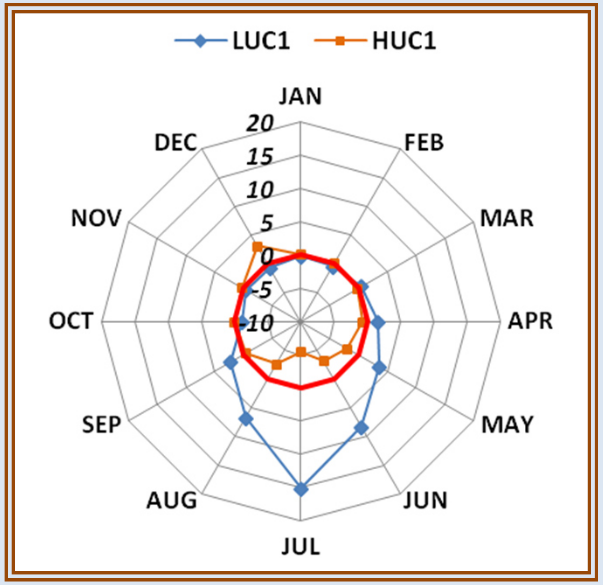


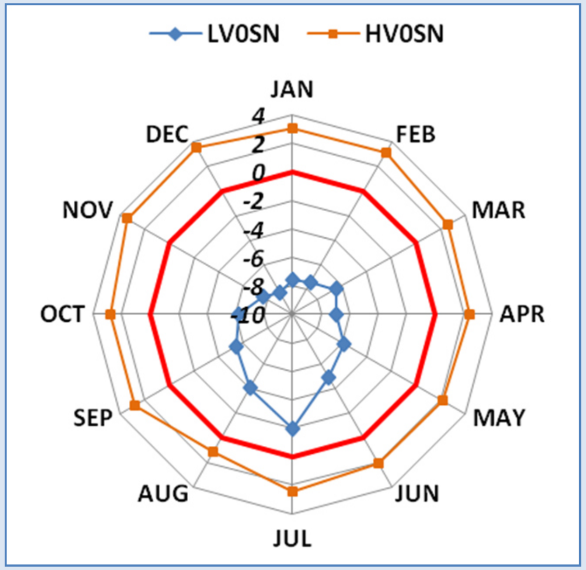
TOT_PREC
Monthly Sensitivities



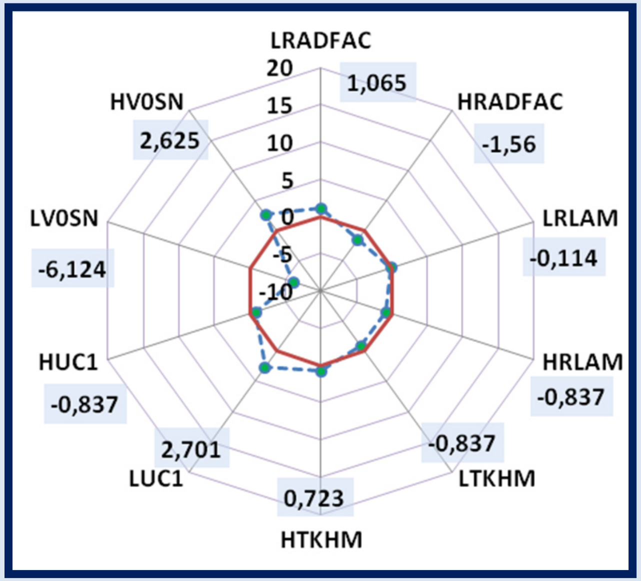


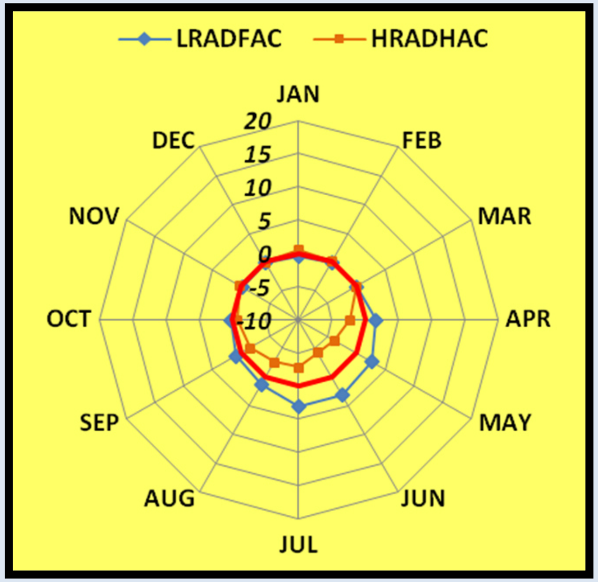


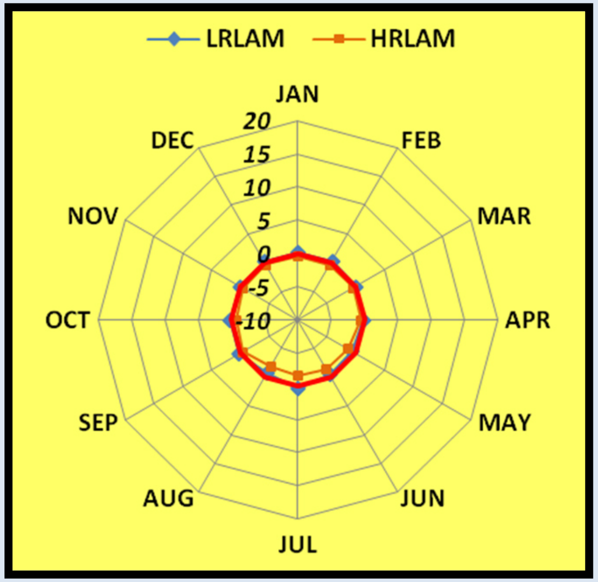


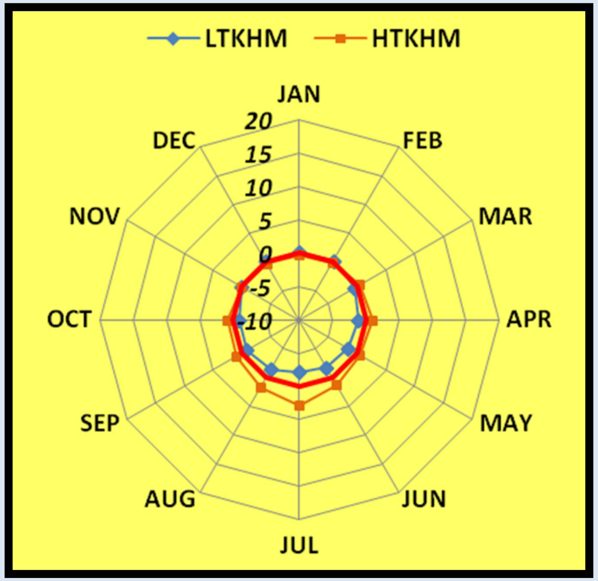


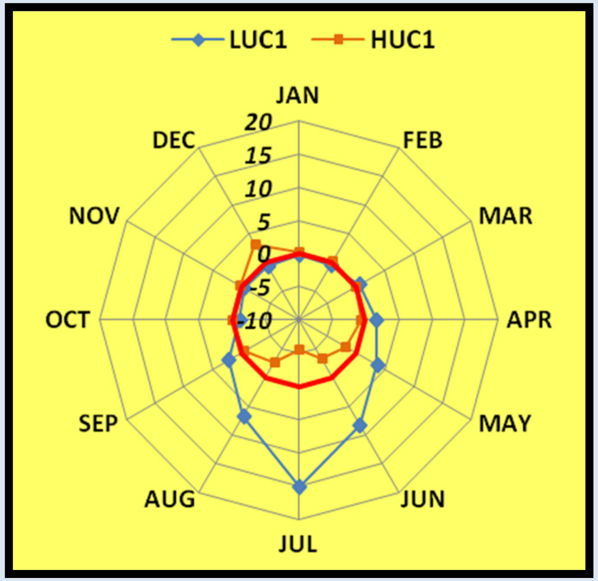
TOT_PREC (Yearly vs Monthly Sensitivities)

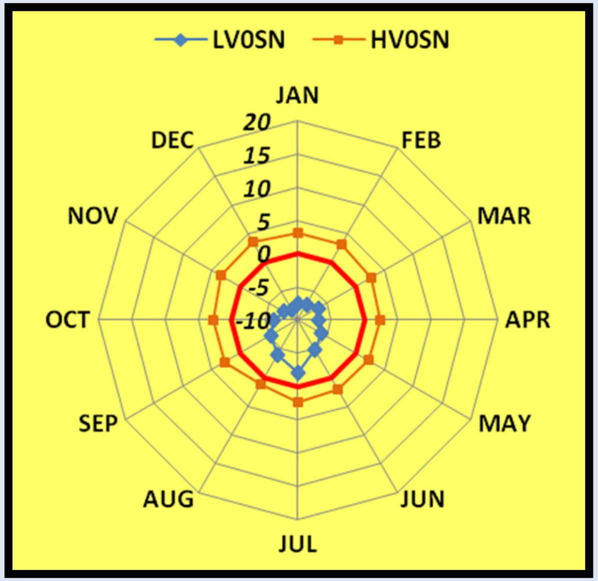




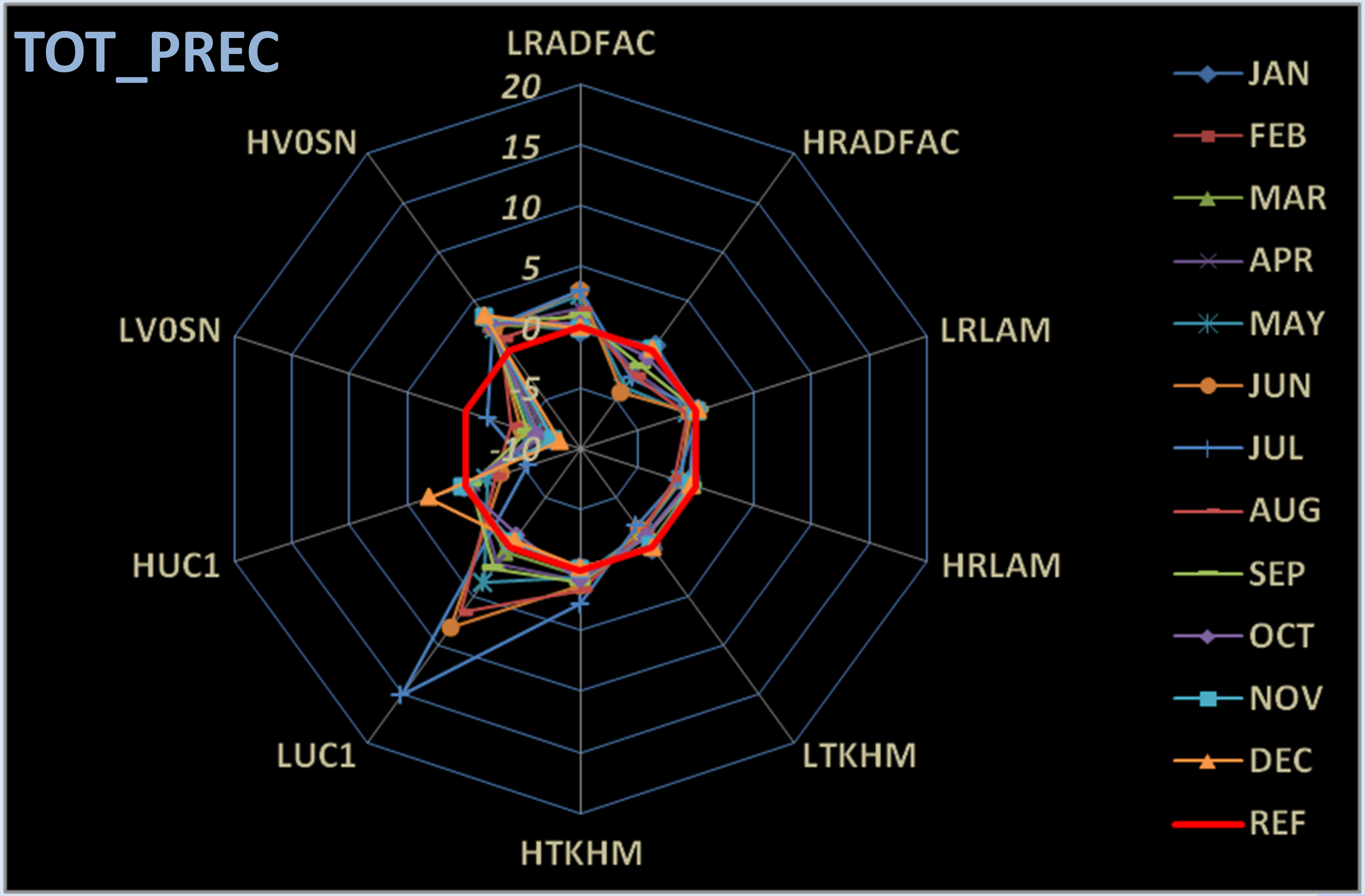




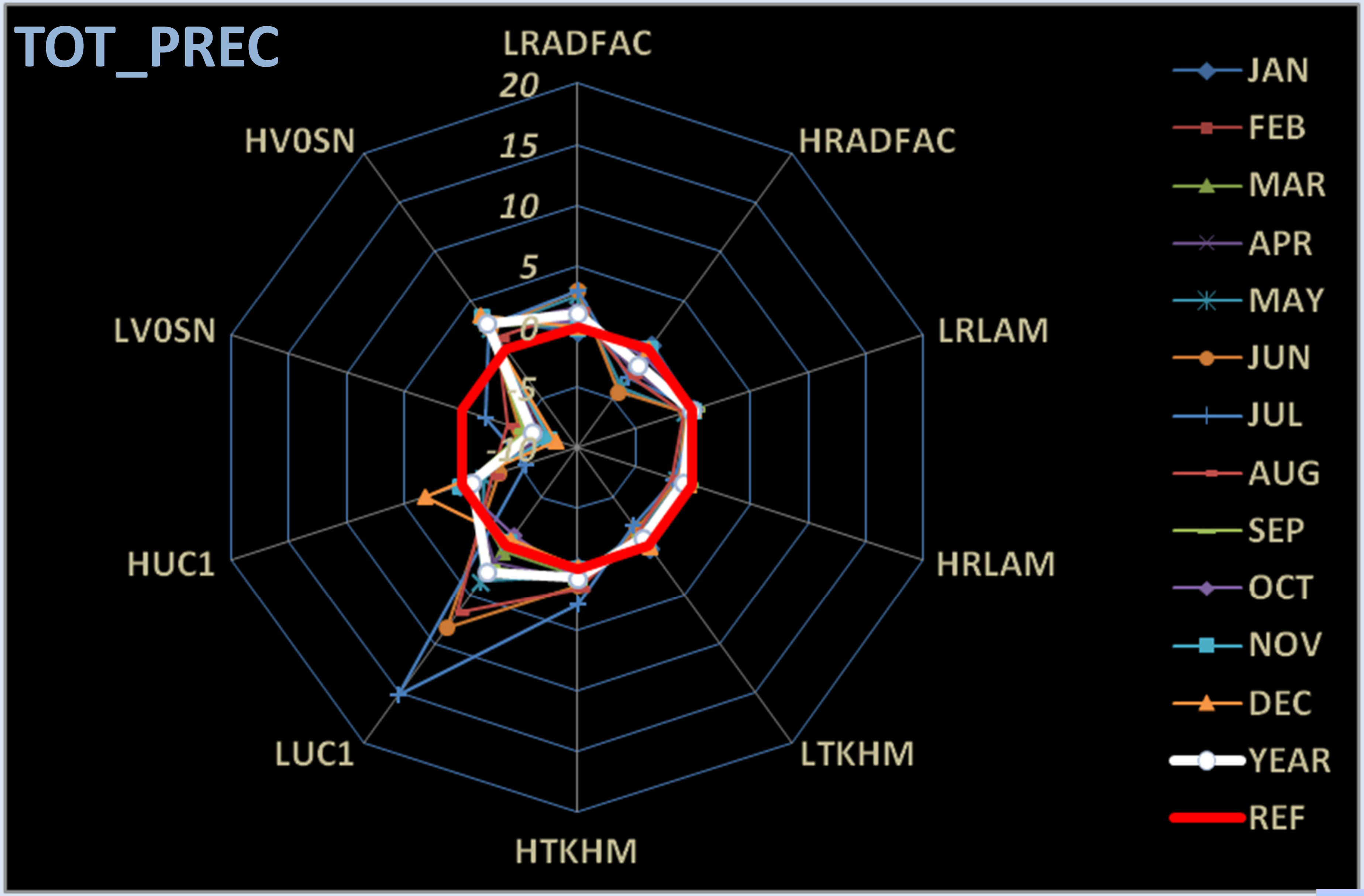




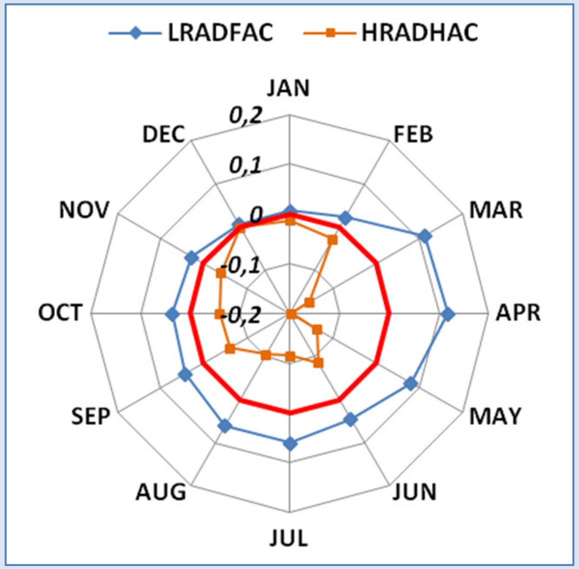
Monthly Sensitivities combined

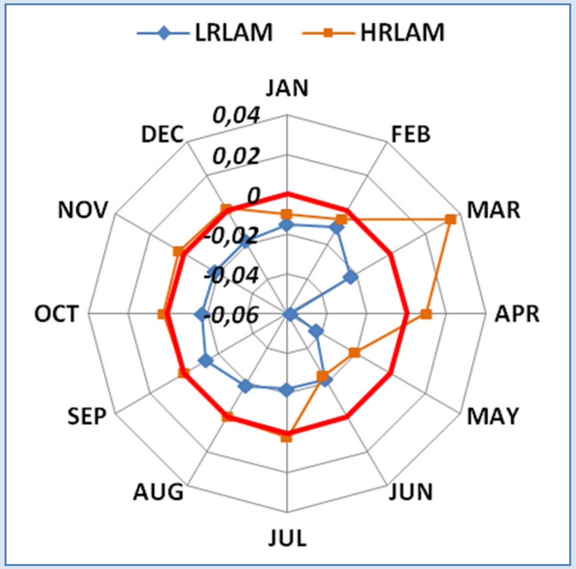


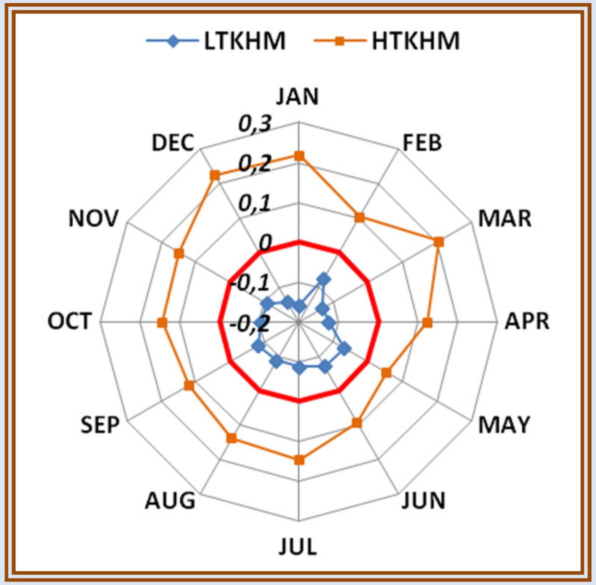
Yearly and Monthly Sensitivities combined

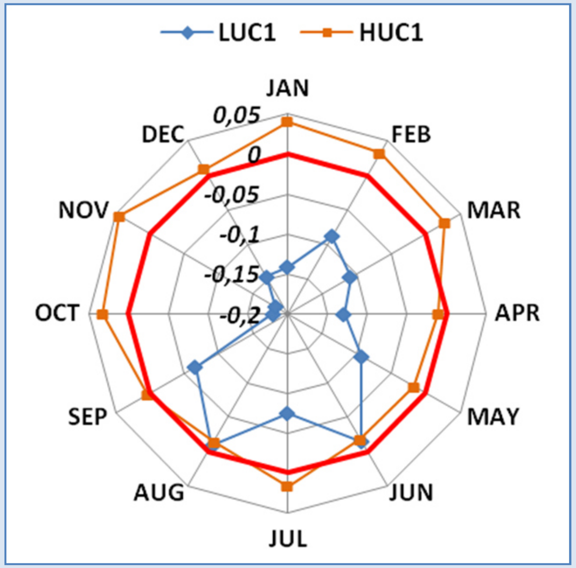


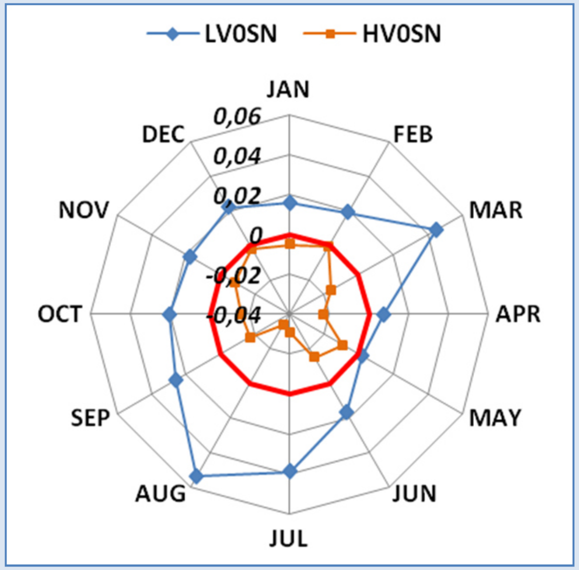
T2m Monthly Sensitivities



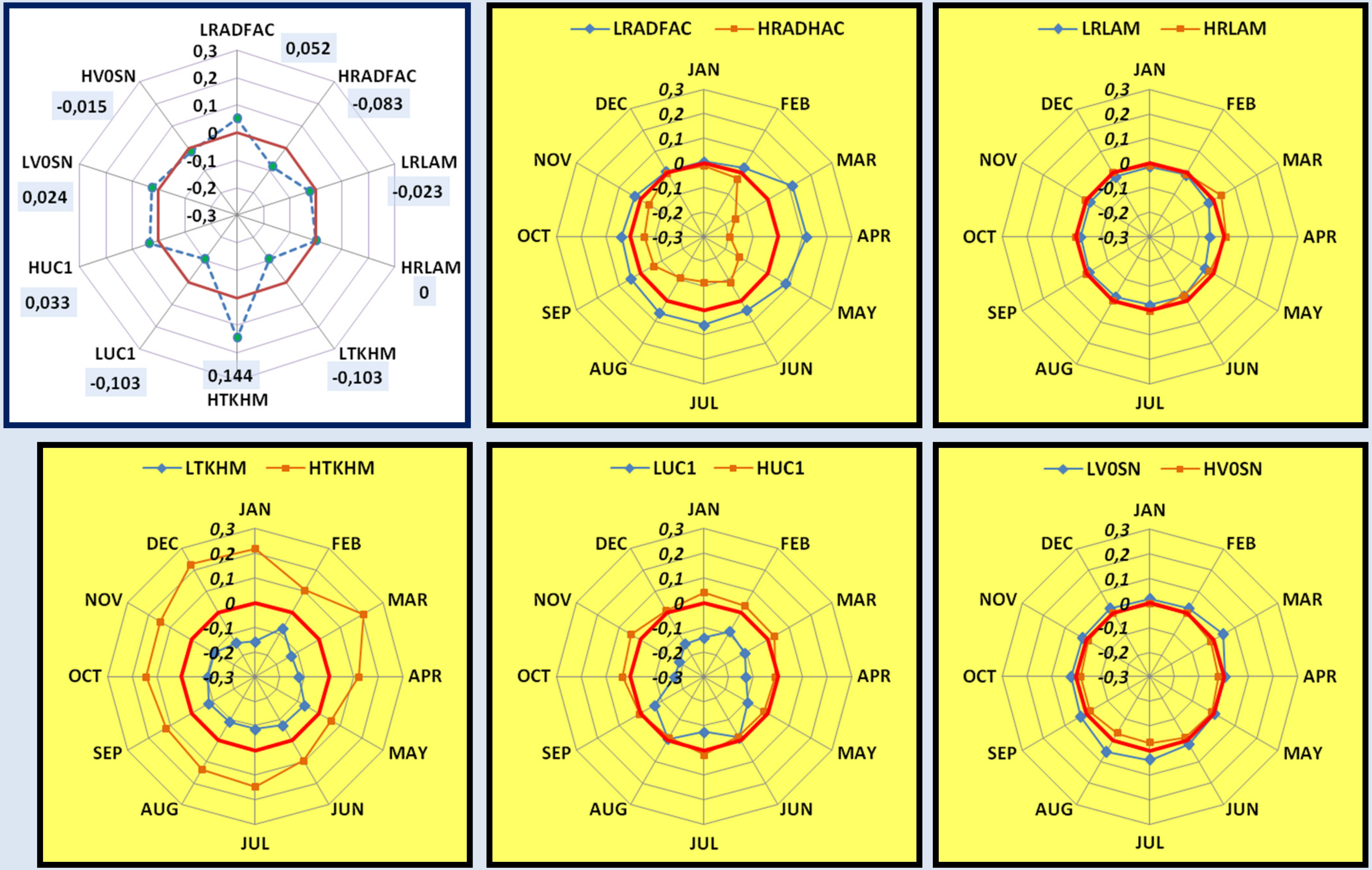




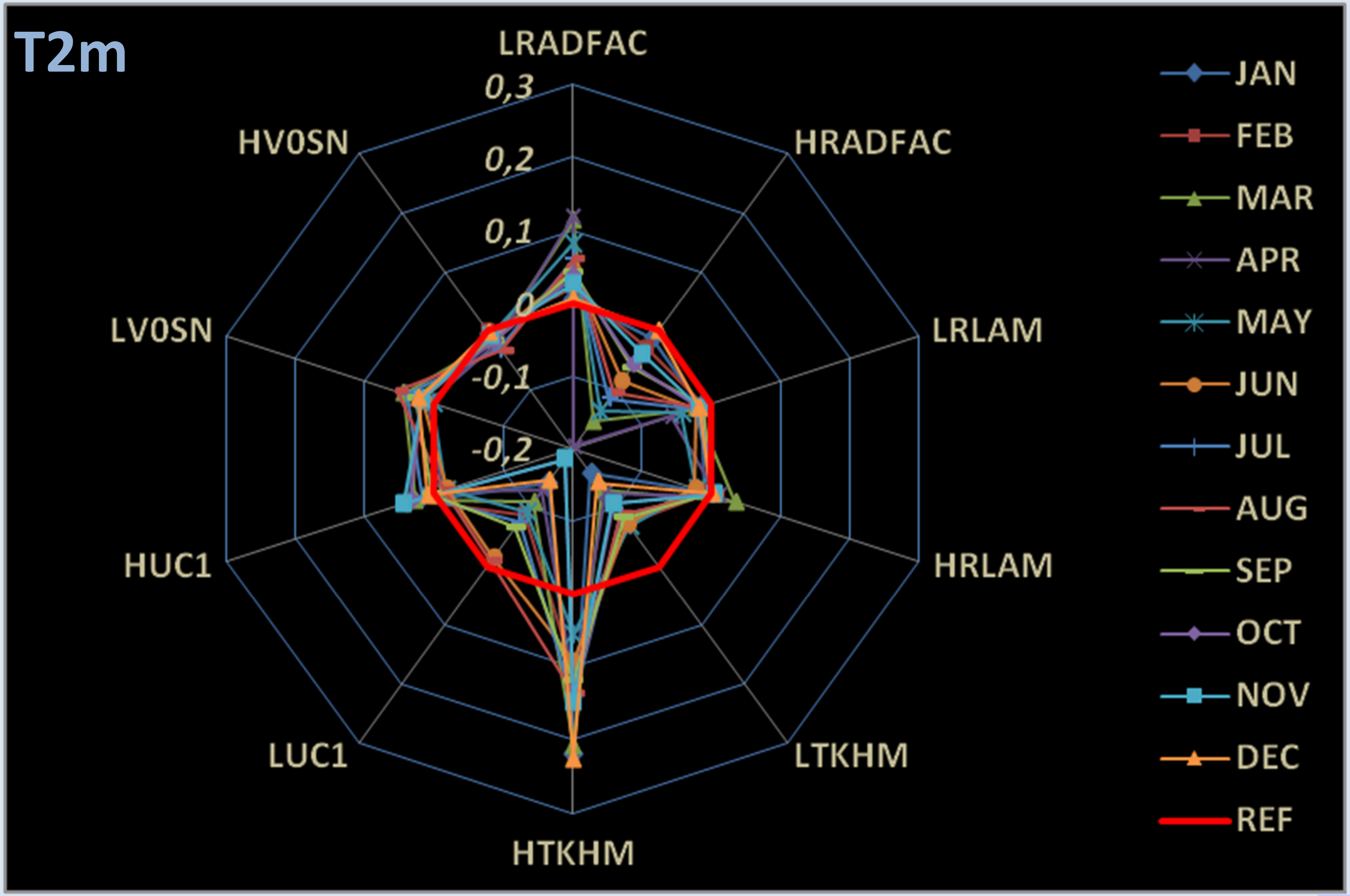




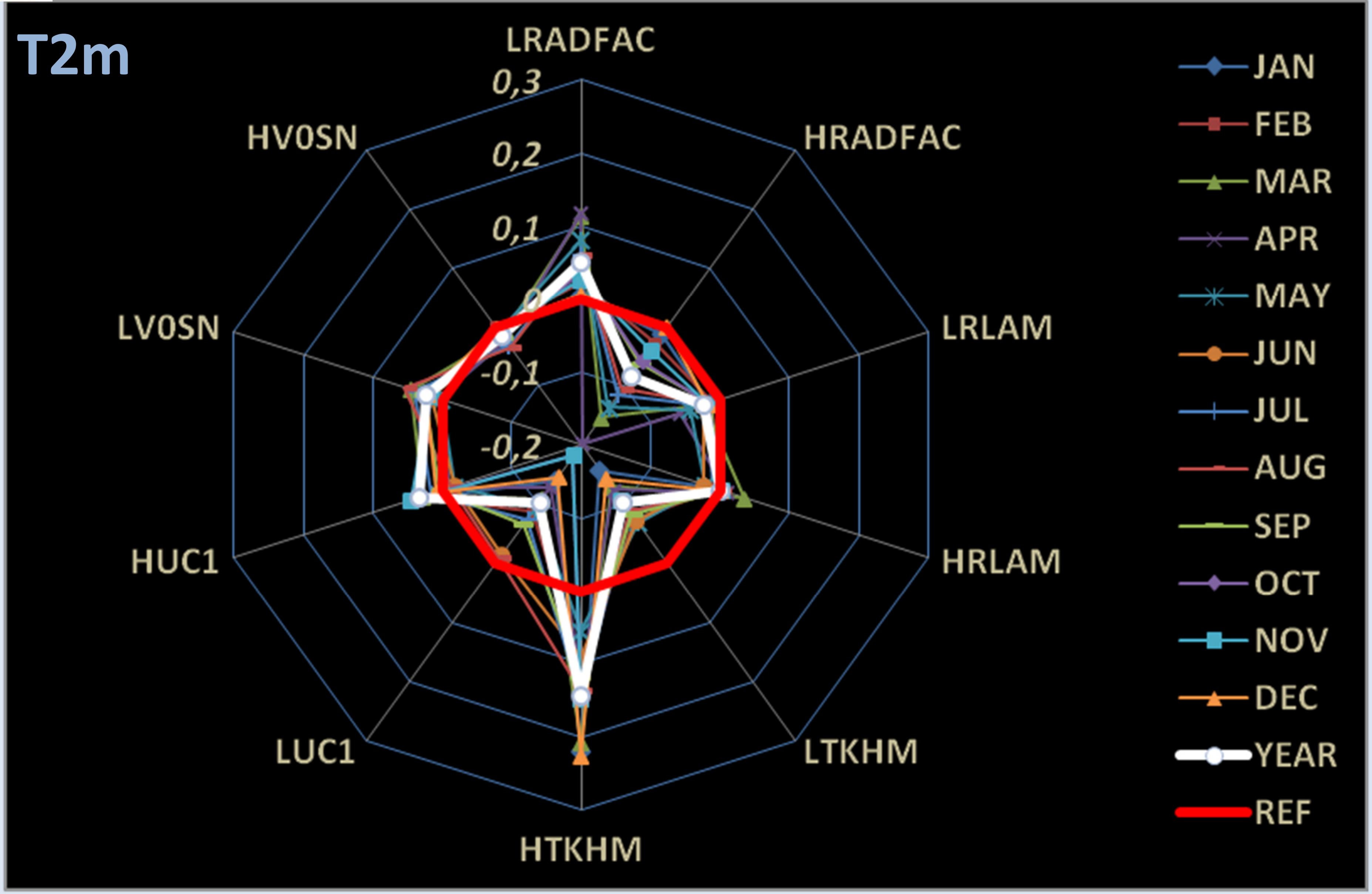
T2m (Yearly vs Monthly Sensitivities)



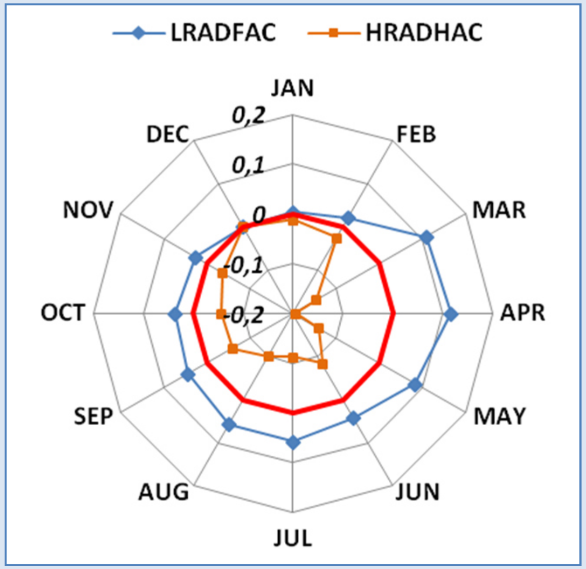
Monthly Sensitivities combined

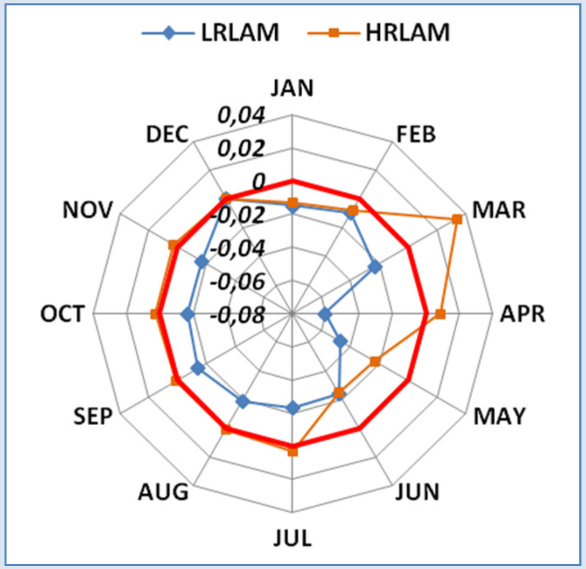


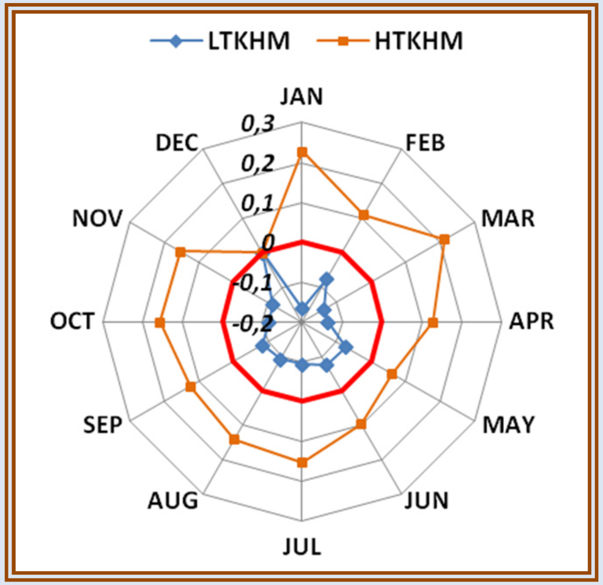
Yearly and Monthly Sensitivities combined

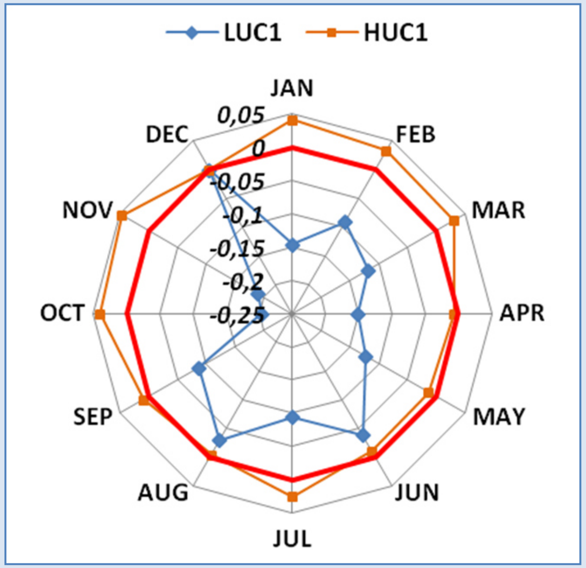


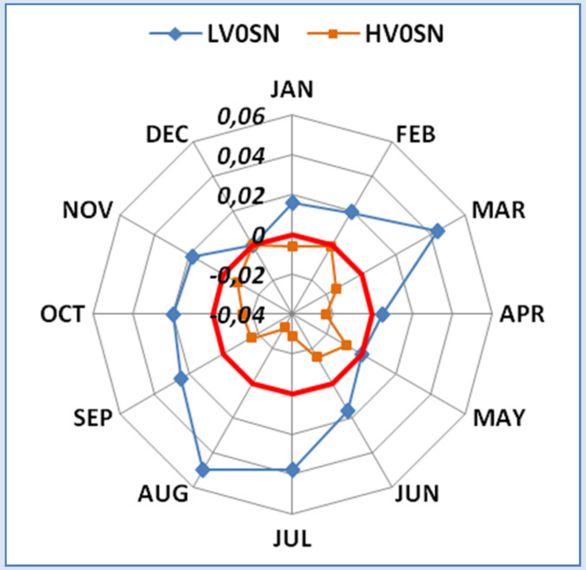
Tmin2m
Monthly Sensitivities



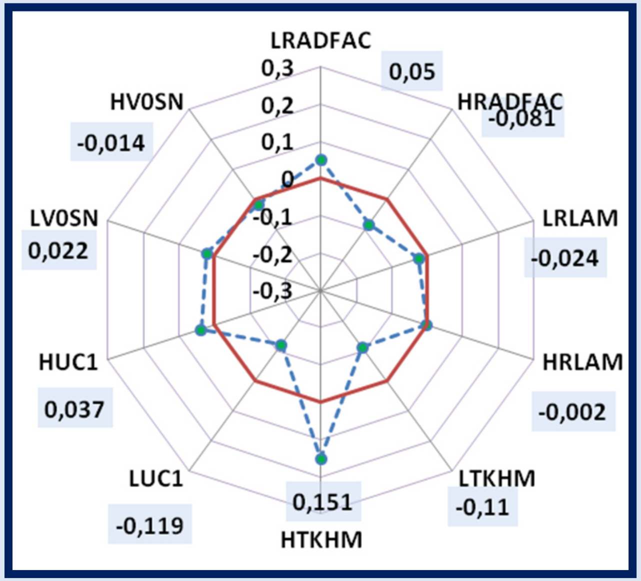


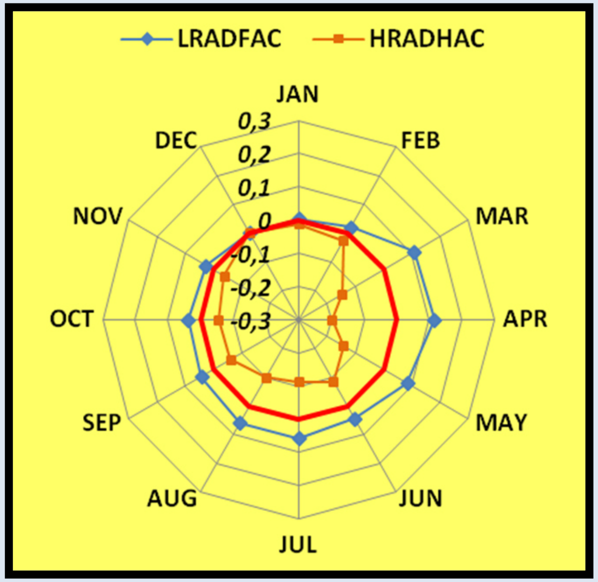


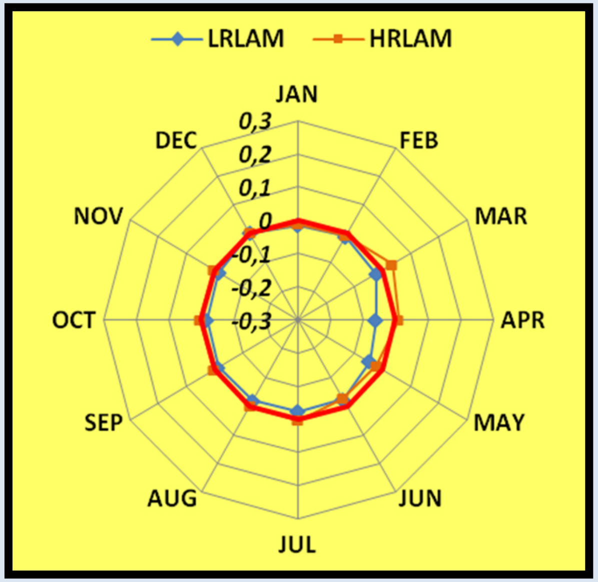


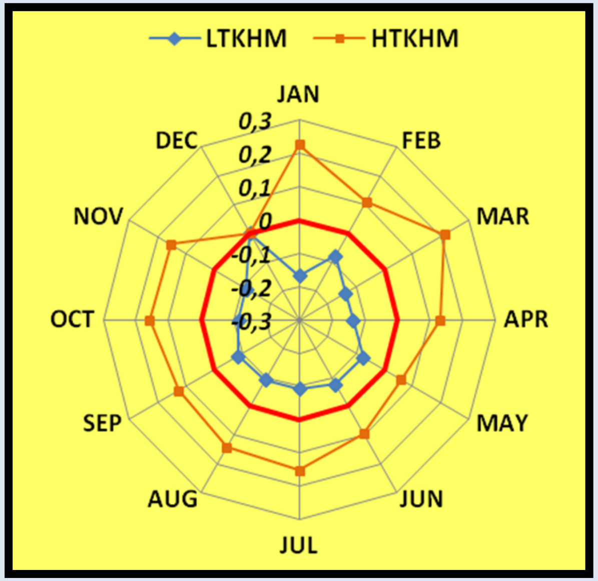


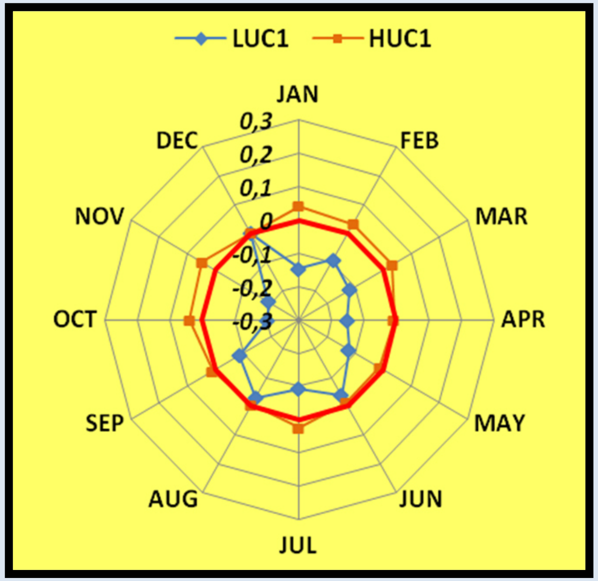
Tmin2m (Yearly vs Monthly Sensitivities)

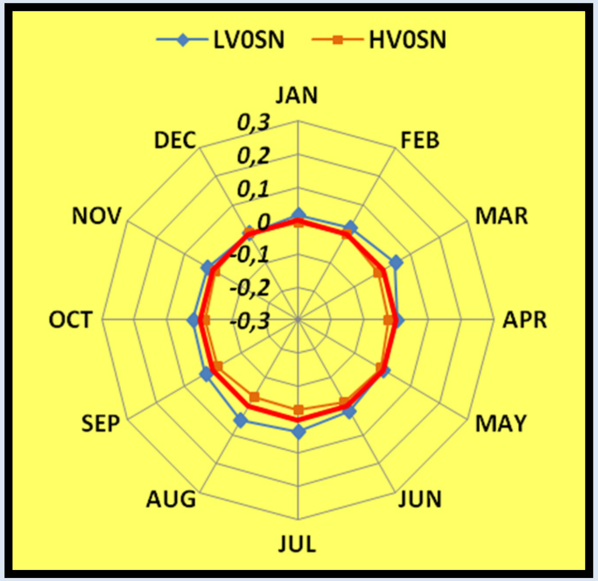




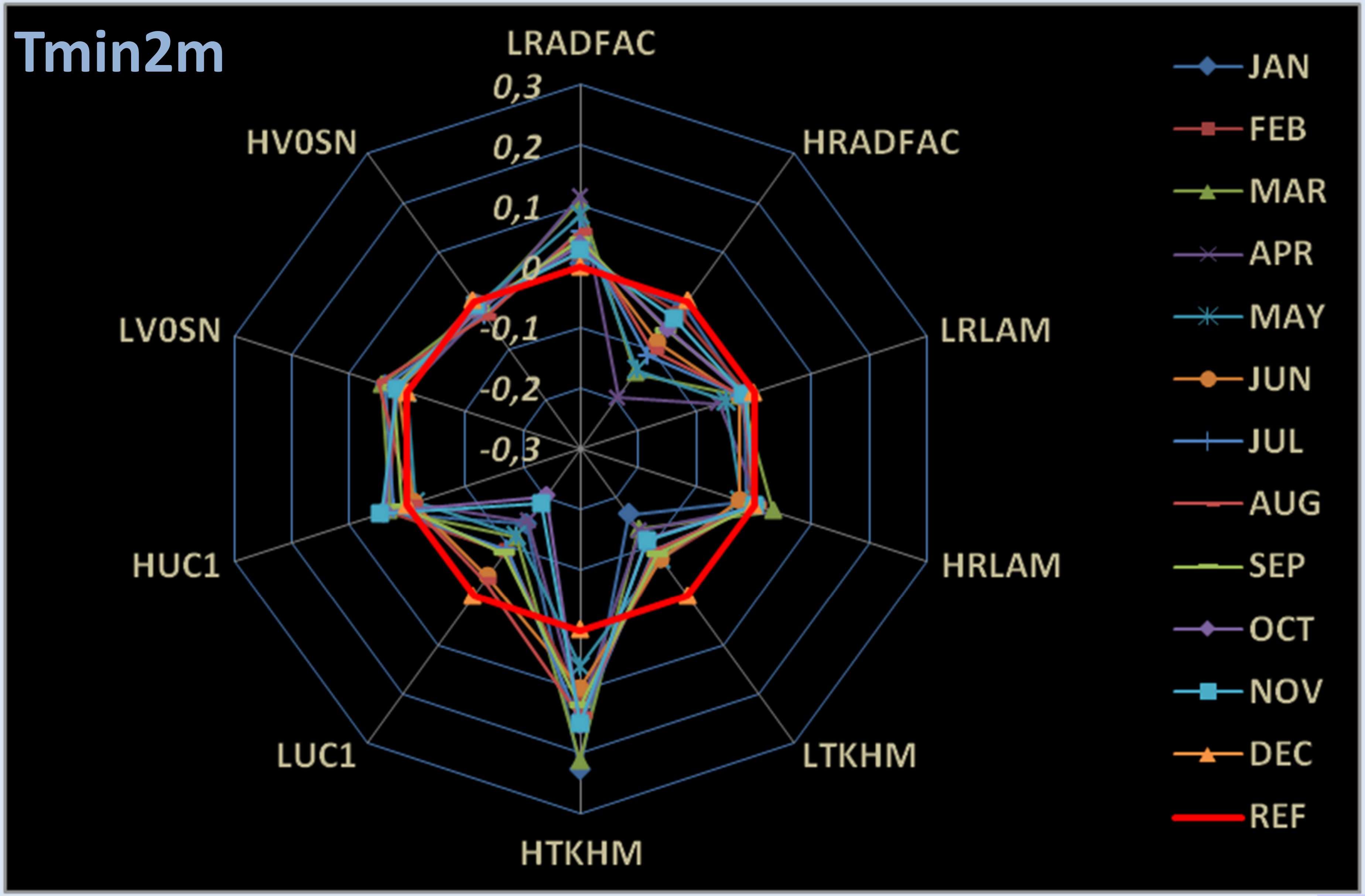




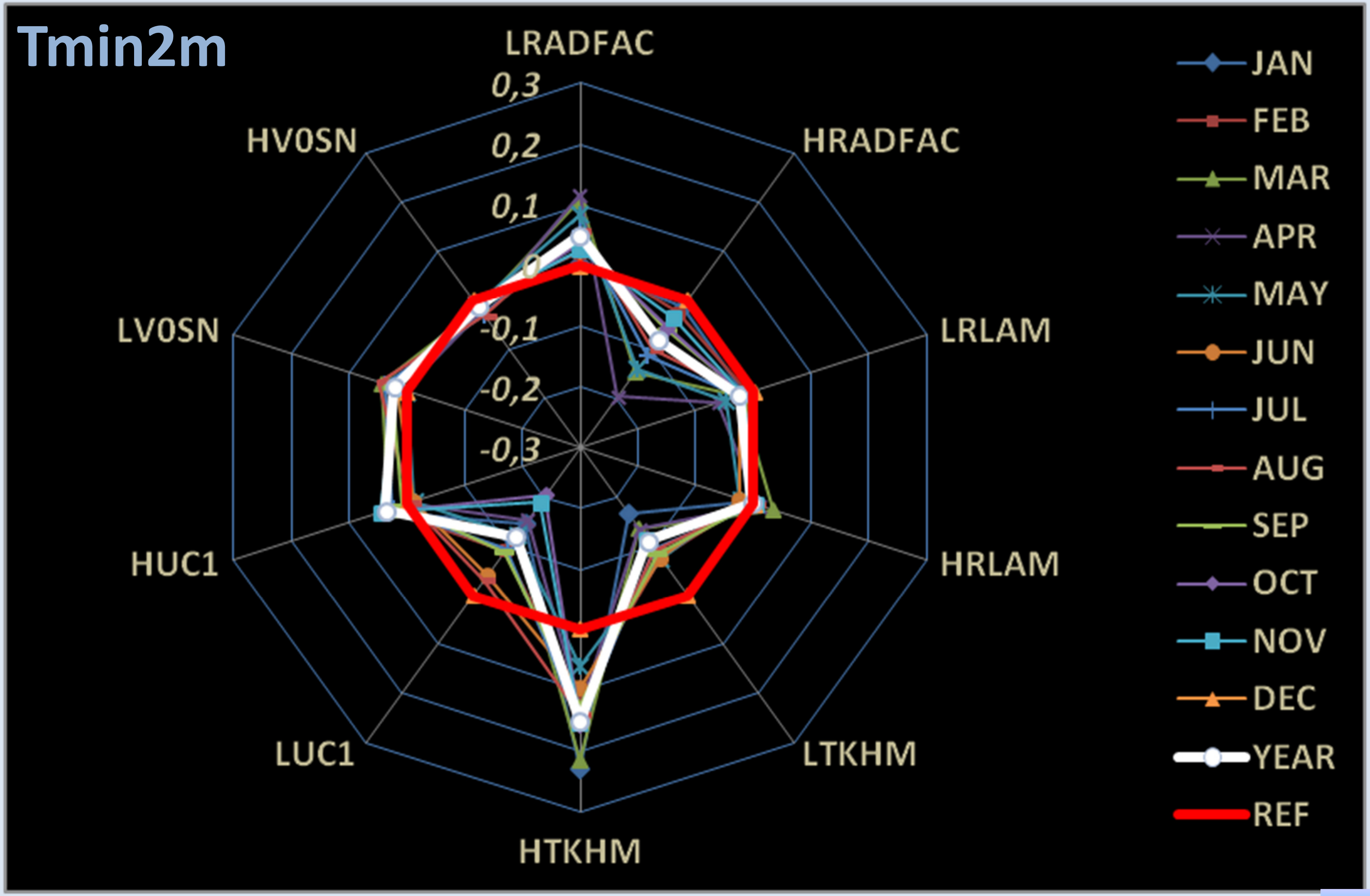




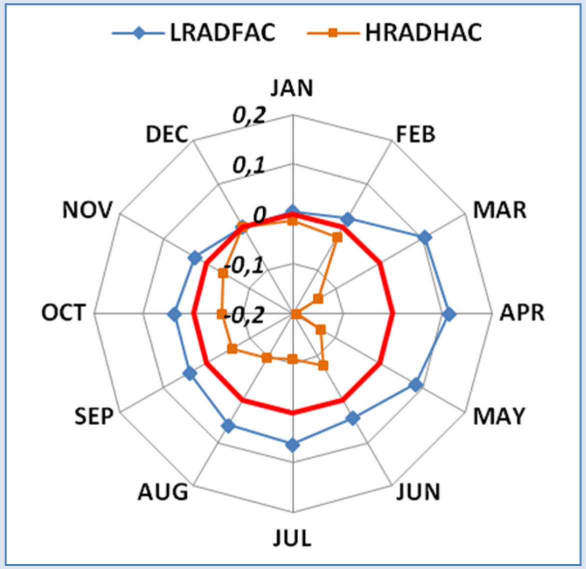
Monthly Sensitivities combined

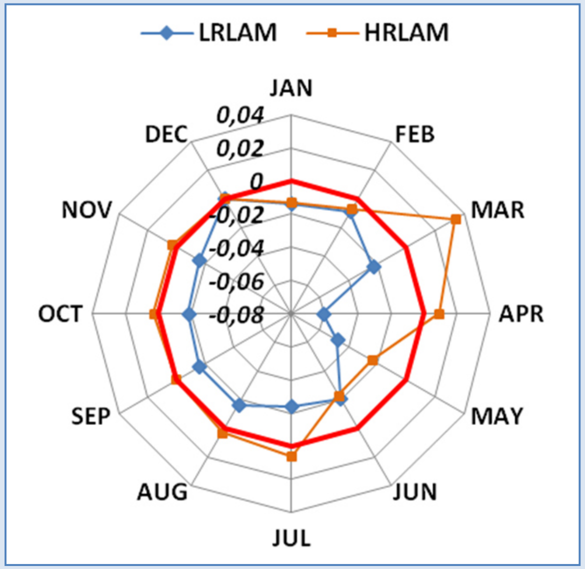


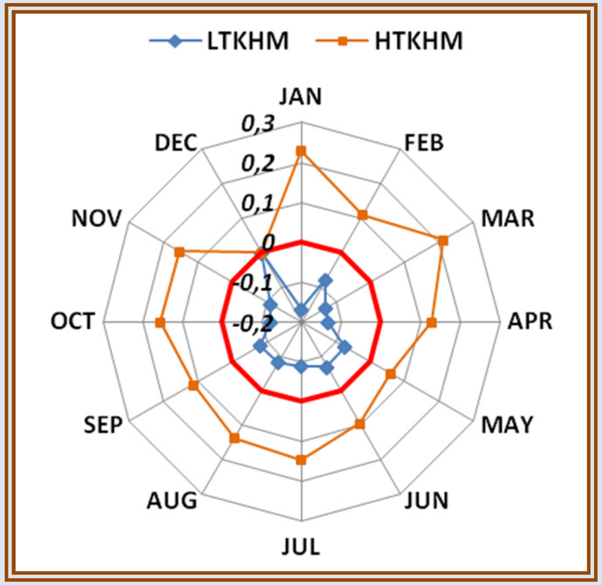
Yearly and Monthly Sensitivities combined

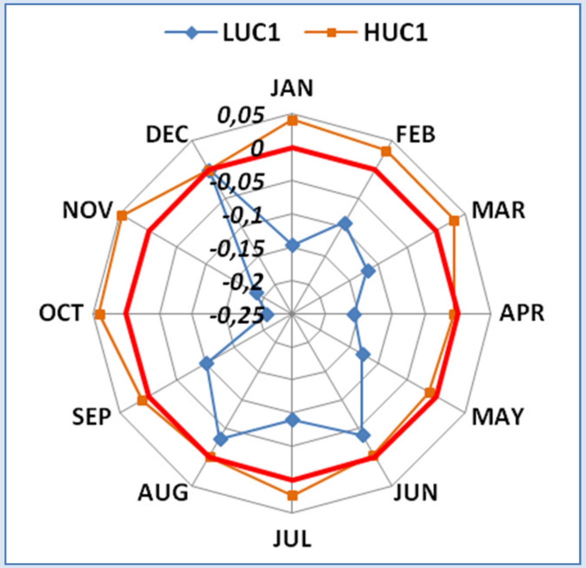


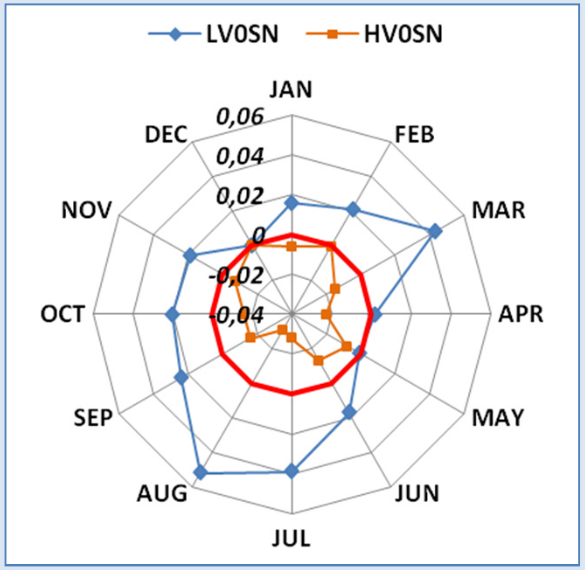
T2m06UTC
Monthly Sensitivities



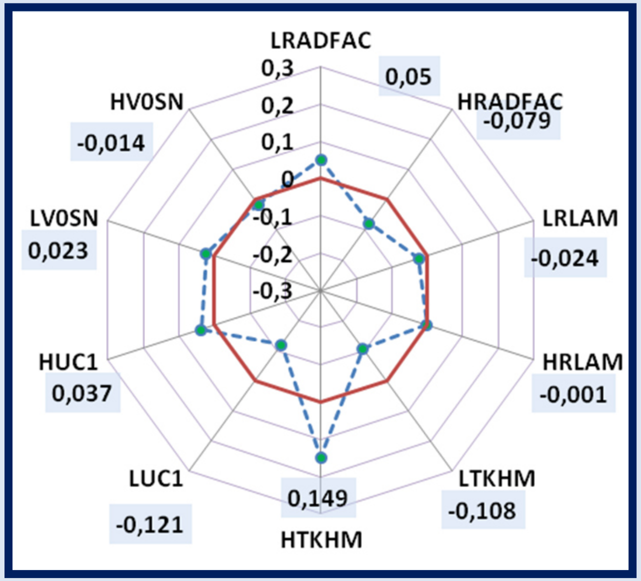


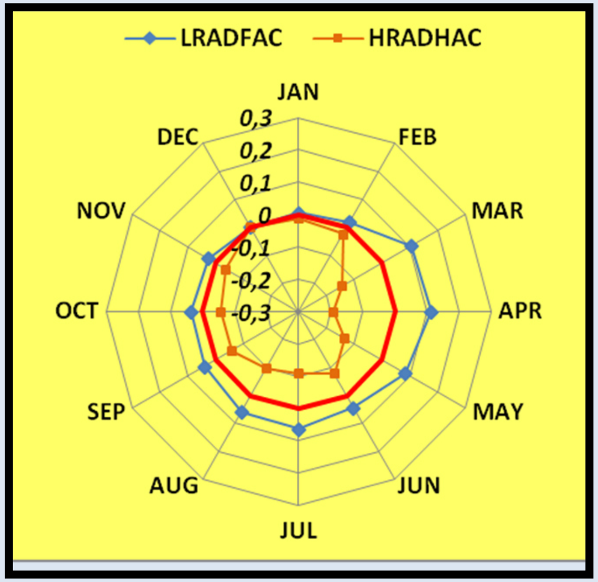


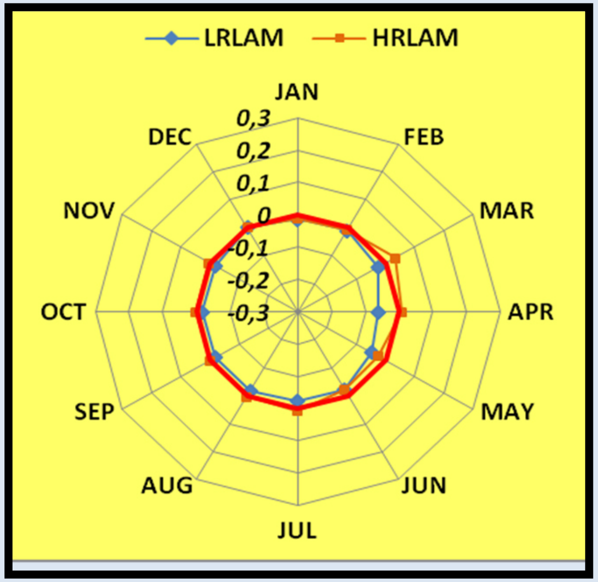


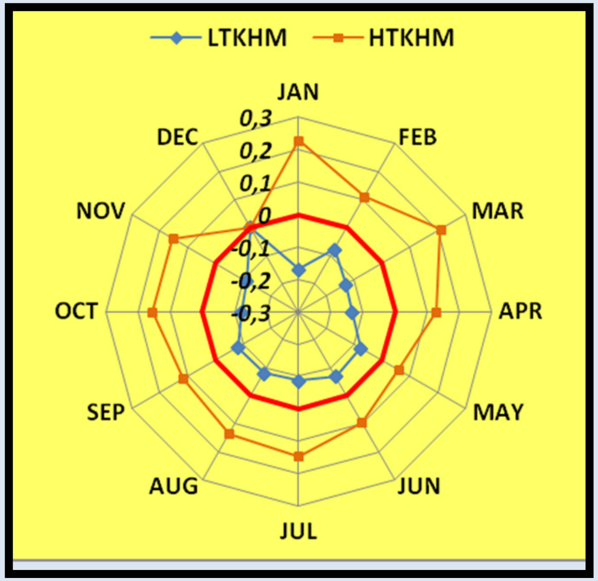


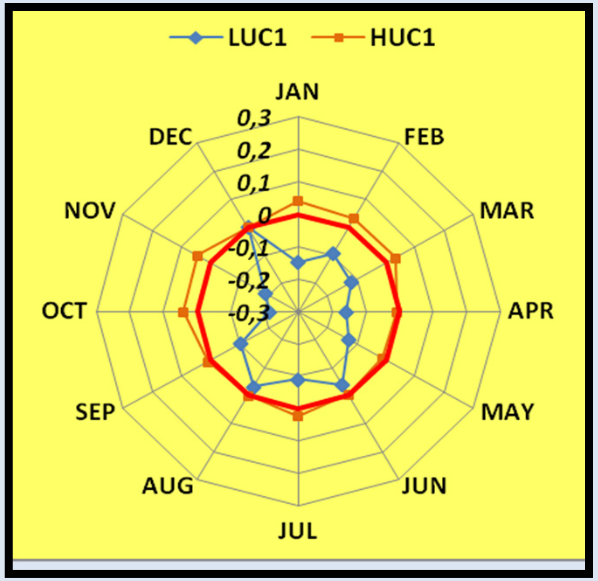
T2m06UTC (Yearly vs Monthly Sensitivities)

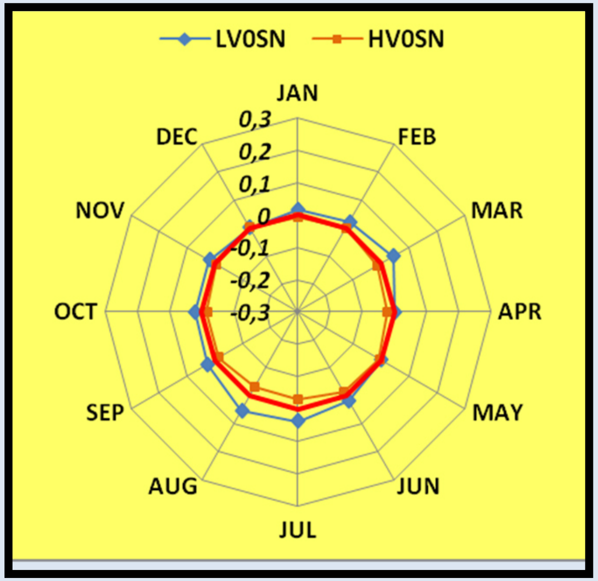




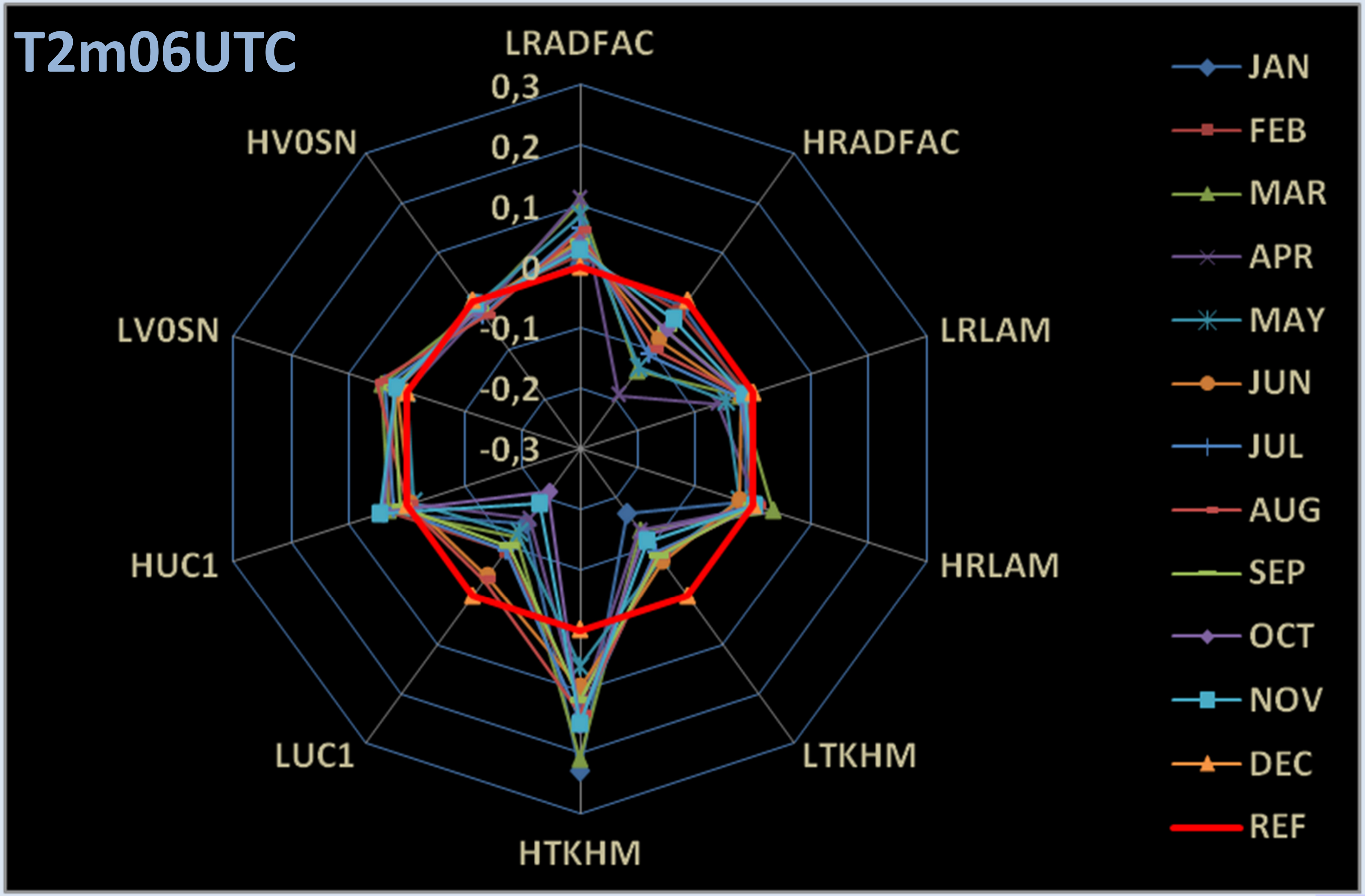




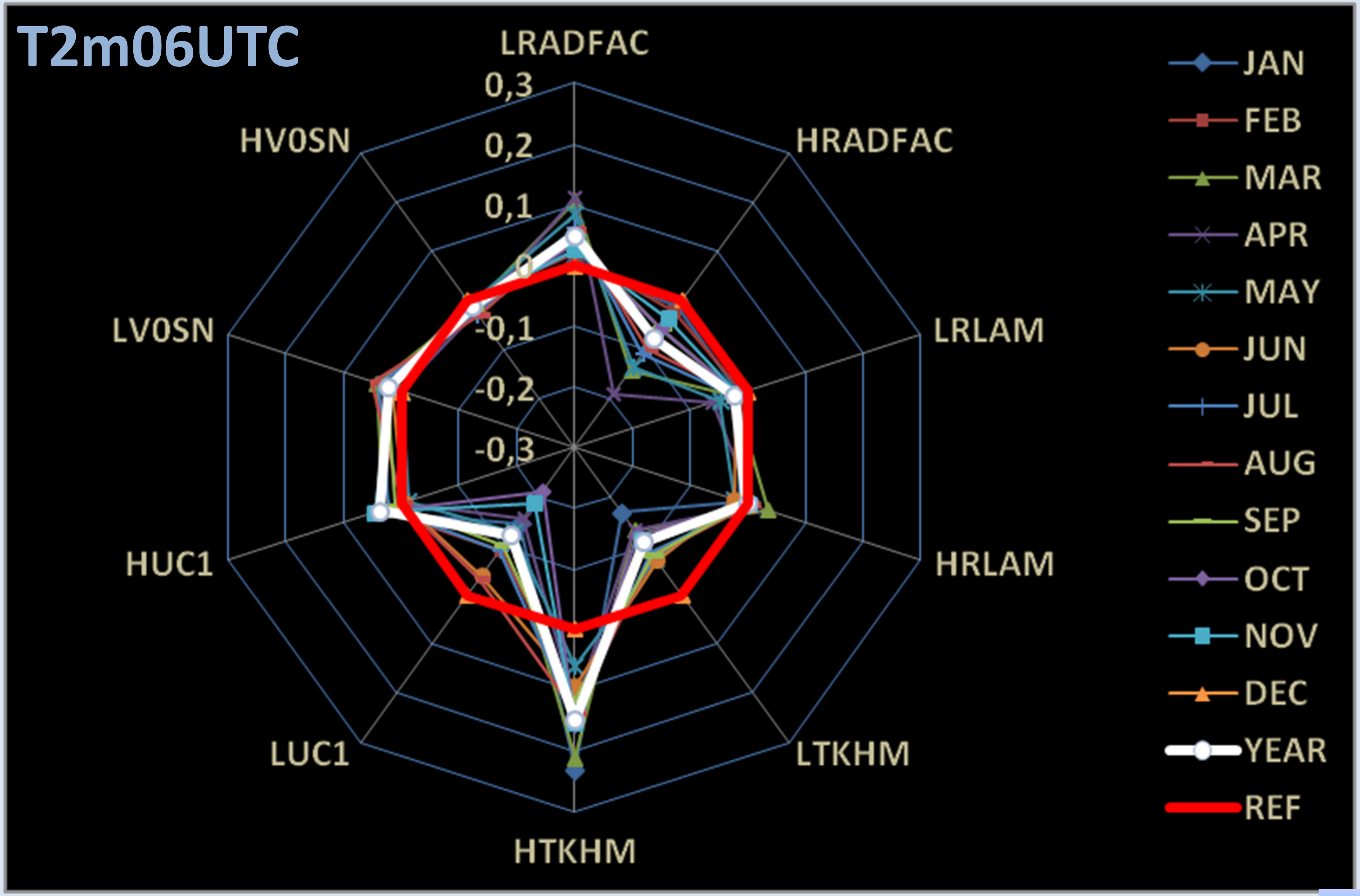


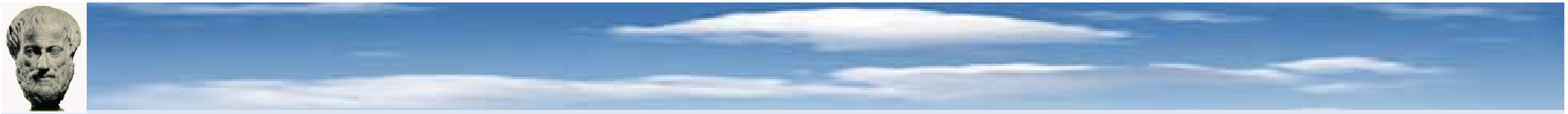


Monthly Sensitivities combined

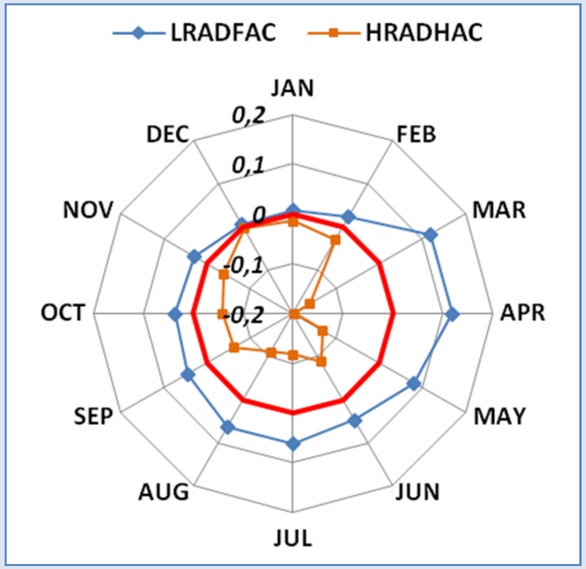


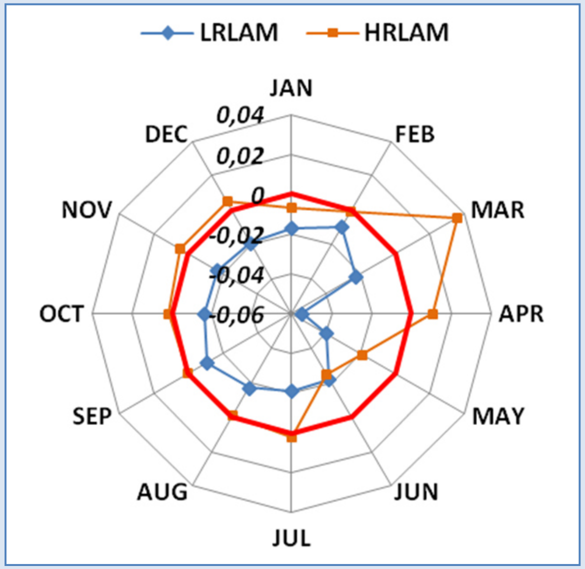
Yearly and Monthly Sensitivities combined

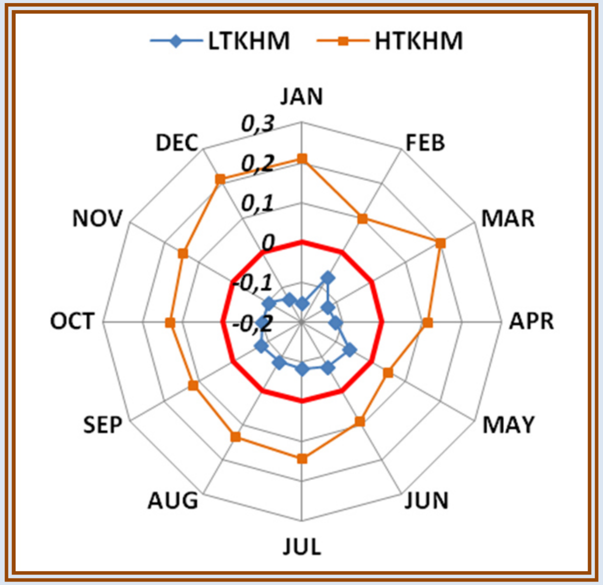


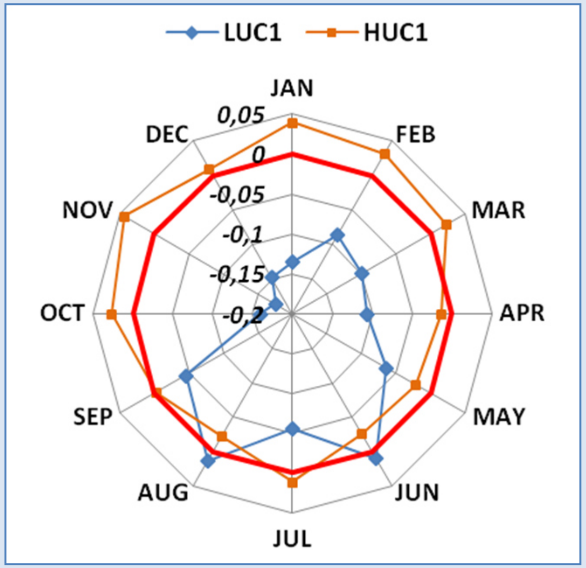


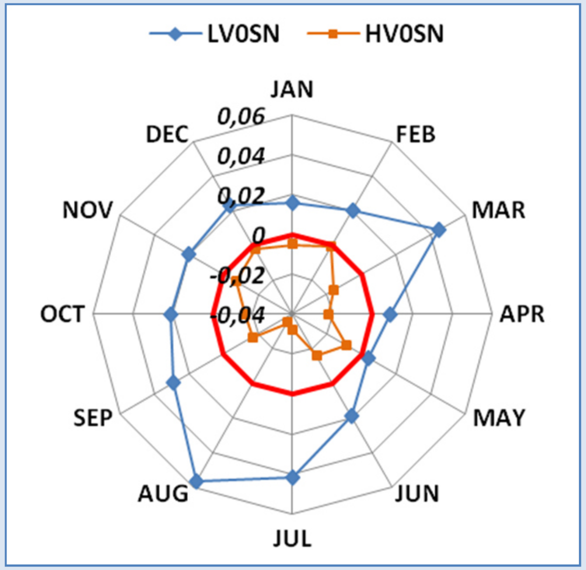
Tmax2m
Monthly Sensitivities



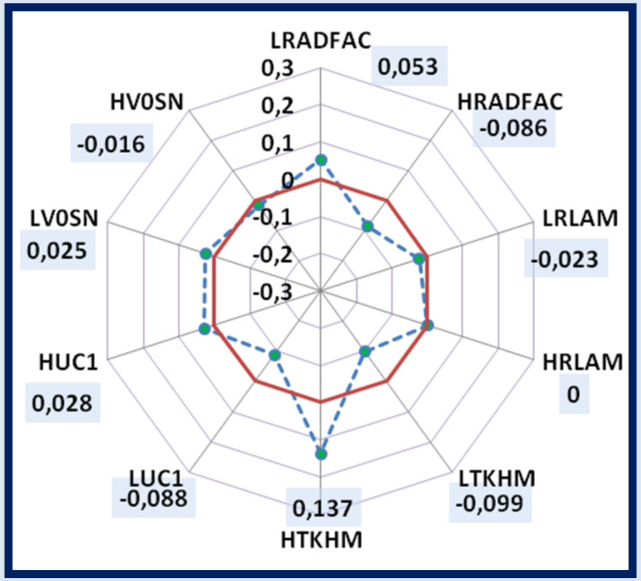


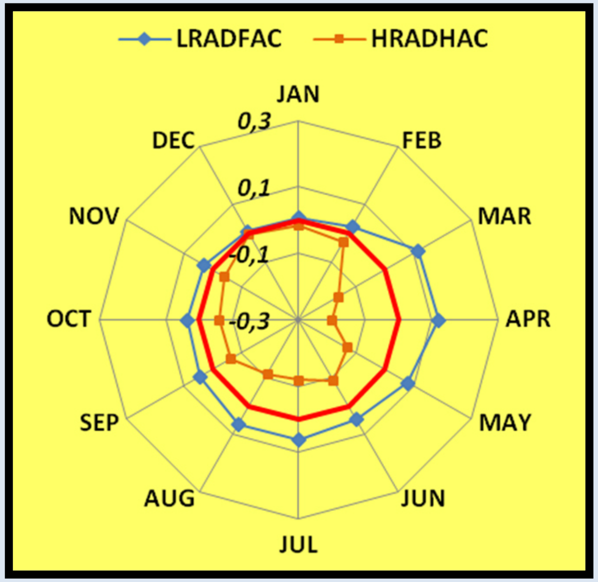


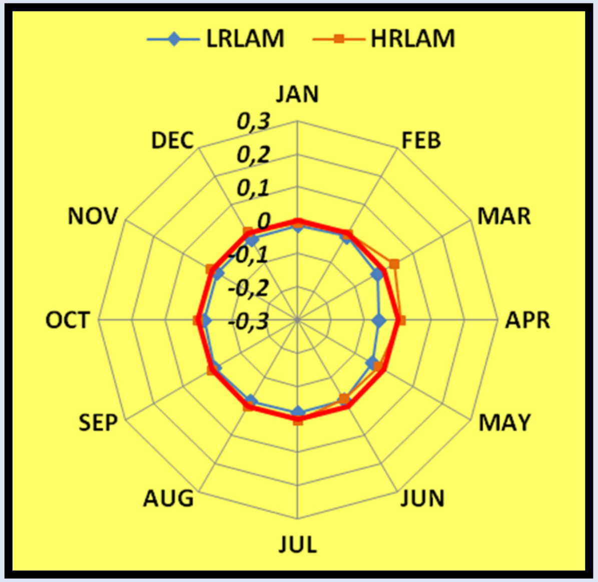


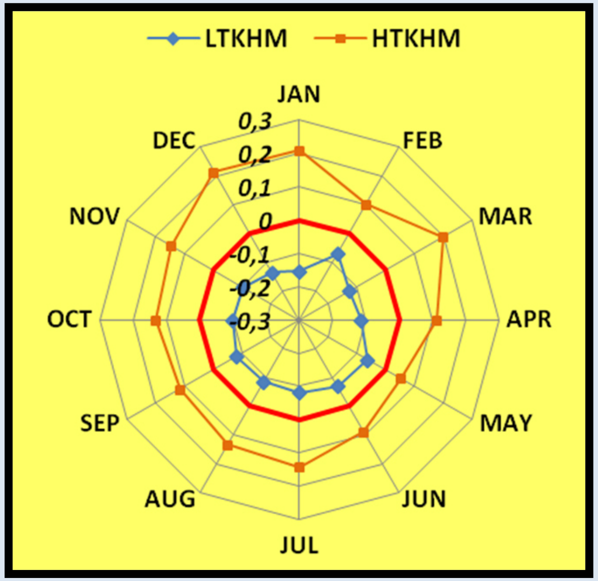


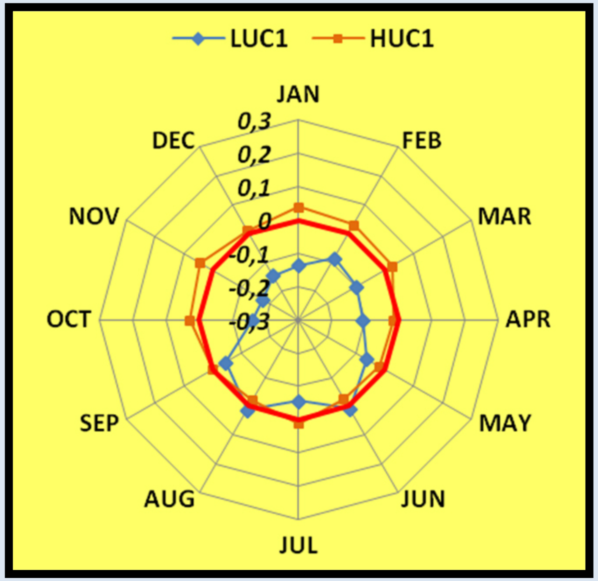
Tmax2m (Yearly vs Monthly Sensitivities)

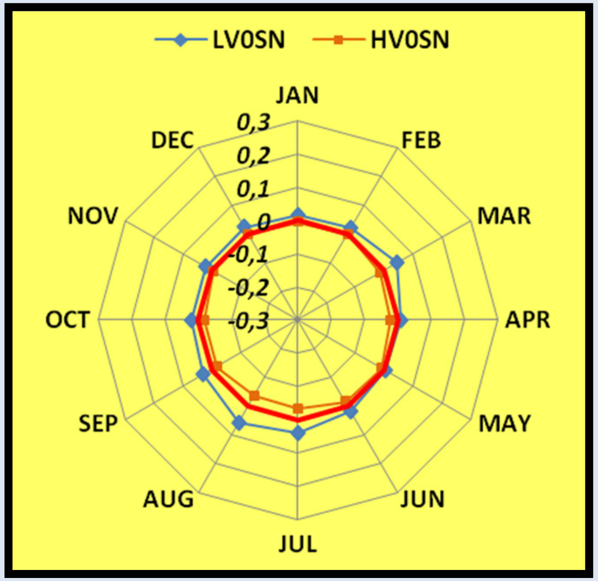




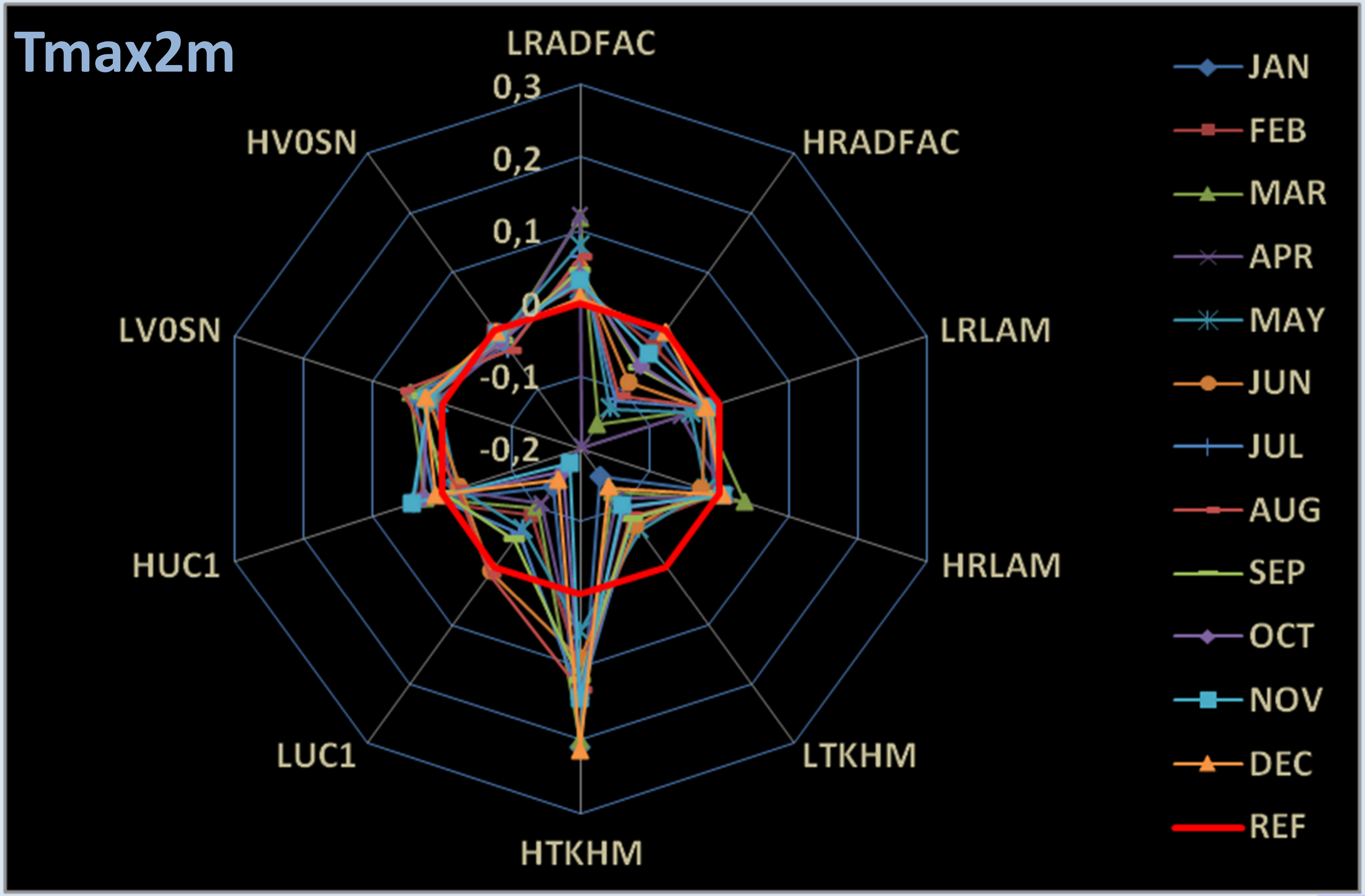




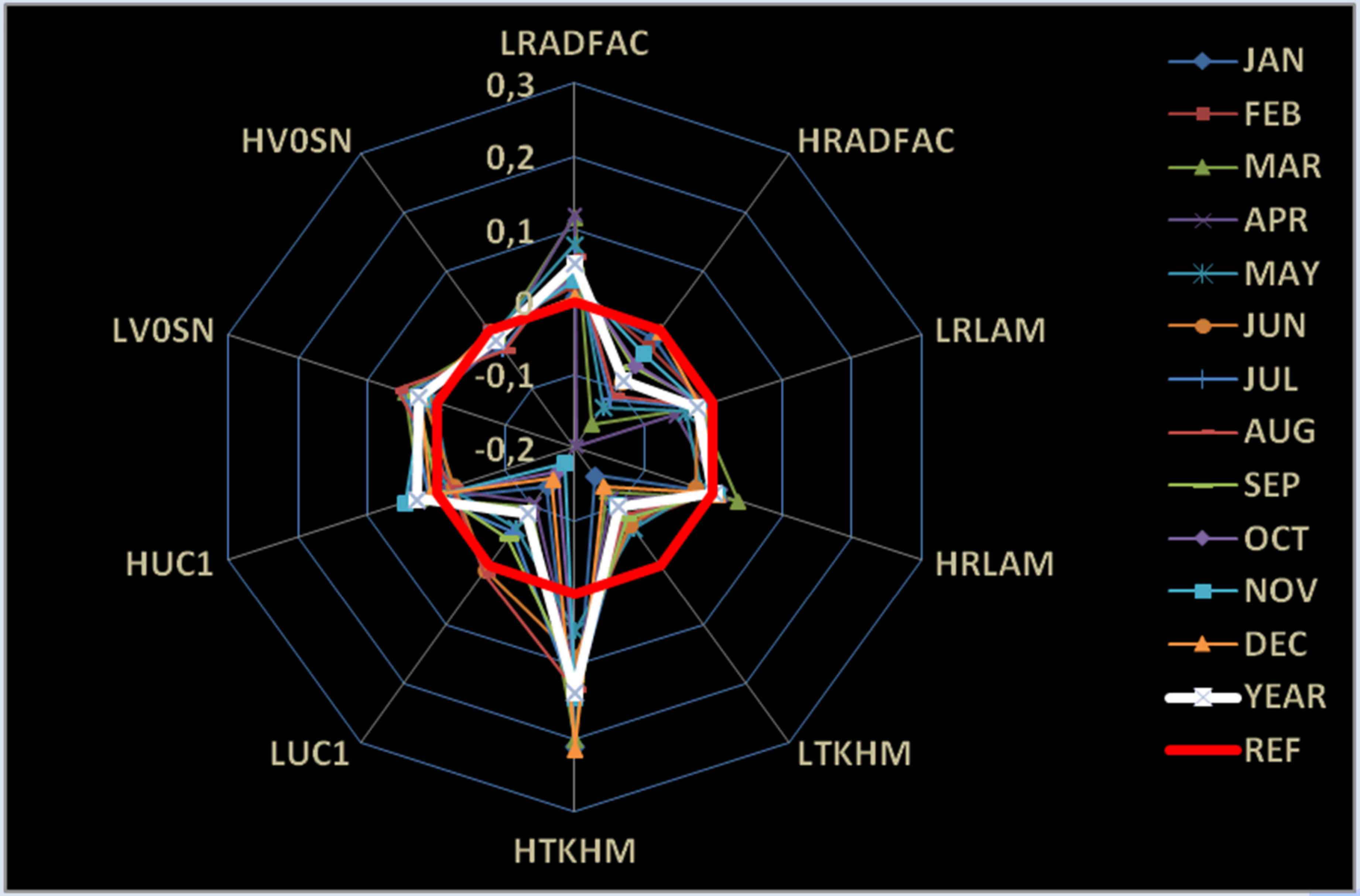




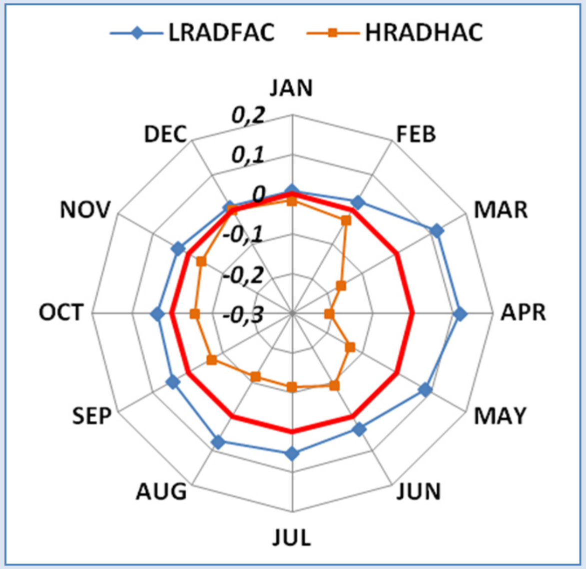
Monthly Sensitivities combined

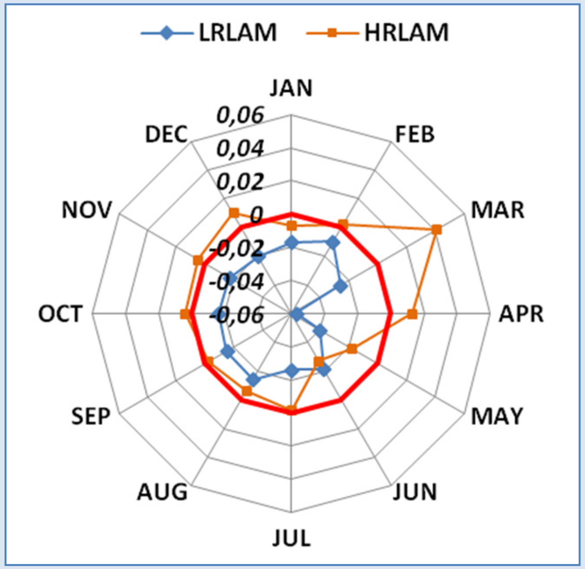


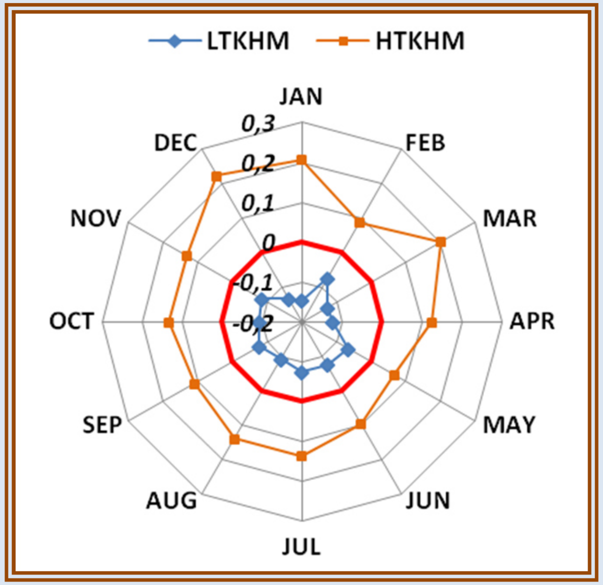
Yearly and Monthly Sensitivities combined

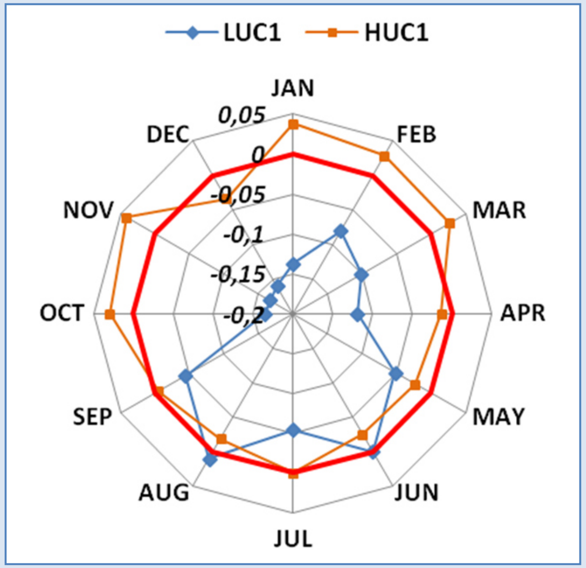


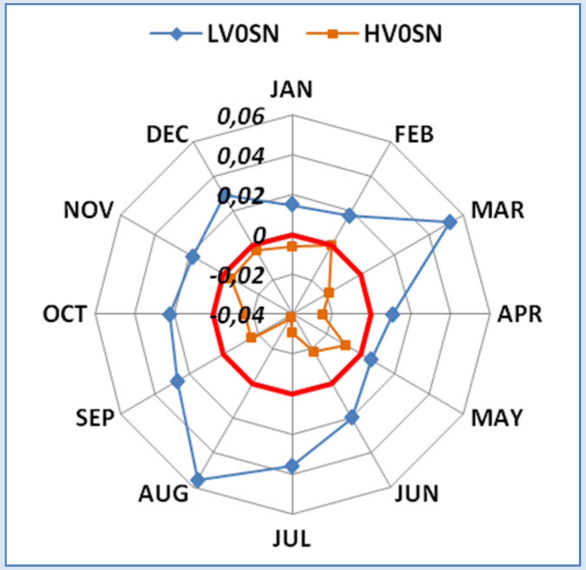
T2m18UTC Monthly Sensitivities



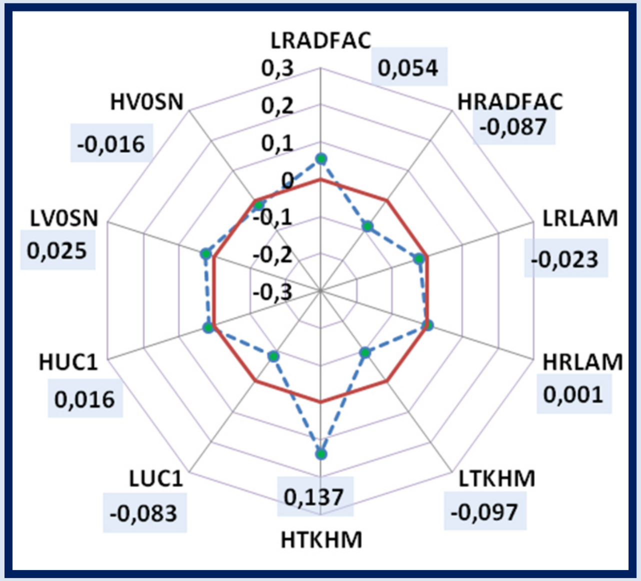


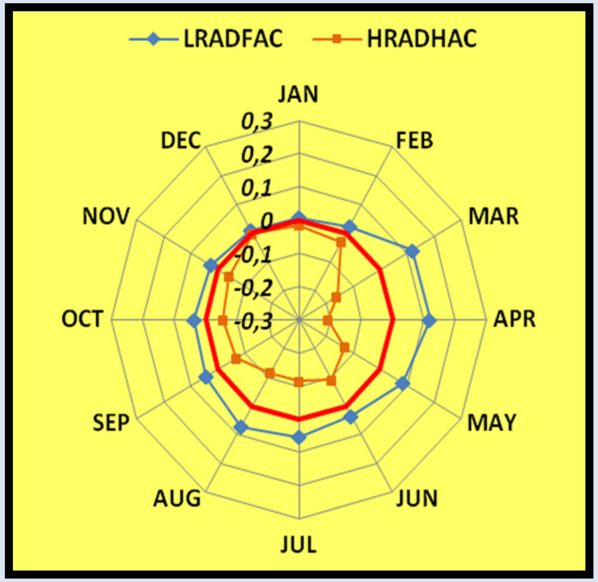


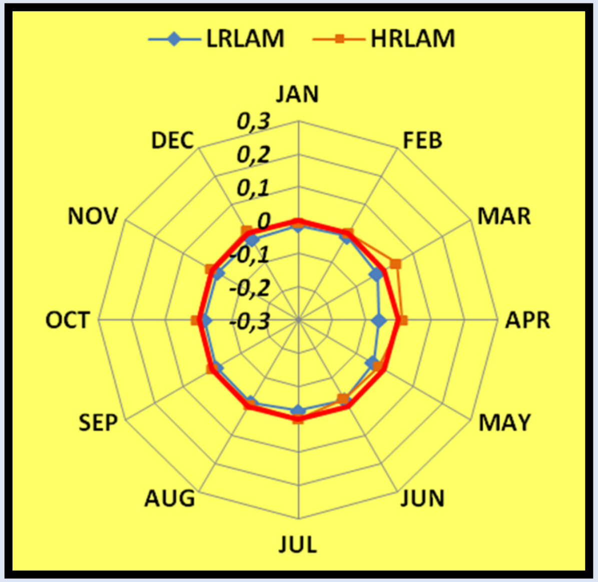


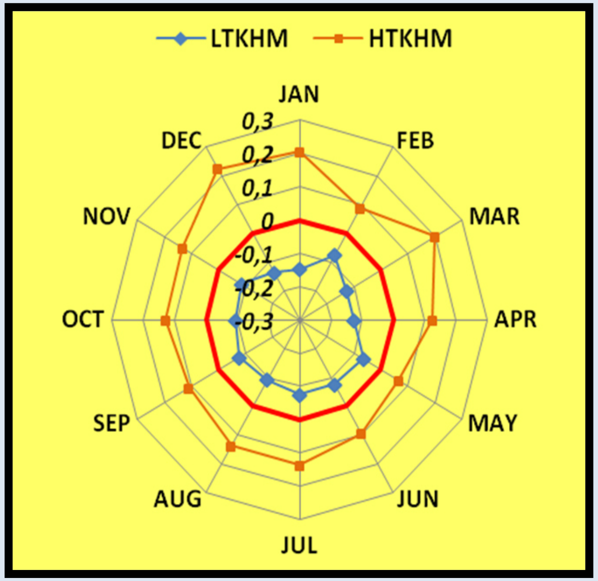


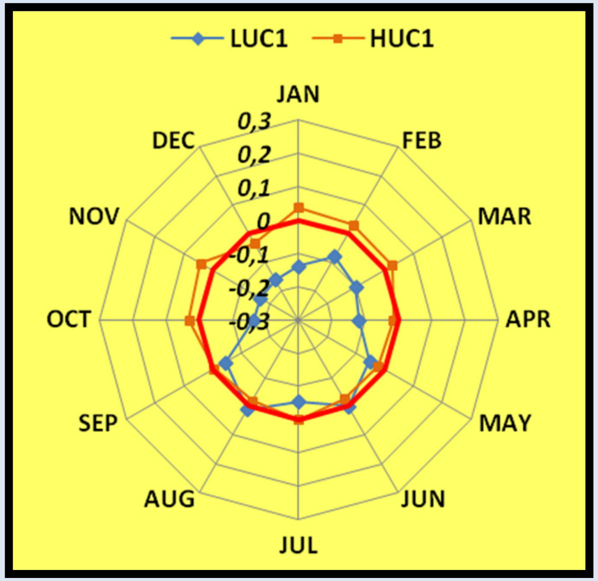
T2m18UTC (Yearly vs Monthly Sensitivities)

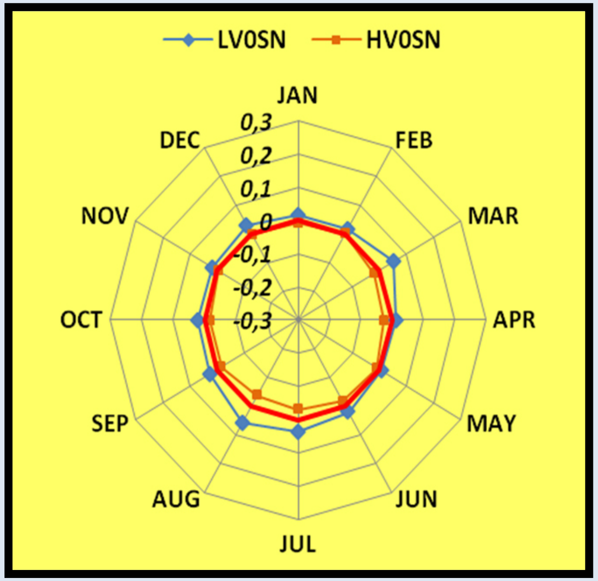




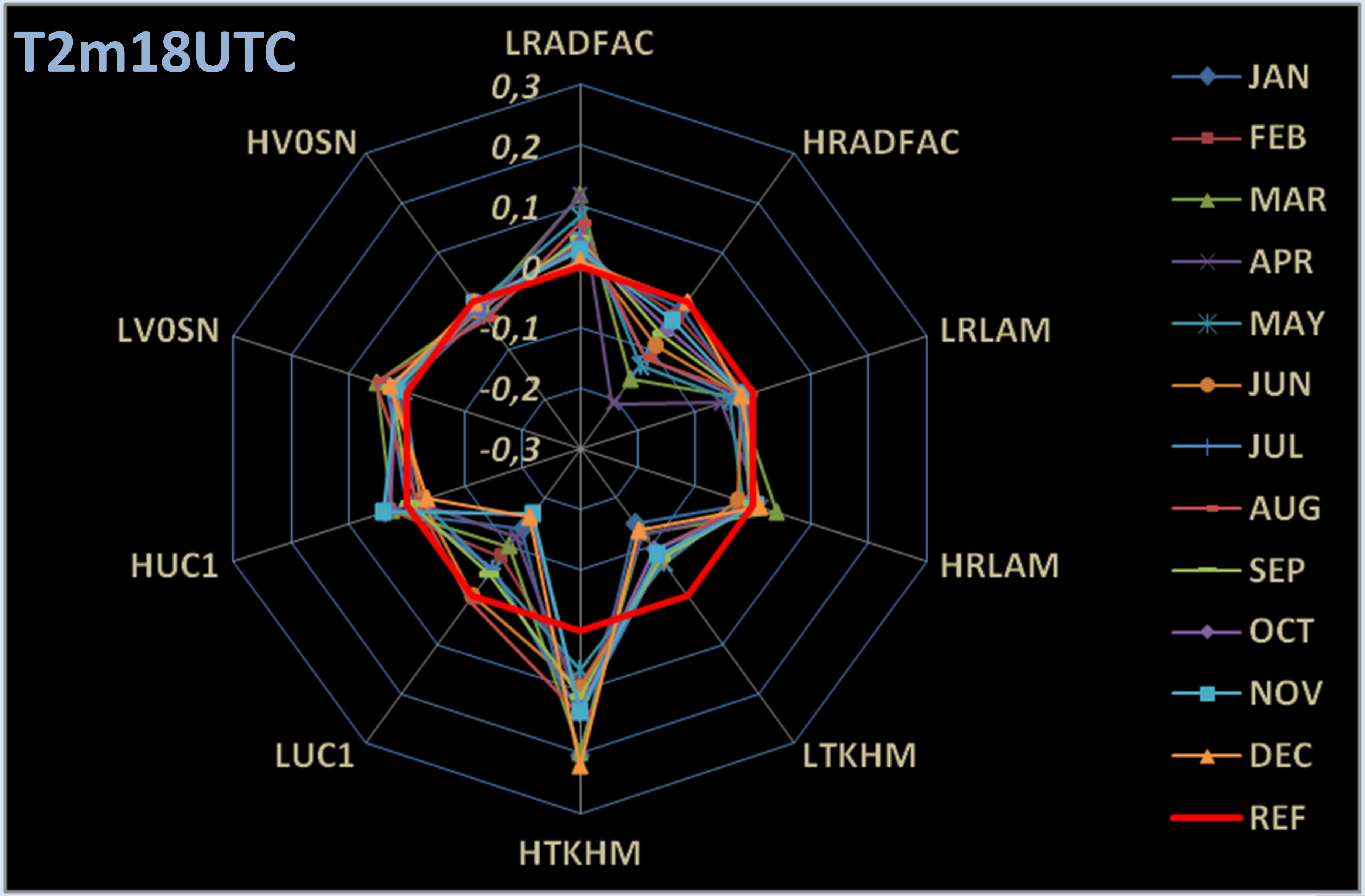




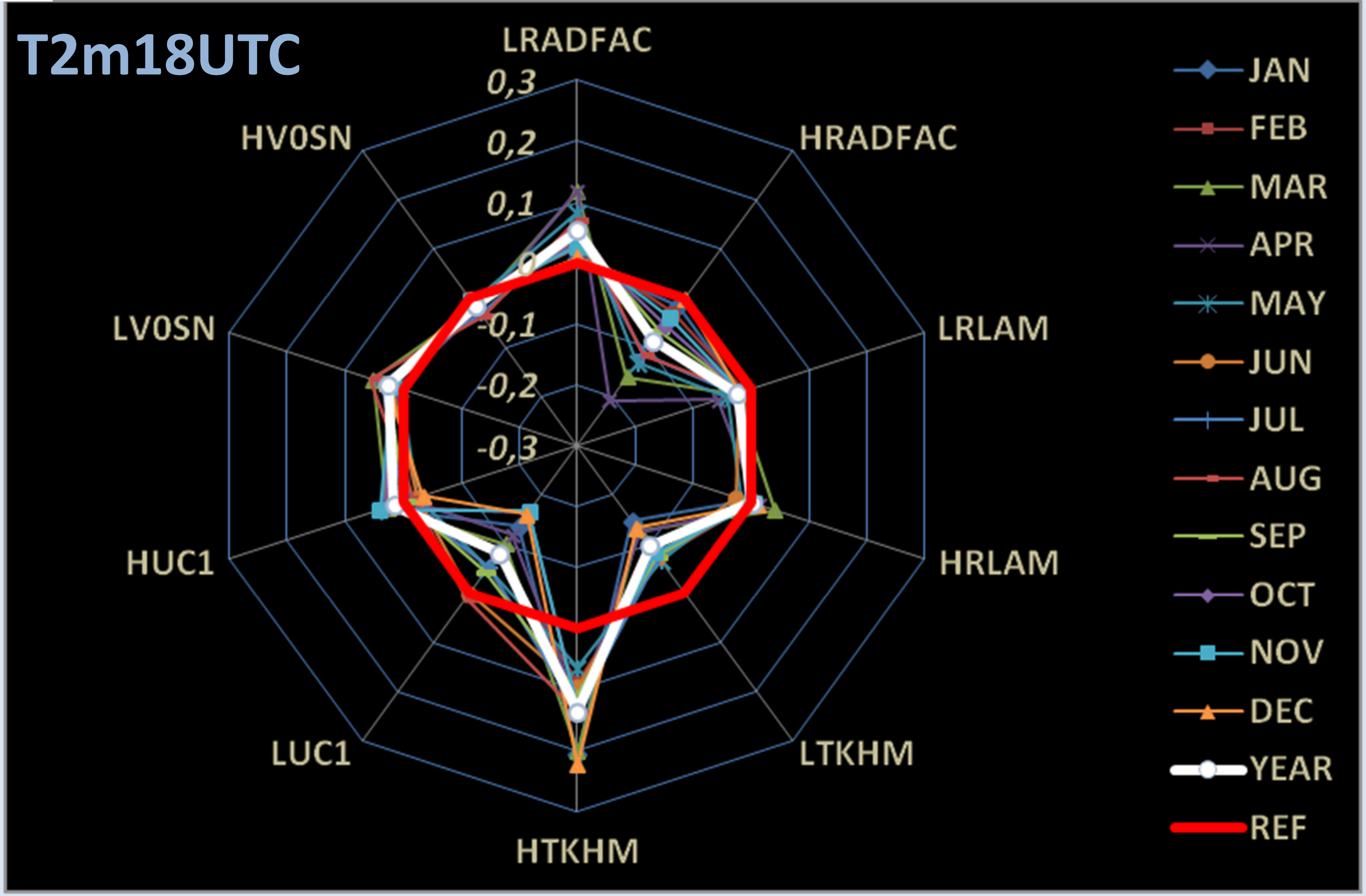


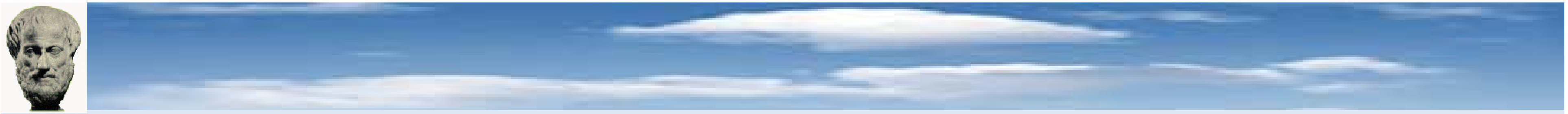


Monthly Sensitivities combined

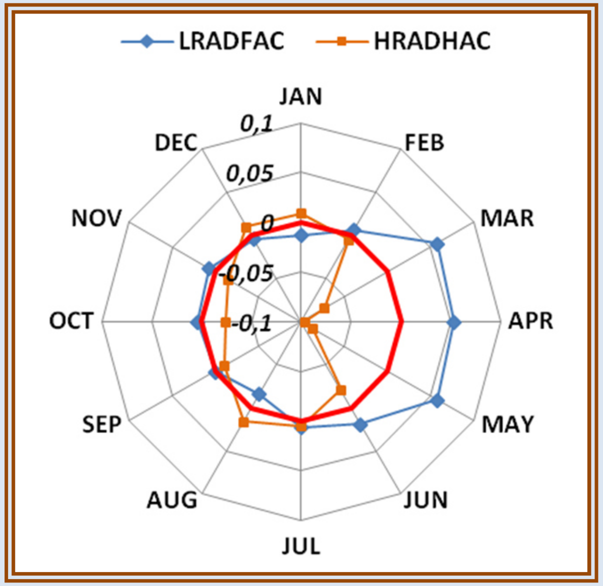


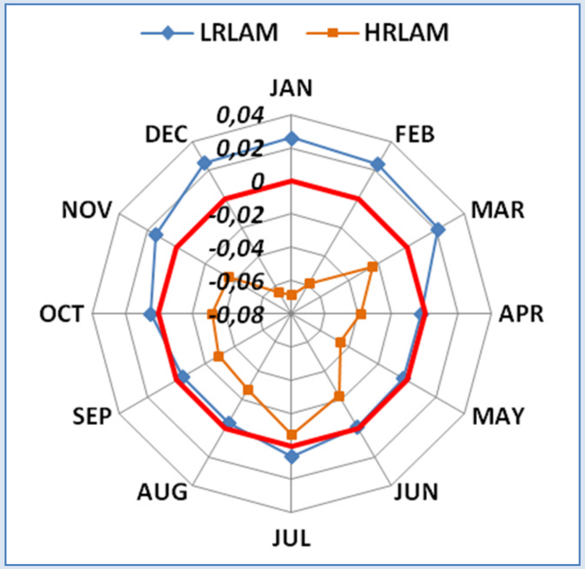
Yearly and Monthly Sensitivities combined

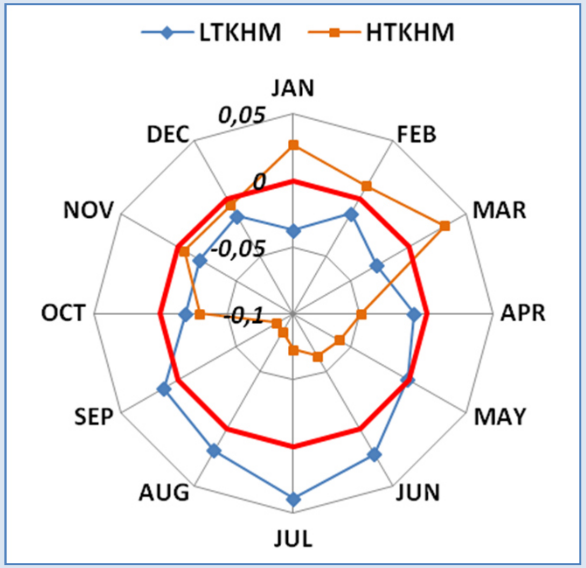


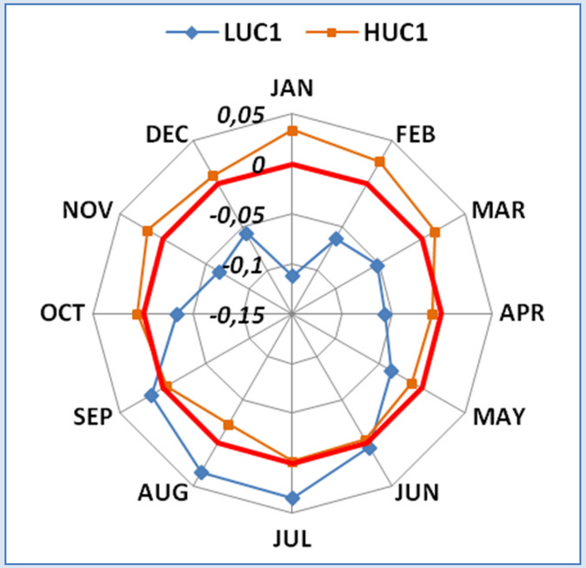


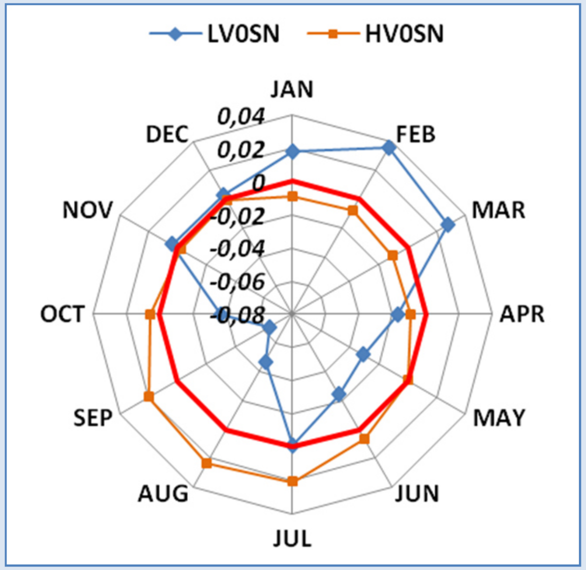
Td
Monthly Sensitivities



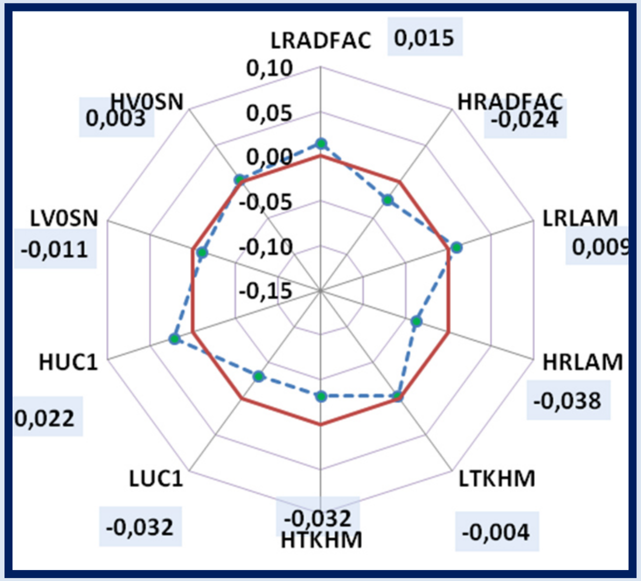


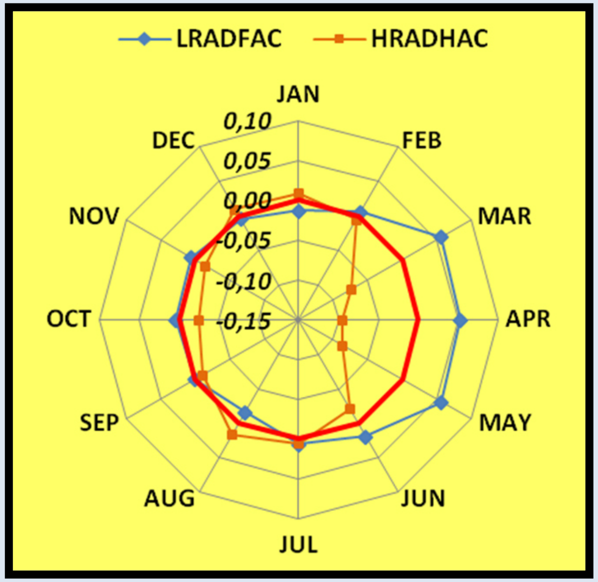


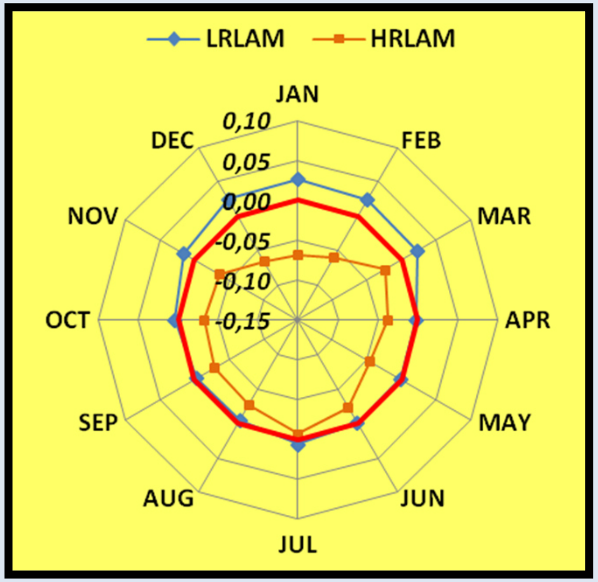


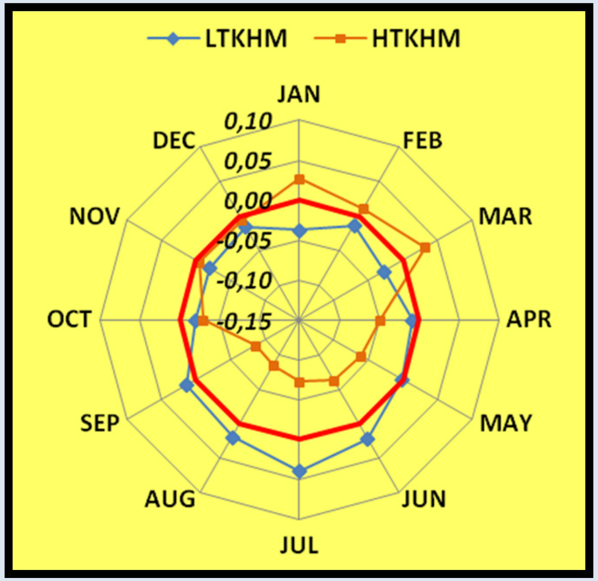


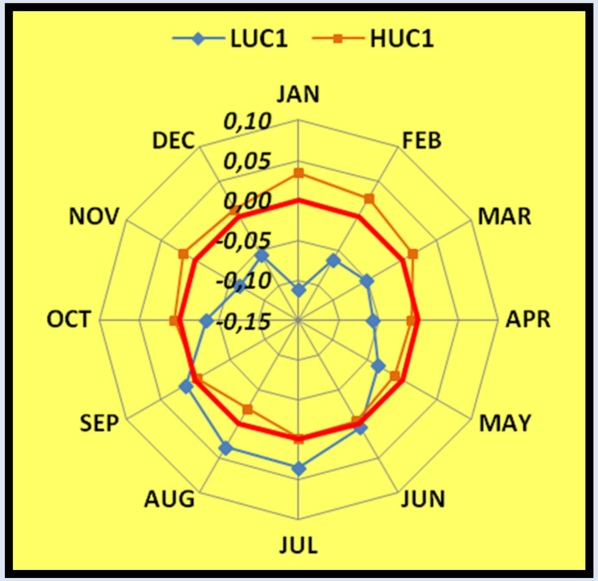
Td (Yearly vs Monthly Sensitivities)

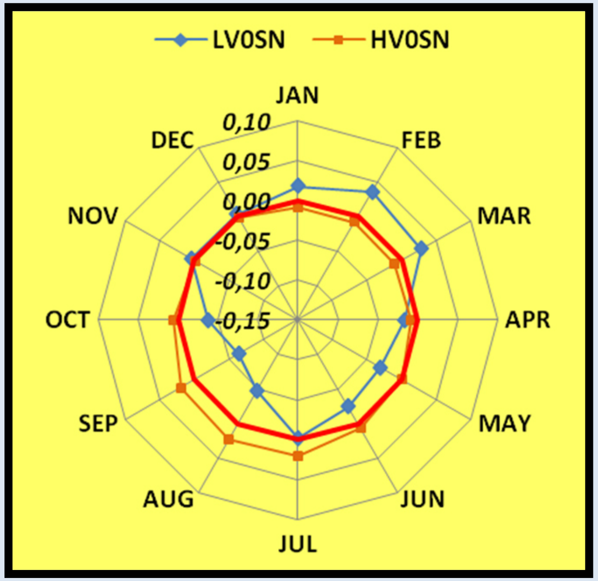




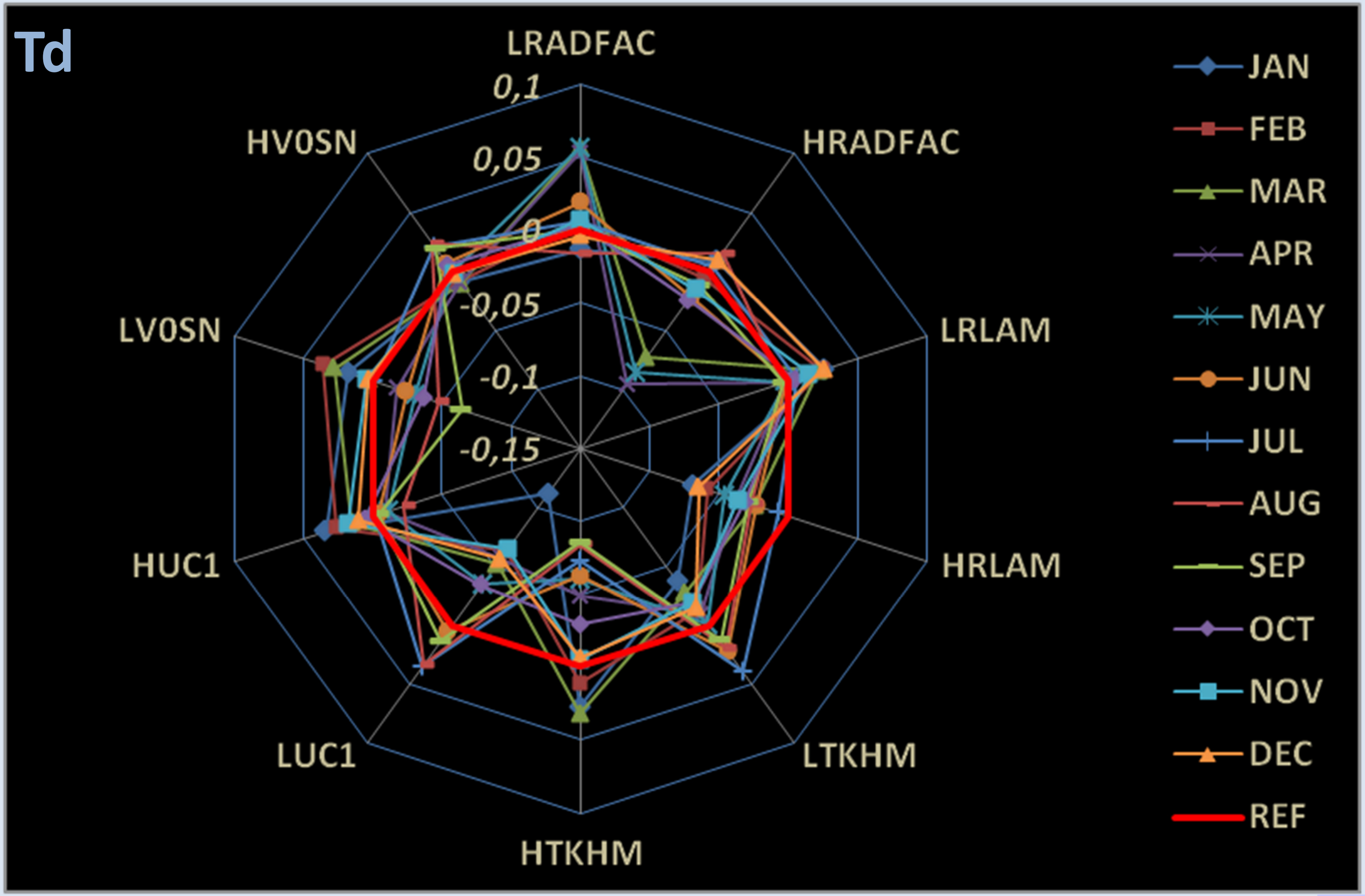




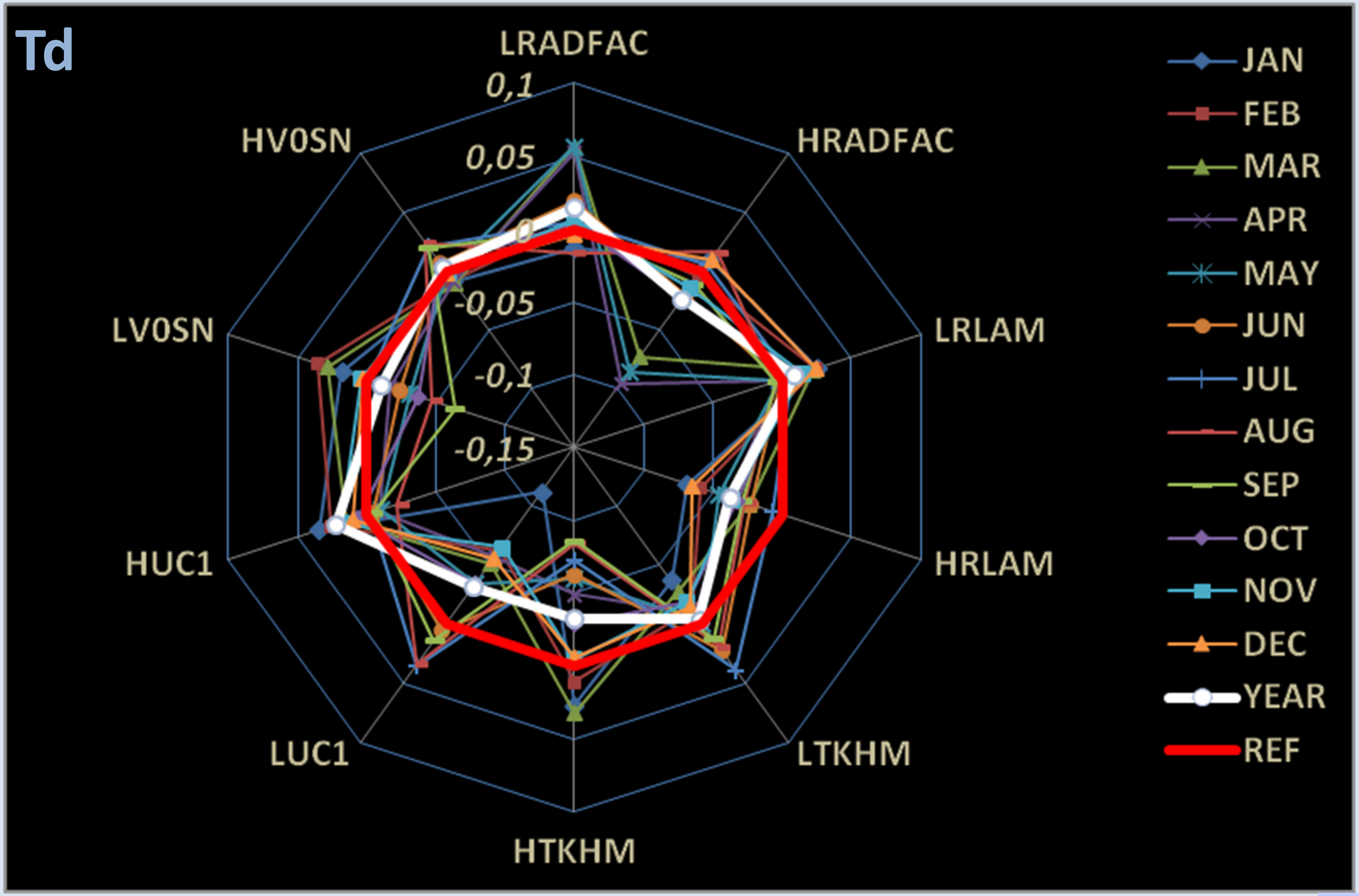




Monthly Sensitivities combined

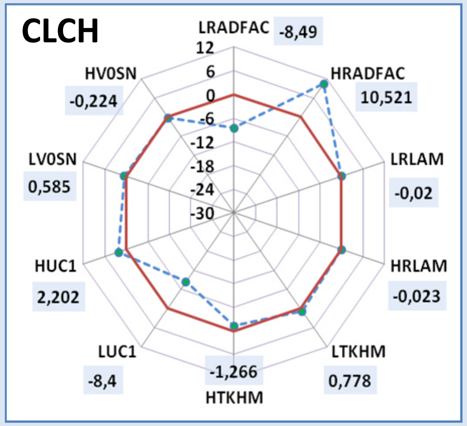


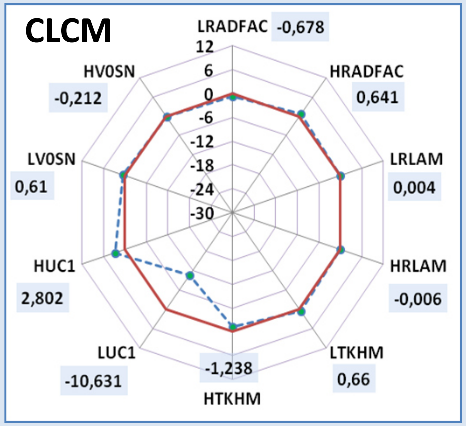
Yearly and Monthly Sensitivities combined

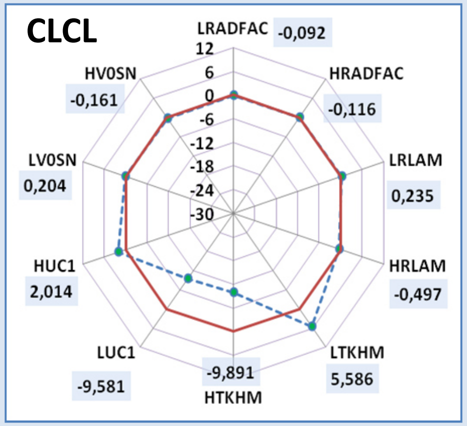


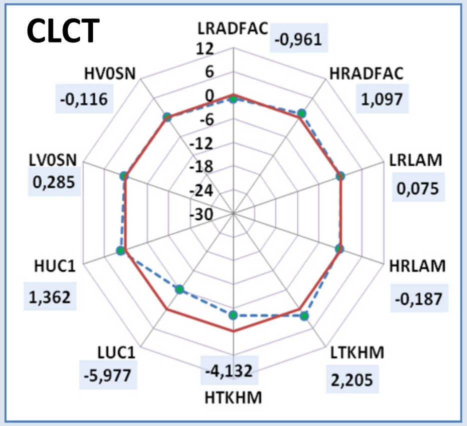
PANORAMA OF MONTHLY SENSITIVITIES FOR 2013

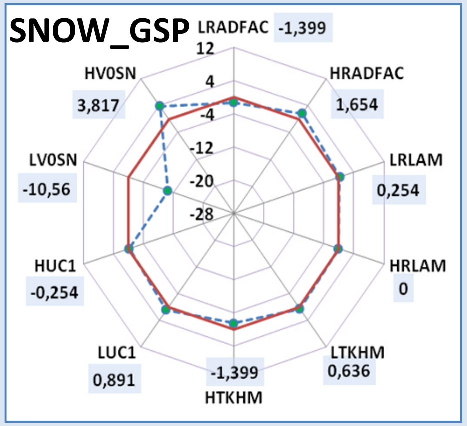
JANUARY

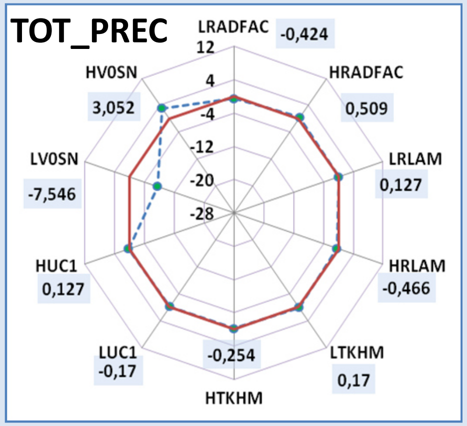


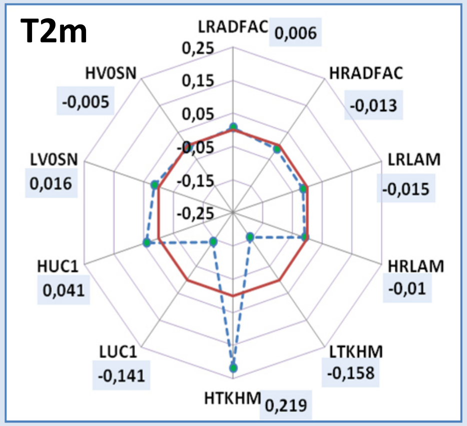


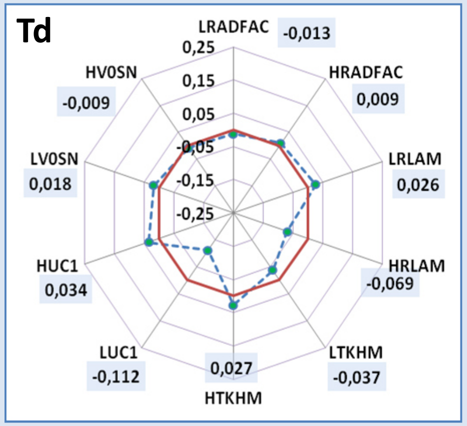


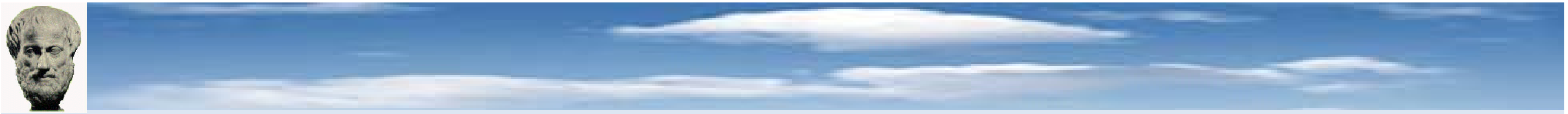




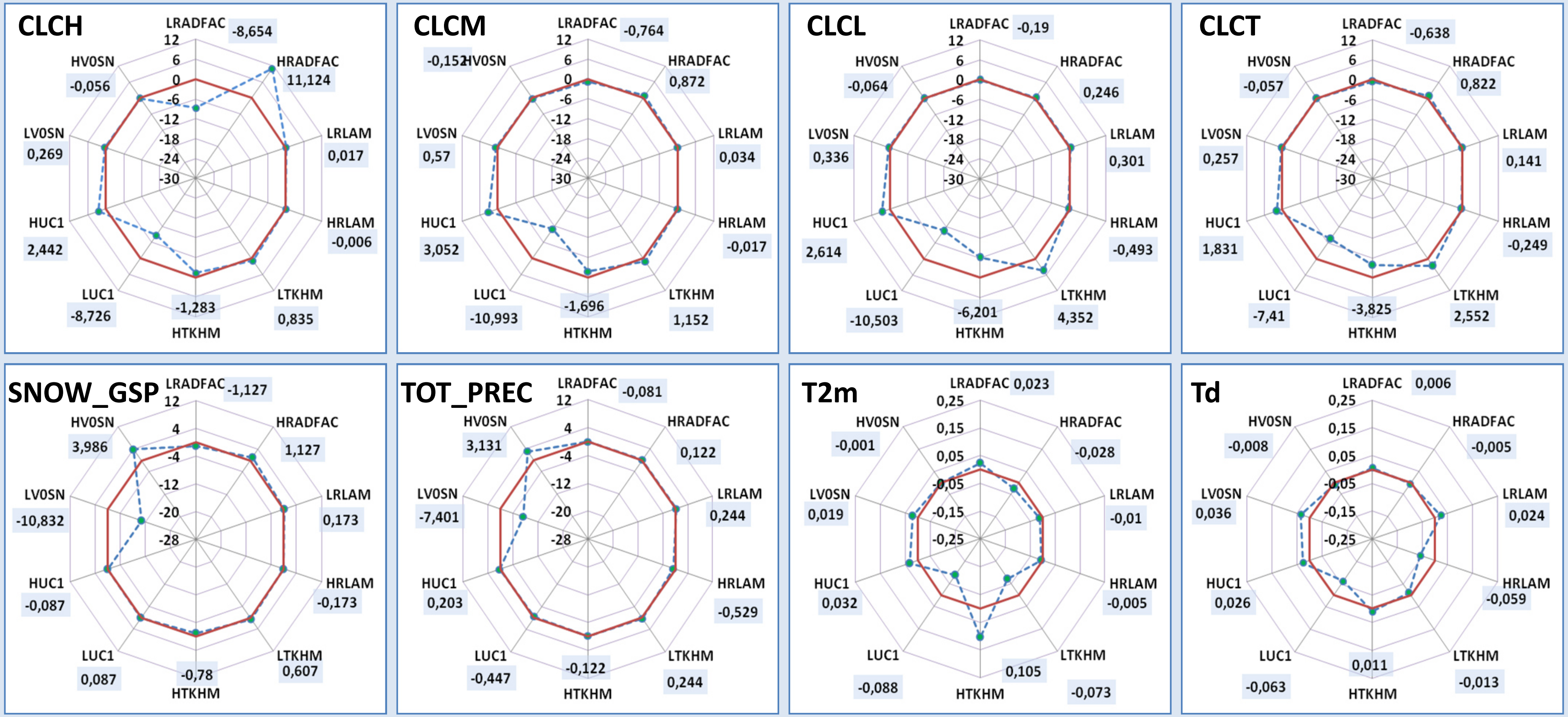








FEBRUARY



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HRLAM -0,006
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HTKHM -1,283
LUC1 -8,726
HUC1 2,442
LV0SN 0,269
HV0SN -0,056
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-18
-24
-30
CLCM
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HRADFAC 0,872
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HRLAM -0,017
LTKHM 1,152
HTKHM -1,696
LUC1 -10,993
HUC1 3,052
LV0SN 0,57
HV0SN -0,152
CLCL
LRADFAC -0,19
HRADFAC 0,246
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HRLAM -0,493
LTKHM 4,352
HTKHM -6,201
LUC1 -10,503
HUC1 2,614
LV0SN 0,336
HV0SN -0,064
CLCT
LRADFAC -0,638
HRADFAC 0,822
LRLAM 0,141
HRLAM -0,249
LTKHM 2,552
HTKHM -3,825
LUC1 -7,41
HUC1 1,831
LV0SN 0,257
HV0SN -0,057
SNOW_GSP
LRADFAC -1,127
HRADFAC 1,127
LRLAM 0,173
HRLAM -0,173
LTKHM 0,607
HTKHM -0,78
LUC1 0,087
HUC1 -0,087
LV0SN -10,832
HV0SN 3,986
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-4
-12
-20
-28
TOT_PREC
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HRADFAC 0,122
LRLAM 0,244
HRLAM -0,529
LTKHM 0,244
HTKHM -0,122
LUC1 -0,447
HUC1 0,203
LV0SN -7,401
HV0SN 3,131
T2m
LRADFAC 0,023
HRADFAC -0,028
LRLAM -0,01
HRLAM -0,005
LTKHM -0,073
HTKHM 0,105
LUC1 -0,088
HUC1 0,032
LV0SN 0,019
HV0SN -0,001
0,25
0,15
0,05
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-0,15
-0,25
Td
LRADFAC 0,006
HRADFAC -0,005
LRLAM 0,024
HRLAM -0,059
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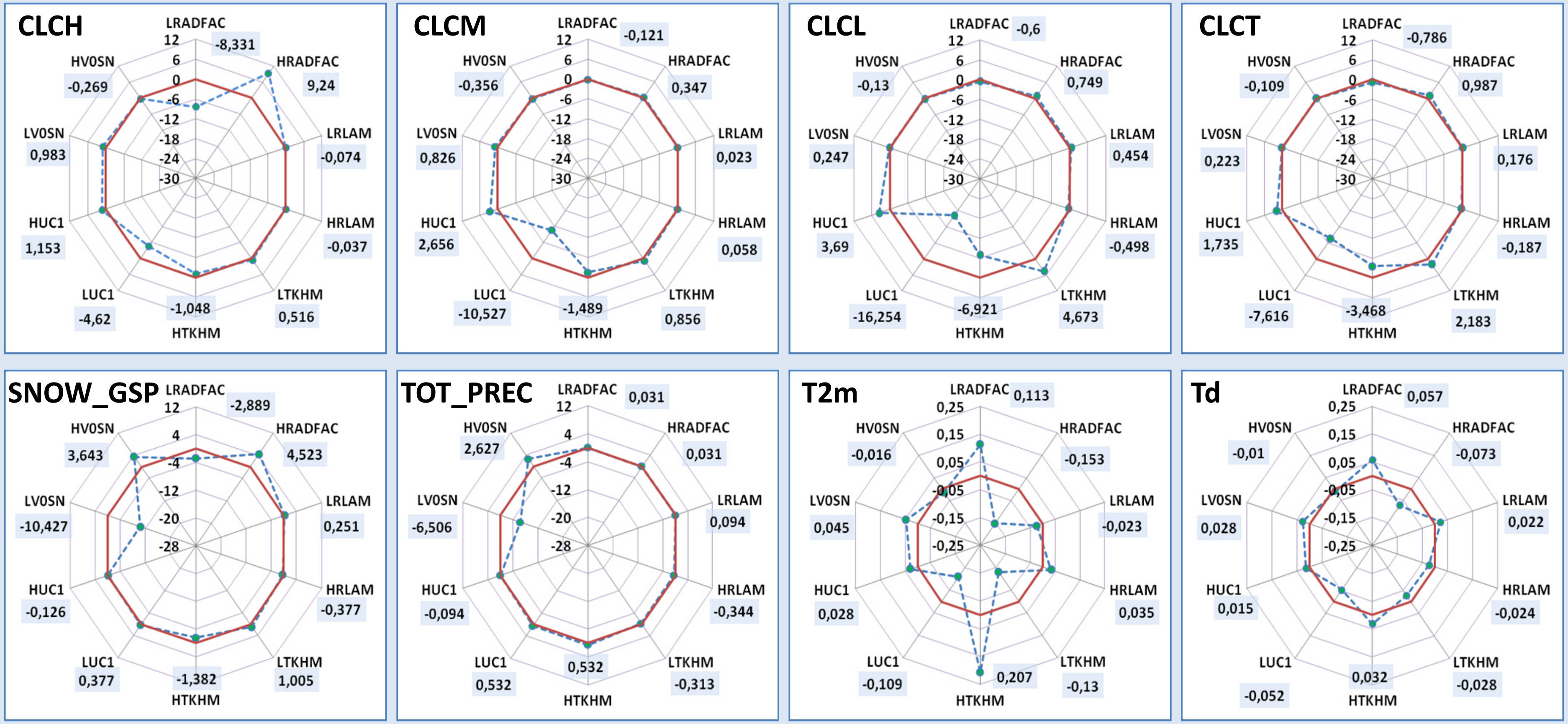
HTKHM 0,011
LUC1 -0,063
HUC1 0,026
LV0SN 0,036
HV0SN -0,008

MARCH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HTKHM -1,048
LUC1 -4,62
HUC1 1,153
LV0SN 0,983
HV0SN -0,269
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CLCM
LRADFAC -0,121
HRADFAC 0,347
LRLAM 0,023
HRLAM 0,058
LTKHM 0,856
HTKHM -1,489
LUC1 -10,527
HUC1 2,656
LV0SN 0,826
HV0SN -0,356
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CLCL
LRADFAC -0,6
HRADFAC 0,749
LRLAM 0,454
HRLAM -0,498
LTKHM 4,673
HTKHM -6,921
LUC1 -16,254
HUC1 3,69
LV0SN 0,247
HV0SN -0,13
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CLCT
LRADFAC -0,786
HRADFAC 0,987
LRLAM 0,176
HRLAM -0,187
LTKHM 2,183
HTKHM -3,468
LUC1 -7,616
HUC1 1,735
LV0SN 0,223
HV0SN -0,109
12 6 0 -6 -12 -18 -24 -30
SNOW_GSP
LRADFAC -2,889
HRADFAC 4,523
LRLAM 0,251
HRLAM -0,377
LTKHM 1,005
HTKHM -1,382
LUC1 0,377
HUC1 -0,126
LV0SN -10,427
HV0SN 3,643
12 4 -4 -12 -20 -28
TOT_PREC
LRADFAC 0,031
HRADFAC 0,031
LRLAM 0,094
HRLAM -0,344
LTKHM -0,313
HTKHM 0,532
LUC1 0,532
HUC1 -0,094
LV0SN -6,506
HV0SN 2,627
12 4 -4 -12 -20 -28
T2m
LRADFAC 0,113
HRADFAC -0,153
LRLAM -0,023
HRLAM 0,035
LTKHM -0,13
HTKHM 0,207
LUC1 -0,109
HUC1 0,028
LV0SN 0,045
HV0SN -0,016
0,25 0,15 0,05 -0,05 -0,15 -0,25
Td
LRADFAC 0,057
HRADFAC -0,073
LRLAM 0,022
HRLAM -0,024
LTKHM -0,028
HTKHM 0,032
LUC1 -0,052
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LV0SN 0,028
HV0SN -0,01
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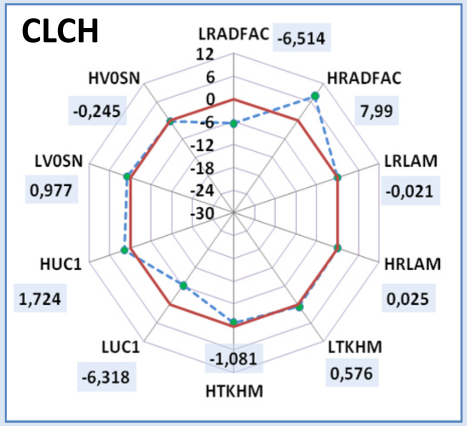
APRIL


CLCH
LRADFAC -6,514
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HRLAM 0,025
LTKHM 0,576
HTKHM -1,081
LUC1 -6,318
HUC1 1,724
LVOSN 0,977
HVOSN -0,245
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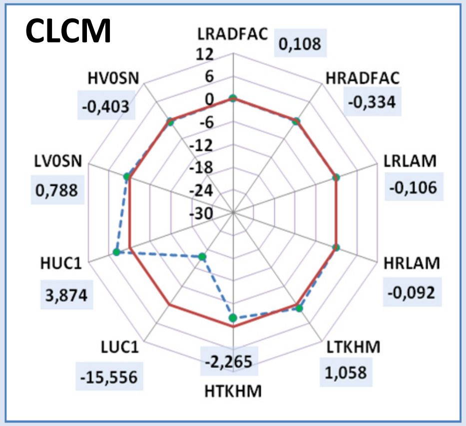
6
0
-6
-12
-18
-24
-30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HRLAM -0,092
LTKHM 1,058
HTKHM -2,265
LUC1 -15,556
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LVOSN 0,788
HVOSN -0,403
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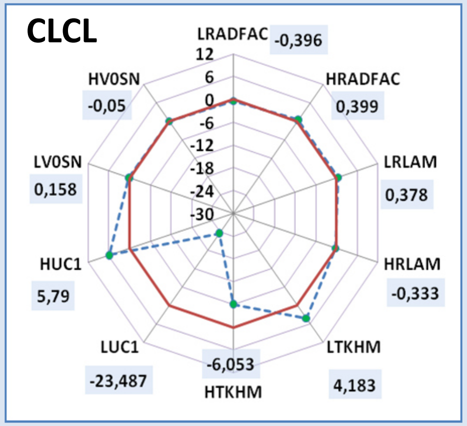
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LVOSN 0,158
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-18
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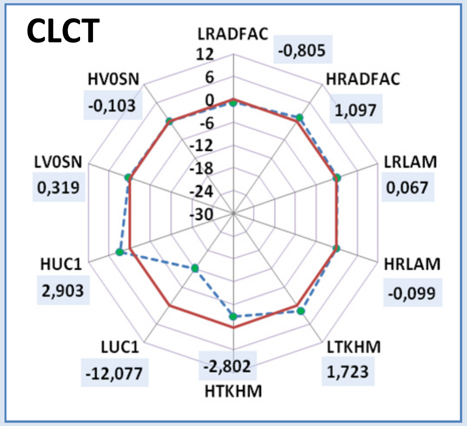
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LRLAM 0,067
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HTKHM -2,802
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LVOSN 0,319
HVOSN -0,103
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-18
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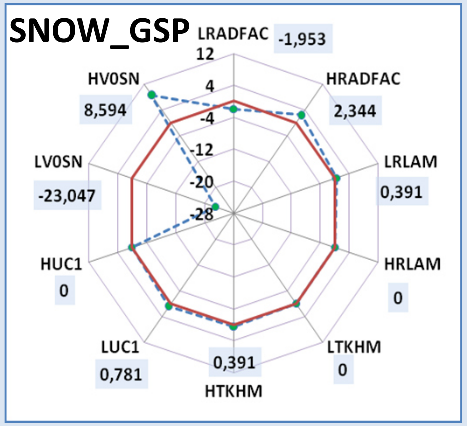
-30


SNOW_GSP
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HRADFAC 2,344
LRLAM 0,391
HRLAM 0
LTKHM 0
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LUC1 0,781
HUC1 0
LVOSN -23,047
HVOSN 8,594
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-20
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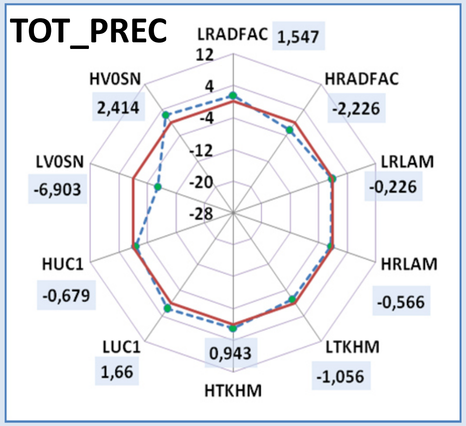
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LRLAM -0,226
HRLAM -0,566
LTKHM -1,056
HTKHM 0,943
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HUC1 -0,679
LVOSN -6,903
HVOSN 2,414
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4
-4
-12
-20
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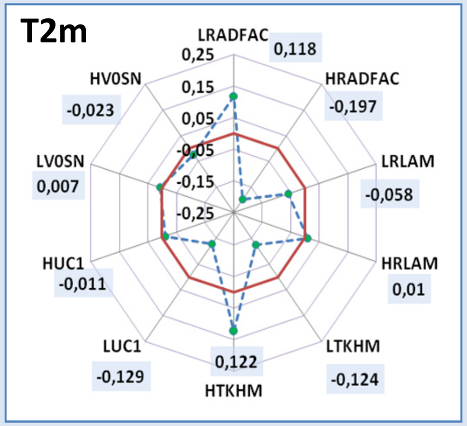
T2m
LRADFAC 0,118
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LRLAM -0,058
HRLAM 0,01
LTKHM -0,124
HTKHM 0,122
LUC1 -0,129
HUC1 -0,011
LVOSN 0,007
HVOSN -0,023
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0,05
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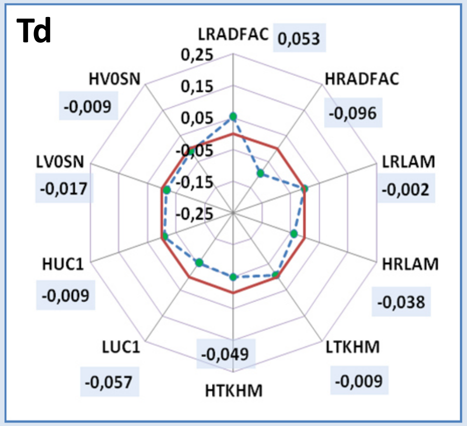
-0,25


Td
LRADFAC 0,053
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LRLAM -0,002
HRLAM -0,038
LTKHM -0,009
HTKHM -0,049
LUC1 -0,057
HUC1 -0,009
LVOSN -0,017
HVOSN -0,009
0,25
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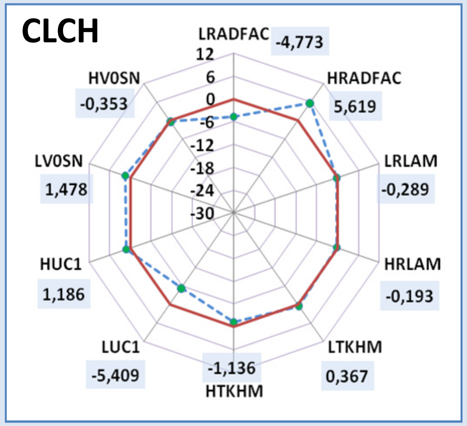
0,05
-0,05
-0,15
-0,25

MAY



CLCH
LRADFAC -4,773
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HRLAM -0,193
LTKHM 0,367
HTKHM -1,136
LUC1 -5,409
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HV0SN -0,353
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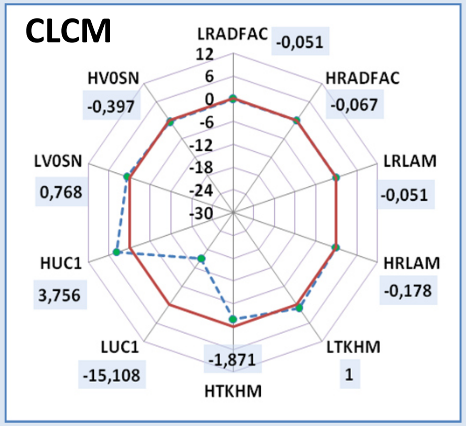

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HRLAM -0,178
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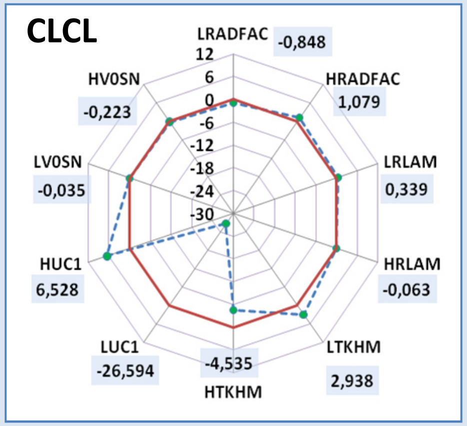
LUC1 -15,108
HUC1 3,756
LV0SN 0,768
HV0SN -0,397
12 6 0 -6 -12 -18 -24 -30



CLCL
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HRLAM -0,063
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LUC1 -26,594
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LV0SN -0,035
HV0SN -0,223
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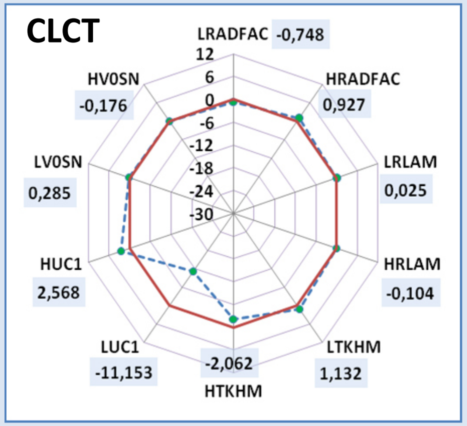

CLCT
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HRADFAC 0,927
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HRLAM -0,104
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HTKHM -2,062
LUC1 -11,153
HUC1 2,568
LV0SN 0,285
HV0SN -0,176
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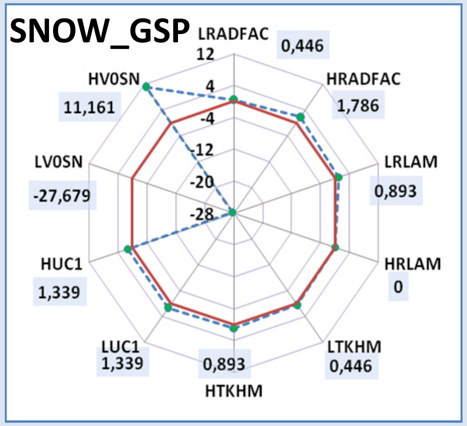

SNOW_GSP
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HRLAM 0
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HTKHM 0,893
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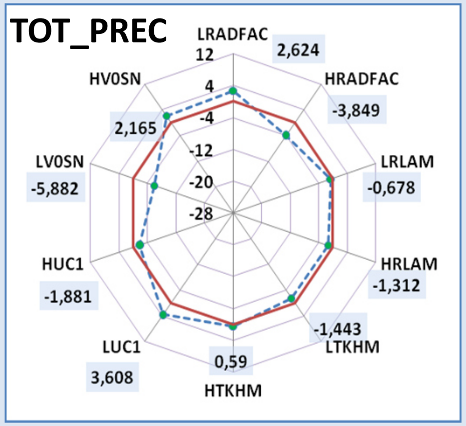

TOT_PREC
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HRLAM -1,312
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HUC1 -1,881
LV0SN -5,882
HV0SN 2,165
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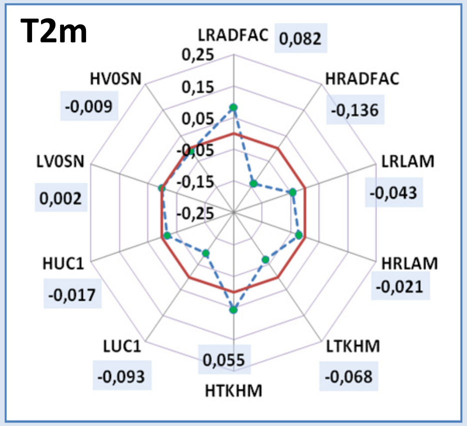

T2m
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HRLAM -0,021
LTKHM -0,068
HTKHM 0,055
LUC1 -0,093
HUC1 -0,017
LV0SN 0,002
HV0SN -0,009
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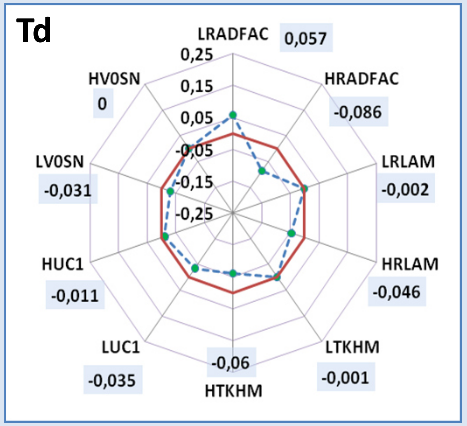

Td
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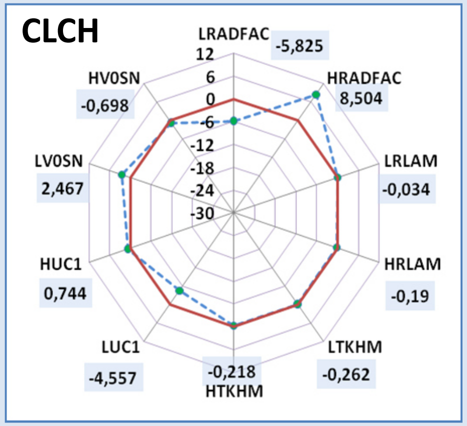
HRLAM -0,046
LTKHM -0,001
HTKHM -0,06
LUC1 -0,035
HUC1 -0,011
LV0SN -0,031
HV0SN 0
0,25 0,15 0,05 -0,05 -0,15 -0,25

JUNE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HRLAM
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HTKHM
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HUC1
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LV0SN
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HV0SN
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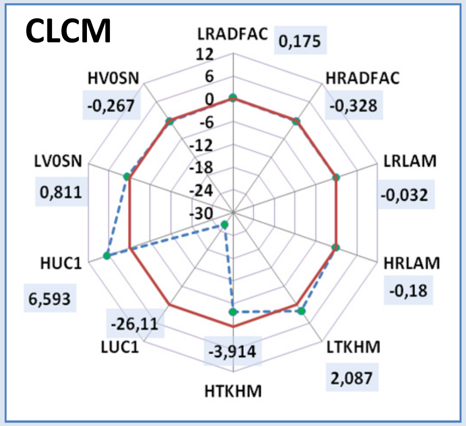
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HRLAM
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LTKHM
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HTKHM
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LUC1
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LV0SN
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HV0SN
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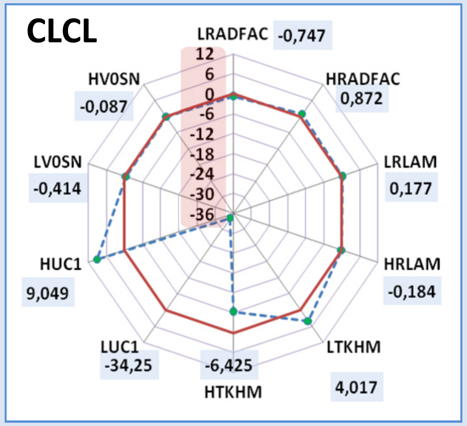
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HRLAM
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LTKHM
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HTKHM
LUC1
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HUC1
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LV0SN
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HV0SN
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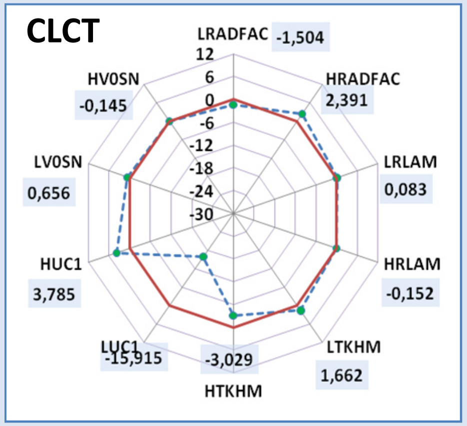
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HV0SN
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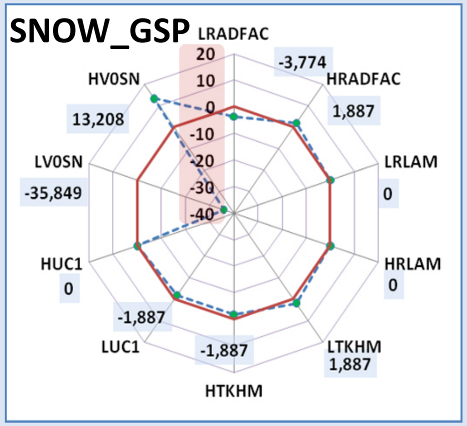
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HRLAM
0
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HTKHM
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LUC1
HUC1
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HV0SN
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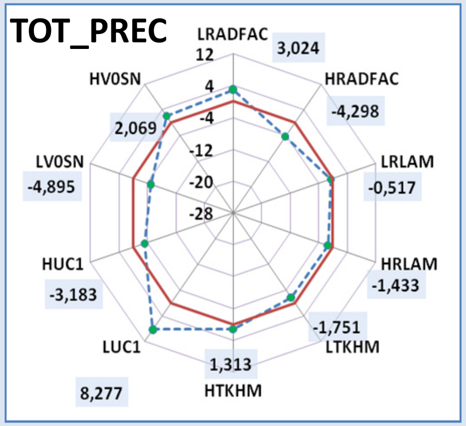
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HRLAM
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HTKHM
LUC1
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HUC1
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LV0SN
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HV0SN
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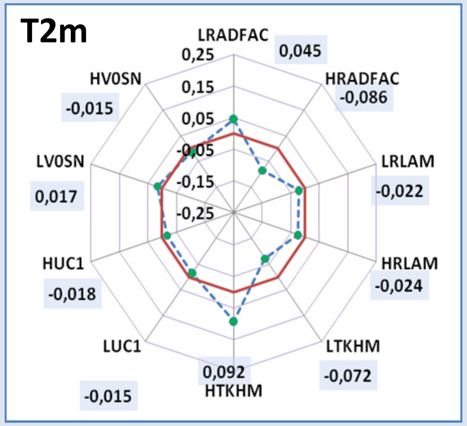
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0,05
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-0,15
-0,25
HRADFAC
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LRLAM
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HRLAM
-0,024
LTKHM
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HTKHM
LUC1
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HV0SN
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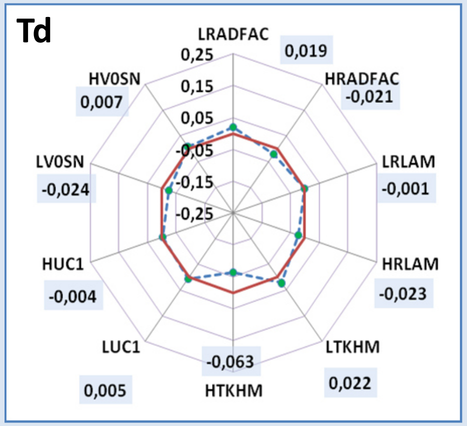
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0,05
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HRADFAC
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HRLAM
-0,023
LTKHM
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HV0SN
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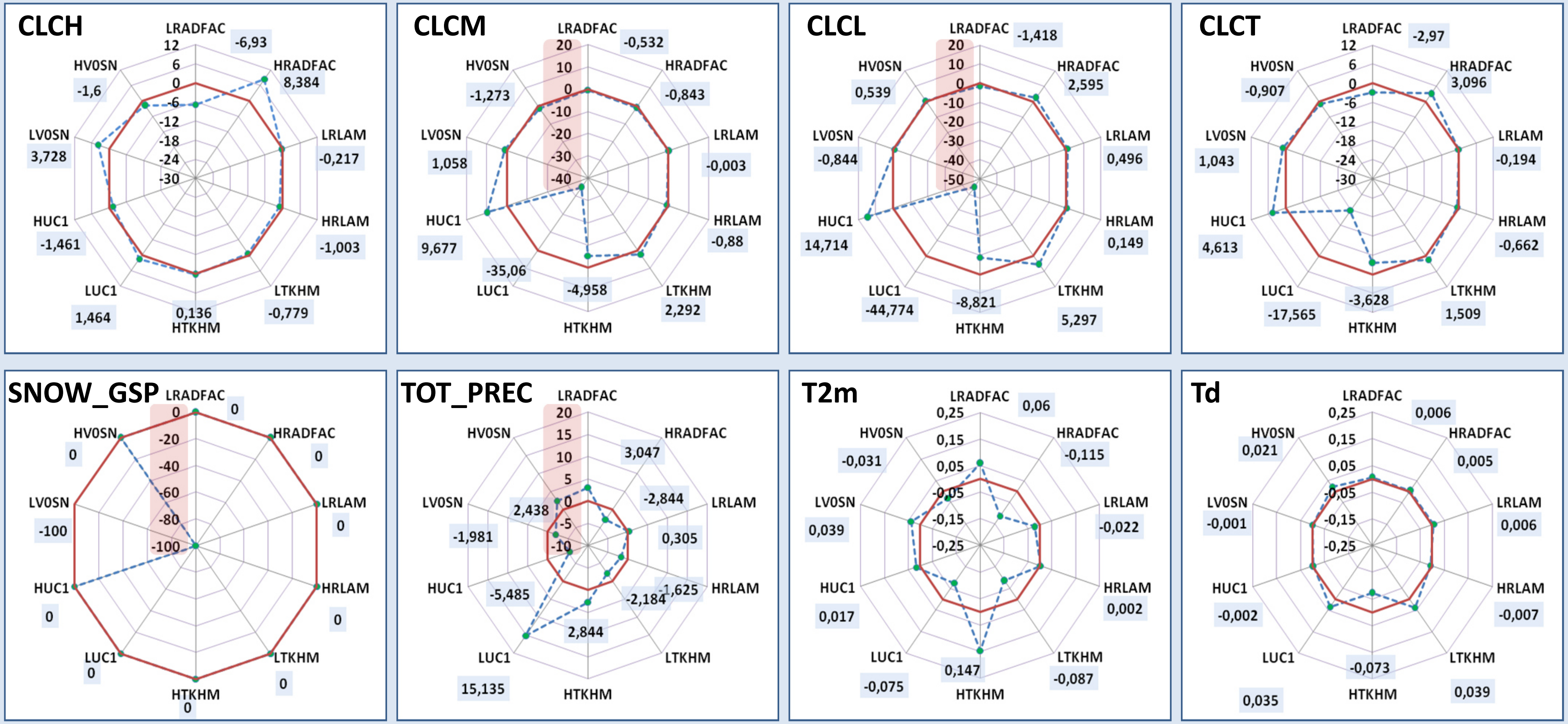
JULY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HTKHM 0,136
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HUC1 -1,461
LV0SN 3,728
HV0SN -1,6
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6
0
-6
-12
-18
-24
-30
CLCM
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HRADFAC -0,843
LRLAM -0,003
HRLAM -0,88
LTKHM 2,292
HTKHM -4,958
LUC1 -35,06
HUC1 9,677
LV0SN 1,058
HV0SN -1,273
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0
-10
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-30
-40
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HRADFAC 2,595
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HRLAM 0,149
LTKHM 5,297
HTKHM -8,821
LUC1 -44,774
HUC1 14,714
LV0SN -0,844
HV0SN 0,539
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10
0
-10
-20
-30
-40
-50
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HRADFAC 3,096
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HRLAM -0,662
LTKHM 1,509
HTKHM -3,628
LUC1 -17,565
HUC1 4,613
LV0SN 1,043
HV0SN -0,907
12
6
0
-6
-12
-18
-24
-30
SNOW_GSP
LRADFAC 0
HRADFAC 0
LRLAM 0
HRLAM 0
LTKHM 0
HTKHM 0
LUC1 0
HUC1 0
LV0SN -100
HV0SN 0
0
-20
-40
-60
-80
-100
TOT_PREC
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HRADFAC 3,047
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HRLAM -1,625
LTKHM -2,184
HTKHM 2,844
LUC1 15,135
HUC1 -5,485
LV0SN -1,981
HV0SN 2,438
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15
10
5
0
-5
-10
T2m
LRADFAC 0,06
HRADFAC -0,115
LRLAM -0,022
HRLAM 0,002
LTKHM -0,087
HTKHM 0,147
LUC1 -0,075
HUC1 0,017
LV0SN 0,039
HV0SN -0,031
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0,15
0,05
-0,05
-0,15
-0,25
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LRADFAC 0,006
HRADFAC 0,005
LRLAM 0,006
HRLAM -0,007
LTKHM 0,039
HTKHM -0,073
LUC1 0,035
HUC1 -0,002
LV0SN -0,001
HV0SN 0,021
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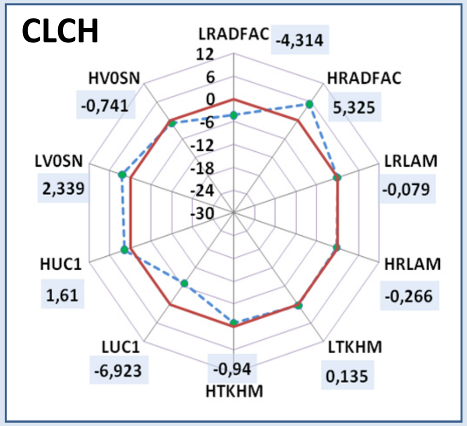
-0,15
-0,25

AUGUST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HTKHM -0,94
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HV0SN -0,741
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-18
-24
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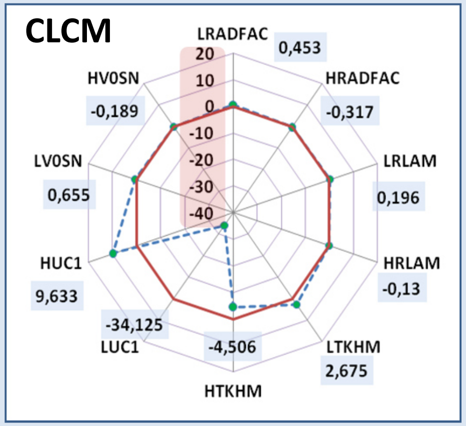
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HRLAM -0,13
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HTKHM -4,506
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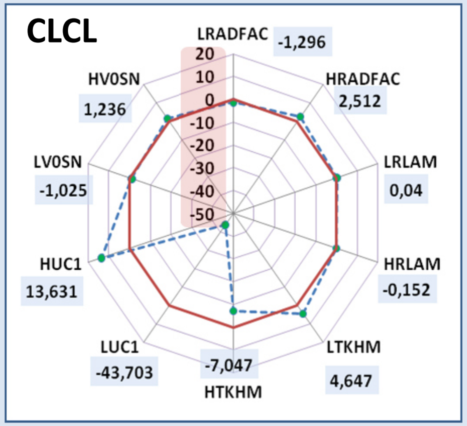
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HRLAM -0,152
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HTKHM -7,047
LUC1 -43,703
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LV0SN -1,025
HV0SN 1,236
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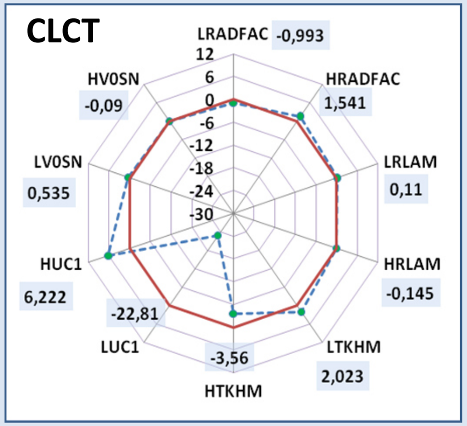
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HRLAM -0,145
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HTKHM -3,56
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LV0SN 0,535
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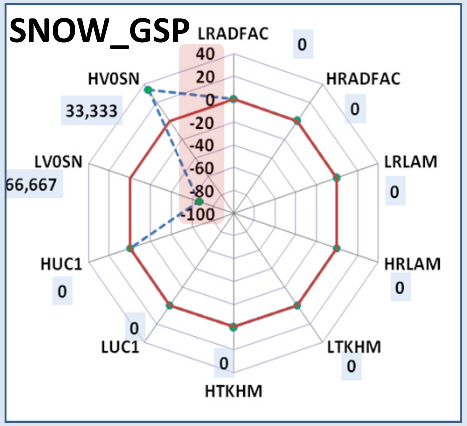
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HRLAM 0
LTKHM 0
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HV0SN 33,333
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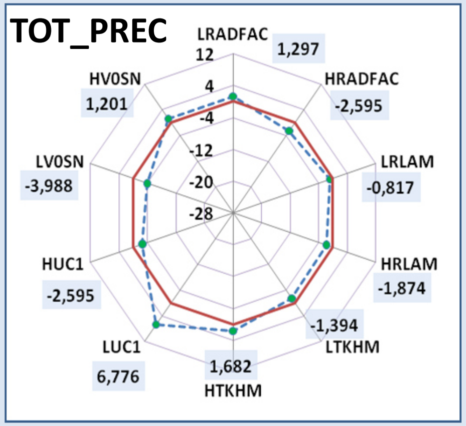
TOT_PREC
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HRLAM -1,874
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HTKHM 1,682
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HV0SN 1,201
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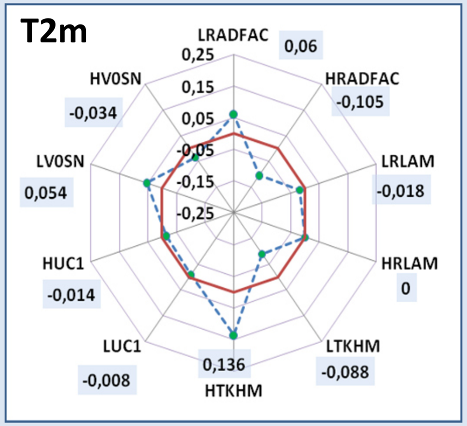
T2m
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LRLAM -0,018
HRLAM 0
LTKHM -0,088
HTKHM 0,136
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0,05
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-0,15
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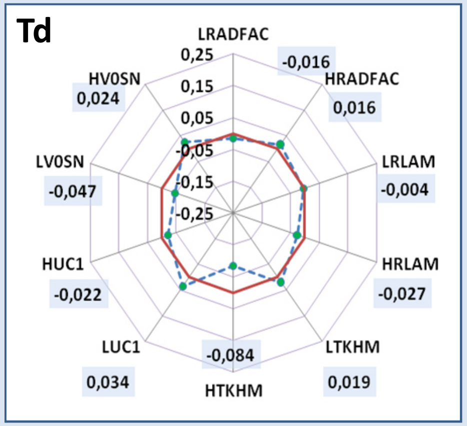
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LRADFAC -0,016
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HRLAM -0,027
LTKHM 0,019
HTKHM -0,084
LUC1 0,034
HUC1 -0,022
LV0SN -0,047
HV0SN 0,024
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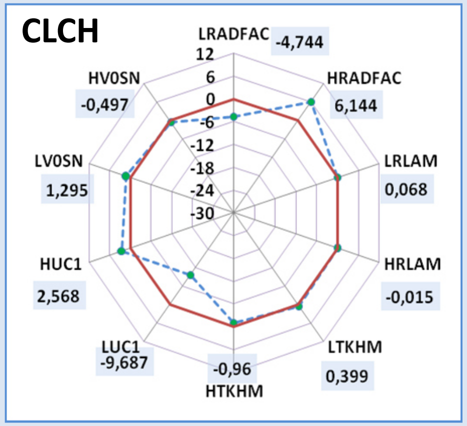
-0,05
-0,15
-0,25

SEPTEMBER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HRLAM
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HTKHM
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HVOSN
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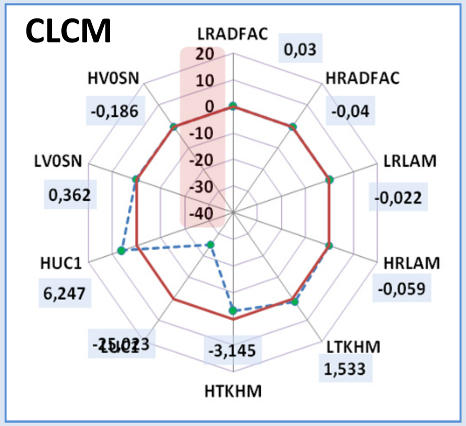
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HTKHM
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LVOSN
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HVOSN
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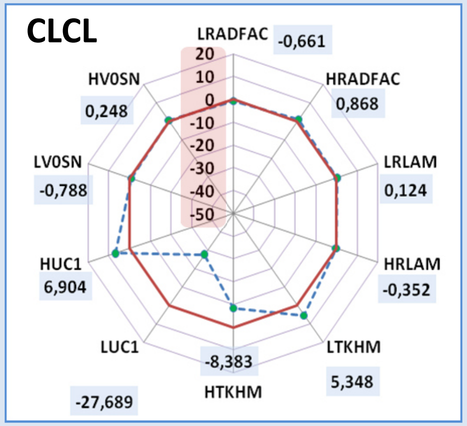
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HTKHM
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LUC1
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HVOSN
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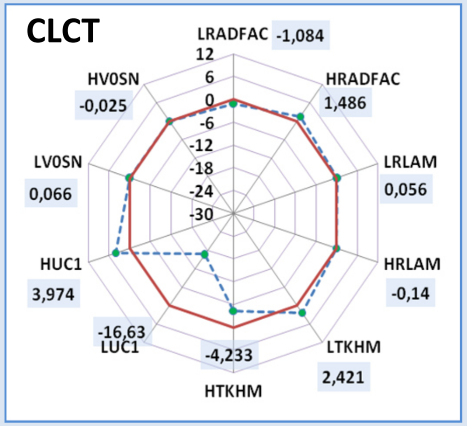
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HTKHM
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LUC1
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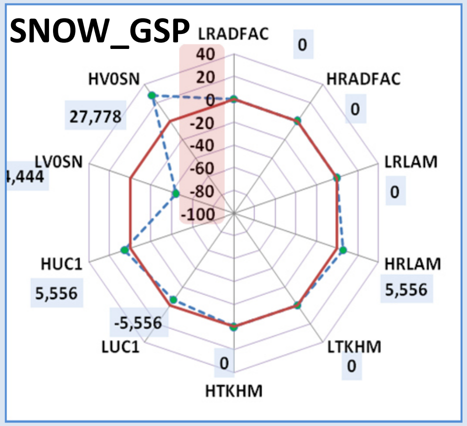
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HRADFAC
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HRLAM
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LTKHM
0
HTKHM
0
LUC1
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5,556
LVOSN
HVOSN
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0
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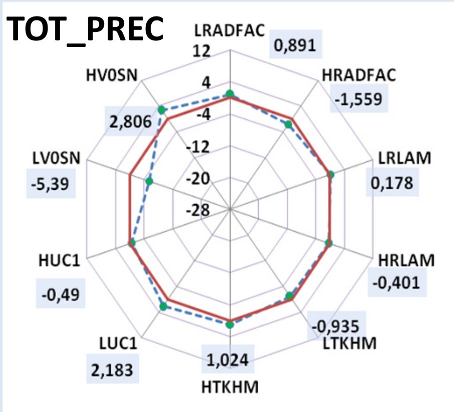
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HTKHM
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LUC1
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HVOSN
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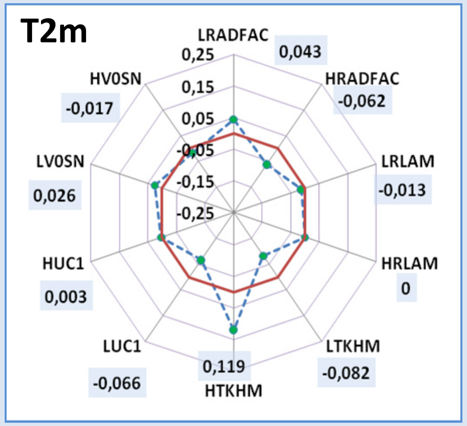
-28


T2m
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HRADFAC
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HRLAM
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LTKHM
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HTKHM
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LUC1
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HUC1
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HVOSN
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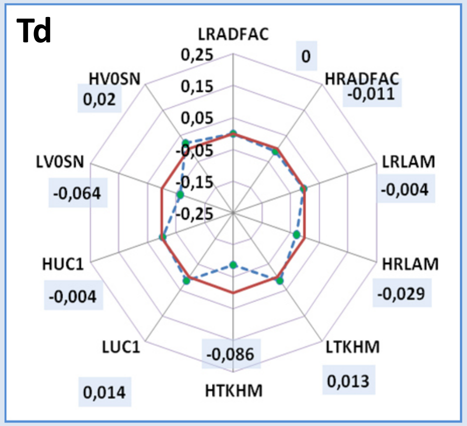
0,05
-0,05
-0,15
-0,25


Td
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HRADFAC
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HRLAM
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HTKHM
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LUC1
0,014
HUC1
-0,004
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HVOSN
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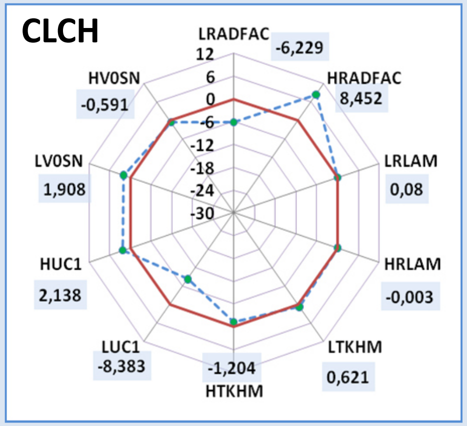
-0,05
-0,15
-0,25

OCTOBER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HRLAM
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LTKHM
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-1,204
HTKHM
LUC1
-8,383
HUC1
2,138
LV0SN
1,908
HV0SN
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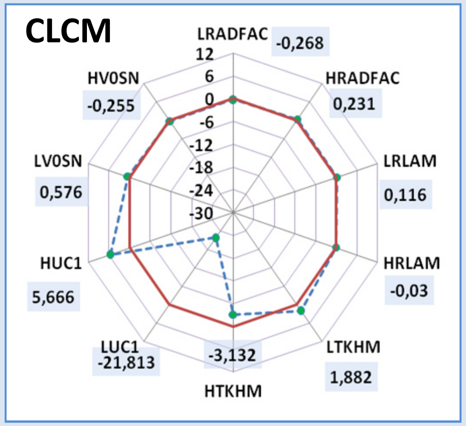
0
-6
-12
-18
-24
-30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LTKHM
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HTKHM
LUC1
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LV0SN
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HV0SN
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0
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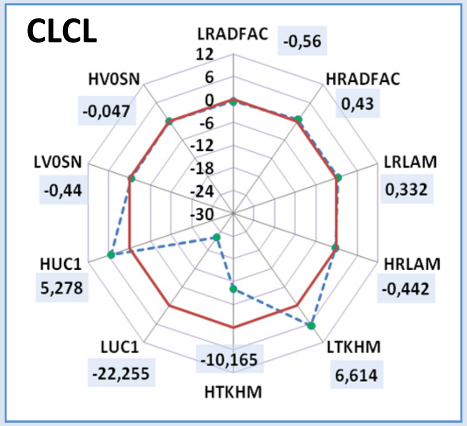
-12
-18
-24
-30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HRADFAC
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HRLAM
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LTKHM
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-10,165
HTKHM
LUC1
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HUC1
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HV0SN
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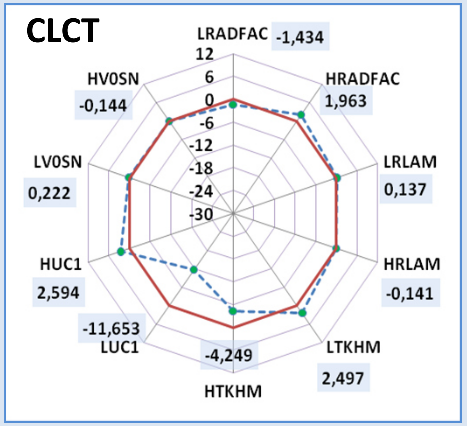
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LRADFAC
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HRADFAC
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HRLAM
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LTKHM
2,497
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HTKHM
-11,653
LUC1
HUC1
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LV0SN
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HV0SN
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0
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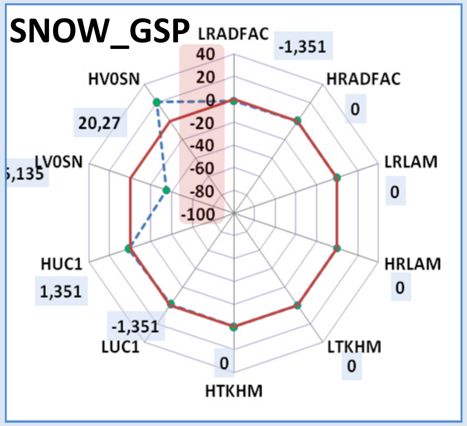
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HRLAM
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LTKHM
0
0
HTKHM
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LUC1
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LV0SN
HV0SN
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0
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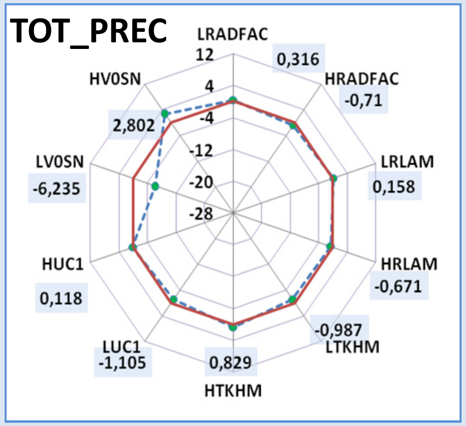
TOT_PREC
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HTKHM
LUC1
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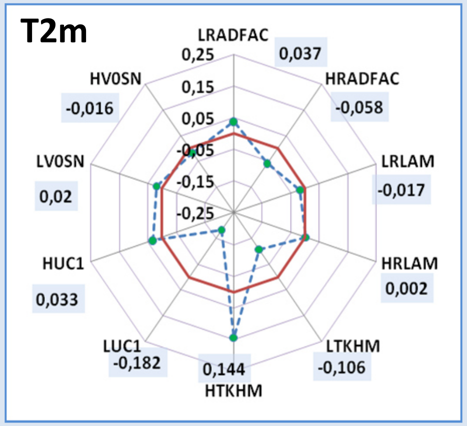
HUC1
0,118
LV0SN
-6,235
HV0SN
2,802
12
4
-4
-12
-20
-28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HRADFAC
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LRLAM
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HRLAM
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LTKHM
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0,144
HTKHM
LUC1
-0,182
HUC1
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0,02
HV0SN
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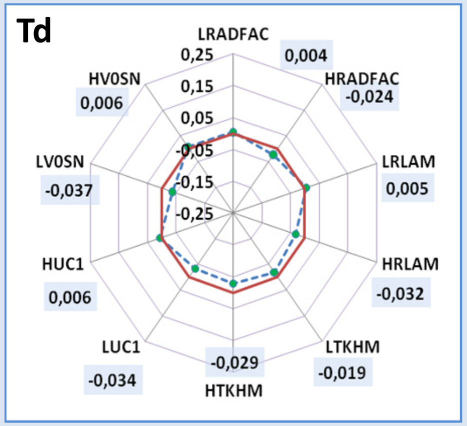
0,25
0,15
0,05
-0,05
-0,15
-0,25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HRADFAC
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LRLAM
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HRLAM
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LTKHM
-0,019
-0,029
HTKHM
LUC1
-0,034
HUC1
0,006
LV0SN
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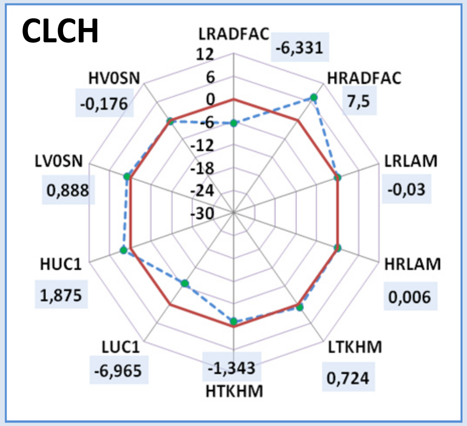
HV0SN
0,006
0,25
0,15
0,05
-0,05
-0,15
-0,25

NOVEMBER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HRLAM
0,006
LTKHM
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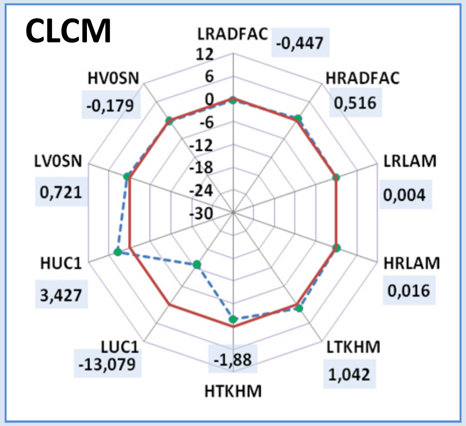
HTKHM
-1,343
LUC1
-6,965
HUC1
1,875
LV0SN
0,888
HV0SN
-0,176
12
6
0
-6
-12
-18
-24
-30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HRADFAC
0,516
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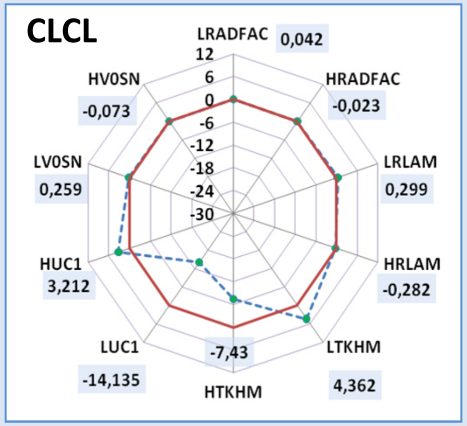
0,004
HRLAM
0,016
LTKHM
1,042
HTKHM
-1,88
LUC1
-13,079
HUC1
3,427
LV0SN
0,721
HV0SN
-0,179
12
6
0
-6
-12
-18
-24
-30


CLCL
LRADFAC
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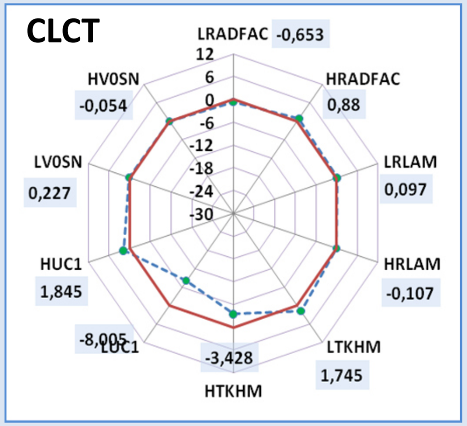
HRADFAC
-0,023
LRLAM
0,299
HRLAM
-0,282
LTKHM
4,362
HTKHM
-7,43
LUC1
-14,135
HUC1
3,212
LV0SN
0,259
HV0SN
-0,073
12
6
0
-6
-12
-18
-24
-30


CLCT
LRADFAC
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HRADFAC
0,88
LRLAM
0,097
HRLAM
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LTKHM
1,745
HTKHM
-3,428
LUC1
-8,005
HUC1
1,845
LV0SN
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HV0SN
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12
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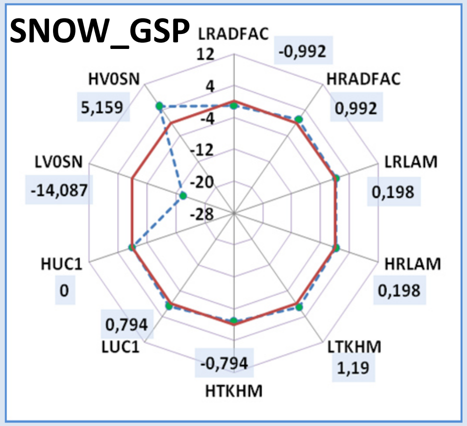
0
-6
-12
-18
-24
-30


SNOW_GSP
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HRADFAC
0,992
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0,198
HRLAM
0,198
LTKHM
1,19
HTKHM
-0,794
LUC1
0,794
HUC1
0
LV0SN
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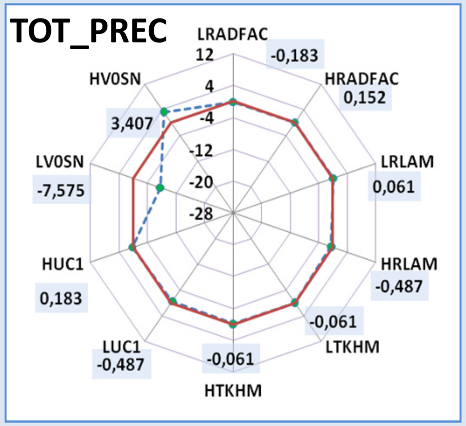
HV0SN
5,159
12
4
-4
-12
-20
-28


TOT_PREC
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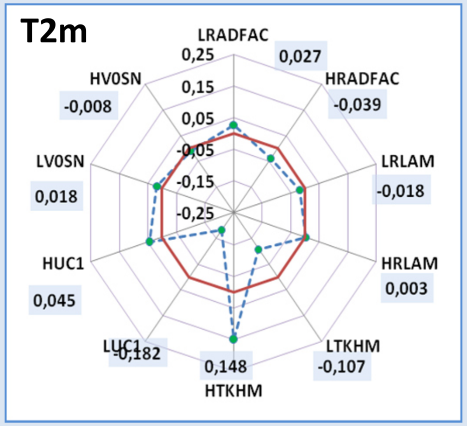
HRADFAC
0,152
LRLAM
0,061
HRLAM
-0,487
LTKHM
-0,061
HTKHM
-0,061
LUC1
-0,487
HUC1
0,183
LV0SN
-7,575
HV0SN
3,407
12
4
-4
-12
-20
-28


T2m
LRADFAC
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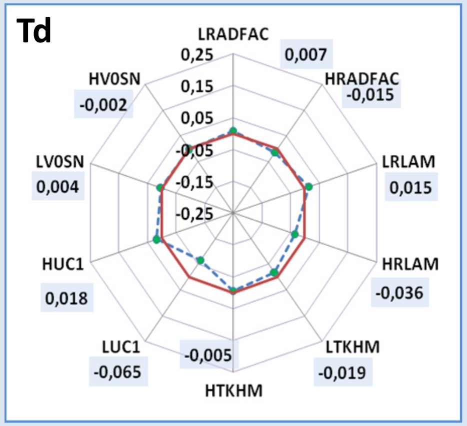
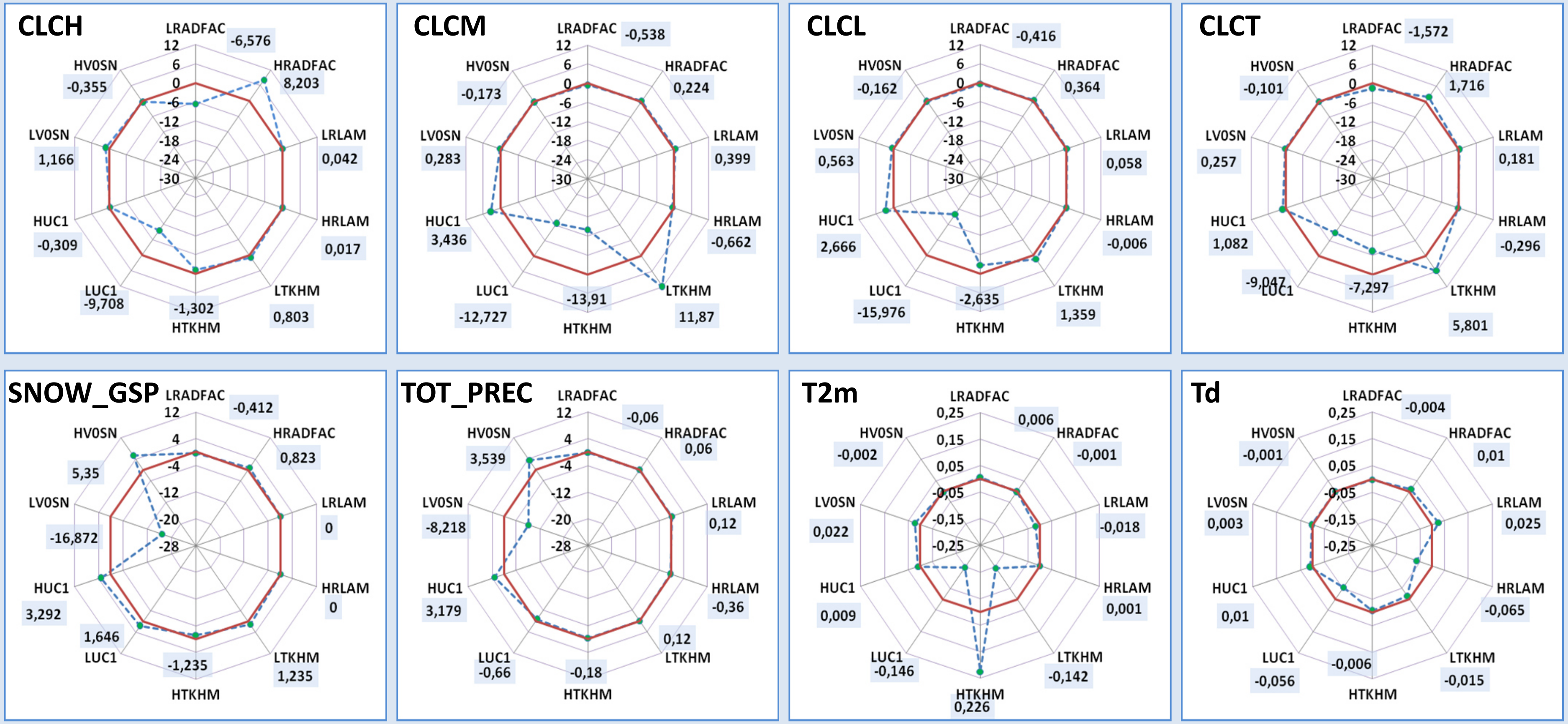
HRADFAC
-0,039
LRLAM
-0,018
HRLAM
0,003
LTKHM
-0,107
HTKHM
0,148
LUC1
-0,182
HUC1
0,045
LV0SN
0,018
HV0SN
-0,008
0,25
0,15
0,05
-0,05
-0,15
-0,25


Td
LRADFAC
0,007
HRADFAC
-0,015
LRLAM
0,015
HRLAM
-0,036
LTKHM
-0,019
HTKHM
-0,005
LUC1
-0,065
HUC1
0,018
LV0SN
0,004
HV0SN
-0,002
0,25
0,15
0,05
-0,05
-0,15
-0,25

DECEMBER


CLCH
LRADFAC
-6,576
HRADFAC
8,203
LRLAM
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HRLAM
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LTKHM
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HTKHM
-1,302
LUC1
-9,708
HUC1
-0,309
LVOSN
1,166
HVOSN
-0,355
12
6
0
-6
-12
-18
-24
-30
CLCM
LRADFAC
-0,538
HRADFAC
0,224
LRLAM
0,399
HRLAM
-0,662
LTKHM
11,87
HTKHM
-13,91
LUC1
-12,727
HUC1
3,436
LVOSN
0,283
HVOSN
-0,173
CLCL
LRADFAC
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HRADFAC
0,364
LRLAM
0,058
HRLAM
-0,006
LTKHM
1,359
HTKHM
-2,635
LUC1
-15,976
HUC1
2,666
LVOSN
0,563
HVOSN
-0,162
CLCT
LRADFAC
-1,572
HRADFAC
1,716
LRLAM
0,181
HRLAM
-0,296
LTKHM
5,801
HTKHM
-7,297
LUC1
-9,047
HUC1
1,082
LVOSN
0,257
HVOSN
-0,101
SNOW_GSP
LRADFAC
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HRADFAC
0,823
LRLAM
0
HRLAM
0
LTKHM
1,235
HTKHM
-1,235
LUC1
1,646
HUC1
3,292
LVOSN
-16,872
HVOSN
5,35
12
4
-4
-12
-20
-28
TOT_PREC
LRADFAC
-0,06
HRADFAC
0,06
LRLAM
0,12
HRLAM
-0,36
LTKHM
0,12
HTKHM
-0,18
LUC1
-0,66
HUC1
3,179
LVOSN
-8,218
HVOSN
3,539
T2m
LRADFAC
0,006
HRADFAC
-0,001
LRLAM
-0,018
HRLAM
0,001
LTKHM
-0,142
HTKHM
0,226
LUC1
-0,146
HUC1
0,009
LVOSN
0,022
HVOSN
-0,002
0,25
0,15
0,05
-0,05
-0,15
-0,25
Td
LRADFAC
-0,004
HRADFAC
0,01
LRLAM
0,025
HRLAM
-0,065
LTKHM
-0,015
HTKHM
-0,006
LUC1
-0,056
HUC1
0,01
LVOSN
0,003
HVOSN
-0,001

APPLICATION OF THE METHODOLOGY TO OBSERVATIONS
A TENTATIVE DRAFT

Mean values for 350days out of 365 days in 2013 over observation «positions» (provided by IMS)

	Obs	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation	Simulation
	Obs	**Default**	**LTKHM**	**HTKHM**	**LRLAM**	**HRLAM**	**LV0SN**	**HV0SN**	**LRADFAC**	**HRADFAC**	**LUC1**	**HUC1**
Daily 2m Tmax [c]	9,5554236	8,3071742	8,1881924	8,439952	5,1267706	8,3117172	8,3126452	8,2809631	8,4094556	8,1257207	8,3634544	8,2612675
Daily 2m Tmin [c]	2,0136913	2,9899176	2,8452023	3,1372939	0,076456602	2,9119855	2,9971762	2,9640281	3,0291088	2,8938131	2,8072147	3,002064
Daily mean of Tdew	5,2250654	5,2899909	5,2708491	5,2671631	2,079497	5,2376039	5,2816001	5,2983604	5,3134511	5,2599145	5,2474442	5,2993684
Daily 2m Tdew maximum [c]	7,7133257	7,7132891	7,691788	7,6972453	4,5032609	7,6814525	7,7065516	7,7252926	7,7544267	7,6638358	7,7154519	7,7156607
Daily 2m Tdew minimum [c]	2,4219839	2,6729404	2,6597769	2,646109	-0,53189374	2,5949414	2,6647681	2,6785359	2,678983	2,6648828	2,6042513	2,6878347
SunDuration [%]	42,843983	46,861793	46,323687	48,263598	43,846275	47,126855	46,814391	46,903763	48,340386	44,880147	50,88742	45,90906
Daily Precipiation [mm/day]	1,9256762	3,4840112	3,4556055	3,5157493	0,6542512	3,4541211	3,3635686	3,5232342	3,5296541	3,4212351	3,5457649	3,4625179

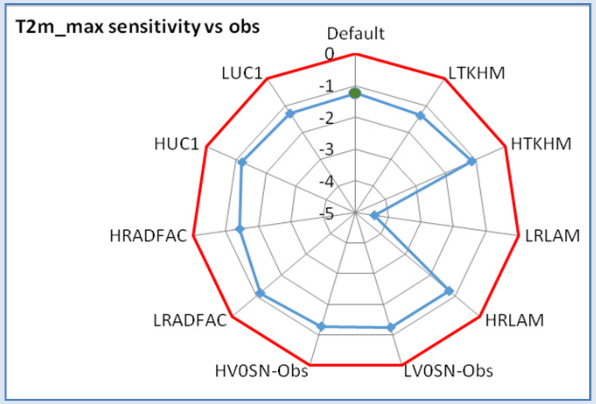
Differences in reference to observations

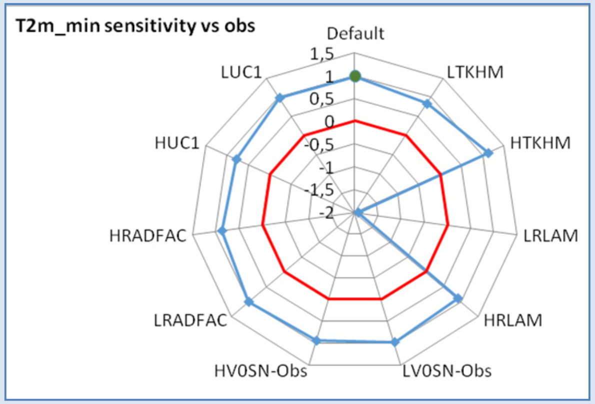
	Obs	Default-Obs	LTKHM-Obs	HTKHM-Obs	LRLAM-Obs	HRLAM-Obs	LV0SN-Obs	HV0SN-Obs	LRADFAC-Obs	HRADFAC-Ob	HUC1-Obs	LUC1-Obs
Daily 2m Tmax [c]	9,5554236	-1,2482494	-1,3672312	-1,1154716	-4,428653	-1,2437064	-1,2427784	-1,2744605	-1,145968	-1,4297029	-1,1919692	-1,2941561
Daily 2m Tmin [c]	2,0136913	0,9762263	0,831511	1,1236026	-1,937234698	0,8982942	0,9834849	0,9503368	1,0154175	0,8801218	0,7935234	0,9883727
Daily mean of Tdew	5,2250654	0,0649255	0,0457837	0,0420977	-3,1455684	0,0125385	0,0565347	0,073295	0,0883857	0,0348491	0,0223788	0,074303
Daily 2m Tdew maximum [c]	7,7133257	-3,66E-05	-0,0215377	-0,0160804	-3,2100648	-0,0318732	-0,0067741	0,0119669	0,041101	-0,0494899	0,0021262	0,002335
Daily 2m Tdew minimum [c]	2,4219839	0,2509565	0,237793	0,2241251	-2,95387764	0,1729575	0,2427842	0,256552	0,2569991	0,2428989	0,1822674	0,2658508
SunDuration [%]	42,843983	4,01781	3,479704	5,419615	1,002292	4,282872	3,970408	4,05978	5,496403	2,036164	8,043437	3,065077
Daily Precipiation [mm/day]	1,9256762	1,558335	1,5299293	1,5900731	-1,271425	1,5284449	1,4378924	1,597558	1,6039779	1,4955589	1,6200887	1,5368417

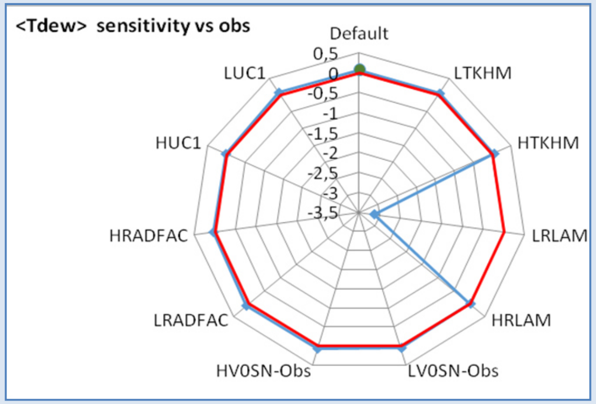
Sensitivities in reference to observations

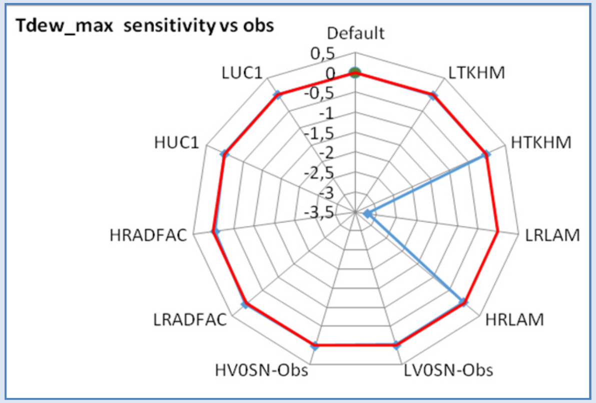
	Obs	Default	LTKHM	HTKHM	LRLAM	HRLAM	LV0SN-Obs	HV0SN-Obs	LRADFAC	HRADFAC	HUC1	LUC1
Daily 2m Tmax [c]	0	-1,2482494	-1,3672312	-1,1154716	-4,428653	-1,2437064	-1,2427784	-1,2744605	-1,145968	-1,4297029	-1,1919692	-1,2941561
Daily 2m Tmin [c]	0	0,9762263	0,831511	1,1236026	-1,937234698	0,8982942	0,9834849	0,9503368	1,0154175	0,8801218	0,7935234	0,9883727
Daily mean of Tdew	0	0,0649255	0,0457837	0,0420977	-3,1455684	0,0125385	0,0565347	0,073295	0,0883857	0,0348491	0,0223788	0,074303
Daily 2m Tdew maximum [c]	0	-3,66E-05	-0,0215377	-0,0160804	-3,2100648	-0,0318732	-0,0067741	0,0119669	0,041101	-0,0494899	0,0021262	0,002335
Daily 2m Tdew minimum [c]	0	0,2509565	0,237793	0,2241251	-2,95387764	0,1729575	0,2427842	0,256552	0,2569991	0,2428989	0,1822674	0,2658508
SunDuration [%]	0	0,093777696	0,081218032	0,126496526	0,023393997	0,099964375	0,092671309	0,094757296	0,128288796	0,04752509	0,18773784	0,071540431
Daily Precipiation [mm/day]	0	0,809240411	0,794489385	0,825721946	-0,660248592	0,793718539	0,746694797	0,829608841	0,832942683	0,7766409	0,84130899	0,798078981
REFERENCE		0	0	0	0	0	0	0	0	0	0	0

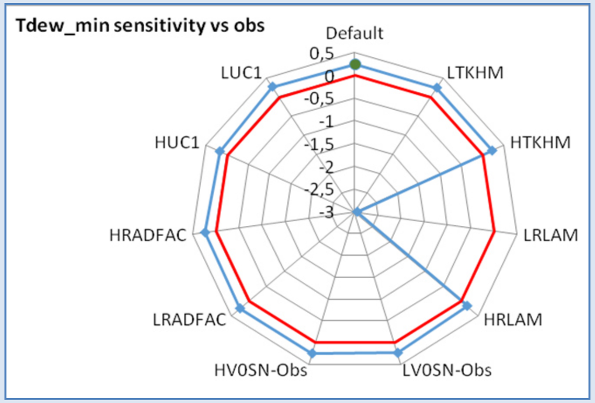
Sensitivity graphs

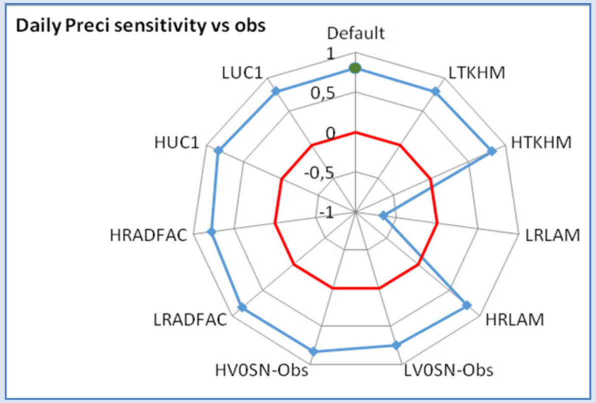


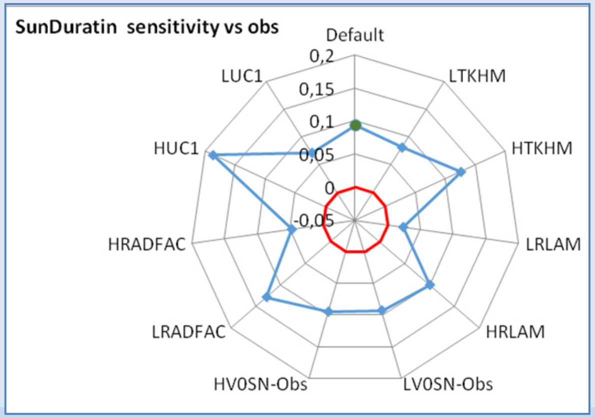












CONCLUSIONS

- The spider graphs with the largest parameter range can potentially denote the most sensitive parameter for a particular field.
- The relative sensitivity ot the other considered parameters can be estlmated by employing the scale with the largest parameter range for the remaining spider-graphs.
- Yearly versus monthly spider graphs can provide a relatively transparent seasonal dependence of the parameters chosen.
- Overall, a relatively systematic, consistent, objective and robust methodology regarding the evaluation of model parameters priority for testing purposes has been presented that can facilitate the formidable task of the model optimization proccess.
- In principle, the use of spider graphs can be used to select objectively the model parameters needed to be optimized.
- However a first tentative application of the methodology in reference to observations displays a framework for substantial considerations.