Status of NCEP ensemble data for TIGGE archive

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Currently, NCEP contributes completely 73 parameters, 21 members at 1*1 degree, every 6hrs out to 16 days, 4 times per day to TIGGE archive through NCDC (partially) and archived by NCAR.

NCDC converts twelve parameters which are transferred to NCAR archive center

ttr	Time-integrated Outgoing Long Wave Radiation
slhf	Time-integrated Surface Latent Heat Flux
str	Time-integrated Surface Net Thermal Radiation
ssr	Time-integrated Top Net Solar Radiation
sshf	Time-integrated Surface Sensible Heat Flux
pt	Potential Temperature
sf6	Snow Fall Water Equivalent
sf	Time-integrated Snow Fall Water Equivalent
sm	Soil Moisture
st	Soil Temperature
tcw	Total Column Water
tp	Total Precipitation

The five radiation parameters above in bold were affected by numerous issues, listed below. Of the five, only two of the fields are correctable without re-running the ncdcTigge generating process (sshf and slhf).

An operational change was made on Wednesday April 09 2014 beginning with the 12:00 UTC ncdcTigge output. The following issues below have been addressed, stating the core cause, symptoms, and countermeasures:

- Rescaling Issue – *ssr str*
    - o The two net parameters were computed from two GEFS fields. Code prior to the change used one of these records to store the computed net values for later time integration. The ECMWF GRIB_API automatically rescaled the net values to the binary and decimal scale factor within the original record rather than the newly inserted net values.
    - o This contributes errors ranging from -5 to 5 W/m^2 for some individual 6-hour intervals during the time integration.

- o Not retrospectively reversible: Without access to the original GEFS input records, there is no way to remedy this error by adjusting output prior to April 09 2014.
- o *Note*: The GEFS issue noted near the end of this document is a different problem causing similar errors.

- Incorrect net calculation – *ssr str*
  - o Due to misunderstanding of sign conventions between various centers, the original TIGGE requirement guidance recommended summing the two fields required to calculate a net flux, assuming the values of the two were of opposite signs. For NCEP GEFS this was not the case.
  - o Incoming and outgoing radiation flux values from GEFS input are both positive, and when both were summed, values which were too large resulted.
  - o Not retrospectively reversible, it is not possible to decompile a sum and turn it into an ordered difference.

- Incorrect level type – *ttr*
  - o Outgoing long wave radiation flux was input with "surface" level type instead of "top of atmosphere", due to an ambiguity in the original TIGGE requirement document.
  - o Values were too large, due to the nature of the fields.
  - o Not retrospectively reversible as the wrong GEFS field was used.

- TIGGE sign convention – *ttr sshf slhf*
  - o Not all fields followed the "positive downward" TIGGE convention for radiation flux.
  - o Values were of incorrect/opposite sign.
  - o Fields sshf, slhf, and ttr were all positive by NCEP convention and should be negative for TIGGE. This may be fixed retrospectively by reversing the sign of all values, after the other possible adjustments listed in this document are applied.

- Initial time step in time integration – *ssr str ttr sshf slhf*
  - o The time integration process in all five radiation fields was not zeroing out the initial time step.
  - o Values throughout the time series are larger than expected in magnitude (positive or negative) by one step (0-1500 W/m^2)
  - o Reversible by subtracting the value of the initial time step (t=000) from all time steps (t=000-384).

- Incorrect time unit conversion – *ssr str ttr sshf slhf*
  - o This conversion was done on each step in the time integration: ((Running sum 0 to fff) / (fff*3600.0))
  - o Produced drastically lower values throughout the forecast.

- Reversible by canceling the formula above, then applying the correct time unit conversion. This will only be effective on sshf slhf, as the three others suffer compounding non-correctable issues.
  (Running sum 0 to fff) * 6 * 3600.0
  (Running sum 0 to fff) * (6 * 3600.0) * (fff * 3600.0)
  Which reduces to:
  (Output value @ fff) * fff * 77760000

The following was identified by NCEP as an issue with the GEFS products input into ncdcTigge program, and thus was not addressed by the NCDC update.

- Rounding issue – ssr
  - The downward solar radiative flux contributing to the calculation of ssr may be rounded to the nearest 1 or 10 W/m^2 depending on the maximum value in the field, while the upward flux is rounded to the nearest 1 W/m^2.
  - This contributes errors ranging from -5 to 5 W/m^2 for some individual 6-hour intervals during the time integration.
  - Not retrospectively reversible. This error will be reduced but not eliminated by a future NCEP upgrade.