New Terrain Data For FV3GFS

FV3GFS Technical Meeting

August 14, 2017

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GTOPO30 Data

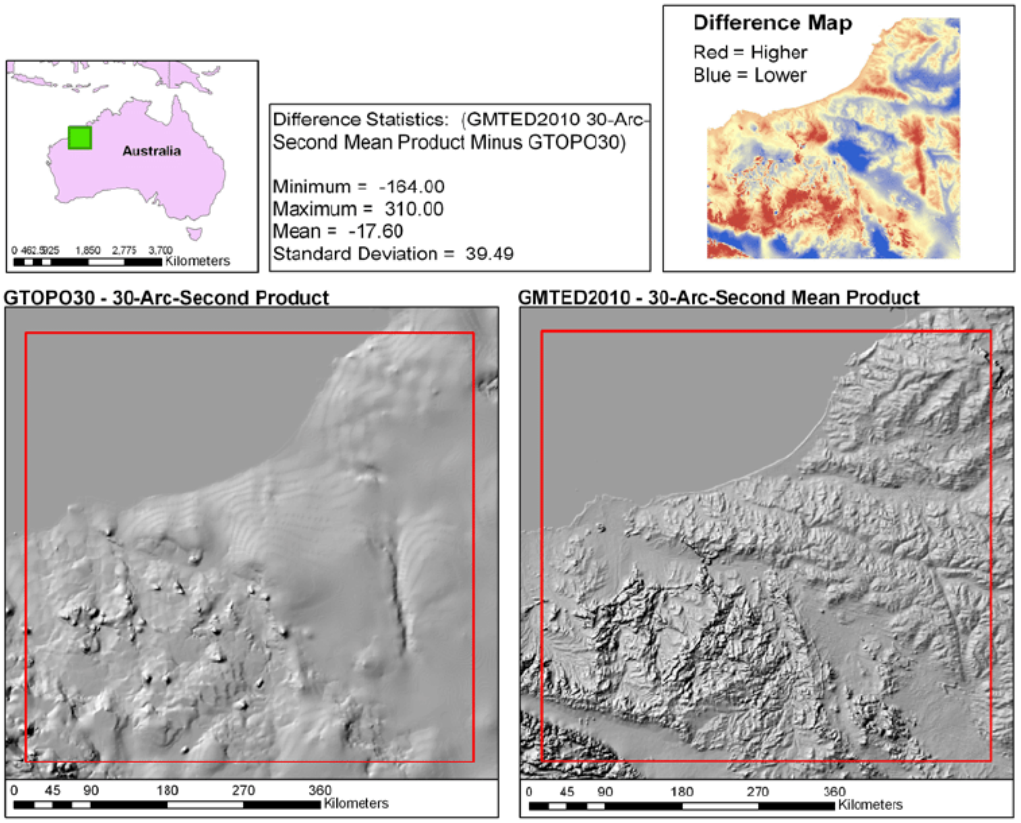
- FV3GFS currently uses GTOPO30 terrain data.
  - Mapped to the cubed-sphere grid using Jordan's orography program.
  - https://svnemc.ncep.noaa.gov/fv3gfs/trunk/global_shared.v15.0.0/sorc/orog.fd
  - Separate data used for Antarctica – more on this later.
    - Radarsat Antarctic Mapping Project (RAMP) Digital Elevation Model - Liu, H. et al. (2001). A 1-km dataset.
    - GTOPO30 had several deficiencies (did not resolve large ice sheets).
- Global 30 arc-seconds (about 1 km).
  - But not really 30-sec everywhere.
- Created by USGS in 1996 from eight different sources.
  - No single, global source at the time.
- Quality varies from continent to continent (and even within continents).

GMTED2010 Data

- More accurate replacement for GTOPO30 data.
  - Created by USGS in 2010.
  - Primarily derived from NASA Shuttle Radar Topography Mission (SRTM) data.
- Three different resolutions – 30/15/7.5 arc second.
  - Corresponds to 1000/500/250 meters.
  - 30 arc-second data is global.
  - 15 and 7.5 arc-second versions have no data for Antarctica or Greenland.
  - I have only acquired the 30 and 15-second versions.
- For more details, see: https://lta.cr.usgs.gov/GMTED2010

GMTED2010 vs GTOPO30

Comparing the datasets for a small area of NW Australia (green box). Although both are 30 arc-sec, the GMTED2010 is much more detailed.



GTOPO30 a merger of different datasets.

GMTED2010 more detailed.

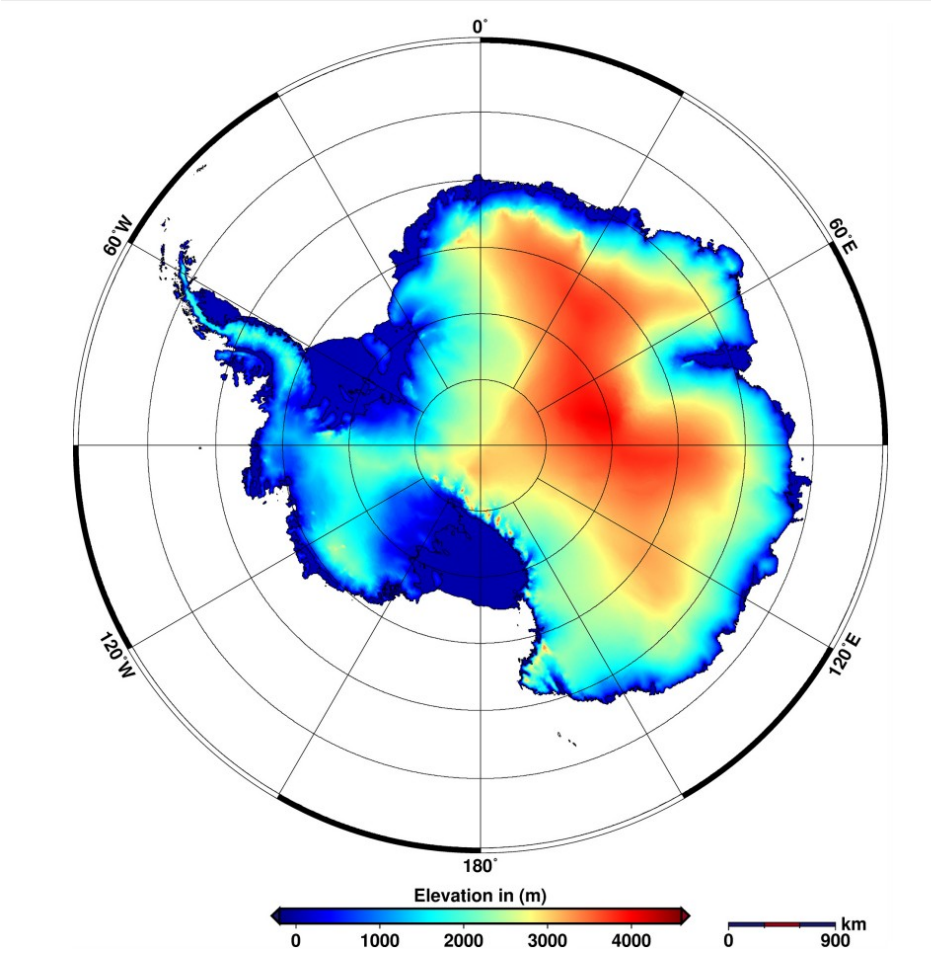
Danielson and Gesch (2011)

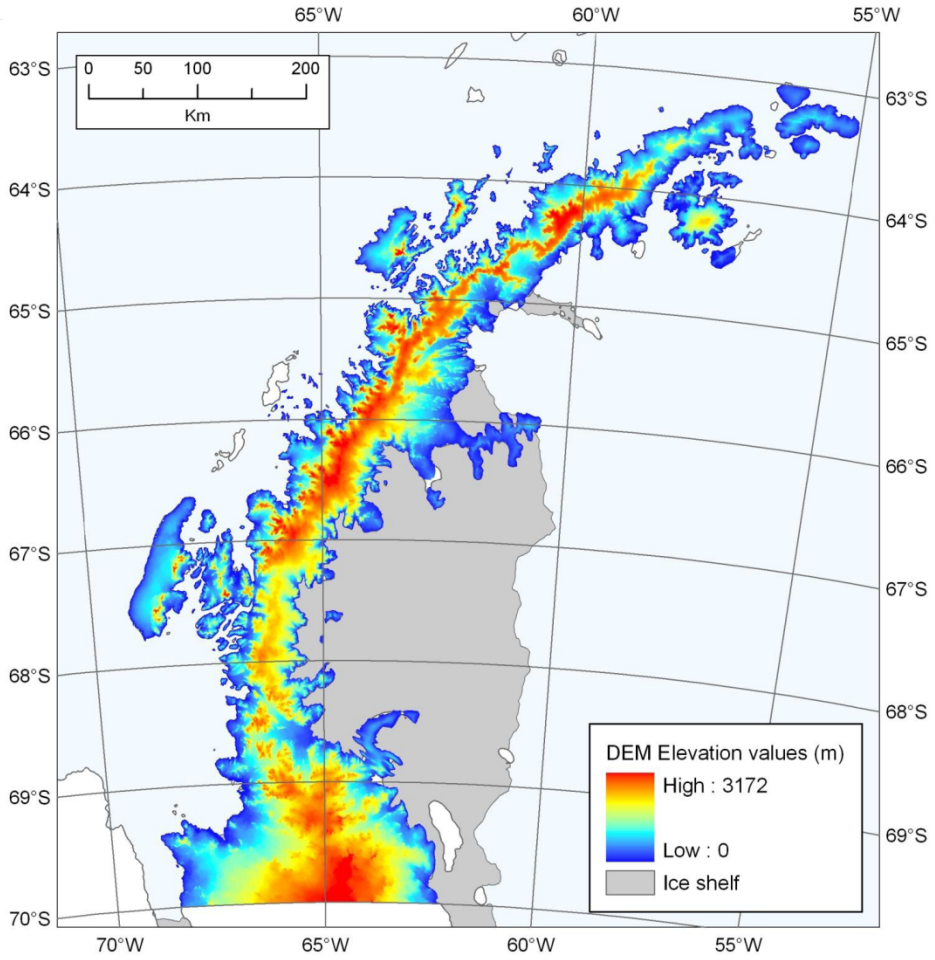
Orography Program

- Creates the following fields for each tile. Many are required by the mountain blocking and GWD.
  - Mean terrain height – records for raw ("orog_raw") and filtered ("orog_filt") are identical. Terrain is filtered by *./sorc/fre-nctools.fd/tools/filter_topo*
  - Standard deviation of height ("stddev")
  - Convexity ("convexity")
  - Orographic Asymetry – four directional (W/S/SW/NW) components ("oa1-4")
  - Orographic Length scale – four directional (W/S/SW/NW) components ("ol1-4")
  - Angle of mountain range with respect to east ("theta")
  - Aniostropy ("gamma")
  - Slope ("sigma")
  - Maximum height about mean ("elvmax")
  - Also creates land mask (0-non-land; 1-land) ("slmsk") and Land fraction (decimal percent) ("land_frac").
- Modifications for GMTED2010 documented under this ticket: https://svnemc.ncep.noaa.gov/trac/fv3gfs/ticket/17
- All plots are C768 uniform grid.
- Unless noted, all plots are of the raw (unfiltered) orography.

C768 Tests

Currently use RAMP data in Antarctica. Should we retain it or use GMTED2010?

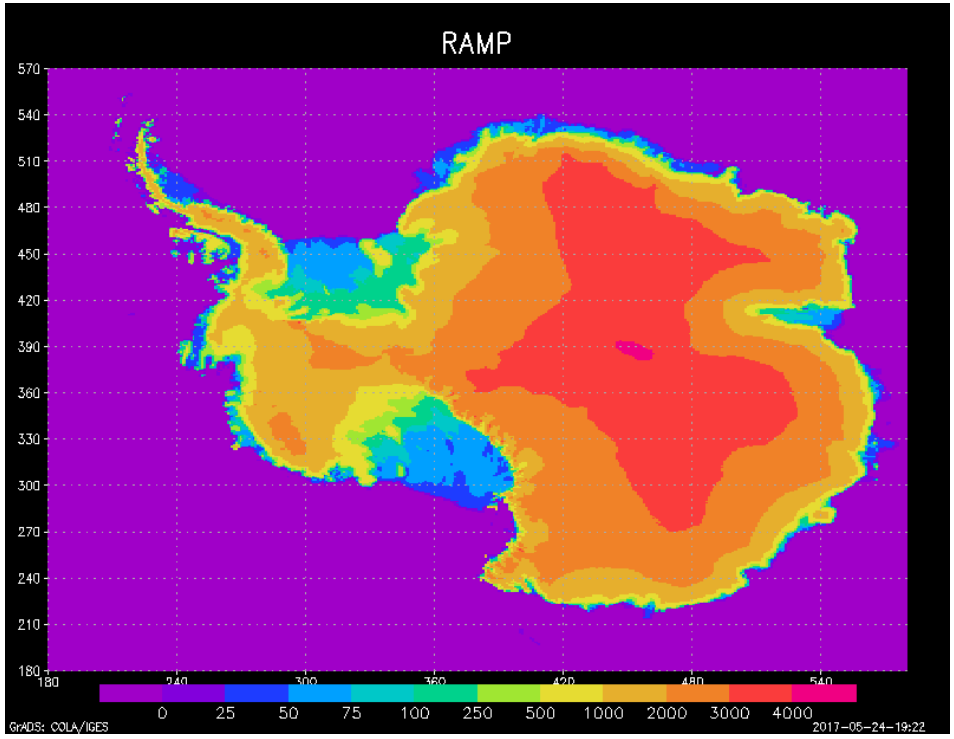




GFDL noted problems with GMTED along Palmer Peninsula.

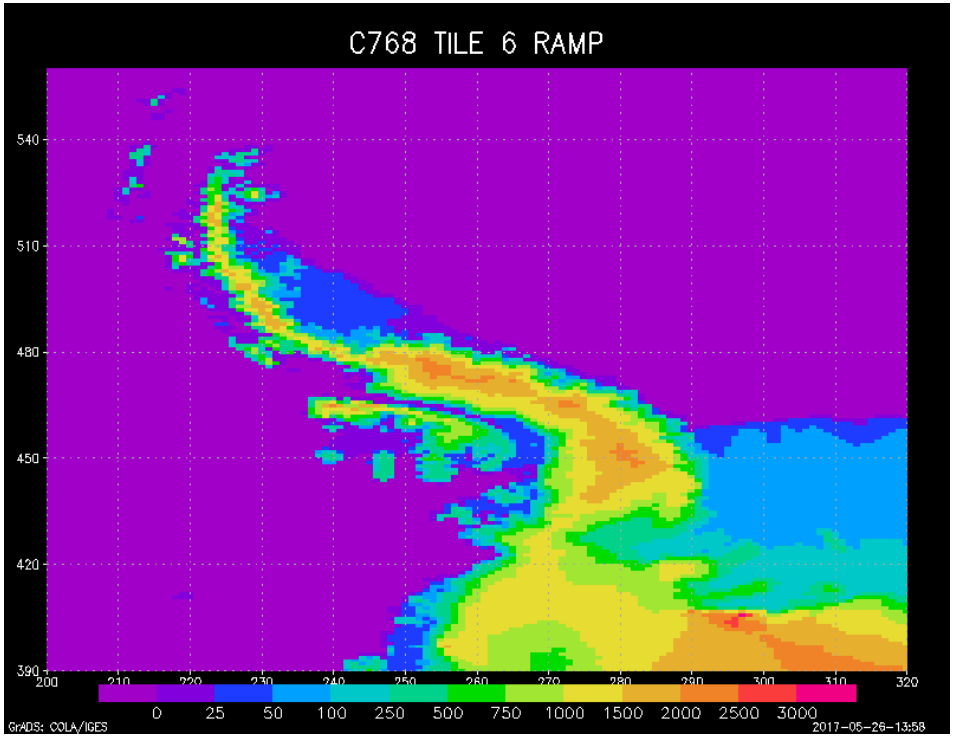
RAMP Data – Tile 6

ANTARCTICA



TERRAIN HEIGHT IN METERS.

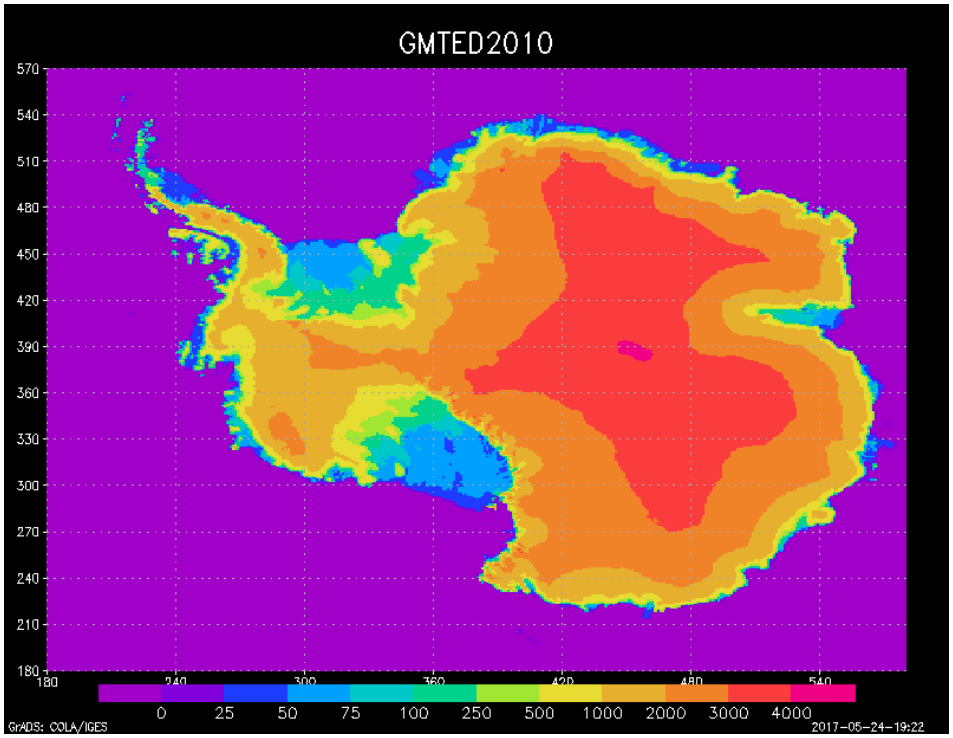
PALMER PENISULA



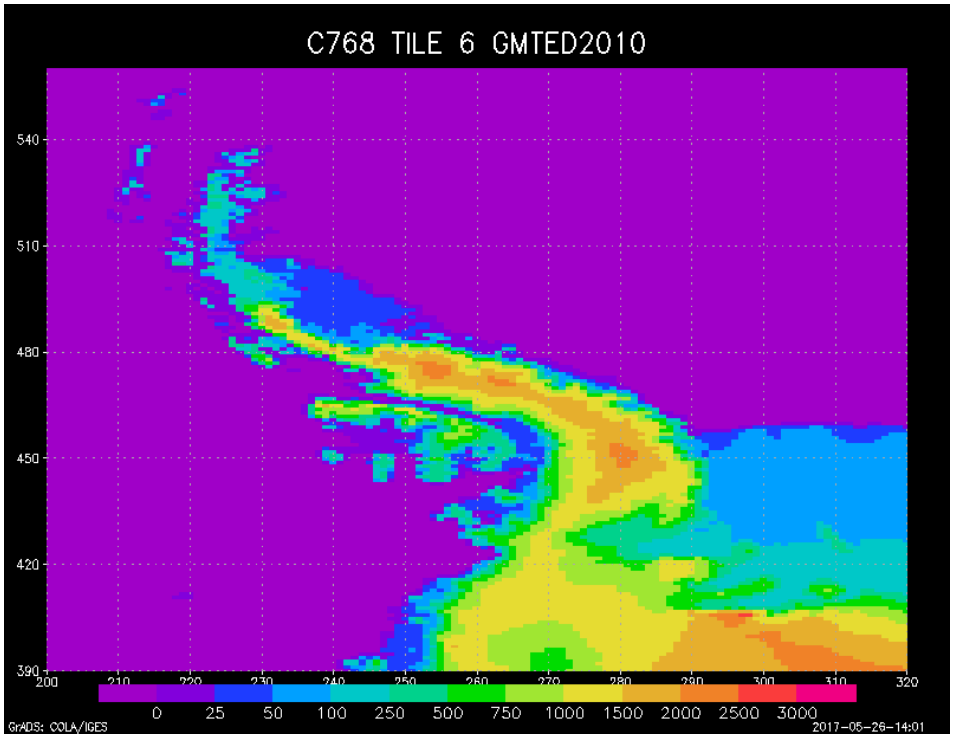
MOUNTAINS EXTEND LENGTH OF PENISULA

GMTED2010 – Tile 6

ANTARCTICA



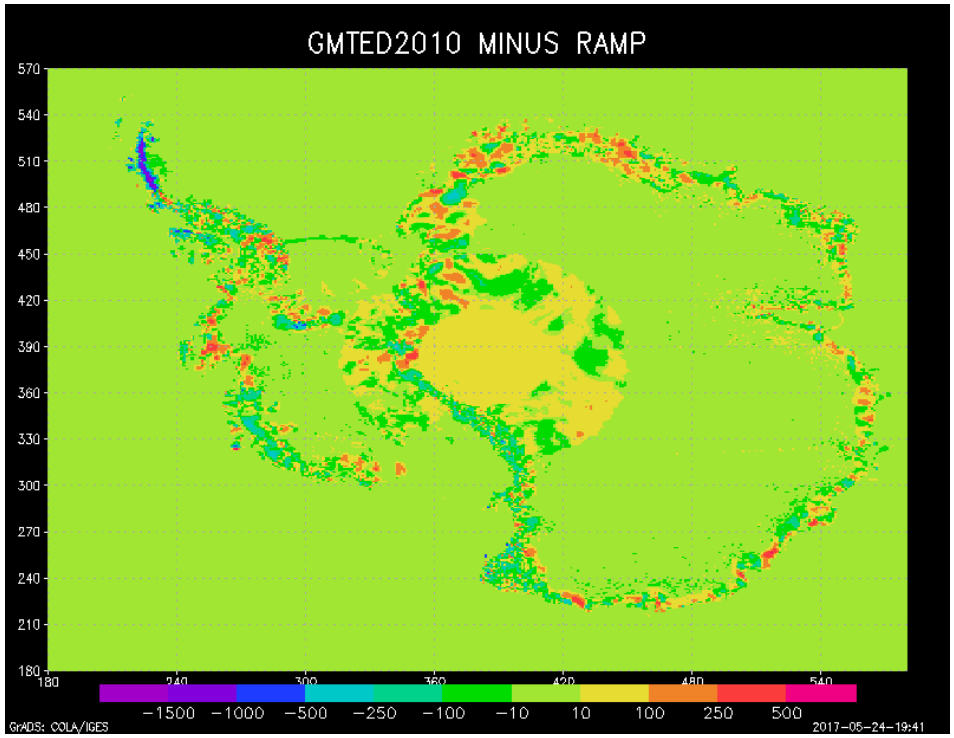
PALMER PENISULA



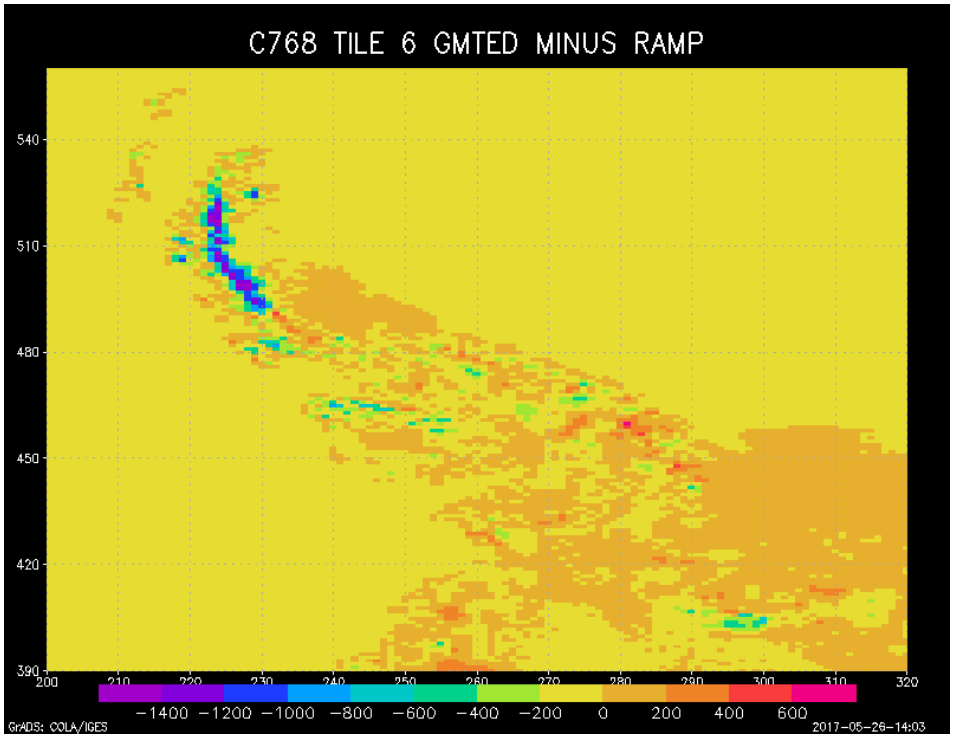
MOUNTAINS POORLY RESOLVED.

Difference – Tile 6

ANTARCTICA



PALMER PENISULA

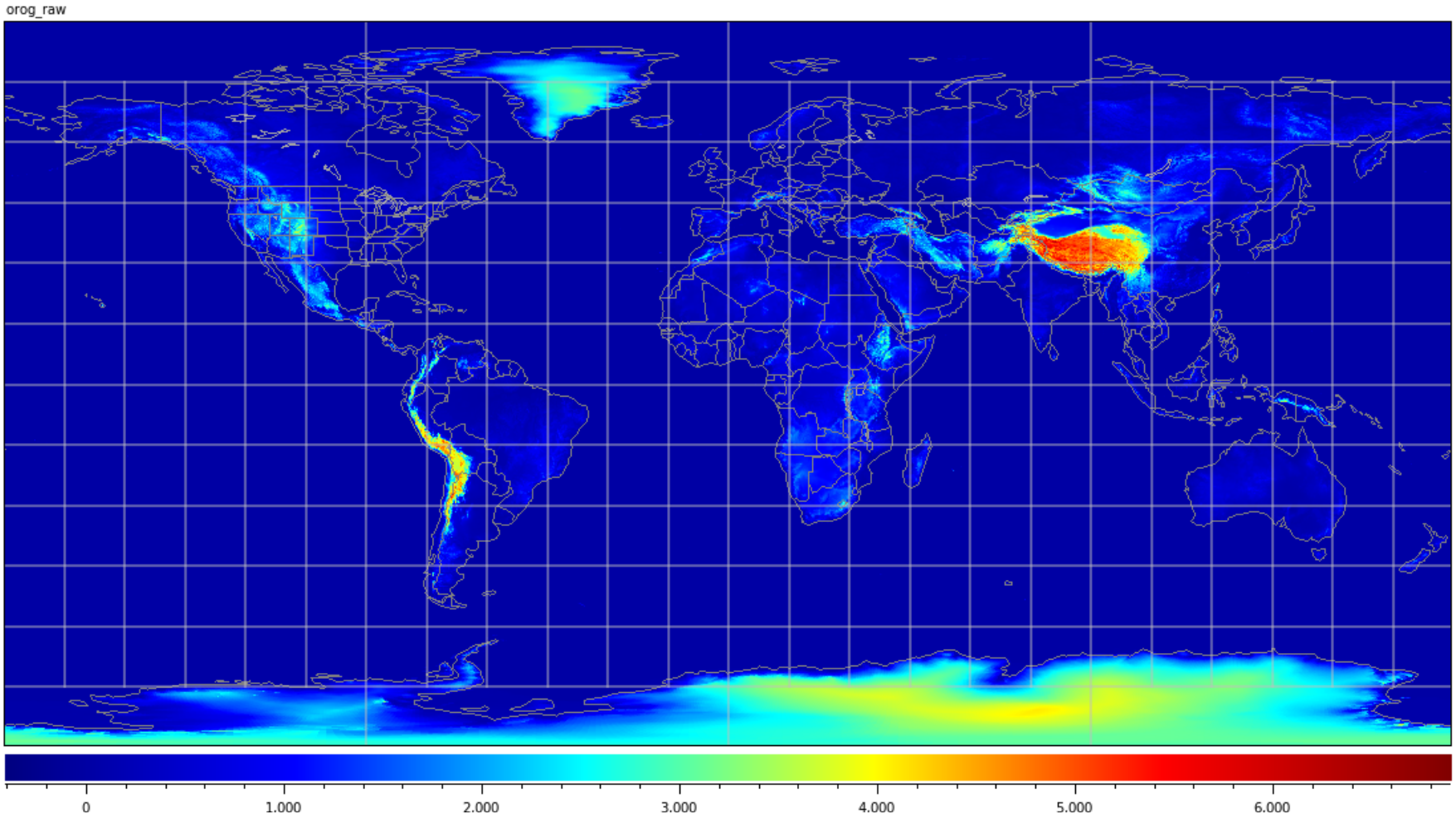


Some large differences. Which is better?

> 1400 meter differences

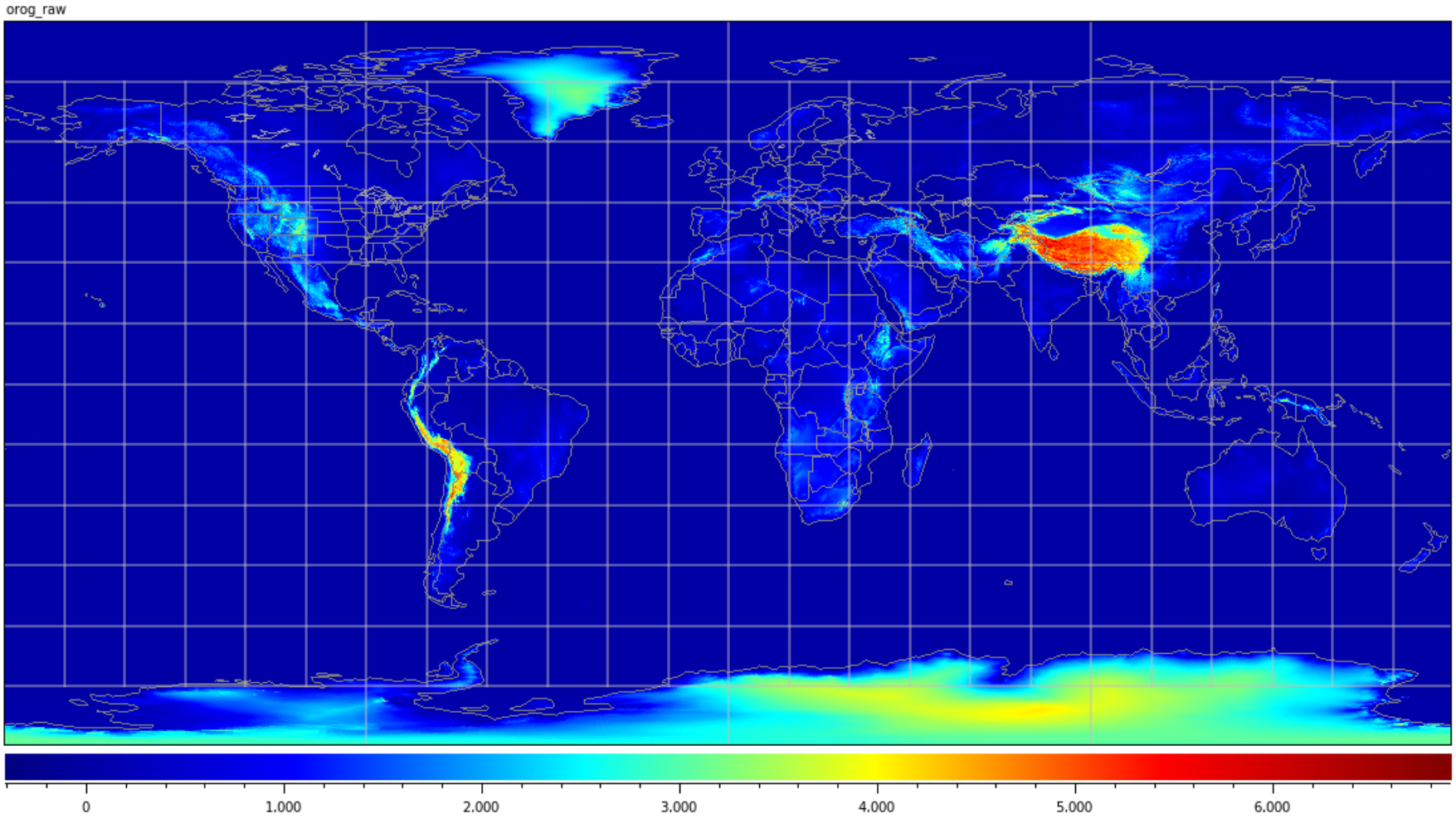
WILL CONTINUE TO USE RAMP DATA FOR ANTARTICA.

GTOPO30 – Terrain Height

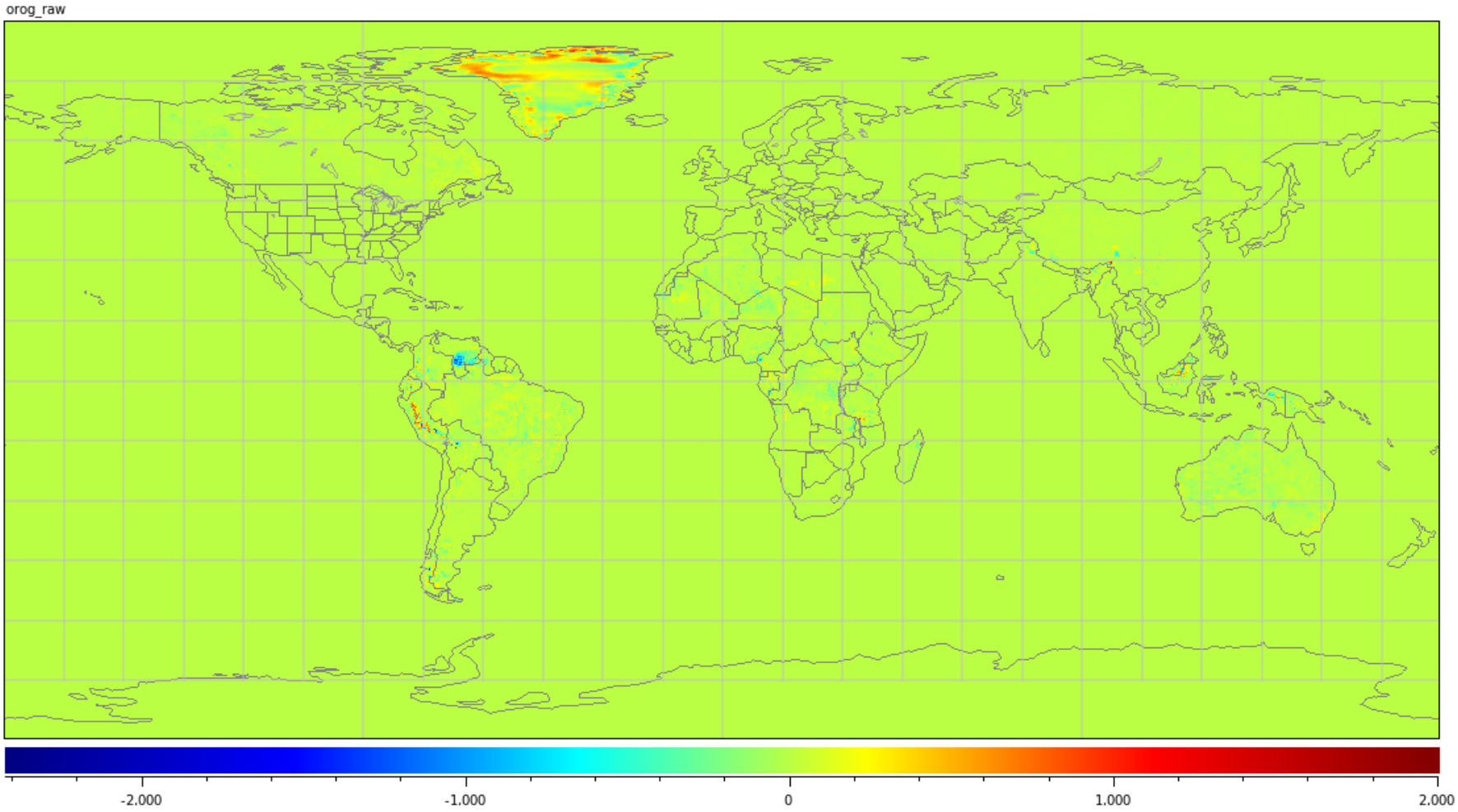


SIX C768 TILES DISPLAYED USING DBROWSE.

GMTED2010 – Terrain height

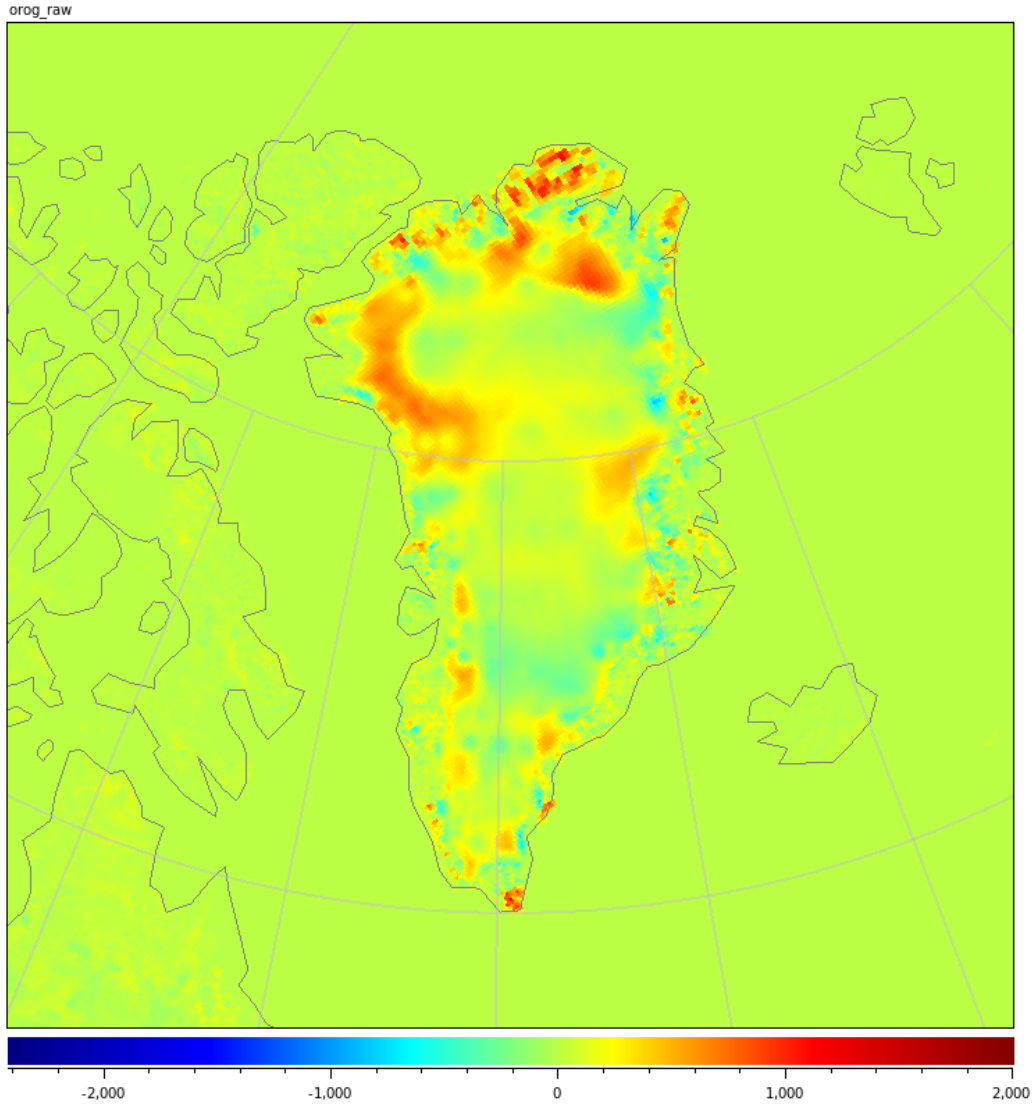


GMTED minus GTOPO30



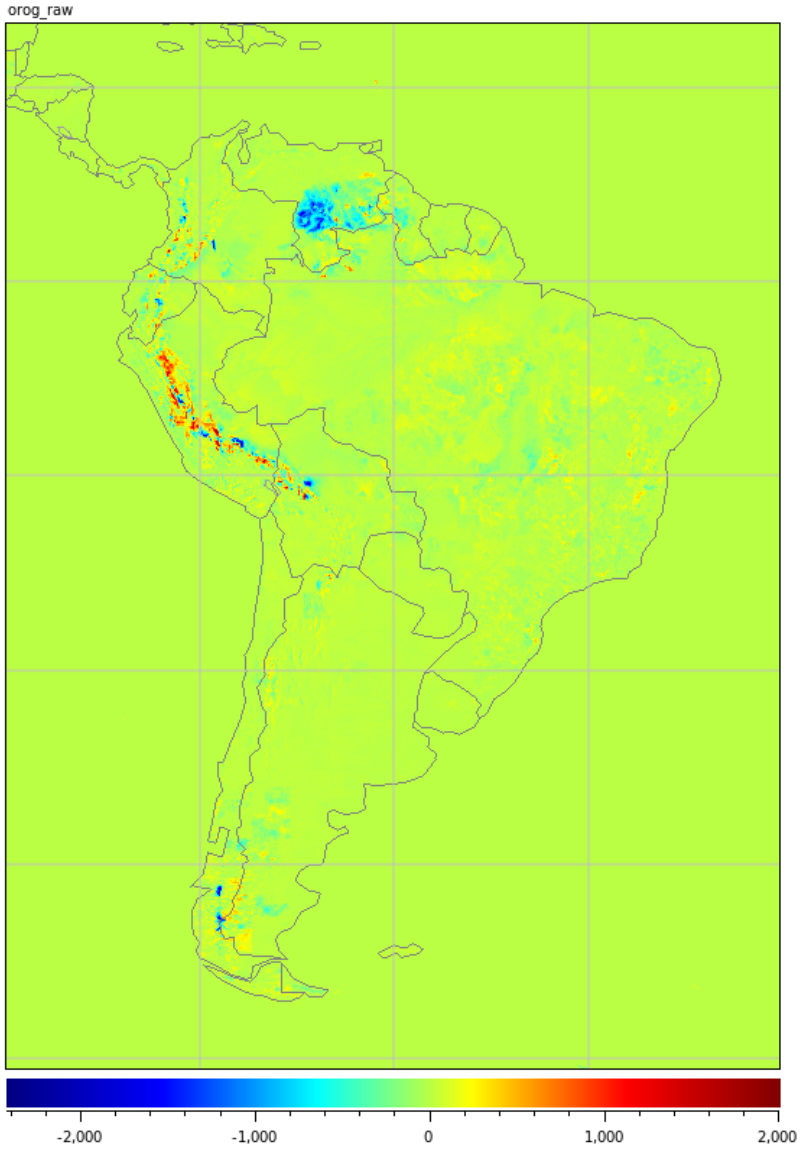
LARGE (>2000 M) DIFFERENCES IN GREENLAND, SOUTH AMERICA, INDONESIA.
SMALL DIFFERENCES IN ALASKA AND CONUS.

GMTED minus GTOPO30



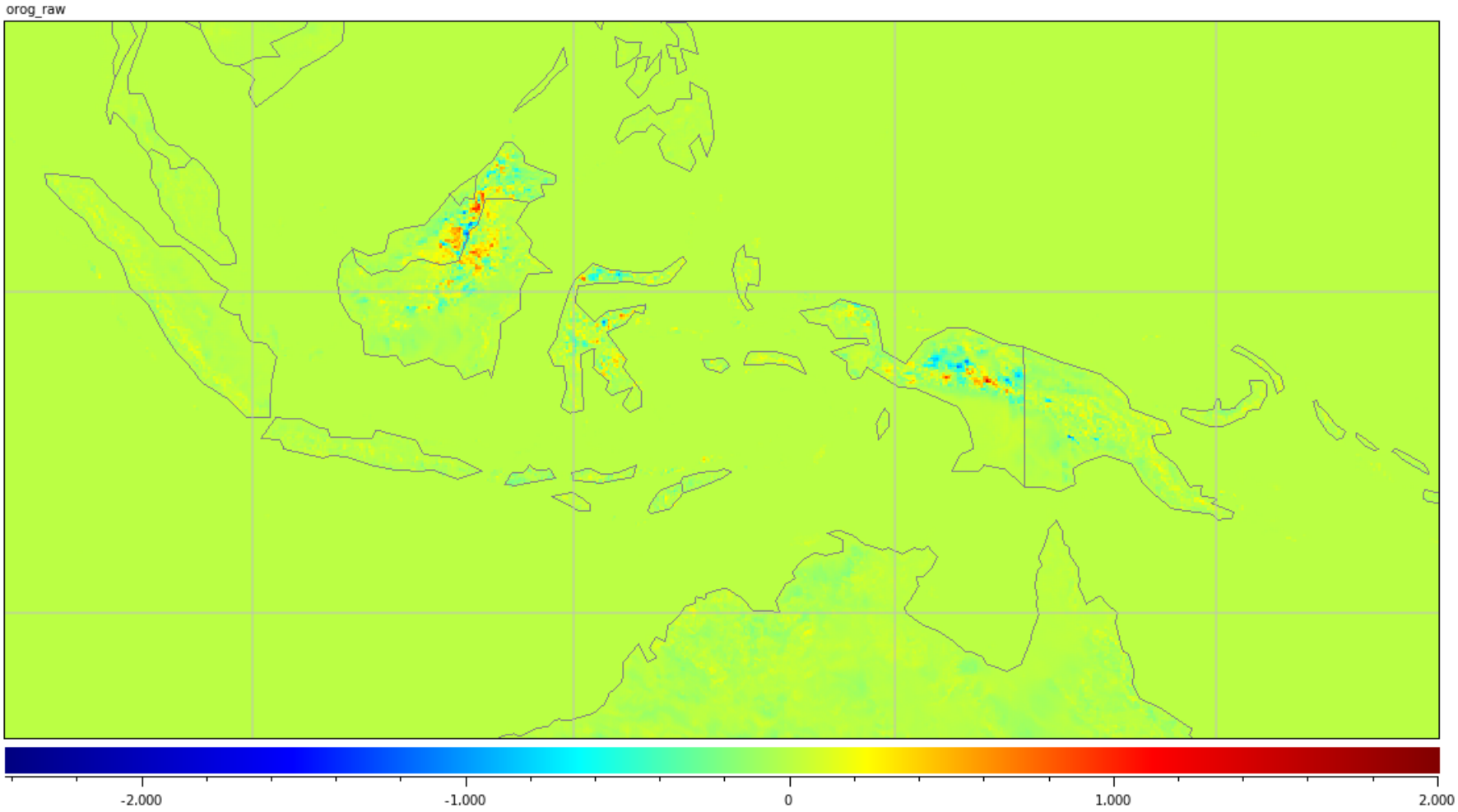
DIFFERENCES IN GREENLAND ARE LARGE IN MAGNITUDE AND AREAL EXTENT.

GMTED minus GTOPO30



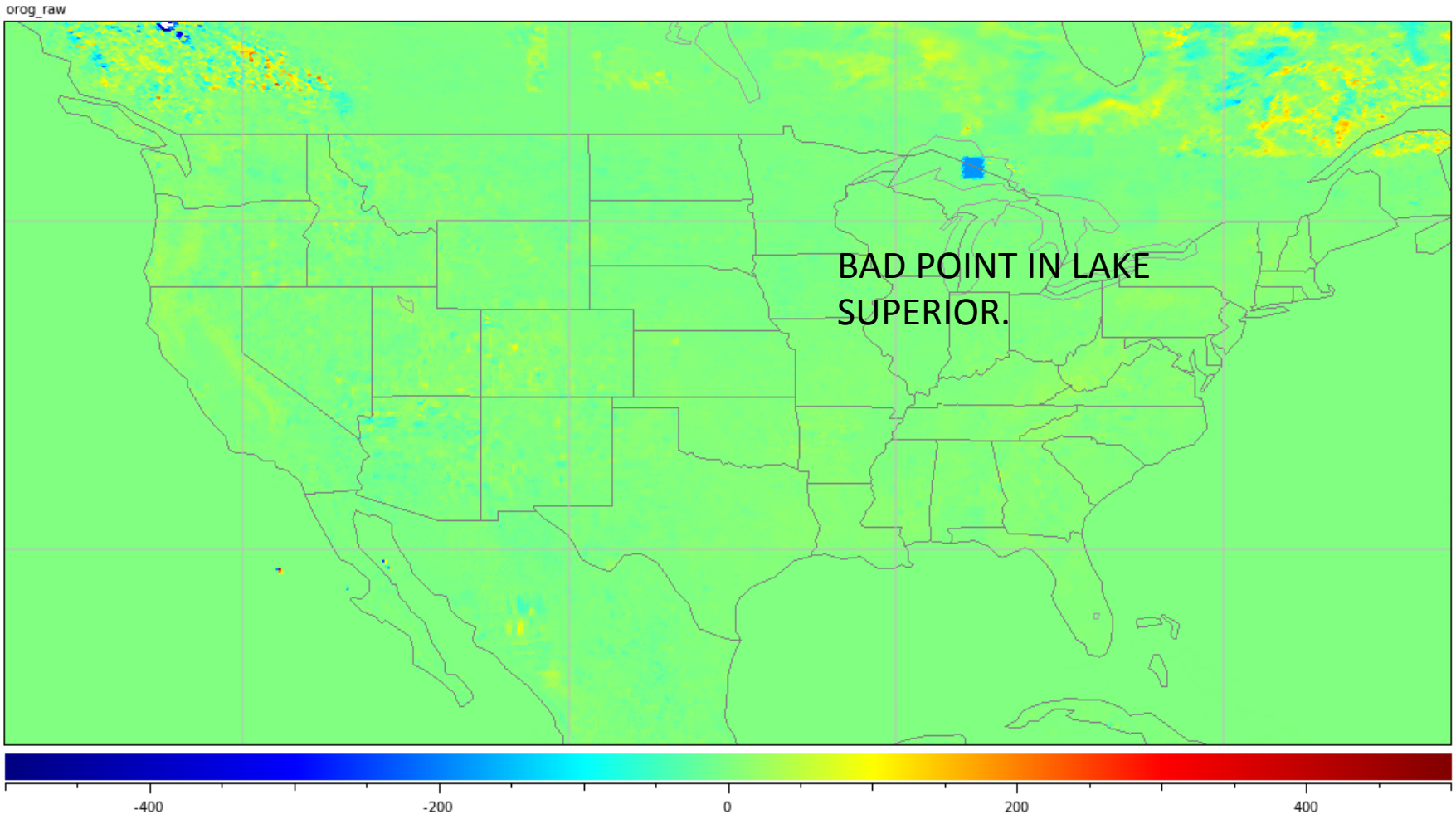
2000 METER DIFFERENES ALONG ANDES AND IN VENEZUELA.

GMTED minus GTOPO30



INDONESIA

GMTED minus GTOPO30

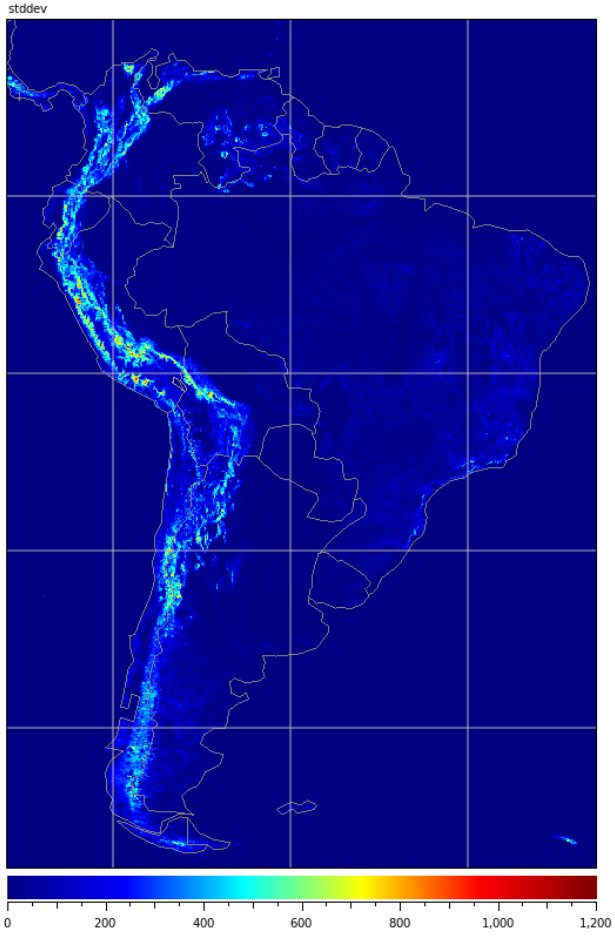


SMALL DIFFERENCES IN CONUS (NOTE NEW COLOR SCALE).

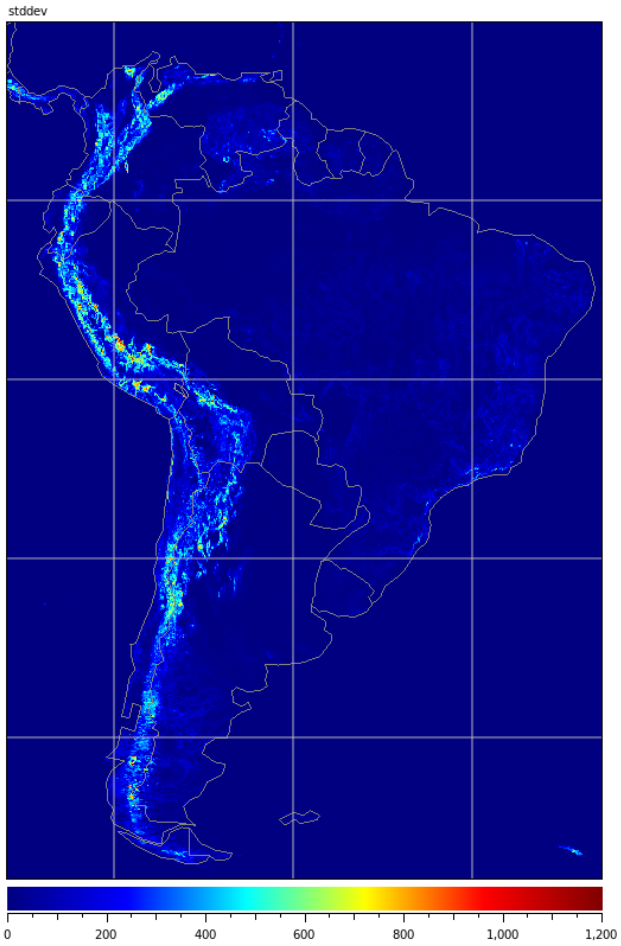
BAD GMTED POINT IN LAKE SUPERIOR (ALSO IN CASPIAN SEA). EASILY FIXABLE.

Terrain Standard Deviation

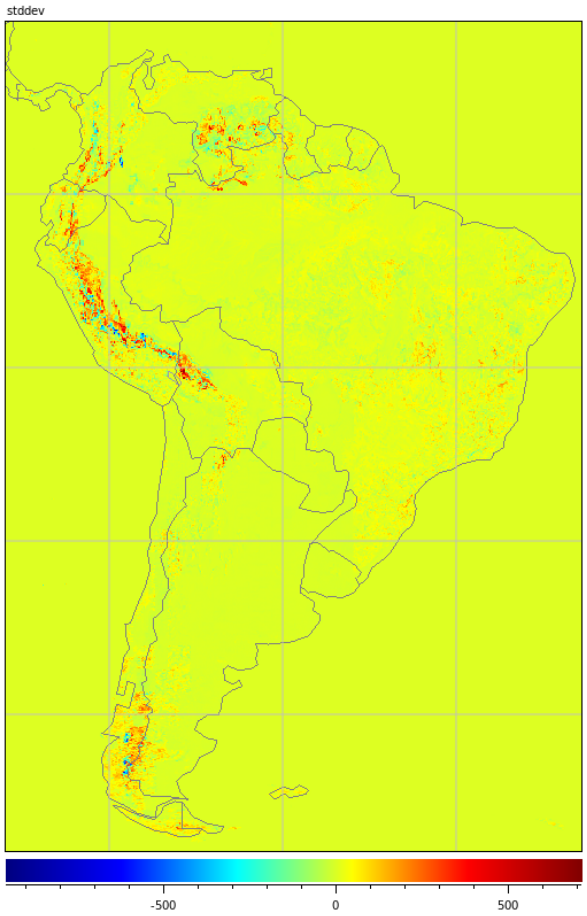
GMTED2010



GTOPO30



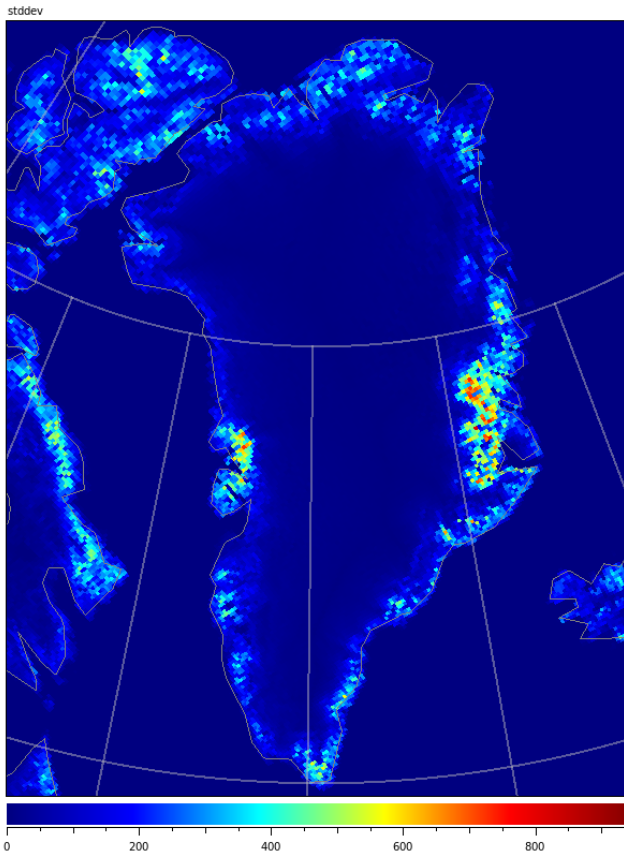
GMTED MINUS GTOPO



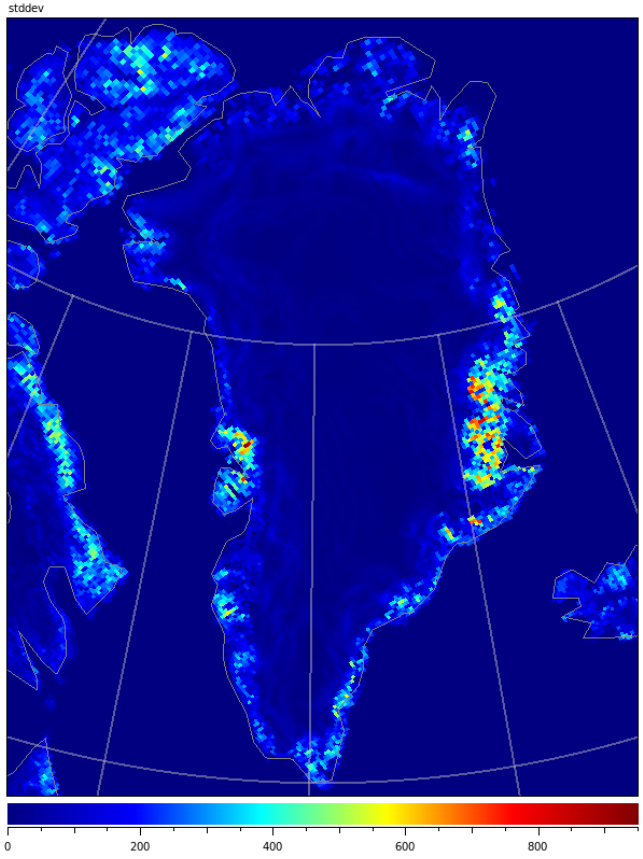
ORANGE/RED INDICATES TERRAIN MORE VARIABLE WITHIN GRID CELL.

Terrain Standard Deviation

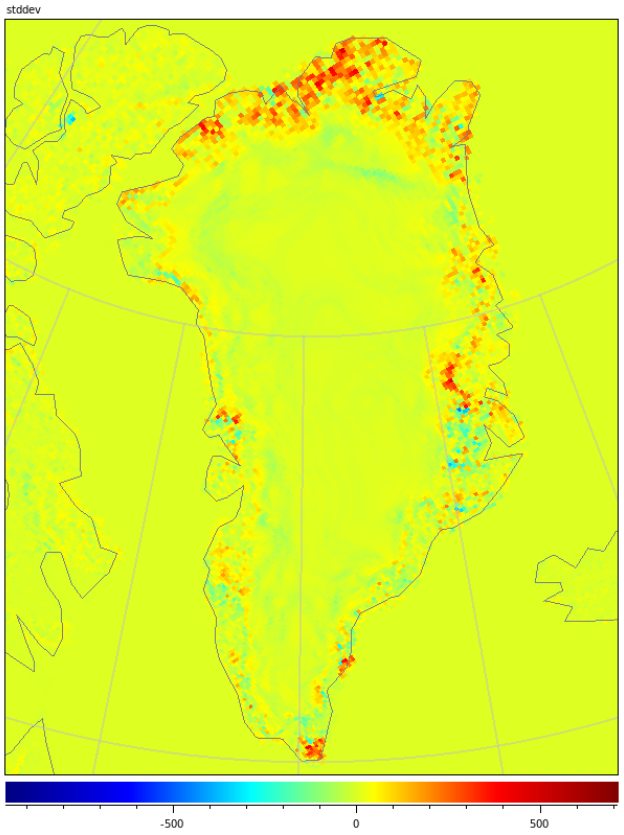
GMTED2010



GTOPO30



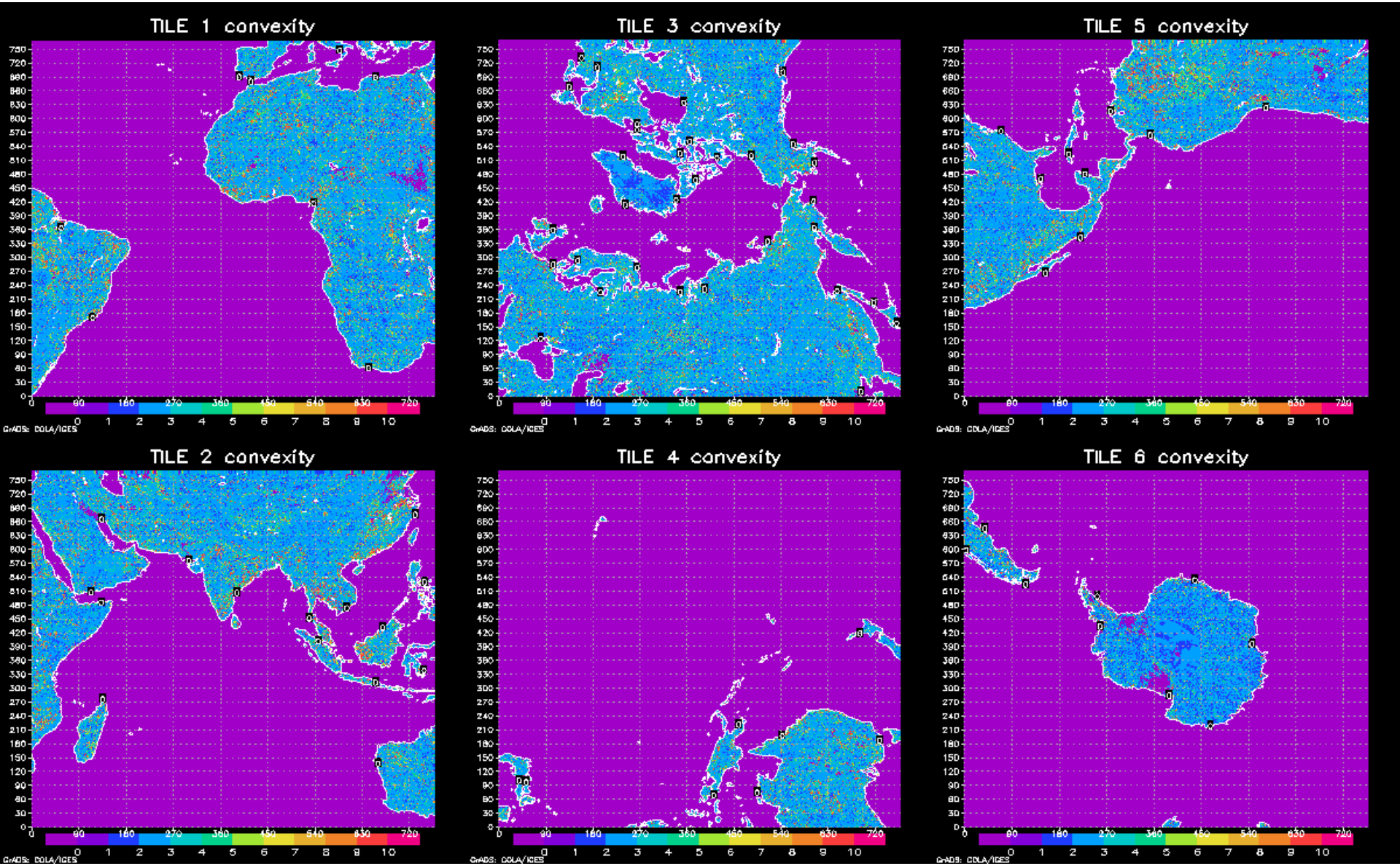
GMTED MINUS GTOPO



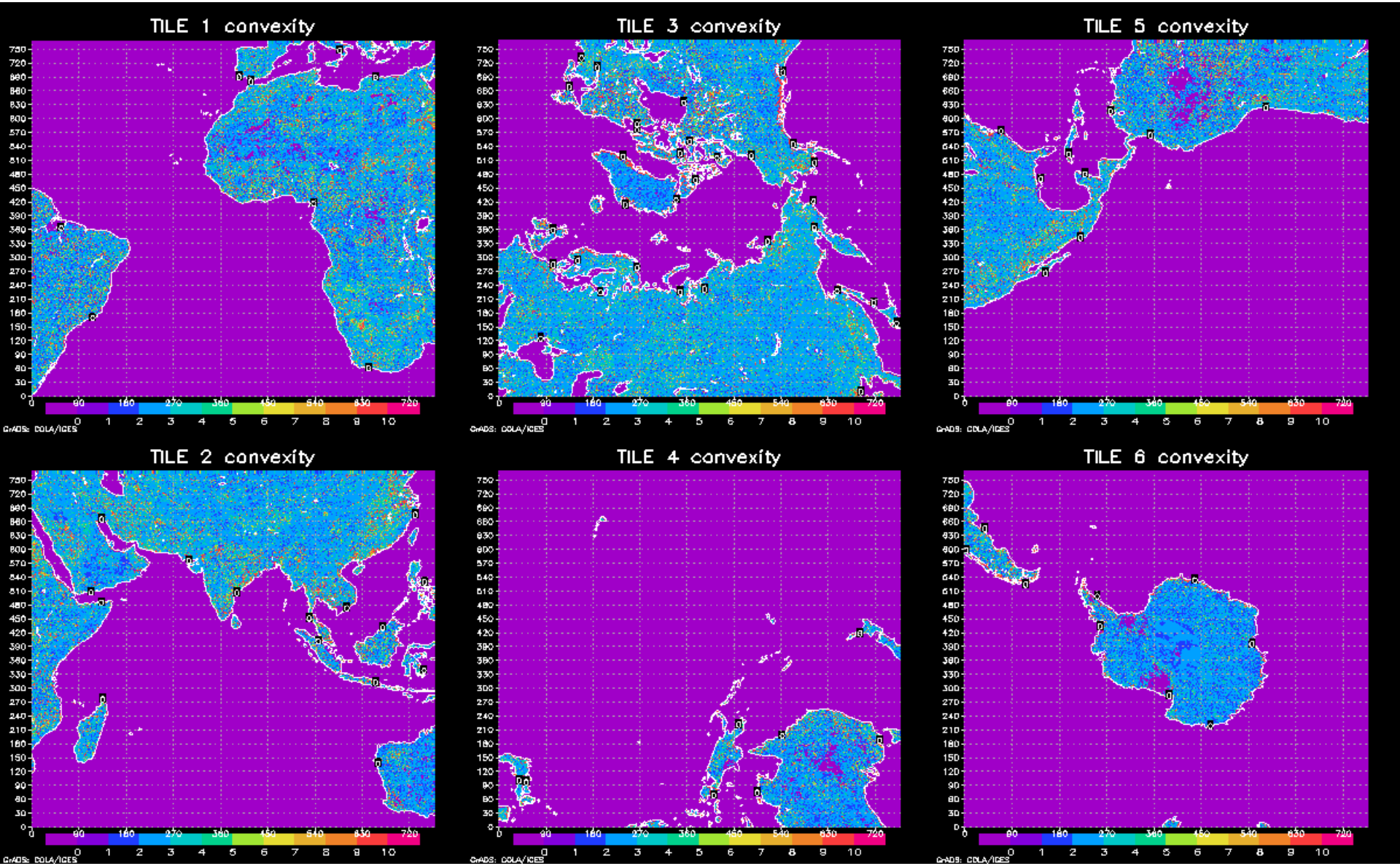
QUESTIONS?

EXTRA SLIDES

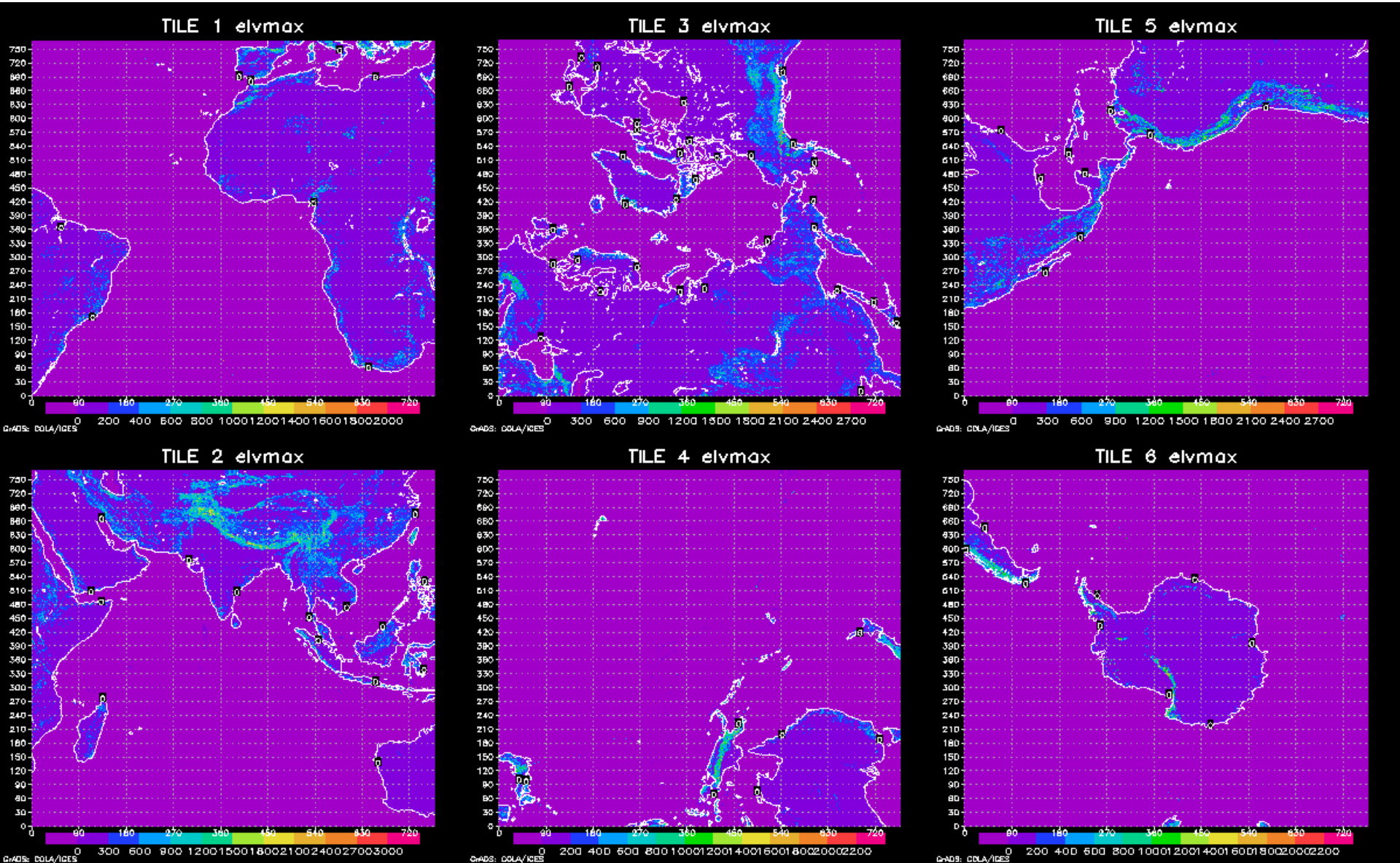
CONVEXITY – GMTED2010



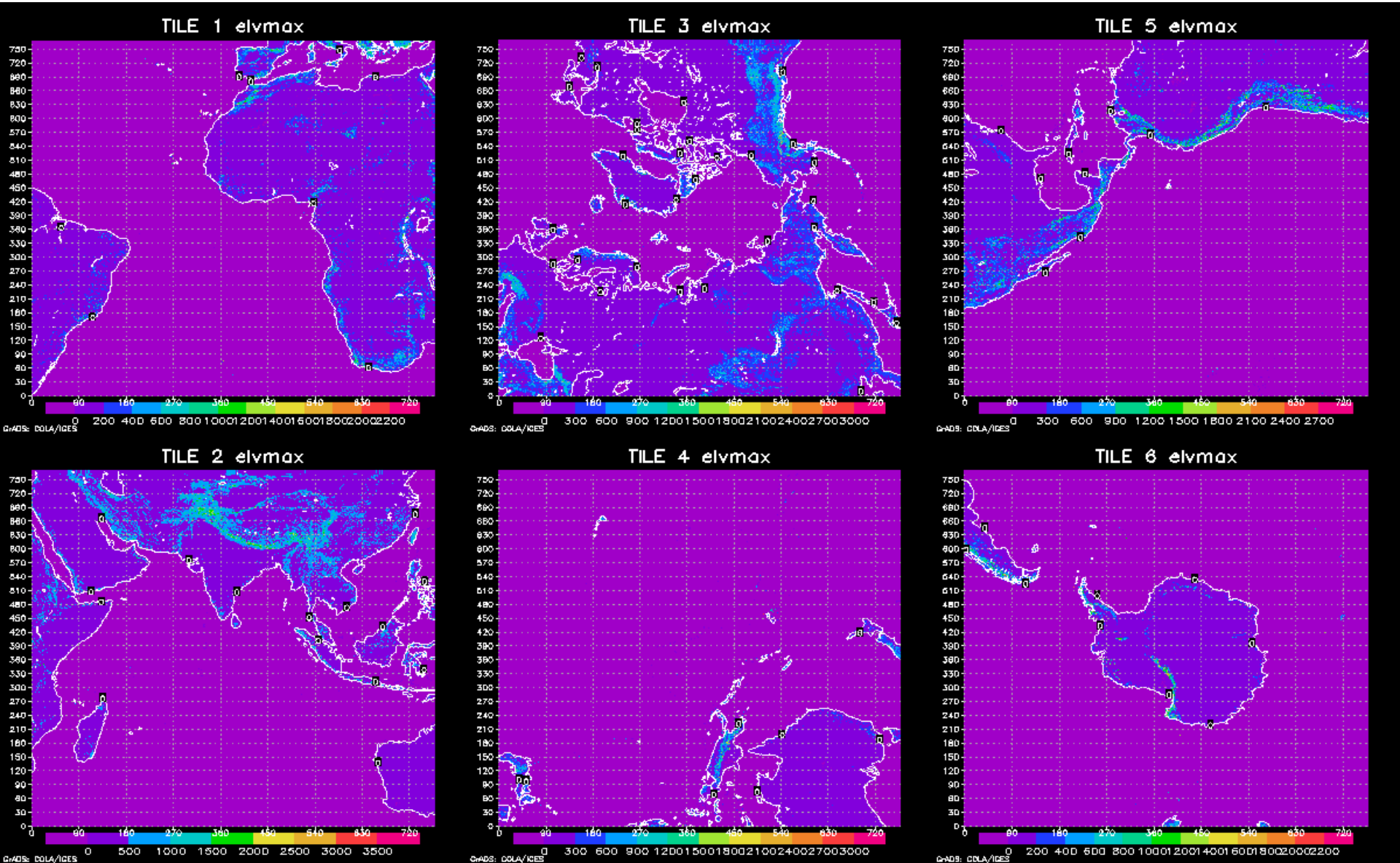
CONVEXITY – GTOPO30



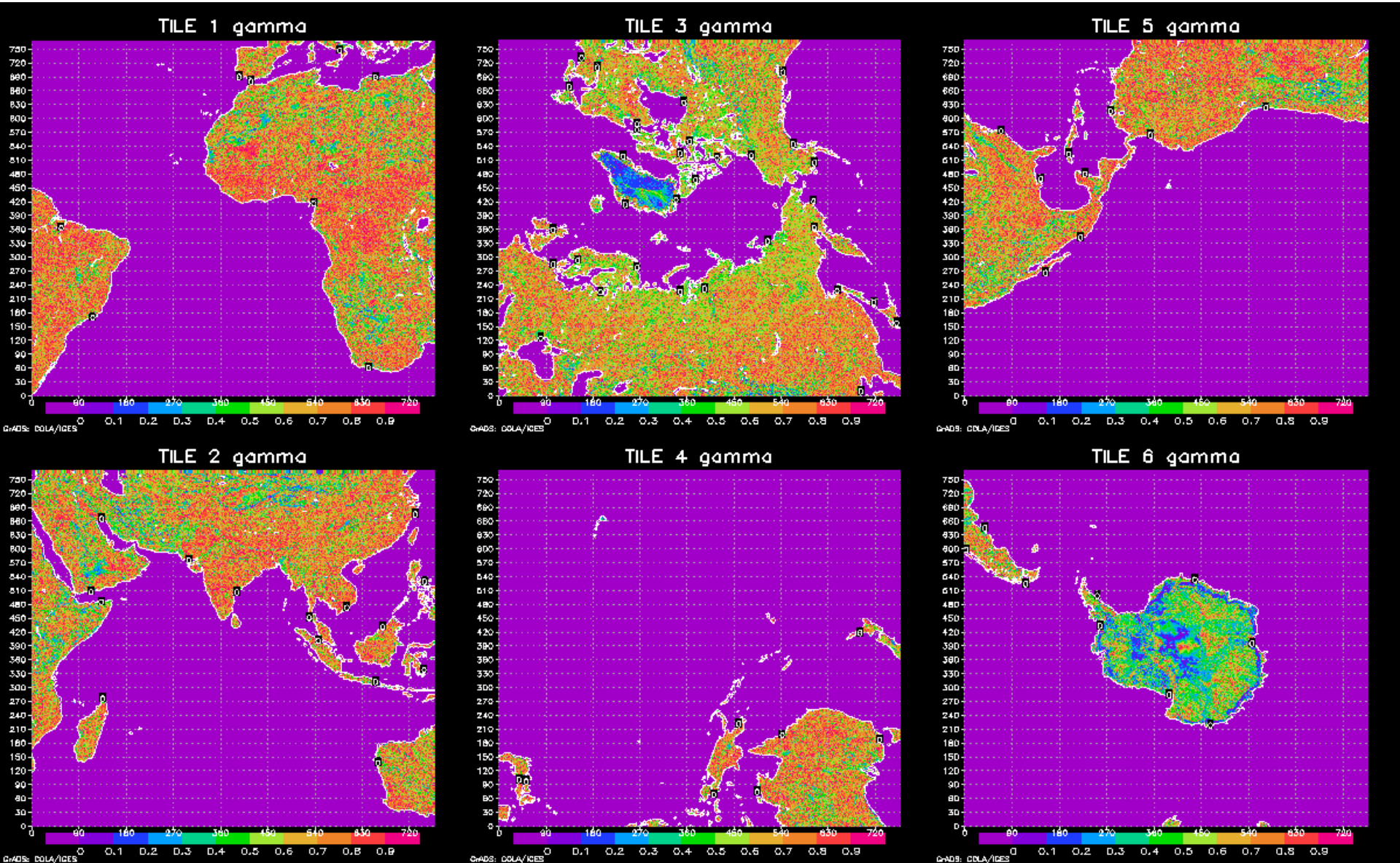
ELVMAX – GMTED2010



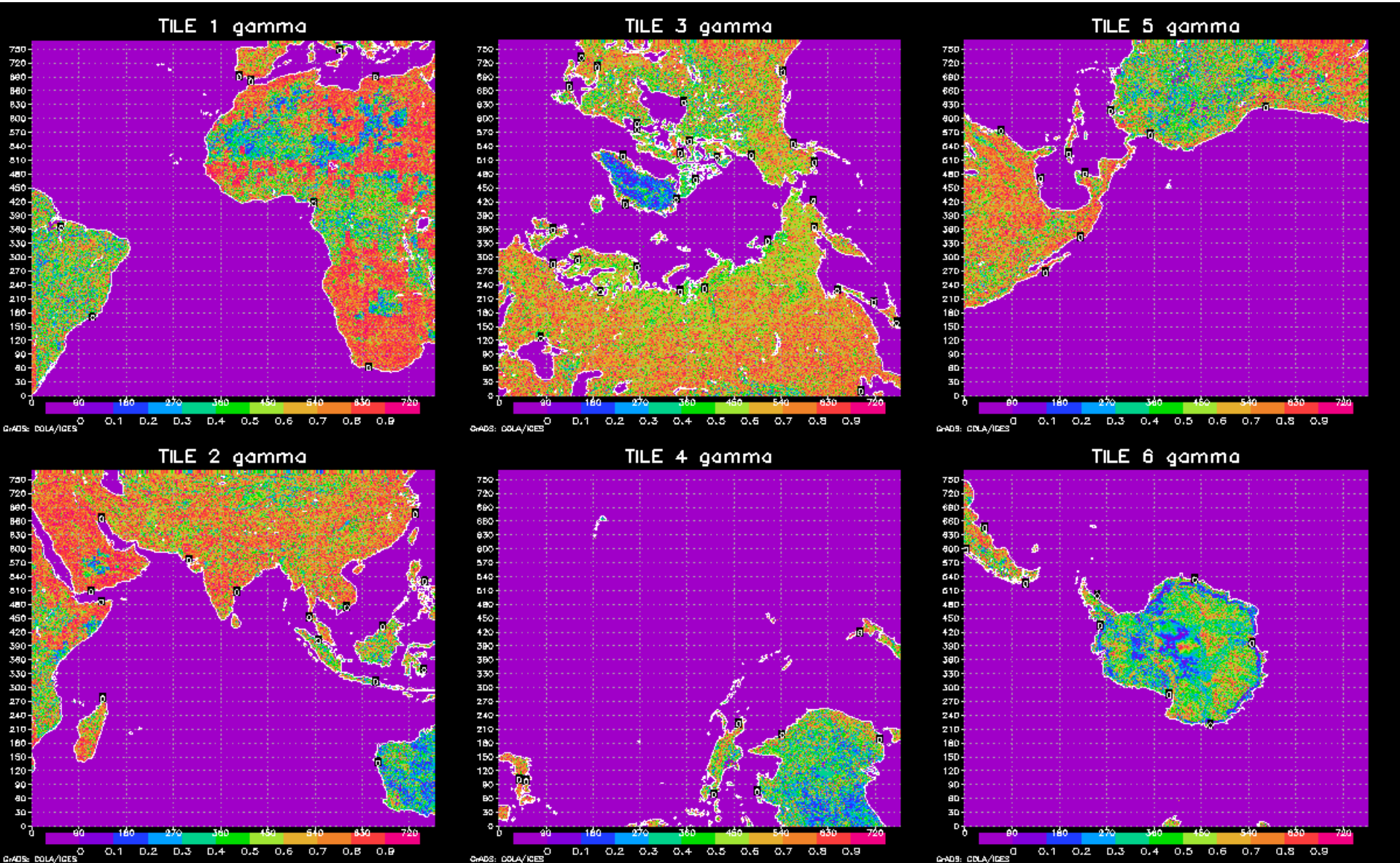
ELVMAX – GTOPO30



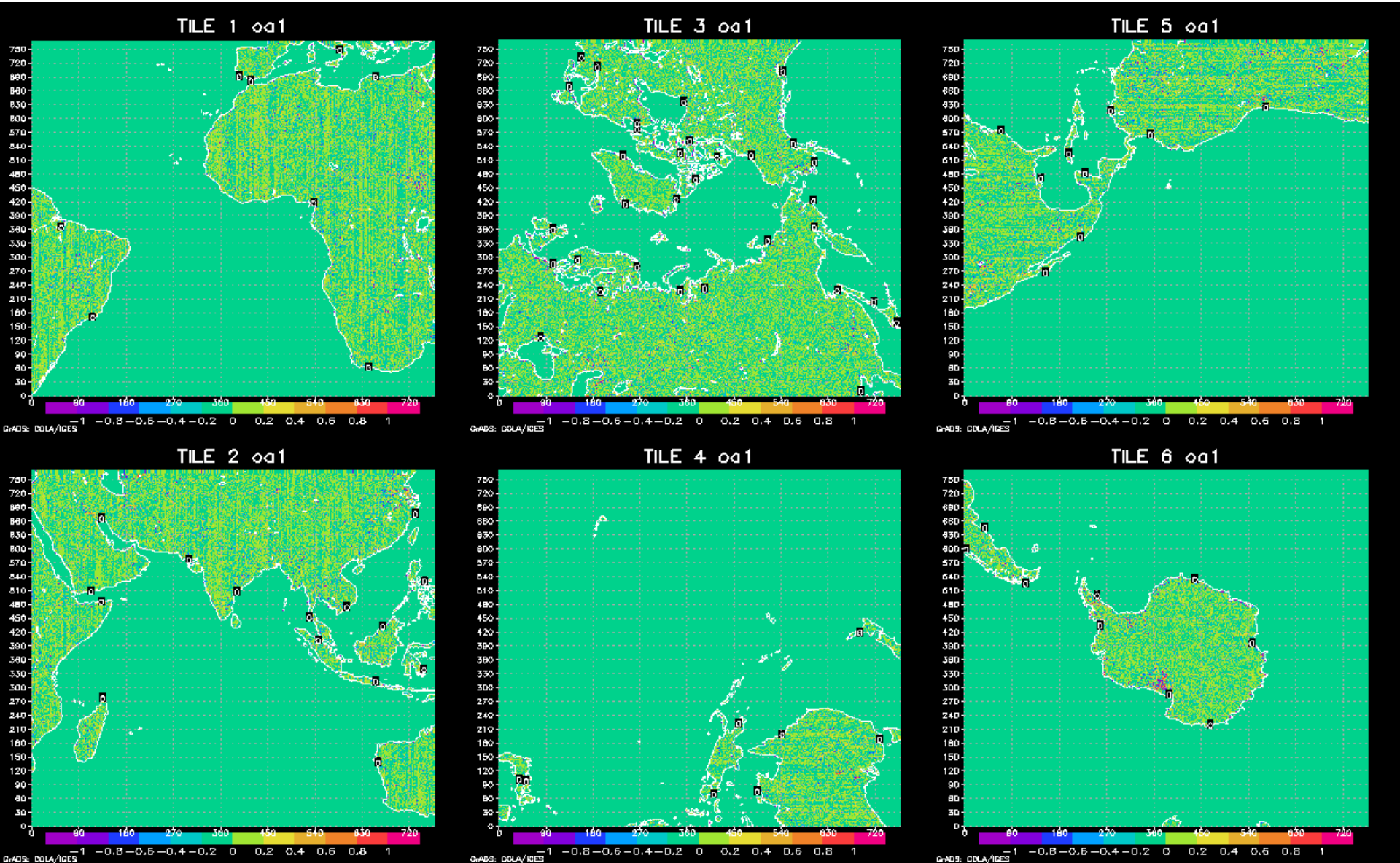
GAMMA – GMTED2010



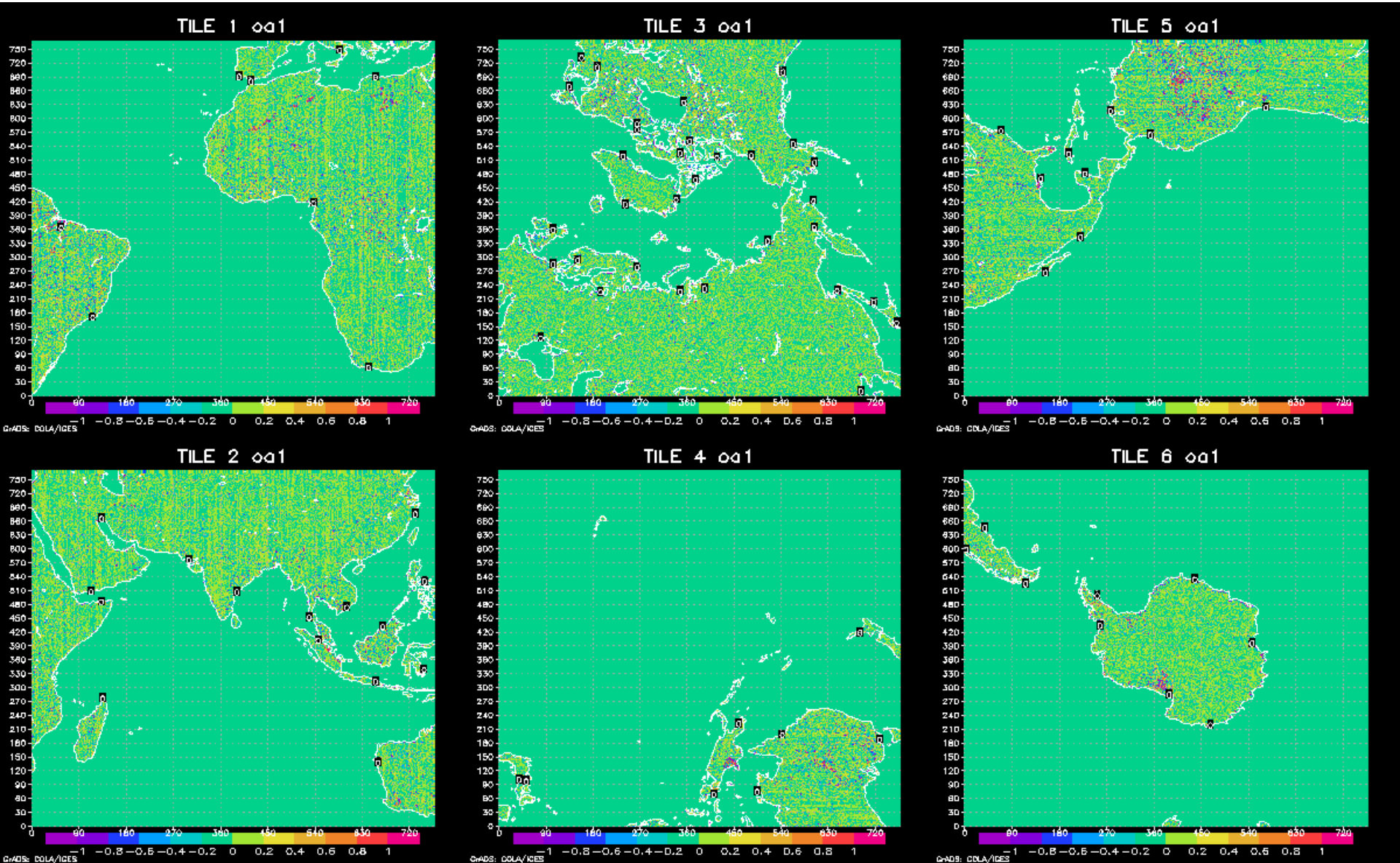
GAMMA – GTOPO30



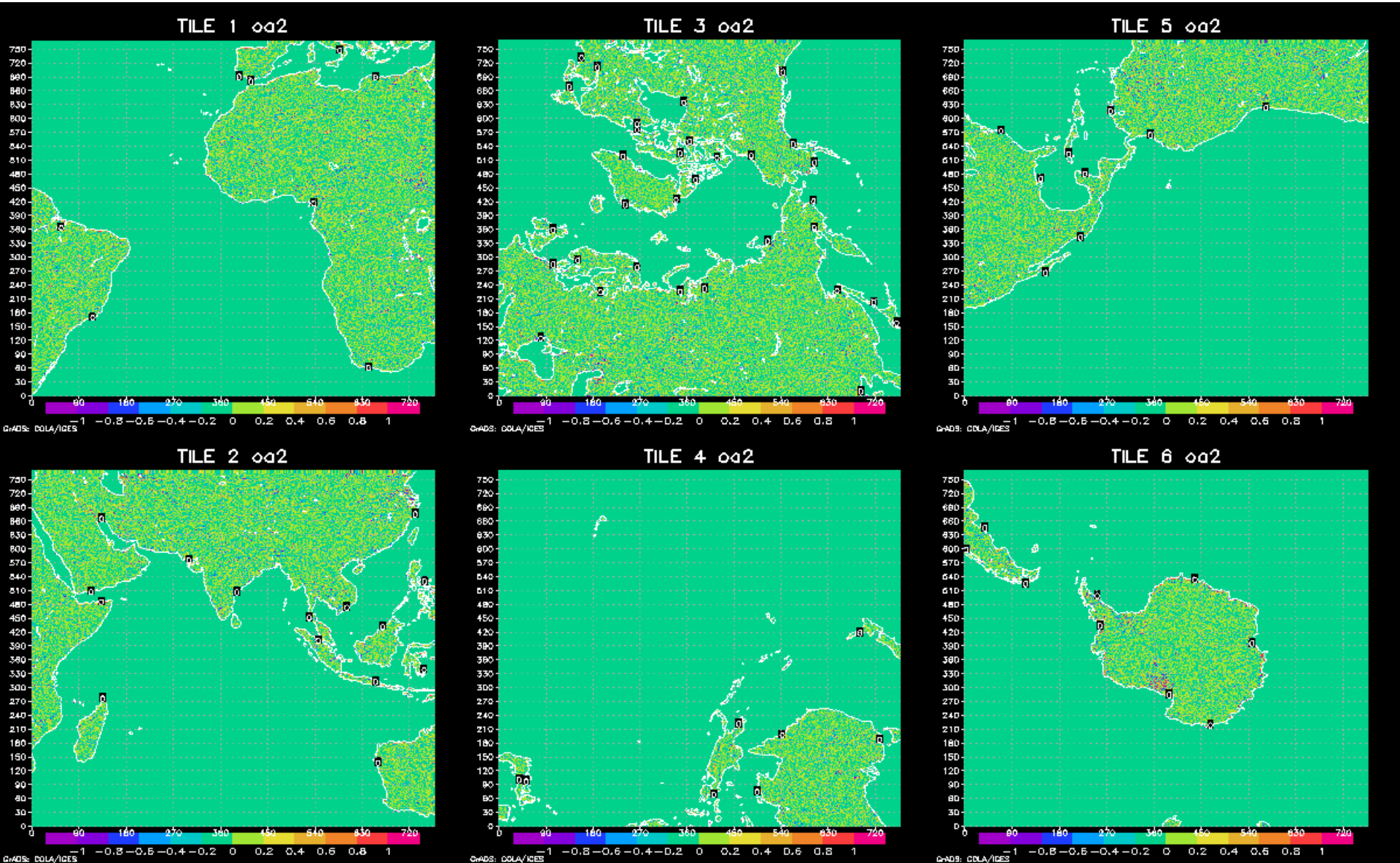
OA1 – GMTED2010



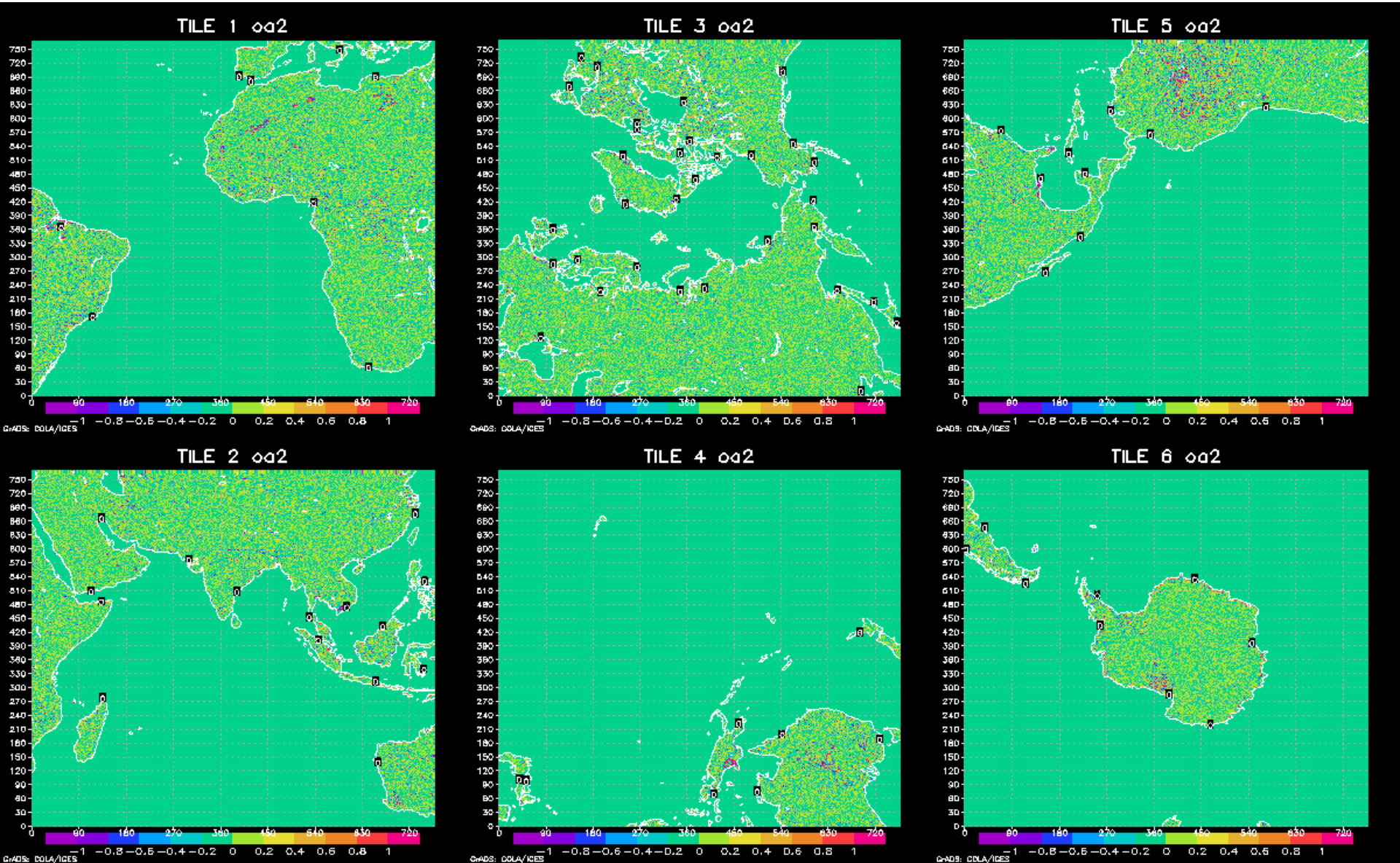
OA1 – GTOPO30



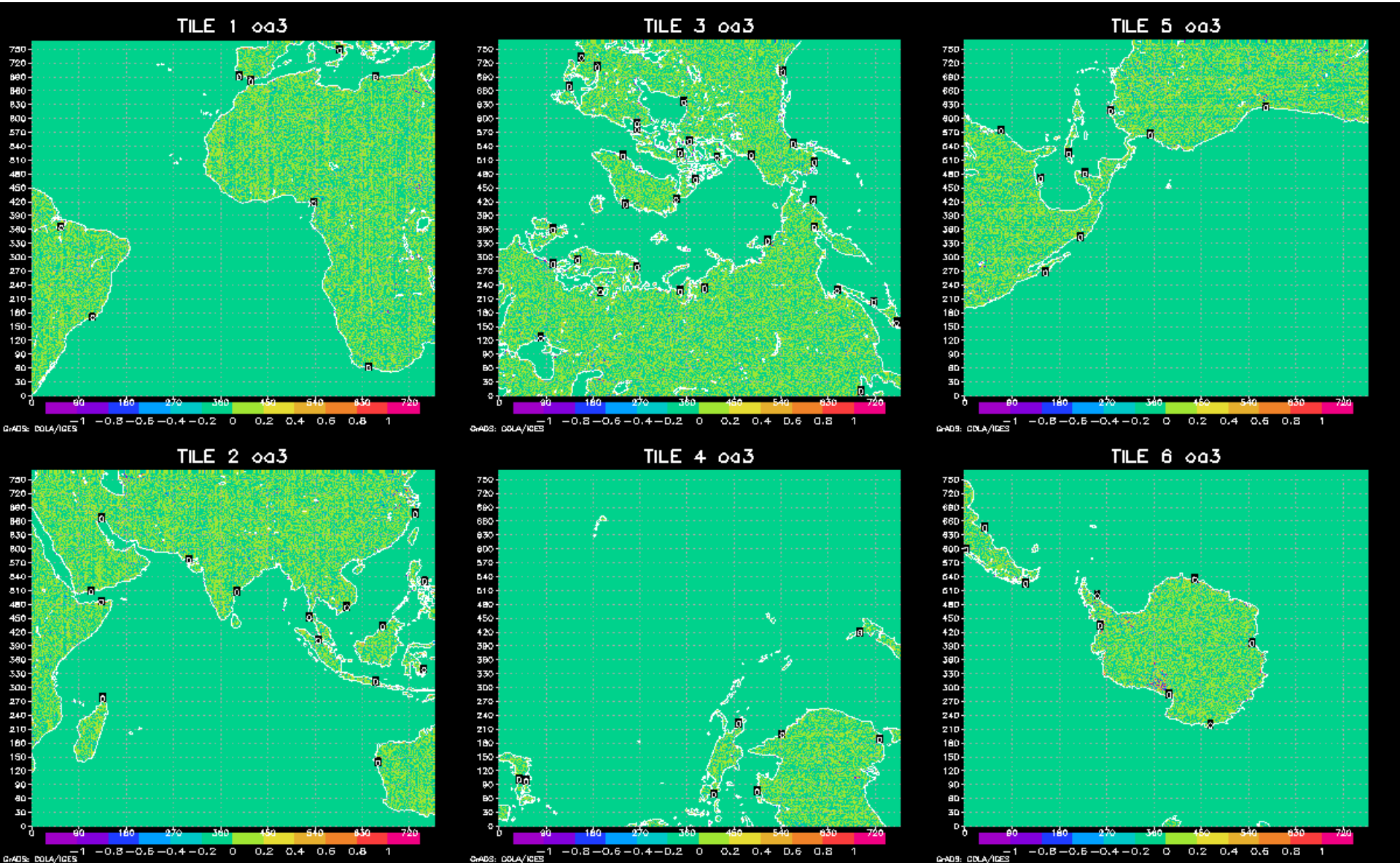
OA2 – GMTED2010



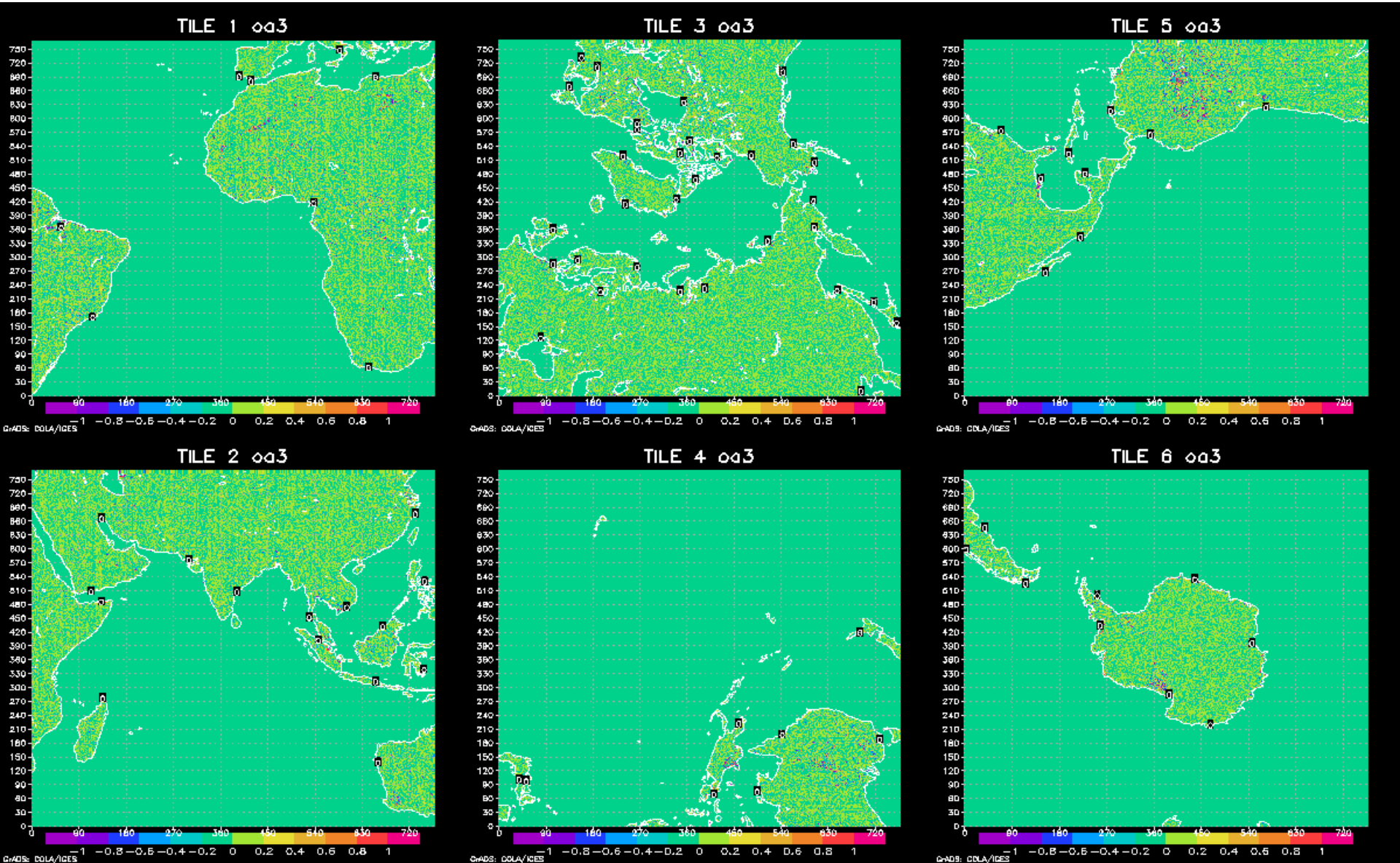
OA2 – GTOPO30



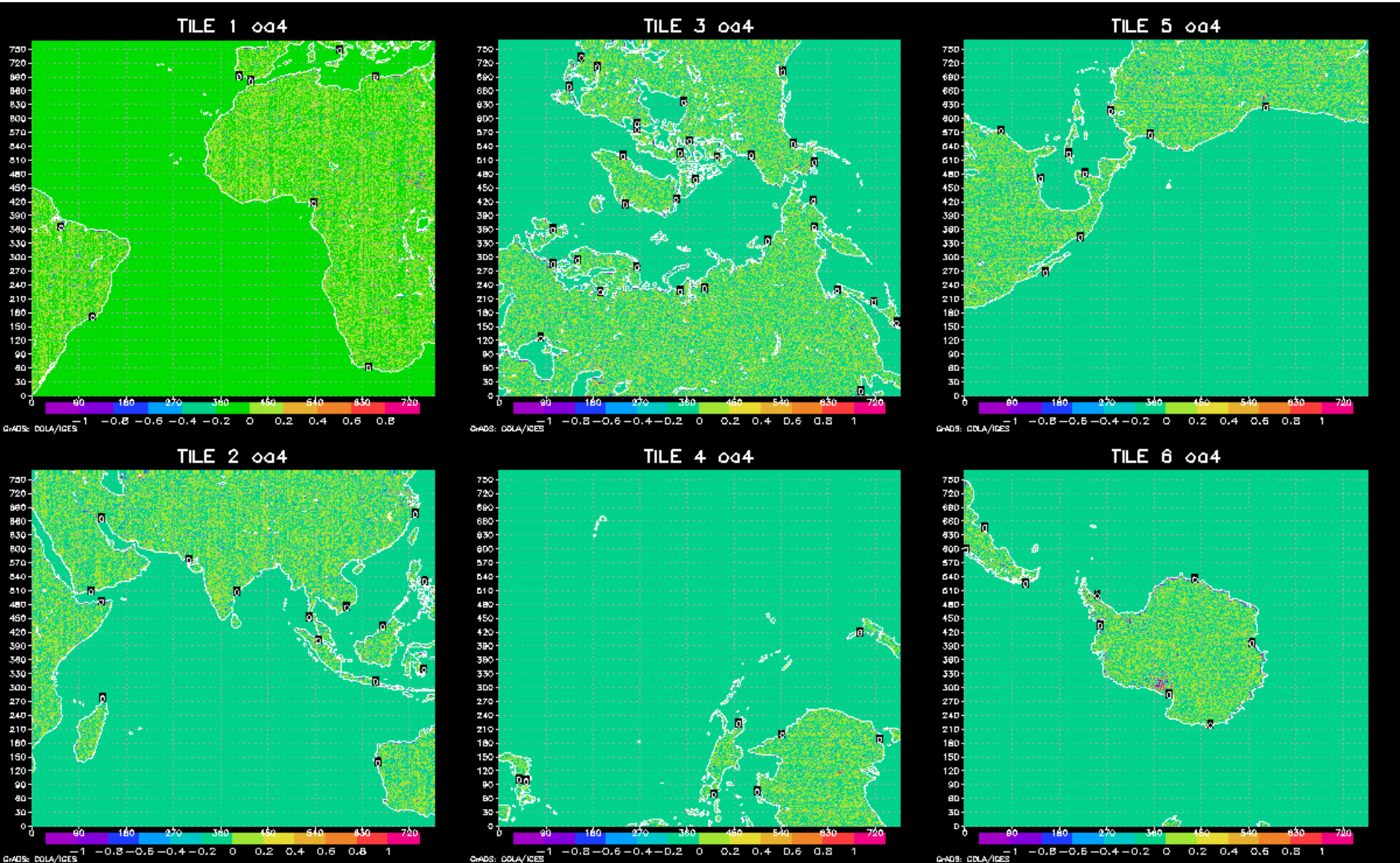
OA3 – GMTED2010



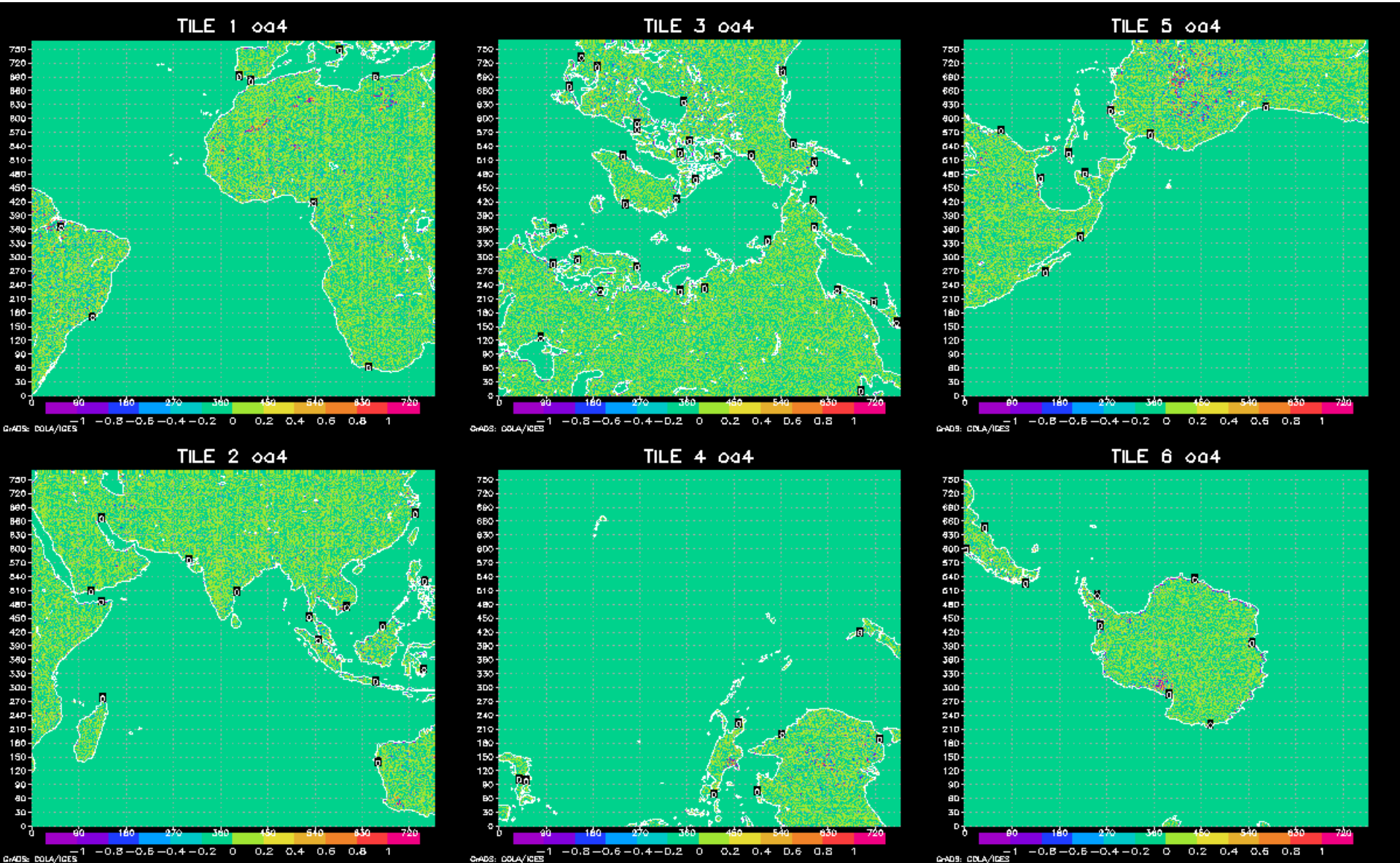
OA3 – GTOPO30



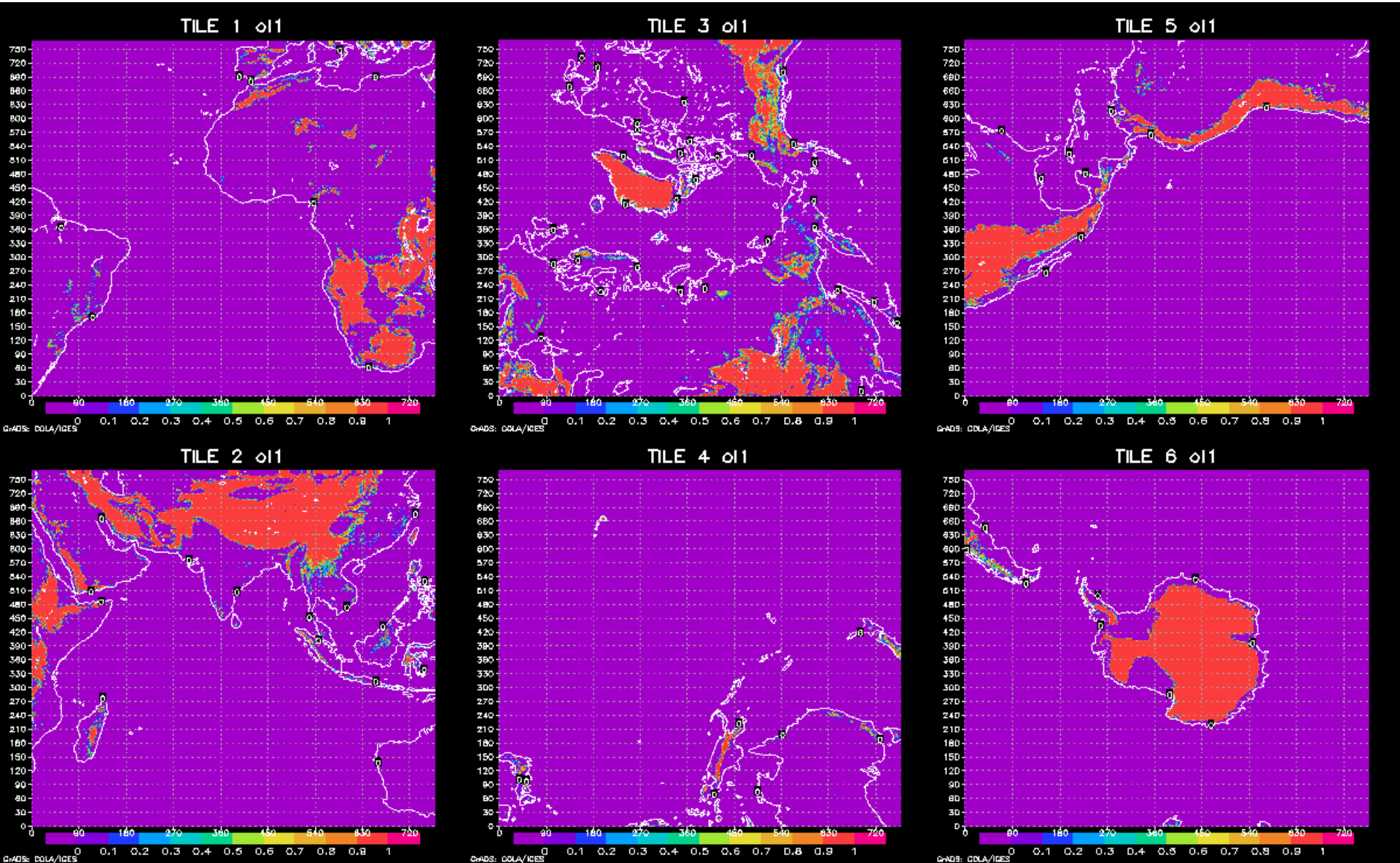
OA4 – GMTED2010



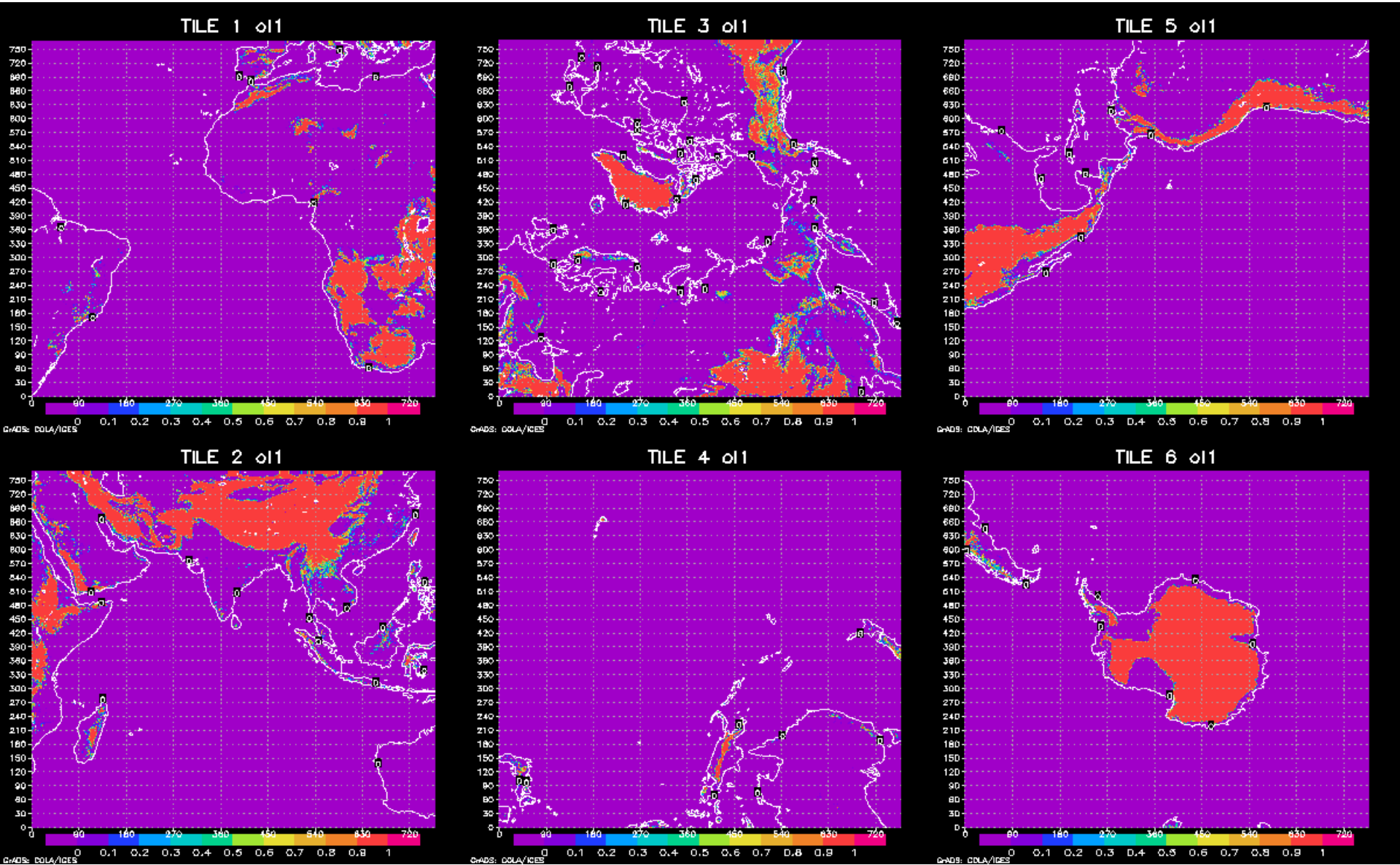
OA4 – GTOPO30



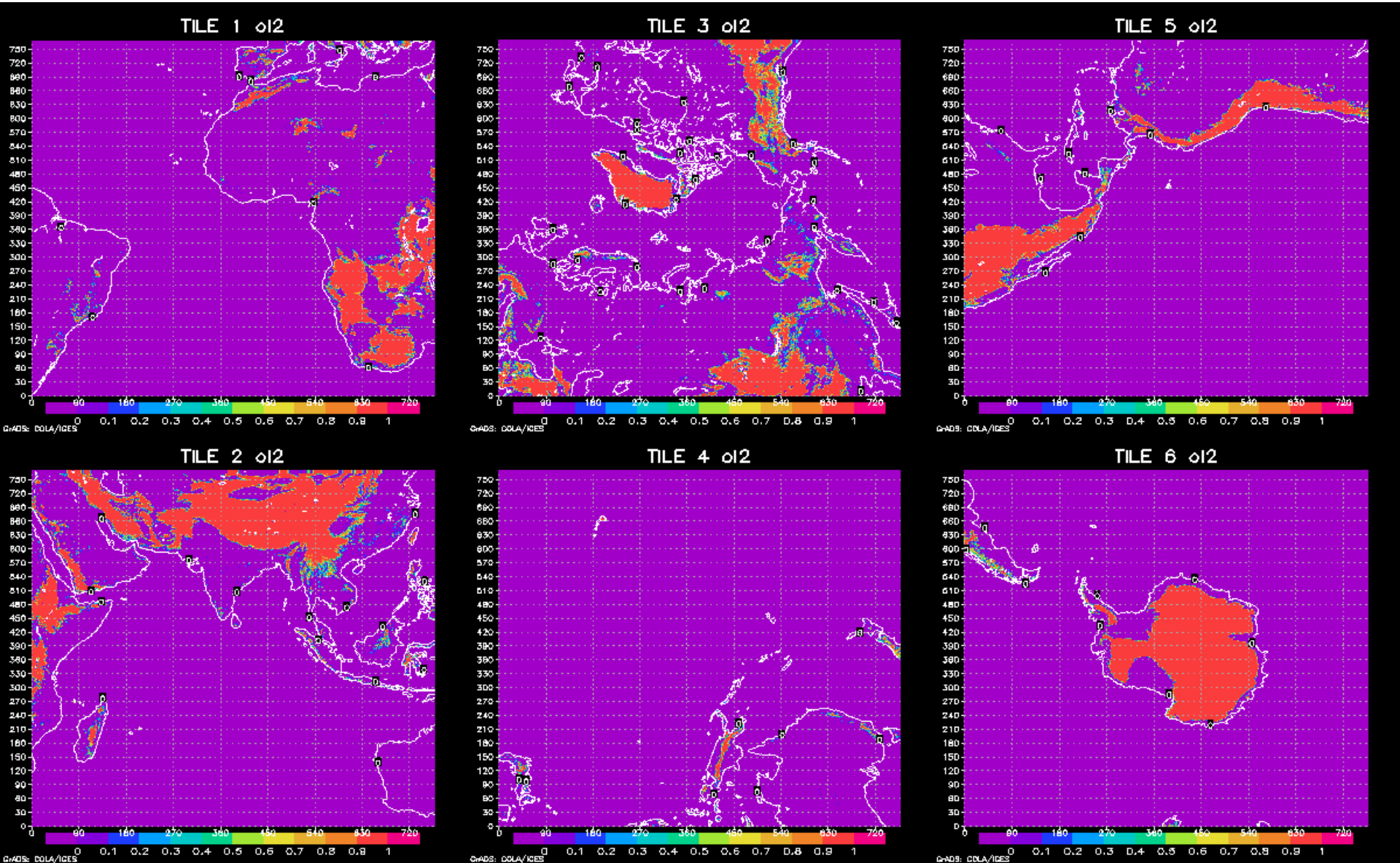
OL1 – GMTED2010



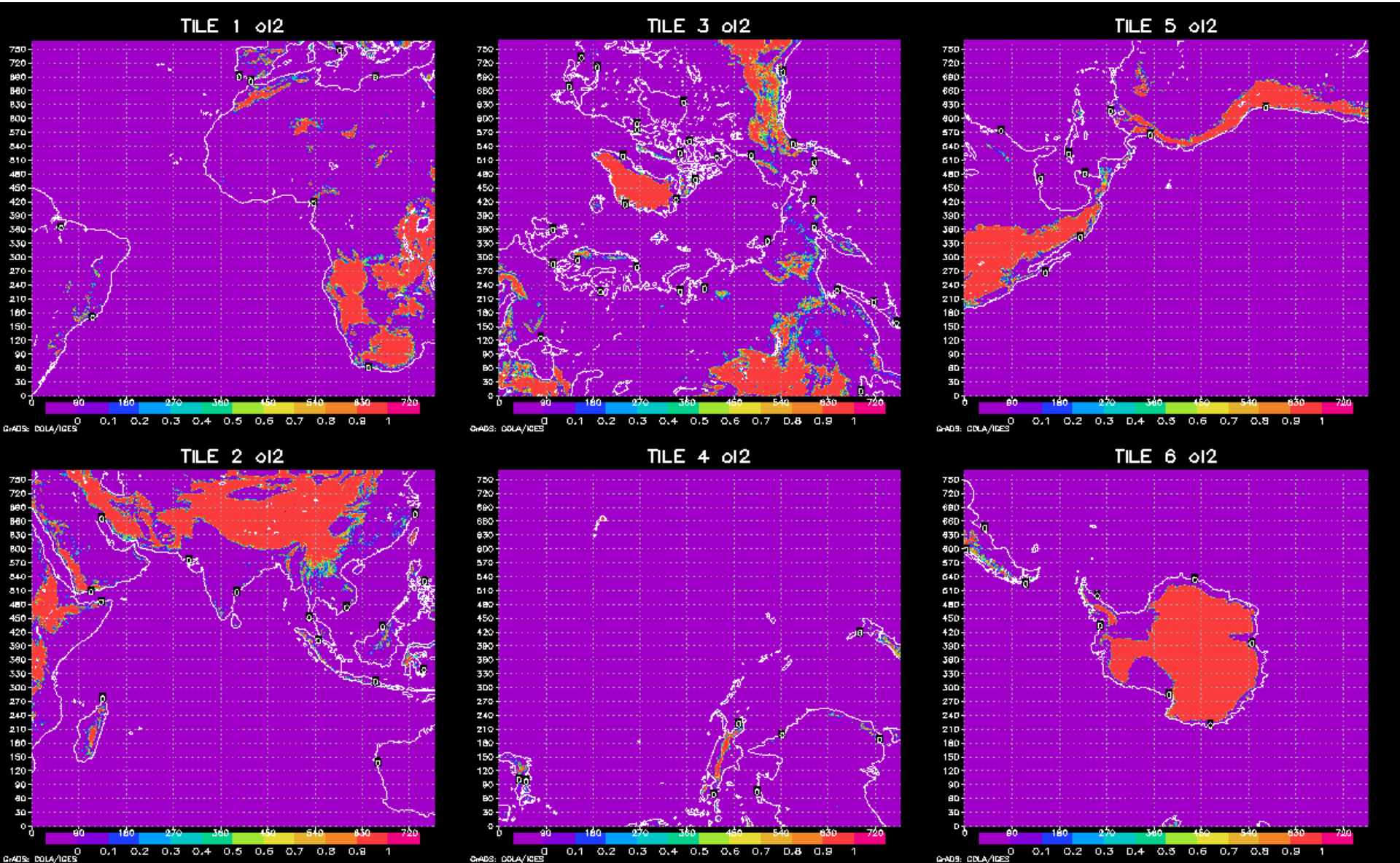
OL1 – GTOPO30


TILE 1 ol1
TILE 3 ol1
TILE 5 ol1
TILE 2 ol1
TILE 4 ol1
TILE 6 ol1
GrADS: COLA/ICES

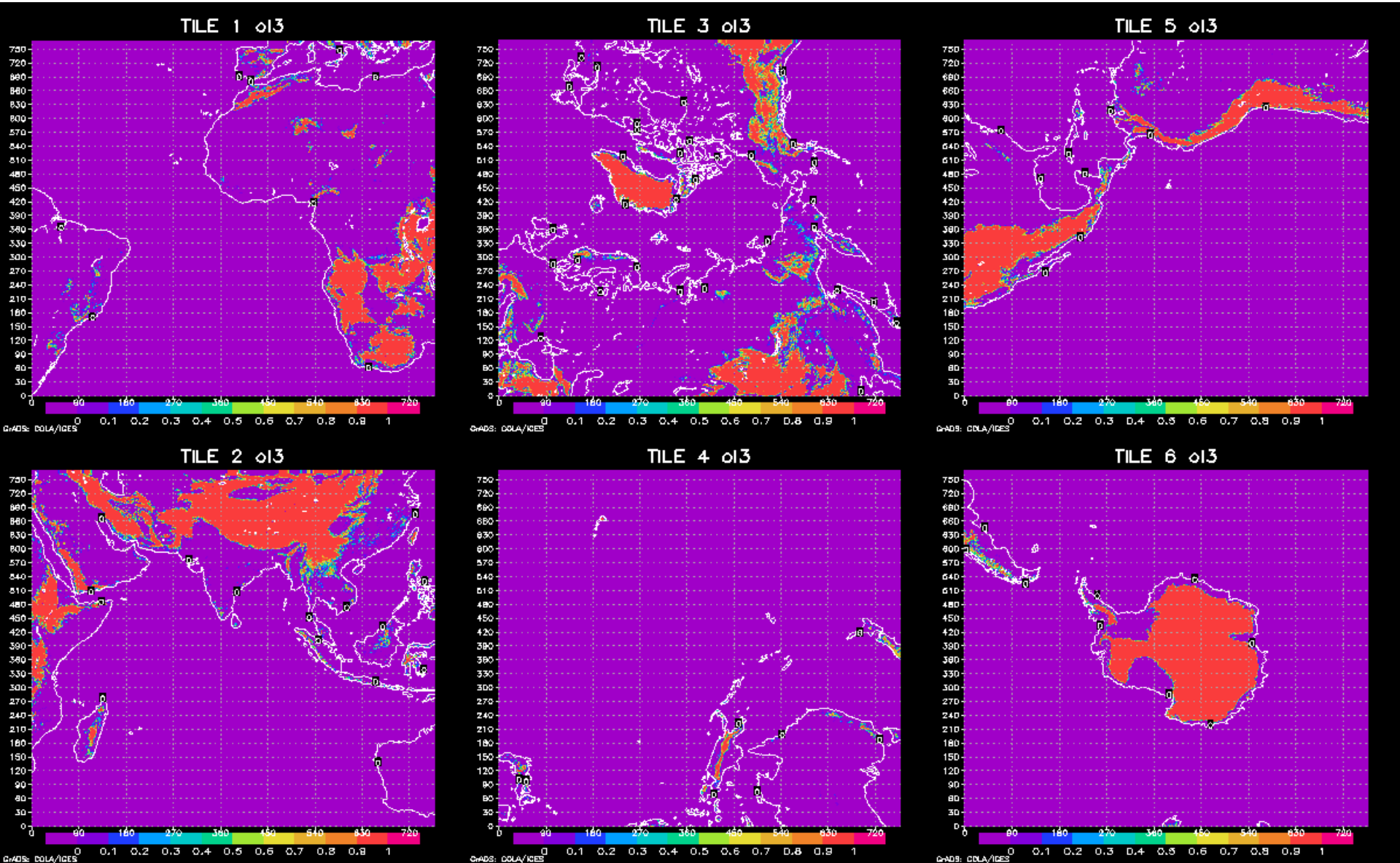
OL2 – GMTED2010



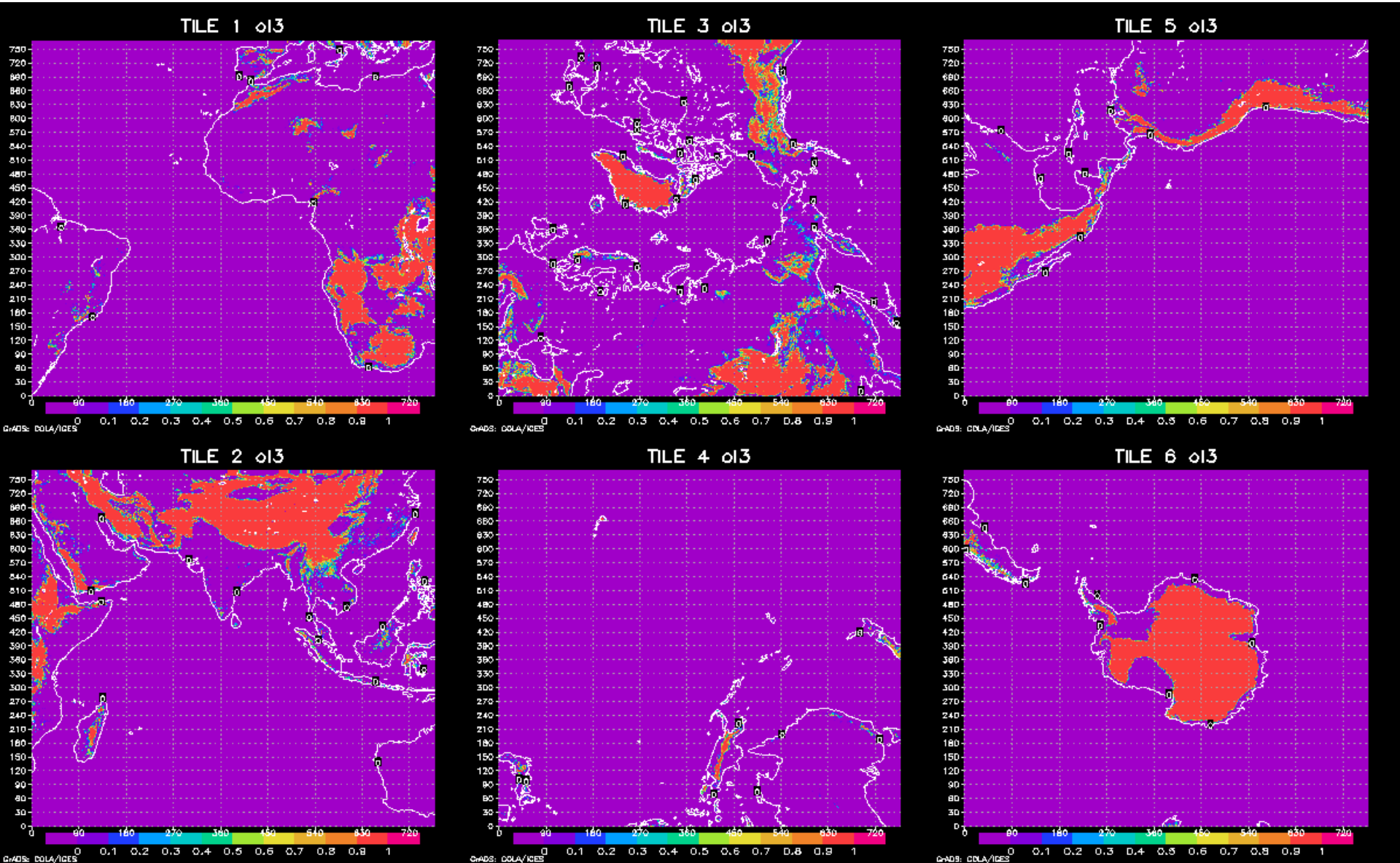
OL2 – GTOPO30


TILE 1 ol2
TILE 3 ol2
TILE 5 ol2
TILE 2 ol2
TILE 4 ol2
TILE 6 ol2
GrADS: COLA/IGES

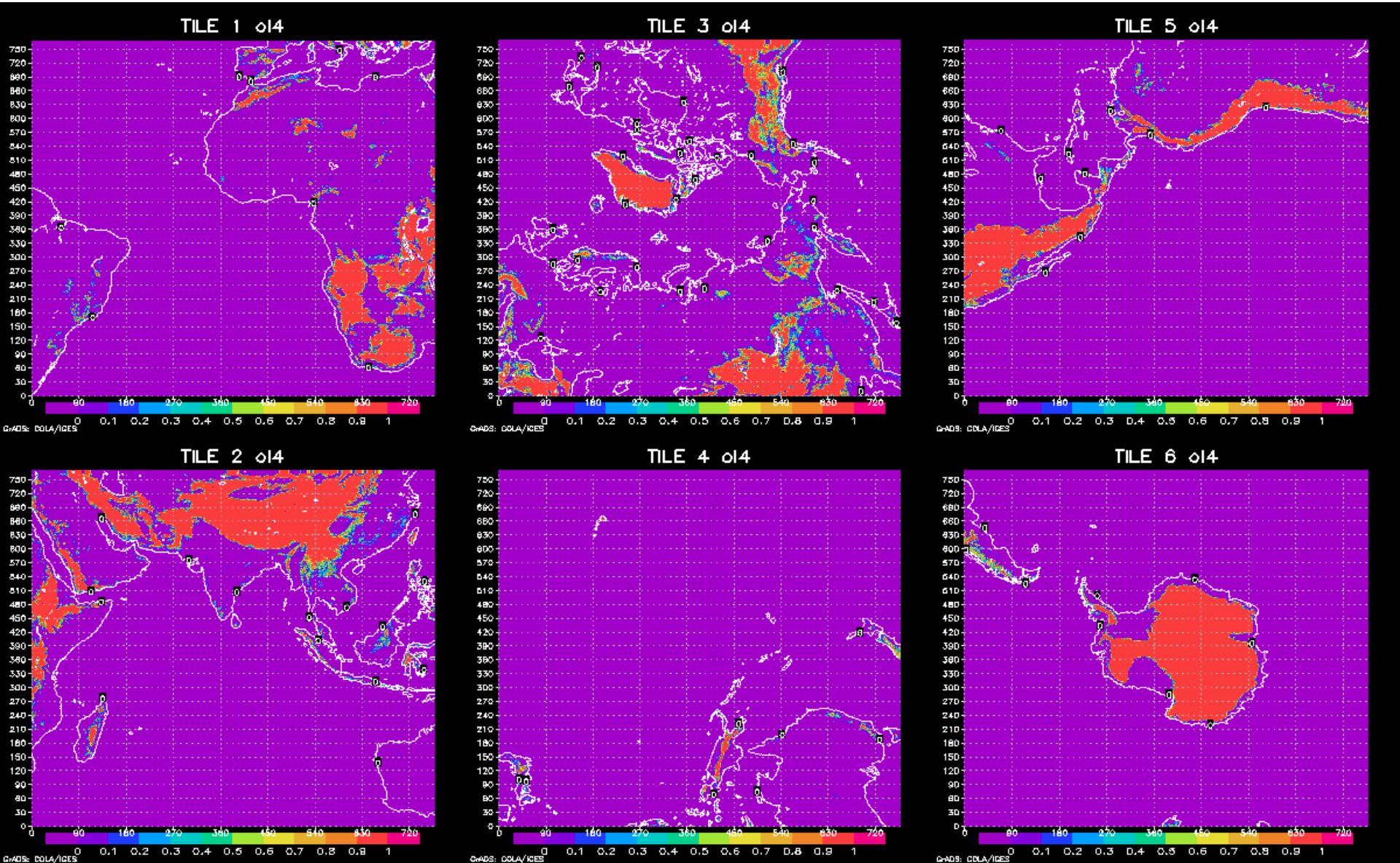
OL3 – GMTED2010



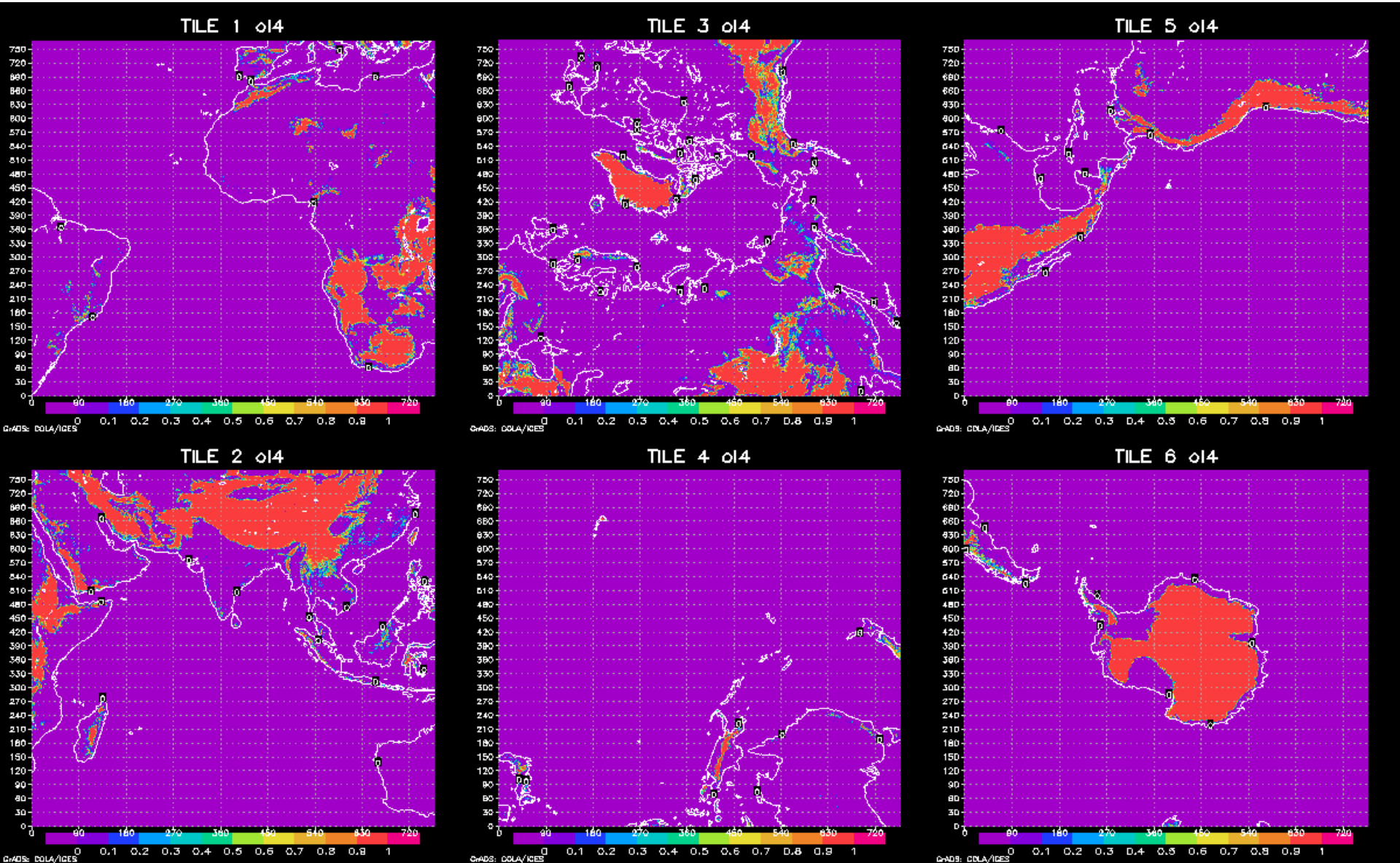
OL3 – GTOPO30


TILE 1 ol3
TILE 3 ol3
TILE 5 ol3
TILE 2 ol3
TILE 4 ol3
TILE 6 ol3
GrADS: COLA/IGES

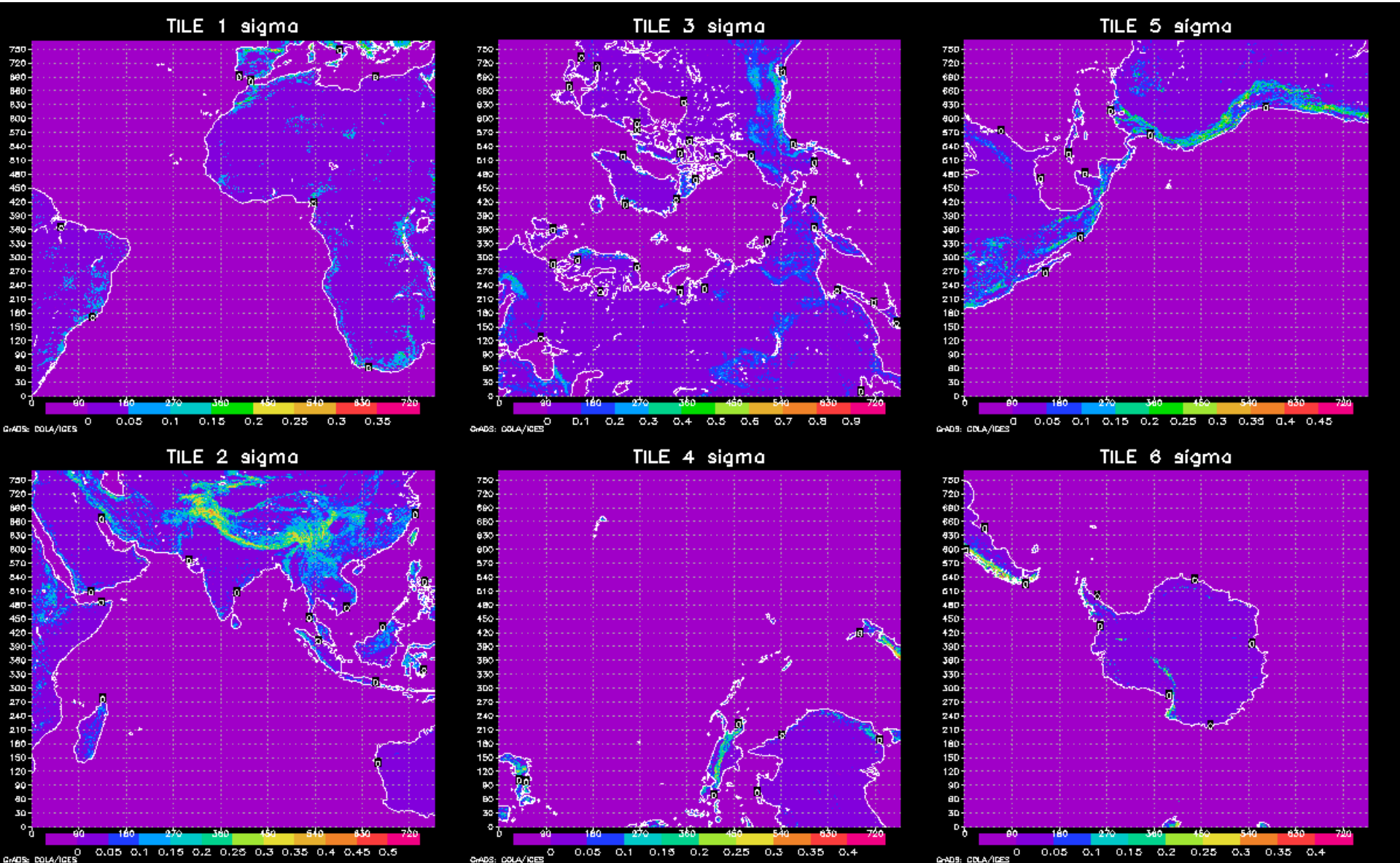
OL4 – GMTED2010



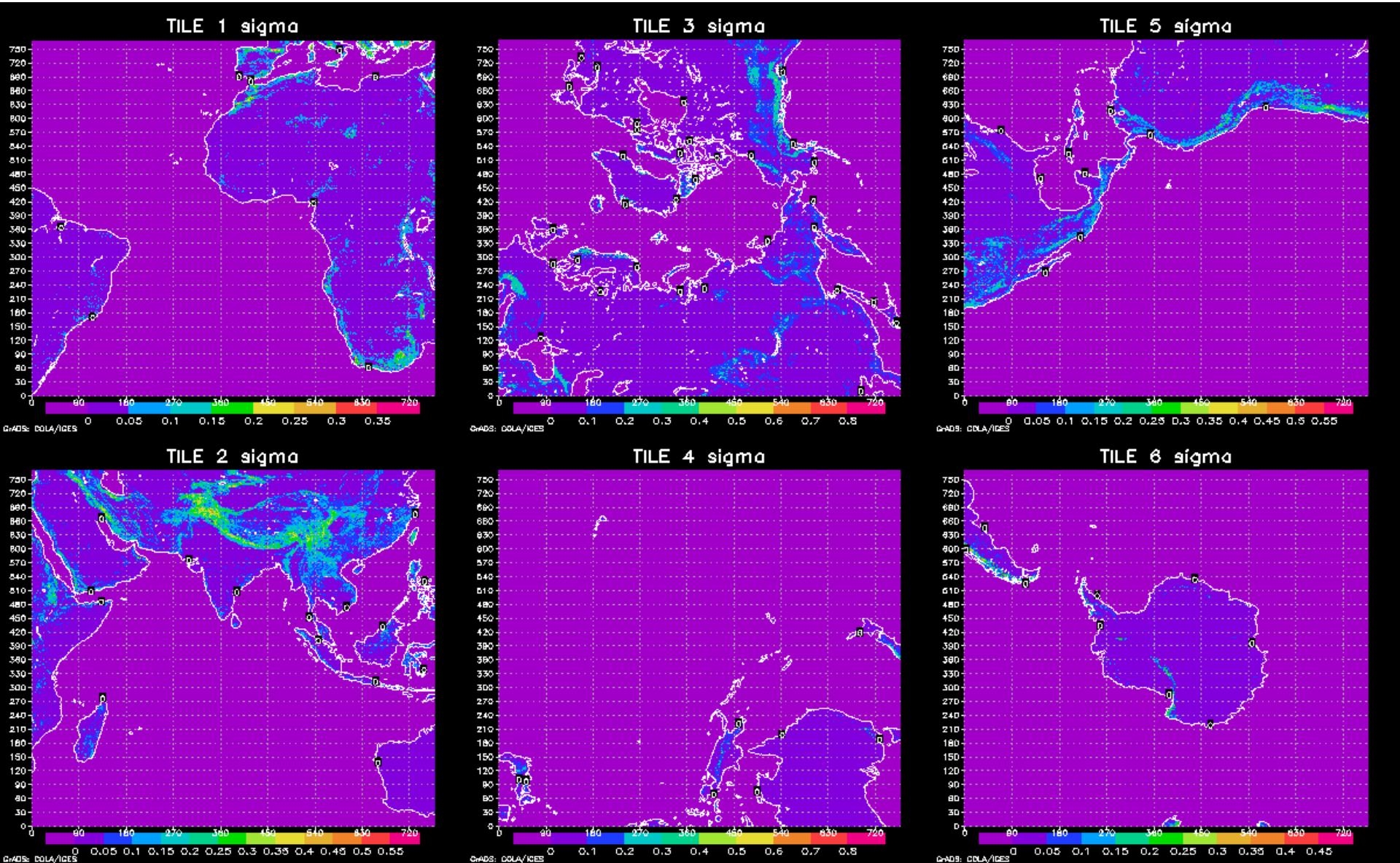
OL4 – GTOPO30


TILE 1 ol4
TILE 3 ol4
TILE 5 ol4
TILE 2 ol4
TILE 4 ol4
TILE 6 ol4
GrADS: COLA/IGES

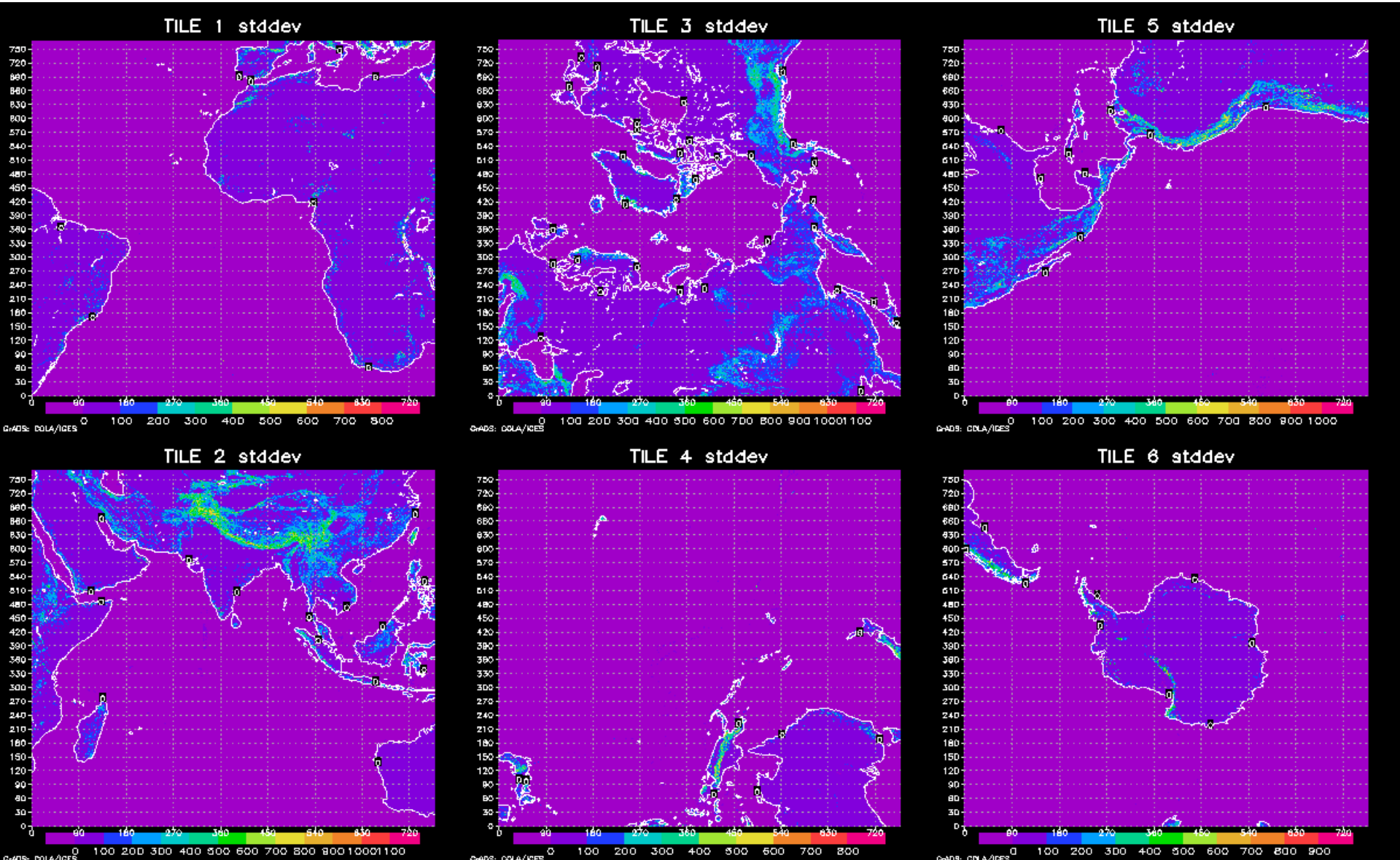
SIGMA – GMTED2010



SIGMA – GTOPO30



STDDEV – GMTED2010



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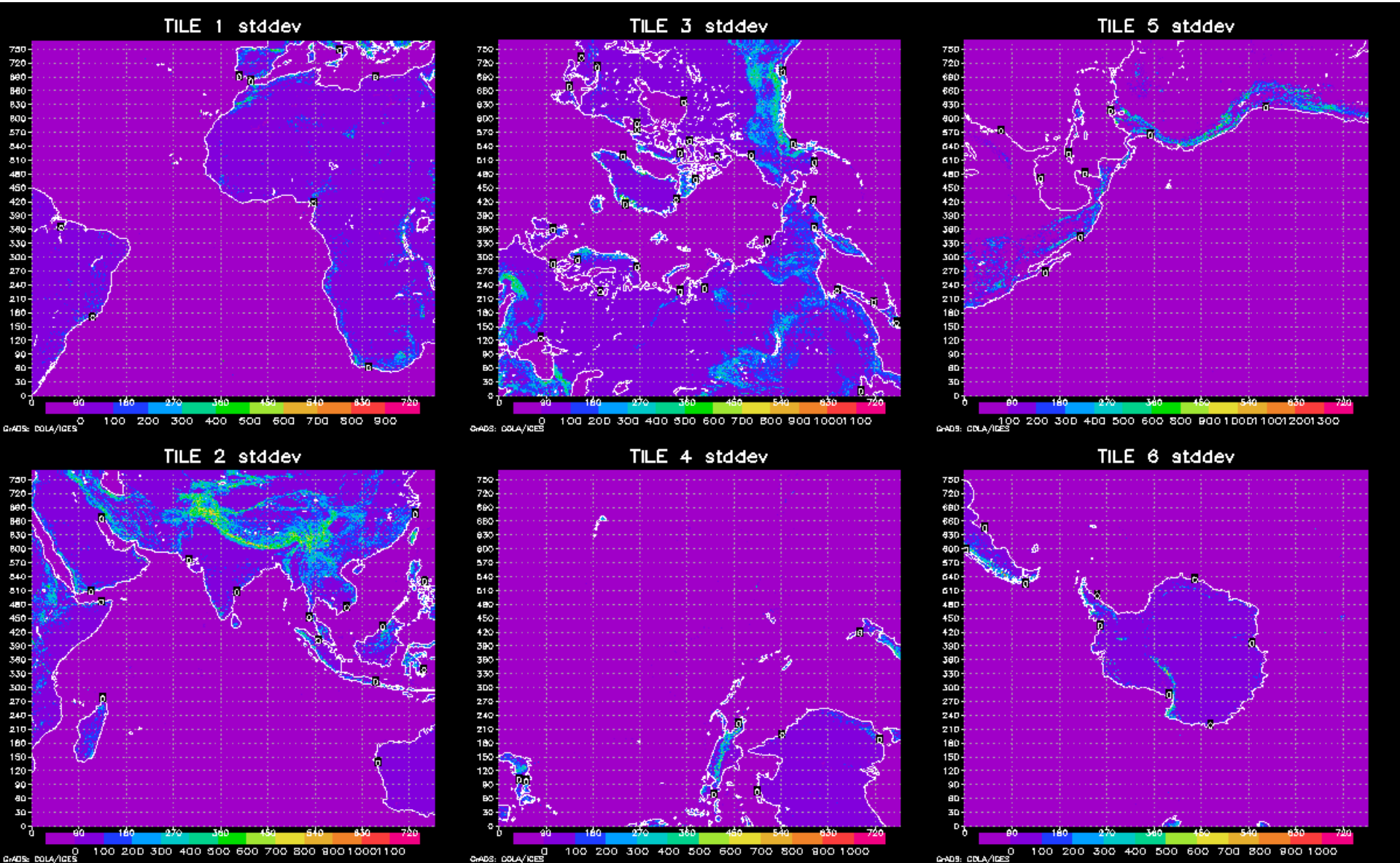

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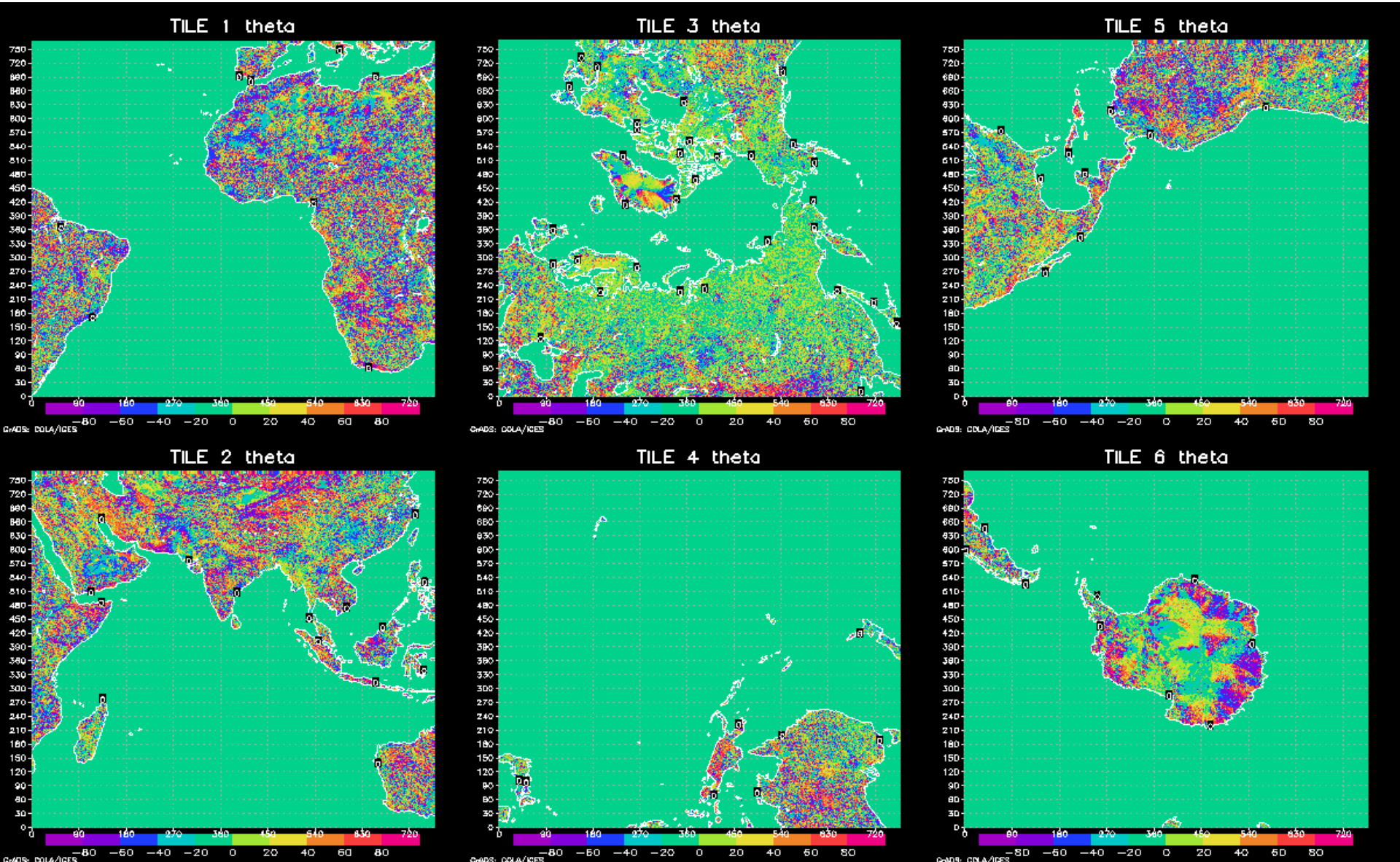
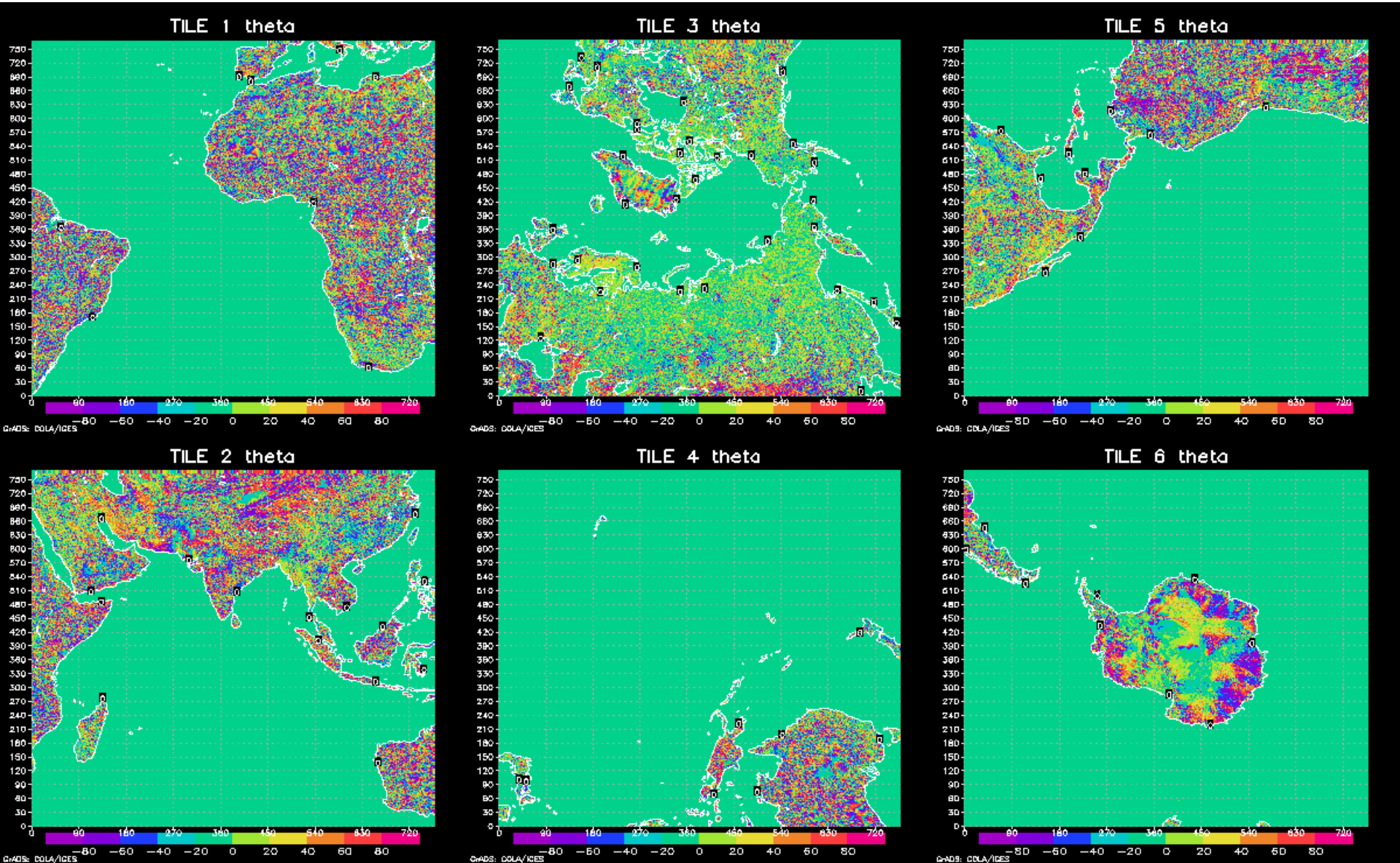
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