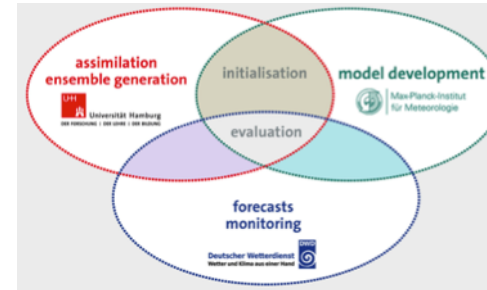# The German Climate Forecast System GCFS2.0

Kristina Fröhlich, **Andreas Paxian**, Mikhail Dobrynin, Katharina Isensee, Claudia Gessner, Johanna Baehr, Barbara Früh, Wolfgang Müller

German Climate Forecast System 2.0

2009
first seasonal experiments

2011
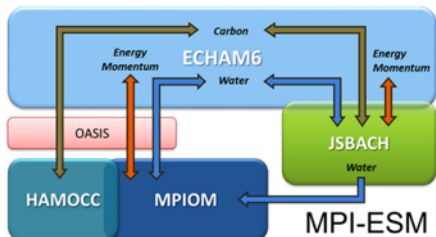DWD joined in to establish an operational system participating in EUROSIP

Development

2016
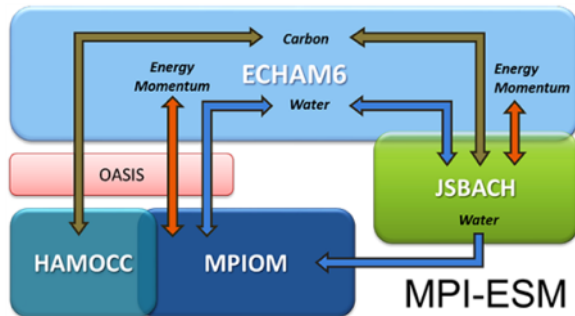First operational forecasts with GCFS1.0
dwd.de/seasonalforecasts

2016
Start of development of GCFS2.0 within Copernicus C3S

Development

German Climate Forecast System 2.0

Important model changes	GCFS1.0 (MPI-ESM-LR)	GCFS2.0 (MPI-ESM-HR)
Atmospheric horizontal resolution:	200 km	100 km
Atmospheric vertical resolution:	47 layers	95 layers
Atmospheric background data	CMIP5	CMIP6
Soil moisture transport	bucket scheme	5 layers
Ocean coupling	Daily	Hourly
Oceanic horizontal resolution	1.5° in tropics	0.4° in tropics

German Climate Forecast System 2.0
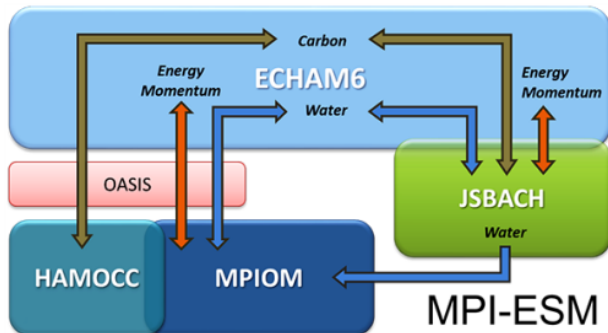
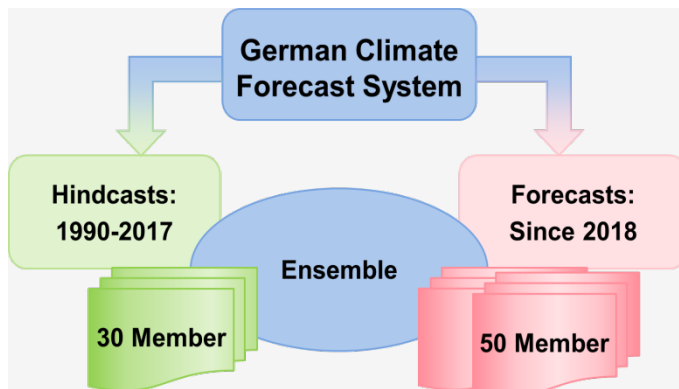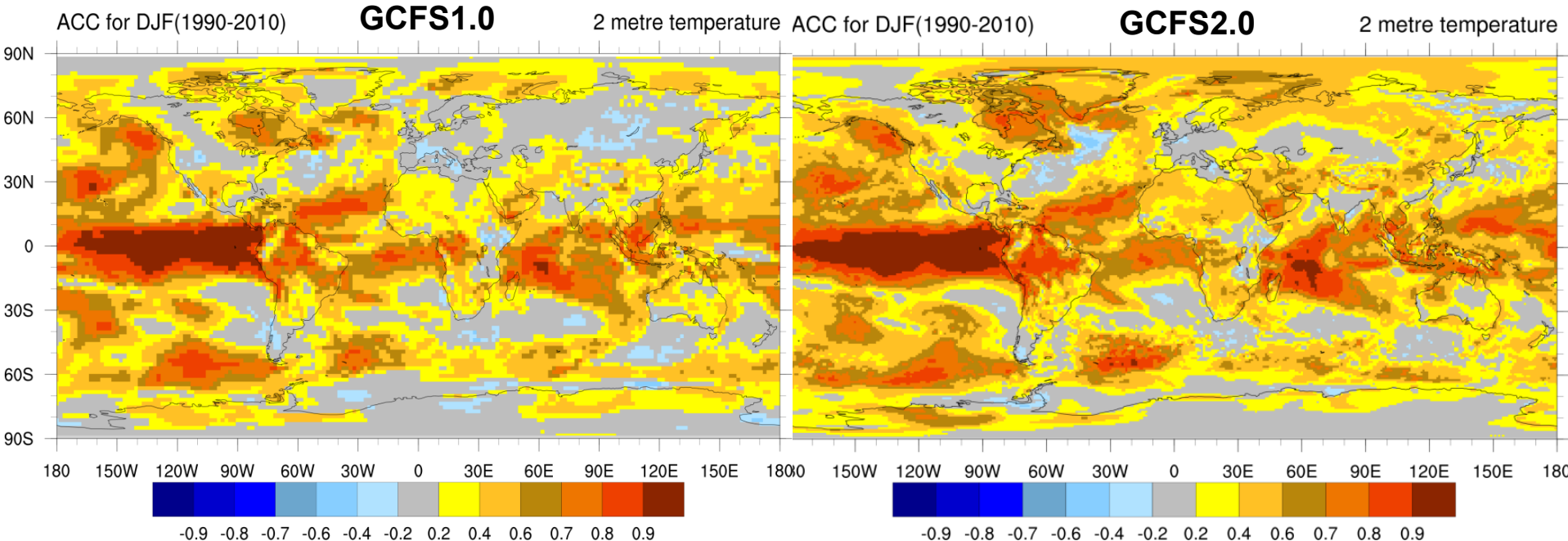| Important changes in forecast system	GCFS1.0	GCFS2.0
Oceanic initial conditions	ORAS4	ORAS5
Hindcasts member	15	30
Hindcast period	1981-2014	1990-2017
Forecast member	30	50
Forecast duration	1 year	6 months

GCFS1.0/ GCFS2.0: Temperature DJF skill

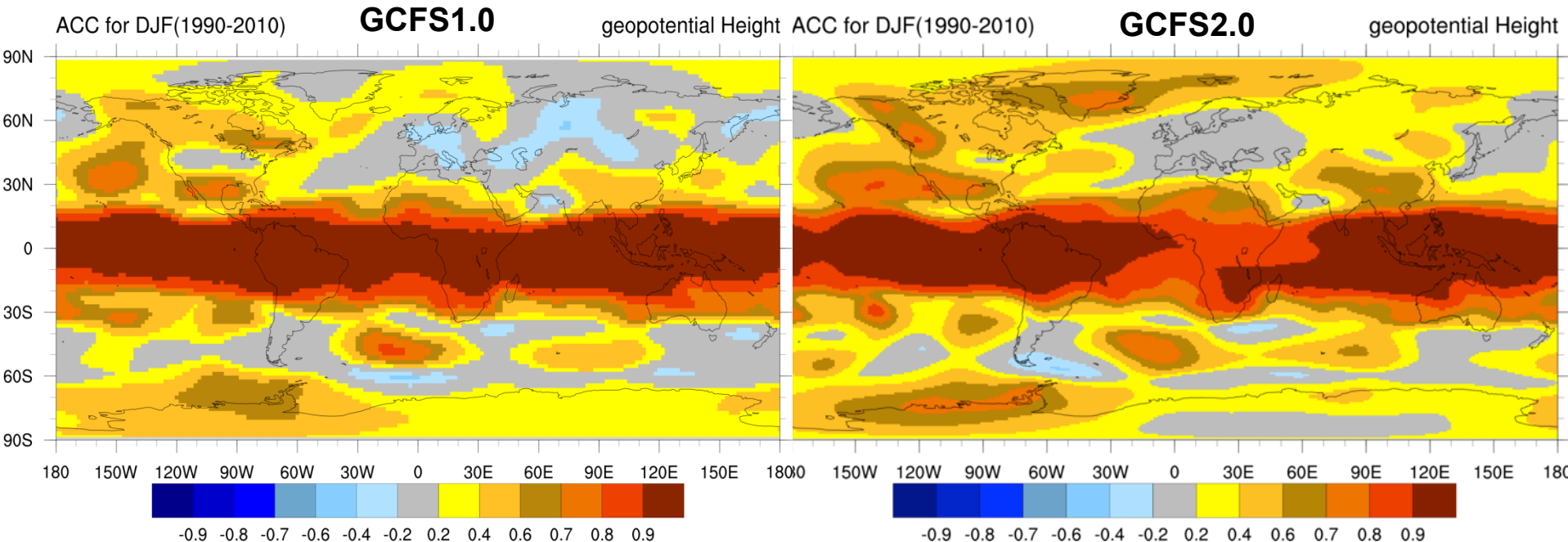## Anomaly correlation to ERA-I for T2m, start in November (1990-2010)

Temperature skill for winter clearly improved:
- improved skill over Arctic regions, East Asia, northern Africa, Indian Ocean
- reduced skill over parts of North Atlantic (possibly ORAS5 feature)

GCFS1.0/ GCFS2.0: 500 hPa GPH DJF skill

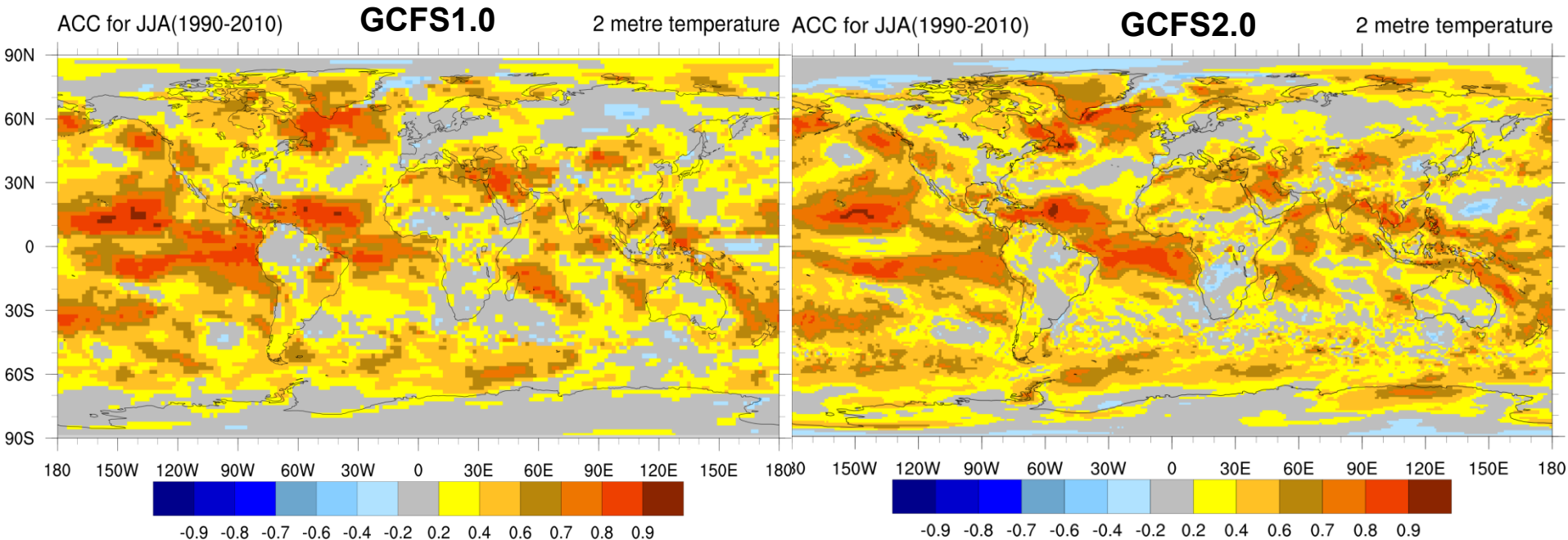## Anomaly correlation to ERA-I for Z500, start in November (1990-2010)

Geopotential height skill for winter clearly improved:

- improved skill over North America, Europe, northern Africa, Russia, China
- reduced skill over tropical Africa

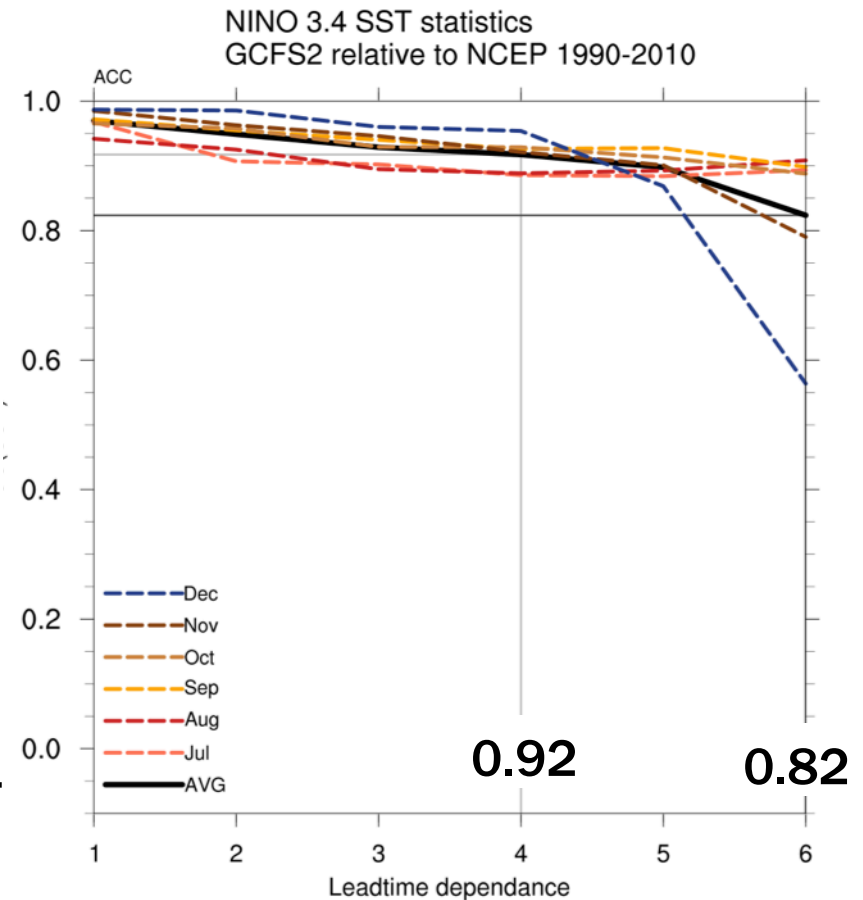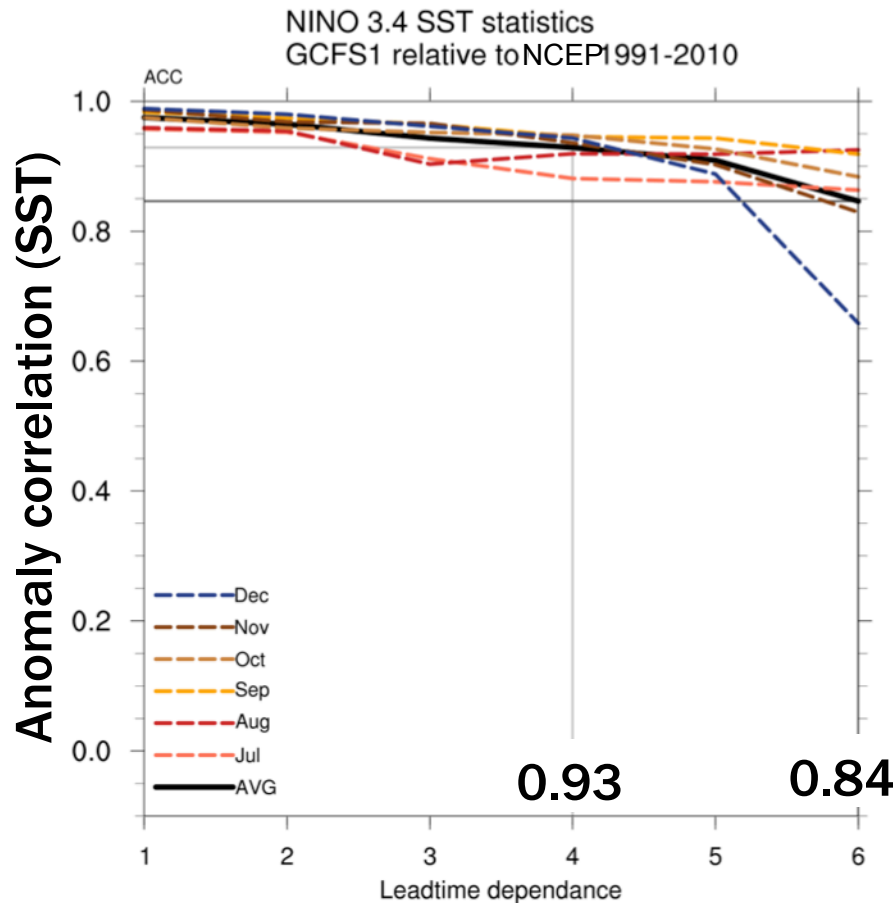# GCFS1.0/ GCFS2.0: Temperature JJA skill

Anomaly correlation to ERA-I for T2m, start in May (1990-2010)

Temperature skill for summer partly improved and partly reduced:
- improved skill over tropical Atlantic, India and South-East Asia
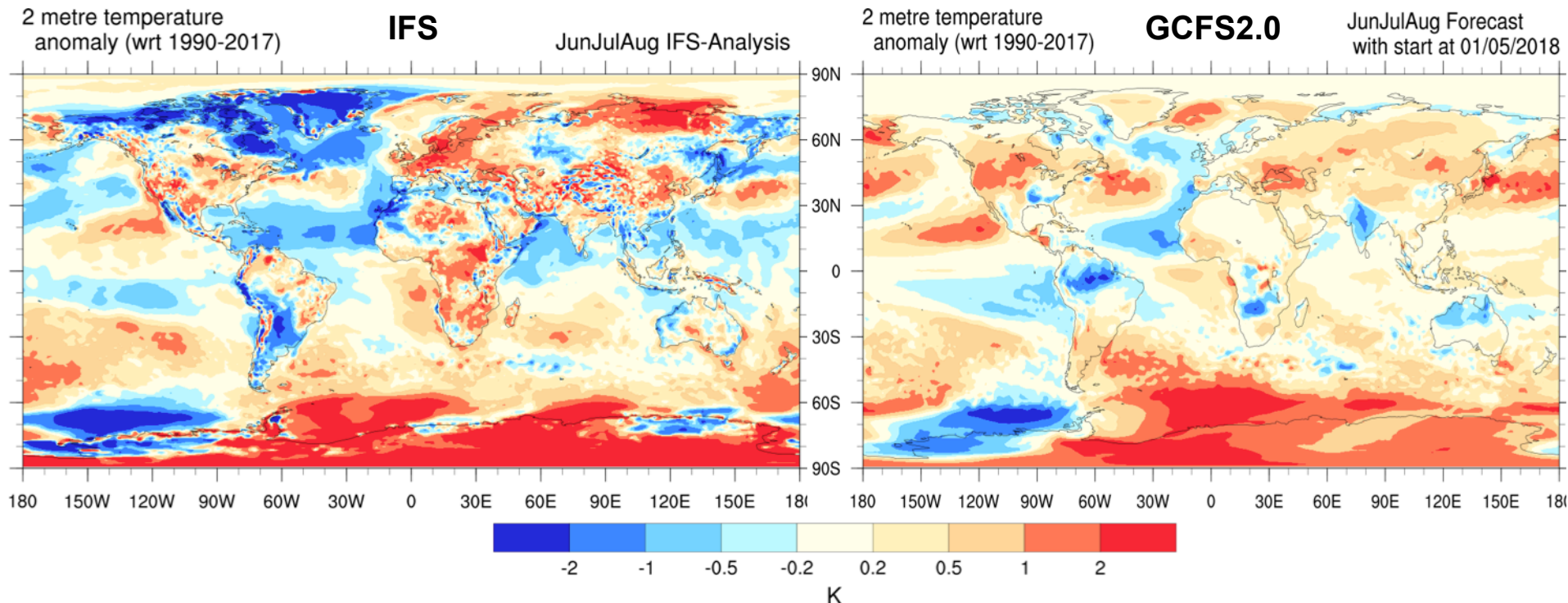- reduced skill over tropical Pacific

GCFS1.0/ GCFS2.0: ENSO skill

NINO 3.4 SST statistics
GCFS1 relative to NCEP 1991-2010

NINO 3.4 SST statistics
GCFS2 relative to NCEP 1990-2010

GCFS1.0 and GCFS2.0 comparably high skill for start months July-December

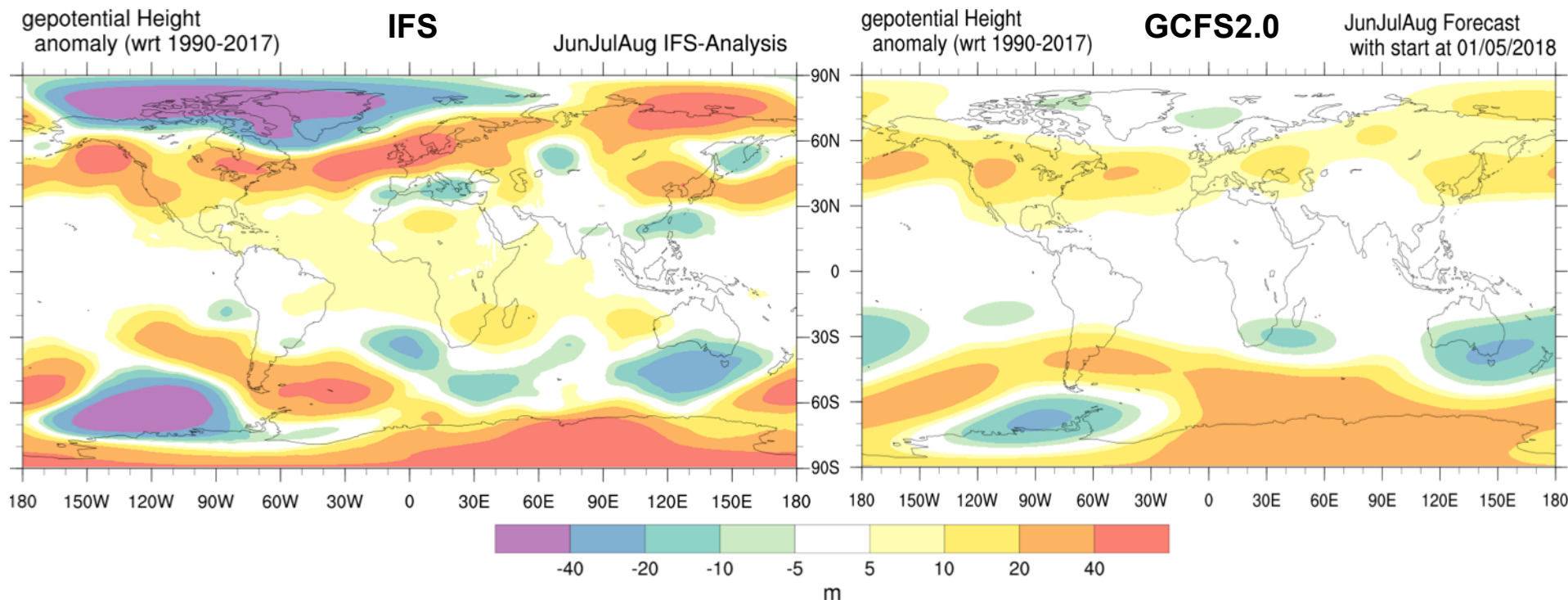# GCFS 2.0: Forecast Temperature JJA 2018

T2m comparison with IFS analyses for May 2018 forecast

- agreement: Pacific, Atlantic, Antarctica, United States, Black Sea, China
- disagreement: Europe, North American Arctic, South America, Africa

GCFS 2.0: Forecast 500 hPa GPH JJA 2018

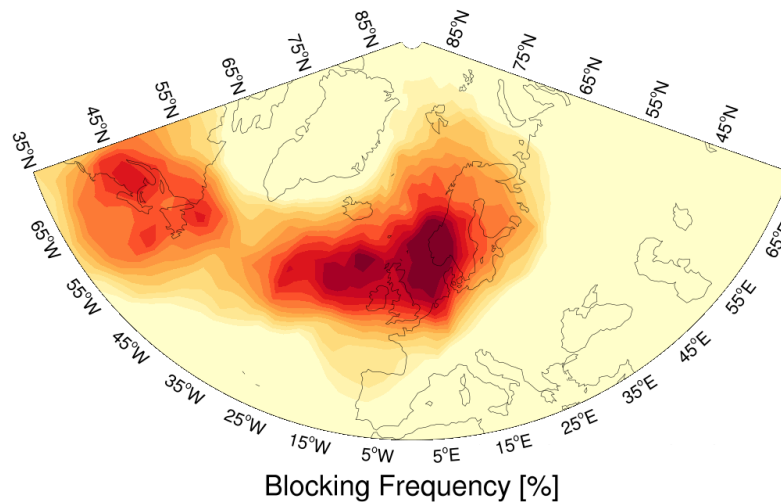## 500 hPa GPH comparison with IFS analyses for May 2018 forecast

- agreement: spatial distribution of global anomalies
- disagreement: maxima/ minima underestimated and shifted (Europe too south)
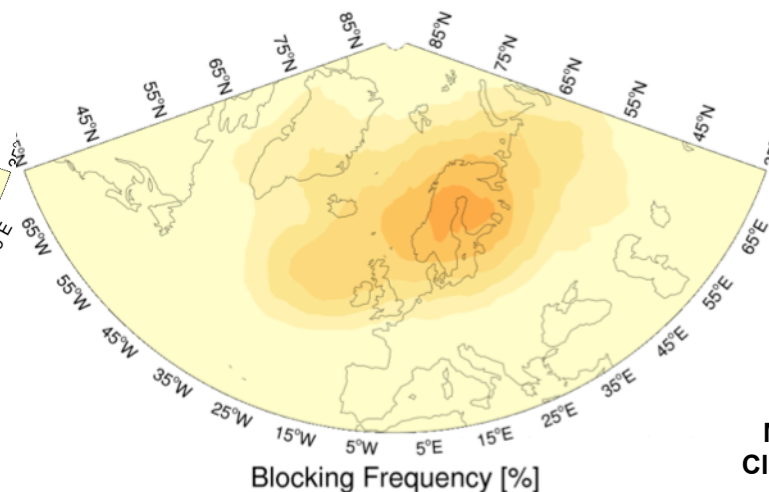
GCFS 2.0: Forecast Blocking JJA 2018

European blocking frequency (percentage of days with blocking)

NCEP1   JJA 2018   GCFS2   JJA 2018

Blocking Frequency [%]

Master thesis Claudia Gessner

Blocking index: Z500 north/ south gradients and climatol. threshold, duration of 5 days, area of 150,000 km² [Tibaldi and Molteno 1990, Richling 2017]:

- blocking position well forecasted over Europe but not over Newfoundland
- frequency of blocking underestimated (stronger zonal winds, less wave activity)

GCFS 2.0: Forecast Precipitation JJA 2018

Precipitation comparison with GPCC First Guess product for May 2018 forecast
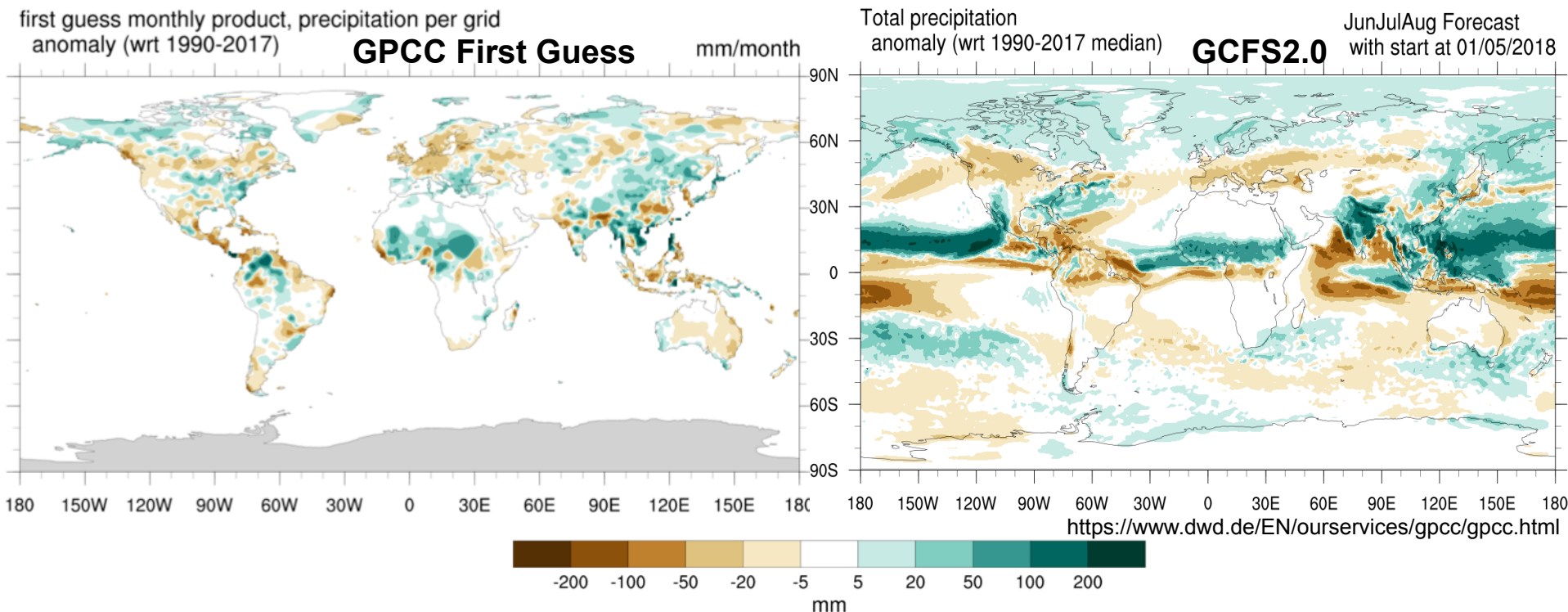
- agreement: North America, central and eastern Europe, China, Africa, Australia
- disagreement: South America, India, southern/ northern Europe (drought too south)

GCFS 2.0: Summary and Outlook

- Temperature, 500hPa GPH, precipitation: winter skill clearly improved, summer skill partly improved and partly reduced

- ENSO: skill for start months Jul-Dec similarly high in both model versions

- Forecast JJA 2018: European heat wave, 500 hPa GPH maximum, blocking frequency and drought underestimated and shifted to south (ongoing research)

- Further development:

  - improved ocean initialization (Ensemble Kalman Filter, Poster Baehr)

  - improved sea-ice initialization (ORAS5 sea ice thickness)

  - skill improvement due to ensemble sub-sampling (Talk Dobrynin)

German Climate Forecast System 2.0

will soon – October/ November 2018 - be available at

- www.dwd.de/seasonalforecasts

- http://www.wmo.int/pages/prog/wcp/wcasp/LC-LRFMME/index.php

- https://climate.copernicus.eu/seasonal-forecasts

Thank you for your attention!