Update of the Special Bureau for the Atmosphere of the IERS

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SB A

1) Excitations of Earth rotation/polar motion

Values of $\chi 1$, $\chi 2$, $\chi 3$ for:

Wind, pressure, pressure, as modified by inverted barometer *(analyses and forecasts)*

2) AAM directly -- values in the three dimensions

3) Mean surface pressure (hPa) over the globe; surface pressure harmonics

4) Torques between atmosphere and Earth

Participating Centers: NOAA; *ECMWF*; UKMO; JMA;
Reanalysis Centers: NCEP-NCAR; ECMWF
Additional Centers: Fleet Numerical; NASA

Developments in the SBA

Excitations of Earth rotation

- Updated formulations and constants (including treatment of topography)
- Reflect angular momentum units
- Both nondimensional excitations and absolute units available for NCEP reanalysis

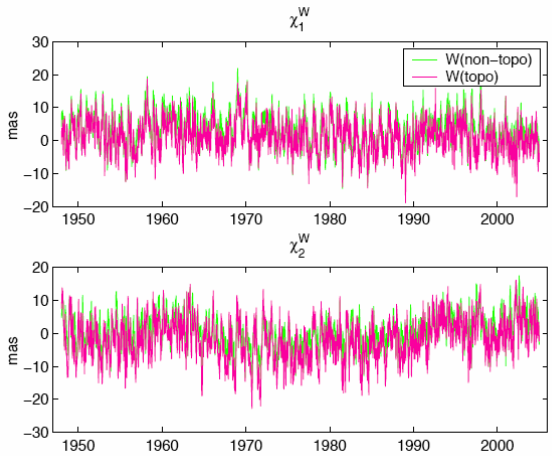
(Accomplished during visit of Y. Zhou to AER -- acknowledgments Descartes/Nutation project)

Experimentation with hourly data based on NASA model

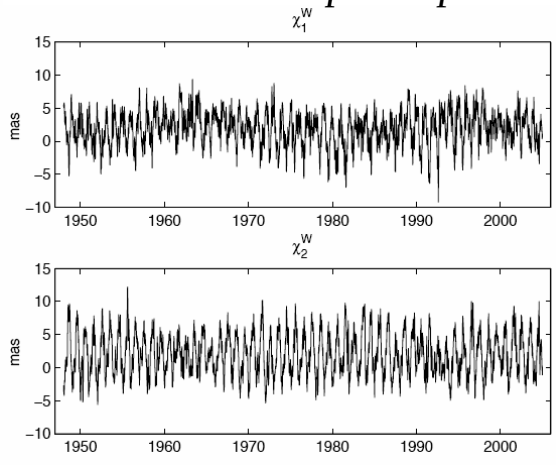
Impact of topography on atmospheric excitations of ERP

Polar motion

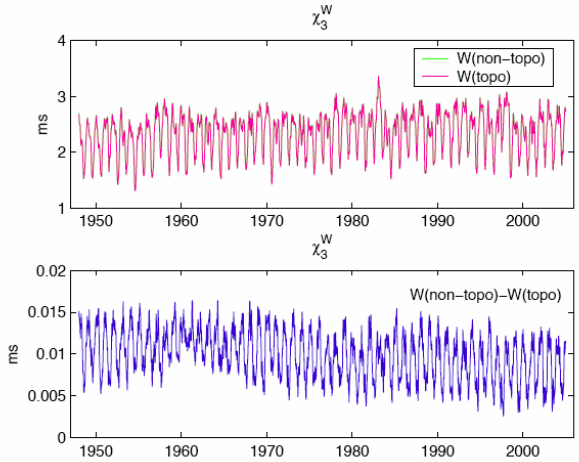
Values



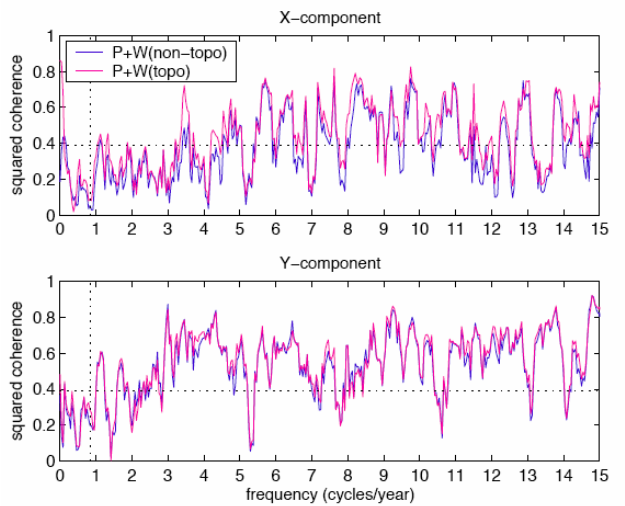
Difference, nontopo - topo



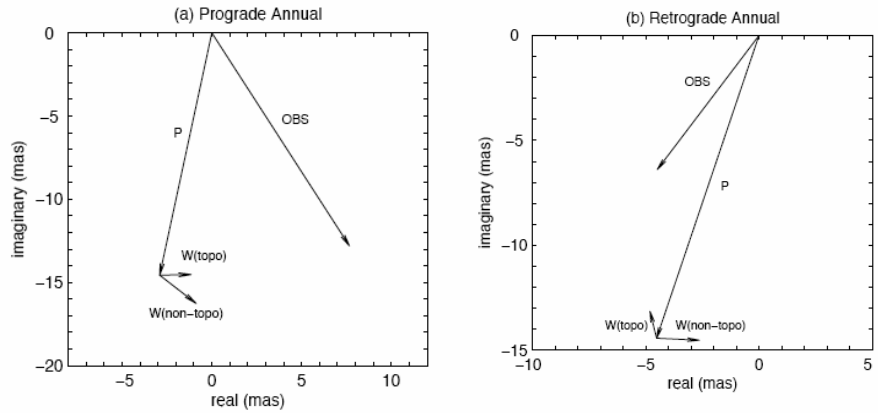
Axial (LOD)



Coherence of atmosphere with polar motion excitations



Impact of topography on annual polar motion budget



Zhou YH, Salstein DA & Chen JL, 2006

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Earth
Ocean
Atmosphere
Space
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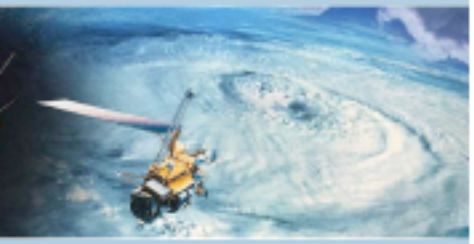
Weather Forecast Suite
Consulting Services



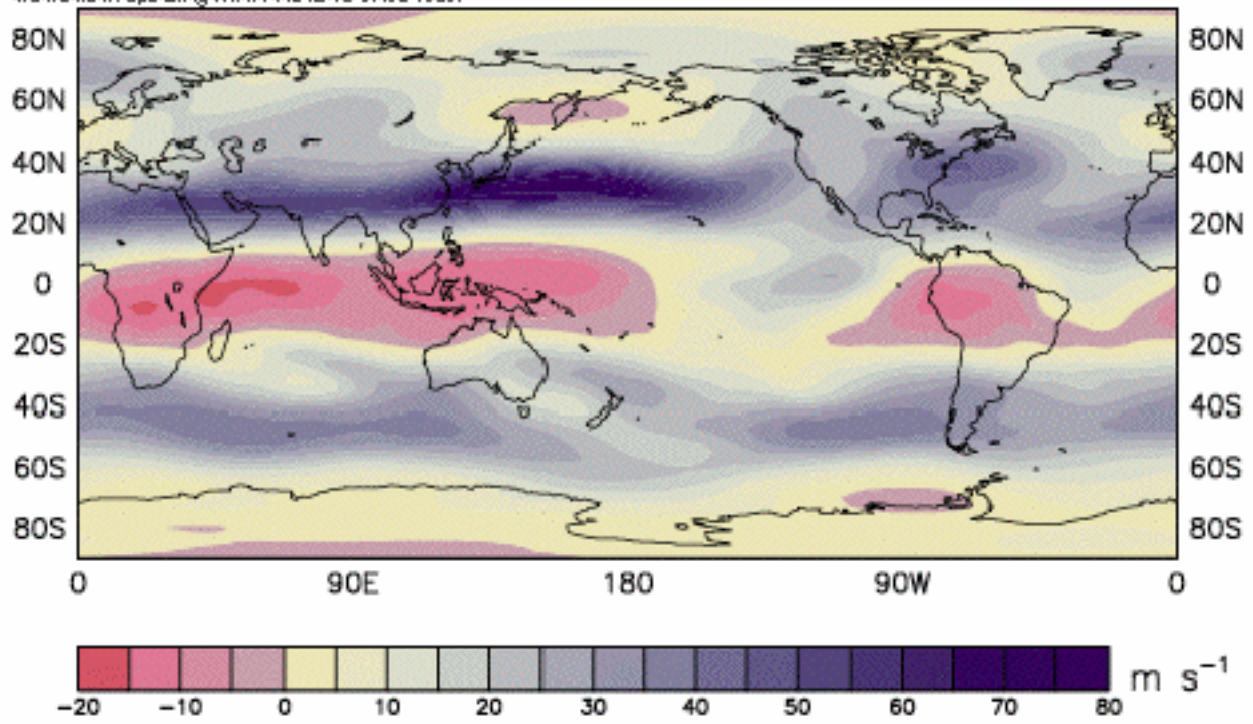
Breakthrough Science

Science & Research

Atmospheric and Oceanic Diagnostics

Special Bureau for the Atmosphere

Within the Global Geophysical Fluids Center of the International Earth Rotation and Reference Systems Service (IERS) the Special Bureau for the Atmosphere (SBA) is a joint effort of Atmospheric and Environmental Research, Inc. (AER) and the U.S. National Centers for Environmental Predi (NCEP) to provide atmospheric data relevant to the study of the Earth's variable rotation. The SBA is a successor to the Sub-bureau for Atmospher Angular Momentum, operating within the IERS since 1989.



Zonal wind field near jet stream levels (sampled here for January 1997), the primary contributor to atmospheric angular momentum and length of day changes.

Our principal data consist of atmospheric angular momentum (AAM) and related quantities from four major meteorological centers: NCEP, the Jap

Filename	Size
aam.ncep.reanalysis.1948.2004	16.6 MB
aam.ncep.reanalysis.2005	298 kb
aam.ncep.reanalysis.2006	271 kb
aamf.ecmwf	1712 kb
aamf.ecmwf.2	632 kb
aamf.jma	1486 kb
aamf.jma.2	1292 kb
aamf.jma.2005	363 kb
aamf.jma.2006	328 kb
aamf.jma.3	949 kb
aamf.ncep	2.4 MB
aamf.ncep.2	743 kb
aamf.ncep.2005	370 kb
aamf.ncep.2006	340 kb
aamf.ncep.3	1506 kb
aamf.ncep.reanalysis.1948.2004	16.6 MB
aamf.ncep.reanalysis.1948.2004.old	20.7 MB
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aamf.ncep.reanalysis.2005.old	32 kb
aamf.ncep.reanalysis.2006	271 kb
aamf.ukmo	1320 kb
aamf.ukmo.2	174 kb
aamf.ukmo.2005	135 kb
aamf.ukmo.2006	115 kb
aamf.ukmo.3	288 kb
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gtorque.ncep.reanalysis	502 kb
mtorque.ncep.reanalysis	502 kb
pcoeff.ncep.formulas.ps	87 kb
pcoeff.ncep.reanalysis.1975.2004	69.6 MB
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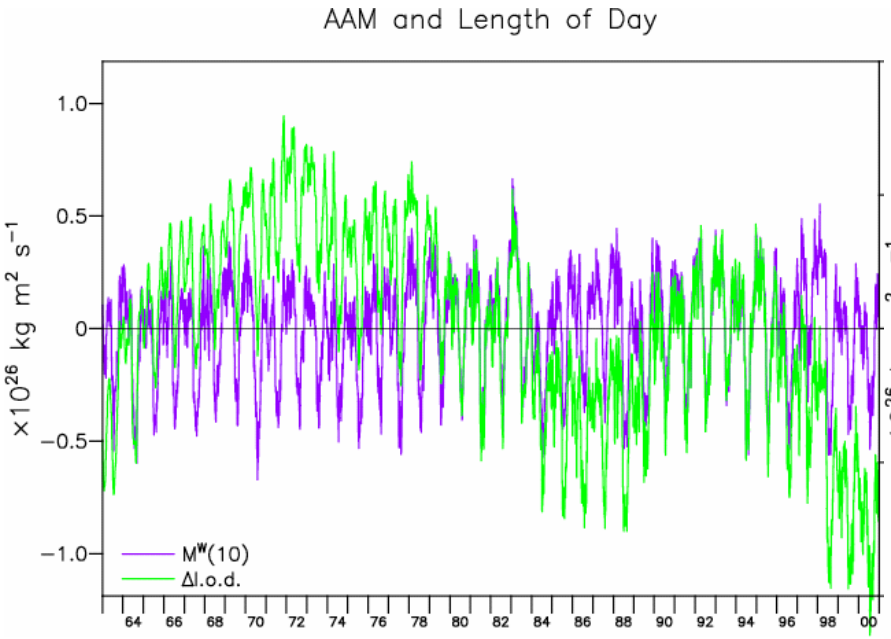
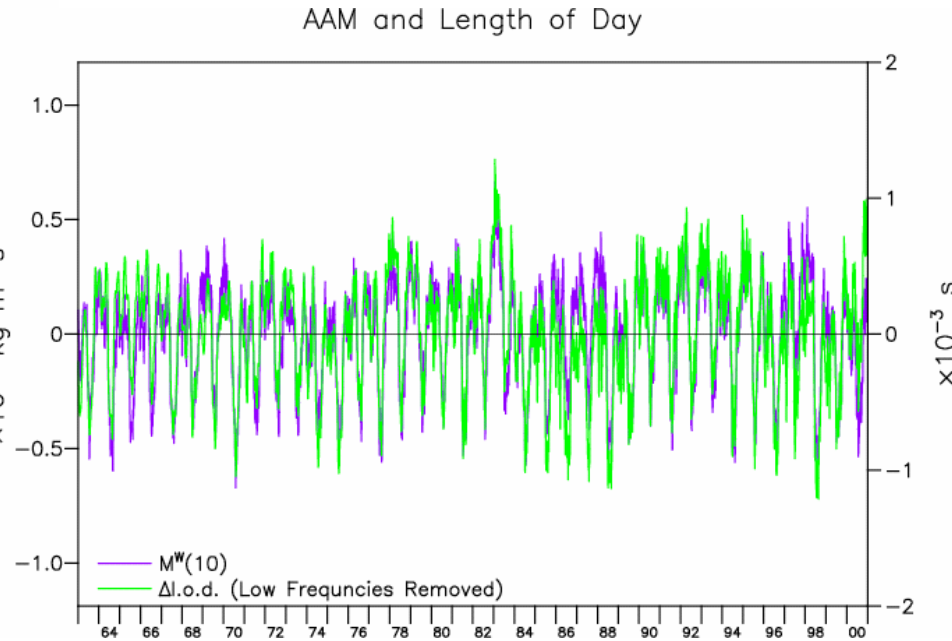
readme.aam.ncep.reanalysis	2.6 kb
readme.aamf.ecmwf	2.9 kb
readme.aamf.jma	2034
readme.aamf.ncep	3.4 kb
readme.aamf.ncep.reanalysis	3.8 kb
readme.aamf.ncep.reanalysis.old	2.3 kb
readme.aamf.ukmo	1755
readme.pcoeff	1295
readme.torque.ncep.reanalysis	1286
RLF-pcoeff.ncep.reanalysis.1975	55.9 MB

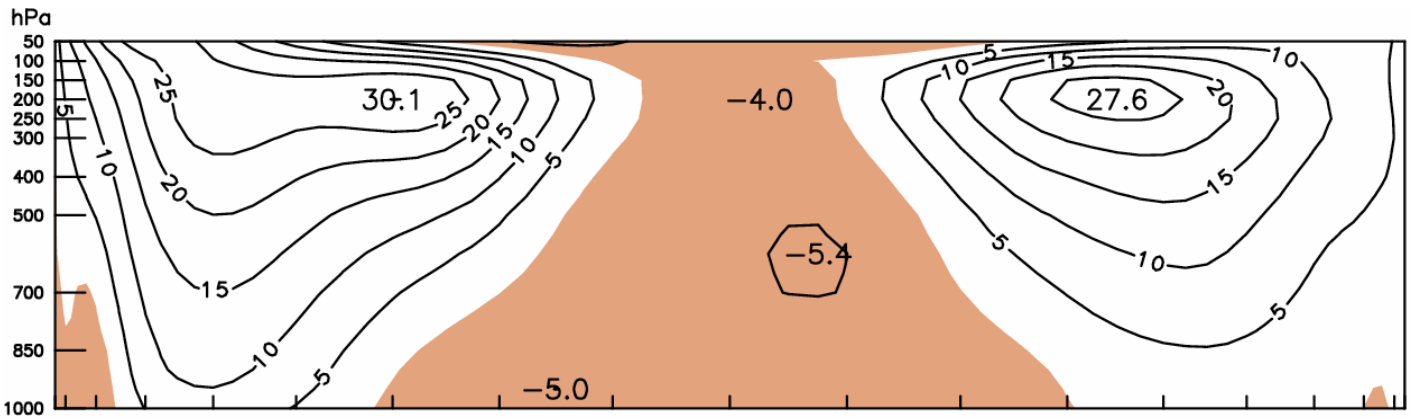
AAM and LOD

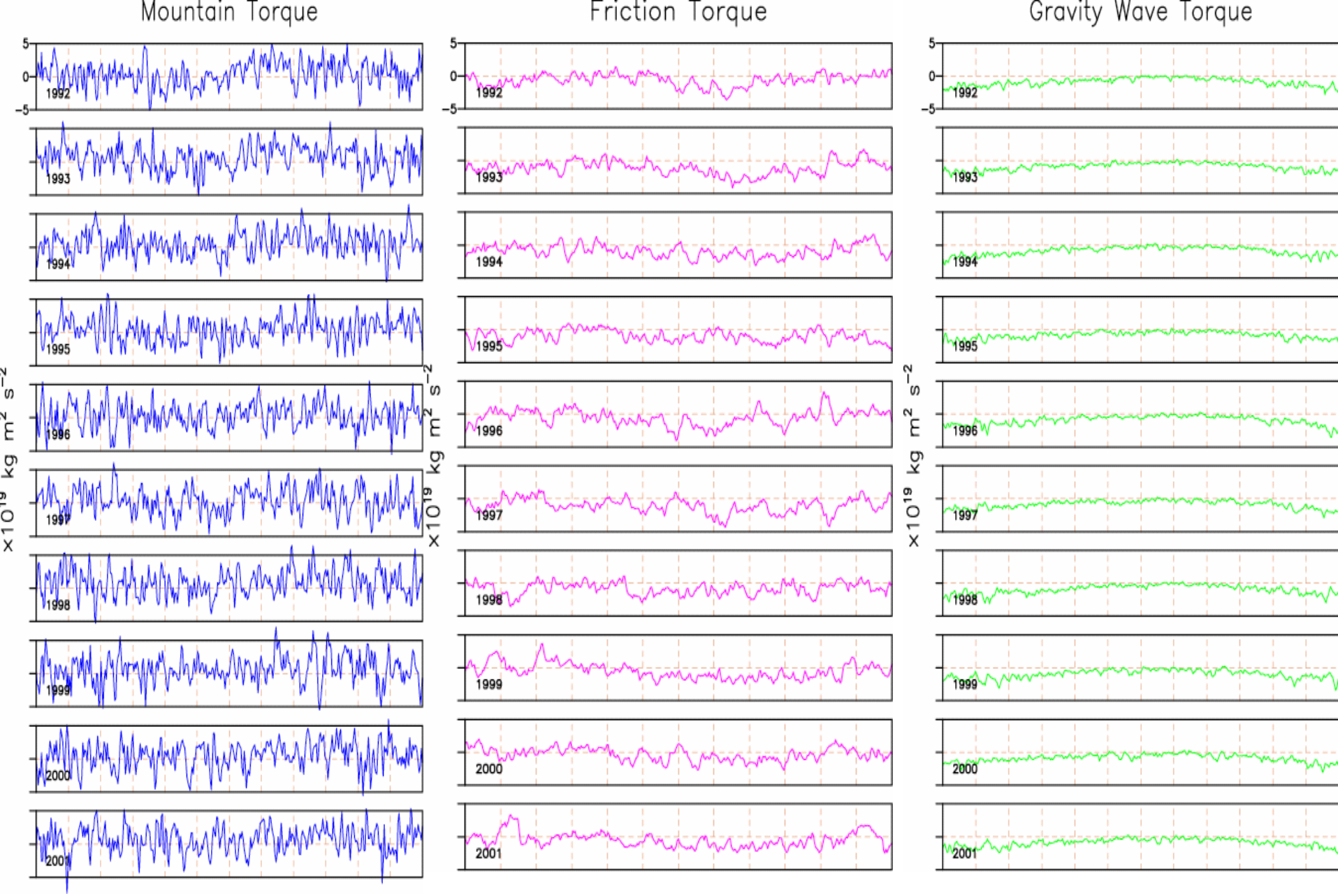
Unfiltered



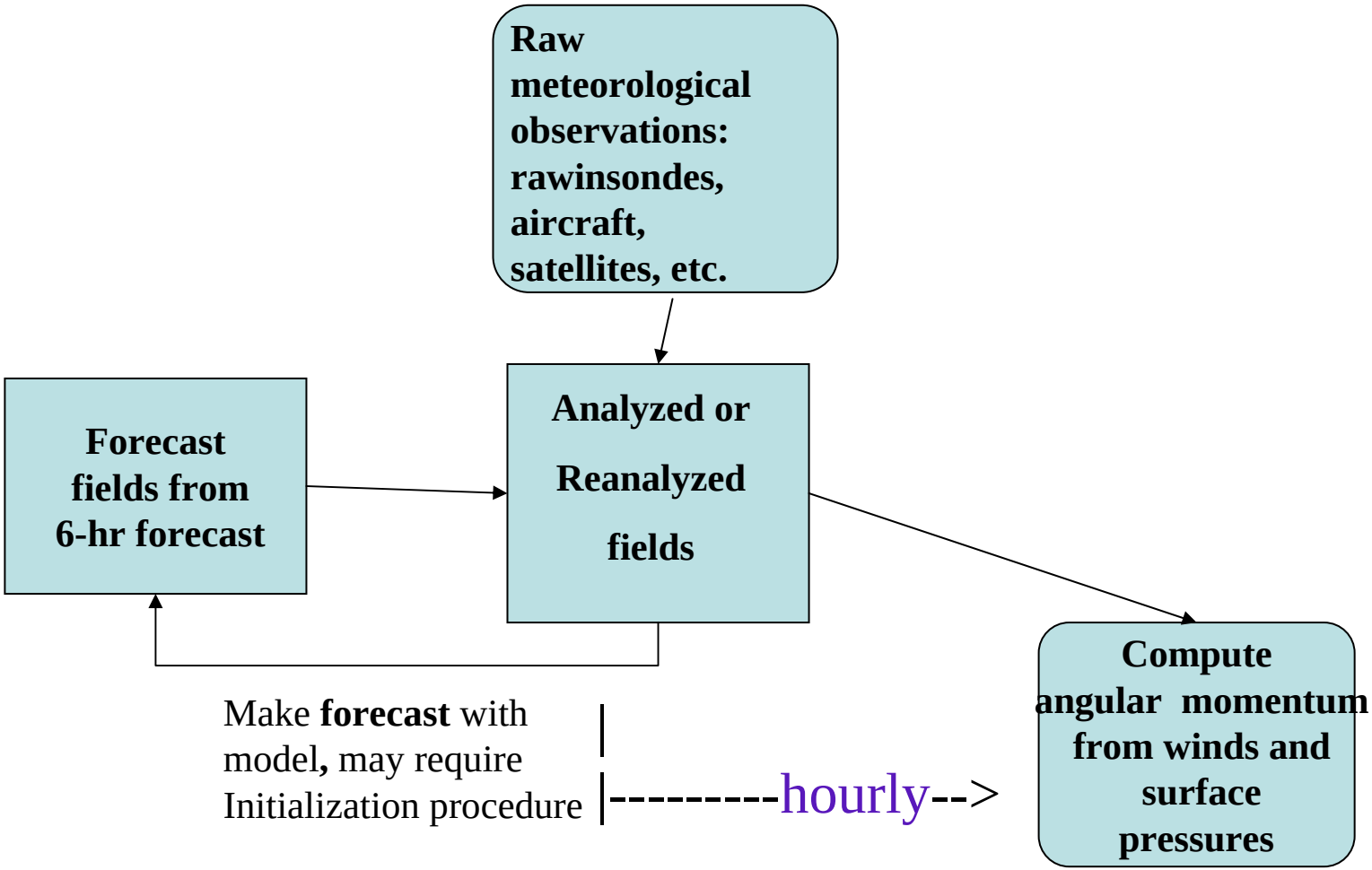
Filtered





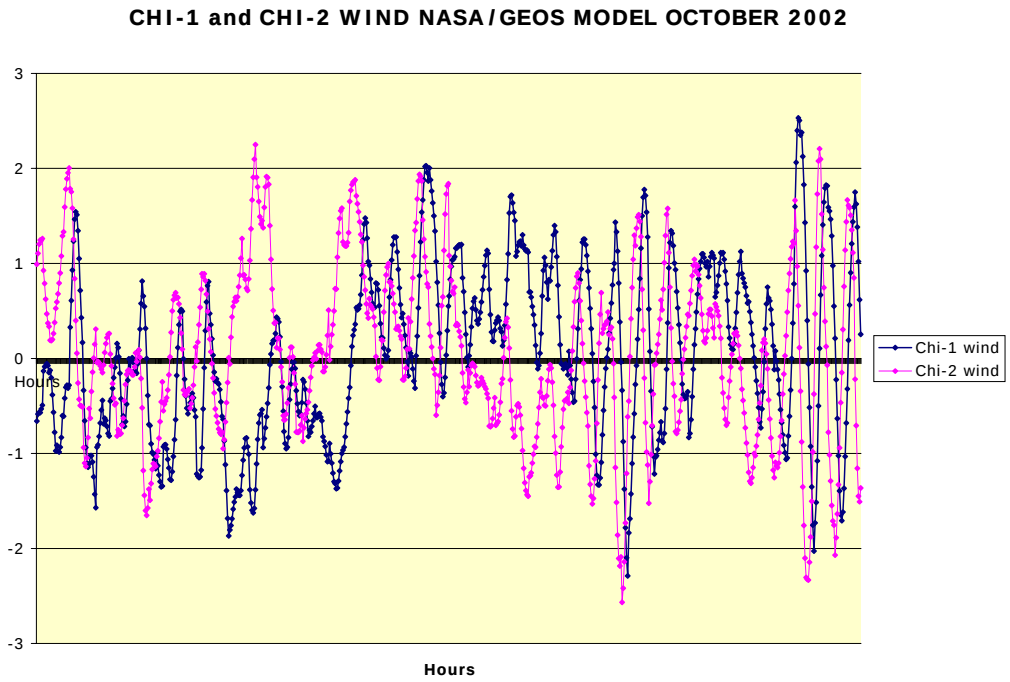

Mountain Torque
Friction Torque
Gravity Wave Torque
5
0
−5
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
x10^19 kg m^2 s^−2

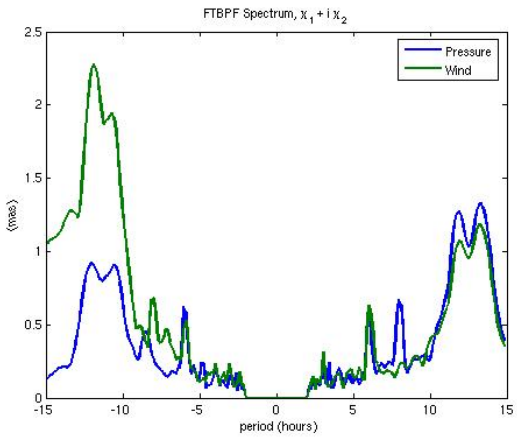
METEOROLOGICAL DATA ASSIMILATION SYSTEM



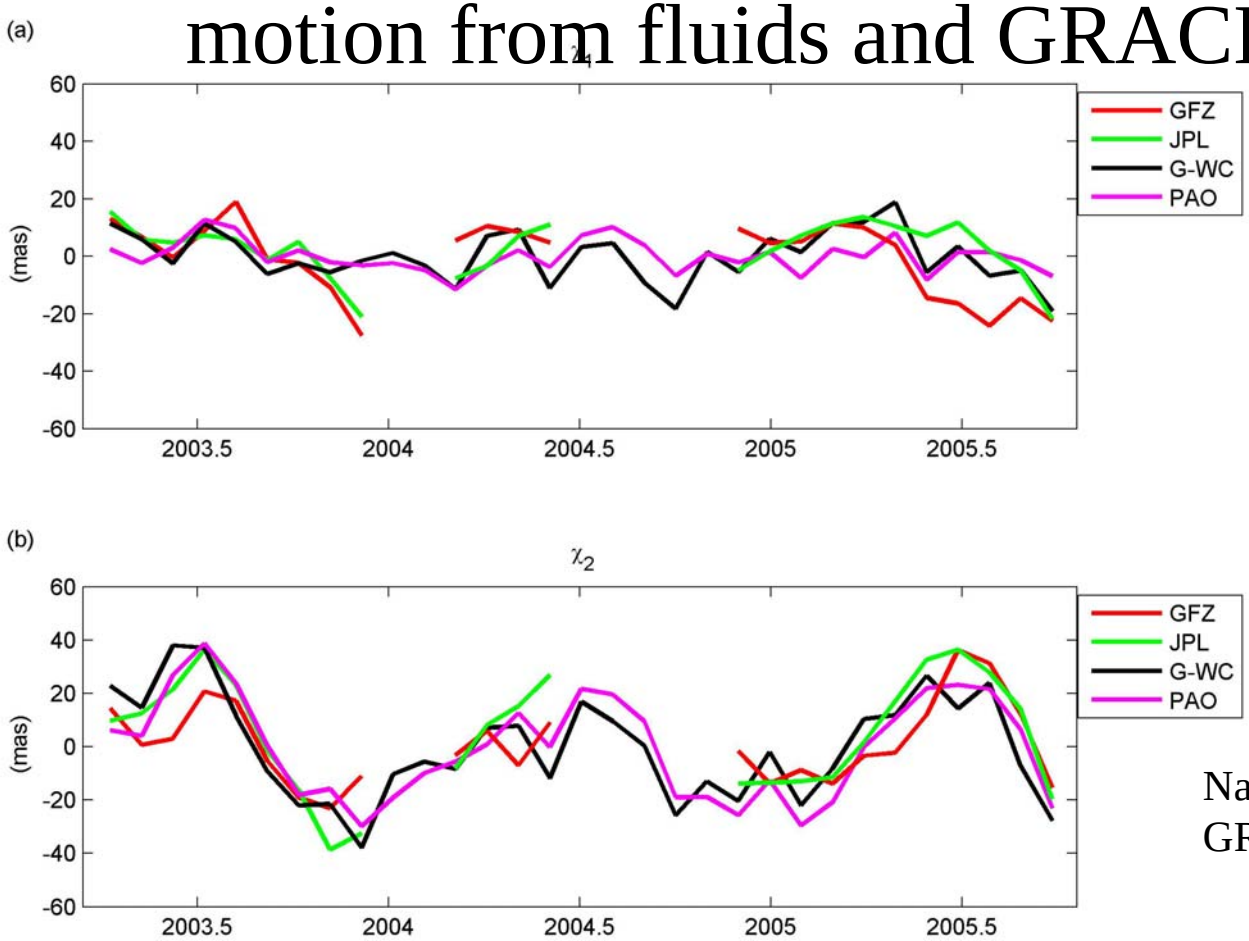
High temporal resolution

From modeling: example: NASA GEOS-4 model, can take hourly data for excitations. Future series may be more continuous, removing discontinuities when analyses are done.





Comparisons of mass excitations for polar motion from fluids and GRACE



Nastula, Ponte, Salstein, GRL submitted

Comparison of mass term of the geodetic excitation function (G – WC; black lines) with two GRACE polar motion excitation functions (JPL in green, GFZ in red) and the pressure term of atmospheric and oceanic polar motion excitation function (PAO; pink). To ensure consistent availability at the same set of time steps, all series shown were processed with the previously described Gaussian smoother. Gaps in the GRACE data coverage are left unfilled.

SBA

Use data from U.S. Fleet Numerical modeling center. (T. Johnson) -- see following

Proposal to examine the regional excitations together J. Nastula) -- following

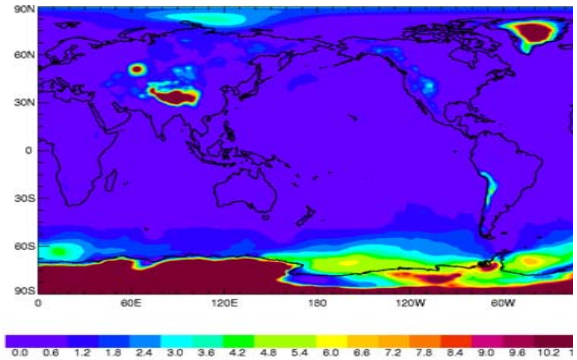
Personnel:

--A. J. Miller (NOAA) has retired; C. Long will continue efforts

--Y. Zhou updates data in center

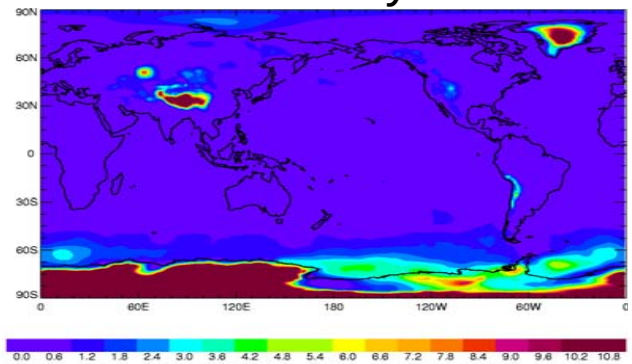
Variance of difference between NCEP, ECMWF sea level pressure fields--timescale dependence: quality of atmospheric pressure

<60 days



30-day smoothed

<10 days



5-day smoothed

Full variance

Full variance (above)
And variance at different temporal resolution (left)

The highest variability at all scales is above Antarctica, the high southern latitude oceans, Greenland, central Asia,

(2001-2003)

Recommendation #1

- Explore atmospheric data from more data sources, especially new reanalyses
- Needed: Higher vertical extent
- Higher temporal resolution

Recommendation #2

- Create combined atmospheric data set
- Problem: errors in atmospheric excitations are not known, so it is difficult to create optimal solution

Recommendation #3

Understand the relationship between the torque and angular momentum approach

Recommendation #4

Explore new formulations and constants for excitation terms

Recommendation #5

Model link with oceans better

Recommendation #6

Atmospheric mass terms: recalculate based on more accurate coordinate approach and gravity field

- --for earth rotation/polar motion
- --for loading
- --for gravity missions

Recommendation #7

Assess forecasts as well as analyses of atmospheric forecasts of AAM

Recommendation #8

Relationship of AAM to climate and weather signature

- --e.g. El Nino/Southern Oscillation; North Atlantic
- Oscillation
- --moving weather systems over continents

Recommendation #9

Understanding the atmosphere with AAM as a diagnostic:

- model intercomparison projects, century-long
- simulations and projections

Recommendation #10

Other needs of atmosphere in geodetic missions.

- With new structure: three pillars of geodesy GGOS