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I.C.T.P., P.O. BOX 586, 34100 TRIESTE, ITALY, CABLE: CENTRATOM TRIESTE

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"Hurricane Modelling"

Y. KURIHARA
GFDL/NOAA
Princeton University
New Jersey
USA

Please note: These are preliminary notes intended for internal distribution only.

Hurricane Modelling

YOSHIO KURIHARA
GFDL/NOAA

1. Structure of hurricanes

Primary structure

A high resolution model is a fundamental of hurricane modelling.

Hurricane movement
  capability of hurricane tracking → multiply-nested movable mesh model

2. GFDL Hurricane Prediction System

Accurate model physics is a fundamental of hurricane modeling.
  simulation capability of primary features of hurricanes

Database of the hurricane model: global analysis, hurricane message

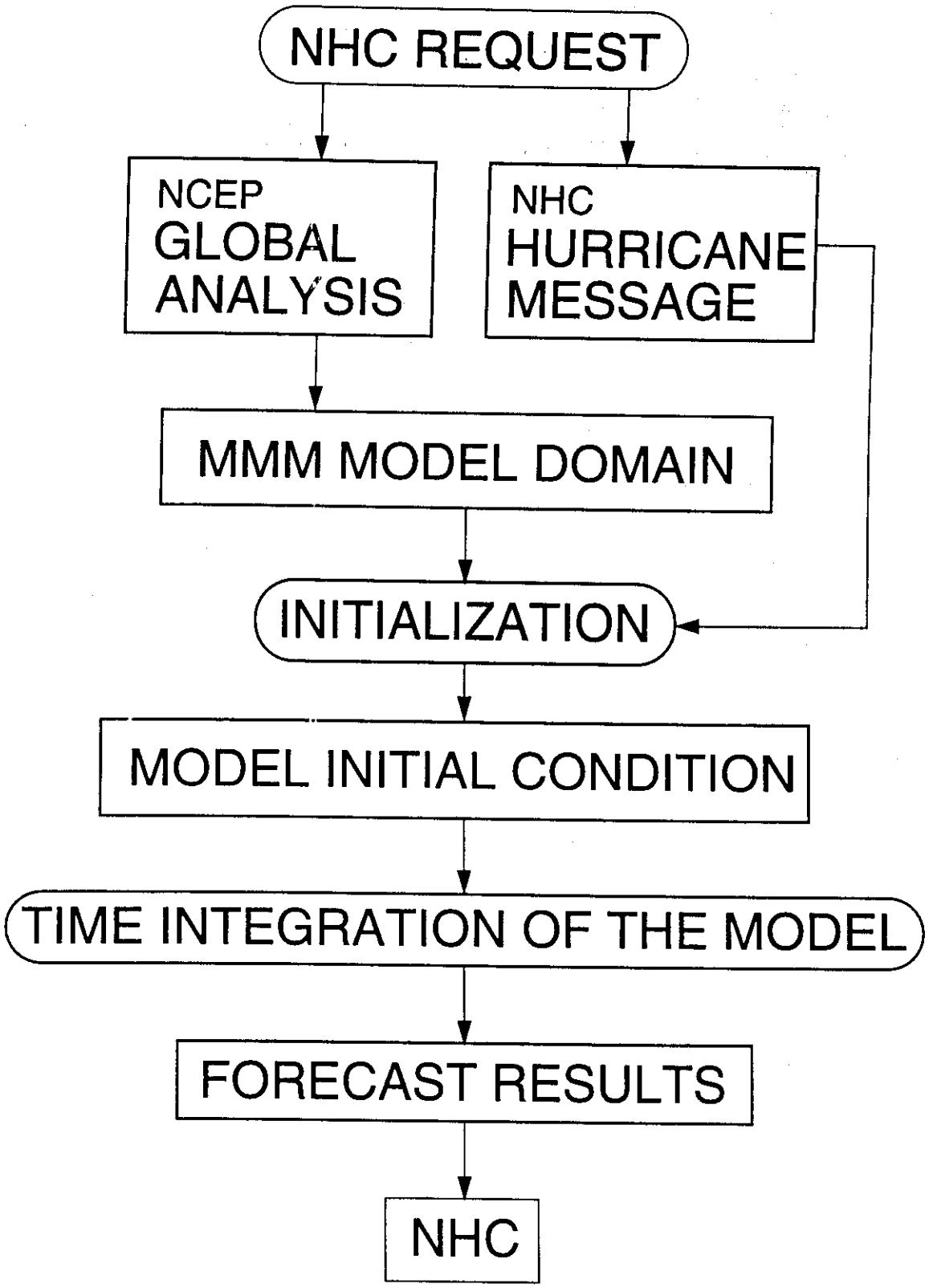
Initialization of the hurricane model
  replacement of a vortex
    ambiguity in field separation
  vortex generation
    controlled spin-up using hurricane messages
    symmetric vortex in a quiet environment
    beta-gyre

3. Prediction skill

storm track
storm structure and intensity

further improvement:
  hurricane model
    parameterization
    ocean coupling
    model resolution
  global analysis: data, mountain
  initialization
    vortex generation including effects of environmental flow
    four-dimensional data assimilation

GFDL HURRICANE PREDICTION SYSTEM



GFDL MMM Hurricane Model

1. primitive equation model
2. 18 vertical σ-levels
3. multiply-nested movable mesh (MMM)

Mesh	Resolution *degrees*	Size *degrees (points)*		Time Step *sec*
1: coarse	1	75	(75x75)	120
2: medium	1/3	11	(33x33)	40
3: fine	1/6	5	(30x30)	20

4. physics
   - diffusion
     horizontal: Smagorinsky nonlinear viscosity
     vertical: Mellor-Yamada turbulence closure scheme level 2
     background mixing added
   - surface flux
     Monin-Obukhov framework, interfacial layer included
     ocean: SST (unchanged from the initial field)
     land: land surface temperature prediction
     vegetation type dependent roughness and wetness
   - cumulus convection
     soft moist-convective adjustment scheme
     entrainment effect considered, relaxation time assumed
   - radiation
     infrared: Schwarzkopf-Fels scheme; solar: Lacis-Hansen scheme
     effects of diurnal cycle and cloud variation considered
5. initialization
   environmental fields from an NCEP global analysis
   generation of a hurricane vortex by controlled spin-up
   replacement of an NCEP analyzed vortex by the generated vortex
6. time integration
   two-step iterative integration scheme
   wind direction dependent boundary condition for limited domain
   mesh by mesh integration using dynamical interface